CARGO SECURING MANUAL

This Manual is in Accordance with Resolution A.489(XII), the Recommendation on the Safe Stowage and Securing of Cargo Units and other Entities in Ship's, as adopted by the International Maritime Organization (IMO).

M.V. TROPICAL ESTORIL
of Malta.

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Sample

Cargo securing manual

Introduction

1　The information contained in this Cargo Securing Manual, required in accordance with the 1994 amendments to the International Convention for the Safety of Life at Sea, 1974 (SOLAS) VI/5.6 and VII/6.6, is in an approved form in accordance with the Guidelines for the Preparation of the Cargo Securing Manual, MSC/Circ.745.

2　The purpose of this manual is to provide guidance to the Master and crew on board the vessel with respect to the proper stowage and securing of cargo units.

3　It is the Masters responsibility to ensure that cargo units (as defined in MSC/Circ.745) are at all times stowed and secured in an efficient manner, taking into account the prevailing conditions and the general principals of safe stowage set out in this Manual, and that the securing equipment and timber used are adequate for the loadings calculated in accordance with this Manual.

4　This Manual should be kept on board the vessel for inspection by Port/Flag State inspectors, Classification Society Surveyors and other interested parties.

5　This manual has been approved by Lloyd's Register of Shipping on behalf of the Government of
_____Republic of MALTA_____.

6　The information contained in or appended to this manual should be regularly reviewed and updated. With the exception of the lists of portable cargo securing devices where equipment is replaced with new equipment of an identical type, amendments should not be made to this Manual without the prior consent of Lloyd's Register of Shipping.

Scope of this Manual

M.V. Tropical Estoril is a Reefer Cargo vessel designed for carriage of break-bulk refrigerated Cargo. The vessel is owned and operated by Dole Fresh Fruit International Limited (and/or subsidiaries). The Vessel carries reefer fruit cargo in loose boxes. This Manual will discuss loading and securing practices as applicable to such cargo.

It is to be noted that this vessel is not designed for unitised pallet loads (the cargo spaces vary in height and width and are not provided with side shoring arrangements).

Further, the vessel does not comply with requirements for carriage of dangerous goods and is not designed or adapted for carriage of freight containers or other mobile transport units.

> Nothing in this manual should be read to exclude the use of computer software or other aids, provided the output achieves minimum safety factors/parameters.

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Extracts from SOLAS Chapter VI and VII

This manual prepared by: Capt. Pawanexh Kohli

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Ship Data

General Data

Year Built: 1974
Builders: Drammen Slip & Verksted

Ship Name:	**Tropical Estoril**
IMO No:	**738 3073**
Flag	**Malta**
Class Notation	**LR X100A1 XLMC**
Type of Ship	**Reefer Break-bulk Cargo Ship**
Gross Tons	**7060**

Ship dimensions

Length, LOA	**144.45 m**
Length, LBP	**135.20 m**
Beam, B	**18.0 m**
Depth moulded, D	**11.63 m**
Draft, T	**9.02 m**
Speed, V	**19.0 kn**
GM, range of values	**0.15 - 1.50 m**

Cargo Compartments

Hatch No.	Deck	Cargo Clear Size mm	Hatch No.	Deck	Cargo Clear Size mm
1	Forecastle	7100 x 4400	3	1st Deck	7200 x 4510
	1st Deck	7200 x 4510		2nd Deck	7200 x 4510
	2nd Deck	7200 x 4510		3rd Deck	7200 x 4510
	3rd Deck	7200 x 4510	4	1st Deck	7200 x 4510
	4th Deck	7200 x 4510		2nd Deck	7200 x 4510
2	1st Deck	7200 x 4510		3rd Deck	7200 x 4510
	2nd Deck	7200 x 4510			
	3rd Deck	7200 x 4510			
	4th Deck	7200 x 4510			

Deck Loads

Forecastle Deck	**8.0 TN/M^2**
No. 1 Deck Fwd Fr 129	**1.4 TN/M^2**
No. 1 Deck Aft Fr 129	**0.95 TN/M^2**
No. 2 Deck	**1.6 TN/M^2**
No. 3 Deck	**1.5 TN/M^2**
No. 4 Deck	**1.5 TN/M^2**
Tank Top	**8.0 TN/M^2**
Wing Tank Top	**4.5 TN/M^2**
The Gratings in each deck are designed for Fork Lift Trucks of a Total Weight of 4500Kgs.	

Chapter 1 – **General**

1.1   Definitions of terms used in this Manual:

i)   "Cargo Units" means vehicles (road vehicles, roll trailers, etc.), railway wagons, containers, flats, pallets, portable tanks, intermediate bulk containers (IBC), packaged units, unit loads, other cargo carrying units such as shipping cassettes, cargo entities such as steel coils and heavy cargo items such as locomotives and transformers. Loading equipment, or any part thereof, transported on the ship, but which is not permanently fixed to the ship, is also considered as cargo units.

ii)   "Cargo Securing Devices" is all fixed and portable devices used to secure and support Cargo Units.

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

iv)   "Standardized Cargo" means cargo for which the ship is provided with an approved securing system based upon cargo units of specific types.

v)   "Semi-standardized Cargo" means cargo for which the ship is provided with a securing system capable of accommodating a limited variety of cargo units, such as vehicles, trailers, etc.

vi)   "Non-standardized Cargo" means cargo which requires individual stowage and securing arrangements.

vii)   "Fixed Securing Devices" means securing points and supports either integral, i.e. welded into the hull structure, or non-integral, i.e. welded onto the hull structure.

viii)   "Portable Securing Devices" means portable devices used for lashing, securing or support of cargo units.

1.2   General Information

i)   The guidance given herein should by no means rule out the principles of good seamanship, neither can they replace experience in stowage and securing practice.

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

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

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

v)   The cargo securing devices mentioned in this manual should be applied so as to be suitable and adapted to the quantity, type of packaging, and physical properties of the cargo to be carried. When new or alternative

types of cargo securing devices are introduced, the Cargo Securing Manual should be revised accordingly. Alternative cargo securing devices introduced should not have less strength than the equipment which it replaces.

vi) There should be a sufficient quantity of reserve cargo securing devices on board the ship.

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

viii) Any equipment supplied by stevedoring companies for the securing of specific cargoes shall be appropriately certified in accordance with national or international standards.

1.3   Usual Cargo and Trade

i) This vessel carries banana boxes (20 kg. each) stowed as individual unit loads.

ii) No fixed securing arrangements or securing points are incorporated in vessel design for such cargo.

iii) No portable securing is required for such cargo.

iv) Block stowage is ensured and no void space is left between the boxes.

v) The vessel does not carry cargo on deck.

vi) The vessel cannot carry Containers.

vii) The vessel does not comply with SOLAS II-2/54 and does not hold a relevant Document of Compliance for carriage of Dangerous Goods.

Chapter 2
Securing devices and arrangements

2.1 Specification for fixed cargo securing devices.

This vessel has no fixed cargo securing devices – no fixed fittings or securing points. The vessel was designed solely for carriage of reefer cargo in insulated holds and no design modifications to its scope or type of carriage ever made.

Specifically-

(i) *No fixed securing facilities on bulkheads, web frames, stanchions, etc.*

(ii) *No fixed securing facilities on decks and their types (e.g. elephant feet fittings, container fittings apertures, etc.).*

(iii) *No fixed securing facilities on deckheads.*

The only securing points and cleats fitted on upper deck are for the solely for use for securing the guy ropes of the derricks. These are not suitable for load lashing and are required to be kept free for safe operation of cargo gear.

If one is in event affected to use these for lashing of any cargo the following rule of thumb to be applied to obtain the MSL:

MSL = d^2 x12 (kN) where d is the rod diameter of rings or eyes in cm.

The MSL obtained is considered valid for mild steel of 37 kN/cm² tensile strength under the following conditions:

w *The supporting structure (deck, tanktop, frame etc.) must be of sufficient strength;*

w *Welded seams must be of equivalent cross-section and not impaired by corrosion;*

w *Both ends of the rod are to be fully welded. i.e. it is not applicable if open ended links or hooks are used.*

Out of plane loading on stiffening members is to be avoided.

2.1.1 No other attachments shall be made to the ships structure without the Masters permission.

Notes: It should be noted that the scantling of existing ship structures does not allow for additional cargo securing loads and any modification in the structure to allow any fixed securing devices may require additional local stiffening.

