RUSSIAN MARITIME REGISTER OF SHIPPING

GUIDELINES

FOR THE PREPARATION OF THE CARGO SECURING MANUAL

ND No. 2-030101-008-E

St. Petersburg
2022

GUIDELINES FOR THE PREPARATION OF THE CARGO SECURING MANUAL

The Guidelines for the Preparation of the Cargo Securing Manual have been approved in accordance with the established approval procedure and come into force on 1 January 2022.

The present edition of the Guidelines is based on the 2016 edition taking into account the amendments and additions developed immediately before publication.

The requirements of the following normative documents have been taken into consideration in the Guidelines:

Technical Requirements for the Arrangement and Securing of the International Standard Containers on Board the Ships Intended for Container Transportation;

IMO resolution A.714(17) "Code for Safe Practice for Cargo Stowage and Securing" as amended;

IMO circular MSC.1/Circ.1353/Rev.2 "Guidelines for the Preparation of the Cargo Securing Manual".

On the entry into force of these Guidelines, the Guidelines for the Preparation of the Cargo Securing Manual in Service, 2016 become void.

REVISION HISTORY

(purely editorial amendments are not included in the Revision History)

Amended paras/chapters/ section	Information on amendments	Number and date of the Circular Letter	Entry-into-force date
Sections 2 — 5	Sections have been amended to harmonize with the requirements of IMO circular MSC.1/Circ.1353/Rev.2	—	01.01.2022
Annex 2	Annex has been amended to harmonize with the requirements of Annex 13 of the Code of Safe Practice for Cargo Stowage and Securing	—	01.01.2022

SCOPE OF APPLICATION, PROCEDURE FOR AGREEMENT AND APPROVAL OF THE CARGO SECURING MANUAL

1. The Guidelines for the Preparation of the Cargo Securing Manual[1] determine the content as well as the procedure for agreement and approval of the Cargo Securing Manual for all ships carrying general cargoes and flying the flag of the Russian Federation and engaged in domestic and international voyages.

2. The Cargo Securing Manual[2] shall be approved by the Maritime Administration[3] or by the Russian Maritime Register of Shipping[4] acting on the MA behalf.

3. The Manual is a normative and technical document determining the arrangements and means for cargo securing based on the methods submitted as well as specifying the procedure for application of arrangements and means to secure certain cargoes based on the values of transverse, longitudinal and vertical forces arising from adverse weather and sea conditions in order to ensure safety of the ship and the protection of the cargo and personnel.

4. Finally developed technical documentation containing all necessary data to verify the fulfillment of the Guidelines requirements shall be subject to review and approval.

5. Approval of the Manual means that the reviewed technical documentation meets the requirements of the Guidelines.

6. The documentation shall be submitted in the Russian and/or English language drawn-up in accordance with the established procedure.

7. If the submitted documentation contains any deviations from the Guidelines, or applied technical solutions do not fully comply with the requirements of the Guidelines but equal thereto, a list of equivalents containing their description and substantiation for their application shall be attached to the set of documentation.

8. The Manual shall be submitted for review in electronic form. Where necessary, the designer shall submit additional materials justifying and explaining the adopted technical solutions. The Manual shall be written in one of the working languages of the crew of the ship but if the language used is not English, Spanish or French, a translation into one of these languages shall be included.

9. The Manual shall be approved, as a rule, without term limitation. In certain cases the period of validity of the approval may be limited.

10. Revision of the Manual may be carried out on the initiative of the shipowner/ship operator in connection with the extension of the list of cargoes carried and/or amendments in the cargo stowage and securing plan considering accumulated experience of their application.

---

1 Hereinafter referred to as "the Guidelines".
2 Hereinafter referred to as "the Manual".
3 Hereinafter referred to as "MA".
4 Hereinafter referred to as "the Register and RS".

1 GENERAL

In accordance with the Regulations VI/5.6 and VII/5 of the International Convention for the Safety of Life at Sea, 1974[1] with relevant amendments cargo units, including containers shall be stowed and secured throughout the voyage in accordance with the Manual approved by the Maritime Administration.

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

The purpose of the Guidelines is to cover all relevant aspects necessary for the development of the Manual and to provide a uniform approach to the preparation of Cargo Securing Manual, their layout and content.

It is important that securing devices meet acceptable functional and strength criteria applicable to the specified 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 shall be instructed in the correct application and use of the cargo securing devices on board the ship.

When developing the Manual it is recommended to follow the layout of the Guidelines to ensure that the numbers of Chapters contained therein correspond to the numbers of Chapters in the Manual.

1.1 TERMS AND DEFINITIONS

1.1.1 Definitions and explanations relating to general terminology of the RS rules and other RS normative documents are given in Part I "Classification" of the Rules for the Classification and Construction of Sea-Going Ships, Part I "General Regulations for Technical Supervision" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

1.1.2 Additionally, in these Guidelines, the following terms and definitions have been adopted for the preparation of the Manual:

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

.2 Portable securing devices are various twistlocks, cones, bridge fittings, lashings, shorings, buttresses and equally efficient means attached to the cargoes and ship structures by detachable joints.

