Ohio Department of Natural Resources
Division of Watercraft
Resource Planning Section

OHIO BOATING FACILITIES STANDARDS AND GUIDELINES

First Edition

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DEFINITIONS

The following definitions apply to the various terms as they are used in these guidelines:

Abutment A wedged shaped concrete block that provides a walkway onto boarding floats, in some cases the boarding floats are anchored to the abutment.

Access Road A road that leads from a public thoroughfare to a launch ramp or parking area.

Aggregate A mass of small rocks or stones.

Asphalt Concrete A mixture of bituminous material, sand, and gravel, usually heated, which is used to form pavement.

Base Course Crushed rock placed on the ground and compacted to form a solid, uniform surface for concrete or asphalt.

Bathymetric Relating to the topography below the water surface. A bathymetric survey is a process by which the underwater ground contours are measured and mapped.

Beam The width of a boat at its widest point.

Boarding Float A platform-type floating structure that provides pedestrian access to and from a boat in the water. "Grounding" floats lay on or adjacent to a boat ramp. "Self-Adjusting" floats move up/down a concrete and steel guideway system on/adjacent to a boat ramp.

Boat Ramp See Launch Ramp.

Bull Rail A rail, usually 4"x 4" treated wood, spaced above the deck surface around the perimeter of the floats used to tie-up and secure boats.

Bumper Strip Rubber material attached to walers to act as a cushion between boats and floats.

Cast-in-place The process of placing concrete into forms. Once the concrete has hardened it remains where it was placed.

Catch Basin A drainage structure that collects surface water and routes it to an outlet.

Channel A waterway that forms a navigation link for the movement of boats.

Cleat A fitting secured to the deck having two projecting horns to which lines are made fast.

COE United States Army Corps of Engineers.

Composting Toilet A toilet system where waste is collected in a tank and combined with wood shavings or bulking material to produce compost.

Concentrated Load Weight that is applied to one point on an structure.

Cross-slope Side-to-side deviation from level.

Curb Cut A section of curbing that is removed to allow pedestrian access or runoff from storm drainage.

Cut-off Wall A concrete wall built along the sides and/or bottom of a launch ramp to help protect it from being undermined.

Dead Load The weight of a structure.

Debris Boom A structure located immediately upstream which provides protection to boarding and transient floats from the collection of debris during the periods of high water or flooding.

Design Boat The length of this boat is used as a basis for the design of the facility to determine required clearances. The size of this boat was determined from the average length of boats expected to use the facility. A design boat for a boarding float will be different than the design boat for a transient float.

DLW Design Low Water - A water surface elevation that is used as the low water elevation for the period of intended use for the design. This elevation may or may not necessarily correlate with OLW.

DHW Design High Water - A water surface elevation that is used as the high water elevation for the period of intended use for the design. This elevation may or may not necessarily correlate with OHW.

Draft The depth of an object that extends below the water surface.

Dredge To clean, widen, or deepen a channel by removal of sediment.

Eddy A current that moves contrary to the main current.

Extruded Curb Concrete curb that is formed under pressure and placed without the need for form boards.

FEMA Federal Emergency Management Agency.

Fetch The open water distance over which the wind blows creating unobstructed waves.

Filter Fabric A synthetic mesh-type fabric that is placed under rock fill to keep the underlying materials from washing out.

Finish Floor The top surface of a concrete floor.

Finish Grade	The final top surface of a road, launch ramp, or parking area.
Flotation	Any material, such as polystyrene, that provides buoyancy.
Freeboard	The vertical distance between the water surface and the deck of a boarding or transient float.
Gangway	A structure which provides pedestrian access between a fixed pier/abutment (shore side) and a transient float.
Grade	The degree of inclination of a slope.
Head-In	A type of parking space that requires a vehicle to back out to leave the space.
Hydraulics	The science, technology and mechanics of fluids.
Launch Ramp	An inclined, hard surface slab that extends into the water, upon which trailer able boats can be launched and retrieved; consisting of one (1) or more lanes.
Live Load	The applied weight that is added to a structure during use.
Maneuver Area	The area at the top of a launch ramp that allows boaters to align their boats prior to backing down the ramp.
Mudline	The underwater ground surface.
Navigable	Water having sufficient depth and width to provide passage of the design boat.
ODNR	Ohio Department of Natural Resources.
OEPA	Ohio Environmental Protection Agency
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.
PCF	Pounds per Cubic Foot, unit weight.
PLF	Pounds per Linear Foot, unit weight.
Pier	A non-floating fixed platform usually extending out over the water from shore to which gangways are usually attached.
Pile	A slender wood or steel member driven into the ground. Used to maintain horizontal position/location of floats by resisting applied lateral

	forces, and to support vertical loads as in the construction of a fixed pier.
Pile Batter	A pile driven at a slope, not vertical, generally for one of two reasons. Individual piles battered at launch ramps reduce the required opening size of the pile hoop. Single or multiple battered piles are used to support an individual vertical pile when heavy lateral loading is anticipated.
Pile Cap	A plastic or metal conical shaped cap attached to the top of a pile to discourage birds from landing.
Pile Hoop	Metal framework used to hold a float against a pile. Allows vertical movement and, with adequate clearance, provides horizontal movement of boarding floats as water level changes. Hoops may be internal or external of the float frame.
Pile Pocket	An opening within a float into which a pile hoop is attached.
Precast Plank	A concrete section of ramp that is cast in a shop or on-site and then moved into position after curing.
PSF	Pounds per Square Foot, a force uniformly applied over a surface.
PSI	Pounds per Square Inch, a force uniformly applied over a surface.
Pull-through	A type of parking space that allows a vehicle to enter from one direction and continue on through to exit. No backing is required.
Riprap	Fractured stone with angular faces used to armor cut banks, fill slopes, and around 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.
Scour	The removal of material by the force of water moving across a surface.
Sedimentation	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.
Sheet Drain	The natural draining of water off the edges of a parking area due to the slope of the surface.
Siltation	See Sedimentation.
Slope	The deviation of a surface from level.
Staging Area	Short term parking area adjacent to the launch ramp used to "Ready" a boat for launching or "Tie-Down" upon retrieval.

Submerged	That portion of land along a water body below OLW that is always underwater.
Submersible	That portion of land along a water body between OLW and OHW that is subject to periodic inundation.
Toe of Slope	Lowermost or vertically lowest point of a sloped surface.
Top of Slope	Uppermost or vertically highest point of a sloped surface.
Topography	The ground features of an area of land.
Traffic Delineator	A brightly colored, flexible rubber post glued to the ramp surface near the abutment. Intended to help boaters locate the edge of the abutment and floats while backing their trailers over the vertical curve.
Transient Float	A platform-type floating structure secured by/to piling that provides a short term tie-up for larger cruising boats and may provide pedestrian access to shore and between boats in the water.
Travel Lane	All driving surfaces within the confines of a parking area that are used for maneuvering.
UHMW	Ultra High Molecular Weight polyethylene. Non-abrasive and highly resistant to wear. Used for rollers and wear blocks.
Unisex Restroom	A toilet room used by either gender.
Uplands	Land that is above OHW.
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey.
Utilities	All inclusive term for water, electrical, and sewer service.
V-Groove	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.
Vault Toilet	A type of restroom where waste is collected and retained in a concrete vault until being pumped out.
Vertical Curve	A smooth transition from one slope to another.
Wake	A boat or vessel generated wave.

Waler A replaceable wood fender or bump board located along the top outside edge of floats used to prevent damage to structural members of the floats.

Wave A ridge or swell moving through or along the surface of a water body.

Wave Attenuator A structure, barrier, or device to reduce wave/wake action thus reducing potential damage to boats and boating facility. The attenuator may consist of a series of lashed logs, deep draft concrete floats, wave fence, fixed rock jetty/berm, or a combination of the above styles.

INTRODUCTION

BACKGROUND

The Ohio Department of Natural Resources' Division of Watercraft recently determined that a need existed to develop and publish "Technical Guidelines." The guidelines help assure that a consistent means of quality design and engineering can be used for all public recreational boat access facilities developed or renovated in Ohio.

The Division of Watercraft 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 Division's Resource Planning Section is responsible for assisting grant applicants with the design and engineering of public access boating facilities.

The Resource Planning Section has amassed tremendous knowledge and experience in efforts to provide quality, low maintenance, and cost-effective facilities. The knowledge we have accumulated throughout the years has enabled us to continually learn from both successful designs and those in need of revision.

In addition, the Resource Planning Team continually reviews and shares similar design information with other states. These Guidelines parallel similar findings made by Oregon State Marine Board access programs as well as the States Organization for Boating Access (April 1996), the *Design Handbook for Recreational Boating and Fishing Facilities*, and *Marinas and Small Craft Harbors* by Tobiasson and Kollmeyer (Second Edition, 2000).

Ohio is not unlike most other states in regards to the typical recreational boat size and user needs. However, Ohio's waterway conditions vary tremendously from other parts of the country with extreme diversity in coastal areas as well as inland rivers, lakes, and reservoirs.

Please use these guidelines as they are intended, as a guide. Every effort has been made to provide our partners with the most reliable design parameters (preferred, minimum, and maximum) that should work in most all locations and conditions. Any deviations beyond the minimum or maximum range should be carefully analyzed.

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

The Division of Watercraft does not consider nor warrant that these guidelines are all inclusive and/or absolute. It is up to the project engineer and owner to carefully consider each individual site for best design and appropriate selection of materials.

SCOPE

These guidelines show a logical method for the design and layout of major elements of public recreational boating facilities found in Ohio. Emphasis has been placed on the proper design and location of boat launch ramps.

Access and parking area layouts are extensively discussed as this may be the most important element which determines efficiency and proper operation of a boat launch facility.

These guidelines include launch ramps, restroom design, parking areas, transient tie-up facilities and other related amenities. They do not include the design of marinas, nonpowered boat facilities, or boat waste collection facilities.

Launch facilities are targeted for public recreational use on a first come basis and designed primarily for motorboats less than 26 ft. in length. Boats over 26 ft. are normally non-trailered. Transient tie-up facilities are targeted for public recreational use on a first come basis for broadside tie-up of boats generally longer than 26 ft. in length. The facilities are owned and operated by public entities.

These guidelines are based on the dimensions of a typical design vehicle, boat, and trailer used in Ohio. The design tow vehicle is 19 ft. long. The design trailer (with boat) is 26 ft. long and 8.5 ft. wide. The design tow vehicle and trailer combination is larger than average. However, by designing for this combination, maneuverability is assured for larger trailered boats and enhanced for smaller vehicle/trailer combinations.

For trailerable boats the following dimensions are used: 20 ft. length, 8 ft. beam, 1.5 ft. gunnel/deck height and 2.5 ft. outdrive/propeller depth. Minimum design navigational depth is 3 ft. For transient tie-up facilities the design boat dimensions are: 40 ft. length, 14 ft. beam, 2.5 ft. gunnel/deck height, and 3.5 ft. propeller depth. Minimum design navigational depth is 4 ft.

Due to the seasonal use of recreational boating activity, it is important to consider and factor the usage criteria for an assumed design use (high and low water) period. In general, the majority of use (90%) on all waterways occurs during a seven month period from April to October with June, July and August being the peak use period.

Therefore, design for any use or access is not a prime concern during non-peak periods (times of high water, high wind, debris, wave and storm). In addition, very few boaters use facilities when the wind exceeds 30 mph, waves exceed 2 ft. vertical, or when there are extreme water fluctuations or high water periods. Facilities do not need to be designed to be “usable” during these conditions, but instead need to be designed to survive without significant damage.

Other typical design criteria used for launch facilities during the design use period include (1) maximum wave/wake design of 2 ft. vertical and, (2) an average current speed on rivers of 5 mph.

PURPOSE

The purpose of these guidelines is to provide technical assistance to projects being developed under the Division of Watercraft's Cooperative Boating Facility Grant Program. The guidelines may 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 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.

Some building codes (Uniform Building Code - UBC) may apply to certain facility components, normally limited to landside structures (restrooms). There are no specific UBC requirements for most recreational boat access and transient tie-up facilities as code requirements generally stop at the water/land interface.

Providing accessibility to persons with disabilities is also problematic at boating facilities as the focus of uniform federal requirements (Americans with Disabilities Act Accessible Guidelines - ADAAG) is on landside features. Please note some provisions in the state building code are more stringent than ADAAG. All project landside accessibility components must be consistent with the provisions of ADAAG and/or state standards such as parking, restrooms, and walkways.

Typical drawings exist for many different project components. No attempt has been made to incorporate detailed project drawings or specifications in these guidelines. Instead, typical illustrations 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, and design requirements. They are, therefore, subject to periodic revisions and updates. Please contact the Division of Watercraft, Resource Planning Section to request a copy of the latest version.

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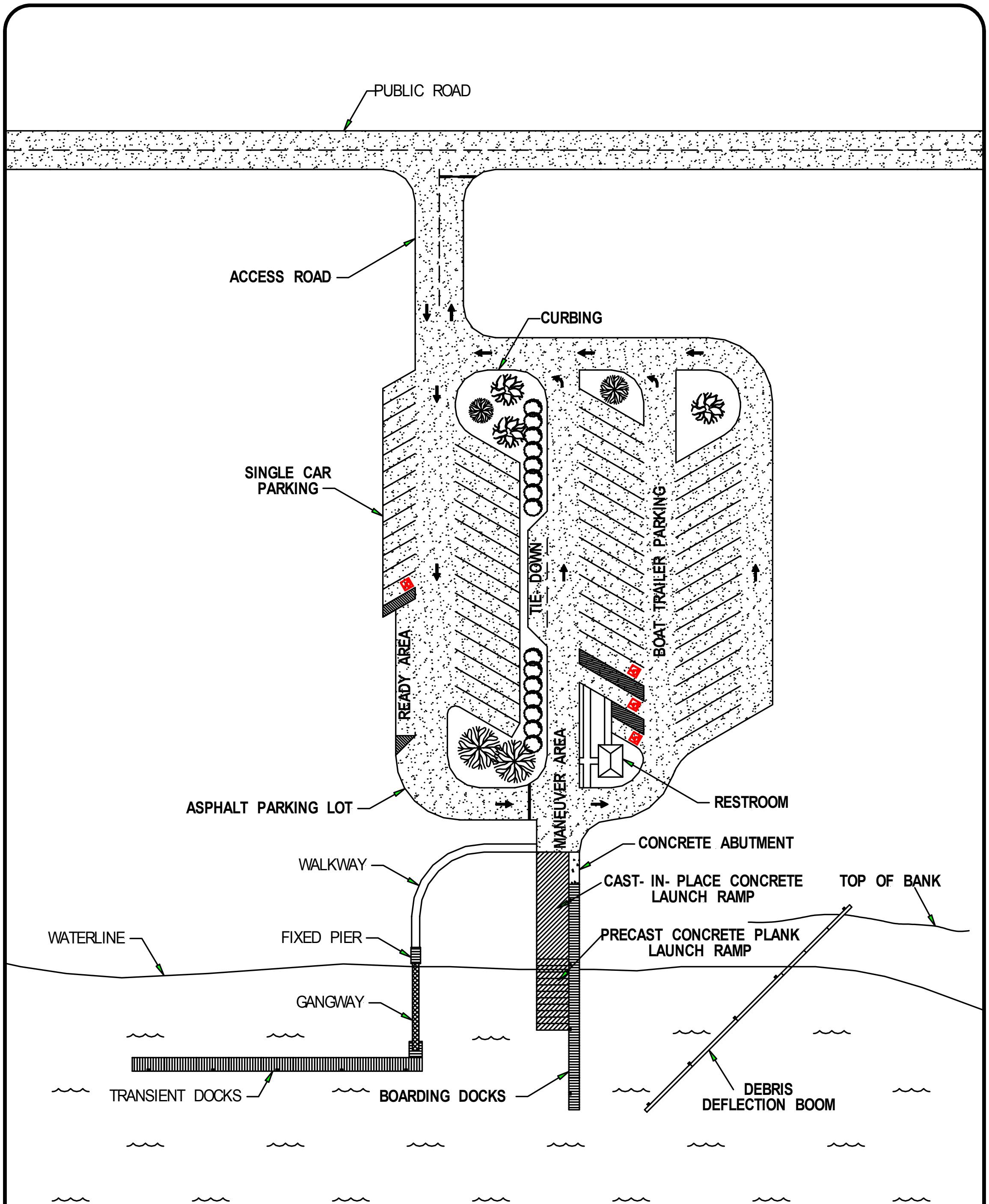


TYPICAL BOATING FACILITY COMPONENTS

PROJECT PLANNING AND IMPLEMENTATION

I. MASTER PLANNING

A. General

Performing 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 may 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 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. Generally 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.

3. 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.

4. A master plan sets the stage for the design engineering. A part of the master plan is a conceptual plan view drawing and layout of the site. This concept drawing is not detailed enough for construction. However, it establishes approximate ramp size and location, targets parking area capacity, defines traffic management and circulation, and locates the restroom.

5. The plan will establish 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 final project engineering (i.e., prepare drawings and specifications ready to bid).

2. A good master plan is an invaluable tool that will help guide the owner and design/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, not during the design and engineering phase.

II. FINAL PROJECT 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 have been successfully used in similar applications.

2. Engineering hinges on several key items. These items include:

- proper site application
- proper use of materials
- appropriate and cost-conscious construction methods

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 as compared to 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, application particular attention should be paid to orientation and impacts to waterway facilities (i.e., current, wave, wake etc.). It is most helpful to obtain an aerial photo of the site (scale 1" =100 ft.) to assist in orientation with respect to current, fetch, debris, and use patterns.

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.

3. For this reason, the engineering design should begin immediately after receiving approval of the grant. It is common to see final design and engineering time severely constrained due to procrastination or waiting to begin the implementation of this phase. Often the owner has to coordinate construction grant funding opportunities with reasonable construction implementation schedules and various in-water and other work restrictions. This "rushed" engineering usually results in many unnecessary and costly change orders as well as poorly constructed facilities.

C. Design

1. We recommend that all design and engineering work receive at least three formal reviews. The first should occur at 25%, which is considered preliminary, 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 wise to develop a very preliminary cost estimate for principal project elements.

2. After the preliminary review the engineer should complete all detail drawings ready for the 50% 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.

3. After the 50% review no significant changes or adjustment to the scope of the project should be made. Engineering should move to the final review just prior to the 95% phase where completed final drawings and technical specifications are prepared and ready to bid.

III. <u>CONSTRUCTION SCHEDULING</u>

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 contractors bid not only reflects purchase of materials, work by subcontractors, and the difficulty in completing the project, but also the competitive nature of the market.

B. Application

1. 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.

2. Heaviest facility use is generally from early June 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 dock construction. River levels are usually high in the winter and spring due to rain and snow melt. Best time for low water construction is late summer or early fall. Flood-control reservoirs are usually drawn down (typically 2-6 feet) beginning in September. Normal recreational-pool elevations normally are reestablished by late May.

4. In-water permit restrictions are established to protect aquatic organisms and 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 ODNR, Division of Wildlife Preferred In-Water Work Periods is advised. In general, higher scrutiny is given to projects that dredge, fill, create suspended sediment, or otherwise impact habitats. In many instances installation of piles and docks can occur outside preferred in-water work periods.

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.

2. Next determine the preferred in-water work time, time of year, water elevation, and impacts to the user. 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, award date, and preconstruction meeting. This assumes that all master plan, 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.

IV. <u>PLANNING AND CONSTRUCTION PERMITS</u>

A. General

Normally all construction projects require some form of land use review and approval, followed by design review, and then limited building code and/or waterway permit review. The following applications must be submitted to the appropriate agencies and approved by those agencies prior to construction.

B. Application

- U.S. Army Corps of Engineers Section 10/404 Permit – Required for all in-water work activities below mean high water or ordinary high water, or if the project will impact any significant habitat or wetlands. May be processed under a nationwide permit or may require an individual permit.
- Ohio EPA 401 Water Quality Certification – Required when a COE 404 permit is processed as an individual permit.