If any future modification be necessitated, the following points should be among those considered:

a. *An arrangement which should be avoided is one in which the lashing lug itself and its attaching welding are of ample strength, but the sub-structure to which the lug is welded is of much reduced strength. This situation arises when heavy lugs are attached to lightweight deck plating or bulwark plating on a ship, or to relatively thin plating forming the casing of deck machinery.*

b. When assessing the weld connections for any form of welded terminal it is important to remember that the yield strength of the weld connections will not be greater than the intrinsic yield strength of the material welded. Ordinary shipbuilding mild steel, which has a yield strength of about 235N/mm², should be generally assumed for the sub structure. If necessary, decrease the size and increase the number of the lashing plates, and reinforce the sub-structure when terminal points are required to be welded to any part of a ship's structure.

c. Eye plates (lashing plates) are not to be welded to the upper side of the sheerstrake nor, in general, are they to penetrate the strength deck plating. Deck, bulwark or other plating is to be of sufficient thickness to withstand any shear forces that may be incurred in way of eye plates due to asymmetrical loading of the eye plate and such plating is to be stiffened as necessary to prevent deformation under direct eye plate loadings.

d. Any attachments to high tensile steel plate must be done under class survey, and in accordance with the Classification Society's Rules.

e. Any welded attachments to the ships deck and bulkhead plating must be aligned to stiffeners, beams, longitudinal stiffeners or floors using an appropriate weld area for the load imposed.

   In order to achieve the necessary hull structural support, the following main principles for attachment of lashing plates should be considered:

i. Lashing plates, or any other securing point are never to be welded on unstiffened platefields.

ii. Lashing plates are preferably to be attached in line with girder webs or bulkheads as shown on figure 2.1, alternatively supported by brackets as shown in figure below.
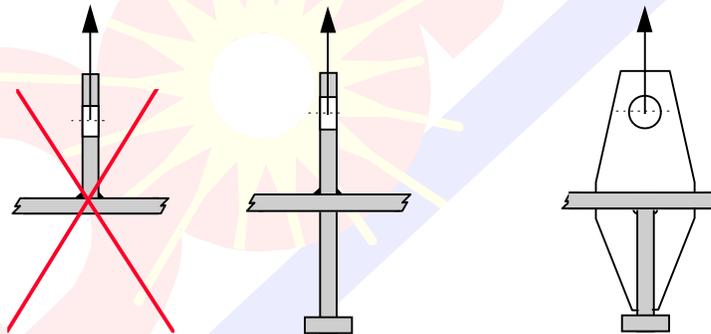

Figure 2.1

iii. Lashing plates are to be fitted parallel to direction of attack for lashing force. See figure 2.2.
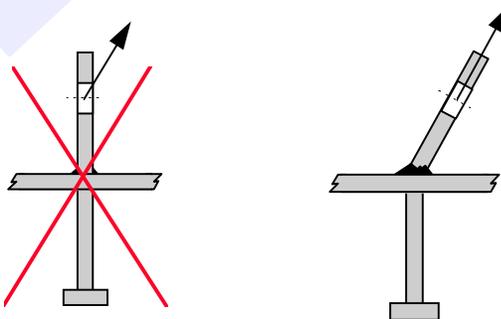

Figure 2.2

iv.   *Welding of lashing plates to doublers should be avoided. In cases where a doubler for some reason is deemed necessary, this should be of substantial thickness to avoid local deflections of the doubler.*

v.   *Attachment of lashing plates directly to side longitudinals at sheer strake or strength deck longitudinals in midship area should in general be avoided. However, if this, for some reason, is deemed necessary, intercoastals between longitudinals are to be fitted for distribution of forces. Thickness of intercoastals to be at least as for longitudinals. See figure 2.3.*
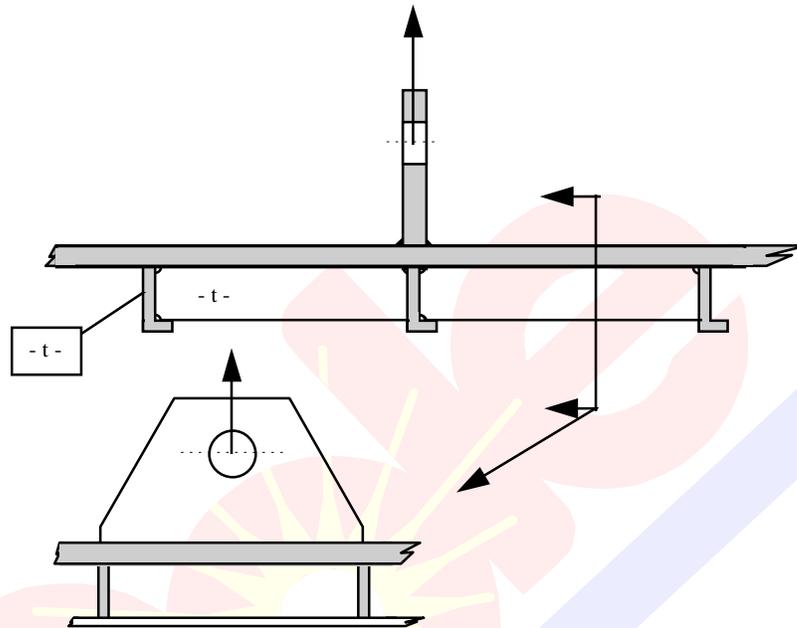

Figure 2.3

f.   *Loads shall not be imposed on ships structural members and shall not be out of plane with the member (i.e. at an angle which imposes a side load).*
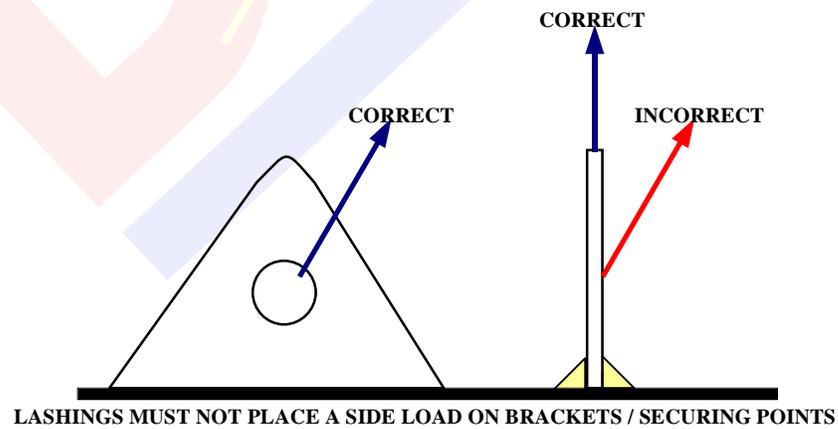

LASHINGS MUST NOT PLACE A SIDE LOAD ON BRACKETS / SECURING POINTS

Figure 2.4

g.   *Any new lashing eyes/"D" rings attached to the ship are to be of an approved type.*

2.2   Specification for portable cargo securing devices.

There are no portable cargo securing devices carried on board the ship. The vessel was purpose built for the carriage of reefer cargo in insulated holds and no design modifications to its scope or type of carriage ever made.

Specifically-

(i)   No container stacking fittings, container deck securing fittings, fittings for interlocking of containers, bridge-fittings, etc., kept on board;

(ii)   No chains, wire lashings, rods, etc., for cargo securing kept on board;

(iii)   No tensioners (e.g. turnbuckles, chain tensioners, etc.) kept on board;

(iv)   No securing gear for cars and other vehicles kept on board;

(v)   No trestles and jacks, etc., for vehicles (trailers) kept on board;

(vi)   No anti-skid material (e.g. soft boards) for use with cargo units having low frictional characteristics, etc kept on board.

The cargo carried on board is in units of 20 kg boxes of fruit. No securing arrangement is applied. Cargo is secured within spaces by ensuring block stow, avoiding any void space.

In the unforeseen event that the vessel may require to carry other type of loads, specific portable lashing material will, if applicable, need to be acquired for the duration of carriage. Chapter 3 will discuss this on the dubious premise that the vessel's carriage requirements may ever be modified.

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Stowage and securing of non-standardized and semi-standardized cargo

MV Tropical Estoril transports banana boxes in its cargo holds – and is purpose built for such carriage. No securing besides proper stowage of the unit boxes is applicable.

This chapter discusses above carriage but also broadly highlights the guidelines for other possible freight cargo.

3.1   Handling and safety instructions

This sub-chapter contains instructions on the proper handling of the securing devices and safety instructions related to handling of securing devices and to securing and unsecuring of units by ship or shore personnel.

3.1.1   General principles of cargo securing

1.   Cargo shall be secured according to recognised principles, taking into account the dynamic forces that may occur during sea transport and the most severe weather condition expected. Ship handling decisions should take into account the type of cargo and stowage position of the cargo and the securing arrangements.
- Care should be taken to distribute the forces as evenly as possible.
- If in doubt the lashing arrangement should be verified using an acceptable calculation method.
- The securing gear should be adapted to the cargo to be carried.
- Lashings are to be kept as short as possible.