.3 Fixed securing devices are various sockets, padeyes, D-rings and equally efficient means permanently fixed on the ship hull structures.

.4 Safe working load (*SWL*) is a term used to define the allowable bearing (load) capacity for a cargo securing device.

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

.6 Proof load (*PL*) is a test load which the cargo securing device shall be capable of withstanding without residual deformations.

.7 Breaking load (*BL*) is a load which causes fracture in a tensile, compression, flexure or torsion test, used for determination of ultimate bearing capacity of the cargo securing device without fracture.

---

[1] Hereinafter referred to as SOLAS-74.

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

.9 Semi-standardized cargo is a 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.

.10 Non-standardized cargo is a cargo which requires individual stowage and securing arrangements.

.11 Self-propelled vehicles are cars and trucks, towing vehicles, tractors, excavators, elevating-transfer vehicles, construction vehicles, road vehicles, agricultural and other wheeled and tracked self-propelled vehicles.

.12 Trailer is a high- or low-bed trailer which has front and rear axles, used for cargo transportation on main roads.

.13 Semi-trailer is a trailer which is designed to be coupled to a semi-trailer towing vehicle and to impose a substantial part of its total mass on the towing vehicle.

.14 Road train is a combination of a motor vehicle with one or more independent trailers connected by a draw-bar. For the purpose of cargo securing device calculation, each element of a road train is considered a separate vehicle.

.15 Articulated road train is a combination of a semi-trailer towing vehicle with a semi-trailer.

.16 Combination of vehicles is a motor vehicle coupled with one or more towed vehicles. For the purpose of cargo securing device calculation, each element of a combination of vehicles is considered a separate vehicle.

.17 Twistlock is a portable containers securing device which function is to prevent either horizontal or vertical movement of a container.

.18 Single stacking cone is a portable containers securing device which function is to prevent horizontal movement of a container.

.19 Double stacking cone is a portable containers securing device which function is to prevent horizontal movement of a container and designed for interconnecting two adjacent stacks.

.20 Lashing is a portable securing device intended for connection of a container or another cargo unit with a fixed cargo securing device and designed to be able of taking up tensile loads, which normally contains an arrangement for length regulation (for example, a turnbuckle, etc.).

.21 Penguin hook is a portable containers securing device which design and method of connection with a container, another securing devices and ship hull structures shall provide the capability of taking up tangential loads combining bend and shear.

.22 Buttress is a portable containers securing device which design and method of connection with a container, fixed cargo securing devices and ship hull structures shall provide the capability of taking up both tensile loads and comprehensive loads acting along the buttress centre line. As a rule, a buttress shall be provided with a length regulator.

.23 Shoring is a portable containers securing device which design and method of connection with a container, fixed cargo securing devices or ship hull structures shall provide the capability of taking up compressive loads only acting along the shoring centre line. As a rule, a shoring shall be provided with a length regulator.

.24 Bridge fitting is a portable securing device which connects the topmost corner fittings of two adjacent containers where the design and the method of connection with the containers shall provide the capability of taking up tensile loads only acting along the bridge fitting centre line.

.25 Cargo unit is a vehicle, container, flat, pallet, portable tank, packaged unit, or any other entity, etc., and loading equipment, or any part thereof, which belongs to the ship but is not fixed to the ship as defined in IMO resolution A.489(XII).

1.2 GENERAL REQUIREMENTS

1.2.1 This Chapter shall contain the following general statements:

.1 "The guidance given herein shall 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 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 and the International Code for the Safe Carriage of Packed Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships (INF Code) (if applicable).";

.3 "The 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 shall be used for cargo securing.";

.5 "The cargo securing devices mentioned in the Manual shall 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 shall be revised accordingly. Alternative cargo securing devices introduced shall not have less strength than the devices being replaced.";

.6 "There shall 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 the Manual. The cargo securing devices shall be maintained in a satisfactory condition. Items worn or damaged to such an extent that their quality is impaired shall 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 shall be provided and maintained in accordance with this plan.".

1.3 GENERAL INFORMATION ON SHIP

1.3.1 Ship information shall include the following:
.1 purpose of ship;
.2 structure of ship;
.3 main dimensions;
.4 cargo carrying capacity of cargo spaces and decks according to types of cargo;
.5 allowable loads on:
flooring of cargo spaces;
upper deck plating and hatch covers;
axes of vehicles;
sockets for containers securing.

2 CARGO SECURING DEVICES AND ARRANGEMENTS

2.1 SPECIFICATION FOR FIXED CARGO SECURING DEVICES

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

.1 a list and/or plan of the fixed cargo securing devices, which shall be supplemented with appropriate documentation for each type of device as far as practicable. The appropriate documentation shall include information regarding:
name of manufacturer;
type designation of item with simple sketch for ease of identification;
list of material(s);
identification marking;
strength test result or ultimate tensile strength test result;
result of non-destructive testing;
maximum securing load (*MSL*);

.2 fixed securing devices on bulkheads, web frames, stanchions, etc. and their types (e.g. D-rings, padeyes), 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*;

.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

2.2.1 This Chapter shall describe the number of and the functional and design characteristics of the portable cargo securing devices carried on board the ship, and shall be supplemented by suitable drawings or sketches if deemed necessary.