- Ohio EPA NPDES Storm Water Permit – Required when one or more acres of land is disturbed by the projects.
- Floodplain Permit – Required when a project is within the 100-year flood plain.
- ODNR Permit to construct Shoreline Erosion Control Structure – Required for any project on the Lake Erie shoreline.
- ODNR State Scenic River Approval – Required when a projects is located on a scenic river.
- Ohio Department of Commerce – Building permits are required for restrooms, office buildings, etc. Many areas have a local building authority that issues these permits.
- Local Jurisdiction Permits (City, County, Township) – Check for all local requirements.

C. Design

1. Of all the permits mentioned the most time consuming one is the 404/401 permit (normally 4+ months to obtain). It is advisable to begin the 404/401 permit process once the 50% preliminary engineering is complete. This will allow time to incorporate any permit conditions.

2. The best time to submit for design and building codes review for restrooms or other buildings is immediately upon completion of 100% engineering. The design and building code review normally takes 1-2 months. Normally no significant changes to the design are required and any modifications can be accomplished with a Bid Addendum or Change Order.

CHANNELS

1. CHANNELS

   A. General

      1. Channel designs must be adequate to allow boats to safely proceed and pass each other, certain widths and depths are necessary. In shallow areas, these navigational channels must be artificially established by dredging the bottom of the waterway.

      2. 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.

      3. The general type of water used by recreational boaters in Ohio is flat water with moderate to no currents. In many locations with shallow water, there are channels, which may be defined and maintained to a navigable depth, for use by recreational motorboats.

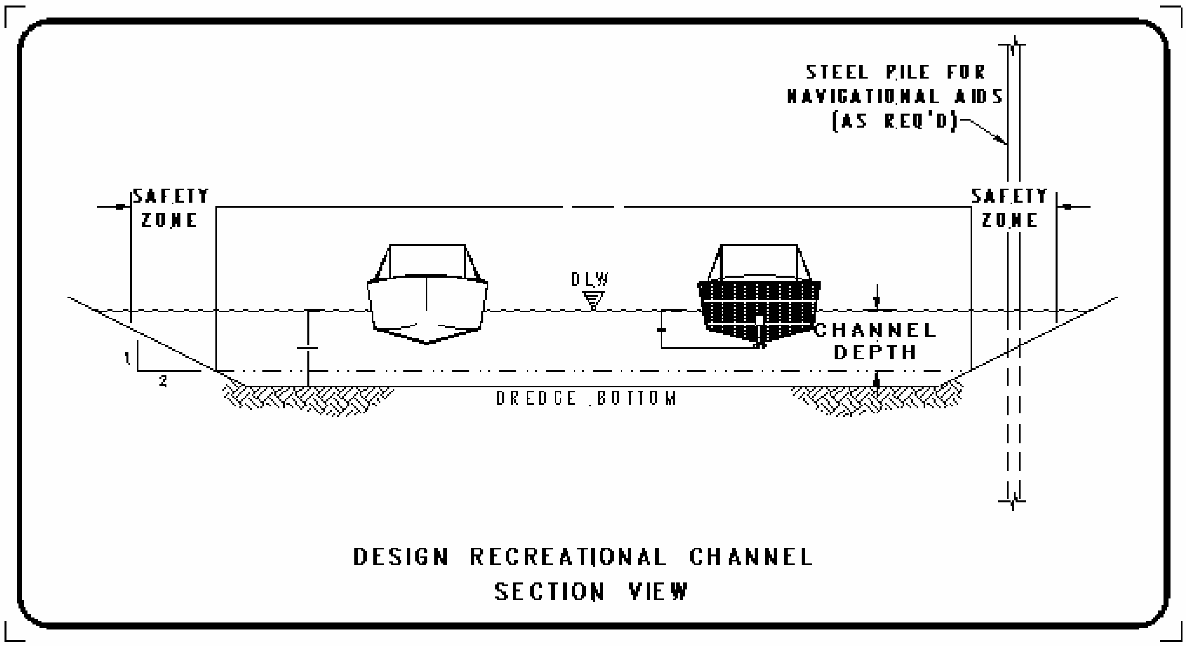
      4. Defined navigation channel width is determined by the width and speed of the design boat, to allow for safe passing. There are two general categories for channels, one for 5 Miles per Hour, Slow No Wake low speed, and one for Speed Above 5 Miles Per Hour.

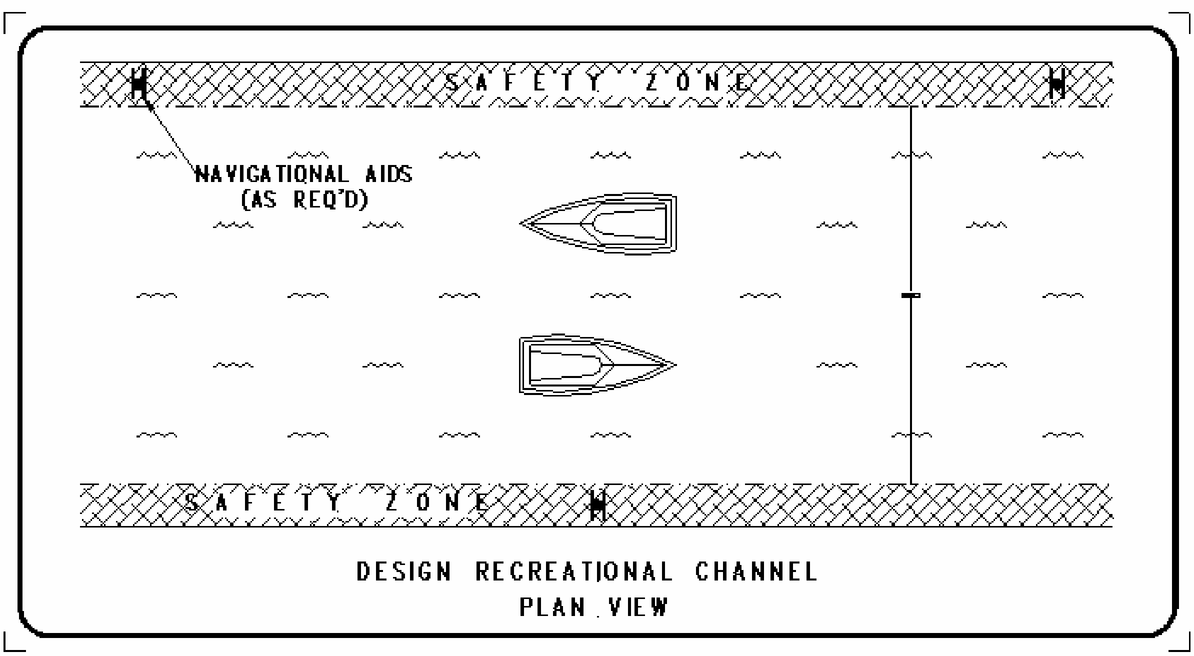
      5. A clear safety zone, for boat turning and shoulder for disabled boats, shall be maintained on each side of all navigational channels. The width of this zone varies with the channel size and speed of boat traffic. The safety zone shall be free of all structures and obstructions, with the exception of buoys or piles for navigational aids are located within the safety zone.

      6. Channel depth is determined by the design boat depth (draft or propulsion device). Non-motorized boats usually draft less than 6" 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.

      7. Although every effort may be made to acquire property with sufficient depth offshore to accommodate boats after launching, in most cases some dredging will be required to provide a channel from the launching ramp to navigable water. The channel should be at least as deep as the water at the end of the ramp; the minimum suggested depth is 3-feet. If the facility will be used regularly to launch such craft as sailboats with centerboards, it may be desirable to provide greater depths.

8. As in deciding how deep the water at the end of the ramp should be, how deep a channel should be also depends on the desired depth during low water conditions. In addition, it is desirable to add one foot to the design depth to delay the inevitable date when maintenance dredging is required to restore the original depth.





B. Application

1. There are several categories of recreational boats that generally use flat water:

   - Small motorboats, under 16' 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.

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

   - Large motorboats, 26' to 40' 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.

   - Very large motorboats exceed 40' 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 4 feet.

2. Minimum channel depth is measured at OLW or MLLW. It is preferable that minimum channel depth be maintained throughout the width and length of a defined channel.

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

4. Adjustments to channel depth are necessary in areas where sailboats are prevalent, to accommodate deeper drafts and large centerboards.

C. Design

1. Non-motorized Boats - Not Applicable

2. Motorized Boats - Channel depth and width shall conform to the following minimum design criteria:

Size of Boat (Motorized)	Min. Channel Depth	Min. Dredge Depth	Channel Width 5 MPH	Channel Width Over 5 MPH	Safety Zone Each Side
SMALL, UNDER 16’					
Minimum	2’	4’	20’	30’	5’
Design	3’	5’	30’	40’	5’
MEDIUM, 16’ – 26’					
Minimum	3’	5’	40’	50’	10’
Design	4’	6’	50’	60’	10’
LARGE, 26’ – 40’, and channels not regulated by USCG/COE					
Minimum	4’	6’	60’	70’	20’
Design	5’	7’	70’	80’	20’

Note: Increase channel depths for sailboats - add 2' to 3'.

Navigational aids, when used, shall 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.

D. Permits

1. Dredging a channel normally will require a permit from either a federal or state agency. The permitting agency will require information about the design of the channel and the nature, quality, quantity, handling, and disposal of the material to be excavated. The excavating often is not as much of a problem as is disposing of the dredged material. The extent to which undesirable elements are found in the materials will dictate the type of disposal required.

E. Dredging

1. Channels can be dredged with a variety of equipment. Described below is specialized according to conditions and/or materials. The facility designer must be knowledgeable not only about the type of material to be excavated but also about equipment limitations.

a. Hydraulic dredges may be most economical where large amounts of material (50,000 cubic yards or more) are to be moved. These are floating pumps with cutter heads that extend to the bottom and churn up the material so that it and the water necessary to transport it can be pumped from the dredged location through pipes to a suitable disposal area. The disposal area is the key to a successful hydraulic dredging operation:

> It must be within the pumping capability of the hydraulic dredge, be suitably diked to contain the materials, and have a sediment trap installed so that largely clear water flows out of the diked area. Since most channels constructed to serve boat launching facilities involve moving only small amounts of materials, hydraulic dredging is rarely used in such construction.

b. A dragline often can be used to dredge a boat launching facility channel. It often can be positioned to a point where its bucket can reach the outer end of the channel; from there it can stockpile the dredged material shoreward as it works. When the material reaches shore it can be loaded into trucks. An alternative is to construct a temporary roadway offshore and back trucks to the dragline; this eliminates the double handling of the material required when it is stockpiled.

c. A backhoe or a crane also may be appropriate; these work much the same way as a dragline but their range is more limited because their buckets are attached to rigid arms. Standard earth-moving equipment such as bulldozers can be used when a channel can be excavated in the dry, that is, during the winter when water elevations are lower than at other times of the year.

d. Draglines, backhoes, and/or cranes on floating barges may be necessary if a channel must extend some distance. This is the most expensive approach to the problem since floating equipment often requires water deeper than the planned channel depth necessitating a change in channel design. In addition, the materials excavated must be barged or rafted to shore for disposal.

F. Navigational Aids

1. Channels must be marked to identify their location, width, and length. If a channel is in waters under the jurisdiction of the federal government, a permit to place navigational markers will be required from the U.S. Coast Guard. The permit will prescribe the number, color, and location of the markers; it also may require that some be lighted to mark the channel at night. If a channel is dredged in waters under only state jurisdiction, a state permit to place navigational markers may be required.

2. The markers prescribed by the Uniform State Waterway Marking System,

which is recognized by the U.S. Coast Guard, usually are suitable for waters not connected to U.S. navigable waters. For either federal or nonfederal waters, the U.S. Coast Guard can provide information about required or suitable navigational markers for a specific channel.

LAUNCH RAMPS

I. <u>FACILITY SITING</u>

A. General

1. Before a launch facility is constructed, careful evaluation of need, site, and waterbody capacity should be completed (contact Division of Watercraft for more information). 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 development. The parcel should have a large enough area for parking adjacent to the proposed 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 in good water conditions near known activity areas.

4. Parking areas should not be separated from the 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.

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 boater use. This will reduce on-water congestion and conflict by separating the different types of users.

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 ft. in length.

4. Launch ramps are generally designed so that the greatest amount of excavation occurs above the water line, with the underwater portion of the 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. Ramp profiles that closely match the topography of the water body bank line are less likely to disturb the local hydraulics of the river. At DHW this design consideration will help minimize scouring, if the ramp is set above grade, or sedimentation if set below grade.

6. 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 wave, wake, current, and wind exposures should be considered as well as the occurrence of, or potential for, sedimentation.

C. Design

1. Ramp Separation

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

II. <u>FACILITY SIZING</u>

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 Division of Watercraft is recommended.

2. It is generally believed that the number of 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. Ramp use is usually concentrated during a two-hour launch period (morning) and a two-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.

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 and different groups of users use (launch/retrieve) 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 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. 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 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*

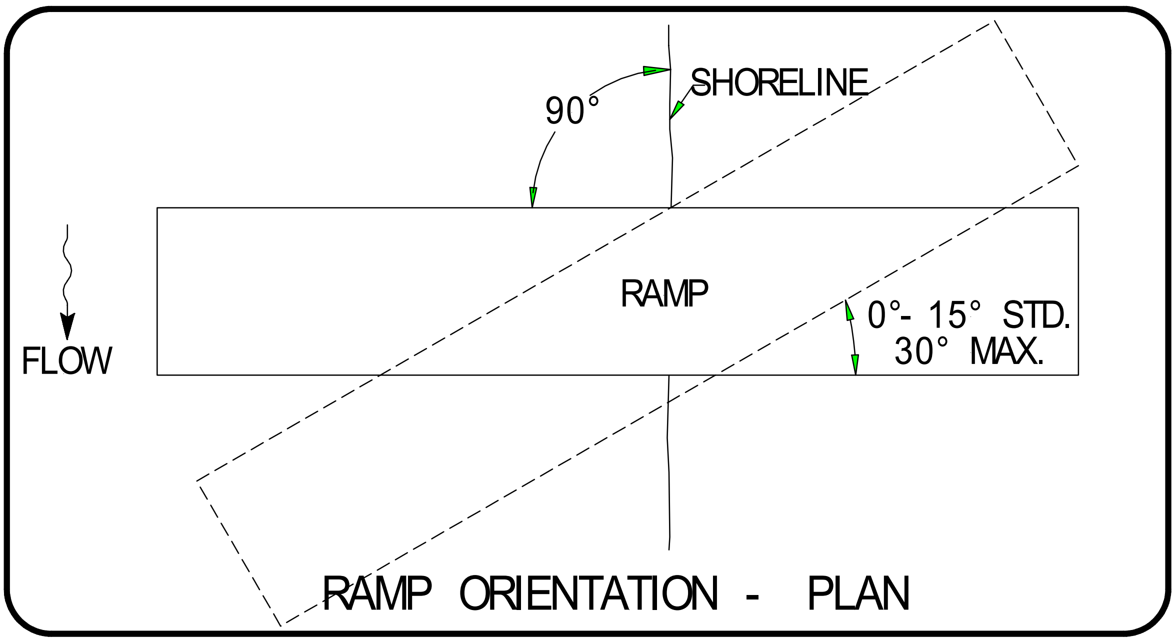
	One Lane	Two Lanes	Three Lanes	Four Lanes
Preferred:	30 Spaces	60 Spaces	90 Spaces	120 Spaces
Minimum:	10 “	30 “	60 “	90 “
Maximum:	50 “	100 “	150 “	200 “

*based on number of boat trailer parking spaces

III. ALIGNMENT

A. General

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



B. Application

1. Typical alignment of a launch ramp is from perpendicular to the bank line, to an allowance of up to 30 degrees rotation downstream to best fit the river flow line at the specific site.

2. Extreme rotation angles, while generally helpful in boat launching and retrieval, are costly to construct and usually require on going maintenance to remove sedimentation from the ramp, or erosion repair due to more exposure to the current.

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

C. Design

1. Ramp Rotation

Preferred: Lakes and Reservoirs - Perpendicular to bank line, 0 degree rotation.
Rivers - 15 degrees rotation downstream from perpendicular to bank line.

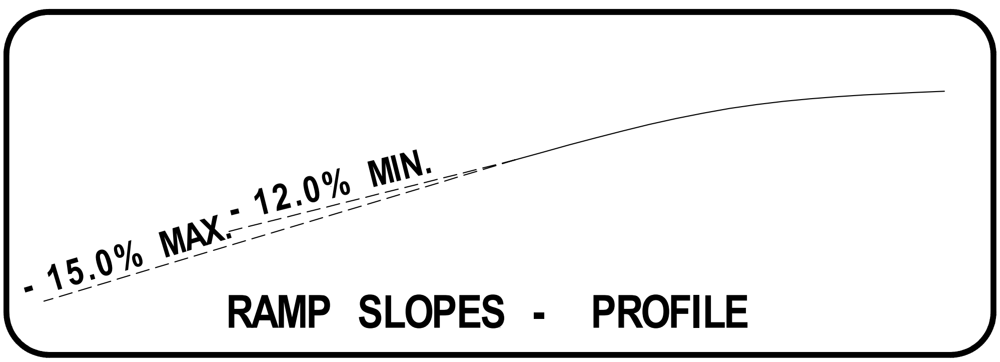
Maximum: Rivers - 30 degree from perpendicular to bank line.

IV. <u>SLOPE</u>

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 ramp slope that has been nationally accepted as a standard. Boaters across the country have successfully manipulated ramps within this slope range for many years.



B. Application

1. The preferred launch ramp slope of 15% 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 boat ramp slopes has been matched to the required depth needed to launch a typical trailerable boat from its trailer.

2. 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.

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, 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 12-13% ramp.

4. In cases where ramp slopes outside the accepted range of 12% to 15% are considered, the engineer must use extreme caution. Potential safety hazards can occur in these situations. If the ramp slope is less than 12%, the tow vehicle and operator are subjected to immersion in water during launch and retrieval. Ramp slopes that exceed 15% may be hazardous, with potential for the tow vehicle losing traction on the ramp and ending up in the water.

5. Currently there are ADAAG guidelines for accessibility to launch ramps. Based on minimum safety criteria for launching a boat, launching docks resting on ramp slopes of 12%-15% are considered to be accessible by Division of Watercraft.

   This is provided that all other specified conditions are met. The Americans with Disabilities Act (ADA) is a comprehensive civil rights law that prohibits discrimination on the basis of disability. The ADA requires that newly constructed and altered state and local government facilities, places of public accommodation, and commercial facilities be readily accessible to, and usable, by, individuals with disabilities.

   The ADA Accessibitility Guidelines (ADAAG) is the standard applied to buildings and facilities. Recreational facilities, including boating facilities, are among the facilities required to comply with the ADA. The Access Board issued accessibility guidelines for newly constructed and altered recreation facilities in 2002. The recreation facility guidelines are a supplement to ADAAG. As a supplement, they must be used in conjunction with ADAAG. Copies of the ADAAG and the recreation facility accessibility guidelines can be obtained through the Board's website at www.access-board.gov or by calling 1-800-872-2253 or 1-800-993-2822 (TTY). Once these guidelines are adopted by the Department of Justice, all newly designed, constructed and altered recreation facilities covered by the ADA will be required to comply.

C. Design

1. Ramp Slope

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

V. DESIGN WATER ELEVATIONS

A. General

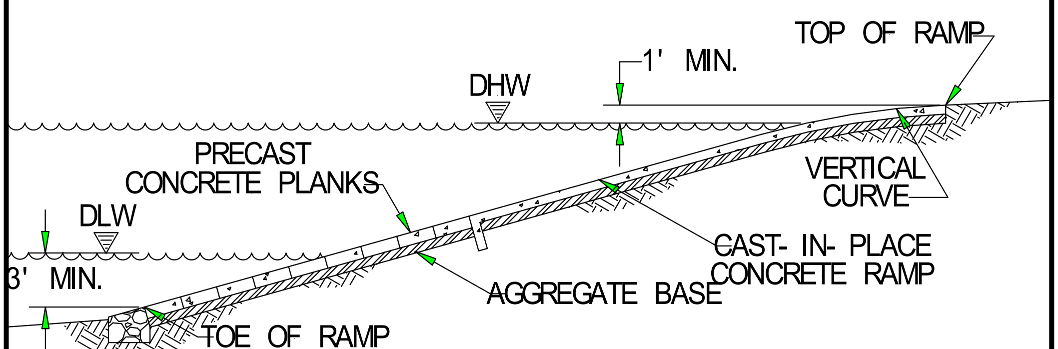
1. Design water elevations should be established and used for the boating facility design instead of OLW and OHW. If the OLW and OHW elevations are used for the facility design, components of the facility may be much larger/longer and exceed the intended period of use.

