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REVISION OF THE CODE OF SAFE PRACTICE FOR SHIPS CARRYING TIMBER DECK CARGOES

Report of the correspondence group

Submitted by Sweden

SUMMARY

Executive summary:	This document contains the report of the Correspondence Group on the Revision of the Code of Safe Practice for Ships Carrying Timber Deck Cargoes
Strategic direction:	5.2
High-level action:	5.2.3
Planned output:	5.2.3.1
Action to be taken:	Paragraph 11
Related documents:	DSC 12/14, DSC 12/WP.1, DSC 13/11 and DSC 13/WP.3

Introduction

1 The Sub-Committee, at its thirteenth session, re-established the Correspondence Group on the Revision of the Code of Safe Practice for Ships Carrying Timber Deck Cargoes, under the coordination of Sweden.

2 Sweden would like to thank Canada, Finland, Japan, the Netherlands, Norway, the Russian Federation, the United Kingdom and the United States as well as ICHCA for their participation in the correspondence group's work.

3 Terms of reference given the correspondence group were as follows:

.1 further review the Code of Safe Practice for Ships Carrying Timber Deck Cargoes, concentrating on chapter 3 of, and Annexes to, the Code, based on documents DSC 13/WP.3 (annex) and DSC 13/11 (annex 2, chapter 3 and annexes);

.2 prepare a draft revised Code for consideration at DSC 14; and

.3 submit a written report to DSC 14.

Review of the existing Code

4 The correspondence group has reviewed the Code of Safe Practice for Ships Carrying Timber Deck Cargoes based on documents DSC 13/WP.3 as well as DSC 13/11, focusing on chapter 3 containing design principles for cargo securing arrangements as well as appendices to the Code containing calculated examples and checklist with practical advice.

5 Extensive work has been carried out by the correspondence group members throughout the year by responding to a number of letters distributed by the coordinator. Interested readers may consult the correspondence group web page (http://www.mariterm.se/TIMRA.html) for information regarding scheduling, contents of correspondence group letters and responses to those letters.

6 In reviewing chapter 3, suggestions for design basis and different cargo securing arrangements presently being put to use have been circulated to, and commented by, the correspondence group. During this process, the correspondence group has expressed diverting views regarding the purpose of the new Code and what type of content it should contain to best suit the intended users. Those points of view can be summarized in the following two statements regarding the general principle for the new Code:

.1 The Code should, apart from general instructions and example procedures with practical advice, present design principles for cargo securing arrangements that could be used by designers while preparing the Cargo Securing Manual, including vessel-specific advice and instructions, and when designing the vessel and its equipment; or

.2 The Code should constitute an effective tool for performing and inspecting stowage and securing of timber deck cargoes and thus contain purely practical advice which can be used and easily understood by the crew and staff ashore directly involved in the loading and discharge operation.

7 Chapter 3 and the checklists in Annex 1 of the draft revised Code have been developed taking both points of view expressed above under consideration.

8 A few example calculations only for cargo securing arrangements have been worked out, circulated and included in Annex 5 of the revised draft Code. It is suggested to complement this section when the general principles for the Code have been further considered.

9 The following checklists to be included in Annex 1 of the Draft Revised Code have been drafted by the correspondence group:

.1 Preparations before loading timber deck cargoes;

.2 Safety during loading and securing of timber deck cargoes;

.3 Securing of timber deck cargoes;

.4 Actions to be taken during the voyage;

.5 Safety during discharge of timber deck cargoes.

Draft revised Code

10 The current version of the draft Code is attached at annex and all comments on the different documents circulated within the correspondence group can be found on the correspondence group web page (http://www.mariterm.se/TIMRA.html).

Action requested of the Sub-Committee

11 The Sub-Committee is invited to consider the information provided in this report and annex and take action as appropriate.

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ANNEX

DRAFT REVISED CODE OF SAFE PRACTICE FOR SHIPS CARRYING TIMBER DECK CARGOES

Preface

The Code of Safe Practice for Ships Carrying Timber Deck Cargoes was first circulated by the Organization in 1972 and subsequently amended in 1978.

The Code was revised by IMO resolution A.715(17) – Code of Safe Practice for Ships Carrying Timber Deck Cargoes, 1991 – that was adopted on 6 November 1991.

In spite of all efforts made to reduce the number of accidents directly or indirectly caused by timber deck cargoes a number of lives and ships are still lost and an increasing number of accidents where ships have run into jettisoned timber is reported every year.

This Code is based on the previous Code, which has been revised and amended in order to reflect the capability of today's ships and the equipment available on board and also taking expected future innovations in mind.

The Code is designed to assist:

.1 shipowners, operating companies and ship's staff;

.2 port industries, shippers and pre-packaging organizations, which are involved in preparation, loading, and stowing of timber deck cargoes; and

.3 Administrations, manufacturers and designers of the ship and equipment associated with the carriage of timber deck cargoes and those developing cargo securing manuals,

in the carriage of timber deck cargoes.

This Code is directed primarily at providing recommendations for the safe carriage of timber deck cargoes.

Status of references

The references given in this consolidated text do not form part of the Code but are inserted for ease of reference.

Chapter 1 – General

1.1 Purpose

1.1.1 The purpose of the Code is to ensure that timber deck cargoes are so loaded, stowed and secured as to prevent as far as practicable, throughout the voyage, damage or hazard to the ship and persons on board as well as loss of cargo overboard[1].

1.1.2 The Code provides:

.1 practices for safe transportation;

.2 methodologies for safe stowage and securing;

.3 design principles for securing systems;

.4 procedures and instructions to be included in ships' cargo securing manuals on safe stowage and securing; and

.5 sample checklists for safe stowage and securing.

1.2 Application

1.2.1 The requirements of this Code apply to all ships of 24 metres or more in length, carrying a timber deck cargo.

1.3 Definitions

(The definitions below are to be complemented as the Code is further elaborated.)

1.3.1 The following *definitions* apply to this Code:

General expressions

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

.2 *Company* means the Owner of the ship or any other organization or person such as the Manager, or the Bareboat Charterer, who has assumed the responsibility for operation of the ship from the Shipowner and who, on assuming such responsibility, has agreed to take over all duties and responsibilities imposed by SOLAS[2].

.3 *Organization* means the International Maritime Organization (IMO).

.4 *Port industries* means the port facilities and/or stevedoring companies serving ships engaged in the stowage of timber deck cargoes.

.5 *Shipper* means any person, organization or Government which prepares a consignment for transport[3].

.6 *SOLAS* means the International Convention for the Safety of Life at Sea, 1974, as amended.

Cargo-related expressions

.7 *Cant* means a log which is "slab-cut", i.e. ripped lengthwise so that the resulting thick pieces have two opposing, parallel flat sides and in some cases a third side which is sawn flat.

.8 *Non-rigid cargo* means sawn wood or lumber, cants, logs, poles, pulpwood and all other types of loose timber or timber in packaged forms not fulfilling specified strength requirement, as defined in chapter 3.3.

.9 *Rigid cargo package* means sawn wood or lumber, cants, logs, poles, pulpwood and all other types of timber in packaged forms, fulfilling specified strength requirement, as defined in chapter 3.3.

.10 *Round wood* means parts of trees that have not been sawn on more than one long side. The term includes, among others, logs, poles and pulpwood in loose or packed form.

.11 *Sawn wood* means parts of trees that have been sawn so that they have at least two parallel flat long sides. The term includes, among others, lumber and cants in loose or packed form.

.12 *Timber* is used as a collective expression used for all types of wooden material covered by this Code, including both round and sawn wood but excluding wood pulp and similar cargo.

Technically related expressions

.13 *Timber deck cargo* means a cargo of timber carried on an uncovered part of a freeboard or superstructure deck.

.14 *Lashing plan* means a sketch or drawing showing the required number and strength of securing items for the timber deck cargo to obtain safe stowage and securing of timber deck cargoes.

.15 *Timber load line* means a special load line assigned to ships complying with certain conditions set out in the International Convention on Load Lines and used when the cargo complies with the stowage and securing conditions of this Code.

.16 *Weather deck* means the uppermost complete deck exposed to weather and sea.

.17 *Stowage Factor (SF)* means the volume occupied by one tonne of a cargo when stowed and separated in the accepted manner.

Chapter 2 – General Recommendations on Stowage and Securing of Timber Deck Cargoes

2.1 Goals

2.1.1 The stowage and cargo securing arrangements for timber deck cargoes should enable a safe yet rational securing of the cargo so that it is satisfactorily prevented from collapsing, sliding and tipping in all directions, taking into account the accelerations the cargo may be subjected to throughout the voyage.

2.1.2 This chapter lists measures and factors that should be taken under consideration in order to achieve such level of cargo securing.

2.1.3 The Company should establish procedures for the preparation of plans and instructions, including checklists as appropriate, for key shipboard operations[5]. Sample checklists for shipboard operations can be found in Annex 1 to this Code.

2.2 Pre-loading operation

2.2.1 Prior to loading the vessel, all relevant cargo information as defined in chapter 3.3 of this Code should be provided by the shipper.

2.2.2 The master of the vessel should study all relevant cargo information and take the precautions which are necessary for the proper stowage and safe carriage of the cargo as defined in the vessel's Cargo Securing Manual and in chapter 3.3 of this Code.

2.2.3 Prior to loading, the stevedoring company should be made aware of the ship specific requirements regarding stowage and securing of timber deck cargoes.

2.2.4 During loading operations the master should ensure that all tanks are maintained in such a condition that free surface effects are minimized. Ballast tanks should be, preferably, full or empty and ballast movement during loading operations should be avoided.

2.2.5 Before timber deck cargo is loaded on any area of the weather deck:[T2]

.1 hatch covers and other openings to spaces below that area should be secured closed and battened down;

.2 air pipes and ventilators should be efficiently protected and check-valves or similar devices should be examined to ascertain their effectiveness against the entry of water;

.3 objects which might obstruct cargo stowage on deck should be removed and safely secured in places appropriate for storage;

.4 accumulations of ice and snow on such area should be removed;

.5 it is normally preferable to have all deck lashings, uprights, etc., in position before loading on that specific area. This will be necessary should a preloading examination of securing equipment be required in the loading port; and

.6 all sounding pipes on the deck should be reviewed and arrangements made that access to these remains, and these not be overstowed.

2.2.6 Further items to consider during pre-loading operations are given in checklist A.1 in Annex 1.

2.3 Permitted Loading Weights on decks and hatch covers

2.3.1 During loading of timber deck cargoes, care should be taken not to exceed the designed maximum permissible load on weather deck and hatches[6]. Potential weight increase of timber deck cargoes due to water absorption, icing, etc., should be taken under consideration.

2.3.2 The hatch cover securing and support arrangements, stoppers, etc., as well as coamings should be so designed and reinforced that they are able to take account of increased loading from timber deck cargoes.

2.4 Stability

2.4.1 The master should ensure that the ship complies with the ship's stability booklet at all times.

2.4.2 A ship carrying timber deck cargo must comply with the Intact Stability Code, particularly the timber deck cargo requirements

2.4.3 Ballast water exchange operations should be carried out in accordance with instructions in the Ballast Water Management Plan, if available[12]. The ballast water exchange operation, if required, should be considered when planning the amount of cargo to be loaded onto deck.

