

CONCRETE FLOATING DOCKS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. FLOATING DOCKS consists of furnishing transportation, labor, materials, and equipment to design, fabricate and install a concrete floating dock system, complete and ready to use, including precast concrete floats, connection hardware, and dock accessories, (cleats, bumpers, fenders, rub rail, pile guide frames, and provisions for routing utility conduits and pipelines).
- B. The layout and functional dimensions of the floating dock system are indicated on Drawings. The floating dock system shall be designed by the Dock manufacturer to meet the requirements of Drawings and this Section. Materials shall be compatible and suited for their intended use in a marine environment.
- C. Dock manufacturer shall have no less than five (5) years of experience in the design of projects similar in scope and magnitude.

1.2 DESIGN CRITERIA FOR FLOATING DOCKS

- A. Information presented in this Section is based upon the Engineer's best estimate of those factors which reasonably can be expected to affect the design, performance, and durability of the floating dock system. These criteria shall be considered as minimum requirements for the proposed floating dock system; however, mere conformance to the minimum sizes, strengths, and design parameters given in this Section will not automatically ensure approval of the proposed system. The proposed floating dock system shall be subject to thorough engineering analysis using all relevant criteria that could affect the stability, structural integrity and durability of the dock system.
- B. Final calculations shall demonstrate that the concrete floating dock system, using the criteria specified as a minimum standard, are designed to withstand the required loading, singularly or in combination, without damage to the dock or pile system, throughout the systems specified design life. The design loads shall be applied at the locations and in the combinations described.
- C. The layout and principal dimensions of the concrete floating dock system are indicated on Drawings. Dock manufacturer shall provide a system that conforms to the layout and dimensions indicated on Drawings and conform to the provisions of this Section.
- D. The dock system shall be made of modular reinforced concrete floats. Modules shall consist of a reinforced concrete deck and reinforced concrete side walls. Minimum thickness of concrete shall be 2-3/8". The concrete floating modules shall be designed such that the reinforced concrete dock itself is the structural element of the dock in order to resist high loads expected from design loads. For low maintenance and dock flexibility, modules shall be connected to form continuous sections of floating dock by semi rigid bolted connections capable of transmitting all loads imposed upon individual dock modules, or combinations of dock modules, to the floating dock restraint system. The foam core shall be encapsulated to prevent any contact between the foam and seawater and protect it from damage. Bottom of concrete docks shall be covered with polyurea coating for additional protection.

- E. The dock system shall be designed such that minimal maintenance shall be required for the duration of the expected lifespan of the system.
- F. Connection components to secure individual concrete float modules together shall be durable and noise-free with sufficient flexibility to withstand the horizontal and vertical forces specified. The connection components shall be designed for minimum to no maintenance over the life expectancy of the system. The concrete floating dock system shall be designed and manufactured such that the float connection components can be easily inspected, repaired or replaced, if necessary, without alterations to the system and without having to remove anchor piles. A rigid connection of independent float modules by means of an external waler (timber, composite, aluminum or steel), or similar, that prohibits adequate flexibility during storm wave conditions is not acceptable. Detailed drawings of the float connections shall be included in bid package.
- G. Freeboard under dead load only shall not be less than 20 inches plus or minus one inch at the end of 1 year from the date of Project acceptance. Sufficient floatation shall be provided to support the required live loads with a minimum freeboard of not less than 12 inches.
- H. The floating dock system shall be designed to float level under dead load conditions. The deck of the float modules shall be level and flush upon completion within the following tolerances.
 - 1. Dead load deck surface slope:
 - a. Transverse Direction: Not more than 1/8 inch per foot.
 - b. Longitudinal Direction: Not more than 1 inch per 10 feet of length.
- I. Special floats shall be designed to support the superimposed dead loads imposed by gangways, ramps, utilities, or other dock accessories. Float modules with special loading shall have the same freeboard as floats with no such loading, so that there shall be no residual stresses or tilting when the floats are interconnected and to ensure that the dock system deck is level within the specified tolerance.
- J. The floating dock system shall be designed to have embedded sleeves with pull-boxes for lighting wiring.
- K. The floating dock system shall be designed to be restrained by steel pipe anchor piles and shall be designed and laid out such that the total number of pilings shall resist the total design lateral forces. The lateral capacity of one floating dock piling shall be provided in the separate mooring analysis described in 1.3 DESIGN REQUIREMENTS – DESIGN LOADS. Dock manufacturer is required to specify the type, size, length and total number of piles based upon their specific system requirements. For bidding purposes, plans depict a preliminary layout of pilings so that dock manufacturers can include in their cost proposal a specified number of pile guides. The layout is schematic in nature and shall be modified as necessary by the MANUFACTURER after contract award and completion of the mooring analysis.
- L. Pile guides shall have adjustable pads designed for easy removal and replacement in case of wear. Pile guide hardware and metal sections required shall be hot-dipped galvanized or stainless steel.

