Common Structural Rules for Bulk Carriers and Oil Tankers

Technical Background for Rule Change Notice 1 to 01 JAN 2017 version

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1. Reason for the Rule Change
Clarification of how to measure the free board length.

2. Background
Amendment of Figure 1 is proposed to be in line with [3.1.2] for concave type of stem above the water line at 85% of the least moulded depth.

3. Impact in Scantlings
There is no impact on scantlings due to this change.

3.1.5 Draughts

1. Reason for the Rule Change
The Rule Change is to clarify the Rules once the Ballast Water Convention enters into force.

2. Background
For ships equipped only with ballast treatment system, i.e. where neither sequential method nor flow-through method is applied, it is not possible to take into account a loading condition corresponding to ballast water exchange operation as a design loading condition.
Consequently a number of paragraphs in the Rules are proposed amended.

3. Impact in Scantlings
Scantling impact is not expected.

3.8 Glossary

3.8.1 Definition of terms

1. Reason for the Rule Change
The Rule Change is to clarify the definition of duck keel, stern frame, stern, rudder post and propeller post.

2. Background
The definition of “stern frame, stern, rudder post and propeller post” used in Pt 1, Ch 10, Sec 3 is not clear considering the recent design so Table 7 is updated.

For the definition of duct keel, the Rule text “extending the length of the cargo tank” is proposed deleted in order to make the definition more general and also applicable for cargo tanks and/or ballast tanks.

3. Impact in Scantlings
Scantling impact is not expected.

CHAPTER 2 GENERAL ARRANGEMENT DESIGN

SECTION 2 SUBDIVISION ARRANGEMENT

1 WATERTIGHT BULKHEAD ARRANGEMENT

1.1 Number and disposition of watertight bulkheads

1.1.1

1. Reason for the Rule Change
The Rule Change is to clarify the requirements.

2. Background
It is required that all ships are to have at least one collision bulkhead, one aft peak bulkhead and one bulkhead at each end of the machinery space, i.e. 4 bulkheads, to be transverse watertight bulkhead. But the description c) that "one bulkhead at each end of the machinery space" may be inducing misunderstanding. Because in the definition of machinery space in Pt 1, Ch 1, Sec 1, [2.4.4], the bulkhead at the aft end of the machinery space is the aft peak bulkhead. Therefore, it is suggested that for the ships with engine room located aft of the cargo tank/hold region in CSR, the requirement in Pt 1, Ch 2, Sec 2, [1.1.1], c) is to be modified.

3. Impact in Scantlings
There is no impact on scantlings due to this change.

SECTION 4 ACCESS ARRANGEMENT

2 CARGO AREA AND FORWARD SPACES

2.1 General

2.1.1 Means of Access

1. Reason for the Rule Change
The Rule Change is to clarify the requirements.

2. Background
The rules provide adequate survey and maintenance of ships, and GBS is applicable for ships above 150 metres in length. However, the criteria selected for application of rules is 20,000 GT. Hence the provisions applicable for bulk carriers 150 m in length and above but below 20,000 GT are not included in the rules.
This Rule Change is related to the application of SOLAS Regulation II-1/3-6 related to the Permanent Means of Access (PMA) to bulk carriers of less than 20,000 GT but having a length of 150m and above.
Having discussed this issue, IACS agrees to apply the requirements set in SOLAS Regulation II-1/3-6 also to bulk carriers of less than 20,000 GT but having a length of 150m and above.
The proposed amendment is based on the Corrective Action Plan to GBS audit Observation No. IACS/2015/FR9-15/OB/01.

3. Impact in Scantlings
There is no impact on scantlings due to this change.

CHAPTER 3 STRUCTURAL DESIGN PRINCIPLES

SECTION 2 NET SCANTLING APPROACH

SYMBOLS

1. Reason for the Rule Change
The Rule Change is to clarify the extended distance of flange in L2 profile.

2. Background
With the amendment, the Rules cover the case of y_w calculation in Pt 1, Ch 8, Sec 5, [2.3.4] for L2 profile. The symbol "d_f" is to be added in Figure 3 to determine the extended distance of flange in L2 profile.

3. Impact in Scantlings
There is no impact on scantlings due to this change.

1 GENERAL

1.3 Scantling compliance

1.3.2

See TB for SYMBOLS in Pt 1, Ch 3, Sec 2

SECTION 6 STRUCTURAL DETAIL PRINCIPLES

10 BULKHEAD STRUCTURE

10.4 Corrugated bulkheads

10.4.10 Upper stool

1. Reason for the Rule Change
The Rule Change is to clarify the requirements of the upper stool height.

2. Background
UR S18 states "The upper stool, where fitted, is to have a height generally between 2 and 3 times the depth of corrugations."

Many existing bulk carriers were designed according to this requirement, as the phrase "in general" has been a part of this requirement since the introduction of UR S18, which has been applicable to all new construction bulk carriers since 1 July 1998.

In many existing bulk carriers, the height of the upper stool is higher than three times the corrugation depth because of considerations related to a vessel's structural arrangement and not lower than twice the corrugation depth (see figures)

In addition, direct strength analysis is mandatory, and provides sufficient verification of structural geometry of the upper stool.

According to the above background, this requirement is updated accordingly as prescriptive requirement for height of upper stool of bulk carriers.

In addition, the Rule Change is to clarify the height of upper stool for rectangular stools.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

Figure 1: Handy

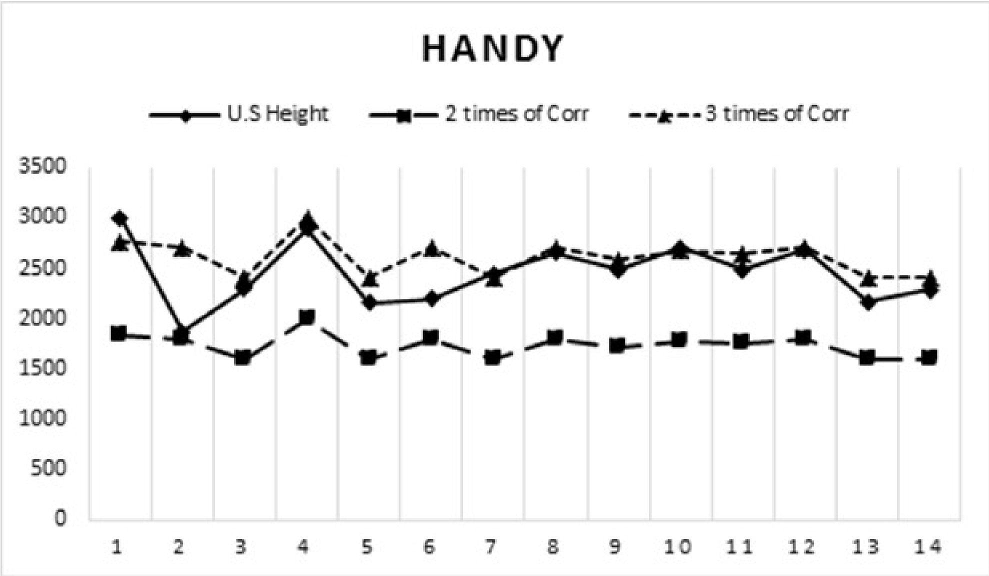


Figure 2: Panamax

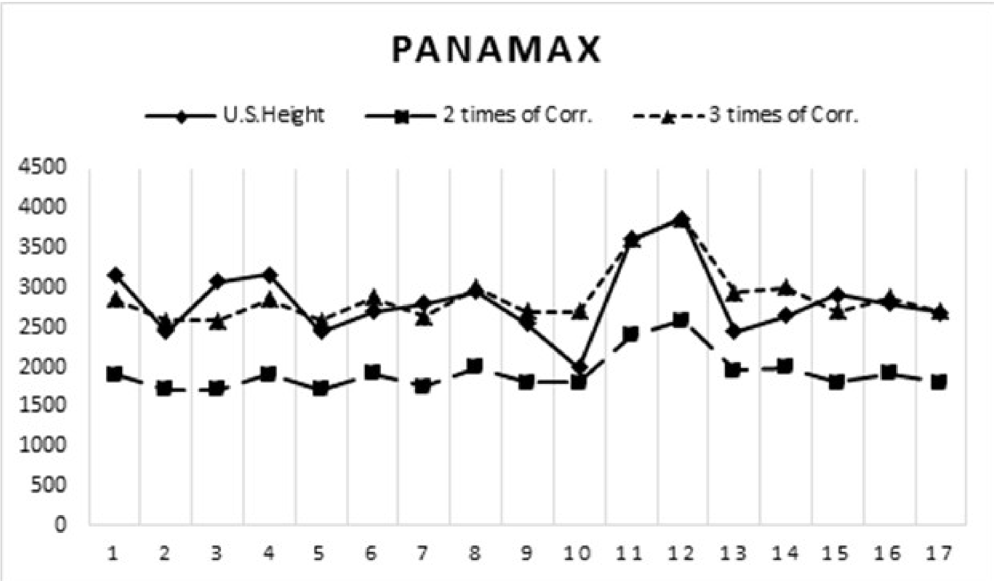
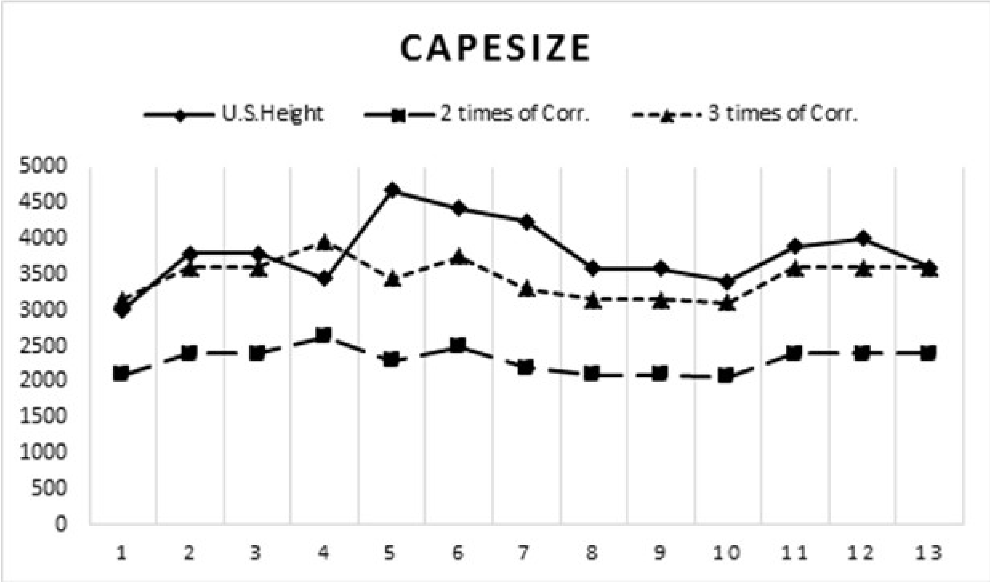


Figure 3: Cape size



SECTION 7 STRUCTURAL IDEALISATION

SYMBOLS

See TB for Pt 1, Ch 3, Sec 7, [1.4.6]

1 STRUCTURAL IDEALISATION OF STIFFENERS AND PRIMARY SUPPORTING MEMBERS

1.4.3 Effective shear depth of stiffeners

1. Reason for the Rule Change

The Rule Change is to clarify the calculation of the net shear depth of stiffeners.

