



2023

Rules for the Classification of
Dredgers

KR



2023

**Rules for the Classification of
Dredgers**

APPLICATION OF "RULES FOR THE CLASSIFICATION OF DREDGERS"

1. Unless expressly specified otherwise, the requirements in the Rules apply to ships of which contracts for construction are signed on or after 1 July 2023.
2. The amendments to the Guidances for 2020 edition and their effective date are as follows;

Effective Date 1 January 2023
(based on the survey application date, Related Circular No. : 2022-11-E)

Chapter 2 REGISTRATION AND CLASSIFICATION SURVEYS

Section 3 Periodical Survey

- 302. 1 has been amended.
- 302. 3 has been newly added.
- 303. 3 has been amended.

Chapter 13 MACHINERY OF DREDGERS

Section 1 Machinery and Dredging Equipment of Non Self-propelled dredgers

- 101. has been amended.

CONTENTS

CHAPTER 1 GENERAL	1
Section 1 General	1
Section 2 Classification	1
Section 3 Definitions	2
CHAPTER 2 REGISTRATION AND CLASSIFICATION SURVEYS	5
Section 1 General	5
Section 2 Classification Survey During Construction	5
Section 3 Periodical Survey	6
CHAPTER 3 LONGITUDINAL STRENGTH	7
Section 1 Longitudinal Strength	7
CHAPTER 4 SHELL PLATING AND DECKS	9
Section 1 Shell Plating	9
Section 2 Decks	11
CHAPTER 5 INTERNAL FRAMES	15
Section 1 Transverse Framing System	15
Section 2 Longitudinal Framing System	26
CHAPTER 6 PILLARS AND TRUSSES	31
Section 1 General	31
Section 2 Scantling of Pillars	31
Section 3 Trusses	32
CHAPTER 7 WATERTIGHT BULKHEADS AND DEEP TANK	35
Section 1 Arrangement of Watertight Bulkheads	35
Section 2 Construction of Watertight Bulkheads	35
Section 3 Deep Tank Construction	37
Section 4 Fittings of Deep Tanks	39
CHAPTER 8 SUPERSTRUCTURE AND DECK HOUSE	41
Section 1 General	41
Section 2 Superstructure End Bulkheads	41
Section 3 Access Opening in Superstructure End Bulkheads	42
Section 4 Deck House Construction	43
CHAPTER 9 HATCHWAYS, DECK OPENINGS AND OTHER EQUIPMENT	45
Section 1 General	45
Section 2 Hatchways	45
Section 3 Companionway and Other Deck Openings	47
Section 4 Bulwarks and Guardrails	47
Section 5 Freeing Ports	47
Section 6 Ventilators	47
Section 7 Companion Way	47

CHAPTER 1 GENERAL

Section 1 General

101. Application

1. The requirements are to apply to non self-propelled dredgers of 150 meters in length or less in accordance with the requirements in **Pt 1, Ch 1, Sec 13** of the **Rules for the Classification of Steel Ships**.
2. A self-propelled dredger which is intended to be registered by this Society is to be subjected to the **Rules for the Classification of Steel Ships**. However, the hopper structures may be subjected to this Rules.
3. For hopper structure self-propelled dredger intended to be assigned reduced freeboards for dredging on the coastal area, it is to be in accordance with the relevant requirements in Annex 1 of the Guidance. *(2020)*

102. Corresponding Application of the Rules for Classification of Steel Ships

The **Rules for the Classification of Steel Ships** are to apply correspondingly to the items for which requirements are not specified in this Rules.

103. Equivalents

The equivalence of alternative and novel features which deviate from or are not directly applicable to the Rules is to be in accordance with **Pt 1, Ch 1** of the **Rules for the Classification of Steel Ships**. *(2020)*

104. Exceptions

Regardless of the above requirements of the **101**, the structures, outfitting, arrangements and dimensions of the dredgers of less than 30 meters and greater than 150 meters in length and of those dredgers to which application of the Rules are not practicable, are to be in accordance with as deemed appropriate by this Society.

Section 2 Classification

201. Classification

The classification of dredgers is to be in accordance with **Ch 1**. Others for which requirements are not specified in the Rules are to be in accordance with **Pt 1, Ch 1** of the **Rules for the Classification of Steel Ships**.

202. Class notations and symbols

The class notation "dredger" is to be assigned to a dredger which is classed with this Society in accordance with the requirements of **Pt 1, Ch 1, 201**, of the **Rules for the Classification of Steel Ships**.

Section 3 Definitions

301. Application

Unless expressly provided otherwise, the definitions and symbols used in the Rules are to be in accordance with **Sec 3**.

302. Dredger

Dredger is a vessel equipped with the dredging equipment for soils, sands, pebbles and stones at the bottom of river, harbor, and sea lanes.

303. Non self-propelled dredger

A non self-propelled dredger is a dredger which is not equipped with propulsion system.

304. Length

Length(L) is the distance in meters, measured on the load line as prescribed in **307**. from the inner side of the stem plating to the inner side of the stern plating. However, in dredgers with hull form of ship type, this length is the distance in meters, measured on the load line as prescribed in **307**. from the fore side of the stem to the after side of the rudder post in case of a dredger with rudder post, or to the axis of the rudder stock in case of a dredger without rudder post.

305. Breadth

Breadth(B) is the horizontal distance in meters, measured between the inner sides of the side plating at the broadest part of the hull.

306. Depth

Depth(D) is the vertical distance in meters at the middle point of L , measured from the top of the keel to the lower side of the upper deck plating at the side of the vessel.

307. Load Line

Load Line is the waterline corresponding to the designed summer load draught in case of a dredger which is required to be marked with load lines, and the waterline corresponding to the designed maximum draught in case of a dredger which is not to be marked with load lines.

308. Load draught

Load draught(d) is the vertical distance in meters, measured from the top of the keel to the load line at the middle of the L .

309. Upper deck

Upper deck is the uppermost continuous deck.

310. Superstructure

The superstructure is a decked structure on the upper deck extending from side to side of the dredger or having its side wall at the position not more than $0.04 B$ from the side shell plating.

311. Midship

The midship is the part covering $0.4 L$ amidships. However, it means $0.6 L$ amidships in the pontoon type or similar shape of dredgers.

312. Fore and aft end part

Fore and aft end means the part covering $0.1 L$ from the fore and aft end of the ship.

313. Strengthened bottom forward

The strengthened bottom forward part is the flat area forward the point of $0.15 L$ from the fore end.

314. Essential installation

Essential installation is an installation which has relation to the safety of life or of dredger.

315. Truss

Truss is a structure connecting the deck and the bottom structure with pillar and diagonal, and sustaining the deck loads effectively. ↓

CHAPTER 2 REGISTRATION AND CLASSIFICATION SURVEYS

Section 1 General

101. General

Registration and classification surveys of the dredger are to be in accordance with **Pt 1** of the **Rules for the Classification of Steel Ships** other than those specified in the Rules.

Section 2 Classification Survey During Construction

201. General

A detailed survey is to be done for structures, materials, dimensions and works of the hull, machinery, equipment and articles at the time of the classification survey during construction and confirm whether or not the applicable requirements of each Chapter is complied with and for the dredger that needs the marking of the load lines, the assignment of the load lines is to be done.

202. Documents to be submitted

1. For a dredger requiring classification survey during construction, the following drawings and other documents are to be submitted and approved by this Society.
 - (1) Hull parts
 - ① General arrangement
 - ② Midship section
 - ③ Construction profile
 - ④ Deck construction
 - ⑤ Superstructure and deckhouse construction
 - ⑥ Shell expansion
 - ⑦ Single and double bottom construction
 - ⑧ Watertight bulkhead
 - ⑨ Fore peak tank and aft peak tank construction
 - ⑩ Transverse section
 - ⑪ Frame structure
 - ⑫ Details of the watertight doors, hatch openings and their arrangements and closing appliances
 - ⑬ Hopper(bottom opening type hold) structure
 - ⑭ Boiler foundation, Main engine foundation, thruster and intermediate shaft foundations, Generator seat and other essential auxiliary seats
 - ⑮ Dredging equipment and foundations
 - ⑯ Mooring and towing equipment
 - ⑰ Steering and anchoring arrangement
 - ⑱ Welding specification
 - ⑲ Fire protection and fire fighting plan
 - ⑳ Other drawings and documents as deemed necessary by this Society
 - (2) Machinery parts
 - ① General arrangement of dredging equipment, power transmission system, diagram of dredging equipment and operating system
 - ② Drawings and documents of main engines, auxiliary engines, pump and piping systems
 - ③ Other drawings and documents as deemed necessary by this Society
2. For a dredger requiring classification survey during construction, the following drawings and documents in addition to those mentioned in the **Par 1** are to be submitted to this society.
 - (1) Specification
 - (2) Calculation sheet of the loads which are from dredging equipment and other installations to the supporting structure
 - (3) Tugging instructions
 - (4) Tank capacity plan and sounding tables

- (5) In a dredger which is intended to get load line assignment, the drawings mentioned in ① to ⑤ and ⑫ in **Par 1**, and the following drawings:
- ① Lines
 - ② Hydrostatic curves
- (6) Machinery particulars
- (7) Torsional vibration calculation sheet for driven shaft of generator of 30 kw and more
- (8) Capacity calculation sheet of battery for navigation lights
- (9) Light weight distribution chart
- (10) Location, mass and limit condition of various mobile dredging equipment according to each load condition
- (11) Shear force and bending moment calculation sheet according to each load condition
- (12) Calculation sheet of the horizontal forces taken to suction pipes and gallow
- (13) Other drawings and documents as deemed necessary by this Society

Section 3 Periodical Survey

301. General

The dates of annual, intermediate and special survey for the dredger are to be in compliance with **Pt 1, Ch 2** of the **Rules for the Classification of Steel Ships**.

302. Annual survey

1. Annual survey is to be carried out in accordance with **Pt 1, Ch 2, 202.** and **203.** of the **Rules for the Classification of Steel Ships**, and on the condition of the safety equipments and appliances as prescribed in **Ch 13, 101.7.** of this Rules.
2. Overall examination is to be carried out for the external and operating condition of dredging equipment.
3. For dredgers assigned with reduced freeboard in accordance with Annex 1, overall examination is to be carried out for the external and operating condition of the following items and onboard status of the instruction, etc. should be confirmed. *(2023)*
 - (1) Dumping System;
 - (2) The emergency control systems for opening the hopper doors and closing the dredging valves;
 - (3) The draft indicators; and
 - (4) Information to be provided to the master including the limiting sea state information posted on the navigating bridge and emergency control system instruction, etc.

303. Intermediate survey

1. In addition to above **302.** Intermediate survey is to be carried out in accordance with **Pt 1, Ch 2, 302.** and **303.** of the **Rules for the Classification of Steel Ships**.
2. Dismantling and opening survey for the dredging equipment.
3. Functional tests are to be carried out for the safety equipments and appliances prescribed in **Ch 13, 101.7.** of this Rules

304. Special survey

1. In addition to above **303.** Special survey is to be carried out in accordance with **Pt 1, Ch 2, 404.** and **405.** of the **Rules for the Classification of Steel Ships**. ↓

CHAPTER 3 LONGITUDINAL STRENGTH

Section 1 Longitudinal Strength

101. Hull section modulus

1. The hull section modulus at the midship part is not to be less than the values obtained from the following formulas, whichever is the greater.

$$Z_1 = 0.95K_1L^2B(C_b + 0.7) \quad (\text{cm}^3), \quad Z_2 = 6.63C \left\{ 1.28C_2L^2BC_b \left(1 + 0.04 \frac{L}{B} \right) + M_s \right\} \quad (\text{cm}^3)$$

K_1 : Coefficient obtained from the following formula;

$$\text{If } L \geq 90 \text{ m : } 10.75 - \left(\frac{300 - L}{100} \right)^{\frac{3}{2}}, \quad \text{If } L < 90 \text{ m : } 0.03L + 5$$

C_b : Block coefficient obtained from dividing moulded volume corresponding to the load line by LBd

K_2 : Coefficient obtained from the following formula;

$$0.0028L + 0.46$$

C : Coefficient given in **Table 3.1**

M_s : Bending moment($kN-m$) at still water. see **Par 2**.

Table 3.1 Coefficient C

	sagging condition	hogging condition
upper deck	1.00	1.03
bottom	1.06	1.03

2. The longitudinal bending moment at still water M_s , is to take the greatest value of sagging and hogging moments calculated by a calculation method as deemed appropriate by this Society, in a loaded condition with cargo and ballast or in a working condition at still water.
3. For a dredger of less than 60 meters in length, Z_2 of **Par 1** may not be applied. However, in special circumstances, the longitudinal bending moment at still water is to be calculated.
4. A special consideration should be given to shearing stress at the transverse sections with high shearing stress.

102. Calculation of the section modulus of the transverse section of hull

One of the followings is to be applied to calculate the hull section modulus.

1. The section modulus on the upper deck is to be calculated by dividing the moment of inertia by the vertical distance from the horizontal neutral axis to the top of the upper deck beam at ship's side. The section modulus on the ship's bottom, however, is to be obtained from dividing the above moment of inertia by the vertical distance from the horizontal neutral axis to the top of the keel.
2. All longitudinal members below the upper deck, regarded to be contributive to the longitudinal strength of hull, is to be included in the calculation. However, for those above the upper deck, only extended part of sheer strake may be included.

3. The openings on the strength deck is to be subtracted from the deck sectional area. However, in case where the small openings (less than 2.5 m in length, and 1.2 m in breadth) are installed, if the sum of the width of those small openings on the same transverse section is not greater than 0.06 ($B - \Sigma b$), these openings may be neglected in calculation. The Σb is the sum of the widths of the openings which are greater than 2.5 m in length and 1.2 m in breadth on the applicable transverse sections.
4. The unit of the area is cm^2 , and the length is m.

103. Loading manual

The master is to be provided with sufficient loading manual approved by this Society to enable him to adjust the cargo loading and ballasting in order to avoid occurrence of the stress not suitable to the structures of the dredger. However, exception may be made where deemed not necessary by this society. ⤵

CHAPTER 4 SHELL PLATING AND DECKS

Section 1 Shell Plating

101. General

1. Consideration for corrosion

The thickness of shell plating, at such places where excessive corrosion is anticipated due to the location, is to be increased over that required by requirements of this Chapter.

2. Special consideration for contact

In case where there is possibility of damage on the shell plating due to the working condition of the dredger, special consideration is to be given to the thickness of shell plating.

102. Plate keels

1. Scantling of plate keels

(1) The breadth of the plate keel over the whole length of the ship is not to be less than that obtained from the following formula.

$$L \geq 90 \text{ m} : 2L + 1,000 \text{ (mm)}, \quad L < 90 \text{ m} : 4.5L + 775 \text{ (mm)}$$

(2) The thickness of plate keels over the whole length of the ship is not to be less than the thickness of bottom shell plating obtained from the requirement in the **103. 4** increased by 1.5 mm. However, this thickness is not to be less than that of the adjacent bottom shell plating.

103. Shell plating at midship part

1. Minimum thickness

The thickness of shell plating below the upper deck at midship part is not to be less than that obtained from the following formula:

$$0.044L + 4.6 \text{ (mm)}$$

2. Thickness of side shell plating

(1) The thickness of side shell plating other than sheer strake is not to be less than that obtained from the following formula.

$$4.1S\sqrt{d+0.04L}+1.5 \text{ (mm)}$$

S : spacing of longitudinal or transverse frames (m)

(2) In case of the square bilge shape dredger, the thickness of the shell plating at the lowest part is not to be less than that obtained from the requirements in above (1) or **103. 4** whichever is the greater.

3. Thickness of sheer strake

The thickness of sheer strake is not to be less than 75% of the thickness of the stringer plate. However, the thickness is not to be less than that of the adjacent side shell plating.

4. Thickness of bottom shell plating

The thickness of bottom shell plating is to be obtained from one of the followings;

- (1) In a transverse framing system, the thickness is not to be less than that obtained from the following formula:

$$4.7S\sqrt{d+0.035L}+1.5 \quad (\text{mm})$$

S : spacing of transverse frame (m)

- (2) In a longitudinal framing system, the thickness is not to be less than that obtained from the following formula:

$$4.0S\sqrt{d+0.035L}+1.5 \quad (\text{mm})$$

S : spacing of longitudinal frame (m)

104. Shell plating for fore and aft end parts

1. Shell plating for fore and aft end parts

The thickness of shell plating may be gradually reduced from the midship section toward the fore and aft end parts. However, the thickness of the fore and aft parts within $0.1L$ is not to be less than that obtained from the following formula.

$$0.044L + 4.6 \quad (\text{mm})$$

2. Shell plating of bottom strengthened forward

The thickness of shell plating of bottom strengthened forward is to be in accordance with followings:

- (1) Where the fore draft in ballast loaded condition is not more than $0.025L$, it is not to be less than that obtained from the following formula.

$$2.15S\sqrt{L}+1.5 \quad (\text{mm})$$

S : Spacing between frames, and girder or longitudinal shell stiffeners, whichever is the smaller. (m)

- (2) Where the fore draft in ballast loaded condition is not less than $0.037L$, it may be the same as that obtained from the **104. 1**
- (3) The smallest fore draft in the ballast loaded condition is in between the above two, the thickness is not to be less than that as obtained from interpolation.

105. Side plating in way of superstructure

1. Side wall plating in way of superstructure

The side wall plating in way of superstructure is not to be less than that obtained from the following formula. However, it is not to be less than 5.5 m.

$$\text{Within } 0.25L \text{ from the fore end} \quad : 1.15S\sqrt{L}+1.0 \quad (\text{mm})$$

$$\text{Others} \quad : 0.94S\sqrt{L}+1.0 \quad (\text{mm})$$

S : Spacings between longitudinal or transverse frames at that place. (m)

106. Local compensation of shell plating

1. Shell plating fitted with hawse pipe and plating below

The shell plating fitted with hawse pipes and plating below is to be increased in thickness, or to be doubled, and of appropriate structure so that its end may not be damaged by the anchor or cables.

2. Shell plating of transverse framing system

In ships with transverse framing system, sufficient consideration is to be given to the prevention of buckling of the shell plating. For the bottom shells within $0.4L$ of the midship, the stiffeners with proper scantling are to be arranged with the spacing of not more than 2 times the spacing of the frames in that part. However, due consideration may be given where L is less than 60 m.

Section 2 Decks

201. General

1. Watertightness of the decks

Except specially permitted by this Society, the decks are to be of watertight structure.

2. Compensation of deck openings

Hatchways and other openings on decks are to have well rounded corners and to be compensated with appropriate means as necessary.

