TEXAS A&M UNIVERSITY GALVESTON CAMPUS

INTRODUCTION TO THE MARITIME INDUSTRY

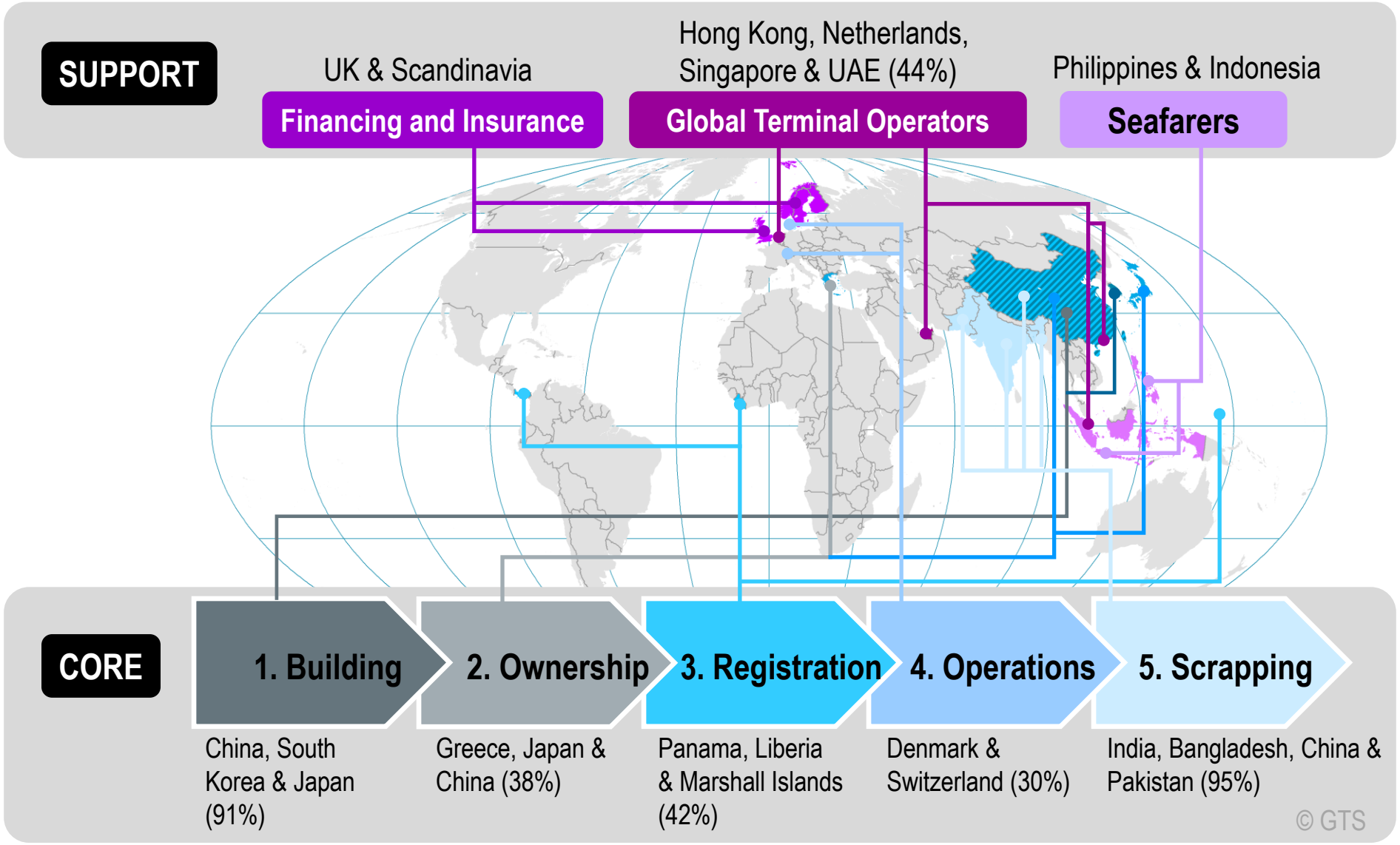
4. Shipbuilding and Scrapping

MARA 205

Professor: Dr. Jean-Paul Rodrigue

The Maritime Transport Life Cycle and Main National Actors

Read this content



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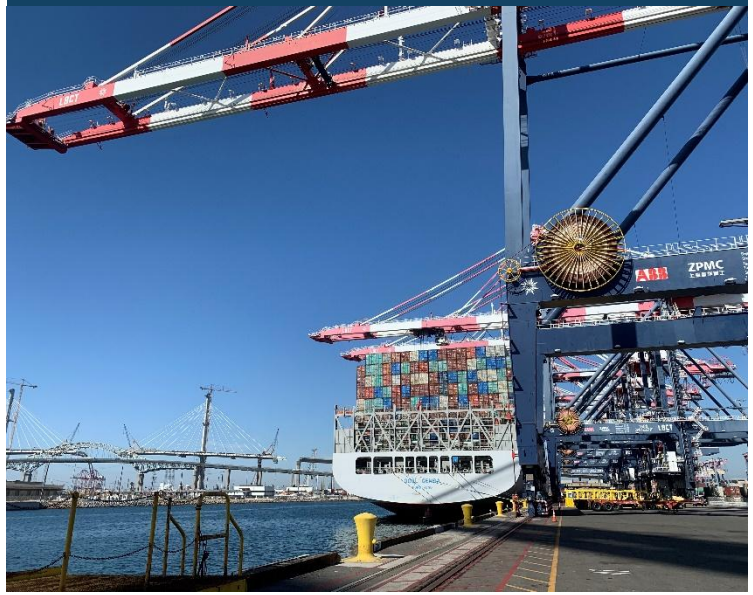


A. Components of a Ship

Note: Adapted from T. Nikolaos, University of Piraeus

Components of a Ship

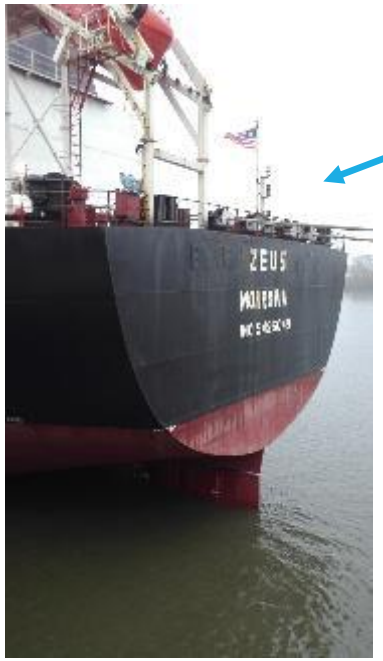
Funnel: The smokestack or the chimney on a ship used to expel boiler steam and smoke or engine exhaust gases.

All exhaust funnels are directed towards the aft of the ship to avoid interfering with navigation.

Scrubbers: Remove particulate matter and noxious gases (NOx, SOx) from engine exhaust.

Poop deck: The highest aftermost deck of a ship.

