Ship and Ship Routines

Duties of the Master, Officers and Crew of a Ship

- A ship's crew can generally be divided into four main categories namely:
  - The deck department
  - The engineering department
  - The stewards department
  - Others
- **Modern ship's complement**
- **Captain/Master**
- The captain or master is the ship's highest responsible officer, acting on behalf of the ship's owner. Whether the captain is a member of the deck department or not is a matter of some controversy, and generally depends on the opinion of an individual captain. When a ship has a Third Mate, the Captain does not stand watch.

DECK DEPARTMENT

- **Chief officer/chief mate** : The chief officer (often called the chief mate in the United States) is the head of the deck department on a merchant vessel, second-in-command after the ship's master. The chief mate's primary responsibilities are the vessel's cargo operations, its stability, and supervising the deck crew.
- The mate is responsible for the safety and security of the ship, as well as the welfare of the crew on board. The chief mate typically stands the 4-8 navigation watch.
- Additional duties include maintenance of the ship's hull, cargo gears, accommodations, the life saving appliances and the firefighting appliances. The Chief Mate also trains the crew and cadets on various aspects like safety, firefighting, search and rescue, and various other contingencies.

Second officer/second mate

- The second officer (or second mate) of a merchant vessel is usually in charge of navigation and is the next licensed position above third officer and below chief officer as third-in-command. The second mate typically stands the 12-4 navigation watch.
- That is, the second mate will stand watch from 1200 to 1600 at noon and again from 0000 to 0400 in the nights. The second mate is typically the navigation officer aboard a ship. The navigation officer is responsible for maintaining the charts and navigational equipment on the bridge.
- The duties also usually entail developing the voyage plans under the direction of the ship's master.

- **Third officer/third mate**
- The third officer (or third mate) of a merchant vessel is primarily charged with the safety of the ship and crew. The third mate is the next licensed position onboard the vessel, being fourth-in-command after the captain, first/chief mate, and second mate. The third mate tends to take the 0800 to 1200 watch.
- **Boatswain**
- A boatswain, often (at least since 1868) phonetically spelled and pronounced *bosun*, is in charge of the unlicensed deck crew and is sometimes also third or fourth mate

Able Seaman

- In the modern merchant marine, an able seaman (AB) is a member of the deck department and must possess a merchant mariner's document.
- An AB will work in a ship's deck department as either a watch stander, a day worker, or a combination of these roles.
- At sea an AB watch stander's duties include standing watch as helmsman and lookout. A helmsman is required to maintain a steady course, properly execute all rudder orders and communicate utilizing navigational terms relating to heading and steering.
- While the ship is not underway, a watch stander may be called upon to stand security-related watches, such as a gangway watch or anchor watch.

Ordinary Seaman

- In the United States Merchant Marine, an ordinary seaman or OS is an entry-level position in a ship's deck department. An OS performs a variety of duties concerned with the operation and upkeep of deck department areas and equipment. Upkeep duties include scaling, buffing, and painting decks and superstructure; as well as sweeping and washing the deck.
- An OS may splice wire and rope; break out, rig, overhaul, and stow cargo-handling gear, stationary rigging, and running gear. Additionally, the OS secures cargo, as well as launches and recovers boats.
- The OS may rig and operate hydrographic and other specialty winches; handle and stow oceanographic explosives; and stage and stow beach support equipment.

Engineering department

- **Chief engineer**
- The chief engineer on a merchant vessel is the official title of someone qualified to oversee the engine department. The qualification for this position is colloquially called a "Chief's Ticket".
- The Chief Engineer commonly referred to as "The Chief", "Cheng", or just "Chief" is responsible for all operations and maintenance that have to do with all engineering equipment throughout the ship.

Second Engineer/First Assistant Engineer

- The second engineer or first assistant engineer is the officer responsible for supervising the daily maintenance and operation of the engine department. He or she reports directly to the chief engineer.
- On a merchant vessel, depending on term usage, "The First" or "The Second" is the marine engineer second in command of the engine department after the ship's chief engineer. The person holding this position is typically the busiest engineer aboard the ship, due to the supervisory role this engineer plays and the operations duties performed.
- Operational duties include responsibility for the refrigeration systems, main engines (steam/gas turbine, diesel), and any other equipment not assigned to the second assistant engineer/third engineer or the third assistant engineer/fourth engineer(s). If the engine room requires round the clock attendance and other junior engineers can cover the three watch rotations, this officer is usually a "day worker" from 0630-1830

Third Engineer/Second Assistant Engineer

- The third engineer or second assistant engineer is junior to the Second Engineer/First Assistant Engineer in the engine department and is usually in charge of boilers, fuel, auxiliary engines, condensate, and feed systems.

- This engineer is the third highest marine engineer in rank. Depending on usage, "The Second" or "The Third" is also typically in charge of fueling or bunkering, if the officer holds a valid Person In Charge (PIC) endorsement for fuel transfer operations.

Fourth Engineer/Third Assistant Engineer

- The fourth engineer or third assistant engineer is junior to the second assistant engineer/third engineer in the engine department.
- The most junior marine engineer of the ship, he or she is usually responsible for electrical, sewage treatment, lube oil, bilge, and oily water separation systems.
- Depending on usage, this person is called "The Third", "The Fourth" or "Pourth" - (if sailing with Filipino crew), and usually stands a watch.
- Moreover, the Fourth Engineer may assist the third mate in maintaining proper operation of the lifeboats.

Engineering cadet

- An unqualified, unticketed, trainee engineer officer. Normally reports to the second engineer. Their role as trainee is to observe and learn, while helping out where possible. As they have no 'ticket' a cadet can not hold a watch, but will likely assist one of the qualified engineers with their watch.
- Typical duties are limited to preparing the tea and coffee at breaks for the engineering team. The Engine Cadets epaulette is purple, as with the other engineers, however has only one gold horizontal strip (UK system)

Steward's Department

- **Chief Steward**
- The chief steward directs, instructs, and assigns personnel performing such functions as preparing and serving meals; cleaning and maintaining officers' quarters and steward department areas; and receiving, issuing, and inventorying stores.
- The chief steward also plans menus; compiles supply, overtime, and cost control records. The Steward make requisition or purchase stores and equipment.
- Additional duties may include baking bread, rolls, cakes, pies, and pastries. A chief steward's duties may overlap with those of the Steward's Assistant, the Chief Cook, and other Steward's Department crew members.

Chief Cook

- The chief cook is a senior unlicensed crew member working in the Steward's department of a ship.
- The chief cook directs and participates in the preparation and serving of meals; determines timing and sequence of operations required to meet serving times
- inspects galley and equipment for cleanliness and proper storage and preparation of food

Procedure for Handing over and Taking over a Watch

- Engineers and deck officers on ships perform their duties in rotational shifts, each having fixed and equal number of hours. This work shift is known as a **WATCH**, and needs to be carried out in an efficient manner to ensure the safety of life and property at sea.
- The normal watch keeping schedule and responsible watch keeping engineers in a fully manned engine room is:

❖ 0800 – 1200 → 4/E; 2000 – 2400 → 4/E

❖ 1200 – 1600 → 3/E 2400 – 0400 → 3/E

❖ 1600 – 2000 → 2/E 0400 – 0800 → 2/E

- An engineer onboard a ship can master the watch keeping procedure in a number of ways, however, he needs to take **Extra Care** while handing over to the next engineer officer so as to ensure that the ship runs safely and smoothly.

- For the engineers, handing over of watch is done according to the instructions provided by the chief engineer's standing orders and the company's instructional manual it should be done very sincerely and honestly so that the watch keeping becomes smoother and continuation of any kind of work is not affected onboard.

- In practical terms, it is impossible for any relieving engineer officer to check all the valves, pipelines, machinery and controllers in the engine room while taking over the watch.

- It is therefore incumbent on the relieved officer to pass the right information to the incoming/relieving engineer, so that there are no surprises during the watch and he can concentrate on his watch and perform more demanding and important jobs

Things to Inform the Relieving/Incoming Officer During a Watch Handover

1. Special orders related to any ship operation from bridge or the company, control system or maintenance work.
2. Standing orders from the chief engineer or the company
3. Level of important tanks such as bilges, ballast tank, sewage tank, reserve tank, slop tank, fuel tank, or any other tank which require attention.
4. Condition and state of fire extinguishing equipment and systems, in case any specific section or fire alarm has been isolated
5. Special mode of navigational operation of ship in case of emergency situation, damage, icy or shallow water, etc.

- 6. In case there is any equipment failure, details of same should be informed him

- 7. in case there is any kind of maintenance being carried out in the engine room by other engineer officers and crew members, then their work location, details of job machinery under maintenance, and information of authorized person and crew members should be provided.