3. Local compensation

- (1) The cofferdam is to be installed or to be strengthened with appropriate means in way of the ladder well
- (2) The places where heavy dredging equipment are installed or local stresses are occurred are to be strengthened appropriately.

202. Deck loads

1. The value h of the deck loads

The value h of deck loads on deck, deck beam, girder, pillar and truss is to be obtained from one of the followings;

- (1) h is to be equivalent to the standards given by 7 times the tween deck height at side of the space(m), or 7 times the height from the deck concerned to the upper edge of hatch coaming of the above deck (m). However, h may be specified as the maximum design cargo weight per unit area of deck (kN/m^2). In this case, the value of h is to be determined by considering the loading height of cargo.
- (2) Deck loads h (kN/m^2) on non-exposed decks and platforms are to be defined by the designer without being less than $3.0(\text{kN/m}^2)$ for accommodation decks and $10.0(\text{kN/m}^2)$ for other decks and platforms.
- (3) The deck loads of the exposed deck are to be obtained from the following formula;

$$a(bf - y) \quad (\text{kN/m}^2)$$

a and b : value obtained from **Table 4.1**

However, h of Item II need not to exceed the value of Item I.

f : the value obtained from the following formula

$$L < 90 \text{ m} : 0.067 L, \quad 90 \text{ m} \leq L \leq 150 \text{ m} : 0.051 L$$

Table 4.1 Value, a and b

Column	Position of deck	a					b
		Deck plating	Beams		Deck girders	Pillars	
			$L < 90\text{m}$	$90\text{ m} \leq L \leq 150\text{ m}$			
I	Forward of $0.15 L$ abaft the fore end	14.7	9.80	$9.81 (0.84 L/100 + 0.25)$	7.35	4.90	1.42
II	Between $0.15 L$ and $0.3 L$ abaft the fore end	11.8	7.85	$9.81 (0.69 L/100 + 0.2)$	5.90	3.90	1.20
III	Between $0.3 L$ abaft the fore end and $0.2 L$ afore the aft end	6.90	4.60	$9.81 (0.38 L/100 + 0.13)$	$2.25^{(1)}$ $3.45^{(2)}$	2.25	1.0
IV	Afterward of $0.2 L$ afore the aft end	9.80	6.60	$9.81 (0.38 L/100 + 0.13)$	4.90	3.25	1.15

NOTES:

(1) In case of longitudinal deck girders outside the line of hatchway opening of the strength deck in midship part of ship.

(2) In case of deck girders other than (1).

y : the vertical distance from the load line to the exposed deck at the ship's side in accordance with the followings;

- (A) For decks located in between fore end and $0.15 L$, it is to be measured from the fore end.
- (B) For decks located in between $0.15 L$ and $0.3 L$ from the fore end, it is to be measured at the point of $0.15 L$ from the fore end.
- (C) For decks located in between the aft end and $0.2 L$ from the aft end, it is to be measured from the aft end.
- (D) For decks other than those mentioned in (A), (B) and (C), it is to be measured from the middle of L .

(4) Regardless of the requirements in the above (3), h is not to be less than that obtained from the formula given in **Table 4.2**;

Table 4.2 Minimum value of h

Column	Position of deck	h	C			
			Deck plating	Beams		Transverses, Longitudinal deck girders and pillars
				$L < 90\text{m}$	$90\text{ m} \leq L \leq 150\text{ m}$	
I and II	Forward of $0.3 L$ abaft the fore end	$C\sqrt{L+50}$	4.20	2.85	$9.81/100 (0.23 L + 8.3)$	1.37
III	Between $0.3 L$ abaft the fore end and $0.2 L$ afore aft end		2.05	1.37	$9.81/100 (0.12 L + 3.2)$	1.18
IV	Afterward of $0.2 L$ afore the aft end	$C\sqrt{L}$	2.95	1.95	$9.81/100 (0.17 L + 4.7)$	1.47

203. Effective sectional area of strength deck

1. Definition

The effective sectional area of strength deck is the sectional area, on each side of the ship's centre line such as strength deck, longitudinal beam and longitudinal girder etc. that are longitudinal or deemed to be longitudinal, extending not less than $0.5 L$ at amidships.

2. Effective sectional area of strength deck

- (1) The effective sectional area of strength deck at the midship part is to be so determined as to be not less than the value that fulfills the section modulus of athwartship section calculated from the requirement in **Ch 3**.
- (2) Beyond the midship part toward the fore end and aft end, the effective sectional area may be gradually reduced. However, at $0.15 L$ from the fore and aft end, it is not to be less than 50 % of the effective sectional area at the midship part.

204. Thickness of the strength deck

1. Thickness of the strength deck

The thickness of the strength deck is not to be less than that obtained from the followings. However, within the superstructure or steel deckhouse, it may be reduced from the thickness obtained from the formula, by 1 mm.

- (1) At amidships, the thickness of deck plating outside the line of hatchway opening is to not to be less than that obtained from the followings;

$$\text{Decks of longitudinal framing system} \quad : t = 1.47 S\sqrt{h} + 1.5 \text{ (mm)}$$

$$\text{Decks of transverse framing system} \quad : t = 1.63 S\sqrt{h} + 1.5 \text{ (mm)}$$

S : spacing of longitudinal or transverse beam (m)

h : the value obtained from **Table 4.1**

- (2) The thickness of the deck plating other than (1) and other deck plating is not to be less than that obtained from the following formula;

$$t = 1.25 S\sqrt{h} + 1.5 \text{ (mm)}$$

S and h : as required in the above (1)

2. Deck plating forming the top of tanks

The thickness of deck plating forming the top of tanks is not to be less than the thickness as required in **Ch 7, Sec 3**, when the spacing of beams is regarded as the spacing of stiffeners. ↓

CHAPTER 5 INTERNAL FRAMES

Section 1 Transverse Framing System

101. Single Bottoms

1. General

In case of single bottoms, the centerline girder that is formed by web and rider plate is to be installed and extended as far forward and afterward as practicable.

2. Center girder

(1) Girder

(A) The thickness of the girder is not to be less than that obtained from the following formula. However, beyond the midship part, the thickness of the girder at the fore end and aft end part may be gradually reduced and it may be 85 % of the thickness obtained from the formula.

$$0.065 L + 4.2 \text{ (mm)}$$

(B) The height of girder is not to be less than the height of the floor.

(2) Rider plates

(A) The rider plates are to be extended from the collision bulkhead to the aft peak bulkhead.

(B) The sectional area of rider plates is not to be less than that obtained from the following. However, beyond the midship part, the thickness of rider plates may be gradually reduced and it may be 85 % of the thickness obtained from the formula at the fore and aft end part.

$$0.6 L + 9 \text{ (cm}^2\text{)}$$

(C) The breadth of rider plates is not to be less than that obtained from the following formula;

$$2.3 L + 160 \text{ (mm)}$$

(D) The girders under the pillars are to be compensated properly by such means as increasing the sectional areas of rider plates of girder.

3. Side girders

(1) Structure and Arrangement

Side girders are to be composed of girders and rider plates, and extended as far forward and afterward as practicable, and to be arranged between the centerline girder and ship's side with the spacing of not more than 2.5 m.

(2) Girders

(A) Girders

The thickness of girders at amidships is not to be less than that obtained from the following formula. However, it is not to be more than the value obtained from **101. 2** (1) (A). And also, their thickness at the fore and aft end parts may be 85 % of those at amidships.

$$0.042 L + 4.8 \text{ (mm)}$$

(B) Rider Plates

The thickness of rider plates is not to be less than that of the side girder plate, and their sectional areas at the midship parts are not to be less than that obtained from the following formula. And also, their sectional areas at the fore and aft end parts may be 85 % of those at amidships.

$$0.45 L + 8.8 \text{ (cm}^2\text{)}$$

4. Floors

(1) Arrangement

The standard spacing of floors is to comply with the requirements in **103. 2.**

(2) Shape

(A) Upper edges of floors at any part are not to be below the level of upper edge at the centerline.

(B) In the midship part, the depth of floors at the inner edge of frame bracket is not to be less than $1/2$ of d_0 specified in the following (3) (A).

(C) The face plates on the upper edge of floors are to be fitted from the upper part of the bilge at one side to the upper part of the bilge on the opposite side in case of the floors with curved shape. In case of floors connected by bracket, they are to be continually fitted extending over the floors.

(3) Scantling of floors

(A) The scantling of floors is not to be less than that obtained from the following formula.

Depth of the floor at the centerline (d_0) : $0.0625 l$ (m)

Thickness of the floor : $10 d_0 + 3.0$ (mm) and 12 mm, whichever is the smaller.

Section modulus of the floor : $4.27 S h l^2$ (cm³)

S : spacing of floor (m)

h : d or $0.66 D$, whichever is the greater (m)

l : span between the inner edge of floor bracket measured at the middle of L plus 0.3 m. However, in case of a floor which has curved shape at the upper edge, the length l may be suitably modified.

(B) The thickness of face plates fitted at the upper edge of floors is not to be less than the thickness of the floors and the breadth of face plates is to be adequate for lateral stability of the floors.

(C) Beyond $0.5 L$ amidships, the thickness of floors may be gradually reduced to 85% of the value specified in the above (A) at the end parts of the ship. However, for the strengthened bottom forward, the following requirements in Item. (4) are to be complied with.

(4) Strengthened bottom forward

At the strengthened bottom forward parts, the depth of floors is to be increased, or the coefficients of floors specified in (1) are to be increased properly.

(5) Frame brackets

The scantling of frame brackets is to be determined in accordance with the requirements of the followings. And, the free edge of the brackets is to be appropriately flanged.

(A) The height of the bracket measured from the top of keel is not to be less than twice the required depth of the floor plate at the centerline of the ship.

(B) The breadth of the floor plate measured along the upper edge of floor plate from the inner edge of frame is not to be less than the depth of the floor plate required at the centerline of the ship.

(C) The thickness of frame brackets is not to be less than that of floor plates.

(6) Drainage holes

Drainage holes are to be provided on the floor plates on both sides of the centerline and for barges with flat bottom, at the low parts of the turn of bilge.

(7) Lightening holes

Lightening holes may be provided on the floors. In this case, however, appropriate strength compensation is to be made by increasing the floor depth or by some other suitable means.

102. Double bottoms

1. General

- (1) Dredger that L is 90 meters and above, is to be of double bottom structure. However, it may be constructed with single bottom structure if approved by this Society.
- (2) The requirements in **102.** may be suitably considered, where longitudinal bulkheads are provided to reduce the supported breadth of double bottoms or partial double bottoms are provided.
- (3) Where the longitudinal framing system is transformed into the transverse framing system, or the depth of the double bottoms changes abruptly, special care is to be taken for the continuity of strength by installing additional girders or floors.
- (4) Manholes and lightening holes are to be provided in all non-watertight members to ensure accessibility and ventilation, except where pillars are provided and where such openings are restricted in accordance with the rules.
- (5) The number of manholes in tank tops is to be kept to the minimum necessary for securing ventilation and ready access to every parts of the inside of double bottom. They are to be so provided that the main watertight compartments are not to be connected each other through the double bottom.
- (6) A suitable means is to be provided for freeing bilge at the top of double bottom. The bilge well fitted at the top of double bottom in accordance with the requirement in (1) above is to be such that, as far as practicable, its depth is to be less than $1/2$ of the depth of double bottom and its bottom is to be situated at a distance of not less than 460 mm from the bottom shell.
- (7) The thickness of the watertight girders and floors and the scantling of the stiffeners attached to them are to comply with the relevant requirements for respective girders and floors as well as the requirements in **Ch 7, 301.** and **302.**
- (8) No structural members of the double bottom is to be less than 6 mm in thickness.

2. Center girders

- (1) Arrangement and structure
 - (A) Center girders are to be extended as far forward and afterward as practicable.
 - (B) In case the center girders are not watertight in double bottom where fuel oil, fresh water or ballast are carried, the breadth of the compartments are not to exceed $0.5 B$. However, such areas that inside of narrow tanks at the fore and aft end and other areas where deemed appropriate by this Society may be considered properly.
- (2) Scantling
 - (A) The height of the center girders are not to be less than $B/16$ except as specially approved by this Society, but in no case is it to be less than 700 mm.
 - (B) The thickness of the center girder is not to be less than that obtained from the following formula:

$$0.05 L + 5 \text{ (mm)}$$

- (3) Manholes
 - (A) Manholes may be provided on center girders in every frame space beyond $0.75 L$ amidships.
 - (B) If L (length of ship) is less than 90 meters, manholes may be provided on center girders in every two frame spaces within $0.75 L$ amidships. However, the depth of manholes is not to exceed $1/3$ of the depth of center girder.

3. Side girders

- (1) Arrangement
 - (A) Side girders, within $0.5 L$ amidships and in between center girders and the ship's side, are to be provided at an interval not more than 4.6 meters.
 - (B) The arrangement of the side girders and half-height girders at the strengthened bottom forward and their forward and afterward parts are to be in accordance with the requirements in **104. 3.**
- (2) Thickness

The thickness of side girder plating is not to be less than that obtained from the following formula;

$$0.65\sqrt{L} + 1.5 \text{ (mm)}$$

- (3) Thickness of half-height girders
The thickness of half-height girders is not to be less than that obtained from the above formula in (2).
- (4) Scantling of vertical stiffeners and struts
(A) Vertical stiffeners are to be provided on side girders at appropriate intervals, and struts are to be provided on half-height girders at the place of the open floors.
(B) The stiffeners are to be of the flat bars or equivalents with the thickness of the same as that of the girder plates to which the stiffeners are attached, and the depth of $0.08 d_0$ or more, where d_0 is the height of the center girder (mm).
(C) The section modulus of struts defined in the above (A) is not to be less than that obtained from the requirement in **202. 5**.
- (5) Lightening holes
The diameter of lightening holes on the side girders within 10% of the length of a hold at the location of the transverse bulkhead, is not to be exceeded 1/3 of the depth of side girders at that place. However, a suitable modification may be made at outside of $0.75 L$ amidships where appropriate compensation has been made and the length of hold is particularly small.

4. Solid Floors

- (1) Arrangement
(A) Solid floors are to be provided within the double bottom at a spacing not exceeding about 3.5 m.
(B) Solid floors are to be provided at the place of the followings regardless of the above requirement the above (A).
① Lower part of the transverse bulkhead.
② At the location specified in the requirement **104. 3** between the collision bulkhead and the after end of the strengthened bottom forward.
(C) Watertight floors are to be so arranged that the double bottom compartment may corresponds to that of the ship as far as practicable.
- (2) Thickness
The thickness of solid floors is not to be less than that obtained from the following formula;

$$0.6\sqrt{L} + 1.5 \text{ (mm)}$$

- (3) Vertical stiffeners
(A) In case of transverse framing system, vertical stiffeners are to be provided on the solid floors at a suitable spacing. In case of a longitudinal framing system, however, they are to be provided at every longitudinal frames.
(B) The thickness of the vertical stiffeners prescribed in (1) is to be the same as that of the flat bar attached to them, and the depth is not to be less than $0.08 d_0$ (m) or equivalent, where d_0 (m) is the depth of the centerline girder.
- (4) Lightening holes
The diameter of lightening holes within $0.1 B$ from side shell plating, is not to be exceeded about 1/5 of the depth of the solid floors that are located within 1/2 length from the middle of a hold. This requirements may, however, be suitably modified to solid floors that have been compensated and located beyond the $0.75 L$ from the amidships or in case that the length of holds are exceptionally small.

5. Open floors

- (1) Arrangement
Where the double bottom is framed transversely, open floors composed of brackets fitted at center girder and margin plate, and main frames and reverse frames are to be provided at every hold frame where solid floors are not provided.
- (2) Scantling of main frames and reverse frames
(A) The section modulus of main frames is not to be less than that obtained from the following formula.

$$CSHl^2 \text{ (cm}^3\text{)}$$

- l : Distance between the bracket attached to the center girder and the bracket attached to the margin plate (m). However, in case side girders are provided, the distance between vertical and bracket (m) is may be taken if it is the greater.
- S : Spacing of frames (m)
- h : Vertical distance to a point of $0.026 L + d$ above the top of keel (m).
- C : Coefficient as the following ;

In case where struts as specified in the following (3) are not provided: 6.0

In case where struts as specified in the following (3) are provided:

under the deep tank : 4.4 Other places : 2.9

- (B) The section modulus of reverse frame is not to be less than the value obtained from the calculation which taken 85 % of the value of C at that main frame as the coefficient C in (1). However, where struts are not provided under deep tank, the value as required in **Ch 7, 302.** is to be taken.
- (3) Struts
- (A) The struts specified in (2) are to be of rolled sections other than flat bars or bulb plates and to be overlapped sufficiently with main frames and reverse frames.
- (B) The section modulus of the struts specified in (A) is not to be less than that obtained from the requirement in **202. 5.**
- (4) Brackets
- (A) Main frames and reverse frames are to be connected to the center girder and margin plate with brackets whose thickness are not to be less than that obtained from the requirement in **202. 3 (3).**
- (B) The above brackets are to be overlapped sufficiently with main frames and reverse frames with their breadth not to be less than 5 % of B . And their free edges are to be suitably stiffened.

6. Inner bottom plating and margin plates

- (1) Thickness of inner bottom plating
The thickness of inner bottom plating is not to be less than that obtained form the following formula;

$$3.8S\sqrt{d} + 1.5 \text{ (mm)}$$

S : the spacing of floors in case of transverse framing system (m)

- (2) Crossline between margin plates and shell planting
It is recommended that the crossline between margin plate and shell plating is to be of sufficient height to protect the bottom up to the turn of the bilge and for forward $0.2 L$ from the stem the margin plates are to extend to the ship's sides horizontally as far as practicable.
- (3) Thickness of margin plates
The thickness of margin plates is to be increased by 1.5 mm above that obtained from the formula in the above (1).
- (4) Breadth of margin plates
Margin plates are to be of adequate breadth and to extend well inward from the inner edge of the outer brackets.

7. Outer brackets

- (1) The thickness of outer brackets connecting hold frames to margin plates is to be increased by 1.5 mm above that obtained from the formula in **202. 3 (3).**
- (2) The free edges of the outer brackets are to be suitably stiffened.

103. Transverse frames

1. General

- (1) Transverse strength
Where the length between transverse bulk heads is long, transverse strength is to be strengthened by means of increasing the scantling of frames or additional provision of web frames etc..
- (2) Frames in deep tanks
The frames in deep tanks are to have the same strength as the stiffeners on the deep tank bulkheads have.
- (3) Connection of the frames
The frames and brackets at the turn of the bilges or tank side brackets in the double bottom are to be effectively connected by overlapping over 1.5 times the depth of frame.