Components of a Ship



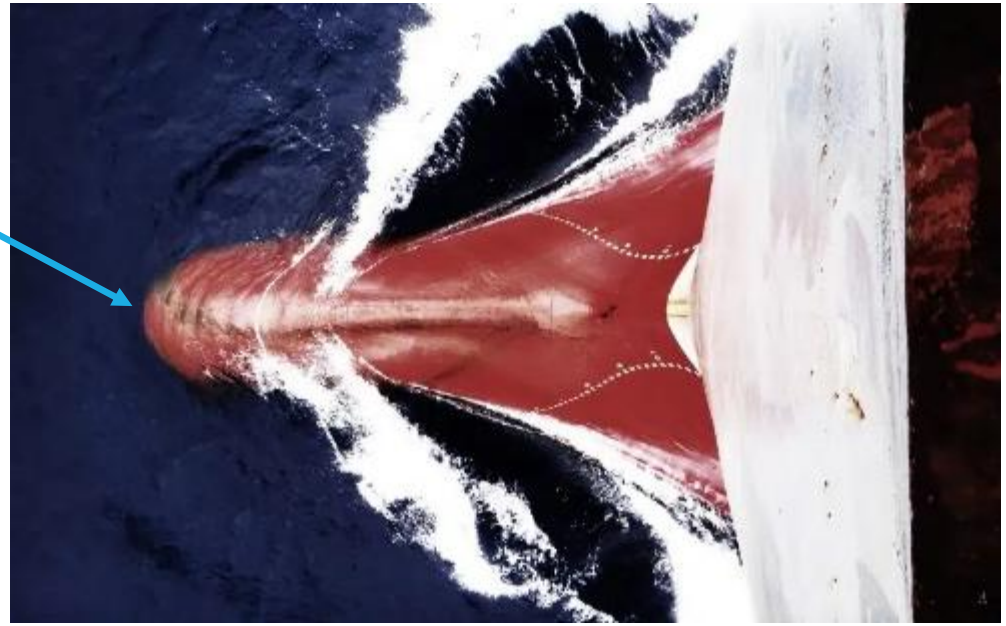
Stern: The back of the aft-most part of a ship.

Propeller: Helps the ship to propel/ move forward. A part of the energy delivered by the engine goes into rotating the propeller, and in turn, a fraction of that thrust generated by the propeller is propelling the ship.

Rudder: Allows the ship to steer itself to the right and left during operation/maneuvering. A rudder must be able to move 35 degrees to port side and starboard side to function safely.

Components of a Ship

Bulbous Bow: A protruding bulb at the bow of a ship just below the waterline. The bulb modifies the water flows around the hull, reducing drag and thus increasing speed, range, fuel efficiency and stability.

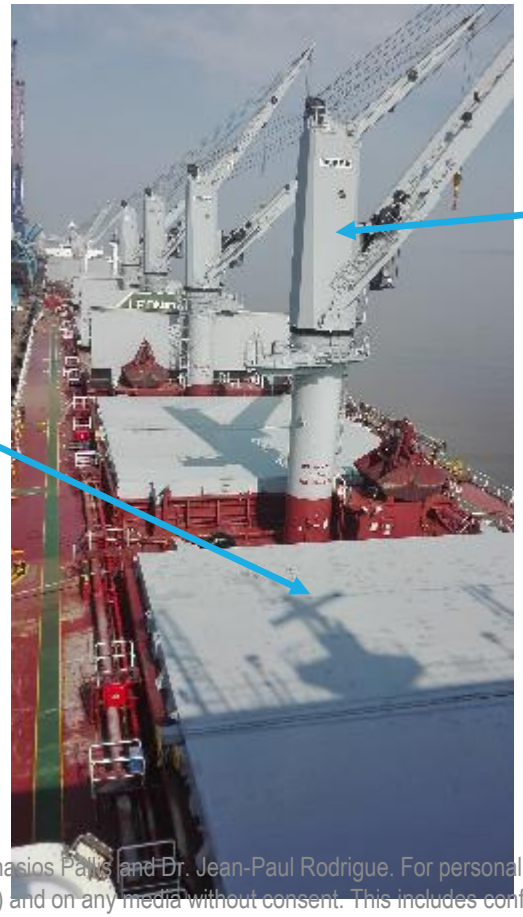


Hull Drag: The net force opposing forward movement due to the pressure and shear forces acting on the surface of the hull. A function of underwater shape and hull friction. Generally, the more surface area, the greater the total frictional resistance.

Components of a Ship

Main Deck: A permanent covering over a compartment or a hull of a ship. The primary or upper deck is the horizontal structure that forms the "roof" of the hull, thereby holding the hull together strengthening it and serving as the primary working surface.

Cargo Cranes: Shipboard cranes of various types and capacities that are used for loading and discharging of multi-purpose cargo.

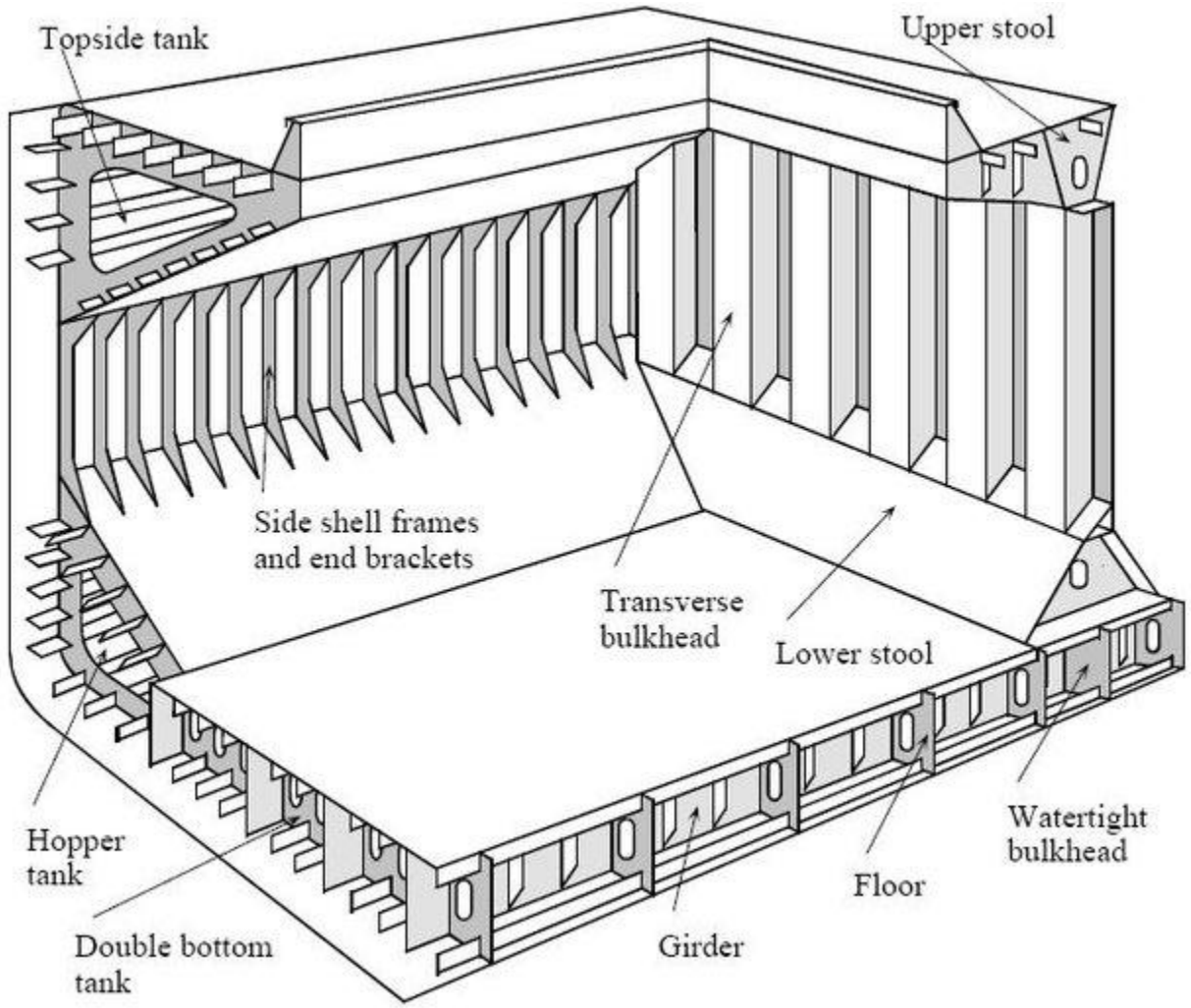


Hatch Covers: Used to cover and protect the cargo in the cargo holds. Hatch covers close off the hatch opening and makes watertight.