It shall contain the following information:

.1 a list for the portable securing devices, which shall be supplemented with appropriate documentation for each type of device, as far as practicable.

The appropriate documentation shall include information regarding:

name of manufacturer;
type designation of item with simple sketch for ease of identification;
list of material(s), including minimum safe operational temperature;
identification marking;
strength test result or ultimate tensile strength test result;
result of non-destructive testing;
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;

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

2.3 INSPECTION AND MAINTENANCE

2.3.1 This Chapter shall describe inspection and maintenance schemes of the cargo securing devices on board the ship.

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

.1 routine visual examinations of components being utilized;

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

2.3.3 This para shall document actions to inspect and maintain the ship's cargo securing devices. Entries shall be made in a record book, which shall be kept with the Manual. This record book shall contain the following information:

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

.2 record of inspections.

2.3.4 This para shall contain information for the master regarding inspections and adjustment of securing arrangements during the voyage.

2.3.5 Computerized maintenance procedures may be referred to in this para when considering availability and movement of cargo securing devices.

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

3.1 HANDLING AND SAFETY INSTRUCTIONS

3.1.1 This Chapter shall contain:

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

.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

3.2.1 This Chapter shall 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 3.2.1.1 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;

.3 examples of how to calculate number and strength of portable securing devices required to counteract the forces referred to in 3.2.1.2 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 Maritime Administration;

.4 it is recommended that the designer of the 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;

.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 3.2.1.1 — 3.2.1.4 above, providing that this system contains the same information.

3.3 APPLICATION OF PORTABLE SECURING DEVICES ON INDIVIDUAL TYPES OF VEHICLES

3.3.1 It is necessary to draw the master's attention to the correct application of portable securing devices, taking into account the following factors:

.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 and 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;

.6 type and packaging of cargo units including vehicles;

.7 intended stowage pattern of the vehicles;

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

3.3.2 This para shall describe the application of portable cargo securing devices as to number of lashings and allowable lashing angles. Where necessary, the text shall 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 shall 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 Chapter shall 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 shall be developed in accordance with Annex 13 of the CSS Code.

3.4 SUPPLEMENTARY REQUIREMENTS FOR RO-RO SHIPS

3.4.1 The Guidelines shall 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.

3.4.2 This Chapter applies to ro-ro ships which regularly carry road vehicles on either long or short international voyages in unsheltered waters. They concern:

road vehicles (self-propelled vehicles, trailers, semi-trailers) as defined in 1.1.2.11 — 1.1.2.14 and 1.1.2.16 with a total mass between 3,5 and 40 t;

road vehicles as defined in 1.1.2.15 with a total mass of not more than 45 t.

3.4.3 For road vehicles having characteristics outside the general parameters for road vehicles (particularly where the normal height of the centre of gravity is exceeded), the location and the number of securing points shall be specially considered.

3.4.4 Arrangement of securing points on ships' decks.

The decks of a ship intended for road vehicles shall be provided with securing points as follows.

3.4.4.1 The arrangement of securing points shall be left to the discretion of the shipowner provided that for each road vehicle or element of a combination of road vehicles there is the following minimum arrangement of securing points:

the distance between securing points in the longitudinal direction shall in general not exceed 2,5 m. However, there may be a need for the securing points in the forward and after parts of the ship to be more closely spaced than they are amidships;

the thwartships spacing of securing points shall not be less than 2,8 m nor more than 3 m. However, there may be a need for the securing points in the forward and after parts of the ship to be more closely spaced than they are amidships;

the *MSL* without permanent deformation of each securing point shall be not less than 100 kN. If the securing point is designed to accommodate more than one lashing (*y* lashings) the *MSL* shall be equal to *y* x 100 kN.

3.4.4.2 In ships which only occasionally carry road vehicles, the spacing and strength of securing points shall be such that the special consideration shall be taken into account by the designer of the Manual.

3.4.5 Arrangement of securing points on road vehicles.

Securing points on road vehicles shall be arranged as follows.

3.4.5.1 Securing points on road vehicles shall be designed for securing the road vehicles to the ship and shall have an aperture capable of accepting only one lashing in various directions to the ship's deck.

3.4.5.2 The same number of not less than two or more than six securing points shall be provided on each side of the road vehicle.

3.4.5.3 The minimum number and minimum strength of securing points shall be in accordance with Table 3.4.5.3.

Table 3.4.5.3

Gross vehicle mass *GVM*, in t	Minimum number of securing points on each side of the road vehicle, in pcs	Minimum strength without permanent deformation of each securing point as fitted, in kN
$3{,}5 \le GVM \le 20$ $20 < GVM \le 30$ $30 < GVM \le 30$	2 3 4	$\frac{GVM \times 10 \times 1{,}2}{n}$
Notes: 1. Where n is the total number of securing points on each side of the road vehicle. 2. If more than one верить the strength for the securing point in the Table. 3. For road trains, the Table applies to each component, i.e. to the motor vehicle and each trailer, respectively.		

