Bulker Q&As and CIs on the IACS CSR Knowledge Centre

KCID No.	Ref.	Type	Topic	Date completed	Question/CI	Answer	Attach ment
283 attc	4/3.2.2.1 & 4/3.2.2.2 & 5/1.4.2.1 & 5/1.4.2.2 & 5/1.4.2.4 & 5/1.4.3.1	Question	design still water bending moment	2007/1/16	Design still water bending moments in CSR Bulk rules - 3 sub-questions with diagrams (see attachment)	Question 1 . We assume the figure in attached file is related to the Fig 2 of Ch 4 Sec 3 [2.2.2] using the formulas of MSW,H & MSW,S and the extent within 0.4L amidships is shown by parallel line drawn in blue color in attached file. In addition the values of the blue line at AE & FE should not be 0 but should be corrected as 0.2MSW in line with Fig 2 of Ch 4 Sec 3 [2.2.2]. At the end of the design process the still water bending moment used for scantling check and FEA has to represent the individual envelope curve (CH4, Sec3, 2.1.1, first sentence). This corresponds to the green line in the figures. Question2 . Ch 4, Sec 3, [2.2.2] should be considered only as a preliminary distribution of SWBM. It is not a minimum value of SWBM. Regarding the strength point of view, the section modulus is to be checked according to its minimum value (see Ch 5, Sec 1, [4.2.1] and [4.2.4]), and to its value based on the permissible distribution of SWBM (see Ch 5, Sec 1, [4.2.2] and [4.3.1]) which may be the preliminary value of SWBM, if the permissible one coming from loading booklet is unknown. Question 3. There is definition of a value of the SWBM in flooded condition. It has to be calculated and included in the loading booklet and used for the checking of hull girder strength according to Ch 5, Sec 1, [4.2.2] and [4.3.1], in addition of the checks in intact condition.	Y
348	5/App1.2.2	question	Hull girder ultimate strength	2009/9/4	1) In Ch 5, App 1, there are editorial errors in the formulae for critical stresses in the following requirements: [2.2.4] - Beam column buckling [2.2.5] - Torsional buckling of stiffeners [2.2.7] - Web local buckling of flat bar stiffeners The correction should be to delete the coefficient in the brackets in formulae giving critical stresses.Please confirm? 2) In Ch 5, App1, [2.2.8] - Buckling of transversely stiffened plate panels, the coefficient is missing in the second line of the formula giving the critical sress, between ReH and the first bracket. Please confirm?	Your observations were correct and the equations were amended in RCN No. 1 (Nov 2007), with further amendments in RCN No.1-1 to the July 2008 Rules.	

KCID No.	Ref.	Type	Topic	Date completed	Question/CI	Answer	Attach ment
353 attc	5/1.2.2.2	Question	Hull Girder	2007/4/2	Multiple Questions on Hull Girder Shear Force Correction. See attached	Q1: (a) For the structures at forward and aft of transverse bulkhead the scantlings should be determined based on (symbol: delta)QCF and (symbol: delta)QCA respectively. (b) Permissible limits should be also based on (symbol: delta)QCF and (symbol: delta)QCA respectively for structures at forward and aft of transverse bulkhead. Q2: (symbol: delta)QC should be calculated for each non-homogeneous loading condition. Therefore the permissible shear force is different for each non-homogeneous loading condition. Q3: Shear force correction should be done at the bulkhead where adjacent holds are in non-homogeneous loading condition. Therefore shear force correction should not be done at other transverse bulkheads than those of No.4 ballast hold. Q4: (a) Total mass of cargo M may include deadweight such as water ballast and fuel oil tank in double bottom, bounded by side girders in way of hopper tank plating or longitudinal bulkhead, if this space is loaded for the non-homogeneous loading condition considered. (b) In [2.2.3] flooded water in the hold may be included into M. (c) Deadweight in double bottom which is as defined in (a) may be included into M. Q5: Yes.	Y

KCID No.	Ref.	Type	Topic	Date completed	Question/CI	Answer	Attach ment
365	Ch 5 Sec 1	Question	Strength of Hull Girder	2007/5/11	Longitudinal strength of hull girder in flooded condition is given in Ch 5 Sec 1 for BC-A and BC-B only. We assume that this is not required for BC-C and ships below 150 m in length. Please confirm.	Yes, your assumption is right. The current CSR requires to BC-A, BC-B and BC-C ships to check the hull girder ultimate strength under not only intact condition but also flooded condition but the yielding check of hull gider under flooded condition is required for BC-A and BC-B ships, and not required to BC-C ships. In order to resolve this discrepancy, it is decided that the yield check of the hull girder is to be performed for BC-A, BC-B and BC-C ships. This will be considered as a rule change.	
366	Ch 5 Sec 2	Question	Hull girder	2007/3/20	Longitudinal strength in flooding condition is given in Sec 1 and is limited to BC-A and BC-B ships only. We assume that the same limitation applies to Sec 2 for ultimate strength of hull girder in flooding condition. Please confirm. If so, please add the limitation in Sec 2 as well.	As mentioned in the requirement Ch 5 Sec 2 [1.1.1], the requirement on ultimate strength check of hull girder apply to ships equal to or greater than 150m in length (L), i.e., BC-A, BC-B and BC-C ships.	
428 attc	5/App1.2.2.8	Question	Formula	2007/4/19	In Ch 5, App 1, [2.2.8], it could be some interpretation on “l” in the formula giving “sigmaCR5”, and of “s” in the formula giving “betaE”.In order to apply such formulae in the right way, it could be useful to specific the exact definition of the parameters “l” and “s”.	For a more clear application of the formulae of the requirement Ch 5, Appendix 1, [2.2.8], please refer to the file attachement "Draft Answer Ch 5, App 1, [2.2.8].doc". **Also Included in Corrigenda 5**	Y
453 attc	Ch.5 Sec.1	Question	Shearforce correction	2007/6/12	According to a draft reply to KC #353, hull girder shear force correction is only considered at bulkheads where adjacent holds are in non-homogeneous loading. In our opinion, this is valid when permissible limits Qp is established according to [5.1.3] considering shear force correction Delta-Qc. Q1: In our opinion, such shear force correction should only be considered to the permissible limit giving the same sign to actual shear force at that bulkhead position and the permissible limit of opposite sign need not be corrected. Please confirm. Q2: For the determination of the required scantlings according to [2.2.2], however, shear force correction Delta-Qc should in principle be considered at every bulkhead for non-homogeneous loading conditions. As explained last time, hull girder shear force will increase after shear force correction, in case of heavy ballast conditions, at the aft bulkhead of the hold aft of the heavy ballast hold thereby requiring larger scantlings. See Point-A in the attached figure. Same issue at the forward bulkhead of the hold forward of the heavy ballast hold. In our opinion, this reflects physics behind shear force correction. In case of a large Capesize bulk carrier, this effect is not negligible giving impact on the required scantligs. Please confirm.	A1:The understanding is correct. A2:Shear force correction is to be considered only at the bulkhead where adjacent holds are in non-homogeneous loading condition. Therefore shear force correction should not be done at other transverse bulkheads than those of No.4 ballast hold. In that case, shear force correction in point A is not relevant.	Y