- 8. Any potential hazard associated with the ongoing maintenance work should also be communicated the relieving officer

- 9. All the checks already made when the ship leaves the port should be noted. In case any check is pending, it should be conveyed to the relieving officer
- 10. All the checks that are made when the ship enters the port should be noted and the relieving officer informed of this should any be missing
- 11. Condition and important information regarding mode of operation of main engine, boiler, and auxiliary engines should be provided
- 12. In case an equipment needs to be monitored manually, details of same should be provided, along with the condition of monitoring and control equipment.

- 13. Any form of adverse ship condition needs to be informed the relieving officer
- 14. Information on the condition and modes of all the important auxiliary machinery such as purifiers, fresh water generator, oily water separator, pumps, sewage treatment plant, etc. should be provided
- 15. In case any important machinery failed to receive attention during the watch, the reliving officer should be told and asked to take care of the same
- 16. The condition and modes of automatic boiler controls and details of other equipment related to the operation of the steam boiler should be provided
- The engineer officer should ensure that all the important parameters regarding main and auxiliary machines are suitably recorded in the engine room log book

NOTE:

- If you are satisfied that the incoming watch keeping engineer is in fit/good condition; not drunk, etc. and mentally and physically prepared to take over the watch then hand over the watch to him by signing the company form

- If the Engineer Officer feels that the relieving Officer is not in a condition to carry out the watch duties efficiently, the former should not handover the watch and should inform same to, and consult with the Chief Engineer officer

Taking over a Watch

- **For an engineer taking over a watch, he should do the following:**

1. Get ready with proper PPE 20 minutes before the watch. Then go outside the accommodation to see the Main engine and Auxiliary engines exhaust gas colour from the funnel

2. Then come down to the engine room in time, take a good round to feel for any abnormality in sound, smell etc.; check for any leak, contamination, level, pressures and temperatures of all running machineries

- 3. After coming back to the control room, check the control panel for any abnormal alarms or parameters

- 4. Check the main electrical switchboard for running diesel generator (D/G) load, volts and amp and stand–by mode of other idle D/G . Also check the megger readings and lamp indications for earth faults in 440volt or 220volt feeder panel.

- 5. then check M/E rpm, T/C rpm and M/E load indicator and ask about Chief engineer and bridge instruction for M/E rpm

- 6. Before taking over watch, ensure that the log book is checked and that all important parameters regarding main and auxiliary machines has been recorded and updated in the engine room log book by the outgoing watch keeping engineer and signed.

Duties of a Watch Keeping Engineer During an Engine Room Watch

- Check and maintain the main engine or propulsion systems functioning and all units exhaust temperature, piston cooling lubricating oil temperature, jacket cooling water (JCW) outlet temperature, lube oil inlet pressure and temperature, air cooler temperature, fuel temperature and pressure
- Auxiliary engine system functioning and all units exhaust temperature, piston cooling lubricating oil temperature, jacket cooling water outlet temperature, lube oil inlet pressure and temperature, air cooler temperature, fuel temperature and pressure to be checked and maintained

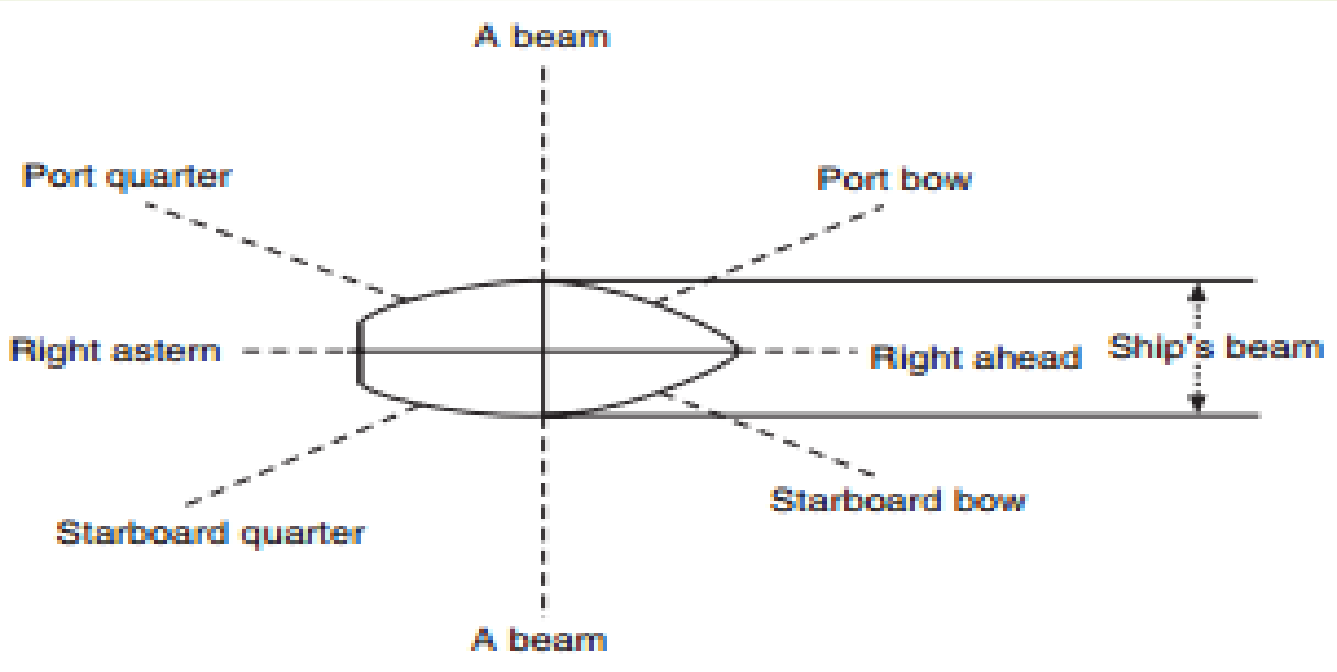
- Steering system functioning, and tank oil level to be checked
- Boiler pressure and water level to be checked. Also check the hot well water level
- Accommodation A/C and provision refrigeration plants to be checked and provision room temperature to be checked too.
- Exhaust gas economizer /Exhaust gas boiler inlet and outlet temperature to be checked
- Bilge level in all bilge wells and bilge holding tanks to be checked
- Sludge tanks and Bilge Separator Oil tanks level to be checked

- Waste oil service tank level and temperature, and incinerator furnace temperature to be monitored, if the incinerator runs
- Sewage treatment plants to be checked for proper functioning
- Check if safety related items such as fire alarms, fire extinguishing system, etc. are functioning properly
- Purifier fuel temperature, pressure and gear oil level to be checked
- Air compressor oil level to be checked
- Drain fuel oil settling and service tanks and check the level and temperature
- Air bottles to be drained and pressures to be maintained

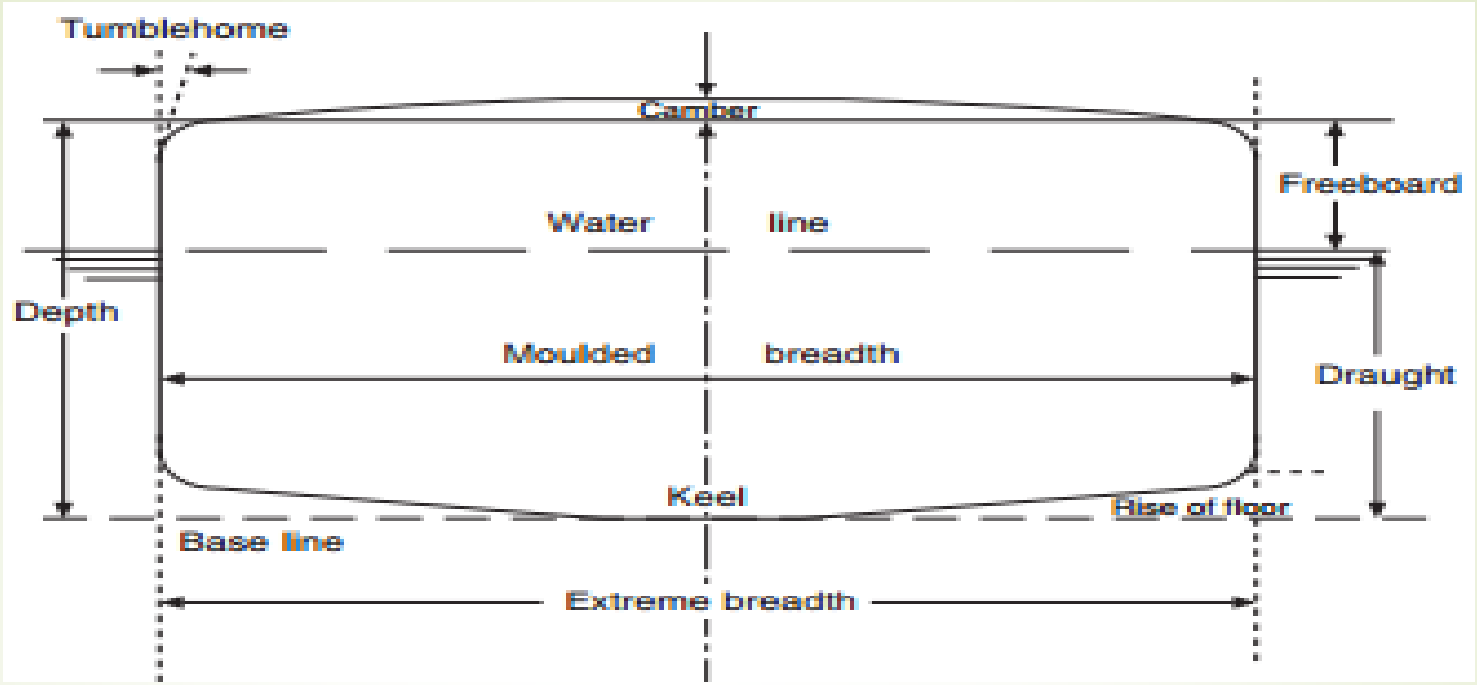
- **Any change in log book parameters will help to make out difference between condition monitoring and easily detects some faults with relevant machineries and indicate there performance. Hence:**
- Different level condition indicates loss, leakage, overflow, etc.
- Change in temperature and pressure will indicate deviation/ abnormality, considering the same ambient condition
- A distillate plant small reading may indicate performance fall off
- FO/DO flow meter increased reading may indicate loss or leakage