2. An example of this would be the ramp length at a flood control reservoir where the pool is drawn down in the fall after the primary and limited use period. Based on the OLW, the ramp length would extend to 3 ft. vertically below OLW (minimum pool) and the ramp length might be 200 ft. long. Using the design low water (DLW) elevation, based on water elevations for the period of use, ramp length might be no more than 80 ft. long. This saves construction dollars for 120 ft. of ramp.

3. The top of the launch ramp is the upper most part of the V-grooved concrete ramp. The top of the ramp should be above the DHW level to provide traction for the tow vehicle.

4. The toe of the launch ramp is the lower end of the V-grooved concrete ramp. The 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 ramp would typically be precast concrete and in a reservoir the entire ramp would be cast-in-place concrete.

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



CONCRETE RAMP - PROFILE

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.

2. The primary and shoulder months of use for the facility should be determined, typically April 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 gauging stations. Historical data may be obtained, usually via the Internet, from the U.S. Geological Survey, the U.S. Army Corps of Engineers, 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. Ordinary 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 ramp toe at 3 ft. (4 ft. for Lake Erie) vertically below the DLW has been found to provide adequate water depth to float the average boat from its trailer. The ramp toe also provides protection from the creation of holes due to power loading.

6. It is desired that the top of the ramp be a minimum of 1 ft. vertically above the DHW elevation. However, local topography will often dictate the establishment of the top of ramp. Sometimes attempting to set the top of ramp elevation to 1 ft. vertical above DHW becomes impractical or cost prohibitive when the entire area is below the DHW elevation.

7. Excessive ramp length above and below the design values is a waste of construction dollars. Underwater ramp construction, on the average, is twice as expensive as comparable upland construction.

C. Design

1. Water Elevations for Facility Design

   Preferred: DHW and DLW
   Minimum: OLW or MLLW
   Maximum: OHW and MHHW

2. Top of Ramp Elevation

   Preferred: Min. 1 ft. vertical above DHW or MHHW

3. Toe of Ramp Elevation

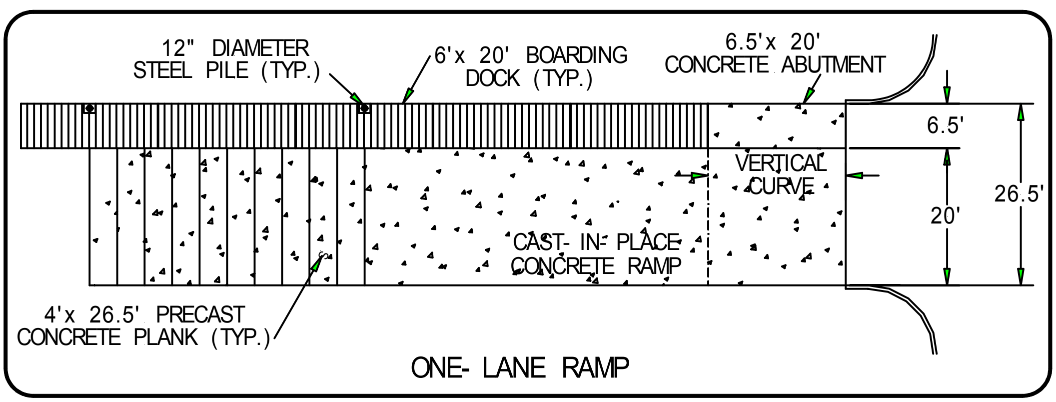
Preferred River:	Min. 3.0 ft. vertically below DLW for water body.
Preferred Reservoir:	To an elevation 3.0 ft. vertically below the minimum water surface elevation for the period of time the ramp is useable.
Preferred Lake:	To an elevation 3.0 ft. vertically below DLW water surface.
Preferred Lake Erie:	Minimum 4.0 ft. vertically below DLW water surface.

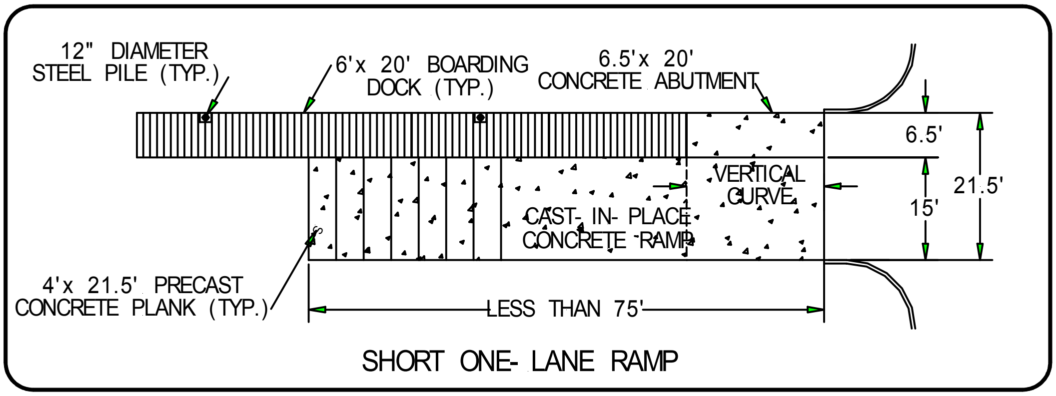
VI. WIDTH

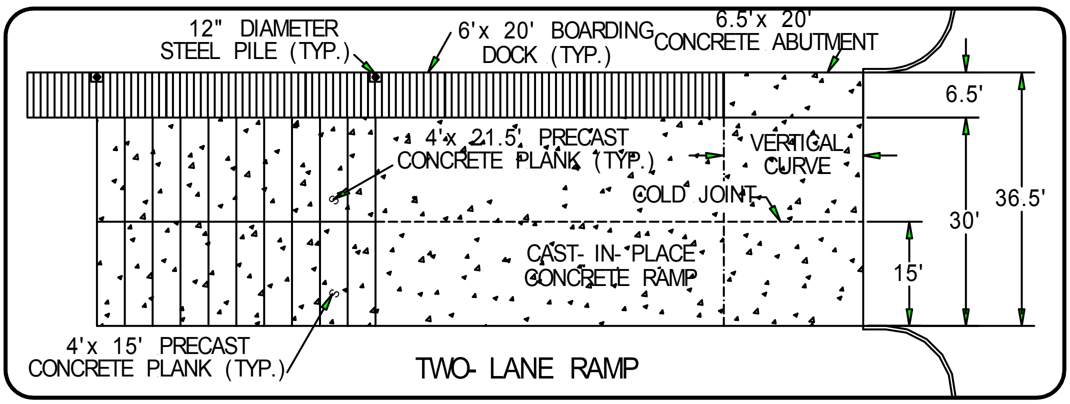
A. General

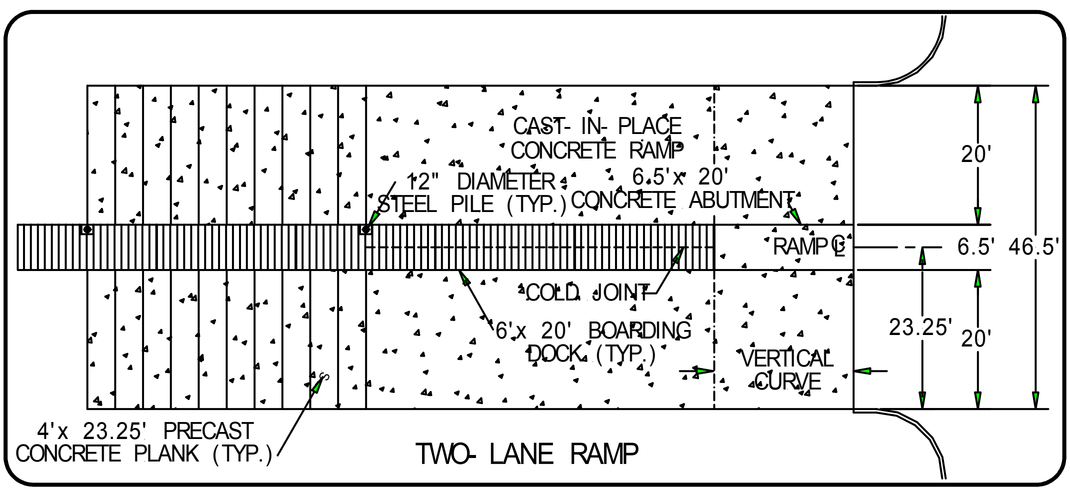
1. Adequate launch ramp width is necessary to provide room for boaters of various capabilities to back or maneuver their boat trailer down the boat ramp. The ramp width should be wide enough to accommodate the boarding floats so they can ground out on the ramp surface.

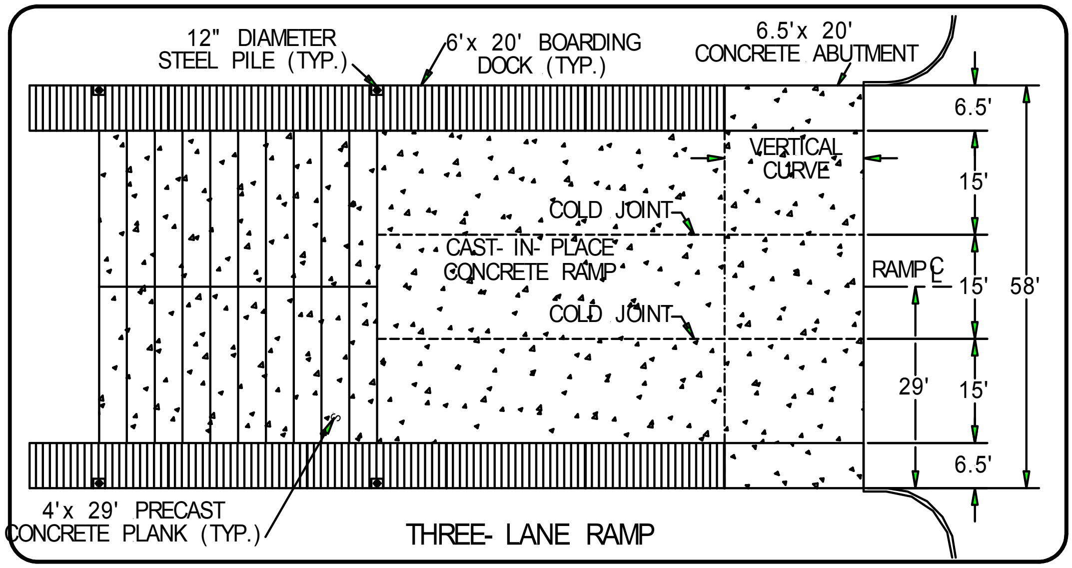
2. Lane widths for single lane ramps are greater than the allowance for adjacent-laned ramps. Lane width is based on a 10 ft. wide vehicle/trailer "occupy area" and a 5 ft. wide area on either side for a maneuvering "buffer zone". The "buffer zone" on adjacent lanes of a multi-lane ramp will overlap. Lane widths may be reduced in this situation.

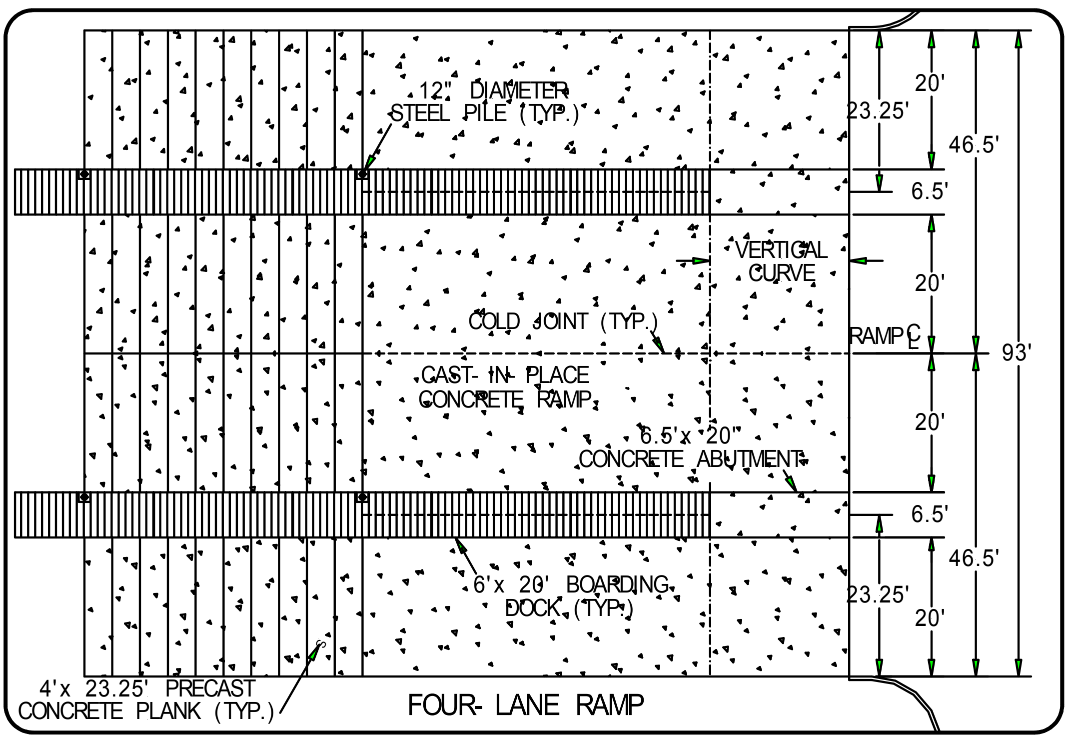


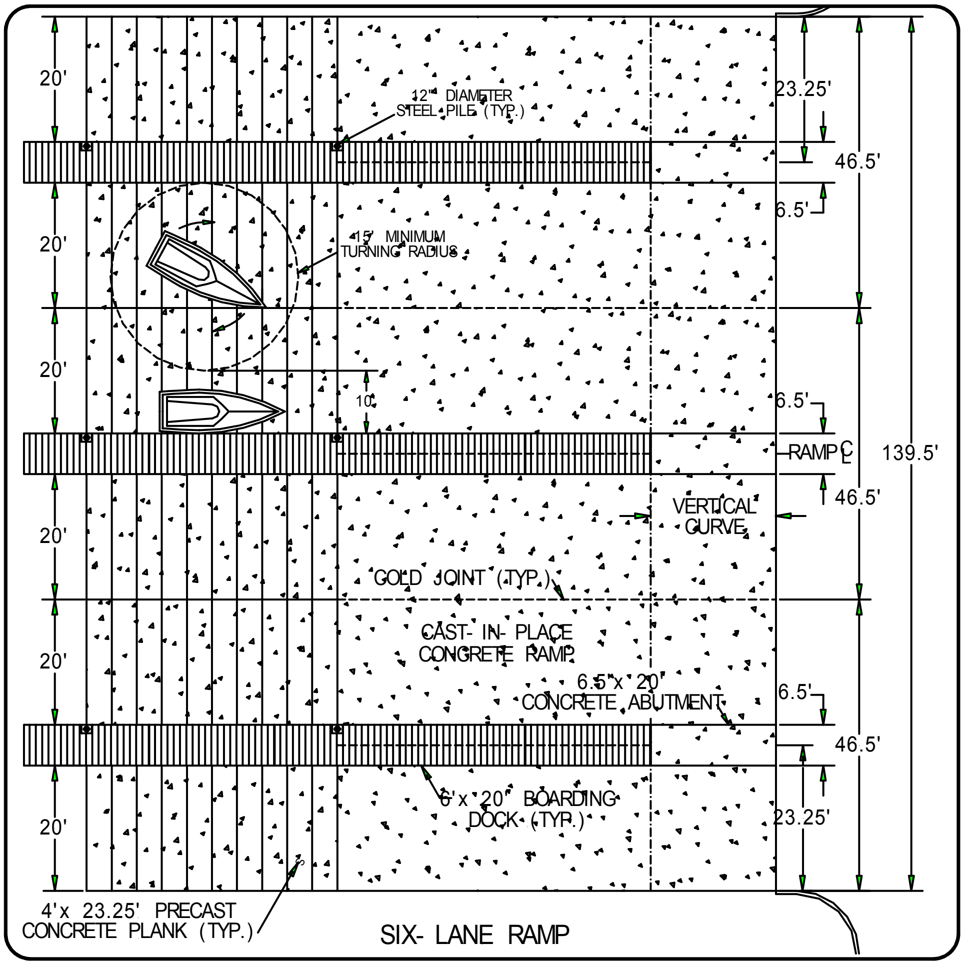

12" DIAMETER
STEEL PILE (TYP.)
6'x 20' BOARDING
DOCK (TYP.)
6.5'x 20'
CONCRETE ABUTMENT
6.5'
VERTICAL
CURVE
21.5'
15'
CAST- IN- PLACE
CONCRETE RAMP
4'x 21.5' PRECAST
CONCRETE PLANK (TYP.)
LESS THAN 75'
SHORT ONE- LANE RAMP


12" DIAMETER
STEEL PILE (TYP.)
6'x 20' BOARDING
DOCK (TYP.)
6.5'x 20'
CONCRETE ABUTMENT
6.5'
4'x 21.5' PRECAST
CONCRETE PLANK (TYP.)
VERTICAL
CURVE
COLD JOINT
36.5'
30'
CAST- IN- PLACE
CONCRETE RAMP
15'
4'x 15' PRECAST
CONCRETE PLANK (TYP.)
TWO- LANE RAMP


CAST- IN- PLACE
CONCRETE RAMP
20'
12" DIAMETER
STEEL PILE (TYP.)
6.5'x 20'
CONCRETE ABUTMENT
RAMP ℄
6.5'
46.5'
COLD JOINT
6'x 20' BOARDING
DOCK (TYP.)
23.25'
20'
VERTICAL
CURVE
4'x 23.25' PRECAST
CONCRETE PLANK (TYP.)
TWO- LANE RAMP


12" DIAMETER
STEEL PILE (TYP.)
6'x 20' BOARDING
DOCK (TYP.)
6.5'x 20'
CONCRETE ABUTMENT
VERTICAL
CURVE
COLD JOINT
CAST- IN- PLACE
CONCRETE RAMP
COLD JOINT
RAMP C
6.5'
15'
15'
15'
6.5'
58'
29'
4'x 29' PRECAST
CONCRETE PLANK (TYP.)
THREE- LANE RAMP


12" DIAMETER
STEEL PILE (TYP.)
VERTICAL
CURVE
COLD JOINT (TYP.)
CAST- IN- PLACE
CONCRETE RAMP
6.5'x 20'
CONCRETE ABUTMENT
6'x 20' BOARDING
DOCK (TYP.)
RAMP C
20'
23.25'
46.5'
6.5'
20'
93'
20'
6.5'
46.5'
23.25'
20'
4'x 23.25' PRECAST
CONCRETE PLANK (TYP.)
FOUR- LANE RAMP



B. Application

1. Typically launch lanes are 20 ft. wide. There are exceptions to the rule, single lane ramps that are less than 75 ft. in total length may be 15 ft. wide. Ramps with two or more adjacent lanes and boarding floats down one side, or without boarding docks, may also be 15 ft. wide. When there are three or more adjacent lanes between strings of boarding docks, lane widths should be 15 ft. each.

2. Another consideration for lane width is the need to provide adequate room between strings of floats for boats to maneuver. The turning radius for a boat is considered to be 1.5 times the length of the craft. A 20 ft. design boat requires a minimum of 30 ft. to turn within. A minimum of forty feet of clearance between the strings of docks should be allowed for turning, assuming one boat is tied off to the dock.

