Subject
Transport of Containers in Bulk Carriers

ClassNK

Technical Information

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To whom it may concern

With the extraordinarily tight market on shipping containers, there is a rapid demand in exploring container transportation by vessels not designed for container carriage, particularly by bulk carriers.

To carry container in cargo holds and/or on upper decks and hatch covers of bulk carriers, there are many challenges to be considered, planned and prepared by ship owners, managers and operators, such as strength of hull structures, ship stability, bridge visibility with containers on deck, container securing arrangements and equipment, on-board documents to be prepared, revised and approved, etc.

ClassNK now release a technical guidance as attached which summarizes the above issues, and we hope the guidance would be useful to the safe carriage of containers in bulk carriers.

For any questions about the above, please contact:

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1. Guidance for Transport of Containers in Bulk Carriers

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Guidance for Transport of Containers in Bulk Carriers

Introduction

The purpose of this guidance is to summarize the technical matters to which shipowners need to pay attention when using bulk carriers which were not originally equipped with dedicated container transportation features for carrying containers.

In principle, bulk carriers are capable of carrying non-bulk cargoes or break-bulk cargoes within their design conditions, and the transport of containers is no exception. As well as the transport of other general cargoes, safe voyage practices for transport of containers considering hull strength, stability, navigation bridge visibility and cargo securing for each actual loading condition shall be ensured referring to the approved loading manual and cargo securing manual under the master's responsibility. On the other hand, since there are some parts that cannot be normally covered by the design conditions or manuals prepared for bulk carriers, the related documents and drawings for the transport of containers shall be approved or re-approved in advance.

Furthermore, as it is assumed that the crews on bulk carriers are unfamiliar with the carriage of containers and do not have the knowledge or understanding to ensure safe carriage, the shipowners are advised to carry out a detailed suitability assessment to ensure that the containers can be safely secured, loaded and unloaded from the ship.

Contents

Reference Drawings and Certificates

The following onboard drawings and certificates shall be referred to for assessing the capabilities of loading containers.

Loading Manual / Cargo Securing Manual / Midship Section / Construction of Hatch Covers / Navigation Bridge Visibility / Load Line Cert. / SOLAS Exemption Cert. / Dangerous Goods Cert.

The related drawings and documents to be approved or re-approved depending on the ship's design conditions and container stowage plan are highlighted with **bold underline** in this guidance.

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Attachment:

1. MSC.1/Circ.1353
2. Annex 1 of CSS code
3. Annex 13 of CSS code
4. Annex 14 of CSS code
5. Guidelines for Container Stowage and Securing Arrangements (Link)

1. Container loading in cargo holds

1.1 Hull Structural Strength

In principle, since stacking containers with deck sockets causes point loads on the inner bottom plating apart from uniform loads due to bulk cargoes, an **additional strength assessment** shall be carried out according to Para. 2.4, IACS UR S21A or relevant applicable rules respectively, and local reinforcement under the container sockets may be needed. If you send us the relevant documents, we will examine and approve them.

Alternatively, appropriate measures such as dunnage etc. shall be utilized so as to distribute the container point loads uniformly and to accommodate them within the tank top strength on the inner bottom described in the loading manual, as well as carrying other non-standardized cargoes defined in MSC.1/Circ.1353 under the master's responsibility.

1.2 Container Securing

Containers shall be stowed and secured according to Annex 1 of CSS code, and the forces acting on the lashing device for securing containers shall be appropriately evaluated referring to effective evaluation methods (e.g., Annex 13 of CSS code).

When containers are stowed with high tiers deviated from Annex 1 of CSS code, the securing plan shall be evaluated taking into account the strength of containers (e.g., racking, compression) and that of container securing devices such as twistlocks and lashing rods referring to our "Guidelines for Container Stowage and Securing Arrangements (Link)". When loading containers without cell guides in cargo holds, please refer to Para 6.4 instead of Para.6.5 in the Guidelines.

1.3 Cargo Securing Manual

1.3.1 In case approved CSM is already onboard

The Onboard Cargo Securing Manual shall be updated when loading containers in cargo holds as most bulk carriers are not intended to be used to carry containers. The following documents shall be inserted to the onboard CSM if the relevant chapter(s) is(are) currently missing.

i. Annex 1 of CSS code

ii. Information of fixed and/or portable cargo securing devices for container securing which are provided by charterers, stevedoring companies or the shipowners specified in Ch. 2 of MSC.1/Circ.1353

When containers are stowed with high tiers deviated from Annex 1 of CSS code, **information specified in Ch. 4 of MSC.1/Circ.1353** shall be added in the **CSM** and re-approved.

1.3.2 In case CSM is not onboard.

A Cargo Securing Manual shall be prepared according to the MSC.1/Circ.1353 and approved.

1.4 Fixed Fire Extinguishing System for Cargo Holds

Cargo holds loading containers on bulk carriers of 2,000 gross tonnage and upwards shall be provided with a fixed fire extinguishing arrangement regardless of the nature of the cargoes in containers.

In case exemption of FFEA is allowed by limiting cargo to the solid bulk cargoes listed in the SOLAS

exemption certificates, it is necessary to obtain special authorization for loading containers in cargo holds from the flag administration.
If transporting containers on decks and/or hatch covers only, FFEA is not required to be installed.

1.5 Dangerous Cargoes

If carrying dangerous goods in a closed freight container in the cargo holds and/or on upper deck and hatch covers, it is necessary to comply with SOLAS II-2 / Reg.19. Please confirm no dangerous goods are carried unless your ship has the DG cert. which allows loading of intended DG cargoes.

2. Container loading on upper decks and/or hatch covers

2.1. In case standard on-deck cargo loading conditions (e.g., lumber) are included in the loading manual

2.1.1 Hull Structural Strength

In principle, since stacking containers with deck sockets causes point loads on the upper decks and/or hatch covers apart from uniform loads, an **additional strength assessment** shall be carried out according to Para. 2.4, IACS UR S21A or relevant applicable rules respectively, and local reinforcement under the container sockets may be needed. If you send us the relevant documents, we will examine and approve them.
Alternatively, appropriate measures such as dunnage etc. shall be utilized so as to distribute the container point loads uniformly and to accommodate them within the allowable loads for cargoes on the upper decks and/or hatch covers described in the loading manual, as well as carrying other non-standardized cargoes defined in MSC.1/Circ.1353 under the master's responsibility.

2.1.2 Container Securing

Containers shall be stowed and secured according to Annex 1 of CSS code, and the forces acting on the lashing device for securing containers shall be appropriately evaluated referring to effective evaluation methods (e.g., Annex 13 of CSS code).
When containers are stowed with high tiers deviated from Annex 1 of CSS code, the stowage plan shall be evaluated taking into account the strength of containers (e.g., racking, compression) and that of container securing devices such as twistlocks and lashing rods referring to our "Guidelines for Container Stowage and Securing Arrangements".

2.1.3 Cargo Securing Manual

2.1.3.1 In case approved CSM is already onboard

The Onboard Cargo Securing Manual shall be updated when loading containers on upper decks and/or hatch covers as most bulk carriers are not intended to be used to carry containers. The following documents shall be inserted to the onboard CSM if the relevant chapter(s) is(are) currently missing.

i. Annex 1 of CSS code
ii. Information of fixed and/or portable cargo securing devices for container securing which are provided by charterers, stevedoring companies or the shipowners specified in Ch. 2 of MSC.1/Circ.1353

When containers are stowed with high tiers deviated from the Annex 1 of CSS code, **information specified in Ch. 4 of MSC.1/Circ.1353** shall be added in the **CSM** and re-approved.

2.1.3.2 In case CSM is not onboard.

A Cargo Securing Manual shall be prepared according to the MSC.1/Circ.1353 and approved.

2.1.4 Stability and Longitudinal strength.

If the intended container loading condition can be suitably evaluated taking into account wind area from the deck cargo using the loading manual and/or loading/stability computer with on deck cargo module, it is acceptable to confirm it under the master's responsibility without our approval of addendum of the loading manual and loading/stability computer.

2.1.5 Navigation Bridge Visibility

If the onboard loading/stability computer with on deck cargo module is able to suitably evaluate the blind distance from the navigation bridge taking into account the on-deck containers for intended loading conditions, it is acceptable to check it under the master's responsibility without our re-approval of the drawing for Navigation Bridge Visibility prepared by the shipyard during the newbuilding process.

2.1.6 Dangerous Cargoes

See 1.5

2.2 In case standard on-deck cargo loading conditions (e.g., lumber) are NOT included in the loading manual

2.2.1 Hull Structural Strength

In principle, since stacking containers with deck sockets causes point loads on the upper decks and/or hatch covers apart from uniform loads, an **additional strength assessment** shall be carried out according to Para. 2.4, IACS UR S21A or relevant applicable rules respectively, and local reinforcement under the container sockets may be needed. If you send us the relevant documents, we will examine and approve them.

Alternatively, appropriate measures such as dunnage etc. shall be utilized so as to distribute the container loads uniformly and to accommodate them within the allowable load for cargo load on the upper decks and/or hatch covers described in the loading manual, as well as carrying other non-standardized cargoes defined in MSC.1/Circ.1353 under the master's responsibility. In this case, the allowable load for cargo load on upper decks and/or hatch covers shall be clarified. You are kindly requested to ask the mother shipyard, hatch cover manufacturers, and/or design companies **to verify the allowable uniform load for cargo load with relevant documents**. Please note, if on-board drawings of the loading manual, hatch covers or hull construction drawings indicate "sea load" or "wave load" only, a strength check for "cargo load" as a design margin is additionally required. If you send us the relevant documents, we will examine and approve them.

2.2.2 Container Securing

See 2.1.2

2.2.3 Cargo Securing Manual.

See 2.1.3

2.2.4 Stability and Longitudinal strength.

Standard on-deck container loading conditions taking into account wind area from the deck cargo shall be added and approved in the **Loading manual**. The onboard loading/stability computer shall be upgraded with an on-deck cargo module so as to achieve the same results as the standard on-deck container loading conditions in the approved addendum of the loading manual.

The **computing accuracy of the upgraded stability computer** capable of considering wind area from the deck cargo shall be verified and re-approved.

2.2.5 Navigation Bridge Visibility

The drawing for **navigation bridge visibility** prepared during the newbuilding process shall be updated and re-approved considering the loadable on-deck container stack height for standard container loading conditions.

2.2.6 Damage Stability

For ships with reduced freeboard (type B-60), **probabilistic damage stability calculation** for SOLAS Chapter II-1 and **damage stability information** for Reg.19.5 (if applied) shall be required and approved. (cf. IACS UI LL65). For ships with freeboard (type B), it may be necessary to re-calculate the damage stability for SOLAS XII.

2.2.7 Dangerous Cargoes

See 1.5

3. Permanent Installation of particular equipment to carry containers

3.1 Cargo Safe Access Plan

Apart from ships temporarily carrying containers on upper decks/hatch covers, if the ships are permanently fitted with ~~a~~ particular equipment for carrying containers on upper decks/hatch covers as well, they shall fall under "containership" as defined in Para.3.2, CSS code Annex 14 and meet the requirements of Annex 14. The **cargo safe access plan** shall be approved and inserted to the CSM.

3.2 Mooring Equipment

If containers are carried on the decks of ships which are not designed for deck cargo, the increased wind area shall be taken into account. Increase of wind area by deck cargo will result in higher mooring forces. If the ship will carry container deck cargoes permanently, a revised **equipment number calculation** must be approved, which might result in modifications.

3.3 Welding Work

Welding work for installation of permanently installed cargo securing equipment or local reinforcement under the deck sockets shall be carried out by approved/qualified welders using class-approved materials and welding consumables.

The installation shall be carried out under the witness of an attending class surveyor based on the **modification plan** approved by us.

INTERNATIONAL MARITIME ORGANIZATION

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REVISED GUIDELINES FOR THE PREPARATION OF THE CARGO SECURING MANUAL

1 In accordance with regulations VI/5 and VII/5 of the 1974 SOLAS Convention, cargo units and cargo transport units shall be loaded, stowed and secured throughout a voyage in accordance with the Cargo Securing Manual approved by the Administration, which shall be drawn up to a standard at least equivalent to the guidelines developed by the Organization.

2 The Maritime Safety Committee, at its eighty-seventh session (12 to 21 May 2010), considered a proposal by the Sub-Committee on Dangerous Goods, Solid Cargoes and Containers (DSC), at its fourteenth session (21 to 25 September 2009), and approved MSC.1/Circ.1353/Rev.1 on *Revised guidelines for the preparation of the Cargo Securing Manual*.

3 These Revised Guidelines were based on the provisions contained in the annex to MSC/Circ.745 but have been expanded to include safe access for lashing of containers, taking into account the provisions of the *Code of Safe Practice for Cargo Stowage and Securing* (CSS Code). They are of a general nature and intended to provide guidance on the preparation of Cargo Securing Manuals required on all types of ships engaged in the carriage of cargoes other than solid and liquid bulk cargoes.

4 The Maritime Safety Committee, at its 102nd session (4 to 11 November 2020), agreed to amend the Revised Guidelines, in conjunction with the approval of amendments to the CSS Code (MSC.1/Circ.1623) and approved *Revised guidelines for the preparation of the Cargo Securing Manual*, as set out in the annex.

5 Member Governments are invited to bring these Guidelines to the attention of all parties concerned, with the aim of having Cargo Securing Manuals carried on board ships prepared appropriately and in a consistent manner, and to:

.1 apply the Revised Guidelines in their entirety to containerships* the keels of which were laid or which were at a similar stage of construction on or after 1 January 2015; and

* As approved by the Maritime Safety Committee at its ninety-fourth session (17 to 21 November 2014), reference to containerships means dedicated containerships and those parts of other ships for which arrangements are specifically designed and fitted for the purpose of carrying containers on deck.

.2 apply chapters 1 to 4 of the Revised Guidelines to existing containerships* the keels of which were laid or which were at a similar stage of construction before 1 January 2015.

6 This circular supersedes MSC.1/Circ.1353/Rev.1.

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ANNEX

REVISED GUIDELINES FOR THE PREPARATION OF THE CARGO SECURING MANUAL

PREAMBLE

1 In accordance with the *International Convention for the Safety of Life at Sea, 1974* (SOLAS) chapters VI, VII and the *Code of Safe Practice for Cargo Stowage and Securing* (CSS Code), cargo units, including containers, shall be stowed and secured throughout the voyage in accordance with a Cargo Securing Manual approved by the Administration.

2 The Cargo Securing Manual is required on all types of ships engaged in the carriage of all cargoes other than solid and liquid bulk cargoes.

3 The purpose of these Guidelines is to ensure that Cargo Securing Manuals cover all relevant aspects of cargo stowage and securing and to provide a uniform approach to the preparation of Cargo Securing Manuals, their layout and content. Administrations may continue accepting Cargo Securing Manuals drafted in accordance with *Containers and cargoes (BC) – Cargo Securing Manual* (MSC/Circ.385) provided that they satisfy the requirements of these Guidelines.

4 If necessary, those manuals should be revised explicitly when the ship is intended to carry containers in a standardized system.

5 It is important that securing devices meet acceptable functional and strength criteria applicable to the ship and its cargo. It is also important that the officers on board are aware of the magnitude and direction of the forces involved and the correct application and limitations of the cargo securing devices. The crew and other persons employed for the securing of cargoes should be instructed in the correct application and use of the cargo securing devices on board the ship.

CHAPTER 1

GENERAL

1.1 Definitions

1.1.1 *Cargo securing devices* are all fixed and portable devices used to secure and support cargo units.

1.1.2 *Maximum securing load (MSL)* is a term used to define the allowable load capacity for a device used to secure cargo to a ship. *Safe working load (SWL)* may be substituted for MSL for securing purposes, provided this is equal to or exceeds the strength defined by MSL.

1.1.3 *Standardized cargo* means cargo for which the ship is provided with an approved securing system based upon cargo units of specific types.

1.1.4 *Semi-standardized cargo* means cargo for which the ship is provided with a securing system capable of accommodating a limited variety of cargo units, such as vehicles and trailers.

1.1.5 *Non-standardized cargo* means cargo which requires individual stowage and securing arrangements.

1.2 Preparation of the manual

The Cargo Securing Manual should be developed, taking into account the recommendations given in these Guidelines, and should be written in the working language or languages of the ship. If the language or languages used is not English, French or Spanish, a translation into one of these languages should be included.

1.3 General information

This chapter should contain the following general statements:

.1 "The guidance given herein should by no means rule out the principles of good seamanship, neither can it replace experience in stowage and securing practice.";

.2 "The information and requirements set forth in this manual are consistent with the requirements of the vessel's trim and stability booklet, International Load Line Certificate (1966), the hull strength loading manual (if provided) and with the requirements of the *International Maritime Dangerous Goods* (IMDG) *Code* (if applicable).";

.3 "This Cargo Securing Manual specifies arrangements and cargo securing devices provided on board the ship for the correct application to and the securing of cargo units, containers, vehicles and other entities, based on transverse, longitudinal and vertical forces which may arise during adverse weather and sea conditions.";

.4 "It is imperative to the safety of the ship and the protection of the cargo and personnel that the securing of the cargo is carried out properly and that only appropriate securing points or fittings should be used for cargo securing.";

.5 "The cargo securing devices mentioned in this manual should be applied so as to be suitable and adapted to the quantity, type of packaging and physical properties of the cargo to be carried. When new or alternative types of cargo securing devices are introduced, the Cargo Securing Manual should be revised accordingly. Alternative cargo securing devices introduced should not have less strength than the devices being replaced.";

.6 "There should be a sufficient quantity of reserve cargo securing devices on board the ship.";

.7 "Information on the strength and instructions for the use and maintenance of each specific type of cargo securing device, where applicable, is provided in this manual. The cargo securing devices should be maintained in a satisfactory condition. Items worn or damaged to such an extent that their quality is impaired should be replaced."; and

.8 The Cargo Safe Access Plan (CSAP) is intended to provide detailed information for persons engaged in work connected with cargo stowage and securing. Safe access should be provided and maintained in accordance with this plan.

