



RULES FOR BUILDING AND CLASSING

STEEL VESSELS FOR SERVICE ON RIVERS AND INTRACOASTAL WATERWAYS 2018

**American Bureau of Shipping
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RULES FOR BUILDING AND CLASSING

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Notices and General Information

Introduction

1. The year 2018 edition of the *Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways* consists of the seven (7) booklets as shown in Table 1. With regard to three booklets, Part 1, Part 2, and Part 7:
 - a) The purpose of the generic title *ABS Rules for Conditions of Classification (Part 1)* is to reflect the expanded contents of PART 1, as a result of including consolidated requirements for “Classification” applicable to all types of and sizes of vessels, barges and specific shipboard arrangements/systems, etc., except for those in offshore service, as specified in the Foreword to Part 1. Additional specific requirements are contained in Part 1 of these *Rules for Building and Classing Steel Vessels Under 90 meters (295 feet) in Length*
 - b) The purpose of the generic title *ABS Rules for Materials and Welding* of PART 2 is to emphasize the common applicability of the requirements to ABS-classed vessels, other marine structures and their associated machinery, and thereby make PART 2 more readily a common “PART” of various ABS Rules and Guides, as appropriate.
 - c) The purpose of the generic title *ABS Rules for Survey After Construction (Part 7)* is to reflect the expanded contents of PART 7, as a result of including consolidated requirements for “Surveys After Construction” applicable to all types and sizes of vessels, barges and specific shipboard arrangements/systems, etc., as specified in Part 7, Chapter 1, Section 1.
2. The numbering system applied in the Rules is shown in Table 2.
3. The primary changes from the 2017 edition of the Rules are identified and listed in Table 3. The effective date of the indicated Rule Changes is 1 January 2018, unless specifically indicated otherwise.
4. The effective date of each technical change since 1993 is shown in parenthesis at the end of the subsection/paragraph titles within the text of each Part. Unless a particular date and month are shown, the years in parentheses refer to the following effective dates:

(2000) and after	1 January 2000 (and subsequent years)	(1996)	9 May 1996
(1999)	12 May 1999	(1995)	15 May 1995
(1998)	13 May 1998	(1994)	9 May 1994
(1997)	19 May 1997	(1993)	11 May 1993
5. Until the next edition of the *Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways* is published, Notices and/or Corrigenda, as necessary, will be published on the ABS website – www.eagle.org – only, and will be available free for downloading. It is not intended to publish hard copies of future Notices and/or Corrigenda to existing Rules or Guides. The consolidated edition of the *Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways*, which includes Notices and/or Corrigenda using different colors for easy recognition, will be published on the ABS website only when Notices and/or Corrigenda are issued.
6. The listing of CLASSIFICATION SYMBOLS AND NOTATIONS is available from the ABS website www.eagle.org for download.

TABLE 1
Applicable Editions of Booklets Comprising 2018 River Rules

Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways		
Notices and General Information		2018
Part 1:	Conditions of Classification (Supplement to the ABS <i>Rules for Conditions of Classification</i>) ⁽¹⁾	2018
Part 3:	Hull Construction and Equipment	2018
Part 4:	Vessel Systems and Machinery	2018
Rules for Conditions of Classification – not included ^(1,2)		
Part 1:	Rules for Conditions of Classification	2018
Rules for Materials and Welding – not included ⁽²⁾		
Part 2:	Rules for Materials and Welding	2018
Rules for Survey After Construction – not included ⁽²⁾		
Part 7:	Rules for Survey After Construction	2018

Notes:

- 1 The requirements for conditions of classification are contained in the separate, generic ABS *Rules for Conditions of Classification (Part 1)*. Additional specific requirements are contained in Part 1 of these Rules.
- 2 The latest edition of these Rules is to be referred to. These Rules may be downloaded from the ABS website at www.eagle.org, Rules and Guides, Downloads or may be ordered separately from the ABS Publications online catalog at www.eagle.org, Rules and Guides, Catalog.

TABLE 2
Division and Numbering of Rules

<i>Division</i>	<i>Number</i>
Part	Part 1
Chapter	Part 1, Chapter 1
Section	Section 1-1-1
Subsection (see Note 1)	1-1-1/1
Paragraph (see Note 1)	1-1-1/1.1
Subparagraph	1-1-1/1.1.1
Item	1-1-1/1.1.1(a)
Subitem	1-1-1/1.1.1(a)i
Appendix	Appendix 1-1-A1 or Appendix 1-A1-1

Note:

- 1 An odd number (1, 3, 5, etc.) numbering system is used for the Rules. The purpose is to permit future insertions of even-numbered paragraphs (2, 4, 6, etc.) of text and to avoid the necessity of having to renumber the existing text and associated cross-references, as applicable, within the Rules and associated process instructions, check sheets, etc.

Change Notice (2018)

TABLE 3
Summary of Changes from the 2017 Rules

Notice No. 1 (effective on 1 July 2017) to the 2017 Rules, which is incorporated into the 2018 Rules, is summarized below.

EFFECTIVE DATE 1 July 2017 – shown as (1 July 2017)
(based on the contract date for new construction between builder and Owner)

<i>Part/Para. No.</i>	<i>Title/Subject</i>	<i>Status/Remarks</i>
PART 4	Vessel Systems and Machinery	
4-2-3/3.25.6 (New)	System Response Under Failure	To detect failure in the steering gear control system and provide the operator with sufficient information to decide what action is required for the different failure scenarios, in line with IACS UR E25 June 2016. (Incorporates Notice No. 1)
4-2-3/3.27.6	Low Oil Level Alarm	To detect failure in the steering gear control system and provide the operator with sufficient information to decide what action is required for the different failure scenarios, in line with IACS UR E25 June 2016. (Incorporates Notice No. 1)
4-2-3/3.27.11 (New)	Earth Fault	To detect failure in the steering gear control system and provide the operator with sufficient information to decide what action is required for the different failure scenarios, in line with IACS UR E25 June 2016. (Incorporates Notice No. 1)
4-2-3/3.27.12 (New)	Deviation	To require a deviation alarm in addition to basic failure detection, in line with IACS UR E25 June 2016. (Incorporates Notice No. 1)
4-3-1/7.21	Hose	To clarify the cases in which flexible hoses need not be of fire-resistant type. (Incorporates Notice No. 1)
4-5-2/7.9	Harmonics	To specify that the harmonic distortion calculation report is to be kept on board for exceptions to the 8% limit in cases where all installed equipment and systems have been designed for higher THD levels, in line with IACS UR E24 June 2016. (Incorporates Notice No. 1)
4-5-2/9.18 (New)	Harmonic Distortion for Ship Electrical Distribution System including Harmonic Filters	To introduce requirements for survey of harmonic filters and harmonic distortion levels, in line with IACS UR E24 June 2016. (Incorporates Notice No. 1)
4-5-2/9.19	Protection of Harmonic Filter Circuits Associated with Electric Propulsion	To introduce requirements for survey of harmonic filters and harmonic distortion levels, in line with IACS UR E24 June 2016. (Incorporates Notice No. 1)
4-5-4/13.1.1	General	To identify the standards that have been withdrawn or replaced by new ones and to consider approaches for cables not manufactured to IEC standards identified, in line with IACS UR E7 Rev.4 Apr. 2016. (Incorporates Notice No. 1)

EFFECTIVE DATE 1 January 2018 – shown as (2018)
(based on the contract date for new construction between builder and Owner)

<i>Part/Para. No.</i>	<i>Title/Subject</i>	<i>Status/Remarks</i>
PART 3	Hull Construction and Equipment	
3-2-1/13.3.1	Permissible Load	To modify the permissible load to consider material yield strength.
3-2-2/11.3.1	Permissible Load	To modify the permissible load to consider material yield strength.
3-2-4/11.1	Permissible Load	To modify the permissible load to consider material yield strength.
3-2-5/13.1	Permissible Load	To modify the permissible load to consider material yield strength.

Notices and General Information

<i>Part/Para. No.</i>	<i>Title/Subject</i>	<i>Status/Remarks</i>
3-6-1	Tank, Bulkhead and Rudder Tightness Testing	To reflect the comments from Administrations, Industry Organizations and IMO considered during review of the proposed Testing Guidelines associated with SOLAS Chapter II-1, Regulation 11, reflected in IACS UR S14 (Rev.6, Sept 2016).
PART 4	Vessel Systems and Machinery	
4-4-1/19.3.2(a)	General	To align the requirements for the location of the control panel with Chapter 10, paragraph 2.4.1.2 of the FSS Code (as amended by resolution MSC.292(87) as interpreted by IMO MSC.1/Circ. 1487 and IACS UI SC 260 (Rev. 1).
4-5-3/Table 1	Minimum Degree of Protection	To permit plugs and socket outlets installed in hazardous areas, in line with IEC 61892-7 Para. 8.11.1 and IEC 60079-14 Para. 5.13.
4-5-4/Table 6	Clearance and Creepage Distance for Switchboards, Distribution Boards, Chargers, Motor Control Centers and Controllers	To align the requirement with IEC 60092-302 and IEC 61892-3.
4-5-4/Table 7	Equipment and Instrumentation for Switchboard	To provide a reference to the requirements for high voltage systems.
4-5-5/1.3.5	Earth Fault Detection and Indication	To clarify the requirements for audible and visual indication of earth faults for high voltage systems.
4-5-6/9.1.1(a)	Location	To explicitly prohibit the installation of other unrelated equipment in the emergency generator room.

PART

1

Conditions of Classification
(Supplement to the ABS Rules for Conditions of Classification)

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PART

1

Foreword (1 January 2008)

For the 2008 edition, Part 1, “Conditions of Classification” was consolidated into a generic booklet, entitled *Rules for Conditions of Classification (Part 1)* for all vessels other than those in offshore service. The purpose of this consolidation was to emphasize the common applicability of the classification requirements in “Part 1” to ABS-classed vessels, other marine structures and their associated machinery, and thereby make “Conditions of Classification” more readily a common Rule of the various ABS Rules and Guides, as appropriate.