2.5 Load line

2.5.1 Ships assigned and making use of their timber load line should follow relevant regulations of the applicable Load Line Convention[13] for stowage and securing of timber.

2.6 Timber freeboard

2.6.1 The timber freeboard, if applicable will be found in the vessel's Load Line Certificate.

2.6.2 Instructions on computation of the timber freeboard are given in the applicable Load Line Convention[14].

2.7 Visibility

2.7.1 Timber deck cargo should be loaded in such a manner as to ensure that the ship complies with the visibility requirements contained in SOLAS chapter V. National deviations may exist and should be taken into consideration as required dependent on the intended voyage.

2.7.2 The SOLAS requirements on visibility as well as instructions on how to calculate the visibility range are given in Annex 2.

2.8 Work Safety and Work Environment Aspects

2.8.1 The Company should establish procedures by which the ship's personnel receive relevant information on the Safety Management System[16] in a working language or languages understood by them.

2.8.2 When deck cargo is being lashed and secured, special measures may be needed to ensure safe access to the top of, and across, the cargo so that the risk of falling is minimized. Safety helmets, proper footwear and non-obstructive high visibility garments should be worn during work on deck.

2.8.3 Loading and discharge operation of timber deck cargoes should not be performed in weather conditions which could threaten safety of the personnel.

2.8.4 The risk of slipping should especially be considered during winter time when loading timber packages covered by plastic wrapping or tarpaulins. Plastic wrapping on packages with lumber of uneven length should be clearly marked.

2.8.5 Lighting during loading and discharge operations should be reasonably constant and arranged to minimize glare and dazzle, the formation of deep shadows and sharp contrasts in the level of illumination between one area and another.

2.8.6 Any obstruction such as lashings or securing points in the access way of escape routes and spaces essential to operation of the vessel, such as machinery spaces and crew's quarters, as well as obstructions to safety equipment, fire-fighting equipment and sounding pipes, should be clearly marked. In no case should an obstruction prevent safe access or egress of escape arrangements and spaces referred to above.

2.8.7 Protection for the crew in the form of a sturdy catwalk with strong railings should be provided above the deck cargo if there is no convenient passage on or below the deck of the ship.[18]

2.8.8 When lashings need to be retightened during voyage, the Master should take appropriate actions to reduce motions of the vessel during such operation.

2.8.9 Additional guidance regarding work safety and work environment aspects can be found in the relevant International Labour Organization (ILO) Conventions.

2.9 Stowage

2.9.1 The basic principle for the safe carriage of timber deck cargo is to make the stow as solid, compact and stable as practicable. The purpose of this is to:

.1 prevent movement in the stow which could cause the lashings to slacken;

.2 produce a binding effect within the stow; and

.3 reduce to a minimum the permeability of the stow.

2.9.2 Openings in the deck exposed to weather over which cargo is stowed should be securely closed and battened down. The ventilators and air pipes should be efficiently protected[19].

2.9.3 Deck cargo should be stowed so that access is provided to and from escape routes and spaces essential to operation of the vessel, such as machinery spaces and crew's quarters, as well as to safety equipment, fire-fighting equipment and sounding pipes[18]. It should not interfere in any way with the navigation and necessary work of the ship[19].

2.9.4 Voids between packages of sawn wood in lower layers are acceptable only in tiers stowed between blocking devices and after careful consideration of the design principles in chapter 3 of this Code including the physical properties of the cargo as found in chapter 3.3 and Annex 3. Examples on how to evaluate the efficiency for securing arrangements for cargoes stowed in such manners can be found in Annex 5 of this Code.

2.9.5 For all other cargo types than packages of sawn wood, voids should be avoided in all layers unless the cargo is satisfactorily prevented from falling into the void.

2.9.6 Timber deck cargo which overhangs the outer side of hatch combings or other structures, should be supported at the outer end by other cargo stowed on deck or railing or equivalent structure of sufficient strength to support it.

2.9.7 For ships assigned and making use of a timber load line, additional practices apply in accordance with the applicable Load Line Convention.[19]

2.10 Securing

2.10.1 The following principal methods may be used to secure timber deck cargoes:

.1 blocking over the full height of the cargo by, e.g., uprights;

.2 bottom blocking of the base layer in combination with lashing arrangements;

.3 different types of lashing arrangements;

.4 frictional securing, taking into account appropriate weather and voyage criteria; and

.5 combinations of the above methods.

2.10.2 Securing arrangements used should be designed in accordance with chapter 3 and documented in accordance with section 2.13 of this Code.

Lashings

2.10.3 Different lashing arrangements are described in chapter 3.5 of this Code.

2.10.4 The following three types of lashing equipment with different strength and elongation characteristics are most frequently used for securing timber deck cargoes:

.1 chain lashings;

.2 wire lashings; and

.3 fabricated web lashings.

		
Chain lashing	*Wire lashing*	*Fabricated web lashing*

Open hooks, which may loosen if the lashing becomes slack, should not be used in securing arrangements for timber deck cargoes.

2.10.5 The appropriate safety factors for the different types of equipment are described in chapter 3.4 of this Code.

2.10.6 All lashing equipment should be visually examined according to the instruction in the cargo securing manual before use and only equipment fit for purpose should be used for securing of timber deck cargoes.

2.10.7 The necessary pre-tension in the lashings used should be maintained throughout the voyage. It is of paramount importance that all lashings be carefully examined and tightened at the beginning of the voyage as the vibration and working of the ship will cause the cargo to settle and compact. They should be further examined at regular intervals during the voyage and tightened as necessary.

2.10.8 Entries of all examinations and adjustments to lashings should be made in the ship's log-book.

2.10.9 Slip hooks or other appropriate methods may be used for quick and safe adjustment of lashings.

2.10.10 Corner protectors should be used to prevent lashings from cutting into the cargo and to protect lashings from sharp corners. The latter especially applies to fabricated web lashings.

Uprights

2.10.11 Uprights should be fitted when required by the nature, height or character of the timber deck cargo. They should be designed in accordance with the design criteria in chapter 3.5 of this Code with safety factors according to chapter 3.4 of this Code taken into account.

2.10.12 Uprights may be supported by hog lashings, running between each pair of uprights on each side of the vessel. The strength, tension and elongation characteristics of the hog lashings should be taken into account when designing cargo securing systems.

2.10.13 If used for blocking, the spacing of the uprights should be such that each tier is supported by at least two uprights.

2.10.14 The uprights should be well fastened to the deck or hatch coamings of the vessel and protected from falling inwards during loading and discharging operations.

2.11 Post-loading operation

2.11.1 The Company should establish procedures for the preparation of plans and instructions, including checklists as appropriate, for key shipboard operations.[5]

2.12 Voyage planning

2.12.1 Prior to proceeding to sea, the master should ensure that the intended voyage has been planned using the appropriate nautical charts and nautical publications for the area concerned, taking into account the guidelines and recommendations developed by the Organization[23].

2.12.2 In order to reduce excessive accelerations, the master should plan the voyage so as to avoid potential severe weather and sea conditions. To this effect, weather reports, weather facsimiles and where available weather routeing agencies should be consulted and the latest available weather information should always be used.[24]

2.12.3 If deviation from the intended voyage plan is considered during the voyage, the same procedure as described in 2.12.1 and 2.12.2 should be followed.

2.12.4 In cases where severe weather and sea conditions are unavoidable, the Master should be conscious of the need to reduce speed and/or alter course at an early stage in order to minimize the forces imposed on the cargo, structure and lashings. The lashings are not designed to provide a means of securing against imprudent ship handling in severe weather and sea conditions. There can be no substitute for good seamanship. The following precautions should be observed:

.1 in the case of marked roll resonance with amplitudes above ±30°, the cargo securing arrangements could be overstressed. Effective measures should be taken to avoid this condition;

.2 in the case of heading into the seas at high speed with marked slamming shocks, excessive longitudinal and vertical acceleration may occur. An appropriate reduction of speed should be considered; and

.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 should be expected with great transverse accelerations as a result. An appropriate change of heading should be considered.

Foreseeable risks

2.12.5 During voyage planning, all foreseeable risks, which could lead to either excessive accelerations causing cargo to shift or conditions leading to water absorption and ice aggregation, should be considered. The following list comprises the most significant situations that should be taken under consideration to that effect:

.1 extreme weather conditions predicted by weather forecasts;

.2 severe wave conditions that have been known to appear in certain navigational areas;

.3 unfavourable directions of encountered waves[25]; and

.4 swell caused by recent weather phenomena in the vicinity of the area of the intended voyage.

2.13 Cargo Securing Manual

2.13.1 Timber deck cargoes should be loaded, stowed and secured, throughout the voyage, in accordance with the Cargo Securing Manual as required by SOLAS chapter VI.

2.13.2 All cargo securing arrangements used for timber deck cargoes should be documented in the vessels Cargo Securing Manual in accordance with section 3.6 of this Code. The Cargo Securing Manual should be drawn up to a standard at least equivalent to the guidelines developed by the Organization[26], [27] and approved by the Administration.[26]

Chapter 3 – Design Principles

3.1 General Requirements

3.1.1 The construction of deck, bulwarks, uprights, hatches and comings should be of a design that allows a load of timber deck cargo to be carried.

3.1.2 The securing systems for timber deck cargoes should be designed according to the same principles as other types of cargoes. The goal is to prevent cargo shifting as far as practicable and the securing system should be designed according to the principles in this chapter.

3.1.3 Loose sawn or round timber should as a general rule be longitudinally stowed and supported on the sides by uprights to the full height of the stow.

3.1.4 Packaged timber deck cargoes may be secured without uprights if the racking strength of the packages is sufficient and sliding is prevented by blocking or lashing.

3.1.5 If the friction is sufficient and the expected transverse accelerations are limited, unpackaged timber cargo may be transversely stowed.

3.2 Accelerations and forces acting on the cargo

3.2.1 The cargo securing arrangement should in transverse direction be designed for accelerations as well as forces by wind and sea according to the Code of Safe Practice for Cargo Stowage and Securing (CSS), Annex 13.

3.2.2 Special securing of timber deck cargoes in longitudinal direction may be dispensed only if great care is taken to avoid excessive accelerations in heavy head seas.

3.2.3 According to the CSS Code and MSC/Circ.745, among others, the following parameters may be taken into account at the design stage of cargo securing systems:

.1 Duration of the voyage,

.2 Geographical area of the voyage,

.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,

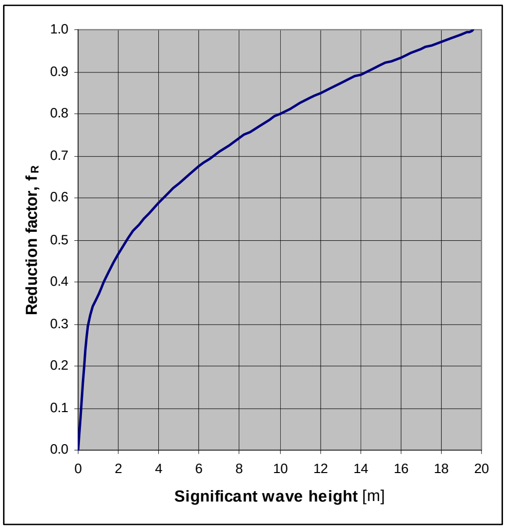
.7 Intended stowage pattern of the cargo units, and

.8 Mass and dimensions of the cargo units.