Cargo Hold: Enclosed space within a ship designed for storing cargo.

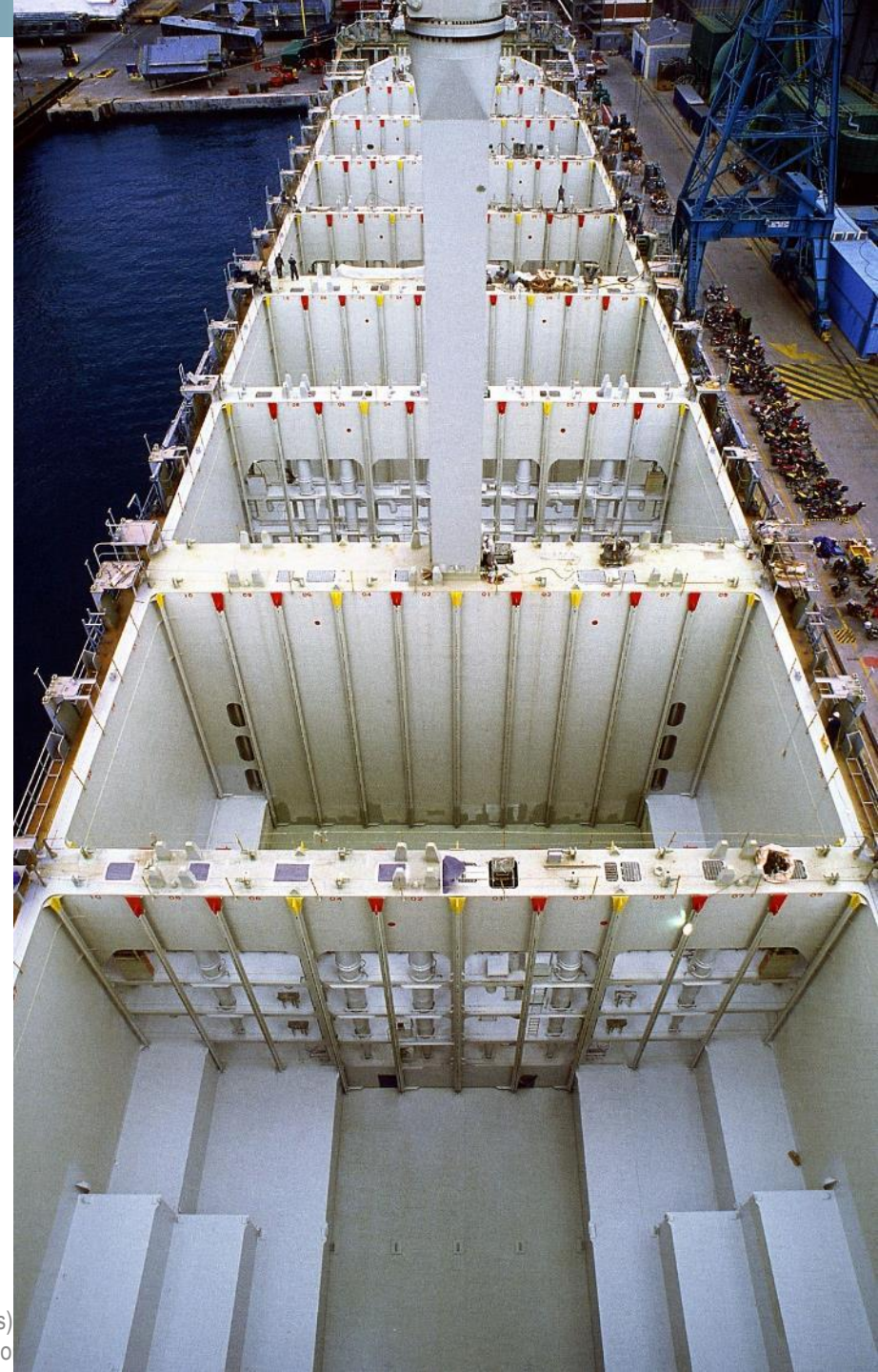
Cargo Hold Structure (Bulk Carrier)

- Topside Tank
  - Tanks of triangular configuration fitted at both shoulders/wings of the cargo holds.
  - Their purpose is to carry ballast water.
- Hopper Tank
  - Tanks used for ballast or for stability when carrying certain cargoes in bulk carriers.
- Double Bottom Tank
  - Bottom of the ship has two complete layers of watertight hull surface
  - One outer layer forming the normal hull of the ship and a second inner hull which is somewhat higher in the ship, which forms a redundant barrier to seawater.
  - The space in between the two bottoms is often used as storage tanks for fresh water or ballast water.



Cargo Hold Structure (Containership)

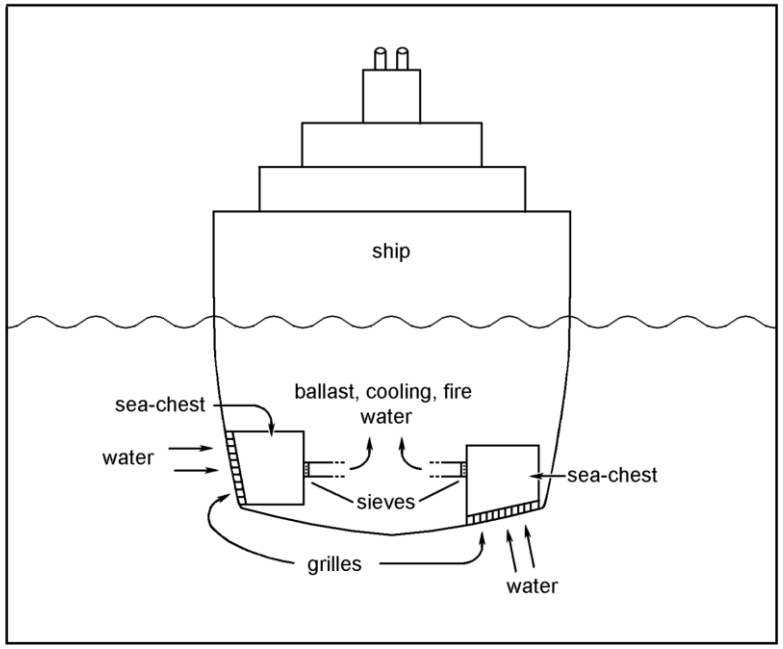
- Two cargo holds
  - Above deck for lighter containers.
  - Below deck for heavier containers (+ a hatch).
  - Double bottom and double hull; provide ballast space.
- Large hatches
  - The full width of the ship.
  - Maximize loading and unloading operations.
- Cell guides
  - Pillar-like structures.
  - Recesses on four sides to fit container latches.



Components of a Ship

Bilge keel: Fixed longitudinal plates fitted at the turn of the bilge so that their drag dampens roll amplitudes.

Sea chests: A recess in a ship's hull that houses pipes to take in seawater. Water is pumped in for cooling engines, washing decks, and as ballast to stabilize the vessel. A sea chest has a grille to keep out large items, but this can also stop smaller organisms from being flushed out.



Components of a Ship

Bulwark: an extension of a ship's sides above the level of the deck.