1.3 DESIGN REQUIREMENTS - DESIGN LOADS

- A. Dead load shall consist of the weight of float modules, framing, fenders, attachment steel, miscellaneous connection devices, and all other permanently attached accessories such as utilities, dock boxes, fire protection equipment, cleats, and ramps.
- B. Minimum Live Loads shall consist of:
 - 1. Dock shall have total buoyancy capacity for a uniform vertical live load of 50 psf.
 - 2. Dock shall not have a freeboard lower than 12 inches when applying a uniform vertical live load of 25 psf.
 - 3. Concentrated Vertical Load (CVL) of 400 Pounds applied at any location on the floating dock greater than 12-inches from an edge.
 - 4. The floating dock system shall be designed to withstand the forces up to a Category 1 Hurricane (sustained winds 74 mph) with two 50-foot vessels tied to the dock.
 - 5. Wind Load (WL) on the projected area of a vessel/dock combination applied as following:
 - a. Minimum Wind Pressure of 15 pounds per square foot
 - b. Design Vessel profile height of vessel shall be 15% of Vessel Length
 - c. Boat length at full occupancy is 50 feet long.
 - d. Wind Load Application:
 - 1) 100 percent berth occupancy.
 - 2) 100 percent applied to vessels in the unshielded berth or row of berths.
 - 3) 20 percent applied to all vessels in the remaining (shielded) berths, provided 100 percent loading is applied for design of each dock finger and finger connection.
- C. Design Calculations:
 - 1. The design calculations shall include but not be limited to the following:
 - a. Transfer of forces at guide pile frames and connections.
 - b. Freeboard calculations for all float modules

1.4 SUBMITTALS

- A. Prior to the fabrication of the dock system components, submit final design calculations. The calculations shall demonstrate that the floating dock system, using the criteria specified herein as minimum requirements, is designed to withstand the specified loads without damage throughout the design life of the system.

1.5 WARRANTY

- A. The floating dock system, including all structural components, shall carry a warranty against defects in materials and workmanship for 3 (three) years from the date of Project acceptance.

PART 2 - PRODUCTS

2.1 FLOATING DOCK MODULES

- A. Structural Concrete
 - 1. Structural concrete shall conform to ASTM C-94
 - 2. Minimum compressive strength at 28 days shall be 6000 psi.
 - 3. "Lightweight or mediumweight" concrete shall not be used.
- B. Reinforcing Steel
 - 1. Reinforcing steel is to conform to ASTM a-615 or a-706, grade 60.
 - 2. Reinforcing steel consists of horizontal and vertical wall bars of in accordance with structural design drawings.
 - 3. Steel shall be epoxy coated per ASTM A775 or hot dipped galvanized.
 - 4. Steel reinforcement may be replaced with equivalent wire mesh.
- C. Fastener: All structural bolts and structural hardware shall be hot dip galvanized steel or stainless steel.
- D. Expanded polystyrene (EPS): Foam core for floats shall be a rigid block of closed cell expanded polystyrene. The polystyrene foam shall have a unit weight between 0.95 pounds per cubic foot and 1.20 pounds per cubic foot. Properties of the foam shall conform to ASTM C578, with maximum water absorption less than 3.0 percent as determined by ASTM C272, Method C. The foam core shall not have more than 10 percent reground material, and reground foam pieces shall not exceed 3/8 inch diameter.
- E. Dock Fendering shall be HDPE material composed of 100% recycled plastic product or plastic composite products. Main and finger docks shall use fendering measuring 3" wide x 6" high nominal. No timber shall be allowed throughout the entire dock system.
- F. PVC pipe shall be ASTM D1785, embedded as required for through rods, piping systems, and electrical raceways.
- G. Pull boxes for electrical raceways, if required, shall conform to Building codes, and shall be set flush with the walking surface, and self-draining. All bolts for lids on pull boxes shall be ASTM F593, Group 2, (316) stainless steel (or equivalent).
- I. Formwork:
 - 1. Float modules shall be cast in forms of sufficient strength and rigidity to maintain the intended size and shape during the casting process.
 - 2. Forms shall be so constructed and braced that all principal planes will be either true horizontal or true vertical and dimensions of the units will not vary more than 1/8-inch from the dimensions shown on the shop drawings, including diagonal distances corner to corner.