KCID No.	Ref.	Type	Topic	Date completed	Question/CI	Answer	Attach ment
459 attc	5/1.5.1.2, 5/1.5.1.3 , 5/1.5.3.2, & 5/1.5.3.3	CI	Shear Stresses & Shear Forces	2007/7/2	Please see the attachment for question containing several figures. Note that reference is made to KC #353 and to the supplementary questions KC #453 submitted on 20 April 2007.	In CSR for bulk carriers, they are two different ways of assessing shear stresses and shear forces: 1 - using direct calculation, as stated in 2.2.1, and in such a case the permissible still water shear force is obtained through 5.1.2, OR 2 - using simplified calculation with correction of shear force as stated in 2.2.2, and in such a case permissible still water shear force is obtained throgh 5.1.3. Both approaches are not to be mixed, and generally the direct calculation approach is used.	Y
460	6/3, 5/2	CI	Ordinary Stiffeners & Stiffened Panels	2007/7/13	Ch. 6 Sec. 3 Bucking & ultimate strength of ordinary stiffeners and stiffened panels. According to [1.1.2] buckling assessment of longitudinal material is not required for flooding conditions. According to URS 17 buckling check is required for flooding condition. Quote: S17.5 - Strength criteria The damaged structure is assumed to remain fully effective in resisting the applied loading. Permissible stress and axial stress buckling strength are to be in accordance with UR S11.Unqoute. The Ch. 5 Sec. 2 HULS is calculating axial stress buckling of hull girder due to flooding bending moment. Q1. We assume that CSR fulfils URS17.5 by HULS check of Ch. 5 Sec.2. Please confirm Q2. We assume that buckling according to Ch. 6 Sec. 3 need not be calculated in flooding condition as outlined in [1.1.2]. Please confirm.	1)Yes. Your assumption is correct. 2)Yes. Your assumption is correct.	
499 attc	Tanker - App A/2.2.2.3 & 2.2.2.4; & Bulker- - Ch.5, App 1. 2.2.2	CI	Hard corners in the Hull Girder Ultimate Strength	2007/10/9	The CSR for Oil Tankers and for Bulk Carriers need to have the same definition of hard corners in the Hull Girder Ultimate Strength. The attachment is a proposal for a common interpretation in this respect. The differences between the Rules in force are: CSR for Oil Tanker:The area on which the value of the buckling stress of transversely stiffened panels applies is to be taken as the breadth between the hard corners, i.e. excluding the end of the hard corner if any. Refer to KC CSR for Bulk Carriers: The definition is too vague and needs improvement through this CI.	The hard corners in the hull girder ultimate strength is defined as shown in the figure of the attached file “Fig._KC499.pdf”.	Y

KCID No.	Ref.	Type	Topic	Date completed	Question/CI	Answer	Attach ment
519 attc	Ch5 App1 2.2	CI	Ultimate Strength by Incremental - iterative	2008/2/7	With regard to calculation procedure for ultimate strength by incremental-iterative approach, please be clarified three questions as follows. Q1. Shortening curve for a stiffened plate element where material of plate and stiffener are different. Q2. Shortening curve for an element where thickness of plate are different. The element can be stiffener or plate. Q3. Shortening curve for an element where material and thickness of attached plate are different. (Attachment included)	(A1) Where materials of plate and stiffener are different, two calculations are carried out: 1) for the stiffener: by adding to the stiffener an attached plating of the same material as the one of the stiffener, then determine the shortening curve and the stress σ to be applied to the stiffener. 2) for the attached plating: by adding a stiffener made of the same material as the one of the attached plating, then determine the shortening curve and the stress σ to be applied to the attached plating. (A2):An average thickness by the area of each considered plate is used for the considered element. (A3): An average thickness and yield strength by the area of each considered plate is used for the considered element.	Y
520 attc	Ch5 App1/ 2.1.1.,	CI	Plates Stiffener	2007/10/23	For plates stiffened by not longitudinally continued stiffeners such as girders in double bottom, how to divide the plate to calculation elements. Should the stiffeners be neglected and considered as plate elements? (Attachment included)	If the stiffener is not continuous it does not participate to the hull girder ultimate strength and thus it is not to be taken into account. But it divides the plate into elementary plate panels which are calculated independently.	Y
521 attc	Bulker Ch5 App1/2.2	CI	Length of Stiffeners	2007/10/23	For stiffeners where one side of web are supported by bracket which space less than the space of primary supporting members, which is length of this element, space of brackets or supporting members? (Attachment included)	The length of the stiffener is taken as the space of primary supporting members as it cannot be considered that a bracket on one side of the stiffener's web is enough to reduce this length.	Y
634 attc	Ch.5, Appendix 1	RCP	Load end shortening Curves	2008/3/26	A change of the Rules regarding load end shortening curves set out in Ch.5, App.1 is proposed. In case that stiffeners and attached plates are of different materials in some areas of hull girder transverse sections, it is proposed that the stipulations relating to the load-end shortening curves defined in Ch. 5, App.1 are expanded as underlined in red in the attachment to meet such case for user-friendliness purposes.	Please refer to the answer in KC ID 519. We will consider the rule change proposal in order to clarify this.	Y

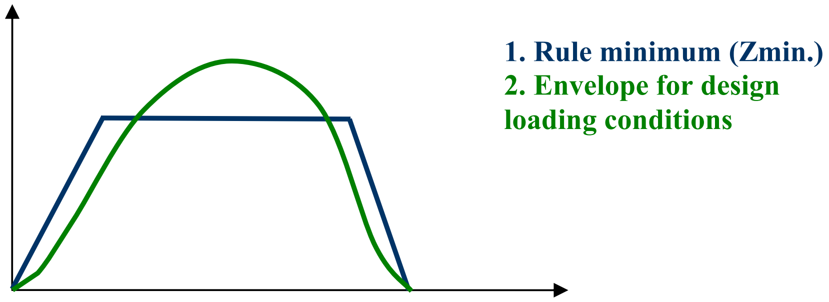
KCID No.	Ref.	Type	Topic	Date completed	Question/CI	Answer	Attach ment
685	6/3.2.1.3 & 5/1.2.2.1	Question	Shear force for buckling assessment	2008/5/30	Ch.6,Sec.3,[2.1.3] defines the shear force for buckling assessment as follows: Q=Q_SW + C_QW x Q_WV. There seems to be no limitation to the signs of Q_SW and Q_WV for their combinations. On the other hand Ch.5, Sec.1, [2.2.1] reads: "When they are combined, vertical shear forces Q_SW and Q_WV in intact condition are to be taken with the same sign." Which way should be taken when calculating Q in Ch.6, Sec.3, [2.1.3]: a) Q to be calculated only for the combinations where Q_SW and Q_WV are of same sign, or b) Q to be calculated for all combinations where Q_SW and Q_WV are of either same sign or opposite signs ?	Hull girder shear stress check should be performed at the maximum absolute shear force. Such case occurs at the combination of either (1) Q_SW_pos +(C_QW_pos x Q_WV), or (2) Q_SW_neg +(C_QW_neg x Q_WV), where, C_QW_pos , C_QW_neg : positive and negative load combination factors according to load cases as defined in Ch.4, sec.4,Table 3. The sentence in Ch.5, Sec.1, [2.2.1], which is quoted in the question, reflects this interpretation. Therefore we will consolidate the paragraphs referring to shear force combination into CH5, Sec1 [2.2.1] and replace CH6, Sec3, [2.1.3] with a note referring to CH5, Sec1.	
788 attc	5/1.5.2.2	RCP	Permissible still water shear force	2008/10/27	Ch4 Sec8 requires that the permissible value of still water shear forces be described in loading manuals. “Permissible still water shear force” is defined in Ch5 Sec1 [5] based on the calculated shear stresses of hull girder strength members. Further, other strength assessments, such as global strength analysis in Ch7 Sec2 and buckling strength assessment in Ch6 Sec3, also refer to hull girder shear force. However, the relationship of shear force values is not clear in CSR. (See attached) Please consider a rule change to clarify the above.	1)The designer should define the design still water shear force QSW in line with Ch.4, Sec.3 [2.3] in the first place. 2) Then using QSW the following strength is assessed (a) hull girder shear strength according to Ch.5 Sec.1 [5]. (b) buckling strength according to Ch.6 Sec.3 (c) global strength according to Ch.7 Sec.2. 3) As a conclusion, the design still water shear forces can be taken as the allowable ones and described in the loading manual. We will consider the RCP in order to clarify this understanding.	Y
973	Bulker 5/App.1 , Tanker 9/1.1.1.2	Question	Hull girder ultimate strength	2010/10/12	With respect to hull girder ultimate strength 1. The scantling requirements by hull girder ultimate strength are to be applied within 0.4L amidships in 9/1.1.1.2 of CSR OT. For CSR BC, It is noted that the normal stresses are to be checked within L, please clarify whether the scantling requirements by hull girder ultimate strength are to be applied within L in CSR BC or not. 2. Our understanding is that the modifications to CH5/Appendix 1 in bulker rcn1 to July 08 are also applicable to CSR OT, please confirm.	1. This issue will be submitted to the Harmonisation teams. 2. We confirm the modifications to CH5/Appendix 1 in CSR/Bulk Carrier RCN1 to July 08 are also applicable to CSR OT. The Rules will be amended to incorporate those modifications.	
977	5/1.3	Question	Application of shear stress check	2010/3/12	From Ch.5 Sec.1 [3], we know that the check of normal stress apply along the scantling length of the hull girder. How about the application of shear stress check and permissible still water shear force? Do they also apply along the scantling length? Please clarify.	The check of shear stress and permissible still water shear force apply along the scantling length of the hull girder. A corrigenda will be considered to clarify this.	

