Strength Evaluation of Container Stowage and Securing Arrangements

Object of Amendment

Rules for the Survey and Construction of Steel Ships Parts A, B, C and CS

Reason for Amendment

In line with recent trends, such as the increase in the volume of freight containers being transported and the interest in ensuring that they are transported safely, expectations and demands for safety standards and strength assessments of container stowage and securing arrangements have increased.

The Society, therefore, published its "Guidelines for Container Stowage and Securing Arrangements", which provides a general guideline for the stowage and securing of containers. This Guidelines has been revised several times over the years for the purpose of incorporating the latest knowledge and feedback related to its practical application.

Relevant requirements for strength evaluation of container stowage and securing arrangements are, therefore, specified based on "Guidelines for Container Stowage and Securing Arrangements" and the results of recent research.

Outline of the Amendment

The main contents of this amendment are as follows:

(1) Specify requirements for strength evaluation of container stowage and securing arrangements in 14.3, Part 2-1, Part C.
(2) Specify requirements for the safe design for container lashing operations in 14.4, Part 2-1, Part C.

Effective Date and application

1. This amendment applies to ships for which the date of contract for construction is on or after 1 July 2027.
2. Notwithstanding the preceding 1, this draft amendment may apply, upon request, to ships for which the date of contract for construction is before the effective date.

An asterisk (*) after the title of a requirement indicates that there is also relevant information in the corresponding Guidance.

ID:DH25-06

Amended	Original	Remarks
RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS	**RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS**	
Part A GENERAL RULES	**Part A GENERAL RULES**	
Chapter 1 GENERAL	**Chapter 1 GENERAL**	
1.2 Class Notations	**1.2 Class Notations**	
1.2.4 Hull Construction and Equipment, etc.*	**1.2.4 Hull Construction and Equipment, etc.***	
10 The class notation indicated in **(1)** and **(2)** below is affixed to the Classification Characters of ships for which strength evaluation of container stowage and securing arrangements are carried out by a method approved by the Society for preparing container securing arrangement plan that is in accordance with **14.3, Part 2-1, Part C**. (1) The notation *Container Stowage and Securing Arrangements* (abbreviated to *CSSA*) is affixed to the Classification Characters of ships for which strength evaluation of container stowage and securing arrangements without taking specific sea routes, seasons or other factors are carried out in accordance with **14.3, Part 2-1, Part C**. (2) Appropriate additional notation is affixed as specified in **(a)** to **(c)** below to the Classification Characters of ships for which strength evaluation of container stowage and securing arrangements considering effects of specific sea routes, seasons or other factors are carried out, in accordance with **14.3, Part 2-1,**	(Newly added)	Correspond to 7.3, “Guidelines for Container Stowage and Securing Arrangements”. Specify notation for ships for which the strength evaluation of container stowage and securing arrangements is carried out.

Amended	Original	Remarks
Part C and **Annex 14.3A "Application of load correction factor in the strength evaluation of container stowage and securing arrangements", Part 2-1, Part C**. If multiple factors in **(a)** to **(c)** below are considered, appropriate notation is affixed to the Classification Characters (e.g. *CSSA-RS/WF*). For **(a)** and **(b)** below, either notation, but not both, may be affixed. (a) For ships for which strength evaluation of container stowage and securing arrangements considering effects of specific routes are carried out: *Container Stowage and Securing Arrangements with Service on Specific Sea Routes* (abbreviated to *CSSA-R*) (b) For ships for which strength evaluation of container stowage and securing arrangements considering effects of specific routes and seasons are carried out: *Container Stowage and Securing Arrangements with Service on Specific Sea Routes and Seasons* (abbreviated to *CSSA-RS*) (c) For ships for which strength evaluation of container stowage and securing arrangements based on weather forecast for short voyages: *Container Stowage and Securing Arrangements with Weather Forecasting* (abbreviated to *CSSA-WF*)		
11 For ships which are specifically designed and fitted for the purpose of carrying containers on deck, in accordance with **14.4, Part 2-1, Part C**, the notation *Safe Design for Container Lashing* (abbreviated to *SDCL*) is affixed to the Classification Characters.	(Newly added)	Correspond to 8.3, "Guidelines for Container Stowage and Securing Arrangements".

Amended-Original Requirements Comparison Table (Strength Evaluation of Container Stowage and Securing Arrangements)

Amended	Original	Remarks
12 For ships intended for the carriage of wood chips, generally are ships of single-side skin construction having a single deck, double bottom and bilge hopper tanks and complying with the provisions of **Part 2-4, Part C**, the notation of *"Chip Carrier"* (abbreviated to *CPC*) is affixed to the Classification Characters. (Omitted)	**10** For ships intended for the carriage of wood chips, generally are ships of single-side skin construction having a single deck, double bottom and bilge hopper tanks and complying with the provisions of **Part 2-4, Part C**, the notation of *"Chip Carrier"* (abbreviated to *CPC*) is affixed to the Classification Characters. (Omitted)	Renumber -13 and remaining sub-requirements in the same way.

Amended-Original Requirements Comparison Table (Strength Evaluation of Container Stowage and Securing Arrangements)

Amended	Original	Remarks

RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part B CLASS SURVEYS

Chapter 2 CLASSIFICATION SURVEYS

2.1 Classification Survey during Construction

2.1.3 Submission of Plans and Documents

RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part B CLASS SURVEYS

Chapter 2 CLASSIFICATION SURVEYS

2.1 Classification Survey during Construction

2.1.3 Submission of Plans and Documents

Table B2.1 Plans and Documents – Hull (General)

Name*1	Notes	Submission			Maintained On Board		
						Ship Construction File	
		Approval	Other	Finished Plans (Submission)	Finished plans (On Board)	Ships engaged in international voyages	Ships subject to *SOLAS* Chapter II-1 Regulation 3-10
(1~99 : omitted)							
100 Operation manual for lashing software	(1) For container carriers engaged in international voyages. (2) As specified in **Annex3.1, Part 2-1, Part C of the Rules**.		○		○		
101 Cargo securing manual	(1) For ships that are subject to **1.2.3, Part B of the Rules**.	○			○*2		
102 Drawings of fixed and portable container securing fittings	(1) For ships that are subject to **14.2, Part 2-1, Part C of the Rules**.	○			○ *2,*3		

Add operation manual for lashing software to the list of documents required for submission as reference drawings.

Amended-Original Requirements Comparison Table (Strength Evaluation of Container Stowage and Securing Arrangements)

<table>
<tr><th>Amended</th><th>Original</th><th>Remarks</th></tr>
<tr><td colspan="2">
<table>
<tr><td>103 Arrangement plan for fixed container securing fittings</td><td>(1) For ships that are subject to **14.2, Part 2-1, Part C of the Rules**.</td><td>○</td><td></td><td></td><td>○
*2,*3</td><td></td><td></td></tr>
<tr><td>104 Drawings of container supporting structures</td><td>(1) For ships that are subject to **14.2, Part 2-1, Part C of the Rules**.</td><td>○</td><td></td><td></td><td>○</td><td></td><td></td></tr>
<tr><td>105 Cargo safe access plan</td><td>(1) For ships that are subject to **14.2, Part 2-1, Part C of the Rules**.</td><td>○</td><td></td><td></td><td>○
*2,*3</td><td></td><td></td></tr>
<tr><td>106 Container stowage plan</td><td>(1) For ships that are subject to **14.2, Part 2-1, Part C of the Rules**.</td><td>○</td><td></td><td></td><td>○
*2,*3</td><td></td><td></td></tr>
<tr><td>107 Container securing arrangement plan</td><td>(1) For ships that are subject to **14.2, Part 2-1, Part C of the Rules**.</td><td>○</td><td></td><td></td><td>○
*2,*3</td><td></td><td></td></tr>
</table>
Notes
*1 : For ships of not less than 500 *gross tonnage* engaged in international voyages, it is recommended submitted pans and documents be marked with *IMO* ship identification numbers.
*2 : Plans and documents plans approved by the Society or copies thereto.
*3 : In case where these plans or documents are parts of Cargo Securing Manual, individual plans or documents do not require stamping.
</td><td>Clarify that the stamping of individual plans or documents is not required when plans or documents 104, 105, and 107 to 109 in Table B2.1 are included in the Cargo Securing Manual.</td></tr>
</table>

Amended	Original	Remarks
RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS	**RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS**	
PART C HULL CONSTRUCTION AND EQUIPMENT	**PART C HULL CONSTRUCTION AND EQUIPMENT**	
PART 2-1 CONTAINER CARRIERS	**PART 2-1 CONTAINER CARRIERS**	
Chapter 3 STRUCTURAL DESIGN PRINCIPLES	**Chapter 3 STRUCTURAL DESIGN PRINCIPLES**	
3.3 Lashing Software	**3.3 Lashing Software**	
3.3.1 General	**3.3.1 General**	
3.3.1.1 General For container carriers engaged in international voyages, the lashing software in accordance with **Annex 3.1, Part 2-1, Part C** capable of evaluating the strength of container stowage and securing arrangements as specified in **14.3, Part 2-1, Part C** is to be provided on board the ship.	**3.3.1.1 General** For container carriers engaged in international voyages, the lashing software in accordance with **Annex 3.1, Part 2-1, Part C** is to be provided on board the ship.	Revise the requirement for the lashing software provided for container carriers engaged in international voyages.

Amended	Original	Remarks
Chapter 14 EQUIPMENT	**Chapter 14 EQUIPMENT**	
14.2 Container Securing Systems	**14.2 Container Securing Systems**	
14.2.5 Container Stowage and Securing Plan	**14.2.5 Container Stowage and Securing Plan**	
14.2.5.1 General The stowage and securing plan, as referred to in *MSC*.1/*Circ*.1353/Rev.2 4.2.1 and 4.2.2, is to be submitted and subject to approval in accordance with **14.2.5.2** and **14.2.5.3**.	**14.2.5.1 General** If the stowage and securing plan, as referred to in *MSC*.1/*Circ*.1353/Rev.2 4.2.1 and 4.2.2, is required by the Administration, the plan is to be submitted and subject to approval in accordance with **14.2.5.2** and **14.2.5.3**.	Specify that the submission and approval of the container stowage and securing plans are mandatory.
14.3 Strength Evaluation of Container Stowage and Securing Arrangements	**(Newly added)**	
Symbols $z_{(i)}$: Distance (*m*) from the lowermost part of the container stack to the top of the container in the *i*-th tier. Here, *i* means the tier number counted from the bottom, with the lowermost tier designated as the first. b_{con}: Breadth of containers (*m*) l_{con}: Length of containers (*m*) $F_{v,(i)}$: Vertical load (*kN*) acting on each of the four bottom corners of containers in the *i*-th tier $H_{ttop,(i)}$: Transverse load (*kN*) acting on the top corners of the end walls of containers in the *i*-th tier for which the tension acting on lashing rods is considered $H_{tbtm,(i)}$: Transverse load (*kN*) acting on the bottom		

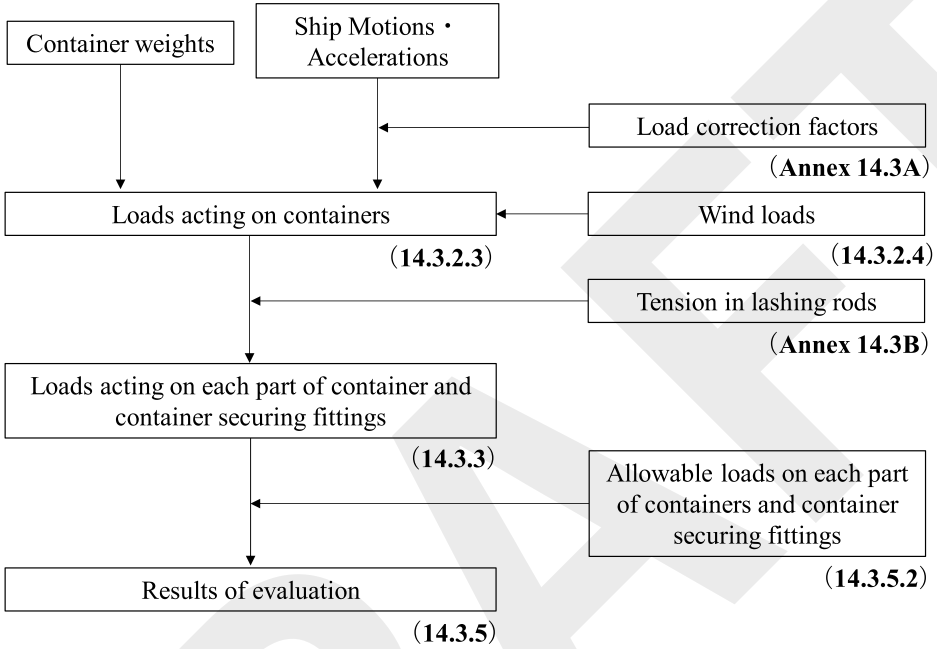
Amended	Original	Remarks
corners of the end walls of containers in the *i*-th tier for which the tension acting on lashing rods is considered $F_{ttop,(i)}$: Transverse load (*kN*) acting on the top corners of the end walls of containers in the *i*-th tier $F_{tbtm,(i)}$: Transverse load (*kN*) acting on the bottom corners of the end walls of containers in the *i*-th tier $F_{ltop,(i)}$: Longitudinal load (*kN*) acting on the top corners of the side walls of containers in the *i*-th tier $F_{lbtm,(i)}$: Longitudinal load (*kN*) acting on the bottom corners of the side walls of containers in the *i*-th tier $T_{xtop,(i)}$: Tension (*kN*) acting on the lashing rods that lash the top corners of containers in the *i*-th tier due to racking deformation of the containers (internal lashing) $T_{xbtm,(i)}$: Tension (*kN*) acting on the lashing rods that lash the bottom corners of containers in the *i*-th tier due to racking deformation of the containers (internal lashing) $T_{etop,(i)}$: Tension (*kN*) acting on the lashing rods that lash the top corners of containers in the *i*-th tier due to racking deformation of the containers (external lashing) $T_{ebtm,(i)}$: Tension (*kN*) acting on the lashing rods that lash the bottom corners of containers in the *i*-th tier due to racking deformation of the containers (external lashing) $S_{xtop,(i)}$: Tension (*kN*) acting on the lashing rods that lash		

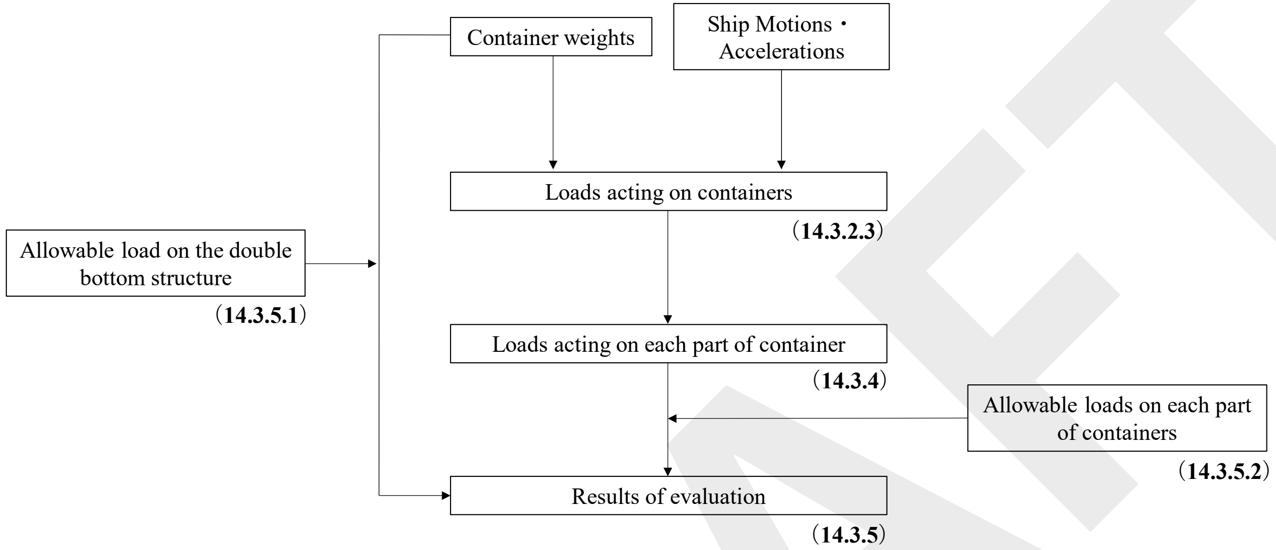
Amended	Original	Remarks
the top corners of containers in the *i*-th tier due to the vertical and horizontal separation between twist locks and corner castings (internal lashing) $S_{xbtm,(i)}$: Tension (*kN*) acting on the lashing rods that lash the bottom corners of containers in the *i*-th tier due to the vertical and horizontal separation between twist locks and corner castings (internal lashing) $S_{etop,(i)}$: Tension (*kN*) acting on the lashing rods that lash the top corners of containers in the *i*-th tier due to the vertical and horizontal separation between twist locks and corner castings (external lashing) $S_{ebtm,(i)}$: Tension (*kN*) acting on the lashing rods that lash the bottom corners of containers in the *i*-th tier due to the vertical and horizontal separation between twist locks and corner castings (external lashing) $\theta_{xtop,(i)}$: Angle (*rad*) of the lashing rods that lash the top corners of containers in the *i*-th tier to the horizontal plane (internal lashing) $\theta_{xbtm,(i)}$: Angle (*rad*) of the lashing rods that lash the bottom corners of containers in the *i*-th tier to the horizontal plane (internal lashing) $\theta_{etop,(i)}$: Angle (*rad*) of the lashing rods that lashes top corner of container in the *i*-th tier to the horizontal plane (external lashing) $\theta_{xbtm,(i)}$: Angle (*rad*) of the lashing rods that lash the bottom corners of containers in the *i*-th tier to the horizontal plane (external lashing)		

