DESIGN GUIDELINES FOR RECREATIONAL BOATING FACILITIES

Third Edition

Oregon State Marine Board

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For
Recreational Boating Facilities

Third Edition

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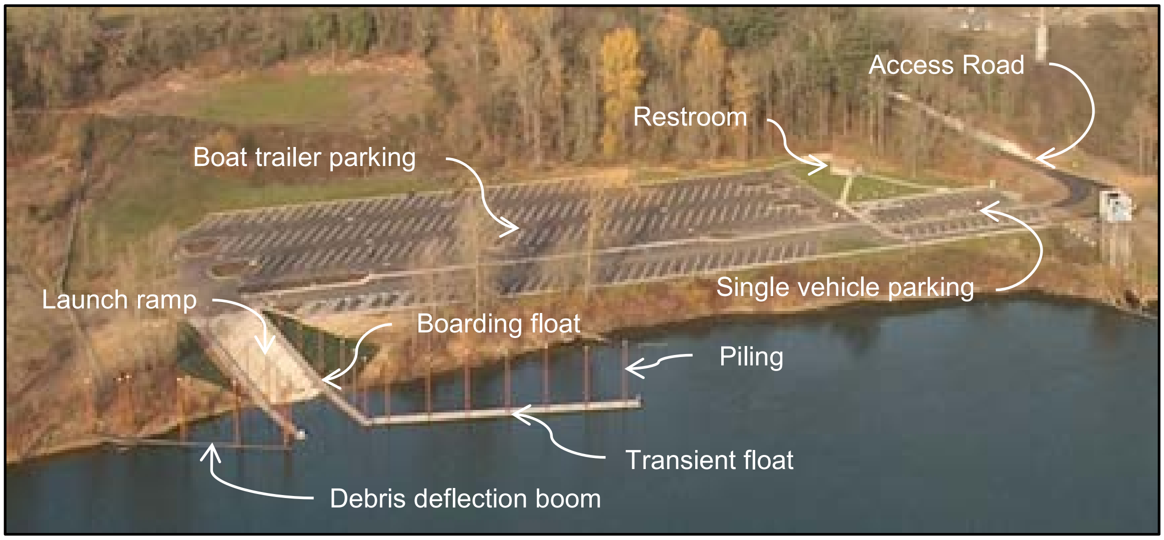


Typical boating facility components

Section 2 – Channels

Section 3 – Launch Ramps


Section 4 – Boarding Floats


Section 5 – Transient Floats


Section 6 – Piling


Section 7 – Gangways


Section 8 – Debris Booms


Section 9 – Parking Facilities


Section 10 – Restrooms

INTRODUCTION

BACKGROUND

Oregon's waterways are as varied as its terrain. More than 900 public recreational boating facilities provide access to coastal sites, inland rivers, high elevation lakes, and numerous reservoirs. In 1988 the Oregon State Marine Board (OSMB) determined that a need existed to develop and publish technical guidelines for the design of public recreational boating facilities (First Edition). These guidelines were developed to assure that consistent, quality design and engineering could be applied to all public recreational boat access facilities developed or renovated in Oregon. It was also recognized that consistent facility design would help provide a consistent boating experience for the user regardless of where in the state the boating activity occurred.

The OSMB Boating Facilities Section administers a program that provides grants to local, state, and federal agencies for public boat access improvement projects. These projects are principally launch ramps, restrooms, parking areas, and transient tie-up facilities. In addition, the Boating Facilities Section's engineering staff is responsible for assisting grant applicants with the design and engineering of public access boating facilities.

With 30 to 40 boating facility projects completed every year, the engineering staff has amassed tremendous knowledge and experience in the past 20+ years in a continuing effort to provide high quality, low maintenance, yet cost-effective facilities. The knowledge accumulated throughout the years has enabled the Marine Board to continually learn from both successful designs and those in need of revision. This Third Edition builds on the format developed in 1996 (Second edition) with extensive revisions based on current design practices, trends, and regulatory requirements.

The OSMB engineering staff members continually review and share similar design information with other states. These guidelines parallel similar findings made by many other state boat access programs as well as the States Organization for Boating Access *Design Handbook for Recreational Boating and Fishing Facilities* (Second Edition May 2006).

Several resource publications exist that provide detailed information on the design and engineering of the various components presented in these guidelines. These other resources should be used extensively to develop and apply sound engineering practices to water related facilities and include *Marinas and Small Craft Harbors* by Tobiasson and Kollmeyer (Second Edition 2000), *Planning and Design Guidelines for Small Craft Harbors* – ASCE Manual No. 50 (Revised Edition 2000) and *Coastal Engineering Manual* – US Army Corps of Engineers.

PURPOSE

The purpose of these guidelines is to provide technical assistance to projects being developed under the OSMB's Boating Facility Grant Program. The guidelines may also be applied to many other types of similar projects regardless of the source of funding.

These guidelines are not codes but instead represent a typical design range from minimum to maximum that should be used as a guide in the design of boating facilities. Each individual boating facility has unique features and conditions which require additional site-specific design and planning beyond the scope of these guidelines. Nothing in these guidelines is intended to relieve the designer from exercising due diligence in the pursuit of the proper final design for the project.

The Marine Board has an extensive collection of standard designs and drawings for many different project components. However, no attempt has been made to incorporate detailed project drawings or specifications in these guidelines. Instead, typical illustrations and photographs are used to supplement the information and design concepts contained herein.

The design guidelines are under constant review and evaluation for new materials, construction methods, design requirements, clarifications and corrections. They are, therefore, subject to periodic revisions and updates. Should you wish to submit comments, corrections, or suggestions for consideration in future editions contact the Marine Board via our internet website at www.boatoregon.com.

SCOPE

These guidelines provide a systematic method for the design and layout of major elements of public recreational boating facilities found in Oregon and include sections for project planning and implementation, channels, launch ramps, boarding floats, transient floats, piling, gangways, debris deflection booms, parking facilities, restrooms, and utilities. Currently they do not include the design of marinas, non-motorized boat facilities, or boat waste collection facilities.

Emphasis has been placed on the proper design and location of boat launch ramps. Launch facilities are primarily used by, and consequently designed for, motorboats less than 26 feet in length. For trailerable boats the following dimensions are used for the "design" boat: 22-foot length, 8-foot beam (width), 1.5-foot gunnel/deck height (freeboard) and 2.5-foot outdrive/propeller depth (draft). Transient tie-up facilities, however, serve a wide range of boat sizes. See Section 5 for information on design boat dimensions at this type of facility.

Access and parking area layouts are extensively discussed as this may be the most important element which determines efficiency and proper function of a boat launch facility. These guidelines are based on the dimensions of a typical design vehicle, boat, and trailer used in Oregon. The design tow vehicle is 19 feet long. The design trailer (with boat) is 26 feet long and 8 feet wide. This design tow vehicle and trailer combination is larger than average based on boat registration data. However, by designing for this combination, maneuverability is assured for larger trailered boats and enhanced for smaller vehicle/trailer combinations. It should be noted that there has been a trend toward larger tow vehicle/boat trailer combinations in recent years. These larger combinations may actually be the norm at some facilities. Design of parking facilities to accommodate these larger combinations is provided in Section 9.

Due to the seasonal use of recreational boating activity, it is important to consider and factor in the usability criteria for an assumed design use (high and low water) period. In general, the majority of use (90%) on all waterways occurs during an eight month period from March through October with June, July and August being the peak use period. Design for any use or access is not a prime concern during non-peak periods. These times often coincide with adverse weather conditions that result in high water, large waves, strong winds, floating debris, snow, and ice. In addition, very few boaters use facilities when the wind speeds exceed 30 mph, waves exceed 2 feet vertical, or when there are extreme high tides or high water periods. It is not the intent to design boating facilities to be usable during these conditions but should be designed to survive without significant damage.

There may be state, local and/or federal regulations that are applicable to some facility components covered in these guidelines. In the absence of established building codes it is the assertion of the OSMB that these guidelines, when properly applied using sound engineering practices, will provide a high degree of safety, health, and welfare to the public. However, the following resources should be consulted for applicability.

State - The Oregon Structural Specialty Code (OSSC), which is based on the International Building Code (IBC), generally applies to landside structures such as restrooms. There are no specific OSSC requirements for most recreational boat access and transient tie-up facilities as code requirements generally stop at the land/water interface. However, there may be components of the on-water or in-water facility that are covered by the OSSC (e.g. piling, gangways).

Local - Some municipalities have an established building code for waterway structures with an emphasis on fire protection, marinas and buildings. Currently that includes the cities of Portland, West Linn, Oregon City and Florence and Wallowa County (Wallowa Lake only). Check with the local planning department early in the design phase.

Federal - Providing accessibility to persons with disabilities can be challenging at boating facilities since the focus of the original uniform federal requirements (1991 Americans with Disabilities Act Accessible Guidelines – 1991 ADAAG) was only on landside features. All project landside accessibility components (e.g. parking, restrooms, and walkways) must be consistent with the provisions of the newly released *2010 ADA Standards for Accessible Design* (2010 ADA Standards) and the OSSC. Please note that there may be some provisions in the OSSC that are more stringent than the 2010 ADA Standards.

Accessibility guidelines for recreational boating facilities did not exist in the original 1991 ADAAG. However, guidelines for public recreational boating facilities have been developed in the last ten years and are now part of the 2010 ADA Standards. Compliance with the 2010 ADA Standards will become mandatory by March 2012. Chapter 10, Section 1003, of the 2010 ADA Standards covers the requirements for public recreational boating facilities. A copy of Chapter 10, Section 1003, of the 2010 ADA Standards is provided in Appendix A. The entire 2010 ADA Standards can be viewed on-line at www.ada.gov.

It has always been OSMB's policy to remove all possible impediments and barriers to facilities to the maximum extent possible. Furthermore, OSMB has implemented the accessibility requirements for boating facilities since the final draft was published in 2004. As a result, the 2010 ADA Standards should not require any alterations to our current standard designs.

APPLICATION

These guidelines are to be used as the name implies, as a guide. Every effort has been made to provide the user with the most reliable design parameters (preferred, minimum, and maximum) that should work in most locations and conditions. Any deviations beyond the minimum or maximum range should be carefully analyzed and justified.

These guidelines (illustrations, photos, and text) should not be used for any type of final construction project drawings or specifications. Each and every project should be fully designed and engineered with details well beyond the scope of these guidelines.

OSMB does not consider or warrant these guidelines to be exhaustive, absolute, or enforceable. Changing regulatory requirements may be in conflict with specific guidelines at time of publication. It is up to the project engineer, designer, and owner to carefully consider each individual site for best design and appropriate selection of materials.

The following is a consistent outline format used for all sections of these guidelines.

Section No.
SECTION TITLE

1.01 SUBSECTIONS

A. General – includes background information, definitions, and explanatory notes.

B. Application – provides specific design criteria, parameters and rationale.

C. Design – summarizes most design parameters with preferred, minimum and maximum values for each. For quick reference, all text is highlighted with a tan background color as shown here.

DEFINITIONS

The following is a comprehensive list of terms and acronyms used in these guidelines. The definitions are concise and do not necessarily provide a complete or conventional explanation. The intent is to convey the meaning of each term as it is used in these guidelines. More thorough definitions and greater understanding of each term are often provided within the context of the various guideline sections.

When another defined term is used as part of a definition that other term will be *italicized* as a cross-reference.

Term	Definition
100-Year Flood	Calculated to be the level of flood water expected to be equaled or exceeded every 100 years on average. The 100-year flood is more accurately referred to as the 1% annual exceedance probability flood, since it is a flood that has a 1% chance of being equaled or exceeded in any single year.
Abutment	A *cast-in-place* block of concrete that provides pedestrian access to a *boarding float* or *gangway*.
Access Road	A road that leads from a *main thoroughfare* to a *launch ramp* or *parking area*.
Accessible	A design element that is functional for individuals with disabilities.
Accessible Route	A pedestrian path from one *accessible* element to another *accessible* element within a facility that meets the requirements of the *ADA Standards*.
ACZA	Ammoniacal Copper Zinc Arsenate. Used as a wood preservative.
ADA Standards	2010 Americans with Disabilities Act Standards. These are the current federal guidelines for providing accessibility to a variety of public facilities including recreational boating facilities.

ADAAG — Americans with Disabilities Act Accessibility Guidelines (1991). Superseded by the *ADA Standards.*

Alignment — The path of an *access road*, *travel lane*, or *launch ramp* that consists of curves and *tangents*.

Anchor Wall — The thickened end of the *cast-in-place* portion of a *launch ramp* to provide an anchor point for the *precast plank* steel rail system. See also *Cut-off Wall*.

Approach Curve — The inside curve from the *travel lane* to the *maneuver area.*

Asphalt (asphalt concrete) — A mixture of bituminous material, sand, and gravel, usually heated, which is used to form pavement.

AWPA — American Wood Preservers Association

Axial Load — A weight or force applied vertically to a pile.

Back-Out Area — A designated no-parking zone at the end of a dead-end *parking area* that provides maneuvering room for vehicles and/or trailers.

Ballast — Weight that is added to a floating structure to improve stability and/or adjust *freeboard*.

Bankline — A physical feature along the course of a *waterbody* that confines the normal flow of water; often defined by a distinct change in slope.

Base Course — Crushed rock placed over *subbase* material and compacted to form a solid, uniform surface under concrete or *asphalt*.

Bathymetry — Relating to the *topography* (ground surface) below the water surface.

Bathymetric Survey — The process by which the underwater ground topography is measured and mapped.

Batter Supported Pile — See **Pile, Batter Supported**

Battered Pile — See **Pile, Battered**

Beam The width of a boat at its widest point.

Block-Out A void area within a concrete pour for the placement of an *abutment* or *pile*.

BMP's Best Management Practices - Construction procedures implemented to avoid or minimize impacts to water quality or aquatic species such as fish.

Boarding Float A platform-type floating structure located within a *launch ramp* that provides pedestrian access to and from a boat in the water.

Boat Ramp See **Launch Ramp**

Brackish The quality of water within a *waterbody* where freshwater and saltwater mix.

Broadside Tie-Up Refers to a boat that is *moored* parallel to the length of a *float*.

Broom Finish A type of surface finish that is applied to fresh concrete using a stiff broom.

Buffer Zone A non-delineated area on both sides of a *launch ramp occupy area* for vehicle, trailer, and boat maneuvering.

Bulkhead A wall-type structure (often timber) used to support one end of a *gangway* or *elevated walkway*.

Bull Rail A continuous steel railing spaced above the deck surface and along both edges of a *float*. Used to tie-off and secure boats.

Bumper Strip See **Rubstrip**

Buoy An anchored floating object used to delineate a *channel,* in-water navigation hazard, or boating regulation.

Buoyancy The tendency of an object to float or to rise when submerged in water.

Cast-In-Place	The process of placing freshly mixed concrete into forms at the construction site. Once the concrete has hardened it remains where it was placed.
Cast-In-Place Curb	See **Curb, Cast-In-Place**
Catch Basin	A drainage structure that collects *runoff* and routes it to an outlet.
Centerline Alignment Angle	The resulting angle between any two *tangents* of an *alignment*.
Centerline Curve Radius	The defined radius of a curve between any two *tangents* of an *alignment*.
Channel	A *waterway* that provides a navigational link from one *waterbody* to another.
Chord	A structural member running the length of a *gangway* to which *webs* are attached to form a truss.
Cleat	A fitting secured to the *float* deck having two projecting horns to which a mooring line is attached.
Cold Joint	A joint in a concrete slab where two separate pours meet.
Composting Toilet	A toilet system where waste is collected in a tank and combined with wood shavings or bulking material to produce compost.
Connector	Structural wood timbers bolted with *through rods* to the sides of *transient floats* to secure them together.
Cross Slope	Deviation from level that is perpendicular to the direction of pedestrian or vehicular travel.
Curb Cut	A section of *curb* that is removed to allow pedestrian access or drainage of storm *runoff*.
Curb, Cast-In-Place	A raised concrete barrier that is placed in forms and then backfilled with rock and pavement.
Curb, Extruded	A raised concrete barrier that is formed using a machine and placed on top of *asphalt*.

Current	The continuous flow or movement of water within a *waterbody*.
Cut	Existing soil that is excavated from a site.
Cut-Off Wall	A thickened concrete edge or wall cast along the sides and/or top of a launch ramp to help protect from undermining. See also *Anchor Wall*.
Dead Load	The weight of a structure.
Debris Deflection Boom	A floating structure located immediately *upstream* of a boating facility that provides protection from floating debris by deflecting it away from the facility.
Deposition	See **Sedimentation**
DEQ	Department of Environmental Quality
Design Boat	A boat size that is the average representation of all boats that will use a particular type of facility. There are different design boats for *launch ramp* facilities, small-vessel transient facilities, and large-vessel transient facilities.
Design Load	The combination of all reasonable anticipated loads that a structure would be subject to.
Design Vehicle	A motor vehicle size that is adequate to tow a design boat with trailer. Used as the basis for maneuvering and *parking area* design.
Dewater	To remove water from a site by pumping or draining.
DHW	Design High Water - A water surface elevation used for facility design that is the high water elevation for the period of intended use. This elevation may or may not correlate with *OHW*.
DLW	Design Low Water - A water surface elevation used for facility design that is the low water elevation for the period of intended use. This elevation may or may not correlate with *OLW*.
Dock	See **Float**

Downstream	In the direction of a river's *current.*
Draft	The depth of a floating object that extends below the water surface.
Dredge	To clean, widen, or deepen a *waterbody* area by removal of *sediment*.
DSL	Oregon Department of State Lands
Dump Station	A unit that receives marine sewage by manually dumping sewage from a portable container. The sewage is then pumped to a disposal system.
Eddy	A *current* that moves contrary to the main *current*.
Elevated Walkway	A *gangway* that has a fixed *slope*.
Encapsulation	The process of completely sealing foam *floatation* to keep it contained and protect it from damage or degredation.
EPS	Expanded Polystyrene foam floatation
Environmental Load	A force acting on an in-water structure as a result of *current*, *wave*, *wake*, or wind.
FEMA	Federal Emergency Management Agency
Fetch	The open water distance over which the wind blows creating unobstructed *waves*.
Fill	Soil or rock material added to a site to raise the elevation and/or allow shaping (grading) of the surface.
Finish Grade	The final top (uppermost) surface of an *access road*, *launch ramp*, or *parking area*.
Fixed Pier	See **Pier**
Flatwater	Non-moving or very slow-moving water.
Float	A platform-type floating structure.
Floatation	Any material, such as *EPS*, that provides *buoyancy*.

Floodplain	An area of land adjacent to a river and subject to flooding.
Flowingwater	Moderately moving water.
Form Board	Temporary structural framework used to contain and control the placement of fresh concrete.
Freeboard	The vertical distance between the water surface and the deck of a *float*.
Full Pool	The maximum water level at a *reservoir* under normal operating conditions.
Gage Data	A collection of water level information for a given point on a *waterbody* over a specified period of time.
Gangway	A bridge-like structure with a variable *slope* that provides pedestrian access between a *land connection* and a *transient float*.
Geotextile Fabric	A synthetic mesh-type fabric that is placed under aggregate material to keep the underlying material (*subgrade*) from mingling.
Grade	The degree or percent of inclination of a *slope*.
Groin	A small rock structure extending into a river to protect a *downstream* facility or to divert water flow.
Grounding Rail	Dimensional lumber attached to the underside of a *boarding float* to elevate and protect the float from damage when in contact with the *launch ramp* surface.
Ground-Out	When a floating structure makes contact with a hard surface such as a *launch ramp* or river bed.
Guideway	A concrete and steel structure within a *launch ramp* to which a *self-adjusting boarding float* is attached.
HDPE	High Density Polyethylene
Head-In Stall	A *parking stall* with a *curb* or *wheel stop* at the far end which requires parked vehicles to back out.

Hinge Connection	A mechanical connection for *boarding floats* similar in design to a door hinge in which matching hinge barrels are held together with a hinge pin.
Hinge Plate	A metal corner plate on a *boarding float* to which the *hinge connection* is attached.
Hydraulics	The science, technology and mechanics of fluids.
IBC	International Building Code
Impervious	The characteristics of a ground surface that does not allow water to infiltrate or be absorbed.
In-Water Work Period	Specific calendar dates established by *permitting agencies* that allow construction work to occur in the water and below *OHW*.
Jetty	A large rock structure extending into a *waterbody* to provide facility protection or to divert the water flow.
Kick Plate	A wide, continuous plate along both sides of a gangway just above the deck surface that provides edge protection.
Land Connection	A structure such as a *pier*, *abutment*, or *bulkhead* to which a *gangway* or *elevated walkway* is attached.
Lateral Load	A force (e.g. *current*, *wave*, wind, impact) applied perpendicular to the length of a *pile*.
Launch Lane	A designated/delineated area within a *launch ramp* for use by one vehicle/boat at a time.
Launch Ramp	An inclined, hard surface slab (typically concrete) that extends into the water, upon which trailerable boats can be launched and retrieved; consisting of one (1) or more *launch lanes*.
Lb/in^2	Pounds per Square Inch
Lb/ft^2	Pounds per Square Foot
Lift Station	A device that contains a pump for the purpose of pushing sewage to a higher elevation (e.g.; gravity sewer main, drainfield, holding tank).

Lifting Insert — A mechanical device cast into a *precast plank* to which a strap is attached for lifting and moving the plank.

Lift-Off Connection — A type of *gangway land connection* that allows rotation under normal water levels but will detach from the *land connection* and allow the *gangway* to float during high-water events.

Light Penetration — Physical opening in the deck surface of a *transient float* that allows natural light to reach the water surface. The opening is covered with grating.

Live Load — A weight or mass that is applied to a structure during use.

Log Boom — See **Debris Deflection Boom**

Low Pool — The minimum water level at a *reservoir* under normal operating conditions.

Main Thoroughfare — A public roadway.

Maneuver Area — The designated area at the top of a *launch ramp* that allows boaters to align their boats prior to backing down the *launch ramp*.

MHHW — Mean Higher High Water - An elevation which is the average height of the higher high tides observed over a specific time interval.

MLLW — Mean Lower Low Water - An elevation which is the average height of the lower lows tides observed over a specific time interval. Tide book elevations are in reference to this datum.

Monolithic — Concrete that is placed into *form boards* in a continuous manner to produce a slab free of any *cold joints*.

Moorage — A *float* or combination of floats where boats may be *moored*.

Moored — Refers to a boat that is tied-off to a *float.*

Mudline	The underwater ground surface of which the upper layer may consist of saturated soil.
NAVD	North American Vertical Datum 1988
Navigable	A *waterbody* having sufficient depth and width to provide passage of a *design boat*.
Navigational Channel	A defined course along a *waterbody* where specified widths and depths are maintained for the safe passage of boats.
NGVD	National Geodetic Vertical Datum 1929
NOAA	National Oceanic and Atmospheric Administration
Occupy Area	The non-delineated 10-foot width within a *launch lane* that is occupied by the vehicle, trailer, and boat.
OHW	Ordinary High Water - An elevation to which the water ordinarily rises annually.
OLW	Ordinary Low Water - An elevation to which the water ordinarily recedes annually.
OSMB	Oregon State Marine Board
OSSC	Oregon Structural Specialty Code
Parking Aisle	The area used by a vehicle to negotiate into and out of a *parking stall*.
Parking Area	A designated area used for parking several vehicles and/or vehicles with trailers.
Parking Facility	A designated area that is comprised of some or all of the following components: *access road*, *staging areas* (ready and tie-down), *maneuver area*, *parking area, parking aisles, and travel lanes*.
Parking Stall	A delineated area to park a single vehicle or vehicle with trailer.
Pervious	A surface characteristic that allows water to infiltrate or be absorbed.

Pier	A non-floating fixed platform usually extending out over the water from shore to which a *gangway* or *elevated walkway* may be attached.
Pile	A slender steel or wood member driven into the ground and used to maintain horizontal position/location of a *float* by resisting an applied *lateral load* or to support an *axial load* of a *pier*.
Pile Cap	A cone-shaped covering affixed to the top of a *pile* that discourages birds from perching.
Pile Cut-Off	The upper elevation to which a *pile* is either driven or cut-off.
Pile Fixity	For design purposes this refers to some determined point below ground about which a *pile* is assumed to bend.
Pile Hammer	A mechanical device attached to the top of a *pile* in order to forcibly drive the pile into the ground.
Pile Hoop	A steel collar attached to the outside of a *float* or *gangway* through which a *pile* is driven.
Pile Pocket	An opening located entirely within the footprint of a *float* through which a *pile* is driven.
Pile, Batter Supported	A vertically driven *pile* that is supported by one or more *battered piles* when a heavy *lateral load* is anticipated.
Pile, Battered	A *pile* that is intentionally driven at an angle (not plumb). B*oarding float piles* are always battered.
Pile, Sheet	Interlocking steel plates driven into the ground for damming or retaining purposes.
Piling	A collective term for a group of *piles*.
Poly-Pipe Boom	See **Debris Deflection Boom**
Precast Plank	A concrete section of *launch ramp* that is cast in a form and then moved into position after curing.
PSI	Pounds per Square Inch

Pull-Through Stall	A *parking stall* that allows a vehicle to enter from one end and exit from the other. No backing is required.
Pumpout	A unit that pumps out sewage from a boat's on-board holding tank. The sewage is then pumped to a disposal system.
PVI	Point of Vertical Intersection. The point where both *tangents* of a *vertical curve* meet.
Ready Area	See **Staging Area**
Regulatory Agencies	Refers to the *USACOE* and *DSL,* in cooperation with other agencies such *DEQ* and *ODFW*, who are responsible for issuing environmental permits authorizing in-water construction work.
Reservoir	A man-made *waterbody* (lake) formed by the damming of a river.
Reservoir Drawdown	The controlled release of water through the dam at a *reservoir* that results in the lowering of the water level.
Reverse Curve	A horizontal roadway curve that is immediately followed by another curve in the opposite direction to form an "S" shape.
Riparian	Of, on, or relating to the area along the banks of a *waterbody.*
Riprap	Fractured stone with angular faces used to armor *cut* and *fill slopes* and the perimeter of *launch ramps* from the eroding effects of *current*, *waves*, and *wakes*. Riprap is divided into classes or groups of gradated stones based on the approximate weight in pounds of the largest stones in the class.
Rubstrip	A flexible, non-marring material attached to the sides of a *float* to protect both boats and *floats* against damage from impact and contact.
Runoff	*Stormwater* that flows across an *impervious* surface.
Runoff Plate	A metal plate located on the deck of a *transient float* and under the rollers of a *gangway* that help guide the horizontal movement of the *gangway*.

Safety Zone — A non-delineated refuge area on both sides of a *navigational channel.*

Scouring — The removal of material by the force of water moving across a surface.

Sediment Fence — A flexible fence made from geotextile fabric that helps to control *runoff* and soil erosion at a construction site.

Sedimentation (Sediment) — The deposition of material suspended in or moved by water in areas where the velocity of the water slows enough for the particles to settle out. Sediment at boating facilities is typically silt, sand, or gravel.

Self-Adjusting Boarding Float — A specially-constructed *boarding float* that automatically moves up or down a *guideway* as water levels fluctuate. Used exclusively on *reservoirs* where large water fluctuations preclude the use of *pile* supported *boarding floats*.

Sheet Drain — *Runoff* that is allowed to drain off the edges of an *impervious* surface.

Sheet Pile — See **Pile, Sheet**

Siltation — See **Sedimentation**

Silt Curtain — A flexible floating fence made from *geotextile fabric*, foam *floatation*, and *ballast* weight that is suspended and anchored in the water for the purpose of containing and controlling *turbidity* from construction activities.

Slip — A *moorage* area often delineated with parallel *floats* set at an angle or perpendicular to a main walkway *float*. The arrangement is similar to that of *parking stalls* in a *parking area*.

Slope — The deviation of a ground surface from level in the longitudinal direction (i.e. direction of travel).

Staging Area — A designated short-term *parking area* in close proximity to the *launch ramp* used to prepare (ready) a boat for launch or secure (tie-down) a boat after retrieval.

Stall Angle	The angle required to turn from the *parking aisle* into the *parking stall*. Typically 45, 60, or 90 degrees.
Stall Curb Length	The width of a *parking stall* measured parallel to the *parking aisle*.
Stall Depth	The distance from the front of the *parking stall* to the back measured parallel to the *parking aisle*.
Stall Length	The distance from the front of a *parking stall* to the back measured along the line of the *stall angle*.
Stall Length, Usable	The distance from a point where the front tires touch the *curb* to a point where the rear of the vehicle or trailer meets the edge of the *parking aisle*.
Stall Width	The width of a *parking stall* measured perpendicular to the *stall angle*.
Stormwater	Water that originates during precipitation events. Stormwater that does not soak into the ground becomes surface *runoff* and either flows directly into surface *waterbodies* or is channeled into storm drains or treatment facilities where it eventually discharges to surface waters.
Stringer	A structural member within a *boarding float* or *pier* that provides support for the decking.
Structural Fill	A term often used when significant depths of *subbase* are required to bring a site to *finish grade*.
Subbase	Crushed rock placed over the *subgrade* and compacted to form a solid, uniform surface prior to placing the *base course*. The size and gradation of subbase material is often larger than that of *base course* material.
Subgrade	The ground surface at a site after all earthwork has been completed and before placement of *subbase* material.
Submerged	That portion of land along a *waterbody* below *OLW* that is always underwater.

Submersible	That portion of land along a *waterbody* between *OLW* and *OHW* that is subject to periodic inundation.
SWMP	Stormwater Management Plan. A written document that details construction and post-construction control of *stormwater* impacts.
Tactile Warning	A textural treatment or device applied to the surface of an *accessible route* to alert the visually impaired of a road crossing.
Tangent	A straight section of a roadway or *alignment*.
Temporary Toilet	A self-contained portable toilet unit that is trucked to a site. Often used to supplement on-site sanitation facilities during periods of high use.
Through Rods	A series of long threaded steel rods that pass through a *transient float* to mechanically fasten the side *connectors* together.
Tie-Down Area	See **Staging Area**
Tie-Up Zone	All remaining *boarding floats* available for *mooring* beyond the end of the *trailer zone*. Used to load and unload passengers and gear.
Toe Rail	A raised curb around a pile pocket or along the edges of an *abutment* that provides edge protection.
Tongue and Groove	An interlocking joint caste into the edges of a *precast plank*.
Topography	The contours and ground features of an area of land.
Traffic Delineator	A brightly colored, flexible post secured to the *launch ramp* surface near the *abutment*. Intended to help boaters visibly locate the edge of the *abutment* and *floats* while backing their trailers over the *vertical curve*.
Trailer Zone	The first 30 feet of in-water *boarding floats* measured from *DLW*.

Transient Float — A platform-type floating structure secured by *piling* that provides short-term tie-up, usually for larger cruising boats. *Upland* access is provided via a *gangway*.

Transition Plate — A hinged metal structure that provides a smooth transition between a *land connection* and *gangway, gangway* and *transient float, or abutment* and *boarding float*.

Trapped Catch Basin — A *catch basin* with a T-fitting on the outfall pipe that prevents oils and solids from being washed out of the *catch basin*.

Travel Lane — All driving surfaces within the confines of a *parking area*, including *parking aisles*, used for maneuvering.

Trench Drain — A continuous open-drain system placed across a wide expanse of asphalt or concrete to intercept sheetflow of *stormwater runoff*.

Turbidity — A water condition in which solids have been stirred up and are suspended in the water column.

Turning Radius, Boat — The minimum circle size required for maneuvering a boat in the water. Assumed to be 1.5 times the length of a *design boat*.

Turning Radius, Vehicle — The size of the smallest circular turn (i.e. U-turn) that a vehicle or vehicle with trailer is capable of making.

UHMW-PE — Ultra High Molecular Weight Polyethylene

Upland — Land that is above *OHW* or *MHHW*.

Uplift — A force generated by wind or water that can cause a structure to be lifted.

Upstream — In the direction opposite of a river's *current*.

Usable Float Length — The length of *boarding floats* that are completely floating with at least 4 feet of water depth at the shore end.

USACE — United States Army Corps of Engineers

USCG	United States Coast Guard
USGS	United States Geological Survey
Utilities	All inclusive term for water, electrical, and sewer service.
Vault Toilet	A type of restroom where waste is collected and retained in a concrete vault until pumped out.
Vertical Curve	A type of curve with a continuously changing radius that provides a smooth transition from one *slope* to another.
V-Groove Finish	A type of *launch ramp* finish created by running a tool with a special "V" pattern across wet concrete. The tool produces peaks and valleys approximately 1 inch deep.
Wake	A boat or vessel generated *wave*.
Waler	Replaceable wood or composite boards located along the top outside edge of a *float*. Prevents damage to structural members of a *float* and provides a surface to attach a *rubstrip*.
Waterbody	A generic term for any *navigable* body of water such as a river, lake, *reservoir*, bay, ocean, etc.
Waterway	A *waterbody*.
Wave	A ridge or swell moving through or along the surface of a *waterbody*.
Wave Attenuator	A structure, barrier, or device to reduce *wave/wake* action and their potential damage to boats and facility structures. The attenuator may consist of a series of lashed logs, deep draft concrete *floats*, wave fence, *jetty/groin*, or a combination of these structures.
Web	A *gangway* structural member positioned between *chord* members to form a truss.
Wheelstop	A short prefabricated concrete or plastic curb located at the head of a *parking stall*.

Whitewater	Fast moving water that is often turbulent.

NOTES

Section 1

PROJECT PLANNING AND IMPLEMENTATION

1.01 MASTER PLANNING

A. General

1. Development of a master plan for large construction or renovation projects is highly recommended. The master plan should address a broad range of issues that may significantly alter project scope, cost, and implementation. After a master plan is completed then final engineering work can commence.

B. Application

1. Principal components of a master plan include:
   - Focus on the highest and best use of the site and adjacent waterway.
   - Physical site attributes and limitations.
   - Profile of intended users or user groups.
   - Current and future demand.
   - Feasibility of the site to accommodate users and the extent of facility needs.
   - Adjacent land use and impacts.
   - Permits, mitigation and environmental impacts.
   - Maintenance and operation needs.
   - Capital and maintenance funding.
   - Conceptual layout.
   - Preliminary capital development cost.

2. A site assessment is generally a good starting point for the master plan. The assessment would not involve formal surveying but rather a walk-through of the site where experienced facility staff can evaluate the site for usefulness as a boating facility *(see photo 1-1)*. The site would be visually evaluated for general topography, anticipated bathymetric conditions, water flow velocities, access to open water from the site, any wetland and riparian constraints, apparent adjacent uses, size of area available for development, proximity

Photo 1-1 Initial site visit to discuss potential facility improvements

of the site to adjacent boating facilities, need for additional boating access points in the area, among other things.

3. Generally at least two public informational meetings are part of a master planning process. These meetings provide an opportunity for the public to offer input and review alternatives for proposed site developments. The meeting will also provide insight into any possible opposition to the proposal.

4. Research information can be found at local planning departments for zoning, permitted uses, any potential cultural sites, and if the site has scenic or wild waterway designation. Road and utility capacity as well as any other improvements necessary to support the proposed project should be considered.

5. A master plan provides a platform for the design and engineering phase. The master plan should include a conceptual plan view drawing and layout of the site. This conceptual drawing is not detailed enough for construction. However, it establishes the approximate ramp size and location, targets parking area capacity, defines traffic management and circulation, and locates the restroom.

6. The plan should identify sources of construction funding and outline options for acquiring the required matching funds. Depending on the project, a cash flow analysis may be done to evaluate the feasibility of a revenue generating improvement. The project scope should outline options to construct the project in logical phases of work over a period of time.

C. Design

1. Once a master plan is completed and adopted by the public entity the next step is to perform conceptual project engineering (i.e., prepare high level drawings and cost estimate).

2. A good master plan is an invaluable tool that will help guide the owner and designer and/or engineer to focus on project components that make highest and best use of the facility. It also serves an important means to gain public support from users, adjacent neighbors and decision makers. The time to have public input and make significant changes is in a master plan phase, <u>not</u> during the final design and engineering phase.

1.02 CONCEPTUAL DESIGN ENGINEERING

A. General

1. A thorough site survey of the project area is completed before developing any conceptual design ideas *(see Photo 1-2)*. This includes both topographic (land) and bathymetric (underwater) surveys. All Pertinent information is collected electronically and imported into design software.

Photo 1-2 Survey crew collecting existing site conditions information

2. The existing site plan is drawn from the survey data. This includes accurately locating all ground features, existing improvements, and generating contours. The survey should include areas well beyond the limits of anticipated improvements. This assists the designer in evaluating impacts to both the project area and adjacent facilities.

3. The conceptual design is a two dimensional look at the facility to determine the size of the site that will be developed. The existing site plan view provides the designer with the information necessary to layout conceptual designs. Conceptual designs are high level facility layouts and are intended to provide a basis for discussion of the project scope, timing, and cost. Several designs are developed and may vary widely or be variations of one or more main ideas. It is not uncommon for five or more concepts to be developed with varied traffic flow, parking patterns, ramp slope, ramp location and restroom/toilet placement.

4. All of the ideas/designs should be thoroughly evaluated to determine the most efficient use of the area available. The best concept that meets the project objectives is selected. This final conceptual design and conceptual cost estimate are submitted to the facility owner for review and comment. Since the conceptual design is only a two dimensional look at the facility there should be adequate contingency added to the conceptual cost estimate. This contingency will cover the unforeseen cut/fill quantities that will become apparent in the preliminary design when cross section and profile drawings are generated and analyzed.

5. It is imperative that the facility owner review the conceptual design carefully. Suggestions, requests, requirements, observations, and any other pertinent information should be provided and discussed at this time. The designer will rely on the owner to advise of seasonal conditions that might not have been apparent during the survey or other site visits and

normal or unique patterns of use. It is important to determine that all issues are being addressed and that the design reflects these observations.

1.03 FINAL DESIGN ENGINEERING

A. General

1. There is no substitute for high quality final engineering on all construction projects. The key to high quality engineering is use of sound design fundamentals, good topographic and bathymetric site surveys, thorough site investigation, accurate cost data, and review of what has been successfully used in similar applications.

2. Engineering hinges on several key items (1) proper site application, (2) proper use of materials and, (3) appropriate and cost-conscious construction design. Striking a balance between the cost and the useful lifespan of a facility is very important since public in-water recreational facilities generally wear out much faster than landside facilities.

3. Careful consideration of operation and maintenance (O&M) activity needs to be considered at all times during the design. Normally, capital construction funds are much easier to obtain than comparable costs for O&M staff and funds. Therefore all reasonable attempts to reduce O&M and increase the lifespan of the facility should be considered.

B. Application

1. To assure proper design, particular attention should be paid to orientation and impacts to waterway facilities (i.e., current, wave, wake etc.). It is helpful to obtain both current and historic aerial photos of the site (scale 1 inch = 100 feet) to assist in orientation with respect to current, fetch, debris, and use patterns. There are a number of internet sites that provide excellent up to date aerial photos as well as historic photos.

2. An efficient design and engineering schedule should start with a clear definition of project work scope and objectives followed by a series of critical design reviews by the owner and engineer. Rushed engineering usually results in many unnecessary and costly change orders as well as poorly designed facilities.

C. Design

1. Design to the 25% level begins the process of refining the conceptual design. Ramifications of the conceptual design may not be readily apparent until the sections and profiles of the site are generated and

applied to the project. As the design is developed it may become necessary to alter the alignment, location, or size of the project components to better fit the site.

2. It is recommended that all design and engineering work beyond the conceptual phase receive at least two formal reviews. The first should occur at 25% with a good plan view of all the project elements. This is considered the most critical review since the scope and objectives must be clearly outlined and agreed upon at this time. It is also advisable to refine the conceptual cost estimate for the principal project components.

3. After the 25% review the engineer should complete all detail drawings ready for the 75% review. At this point the owner should carefully review all details to ensure that every need is met. In addition, the project specifications should be prepared in draft form along with a revised preliminary project cost estimate.

4. At the 75% review permit drawings and a quantities worksheet should be developed and submitted to begin the COE/DSL permit review process. Experience has shown that detailed drawings with accurate quantities are required for the permit review process. Any significant changes to the design after the review process has begun may require amendments which will inevitably delay the review process. Any requests to modify the scope of work after permits have been issued may trigger a complete reevaluation, further delaying the project.

5. No significant changes or adjustment to the scope of the project should be made after the 75% review. Engineering should move to the 100% phase where completed final drawings, technical specifications, and cost estimate are prepared and ready to bid.

1.04 CONSTRUCTION SCHEDULING

A. General

1. Particular attention should be placed on the optimum project construction period that is most feasible and cost efficient. These periods vary for each geographic area of the state. Factors such as weather, heavy use periods, water elevations, and in-water work permit requirements should be considered.

2. Except for actual engineering (completed drawings and specifications) construction scheduling is the most important item with respect to final project cost. Timing is critical for contractors. A contractor’s bid not only reflects purchase of materials, work by subcontractors, project complexity, and scheduling, but also the competitive nature of the market.

B. Application

1. For upland improvement projects that have no in-water work, weather, seasons, climate, and location are very important factors in facility construction. Overall the preferred construction period based on the climate is spring, summer and fall. Projects in coastal areas with mild climates have a wider range than inland, high-elevation lakes and reservoirs.

2. Heaviest facility use is generally from late May to early September. Unless the project component can be isolated, or impact to existing use minimized, it is best to avoid these months.

3. Water elevations are critical for projects that involve launch ramp, pile, or transient float construction. In general tidal water levels are relatively constant throughout the year. River levels are usually high in the winter and spring due to rain and snow melt. The best time for low water construction is late summer or early fall. Flood control reservoirs are usually drained in September and begin to refill in early February. Irrigation reservoirs are at their lowest in late summer and early fall and refill in winter and spring.

4. In-water permit restrictions are established to protect fish and other habitat. They are the most restrictive obstacle to in-water work and often do not correspond to the lowest water period or best season for construction. Careful attention to the Oregon Department of Fish and Wildlife (ODFW) In-Water Work Period is advised since this will mandate the construction period for the project.

C. Design

1. A sense of timing is critical in the implementation of marine projects. Allow a margin of safety for weather related and other possible construction problems. Consider project size and project complexity, then determine necessary construction time. All are driven by permit allowances.

2. Determine the allowable in-water work period, time of year, water elevations at time of construction, how much work can or needs to occur after the end of the in-water work period, and impacts to the users. Then, working backwards, establish the desired completion date, factor in the construction period, and set the Notice-to-Proceed date (start date).

3. From the Notice-to-Proceed date, continue to work backwards to allow at least 60 days for the advertisement, bid opening, contract award date, preconstruction meeting, and materials lead time. This assumes that final engineering, permits, and funding activities are complete when the project is bid. A critical path project schedule is essential to meet all these time lines.

1.05 PLANNING AND CONSTRUCTION PERMITS

A. General

1. Normally, all construction projects require some form of land use review and approval. This will be followed by design review and possibly building code and/or waterway permit review.

2. Land use review rarely raises any issues since recreational boating is an allowable or conditional use in most land use regulations. Certifications for building elevation or no rise in base flood elevation may be necessary for compliance with Federal Emergency Management Agency (FEMA) regulations. Check with the local planning department for details.

B. Application

1. Waterway permits - A permit from the US Army Corps of Engineers (USACE) and the Oregon Department of State Lands (DSL) is required for over-water or in-water work activities below ordinary high water or mean high water; or if the project will impact any significant habitat or wetlands.

2. Review will often include, but is not limited to, impacts to navigation, aquatic species, wildlife, habitat, water quality, natural resources, and cultural resources. Reviewing agencies often include, but not limited to, the USACE, DSL, ODFW, NOAA Fisheries, Oregon department of Environmental Quality (DEQ), State Historic Preservation Office (SHPO), Oregon Parks and Recreation Department (OPRD), and Tribal Agencies.

3. Building code review is normally limited only to landside structures (restrooms) as the OSSC does <u>not</u> have any specific sections on any recreational marine facilities (boat launch ramps, floats, gangways or transient tie-up floats). Extreme caution is advised when applying OSSC requirements to apparently similar water related structures since the occupancy and intended type of use is much different from recreational boating facilities. Refer to the Introduction for a discussion on codes.

4. Providing disabled access, accessible walkways, maneuvering, loading and other criteria to waterside facilities is a design challenge at all sites where design water elevation is greater than five vertical feet. This

represents more than 90% of all Oregon's waterways. Refer to the Introduction for a discussion on accessibility issues.

C. Design

1. Waterway permits are the most time-intensive of all permits in terms of working through the review process. It is advisable to begin the waterway permit process at least one year before submitting a funding request. This will allow time to incorporate any permit conditions into the design and project budget. Be aware that permit drawings will need to be at the 75%-100% final design level for submission.

2. Wetland impacts and mitigation are very complex and well beyond the scope of these guidelines. These types of projects normally require separate wetland delineation, engineering, and mitigation planning.

3. The best time to submit for design and building codes review is immediately upon completion of 100% engineering. In fact, most review agencies will require final stamped drawings before beginning the review process. The design and building code review can take two to eight weeks to complete. Normally no significant changes to the design are required and any modifications can be accomplished with a bid addendum or change order.

NOTES

Section 2

CHANNELS

2.01 CHANNEL DESIGN

A. General

1. This section is applicable only to primary access to public recreational boating facilities; for example, access from a launch ramp to the main body of water. For guidelines that address private, commercial, or industrial facilities and development please refer to the *OSMB Clearance Guidelines* available on-line at www.boatoregon.com. These guidelines are not intended to be applied to waters subject to or otherwise regulated by the U.S. Coast Guard (USCG) or U.S. Army Corps of Engineers (USACE) clearance requirements.

2. Channel designs must be adequate to allow boats to safely proceed and pass each other. To accomplish this, certain widths and depths are necessary. In shallow areas, these navigational channels must be artificially established by dredging the bottom of the waterway *(see Photo 2-3)*.

3. Width and depth criteria for channels are dependent on waterway physical characteristics, size and type of the design boat for that location, direction of traffic, boat passage, and speed.

4. There are three general types of water used by recreational boaters.

   a. Flatwater - non-moving or very slow-moving water flowing between 0 to 4 mph with an average gradient of 0 to 6 feet/mile. Typical waterways include lakes, reservoirs, and lower reaches of rivers and tidal bays. These waterways are classified as Class A and B flatwater. Channels are easily defined and maintained to a navigable depth for use by recreational motorboats.

   b. Flowingwater - moderately moving water flowing between 4 and 8 mph with an average gradient of 6 to 12 feet/mile. Typical waterways include middle reaches of rivers. These waterways are classified as Class C and D flowingwater. Channels may be defined and maintained to a navigable depth for use by recreational motorboats but are more susceptible to deposition, scouring, and shifting.

c. Whitewater - fast-moving water between 8 and 12+ mph with an average gradient of 12 to 18+ feet/mile. Typical waterways include upper reaches of small size rivers and streams. These are further classified as Class E and F whitewater. Whitewater has frequently shifting natural passageways with no defined channels and is normally used by float boats.

5. Defined navigation channel width is determined by the width and speed of the design boat to allow for safe passing. There are two general categories for channels; one for low speeds less than five miles per hour and one for speeds above five miles per hour *(see Table 2-1)*.

6. A clear safety zone should be provided and maintained on each side of all navigational channels *(see Figure 2-1)*. The safety zone may be used for boat turning and to provide a refuge area for boats with mechanical problems. The width of this zone varies with the channel size and speed of boat traffic *(see Table 2-1)*. The safety zone should be free of all structures and obstructions with the exception of buoys or piles for navigational aids. These aids should only be located within the safety zone *(see Photo 2-1)*.

7. Channel depth is determined by the design boat depth (draft or propulsion device). Non-motorized boats usually draft less than 6 inches and can operate in very shallow waters. Motorized boats need sufficient depth to avoid grounding or damage to props. Also, adjustments need to be made for sailboats, which due to draft and centerboard dimensions require greater channel depth and width.

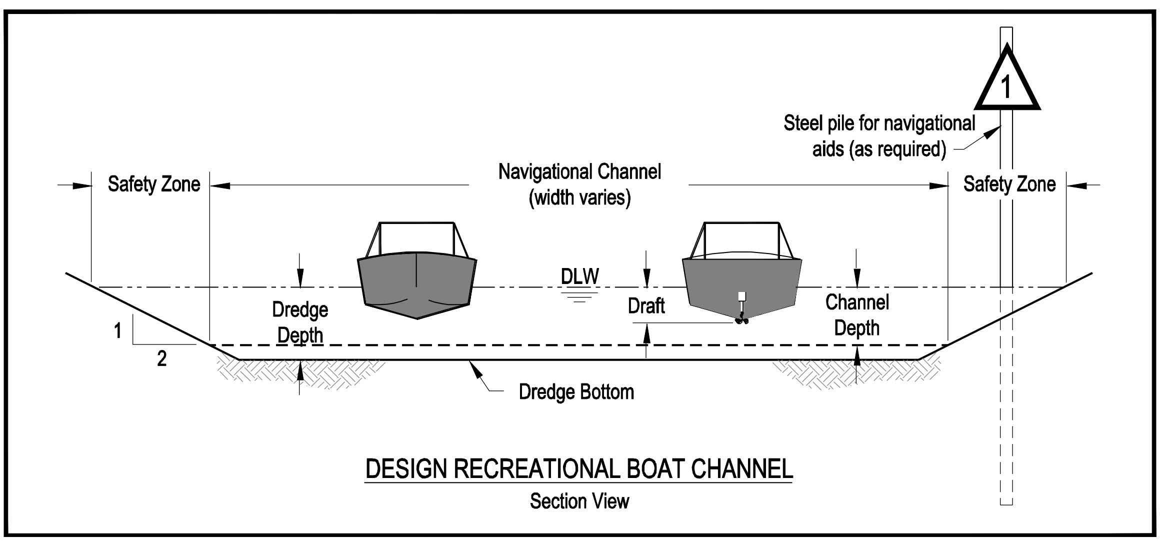


Figure 2-1 Cross section view of a typical recreational boat channel

Photo 2-1 Navigation channel with navigational aid in safety zone on left side

B. Application

1. Recreational boat usage on flatwater and flowingwater.

    a. Small motorboats, under 16 feet in length, are almost always trailered to the launch site each day of use. For small outboard motors and personal watercraft, the average draft and minimum safe propeller clearance required is 2 feet.

    b. Medium motorboats, 16 feet to 26 feet in length, are generally trailered to the launch site each day of use. For outboard motors and stern drive craft, the average draft and minimum safe propeller clearance required is 3 feet.

    c. Large motorboats, 26 feet to 40 feet in length, are generally left in the water in long term moorage. They are stern drive, and the average draft and minimum safe propeller clearance required is 4 feet to 6 feet.

    d. Very large motorboats exceed 40 feet in length and almost always remain in the water in long term moorage. Most of these boats operate in U.S. Coast Guard/ U.S. Corps of Engineers defined commercial/recreational channels, generally in water depths over 6 feet.