2. Frame spacing

- (1) The standards spacing of transverse frame is obtained from the following formula;

$$L < 40 \text{ m} : 530 \text{ (mm)}, \quad L \geq 40 \text{ m} : 2 L + 450 \text{ (mm)}$$

- (2) Transverse frame spacing in fore and after peaks is not to exceed 610 mm or the standard spacing in (1), whichever is the smaller.
- (3) The requirement in (2) may be modified, where structural arrangements or scantlings are suitably considered.

3. Scantling of frames

- (1) The section modulus of transverse frames under the upper deck between the collision bulkhead and aft peak bulkhead is not to be less than that obtained from the following formula. It should not, however, be less than 30 cm^3 .

$$CShl^2 \quad (\text{cm}^3)$$

S : Spacing of frames (m)

l : Vertical distance from top of inner bottom plate or floor of single bottoms at side to the upper edge of the deck beam at the top of frames (m)

h : Vertical distance for each frame from the lower part of l to the following points;

$$30 \text{ m} < L \leq 90 \text{ m} : \text{top of the keel } d + 0.004 L - 0.54$$

$$L > 90 \text{ m} : \text{top of the keel } d + 0.038 L$$

C : Coefficient as the following ;

Frames in between $0.15 L$ from the collision bulkhead and aft peak bulkhead: 2.6

Frames in between $0.15 L$ from the collision bulkhead and the collision bulkhead: 3.4

- (2) Where the height of floors in the ship's centerline is less than $B/16$, the scantling of frames in the requirement of (1) is to be suitably increased.

4. Fore and aft peak tank frames

- (1) Transverse frames in fore peak tank

The section modulus of transverse frames under the upper deck at forward of the collision bulkhead is not to be less than that obtained from the following formula. It should not, however, be less than 30 cm^3 .

$$8Shl^2 \quad (\text{cm}^3)$$

S : Spacing of frames (m)

l : Vertical distance between frames (m). However, it is to be taken 2 m where the distance is less than 2 m.

h : Vertical distance between the middle of l and $0.12 L$ on top of the keel. However, it is to be taken $0.06 L$ (m) where the distance is less than $0.06 L$.

(2) Transverse frames in aft peak tank

The section modulus of transverse frames under the upper deck at aftward of the aft peak bulkhead is not to be less than that obtained from the following formula. It should not, however, be less than 30 cm^3 .

$$8Shl^2 \quad (\text{cm}^3)$$

S : Spacing of frames (m)

l : Vertical distance between frames (m). However, it is to be taken 2 m where the distance is less than 2 m.

h : Vertical distance between the middle of l and the following points.

$30 \text{ m} < L \leq 90 \text{ m}$: top of the keel $d + 0.044 L - 0.54$

$L > 90 \text{ m}$: top of the keel $d + 0.038 L$

104. Fore and aft end construction

1. General

- (1) For the bottom and ship's side structures at the fore and aft end parts, the requirements are to be applied, and for ship's side frames, the requirements in **103.** are to be applied.
- (2) Where fore and aft end parts are used for deep tank, the requirements in **Ch 7, Sec 3** are also to be applied.
- (3) Wash plates
In the fore and aft holds which are used for deep tank, the effective wash plating is to be provided on the centerline or scantling of structural members is to be suitably increased.

2. Constructions forward collision bulkhead

- (1) Construction and Arrangement
 - (A) Deep center girders or longitudinal bulkhead on the ship's centerline are to be provided forward the collision bulkhead, or center girders and deck structure are to be of truss structure that connects each other with strut and diagonal.
 - (B) In the transverse framing system, floors having sufficient height are to be provided at every frames. And those floors are to be supported by side girder provided with spacing of 2.5 m or less. The frames are to be supported by structures specified in **104. 2 (1) (E) to (G)** at vertical interval of 2.5 m.
- (2) Scantling of structural members
 - (A) Thickness of center girder and floor plate is not to be less than that obtained from the following formula. However, it does not need to exceed 11 mm.

$$0.045 L + 4.5 \text{ (mm)}$$

- (B) Floor plates are to have appropriate depth, and stiffeners are suitably provided as necessary.
- (C) The upper edge of the floor plates and center girders are suitably stiffened.
- (D) The thickness of side girder is to be the same as that of center girder and its height is to be appropriately modified according to the height of floor plates.
- (E) Stiffening beam is to be provided on each frame, and where steel plates having lightening holes are provided from the ship's side to the other side, scantling of stiffening beams and steel plates is not to be less than that obtained from the following formula;

$$\text{Sectional area of stiffener} : 0.1 L + 5 \text{ (cm}^2\text{)}$$

$$\text{Thickness of steel plate} : 0.02 L + 4.5 \text{ (mm)}$$

- (F) In case that a ship's side stringer is installed, its scantling is not to be less than that obtained from the following formula.

Depth of stringer : $0.2 l$ (m) or 2.5 times the depth of slot for penetrating longitudinal frames, whichever is the greater. However, it is not to be less than that obtained from the

following formula;

$$L < 90 \text{ m} : 0.0053 L + 0.25 \text{ (m)}, \quad L \geq 90 \text{ m} : 0.0025 L + 0.5 \text{ (m)}$$

$$\text{Section modulus of stringer} : 8Shl^2 \text{ (cm}^3\text{)}$$

$$\text{Thickness of Web} : 0.02 L + 5.5 \text{ (mm)}$$

S : Width supported by ship's side stringer (m)

h : Vertical distance from the middle of S to $0.12 L$ on the top of keel.

However, $0.06 L$ (m) is taken, in case the distance is less than $0.06 L$ (m)

l : Length between supporting points including Connection part of the ship's side stringer (m)

(G) Stiffening beam is to be provided on every other frame, and the scantling of stiffening beam and stringer plate in case that the stringer plate is connected to shell plating is to be as follows;

① Stiffening beam : Sectional area of stiffening beam is not to be less than that obtained from the following formula.

$$0.3 L \text{ (cm}^3\text{)}$$

② Stringer plate :

$$\text{Width} : L < 90 \text{ m} : 5.3 L + 250 \text{ (mm)}, \quad L \geq 90 \text{ m} : 2.5 L + 500 \text{ (mm)}$$

$$\text{Thickness} : 0.02 L + 5.5 \text{ (mm)}$$

(3) Truss

Where bottom structures and deck structures are connected by truss, the followings are to be applied.

(A) The sectional area of the strut is not to be less than that obtained from the following formula

$$\frac{0.33SbL}{2.72 - \frac{l}{k}} \text{ (cm}^3\text{)}$$

S : Distance between the center of span extending from one strut to its next strut or to the bulkhead (m)

b : Distance between the center of span extending from one strut to its next strut or to the inside of bracket at ship's side (m)

l : Length of strut (m)

$$k = \sqrt{\frac{I}{A}}$$

I : Moment of inertia of strut (cm⁴)

A : Sectional area of strut (cm²)

(B) Diagonal

An angle with the horizontal line is to be about 45° and the sectional area is not to be less than 75% of the sectional area of strut as required in (1).

(C) Where fore peak tank is to be used as deep tank, the strut and diagonal are to be of solid type one.

3. Construction of strengthened bottom forward

(1) General

These requirements are to be applied in ships having a fore draught of less than $0.037 L$ in ballast condition.

(2) Structure

(A) Side girders or half side girders are to be provided in accordance with **Table 5.1** in between the collision bulkhead and $0.2 L$ from the fore end. However, half girders may be provided in between the collision bulkhead and $0.175 L$ from the fore end.

(B) Solid floors are to be provided in accordance with **Table 5.1** in between the collision bulkhead and the $0.15 L$ from the fore end.

(C) In ships where the fore draught in ballast condition is more than $0.025 L$ and less than $0.037 L$ and the arrangement of the structures in the compensated parts at the forward bottom is such that it may be hard to comply with the requirements prescribed in previous paragraphs, floors and side girders are to be suitably compensated. However, exception is to be made for ships having tugging and pushing speed exceptionally low, compared with L .

Table 5.1 Structure of the compensated parts at the forward bottom

members double bottom ship's side structure		Side girder	Half girder	Solid floor
		Transverse	set up at an interval not exceeding 2.5 m	set up at middle of side girder
Longitudinal	at an interval not exceeding 2.5 m			
Longitudinal	Transverse	ditto	-	at every other hold frames
	Longitudinal			at an interval not exceeding 2.5 m

4. Structures at the afterward of the Aft peak bulkhead

(1) Floor

Scantling and construction of floors in aft peak tank are to be in compliance with the requirements in **104. 2** (2).

(2) Frames

Where the distance measured from the outside of the frame to the supporting point of the frame is over 2.5 m, either the scantling of frame may be increased or stiffening of the ship's side be increased by a suitable mean.

(3) Other structural members

Where the structures in the aft peak tank are of the same as those in the fore peak tank as required in **104. 2**, the scantlings of transverses, stringers, longitudinal frames, struts and diagonals may be reduced with 30% that required in **104. 2**.

105. Beam

1. General

(1) Camber

The standard camber of weather decks is to be $\frac{B}{50}$ at the middle of L of barge.

(2) Connection of beam

(A) Transverse beam is to be connected to frame by brackets

(B) Transverse beam, which is provided at a place where frame is not provided, in between decks or superstructures, is to be connected to shell plating by beam bracket.

(3) Place where longitudinal beam system is transformed to transverse beam system

Special care is to be taken to keep the continuity of strength at the place where longitudinal beam system is transformed to transverse beam system.

2. Transverse beams

(1) Arrangement and shapes

- (A) Transverse beams are to be provided on every frames. The length–depth ratio of the transverse beam is preferably to be of 30 or less at strength deck.
 (B) 40 or less at superstructure deck as far as practicable.
- (2) Section modulus
 The section modulus of transverse beam is not to be less than that obtained from the following formula;

$$0.43Shl^2 \quad (\text{cm}^3)$$

S : Spacing of beams (m)

h : Deck loads as required in **Ch 4, 202**. (kN/m²)

l : Distance between the inner end of the beam bracket and the nearest deck longitudinal girder or between each deck longitudinal girders (m).

3. Beams at bulkhead recess

Section modulus of beam provided for the deck which forms the bulkhead recesses, is to be in compliance with this chapter as well as the requirement in **Ch 7, 203**.

4. Beams on top of deep tank

Section modulus of beam provided for the deck which forms deep tank is to be in compliance with this chapter as well as the requirement in **Ch 7, 302**.

5. Deck beam supporting especially heavy weight

Superstructure or end parts of deckhouse, and deck beams supporting mast, ladder, dredging machineries, auxiliary machinery or especially heavy weight are to be properly reinforced by increasing the scantling of beams, or by installing additional deck girders or pillars.

106. Deck girders

1. Arrangement

- (1) Longitudinal girders under the deck are to be provided to support the transverse beams.
- (2) In way of the bulkhead recess and the top of tank, deck girders are to be arranged at an interval not exceeding 4.6 m as far as practicable.

2. Construction

- (1) Deck girders are to be composed of face plate provided along the lower edge.
- (2) Tripping brackets are to be provided at an interval of about 3 m and where the breadth of face plate exceeds 180 mm in either side, the tripping brackets are to be so arranged as to support the face plate as well.
- (3) The thickness of face plates forming girders is not to be less than that of web plates and the width of the face plates is not to be less than that obtained from the following formula.

$$85.4\sqrt{d_0l} \quad (\text{mm})$$

d_0 : depth of girder (m)

l : span of girders (m). If there is a effective tripping brackets, it is considered between supporting points

- (4) The depth of girder is to be kept constant between two adjacent bulkheads and is to be more than 2.5 times of slot depth for beam.
- (5) The girders are to have sufficient rigidity to prevent excessive deflection of decks and excessive additional stresses at the end of beams.

3. Section Modulus

- (1) The section modulus of deck girders outside the lines of hatchway opening of the strength deck for midship part is not to be less than that obtained from the following formula.

$$1.29 bhl^2 \quad (\text{cm}^3)$$

b : Distance between the centres of two adjacent spans of beams supported by the girders or the beam bracket (m)

h : Deck loads specified in **Ch 4, Sec 2** (kN/m²)

l : Distance between the supports of longitudinal girders (m)

- (2) The section modulus of deck girders outside the lines of hatchway opening of the strength deck for the part forward and aftward the midship part may be gradually reduced. In no case, however, the section modulus is not to be less than that obtained from the following formula.

$$0.484 bhl^2 \quad (\text{cm}^3)$$

b , h and l : as specified in (1)

- (3) The section modulus of deck girders other than (1) and (2) is not to be less than that obtained from (2).

4. Web thickness

The thickness of web plate of longitudinal girder is not to be less than that obtained from the following formula.

$$10 S_1 + 1.5 \quad (\text{mm})$$

S_1 : spacing of web stiffeners or depth of girders, whichever is the smaller (m)

5. End connection

- (1) Where Girder ends are connected to bulkhead plating or top plating of tank, effective supporting members are to be provided on the opposite side of bulkhead plating or top plating of tank.
- (2) The bulkhead stiffeners or stiffening girders which are connected to the deck girders are to have sufficient strength to support the deck girders
- (3) Longitudinal deck girders are to be continuous or to be effectively connected so as to maintain the continuity at ends.

Section 2 Longitudinal Framing System

201. General

1. General

Other than specified this Chapter, the longitudinal framing system is to be in compliance with the relevant rules of **Sec 1**.

2. Application

The requirements of this Chapter are generally to applying to the longitudinal framing system of pontoon type dredgers

202. Construction and scantlings

1. Structural arrangement

- (1) In the ship's centerline, longitudinal bulkhead is to be provided or special consideration is to be taken to have equivalent strength.
- (2) Bottom transverse, side transverse and deck transverse are to be arranged at an interval of 3.5 m or less.
- (3) The standard spacing of longitudinal beam, bottom and side frame is obtained from the following formula.

$$2L + 550 \text{ (mm)}$$

- (4) When flat bars are used for longitudinal beams, the ratio of depth and thickness is not to be exceeded 15.

2. Solid floor

In the longitudinal framing system of double bottom construction, the thickness of solid floor is not to be less than that obtained from following formula.

$$0.7\sqrt{L} + 1.5 \text{ (mm)}$$

3. Bracket

- (1) In the longitudinal framing system of double bottom construction, the brackets connected to adjacent bottom longitudinal are to be provided at an interval not exceeding 1.75 m on the center girder between the solid floors and connected to center girder, shell plating and bottom longitudinals.
- (2) In the longitudinal framing system of double bottom construction, the brackets extending from the margin plate to adjacent bottom and inner bottom longitudinals are to be provided at every hold frame and connected to margin plate, shell plate and longitudinal frames etc.
- (3) The thickness of bracket mentioned above is not to be less than that obtained from the following formula. However, it does not need to exceed the thickness of solid floor.

$$0.6\sqrt{L} + 1.5 \text{ (mm)}$$

- (4) The thickness of stiffeners required by (1) is to be same as that of plating and the depth of stiffener is not to be less than $0.08 d_0$ (m) of plat bar or equivalents. Where d_0 is the depth of center girder.

4. Bottom longitudinal and inner bottom longitudinal

- (1) The section modulus of bottom longitudinals is not to be less than that obtained from the following formula.

$$9.5SDI^2 \text{ (cm}^3\text{)}$$

S : Space of longitudinal (m)

l : Distance between supports (m)

- (2) In the longitudinal framing system of double bottom construction, the section modulus of inner bottom longitudinals is not to be less than 85 % of section modulus obtained from (1). And inner bottom longitudinals in the lower part of deep tank which is not arranged strut is to be of **Ch 7, 302**.

5. Strut

- (1) When the distance between floors is exceeded 2.5 m, the strut is to be installed at the mid-point between floors. The strut is to be of rolled sections other than flat bars or bulb plates and to be well overlapped with web plating of bottom and inner bottom longitudinal.
- (2) The sectional area of strut of **Par 1** is not to be less than that obtained from the following formula.

$$2.2Sbh \quad (\text{cm}^3)$$

S : space of floor (m)

b : breadth of area supported by strut (m)

h : Vertical distance from the longitudinals to a point of $d + 0.026L$ above the top of keel (m)

6. Bottom transverse

The scantling of bottom transverse is not to be less than that obtained from the following formula.

$$\text{Section modulus} : 7.4SDl^2 \quad (\text{cm}^3), \quad \text{thickness of web} : 10d_0 + 1.5 \quad (\text{mm})$$

S : space of transverse (m)

l : length between supports by transverse (m)

d_0 : depth of web (m)

7. Thickness of inner bottom plating

The thickness of inner bottom plating is not to be less than that obtained from the following formula.

$$3.8S\sqrt{d} + 1.5 \quad (\text{mm})$$

S : space of inner bottom longitudinals (m)

8. Bottom longitudinal

- (1) The section modulus of bottom longitudinals is to comply with followings.
- (A) The section modulus of longitudinal in the midship part is not to be less than that obtained from the following formula.

$$9.5Shl^2 \quad (\text{cm}^3)$$

S : space of longitudinals (m)

l : length between supports of longitudinal (m)

h : vertical distance from the position of each longitudinal to the point of D above the keel plate. However, when h is less than $0.3\sqrt{L}$ (m), h is to be taken as $0.3\sqrt{L}$ (m).

- (B) The section modulus of longitudinals in the forward and aft part other than midship part may be gradually reduced and it may be of 85 % of that obtained from the formula of (A). However, the section modulus of longitudinals between $0.15L$ from fore end and the collision bulkhead is not to be less than that obtained from the formula of (A).
- (2) The ratio of depth to thickness is not to be exceeded to 15 when flat bars are used for longitudinals.
- (3) The slenderness ratio of longitudinals attached to sheer srake in midship part is not to be exceeded 60.

9. Side transverse

- (1) The scantling of side transverse is not to be less than that obtained from the following formula.

$$\text{Section modulus : } 8Shl^2 \text{ (cm}^3\text{),} \quad \text{thickness of web : } 10d_0 + 1.5 \text{ (mm)}$$

S : space of side transverse (m)

l : distance between supports of transverse (m)

h : vertical distance from midpoint of l to D on the keel plate

However, h is less than $0.3\sqrt{L}$ (m), h is to be taken as $0.3\sqrt{L}$ (m).

d_0 : depth of web (m)

- (2) The side transverses are to be provided with tripping brackets at an interval of about 3 m or the webs are to be strengthened by fitting the stiffeners where longitudinals are penetrated. However, a stiffener can be provided at every longitudinal in the middle part of side transverses.