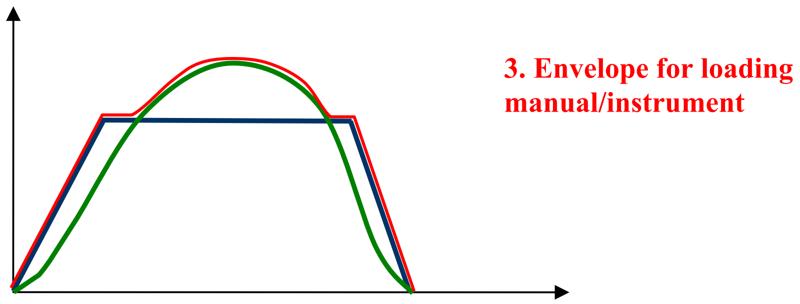
KCID No.	Ref.	Type	Topic	Date completed	Question/CI	Answer	Attach ment
1051	Text 5/1.2.2.2	Interpretation	Defenition of Homogenous loading condition to make shear reduction	2010/10/20	In CSR BC, there is no clear definition of a "homogeneous loading" condition. This definition is important to know whether or not it is possible to make a shear reduction according to Ch5, Sec1, 2.2 We think it's possible to use the definition of homogeneous loading condition given in URS 18: "...homogeneous loading condition means a loading condition in which the ratio between the highest and the lowest filling ratio, evaluated for each hold, does not exceed 1,20, to be corrected for different cargo densities." Please let us if you confirm this proposition	We agree with your proposal to use the definition of homogeneous loading condition given in URS 18 in CSR for Bulk Carriers: "...homogeneous loading condition means a loading condition in which the ratio between the highest and the lowest filling ratio, evaluated for each hold, does not exceed 1,20, to be corrected for different cargo densities." The definition will be included in the Rules.	

KC#283

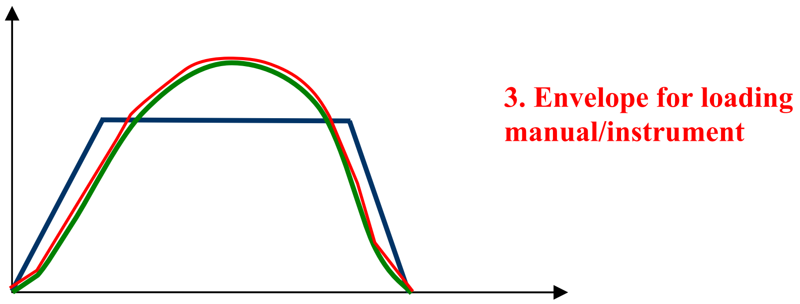
Design still water bending moments in CSR Bulk rules.
Ch.4 Sec.3 [2.2.1] and [2.2.2] and Ch.5 Sec.1 [4.2.1], [4.2.2], [4.2.4] and [4.3.1]

We assume the following interpretation is valid for design bending moments in **intact** condition:





Alt 2

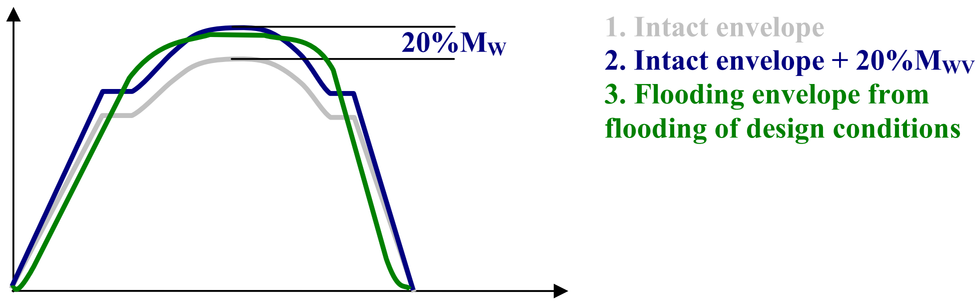


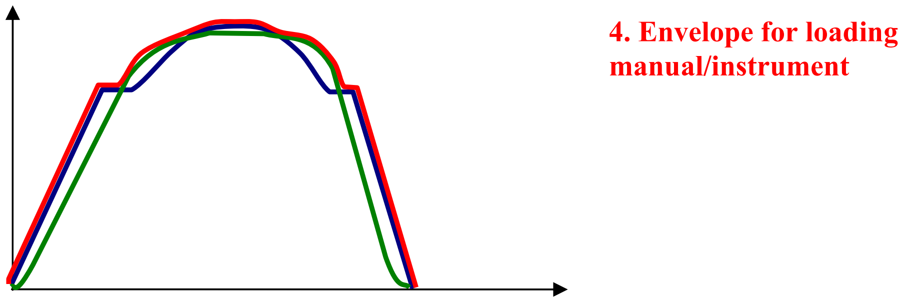
1(blue). Rule minimum Z (section modulus) is maintained within 0.4 L amidships according to Ch 5 Sec 1 [4.2.1] and [4.2.4]. Corresponding bending moments are given as preliminary design moments in Ch 4 Sec 3 [2.2.2].
2(green). Envelope curve for all loading conditions in the loading manual. For some points this may exceed the rule minimum requirement (ref. Ch.4 Sec.3 [2.2.1] and Ch.5 Sec.1 [4.2.2] and [4.3.1]).
3(red). Envelope (permissible) curve for loading manual/instrument.

Q1: As long as the item 1 is satisfied, i.e., Rule min. Z is maintained within 0.4L amidships, could “Alt 2” below be used as Envelope for the loading manual/instrument? Could “Alt 2” be used for sig-x for local scantlings and for design bending moment for FEM calculation? Note that the red line may have an uneven distribution within 0.4L amidships and might be below rule minimum (item 1 above).

Q2: In this connection, please clarify if Ch.4 Sec.3 [2.2.2] is a minimum requirement within 0.4L amidships or just a guidance. If it is not a rule minimum, and in case the Envelope (line 2) is below Min. Z (line 1), hull girder capacity of min Z is not fully utilised by the design/permissible still water bending moments of the vessel. As far as we understand, this is given as a minimum requirement for design still water bending moment in the CSR-Tanker rules. Please clarify.

Q3: For the **flooding** condition, we assume the following relationship. We assume that the same principle also applies to harbour condition. Please confirm if our assumptions are correct.





1. The intact bending moment based on above assumptions.
2. The Intact envelope + 20%M_{VW}
3. The envelope curves from flooding of design loading conditions. This curve exceed curve 2 for certain points.
4. Design limit for the flooding condition and envelope curve for loading manual/instrument.

KC#353

Questions on hull girder shear force correction

The below questions except Q4 are based on a assumption that shear force correction ΔQ_C as defined in Ch.5 Sec.1 [2.2.2] is relevant during design and approval stages. During in service, actual loading conditions will be checked by the loading instrument based on the Qp as defined in [5.3.1] without shear force correction in each loading condition.