2. Recreational boat usage on whitewater.

   a. Non-motorized boats include kayaks, canoes, rafts, and drift boats or similar craft frequently operate on whitewater with no defined channels necessary. Generally, the non-motorized boats proceed in one direction, with the flow of water, at the speed of the current.

   b. Jetboats, propelled by the force of water passed through a powerful pump, are also frequently used on whitewater with no defined channels necessary. While underway, these boats can be operated in water depths of only 6 to 12 inches but need 1 to 2 feet when off plane *(see Photo 2-2)*.

3. Minimum channel depth is measured at Design Low Water (DLW) which is often ordinary low water (OLW) or mean lower low water (MLLW). It is preferable that minimum channel depth be maintained throughout the width and length of a defined channel.

4. Due to irregularities in the bottom of a dredged channel, the dredge bottom elevation should be established at least 2 feet below minimum clearance required, as determined by the size and type of boat.

5. Adjustments to channel depth and widths may be necessary in areas where sailboats are prevalent. This is to accommodate deeper drafts, large centerboards and greater maneuvering requirements. Furthermore, overhead clearance must be considered because of sailboat masts.

Photo 2-2 Jetboat navigating on a whitewater river

C. Design

1. Non-motorized Boats - Not Applicable

2. Motorized Boats - Channel depth (below OLW or MLLW) and width should conform to the following minimum design criteria:

Size of Boat (Motorized)	Channel Depth	Dredge Depth	Channel Width 5 mph	Channel Width >5 mph	Safety Zone Each Side
Small (<16 feet)					
Minimum	2'	4'	20'	30'	5'
Design	3'	5'	30'	40'	5'
Sailboats	5’	7’	40’	60’	5’
Medium (16 feet to 26 feet)					
Minimum	3'	5'	40'	50'	10'
Design	4'	6'	50'	60'	10'
Sailboats	7’	9’	80’	100’	10’
Large (over 26 feet)					
Minimum	5'	7'	60'	70'	20'
Design	6'	8'	70'	80'	20'
Sailboats	9’	11’	120’	140’	20’

Table 2-1 Channel widths and depths for various boat sizes

3. Navigational aids, when used, should be located within the safety zone on each side of the channel. Navigational aids are the only obstruction to navigation permitted within the safety zones.

Photo 2-3 Suction dredging barge

NOTES

Section 3

LAUNCH RAMPS

3.01 FACILITY SITING

A. General

1. Before a launch facility is constructed careful evaluation of need, site, and waterbody capacity should be completed. In general, boating facilities should be appropriately spaced along or around a waterway to disperse boater use.

2. The proposed facility site should have access to adequate public roadways and utilities depending on the intended level of development. The parcel should have a large enough area for parking adjacent to the proposed launch ramp location.

3. User safety and access should be considered when evaluating a site. It is preferred that the parking area be located close to the launch ramp for easy access and convenience. Furthermore, launch ramps should be sited near favorable boating activity areas where topographic conditions provide adequate protection against adverse waterbody and environmental forces (i.e. wind, waves, boat wake, current, debris).

4. Parking areas should not be separated from the launch ramp by local roadways. Pedestrian crossing, low speed maneuvering, and parking of vehicles on and across roadways present safety hazards.

5. Local topography will play a large part in the construction cost and feasibility of the proposed facility development. Large amounts of cut or fill required to make a site useable may be more costly than can be justified for the facility development *(see Photo 3-1)*.

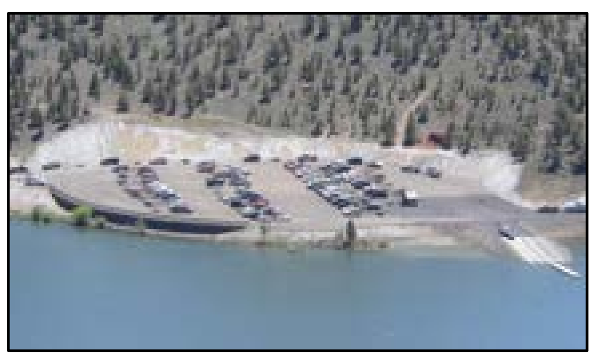


Photo 3-1 Launch facility where a large cut (parking lot) and fill (launch ramp) was required to fit the local topography

B. Application

1. To the extent practicable, boating access sites should be located along or around the shores of a water body to disperse the boating activity. This

will reduce on-water congestion and conflict by separating the different types of boating activities.

2. Typically boating facilities are located at an approximate interval of ten miles along rivers or a five-mile radius on lakes and reservoirs. These distances may change in cases where there are dams or sections of non-navigable water, or when the driving distance to the adjacent facility on the other side of a river is unreasonable. Most boating use occurs within a five-mile radius of the launch ramp.

3. Boats that are trailered to launch sites are typically less than 26 feet in length. Launching facilities should be sized and designed accordingly.

4. Launch ramps are generally designed so that the greatest amount of excavation occurs above the water line, with the underwater portion of the launch ramp closely matching the mudline topography whenever possible. This will reduce the required cut or fill in the submerged/submersible zone and decrease any resulting environmental impacts and issues.

5. Launch ramp profiles that closely match the topography of the waterbody bank line are less likely to disturb the local hydraulics of the river. At high water elevations this design consideration will help minimize scouring if the launch ramp is set above grade or sedimentation if set below grade.

6. Launch ramps constructed on an excavated channel off of small lakes or rivers are not recommended. While providing a launch site protected from current they are (1) more costly to construct, (2) challenging to get permitted and, (3) susceptible to siltation at the mouth of the channel requiring annual maintenance.

7. The effects of waves, wakes, current, and wind exposure should be considered as well as the occurrence of, or potential for, sedimentation.

C. Design

1. Launch Ramp Separation

Preferred: Navigable Rivers - 10 River Miles
Navigable Lakes and Reservoirs - 5 Mile Radius

3.02 FACILITY SIZING

A. General

1. Facility sizing is a means of managing boating use on a water body. The parking area and number of launch lanes should provide no more capacity

than the desired level for the type of use, user experience, and user safety. Consultation with regulators, users, adjacent land owners, and the Marine Patrol is recommended.

2. It is generally believed that the number of launch lanes will determine the size of the facility; however, the contrary is true. The parking area capacity at the facility will control the number of launch lanes needed.

3. Launch ramp use is usually concentrated during a three-hour launch period (morning) and a three-hour retrieval period (afternoon). Optimum design allows for five minutes to launch and five minutes to retrieve each boat. This time allotment includes parking of the vehicle. Therefore, capacity becomes a function of time. This approach may be idealistic but is only intended to establish some reasonable capacity numbers. Refer to section 3.02 C.1 for details.

B. Application

1. The number of launch lanes needed depends on the number of boat trailer parking spaces in the parking area. If the number of parking spaces exceeds the preferred number, the use at the facility should be evaluated to see if an additional lane is needed. The maximum number of parking spaces per launch lane should only be used when traffic flow is optimal, staging areas are provided, and use is less concentrated.

2. If the use at the facility is diversified, with different groups of users using the facility at different times of the day, then the addition of a lane may not be required. However, if all of the use at the facility is the same and occurs at approximately the same time of the day, addition of a lane will reduce congestion, conflict, and launch and retrieval time.

3. Multi-lane launch ramps with differing lane lengths have been used successfully at reservoir facilities where the fill curve (water elevation) and use curve (number of users) are similar in shape and timing *(see Photo 3-2)*. During the shoulder use times, as the water level in the reservoir is rising (spring) or receding (fall), the use can be handled by one lane that provides low pool access during those periods. As the water level approaches full pool, during the summer peak use period, the water level reaches one or more shorter lanes that are now useable. This

Photo 3-2 Two-lane ramp with short lane on left and long lane on right

concept matches the number and length of lanes to the demand without adding unnecessary construction and construction cost.

C. Design

1. Number of Launch Lanes Required (based on number of boat trailer parking spaces)

	15-45 Spaces	45-75 Spaces	75-125 Spaces	125-175 Spaces	175-250 Spaces
Preferred:	1 Lane	2 Lanes	3 Lanes	4 Lanes	6 Lanes

3.03 ALIGNMENT

A. General

1. The alignment of the launch ramp to the river flow line can improve the boater's ability to launch and retrieve boats, and reduce the required maintenance to keep the launch ramp useable.

B. Application

1. Typical alignment of a launch ramp is oriented perpendicular to the bank line, up to 45 degrees rotation downstream to best fit the river flow line at the specific site *(see Figure 3-1 and Photo 3-3)*.

Photo 3-3 Launch ramp angled approximately 45 degrees in the downstream direction

2. An extreme rotation angle, while generally helpful in boat launching and retrieval, is costly to construct and usually requires on-going maintenance to remove sedimentation from the launch ramp or erosion repair due to more exposure of the upstream edge of the launch ramp to the current *(see Photo 3-4)*.

Photo 3-4 Launch ramp aligned nearly parallel to river. Development of gravel bar has made this ramp unusable at lower water levels.

3. Unless the launch ramp enters the river in an eddy or a protected location, the launch ramp should not be angled or faced in an upstream direction. Controlling a boat is difficult when launching or retrieving against the current.

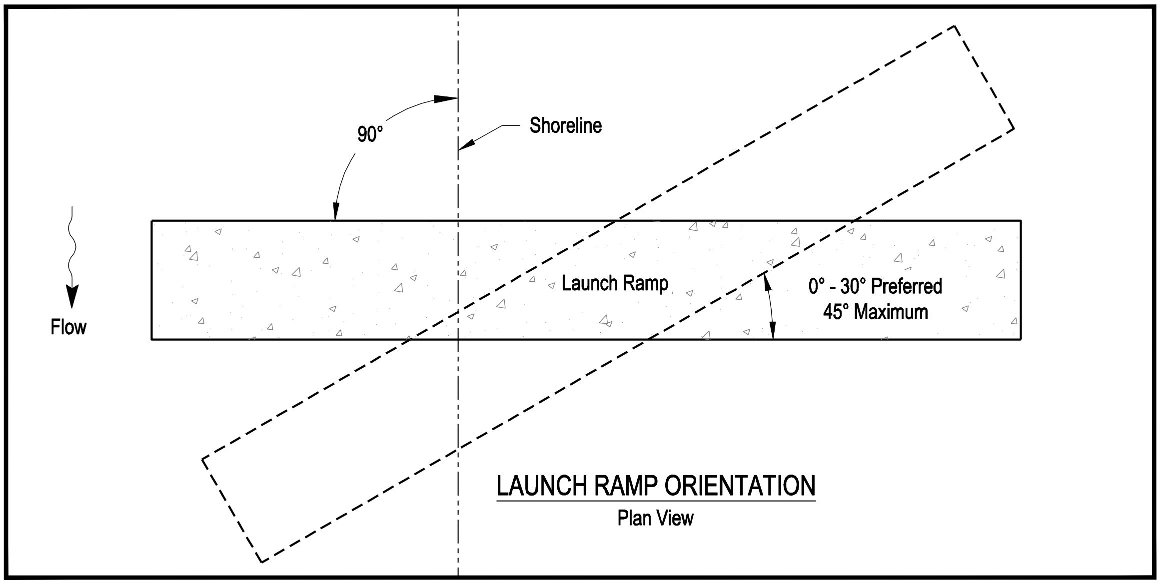


Figure 3-1 Rotation of launch ramp in relation to waterbody flow and bankline

C. Design

1. Launch Ramp Rotation

Preferred: Lakes and Reservoirs - Perpendicular to bank line, 0 degree rotation unless wind and wind generated waves are an issue.
Rivers – Dictated by site conditions. Often in the range of 10 to 30 degrees rotation downstream from perpendicular to bank line.

Minimum: Rivers - 0 degrees from perpendicular to bank line.

Maximum: Rivers - 45 degrees from perpendicular to bank line.

3.04 SLOPE

A. General

1. Launch ramp slope must be steep enough to float a boat from the trailer before the tow vehicle tires reach the water, and not so steep that tow vehicle traction becomes a concern.

2. There is a narrow range of launch ramp slope (12%-15%) that has been nationally accepted as a standard. Boaters across the country have successfully manipulated launch ramps within this slope range for many years *(see Figure 3-2)*.

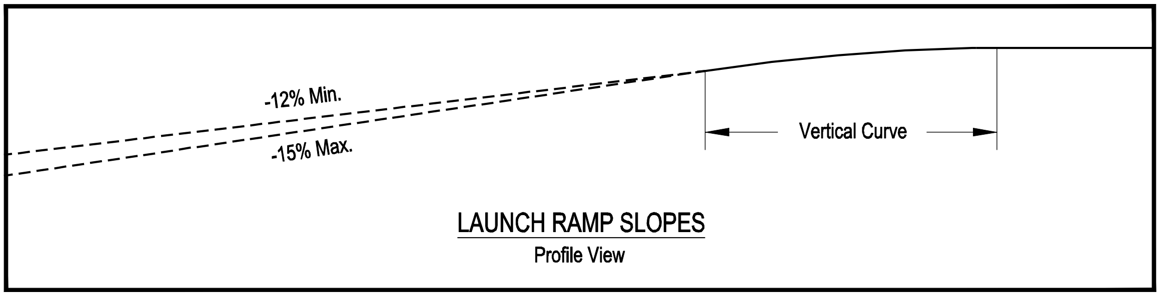


Figure 3-2 Typical range of launch ramp slopes

B. Application

1. The preferred launch ramp slope of 14% will allow the boat trailer to be in deep enough water to launch and retrieve from the trailer without the rear tires of the tow vehicle being in the water. Establishment of launch ramp slopes has been matched to the required depth needed to launch a typical trailerable boat from its trailer.

2. It is desirable that the area under the trailer tongue should be above the waterline so the operator does not have to stand in the water to operate the boat trailer winch during launch or retrieval activities *(see Photo 3-5)*.

Photo 3-5 Proper ramp slope keeps tow vehicle out of the water and provides access to the trailer

Photo 3-6 Insufficient ramp slope places tow vehicle in the water and does not provide access to the trailer without getting wet

3. Occasionally, local conditions will dictate that a grade slightly more or less from the preferred be used. To reduce the amount and cost of cut or fill material, launch ramp slopes have been modified to better fit the grade of the bank (within the allowable range). A small facility that caters to small fishing boats does quite well with a 12% to 13% launch ramp.

4. The designer must use extreme caution when considering launch ramp slopes outside the accepted range of 12% to 15%. Potential safety hazards can occur in these situations. If the launch ramp slope is less than 12%, the tow vehicle and operator are subjected to immersion in water during launch and retrieval *(see Photo 3-6)*. Launch ramp slopes that exceed 15% may cause traction or vehicle/trailer handling issues.

5. The 2010 ADA Standards does not address accessibility of the launch ramp itself. However, there are guidelines for boarding floats located within the launch ramp *(see Appendix A)*. Based on minimum safety and functionality criteria for launching a boat, launch ramp slopes of 12% to 15% with 1-inch deep v-grooves are considered to be accessible. This is provided that all other specified conditions leading to the launch ramp are met.

C. Design

1. Launch Ramp Slope

Preferred: 14%
Minimum: 12%
Maximum: 15%

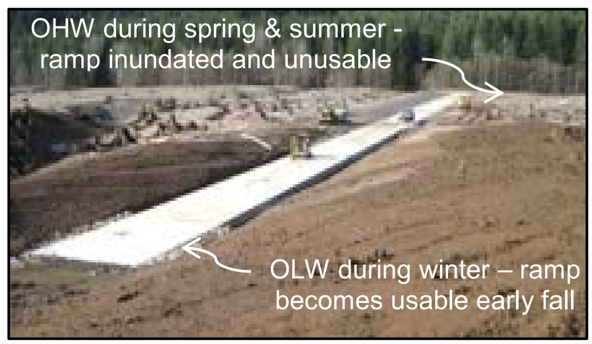


Photo 3-7 Low water launch ramp at a reservoir

3.05 DESIGN WATER ELEVATIONS

A. General

1. The Ordinary Low Water (OLW) elevation is often used as the basis for launch ramp toe design. This is true of most river facilities. Coastal (tidally influenced) facilities should use an extreme low tide elevation for design. Reservoirs and lakes should use a water elevation based on season of use.

2. The Ordinary High Water (OHW) elevation, at minimum, should be used for the top of launch ramp design. This is true of reservoirs and lakes that operate at full pool during the boating season. Coastal (tidally influenced) facilities should use an extreme high tide for design. River facilities must often be designed at elevations well above the OHW line because of the logistics of access.

3. Some river facilities may be located at or below OHW and are subject to seasonal flooding. This is certainly not desirable for new facility design but is often a reality for existing facilities. Also, low water launch ramps at reservoirs may be inundated during the peak boating season and only become usable after reservoir drawdown during the fall and winter *(see Photo 3-7)*.

4. Design Low Water (DLW) and Design High Water (DHW) elevations should be established and used for the boating facility design instead of OLW and OHW. Generally there will be little or no difference between OLW/DLW and OHW/DHW. However there are situations where the difference may be significant. An example of this would be the launch ramp length at a flood control reservoir where the pool is drawn down in the fall after the primary and limited use period. Assuming a 100-foot vertical water elevation drop and launch ramp toe design elevation to OLW the launch ramp length might be 700 feet long. Using Design Low Water (DLW), based on water elevations for the period of use, launch ramp length might be no more than 200 feet long. This saves construction dollars for 500 feet of launch ramp. Conversely, river levels are at their lowest during the peak use period and launch ramp lengths should be based on OLW.

5. The top of the launch ramp is the upper-most part of the v-grooved concrete launch ramp and includes the vertical curve. The top of the launch ramp should be a minimum of 1 foot above DHW *(see Figure 3-3)*.

6. The toe of the launch ramp is the lower end of the v-grooved concrete launch ramp. The launch ramp toe extends below the DLW level to provide a hard surface for the trailer to travel on during launch and retrieval. In a river or lake the toe of the launch ramp would typically be constructed of precast concrete planks and in a reservoir the entire launch ramp would be cast-in-place concrete *(see Figure 3-3)*.

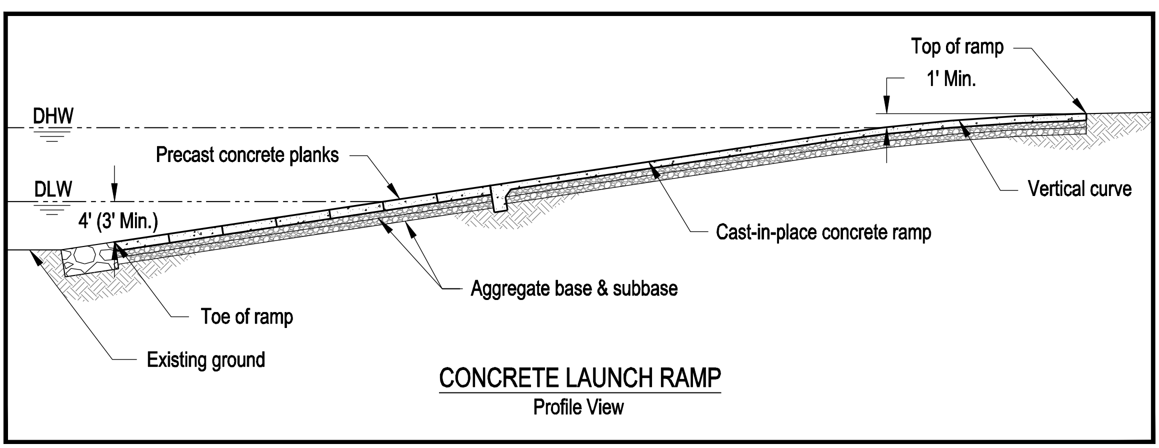


Figure 3-3 Design water levels as they relate to top and toe elevations of launch ramp

7. Top and toe elevations of a launch ramp have a direct effect on the period of serviceability of the launch ramp for boaters. It is important to carefully evaluate the historic water fluctuations for the water body at the proposed site to ensure usability of the launch ramp during the intended period of use and to avoid over or under constructing.

B. Application

1. It is suggested that a record of high and low water elevations for each month of the intended use period, over at least a ten-year period, be used to establish the facility design high and low water elevations. It is important to note that some facilities are used year round.

2. Both the primary and shoulder months of use for the facility should be determined, typically March through October. High and low water elevations for each of the selected months for the past ten-year period can be established from gage readings. This information is compiled from gaging stations. Historical data may be obtained, most readily via the Internet, from the U.S. Geological Survey, the U.S. Army Corps of Engineers, Oregon Water Resources, and several other sources.

3. Tabulate the frequencies for the highs and lows for each month of the period. Calculate the design high water (DHW) and design low water (DLW) elevations, based on frequency of events that will serve the facility 90% of the time. This will eliminate the extreme high and low elevations.

4. Observed water elevations may be used if no gage data is available for the calculation of design values. Consultation with local officials can be very helpful in the establishment of the historic patterns.

5. Establishing the launch ramp toe at 4 feet vertically below the DLW has been found to provide adequate water depth to float the average boat from its trailer. With 4 feet of water depth the creation of power loading holes out beyond the end of the ramp are minimized. Furthermore, the 4-foot depth provides a 1-foot buffer to accommodate an extreme low water level or construction tolerances. If either condition occurs there will still be 3 feet of water depth to launch and retrieve *(see Figure 3-3)*.

6. It is desired that the top of the launch ramp be a minimum of 1-foot vertically above the DHW elevation *(see Figure 3-3)*. However, local topography will often dictate the establishment of the top of launch ramp.

7. Excessive launch ramp length above and below the design values is a waste of construction dollars. Underwater launch ramp construction (precast plank system) is generally more than twice as expensive as comparable upland cast-in-place construction.

8. Reservoir launch ramps greater than 200 feet in length should be provided with widened areas for boaters to make U-turns *(see Photo 3-8)*. These turnouts should be spaced at intervals that would reduce backing distance to a maximum of 200 feet. It is not uncommon for reservoir launch ramps to have lengths that exceed 1,000 feet due to water level draw down during the period of use.

Photo 3-8 This launch ramp is nearly 400 feet in length and is designed with a turnout at the halfway point

9. In a river situation it is desirable to keep the toe of the launch ramp in a slight fill situation rather than cut that could result in deposition.

C. Design

1. Water Elevations for Facility Design

Preferred:	River DLW = OLW
	River DHW = OHW
Preferred:	Coastal DLW = 3 feet below MLLW (i.e. -3 tide)
	Coastal DHW = Extreme high tide
Preferred:	Reservoir/Lake DLW = Based on season of use
	Reservoir/Lake DHW = Full pool
Minimum:	Dictated by local topography
Maximum:	Dictated by local topography

2. Top of Launch Ramp Elevation

Preferred:	1 foot vertically above DHW (Minimum)
Minimum:	Dictated by local topography
Maximum:	Dictated by local topography

3. Toe of Launch Ramp Elevation

Preferred Coastal:	4 feet vertically below DLW (-7.0 MLLW)
River:	4 feet vertically below DLW
Reservoir:	4 feet vertically below DLW
Lake:	4 feet vertically below DLW
Minimum:	3 feet instead of Preferred values
Maximum:	5 feet instead of Preferred values

3.06 WIDTH

A. General

1. Adequate launch ramp width is necessary to provide room for boaters of various capabilities to back or maneuver their boat trailer down the boat launch ramp. The launch ramp width should be wide enough to accommodate the boarding floats so they can ground-out on the launch ramp surface. Various launch ramp configurations are shown in *Figures 3-5 through 3-12* and *Photos 3-9 through 3-16*.

2. Lane width is based on a 10-foot wide vehicle/trailer "occupy area" and a 5-foot wide area on either side for a maneuvering "buffer zone" *(see Figure 3-4)*. The "buffer zone" on adjacent lanes of a multi-lane launch ramp will overlap. Lane widths may be reduced in this situation.

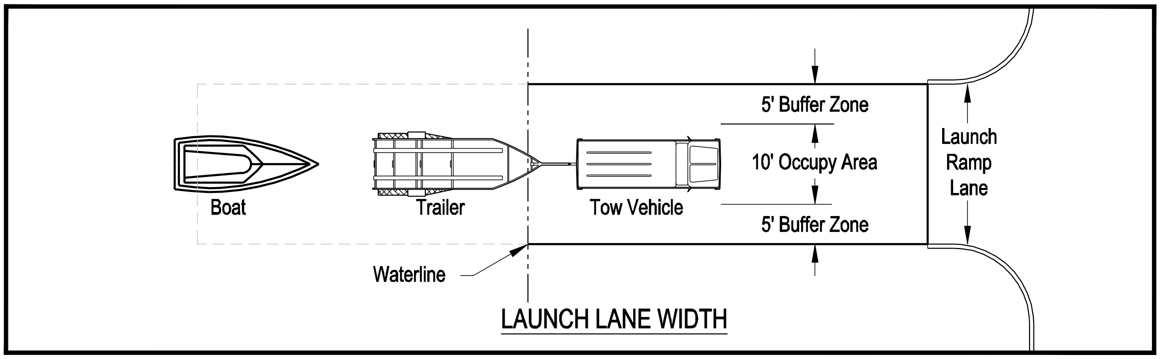


Figure 3-4 Criteria for launch lane width showing vehicle/trailer occupy area and buffer zones

B. Application

1. Launch lanes are typically 20 feet wide based on the above criteria. However, there are exceptions to the rule; (1) Single lane launch ramps that are less than 100 feet in total length may be 15 feet wide *(see Figure 3-5)*; (2) Launch ramps with two or more adjacent lanes and boarding floats down one side, or without boarding floats, may also be 15 feet wide per lane *(see Figure 3-7)*; (3) When there are three or more adjacent lanes between strings of boarding floats, lane widths may be 15 feet wide per lane *(see Figure 3-9)*.

2. Another consideration for lane width is the need to provide adequate room between parallel sets of floats for boats to maneuver. The turning radius for a boat is assumed to be 1.5 times the length of the boat. For example, a 20-foot boat requires a minimum of 30 feet for turning (15-foot radius). An additional 10 feet of "occupy area" is required to have adequate room for a second boat to safely maneuver. Therefore, 40 feet is the minimum width between parallel sets of floats to provide for two launch lanes *(see Figure 3-11)*.

An exception to this is the center lane of the alternative three-lane ramp layout *(see Figure 3-10)*. Based on the turning radius criterion, the center lane should be 30 feet wide. However, it is likely that boaters may assume this center lane to be two lanes and become accustomed to using it in that fashion. Although it could function in this manner it is not desirable. Therefore, the intended single-lane use should be reinforced by adequate signage and striping to clearly delineate the lane. Application of the alternative three-lane ramp layout is limited since an additional 10 feet of overall ramp width converts this to a four-lane ramp.

3. Lane delineation stripes should be painted on multi-lane launch ramps. This is very helpful to the boater for alignment of their trailer to the launch ramp and shows maneuvering limits.

Photo 3-9 Single-lane launch ramp without boarding floats

Photo 3-10 Single-lane launch ramp with boarding floats. Lane width is 20 feet with cold joint centered on launch lane.

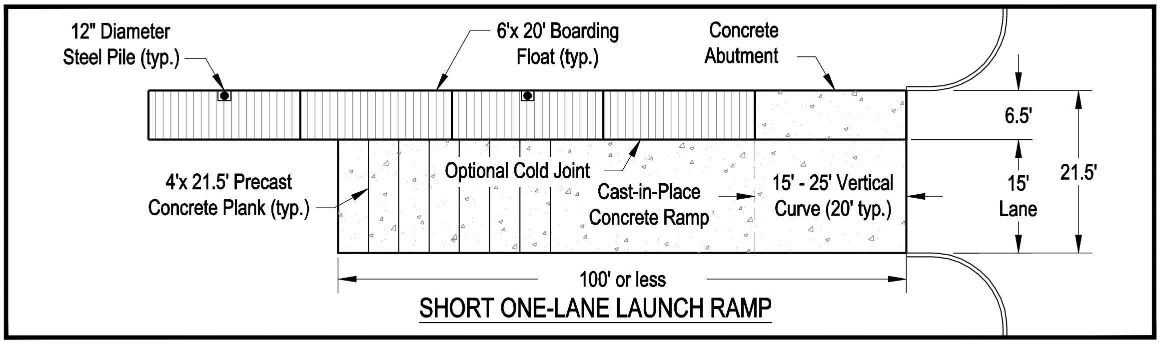


Figure 3-5 Short one-lane launch ramp configuration

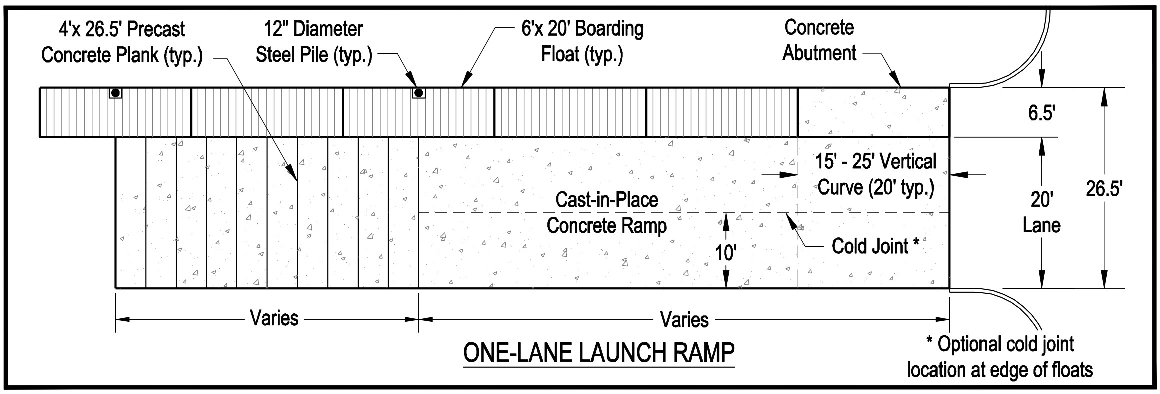


Figure 3-6 One-lane launch ramp configuration

Photo 3-11 Two-lane launch ramp with boarding floats down the center between lanes

Photo 3-12 Two-lane launch ramp with boarding floats down one side only

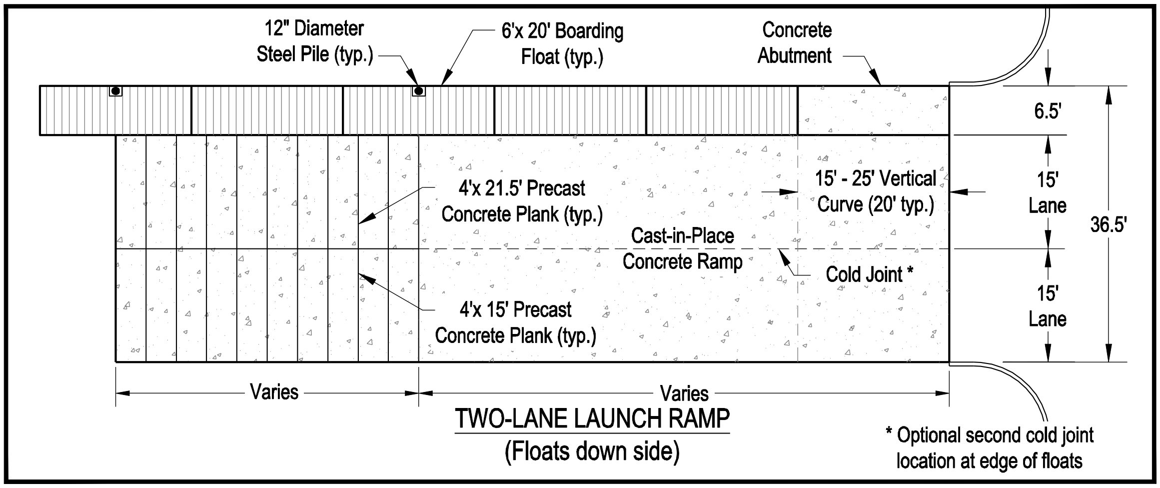


Figure 3-7 Two-lane launch ramp configuration with boarding floats down one side

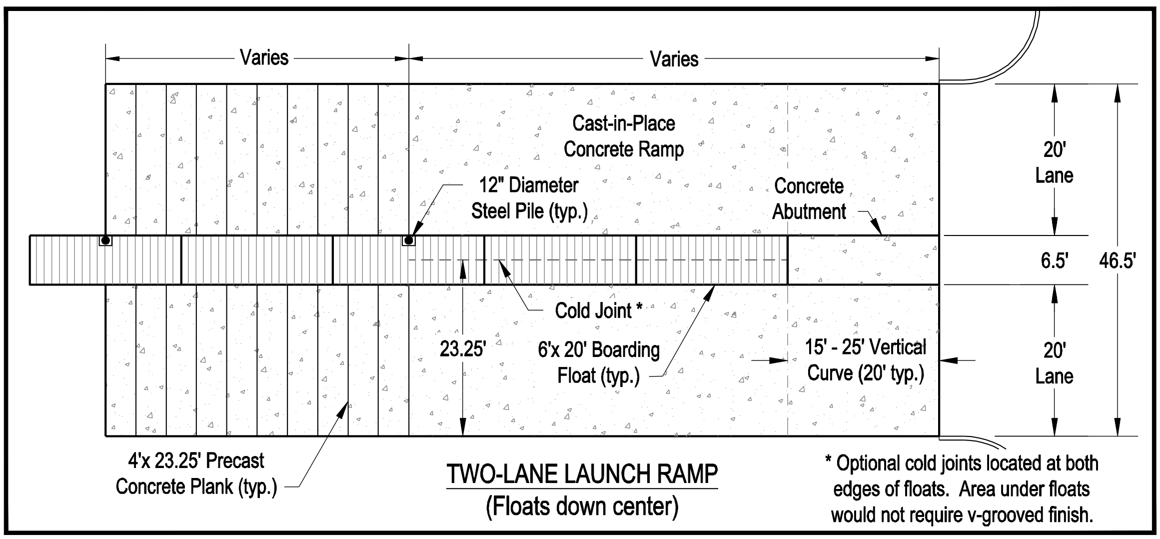


Figure 3-8 Two-lane launch ramp configuration with boarding floats down the center

Photo 3-13 Three-lane launch ramp with boarding floats down both sides

Photo 3-14 Alternate three-lane launch ramp configuration with boarding floats between lanes

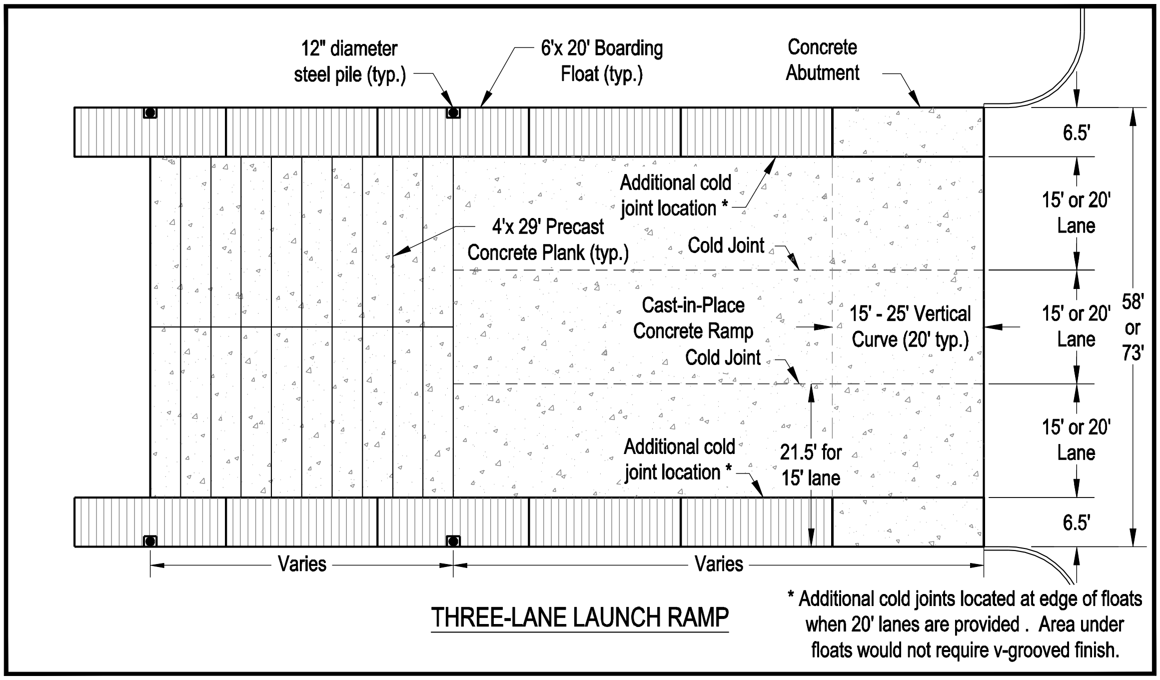


Figure 3-9 Three-lane launch ramp configuration

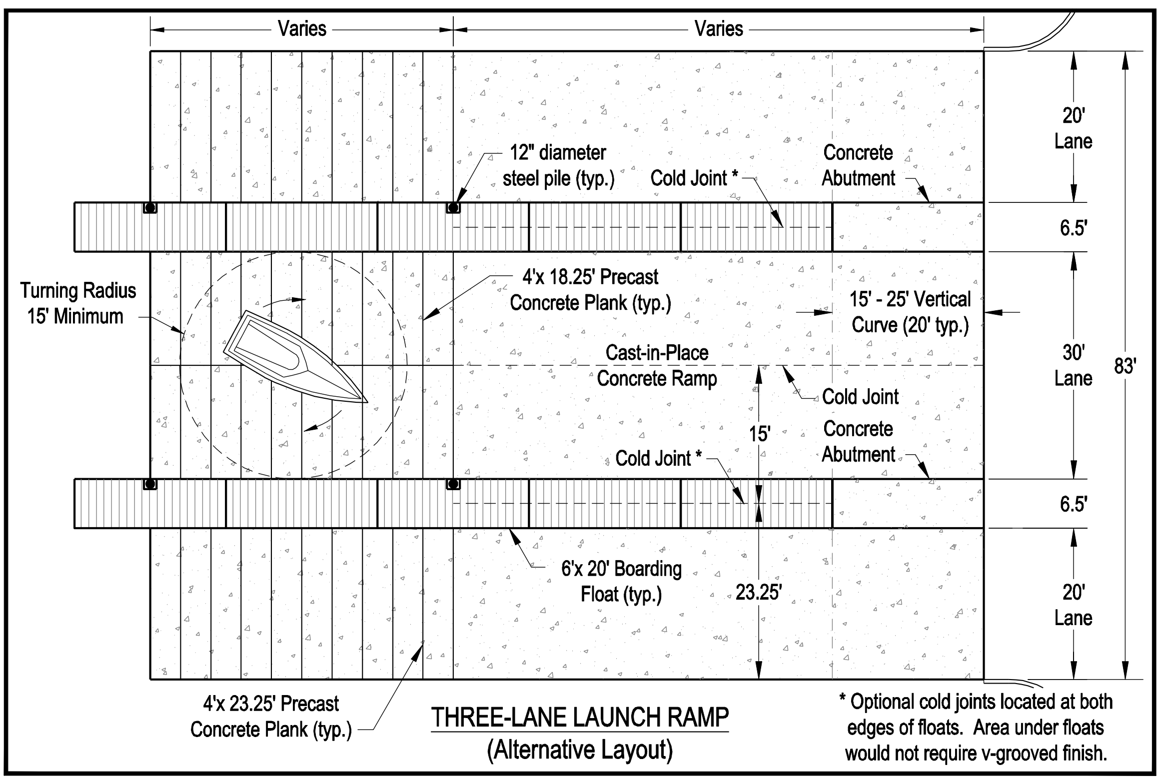


Figure 3-10 Three-lane launch ramp alternative configuration

Photo 3-15 Four-lane launch ramp with boarding float access for each lane

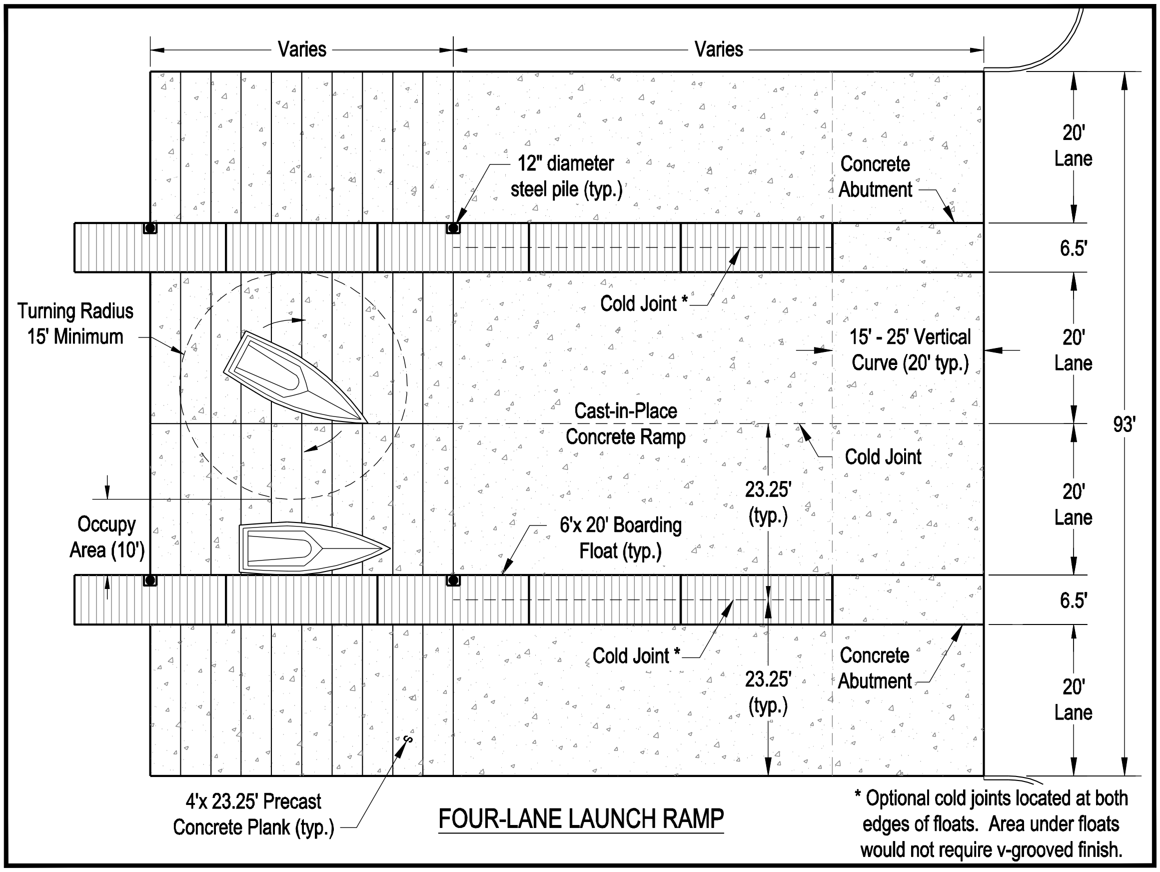


Figure 3-11 Four-lane launch ramp configuration

Photo 3-16 Six-lane launch ramp with boarding float access for each lane

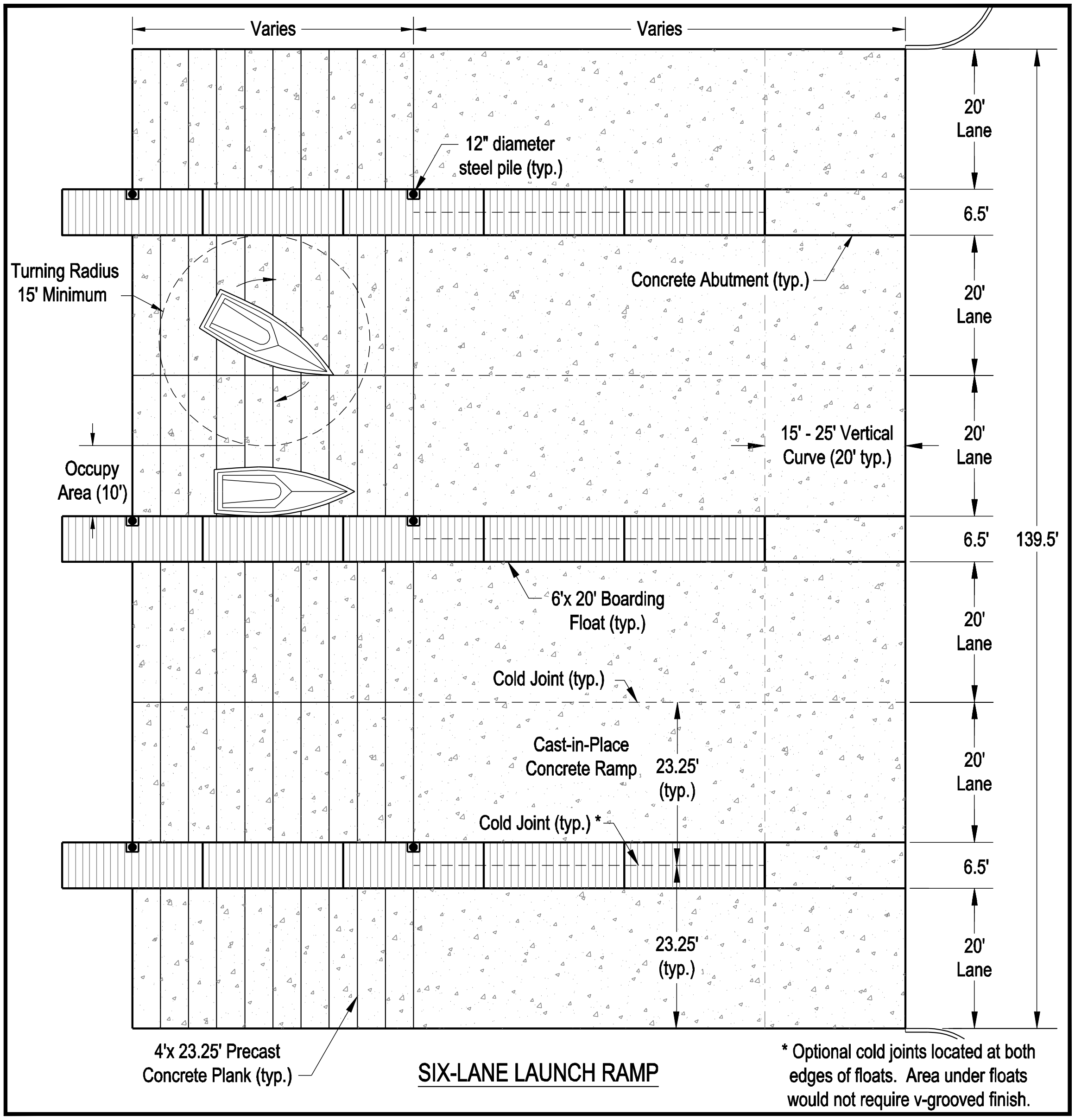


Figure 3-12 Six-lane launch ramp configuration

C. Design

1. Launch Lane Widths

Preferred:	Single lane or 2 lanes separated by floats = 20 feet Single lane less than 75 feet long = 15 feet 2 adjacent lanes w/ floats on each side = 20 feet 2 adjacent lanes w/ floats on one side = 15 feet 3 or more adjacent lanes = 15 feet (20 feet if space and budget allow)
Minimum:	All configurations = 15 feet

Maximum: All configurations = 20 feet (except center lane of alternative three-lane ramp = 30 feet)

3.07 SURFACES

A. General

1. There are several types of launch ramp surfaces typically used around the state. Some are better than others but they all serve the same purpose.

B. Application

1. Gravel launch ramps are the least expensive of the three main types. Generally they are not at any particular grade or slope and have been used to launch small light weight boats such as car-top or carry down boats. These launch ramps provide very limited traction and often require a four-wheel drive tow vehicle. Gravel launch ramps are not recommended because of safety, capacity, and maintenance issues *(see Photo 3-17)*.

Photo 3-17 Gravel ramp in poor condition and with inadequate slope

2. Asphalt launch ramps are an improvement over gravel launch ramps but still have limitations. Though often constructed to design grade or slope and providing a hard surface for the vehicle and trailer, asphalt lacks the structural strength of concrete and the required roughness for adequate traction - especially in coastal environments. Furthermore, asphalt can only be placed to the water's edge at time of construction. During high water events, with increased velocities, it is not

Photo 3-18 Asphalt ramp in poor condition. Note deteriorated asphalt at water's edge and missing asphalt below the water line due to inadequate edge protection and scouring from the river flow.

uncommon for the water to move entire sections of asphalt from their original locations *(see Photo 3-18)*. Asphalt launch ramps are not recommended nor should they be considered. Asphalt that may become inundated (i.e. below OHW) is currently not allowed by the regulatory agencies.

3. Concrete launch ramps are superior to gravel and asphalt launch ramps. It is easy to control and set the grade or slope of the concrete launch ramp during construction. Concrete, when finished with a v-groove finish, offers very good traction for tow vehicles. Reinforced concrete has some structural strength to span soft spots in the subbase and has the mass to stay in place in events of high water.

   a. When constructing a concrete launch ramp above the water level it is recommended that it be cast-in-place. It is the least expensive of the concrete options and is the easiest to maintain control of slope and grades. Furthermore, it allows for the forming of cutoff walls that help protect the launch ramp from undercutting.

   b. When constructing the lower end of the launch ramp, underwater portion, it is recommended that precast concrete planks be used.