2. Background

The current formula for the net shear depth of stiffener does not properly account for the case where the corrosion addition for stiffener is different from the one of attached plating. So it is proposed to amend the formula to clarify for these cases.

3. Impact in Scantlings

Scantling impact is not expected.

1.4.4 Elastic net section modulus and net moment of inertia of stiffeners

1. Reason for the Rule Change

The Rule Change is to enhance the requirements.

2. Background

The current practice of calculating the section modulus of stiffeners with an inclined angle is a simplified method. This same calculation method has been extended for the determination of the inertia of stiffeners attached to plating at an inclined angle. Justification of the proposed formula are shown below.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

Stiffener Properties		T profile			Flat bar			I.Angle		
hw	mm	400	400	400	300	300	300	450	450	450
tw	mm	11.5	11.5	11.5	28.5	28.5	28.5	11.5	11.5	11.5
bf	mm	150	150	150	0	0	0	125	125	125
tf	mm	14.5	14.5	14.5	0	0	0	18	18	18
tp	mm	22.5	22.5	22.5	33	33	33	24	24	24
bp	mm	370	370	370	865	865	865	630	630	630
phi-w	deg	45	60	75	45	60	75	45	60	75
SM(cm3)	Exact value(a)	2729	3224	3538	11385	11125	11297	5464	6415	7019
	w/phi=90	3646	3646	3646	11387	11387	11387	7226	7226	7226
	sin phi-w (b)	2578	3157	3522	8082	9861	10999	5110	6258	6980
	Ratio (b/a)	0.94	0.98	1.00	0.71	0.89	0.97	0.94	0.98	0.99
I (cm4)	Exact value(a)	21380	31387	38676	13378	19185	23383	33258	48978	60427
	w/phi=90	41338	41338	41338	24911	24911	24911	64609	64609	64609
	sin2 phi-w(b)	20669	31003	38569	12455	18683	23242	32305	48457	60281
	Ratio (b/a)	0.97	0.99	1.00	0.93	0.97	0.99	0.97	0.99	1.00

Ratio (b/a) : The ratio of the calculated value/exact value.

1.4.6 Effective net plastic section modulus of stiffeners

1. Reason for the Rule Change

Clarification of the effective net plastic section modulus for bulb profile section and L3 profile section.

2. Background

The property of bulb profile sections are to be determined by either direct calculation or equivalent built-up section for both elastic and plastic section modulus in accordance with Pt.1Ch.3 Sec.7 [1.4.1].

For plastic section modulus in [1.4.6], table 1 & 2 is to be used for bulb profile in addition to the direct/equivalent approach according to [1.4.1] and table 1 and 2 are incomplete table so do not cover all dimensions of bulb profiles.

To be consistent with Pt.1Ch.3 Sec.7 [1.4.1], the references used in [1.4.6] are clarified for bulb profile section and table 1 & 2 are consequently also deleted.

In addition, the Rule Change is to clarify the $h_{f\text{-}ctr}$ of stiffener in net height of L3 profile section.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

2 PLATES

2.2 Load calculation point

2.2.1 Yielding

Table 4: LCP coordinates for yielding

1. Reason for the Rule Change

The Rule Change is to clarify the y coordinate of the load point of the transom for the external dynamic pressure to avoid misunderstanding which is applied to the structure of the transom.

2. Background

According to TB Report “EDW Definition of Extreme Loads” [6.1.1], the formula of the hydrodynamic pressure, “P_Mid”, is based on the amplitude at midship which means that the load point is on the side shell. However, the transom is the transversal structure that envelops the aftmost end of the ship hull, and the load points on it are not on the side shell. The rule is changed to clarify the y coordinate of the load point of the transom.

3. Impact in Scantlings

In order to assess the effect of the hydrodynamic pressure, a transom structure of a VLCC is selected as in Figure 1.

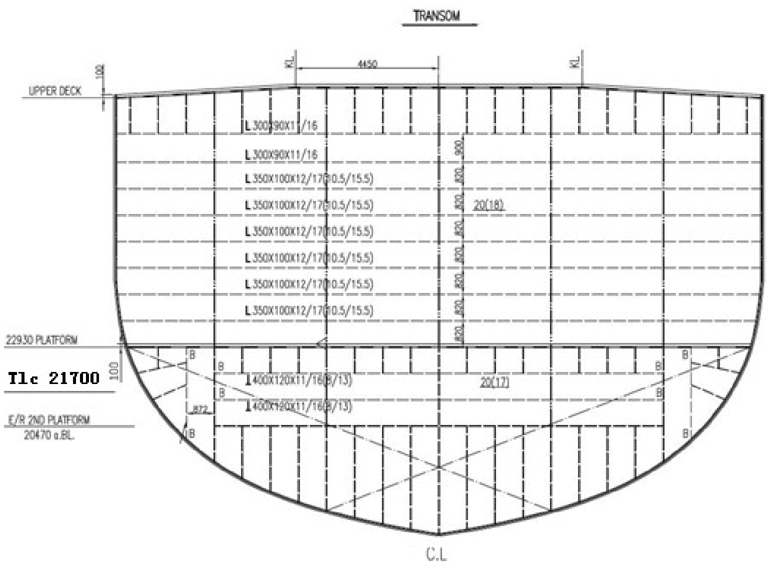


Figure 1 Transom Structure Plan

The load calculation points (LCPs) are selected as Figure 2. P1 to P9 are below the full loading draught (T_{lc}) which are on the shell, P10 is below T_{lc} which is at the middle of stiffeners, and P11 is above T_{lc} which is at the middle of stiffeners.

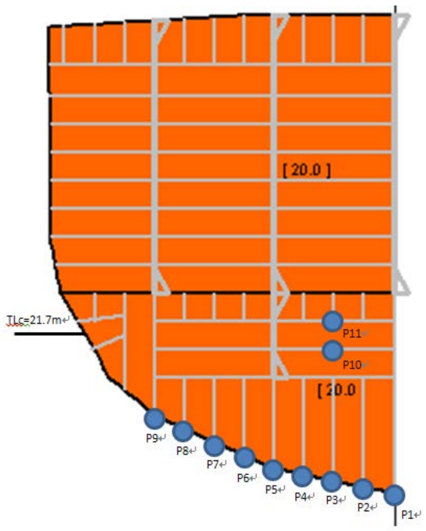


Figure 2 LCPs of the model

The hydrodynamic pressure results in the dominant load case (OST-1P) are listed as following table.

LCPs	CSR			RCN		
	Coordinate (m)		Pressure (kN/m²)	Coordinate (m)		Pressure (kN/m²)
	z	y	P	z	y	P
P1	17.00	0.00	297.11	17.00	0.00	297.11
P2	17.28	0.87	295.17	17.28	0.87	295.17
P3	17.46	1.74	288.82	17.46	1.74	288.82
P4	17.64	2.62	279.32	17.64	2.62	279.32
P5	17.81	3.49	266.68	17.81	3.49	266.68
P6	18.20	4.36	252.54	18.20	4.36	252.54
P7	18.59	5.23	234.85	18.59	5.23	234.85
P8	18.97	6.10	213.62	18.97	6.10	213.62
P9	19.36	6.98	188.85	19.36	6.98	188.85
P10	*21.29*	*1.74*	*329.96*	*21.29*	*8.77*	*130.53*
P11	22.11	1.74	117.76	22.11	9.25	117.76

The results show that following conclusion:

a) For the LCP with $z < T_{lc}$:
- For P1 to P9, the hydrodynamic pressures for CSR are the same as those for RCN, because the LCPs are the same which are on the shell.
- For P10, the hydrodynamic pressure found to be not reasonable, so RCN corrected this.

b) For the LCP with $z > T_{lc}$, P11, the pressure is not influenced by RCN.

3 STIFFENERS

3.2 Load calculation points

3.2.1 LCP for Pressure

1. Reason for the Rule Change

The Rule Change is to clarify the y coordinate of the load point of the transom for the external dynamic pressure to avoid misunderstanding which is applied to the structure of the transom.
See explanation in 2.2.1 for plates

4 PRIMARY SUPPORTING MEMBERS

4.1 Load calculation point

4.1.1

1. Reason for the Rule Change

The Rule Change is to clarify the load calculation point for primary support members.

2. Background

The requirement in Pt 1, Ch 3, Sec 7, 4.1.1 is a general definition when there is no definition in the specific requirements.

The requirements in Pt 2, Ch 1 for bulk carrier and Ch 2 for oil tanker have special definitions for the load calculation for each primary support member requirement i.e horizontal stringers are in Pt 2, Ch 2, Sec 3, 1.8.2.

In addition the change is to clarify that full length is to be taken as length *l* rather than *S*.

3. Impact in Scantlings

There is not expected to be any impact on scantlings due to this Rule Change.

CHAPTER 4 LOADS

SECTION 4 HULL GIRDER LOADS

2 VERTICAL STILL WATER HULL GIRDER LOADS

2.2 Vertical still water bending moment

2.2.4 Permissible vertical still water bending moment in flooded condition at sea

1. Reason for the Rule Change

The Rule Change is to clarify ballast water exchange condition is excluded from flooding conditions.