The Ship

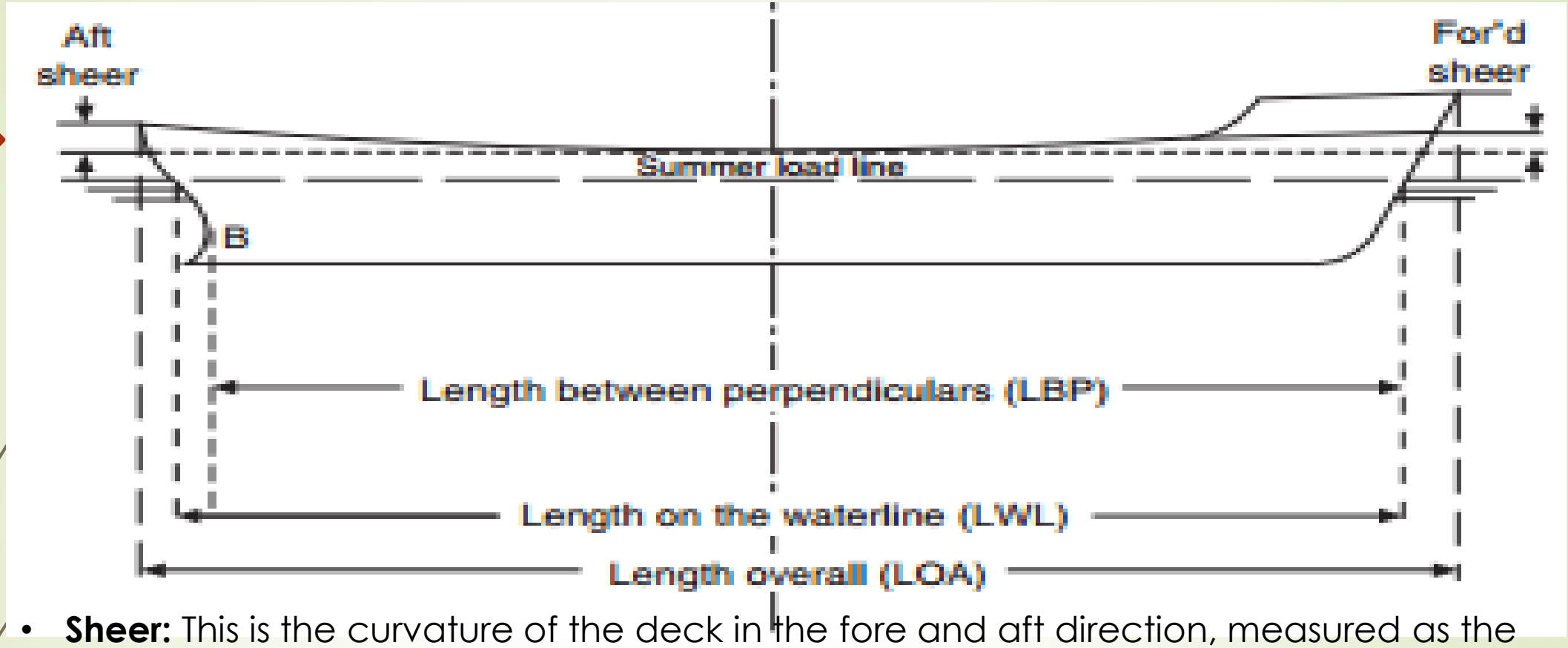
- **Abeam**: A bearing projected at right-angles from the fore and aft line, outwards from the widest part of the ship



- **Ahead**: 'Right ahead' is the line the fore and aft line, if projected, would extend in
front of the vessel. Opposite to the term 'astern', when used in relation to relative bearings. It may also be used as an engine-room order to cause the engines to turn in order to move the ship ahead.



- **Athwartships:** Defined as 'in a direction' from one side of the ship to the other, at right angles to the fore and aft line.
- ***Breadth*:** The maximum beam of the vessel measured from the outside edge of the shell plating on either side of the vessel is the *extreme* breadth The beam of the vessel measured amidships, between the inside edge of the shell plating on either side of the vessel, is the moulded breadth
- **Camber (or round of beam):** The curvature of the deck in the athwartships direction. The measurement is made by comparing height of deck at the centre of the vessel to height of deck at the side of the vessel
- **Depth:** The *extreme* depth of the vessel is measured from the bottom side of the keel to the top of the deck beams, the measurement being taken at the side of the vessel



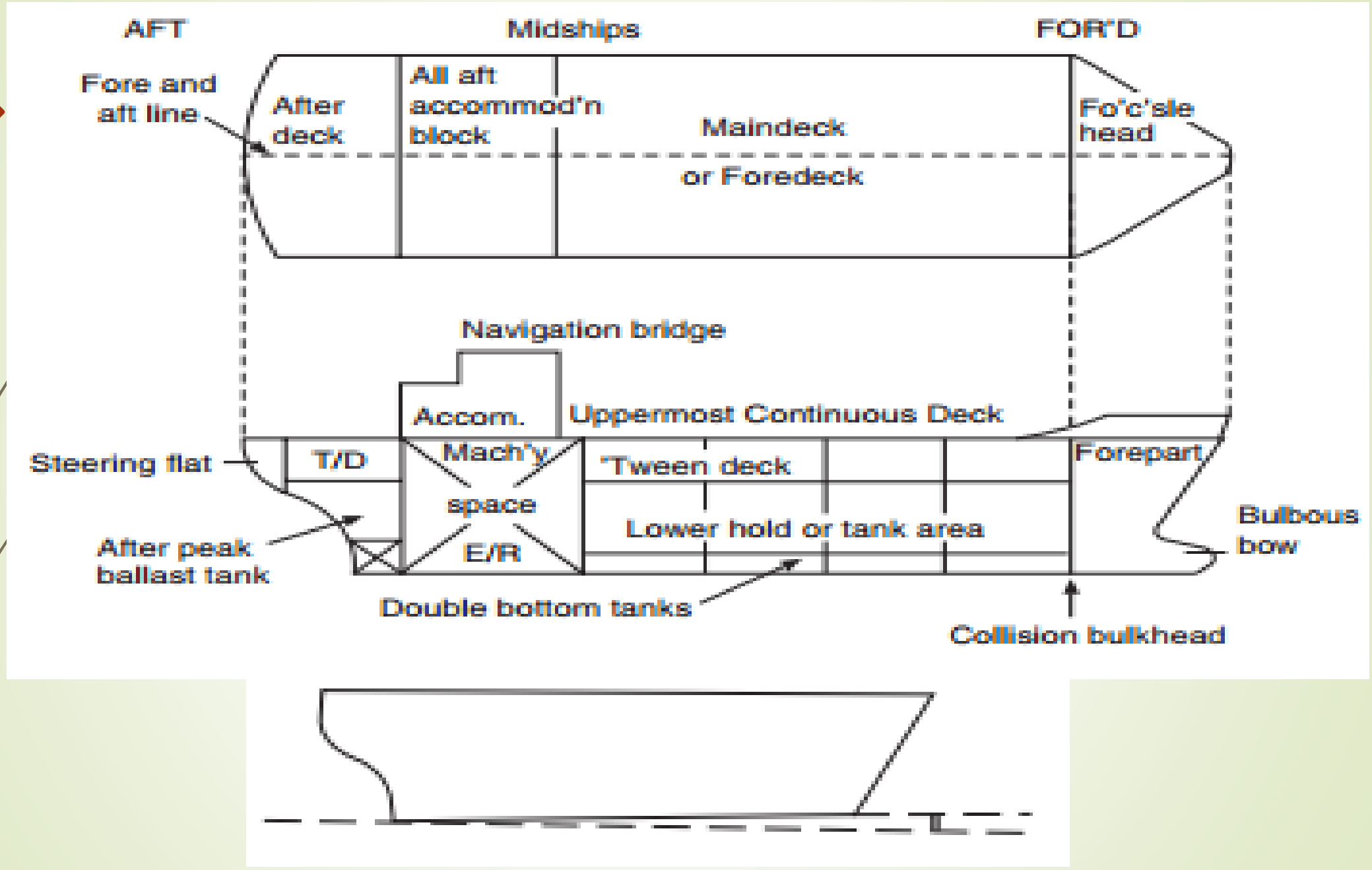
- **Sheer:** This is the curvature of the deck in the fore and aft direction, measured as the height of the deck at various points above the height of the deck at the midships point