Thus, this supplement specifies only the unique requirements applicable to steel vessels for service on rivers and Intracoastal waterways. This supplement is always to be used with the aforementioned *Rules for Conditions of Classification (Part 1)*.

PART
1

CHAPTER 1 Scope and Conditions of Classification

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PART

1

CHAPTER 1 Scope and Conditions of Classification

SECTION 1 Classification (*1 January 2008*)

The requirements for conditions of classification are contained in the separate, generic *ABS Rules for Conditions of Classification (Part 1)*.

Additional requirements specific to steel vessels for service on rivers and intracoastal waterways are contained in the following Sections of this Part.

PART

1

CHAPTER 1 Scope and Conditions of Classification

SECTION 2 Classification Symbols and Notations (1 January 2008)

A listing of Classification Symbols and Notations available to the Owners of vessels, offshore drilling and production units and other marine structures and systems, "List of ABS Notations and Symbols" is available from the ABS website "<http://www.eagle.org>".

The following notations are specific to vessels intended for service on rivers or Intracoastal waterways.

1 River Service

Vessels which have been built to the satisfaction of the ABS Surveyors to the requirements of these Rules, where approved by the Committee, will be classed and distinguished in the *Record* by the symbols **⊠ A1**, followed by the service limitation **River Service**.

3 Special Rules

Vessels which have been built to the satisfaction of the ABS Surveyors to the requirements as contained in the Rules for special types of vessels and which are approved by the Committee will be classed and distinguished in the *Record* by the symbols **⊠ A1** followed by appropriate notation and service limitation such as **Oil Tank Barge, River Service, Barge, River Service, Towing Vessel, River Service, Chemical Tank Barge, River Service, Passenger Vessel, River Service**, etc.

PART

1

CHAPTER 1 Scope and Conditions of Classification

SECTION 3 Rules for Classification (*1 January 2008*)

1 Application

1.1 General

These Rules have been developed for barges, towboats, cargo vessels and passenger vessels in service on major rivers and on connecting intracoastal waterways. These Rules provide for certain features peculiar to this service such as push-towing, integrated tows consisting of barges in contact and frequent transiting of locks. However, they are intended to apply to and may be used in development of designs for vessels intended for service in other bodies of comparatively smooth water. These Rules are not intended to apply to vessels in service on the Great Lakes of North America, coastwise operation, or on any ocean. In the design of self-propelled vessels intended to carry dry or liquid cargoes, the arrangements and scantlings in way of the cargo spaces may be taken from the appropriate Sections for barges.

These requirements are applicable to those features that are permanent in nature and can be verified by plan review, calculation, physical survey or other appropriate means. Any statement in the Rules regarding other features is to be considered as a guidance to the designer, builder, owner, et al.

1.3 Application (2005)

The application of the Rules is, in general, based on the contract date for construction between the shipbuilder and the prospective owner. (e.g., Rules which became effective on 1 July 2005 are not applicable to a vessel for which the contract for construction was signed on 30 June 2005.) See also 1-1-4/3 of the ABS *Rules for Conditions of Classification (Part 1)*.

PART

1

CHAPTER 1 Scope and Conditions of Classification

SECTION 4 Submission of Plans

1 Hull Plans (2011)

Plans showing the scantlings, arrangements, and details of the principal parts of the hull structure of each vessel to be built under survey are to be submitted and approved before the work of construction is commenced. These plans are to indicate clearly the scantlings and details of welding, and they are to include, if applicable, such particulars as the design draft and design speed. Where provision is to be made for any special type of cargo or for any exceptional conditions of loading, whether in ballast or with cargo, particulars of the weights to be carried and of their distribution are also to be given. In general, the following plans are to be submitted for review or reference.

- Vessel Specifications
- General Arrangement
- Midship Section
- Scantling Profile
- Bottom Construction, Floors, Girders, etc.
- Framing
- Rake Framing
- Bow Framing
- Stem
- Inner Bottom
- Shell Plating
- Decks
- Trusses
- Pillars and Girders
- Watertight and Deep Tank Bulkheads
- Shaft Tunnels
- Machinery Casings, Boiler, Engine and Main Auxiliary Foundations
- Stern Framing
- Stern Frame and Rudder
- Shaft Struts
- Superstructures and Deckhouses
- Hatches and Hatch-Closing Arrangements
- Ventilation System on Weather Decks

Plans should generally be submitted electronically to ABS. However, hard copies will also be accepted.

3 Machinery Plans

Plans showing the boiler, main propulsion engine, reduction gear, shafting and thrust bearing foundations (See 3-2-1/25 or 3-2-2/21), including holding-down bolts; also machinery general arrangement, installation and equipment plans as referenced in Part 4, are to be submitted and approved before proceeding with the work.

5 Additional Plans

Where certification under 1-1-5/3 or 1-1-5/5 of the *ABS Rules for Conditions of Classification (Part 1)* is requested, submission of additional plans and calculations may be required.

PART

2

Materials and Welding

The independent booklet, *ABS Rules for Materials and Welding (Part 2)*, for steels, irons, bronzes, etc., is to be referred to. This booklet consists of the following Chapters:

Rules for Testing and Certification of Materials

CHAPTER 1 Materials for Hull Construction

CHAPTER 2 Equipment

CHAPTER 3 Materials for Machinery, Boilers, Pressure Vessels, and Piping

APPENDIX 1 List of Destructive and Nondestructive Tests Required for Materials and Responsibility for Verifying

APPENDIX 4 Procedure for the Approval of Manufacturers of Hull Structural Steel

APPENDIX 5 Procedure for the Approval of Manufacturers of Hull Structural Steels Intended for Welding with High Heat Input

APPENDIX 6 Nondestructive Examination of Marine Steel Castings

APPENDIX 7 Nondestructive Examination of Hull and Machinery Steel Forgings

APPENDIX 8 Additional Approval Procedure for Steel with Enhanced Corrosion Resistance Properties

Rules for Welding and Fabrication

CHAPTER 4 Welding and Fabrication

APPENDIX 2 Requirements for the Approval of Filler Metals

APPENDIX 3 Application of Filler Metals to ABS Steels

APPENDIX 9 Welding Procedure Qualification Tests of Steels for Hull Construction and Marine Structures

PART

3

Hull Construction and Equipment

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CHAPTER 1 General

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PART

3

CHAPTER 1 General

SECTION 1 Definitions

1 Application

Unless specified otherwise, the following definitions apply in all cases where reference is made in these Rules, Tables and equations.

3 Length

3.1 Barges

L is the distance, in meters (feet), measured on the centerline between the inside surfaces of the head log plates at each end. For barges of special form such as those having rounded ends or with wells or recesses in the ends, the length for the purpose of these Rules is to be specially determined.

3.3 Self-Propelled Vessels

L is the overall distance, in meters (feet), measured on the centerline, between the inside surfaces of the shell plates at each end.

5 Breadth

The breadth, B , is the greatest horizontal distance, in meters (feet), between the inner surfaces of the side shell plating.

7 Depth

The depth, D , is the vertical distance, in meters (feet), measured at the middle of L from the base line to the under surface of the deck plating at the side of the vessel.

9 Design Draft

The design draft, d , is the vertical distance, in meters (feet), measured at the middle of L from the baseline to the deepest design waterline.

11 Baseline

The *Baseline* is a horizontal line extending through the upper surface of the bottom shell plating at the centerline.

13 Truss

A *Truss* is a system of internal framing members comprised of top and bottom chords extending either longitudinally or transversely in association with regularly spaced stanchions and diagonals. A single laced truss is one having diagonal bracing in only one direction in each space between stanchions; a double laced truss is one having diagonal bracing in both directions in each space.

15 Amidships

Amidships is the middle of the length L .

17 Block Coefficient (C_b)

The *Block Coefficient* (C_b), is given by

$$C_b = \nabla / LBd$$

where ∇ is the volume of molded displacement, excluding appendages, in cubic meters (cubic feet).

19 Double Ended Rake Barge

A *Double Ended Rake Barge* is a barge with similar rakes at each end and fitted with towing bitts arranged in such a manner that the barge in normal circumstances may be towed from either end. Each end of barges with this configuration is to be considered as the forward end in the application of these Rules.

21 Oil

As used in these Rules, the term *Oil* refers to petroleum products having flash points at or below 60°C (140°F), (closed cup test).

23 Passenger

A *Passenger* is every person other than the master and the members of the crew or other persons employed or engaged in any capacity onboard a vessel on the business of that vessel and children under one year of age.

25 Superstructure

A *Superstructure* is a decked structure on the freeboard deck extending from side to side of the barge or vessel, or with the side plating not being inboard of the shell plating more than 0.04B.

27 Cargo Area

The *Cargo Area* is that part of a barge that contains cargo tanks, slop tanks and cargo pump rooms and includes ballast and void spaces, cofferdams and pump rooms adjacent to cargo tanks and also deck areas throughout the entire length and breadth of that part of the barge over the above mentioned spaces. In chemical and liquefied gas tank barges having independent cargo tanks installed in hold spaces, cofferdams or ballast or void spaces aft of the aftermost hold space bulkhead or forward of the forward-most hold space bulkhead are excluded from the cargo area.

29 Cargo Pump Room

A *Cargo Pump Room* is a space containing pumps and their accessories for the handling of the cargo.

31 Weathertight

Weathertight means that in any sea conditions water will not penetrate into the vessel.

33 Gross Tonnage

For vessels in domestic service, gross tonnage is the national gross tonnage as specified by the country in which the vessel is to be registered. For vessels which are engaged in international voyages, gross tonnage is to be determined by the International Convention on Tonnage Measurement of Ships, 1969.