3.2.4 To take account for the factors mention in paragraph 3 above, the acceleration data calculated according to Annex 13 of the CSS Code may be multiplied by a reduction factor ranging from 0 to 1, depending on expected maximum significant wave height during the intended voyage. The reduction factor is obtained by the following formula:

$$f_R = \sqrt[3]{\frac{H_{1/3}}{19.6}}$$

Where the variable $H_{1/3}$ means the maximum expected significant wave height in metres. (The value 19.6 is the assumed twenty year wave that will occur in the Northern Atlantic Ocean.)



Plot of the reduction factor as a function of the expected significant wave height.

3.2.5 Reduced acceleration may be used for the design of securing arrangements for timber deck cargoes in any of the following ways:

.1 Required securing arrangements are designed for different wave heights and the securing arrangement is selected according to the maximum expected wave height for each voyage.

.2 The maximum wave height that a particular securing arrangement can withstand is calculated and the vessel is limited to operate in wave heights up to the maximum calculated. Examples on such arrangements are unsecured transversely stowed timber deck cargoes in restricted sea areas.

.3 The required securing arrangement is calculated for the maximum expected twenty year wave in a particular restricted area and the cargo is always secured according to the designed arrangement when operating in that area. The significant twenty year wave in some sea areas can be found in the table below.

Sea area	**Significant wave height, H_s** [m]	**Reduction factor, f_R**
Unrestricted navigation	19.6	1.00
The Norwegian Sea (summer)	14.9 8.8	0.91 0.77
The Mid North Sea	11.9	0.85
The Skagerak	9.6	0.79
The Kattegat	8.7	0.76
The Baltic Sea	8.5	0.76

Significant twenty year wave heights with probability level 10^{-8} and corresponding reduction factor for some sea areas.

3.2.6 If one of the two first mentioned methods in paragraph 5 are used for decision on securing arrangements, it is important that procedures for forecasting the maximum expected wave height on intended voyages is developed and followed and documented in the ISM system.

3.3 Physical Properties of Timber Deck Cargoes

3.3.1 Prior to loading of timber deck cargoes, all relevant cargo information, as described in this section and in Annex 3, should be submitted to and confirmed by the master of the vessel.

Friction

3.3.2 Friction is one of the most important factors preventing cargo from shifting. Deck cargo may shift due to a lack of internal friction. Snow, ice, frost, rain, and other slippery surface conditions drastically affect friction. Special consideration should be given to package materials, contact surfaces, and weather conditions.

3.3.3 Static friction may be used for tight block stowage arrangements as well as for the design of frictional lashing systems such as top-over lashing systems.

3.3.4 Dynamic friction should be used for non rigid lashing systems [, e.g., loop lashings], which due to elasticity of securing equipment allow for minor dislocation of the cargo before full capacity of the securing arrangement is reached.

3.3.5 Test procedures for determining coefficients of friction as well as generic friction values for material contacts common for timber deck cargoes are given in annex 3.

Rigidity of Timber Packages

3.3.6 The rigidity of timber packages is of great importance for the stability of the deck cargo and the racking strength of the timber packages should be taken into consideration when securing systems are designed.

3.3.7 The definition of the Rigidity of timber packages for the purpose of this code as well as methods for determining it are presented in Annex 3.

3.4 Safety Factors

3.4.1 Safety factors are to be used when:

.1 calculating the Maximum Securing Load (MSL) of the lashings from the Minimum Breaking Load (MBL);

.2 calculating the maximum allowed Calculated Strength (CS) in the lashings as function of MSL.

3.4.2 MSL as function of the MBL should be taken according to annex 13 of the CSS Code.

3.4.3 The maximum allowed Calculated Strength (CS) in lashings and uprights used in the calculations should be taken from the following formula:

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

3.5 Design criteria for different securing arrangements

3.5.1 Securing arrangements for timber deck cargoes should be based on accelerations, physical properties and safety factors as described in sections 3.2-3.4 above.

3.5.2 Design criteria for some different securing arrangements are given below. Other securing arrangements may also be used as long as the system is designed according to the principles given in this Code.

3.5.3 In Annex 5, detailed descriptions and example design calculations are given for some stowage and securing arrangements.

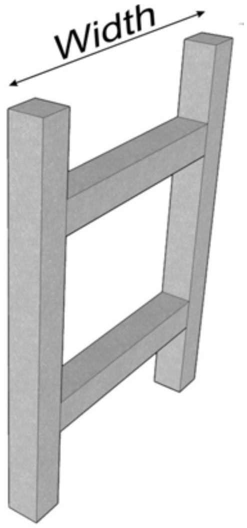
3.5.4 The denotations used in the formulas in this chapter are listed in annex 4 to this Code.

Filling of Voids in the Stow

3.5.5 When cargo is loaded voids (wells) may occur in the stow between packages as well as between bulwarks or gantry crane rails etc and other fixed constructions such as the hatch coming.

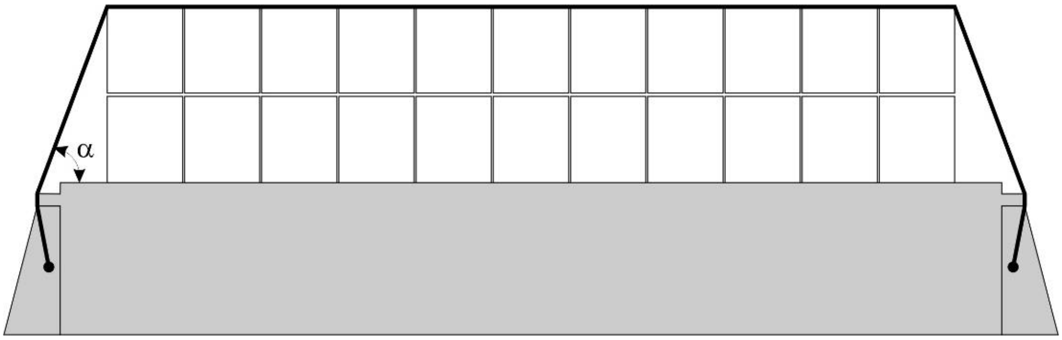
3.5.6 Care should be taken to avoid the creation of voids or open spaces when loading cargo. Voids, where created, should be filled with loose timber or blocked by vertical H-frames with required strength to avoid cargo from shifting. The MSL for double H-frames of different widths and dimensions are given in the table below. The values apply to sound wood.

Dimensions of battens	**MSL in kN of double H-frames with different widths**					
t x b mm	*0.5 m*	*1.0 m*	*1.5 m*	*2.0 m*	*2.5 m*	*3.0 m*
50 x 50	75	53	30	17		
50 x 75	113	79	46	26	17	
50 x 100	151	106	61	34	22	
50 x 150	226	159	91	51	33	23
75 x 75	186	153	119	85	56	39
75 x 100	248	203	159	114	74	51
75 x 150		305	238	171	111	77
75 x 200			317	227	148	103
100 x 100		301	256	212	167	122
125 x 125					334	274



Top-Over Lashed Longitudinally Stowed Timber Packages

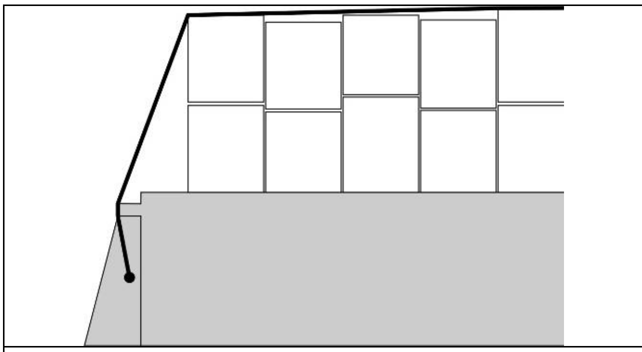
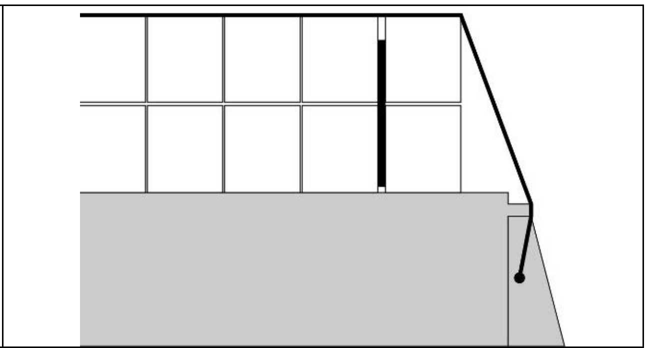
3.5.7 Top-over lashing alone is a frictional lashing method and the effect of the lashing is to apply vertical pressure increasing the friction force between the outer stows of deck cargo and the ship's deck/hatch cover.



3.5.8 For pure top-over lashing arrangements the friction alone will have to counteract the transverse forces so that the following equilibrium of forces is satisfied:

$$\left(m \cdot g_0 + 2 \cdot n \cdot PT_V \cdot \sin\alpha\right) \cdot \mu_{static} \geq m \cdot a_t + PW + PS$$

3.5.9 Sliding between the layers should be prevented by stowing timber packages of different heights in the same layer or by inserting vertical, sturdy battens between the rows.

	
Sliding of upper layer prevented by different height of packages in the bottom layer.	*Sliding of upper layer prevented by sturdy vertical battens.*

3.5.10 If sliding between layers is not prevented, sliding between each individual layer should be considered by the following equilibrium of forces:

$$(m_a \cdot g_0 + 2 \cdot n \cdot PT_V \cdot sin\alpha) \cdot \mu_{static\ a} \geq m_a \cdot a_t + PW_a + PS_a$$

where units denoted with **a** *considers cargo units above the sliding layer only*

3.5.11 To prevent the packages in the bottom layer from collapsing due to racking, the weight of the cargo stowed on top of the bottom layer should be limited so that the following equilibrium of forces is satisfied:

$$n_p \cdot RS \geq m_a \cdot a_t + PW_a + PS_a$$

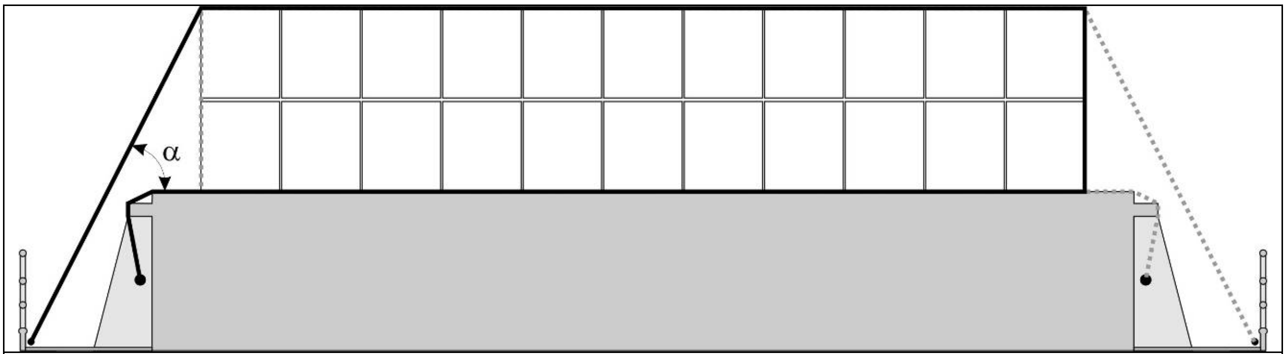
where units denoted with **a** *considers cargo units above the bottom layer only*

3.5.12 It is extremely important to keep the lashings tight when a top-over lashing arrangement is used as the arrangement is based on the vertical pressure from the lashings. After initial stressing, the lashings should show an elongation of not more than 5% at 80% of their breaking strength.