2.   Prior to loading cargo, the following should be checked:
- Relevant deck areas are, as far as practicable, to be clean, dry and free from oil and grease.
- Cargo, cargo transport unit or vehicle to be suitable for transport.
- Necessary securing equipment is to be found onboard.
- See item 5.

3.   The securing equipment should be:
- available in sufficient quantity including reserves
- suitable for the purpose
- of adequate strength
- practical and maintained

4.   Securing operations shall be completed before the ship leaves the berth and the securing should be based on proper planning, execution and supervision. Relevant personnel should be properly qualified and experienced and should have a sound practical knowledge of the application and content of this Cargo Securing Manual.
- The master shall take care in planning and supervising the stowage and securing of cargoes based on information about the cargo.
- The cargo is to be distributed with attention to the ship stability so that the hazards of excessive accelerations are reduced as far as practicable.
- Due attention to the ship's structural strength should be taken.

Excessive accelerations are expected to occur in the far forward and aft part of the ship, but can also occur in general as a result of a high GM value.

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5.   Relevant expertise should be called for, if found necessary, when considering the shipment of a cargo with unusual characteristics, i.e. cargo which may require special attention to location, stowage/securing and weather conditions.
-       Different commodities should be compatible with each other or suitable separated
-       Cargo must be suitable for the ship and vice versa

6.   If the duty officer considers that a cargo is not safely secured to a cargo unit, measures shall be taken to avoid shifting of the cargo. If adequate measures are not possible, due to the nature of the cargo or lack of securing points, the cargo unit shall not be taken on board.

7.   The securing arrangements shall be adequate to ensure that there will be no movement which will endanger the ship. Slackening of the securing gear due to cargoes which have a tendency to deform or to compact during voyage shall be avoided.

8.   Cargo units containing hanging loads (e.g. chilled meat, floated glass) and very high cargo units are, because of the relatively high position of the centre of gravity, particularly prone to tipping. Whenever possible they should be located in positions of least movement i.e. on the centre line, towards amidships and on a deck near the waterline.

9.   The cargo spaces should be, as far as practicable, regularly inspected during voyage.

10.   Lashings shall not be released for unloading before the ship is secured at the berth, without the Masters express permission.

11.   Cargo or its securing shall not obstruct the operating controls of side doors, entrances to accommodation and/or fire fighting equipment.

14.   Special cargo transport units
MV Tropical Estoril is not designed for carriage of any specialised cargo transport units.

The shipowner and the ship operator should, when necessary, make use of relevant expertise when considering the shipment of a cargo with unusual characteristics.

Such shipments may require special modifications to the vessel structure and due attention to be given to its location on board vis-à-vis the structural strength of the ship, its stowage and securing, and the weather conditions which may be expected during the intended voyage.

15.   Cargo information
Prior to shipment the shipper should provide all necessary information about the cargo to enable the shipowner or ship operator to ensure that:
-       the different commodities to be carried are compatible with each other or suitably separated;
-       the cargo is suitable for the ship;
-       the ship is suitable for the cargo; and
-       the cargo can be safely stowed and secured on board the ship and transported under all expected conditions during the intended voyage.

The master should be provided with adequate information regarding the cargo to be carried so that its stowage may be properly planned for handling and transport.

16.   Suitability of cargo for transport
Cargo carried in containers, road vehicles, shipborne barges, railway wagons and other transport units cannot be carried on MV Tropical Estoril.

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17.   Cargo distribution

The cargo should be distributed so as to ensure that the stability of the ship throughout the entire voyage remains within acceptable limits so that the hazards of excessive accelerations are reduced as far as practicable.

Cargo distribution should be such that the structural strength of the ship is not adversely affected.

18.   Cargo securing arrangements

Particular care should be taken to distribute forces as evenly as practicable between the cargo securing devices. If this is not feasible, the arrangements should be upgraded accordingly.

If, due to the complex structure of a securing arrangement or other circumstances, the person in charge is unable to assess the suitability of the arrangement from experience and knowledge of good seamanship, the arrangement should be verified by using an acceptable calculation method.

The cargo securing gear should be adapted to the quantity and properties of the cargo to be carried and, when required, additional gear should be provided.

Lashings should be kept as short as possible. Long lashings are difficult to tighten and difficult to keep taut.

19.   Residual strength after wear and tear

Cargo securing arrangements and equipment should have sufficient residual strength to allow for normal wear and tear during their lifetime.

20.   Friction forces

Cargoes with low friction coefficient should also be tightly stowed across the ship to avoid sliding. Suitable material such as soft boards or dunnage should be used to increase friction.

21.   Shipboard supervision

The principal means of preventing the improper stowage and securing of cargoes is through proper supervision of the loading operation and inspections of the stow.

As far as practicable, cargo spaces should be regularly inspected throughout the voyage to ensure that the cargo units remain safely secured.

22.   Entering enclosed spaces

The atmosphere in any enclosed space may be incapable of supporting human life through lack of oxygen or it may contain flammable or toxic gases. The relevant company QSMS guidelines and checklists to be applied.

23.   Causes of cargo loss

Some of the most common causes of cargo loss, which should be given careful consideration when securing cargoes, are as follows:

-        Severe adverse weather.
-        Insufficient or ineffective use of dunnage.
-        Lashings inadequate in number or strength.
-        Port and starboard or forward and aft lashings ill-balanced.
-        Wire attachment eyes or loops badly formed.
-        Incorrect use of bulldog grips.
-        Lack of strength continuity as between wire, attachment eyes, chain, turnbuckles, lashing webbing, shackles and fixed point terminations.
-        Lashings secured around sharp or unprotected edges.
-        Failure to appreciate the forces generated on a sea-going vessel.
-   Failure to provide sufficient personnel or time to effectively complete the work before sailing.

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3.2 Evaluation of forces acting on cargo units.

This sub-chapter contains the following information:

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

2 examples of the forces acting on typical cargo units when subjected to the accelerations referred to in paragraph 1 above and angles of roll and metacentric height (GM) values above which the forces acting on the cargo units exceed the permissible limit for the specified securing arrangements as far as practicable;

3 examples of how to calculate number and strength of portable securing devices required to counteract the forces referred to in 2 above as well as safety factors to be used for different types of portable cargo securing devices.

3.2.1 Introduction to Forces:

1. A cargo unit stowed on board will be subjected to the same movements the vessel experiences at sea. The most important, for securing purposes, are:

   1. Rolling.   3. Heaving.
   2. Pitching.   4. Wind Force.

Fig 3-1 showing the various motions affecting any cargo unit.
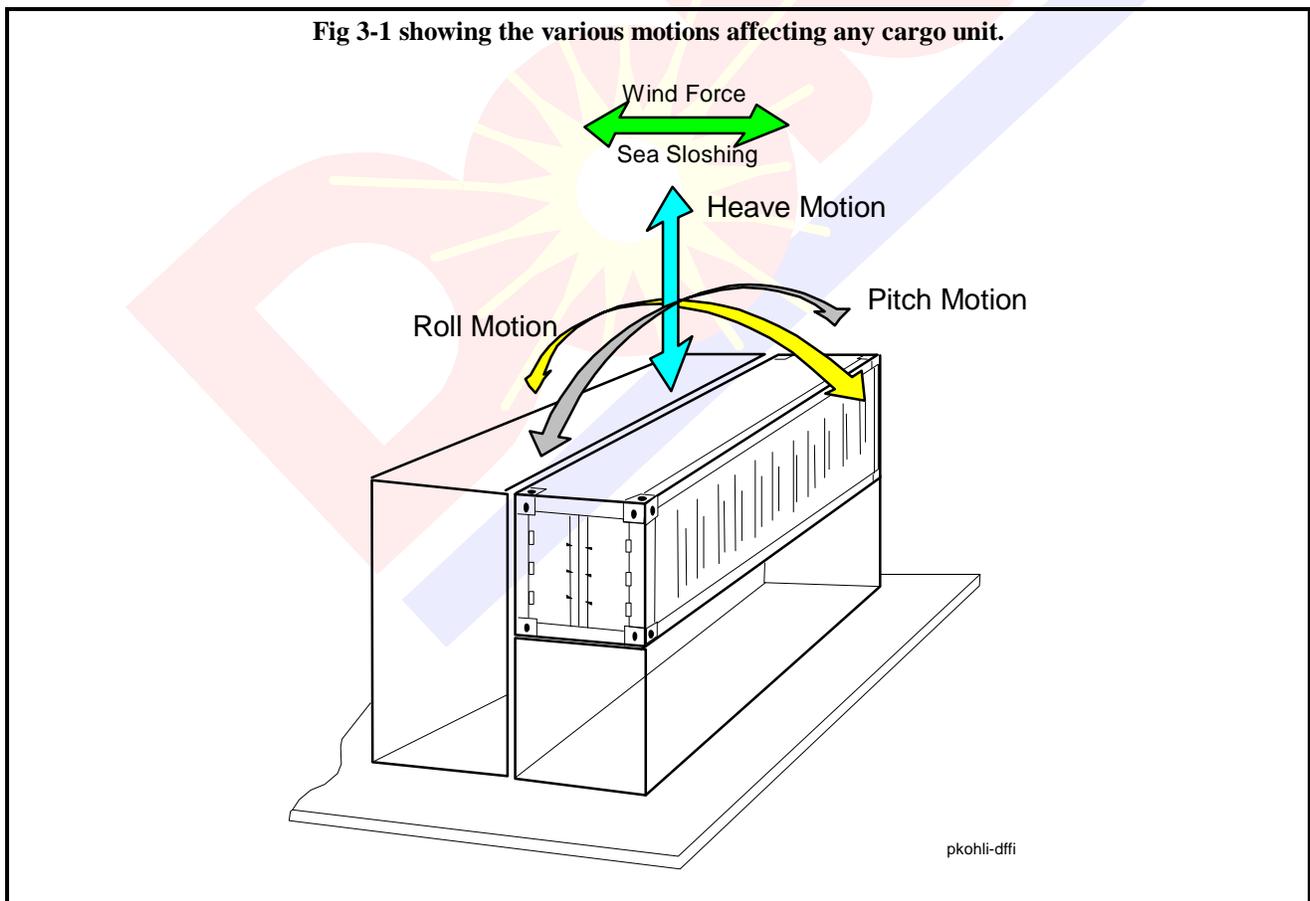
Of the above-mentioned motions, the time period involved and the amplitude of motion are significant.