35 Units

These Rules are written in two systems of units, i.e., MKS units and US customary units. Each system is to be used independently of any other system.

Unless indicated otherwise, the format of presentation in the Rules of the two systems of units is as follows:

MKS units (US customary units)

PART

3

CHAPTER 1 General

SECTION 2 General Requirements

1 Materials

1.1 Steel (2017)

These Rules are intended for barges and vessels of welded construction using steels complying with the requirements of Chapters 1 and 2 of the *ABS Rules for Materials and Welding (Part 2)*. Use of steels other than those in Chapters 1 and 2 of the above Part 2 and the corresponding scantlings will be specially considered. Where it is intended to use material of cold flanging quality, this steel is to be indicated on the plans. ASTM A36 steel otherwise manufactured by an ABS approved steel mill, tested and certified to the satisfaction of ABS may be used in lieu of Grade A for a thickness up to and including 12.5 mm (0.5 in.) for plates and up to and including 19 mm (0.75 in.) for sections.

1.3 Aluminum Alloys

The use of aluminum alloys in hull structures will be considered upon submission of the proposed specification for the alloy and the method of fabrication.

1.5 Design Consideration

Where scantlings are reduced in connection with the use of higher-strength steel or where aluminum alloys are used, adequate buckling strength is to be provided. Where it is intended to use material of cold flanging quality for important longitudinal strength members, this steel is to be indicated on the plans.

1.7 Guidance for Repair

Where a special welding procedure is required for the special steels used in the construction, including any low temperature steel and those materials not in Chapters 1 and 2 of the *ABS Rules for Materials and Welding (Part 2)*, a set of plans showing the following information for each steel should be placed aboard the barge or vessel.

- Material Specification
- Welding procedure
- Location and extent of application

These plans are in addition to those normally placed aboard which are to show all material applications.

1.9 Materials Containing Asbestos (2005)

See 4-1-1/21.

3 Scantlings

3.1 General

Sections having appropriate section moduli or areas, in accordance with their functions in the structure as stiffeners, columns or combinations of both, are to be adopted, due regard being given to the thickness of all parts of the sections to provide a proper margin for corrosion. It may be required that calculations be submitted in support of resistance to buckling for any part of the vessel's structure.

3.3 Workmanship

All workmanship is to be of commercial marine quality and acceptable to the Surveyor. Welding is to be in accordance with the requirements of Section 3-2-6. The Surveyors are to satisfy themselves that all operators to be employed in the construction of barges and vessels to be classed are properly qualified in the type of work proposed and in the proper use of the welding processes and procedures to be followed.

5 Proportions

In general, these Rules are valid for vessels having lengths not exceeding 30 times their depth, and breadths not exceeding 6 times their depth. Vessels with other proportions will be specially considered.

7 Structural Sections

7.1 Required Section Modulus

The scantling requirements of these Rules are applicable to structural angles, channels, bars, and rolled or built-up sections. The required section modulus of members such as girders, webs, etc., supporting frames and stiffeners is to be obtained with an effective width of plating basis as described below, unless otherwise noted. The section modulus is to include the structural member in association with an effective width of plating equal to one-half the sum of the spacing on each side of the member or 33% of the unsupported span ℓ , whichever is less. For girders and webs along hatch openings, an effective breadth of plating equal to one-half the spacing or 16.5% of the unsupported span ℓ , whichever is less, is to be used. Where channel construction is adopted, as illustrated in 3-2-1/Figure 5 and 3-2-2/Figure 5, the required section modulus is to be obtained solely by the channel.

The required section modulus of frames and stiffeners is assumed to be provided by the stiffener and one frame space of the plating to which it is attached. For bars or shapes which are not attached to the plating, the section modulus is to be obtained in the member only. It may be required that calculations be submitted in support of the resistance to buckling of longitudinals.

7.3 Serrated Sections

Serrated sections may be used for girders, webs, frames and stiffeners, but the depth of the member is not to be less than 2 times the depth of any cutout. The cutouts are to be arranged to provide regularly spaced points of contact with the plating sufficient to obtain the welding required. Where supporting members are cut out for framing and stiffening members, the depth of the cutout should not exceed 50% of the depth of the supporting member.

9 Structural Design Details

9.1 General

The designer shall give consideration to the following:

9.1.1

The thickness of internals in locations susceptible to rapid corrosion.

9.1.2

The proportions of built-up members to comply with established standards for buckling strength.

9.1.3

The design of structural details, such as noted below, against the harmful effects of stress concentrations and notches:

- i) Details of the ends, the intersections of members and associated brackets.
- ii) Shape and location of air, drainage, or lightening holes.
- iii) Shape and reinforcement of slots or cut-outs for internals.
- iv) Elimination or closing of weld scallops in way of butts, “softening” of bracket toes, reducing abrupt changes of section or structural discontinuities.

9.1.4

Proportions and thickness of structural members to reduce fatigue response due to cyclic stresses, particularly for higher-strength steels.

9.3 Termination of Structural Members

Unless permitted elsewhere in the Rules, structural members are to be effectively connected to the adjacent structures in such a manner as to avoid hard spots, notches and other harmful stress concentrations. Where members are not required to be attached at their ends, special attention is to be given to the end taper, by using soft-toed concave brackets or by a sniped end of not more than 30°. Where the end bracket has a face bar, it is to be sniped and tapered not more than 30°. Bracket toes or sniped ends are to be kept within 25 mm (1.0 in.) of the adjacent member, and the depth at the toe or snipe end is generally not to exceed 15 mm (0.60 in.). Where a strength deck or shell longitudinal terminates without end attachment, it is to extend into the adjacent transversely framed structure or stop at a local transverse member fitted at about one transverse frame space beyond the last floor or web that supports the longitudinal.

PART 3

CHAPTER 2 Hull Structures and Arrangements

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PART

3

CHAPTER 2 Hull Structures and Arrangements

SECTION 1 Tank Barges

1 Application

The following Rules and Tables apply to barges intended for the transportation of liquid cargoes in bulk in services which require operation in comparatively smooth water exclusively, such as in rivers, intracoastal waterways, etc. For additional chemical tank barge requirements see Section 3-2-3.

3 Classification

The classification **✕ A1 Oil Tank Barge, River Service** is to be assigned to vessels designed for the carriage of oil (See 3-1-1/21) cargoes in bulk, and built to the requirements of this Section and other relevant Sections of these Rules. Vessels intended to carry fuel oil having a flash point above 60°C (140°F), closed cup test, and to receive classification **✕ A1 Fuel Oil Tank Barge, River Service** are to comply with the requirements of this section and other relevant sections of these Rules with the exception that the requirements for cofferdams and gastight bulkhead may be modified.

5 Structural Arrangement

5.1 Between the Rakes

5.1.1 Framing

Framing may be arranged either longitudinally, transversely or a combination of both. Longitudinal frames are to be supported by regularly spaced transverse deep frames formed either by channels extending across the inner faces of the longitudinal frames, or by flanged plates notched over the frames and attached to the shell or deck and the longitudinals.

At bulkheads, longitudinals are to be attached at their ends to develop effectively the sectional area and resistance to bending.

5.1.2 Trusses

Trusses are to be arranged as necessary for the support of the framing. In vessels with transverse frames, the trusses are to extend fore and aft and be arranged to limit the spans of the frames to a maximum of 4 m (13 ft). With longitudinal framing, they may extend either fore and aft or athwartships.

In all vessels where the ratio of L to $(D + \frac{1}{2} \text{ the deck crown})$ exceeds 20, at least one fore-and-aft single laced truss is to be fitted on each side of the centerline and where the ratio exceeds 25, at least one fore-and-aft double laced truss or two single laced trusses are to be fitted on each side; in the latter case the diagonal bracing in the two trusses on each side should be reversed in direction with each other to provide tension members whether the conditions of load create either hogging or sagging forces.

5.1.3 Bilge and Gunwale Brackets

In tanks where the radius at the bilge exceeds 305 mm (12 in.), the bilge brackets connecting the lower ends of vertical side frames with transverse bottom frames are to be cut to fit against and support the bilge plate. In longitudinally framed vessels, a similar arrangement will be required at each main transverse frame and in addition, intermediate brackets are to be fitted spaced not over 0.9 m (3 ft) apart. See 3-2-1/Figures 1 and 2. Similar brackets may be required to be fitted at the gunwales where no gunwale angle is used. See 3-2-1/Figure 4. As an alternative to the fitting of bilge brackets, an additional inverted angle or flat bar longitudinal may be fitted as shown in 3-2-1/Figure 3.

5.3 Rakes

The bottom and deck framing is to consist of longitudinal bottom frames and beams, attached to the rake bulkheads by effective brackets and to the head log by deep diaphragm plates or by a system of vertical channels which in turn support horizontal stiffening on the head log. The longitudinal bottom frames and beams are to have intermediate supports obtained by a system of strut angles extending between each corresponding beam and frame to form an effective longitudinal truss, or as an alternative, stanchions and diagonals may be fitted on the longitudinal frames at regular intervals in association with channel or flanged plate transverses for the support of the intervening rake frames and beams. A typical arrangement is shown in 3-2-1/Figure 11.

The sides of rakes may be framed vertically, diagonally or horizontally.

Special heavy plates are to be fitted to form the head logs and these are to be terminated at the corners of the barge in special heavy castings or weldments.

5.5 Double Skin Construction

These Rules contain requirements for single skin as well as double skin tank barges. Consideration is to be given to double skin construction as may be required by governmental regulations for certain types of cargoes.

For an oil barge of U.S. registry less than 10,000 DWT in service exclusively on inland or limited short protected coastwise routes, 33CFR157.10d(d) specifies the following double hull dimensions and clearances:

- *Double Bottom* 610 mm (2 ft) measured at right angles to the bottom shell
- *Wing Tank or Space* 610 mm (2 ft) measured at right angles to the side shell.