Amended	Original	Remarks
14.3.1 General **14.3.1.1 Overview** **1** A method for strength evaluation of container stowage and securing arrangements is specified in **14.3**. For the purpose of this **14.3**, "strength evaluation of container stowage and securing arrangements" means the calculation of loads acting on containers, container securing fittings and hull structures corresponding to specific weight distribution and arrangement of container securing fittings in a container stack, due to ship motions, accelerations and wind, and the verification that such loads do not exceed permissible values. **2** The Cargo Securing Manual may include information based on the strength evaluation of container stowage and securing arrangements carried out in accordance with **Annex 14.3A "Application of load correction factor in the strength evaluation of container stowage and securing arrangements"** using load correction factors. **3** **Fig. 14.3.1-1** and **Fig. 14.3.1-2** show flowcharts for the strength evaluation of container stowage and securing arrangements on deck and in cargo holds.	**(Newly added)**	

Amended	Original	Remarks

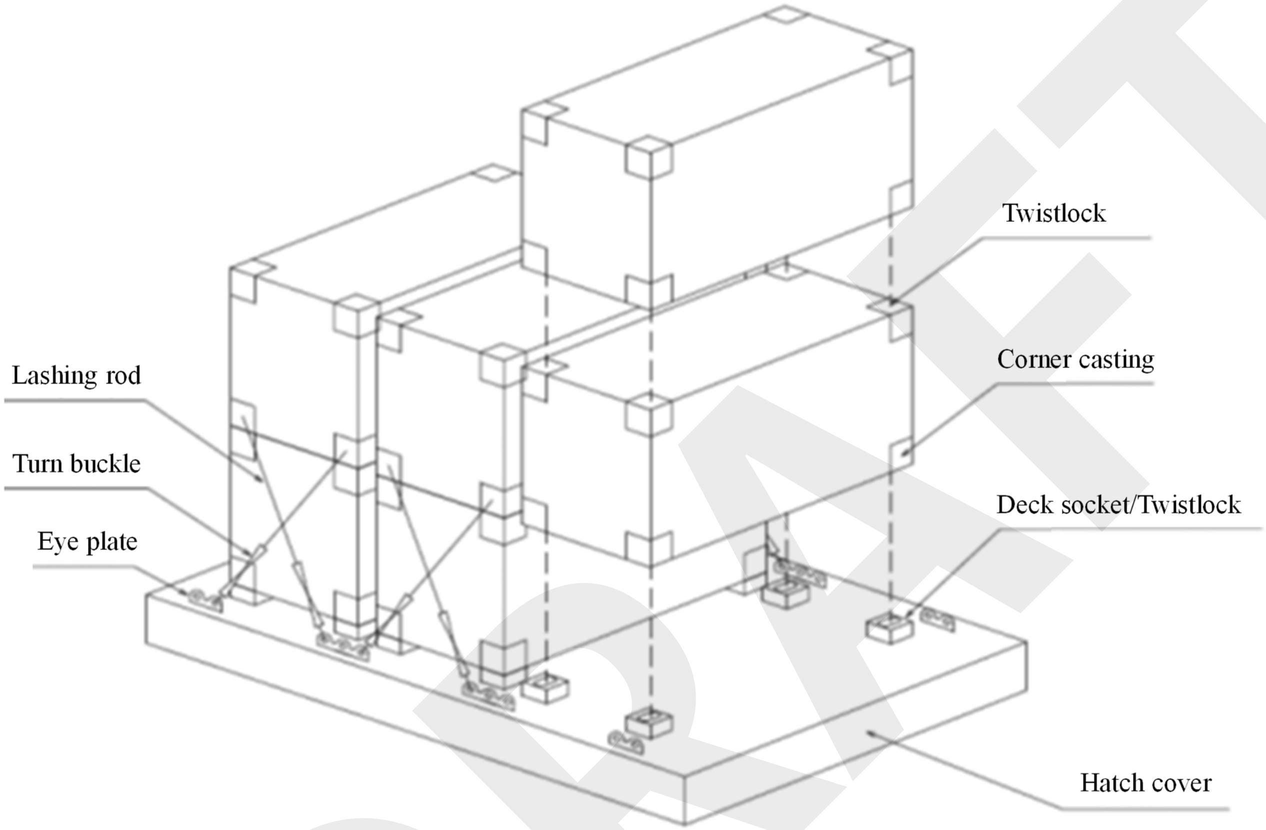
Fig. 14.3.1-1 Flowchart for Strength Evaluation of Container Stowage and Securing Arrangements on Deck



Amended	Original	Remarks
Fig. 14.3.1-2 Flowchart for Strength Evaluation of Container Stowage and Securing Arrangements in Cargo Holds  		
14.3.1.2 Application For container carriers engaged in international voyages, the container securing arrangement plan specified in **14.2.5.1** is to comply with the strength evaluation of container stowage and securing arrangements specified in **14.3**.	**(Newly added)**	
14.3.1.3 Assumptions **1** The following **(1)** to **(8)** assumptions are made in the strength evaluation specified in **14.3**. (1) Excessive ship motions, such as parametric rolling, are not taken into account. (2) Ship motions and wave environments exceeding those specified for the strength evaluation are not taken into account. (3) Containers are stowed so that the longitudinal edge of	**(Newly added)**	Correspond to Chapter 1, “Guidelines for Container Stowage and Securing Arrangements”.

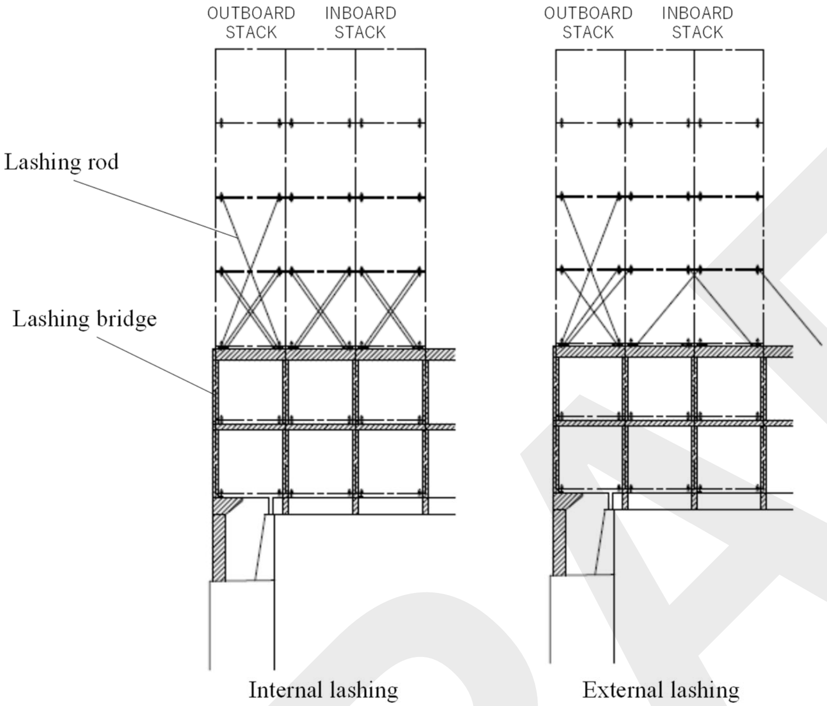
Amended	Original	Remarks
the container is along the longitudinal direction of the ship. (4) Containers, container securing fittings and lashing bridges are maintained in good condition. (5) Only racking deformation occurs in the containers. (6) The dimensions of the containers are based on *ISO*1496-1 or other appropriate international standards. (7) The following **(a)** to **(e)** assumptions, in addition to **(1)** to **(6)** above, are made for container stowage on deck. (a) Containers are secured by loose securing fittings (lashing rods, turnbuckles, twistlocks, etc.) in order to prevent them from moving or tipping over. (b) Containers are stowed on deck sockets installed on exposed decks and hatch covers. Vertical and horizontal movements of containers are prevented by twistlocks fitted between deck sockets and the first tier containers or connections between containers. Furthermore, containers are secured by lashing rods and turnbuckles through the use of eye plates fixed on lashing bridges or hatch covers and the corner castings of end walls. An example of container securing on deck is shown in **Fig. 14.3.1-3**. (c) The door end and closed end of a container are similarly secured. Containers are secured by either internal lashing or external lashing. Examples of container securing by lashing rods are shown in **Fig. 14.3.1-4**. (d) As shown in **Fig. 14.3.1-5**, only lashing rods that experience tension due to racking deformation of		

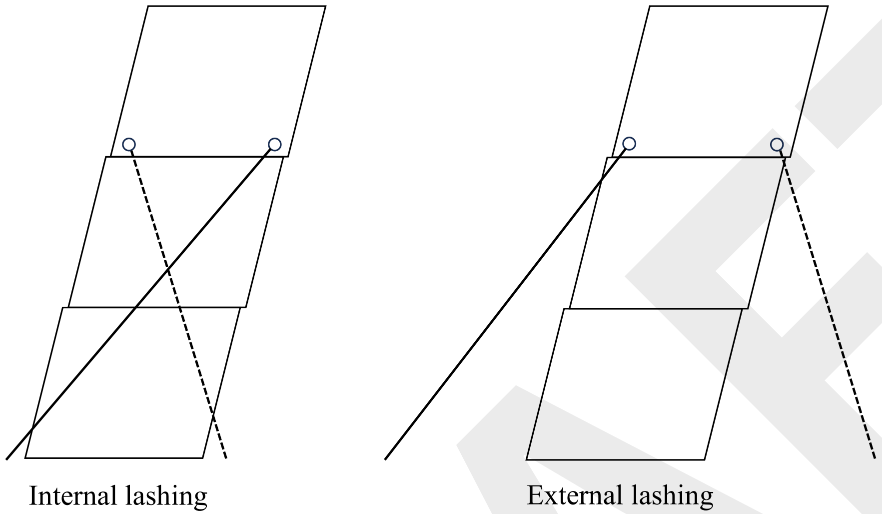
Amended	Original	Remarks
the containers are considered in the strength evaluation of container stowage and securing arrangements. For strength evaluations considering racking deformation in the longitudinal direction of the containers, the effects of lashing rods are not taken into account. (e) Containers are stowed within the allowable range of hatch cover stacking loads. (8) The following **(a)** to **(c)** assumptions, in addition to **(1)** to **(6)** above, are made for container stowage in cargo holds. (a) Containers are not secured since cell guides prevent them from moving or tipping over. In cases where a container is supported at its four corners by cell guides with small gaps, the load acting on the container in a transverse direction is supported by the cell guides. A cell guide overview is shown in **Fig. 14.3.1-6**. (b) In cases where 20’ containers are stowed in a 40’ container bay, container moving is prevented by container guides and stackers since one end wall of the 20’ container is not supported by cell guides. (c) Containers are stowed within the allowable range of double bottom stacking loads.		

Amended	Original	Remarks
Fig. 14.3.1-3 Example of Container Securing on Deck  		

Amended	Original	Remarks

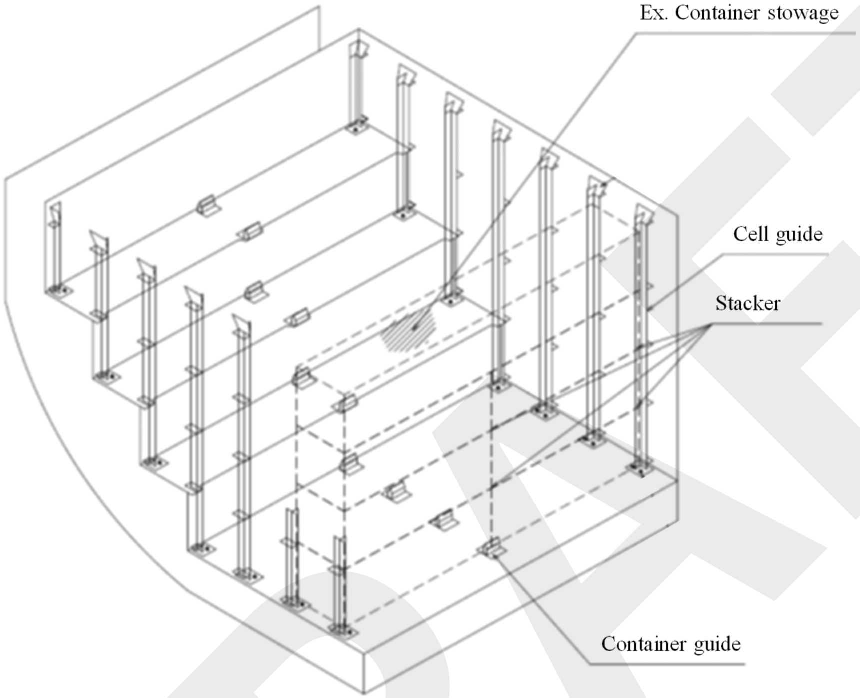
Fig. 14.3.1-4 Examples of Container Securing by Lashing Rods



Amended	Original	Remarks
Fig. 14.3.1-5 Lashing Rods Considered in Strength Evaluation  Internal lashing External lashing Solid line：Lashing rod included in the strength evaluation Dotted line：Lashing rod excluded from the strength evaluation		

Amended	Original	Remarks

Fig. 14.3.1-6 Cell Guide Overview



Amended	Original	Remarks
14.3.1.4 Evaluation Targets and Conditions For each evaluation target specified in **Table 14.3.1-1**, a strength evaluation is to be carried out at the stowage locations in accordance with the table. The wave conditions specified in **Table 14.3.1-1** are to be considered according to the evaluation target. The wave headings and representative characteristics of wave conditions LC1, LC2 and LC3 are given in **Table 14.3.1-2**.	**(Newly added)**	Define the evaluation stowage locations and wave conditions to be considered according to evaluation target

Table 14.3.1-1 Stowage Locations and Wave Headings for Each Evaluation Target

Evaluation targets		Stowage locations	Wave conditions
Member／securing fittings	Loads		
End walls of containers	Racking loads in the transverse direction	On deck／In cargo holds	*LC*1／*LC*3
Side walls of containers	Racking loads in the longitudinal direction	On deck	*LC*2
Corner posts of containers	Compressive loads	On deck／In cargo holds	*LC*1／*LC*3
Corner castings of containers	Loads in the horizontal direction due to tension acting on the lashing rod	On deck	
	Loads in the vertical direction due to tension acting on the lashing rod		
	Compressive loads		
Twistlocks	Shear loads		
	Tension		
Lashing rods	Tension		

Amended	Original	Remarks

Table 14.3.1-2 Wave Conditions

Wave conditions		Heading	Representative feature		Wind directions to be considered
*LC*1	*LC*1-1*P*	Beam sea	Port side: weather side down	Roll angle reaches its minimum	Starboard side: windward side
	*LC*1-2*P*	Beam sea	Port side: weather side up	Roll angle reaches its maximum	Port side: windward side
	*LC*1-1*S*	Beam sea	Starboard side: weather side down	Roll angle reaches its maximum	Port side: windward side
	*LC*1-2*S*	Beam sea	Starboard side: weather side up	Roll angle reaches its minimum	Starboard side: windward side
*LC*2		Head sea	Pitch angle reaches its maximum		-
*LC*3	*LC*3-1*P*	Oblique sea	Port side: weather side up	Pitch angular acceleration reaches its maximum	Port side: windward side
	*LC*3-2*P*	Oblique sea	Port side: weather side down	Pitch angular acceleration reaches its minimum	Starboard side: windward side
	*LC*3-1*S*	Oblique sea	Starboard side: weather side up	Pitch angular acceleration reaches its maximum	Starboard side: windward side
	*LC*3-2*S*	Oblique sea	Starboard side: weather side down	Pitch angular acceleration reaches its minimum	Port side: windward side

Notes:
Definitions of positive and negative roll and pitch are specified in **4.1.3.2, Part 1**.
Definitions of weather side down and weather side up are specified in **Table 4.6.2-3, Part 1**.

Correspond to 5.4, “Guidelines for Container Stowage and Securing Arrangements”.
Wave condition LC3 is newly defined by incorporating the concept of equivalent design wave AV specified in Chapter 4, Part 2-9, Part C.

Amended	Original	Remarks
14.3.2 Loads Acting on Containers	**(Newly added)**	
14.3.2.1 General In the strength evaluation of container stowage and securing arrangements, inclined gravitational components due to ship motions and accelerations, loads due to ship accelerations and		Correspond to 5.1, “Guidelines for Container Stowage and

Amended	Original	Remarks
wind loads are to be considered as loads acting on containers. However, where deemed necessary by the Society, loads due to other factors are to be considered. **14.3.2.2 Loads Acting on Containers due to Ship Motions** **1** In wave conditions $LC1$, $LC2$ and $LC3$ specified in **Table 14.3.1-2**, the loads acting on containers F_l, F_t and F_v (kN) are to be in accordance with **Table 14.3.2-1**. **2** Load correction factors may be applied in calculation of loads acting on containers in accordance with **Annex 14.3A "Application of load correction factor in the strength evaluation of container stowage and securing arrangements"**.		Securing Arrangements".

