Cargo calculation and cargo plans

Bale capacity:

This is cubic capacity of a space where the breadth is taken from inside of the cargo battens, the depth from the wood ceiling to the underside of the deck beams and the length from the inside of the bulkhead stiffeners or spar-ceiling where fitted.

Grain capacity:

This will be larger than above, and is the capacity of a space where the lengths, breadths and depths are taken right to the plating. An allowance is made for the volume occupied by frames and beams.

Stowage factor:

This is the figure for any commodity which express the actual number of cubic metres that are required to stow one tone of commodity.

This is not the actual cubic measurement of one tone and therefore should include an allowance for the dunnage require and any broken stowage caused by the shape of package, which in some irregular shapes could be quite considerable.

Broken stowage:

The space between packages which remains unfilled. The percentage that has to be allowed varies with the type of cargo and with the shape of the hold. It is greatest when large cases have to be stowed in an end hold.

The stowage factor is an essential important for ship's officer in planning his stowing order to decide what parcels of cargo go where.

Dead weight:

This is the weight a vessel can carry when fully laden, the combined weight of cargo, stores, water, crew etc. and is equal to displacement at any draft minus the weight of light ship.

In order to decide upon how much cargo the v/l can load, we will also have to consider the dead weight available for cargo.

When carrying heavy cargo it will be the dead weight which will limit how much can be loaded, whilst the light bulky cargoes, it will be capacity of the ship.

Stowage principles:

- Cargo planning and distribution.
- Operating procedures, the cargo stow.

- Accepting cargo in different forms.
- Preparation for cargo reception, cleaning holds and spaces, use of dunnag.
- Separation of cargoes, port marking.
- Special cargo.
- Broken stowage.
- Voyage care.
- Procedures for discharging.
- Damage to cargo, precaution to be adopted, slinging, crushing, fork lift, strain and stress on cargo at sea.

All above are important factors which due regards shall be made towards.

Cargo calculation :

Q- 1

Calculate the amount of following cargoes which can be loaded

In hold no: 3 which has a grain capacity of 6848.5

A)- wheat, s.f = 1.18 cu.m.t

B)- coal, 1.08 cu.m.t

C)- maze, 1.41 cu.m.t

$$W_A = \frac{vol}{S.F} = \frac{6848.5}{1.18} = 5803.8 \text{ mt}$$

$$W_B = \frac{6848.5}{1.08} = 6341.2 \text{ mt}$$

$$W_C = \frac{6848.5}{1.41} = 4857.1 \text{ mt}$$

Q –2

Calculate the space required for following cargoes?

A)- 3245 mt of copper cuttings s.f = 3.07 cu.m.t.

B)- 1848 mt of bannas in cartons s.f = 3.90 m^3 / t.

$Vol_{(a)} = 3245 \times 3.07 = 9962.1\ m^3$

$Vol_{(b)} = 1848 \times 3.90 = 7207.2\ m^3$

Q- 3 Calculate total amount of steel bar in bundle in a hold having following dimensions:

L = 26.8m b = 23, h.t = 4m

Load density = $5t / m^2$

Bundles size = 12 m × 0.5 m × 0.6 m

Weight of each bundles = 3.5 tons

Area for one bdls = 12 × 0.5 = 6 m^2

In above area total weight that can be loaded = 6 × 5 = 30 t.

30 ÷ 3.5 = 8.57 = 8 tiers of bdls.

Number of balsa can be loaded transversely = 23 ÷ 0.5 = 46 bdls. Number of bdls loaded fwd part of hold = 46 × 8 = 368 bundles.

Number of bdls loaded aft part of hold = 46 × 8 = 368 bundles

Total = 368 × 2 = 736 bundles.

Total weight = 736 × 3.5 = 2576 tons

Q- 4

Calculate total amount of paint in drums having stowage factor of m^3 / t in 0.56 following holds, considering broken stowage of each holds.

Hold no.1, 1020 cbm , b.s = 7 %

Hold no.2, 1823 cbm , b.s = 5 %

Hold no.3, 2012 cbm , b.s = 3.5 %

#.1 b.s of hold = 1020 × 0.07 = 71.4 m^3

Net space = 1020 - 71.4 = 948.6 m^3

Weight = $\frac{vol}{S.F} = \frac{948.6}{0.56} = 1693.9t.$

#.2 b.s of hold = 1823 × 0.05 = 91.1 m^3

Net spAce = 1823 - 91.1 = 1732 m^3

Weight = $\frac{948.6}{0.56} = 1693.9\ t.$

#.3 b.s of hold = 2012 × 0.035 = 70.42 m^3

Net space = 2012 - 70.42 = 1941.6 m^3

Weight = $\frac{1941.6}{0.56}$ = 3467 t.

Q- 5

Calculate total amount of wheat cargo in bulk having s.f = 1.18 m^3/t. In a bulk carrier with following particulars at load port. V/l is in summer zone area, and will go to tropical area.

Total grain capacity = 52560.9 m^3

S. Draft = 11.6 m.

S. Δ = 52609 tons.

S.dead weight = 43265 tons.

Lt. Δ = 9344 tons

Departure condition:

F.o = 653 t

D.o = 124 t

F.w = 240 t

Unpumpable ballast = 170 t

Stores = 38 t

Constant = 250 t

Weight as per capacity:

Weight = $\frac{52561}{1.18}$ = 44543 tons

But v/l can not load more than summer draft.

S.disp - total deductable = cargo can be loaded.

Total.d.d =9344+ 653 +124 +240+170+ 38 + 250 =10819 tons

Cargo = 52609 - 10819 = 41790 tones

Which is less than summer deadweight, 43265 tons.

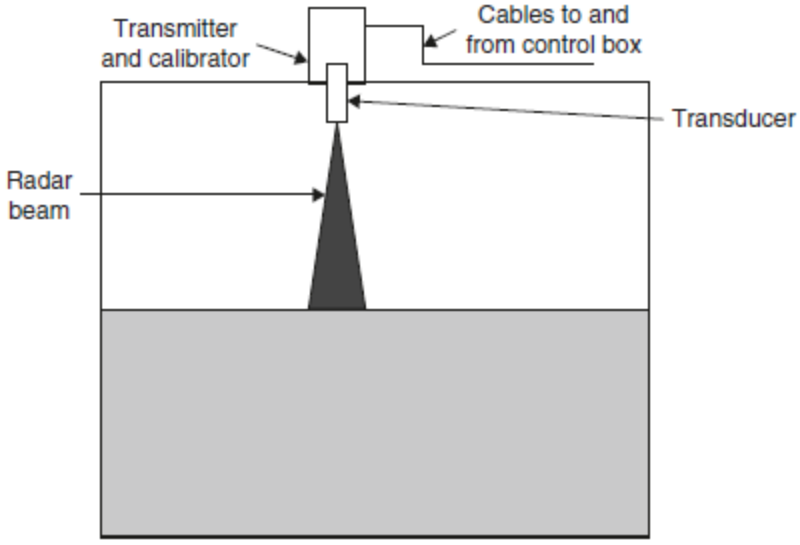
<u>Measurement of liquid cargoes:</u>

The volume of oil in a tank is ascertained by measuring the distance from a fixed point on deck to the surface of the oil. This distance is known as the ullage and is usually measured by means of a plastic tape, now days electronic instruments are in use.

A set of tables is supplied to every ship showing, for each compartment, the volume of liquid corresponding to a range of ullages which calls calibration tables. by use of tank calibration tables and given cargo density we can calculate the weight in a given tank.

by use of tank calibration tables and given weights and densities of cargoes we can determine the ullage required for completion of loading in each tank.

The ullage opening is set as nearly as possible in the center of each tank so that for a fixed volume of oil the ullage is not appreciably affected by conditions of list or trim.



Water:

At the time of taking ullage it is necessary to determine the amount of water present in the tank. This is obtained by the use of a water finder, a graduated rod, some 12 inch long, to which is attached water finding litmus paper or paste.

Temperatures:

The correct taking of temperatures is most important in view of the fact that varying temperatures cause variations in the volume of the oil. Special thermometers are provided by the principal oil companies and these should always be use.

Specific gravity:

The specific gravity is determined usually by the hydrometer, from samples taken from the ship tanks.

Effect of temperature upon specific gravity:

Changes in temperature affect the volume of a liquid, causing expansion or contraction.

Increase in volume, due to rising temperature, causes a decrease in the s.g, whilst a falling temperature, with the consequent contraction of volume, increases the s.g.

It is important to Determines the ullage to leave to produce a given minimum ullage allowing for expansion of cargo.

Liquid cargo calculation :

Q – 1

Find amount of crude oil having rd = 0.98 t/ m^3 which can be loaded in hold with following dimension leaving 0.2m ullage for cargo expansion?

L = 15 , b = 10 , h = 4.5 m

Volume of oil = 15 × 10 × (4.5 - 0.2) = 645 m^3

Weight = vol × r.d = 645 × 0.98 = 632.1 mt.

S.g. Correction coefficient:

The amount by which the s.g increase or decreases, per one degree change in temperature is known as the s.g correction coefficient (correction factor), it vary with the type of oil.

Q – 1

A cargo tank 50_M × 20_m × 10_m is loaded with oil of r.d = 0.75 t / m^3 at 16º c. Having 0.35m ullage.

A) Find total weight of oil in the tank.

Vol of oil = 50 × 20 × (10 - 0.35) = 9650 m^3

W = vol × r.d = 9650 × 0.75 = 7237.5 mt.

B) Find total weight of oil in the tank, if loading to be done at 26º c

Temperature. Oil correction factor = 0.00027º c.

Temp deference = 26º c - 16º c = 10º c.

Change in r.d = 10 × 0.00027 = 0.7473

W = 9650 × 0.7473 = 7211.4 mt.

Cargo stowage plans :

This is a plan or plans showing all cargo compartments & disposition of cargo throughout the vessel. It should be on a generous scale, and while not exactly to scale. The plans shall indicates:

1- The comparative volume of different parcels in any compartment.
2- All pillars, beams, lockers and position of doors should be shown.
3- Number and type of derricks / cranes of each hatcH.
4- Dimensions of holds, length and breadth of hatches.

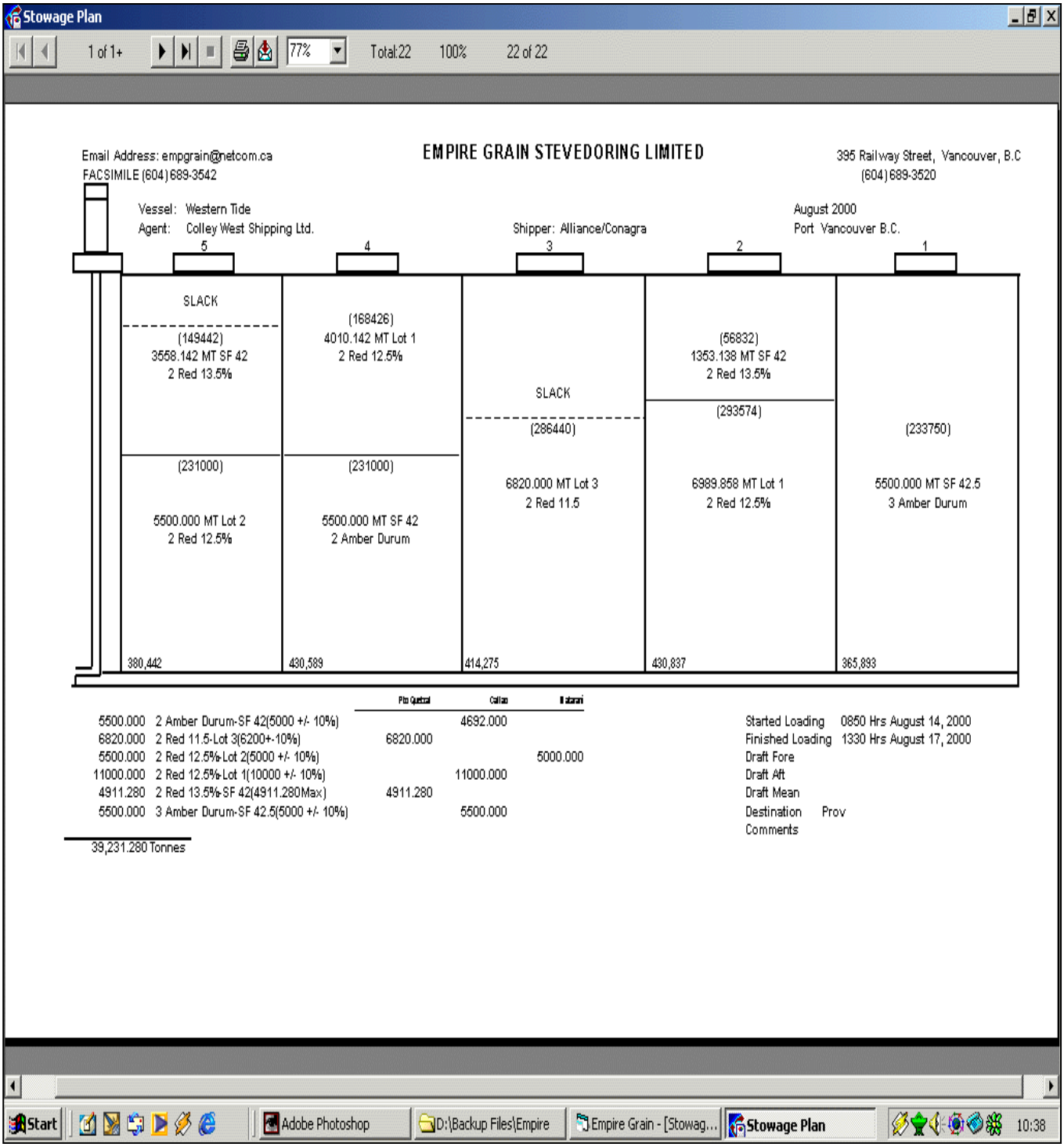
5- The position of cargo parcels.

6- Whether cargo is on pallets, whether stowed by fork lift trucks.

7- Particular of awkward cargoes have been loaded.

8- If possible, marks, quantities and position of packages.

9- When loading from more than one port a different colour should be used .



CARGO SECURING

Reasons for securing cargo onboard ships:

The cargo loaded onboard a ship is subject to the constant movement and stress of transport. In heavy seas, the cargo is exposed to compressive forces due to pitching and rolling. These forces may increase the normal strain on lashings, struts and other securing devices as much as 100%. Effective securing of the load throughout the entire transport process is of absolute importance.

Reference books of note for detailed information include :

IMO Code of Safe Practice for Cargo Stowage and Securing, Vessel Cargo Securing Manuals, available onboard all merchant vessels and approved by the vessels Flag State Maritime Authority, Thomas' Stowage.