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

C. Design

1. Launch Lane Widths

Preferred:	Single Lane or 2 Lane Separated by Docks - 20 ft. Wide
	Single Lane less than 75 ft. Long - 15 ft. Wide
	2 Adjacent Lanes w/ Docks on Each Side - 20 ft. Wide
	2 Adjacent Lanes w/ Docks on One Side - 15 ft. Wide
	3 or More Adjacent Lanes - 15 ft. Wide
Minimum:	All Configurations - 15 ft. Wide

VII. SURFACES

A. General

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

B. Application

1. Gravel 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. These ramps provide very limited traction, typically requiring a four-wheel drive tow vehicle. Gravel ramps are not recommended due to safety and capacity reasons and the Division of Watercraft will not fund this ramp application.

2. Asphalt ramps are an improvement over gravel ramps but have some short falls. These ramps are generally constructed on a grade and provide a hard surface for the vehicle and trailer to travel. However, placing asphalt underwater to extend it to the ramp toe is difficult. Asphalt lacks the structural strength of concrete when placed on a soft subbase and the required roughness for adequate traction, especially in coastal environments. During events of high water it is common for the water to move the asphalt from its original location. Asphaltic concrete ramps are not recommended and the Division of Watercraft will not fund this ramp application.

3. Concrete ramps are superior to gravel and asphalt ramps. It is easy to control and set the grade or slope of the concrete ramp during construction. Concrete, when finished with a V-groove finish, offers very good traction for tow vehicles. 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. Precast concrete can be placed below the water line to construct the toe of the ramp.

4. When constructing a concrete ramp above the water level it is recommended that it be cast-in-place. It is the cheapest of the concrete options and is the easiest to maintain control over the slope and grades.

5. When constructing the lower end of the ramp, underwater portion, it is recommended that precast planks be used. Another option for construction of the ramp toe is a push-in-place system. The entire ramp toe is cast-in-place above the water line and is then pushed into place with one or more crawler type of tractors.

C. Design

1. Ramp Surface

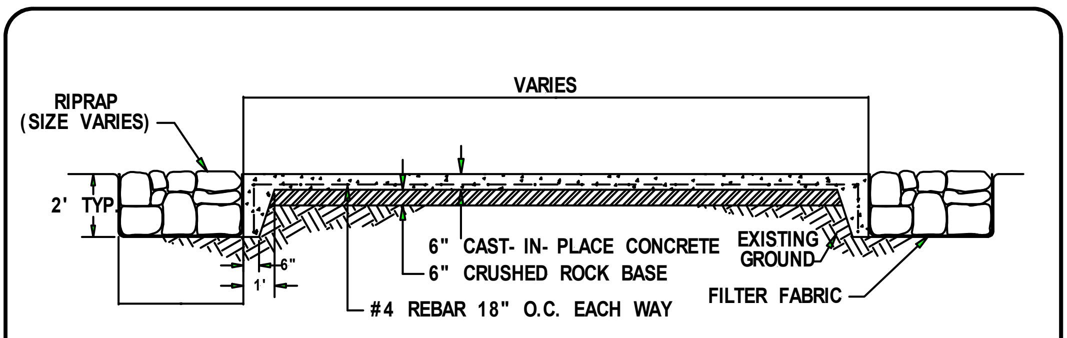
Preferred: Concrete (Precast and Cast-in-Place)

VIII. CAST-IN-PLACE CONCRETE

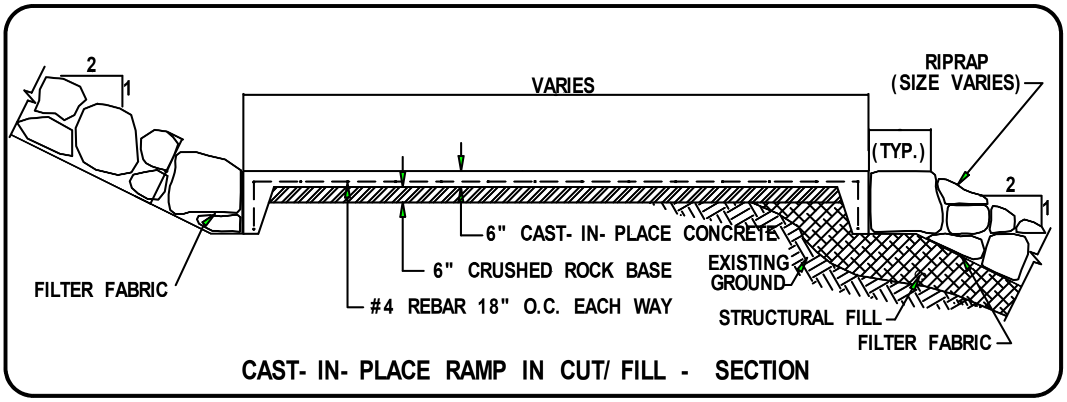
A. General

1. Cast-in-place 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 conditions where marine growth creates a slick coating on the submerged and submersible surfaces of the ramp. Concrete is also structurally superior and more durable than asphalt in marine environments.



CAST- IN- PLACE RAMP AT GRADE - SECTION



B. Application

1. Cut-off walls should be constructed down both sides and across the lower end of the cast-in-place portion of the launch ramp. The 2 ft. deep, tapered cut-off walls around the perimeter of the ramp help protect it from being undermined in case of erosion protection (riprap) failure.

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

3. The cast-in-place ramp should be reinforced with #4 rebar, both directions, in a 12"x 12" grid.

4. Block-outs or cut-outs for any piles that may need to go through part of the ramp need to be considered. Also, provide a block-out for the abutment if docks are a part of the project. Rebar should run through the block-out boards to tie the abutment and ramp together.

5. The concrete should be placed on a 6" thick compacted leveling course of 3/4"-0" aggregate base.

6. Attempting to do a V-groove finish when the width exceeds 20 ft. is not recommended. It is difficult to control the V-groove finish tool and apply the required pressure to form grooves in the concrete. The ramp should be divided into widths not more than 20 ft. with longitudinal joint(s). This creates widths for manageable V-grooving.

7. When dividing the ramp into longitudinal cold joints, the joints should fall in the center of a single lane ramp with floats, at the edges of each lane for a multi-laned ramp for painted lane delineation, or under the boarding floats.

8. When forming for longitudinal joints the form boards should be notched to allow rebar to run through the joint. Rebar shall be blocked up off the aggregate base with 3" high blocks or stands designed for that purpose.

9. Curbs along the sides of ramp keep any parking area run-off on the ramp and keep it from potentially eroding the material next to the ramp.

10. Curbs at the end of a ramp help a user determine when the trailer is at the end of the ramp. However, sedimentation may fill in the face of the curb creating a ramped surface. It may not be readily apparent when the trailer tires are at the curb and the boater may inadvertently back over the curb catching the trailer. The Division of Watercraft does not recommend curbs at the end of the ramp.

C. Design

1. Cast-in-Place Ramp Thickness

   Preferred: 6" Min.

2. Cast-in-Place Concrete Compressive Strength

   Preferred: 4,000 psi Min.

3. End of Cast-in-Place Concrete Ramp

Preferred for Rivers:	Min. 2.0 ft. above anticipated water elevation at the time of construction.
Preferred for Reservoirs:	Entire ramp should be cast-in-place and placed after reservoir has been drawn down to lowest water level.
Preferred for Lakes:	Min. 2.0 ft. above anticipated water elevation at the time of construction.

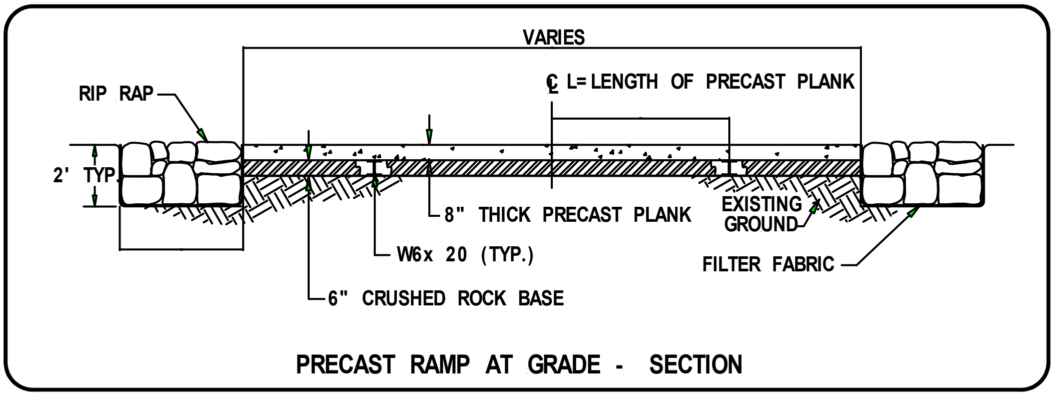
IX. <u>PRECAST CONCRETE PLANKS</u>

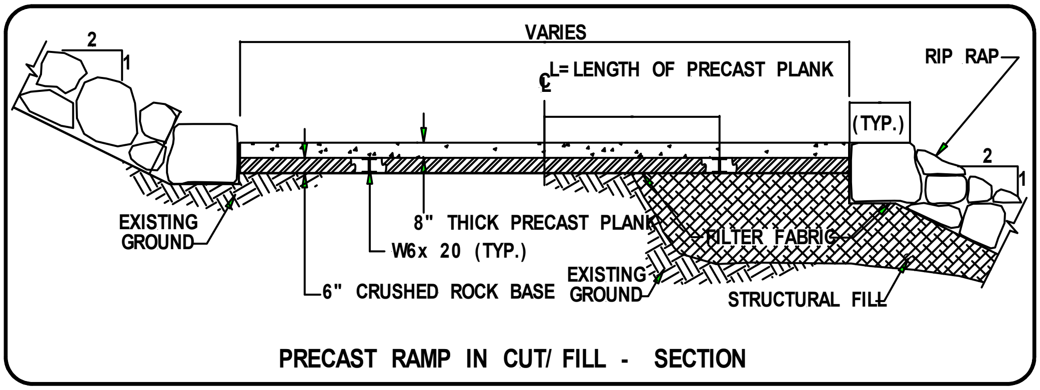
A. General

1. Precast concrete planks are small manageable slabs of concrete that are cast-in-place at an upland location. The planks are cast before they are moved, used, or located in their final position, hence the term "precast."

2. 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 necessary to cast the concrete in place.

3. Generally, the construction cost of the precast portion of the ramp is twice as expensive, per square unit, as the cast-in-place portion of the ramp. Therefore, scheduling of the project during times of low water is crucial in keeping the construction cost down.





B. Application

1. The interlocking tongue and groove planks eliminate the gap between logs that would expose the aggregate base to erosion by the river flow and/or prop wash. This hazard for boaters often results in twisted or broken ankles. In extreme cases the aggregate base supporting the logs has been eroded away causing a failure in that portion of the ramp.

2. The beginning elevation of the precast portion of the ramp is determined in part by the control elevation at the toe. When the toe elevation has been established, add the required number of 4 ft. wide planks until the top of the planks is at least 2 ft. vertical above the water level during construction.

3. Plank lengths from 15 ft. to 30 ft. have typically been used in ramp construction. Planks longer than 30 ft. are difficult to handle and place in 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 should be epoxy coated.

5. Locate the joints of the precast planks, for ramps with multiple lanes, under the boarding docks. Any misalignment in the adjacent planks will not be seen or cause a trip hazard for the users of the facility.

6. Avoidance of dewatering operations for launch ramp construction projects should be considered whenever possible. It has been our experience that the operation often costs more time and money than simply using precast planks. The dewatering operations disrupt more of the marine environment than placing precast planks. This could have a major impact on the permitting for the project.

7. It is recommended that a silt curtain be used around the perimeter of the precast plank placement operation. This will reduce the migration of turbidity beyond the construction zone within the waterway.

C. Design

1. Plank Size

   Preferred: 8" Min. Thickness and 4 ft. Wide w/ Tongue & Groove

2. Compressive Strength

   Preferred: 4,000 psi Min.

3. Begin Precast Section

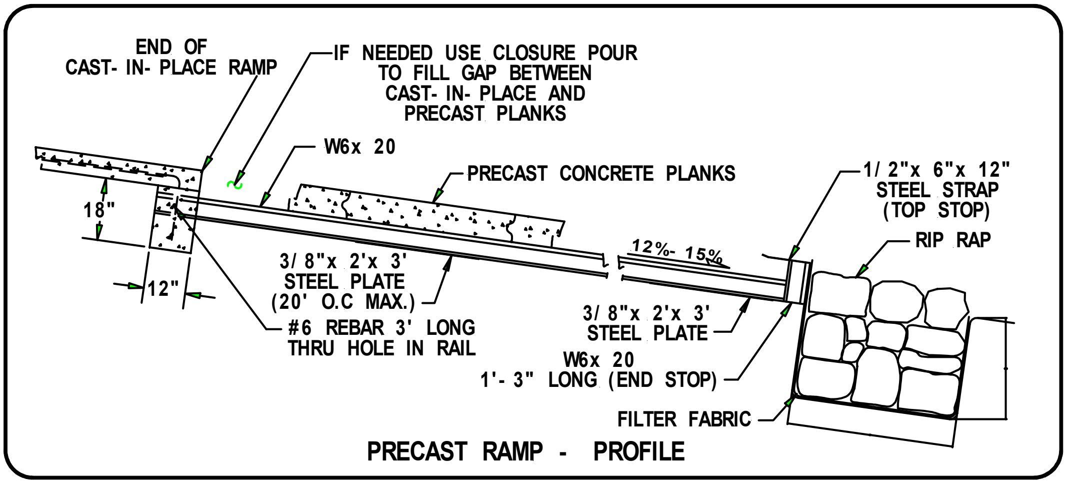
   Preferred Rivers: Min. 2.0 ft. above water elevation at time of construction.
   Preferred Lakes: Min. 2.0 ft. above water elevation at time of construction.

X. RAIL SYSTEM FOR PRECAST PLANKS

A. General

1. The primary purpose of the rail system is to keep the tongue and groove precast planks interlocked. The rails are not intended to provide support for the weight of the planks, that is the purpose of the subgrade.

2. A steel rail system constructed from W-beams provides grade control during construction of the precast portion of the ramp and holds the planks together after the construction is complete.



B. Application

1. Welding the two rails together with cross members into a single unit is recommended. 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.

2. Six-inch deep beams are used for the rails 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 screeded off to the top of the rails.

3. The rail length should be long enough to extend into the lower end of the cast-in-place portion of the ramp to tie both portions of the ramp together.

C. Design

1. Rail Construction

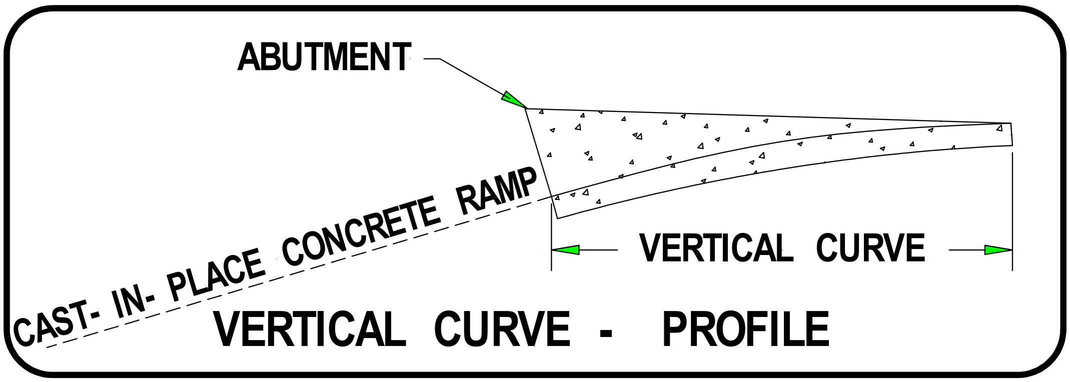
Preferred Shape: W 6x20

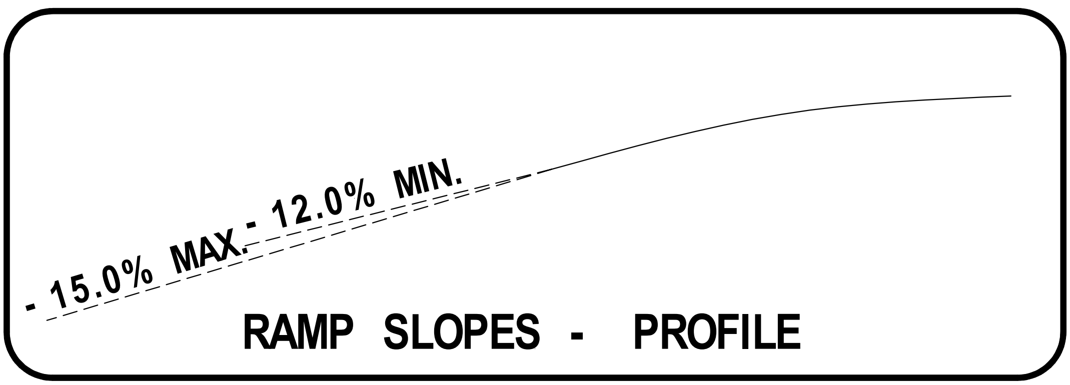
XI. VERTICAL CURVE

A. General

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

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





B. Application

1. The vertical curve should be located at the change of grade between the ramp slope and the maneuver area slope, generally the upper most portion of the launch ramp. Typically a 20 ft. long vertical curve is adequate for a 12% change in grade (2% maneuver area with a 14% ramp). See recommendations below for other grade combinations.

C. Design

1. Vertical Curve (V.C.) Lengths

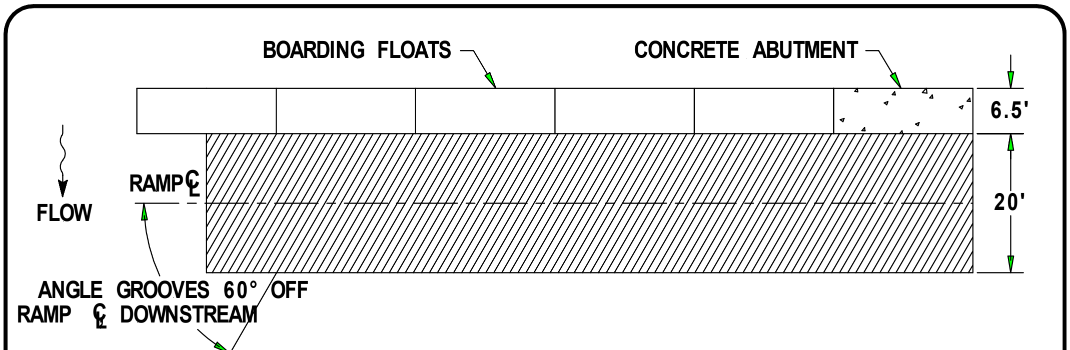
10 ft. V.C.	For 5% to 7% Change in Grade
15 ft. V.C.	For 8% to 10% Change in Grade
20 ft. V.C.	For 11% to 13% Change in Grade
25 ft. V.C.	For 14% to 15% Change in Grade

XII. <u>CONCRETE FINISH</u>

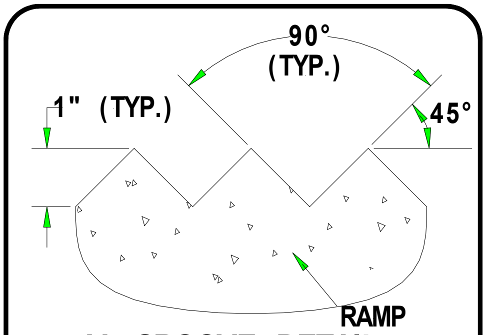
A. General

1. All concrete launch ramps shall 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 particularly important where marine growth is particularly heavy.

2. The grooves also serve a secondary purpose by helping keep the ramp surface clean. Wave action and water, carried up the ramp by boats being retrieved, wash debris down the grooves to the down stream side of the ramp.



V- GROOVE - PLAN



V- GROOVE DETAIL

B. Application

1. The 1" deep V-grooves are formed in the ramp surface immediately after the concrete is placed in the forms and leveled with a power screed or screed board. A special finishing tool is fabricated from 1-1/4" steel or aluminum angles welded together to form the V-grooves.