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- The time period of roll motion is obtained from the formula "Roll Tr = 0.7B ÷√GMT". A maximum roll amplitude of 30 degrees is specified.
- Pitch time period is "Tp = 0.5 ÷ Lpp". A maximum pitch amplitude of 8 degrees is accounted.
- Heave period is "Th = 0.5 ÷ Lpp". The Heave amplitude is Lpp ÷ 80 m.
- Wind force and Sea Sloshing are considered to act constantly, athwart ship only – at 1kN/m²

The Forces acting on a shipboard weight can be resolved into vertical and transverse directions.

Figure 3-2

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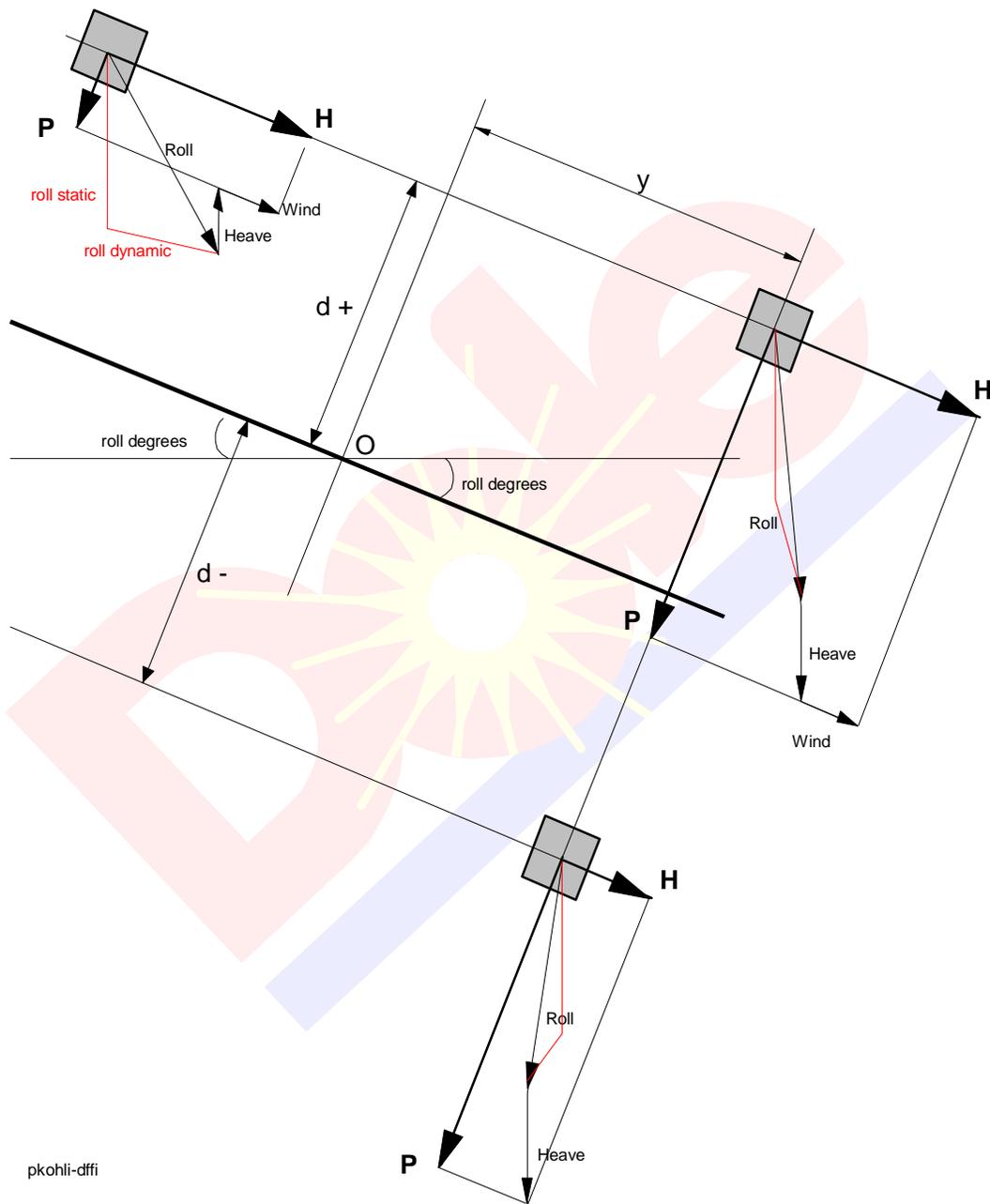
In the figure 3-2 above, O is the motion centre, d+ & d- are the vertical distances (positive or negative) from this centre. The transverse distance from O is shown as y. The force P is the pressure acting normal to deck and H is the sliding force horizontal to deck. Both have been resolved from the forces that arose due to:

i)   Rolling (dynamic and static)

ii)   Heave, and
iii)   Wind (Sea) (acts on above deck weights).

The centre of motion (though constantly changing the affect of such changes is small), is considered to be:
- on the centreline of the vessel.
- at the long. centre of floatation.
- at the waterline or at one half of the moulded depth, whichever is greater.

(Remark: For the purpose of stowage and securing cargo, longitudinal and transverse forces are considered predominant.)

2   Static component of the forces are due to gravity. The Dynamic components arise from the vessel's motions in seaway.

3   Transverse forces alone, or the resultant of transverse, longitudinal and vertical forces, normally increase with the height of the stow and the longitudinal distance of the stow from the ship's centre of motion in a seaway. The most severe forces can be expected in the furthest forward, the furthest aft and the highest stowage position on each side of the ship.

4   The transverse forces exerted increase directly with the metacentric height of the ship. An undue metacentric height may be caused by:

i)   improper design of the ship;
ii)   unsuitable cargo distribution; and
iii)   unsuitable bunker and ballast distribution

5   Cargo should be so distributed that the ship, at all times during the voyage, has a metacentric height in excess of the required minimum and, whenever practicable, within an acceptable upper limit to minimize the forces acting on the cargo.

6   In addition to the forces referred to above, cargo carried on deck may be subjected to forces arising from the effects of wind and green seas.

7   Improper shiphandling (course or speed) may create adverse forces acting on the ship and the cargo.

8   The magnitude of the forces may be estimated by using the appropriate calculation methods as contained in this Cargo Securing Manual.

3.2.2   Methods to assess the efficiency of securing arrangements for non-standardized cargo:

1.   Scope of Application

Nothing in this manual should be read to exclude the use of computer software, provided the output achieves design parameters, which meet the minimum safety factors applied in this sub-chapter.

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

2.   Strength of securing equipment
       Though vessel design and trade does not involve any securing equipment to be maintained for use on board, this manual attempts a general discourse on such common equipment.

2.1   Manufacturers of securing equipment should at least supply information on the nominal breaking strength of the equipment in kilo-Newton's (kN) (1kN=1000 kg)

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2.2   Maximum securing load" (MSL) is a term used to define the load capacity for a device used to secure cargo to a ship. Maximum securing load is to securing devices as safe working load is to lifting tackle.