CHAPTER 2

SECURING DEVICES AND ARRANGEMENTS

2.1 Specification for fixed cargo securing devices

This section should indicate and where necessary illustrate the number, locations, type and MSL of the fixed devices used to secure cargo and should as a minimum contain the following information:

.1 a list and/or plan of the fixed cargo securing devices, which should be supplemented with appropriate documentation for each type of device as far as practicable. The appropriate documentation should include information as applicable regarding:

.1 name of manufacturer;

.2 type designation of item with simple sketch for ease of identification;

.3 material(s);

.4 identification marking;

.5 strength test result or ultimate tensile strength test result;

.6 result of non-destructive testing; and

.7 maximum securing load (MSL);

.2 fixed securing devices on bulkheads, web frames, stanchions, etc. and their types (e.g. pad eyes, eyebolts), where provided, including their MSL;

.3 fixed securing devices on decks and their types (e.g. elephant feet fittings, container fittings, apertures) where provided, including their MSL;

.4 fixed securing devices on deckheads, where provided, listing their types and MSL; and

.5 for existing ships with non-standardized fixed securing devices, the information on MSL and location of securing points is deemed sufficient.

2.2 Specification for portable cargo securing devices

This section should describe the number of and the functional and design characteristics of the portable cargo securing devices carried on board the ship, and should be supplemented by suitable drawings or sketches if deemed necessary. It should contain the following information as applicable:

.1 a list for the portable securing devices, which should be supplemented with appropriate documentation for each type of device, as far as practicable; the appropriate documentation should include information as applicable regarding:

.1 name of manufacturer;

.2 type designation of item with simple sketch for ease of identification;

.3 material(s), including minimum safe operational temperature;

.4 identification marking;

.5 strength test result or ultimate tensile strength test result;

.6 result of non-destructive testing; and

.7 maximum securing load (MSL);

.2 container stacking fittings, container deck securing fittings, fittings for interlocking of containers, bridge-fittings, etc. their MSL and use;

.3 chains, wire lashings, rods, etc. their MSL and use;

.4 tensioners (e.g. turnbuckles, chain tensioners), their MSL and use;

.5 securing gear for cars, if appropriate, and other vehicles, their MSL and use;

.6 trestles and jacks, etc. for vehicles (trailers) where provided, including their MSL and use; and

.7 anti-skid material (e.g. soft boards) for use with cargo units having low frictional characteristics.

2.3 Inspection and maintenance schemes

This section should describe inspection and maintenance schemes of the cargo securing devices on board the ship.

2.3.1 Regular inspections and maintenance should be carried out under the responsibility of the master. Cargo securing devices inspections as a minimum should include:

.1 routine visual examinations of components being utilized; and

.2 periodic examinations/re-testing as required by the Administration; when required, the cargo securing devices concerned should be subjected to inspections by the Administration.

2.3.2 This section should document actions to inspect and maintain the ship's cargo securing devices. Entries should be made in a record book, which should be kept with the Cargo Securing Manual. This record book should contain the following information:

.1 procedures for accepting, maintaining and repairing or rejecting cargo securing devices; and

.2 record of inspections.

2.3.3 This section should contain information for the master regarding inspections and adjustment of securing arrangements during the voyage.

2.3.4 Computerized maintenance procedures may be referred to in this section.

CHAPTER 3

STOWAGE AND SECURING OF NON-STANDARDIZED AND SEMI-STANDARDIZED CARGO

3.1 Handling and safety instructions

This section should contain:

.1 instructions on the proper handling of the securing devices; and

.2 safety instructions related to handling of securing devices and to securing and unsecuring of units by ship or shore personnel.

3.2 Evaluation of forces acting on cargo units

This section should contain the following information:

.1 tables or diagrams giving a broad outline of the accelerations which can be expected in various positions on board the ship in adverse sea conditions and with a range of applicable metacentric height (GM) values;

.2 examples of the forces acting on typical cargo units when subjected to the accelerations referred to in paragraph 3.2.1 and angles of roll and metacentric height (GM) values above which the forces acting on the cargo units exceed the permissible limit for the specified securing arrangements as far as practicable;

.3 examples of how to calculate number and strength of portable securing devices required to counteract the forces referred to in 3.2.2 as well as safety factors to be used for different types of portable cargo securing devices; calculations may be carried out according to annex 13 to the CSS Code or methods accepted by the Administration;

.4 it is recommended that the designer of a Cargo Securing Manual convert the calculation method used into a form suiting the particular ship, its securing devices and the cargo carried; this form may consist of applicable diagrams, tables or calculated examples; and

.5 other operational arrangements such as electronic data processing (EDP) or use of a loading computer may be accepted as alternatives to the requirements of paragraphs 3.2.1 to 3.2.4 above, providing that this system contains the same information.

3.3 Application of portable securing devices on various cargo units, vehicles and stowage blocks

3.3.1 This section should draw the master's attention to the correct application of portable securing devices, taking into account the following factors, as reflected in annex 13 of the CSS Code:

.1 duration of the voyage;

.2 geographical area of the voyage with particular regard to the minimum safe operational temperature of the portable securing devices;

.3 sea conditions which may be expected;

.4 dimensions, design and characteristics of the ship;

.5 expected static and dynamic forces during the voyage;

.6 type and packaging of cargo units including vehicles;

.7 intended stowage pattern of the cargo units including vehicles; and

.8 mass and dimensions of the cargo units and vehicles.

3.3.2 This section should describe the application of portable cargo securing devices as to number of lashings and allowable lashing angles. Where necessary, the text should be supplemented by suitable drawings or sketches to facilitate the correct understanding and proper application of the securing devices to various types of cargo and cargo units. It should be pointed out that for certain cargo units and other entities with low friction resistance, it is advisable to place soft boards or other anti-skid material under the cargo to increase friction between the deck and the cargo.

3.3.3 This section should contain guidance as to the recommended location and method of stowing and securing of containers, trailers and other cargo carrying vehicles, palletized cargoes, unit loads and single cargo items (e.g. woodpulp, paper rolls), heavy weight cargoes, cars and other vehicles.

3.3.4 When weather-dependent lashing is applied, operational procedures should be developed in accordance with annex 13 of the CSS Code.

3.4 Supplementary requirements for ro-ro ships

3.4.1 The manual should contain sketches showing the layout of the fixed securing devices with identification of strength (MSL) as well as longitudinal and transverse distances between securing points. In preparing this section further guidance should be utilized from IMO Assembly resolutions A.533(13) and A.581(14), as appropriate.

3.4.2 In designing securing arrangements for cargo units, including vehicles and containers, on ro-ro passenger ships and specifying minimum strength requirements for securing devices used, forces due to the motion of the ship, angle of heel after damage or flooding and other considerations relevant to the effectiveness of the cargo securing arrangement should be taken into account.

3.5 Bulk carriers

If bulk carriers carry cargo units falling within the scope of chapter VI/5 or chapter VII/5 of the SOLAS Convention, this cargo shall be stowed and secured in accordance with a Cargo Securing Manual, approved by the Administration.

CHAPTER 4

STOWAGE AND SECURING OF CONTAINERS AND OTHER STANDARDIZED CARGO

4.1 Handling and safety instructions

This section should contain:

.1 instructions on the proper handling of the securing devices; and

.2 safety instructions related to handling of securing devices and to securing and unsecuring of containers or other standardized cargo by ship or shore personnel.

4.2 Stowage and securing instructions

This section is applicable to any stowage and securing system (i.e. stowage within or without cellguides) for containers and other standardized cargo. On existing ships the relevant documents regarding safe stowage and securing may be integrated into the material used for the preparation of this chapter.

4.2.1 Stowage and securing plan

This section should consist of a comprehensive and understandable plan or set of plans providing the necessary overview on:

.1 longitudinal and athwartship views of under deck and on deck stowage locations of containers as appropriate;

.2 alternative stowage patterns for containers of different dimensions;

.3 maximum stack masses;

.4 permissible vertical sequences of masses in stacks;

.5 maximum stack heights with respect to approved sight lines; and

.6 application of securing devices using suitable symbols with due regard to stowage position, stack mass, sequence of masses in stack and stack height; the symbols used should be consistent throughout the Cargo Securing Manual.

4.2.2 Stowage and securing principle on deck and under deck

This section should support the interpretation of the stowage and securing plan with regard to container stowage, highlighting:

.1 the use of the specified devices; and

.2 any guiding or limiting parameters such as dimension of containers, maximum stack masses, sequence of masses in stacks, stacks affected by wind load, height of stacks.

It should contain specific warnings of possible consequences from misuse of securing devices or misinterpretation of instructions given.

4.3 Other allowable stowage patterns

4.3.1 This section should provide the necessary information for the master to deal with cargo stowage situations deviating from the general instructions addressed under section 4.2, including appropriate warnings of possible consequences from misuse of securing devices or misinterpretation of instructions given.

4.3.2 Information should be provided with regard to, inter alia:

.1 alternative vertical sequences of masses in stacks;

.2 stacks affected by wind load in the absence of outer stacks;

.3 alternative stowage of containers with various dimensions; and

.4 permissible reduction of securing effort with regard to lower stacks masses, lesser stack heights or other reasons.

4.4 Forces acting on cargo units

4.4.1 This section should present the distribution of accelerations on which the stowage and securing system is based, and specify the underlying condition of stability. Information on forces induced by wind and sea on deck cargo should be provided.

4.4.2 It should further contain information on the nominal increase of forces or accelerations with an increase of initial stability. Recommendations should be given for reducing the risk of cargo losses from deck stowage by restrictions to stack masses or stack heights, where high initial stability cannot be avoided.

CHAPTER 5

CARGO SAFE ACCESS PLAN (CSAP)

5.1 Ships which are specifically designed and fitted for the purpose of carrying containers should be provided with a Cargo Safe Access Plan (CSAP) in order to demonstrate that personnel will have safe access for container securing operations. This plan should detail arrangements necessary for conducting cargo stowage and securing in a safe manner. It should include the following for all areas to be worked by personnel:

.1 handrails;

.2 platforms;

.3 walkways;

.4 ladders;

.5 access covers;

.6 location of equipment storage facilities;

.7 lighting fixtures;

.8 container alignment on hatch covers/pedestals;

.9 fittings for specialized containers, such as reefer plugs/receptacles;

.10 first aid stations and emergency access/egress;

.11 gangways; and

.12 any other arrangements necessary for the provision of safe access.

5.2 Guidelines for specific requirements are contained in annex 14 to the CSS Code.

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ANNEX 1

SAFE STOWAGE AND SECURING OF CONTAINERS ON DECK OF SHIPS WHICH ARE NOT SPECIALLY DESIGNED AND FITTED FOR THE PURPOSE OF CARRYING CONTAINERS

1 Stowage

1.1 Containers carried on deck or on hatches of such ships should preferably be stowed in the fore-and-aft direction.

1.2 Containers should not extend over the ship's sides. Adequate supports should be provided when containers overhang hatches or deck structures.

1.3 Containers should be stowed and secured so as to permit safe access for personnel in the necessary operation of the ship.

1.4 Containers should at no time overstress the deck or hatches on which they are stowed.

1.5 Bottom-tier containers, when not resting on stacking devices, should be stowed on timber of sufficient thickness, arranged in such a way as to transfer the stack load evenly on to the structure of the stowage area.

1.6 When stacking containers, use should be made of locking devices, cones, or similar stacking aids, as appropriate, between them.

1.7 When stowing containers on deck or hatches, the position and strength of the securing points should be taken into consideration.

2 Securing

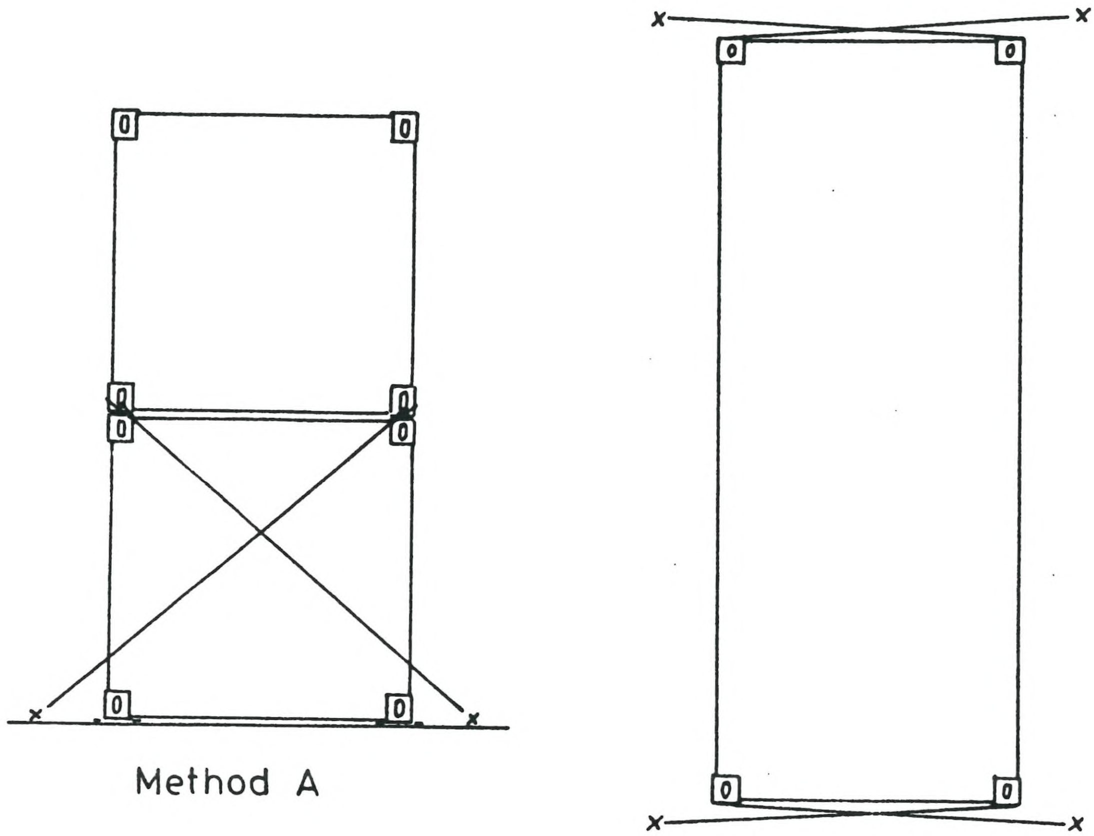
2.1 All containers should be effectively secured in such a way as to protect them from sliding and tipping. Hatch covers carrying containers should be adequately secured to the ship.

2.2 Containers should be secured using one of the three methods recommended in figure 1 or methods equivalent thereto.

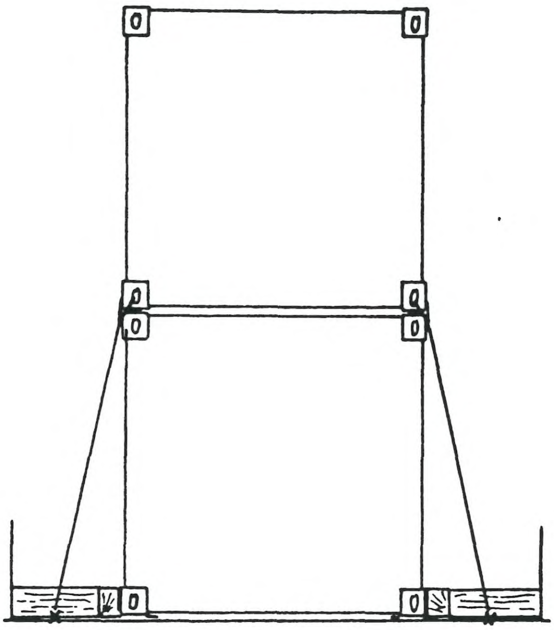
2.3 Lashings should preferably consist of wire ropes or chains or material with equivalent strength and elongation characteristics.