2. The grooves shall be formed in the ramp surface angled 60 degrees from the longitudinal axis of the ramp and oriented to the down stream side of the ramp. This will carry small debris to the downstream side of the ramp where it can be carried away by the current.

3. Success in forming 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" wide edger. This gives the ramp a clean finished look because of the difficulty in finishing the 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.

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

   a. That portion from the top of the abutment to the top of the ramp and as wide as the abutment. This portion should have a broom finish to provide an accessible walking surface to the abutment.

   b. That portion which lies beneath the boarding floats.

C. Design

1. Ramp Surface

   Preferred: 1" V-Grooves

XIII. <u>RIPRAP</u>

A. General

1. Riprap is fractured stone with angular faces used to armor 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, in pounds, of the largest stones in the class.

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, and wakes) on the structure.

2. Riprap is typically placed on a layer of geotextile fabric. This layer helps keep the subbase from being washed out through the openings of the riprap.

3. Type C is the minimum size riprap recommended at the ramp toe and along the sides or precast concrete portions of a launch ramp.

4. A typical construction procedure is to trench for the riprap around the perimeter of the ramp 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 ramp, the riprap is pulled into the trench and tamped into place with a backhoe with rubber tires. This method keeps the trucks and track hoes off the new ramp and prevents the riprap from damaging the ramp surface when handled.

C. Design

1. Riprap Size

   Preferred: Type A or B (ODOT)
   Minimum: Type C (ODOT)

BOARDING DOCKS

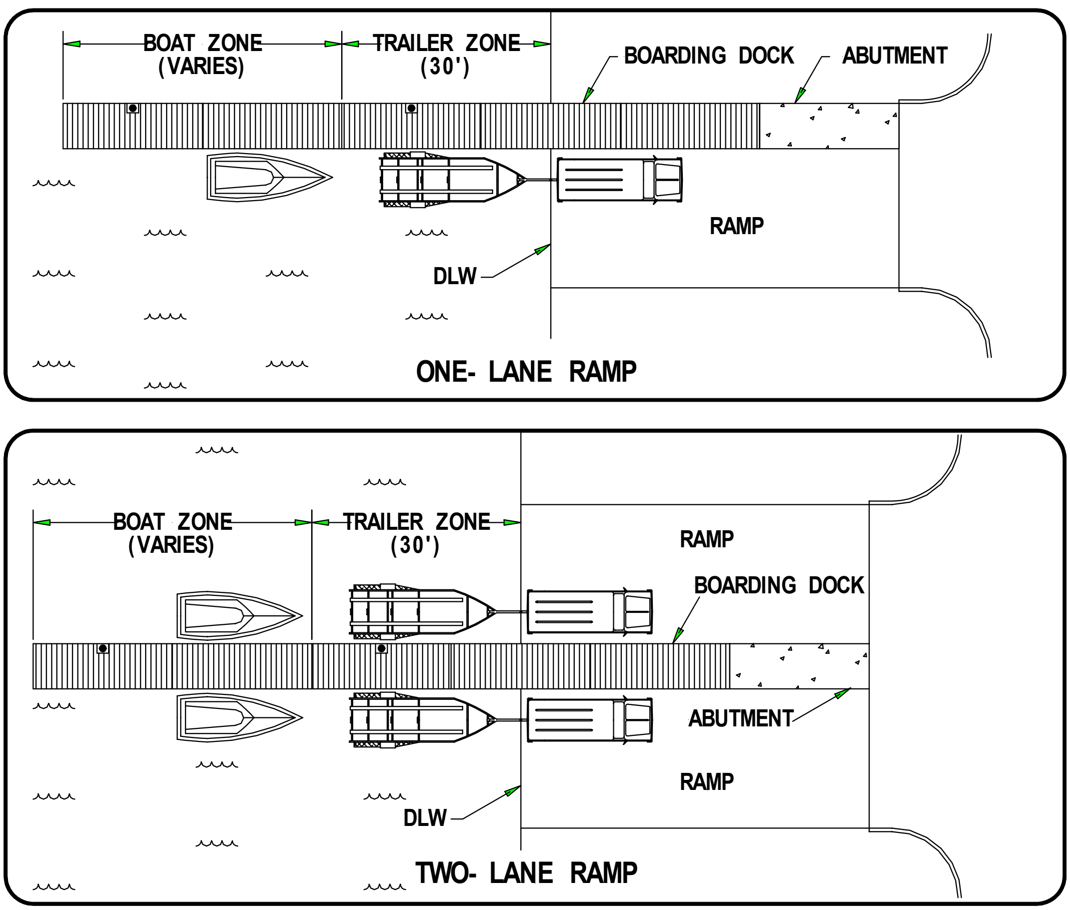
I. PLACEMENT AND LAYOUT

A. General

1. Boarding docks serve as a means to help safely and efficiently launch, retrieve, load and unload boaters at boat launch facilities.

2. The placement of boarding docks whether on one side of the ramp or the other, 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 ramp.

3. Boarding dock 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. A long string of docks may be angled up to 90 degrees (dogleg) to avoid navigation channels or exposure to current, debris, or waves.



B. Application

1. Boarding docks are preferably placed along the right side edge (facing the water) of a single lane ramp. This helps drivers to “spot” the ramp while backing their trailers down the ramp. For all rivers, however, boarding docks should be placed on the upstream side of the ramp with the piles on the upstream side of the dock.

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

3. On two lane ramps where one set of boarding docks exist, they should be placed down the center of the ramp providing access to the float from either lane. In this case, piles are placed just inside the dock (internal pile pocket) on the upstream side to optimize boat moorage capacity on each side.

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

5. Beyond the boat trailer launch zone, every 20 ft. of boarding docks will serve 1 boat (one side) or 2 boats (both sides).

6. Maneuver areas around the docks and ramp should have a minimum water depth of 3 ft. at DLW. This depth has been found to accommodate most all trailerable boats less than 26 ft.

C. Design

1. Preferred Location of Docks

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

2. Water Depth at DLW

Preferred :	4 ft.
Minimum:	3 ft.
Maximum:	N/A

3. Preferred length of courtesy docks in water at DLW based on number of trailer parking spaces.

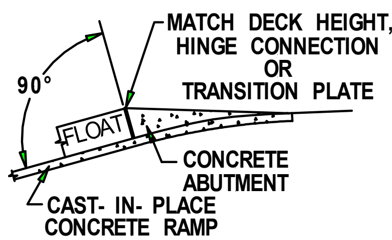
ONE LANE RAMP		TWO LANE RAMP	
Parking Spaces	Courtesty Docks	Parking Spaces	Courtesy Docks
10 - 20	50 ft.	30 - 40	50 ft.
21 - 30	70 ft.	41- 60	70 ft.
31 - 40	90 ft.	61 - 80	90 ft.
41 - 50	110 ft.	81 - 100	110 ft.

II. ABUTMENT

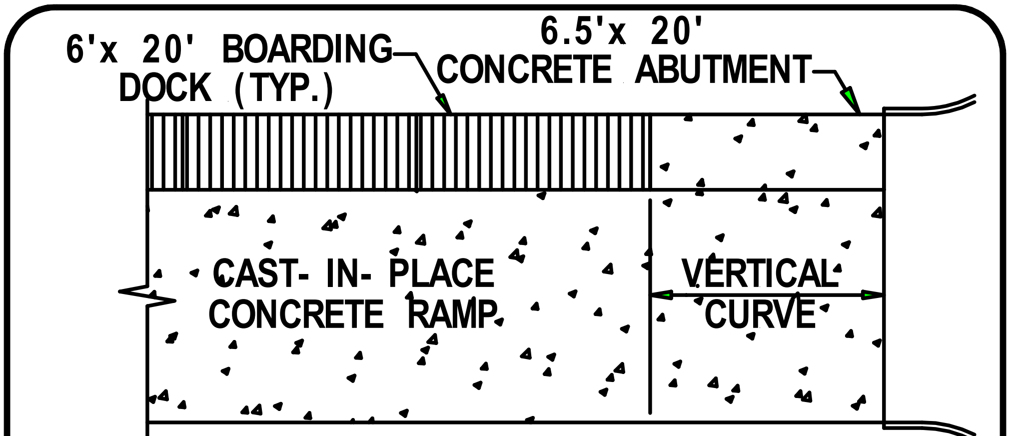
A. General

1. Abutments provide ramped pedestrian access to boarding docks at or near the top of the launch ramp. The abutment may also act as an anchor for the top end of the boarding docks.

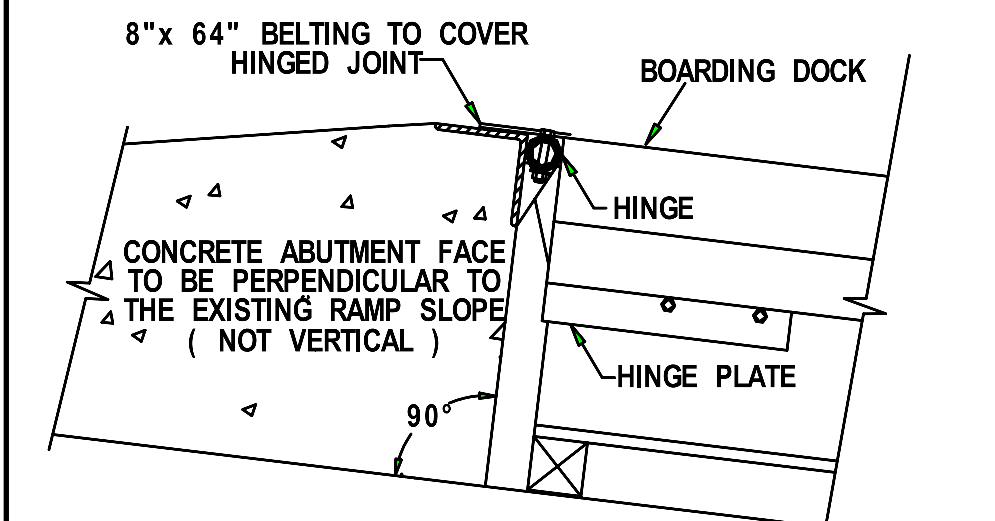
2. Docks should have a hinged connection at sites where the abutment is located above the floodplain. If the abutment is located below the floodplain a transition plate should be used (see hardware section for details).



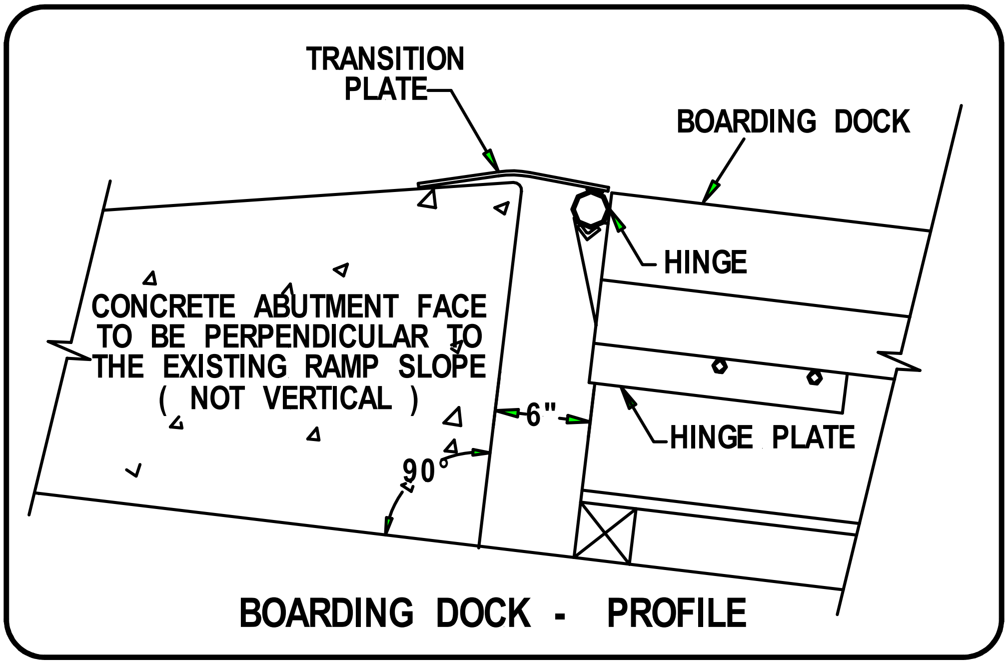
ABUTMENT PROFILE



RAMP PLAN



BOARDING DOCK - PROFILE



B. Application

1. An abutment is a block of cast-in-place concrete with a rough broom finish on all surfaces and all edges finished to a 1" radius.

2. Generally the abutment is the same length as the vertical curve. In cases where the abutment is longer than the vertical curve, the abutment should start at the top of the 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 vertical tangency).

3. When the abutment is located within a ramp, the ramp is cast first and a section of the ramp is blocked out for the abutment. The abutment should not be cast on top of the ramp. This practice tends to cause the beginning portion of the abutment surface to break off leaving a lip.

4. If the abutment is adjacent to the ramp the bottom of the abutment should be cast 12" below existing ground. If the abutment is within the ramp, the base should be set 6" below the ramp surface. In addition, the ramp rebar grid should extend through the block out for the abutment.

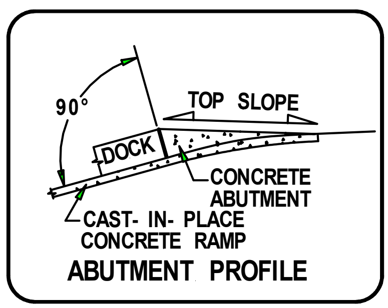
5. It is recommended that traffic delineator(s) be epoxied to the ramp side(s) of each abutment. This will help the boater in locating the edge of the abutment and docks as the trailer is backed over the vertical curve.

6. The offshore face of the abutment should be perpendicular to the ramp surface and not vertical. If the abutment face is vertical then the bottom of the dock could bear against the face of the abutment before the dock grounds out on the ramp surface. This results in damage to the dock and/or the dock hinged connection to the abutment.

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

8. At sites where the abutment is located adjacent to the launch ramp and the shore-end of the abutment does not abut hard surfacing, a concrete landing should be provided. The landing should be at least 5'-0" long by the width of the abutment. This will provide access from the abutment to the ramp.

9. Ideally an abutment top slope should be flat 2% +/- and is generally considered too long if the top surface exceeds a negative 2% slope. Design values given below will assist in selecting the appropriate abutment length for the vertical curve used.



C. Design

1. Abutment Lengths:

10 ft. V.C.	15 ft. Abutment	+2.7% +/- Top Slope
	20 ft. Abutment	- 1.5% +/- Top Slope
15 ft. V.C.	15 ft. Abutment	+4.7% +/- Top Slope
	20 ft. Abutment	0.0% +/- Top Slope
20 ft. V.C.	15 ft. Abutment	+3.2% +/- Top Slope
	20 ft. Abutment	+1.5% +/- Top Slope
	25 ft. Abutment	-1.6% +/- Top Slope

25 ft. V.C.	15 ft. Abutment	+2.3% +/- Top Slope
	20 ft. Abutment	+0.3% +/- Top Slope
	25 ft. Abutment	-0.4% +/- Top Slope

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

2. Abutment Width

Preferred: 6'-6" Wide Abutment for 6 ft. nominal width floats.

III. DIMENSIONS

A. General

1. Boarding docks 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 dock. Also, adequate width should be provided so boaters may pass each other without getting too close to the edge of the dock.

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

B. Application

1. Boarding docks are typically constructed in 6' x 20' sections. These docks remedy the problem of boats grounding out on shore and provide a safe platform for loading and unloading of passengers. Docks less than 6 ft. wide tend to be unstable and do not provide adequate room for pedestrian traffic or work from both sides simultaneously. Docks less than 20 ft. in length require more hinges and are generally more unstable.

2. Minimum clear travel width of a dock deck should not be less that 5'-0" (60") between cleats and other mooring hardware mounted along the edges of the float. If internal piles are used then the minimum clear width at the pile may be reduced to 36".

3. Deck height can usually be kept to less than 24" from the ramp surface, when grounded out, depending on the design. Heights less than 24" provide a manageable step from the dock deck to ramp surface without getting down by way of the abutment or use of a ladder.

4. Maximum overall height of boarding docks should not exceed 30" where dock sections will come to rest on the upper reaches of the launch ramp during periods of low water.

5. If exceeding a 30" maximum height is necessary, safety hand rails should be provided. However, rails make launching and retrieving boats difficult and usually interfere with the efficient movement of people, boats and boat lines along the dock. Therefore, every effort should be made to keep the overall height of the boarding docks to 30" or less.

C. Design

1. Dock Width

Preferred:	6 ft.
Minimum:	5 ft.
Maximum:	8 ft.

2. Dock Length

Preferred:	20 ft.
Minimum:	15 ft.
Maximum:	25 ft.

IV. 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 dock. It is the dimension used to match the dock to the boats for which it is designed to serve.

B. APPLICATION AND DESIGN

1. Dead Load Design.

a. Dead load is defined as the weight of the entire dock and utilities including all electric, water, sewage, fire, dock boxes, power pedestals, pile guides, winch stands, cable and chain weight, cleats, etc. Pipes carrying liquids shall be assumed to be full when calculating dead load.

b. Dead load freeboard shall be designed as follows:

For inland lakes: 18" to 22".
For Lake Erie: 22" to 26".

c. Structural frame members shall be a minimum of 5 inches above the water at full dead load for the life of the dock system.

1. Vertical Live Load Design

a. All dock walking surfaces shall have adequate flotation under them to support all dead loads plus a minimum of 30 pounds per square foot live load.

b. Additional flotation shall be provided under docks at bridges so as to prevent loss of freeboard (defined as 25 percent of total freeboard) under the bottom of the bridge with a 50% design live load condition.

c. Under dead and full live load, there shall be a minimum freeboard of 6 inches.

d. When a 400 pound load is applied in the center of a finger dock or cantilever dock, 2 foot from the outer end, there shall be no more than 4 inches loss of freeboard at the end of the dock.

e. If docks cantilever off of the shore, there shall be no more than 4 inches of loss of freeboard when a 400 pound load is applied to the junction of the bridge and the first dock section.

f. When a 200 pound load is applied to one outer corner of a finger dock or cantilever dock, there shall be no more than 2 inches of difference in freeboard across the end of a 3 foot wide finger, and proportionally more on wider fingers.

3. Horizontal Live Load Design

a. Wind Loads

Wind loads shall be 15 pounds per square foot (77 miles per hour) approaching from any and all directions. Loads shall be calculated perpendicular to diagonally opposite corners of the dock, perpendicular to the main walk and perpendicular to dock fingers.

Wind loads shall be applied to the dock continuously without any deductions for walkways, fingers or open areas between boats.

Wind loads shall be applied to a vertical plane from the water surface up to the average high profile of all boats expected to use that dock. Boat profile heights shall be used in calculating the design loads on the anchorage system according to the following table:

FINGER LENGTH	BOAT LENGTH*	PROFILE HEIGHT**
16'	16'	7'
20'	20	7'
24'	24'	7'
28'	28'	7.5'
32'	32'	8'
36'	36'	8.5'
40'	40'	9'

* Includes swim platform and bow pulpit lengths.