Table 14.3.2-1 Loads Acting on Containers

Wave conditions		Longitudinal loads F_l (*kN*)	Transverse loads F_t (*kN*)	Vertical loads F_v (*kN*)(1)
*LC*1	*LC*1-1*P*	0	$-M[-g\cdot\sin\theta$ $+(-0.2f_T+0.2)a_2-a_4(z-z_G)]$	$M[g\cdot\cos\theta$ $+(0.7-0.4f_T)a_3+a_4y]$
	*LC*1-2*P*	0	$-M[g\cdot\sin\theta$ $+(0.2f_T-0.2)a_2+a_4(z-z_G)]$	$M[g\cdot\cos\theta$ $+(-0.7+0.4f_T)a_3-a_4y]$
	*LC*1-1*S*	0	$-M[g\cdot\sin\theta$ $+(0.2f_T-0.2)a_2+a_4(z-z_G)]$	$M[g\cdot\cos\theta$ $+(0.7-0.4f_T)a_3-a_4y]$
	*LC*1-2*S*	0	$-M[-g\cdot\sin\theta$ $+(-0.2f_T+0.2)a_2-a_4(z-z_G)]$	$M[g\cdot\cos\theta$ $+(-0.7+0.4f_T)a_3+a_4y]$
*LC*2		$-M[g\cdot\sin\phi+(z-z_G)a_5]$	-	-
*LC*3	*LC*3-1*P*	$-M[-0.5g\cdot\sin\phi$ $+0.1a_1-0.95a_5(z-z_G)]$	$-M[0.1g\cdot\sin\theta$ $+0.01GMa_2+0.1a_4(z-z_G)$ $-0.9a_6(x-x_G)]$	$M\Bigl[g+\Bigl(1.7\frac{\lambda_{AV}}{L_C}-0.6\Bigr)a_3$ $-0.1a_4y+0.95a_5(x-x_G)]$
	*LC*3-2*P*	$-M[0.5g\cdot\sin\phi$ $-0.1a_1+0.95a_5(z-z_G)]$	$-M[-0.1g\cdot\sin\theta$ $-0.01GMa_2-0.1a_4(z-z_G)$ $+0.9a_6(x-x_G)]$	$M\Bigl[g+\Bigl(-1.7\frac{\lambda_{AV}}{L_C}+0.6\Bigr)a_3$ $+0.1a_4y-0.95a_5(x-x_G)]$
	*LC*3-1*S*	$-M[-0.5g\cdot\sin\phi$ $+0.1a_1-0.95a_5(z-z_G)]$	$-M[-0.1g\cdot\sin\theta$ $-0.01GMa_2-0.1a_4(z-z_G)$ $+0.9a_6(x-x_G)]$	$M\Bigl[g+\Bigl(1.7\frac{\lambda_{AV}}{L_C}-0.6\Bigr)a_3$ $+0.1a_4y+0.95a_5(x-x_G)]$
	*LC*3-2*S*	$-M[0.5g\cdot\sin\phi$ $-0.1a_1+0.95a_5(z-z_G)]$	$-M[0.1g\cdot\sin\theta$ $+0.01GMa_2+0.1a_4(z-z_G)$ $-0.9a_6(x-x_G)]$	$M\Bigl[g+\Bigl(-1.7\frac{\lambda_{AV}}{L_C}+0.6\Bigr)a_3$ $-0.1a_4y-0.95a_5(x-x_G)]$

(Notes)

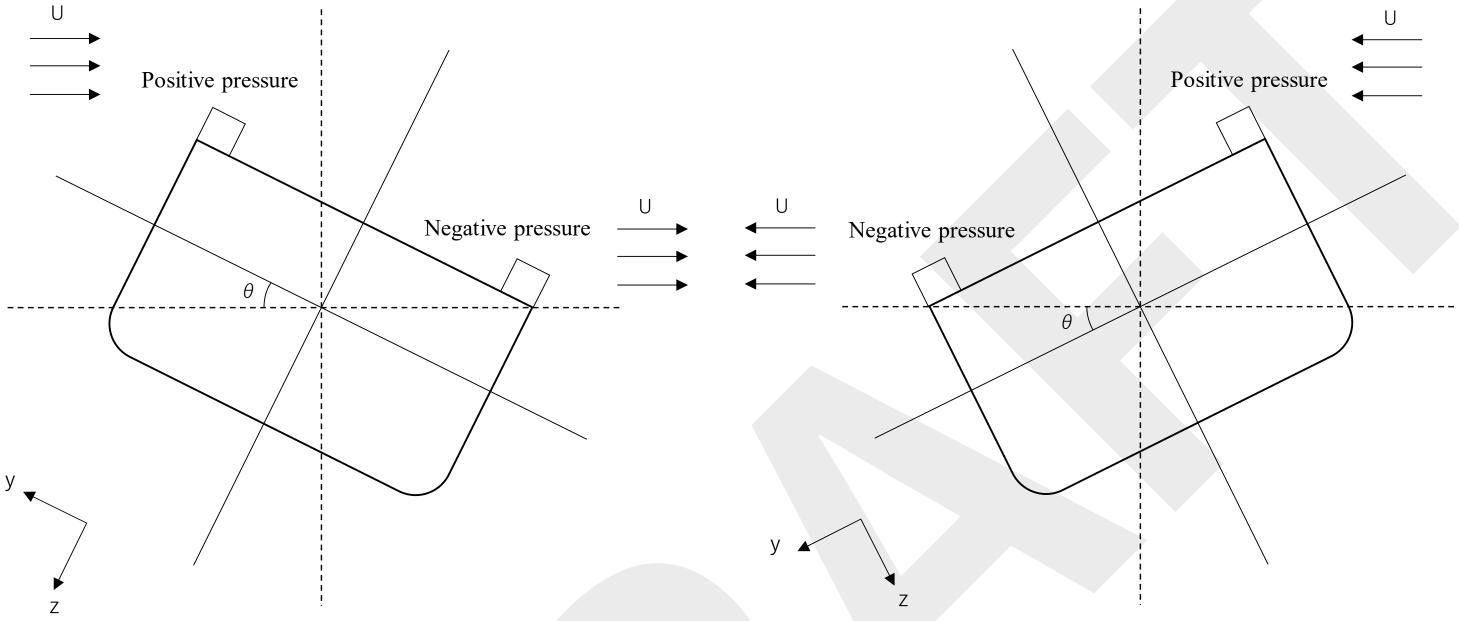
M: Mass per container (*t*)

a_1, a_2, a_3, a_4, a_5 and a_6: As specified in **4.2.3, Part 1**. The values for the maximum load condition are to be applied.

Amended	Original	Remarks
x, y and z : The coordinates of the centre of the gravity of a container. The vertical distance h_{cg} (*m*) from bottom of a container to the centre of the gravity of the container is to be calculated from the following formula and taken as the standard. $h_{cg} = 0.33h_{con}$ h_{con}: Height of container (*m*) θ and ϕ: As specified in **4.2.2, Part 1**: the values for the maximum load condition are to be applied. x_G: *X*-coordinate of the centre of gravity of the ship (*m*), to be obtained from the following formula. However, values calculated in consideration of loading conditions may be applied instead. $x_G = (0.36 + 0.2C_{B\_LC})L_C$ z_G: *Z*-coordinate of the centre gravity of the ship (*m*) for the loading condition under consideration. GM: Metacentric height (m): the value$^{(2)}$ for the loading condition under consideration, which is described in the loading manual, is to be adopted. λ_{AV}: As specified in **Table 4.3.2-5, Part2-9, Part C**. (1) Notwithstanding **1.4.3.6, Part 1**, vertical force is defined as positive when the load acts downward. (2) GM is not to be less than $0.002B^2$.		
14.3.2.3 Wind Loads Acting on Containers **1** In the strength evaluation of container stowage and securing arrangements on deck, where wave condition *LC*1 or *LC*3 is considered, the wind loads acting on containers specified in **14.3.2.3** are to be considered in addition to loads specified in **Table 14.3.2-1**. **2** Wind loads are considered to act on containers only in the transverse direction of such containers. **3** Wind loads are considered to act only on containers stowed in outboard stacks. **4** Wind loads acting on containers are to be in accordance with the following **(1)** and **(2)**. (1) The wind pressure acting on a container P_{wind} (*kN/m*^{2}) is to be in accordance with the following formula.	**(Newly added)**	Correspond to 5.5, "Guidelines for Container Stowage and Securing Arrangements".

Amended	Original	Remarks
$P_{wind} = 0.611 C_p U^2 \cdot 10^{-3}$ C_p: Pressure coefficient, to be taken as follows depending on the wind direction. Wind loads act on containers as positive pressure where wall surfaces exposed to winds are on the windward side, and as negative pressure where wall surfaces exposed to winds are on the leeward side, as shown in **Fig.14.3.2-1**. Where wall surfaces exposed to winds are on the windward side (positive pressure): $C_p = 1.0$ Where wall surfaces exposed to winds are on the leeward side (negative pressure): $C_p = 0.5$ U : Design wind speed, to be taken as 36 *m/s* as standard. However, an appropriate value is to be taken in consideration of service conditions. (2) Transverse wind loads acting on a container F_{wind} (kN/m^2) are to be in accordance with the following formula. $F_{wind} = P_{wind} \cdot A \cos\theta$ A: Area of the side face of the container (m^2) θ: As specified in **4.2.3, Part 1**. The values for the maximum load condition are to be applied.		

Fig. 14.3.2-1 Wind Direction Corresponding to Wind Pressure



14.3.3 Loads Acting on Container Stacks Stowed on Deck

14.3.3.1 General

In the strength evaluation of container stowage and securing arrangements on deck, where wave condition *LC*1 or *LC*3 is considered, all end walls, all securing fittings and all corner castings are to be evaluated. In addition, where wave condition *LC*2 is considered, all side walls are to be evaluated.

(Newly added)

Amended	Original	Remarks
14.3.3.2 Loads to be Evaluated **1** In the strength evaluation of container stowage and securing arrangements on deck, the loads acting on the parts of containers and securing fittings given in the following **(1)** to **(9)** are to be calculated. (1) Transverse racking load acting on containers (2) Longitudinal racking load acting on containers (3) Compressive load acting on the corner posts of containers (4) Horizontal load acting on container corner castings due to the tension of lashing rods (5) Vertical load acting on container corner castings due to the tension of lashing rods (6) Compressive load acting on corner castings (7) Shear load acting on twistlocks (8) Lifting load acting on twistlocks (9) Tension load acting on lashing rods **2** As shown in **Table 14.3.3-1,** the loads to be evaluated are specified according to wave condition.		Correspond to 6.4.3.2, "Guidelines for Container Stowage and Securing Arrangements".

Table 14.3.3-1 Load to be Evaluated Corresponding to Wave Condition

Wave condition	Load to be evaluated
*LC*1	(1), (3), (4), (5), (6), (7), (8) and (9)
*LC*2	(2)
*LC*3	(1), (3), (4), (5), (6), (7), (8) and (9)

Amended	Original	Remarks
14.3.3.3 Distribution of Loads Acting on Each Container Stowed on Deck **1** Transverse loads acting on the top and bottom corners of the end walls of containers are to be calculated in accordance with the following **(1)** to **(4)**. (1) Transverse load F_t (*kN*) acting on the container in the *i*-th tier in the container stack evaluated is to be obtained in accordance with **14.3.2.2**. (2) Transverse load $F_{t,(i)}$ (*kN*) acting on one end wall of the container in the *i*-th tier is to be obtained from the following formula. $F_{t,(i)} = \frac{F_t}{2}$ (3) Wind load F_{wind} (*kN*) acting on the container in the *i*-th tier is to be obtained in accordance with **14.3.2.3**. (4) Transverse loads acting on the top $F_{ttop,(i)}$ (*kN*) and bottom $F_{tbtm,(i)}$ (*kN*) corners of the end walls of the container in the *i*-th tier are to be obtained from the following formulae. $F_{ttop,(i)} = \alpha_{con} \cdot F_{t,(i)} + \frac{F_{wind}}{4}$ $F_{tbtm,(i)} = (1 - \alpha_{con})F_{t,(i)} + \frac{F_{wind}}{4}$ α_{con}: The ratio of vertical distance from the bottom of container to the centre of the gravity of container to the height of one container **2** Longitudinal loads acting on the top and bottom corners of the side walls of containers are to be calculated in accordance with the following **(1)** to **(3)**. (1) Longitudinal load F_l (*kN*) acting on the container in	**(Newly added)**	Correspond to 6.4.2, "Guidelines for Container Stowage and Securing Arrangements".

Amended	Original	Remarks
the *i*-th tier in the container stack evaluated is to be obtained in accordance with **14.3.2.2**. (2) Longitudinal load $F_{l,(i)}$ (kN) acting on one side wall of the container in the *i*-th tier is to be obtained from the following formula. $F_{l,(i)} = \frac{F_l}{2}$ (3) Longitudinal loads acting on the top $F_{ltop,(i)}$ (kN) and bottom $F_{lbtm,(i)}$ (kN) corners of the side walls of the container in the *i*-th tier are to be obtained from the following formulae. $F_{ltop,(i)} = \alpha_{con} \cdot F_{l,(i)}$ $F_{lbtm,(i)} = (1 - \alpha_{con})F_{l,(i)}$ α_{con}: As specified in **14.3.3.3-1(4)**. **3** Vertical loads acting on the bottom corners of containers are to be calculated in accordance with the following **(1)** and **(2)**. (1) Vertical load F_v (kN) acting on the container in the *i*-th tier in the container stack evaluated is to be obtained in accordance with **14.3.2.2**. (2) Vertical load $F_{v,(i)}$ (kN) acting on each of the four bottom corners of the container in the *i*-th tier is to be obtained from the following formula. $F_{v,(i)} = \frac{F_v}{4}$		
14.3.3.4 Loads Acting on Each Part of Containers and Securing Fittings **1** Loads acting on each part of containers and securing fittings in an *n*-tier container stack are to be in accordance with	**(Newly added)**	Correspond to 6.4.3.2, "Guidelines for

Amended	Original	Remarks
Table 14.3.3-2 to **Table 14.3.3-4** according to on wave conditions. Loads acting on each part of containers and securing fittings act as shown in **Fig. 14.3.3-1** in an *n*-tier container stack. **2** In cases where 20’ containers are stowed in the longitudinal direction of the ship and one or more 40’ container is stowed on top of the 20’ containers on deck, loads acting on each part of the containers and securing fittings are to be calculated as specified in **-1** above in accordance with **(1)** and **(2)**. (1) In calculating the positions at both ends of 40’ containers, all containers in the container stack are to be considered as 40’ containers. Furthermore, the weight of the container in a tier composed of 20’ containers is to be replaced with weight of one 20’ container. (2) In calculating positions in which two 20’ containers face each other, it is to be considered that said containers are not secured. Furthermore, the weight of 40’ containers and dynamic load due to their inertia may not be considered.		Container Stowage and Securing Arrangements”. Define the evaluation method for “Russian-stow” type stowage.

Amended-Original Requirements Comparison Table (Strength Evaluation of Container Stowage and Securing Arrangements)

Amended	Original	Remarks
Table 14.3.3-2 Loads Acting on Each Part of Containers and Securing Fittings (Wave Condition: $LC1$)		Correspond to 6.4.3.2, “Guidelines for Container Stowage and Securing Arrangements”

Load		Formula
(1)	Transverse racking load acting on the top corners on one side of the end walls of containers in the *j*-th tier	$\sum_{i=j}^{n} H_{ttop,(i)} + \sum_{i=j+1}^{n} H_{tbtm,(i)}$
(2)	Compressive load acting on one corner post of containers in the *j*-th tier	$\sum_{i=j+1}^{n} F_{v,(i)} + \sum_{i=j}^{n}\left(H_{ttop,(i)}\frac{z_{(i)} - z_{(j-1)}}{b_{con}}\right) + \sum_{i=j}^{n-1}\left(H_{tbtm,(i+1)}\frac{z_{(i)} - z_{(j-1)}}{b_{con}}\right)$ $+ \sum_{i=j}^{n} T_{xtop,(i)} \sin\theta_{xtop,(i)} + \sum_{i=j+1}^{n} T_{xbtm,(i)} \sin\theta_{xbtm,(i)} + \sum_{i=j}^{n} S_{xtop,(i)} \sin\theta_{xtop,(i)} + \sum_{i=j+1}^{n} S_{xbtm,(i)} \sin\theta_{xbtm,(i)}$
(3)	Horizontal load acting on one container corner casting due to the tension of the lashing rods securing containers in the *j*-th tier	For internal lashing $\left(T_{xtop,(j)} + S_{xtop,(j)}\right)\cos\theta_{xtop,(j)}\ ,\ \ \left(T_{xbtm,(j)} + S_{xbtm,(j)}\right)\cos\theta_{xbtm,(j)}$ For external lashing $\left(T_{etop,(j)} + S_{etop,(j)}\right)\cos\theta_{etop,(j)}\ ,\ \ \left(T_{ebtm,(j)} + S_{ebtm,(j)}\right)\cos\theta_{ebtm,(j)}$
(4)	Vertical load acting on one container corner casting due to the tension of the lashing rods securing containers in the *j*-th tier	For internal lashing $\left(T_{xtop,(j)} + S_{xtop,(j)}\right)\sin\theta_{xtop,(j)}\ ,\ \ \left(T_{xbtm,(j)} + S_{xbtm,(j)}\right)\sin\theta_{xbtm,(j)}$ For external lashing $\left(T_{etop,(j)} + S_{etop,(j)}\right)\sin\theta_{etop,(j)}\ ,\ \ \left(T_{ebtm,(j)} + S_{ebtm,(j)}\right)\sin\theta_{ebtm,(j)}$
(5)	Compressive load acting on one container corner casting at the bottom corners of containers in the *j*-th tier	$\sum_{i=j}^{n} F_{v,(i)} + \sum_{i=j}^{n}\left(H_{ttop,(i)}\frac{z_{(i)} - z_{(j-1)}}{b_{con}}\right) + \sum_{i=j}^{n-1}\left(H_{tbtm,(i+1)}\frac{z_{(i)} - z_{(j-1)}}{b_{con}}\right)$ $+ \sum_{i=j}^{n} T_{xtop,(i)} \sin\theta_{xtop,(i)} + \sum_{i=j}^{n} T_{xbtm,(i)} \sin\theta_{xbtm,(i)} + \sum_{i=j}^{n} S_{xtop,(i)} \sin\theta_{xtop,(i)} + \sum_{i=j}^{n} S_{xbtm,(i)} \sin\theta_{xbtm,(i)}$
(6)	Shear load acting on one twistlock at the bottom corners of containers in the *j*-th tier	$0.5\sum_{i=j}^{n}\left(H_{ttop,(i)} + H_{tbtm,(i)}\right)$