❖ **The moulded depth:** is measured from the top side of the keel to the top of the deck beams, at the side of the vessel.

❖ ***Length between Perpendiculars (LBP)*: The distance between the forward and aft perpendiculars.**

❖ **Length Overall (LOA): The maximum length of the vessel measured from the extreme for'd point of the vessel to the extreme after point**

- ***Flare*:** The outward curvature of the shell plating in the foremost part of the vessel, providing more width to the forecastle head and at the same time helping to prevent water coming aboard.
- ***Fore and Aft Line:*** An imaginary line passing from the stem to the stern through the centre of the vessel.
- ***Freeboard*:** This is the vertical distance, measured at the ship's side, from the waterline to the top of the freeboard deck edge. The freeboard measurement is taken at the midships point. Deck edge is marked by a painted line 25mm x 100mm, above the plimsoll line.
- ***Keel Rake*:** The inclination of the line of the keel to the horizontal.
- ***Rise of Floor:*** This is the rise of the bottom shell plating above the base line (taken from the top edge of the keel)
- A perpendicular drawn to the waterline from a point on the summer loadline where it intersects the stempost is called the **forward perpendicular** (FP).
- A perpendicular drawn to the waterline at a point where the after side of the rudder post meets the summer waterline is called the **aft perpendicular** (AP). If a rudder post is not fitted, then it is drawn from the centre of the rudder stock.


AFT
Midships
FOR'D
Fore and aft line
After deck
All aft accommod'n block
Maindeck
or Foredeck
Fo'c'sle head
Navigation bridge
Accom.
Uppermost Continuous Deck
Steering flat
T/D
Mach'y space
E/R
'Tween deck
Forepart
Lower hold or tank area
Bulbous bow
After peak ballast tank
Double bottom tanks
Collision bulkhead

Keel rake.

- **Tumblehome**: The inward curvature of the ship's side shell plating above the summer loadline

- ***Stem Rake:*** The inclination of the stem line to the vertical.

- ***Ship's Beam:*** The widest part of the ship in the transverse athwartships direction

- ***Tonnage:*** All ships constructed on or after 8 July, 1982 are measured in accordance with the IMO 1969 International Conference on Tonnage Measurement. Existing ships built prior to this date were allowed to retain their existing tonnage if the owner so desired, for a period of 12 years. All ships must now comply with the 1969 Convention from 18 July, 1994.

- ***Gross Tonnage (GT)*** is defined as that measurement of the internal capacity of the ship. The Gross Tonnage value is determined by the formula:

$$GT = K_1 V$$

when $K_1 = 0.2 + 0.02 \log_{10} V$

V = total volume of all enclosed spaces measured in cubic metres.

- **Net Tonnage (NT)** is that measurement which is intended to indicate the working/earning capacity of the vessel. Port and harbour dues are based on the gross and net tonnage figures. Net Tonnage for Passenger Ships, carrying more than 13 passengers is determined by the formula:

$$NT = K_2 V_C \left[\frac{4d}{3D}\right]^2 + K_3 \left[N_1 + \frac{N_2}{10}\right]$$

Net Tonnage for other vessels:

$$NT = K_2 V_C \left[\frac{4d}{3D}\right]^2$$

where

V_C = total volume of cargo spaces in cubic metres.

d = moulded draught at midships in metres (Summer loadline draught or deepest subdivision load line in passenger vessels)

D = Moulded depth in metres amidships.

$K_2 = 0.2 + 0.02 \log_{10} V_C$

$$K_3 = 1.25 \frac{(GT + 10,000)}{10,000}$$

N_1 = Number of passengers in cabins with not more than 8 berths.

N_2 = Number of other passengers.

NT is not to be taken as less than 0.30 GT. The factor $[4d/3D]^2$ is not taken to be greater than unity.

The expression $K_2 V_C [4d/3D]^2$ is not to be taken as less than 0.25 GT

TERMS AND DEFINITIONS CONCERNING STABILITY

***Bulkhead Deck*:** Defined as the uppermost deck to which the watertight bulkheads are taken to.

- ***Centre of Flotation*:** That point in the ship's length about which the vessel will trim by the head/by the stern. In layman's terms the tipping centre of the ship, which is very rarely the exact midships point.

- ***Coefficient of Fineness* (of the water-plane area) Cw**: The ratio of the water-plane area to the area of the rectangle having the same extreme length and breadth. Block coefficient of fineness of displacement is similarly applied, using the values of volume instead of area.

- ***Displacement*:** The displacement of a vessel is the weight of water it displaces, i.e. the weight of the vessel and all it contains. It is the immersed volume of the ship in cubic metres x density of the water, expressed in tonnes per cubic meter. It is normal practice to regard the ship's displacement as being that displacement when at her load draught (load displacement).

- ***Floodable Length*:** The maximum length of a compartment which can be flooded so as to bring a damaged vessel to float at a waterline which is tangential to the margin line. Note: in determining this length account must be taken of the permeability of the compartment.
- ***Lightship Displacement*:** Lightship is defined as the extreme displacement of a ship, when fully equipped and ready for sea but without cargo, crew, passengers, fuel, ballast water, fresh water and, consumable stores. The boilers are filled with water to their working level. NB. Displacement of a vessel can be expressed as a volume, in cubic metres or as a weight determined by the Volume x Density of the water displaced. In sea water the density constant is taken as 1025 kg/m3
- ***Load Deadweight*:** Deadweight is defined by the difference in tonnes between the displacement of a ship in water of a specific gravity of 1.025 at the load waterline corresponding to the assigned summer freeboard and the lightweight of the ship. It consists of the total weight of cargo, stores, bunkers etc., when the vessel is at her summer loadline.

- ***Margin Line*:** Defined by a line at least 76 mm below the upper surface of the bulkhead deck, as measured at the side of the vessel.

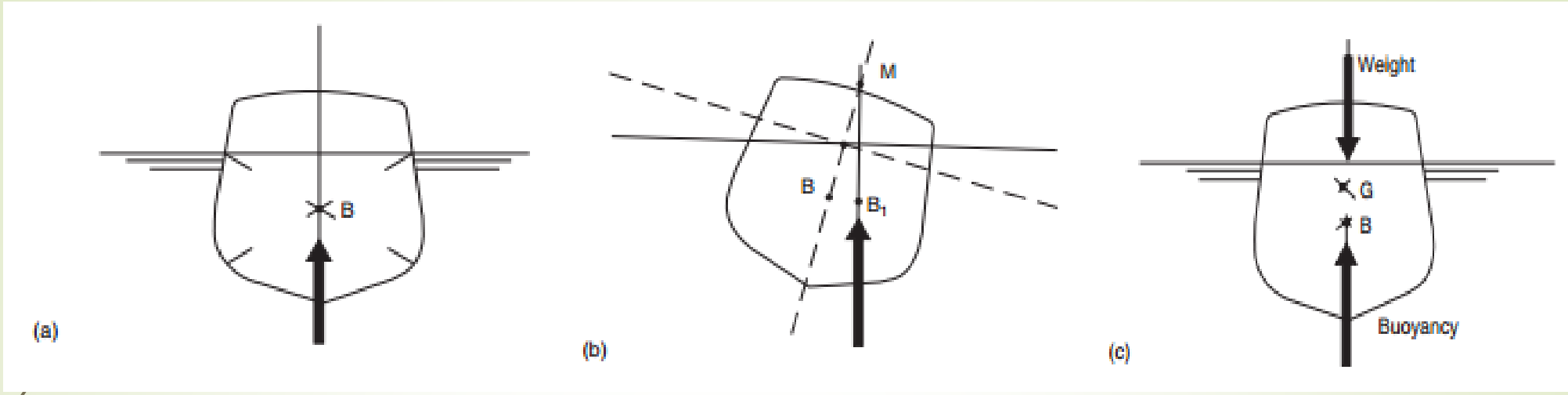
- **Permeability**: In relation to a compartment space means the percentage of that space
which lies below the margin line, which can be occupied by water. Note: various formulae within the Ship Construction Regulations are used to determine the permeability of a particular compartment. Example values are:
Spaces occupied by cargo or stores 60%
Spaces employed for machinery 85%
Passenger and crew spaces 95%