Securing Fundamentals:

Contained in the IMO code above is a simple "Rule of Thumb to apply to securing loads aboard ship. (Refer to the code for more detailed information).

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 .MSL or Maximum Securing Load is for securing devices same as safe working load (SWL) is to lifting gears.

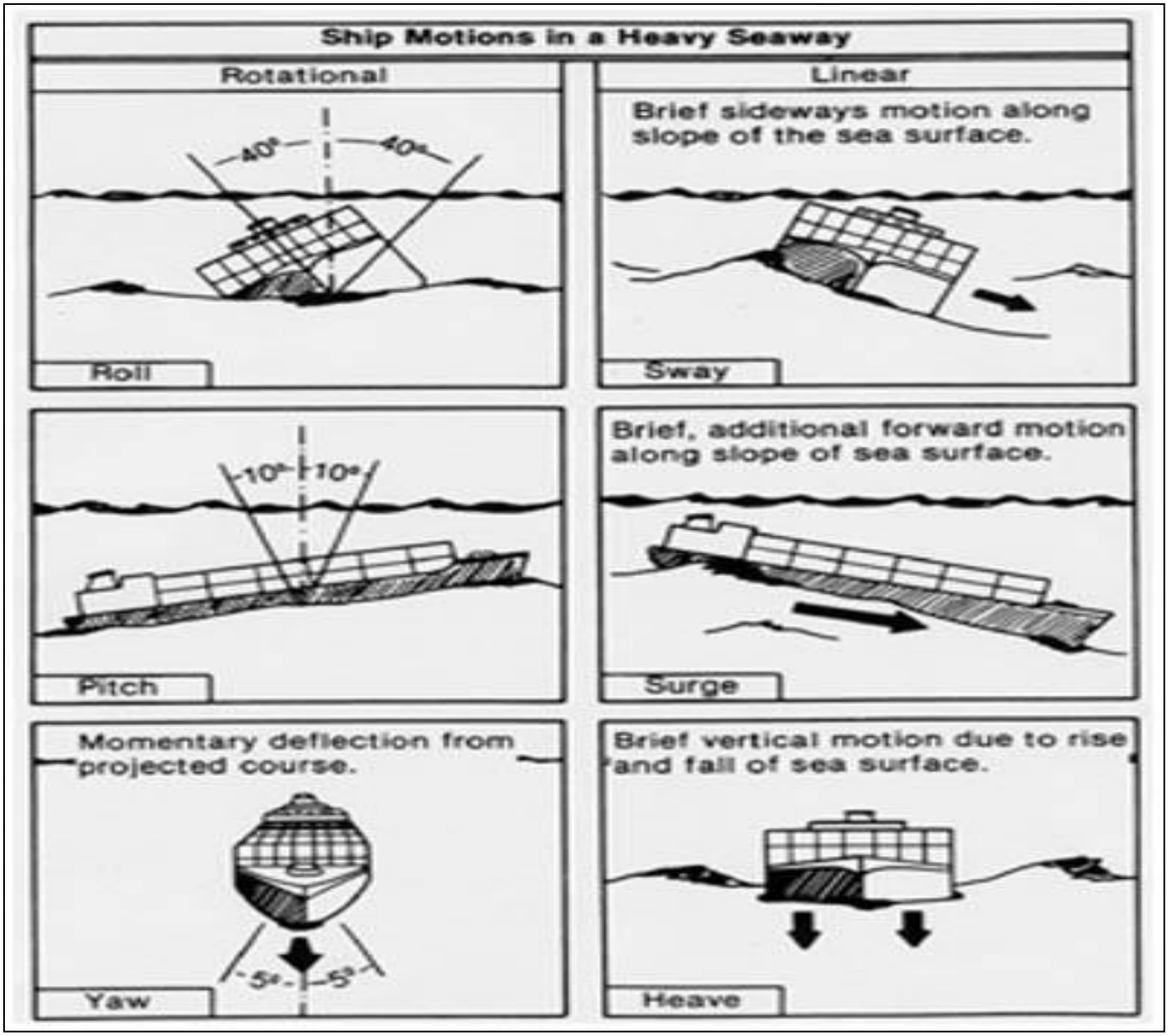
It is a term used to define the load capacity for a securing device.

Lashing and securing is a matter of know-how and experience and is normally performed either by terminal staff or specialized riggers. Essential information required when considering any piece of sizeable cargo is:

Mass in metric tons, Principle dimensions (drawing if possible) Location of center of gravity, Bedding area and particular bedding precautions. Sometimes referred to as the "Footprint."Lifting points or slinging positions Lifting gear if any accompanying the cargo, complete with test certificates Securing arrangements aboard ship Landside transport arrangements.

When considering the shipboard stowage location of cargo items, acceleration forces should be borne in mind:

Lower accelerations forces occur in the amidships sections, lowest cell position under deck and as close to the centerline as possible .Higher accelerations forces occur at ship's extremities, high on deck and in the outrigger slots by the ship's side



Most types of cargo can be secured using the following materials , (portable cargo securing d e v i c e s . **.**

- Timber beams, struts, chocks, planks for shoring, bracing and relieving pressure .
- Adjustable wooden battens, rods or strap belts for securing the load in sections, facilitating mechanical discharge .
- Plywood and dunnage to separate several layers of cargo or to segregate different types of cargo into separate sections
- Foam-rubber cushions and air bags to reduce vibration and prevent the load from shifting
- Second hand tiers or bags with paper waste or sawdust to fill empty spaces soften the impact and prevent shifting .
- Nets to secure fragile goods

- Rope (hemp, manila, sisal etc.), wire, steel bands and terylene straps for lashing .
- Nylon span sets .
- Lashing chain with tensioner
- Turnbuckles
- Lashing wire of different sizes
- Shackles, hook, rings.
- Air bags
- Lashing straps (steel / nylon.
- Twist lock, lashing bar, stacking cone, bridge fitting ……

Fixed cargo securing devices;

These are permanent welded / riveted eye, rings, on bulkhead and deck. If it is required more lashing point can be welded to deck and bulkhead.

In certain circumstances when there is no lashing point, the coaming bracket notches on deck and frame / stiffener notches in hold can be used provided it is recommended in vessel cargo securing manuals.

2 SECURING DEVICES AND ARRANGEMENTS

2.1 Specification for fixed cargo securing devices

2.1.1 Fixed cargo securing devices for the securing of cargo on the deck

There is no fixed cargo securing devices for the securing of cargo on hatch covers. Coaming bracket notches can be used for cargo securing on the hatch cover (see figure 2.1).

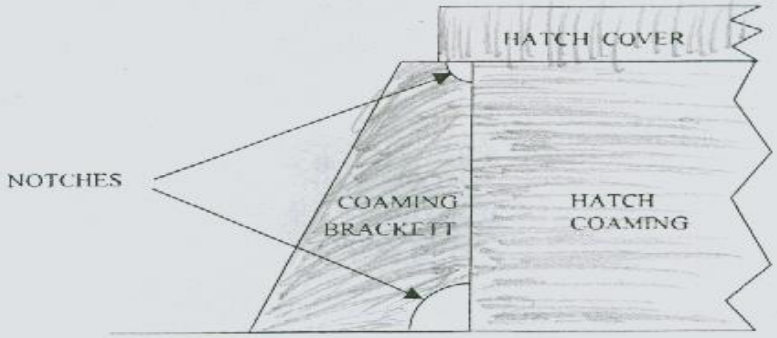


Figure 2.1 *Coaming bracket notches.*

2.1.2 Fixed cargo securing devices for the securing of cargo in holds

There is no fixed cargo securing devices for the securing of cargo in the holds. Frame / stiffener notches can, however, be used for cargo securing in the holds (see figure 2.2).

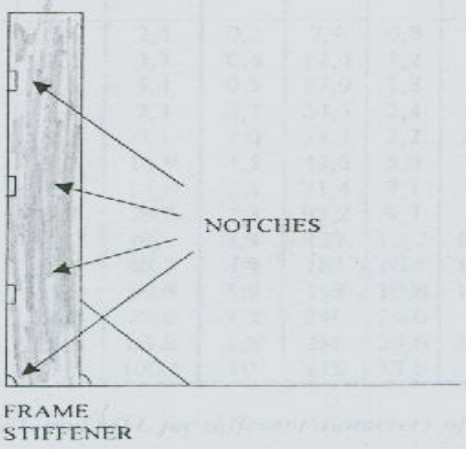


Figure 2.2 *Frame / stiffener notches in cargo hold.*

2.1

Points to be considered when securing cargo :

- When any cargo require lashing the usual approach is to lash the cargo to itself to form a single solid block of cargo this is the method normally used for steel coils and cargo similar to it.
- For some cargoes such as pipe and structural steel it may be necessary to use eye bolts (paddy's) welded to the ship's side and the tank top. If not already

fitted, eye bolts can only be safely welded in positions where no fuel tanks are located.

- The method of stow will help securing cargo, avoiding their movement e.g the cargo liable to slide during v / l rolling, such as steel rails should be stowed fore and aft.
- Different cargoes require different securing systems. Such systems range from that required for reinforcing bars (bundles of long steel rods) which normally require no lashing, through that for steel billets (large rectangular slabs of steel which simply require chocking with timber to secure any gaps in the top tier of billets, to that for steel coils, which require an elaborate system of chocking and lashing reinforced with wedges.
- Chocking is the process of preventing cargo from moving by filling gaps in the stow with lengths of swan timber which has been used for the process of chocking. The individual pieces of timber which form the chocking should be nailed
- together to prevent them from falling apart and dropping out of the stow, as is possible when a ship works in a seaway.
- A block stow of cargo in the fore end of the hold is always likely to be less secure than one in the after end because of the ship's normal stern trim. When the whole length of the hold is not to be used, a stow in the after end is to be preferred to one in the fore end.
- It is more difficult to achieve a secure, tight stow of large symmetrical items in holds such as no. 1, which does not have parallel sides. Where possible such irregular spaces should be used for smaller items of cargo.
- Dunnage will be used to protect cargo from steel member of the ship's structure, but this also will help to avoid cargo sliding on surface, and when used between tiers of steel product avoid sliding over each tiers.
- In general terms steel products are not only need to have individual securing arrangements, such as lashing and / or interlocking but preferably, should be over stowed with other suitable cargo.

Steel coils securing :

Great care is needed in stowing and securing cargoes of steel coils. Wherever possible, they should be stowed in regular tiers from side to side of the vessel, making full use of pillars, stanchions and center line bulkheads. The core of steel coil should be in fore & aft direction.

Dunnage is used beneath and within all cargoes of steel coils and at the ends of the holds to keep the cargo clear of the v / l structure. fill the empty space between tiers of cargo with locking coil. Connect coils to each other with steel wire or strap. When loading complete pass two wire on the top of cargo. The wire ropes are fastened with wire grips and set taut with lashing screws (turnbuckles) lashing screws must be locked or lashed to prevent them from working back becoming slack under the effect of vibration. Use wedges beneath the cargo to avoid movement of coils.

Care must also be taken to ensure that the lashings are in positions where they will not damage the cargo.

Steel plates securing:

Whenever it is not possible to stow steel plates where they cannot be locked by the boundaries of timber spacing, they should be independently secured by chain wire lashings as well as by tomming.

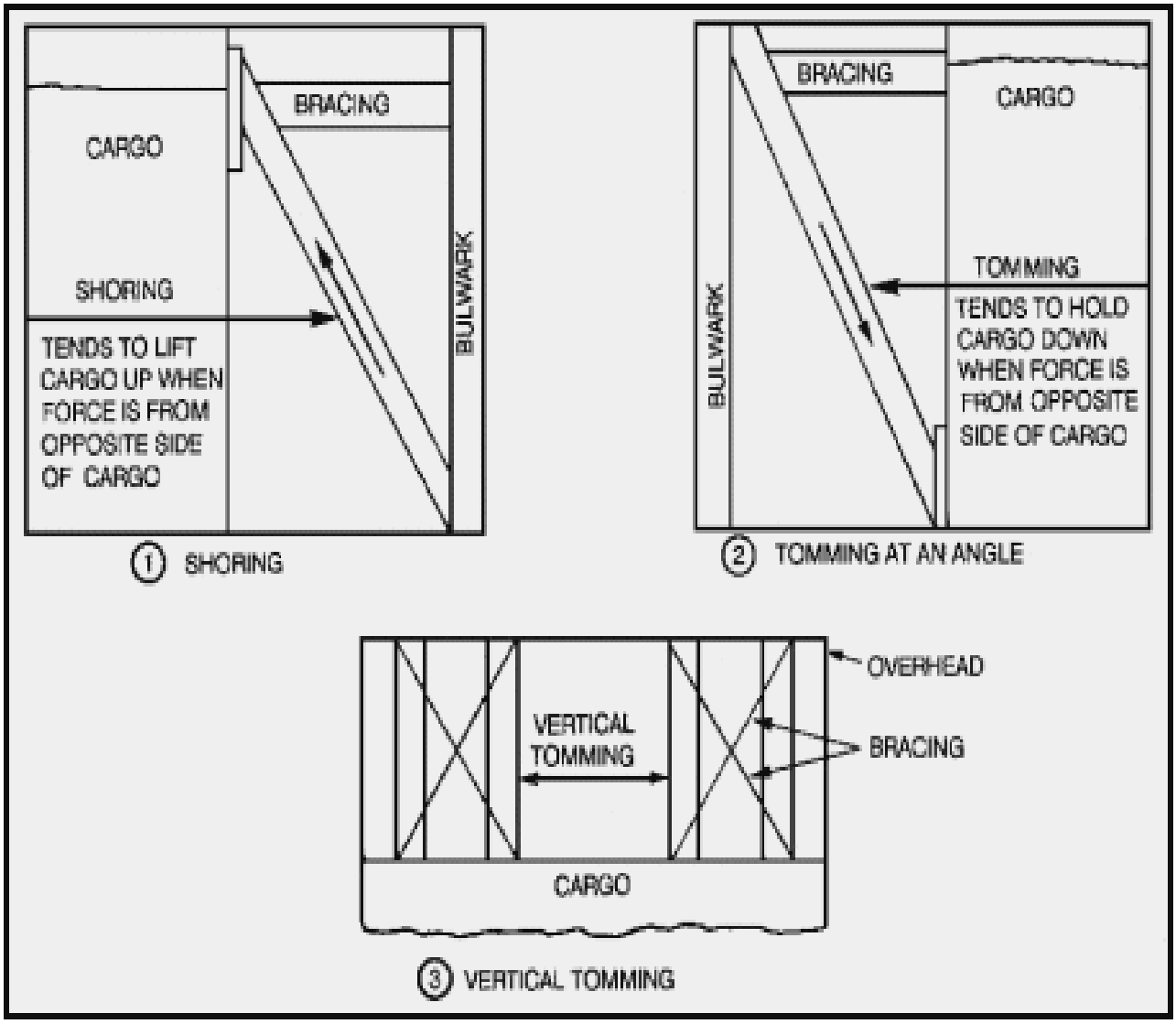
Steel rails securing:

This cargo needs great care in stowage to prevent its movement during the voyage and also to avoid and unduly stiff ship. Heavy dunnage will be required in order to build a floor on which to stow the rails, and also to shore off at the ends and sides of the compartment.