A minimum clearance of 460 mm (18 in.) for passage between framing must be maintained throughout the double sides and double bottom.

7 Longitudinal Strength (2001)

7.1 Definitions

7.1.1 Limiting Draft

A limiting draft is the maximum draft to which cargo of the specified densities may be loaded.

7.1.2 Homogeneous Cargo

Homogeneous cargo is a cargo having a density which, when all cargo tanks are completely filled, will submerge the barge to the approved limiting draft. The density of homogeneous cargo is obtained by dividing the cargo deadweight at that limiting draft by the total volume of all cargo tanks.

7.1.3 Approved Cargo Density

Approved cargo density is the maximum density corresponding to the limiting draft. It is not to be less than the density of homogeneous cargo or 1.05 whichever is greater.

7.3 Loading Conditions

The following definitions of loading conditions are to be understood for the purpose of these Rules.

7.3.1 Normal Conditions

Normal conditions are those expected during the normal operation of the barge, including intermediate conditions during loading and unloading.

While in transit, the barge is assumed to be full with homogeneous cargo, unless bending moment calculations are submitted for other condition intended for normal operation.

7.3.2 High Density Cargo Condition

A high density cargo condition is a condition expected during the normal operation of the barge including intermediate conditions during loading and unloading wherein tanks are loaded with cargo having the maximum approved density that is in excess of homogeneous cargo density.

7.5 Loading/Unloading Sequences and Bending Moment Calculations

For tank barges of 53 m (175 ft) or above in length, loading/unloading sequences and bending moment calculations are to be submitted for review as follows:

7.5.1 Loading/unloading Sequences

For each cargo loading condition, a step by step description of the sequence of loading and unloading is to be submitted together with the mass of cargo in each tank at every step.

7.5.2 Bending Moment Calculations

Bending moment calculations are to be submitted where any of the following conditions apply:

- i) Where conditions other than homogeneous cargo condition are contemplated. See 3-2-1/7.3.1,
- ii) For high density cargo conditions, or
- iii) For any step of loading/unloading as may be required after review of the loading/unloading sequence required above.

7.7 Hull Girder Section Modulus (1 July 2016)

The hull girder section modulus within the midship $0.5L$ for vessels of 53 meters (175 feet) in length or above is to be not less than obtained from the following equation:

$$SM = M_{sw}/f_p \quad \text{cm}^2\text{-m (in}^2\text{-ft)}$$

where

SM = minimum required hull girder section modulus, in $\text{cm}^2\text{-m (in}^2\text{-ft)}$

M_{sw} = maximum calculated still water bending moment or M_s , whichever is greater, in tf-m (Ltf-ft) . See 3-2-1/7.5.

M_s = a standard still water bending moment

$$= L^2BD/5.76 \text{ kN-m} \quad \text{for SI units}$$

$$= L^2BD/56.44 \text{ tf-m} \quad \text{for MKS units}$$

$$= L^2BD/2025 \text{ Ltf-ft} \quad \text{for US units}$$

f_p = nominal permissible bending stress of 13.1 kN/cm^2 (1.34 tf/cm^2 , 8.5 Ltf/in^2)

for compressive side, f_p is not to be taken greater than 0.67 times the reference stress (f_r) as specified below, or permissible stress f as specified in 3-2-3/7.5.3(b) whichever is less.

f_r = $k f_c \{ [C_2 + (a/st)] / [1 + (a/st)] \} f_y$ for longitudinally framed deck or bottom

= $[C_2 s/b + 0.115(1 - s/b)(1 + 1/\beta^2)] f_y$ for transversely framed deck or bottom

C_2	=	$2.25/\beta - 1.25/\beta^2$	for $\beta > 1.25$
	=	1	for $\beta < 1.25$
k	=	0.8	for serrated longitudinals
	=	0.95	for non-serrated longitudinals
f_c	=	f_E	for $f_E < 0.6$
	=	$1 - 0.24/f_E$	for $f_E > 0.6$
f_E	=	$\pi^2 EI / [\ell^2 (a + C_2 s t) f_y]$	
a	=	area of longitudinal, in mm ² (in ²)	
ℓ	=	unsupported span of longitudinals in mm (in.)	
β	=	$(f_y/E)^{1/2} s/t$	
s	=	spacing of the deck/bottom longitudinals or beams, in mm (in.)	
b	=	unsupported length of the deck/bottom transverse beams/frames, in mm (in.)	
t	=	thickness of the deck/bottom plating, in mm (in.)	
f_y	=	yield strength of the deck/bottom material, in N/cm ² (kgf/cm ² , lbf/in ²)	
E	=	modulus of elasticity, in N/cm ² (kgf/cm ² , lbf/in ²)	
I	=	moment of inertia of the deck/bottom longitudinal with its associated effective deck/bottom plating in cm ⁴ (in ⁴)	

L , B and D are as defined in Section 3-1-1.

Beyond the midship $0.5L$, scantlings may be tapered to their normal requirements.

7.9 Items Included in the Section Modulus Calculation

In general, the following items may be included in the calculation of the section modulus.

- Deck and trunk plating
- Shell and inner bottom plating
- Deck and bottom girders
- Plating and longitudinal stiffeners of longitudinal bulkheads
- All longitudinals of deck, trunk, sides, bottom and inner bottom

All items are to be continuous or effectively developed at the transverse bulkheads and all other joints. In general, the net sectional areas of longitudinal-strength members are to be used in the hull girder section modulus calculation.

9 Deck and Trunk Plating

9.1 Between the Rakes

The thickness of deck, trunk and trunk side plating between the rakes is to be not less than the greater of 3-2-1/9.1.1 or 3-2-1/9.1.2 below.

9.1.1 Minimum Thickness

The thickness of plating is to be not less than determined by the following equations.

- *With Transverse Beams*

$$t = 0.066L + 3.5 \text{ mm} \quad t = 0.0008L + 0.14 \text{ in.}$$

- *With Longitudinal Beams*

$$t = 0.066L + 2.5 \text{ mm} \quad t = 0.0008L + 0.10 \text{ in.}$$

Note The thickness of decks and trunk tops and sides with longitudinal beams and $L \geq 79$ meters (260 feet) need not be greater than 8.0 mm (0.31 in. except as required to provide adequate hull girder strength and resistance to buckling. For decks and trunks with longitudinal beams, for $L \geq 30.5$ meters (100 feet), the thickness of the deck and trunk top and side plating is to be not less than 4.5 mm (0.18 in.).

9.1.2 Thickness for Compression (2001)

The thickness of plating is to be not less than what is required for longitudinal hull girder strength (see 3-2-1/7).

9.3 Rake Decks

The thickness of rake deck plating is to be not less than 0.01 mm (0.01 in.) per mm (in.) of frame spacing.

11 Frames

Each frame, in association with the plating to which it is attached, is to have a section modulus, SM , not less than obtained from the following equation:

$$SM = 7.8chs\ell^2 \text{ cm}^3 \quad SM = 0.0041chs\ell^2 \text{ in}^3$$

where

- c = coefficient appropriate to the member under consideration and the type of construction employed as given in 3-2-1/Figures 5 through 11
- = 1.0 for rake side frames
- h = distance from the middle of ℓ to the deck at side, in m (ft)
- = for rake bottom frames, the vertical distance from the middle of ℓ to the height of the deck at side at the rake bulkhead, in m (ft)
- = for rake deck transverses and longitudinals, 1.2 m (4.0 ft)
- = in way of tanks, h as defined in 3-2-1/17, but not to be taken less than h_e as indicated in 3-2-1/Figures 8 and 9 for bottom transverses and floors on double skin tank barges with void wing compartments
- s = member spacing in m (ft)
- ℓ = unsupported span of the member, in m (ft). Where brackets of the thicknesses given in 3-2-1/Table 1 are fitted, ℓ may be measured to a point 25% of the extent of the bracket beyond its toe.

Rake side vertical frames are to be fitted at their upper and lower ends with brackets extending over to the first adjacent longitudinal beam or frame.

13 Trusses

13.1 Top and Bottom Chords

Each top and bottom chord is to have a section modulus, SM , not less than obtained from the following equation:

$$SM = 7.8chs\ell^2 \text{ cm}^3 \quad SM = 0.0041chs\ell^2 \text{ in}^3$$

where c , h , s and ℓ are as defined in 3-2-1/11.

13.3 Stanchions

The spacing of truss stanchions is generally not to exceed the depth of the truss.

13.3.1 Permissible Load (2018)

The permissible load, W_a , of each stanchion is to be obtained from the following equation and is to be not less than the calculated load W given in 3-2-1/13.3.2 below.

$$W_a = [k - n\ell/r]A \quad \text{kN (tf, Ltf)}$$

where

k	=	12.09 (1.232, 7.83)	ordinary strength steel
	=	16.11 (1.643, 10.43)	HT32 strength steel
	=	18.12 (1.848, 11.73)	HT36 strength steel
n	=	0.0444 (0.00452, 0.345)	ordinary strength steel
	=	0.0747 (0.00762, 0.581)	HT32 strength steel
	=	0.0900 (0.00918, 0.699)	HT36 strength steel
ℓ	=	unsupported span of the stanchion, in cm (ft)	
r	=	least radius of gyration, in cm (in.)	
A	=	cross sectional area of the stanchion, in cm ² (in ²)	

13.3.2 Calculated Load

The calculated load for each truss stanchion is to be determined by the following equation:

$$W = nbhs \quad \text{tf (Ltf)}$$

where

n	=	1.07 (0.03)
b	=	mean breadth of the area supported, in m (ft)
h	=	distance from the bottom shell at the center of the area supported to the underside of the deck plating at side, in m (ft)
s	=	spacing of the stanchions, in m (ft)

13.5 Diagonals

Diagonals in trusses are to have a sectional area of approximately 50% of that of the stanchions.