C. Design

1. Launch Ramp Surface

   Preferred: Concrete (Precast and Cast-in-Place) with v-groove finish

3.08 CAST-IN-PLACE CONCRETE

A. General

1. Cast-in-place (C-I-P) concrete has proven to be the most durable and cost effective material for launch ramp construction. Use of form boards, into which fresh concrete is placed, allows for accurate control of grades and slope.

2. With the ability to form a v-groove finish in the concrete adequate traction is provided. This is especially important in coastal conditions where marine growth creates a slick coating on the submerged and submersible surfaces of the launch ramp. Concrete is also structurally superior and more durable than asphalt in marine environments.

B. Application

1. Cut-off walls should be constructed down both sides and across the lower end (anchor wall) of the cast-in-place portion of the launch ramp. The 2-foot deep, tapered cut-off walls around the perimeter of the launch ramp help protect it from being undermined in case of erosion protection (riprap) failure *(see Figures 3-13 and 3-14 and Photo 3-19)* and also function as grade beams to strengthen the ramp edges.

Photo 3-19 Cutoff wall along edge of ramp and riprap backfill

2. In locations where the top of the launch ramp is below OHW it is recommended that a cutoff wall be constructed across the top edge of the launch ramp. The thickened edges give the launch ramp additional strength at the perimeter and helps prevent edges and/or corners from cracking and breaking off.

3. The cast-in-place launch ramp should be reinforced with #4 rebar, both directions, in a 12-inch by 12-inch grid. Rebar should be epoxy coated *(see Figure 3-15 and Photo 3-20)*.

4. Block-outs or cut-outs should be provided for any piles that may need to go through part of the launch ramp. Also, a block-out should be provided for the abutment if floats are a part of the project. Rebar should run through the block-out boards to tie the abutment and launch ramp together *(see Figure 3-15 and Photo 3-20)*.

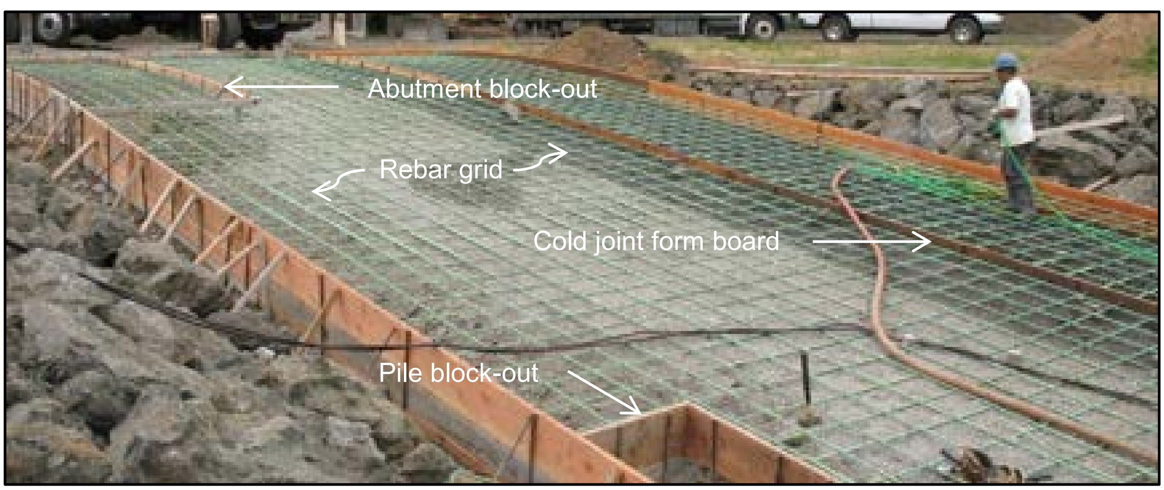


Photo 3-20 Cast-in-place launch ramp form work

5. The concrete should be placed over a thoroughly compacted subgrade, geotextile fabric, minimum 6-inch thick layer of compacted aggregate subbase and 6-inch thick layer of compacted aggregate base course.

6. Subbase material should be 2½-inch or 3-inch minus crushed aggregate. Base material should be ¾-inch or 1-inch minus crushed aggregate *(see Figures 3-12 and 3-13).* Open graded versions of the above should be used for underwater grading to reduce turbidity.

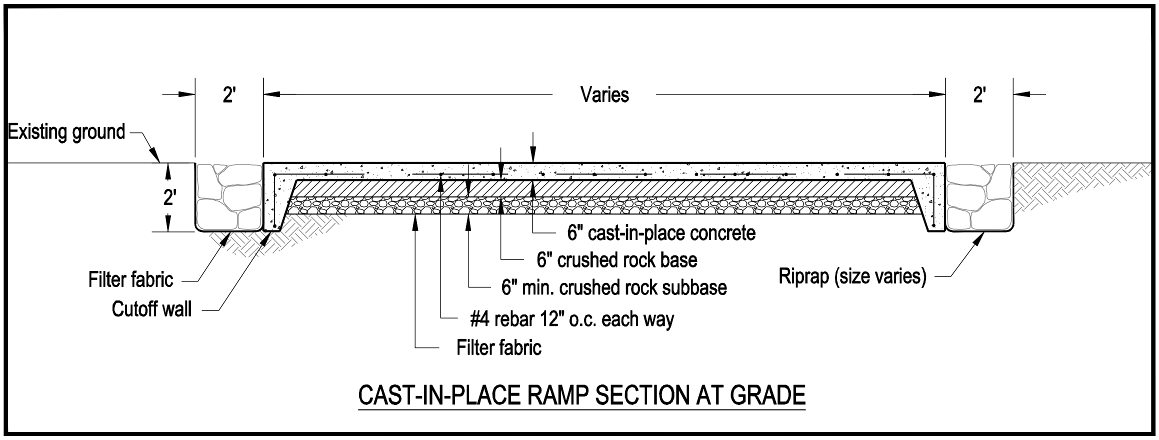


Figure 3-13 Cast-in-place ramp section at grade

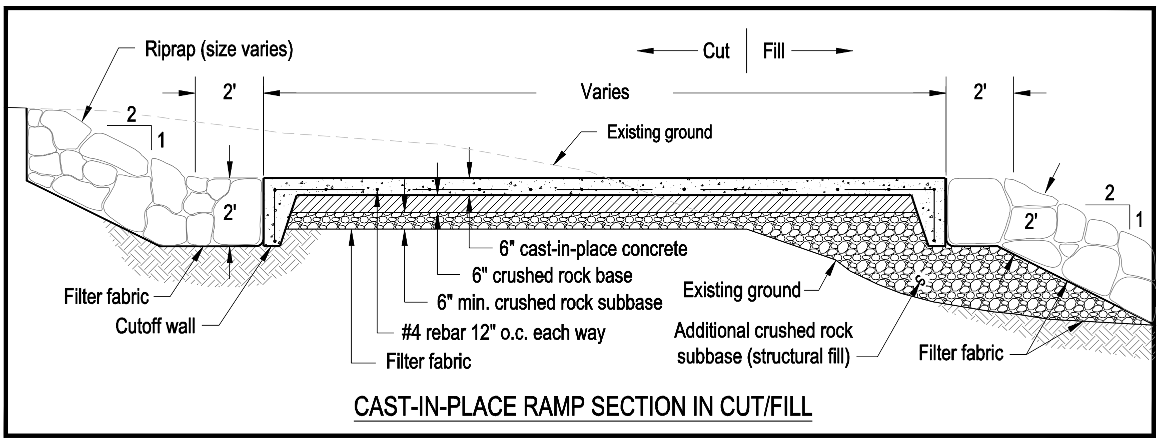


Figure 3-14 Cast-in-place ramp section in a cut and/or fill situation

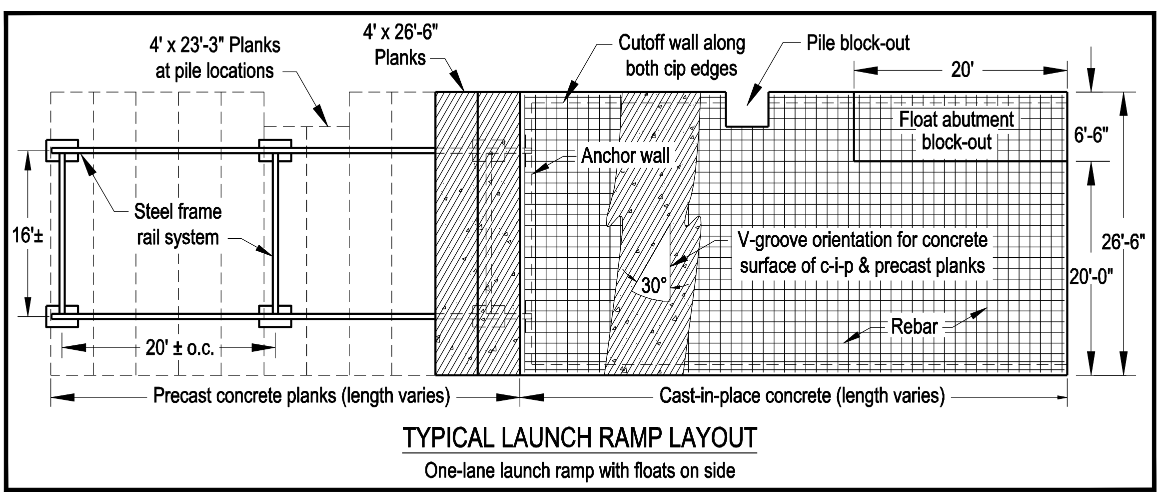


Figure 3-15 Launch ramp layout showing rebar, rails, and block-outs

7. Cold Joints

a. Attempting to do a v-groove finish when the width exceeds 20 feet is not recommended. It can be difficult to control the v-groove finish tool and apply the required pressure to form grooves in the concrete. The launch ramp should be divided into appropriate widths with logically placed longitudinal cold joint(s) to make the v-groove application manageable.

Photo 3-21 Longitudinal cold joint at edge of launch lane and form boards notched for rebar. Rebar will be blocked prior to placement of concrete.

b. When installing a longitudinal cold joint, the joint should be located at the float-edge of a single-lane launch ramp with floats or centered on the launch lane. For multi-lane launch ramps, the joint should occur at the edges of each lane or under the boarding floats *(see Photo 3-21)*.

c. When forming for longitudinal joints the form boards should be notched to allow rebar to run through the joint. Rebar should be blocked up off the aggregate base with 2-inch blocks or stands designed for that purpose *(see Photo 3-21)*.

d. Transverse cold joints are rarely necessary and should be avoided if possible. This might occur if there is a significant delay in concrete trucks that would cause the in-place concrete to begin setting. A clean transverse edge would then be required.

C. Design

1. Cast-in-Place Launch Ramp Thickness

Preferred: 6 inches (minimum)

2. Cast-in-Place Concrete Compressive Strength

Preferred: 4,000 psi (minimum)

3. Cast-in-Place Concrete Reinforcement

Preferred: #4 epoxy coated rebar

4. End of Cast-in-Place Concrete Launch Ramp Elevation (transition point to precast planks)

Preferred Coastal:	+3 MLLW (tidal)
Preferred Rivers:	2 feet (minimum) above anticipated water elevation at the time of construction.
Preferred Reservoirs:	Entire launch ramp should be cast-in-place and placed after reservoir drawn down to low water.
Preferred Lakes:	2 feet (minimum) above anticipated water elevation at time of construction.

3.09 PRECAST CONCRETE PLANKS

A. General

1. Precast concrete planks are movable slabs of reinforced concrete that are cast-in-place at an upland location. After curing the planks are moved into their final position, hence the term "precast."

2. Precast planks should be cast in a controlled environment preferably by a plant that is regularly engaged in the manufacture of precast concrete structures *(see Photo 3-22)*. On-site casting of planks is not recommended because of potential quality and tolerance issues.

Photo 3-22 Shop fabricated precast planks. The form in the foreground is ready for placement of concrete. The form in the background has concrete in place. These planks are cast upside. The cable loops are used to lift and turn the planks and will be cut off flush with the bottom.

3. Precast concrete planks are used for the construction of the underwater portion of a launch ramp. The use of precast planks eliminates the need for costly dewatering operations that would be necessary to cast the concrete in place.

4. Use of precast concrete planks allows the transition to cast-in-place concrete to occur above the water line and in the dry. This keeps green (uncured) concrete out of the water.

5. Generally, the construction cost of the precast portion of the launch ramp is twice as expensive, per square unit, as the cast-in-place portion of the launch ramp. Therefore, scheduling of the project during times of low water is crucial in keeping the construction cost down provided that in-water work periods coincide with times of low water.

6. Precast concrete planks are of tongue and groove construction that lock all the planks together and eliminates gaps. Old-style planks did not have tongue and groove construction but were held together with rebar hoops. This often resulted in gaps between planks that would expose the aggregate base to erosion by the river flow and/or prop wash. Aside from the obvious safety hazard, there have been cases where the aggregate base supporting the planks has been eroded away causing a failure in that portion of the launch ramp.

7. Precast planks are 8 inches thick by 4 feet wide and vary in length. Typical lengths are 15 feet, 20 feet, 21.5 feet, 23.25 feet, and 26.5 feet. One long edge has a groove while the other long edge has a corresponding tongue *(see Figures 3-16 and 3-17 and Photo 3-23)*. Compressive strength of the concrete should be 5000 lb/in^2 minimum with sufficient reinforcement to withstand the stresses of handling. Four lifting inserts are cast into each plank at strategic points to minimize the stresses during lifting.

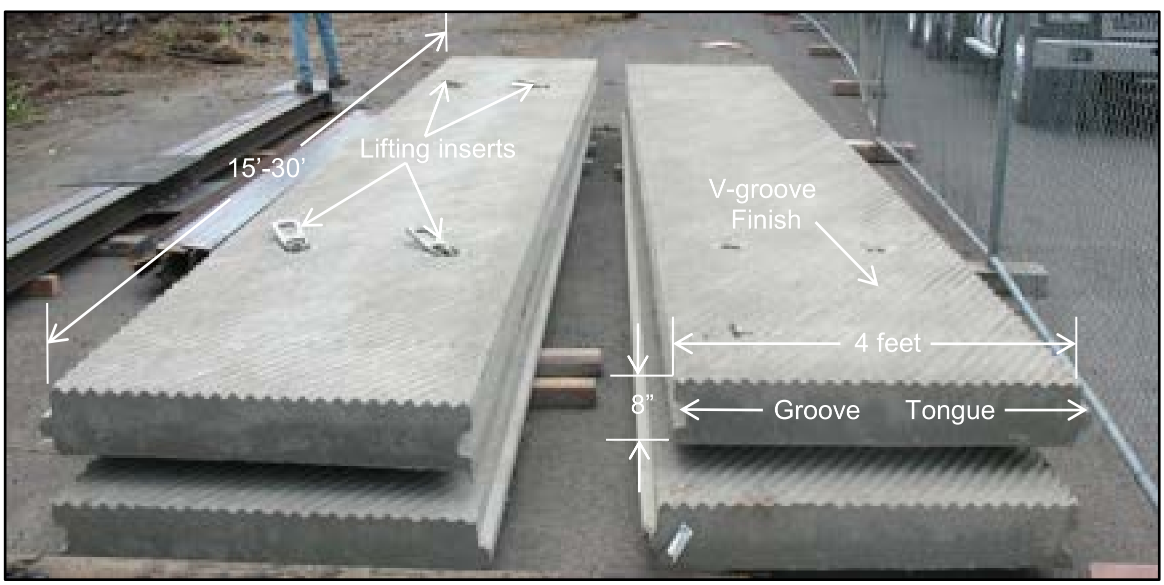


Photo 3-23 Precast concrete plank design elements

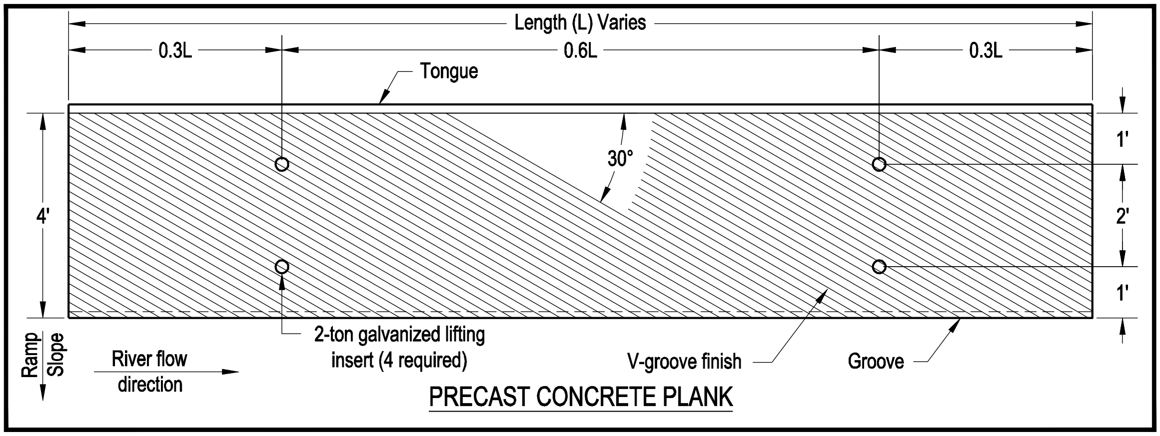


Figure 3-16 Precast concrete plank plan view

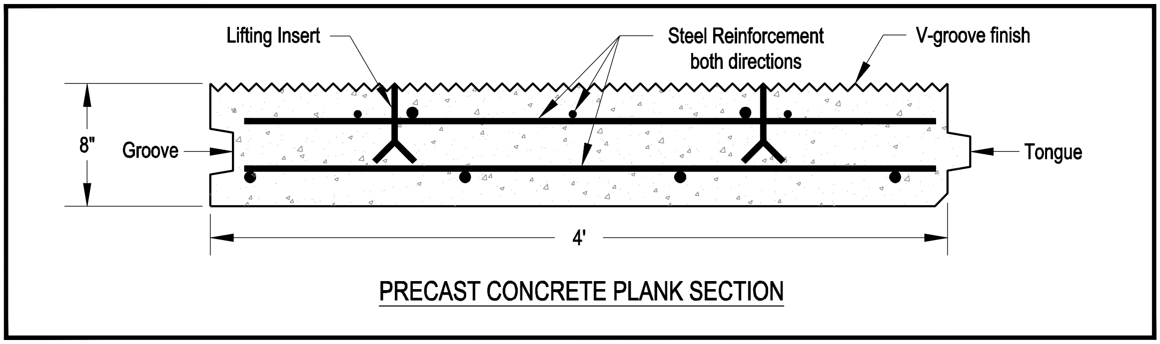


Figure 3-17 Precast concrete plank section

B. Application

1. The elevation at the transition from C-I-P concrete launch ramp to the precast portion of the launch ramp is determined in part by the design elevation at the toe of the launch ramp. After establishing the launch ramp toe elevation, add the required number of 4-foot wide planks to achieve a transition point that is at least 2 feet vertically above the water level during construction *(see Photo 3-24)*. For example, consider a launch ramp toe elevation of 100 feet, a water elevation at time of construction of 105 feet and a launch ramp slope of 14%. The transition to C-I-P launch ramp should occur at elevation 107 feet. The vertical elevation difference from toe-to-transition is 7 feet. At a 14% launch ramp slope this difference will require 50 feet of planks. The required number of

Photo 3-24 Proper number of precast planks above the water line for transition to cast-in-place ramp

planks is 50 feet divided by 4 feet or 12.5 planks. This would be rounded to 13 planks.

2. Careful consideration should be given to potential water depths and water fluctuations during construction in order to minimize the number of planks required. In a majority of cases, the precast plank portion of a launch ramp will not exceed 60 feet in length (15 planks).

3. Planks ranging in length from 15 feet to 30 feet are common in launch ramp construction. Planks longer than 30 feet are difficult to handle and place within the confines of some boating facilities. Special considerations such as a spreader bar must be used to keep from breaking the plank when it is handled.

4. Rebar used in precast planks for all applications should be epoxy coated *(see Photo 3-22)*.

5. Whenever possible it is preferred to locate the end joints of the precast planks, for launch ramps with multiple lanes, under the boarding floats. Any misalignment in the adjacent planks will not be seen or cause a trip hazard for users of the facility. If the end joints must be exposed then great care must be taken to ensure that no vertical or horizontal difference occurs between planks *(see Photo 3-25)*.

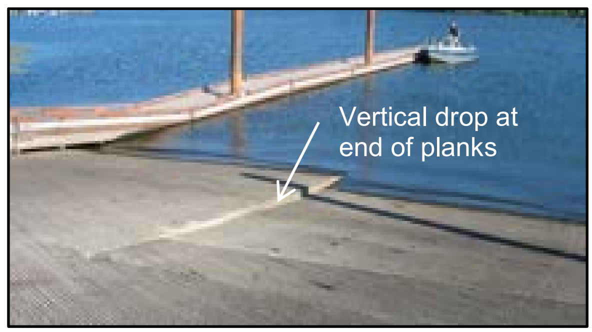


Photo 3-25 This photo illustrates the potential problem when the ends of planks occur in the launch lanes. The vertical drop from one plank to the next is excessive. This problem was corrected by removing the right-side planks, adjusting the rails and grade rock before reinstalling the planks.

6. The interlocking feature of the tongue and groove planks along with proper riprap armoring will preserve the integrity of the system. However, under very rare circumstances it is possible for severe hydraulic action to cause shifting, uplift, or displacement of planks. This can be remedied by casting two PVC pipe chases into each plank through which rebar can be inserted after installation of all planks.

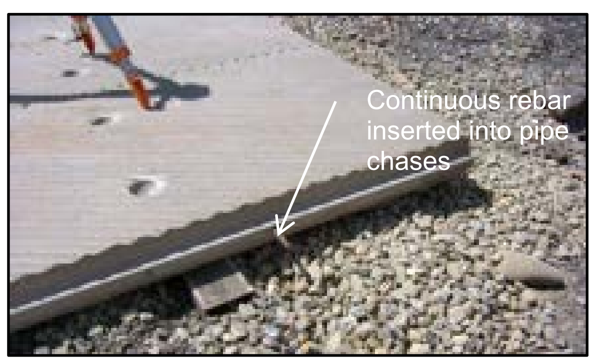


Photo 3-26 Plank with longitudinal pipe chases cast in for insertion of continuous rebar

This will provide both an additional and continuous mechanical connection between all planks. The potential for hydraulic forces to act on any one plank will be virtually eliminated *(see Photo 3-26)*.

7. Dewatering operations for launch ramp construction projects should be avoided whenever possible. Experience suggests that the operation generally does not work as expected and often costs more time and money than simply using precast concrete planks. The dewatering operations could disrupt more of the marine environment than placing precast concrete planks. This could have a major impact on the permitting for the project. If dewatering is to be used it must be identified in the permit application and approved as a construction method.

8. Permits require that a silt curtain be used around the perimeter of all improvements during in-water construction. This will reduce the migration of turbidity beyond the construction zone within the waterway and isolate fish from the work area *(see Photo 3-27)*.

Photo 3-27 Floating silt curtain in-place to isolate work area and control turbidity

C. Design

1. Precast Concrete Plank Size

   Preferred: 8 inches thick and 4 feet wide w/ tongue & groove edges. Length as needed up to 30 feet.

2. Precast Plank Compressive Strength

   Preferred: 5,000 psi (minimum)

3. Precast Plank Reinforcement

   Preferred: #3, 4, & 6 epoxy coated rebar in two layers

4. Begin Precast Section

   Preferred Coastal: +3 MLLW (tidal)
   Preferred Rivers: 2 feet (minimum) above water elevation at time of construction.
   Preferred Lakes: 2 feet (minimum) above water elevation at time of construction.

3.10 RAIL SYSTEM FOR PRECAST PLANKS

A. General

1. The primary purpose of the rail system is to assist in the placement of the precast concrete planks and to hold the planks together. The rails are not intended to provide support for the weight of the planks; that is accomplishes with the rock base.

2. A steel rail system *(see Figures 3-15 and 3-18 and Photo 3-28)* constructed from W-beams provides alignment and grade control during construction of the precast portion of the launch ramp. The end stop keeps the planks from shifting horizontally and the top strap (in conjunction with the tongue and groove design) prevents the planks from shifting vertically.

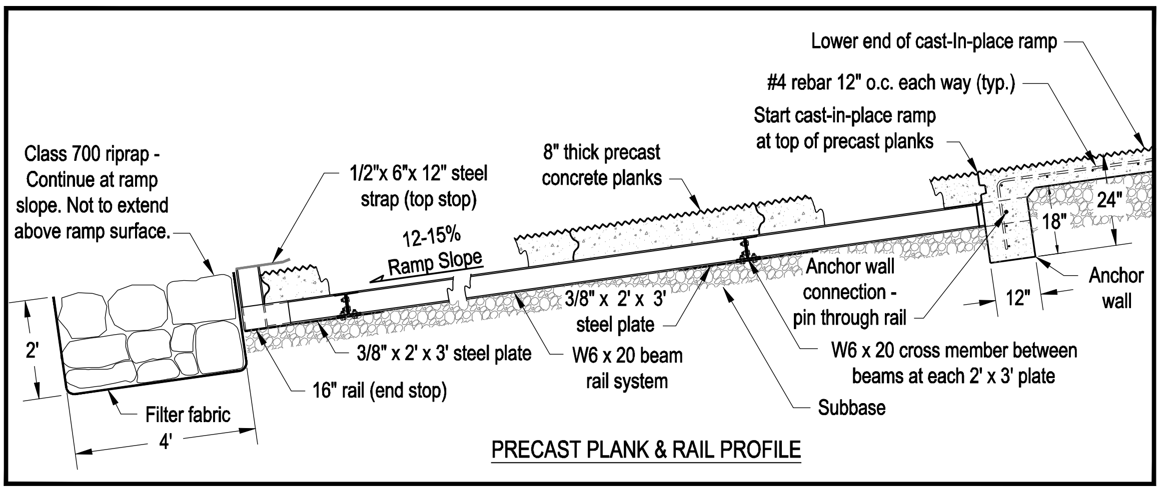


Figure 3-18 Precast plank and rail system profile

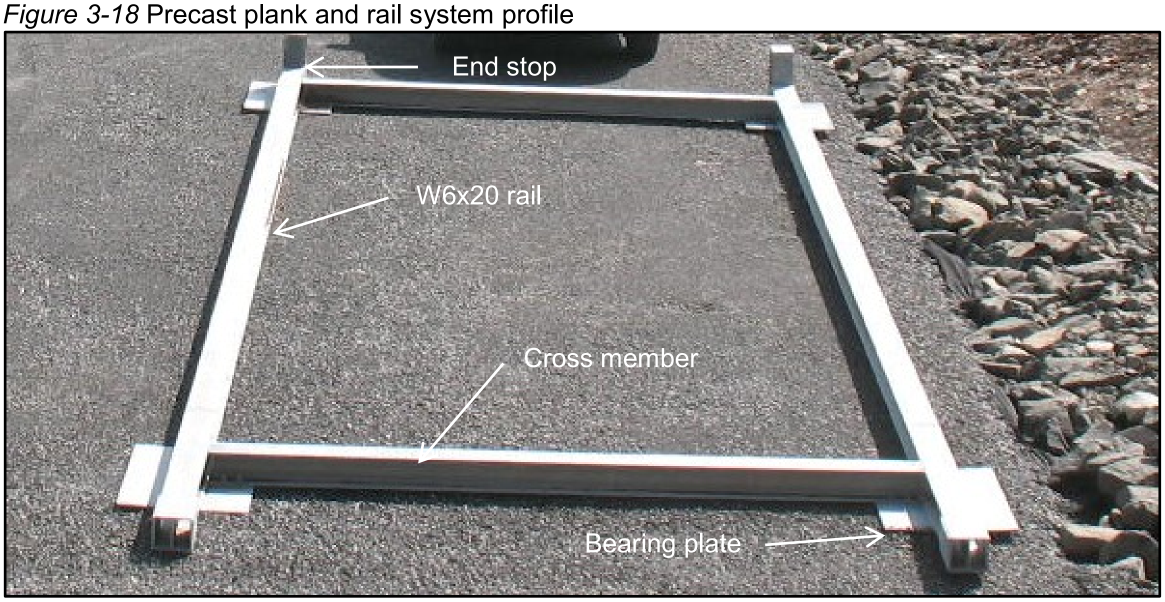


Photo 3-28 Rail system for precast concrete planks

3. It is not necessary to galvanize the rail system. The rail system is not structural and corrosion is minimized since there is no exposure to air. Furthermore, the process of installing, adjusting, and backfilling the rail with rock will compromise any coating that is applied.

B. Application

1. The rail system eliminates the exposed rebar loops of older designs that would eventually rust through. This would allow the planks to separate, create holes in the launch ramp, and in some cases result in the loss of the lower section or side of the launch ramp.

2. Bolting or welding the two longitudinal rail sections together with cross members into a single unit is recommended *(see Photo 3-28)*. This procedure keeps the rails parallel to each other and simplifies the establishment of the toe and top grades and the slope for the rails. Bolting has the advantage of fabricating smaller pieces in the shop and field assembling the entire unit. This often simplifies transportation as well.

3. Six-inch deep beams are used for the rail system. The six-inch deep beams match the depth of aggregate base. After the subbase is to grade and slope, the rails are set, and the aggregate base is placed, packed, and leveled off to the top of the rails *(see Figures 3-19 and 3-20)*. The subbase and base material should be similar to that for the cast-in-place portion of the launch ramp (see Section 3.08 B5).

   There is justification for using deeper beams (8 inches or 10 inches) since they provide greater stiffness which can minimize sagging or deflection while being placed and leveled. The trade-off is increased cost for not only the rail system but the additional rock base. Long rail systems may benefit from these deeper beams.

4. The rail length should be long enough to extend into the lower end (anchor wall) of the cast-in-place portion of the launch ramp to tie both portions of the launch ramp together *(see Photo 3-29)*.

Photo 3-29 Transition from precast planks to cast-in-place concrete. This photo shows the 24” deep anchor wall being poured. A rebar pin through the web of the rail and rebar hooks into the anchor wall tie the precast planks and rail system to the cast-in-place launch ramp.

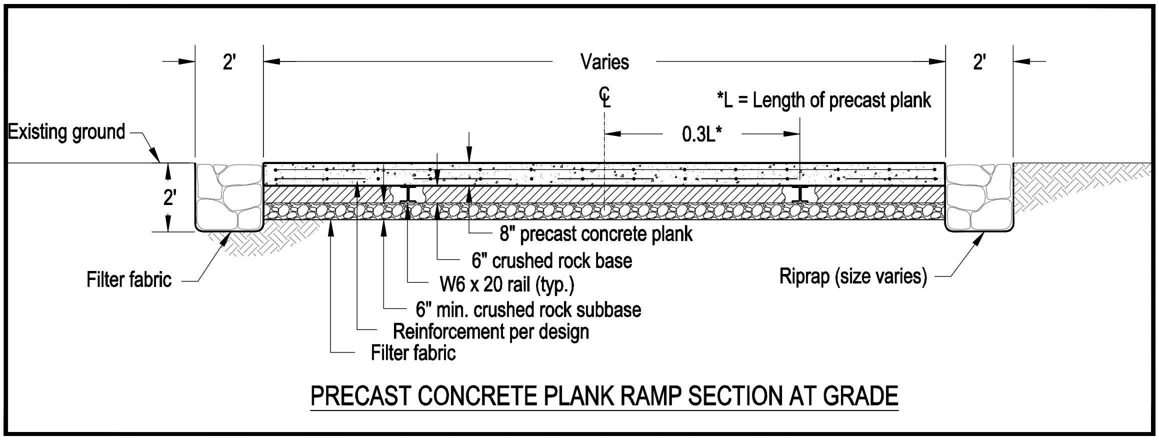


Figure 3-19 Precast concrete plank ramp section at grade

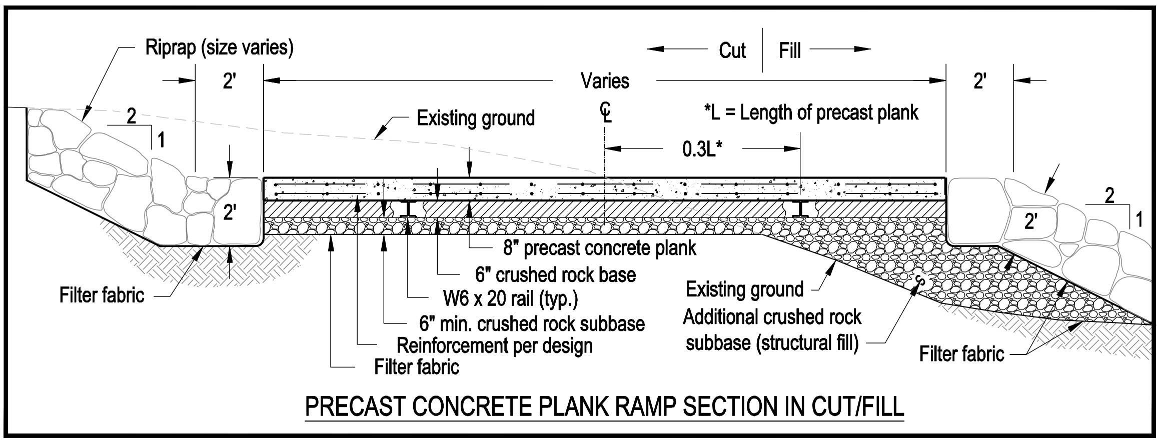


Figure 3-20 Precast concrete plank ramp section in a cut and/or fill situation

C. Design

1. Rail Construction

   Preferred Shape: W 6x20
   Alternative Shape: W 8x31

3.11 VERTICAL CURVE

A. General

1. The vertical curve is a small, but important detail which must not be overlooked or neglected. It enhances the tow vehicle driver’s vision of the boat/trailer while backing through the grade change zone.

2. The smooth transition between the maneuver area grade and the steep launch ramp grade enhances the tow vehicle traction through the change in vertical grade. It also eliminates the problem of trailer hitches dragging on the launch ramp surface at the grade change.

B. Application

1. The vertical curve should be located at the change of grade between the launch ramp slope and the maneuver area slope, generally the upper most portion of the launch ramp *(see Figure 3-21 and Photo 3-30)*. Typically, a 20-foot long vertical curve is adequate for a 12% change in grade (-2% maneuver area to a -14% launch ramp). See recommendations in section 3.11 C.1 for other grade combinations. A 20-foot vertical curve can be used almost exclusively.

Photo 3-30 Vertical curve at top of launch ramp. Photo also shows block-out for float abutment.

2. The preferred slope coming into the vertical curve is -2% (elevations decreasing toward the launch ramp). This provides positive drainage to the top of the launch ramp and lessens the transition into the launch ramp slope. Any slope between 0% and -2% is acceptable, however, careful attention to grading must be considered when using a 0% slope to avoid drainage issues. Positive approach slopes (elevations increasing toward the launch ramp) in the range of >0% to +2% maximum should be avoided unless there is a compelling reason to do so (e.g. to follow natural topography, minimize/divert runoff to the launch ramp, match other grades). Any slope within the range of -2% to +2% are compliant with the cross slope requirements for an accessible route per the 2010 ADA Standards. Slopes greater than -2% and up to -5% could be used provided the designated accessible route to the top of the launch ramp is in line with the launch ramp and not perpendicular. This scenario could exist where boarding floats are located along one side of the launch ramp.

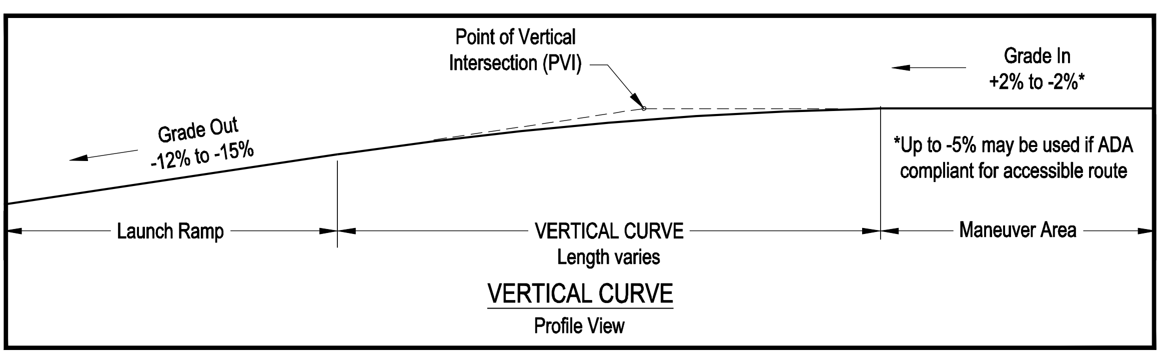


Figure 3-21 Vertical curve profile

C. Design

1. Vertical Curve Lengths

15-foot vertical curve:	7% to 10% change in grade
20-foot vertical curve:	11% to 14% change in grade
25-foot vertical curve:	15% or greater change in grade

2. Incoming slope

Preferred:	-2% (elevation decreases toward top of launch ramp)
Minimum:	N/A
Maximum:	+2% (elevation increases toward top of launch ramp)
	-5% (if compliant with 2010 ADA Standards)

3.12 CONCRETE FINISH

A. General

1. All concrete launch ramps should be finished with a non-skid v-groove finish to ensure maximum traction for tow vehicles launching and retrieving boats. The v-groove finish is especially important in saltwater areas where marine growth is particularly heavy.

2. The v-grooves also serve a secondary purpose by helping keep the launch ramp surface clean. Water, carried up the launch ramp by wave and wake action, washes debris along the v-grooves and off to the side of the launch ramp.

B. Application

1. The 1-inch deep v-grooves are formed in the launch ramp surface immediately after the concrete is placed in the forms and leveled with a power screed or screed board *(see Photos 3-31, 3-32, and 3-33)*. A special finishing tool is fabricated from 1¼-inch steel or aluminum angles welded together to form the v-grooves *(see Figure 3-22)*.

2. The v-grooves should be formed in the launch ramp surface angled 30 degrees from the perpendicular axis of the launch ramp and oriented to the downstream side of the launch ramp *(see Figure 3-23)*. This will carry small debris to the downstream side of the launch ramp where it can be

carried away by the current. For non-river applications the groove orientation should be away from the floats.

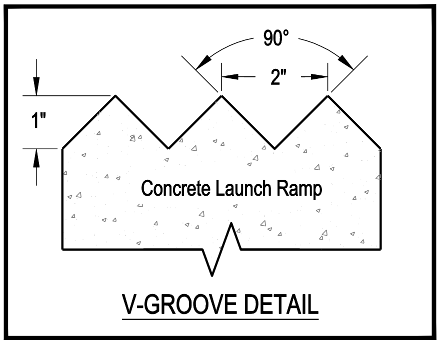


Figure 3-22 V-groove finish detail

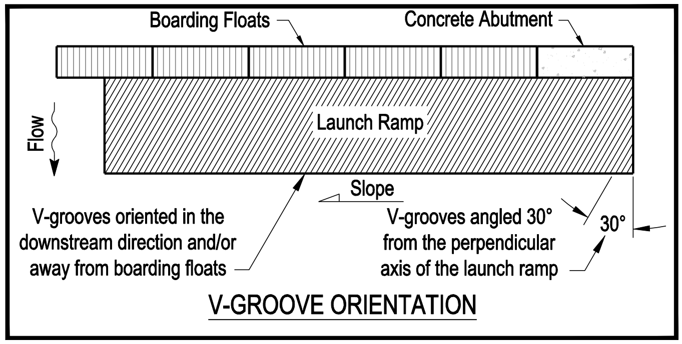


Figure 3-23 V-groove finish orientation

Photo 3-31 Placing fresh concrete into forms and using a power screed to level concrete with tops of forms

Photo 3-32 Cutting grooves into fresh concrete. The plank acts as a guide for groove alignment and tool control.

Photo 3-33 Subsequent passes with the groove tool cleans up the grooves and adds definition

Photo 3-34 Final refinement is done with hand tools including a flat 4" border at edges. Note groove angle matches precast planks.

3. Success in forming v-grooves in the freshly placed concrete depends largely on the careful timing of the concrete truck deliveries, use of retarders if the haul distance is too great, and starting the grooving operation right behind the screed.

4. The edges of the launch ramp should be tooled with a 4-inch wide edger *(see Photo 3-34)*. This gives the launch ramp a clean finished look because of the difficulty in finishing the v-grooves up against the form boards. The edger also accomplishes two goals for interior, longitudinal cold joints. It provides a smooth surface for the screed board to ride against during the successive placement of concrete for the adjacent lane. It also provides a smooth surface on which to paint a lane delineation stripe. No edge should be tooled where the cast-in-place concrete meets the precast planks.

5. The entire concrete launch ramp should be v-grooved with the following exceptions:

   a. If the top of the abutment does not begin at the top of the launch ramp, then that portion from the top of the abutment to the top of the launch ramp and as wide as the abutment. This portion should have a broom finish to provide an accessible walking surface to the abutment. All edges should be tooled with a 4-inch edger *(see Photo 3-35)*.

Photo 3-35 Broom finish on walkway leading to float abutment

   b. That portion which lies beneath the boarding floats. This may facilitate easier construction.

C. Design

1. Launch Ramp Surface

   Preferred: 1-inch deep v-grooves

3.13 RIPRAP AND BANK PROTECTION

A. General

1. Riprap is fractured stone with angular faces used to stabilize cut banks, fill slopes, and launch ramps from the eroding effects of current, waves, and wakes.

2. Riprap is divided into classes or groups of graded stones based on the approximate weight of the largest stones in the class.

3. Riprap is currently allowed as ramp edge and toe protection but may be limited in use for slope protection particularly below ordinary high water. The designer should consider, or may be required to provide, alternatives to riprap where significant cut slopes are anticipated.

B. Application

1. Riprap is placed along both sides and across the lower end of all ramps for protection from external water generated forces (current, waves, boat wake, and prop wash) eroding/undermining the structure.

2. Riprap is typically placed on a layer of geotextile fabric to minimize erosion and to keep fines from being washed out through the openings of the riprap.

3. Class 700 is the minimum size riprap recommended at the launch ramp toe of all ramps. Power loading boats onto trailers creates a high velocity flow of water that erodes base material at and from under launch ramp toes. The movement of material can also create a drop-off at the toe of the launch ramp. Large riprap stays in-place under these conditions, helps disperse energy from power loading, and extends the protected portion of the launch ramp into deeper water. Class 700 riprap is also recommended along the sides of a launch ramp in river applications where the river current could erode or undercut the sides of the launch ramp.

4. Class 100 riprap works well along the sides of ramps in lake and reservoir applications. Specific sites should be evaluated for exposure to wind generated waves. The wave action may require the use of the larger Class 700 riprap. Class 100 should also be used on river launch ramps to “choke” or fill in the voids of class 700 riprap placed along the sides.

5. Some projects do not have quarries with state classed riprap or rock large enough to assemble a Class 700 riprap. If hydraulic conditions are not severe then the assembly of a graded mix of smaller stones for a Class 350 to 500 may be acceptable. Many times the smaller rock will work very well.

6. A typical construction procedure is to trench around the perimeter of the launch ramp for riprap and form construction prior to the placement of precast planks and/or cast-in-place concrete. Riprap is then placed along the outside edges of the trench. After the planks and/or concrete are placed for construction of the launch ramp, the riprap is pulled into the trench and tamped into place with a rubber tired backhoe. This method

keeps the trucks and track hoes off the new launch ramp and prevents the riprap from damaging the launch ramp surface when handled.

7. Care should be taken when placing riprap so that the top of riprap does not extend above the surface of the adjacent launch ramp. This is to avoid the creation of a submerged hazard that may damage boat hulls or props or impede navigation.

8. Riprap along the sides of the launch ramp should be a minimum of two feet wide by two feet deep and level with the ramp surface *(see Figures 3-13, 3-14, 3-19, and 3-20 and Photo 3-36)*. Riprap at the toe of the ramp should be a minimum of four feet wide by two feet deep and continuing at the slope of the ramp *(see Figure 3-18)*. These minimum dimensions should always be provided prior to transitioning to cut or fill slopes. Doing so helps to protect vehicles from abrupt drop-offs in a fill situation and provides a buffer zone for sloughing bank material in a cut situation.

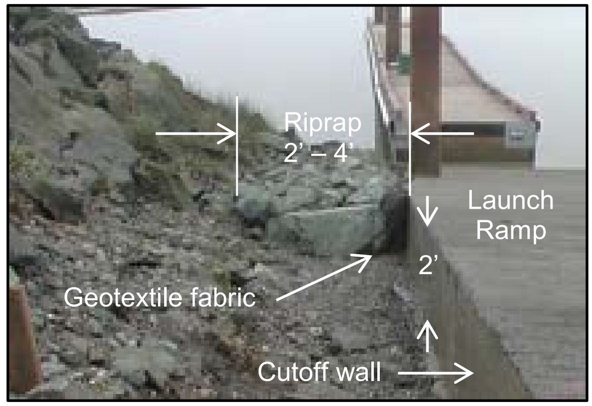


Photo 3-36 Riprap being placed along edge of launch ramp

9. Riprap should be placed on a slope of 2 horizontal to 1 vertical. Steeper slopes are possible but not recommended. Shallower slopes (e.g. 4h to 1v) are desirable but require greater amounts of earthwork and material. Permit requirements will often dictate how much riprap is allowed.

C. Design

1. Riprap Size

Preferred:	Class 700 (ODOT)	River Applications, all launch ramp toes
Minimum:	Class 100 (ODOT)	Lake/Reservoir Applications
Maximum:	N/A	

2. Riprap Dimensions

Preferred:	Two feet wide (sides) or four feet wide (toe) and two feet deep.
Minimum:	Same as Preferred
Maximum:	N/A – may be regulated by permit requirements

3. Riprap Slopes

Preferred:	2 horizontal to 1 vertical
Minimum:	N/A – may be regulated by permit requirements
Maximum:	1½ horizontal to 1 vertical – feasible but not recommended

3.14 STORMWATER

A. General

1. Stormwater that flows onto the launch ramp surface must be collected and treated. The inherent problem in collecting and treating stormwater at boating facilities is the proximity of the treatment process to the water's edge. The challenge lies in the fact that there is little or no room to collect and treat the runoff before returning to the adjacent waterbody.

2. Treatment of precipitation that falls directly onto the launch ramp surface is even more difficult to treat. However, runoff from this area will be quite insignificant due to the small area of the launch ramp surface above the water level. This area occurs below the top of the bank leaving no place to effectively collect and treat runoff between the top and bottom of the bank. Vehicles spend very little time (minutes) on the launch ramp as they launch/retrieve their boats into/from the waterbody. The momentary time the vehicles are on the launch ramp is a small window of opportunity for detrimental matter to be deposited on the launch ramp surface.

B. Application

1. Trench drains at the top of the launch ramp, and across the entire width, effectively intercept any surface runoff that might make its way down the launch ramp *(see Photo 3-37)*. Trench drains should be fitted with ADA

Photo 3-37 Trench drain installed along top of launch ramp

Photo 3-38 Trapped catch basin

compliant grating. The bottom of the trench drain is pre-sloped and drains to a catch basin fitted with a tee and vertical pipe on the outfall pipe *(see 3-38)*. The catch basin will allow sediments, particulate matter, solids, and grit to settle out in the basin. The tee-fitted outfall pipe will trap oil, grease, heavy metals, and scum that are carried into the basin by the runoff. Periodic maintenance is required to maintain treatment effectiveness.

2. The design of the launch ramp surface in conjunction with the materials along the launch ramp's edge is currently recognized as an acceptable means for the collection and treatment of precipitation that falls on the launch ramp surface. As a secondary function, the launch ramp v-grooves provide a means to disperse or channel the runoff thus enabling the runoff to infiltrate through the aggregate material and natural vegetation along the side of the launch ramp.

NOTES

Section 4

BOARDING FLOATS

4.01 PLACEMENT AND LAYOUT

A. General

1. Boarding floats (docks) serve as a means to help safely and efficiently launch and retrieve boats, and load and unload boaters at boat launch facilities. For this reason, boarding floats are sometimes referred to as courtesy docks. Small facilities with one lane launch ramps may not warrant the cost of boarding floats. Furthermore, site or waterbody conditions may not be suitable for installation of floats. However, boarding floats are preferred at all launch ramps with two or more lanes whenever site and waterbody conditions are favorable.

2. The placement of boarding floats in relation to the launch ramp is first determined by the direction of river flow and second by the location providing the most visibility for the boater as they maneuver the trailer down the launch ramp.

3. Boarding float length should be long enough at DLW to extend beyond the end of the submerged boat trailer to tie off the boat to the float. Additional floats may be angled up to 90 degrees (dogleg) to avoid navigation channels or exposure to current, debris, or waves *(see Photo 4-1)*. At least 50 ft. of floats at DLW should be parallel with the launch ramp prior to the dogleg (See 4.01 B 7).

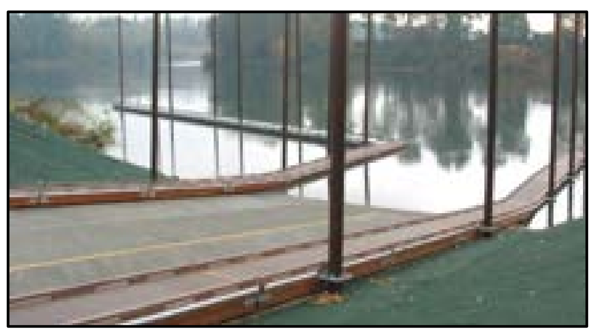


Photo 4-1 Boarding floats with dogleg section

B. Application

1. Boarding floats are preferably placed along the right side edge (facing the water) of a single-lane launch ramp. This provides drivers with a visual delineation of the launch ramp while backing their trailers. For all rivers, however, boarding floats should be placed on the upstream side of the launch ramp with the piles on the upstream side of the float *(see Photo 4-2)*. This arrangement keeps a boat from being pushed up against the floats which provides greater control during retrieval.

Photo 4-2 Preferred boarding float location for a single-lane launch ramp. Floats are placed on the right-hand and upstream side of launch ramp with internal pile pockets opposite the launch lane. Also note angle of launch ramp in the downstream direction.