Amended	Original	Remarks

(7)	Lifting load acting on one twistlock at the bottom corner of container in the *j*-th tier	$\frac{-\sum_{i=j}^{n} F_{v,(i)} + \sum_{i=j}^{n}\left(H_{ttop,(i)}\frac{z_{(i)} - z_{(j-1)}}{b_{con}}\right) + \sum_{i=j}^{n-1}\left(H_{tbtm,(i+1)}\frac{z_{(i)} - z_{(j-1)}}{b_{con}}\right)}{-\sum_{i=j}^{n} T_{etop,(i)} \sin\theta_{etop,(i)} - \sum_{i=j}^{n} T_{ebtm,(i)} \sin\theta_{ebtm,(i)} - \sum_{i=j}^{n} S_{etop,(i)} \sin\theta_{etop,(i)} - \sum_{i=j}^{n} S_{ebtm,(i)} \sin\theta_{ebtm,(i)}}$
(8)	Tension acting on one lashing rod securing container in the *j*-th tier	For internal lashing $T_{xtop,(j)} + S_{xtop,(j)},\ T_{xbtm,(j)} + S_{xbtm,(j)}$ For external lashing $T_{etop,(j)} + S_{etop,(j)},\ T_{ebtm,(j)} + S_{ebtm,(j)}$

Notes:
$H_{ttop,(i)}$ and $H_{tbtm,(i)}$: As specified in **An3.2.3-3, Annex14.3B “Calculation of tension on lashing rods”**
$T_{xtop,(i)}, T_{xbtm,(i)}, T_{etop,(i)}$ and $T_{ebtm,(i)}$: As specified in **Table An2, Annex14.3B**
$S_{xtop,(i)}, S_{xbtm,(i)}, S_{etop,(i)}$ and $S_{ebtm,(i)}$: As specified in **Table An3, Annex14.3B**

Table 14.3.3-3 Loads Acting on Each Part of Containers (Wave Condition: *LC*2)

Load		Formula
(1)	Longitudinal racking load acting on the top corners on one side of the side walls of containers in the *j*-th tier	$\sum_{i=j}^{n}\lvert F_{ltop,(i)}\rvert + \sum_{i=j+1}^{n}\lvert F_{lbtm,(i)}\rvert$

Correspond to 6.4.3.2, “Guidelines for Container Stowage and Securing Arrangements”

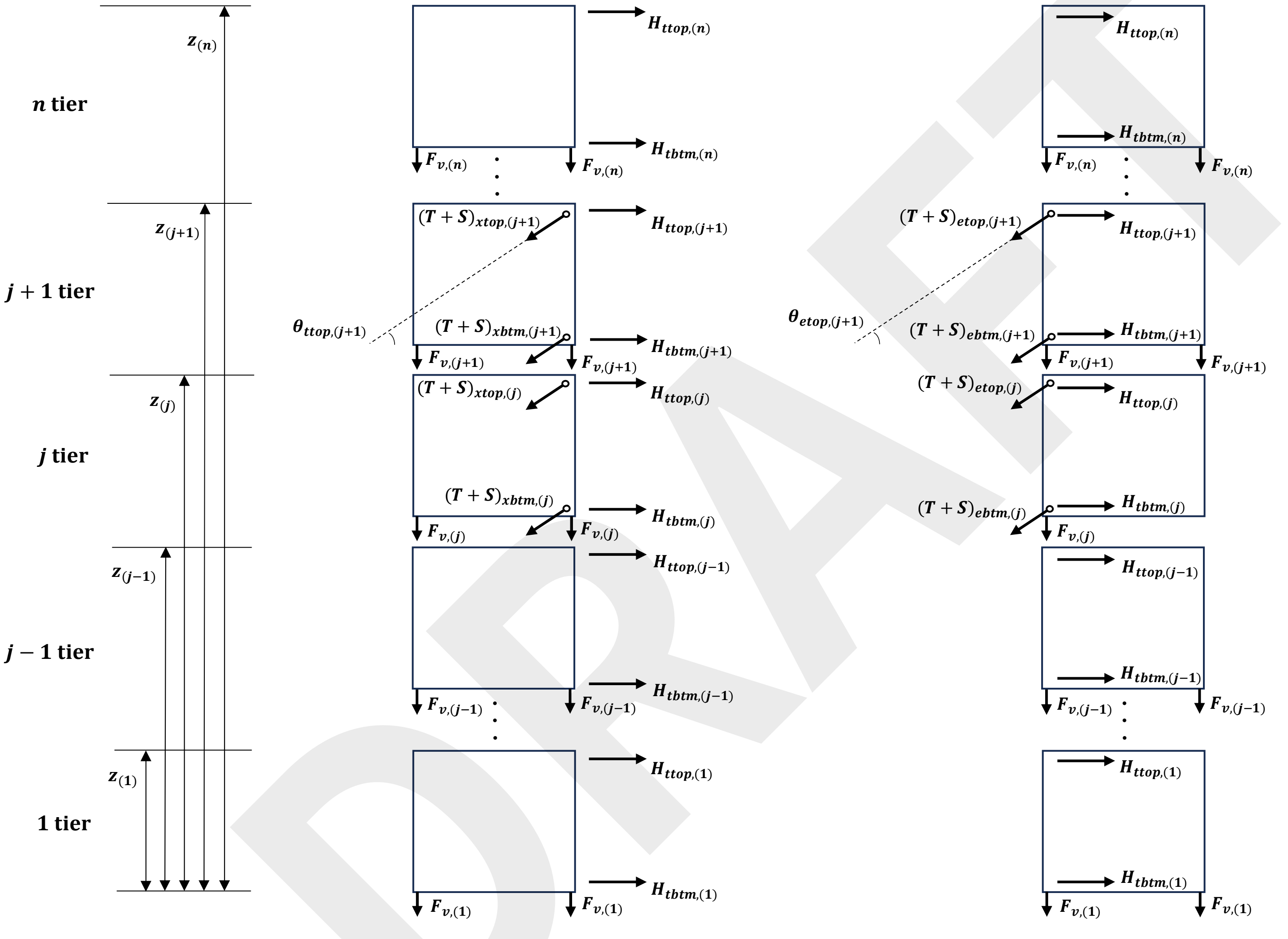
Amended-Original Requirements Comparison Table (Strength Evaluation of Container Stowage and Securing Arrangements)

<table>
<tr><th>Amended</th><th>Original</th><th>Remarks</th></tr>
<tr><td>
Table 14.3.3-4 Loads Acting on Each Part of Containers and Securing Fittings (Wave Condition: $LC3$)
<table>
<tr><th colspan="2">Load</th><th>Formula</th></tr>
<tr><td>(1)</td><td>Transverse racking load acting on the top corners on one side of the end walls of containers in the j-th tier</td><td>$$\sum_{i=j}^{n} H_{ttop,(i)} + \sum_{i=j+1}^{n} H_{tbtm,(i)}$$</td></tr>
<tr><td>(2)</td><td>Compressive load acting on one corner post of containers in the j-th tier</td><td>$$\sum_{i=j+1}^{n} F_{v,(i)} + \sum_{i=j}^{n}\left(H_{ttop,(i)}\frac{z_{(i)}-z_{(j-1)}}{b_{con}}\right) + \sum_{i=j}^{n-1}\left(H_{tbtm,(i+1)}\frac{z_{(i)}-z_{(j-1)}}{b_{con}}\right)$$
$$+\sum_{i=j}^{n} T_{xtop,(i)}\sin\theta_{xtop,(i)} + \sum_{i=j+1}^{n} T_{xbtm,(i)}\sin\theta_{xbtm,(i)} + \sum_{i=j}^{n} S_{xtop,(i)}\sin\theta_{xtop,(i)} + \sum_{i=j+1}^{n} S_{xbtm,(i)}\sin\theta_{xbtm,(i)}$$
$$+\sum_{i=j}^{n}\left(\left|F_{ltop,(i)}\right|\frac{z_{(i)}-z_{(j-1)}}{l_{con}}\right) + \sum_{i=j}^{n-1}\left(\left|F_{lbtm,(i+1)}\right|\frac{z_{(i)}-z_{(j-1)}}{l_{con}}\right)$$</td></tr>
<tr><td>(3)</td><td>Horizontal load acting on one container corner casting due to the tension of the lashing rods securing containers in the j-th tier</td><td>For internal lashing
$$\left(T_{xtop,(j)} + S_{xtop,(j)}\right)\cos\theta_{xtop,(j)}\ ,\quad \left(T_{xbtm,(j)} + S_{xbtm,(j)}\right)\cos\theta_{xbtm,(j)}$$
For external lashing
$$\left(T_{etop,(j)} + S_{etop,(j)}\right)\cos\theta_{etop,(j)}\ ,\quad \left(T_{ebtm,(j)} + S_{ebtm,(j)}\right)\cos\theta_{ebtm,(j)}$$</td></tr>
<tr><td>(4)</td><td>Vertical load acting on one container corner casting due to the tension of the lashing rods securing containers in the j-th tier</td><td>For internal lashing
$$\left(T_{xtop,(j)} + S_{xtop,(j)}\right)\sin\theta_{xtop,(j)}\ ,\quad \left(T_{xbtm,(j)} + S_{xbtm,(j)}\right)\sin\theta_{xbtm,(j)}$$
For external lashing
$$\left(T_{etop,(j)} + S_{etop,(j)}\right)\sin\theta_{etop,(j)}\ ,\quad \left(T_{ebtm,(j)} + S_{ebtm,(j)}\right)\sin\theta_{ebtm,(j)}$$</td></tr>
</table>
</td><td></td><td>Define new formulae for wave condition LC3.</td></tr>
</table>

Amended			Original	Remarks
(5)	Compressive load acting on one container corner casting at the bottom corners of containers in the *j*-th tier	$\sum_{i=j}^{n} F_{v,(i)} + \sum_{i=j}^{n}\left(H_{ttop,(i)}\frac{z_{(i)} - z_{(j-1)}}{b_{con}}\right) + \sum_{i=j}^{n-1}\left(H_{tbtm,(i+1)}\frac{z_{(i)} - z_{(j-1)}}{b_{con}}\right)$ $+ \sum_{i=j}^{n} T_{xtop,(i)} \sin\theta_{xtop,(i)} + \sum_{i=j}^{n} T_{xbtm,(i)} \sin\theta_{xbtm,(i)} + \sum_{i=j}^{n} S_{xtop,(i)} \sin\theta_{xtop,(i)} + \sum_{i=j}^{n} S_{xbtm,(i)} \sin\theta_{xbtm,(i)}$ $+ \sum_{i=j}^{n}\left(\lvert F_{ltop,(i)}\rvert \frac{z_{(i)} - z_{(j-1)}}{l_{con}}\right) + \sum_{i=j}^{n-1}\left(\lvert F_{lbtm,(i+1)}\rvert \frac{z_{(i)} - z_{(j-1)}}{l_{con}}\right)$		
(6)	Shear load acting on one twistlock at the bottom corners of containers in the *j*-th tier	$0.5\sum_{i=j}^{n}(H_{ttop,(i)} + H_{tbtm,(i)})$		
(7)	Lifting load acting on one twistlock at the bottom corners of containers in the *j*-th tier	$-\sum_{i=j}^{n} F_{v,(i)} + \sum_{i=j}^{n}\left(H_{ttop,(i)}\frac{z_{(i)} - z_{(j-1)}}{b_{con}}\right) + \sum_{i=j}^{n-1}\left(H_{tbtm,(i+1)}\frac{z_{(i)} - z_{(j-1)}}{b_{con}}\right)$ $- \sum_{i=j}^{n} T_{etop,(i)} \sin\theta_{etop,(i)} - \sum_{i=j}^{n} T_{ebtm,(i)} \sin\theta_{ebtm,(i)} - \sum_{i=j}^{n} S_{etop,(i)} \sin\theta_{etop,(i)} - \sum_{i=j}^{n} S_{ebtm,(i)} \sin\theta_{ebtm,(i)}$ $+ \sum_{i=j}^{n}\left(\lvert F_{ltop,(i)}\rvert \frac{z_{(i)} - z_{(j-1)}}{l_{con}}\right) + \sum_{i=j}^{n-1}\left(\lvert F_{lbtm,(i+1)}\rvert \frac{z_{(i)} - z_{(j-1)}}{l_{con}}\right)$		
(8)	Tension load acting on one lashing rod securing containers in the *j*-th tier	For internal lashing $T_{xtop,(j)} + S_{xtop,(j)},\ \ T_{xbtm,(j)} + S_{xbtm,(j)}$ For external lashing $T_{etop,(j)} + S_{etop,(j)},\ \ T_{ebtm,(j)} + S_{ebtm,(j)}$		
Notes: $H_{ttop,(i)}$ and $H_{tbtm,(i)}$: As specified in **An3.2.3-3, Annex14.3B “Calculation of tension on lashing rods”** $T_{xtop,(i)}$, $T_{xbtm,(i)}$, $T_{etop,(i)}$ and $T_{ebtm,(i)}$: As specified in **Table An2, Annex14.3B** $S_{xtop,(i)}$, $S_{xbtm,(i)}$, $S_{etop,(i)}$ and $S_{ebtm,(i)}$: As specified in **Table An3, Annex14.3B**				

Amended	Original	Remarks

Fig. 14.3.3-1 Loads Acting on Each Part of Containers



Internal lashing External lashing

Amended	Original	Remarks
14.3.4 Loads Acting on Container Stacks Stowed in Cargo Holds	**(Newly added)**	
14.3.4.1 Loads to be Evaluated **1** In the strength evaluation of container stowage and securing arrangements in cargo hold, the loads acting on each part of the containers given in the following **(1)** and **(2)** are to be calculated. (1) When containers are stowed in holds exclusive for 20'containers or 40' containers; (a) Compressive load acting on the corner posts of containers in the lowest tier (2) When 20' containers are stowed in 40' container bays; (a) Transverse racking load acting on containers (b) Compressive load acting on the corner posts of containers in the lowest tier **2** In cases where two 20' containers are stowed in 40' container bays in the longitudinal direction of the ship, and one or more 40' container is stowed on top of the 20' containers on deck, the stacking loads of containers on double bottoms are also to be calculated. **3** The loads given in **-1** above are to be evaluated for wave conditions *LC*1 and *LC*3. In the strength evaluation of container stowage and securing arrangements in cargo holds, wave condition *LC*2 is not considered.		Correspond to 6.5.3, "Guidelines for Container Stowage and Securing Arrangements".
14.3.4.2 Distribution of Loads Acting on Each Container Stowed in Cargo Holds **1** Loads acting on each part of containers stowed in holds are, in principle, to be obtained in accordance with **14.3.3.3**. **2** In cases where two 20' containers are stowed in 40' container bays in the longitudinal direction of the ship,		Correspond to 6.5.2, "Guidelines for Container Stowage and Securing Arrangements".

Amended	Original	Remarks
$F_{ttop,(i)}$ (kN) and $F_{tbtm,(i)}$ (kN) are to be calculated in accordance with the following **(1)** and **(2)** in addition to **14.3.3.3-1**. (1) In cases where two 20’ containers are stowed in 40’ container bays in the longitudinal direction of the ship, the transverse loads $F_{t,(i)}$ (kN) acting on end walls that are not supported by cell guides are to be obtained from the following formula. That is, the transverse load F_t (kN) acting on the container in the i-th tier is distributed as three-fifths to end walls supported by cell guides and two-fifths to those not supported. $F_{t,(i)} = \frac{2}{5}F_t$ (2) In cases where two 20’ containers are stowed in 40’ container bays in the longitudinal direction of the ship and one or more 40’ container is stowed on top of the 20’ containers on deck, the transverse loads $F_{t,(i)}$ (kN) acting on end walls that are not supported by cell guides are to be obtained from the following formula. That is, the transverse load F_t (kN) acting on the container in the i-th tier is distributed as two-thirds to end walls supported by cell guides and one-third to those not supported. $F_{t,(i)} = \frac{F_t}{3}$		

Amended	Original	Remarks
14.3.4.3 Loads Acting on Each Part of Containers and Stacking Loads of Containers on Double Bottoms **1** In the strength evaluation of containers stowed in holds exclusive for 20’ containers or 40’ containers, the loads acting on each part of containers in an n-tier container stack are to be in accordance with **Table 14.3.4-1** for wave conditions $LC1$ and $LC3$. **2** In the strength evaluation of 20’ containers stowed in 40’ container bays in the longitudinal direction of the ship, the loads acting on each part of containers in an n-tier container stack are to be in accordance with **Table 14.3.4-2** and **Table 14.3.4-3** according to wave condition. Transverse racking loads acting on containers are to be evaluated only for end walls that are supported by cell guides. **3** In case where 20’ containers are stowed in 40’ container bays in the longitudinal direction of the ship and one or more 40’ container is stowed on top of the 20’ containers, the stacking loads of the containers on double bottoms are to be taken as the following **(1)** and **(2)**, where said stacking loads act as shown in **Fig. 14.3.4-1**. (1) Stacking load at the corner of a 40’ container bay $\frac{(m_1+m_2+m_3+\cdots)}{4}+\frac{(M_1+M_2+\cdots)}{4}$ m_1, m_2 and m_3: Mass per 20’ container (t) M_1 and M_2: Mass per 40’ container (t) (2) Stacking load at the centre of a 40’ container bay $\frac{(m_1+m_2+m_3+\cdots)}{4}$		Correspond to 6.5.3, “Guidelines for Container Stowage and Securing Arrangements”.