Forecastle: Fwd part of deck. All the lines and machinery needed for mooring of the fwd part of the ship are located there.

Bollard: An iron post found as a deck-fitting on a ship upon which 2 vertical bitts are welded and used to secure ropes for towing and mooring.

Roller: Used to point or guide the mooring line in a particular direction.

Foremast: Navigation lights are attached there for safe navigation of the ship.

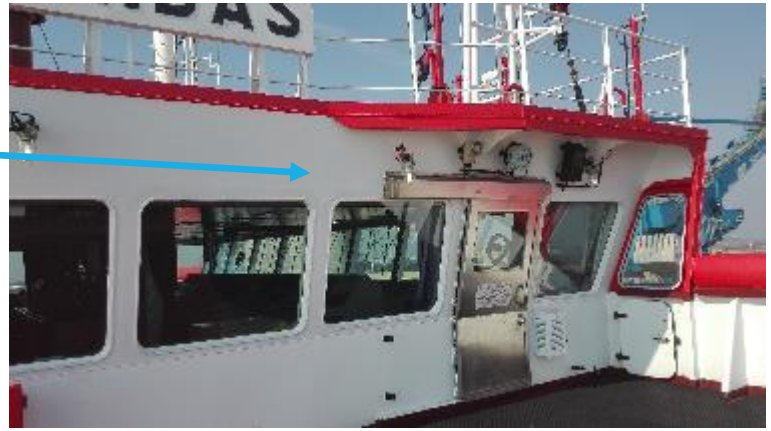
Fairlead: A device to guide a line, rope or cable around an object, out of the way or to stop it from moving laterally.

Mooring Winch: An equipment with various barrels used for pulling ropes necessary for the ship to berth safely. The barrels, also known as winch drums, are used for hauling in or letting out the ropes, which will help in fastening the ship to the berth.

Windlass: A drum shaped device that is used for hoisting weights or for winding ship's anchor cable. It rotates in a vertical plane and around a horizontal axis.

Components of a Ship

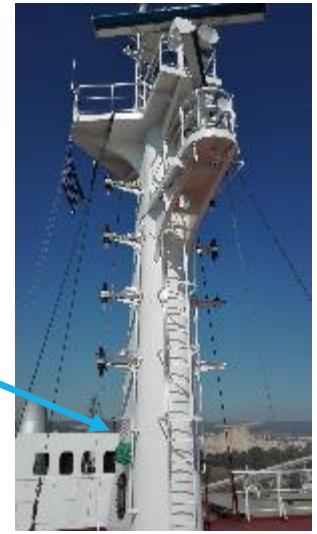
Bridge Deck: The area from which navigation and ship control are exercised.



Bridge wings: Parts of the bridge on both sides of the wheelhouse that extend to the ship side.

Wheelhouse: An enclosed compartment that contains the wheel of the ship, used to steer the ship by controlling the rudder together with the rest of the navigation equipment.

Monkey Island/Monkey deck: Deck located at the topmost accessible height.



Watch this video

Components of a Ship

Boat deck: Deck in outer accommodation area where the rescue boat is located.

Rescue Boat: A boat designed with specialized features for searching, rescuing and saving the lives of people in peril at sea.

Free Fall Lifeboat: A lifeboat constructed for free-fall launching.

Liferafts: Rafts, often inflatable, for use in emergencies, as when a ship must be abandoned.

Components of a Ship

Battery Room: A room that houses batteries for backup or uninterruptible power systems. Used to segregate the fumes and corrosive chemicals of wet cell batteries (often lead–acid) from the operating equipment, and for better control of temperature and ventilation.

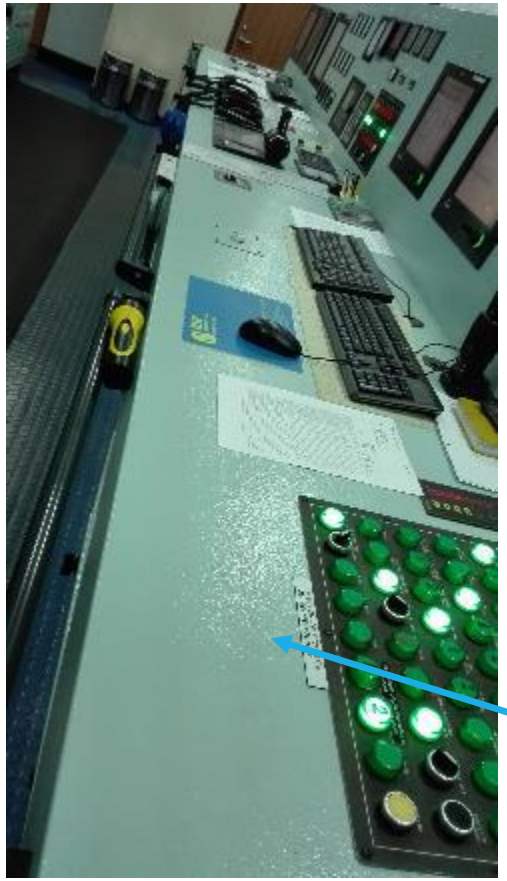
Fixed CO_2 Room: Contains CO_2 bottles part of the CO_2 flooding system, a common fixed fire fighting system installed on most ships. It releases carbon dioxide (CO_2) in bulk quantity to a protected space (such as engine room, cargo hold, purifier room, pump room, etc.) under fire.

Emergency Generator Room: It is located outside the main and auxiliary machinery space.

Components of a Ship

Main Engine: The “heart” of the ship. Main engines are used to turn the ship's propeller and move the ship through the water.

Turbocharger: A centrifugal blower driven by exhaust gas turbines and used to supercharge an engine.



Diesel Generators: Diesel generators provide auxiliary power for lights, fans, winches etc.

Engine Control Room: The command center of the engine room in a ship, which can act as a secondary bridge.

Watch this video

Components of a Ship

Steering Gear Room: The space in the engine room where the steering gear is located. It provides a movement of the rudder in response to a signal from the bridge. The control equipment conveys a signal of ordered rudder angle from the bridge and activates the steering gear to move the rudder to the desired angle.

Workshop: An area in the engine room designated for general engine works.

Components of a Ship

Centrifugal Pumps: Mechanical devices designed to move fluid by means of the transfer of rotational energy from one or more driven rotors, called impellers. The action of the impeller increases the fluid's velocity and pressure and also directs it toward the pump outlet (e.g. ballast water pumps, bilge pump, fire and general service pump, etc.).

Screw Pumps: Positive displacement pumps that use one or several meshing screws or rotors to rotate within a cylindrical cavity or liner and increase the pressure of oil or hydraulic liquid to get it to transfer from one point to another (e.g. fuel oil pumps, lub. oil pumps, etc.)