10. Longitudinal beams

- (1) The section modulus of longitudinal beams in the midship part is not to be less than that obtained from the following formula.

$$1.14Shl^2 \text{ (cm}^3\text{)}$$

S : space of longitudinal (m)

l : length between supports of longitudinal beam (m)

h : specified in the requirements of **Ch 4, 202. 1**

- (2) The section modulus of longitudinals installed in forward and aftward of midship part can be gradually reduced. However, it is not to be less than that obtained from the following formula.

$$0.43Shl^2 \text{ (cm}^3\text{)}$$

S , h and l : specified in (1)

11. Deck transverses

The scantling of deck transverses is not to be less than that obtained from the following formula.

$$\text{Section modulus : } 0.484Shl^2 \text{ (cm}^3\text{),} \quad \text{thickness of web : } 10d_0 + 1.5 \text{ (mm)}$$

S : space of deck transverse (m)

l : length between supports of deck transverse (m)

h : specified in **Ch 4, 202. 1**

d_0 : depth of web (m)

203. Fore and aft construction

1. General

- (1) Bottom and side transverses supporting bottom and side longitudinal frames are to be arranged at an interval of about 2.5 m, and supported by side girders and side longitudinal girders or cross tie which are arranged at an interval of about 4.6 m. And side transverses are to be effectively connected with bottom transverses.

2. Longitudinals in fore peak tank

The section modulus of longitudinals below the upper deck in the forward of collision bulkhead are not to be less than that obtained from the following formula. However, it is not to be less than 30 cm³.

$$8 S h l^2 \quad (\text{cm}^3)$$

S and l : complying with **202. 8** (1) of Rules.

l : vertical distance from the frame to 0.12 L above the keel plate.

However, l is less than 0.06 L (m), l is to be taken as 0.06 L (m)

3. Construction forward the collision bulkhead

- (1) The scantlings of bottom transverse supported at ship centerline are not to be less than that obtained from the following formula.

depth of transverse : 0.2 l (m) and 0.0085 L + 0.18 (m), whichever is the greater

section modulus of transverse : 1.2 $S L l^2$ (cm³)

thickness of web : $0.005 \frac{S L l}{d_1} + 1.5$ (mm) and $0.6 \sqrt{L} + 3$ (mm), whichever is the greater.

S : space of transverse (m)

l : length between supports by transverse (m)

d_1 : value which is the depth of transverse deducted depth of slot (m)

- (2) The scantling of center girder is not to be less than that specified (1).
 (3) The scantling of side transverse supporting longitudinal frames is not to be less than that obtained from the following formula.

Depth of transverse : 0.2 l_0 (m) and 2.5 times of the depth of slot for longitudinal frame penetration, whichever is the greater. However, it is not to be less than that obtained the following formula.

$$L < 90 \text{ m} : 0.0053 L + 0.25 \text{ (m)}, \quad L \geq 90 \text{ m} : 0.0025 L + 0.5 \text{ (m)}$$

Section modulus of transverse : $8 S h l_0^2$ (cm³)

Thickness of web : $0.042 \frac{S h l_0}{d_1} + 1.5$ (mm) and $0.02 L + 5.5$ (mm), whichever is the greater.

S : space of transverse (m)

d_1 : complying with rules of **Par 1**.

h : vertical distance from midpoint of l_0 to the point 0.12 L above keel plate (m).

However, h is less than 0.06 L , h is to be taken as 0.06 L .

l_0 : unsupported length of side transverse (m)

- (4) Where the longitudinal is penetrating the side stringer, the side transverse is to be strengthened by fitting stiffeners.
 (5) The scantling of side stringer supporting side transverse is to be greater than that obtained from the following formula.

Depth of stringer : $0.2 I_1$ (m) and the value obtained from the following formula, whichever is the greater

$$L < 90 \text{ m} : 0.0053 L + 0.25 \text{ (m)}, \quad L \geq 90 \text{ m} : 0.0025 L + 0.5 \text{ (m)}$$

Section modulus of stringer : $4Shl_0l_1$ (cm³)

web thickness : $0.031 \frac{Shl_1}{d_1} + 1.5$ (mm) and $0.02 L + 5.5$ (mm), whichever is greater

S : space of side stringer (m)

h : vertical distance from the center of S to $0.12 L$ on the keel plate (m)
 However, the distance is less than $0.06 L$ (m), it is to be of $0.06 L$ (m)

l_0 : distance between supports of side transverse (m)

l_1 : distance between supports of side transverse (m)

d : distance between supports of side transverse (m)

- (6) The sectional area of cross tie supporting side transverse is not to be less than that obtained from the following formula.

In case, l/k is greater than 0.6 : $\frac{0.77Sbh}{1-0.5(l/k)}$ (cm³)

In case, l/k is less than 0.6 : $1.1Sbh$ (cm³)

S : space of side stringer (m)

h : vertical distance from the center of S to $0.12 L$ above the keel plate (m)
 However, h is less than $0.06 L$ (m), h is to be taken as $0.06 L$ (m)

l : depth of cross tie (m)

$$k = \sqrt{\frac{I}{A}}$$

I : Minimum moment of inertia of cross tie (cm⁴)

A : sectional area of cross tie (cm²) ↓

CHAPTER 6 PILLARS AND TRUSSES

Section 1 General

101. Arrangement

1. The pillars and trusses are to be provided in line with the keelson or double bottom girders or as close as practicable, and the structure under the pillars is to be of sufficient strength to distribute the load effectively.
2. Where the pillars and trusses which are subjected to tensile loads such as under bulkhead recesses or top of deep tank, the pillars and trusses are to be efficiently secured to withstand the tensile loads.

Section 2 Scantling of Pillars

201. Sectional area of pillars

The sectional area of pillars is not to be less than that obtained from the following formula.

$$\frac{0.223 w}{2.72 - \frac{l}{k}} \quad (\text{cm}^2)$$

l : length of pillar (m)

k : Minimum radius of gyration of pillar, obtained from the following formula (cm)

$$k = \sqrt{\frac{I}{A}}$$

I : minimum moment of inertia of pillar (cm⁴)

A : sectional area of pillar (cm²)

w : deck load supported by pillar specified in **202.** (kN/m^2)

202. Load supported by pillar

Load(w) supported by pillar is not less than that obtained the following formula.

$$Sbh \quad (kN)$$

S : distance between the midpoints of two adjacent span of girders supported by the pillars or the bulkhead stiffeners or bulkhead girders (m) (see **Fig 6.1**)

b : distance between the midpoints of two adjacent span of girders supported by the pillars or inner side of brackets (m) (see **Fig 6.1**)

h : deck load specified in **Ch 4, 202.** for the deck supported (kN/m^2)

203. Thickness of pillars

1. The thickness of tubular pillar is not to be less than that obtained from the following formula. However, this requirement may be suitably modified for the pillars provided in accommodation spaces.

$$0.022 dp + 3.6 \quad (\text{mm})$$

dp : outside diameter of tubular pillar (mm)

2. The thickness of web and flange plates of built-up pillars is to be of sufficient for the prevention of local buckling.

204. Outside diameter of tubular pillars

The outside diameter of solid round pillars and tubular one is not to be less than 50 mm.

205. Pillars provided in deep tank

1. Pillars provided in deep tank are not to be of tubular one.
2. The sectional area of pillars is not to be less than that specified in **201**, or that obtained from the following formula, whichever is the greater.

$$1.09Sbh \quad (\text{cm}^2)$$

S and b : specified in **202**.

h : 0.7 times the vertical distance from the top plate of deep tank to the point 2.0 m above the top of overflow pipe (m)

Section 3 Trusses

301. Scantling

The scantling of pillars composing trusses is to complying with the requirements of **Sec 2**.

302. Diagonals

1. The angle of diagonal is to be of about 45° the horizontal line.
2. The sectional area of diagonal is not to be less than 50 % of the value obtained from the formula specified in **Ch 8, 301**. ↴

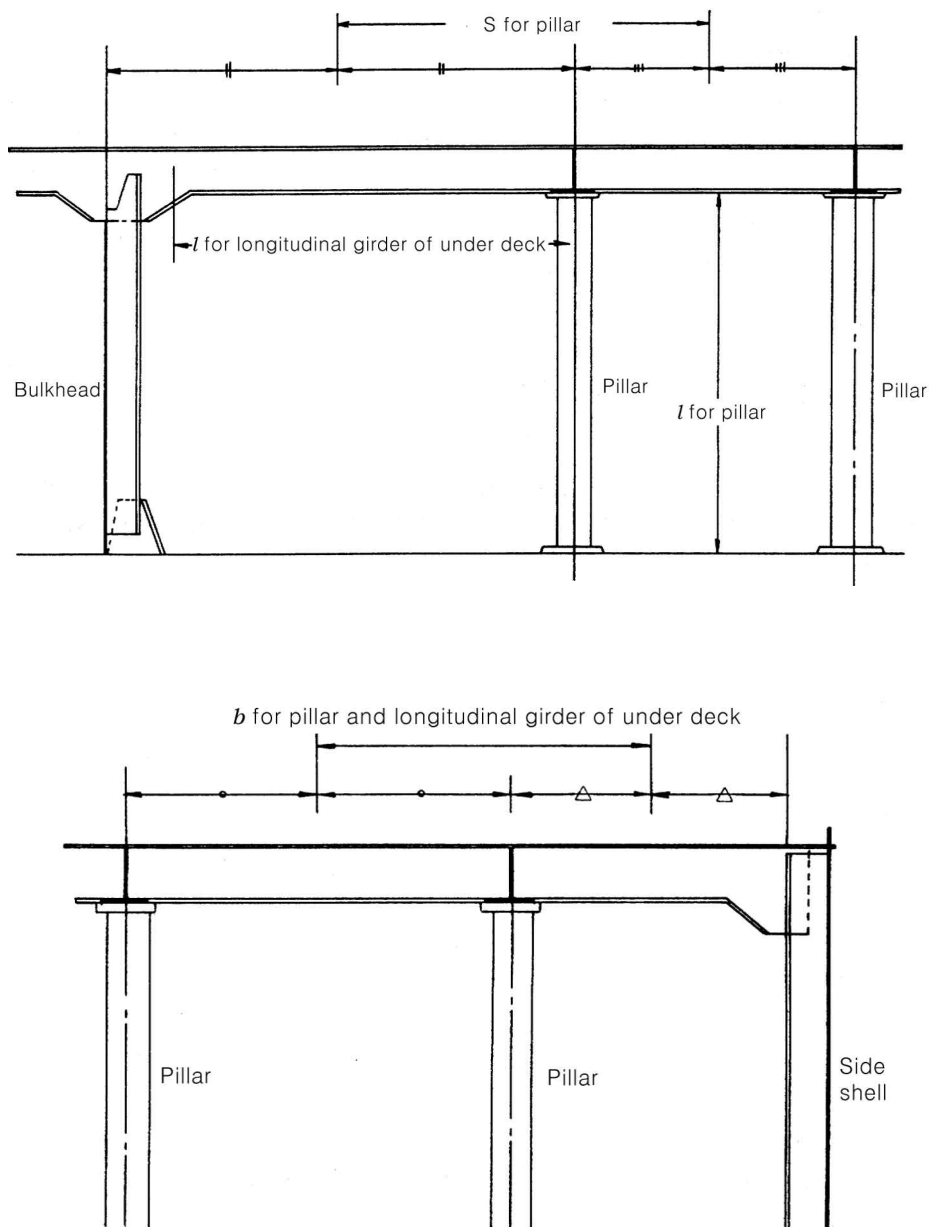


Fig 6.1 Measurement of S , b , l for pillar, and longitudinal and transverse girder

CHAPTER 7 WATERTIGHT BULKHEADS AND DEEP TANK

Section 1 Arrangement of Watertight Bulkheads

101. Collision bulkhead

The collision bulkhead is to be arranged at a position not less than $0.05 L$ but not more than $0.08 L$ from the fore end on the designed load line. However, the length of ship is less than 90 m, the maximum length from the fore end is taken as $0.13 L$.

102. Aft peak bulkhead

Aft peak bulkhead is to be arranged at a suitable position.

103. Bulkhead in middle part

Watertight bulkheads in addition to collision and aft peak bulkhead are to be arranged suitably for the need of transverse strength and the flooding requirements.

104. Chain locker

When the chain locker is located abaft the collision bulkhead or in fore peak tank, it is to be of watertight and to be provided with means for effective drainage by pumps.

Section 2 Construction of Watertight Bulkheads

201. Thickness

The thickness of bulkhead plating is not to be less than that obtained from the following formula.

$$3.2S\sqrt{h} + 1.5 \text{ (mm)}$$

S : spacing of stiffeners (m)

h : distance from the lower edge of bulkhead plate to upper deck at ship centerline (m).

However, h is not to be less than 3.4 m.

202. Increase of thickness

1. The thickness of lower strake plating of bulkhead is not to be less than that obtained from the formula given in **201.** plus 1 mm.
2. The lowest strake of bulkhead plating is to extend at least 600 mm above the top of inner bottom plating in way of double bottom construction or at least 900 mm above the keel plate in way of single bottom construction. Where the double bottom is provided only on one side of bulkhead, the extension of the lowest strake is to be of the greater value between two cases above mentioned.
3. The thickness of bulkhead platings in way of bilge wells is to be at least 2.5 mm thicker than that given in **201.**
4. The thickness of deck plating in way of bulkhead recesses is to be at least 1 mm greater than that given by **201.**, regarding the deck plating as bulkhead plating with same height and the beams as the stiffeners with same spacing. However, the thickness is not to be less than that of deck plating in that location.

203. Stiffeners

The section modulus of stiffeners is not to be less than that obtained from the following formula.

$$2.8CS hl^2 \quad (\text{cm}^3)$$

- l : span measured between the adjacent supports of stiffeners including the length of connection (m). However, where girders are provided, it is the distance from the heel of end connection to the first girder or the distance between the girders.
- S : spacing of stiffeners (m)
- h : vertical distance measured from the midpoint of l for vertical stiffeners, and from the midpoint of distance between the adjacent stiffeners for horizontal, to the top of bulkhead deck at the center line of ship (m). However, where the vertical distance is less than 6.0 m, h is to be taken as 0.8 times the vertical distance plus 1.2 m.
- C : value given in **Table 7.1** (m)

Table 7.1 Value of C

One end The other end	Supported girder, lug connection or bracket connection	Snip
Supported girder, lug connection or bracket connection	1.00	1.35
Snip	1.35	2.00

204. Girders

- The section modulus of girders supporting stiffeners is not to be less than that obtained from the following formula.

$$4.75Shl^2 \quad (\text{cm}^3)$$

- S : breadth of the area supported by girder (m)
- h : vertical distance(m) measured from the midpoint of S for horizontal girders, and from the midpoint of l for vertical girders, to the top of bulkhead deck at the center line of ship respectively. However, where the vertical distance is less than 6.0 m, h is to be taken as 0.8 times the vertical distance plus 1.2 m.
- l : span measured between adjacent supports of girders (m)
- The moment of inertia of girders is not to be less than that obtained from the following formula. However, the depth of girder is not to be less than 2.5 times of the depth of slots of stiffeners.

$$10hl^4 \quad (\text{cm}^4)$$

h and l : specified in **Par 1**

- The thickness of girder plating is not to be less than that obtained from the following formula.

$$10.S_1 + 1.5 \quad (\text{mm})$$

S_1 : spacing of web stiffener or depth of girder, whichever is the smaller (m)

4. The girder is to be provided with tripping brackets at an interval of about 3 m and the tripping brackets are to be so arranged to support the face plating of girders.

205. Platings of collision bulkhead

The thickness of plates and section modulus of stiffeners for collision bulkhead are not to be less than those specified in the formula of **201.** and **203.** respectively taking h as 1.25 times the specified height.

Section 3 Deep Tank Construction

301. Bulkhead plating

The thickness of bulkhead plating is not to be less than that obtained from the following formula.

$$3.6\sqrt{h} + 2.5 \quad (\text{mm})$$

S : spacing of stiffeners (m)

h : distance given belows, whichever is the greater (m)

(1) Vertical distance from the lower edge of bulkhead plating to the midpoint of the distance between the top of tank and the top of overflow pipe. However, additional hydraulic pressure is to be considered for the bulkheads of large tanks.

(2) 0.7 times the vertical distance measured from the lower edge of bulkhead plating to the point of 2.0 m above the top of overflow pipes (m)

302. Stiffeners

The section modulus of stiffeners is not to be less than that obtained from the following formula.

$$7CSht^2 \quad (\text{cm}^3)$$

S and l : as specified in **203.**

h : vertical distance given belows (m), whichever is the greater, measured from the midpoint of l for vertical stiffeners, or from the midpoint of distance between the adjacent stiffeners for horizontal stiffeners.

(1) from the lower edge of bulkhead plating to the midpoint of the distance between the top of tank and the top of the overflow pipe. However, additional hydraulic pressure is to be considered for the bulkheads of large tanks.

(2) 0.7 times the vertical distance measured from the lower edge of bulkhead plating to the point of 2.0 m above the top of overflow pipes (m)

C : Coefficient given in **Table 7.2**, according to the type of end connection of girders supporting stiffeners.

Table 7.2 Value of C

The other end \ One	Bracket connection	Supported by girder or lug connection	Snip
Bracket connection	0.70	0.85	1.30
Supported by girder or lug connection	0.85	1.00	1.50
Snip	1.30	1.50	1.50

303. Girders supporting stiffeners

1. The section modulus of girders supporting stiffeners is not to be less than that obtained from the following formula.

$$7.13Shl^2 \quad (\text{cm}^3)$$

S : breadth of the area supported by girder (m)

h : vertical distance (m) measured from the midpoint of S for horizontal girders, and from the midpoint of l for vertical girders, to the top of h specified in **203**.

l : span measured between adjacent supports of girders (m)

2. The moment of inertia of girder is not to be less than that obtained from the following formula. However, the depth of girder is not to be less than 2.5 times of the depth of slots of stiffeners.

$$30hl^4 \quad (\text{cm}^4)$$

3. The thickness of girder plating is not to be less than that obtained from the following formula.

$$10 S_1 + 2.5 \quad (\text{mm})$$

S_1 : spacing of web stiffener or depth of girder, whichever is the smaller (m)

304. Top and bottom construction

The scantling of structural members forming the top or the bottom of deep tanks is to be in accordance with the requirements in **Sec 3**, regarding those as the members the deep tank bulkheads at the same location. However, the scantling is not to be less than that required for deck platings, and for the top platings of deep tanks, the thickness is to be at least 1 mm greater than that obtained from the formula of **301**.

305. Plating of bulkhead and girder not in contact with sea water

The thickness of bulkhead and girders which are not in contact with sea water in voyage condition may be reduced from the requirements specified in **301**, and **303. 3** by value given as follows. However, bulkhead platings in way of the location such as bilge well, etc. are to be regarded as platings in contact with sea water.