2.4 Timber shoring should not exceed 2 m in length.

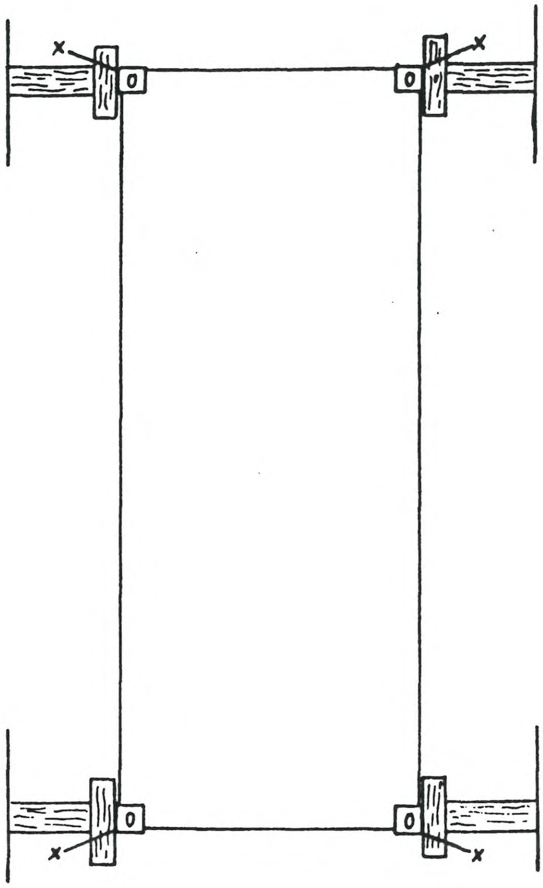
Figure 1: Recommended methods of non-standardized securing of containers



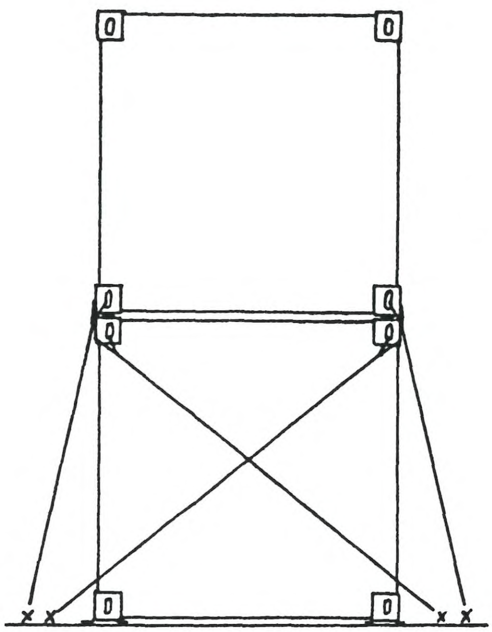
Method A: Medium weight containers: weight of top container not more than 70% of that of bottom container



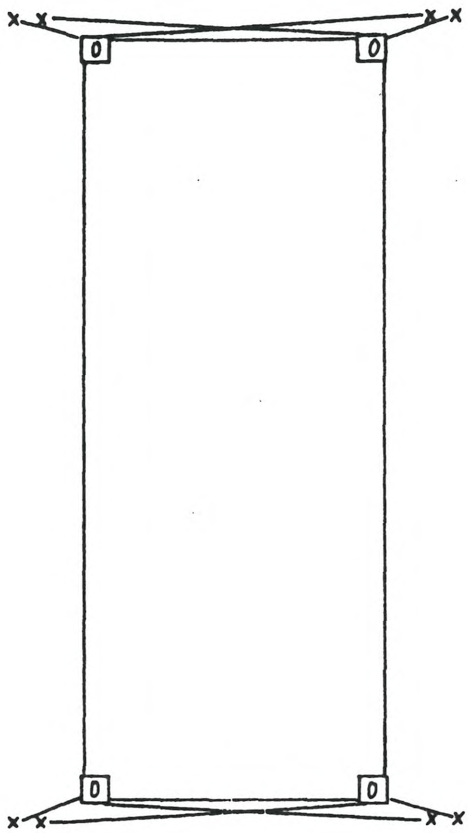
Method B



Method B: Medium weight containers: weight of top container may be more than 70% of that of bottom container



Method C

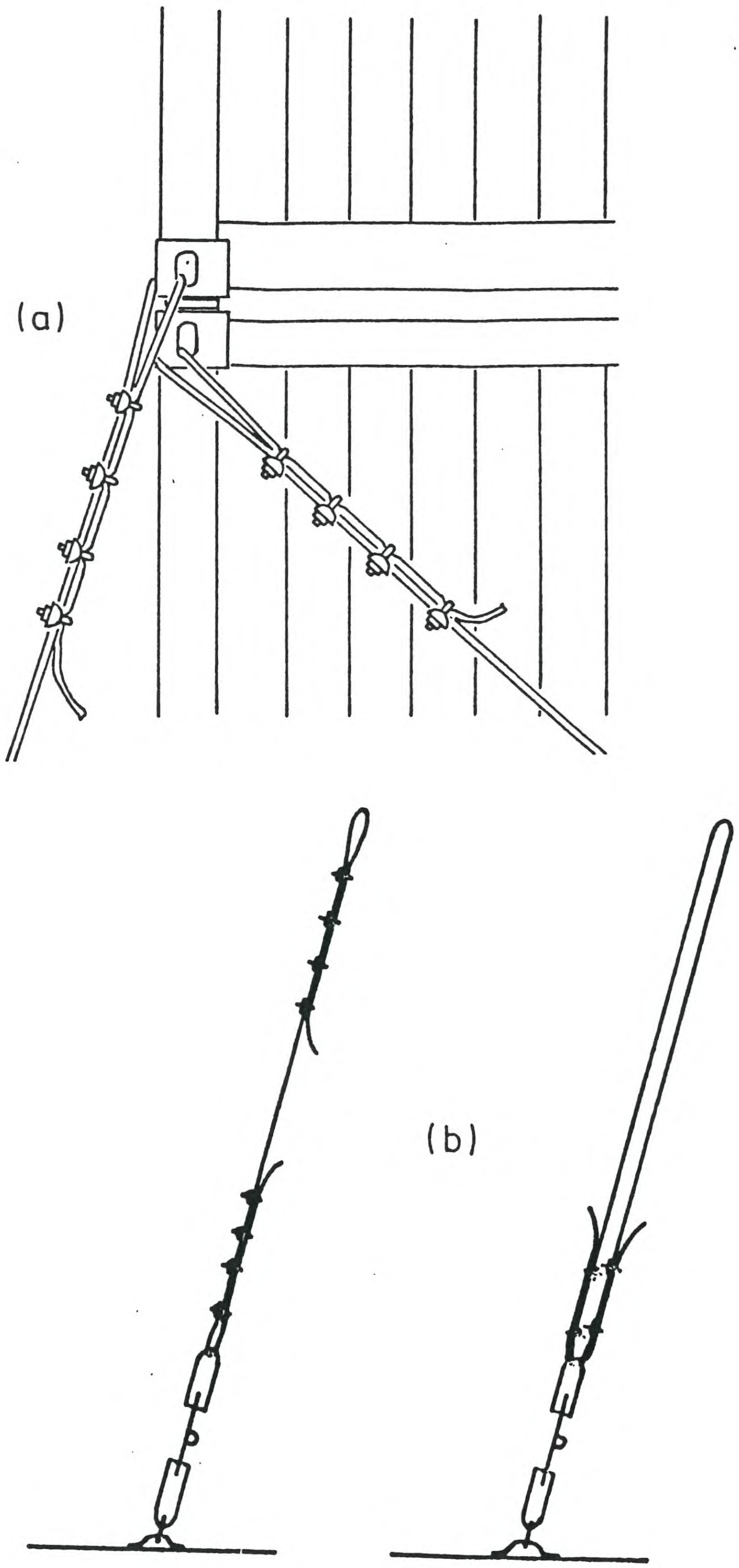


Method C: Heavy weight containers: weight of top container may be more than 70% of that of bottom container

2.5 Wire clips should be adequately greased, and tightened so that the dead end of the wire is visibly compressed (figure 2).

2.6 Lashings should be kept, when possible, under equal tension.

Figure 2:



Fastening of wire lashings to corner fittings

Alternative constructions of wire lashings

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MSC.1/Circ.1623
7 December 2020

AMENDMENTS TO THE CODE OF SAFE PRACTICE FOR CARGO STOWAGE AND SECURING (CSS CODE)

1 The Maritime Safety Committee, at its 102nd session (4 to 11 November 2020), approved amendments to the *Code of Safe Practice for Cargo Stowage and Securing* (CSS Code), as prepared by the Sub-Committee on Carriage of Cargoes and Containers, at its sixth session (9 to 13 September 2019), as set out in the annex.

2 Member States are invited to bring the amendments to the attention of shipowners, ship operators, ship masters and crews and all parties concerned.

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ANNEX

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AMENDMENTS TO THE CODE OF SAFE PRACTICE FOR CARGO STOWAGE AND SECURING (CSS CODE)

ANNEX 13

Methods to assess the efficiency of securing arrangements
For semi-standardized and non-standardized cargo

The complete text of annex 13, together with its four appendices, is replaced by the following:

"1 Scope of application

1.1 The methods described in this annex should be applied to semi-standardized and non-standardized cargo including very heavy and/or very large cargo items. Standardized stowage and securing systems, in particular containers on containerships, are excluded.

1.2 Cargoes carried on towed barges should be secured according to the provisions of this annex except that the assumed external forces may be determined using an alternative method acceptable to the Administration instead of that described in section 7.1 of this annex.

1.3 Very heavy and/or very large cargo items as addressed in chapter 1.8 of this Code may require provisions and considerations beyond the general scope of this annex. Examples of such provisions and considerations are given in appendix 3 of this annex.

1.4 Semi-standardized cargoes, for which the securing arrangements are often designed based on worst case assumptions on cargo properties, lashing angles and stowage positions on board, may require provisions and considerations beyond the general scope of this annex. Examples of such provisions and considerations are given in appendix 4 of this annex.

1.5 Notwithstanding the general principles contained in this annex, the adequacy of cargo securing may be demonstrated by means of detailed engineering calculations based upon the general principles and encompassing the additional provisions and considerations shown in appendix 3 of this annex. Computer programs used for that purpose should be validated against a suitable range of model tests or full-scale results in irregular seas. When using new software for new and unconventional applications, the validation should be documented.

1.6 The application of the methods described in this annex is supplementary to the principles of good seamanship and should not replace experience in stowage and securing practice.

2 Purpose of the methods

The methods should:

.1 provide guidance for the preparation of Cargo Securing Manuals and the examples therein;

.2 assist ship's staff in assessing the securing of cargo items not covered by the Cargo Securing Manual;

.3 assist qualified shore personnel in assessing the securing of cargo items not covered by the Cargo Securing Manual; and

.4 serve as a reference for maritime and port-related education and training.

3 Presentation of the methods

The methods are presented in a universally applicable and flexible way. It is recommended that designers of Cargo Securing Manuals convert this presentation into a format suiting the particular ship, its securing equipment and the cargo carried. This format may include applicable diagrams, tables or calculated examples.

4 Strength of securing equipment

4.1 Manufacturers of securing equipment should at least supply information on the nominal breaking strength of the equipment in kilonewtons (kN).[1]

4.2 "Maximum securing load" (MSL) is a term used to define the load capacity for a device used to secure cargo to a ship. "Safe working load" (SWL) may be substituted for MSL for securing purposes, provided this is equal to or exceeds the strength defined by MSL.

Where practicable, the MSL should preferably be marked on the securing equipment.

The MSLs for different securing devices are given in table 1 if not given under 4.3.

The MSL of timber should be taken as 0.3 kN/cm2 normal to the grain.

Table 1 – Determination of MSL from breaking strength

Material	MSL
Shackles, rings, deckeyes, turnbuckles of mild steel	50% of breaking strength
Fibre rope	33% of breaking strength
Web lashing	50% of breaking strength
Wire rope (single use)	80% of breaking strength
Wire rope (re-useable)	30% of breaking strength
Steel band (single use)	70% of breaking strength
Chains	50% of breaking strength

4.3 Particular securing devices (e.g. fibre straps with tensioners or special equipment for securing containers) may be marked with a permissible working load, as prescribed by an appropriate authority. This may be taken as the MSL.

4.4 When the components of a lashing device are connected in series (e.g. a wire to a shackle to a deckeye), the minimum MSL in the series should apply to that device.

4.5 Where temporary welded fittings are used, they should be designed to be adequate for the expected loading, and installed by qualified welders in accordance with established welding procedures. The design and placement of these fittings should be such as to minimize bending.

[1] 1 kN ≈ 100 kg.

4.6 Simple stoppers may be used to provide securing against sliding. These are generally welded to a surface by fillet welds, characterized by thickness (*a*) and length (*l*). A face plate should be provided against the cargo piece so that welds are not loaded by a shear force at right angles to the weld direction or by significant bending forces. As a simple rule of thumb for welded steel stoppers, the MSL of single-lay weld leg can then be approximated as 4 kN/cm (*l*) normal to the face plate, assuming 5 mm weld thickness (*a*). For a triple-lay weld leg, MSL can be taken as 10 kN/cm normal to the face plate.

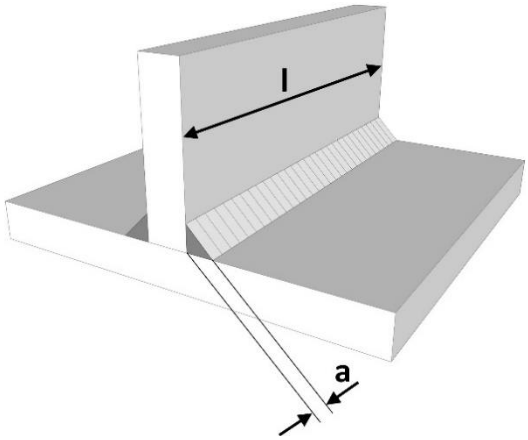

Figure 16.1 – Welding of steel stoppers

4.7 All securing devices to be accounted for in the balance calculations described in this annex should be capable of transferring forces directly from the vessel to the cargo or vice versa, in order to reflect their MSLs. For that purpose, lashings should be attached to fixed securing points or strong supporting structures marked on the cargo item or advised as being suitable, or taken as a loop around the item with both ends secured to the same side as shown in figure 7 in annex 5 of the Code. Lashings going over the top of the cargo item, whose only function is to increase friction by their pre-tension, cannot be credited in the evaluation of securing arrangements under this annex.

5 Rule-of-thumb method

5.1 The total of the MSL values of the securing devices on each side of a cargo item (port as well as starboard) should equal the weight of the item.[2]

5.2 This method, which implies a transverse acceleration of 1g (9.81 m/s^2), applies to nearly any size of ship, regardless of the location of stowage, stability and loading condition, season and area of operation. The method, however, takes into account neither the adverse effects of lashing angles and non-homogeneous distribution of forces among the securing devices nor the favourable effect of friction.

5.3 Transverse lashing angles to the deck should not be greater than 60° and it is important that adequate friction is provided by the use of suitable material. Additional lashings at angles of greater than 60° may be desirable to prevent tipping but are not to be counted in the number of lashings under the rule of thumb.

6 Safety factor

6.1 When using balance calculation methods for assessing the strength of the securing devices, a safety factor is used to take account of the possibility of uneven distribution of forces among the devices or reduced capability due to the improper assembly of the devices or other

[2] The weight of the unit should be taken in kN.

reasons. This safety factor is used in the formula to derive the calculated strength (*CS*) from the MSL and shown in the relevant method used.

$$CS = \frac{MSL}{safety\ factor}$$

6.2 Notwithstanding the introduction of such a safety factor, care should be taken to use securing elements of similar material and length in order to provide a uniform elastic behaviour within the arrangement.

6.3 If securing devices of different elasticity are used in the same direction, e.g. welded bottom stoppers and fibre belts or long wire lashings, the more flexible securing devices in such an arrangement should be excluded if they, due to their elongation, do not contribute to preventing initial movement of the cargo.

7 Advanced calculation method

7.1 Assumption of external forces

7.1.1 External forces to a cargo item in longitudinal, transverse and vertical directions should be obtained using the formula:

$$F_{(x,y,z)} = m \cdot a_{(x,y,z)} + F_{w(x,y)} + F_{s(x,y)}$$

where

$F_{(x,y,z)}$ = longitudinal, transverse and vertical forces
m = mass of the item
$a_{(x,y,z)}$ = longitudinal, transverse and vertical accelerations (see table 2 below)
$F_{w(x,y)}$ = longitudinal and transverse forces by wind pressure
$F_{s(x,y)}$ = longitudinal and transverse forces by sea sloshing.

The basic acceleration data are presented in table 2.

Table 2 – Basic acceleration data

	Transverse acceleration a_y in m/s^2									Longitudinal acceleration a_x in m/s^2
on deck, high	7.1	6.9	6.8	6.7	6.7	6.8	6.9	7.1	7.4	3.8
on deck, low	6.5	6.3	6.1	6.1	6.1	6.1	6.3	6.5	6.7	2.9
'tween-deck	5.9	5.6	5.5	5.4	5.4	5.5	5.6	5.9	6.2	2.0
lower hold	5.5	5.3	5.1	5.0	5.0	5.1	5.3	5.5	5.9	1.5
0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	*L*
	Vertical acceleration a_z in m/s^2									
	7.6	6.2	5.0	4.3	4.3	5.0	6.2	7.6	9.2	

Remarks:

The given transverse acceleration figures include components of gravity, pitch and heave parallel to the deck. The given vertical acceleration figures do not include the static weight component.

7.1.2 The basic acceleration data are to be considered as valid under the following operational conditions:[3]

.1 operation in unrestricted area;

.2 operation during the whole year;

.3 length of ship is 100 m;

.4 service speed is 15 knots; and

.5 $B/GM \geq 13$ (B = moulded breadth of ship, GM = metacentric height).

7.1.3 For operation in a restricted area, reduction factors for accelerations may be considered, taking into account the season of the year, the accuracy of the weather forecast affecting the wave heights during the intended voyage and the duration of the voyage. Restricted area means any sea area in which the weather can be forecast for the entire sea voyage or shelter can be found during the voyage.

7.1.4 Reduction factors, f_R, may be applied to significant wave heights[4], H_s, not exceeding 12 m for the design of securing arrangements in any of the following cases:

.1 The required securing arrangement is calculated for the maximum expected 20-year significant wave height in a particular restricted area and the cargo is always secured according to the designed arrangement when operating in that area.

.2 The maximum significant wave height that a particular securing arrangement can withstand is calculated and the vessel is limited to operating only in significant wave heights up to the maximum calculated. Procedures for ensuring that any operational limitation is not exceeded should be developed and followed and documented in the ship's approved Cargo Securing Manual.

.3 Required securing arrangements are designed for different significant wave heights and the securing arrangement is selected according to the maximum expected wave height for each voyage for which an accurate weather forecast is available. Thus, the duration of the voyage should not exceed 72 hours or a duration as accepted by the Administration.