2. Piles are generally placed internally unless the boarding floats have limited or no access to one side of the floats. In this case piles may be located externally on the side with limited or no access to allow users more maneuvering room on the floats. Internal piling helps to optimize boater tie-up capacity when both sides of the float are accessible.

3. Boarding floats should be placed down the center of two-lane launch ramps. Doing so will provide access to the floats from either lane. Piles should be placed just inside the float (internal pile pocket) on the upstream side or alternating side-to-side to optimize boat moorage capacity on each side *(see Photo 4-3)*. A less desirable alternative is to place the floats down one side only.

Photo 4-3 Boarding floats between launch lanes

4. On launch ramps with four lanes or more, boarding floats should be placed such that a float is adjacent to one side of each launch lane.

5. A minimum of 20 lineal feet of usable boarding floats should be provided at DLW for every 10 trailer parking spaces. "Usable float length" is defined as floats that are completely floating with at least 4 feet of water

depth at the shore end *(see Figure 4-1)*. Where applicable, both sides of the boarding floats may be considered usable even on a single-lane launch ramp. In these cases, the lineal footage would be doubled.

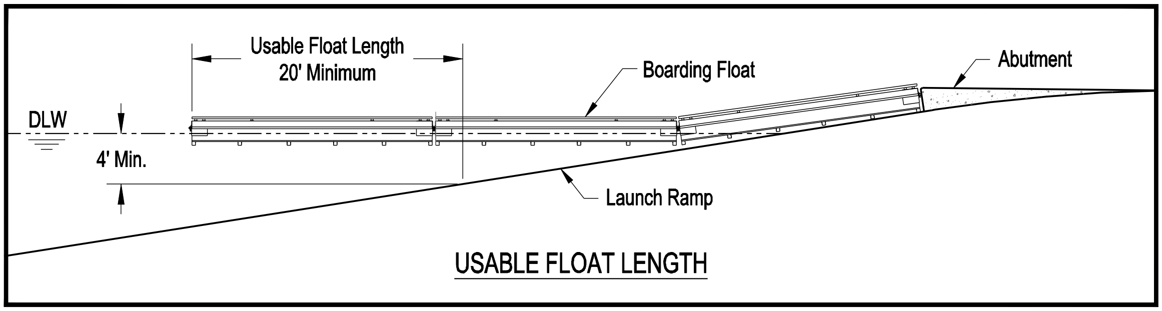


Figure 4-1 Boarding float profile showing usable float length at design low water

6. Maneuver areas around the floats and launch ramp should have 4 feet or more of water depth at DLW. This depth has been found to accommodate most trailerable boats less than 26 feet. However, 3 feet at DLW is the design minimum but should only be used if site conditions do not allow greater depths.

7. Boarding float systems should be of sufficient length to provide not less than 50 feet of float in the water at the design low water level. The first 30 feet is considered the "trailer zone" for launch and retrieval of boats. The remaining length is considered the "tie-up zone". The 50-foot minimum will ensure that the minimum 20 feet of "usable float length" is provided *(see Figure 4-2)*.

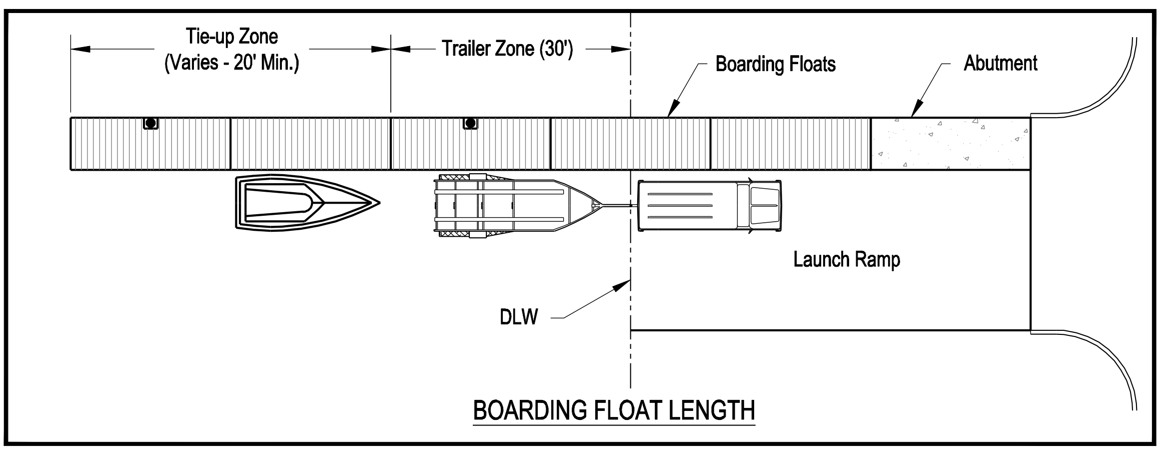


Figure 4-2 Boarding floats showing minimum 50-foot length at design low water

C. Design

1. Preferred Location of Boarding Floats

Rivers:	On upstream side of the launch ramp
Lakes/Reservoirs:	On right side of launch ramp, looking toward the water

2. Water Depth for usable float length at DLW

   Preferred : 4 feet
   Minimum: 3 feet
   Maximum: N/A

3. Minimum usable float length at DLW based on number of trailer parking spaces (may include both sides of floats)

Table 4-1 Usable Float Length at DLW

Parking Spaces	Usable Float Length	Parking Spaces	Usable Float Length
10 - 19	20 feet	70 - 79	140 feet
20 - 29	40 feet	80 - 89	160 feet
30 - 39	60 feet	90 - 99	180 feet
40 - 49	80 feet	100 - 149	200 feet
50 - 59	100 feet	150 - 199	240 feet
60 - 69	120 feet	200+	280 feet

4.02 ABUTMENT

A. General

1. Abutments provide ramped pedestrian access to boarding floats at or near the top of the launch ramp. The abutment may also act as an anchor for the shore end of the boarding floats *(see Photo 4-4)*.

Photo 4-4 Concrete float abutment

2. Floats should have a hinged connection at sites where the abutment is located above the 100 year flood elevation or extreme high tide. If the abutment is located below the 100 year flood elevation or extreme high tide a transition plate should be used (see Section 4.07).

B. Application

1. An abutment is a wedge-shaped block of cast-in-place concrete with a rough broom finish on the top or walking surface and all edges tooled with a 4-inch edger and 1 inch radius or chamfer *(see Photo 4-4)*.

2. Generally the abutment is the same length as the vertical curve of the launch ramp. In cases where the abutment is longer than the vertical

curve, the abutment should start at the top of the launch ramp/vertical curve and extend through the vertical curve. When the abutment is shorter than the vertical curve, the face of the abutment should be located at the lower end of the vertical curve (point of uniform launch ramp slope).

3. An abutment may be located some distance down from the top of ramp to correlate with OHW or DHW which eliminates unnecessary boarding floats and associated costs *(see Photo 4-6)*.

4. The launch ramp is cast first and a section of the launch ramp is blocked out for the abutment. The launch ramp rebar grid should extend through the block-out for the abutment and the bottom of the abutment cast on the top of the base course *(see Photos 4-5 & 4-6)*.

Photo 4-5 Float abutment formed and ready for concrete

Photo 4-6 Float abutment and walkway after placement of concrete. Both have a broom finish.

5. If the abutment is cast adjacent to the launch ramp (retrofit application only) the bottom of the abutment should be cast a minimum of 12 inches below the existing ground surface.

6. Flexible traffic delineator(s) should be epoxied to the launch ramp side(s) of each abutment *(see Figure 4-3 and Photo 4-7)*. This will help the vehicle driver to locate the edge of the abutment and floats as the trailer is backed over the vertical curve.

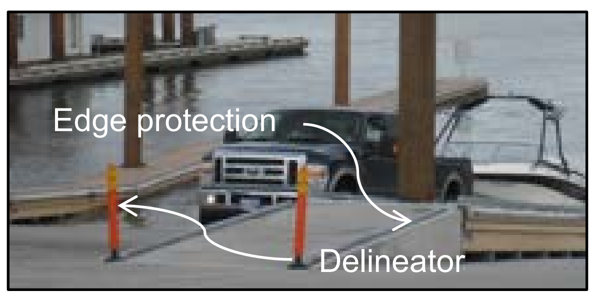


Photo 4-7 Traffic delineators and edge protection

7. The offshore face of the abutment should be perpendicular to the launch ramp surface and <u>not</u> vertical *(see Figure 4-3)*. If the abutment face is vertical then the bottom of the float could bear against the face of the abutment before the float grounds out on the launch ramp surface. This

results in damage to the float and/or the float hinged connection to the abutment.

8. The abutment width should be 6 inches wider than the nominal width of the boarding float it is serving (inclusive of walers). The abutment will protect overall outside width of the shore-end of the float from boat trailer impacts.

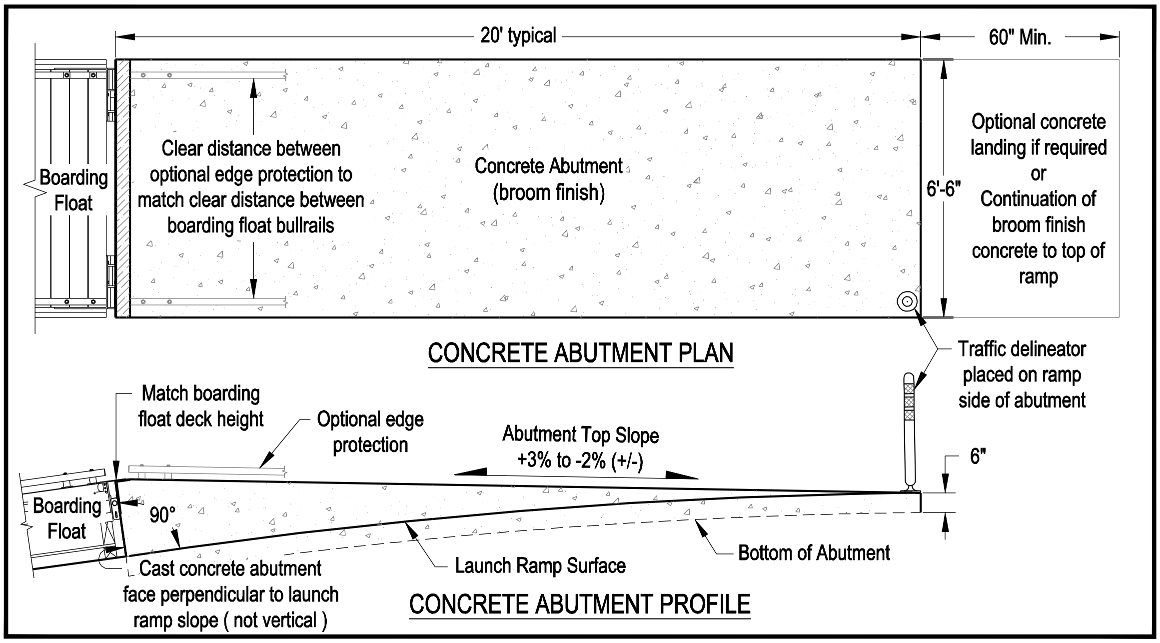


Figure 4-3 Concrete abutment plan and profile views

9. A concrete landing should be provided at sites where the abutment is located along the edge of the launch ramp and the shore-end of the abutment does not abut hard surfacing. The landing should be at least 60 inches long by the width of the abutment *(see Figure 4-3)*. This will provide access from the maneuver area to the abutment.

10. A broom-finished concrete walking surface should be provided from the top of the launch ramp to the beginning of the abutment at sites where the abutment begins at some distance from the top of the launch ramp *(see Photo 4-6)*.

11. Abutments less than 15 feet in length should be avoided. Abutment slope combined with launch ramp slope may result in an excessive change in grade between the two *(see Photo 4-9)*.

12. Generally the longitudinal slope of an abutment should be within the range of +3% to -2% *(see Figure 4-3)*. Design values given below will assist in selecting the appropriate abutment length for the vertical curve used.

Some slope to the top of the abutment is desired for drainage of stormwater. Cross slope should be 0%.

13. Edge protection may be provided along both edges of the abutment *(see Photo 4-7)*. The minimum clear distance between edge protection should be 60 inches. Furthermore, the inside edges should be in alignment with the inside edges of the boarding float bullrails to avoid the creation of a potential tripping hazard *(see Figure 4-3)*. Handrails or guardrails are not recommended but may be requested by the facility owner or required by the local jurisdiction.

14. A tactile warning pad may be required if the accessible route immediately crosses the approach or exit lane from the maneuver area.

C. Design

1. Abutment Walking Surface Slope:

10-foot Vertical Curve	15-foot Abutment	+2.7% +/-
	20-foot Abutment	- 1.5% +/-
15-foot Vertical Curve	15-foot Abutment	+4.7% +/-
	20-foot Abutment	0.0% +/-
20-foot Vertical Curve	15-foot Abutment	+3.2% +/-
	20-foot Abutment	+1.5% +/-
	25-foot Abutment	- 1.6% +/-
25-foot Vertical Curve	15-foot Abutment	+2.3% +/-
	20-foot Abutment	+0.3% +/-
	25-foot Abutment	- 0.4% +/-

Note: Abutment slopes were calculated using a -2% maneuver area grade and -14% launch ramp grade. Abutment slopes will vary slightly if different maneuver and/or launch ramp grades are used.

2. Abutment Width

Preferred: 6.5 feet for 6-foot nominal width floats.

4.03 DIMENSIONS

A. General

1. Boarding floats should be wide enough to provide stability and adequate room for a boater to handle, guide, and tie-down their boat without stepping or falling off the float. Also, adequate width should be provided so boaters may pass each other without getting too close to the edge of the float.

2. It is desired that the float deck height be no higher than what will allow a boater to get on to or off a float without the use of a ladder or need to walk up to the abutment and back down the launch ramp.

B. Application

1. Boarding floats are typically constructed in 6-foot by 20-foot sections. Floats less than 6 feet wide tend to be unstable and do not provide adequate room for two-way pedestrian traffic or to work from both sides simultaneously. Floats greater than 6 feet in width may provide increased stability and maneuvering room but do not necessarily warrant the additional expense. Furthermore, current permit requirements exempt 6-foot wide floats from the light penetration provision through the floats. Floats less than 20 feet in length increases the number sections required which adds more moving parts that may contribute to increased instability and maintenance. Float sections longer than 20 feet may be difficult to construct due to available lumber lengths *(see Figure 4-4)*.

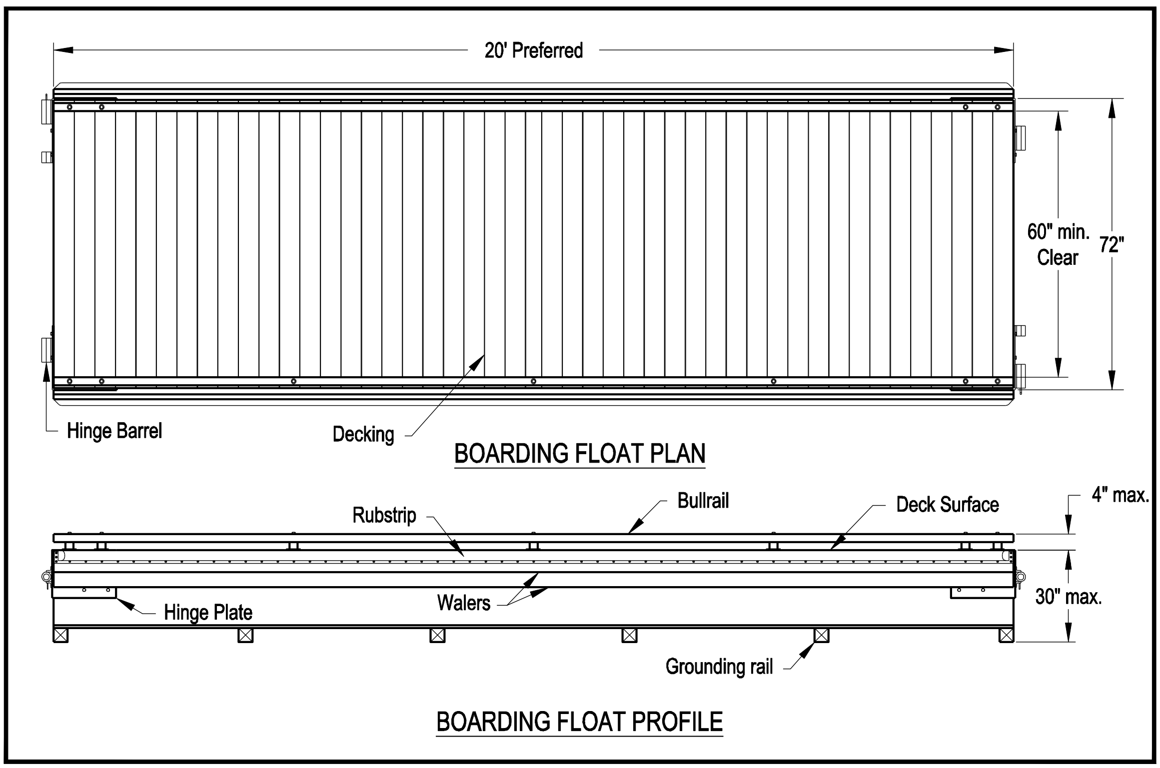


Figure 4-4 Boarding float plan and profile views

2. Minimum clear travel width of a float deck should be no less that 60 inches between bull rails, toe rails, cleats, and other mooring hardware mounted along the edges of the float *(see Figure 4-4)*. If internal piles are used

then the minimum clear width at the pile may be reduced to 36 inches over a length of 24 inches.

3. In waters with large fluctuations such as lakes and reservoirs, self-adjusting boarding floats are a good alternative. Self-adjusting floats are secured to a raised concrete guideway. As water elevations fluctuate, the floats travel up and down the guideway providing 60 feet (120 lineal feet) of accessible boarding floats at all water elevations *(see Figure 4-5 and Photo 4-8)*.

Photo 4-8 Self-adjusting boarding floats

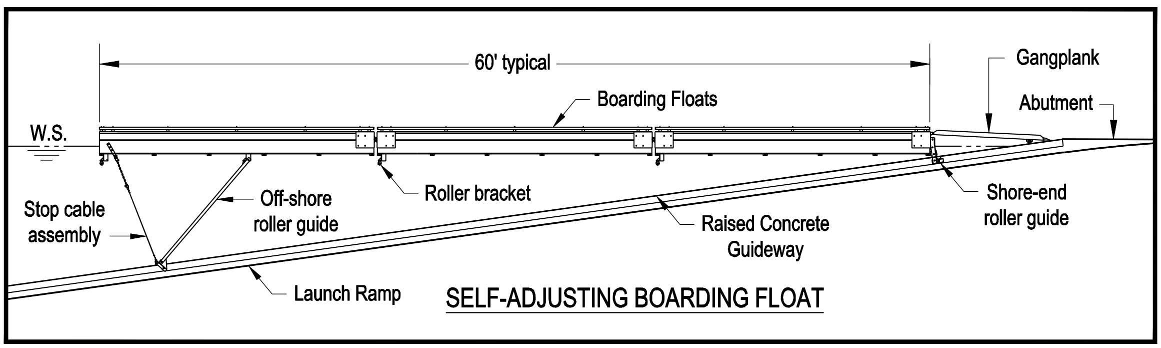


Figure 4-5 Self-adjusting boarding floats

4. Deck height can usually be kept to less than 24 inches from the launch ramp surface, when grounded out, depending on the design. Heights less than 24 inches provide a manageable step from the float deck to launch ramp surface without requiring the use of the abutment or a ladder *(see Photo 4-2)*.

Photo 4-9 Example of floats that are too tall when grounded on the launch ramp. The slope of the abutment is also excessive.

5. Maximum overall height of boarding floats should not exceed 30 inches where float sections will come to rest on the upper reaches of the launch ramp during periods of low water.

6. Grounded floats that exceed 30 inches in height should have safety guardrails provided. However, guardrails make launching and retrieving boats difficult and usually interfere with the efficient movement of people, boats and boat lines along the float. Therefore, every effort should be made to keep the overall height of the boarding floats to 30 inches or less *(see Photo 4-9)*.

7. The 30-inch maximum does not apply to the self-adjusting boarding float system that operates on a raised walkway. During periods of low water these floats bear against rail stops and come to rest on top of the raised walkway as the water recedes. During these low water periods the floats are "high and dry" and are out of service to the boaters and do not provide pedestrian access. Therefore, the height is not critical from a safety stand point and handrails should not be required.

8. The 2010 ADA Standards identifies boarding floats, located within a launch ramp, as part of an accessible route. Details of the requirements for accessible boarding floats can be found in *Appendix A*.

C. Design

1. Float Width

Preferred: 6 feet
Minimum: 6 feet
Maximum: 8 feet (not recommended due to potential permit restrictions)

2. Float Section Length

Preferred: 20 feet
Minimum: 15 feet
Maximum: 25 feet

3. Float Height

Preferred: 22 to 24 inches
Minimum: Calculated based on minimum freeboard requirements
Maximum: 30 inches

4.04 DESIGN LOADS AND FREEBOARD

A. General

1. Design loads are used to calculate the freeboard based on existing dead loads and anticipated live loads.

2. Freeboard is the vertical distance from the water surface to the deck surface of the float *(see Figure 4-6)*. It is the dimension used to match the float to the boats for which it is designed to serve. The typical design boat used at launch ramps is best served with 12 inches of freeboard.

B. Application

1. Twenty pounds per square foot (20 lb/ft^2) is a statewide and nationally recognized standard uniform live loading for launch ramp boarding floats and assumes the floats are completely floating in the water. This equates to approximately 14 people on a 6-foot by 20-foot boarding float with an average weight of 165 pounds per person.

2. A concentrated live load of 400 pounds applied at any point on the boarding float deck, but no closer than 12 inches from the edge of the float, should not create a cross slope greater than 2%.

3. Floats should be designed to withstand environmental loads including wind, wave, current, and impact that may be expected to occur during the life of the structure as the result of the float's location and exposure. Design procedures are thoroughly discussed in the other publications referenced in the Introduction to these guidelines.

4. Freeboard should not exceed 15 inches for a dead load only condition nor be less than 6 inches for a combined dead and live load condition *(see Figure 4-6).*

C. Design

1. Dead Load: Weight of construction materials

2. Live Load

   Preferred: 20 lb/ft^2
   Minimum: 20 lb/ft^2
   Maximum: N/A

3. Freeboard (Dead load only)
   Preferred: 12 inches
   Minimum: 10 inches
   Maximum: 15 inches

4. Freeboard (Combined dead load and live load)

   Preferred: 8 inches
   Minimum: 6 inches
   Maximum: 11 inches

5. Cross Slope

   Preferred: 0%
   Minimum: N/A
   Maximum: 2%

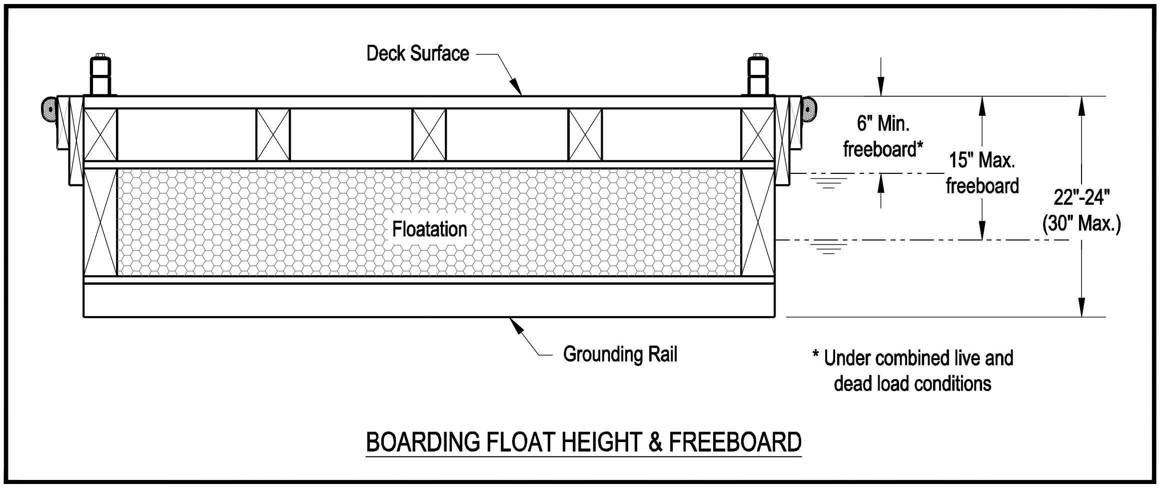


Figure 4-6 Boarding float freeboard and height requirements

4.05 CONSTRUCTION

A. General

1. Wood (often pressure treated) is the traditional material for construction of boarding floats in Oregon. It holds up well to abuse and is less likely to cause damage to boats than metal or concrete systems.

2. Wood is durable, readily available, easy to work, and accepts through bolted or lag screwed metal hinge systems required for boarding float systems that ground out. It offers good natural floatation characteristics and significant weight. The resulting low center of mass provides stability when floating and helps to achieve the desired dead load freeboard. Wood floats are easy for maintenance workers to make required on-site repairs.

3. The Marine Board has developed and successfully used a standard wood frame boarding float for many years *(see Figure 4-7 and Photo 4-10)*. There is a wide array of other materials and methods used that may or may not be able to meet minimum design criteria, design life, and/or maintenance needs.

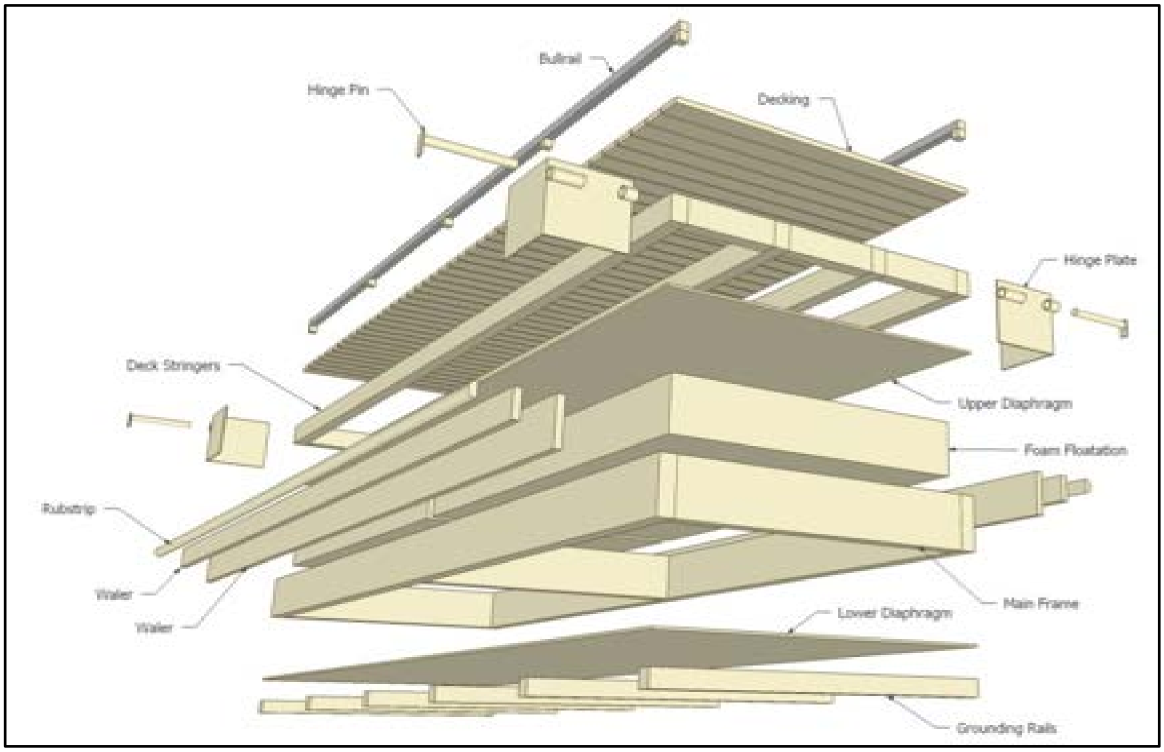


Figure 4-7 Exploded view of standard Marine Board wood boarding float design

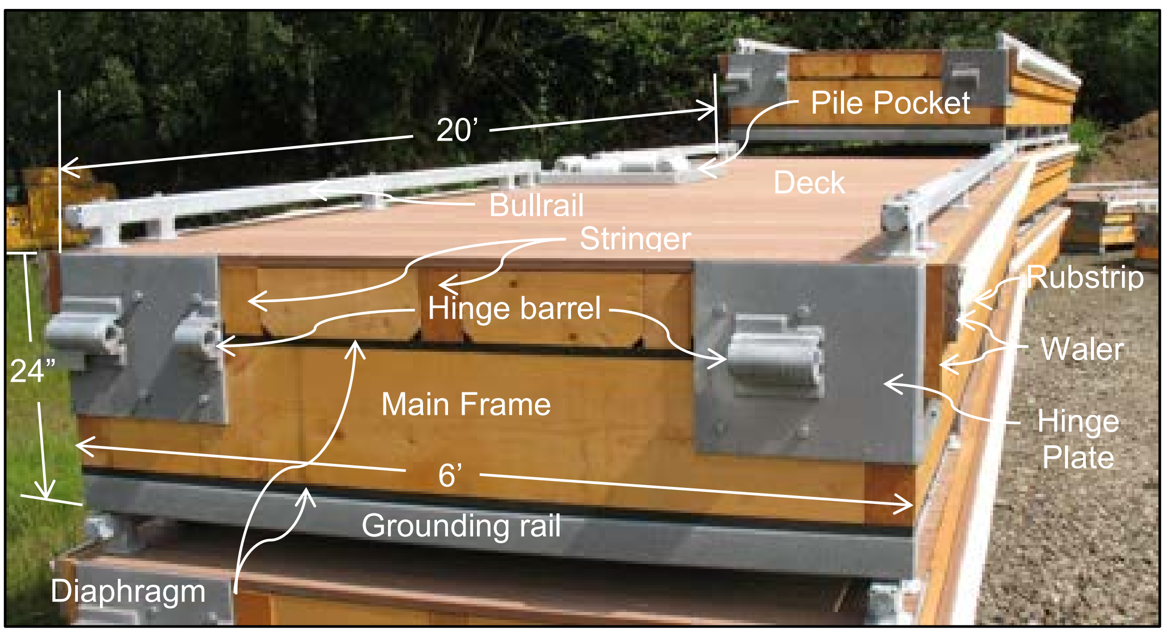


Photo 4-10 Standard wood boarding float dimensions and components

B. Application

1. Wood species typically used for boarding float construction in the northwest include coastal Douglas fir and Hem-fir. To extend service life of the floats, these species should be pressure treated with the appropriate treatment for the application and to a retention rate as prescribed by the latest requirements of the American Wood Preservers Association (AWPA) for the specific application. However, recent environmental permit requirements have severely limited or prohibited the use of pressure treated wood in or over the water. Encapsulation of pressure treated wood (e.g. poly-urea) may be an option. The designer should inquire about use of pressure treated wood prior to specifying it.

2. Cedar is commonly available on the west coast, and has natural resistance to rot and decay. Cedar has and is currently being used as an alternative to pressure treated wood; but a reduced service life can be expected. Floats constructed with cedar have been in use in Oregon since 2002 and have held up well in fresh water applications. Installation in a salt water environment is not recommended. Brackish water applications may be appropriate depending on worst-case seasonal salinity levels.

3. Creosote and creosote coal-tar solution preservatives are not allowed for boarding float construction.

4. All metals used to fabricate clips, brackets, hinges, and other structural parts for boarding floats should be made from material not less than ¼ inch in thickness. All ferrous metal hardware used should be hot dip galvanized after fabrication.

5. Floats should have heavy duty tie-up cleats or continuous ADA accessible galvanized steel bull rails around the perimeter of the float. The bull rail is the preferred means of tie-down. In addition to tying down at any point it also provides a continuous barrier for edge delineation of floats. Cleats only provide intermittent tie-down and can be a trip point. Bullrails should be constructed of 2 inch by 2 inch galvanized steel tube spaced off the deck with similar 2 inch high posts. The resulting 2 inch gap between deck and bullrail provides sufficient space to pass tie-off lines. This design meets the 2010 ADA Standards accessibility edge protection requirement that limits edge protection to no more than 4 inches in height and 2 inches in width *(see Figure 4-4)*.

6. Belting should be applied over all hinged joints in the boarding float deck. The belting should be attached to the float deck along one side of the joint only. This will allow the belting to move as the float sections rotate from

grounded to floating without buckling thus minimizing a potential trip hazard.

7. Special design considerations should be utilized to protect floats in waters that freeze. Floats should be designed for easy removal/installation and are normally stored on land during freezing conditions.

8. The deck surface of boarding floats should be composite decking boards with the following characteristics.

   a. Manufactured from a 100% recycled-content, wood-plastic composite. Composite should be approximately 50% recycled plastic and 50% waste wood fiber. Plastic content should be a mixture of high-density and low-density polyethylene.

   b. Color should be brown or gray.

   c. Finish should be non-slip wood grain.

   d. Be able to bridge a minimum 16-inch span.

   e. Be a minimum 1¼ inches actual thickness and 5½ inches wide.

   f. Have a solid plank cross sectional area.

   g. Have square corners (less than ⅛ inch radius). Large radius corners may not be ADA compliant because of the resulting gap between deck boards.

C. Design

1. Wood Species

   Preferred: Port Orford cedar (fresh water and some brackish water)
   Preferred: Pressure treated coastal Douglas fir and Hem-fir. Saltwater applications if permitted. Poly-urea coated.

2. Treatment (If allowed)

   Preferred: ACZA

3. Ferrous Hardware Coating:

   Preferred: Hot Dip Galvanization
   Optional: Stainless Steel

4. Tie-Down

   Preferred: Continuous galvanized steel bull rail (2 inches by 2 inches) with a maximum height of 4 inches and maximum width of 2 inches (Meets 2010 ADA Standards for accessibility).

5. Decking

   Preferred: Composite decking

4.06 PILE HOOPS AND POCKETS

A. General

1. All floats secured by piles should have adequate room within the pile guide to compensate for float travel. This is particularly true for boarding floats where the pile hoops and pockets are rectangular with the long dimension parallel to the longitudinal axis of the float. If wood piles are being used (not recommended) the size of the guide opening should take into consideration the taper of the wood piles. This is to keep the hoop or pocket from jamming on the pile during articulation.

2. Two types of pile guides are used on boarding floats; internal pockets *(see Figure 4-8 and Photo 4-11)* and external hoops *(see Figure 4-9 and Photo 4-12)*. Pile pockets are placed internally since this allows unrestricted use on both sides of the float. If the boarding floats have limited or no access to one side of the floats then pile hoops could be located externally on the side. External hoops also work well in retrofits or where difficult sites require that pile locations be adjusted in the field.

3. Pile hoops and pockets are typically rectangular and use four rollers constructed from high density polyethylene (HDPE) of ultra-high molecular weight polyethylene (UHMW-PE). These rollers are used to reduce friction that may restrict floats from fluctuating as water elevations change.

4. Pile hoops and pockets should be designed in conjunction with pile batter to minimize the size of the opening. For pile pockets this helps in two ways (1) minimizes loss of floatation and (2) keeps pile-to-roller tolerances tight. These tight tolerances along with edge protection greatly reduce the risk of users inadvertently stepping into the gaps around the pile.

B. Application

1. Pile hoops and pockets for boarding floats typically have a rectangular opening for the pile to accommodate the horizontal travel of the floats. Boarding floats tend to travel in an arc as one of more floats is grounded out on the launch ramp. As the floats travel throughout this vertical arc there is a horizontal component in the float movement that must be allowed for in the pile hoop/pocket clearances.

2. Boarding floats have two clearances between the pile and the pile roller due to its rectangular shape. The inside clear dimension between rollers for the narrow dimension should be 1½ inches greater that the largest outside diameter of the pile. This will provide ¾-inch clearance on each side of the pile. The inside clear dimension between rollers for the long dimension of the guide should be 4¾ inches greater than the largest outside diameter of the pile. This will provide 2⅜-inch clearance on each side of the pile.

3. Pile hoops and pockets should have a gated frame member on the outside edge to allow the float to be removed from the pile without lifting the float over the top of the pile. Optionally, on external pile hoops the three-sided hoop could be designed to be removable from the attachment plate.

4. Walers should be notched as necessary at pile hoop and pocket locations and hoops attached directly to boarding float frame.

5. UHMW-PE or HDPE plastic rollers are used to reduce wear on piles and provide a quiet, smooth transition between varied water levels.

6. Pile hoops and pockets should be made of a durable material, preferably galvanized steel, with sufficient strength to transmit all loads from floats to piling. The hoop and pockets should be securely attached to the float with through bolts to prevent pull out or separation during periods of peak loading.

7. Edge protection (steel toe rails) should be provided around three sides of all pile pockets.

C. Design

1. Materials

Preferred: Galvanized steel framework
Stainless steel roller axles w/ UHMW-PE or HDPE rollers

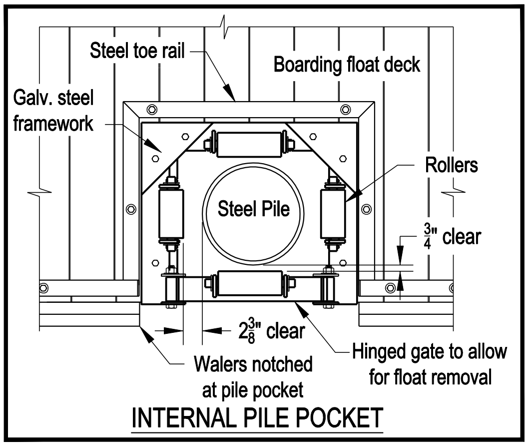


Figure 4-8 Internal pile pocket

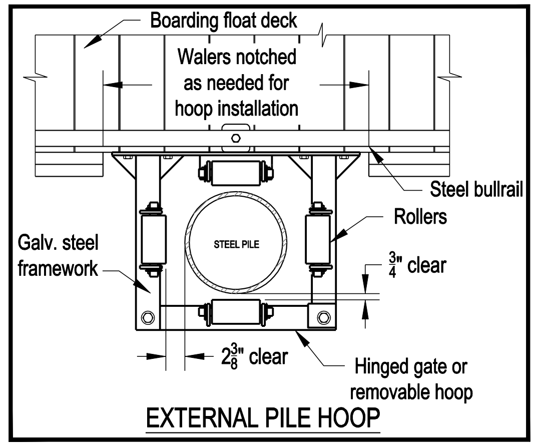


Figure 4-9 External pile hoop

Photo 4-11 Internal pile pocket

Photo 4-12 External pile hoop

4.07 ABUTMENT/FLOAT INTERFACE AND HINGES

A. General

1. Floats should have a hinged connection to the abutment when the abutment is not likely to be inundated (i.e. above the 100-year flood or extreme high tide elevation). This will serve as an anchor for the boarding floats and eliminate the need for piling in the first float *(see Figure 4-10 and Photo 4-13)*. If inundation is likely, then a transition plate should be used to allow the boarding floats to float free from the abutment during high water *(see Figure 4-11 and Photo 4-14)*. In this scenario a pile should be placed in the first float.

2. Hinges are used to connect boarding floats together. Heavy duty hinges should be used for boarding floats and capable of handling the forces imposed by wave heights up to 4 feet.

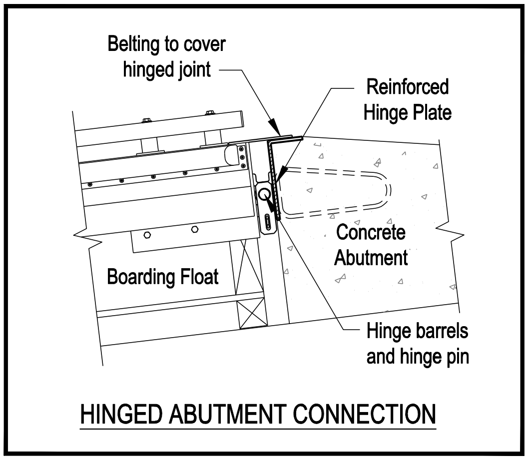


Figure 4-10 Hinged connection

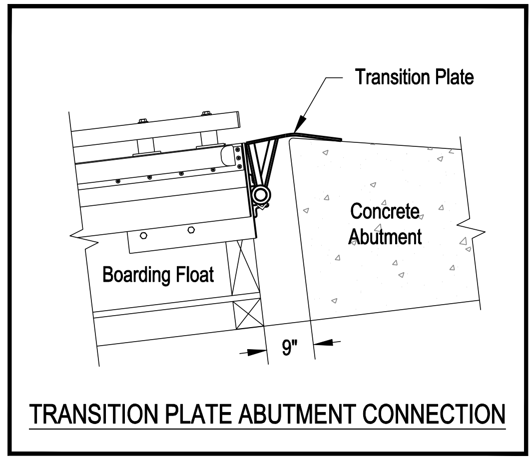


Figure 4-11 Transition plate connection

Photo 4-13 Hinged abutment connection

Photo 4-14 Transition plate connection

B. Application

1. The transition plate bridges the gap between the abutment and boarding floats. This plate is attached to the boarding float by steel pipe pins and lugs acting as a hinge pin. A stop should be attached to the underside of the plate to limit its rotation when the floats float free from the abutment. The transition plate is galvanized steel plate with a slip resistant surface approximately 12 inches long and 68 inches wide.

2. Hinge barrels are attached at the end of each float (excluding end of the last float). The floats are then connected together by steel pins and lugs acting as a hinge pin *(see Photo 4-15)*.

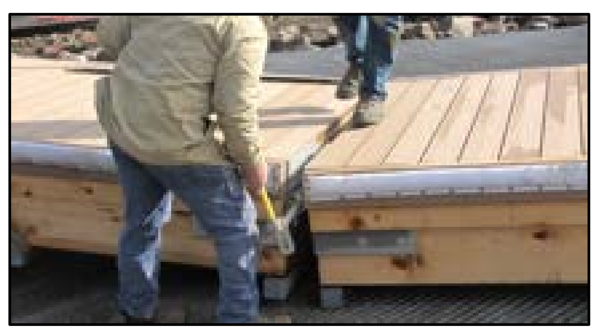


Photo 4-15 Connecting boarding float sections

3. All metal used to fabricate clips, brackets, hinges, transition plate, and other structural parts

for boarding floats should be made from material not less than 1/4" in thickness. All ferrous metal hardware used should be hot dip galvanized after fabrication.

C. Design

1. Abutment located above the 100-year or extreme high tide elevation

   Preferred: Hinged Connection

2. Abutment located below the 100-year or extreme high tide elevation

   Preferred: Transition Plate

4.08 RUBSTRIPS

A. General

1. Rubstrips are added to the outside edges of boarding floats to protect the boats and floats from damage in case of an impact.

2. Rubstrips and walers are generally considered to be sacrificial items and will wear out over a period of years. The replacement of these items is considered maintenance and may occur several times over the life span of the float. They serve to protect not only boat hulls but the structural components of the float as well *(see Photo 4-16)*.

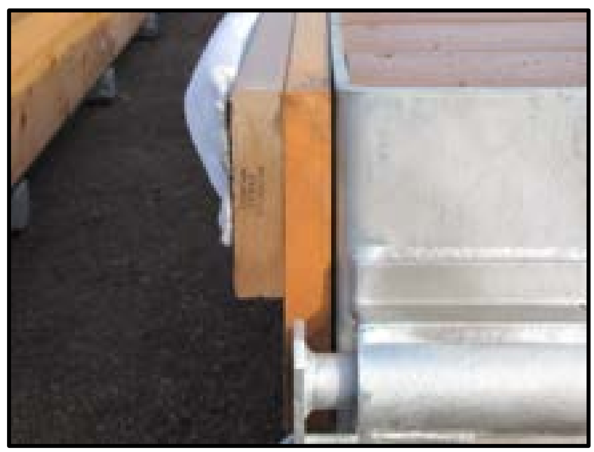


Photo 4-16 Walers and rubstrip

B. Application

1. Appropriately-sized wood walers and rubstrips should be placed along the top outside edges of all floats subject to boat contact or impacts. In some cases where bull rails are used it has been necessary to space the rubstrips out so the curved boat hull will contact the rubstrip before it hits the top edge of the bull rail.

2. Rubstrips should be made of a material and color that will not mark boats that contact it. Solid plastics or rubber, although durable, may mar or

damage hulls. Hollow core rubber or vinyl materials tend to tear easily leaving exposed metal or screws that can damage hulls. Heavy woven fabric over a foam core has proven to be a good compromise.

C. Design

1. Material

Preferred: A durable, non-marring, shock absorbing material

4.09 FLOTATION AND ENCAPSULATION

A. General

1. Floatation is a material that displaces water which gives the floats load capacity and freeboard. Floatation comes in various forms such as logs, barrels, pontoons, and polystyrene floatation, among other things.

2. Polystyrene floatation must be encapsulated to reduce the amount of damaged or degraded polystyrene in the waterways.

B. Application

1. One type of foam used as floatation is expanded polystyrene (EPS) with a density of 1 to 2 pounds per cubic foot (lb/ft^3), compressive strength of 15 to 20 lb/in^2, and maximum water absorption of 4% by volume. The foam material is an open-cell type made by steaming small pellets of polystyrene inside a mold. It is easily damaged and will dissolve upon contact with gasoline, oil, paint thinner, and solvents that are often used around boats and boating facilities. However, it is relatively inexpensive and works well inside a protected float structure.

2. A second type of foam used is closed-cell extruded polystyrene with a density of 1.2 to 2.0 lb/ft^3, an average compressive strength of 18 lb/in^2, and maximum water absorption of 0.5% by volume. This type of foam is much more resistant to mechanical damage than open-cell but will also dissolve when in contact with petroleum products. Closed-cell foam is more expensive that EPS.

3. A third type of foam used is polyurethane. It is closed-cell foam made by pouring a mixture of components into a mold and allowing it to expand to the form as it cures. It is denser than the polystyrene foam and is more resistant to melting when in contact with petroleum products. However, the quality control of mixing, pouring, and curing is highly critical and is greatly influenced by temperature, mixing time, and other variables. As the polyurethane cures (foams) it will often fold over itself creating

sizeable voids that cannot be detected. These voids will sometimes fill with water over time and create serious floatation problems. Also some tests have shown that saturated polyurethane that is repeatedly frozen loses its flotation characteristics. The use of polyurethane foam for floatation is not recommended.

4. All polystyrene foam floatation used in floats must be encapsulated according to OSMB standards to prevent degradation and/or disintegration of foam in the waterways.

C. Design

1. Required: Compliance with Oregon's Polystyrene Foam Encapsulation Program Administered by the OSMB (See OAR 250-014-0030 at www.boatoregon.com).

NOTES

Section 5

TRANSIENT FLOATS

5.01 FACILITY SITING

A. General

1. In general, transient floats (docks) serve non-trailered boats over 26 feet in length. Tie-up facilities should be spaced along cruising routes with separation distances that match the boaters cruise distances, upland amenities or offer natural attractions.

2. Before a transient facility is constructed on a waterbody an evaluation should be done to establish the need, demand, site availability, capability, protection, compatibility with or impacts to adjacent uses, and waterway capacity for the proposed improvements. To the extent possible transient facilities should be appropriately spaced along/around a waterway to disperse boater use.

3. User safety, access, and support facilities should be considered when evaluating a site.

4. Site topography and waterway characteristics may play a large part in the construction cost and feasibility of the proposed facility development.

5. This section is not intended to be applied to the design of transient-type facilities for lake or reservoir applications. Use on lakes and reservoirs is usually seasonal and often requires removal of the float structure during the winter or allowance for grounding at low water levels. A boarding float design would be more applicable (See Section 4).

B. Application

1. Data collected from boater surveys indicates that cruisers tend to travel about 20 river miles per day. Transient floats along main cruising routes may be spaced approximately every 20 river miles, depending on the locations of appropriate sites. These sites may be selected for their ability to offer shelter for boaters from strong currents, wind, wind generated waves, and commercial vessel wakes.

2. Another consideration for float placement might be at locations where barriers present themselves along the river. Dams are one such barrier. In this situation recreational boaters may have to wait several hours for their turn to lock through or possibly spend the night before locking through the next morning.

3. Transient floats generally have access to shore via gangways and/or elevated walkways. Those structures provide access to land-based amenities (e.g. parks, picnic shelters, restrooms, camp areas). In this case local topography should be considered to allow for adequate mooring depth and safe access to and from shore. In some cases, shore access may be limited due to land ownership or topography *(See Photo 5-1)*.

Photo 5-1 Transient facility showing gangway connection to upland amenities

4. Consideration should be given to providing a vessel waste collection system at facilities that serve more than 10 boats. Components include a pumpout and/or dump station *(see Photo 5-2)*. Installation is contingent on the availability of upland utilities (i.e. water, sewer, electric) and should be located on the floats for easy access and to minimize utility runs. Float design will often incorporate utility chases within the floats *(see Photo 5-8)*.

Photo 5-2 Float mounted pumpout and dump station

C. Design

1. Transient Float Spacing

   Preferred: 20 river miles
   Minimum: 10 river miles
   Maximum: 40 river miles

5.02 PLACEMENT AND LAYOUT

A. General

1. Most transient facilities are located on the Columbia, Willamette, and large coastal Rivers and should be designed based on the large-vessel criteria given below. A smaller design vessel is warranted for facilities located on the Willamette River above the Willamette Falls and on other waterbodies where local conditions limit practical boat size.

2. The float should be laid out to provide boaters adequate maneuverability within the facility and as they approach or depart.

3. Transient floats should be located in areas that offer adequate water depth on both sides and ready access to the navigation channel.

4. Pile hoops on transient floats should be located internally. This will allow boaters to tie-up on both sides of the floats to maximize float space.

5. Transient float design is based on single-row broadside tie-up (no double or triple bunking) with the assumption that boaters will use both sides of the floats.

B. Application

1. Floats should be placed in a location that offers a minimum of 6 feet of water depth at DLW for access, mooring, and maneuvering. This depth has been found to accommodate most recreational cruisers and some sailing vessels. Larger sailing vessels may require a deeper minimum (See Section 2.01 C. 2).