Heavy planks should be arranged at the bulkheads to avoid damage to them and also to prevent the rails moving in a fore and aft direction with the pitching of the vessel, whilst chocking with timber is necessary at the sides of compartment.

It is advisable to provide efficient chain and wire lashings, whilst lengths of old rope laid between tiers help to provide a compact stow.

The reference of cargo securing systems is cargo securing manual for each ship, which is to be strictly complied with.



Stowage / securing motor vehicles:

- These are shipped in cases, crates or unpacked. In the case of the first two the stowage is similar to that for any cased or crated goods. Motor vehicles which are not so protected require more attention and will be discussed assuming that they are to be loaded into a general cargo vessel.
- A large open hatch should be selected for their stowage, having a flat level deck or a lower hold cargo providing a similar platform. Tween deck stowage is to be preferred, with no over stowing of the vehicles.
- The vehicles should be examined on the quay before loading and any damage or deficiencies existing noted on the receipt.

- Suitable lifting gear must be selected having rigid spreaders to prevent damage to the paintwork by the ropes from the wheel nets or special fittings. Straw filled soft bags should be available to put between the lifting gear and the bodywork to protect this.
- The vehicles should be handled carefully at all times. When lifted onboard, steadying ropes should be attached to the slings to guide them into the hold space. The vehicles should be pushed into the spaces and not moved under engine power.

- The vehicles should be stowed fore and aft. After being put in place a reasonable person must check that windows and doors are locked, bonnet and boot are secure, fuel tank contains no petrol and, if the ship is going to low temperature areas, radiators are drained. The keys should be handed to the chief officer. Handbrake should be fully on.
  - Vehicles should be stowed at least 220mm. Apart and clear of any obstructions which might damage them due to movement on the suspension on passage.
  - Lashing, consisting of strong small stuff, point line etc. should be placed on approved parts of the vehicle and tightened with a Spanish windlass.
  - If there are no special lashing arrangements on the ship's deck, at least four strong lashings should be taken to suitable point in the hatch pillars, fixed ladders frames, ring bolts etc.
  - A frame of 3" × 3" dunnage may be used to enclose the wheels and provide further restraint if considered necessary.

Heavy lift

Following information must be obtained prior to loading a H.L.

1) Dimension, shipper.
2) Weight, shipper.
3) Deck strength, permissible load. Capacity plan of vsl

Precautions:

1) All deck cargo requirements are met.
2) FFA and LSA regulation complied.
3) V / l should have adequate stability during loading and throughout voyage.
4) V / l do not or will not have excessive trim.
5) Sufficient under keel clearance, during loading

6) Adequate securing points are in position, if not enough, more to be welded.
7) Cargo gear is properly rigged & inspected.
8) Loading gangs / securing Ganges are available.
9) All loose gear, cargo is secured.
10) Other works are stopped.
11) Port authorities are informed.
12) Extra power is on deck.
13) Engineers are informed. Galley to be informed
14) V / l is secured alongside, crew attending ropes, all ropes tight.
15) All tanks emptied or pressed up to avoid free surface effect.
16) Gangway is removed.
17) Unnecessary persons are removed from deck.
18) An experienced winch operator is on station.
19) Signal man is available.
20) Adequate dunnage is available.
21) Swing the boom so that the cargo hook is directly above the center of gravity of cargo.
22) Make fast steadying lines to cargo.
23) Lift the cargo just clear of the quay and check that the v / l has proper stability.

Conduct the operation slowly and clearly and each maneuver to be done separately (lifting, swinging, lowering).When two heavy cargo are to be loaded, first load the offshore one.

Question:

DESCRIBE THE PRECAUTIONS TO BE TAKEN TO PREVENT DAMAGE TO GENERAL CARGO AND TO MAKE SURE OF ITS ARRIVAL AT DESTINATION PORT IN GOOD CONDITION.

To protect cargoes from damages first we should know the causes of cargo damage in order to take precautions against such damages , they are as follows:

1- During handling:

Considerable damage to cargo may result if due care is not paid to handling thus the officer on duty must give efficient attention on all occasion. Lack of care while loading / discharging may result in cargo damage which is not immediately apparent. Such damages may include:

A) Inefficient and improper slinging. Cargoes should be slinged properly using appropriate slings. Heavy cases should not be slung with light cases. Canvas sling should be used for bagged goods. The

use of Trays affords the better methods for small & breakable goods. in all cases of slinging due attention should be given to the weight of the cargo in the sling.

B) Damage of fork lift trucks. The use of these mechanical Handling devices can constitute handling devices can constitute a serious source of cargo damage when working in cargo space if prudent precautions are not taken. Constant supervision of duty officer is vital, high speed of FLT to be avoided.

C) Cargo gear damage. Much damage to cargo results from Slings contacting with hatch coaming, bulwarks and Obstructions within a compartment. This is due to careless Winch or crane work. The guys on derricks should be kept tight. The officer On duty should make an inspection of guys regularly. To avoid cargo damage and minimize the stress upon The gear.

D) Crushing. This is mainly due to lack of both thought and care On stowing. Incorrect use of wooden dunnage, unsuitable Space allocations to cargo, insufficient attention paid to The type of cargo being loaded and to the order of stowage, are potential factors contributing to damage from this source.

The following methods to be use in order avoiding cargo crushing:

I) crates of glass should always be stowed on edges, athwart ship, packed solidly together, on a perfectly level floor of dunnage, lashed to prevent movement and no cargo of any nature stowed on top.

Ii) Rolls of paper, likewise, should be stowed on their Flats. Stowage on the round would very likely result In flattening deformation to such an extent as to render, the rolls unsuitable for machine use.

2- Strain and stress on cargo at sea.

A v / l rolling and pitching heavily in a sea is subject to strain which results in the buildup of stresses throughout the whole of the structure.correctly and solidly stowage of cargo can minimize damage to cargoes. Where the stow might be loose the stresses which are mainly of a vibratory nature, could cause damage by cargo movement which, in itself, could cause damage to adjoining stowage.

Deck cargo

1) The following types of cargoes are commonly carried on deck:
2) Dangerous goods not permitted below deck.

3) Large units difficult to stow below, which can be safely exposed to weather.
4) Cargo which have low weight but occupy a very large space below deck, and can be exposed to weather, e.g timber.
5) Livestock in limited numbers

Deck regulation:

The regulation were made under the MS (load line) 1967 act and came into operation on 29 July 1968. They state the requirements which must be complied with when cargo is carried on deck. The regulations are in two parts, 1- all deck cargo. 2- Timber deck cargo.

Requirements for carriage of all deck cargoes:

1) Excessive deck loading stresses to be avoided: load density of deck and / or hatch covers to be considered, the hatches should be securely closed and cleated before loading over them. The weight of the deck cargo should never exceed the maximum permissible load on the deck or hatch covers. This can be avoided by spread of the weight using proper and sufficient dunnage and deck shoring.

2) Adequate stability to be retained for all stages of the voyage:

I) The vertical distribution of the deck cargo, as it will cause rise of center of gravity of the vessel (G)

Ii) Absorption of water and / or ice accretion this one also causes rise of g hence reduction of gm.

Iii) Expected wind moments effect on the v / l due to high windage area.

Iv) Clearing of water from deck in heavy weather, which causes water to be trapped between cargoes, thus increase of weight on deck.

V) Consumption of stores, fuel, fresh water which increase free surface effect and rise of G

3) The weather-tight and water-tight integrity of the ship must not be impaired, special attention should be paid to the protection of ventilator and air pipes. The cargo can damage the air pipe and cause flooding of the tanks.

4) providing safe access to essential equipment and spaces such as:

I) Steering gear arrangements

Ii) Devices for remote operation of valves.

Iii) Mooring arrangements.

Iv) FFA and LSA.

V) Crew accommodation and working spaces.

Vi) Sounding pipes.

5) Height of deck cargo should not interfere with safe navigation of ship, it should not impair keeping of an effective lookout.

Securing deck cargoes:

Deck cargo must be secured so as to ensure that there will be no movement of cargo in the worst weather that can be expected on the voyage.

The lashings and all fittings used for the attaching of lashings must be of adequate strength to be able to withstand the strong inflicted upon the ship and cargo by such weather condition.

Access:

A v / l which carry deck cargo must provide access for crew between their quarters and the working area of the ship. On ships without permanently constructed of such passage, a walkway must be fitted over the deck cargo and effectively secured.

The walkway must not be less than one meter wide and it must have a set of guard rails or wires on each side, which are supported by stanchions securely fitted to the walkway at intervals not exceeding 1.5m. The guard rails or wires should be to a height of not less than 1m and each set should consist of three courses. No opening below the lowest course should exceed 230mm in height and no opening above that course should exceed 380mm in height.

Additional requirements for carriage of timber deck cargoes:

- when the ship is in winter period the deck cargo must be stowed so that at no point throughout it's length the height of the cargo above the weather deck exceeds one-third of the extreme breadth of the ship.
- ًA walkway must always be provided on top of the timber even if the ship has a permanent passageway.
- the cargo must be compactly stowed and secured throughout it's length by a system of overall lashing of adequate strength. Efficient arrangements, which must be provided for the release of lashing and fittings.
- Uprights, which are sufficiently strong for the purpose, must be fitted if the nature of the timber is such that uprights are necessary to ensure a compact and secure stow.

- uprights should extend above the outboard top edge of the cargo, they should be fitted with a locking pin and each port and starboard pair of uprights should be linked by athwart ship lashings.
- If a device which is capable of quick cargo release is fitted, the design of it should ensure that it cannot be accidentally released or activated.
- Lashings should be capable load of not less than 133 kn.
- The spacing of lashings should be determined by the maximum height of the timber in the vicinity of the lashing.

I) 4 meters and less, spacing should be 3 meters.

Ii) 6 meters and more, spacing should be 1.5 meters.

- In addition to the walkway, a life line of wire rope with a stretching device should be set up tight as near as Practical to the centerline of the ship.
- All securing equipment should be laid out on the main deck some time before loading commences and closely inspected.
- neatly stow the timber so that if possible, the timber interlocks within each layer. Do not stack timber piece on piece as this will not ensure a compact stow.
- Any openings around deck appliances or mast houses should be fenced off to prevent personnel falling into gaps in the cargo.

The IMO publication should be read in full as they have more practical advice with regard to the stowing and securing of timber deck cargoes .

Question

What factors must be taken into account when loading cargo on deck?

1- The strength of the deck carrying the deck cargo must be considered and excessive loads to be avoided.
2- In cases where highly concentrated loads are expected, as when loading heavy lifts on deck, the deck may be supported from below by shores.
3- Deck cargo has a high center of gravity and the effect on the ship's stability must be carefully considered at all stages of the passage.

4- Deck cargo is also liable to affect stability by preventing water from leaving the decks quickly, increasing the wind area of the vessel, increasing top weight from water absorption and ice accretion.

5- Air pipes and ventilators must be adequately protected from damage by the deck cargo, sounding pipes must be accessible and clearly marked.

6- The deck cargo must not obstruct any doors or other openings which would affect the weather-tightness or water-tightness of the ship.

7- Safe access for the crew across and along the decks must be ensured when stowing these cargoes. Safe gangways may have to be constructed across the deck cargo in some cases.

8- The steering of the ship must not be affected in any way-emergency steering equipment must be opera table with the deck cargo on board.

9- The safe navigation of the vessel must not be affected in any way due to visibility being impaired or lights obscured.

10-The deck cargo lashings must be adequate to ensure no movement in any weather. Lashing points must be selected and, if insufficient points are available on existing ship structure extra eyes should be welded on.

11-When carrying dangerous cargoes on deck, it may be necessary to get rid of them at sea. The method by which this might be accomplished should therefore be carefully considered before loading commences.

12-The effect on the ship of losing part of the deck cargo should be considered and provision made for quick release of cargo on the opposite side of the deck.

13-The availability of discharging facilities at the destination, particularly in the case of heavy or awkward cargoes, should be carefully investigated.

Containerized cargo:

The practice of packing a large quantity of small goods into one big container makes for easier and quicker transfer between ships and quay, as well as reducing pilferage / damage caused by handling, as the goods are packed into the containers at the place of

manufacture, then sealed for the transit and finally unpacked at the consignee's warehouse.

Advantages of container cargo:

1- Movement damage:

The conventional system of cargo handling frequently resulted in damage from handling dropping, impact, crushing and slinging. But these risk have been minimize in container ship. Any cargo loaded in a container should load securely so that no movement occur within container and weight should be distributed so that container will be in balance condition.

2- Ventilation:

In a container sweat can be formed so precaution should be made to prevent any sweat in container, some containers have special facility for this.

3- Deck carriage:

Those type of container which are in good condition should be located on deck and well secured against great hazard of sea water. So in container ships large amount of container can be carried on deck.

4- Lifting containers: There are four attachment on four top corner of container to lift it. There is arrangement on each container to be lift up with fork lift truck, thus they are easy for handling.

5- Fast / Safe Rate of loading / discharging thus less port stay.

Containers classification:

1- Standard steel constructed 20 × 8 × 8 ft, use for normal stowage and capacity of 1000 cu / ft.

2- Standard (insulated) similar to above, but internal insulation of polyurethane type fitted between a plywood lining and other skin.

3- Top loader. Similar size, with roof aperture opening. Capacity is 1050 cu/ft.

4- Half heights. Usually 20 × 8 × 4 ft and completely open and capacity is 400 cu/ft.

5-Standard steel constructed 40 × 8 × 8 ft.

There are many other type of containers in use. E.g tank container, bulk container, open sided, ISO flat racks, Mini container, sea freighter, etc.

Locating a container within a ship:

Bay:

Hatches are divided into transverse sections called bays. A bay is generally 20 feet long and coded with two digit odd number e.g 01, 03, 05, ….

On deck two adjacent bays may be combined to accommodate a 40 feet container. In this case the bay number would be the two digit even number. E.g a 40' container in bays 03 and 05 would be numbered 04.