15 Web Frames, Girders and Stringers

Each web frame, girder and stringer is to have a section modulus, SM , not less than obtained from the following equation:

$$SM = 7.8chs\ell^2 \quad \text{cm}^3 \qquad SM = 0.0041chs\ell^2 \quad \text{in}^3$$

where c , h , s and ℓ are as defined in 3-2-1/11.

17 Tank Head for Scantlings

Except for stanchions (see 3-2-1/13.3.2), the scantling head of structural members in tanks is to be obtained from 3-2-1/17.1 or 3-2-1/17.3 depending upon the pressure setting of the pressure-vacuum valve.

17.1 Pressure Setting 0.12 kgf/cm² (1.7 psi) or Less

The scantling head, h , in m (ft), is not to be less than h_1 , nor less than h_o , where spill valves or rupture disks are fitted in lieu of high level alarms.

$$h_1 = \rho h_t + 1.2 \text{ m}$$

$$h_1 = \rho h_t + 4.0 \text{ ft}$$

h_1 is not to be less than the distance to the top of the hatch.

where

$$h_o = (2/3)(\rho h_s + 10p_s) \text{ m} \quad h_o = (2/3)(\rho h_s + 2.3p_s) \text{ ft}$$

$$\rho = 1.0 \text{ where specific gravity of the liquid is 1.05 or less}$$

$$= \text{specific gravity of liquid where it is in excess of 1.05}$$

$$h_t = \text{head from the center of the supported area or lower edge of the plating to the deck at side for tanks outside trunks, or to the top of the trunk at side for tanks within trunks.}$$

$$h_s = \text{head to the spill valve or rupture disc, where fitted, in m (ft)}$$

$$p_s = \text{relieving pressure of spill valve or rupture disc, where fitted, in kgf/cm}^2 \text{ (psi)}$$

17.3 Pressure Setting Over 0.12 kgf/cm² (1.7 psi)

The scantling head is to be in accordance with 3-2-1/17.1, except that h_2 is to be used in lieu of h_1 .

$$h_2 = \rho h_t + 10p \text{ m}$$

$$h_2 = \rho h_t + 2.3p \text{ ft}$$

where

$$p = \text{pressure setting of pressure-vacuum valve, in kgf/cm}^2 \text{ (psi)}$$

19 Bulkheads

19.1 Arrangement

19.1.1 Subdivision

It is assumed that those responsible for the design of the vessels have assured themselves that the subdivision is such as to ensure sufficient stability in service when the tanks are being filled or emptied. The length of the tanks and the positions of longitudinal bulkheads are to be such as to avoid excessive stresses in the hull structure.

19.1.2 Cofferdams

In vessels intended for the carriage of flammable or combustible liquids having flash points at or below 60°C (140°F) (closed-cup test), bulkheads are to be arranged to provide cofferdams between the cargo tanks and any spaces used for living quarters, general cargo, or containing machinery where sources of vapor ignition are normally present. Spaces containing cargo pumps, steam pumping engines or which are used as tanks for products having flash points not less than 60°C (140°F) (closed-cup test) may be considered as cofferdams for the purpose of this requirement, but in the latter case the piping and pumping arrangements for the high flash point liquid are to be entirely separate from and have no means for connection with the arrangements for handling the low flash point products.

19.1.3 Pump Rooms

Spaces containing pumps, piping and valves for handling flammable or combustible liquids having flash points below 60°C (140°F) (closed-cup test) are to be completely separated from all sources of vapor ignition by gastight bulkheads. Steam driven engines are not considered sources of vapor ignition for the purposes of this requirement. The gastight bulkheads may be pierced by fixed lights for lighting from outside sources and by pumping engine shafts and control rods, provided the shafts and rods are fitted with efficient stuffing boxes where they pass through the bulkhead.

19.3 Construction of Tank Boundary Bulkheads

19.3.1 Plating

Plating is to be of thickness obtained from the following equation:

$$t = (s\sqrt{h}/254) + 1.78 \text{ mm} \quad (\text{min. } t = 5 \text{ mm})$$

$$t = (s\sqrt{h}/460) + 0.07 \text{ in.} \quad (\text{min. } t = 0.20 \text{ in.})$$

where

h = height, in m (ft), in accordance with 3-2-1/17.

s = for flat plate bulkheads, the spacing of stiffeners, in mm (in.)

= for corrugated bulkheads, the greater of dimensions a or c as indicated in Section B-B of 3-2-1/Figures 8 and 9.

For corrugated bulkheads, the angle is to be 45° or more

19.3.2 Stiffening

The ends of stiffeners are to be either bracketed or clipped, and those of trunk top transverse beams are to be effectively attached as shown in 3-2-1/Figure 8a or 3-2-1/Figure 9a. Each stiffener, in association with the plating to which it is attached, is to have a section modulus SM not less than obtained from the following equation:

$$SM = 7.8csh\ell^2 \text{ cm}^3$$

$$SM = 0.0041chs\ell^2 \text{ in}^3$$

where

c = 1.00

h = height, in m (ft), in accordance with 3-2-1/17

s = stiffener spacing, in m (ft)

= for corrugated bulkheads, $a + b$ where a and b are as indicated in Section B-B of 3-2-1/Figures 8 and 9

ℓ = as defined in 3-2-1/11

= for corrugated bulkheads, the distance between the supporting members, in m (ft)

The developed section modulus, SM , for corrugated bulkheads may be obtained from the following equation, where a , t and d are as indicated in Section B-B, 3-2-1/Figures 8 and 9.

$$SM = (td^2/6) + (adt/2)$$

19.3.3 Drainage and Air Escape

Limber and air holes are to be cut in all parts of the structure as required to ensure the free flow to the suction pipes and the escape of air to the vents. Efficient arrangements are to be made for draining the spaces above deep tanks.

19.5 Construction of Other Watertight Bulkheads

19.5.1 Plating

Plating is to be of thickness obtained from the following equation:

$$t = (s\sqrt{h}/290) + 1.0 \text{ mm} \quad (\text{min. } t = 4.5 \text{ mm})$$

$$t = (s\sqrt{h}/525) + 0.04 \text{ in.} \quad (\text{min. } t = 0.18 \text{ in.})$$

where

s = as defined in 3-2-1/19.3.1

h = vertical distance measured in m (ft) from the lower edge of the plate to the height of the deck at centerline.

19.5.2 Stiffening

Each stiffener, in association with the plating to which it is attached, is to have a section modulus SM not less than obtained from the following equation:

$$SM = 7.8chs\ell^2 \text{ cm}^3$$

$$SM = 0.0041chs\ell^2 \text{ in}^3$$

where

c = 0.46

h = vertical distance from the middle of ℓ to the deck at centerline, in m (ft)

s = for flat plate bulkheads, stiffener spacing, in m (ft)

= for corrugated bulkheads, $a + b$ where a and b are as indicated in Section B-B of 3-2-1/Figures 8 and 9

ℓ = as defined in 3-2-1/19.3.2

Stiffeners on these bulkheads may have unattached sniped ends provided the above value of SM is increased 25%.

The developed section modulus, SM , for corrugated bulkheads may be obtained as indicated in 3-2-1/19.3.2.

21 Shell Plating

21.1 Bottom Shell

The thickness of the bottom shell plating throughout is not to be less than determined by the following equation:

$$t = 0.069L + 0.007s - 0.5 \text{ mm} \quad (\text{min. } t = 5 \text{ mm})$$

$$t = 0.000825L + 0.007s - 0.02 \text{ in.} \quad (\text{min. } t = 0.20 \text{ in.})$$

where

s = stiffener spacing, in mm (in.)

L = length of the vessel, in m (ft)

21.3 Side Shell

The thickness of the side shell plating is to be not less than determined by the following equation and not less than 5 mm (0.20 in.).

$$t = 0.069L + 0.007s - 1.0 \text{ mm} \quad L < 73 \text{ m}$$

$$t = 0.069L + 0.007s - 1.5 \text{ mm} \quad L \geq 73 \text{ m}$$

$$t = 0.000825L + 0.007s - 0.04 \text{ in.} \quad L < 240 \text{ ft}$$

$$t = 0.000825L + 0.007s - 0.06 \text{ in.} \quad L \geq 240 \text{ ft}$$

21.5 Bilge Plating

Where radiused bilges are used, the bottom thickness is to extend to the upper turn of the bilge. Where the radius at the bilge exceeds 305 mm (12 in.), the thickness of the plating should be at least 1.5 mm (0.06 in.) greater than the required thickness for side plating.

21.7 Tank Spaces

In way of the cargo tanks the bottom, side and bilge plating are not to have less thickness than required by 3-2-1/19.3.1 for the plating of deep tank bulkheads where the spacing of the stiffeners is equal to the frame spacing and the value of h in accordance with 3-2-1/17.

21.9 Bilge Angles

Where angles are used at the bilges or gunwales they are to have a thickness at least 1.5 mm (0.06 in.) greater than that of the thinner of the two plates joined.

23 Hatches and Fittings

23.1 Hatchways

Hatchways of sufficient size to provide access and ventilation and having substantial oiltight steel covers are to be fitted to each tank. Where openings are located close to the gunwales, doubling plates or other compensation may be required.

23.3 Deck Fittings

The structure in way of cleats, bitts and chocks is to be suitably reinforced by installation of headers, additional beams, brackets or doubling plates

25 Barge Reinforcement

25.1 General

The following paragraphs are intended to provide for additional protection against contact with locks and river bottom and against other wear and tear damage associated with normal operation with other floating equipment.