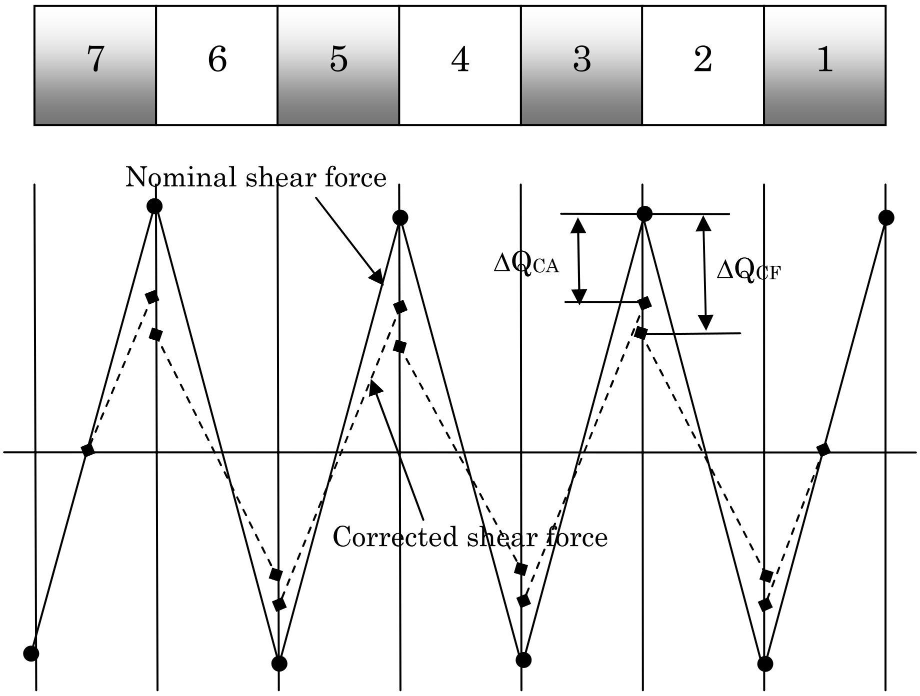
Q1: When applying shear force correction according to Ch.5 Sec.1 [2.2.2], there are two values of ΔQ_C calculated at each bulkhead position for the fore and aft holds respectively as illustrated below. The scantlings should then be determined (and strength is verified) based on the smaller of the ΔQ_{CA} and ΔQ_{CF} in each loading condition. Permissible limits will then be corrected according to [5.1.3] with the maximum of these ΔQ_C values as calculated above for different loading conditions. Please confirm.

Q2: When the shear force correction is made to the permissible shear force limits according to [5.1.3], shear force correction is only available either positive or negative at each bulkhead position as illustrated below. This should be applicable to alternate loading conditions and heavy ballast condition but may not be applicable for new loading conditions with uneven distribution of dead weight. Please confirm.

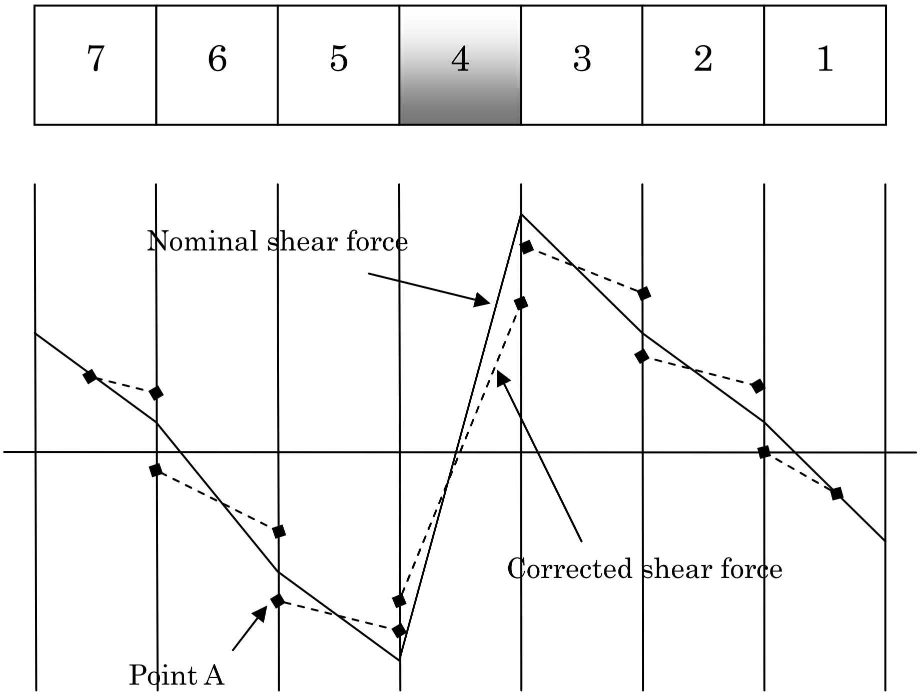
Q3: When the shear force correction is made for the heavy ballast condition, corrected shear force will “increase” at the aft end of the aft hold (Point A) and fore end of the fore hold adjacent to the ballasted hold. How the shear force correction should be made at such bulkhead positions? They may be decisive. Permissible limit should then be “reduced” from nominal limit?

Q4: Cargo mass as defined in [2.2.2] include deadweight such as water ballast and fuel oil in the double bottom and hopper tanks excluding topside tanks. In [2.2.3] flooded water in the hold is taken into account. Dead weight in double bottom and hopper tank should be treated in the same manner. Please confirm.

Q5: The above items should also apply to harbour and flooding conditions. Please confirm.



Alternate loading condition



Heavy ballast condition

KC#428

For a more clear application of the formulae of the requirement Ch 5, Appendix 1, [2.2.8], the following are to be considered:

$$\beta_E = 10^3 \frac{s}{tp}\sqrt{\frac{\varepsilon \mathrm{Re} H}{E}}$$

s: plate breadth, in m, taken as the spacing between the ordinary stiffeners,
ℓ: longer side of the plate, in m

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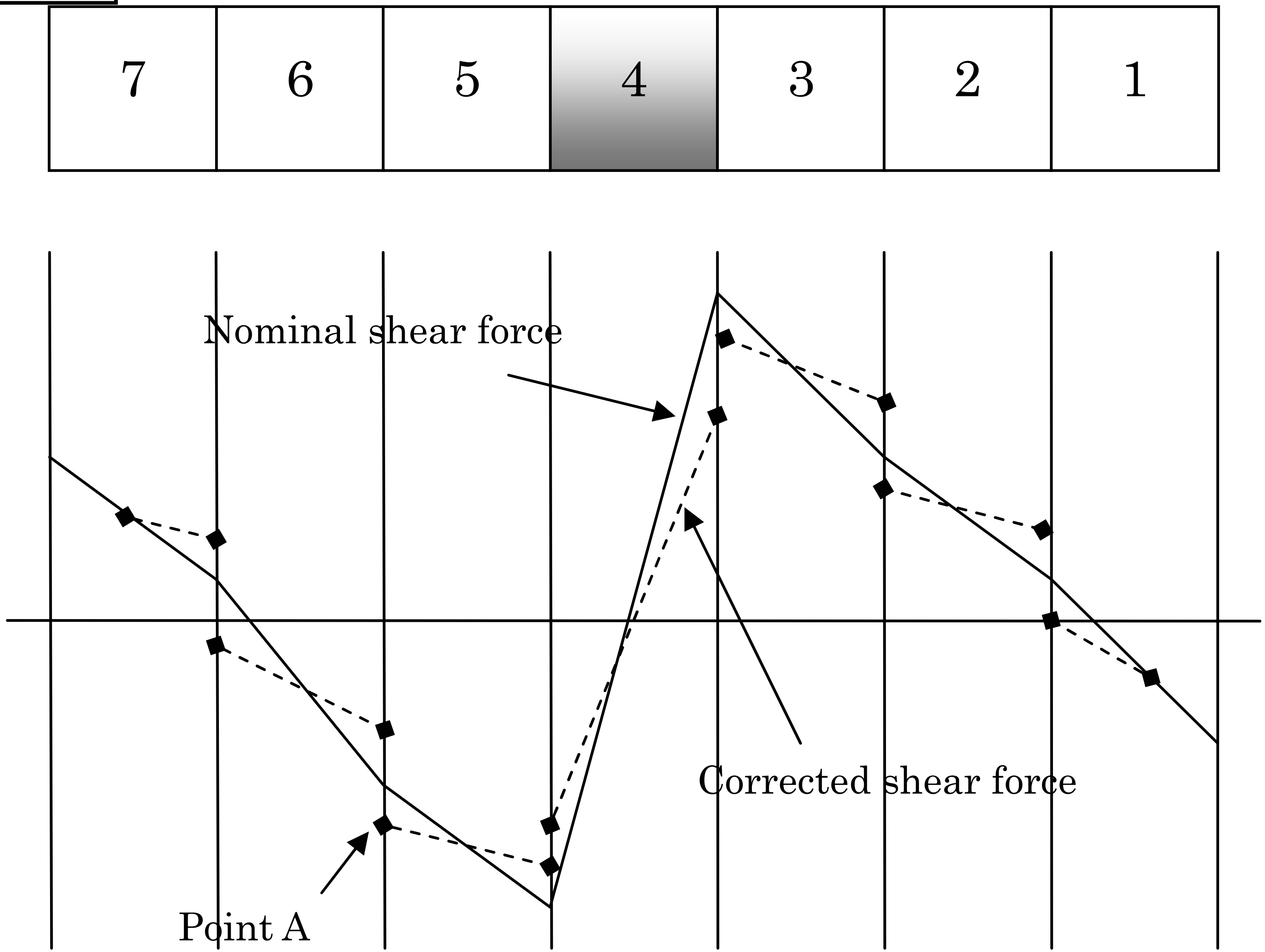
KC#453



<u>Heavy ballast condition</u>

KC#459

Reference is made to KC #353 and to the supplement questions KC#453 submitted to IACS on 20 April 2007.