Stacks:

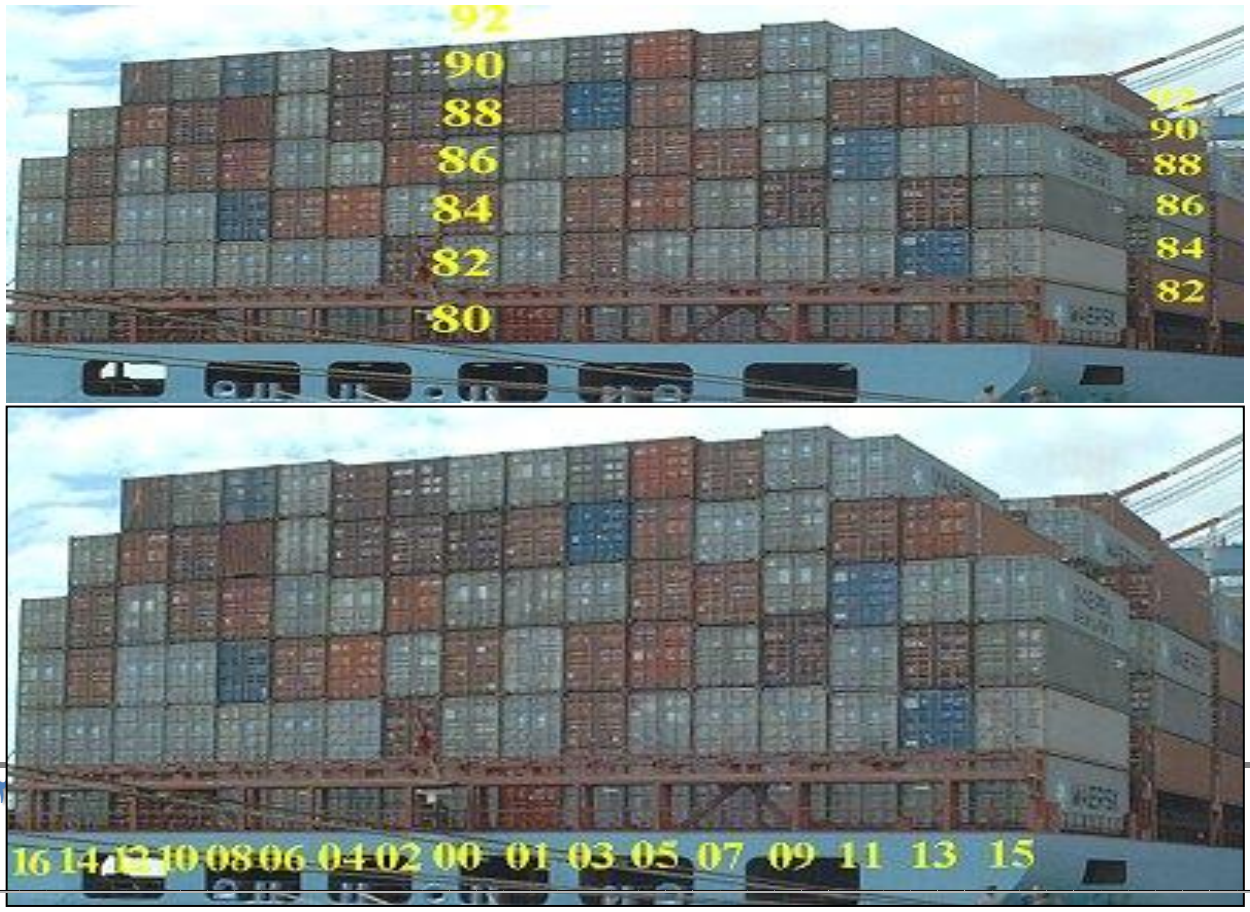
Bays are divided vertically into stacks (rows). Stacks to port of the center line have two digit even number, e.g 04, 06, 08. And stbd of center line two digit odd number e.g 03, 05, 07 any center line container is numbered 00.

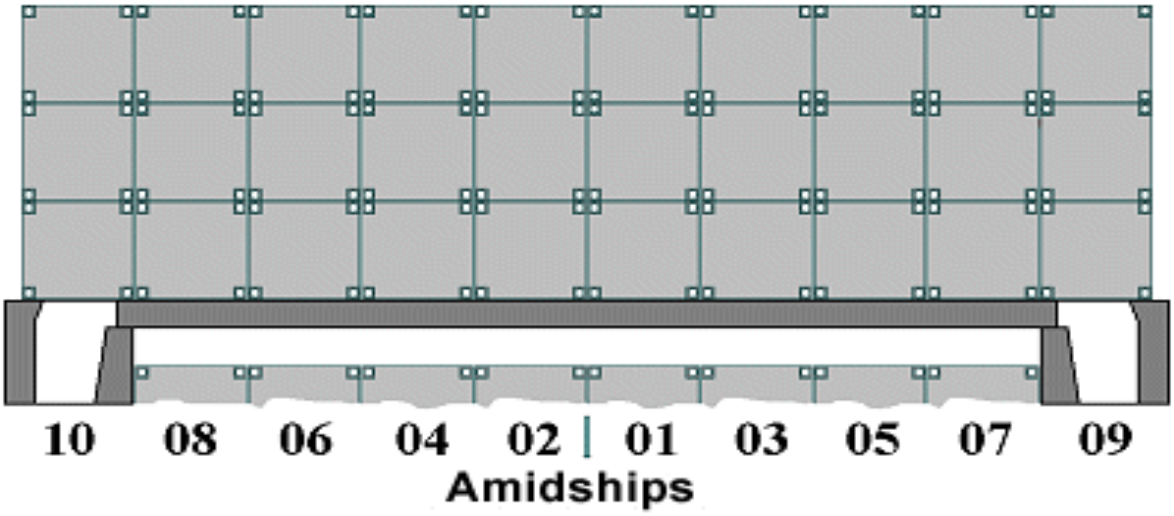
Tiers: Bays are divided horizontally into tiers. Tiers have even number starting at 02 from the bottom below deck. On deck tiers begin with initial 8 e.g 82, 84.

Each container therefore will be referenced as a cell number consisting of 6 digits (bay, stack, tier) e.g 050308, indicates, third bay from forward (05) second stack to stbd of center line (03), forth tier up from datum reference (08).

E.g cell number 060882, effectively fills cell numbers 050882 and 070882 within a 40' container on deck.

TEU: twenty equivalent units. 20' container , **FEU:** Forty equivalent units. 40' container

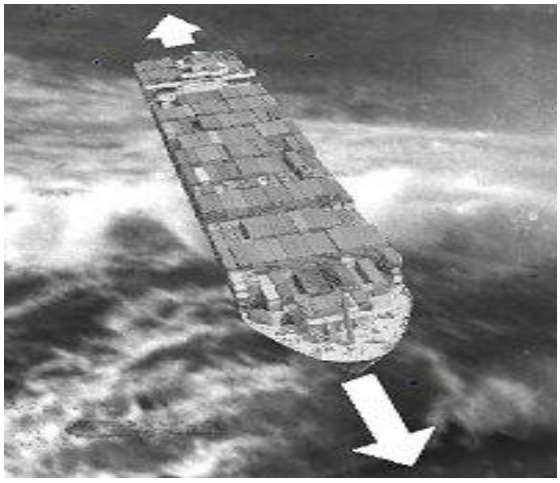




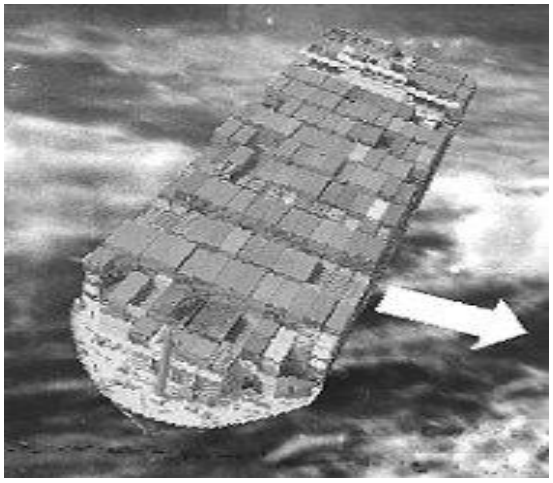
Stresses:

It is important to remember that the stack of containers onboard a ship is subjected to dynamic forces in fore and aft, transverse & vertical direction. The forces in transverse direction are greater due to rolling & this will cause to stack to be subjected to tipping & racking stresses.(torsion).

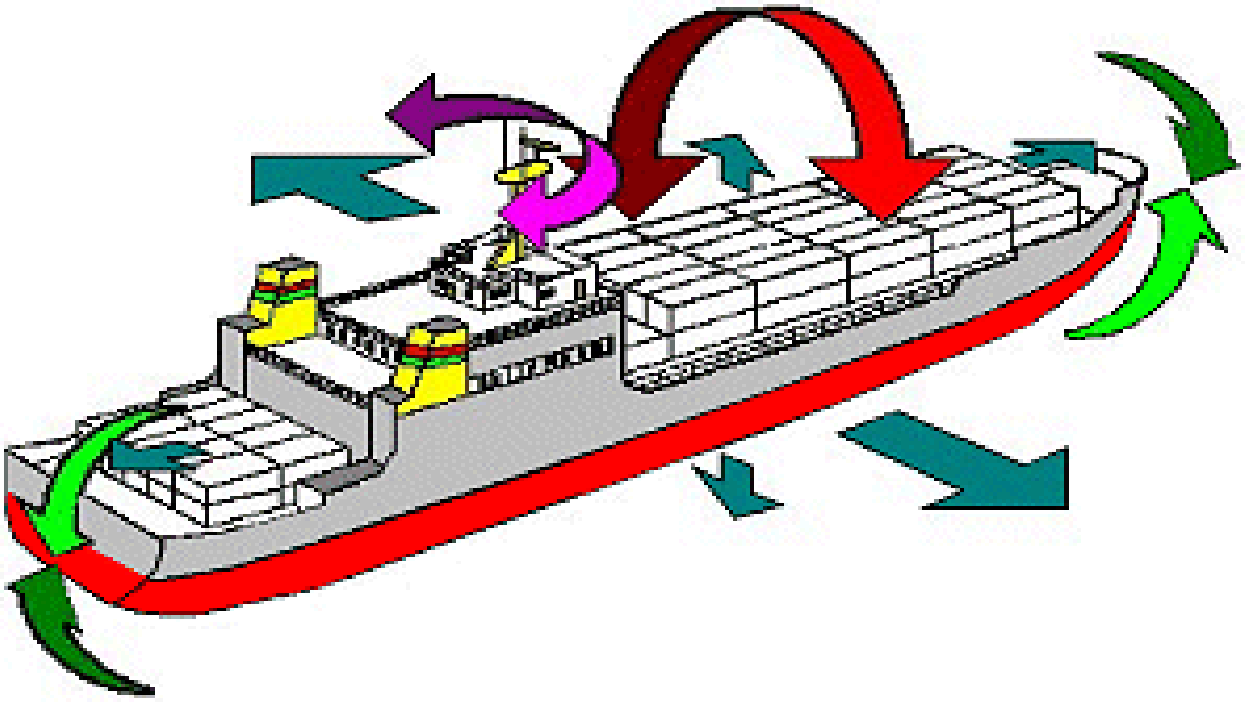
Containers on deck are subject to greater dynamic forces than those below deck. Racking is greater in the lower tiers of the stack & tipping in the higher tiers. The weight of container is important, the heavier container, the heavier stresses.

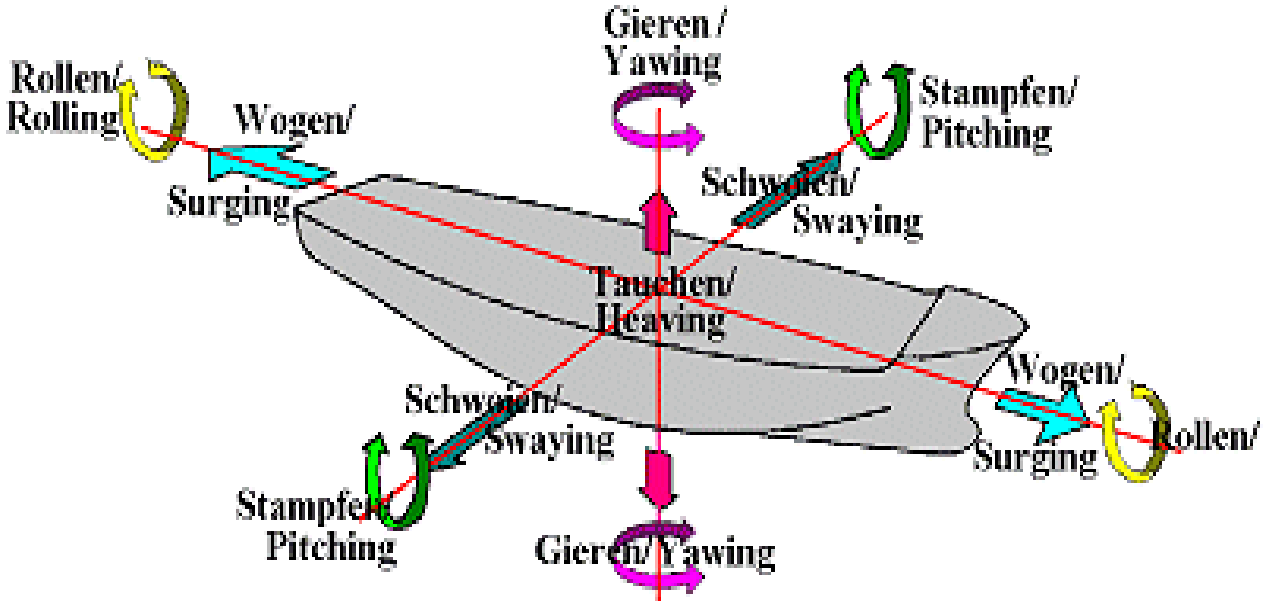


Swaying



Surging





Securing methods:

1- Some vessels have cell guide on deck or below deck, the containers in this type of ships does not require any further securing.

2- Some v / l have special constructional feature & fitting for securing containers.