** For Lake Erie and Ohio River for 32’, 36’ and 40’ use 40% of length for profile height.

Wind loads shall be applied 100 percent to the exposed boats and an additional 15 percent to each shielded boat behind the exposed boat.

b. Wave Loads

Docks shall be designed to withstand 1-foot continuous waves and occasional waves up to 2.5 foot for duration of four hours.

c. Current Loads

Docks shall be designed to withstand up to a 2 foot per second current flow perpendicular to the finger dock. The load shall be applied to the maximum size boat, which could normally use that slip with appropriate underwater draft.

d. Combined Loads

Anchorage design shall be adequate to withstand wind, wave and currents and shall be applied cumulative.

e. Ice Loads

The structures, floats and anchorage system shall be designed to withstand the forces of NON moving ice without damage. "Winterization Procedures" for moving ice shall be provided in the winterization manual furnished by the contractor/dock manufacturer.

f. Impact Loads

All main walk docks, finger docks and connections shall be designed to resist the impact of a boat, the length of the finger, striking the edge of the finger dock, at the outer end, at a maximum angle of 10 degrees to the dock centerline at a velocity of 3 feet per second. Boat weights for various boat lengths shall be assumed as follows:

20 foot 4,000 pounds	40 foot 34,000 pounds
24 foot 8,000 pounds	44 foot 44,000 pounds
28 foot 13,000 pounds	48 foot 50,000 pounds
32 foot 18,000 pounds	52 foot 70,000 pounds
36 foot 26,000 pounds	56 foot 80,000 pounds

C. BRIDGE DESIGN LOADINGS

1. Bridges shall be designed to support a full live load of 50 pounds per square foot.

2. Bridge handrails shall be designed for a 250 pound load applied in any direction and at any point along the handrail. Railing shall also be designed for 30 pounds per linear foot applied to the top rail.

3. Bridge substructure shall have sufficient strength to resist all live and dead loads listed without excessive deformation. Substructure shall be designed to support full live and dead loads for the length of the bridge span with a maximum deflection of L/180 (ultimate strength method).

D. FLEXIBLE CONNECTIONS

1. Each dock unit shall be connected to each adjacent dock unit with flexible connections capable of transmitting all loads and forces upon each dock unit and each series of dock units, including the combined transverse and longitudinal effects of wind action, wave action, and bumping and ramming by average pleasure craft.

V. CONSTRUCTION

A. GENERAL

Floating docks made with wood decking on a metal frame attached to black expanded-in-place polystyrene floats have typically worked best in Ohio.

B. APPLICATION

1. Dock Substructure

C. Individual dock units shall be made up of steel or aluminum welded together to make a structural frame. The structure shall carry all design loads (as per Part 1.09 B of this specification). Decking and flotation shall not contribute to structural strength.

D. Modifications to structural frame for anchorage system, attachments, etc. shall be factory fabricated prior to dock assembly and galvanized.

E. All structural steel frames shall be hot-dip galvanized after being completely assembled and all welds, drilled holes, etc. are performed.

2. Flotation

A. Individual flotation units shall be attached directly to the structural frame, using a minimum 3/8” bolt, washer and nut fastener which have a life expectancy as long as the flotation unit itself. Fasteners are all not permitted to penetrate float encasements under any circumstances. All mounting slots of float must be bolted to the frame if dock is exposed to wave action, otherwise at least four mounting slots must be used to mount float.

B. Both sides and ends of float must be supported by the dock frame. Minimum frame support of float drum must be every 48” by 48” or 16 square feet.

C. Flotation units shall be attached in such a manner as to allow easy removal or replacement of damaged units.

3. Decking on Docks

A. Deck boards shall be laid along the long axis or at right angles of docks with "best side" up and if no best side, then bark side up. Factory spacing between boards shall be set at 1/8 inch. When butting deck boards offset each joint and attach to next double metal structural support.

B. Deck boards shall be attached to structural supports with self-tapping flat head screws at a maximum of 3-foot centers, 2 screws at intermediate supports and 3 screws at deck board ends and joints. Deck screws shall be zinc or cadmium plated and be driven flush with the upper surface of the decking so as to not splinter or split the board or enable water to pond in screw head. Stainless steel flat head screws shall be used with aluminum frames.

C. Structural metal supports for deck boards shall be a minimum of 2 inches wide with double supports at all deck board splices including each offset joint location.

D. Butted boards shall be of the same size and thickness aligning with each other and have square cut ends.

E. At the ends of individual docks units the deck boards shall be chamfered or rounded to about 45 degrees back between 1/8 inch and 1/4 inch.

F. Wood rub rails shall be 2x8 boards, with single planks in runs up to 20 foot. Lengths over 20 feet shall be made up of multiple long lengths with minimum 8-foot lengths, where possible. Joints shall fall a minimum of 2 feet away from structural frame joints.

4. Bridges

A. Floating dock bridges, unless specified as aluminum, shall be of similar construction and materials as floating docks, with the exception that flotation in bridges may be encased pre-formed billets instead of the specified flotation units.

B. Bridge decking shall meet the requirements of dock decking except that boards shall be at right angles to the length of the bridge and shall be supported in the middle of the span.

C. Bridges shall have railings on both sides with a top rail at 42 inches and a mid rail at approximately 21 inches. For ADA bridges an additional handrail and a toe rail shall also be provided per ADA requirements.

D. Ends of top handrails shall run the full length of the bridge horizontally and then curve downward to the base of the bridge extending past the ends of the bridge a minimum of 1 foot. Ends shall be curved or mitered.

E. Handrails shall be smooth with no open joints, burrs, zinc deposits, etc., which would cause possible, cuts on a person's hand.

F. Bridge and ramp decks of dock units shown on the drawings shall be covered their length and width with matting as manufactured by Koneta Industrial Products, telephone number 1-800-331-0775 or approved equal. The mat shall be fastened on approximately 1-foot centers with flat head or oval head screws. Provide beveled ends with a slope no greater than 2:1 on rubber matting per ADA guidelines. ADA bridges shall use Nyracord Drain – EZ matting with ribs running parallel to length of bridge. Non-ADA bridges shall use Nyracord Counter Tred, open slot with 80% recycled rubber content.

5. Connections

A. Connections between docks, bridges, and shoreline abutments or dock abutments (where required) shall be made flexible as indicated on the detailed drawings and approved shop drawings. Connections shall be made by double shear connectors at the outer edges of dock or bridge units with a maximum opening of 1-½ inches. For ADA docks maximum opening shall also be 1/2 inch between units.

B. Structural parts of connectors shall be of the same base metal as the dock's structural frame. Bolts, lock nuts and washers shall be stainless, galvanized or cadmium plated steel.

C. Connections shall not protrude above the level of the deck and shall present a relatively smooth top surface with no sharp edges, or upward projections. Connections may have sufficient "play" to permit them to work freely, but such "play" shall be controlled to prevent no more than 1/2-inch transverse movement. The maximum difference between the bolt diameter and hole diameter shall be 1/16 inch.

D. Where there are wheels at the dock end of a bridge, there shall be no more than a 6-inch drop to the deck. A transition plate, properly reinforced, shall be placed at the end of the bridge and have a slope no greater than 1:4. The wear edge shall be rounded for easy sliding on the deck. For ADA docks and bridges, the slope of the transition plate shall be no greater than 1:12. The dock section under the bridge wheels shall have protective metal plates under the wheels.

6. Dock Accessories

A. Dock cleats shall be bolted thru the deck boards and into the dock structural framework. Bolts shall be galvanized or cadmium plated. Cleats shall be provided where shown on the drawing.

B. Bumpers/rub strips shall be attached to dock facia boards with 1" galvanized roofing nails or 1 ½ inch long x 1 inch wide staples at 4 inch maximum centers in a neat and repeated pattern on both top and bottom flanges. Dock fascia boards are to be attached to the frame with flat head truss bolts at maximum 5-foot centers. Hinge plates are to rotate freely through the full range of rotation required.

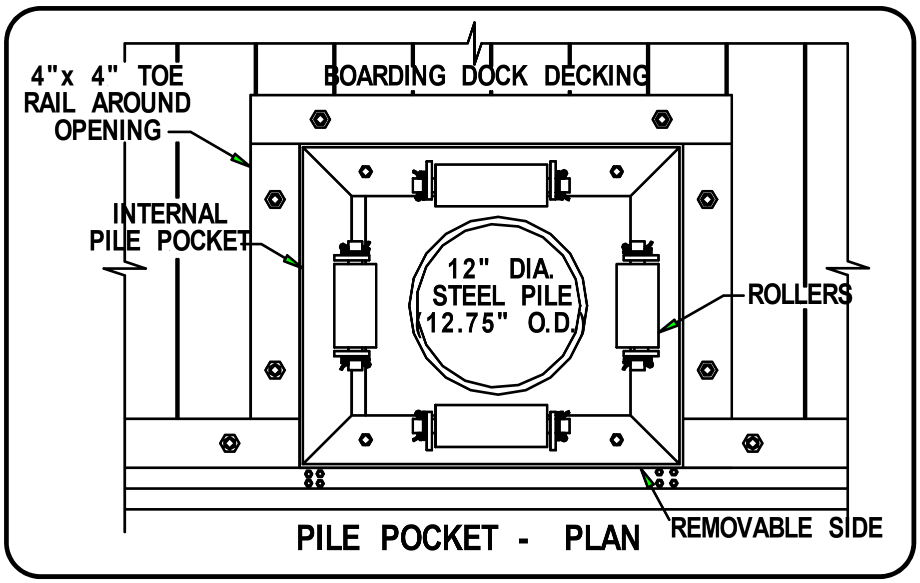
C. Exposed corners of floating docks shall have vertical pieces of bumper material attached the full depth of the rub rail.

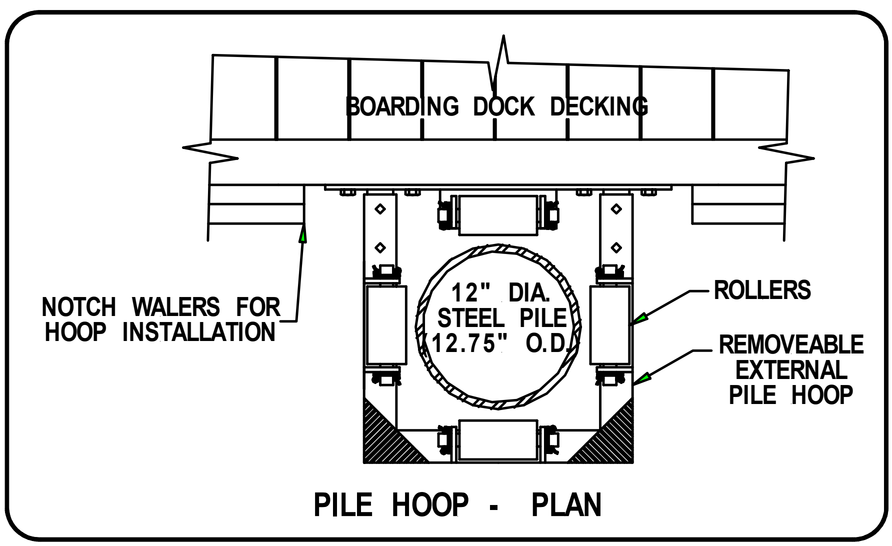
VI. PILE HOOPS AND POCKETS

A. General

1. All docks secured by piles should have adequate room within the pile guide to compensate for dock travel. This is particularly true for boarding docks where the pile hoops and pockets are rectangular with the long dimension parallel to the longitudinal axis of the dock. 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 dock frame. With this option both sides of the docks allow unrestricted use by boaters. External hoops are sometimes used. In this design a steel hoop is through bolted or lag screwed to the outside of the dock frame member. This type works well in retrofits or where difficult sites require that pile locations be adjusted in the field.





B. Application

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

2. Boarding docks have two clearances between the pile and the pile hoop/roller due to its rectangular shape. Clearance for the narrow dimension should be 3/4" on each side of the pile for a 12" diameter steel pile. For other pile sizes the clear dimension inside the guide should be 1-1/2" greater that the largest outside diameter of the pile. On the long dimension of the guide the clearance should be 2-3/8" on each side of the pile (12" dia. steel) or, for other pile sizes, a clear inside dimension of 4-3/4" greater than the largest outside diameter of the pile.

3. UHMW plastic rollers of wear blocks are used to reduce wear on piles and provide a quiet, smooth transition between varied water levels.

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

C. Design

1. Materials

Preferred: Galvanized tubular steel frames for external hoops.
UHMW rollers or wear pads.

GANGWAYS

I. CONSTRUCTION

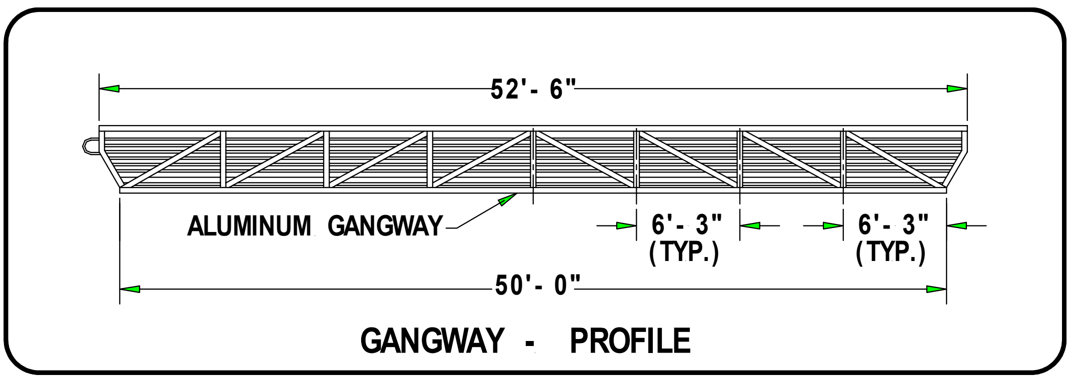
A. General

1. Gangways are walkways that are hinged at a pier or abutment with the other end supported by a transient or boarding dock.

2. Gangways are typically used to provide pedestrian access between a fixed pier/abutment and a transient dock. They provide a transition from land to water and vice versa.

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

4. Slope can be improved by increasing the length of the gangway and/or lowering the elevation at the pier/abutment. Careful evaluation of DLW and DHW should be considered.



B. Application

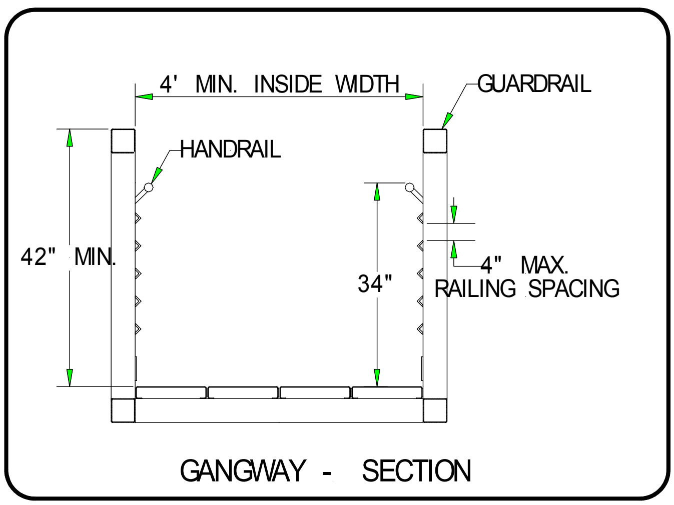
1. Structural aluminum is the preferred material for gangway construction. Aluminum is strong, lightweight, and has excellent corrosion resistance.

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 has worked out very well except at locations where loaded hand trucks deform the grating or where significant bare foot traffic is anticipated. In those locations, wood decking with rubber matting can be used. This type of decking is less abrasive making it far more comfortable for bare foot walking. It is also less likely to deform under heavy concentrated loads.

3. There are specified ADAAG requirements for gangway accessibility. Because DLW - DHW elevations generally exceed 5 ft. vertical, gangways often exceed the 8.33% maximum slope established for landside walkway and ramp applications. However, every effort should be made to incorporate barrier-free elements 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. Guidelines by ADAAG permit gangways to be up to 80 ft. in length without any intermediate landings. Division of Watercraft considers gangways to be “accessible” in this range provided other specified criteria are met. The 80 ft. length is inclusive of the transition plate at the bottom of the gangway.

5. Typically gangways are 4 feet wide. This dimension includes required handrails. Gangways should be no wider than is necessary to provide adequate room for the anticipated use. A 4 ft. wide gangway is suitable for most applications and will allow two people to safely pass each other. Wider gangways may be necessary at large, high use facilities.



6. Guardrail height shall be a minimum of 42" above the walking surface. Handrails shall be provided on both sides of the gangway at a height of 34". The handrail shall extend 12" beyond the dock end of the gangway with a 6" radius return. Intermediate or mid railing on each side of the gangway shall be used. A 4" wide kick plate shall be installed along the bottom sides 1"-2" off the walking surface.

7. Ultra high molecular weight rollers should be provided under the dock end of the gangway to allow free travel under varied water levels. Rollers should bear at all times on metal plates attached to the dock. Some means of restraint should be applied to the plates to minimize lateral movement of the gangway.

8. In cases where the landside connection for the gangway is below design high water, flotation pods should be considered on the underside of the gangway to float the gangway off the abutment/pier. In these situations piling or some other means of lateral support should be provided at least at the shore end of the gangway. If no piling is provided at the dock end, some type of blocking/stop shall be provided at the downstream side of the gangway to keep the water flow from pushing the gangway off of the dock.

9. Dock deck elevation at design low water is the basis for determining maximum slope. Every effort should be taken to maintain as flat a slope as possible. Preferably the slope should be less than 4 horizontal to 1 vertical.

C. Design

1. Gangway Width

   Preferred/Minimum: 48"

2. Gangway Length

   Preferred: As needed for a maximum of 8.33% slope
   Minimum: N/A
   Maximum: 80 ft.

3. Guardrail Height (above walking surface)

   Required: 42"

4. Hand Rail Height (above walking surface)

   Required: 34"

5. Mid Railing and Kick Plate:

   Required: 34”

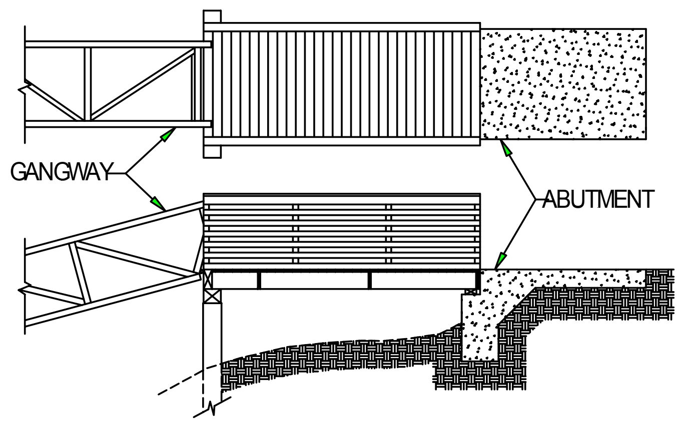
6. Gangway Slope

Preferred :	Less than 4 to 1
Minimum:	N/A (less slope is better)
Maximum:	3 to 1

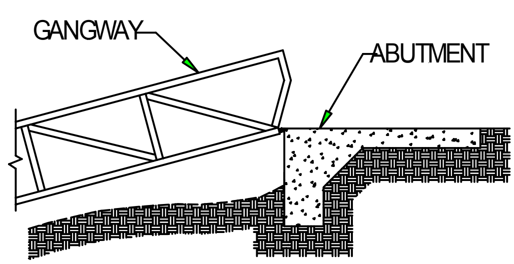
II. LANDSIDE CONNECTIONS

A. General

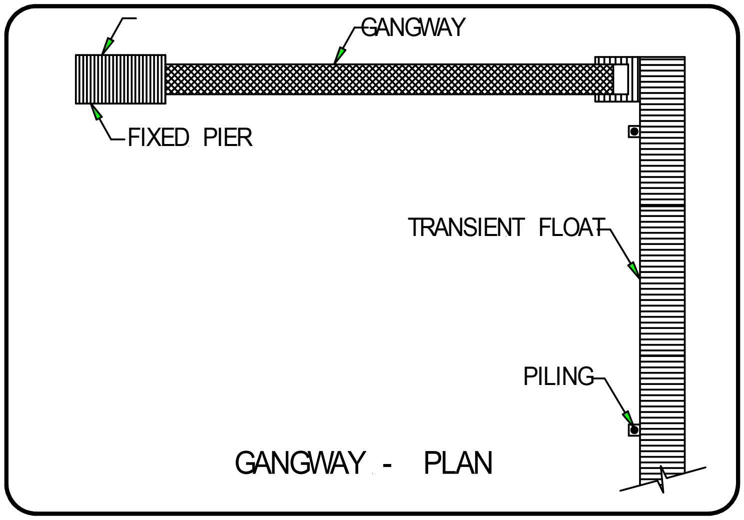
1. There are two types of landside connections typically used for gangways (1) fixed steel pier and, (2) concrete abutment. Each is well suited for different site conditions at the point of connection.