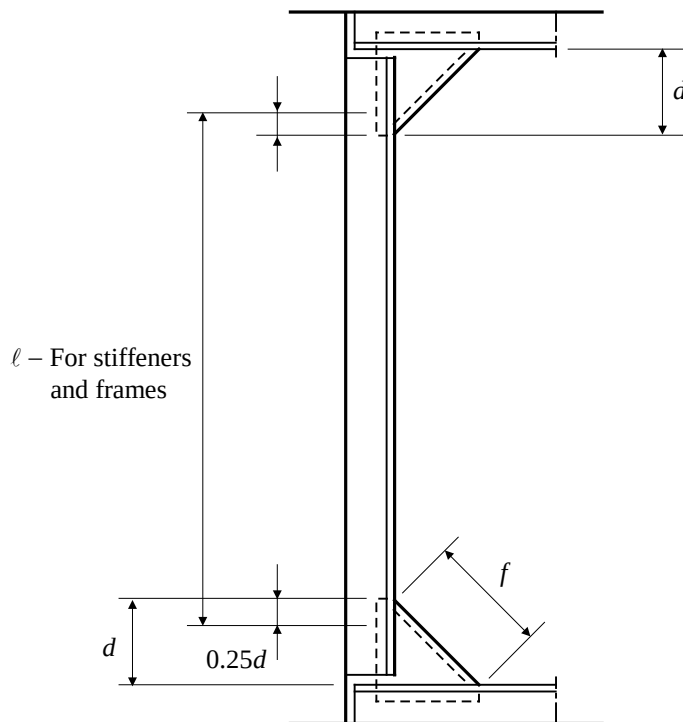
A design intended for Classification will be reviewed for compliance with 3-2-1/25.3 when requested. A notation **Reinforcement A** or **Reinforcement B** will be entered in the *Record* indicating compliance with all of the requirements for Reinforcement A or B in 3-2-1/25.3.

25.3 Reinforcement

Where the option for reinforcement in 3-2-1/25.1 is chosen, the hull parts to be reinforced are given in the following table, the reinforced plate thicknesses are to be not less than given in column Reinforcement A or column Reinforcement B, as appropriate.

	<i>Reinforcement A</i>	<i>Reinforcement B</i>
Bilge radius for full-length of barge (knuckle plate)	$t_{\min} = 16.0 \text{ mm } (5/8 \text{ in.})$	$t_{\min} = 12.5 \text{ mm } (1/2 \text{ in.})$
Side shell	$t_{\min} = 11.0 \text{ mm } (7/16 \text{ in.})$	$t_{\min} = 9.5 \text{ mm } (3/8 \text{ in.})$
Headlog and sternlog plate	$t_{\min} = 19.0 \text{ mm } (3/4 \text{ in.})$	$t_{\min} = 16.0 \text{ mm } (5/8 \text{ in.})$
Transom side and bottom periphery (picture frame) plates	$t_{\min} = 16.0 \text{ mm } (5/8 \text{ in.})$	$t_{\min} = 12.5 \text{ mm } (1/2 \text{ in.})$
All side shell, bottom shell and deck structural members in wing and rake compartments	Use appropriate Rule coefficients with 1.83 m (6 ft) overflow above deck at side. Where no wing tanks are fitted, the reinforcement is to apply to the side shell structure in way of cargo tanks and the side, bottom and deck structure in way of rakes.	Use appropriate Rule coefficients with 1.22 m (4 ft) overflow above deck at side.

TABLE 1
Brackets



Metric Units

Length of Face, f mm	Thickness, mm		Width of Flange mm
	Plain	Flanged	
Not exceeding 455	6.5	---	---
Over 455 to 660	8.0	6.5	50
Over 660 to 915	9.5	8.0	63
Over 915 to 1370	11.0	9.5	75

US Units

Length of Face, f in.	Thickness, mm		Width of Flange in.
	Plain	Flanged	
Not exceeding 18	$\frac{1}{4}$	---	---
Over 18 to 26	$\frac{5}{16}$	$\frac{1}{4}$	2
Over 26 to 36	$\frac{3}{8}$	$\frac{5}{16}$	$2\frac{1}{2}$
Over 36 to 54	$\frac{7}{16}$	$\frac{3}{8}$	3

FIGURE 1
Bilge Bracket (see 3-2-1/5.1.3)

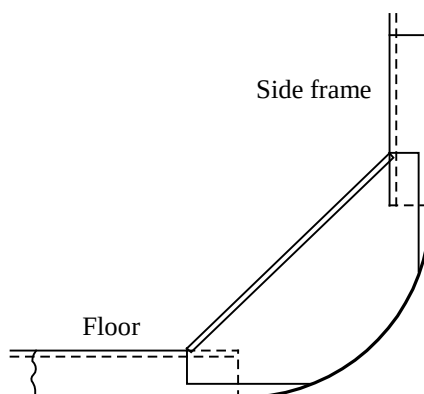


FIGURE 2
Intermediate Bilge Bracket (see 3-2-1/5.1.3)

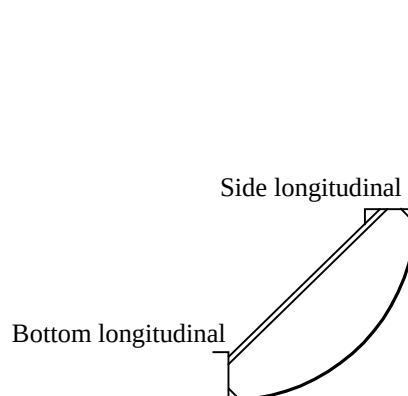


FIGURE 3
Alternative Arrangement (see 3-2-1/5.1.3)

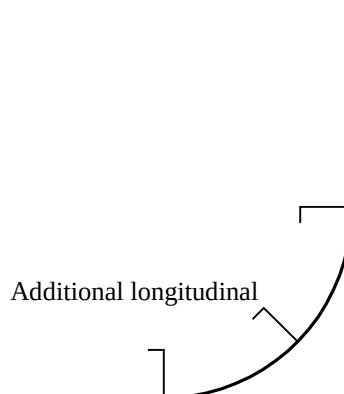


FIGURE 4
Gunwale Bracket (see 3-2-1/5.1.3)

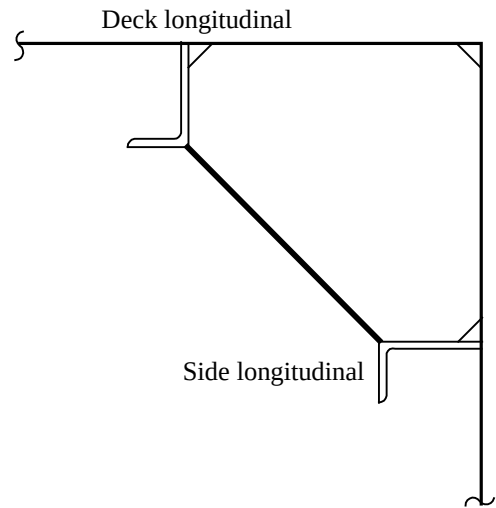
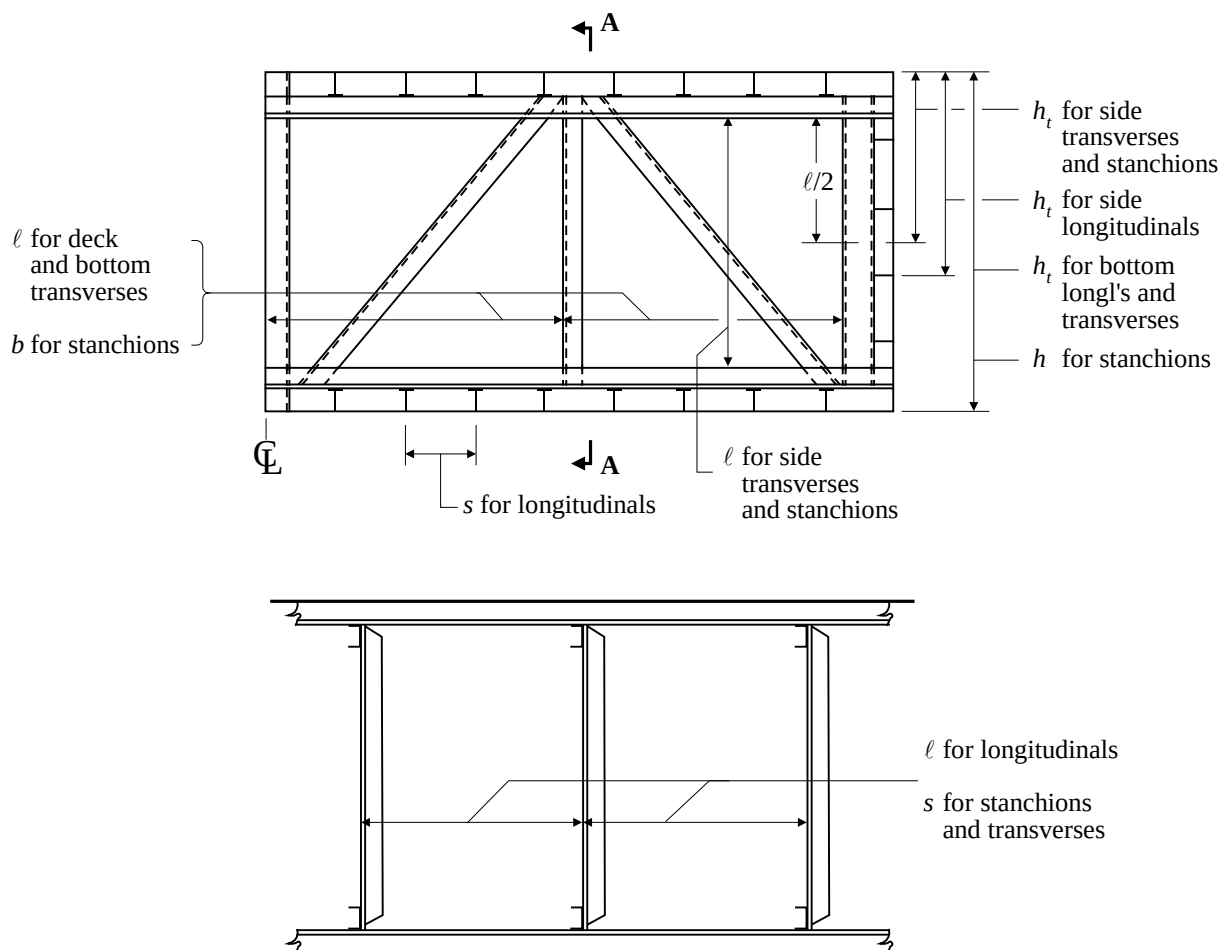