Q1 According to latest information available to us, we understood that the shear force correction may be applied to each uneven loading condition according to [2.2.2] and thereby compared to the uncorrected shear force capacity curve according to [5.1.2]. The procedure is drawn up in items 1 to 3 below. Please review and confirm.

1. Shear force capacity curve.
   Qp according to [5.1.2] are drawn up based on direct shear force calculation as given in [2.2.1]. Shear force capacity to be established based on direct calculation meaning shear flow analysis. See figure 1. Please confirm.

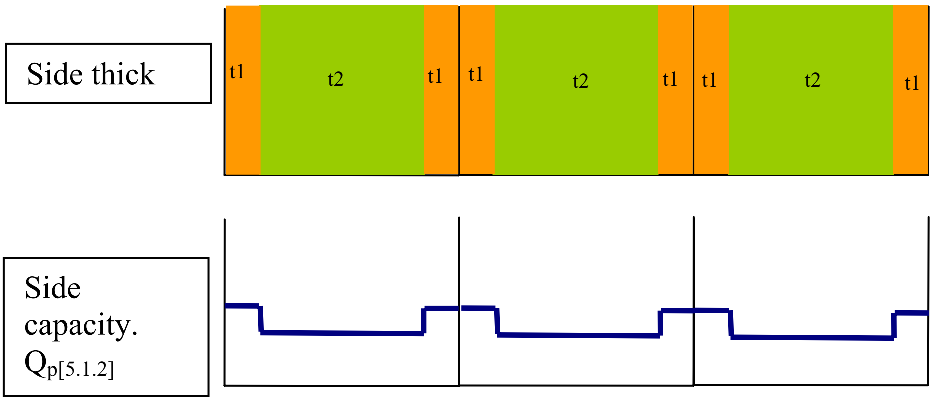


Figure 1 Shear force capacity according to [5.1.2]

2. Approval verification.
   Design loading conditions in the loading manual should be plotted with both corrected and uncorrected shear force. Corrected shear forces are compared against Qp according to Ch.5 Sec.1 [5.1.2]. The correction is performed according to [2.2.2] and performed for uneven loading conditions only. See figure 2. Please confirm.

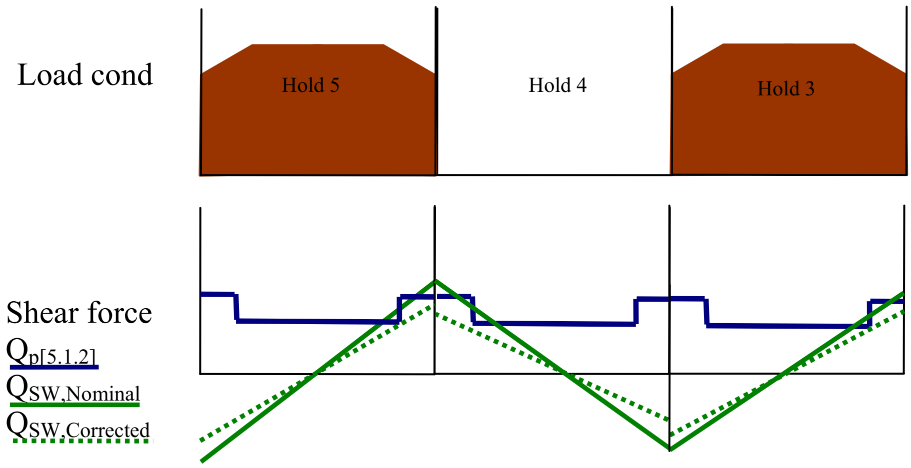


Figure 2 Strength check according to [2.2.2] and [5.1.2]

3. In service verification with loading computer.
   When the ship crew enters an uneven loading condition into the loading instrument, the strength verification is performed similar to item 2 above. That is, the loading computer computes the corrected shear force according to [2.2.2] and compares the results with the $Q_{p[5.1.2]}$ according to the direct approach. Please confirm.

Q2 If above iQ1 is confirmed the, definition of Qp is different between [5.1.2] and [5.1.3] regarding application of shear force correction.
The Qp defined by [5.1.2] should be compared to “net shear forces” after shear force correction applied to each uneven loading condition calculated by Loading Computer onboard. Same with such conditions included in the Loading Manual.
Qp given in [5.1.3] includes shear force correction Delta-Qc which is absolutely “added” on top of the capacity limit based on the given scantlings and allowable stress. We suppose the intention of Qp as given in [5.1.3] is to make shear force correction unnecessary in each loading condition calculated by the Loading Computer onboard. Please refer to figure 3 where the correction is made for one alternate loading condition.

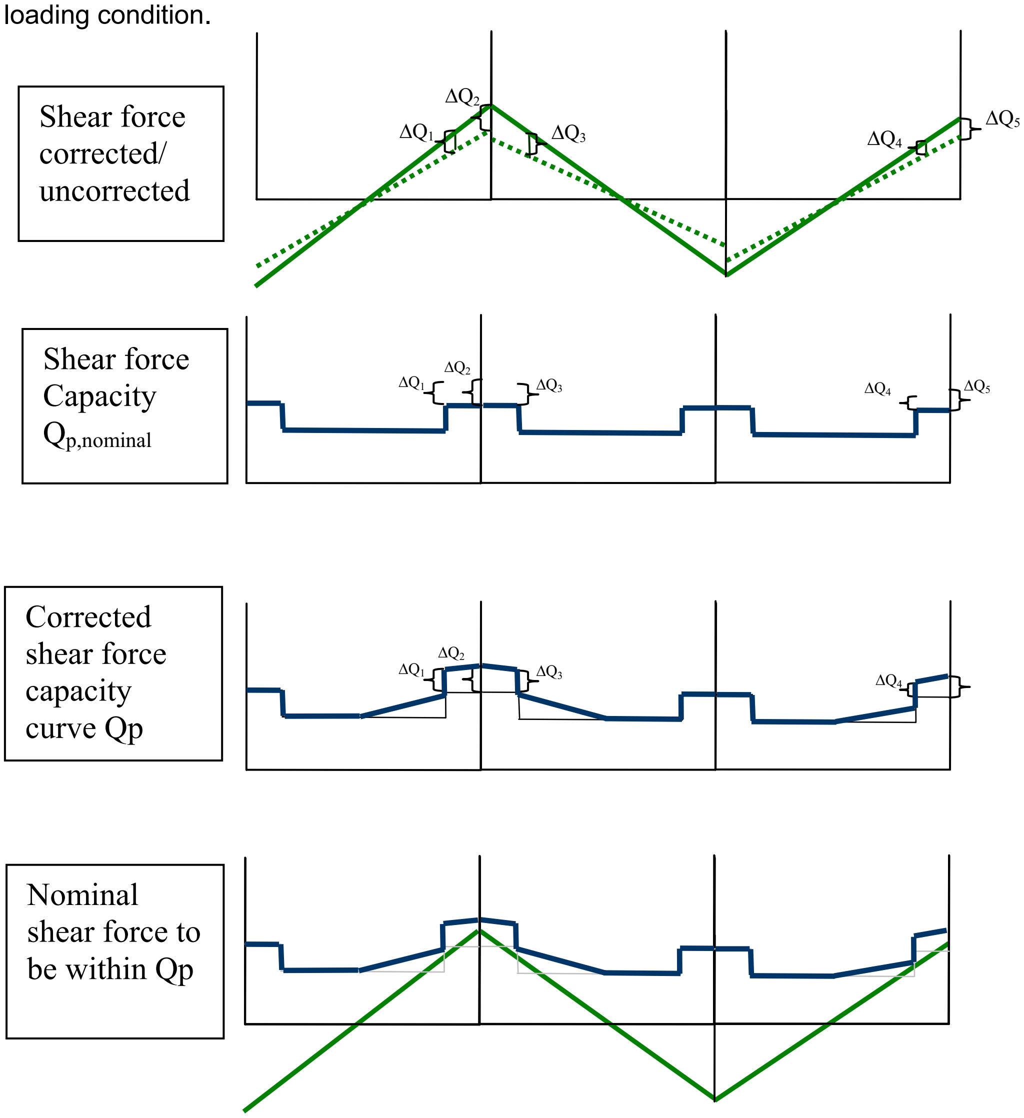


Figure 3 Shear force approach according to [5.1.3]