FIXED PIER - PLAN & PROFILE



GANGWAY - PROFILE



B. Application

1. A steel pier is the most versatile means of connection. It can be constructed into the bank or extend out over a gradually sloped or eroded bank. It does not require the need for concrete trucks or mixers. The supporting piles provide both vertical and horizontal support for the pier. There is little concern of potential bank erosion provided adequate pile penetration has been achieved. Piers work well with steep or shallow sloped bank lines and can be used to extend the gangway out over the bank line.

2. A concrete abutment 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.

3. 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".

C. Design

1. Preferred: Concrete Abutment if site conditions are suitable, <u>or:</u>

2. Steel Pier if concrete abutment not feasible.

III. 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 50 psf live load for intermittent pedestrian use. If heavier use is anticipated then a 100 psf loading should be used.

2. Gangways should be designed to minimize dead loads transmitted to transient docks.

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

Minimum:	50 Pounds Per Square Foot (light loading applications)
Minimum	100 Pounds Per Square Foot (heavy loading applications)

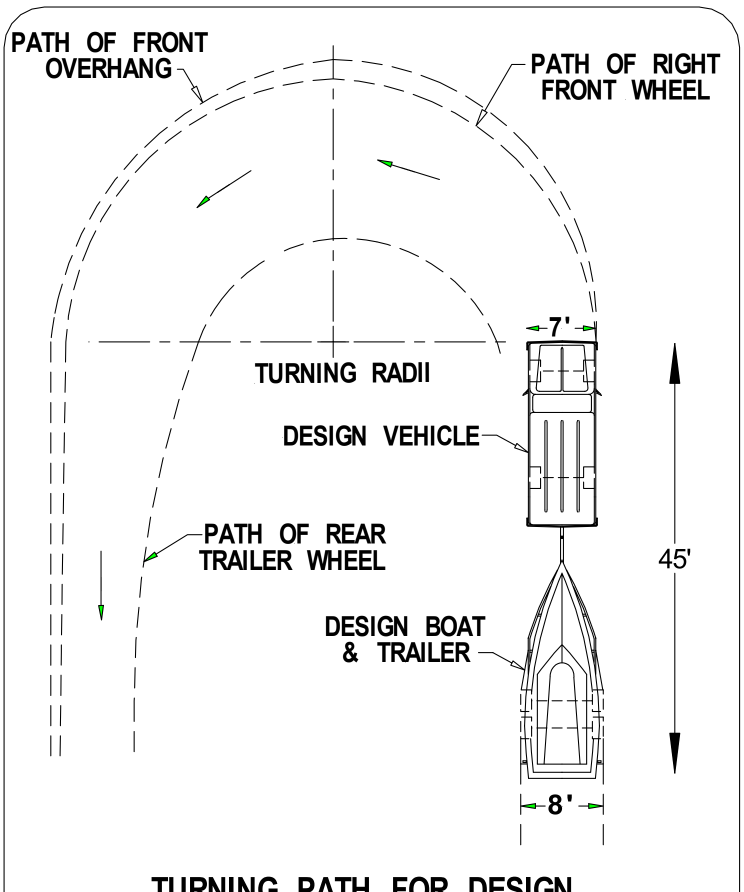
PARKING AND ROADWAYS

I. 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. Typically access roads do not serve other non-boating related areas. The main thoroughfare is considered a public roadway or a primary roadway within a park.

2. All the maneuverability guidelines are based on the dimensions of a design vehicle with boat and trailer. The tow vehicle is 19 ft. long and the trailer with a boat is 26 ft., maximum width is 8.5 ft. These dimensions represent a vehicle/boat trailer combination that is larger than the average. By designing for this size combination then maneuverability for smaller more typical vehicle/boat trailer combinations will be enhanced.



TURNING PATH FOR DESIGN VEHICLE/ TRAILER COMBINATION

B. Application

1. Access roads should be a minimum of 10 ft. (12ft. preferred) wide, per lane, for two-way traffic and 15 ft. wide for one-way traffic. Travel shoulders are usually not required.

2. Curves

   a. Curves greater than 45 degrees on one-way roads should use non-parallel outside/inside curves to allow for adequate wheel travel through the curve. The minimum outside curve radius should be 30 ft. The minimum inside curve radius should be 20 ft.

   b. Curves greater than 45 degrees on two-way roads can use parallel outside/inside curves. Minimum inside radius should be 35 ft.

   c. Curves less than 45 degrees may use parallel inside/outside curves provided the inside curve is not less that 30 ft. radius.

   d. Curves greater than 90 degrees should be avoided.

3. Grades should not exceed 17%. Changes in grade should not exceed 20%. Vertical curves (20 ft. min.) should be provided for any change in grade greater than 7%.

4. Two-way access roads should be oriented as perpendicular as possible to the main roadway that serves the facility. One-way access roads should be oriented so that a turn no greater than 90-degrees is required onto the main roadway. Access roads should be straight with grades not exceeding 5% within 50 ft. of the main roadway.

5. All access roads should be paved with a minimum of 2" asphaltic concrete over a 6" compacted crushed rock base (3/4"-0). No base is required when overlaying an existing asphalt or concrete access road in fair to good condition. Deteriorated areas of asphalt or concrete should be removed and full depth repair completed prior to paving.

6. Gravel access roads should have a minimum 6" of well graded and compacted 3/4"-0 crushed rock. Heavy use may warrant an additional 6" layer of 1-1/2"-0 crushed rock below the 3/4"-0 layer.

7. Base course should extend a minimum of 12" (6” per side) beyond the edge of the asphalt before sloping to grade at a minimum 2 to 1 slope.

8. Access roads should be graded to allow for sheet draining off the sides. If sheet draining of any portion of an access road is not possible then catch basins should be provided to collect and divert all water. No area should be graded as to allow for standing water.

9. All access roads should have any necessary traffic control signs. All asphalt surfaced access roads should be striped and painted with appropriate traffic control markings as required.

C. Design

1. Lane width

Preferred:	12 ft. (Two-way)	15 ft. (One-way)
Minimum.:	10 ft. (Two-way)	15 ft. (One-way)
Maximum:	N/A	

2. Inside Radius of Curves Less Than 45 degrees (all road or lane widths)

Preferred:	As large as possible
Minimum:	30 ft.
Maximum:	300 ft.

Outside curve radius should be a parallel offset of the inside curve

3. Inside Radius of Curves 45-90 Degrees (road or lane width 20 ft. and greater)

Preferred:	As large as possible
Minimum:	35 ft.
Maximum:	100 ft.

4. Inside/Outside Radii of Curves 45-90 Degrees (lane width less than 20 ft.)

Outside Radius	Inside Radius
30 ft.	27 ft.
35 ft.	30 ft.
40 ft.	33 ft.
45 ft.	36 ft.
50 ft.	39 ft
55 ft.	42 ft.
60 ft.	45 ft.
60+ ft.	Parallel offset distance

5. Access Road Grades and Cross Slopes

Preferred Grade:	1%-10%	Preferred Cross Slope:	0%-2%
Minimum Grade:	N/A	Minimum Cross Slope:	N/A
Maximum Grade:	17%	Maximum Cross Slope:	5%

6. Access Road Changes in Grade

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

II. STAGING AREAS

A. General

1. Staging areas include “make-ready” and “tie-down” spaces that can be provided when approaching and leaving the maneuver area respectively. These 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.

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 make-ready area and one tie-down area.

B. Application

1. The preferred size is 12 ft. wide by 60 ft. long. Spaces are located adjacent and parallel to either or both sides of the access road. Spaces should be located along a straight or gently curved (radius greater than 100 ft.) stretch of the access road. Spaces should be located no closer than 40 ft. from the maneuver area.

2. Ideally, one space of each should be provided for every launch lane. However, site constraints will dictate the actual number of spaces.

3. All staging areas should be paved with a minimum of 2" asphaltic concrete over a 6" compacted crushed rock base (3/4"-0). When paving an existing gravel staging area the base can be reduced to 3". No base is required when overlaying an existing asphalt or concrete staging area in fair to good condition. Deteriorated areas of asphalt or concrete should be removed and brought to grade prior to paving.

4. Gravel staging areas should have a minimum 6" of well graded and compacted 3/4"-0 crushed rock.

5. Base course should extend a minimum of 12" beyond the edge of the asphalt before sloping to grade at a minimum 2 to 1 slope.

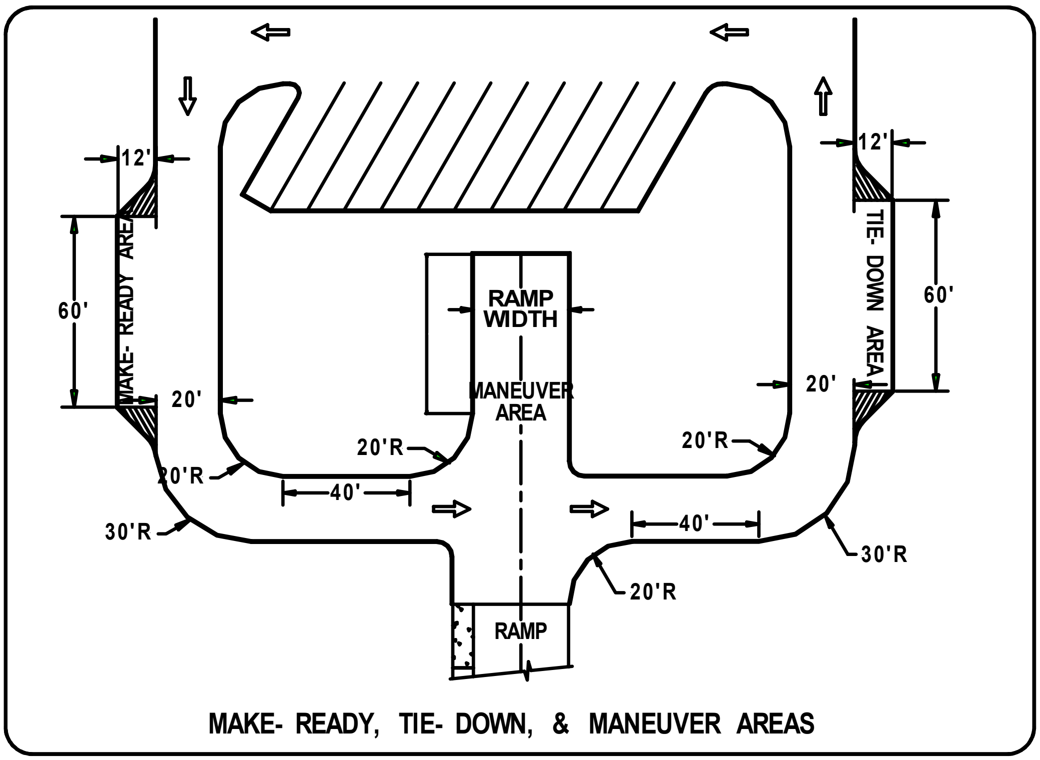
6. Staging areas should be graded to allow for sheet draining off the sides. If the staging areas are curbed then curb cuts should be provided every 20 ft. and at all low points. If sheet draining of any portion of the staging areas is not possible then catch basins should be provided to collect and divert all water. No area should be graded as to allow for standing water.

7. All staging areas should have signs posted. All asphalt surfaced staging areas should be striped and painted with appropriate pavement markings as required.

C. Design

1. Number of Ready and Tie-Down Spaces

Preferred:	One Make-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



III. 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.

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 greater than a 90-degree turn, within the designated maneuver area, in order to be in position to launch.

B. Application

1. The maneuver area should be as wide as, and in-line with, the ramp. Length should be a minimum of 50 ft. from the end of the approach curve. The approach curve should be a minimum 20 ft. radius.

2. The slope of the maneuver area should always be toward the launch ramp. A 0% slope is permissible but should be avoided. Cross slope should be 0% with a maximum 2% allowed.

3. The approach and departure lanes to and from the maneuver area should be a minimum of 15 ft. wide per lane.

4. The maneuver area should be paved with a minimum of 2" asphaltic concrete over a 6" compacted crushed rock base (3/4"-0). When paving an existing maneuver area the base can be reduced to 3". No base is required when overlaying an existing asphalt or concrete maneuver area in fair to good condition. Deteriorated areas of asphalt or concrete should be removed and brought to grade prior to paving.

5. A gravel maneuver area should have a minimum 6" of well graded and compacted 3/4"-0 crushed rock.

6. Base course should extend a minimum of 12” beyond the edge of the asphalt before sloping to grade at a minimum 2 to 1 slope.

7. All maneuver areas should have signs posted. All asphalt surfaced maneuver areas should be striped and painted with appropriate pavement and traffic control markings as required.

C. Design

1. Maneuver Area Grades and Cross Slopes

Grade toward ramp		Cross Slope		Length	
Preferred:	1%-5%	Preferred:	0%	Preferred	50 ft.
Minimum:	0%	Minimum:	N/A	Minimum	50 ft.
Maximum:	10%	Maximum:	2%	Maximum	NA

IV. PARKING AREA

A. General

1. Launch ramps must have an adjacent boat trailer and single car 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 boat trailer spaces. However, an increasing number of people arrive at boating facilities in single cars to participate in boating activities. Single car parking, for boating associated use, should be 10% - 20% of the boat trailer spaces.

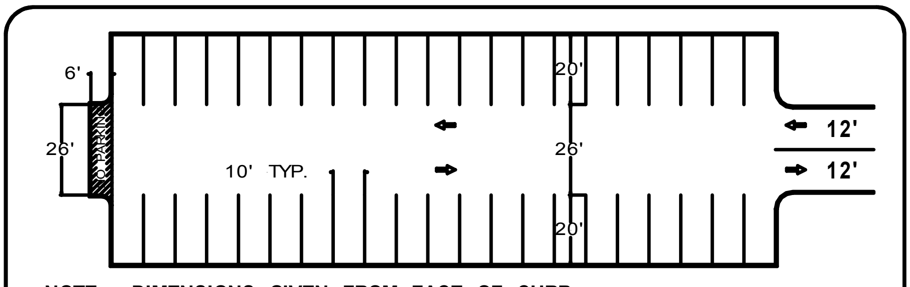
3. Ease of maneuverability and clear, unquestionable direction of flow are of primary importance in the design of parking areas. This will relieve congestion, gridlock, and irregular parking.

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.

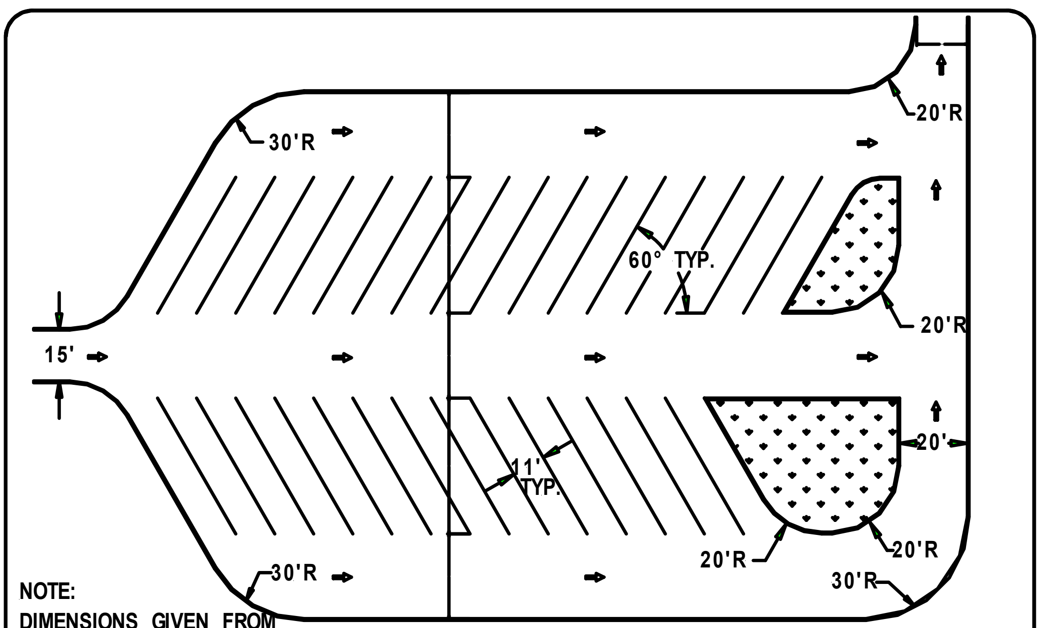
5. All the maneuverability guidelines are based on the dimensions of a design vehicle with boat and trailer. The tow vehicle is 19 ft. long and the trailer with a boat is 26 ft., maximum width is 8.5 ft. These dimensions represent a vehicle/boat trailer combination that is larger than the average. By designing for this size combination then maneuverability for smaller more typical vehicle/boat trailer combinations will be enhanced.

6. The parking space guidelines are based on the same design vehicle combination less the boat. This reduces the overall length from 45 ft. to 42 ft. Consequently this combination extends 2 ft. beyond the ends of the typical 40 ft. long parking space. However, overhangs of up to 4 ft. are acceptable without impacting the aisles. Once again, the typical smaller vehicle/trailer combination fits well within the 40 ft. parking space.

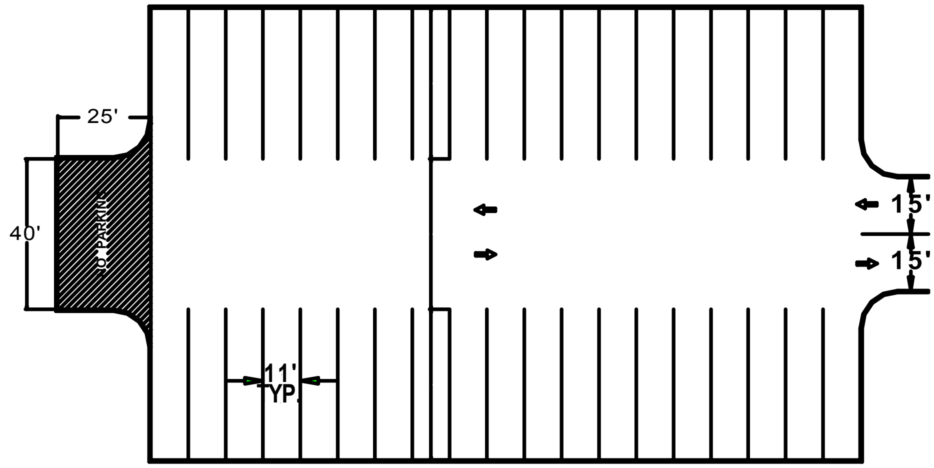
7. Roadways within the parking area (excluding access roads and areas where vehicles maneuver in and out of parking stalls) should use road widths of 20 ft. This width will aid in the ease of maneuvering trailered vehicles throughout the parking area.