3.4.5.4 Data from tab_3_4_5_3 do not apply to towing vehicles.

Towing vehicles shall be provided with two securing points at the front of the vehicle, the strength of which shall be sufficient to prevent lateral movement of the front of the vehicle. A towing coupling at the front may replace the two securing points.

The towing coupling that is not used for securing semi-trailers shall not be used for securing towing vehicle to the deck.

3.4.6 Securing points on vehicles shall be so located as to ensure effective restraint of the vehicle by the lashings and that the lashings can be readily and safety attached.

3.4.7 The internal free passage of each securing point's aperture shall be not less than 80 mm but the aperture need not be circular in shape.

3.4.8 Number and strength of securing points on vehicles not stated in Table 3.4.5.3 shall be at least equivalent to the requirements of this Chapter.

3.5 BULK CARRIERS

3.5 If bulk carriers carry cargo units falling within the scope of Chapter VI/5 or Chapter VII/5 of SOLAS 74, this cargo shall be stowed and secured in accordance with a Cargo Securing Manual, approved by the Maritime Administration.

4 STOWAGE AND SECURING OF CONTAINERS AND OTHER STANDARDIZED CARGO

4.1 HANDLING AND SAFETY INSTRUCTIONS

4.1.1 This Chapter shall contain:

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

.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

4.2.1 This Chapter shall cover all conditions considered when developing of adopted stowage and securing pattern for containers and other standardized cargo on board the ship. On existing ships the relevant documents regarding safe stowage and securing of containers may be integrated into the material used for the preparation of this Chapter.

4.2.2 Stowage and securing plan.

This Chapter shall 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 shall be consistent throughout the Manual.

4.2.3 Stowage and securing principle on deck and under deck.

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

.1 the use of the specified devices;

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

4.3 ALLOWABLE STOWAGE PATTERNS

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

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

.1 alternative vertical sequences of masses in stacks (possible deviations from the allowable vertical container mass distribution 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 Chapter shall 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 shall be provided.

4.4.2 It shall further contain information on the nominal increase of forces or accelerations with an increase of initial stability. Recommendations shall 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.

5 CARGO SAFE ACCESS PLAN (CSAP)

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

It shall 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.

ANNEX 1

RECOMMENDED AVAILABILITY AND MOVEMENT SHIP RECORD FORM FOR CARGO SECURING DEVICES

Nos.	Type of equipment	Type of equipment	Number	Delivery date	Test date	Remarks
T1	Steel wire rope lashing					
T2	Chain lashing					
T3	Turnbuckle					
T4	Wooden dunnages					
T5						
T6						

ANNEX 2

METHODS TO ASSESS THE EFFICIENCY OF SECURING ARRANGEMENTS FOR NON-STANDARDIZED CARGO

1 SCOPE OF APPLICATION

1.1 The methods described in this Annex shall be applied to non-standardized cargoes, but not to containers on containerships.

1.2 Very heavy units as carried under the requirements of 1.8 of Chapter 1 of the CSS Code and those items for which exhaustive advice on stowage and securing is given in the Annexes to the CSS Code shall be excluded.

1.3 Nothing in this Annex shall be read to exclude the use of computer software, provided the output achieves design parameters which meet the minimum safety factors applied in this Annex.

1.4 The application of the methods described in this Annex is supplementary to the principles of good seamanship and shall not replace experience in stowage and securing practice.

2 PURPOSE OF THE METHODS

2.1 The methods shall:

.1 provide guidance for the preparation of the Manual and the examples therein;

.2 assist ship's personnel in assessing the securing of cargo units not covered by the Manual;

.3 assist qualified shore personnel in assessing the securing of cargo units not covered by the Manual;

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

3 PRESENTATION OF THE METHODS

3.1 The methods are presented in a universally applicable and flexible way. It is recommended that designers of the Manual convert this presentation into a form suiting the particular ship, its cargo securing devices and the cargo carried. This form may consist of applicable diagrams, tables or calculated examples.

4 STRENGTH OF CARGO SECURING EQUIPMENT

4.1 Manufacturers of cargo securing equipment shall at least supply information on the nominal breaking strength of the devices in kN.

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

The *MSLs* for different securing devices depending on the breaking strength value shall be determined according to data given in Table 4.2.

Table 4.2

Type of securing device	*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-usable)	30 % of breaking strength
Steel band (single use)	70 % of breaking strength
Chains	50 % of breaking strength

The MSL of timber shall be taken as 0,3 kN/cm^2 normal to the grain.

4.3 For particular securing devices (e.g., synthetic and fibre straps with tensioners or special equipment for securing containers), a permissible working load may be prescribed and marked by authority.

This shall be taken as the MSL.

4.4 When the components of a lashing device are connected in series (for example, a wire to a shackle to a deckeye), the minimum *MSL* in the series shall apply to that device.

5 RULE-OF-THUMB METHOD

5.1 The total of the *MSL* values of the securing devices on each side of a unit of cargo (port as well as starboard) shall equal the weight of the unit in kN.