Components of a Ship

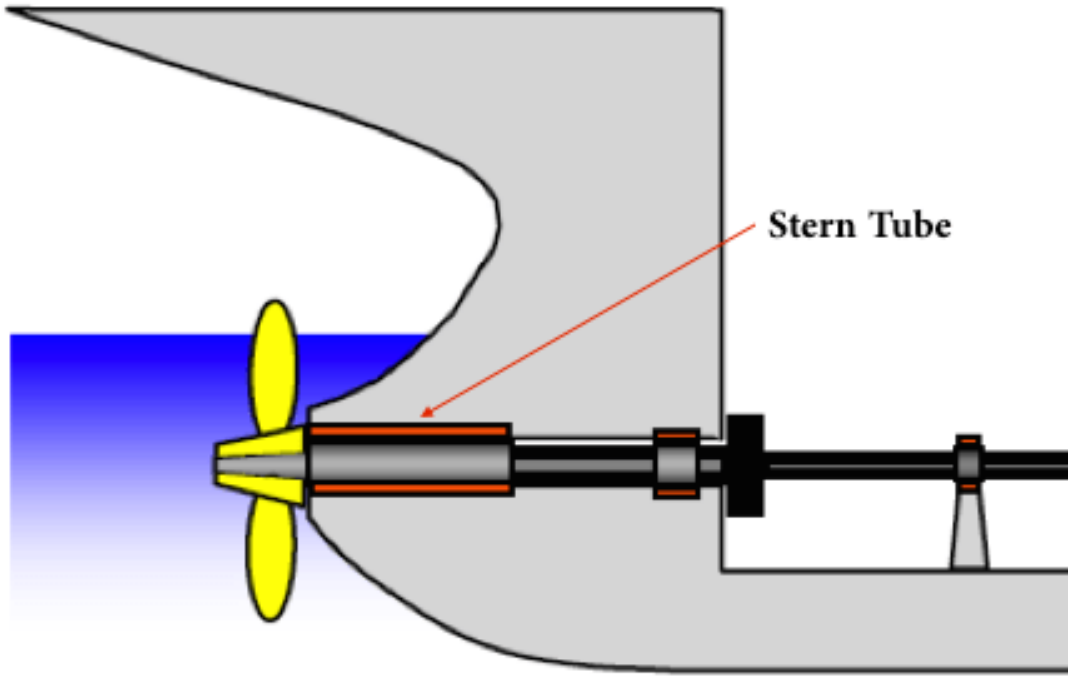
Fresh Water Generator: Converts seawater (saltwater) to fresh water via distillation.

HT & LT Coolers: In a split system the low temperature (LT) circuit is used for low temperature zone; hence its temperature is lower than the high temperature (HT) circuit. The LT circuit comprises of all auxiliary systems. The HT circuit mainly comprises of jacket water system of the main engine where the temperature is quite high.

Sewage Treatment Plant: Sewage on the sea is generally the waste produced from toilets, urinals, and WC scuppers. The rules say that the sewage can be discharged into the seawater only after it is treated and the distance of the ship is 4 nautical miles from the nearest land.

Components of a Ship

Stern Tube: A hollow tube that accommodates the bearings, the seal boxes, and the propeller shaft. The stern tube is filled with oil, grease, or water and forms a barrier between the water outside and the engine room inside the vessel.



Components of a Ship

Ballast Water Treatment System (BWTS): A system designed to remove and destroy/inactive biological organisms (zooplankton, algae, bacteria) from ballast water.

Components of a Ship

Air conditioning plant room: An area where the main air conditioning unit is located, which provides cold air inside the ship's spaces by removing heat and humidity from the indoor air. It returns the cooled air to the indoor space and transfers the unwanted heat and humidity outside.

Provision refrigeration plant: Keeps the provisions of the crew under refrigeration (Meat Room, Fish Room, Vegetable Room, Diary room)

Galley: The cooking area onboard the vessel.

Components of a Ship

Fire control station: The space in the accommodation where fire control equipment is kept.

Ballast Room: A room where the ship's office is located and where the cargo and ballast calculations are taking place.

Mess Room: Area where crew having their daily meals.

Infirmary: A designated area for crew when they get sick having all emergency medical equipment and medicine.

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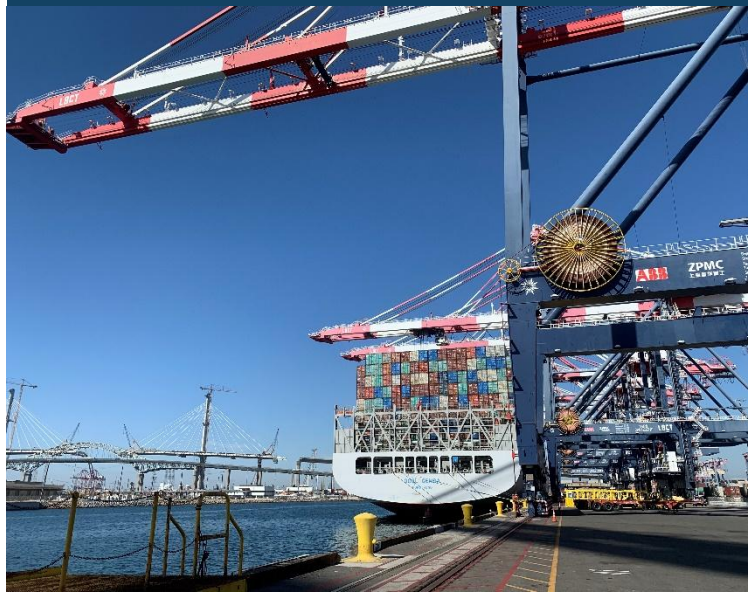
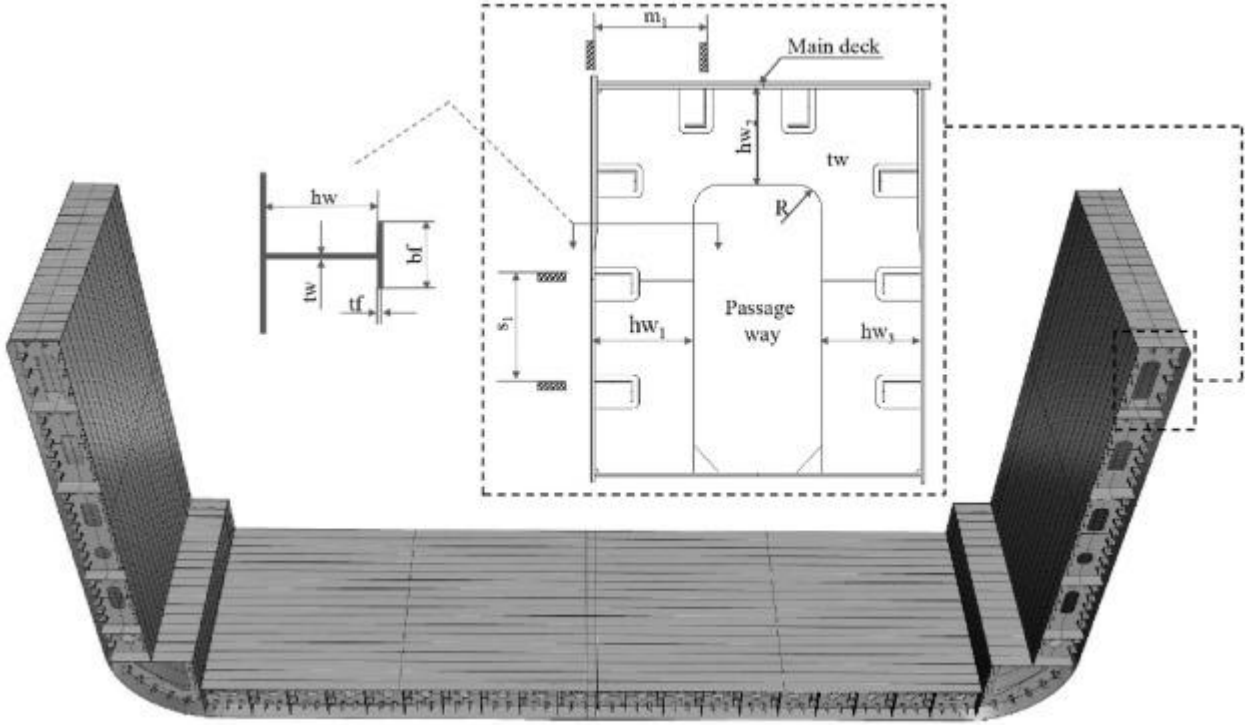
INTRODUCTION TO THE MARITIME INDUSTRY