2. Background

Ballast water exchange conditions are excluded from flooding conditions, as they are very transient conditions, and normally they occur in the normal conditions and not extreme conditions.

3. Impact in Scantlings

Scantling impact is not expected.

2.3 Vertical still water shear force

2.3.5 Permissible still water shear force in flooded condition at sea

1. Reason for the Rule Change

The Rule Change is to clarify ballast water exchange condition is excluded from flooding conditions.

2. Background

Ballast water exchange conditions are excluded from flooding conditions, as they are very transient conditions, and normally they occur in the normal conditions and not extreme conditions.

3. Impact in Scantlings

Scantling impact is not expected.

SECTION 5 EXTERNAL LOADS

SYMBOLS

1. Reason for the Rule Change

Rules are not clear about the y co-ordinate of the waterline in the definition of $P_{W.WL}$.

The reason for the Rule Change with respect to z_{SD} is to clarify the load point and the draught to be used for design external pressure calculations for super structure and deck houses.

2. Background

With the amendment in the definition of $P_{W.WL}$, the Rules clarify the location of y and z co-ordinates at the considered waterline in the calculation of $P_{W.WL}$.

Regarding to the additional symbol, z_{SD}, both requirements in [4.3.1] "Sides of super structures" and [4.4.1] "End bulkheads of super structures and deck house walls" originate from CSR-BC Ch 4 Sec 5 [3.3.1] and [3.4.1] respectively and UR S3, in which the vertical distance in metres from summer waterline to midpoint of stiffener span is used. The z coordinate of the midpoint of stiffener span or the middle of the plate field, z_{SD}, is defined in the [Symbols], which is applied to these requirements so as to be in line with CSR-BC and UR S3.

The draught in [4.3.1] is to be the same as that in [4.4.1]. The scantling draught, T_{SC}, is applied to Pt 1, Ch 4, Sec 5, [4.4.1], instead of T_{LC} or moulded draught, T. The amendment is to be in line with the draught applied in [4.4.1].

3. Impact in Scantlings

There is no impact on scantlings due to the clarification of $P_{W.WL}$, but the introduction of new symbol, z_{SD} expects limited impact on scantlings.

3 EXTERNAL IMPACT PRESSURES FOR THE BOW AREA

3.2 Bottom slamming pressure

3.2.1

See TB for Pt 1, Ch 1, Sec 4, [3.1.5]

3.2.2 Loading manual information

See TB for Pt 1, Ch 1, Sec 4, [3.1.5]

4 EXTERNAL PRESSURES ON SUPERSTRUCTURES AND DECKHOUSES

4.3 Sides of superstructures

4.3.1

See TB for Section 5 SYMBOLS.

4.4 End bulkheads of superstructures and deckhouse walls

4.4.1

See TB for Section 5 SYMBOLS.

SECTION 6 INTERNAL LOADS

SYMBOLS

Change of ρ_{ST} and P_{PV}

1. Reason for the Rule Change

The Rule Change is to clarify the definition of ρ_{ST} and P_{PV}.

2. Background

P_{pv}: In the Rules a minimum pressure is stipulated for the setting of pressure relief valve, P_{PV}. However, it is not correct to define P_{PV} as the pressure relief device setting pressure. The pressure relief device setting should be, and is usually, lower than the design pressure for the cargo tanks.

ρ_{ST} : Updated to 7.85 from 7.8, as 7.85 is common industry practice.

3. Impact in Scantlings

There may be slight impact on scantlings in some cases, but the results could be considered more conservative and rational.

7 DESIGN PRESSURE FOR TANK TESTING

7.1 Definition

7.1.1

1. Reason for the Rule Change

The Rule Change is to clarify design testing load height for chain locker.

2. Background

The design testing load height for chain locker is changed from top of tank to the top of the chain pipe to be more practicable head acting on chain locker.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

SECTION 8 LOADING CONDITIONS

2 COMMON DESIGN LOADING CONDITIONS

2.3 Seagoing conditions

2.3.1

See TB for Pt 1, Ch 1, Sec 4, [3.1.5]

4 BULK CARRIER

4.1 Specific design loading condition

4.1.1 Seagoing conditions

1. Reason for the Rule Change

The Rule Change is to clarify the ship length used for the moulded forward draught requirement to be in line with trim requirement.

2. Background

The Rule Change corrects the definition of ship length used for the moulded forward draught requirement that immediately follows the trim requirement in heavy ballast condition. Therefore, L is to be replaced with L_{LL} to be in line with the trim requirement and to be harmonised with the rule requirements in [3.1.1] for oil tanker, which are in line with the MARPOL convention.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

4.2 Design load combinations for direct strength analysis

4.2.1 Applicable general loading patterns

1. Reason for the Rule Change

Rules are not clear about loading for the deepest ballast condition for the connected ballast tanks between double bottom and top side tanks.

2. Background

The Rule Change clarifies that when a topside tank and double bottom tank are permanently connected as a common tank, both empty and full conditions need to be considered for direct strength analysis.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

5 STANDARD LOADING CONDITIONS FOR FATIGUE ASSESSMENT

5.1 Oil Tanker

5.1.1

1. Reason for the Rule Change

The Rule Change is to clarify the loading height for tanks for fuel oil/other oil/fresh water when these are located in the cargo hold region.

2. Background

In Pt 1, Ch 4, Sec 8, there are some loading patterns that are to be applied for direct strength analysis with fuel oil tanks in way of the cargo hold, being 100% or being empty.

The Rules do not clearly specify the filling level of these tanks, and the Rule Change is intended to clarify this aspect.
For prescriptive requirements, the dynamic pressure for longitudinal stiffeners located above 50% of the filling level is to be taken as zero in consideration of mean approach for fatigue, however, this assumption on the relation of filling ratio and dynamic stress is not applied in the FE analysis of details, i.e. hopper knuckle.

3. Impact in Scantlings
Scantling impact is not expected.

5.2 Bulk carriers

5.2.1

See TB for Pt.1 Ch.4 Sec. 8 [5.1.1]

CHAPTER 5 HULL GIRDER STRENGTH

APPENDIX 2 HULL GIRDER ULTIMATE CAPACITY

2 INCREMENTAL-ITERATIVE METHOD

2.3 Load-end shortening curves

2.3.1 Stiffened plate element and stiffener element

1. Reason for the Rule Change

The Rule Change is to clarify the requirements.

2. Background

The requirement has been corrected to improve clarity of the requirements by updating the reference giving information on how to consider openings in the calculation of capacity.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

CHAPTER 6 HULL LOCAL SCANTLINGS

SECTION 2 LOAD APPLICATION

1 LOAD COMBINATION

1.2 Lateral pressures

1.2.2 Lateral pressure in flooded conditions

1. Reason for the Rule Change

Feedback indicated that the application of the flooding requirements for compartments not carrying liquids was not sufficiently clear.

2. Background

Clarification of the requirements. In Note (6) it is specified that FD-1 and FD-2 are not applicable to external shell. External shell is defined in Pt 1, Ch 1, Sec 4, Table 7 as "The shell plating forming the effective hull girder exclusive of the strength deck plating." Hence FD-1 and FD-2 is to be applied to the exposed deck plating.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

2 DESIGN LOAD SETS

2.1.3 Design load sets for plating, stiffeners and PSM

See TB for Pt 1 Ch 6 Sec 2, [1.2.2]

SECTION 4 PLATING

SYMBOLS

1. Reason for the Rule Change

The Rule Change is made to clarify the application of the coefficient "χ".

2. Background

In the current Rule text, there is only definition of application that "χ=0.7 for plating and 0.9 for stiffeners/primary supporting members in way of the inner bottom and the hopper of bulk carriers". On the face of the Rule, it seems that "χ" is applied to the whole ship for bulk carriers.

However, according to the existing Technical Background Rule Reference, the coefficient "χ" is applied only to adjust scantling requirement for plate and stiffeners/primary supporting members in cargo holds. Considering the background, "χ" should be applied only to cargo area of bulk carriers.

3. Impact in Scantlings

There is no impact on scantlings due to this change since the Rule Change is just to clarify the original intention of the requirement.

2 SPECIAL REQUIREMENTS

2.6 Supporting structure in way of corrugated bulkheads

2.6.3 Upper stool

1. Reason for the Rule Change

The Rule Change is to clarify the application of the rule.

2. Background

The rule reference in [2.6.3] has been modified to consider the different ship types and [1.1] is added as a minimum thickness requirement based on lateral pressure.

3. Impact in Scantlings

Scantling impact is not expected.

SECTION 5 STIFFENERS

SYMBOLS

See TB for Pt.1 Ch.6 Sec.4 SYMBOLS

1 STIFFENERS SUBJECT TO LATERAL PRESSURE

1.1 Yielding check

1.1.2 Section modulus

1. Reason for the Rule Change

The Rule Change is to clarify the requirements.

2. Background

The maximum limit of "*permissible bending stress coefficient* χC_s" is missing in [1.1.2]. The maximum limit is to be applied not only for plate [1.1.1] but also for stiffeners [1.1.2].

3. Impact in Scantlings

There is an ignorable impact (3% of section modulus) on watertight boundary of compartment with flooding condition only.

1.1.3 Group of stiffeners

1. Reason for the Rule Change

The Rule Change is to clarify the requirements.

2. Background

The requirement has been updated to clarify that a stiffened panel for application of stiffener grouping is defined between primary support members.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

SECTION 6 PRIMARY SUPPORTING MEMBERS AND PILLARS

SYMBOLS

See TB for Pt.1 Ch.6 Sec.4 SYMBOLS

CHAPTER 7 DIRECT STRENGTH ANALYSIS

SECTION 2 CARGO HOLD STRUCTURAL STRENGTH ANALYSIS

4 LOAD APPLICATION

4.4 Procedure to adjust hull girder shear forces and bending moments

4.4.9 Procedure to adjust vertical and horizontal bending moments outside midship cargo hold region

1. Reason for the Rule Change

The vertical bending moment adjustment at each longitudinal location, *i*, and the direction of m_{end} in Figure 19 are amended so as to avoid the confusion.