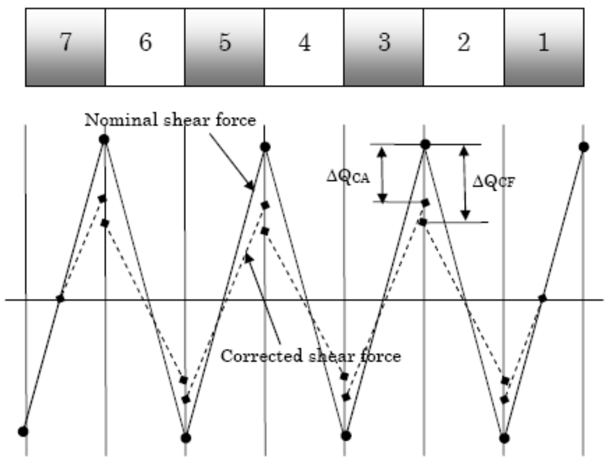
This has created some confusion and uncertainty of Qp as defined by [5.1.3] such as:

1) Uncertainty of shear force correction Delta-Qc included in Qp when applied to a new loading condition calculated by Loading Computer onboard.
2) A few sets of Qp need to be established to deal with different uneven loading conditions correctly.
3) In case of flooding conditions, the above two issues 1) and 2) will be more confusing and difficult to deal with.

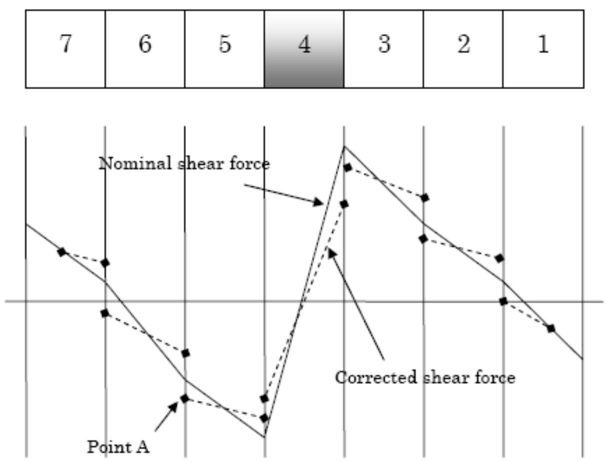
To avoid any confusion and uncertainty, we therefore propose to take out Delta-Qc term from the Qp formula given in [5.1.3] and instead add texts in both [5.1.2] and [5.1.3] to the effect; “shear force correction as given in [2.2.2] should be applied to uneven loading conditions calculated by Loading Computer onboard. Corrected shear forces are then compared against Qp.” Same applies to Qpf formula in [5.3.3]. Please consider.

Q3 As discussed in above Q2, we assume that [5.1.3] does not apply if Qp is obtained by [5.1.2]. Similarly, [5.3.3] does not apply if Qpf is obtained by [5.3.2] for flooding cases.
Please confirm.

Q4 In this connection, we find it difficult to agree to the answer to Q3 of KC #353 where it is stated that “shear force correction should be done at the bulkhead where adjacent holds are in non-homogeneous loading condition.” As we mentioned in Q2 submitted on 20 April 2007, the answer will not correctly reflect the physics behind the shear force correction in case of heavy ballast condition. Please see Point A in the attached illustration. This is more prominent in case of Capesize. Please re-consider.

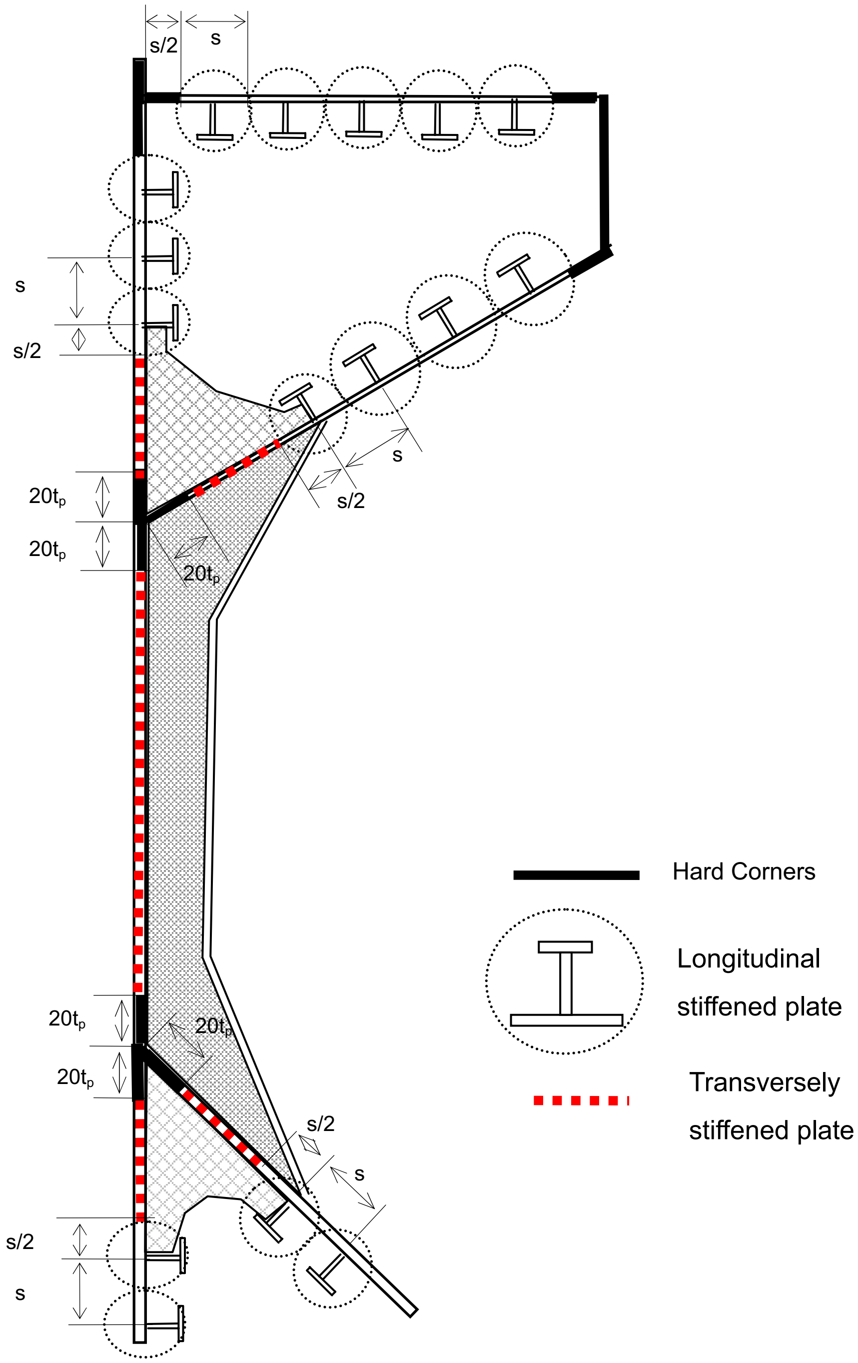


Alternate loading condition



Heavy ballast condition

KC#499



s/2
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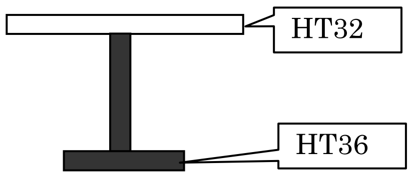
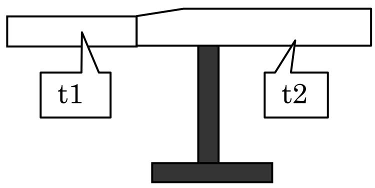
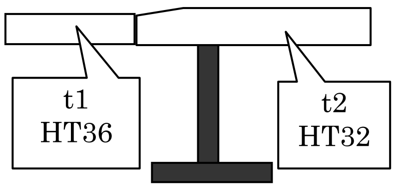
Hard Corners
Longitudinal stiffened plate
Transversely stiffened plate

KC#519

Question for ULS

Rule Ref.: Bulker CSR Ch5 Appendix 1, Tanker CSR Appendix A 2.3

Interpretation requested to calculation procedure for ultimate strength by incremental-iterative approach.