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 shall 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 shall not 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 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

$$CS = \frac{MSL}{safety\ factor}. \tag{6.1}$$

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

7 ADVANCED CALCULATION METHOD

7.1 ASSUMPTION OF EXTERNAL FORCES

External forces to a cargo unit in longitudinal, transverse and vertical directions shall be obtained using the formula

$$F_{(x,y,z)} = ma_{(x,y,z)} + F_{w(x,y)} + F_{s(x,y)} \qquad (7.1\text{-}1)$$

where $F_{(x,y,z)}$ = longitudinal, transverse and vertical forces;
m = mass of the unit;
$a_{(x,y,z)}$ = longitudinal, transverse and vertical acceleration (refer to Table 7.1-1);
$F_{w(x,y)}$ = 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 7.1-1.

Table 7.1-1

	Transverse acceleration a_y, in m/s²											Longitudinal acceleration a_x, in m/s²
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/s²											
		7,6	6,2	5,0	4,3	4,3	5,0	6,2	7,6	9,2		
N o t e . 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.												

The basic acceleration data shall be considered as valid under the following operational conditions:
operation in unrestricted area;
operation during the whole year;
duration of the voyage is 25 days;
length of ship is 100 m;
service speed is 15 knots;
$B/GM \geq 13$ (B — breadth of ship; GM — metacentric height).

For operation in a restricted area, reduction of these figures may be considered, taking into account the season of the year and the duration of the voyage.

For ships of a length other than 100 m and a service speed other than 15 knots, the acceleration figures shall be corrected by a factor given in Table 7.1-2.

Table 7.1-2

Correction factors for length and speed

Length, in m / Speed, in knots	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

Speed, in knots \ Length, in m	50	60	70	80	90	100	120	140	160	180	200
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

For length/speed combinations not directly stated in Table 7.1-2, the correction factor may be determined by using the formula

$$correction\ factor = (0{,}345 \cdot v/\sqrt{L}) + (58{,}62 \cdot L - 1034{,}5)/L^2 \qquad (7.1\text{-}2)$$

where L = length between perpendiculars, in m;
v = speed, in knots.

Formula (7.1-2) shall not be used for ships lengths less than 50 m or more than 300 m.

In addition, for ships with B/GM less than 13, the transverse acceleration figures shall be corrected by a factor given in Table 7.1-3.

Table 7.1-3

Correction factors for B/GM<13

B/GM	7	8	9	10	11	12	13 or above
On deck, high	1,56	1,40	1,27	1,19	1,11	1,05	1,00
On deck, low	1,42	1,30	1,21	1,14	1,09	1,04	1,00
Tween-deck	1,26	1,19	1,14	1,09	1,06	1,03	1,00
Lower hold	1,15	1,12	1,09	1,06	1,04	1,02	1,00

The following cautions shall be observed:

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

in the case of heading into the seas at high speed with marked slamming shocks, the given figures of longitudinal and vertical acceleration may be exceeded. An appropriate reduction of speed shall be considered;

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 shall be considered.

Forces by wind and sea to cargo units above the weather deck shall be accounted for by a simple approach:

force by wind pressure equal to 1 kN per m^2;

force by sea sloshing equal to 1 kN per m^2.

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

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

For voyages in a restricted area, sea sloshing forces may be neglected.

7.2 BALANCE OF FORCES AND MOMENTS

The balance calculation shall preferably be carried out for:

transverse sliding in port and starboard directions; transverse tipping in port and starboard directions;

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

In the case of symmetrical securing arrangements, one appropriate calculation is sufficient.

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

7.2.1 Transverse sliding.

The balance calculation shall meet the following condition (refer to Fig. 7.2.1):

$$F_y \leq \mu \cdot m \cdot g + CS_1 \cdot f_1 + CS_2 \cdot f_2 + \cdots + CS_n \cdot f_n, \qquad (7.2.1)$$

where n = number of lashings being calculated;
F_y = transverse force from load assumption, in kN;
μ = friction coefficient the value of which is accepted as per Table 7.2.1-1;
m = mass of the cargo unit, in t;
g = gravity acceleration of earth = 9,81 m/s^2,
$CS = MSL/1{,}5$ = calculated strength of transverse securing devices, in kN;
f = a function of μ and the vertical securing angle α (refer to Table 7.2.1-2).

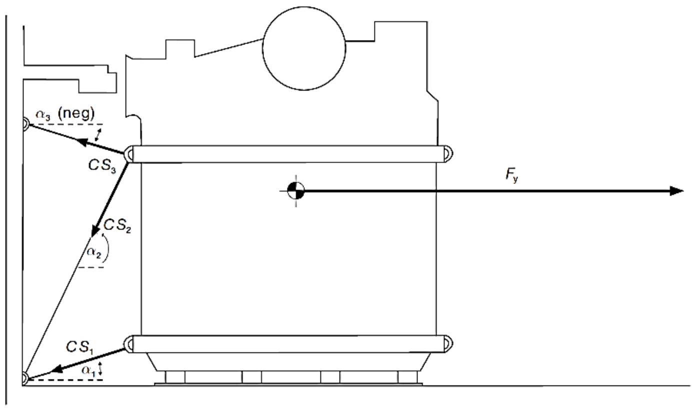

Fig. 7.2.1
Balance of transverse forces

Table 7.2.1-1

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

Table 7.2.1-2

***f* values as a function of α and μ**

μ \ α	−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

Note. $f = \mu \cdot \sin\alpha + \cos\alpha$.