The MSLs for different securing devices are given in table 3-0.

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

Table 3-0 - Determination of MSL from breaking strength

Material	MSL
shackles, rings, deckeyes, turnbuckles of mild steel	50% of breaking strength
fibre rope	33% of breaking strength
wire rope (single use)	80% of breaking strength
wire rope (re-useable)	30% of breaking strength
steel band (single use)	70% of breaking strength
chains	50% of breaking strength
web lashings	70% of breaking strength (IMO/DSC 2, feb. 97)

2.3 For particular securing devices (e.g. fibre straps with tensioners or special equipment for securing containers), a permissible working load may be prescribed and marked by authority. This should be taken as the MSL.

2.4 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.

3.   Safety factor

Within the assessment of a securing arrangement by a calculated balance of forces and moments, the calculated strength (CS) of securing devices should be reduced against MSL, using a safety factor of 1.5, as follows:

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

The reasons for this reduction are the possibility of uneven distribution of forces among the devices, strength reduction due to poor assembly and others.

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

4.   Rule-of-thumb-method

Simplified method for evaluation of required lashing strength for safe securing of a cargo unit. The method does, by no means, optimise any arrangement, but may be used as a first approach to define the arrangement. A later control with the advanced calculation method is advisable.

1.1   The total of the MSL values of the securing devices on each side of a unit of cargo (port as well as starboard) should equal the weight of the unit. (The weight of the unit should be taken in kN).

1.2   This method, which implies a transverse acceleration of 1g (9.81 m/s²), 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 friction.

1.3   Transverse lashing angles to the deck should not be greater than 60° and it is important that adequate friction is provided by the use of suitable material. Additional lashings at angles of greater

Sample

than 60° may be desirable to prevent tipping but are not to be counted in the number of lashings under the rule-of-thumb.

5. Advanced calculation method

In the advanced method, acceleration is applied to cargo mass to obtain the external forces to a cargo unit in longitudinal, transverse and vertical directions. This calculation then enables us to compare with the securing force which is applied to this cargo through application of lashing.

The acceleration data for Tropical Estoril are presented in the tables 3-1 and 3-2.

Table 3-1

Vessel Name: Tropical Estoril						**Ship IMO No:** 738073					
Accelerations according to Annex 13 to IMO Res. A714(17)											
Transverse acceleration a_y in m/s^2											Long acc
Long. position:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	a_x in m/s^2
Deck, high	**6.68**	**6.68**	**6.49**	**6.40**	**6.30**	**6.30**	**6.40**	**6.49**	**6.68**	**6.96**	**6.96**	**3.57**
Deck, low	**6.11**	**6.11**	**5.92**	**5.74**	**5.74**	**5.74**	**5.74**	**5.92**	**6.11**	**6.30**	**6.30**	**2.73**
Tween-deck	**5.55**	**5.55**	**5.27**	**5.17**	**5.08**	**5.08**	**5.17**	**5.27**	**5.55**	**5.83**	**5.83**	**1.88**
Lower hold	**5.17**	**5.17**	**4.98**	**4.80**	**4.70**	**4.70**	**4.80**	**4.98**	**5.17**	**5.55**	**5.55**	**1.41**
Vertical acceleration a_z in m/s^2											
	7.15	**7.15**	**5.83**	**4.70**	**4.04**	**4.04**	**4.70**	**5.83**	**7.15**	**8.65**	**8.65**	

Note !
Accelerations apply for GM of 0.15m to 1.25m

Accelerations according to IMO Res.A714(17), Annex 13.
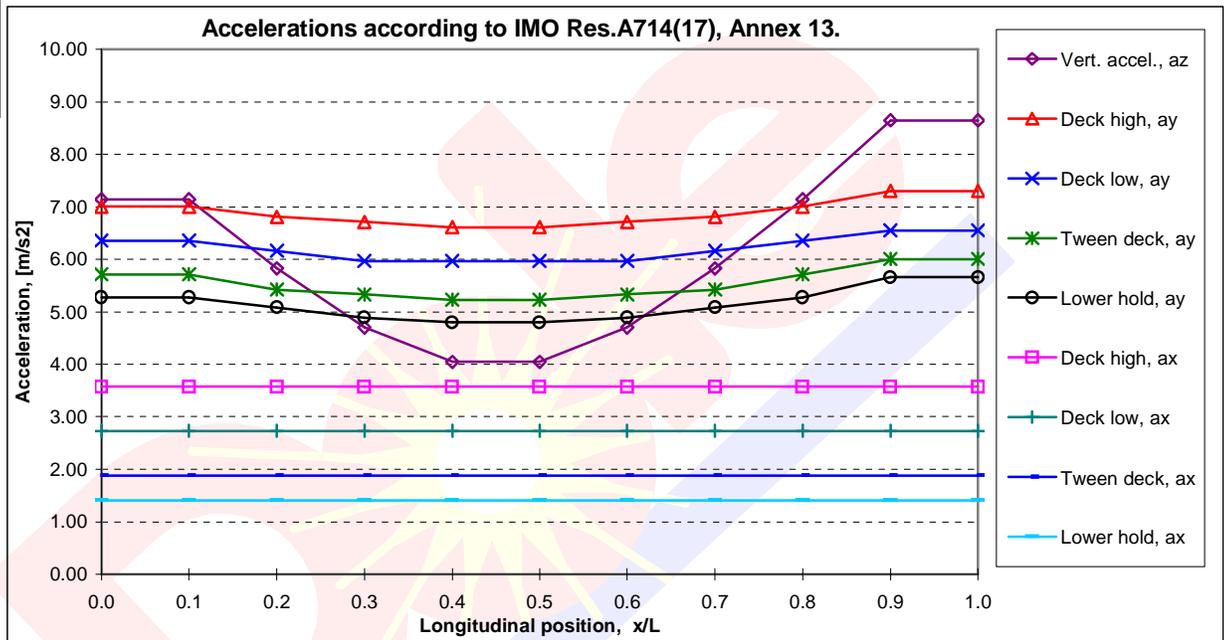
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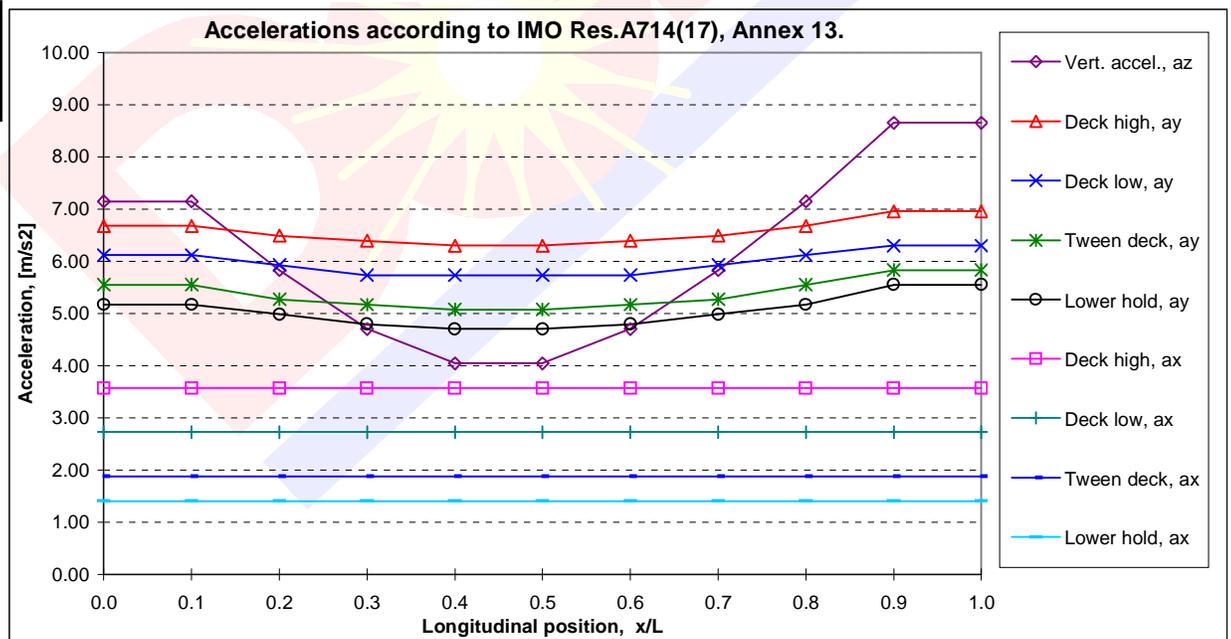
Above table 3-1 shows accelerations as evident on MV Tropical Estoril over a range of GM values from 0.15 to 1.25m. No change in acceleration is quantifiable over this GM range.