3. Forms shall be thoroughly cleaned after each use and coated with oil, paraffin, or other applications, as may be necessary to prevent bonding of the concrete and to leave clean, smooth and hard surfaces.
4. The foam core shall be pre-formed to the interior configuration as a solid block with an allowable variation of 1/8-inch from the dimensions shown on the shop drawings. Cores shall be securely anchored in place during the casting of concrete. Displacement that results in loss of minimum concrete cover over reinforcement of 1 inch or less than 1-1/2 inches wall thickness or less than 2 inches deck thickness shall be cause for rejection.

J. Concrete Mixing and Placing:

1. Before handling concrete materials, all handling equipment and forms shall be thoroughly cleaned of concrete splashing, dirt, debris and other foreign matter and forms shall be coated as herein or elsewhere specified.
2. Size of batches shall be so controlled that concrete is placed in forms within one hour after materials have been placed in the mixer. Where practical, mixing and casting shall be performed under cover and the casting area screened from sun, wind and other elements.
3. Concrete shall be conveyed from the mixer and deposited in its final position in a manner to prevent separation and segregation of materials. Flowing shall be avoided as it causes segregation. Floats shall be cast monolithically and the placing of concrete shall be a continuous operation from the start to the completion of a float module.
4. The plastic concrete shall be thoroughly compacted to fill all form cavities and surround all reinforcement and embedment, which shall be achieved by use of a powered vibrator. All components shall be secured against displacement during the placing of concrete.

K. Concrete Finishing:

1. Concrete deck surfaces shall be broom finished in the direction perpendicular to the long axis of the dock as approved by the Engineer to give a coarse, non-slip surface. Edges shall be finished uniformly 3 inches back onto the deck with a smooth finishing tool that will give a bull-nosed edge to 1/2 inch radius.
2. Each float module shall be permanently marked in an accessible place on the exterior surface identifying the manufacturer and showing casting date and lot number.
3. Voids up to 1/2 inch diameter or 1/8 inch depth shall be patched with an approved epoxy grout. Larger voids shall be cause for rejection of the float.

L. Curing, Handling and Storage:

1. Curing may be affected by any of the following methods:
 - a. Spraying with "Hunt's Process" or equal as soon as exposed surfaces are firmly set and as soon as forms are removed from formed surfaces.
 - b. Covering with burlap or other suitable material and keeping constantly wet.
 - c. Immersing in water.

2. Dock manufacturer shall select the method of curing and be responsible for the result, except that all curing shall be with complete protection from sun, wind, and freezing temperatures.

M. Cracks in Concrete Floats:

1. The possibility of cracked floats whether structural, cosmetic or from temperature shrinkage shall be controlled and minimized whenever possible.
2. Acceptable Cracking: Minor shrinkage cracking can occur in concrete products. Temperature shrinkage cracks shall be acceptable.
3. Structural Cracking: Cracks that are determined to be structural shall be repaired by the dock manufacturer.

2.2 PILE GUIDE

- A. Pile guides shall consist of a stainless steel mounting bracket fabricated from minimum 3/8 inch thick plate and a block or pad of ultra high molecular weight (UHMW) polyethylene.
- B. Pile guide blocks or pads shall be adjustable to accommodate guide pile installation tolerances; clearance between each pad and the pile shall be adjusted to 1 inch maximum and 1/2 inch minimum under "no load" condition. Fixed or binding guides are prohibited.

2.3 DOCK CLEATS

- A. Dock cleats shall be cast aluminum. Cleat locations and sizes shall be as indicated on Shop Drawings. Cleats shall be secured to the concrete dock via embedded stainless steel threaded inserts. No "S" cleats shall be permitted.

2.4 HARDWARE

- A. Stainless steel hardware shall be Type 316 unless otherwise noted. Bolts shall be ASTM F593 Group 2 (or equivalent). Nuts shall be ASTM F594 Group 2 (or equivalent).
- B. Fasteners for dock accessories shall be stainless steel unless otherwise noted on Drawings.