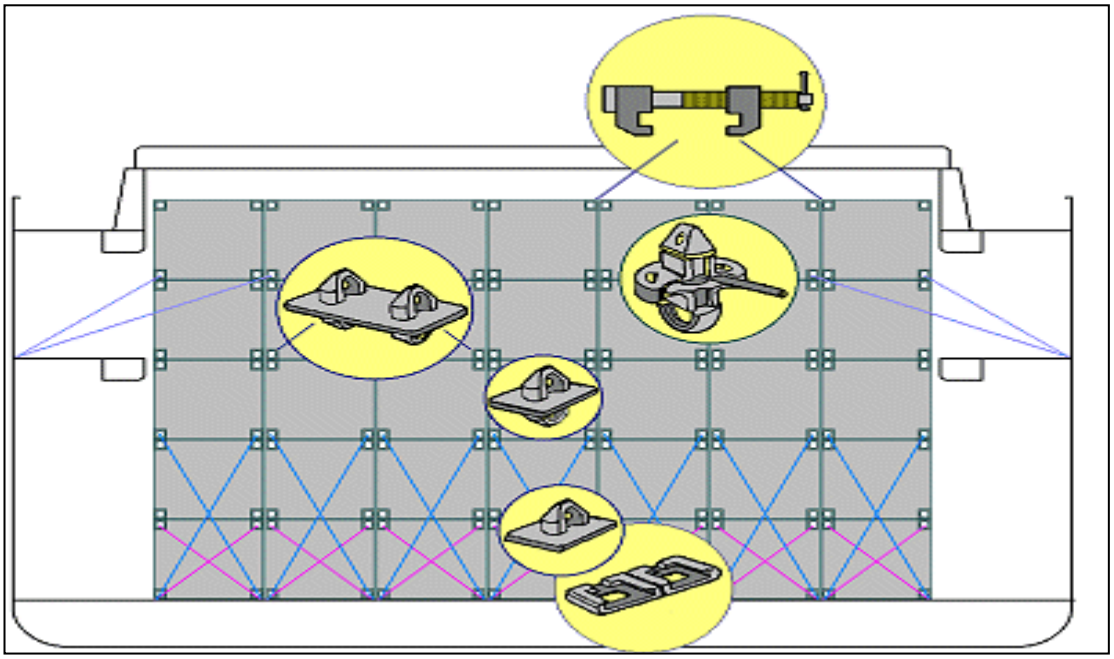
3- Some v / l have stabilizer to reduce dynamic forces on the stack of container.

4- Empty container may require less lashing than full containers and may allowed to be stacked higher.

5- Containers on deck must be stowed and secure to comply with load line & deck cargo regulations.

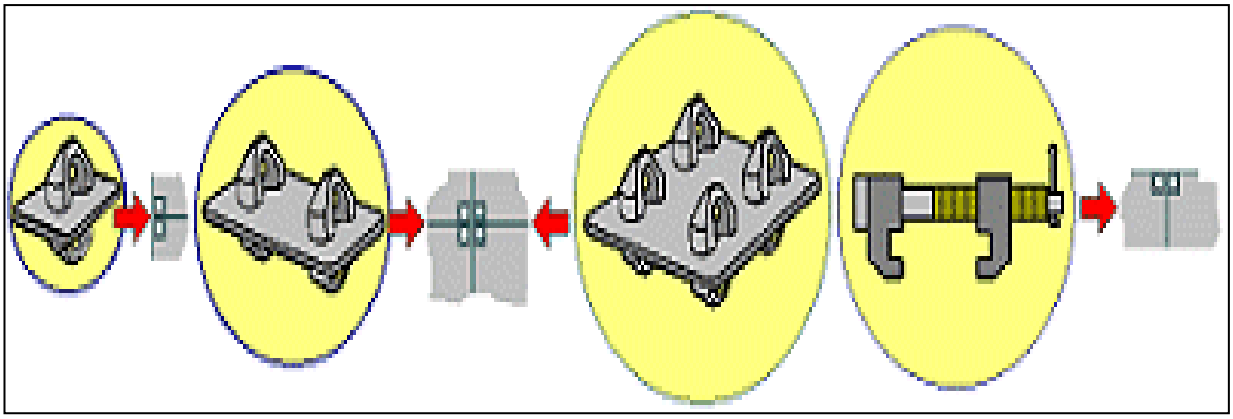
6- Classification society usually provides the information for securing containers.

Every ship must have cargo securing manual approved by her class and should be complied with.

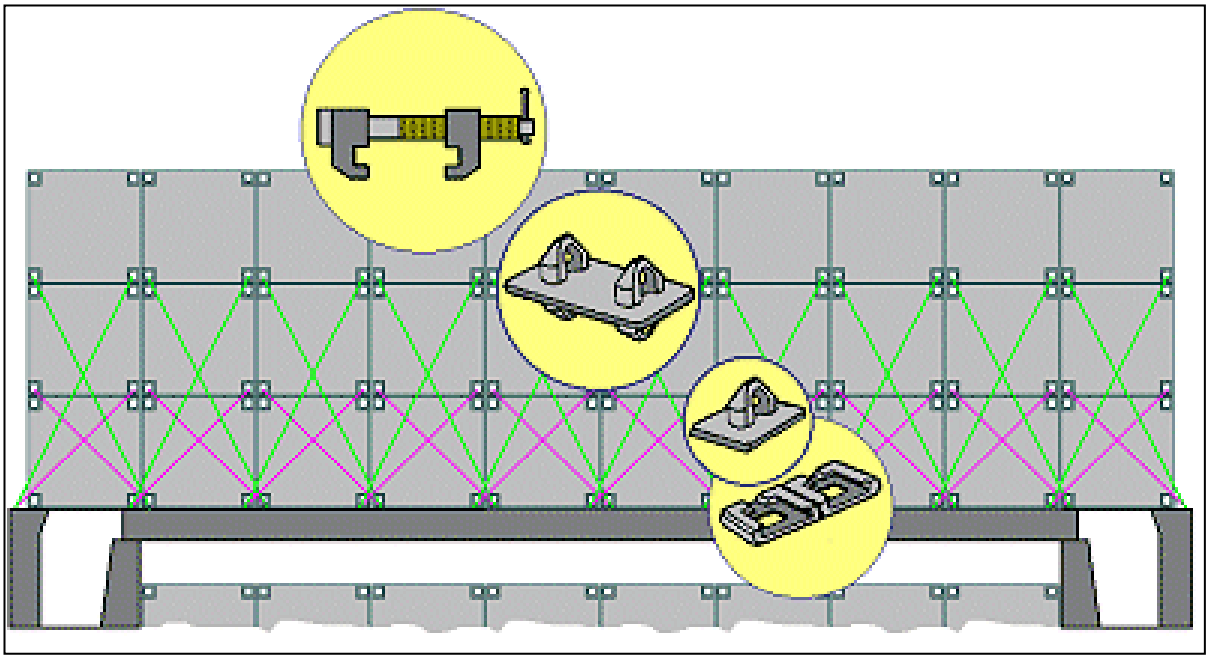


Example of stacked stowage with conventional securing

The lower containers stand on foundations capable of withstanding the stack pressures which arise. Dovetail foundations, into which sliding cones fit, are provided to prevent slippage. The containers are connected together by single or double stacking cones or twist locks. The entire stack or container block is lashed using lashing wires or rods and turnbuckles. This system entails a lot of lashing work and material and, moreover, is less secure than securing in cell guides.



Fastening containers together



Example of block stowage securing on deck

Carriage of containers and flats in ships not designed for carriage of container: m – 1167

1- Containers carried on deck should be stowed one high only, preferably fore and aft, prevented from sliding athwart ships and securely lashed ageist tipping. At

no time should deck - loaded containers overstress the hatch covers or the hatchway structure.

2- Securing of containers and flats should be by means of chains, wires or other equally effective arrangements, in each case provide with means of tensioning deck fittings should be so located that there will always be a good lead for securing arrangements.

3- It is particularly important that master obtain an accurate cargo stowage and in addition, details of the contents of any cargo units containing dangerous good.

4- It is important that due regard be paid to prevailing, forecast, and anticipated weather conditions during the voyage.

5- Satisfactory means in the form of guard rails, life lines, walkways or gangway, etc. should be provided for the protection of the crew in getting to and from their quarters, to the machinery space, and all other parts used in the necessary work of the ship.

Question

(A) LIST THE FACTORS WHICH SHOULD BE CONSIDERED BY AN OFFICER OF THE WATCH WHEN LOADING A CONTAINERIZED CARGO.

(B) LIST FIVE ITEMS OF EQUIPMENT WHICH IS COMMONLY USED FOR SECURING CONTAINERS IN A STOW.

1. Condition of container coming aboard, noting any damage.
2. Stowage positions and labeling of dangerous goods containers.
3. check securing of containers as per cargo securing manual
4. The declared contents of refrigerated containers so that the correct temperature setting may be checked and / or set.
5. Ship's officers should liaise closely with shore planners to obtain the latest information on container stowage positions, so that stability and other calculations can be monitored and checked prior to putting to sea.
6. Containers of cargo that come aboard without seals or locks on the doors should not be loaded until a fresh seal put on and a note made of the number.

7. Containers should be stowed in the fore and aft line so that the cargo inside them gets the benefit of the restraint of the side walls.
8. The stowage arrangement must be such that adequate securing of the containers may be achieved.

B)

1- Cone, single and double.

2- Container shoe.

3- Twist lock, manual / automatic.

4- Bridge fitting.

5- Tension and compression clamp.

6- Coaming chock.

7- Coaming shackle.

8- Fixed / removable locator.

9- Lashing rods, lashing wire, lashing chain.

BULK CARGO

What is IMSBC or International Maritime Solid Bulk Cargoes Code & What are its contents?

The primary aim of the International Maritime Solid Bulk Cargoes Code (IMSBC Code), which replaces the Code of Safe Practice for Solid Bulk Cargoes (BC Code), is to facilitate the safe stowage and shipment of solid bulk cargoes by providing information on the dangers associated with the shipment of certain types of solid bulk cargoes and instructions on the procedures to be adopted when the shipment of solid bulk cargoes is contemplated**.**

IMSBC Code is supplemented by the Code of Practice for the Safe Loading and Unloading of Bulk Carriers (BLU Code including BLU Manual) & recommendation on the safe use of pesticides in ships applicable to the fumigation of cargo holds. It also includes a directory of contact names and addresses of offices of designated national

competent authorities responsible for the safe carriage of grain and solid bulk cargoes. IMSBC Code and supplement is commended to Administrations, ship owners, shippers and masters and all others concerned with the standards to be applied in the safe stowage and shipment of solid bulk cargoes, excluding grain.

Aim of code of safe practice for solid bulk cargoes:-

The IMSBC Code replaced the Code of Safe Practice for Solid Bulk Cargoes (BC Code), which was first adopted as a recommendatory code in 1965 .

The aim of code of safe practice for solid bulk cargoes were

- To highlight the dangers associated with shipment of the bulk cargoes
- To give guidance on procedures to be adopted
- To list typical material currently being shipped in bulk
- To describe test procedure to determine various characteristics of bulk cargoes.

The format of the IMSBC Code is similar to that of the existing BC Code. Like the BC Code, the IMSBC Code categorizes cargoes into three groups – A, B and C:

Group A consist of the cargoes which may liquefy if shipped with moisture content in excess of their transportable moisture limit.

Group B consists of cargoes which possess a chemical hazard which could give rise to a dangerous situation on a ship.

Group C consists of cargoes which are not liable to liquefy (Group A) and do not possess chemical hazards (Group B).

Solid bulk cargo means any cargo, other than liquid or gas, consisting of a combination of particles, granules or any larger pieces of material generally uniform in composition, which is loaded directly into the cargo spaces of a ship without any intermediate form of containment. The carriage of solid bulk cargoes other than grain shall be in compliance with the relevant provisions of the IMSBC Code.

Difference between Group A and Group C cargoes under the IMSBC Code :-

Cargoes which may liquefy are cargoes which contain a certain proportion of fine particles and a certain amount of moisture. Such cargoes aredesignated as Group A under the IMSBC Code.

Cargoes designated as Group C will not liquefy regardless of the moisture content, and are therefore not hazardous.

In order to assess whether a given material may liquefy, Appendix 3 of the IMSBC Code specifies that any damp or wet cargo containing a proportion of fine particles should be tested for flow characteristics prior to loading.

1. Cargoes can be tested using either the flow table method or the penetration test method, both of which involve increasing the moisture content of a sample until actual liquefaction is observed.
2. For genuine Group C cargoes, this point is never reached and so no transportable moisture limit can be determined. As a result, any cargo which possesses a TML determined by either of these methods is a Group A cargo. However, it should be noted that some materials which are untestable by these tests may still liquefy, and as such are Group A cargoes. Similarly, any cargoes for which actual liquefaction occurs (for example by a flattening of the stow or large-scale cargo flow during ocean carriage) are Group A cargoes, independently of any tests carried out.
3. On a practical level, Group A cargoes contain sufficient small particles that they can take on a muddy consistency if wet enough. Group C cargoes, by contrast, are gravel-like materials which never become muddy regardless of how wet they are, as any water added drains through the gaps between the particles. Simple qualitative tests to assess this can be carried out on the spot by taking a cargo sample and adding water to it to see if it turns into a mud-like consistency. If yes, the material is likely to be a Group A cargo.

Table of Contents of IMSBC code:

Cargo information shall be confirmed in writing and by appropriate shipping documents prior to loading.

The cargo information shall include:

1. The BCSN when the cargo is listed in IMSBC code. Secondary names may be used in addition to the BCSN; (Each solid bulk cargo in IMSBC code has been assigned a Bulk Cargo Shipping Name (BCSN). When a solid bulk cargo is carried by sea it shall be identified in the transport documentation by the BCSN. The BCSN shall be supplemented with the United Nations (UN) number when the cargo is dangerous goods.)
2. The cargo group (A and B, A, B or C);
3. The IMO Class of the cargo, if applicable;
4. The UN number preceded by letters UN for the cargo, if applicable;
5. The total quantity of the cargo offered;
6. The stowage factor;
7. The need for trimming and the trimming procedures, as necessary;
8. The likelihood of shifting, including angle of repose, if applicable;
9. Additional information in the form of a certificate on the moisture content of the cargo and its transportable moisture limit in the case of a concentrate or other cargo which may liquefy;
10. Likelihood of formation of a wet base
11. Toxic or flammable gases which may be generated by cargo, if applicable;
12. Flammability, toxicity, corrosiveness and propensity to oxygen depletion of the cargo, if applicable;
13. Self-heating properties of the cargo, and the need for trimming, if applicable;
14. Properties on emission of flammable gases in contact with water, if applicable;
15. Radioactive properties, if applicable; and
16. Any other information required by national authorities.

Definitions:

Angle of repose:

Is the angle between the horizontal plane and the cone slope of the cargo.

Cargo which may liquefy:

Cargo which are subject to moisture migration and subsequent liquefaction if shipped with a moisture content in excess of transportable moisture limit.

Flow moisture point:

Is the percentage of the moisture content found while in its wet state, at which a flow state develop, under the prescribed method of test on a representative sample of the cargo material.