Table 3-2

Vessel Name: Tropical Estoril							**Ship IMO No:** 738073					
Accelerations according to Annex 13 to IMO Res. A714(17)												
Transverse acceleration a_y in m/s^2												Long acc
Long. position:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	a_x in m/s^2
Deck, high	**7.01**	**7.01**	**6.81**	**6.71**	**6.62**	**6.62**	**6.71**	**6.81**	**7.01**	**7.31**	**7.31**	**3.57**
Deck, low	**6.36**	**6.36**	**6.16**	**5.97**	**5.97**	**5.97**	**5.97**	**6.16**	**6.36**	**6.55**	**6.55**	**2.73**
Tween-deck	**5.72**	**5.72**	**5.42**	**5.33**	**5.23**	**5.23**	**5.33**	**5.42**	**5.72**	**6.01**	**6.01**	**1.88**
Lower hold	**5.28**	**5.28**	**5.08**	**4.89**	**4.80**	**4.80**	**4.89**	**5.08**	**5.28**	**5.66**	**5.66**	**1.41**
Vertical acceleration a_z in m/s^2												
	7.15	**7.15**	**5.83**	**4.70**	**4.04**	**4.04**	**4.70**	**5.83**	**7.15**	**8.65**	**8.65**	

Note !
Accelerations apply for GM of 1.50m

Accelerations according to IMO Res.A714(17), Annex 13.

pkohli-dffi

Above table 3-1 shows accelerations as evident on MV Tropical Estoril at a of GM value 1.50m.

Remarks:

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

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

1. Operation in unrestricted area;
2. Operation during the whole year;
3. Duration of the voyage is 25 days;
4. Length of ship is 135.2 m (for Tropical Estoril);
5. Service speed is 19.5 knots (for Tropical Estoril);
6. GM range of 0.15 to 1.25m and GM of 1.50m (for Tropical Estoril).

Sample

The following cautions should be observed;

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

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 should 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 should be considered.

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

force by wind pressure   = 1 kN/m²
force by sea sloshing   = 1 kN/m²

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

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

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

5.1   Assumption of external forces

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

$F_{(x,y,z)} = ma_{(x,y,z)} + F_{w(x,y)} + F_{s(x,y)}$ where,

$F_{(x,y,z)}$	=	longitudinal, transverse and vertical forces
m	=	mass of unit
$a_{(x,y,z)}$	=	longitudinal, transverse and vertical accelerations (see table 3-1, 3-2)
$F_{w(x,y)}$	=	longitudinal and transverse forces by wind pressure
$F_{s}(x,y)$	=	longitudinal and transverse forces by sea sloshing

5.2   Balance of forces and moments

The balance calculation should 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.

5.2.1   Transverse sliding

The balance calculation should meet the following condition (see also figure 3-3):

$F_y \leq \mu\, m\, g + CS_1\, f_1 + CS_2\, f_2 + ... + CS_n\, f_n$

Sample

where

|		
n	is the number of lashings being calculated
F_y	is transverse force from load assumption (kN)
μ	is friction coefficient
	(μ = 0.3 for steel - timber or steel - rubber)
	(μ = 0.1 for steel - steel, dry)
	(μ = 0.0 for steel - steel, wet)
m	is mass of the cargo unit (t)
g	is gravity acceleration of earth = 9.81 m/s²
CS	is calculated strength of transverse securing devices (kN)
f	is a function of μ and the vertical securing angle $\propto$ (see table 3-3).
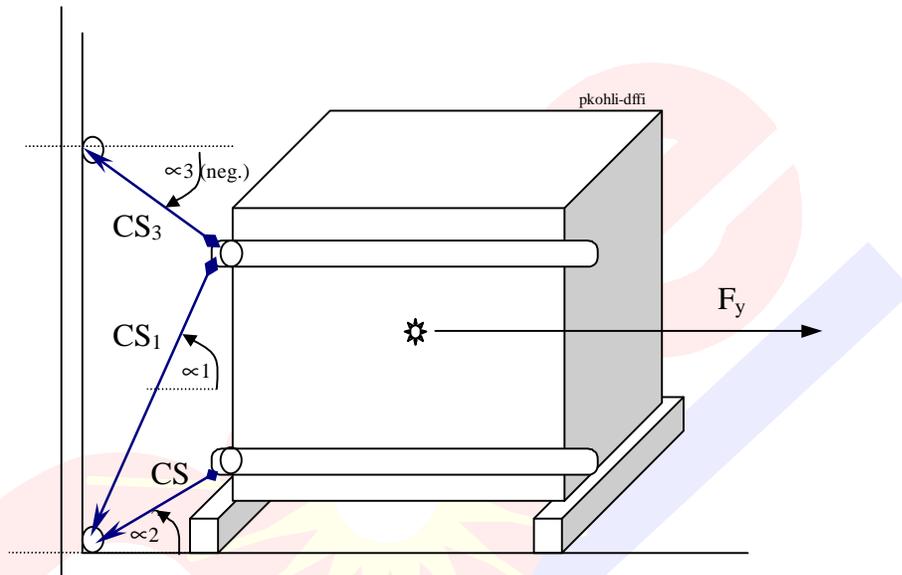
Figure 3-3 - Balance of transverse forces

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

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

Table 3-3 (f – values as a function of m & μ)

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

Remark: $f = m \sin \mu + \cos \mu$

Sample

5.2.2 Transverse tipping

This balance calculation should meet the following condition (see also figure 3-4):

$$F_y \, a \leq b \, m \, g + CS_1 \, c_1 + CS_2 \, c_2 + ... + CS_n \, c_n$$

Where

F$_y$, m, g, CS, n are as explained under 5.2.1.
a is lever-arm of tipping (m) (the CG of cargo from deck)
b is lever-arm of stableness (m) (see figure 3-4)
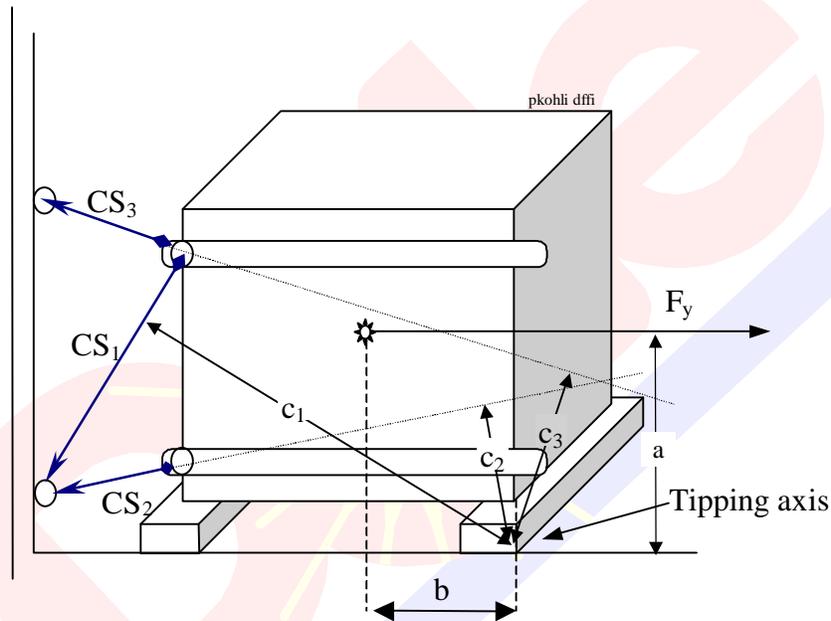c is lever-arm of securing force (m) (see figure 3-4)

Figure 3-4 Balance of transverse moments

5.2.3 Longitudinal sliding

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

$$F_x \leq \mu \, (m \, g - F_z) + CS_1 \, f_1 + CS_2 \, f_2 + ... + CS_n \, f_n$$

where

F$_x$ is longitudinal force from load assumption (kN)
μ, m, g, f, n are as explained under 7.2.1
F$_z$ is vertical force from load assumption (kN)
CS is calculated strength of longitudinal securing devices (kN)

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

Sample

6.   Explanations and interpretation of "Procedure for calculation of forces in semi- and non-standardised lashing arrangements"

1.   The exclusion of very heavy units as carried under the provisions of chapter 1.8 of the Code from the scope of application of the methods should 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 should 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 2, in combination with the correction factors, represent peak values on a 25-day voyage. This does not imply that peak values in x, y and z directions occur simultaneously with the same probability. It can be generally assumed that peak values in the transverse direction will appear in combination with less than 60% of the peak values in longitudinal and vertical directions.