2. Dimensions for the design-boat at large-vessel facilities should be 60 feet long with a 20-foot beam (width) and 11-foot profile height. Dimensions for the design-boat at small-vessel facilities should be 40 feet long with a 15-foot beam (width) and 8-foot profile height. Other design-boat dimensions should only be used if local or site specific use is justified. Profile height is that portion of the boat that is above the waterline and is used for wind loading calculations.

Photo 5-3 Small-vessel facility

Photo 5-4 Large-vessel facility

3. Turning radii should be large enough to account for one row of boats moored broadside against only one set the floats. The turning radius should be based on 1.5 times the length of the design vessel to allow for adequate maneuverability. For a large-vessel facility this would be 60 feet x 1.5 = 90 feet / 2 = 45-foot radius. For a small-vessel facility this would be 40 feet x 1.5 = 60 feet / 2 = 30-foot radius. Therefore, at a large-vessel facility the distance between the legs of a U-shaped transient float would be 90 feet plus the 20-foot beam of a boat moored along one leg for a total of 110 feet clear-distance between float legs *(see Figure 5-1)*. At a small-vessel facility the clear-distance would be 60 feet plus 15 feet for a total of 75 feet *(see Figure 5-2)*.

4. The minimum width on the most shoreward side of a transient float does not take into account any moored boats against the floats and should be 90 feet for a large-vessel facility and 60 feet for a small-vessel facility. These dimensions are measured from the float edge to a point where there is a minimum of 6 feet of water depth at design low water *(see Figures 5-1, 5-2, 5-4 and Photo 5-5)*.

5. A minimum 50-foot clear distance should be maintained between the transient float and any adjacent navigation channels. Regulatory agencies may require a greater distance depending on the site *(see Figures 5-1, 5-2 and Photo 5-5)*.

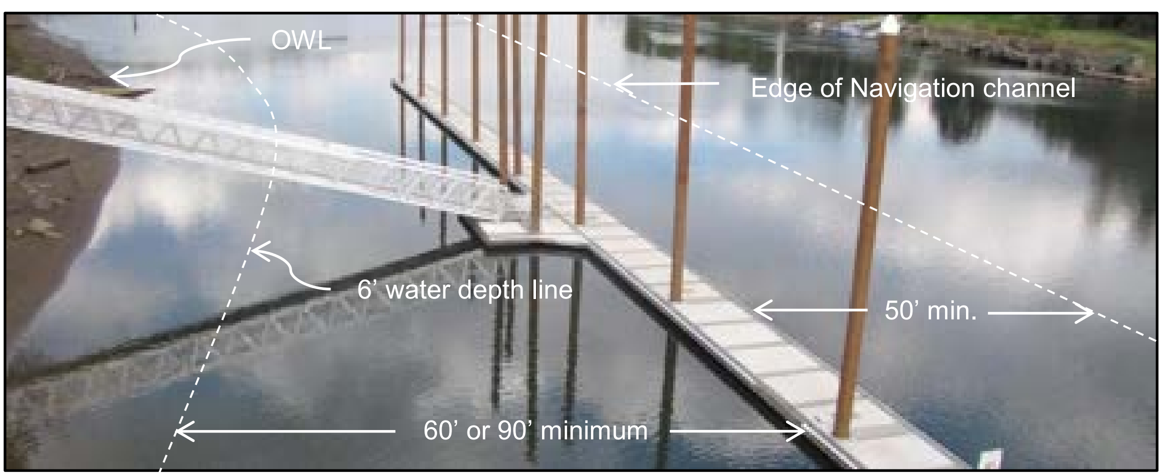


Photo 5-5 Minimum transient float clearances

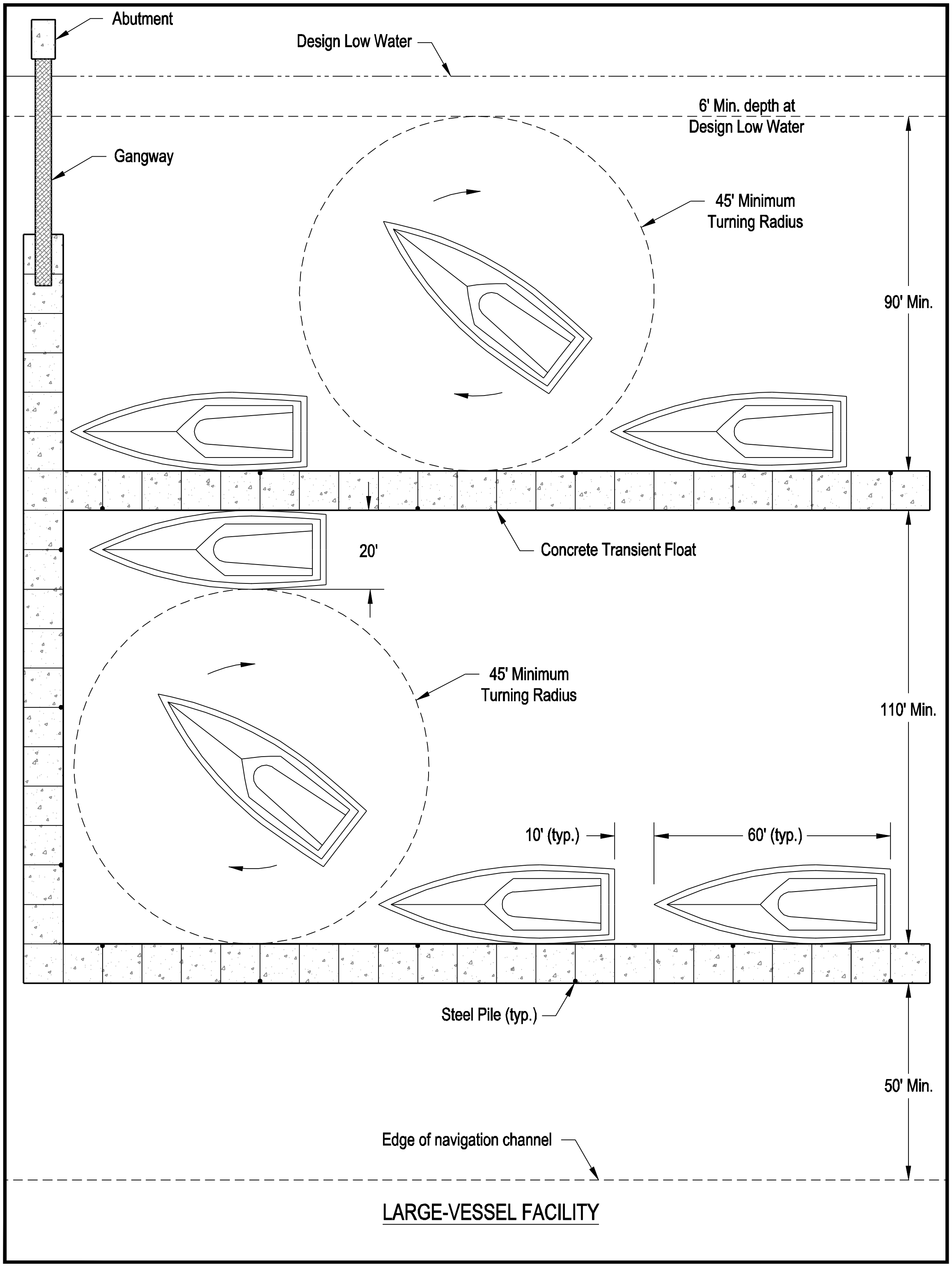


Figure 5-1 Transient float layout for a large-vessel facility

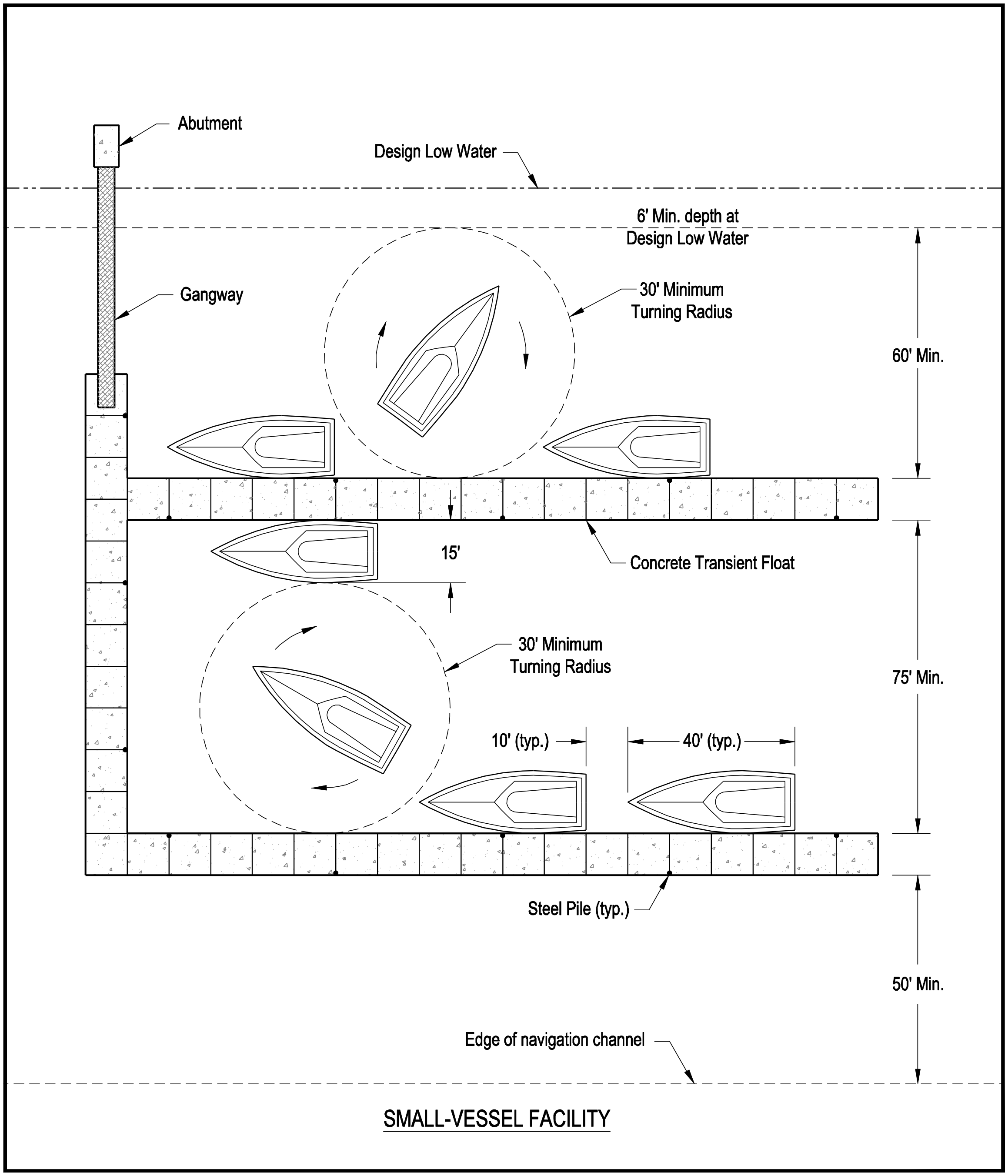


Figure 5-2 Transient float layout for a small-vessel facility

C. Design

1. Water Depth at DLW

Preferred: >6 feet
Minimum: 6 feet
Maximum: N/A

2. Clearance Between Parallel Float Legs

Preferred:	Large-Vessel Facility = 120 feet
	Small-Vessel Facility = 80 feet
Minimum:	Large-Vessel Facility = 110 feet
	Small-Vessel Facility = 75 feet
Maximum:	Large-Vessel Facility = 130 feet
	Small-Vessel Facility = 90 feet

3. Clearance to minimum 6-foot Water Depth at DLW

Preferred:	Large-Vessel Facility = 100 feet
	Small-Vessel Facility = 70 feet
Minimum:	Large-Vessel Facility = 90 feet
	Small-Vessel Facility = 60 feet
Maximum:	Large-Vessel Facility = 110 feet
	Small-Vessel Facility = 75 feet

4. Clearance to Navigational Channels

Preferred:	50 feet, but may be subject to regulatory requirements.
Minimum:	50 feet
Maximum:	N/A

5. Pile Hoop Location on 8-foot Wide Transient Floats

Preferred: Internal along shore-side edge of float

6. Pile Hoop Location on 10-foot wide transient floats

Preferred: Internal along either side or alternating sides

5.03 DESIGN WATER ELEVATIONS

A. General

1. Design water elevations (See Section 3.05 for discussion) should be determined and used for the facility design. DLW is often OLW or extreme low tide. DHW is based on the shore-side connection point for the gangway or elevated walkway and represents the point at which the facility will begin to become unusable. This point is often flood stage, top of bank, OHW, extreme high tide or dictated/limited by site topography. Please note that the entire facility must be designed to survive the occurrence of a 100-year flood event.

B. Application

1. For a river application the shore-side connection point should be located 2 feet above flood stage or as topography allows. This will often be located at the top of bank.

2. For a reservoir or lake application the shore-side connection point should be at least 2 feet above full pool or as topography allows.

3. For coastal applications the shore-side connection point should be 2 feet above an extreme high tide, top of bank or as topography allows.

C. Design

1. Water Elevations for Facility Design

Preferred: DLW and 2 feet above DHW

5.04 DIMENSIONS

A. General

1. Transient floats are typically wider than boarding floats to allow for broadside tie-up overhang from larger boats that may encroach into walking areas. Added width also offers more stability and capability to support a greater number of users at any given time *(See Photo 5-6)*.

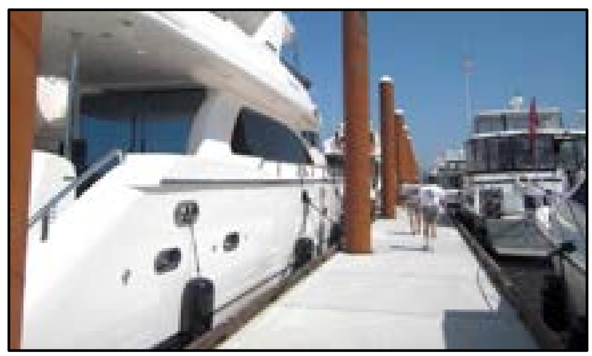


Photo 5-6 Wide transient floats accommodate boats and pedestrians

2. Transient floats should be long enough to handle several design boat length vessels for short term moorage. These large cruisers require a buffer space between their vessels when moored. It is common to allow 10 to 20 feet of buffer space between moored vessels. For design purposes each design-boat should be allotted a total of 10 feet of buffer space.

B. Application

1. Typical transient floats are 10 feet wide. Individual float sections are usually 10 feet wide by 10 feet long and continuously secured together for a unified and rigid structure *(see Photos 5-7 and 5-8)*.

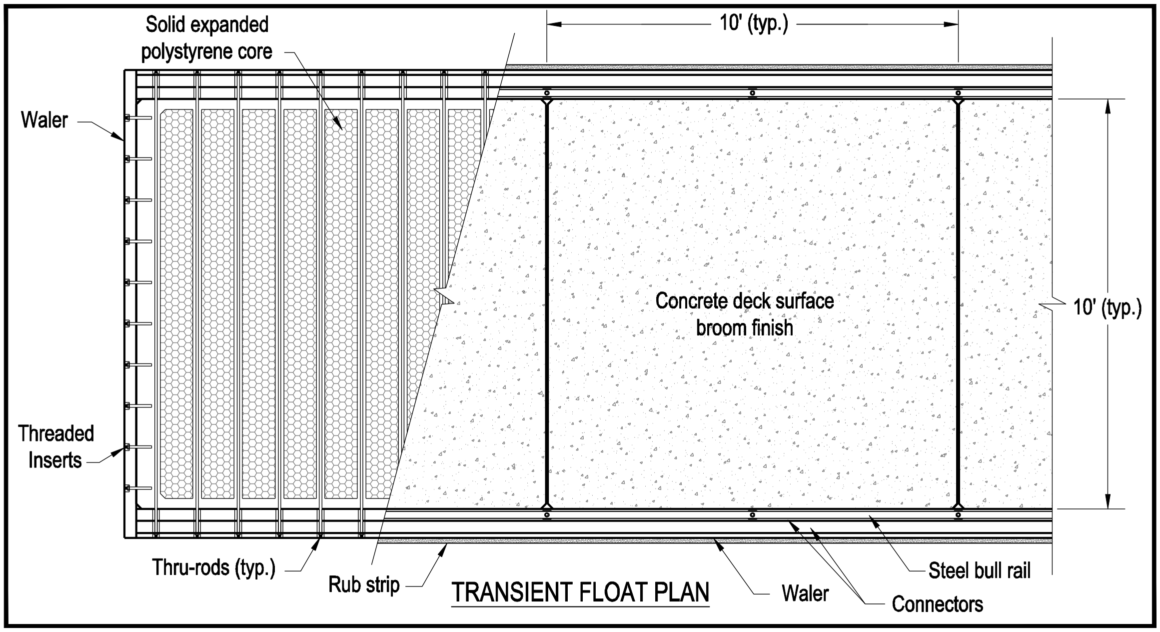


Figure 5-3 Transient float dimensions and construction components

Photo 5-7 Individual concrete float sections

Photo 5-8 Individual float sections connected together with wood walers to make sub-assemblies. The holes in the end of the float are utility chases.

2. Transient floats vary from 250 feet to 1000 feet in length with an optimum design length of 400 to 700 feet. However, no length of floats should ever be more than 500 feet from an access point to shore. For example, if the floats are 1000 feet in length then a gangway, or perpendicular floats leading to a gangway, should be located at the midpoint. Access points that exceed 500 feet restrict easy shore access and may pose a safety hazard due to limited access to shore in case of emergencies.

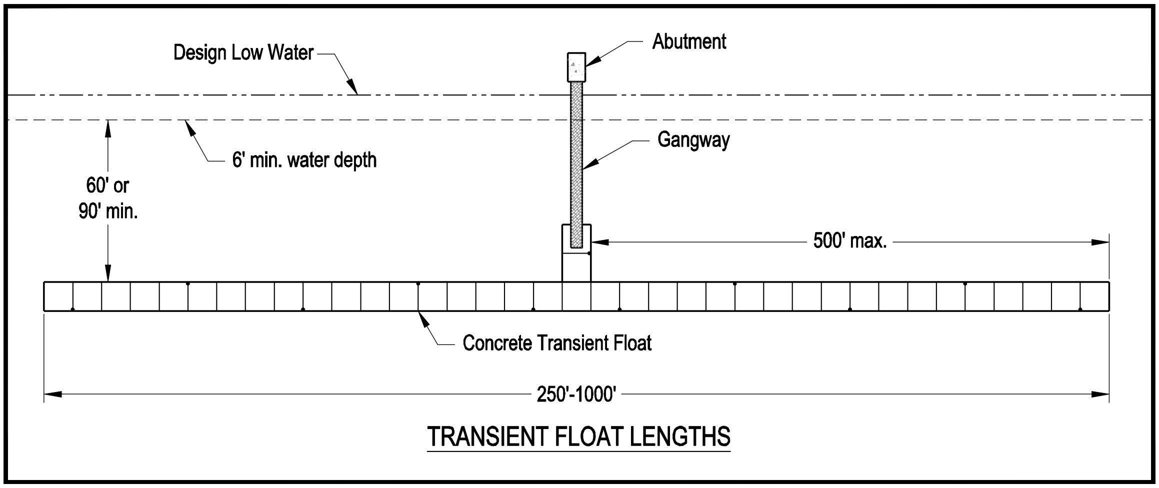


Figure 5-4 Transient float lengths

Photo 5-9 Transient float configuration with gangway located at midpoint

3. Minimum float lengths will provide moorage for 10 design-boats. Preferred lengths will provide moorage for 15 to 20 design-boats. Maximum lengths will provide moorage for 40 small-facility design-boats or 30 large-facility design-boats. These numbers are based on a single-row float configuration.

4. Multiple length and width of floats may be used to configure a float system into a horseshoe or U-shaped pattern *(see Figures 5-1 and 5-2 and Photo 5-10)*. This will maximize water area and keep the land access from being an unreasonable distance from either end of the float. The U-shape can provide some wave and wake protection for boats mooring on the inside of the U-

Photo 5-10 Transient float in a horseshoe or U-shaped configuration

shape configuration.

5. Wide, deep-draft concrete floats (10-12 feet wide and 4 feet deep) have been successfully used for many years as a means of wave/wake attenuation. These floats provide a measure of protection for boats on the inside (shore side) of the float during rough water events. Deeper profiles or the use of vertical boards may be used if greater wave attenuation is desired.

C. Design

1. Float Width

Preferred: 10 feet
Minimum: 8 feet
Maximum: 12 feet *

*Note: Greater widths can be used if wave attenuation is a high priority for the site

2. Float Length (Assuming Single Row Configuration)

Preferred:	Large-Vessel Facility =	500 feet to 700 feet (15 to 20 boats)
	Small-Vessel Facility =	400 feet to 500 feet (15 to 20 boats)
Minimum:	Large-Vessel Facility =	350 feet (10 boats)
	Small-Vessel Facility =	250 feet (10 boats)
Maximum:	Large-Vessel Facility =	1000 feet (30 boats)
	Small-Vessel Facility =	1000 feet (40 boats)

3. Float Depth

Preferred: 36 inches to 48 inches
Minimum: 36 inches
Maximum: As needed for required wave attenuation

5.05 DESIGN LOADS AND FREEBOARD

A. General

1. Design loads are used to calculate the freeboard based on existing dead loads and anticipated live loads.

2. Freeboard is the vertical distance from the water surface to the deck surface of the float. The typical design boat used at transient tie-up facilities is best served with 16 inches to 20 inches of freeboard under dead load conditions.

B. Application

1. Forty pounds per square foot (40 lb/ft^2) is a statewide and nationally recognized standard uniform live loading for transient floats. It is equivalent to approximately 24 people on a 10-foot by 10-foot transient float pod, each weighing an average of 165 pounds. There may be justification for use of smaller live loads but in no case should the live load be less than 30 lb/ft^2.

2. A concentrated live load of 400 pounds applied at any point on the transient float deck, but no closer than 12 inches from the edge of the float, should not create a cross slope greater than 2%.

3. Floats should be designed to withstand environmental loads including wind, wave, current, and impact that may be expected to occur during the life of the structure as the result of the floats location and exposure. Design procedures are thoroughly discussed in the other publications referenced in the Introduction to these guidelines.

4. Freeboard should not exceed 20 inches for a dead load only condition nor be less than 8 inches for a combined dead and live load condition *(see Figure 5-5).*

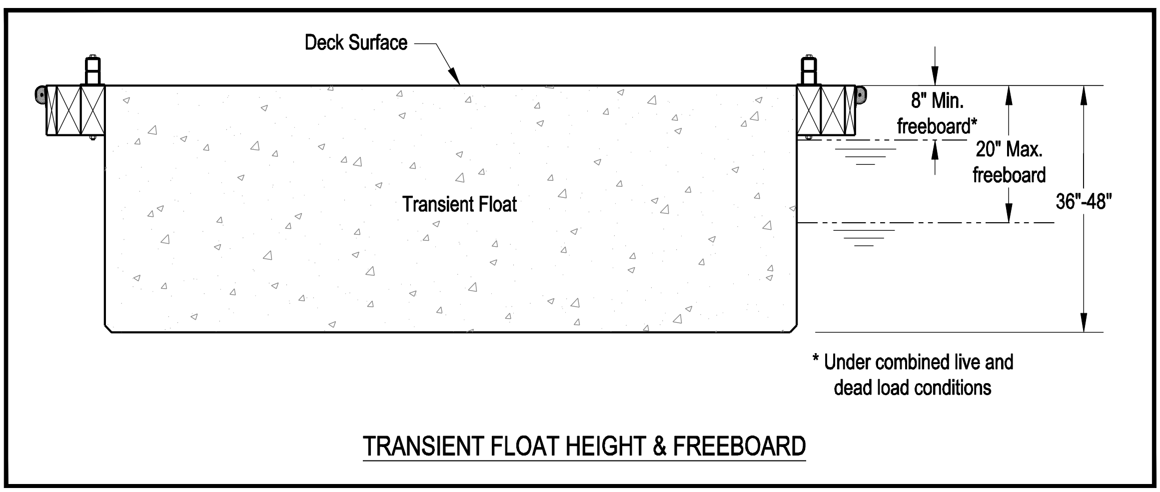


Figure 5-5 Transient float freeboard and height requirements

5. At locations where live loads are transmitted from gangways to floating structures the gangway live load may be assumed to be 40 lb/ft^2 for purposes of calculating the reaction only. Adequate float structure should compensate for the gangway dead load. Additional flotation may be required to compensate for the live load reaction on the float system to maintain the prescribed freeboard *(see Photo 5-11)*.

Photo 5-11 Inadequate floatation to compensate for gangway live load. Gangway support floats should be floating level under this loading condition – not submerged at shore end. Although the load is still supported this may induce stresses at the connection points and conveys a visual sense of being unsafe.

C. Design

1. Dead Load

   Weight of Construction Materials

2. Live Load

   Preferred: 40 lb/ft^2
   Minimum: 30 lb/ft^2
   Maximum: N/A

3. Freeboard Under Dead Load Condition

   Preferred: 18 inches
   Minimum: 16 inches
   Maximum: 20 inches

4. Freeboard Under combined dead and live loads

   Preferred: 10 inches
   Minimum: 8 inches
   Maximum: 12 inches

5. Cross Slope

   Preferred: 0%
   Maximum: 2%

5.06 CONSTRUCTION

A. General

1. Concrete and wood work well as materials for the construction of transient floats. Typically the floats will never ground out so hinge connections need not be provided for that purpose. A rigid type connection (timber connectors and through-rods) offers stability by transferring loads throughout the length of the transient float. This type of connection also reduces noise and points of wear typically found on floats using hinged connections.

2. Typical concrete transient float construction is illustrated in Figures 5-3 and 5-6.

B. Application

1. Concrete floats work very well for transient float applications because of their durability, low maintenance, and reasonable cost. The float pods can also be ballasted for deep draft to act as a wave attenuation device. Its mass reduces the effect of waves and wakes resulting in improved stability.

2. Careful attention to concrete specifications, reinforcement, and connection details are strongly recommended. It is common practice to have a concrete float manufacturer develop the float design, evaluate environmental loadings from provided design criteria, and produce structural calculations.

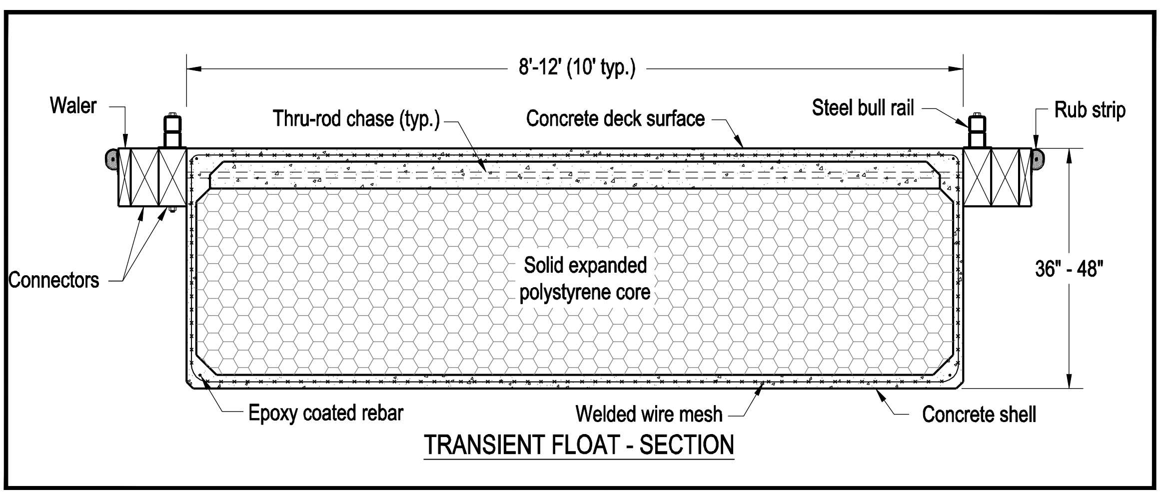


Figure 5-6 Transient float section showing typical construction

3. All metal used to fabricate clips, brackets, hinges, and other structural parts for transient floats should be made from material not less than ¼ inch in thickness. All ferrous metal hardware used should be hot dip galvanized after fabrication.

4. Transient floats should have heavy duty tie-up cleats or continuous ADA accessible galvanized steel bull rails around the perimeter of the float. The bull rail is the preferred means of tie-down. In addition to tying down at any point it also provides a continuous barrier for edge delineation of floats. Cleats only provide intermittent tie-down and can be a trip point. Bullrails should be constructed of 2 inch by 2 inch galvanized steel tube spaced off the deck with similar 2 inch high posts. The resulting 2 inch gap between deck and bullrail provides sufficient space to pass tie-off lines. This design meets the 2010 ADA Standards accessibility edge protection requirement that limits edge protection to no more than 4 inches in height and 2 inches in width.

5. Concrete transient floats should have a broom finish. Other float surfaces should be constructed or coated with a non-skid surfacing to prevent users from slipping or falling.

6. Environmental permits may require light penetration at regular intervals through the deck of the floats. This is to address the issue of potential shading under the floats where predatory fish may congregate. Requirements may vary so the designer is encouraged to ascertain early on in the design phase just how much open space is needed and at what intervals *(see Photo 5-12)*.

Photo 5-12 Grating in deck surface to allow for light penetration through the float

C. Design

1. Construction Material

   Preferred: Concrete

2. Means of Connection

   Preferred: Rigid using through-rod connectors or similar method

3. Ferrous Hardware Coating

   Preferred: Hot Dip Galvanization

4. Tie-Down Device

   Preferred: Continuous 2 inch by 2 inch bull rail, galvanized steel, maximum height 4 inches, maximum width 2 inches (ADA accessible).

5. Deck Surface

   Preferred: Broom finish concrete

5.07 PILE HOOPS AND POCKETS

A. General

1. All floats secured by piles should have adequate room within the pile guide to compensate for vertical only float travel. If existing wood piles are being used (not recommended for new construction) the size of the guide opening should take into consideration the taper of the piles. This is to keep the hoop or pocket from jamming on the pile during articulation.

2. There are two types of pile guides. Preferred is an internal guide where the pile pocket is inside the float frame *(see Photo 5-13)*. With this option both sides of the floats allow unrestricted use by boaters. Normally the piles are driven through these openings in the floats. External hoops are sometimes used when access to floats is limited to only one side. These are steel hoops through bolted or lag screwed to the outside of the float frame member *(see Photo 5-14)*. This type works well in retrofits or where difficult sites require that pile locations be adjusted in the field.

Photo 5-13 Internal pile pocket

Photo 5-14 External pile hoop

The internal pile pocket is preferred at sites where boats are expected to moor on both sides of the float. The external pile hoop is desired at sites where the floats need to be removed at certain times of the year.

B. Application

1. Transient floats will generally have a square or circular pile hoop/pocket opening. Piles for transient floats are driven vertical. No accommodation for horizontal movement of the floats is required since none of the floats ground out. Clearance should be ¾ inch on each side of the pile for a 12-inch diameter steel pile. For other pile sizes the clear dimension inside the guide should be 1½ inches greater that the largest outside diameter of the pile.

2. HDPE or UHMW-PE plastic rollers or wear pads are typically used to reduce wear on piles and afford a quiet, smooth transition between varied water levels.

3. Pile hoops/pockets should be made of a durable material, preferably galvanized steel, with sufficient strength to transmit all loads from floats to piling. The hoop/pockets should be securely attached to the float to prevent pull out or separation during periods of peak loading.

C. Design

1. Materials

   Preferred: Galvanized steel frames. UHMW-PE or HDPE rollers or wear pads.

2. Pile Hoops

   Preferred: Internal

5.08 LAND CONNECTION

A. General

1. Access to adjacent uplands from a transient float facility is achieved either by a gangway *(see Photo 5-15)* or boarding floats adjacent to a launch ramp *(see Photo 5-16)*.

2. In both cases the connection to a structure at the shore-end will be accomplished with either a transition plate or hinge. See Section 4 (Boarding Floats) or Section 6 (Gangways) for discussion on applicability.

Photo 5-15 Gangway connection to uplands

Photo 5-16 Boarding float connection to uplands

5.09 RUBSTRIPS

A. General

1. Rubstrips are added to the outside edges of transient floats to protect the boats and/or floats from damage in case of impact.

2. Rubstrips and walers are generally considered a consumable item and will be worn out over a period of years. The replacement of these items is considered maintenance and may occur several times over the life span of the float. They serve to protect the structural components of the float.

B. Application

1. Appropriately-sized wood walers and rubstrips should be placed along the top outside edges of all floats subject to boat contact or impacts.

2. Rubstrips should be made of a material and color that will not mark boats that contact it. Solid plastics or rubber, although durable, may mar or damage hulls. Hollow core rubber or vinyl materials tend to tear easily leaving exposed metal or screws that can damage hulls. Heavy woven fabric over a foam core has proven to be a good compromise.

C. Design

1. Material

Preferred: A Durable, Non-Marring (Marking), Shock Absorbing Material

5.10 FLOTATION AND ENCAPSULATION

A. General

1. Floatation is a material that displaces water and gives the floats load capacity and freeboard. Floatation comes in various forms such as logs, barrels, pontoons, and polystyrene floatation, among other things.

2. Polystyrene floatation must be encapsulated to reduce the amount of damaged or degraded polystyrene in the waterways.

B. Application

1. One type of foam used as floatation is expanded polystyrene (EPS) with a density of 1 to 2 pounds per cubic foot (lb/ft^3), compressive strength of 15 to 20 lb/in^2, and maximum water absorption of 4% by volume. The foam material is an open-cell type made by steaming small pellets of polystyrene inside a mold. It is easily damaged and will dissolve upon contact with gasoline, oil, paint thinner, and solvents that are often used around boats and boating facilities. However, it is relatively inexpensive and works well inside a protected float structure.

2. A second type of foam used is closed-cell extruded polystyrene with a density of 1.2 to 2.0 lb/ft^3, an average compressive strength of 18 lb/in^2, and maximum water absorption of 0.5% by volume. This type of foam is much more resistant to mechanical damage than open-cell but will also dissolve when in contact with petroleum products. Closed-cell foam is more expensive that EPS.

3. A third type of foam used is polyurethane. It is closed-cell foam made by pouring a mixture of components into a mold and allowing it to expand to the form as it cures. It is denser than the polystyrene foam and is more resistant to melting when in contact with petroleum products. However, the quality control of mixing, pouring, and curing is highly critical and is greatly influenced by temperature, mixing time, and other variables. As the polyurethane cures (foams) it will often fold over itself creating sizeable voids that cannot be detected. These voids will sometimes fill with water over time and create serious flotation problems. Also some tests have shown that saturated polyurethane that is repeatedly frozen loses its flotation characteristics. The use of polyurethane foam for floatation is not recommended.

4. All polystyrene foam floatation used in floats must be encapsulated according to OSMB standards to prevent degradation and/or disintegration of foam in the waterways.

C. Design

1. Required: In Compliance with Oregon's Polystyrene Foam Encapsulation Program Administered by the OSMB (See OAR 250-014-0030 at www.boatoregon.com).

NOTES

Section 6

PILING

6.01 MATERIALS

A. General

1. Piling shape should be a slender member with a uniform cross-sectional area throughout the length of the pile in order to maintain a uniform clearance between the pile and the float attachment hardware.

2. Piles need to have properties such as corrosion resistance and stiffness to resist applied lateral loads. Lateral loads are applied by floats, boats, current, wind, waves, and in some cases, debris. Piles are also required to resist both axial and lateral loads when used in the construction of structures like fixed piers.

3. The most common pile materials include steel, wood, concrete, fiberglass, and plastics.

B. Application

1. Round steel pipe is preferred to other materials and shapes due to reduced wear on pile/float attachment hardware. Also, round piles present no problem if they rotate when driven. Twelve-inch nominal diameter steel piles with ½ inch wall thickness are widely used for boarding floats and up to 24-inch diameter for transient floats and debris booms.

2. Wood piles are tapered, difficult to get in long lengths, and generally untreated with raises concerns of longevity. Driving with a vibratory hammer may be difficult if not impossible in hard soils. In general, wood piles should not be used.

3. Concrete plastic, and fiberglass piles are generally very costly and are not commonly available.

6.02 VERTICAL ALIGNMENT

A. General

1. Boarding Floats - Since movement of boarding floats is in an arc, battering or sloping piles toward the water can reduce the required opening size of the pile hoop to nearly half. This reduces the added weight of the larger

steel hardware (which must be supported by the float) and reduces the movement of the floats about the pile *(see Photo 6-1)*.

2. Transient - Piles should be driven vertically since movement of the transient floats is in the vertical direction only *(see Photo 6-1)*.

3. Debris Deflection Boom - Piles should be driven vertically since movement of the debris deflection boom is in the vertical direction only. However, soil conditions and/or anticipated high debris loading may warrant reinforcement of the vertical piles with battered support piles *(see Photo 6-2)*.

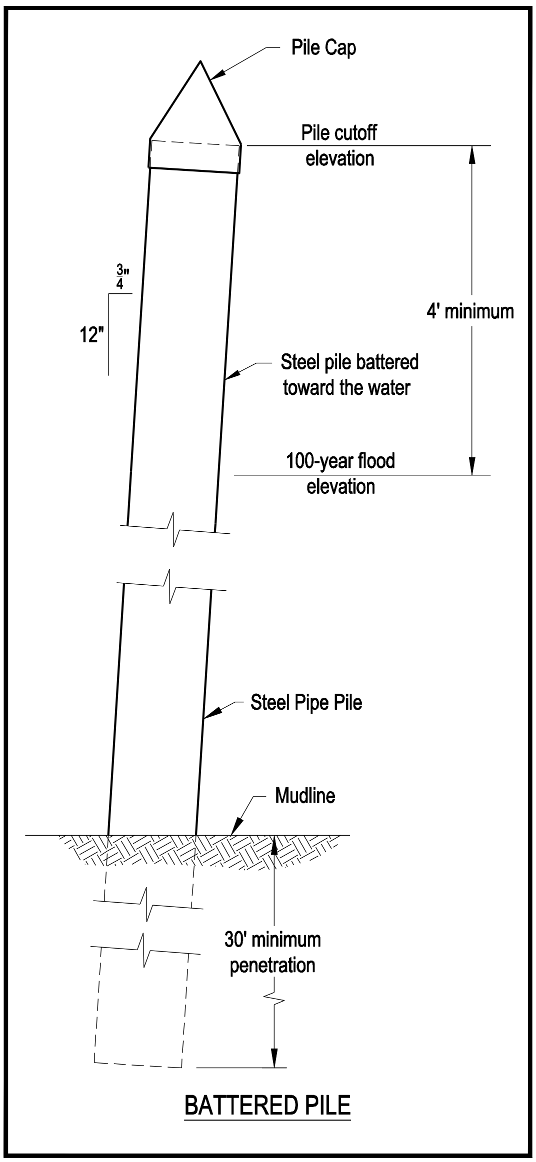


Figure 6-1 Pile driven on a batter (angle)

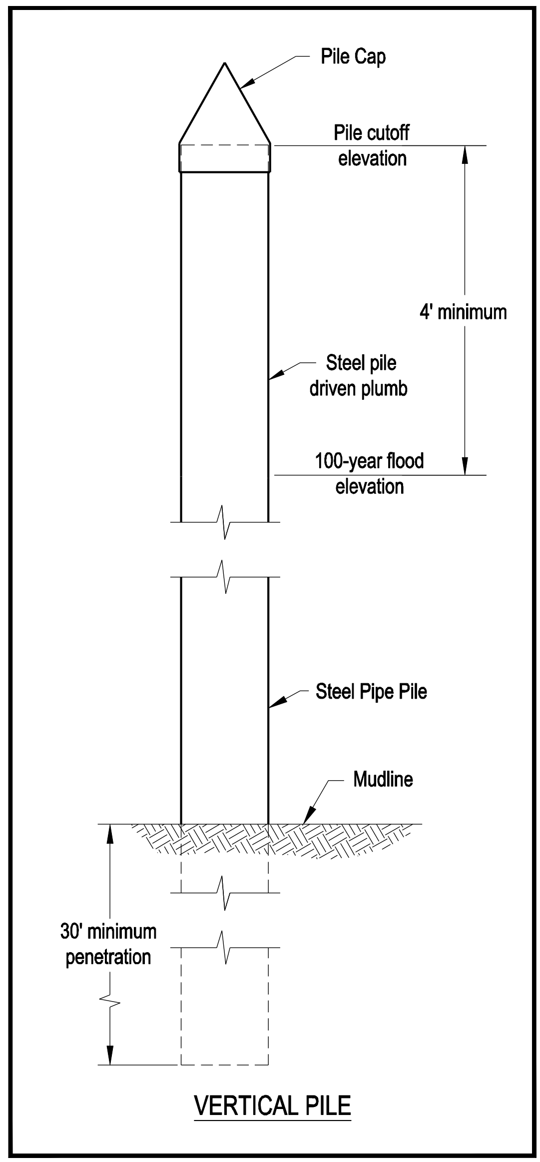


Figure 6-2 Pile driven vertically (plumb)

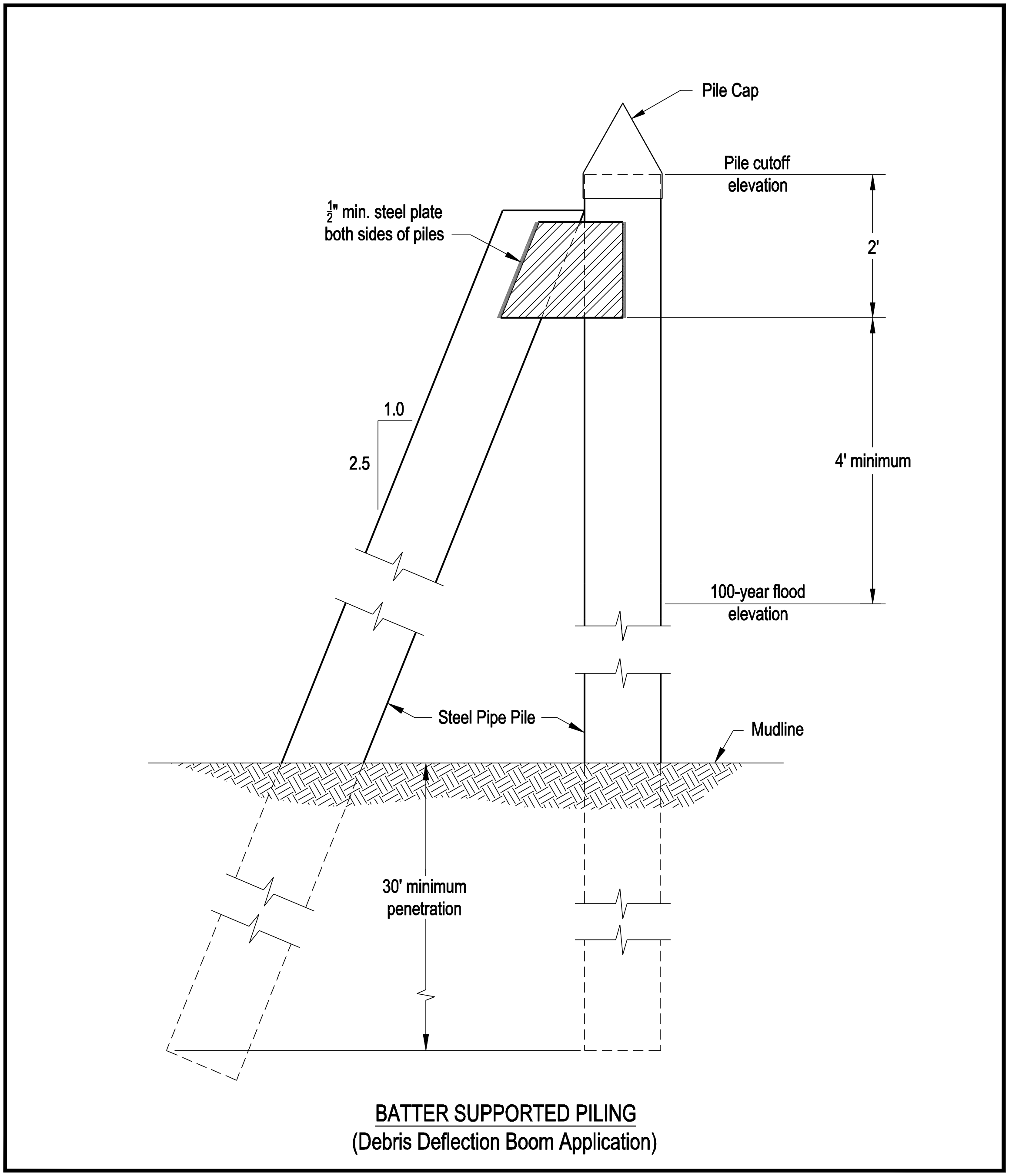


Figure 6-3 Pile driven vertically and supported with a battered pile

B. Application

1. Boarding Floats

a. Piles at launch ramps that support boarding floats should be battered. The pile batter should be ¾ inch horizontal per one foot vertical toward the water which bisects the arc that the floats travel and helps to keep the pile centered in the pocket or hoop as water levels change. Pile location should not deviate, in alignment, more than half the available clear space from outside of pile to inside of pile hoop *(see Figure 6-1)*.

b. Pile batter minimizes the required size of pile hoops, pile pockets, and roller systems. It allows less movement of the float system and provides increased float strength and stability. Battering of boarding float piles is required for all OSMB facility grant projects.

2. Transient Floats and Gangways

a. Piles for transient floats and gangways should be driven vertical (plumb) within a tolerance of ½ of one percent *(see Figure 6-2)*.

3. Debris Booms

a. Piles for debris booms should be driven vertical (plumb) within a tolerance of ½ of one percent *(see Figure 6-2)*.

b. Support piles (if required) should be driven on a batter of 1 horizontal to 2.5 vertical or as determined through analysis. Support and vertical piles should be rigidly and adequately connected at the top *(see Figure 6-3)*.

Photo 6-1 Battered boarding float pile in foreground and vertical transient float piles in background

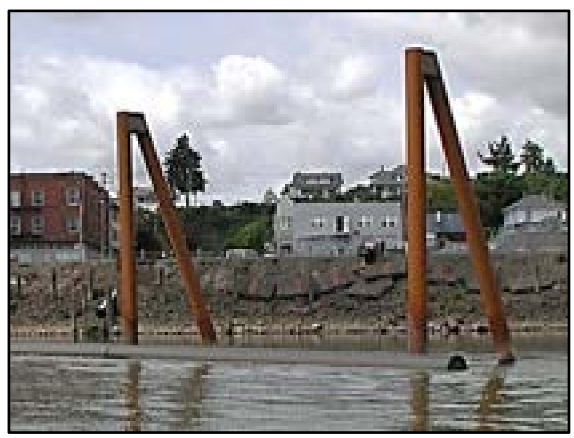


Photo 6-2 Batter supported vertical piles

C. Design

1. Boarding float piles battered ¾ inch per 12 inches toward the water.

2. Transient float, gangway, and debris deflection boom piles driven vertical.

6.03 CUT-OFF ELEVATION

A. General

1. Pile cut-off elevation should be at least 4 feet above the 100-year flood elevation. For coastal applications the storm tide elevation for that site should be used instead of a 100-year flood elevation *(see Figures 6-1 and 6-2)*.

2. Pile cut-off elevation for batter supported piles should be sufficient to provide at least 4 feet above the 100-year flood elevation or storm tide elevation at the lowest point at which the vertical and battered piles are joined *(see Figure 6-3)*.

2. After the piles have been driven and cut off at the proper elevation, they should be capped with polyethylene cone-shaped white caps with a minimum thickness of ⅛ inch. The pile caps discourage the nesting and roosting of birds on the piles and improve appearance. Bird droppings are unsightly, cause slippery deck surfaces, and are highly corrosive to metal parts on boats and floats. Pile caps can be fastened to wood piles with galvanized nails or screws and to steel piles with epoxy adhesives. Installation of pile caps is often a regulatory requirement to keep pisciverous (fish eating) birds from perching.

6.04 SIZE, SPACING, AND PENETRATION

A. General

1. A sufficient number of piles should be installed to permanently maintain position and location of the float and to resist anticipated lateral loads resulting from wind, waves, current, and impact forces from boats and debris.

2. Piles should have adequate penetration to resist the forces capable of overturning the piling. A pile should never fail from lack of soil support. Piling should resist loadings by deflecting about a fixed point. Point of fixity is the depth into the ground where a pile is assumed fixed against rotation. Simply put, the pile would have bending and deflection characteristics similar to a cantilevered beam.

B. Application

1. Pile size, spacing, and depth of embedment should be designed for a reasonable combination of loads anticipated from wind, waves, current, impacts, and any other applied loads. The designer or engineer should

consult any applicable codes or design standards including, but not limited to, the OSSC and *Marinas and Small Craft Harbors.*

2. Pile driving can be accomplished from a barge mounted crane *(see Photo 6-3)* or land-based crane *(see Photo 6-4)*. Driving techniques include (1) drop hammer - a heavy weight is dropped onto the end of the pile forcing the pile into the ground, (2) Impact hammer – similar to a drop hammer except an engine driven piston provides the driving force *(see Photo 6-5)*, (3) vibratory - by vibrating the pile the soil is loosened and allows the pile to penetrate *(see Photo 6-6)*, and (4) drilling – teeth attached to the end of the pile cut their way through soil in a rotary action *(see Photos 6-7 and 6-8)*. This is a very expensive process and generally only used to embed piles into solid rock.

Photo 6-3 Barge mounted pile driving crane with vibratory hammer

Photo 6-4 Land-based pile driving crane with vibratory hammer

3. Pile removal can be accomplished by pulling the pile completely out of the ground, cutting the pile at the mudline, or snapping the pile off. Piles that are cut or snapped off may need to be driven to some depth below the mudline. Permit requirements will often dictate how piles are removed.