Table 14.3.4-1 Loads Acting on Each Part of Containers Stowed in Holds Exclusive for 20’ Containers or 40’ Containers (Wave Conditions: $LC1$ and $LC3$)

Load		Formula
(1)(a)	Compressive load acting on the corner posts of containers in the lowest tier	$\sum_{i=2}^{n} F_{v,(i)}$

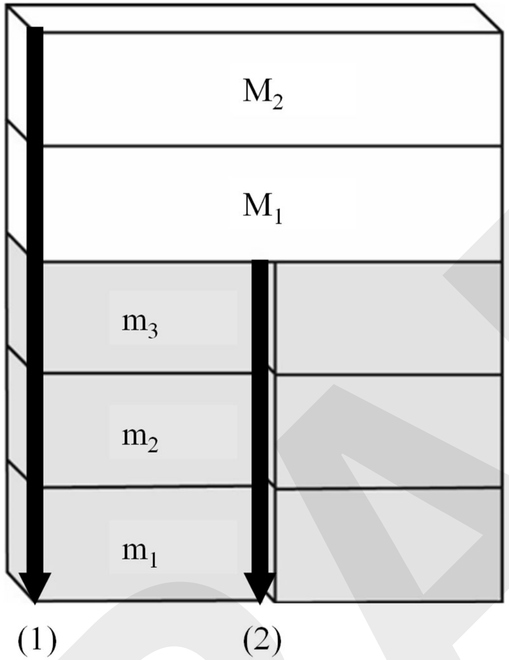
Table 14.3.4-2 Loads Acting on Each Parts of 20’ Containers Stowed in 40’ Container Bays (Wave Condition: $LC1$)

Load		Formula
(2)(a)	Transverse racking load acting on the top corners on one side of the end walls of containers in the j-th tier	For end walls that are not supported by cell guides $\sum_{i=j}^{n} \lvert F_{ttop,(i)} \rvert + \sum_{i=j+1}^{n} \lvert F_{tbtm,(i)} \rvert$
(2)(b)	Compressive load acting on the corner posts of containers in the lowest tier	For end walls that are supported by cell guides in cases where two 20’ containers are stowed in 40’ container bays in the longitudinal direction of the ship $\sum_{i=2}^{n} F_{v,(i)}$ For end walls that are not supported by cell guides in cases where two 20’ containers are stowed in 40’ container bays in the longitudinal direction of the ship $\sum_{i=2}^{n} F_{v,(i)} + \sum_{i=1}^{n} \left(\lvert F_{ttop,(i)} \rvert \frac{z_{(i)}}{b_{con}} \right) + \sum_{i=1}^{n-1} \left(\lvert F_{tbtm,(i+1)} \rvert \frac{z_{(i)}}{b_{con}} \right)$ In cases where two 20’ containers are stowed in 40’ container bays in the longitudinal direction of the ship and one or more 40’ container is stowed on top of the 20’ containers $\sum_{i=2}^{n} F_{v,(i)}$

Amended	Original	Remarks

Table 14.3.4-3 Loads Acting on Each Part of 20’ Containers Stowed in 40’ Container Bays (Wave Condition: *LC*3)

Load		Formula
(2)(a)	Transverse racking load acting on the top corners on one side of the end walls of containers in the *j*-th tier	For end walls that are not supported by cell guides $\sum_{i=j}^{n}\left\|F_{ttop,(i)}\right\| + \sum_{i=j+1}^{n}\left\|F_{tbtm,(i)}\right\|$
(2)(b)	Compressive load acting on the corner posts of containers in the lowest tier	For end walls that are supported by cell guides in cases where two 20’ containers are stowed in 40’ container bays in the longitudinal direction of the ship $\sum_{i=2}^{n} F_{v,(i)}$ For end walls that are not supported by cell guides in cases where two 20’ containers are stowed in 40’ container bays in the longitudinal direction of the ship $\sum_{i=2}^{n} F_{v,(i)} + \sum_{i=1}^{n}\left(\left\|F_{ttop,(i)}\right\| \frac{z_{(i)}}{b_{con}}\right) + \sum_{i=1}^{n-1}\left(\left\|F_{tbtm,(i+1)}\right\| \frac{z_{(i)}}{b_{con}}\right) + \sum_{i=1}^{n}\left(\left\|F_{ltop,(i)}\right\| \frac{z_{(i)}}{l_{con}}\right) + \sum_{i=1}^{n-1}\left(\left\|F_{lbtm,(i+1)}\right\| \frac{z_{(i)}}{l_{con}}\right)$ In cases where two 20’ containers are stowed in 40’ container bays in the longitudinal direction of the ship and one or more 40’ container is stowed on top of the 20’ containers $\sum_{i=2}^{n} F_{v,(i)}$

Amended	Original	Remarks
Fig. 14.3.4-1 Stacking Loads of Containers on Double Bottoms  		
14.3.5 Strength Evaluation **14.3.5.1 General** **1** The strength evaluation is to demonstrate that loads acting on each part of containers and securing fittings calculated in accordance with **14.3.3** and **14.3.4** do not exceed the allowable loads specified in **14.3.5.2**. **2** In cases where 20' containers are stowed in 40' container baysin hold, the strength evaluation is to demonstrate that the stacking loads of containers on double bottoms calculated in accordance with **14.3.4.3-3** do not	**(Newly added)**	

Amended	Original	Remarks
exceed the allowable loads at the corners and centre of a 40' container bay as established for each ship. **14.3.5.2 Allowable Loads** **1** In the strength evaluation for 20’ containers or 40’ containers, the allowable loads for each part of the containers are to be in accordance with **Table 14.3.5-1**. For containers of other sizes, values based on recognised standards or test loads are to be taken as the allowable loads. **2** The Safe Working Load (*SWL*) approved by the Society or organisation deemed appropriate by the Society is to be taken as the allowable load for securing fittings (lashing rods and twistlocks). **3** Notwithstanding **-1** or **-2** above, allowable loads are to be determined in consideration of the situation in which the loads act on each part of containers and securing fittings, such as the structure and contact angles of the lashing rods and corner castings, and the corrosion of containers and securing fittings.		Correspond to 6.3, “Guidelines for Container Stowage and Securing Arrangements”.

Amended	Original	Remarks

Table 14.3.5-1 Allowable Loads for Each Part of Containers

	Allowable load (kN)
Transverse racking load acting on containers	150
Longitudinal racking load acting on containers	150
Compressive load acting on corner posts of containers	$848^{(1)}$
Horizontal load acting on container corner castings due to the tension of lashing rods	150
Vertical load acting on container corner castings due to the tension of lashing rods	300
Compressive load acting on corner castings	$848^{(1)(2)}$

(1) For containers certified in accordance with *ISO* 1496-1:1990 (including Amendment 4), an allowable load of 942 kN may be applied.

(2) For corner castings of containers in the lowest tier, an allowable load of $848 + 1.8\,Rg/4$ kN may be applied. When **(1)** above is applicable, an allowable load of $942 + 1.8\,Rg/4$ kN may be applied.

R: The rated value of the maximum allowable superimposed load (t)

Amended	Original	Remarks
14.4 Safe Design for Container Lashing	**(Newly added)**	
14.4.1 General		
14.4.1.1 Application Container securing arrangements on decks of ships intended to be registered with the class notation *Safe Design for Container Lashing* (abbreviated to *SDCL*) affixed to their Classification Characters are to be accordance with Annex 14 of the *"Code of Safe Practice for Cargo Stowage and Securing" (CSS Code)*.		Correspond to Chapter 8, "Guidelines for Container Stowage and Securing Arrangements".

Amended	Original	Remarks
Annex 14.3A APPLICATION OF LOAD CORRECTION FACTOR IN THE STRENGTH EVALUATION OF CONTAINER STOWAGE AND SECURING ARRANGEMENTS **Symbols** $f_{\theta,(i)}$: Load correction factor for the roll angle in sea route *i* $f_{\theta,(i,j)}$: Load correction factor for the roll angle in sea route *i* and month *j* $f_{\theta,sv}$: Load correction factor for the roll angle in a short voyage, refer to the **“Guidelines for the Safety of Maritime Cargo Based on Weather Forecasts”** f_{ART}: Load correction factor for the roll angle considering the effect of anti-rolling tank, refer to the **“Guidelines for Anti-rolling Devices”** $f_{\phi,(i)}$: Load correction factor for the pitch angle in sea route *i* $f_{\phi,(i,j)}$: Load correction factor for the pitch angle in sea route *i* and month *j* $f_{\phi,sv}$: Load correction factor for the pitch angle in a short voyage, refer to the **“Guidelines for the Safety of Maritime Cargo Based on Weather Forecasts”** $f_{a_5,(i)}$: Load correction factor for the pitch angular acceleration in sea route *i* $f_{a_5,(i,j)}$: Load correction factor for the pitch angular acceleration in sea route *i* and month *j* $f_{a_5,sv}$: Load correction factor for the pitch angular	**(Newly added)**	

Amended	Original	Remarks
acceleration in a short voyage, refer to the **"Guidelines for the Safety of Maritime Cargo Based on Weather Forecasts"** $(\,)_i$: Value of long-term distribution of ship motion and acceleration based on the sea state conditions of sea route *i* $(\,)_{ij}$: Value of long-term distribution of ship motion and acceleration based on the sea state conditions of sea route *i* and month *j* $(\,)_{NA}$: Value of long-term distribution of ship motion and acceleration based on the sea state conditions of North Atlantic over one year *Hs*: Significant wave height (*m*) *Tp*: Peak wave period (*sec*)		
An1. General	**(Newly added)**	
An1.1 Application **An1.1.1** In applying **14.3.2.2-2**, the application of load correction factor in the strength evaluation of container stowage and securing arrangements is to be accordance with this Annex. **An1.2 Overview** **An1.2.1** In calculating loads acting on containers in accordance with **14.3.2.2**, one of the load correction factors given in the following **(1)** to **(4)** may be applied. (1) Load correction factor considering the effects of		

Amended	Original	Remarks
specific routes (**An2.2**) (2) Load correction factor considering the effects of specific routes and seasons (**An2.2**) (3) Load correction factor based on the weather forecast for short voyages (**An2.3**) (4) Load correction factor considering the effects of anti-rolling devices (**An2.2**)		
An1.3 Note to Cargo Securing Manual for Application of Load Correction Factor		
An1.3.1 **1** The items given in the following **(1)** to **(3)** are to be noted in the Cargo Securing Manual and approved by the Society for the strength evaluation of container stowage and securing arrangements with the load correction factors specified in **An1.2.1(1)** to **(4)**. (1) Name of tools used for the calculation of load correction factors and the version number or method used for said calculations (2) Procedure for applying load correction factors in the lashing software (3) Applicability for load correction factors **2** The items given in the following **(1)** and **(2)** are to be noted in the Cargo Securing Manual and approved by the Society, in addition to **-1** above, for the strength evaluation of container stowage and securing arrangements with the load correction factors specified in **An1.2.1(1)** to **(3)**. (1) The values of load correction factors for the typical sea routes. (2) Container securing plans for the typical sea routes but in accordance with the following **(a)** to **(c)**. (a) The plans are to cover at least three different container bays.		Define new requirements for the inclusion of information regarding the application of load correction factors in the Cargo Securing Manual.

Amended	Original	Remarks
(b) The plans are to assume stowage of both 20’ containers and 40’ containers. (c) The plans are to cover stowage both on deck and in cargo holds. **3** The items given in the following **(1)** and **(2)** are to be noted in the Cargo Securing Manual and approved by the Society, in addition to **-1** above, for the strength evaluation of container stowage and securing arrangements with the load correction factors specified in **An1.2.1(4)**. (1) The values of load correction factors for the loading condition under consideration. (2) Container securing plans for the loading condition under consideration but in accordance with the following **(a)** to **(c)**. (a) The plans are to cover at least three different container bays. (b) The plans are to assume stowage of both 20’ containers and 40’ containers. (c) The plans are to cover stowage both on deck and in cargo holds.		
An2. Application of Load Correction Factors	**(Newly added)**	
An2.1 General Provisions		
An2.1.1 **1** The load correction factors given in **An1.2.1(1)** to **(3)** may be applied in wave conditions *LC*1, *LC*2 and *LC*3. The load correction factors specified in **An1.2.1(4)** may be applied only in wave condition *LC*1. **2** The load correction factors for the roll angle, the pitch angle and pitch angular acceleration may be applied in wave		Define the precautions to be taken when applying load correction factors.

Amended	Original	Remarks
conditions *LC*1, *LC*2 and *LC*3. The values given in **Table An1** are to be multiplied by the load correction factors. **3** The load correction factors given in **An1.2.1(1)** to **(4)** are not to be applied in combination. **4** In determining the container stowage and securing for actual voyages by performing strength evaluation applying the load correction factors specified in **An1.2.1(1)** to **(4)**, the ship's master must keep available those items depending on the load correction factors applied and provide them when requested. The items depending on the load correction factors include the values of factors applied, planned routes for calculation of the factors, season for voyage defined by months, design effective wave height, weather forecast details, name of weather forecast company and the date and time checking forecast.		

Table An1 Values to be Multiplied by Load Correction Factors

Wave condition	Load correction factors		Value to be multiplied by load correction factor
*LC*1	$f_{\theta,(i)}$ $f_{\theta,(i,j)}$ $f_{\theta,sv}$ f_{ART}	Load correction factors for roll angle	For the load correction factors specified in **An1.2.1(1)** to **(3)**: θ, a_2, a_3 and a_4(1) For the load correction factors specified in **An1.2.1(4)**: θ and a_4(1)
*LC*2	$f_{\phi,(i)}$ $f_{\phi,(i,j)}$ $f_{\phi,sv}$	Load correction factors for pitch angle	ϕ and a_5(2)
*LC*3	$f_{a_5,(i)}$ $f_{a_5,(i,j)}$ $f_{a_5,sv}$	Load correction factors for pitch angular acceleration	θ, ϕ, a_1, a_2, a_3, a_4(1), a_5(2) and a_6

(1) In calculating the roll angular acceleration a_4 in accordance with **Table 14.3.2-1**, the roll angle θ is not to be multiplied by load correction factors.

(2) In calculating the pitch angular acceleration a_5 in accordance with **Table 14.3.2-1**, the roll angle ϕ is not to be multiplied by load correction factors.

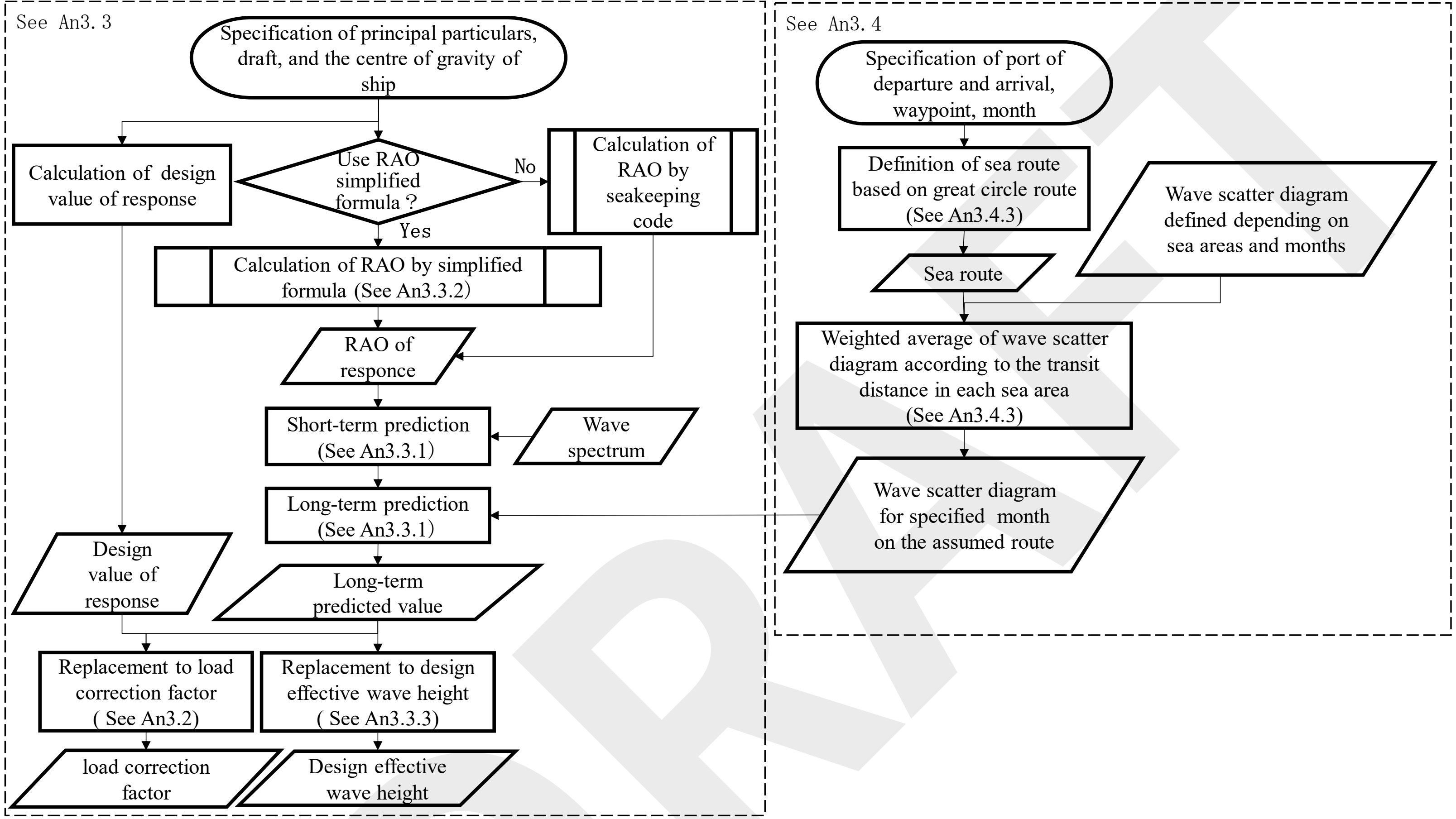
Amended	Original	Remarks
An2.2 Load Correction Factor Considering the Effects of Specific Routes or Specific Routes and Seasons **An2.2.1 General** The load correction factors specified in **An1.2.1(1)** and **(2)** are to be applied in accordance with this **An2.2**. **An2.2.2 Calculation Methods of Load Correction Factors and Application for Strength Evaluation** **1** Load correction factors are to be calculated in accordance with **An3**.. **2** "Seasons for voyage" is defined by the months used	**(Newly added)**	Correspond to 5.3.2, "Guidelines for Container Stowage and Securing Arrangements"

Amended	Original	Remarks
for calculating the load correction factor specified in **An1.2.1(2)**. If the voyage extends over multiple months, the greatest of the load correction factors for each month is to be applied. **3** The load correction factors to be applied are to be not less than 0.65 and not more than 1.0. In addition, the roll angle calculated by applying the load correction factor is to be not less than 10°.		
An2.3 Load Correction Factor Based on Weather Forecasts for Short Voyages		Correspond to 5.3.2, "Guidelines for Container Stowage and Securing Arrangements"
An2.3.1 General The load correction factors specified in **An1.2.1(3)** are to be applied in accordance with the **"Guidelines for the Safety of Maritime Cargo Based on Weather Forecasts"**.		
An2.4 Load Correction Factor Considering the Effects of Anti-rolling Devices		Correspond to 5.3.2, "Guidelines for Container Stowage and Securing Arrangements"
An2.4.1 General The load correction factors specified in **An1.2.1(4)** are to be applied in accordance with the **"Guidelines for Anti-rolling Devices"**.		
An3. Calculation of Load Correction Factors	**(Newly added)**	
An3.1 General		
An3.1.1 Overview **1** The load correction factors given in **An1.2.1(1)** and **(2)** are to be calculated in accordance with this **An3**. Said load		Correspond to 5.3.2, "Guidelines for Container Stowage and Securing Arrangements"

Amended	Original	Remarks
correction factors may be calculated using WACDAS (Wave Climate Data Aggregation for Ships) provided by the Society. **2** Ship motions and acceleration of ship gravity are to be calculated considering the sea routes and the sea state conditions per month. The standard calculation flow is shown in **Fig. An1**.		Specify the calculation method for load correction factors in An3.2 and subsequent sections.