A vertical securing angle α greater than 60° shall reduce the effectiveness of this particular securing device in respect to sliding of the unit. Disregarding of such devices from the balance of forces shall 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.

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

As an alternative to using Table 7.2.1-2 to determine the forces in a securing arrangement, the method outlined in 7.3 can be used to take account of transverse and longitudinal components of lashing forces.

7.2.2 Transverse tipping.

This balance calculation shall meet the following condition (refer to Fig. 7.2.2):

$$F_y \cdot a \leq b \cdot m \cdot g + CS_1 \cdot c_1 + CS_2 \cdot c_2 + \cdots + CS_n \cdot c_n \qquad (7.2.2)$$

where F_y, m, m, CS, n = as explained under 7.2.1;
a = lever-arm of tipping, in m;
b = lever-arm of stableness, in m;
c = lever-arm of securing force, in m.

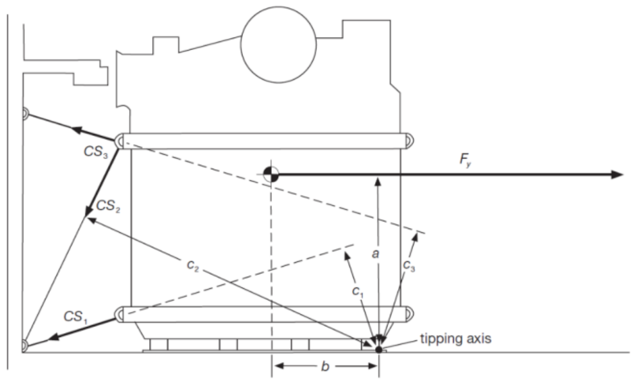

Fig. 7.2.2
Balance of transverse moments

7.2.3 Longitudinal sliding.

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

$$F_x \leq \mu \cdot (m \cdot g - F_z) + CS_1 \cdot f_1 + CS_2 \cdot f_2 + \cdots + CS_n \cdot f_n \qquad (7.2.3)$$

where F_x = longitudinal force from load assumption, in kN;
n, μ, m, g = as explained under 7.2.1;
F_z = vertical force from load assumption, in kN;
$CS = MSL/1{,}5$ = calculated strength of longitudinal securing devices, in kN.

N o t e. Longitudinal components of transverse securing devices shall not be assumed greater than 0,5 · CS.

7.3 ALTERNATIVE METHOD — BALANCE OF FORCES

The balance of forces described in 7.2.1 and 7.2.3 shall 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.

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 shown on Fig. 7.3-1 and defined as the angle of deviation from the transverse direction. The angle β shall be scaled in the quadrantal mode, i.e., between 0 and 90°.

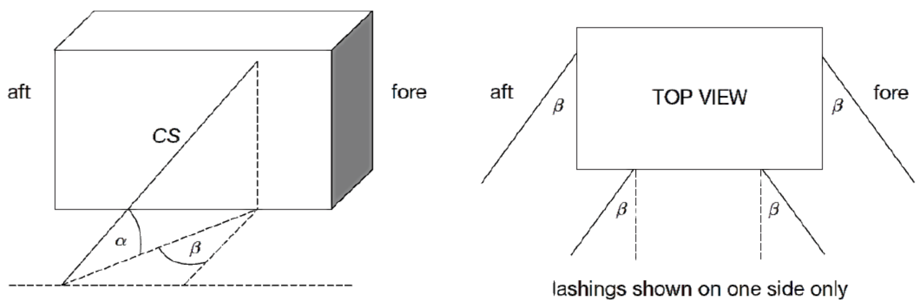

Fig. 7.3-1
Definition of the vertical and horizontal securing angles α and β

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 7.3-1.

Table 7.3-1 consists of five sets of figures, one each for the friction coefficients μ = 0,4; μ = 0,3; μ = 0,2; μ = 0,1; μ = 0,0. 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 7.3-1 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: $F_x \leq \mu \cdot m \cdot g + f_{y1} \cdot CS_1 + \cdots + f_{yn} \cdot CS_n$; (7.3-1)

Longitudinal sliding: $F_x \leq \mu \cdot (m \cdot g) + f_{x1} \cdot CS_1 + \cdots + f_{xn} \cdot CS_n$; (7.3-2)

Transverse tipping: $F_y \cdot a \leq b \cdot m \cdot g + 0{,}9 \cdot (CS_1 \cdot c_1 + CS_2 \cdot c_2 + \cdots + CS_n \cdot c_n)$. (7.3-3)

All symbols used in these formulae have the same meaning as defined in 7.2, except f_x and f_y, obtained from Table 7.3-1, and CS, is as follows:

$$CS = MSL/1{,}35.$$

Note. Securing devices which have a vertical angle α of less than 45°, in combination with horizontal angle β greater than 45° shall not be used in the balance of transverse tipping in the above formula.

