PART II RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF VESSELS IDENTIFIED BY THEIR MISSIONS

TITLE 46 FLOATING DOCK

SECTION 2 STRUCTURES

CHAPTERS

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CHAPTER A
SCOPE

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A1. APPLICATION

100. Types of ship missions

101. These Rules apply to structures of vessels of its Title 46, floating dock, as Class Mention listed in its Part I, Title 01, Section 1, Chapter B3.

200. Proportions of the hull

- See Part II, Title 11, Section 2, Subchapter A1, item 200.

201. To be designed to meet maximum allowable stresses on the hull defined in the Rules of the RBNA

CHAPTER C
PRINCIPLES OF CONSTRUCTION

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C1. PIPING ARRANGEMENT

100. Piping systems

101. Design data shall be provided witch show that the following requirements are satisfied on those docks originally designed to have such features:

a. The suction pipes shall be arranged to permit unrestricted flow from the tank to these pipes.

b. The overboard discharge lines shall be provided with a positive closing overboard discharge valve located adjacent to the shell of the dry dock and operable from the safety deck. A nonreturnable valve shall be located inboard or outboard of the discharge valve.

c. The flooding valves shall be located close to the shell or inlet sea chest and inlets shall be protected by bar or other type strainers.

d. Cross flooding, if provided, shall be arranged so that stability is maintained.

e. The extended pump drives and valves shafts shall be protected from corrosion.

f. Adequate venting shall be provided.

102. Reliability the data provided in the certification reports shall demonstrate that failure of a pump will neither put the dock out of operation nor cause damage to either dock or ship in dock.

103. Ballast- deballast control. System descriptions shall be provided showing valve and pump control systems and both normal and emergency methods, demonstrating that the following requirements are met:

a. Pump controlled docks. Valves may be manually controlled form the vicinity of the pumps or remotely from a central control station (with manual override control).

b. Operational control of the pumps is preferable from a central control station. Control may be exercised locally if sufficient personnel are available to maintain control if good communication with the central control station exists.

c. Valve - controlled docks. Its is preferred that valves and pumps be controlled remotely from a central control station.

d. However control of valves may be exercised locally if sufficient personnel are available to maintain control and if good communication with the control station exists.

e. Valves shall have a manual method of operation in addition to any method of remote operation.

CHAPTER D
PRINCIPLES OF CONSTRUCTION

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D1. INSTALLATIONS

100. Electric power system

101. The electric power system shall support a maximum load, developed during simultaneous operation of dry dock's dewatering pumps, fire protection pumps, valve opening and closing mechanisms, communication equipments, lighting alarms, and any other support equipment or system or systems necessary for the safe operation of the dry dock. An adequate alternate power source shall be provided to ensure that a backup capability is available to complete critical docking operations at a reduced rate and to operate alarms, lighting and fire protection equipments in case primary power system fails. The dry dock shall have a lighting system in

vital spaces which is automatically actuated in case of main electric power failure. System descriptions and diagrams of the power distribution for equipment operation from both the primary and alternate electric power source shall be provided.

102. for more details see the See Part II, Title 11, Section 2, Chapter D

CHAPTERS H
GLOBAL DIMENSIONING OF THE HULL GIRDER

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See Part II, Title 11, Section 2, Chapter H, where applicable, and what is stated here after.

H1. **STRUCTURAL DATA**

100. Structural documents

101. When a floating dock is intended to be classed with RBNA, plans and documents showing the scantlings, arrangements and details of the principal parts of the structure, and relevant data are to be submitted for review or approval.

a. Transverse section scantlings at mid-length of the dock;

b. Structural plans of the wing walls and pontoons;

c. Structural plans of the decks and bulkheads;

d. Calculations and data for longitudinal, transverse and local strength;

e. Data relating to overall load due to crane including hook load and arrangement if cranes are installed;

f. Coating specifications;

H2. LONGITUDINAL STRENGTH

100. Operational conditions and stresses limits

100. The longitudinal strength of the dock is to be investigated for the condition when the dock supports the shortest ship the weight of which equals the nominal lifting capacity of the dock. The rigidity of the docked ship is not to be considered in this calculation.

101. At no point of the dock, the stress resulting from the smallest bending moment which can be achieved with the pumping system of the dock is not to exceed the following values:

a. for ordinary hull structural steel:

$\sigma = 120$ [N/mm^2]

b. for St 37-2:

$\sigma = 110$ [N/mm^2].