Peak values in longitudinal and vertical directions may be associated more closely because they both arise from 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 would 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 should be seen in various influences which may appear in practical shipping, as: moisture, grease, oil, dust and other residues, and 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 should necessarily include the consideration of:

- load-elongation behaviour (elasticity),
- geometrical arrangement (angles, length),
- pre-tension of each individual securing element.

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

Therefore a simplified approach has been 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 1.5.

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

It should 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 goal anyway. There is no clear-cut borderline between safety and non-safety. If in doubt, the arrangement should be improved.

7. Calculations specific to Tropical Estoril – Examples.

A box of banana weighs 20.4 kg when loaded with dimensions 240mm x 300 mm. Below calculations are for a stow position at 0.9L and in tween deck. Friction coeff. between cardboard box and wood gratings is taken as 0.3 (same as steel to wood) for this example.

F (transverse) = mass X transverse acceleration; 0.0204 x 5.88 = 0.11 kN

F (tipping) = F (transverse) X Lever arm of tipping; = 0.11 x 0.12 = 0.01 kN

Following figure 3-5, show calculations for a theoretical cargo of 5 tonnes loaded at 0.4L in tween deck. This example shows the steps required to calculate forces in the athwartship direction and attempts to balance them against 4 lashing arrangements applied.

Tropical Estoril   **Direction: Port or Starboard**

Step 1: Give required cargo input   **Step 2**: Calculate external forces

				External forces:			
Cargo unit mass	C1	5.0	[t]				
Centre of gravity above deck	C2	1.1	[m]	Sliding force	C7	25.4	C7 = C1 x C5 + 2 x C6
Lever arm of stableness	C3	1.0	[m]	Tipping moment	C8	27.9	C8 = C7 x C2
Coefficient of friction	C4	0.30	[-]	Cargo stabilising charicteristics:			
Transverse acceleration - tables 3-1, 3-2	C5	5.08	[m/s²]	Friction force	C9	14.7	C9 = 9.81 x C1 x C4
Wind and sea exposed area	C6	0.0	[m²]	Transverse tippii	C10	49.1	C10 = 9.81 x C1 x C3

Step 3: Calculate stabilising characteristics

Lashing Table

Lashing no.		1	2	3	4	5	6	7	8	9	10		
MSL [kN]	C11	3	3	3	3								
Lashing angle, α [°]	C12	30	30	45	45								
f-value, table 3-3	C13	1.02	1.02	0.96	0.96								

Step 4: Give required input for each lashing

C14 = 0.67 x C11 x C13   **Step 5**: Calculate sliding capacity for each lashing   C17 = ΣC14₁₋₁₀

													C17	8.0
Sliding	C14	2.1	2.1	1.9	1.9									
Lever-arm, c [m]	C15	1.5	1.5	2.2	2.2									

Step 6: Sum of sliding capacities for all lashings

C16 = 0.67 x C11 x C15   **Step 7**: Give lever-arm for each lashing, see figure 3.3   C18 = ΣC16₁₋₁₀

													C18	14.9
Tipping	C16	3.0	3.0	4.4	4.4									

Step 8: Calculate tipping capacity each lashing   **Step 9**: Sum of tipping capacities for all lashings given

Balance criteria:		C7		C9		C17		C9 + C17		OK / Not OK
	Sliding:	25.4	<	14.7	+	8.0	=	22.7		Not OK
		C8		C10		C18		C10 + C18		OK / Not OK
	Tipping	27.9	<	49.1	+	14.9	=	63.9		OK

Step 10: Perform balance control

Figure 3-5

In the above example, one sees that the sliding force is not balanced with lashing capacity. A similar form can be used for more calculations when needed.

Similarly, the following figure 3-6 shows a format that can be used when calculating longitudinal forces for a cargo unit.

Tropical Estoril								Direction: Forward or Aft	
Step 1: Give required cargo input					**Step 2**: Calculate external forces				
Cargo unit mass		C1	5.0	[t]	External force:				
Coefficient of friction		C2	0.30	[m]	Sliding force		C6	9.4	C6 = C1 x C3 + 2 x C5
Longitudinal acceleration - tables 3-1, 3-2		C3	1.88	[m]					
Vertical acceleration - tables 3-1, 3-2		C4	4.04	[-]	Cargo stabilising charicteristics:				
Wind and sea exposed area		C5	0.0	[m²]	Friction force		C7	8.7	C7 = C1 x C2 x (9.81 - C4)
					Step 3: Calculate stabilising characteristics				

Lashing Table

Lashing no.	1	2	3	4	5	6	7	8	9	10	
MSL [kN] C8											
Lashing angle, α [°] C9				**Step 4**: Give required input for each lashing							
f-value, table 3-3 C10											
C10 = 0.67 x C8 x C10			**Step 5**: Calculate sliding capasity for each lashing							C12 = ΣC11₁.₁₀	
Sliding C11										C12	
					Step 6: Calculate sum of sliding capasities for all lashings given						

Step 7: Perform balance control

Balance criteria: Sliding: [C6] < [C7] + [C12] = [C7 + C12] [OK / Not OK]

Figure 3-6

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

3.3.1 This vessel only carries cargo in block stow in cargo holds. Cargo holds are insulated for refrigerated cargo and do not have any fixed securing points. There are no securing points on upper deck and no deck loads are transported.

In general - in order to ensure the correct application of the portable securing devices, the following factors should be taken into account:

(i)   duration of the voyage;

(ii)   geographical area of the voyage with particular regard to the minimum safe operational temperature of the portable securing devices (this is particularly important where ambient deck temperatures at or below 0°C may be encountered. Appropriate grades of steel should be used in such cases);

(iii)   sea conditions which may be expected;

(iv)   dimensions, design and characteristics of the ship;

(v)   expected static and dynamic forces during the voyage;

Sample

(vi)   type and packaging of cargo units;

(vii)   intended stowage pattern of the cargo units; and

(viii)   mass and dimensions of the cargo units.

3.3.2   There are no specified lashing points available on board. Further, it is not recommended to secure cargo against vessel rails or structure which is not designed for tangential loads. Vessel scantling does not allow lashing to cargo blocks. For stowage of cargo (fruit boxes) on board, see Annex 1 of this manual.

It should be noted 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 vessel cannot containers, trailers and other cargo carrying vehicles.

Refrigerated cargo is nowadays also transported in pallets-

Such palletised cargoes are also a difficult proposition on board as the cargo holds and tween decks evidence a camber and a fore and aft pitch. The deck heights vary athwartship and in the fore and aft direction. Thus pallets can never be of uniform heights and will need to be modified depending on stow position within the cargo space for the height available. Further complicating matters is the ship's sheer evidenced along the sides.

The Tropical Estoril was not designed for carriage of palletised cargo – camber, pitch, sheer evidenced. Many decks are overhanging the engine space or tanks. Additional insulation in these localised areas creates a sharp slope - a ramp like structure within these tween decks, usually towards the ends. All this should be deliberated upon before deciding to carry palletised cargo.

As the cargo spaces on Tropical Estoril are not of a rectangular shape, horizontally and vertically. Cargo spaces should be transformed into a rectangular shape both athwartships and longitudinally by the use of suitable timber. Vertical side shoring require to be built to present a vertical support structure to the outboard pallets. Such a framework of side shoring needs to be constructed of wood planks (and/or plywood).

In the event that the vessel does attempt to load palletised cargo-
   a) Construct suitable side boards on the hatch sides.
   b) Enable a secure tight stow across the available loading area.
   c) Use portable Inflatable Dunnage Bags to shore up any gaps between pallets.

The above ensures a tight athwartship stow and prevents any transverse shift. If a hold is partly loaded, longitudinal shift is prevented by applying wooden shoring, observing prudent seamanship.