FIGURE 5
Tank Barge

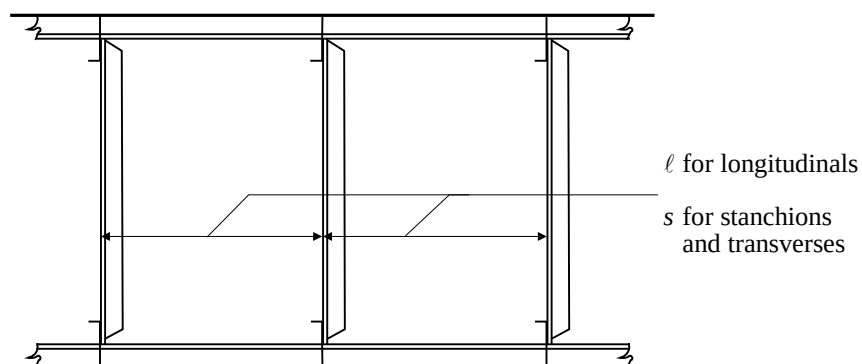
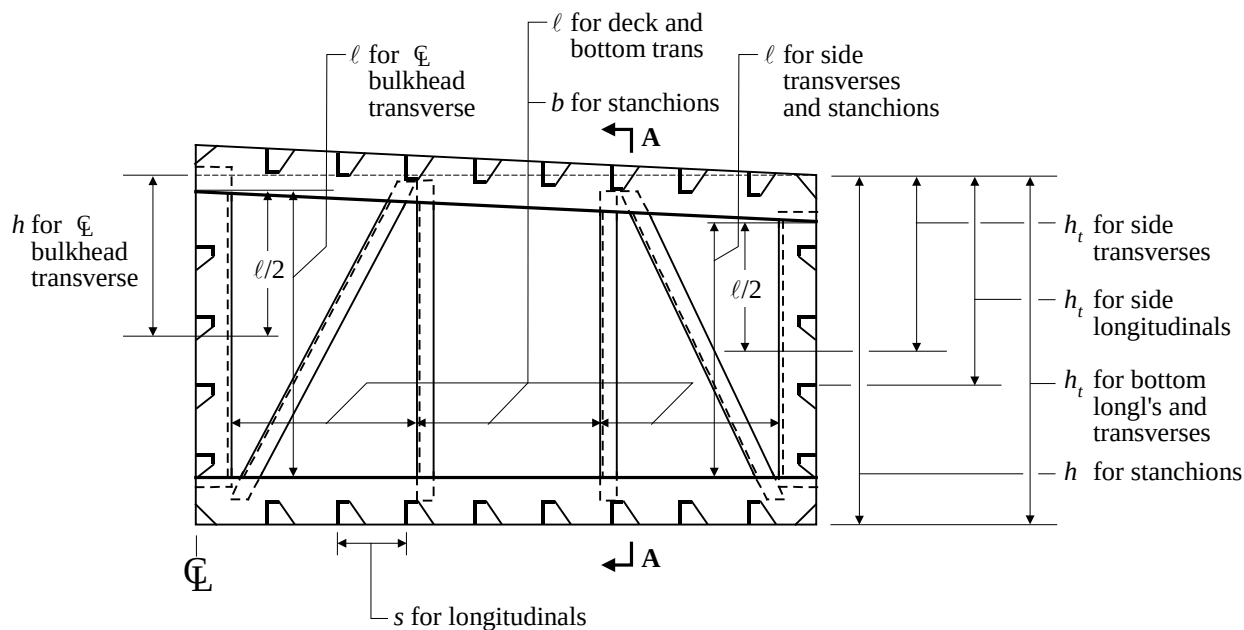


Section A-A

Bottom transverse	$c = 1.08$	Bottom longitudinal	$c = 1.28$
Side transverse	$c = 1.75$	Side longitudinal	$c = 1.28$
Deck transverse	$c = 1.08$	Deck longitudinal	$c = 1.75$

h = in accordance with 3-2-1/17

FIGURE 6
Tank Barge

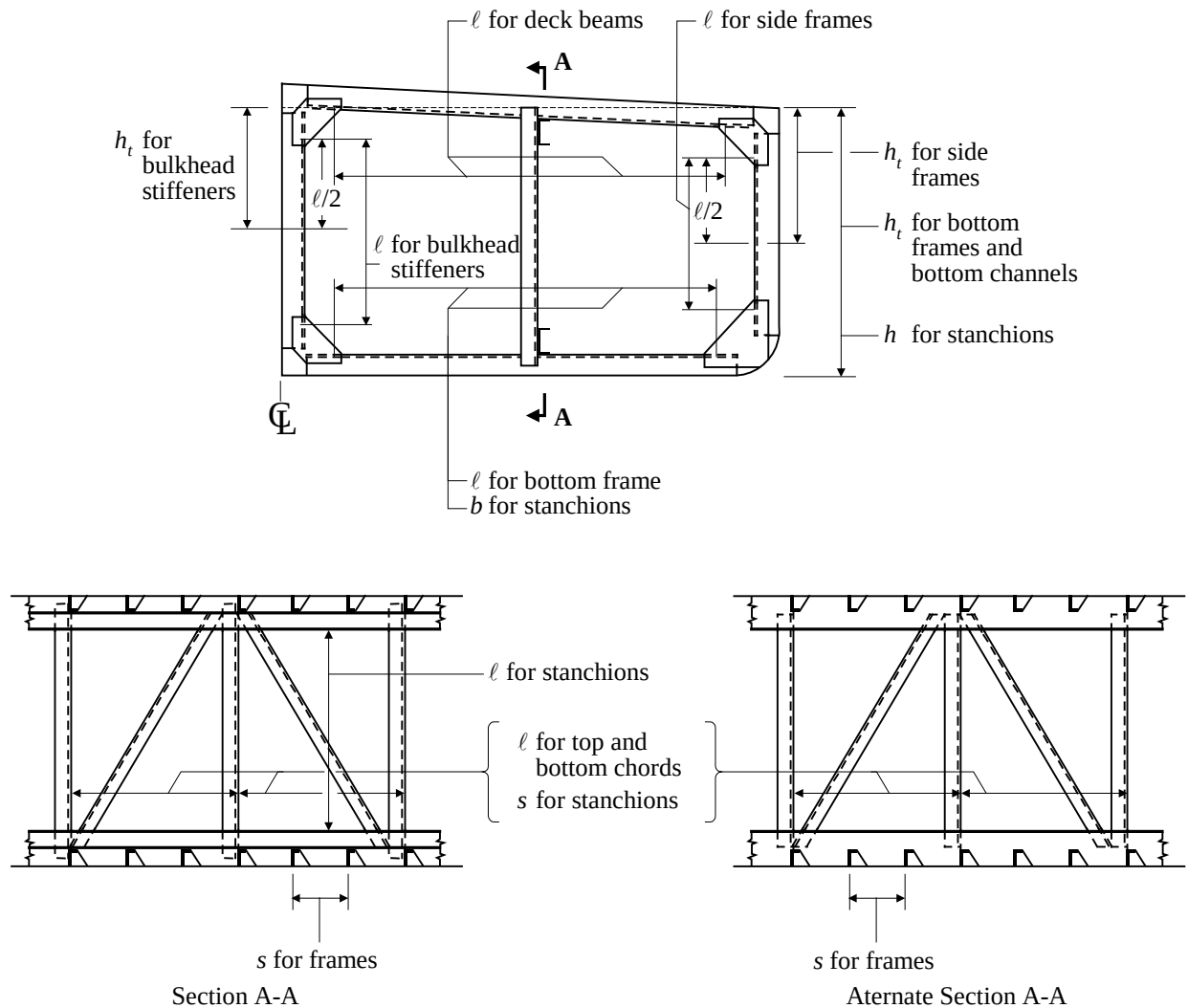


Section A-A

Bottom transverse	$c = 1.08$	Bottom longitudinal	$c = 1.28$
Side transverse	$c = 1.75$	Side longitudinal	$c = 1.28$
Deck transverse	$c = 1.08$	Deck longitudinal	$c = 1.75$
C.L. Bulkhead transverse	$c = 1.08$	C.L. Bulkhead longitudinal	$c = 1.00$