For plating of which one side is in contact with sea water : 0.5 mm

For plating of which neither side is in contact with sea water : 1.0 mm

Section 4 Fittings of Deep Tanks

401. Swash bulkhead

The fresh water tanks, fuel oil tanks and other tanks which are not intended to be kept filled fully in voyage condition are to be arranged additional swash bulkhead or deep swash plates as necessary to minimize the dynamic forces acting on the structures.

402. Waterway and air holes

Waterways and air holes are to be arranged suitably in the structural members to ensure that water or air does not remain stagnated in any part of tank. ↓

CHAPTER 8 SUPERSTRUCTURE AND DECK HOUSE

Section 1 General

101. Application

1. The construction and scantling of superstructure end bulkhead are to be in compliance with the relevant Chapters in addition to this Chapter.
2. The requirements of this Chapter are prescribed for the superstructure or deck house up to the 1st tier above the upper deck. As for the superstructure or deck house on or above the 2nd tier, the construction and scantlings are to be deemed appropriate by this society.
3. As for the superstructure or deck house in Dredger, the construction of superstructure or deck house, the construction of end bulkheads and side bulkheads may be suitably modified subject to the approval by this society.

Section 2 Superstructure End Bulkheads

201. Water head

1. The water head for calculating the scantling of superstructure end bulkhead " h " is not to be less than that obtained from the following formula.

$$ac(bf - y) \quad (\text{t/m}^2)$$

a and b : value specified in **Table 8.1**

c : 1.0

Table 8.1 Value of a and b

	Forward of the midship		Afterward of the midship	
	a	b	a	b
Front bulkhead	$\frac{L}{100} + 2$	1.2	$\frac{L}{100} + 2$	1.15
Side bulkhead	$\frac{L}{150} + 0.5$		$\frac{L}{150} + 0.5$	
Aft bulkhead	$\frac{L}{1000} + 0.4$		$\frac{L}{1000} + 0.7$	

f : Value given in following formula

L is less than 90 m : $0.067 L$

L is more than 90 m : $0.051 L + 1.45$

y : vertical distance from the load line to the midpoint of span of stiffener in case where the scantlings for stiffeners are determined, and to the midpoint of plating in case where the scantlings for bulkhead platings are determined (m)

2. The water head " h " is not to be less than that obtained from the following formula irrespective of the provision in **Par 1**.

	Exposed front bulkhead	Others
L is more than 50 m	3.0	1.5
L is less than 50 m	$\frac{L}{100} + 2.5$	$\frac{L}{200} + 1.25$

202. Thickness of bulkhead plating

1. The thickness of superstructure end bulkhead platings is not to be less than that obtained from the following formula.

$$3S\sqrt{h} \quad (\text{mm})$$

h : water head specified in **201**.

S : spacing of stiffeners (m)

2. The thickness of superstructure end bulkhead platings is not to be less than that obtained from the following formula irrespective of the provision in **Par 1**.

$$\frac{L}{100} + 4.0 \quad (\text{mm})$$

203. Stiffeners

1. The section modulus of stiffeners on superstructure end bulkheads is not to be less than that obtained from the following formula.

$$3.5Shl^2 \quad (\text{cm}^3)$$

S : spacing of stiffeners (m)

h : head of water specified in **201**.

l : height between decks (m). However, l is less than 2 m, l is to be taken as 2 m.

2. Both ends of stiffeners on the exposed bulkhead of superstructure are to be connected to the deck by welding except otherwise approved by this society.

Section 3 Access Opening in Superstructure End Bulkheads

301. Closures for access opening

1. The doors provided on access opening in the end bulkhead of enclosed superstructure are to be in compliance with following requirements.
- (1) The doors are to be of steel or other equivalent materials and to be permanently and rigidly fitted on the bulkhead.
 - (2) The doors are to be rigidly constructed, equivalent strength to that of intact bulkhead and of watertight when closed
 - (3) The means for ensuring weathertightness are to be composed of gaskets and clamping devices or other equivalents and to be permanently fitted to the bulkhead or the doors.
 - (4) The doors are to be operated from the both side of the bulkhead.
 - (5) The hinged doors are, in principle, to be opened outward.

2. The sill height of access openings is not to be less than 380 mm above the upper surface of the deck. However, higher sill height may be required when deemed necessary by this society.

Section 4 Deck House Construction

401. Water head

The water head " h " for the calculation of the scantling of boundary walls of deckhouse is not to be less than that obtained from the formula in **201**. However, " c " in the formula **201. 1** is as given in the following formula, and b'/B' is less than 0.25, b'/B' is to be taken as 0.25.

$$0.7 b'/B' + 0.3$$

b' : breadth of deckhouse at the position under consideration (m)

B' : breadth of ship on the exposed deck at the position under consideration (m)

402. Thickness of bulkhead and stiffeners

1. The thickness of boundary wall plating and the scantling of stiffeners are not to be less than that required in the **202.** and **203.**, taking the head of water specified in **401.**
2. Both ends of stiffeners on exposed boundary walls of deck house are to be connected to the deck except otherwise approved by this society.

403. Closing means for access door

Access openings of deckhouse protecting companionways giving access to the spaces under upper deck or spaces in the enclosed superstructures are to be provided with closing means complying with the requirements in **Sec 3.**

404. Deckhouse under the space loaded with specially heavy equipment

Deckhouses under the space loaded with specially heavy equipment such as deck machineries and so on are to be suitably reinforced. ↓

CHAPTER 9 HATCHWAYS, DECK OPENINGS AND OTHER EQUIPMENT

Section 1 General

101. Application

1. The requirements of this Chapter apply to hatchways, deck openings and other equipment on the exposed upper deck of dredger less than 24 m in length which are not intended to international voyage.
2. For the hatchways, deck openings and other equipment on the exposed upper deck of dredger greater than 24 m in length are to comply with the requirements specified in **Pt 4, Ch 2** and **Ch 4** of the **Rules for the Classification of Steel Ships**.
3. Relaxation from the requirements in this Chapter will be specially considered where the dredger has an unusually large freeboard.

102. Weathertightness

The hatchways and other deck openings are to be provided with closing means capable of being weathertight.

103. Position of exposed deck openings

The position of exposed deck openings is defined as follows.

position I : upon exposed freeboard and raised quarter deck, and upon exposed superstructure deck situated forward of a point $0.25 L$ from the forward perpendicular.

position II : upon exposed superstructure deck situated abaft of a point $0.25 L$ from the forward perpendicular.

Section 2 Hatchways

201. Hatch coaming

1. The height of hatch coaming above the deck is not to be less than 600 mm in position I and 450 mm in position II. However, it may be of the height given in **Table 9.1** where the dredger is less than 30 m in length.

Table 9.1 Height of hatch coaming

	Hatch opening	Hatch opening of 1.5 m ² or less in area
Position I	450	380
Position II	300	230

2. The thickness of hatch coaming is not to be less than that obtained from the following formula. However, it is not necessary to exceed 11 mm.

$$0.05 L + 5.0 \quad (\text{mm})$$

3. The hatch coaming is to be provided with horizontal stiffeners at the proper position and to be strengthened with half round steel bar or proper means on the upper edge of coaming.

4. The hatch coaming is to be supported by rigid brackets extending from horizontal stiffeners to the deck or stays at an interval of about 3 m.
5. For the sliding type hatch covers, the hatch coaming is to be strengthened properly in accordance with the weight of hatch cover.

202. Hatch covers

1. The thickness of hatch cover plating is not to be less than 1 % of stiffener space or 6 mm, whichever is the greater.
2. The steel hatch cover is to be provided with stiffeners at an interval not exceeding 750 mm, and the section modulus of hatch cover is not to be less than that obtained from the following formula.

$$CSl^2 \quad (\text{cm}^3)$$

S : spacing of stiffeners (m)

l : span of stiffeners (m)

C : Value obtained from the following formula

$$0.15 L + 12$$

3. The boundaries of steel hatch cover are to be provided with stiffeners with sufficient stiffness in order to avoid the deflection when handled.
4. The scantling of hatch beams is to comply with the requirements specified in **Par 2**. However, S is the space of hatch beams and l is the length of hatch beam. And, the thickness of wooden covers is not to be less than that obtained from the following formula. However, it is not to be less than 60 mm in any case.

$$40S \quad (\text{mm})$$

S : space of hatch beams (m)

203. Others

1. The depth of hatch beams and breadth of face plates are to have proper scantling in consideration of trimming and deflection.
2. The supporting parts of hatch coaming are to be reinforced properly.
3. The supporting materials to support the hatch beams are to be of steel and the breadth and the thickness of supportings are 75 mm or more and 12.5 mm or more respectively.
4. Each supportings fitted on the side coaming are to have proper devices to prevent falling off the hatch beams.

Section 3 Companionway and Other Deck Openings

301. Manholes and Flush scuttles

The manholes and flush scuttles in exposed positions on the freeboard deck and superstructure deck or in superstructure other than enclosed superstructures are to be closed by steel covers capable of being watertight.

302. Companionway

The sill height of access opening above deck is not to be less than that specified in **Table 9.2**.

Section 4 Bulwarks and Guardrails

401. General

All exposed parts of upper deck and superstructure or similar deck of deckhouses are to be provided with effective bulwarks or guardrails.

402. Scantlings

The height of bulwarks or guardrails specified in **401**, is not to be less than 1 m. However, where this height would interfere with the normal operation of the dredger, the height may be reduced under the approval of this Society.

403. Construction

1. The bulwark is to be of rigid structure in accordance with its height and the upper edge of bulwarks are to be effectively stiffened. The thickness of bulwark plating on upper deck is not to be less than 6 mm.
2. The bulwark is to be provided with strong stays at the position of deck beams and the space of stays on upper deck is to be less than 1.8 m.

Section 5 Freeing Ports

501. Freeing port

The freeing ports are to be provided on upper deck or exposed deck of superstructures for freeing the decks of water rapidly and ample provisions shall be made for draining them.

Section 6 Ventilators

601. Ventilators

1. The height of ventilators above decks is not to be less than that given in **Table 9.3** in accordance with L and position specified in **103**. However, the height of ventilator may be reduced where the dredger has an unusually large freeboard, or ventilators to unenclosed superstructure.
2. The thickness of ventilator is to comply with those approved by this society.

Section 7 Companion Way

701. Companion way

A sufficient means for safe passage of crew shall be fitted around all exposed deck. ↓

Table 9.2 Height of sill (mm)

L Position	$L \geq 30$ m	$L < 30$ m
I	450	300
II	300	150

Table 9.3 Coaming height of ventilator (mm)

L Position	$L \geq 30$ m	$L < 30$ m
I	900	760
II	760	450

CHAPTER 10 HOPPER TYPE DREDGERS

Section 1 General

101. Application

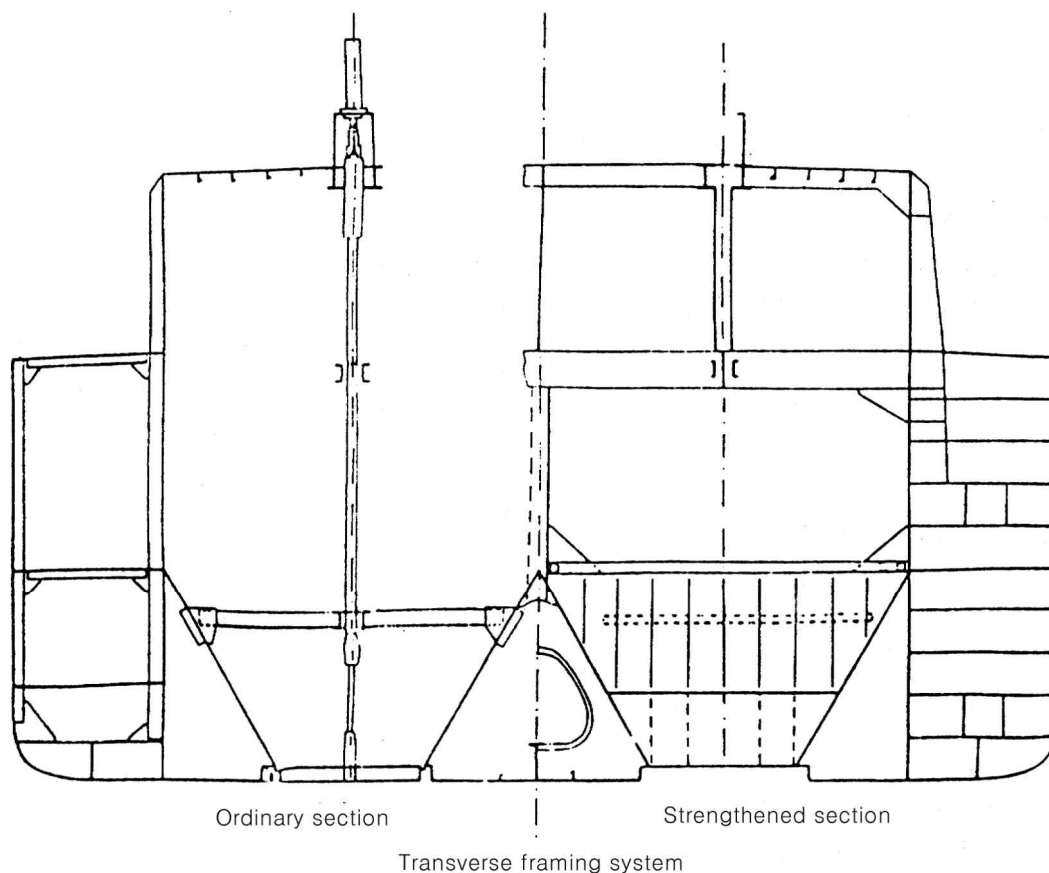
1. The requirements of this chapter are to apply to the dredger of which the holds are hopper type.
2. Otherwise specified specially in this Chapter, the requirements of relevant Chapters are to apply to hopper type Dredgers.

Section 2 Construction and Arrangement

201. Construction

The hopper type structures are to be arranged with transverse or longitudinal framing system as Fig 10.1 and classified with following types.

1. one or two hopper hold type in midship
2. bucket well type



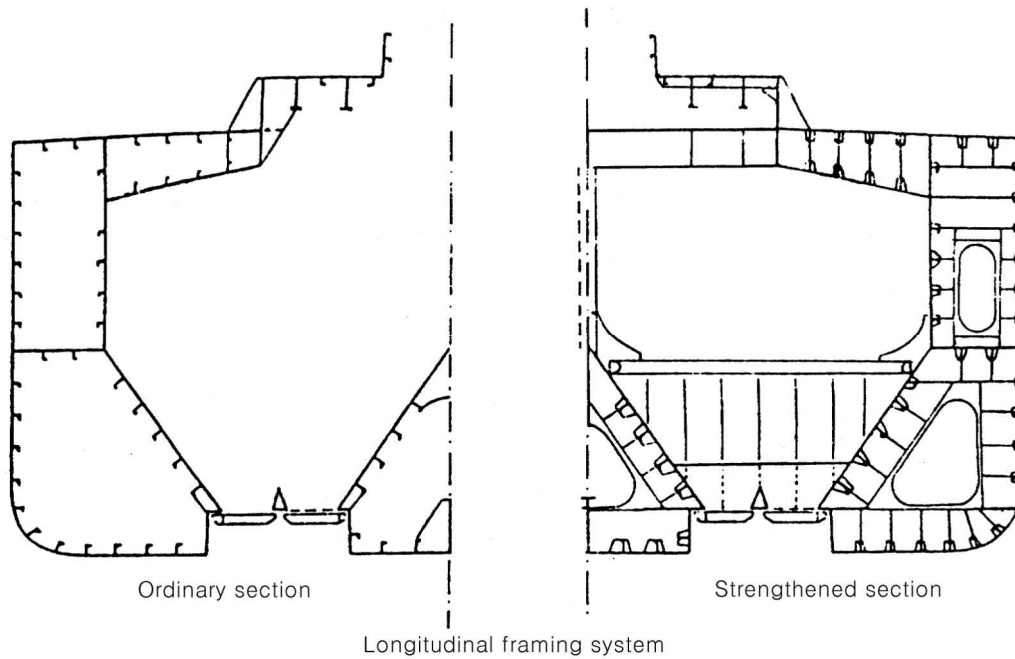


Fig 10.1 Hopper construction

202. Arrangement

1. The hopper type dredgers, since they have many structural discontinuities, are to be specially considered for the structural continuity.
2. The hopper holds are to be provided with weirs for freeing the water or mud.
3. In case, where the dredger is operating with hopper barges, the fenders are to be provided properly for the protection of shell plating. The places where the fenders are fitted are to be reinforced in accordance with the approval of the society.

203. Discontinuity of transverse members

1. The cellular keel is to be rigidly connected to the transverse ring.
2. The upper parts of cellular keel are to be connected with decks or trunk structures by strong beams or centerline wash bulkhead.
3. The structural continuity of hopper holds including longitudinal bulkhead and cellular keel is to be sufficiently considered.

204. Discontinuity of longitudinal members

1. The end of longitudinal bulkhead is to be extended by large brackets at forward and aftward of hopper holds.
2. The ends of forward and aftward of cellular keel are to be provided with brackets which have the same depth of the keel.
3. The both sides of trunk are to be extended with 1.5 times or more the height of trunk to the ends of hopper hold.
4. Special attention is to be made for the other structural arrangements.

Section 3 Longitudinal Strength

301. Special consideration

Transverse section with high sheer stress especially the end parts of hopper holds, sheer stresses are to be specially considered.

Section 4 Shell Plating and Deck

401. Thickness of deck plating and stringer plating

1. The upper deck and stringer platings are to be extended to the longitudinal bulkhead of hopper holds.
2. The thickness of deck platings for storage of heavy dredging equipment is not to be less than that obtained from the following formula. However, exceptions may be considered for the deck platings specially protected.

$$0.05 L + 9 \text{ (mm)}$$

3. The structural scantlings of horizontal plane of trunk which are used same purpose of deck are to comply with the requirements of decks.

402. Openings in trunk

The cut-outs of trunk or weir are to have sufficient sectional area for the specific gravity of mud.

Section 5 Transverse Framing System

501. Floors

1. In single bottom structures, the lower parts of hopper holds are to be provided with solid floors at every frame space.
2. The inside of cellular keel is to be provided with transverse ring which have the same scantlings of solid floor at every frame space.
3. The scantlings of large space in double bottom such as pump room are to be determined by approved direct calculation method.