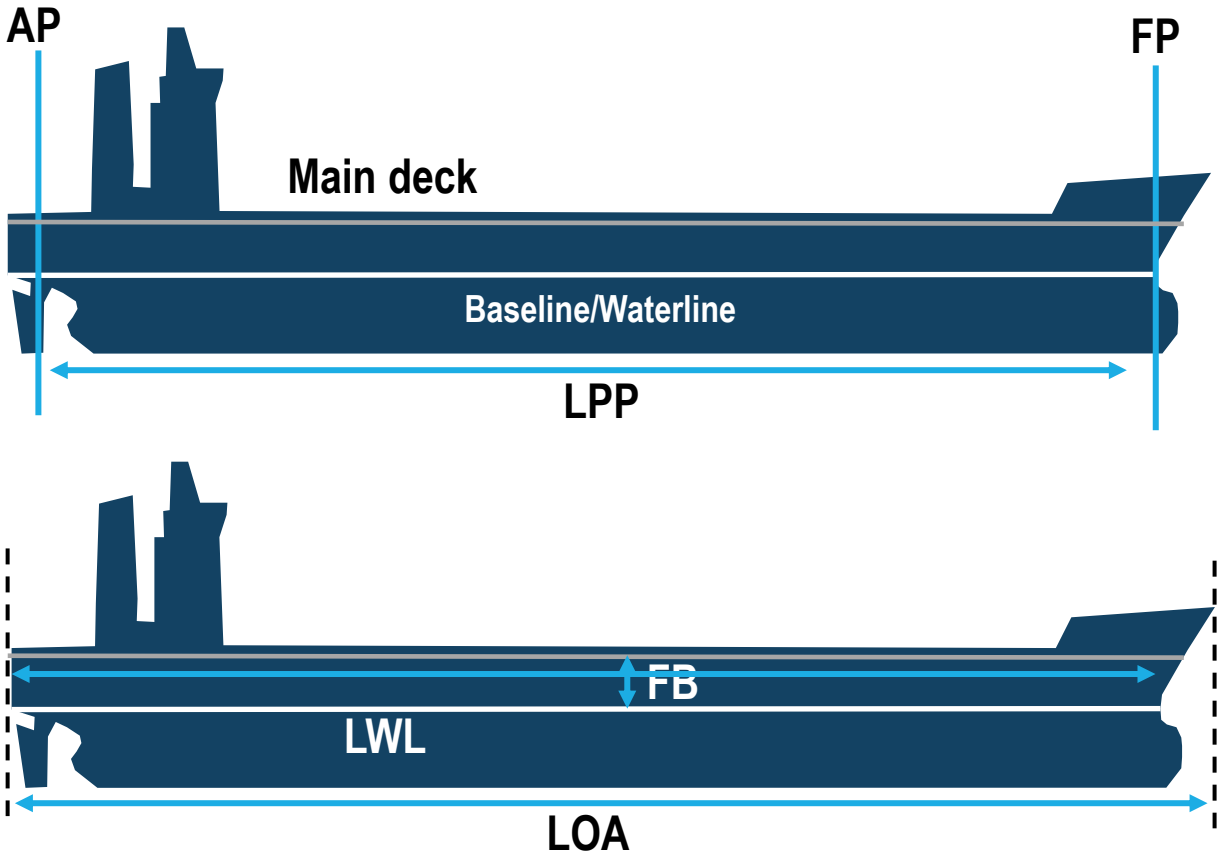
B. Ship Structure

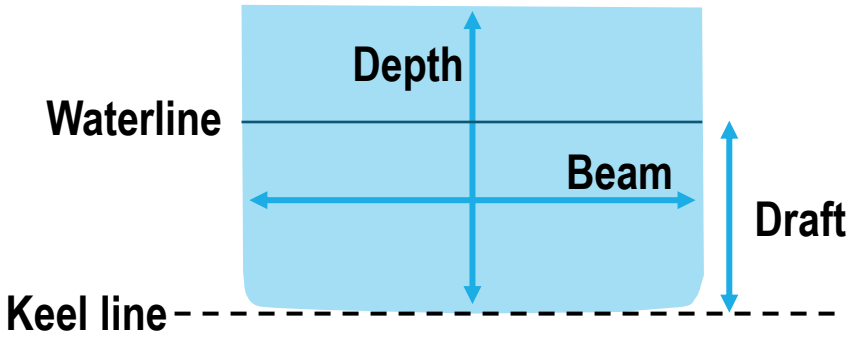
Hull Structure

- Hull
  - Main body of the ship exclusive of masts and superstructure.
  - Built to suit the mission of the ship.
  - Must withstand forces of load, buoyancy, dynamic (waves), wind and machinery vibration in addition to ship motions.
- The hull structure members comprise a “box girder” of stiffened plating
  - Limits longitudinal bending.
  - Withstands water pressure.
  - Withstands localized loads.
  - Withstands water spilled on deck.
  - Withstands dry-docking loads.