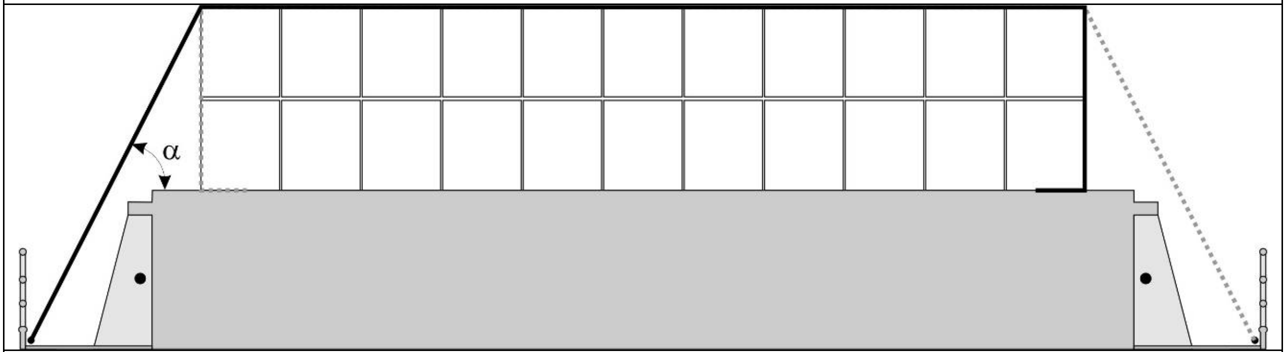
3.5.13 Top-over lashings alone are rarely a sufficient securing method unless the friction is very good or the expected transverse acceleration is very low.

Loop Lashed Longitudinally Stowed Timber Packages

3.5.14 Loop lashings are always applied in pairs as shown in the figure below. The lashings are drawn from one side of the cargo, under the cargo to the other side, up over the cargo and back to the same side. Alternatively, the lower part of the lashing may be fastened to a securing point on top of the hatch cover underneath the cargo.



Loop lashing, alternative 1



Loop lashing, alternative 2. The shorter length of the lashing compared to alternative 1 reduces the movement of the cargo due to elongation of the lashing.

3.5.15 The number and strength of the lashings are to be chosen so that the following equilibrium is satisfied:

$$(m \cdot g_0 + n \cdot CS \cdot \sin\alpha) \cdot \mu_{dynamic} + n \cdot CS + n \cdot CS \cdot \cos\alpha \geq m \cdot a_t + PW + PS$$

3.5.16 Sliding between the layers should be prevented by stowing timber packages of different heights in the same layer or by inserting vertical sturdy battens between the layers, see section 3.6.9.

3.5.17 To prevent the packages in the bottom layer from racking, the weight of the cargo stowed on top of the bottom layer should be limited so that the following equilibrium is satisfied:

$$n_p \cdot RS + n \cdot CS \cdot \cos\alpha \geq m_a \cdot a_t + PW_a + PS_a$$

where units denoted with **a** *considers cargo units above the bottom layer only*

3.5.18 The transverse movement of the deck cargo due to elongation of the lashings is calculated according to the following formula:

$$\delta = L_L \cdot \frac{(CS - PT_V)}{MSL} \cdot \varepsilon$$

Bottom Blocked and Top-Over Lashed Longitudinally Stowed Timber Packages

3.5.19 Blocking means that the cargo is stowed against a blocking structure or fixture on the vessel. If the cargo consists of packages with large racking capacity, bottom blocking should be sufficient in combination with top-over lashings.

Example of uprights for bottom blocking.

3.5.20 The required strength, MSL, of the bottom blocking devices is calculated by satisfying the following equilibrium:

$$\left(m \cdot g_0 + 2 \cdot n \cdot PT_V \cdot \sin\alpha\right) \cdot \mu_{static} + n_b \cdot \frac{MSL}{1.35} \geq m \cdot a_t + PW + PS$$

3.5.21 The spacing in longitudinal direction of the top-over lashings should be maximum 3 m for stowage heights of 4 m and below, and maximum 1.5 m for stowage heights above 4 m.

3.5.22 The Pretension PT_V in the vertical part of the lashings should be not less than 16 kN. In case the tensioning device is placed on top of the cargo, the pretension PT_H in the horizontal part of the lashing should not be less than 27 kN.

3.5.23 All lashings and components used for securing in combination with bottom blocking should:

.1 possess a breaking strength MBL of not less than 133 kN;

.2 after initial stressing, show an elongation of not more than 5% at 80% of their breaking strength; and

.3 show no permanent deformation after having been subjected to a proof load of not less than 40% of their original breaking strength.

3.5.24 The bottom blocking devices are to be placed on both sides of the deck cargo equally spaced. At least one, preferably two blocking device per side should be used per cargo section.

3.5.25 Sliding between the layers should be prevented by stowing timber packages of different heights in the same layer or by inserting vertical sturdy battens between the layers, see section 3.5.9 of this Code. If no such measures are taken, sliding between layers should be checked by the equilibrium in section 3.5.10 of this Code.

3.5.26 To prevent the packages in the bottom layer from racking, the weight of the cargo stowed on top of the bottom layer should be limited so that the following equilibrium is satisfied:

$$n_p \cdot RS \geq m_a \cdot a_t + PW_a + PS_a$$

where units denoted with **a** *considers cargo units above the bottom layer only*

Stanchion Blocked and Top-Over Lashed Longitudinally Stowed Timber Packages and Round Wood

3.5.27 Longitudinally stowed timber packages, loose sawn timber or round wood may be secured by stanchions in combination depending on trading pattern with or without top-over lashings.

3.5.28 The stanchions should be designed in accordance with sections 3.5.36 through 3.5.41.

3.5.29 The stanchions should be placed on both sides of the cargo, equally spaced. Each stow should be supported by at least two stanchions per side.

3.5.30 The spacing in longitudinal direction of the top-over lashings should be maximum 3 m for stowage heights of 4 m and below, and maximum 1.5 m for stowage heights above 4 m.

3.5.31 The pretension PT_V in the vertical part of the lashings should be not less than 16 kN. In case the tensioning device is placed on top of the cargo, the pretension PT_H in the horizontal part of the lashing should not be less than 27 kN.

3.5.32 All lashings and components used for securing in combination with bottom blocking should:

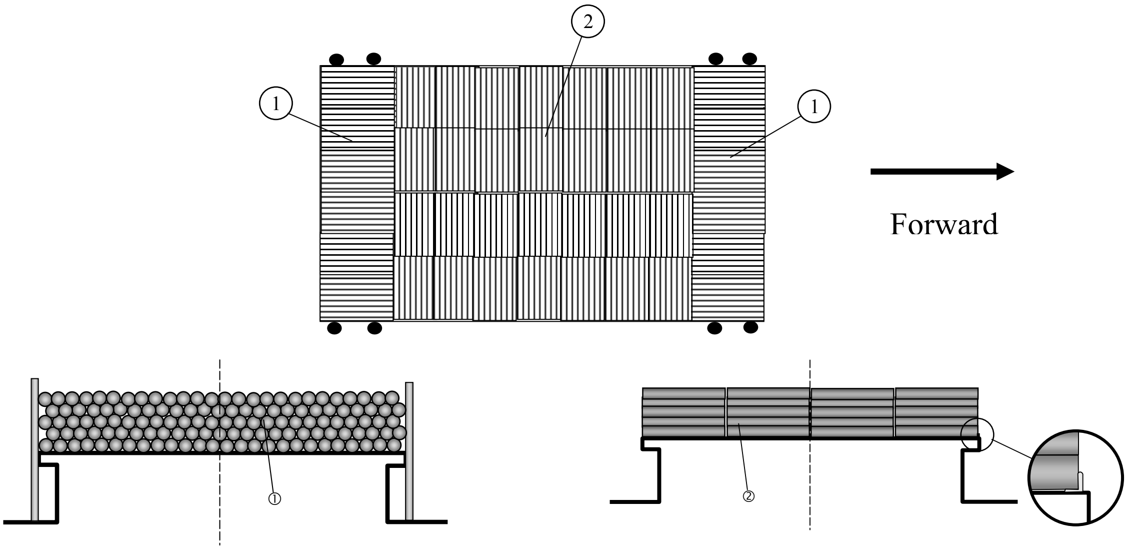
.1 possess a breaking strength MBL of not less than 133 kN;

.2 after initial stressing, show an elongation of not more than 5% at 80% of their breaking strength; and

.3 show no permanent deformation after having been subjected to a proof load of not less than 40% of their original breaking strength.

Frictional Securing

3.5.33 In restricted sea areas timber deck cargoes may be transversely stowed and secured by bottom blocking and friction between layers only. This may be done only if the friction is sufficient and the expected transverse accelerations are limited.



In the figure above the sections marked 1 are longitudinally stowed timber cargo secured by uprights and sections marked 2 are transversely stowed timber cargo secured by bottom blocking and friction only.

3.5.34 The required strength, MSL, of the bottom blocking devices is calculated by satisfying the following equilibrium:

$$m \cdot g_0 \cdot \mu_{static} + n_p \cdot \frac{MSL}{1.35} \geq m \cdot a_t + PW + PS$$

3.5.35 The required friction between the layers can be calculated by satisfying the following equilibrium:

$$m \cdot g_0 \cdot \mu_{static} \geq m \cdot a_t + PW + PS$$

Uprights With or Without Complementary Lashings

3.5.36 Longitudinally stowed loose sawn timber, round timber and timber packages with limited racking strength should be supported by uprights reaching up to the top of the stow.

3.5.37 Uprights should be designed for the forces they have to take up according to the formulas in this section. Especially the design of high uprights should be such that the deflection is limited. Uprights may be complemented by different lashing arrangements.

Uprights for blocking over the entire height of the stow.