502. Frames

Where the stringers are supported by transverse ring, the section modulus of frames may be reduced. However, the scantlings of stringers are to be determined by approved direct calculation method.

503. Deck beam

The scantlings of deck beams on deck areas for storage of heavy equipment are to be determined by direct calculation method.

Section 6 Longitudinal Framing System

601. Inner bottom longitudinal

The inner bottom longitudinals in double bottom structure outside hopper hold are to be specially considered.

602. Deck longitudinal

The scantlings of deck longitudinals on deck areas where are subject to the high concentrated loads are to be determined by direct calculation method.

Section 7 Transverse Ring

701. Arrangement

1. The transverse ring is to be provided on solid floors as strong beams in hopper hold inside or on deck parts.
2. The transverse ring is to be provided in the double hull structures of hopper hold as the reinforcement ring.

702. Deck structure without strong beam

Where, the strong beams are not provided on deck or provided only on trunk parts, the deck beams, shear strakes and the top of wells are to be specially considered.

Section 8 Hopper Well Structure

801. General

1. The ends of hopper hold are to be provided with transverse bulkhead in whole breadth or web ring with sufficient strength.
2. It is recommended to provide the wear margin to each platings (wall of hopper hold, weir etc), where these margin might not interfere with dredging works.

802. Bulkhead plating and cellular keel plating

1. The thickness of bulkhead platings and cellular keel platings are not to be less than that obtained from the following formula.

$$4S\sqrt{8h}+1 \text{ (mm) (However, } t \text{ is not less than 10 mm), } 1.2L^{0.5} \text{ (mm)}$$

$$h = d + h_0 + 0.1b_1 + 0.03Lp$$

S : spacing of stiffeners (m)

d : distance between the lower edge of bulkhead or cellular keel plate and deck line (m)

h_0 : spacing from the top of weir to deck line (m)

(when the top of weir is located below deck line, h_0 becomes minus(-))

b_1 : distance between longitudinal bulkheads (m)

Lp : length of hopper hold (m)

2. The thickness of bulkhead platings of bucket well is to be determined with same thickness of shell platings.
3. For the structures and scantlings of coaming, buckling is to be specially considered.

803. Stiffeners

The scantlings of stiffeners of bulkhead and cellular keelson in hopper well are to be increased properly considering the specific gravity of mud.

804. Floors

1. The scantlings of open well with flap are to be determined by direct calculation method approved by this Society.
2. There are generally 5 type of flaps such as **Fig 10.2** and the calculation sheet for the scantlings of flap is to be submitted and approved by this Society.

805. Gusset stays for trunk

The transverse rings are to be provided with gusset stays supported by trunk and both ends of gusset stays are to be fitted rigidly.

806. Girder supporting hydraulic equipment

The girders supporting hydraulic equipment in hopper holds are to have sufficient strength to the force transmitted by hydraulic equipment. ↓

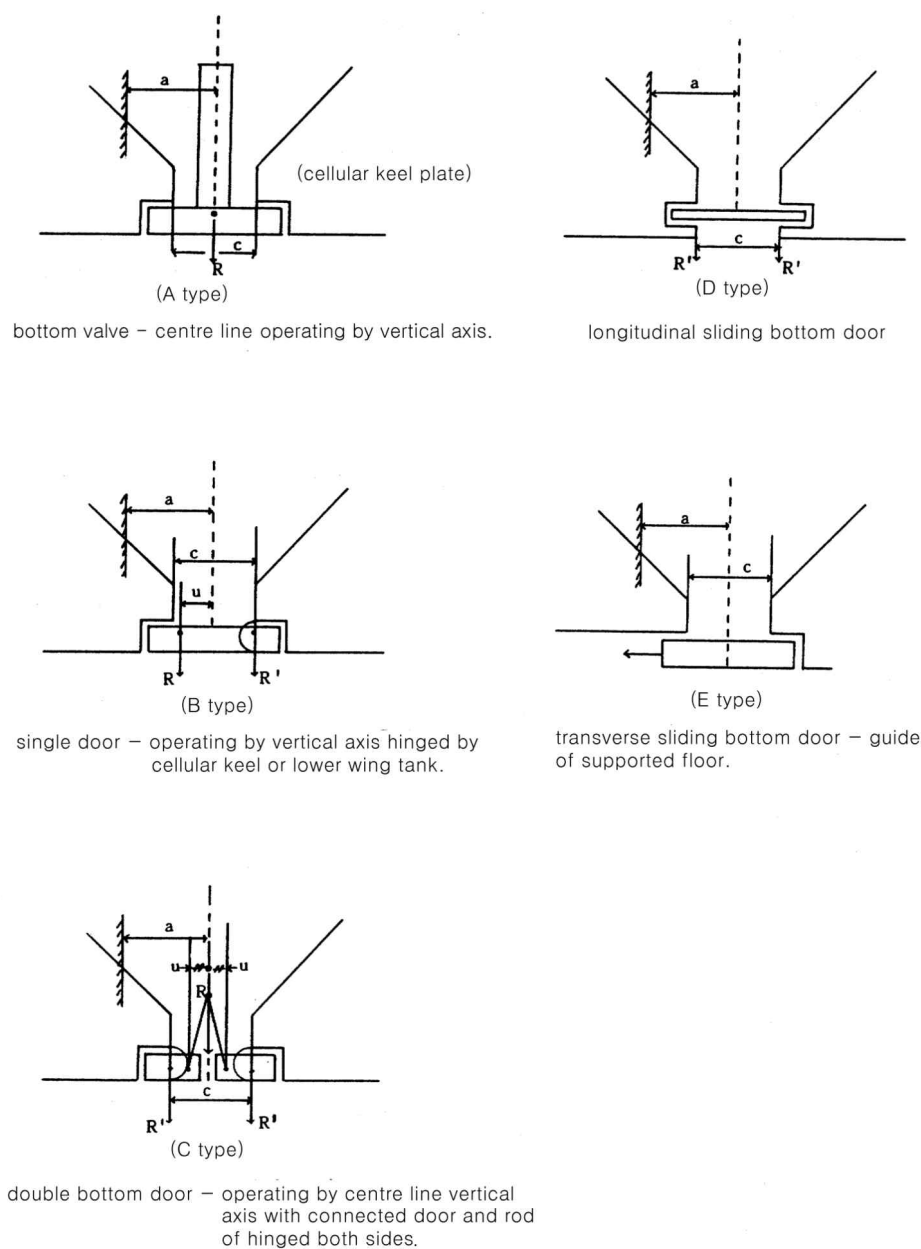


Fig 10.2 Kind of flap

CHAPTER 11 EQUIPMENT

Section 1 Anchor, Chain and Rope

101. General (2020)

1. Equipment number and Equipment are to be in accordance with the **Pt 4, Ch 8** of the **Rules for the Classification of Steel Ships**.
2. For the dredger having 205 or below in equipment number, the wire ropes may be used in lieu of chain cables.

102. Equipment number (2020)

1. As specified in **Pt 4, Ch 8, Sec 2** of the **Rules for the Classification of Steel Ships**.
2. When calculating the Equipment Number, bucket ladders and gallows are not to be included.

103. Anchors (2020)

As specified in **Pt 4, Ch 8, Sec 2** of the **Rules for the Classification of Steel Ships**. ↕

CHAPTER 12 DREDGER REGISTERED WITH RESTRICTED SERVICES

Section 1 General

101. Application

1. The requirements of this Chapter are to apply to the Dredgers which are intended to register with restricted service areas.
2. The requirements of relevant Chapters are to apply correspondingly unless otherwise specified in this Chapter.

Section 2 Vessel Registered with Coastal Service

201. Application

The requirements are to apply to the dredger which is intended to register with coastal service.

202. Reduction of scantling

1. For the scantling of structural members, the values obtained from the formulas in relevant Chapters may be reduced with the ratios given in **Table 12.1**. However, those are not to be less than the minimum scantlings given in **Table 12.1**.
2. The reduction of structural members other than that given in **Table 12.1** is to comply with at the discretion of this Society.
3. The deck beams, inner bottom platings and inner bottom longitudinals and structural members of deep tanks which are subject to heavy cargoes or concentrated loads are not to be less than that obtained from the requirements of relevant Chapters regardless of the requirements of **Par 1** and **Par 2**.

Table 12.1 Reduction ratio and minimum scantlings of structural member

Items	coastal service	smooth water area	Min. scantling
Longitudinal strength	5 %	10 %	-
Shell plating(incl. keel plate)	5 %	10 %	6 mm, (excluding superstructure)
Min. thickness of deck	1 mm	1 mm	5 mm
Section modulus of frame (incl. bottom longitudinal)	10 %	20 %	30 cm ²
Section modulus of beam	15 %	15 %	-
Section modulus of deck girder	15 %	15 %	-
Plate thickness of double bottom structure	1 mm	1 mm	5.5 mm
Plate thickness of single bottom structure	0.5 mm	10 % or 1 mm, whichever is the smaller	-
Plate thickness of super structure end bulkhead and stiffeners	10 %	10 %	-

203. Equipment

1. The dredger, according to its equipment number specified in **Ch 11**, is to be provided with equipment of **Table 11.1**. However, the weight of one anchor between two may be of 85 % of that given in **Table 11.1**.

Section 3 Dredger Registered with Smooth Water Service

301. Application

The requirements are to apply to the dredger which is intended to register with smooth water service.

302. Deduction of scantling

1. For the Dredgers which are intended to register with smooth water service, the scantlings of structural members obtained from relevant Chapters may be reduced with the ratio given in **Table 12.1**. However, the reduced scantlings are not to be less than the minimum given in **Table 12.1**.
2. The reduction of other structural members other than that given in **Table 12.1** are to be at the discretion of this society.
3. The deck beams, inner bottom platings and inner bottom longitudinals and structural members of deep tanks which are subject to heavy cargoes or concentrated loads are not to be less than that obtained from **Par 1** and **Par 2**.

303. Height of hatch coaming, etc.

The coaming height of hatches and access openings are not to be less than that given in **Table 12.2**.

Table 12.2 Sill height of hatch coaming and access opening

Coaming Position	Hatch opening	Small hatch (Area of 1.5 cm ² or less)	companion- way	access opening on end bulkhead of super- structure	Ventilator
I	450	380	300	300	760
II	300	230	100	100	450

304. Hatch covers

1. The closing of hatches may be of rainproof.
2. Where, there are no cargoes on hatch covers, the thickness of cover platings may be of 4.5 mm.
3. The hatch covers are to be provided with stiffeners with proper spacing, and the section modulus of hatch cover may be of the value obtained from the formula specified in **Ch 9, 202. 2** by substituting 1.7 for *C*.

305. Equipment

1. According to the Equipment Number obtained from the rules in **Ch 11**, the equipment which are one grade lower than that given in **Table 11.1** may be used.
2. The weight of one anchor is to be of that given in **Par 1** and the others may be of 85 % of the weight given in **Par 1**.

306. Airpipe

The height from deck to opening part of the pipes and closing appliances of air pipes which are leading to exposed deck are of at the discretion of this Society. ⚡

CHAPTER 13 MACHINERY OF DREDGERS

Section 1 Machinery and Dredging Equipment of Non Self-propelled dredgers

101. General

1. The requirements in this Chapter apply to prime mover, power transmission system, boiler, pressure vessels, auxiliary machinery, piping system and electric installations for pump type, bucket type, dipper type or grab type non self-propelled dredgers.
2. The machinery is to be designed, manufactured and installed in order not to hinder the safety of dredger and the safety of life in normal operating condition.
3. The rotating, reciprocating, high temperature and electrically charged of machinery are to be provided with proper protection devices in order not to be hindered to monitor, handle or access to these parts.
4. The machinery is not to be leaked the gas which are harmful to the health of operators or dangerous of fire as far as practicable.
5. The machinery space is to be well ventilated to exhaust the gas of **Par 3** rapidly.
6. The machinery is to be of the constructions and arrangements which are easily maintained and inspected.
7. The equipments or installations which are related to the safety of dredgers are;
 - (A) Anchoring system
 - (B) Mooring system
 - (C) Fire-fighting system
 - (D) Bilge discharging system
 - (E) Ballasting and de-ballasting system
 - (F) Lighting system
 - (G) Communication system
 - (H) Ventilation system for the spaces of internal combustion engines or boilers and the spaces which are required ventilation
 - (I) Feed water supply and burning system of boiler which are to supply steam to the equipment or installations mentioned from (A) to (H) and (J).
 - (J) Electrical power generating and its starting system which are supplying the electricity to the equipment or installations mentioned from (A) to (I) and navigational lights, signal lights and radio equipment.
 - (K) Other installations where deemed necessary by this society
8. The dredgers with restricted service areas are the dredgers of which navigational or working areas are restricted to smooth water and coastal, or equivalent area of smooth or coastal.
9. Specially designed machinery or equipment are to comply with that acceptable to this society.

102. Prime mover and power transmission system

1. Internal combustion engine

- (1) General arrangement, installation, safety devices, gas exhaust system and fuel oil system of internal combustion engine are to comply with the requirements specified in **Pt 5, Ch 2** and **Ch 6** of the **Rules for the classification for steel ships**. However, the alarm system for pressure reduction of lubricating oil specified in **Pt 5, Ch 2, 203. 10** of the **Rules for the Classification of Steel Ships** is to apply only to the prime mover of generator for electrical power supply and the prime mover for power source of dredging equipment.
- (2) The machinery using for the systems and equipment which are related to the safety of dredgers are to comply with the requirements specified in **Pt 5, Ch 3** of the **Rules for the Classification of Steel Ships**.

2. Steam turbine

- (1) The steam turbine is to be provided with the overspeed protecting devices and adjusted that the speed is not to be exceeded 115% of maximum continuous revolution.
- (2) The steam turbine using for systems and equipment which have relation to the safety of dredgers, are to comply with the requirements of **Pt 5, Ch 2, Sec 3** of the **Rules for the Classification of Steel Ships**.

3. Gas turbine

The gas turbine is to comply with the requirements of **Pt 5, Ch 2, Sec 4** of the **Rules for the Classification of Steel Ships**.

4. Power transmission system

The power transmission system used for equipment or installations which have relation to the safety of dredger is to be of the construction acceptable to this Society.

5. Starting system of prime mover

The starting devices are to be provided to ensure that prime mover of generator for electric power supply and the prime mover of generator for power source of dredging equipment can be started without external supply such as the supply of electricity or compressed air. However, these requirements are not applying to the dredgers with restricted service areas.

103. Boiler and pressure vessels

1. General

The boilers and pressure vessels are to comply with the requirements specified in **Pt 5, Ch 5** of the **Rules for the Classification of Steel Ships**. However, the Class 3 pressure vessels used for the equipment and systems which have not relation to the safety of dredgers are not to comply with those requirements. And, one(1) feed water opening for boiler may be accepted.

104. Auxiliary machinery and piping system

1. General

- (1) The auxiliary machinery and piping systems installed on the dredgers are to comply the requirements of **Pt 5, Ch 6** of the **Rules for the Classification of Steel Ships** and this chapter.
- (2) The valves of piping systems which are operated by powered remote control system are to be provided with means operable by manual.

2. Feed water system and burning system for boiler

Regardless of the requirements of **Pt 5, Ch 6, Sec 5** and **Sec 9** of the **Rules for the Classification of Steel Ships**, one(1) set of feed water pipings, feed water pump and burning system for boiler may be accepted.

3. Cooling piping system, LO piping system and fuel oil system for Internal combustion engine

Regardless of the requirements of **Pt 5, Ch 6, Sec 7, Sec 8** and **Sec 9** of the **Rules for the Classification of Steel Ships**, the spare pumps may be dispensed with respectively.

4. Auxiliary and piping system for dredging works

Regardless of the requirements of **Pt 5, Ch 6** of the **Rules for the Classification of Steel Ships**, the materials and construction of auxiliary machinery and pipings which are using only for dredging works, are to be in accordance with the standards which are acceptable to this Society.

5. Fuel oil transfer system for dredgers with restricted service areas

Regardless of the requirements of **Pt 5, Ch 6, Sec 9** of the **Rules for the Classification of Steel Ships**, one(1) set of fuel oil transfer pump may be accepted for the dredgers with restricted service areas.

6. Bilge piping system

- (1) For the spaces which is not related to the safe of dredger, regardless of the requirements of **Pt 5, Ch 6, Sec 4** of the **Rules for the Classification of Steel Ships**, the bilge piping system may be dispensed with.
- (2) Emergency bilge suction pipes, regardless of the requirements of **Pt 5, Ch 6, 403. 6** of the **Rules for the Classification of Steel Ships**, may be dispensed with.
- (3) The spaces required to arrange the direct bilge suction pipe in accordance with the requirements of **Pt 5, Ch 6, Sec 4** of the **Rules for the Classification of Steel Ships**, are the spaces that are located below the load line specified in **Ch 1, 307.** of this Rules and installed electrical power source. However, the dredgers are designed that the bilges of those spaces are sucked by exclusive bilge pump, the direct bilge suction piping may be dispensed with in those spaces.
- (4) The ejector and its attached pumps which are arranged to suck in bilge effectively are to be regarded as the independent powered bilge pumps specified in **Pt 5, Ch 6, Sec 4** of the **Rules for the Classification of Steel Ships**.
- (5) Where dredgers have a special shape, and it is difficult to comply with the requirements of **Pt 5, Ch 6, Sec 4** of the **Rules for the Classification of Steel Ships**, the internal diameter of main and branch bilge suction pipe, they are to comply with following formula,
 - (A) Branch bilge suction pipe

$$d = 2.15\sqrt{A} + 25$$

d : Inner diameter of bilge suction pipe (mm)

A : Free surface area assumed that half of the depth of compartment is flooded (m²).
However, the surfaces of internal members are not to be included in the free surface area.

- (B) The inside sectional area of main bilge suction pipe is not to be less than the sum of inside sectional areas of the largest two branch bilge suction pipes which are connected to the main bilge line.
- (6) Regardless of the requirements of **Pt 5, Ch 6, Sec 4** of the **Rules for the Classification of Steel Ships**, the number of bilge pump may be of one(1) set, where this society accepts considering the purpose and operating method etc. of the dredger.

7. Ballasting and deballasting system

- (1) During operation, voyage or between these two periods, the dredger that ballasting and deballasting are essential to the safe operation, is to be provided with proper ballasting and deballasting systems in order to ballast and deballast with safe and rapid.