As hold decks comprise of corrugated wooden gratings, a suitably high friction force exists (μ 0.4 to 0.6)

Using the methods explained earlier (3.2..), for a standard pallet stowed in tween deck at 0.8L:
Weight – 890kgs, CG - 0.9m, Lever arm of stableness – 0.5m, friction coeff. μ – 0.4 (wood-wood)

Each pallet will be subject to:
   Transverse sliding force – 4.9kN
   Longitudanal sliding force – 1.6kN
   Tipping force – 4.4kN

Friction alone provides a securing capacity:
   Sliding capacity – 3.5kN (tight stowage suffices)
   Tipping capacity – 4.4kN

Air Bags are usually designed and marked for gap width (usually 400-450mm) and max pressure (usually 2 PSI). The vessel holds no stock of air bags – does not carry palletised cargo.
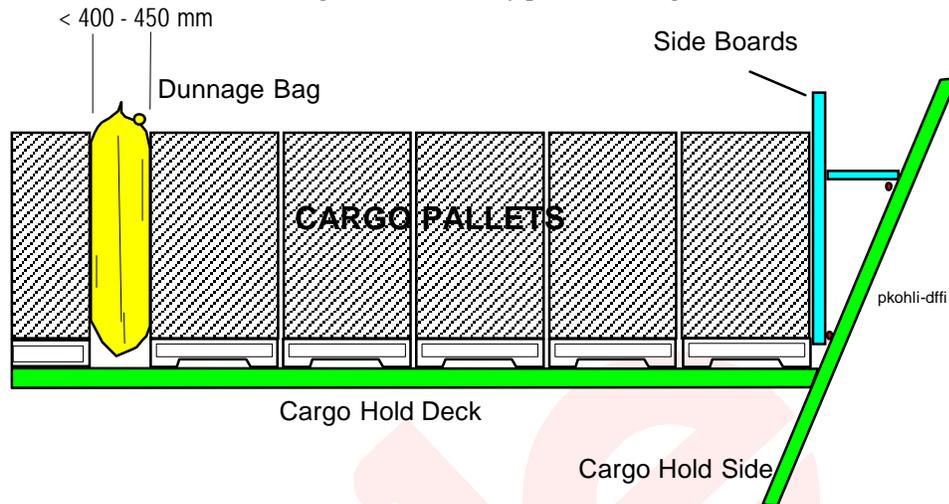

Figure 3-7

Above figure shows a sample arrangement for cargo on pallets, if it where to be carried on board.

Note: *As lashing is not possible for of securing cargo, timber shoring and wedging is the more frequently used method for packaged units below decks. Shoring and wedging are the most appropriate method of securing in many cases since the cargo thrust acts opposite to hydrostatic loading in the case of side shell frames, bulkhead stiffeners and deck beams.*

Maximum permissible deck and hatch loadings should not be exceeded. Point loading and uneven distribution of cargo can, and frequently do, cause unnecessary damage to decks and hatch covers. The ships capacity plan and/or general arrangement plan should always be consulted, if the information is not there the ships stability booklet should be consulted. The relevant figures are quoted in this Manual (Page 5)

Additionally, following is a Table of default values of the maximum permissible deck and hatch loadings taken from the Lloyd's Register Ship Rules:

	Permissible Cargo Loading in tonne f/m^2
Inner Bottom	T
Cargo Decks in Holds	Htd/1.39
Cargo Hatch Covers	Htd/1.39
Weather Deck	0.865
Weather Deck Hatch Covers	0.865

Where: T = Summer Load Draft in Metres
Htd = Tween Deck Height in Metres

Sample

Annex 1
Safe stowage and securing of Banana Boxes.

1   **Introduction**

This vessel transports loose cartons of banana boxes in insulated cargo holds. No lashing arrangement is applicable and the practice of tight stow is realized to minimize cargo shift in seaway.

2   **Cargo information**

2.1   the total number of unit loads and commodity to be loaded; provided by operations department.

2.2   the dimensions of a unit load in metres; every box is of 0.24m height

2.3   the gross mass of a unit load in kilogrammes; is at an average 20.4 kgs.

2.4   Each box is made of soft cardboard.

3   **Recommendations**

3.1   The cargo spaces of the ship in which unit loads will be stowed should be clean, mould free, dry and free from oil and grease.

3.2   During the ballast voyage, the cargo holds are to be cleaned, remnants of the previous cargo removed, and the holds are to be ventilated with fresh air when possible. The wooden "warkhaus" gratings should be replaced in the decks, including the tank top after the usual pre-loading cleaning.

3.3   Loadports advise the Master of the estimated time that loading will begin and the cargo spaces to be loaded. The compartments that are to be loaded should be precooled (check Dole manual for precooling temperatures).

3.4   Bananas must be stowed not higher than 6 inches below the deck head beams or overhead insulation to allow return air to reach the cooling batteries. The deck area of a compartment, which is partially loaded, is to be covered by one tier, preferably two tiers of boxes, evenly distributed. The open deck spaces can also alternatively be covered with a tarpaulin or kraftpaper if available. This is required to inhibit any short cycling of cooling air.

4   **Stowage**

4.1   The boxes should be stowed without any void space between the loads and the ship's sides.

4.2   Bananas must be stowed not higher than 6 inches below the deck head beams or overhead insulation.

4.3   The stowage is done by hand and care should be taken to allow minimize any loss of stow capacity.

Sample

4.4 During stowage, stevedores may attempt to walk across the boxes. To minimize damage to boxes plywood or rubber sheets should be laid over the boxes when such access is required.

5   Securing

5.1 Block stowage should be ensured and no void space be left between the unit loads.

5.2 Where full deck loads are not possible, cargo should be stepped down as a securing measure.

See Figure A-1 below for a typical stow arrangement.
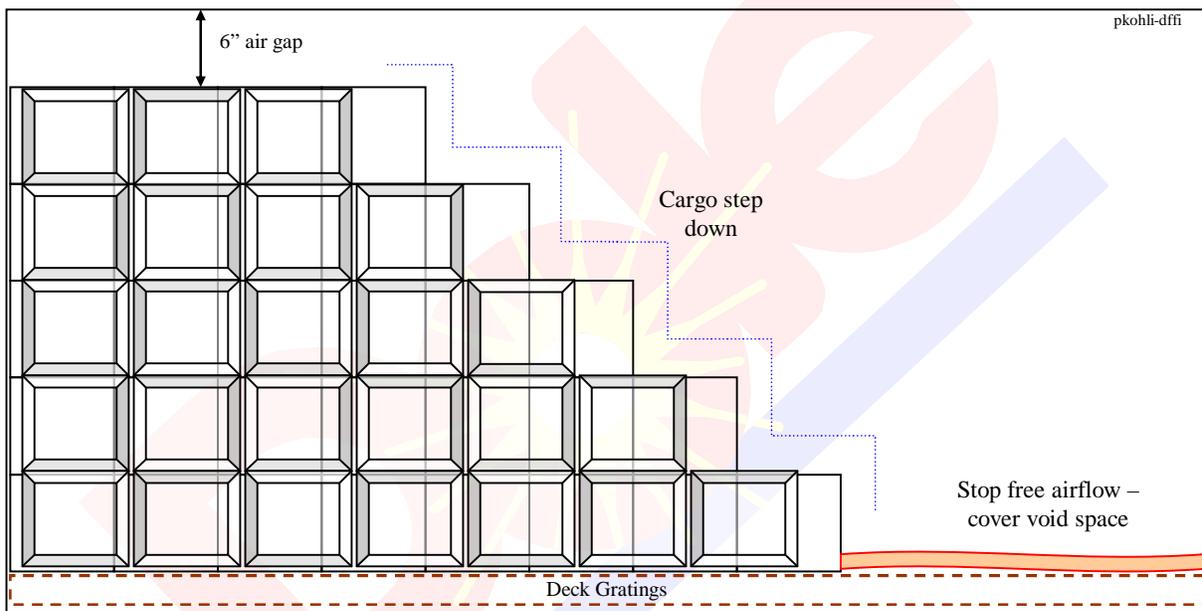
SOLAS CHAPTER VI
CARRIAGE OF CARGOES

Regulation 1 - Application

This chapter applies to the carriage of cargoes (except liquids in bulk, gases in bulk and those aspects of carriage covered by other chapters) **which, owing to their particular hazards to ships or persons on board, may require special precautions** in all ships to which the present regulations apply, and in cargo ships of less than 500 tons gross tonnage. However, for cargo ships of less than 500 tons gross tonnage, the Administration, if it considers that the sheltered nature and conditions of voyage are such as to render the application of any specific requirements of part A or B of this chapter unreasonable or unnecessary, may take other effective measures to ensure the required safety for these ships.

Regulation 5 - Stowage and securing

All cargoes other than solid and liquid bulk cargoes shall be loaded, stowed and secured throughout the voyage, in accordance with the Cargo Securing Manual approved by the Administration. In ships with ro-ro cargo spaces, as defined in regulation II-2/3.14, all securing of such cargoes, in accordance with the Cargo Securing Manual shall be completed before the ship leaves the berth. The Cargo Securing Manual shall be drawn up to a standard at least equivalent to the guidelines developed by the Organization.

SOLAS CHAPTER VII
CARRIAGE OF DANGEROUS CARGOES

Regulation 5 - Stowage requirements

All cargoes other than solid and liquid bulk cargoes shall be loaded, stowed and secured throughout the voyage, in accordance with the Cargo Securing Manual approved by the Administration. In ships with ro-ro cargo spaces, as defined in regulation II-2/3.14, all securing of such cargoes, in accordance with the Cargo Securing Manual shall be completed before the ship leaves the berth. The Cargo Securing Manual shall be drawn up to a standard at least equivalent to the guidelines developed by the Organization.