7.1.5 The basic acceleration data in table 2 may be multiplied by the following reduction factor:

$f_R = 1 - (H_s - 13)^2 / 240$, where H_s is:

.1 the maximum expected 20-year significant wave height in the area according to ocean wave statistics; or

.2 the maximum predicted significant wave height on which the operational limitations are based; or

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[3] The acceleration values in table 2 are calculated according to the guidance formulae for acceleration components in the IGC Code (resolution MSC.5(48)) and reduced to a probability level of 25 days.

[4] Arithmetic mean of the highest one third of waves measured from trough to crest.

.3 for voyages not exceeding 72 hours the maximum predicted significant wave height according to weather forecasts.

7.1.6 When weather-dependent lashing is applied, operational procedures for the following activities should be developed, followed and documented in the ship's approved Cargo Securing Manual, or otherwise included in the ship's safety management system:

.1 decision on the level of cargo securing based on the length of the voyage and the weather forecast;

.2 communication to all concerned parties of the decided level of cargo securing for the intended voyage;

.3 execution and supervision of appropriate cargo securing efforts in accordance with the Cargo Securing Manual; and

.4 monitoring of environmental conditions and ship motions to ensure that the applied level of cargo securing is not exceeded.

7.1.7 For ships of a length other than 100 m and a service speed other than 15 knots, the acceleration figures should be multiplied by a correction factor given in table 3.

Table 3 – Correction factors for length and service speed

Length (m) / Speed (kn)	50	60	70	80	90	100	120	140	160	180	200
9	1.20	1.09	1.00	0.92	0.85	0.79	0.70	0.63	0.57	0.53	0.49
12	1.34	1.22	1.12	1.03	0.96	0.90	0.79	0.72	0.65	0.60	0.56
15	1.49	1.36	1.24	1.15	1.07	1.00	0.89	0.80	0.73	0.68	0.63
18	1.64	1.49	1.37	1.27	1.18	1.10	0.98	0.89	0.82	0.76	0.71
21	1.78	1.62	1.49	1.38	1.29	1.21	1.08	0.98	0.90	0.83	0.78
24	1.93	1.76	1.62	1.50	1.40	1.31	1.17	1.07	0.98	0.91	0.85

7.1.8 For length/speed combinations not directly tabulated, the following formula may be used to obtain the correction factor with v = speed in knots and L = length between perpendiculars in metres:

$$\text{correction factor} = (0.345 \cdot v/\sqrt{L}) + (58.62 \cdot L - 1034.5)/L^2$$

This formula should not be used for ship lengths less than 50 m or more than 300 m.

In addition, for ships with B/GM less than 13, the transverse acceleration figures should be multiplied by the correction factor given in table 4.

Table 4 – Correction factors for B/GM

B/GM	3	4	5	6	7	8	9	10	11	12	13 or above
on deck, high	2.64	2.28	1.98	1.74	1.56	1.40	1.27	1.19	1.11	1.05	1.00
on deck, low	2.18	1.93	1.72	1.55	1.42	1.30	1.21	1.14	1.09	1.04	1.00
'tween deck	1.62	1.51	1.41	1.33	1.26	1.19	1.14	1.09	1.06	1.03	1.00
lower hold	1.24	1.23	1.20	1.18	1.15	1.12	1.09	1.06	1.04	1.02	1.00

7.1.9 The following should be observed:

.1 In the case of marked roll resonance with amplitudes above ±30°, the given figures of transverse acceleration may be exceeded. Effective measures should be taken to avoid this condition.

.2 In the case of heading into the seas at high speed with marked slamming impacts, the given figures of longitudinal and vertical acceleration may be exceeded. An appropriate reduction of speed should be considered.

.3 In the case of running before large stern or quartering seas with a stability which does not amply exceed the accepted minimum requirements, large roll amplitudes must be expected with transverse accelerations greater than the figures given. An appropriate change of heading should be considered.

.4 Forces by wind and sea to cargo items above the weather deck should be accounted for by a simple approach:

.1 force by wind pressure = 1 kN per m^2

.2 force by sea sloshing = 1 kN per m^2

.5 The wind force may be reduced by the same principles as the accelerations, i.e. multiplying it with a reduction factor, f_R, based on the expected significant wave height.

.6 Sloshing by sea can induce forces much greater than the figure given above. This figure should be considered as remaining unavoidable after adequate measures to prevent overcoming seas.

.7 Sea sloshing forces need only be applied to a height of deck cargo up to 2 m above the weather deck or hatch top.

.8 For voyages in a restricted area and with forecast wave heights for which no sea sloshing is expected, sea sloshing forces may be neglected.

7.2 Balance of forces and moments

7.2.1 The balance calculation should preferably be carried out for:

.1 transverse sliding in port and starboard directions;

.2 transverse tipping in port and starboard directions; and

.3 longitudinal sliding under conditions of reduced friction in forward and aft directions.

7.2.2 In the case of symmetrical securing arrangements, one appropriate calculation for each case above is sufficient.

7.2.3 Friction contributes towards prevention of sliding. The following friction coefficients (μ) should be applied.

Table 5 – Friction coefficients

Materials in contact	Friction coefficient (μ)
Timber–timber, wet or dry	0.4
Steel–timber or steel-rubber	0.3
Steel–steel, dry	0.1
Steel–steel, wet	0.0

A friction increasing material or deck coating with higher friction coefficients may be used assuming a certified conservative friction coefficient and the endurable shear stress of the material under repeated loads, as they occur in heavy weather at sea. The applicability of these data should be reviewed with due consideration of the prevailing conditions in terms of moisture, dust, greasy dirt, frost, ice or snow as well as the local pressure applied (weight per area) to the material. Specific advice on this matter as well as instructions for maintenance of coatings should be included in the ship's Cargo Securing Manual, if appropriate.

7.2.4 Transverse sliding

7.2.4.1 The balance calculation should meet the following condition (see also figure 17):

$$F_y \leq \mu \cdot m \cdot g + CS_1 \cdot f_1 + CS_2 \cdot f_2 + \ldots + CS_n \cdot f_n$$

Where:

n is the number of lashings being calculated
F_y is transverse force from load assumption (kN)
μ is friction coefficient
m is mass of the cargo item (t)
g is gravity acceleration of earth = 9.81 m/s^2
CS is calculated strength of transverse securing devices (kN)
$CS = \frac{MSL}{1.5}$
f is a function of μ and the vertical securing angle α (see table 6).

7.2.4.2 A vertical securing angle α greater than 60° will reduce the effectiveness of this particular securing device in respect to sliding of the item. Disregarding of such devices from the balance of forces should be considered, unless the necessary load is gained by the imminent tendency to tipping or by a reliable pre-tensioning of the securing device and maintaining the pre-tension throughout the voyage.

7.2.4.3 Any horizontal securing angle, i.e. deviation from the transverse direction, should not exceed 30°, otherwise an exclusion of this securing device from the transverse sliding balance should be considered.

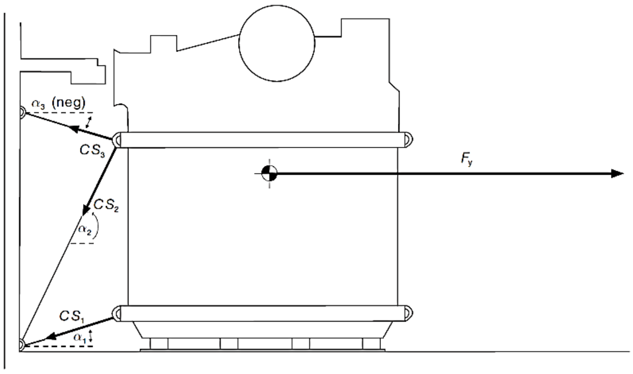


Figure 17 – Balance of transverse forces

Table 6 – f values as a function of α and μ

α / μ	–30°	–20°	–10°	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
0.3	0.72	0.84	0.93	1.00	1.04	1.04	1.02	0.96	0.87	0.76	0.62	0.47	0.30
0.1	0.82	0.91	0.97	1.00	1.00	0.97	0.92	0.83	0.72	0.59	0.44	0.27	0.10
0.0	0.87	0.94	0.98	1.00	0.98	0.94	0.87	0.77	0.64	0.50	0.34	0.17	0.00

Remark: $f = \mu \cdot \sin\alpha + \cos\alpha$

7.2.4.4 As an alternative to using table 6 to determine the forces in a securing arrangement, the method outlined in paragraph 7.3 can be used to take account of transverse and longitudinal components of lashing forces.

7.2.5 Transverse tipping

This balance calculation should meet the following condition (see also figure 18):

$$F_y \cdot a \leq b \cdot m \cdot g + CS_1 \cdot c_1 + CS_2 \cdot c_2 + \ldots + CS_n \cdot c_n$$

where
F_y, m, g, CS, n are as explained under 7.2.1

a is lever-arm of tipping (m) (see figure 18)
b is lever-arm of stableness (m) (see figure 18)
c is lever-arm of securing force (m) (see figure 18)

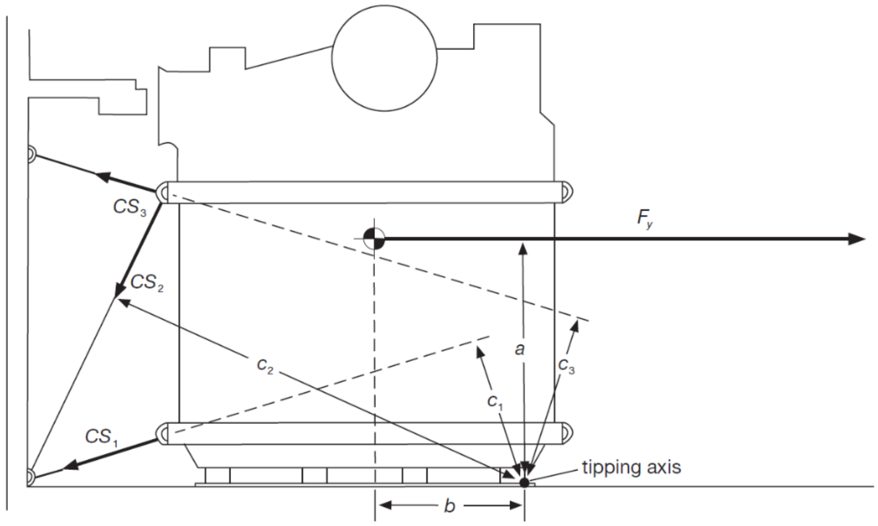


Figure 18 – Balance of transverse moments

7.2.6 Longitudinal sliding

7.2.6.1 Under normal conditions the transverse securing devices provide sufficient longitudinal components to prevent longitudinal sliding. If in doubt, a balance calculation should meet the following condition:

$$F_x \leq \mu \cdot (m \cdot g - f_z \cdot F_z) + CS_1 \cdot f_1 + CS_2 \cdot f_2 + \ldots + CS_n \cdot f_n$$

where
F_x is longitudinal force from load assumption (kN)
μ, m, g, f, n are as explained under 7.2.1
F_z is vertical force from load assumption (kN)
f_z is a correction factor for the vertical force, depending on friction as indicated below:

μ	0.0	0.1	0.2	0.3	0.4	0.6
f_z	0.20	0.50	0.70	0.80	0.85	0.90

7.2.6.2 *CS* is calculated strength of longitudinal securing devices (kN)

$$CS = \frac{MSL}{1.5}$$

Remark*:* Longitudinal components of transverse securing devices should not be assumed greater than 0.5 · *CS*.

7.2.6.3 Instead of service speed, a reduced operational speed is allowed to be used when the correction factor for length and speed is calculated according to table 3 for the correction of the longitudinal and vertical accelerations. The longitudinal acceleration calculated using table 3 in this annex should be verified by monitoring during the voyage. When necessary the speed should be further reduced in order to ensure that the calculated acceleration is not exceeded. In the Cargo Securing Manual, it should be noted that the speed has to be reduced in heavy head seas to avoid longitudinal shifting of cargo. It should also be noted for which speed the accelerations in longitudinal direction have been calculated.

Note: Correction factors for speeds less than the service speed are not allowed for the correction of transverse accelerations.

7.2.7 Calculated example

A calculated example for this method is shown in appendix 1 of annex 13.

7.3 Balance of forces – alternative method

7.3.1 The balance of forces described in paragraph 7.2.4 and 7.2.6 will normally furnish a sufficiently accurate determination of the adequacy of the securing arrangement. However, this alternative method allows a more precise consideration of horizontal securing angles.

7.3.2 Securing devices usually do not have a pure longitudinal or transverse direction in practice but have an angle β in the horizontal plane. This horizontal securing angle β is defined in this annex as the angle of deviation from the transverse direction. The angle β is to be scaled in the quadrantal mode, i.e. between 0° and 90°.

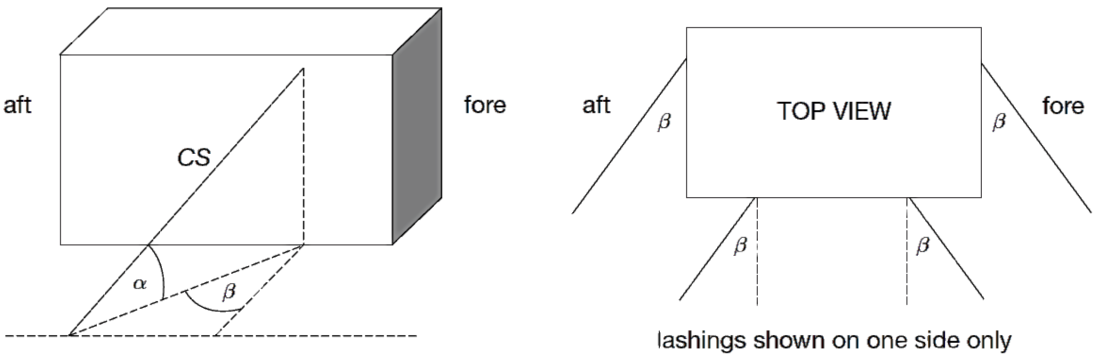


Figure 19 – Definition of the vertical and horizontal securing angles α and β

7.3.3 A securing device with an angle β develops securing effects both in longitudinal and transverse direction, which can be expressed by multiplying the calculated strength *CS* with the appropriate values of f_x or f_y. The values of f_x and f_y can be obtained from table 7.

7.3.4 Table 7 consists of five sets of figures, one each for the friction coefficients μ = 0.4, 0.3, 0.2, 0.1 and 0. Each set of figures is obtained by using the vertical angle α and horizontal angle β. The value of f_x is obtained when entering the table with β from the right while f_y is obtained when entering with β from the left, using the nearest tabular value for α and β. Interpolation is not required but may be used.

The balance calculations are made in accordance with the following formulae:

Transverse sliding: $F_y \leq \mu \cdot m \cdot g + f_{y1} \cdot CS_1 + \ldots + f_{yn} \cdot CS_n$
Longitudinal sliding: $F_x \leq \mu \cdot (m \cdot g - f_z \cdot F_z) + f_{x1} \cdot CS_1 + \ldots + f_{xn} \cdot CS_n$
Transverse tipping: $F_y \cdot a \leq b \cdot m \cdot g + 0.9 \cdot (CS_1 \cdot c_1 + CS_2 \cdot c_2 + \ldots + CS_n \cdot c_n)$

Caution:

Securing devices which have a vertical angle α of less than 45° in combination with horizontal angle β greater than 45° should not be used in the balance of transverse tipping in the above formula. All symbols used in these formulae have the same meaning as defined in paragraph 7.2 except f_y and f_x, obtained from table 7, and *CS* is as follows:

$$CS = \frac{MSL}{1.35}$$

A calculated example for this method is shown in appendix 1 of annex 13.