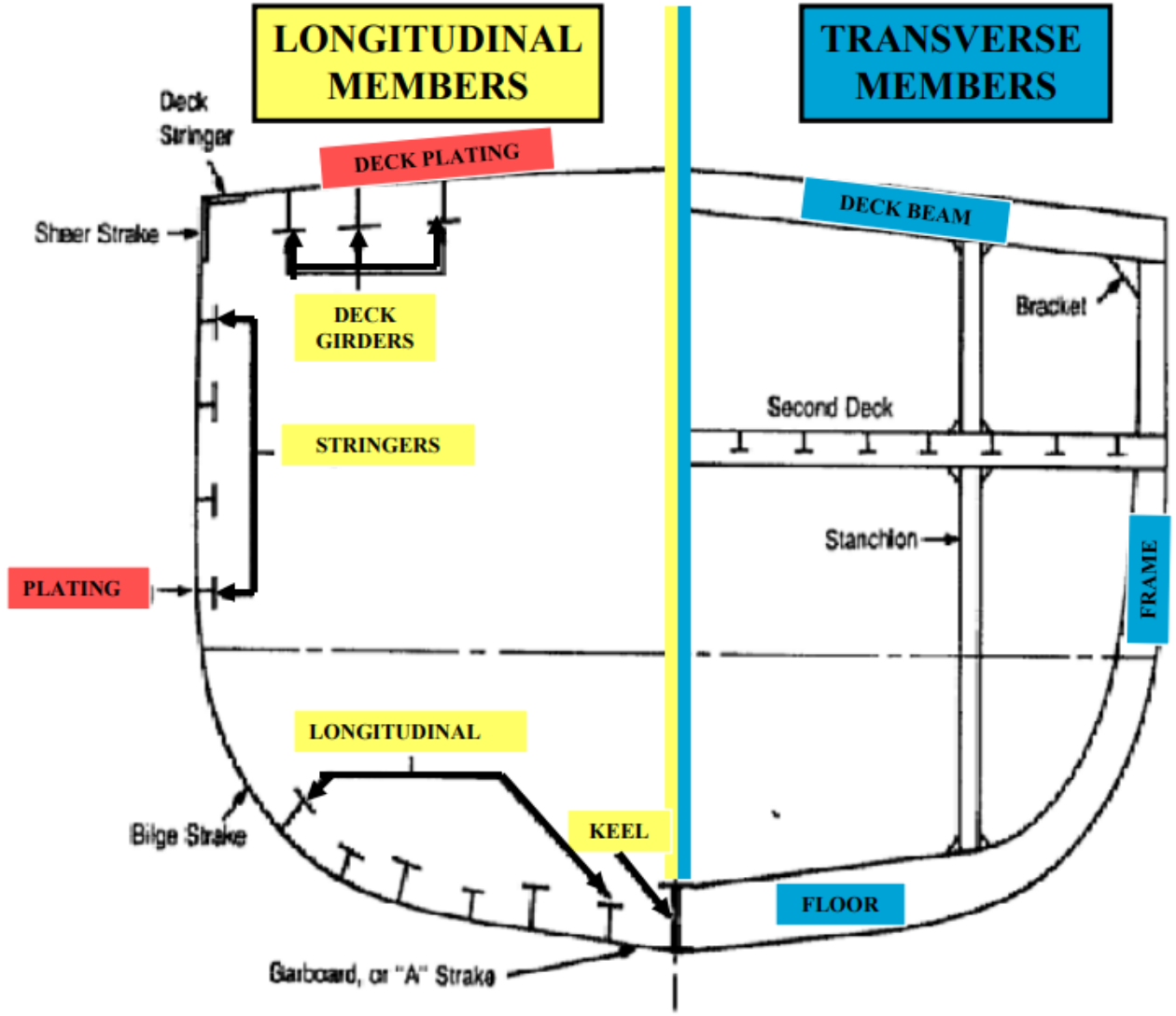
Hull Form Terms



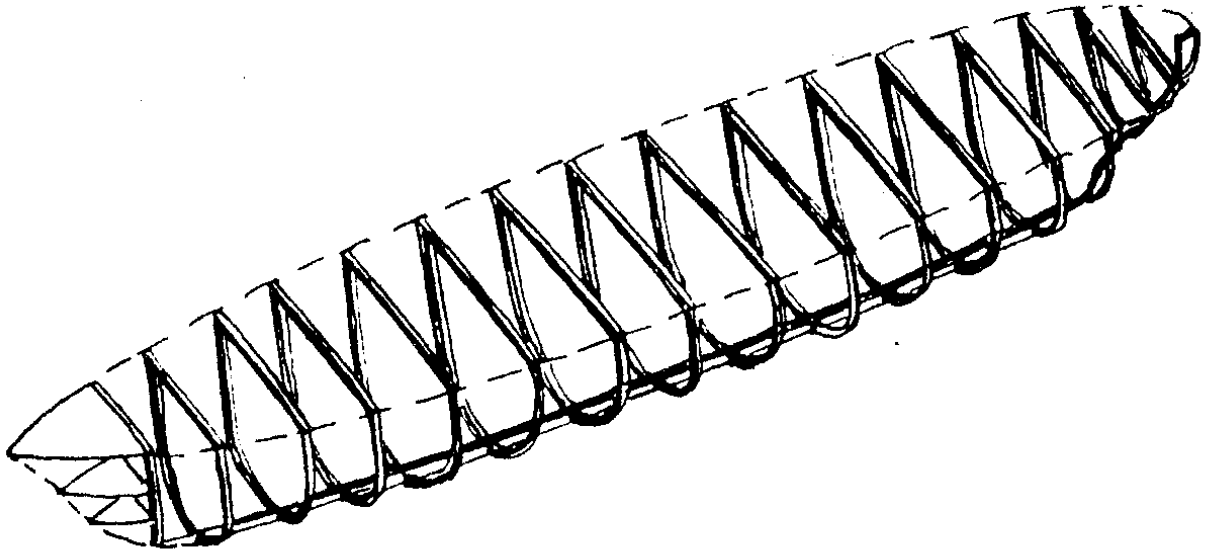


Frame Systems

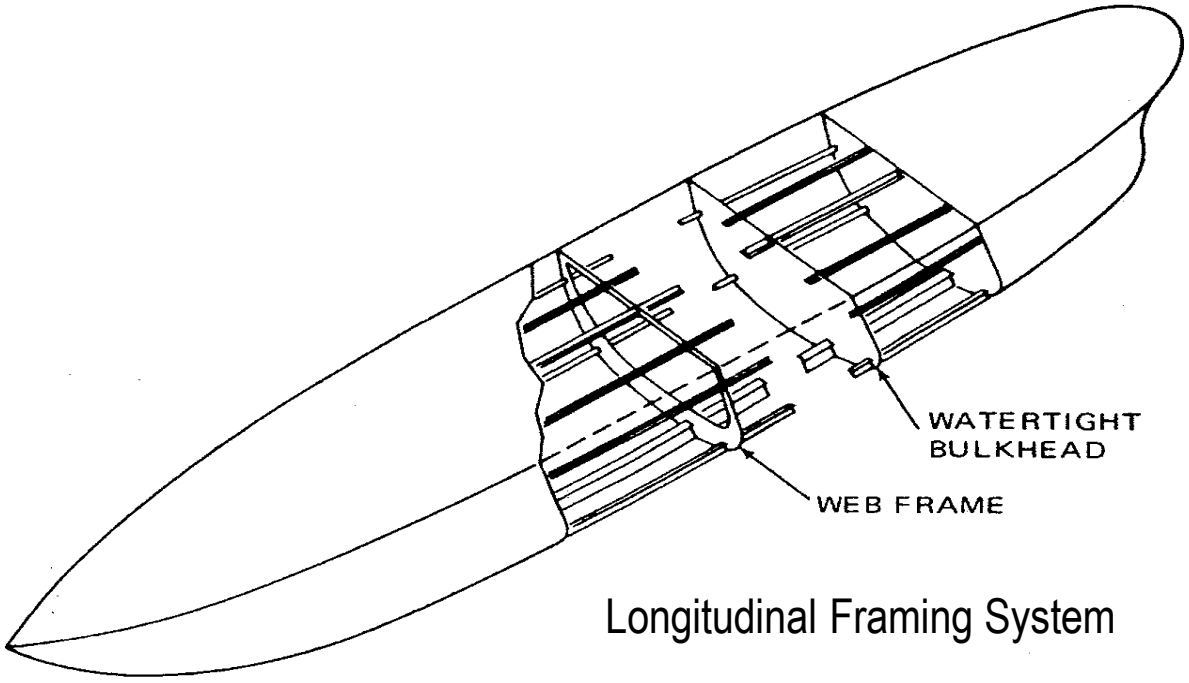
- TRANSVERSE
  - Lateral orientation.
  - Spaced frames and beams forming rings.
  - Can form watertight bulkheads.
  - Resist the hydrostatic loads.
- LONGITUDINAL
  - Longitudinal orientation.
  - Spaced plating, girders and stringers.
  - Keel:
    - Bottom centerline longitudinal.
    - Considered the backbone of the ship.
    - Continuous girder from stem to stern.