Flow state:

It occurs when a mass of the cargo under test is so saturated with moisture that under the influence of external forces, such as vibration, impaction or ship's motion, it loses its internal cohesion and behaves like a liquid.

Transportable moisture limit:

Of a cargo which may liquefy is the maximum moisture content of the material which is considered safe for carriage in ships which are not specially fitted or constructed.

Moisture content:

Is that portion of a representative sample consisting of water, ice or other liquid expressed as a percentage of the total wet mass of the sample.

Moisture migration:

Is the movement of moisture contained in cargoes, by settling and consolidation of the cargo material due to vibration and the ship's motion which may result in some portions or all of it developing free surface.

Stowage factor: Is the figure which expresses the number of cubic meters which one tonne of cargo will occupy.

Bulk cargo main hazards:

1- The structural damage:

This is due to bad distribution of loads which may cause hogging, sagging, shear, deformation of decks and bulkhead.

Great care must be taken when loading high density cargoes (0.56 m per tonne or less) which large weight will occupy a small space giving too great a load in certain areas or compartment.

Apart from electronic calculator, there is sufficient information in the ship's stability information booklet to enable the officers to calculate the shear forces & bending moments in the ship for any particular condition of loading.

As a general guide, the tonnage in any compartment should be the same as for a homogeneous cargo 1.3 m3 per tonne. Various formulae are given in the IMO BC code for determining the tonnage in any compartment.

2- Reduction or loss of stability during the voyage:

Stability hazards can be divided in to two parts.

i) High GM due to stowing high density cargo in the bottom of the holds.

ii) Shift of cargo. Dry shift or liquefaction due to vibration and high moisture content.

When dens cargo loaded in lower holds the v/l will have large gm & she is call stiff. The violent motion could cause the cargo to shift.

If it is possible (in general cargo ship) some cargo to be loaded at higher level.

To avoid / minimize shifting the shifting boards should be erected.

When the angle of repose of the cargo is less than 35º the surface should be trimmed reasonably level.

When the angle of repose of the cargo is greater than 35º, the cargo should be trimmed sufficiently to equalize the weight distribution on the bottom structure.

3- Chemical hazards:

- Due to the giving out of toxic, flammable or explosive gases. They also include spontaneous combustion and severe corrosion.
- Certain cargoes are liable to oxidation which will result in oxygen deficiency in the cargo compartment and possibly in adjacent spaces.
- Other cargoes may give off toxic gases in the cargo compartment and possibly in adjacent spaces.
- In both above cases, the procedure for entering enclosed spaces should always be carried out.
- Cargo spaces containing cargo which may give off flammable gases should be well ventilated.
- Dust laden atmosphere can be flammable atmosphere and is health hazard. Protective clothing and barrier creams together with a clothing laundry routine if the materials are toxic is essential. Personnel exposed to dusty atmospheres when loading

- during discharging the cargo, or cleaning holds after discharging, should maintain a high standard of personal hygiene.

Trimming procedures:

A) Cargo with angle of repose less than 35º:

1- These are generally grain type cargoes which tend to shift in the dry state.

2- Compartments to be filled as completely as possible, particularly filled spaces to be trimmed level throughout.

3- Grain type cargoes can be secured with grain type fittings but they should be of proportionate strength.

B) Cargo with angle of repose more than 35º:

1- These tend to form peak which may overstress the tank top structure.

2- Trim the peck off level at the tween deck or leave sufficient space for the peak to slide into the lower hold.

Cargoes which may liquefy

These type of cargo generally consist of a mixture of small particles the danger of these cargoes is that they appear to be dry when loaded, but they contain more moisture than the maximum transportable moisture limit under the influence of impaction and vibration, the moisture rises to the top and the solid particles settle thus giving rise to free surface effect.

Precautions requires for liquefied cargo:

i) Ensure that the moisture content is below the maximum transportable moisture limit.

ii) Other cargoes which contain liquids, other than canned goods, should not be carried in the same compartment.

iii) This cargo should be trimmed reasonably level on completion of loading, irrespective of its angle of repose.

iv) Adequate precautions should be taken to prevent water from entering the cargo space.

v) Water should not be excessively used when cooling a shipment. If it is necessary to cool the material, water should only be used in the form of spray.

Determining angle of repose:

1- This information should be supplied by the shipper who will use a laboratory technique such as the tilting box.

2- Officers can go ashore and measure the stock pile angle.

Test for flow:

The shipper document will show the moisture content & state of flow, but the cargo should be continuously observed during loading to check on the appearance of free water, its tendency to flow and non-uniformity.

If the master doubts the shippers data with respect to flow, he may use the following supplementary test, if it gave positive indication of flow then he can reject cargo.

Test procedure:

Half fill a cylindrical can (0.5 – 1.0 liter) and strike sharply on a hard surface 25 times at 2 second intervals from a height of about 0.2 m. If free moisture or fluid conditions result then have additional laboratory tests done.

Precautions, while loading / discharging bulk cargoes

1- The cargo holds to be cleaned and inspected.

2- Make sure all the bilge lines, sounding pipes, air pipes and other service lines within cargo compartment are in order.

3- The bilge covers to be protected by burlap and cementing the edges to the tank top.

4- All deck machinery and external navigational aids should be protected from dust.

5- All doors and portholes should be closed the ventilation system should be shut down or effectively screened. Air conditioning should be placed on recirculation to prevent entry of dust.

6- A plan for loading and DE ballasting should be made up in advance.

7- According to angle of repose make sure proper trimming of cargo, try to fill cargo spaces as much as possible.

8- Consider proper distribution of cargo a v/l stability in all stage of loading / discharging.

9- Observe all safety precautions and all national / port regulations.

10- Keep (WHO , IMO , ILO) medical first aid guide handy for emergency.

Information to be supplied by shipper:

Before loading can commence, the shipper should supply the following information:

1- Angle of repose.

2- Transportable moisture limit.

3- Moisture content.

4- Stowage factor.

5- Statement of chemical hazards.

The shipper should give to master certificate of tests related to cargo. The samples of every kind of cargo loaded also to be delivered to master.

Certificate of test:

A certificate (s) stating the relevant characteristics of the material to be loaded should be provided to the master at the loading port. They should be accompanied by, or contain a statement by the shipper stating that these details e.g moisture content, chemical hazards are to the best of his knowledge and belief, those existing at the time of the vessel's loading.

Stowage and segregation requirements:

Incompatible substances should not be handled simultaneously and should be segregated accordingly to the schedules. After loading on substance, the hatches should be closed and decks washed before loading the second similarly for discharging.

Toxic materials should be segregated from foodstuffs, stowed so that gases do not enter accommodation, and after discharging holds to be cleared.

There are four types of segregation designated by code numbers as follows:

No.1- away from:

Effectively separated so that incompatible materials cannot interact dangerously in the event of an accident, but may be carried in the same hold or compartment provided that a minimum horizontal separation of three meters projected vertically is maintained.

No.2- separated from:

In different holds when stowed under decks, provided an intervening deck is resistant to fire and liquid, they can be stowed in the same hold. If not they must be stowed in adjacent compartments provided the vertical separation is fire resistant and watertight.

No.3- separated by a complete compartment or hold from:

Means either a vertical or a horizontal separation. If the decks are not resistant to fire and liquid, then only a longitudinal separation i.e by an intervening complete compartment, is acceptable.

No.4- separated longitudinally by an intervening complete compartment or hold from:

Vertical separation alone does not satisfy this requirement.

The IMDG code should also be consulted for additional requirements regarding the stowage and segregation of packaged dangerous goods.

Concentrates: Concentrates are obtained from natural ore by a process of purification which removes unwanted constituents. They therefore usually consist of pure mineral particles of a dense nature which flow like fine sand.

The major single hazard associated with carriage of bulk concentrates is liquefaction, but there are other chemical hazards.

The inherent hazards of concentrates:

- **Fire:** some concentrates are subject to spontaneous combustion, other will ignite if an external heat source is applied to them.
- **Explosion:** the dust mixed with air can be explosive, e.g. Sulphur.
- **Suffocating gas:** some concentrates evolve suffocating gas when involved in a fire. E.g sulphur.
- **Toxic gas:** many concentrates produce toxic gases in various ways.
- **Dust inhalation:** the dust of most concentrates should be avoided as many are toxic if the dust is inhaled e.g antimony ore.
- **Swallowing:** personnel are unlikely to swallow cargo directly but dust can settle on food and many concentrates are toxic if swallowed. E.g barium nitrate.
- **Contact:** direct contact with the cargo should be avoided as even seemingly innocuous cargoes can cause health problems. Castor beans can cause irritation.
- **Oxidation:** this is the process of combining with oxygen and it usually produces a chemical reaction.

- **Water contact:** aluminum dross may heat and evolve flammable and toxic gases upon contact with water.
- **Corrosion:** due to galvanic action and others can mix with water and produce corrosive acids e.g sulphur.

Carriage of coal cargoes:

There are various category of coal which being carried by ships, but generally they have following hazards.

1- Coal may release methane and hydrogen, both of which are flammable gases which can make an explosive mixture with air.

2- Some coals are liable to spontaneous heating, which can cause fire, and may when heated emit flammable gases, including carbon monoxide, which is also toxic.

3- Coal is subject to oxidation within a cargo compartment, the oxygen will be depleted and carbon dioxide will increase, creating an atmosphere in which breathing is impossible.

4- The sulphur in coal when combined with moisture can produce sulphuric acid, which is liable to corrode the ship's structure.

5- Some type of coal can liquefy and shift when the moisture content is above TML.

Precautions requires when loading / discharging carrying coal cargo:

1- Make sure to receive cargo declaration and all relevant test certificate before commencement of loading.

2- Plan / distribute cargo properly in a advance keep in mind, coal must be separated from dangerous cargo and must not be stowed adjacent to hot areas.

3- Holds and bilges should be thoroughly cleaned, and any cargo batten removed to prevent the formation of air pocket in the cargo.

4- Coal cargoes having a moisture content in excess of the TML must never be carried.

5- Other cargoes contain liquids must not be stowed where they can leak into coal. Cargo spaces must be watertight to prevent leakage from the sea.

6- Never use water to cool cargo of coal as it may cause the cargo to liquefy.

7- All electrical circuits in holds and adjacent compartments must be isolated.

8- Ventilation trunks leading down into the body of the cargo must be sealed, but ventilation trunks providing surface ventilation must be left unsealed, and available to provide surface ventilation.

9- Appropriate instrument to be carried on board for measuring the following without entry into the cargo space:

i) Concentration of methane in atmosphere.

ii) Oxygen content in holds.

iii) Carbon monoxide content.

iv) Ph value of cargo hold bilges.

v) Temperature of the cargo in the range 0-100 at different level.

10- Smoking and naked lights near cargo spaces should be prohibited, and suitable notices posted.

11- Burning, cutting, chipping, welding and other sources of ignition should not be permitted near cargo spaces unless such spaces have been ventilated and tested free of methane.

12-The cargo should be trimmed reasonably level to the boundaries of the cargo space to prevent the formation of gas pocket and to minimize the mixing of air with the coal.

13-Daily test and recording of temperatures oxygen, flammable gas, toxic gas, ph value of each hold to be maintained through out voyage.

14-When excessive acidity is detected the bilges should be regularly pumped dry to reduce corrosion of the tank tops and the bilge system.

15-If the temperature of the cargo exceeds 55º c and the temperature or the carbon monoxide level is increasing rapidly, a fire may be developing. The cargo hold must completely closed down and all ventilation ceased. No attempt to be made for opening the hatch as admission of oxygen could cause a sudden fire.

The master should seek expert advice immediately and should consider making for the nearest suitable port of refuge. Water should only to be used for boundary cooling. The use of co2 or inert gas, if available should be with held until fire is apparent.

16-Lightly grease the hatch cover track ways before opening the hatches for the first time after a passage at discharge port, to prevent spark which could cause an explosion if pockets of gas exist in the hold.

Bulk cargo separation:

1-Vertical fencing:

Consignment like pig iron are separated by vertical fencing supported on steel wire ropes stretched athwart ships across the hold. The fence must be strong enough to support the weight of cargo on one side until the next parcel is loaded on the other side and must withstand accidental blows from the grab.

Each consignment must be allocated ground space (tank top area) proportional to the tonnage of cargo in the consignment, but this guideline must be modified with small consignments to ensure that space between the fences is sufficient to provide easy access for discharging by grab.

2- Use of steel sheet and / or plastic sheeting:

Parcels of various bulk commodities can be loaded in same holds, when loading commences the first parcel will be loaded to one end of the hold, where a rubber tired loader with a long arm will be used

to trim or push the cargo upwards against the bulkhead until it is stacked against the bulkhead with a sloping face corresponding to its angle of repose.

Parcels of cargo are separated with hot rolled steel sheets measuring 2 . 4 × 1. 2 meter and 1 . 6 mm thickness, which are fitted over the surface of the cargo like a skin. The sheets are cut with oxy- acetylene torches to fit the shape of bulkhead corrugations, and to allow for ladders and pipe work, and are tack welded with stitches of about 25mm at a spacing of 300mm.

The sheets are welded in position like the tiles on the roof of a house, starting at the base of the stow.

When the parcels are fines, or when there is a danger of contamination between adjacent parcels, plastic sheeting is placed over the parcel and taped at the boundaries before the sheets are put in place, and the welded joints between the steel plates are sealed with a heavy strong adhesive tape.

At the time of discharging the steel plates are pulled away by cranes, and are reportedly dumped or sold for scrap.

Question

(A) EXPLAIN THE HAZARDS ASSOCIATED WITH SOLID BULK CARGO.

(B) DEFINE THE FOLLOWING TERMS:

(I) ANGLE OF REPOSE (II) CONCENTRTES (III) MOISTURE MIGRATION

(IV) TRANSPORTABLE MOISTURE LIMIT.

A) The different commodities have different hazards, but, they can all be grouped under the following headings:

1- Structural damage to the ship due to bad distribution of loads.

2- Reduction or loss of stability during the voyage.

3- Chemical hazards due to the giving out of toxic, flammable or explosive gases. They also include spontaneous combustion and severe corrosion.

4- Health hazards due to dust inhaled or ingested. They also include skin contact with the cargo or its dust.

B)

i) Angle of repose is the angle between the horizontal plane and the cone slope of the cargo.

ii) Concentrates are materials obtained from natural ores by a process of purification by physical or chemical separation and the removal of unwanted constituents.

iii) Moisture migration is the movement of moisture contained in cargoes by settling and consolidation of the cargo Material due to vibration and the ship's motion which May result in some portions or all of it developing Free surface.