Table 7 – *f_x values and f_y values as a function of α, β and μ*

Table 7.1 for μ = 0.4

β for	α														*β* for
f_y	**–30**	**–20**	**–10**	**0**	**10**	**20**	**30**	**40**	**45**	**50**	**60**	**70**	**80**	**90**	f_x
0	0.67	0.80	0.92	1.00	1.05	1.08	1.07	1.02	0.99	0.95	0.85	0.72	0.57	0.40	**90**
10	0.65	0.79	0.90	0.98	1.04	1.06	1.05	1.01	0.98	0.94	0.84	0.71	0.56	0.40	**80**
20	0.61	0.75	0.86	0.94	0.99	1.02	1.01	0.98	0.95	0.91	0.82	0.70	0.56	0.40	**70**
30	0.55	0.68	0.78	0.87	0.92	0.95	0.95	0.92	0.90	0.86	0.78	0.67	0.54	0.40	**60**
40	0.46	0.58	0.68	0.77	0.82	0.86	0.86	0.84	0.82	0.80	0.73	0.64	0.53	0.40	**50**
50	0.36	0.47	0.56	0.64	0.70	0.74	0.76	0.75	0.74	0.72	0.67	0.60	0.51	0.40	**40**
60	0.23	0.33	0.42	0.50	0.56	0.61	0.63	0.64	0.64	0.63	0.60	0.55	0.48	0.40	**30**
70	0.10	0.18	0.27	0.34	0.41	0.46	0.50	0.52	0.52	0.53	0.52	0.49	0.45	0.40	**20**
80	–0.05	0.03	0.10	0.17	0.24	0.30	0.35	0.39	0.41	0.42	0.43	0.44	0.42	0.40	**10**
90	–0.20	–0.14	–0.07	0.00	0.07	0.14	0.20	0.26	0.28	0.31	0.35	0.38	0.39	0.40	**0**

Table 7.2 for μ = 0.3

β for	A														*β* for
f_y	**–30**	**–20**	**–10**	**0**	**10**	**20**	**30**	**40**	**45**	**50**	**60**	**70**	**80**	**90**	f_x
0	0.72	0.84	0.93	1.00	1.04	1.04	1.02	0.96	0.92	0.87	0.76	0.62	0.47	0.30	**90**
10	0.70	0.82	0.92	0.98	1.02	1.03	1.00	0.95	0.91	0.86	0.75	0.62	0.47	0.30	**80**
20	0.66	0.78	0.87	0.94	0.98	0.99	0.96	0.91	0.88	0.83	0.73	0.60	0.46	0.30	**70**
30	0.60	0.71	0.80	0.87	0.90	0.92	0.90	0.86	0.82	0.79	0.69	0.58	0.45	0.30	**60**
40	0.51	0.62	0.70	0.77	0.81	0.82	0.81	0.78	0.75	0.72	0.64	0.54	0.43	0.30	**50**
50	0.41	0.50	0.58	0.64	0.69	0.71	0.71	0.69	0.67	0.64	0.58	0.50	0.41	0.30	**40**
60	0.28	0.37	0.44	0.50	0.54	0.57	0.58	0.58	0.57	0.55	0.51	0.45	0.38	0.30	**30**
70	0.15	0.22	0.28	0.34	0.39	0.42	0.45	0.45	0.45	0.45	0.43	0.40	0.35	0.30	**20**
80	0.00	0.06	0.12	0.17	0.22	0.27	0.30	0.33	0.33	0.34	0.35	0.34	0.33	0.30	**10**
90	–0.15	–0.10	–0.05	0.00	0.05	0.10	0.15	0.19	0.21	0.23	0.26	0.28	0.30	0.30	**0**

Table 7.3 for μ = 0.2

β for	A														*β* for
f_y	**–30**	**–20**	**–10**	**0**	**10**	**20**	**30**	**40**	**45**	**50**	**60**	**70**	**80**	**90**	f_x
0	0.77	0.87	0.95	1.00	1.02	1.01	0.97	0.89	0.85	0.80	0.67	0.53	0.37	0.20	**90**
10	0.75	0.86	0.94	0.98	1.00	0.99	0.95	0.88	0.84	0.79	0.67	0.52	0.37	0.20	**80**
20	0.71	0.81	0.89	0.94	0.96	0.95	0.91	0.85	0.81	0.76	0.64	0.51	0.36	0.20	**70**
30	0.65	0.75	0.82	0.87	0.89	0.88	0.85	0.79	0.75	0.71	0.61	0.48	0.35	0.20	**60**
40	0.56	0.65	0.72	0.77	0.79	0.79	0.76	0.72	0.68	0.65	0.56	0.45	0.33	0.20	**50**
50	0.46	0.54	0.60	0.64	0.67	0.67	0.66	0.62	0.60	0.57	0.49	0.41	0.31	0.20	**40**
60	0.33	0.40	0.46	0.50	0.53	0.54	0.53	0.51	0.49	0.47	0.42	0.36	0.28	0.20	**30**

β for f_y	A														β for f_x
	–30	**–20**	**–10**	**0**	**10**	**20**	**30**	**40**	**45**	**50**	**60**	**70**	**80**	**90**	
70	0.20	0.25	0.30	0.34	0.37	0.39	0.40	0.39	0.38	0.37	0.34	0.30	0.26	0.20	**20**
80	0.05	0.09	0.14	0.17	0.21	0.23	0.25	0.26	0.26	0.26	0.26	0.25	0.23	0.20	**10**
90	–	–	–	0.00	0.03	0.07	0.10	0.13	0.14	0.15	0.17	0.19	0.20	0.20	**0**

Table 7.4 for μ = 0.1

β for f_y	A														β for f_x
	–30	**–20**	**–10**	**0**	**10**	**20**	**30**	**40**	**45**	**50**	**60**	**70**	**80**	**90**	
0	0.82	0.91	0.97	1.00	1.00	0.97	0.92	0.83	0.78	0.72	0.59	0.44	0.27	0.10	**90**
10	0.80	0.89	0.95	0.98	0.99	0.96	0.90	0.82	0.77	0.71	0.58	0.43	0.27	0.10	**80**
20	0.76	0.85	0.91	0.94	0.94	0.92	0.86	0.78	0.74	0.68	0.56	0.42	0.26	0.10	**70**
30	0.70	0.78	0.84	0.87	0.87	0.85	0.80	0.73	0.68	0.63	0.52	0.39	0.25	0.10	**60**
40	0.61	0.69	0.74	0.77	0.77	0.75	0.71	0.65	0.61	0.57	0.47	0.36	0.23	0.10	**50**
50	0.51	0.57	0.62	0.64	0.65	0.64	0.61	0.56	0.53	0.49	0.41	0.31	0.21	0.10	**40**
60	0.38	0.44	0.48	0.50	0.51	0.50	0.48	0.45	0.42	0.40	0.34	0.26	0.19	0.10	**30**
70	0.25	0.29	0.32	0.34	0.35	0.36	0.35	0.33	0.31	0.30	0.26	0.21	0.16	0.10	**20**
80	0.10	0.13	0.15	0.17	0.19	0.20	0.20	0.20	0.19	0.19	0.17	0.15	0.13	0.10	**10**
90	–0.05	–0.03	–0.02	0.00	0.02	0.03	0.05	0.06	0.07	0.08	0.09	0.09	0.10	0.10	**0**

Table 7.5 for μ = 0.0

β for f_y	A														β for f_x
	–30	**–20**	**–10**	**0**	**10**	**20**	**30**	**40**	**45**	**50**	**60**	**70**	**80**	**90**	
0	0.87	0.94	0.98	1.00	0.98	0.94	0.87	0.77	0.71	0.64	0.50	0.34	0.17	0.00	**90**
10	0.85	0.93	0.97	0.98	0.97	0.93	0.85	0.75	0.70	0.63	0.49	0.34	0.17	0.00	**80**
20	0.81	0.88	0.93	0.94	0.93	0.88	0.81	0.72	0.66	0.60	0.47	0.32	0.16	0.00	**70**
30	0.75	0.81	0.85	0.87	0.85	0.81	0.75	0.66	0.61	0.56	0.43	0.30	0.15	0.00	**60**
40	0.66	0.72	0.75	0.77	0.75	0.72	0.66	0.59	0.54	0.49	0.38	0.26	0.13	0.00	**50**
50	0.56	0.60	0.63	0.64	0.63	0.60	0.56	0.49	0.45	0.41	0.32	0.22	0.11	0.00	**40**
60	0.43	0.47	0.49	0.50	0.49	0.47	0.43	0.38	0.35	0.32	0.25	0.17	0.09	0.00	**30**
70	0.30	0.32	0.34	0.34	0.34	0.32	0.30	0.26	0.24	0.22	0.17	0.12	0.06	0.00	**20**
80	0.15	0.16	0.17	0.17	0.17	0.16	0.15	0.13	0.12	0.11	0.09	0.06	0.03	0.00	**10**
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0**

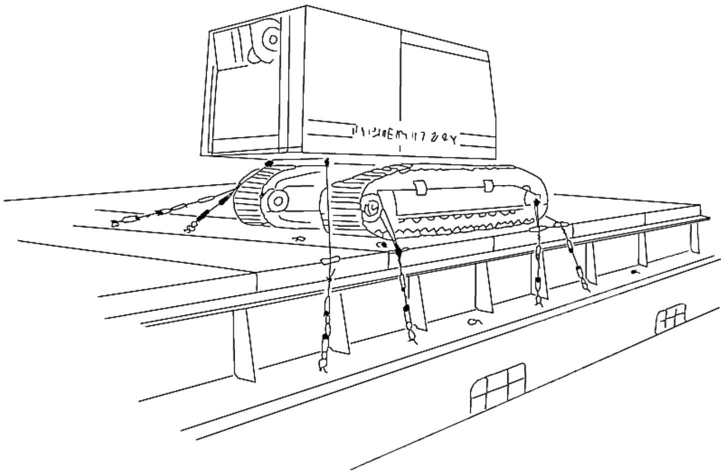
Remark: $f_y = \cos\alpha \cdot \cos\beta + \mu \cdot \sin\alpha$ $f_x = \cos\alpha \cdot \sin\beta + \mu \cdot \sin\alpha$.

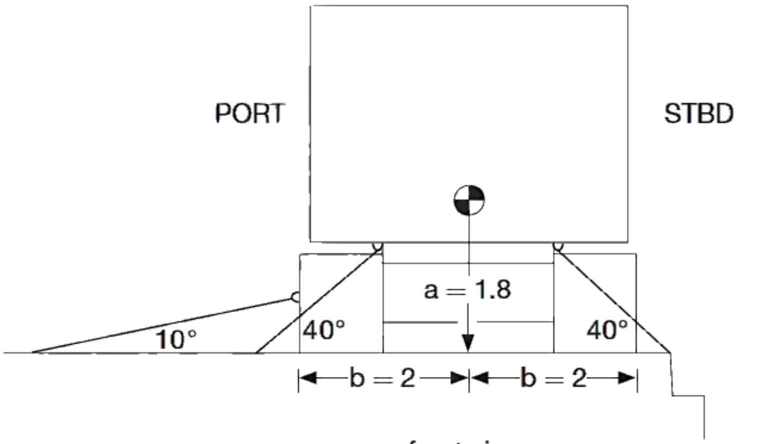
APPENDIX 1

CALCULATED EXAMPLE 1

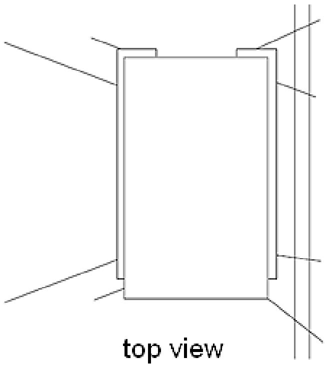
(refer to paragraph 7.2, Balance of forces and moments)

Ship: L = 120 m; B = 20 m; GM = 1.4 m; speed = 15 knots
Cargo: m = 62 t; dimensions = 6 × 4 × 4 m;
stowage at 0.7L on deck, low





front view



top view

Securing material:

wire rope (single use): breaking strength = 125 kN; *MSL* = 100 kN
shackles, turnbuckles, deck rings: breaking strength = 180 kN; *MSL* = 90 kN
stowage on dunnage boards: μ = 0.3; *CS* = 90/1.5 = 60 kN

Securing arrangement:

side	*n*	*CS*	α	*f*	*c*
STBD	4	60 kN	40°	0.96	–
PORT	2	60 kN	40°	0.96	–
PORT	2	60 kN	10°	1.04	–

External forces:

$F_X = 2.9 \times 0.89 \times 62 + 16 + 8 = 184$ kN
$F_Y = 6.3 \times 0.89 \times 62 + 24 + 12 = 384$ kN
$F_Z = 6.2 \times 0.89 \times 62 = 342$ kN

Balance of forces (STBD arrangement):

$384 < 0.3 \times 62 \times 9.81 + 4 \times 60 \times 0.96$
$384 < 412$ this is OK!

Balance of forces (PORT arrangement):

$384 < 0.3 \times 62 \times 9.81 + 2 \times 60 \times 0.96 + 2 \times 60 \times 1.04$
$384 < 422$ this is OK!

Balance of moments:

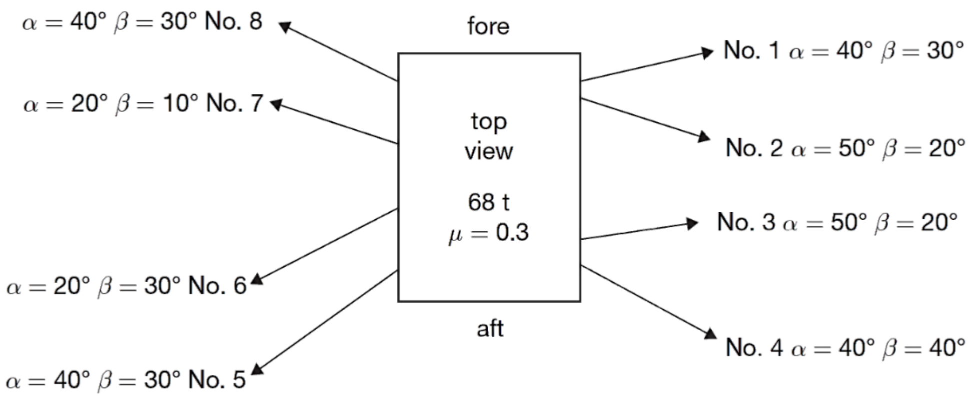
$384 \times 1.8 < 2 \times 62 \times 9.81$
$691 < 1216$ no tipping, even without lashings!

Calculated example 2

(refer to section 7.3, Balance of forces – alternative method)

A cargo item of 68 t mass is stowed on timber ($\mu = 0.3$) in the 'tween deck at 0.7*L* of a vessel.
L = 160 m, *B* = 24 m, *v* = 18 knots and GM = 1.5 m.
Dimensions of the cargo item are height = 2.4 m and width = 1.8 m.
The external forces are: $F_x = 112$ kN, $F_y = 312$ kN, $F_z = 346$ kN, $f_z = 0.8$ and $f_z \cdot F_z = 276.8$ kN

The top view shows the overall securing arrangement with eight lashings.



Calculation of balance of forces:

No.	MSL (kN)	CS (kN)	α	β	f_y	$CS \times f_y$	f_x	$CS \times f_x$
1	108	80	40° stbd	30° fwd	0.86	68.8 stbd	0.58	46.4 fwd
2	90	67	50° stbd	20° aft	0.83	55.6 stbd	0.45	30.2 aft
3	90	67	50° stbd	20° fwd	0.83	55.6 stbd	0.45	30.2 fwd
4	108	80	40° stbd	40° aft	0.78	62.4 stbd	0.69	55.2 aft
5	108	80	40° port	30° aft	0.86	68.8 port	0.58	46.4 aft
6	90	67	20° port	30° aft	0.92	61.6 port	0.57	38.2 aft
7	90	67	20° port	10° fwd	1.03	69.0 port	0.27	18.1 fwd
8	108	80	40° port	30° fwd	0.86	68.8 port	0.58	46.4 fwd

Transverse balance of forces (STBD arrangement) Nos. 1, 2, 3 and 4:

$312 < 0.3 \times 68 \times 9.81 + 68.8 + 55.6 + 55.6 + 62.4$

$312 < 443$ this is OK!

Transverse balance of forces (PORT arrangement) Nos. 5, 6, 7 and 8:

$312 < 0.3 \times 68 \times 9.81 + 68.8 + 61.6 + 69.0 + 68.8$

$312 < 468$ this is OK!

Longitudinal balance of forces (FWD arrangement) Nos. 1, 3, 7 and 8:

$112 < 0.3 (68 \times 9.81 - 276.8) + 46.4 + 30.2 + 18.1 + 46.4$

$112 < 258$ this is OK!

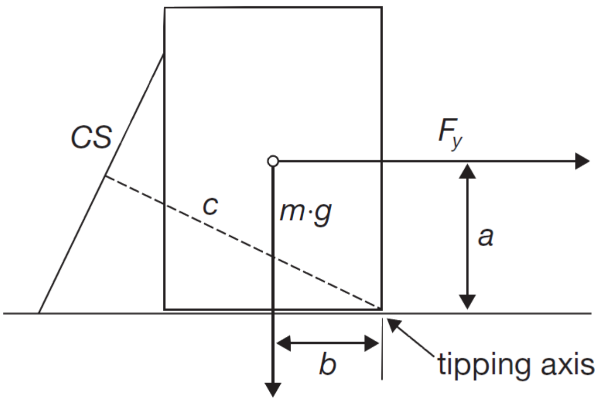
Longitudinal balance of forces (AFT arrangement) Nos. 2, 4, 5 and 6:

$112 < 0.3 (68 \times 9.81 - 276.8) + 30.2 + 55.2 + 46.4 + 38.2$

$112 < 287$ this is OK!

Transverse tipping

Unless specific information is provided, the vertical centre of gravity of the cargo item can be assumed to be at one half the height and the transverse centre of gravity at one half the width. Also, if the lashing is connected as shown in the sketch, instead of measuring *c*, the length of the lever from the tipping axis to the lashing *CS*, it is conservative to assume that it is equal to the width of the cargo item.



$F_y \cdot a \quad \leq b \cdot m \cdot g + 0.9 \cdot (CS_1 \cdot c_1 + CS_2 \cdot c_2 + CS_3 \cdot c_3 + CS_4 \cdot c_4)$

312 × 2.4/2 < 1.8/2 × 68 × 9.81 + 0.9 × 1.8 × (80 + 67 + 67 + 80)

374 < 600 + 476

374 < 1076 this is OK!

APPENDIX 2

EXPLANATIONS AND INTERPRETATION OF METHODS TO ASSESS THE EFFICIENCY OF SECURING ARRANGEMENTS

1 The acceleration figures given in table 2, in combination with the correction factors, represent peak values on a 25-day voyage. This does not imply that peak values in *x*, *y* and *z* directions occur simultaneously with the same probability. It can be generally assumed that peak values in the transverse direction will appear in combination with less than 60% of the peak values in longitudinal and vertical directions.

2 Peak values in longitudinal and vertical directions may be associated more closely because they have the common source of pitching and heaving.

3 The advanced calculation method uses the "worst case approach". That is expressed clearly by the transverse acceleration figures, which increase to forward and aft in the ship and thereby show the influence of transverse components of simultaneous vertical accelerations. Consequently, there is no need to consider vertical accelerations separately in the balances of transverse forces and moments. These simultaneously acting vertical accelerations create an apparent increase of weight of the item and thus increase the effect of the friction in the balance of forces and the moment of stableness in the balance of moments. For this reason there is no reduction of the force $m \cdot g$ normal to the deck due to the presence of an angle of heel.

4 The situation is different for the longitudinal sliding balance. The worst case would be a peak value of the longitudinal force F_x accompanied by an extreme reduction of weight through the vertical force F_z.