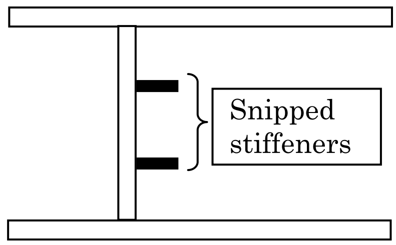
ID	Questions	Figures
Q1	Shortening curve for a stiffened plate element where material of plate and stiffener are different.	
Q2	Shortening curve for an element where thickness of plate are different. The element can be stiffener or plate.	
Q3	Shortening curve for an element where material and thickness of attached plate are different	

KC#520

Question for ULS

Rule Ref.: Bulker CSR Ch5 Appendix 1, Tanker CSR Appendix A 2.3

Interpretation requested to calculation procedure for ultimate strength by incremental-iterative approach.

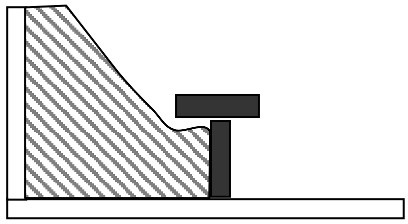
ID	Questions	Figures
Q1	For plates stiffened by not longitudinally continued stiffeners such as girders in double bottom, how to divide the plate to calculation elements. Should the stiffeners be neglected and considered as plate elements?	

KC#521

Question for ULS

Rule Ref.: Bulker CSR Ch5 Appendix 1, Tanker CSR Appendix A 2.3

Interpretation requested to calculation procedure for ultimate strength by incremental-iterative approach.

ID	Questions	Figures
Q1	For stiffeners where one side of web are supported by bracket which space less than the space of primary supporting members, which is length of this element, space of brackets or supporting members?	

KC#634

CHAPTER 5 – HULL GIRDER STRENGTH

APPENDIX 1 HULL GIRDER ULTIMATE STRENGTH

2. Criteria for the calculation of the curve M-χ

2.2 Load-end shortening curve σ-ε

2.2.4 Beam column buckling

The equation describing the load-end shortening curve σ_{CR1}-ε for the beam column buckling of ordinary stiffeners composing the hull girder transverse section is to be obtained from the following formula (see Fig 3):

$$\sigma_{CR1} = \frac{\Phi_s \sigma_{C1s} A_{Stif} + \Phi_p \sigma_{C1p} \cdot 10 b_E t_p}{A_{Stif} + 10 s t_p}$$

where:

Φ_s : Edge function defined in [2.2.3], for ordinary stiffener

Φ_p : Edge function defined in [2.2.3], for attached plate

R_{eHs} : Minimum yield stress, in N/mm2, of the material of the stiffener

R_{eHp} : Minimum yield stress, in N/mm2, of the material of attached plate

A_{Stif} : Net sectional area of the stiffener, in cm^2, without attached plating

σ_{C1s} : Critical stress for the stiffener with its material of R_{eHs}, in N/mm^2, equal to:

$$\sigma_{C1s} = \frac{\sigma_{E1}}{\varepsilon_s} \quad \text{for } \sigma_{E1} \le \frac{R_{eHs}}{2}\varepsilon_s$$

$$\sigma_{C1s} = R_{eHs}\left(1 - \frac{R_{eHs}\,\varepsilon_s}{4\sigma_{E1}}\right) \quad \text{for } \sigma_{E1} > \frac{R_{eHs}}{2}\varepsilon_s$$

ε_s : Relative strain of the material of the stiffener, equal to:

$$\varepsilon_s = \frac{\varepsilon_E}{\varepsilon_{Ys}}$$

ε_{Ys} : Strain at yield stress of the material of the stiffener, equal to:

$$\varepsilon_{Ys} = \frac{R_{eHs}}{E}$$

ε_E : Element strain

σ_{C1p} : Critical stress for the stiffener with the material of R_{eHp}, in N/mm^2, equal to:

$$\sigma_{C1p} = \frac{\sigma_{E1}}{\varepsilon_p} \quad \text{for } \sigma_{E1} \le \frac{R_{eHp}}{2}\varepsilon_p$$

$$\sigma_{C1p} = R_{eHp}\left(1 - \frac{R_{eHp}\,\varepsilon_p}{4\sigma_{E1}}\right) \quad \text{for } \sigma_{E1} > \frac{R_{eHp}}{2}\varepsilon_p$$

ε_p : Relative strain of the material of attached plate, equal to:

$$\varepsilon_p = \frac{\varepsilon_E}{\varepsilon_{Yp}}$$

ε_{Yp} : Strain at yield stress of the material of attached plate, equal to:

$$\varepsilon_{Yp} = \frac{R_{eHp}}{E}$$

σ_{E1} : Euler column buckling stress, in N/mm^2, equal to:

$$\sigma_{E1} = \pi^2 E \frac{I_E}{A_E l^2} 10^{-4}$$

I_E : Net moment of inertia of ordinary stiffeners, in cm^4, with attached shell plating of width b_{E1}

b_{E1} : Effective width, in m, of the attached shell plating, equal to:

$$b_{E1} = \frac{s}{\beta_E} \quad \text{for } \beta_E > 1.0$$

$$b_{E1} = s \quad \text{for } \beta_E \le 1.0$$

$$\beta_E = 10^3 \frac{s}{t_p}\sqrt{\varepsilon_E}$$

A_E : Net sectional area, in cm^2, of ordinary stiffeners with attached shell plating of width b_E

b_E : Effective width, in m, of the attached shell plating, equal to:

$$b_E = \left(\frac{2.25}{\beta_E} - \frac{1.25}{\beta_E^2}\right)s \quad \text{for } \beta_E > 1.25$$

$$b_E = s \quad \text{for } \beta_E \le 1.25$$

2.2.5 Torsional buckling

The equation describing the load-end shortening curve σ_{CR2}-ε for the flexural-torsional buckling of ordinary stiffeners composing the hull girder transverse section is to be obtained according to the following formula (see Fig 4).

$$\sigma_{CR2} = \frac{\Phi_s A_{Stif}\sigma_{C2} + \Phi_p \cdot 10 s t_p \sigma_{CP}}{A_{Stif} + 10 s t_p}$$

where:

Φ_s : Edge function defined in [2.2.4]

Φ_p : Edge function defined in [2.2.4]

A_{Stif} : Net sectional area of the stiffener, in cm^2, without attached plating

R_{eHs} : Minimum yield stress, in N/mm2, defined in [2.2.4]

R_{eHp} : Minimum yield stress, in N/mm2, defined in [2.2.4]

ε_s : Relative strain for the material of ordinary stiffener, defined in [2.2.4]

σ_{C2} : Critical stress, in N/mm^2, equal to:

$$\sigma_{C2} = \frac{\sigma_{E2}}{\varepsilon_s} \quad \text{for } \sigma_{E2} \le \frac{R_{eHs}}{2}\varepsilon_s$$

$$\sigma_{C2} = R_{eHs}\left(1 - \frac{R_{eHs}\,\varepsilon_s}{4\sigma_{E2}}\right) \quad \text{for } \sigma_{E2} > \frac{R_{eHs}}{2}\varepsilon_s$$

σ_{E2} : Euler torsional buckling stress, in N/mm^2, defined in Ch 6, Sec 3, [4.3]

σ_{CP} : Buckling stress of the attached plating, in N/mm^2, equal to:

$$\sigma_{CP} = \left(\frac{2.25}{\beta_E} - \frac{1.25}{\beta_E^2}\right)R_{eHp} \quad \text{for } \beta_E > 1.25$$

$$\sigma_{CP} = R_{eHp} \quad \text{for } \beta_E \le 1.25$$

β_E : Coefficient defined in [2.2.4]