2. Background

The origination of the vertical bending moment adjustment is from the following equation:

$$M_{v-targ}(i) = f(i) + M_{V-FEM}(i) + M_{lineload}(i) + M_{Y-aft} \cdot \left(2 \cdot \frac{x_i - x_{aft}}{x_{fore} - x_{aft}} - 1\right)$$

So the vertical bending moment adjustment, $f_{(i)}$, is:

$$f(i) = M_{v-targ}(i) - M_{V-FEM}(i) - M_{lineload}(i) - M_{Y-aft} \cdot \left(2 \cdot \frac{x_i - x_{aft}}{x_{fore} - x_{aft}} - 1\right)$$

To be consistent with the definition of the reference coordinate system in Pt 1, Ch 1, Sec 4, Figure 3, it was necessary to amend Figure 19 in order to satisfy the following equation:

$$m_{v\_end} = -\sum_{j=0}^{n_t} m_{vj}$$

3. Impact in Scantlings

The RCN is based on the principles of structural mechanics and there is no impact on scantlings.

SECTION 3 LOCAL STRUCTURAL STRENGTH ANALYSIS

2 LOCAL AREAS TO BE ASSESSED BY FINE MESH ANALYSIS

2.1 List of mandatory structural details

2.1.5 Connections between deck and double bottom longitudinal stiffeners and adjoining structures of transverse bulkhead

1. Reason for the Rule Change

The Rule Change is made to clarify of the requirements for the scantlings of end connections of deck and double bottom longitudinal stiffeners in way of transverse bulkhead outside 0.4L.

2. Background

Feedback indicates that there are no fine mesh analysis requirement nor screening requirement for connections as given in [2.1.5] for outside midship cargo hold region.

From the past CSR-OT and CSR-BC experience, the scantlings of "connections of deck and double bottom longitudinal stiffeners to transverse bulkhead" in the conventional design are normally identical within whole cargo hold region based on the findings from the fine mesh analyses within midship cargo hold region. Hence, the application of the same scantling within whole cargo hold region seems reasonable considering the decrease of hull girder bending stress in way of outside midship cargo hold region.

The Rule Change is to require the scantlings outside the midship cargo hold region not to be less than the required scantlings based on the fine mesh analysis for the midship cargo region in consideration of the different design loading conditions, structural arrangements and scantlings between midship area and fore/aft area.

Alternatively, the designers may do the fine mesh analysis to demonstrate that the proposed scantlings are acceptable.

3. Impact in Scantlings

Limited impact on scantlings is expected.

CHAPTER 8 BUCKLING

SECTION 2 SLENDERNESS REQUIREMENTS

3 STIFFENERS

3.1 Proportions of stiffeners

3.1.1 Net thickness of all stiffener types

1. Reason for the Rule Change (Figure)

The Rule Change is to clarify the dimension of L2 Profile and L3 Profile as defined in Ch 3 Sec 2 Figure 3.

2. Background

The purpose is to make consistency with the profile types defined in Ch 3 Sec 2 Figure 3.

3. Impact in Scantlings

There is not expected to be any impact on scantlings due to this Rule Change.

5 BRACKETS

5.3 Edge reinforcement

5.3.1 Edge reinforcement of bracket edges

1. Reason for the Rule Change

The Rule Change is to correct an editorial error contained in the published Corrigenda 1 to CSR BC&OT 01 Jan 2017.

2. Background

In the published Corrigenda 1 to CSR BC&OT 01 Jan 2017, the text of “or 50, whichever is greater” in the rule requirement is found to be missed. This amendment is to correct the rule requirement including the original requirement.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

SECTION 5 BUCKLING CAPACITY

SYMBOLS

See TB for Pt 1, Ch 8, Sec 2, [3.1.1]

2 BUCKLING CAPACITY OF PLATES AND STIFFENERS

2.2 Plate capacity

2.2.4 Correction factor F_{long}

See TB for Pt 1, Ch 8, Sec 2, [3.1.1]

2.3 Stiffeners

2.3.4 Ultimate buckling capacity

1. Reason for the Rule Change (M_1, w_1, τ, y_w, Moment of Inertia)

With the amendments, the Rules cover the case with stiffeners one end snipped and one end continuous.

Regarding to y_w, and Moment of Inertia, see TB for Pt 1, Ch 8, Sec 2, [3.1.1].

2. Background

The existing requirements are not clear in the case when stiffeners are one end snipped and one end continuous.

M_1: Factor 14.2 is used in line with Pt 1, Ch 6, Section 6, Table 2.
w_1: Basic principles of elastic stability.
τ: For prescriptive assessment of stiffeners, τ is the shear stress calculated in accordance with Ch 8, Sec 3, [2.2.1] at the load calculation point at the location of the stiffener attached plating.

In addition, for y_w and Moment of Inertia, see TB for Pt 1, Ch 8, Sec 2, [3.1.1].

3. Impact in Scantlings

There is not expected to be any impact on scantlings due to this Rule Change.

CHAPTER 9 FATIGUE

SECTION 2 STRUCTURAL DETAILS TO BE ASSESSED

2 FINITE ELEMENT ANALYSIS

2.1 Structural details to be assessed

2.1.3 Details to be checked by screening fatigue assessment

1. Reason for the Rule Change

The Rule Change is to correct a cross reference and to fix Tables 3, 8, 9 and 10 to clarify the critical details shown are critical both for longitudinal and transverse bulkheads.

2. Background

In Table 2, locations are given for screening fatigue assessment. In note 1 it is furthermore clarified which critical details are subject to yielding screening. If bracket toes in way of the cargo region satisfy the yielding screening criteria, then fatigue screening is not required.

With regards to the two cross references in Table 2:

Firstly, the current Rule cross reference to Ch 7, Sec 3, [2.1] is listing the mandatory locations so bracket toes are not included. Consequently [2.1] is not correct.

Secondly, reference Ch 7, Sec 3, [3.3.2] is the criteria of yielding fine mesh screening so [3.2] “list of structural details for screening” is to be referred instead of [3.3.2].

Conclusively, the Rule Change is to replace Ch 7, Sec 3, [2.1] & [3.3.2] with Ch 7, Sec 3, [3.2]

In addition, Tables 3, 8, 9 and 10 are updated to clarify that the critical details shown in the area in way of the connection of the corrugated bulkhead to the lower stool / inner bottom are critical both for longitudinal and transverse bulkheads.

3. Impact in Scantlings

Scantling impact is not expected.

SECTION 3 FATIGUE EVALUATION

6 WELD IMPROVEMENT METHODS

6.2 Weld toe burr grinding

6.2.1

1. Reason for the Rule Change

The Rule Change is made to ensure consistency in the Rules.

2. Background

In the Rules in paragraph 6.2.1 and Figure 6 the extent of grinding is stipulated. However, paragraph [6.2.1] and Figure 6 are not consistent with each other.
The Rule Change is in line with "IIW Recommendations on Post Weld Improvement of Steel and Aluminium Structures.

3. Impact in Scantlings

Scantling impact is not expected.

SECTION 4 SIMPLIFIED STRESS ANALYSIS

5 STRESS CONCENTRATION FACTORS

1. Reason for the Rule Change

It was noticed by IACS that the geometrical stress concentration factor (SCF) for stress due to axial load (K_a) assigned to soft toes of tripping brackets (TB) are higher than that assigned to soft toes of flat bar web stiffeners (FB).

This is a notable departure from the IACS CSR-BC and IACS CSR-OT Rules, which assign the same SCF (or fatigue joint class in the case of CSR-OT) to soft toes irrespective of whether it is on a tripping bracket or flat bar web stiffener.

It is also noted that the International Institute of Welding (IIW) "Recommendations for Fatigue Design of Welded Joints and Components" assigns the same SN curve to soft toes without distinguishing between a tripping bracket or flat bar web attachment as long as the toe design complies with the recommendation.

With this motivation, IACS carried out further investigation of the hot spot stress using finite element analysis and it was found that the SCF for soft toe connections for TB and FB are comparable to each other and the higher stress concentration factor for stress due to axial load (K_a) assigned to tripping brackets is unsubstantiated and unnecessary.

In addition to this, a re-analysis of bracket end connection with key-hole scallop was done. It has been found that also here the given stress concentrations factors are too conservative.

For all longitudinal end connections, only axial load was applied to simulate the effect of hull girder bending, as only the hot spot stress under this mode of loading is being investigated.

2. Background

The finite element analysis is summarised in 2.1 below together with the findings.

2.1 Comparison of Hot Spot Stress for Soft Toes

A finite element analysis using very fine mesh was carried out for comparison of the hot spot stress in way of the soft toes for a typical tripping bracket (TB) and a typical Flat Bar web stiffener (FB), attached to a typical deck longitudinal stiffener and typical Tee stiffener for a Capesize bulk carrier. These are summarised below.

2 types of longitudinal stiffeners, namely:

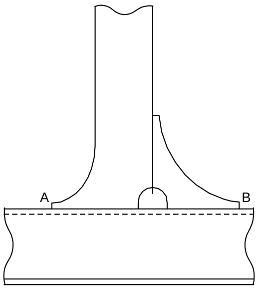
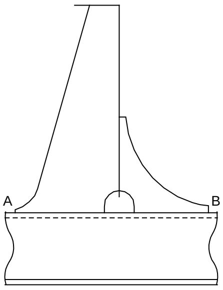
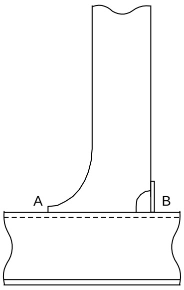
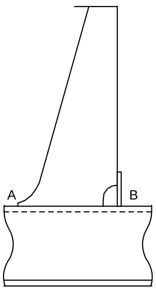
- 420x35 Flat Bar (typical for deck of a Capesize bulk carriers)
- 420x12+200x20 Tee (typical for bottom/inner bottom of a Capesize bulk carriers)

4 types of end connections, namely:

- 400x13 FB with soft toe and soft back bracket (ID 5)
- 400x13 TB with soft toe and soft back bracket (ID19)
- 400x13 FB with soft toe and collar (ID26)
- 400x13 TB with soft toe and collar (ID29)

See illustrations in Table 1 below for the connections and the reference IDs extracted from the Rules, with the SCF in question underlined for ease of reference.