5 The friction coefficients shown in the tables of this annex are generally lower than the ones given in other publications, such as the CTU Code. The reason for this can be seen in various influences which may appear in practical shipping, such as: vibration of the ship, moisture, grease, oil, dust and other residues.

6 There are certain stowage materials available which are said to increase friction considerably. Extended experience with these materials may bring additional coefficients into practical use.

7 The principal way of calculating forces within the securing elements of a complex securing arrangement should necessarily include the consideration of:

.1 load-elongation behaviour (elasticity);

.2 geometrical arrangement (angles, length); and

.3 pre-tension, of each individual securing element.

8 This approach would require a large volume of information and a complex, iterative calculation. The results would still be doubtful due to uncertain parameters.

9 Therefore, the simplified approach was chosen with the assumption that the elements take an even load of *CS* (calculated strength) which is reduced against the MSL (maximum securing load) by the safety factor.

10 When employing the advanced calculation method, the way of collecting data should be followed as shown in the calculated example. It is acceptable to estimate securing angles, to take average angles for a set of lashings and similarly to arrive at reasonable figures of the levers *a*, *b* and *c* for the balance of moments.

11 It should be borne in mind that this annex contains a number of assumptions based on approximations. Even though safety factors are also incorporated, there is no clear-cut borderline between safety and non-safety. If in doubt, the arrangement should be improved.

APPENDIX 3

ADVANCED PROVISIONS AND CONSIDERATIONS APPLICABLE TO VERY HEAVY AND/OR VERY LARGE CARGO ITEMS

This appendix contains additional advice that may be considered for the stowage and securing of cargo with unusual characteristics, as referenced in chapter 1.8 of this Code and may include items of exceptional mass and/or dimension. However, the listed considerations do not claim to be complete.

1 Longitudinal tipping

For the securing of large and tall cargo items in longitudinal direction, the balance calculation should also consider longitudinal tipping and meet the following condition:

$$F_x \cdot a \leq b \cdot (m \cdot g - f_z \cdot F_z) + CS_1 \cdot c_1 + CS_2 \cdot c_2 + ... + CS_n \cdot c_n \ [kNm]$$

Where:

F_x, m, g, F_z, CS, n are as explained under 7.2.1 of this annex.

a is lever-arm of tipping (m) (see figure 18)
b is lever-arm of stableness (m) (see figure 18)
c is lever-arm of securing force (m) (see figure 18)

The factor f_Z is obtained by the applicable relation of b/a as shown below:

b/a	0.1	0.2	0.3	0.4	0.6	1.0	2.0	3.0
f_Z	0.50	0.70	0.80	0.85	0.90	0.94	0.98	1.00

2 Rotational inertia of large cargo items

2.1 The algorithm used in 7.2.2 of this annex and section 1 above for defining the tipping moment acting on a distinct cargo item replaces the physical extent of the item by its centre of gravity. The tipping moment is then declared as the determined horizontal force F_x or F_y, multiplied by the vertical distance "*a*" of this centre of gravity to the edge of the footprint, i.e. the tipping axis of the item. This is sufficiently accurate, as long as the spatial dimensions of the item remain below about 6 metres.

2.2 Larger items, however, will develop a substantial additional tipping moment by their rotational inertia against the rotational acceleration of the ship in rolling or pitching motions. The additional tipping moment is independent from the stowage position of the item in the ship and always positive, i.e. intensifying the tipping impulse. This phenomenon requires additional securing measures and, therefore, should be included in tipping balances for large cargo items by the use of a simple algorithm.

2.3 Transverse tipping balance

2.3.1 For cargo items of width *w* (measured athwartships) and height *h*, where $(w^2 + h^2) > 50\ m^2$, the additional tipping moment $k \cdot J$ due to rotational inertia of the cargo item should be added to the ordinary tipping moment $F_y \cdot a$ in the transverse tipping balance.

2.3.2 The appropriate figure of the moment of rotational inertia J should be supplied by the shipper related to the centre of gravity of the item for the plane of transverse tipping. If such information is not available, an estimated figure may be used by:

$J = m \cdot \left(\frac{w^2+h^2}{12}\right)$ $[tm^2]$ for homogeneous distribution of mass in the item

$J = m \cdot \left(\frac{(w+h)^2}{12}\right)$ $[tm^2]$ for an item with peripheral concentration of mass.

The reverse angular acceleration k may be taken as $k = \frac{36 \cdot GM}{B^2}$ $[s^{-2}]$.

2.4 Longitudinal tipping balance

2.4.1 For cargo items of length *l* (measured fore and aft) and height h, where $(l^2 + h^2) > 50\ m^2$, the additional tipping moment $k \cdot J$ due to rotational inertia of the cargo item should be added to the ordinary tipping moment $F_x \cdot a$ in the longitudinal tipping balance.

2.4.2 The appropriate figure of the moment of rotational inertia J should be supplied by the shipper related to the centre of gravity of the item for the plane of longitudinal tipping. If such information is not available, an estimated figure may be used by:

$J = m \cdot \left(\frac{l^2+h^2}{12}\right)$ $[tm^2]$ for homogeneous distribution of mass in the item

$J = m \cdot \left(\frac{(l+h)^2}{12}\right)$ $[tm^2]$ for an item with peripheral concentration of mass

The reverse angular acceleration k may be taken as $k = \frac{25}{L}$ $[s^{-2}]$.

3 Separate consideration of wind and sea sloshing

3.1 The algorithm used in this annex for defining the horizontal force F_x or F_y, acting on a cargo item stowed on deck, combines horizontal weight components, inertia forces and wind/sloshing forces for reasons of simplification. This is correct for the balance of sliding; however, it is an approximation only for the balance of tipping. Particularly, high deck cargo items with their major wind exposed area well above the centre of gravity should be given a separate compilation of moments from wind forces, sea sloshing forces and gravity/inertia forces in order to get a more realistic tipping moment. The inertia forces strike on the centre of gravity of the cargo item, the sea sloshing strikes on the cargo area not more than 2 m above the weather deck and the wind forces strike on the lateral area of the cargo item exposed to wind.

Example: The figures of the tipping lever "*a*" relate to a large portal harbour crane shipped on deck of a heavy lift ship. The centres of attack by wind and spray deviate considerably from the centre of gravity. A separate compilation of the longitudinal tipping moment reads:

	F_x	a	$F_x \cdot a$
Gravity/inertia	1373 kN	13.0 m	17849 kNm
Wind	170 kN	20.0 m	3400 kNm
Spray	4 kN	1.0 m	4 kNm
Total	**1547 kN**		**21253 kNm**

3.2 The conventionally computed tipping moment would be only:

Total	**1547 kN**	**13.0 m**	**20111 kNm**

3.3 The surplus over the conventional tipping moment here is about 6%. The potential additional tipping moment by rotational inertia has not been reflected in this example.

4 Interpretation of "on deck high"

4.1 The stowage level "on deck high" in table 2 of annex 13 has been positioned at a distance above the water line of about two thirds of the ship's breadth. With extremely large cargo items this level can easily be exceeded. In order to avoid uncertainties in the determination of transverse and longitudinal accelerations in such cases, it is recommended to use the original mathematical model, which has been the basis for acceleration tables in annex 13. This model may easily be programmed, e.g. in a suitable spreadsheet.

4.2 The shown mathematical model is identical to that used in the *International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk* (IGC Code) (resolution MSC. 5(48)). However, while in the IGC Code the probability level of accelerations refers to the lifetime of a ship of 10^4 days, annex 13, in order to remain within the scope of practical cargo securing experience, applies a reduction factor of 0.74, corresponding to the 25-day significant wave height in the North Atlantic. Furthermore, the model has been expanded to supply reasonable *K*-parameters for *B/GM*-relations less than 7, applicable to ships with exceptional large *GM*-values.

Mathematical model of the acceleration tables 2 to 4

4.3 The longitudinal, transverse and vertical accelerations acting on a cargo item may be obtained alternatively by the set of formulas as follows:

$$a_x = c_1 \cdot c_2 \cdot c_3 \cdot a_{x0} \cdot g\ [m/s^2]$$
$$a_y = c_1 \cdot c_2 \cdot c_3 \cdot a_{y0} \cdot g\ [m/s^2]$$
$$a_z = c_1 \cdot c_2 \cdot c_3 \cdot a_{z0} \cdot g\ [m/s^2]$$

a_x: longitudinal acceleration (gravity component of pitch included)
a_y: transverse acceleration (gravity component of roll included)
a_z: vertical acceleration (component due to static weight not included)
c_1: correction factor for navigation area, taken as 1.0 worldwide in annex 13
c_2: correction factor for season, taken as 1.0 for whole year in the annex 13
c_3: correction factor for 25 navigation days, taken as $0.6 + 0.1 \cdot \log_{10} 25 = 0.74$ in annex 13

$$a_{x0} = \pm a_0 \cdot \sqrt{0.06 + A^2 - 0.25 \cdot A}$$

$$a_{y0} = \pm a_0 \cdot \sqrt{0.6 + 2.5 \cdot \left(\frac{x}{L} + 0.05\right)^2 + K \cdot \left(1 + 0.6 \cdot K \cdot \frac{z}{B}\right)^2}$$

$$a_{z0} = \pm a_0 \cdot \sqrt{1 + \left(5.3 - \frac{45}{L}\right)^2 \cdot \left(\frac{x}{L} + 0.05\right)^2 \cdot \left(\frac{0.6}{C_b}\right)^{3/2}}$$

therein:

$$a_0 = 0.2 \cdot \frac{v}{\sqrt{L}} + \frac{34 - 600/L}{L}$$

$$A = \left(0.7 - \frac{L}{1200} + \frac{5 \cdot z}{L}\right) \cdot \left(\frac{0.6}{C_b}\right)$$

$K = R \cdot \frac{13 \cdot GM}{B}$, but never less than 1.0

$R = \left(\frac{B}{7 \cdot GM}\right)^{\left(\frac{GM}{B}\right)}$, but never greater than 1.0

L = length between perpendiculars [m]
B = moulded breadth of ship [m]
GM = metacentric height of ship [m]
C_b = block coefficient of ship
x = longitudinal distance from amidships to calculating point, positive forward [m]
z = vertical distance from actual waterline to calculating point, positive upward [m]
v = service speed [knots]
g = gravity acceleration = 9.81 [m/s^2]

5 Structural strength assessment

5.1 Dry cargo ships are typically designed on the assumption that cargo is homogeneously distributed. The maximum permissible surface load is usually specified in the ship's documentation and given in t/m² for all relevant stowage areas, i.e. double bottom (tank top), top of stepped side tanks, 'tween deck pontoons, weather deck and weather deck hatch covers.

5.2 Heavy cargo items tend to produce concentrated strip or point loads rather than homogeneous loads. Then care should be taken that the stress parameters, corresponding to the maximum permissible homogeneous load, are not exceeded by the load induced by the heavy item. The essential parameters for stresses in deck sections, hatch covers and 'tween deck pontoons or panels are shear forces and bending moments. Suitable steel or timber beams or equivalent panel structures should be used to transfer the strip or point load to the primary members of the load-bearing structure.

5.3 Where a loading situation appears to be too complex to be safely examined by manual calculation or where stress parameters obtained by a manual calculation method come close to the applicable limit of the supporting structure, utilization of finite element analysis should be considered.

6 Weather routeing

6.1 Utilizing weather routeing services may significantly contribute to performing a safe passage. Care should be taken that the engaged service complies with the recommendations laid down in MSC/Circ.1063 on *Participation of ships in weather routeing services*.

6.2 In case of transporting heavy and/or large cargo items, where safe securing is an essential requirement, the routeing decisions should be oriented to the avoidance of severe ship motions rather than to other criteria, such as swift passage or fuel economy. However, the engagement of a weather routeing service does not eliminate the need for the application of securing measures as required in this annex.

7 Other considerations

When planning the transport of very heavy and/or very large cargo items on deck of a vessel, particular consideration should be given to:

.1 the observation of sight line requirements as stipulated in SOLAS regulation V/22, and, in case of non-compliance, the conditions for a temporary exemption by the Flag State Administration;

.2 the provision of unimpeded radar transmission with due observation of resolution MSC.192(79) on *Revised performance standards for radar equipment* and SN.1/Circ.271 on *Guidelines for the installation of shipborne radar equipment*; and

.3 the provision of visibility of navigations light as required by annex I of International Regulations for Preventing Collisions at Sea and specified in resolution MSC.253(83) *on Performance standards for navigation lights, navigation light controllers and associated equipment*.

APPENDIX 4

ADVANCED PROVISIONS AND CONSIDERATIONS APPLICABLE TO SEMI-STANDARDIZED CARGOES

This appendix contains advice that may be considered for the stowage and securing of semi-standardized cargoes in addition to the other provisions of chapter 4, annex 4 and annex 13 of this Code.

The provisions in section 1 below may be used for the following conditions:

.1 worst case accelerations are used for the design of securing arrangements of semi-standardized cargoes, i.e. the most severe external forces within the particular deck or otherwise defined region of the vessel are applied;

.2 uniform securing arrangements are used for types of cargo items considering stepped weight classes, whereby arrangements always cover the highest weight within a class and the most unfavourable position of the centre of gravity;

.3 the range of lashing angles is well defined by the pattern of securing points in the vessel, as well as on vehicles. The assessment uses worst case angles, i.e. the worst combination of vertical and horizontal angles within the given ranges; and

.4 securing equipment is regularly inspected when used for recurrent application.

1 Performance factor for short voyages

For cargo securing arrangements considered in section 7.1 case .3 (short duration voyages up to 72 hours), the forces and moments on the right side of the balance equations in section 7.3 may be multiplied by the F_P performance factor of 1.15, as illustrated below:

Transverse sliding: $F_y \leq (\mu \cdot m \cdot g + f_{y1} \cdot CS_1 + \ldots + f_{yn} \cdot CS_n) \cdot F_P$

Longitudinal sliding: $F_x \leq (\mu \cdot (m \cdot g - f_z \cdot F_z) + f_{x1} \cdot CS_1 + \ldots + f_{xn} \cdot CS_n) \cdot F_P$

Transverse tipping: $F_y \cdot a \leq (b \cdot m \cdot g + 0.9 \cdot (CS_1 \cdot c_1 + CS_2 \cdot c_2 + \ldots + CS_n \cdot c_n)) \cdot F_P$

2 Asymmetrical securing arrangements

For asymmetrical lashing arrangements and for cargoes resting on supports with different coefficients of friction, separate sliding of the item's fore and aft ends should be considered in the transverse direction. The calculations for each end should be based on the part of the item's weight resting on each support and the characteristics of the cargo securing devices attached to each end.

3 Safety factor

In the case of elementary securing arrangements, where no more than two devices per impact direction are used and loads are evenly distributed by proper orientation to the centre of gravity of the cargo item, the calculated CS of securing devices may be obtained by:

$$CS = \frac{MSL}{1.2}$$

The specific conditions for the use of the reduced safety factor should be outlined in the ship's Cargo Securing Manual.

4 Friction coefficients

In addition to the friction coefficients in table 5 in section 7.2, the following friction coefficients (μ) may be applied.

Table 8 – Additional friction coefficients

Materials in contact	Friction coefficient (μ)
Steel–rubber tyre, dirty, wet or dry	0.3
Steel–solid rubber tyre, dry and clean[5]	0.3
Steel–air rubber tyre, wet and clean[5]	0.4
Steel–air rubber tyre, dry and clean[5]	0.45

5 Effect of parking brake and wheel chocks

For wheel-based cargoes, the effect of parking brakes as well as the effect of wheel chocks may be taken into account when dimensioning securing arrangements against movement in the rolling direction. Usually parking brakes have a braking capacity corresponding to a force equal to $0.2 \cdot g \cdot GVM$ (kN), where GVM is the gross vehicle mass of the item in tonnes and in most cases the parking brake is applied on one axle only. If a wheel is chocked it can be considered not to roll and the friction in the rolling direction should be taken as the lesser of the friction between the tyre and the ship's deck, and the chock and the ship's deck."

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[5] Conditions of cleanliness as defined in the ship's Cargo Securing Manual.

INTERNATIONAL MARITIME ORGANIZATION

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MSC.1/Circ.1352/Rev.1
15 December 2014

AMENDMENTS TO THE CODE OF SAFE PRACTICE FOR CARGO STOWAGE AND SECURING (CSS CODE)

1 The Maritime Safety Committee (the Committee), at its ninety-fourth session (17 to 21 November 2014), considered and approved amendments to the Code of Safe Practice for Cargo Stowage and Securing (CSS Code), set out in the annex. The present circular also incorporates the amendments approved by the Committee, at its eighty-seventh session (12 to 21 May 2010) (MSC 87/26, paragraph 10.4 refers).

2 Member Governments are invited to bring the annexed Amendments to the CSS Code to the attention of shipowners, ship operators, shipmasters and crews and all other parties concerned and, in particular, encourage shipowners and terminal operators to:

.1 apply the annexed amendments in its entirety for containerships*, the keels of which were laid or which are at a similar stage of construction on or after 1 January 2015;

.2 apply sections 4.4 (Training and familiarization), 7.1 (Introduction), 7.3 (Maintenance) and section 8 (Specialized container safety design) to existing containerships*, the keels of which were laid or which are at a similar stage of construction before 1 January 2015; and

.3 apply the principles of this guidance contained in sections 6 (Design) and 7.2 (Operational procedures) to existing containerships* as far as practical by the flag State Administration with the understanding that existing ships would not be required to be enlarged or undergo other major structural modifications as determined.

3 This circular revokes MSC.1/Circ.1352 issued on 30 June 2010 and any reference to MSC.1/Circ.1352 should be read as reference to the present circular.

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* Reference to containerships means dedicated containerships and those parts of other ships for which arrangements are specifically designed and fitted for the purpose of carrying containers on deck.