3.5.38 For vessels carrying loose sawn timber and round timber, the design bending moment per upright is calculated as the greater of the two moments given by the following formulas:

[$$CM_{bending\,1} = 0.12 \cdot \frac{H^2}{B \cdot N} \cdot m \cdot g_0$$

$$CM_{bending\,2} = \frac{0.45 \cdot H}{k \cdot N} \cdot \left(m \cdot \left(a_t - \mu \cdot g_0\right) + 2 \cdot H \cdot L\right)$$

$$M_{bending} \geq 1.35 \cdot max\left(CM_{bending\,1},\ CM_{bending\,2}\right)$$]

3.5.39 The design bending moment per upright supporting timber packages is to be taken as the greatest of the three moments given by the following formulas:

[$$CM_{bending\,1} = \frac{m}{n_p \cdot k \cdot N} \cdot \left(a_t \cdot \frac{H}{2} - g_0 \cdot \frac{b}{2}\right) \cdot \frac{1 - \left(1 - f_i\right)^n}{f_i}$$ *(Moment required to prevent tipping)*

where $$f_i = \mu_{internal} \cdot \frac{2b}{H}$$ *(f_i = Factor for considering internal moment)*

$$CM_{bending\,2} = \frac{H}{2 \cdot k \cdot N} \cdot m \cdot \left(a_t - \mu_{internal} \cdot g_0\right)$$ *(Moment required to prevent sliding)*

$$CM_{bending\,3} = \frac{1}{k \cdot N} \cdot \left(m \cdot a_t - \left(n_p - 4\right)\left(q - 2\right) \cdot RS\right) \cdot \frac{\left(q - 1\right)}{2q} \cdot H$$ *(Moment required to prevent racking)*

$$M_{bending} \geq 1.35 \cdot max\left(CM_{bending\,1},\ CM_{bending\,2},\ CM_{bending\,3}\right)$$]

3.5.40 If hog lashings are used, the required MSL of each hog lashing is calculated by the following formula:

[$$MSL \geq \frac{M_{bending}}{2 \cdot h}$$]

3.5.41 The design bending moment should not produce greater stress than 50% of the ultimate stress for the material in any part of the uprights.

3.6 Documentation

3.6.1 Each cargo securing arrangement for timber deck cargoes should be documented in the ships Cargo Securing Manual in accordance with the instructions in MSC/Circ.745.

3.6.2 In the Cargo Securing Manual each stowage and securing arrangements should additionally be documented by a Lashing Plan showing at least the following:

.1 Maximum cargo weight for which the arrangement is designed,

.2 Maximum stowage height,

.3 Required number and strength of blocking devices and lashings as applicable,

.4 Required pretension in lashings,

.5 Other cargo properties of importance for the securing arrangement such as friction, rigidity of timber packages, etc.,

.6 Illustrations of all securing items that might be used,

.7 Any restriction regarding maximum accelerations, weather criteria, for non-winter conditions only, etc.

ANNEX 1 – **Sample Checklists**

1 Preparations before Loading of Timber Deck Cargoes

Items	**Checked by:**	
	Responsible officer	***Master***
General preparations		
The following cargo information as applicable is collected: • Total weight of cargo booked as deck cargo • Typical dimensions of the cargo • Density of the cargo • Stowage factor of the cargo • Racking strength for packaged cargo • Type of cover of packages • Relevant coefficients of friction.		
Confirmation on when the deck cargo will be ready for loading is received.		
A pre-loading plan according to the vessel's Trim and Stability Book is done and the following is calculated and checked: • Stowage height • Weight per m^2 • Required amount of water ballast • Displacement, draft, trim and stability at departure and arrival. The stability is within required limits during the entire voyage and to avoid too violent motions of the vessel the metacentric height should preferably not exceeded 3% of the breadth of the vessel during the voyage.		
During stability calculations, variation in displacement, centre of gravity and free surface moments due to the following factors are considered: • Absorption of water in dried or seasoned timber carried as timber deck cargo • Ice accretion, if applicable • Loss of weight due to drying • Variations in consumables • Ballast water exchange operations.		

Items	**Checked by:**	
	Responsible officer	***Master***
Proper instructions for ballast water exchange operations, if applicable for the intended voyage, are available in the Ballast Water Management Plan.		
A pre-lashing plan according to the vessel's Cargo Securing Manual (CSM) is done and the following calculated: • Number of sections per hatch • Required number of lashing equipment • Required number of uprights, if applicable.		
The certificates for the lashing equipment are available in the vessel's Cargo Securing Manual.		
When stability calculations and lashing plan have been satisfactorily carried out, the maximum cargo intake is confirmed.		
Pre-load loading and pre-lashing plans are distributed to all involved parties (i.e. supercargo, stevedores, agent, etc.).		
Weather report for loading period and forecasted weather for the sea voyage is checked.		
It is confirmed that the stevedoring company is aware of the ship's specific requirements regarding stowage and securing of timber deck cargoes.		
Vessel readiness		
All ballast tanks required for the voyage and included in the stability calculations are filled before commencing loading on deck and it is ensured that tanks are completely full or empty to minimize the amount of free surfaces.		
Hatch covers and other openings to spaces below deck are closed, secured and battened down.		
Air pipes, ventilators and check-valves are protected and examined to ascertain their effectiveness against entry of water.		
Objects which might obstruct cargo stowage on deck are removed and secured safely in places appropriate for storage.		

Items	**Checked by:**	
	Responsible officer	***Master***
Accumulations of ice and snow on loading area are removed.		
All sounding pipes on the deck are reviewed and necessary precautions are taken that safe access to these remains, and that they are not over stowed.		
Required fixed and portable lashing equipment and uprights are checked and prepared for use.		
It is confirmed that the MBL of stanchions utilized are not at risk of being exceeded by the intended cargo stowage arrangement at the intended voyage.		
A firm and level stowage surface is prepared. Dunnage, where used, is of rough lumber and placed in the direction which will spread the load across the ship's under-deck structure and assist in draining.		
It is ensured that dunnage is at place and in good condition.		
Cranes with wires, brakes, micro switches and signals (if they are to be used) are controlled.		
It is controlled that illumination on deck is working and ready for use.		
Ship-to-shore communication		
Radio channels to be used during cargo operations are assigned and tested.		
It is confirmed that crane drivers and loading stevedores/crew understands signals to be used during cargo operations.		
A plan is worked out for possible ceasing of the loading operations due to deteriorating weather.		

Items	**Checked by:**	
	Responsible officer	***Master***
Dressing		
It is made sure that personnel involved in the loading process are aware of all requirements regarding protective clothing, i.e. hardhats, proper footwear, gloves, etc.		

Above read and signed *Responsible officer:*	*Master:*
Place and date:	

2 Safety during Loading and Securing of Timber Deck Cargoes

Items	**Checked by:**	
	Responsible officer	***Master***
Lashing equipment		
If applicable, uprights are mounted before loading on deck is commenced. All lashing equipment is in place.		
Cargo securing equipment has been examined in preparation for use in securing of timber deck cargoes and any defective equipment found has been removed from service, tagged for repair and replaced.		
Vessel's safety		
All loading operations are planned to immediately cease if a list develops for which there is no satisfactory explanation and it would be imprudent to continue loading.		
In the event that the vessel takes up an unexplained list, then no further work to be undertaken until all ship's tanks are sounded and assessment made of the ship's stability condition.		
The loading operations are ceased if the weather condition deteriorating significantly.		
Samples of the timber cargo are weighed during loading and their actual weight compared to the weight stated by the shipper, in order to correctly assess the ship's stability.		
Draft surveys are regularly carried out during the course of loading and the ship's displacement is calculated to ensure that the ship is not over loaded.		
Permitted loading weights on deck and hatches are not exceeded.		
The stability of the vessel is at all times positive and in compliance with the vessels intact stability requirements.		
Emergency escape routes are free and ready for use.		

Items	Checked by:	
	Responsible officer	***Master***
There is free access to ventilation ducts and valves.		
Any obstruction such as lashings or securing points in the access way of escape routes and spaces essential to operation of the vessel, such as machinery spaces and crew's quarters, as well as obstructions to safety equipment, fire fighting equipment and sounding pipes are kept to minimum and in any case are clearly marked.		
The metacentric height is determined from the rolling period. Rolling may be initiated by shifting cargo with the deck cranes or dropping cargo bundles onto other deck cargo at one side of the vessel.		
Stowage		
The stow of the deck cargo is as solid and compact as practicable and the cargo is tightly stowed. Slack in the stow is prevented as such could cause the lashings to slacken.		
A binding effect is as far as practicable obtained within the stow to minimize the risk of cargo shifting during the sea voyage.		
The permeability of the stow is reduced to a minimum.		
Stowage of damaged timber packages is not allowed. Timber packages that have deformed or are found with broken bands are returned to shore for rectification.		
The creation of voids or open spaces when loading cargo is avoided. Voids, where created, are filled with loose timber or blocked by vertical H-frames with required strength to avoid cargo from shifting.		
Cargo is not stowed overhanging the ship's side. Timber deck cargo which overhangs the outer side of hatch combings or other structures, are supported at the outer end by other cargo stowed on deck or railing or equivalent structure of sufficient strength to support it.		

Items	**Checked by:**	
	Responsible officer	***Master***
Avoid the risk of sliding in the stow		
Ice and snow are continuously removed form the hatches and deck cargo in order to obtain a high coefficient of friction in the stow.		
Sliding between the layers is prevented by stowing timber packages of different heights in the same layer or by inserting vertical, sturdy battens between the layers.		
Work safety		
Personnel involved in the loading process are equipped with protective clothing, i.e. hardhats, proper footwear, gloves etc according to ship's and harbour requirements.		
Personnel working on cargo stowed at heights 2 metres and above are protected from falls with fall restraint equipment such as a safety harness or other approved fall restraining devices.		
While working on the cargo there is possibilities for safety wirers and the use of safety harness if applicable.		
Correct signals are used with crane operator(s).		
Safe access is available to the top of, and across, the cargo stow.		
All possible actions are taken to minimize the risk of slipping on the cargo (i.e. when plastic wrapping or tarpaulins are used as covers).		
Illumination is working when required during the cargo operation.		

Above read and performed *Responsible officer:*	 *Master:*
Place and date:	

3 Securing of Timber Deck Cargoes

Items	Checked by:	
	Responsible officer	***Master***
Basic requirements on the securing		
The stevedoring company and the crew are informed about the requirements on the securing arrangements.		
If required, extra lashing points are welded to the vessel with strength according to the vessel's Cargo Securing Manual.		
Uprights, when used, are well fastened to the deck or hatch coamings of the vessel and protected from falling inwards during loading and discharging operations.		
If required uprights are connected by hog lashings, running between each pair of uprights on opposing sides of the stow.		
Repair or replacement of damaged securing equipment		
Only undamaged cargo securing equipment is used for the securing of the timber deck cargoes. Damaged equipment that is beyond repair is marked as unserviceable and removed from the vessel.		
If any damage is noted on any of the uprights or their support on deck or coamings, this is immediately repaired.		
If any damage is noted on the fixed lashing equipment this is immediately repaired.		
If any damage is noted on the portable lashing equipment this is immediately repaired or the equipment is exchanged by new certified equipment.		
Tightening of lashings		
Threads on turnbuckles are greased to increase pre-tension in the lashings.		
All lashings are thoroughly tightened and all bolts and screws on shackles and turnbuckles are tightly fastened.		

