Amendments of the Rules

(For external opinion inquiry)

Guidance on Strength Assessment of Container ships Considering the Whipping Effect

2022. 2.

Hull Rule Development Team

- Major revisions -

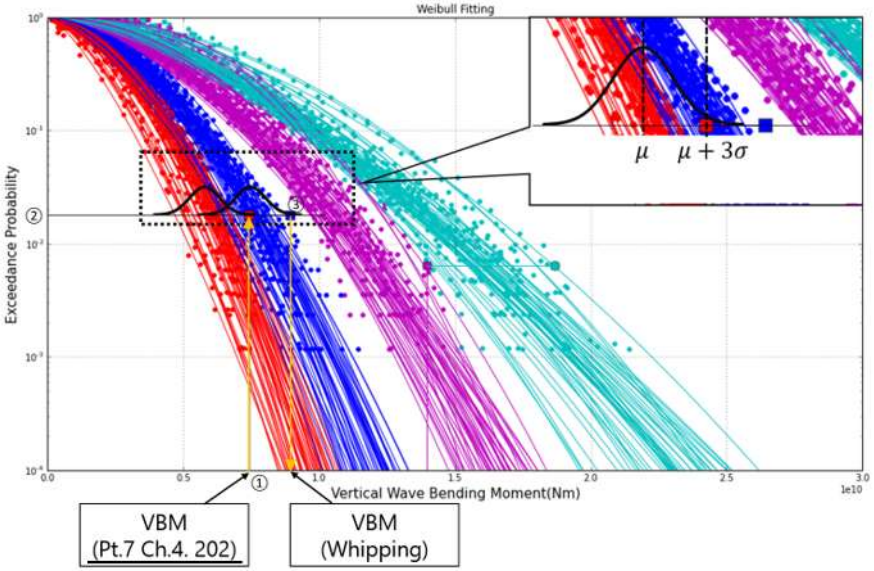
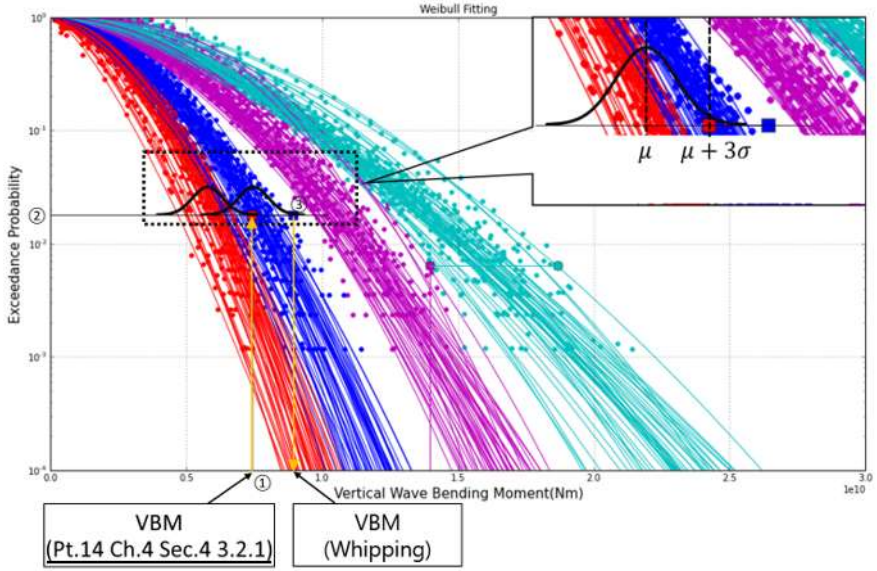
1. Modification of the regulations referenced in this guidance to the Pt 14 (previous reference: Pt 7)
   - In this guidance, the regulation of vertical wave bending moment, etc. is referred to the "Pt 7 Ships of Special Service" rules.
   - As "Pt 14 Structural Rules for Container Ship" is applied to newly built container ships, the regulations referenced in this guidance are modified to Pt 14 rules.

2. Reduction of the partial safety factor for vertical wave bending moment including whipping effect
   - When evaluating the hull girder ultimate strength, a partial safety factor is applied to take into account the uncertainties related to the estimation of the vertical wave bending moment.
   - For container ships, the partial safety factor, γ_W, of 1.2 for the vertical wave bending moment is applied in accordance with UR S11A.
   - In this guidance, the uncertainties related to the vertical wave bending moment evaluation is resolved to some extent by taking into account whipping effect, so the partial safety factor γ_{Whip} is newly defined and taken as 1.05.