Table 1: Extract of CSR-BC & OT Rules Pt 1, Ch 9, Sec 4, Table 4: Stress Concentration Factors

ID	Connection Type	Point 'A'		Point 'B'	
		K_a	K_b	K_a	K_b
5		1.28	1.34	1.28	1.34
19		1.34	1.34	1.28	1.34
26		1.28	1.34	1.34	1.47
29		1.34	1.34	1.34	1.47

The hot spot stress in way of the toe i.e. point "A", obtained for ID 26 and ID29 are considered equally representative of the toe stress for connection types with other heel configurations i.e. the toe stress at point A is not affected by the heel detail geometry at point "B", whether it is a collar, a regular scallop or key hole scallop. The selection of ID 26 and ID 29 was based on convenience of modelling by simply removing the back bracket without the need for modelling the scallop geometry.

The hot spot stresses are summarised in Tables 2a & 2b below. For ease of comparison, the stresses are shown as normalised values. ID5 and ID26 have been used as reference and therefore their Hot Spot stress has been set to 1,00. The results displayed for ID 19 and 29 are respectively the ratios $\frac{\sigma HS_{19}}{\sigma HS_5}$ and $\frac{\sigma HS_{29}}{\sigma HS_{26}}$. If the normalised stress is greater than 1.0, then the stress is higher than the reference value, and vice versa.

Table 2a: Normalised hot spot stress (ID5, ID19)

Longitudinal stiffener	400x13 FB (ID5)		400x13 TB (ID19)	
	A	B	A	B
400x35 Flat Bar	1.00	1.00	1.00	1.03
400x12+200x20 Tee	1.00	1.00	1.01	0.99

Table 2b: Normalised hot spot stress (ID26, ID29)

Longitudinal stiffener	400x13 FB (ID26)		400x13 TB (ID29)	
	A	B	A	B
400x35 Flat Bar	1.00	–	0.99	–
400x12+200x20 Tee	1.00	–	0.99	–

It can be seen that the hot spot stress in way of TB (ID19 & ID29) and FB (ID5 & ID26) soft toes are essentially the same.

It is concluded from this study that the assignment of higher SCF (K_a) for tripping bracket soft toes in the CSR-BC & OT Rules is unnecessary, and that assigning the same SCF (K_a) or joint class for both tripping bracket and flat bar stiffener soft toes as per the CSR-OT and CSR-BC Rules remain valid, and the CSR-BC & OT Rules should therefore be amended accordingly by adopting SCF (K_a) = 1.28 for point A of tripping bracket soft toes.

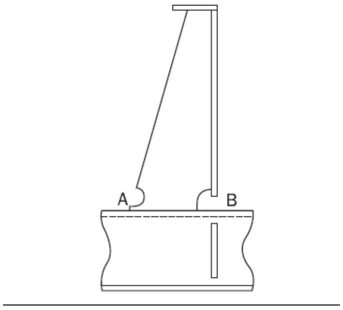
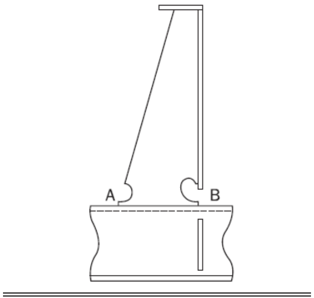
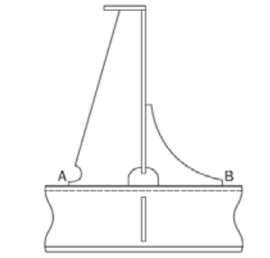
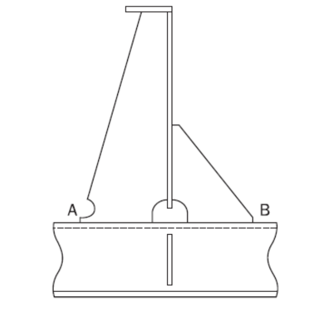
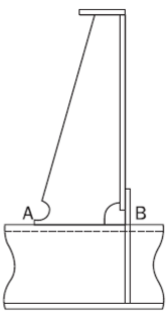
2.2 Comparison of Hot Spot Stress for Soft Toe and key-hole scallop

In addition to the soft toe bracket and stiffener termination investigated in 2.1, high SCFs for details with key-hole scallops were found to be questionable. To evaluate the influence of such key-hole scallop on tripping brackets, five types of end connections have been studied as listed below.

- 400x13 FB with undercut and collar (ID21)
- 400x13 TB with undercut and collar (ID22)
- 400x13 TB with undercut and soft back bracket (ID23)
- 400x13 TB with undercut and soft back bracket (ID24)
- 400x13 TB with undercuts (ID 30)

See illustrations in Table 3 below for the connections and the reference IDs extracted from the Rules. IDs 19 and 29 have been taken as reference values and changes in SCFs for details listed below have been based on this. The connection types with the SCFs in question are underlined for ease of reference.

Table 3: Extract of CSR-BC & OT Rules Pt 1, Ch 9, Sec 4, Table 4: Stress Concentration Factors

ID	Connection Type	Point 'A'		Point 'B'	
		K_a	K_b	K_a	K_b
21		1.34	1.34	1.52	1.67
22		1.34	1.34	1.34	1.34
23		1.34	1.34	1.28	1.34
24		1.34	1.34	1.52	1.67
30		1.34	1.34	1.34	1.47

The key-hole scallop details 21 to 24 and 30 are copied from CSR-OT with the same numbering but all are graded as class F corresponding to an SCF of 1.28.

The Hot Spot stresses at point A are summarised in Tables 4a & 4b below. As in 2.1, the results have been displayed as the ratio between Hot Spot stress value of the investigated ID and the reference value (ID 19 and ID 29 this time).

Table 4a: Normalised hot spot stress (ID19, 23, 24)

Longitudinal stiffener	400x13 TB (ID19)	400x13 TB (ID23)	400x13 TB (ID24)
400x2+ 200x20 Tee	1.00	0.94	0.94

Table 4b: Normalised hot spot stress (ID29, 21, 22, 30)

Longitudinal Stiffener	ID 29	ID 21	ID 22	ID 30
400x12+200x20 Tee	1.00	0.94	0.94	0.94

The results obtained for end connections with key-hole scallop (IDs 21 to 24 and 30) are somewhat lower than those with soft toes (IDs 19 and 29) possibly because the attachment length is reduced.

It is therefore concluded from this study that the assignment of higher SCF (K_a) for key-hole scallops in the CSR-BC & OT Rules is unnecessary and that assigning the same SCF (K_a) or joint class for both tripping bracket and key-hole scallop as per the CSR-OT Rules remain valid, and the CSR-BC & OT Rules should therefore be amended accordingly by adopting SCF (K_a) = 1.28 for point A of key-hole scallop.

3. Impact in Scantlings

The cape-size bulk carrier BC03 has been used in this impact study.
For the impact study, the end connections arrangement summarised below has been adopted.
<u>In way of ordinary (non-tight) frames:</u>

- Offset web stiffeners (ID32, K_a=1.13) are arranged at DK-1 to 7,
- Tripping brackets (ID19) are fitted at DK-8 and DK-12,
- 150x13 flat bar web stiffener (ID1, K_a=1.28) are arranged at DK-9 to 11 and DK-13.

<u>In way of bulkhead (water-tight) frames:</u>

- Web stiffeners with soft toe and soft back brackets (ID5, K_a=1.28) are fitted at all connections

The axial stress from hull girder vertical bending is solely dominant at the deck, therefore the lowest fatigue life at a deck stiffener over the extent of the selected hold is determined at the frame locations with the highest SCF (K_a), namely tripping bracket (ID19) for DK-8 and DK-12 and web stiffeners with double soft toes (ID5) for the remaining locations. The fatigue lives are shown in Figure 1 below.

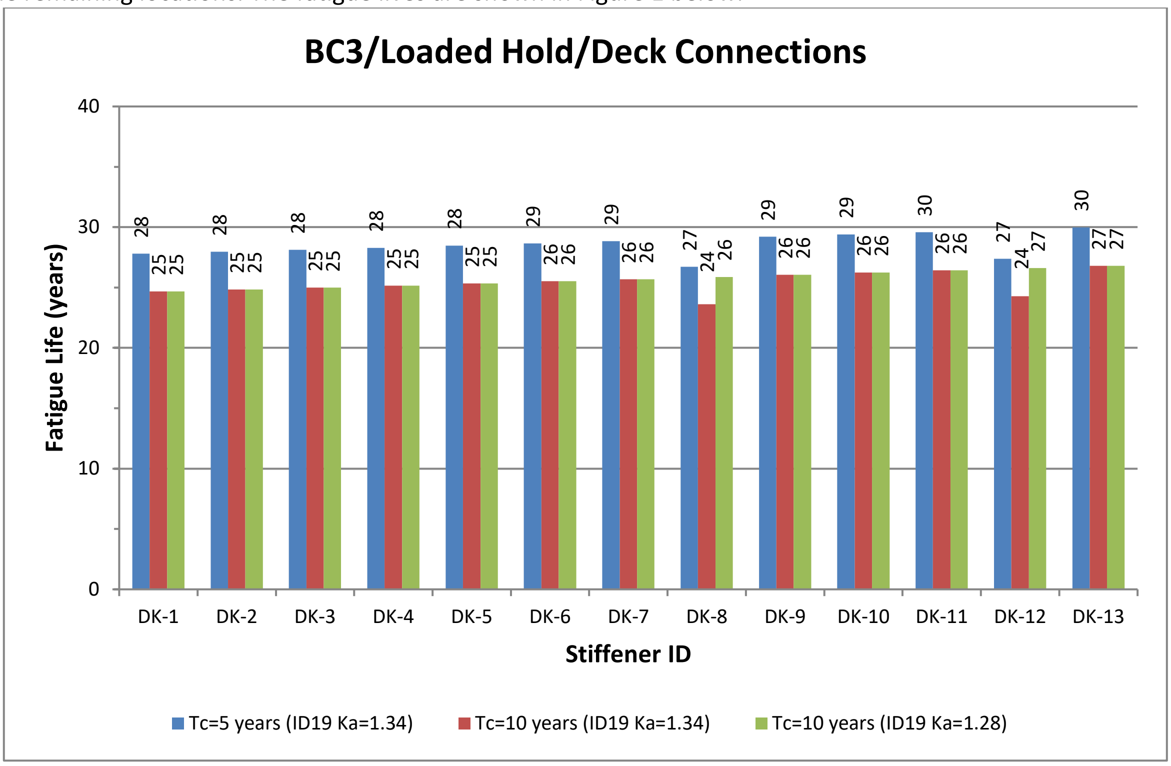


Figure 1: Fatigue Lives for Deck Connections of BC03, before and after the proposed Rule revision.