SINGLE CAR PARKING LAYOUT (HEAD- IN, TWO WAY)

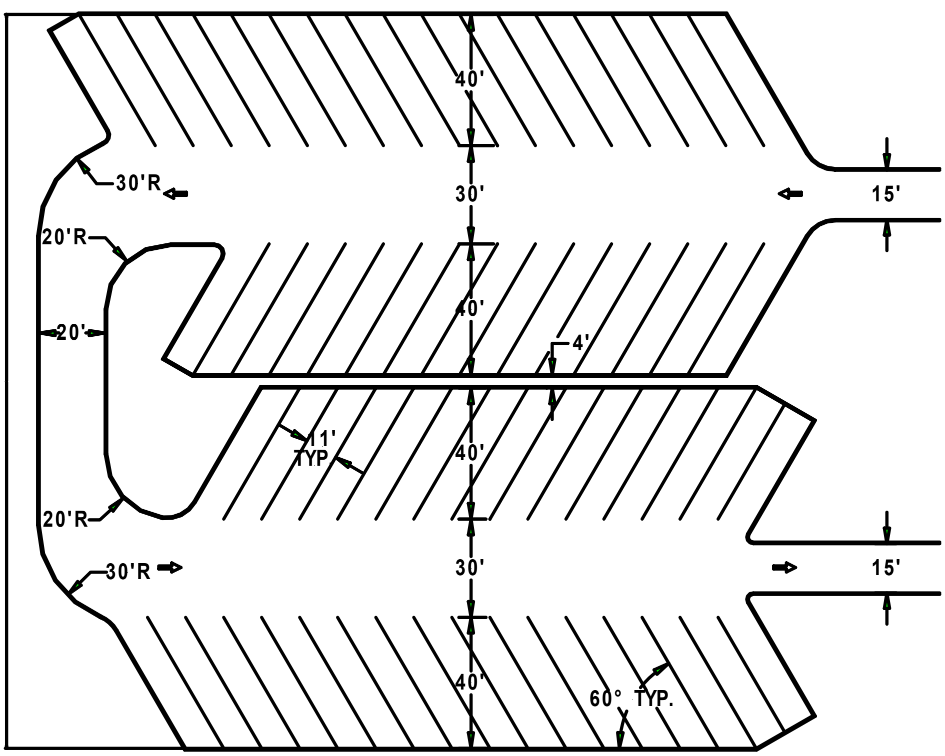


TRAILER PARKING LAYOUT (PULL- THROUGH)



NOTE: DIMENSIONS GIVEN FROM FACE OF CURB

PARKING LAYOUT (HEAD- IN, TWO WAY)



NOTE: DIMENSIONS GIVEN FROM FACE OF CURB

PARKING LAYOUT (HEAD- IN, ONE WAY)

B. Application

1. Boat trailer spaces should be a minimum of 11 ft. wide by 40 ft. long for a 90-degree parking space. However, the preferred trailer space should be 12ft. wide by 40 ft. long. Angled parking spaces are allowed and actually preferred. Angles of 60 and 45 degrees are the most common. The 40 ft. 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.

2. 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.

3. Where possible the parking area should be located immediately adjacent to the ramp. Avoid long distance separation of parking area from launch ramp or separation by an intervening public roadway.

4. There should be sufficient parking spaces to meet the expected demand on a normal peak day during the boating season.

5. To the extent possible, car only areas should be separated from designated boat trailer parking areas. However, car spaces can often be incorporated into the unusable areas at the end of aisles. The number of car spaces should equal 10%-20% of the boat trailer spaces provided.

6. Large visual expanses of asphalt paving are to be avoided through the use of appropriately placed planter islands and planter strips every 15-20 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 grass or landscaping.

7. Finish parking area grades should be a minimum of 1%. Every effort should be made to hold the maximum grade to 5%. Parking areas should not have grades in excess of 7%. Grade changes in excess of 10% should be avoided. Cross slopes should be as flat as possible with a max. 5% allowed.

8. Avoid any boat trailer parking spaces that require backing up a grade greater than 3%.

9. Design parking aisle widths for various configurations are given in the *Design Aisle Widths* diagram.

10. Refer to the *Design Parking Area Layout* diagram for illustration of typical elements often found in a one-way grid system parking area.

11. Accessible Parking

    a. Accessible parking spaces and access aisles shall meet the design requirements as specified in the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and any local codes. As a guideline, boat trailer spaces should be 10 ft. wide and access aisles 5 ft. wide. Car spaces should be 10 ft. wide and access aisles 5 ft. wide. At least one (1) boat trailer access aisle and one (1) single car access aisle shall be provided for van accessibility. Which requires an 8 ft. access aisle.

    b. Parking areas at boating facilities contain both single car spaces and boat trailer spaces but the total number of all spaces should be used to determine the number of accessible designated spaces required. There should be a minimum of one of each type provided with all additional accessible spaces proportionately applied to each type. For example; 100 boat trailer spaces and 30 car spaces (130 total) requires 5 accessible parking spaces. Since 100 boat trailer spaces represents 77% of all spaces then 77% of the 5 accessible spaces should be of boat trailer size (4 boat trailer and 1 single car).

    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. Boat trailer spaces should be located as close as possible to the top of ramp. Car 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.

12. All parking areas should be paved with a minimum of 2" asphaltic concrete over a 6" compacted crushed rock base (3/4"-0). When paving an existing gravel parking area the base can be reduced to 3". No base is required when overlaying an existing asphalt or concrete parking area in fair to good condition. Deteriorated areas of asphalt or concrete should be removed and brought to grade prior to paving.

13. Gravel parking areas should have a minimum 6" of well graded and compacted 3/4"-0 crushed rock.

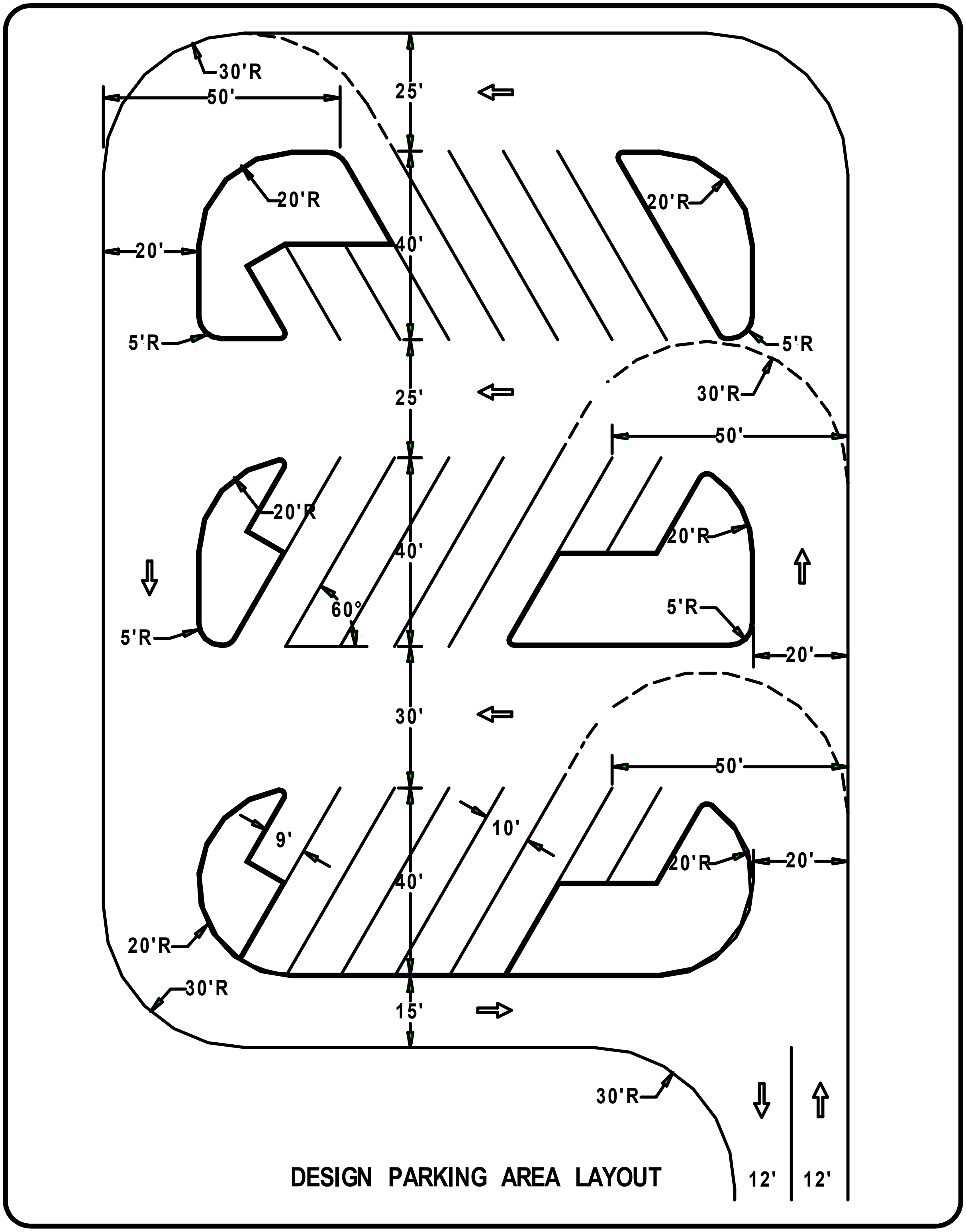
14. Base course should extend a minimum of 12" beyond the edge of the asphalt before sloping to grade at a minimum 2 to 1 slope.

15. All parking areas should have any necessary signs posted. All asphalt surfaced parking areas should be striped and painted with appropriate pavement and traffic control markings as required.

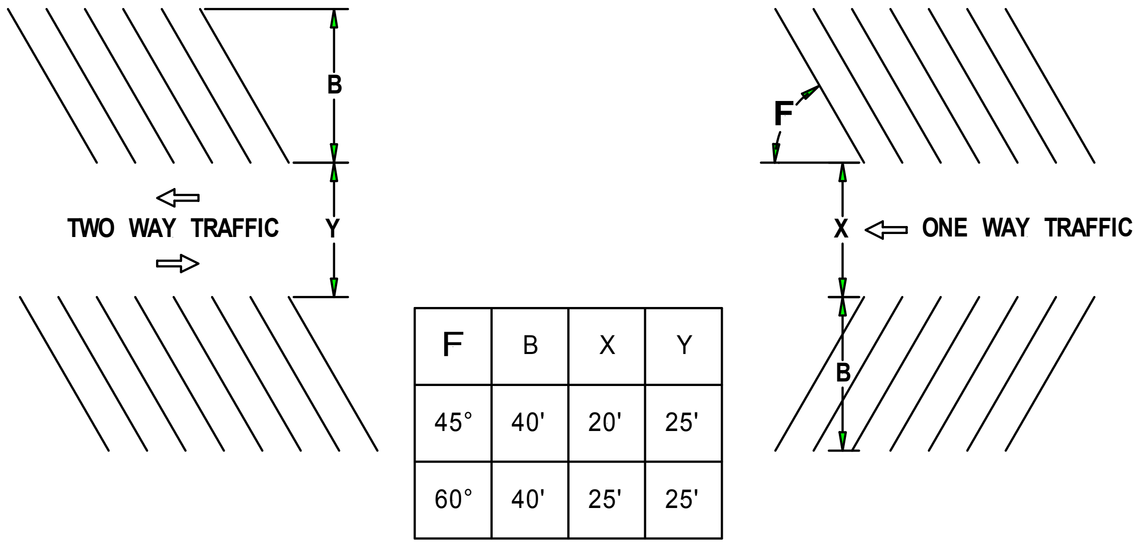
16. All head-in parking spaces without curbs require wheel stops placed a minimum of 2 ft. from the end of the space. Wheel stops should be a minimum of 6" square by 8 ft. long and securely anchored to the parking surface.

17. All sidewalks should be a minimum of 5 ft. wide and placed so that no vehicle overhang encroaches the sidewalk. Curb cuts with ramps shall be provided to access all sidewalks from the parking area. All accessibility and building codes shall be adhered to.

18. Parking areas should be graded to allow for sheet draining off the sides. If the parking area is curbed then curb cuts should be provided every 20 ft. and at all low points. If sheet draining of any portion of the parking area is not possible then catch basins should be provided to collect and divert all water. No area should be graded as to allow for standing water. Local storm water regulation should be considered.

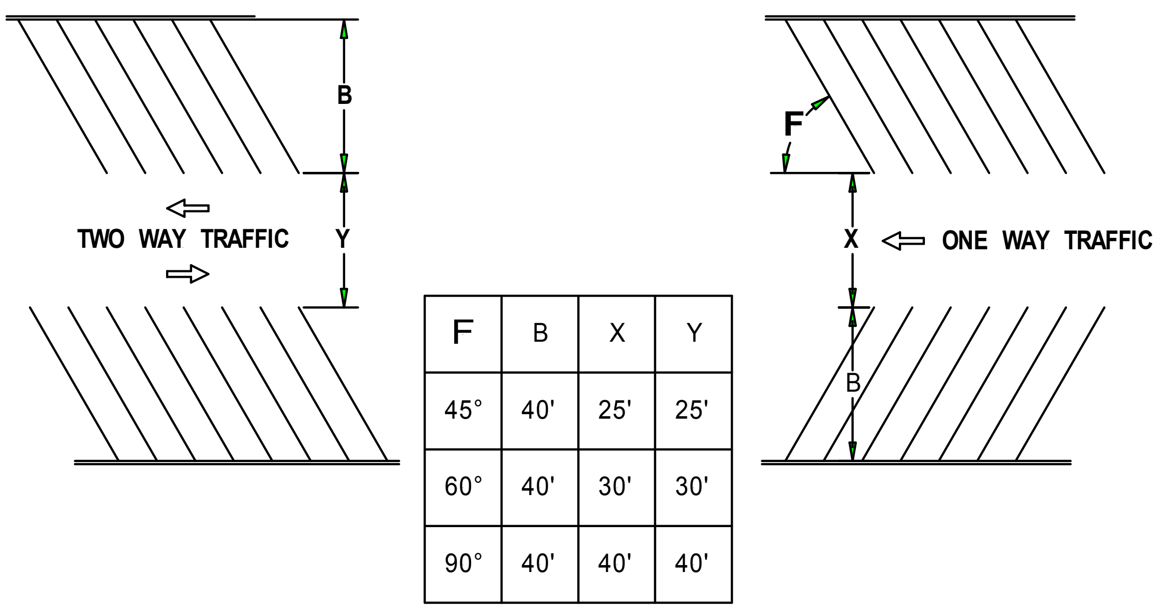


DESIGN PARKING AREA LAYOUT



F	B	X	Y
45°	40'	20'	25'
60°	40'	25'	25'

DESIGN AISLE WIDTHS
FOR PULL THROUGH PARKING SPACES



F	B	X	Y
45°	40'	25'	25'
60°	40'	30'	30'
90°	40'	40'	40'

DESIGN AISLE WIDTHS
FOR HEAD- IN PARKING SPACES

C. Design

1. Parking Space Angles

   Preferred: 60 degrees
   Minimum: 90 degrees
   Maximum: 45 degrees

2. Boat Trailer Parking Space Dimensions

   Preferred: 12'x 40'
   Minimum: 11'x 40'
   Maximum: 12'x 45'

   Single Car Parking Space Dimensions

   Preferred: 10'x 20'
   Minimum: 9'x 20'
   Maximum: NA

3. Boat Trailer Parking Space Type

   Preferred: Pull-through
   Minimum: Head-in
   Unacceptable: Parallel

4. Number of Boat Trailer Spaces per Launch Lane

	One Lane	Two Lanes	Three Lanes	Four Lanes
Preferred:	25 Spaces	50 Spaces	75 Spaces	100 Spaces
Minimum:	10 "	30 "	60 "	90 "
Maximum:	50 "	100 "	150 "	200 "

5. Number of Single Car Parking Spaces Required

   Preferred: 10% of boat trailer spaces
   Minimum: 10% of boat trailer spaces or a minimum of 3
   Maximum: 20% of boat trailer spaces

6. Parking Area Grades and Cross Slopes

Preferred Grade:	2%-5%	Preferred Cross Slope:	1%-2%
Minimum Grade:	1%	Minimum Cross Slope:	N/A
Maximum Grade:	7%	Maximum Cross Slope:	5%

7. Parking Area Changes in Grade

    Preferred: 1%-5%
    Minimum: N/A
    Maximum: 10% (provide vertical curve if greater than 7%)

8. Boat Trailer Backing Up Grades

    Preferred: 0%-2%
    Minimum: N/A
    Maximum: 3%

9. Aisle Widths

    Preferred: See *Design Aisle Width* diagram
    Minimum: 5 ft. less than values in diagram
    Maximum: Values in diagram

10. 90-Degree Corner Inside Radius

    Preferred: 20 ft. - 40 ft.
    Minimum: 20 ft.
    Maximum: N/A

11. Accessible Parking Spaces

Total Parking Spaces	Minimum number of Accessible spaces
1 to 25	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

RESTROOMS

I. RESTROOM FACILITIES

A. General

1. Restroom/toilet facilities could be considered 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 ft. radius of the top of ramp.

2. Sanitary facility construction shall meet all local, state, and federal public health and building code requirements.

3. Restroom/toilet structures shall be designed to meet all accessibility requirements for persons with disabilities in accordance with ADAAG.

4. Building materials such as concrete masonry block, brick, precast concrete, stainless steel fixtures, ultra high molecular weight (UHMW) plastic partitions, 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 ft. radius

   Minimum: N/A

   Maximum: 400 ft. radius

II. SELECTION, SIZING, AND SITING

A. General

1. Sanitary facilities could be provided at all boating facilities unless the facility is so small or seldom 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.

3. A flush restroom is preferred if a municipal sanitary sewer or on-site drainfield system is within a reasonable distance.

4. 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 ft. above OHW.

5. Consult floodplain, Federal Emergency Management Agency (FEMA) flood insurance rate maps and local sanitation authorities 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. Typically one toilet fixture is required for every 39 parking spaces or fraction thereof. Small sanitary facilities with one and two stalls are typically unisex.

3. 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 need to be constructed with slopes and run lengths that comply with ADAAG.

C. Design

1. Sizing (number of toilet stalls to all parking spaces)

   0-39 parking spaces 1 toilet stall
   40-79 parking spaces 2 toilet stalls
   80-159 parking spaces 4 toilet stalls

2. Floor Elevations

Preferred:	1 foot above 100 year flood elevation
Minimum:	1 foot above OHW
Maximum:	N/A

III. 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, hand dryers, etc.) that may be vandalized. However, if these components are fabricated from stainless steel they are relatively vandal resistant.

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.

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.

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. Since water is available an accessible drinking fountain may be provided at the restroom.

4. If there is access to a telephone line then a telephone may be provided at the restroom.

IV. VAULT TOILET

A. General

1. A vault toilet collects the waste in a concrete vault under the toilet until a pump truck pumps out the vault, hence the name vault toilet. There is no discharge from the vault into the environment.

2. They are fairly durable and good to locate at rural sites. There are very few moving parts that can be vandalized.

3. No utilities are required (i.e. sewer, drain field, power, water).

B. Application

1. Vaults can handle a lot of use 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/interior area lighting option for these units if electrical power is available at the site.

C. Design

1. There are precast units can be installed quickly. They can be usable within hours after delivery to the site.

2. The units need to be accessible by a pump truck to service the vault.

V. COMPOSTING TOILET

A. General

1. Composting toilets are typically used at very remote facilities where there is sub-standard or non-existent road access. Generally these sites are primitive and without utility improvements or the need for them.

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.

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 can be 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.

C. Design

1. Composting toilets do not require any outside sources of energy other than the sun. Energy can be collected by the solar panels to charge the lead/acid batteries that operate the ventilation fan.

VI. TEMPORARY TOILET

A. General

1. This is a temporary or short term single stall toilet, enclosed with thin wall plastic sheeting, typically used at construction sites and sporting 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 so low or site conditions are not conducive to provide permanent sanitary facilities. These units are brought in just for limited periods of use and are not offered the rest of the year.
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 temporary toilet owner. The number of these units can be changed as quickly as a phone call for anticipated fluctuation in use.

4. These units are stand alone and do not require any utilities.

5. ADA units are available. The first unit at each site should be ADA.

UTILITIES

I CONSTRUCTION

A. General

1. Drinking fountains may be provided if there is potable water readily available. If a public phone is not located near the facility, considerations should be made to provide phone service for safety reasons.

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.

B. Application

1. Typically drinking fountains and public phones are located at the restroom. If a public phone is not installed during restroom construction, conduits should be provided to allow for future phone service if needed. Access to drinking fountains and phones shall meet design requirements as specified in ADAAG and any other local codes.

2. A white light fixture approximately 20-25 ft. high in the immediate vicinity of the head of the 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. Power lines should not be located over 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.

C. Design

1. Drinking Fountain

   Preferred: Where Potable Water is Readily Available

2. Public Phone

   Preferred: When Access to Public Phones Are Limited

3. Area Lighting

   Preferred: Parking Areas and Top of Launch Ramp

4. Power Lines

Preferred: No Overhead Power Lines in Travel Areas
Locate Power Lines Underground