102. Achieved by the "compensating ballast water" available, and thus by unequal water levels in the bottom compartments, the condition with the ballast water evenly distributed over the entire length of the dock is also to be investigated. The stress related to the bending moment thus computed is not to exceed $\sigma = 160$ [N/mm^2] (for ordinary hull structural steel) or $\sigma = 140$ [N/mm^2] (for St 37-2).

103. The analysis required under H2.107 may be omitted if at least two different types of deflection meters, operating independently of each other, are fitted and the maximum admissible deflection is indicated in such a way that the corresponding stresses can in no case exceed the values specified under H2.106.

104. Where the longitudinal strength due to the dock being towed in open waters has to be considered, the calculations are to be based on wave lengths and heights, depending on the voyage route and season of the year.

105. In general, the length of wave is to be assumed as being equal to the length of dock. Deviating assumptions have to be authenticated.

106. The following permissible stress values shall be used in the analysis:

$\sigma_{perm} = 180$ [N/mm^2]

$\sigma_{perm} = 160$ [N/mm^2] (St 37–2).

107. Where, however, this smallest bending moment is achieved by the "compensating ballast water" available, and thus by unequal water levels in the bottom compartments of the floating dock , the condition with the ballast water evenly distributed over the entire length of the dock is also to be investigated. The stress related to the bending moment thus computed is not to exceed the values showed in the topic H2.106 in accordance with the steel.

200. Section Modulus and permissible still water bending moment

201. When calculating the midship section modulus within 0,4L amidships the sectional area of all continuous longitudinal strength members are to be taken into account.

202. Where it is intended that the normal operation of the dock is performed with ballast water evenly distributed over its entire length, the minimum required modulus in the bottom or upper deck of the pontoon can be obtained by the following formula:

$W_{min} = 143{,}8x\ L.C - 2x10^6$ cm³

203. The permissible still water bending moment can be obtained by the following formula:

$M_S = 1{,}4 \times W_{min} \times 10^{-2}$ t.m

204. Where provision is made for the normal operation of the dock to be complemented by the differential emptying of the ballast compartments, the required minimum section modulus can obtained as the follows:

$\underline{W}_{min} = c\ x\ (143{,}8x\ L.C - 2x10^6)$ cm³

where:

c = defined as 0, 96

205. The permissible still water bending moment can be defined as follows:

$\underline{M}_S = 1,\ 4 \times \underline{W}_{min} \times 10^{-2}$ t.m

206. The requirements set forth in the paragraphs 202. to 205. are applicable to floating docks which are intended to be operated near the construction yard.

207. When determining allowable stresses induced by longitudinal bending, it is extremely important to investigate critical buckling stresses for all plate panels that are in compression. Low critical buckling stresses can severely limit the allowable longitudinal bending moment for a dock.

300. Deflection

301. Monitoring longitudinal deflection is essential for longer docks. The magnitude of the stress induced by longitudinal bending is in direct relation to the longitudinal deflection of the dock.

302. The dock's designer should have calculated the deflection that will produce the maximum allowable stress in the dock.

303. In principle, two completely independent deflection meters are to be fitted and be capable of outputting deflections over the length of the dock L_D. One of the two deflection monitoring systems required should be of the hydraulic type. In all cases, the systems should be arranged so as to measure the longitudinal deflection of a wing wall.

304. The readings of one of the systems installed should be displayed on an indicator board in the control room of the dock.

305. Consideration will be given to acceptance of only one deflection control system for dock designed to operate without using differential ballasting. Such a system could then be of optical type.

306. In all cases, the methods of monitoring and limiting the dock deflections in service are to be submitted for approval. In general, these methods are to include arrangements for visual and audible warning, and procedures for ballast control to prevent maximum allowable deflections being exceeded. The maximum allowable deflection should be related to a permissible still water bending moment.

301. The deflection of the deck due to the loadings is to be monitored by two independent systems and be read in the control room of the dock.

302. For docks with length less than 50 (fifty) meters, can be assessed a system that limits the stresses in the structure.

400. Special provision

401. Where specially requested, structural design of the dock can be based on L_S/L_D = 1,0. In such a case, however, a special feature notation will be assigned as follows:

a. dock designed to operate at full lifting capacity only when the length of the ship is equal to the length of the dock.

b. lifting capacities at other L_S/L_D ratios will have to be stated during submission of plans.