Iv) Transportable moisture limit of a cargo which may Liquefy is the maximum moisture content of the material which is considered safe for carriage in ships which are not constructed specially for the carriage of cargoes which may liquefy. It is obtained from the flow moisture point or from tests done on the cargo to be loaded.

Question:

WHAT PRECAUTIONS SHOULD BE OBSERVED IN ORDER TO MINIMIZE THE RISK OF FIRE IN COAL CARGOES?

QUOTE THE OFFICIAL REQUIREMENTS IN REGARD TO THE VENTILATION OF A COAL CARGO FOR A LONG VOYAGE?

1- Cargo temperature should be monitored at regular intervals, daily monitoring at different level recommended.

2- Smoking and naked flames near cargo spaces should be prohibited, and suitable notice posted.

3- Burning, cutting, shipping, welding and other sources of ignition should not be permitted near cargo spaces unless such spaces have been ventilated and tested free from methane.

4- The cargo should be trimmed reasonably level to the boundaries of the cargo space to prevent the formation of gas pockets, and to minimize the mixing of air with coal.

5- If temperature of cargo exceeds 55º c and the temperature or the carbon monoxide level is increasing rapidly a fire may be developing. The cargo space must be completely sealed, the master should seek advice from expert and consider port of refuge.

6- At discharge port; lightly grease the hatch cover track ways before opening the hatches for the first time after passage, to prevent spark.

Ventilation requirements:

1- The IMSBC code recommends surface ventilation when the cargo is expected to emit methane or when methane is detected, but makes no recommendation regarding surface ventilation at other times.

2- If ventilation was ceased due to adverse weather condition, the danger of build-up of methane gas in holds to be considered.

3- Gases from the cargo should not be allowed to accumulate in enclosed spaces, such as storerooms and workshops, near holds, such spaces should be ventilated and regularly monitored for gas.

4- Spaces should be ventilated before opening hatch covers, and avoid naked lights, and the creation of sparks when opening.

5- Compartments adjacent to holds must be ventilated and monitored for gas, particularly before entry to them, or before equipment is energized.

Question

(A) WRITE SHORT NOTES ON THE CARRIAGE OF CONCENTRATES.

(B) STATE THE PRECAUTIONS TO BE TAKEN IF THE VESSEL IS NOT SPECIFICALLY DESIGNED FOR THE CARRIAGE OF CONCENTRATES.

A) Concentrates are usually powdery in character and carry considerable moisture content. As the cargo settles the surface may become slushy and so very liable to shift. It is particularly important that the question of special precautions should be considered whenever the cargo to be carried has a moisture content which is likely to exceed 7 percent in any part of the shipment. Concentrate are partially washed or concentrated ores. Copper, lead and zinc are shipped as bulk in concentrate form.

The normal moisture content may have been seriously increased should there have been heavy rain during storage or loading or leakage into the holds during the voyage. In these circumstances the vibration of the ship may cause the moisture to saturate and the concentrate to turn into slurry with consequent danger of the vessel taking a serious list.

B) general precautions:

1- The general fore and aft distribution of weight should not differ appreciably from that found satisfactory for general cargoes.

2- The maximum number of tones of cargo loaded in any space should not exceed 0.9 LBd tones.

L = length of the hold in meters.

B = average breadth of the hold in meter.

d= the summer load draught in meters.

3- If cargo is untrimmed, the height of the cargo pile above the floor should not exceed in meters. 1.1 × d × stowage factor. S.F is given in cubic metres per tonne.

4- It is recommended that concentrate should be trimmed reasonably level on completion of loading irrespective of the angle of repose.

5- Cargo which contain liquids should not be stowed in the same cargo space above or adjacent to these cargos.

6- The moisture content should not be in excess of the transportable moisture limit.

7- No liquid should be permitted to enter the cargo spaces.

8- If it is necessary to cool the cargo, the water should be applied in the form of a spray to reduce the possibility of inducing a flow state.

9- The stresses to be pre-calculated for the loading / discharging operation as well as for the voyage. Difficulty may be encountered when securing cargo hatches on ship's which hog or sag and the watertight integrity of the ship may be impaired.

10- An excessively high GM should be avoided and it may be necessary to load cargo into tween deck spaces in order to reduce the ship's metacentric height, but precaution to be taken to avoid overstressing the tween deck structure.

11- Precaution to be taken against chemical hazards of this cargo which are:

Fire hazard – explosion – suffocating gas - toxic gas - dust inhalation – swallowing oxidation – water contact.

BULK GRAIN CARGO

DEFINITIONS

Grain:

Includes wheat, maize, oats, rye, barley, rice, pulses and seeds, whether in natural form or in such a processed form that its characteristics resemble those of its natural form with regard to liability to shift when loaded.

Filled compartment:

Means any compartment in which the bulk grain is loaded and trimmed in accordance with required regulations.

Partly filled compartment:

Means any compartment in which bulk grain is loaded which is not filled compartment.

Angle of flooding :

Means that angle of heel at which openings in the hull, superstructures or deckhouses that cannot be closed weather tight immerse.

Void : Means a space in a compartment into which grain has been poured, which space is between the surface of the grain and the crown of the compartment.

Hints on Cleaning & preparation of holds:

For obtaining maximum amount of cleaning the following aspect must be taken into consideration in details:

1- Cargo residue.

2- Sweeping, washing with sea & f.w.

3- Loose scale removal.

4- Drying the hold using ventilation.

5- Bilges; scuppers, strainer strum box, bilge covers, testing its suction, it's non-return valve, sweetening the bilges (lime wash) etc.

6- Hatch cover cleaning, washing, hose test.

7- Final inspection.

8- Log book entries.

9- Painting bare patches if time allows.

Thorough check for rodents & infestation:

The holds should be inspected for items which are not so easily seen. The presence of vermin like rats and mice will be seen from their droppings. If present, rat poison or traps should be set down. If there are any smells, the hold should be well ventilated and deodorant used. In this case the bilges would be cleaned out, dried out and sweetened.

Trimming:

In a filled compartment the grain shall be trimmed to fill all Spaces under the decks and hatch covers as far as possible.

Partly filled compartments shall be trimmed level.

Trimming will help in avoiding cargo shift and distribute weight, in a cargo compartment. Normally trimming will be done by ship loader arm (shooter) moving fwd and aft / port and starboard if requires a small trimming loader can be use inside each hold at end of cargo loading completion.

All free grain surface should be leveled to minimize the effect of the grain shifting. In any filled compartment the bulk grain must be trimmed so as to fill all the spaces under the decks and hatch covers. All free grain surfaces in partly filled compartments must be level.

Intact stability requirements :

The intact stability characteristics of any ship carrying bulk grain shall be shown to meet, throughout the voyage, at least the following criteria:

i) the angle of the heel due to the shift of grain shall be not greater than 12º .

ii) in the statical stability diagram, the net area between the heeling and righting arm curves up to a given angle to be at least 0.075 meter radian. (the given angle is 40º or the angle of flooding (θ_f) whichever is the least).

iii) the initial metacentric height, after tank free surface correction (fluid GM), is to be at least 0.3m.

Document of authorization:

Every ship which is to carry grain must have on board a document of authorization.

This document takes the form of a booklet of stability information which includes grain loading conditions and other information which indicates that the ship meets the relevant SOLAS requirements for carrying grain.

Every booklet must be stamped by the administration of the country in which the ship is registered, or by a certifying authority on its behalf. The grain regulations are based on ensuring that the ship will at all times during the voyage have adequate stability, after taking into account the heeling moment caused by the assumed pattern of grain shift.

Methods of securing grain:

The IMO grain regulation state various methods of securing grain surface to reduce heeling moment caused by grain shift.

These methods for filled & partly filled compartments are:

A) filled compartments:

Any of the followings may be used to reduce the heeling moment caused by the assumed shift of 15º .

1- longitudinal division: For the purpose of reducing the adverse heeling effect of grain shift or of limiting the depth of the cargo used for securing grain, compartments may be fitted with longitudinal divisions.

These must be grain tight and fitted on the centre line. In a tween deck they must extend from deck to deck. In a hold extending downwards from deck head to 0.6 m below the lowest void formed after an assumed shift.

fig-4 .

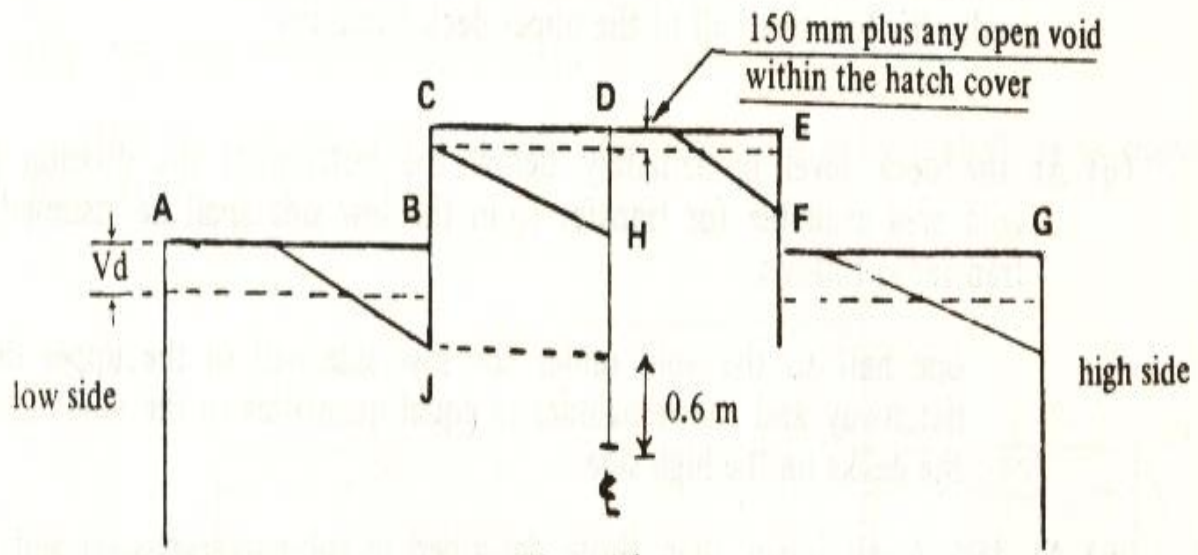
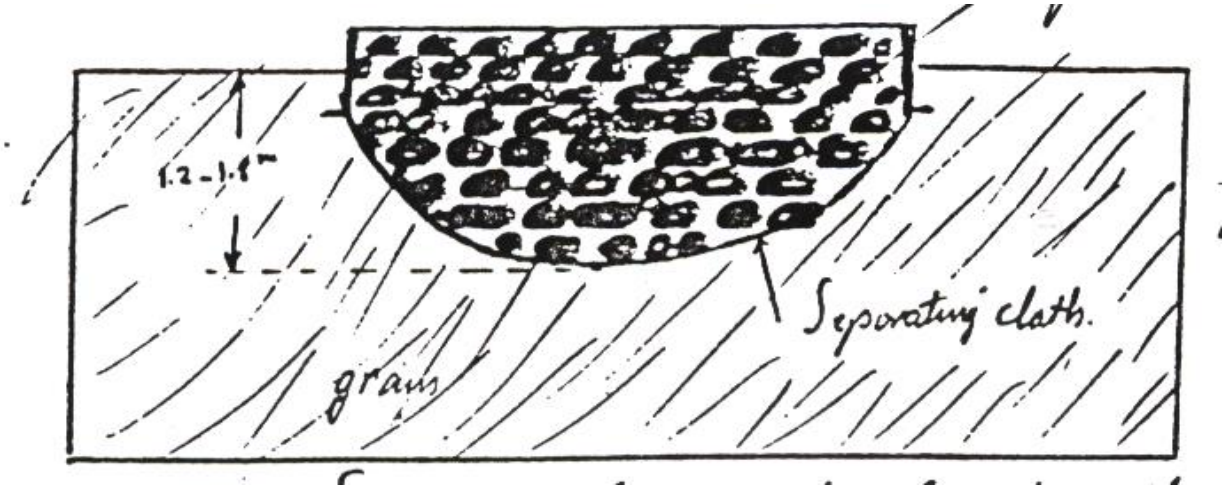


Figure 4

2- saucers:

May be used instead of longitudinal divisions except when carrying oil seeds. In way of the hatch square a saucer shaped hollow is left in the bulk grain surface. A separation cloth is laid over the surface and the remaining space filled with bagged grain or other suitable cargo. The bags are to be sound, well filled and securely closed and tightly stowed against the coaming and any portable beams.

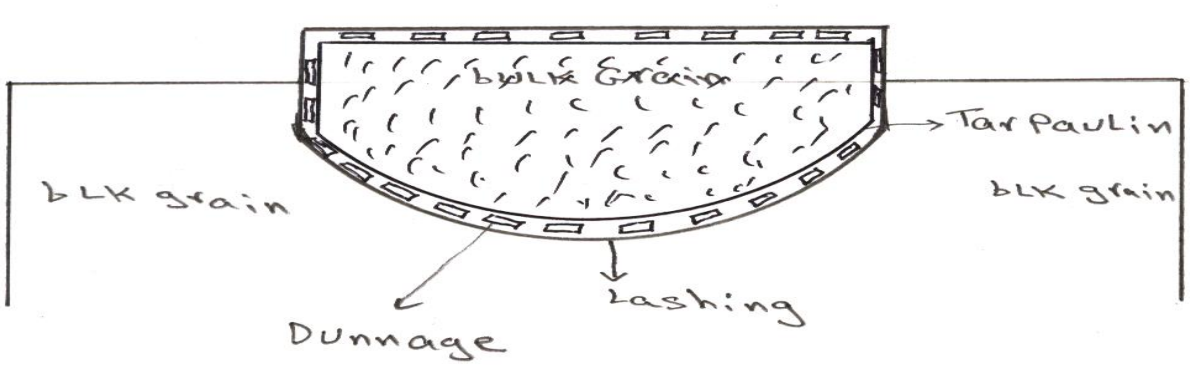
The depth of the saucer varies between 1.2m and 1.8m dependent upon the breadth of the vessel and is measured from the deck line downwards.