SECTION 6 DETAIL DESIGN STANDARD

4 HOPPER KNUCKLE CONNECTION

4.1 Design standard C to H

1. Reason for the Rule Change
The Rule Change is to clarify the requirement

2. Background
Table 8:
“800 mm in figure” distance between additional transverse brackets and transverse floor is deleted since it is to be based on Note 3 considering different design case by case.

“R=100-150 mm” in the critical locations figure, at the radius of upper hopper knuckle is deleted because radius is to be based on as-built thickness in accordance with Pt.1 Ch.12 Sec.1 3 “Cold forming” or 4 “Hot forming”.

3. Impact in Scantlings
There is no impact on scantlings due to this change.

6 BULKHEAD CONNECTION TO LOWER AND UPPER STOOL

6.1 Design standard J, K and L

1. Reason for the Rule Change
The Rule Change is to clarify the requirement.

2. Background
Table 11:
The rules are updated to clarify that the corrugation connection to the stool top plate is critical both for longitudinal and transverse bulkheads.

3. Impact in Scantlings
There is no impact on scantlings due to this change.

CHAPTER 10 OTHER STRUCTURES

SECTION 1 FORE PART

3 STRUCTURE SUBJECTED TO IMPACT LOADS

3.3 BOW IMPACT

3.3.6 Primary supporting members

1. Reason for the Rule Change

The Rule Change is to correct the stress to be used in the net web thickness.

2. Background

Based on plate buckling, not pillar buckling, the plating thickness requirement in Pt 1, Ch 10 Sec 1, [3.3.6] g) is specified for the web of primary support members on the side shell or deck/bulkhead panel in way of the bow area. The following actions have been taken:

(1) "σcrb" should be "σcr" in the equation for tw.
(2) The definition of σ_cr should be "...in way of the applied load given by Ch 8, Sec 5, [2.2.3]...", not "...in way of the applied load given by Ch 8, Sec 5, [3.1.1]...".

3. Impact in Scantlings

Scantling impact is not expected.

4 ADDITIONAL SCANTLING REQUIREMENTS

4.1 Plate stem

4.1.2 Breasthooks and diaphragm plating

1. Reason for the Rule Change

The Rule Change is to clarify the application area of breast hooks/diaphragm plates.

2. Background

[4.1.2] is originated from CSR OT Ch 1. Sec 8, [6.4.5.4] which is applicable only for bow impact zone. The current rule for the net thickness of breast hooks/diaphragm plates is not clear whether the application area is only limited to the bow impact strengthening area defined in [3.3.1] and the Rule Change is intended to clarify this aspect. [4.1.2] is not to be applied for the outside the bow impact zone.

3. Impact in Scantlings

Scantling impact is not expected.

SECTION 3 AFT PART

2 AFT PEAK

2.2 Stiffening of floors and girders in aft peak

2.2.1

1. Reason for the Rule Change

The Rule Change is to clarify the application of the rule requirement.

2. Background
The application area defined in existing [2.2.3] is also applicable for existing [2.2.1] and existing [2.2.2] so this update reorders and renumbers the existing text.

3. Impact in Scantlings
Scantling impact is not expected.

2.2.2

See 2.2.1

2.2.3

See 2.2.1

3 STERN FRAMES

3.3 Connections

3.3.1 Connections with hull structure

1. Reason for the Rule Change
The Rule Change is to clarify the reference of requirement and the application area of the rule.

2. Background
[3.3.1] should be a requirement for the lower part of propeller post and this scantling is to be extended from the aft end of the propeller post to a length not less than 1500 + 6 L_2 mm toward aft peak tank bulkhead. Rule Change is intended to clarify this aspect.

3. Impact in Scantlings
Scantling impact is not expected.

4 SPECIAL SCANTLING REQUIREMENTS FOR SHELL STRUCTURES

4.1 Shell plating

4.1.2 Heavy shell plates

1. Reason for the Rule Change
The requirement of the heavy shell plate thickness is not clear.
2. Background
[4.1.2] has been updated to clarify a thickness requirement by reference to [4.1.1].
3. Impact in Scantlings
Scantling impact is not expected.

SECTION 4 TANKS SUBJECT TO SLOSHING

2 SCANTLING REQUIREMENTS

2.2 Stiffeners

2.2.1

1. Reason for the Rule Change

Permissible bending stress coefficient in Table2 is based on hull girder stress. Other strength members in Table 3, such as stiffener on transverse bulkhead, are free from hull girder stress and not specifically covered by Table 2. So, editorial improvement is considered necessary so that permissible bending stress is available for "For members subject to hull girder stress" or "otherwise".

2. Background

The proposed amendment is based on comment from the industry.

3. Impact in Scantlings

No impact in scantling is expected by the Rule Change.

CHAPTER 11 SUPERSTRUCTURE, DECKHOUSES AND HULL OUTFITTING

SECTION 3 EQUIPMENT

1. Reason for the Rule Change

The Rule Change is to be in line with IACS unified requirement.

2. Background

Due to concerns raised by the industry in view of an increasing number of incidents, IACS decided to review and update Unified Requirement A1, A2 and Recommendation No. 10 “Anchoring, Mooring, and Towing Equipment”. These changes have been reflected in Ch 11, Sec 3 and Sec 4.

3. Impact in Scantlings

Due to the increase of design loads for supporting structures, scantling impact is expected.

SECTION 4 SUPPORTING STRUCTURE FOR DECK EQUIPMENT AND FITTINGS

See TB for Ch.11 Sec. 3

CHAPTER 12 CONSTRUCTION

SECTION 3 DESIGN OF WELDED JOINTS

2 TEE OR CROSS JOINT

2.4 Partial or full penetration welds

2.4.4 Extent of full or partial penetration welding

1. Reason for the Rule Change

To provide rule clarification.

2. Background

The 300 mm distance is the default requirement, adding "unless otherwise specifically stated" is to reflect where local distances such as the 150 mm distance in 2.4.7 is indicated in the rules.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

2.4.5 Locations required for full penetration welding

1. Reason for the Rule Change

The Rule Change is to clarify the extent of the full penetration weld requirements.

2. Background

Locations where the rules require full penetration welding were added. The main reasons for this are as follows:

a) Localized fractures have been encountered in pre-CSR vessels.
b) Feedback from vessel operators from the IACS Knowledge Centre database shows several requests regarding the weld detail connections of corrugated bulkhead since 2013. The following sentence is a typical request extracted from the database:
"Welding requirements in the CSR-H should change. **Full penetration welding is to replace partial or deep penetration welding** for the critical areas unless advanced fracture mechanics analysis is to be undertaken."
c) Feedback from the IMO GBS audit team, see GBS observation IACS/2015/FR1-8/OB/07 as follows:
Statement of facts
CSR-H Pt 1, Ch 12, Sec 3, [2.4.5 (d)] requires full penetration welding for the connection of vertical corrugated bulkhead to top plating of lower stool, while Sec 3, [2.4.6 (c), (d) and (e)] allows the choice of full or partial penetration welding for the connection between: lower stool side plating to lower stool top plate (c); lower stool side plating to inner bottom (d); and lower stool supporting floors to inner bottom (e).
Observation
The technical background offers no explanation or justification as to why partial penetration welding may suffice in these critical areas that are prone to cracking.
Whereas partial penetration welding in way of the areas described above is in line with the current version of IACS UR S18 (18.4.1(a), Rev.9 April 2014), it deviates from the requirements in the original UR S18 of 1997, which required: "*corrugations and stool side plating are generally to be connected to the stool top plate by full penetration welds. The plating of the lower stool and supporting floors is generally to be connected to the inner bottom by full penetration welds.*" It needs to be noted that compliance with the

original UR S18 was referenced by resolution 3, *Recommendations on compliance with SOLAS regulation XII/5*, adopted by the 1997 SOLAS Conference.
Furthermore, the provision giving the choice to the shipbuilder between full and partial penetration welding needs to be contrasted with IACS Rec. No.76 and Rec. No.96 which presently require the much safer full penetration welding for the repair of critical areas in bulk carriers and tankers.

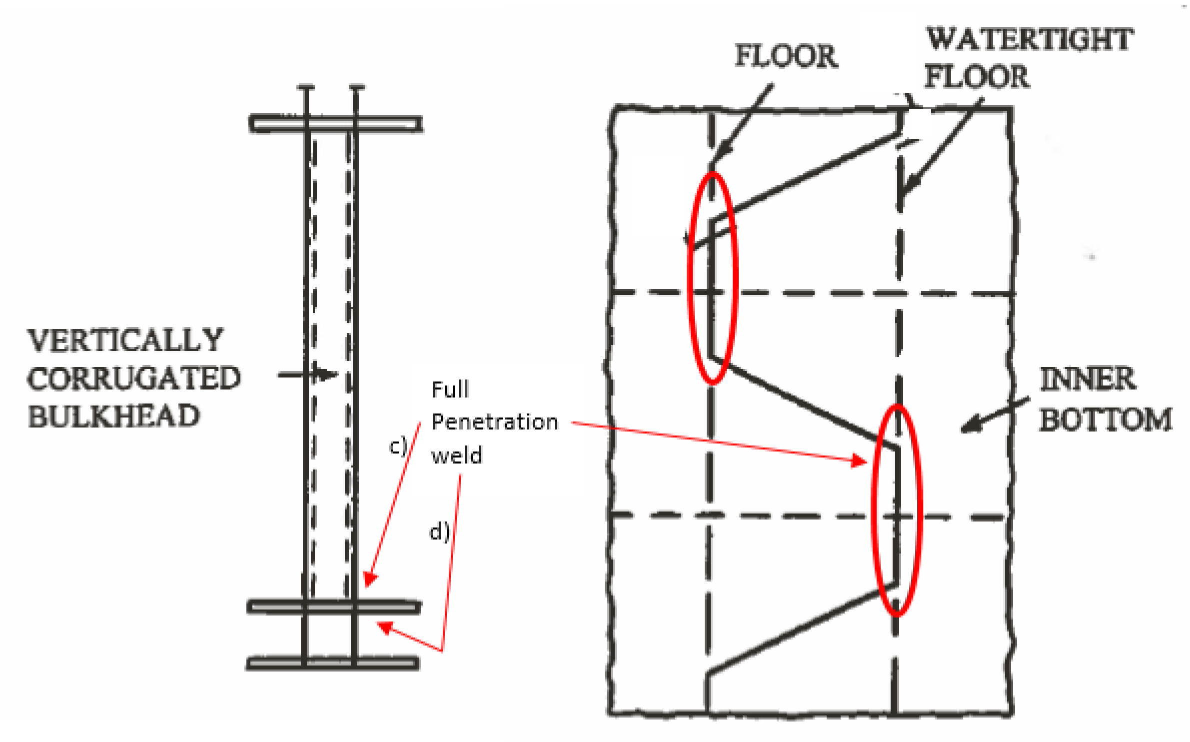
d) Feedback from the Greek Administration in paper MSC 96/5/9 “Auditors observed that the version of URS-18 as referred to Res.3 (1997) requires full penetration welding for certain critical areas, whereas CSR have replaced that with "full or partial" penetration. IACS' proposed corrective action includes a provision of "more explanations"; however, Greece would agree with the auditors that the IMO-approved URS-18 version should be immediately applied in CSR. Any other versions should be submitted to IMO and applied after approval.”