500. Dock buoyancy

501. Dock buoyancy distribution may be assumed rectangular over the length of the dock, L_D.

600. Ship weight curve

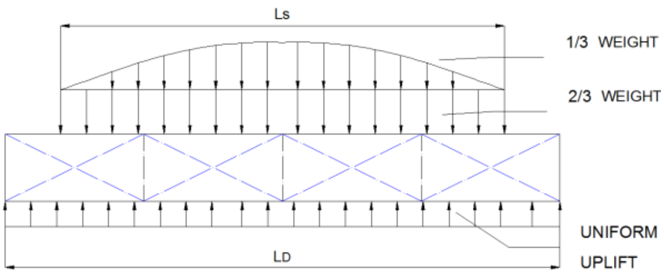
601. The weight curve of the floating dock can be taken as a rectangle with superimposed parabola of half the area of rectangle, the length of each area being taken as L_S.

602. For normal cases, for docks below 40,000 tons lift capacity, Ls may be assumed to be:

$L_S = 0,\ 8\ L_D$

L_S= the length between perpendiculars of the shortest ship whose displacement is equal to the lifting capacity of the dock as shown on the figure F.H2.602.1

FIGURE F.H2.602.1. – WEIGHT DISTRIBUTION



where:

L_S = the length between perpendiculars of the shortest ship whose displacement is equal to the lifting capacity of the dock, in meters.

603. For docks exceeding 40.000 tones lifting capacity L_s/L_D ratio can be taken as in accordance with the table T.H2.603.1:

TABLE. T.H2.603.1.- LIFTING CAPACITY L_s/L_D

L.C	L_s/L_D
40.000	0,8000
42.000	0,8104
44.000	0,8208
46.000	0,8305
48.000	0,8403
50.000	0,8500
52.000	0,8568
54.000	0,8656
56.000	0,8716
58.000	0,8798
60.000	0,8880
62.000	0,8944
64.000	0,9008
66.000	0,9072
68.000	0,9072
70.000 and above	0,9200

H3. TRANSVERSE STRENGTH

100. Loading for transverse strength

100. The transverse strength of the dry dock is provided by the transverse bulkheads (watertight and non-watertight) and/or transverse trusses in the pontoon.

101. The pontoon structure must distribute the concentrated load of the ship along the dock's centerline to the buoyant support of the water over its entire width by its transverse strength.

102. At least 4 separate loading conditions should be investigated when analyzing transverse strength:

a. Maximum positive bending

b. 50% Keel, 50% Side block loading

c. Partial load, Maximum head condition

d. Reverse bending

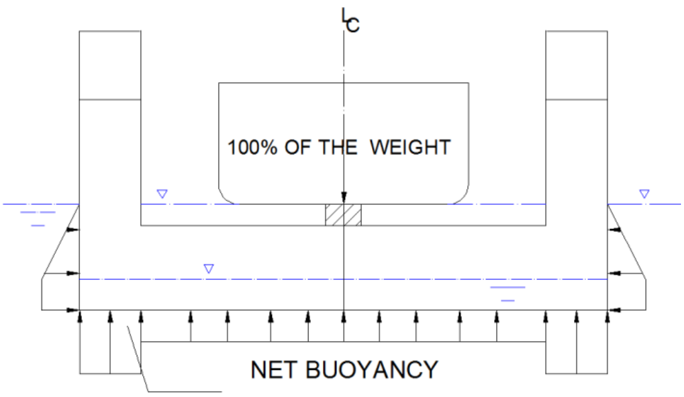
200. Maximum positive bending

201. The maximum positive transverse bending moment occurs at the point when the exterior water is at the top of the keel blocks. At this time, there is 100% of the vessel weight on the dock while the pontoon and the submerged section of the wing provide lift.

300. Loading distribution on blocks

301. The submerged section of the wing provides additional buoyancy farther away from the dock centerline, which increases the bending moment. For this case 100% of the ship's weight is assumed to act on the keel blocks at the transverse centreline.

TABLE T.H3.301.1. NET LOADING FOR 100% ON KEEL BLOCKS

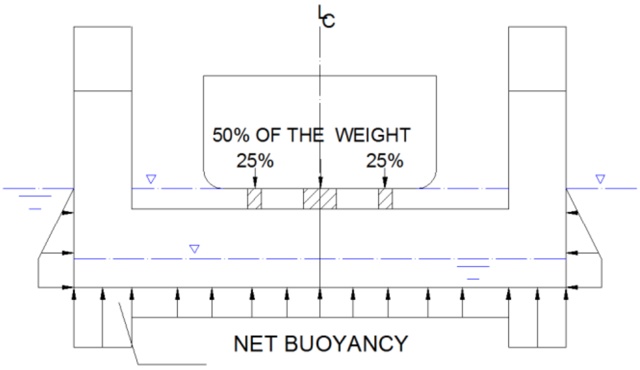


302. The case in which 50% of the vessel load is on the keel blocks and 25% is on each row of side blocks should also be investigated.