ANNEX

AMENDMENTS TO THE CODE OF SAFE PRACTICE FOR CARGO STOWAGE AND SECURING (CSS CODE)

1 The following new annex 14 is inserted after the existing annex 13:

"ANNEX 14

GUIDANCE ON PROVIDING SAFE WORKING CONDITIONS FOR SECURING OF CONTAINERS ON DECK

1 AIM

To ensure that persons engaged in carrying out container securing operations on deck have safe working conditions and, in particular safe access, appropriate securing equipment and safe places of work. These guidelines should be taken into account at the design stage when securing systems are devised. These guidelines provide shipowners, ship builders, classification societies, Administrations and ship designers with guidance on producing or authorizing a Cargo Safe Access Plan (CSAP).

2 SCOPE

Ships which are specifically designed and fitted for the purpose of carrying containers on deck.

3 DEFINITIONS

3.1 *Administration* means the Government of the State whose flag the ship is entitled to fly.

3.2 *Containership* means dedicated containerships and those parts of other ships for which arrangements are specifically designed and fitted for the purpose of carrying containers on deck.

3.3 *Fencing* is a generic term for guardrails, safety rails, safety barriers and similar structures that provide protection against the falls of persons.

3.4 *Lashing positions* include positions:

.1 in between container stows on hatch covers;
.2 at the end of hatches;
.3 on outboard lashing stanchions/pedestals;
.4 outboard lashing positions on hatch covers; and
.5 any other position where people work with container securing.

3.5 *SATLs* are semi-automatic twistlocks.

3.6 *Securing* includes lashing and unlashing.

3.7 *Stringers* are the uprights or sides of a ladder.

3.8 *Turnbuckles and lashing rods** include similar cargo securing devices.

4 GENERAL

4.1 Introduction

4.1.1 Injuries to dockworkers on board visiting ships account for the majority of accidents that occur within container ports, with the most common activity that involves such injuries being the lashing/unlashing of deck containers. Ships' crew engaged in securing operations face similar dangers.

4.1.2 During the design and construction of containerships the provision of a safe place of work for lashing personnel is essential.

4.1.3 Container shipowners and designers are reminded of the dangers associated with container securing operations and urged to develop and use container securing systems which are safe by design. The aim should be to eliminate or at least minimize the need for:

.1 container top work;
.2 work in other equally hazardous locations; and
.3 the use of heavy and difficult to handle securing equipment.

4.1.4 It should be borne in mind that providing safe working conditions for securing containers deals with matters relating to design, operation, and maintenance, and that the problems on large containerships are not the same as on smaller ones.

4.2 Revised recommendations on safety of personnel during container securing operations (MSC.1/Circ.1263)

Shipowners, ship designers and Administrations should take into account the recommendations on safe design of securing arrangements contained in these guidelines, and in the Recommendations on safety of personnel during container securing operations (MSC.1/Circ.1263).

4.3 Cargo Safe Access Plan (CSAP)

4.3.1 The *Guidelines for the preparation of the Cargo Securing Manual* (MSC/Circ.745) requires ships which are specifically designed and fitted for the purpose of carrying containers to have an approved Cargo Safe Access Plan (CSAP) on board, for all areas where containers are secured.

4.3.2 Stakeholders, including, but not limited to shipowners, ship designers, ship builders, administrations, classification societies and lashing equipment manufacturers, should be involved at an early stage in the design of securing arrangements on containerships and in the development of the CSAP.

4.3.3 The CSAP should be developed at the design stage in accordance with chapter 5 of the annex to MSC.1/Circ.1353.

4.3.4 Designers should incorporate the recommendations of this annex into the CSAP so that safe working conditions can be maintained during all anticipated configurations of container stowage.

* Refer to standard ISO 3874, Annex D Lashing rod systems and tensioning devices.

4.4 Training and familiarization

4.4.1 Personnel engaged in cargo securing operations should be trained in the lashing and unlashing of containers as necessary to carry out their duties in a safe manner. This should include the different types of lashing equipment that are expected to be used.

4.4.2 Personnel engaged in cargo securing operations should be trained in the identification and handling of bad order or defective securing gear in accordance with each ship's procedures to ensure damaged gear is segregated for repair and maintenance or disposal.

4.4.3 Personnel engaged in cargo securing operations should be trained to develop the knowledge and mental and physical manual handling skills that they require to do their job safely and efficiently, and to develop general safety awareness to recognize and avoid potential dangers.

4.4.4 Personnel should be trained in safe systems of work. Where personnel are involved in working at heights, they should be trained in the use of relevant equipment. Where practical, the use of fall protection equipment should take precedence over fall arrest systems.

4.4.5 Personnel who are required to handle thermal cables and/or connect and disconnect temperature control units should be given training in recognizing defective cables, receptacles and plugs.

4.4.6 Personnel engaged in containership cargo operations should be familiarized with the ship's unique characteristics and potential hazards arising from such operations necessary to carry out their duties.

5 RESPONSIBILITIES OF INVOLVED PARTIES

5.1 Administrations should ensure that:

.1 lashing plans contained within the approved Cargo Securing Manual are compatible with the current design of the ship and the intended container securing method is both safe and physically possible;

.2 the Cargo Securing Manual, lashing plans and the CSAP are kept up to date; and

.3 lashing plans and the CSAP are compatible with the design of the vessel and the equipment available.

5.2 Shipowners and operators should ensure that:

.1 portable cargo securing devices are certified and assigned with a maximum securing load (MSL). The MSL should be documented in the cargo securing manual as required by the CSS Code;

.2 the operational recommendations of this annex are complied with;

.3 correction, changes or amendments of the Cargo Securing Manual, lashing plans and the Cargo Safe Access Plan (CSAP) should be promptly sent to the competent authority for approval; and

.4 only compatible and certified equipment in safe condition is used.

5.3 Designers should follow design recommendations of these guidelines.

5.4 Shipbuilders should follow design recommendations of these guidelines.

5.5 Containership terminal operators should ensure that the recommendations of relevant parts of this annex are complied with.

6 DESIGN

6.1 General design considerations

6.1.1 *Risk assessment*

6.1.1.1 Risk assessments should be performed at the design stage taking into account the recommendations of this annex to ensure that securing operations can be safely carried out in all anticipated container configurations. This assessment should be conducted with a view toward developing the Cargo Safe Access Plan (CSAP). Hazards to be assessed should include but not be limited to:

.1 slips, trips and falls;

.2 falls from height;

.3 injuries whilst manually handling lashing gear;

.4 being struck by falling lashing gear or other objects;

.5 potential damage due to container operations. High-risk areas should be identified in order to develop appropriate protection or other methods of preventing significant damage;

.6 adjacent electrical risks (temperature controlled unit cable connections, etc.);

.7 the adequacy of the access to all areas that is necessary to safely perform container securing operations;

.8 ergonomics (e.g. size and weight of equipment) of handling lashing equipment; and

.9 implications of lashing 9'6" high, or higher, containers and mixed stows of 40' and 45' containers.

6.1.1.2 Shipbuilders should collaborate with designers of securing equipment in conducting risk assessments and ensure that the following basic criteria are adhered to when building containerships.

6.1.2 Ship designers should ensure that container securing operations performed in outer positions can be accomplished safely. As a minimum, a platform should be provided on which to work safely. This platform should have fencing to prevent workers falling off it.

6.1.3 The space provided between the containers stows for workers to carry out lashing operations should provide:

.1 a firm and level working surface;

.2 a working area, excluding lashings in place, to provide a clear sight of twist lock handles and allow for the manipulation of lashing gear;

.3 sufficient spaces to permit the lashing gear and other equipment to be stowed without causing a tripping hazard;

.4 sufficient spaces between the fixing points of the lashing bars on deck, or on the hatch covers, to tighten the turnbuckles;

.5 access in the form of ladders on hatch coamings;

.6 safe access to lashing platforms;

.7 protective fencing on lashing platforms; and

.8 adequate lighting in line with these guidelines.

6.1.4 Ship designers should aim to eliminate the need to access and work on the tops of deck stows.

6.1.5 Platforms should be designed to provide a clear work area, unencumbered by deck piping and other obstructions and take into consideration:

.1 containers must be capable of being stowed within safe reach of the workers using the platform; and

.2 the work area size and the size of the securing components used.

6.2 Provisions for safe access

6.2.1 *General provisions*

6.2.1.1 The minimum clearance for transit areas should be at least 2 m high and 600 mm wide (see table in supplement, dimensions B, J, K1).

6.2.1.2 All relevant deck surfaces used for movement about the ship and all passageways and stairs should have non-slip surfaces.

6.2.1.3 Where necessary for safety, walkways on deck should be delineated by painted lines or otherwise marked by pictorial signs.

6.2.1.4 All protrusions in access ways, such as cleats, ribs and brackets that may give rise to a trip hazard should be highlighted in a contrasting colour.

6.2.2 *Lashing position design (platforms, bridges and other lashing positions)*

6.2.2.1 Lashing positions should be designed to eliminate the use of three high lashing bars and be positioned in close proximity to lashing equipment stowage areas. Lashing positions should be designed to provide a clear work area which is unencumbered by deck piping and other obstructions and take into consideration:

.1 the need for containers to be stowed within safe reach of the personnel using the lashing position so that the horizontal operating distance from the securing point to the container does not exceed 1,100 mm and not less than 220 mm for lashing bridges and 130 mm for other positions (see table in supplement, dimensions C1, C2, C3);

.2 the size of the working area and the movement of lashing personnel; and

.3 the length and weight of lashing gear and securing components used.

6.2.2.2 The width of the lashing positions should preferably be 1,000 mm, but not less than 750 mm (see table in supplement, dimensions A, GL, GT, I, K).

6.2.2.3 The width of permanent lashing bridges should be:

.1 750 mm between top rails of fencing (see table in supplement, dimension F); and

.2 a clear minimum of 600 mm between storage racks, lashing cleats and any other obstruction (see table in supplement, dimension F1).

6.2.2.4 Platforms on the end of hatches and outboard lashing stations should preferably be at the same level as the top of the hatch covers.

6.2.2.5 Toe boards (or kick plates) should be provided around the sides of elevated lashing bridges and platforms to prevent securing equipment from falling and injuring people. Toe boards should preferably be 150 mm high, however, where this is not possible they should be at least 100 mm high.

6.2.2.6 Any openings in the lashing positions through which people can fall should be possible to be closed.

6.2.2.7 Lashing positions should not contain obstructions, such as storage bins or guides to reposition hatch covers.

6.2.2.8 Lashing positions which contain removable sections should be capable of being temporarily secured.

6.2.3 *Fencing design*

6.2.3.1 Bridges and platforms, where appropriate, should be fenced. As a minimum, fencing design should take into consideration:

.1 the strength and height of the rails should be designed to prevent workers from falling;

.2 flexibility in positioning the fencing of gaps. A horizontal unfenced gap should not be greater than 300 mm;

.3 provisions for locking and removal of fencing as operational situations change based on stowage anticipated for that area;

.4 damage to fencing and how to prevent failure due to that damage; and

.5 adequate strength of any temporary fittings. These should be capable of being safely and securely installed.

6.2.3.2 The top rail of fencing should be 1 m high from the base, with two intermediate rails. The opening below the lowest course of the guard rails should not exceed 230 mm. The other courses should be not more than 380 mm apart.

6.2.3.3 Where possible fences and handrails should be highlighted with a contrasting colour to the background.

6.2.3.4 Athwartships cargo securing walkways should be protected by adequate fencing if an unguarded edge exists when the hatch cover is removed.

6.2.4 ***Ladder and manhole design***

6.2.4.1 Where a fixed ladder gives access to the outside of a lashing position, the stringers should be connected at their extremities to the guardrails of the lashing position, irrespective of whether the ladder is sloping or vertical.

6.2.4.2 Where a fixed ladder gives access to a lashing position through an opening in the platform, the opening shall be protected with either a fixed grate with a lock back mechanism, which can be closed after access, or fencing. Grabrails should be provided to ensure safe access through the opening.

6.2.4.3 Where a fixed ladder gives access to a lashing position from the outside of the platform, the stringers of the ladder should be opened above the platform level to give a clear width of 700 to 750 mm to enable a person to pass through the stringers.

6.2.4.4 A fixed ladder should not slope at an angle greater than 25° from the vertical. Where the slope of a ladder exceeds 15° from the vertical, the ladder should be provided with suitable handrails not less than 540 mm apart, measured horizontally.

6.2.4.5 A fixed vertical ladder of a height exceeding 3 m, and any fixed vertical ladder, from which a person may fall into a hold, should be fitted with guard hoops, which should be constructed in accordance with paragraphs 6.2.4.6 and 6.2.4.7.

6.2.4.6 The ladder hoops should be uniformly spaced at intervals not exceeding 900 mm and should have a clearance of 750 mm from the rung to the back of the hoop and be connected by longitudinal strips secured to the inside of the hoops, each equally spaced round the circumference of the hoop.

6.2.4.7 The stringers should be carried above the floor level of the platform by at least 1 m and the ends of the stringers should be given lateral support and the top step or rung should be level with the floor of the platform unless the steps or rungs are fitted to the ends of the stringers.

6.2.4.8 As far as practicable, access ladders and walkways, and work platforms should be designed so that workers do not have to climb over piping or work in areas with permanent obstructions.

6.2.4.9 There should be no unprotected openings in any part of the workplace. Access opening must be protected with handrails or access covers that can be locked back during access.

6.2.4.10 As far as practicable, manholes should not be situated in transit areas, however, if they are, proper fencing should protect them.

6.2.4.11 Access ladders and manholes should be large enough for persons to safely enter and leave.

6.2.4.12 A foothold at least 150 mm deep should be provided.

6.2.4.13 Handholds should be provided at the top of the ladder to enable safe access to the platform to be gained.

6.2.4.14 Manhole openings that may present a fall hazard should be highlighted in contrasting colour around the rim of the opening.

6.2.4.15 Manhole openings at different levels of the lashing bridge should not be located directly below one another, as far as practicable.

6.3 Lashing systems

6.3.1 *General provisions*

Lashing systems, including tensioning devices, should:

.1 conform to international standards*, where applicable;

.2 be compatible with the planned container stowages;

.3 be compatible with the physical ability of persons to safely hold, deploy and use such equipment;

.4 be uniform and compatible, e.g. twistlocks and lashing rod heads should not interfere with each other;

.5 be subject to a periodic inspection and maintenance regime. Non-conforming items should be segregated for repair or disposal; and

.6 be according to the CSM.

6.3.2 *Twistlock design*

6.3.2.1 Shipowners should ensure that the number of different types of twistlocks provided for cargo securing is kept to a minimum and clear instructions are provided for their operation. The use of too many different types of twistlocks may lead to confusion as to whether the twistlocks are locked.

* Refer to standard ISO 3874 – The Handling and Securing of Type 1 Freight Containers, annex A-D.

6.3.2.2 The design of twistlocks should ensure the following:

.1 positive locking with easy up and down side identification;

.2 dislodging from corner fitting is not possible even when grazing a surface;

.3 access and visibility of the unlocking device is effective in operational situations;

.4 unlocked positions are easily identifiable and do not relock inadvertently due to jolting or vibration; and

.5 unlocking poles are as light as possible, of a simple design for ease of use.

6.3.2.3 Where it is not feasible to entirely eliminate working on the tops of container stows, the twistlock designs used should minimize the need for such working, e.g. use of SATLs, fully automatic twistlocks or similar design.

6.3.3 *Lashing rod design*

6.3.3.1 The design of containership securing systems should take into account the practical abilities of the workers to lift, reach, hold, control and connect the components called for in all situations anticipated in the cargo securing plan.

6.3.3.2 The maximum length of a lashing rod should be sufficient to reach the bottom corner fitting of a container on top of two high cube containers and be used in accordance with the instructions provided by the manufacturers.

6.3.3.3 The weight of lashing rods should be minimized as low as possible consistent with the necessary mechanical strength.

6.3.3.4 The head of the lashing rod that is inserted in the corner fitting should be designed with a pivot/hinge or other appropriate device so that the rod does not come out of the corner fitting accidentally.

6.3.3.5 The rod's length in conjunction with the length and design of the turnbuckle should be such that the need of extensions is eliminated when lashing high cube (9'6") containers.

6.3.3.6 Lightweight rods should be provided where special tools are needed to lash high cube containers.

6.3.4 *Turnbuckle design*

6.3.4.1 Turnbuckle end fittings should be designed to harmonize with the design of lashing rods.

6.3.4.2 Turnbuckles should be designed to minimize the work in operating them.

6.3.4.3 Anchor points for turnbuckles should be positioned to provide safe handling and to prevent the bending of rods.

6.3.4.4 To prevent hand injury during tightening or loosening motions, there should be a minimum distance of 70 mm between turnbuckles.

6.3.4.5 The turnbuckle should incorporate a locking mechanism which will ensure that the lashing does not work loose during the voyage.

6.3.4.6 The weight of turnbuckles should be minimized as low as possible consistent with the necessary mechanical strength.

6.3.5 *Storage bins and lashing equipment stowage design*

6.3.5.1 Bins or stowage places for lashing materials should be provided.

6.3.5.2 All lashing gear should be stowed as close to its intended place of use as possible.

6.3.5.3 The stowage of securing devices should be arranged so they can easily be retrieved from their stowage location.

6.3.5.4 Bins for faulty or damaged gear should also be provided and appropriately marked.

6.3.5.5 Bins should be of sufficient strength.

6.3.5.6 Bins and their carriers should be designed to be lifted off the vessel and restowed.

6.4 Lighting design

A lighting plan should be developed to provide for:

.1 the proper illumination† of access ways, not less than 10 lux (1 foot candle)*, taking into account the shadows created by containers that may be stowed in the area to be lit, for example different length containers in or over the work area;

.2 a separate fixed or temporary (where necessary) lighting system for each working space between the container bays, which is bright enough, not less than 50 lux (5 foot candle)*, for the work to be done, but minimizes glare to the deck workers;

.3 such illumination should, where possible, be designed as a permanent installation and adequately guarded against breakage; and

.4 the illumination† intensity should take into consideration the distance to the uppermost reaches where cargo securing equipment is utilized.