e) Reference is made to Area 4 of IACS Recommendation No. 76 “Bulk Carriers – IACS Guidelines for Surveys, Assessment and Repair of Hull Structure”, and Group 5 of No. 96 “Double Hull Oil Tankers –Guidelines for Surveys, Assessment and Repair of Hull Structures” which illustrate common fractures collected by IACS from several classed vessels and full penetration welds used during repair. Feedback from vessel owners has indicated that rather than provide full penetration welding during repairs of areas known to experience fractures, the full penetration welds should be provided at the time of new construction.

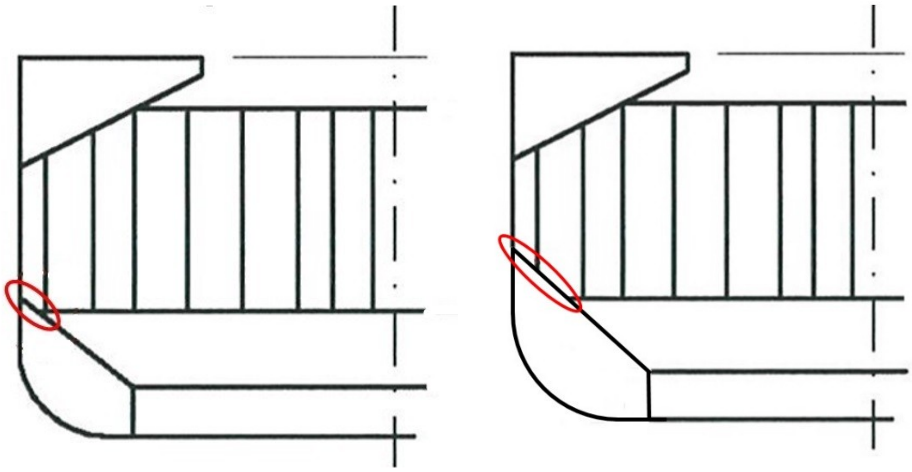
The proposed amendment is made because of the above feedback and experience.

the following sketches are provided for a better understanding the new locations described in [2.4.5]:

Location c) and d) :



Location e) :



Location g)

Sketch not considered necessary since this item relocated from [2.4.6 c].

Location h)

Sketch not considered necessary since this item relocated from [2.4.6 d].

Location i)

Sketch not considered necessary since this item is included in Rule Figure 3.

3. Impact in Scantlings

There is no impact on scantlings due to this change, however there is an impact on welding.

2.4.6 Locations required for partial penetration welding

1. Reason for the Rule Change

The Rule Change is to clarify the requirements.

2. Background

It is intended that partial penetration welding be provided in the locations included in Pt 1, Ch 12, Sec 3, [2.4.6]. The original rule text indicating “full or partial penetration welding” was intended to reflect that designers may elect to provide full penetration welding. However it was pointed out that by including the text covering both options caused confusion. Therefore only partial penetration will be clearly stated in the rule heading and in Figure 3. While the rule has been clarified to indicate partial penetration welding is acceptable, designers may still optionally elect to provide full penetration welding in these locations.

Two locations covering the corrugated bulkhead lower stool side plating to lower stool top plate and to the inner bottom were moved from [2.4.6] to [2.4.5], and also the connection of the inner bottom plate to structural elements in double bottom in holds intended for the carriage of liquid at sea in way of 300 mm of the side plating of the lower stool, thereby upgrading the requirement from partial penetration welding to full penetration welding for these locations.

The proposed amendment is also made as a result of the feedback mentioned in [2.4.5] above and the IMO GBS Audit carried out in 2014-2015, Observation No. IACS/2015/FR1-8/OB/07.

In addition, the radiused hopper knuckle and welded hopper knuckle in Figure 3 is deleted due to the duplication with Ch 9, Sec 6, Table 3 and 5.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

2.5 Weld size criteria

2.5.2

1. Reason for the Rule Change

The Rule Change is made to clarify the detailed treatment of leg length for some specific cases.

2. Background

There is no clear definition about coefficient f_2 when determine the leg length of intermittent fillet welding without bevelling since this type of welding is often used for some specific cases, e.g. hatch cover constructions, the definition of f_2 is clarified in [2.5.2] to be applicable for this case as well.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

Table 4

1. Reason for the Rule Change

The Rule Change is to clarify the requirements.

2. Background

The requirement has been updated to clarify the extent of the length for coverage of the increased fillet weld over the length of the member.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

5 CONNECTION DETAILS

5.1 Bilge keels

5.1.1

1. Reason for the Rule Change (Table 5)

The Rule Change is proposed to clarify how the welding requirements should be applied.

2. Background

The Rules in Pt 1 Ch 12 Sec 3, 5.1, specify the leg length of welds between ground bar and the shell and between bilge keel web and ground bar. However, while "the ends" of welds are specified to have larger leg length than "elsewhere", there is no clear definition for "the ends" of welds in the Rules.

In the CSR-OT where the requirements originate from (Sec 11, 3.3.4), the weld throat thickness is specified in a similar table (Table 11.3.1), where the ends of welds are defined as Zone 'B' as shown in Fig. 11.3.5 (a) and (d). These figures have been incorporated in CSR-BC & OT as Fig. 19 and Fig. 20 in Pt 1 Ch 3 Sec 6, while Zone 'B' is not being mentioned anywhere in the requirements.

The Rule Change includes a definition of "the ends" for CSR-BC&OT to be the same as that for CSR-OT, and therefore Zone 'B' in Fig. 19 and Fig. 20 in Pt 1 Ch 3 Sec 6 should be referred to by Table 5 in Pt 1 Ch 12 Sec 3.

3. Impact in Scantlings

Scantling impact is not expected.

CHAPTER 13 SHIP IN OPERATIOM-RENEWAL CRITERIA

SECTION 1 PRINCIPLES AND SURVEY REQUIREMENTS

1 PRINCIPLES

1.3 Requirements for documentation

1.3.2 Hull girder sectional properties

1. Reason for the Rule Change

To provide rule clarification.

2. Background

The Rule Change determines the transverse sections requiring the minimum hull girder sectional properties with additional clarification in expression of "representative" instead of "typical" to be in line with the expression in UR Z10.

3. Impact in Scantlings

There is no impact on scantlings due to this change.

PART 2 SHIP TYPES

CHAPTER 1 BULK CARRIERS

SECTION 3 HULL LOCAL SCANTLINGS

1 CARGO HOLD SIDE FRAMES OF SINGLE SIDE BULK CARRIERS

1.4 Provided support at upper and lower connections of side frames

1.4.2 Net connection area of brackets

1. Reason for the Rule Change

The strength requirement for net connection area of brackets for hold side frames is revised based on the technical background.

2. Background

The section modulus of the longitudinals is required to have sufficient bending strength to support the end fixing moment of the side frame about the intersection point of the sloping bulkhead and the side shell.
The end fixing moment of the side frame is that induced by the external sea pressure acting on the side frame (end brackets excluded) and the deflection and rotation of the end support due to the loading on the hopper and the double bottom.
The sea pressure loading on the end brackets is not included because the sea pressure loading on this and on the connecting structure of the hopper and topside tank are assumed to cancel.
The end fixing moment, M_{ef}, of the side frame about the intersection point of the sloping bulkhead and the side shell in Nm is given as:

$$M_{ef} = \alpha_T \cdot P \cdot s \cdot l_{SF}^2 \cdot 10^{-3} \qquad (1)$$

Where

α_T : The coefficient determined by the results of FEA considering the moments transferred from the topside structure or bilge hopper structure.

- α_T=150 for the longitudinal stiffeners supporting the lower connecting brackets.
- α_T=75 for the longitudinal stiffeners supporting the upper connecting brackets.

P : Pressure, in kN/m^2, at the side frame to be considered.

s : The space, in mm, of the side frame

l_{SF} : The span, in m, of the side frame

The end fixing moment, M_{ef}, gives rise to line loads on the connected side and sloping bulkhead stiffeners, q_{efi}, in N/m such that:

$$M_{ef} = s \cdot \sum_i q_{efi} \cdot d_i \cdot 10^{-3} \qquad (2)$$

Where,

d_i : Distance, in m, of the i-th longitudinal stiffener from the intersection point of the side shell and topside/bilge hopper tank.

The line load, q_{efi}, gives rise to plastic bending moments in the connected side and sloping bulkhead stiffeners, M_{ci}, in Nm, given as:

$$M_{ci} = \frac{q_{efi} \cdot l_1^2}{16} \qquad (3)$$

Where,

l_1 : Spacing, in m, of transverse supporting webs in topside / bilge hopper tank.