303. Also, other combinations of keel and side block loading should be analyzed if the ships to be docked might impose unusually large side block loadings.

304. Although the transverse bending at centerline for this case is less than that for the previous case, the moments along the outer portions of the bulkheads may be greater.

TABLE T.H3.302.1. NET LOADING FOR 50% ON KEEL BLOCKS



400. Partial Load, Maximum Head Condition

401. The partial load, maximum head condition is the point at which the maximum hydrostatic head occurs on the shell of the dry dock.

402. Although the load at the centerline is only a portion of the total vessel load and the bending moment is not as great as in the first case, the bending stresses, when combined with the local stresses caused by hydrostatic head pressure may control.

403. The partial load, maximum head condition occurs when the internal water level has reached the base of the wings.

404. Dock supports a ship of the nominal lifting capacity, and the dock is emerged to the freeboard at the pontoon deck. The transverse strength is to be investigated for the load caused by water pressure and load on the keel blocks.

405. Dock with a ship emerged to such a height that the maximum pressure difference between the inside and outside water is reached. The transverse structure is to be investigated for the load caused by water pressure and load on keel blocks.

406. In these calculations, the load on keel blocks is to be the maximum admissible load per meter of length of dock specified in the Building or Working Instructions; this load is to be determined from the data given for the shortest ship having a displacement equal to the lifting capacity of the dock.

407. The load on keel blocks to be used in the calculations is however, not to be less than:

$$q = \frac{1{,}5x\ L.C}{Ls}$$

where:

q = ship weight per unit length (tones/ m).

L.C= nominal lifting capacity in (t).

408. The stresses in the transverse girders, in plating and frames are not to exceed the values specified in the table T.H3.408.1:

TABLE T.H3.408.1. ORDINARY HULL STRUCTURALSTEEL

Type of loading	Material	
	Ordinary Hull structural steel	**St 37–2**
Compressive, tensile and bending stresses limits	σ_{perm} = 160 N/ mm²	σ_{perm} = 140 N/ mm²
Shear stress	τ_{perm} = 100 N/ mm²	τ_{perm} = 95 N/ mm²
Equivalent stress	σ_v = 200 N/ mm²	σ_v = 180 N/ mm²

409. The blocks and berths are to be structured to support side load corresponding to a list angle of 3 degrees (this corresponds to 5% of the vertical force).

500. Bending and shear stresses

501. The equivalent stress is to be derived from the formula:

$$\sigma c = \sqrt{\sigma^2 + 3 \times \tau^2}$$

502. Proof of sufficient buckling strength of all structural parts is to be submitted. This proof can be provided on the basis of the relevant requirements for the ship's hull.

600. Buckling stresses

601. The longitudinal members are to have stiffeners to prevent occurrence of buckling.

H4. LOADINGS OF THE GLOBAL STRUCTURE

100. Overall longitudinal bending moment

101. The overall longitudinal bending moment is the sum of the moment in still water with the moment caused by the waves, for a given loading.

102. The bending moment is calculated for the loading conditions described in Part II, Title 46, Chapter 1, Subchapter H3.

200. Moment in still water

201. The moment in still water Mc is calculated from the load distribution and lightweight, indicated on the loading booklet, with indications of data and the calculation method used.

202. The calculation is to begin from the ordinates of the load per meter, entering values before and after the bulkheads, or other milestones, where the loading vary discontinuously.

300. Moment in waves – non-sheltered waters and seagoing – MS

301. In the case of non-sheltered waters, the moment in waves to be computed is the one of Class Mention I2 of the Rules of the RBNA for inland waterways, in conjunction with the moment in the still water of the lightship condition.

302. To the eventual condition of the dock being towed in open waters from the port of construction, check the wave moment of the Mention O1 of the Rules of the RBNA navigation in open seas, in conjunction with the moment in the still water of the light ship condition.

400. Overall moment

401. The overall moment is given by the sum:

$Mt = Mc + \underline{M_S}$ (t x m)

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