Items	**Checked by:**	
	Responsible officer	***Master***
Turnbuckles have sufficient threads remaining to permit lashings to be tightened during the voyage if needed.		
Top-over lashings are tensioned with the force specified in the cargo securing plan.		
Edge protectors are used when required according to the vessel's Cargo Securing Manual to obtain good pretension in both vertical and horizontal parts of the lashings.		
Provision of catwalk		
If there is no convenient passage on or below the deck of the ship, a sturdy catwalk with strong railings is provided above the deck cargo.		
Securing according to the vessel's Cargo Securing Manual		
The timber deck cargo is secured according to the vessel's Cargo Securing Manual and the manual is approved by the Administration.		
Number and strength of uprights and lashing equipment used for the securing of the timber deck cargo is in accordance with the vessel's Cargo Securing Manual approved by the Administration. Certificates for the lashing equipment used are enclosed with the vessel's Cargo Securing Manual.		

Above read and performed *Responsible officer:*	 *Master:*
Place and date:	

4 Actions to be Taken during the Voyage

Items	**Checked by:**	
	Responsible officer	***Master***
Voyage Planning		
During voyage planning, all foreseeable risks which could lead to either excessive accelerations causing cargo to shift or sloshing sea causing water absorption and ice aggregation, are taken under consideration.		
Before the vessel proceeds to sea, the following are verified: • The ship is upright • The ship has an adequate metacentric height • The ship meets the required stability criteria • The cargo is properly secured.		
Soundings of tanks are continuously carried out throughout the voyage.		
The rolling period of the vessel is continuously checked in order to establish that the metacentric height is still within the acceptable range.		
In cases where severe weather and sea conditions are unavoidable, the Master should be conscious of the need to reduce speed and/or alter course at an early stage in order to minimize the forces imposed on the cargo, structure and lashings. If deviation from the intended voyage plan is considered during the voyage, a new plan should be made.		
Cargo Safety Inspections during Sea Voyages		
Cargo Safety Inspections, in accordance with the items below, are continuously checked throughout the voyage.		
Prior to any inspections being commenced on deck, the Master has taken appropriate actions to reduce the motions of the vessel during such operations.		
No movement of the cargo which would threaten the safety of the vessel has occurred.		
All lashing equipment are visually examined for any abnormal wear or tear or other damages.		

Items	**Checked by:**	
	Responsible officer	***Master***
If needed, since vibrations and working of the ship will cause the cargo to settle and compact, lashing equipment are retightened to produce the necessary pre-tension.		
Uprights have not sustained any damage or been deformed.		
Supports for upright are undamaged.		
Corner protections are still in place.		
All examinations and adjustments to cargo securing equipment during the voyage are entered in the ship's log-book.		
List during voyage		
If a list occurs that is not caused by normal use of consumables, it is immediately determined if such list can be attributed to one of the three causes, or possibly a combination of same: • Cargo shift • Water ingresses • The angle of loll (poor stability).		
Even if no major shift of the deck cargo is apparent, it is examined whether the deck cargo has shifted imperceptibly or if there has been a shift of cargo below deck.		
It is considered whether the weather conditions are such that sending the crew to release or tighten the lashings on a moving or shifted cargo present a greater hazard than retaining an overhanging load.		
The possibility of water ingress is determined by sounding throughout the vessel. In the event that unexplained water is detected, all available pumps are used to bring the situation under control.		
The current metacentric height is determined by timing the rolling period.		

Items	Checked by:	
	Responsible officer	***Master***
If the list is corrected by ballasting and deballasting operations, the order in which tanks are filled and emptied is decided with consideration to the following factors: • When the draft of the vessel increases, water ingress may occur through openings and ventilation pipes • If ballast have been shifted to counteract a cargo shift or water ingress, a far greater list may rapidly develop to the opposite side • If the list is due to the ship lolling, and if empty divided double bottom space is available, the tank on the lower side should be ballasted first in order to immediately provide additional metacentric height – after which the tank on the high side should also be ballasted • Free surface moments should be kept at a minimum by operating only one tank at a time.		
If the list is corrected by jettisoning deck cargo, the following aspects are noted: • Jettisoning is unlikely to improve the situation as the whole stack would probably not fall at once • Severe damage may be sustained by the propeller if it is still turning when the timber is jettisoned.		
If the whole or partial timber deck load is either jettisoned or accidentally lost overboard, the information on a direct danger to navigation[28] is communicated by the master by all means at his disposal to the following parties: • Ships in the vicinity • Competent authorities at the first point on the cost with which he can communicate directly. Such information is to include the following: • The kind of danger • The position of the danger when last observed • The time and date (coordinated universal time) when the danger was last observed.		

Above read and signed: *Responsible officer:*	 *Master:*
Date:	

5 Safety during Discharge of Timber Deck Cargoes

Items	**Checked by:**	
	Responsible officer	***Master***
Cargo Securing Equipment		
The cargo securing equipment is collected and examined and damaged equipment is either repaired or scrapped.		
Uprights, when used, are well fastened to the deck or hatch coamings of the vessel and protected from falling inwards during discharging operations.		
Vessel's Safety		
All loading operations are planned to immediately cease if a list develops for which there is no satisfactory explanation and it would be imprudent to continue loading.		
The stability of the vessel is at all times positive and in compliance with the vessels intact stability requirements.		
Emergency escape routes are free and ready for use.		
Work Safety		
Personnel involved in the loading process are dressed with protective clothing, i.e. hardhats, proper footwear, gloves, etc., according to ship's and harbour requirements.		
While working on the cargo there are possibilities for safety wires and the use of safety harness if applicable.		
Correct signals are used with crane operator(s).		
Safe access is available to the top of, and across, the cargo stow.		
All possible actions are taken to minimize the risk of slipping on the cargo (i.e. when plastic wrapping or tarpaulins are used as covers).		
Illumination is used when required during the cargo operation.		

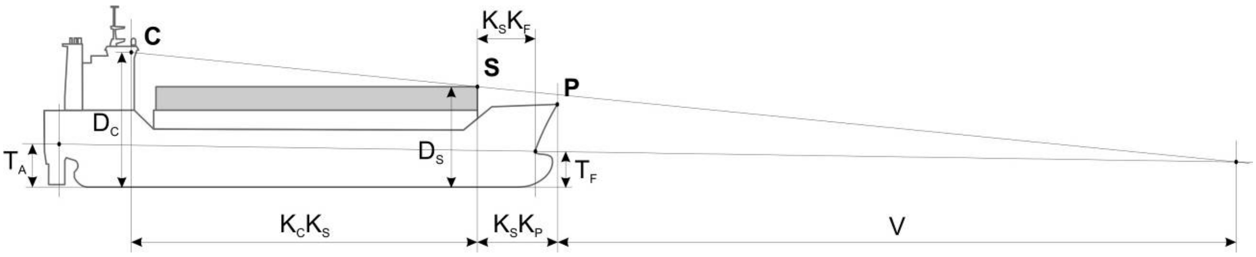
Above read and signed:	
Responsible officer:	*Master:*
Date:	

ANNEX 2 – **Visibility**

1 According to SOLAS chapter V, the view of the sea surface from the conning position should not be obscured by more than two ship lengths, or 500 m, whichever is the less, forward of the bow to 10° on either side under all conditions of draught, trim and deck cargo. National deviations may exist and should be taken into consideration as required dependent on the intended voyage.

2 No blind sector, caused by cargo, cargo gear or other obstructions outside of the wheelhouse forward of the beam which obstructs the view of the sea surface as seen from the conning position, should exceed 10°. The total arc of blind sectors should not exceed 20°. The clear sectors between blind sectors should be at least 5°. However, in the view described in B.1, each individual blind sector should not exceed 5°.

3 The following formula can be used for calculating the bridge visibility for load conditions with moderate trim:



The following distances are used to calculate the bridge visibility, V:

L_{PP}	*Length between perpendiculars*
T_F	*Draft Fore*
T_A	*Draft Aft*
D_C	*Height of conning position*
D_S	*Height of position '**S**'*
$K_C K_S$	*Horizontal distance from conning position to position '**S**'*
$K_S K_P$	*Horizontal distance from position '**S**' to position '**P**'*
$K_F K_S$	*Horizontal distance from FP to position '**S**'*

$$V = \frac{\left(D_S - \frac{T_A - T_F}{L_{PP}} \cdot K_F K_S - T_F \right) \cdot K_C K_S}{\left(D_C - D_S \right) - \frac{T_A - T_F}{L_{PP}} \cdot K_C K_S} - K_S K_P$$

ANNEX 3 – **Physical Properties of Timber Cargoes**

1 Stowage factors

1.1 Typical values for density and stowage factors are given in the table below for different types of timber deck cargoes.

Type of timber	**Density** [ton/m^3]	**Stowage factor** [cbft/m^3]
Sawn timber		
Packages of sawn timber package with even ends	0.5 – 0.55	48
Packages of sawn timber package with uneven ends	0.5 – 0.55	55
Packages of planed timber package with even ends	0.5	43
Round wood		
Un-barked coniferous tree, fresh	0.9 – 1.1	70 – 75
Un-barked broad-leaf tree, fresh	0.9 – 1.9	70 – 75
Un-barked round wood, dried	0.65	70 – 75
Barked coniferous tree, fresh		
Barked broad-leaf tree, fresh		
Barked round wood, dried		

1.2 The densities and stowage factors in the table above are presented for information purpose only to aid preplanning operations. The corresponding values for actual loads may vary significantly from those presented in the table depending on the timber type and condition. During actual loading more accurate values of the cargo weight is obtained by repeated check of the vessel's displacement.

1.3 The weight of timber and logs may change during a voyage due to loss or absorption of water. Timber and logs stowed under deck may loose weight whereas timber and logs stowed on deck may gain weight by absorption of water. Particular attention should be given to the impact that these and other changing conditions have on stability throughout a voyage.

2 Friction factors

2.1 Cargo in rest is prevented from sliding by static friction. When movement has been initiated the resistance in the material contact is reduced and sliding is counteracted by dynamic friction instead.

2.2 The static friction may be determined by an inclination test. The angle ρ is measured when the timber cargo starts to slide. The static friction is calculated as:

$$\mu = tan\ (\rho).$$

2.3 Five inclination tests should be performed with the same combination of materials. The highest and the lowest values should be disregarded and the friction factor is taken as the average of the three middle values. This average figure should be rounded down to the nearest fraction of 0.05.

2.4 If the values are intended to be used for non-winter conditions, the coefficient of friction for both dry and wet contact surfaces should be measured in separate series of tests and the lower of the two values are to be the used when designing cargo securing arrangements.

2.5 If the values are intended to be used for winter conditions when exposed surfaces are covered by snow and ice, the lowest coefficient of friction found for either dry, wet or snowy and icy contact surfaces should be used.

2.6 If not specially measured the dynamic friction factor may be taken as 70% of the static values.

2.7 The following values of static friction for the mentioned conditions may be used when designing securing arrangements for timber deck cargoes unless the actual coefficient of friction is measured and documented as described above.

Contact surface	**Non winter conditions** *Dry or wet*	**Winter conditions**
Sawn timber package *against* painted steel	0.45	0.05
against sawn timber	0.50	0.30
against plastic cover		0.25
Round wood un-barked coniferous tree *against* painted steel	0.35	
un-barked coniferous tree *between layers*	0.75	
un-barked broad-leaf tree *against* painted steel		
un-barked broad-leaf tree *between layers*		
barked round wood *against* painted steel		
barked round wood *between layers*		

2.8 Static friction may be used for tight block stowage arrangements as well as for the design of frictional lashing systems such as top-over lashing systems.