- ***Permissible Length:*** Of a compartment, having its centre at any point in the ships length, is
determined by the product of the floodable length at that point and the factor of sub-division of the vessel.
Permissible Length = Floodable Length x Factor of Sub-Division

- **Subdivision Factor:** The factor of subdivision varies inversely with the ships length, the number of passengers and the proportion of the underwater space used for passengers/crew and machinery space. In effect it is the factor of safety allowed in determining the maximum space of transverse watertight bulkheads, i.e. the permissible length

Reserve Buoyancy

- The buoyancy of the immersed portion of the vessel is that which is necessary to keep the vessel afloat. The buoyancy of all other enclosed watertight spaces above the waterline is therefore residual buoyancy, more commonly referred to as ‘reserve buoyancy’.
- It must be assumed that in the case of the conventionally designed ship, if water equal to the displacement and reserved buoyancy enters the vessel, it will sink. Sufficient reserve buoyancy is necessary in all seagoing vessels in order for the ship to rise quickly, owing to the lift effect, when navigating, especially in heavy sea conditions.



(*a*) ***Centre of buoyancy:*** The centre of buoyancy (C of B) is that point through which the resultant of all the forces due to buoyancy may be considered to act. It is the geometric centre of the underwater volume of the ship.

(*b*) ***Transverse metacentre***: The transverse metacentre (M) is that point of intersection of a vertical line through the centre of buoyancy, in the upright position, with a vertical line through the new centre of buoyancy (B_1) in a slightly inclined position.

(c) Forces acting on a vessel in still water: The force of buoyancy must be equal and opposite to the forces of gravity if no vertical movement of the body is to take place. For the body to float in the upright position, both forces must act in the same vertical plane.

Equilibrium

- A body is said to be in ***stable* equilibrium** if, when slightly disturbed and inclined from its initial position, it tends to return thereto.

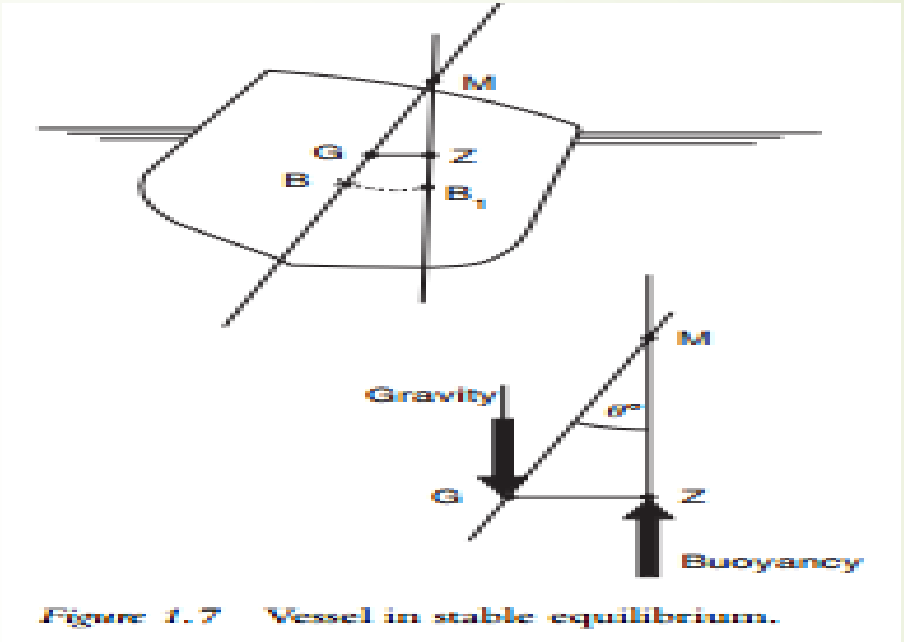


Figure 1.7 Vessel in stable equilibrium.

- A body is said to be in a state of ***neutral* equilibrium** if, when slightly disturbed from its initial position, it exhibits no tendency to return thereto or to move to another new position.
- A body is said to be in ***unstable* equilibrium** if, when slightly disturbed from its initial position, it tends to move further from it. The figure above shows a *vessel in stable equilibrium*. As the vessel heels to θ° by an external force (e.g. waves, wind), G remains in the same position and B moves to B_1. A righting couple is formed WGZ, where W is the weight effect of the ship acting through G (due to gravity) GZ, being known as the righting lever. In triangle MGZ, *GZ = GM sin θ°*. Therefore W x GZ = W. *GM sin θ°*, bringing the vessel back to the upright position. This is the situation when G is below M, i.e. *when GM is positive*.

Varieties of Ship

What types of vessels are these?