4. There should be no more than two splices per steel pile. Splices should not be located at the mudbed or within 10 feet of the mudline. Splices should have beveled edges with full penetration welds.

5. Whenever possible, pile calculations should be performed to determine size, spacing, and embedment depth based on available subsurface site conditions (soils) and anticipated pile loading data. Piles are commonly driven to a minimum of 30 feet penetration which is both economical and easily obtained. Historically this has been sufficient for a vast majority of projects. Pile embedment should be adjusted as necessary due to local conditions known or suspected. For example, deeper embedment is often required for sandy soils. Pile driving records can provide important information regarding adequacy of actual soil conditions.

6. Contractors driving piles should keep pile driving records for each pile driven. These records should include the length of pile driven, cutoff and tip elevations, size of hammer and rate of operation, number of blows for each foot of penetration and an assessment of the driving conditions (i.e. easy, moderate, hard, difficult). Vibratory driving should include time to drive over a given distance. If driving is not at a constant rate for the entire distance then time and distance should be recorded at each change in rate. As an example, driving may be constant for the first 10 feet and takes 5 minutes; then the next 10 feet are a constant rate and takes 20 minutes; and finally the last 10 feet are constant and takes 10 minutes.

Photo 6-5 Vibratory hammer

Photo 6-6 Impact hammer

Photo 6-7 Drill rig preparing for drilling

Photo 6-8 Drill rig in position and drilling

C. Design

1. Wind loading on a float should be a based on current OSSC design speed applied to the maximum allowable freeboard exposure. Due to high wave conditions associated with high winds, it is assumed that wind speed within 2 vertical feet of the water surface will not exceed 60 mph.

2. Assume freeboard for boarding floats to be 12 inches. Assume freeboard for transient floats to be 18 inches.

3. Design boat wind loading (assuming 100% occupancy) should be based on a minimum 15 mph wind for boarding floats, and 30 mph for transient floats. It is applied to the average boat's total height above water line. The difference in wind speed is due to the different use patterns for each type of facility.

4. A boarding float design-boat should be 20 feet long with an average profile height of 3 feet floating above the waterline. A transient float design-boat should be 60 feet long with an average profile height of 11 feet above the waterline for a large-vessel facility or 40 feet long with an average profile height of 8 feet above the waterline for a small-vessel facility.

5. For boarding floats, it is assumed boaters would not use the facility when wind speeds approach 60 mph. For transient floats, it is assumed the facility might be 50% occupied when wind speeds approach 60 mph. For all floats, the combined float and boat wind loading should be not be applied concurrently, due to the "shadowing" effect that occurs from boats shielding the floats from the wind, or vice versa.

6. To calculate wind design, consideration must be given to unoccupied floats, partially occupied floats, and totally occupied floats, depending on the severity of the wind and boat occupancy. Worst case condition should be used.

7. Summary of minimum wind loads used for piling design:

	Boarding Float	Transient Float
Design-Float Freeboard	12 inches	18 inches
Design-Boat Height above W/L*	3 feet	8 or 11 feet
Design-Boat Length*	20 feet	40 or 60 feet
Wind Speed		
w/ 0% Boat Occupancy	Per OSSC	Per OSSC
w/ 50% Boat Occupancy	30 mph	60 mph
w/ 100% Boat Occupancy	15 mph	30 mph

*Design-boat heights and lengths are 8 feet and 40 feet for a small-vessel transient facility and 11 feet and 60 feet for a large-vessel transient facility respectively.

8. Pile location should not deviate more than 0.5% from the design axis.

9. Severe environmental conditions should be considered on a case-by-case basis and the design values adjusted accordingly. Wave, current, and debris loads are site specific, but are very significant and must not be neglected during design.

10. Pile Size (depends on application and strength requirements)

Preferred:	12-inch diameter steel pile w/½" wall thickness
	16-inch diameter steel pile w/½" wall thickness
	18-inch diameter steel pile w/½" wall thickness
	20-inch diameter steel pile w/½" wall thickness
	24-inch diameter steel pile w/½" wall thickness
Minimum:	12-inch diameter steel pile w/½" wall thickness
Maximum:	24-inch diameter steel pile w/½" wall thickness

11. Pile Spacing

Preferred:	30 - 40 feet
Minimum:	20 feet
Maximum:	40 feet

12. Pile Penetration (depends on site conditions/soils)

Preferred:	As Required
Minimum:	30 feet
Maximum:	N/A

NOTES

Section 7

GANGWAYS

7.01 CONSTRUCTION

A. General

1. A gangway is an inclined walkway that is connected to an abutment, pier, or bulkhead and supported at the opposite end by a floating structure – usually a transient float *(see Photo 7-1)*.

Photo 7-1 Typical gangway application

2. Gangways are typically used to provide pedestrian access from land to a structure in the water and vice versa.

3. A series of two or three gangways are occasionally used to span long distances from land to a floating structure; although gangways up to 130 feet in length have been successfully used. When a series of gangways is used only one usually pivots. The other(s) have fixed elevations with slopes up to 5% and are considered elevated walkways *(see Photo 7-2)*.

Photo 7-2 A series of gangways is required at this facility to access the transient floats. The two shoreward gangways are considered elevated walkways.

4. The slope of the gangway varies with changing water levels. Elaborate designs to minimize inclined slope are generally impractical or cost prohibitive.

5. Slope can be improved by increasing the length of the gangway and/or lowering the elevation at the pier/abutment.

B. Application

1. Structural aluminum is the preferred material for gangway construction. Aluminum is strong, lightweight, and has excellent corrosion resistance. Refer to *Figures 7-1, 7-2 and Photo 7-8* for typical gangway components and construction.

2. The walking surface of the gangway should be constructed of a non-skid material to insure safe and adequate traction under all conditions. Non-skid aluminum grating is an acceptable decking material but has largely been replaced by pultruded fiberglass decking *(see Photo 7-3)*. This type of decking is less abrasive making it far more comfortable for barefoot walking, is less likely to deform under heavy concentrated loads, and meets regulatory agencies requirements for light penetration. Plywood, wood, or composite decking is not recommended for safety and permitting reasons. Wood or metal strips that are attached perpendicular to the deck surface to provide traction should not be used because they are a barrier to access and a potential trip hazard.

Photo 7-3 Pultruded fiberglass decking. Bar gaps are less than ½" for ADA compliance.

3. Gangways often exceed the 8.33% maximum slope established for landside walkway and ramp applications because of the vertical distance from a landside connection point to a floating structure. The 2010 ADA Standards addresses this issue and has specific requirements for gangway accessibility. Barrier-free elements must be incorporated into the design wherever possible. This would include consideration of gap widths, obstructions, edge protection, handrails, abrupt changes in height, widths, trip points, etc.

4. The 2010 ADA Standards has several exceptions for slope requirements. However, if a gangway is at least 80 feet in length there are no restrictions on slope. For this reason, and the additional benefit of minimizing slopes, it is recommended that 80-foot gangways be used. Preferably the slope should be less than 3 horizontal to 1 vertical.

5. Gangways are usually 4 or 5 feet wide on the inside. This dimension includes required handrails *(see Figure 7-1 and Photo 7-8)*. Gangways should be no wider than is necessary to provide adequate room for the anticipated use. A 4-foot wide gangway is suitable for most applications and will allow two people to safely pass each other. Wider gangways should be used at large, high-use facilities or when the gangway length exceeds 80 feet.

6. A transition plate bridges the gap between the shore connection and the gangway. This plate is typically attached using pipe and pipe lugs acting as a hinge pin. The transition plate is made of aluminum plate with a non-slip surface and is approximately 12 to18 inches long and wide enough to fit within the interior dimension of the gangway *(see Photo 7-4)*.

7. The 2010 ADA Standards requires that the transition plate at the float end of the gangway not exceed a slope of 1 in 12 (8.33%). For this reason, the transition plate will be longer and may require handrails with returns *(see Photo 7-5)*. The handrail requirement applies if the worst-case slope of the transition plate exceeds 5%. Gangway and/or transition plate designs can often be modified to keep slopes at or below 5%.

Photo 7-4 Transition plate at shore-end of gangway

Photo 7-5 Transition plate at float end of gangway. In this application handrails are required since the slope exceeds 5%.

8. A hinged or link type connection to an upland structure (abutment or pier) should be used at sites where the top of the gangway is not susceptible to inundation. This will serve as a mechanical connection for the gangway and potentially eliminate the need for piling at the top of the gangway *(see Photo 7-6)*. A lift-off connection and transition plate with piling should be used if the gangway is susceptible to inundation. This connection will allow the gangway to float free during a high water event *(see Figure 7-3 and Photo 7-7)*. Flotation pods must be affixed to the bottom of the gangway at the shore end to carry the weight of the gangway under this condition *(see Figure 7-3 and Photo 7-13)*.

Photo 7-6 Link connection at pier-end of gangway

Photo 7-7 Lift-off connection at abutment end of gangway

9. If piling is required at the shore-end of the gangway then an external pile hoop similar in design to a boarding float pile hoop should be used *(see Photo 7-13 and Section 4.06)*.

10. Guardrail height should be a minimum of 42 inches above the walking surface. Handrails should be provided on both sides of the gangway at a height of 34 inches. The handrail should extend 12 inches beyond the ends of the gangway with a 6-inch radius return. Evenly-spaced intermediate horizontal railing on each side of the gangway should be installed so that a 4-inch sphere will not pass through the railing. A 4-inch wide kick plate should be installed along the bottom sides 1 to 2 inches off the walking surface *(see Figure 7-1 and Photo 7-8)*. These dimensions are consistent with the OSSC and 2010 ADA Standards requirements.

11. UHMW Polyethylene or HDPE rollers should be provided under the float end of the gangway to allow free travel under varied water levels. Rollers should bear at all times on aluminum plates attached to the float surface. Some means of side-restraint should be applied to the plates to minimize lateral movement of the gangway. If no piling is provided at the float end of the gangway, some type of blocking/stop should be provided at the downstream side of the gangway to keep debris and water flow from pushing the gangway off of the float.

Photo 7-8 Runoff plate at float end of gangway. A grooved roller rides on the HDPE roller guide strip and provides side-restraint.

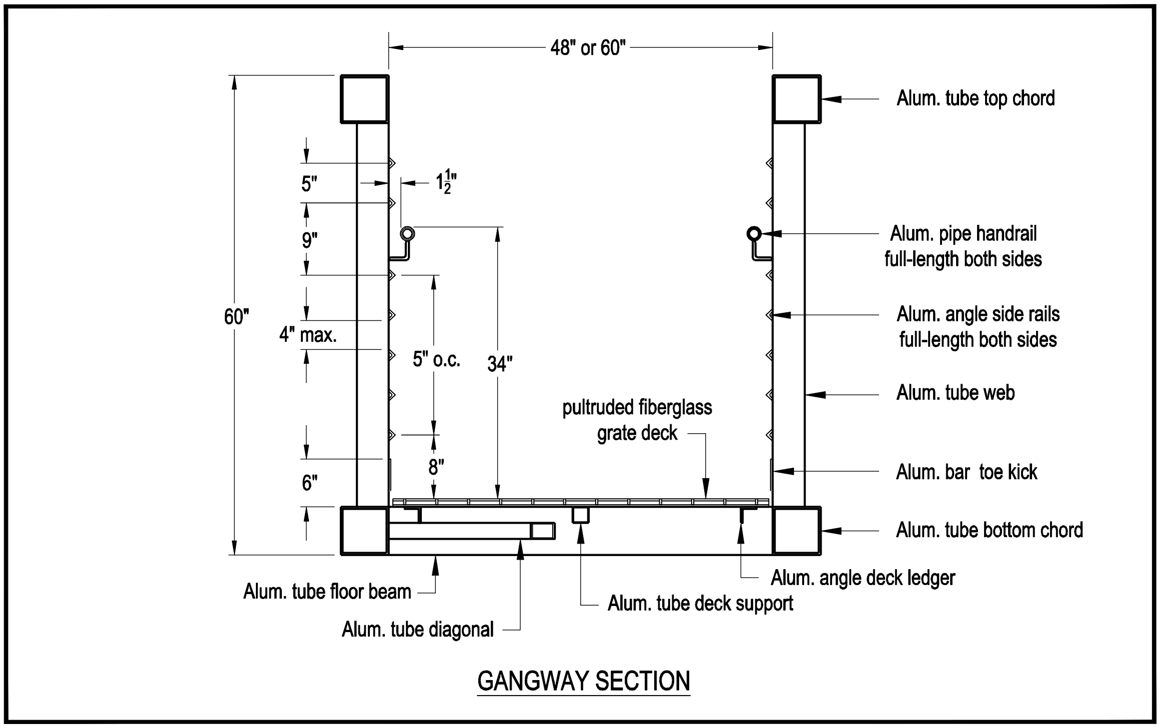


Figure 7-1 Typical gangway construction in section view

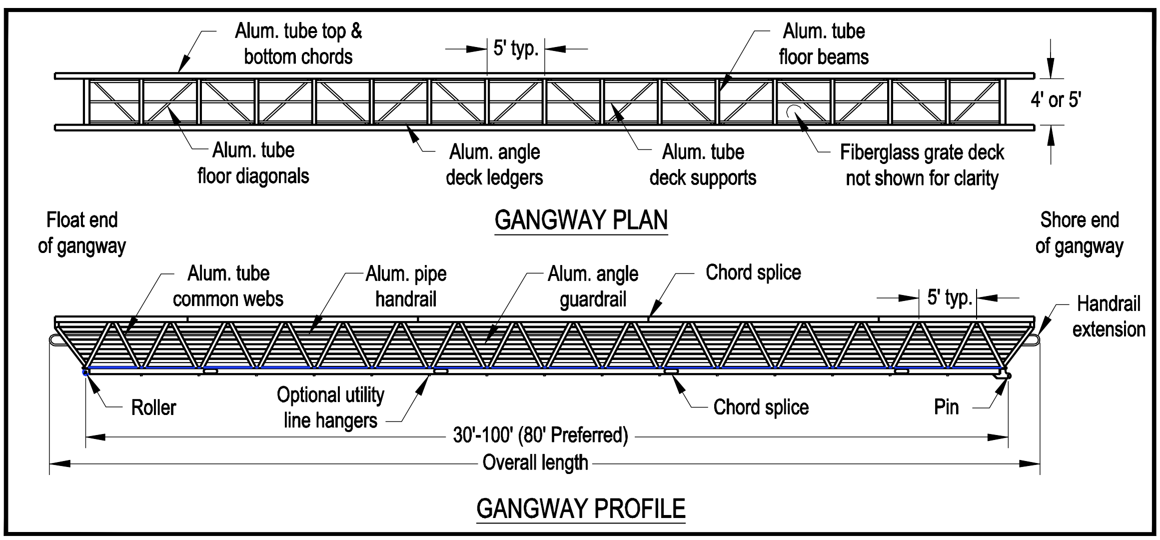


Figure 7-2 Typical gangway construction in plan and profile views

Photo 7-8 Gangway design components

C. Design

1. Gangway Width (inside dimension inclusive of handrails)

   Preferred: 48 inches
   Minimum: 48 inches
   Maximum: 60 inches

2. Gangway Length

   Preferred: 80 feet
   Minimum: 30 feet (meets 2010 ADA Standards requirement for a small facility - See Appendix A 1003.2.1 Exception 4).
   Maximum: 120 feet

3. Guardrail Height (above walking surface)

   Required: 42 inches

4. Hand Rail Height (above walking surface)

   Preferred: 34 inches
   Minimum: 34 inches
   Maximum: 38 inches

5. Railing Spacing:

   Required: Less than 4 inches

6. Gangway Slope

   Preferred: Less than 3 to 1
   Minimum: N/A (less slope is better)
   Maximum: 2.5 to 1

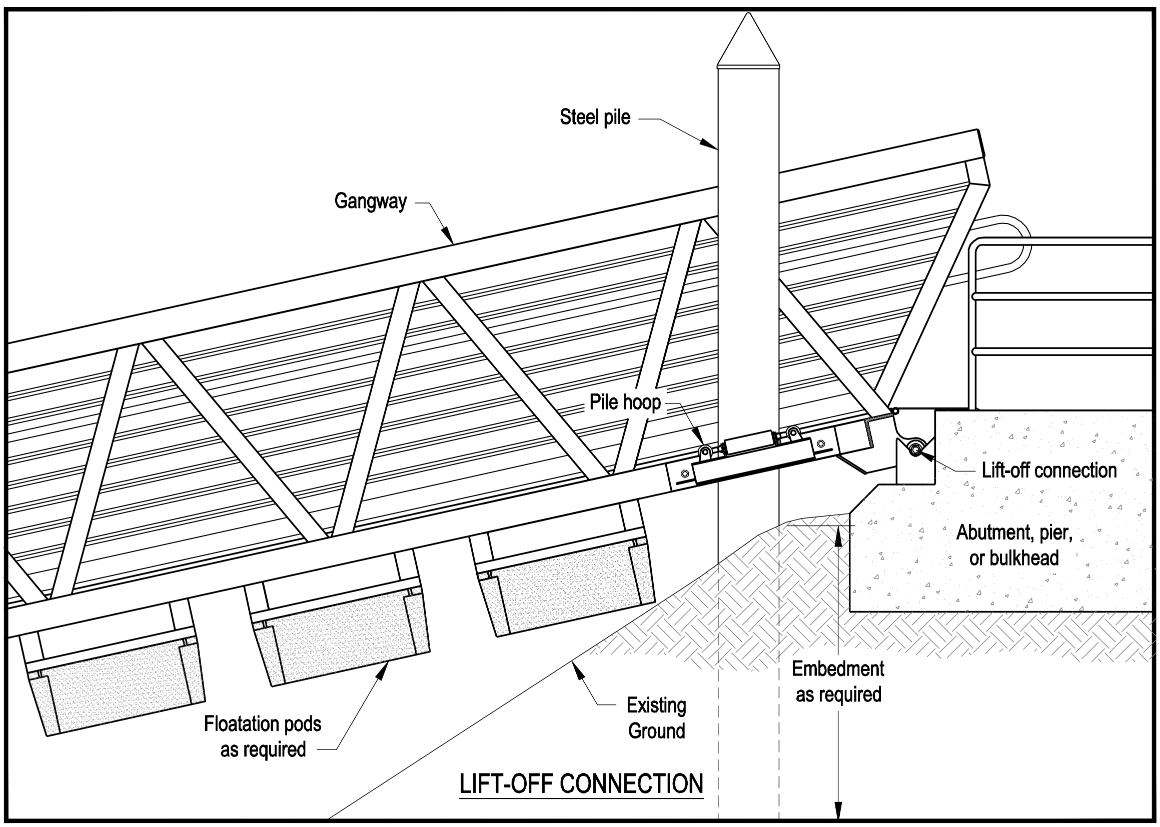


Figure 7-3 Required lift-off connection when water levels may exceed connection point elevation

7.02 LANDSIDE CONNECTIONS

A. General

1. There are three types of landside connections typically used for gangways (1) fixed pier, (2) concrete abutment, (3) timber bulkhead. Each is well suited for different site conditions at the point of connection. The most common of the three is the concrete abutment.

B. Application

1. A fixed pier, often constructed of timber, is the most versatile means of connection *(see Figure 7-4 and Photos 7-9 and 7-10)*. It can be constructed into the bank or extend out over a gradually sloped or eroded bank. It does not necessarily require the need for concrete trucks or mixers, just a pile driver. The supporting piles provide both vertical and horizontal support for the pier. Concern with loss of structural integrity due to potential bank erosion is minimized provided adequate pile penetration is achieved. Piers work well with steep or gradually sloped bank lines and can be used to extend the gangway out over the bank line.

2. A concrete abutment *(see Figure 7-5 and Photo 7-11)* requires a stable bank line for construction. The concrete abutment generally requires deep water adjacent to the shore line so the floats supporting the gangway will not ground out. Access to the site for a concrete truck is desired. Piles may also be driven at the face of the abutment for additional support or to act as a guideway for a gangway that must float free during high water.

3. A timber bulkhead *(see Figure 7-6 and Photo 7-12)* works well at sites where there is a steep bank and access to a primitive or non-hard surface trail. A timber bulkhead system consists of timber planks attached to the backside of two adjacent piles. The timbers hold the soil back and provide a place to anchor or support a gangway or bridge. These have been successfully used on islands where concrete trucks cannot access or where the cost or feasibility of a fixed pier is not warranted.

4. Guardrails should be used at any point along the sides or face of the landside connection when the distance from the walking surface to the ground exceeds 30 inches.

C. Design

1. Landside Connection

   Preferred: Concrete Abutment if site conditions are suitable.

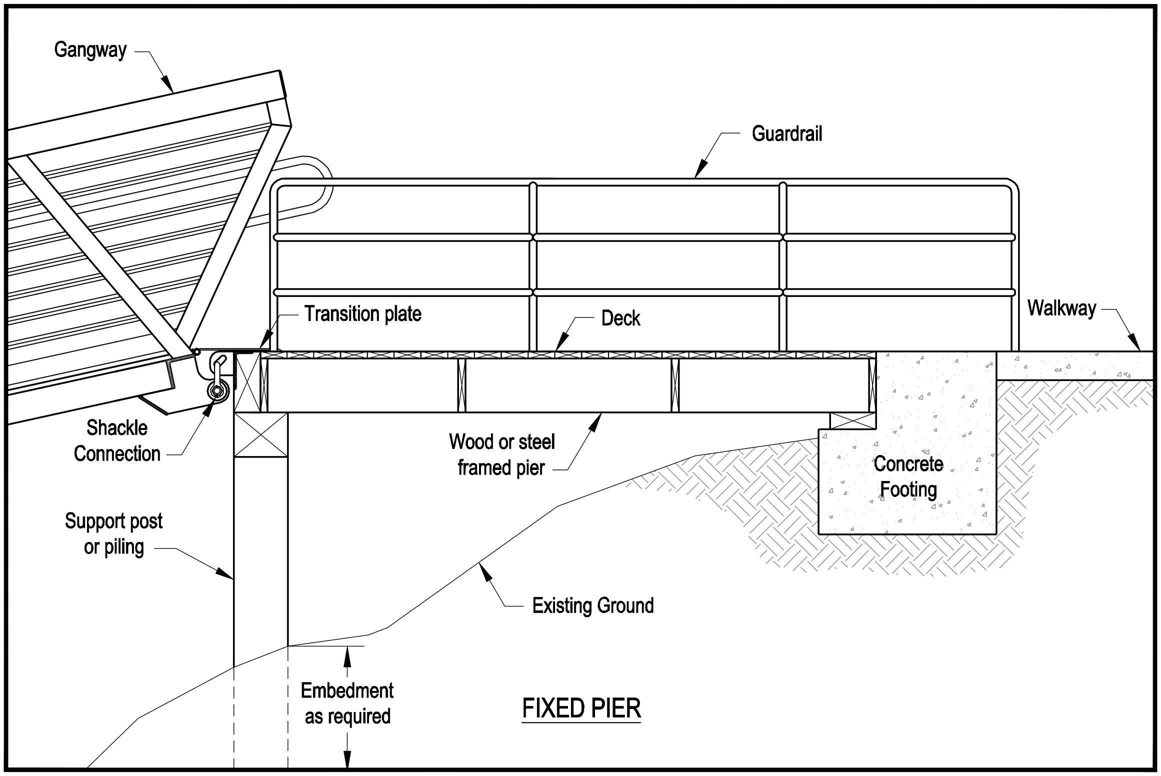


Figure 7-4 Fixed pier landside connection

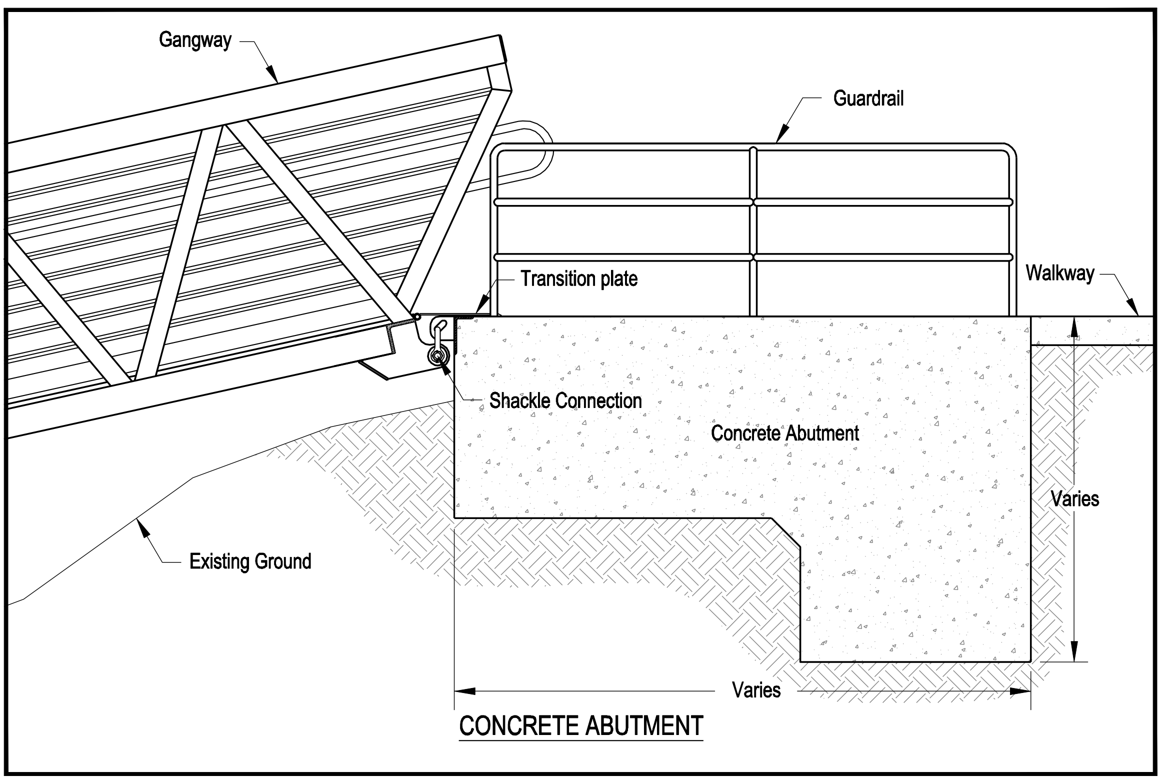


Figure 7-5 Concrete abutment landside connection

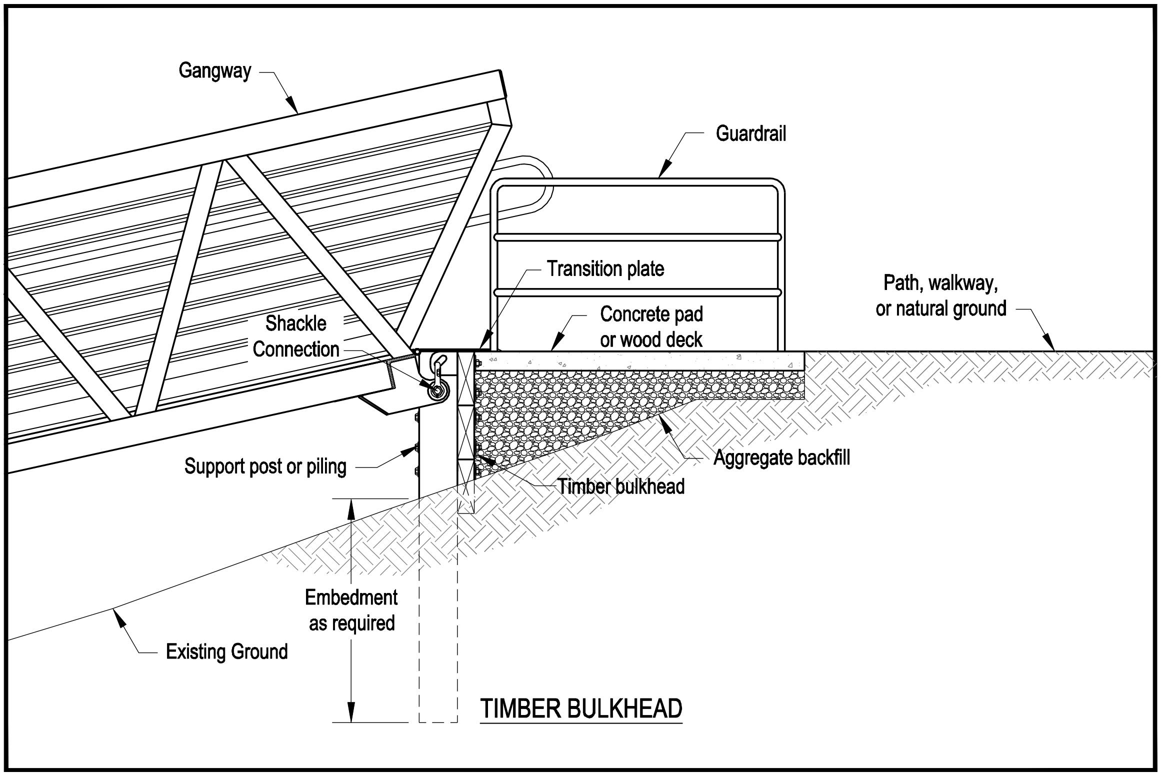


Figure 7-6 Timber bulkhead landside connection

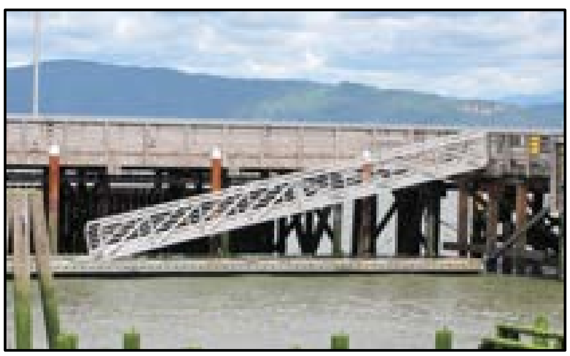


Photo 7-9 Timber fixed-pier connection

Photo 7-10 Cantilevered steel and timber fixed-pier connection

Photo 7-11 Concrete abutment connection

Photo 7-12 Timber bulkhead connection

Photo 7-13 Floatation pods and pile hoops for lift-off connection

Photo 7-14 Pile supported connection for two gangways

7.03 WATERSIDE CONNECTION

A. General

1. Gangways are always supported at the waterside end and free to move both laterally and vertically. There should never be a rigid connection on the waterside end.

B. Application

1. Gangways supported by transient floats should have sufficient surface area and floatation to carry the dead load from the gangway, anticipated gangway live load, and any tributary transient float live load.

2. Gangways will generally be aligned in a straight line with transient floats but in various configurations *(see Figure 7-7).* There may be occasion when the gangway lands on the floats at an angle *(see Photo 7-8)*.

3. Gangways that act as elevated walkways are supported by a fixed platform that is typically pile supported *(see Photo 7-14)*.

C. Design

1. Gangway Connection

Preferred: Free end with rollers to allow for movement

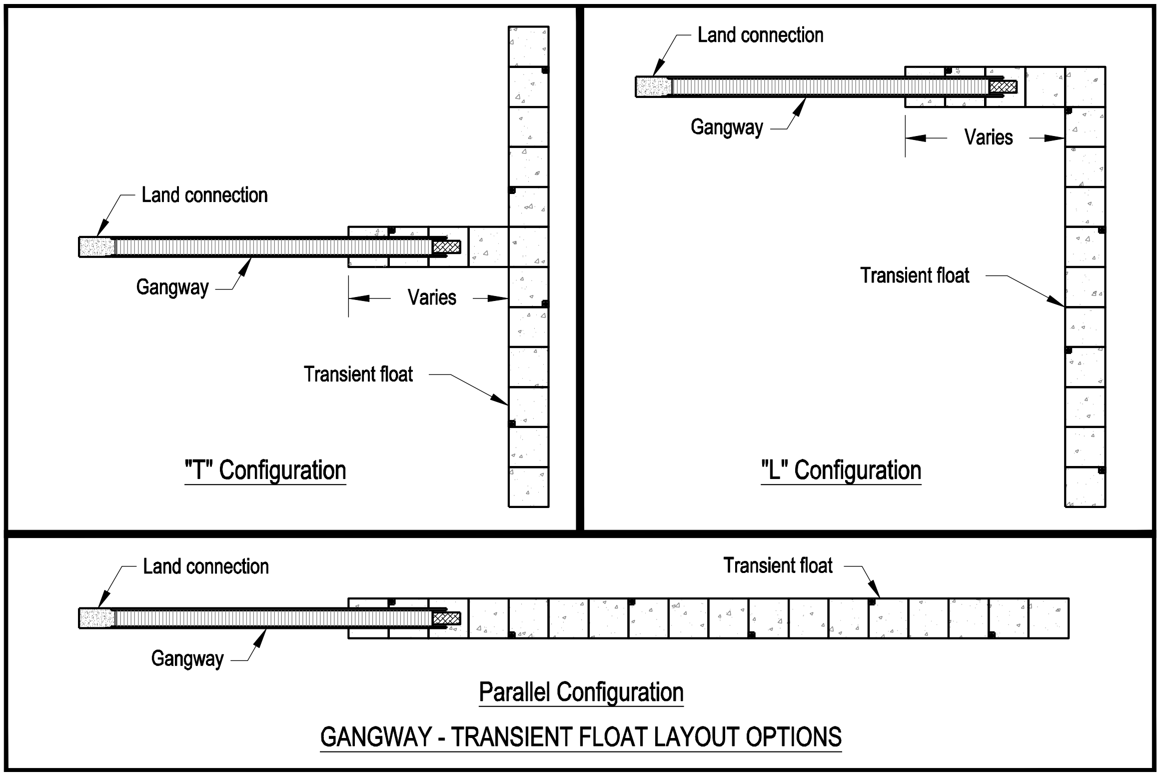


Figure 7-7 Gangway-transient float layout options

7.04 DESIGN LOADS

A. General

1. Gangways are generally transitory use structures and not subject to sustained live loads. However, if sustained or excessive live and/or dead loads are anticipated then this should be taken into account.

2. Gangway use can be varied. Normally, intermittent pedestrian traffic is all that is anticipated. In other applications where heavy loads are trucked up and down the gangway, utility lines are attached, or pedestrians densely congregate, increased loading criteria should be considered.

B. Application

1. Design should be based on a 100 lb/ft^2 live load. Designing to this standard provides a greater sense of stability for the user due to the stiffness and minimal deflection of the structure. A 50 lb/ft^2 live load may be used for gangways in excess of 100 feet in length. The designer should check with any local floating structure codes for live load requirements.

2. Gangways should be designed to minimize dead loads transmitted to transient floats. This can be accomplished through material selection and gangway contact point on the transient float.

3. Gangways should be designed to withstand wind and impact loads that may reasonably be expected to occur during the life of the structure.

C. Design

1. Gangway Live Loads

Preferred: 100 lb/ft^2
Minimum: 50 lb/ft^2 (light loading applications or lengths >100 feet)
Maximum: N/A

NOTES

Section 8

DEBRIS DEFLECTION BOOMS

8.01 DESIGN

A. General

1. Boating facility structures located on rivers and exposed to the flow of water are susceptible to varying amounts of floating debris. This debris occurs not only during flood events but also at flows near or above Ordinary High Water (OHW) - Mean Higher High Water (MHHW) in tidal areas. These high flows usually occur during winter storms or spring snow runoff.

2. Launch ramps are generally not affected; unless they have boarding floats and piles *(see Photo 8-1)*. If boarding floats are removed during high-water seasons, the risk of trapping debris is greatly reduced. Transient floats are always susceptible if not impacted to some degree *(see Photo 8-2)*.

Photo 8-1 Debris at launch ramp floats. Boarding floats are not generally susceptible to debris of this magnitude but this occurred during a 100-year flood event.

Photo 8-2 Debris accumulation at a transient float facility. This occurred during a normal high water event. A debris deflection boom was subsequently installed to protect the facility.

3. Location of the facility, flow velocities, orientation of flow, and topographical features help determine the need for a debris deflection boom. There is no need for a boom if the facility is located in a boat basin, eddy area, or protected by jetties, groins, or sheet piles.

4. The level of exposure, and value of the facility being protected, helps determine the need and type of upstream structure.

5. Deflection booms are therefore highly site dependent, and may or may not be warranted. At certain locations they are considered critical to assure a measure of safety and reduce operations and maintenance costs.

6. A complete engineering analysis is essential to the successful design and installation of a debris deflection boom.

B. Application

1. A site survey and analysis of all available hydrological data are necessary. Flow velocities, direction of flow, angle between the facility and flow direction, and extent of water level fluctuations are of particular importance, to ensure maximum protection for downstream facilities is achieved.

2. A significant amount of large (over 6 inches in diameter) woody debris must be available along the river edges upstream from the facility, to warrant a protective boom installation. In coastal bays consideration should be given to driftwood transported either on ebb or flood tides.

3. Log Booms

   a. Booms comprised of floating logs were common in the past and at some locations is still the most feasible and cost effective solution. A single log design is simple and relatively inexpensive *(see Photo 8-3)*. Three logs floating side by side, and connected together, provide greater protection, but are more costly to construct.

Photo 8-3 Log debris boom

   b. Log booms are suitable at locations where the flow velocities at OHW and above are low, not to exceed 5 feet per second. The boom helps keep debris from accumulating along the floats and/or on the launch ramp.

   c. Floating log booms have obvious limitations. It is not feasible to obtain a reasonable length log (40 feet) with minimum diameter greater than about 18". This provides only 9 inches of protection above the water surface and 9 inches below. There is very little deflection of the current to assist in the self-cleaning of the boom. Submerged debris tends to float under the log, and/or over the top. Also, there are discontinuities at the connections between the adjacent 40-foot lengths of logs. These limitations combine to often result in a collection, rather than a deflection, of floating debris. If these materials are not removed, a costly maintenance procedure, the accumulation and resultant current forces may result in complete destruction of the boom during annual high water events.

4. Poly-Pipe Deflection Booms

   a. A heavy-duty boom design was developed by the Marine Board and first installed in 1996. It is constructed of two, 24-inch diameter polyethylene pipes, stacked one on top of the other, and connected with a steel beam placed lengthwise between the two pipes *(see Figure 8-1 and Photos 8-4 and 8-5)*. The upper pipe is foam-filled for floatation and the lower pipe is open for water ballast. Joints are either smoothly connected every 40 feet or overlapped in the downstream direction. This boom design floats with approximately 9" freeboard above the water but extends nearly 40 inches below the water surface. The system is designed to be free floating at all times.

Photo 8-4 Poly-pipe debris boom

Photo 8-5 Poly-pipe debris boom details. Note pile stops to prevent grounding during low water.

   b. Rigid connections between poly-pipe segments allows for the creation of a continuous single-plane surface for debris to move along unimpeded. From a functional standpoint this is both desirable and feasible but not recommended. Experience has shown that without periodic inspection and maintenance rigid connections between segments tend to work loose over time and can induce unwanted stresses at the connections. Damage to or failure of the connection can occur under these conditions.

Allowing boom segments to move independently of each other is the preferred design and construction method.

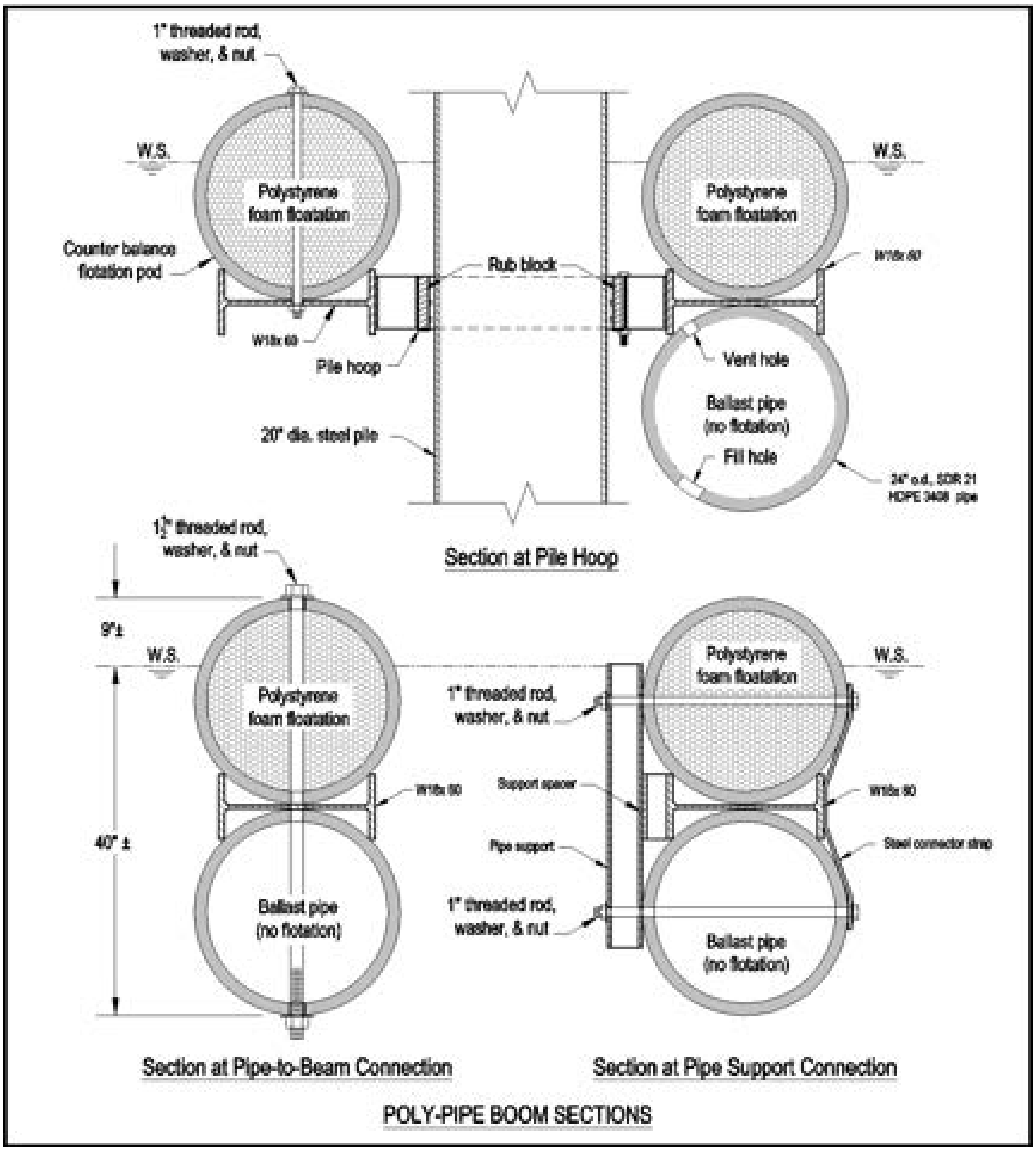


Figure 8-1 Poly-pipe boom sections showing construction details

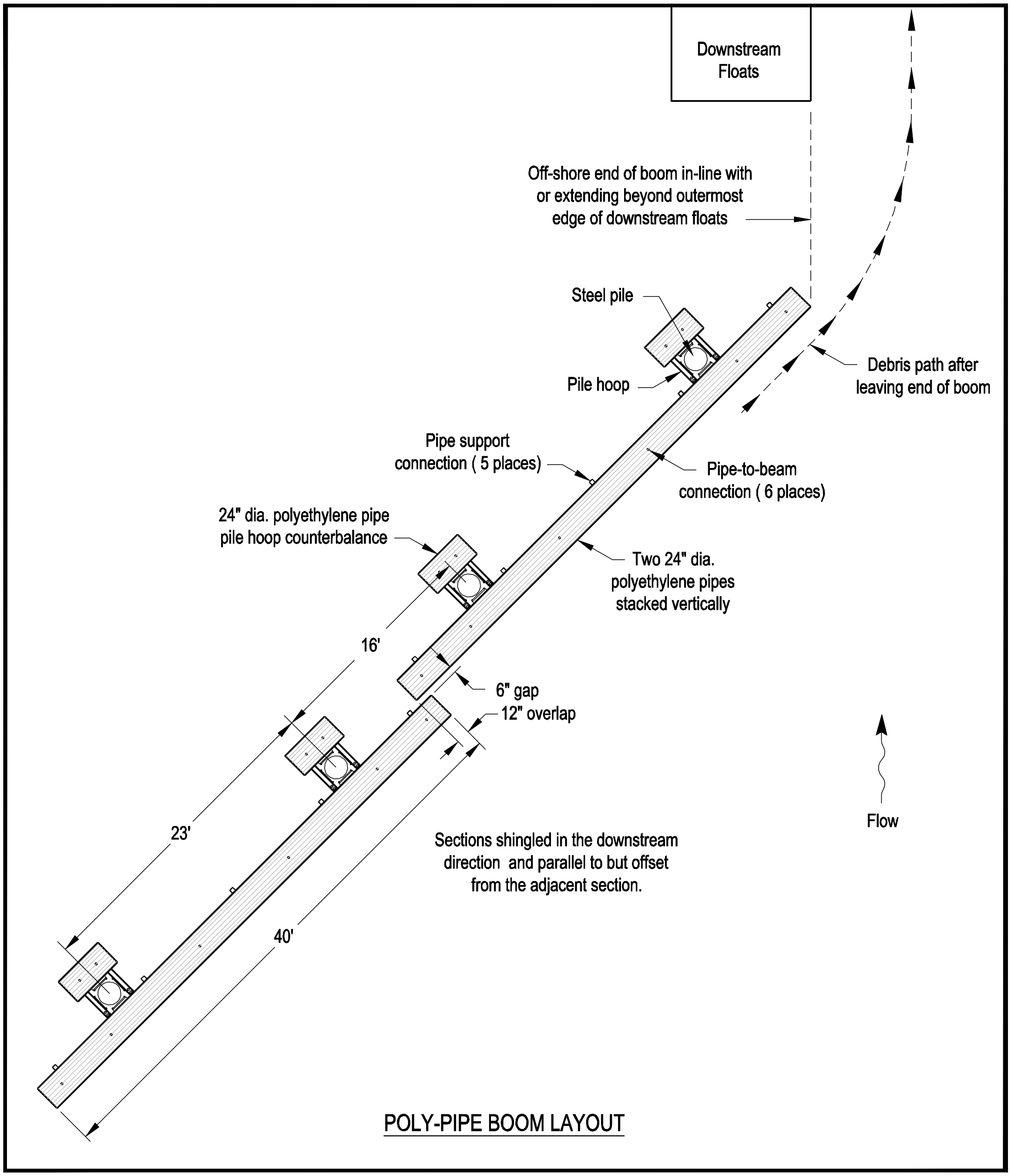


Figure 8-2 Boom layout

c. Poly-Pipe booms are designed to be self-cleaning, and are especially applicable at locations where the flow velocity at OHW exceeds 5 feet per second.

d. The polyethylene pipe boom, with its stacked design, has a greater height/depth profile than logs and provides an increased degree of self-cleaning action, in part due to the deflection of the current. In addition, the boom diverts the current along its face that continues for a short distance beyond the end of the boom before normalizing to the flow of the waterbody. This produces a distinct arc at the end of the boom that helps to carry deflected debris away from the downstream facility (see Figure 8-2 and Photo 8-6).

e. The poly-pipe boom is expensive, but highly effective, durable, and able to deflect significant amounts of large debris with little maintenance required.

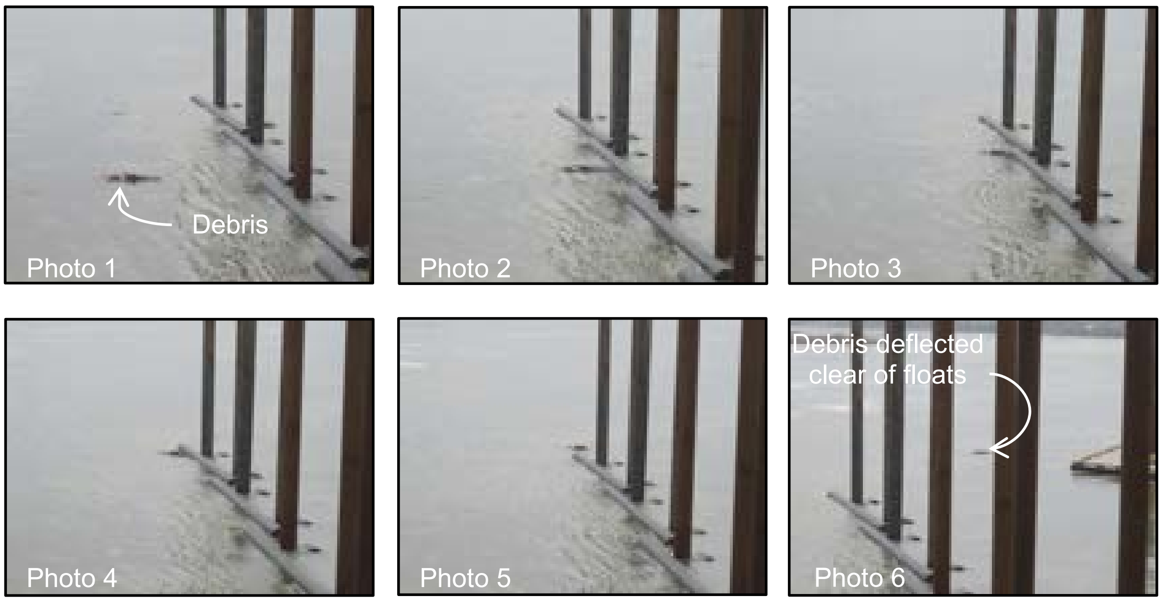


Photo 8-6 Progression of debris as it approaches, engages, and leaves the debris deflection boom

C. Design

1. Provide a minimum of 20 feet clear distance from the end of the boom and any downstream floats if boats will not be navigating between the end of the boom and the floats. If boats need to pass between the boom and the downstream floats then provide the following minimum clear distances *(see Figure 8-3)*.

   a. No launch lane between boom and boarding floats – 30 feet.

   b. With launch lane between boom and boarding floats – 40 feet.

   c. Transient floats – 60 feet

2. At minimum, the off-shore end of the boom should be in-line with the outermost edge of the downstream floats. Debris that leaves the end of the boom has a tendency to continue traveling along the angle of the boom for a short distance before normalizing to the waterbody flow. This

ensures that debris will not get pulled or pushed back inside the footprint of the downstream floats.