Amended	Original	Remarks

Fig. An1Calculation Flowchart



Amended	Original	Remarks
An3.2 Definitions **An3.2.1 Load Correction Factor for the Roll Angle** 1 Load correction factor for the roll angle in sea route *i* is to be taken as follows.	**(Newly added)**	

Amended	Original	Remarks
$f_{\theta,(i)} = \frac{\theta_i}{\theta_{NA}}$ **2** Load correction factor for the roll angle in sea route i and month j is to be taken as follows. $f_{\theta,(i,j)} = \frac{\theta_{ij}}{\theta_{NA}}$ **An3.2.2 Load Correction Factor for the Pitch Angle** **1** Load correction factor for the pitch angle in sea route i is to be taken as follows. $f_{\phi,(i)} = \frac{\phi_i}{\phi_{NA}}$ **2** Load correction factor for the pitch angle in sea route i and month j is to be taken as follows. $f_{\phi,(i,j)} = \frac{\phi_{ij}}{\phi_{NA}}$ **An3.2.3 Load Correction Factor for Pitch Angular Acceleration** **1** Load correction factor for the pitch angular acceleration in sea route i is to be taken as follows. $f_{a5,(i)} = \frac{a_{5\_i}}{a_{5\_NA}}$ **2** Load correction factor for the pitch angular acceleration in sea route i and month j is to be taken as follows. $f_{a5,(i,j)} = \frac{a_{5\_ij}}{a_{5\_NA}}$		

Amended	Original	Remarks
An3.3 Long-term Predicted Values and Short-term Predicted Values **An3.3.1 Conditions to be Considered** **1** Long-term and short-term predicted values of ship motion and acceleration of the centre of gravity of the ship may be obtained in accordance with **Annex 5, “Guidelines for Direct Load Analysis and Strength Assessment”**, with necessary modifications. **2** θ_{NA}, ϕ_{NA} and a_{5_NA} are to be the long-term predicted values for 25 years based on wave spectrum, directional spreading and wave scatter diagram, considering the sea state conditions of North Atlantic over one year. **3** θ_i, ϕ_i and a_{5_i} are to be the long-term predicted values for 25 years based on wave spectrum, directional spreading and wave scatter diagram, considering the sea state conditions in sea route *i* over one year. **4** θ_i, ϕ_i and a_{5_i} are to be the long-term predicted values for 25 years based on wave spectrum, directional spreading and wave scatter diagram, considering the sea state conditions in sea route *i* and month *j*. **5** In applying **-2** to **-4** above the application needs to be based on the amplitude value of the response amplitude operator (RAO) specified in **An3.3.2**. However, the amplitude value of the response amplitude operator may be obtained using computer programs for direct load analysis deemed appropriate by the Society. As for the adjustment, the full load condition is considered as the standard, and the speed of the ship may be obtained by considering the effect of reduced speed during heavy weather. **6** In applying **-2** to **-4** above, the operating effect and the nonlinearity of ship response may be taken into account.	**(Newly added)**	

Amended	Original	Remarks
An3.3.2 Simplified Formulae of RAO **1** RAO $X_4(\omega,\beta)$ for the roll angle may be taken as follows. $X_4(\omega,\beta)=\frac{1}{B}\frac{0.8\lvert\bar{E}_4^{FK}\rvert}{\sqrt{(\bar{M}_{44}+\bar{A}_{44}-\bar{C}_{44})^2+\bar{B}_{44}^2}}$ ω: Wave frequency (*rad/s*) β: Wave direction (*rad*) $\bar{E}_4^{FK}$: Dimensionless Froude-Krylov force, to be obtained from the following formula. $\bar{E}_4^{FK}=k\,B\sin\beta\exp\left(-kT_{LC}\frac{C_{B\_LC}}{C_{W\_LC}}\right)\frac{2}{C_{W\_LC}\bar{k}_l}\sin\frac{C_{W\_LC}\bar{k}_l}{2}\bar{C}_{44}$ k: Wave number (*rad/m*), to be obtained from the following formula. $k=\omega^2/g$ $\bar{k}_l$: Dimensionless wave number in the longitudinal direction of the ship, to be obtained from the following formula. $\bar{k}_l=kL_C\cos\beta$ $\bar{\mathrm{C}}_{44}$: Dimensionless coefficient related to stability, to be obtained from the following formula. $\bar{C}_{44}=\frac{T_{LC}C_{B\_LC}}{B^2}GM$ $\bar{M}_{44}$: Dimensionless moments of inertia, to be obtained from the following formula. $\bar{M}_{44}=0.12KT_{LC}C_{B\_LC}$ K: As obtained by the following formula.		

Amended	Original	Remarks
$K = \omega_e^2/g$ ω_e: Encounter wave frequency (*rad/s*), to be obtained from the following formula. $\omega_e = \omega - 2.57k\cos\beta$ $\bar{A}_{44}$: Dimensionless coefficient related to added mass, to be obtained from the following formula. $\bar{A}_{44} = BK\frac{C_{W\_LC}^{2.25}}{16\pi}\left[1-10.6\left(\frac{z_G}{B}\right)^2+17\left(\frac{z_G}{B}\right)^3\right]$ z_G: Height of the centre of ship (*m*), to be obtained from the following formula. $z_G = \frac{B^2}{T_{LC}C_B}\frac{C_{W\_LC}^{1.7}}{12}+0.49\left(\frac{C_{B\_LC}}{C_{W\_LC}}\right)^{-0.4}T_{LC}-GM$ $\bar{B}_{44}$:Dimensionless coefficient related to damping, to be obtained from the following formula. $\bar{B}_{44} = 5.40\sqrt{\frac{\bar{E}_{FK}}{B}\bar{C}_{44}N}$ N: Bertin's N-coefficient, to be taken as 0.02. **2** RAO $X_5(\omega,\beta)$ for the pitch angle may be taken as follows. $X_5(\omega,\beta) = \frac{1}{L_C}\frac{\lvert\bar{E}_5^{FK}\rvert}{\sqrt{(\bar{C}_{55}-\bar{M}_{55})^2+\bar{B}_{55}^2}}$ $\bar{E}_5^{FK}$: Dimensionless Froude-Krylov force, to be obtained from the following formula.		

Amended	Original	Remarks
$\bar{E}_5^{FK} = \bar{C}_{55}\exp\left(-kT_{LC}\frac{C_{B\_LC}}{C_{W\_LC}}\right)\bar{k}_l f_{E5}$ $\bar{C}_{55}$: Dimensionless coefficient related to stability, to be obtained from the following formula. $\bar{C}_{55} = \frac{1}{12}\left(2.2C_{W\_LC}^2 - 1.8C_{W\_LC} + 0.6\right)$ f_{E5} : As obtained by the following formula. $f_{E5} = \frac{12}{\kappa^2}\left(\frac{2}{\kappa}sin\frac{\kappa}{2} - cos\frac{\kappa}{2}\right)$ κ: As obtained by the following formula. $\kappa = C_{W\_LC}C_{B\_LC}^{-0.15}\bar{k}_l$ $\bar{M}_{55}$: Dimensionless moments of inertia, to be obtained from the following formula. $\bar{M}_{55} = KT_{LC}C_{B\_LC}\left(\frac{K_{yy}}{L_C}\right)^2$ K_{yy}: Radius of gyration (m) around the z-axis, to be obtained from the following formula. $K_{yy} = 0.25L_C$ $\bar{B}_{55}$: Dimensionless coefficient related to stability, to be obtained from the following formula. $\bar{B}_{55} = f_{B55}f_{B33}\exp\left(-2KT_{LC}\left(\frac{C_{B\_LC}}{C_{W\_LC}}\right)^4\right)\frac{C_{W\_LC}^2}{6(3-2C_{W\_LC})(3-C_{W\_LC})}$ f_{B33}: As obtained by the following formula. $f_{B33} = 0.09(KB)^2 - 0.24KB + 0.7$		

f_{B55}: As obtained by the following formula.

$$f_{B55} = \left(0.86\left(\frac{2\pi}{KL}\right)^2 - 0.97\left(\frac{2\pi}{KL}\right) + 1.34\right)^{-1}$$

ω, β, k and $\bar{k}_l$: As specified in **-1** above.

3 RAO $X_4(\omega,\beta)$ for the pitch angular acceleration may be taken as follows.

$$X_{a5}(\omega,\beta) = \omega_e^2\, X_5(\omega,\beta)$$

ω, β, ω_e and $X_5(\omega,\beta)$: As specified in **-2** above.

An3.3.3 Design Effective Wave Height

1 It is necessary to calculate corresponding to each of the load correction factors specified in **An3.2**.

2 Design effective wave height for the roll angle, pitch angle and pitch angular acceleration is defined as the significant wave height for which the maximum expected values of the ship motion and acceleration in the short-term sea state are equal to their respective long-term predicted values.

3 Design effective wave height corresponding the load correction factors for the assumed route over one year is to be the minimum of the design effective wave heights for roll angle, pitch angle and pitch angular acceleration.

4 Design effective wave height corresponding the load correction factors for assumed route and months of navigation is to be the minimum of the design effective wave heights for roll angle, pitch angle and pitch angular acceleration.

An3.4 Wave Scatter Diagram

(Newly added)

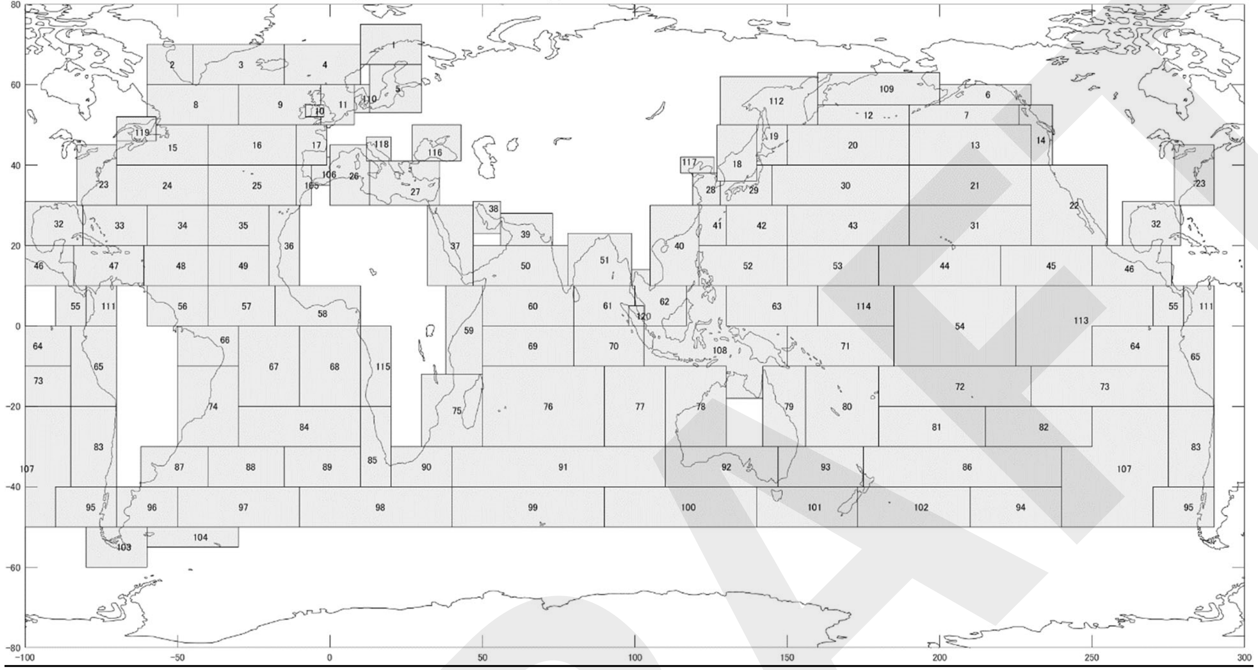
An3.4.1 Requirements

1 The wave scatter diagrams corresponding to assumed route or assumed route and months of navigation referred to in

Amended	Original	Remarks
An3.3.1 are to be a representation of the sea conditions encountered by ships in the assumed route and months of navigation. In addition, at least two variables, significant wave height and wave period, are to be included in the wave scatter diagrams. **2** In applying **-1** above, a sufficient amount of short-term sea state data is to be included in the wave scatter diagrams in order to obtain long-term predicted values for 25 years. The fundamental data used for establishing the wave scatter diagrams is to cover a sufficient period. With respect to sea state data, which is one of the fundamental data types, data provided by an appropriate organisation or company is to be used. The accuracy of the data is to be verified, and attention must be paid to the influence of factors not considered in the construction of the sea state data. In addition, when estimating the sea conditions encountered by ships, the ship position data must be representative of the ship positions corresponding to the target ship type and size. **An3.4.2 Standard Method** **1** The sea conditions encountered by ships are, in principle, to be statistically processed by modelling the probability distribution of significant wave height and the conditional distribution of wave period on significant wave height. In fitting a statistical distribution to the fundamental data, sufficient attention is to be paid to the fitting accuracy. In this regard, it is common practice to refer to the likelihood function or Q-Q plots. Furthermore, in order to avoid overfitting, it is recommended that the number of parameters in the statistical model be kept only to those necessary and sufficient, such as by referring to information criteria. In addition, in order to evaluate the uncertainty inherent in the fundamental data, it is recommended to assess the confidence intervals of the parameters obtained by statistical analysis.		

Amended	Original	Remarks
2 In modelling the probability distribution of significant wave height, attention is to be paid to meteorological conditions that result in high waves (storms). It is recommended that statistical processing be performed after distinguishing between the types of meteorological phenomena that generate storms, such as extratropical cyclones, tropical cyclones and monsoons. **3** In statistically analysing the sea conditions encountered, the sea area is to be appropriately divided, and a wave scatter diagram is to be established for each such sea area subdivision. The sea area subdivisions are to take into consideration the characteristics of the waves in the area and the geographical distribution of navigation traffic. Examples of sea area subdivisions are shown in **Fig. An2**.		

Fig. An2 Examples of Sea Area Subdivisions



An3.4.3 Establishment of the Wave Scatter Diagram for the Assumed Route

If the assumed route extends over multiple sea area subdivisions, the wave scatter diagram is to be weighted and averaged according to the transit time in each sea area along the assumed route. The assumed route is to be standardised as the shortest route connecting the port of departure and the port of arrival, namely the Great Circle Route, but this may be altered in accordance with the actual circumstances of the route.