Hence, assuming an allowable stress of the i-th longitudinal stiffener equal to yielding stress, $R_{eH,lg-i}$, in N/mm^2, the required section modulus, $z_{i,r}$, for a connected side or sloping bulkhead longitudinal in cm^3 becomes:

$$z_{i,r} = \frac{M_{ci}}{R_{eH,lg-i}} \qquad (4)$$

Injecting the expression of M_{ci} from (3) into (4), putting q_{efi} into (2) and M_{ef} into (1), we obtain:

$$\sum_i z_{i,r} \cdot d_i \cdot R_{eH,lg-i} = \frac{M_{ef} \cdot l_l^2}{16s} \cdot 10^3 = \frac{\alpha_T \cdot P \cdot l_{SF}^2 \cdot l_1^2}{16} \qquad (5)$$

The above expression allows the required section modulus of the connected longitudinals to be determined and is given as:

$$\sum_i z_{pli} \cdot d_i \cdot R_{eH,lg-i} \geq \sum_i z_{i,r} \cdot d_i \cdot R_{eH,lg-i} = \frac{M_{ef} \cdot l_l^2}{16s} \cdot 10^3 = \frac{\alpha_T \cdot P \cdot l_{SF}^2 \cdot l_1^2}{16} \qquad (6)$$

Where,

z_{pli} : The offered net plastic modulus, in cm^3, of the i-th longitudinal stiffener

If the lowest value of specified yield stress, $R_{eH,lg}$, in N/mm^2, is applied, among the materials of the longitudinal stiffeners of side shell and hopper/topside tanks that support the lower/upper end connecting bracket of the side frame. Then the formula (6) can be changed to:

$$\sum_i z_{pli} \cdot d_i \geq \frac{\alpha_T \cdot P \cdot l_{SF}^2 \cdot l_1^2}{16 \cdot R_{eH,lg}} \qquad (7)$$

The connecting force Q_{efi}, in N, is transferred through shear between the brackets and the longitudinals, with:

$$Q_{efi} = s \cdot q_{efi} \cdot 10^{-3} \qquad (8)$$

Assuming an allowable shear stress of the connecting bracket of the i-th longitudinal stiffener equal to $0.5R_{eH,bkt-i}$, in N/mm^2, which is safe side comparing with the ultimate shear stress $R_{eH}/\sqrt{3}$. If $A_{i,r}$, in cm^2, is the required connection area of the bracket connecting with the i-th longitudinal, following formula is educed:

$$0.5R_{eH,bkt-i} = \frac{Q_{efi}}{100A_{i,r}} = \frac{s \cdot q_{efi}}{100A_{i,r}} \cdot 10^{-3} \qquad (9)$$

Injecting q_{efi} from (3) and (4) inside (9), we obtain:

$$A_{i,r} \cdot R_{eH,bkt-i} = 0.32 \frac{s \cdot z_{i,r} \cdot R_{eH,lg-i}}{l_1^2} \cdot 10^{-3} \qquad (10)$$

Because $z_{i,r}$ cannot be obtained directly, the formula (10) is changed to:

$$\sum_i A_{i,r} \cdot d_i \cdot R_{eH,bkt-i} = 0.32 \frac{s}{l_1^2} \sum_i z_{i,r} \cdot d_i \cdot R_{eH,lg-i} \cdot 10^{-3} \qquad (11)$$

According to (5)，(11) can be changed as:

$$\sum_i A_{i,r} \cdot d_i \cdot R_{eH,bkt-i} = 0.02\alpha_T \cdot P \cdot s \cdot l_{SF}^2 \cdot 10^{-3} \qquad (12)$$

The requirement of the connecting area of the brackets is following:

$$\sum_i A_i \cdot d_i \cdot R_{eH,bkt-i} \geq 0.02\alpha_T \cdot P \cdot s \cdot l_{SF}^2 \cdot 10^{-3} \qquad (13)$$

Where,

A_i : The offered net connection area of the bracket connecting with the i-th longitudinal, in cm^2.

3. Impact in Scantlings

As an example, a representative Capesize bulk carrier is assessed to illustrate the consequences of the Rule Change. Cross sections of the upper and lower connections of side frame are provided as Figure 1.

The pressure, space and span of the side frame are following:

P=195.1 kN/m^2

s=910 mm

l_{SF}=7.83 m

According to the formula (13), the consequence assessment for the upper and lower connections of side frame is shown in Table 1 and Table 2 respectively.

Conclusion

According to the consequence assessment in Table 1 and Table 2, there is no impact in scantlings.

Figure 1. The upper and lower connections of side frame

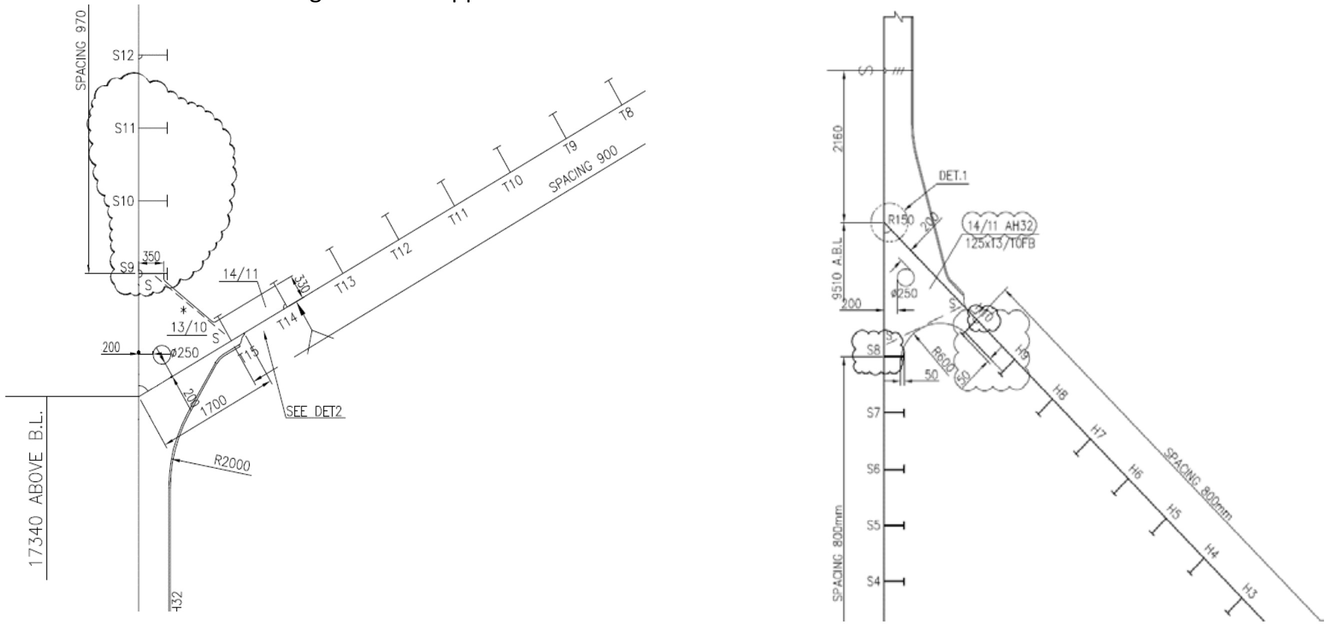


Table 1. The upper connections of side frame

i	Position	A_i (cm^2)	d_i (m)	$R_{eH,bkt-i}$ (N/mm^2)	$A_i \cdot d_i \cdot R_{eH,bkt-i}$
1	T15	33.0	1.512	235	11725.6
2	S9	35.0	1.640	235	13489.0
$\sum_i A_i \cdot d_i \cdot R_{eH,bkt-i}$					25214.6
$0.02\alpha_T \cdot P \cdot s \cdot l_{SF}^2 \cdot 10^{-3}$					16324.5
$\sum_i A_i \cdot d_i \cdot R_{eH,bkt-i} > 0.02\alpha_T \cdot P \cdot s \cdot l_{SF}^2 \cdot 10^{-3}$ The results show that the bracket areas of upper connections of side frame satisfy the rule requirement.					

Table 2. The lower connections of side frame

i	Position	A_i (cm^2)	d_i (m)	$R_{eH,bkt-i}$ (N/mm^2)	$A_i \cdot d_i \cdot R_{eH,bkt-i}$
1					
2	H10	27.5	1.956	315	16943.9
3	S8	27.5	1.910	315	16545.4
$\sum_i A_i \cdot d_i \cdot R_{eH,bkt-i}$					33489.2
$0.02\alpha_T \cdot P \cdot s \cdot l_{SF}^2 \cdot 10^{-3}$ Note: α_T=150					32649.0
$\sum_i A_i \cdot d_i \cdot R_{eH,bkt-i} > 0.02\alpha_T \cdot P \cdot s \cdot l_{SF}^2 \cdot 10^{-3}$ The result shows that the bracket areas of lower connections of side frame satisfy the rule requirement.					

4 ALLOWABLE HOLD LOADING FOR BC-A & BC-B SHIPS IN FLOODED CONDITIONS

4.1 Evaluation of double bottom capacity and allowable hold loading

4.1.4 Allowable hold loading

1. Reason for the Rule Change

The density of steel is to be modified in order to keep in line with the Rule Change in Pt 1, Ch 4, Sec 6, SYMBOL.

2. Background

ρ_{ST} : Updated to 7.85 from 7.8, as 7.85 is common industry practice.

3. Impact in Scantlings

There may be slight impact on scantlings in some cases but the results could be considered more conservative and rational.

SECTION 5 CARGO HATCH COVERS

7 WEATERTIGHTNESS, CLOSING ARRANGEMENT, SECURING DEVICES AND STOPPERS

7.2 Gaskets

7.2.1

1. Reason for the Rule Change

The Rule Change is to clarify the requirements.

2. Background

The weight of hatch covers, and any cargo stowed thereon, together with inertia forces generated by ship motions, are to be transmitted to the ship's structure by different means.
Designers are to provide proper supporting pads in accordance with industry practice and permit various materials based on technical experiences gained by shipyard and hatch cover maker. For example, the transmission of the forces to the ship structure may be achieved by using continuous skirt plates on the hatch covers, bearing pads (Steel to steel contact).

3. Impact in Scantlings

There is no impact on scantlings due to this change.