Tanker

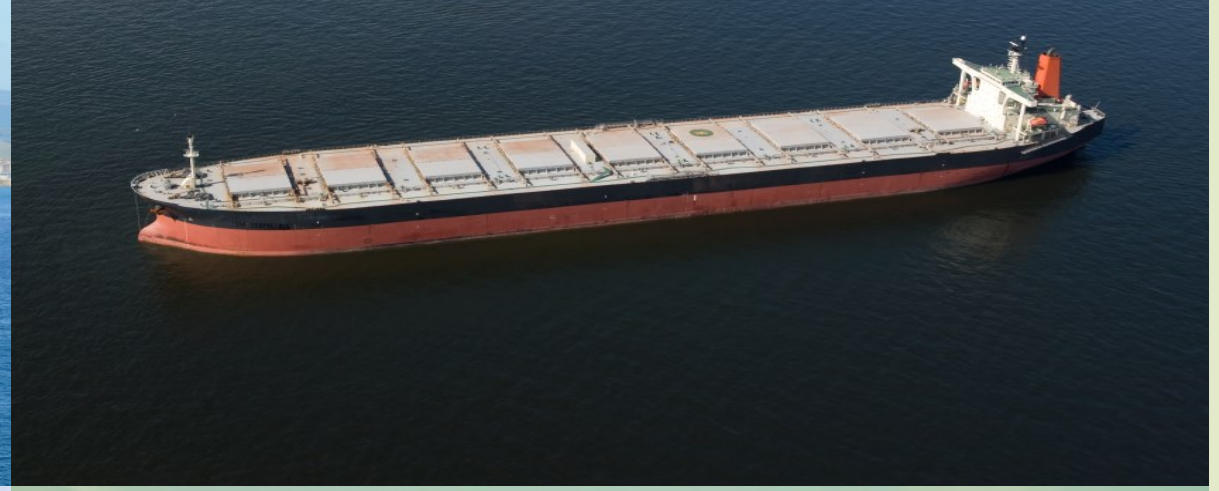
Container Ship

PaxCar ferries

Varieties of Ship

Crude Carrier

Dry Cargo Ship: Bulk Carrier



Chemical Carrier

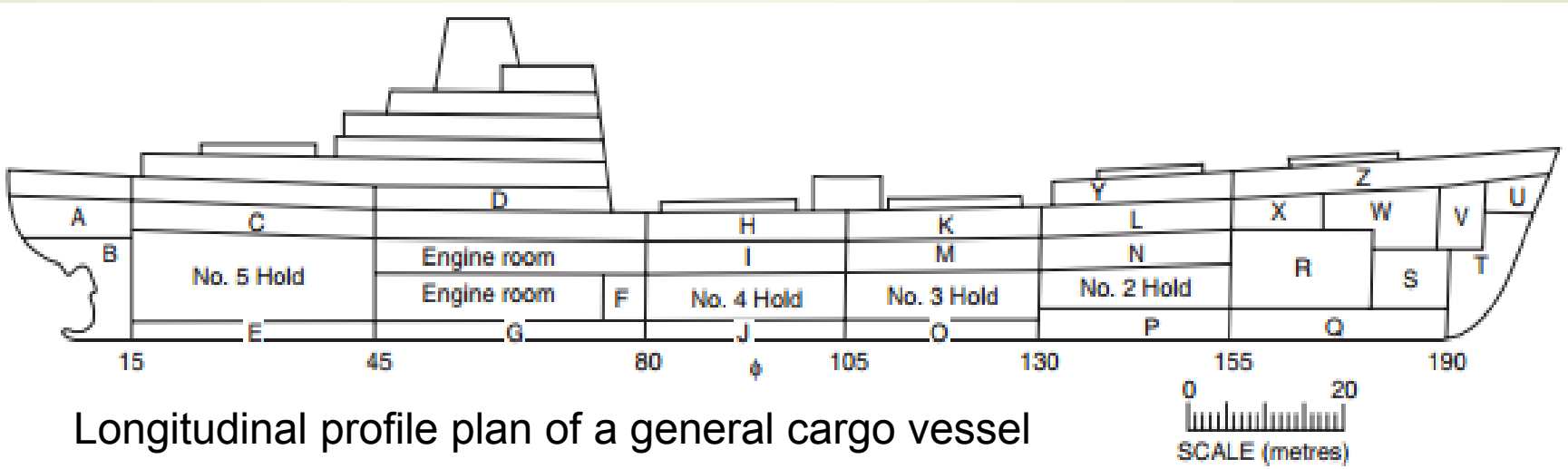
LNG Carrier

Railway Ferry (Ro-Ro)


DSND
Offshore Supply Vessel

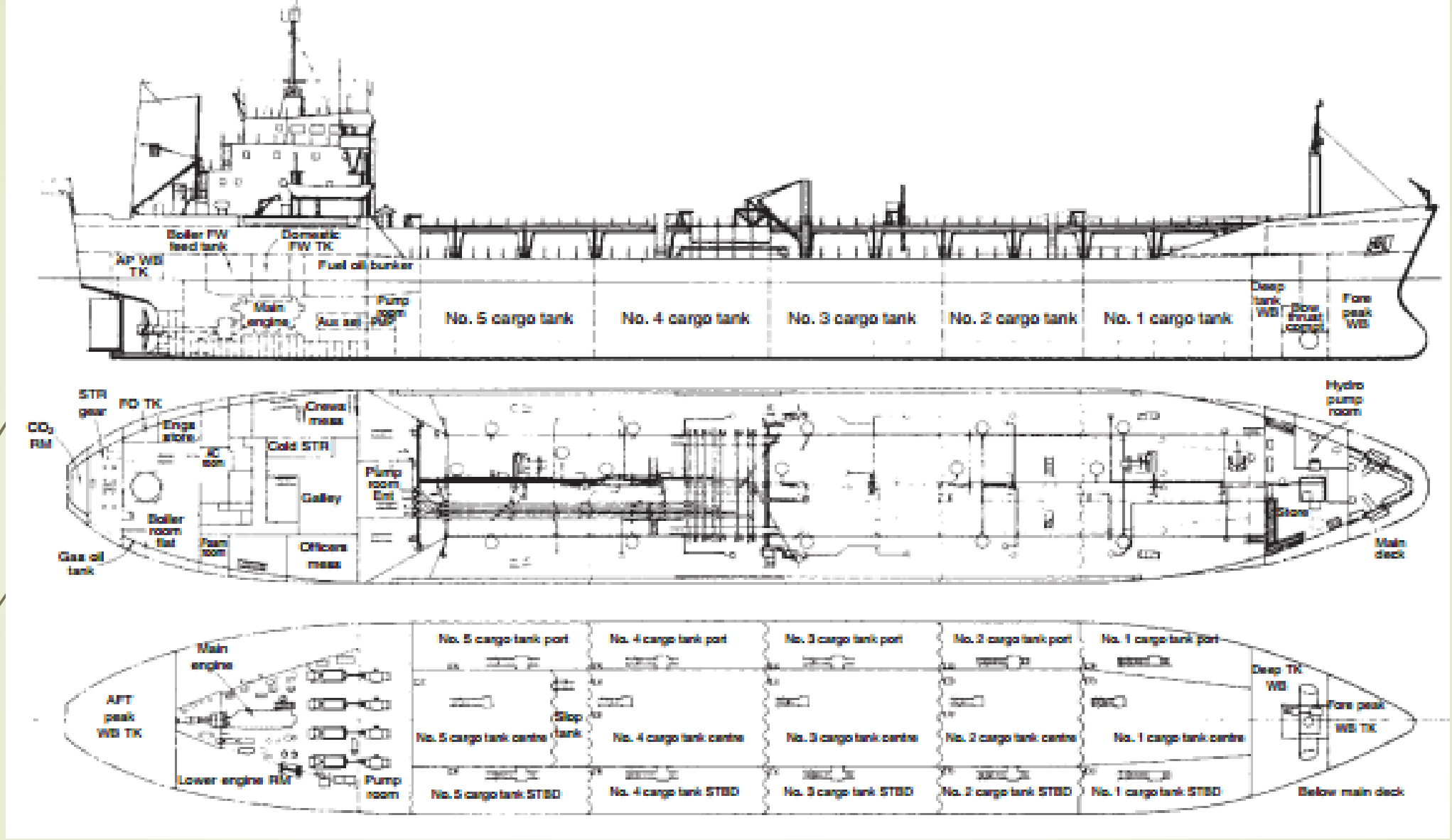

Tug


RKK LINE
Roll-on/Roll-off Ships (Ro-Ro)