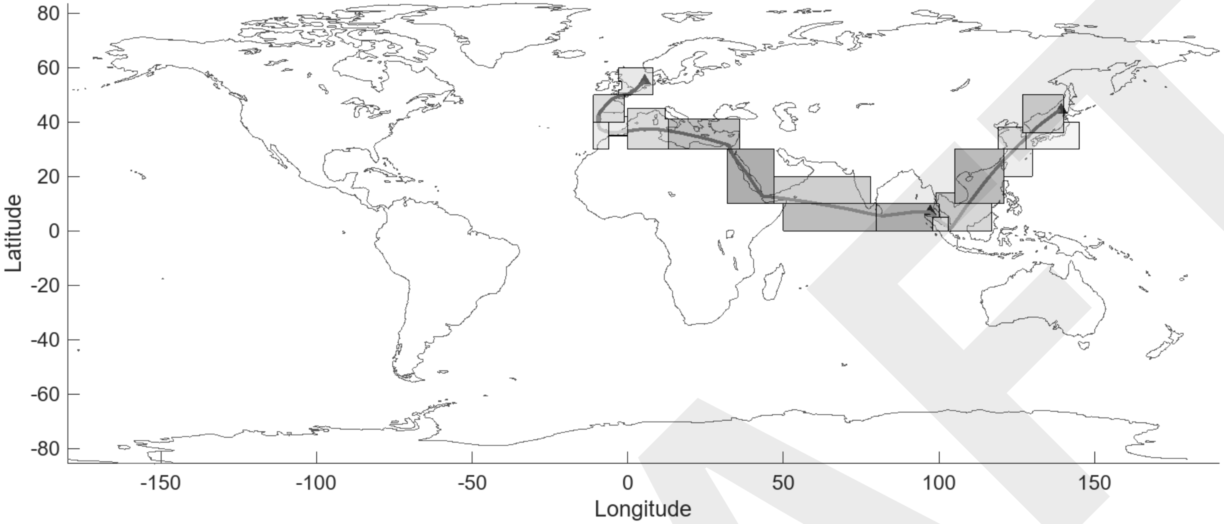
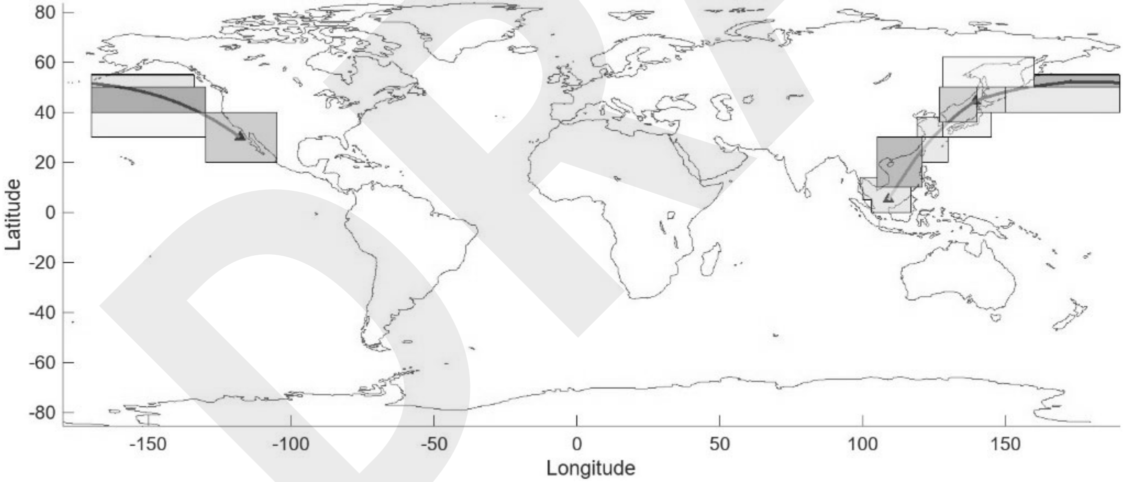
Amended	Original	Remarks
An4. Calculation Example **An4.1 Example for Typical Sea Routes and Typical Ships** **An4.1.1** **1** Calculation examples of load correction factors for typical routes are shown in **Table An2**, depending on the wave scatter diagrams established in accordance with **An3.4**. The principal particulars of the ship assumed for said calculations are shown in **Table An3**. **2** The wave scatter diagram for October on the "Intra-Asia" route is shown in **Table An4** as an example of a wave scatter diagram established in accordance with **An3.4**. This wave scatter diagram is defined by significant wave height Hs (*m*) and peak wave period Tp (*sec*).	**(Newly added)**	

Table An2 Calculation Examples of Load Correction Factors for Typical Routes

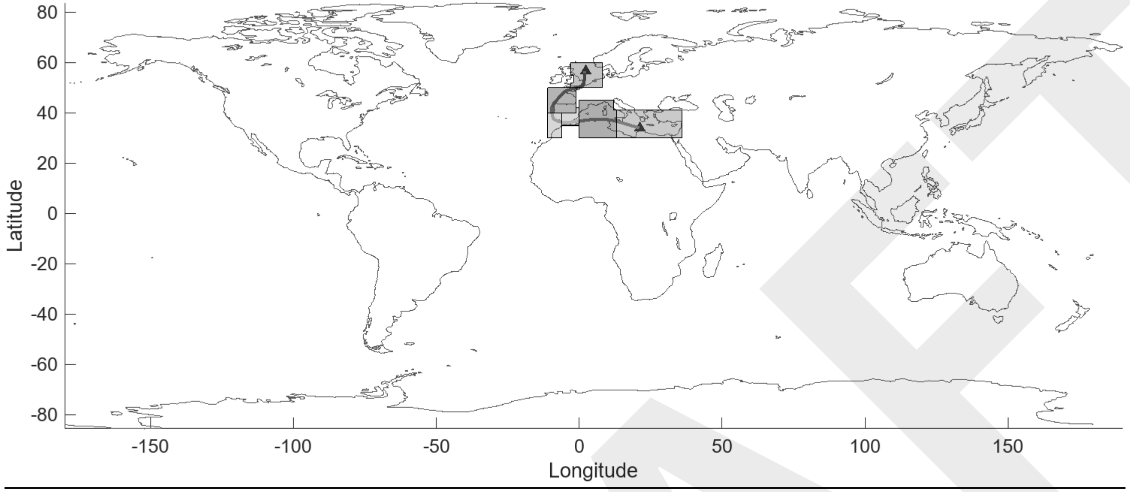
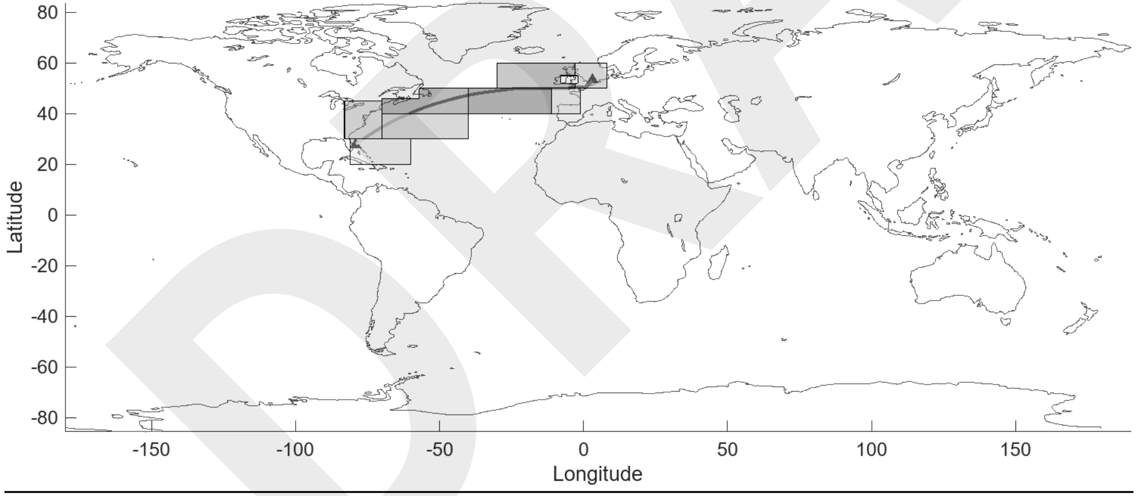
	Month	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
$f_{\theta,(i,j)}$	Asia – Europe (via Red Sea)	0.76	0.82	0.82	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.66	0.75
	Pacific	0.92	0.89	1.00	0.66	0.65	0.65	0.65	0.65	0.86	0.91	0.87	0.92
	North Sea – Mediterranean Sea	0.84	0.92	0.93	0.65	0.65	0.65	0.65	0.65	0.65	0.69	0.74	0.85
	North Atlantic	1.00	1.00	1.00	0.74	0.65	0.65	0.65	0.65	0.78	0.86	0.90	1.00
	Intra-Asia	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.76	0.80	0.65	0.65
	Asia – Europe (via Cape of Good Hope)	0.76	0.82	0.82	0.65	0.85	0.73	0.70	0.78	0.73	0.71	0.66	0.75
$f_{\phi,(i,j)}$	Asia – Europe (via Red Sea)	0.78	0.83	0.82	0.65	0.65	0.65	0.65	0.65	0.69	0.7	0.68	0.77
	Pacific	0.94	0.92	1.00	0.76	0.65	0.65	0.65	0.69	0.88	0.94	0.90	0.95
	North Sea – Mediterranean Sea	0.86	0.92	0.92	0.68	0.65	0.65	0.65	0.65	0.65	0.69	0.75	0.86
	North Atlantic	1.00	1.00	1.00	0.80	0.67	0.65	0.65	0.76	0.86	0.88	0.92	1.00
	Intra-Asia	0.65	0.65	0.65	0.65	0.65	0.65	0.73	0.77	0.85	0.87	0.65	0.65
	Asia – Europe (via Cape of Good Hope)	0.78	0.83	0.82	0.65	0.88	0.79	0.75	0.79	0.78	0.77	0.68	0.76
$f_{a5,(i,j)}$	Asia – Europe (via Red Sea)	0.89	0.89	0.85	0.81	0.69	0.67	0.77	0.84	0.88	0.86	0.82	0.87
	Pacific	1.00	1.00	1.00	0.94	0.80	0.77	0.80	0.89	0.98	1.00	1.00	1.00
	North Sea – Mediterranean Sea	0.97	0.97	0.93	0.78	0.73	0.65	0.65	0.65	0.73	0.84	0.86	0.95
	North Atlantic	1.00	1.00	1.00	0.94	0.87	0.82	0.75	0.93	1.00	0.98	1.00	1.00
	Intra-Asia	0.84	0.83	0.84	0.82	0.77	0.78	0.87	0.96	1.00	0.99	0.82	0.85
	Asia – Europe (via Cape of Good Hope)	0.89	0.89	0.85	0.80	0.93	0.89	0.85	0.88	0.92	0.90	0.81	0.87

Table An3 Principal Particulars of Ship Assumed for Calculation

L_C (m)	352
B (m)	50
GM (m)	4.75
T_{LC} (m)	15
C_{B_LC}	0.676
C_{W_LC}	0.853

Amended	Original	Remarks
Fig. An3 Asia – Europe (via Red Sea)  Fig. An4 Pacific 		

Amended-Original Requirements Comparison Table (Strength Evaluation of Container Stowage and Securing Arrangements)

Amended	Original	Remarks
Fig. An5 North Sea – Mediterranean Sea  Fig. An6 North Atlantic 		

Amended-Original Requirements Comparison Table (Strength Evaluation of Container Stowage and Securing Arrangements)

Amended	Original	Remarks

Fig. An7 Intra-Asia

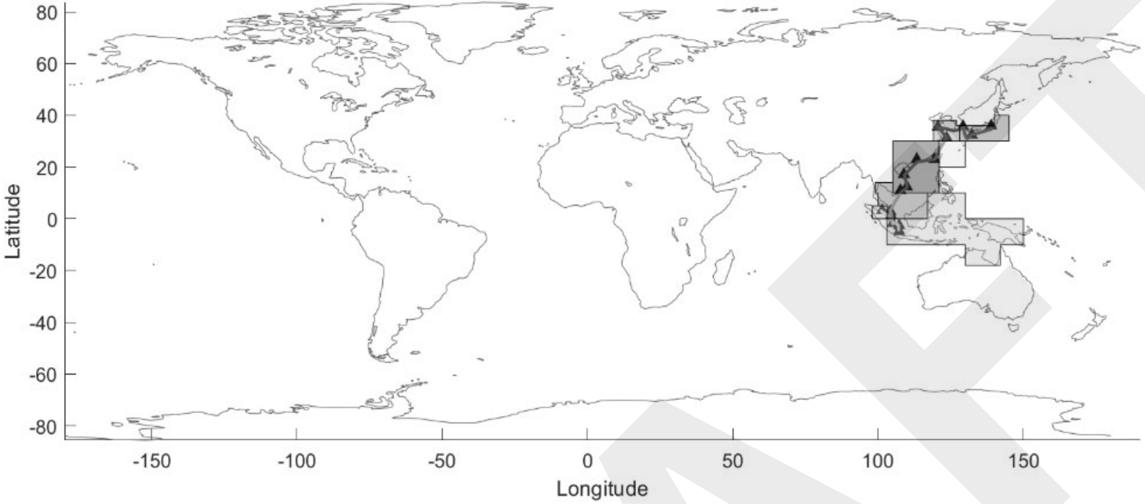


Fig. An8 Asia – Europe (via Cape of Good Hope)

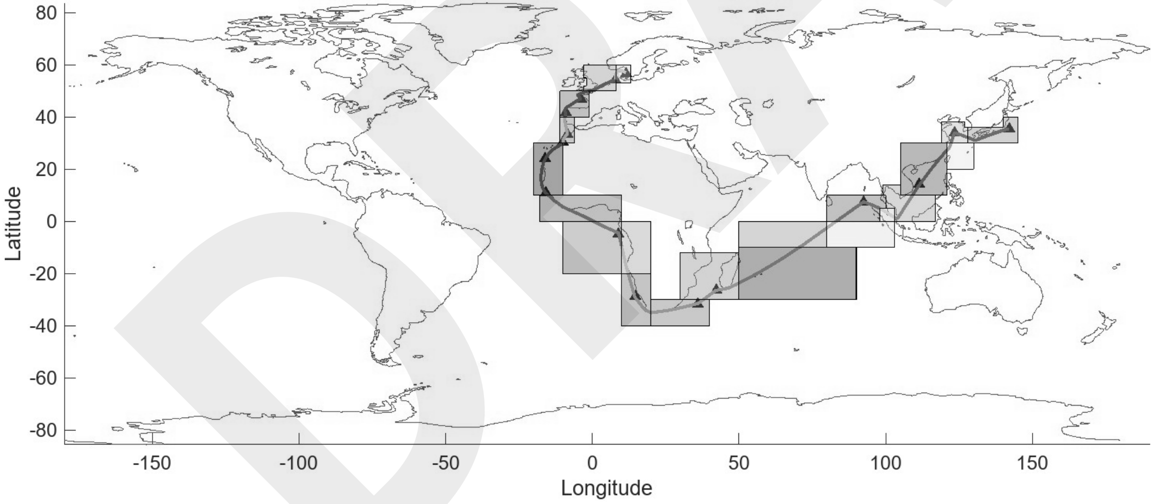


Table An4 Wave Scatter Diagram for October on the "Intra-Asia" route

Hs/Tp	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5
0.5	177.97	398.69	2222.93	5905.36	7034.36	5016.75	3512.44	2728.89	3009.78	2265.64
1.5	0.00	0.00	0.24	116.02	1546.19	5437.43	7428.14	5511.81	5390.11	5836.12
2.5	0.00	0.00	0.00	0.00	2.72	125.75	1364.19	3527.01	3576.42	2567.43
3.5	0.00	0.00	0.00	0.00	0.00	0.22	20.24	439.70	1430.13	1340.42
4.5	0.00	0.00	0.00	0.00	0.00	0.01	0.12	12.55	127.02	385.05
5.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44	9.74	64.93
6.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	9.61
7.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.38
8.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
9.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

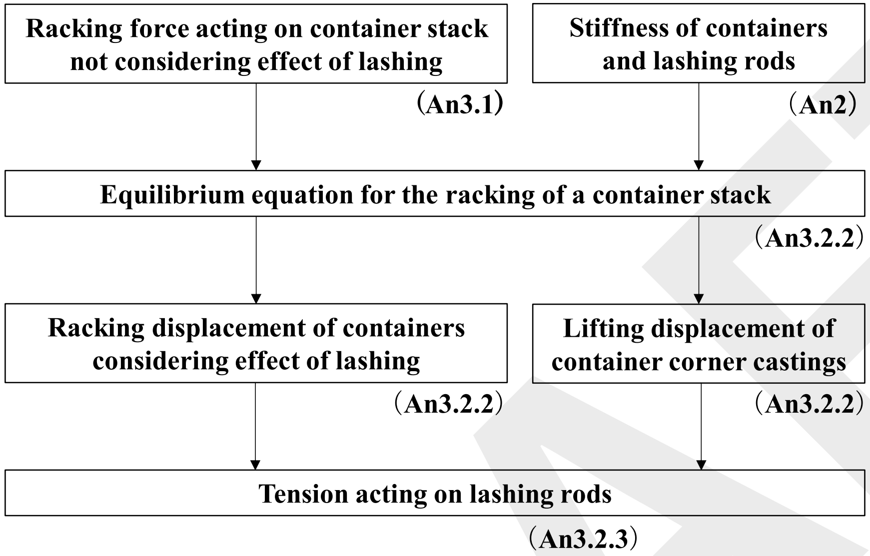
Hs/Tp	10.5	11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5
0.5	1358.59	695.17	466.97	385.04	364.67	337.17	192.85	93.70	73.42	27.42
1.5	4592.99	1982.08	1156.19	740.55	428.63	216.94	115.09	53.93	25.67	8.12
2.5	2060.42	1218.39	812.11	416.07	239.38	137.69	50.21	13.18	5.03	1.28
3.5	781.62	470.51	320.80	172.16	117.94	49.35	19.61	5.99	2.03	0.58
4.5	333.97	179.72	104.84	38.89	27.51	15.15	9.95	1.95	0.62	0.15
5.5	136.96	89.63	41.42	13.61	8.74	5.53	5.28	0.45	0.18	0.01
6.5	36.83	41.45	16.43	6.58	4.29	3.53	2.41	0.31	0.09	0.00
7.5	8.58	17.75	9.44	3.47	2.15	2.15	1.05	0.17	0.00	0.00
8.5	1.91	6.15	5.30	2.57	1.43	1.36	0.76	0.09	0.00	0.00
9.5	0.12	1.26	2.01	1.37	0.65	0.85	0.44	0.04	0.00	0.00
10.5	0.02	0.36	0.89	0.72	0.44	0.60	0.32	0.01	0.00	0.00
11.5	0.00	0.06	0.20	0.25	0.26	0.50	0.30	0.00	0.00	0.00

12.5	0.00	0.01	0.03	0.11	0.09	0.30	0.20	0.00	0.00	0.00
13.5	0.00	0.00	0.01	0.03	0.06	0.24	0.17	0.00	0.00	0.00
14.5	0.00	0.00	0.00	0.01	0.02	0.09	0.13	0.00	0.00	0.00
15.5	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.00	0.00	0.00
16.5	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
17.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Hs/Tp	20.5	21.5	22.5	23.5	24.5	25.5	26.5	27.5	28.5	29.5
0.5	22.36	5.01	4.59	1.28	0.73	0.10	0.00	0.16	0.08	0.09
1.5	4.25	0.90	0.58	0.21	0.12	0.00	0.00	0.00	0.00	0.00
2.5	0.64	0.19	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00
3.5	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Amended	Original	Remarks
Annex14.3B CALCULATION OF TENSION ACTING ON LASHING RODS **An1. General** **An1.1 General** **An1.1.1 Overview** **1** This Annex specifies a method for the calculation of tension acting on lashing rods when evaluating the parts of containers and securing fittings in accordance with **14.3**. **2** Flowcharts for calculations of linear and non-linear tension acting on the lashing rods are shown in **Fig. An1**. **3** In calculating the loads acting on the parts of containers and securing fittings, racking deformation in the longitudinal direction on side walls of containers and racking deformation in the transverse direction on end walls are to be considered. The loads acting on the parts and securing fittings are to be calculated for both door ends and closed ends walls of the containers in wave conditions $LC1$ and $LC3$ since the stiffness of the container stack differs between door ends and closed ends walls.	**(Newly added)**	

Fig. An1 Flowcharts for Calculations of Linear and Non-linear Tension Acting on Lashing Rods



An1.1.2 Definitions

For the purpose of this Annex, definitions of terms are as specified in the following.