Present	Amendment	Note
CHAPTER 1 GENERAL	**CHAPTER 1 GENERAL**	
Section 1 General	**Section 1 General**	
101. Application	**101. Application**	
1. Purpose of these guidances is to estimate the extreme load considering the whipping effect and to evaluate the structural integrity of the ship. It is applied to the ship which requires consideration of the whipping effect due to slamming load, in accordance with **Pt 7, Ch 4, 207.** of **Rules for the Classification of Steel Ships.** Other ships may be applied in consultation with the Society.	**1.** Purpose of these guidances is to estimate the extreme load considering the whipping effect and to evaluate the structural integrity of the ship. It is applied to the ship which requires consideration of the whipping effect due to slamming load, in accordance with **Pt 14, Ch 5, Sec 2, 2.4.1** of **Rules for the Classification of Steel Ships.** Other ships may be applied in consultation with the Society.	* For container ships contracted for new construction, "Pt 14 Structural Rules for Container Ships" is applied. Therefore, the reference that was made based on "Pt 7 Ships of Special Service" was revised based on Pt 14.
2. ~ **4.** 〈omitted〉	**2.** ~ **4.** 〈same as the current Rules〉	
102. Class Notations 〈omitted〉	**102. Class Notations 〈same as the current Rules〉**	
Section 2 Analysis Procedure	**Section 2 Analysis Procedure**	
201. General 〈omitted〉	**201. General 〈same as the current Rules〉**	
202. Design Wave Method	**202. Design Wave Method**	
1. 〈omitted〉	**1.** 〈same as the current Rules〉	
2. The amplitude of the design wave shall be calculated using the value of the vertical wave bending moment specified in **Pt 7, Ch 4, 202. 3** of the **Rules for the Classification of Steel Ships**.	**2.** The amplitude of the design wave shall be calculated using the value of the vertical wave bending moment specified in **Pt 14, Ch 4, Sec 4, 3.2.1** of the **Rules for the Classification of Steel Ships**.	*
3. ~ **5.** 〈omitted〉	**3.** ~ **5.** 〈same as the current Rules〉	
203. Design Sea State Method 〈omitted〉	**203. Design Sea State Method 〈same as the current Rules〉**	

Present	Amendment	Note
CHAPTER 2 Selection of design wave and dominant sea state	**CHAPTER 2 Selection of design wave and dominant sea state**	
Section 1 General 〈omitted〉	**Section 1 General 〈same as the current Rules〉**	
Section 2 Design wave selection	**Section 2 Design wave selection**	
201. Long-term analysis value of vertical wave bending moment	**201. Long-term analysis value of vertical wave bending moment**	
1. For container ships, use the linear wave bending moment as the long-term analysis value by excluding the non-linear correction factor f_{NL-Hog}, from the vertical wave bending moment for hogging M_{W-Hog}, in accordance with **Pt 7, Ch 4, 202. 3** of **the Rules for the Classification of Steel Ships**.	**1.** For container ships, use the linear wave bending moment as the long-term analysis value by excluding the non-linear correction factor f_{NL-Hog}, from the vertical wave bending moment for hogging M_{wv-Hog}, in accordance with **Pt 14, Ch 4, Sec 4, 3.2.1** of **the Rules for the Classification of Steel Ships**.	*
2. Ships other than container ships are to be decided in consultation with the Society.	**2.** Ships other than container ships are to be decided in consultation with the Society.	
202. Design wave selection 〈omitted〉	**202. Design wave selection 〈same as the current Rules〉**	
Section 3 Dominant sea state selection 〈omitted〉	**Section 3 Dominant sea state selection 〈same as the current Rules〉**	
CHAPTER 3 Hydro-elastic simulation 〈omitted〉	**CHAPTER 3 Hydro-elastic simulation 〈same as the current Rules〉**	

Present	Amendment	Note
CHAPTER 4 Evaluation of hull girder strength considering the whipping effect	**CHAPTER 4 Evaluation of hull girder strength considering the whipping effect**	
Section 1 General 〈omitted〉	**Section 1 General 〈same as the current Rules〉**	
Section 2 Estimation of whipping contribution by design wave method 〈omitted〉	**Section 2 Estimation of whipping contribution by design wave method 〈same as the current Rules〉**	
Section 3 Estimation of whipping contribution by design sea state method	**Section 3 Estimation of whipping contribution by design sea state method**	
301. ~ 302. 〈omitted〉	**301. ~ 302. 〈same as the current Rules〉**	
303. Estimation of parameters of the probability distribution	**303. Estimation of parameters of the probability distribution**	
1. ~ 4. 〈omitted〉	**1. ~ 4.** 〈same as the current Rules〉	