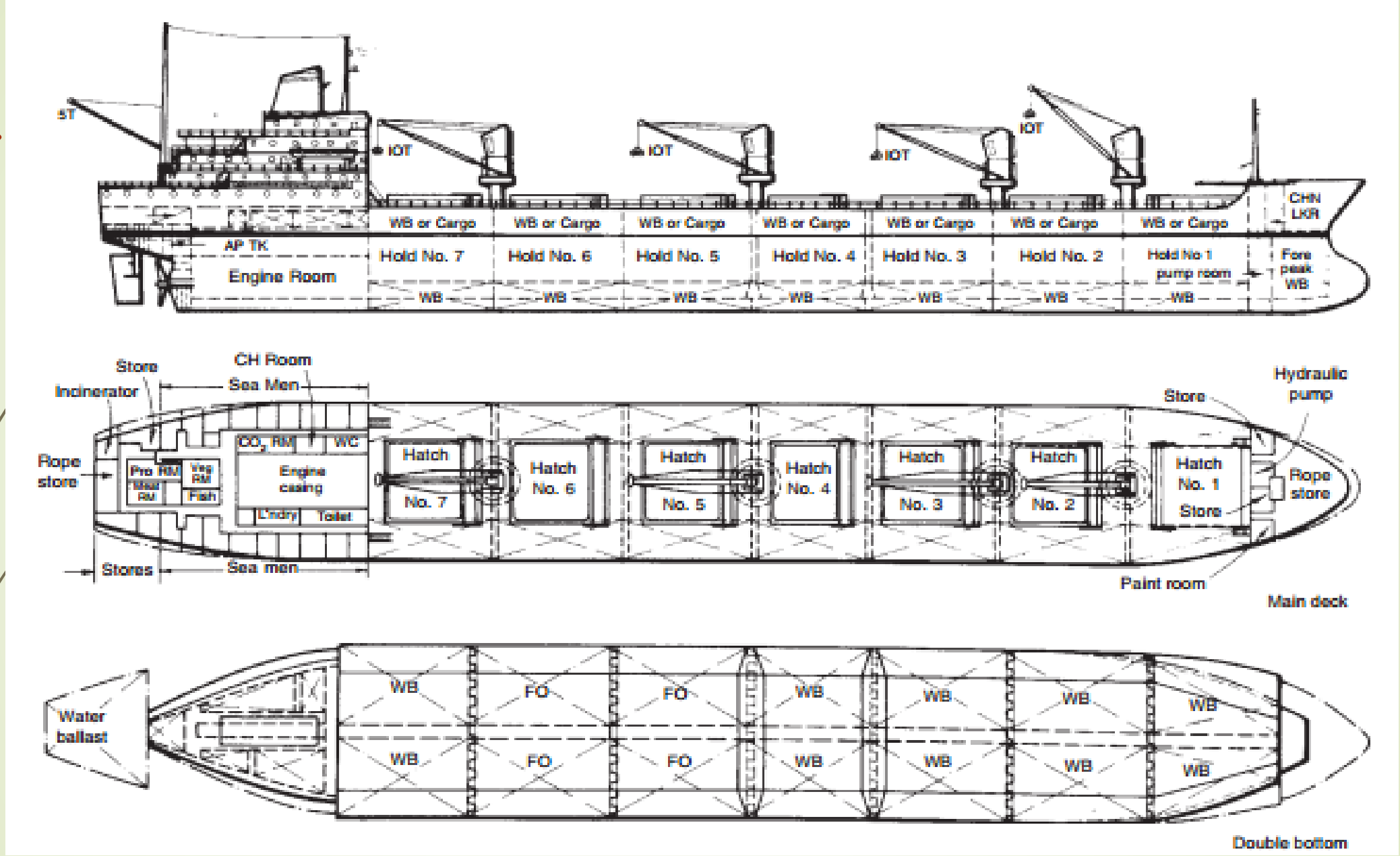


Longitudinal profile plan of a general cargo vessel

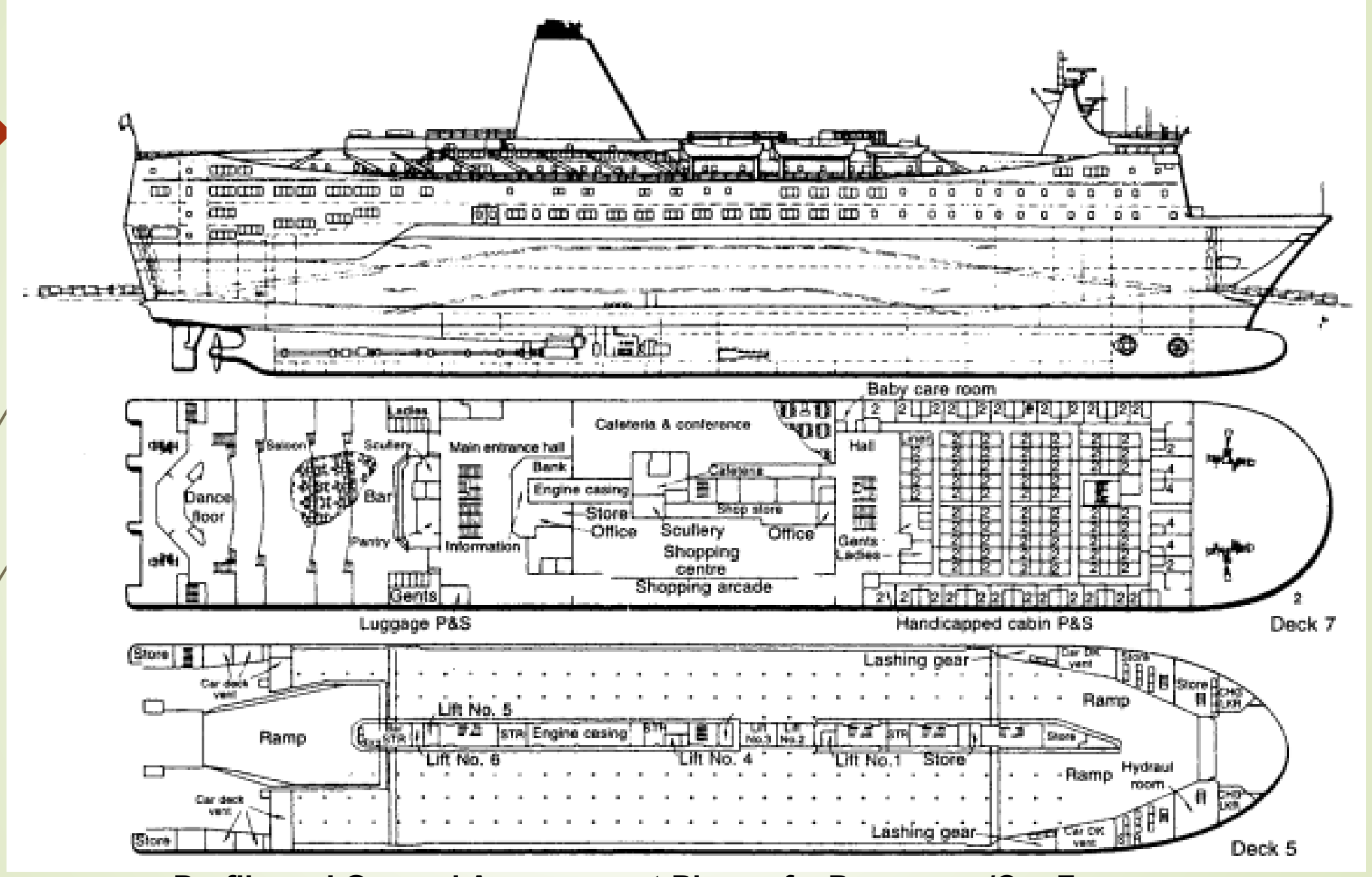
A	Steering gear flat
B	Aft peak
C	Upper 'tween deck
D	Poop 'tween deck
E	No. 5 double bottom tanks
F	Oil fuel tanks
G	Engine room double bottom tanks
H	Upper 'tween deck
I	Lower 'tween deck
J	No. 4 double bottom tanks
K, L	Upper 'tween deck
M, N	Lower 'tween deck
O	No. 3 double bottom tanks
P	No. 2 double bottom tanks
Q	No. 1 double bottom tanks
R	No. 2 cargo tank
S	Ballast tank
T	Forepeak
U	Store
V	Chain locker
W	No. 1 cargo tank
X	No. 1 upper 'tween deck
Y	No. 2 fo'c' sle 'tween deck
Z	No. 1 fo'c' sle 'tween deck



Profile and deck plans of 8030 tonne DW products tanker *Cableman.*

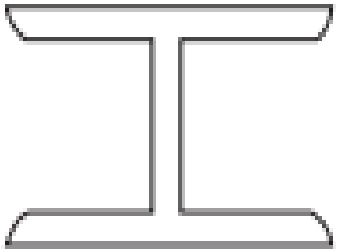


Profile and deck plans of a Bulk Carrier (*Lok priti*)

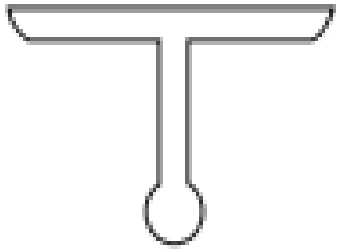


Profile and General Arrangement Plans of a Passenger/Car Ferry

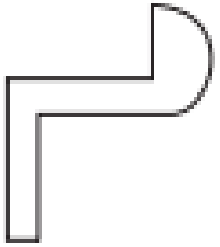
General steelwork sections used in basic ship construction



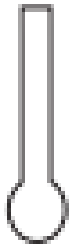
'*H*' *bar.* Employed in the form of strong beams and girders.



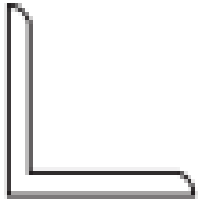
'*T*' *bulb.* Employed as main beam in association with wooden decks.



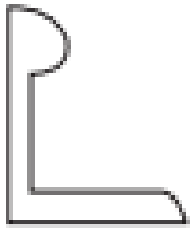
Tyzack bar. Generally found about the upper edge of hatchways. Forms the upper edge of the coaming to accommodate hatch boards (conventional builds).



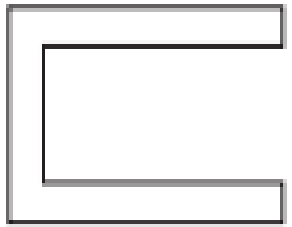
Bulb plate. Employed for stiffening welded framing and bilge rails.



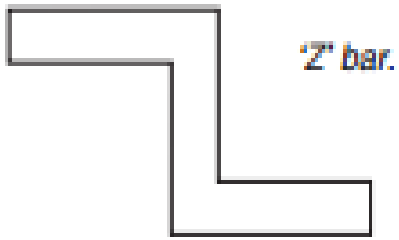
Angle bar. A length of mild steel shaped into a right-angle section. It is used for frames, reverse frames, keelsons, bulkhead stiffeners, and right-angle connections.



Bulb angle. A similar shape to the angle bar but has the toe of one flange thickened, thus increasing the stiffening capability considerably.



Channel bar. Used when greater stiffness is required, for frames and beams.



'*Z*' *bar.* Used for all-purpose stiffening.