(1) "Platform" means stages on lashing bridges that function as walkways and working platforms for cargo operators during transverse movement.

(2) "MM platform" means additional platforms installed at the outermost and uppermost positions of lashing bridges.

Amended-Original Requirements Comparison Table (Strength Evaluation of Container Stowage and Securing Arrangements)

Amended	Original	Remarks
An2. Stiffness **An2.1 Stiffness of Containers** **An2.1.1** Stiffness of containers with respect to transverse racking deformation are to be accordance with **Table An1** according to container height. For containers of other sizes, stiffness is to be as deemed appropriate by the Society.	**(Newly added)**	Correspond to 6.2, "Guidelines for Container Stowage and Securing Arrangements" Define stiffness values for each container dimension.

Table An1 Stiffness for containers

Container height	Stiffness with respect to transverse racking deformation (*kN/mm*)	
	Door end	Closed end
2591 *mm* (8*ft* 6*in*)	3.7	15.7
2896 *mm* (9*ft* 6*in*)	3.35	13.5

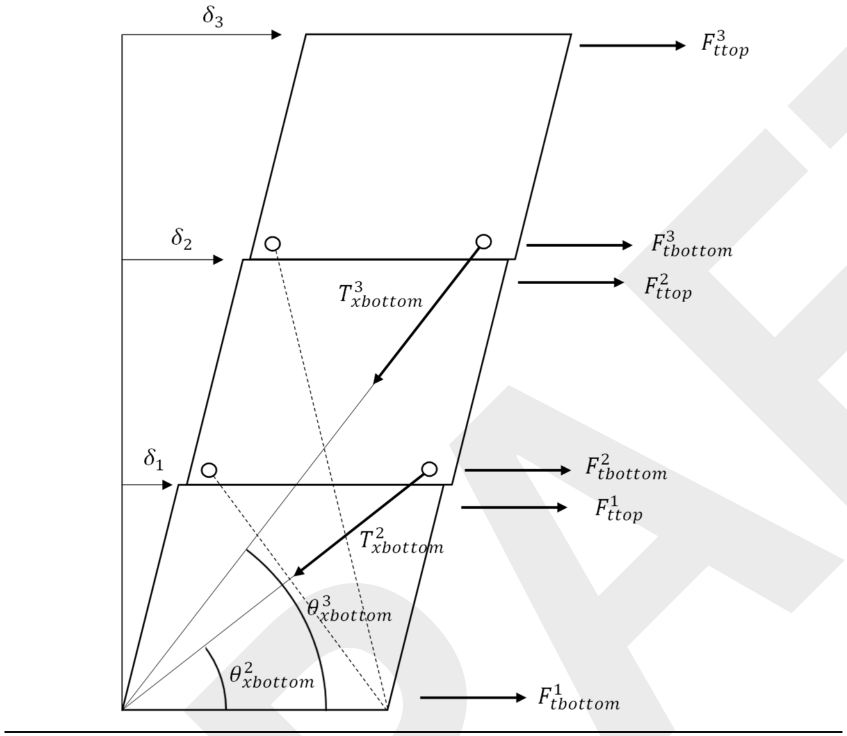
Amended	Original	Remarks
An2.2 Stiffness of Lashing Rods **An2.2.1** **1** Stiffness (*kN/mm*) of lashing rods securing containers are to be obtained from the following formula. $K_L = \frac{EA}{l}$ E: Effective modulus of elasticity (*kN/mm*^{2}), to be taken as 140 *kN/mm*^{2} if specific values are unavailable. A: Cross sectional area of lashing rod (*mm*^{2}) l: Length of lashing rod (*mm*) **2** In cases where lashing rods are connected to lashing bridges and lashing bridge deformation is not negligible, the stiffness of the lashing bridge is to be considered when	**(Newly added)**	Correspond to 6.2, "Guidelines for Container Stowage and Securing Arrangements" Specify the evaluation method for lashing rod stiffness, taking into account the stiffness of the lashing bridge.

Amended	Original	Remarks
calculating the stiffness of the lashing rods. The stiffness K'_L (*kN/mm*) of the lashing rods considering the stiffness of the lashing bridge is to be obtained from the following formula. $K'_L = \left(\frac{1}{K_L} + \frac{\cos^2\theta_L}{K_{b,(i)}}\right)^{-1}$ $K_{b,(i)}$: Stiffness (*kN/mm*) of lashing bridge, as specified in **An2.3.1**. θ_L: Angle (*rad*) of the lashing rods to the horizontal plane		
An2.3 Stiffness of Lashing Bridge **An2.3.1** In cases where lashing rods are connected to the *i*-th tier platform of the lashing bridge, the stiffness $K_{b,(i)}$ (*kN/mm*) of the lashing bridge is, in principle, to be obtained from the following formula, but values determined by designer may be used instead. The lashing bridge should be designed to ensure that lashing rod securing performance is not compromised. $K_{b,(i)} = \left(\sum_{j=1}^{i} \frac{1}{k_{lb,(j)}}\right)^{-1}$ $K_{lb,(i)}$: Transverse spring stiffness of the *i*-th tier platform of the lashing bridge, as given by the following formula. $K_{lb,(i)} = \frac{C_{lb,(i)}}{H_{lb,(i)}}$ $C_{lb,(i)}$: Lashing bridge stiffness coefficient of the *i*-th tier platform, to be taken as 50 for MM platforms and 70 for other platforms as standard.	**(Newly added)**	Specify the evaluation method for the stiffness of lashing bridges.

Amended	Original	Remarks
$H_{lb,(i)}$: Height (m) from the i-1 tier platform to the i-th tier platform.		
An3. Racking Displacement of Containers due to Transverse Loads and Tension Acting on Lashing Rods	**(Newly added)**	
An3.1 Transverse Racking Loads Acting on Containers not Considering the Effect of Lashing **An3.1.1** When the securing effect of lashing rods or other devices is not taken into account, the transverse racking load $F_{tracking,(j)}$ (kN) acting on the top corners of the end walls of containers in the j-th tier in an n-tier container stack is to be obtained from the following formula. $F_{tracking,(j)} = \sum_{i=j}^{n} \lvert F_{ttop,(i)} \rvert + \sum_{i=j+1}^{n} \lvert F_{tbtm,(i)} \rvert$		Correspond to 6.4.3.2, “Guidelines for Container Stowage and Securing Arrangements”
An3.2 Evaluation of Transverse Racking Displacement of Containers Considering Lashing and Tension Acting on Lashing Rods **An3.2.1 Overview** **1** In calculating the transverse racking displacement of container stacks secured by lashing rods, the racking displacement of container stacks and the elongation of lashing rods are to be evaluated, taking into account the stiffness of the lashing rods and the racking stiffness of the containers.	**(Newly added)**	Correspond to 6.4.3.2, “Guidelines for Container Stowage and Securing Arrangements”

Amended	Original	Remarks
2 In cases where the containers are secured by fully automatic or semi-automatic twistlocks, the linear tension acting on the lashing rods due to the racking deformation of the containers and non-linear tension due to the lifting of corner castings are to be taken into account.		
An3.2.2 Transverse Racking Displacement of Containers **1** In cases where the containers are secured by fully automatic or semi-automatic twistlocks, the non-linear tension $F_{rod,NL}$ acting on lashing rods is to be taken into account when evaluating transverse racking displacement, whereas the non-linear tension $F_{rod,NL}$ is to be obtained considering the lifting displacement in the vertical direction due to the clearance between twistlocks and corner castings at the bottom corners of containers in the *i*-th tier. In addition, if horizontal clearance between twistlocks and corner castings exists, the tension acting on the lashing rods due to this clearance is to be taken into account. **2** The vector $\boldsymbol{\delta}$ for the racking displacement of the container stack, which represents the transverse displacement of the top of each container tier within the stack, is to be obtained from the following formula. Here, K represents the racking stiffness matrix of the lashed container stack, and $F_{tracking}$ is the transverse racking load vector for the unlashed condition derived from $F_{tracking,(j)}$. For calculation with the following equation, iterative processing is to be carried out taking $u_{vgap,(i)}$ as a variable in accordance with **An3.3.** $\boldsymbol{\delta} = K^{-1}(F_{tracking} - F_{rod,NL}(u_{NL}, \delta))$ u_{NL} is represented by the following vector.		Correspond to 6.4.3.2, "Guidelines for Container Stowage and Securing Arrangements"

Amended	Original	Remarks
$u_{NL} = \left(u_{vgap,(1)}, u_{vgap,(2)}, u_{vgap,(3)}, \cdots u_{vgap,(i)}, \cdots u_{vgap,(n)}\right)^T$ $u_{vgap,(j)}$: Vertical displacement (*m*) of corner castings at the bottom corners of containers in the *j*-th tier **3** The racking stiffness matrix K specified in **-2** above is to be calculated based on the stiffness of the securing fittings, such as lashing rods, and the stiffness of the container stack. The following is an example of the stiffness matrix for the lashing pattern shown in **Fig. An2**. $\boldsymbol{K} =$ $\begin{bmatrix} k_{C,(3)} & -k_{C,(3)} & 0 \\ 0 & k_{C,(2)} + k_{b,(3)} cos^2 \theta_{b,(3)} & -k_{C,(2)} \\ 0 & -k_{b,(3)} cos^2 \theta_{b,(3)} & k_{C,(1)} + k_{b,(2)} cos^2 \theta_{b,(2)} \end{bmatrix}$ $k_{C,(i)}$: Transverse racking stiffness of the containers in the *i*-th tier $k_{b,(i)}$: Axial stiffness of the rashing rod connected to the bottom corners of containers in the *i*-th tier $\theta_{b,(i)}$: Angle (*rad*) of the lashing rods connected to the bottom corners of containers in the *i*-th tier to the horizontal plane **4** In the calculations specified in **-2** above for internal lashing, those lashing rods which do not experience tension resulting from the inclination of the container stack (represented by dotted lines in **Fig. An2**) may not be taken into account when calculating the racking displacement vector.		

Amended	Original	Remarks
Fig. An2 Example of a 3-tier Container Stack  		
An3.2.3 Linear and Non-linear Tension Acting on Lashing Rods **1** The axial linear tension (*kN*) acting on lashing rods connected to the top and bottom of the *i*-th tier container, resulting from the racking deformation of the container, is given in **Table An2**. **2** The axial non-linear tension (*kN*) acting on lashing rods connected to the top and bottom of the *i*-th tier container, resulting from the vertical and horizontal clearance between twistlocks and corner castings, is given in **Table An3**. **3** The transverse loads $H_{ttop,(i)}$ (*kN*) and $H_{tbtm,(i)}$		Correspond to 6.4.3.2, "Guidelines for Container Stowage and Securing Arrangements"

(*kN*) acting on the top and bottom of the end walls of the *i*-th tier container, taking into account the effects of the tension from the lashing rods specified in **-1** and **-2** above, are to be obtained from the following formulae.

$$H_{ttop,(i)} = \left|F_{ttop,(i)}\right| - T_{xtop,(i)} \cos\theta_{xtop,(i)} - T_{etop,(i)} \cos\theta_{etop,(i)} - S_{xtop,(i)} \cos\theta_{xtop,(i)} - S_{etop,(i)} \cos\theta_{etop,(i)}$$

$$H_{tbtm,(i)} = \left|F_{tbtm,(i)}\right| - T_{xbtm,(i)} \cos\theta_{xbtm,(i)} - T_{ebtm,(i)} \cos\theta_{ebtm,(i)} - S_{xbtm,(i)} \cos\theta_{xbtm,(i)} - S_{ebtm,(i)} \cos\theta_{ebtm,(i)}$$

Table An2 Axial Linear Tension Acting on Lashing Rods

Axial linear tension (*kN*) acting on lashing rods resulting from the racking deformation of the container		
Internal lashing	Connected to the top of the container	$T_{xtop,(i)} = k\delta_{(i)} \cos\theta_{xtop,(i)}$
	Connected to the bottom of the container	$T_{xbtm,(i)} = k\delta_{(i-1)} \cos\theta_{xbtm,(i)}$
External lashing	Connected to the top of the container	$T_{etop,(i)} = k\delta_{(i)} \cos\theta_{etop,(i)}$
	Connected to the bottom of the container	$T_{ebtm,(i)} = k\delta_{(i-1)} \cos\theta_{ebtm,(i)}$

Notes:

k: Axial stiffness value (*kN/mm*) of the lashing rod

$\delta_{(i)}$: The sum of the transverse racking displacement (*mm*) at the top of the containers, accumulated from the lowest tier to the *i*-th tier (See **Fig. An3**)

Amended	Original	Remarks

Table An3 Axial Non-linear Tension Acting on Lashing Rods

Axial non-linear tension (*kN*) acting on lashing rods resulting from the vertical and horizontal clearance between twistlocks and corner castings		
Internal lashing	Connected to the top of the container	$S_{xtop,(i)} = \sum_{j=1}^{i} ku_{hgap,i(j)} \cos\theta_{xtop,(i)}$
	Connected to the bottom of the container	$S_{xbtm,(i)} = \sum_{j=1}^{i-1} ku_{hgap,i(j)} \cos\theta_{xbtm,(i)}$
External lashing	Connected to the top of the container	$S_{etop,(i)} = \sum_{j=1}^{i} ku_{hgap,i(j)} \cos\theta_{etop,(i)} + \sum_{j=1}^{i} ku_{vgap,(j)} \sin\theta_{etop,(i)}$
	Connected to the bottom of the container	$S_{ebtm,(i)} = \sum_{j=1}^{i-1} ku_{hgap,i(j)} \cos\theta_{ebtm,(i)} + \sum_{j=1}^{i} ku_{vgap,(j)} \sin\theta_{ebtm,(i)}$

Notes:

$u_{hgap,i(j)}$: Horizontal displacement (*mm*) at the top of the *i*-th tier container due to the lifting of the corner casting of the bottom of the *i*-th tier container, as given by the following formula.

$$u_{hgap,i(j)} = \frac{u_{vgap,(j)}H}{b_{con}}(i+1-j)$$

H: Height on container (*m*)

b_{con}: Breadth of containers (*m*)

$u_{vgap,(j)}$: Vertical displacement (*mm*) at the bottom of the *j*-th tier container

Amended	Original	Remarks
An3.3 Iterative Processing **An3.3.1** **1** Since the vertical displacement $u_{vgap,(i)}$ due to the lifting of the corner casting depends on the tension of the lashing rods associated with said lifting, an iterative calculation taking $u_{vgap,(i)}$ as a variable is to be carried out to evaluate the tension acting on lashing rods and the racking force acting on the containers in accordance with **An3.2**. **2** The iterative calculation can be considered converged	**(Newly added)**	Correspond to 6.4.3.2, "Guidelines for Container Stowage and Securing Arrangements"

Amended	Original	Remarks
when the vertical displacement $u_{vgap,(i)}$ due to the lifting of the corner casting satisfies either of the following conditions within an appropriate tolerance. Note that $u_{vclearance,(i)}$ is the maximum lifting displacement (*kN*) of the corner casting at the bottom of the *i*-th tier container, which is a value determined by the designer based on the geometry of the corner castings and twistlocks. $\begin{cases} F_{ct,(i)} > 0 \text{ and } u_{vgap,(i)} = u_{vclearance,(i)} \\ F_{ct,(i)} = 0 \text{ and } 0 < u_{vgap,(i)} < u_{vclearance,(i)} \\ F_{ct,(i)} < 0 \text{ and } u_{vgap,(i)} = 0 \end{cases}$ $F_{ct,(i)}$: Lifting load acting on the corner casting at the bottom corners of containers in the *i*-th tier, in accordance with **14.3.3.4**. **3** For the purpose of the iterative calculation, it may be assumed that lifting starts from the corner castings in the higher tiers.		

Amended	Original	Remarks
RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS	**RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS**	
PART CS HULL CONSTRUCTION AND EQUIPMENT OF SMALL SHIPS	**PART CS HULL CONSTRUCTION AND EQUIPMENT OF SMALL SHIPS**	
Chapter 23 EQUIPMENT	**Chapter 23 EQUIPMENT**	
23.4 Container Securing Systems	**23.4 Container Securing Systems**	
23.4.2 Strength Evaluation of Container Stowage and Securing Arrangements The container securing arrangement plan specified in **23.4.1** is to comply with the strength evaluation of container stowage and securing arrangement specified in **14.3, Part 2-1, Part C**.	**(Newly added)**	
Chanter 28 LASHING SOFTWARE	**Chanter 28 LASHING SOFTWARE**	
28.1 Lashing Software	**28.1 Lashing Software**	
28.1.1 General For container carriers engaged in international voyages, the lashing software in accordance with **Annex 3.1, Part 2-1, Part C** capable of evaluating the strength of container stowage and securing arrangements as specified in **14.3, Part 2-1, Part C** is to be installed on board.	**28.1.1 General** For container carriers engaged in international voyages, the lashing software in accordance with **Annex 3.1, Part 2-1, Part C** is to be installed on board.	Revise the requirement for the lashing software provided for container carriers engaged in international voyages.

Amended-Original Requirements Comparison Table (Strength Evaluation of Container Stowage and Securing Arrangements)

<table>
<tr><th>Amended</th><th>Original</th><th>Remarks</th></tr>
<tr><td colspan="2">EFFECTIVE DATE AND APPLICATION
1. Effective date of this amendment is 1 July 2027.
2. Notwithstanding the amendments, the current requirements apply to ships for which the date of contract for construction is before the effective date.
3. Notwithstanding the provision of preceding **2.**, the amendments may apply to ships for which the date of contract for construction is before the effective date upon requests.</td><td></td></tr>
</table>