h = in accordance with 3-2-1/17

FIGURE 7
Tank Barge

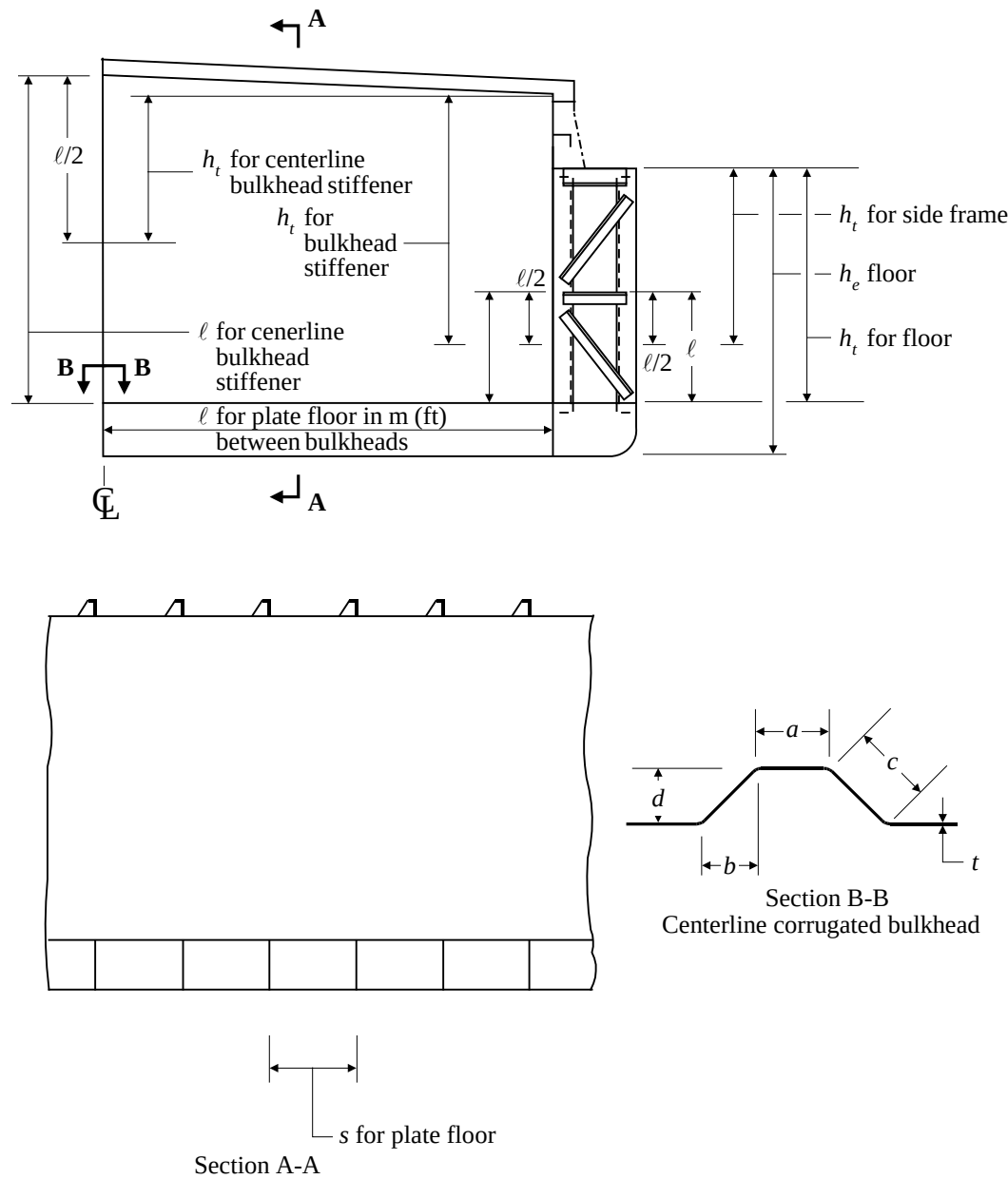


Bottom frame	$c = 1.00$
Truss bottom chord	$c = 1.08$
Truss top chord	$c = 1.08$

Deck beam	$c = 1.00$
Side frame	$c = 1.00$

h = in accordance with 3-2-1/17

FIGURE 8
 Double Skin Tank Barge



Floor	$c = 1.00$	Bulkhead Stiffener	$c = 1.00$
Centerline bulkhead stiffener	$c = 1.00$	Side frame	$c = 1.00$
Deck beam	$c = 1.00$		

h = in accordance with 3-2-1/17
 (Center compartment – liquid cargo)
 (Wing compartment – void or ballast)

FIGURE 8A
Trunk Top Beam End Connection

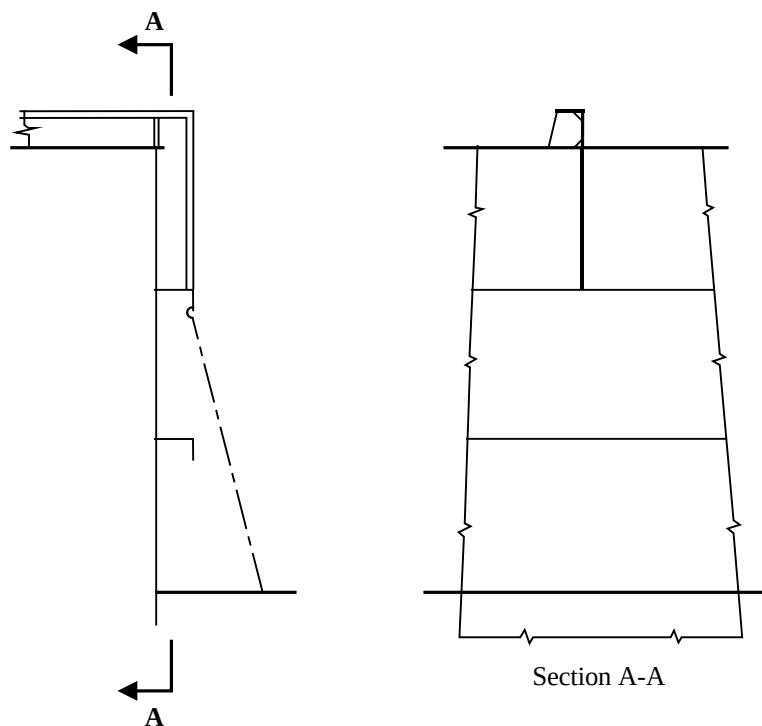
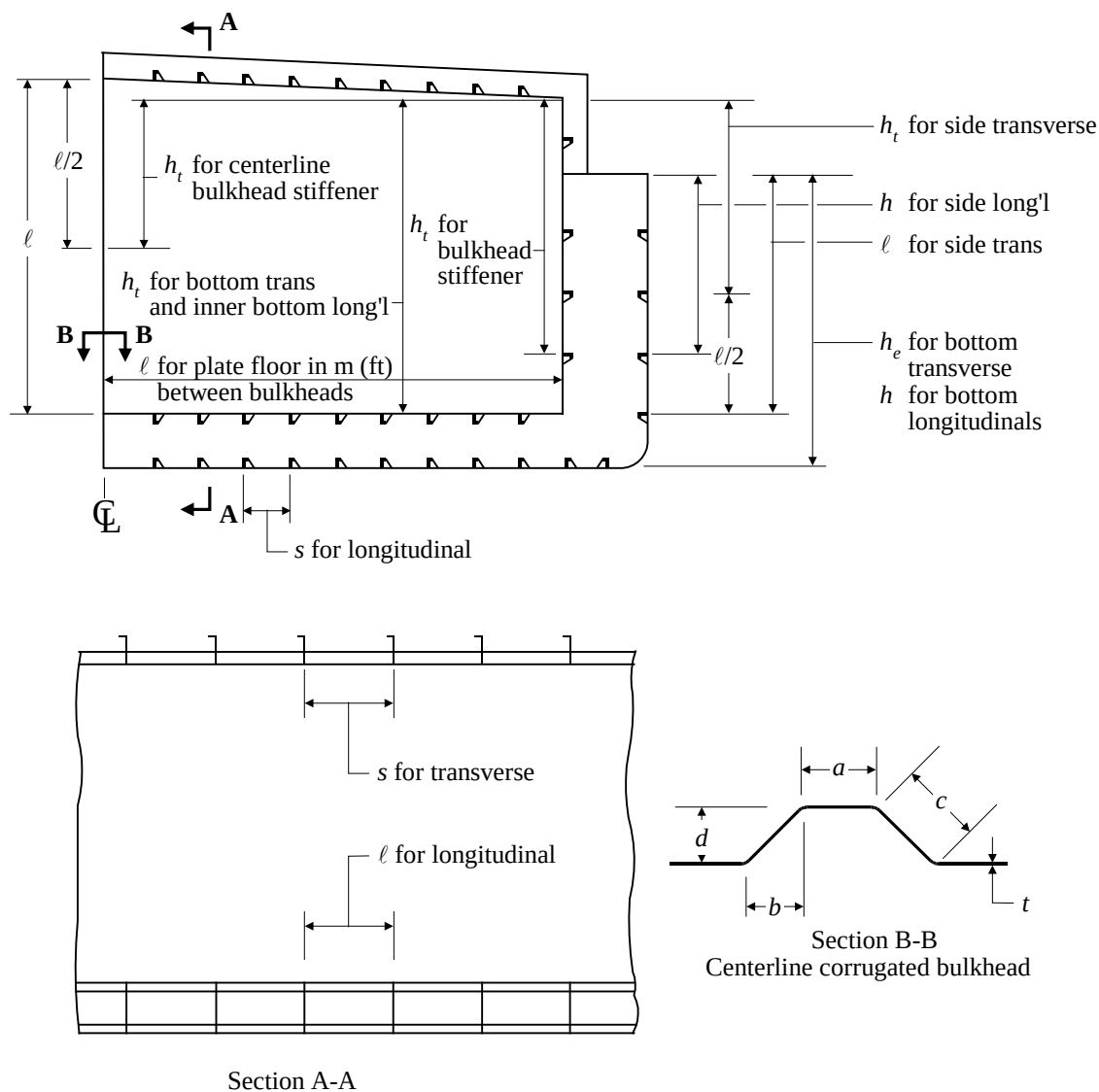


FIGURE 9
Double Skin Tank Barge



Bottom longitudinal

Side longitudinal

Inner bottom longitudinal

Bulkhead stiffener

Centerline bulkhead stiffener

Bottom transverse

Side transverse

Deck transverse

Deck longitudinal

$c = 1.08$

$c = 1.08$ (Wing compartment – void)

$c = 1.28$ (Wing compartment – ballast)

$c = 1.00$

$c = 1.00$

$c = 1.00$

$c = 1.08$

$c = 1.08$

$c = 1.08$

$c = 1.75$

h = in accordance with 3-2-1/17

(Center compartment – liquid cargo)

(Wing compartment – void or ballast)