8. Air pipe and sounding pipe

- (1) Regardless of the requirements of the of **Pt 5, Ch 6, Sec 2** of the **Rules for the Classification of Steel Ships**, one(1) air pipe is accepted where deemed appropriate by this society considering the type of dredger and working condition.
- (2) All tanks are to be provided with independent sounding pipes or remote water level indicator which is type-approved by this society. In case sounding pipe is exceeding 20 m in length, the internal diameter of sounding pipe is not to be less than 50 mm regardless of the requirements of the **Rules for the Classification of Steel Ships**.
- (3) In case remote water level indicator is installed in the tanks which are not easily accessed, other means of spare sounding device are to be provided.

9. Remote operation of Sea suction and discharge valve

- (1) The sea suction and discharge valves located in the spaces(generally, unmanned compartments) below the load line specified in **Ch 1, 307.**, are to be of remotely operating valves.
- (2) In case sea suction and discharging valves of generator are of power and remotely operating ones, in no case opened valve is closed or shut valve is open when electrical power supply of control system fails.

10. Testings

Regardless of the requirements of **Pt 5, Ch 6** of the **Rules for the Classification of Steel Ships**, the testings of machinery, equipment and piping systems are to comply with **109.** of this Chapter.

105. Dredging equipment

1. General

- (1) Prime mover, machinery, strength and safety devices of dredgers are to be of that acceptable to this society.
- (2) In case dredging equipment are breaking down of its parts and control system, or losing power source of driving system, they are not to lower the safety of dredgers.
- (3) In case hydraulic or compressed air is used as a power source of dredging equipment. the power source of hydraulic or compressed air is not to be less than two(2), and the dredging equipment are to be operated when either of power sources fails. However, for the dredger operating in restricted service areas, one(1) power source of hydraulic or air pressure may be accepted.

2. Pump type dredging equipment

- (1) The suction and discharging pipes for dredging pumps are not to comply with the requirements of **Pt 5, Ch 6, 30I.** of the **Rules for the Classification of Steel Ships.**
- (2) In case the dredger is working in the areas with 25 m or more in depth, the reducing device to decrease the suction pressure is to be provided in the suction pipes for the prevention of pump cavitation.

3. Bucket type dredging equipment

- (1) The bucket lip is to be made of wear resistant steel and to be of easily maintenance and change.

4. Grab type dredging equipment

- (1) The material of grab is to be of steel or equivalent strength to wear and impact resistant.

106. Electric installations

1. General

- (1) The requirements except testing ones of the **Pt 6 Ch 1 Sec 17** of the **Rules for the Classification of Steel Ships.** in principal, are applying to the electric installations for the dredgers. However, these requirements are not applying to the electric installations only for dredging works but this society may require that the electric installations are to be appropriate to the requirements of the nations or the international standards where deemed appropriate by this society.
- (2) In case the requirements of **Pt 6, Ch 1** of the **Rules for the Classification of Steel Ships** according to the above mentioned requirements, the requirements of **106. 2** to **106. 6** are applying to the electric installations in stead of the requirements of the high voltage electric installations of the **109.** of the **Rules for the Classification of Steel Ships** and that approved by this society.

2. Main source of Electric power

- (1) The dredger is to be provided with at least two sets of electric power systems, and the capacity of these electric power systems are to be such that in the event of any one of electric power system being breakdown by any failure of generator, its prime mover or its relevant auxiliaries, the remaining electric power system is to be of sufficient to supply the electrical power to the following electric loads and equipment or systems which have relation to the safety of dredgers.
 - (A) Navigation lights and signal lights etc. Required by domestic or international regulations
 - (B) Wireless radio system
- (2) For the dredgers with restricted service area, one(1) set of electric power system is acceptable. However, the dredgers of which the navigational lights and signal lights etc. mentioned above (A) are of only electric type, are to be provided with other proper source of electrical power separately in order to capable of lighting when source of electric power fails

- (3) In case the source of electric power is of A.C. generator, other generating motor is not to be failed or over voltage drop which gives harmful effect to other electric installations is not to be arose by starting current of maximum output of generator.
- (4) The requirements of (1) to (3) are not applying to the dredgers which are planned to be supplied electricity from other dredgers or source of electric power of shore-based. However, the dredgers which have navigational lights, signal lights etc. required by (1) (A) are to be capable of lighting without supply of electric power from other dredgers or source of electrical power of shore-based.
- (5) For sources of electric power which are installed on dredgers with restricted service areas, the generator and its prime mover as the source of electric power needed for dredging works other than that required by (2) may be regarded as the machinery for using only dredging works even in case they are installed for using of source of electric power.

3. The number and capacity of transformer for power and lighting

- (1) The number and capacity of transformer using for electric supply of dredgers are to be sufficient to supply the electric power to the equipment or installations which have relation with the safety of dredgers and loads specified in **106. 2** (1) (A) and (B) in case of any one generating set being stopped. However, one(1) transformer may be accepted where other proper means is considered to supply the electrical power to the loads.
- (2) The dredgers with restricted service areas are not to comply with the requirements mentioned previous Para. where deemed appropriate by this Society.

4. Emergency electric installations

- (1) The dredgers are to be provided with emergency electric installations which are appropriate to the requirements of **Pt 6, Ch 1, 203.** of the **Rules for the Classification of Steel Ships.** However, the supplying time of emergency electric power and the kind of emergency loads may be increased or decreased according to the type of dredgers.
- (2) The emergency source of electric power equipment are to be installed in the space which is apart from dangerous spaces specified in each Chapters, and it is to be located such as to ensure the electric supply to emergency loads without any difficulties in case of a fire, flooding or other casualties in the space containing main source of electric power.
- (3) The requirements of (1) and (2) are not to apply to the dredgers with restricted service areas.

5. Final sub-circuits

- (1) In general, a separate final sub-circuit is to be provided for every electric motor used for installations and equipment which have relation with the safety of dredgers.
- (2) Final sub-circuits for lightings are not to be connected with heaters and motors. However, small sized electric appliances for life such as electric fan etc. are excluded.
- (3) A separate final sub-circuit is to be provided for each heater. However, a final sub-circuit not exceeding 15 A in rating may be connected with two or more heaters.
- (4) Each insulated pole of final sub-circuit is to be protected by a fuse or a circuit breaker.

6. High voltage electric installations

- (1) In case where High voltage exceeding 500 V is used for the equipments or installations which have relation with the safety of dredgers are to be of that deemed appropriate by this Society.
- (2) High voltage machinery and cables used for dredging works are to be of that are appropriate to the requirements of nations or international standards where deemed appropriate by this Society.

107. Automatic and remote control of machinery

1. General

- (1) The dredgers of which the machinery is automatic controlled, are to be provided with control and monitoring systems in order to operate safely by planned staff.
- (2) The control system is to be operated in fail-safe side in order not to give danger to the crew in charge or targets to be controlled in case of failure of system or failure of main source of electrical power.
- (3) The machinery used for equipment or installation which have relation to the safety of dredgers are to be operated by other means without any difficulties even in case of failure of automatic or remote control system.

108. Spare parts, tools and instruments

1. General

The dredgers are to be provided with spare parts, tools and instruments specified in this requirements.

2. Spare parts

- (1) The spare parts for diesel engine, steam turbine and boiler which are intended for electric power source, are to comply correspondingly with the requirements of **Pt 5, Ch 1, Sec 4** of the **Rules for the Classification of Steel Ships** for the spare parts of auxiliary diesel engine, steam turbine and boiler.
- (2) The spare parts of bilge pump is to comply with requirements of **Pt 5, Ch 1, Sec 4** of the **Rules for the Classification of Steel Ships**.
- (3) The spare parts of ballast pump specified in **106. 6** of this Chapter is to comply correspondingly with the requirements of **Pt 5, Ch 1, Sec 4** the **Rules for the Classification of Steel Ships** for the spare parts of bilge pump.
- (4) The spare parts of air compressor which is intended for starting of diesel engine used for electrical power system are to comply correspondingly with the requirements of **Pt 5, Ch 1, Sec 4** of the **Rules for the Classification of Steel Ships** for air compressor.

3. Tools and instruments

The tools and instruments of boilers using for electric source and all other boilers are to comply correspondingly with the requirements of **Pt 5, Ch 1, Sec 4** of the **Rules for the Classification of Steel Ships** for essential auxiliary boiler and all auxiliary boilers.

4. Spare parts for the dredgers with restricted services

The dredgers with restricted service areas are to be considered appropriately for applying the requirements of **108. 2** and **108. 3**

109. Testing

1. General

- (1) The testing of machinery is to comply with the requirements of this Chapter.
- (2) Where deemed necessary by this society, the testings other than that specified in the Rules may be required.
- (3) Where the machinery have certificates which are considered appropriate by this society, parts or all of tests may be omitted.
- (4) For the machinery manufactured by mass production system or special managing system, at the request of manufacturer and where the manufactory is considered appropriate by this Society, the proper testing methods fit for manufacturing system is to be adopted.
- (5) Where considered appropriate by this Society, the test methods other than that specified in **109.** may be adopted.

2. Testing

- (1) Boilers, class 1 and class 2 pressure vessels, piping systems and electric installations are to be tested in accordance with the requirements of relevant Chapters. However, the piping systems used for only dredging works and liquids other than flammable or toxic are not to comply with that mentioned above. And, the shop tests are to be carried out only for electric installations which have relations to the safety of dredgers among those specified in (A) to (E). However, electric installations exceeding 3,000 V in rated voltage and using for others purposes which have no relation to the safety of dredgers, a voltage resistant testing which is deemed appropriate by this Society, is to be carried out.

- (A) Generators and electric motors
- (B) Control system for electric motor
- (C) Main switch boards
- (D) Transformer for power and lighting
- (E) Semi conductor regulator and its accessories

- (2) Prime mover, power transmission system, class 3 pressure vessels and auxiliaries using for installations or systems which are related with the safety of dredgers, are to be tested with the requirements of relevant Chapters. However, where deemed appropriate by this society, the contents of testing may specially considered in accordance with the purpose of installations.
- (3) The operating tests for the installations and equipment which have relation to the safety of dredgers, are to be carried out after their installation onboard.
- (4) The functional tests, for the installations, equipment and remote control and automatic control systems attached to the boiler which have relation to the safety of dredgers, are to be carried out after their installation onboard.
- (5) The functional tests for the safety equipment and systems which are required by this Rules, are to be carried out after their installation onboard.
- (6) Source of electrical power regarded as machinery used for only dredging works in accordance with the requirements of **602. 5** of the requirements and source of electrical power used for equipment and systems other than that are related to the safety of dredgers, of which are related with followings are to be carried out operating tests after installed onboard.
 - (A) Source of electrical power of which the voltage is exceeding direct current 1,000 V or alternate current 3,000 V
 - (B) Parallel operation with source of electrical power (Including transfer of source of electrical power)

Section 2 Machinery Installations of Self-propelled dredgers

201. General

1. Application

The machinery for self propelled dredger are to comply with the relevant requirements of the **Rules for the classification of steel ships** in addition to this rules and regulations.

2. Control and monitoring of propulsion system

Generally, if there is no crew in propulsion machinery spaces of dredgers during voyage, the control and monitoring systems are to be provided in accordance with the requirements of the **Rules for the Classification of Steel Ships**. ↓

Annex 1 Guidance for the Assignment of Reduced Freeboards for Dredgers

1. General

(1) Purpose

The purpose of this Guidance is to specify design criteria, construction and survey standards, and operational safety measures for dredgers permitting safe operation at freeboards less than the minimum freeboards prescribed by the ICLL as amended. For dredgers verified to be in compliance with these Guidance, Additional Special Notation "Reduced Freeboard" is to be added.

(2) Application

(A) This Guidance apply to dredgers of 500 gross tons (GT) as measured under the 1969 International Tonnage Convention (ITC).

(B) Similar units such as (non self-propelled) hopper barges and stone dumping vessels etc., which are capable of discharging their cargo as required under 7. (1) of this Guidance, may be treated as dredgers. Application of this Guidance to unmanned or non-self propelled vessels is addressed in section 10. of this Guidance.

(C) Nevertheless **Pt 4, Ch 2, 104.** of the Guidance, where the ships are in compliance with this Guidance, hatch covers may be dispensed with.

(D) Nevertheless ICLL and Standard for Load Line, where the ships are in compliance with this Guidance, freeboards less than the minimum freeboards prescribed by the Convention and the Standard may be assigned with. In this case, it is subject to the approval by the flag state.

(3) Definitions

For the purpose of this Guidance, the following definitions apply:

- A dredger is a self-propelled, manned vessel capable of loading dredgings at sea and fitted with bottom doors or of split type. Similar means for discharging or dumping the dredgings to the sea shall be to the satisfaction of the Society.
- Dredgings are materials consisting of soil, sand, gravel, or rock.
- Cargo means dredgings and entrained water.
- Convention means International Convention on Load Lines, 1966, as modified by the 1988 Protocol relating thereto, as amended.

2. Load Line Marks

(1) In addition to the load line mark and load lines prescribed by the applicable provisions of the Convention, a dredger load line and dredger fresh water load line, corresponding to the reduced freeboard assigned in accordance with the provisions of this Guidance, shall be permanently marked on both sides of the dredger, extending aft and forward respectively of a vertical line joining the two.

(2) The vertical line shall be placed 540 mm aft of the centre of the load line mark. The vertical line and dredger load lines shall be 25 mm in width and the dredger load lines 230 mm in length.

(3) The dredger load line is indicated by the upper edge of that line to be marked DR, and the dredger fresh water load line by the upper edge of that line to be marked DRF. The lines should be painted in a colour contrasting with the colour of the hull.

(4) The assigned dredger load lines (DRF and DR) refer to the top of the freeboard deck regardless of any possible deck line correction as covered by Regulation 32 of the Convention.

(5) Appendix 1 to this Guidance provides a diagram that shows the particulars of the load line marks specified in this section.

3. Freeboard

(1) The dredger may be assigned a reduced freeboard for loading, carrying or discharging dredgings. The reduced freeboard is the summer freeboard calculated for a type B ship in accordance with Regulation 40 of the Convention, reduced by 2/3 of the resulting summer freeboard to be calculated without Regulation 39 (bow height and reserve buoyancy) of the Convention taken into account.

For calculating the dredger freeboard, the resulting summer freeboard as for a type B vessel without any reduction or addition shall be used.

- (2) The minimum bow height at the dredger load line is the bow height provided by the Convention, Regulation 39(1), reduced by the reduction as calculated in (1).
The reserve buoyancy as required by Regulation 39.5 of the Convention need not be taken into account for the determination of the dredger freeboards.
- (3) The minimum dredger freeboard in freshwater of unit density shall be obtained by deducting from the minimum dredger freeboard in salt water:

$\Delta/40 T$ centimetres

Δ : displacement in salt water in tons at the dredger load waterline

T : tons per centimetre immersion in salt water at the dredger load waterline

For hopper dredgers where the hopper may be temporarily open to sea, the hopper is to be considered as closed for the purpose of calculating the ship's moulded displacement.

4. Specific Load Line Provisions

- (1) No bulwarks shall be fitted along the ships' sides abreast of any hopper which is an open hopper.
- (2) A safe access from the fore end to the aft end of the dredger shall be provided for the protection of the crew. The safe access shall comply with the applicable provisions of the Convention, Regulation 25-1.
Where the access is located above the freeboard deck it shall be at least as high above the freeboard deck as the difference between the summer freeboard and the dredger load line freeboard.
- (3) Means for overflow of process water shall be arranged as follows:
 - (A) over the spill-out edge of the hopper coaming; or
 - (B) through overflow ducts or spillways in the hopper walls; or
 - (C) through adjustable overflows.

The overflow arrangements prescribed at (B) and (C) shall have an area of at least:

- $0.7(L_h)^2/1000 m^2$, where L_h is the maximum length of the hopper in metres, or
- $Q/3 m^2$, in which Q is the total maximum water capacity of the suction dredge pumps in m^3/sec ; whichever is greater.

- (4) A suitable hopper geometry shall consist of:
 - (A) the height above the dredger load line of the spill-out edge of the hopper, exceeding at all points the minimum bow height value calculated according to section 3. (2); or
 - (B) freeing ports of sufficient area to ensure rapid outflow of sea water, the area of such ports being at least equivalent to the area required by regulation 24(1) of the annex to the Convention when hopper length and height above overflow ducts or spillways are substituted for bulwark length and height above deck; or
 - (C) closed hopper.

Subject to suitable hopper geometry, the content of the hopper at the dredger load line may be assumed to be cargo up to the lower edge of the overflow arrangement, and when dredging dense cargoes may be assumed to consist of a layer of seawater on top of the cargo up to the lower edge of the overflow arrangement; where no overflow arrangement is provided the layer of seawater on top of the cargo shall be assumed to extend to the spill-out edge of the hopper.

- (5) For openings addressed by Regulations 21 (Cargo Ports and other similar Openings), 22 (Scuppers, Inlets and Discharges) and 23 (Side Scuttles, Windows and Skylights) of the Convention, the terms "uppermost load line", "summer load line" and "load waterline" are to be replaced by the term "dredger load line."

The minimum coaming height of air pipes and ventilators located on the freeboard deck shall be increased by the difference between the summer freeboard and the freeboard at the dredger

load line.

The coaming of ventilators and airpipes on board of the ship shall not be lower above the waterline than calculated for the coaming height of air pipes and ventilator on the freeboard deck.

5. Construction

The structural strength of the dredger operating at the dredger load line shall be approved.

6. Stability

(1) Intact Stability

The intact stability of the ship is to be sufficient to comply with the criteria indicated in (C) for each of the loading conditions of (B) in accordance with the calculation method described in (A).

(A) Calculation Method

In addition to the provisions of paragraph 4. (4) of this Guidance, the calculation of the righting lever curves shall take into account:

- the change of trim due to heel
- in the case of an open hopper the inflow of seawater or outflow of liquid cargo and sea water over the spill-out edge of the hopper,
- the inflow of seawater through any overflow, spillway or freeing port, either at the lower edge of the opening or at the cargo/ seawater interface, whichever is the lower.
- outflow of the cargo only occurs over the spill-out edge of the hopper where this edge has a length of at least 50 % of the maximum hopper length at a constant height above the freeboard deck on both sides of the hopper.

The intact stability computer program shall be acceptable to the Classification Society.

(B) Loading Conditions

The following loading conditions considering the full range of cargo densities should be assumed for the calculations of the intact stability.

(a) State of cargo: liquid

The calculations are to be carried out for each of the loading conditions i) and ii) considering:

- the ship loaded to the dredger load line,
- the cargo as a liquid

i) the hopper(s) fully loaded with a homogeneous cargo of density ρ_m (kg/m³) up to the spill-out edge of the hopper:

$$\rho_m = M_1 / V_1$$

M_1 : mass of cargo in the hopper when loaded at the dredger load line, in kg.