Table 7.3-1

Dependence of f_x and f_y from α, β and μ

for μ = 0,4

β for f_y	α, in deg.														β for f_x
	−30	−20	−10	0	10	20	30	40	45	50	60	70	80	90	
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

for μ = 0,3

β for f_y	α, in deg.														β for f_x
	−30	−20	−10	0	10	20	30	40	45	50	60	70	80	90	
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	0,19	0,23	0,26	0,28	0,30	0,30	0

for μ = 0,2

β for f_y	α, in deg.														β for f_x
	−30	−20	−10	0	10	20	30	40	45	50	60	70	80	90	
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
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	−0,10	−0,07	−0,03	0,00	0,03	0,07	0,10	0,13	0,14	0,15	0,17	0,19	0,20	0,20	0

for μ = 0,1

β for f_y	α, in deg.														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

β for f_y	α, in deg.														β for f_x
	−30	−20	−10	0	10	20	30	40	45	50	60	70	80	90	
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

for $\mu = 0{,}0$

β for f_y	α, in deg.														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

Examples of application of calculation methods.

Example No. 1. Main method (refer to Fig. 7.3-2)

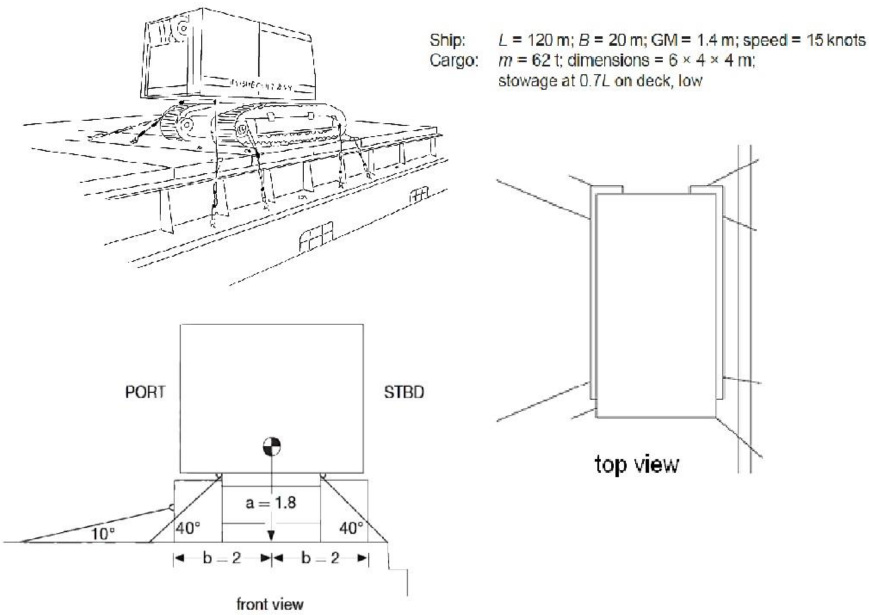

Fig. 7.3-2

Securing material:
wire rope: $BL = 125$ kN; $MSL = 100$ kN;
shackles, turnbuckles, deck rings: $BL = 180$ kN; $MSL = 90$ kN;
stowage on dunnage boards: $\mu = 0{,}3$; $CS = 90/1{,}5 = 60$ kN.

Securing arrangement (lashings):

side	n	CS	α	f	c
Starboard	4	60 кН	40°	0,96	—
Port	2	60 кН	40°	0,96	—
Port	2	60 кН	10°	1,04	—

External forces:
$F_x = 2{,}9 \cdot 0{,}89 \cdot 62 + 16 + 8 = 184$ kN;
$F_y = 6{,}3 \cdot 0{,}89 \cdot 62 + 24 + 12 = 384$ kN;
$F_z = 6{,}2 \cdot 0{,}89 \cdot 62 = 342$ kN.

Balance of forces (starboard lashings):
$384 < 0{,}3 \cdot 62 \cdot 9{,}81 + 4 \cdot 60 \cdot 0{,}96$;
$384 < 412$. This is OK

Balance of forces (port lashings):
$384 < 0{,}3 \cdot 62 \cdot 9{,}81 + 2 \cdot 60 \cdot 0{,}96 + 2 \cdot 60 \cdot 1{,}04$;
$384 < 422$. This is OK.

Balance of moments:
$384 \cdot 1{,}8 < 2 \cdot 62 \cdot 9{,}81$;
$691 < 1216$. No tipping, even without lashings.

Example No. 2. Alternative method (refer to Fig. 7.3-3)
A cargo unit of 68 t mass is stowed on timber (μ = 0,3) in the tween deck at 0,7L of a ship.
Main ship particulars:
L = 160 м;
B = 24 м;
speed v = 18 knots;
metacentric height GM = 1,5 m.
Dimensions of the cargo unit: height = 2,4 m, width = 1,8 m.
The external forces: F_x = 112 kN, F_y = 312 kN, F_z = 346 kN.