2.2.6 Web local buckling of ordinary stiffeners made of flanged profiles

The equation describing the load-end shortening curve σ_{CR3}-ε for the web local buckling of flanged ordinary stiffeners composing the hull girder transverse section is to be obtained from the following formula:

$$\sigma_{CR3} = \frac{\Phi_p R_{eHp} \cdot 10^3 b_E t_P + \Phi_s R_{eHs}(h_{we} t_w + b_f t_f)}{10^3 s t_p + h_w t_w + b_f t_f}$$

where:

Φ_s : Edge function defined in [2.2.4]

Φ_p : Edge function defined in [2.2.4]

R_{eHs} : Minimum yield stress, in N/mm2, defined in [2.2.4]

R_{eHp} : Minimum yield stress, in N/mm2, defined in [2.2.4]

b_E : Effective width, in m, of the attached shell plating, defined in [2.2.4]

h_{we} : Effective height, in mm, of the web, equal to:

$$h_{we} = \left(\frac{2.25}{\beta_w} - \frac{1.25}{\beta_w^2}\right)h_w \quad \text{for } \beta_w > 1.25$$

$$h_{we} = h_w \quad \text{for } \beta_w \le 1.25$$

$$\beta_w = \frac{h_w}{t_w}\sqrt{\varepsilon_E}$$

ε_E : Element strain

2.2.7 Web local buckling of ordinary stiffeners made of flat bars

The equation describing the load-end shortening curve σ_{CR4}-ε for the web local buckling of flat bar ordinary stiffeners composing the hull girder transverse section is to be obtained from the following formula (see Fig 5):

$$\sigma_{CR4} = \frac{\Phi_p \cdot 10 s t_P \sigma_{CP} + \Phi_s A_{Stif} \sigma_{C4}}{A_{Stif} + 10 s t_P}$$

where:

Φ_s : Edge function defined in [2.2.4]

Φ_p : Edge function defined in [2.2.4]

R_{eHs} : Minimum yield stress, in N/mm2, defined in [2.2.4]

A_{Stif} : Net sectional area of the stiffener, in cm^2, without attached plating

σ_{CP} : Buckling stress of the attached plating, in N/mm^2, defined in [2.2.5]

σ_{C4} : Critical stress, in N/mm^2, equal to:

$$\sigma_{C4} = \frac{\sigma_{E4}}{\varepsilon_s} \qquad \text{for } \sigma_{E4} \le \frac{R_{eHs}}{2}\varepsilon_s$$

$$\sigma_{C4} = R_{eHs}\left(1 - \frac{R_{eHs}\,\varepsilon_s}{4\sigma_{E4}}\right) \qquad \text{for } \sigma_{E4} > \frac{R_{eHs}}{2}\varepsilon_s$$

σ_{E4} : Local Euler buckling stress, in N/mm^2, equal to:

$$\sigma_{E4} = 160000\left(\frac{t_w}{h_w}\right)^2$$

ε_s : Relative strain for the material of ordinary stiffener, defined in [2.2.4]

2.2.8 Plate buckling

The equation describing the load-end shortening curve σ_{CR5}-ε for the buckling of transversely stiffened panels composing the hull girder transverse section is to be obtained from the following formula:

$$\sigma_{CR5} = \min\begin{cases} R_{eHp}\,\Phi_p \\ \Phi_p R_{eHp}\left[\frac{s}{\ell}\left(\frac{2.25}{\beta_E} - \frac{1.25}{\beta_E^2}\right) + 0.1\left(1 - \frac{s}{\ell}\right)\left(1 + \frac{1}{\beta_E^2}\right)^2\right] \end{cases}$$

where:

Φ_p : Edge function defined in [2.2.4].

R_{eHs} : Minimum yield stress, in N/mm2, defined in [2.2.4]

β_E : Coefficient defined in [2.2.4].

KC#788

Item	Still water (SW) shear force	Still water (SW)bending moment	Note
Ch 1 Sec 4 [2.3] loads [Definition]	Design	Design	
Ch 4 Sec 3 [1.1.1] [sign convention]	Vertical shear force	Vertical bending moment	A term, 'vertical', is missing in the title of Figure1.
Ch 4 Sec 3 [2.1.1] {Still water loads}	Shear force To be treated as the upper limit	Vertical SW bending moment To be treated as the upper limit	
Ch 4 Sec 3 [2.2] [SW bending moment] Ch 4 Sec 3 [2.3] [SW shear force]	Design SW shear force: Maximum shear force for the loading condition	Design SW bending moment: Maximum SW bending moment for the loading condition.	Greater values may be considered if defined by the Designer.
Ch 4 Sec 3 [2.4] {flooded condition}	SW shear force	SW bending moment	
Ch 4 Sec 4 Table 2	Ver. SF	Ver BM	
Ch 4 Sec 7 [1.2.4] & {1.2.5] [Loading condition]			Design loading conditions specified in the loading manual
Ch 4 Sec 7 [4.2.1]	SW vertical shear force in Table 3	SW vertical bending moment in Table 2	A term, 'vertical', is missing in the title of 4.2.
Ch 4 Sec 7 [4.2.2]		If one loading condition in LM has a SW vertical bending moment more severe than the value in Table 2	Vertical shear force should also be considered.
Ch 4 Sec 7 Table 2 & Table 3	**Allowable** SW shear force	**Allowable** SW vertical bending moment	
Ch 4 Sec 8 [2.1.1] (All ships) Ch 4 Sec 8 [2.1.2] (flooding, L>150m)	Permissible limits of SW shear force	Permissible limits of SW bending moment	Same term as stated in UR S1A.2.1.c).
Ch 4 Sec 8 [3.1.1] & [3.1.2]	SW shear forces do not exceed the specified permissible limits	SW bending moments do not exceed the specified permissible limits	
Ch 4 Sec 8 [3.2.2]	Hull girder shear force limits	Hull girder bending moment limits	
Ch 5 Sec 1 Symbol	Design SW shear force	Design SW bending moment	
Ch 5 Sec 1 [1.1.1]	the criteria for calculating HG strength to be used for the checks 2 to 5, i.a.w. the HG loads specified in Ch 4 Sec 3.		Hull girder strength estimation is carried out with 'Design loads'
Ch 5 Sec 1 [2.1] and [2.2]	Qsw: Design	Msw: Design	

Ch 5 Sec 1 [4]		Msw: Design	
Ch 5 Sec 1 [5.1.1]		Permissible SW bending moment is the value Msw (Design)	Permissible value = Design value
Ch 5 Sec 1 [5.1.2] Direct Ch 5 Sec 1 [5.1.3] Simplified	Permissible SW shear force, calculated based on allowable stress		A lower value of the permissible SW shear force may be considered, if requested by the Shipbuilder.
Ch 5 Sec 1 [5.2.2] Simplified (Harbour conditions)	Permissible SW shear force, with reference to the value in [5.1.3].		Same as above
Ch 5 Sec 1 [5.3.1]		Permissible SW bending moment is Msw,F (Design)	Permissible value = design value
Ch 5 Sec 1 [5.3.2] direct Ch 5 Sec 1 [5.3. 3] Simplified	Permissible SW shear force, calculated based on allowable stress		
Ch 5 Sec 2 and Appendix 1		Msw: Design SW bending moment	
Ch 6 Sec 1 [3.1.5] Ch 6 Sec 2 [3.1.5] Ch 6 Sec 4 [2.1.5]		Msw: Permissible SW bending moment	
Ch 6 Sec 3 [2.1.3]	Design SW shear force If design SW shear force is not available, the following default value may be used.		
Ch 7 Sec 2 Symbol	Qsw: **Allowable** SW shear force	Msw; Design vertical bending moment	Terms, 'Still Water' are missing in the definition of Msw.
Ch 7 Sec 2 [2.5.2] and [2.5.3]	Maximum vertical shear force	Maximum vertical bending moment	
Ch 8 Sec 3 [3.2.2] & Sec 4 [3.2.2]		SW vertical bending moment in Ch 4 Sec 3 [2.2], If the design value is not available, the permissible value is obtained by the following formula	Hull girder strength estimation is carried out with 'Design loads'