V_1 : volume of the hopper at the spill-out edge of the hopper, in m³

The stability calculations are made for the conditions of stores and fuel equal to 100% and 10% and an intermediate condition if such a condition is more critical than both 100% and 10%.

ii) the hopper(s) filled or partly filled with a homogeneous cargo of densities equal to 1000, 1200, 1400, 1600, 1800, 2000 kg/m³.

When the dredger load line cannot be reached due to the density of the cargo, the hopper is to be considered filled up to the spill-out edge of the hopper.

The stability calculations are made for the condition of stores and fuel that is the most critical to meet the stability criteria in the stability calculations for density ρ_m as described in i).

(b) State of cargo: solid

The stability calculations are to be carried out for each of the conditions i) and ii)

considering:

- the ship loaded to the dredger load line
- the cargo as solid

i) the hopper(s) fully loaded with a homogeneous cargo of density ρ_m up to the spill-out edge of the hopper, as calculated in (a) i).

The stability calculations are made for the conditions of stores and fuel equal to 100%, 10% and an intermediate condition if such a condition is more critical than both 100% and 10%.

ii) the hopper(s) filled or partly filled with a homogeneous cargo of densities equal to 1400, 1600, 1800, 2000, 2200 kg/m³ which are greater than ρ_m

The stability calculations are made for the condition of stores and fuel that is the most critical to meet the stability criteria in the stability calculations for density ρ_m as described in i).

iii) for dredgers with bottom doors or similar means at port side and at starboard side, an additional calculation is to be made for asymmetric discharging as described below:

The dredger is assumed to be loaded to the dredger load line with solid cargo of a density equal to 1900 kg/m³; when discharging, 20% of the total hopper load is assumed to be discharging only at one side of the longitudinal centre line of the hopper, horizontally equally distributed at the discharging side.

In this situation:

- the angle of equilibrium should not exceed 25°
- the righting lever GZ within the 30° range beyond the angle of equilibrium should be at least 0.10 m
- the range of stability should not be less than 30°.

(c) No cargo.

Stability calculations are to be carried out for the hopper(s) with no cargo, the bottom dumping system being open to sea, and with stores and fuel at each of 100% and 10% and an intermediate condition if such a condition is more critical than both 100% and 10%.

For split hopper dredgers, an additional stability calculation is to be made in split hull configuration, with stores and fuel at each of 100% and 10% and an intermediate condition if such a condition is more critical than both 100% and 10%.

(C) Intact Stability Criteria

For the conditions of loading stipulated in (B), the dredger shall meet the following intact stability criteria, except loading conditions involving asymmetric discharge in which case the criteria contained in (B) (b) iii) shall be met:

- The area under the righting lever curve shall not be less than 0.07 m.rad up to an angle of 15° when the maximum righting lever GZ_{max} occurs at 15° and 0.055 m.rad up to an angle of 30° when the maximum righting lever GZ_{max} occurs at 30° or above;
- Where the maximum righting lever GZ_{max} occurs at angles of between 15° and 30°, the corresponding area under the righting lever curve shall be $0.055 + 0.001(30 - \theta_{max}^*)$ m.rad;
- The area under the righting lever curve between the angles of heel of 30° and 40°, or between 30° and θ_f^{**} if this angle is less than 40°, shall not be less than 0.03 m.rad;
- The righting lever GZ shall be at least 0.20 m at an angle of heel equal to or greater than 30°;
- The maximum righting lever GZ_{max} shall occur at an angle of heel not less than 15°; and
- The initial metacentric height GM_0 as corrected for the free surface effect of tanks and hopper(s) containing liquids, shall not be less than 0.15 m.

* θ_{max} is the angle of heel, in degrees, at which the righting lever curve reaches its maximum.

** θ_f is the angle of heel, in degrees, at which openings in the hull, superstructure or deckhouses which cannot be closed weathertight immerse. In applying this criterion, small openings through which progressive flooding cannot take place need not be considered as open.

(D) Weather Criterion

The dredger shall comply with the weather criterion of the IMO Code on Intact Stability, as amended, at the summer load line taking into account the following loading condition:

- state of the cargo: liquid
- stores and fuel: 10 %
- hopper(s) loaded with a homogeneous cargo up to the spill-out edge of the hopper where the density of such cargo equals or exceeds 1000 kg/m^3 ;
where this condition implies a lighter cargo than 1000 kg/m^3 the hopper is considered to be partially filled with a cargo of density equal to 1000 kg/m^3 .

In addition to the weather criterion requirement at the summer load line, the dredger shall comply, for the conditions at the dredger load line calculated according (B) (a), (B) (b) and (B) (c) of this Guidance, with the weather criterion of the International Code on Intact Stability, 2008, as amended, assuming a reduced wind pressure of $P = 270 \text{ N/m}^2$.

(2) Damage Stability

Provisions of Chapter II-1 of SOLAS 1974, as amended, relevant to damage stability and as further amended and modified by following (A), (B) and (C), shall be complied with. For a dredger with a subdivision length less than 80 metres, Subdivision Index (R) should be calculated using $L_s = 80$ metres.

(A) Calculation Method

a) The calculation of the righting lever curves shall take into account:

- the change of trim due to heel.
- in the case of an open hopper the inflow of seawater or outflow of liquid cargo and sea water over the spill-out edge of the hopper.
- the inflow of seawater through any overflow, spillway or freeing port, either at the lower edge of the opening or at the cargo/seawater interface, whichever is the lower. Adjustable overflows operated from the navigation bridge, may be considered to be located at the highest position.
- outflow of the cargo only occurs over the spill-out edge of the hopper where this edge has a length of at least 50 % of the maximum hopper length at a constant height above the freeboard deck on both sides of the hopper.
- the sliding of the cargo surface in the hopper, in transverse and longitudinal direction according to the following shifting law:

The cargo surface is assumed to be plane, and

$$\theta_r = \theta_g \quad \text{for } \rho \leq 1400 \text{ (liquid cargo)}$$

$$\theta_r = \theta_g (2000 - \rho) / 600 \quad \text{for } 1400 < \rho < 2000 \text{ (sliding cargo)}$$

$$\theta_r = 0 \quad \text{for } \rho \geq 2000 \text{ (solid cargo)}$$

With:

ρ [kg/m³] cargo density

θ_r [degrees] shifting angle of the cargo surface

θ_g [degrees] angle of heel or angle of trim

b) The damage stability calculations shall take into account all the possible progressive floodings. A progressive flooding is an additional flooding of spaces interconnected with those assumed to be damaged.

Such additional flooding may occur through openings or pipes as indicated in the following conditions:

Internal progressive flooding via:

- pipes and connected valves which are located within the assumed damage, where no valves are fitted outside the damage zone,
- pipes, even if located outside the damage zone, where all the following conditions apply:
 - the pipe connects a damaged space to one or more intact spaces

- the pipe is below a damage waterline at all points between the connected spaces
- the pipe has no valves between the connected spaces
- all internal doors other than
 - remotely operated sliding watertight doors
 - watertight access doors required to be normally closed at sea

External progressive flooding via:

- external openings where a damage waterline, taking into account sinkage heel and trim, immerses the lower edge of the sill or coaming and where the openings are not fitted with watertight means of closure. Such non watertight openings include air pipes whether or not fitted with automatic weathertight closure, ventilators, hatch covers whether or not fitted with weathertight means of closure. Openings which may be assumed watertight include manhole covers, flush scuttles and small watertight hatch covers which maintain the high integrity of the deck, side scuttles of the non opening type.
- c) The damage stability computer program shall be acceptable to the Classification Society.
- d) When calculating the damaged stability, only the loaded dredger draft (d_{dL}) and the light service draft (d_1) need to be taken into account.

(B) Loading Conditions

- a) The attained subdivision index A_1 is to be calculated for the light service draft d_1 and corresponding trim, assuming the dredger is loaded with 50% stores and fuel, no cargo in the hopper(s), and the hopper(s) in direct communication with the sea.
- b) The attained subdivision index A_{dL} is to be calculated for each cargo density defined in i) and ii) assuming the dredger is loaded at dredger load line dL, with 50% stores and fuel.

The damage stability calculations are to be performed taking into account the initial trim of the dredger load line and an assumed permeability of the cargo filled hopper space of 0 % and a permeability of the space above the cargo equal to 100%.

In performing these calculations, the spoils are considered not to be porous and that any seawater that enters a partially full hopper due to damage ingresses only to the space above the upper surface of the spoils.

- i) the design density ρ_d corresponding to the dredger load line where:

$$\rho_d = M_2 / V_2$$

M_2 [kg] mass of cargo in the hopper when loaded at dredger load line with stores and fuel at 50%.

V_2 [m³] volume of the hopper at the highest overflow position

- ii) each density ρ_i greater than ρ_d , defined by:

$$\rho_i = 2200 - 200(i) \text{ where } i = [0, 1, 2, 3, \dots, 6.]$$

(C) Damage Stability Criteria

The Required Subdivision Index R and the Attained Subdivision Index A are calculated according to SOLAS chapter II-1, as amended, except that instead of the formula set out in SOLAS Chapter II-1 regulation 7.1 the following shall be taken into account:

$$A \geq R \quad \text{for each cargo density defined in (B) b)}$$

$$A_1 \geq 0.7R$$

$$A_{dL} \geq 0.7R \quad \text{for each cargo density defined in (B) b)}$$

Where:

$$A = 0.5(A_1 + A_{dL})$$

A_1 = attained subdivision index at light service draft d_1

A_{dL} = attained subdivision index at loaded dredger draft d_{dL} and cargo densities defined in (B) b)

7. Equipment

(1) Dumping System

(A) The cargo dumping system shall be capable of discharging the cargo by gravity, such that the dredger shall increase its freeboard from the dredger load line to the summer load line within 8 minutes using normal operation of the dumping system. Means of overflow and spillways shall not be regarded equivalent to a cargo dumping system.

(B) Emergency devices, controlled from the navigating bridge, shall be fitted so that the discharge of cargo is also possible in case of failure of the main electric power supply and/or the main hydraulic unit and/or single failure of the normal control systems.

(C) For the dumping system, the calculation or performance data for the cargo discharge time required by (A) shall be submitted for reference at the time of plan approval.

(D) For the dumping systems, the validity of the cargo discharge time required by (A) is to be verified during dredging test and sea trial.

(2) Draught Gauges

An accurate draught indicator, capable of showing the corresponding position of the dredger draught, shall be fitted at the navigating bridge. This draught indicator shall also be capable of providing a record of draught as a function of time.

(3) Dredge valves emergency closing

Emergency closing devices shall be provided for dredge valves in piping systems penetrating the shell below the freeboard deck and which are normally open when loading cargo by dredging. The emergency closing devices shall be operable from the navigating bridge. They shall be capable of operation in case of failure of the main electric power supply and/or the main hydraulic unit and/or single failure of the normal control systems.

(4) Wave height information

During operations at dredger load line in operational areas defined by a limiting significant wave height, the master shall be provided with meteorological information and a forecast of the relevant seaway condition in terms of significant wave height.

Where such information may not be obtained, a wave measuring system, acceptable to the Society, shall be used.

8. Information to the Master

The master shall be provided with written information posted on the navigation bridge, which may be supplemented by other media, as follows:

(1) Sufficient information, in a format approved by the Society, to enable the master to arrange for the loading and ballasting of the dredger so as to avoid the creation of any unacceptable stresses in the ship's structure. The information shall define any sea state restrictions in terms of maximum significant wave height when operating at dredger load line.

(2) Sufficient information, in a format approved by the Society, to enable the master by rapid and simple means to ensure compliance with the intact and damage stability requirements of this Guidance. The following items shall be included:

- Hydrostatic data for a range of draughts from lightship to dredger load line.
- Tank and hopper filling calibrations detailing volumes, centroids and free surface inertia's, and including the volumes of hoppers above spillways.
- Righting lever curves for the loading conditions as specified in section 6. (1) (B) for each of the specified densities.
- The particulars of those loading conditions showing the fulfillment of the criteria in section 6. (1) (C) of the Guidance.
- A summary of the required and attained subdivision indices resulting from the probabilistic damaged stability calculations in accordance with section 6. (2) of the Guidance.
- Relevant information for the master for which damage cases of flooding of main compartments the dredger will remain afloat at the dredger draught and at the unloaded draught, described on a wheelhouse poster and derived from the calculations made in accordance with the Guidance.
- Instructions concerning the closure of watertight doors and valves.

- Instructions concerning the operation of cross-flooding arrangements where fitted.
- Instructions on maintaining dry bilge's in void spaces.
- All other data and aids which might be necessary to maintain stability after damage.

Note: A curve of minimum operational metacentric heights (GM) against draught or of maximum allowable vertical centers of gravity (KG) against draught is not required if the dredger meets the relevant intact and damage stability requirements for all possible loading conditions as defined in paragraph 6. (1) (B).

- (3) Information on the adjustment of the overflow systems in order to avoid submergence of the dredger load line and to assure compliance with the intact stability requirements.
- (4) Clear instructions for the operation of the dumping system, the dredge pumps and the dredge valves in case of emergency. A copy of these instructions shall be permanently posted at the navigating bridge.
- (5) Clear instructions on sea state limitations to be observed and on procedures with regard to wave height prediction.
- (6) Plans showing clearly for each deck and hold the boundaries of the watertight compartments, the openings therein with their means of closure and position of any associated controls, and the arrangements for the correction of any list due to flooding. Such plans shall also be made available to watchkeeping officers of the dredger and shall be permanently exhibited or readily available on the navigating bridge.

9. Equivalents

- (1) Where this Guidance require that a particular fitting, material, appliance, apparatus or type thereof should be fitted or carried, or that any particular provision should be made, or any procedure or arrangement should be complied with the Society may allow any other fitting, material, appliance, apparatus or type thereof to be fitted or carried, or other provision made, or other procedure or arrangement complied with if it is satisfied by trial thereof or otherwise that such fitting, material, appliance, apparatus or type thereof or such provision, procedure or arrangement is at least as effective as that required by this Guidance.
- (2) When the Society allows any substitution under paragraph (1), it should communicate for the information of the participants to the agreement for the Guidance, full particulars together with a report on the justification for such allowance.
- (3) In any case in which the Society may allow a substitution of part or all of the dumping system required under paragraph 7. (1) of this Guidance, the Society must confirm that an equivalent level of safety is maintained.

10. Special considerations for unmanned or non-self propelled¹⁾ units similar to dredgers

- (1) Freeboard:
An unmanned unit similar to a dredger is not required to meet the minimum bow height requirement as set forth in section 3. (2) of this Guidance, as permitted by the Convention, Regulation 27(14). In those cases where the hopper geometry shall comply with 4. (4) (a) of this Guidance, the spill-out edge shall exceed the required bow height calculated for manned dredgers.
- (2) Specific Load Line Provisions:
In complying with the provisions of section 4. (2) of this Guidance, a unmanned unit similar to a dredger need not comply with the height of safe access requirement contained in section 4. (2).
- (3) Emergency Dumping Controls:
For an unmanned unit similar to a dredger, remotely operated emergency dumping controls fitted to comply with the requirements of section 7. (1) of this Guidance, shall be remote controlled from a safe, permanently manned location within sight of the unmanned unit.
- (4) Draught Gauges:
For an unmanned unit similar to a dredger, draft gauges fitted to comply with the requirements of section 7. (2) of this Guidance, shall indicate the dredgers draft on a safe, permanently manned location within sight of the unmanned unit.

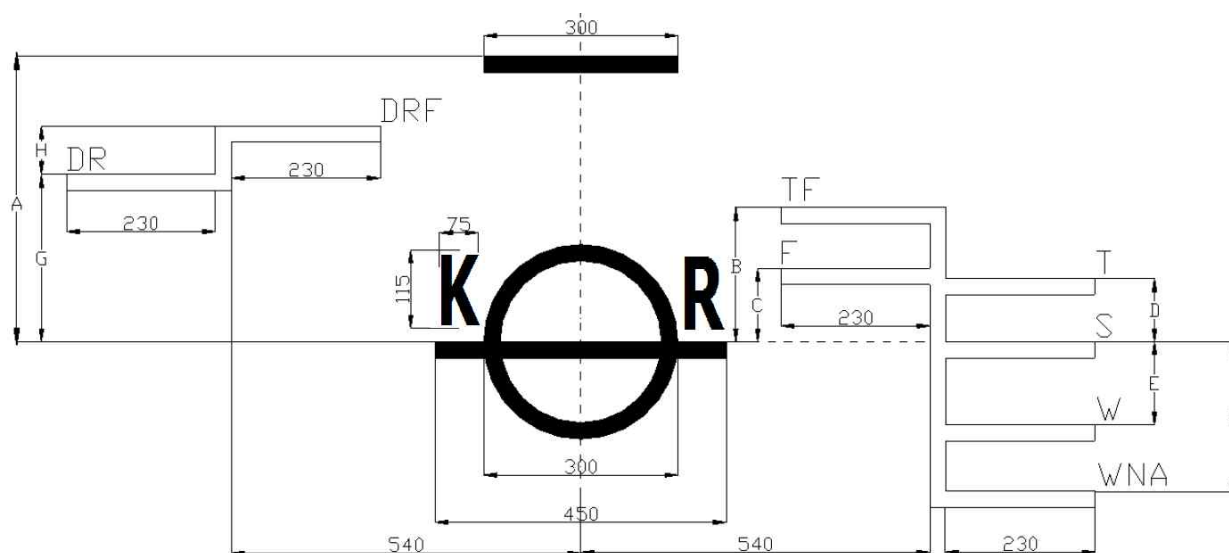
Appendix 1: Particulars for positioning of the load line marks

According to the calculation for the freeboard of “_____”, building number: _____ the load line marks should be placed on both sides of the ship, as indicated below.

The length (L) as stated in Annex 1, Chapter 1, Regulation 3 ICLL is measured _____ meter.

The upper edge of the deckline is positioned ____ mm. below / above the _____ deck at side.

The centre of the deckline is ____ mm. _____ frame no. ____



The distance A is : mm The distance B is : mm
 The distance C is : mm The distance D is : mm
 The distance E is : mm The distance F is : mm
 The distance G is : mm The distance H is : mm

All lines have a thickness of 25 mm.

The international load lines shall be positioned forward of the ring on port side and starboard side. ⚓

RULES FOR THE CLASSIFICATION OF DREDGERS

Published by

KR

36, Myeongji ocean city 9-ro, Gangseo-gu,
BUSAN, KOREA

TEL : +82 70 8799 7114

FAX : +82 70 8799 8999

Website : <http://www.krs.co.kr>

Copyright© 2023, KR

Reproduction of this Rules and Guidance in whole or in
parts is prohibited without permission of the publisher.