3. The face of the boom should be angled in the downstream direction. The angle with the current direction should be 45 degrees to properly deflect the debris.

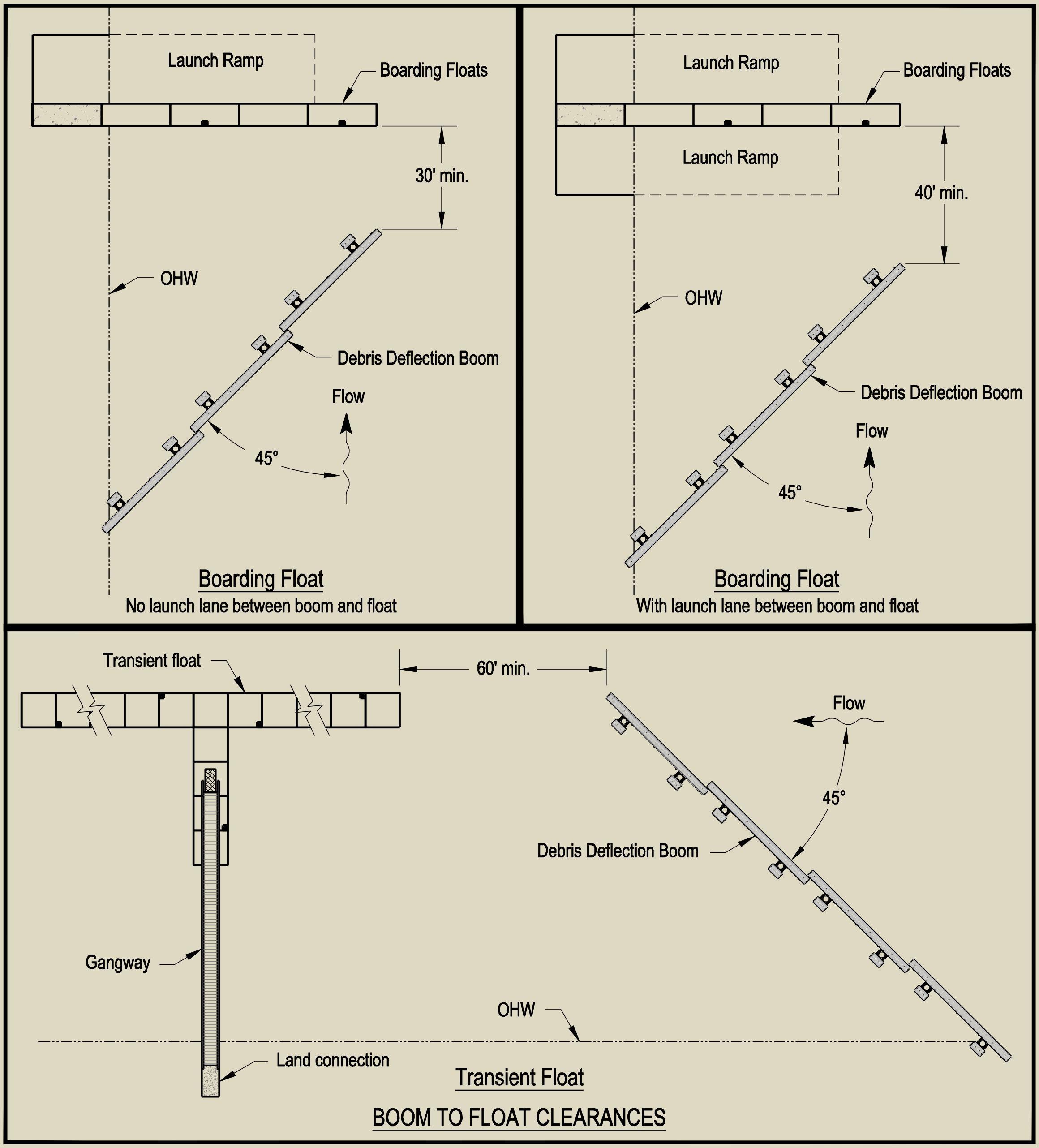


Figure 8-3 Boom to float clearances and angle of boom to waterbody flow

4. The boom should extend shoreward only as far as needed to keep debris from flowing behind the boom during high water events. Often this point is at the top of bank where flow velocities diminish during periods of very high water. Shore-end segments may need to be short pieces (10 feet or 20 feet) to negotiate steep banks. However, permit requirements may (usually) restrict or prohibit the grounding of boom segments. If this is the case, then stops should be attached to the piles to support the boom sections and keep them from grounding out *(see Figure 8-4 and Photos 8-5 and 8-7)*.

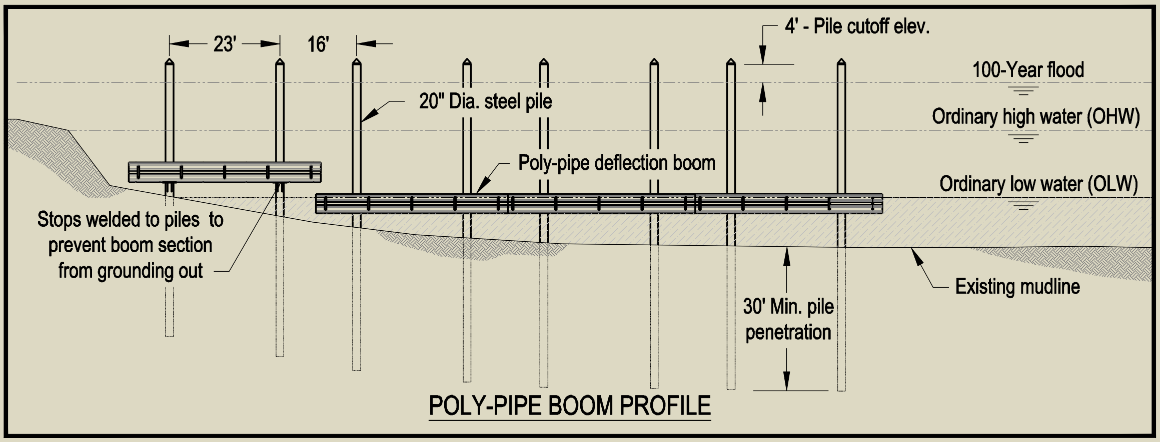


Figure 8-4 Poly-pipe boom profile

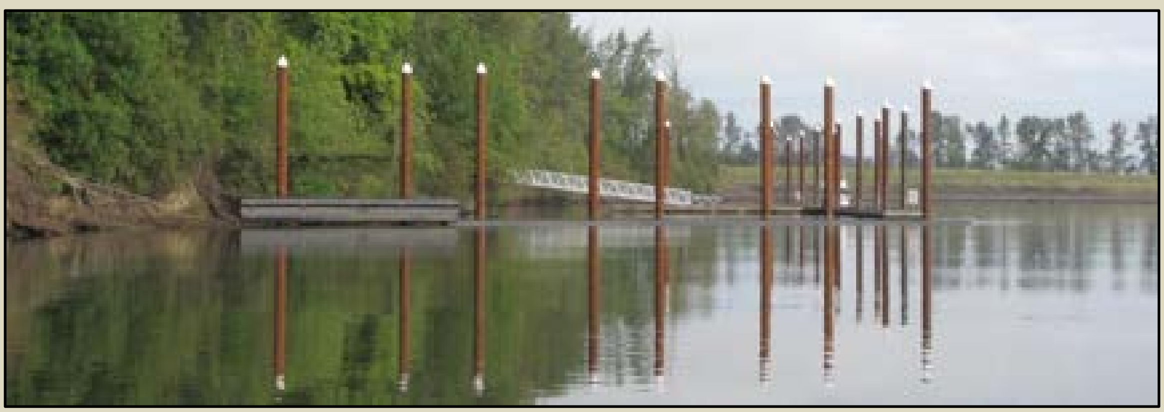


Photo 8-7 Poly-pipe debris boom protecting a transient facility

5. Piles provide support for the floating deflection boom, and must be designed to withstand all structural forces imposed by the current, and impact of floating debris. Length of pile from mud line to high water line affects pile spacing and design. Current velocity and size of the anticipated floating debris are to be considered when determining the appropriate impact forces to be used for pile design.

6. Steel piles, 20-inch nominal diameter with ½ inch thick wall, are the preferred size, with spacing determined by engineering design. Batter

piles may be required to provide necessary support for the vertical piles. Typically, each 40-foot boom section is supported by two piles located so as to balance the positive and negative moments of the boom section *(see Figure 8-2)*.

7. Pile hoops must have floatation attached to counterbalance the weight of the pile hoop and keep the boom segment floating upright *(see Figure 8-1)*.

8. Individual poly-pipe segments should be shingled in the downstream direction and parallel but offset from the adjacent section *(see Figure 8-2 and Photo 8-4)*. The end overlap distance should be 12 inches and the gap between segments 6 inches.

9. Boom type

   Preferred: 48" deep poly-pipe
   Minimum: 18" wood log
   Maximum: N/A

10. Boom Alignment

    Preferred: 45 degrees to the current
    Minimum: 35 degrees to the current
    Maximum: 45 degrees to the current

11. Boom Layout

    Preferred: Independent overlapping segments
    Optional: Continuous with rigid connections (not recommended)

12. Boom Clearance to Floats (no boat access between boom and floats)

    Preferred: 30 feet
    Minimum: 20 feet
    Maximum: N/A

13. Boom Clearance to Boarding Floats (without adjacent launch lane)

    Preferred: 40 feet
    Minimum: 30 feet
    Maximum: 50 feet

14. Boom Clearance to Boarding Floats (with adjacent launch lane)

Preferred: 50 feet
Minimum: 40 feet
Maximum: 60 feet

15. Boom Clearance to Transient Floats

Preferred: 70 feet
Minimum: 60 feet
Maximum: 80 feet

NOTES

Section 9

PARKING FACILITIES

9.01 PARKING FACILITIES

A. General

1. A parking facility is comprised of some or all of the following components: access road, staging areas (ready and tie-down), maneuver area, parking aisles, travel lanes, and parking area.

2. Parking facilities may be surfaced with asphalt, concrete, gravel or a combination of these materials.

3. All parking facility guidelines are based on the dimensions of a design vehicle with boat and trailer. The tow vehicle is 19 feet long and the trailer with boat is 26 feet. Overall width is 8 feet. These dimensions represent a vehicle/boat trailer combination that is larger than the average *(see Figure 9-1 and Photo 9-1)*. Designing for this size combination enhances maneuverability for smaller more typical vehicle/boat trailer combinations. It should be noted that there has been a trend toward larger tow vehicle/boat trailer combinations in recent years *(see Photo 9-2)*. These larger combinations may actually represent a significant percentage of the total at some facilities.

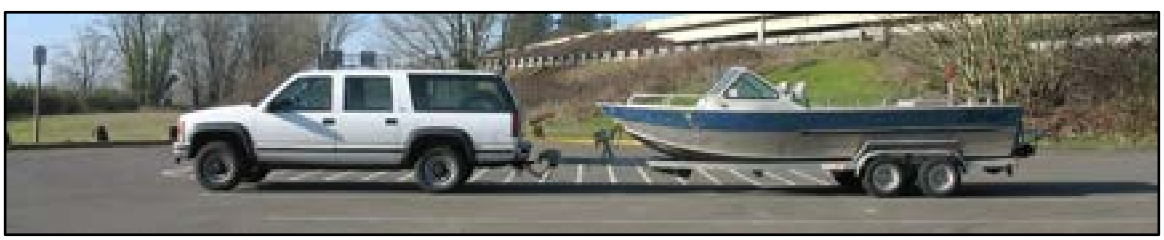


Photo 9-1 Design vehicle, boat, and trailer with an overall length of 45 feet

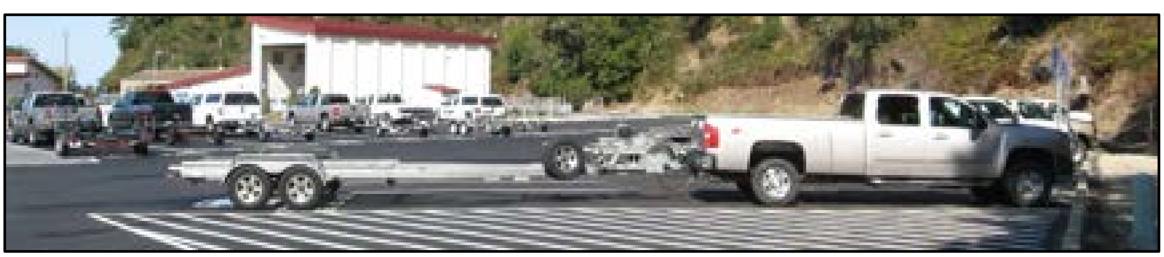


Photo 9-2 Large vehicle and trailer combination with an overall length of 50 feet or more

4. All turning radii are based on standard criteria for the design vehicle and trailer combination and derived from computer simulations. The tow vehicle is assumed to be centered in the travel lane which provides a conservative outcome *(see Figure 9-1)*.

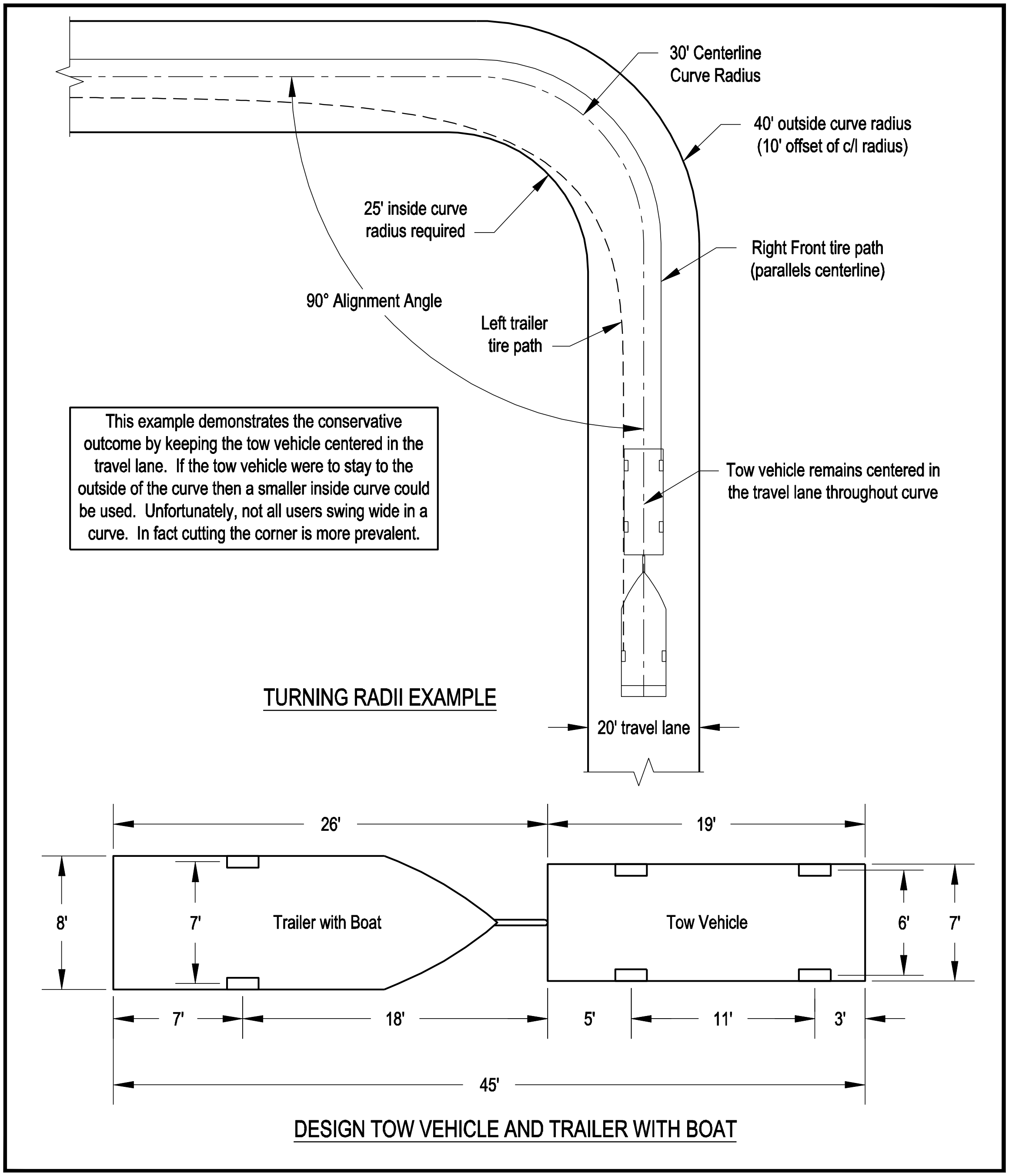


Figure 9-1 Design vehicle/trailer dimensions and turning radii example

B. Application

1. Hard surfaced parking facility areas should be paved with a minimum of 2 inches of asphalt over 12 inches (minimum) of compacted crushed rock. The crushed rock should be a minimum 6 inches of 2½-inch or 3-inch minus subbase material and 6 inches of ¾-inch or 1-inch minus base material. Geotextile fabric should be laid over the thoroughly compacted subgrade prior to placing subbase material *(see Photo 9-3)*. When paving an existing gravel area, the overall base thickness can be reduced to 4 inches of ¾-inch or 1-inch minus to provide sufficient material for grading. No base is required when overlaying an existing asphalt or concrete area in fair to good condition. Deteriorated areas of asphalt or concrete should be removed, base repaired, and patched to grade prior to paving.

Photo 9-3 Pavement section during final grading

2. Gravel parking facility areas should have a minimum 6 inches of well graded and compacted ¾-inch or 1-inch minus crushed rock over a thoroughly compacted subgrade and geotextile fabric. However, standard practice is to place a minimum 6 inches of larger size (2½-inch or 3-inch minus) crushed rock prior to placing the ¾-inch or 1-inch minus material. The larger rock is well suited to areas of fill. This provides a 12-inch minimum thickness of crushed rock.

3. Base course should extend a minimum of 6 inches beyond the edge of the asphalt before sloping no greater than 2 to 1 to grade.

4. Curbing, if used, should be extruded or cast-in-place concrete *(see Photos 9-3 and 9-4)*. Nominal dimensions should be 6 inches by 6 inches. The face of curb should be set a minimum of 12 inches from the edge of asphalt for extruded curb. Minimum dimensions should always be measured to face of curb.

Photo 9-4 Installation of extruded concrete curb

Photo 9-5 Installation of cast-in-place concrete curb with curb cuts for sheet drainage

5. Parking facility areas should be graded to allow for sheet draining off the sides. If any areas are curbed then curb cuts should be provided every 20 feet and at all graded low points *(see Photo 9-5)*. If sheet draining of any portion of a parking facility area is not possible or permitted then catch basins should be provided to collect and divert all stormwater. No areas should be graded or curbed that would allow for trapped or standing water.

6. All parking facility areas should have any necessary traffic control signs. All asphalt surfaced areas should be striped and painted with appropriate traffic control markings as required (see *OSMB Guidelines for Signage and Striping*, separate publication).

9.02 ACCESS ROADS

A. General

1. Access roads are defined as those roadways that lead from the main thoroughfare to the parking area and launch ramp. The main thoroughfare is considered a public roadway or a primary roadway within a public park. Typically, access roads do not serve other non-boating related areas.

2. Typical access road components include centerline alignment angles, centerline curve radii, inside and outside curve radii, tangents (straight sections of road), travel lane widths, reverse curves, and shoulders *(see Figure 9-2 and Photos 9-6 and 9-7)*.

B. Application

1. Access road travel lanes should be either 15 feet or 20 feet wide for one-way traffic and a minimum of 12 feet wide, per lane, for two-way traffic. An additional 1 to 2 feet beyond the travel lane should be provided as a shoulder.

2. Travel lanes should be delineated with painted fog lines or curbing. Centerline striping should always be provided on two-way access roads.

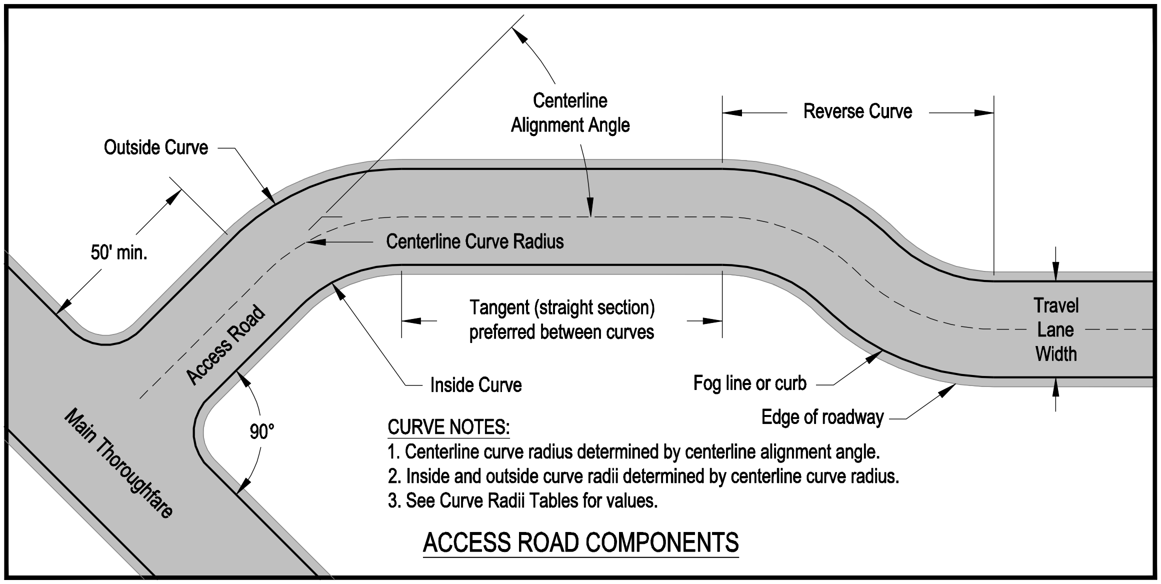


Figure 9-2 Access road components

Photo 9-6 Typical two-lane access road

Photo 9-7 Intersection of access road and main thoroughfare

3. Curves

   a. The Curve Radius Tables should be used to determine appropriate inside and outside curve radii based on the roadway centerline radius and alignment angle.

      1. Select the appropriate design roadway width table. Options are 15-foot wide one-way traffic travel lane *(see Table 9-1)*, 20-foot wide one-way traffic travel lane *(see Table 9-2)*, and two, 12-foot wide

two-way traffic travel lanes *(see Table 9-3)*. It should be noted that values for the two-way travel lanes will keep both the vehicle and trailer within their respective travel lane. Values that deviate from the chart may result in trailers that cross the centerline while negotiating the curve.

2. Select the design centerline curve radius located across the top of the table. Then select the design centerline alignment angle located down the left side. Read down and across to find the minimum outside and inside curve radii. Interpolate for centerline radii not shown in charts.

3. Values are based on the assumption that the tow vehicle remains centered in the travel lane throughout the curve (conservative approach). The minimum centerline radius is 22.5 feet which is derived from the minimum design tow vehicle turning radius.

4. Some centerline radii for two-way traffic will not work because the centerline is also the inside radius for the outside lane. Those radii are indicated N/A (not applicable) in the table. Also, for two-way traffic curve alignments up to 50 degrees there is no practical advantage to large centerline radii. Those radii are indicated N/R (not recommended) in the table.

5. For ease of maneuverability curves should be limited to 90 degrees with a minimum 60-foot tangent (straight stretch) between successive curves. An exception to this is for reverse curves (see below).

b. If necessary, curves greater than 90 degrees and up to 180 degrees may be used with the following minimum centerline radii. Radii given will allow for parallel offsets of the inside and outside curve radii.

15-foot wide lane (one-way traffic):	60-foot centerline radius
20-foot wide lane (one-way traffic):	40-foot centerline radius
12-foot wide lane (two-way traffic):	120-foot centerline radius

c. Reverse curves (two successive curves) should only be used if site constraints do not allow for an intermediate tangent section and should be limited to a total of 90 degrees. Examples include a 45-degree curve into a 45-degree curve or a 70-degree curve into a 20-degree curve.

Curve Radii 15' Wide Travel Lane (One-Way Traffic)									
	Centerline Radius								
	22.5'	**27.5'**	**32.5'**	**37.5'**	**42.5'**	**47.5'**	**52.5'**	**57.5'**	**>57.5'**
Alignment Angle									
0-25 Degrees									
Outside Radius	30'	35'	40'	45'	50'	55'	60'	65'	>65'
Inside Radius	15'	20'	25'	30'	35'	40'	45'	50'	PO
26-30 Degrees									
Outside Radius	30'	35'	40'	45'	50'	55'	60'	65'	>65'
Inside Radius	20'	25'	25'	30'	35'	40'	45'	50'	PO
31-35 Degrees									
Outside Radius	30'	35'	40'	45'	50'	55'	60'	65'	>65'
Inside Radius	25'	30'	30'	35'	35'	40'	45'	50'	PO
36-40 Degrees									
Outside Radius	30'	35'	40'	45'	50'	55'	60'	65'	>65'
Inside Radius	30'	35'	35'	35'	35'	40'	45'	50'	PO
41-45 Degrees									
Outside Radius	30'	35'	40'	45'	50'	55'	60'	65'	>65'
Inside Radius	35'	40'	40'	40'	40'	45'	45'	50'	PO
46-90 Degrees									
Outside Radius	30'	35'	40'	45'	50'	55'	60'	65'	>65'
Inside Radius	35'	40'	40'	40'	45'	45'	50'	50'	PO

Table 9-1 15' wide travel lane inside and outside curve radii

20' Wide Travel Lane (One-Way Traffic)					
	Centerline Radius				
	22.5'	**25'**	**30'**	**35'**	**>35'**
Alignment Angle					
0-25 Degrees					
Outside Radius	30'	35'	40'	45'	>45'
Inside Radius	15'	15'	20'	25'	PO
26-30 Degrees					
Outside Radius	30'	35'	40'	45'	>45'
Inside Radius	15'	20'	20'	25'	PO
31-60 Degrees					
Outside Radius	30'	35'	40'	45'	>45'
Inside Radius	15'	20'	25'	25'	PO
61-75 Degrees					
Outside Radius	30'	35'	40'	45'	>45'
Inside Radius	20'	20'	25'	25'	PO
76-90 Degrees					
Outside Radius	30'	35'	40'	45'	>45'
Inside Radius	25'	25'	25'	25'	PO

Table 9-2 20' wide travel lane inside and outside curve radii

Notes:
1. Tables 9-1, 9-2, 9-3 Assumes vehicle remains centered in travel lane throughout the curve.
2. Table 9-1 All outside radii are 7.5' offset from centerline radii.
3. Table 9-2 All outside radii are 10' offset from centerline radii.
4. Table 9-1 Shaded boxes indicate an inside radius that is a 15' parallel offset (PO) from the outside radius.
5. Table 9-2 Shaded boxes indicate an inside radius that is a 20' parallel offset (PO) from the outside radius.
6. Table 9-3 Shaded boxes indicate inside and/or outside radii that are a 12' parallel offset (PO) from the centerline radius.
7. N/A Not applicable
8. N/R Not Recommended

Two 12' Travel Lanes (Two-Way Traffic)											
	Centerline Radius										
	30'	**40'**	**50'**	**60'**	**70'**	**80'**	**90'**	**100'**	**110'**	**120'**	**>120'**
Alignment Angle											
0-20 Degrees											
Outside Radius	42'	52'	PO	PO	PO	N/R	N/R	N/R	N/R	N/R	N/R
Inside Radius	30'	28'	PO	PO	PO	N/R	N/R	N/R	N/R	N/R	N/R
21-30 Degrees											
Outside Radius	N/A	N/A	62'	72'	82'	PO	PO	PO	N/R	N/R	N/R
Inside Radius	N/A	N/A	50'	60'	58'	PO	PO	PO	N/R	N/R	N/R
31-50 Degrees											
Outside Radius	N/A	N/A	N/A	N/A	82'	92'	102'	PO	PO	PO	N/R
Inside Radius	N/A	N/A	N/A	N/A	70'	80'	78'	PO	PO	PO	N/R
51-70 Degrees											
Outside Radius	N/A	N/A	N/A	N/A	N/A	N/A	102'	112'	PO	PO	PO
Inside Radius	N/A	N/A	N/A	N/A	N/A	N/A	90'	88'	PO	PO	PO
71-90 Degrees											
Outside Radius	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	122'	132'	PO
Inside Radius	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	110'	108'	PO

Table 9-3 12' wide travel lane (two-way traffic) inside and outside curve radii

4. Grades should not exceed 15%. Changes in grade should not exceed 20%. Vertical curves (20-foot minimum) should be provided for any change in grade greater than 7%.

5. The main thoroughfare and the facility access road intersection should be aligned as perpendicular (90 degrees) to each other as possible. Access road alignments should be straight within 50 feet of the main roadway with grades not exceeding 5%. Access road intersections should be located to provide adequate sight distance with the main thoroughfare *(see Figure 9-2 and Photo 9-7)*.

C. Design

1. Lane width

Preferred:	20 ft. (One-way)	12 ft. (Two-way)
Minimum:	15 ft. (One-way)	12 ft. (Two-way)
Maximum:	20 ft. (One-way)	15 ft. (Two-way)

2. Centerline Curve Radius

Preferred (all lane widths):	Per Curve Radii Tables 9-1, 9-2, & 9-3
Minimum 15-foot lane (one-way):	22.5 feet
Minimum 20-foot lane (one-way):	22.5 feet
Minimum 12-foot lane (two-way):	30 feet
Maximum (all lane widths):	N/A

3. Inside Curve Radius

Preferred:	Per Curve Radii Tables 9-1, 9-2, & 9-3
Minimum:	Per Curve Radii Tables 9-1, 9-2, & 9-3
Maximum:	N/A

4. Outside Curve Radius

Preferred:	Per Curve Radii Tables 9-1, 9-2, & 9-3
Minimum:	Per Curve Radii Tables 9-1, 9-2, & 9-3
Maximum:	N/A

5. Centerline Alignment Angle

Preferred:	90 degrees or less
Minimum:	N/A
Maximum:	180 degrees

6. Access Road Slopes and Cross Slopes

Preferred Slope:	1%-10%	Preferred Cross Slope:	0%-2%
Minimum Slope:	N/A	Minimum Cross Slope:	N/A
Maximum Slope:	15%	Maximum Cross Slope:	5%

7. Access Road Changes in Grade

Preferred:	1%-7% (no vertical curve required)
Minimum:	N/A
Maximum:	20% (minimum 20-foot vertical curve required if over 7%)

9.03 STAGING AREAS

A. General

1. Staging areas include "ready" and "tie-down" spaces that can be provided when approaching and leaving the maneuver area respectively *(see Figure 9-3)*. These dedicated spaces provide boaters the opportunity to prepare their boats and trailers without spending extra time in the maneuver area, access road, or on the ramp. This reduces congestion and increases ramp efficiency.

Photo 9-8 Ready area adjacent to travel lane

2. Staging areas for one and two lane ramps should be added only as space allows. Parking areas should be maximized and an adequate maneuver area provided before considering staging areas. Parking and maneuver areas at small facilities (one launch lane) should not be compromised for the sake of providing staging areas. Larger facilities (two or more lanes) should have at least one ready area and one tie-down area.

B. Application

1. The preferred size is 12 feet wide by 60 feet long. Spaces are located adjacent and parallel to one or both sides of the travel lane *(see Photo 9-8)*. Spaces should be located along a straight or gently curved (radius greater than 100 feet) stretch of the travel lane *(see Figure 9-3)*.

2. Spaces should be located no closer than 40 feet from the maneuver area. This will allow one vehicle with trailer to be staged awaiting entrance to the

maneuver area without blocking the ready area *(see Figure 9-3)*. This distance is also applicable to the tie-down area if located perpendicular to the maneuver area. If a tie-down area is located parallel with the maneuver area then it should be located outside the designated maneuver area *(see Figure 9-4)*.

3. Ideally, one ready area and one tie-down space should be provided for every launch lane. However, site constraints will dictate the actual number of spaces.

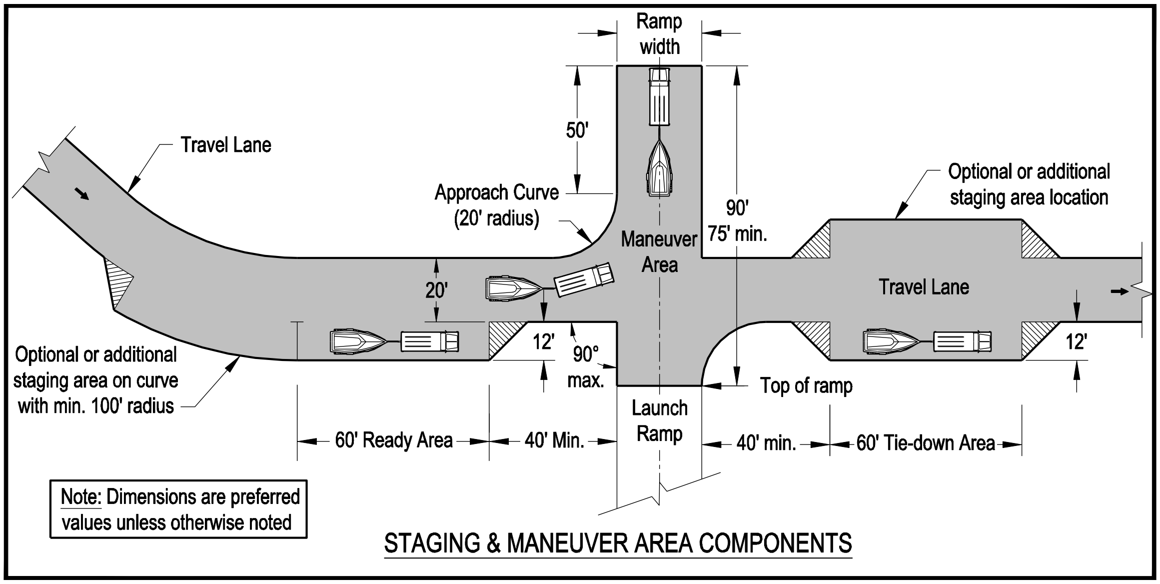


Figure 9-3 Ready, tie-down, and maneuver area components

C. Design

1. Number of Ready and Tie-Down Spaces

Preferred:	One Ready and one Tie-down per launch lane
Minimum:	None for 1 lane ramps, one of each for 2+ lanes
Maximum:	Two of each per launch lane. More may be added if room allows and demand warrants.

9.04 MANEUVER AREA

A. General

1. A maneuver area is located at the top of the ramp and provides an area for boaters to align their trailers with the ramp prior to backing down the ramp *(see Figure 9-3 and Photos 9-9 and 9-10)*.

2. Adequate space for the maneuver area should be considered when siting the launch ramp.

3. A perpendicular approach to the maneuver area is preferred. Avoid a head-in approach (vehicle pointing toward the ramp). This angle of approach makes it very difficult for the driver to get the vehicle and trailer turned and in-line with the ramp within the confines of the maneuver area. The approach should always enter the maneuver area at or near the top of ramp. A vehicle should not be required to make a turn greater than 90 degrees within the designated maneuver area in order to be in position to launch *(see Figure 9-3 and Photo 9-9)*.

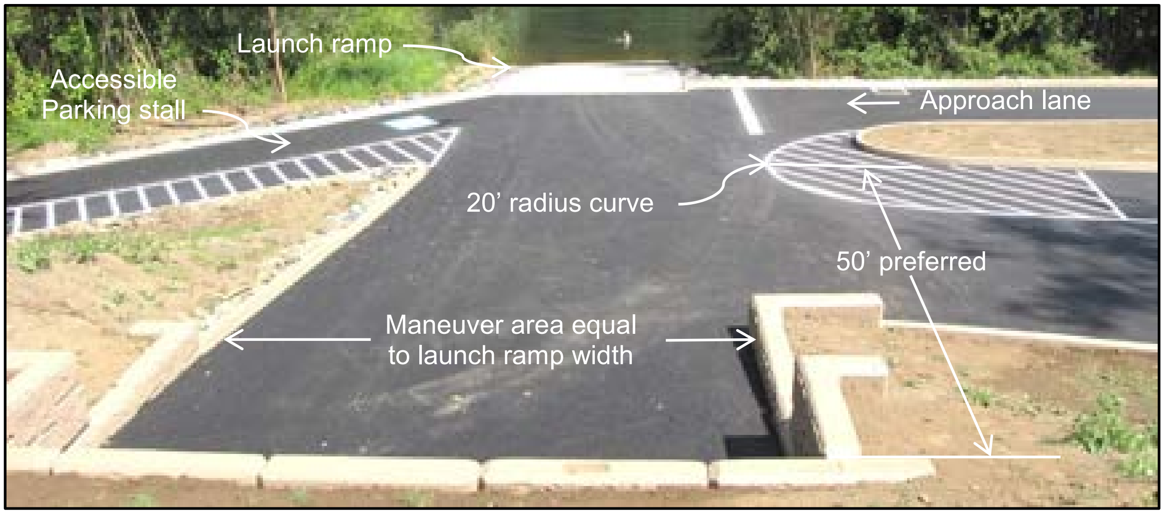


Photo 9-9 Typical maneuver area

B. Application

1. The maneuver area should be as wide as, and in-line with, the ramp. The length should be a minimum of 40 feet from the end of the approach curve but 50 feet is preferred. The approach curve should have a 20-foot radius *(see Figure 9-3 and Photo 9-9)*. Likewise, the curve onto the departure lane from the launch ramp should have a 20-foot radius.

2. The approach and departure lane to and from the maneuver area should be a minimum of 15 feet wide but 20 feet is preferred.

3. The maneuver area slope is on the same centerline alignment as the launch ramp. The preferred slope is negative (elevation decreasing) toward the launch ramp. For topographic, drainage, or stormwater management reasons a positive slope (elevation increasing) toward the ramp may be used.

4. The maneuver area may have two slopes to accommodate natural topography, to minimize cut or fill, or match other grades. However, the slope within 20 feet of the top of ramp should follow the guidelines for launch ramp vertical curves (See Section 3.11 B). Generally, within 20 feet of the top of ramp the slope range should be -2% to +2%.

C. Design

1. Primary Maneuver Area Slope toward ramp (within 20 feet of ramp)

   Preferred: -2% (meets 2010 ADA Standards cross slope requirements)
   Minimum: N/A
   Maximum: +2% (meets 2010 ADA Standards cross slope requirements)
   Optional: >-2 to -5% (only if accessible route direction-of-travel is parallel to this slope)

2. Secondary Maneuver Area Slope toward ramp (not required)

   Preferred: -5% maximum (meets 2010 ADA Standards slope requirements)
   Minimum: 0%
   Maximum: -9% (provided change in grade with primary slope does not exceed 7%)

3. Approach Curve Radius

   Preferred: 20 feet
   Minimum: 20 feet
   Maximum: N/A

Photo 9-10 Photo series showing the maneuver area approach, alignment, backing, and departure

9.05 PARKING AREA

A. General

1. Launch ramps must have an adjacent boat trailer and single vehicle parking area that is safe, convenient, and properly sized.

2. Launch ramps serve the boating community. Consequently, an available parking area should be utilized to maximize the number of designated boat trailer spaces. However, an increasing number of people arrive at boating facilities in single vehicles to participate in boating activities. Single vehicle parking, for boating associated use, should be 30% of the boat trailer spaces. Additional space may be warranted if adjacent activities are provided (e.g. picnic and day-use areas).

3. Ease of maneuverability and clear, unquestionable direction of flow are of primary importance in the design of parking areas. This will relieve congestion, gridlock, and irregular parking.

4. Every effort should be made to maintain a one-way grid system within the parking area. One-way grid systems are proven to improve traffic flow and help eliminate indecision on the part of drivers. Curbing is one of the best ways to define the flow of traffic. Proper placement of curbs will direct drivers in the correct direction to go. At any point-of-decision the direction of flow should be evidently clear. Intersections should be avoided. If it is not possible to avoid the use of an intersection, one or both lanes of traffic should be stopped *(see Photo 9-11)*.

5. All the maneuverability guidelines are based on the dimensions of a design vehicle with boat and trailer (See 9.01 A. 3).

6. The parking space guidelines are based on the same design vehicle combination less the boat. This reduces the overall length from 45 feet to 42 feet. Consequently this combination extends 2 feet beyond the end of the typical 90-degree, 40-foot long parking space. However, the 2 feet is often accounted for by the vehicle overhang at the head of the stall where the front tires contact the curb or wheelstop. An additional 2 feet of overhang at the other end of the stall is acceptable without adversely impacting the parking aisle. Once again, the typical smaller vehicle/trailer combination fits well within the 40-foot parking space.

7. It has already been stated that there has been a trend toward larger tow vehicle/boat trailer combinations. The standard boat trailer space may not work as efficiently for these larger combinations. As part of the planning phase of a project careful consideration should be given to anticipated boat size. If larger combinations can be expected then a proportional

number of appropriately-sized parking spaces should be provided. It is always desirable to maximize parking spaces. To design all spaces to be larger (longer, wider or both) will decrease the number of spaces available. Unless there is compelling justification, the percentage of larger parking spaces should not exceed 25% of the total. Furthermore, all larger spaces should be grouped together for efficiency and designated in some manner (sign or pavement marking) as oversized.

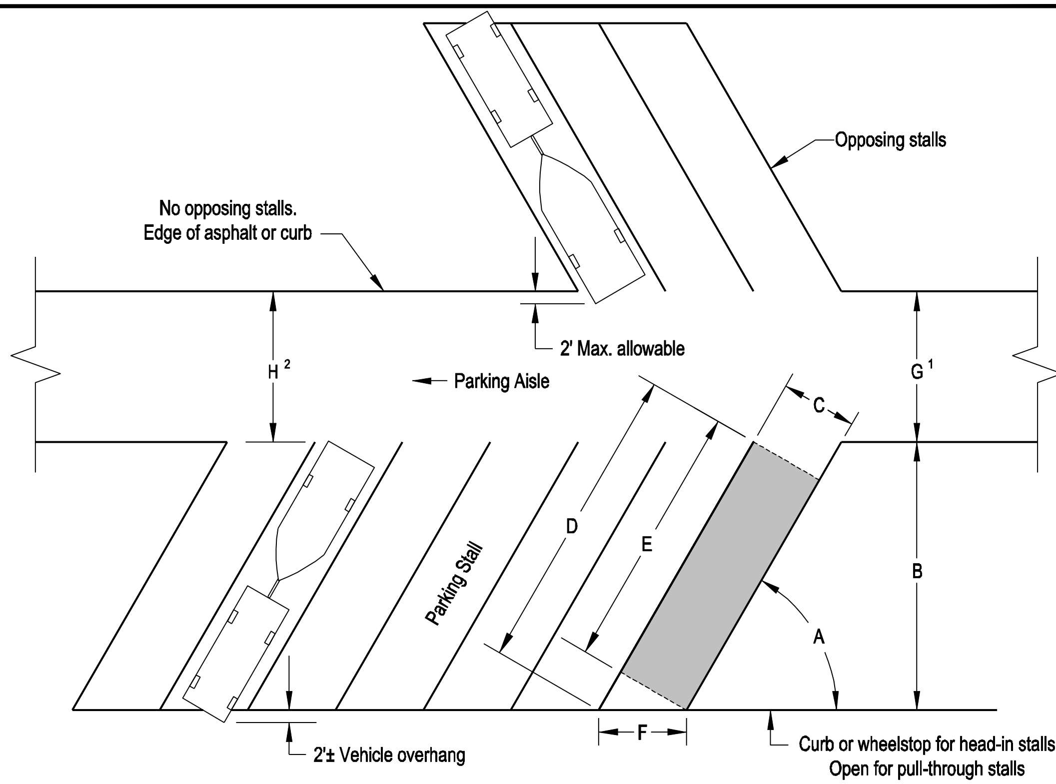
B. Application

1. Boat trailer and single vehicle parking stall dimensions for a variety of combinations are shown in *Table 9-4*. The tables are used by first selecting the desired stall angle (A), then selecting the stall depth (B), and finally selecting the stall width (C). Dimensions D-F are derived from these three.

2. Standard boat trailer parking spaces should be a minimum of 10 feet wide by 40 feet long for 90-degree parking. Angled parking spaces are allowed and actually preferred. Angles of 60 degrees and 45 degrees are the most common. The 40-foot stall length is a parallel offset distance from the front of the space to the back. By keeping a constant distance front to back the actual length of each angled space will increase as it deviates from 90 degrees. Overall stall length should not be confused with usable stall length on angled parking spaces. Usable stall length is defined as the distance from where the front vehicle tire touches the curb or wheelstop to a point where the back of the trailer meets the parking aisle.

3. Oversized boat trailer parking spaces (See discussion in 9.05 A.7) may increase the standard width by up to 2 feet and the standard length by up to 10 feet. Any combination of width and length is acceptable up to a maximum of 12 feet wide by 50 feet long.

Photo 9-11 Typical one-way grid system parking area with angled stalls



Notes:

1 Distance assumes vehicle is 4 feet clear of opposing stalls prior to turn

2 Distance assumes vehicle is 2 feet clear of curb or edge of asphalt prior to turn

3 Increase to 30' for two-way traffic

Legend	
A - Stall Angle	E - Usable stall length
B - Stall depth	F - Curb length
C - Stall width	G - Aisle width with opposing stalls [1]
D - Stall length	H - Aisle width without opposing stalls [2]

BOAT TRAILER PARKING

45° Stall Angle (A)

B	40	40	40	45	45	45	50	50	50
C	10	11	12	10	11	12	10	11	12
D	56.6	56.6	56.6	63.6	63.6	63.6	70.7	70.7	70.7
E	46.6	45.6	44.6	53.6	52.6	51.6	60.7	59.7	58.7
F	14.1	15.6	17.0	14.1	15.6	17.0	14.1	15.6	17.0
G	30	30	25 [3]	30	30	25 [3]	30	30	25 [3]
H	25 [3]	25 [3]	25 [3]	25 [3]	25 [3]	25 [3]	25 [3]	25 [3]	25 [3]

60° Stall Angle (A)

B	40	40	40	45	45	45	50	50	50
C	10	11	12	10	11	12	10	11	12
D	46.2	46.2	46.2	52.0	52.0	52.0	57.7	57.7	57.7
E	40.4	39.8	39.3	46.2	45.6	45.0	52.0	51.4	50.8
F	11.6	12.7	13.9	11.6	12.7	13.9	11.6	12.7	13.9
G	35	35	30	35	35	30	35	35	30
H	30	30	25 [3]	30	30	25 [3]	30	30	25 [3]

90° Stall Angle (A)

B	40	40	40	45	45	45	50	50	50
C	10	11	12	10	11	12	10	11	12
D	40	40	40	45	45	45	50	50	50
E	40	40	40	45	45	45	50	50	50
F	10	11	12	10	11	12	10	11	12
G	45	45	40	45	45	40	45	45	40
H	40	40	40	40	40	40	40	40	40

CAR PARKING

45° Stall Angle (A)

B	20	20
C	9	10
D	28.3	28.3
E	19.3	18.3
F	12.7	14.1
G	15	15
H	15	15

60° Stall Angle (A)

B	20	20
C	9	10
D	23.1	23.1
E	17.9	17.3
F	10.4	11.6
G	20	20
H	20	20

90° Stall Angle (A)

B	20	20
C	9	10
D	20	20
E	20	20
F	9	9
G	24	24
H	24	24

PARKING STALL & AISLE DIMENSIONS

Table 9-4 Parking stall and parking aisle diagram and dimensions

4. Single vehicle parking spaces should be 9 feet wide by 20 feet long.

5. Project designs should incorporate angled pull-through boat trailer parking spaces to the maximum extent possible. Pull-through spaces relieve boaters from having to back their trailers out of the parking space. However, pull-through spaces are the least efficient use of space. Head-in parking will generally maximize the number of parking spaces.

6. Where possible the parking area should be located immediately adjacent to the launch ramp. Avoid long distance separation of the parking area from the launch ramp or separation by an intervening public roadway.

7. There should be sufficient parking spaces to meet the expected demand on a average day during the boating season. It is not feasible to design for peak or special event use.

8. To the extent possible, vehicle-only areas should be separated from designated boat trailer parking areas. However, vehicle spaces can often be incorporated into the unusable areas at the end of parking aisles. The number of vehicle spaces should equal 30% of the boat trailer spaces provided.

9. Large visual expanses of asphalt paving are to be avoided through the use of appropriately placed planter islands and planter strips every 15 to 20 spaces. These planter areas should also be used as a primary means of directing and controlling traffic flow. The interior of islands should not be paved so as to allow for landscaping (avoid root invasive trees). If feasible, islands can also be used as swales for stormwater management.

10. Finish grades for parking areas should have a minimum of 1% slope in at least one direction. Slopes of 0% are acceptable provided the perpendicular slope (cross slope) is at least 1%. Most parking areas can be graded with slopes no greater than 2% in any direction. This will provide for adequate drainage and meet the 2010 ADA Standards requirements for accessible routes.

11. Terracing of parking areas is an effective means to achieve the 2% guideline where natural topography is more severe. Every effort should be made to hold the maximum grade to 5% when transitioning from one terraced area to another. Again, this will meet the 2010 ADA Standards requirements for accessible routes.

12. The maximum change is grade should not exceed 10% (e.g. -5% to +5%). Grade changes over 7% should have a minimum 20 foot vertical curve. Cross slope grades should be as flat as possible with a maximum 5% allowed.

13. Parking aisle widths for various configurations are given in *Table 9-4* (dimensions G and H). Aisle widths were established based on the turning path of the design vehicle/boat trailer combination that allows it to safely enter the stall without encroachment on adjacent stalls. It further assumes that the side of the vehicle opposite the direction of turn will be 4 feet clear of adjacent stalls or 2 feet clear of adjacent curb or edge of asphalt.