† For the upper tier of a lashing bridge, lights at the port and starboard extremities are generally adequate.
* Refer to Safety and Health in Ports, ILO Code of Practice, section 7.1.5.

7 OPERATIONAL AND MAINTENANCE PROCEDURES

7.1 Introduction

7.1.1 Procedures for safe lashing and securing operations should be included in the ship's Safety Management System as part of the ISM Code documentation.

7.1.2 Upon arrival of the ship, a safety assessment of the lashing positions and the access to those positions should be made before securing work commences.

7.2 Operational procedures

7.2.1 *Container deck working*

7.2.1.1 Transit areas should be safe and clear of cargo and all equipment.

7.2.1.2 Openings that are necessary for the operation of the ship, which are not protected by fencing, should be closed during cargo securing work. Any necessarily unprotected openings in work platforms (i.e. those with a potential fall of less than 2 m), and gaps and apertures on deck should be properly highlighted.

7.2.1.3 The use of fencing is essential to prevent falls. When openings in safety barriers are necessary to allow container crane movements, particularly with derricking cranes, removable fencing should be used whenever possible.

7.2.1.4 It should be taken into account that, when lifting lashing bars that can weigh between 11 and 21 kg and turnbuckles between 16 and 23 kg, there may be a risk of injury and severe illness as a result of physical strain if handled above shoulder height with the arms extended. It is therefore recommended that personnel work in pairs to reduce the individual workload in securing the lashing gear.

7.2.1.5 The company involved with cargo operation should anticipate, identify, evaluate and control hazards and take appropriate measures to eliminate or minimize potential hazards to prevent in particular with harmful lumbar spinal damage and severe illness as a result of physical strain.

7.2.1.6 Personnel engaged in containership cargo operations should wear appropriate Personnel Protective Equipment (PPE) whilst carrying out lashing operations. The PPE should be provided by the company.

7.2.1.7 Manual twistlocks should only be used where safe access is provided.

7.2.1.8 Containers should not be stowed in spaces configured for larger sized containers unless they can be secured under safe working conditions.

7.2.2 *Container top working*

7.2.2.1 When work on container tops cannot be avoided, safe means of access should be provided by the container cargo operation terminal, unless the ship has appropriate means of access in accordance with the CSAP.

7.2.2.2 Recommended practice involves the use of a safety cage lifted by a spreader to minimize the risk to personnel.

7.2.2.3 A safe method of work should be developed and implemented to ensure the safety of lashers when on the top of container stows on deck. Where practical, the use of fall prevention equipment should take precedence over fall arrest equipment.

7.2.3 *Failure to provide safe lashing stations on board/carry out lashing by port workers*

7.2.3.1 Where there are lashing and unlashing locations on board ship where no fall protection, such as adequate handrails are provided, and no other safe method can be found, the containers should not be lashed or unlashed and the situation should be reported to shoreside supervisor and the master or deck officer immediately.

7.2.3.2 If protective systems cannot be designed to provide safe protected access and lashing work positions, in all cargo configurations then cargo should not be stowed in that location. Neither crew nor shore workers should be subjected to hazardous working conditions in the normal course of securing cargo.

7.3 Maintenance

7.3.1 In line with section 2.3 (Inspection and maintenance schemes) of the *Revised guidelines for the preparation of the cargo securing manual* (MSC.1/Circ.1353) all ships should maintain a record book, which should contain the procedures for accepting, maintaining and repairing or rejecting of cargo securing devices. The record book should also contain a record of inspections.

7.3.2 Lighting should be properly maintained.

7.3.3 Walkways, ladders, stairways and fencings should be subject to a periodic maintenance programme which will reduce/prevent corrosion and prevent subsequent collapse.

7.3.4 Corroded walkways, ladders, stairways and fencings should be repaired or replaced as soon as practicable. The repairs should be effected immediately if the corrosion could prevent safe operations.

7.3.5 It should be borne in mind that turnbuckles covered with grease are difficult to handle when tightening.

7.3.6 Storage bins and their carriers should be maintained in a safe condition.

8 SPECIALIZED CONTAINER SAFETY DESIGN

8.1 Temperature controlled unit power outlets should provide a safe, watertight electrical connection.

8.2 Temperature controlled unit power outlets should feature a heavy duty, interlocked and circuit breaker protected electrical power outlet. This should ensure the outlet can not be switched "live" until a plug is fully engaged and the actuator rod is pushed to the "On" position. Pulling the actuator rod to the "Off" position should manually de-energize the circuit.

8.3 The temperature controlled unit power circuit should de-energize automatically if the plug is accidentally withdrawn while in the "On" position. Also, the interlock mechanism should break the circuit while the pin and sleeve contacts are still engaged.

This provides total operator safety and protection against shock hazard while eliminating arcing damage to the plug and receptacle.

8.4 Temperature controlled unit power outlets should be designed to ensure that the worker is not standing directly in front of the socket when switching takes place.

8.5 The positioning of the temperature controlled unit feed outlets should not be such that the flexible cabling needs to be laid out in such a way as to cause a tripping hazard.

8.6 Stevedores or ship's crew who are required to handle temperature controlled unit cables and/or connect and disconnect reefer units should be given training in recognizing defective wires and plugs.

8.7 Means or provisions should be provided to lay the temperature controlled unit cables in and protect them from lashing equipment falling on them during lashing operations.

8.8 Defective or inoperative temperature controlled unit plugs/electrical banks should be identified and confirmed as "locked out/tagged out" by the vessel.

9 REFERENCES

ILO Code of Practice – Safety and Health in Ports

ILO Convention 152 – Occupational Safety and Health in Dock Work

ISO Standard 3874 – The Handling and Securing of Type 1 Freight Containers

International Convention on Load Lines, 1966, as modified by the 1988 LL Protocol

Revised Recommendation on safety of personnel during container securing operations (MSC.1/Circ.1263)

Revised Guidelines for the preparation of the Cargo Securing Manual (MSC.1/Circ.1353/Rev.1).

SUPPLEMENT

CONTAINER SECURING DIMENSIONS

Dimension (*see* Figures)	Description	Requirement (mm)
A	Width of work area between container stacks(see figure 1)	750 minimum
B	Distance between lashing plates on deck or on hatch covers (see figure 1)	600 minimum
C1	Distance from lashing bridge fencing to container stack (see figure 2)	1100 maximum
C2	Distance from lashing plate to container stack (lashing bridge) (see figure 2)	220 minimum
C3	Distance from lashing plate to container stack (elsewhere) (see figures 1 and 4)	130 minimum
F	Width of lashing bridge between top rails of fencing (see figure 2)	750 minimum
F1	Width of lashing bridge between storage racks, lashing cleats and any other obstruction (see figure 2)	600 minimum
GL	Width of working platform for outboard lashing – fore/aft (see figure 3)	750 minimum
GT	Width of working platform for outboard lashing – transverse (see figure 3)	750 minimum
I	Width of work platform at end of hatch cover or adjacent to superstructure (see figure 4)	750 minimum
J	Distance from edge of hatch cover to fencing (see figure 4)	600 minimum
K	Width of lashing bridge between top rails of fencing (see figure 2)	750 minimum
K1	Width of lashing bridge between the pillars of the lashing bridge (see figure 2)	600 minimum

NOTES

B	-	Measured between the centres of the lashing plates.
C1	-	Measured from inside of fencing.
C2, C3	-	Measured from centre of lashing plate to end of container.
F, K	-	Measured to inside of fencing.
GL	-	Measured from end of container to inside of fencing.
GT	-	Measured to inside of fencing.
I	-	Measured to inside of fencing.
J	-	Measured to inside of fencing.

Figure 1

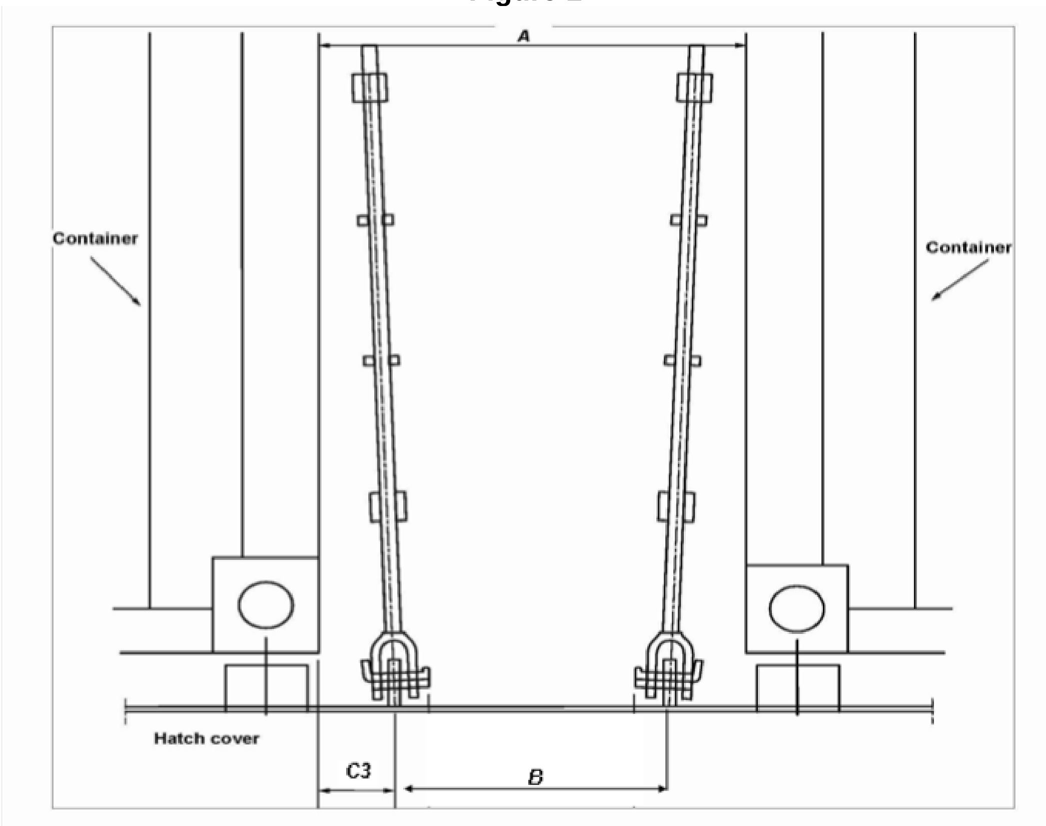
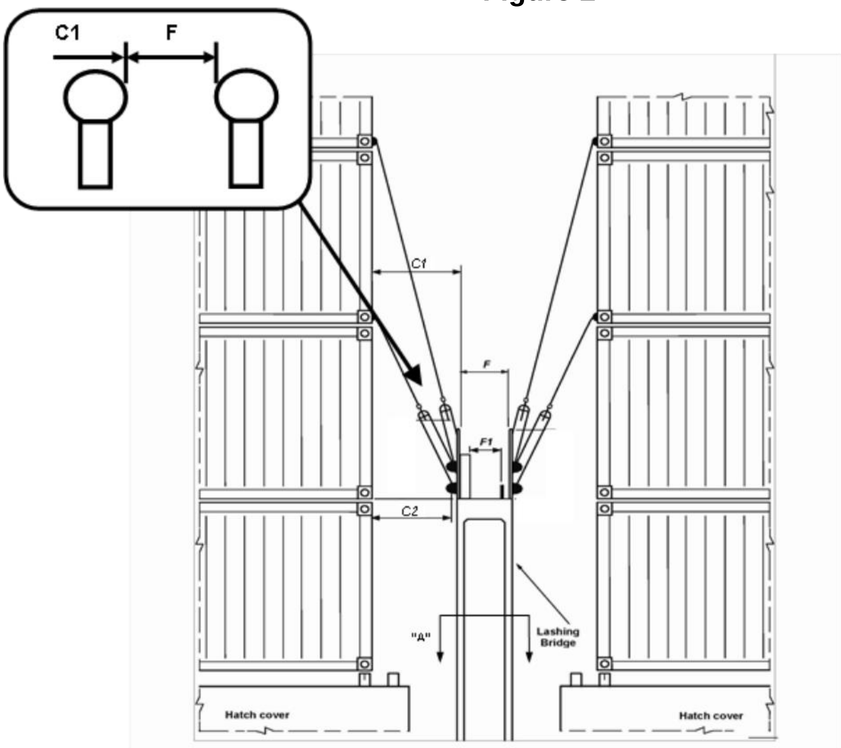


Figure 2



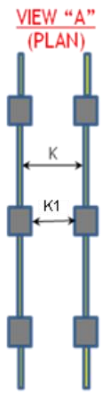


Figure 3

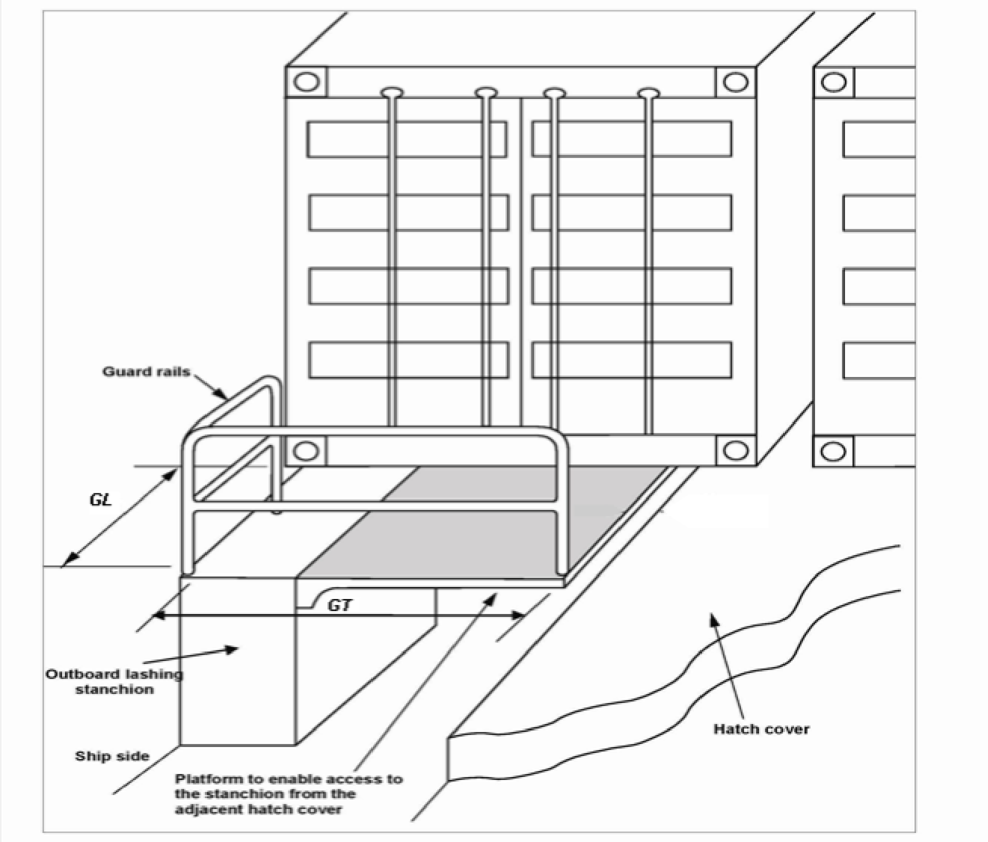
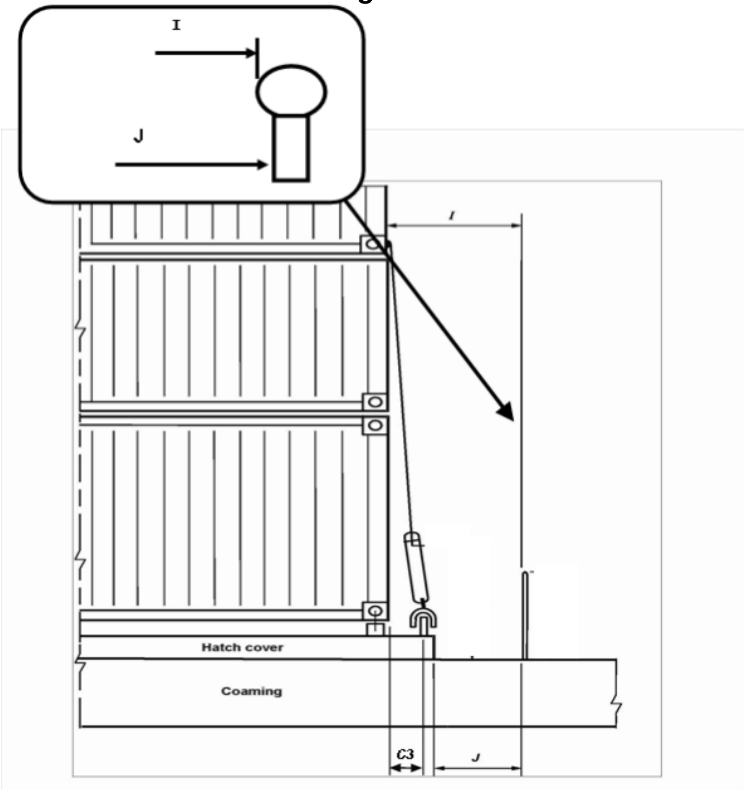


Figure 4



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