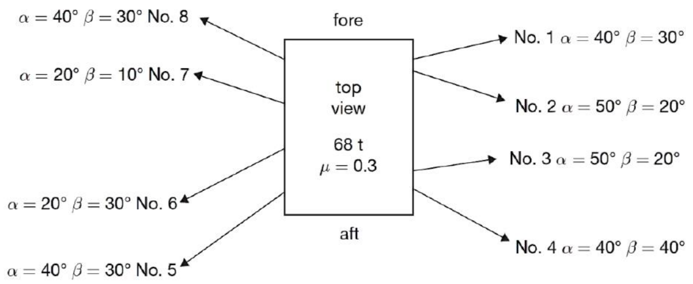

Fig. 7.3-3
The top view shows the overall securing arrangement with eight lashings

Calculation of balance of forces is given in Table 7.3-2.

Table 7.3-2

No.	MSL, kN	CS, kN	α, degrees	β, degrees	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	0,99	66,3 port	0,57	38,2 aft
7	90	67	20, port	10, fwd	1,03	69,0 port	0,27	18,1 fwd
5	108	80	40, port	30, fwd	0,86	68,8 port	0,58	46,4 fwd

Transverse balance of forces (starboard lashings Nos. 1, 2, 3 and 4):
$312 < 0{,}3 \cdot 68 \times 9{,}81 + 68{,}8 + 55{,}6 + 55{,}6 + 62{,}4$;
$312 < 443$. This is OK.

Transverse balance of forces (port lashings Nos. 5, 6, 7 and 8):
$312 < 0{,}3 \cdot 68 \times 9{,}81 + 68{,}8 + 66{,}3 + 69{,}0 + 68{,}8$;
$312 < 473$. This is OK.

Longitudinal balance of forces (FWD arrangement Nos. 1, 3, 7, 8):
$112 < (68 \cdot 9{,}81 - 346) + 46{,}4 + 30{,}2 + 18{,}1 + 46{,}4$;
$112 < 237$. This is OK.

Longitudinal balance of forces (AFT arrangement Nos. 2, 4, 5, 6):
$112 < (68 \cdot 9{,}81 - 346) + 30{,}2 + 55{,}2 + 46{,}4 + 38{,}2$;
$112 < 266$. This is OK.

Transverse tipping.

Unless specific information is provided, the vertical centre of gravity of the cargo unit 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 Fig. 7.3-4, 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 unit.

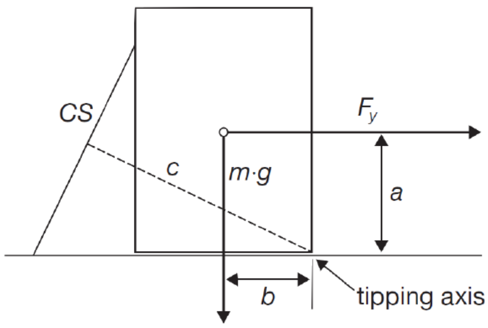

Fig. 7.3-4
Arrangement of cargo unit transverse the ship:
$F_y a \leq b \cdot m \cdot g + 0{,}9 \cdot (CS_1 \cdot c_1 + CS_2 \cdot c_2 + CS_4 \cdot c_4)$;
$312 \cdot 2{,}4/2 < 1{,}8/2 \cdot 68 \cdot 9{,}81 + 0{,}9 \cdot 1{,}8 \cdot (80 + 67 + 67 + 80)$;
$374 < 600 + 476$;
$347 < 1076$. This is OK.

Appendix 1

Explanations and interpretation of "Methods to assess the efficiency of securing arrangements for non-standardized cargo"

1. The exclusion of very heavy units as carried under the provisions of 1.8 of Chapter 1 of the CSS Code from the scope of application of the methods shall be understood to accommodate the possibility of adapting the stowage and securing of such units to specifically determined weather conditions and sea conditions during transport. The exclusion shall not be understood as being a restriction of the methods to units up to a certain mass or dimension.

2. The acceleration figures given in Table 7.1-1, 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 shall appear in combination with less than 60 % of the peak values in longitudinal and vertical directions.

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 unit 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 (*mg*) normal to the deck due to the presence of an angle of heel.

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

4. The friction coefficients shown in the methods are somewhat reduced against appropriate figures in other publications. The reason for this shall be seen in various influences which may appear in practical shipping, as: moisture, grease, oil, dust and other residues, vibration of the ship.

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.

5. The principal way of calculating forces within the securing elements of a complex securing arrangement shall necessarily include the consideration of:

load-elongation behaviour (elasticity);

geometrical arrangement (angles, length);

pre-tension of each individual securing element.

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

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.

6. When employing the advanced calculation method, the way of collecting data shall 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.

It shall be borne in mind that meeting or missing the balance calculation just by a tiny change of one or the other parameters indicates to be near the limit anyway. There is no clear-cut borderline between safety and non-safety. If in doubt, the arrangement shall be improved.

Russian Maritime Register of Shipping

Guidelines for the Preparation of the Cargo Securing Manual

FAI "Russian Maritime Register of Shipping"
8, Dvortsovaya Naberezhnaya,
191186, St. Petersburg,
Russian Federation
www.rs-class.org/en/