2.9 Dynamic friction should be used for non rigid lashing systems, which due to elasticity of securing equipment allow for minor dislocation of the cargo before full capacity of the securing arrangement is reached. If not specially measured the dynamic friction factor may be taken as 70% of the static values.

3 Plastic Covers

3.1 Plastic sheeting is often used on packages of sawn timber to protect the cargo. High friction coatings can be incorporated into plastic sheeting as an important means of improving the safe transport of these cargoes.

3.2 Special precautions should be taken to prevent slippery plastic from becoming a danger.

4 Package Weight Marking

4.1 All packages over 1 metric ton should be clearly marked with the weight of the package. The marking should be clearly visible on the top of the package as well as both long sides.

5 Water Absorption

5.1 Sea spray may increase the weight of the timber deck cargo and thus influence on the stability. The weight increase of the timber varies with time of exposure and type of timber. The value of increased weight of timber deck cargo due to water absorption should be taken according to the Intact Stability Code.

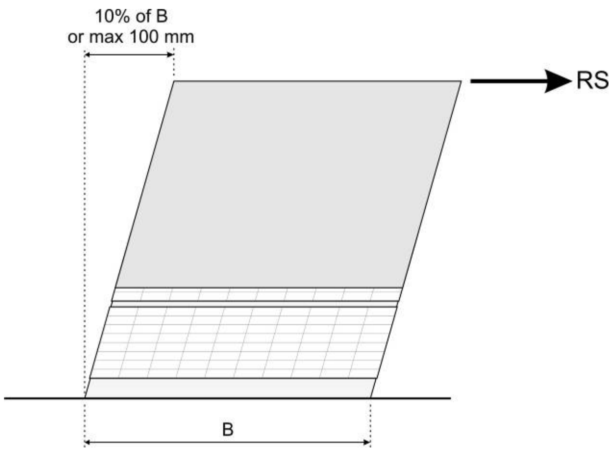
5.2 A value of weight increase that is less than the above mentioned may be used if the value could be proven by practical tests accepted by the administration.

6 Weight of Ice

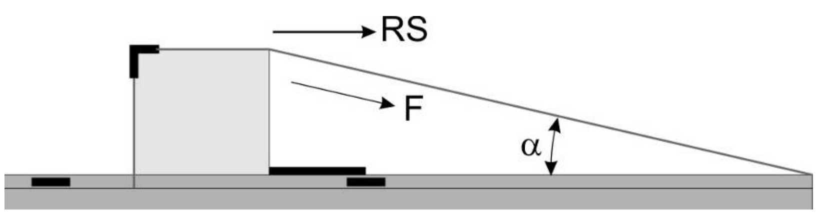
6.1 During cold weather conditions ice may form from sea spray and the stability may be affected as the ice can add weight rapidly. Increasing of the weight due to icing should be taken according to the Intact Stability Code.

7 Rigidity of Timber Packages

7.1 The Racking Strength, RS, of a timber package is defined as the horizontal force that a package can withstand without collapsing or deforming more than 10% of its width, B, or a maximum of 100 mm as shown in the figure below.



7.2 The racking strength of timber packages can be measured by a test setup as shown in the following figure. The angle α should not be greater than 30°.



7.3 The Racking Strength, RS, is taken as the applied force $F \cos \alpha$ (see figure above) when the package collapses or when the deflection in the top is 10% of the package width, B, or maximum 100 mm.

7.4 Racking strength measurements will have to be carried out by the shipper and the information should be supplied to the master as one of the required cargo information mentioned in SOLAS chapter VI.

ANNEX 4 – **Denotations Used in Design Criteria**

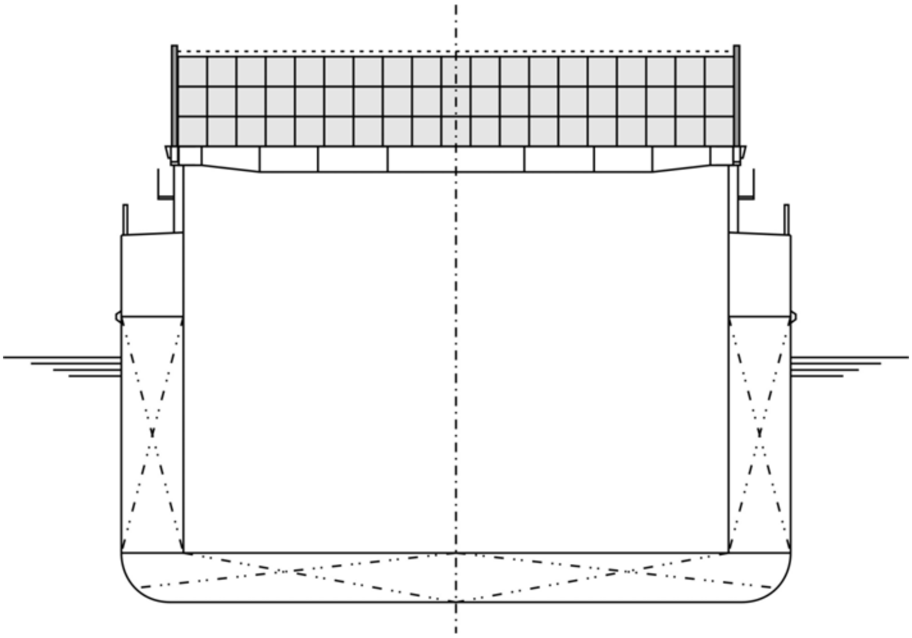
The denotations used in the formulas in the design criteria this code are listed below:

m	=	*Mass of the deck cargo or section to be secured in tonnes, including absorbed water and possible icing*
g_0	=	*Gravity acceleration 9.81 m/s²*
a_t	=	*Largest transverse acceleration at the centre of gravity of the deck cargo in the forward or aft end of the stow in m/s²*
μ_{static}	=	*Static coefficient of friction between the timber deck cargo and the ship's deck/hatch cover*
$\mu_{dynamic}$	=	*Dynamic coefficient of friction between the timber deck cargo and the ship's deck/hatch cover*
$\mu_{internal}$	=	*Coefficient of dynamic friction found internally between the timber packages*
PW	=	*Wind pressure in kN based on 1 kN per m² wind exposed area, see CSS Code, Annex 13*
PS	=	*Pressure from unavoidable sea sloshing in kN based on 1 kN per m² exposed area, see CSS Code, Annex 13*
n	=	*Number of lashings*
L_L	=	*Length of each lashing in metre*
δ	=	*Dislocation of deck cargo in metre due to elasticity of lashing arrangement*
ε	=	*Elasticity factor for lashing equipment, taken as fraction of elongation experienced at the load of MSL for the lashing*
PT_V	=	*Pretension in the vertical part of the lashings in kN*
PT_H	=	*Pretension in the horizontal part of the lashings in kN*
CS	=	*Calculated strength of lashing in kN, see chapter 3.4*
MSL	=	*Maximum Securing Load in kN of cargo securing devices*
α	=	*Angle between the horizontal plane and the lashings in degrees*
n_p	=	*Number of stacks of packages abreast in each row*
q	=	*Number of layers of timber packages in metre*
RS	=	*Racking Strength per timber package in kN, see chapter 3.4*
n_b	=	*Number of bottom blocking devices per side of the deck cargo*
N	=	*Number of uprights supporting the considered section on each side*
H	=	*Height of deck cargo in metre*
B	=	*Width of deck cargo in metre*
L	=	*Length of the deck cargo or section to be secured in metre*
b	=	*Width of each individual stack of packages*
$M_{bending}$	=	*Design bending moment on uprights in kNm*
h	=	*Height above deck at which hog lashings are attached to the uprights in metre*
k	=	*Factor for considering hog lashings:* $k = 1$ *if no hog lashings are used* $k = 2$ *if hog lashings are used*

ANNEX 5 – Samples of Stowage and Securing Methods

1 Example Calculation – Uprights for Timber Packages

In the example below, the dimensioning moment for uprights supporting timber packages on deck is calculated for one cargo section supported by two stanchions on each side.



Midship section of vessel with timber packages secured with uprights.

Vessel particulars

Length between perpendiculars, LPP:	*148 metres*
Moulded breadth, B_M:	*25 metres*
Service speed:	*16 knots*
Metacentric height, GM:	*1.8 metres*

The considered cargo section consists of 3 layers with 19 packages in each. It has the dimensions L × B × H = 3 × 20.9 × 3.3 metres. The stowage factor for the timber packages is 0.45 ton/m^3.

With particulars as above and considering the foremost stowage position on deck, which is at 0.9 L, Annex 13 of the Code of Safe Practice for Cargo Stowage and Securing gives a transverse acceleration of $a_t = 5.9\ m/s^2$, using the following basic acceleration and correction factors:

	$a_{t\,basic}$	=	7.4	m/s^2	=	*Basic transverse acceleration*
	f_{R1}	=	0.80		=	*Correction factor for length and speed*
	f_{R2}	=	1.00		=	*Correction factor for B_M/GM*

$$a_t = a_{t\,basic} \cdot k_1 \cdot k_2 = 7.4 \cdot 0.80 \cdot 1.00 = 5.9\,m/s^2$$

Cargo properties

	m	=	93	*ton*	=	*Mass of the section to be secured in ton, including absorbed water and possible icing*
	$\mu_{internal}$	=	0.30		=	*Coefficient of internal friction between the timber packages*
	H	=	3.3	*m*	=	*Height of deck cargo in metre*
	b	=	1.1	*m*	=	*Width of each individual stack of packages*
	n_p	=	19	*pcs*	=	*Number of stacks of timber packages abreast in each row*
	q	=	3	*pcs*	=	*Number of layers of timber packages*
	RS	=	15	*kN*	=	*Racking strength per timber package in kN*
	N	=	2	*pcs*	=	*Number of uprights supporting the considered section on each side*
	h	=	3.5	*m*	=	*Height above deck at which hog lashings are attached to the uprights in metres*
	k	=	2		=	*Factor for considering hog lashings:* *k = 1 if no hog lashings are used* *k = 2 if hog lashings are used*

Bending moment in uprights

The design bending moment per upright supporting timber packages is to be taken as the greatest of the three moments given by the following formulas:

$$CM_{bending\,1} = \frac{m}{n \cdot k \cdot N} \cdot \left(a_t \cdot \frac{H}{2} - g_0 \cdot \frac{b}{2} \right) \cdot \frac{1-(1-f_i)^n}{f_i}$$ *(Moment required to prevent tipping)*

where $$f_i = \mu_{internal} \cdot \frac{2b}{H}$$ *(f_i = Factor for considering internal moment)*

$$CM_{bending\,2} = \frac{H}{2 \cdot k \cdot N} \cdot m \cdot (a_t - \mu_{internal} \cdot g_0)$$ *(Moment required to prevent sliding)*

$$CM_{bending\,3} = \frac{1}{k \cdot N} \cdot \left(m \cdot a_t - (n_p - 4)(q-2) \cdot RS\right) \cdot \frac{(q-1)}{2q} \cdot H$$ *(Moment required to prevent racking)*

With cargo properties and acceleration as given above, the following bending moments are calculated:

$$f_i = 0.3 \cdot \frac{2 \cdot 1.1}{3.3} = 0.2$$

$$CM_{bending\,1} = \frac{93}{19 \cdot 2 \cdot 2} \cdot \left(5.9 \cdot \frac{3.3}{2} - 9.81 \cdot \frac{1.1}{2} \right) \cdot \frac{1-(1-0.2)^{19}}{0.2} = 26\ kNm$$

$$CM_{bending\,2} = \frac{3.3}{2 \cdot 2 \cdot 2} \cdot 93 \cdot (5.9 - 0.35 \cdot 9.81) = 113\ kNm$$

$$CM_{bending\,3} = \frac{1}{2 \cdot 2} \cdot (93 \cdot 5.9 - (19 - 4)(3 - 2) \cdot 15) \cdot \frac{(3 - 1)}{2 \cdot 3} \cdot 3.3 = 89\ kNm$$

The design bending moment, taken as the maximum bending moment calculated by the three formulae above multiplied with the safety factor of 1.35, thus becomes 153 kNm:

$$M_{bending} \geq 1.35 \cdot max(CM_{bending\,1},\ CM_{bending\,2},\ CM_{bending\,3}) = 1.35 \cdot 113 = 153\ kNm$$

[**Suitable dimensions for uprights**

For a cylindrical stanchion, with MSL taken as 50% of the MBL for steel with the ultimate strength 360 MPa, and a wall thickness of 18 mm, the diameter would have to be 250 mm to be able to safely take up the dimensioning bending moment of 153 kNm.]