3- bulk bundle:

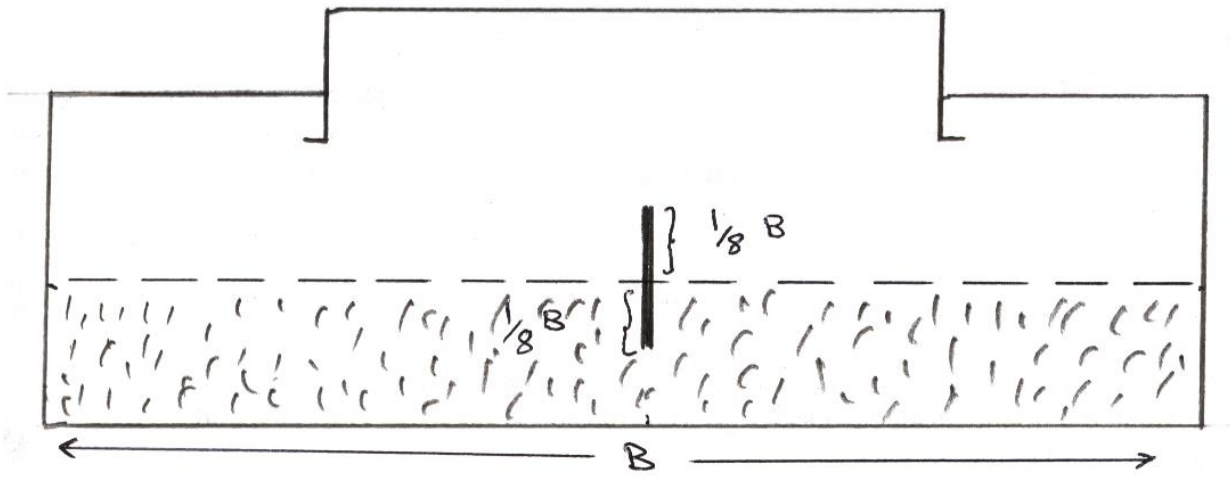
This is an alternative to filling the saucer with bagged grain. The saucer is covered with a tarpaulin of specified strength.

This is then filled with bulk grain. The sides and ends of the tarpaulin are then drawn together over the upper surface and secured together. Slightly weaker tarpaulins may be used if the bundle is secured as shown below



B) party filled compartments:

The followings may be used to reduce the heeling moment caused by the assumed shift of 25º .



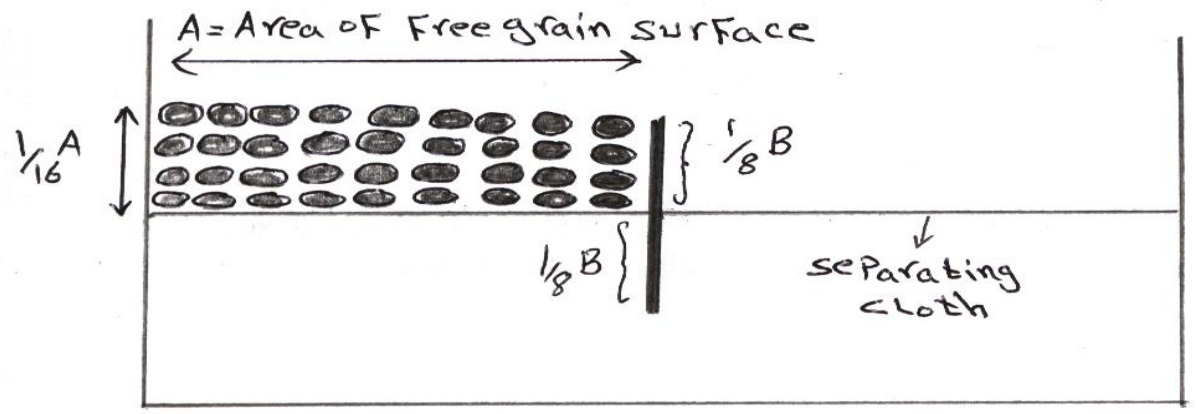
1- longitudinal division:

This shall extend 1/8 of the maximum breadth of the compartment above and below the grain surface.

2- over stowing: The grain surface is covered with a separation cloth or dunnage platform and bagged grain or other suitable cargo is stowed to a height of 1/16 of the maximum width of the free grain surface or 1.2m whichever is greater.

A longitudinal division may be used to limit the width of the free grain surface and thus the height of over stowing the division must extend at least 0.6m above the surface and 1/8 of the maximum breadth of the compartment above and below the surface.

3- strapping or lashing:



The grain surface is trimmed with a slight crown and covered with tarpaulins or separation cloths, then a timber platform, then lashings or steel straps are secured to the frames below the grain surface and secured tight by turnbuckles or winch lighteners and wrenches.

Combination arrangements

Lower holds and 'tween deck spaces in way thereof may be loaded as one compartment if, in calculating transverse heeling moments, proper account is taken of the flow of grain into the lower spaces.

Notes on loading grain

- When notified that the ship is to load a grain cargo, the first step will be to clean the hatches scrupulously. This requires the chief officer's close supervision as for this cargo the surveyors are very particular.
- The chief officer will have studied the grain rules (imo or government of loading port). He will use the grain stability loading booklet, if he has forms on board, he will complete a pre-loading form, if not on a sheet of paper he will calculate followings:

A) the fluid GM of the ship on completion of loading.

B) the angle of heel.

$$\text{Tang. } \theta = \frac{\text{grain trimming moment}}{\text{S.F x Displ x GMf}}$$

C)Construct a curve of statical stability.

He will make up a plan of loading and deballasting bearing in mind the following:

1- limiting draughts.

2- structural stresses.

3-A good trim by the stern for draining the ballast tanks.

4-The trim on completion.

- In the loading port there will be a number of surveyors; Government, grain board (sometimes state and federal) and receiver's.

- After checking the holds and passing them, they will each give the c/o a number of copies of forms allowing the v/l to carry the grain.
- The government surveyor after he has checked the pre-loading grain form, will give the c/o written permission to commence loading.

- There will be initial / final draught survey to check the weight of cargo loaded. This will be a joint effort by the c/ o & shipper's surveyors.
- They will take mean forward, mean amidships, and mean aft & finally mean of mean draughts will be obtained, they take the dock water density at same time.
- They will take the displacement from the ship's displacement scale and correct it for density of the dock water.
- They obtain all known weights on board including, ballast, fuel, fresh water Stores on board.
- At end of loading by obtaining the final displacement, the difference of the two will give cargo loaded, allowing for constant (unknown weight onboard).

LOADING TWO GRADES OF GRAIN IN THE SAME HOLD:

To load e.g cornmeal and wheat, or any two grains, in the same hold the procedure is as follows:

1- Load the heavier cargo (cornmeal) first.
2- Spout trim the cargo as level as possible.
3- Cover cargo with stout tarpaulins.
4- Infill frame spaces and bulkhead corrugations with burlap or tarpaulin off cuts.
5- Lay plywood sheets on top of tarpaulin.
6- Cover plywood joins with overlapping plywood strips.
7- Secure the plywood sheets an strips to the tarpaulin with staples, tacks or nails.
8- Load the next cargo.

Insect infestation:

Any trace of insect infestation in the hold or in the bilges is unacceptable with an edible cargo. Spraying with a suitable spray may be sufficient, or the hold may have to be

fumigated. Loose scale is a favorite hiding place for insects, and the inspection for them should be very thorough before perishable cargoes are carried. If detected by the inspectors, insect infestation can result in expense, delay and off hire whilst the ship is fumigated. If they are undetected, there is a danger that the cargo will be damaged and massive cargo claims will be experienced.

A ship may be infested by insects or by rats. Infestation by insects may exist aboard ship or may be brought aboard with the cargo. The purpose of its removal may be to satisfy the agricultural authorities in the discharge port or to ensure that the cargo remains acceptable to the receiver. Infestation can cause cargo to overheat. Infestation by rats must be eliminated in accordance with international health regulations. Infestation is assisted by dirt and cargo residues holds, accommodation, storerooms and machinery spaces should be kept very clean to remove any opportunity for infestation.

Treatment of infestation:

For minor infestation contact insecticides can be used. These are applied in spray or fog form and can be performed by ship's crew using hand spray, pressurized knapsack spray or smoke bomb.

For more serious or deep-seated infestation of cargo space or an infestation of cargo, the fumigant is to be used. Fumigants are administered as gases or liquid sprays. The gas may be delivered in pellets which decompose during the voyage and give a slow release of gas. Full recommendation for the use of pesticides in ship (IMO) to be followed.

LOADING GRAIN :

DISCHARGING GRAIN :

Question

DESCRIBE THE APPROVED METHODS OF SECURING A LOWER HOLD, CONTAINING BULK GRAIN, WHEN:

(A) NEARLY FULL OF BULK GRAIN.

(B) HALF FULL OF BULK GRAIN.

(a) Filled compartment.

i) Longitudinal divisions / shifting boards:

These are grain tight boards fitted on center line, Extending from deck head to 0.6m below the grain Surface after an assumed shift of 15 º.

ii) saucers:

It may be used instead of longitudinal divisions except when carrying oil seeds. In way of the hatch square a saucer shaped hollow is left in the bulk grain surface.

A separation cloth is laid over the surface and the remaining space filled with bagged grain or other Suitable cargo. The bags are to be sound, well filled And securely closed and tightly stowed against the

Coamings and any portable beams. The depth of saucer Varies between 1 .2 m and 1 . 8 m dependent upon the Breadth of the vessel and is measured from the deck Line downwards.

iii) bulk bundle:

This is an alternative to filling the saucer with bagged Grain. The saucer is covered with a tarpaulin of specified Strength. This is then filled with bulk grain, the sides and ends of tarpaulin are then drawn together over the upper surface and secured together.

(b) partly filled compartments.

i) longitudinal divisions :

This shall extend to 1/8 of the maximum breadth of the Compartment above and below the grain surface. When Used to limit the depth of over stowing cargo it shall Extend at least 0.6 m above the grain surface.

ii) over stowing:

The grain surface is covered with a separation cloth r dunnage platform and bagged grain or other suitable Cargo is stowed to a height of 1/16 of the maximum width Of the free grain surface or 1. 2m whichever is greater.

iii) strapping or lashing:

surface trimmed level and covered with cloths, Overlapping by at least 1 . 8m. Two solid floors (25mm × 200mm) top floor fore and aft Nailed to lower floor or one solid fore and aft floor (50mm) nailed to transverse bearers (50 mm × 150 mm) not More than 2 . 4 m apart extending full width of compartment. Lashings are 19 mm steel wire rope double steel strapping (50 mm × 1 . 3 mm) with b.s 5000 kg, or equivalent chain, set Tight with 32 mm turn buckles.

Lashing to be attached to frames with 25 mm shackles or Equivalent beam clamps at about 450 mm below final grain surface.

Question

WHERE WOULD YOU FIND INFORMATION ON LOADING AND CARRYING GRAIN CARGO?

WHAT ARE THE STABILITY REQUIREMENTS FOR SHIPS CARRYING GRAIN?

Grain information can be obtained from the International Code for the Safe carriage of grain .

Stability requirements :

a) The angle of heel due to shifting of grain shall not be greater than 12 degrees or if ship constructed after 1 January 1994 the angle at which the deck edge is immersed, whichever the lesser.

b) In the statical stability diagram the net or residual area between heeling arm curve and righting arm curve up to angle of heel of max difference between the ordinates of the two curves, or 40 degrees or the angle of flooding whichever is the least shall in all conditions of loading be not less than 0.075 m / radians

c) The initial met centric height after correction for free surface effects of liquids in tanks shall not be less than 0.3m

d) The ship shall be upright before proceeding to sea.

Question

WHAT IS A DOCUMENT OF AUTHORIZATION?

This document shall be issued for every ship loaded in accordance with the regulations of the International Grain Code.

It is issued by the Administration or an organization recognized by it or a contracting government.

The document is accepted as evidence that the ship is capable of complying with the regulations and should be incorporated into the ships grain loading manual.

Question

YOU ARE ABOUT TO LOAD A CARGO OF GRAIN. WHICH BOOK WOULD YOU SELECT THE SHELVES IN YOUR OFFICE WHICH WOULD GIVE YOU- LOADING INFORMATION SPECIFIC TO YOUR SHIP? WHAT INFORMATION WOULD YOU FIND IN THIS BOOK?

The Grain Loading Manual contains:

a) Ships particulars

b) Light ship displacement and KG

c) Table of liquid free surface corrections

d) Various curves or tables including angle of flooding, hydrostatic properties, stability, and heeling moments

e) Loading instructions in the form of notes /summarizing the requirements of the grain code

f) A worked example for guidance

g) Typical loaded service departure and arrival conditions and where necessary immediate worst service conditions

Question

YOU RECEIVE ORDERS TO PROCEED TO ROTTERDAM TO LOAD GRAIN. IF YOUR SHIP DOES NOT HAVE A DOCUMENT OF AUTHORIZATION WHAT MUST YOU DO IN ORDER TO BE ABLE TO ACCEPT THE CARGO?

The Master must demonstrate to the authority at the port of loading that the ship in its loaded condition on the intended voyage complies with the optional stability requirements of the code:

a) Total weight of the bulk grain not to exceed one third of the dead-weight of the ship

b) All filled compartments, trimmed, shall be fitted with center line divisions. Saucers may be accepted for some cargoes

c) All hatches to filled compartments, trimmed, shall be closed and covers secured in place

d) All free grain surfaces in partly filled cargo spaces shall be trimmed level and secured in accordance with the regulations

e) Throughout the voyage the metacentric height after correction for free surface effects of liquids in tanks shall be 0.3m or that given by a formula in the code whichever is the greater

Question

YOU ARE TO LOAD A CARGO OF GRAIN AND CANNOT COMPLY WITH THE STABILITY REQUIREMENTS. WHAT CAN YOU DO AND HOW WOULD YOU DO IT?

- Stabilize the free surface of the grain:
- Longitudinal divisions
- Saucering and bundling
- Over stowing
- Strapping or lashing
- Securing with a wire mesh

Question

LIST THE ITEMS YOU WILL CHECK BEFORE LOADING GRAIN CARGO?

- ❖ Check out the stability book to make sure you can safely take this amount of grain onboard .
- ❖ Make sure the ship is fumigated before the grain is taken aboard (it can be oxygen deficient or have flammable gases in it) .When a ship is fumigated, the detailed recommendations contained in the Recommendations on the Safe Use of Pesticides in Ships" should be followed. Spaces adjacent to fumigated spaces should be treated as if fumigated.

Failure to observe simple procedures can lead to people being unexpectedly overcome when entering enclosed spaces. Observance of the principals outlined above will form a reliable basis for assessing risks in such spaces and for taking necessary precautions .

- ❖ Check out the grain loading plans.
- ❖ Check out the stowage details for the grain.
- ❖ Find out the type of grain carried and see what (if any) gases it gives off .

- Find the total weight of the grain .
- Find out what draft and freeboard you have before loading and after loading .
- Make sure that the grain cannot shift by taking precautions using boards transversely and athwart ships to minimize F.S.E. (Free Surface Effect) .
- Watch for overheating (sweating though Cargo sweat or Ships sweat) both are dangerous and can ignite and explode by itself .