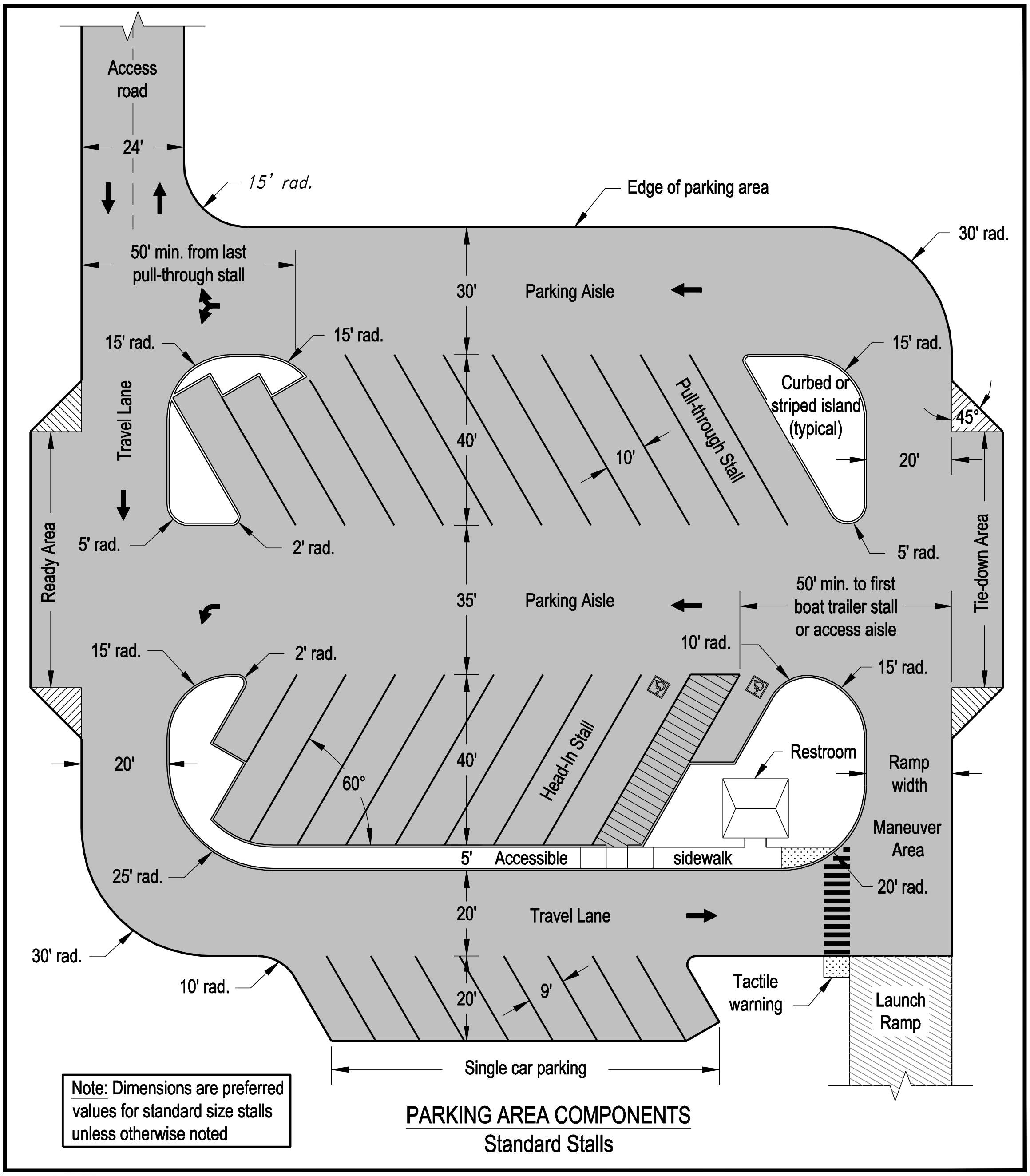


Figure 9-4 Parking area components with standard size stalls

14. Perimeter travel lanes within a parking area should follow the guidelines for access roads. For those instances where a turn occurs from a parking aisle onto a travel lane or vice versa a 15-foot inside curve radius is adequate. *Figure 9-4* shows a one-way grid system parking layout with standard components and preferred dimensions.

Photo 9-12 Aerial photo of a parking facility showing one-way traffic grid pattern and separation of boat trailer and single vehicle parking areas. Additional single vehicles stalls are incorporated at ends of landscape islands. This facility uses pull-through stalls to the maximum extent possible and head-in stalls along the perimeter.

15. Accessible Parking

a. Accessible parking spaces and access aisles should meet the design requirements as specified in the 2010 ADA Standards, OSSC and any local codes. As a guideline, boat trailer spaces should be 10 feet wide and access aisles 8 feet wide. Single vehicle spaces should be 9 feet wide and access aisles 8 feet wide. At least one (1) boat trailer access aisle and one (1) single vehicle access aisle should be provided for van accessibility. The 8-foot wide access aisle meets the requirement for van accessibility provided that the aisle is on the passenger side. For additional spaces, narrower access aisles can be provided, however, OSMB practice is to make all access aisles 8 feet in width. Doing so provides the potential for all spaces to be considered van accessible.

b. The 2010 ADA Standards does not make a distinction between different types of vehicles when calculating the minimum number of required accessible parking spaces. Since boating facility parking areas contain both boat trailer and single vehicle spaces there are two methods available to determine the total number of accessible designated spaces required. Method one totals all parking spaces and uses this number to determine the minimum required accessible spaces. The required accessible spaces would be apportioned according to the percentage of each type of parking spaces provide. However, there should be a minimum of one of each type provided. For example; 110 boat trailer spaces and 30 single vehicle spaces (140 total) requires 5 accessible parking spaces (per 2010 ADA Standards and OSSC). Since 110 boat trailer spaces represents 79% of all spaces then 79% of the 5 accessible spaces should be of boat trailer size (4 boat trailer and 1 single vehicle). Method two treats each type of parking space independently. Using the same example, 110 boat trailer spaces will require 5 accessible parking spaces and 30 single vehicle spaces will require 2 accessible parking spaces. Method two requires two additional accessible parking spaces over method one. Either method is acceptable but method two yields a more conservative result. The number of accessible spaces is the minimum. Additional spaces may be required based on local need or desire.

c. Accessible parking spaces should be grouped together and share access aisles wherever possible (i.e. two spaces are allowed to share a common access aisle).

d. Accessible boat trailer spaces should be located as close as possible to the top of ramp. Accessible single vehicle spaces should be located as close as possible to an accessible restroom. If no restroom exists, spaces should be located as close as possible to the top of launch ramp.

e. An accessible route should be provided from the accessible parking spaces to the top of the ramp and to the restroom.

f. Consider parking area grades when designing an accessible route and in particular any accessible parking spaces. Parking spaces and access aisles are required to have no more 2% slope in any direction. The term “in any direction” is clarified as slope in the direction of travel (longitudinal slope) and the slope perpendicular to the direction of travel (cross slope). It should not be assumed that just because a parking area is graded at 2% in both directions that accessible routes, including parking stall aisles, will be in compliance. Parking stall aisles are often oriented at an angle to the surface grades and may result in slopes that are out of compliance. For example, 2% parking area slopes in both directions with parking stall angles at 60 degrees will result in an access aisle slope of 2.7% (non-compliant). Refer to *Tables 9-5 and 9-6* for assistance in determining slope combinations for accessibility compliance.

45° Parking Stall Angle

Parking Area Slope A (%)	Parking Area Slope B (%) -2.5		-2		-1.5		-1		-0.5		0		0.5		1		1.5		2		2.5		
	Long	Cross	Long	Cross	Long	Cross	Long	Cross	Long	Cross	Long	Cross	Long	Cross	Long	Cross	Long	Cross	Long	Cross	Long	Cross	
-2.5	3.8	0.0	3.5	0.4	3.1	0.7	2.8	1.1	2.4	1.4	2.1	1.8	1.7	2.1	1.4	2.5	1.0	2.8	0.6	3.2	0.3	3.5	-2.5
-2	3.4	0.4	3.1	0.0	2.7	0.4	2.4	0.7	2.0	1.1	1.6	1.4	1.3	1.8	0.9	2.1	0.6	2.5	0.2	2.8	0.1	3.2	-2
-1.5	3.0	0.7	2.6	0.4	2.3	0.0	1.9	0.4	1.6	0.7	1.2	1.1	0.9	1.4	0.5	1.8	0.2	2.1	0.2	2.5	0.5	2.8	-1.5
-1	2.6	1.1	2.2	0.7	1.9	0.4	1.5	0.0	1.2	0.4	0.8	0.7	0.5	1.1	0.1	1.4	0.2	1.8	0.6	2.1	0.9	2.5	-1
-0.5	2.2	1.4	1.8	1.1	1.5	0.7	1.1	0.4	0.8	0.0	0.4	0.4	0.1	0.7	0.3	1.1	0.6	1.4	1.0	1.8	1.4	2.1	-0.5
0	2.1	1.8	1.6	1.4	1.2	1.1	0.8	0.7	0.4	0.4	0.0	0.0	0.4	0.4	0.8	0.7	1.2	1.1	1.6	1.4	2.1	1.8	0
0.5	1.4	2.1	1.0	1.8	0.6	1.4	0.3	1.1	0.1	0.7	0.4	0.4	0.8	0.0	1.1	0.4	1.5	0.7	1.8	1.1	2.2	1.4	0.5
1	0.9	2.5	0.6	2.1	0.2	1.8	0.1	1.4	0.5	1.1	0.8	0.7	1.2	0.4	1.5	0.0	1.9	0.4	2.2	0.7	2.6	1.1	1
1.5	0.5	2.8	0.2	2.5	0.2	2.1	0.5	1.8	0.9	1.4	1.2	1.1	1.6	0.7	1.9	0.4	2.3	0.0	2.6	0.4	3.0	0.7	1.5
2	0.1	3.2	0.2	2.8	0.6	2.5	0.9	2.1	1.3	1.8	1.6	1.4	2.0	1.1	2.4	0.7	2.7	0.4	3.1	0.0	3.4	0.4	2
2.5	0.3	3.5	0.6	3.2	1.0	2.8	1.4	2.5	1.7	2.1	2.1	1.8	2.4	1.4	2.8	1.1	3.1	0.7	3.5	0.4	3.8	0.0	2.5

Shaded boxes indicate parking area slope combinations that result in non-compliance

Table 9-5 Slopes for 45 degree angled accessible parking stalls based on parking area slopes

60° Parking Stall Angle

Parking Area Slope A (%)	Parking Area Slope B (%) -2.5		-2		-1.5		-1		-0.5		0		0.5		1		1.5		2		2.5		
	Long	Cross	Long	Cross	Long	Cross	Long	Cross	Long	Cross	Long	Cross	Long	Cross	Long	Cross	Long	Cross	Long	Cross	Long	Cross	
-2.5	3.4	0.9	3.2	0.5	2.9	0.0	2.7	0.4	2.4	0.8	2.2	1.3	1.9	1.7	1.7	2.1	1.4	2.5	1.2	3.0	0.9	3.4	-2.5
-2	3.0	1.3	2.7	0.7	2.5	0.3	2.2	0.1	2.0	0.6	1.7	1.0	1.5	1.4	1.2	1.8	1.0	2.3	0.7	2.7	0.5	3.2	-2
-1.5	2.5	1.4	2.3	1.0	2.0	0.5	1.8	0.1	1.5	0.3	1.3	0.8	1.0	1.2	0.8	1.6	0.5	2.0	0.3	2.5	0.0	2.9	-1.5
-1	2.1	1.7	1.9	1.2	1.6	0.9	1.4	0.4	1.1	0.1	0.9	0.5	0.6	0.9	0.4	1.4	0.1	1.8	0.1	2.2	0.4	2.7	-1
-0.5	1.7	1.9	1.4	1.5	1.2	1.0	0.9	0.6	0.7	0.2	0.4	0.3	0.2	0.7	0.1	1.1	0.3	1.5	0.6	2.0	0.8	2.4	-0.5
0	1.3	2.2	1.0	1.7	0.8	1.3	0.5	0.9	0.3	0.4	0.0	0.0	0.2	0.4	0.5	0.8	0.7	1.3	1.0	1.7	1.3	2.2	0
0.5	0.8	2.4	0.6	2.0	0.3	1.5	0.1	1.1	0.2	0.7	0.4	0.2	0.7	0.2	0.9	0.6	1.2	1.0	1.4	1.5	1.7	1.9	0.5
1	0.4	2.7	0.1	2.2	0.1	1.8	0.4	1.4	0.6	0.9	0.9	0.5	1.1	0.1	1.4	0.4	1.6	0.8	1.9	1.2	2.1	1.7	1
1.5	0.0	2.9	0.3	2.5	0.5	2.0	0.8	1.6	1.0	1.2	1.3	0.7	1.5	0.3	1.8	0.1	2.0	0.5	2.3	1.0	2.5	1.4	1.5
2	0.5	3.2	0.7	2.7	1.0	2.3	1.2	1.8	1.5	1.4	1.7	1.0	2.0	0.6	2.2	0.1	2.5	0.3	2.7	0.7	3.0	1.3	2
2.5	0.9	3.4	1.2	3.0	1.4	2.5	1.7	2.1	1.9	1.7	2.2	1.3	2.4	0.8	2.7	0.4	2.9	0.0	3.2	0.5	3.4	0.9	2.5

Shaded boxes indicate parking area slope combinations that result in non-compliance

Table 9-6 Slopes for 60 degree angled accessible parking stalls based on parking area slopes.

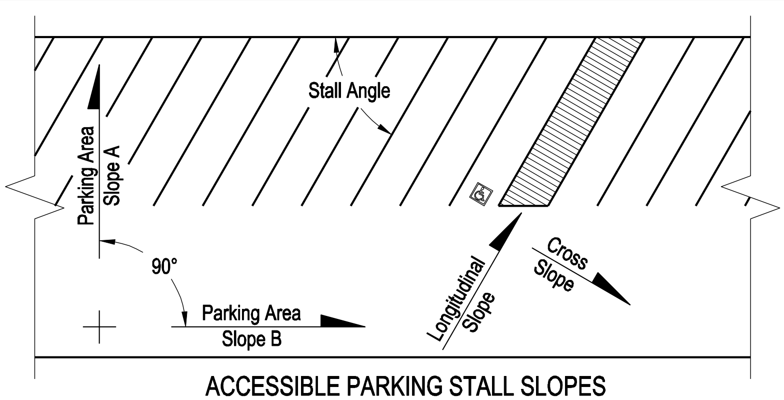


Figure 9-5 Accessible parking stall slopes

16. All head-in parking spaces without curbs require wheel stops placed a minimum of 2 feet from the end of the space. Wheel stops should be a minimum of 6 inches square by 6 feet long and securely anchored to the parking surface.

17. A 90-degree stall layout with a dead-end parking aisle is acceptable for single vehicles. Boat trailers, however, require over 2500 ft^2 of open space to negotiate the 180-degree turn-around necessary for this type of layout. For this reason, the dead-end parking aisle layout for boat trailer parking is not recommended but, if used, should have a designated back-out area for parked vehicles to maneuver. The width of the back-out area should be 40 feet for boat trailers and 24 feet for single vehicles. The depth should be 25 feet for boat trailers and 10 feet for single vehicles. The back-out area should be paint striped and posted as no parking *(see Figure 9-6 and Photo 9-13)*.

Photo 9-13 Designated back-out area for dead-end boat trailer parking

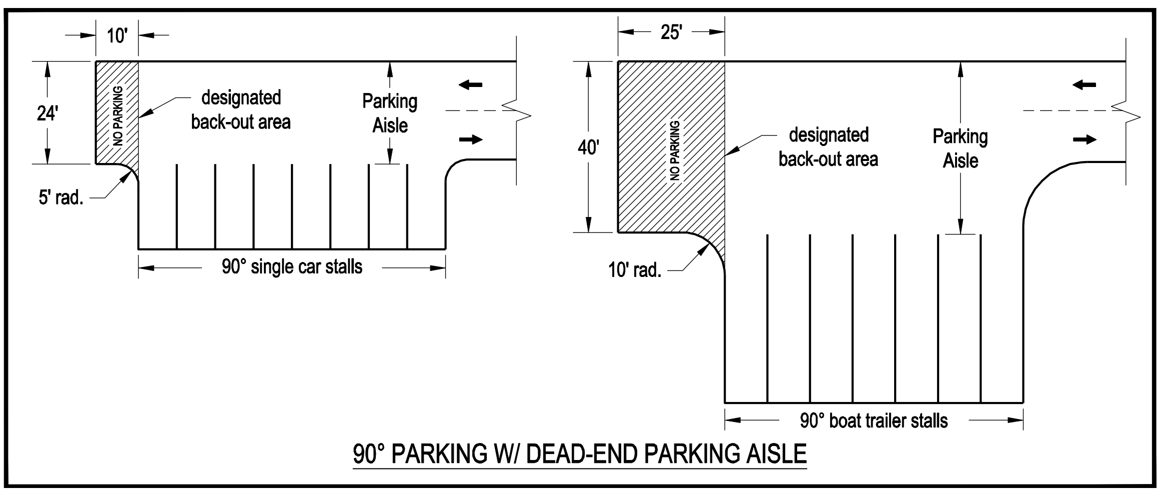


Figure 9-6 Dimensions for dead-end parking aisles

17. All sidewalks should be a minimum of 5 feet wide and designed so that parked vehicles will not encroach onto the sidewalk. This can be achieved with the use of planter strips or wheelstops. Curb cuts with ramps should be provided to access all sidewalks from the parking area. All accessibility and building code requirements must be adhered to, including the installation of tactile warning devices and delineated crosswalks.

18. Stormwater management of runoff both during and after construction must be taken into account for design and permitting reasons. Regulatory agencies are interested in water quality and have specific requirements to be implemented in boating facility construction. These requirements are not unique to boating facility projects therefore it is not the intent of these guidelines to discuss the details of stormwater facilities construction or erosion control BMP's. There are several manuals available for the design, construction and maintenance of a variety of stormwater structures and facilities. The designer or engineer should develop and implement a stormwater management plan (SWMP) for the facility design. The SWMP is typically submitted along with the COE/DSL permit application.

C. Design

1. Parking Space Angles

Preferred:	60 degrees	Good compromise
Minimum:	90 degrees	Most efficient but least desired*
Maximum:	45 degrees	Least efficient but most desired*

* Efficiency is in reference to use of available space

2. Boat Trailer Parking Space Type

Preferred:	Pull-through - Least efficient but most desired*
Acceptable:	Head-in - Most efficient less desirable*
Unacceptable:	Parallel

* Efficiency is in reference to use of available space

3. Boat Trailer Parking Space Dimensions

Preferred:	11 feet wide by 45 feet long*
Standard:	10 feet wide by 40 feet long
Maximum:	12 feet wide by 50 feet long

* The Preferred dimensions should provide an excellent level of serviceability at facilities with a variety of vehicle and boat trailer sizes. However, many facilities will function efficiently using the standard dimensions of 10 feet wide by 40 feet long.

4. Single Vehicle Parking Space Dimensions

Preferred:	9 feet wide by 20 feet long
Minimum:	8.5 feet wide by 18 feet long
Maximum:	10 feet wide by 22 feet long

5. Number of Standard Boat Trailer Spaces per Launch Lane*

	One Lane	Two Lanes	Three Lanes	Four Lanes	Six Lanes
Preferred:	30	60	100	150	200
Minimum:	15	45	75	125	175
Maximum:	45	75	125	175	250

* Up to 25% of boat trailer spaces may be oversized if needed

6. Number of Single Vehicle Parking Spaces Required

Preferred:	30% of boat trailer spaces
Minimum:	10% of boat trailer spaces or a minimum of 3
Maximum:	50% of boat trailer spaces

7. Parking Area Slopes and Cross Slopes

Preferred Slope:	2%	Preferred Cross Slope:	1%-2%
Minimum Slope:	0%*	Minimum Cross Slope:	0%*
Maximum Slope:	5%	Maximum Cross Slope:	5%

*Under no circumstance should both slope and cross slope be 0%

8. Parking Area Changes in Grade

Preferred:	1%-5%
Minimum:	N/A
Maximum:	10% (provide vertical curve if greater than 7%)

9. Aisle Widths

Preferred:	See *Table 9-4 - Parking Stall & Aisle Dimensions*
Minimum:	5 feet less than values in table but never less than 25 feet
Maximum:	5 feet greater than values in table

10. 90-Degree Corner Inside Radius

Preferred: 15 feet for parking aisle onto travel lane turn or vice versa. Per access road guidelines for travel lane onto travel lane
Minimum: 15 feet or per access road guidelines.
Maximum: N/A

11. Accessible Parking Spaces

Total Parking Spaces	Minimum number of Accessible spaces
25 or less	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8

NOTES

RESTROOMS

10.01 RESTROOM FACILITIES

A. General

1. Restroom/toilet facilities should be provided at all boating facilities. Depending on the anticipated facility use, duration of use, location, and anticipated vandalism there are different types of sanitary facilities that will serve the need.

2. Vandal resistant construction materials and fixtures should be used for restroom/toilet construction.

B. Application

1. Typically sanitary facilities are located as close to the launch ramp as practicable. The design standard is to site a restroom/toilet within a 200-foot radius of the top of launch ramp *(see Photo 10-1).*

Photo 10-1 Restroom located in close proximity to the launch ramp and parking area. Photo is taken from top of launch ramp.

2. Sanitary facility construction should meet all local, state, and federal public health and building code requirements.

3. Restroom/toilet structures should be designed to meet all accessibility requirements for persons with disabilities in accordance with the 2010 ADA Standards and OSSC.

4. Trash receptacles should be provided near the ramp, restrooms, and any other appropriate areas. This helps keep the facility clean and, in the case of vault or composting units, helps to keep trash out of the tanks.

5. Building materials such as concrete masonry block, brick, precast concrete, stainless steel fixtures, and interior and exterior finishes

tend to be vandal resistant and assist in facility clean up and longevity.

C. Design

1. Proximity to top of launch ramp

Preferred:	within 200-foot radius
Minimum:	N/A
Maximum:	400-foot radius

10.02 SELECTION, SIZING, AND SITING

A. General

1. Permanent sanitary facilities should be provided at all boating facilities unless the facility is so small or seasonally used that it is not feasible. Temporary toilets may be used at small, low use facilities.

2. Sizing the sanitary facility to match the anticipated need is based on the number of parking spaces and any other adjacent anticipated use (see 10.02 C).

3. A flush restroom is preferred if a municipal sanitary sewer or on-site drainfield system is within a reasonable distance.

4. Whenever possible the restroom structures should be constructed above the 100-year flood elevation. This is often not practical due to the topography or distance from the launch ramp. If the distance to the restroom is too great then users will tend not to use it. The minimum floor elevation of restrooms should be 1 foot above OHW.

5. There are many flush, vault, and composting toilet designs that utilize materials that allow them to be successfully placed within the floodplain. During high water any utilities are disconnected and the structure is closed to public use and allowed to be submerged. Other than cleanup, damage is minimal.

6. Consult floodplain, Federal Emergency Management Agency (FEMA) flood insurance rate maps, state, county or local sanitation authorities and local planning department prior to locating any sanitary facilities.

B. Application

1. There are four basic types of sanitary facilities that are typically offered at recreation boating facilities: flush restroom, vault toilet, composting toilet, and temporary toilet. Each design is intended for different sites, use, maintenance, and durability.

2. When selecting and sizing a restroom/toilet consider the anticipated use from the facility and adjacent uses such as a day use park or RV park. In some cases the boating facility/park is used as a rest area if located along a busy highway.

3. Typically one toilet fixture is required for every 25 parking spaces or fraction thereof. Small sanitary facilities with one and two stalls are typically unisex.

4. Often before the planning department will allow construction in a flood zone, two reports will need to be made. A hydrostatic and hydrodynamic evaluation of the flood waters effect on the structure and an evaluation of the structure's impact on the base flood elevation. Both reports are required to be done by a registered engineer.

5. If a restroom is to be constructed within the flood zone, every attempt should be made to keep the finish floor of the building as high as possible (preferably above the 100-year flood elevation). At the very minimum the structure should be sited 1 foot above OHW *(see Photo 10-2)*.

6. By keeping the electrical components of the restroom (e.g. hand dryers, service panel, and control panels) above OHW, post flood start up time and cost will be reduced. If the design requires a surge tank, it should be anchored to the floor. This will keep the buoyancy of the tank from overcoming the strength of the plumbing fittings as the flood waters rise.

7. Often a restroom can be conveniently sited by placing it on structural fill material. However, fills in excess of 5 feet should be avoided. When restrooms are constructed on higher ground to reduce the impact of flood waters, disabled access may become a challenge. Any ramped walkways from the parking area to the restroom should to be constructed with slopes and run lengths that comply with the 2010 ADA Standards and OSSC requirements *(see Photo 10-3)*.

Photo 10-2 This photo was taken during a 100-yr flood event. The restroom was built well above the flood elevation.

Photo 10-3 Restroom built on fill to be above the 100-yr flood elevation. The sidewalk provides ADA accessibility while the stairs provide a more direct route.

C. Design

1. Sizing (number of toilet stalls to all parking spaces)

25 or less parking spaces	1 toilet stall
26-50 parking spaces	2 toilet stalls
51 -100 parking spaces	4 toilet stalls
>100 parking spaces	6+ toilet stalls (possibly two structures)

2. Sizing (Transient Facilities)

Small facility (< 20 boats)	1 toilet stall
Large facility (> 20 boats)	2 toilet stalls
Urban Park Setting	Consider 4 toilet stalls

3. Floor Elevations

Preferred:	1 foot above 100-year flood elevation
Minimum:	1 foot above OHW
Maximum:	N/A

10.03 FLUSH RESTROOM

A. General

1. Flush restrooms are preferred by users at larger, high-use boating facilities and where on-site or municipal sewage disposal, water, and electricity are available.

2. Flush restrooms are typically easier to maintain than other types.

B. Application

1. The restrooms have more components (mirror, lavatory, urinal, water closet, soap and paper dispensers, hand dryers, etc.) that may be vandalized. However, if these components are fabricated from stainless steel they are relatively vandal resistant *(see Photo 10-4)*.

Photo 10-4 Stainless steel toilet room fixtures

2. Generally the restrooms are located below gravity service to the local sewer system and may require a wet well with lift station to pump the sewage up to the municipal system. Gravity systems are preferred for reduced maintenance and cost *(see Photo 10-5)*.

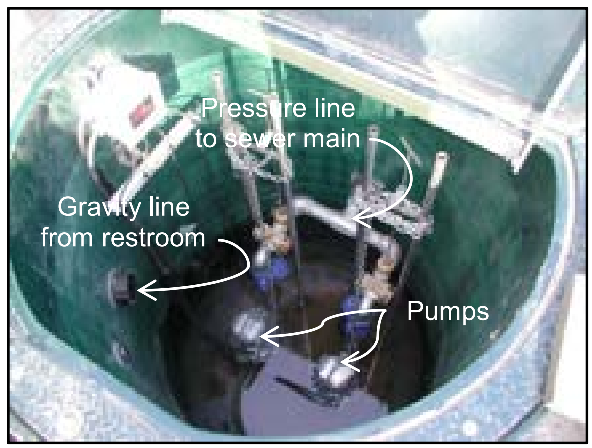


Photo 10-5 Sewage wet well with two pumps

3. Heaters are an option where the restroom will be used during freezing weather. The heaters are designed to keep the temperature in the restroom around 45 degrees, just enough to keep the pipes from freezing. Otherwise the facilities are winterized and closed for the season. Reference the State Energy Code for specifics.

4. Restroom buildings are either site-built from concrete block or prefabricated concrete structures *(see Photos 10-6 and 10-7)*. In either case they have proven to withstand the effects of flooding with minimal damage. Site-built buildings are far more expensive and should only be considered if there is adequate justification.

Photo 10-6 Site-built flush restroom

Photo 10-7 Precast concrete flush restroom

C. Design

1. Flush restrooms are available in several sizes: single room unisex, two-room unisex, two-room four stall, and two-room six stall.

2. Flush restrooms need the full range of utilities, municipal sewer system or on-site disposal, municipal or well water, and electricity.

3. An accessible drinking fountain should be provided at the restroom since potable water is available.

10.04 VAULT TOILET

A. General

1. This type of toilet collects the waste in a concrete vault located beneath the toilet structure. Sewage from the vault (holding tank) is pumped out and disposed of at a sewage treatment facility. There is no discharge from the vault into the environment. Typically, 1000-gallon vaults are located under each stall *(see Photos 10-8 and 10-9)*.

Photo 10-8 Installation of precast vault toilet

Photo 10-9 Precast concrete vault toilet

2. Vault toilets are concrete structures, very durable, and an excellent choice to locate at rural sites. There are very few moving parts and no utilities that can be vandalized.

3. No utilities are required (i.e. sewer, drainfield, power, water).

B. Application

1. Vault toilets can handle a great amount of volume as long as routine servicing is maintained.

2. Lack of proper venting and/or maintenance can produce strong odors. This situation may make people reluctant to use them.

3. Vault toilets are generally used at small boating facilities in rural locations where the use is moderate to low. These units are considered a basic toilet service and, if well vented and maintained, serve the purpose quite well.

4. There is an exterior area lighting option for these units if electrical power is available at the site.

C. Design

1. Precast units are installed quickly. They can be usable within hours after delivery to the site.

2. Site the structure so that vent stack has an unobstructed southern exposure to provide the best vent draw and reduce odors.

3. The units need to be accessible by a pump truck to service the vault.

10.05 COMPOSTING TOILET

A. General

1. Composting toilets are typically used at very remote facilities (e.g. islands) where there is sub-standard or non-existent road access to allow for the installation and maintenance of a vault toilet.

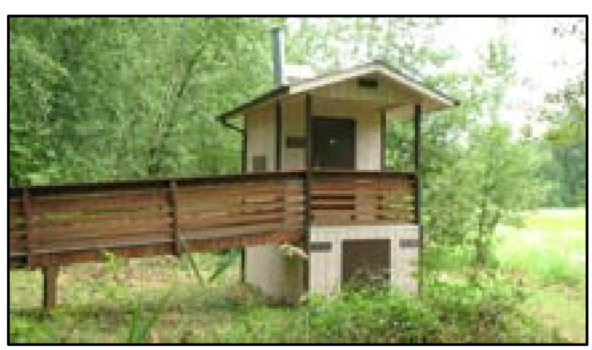


Photo 10-10 Composting toilet

Generally these sites are primitive and without utility improvements or the need for them *(see Photo 10-10)*.

2. Composting toilets have a limited capacity of use. They should never be used when a flush or vault toilet is a viable option. Consistent maintenance is essential to the efficiency of the unit.

3. To date, all composting units funded by the Marine Board are on islands in marine parks.

B. Application

1. Composting toilets collect the waste in a tank that is filled with wood shavings or bulking material. The waste that is collected below the toilet riser has to be raked out by a maintenance person on a regular basis, depending on the use. A short drain line is connected to a very small on-site disposal field to drain any minor amount of residual liquids from the tank.

2. There is a battery operated fan (recharged by a solar panel) within the vent pipe to draw air through the tank to promote composting action. This also keeps the odor out of the toilet compartment.

3. Typically the buildings are constructed of wood. This seems to be the most practical construction material given the remoteness of most sites. Generally, it is cost prohibitive to construct these structures with concrete or concrete block.

4. Composting toilets should be placed at inland locations where use occurs during warm to hot weather when the composting action is most like to occur. Coastal and winter use applications are not recommended.

C. Design

1. Composting toilets do not require any outside sources of energy other than the sun. Energy is collected by the solar panels to charge the lead/acid batteries that operate the ventilation fan.

10.06 TEMPORARY TOILET

A. General

1. Temporary portable toilets, enclosed with thin wall plastic sheeting, are typically used at construction sites and outdoor public events.

The units collect the waste in a tank under the toilet seat. Vents and chemicals help to keep odors to a minimum.

B. Application

1. Temporary toilets are typically used at boating facilities where facility use is low or site conditions are not conducive to provide permanent sanitary facilities. These units are brought in (rented) for limited periods of use and are not offered the rest of the year *(see Photo 10-11)*.

Photo 10-11 Portable toilets

2. Temporary toilets have also been successfully used at larger boating facilities to augment the use of a permanent restroom during the peak use periods.

3. These units are cheap, generally rented or leased and maintained by the toilet owner. More units can be quickly added for anticipated fluctuations in use.

4. These units are stand-alone and do not require any utilities. Unfortunately, because of their light weight construction they tend to be susceptible to vandalism.

NOTES

Section 11

UTILITIES

11.01 CONSTRUCTION

A. General

1. Drinking fountains should be provided if there is potable water readily available.

2. General area lighting in parking areas and at the top of the launch ramp is recommended if use and security conditions warrant.

3. Power lines should be located underground whenever possible. Overhead lines are a safety hazard for boats with tall masts in the vicinity of the parking area, maneuver area and launch ramp.

4. Pay phones were once a desired amenity and could be easily installed at the restroom building. However, with the wide-spread availability and use of cellular phones the need for public pay phones is no longer warranted.

5. Security cameras may be justified at facilities with a documented history of vandalism or other undesirable activities.

B. Application

1. Drinking fountains should be considered at flush restroom sites. Access to drinking fountains must meet design requirements as specified in the 2010 ADA Standards, OSSC, and any other local codes.

2. A white light fixture approximately 20 to 25 feet high in the immediate vicinity of the top of ramp should be considered for projects where early morning launching and/or night retrieving occurs. A white light on a standard pole on shore will not violate navigation codes, and serves as a guide to locate the ramp for incoming boats.

3. Overhead power lines must not be located over maneuver areas, parking areas, launching areas, and/or any other areas where fully rigged trailerable boats (i.e. sailboats) have access. This provision is included as a safety measure in consideration of the growing number of trailerable sailboats that are equipped with metal masts and rigging hardware that will conduct electrical current.

4. Security cameras should be placed near the restroom, top of launch ramp, and other strategic locations to maximize visibility of the parking area.

C. Design

1. Drinking Fountain

   Preferred: Where potable water is readily available

2. Area Lighting

   Preferred: Parking areas and top of launch ramp

3. Power Lines

   Preferred: No overhead power lines in vehicle travel areas. Locate power lines underground.

4. Security Cameras

   Preferred: At restroom, top of launch ramp, and parking areas.

Photo 11-1 This restroom incorporates two drinking fountains (one ADA compliant) and exterior lighting. The pole light in the background is located at the top of the launch ramp.

APPENDIX A

Accessibility Guidelines for Recreational Boating Facilities

The following is an excerpt from the 2010 ADA Standards for Accessible Design; specifically Section 1003: Recreational Boating Facilities. This document references other sections from the ADA Standards but those sections are not reprinted here. A complete viewable or printable copy of the ADA Standards is available on-line at www.ada.gov. This excerpt is reprinted with permission from the Department of Justice.

1003 Recreational Boating Facilities

1003.1 General. Recreational boating *facilities* shall comply with 1003.

1003.2 Accessible Routes. *Accessible* routes serving recreational boating *facilities*, including *gangways* and floating piers, shall comply with Chapter 4 except as modified by the exceptions in 1003.2.

1003.2.1 Boat Slips. *Accessible* routes serving *boat slips* shall be permitted to use the exceptions in 1003.2.1.

EXCEPTIONS: 1. Where an existing *gangway* or series of *gangways* is replaced or *altered*, an increase in the length of the *gangway* shall not be required to comply with 1003.2 unless required by 202.4.

2. *Gangways* shall not be required to comply with the maximum rise specified in 405.6.

3. Where the total length of a *gangway* or series of *gangways* serving as part of a required *accessible* route is 80 feet (24 m) minimum, *gangways* shall not be required to comply with 405.2.

4. Where *facilities* contain fewer than 25 *boat slips* and the total length of the *gangway* or series of *gangways* serving as part of a required *accessible* route is 30 feet (9145 mm) minimum, *gangways* shall not be required to comply with 405.2.

5. Where *gangways* connect to *transition plates*, landings specified by 405.7 shall not be required.

6. Where *gangways* and *transition plates* connect and are required to have handrails, handrail extensions shall not be required. Where handrail extensions are provided on *gangways* or *transition plates*, the handrail extensions shall not be required to be parallel with the ground or floor surface.

7. The *cross slope* specified in 403.3 and 405.3 for *gangways*, *transition plates*, and floating piers that are part of *accessible* routes shall be measured in the static position.

8. Changes in level complying with 303.3 and 303.4 shall be permitted on the surfaces of *gangways* and *boat launch ramps*.

> **Advisory 1003.2.1 Boat Slips Exception 3.** The following example shows how exception 3 would be applied: A gangway is provided to a floating pier which is required to be on an accessible route. The vertical distance is 10 feet (3050 mm) between the elevation where the gangway departs the landside connection and the elevation of the pier surface at the lowest water level. Exception 3 permits the gangway to be 80 feet (24 m) long. Another design solution would be to have two 40 foot (12 m) plus continuous gangways joined together at a float, where the float (as the water level falls) will stop dropping at an elevation five feet below the landside connection. The length of transition plates would not be included in determining if the gangway(s) meet the requirements of the exception.

1003.2.2 Boarding Piers at Boat Launch Ramps. *Accessible* routes serving *boarding piers* at *boat launch ramps* shall be permitted to use the exceptions in 1003.2.2.

EXCEPTIONS: 1. *Accessible* routes serving floating *boarding piers* shall be permitted to use Exceptions 1, 2, 5, 6, 7 and 8 in 1003.2.1.

2. Where the total length of the *gangway* or series of *gangways* serving as part of a required *accessible* route is 30 feet (9145 mm) minimum, *gangways* shall not be required to comply with 405.2.

3. Where the *accessible* route serving a floating *boarding pier* or skid pier is located within a *boat launch ramp*, the portion of the *accessible* route located within the *boat launch ramp* shall not be required to comply with 405.

1003.3 Clearances. Clearances at *boat slips* and on *boarding piers* at *boat launch ramps* shall comply with 1003.3.

> **Advisory 1003.3 Clearances.** Although the minimum width of the clear pier space is 60 inches (1525 mm), it is recommended that piers be wider than 60 inches (1525 mm) to improve the safety for persons with disabilities, particularly on floating piers.

1003.3.1 Boat Slip Clearance. *Boat slips* shall provide clear pier *space* 60 inches (1525 mm) wide minimum and at least as long as the *boat slips*. Each 10 feet (3050 mm) maximum of linear pier edge serving *boat slips* shall contain at least one continuous clear opening 60 inches (1525 mm) wide minimum.

EXCEPTIONS: 1. Clear pier *space* shall be permitted to be 36 inches (915 mm) wide minimum for a length of 24 inches (610 mm) maximum, provided that multiple 36 inch (915 mm) wide segments are separated by segments that are 60 inches (1525 mm) wide minimum and 60 inches (1525 mm) long minimum.

2. Edge protection shall be permitted at the continuous clear openings, provided that it is 4 inches (100 mm) high maximum and 2 inches (51 mm) wide maximum.

3. In existing piers, clear pier *space* shall be permitted to be located perpendicular to the *boat slip* and shall extend the width of the *boat slip*, where the *facility* has at least one *boat slip* complying with 1003.3, and further compliance with 1003.3 would result in a reduction in the number of *boat slips* available or result in a reduction of the widths of existing slips.

Advisory 1003.3.1 Boat Slip Clearance Exception 3. Where the conditions in exception 3 are satisfied, existing facilities are only required to have one accessible boat slip with a pier clearance which runs the length of the slip. All other accessible slips are allowed to have the required pier clearance at the head of the slip. Under this exception, at piers with perpendicular boat slips, the width of most "finger piers" will remain unchanged. However, where mooring systems for floating piers are replaced as part of pier alteration projects, an opportunity may exist for increasing accessibility. Piers may be reconfigured to allow an increase in the number of wider finger piers, and serve as accessible boat slips.

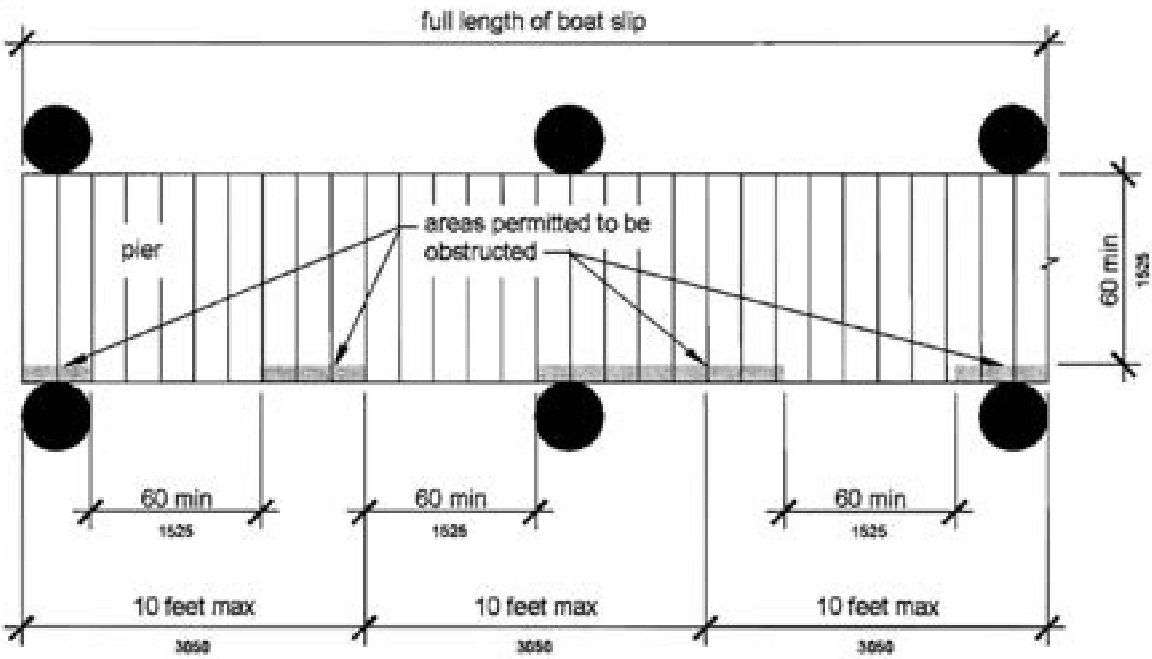


Figure 1003.3.1
Boat Slip Clearance

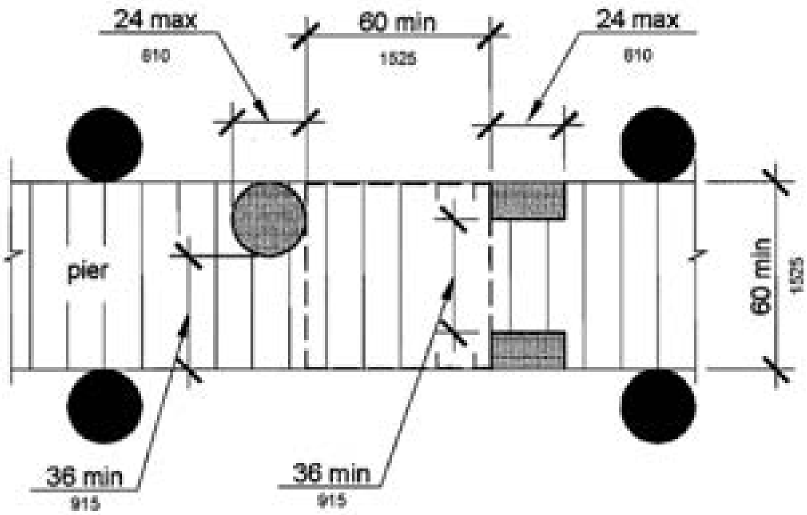


Figure 1003.3.1 (Exception 1)
Clear Pier Space Reduction at Boat Slips

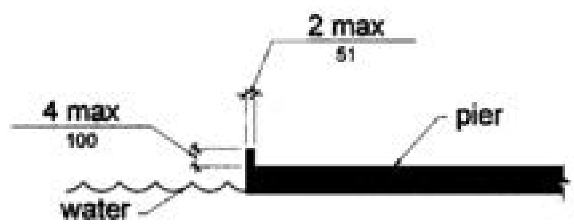


Figure 1003.3.1 (Exception 2)
Edge Protection at Boat Slips

1003.3.2 Boarding Pier Clearances. *Boarding piers* at *boat launch ramps* shall provide clear pier *space* 60 inches (1525 mm) wide minimum and shall extend the full length of the *boarding pier*. Every 10 feet (3050 mm) maximum of linear pier edge shall contain at least one continuous clear opening 60 inches (1525 mm) wide minimum.

EXCEPTIONS: 1. The clear pier *space* shall be permitted to be 36 inches (915 mm) wide minimum for a length of 24 inches (610 mm) maximum provided that multiple 36 inch (915 mm) wide segments are separated by segments that are 60 inches (1525 mm) wide minimum and 60 inches (1525 mm) long minimum.

2. Edge protection shall be permitted at the continuous clear openings provided that it is 4 inches (100 mm) high maximum and 2 inches (51 mm) wide maximum.

Advisory 1003.3.2 Boarding Pier Clearances. These requirements do not establish a minimum length for accessible boarding piers at boat launch ramps. The accessible boarding pier should have a length at least equal to that of other boarding piers provided at the facility. If no other boarding pier is provided, the pier would have a length equal to what would have been provided if no access requirements applied. The entire length of accessible boarding piers would be required to comply with the same technical provisions that apply to accessible boat slips. For example, at a launch ramp, if a 20 foot (6100 mm) long accessible boarding pier is provided, the entire 20 feet (6100 mm) must comply with the pier clearance requirements in 1003.3. Likewise, if a 60 foot (18 m) long accessible boarding pier is provided, the pier clearance requirements in 1003.3 would apply to the entire 60 feet (18 m).

The following example applies to a boat launch ramp boarding pier: A chain of floats is provided on a launch ramp to be used as a boarding pier which is required to be accessible by 1003.3.2. At high water, the entire chain is floating and a transition plate connects the first float to the surface of the launch ramp. As the water level decreases, segments of the chain end up resting on the launch ramp surface, matching the slope of the launch ramp.

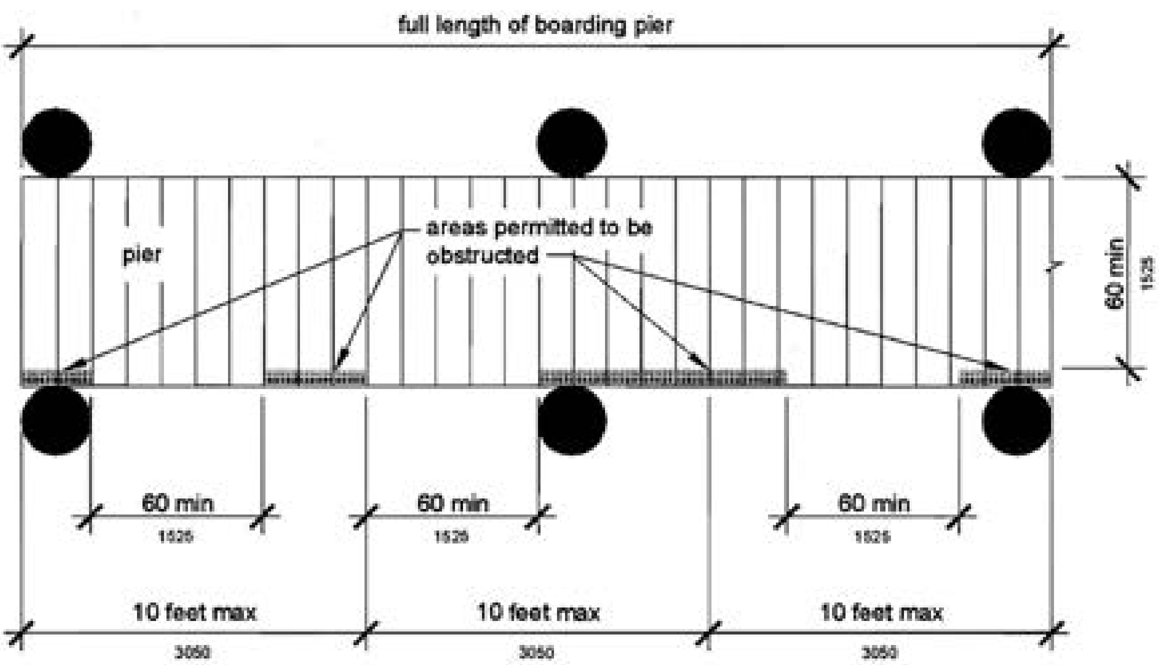


Figure 1003.3.2
Boarding Pier Clearance

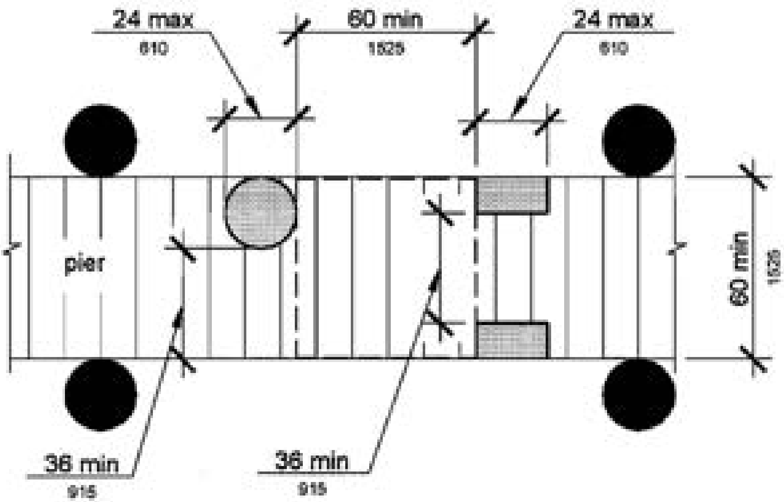


Figure 1003.3.2 (Exception 1)
Clear Pier Space Reduction at Boarding Piers

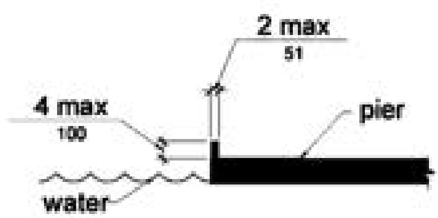


Figure 1003.3.2 (Exception 2)
Edge Protection at Boarding Piers

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