Present	Amendment	Note
		*
Fig 4.3 Weibull fitting of cumulative probability distribution	**Fig 4.3 Weibull fitting of cumulative probability distribution**	
304. Estimation of probability level and calculation of extreme load	**304. Estimation of probability level and calculation of extreme load**	
1. ~ **2.** 〈omitted〉	**1.** ~ **2.** 〈same as the current Rules〉	
3. The exceedance probability level for estimating the extreme load is the level when the representative value of the load response without whipping reaches the value of the vertical bending moment in accordance with **Pt 7, Ch 4, 202. 3** of the **Rules for the Classification of Steel Ships**. The representative value for each exceedance probability is the value of three times the standard deviation added to the mean value of normal distribution.	**3.** The exceedance probability level for estimating the extreme load is the level when the representative value of the load response without whipping reaches the value of the vertical bending moment in accordance with **Pt 14, Ch 4, Sec 4, 3.2.1** of the **Rules for the Classification of Steel Ships**. The representative value for each exceedance probability is the value of three times the standard deviation added to the mean value of normal distribution.	*
4. ~ **5.** 〈omitted〉	**4.** ~ **5.** 〈same as the current Rules〉	

Present	Amendment	Note
Section 4 Estimation of whipping contribution of vertical bending moment and ultimate hull girder strength	**Section 4 Estimation of whipping contribution of vertical bending moment and ultimate hull girder strength**	
401. Calculation of whipping contribution of vertical bending moment The whipping contributions defined in **Sec 2** and **3** can be rewritten as:	**401. Calculation of whipping contribution of vertical bending moment** The whipping contributions defined in **Sec 2** and **3** can be rewritten as:	
$\gamma_{whip} = \frac{M_{whip}}{M_{rigid}}$	$f_{Whip} = \frac{M_{Whip}}{M_{Rigid}}$	※ Modification of symbols
γ_{whip} : Whipping contribution to vertical wave bending moment M_{whip} : Vertical wave bending moment with whipping effect M_{rigid} : Vertical wave bending moment without whipping effect	f_{Whip} : Whipping contribution to vertical wave bending moment M_{Whip} : Vertical wave bending moment with whipping effect M_{Rigid} : Vertical wave bending moment without whipping effect	
402. Hull girder ultimate strength assessment considering the whipping effect In case of container ship, the hull girder ultimate strength of hogging condition considering whipping for amidship should satisfy the following criteria. Ships other than container ships are to be decided in consultation with the Society.	**402. Hull girder ultimate strength assessment considering the whipping effect** In case of container ship, the hull girder ultimate strength of hogging condition considering whipping for amidship should satisfy the following criteria. Ships other than container ships are to be decided in consultation with the Society.	
$\gamma_S M_S + \gamma_W \gamma_{whip} M_W \leq \frac{M_U}{\gamma_M \gamma_{DB}}$	$\gamma_S M_S + \gamma_W f_{Whip} M_W \leq \frac{M_U}{\gamma_M \gamma_{DB}}$	※
M_S : Permissible still water vertical bending moment at hogging condition(kNm). M_W : Vertical wave bending moment in accordance with **Pt 7, Ch 4, 202. 3** of the **Rules for the Classification of Steel Ships**(kNm). M_U : Vertical hull girder ultimate bending capacity in accordance with **Pt 7, Ch 4, 206. 3** of the **Rules for the**	M_S : Permissible still water vertical bending moment at hogging condition(kNm). M_W : Vertical wave bending moment in accordance with **Pt 14, Ch 4, Sec 4, 3.2.1** of the **Rules for the Classification of Steel Ships**(kNm). M_U : Vertical hull girder ultimate bending capacity in accordance with **Pt 14, Ch 5, Sec 2, 2.1.1** of the **Rules for the**	* *

Present	Amendment	Note
Classification of Steel Ships(kNm). γ_S : Partial safety factor for the still water bending moment, to be taken as 1.0. γ_W : Partial safety factor for the vertical wave bending moment, to be taken as 1.2. γ_{whip} : Whipping contribution to vertical wave bending moment, defined in **401**. ⚓	**Classification of Steel Ships**(kNm). γ_S : Partial safety factor for the still water bending moment, to be taken as 1.0. γ_{Whip}: Partial safety factor for the vertical wave bending moment (with whipping included), to be taken as 1.05. f_{Whip}: Whipping contribution to vertical wave bending moment, defined in **401**. ⚓	Define the partial safety factor for the vertical wave bending moment including the whipping effect and set it to 1.05. **