PLATE AND CONSTRUCTION TERMS

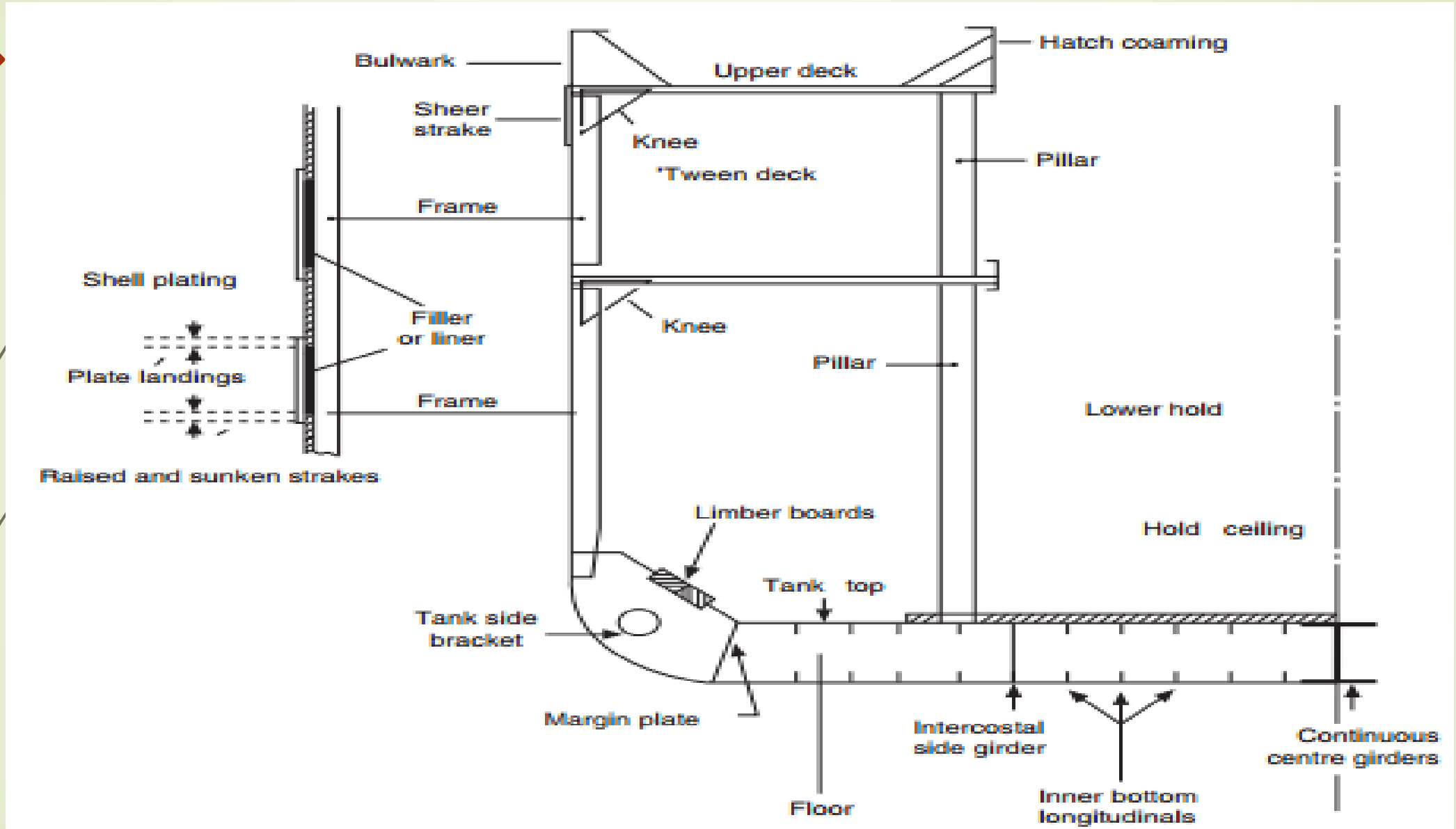
- ***'A' Frame:*** Supporting framework for the stern tube of a twin-screw vessel. Used as an alternative to a spectacle frame.
- ***Boss Plate:*** A shell plate parallel to the stern tube at the level of the propeller boss.
- ***Bulkhead:*** A vertical partition between compartments. May be in the fore and aft line or athwartships.
- ***Coffin Plate:*** The aftermost plate of the keel, dish (coffin)-shaped to fit the stern frame.
- ***Collision Bulkhead:*** A heavy duty bulkhead in the forepart of the vessel to withstand damage after impact from collision.
- ***Floor:*** A vertical athwartships member in way of the double bottom. A floor will run from the centre girder out to the margin plate on either side of the vessel. Floors may be in steel plate, solid or framed bracket form.
- ***Frame:*** Internal support member for the shell plating. Vessels may be framed transversely or longitudinally.
- A **strake** is a continuous line of plates or planks running from bow to stern that contributes to a vessels skin

- ***Garboard Strake*:** The first strake out from the keel.
- ***Gusset Plate*:** Triangular plate often used for joining angle bar to a plate.
- ***Intercostal:*** A side girder in the fore and aft line sited either side of the keel. Integral connection with the tank top and the ship's bottom plating and rigidly connected by the floors.
- ***Keel*:** Centre line plate passing from the stem to the stern frame. Referred to as a flat plate keel. Generally of increased scantlings.
- ***Duct Keel:*** The *duct keel* is a plated box/ tunneled keel allowing passage right forward. It provides additional buoyancy, together with a through passageway for cables and pipelines running in the fore and aft direction.
- **Lightening Holes:** Holes cut into floors, or intercostals to reduce the weight content of the ship's build and to provide access to tank areas.

- ***Longitudinal*:** A fore and aft strength member connecting the athwartships floors. Some vessels are longitudinally strengthened by having the frames run in a fore and aft direction as opposed to transverse framing. Additional longitudinals are to be found in areas where pounding can be anticipated when the vessel is at sea.
- ***Margin Plate*:** A fore and aft plate sited at the turn of the bilge (Figure 1.21).The upper edge is normally flanged to allow connection to the tank top plating, while the opposite end is secured to the inside of the shell plate by an angle-bar connection. It provides an end seal to the double bottom tanks, having all the floors joining at right-angles, up to the collision bulkhead.
- ***Oxter Plate*:** A shell plate of double curvature found under the transom floor, being extended from the fore side of the sternpost in the direction of the bow.

- ***Panting Beams***: Athwartships members in the forepart introduced to reduce the in/out tendency of the shell plating, caused by varying water pressure on the bow when the vessel is pitching.
- ***Panting Stringers***: Internal horizontal plates secured to the shell plating and braced athwartships by the panting beams.
- ***Plate Landings:*** Refers to the shell plate. When shell plate is set in the raised and sunken method, the region where adjoining plates overlap is known as the plate landing. Generally superseded by welded flush structures.
- ***Scantlings***: Originally applied to the size of lintels in the building of wooden ships but now used to indicate the thickness of plates, angles and flanges. Measurements of steel sections.
- ***Sheer Strake:*** The continuous row of shell plates on a level with the uppermost continuous deck
- ***Stealer Plate:*** A plate found at the extremities of the vessel in the shell or deck plating. Its purpose is to reduce the width of the plating by merging, say, three strakes into two. The single plate producing this effect is known as a stealer plate.

Midships section through general cargo vessel



The above example shows a longitudinally framed double bottom structure

MAIN STRUCTURAL MEMBERS – COMPENSATING STRESS FACTORS AFFECTING THE VESSEL

- ***Beam Knees***: Resist racking, heavy weights and localised stresses.
- ***Beams:*** Resist racking, water pressure, longitudinal torsional stresses and local stresses due to weights.
- ***Bulkheads:*** Resist racking stresses, water pressure, dry-docking, heavy weights, hogging and sagging, torsion stresses and shear forces.
- ***Decks:*** Resist hogging and sagging, shearing, bending, heavy weights, and water pressure.
- ***Floors***: Resist water pressure, dry-docking stresses, heavy weights, local stresses, racking, vibration and pounding.
- ***Frames:*** Resist water pressure, panting, dry-docking and racking stresses. May be compared to the ribs of the body, which stiffen the body of the vessel. May be longitudinally or transversely constructed.
- ***Longitudinal Girders:*** Resist hogging and sagging, water pressure, dry-docking and pounding stresses, and localised shearing stresses. Examples: keel, keelsons, fore and aft members, intercostals.

- ***Pillars:*** Resist stresses caused by heavy weights, racking, dry-docking and water pressure. Extensively found in general cargo vessels in lower hold structure.
- ***Shell Plating:*** Steel plates of various size, which, when joined together form the sides of the ship's hull. Plates are generally of an increased thickness (increased scantlings) in and about the keel area. The 'Garboard strake' and the 'Sheer strake' are also increased in thickness compared to other shell plates. Shell plating compensates for all stresses affecting the vessel. Where localised stresses are experienced as with 'shell doors' then increased scantlings can be expected to provide the continuity of strength required. Shell plates can be identified by inspection of the 'shell expansion plan'.