Strength in hog lashings

The required MSL of each hog lashing is calculated by the following formula:

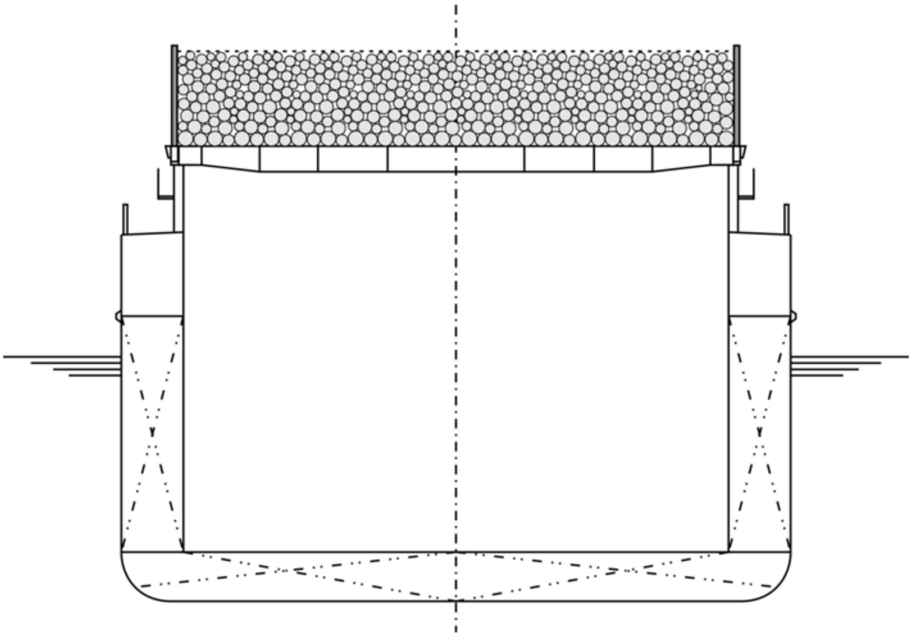
$$MSL \geq \frac{M_{bending}}{2 \cdot h}$$

In this case, the hog lashings are attached at a height of h = 3.5 metres and the required strength is calculated as:

$$MSL \geq \frac{M_{bending}}{2 \cdot h} = \frac{153}{2 \cdot 3.5} = 22\ kN \approx 2.2\ ton$$

2 Example Calculation – Uprights for Round Timber

In the example below, the dimensioning moment for uprights supporting round timber on deck is calculated for one cargo section supported by two stanchions on each side.



Midship section of vessel with round timber secured with uprights.

Vessel particulars

Length between perpendiculars, LPP:	*148*	*metres*
Moulded breadth, BM;	*25*	*metres*
Service speed:	*16*	*knots*
Metacentric height, GM:	*1.8*	*metres*

The considered cargo section consists of round timber with a stowage factor of 0.65 ton/m^3. It as the dimensions L × B × H = 3.5 × 20.9 × 3.3 metres.

With particulars as above and considering a foremost stowage position on deck at 0.9 L, Annex 13 of the Code of Safe Practice for Cargo Stowage and Securing gives a transverse acceleration of $a_t = 5.9\ m/s^2$, using the following basic acceleration and correction factors:

	$a_{t\ basic}$	=	7.4	m/s^2	=	*Basic transverse acceleration*
	f_{R1}	=	0.80		=	*Correction factor for length and speed*
	f_{R2}	=	1.00		=	*Correction factor for B_M/GM*

$$a_t = a_{t\ basic} \cdot k_1 \cdot k_2 = 7.4 \cdot 0.80 \cdot 1.00 = 5.9\, m/s^2$$

Cargo properties

	m	=	*154*	*ton*	=	*Mass of the section to be secured in ton, including absorbed water and possible icing*
	μ_{static}	=	*0.35*		=	*Coefficient of static friction between the timber deck cargo and the ship's deck/hatch cover*
	H	=	*3.5*	*m*	=	*Height of deck cargo in metre*
	B	=	*20.9*	*m*	=	*Width of deck cargo in metre*
	L	=	*3.5*	*m*	=	*Length of the deck cargo or section to be secured in metres*
	N	=	*2*	*pcs*	=	*Number of uprights supporting the considered section on each side*
	h	=	*3.5*	*m*	=	*Height above deck at which hog lashings are attached to the uprights in metre*
	k	=	*2*		=	*Factor for considering hog lashings:* *k = 1 if no hog lashings are used* *k = 2 if hog lashings are used*

Bending moment in uprights

For vessels carrying loose sawn timber and round timber, the design bending moment per upright is calculated as the greater of the two moments given by the following formulas:

$$CM_{bending\,1} = 0.12 \cdot \frac{H^2}{B \cdot N} \cdot m \cdot g_0$$

$$CM_{bending\,2} = \frac{0.45 \cdot 1.35 \cdot H}{k \cdot N} \cdot \left(m \cdot \left(a_t - \mu \cdot g_0\right) + 2 \cdot H \cdot L\right)$$

With cargo properties and acceleration as given above, the following bending moments are calculated:

$$CM_{bending\,1} = 0.12 \cdot \frac{3.5^2}{20.9 \cdot 2} \cdot 154 \cdot 9.81 = 53\ kNm$$

$$CM_{bending\,2} = \frac{0.45 \cdot 3.5}{2 \cdot 2} \cdot \left(154 \cdot \left(5.9 - 0.35 \cdot 9.81\right) + 2 \cdot 3.5 \cdot 3.5\right) = 159\ kNm$$

The design bending moment, taken as the maximum bending moment calculated by the formulae above multiplied with a safety factor of 1.35, thus becomes 215 kNm:

$$M_{bending} \geq 1.35 \cdot max\left(CM_{bending\,1},\ CM_{bending\,2}\right) = 1.35 \cdot 161 = 215\ kNm$$

[**Suitable dimensions for uprights**

For a cylindrical stanchion, with MSL taken as 50% of the MBL for steel with the ultimate strength 360 MPa and a wall thickness of 20 mm, the diameter would have to be 280 mm to be able to safely take up the dimensioning bending moment of 215 kNm.]

Strength in hog lashings

The required MSL of each hog lashing is calculated by the following formula:

$$MSL \geq \frac{M_{bending}}{2 \cdot h}$$

In this case, the hog lashings are attached at a height of 3.5 metres and the required strength is calculated as:

$$MSL \geq \frac{M_{bending}}{2 \cdot h} = \frac{215}{2 \cdot 3.5} = 31\ kN \approx 3.1\ ton$$

ANNEX 6 **– References**

[1] **SOLAS** – chapter VI, regulation 5, section 1 – Carriage of cargoes – Stowage and securing

[2] **ISM Code** – part A, Implementation – paragraph 1.1.2

[3] **IMDG Code** – part 1, chapter 1.2.1 – Definitions

[4] **SOLAS** – chapter VI, regulation 2 – Cargo Information

[5] **ISM Code** – clause 7, Development of Plans for Shipboard Operations

[6] **Load Lines, 1966** – Annex I, chapter II, regulation 16 – Regulations for Determining Load Lines − Conditions of Assignment of Freeboard

[7] **SOLAS** – chapter II-1, part B-1, regulation 25-8 – Stability Information

[8] **IS Code** (SLF 50/4/1) – part A, chapter 3.3 – (Special criteria) for ships carrying timber deck cargoes

[9] **IS Code** (SLF 50/4/1) – part B, chapter 3.6.3 – (Stability booklet) for ships carrying timber deck cargoes

[10] **IS Code** (SLF 50/4/1) – part B, chapter 3.7 – Operational measures for ships carrying timber deck cargoes

[11] **IS Code** (SLF 50/4/1) – Intact Stability for All Types of Ships Covered by IMO Instruments

[12] **MEPC.127(53)** – Development of Ballast Water Management Plans

[13] **Load Lines, 1966** – Annex I, Regulations for Determining Load Lines – chapter IV, Special requirements for ships assigned timber freeboards – regulation 44, Stowage, Uprights, Lashings, Stability, Protection of crew, access to machinery spaces, etc.

[14] **Load Lines, 1966 –** Annex I, Regulations for Determining Load Lines – chapter IV, Special requirements for ships assigned timber freeboards – regulation 45, Computation for freeboard

[15] **SOLAS** – chapter V, regulation 22 – Navigational bridge visibility

[16] **ISM Code** – clause 6.6, Resources and Personnel

[17] **ILO Convention No.152** – Convention Concerning Occupational Safety and Health in Dock Work

[18] **Load Lines, 1966 –** Annex I, Regulations for Determining Load Lines – chapter II, Conditions of Assignment of Freeboard – regulation 25, Protection of the Crew

[19] **Load Lines, 1966 –** Annex I, Regulations for Determining Load Lines – chapter IV, Special requirements for ships assigned timber freeboards – regulation 44, Stowage, Uprights, Lashings, Stability, Protection of crew, Access to machinery spaces, etc.

[20] **CSS Code** – annex 13, chapter 4 – Strength of Securing Equipment

[21] **ISM Code** – clause 7, Development of Plans for Shipboard Operations

[22] **STCW Code** – section A-VIII/2, Watchkeeping arrangements and principles to be observed – part 2, Voyage Planning

[23] **SOLAS** – chapter V, regulation 34 – Safe Navigation

[24] **CSS Code** – chapter 6, Actions which may be taken in heavy weather – 6.3

[25] **MCS/Circ**.1228 – Revised Guidance to the master for avoiding dangerous situations in adverse weather and sea conditions

[26] **SOLAS** – chapter VI, regulation 5, section 2 – Carriage of cargoes – Stowage and securing

[27] **MSC/Circ.745** – Guidelines for the Preparation of the Cargo Securing Manual

[28] **SOLAS** – chapter V, regulation 31 – Safety of navigation – Danger messages

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