Transverse and Longitudinal Framing System

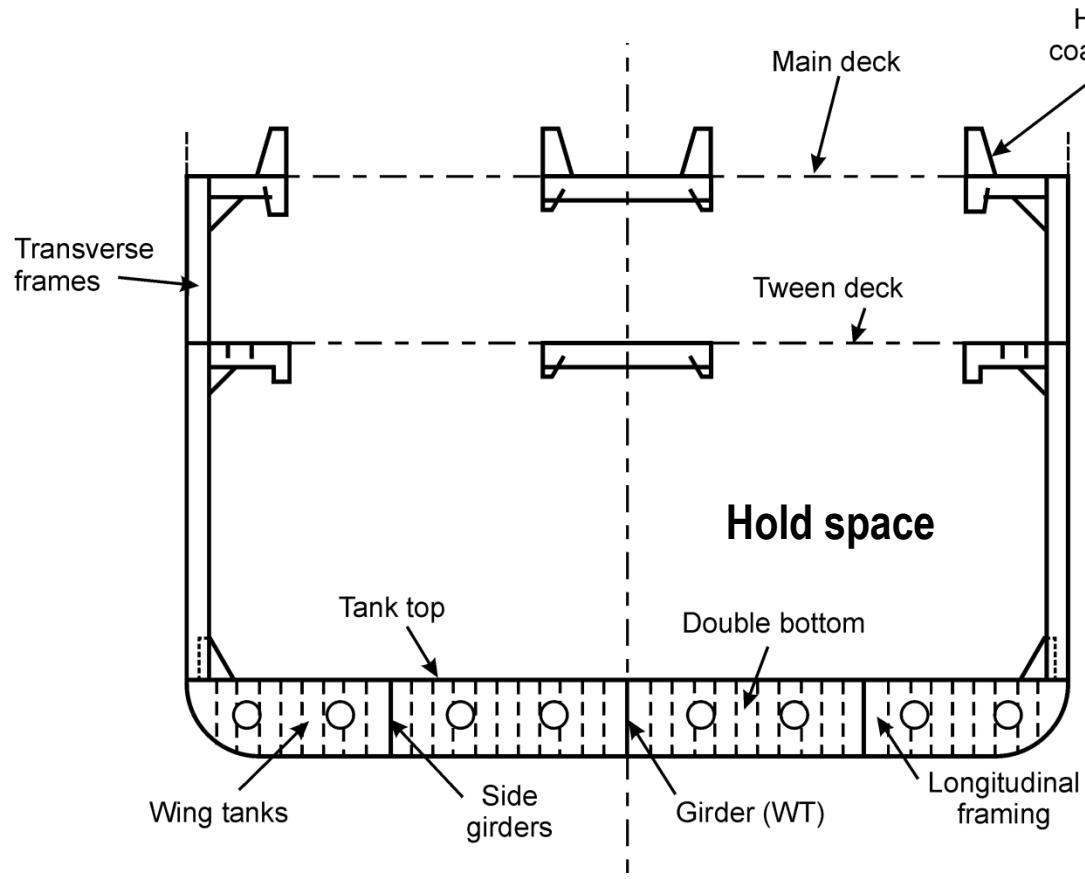


Transverse Framing System



Longitudinal Framing System

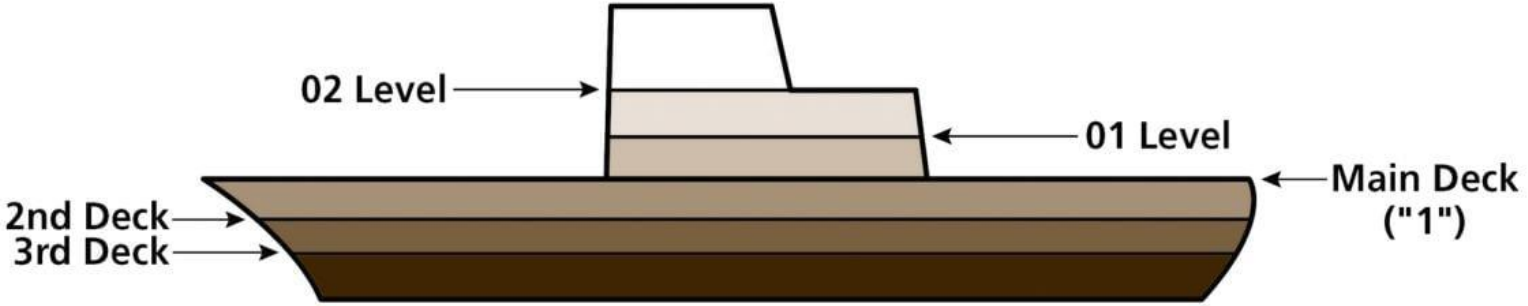
Transverse Framing



Tween deck: Any deck below the main (or weather deck)

Decks

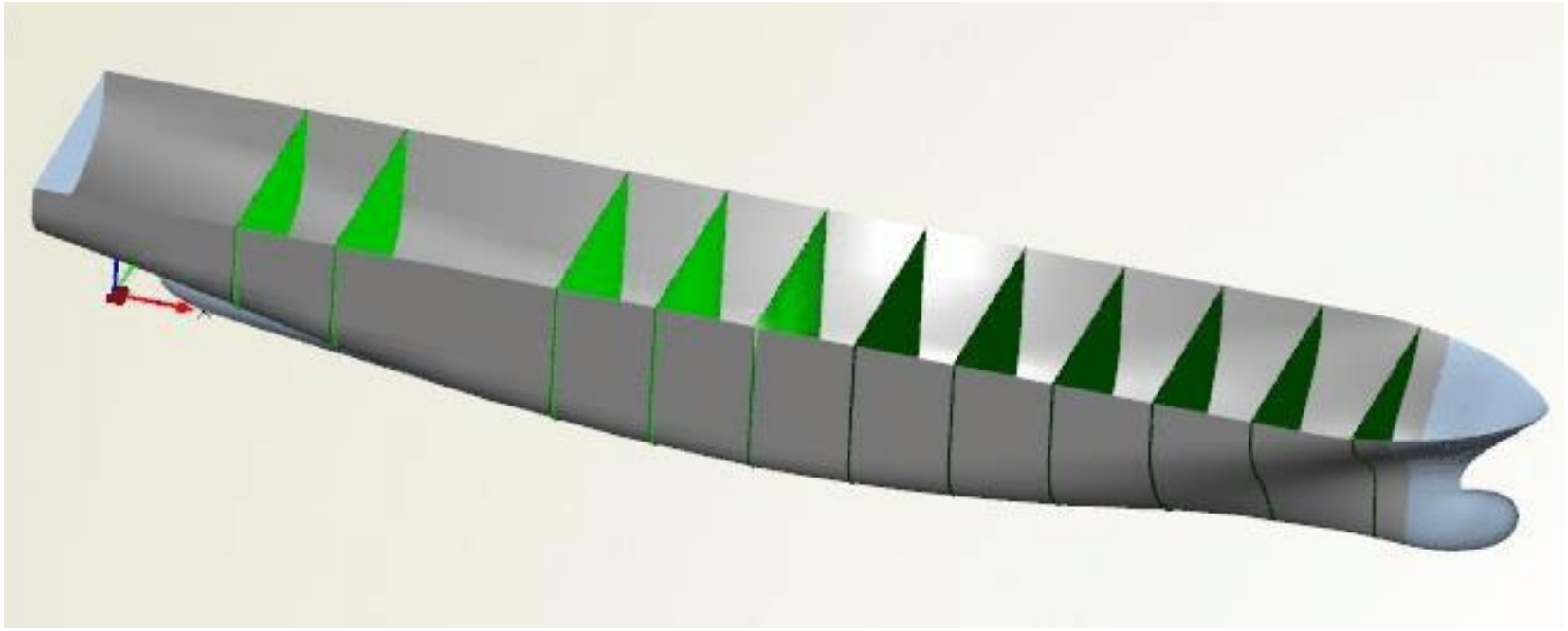
- Provide
  - Structural strength.
  - Cargo stowage.
  - Living quarters.
- Main Deck
  - Uppermost deck from stem to stern.
- Forecastle deck
  - Partial deck above main deck at the bow.
- Poop Deck
  - Partial deck above stern.
- Upper deck or bridge deck
  - Partial decks above amidship area.



- Decks below the main deck
  - Second deck (tween deck).
  - Third deck, etc.
- Decks above the main deck are named
  - Function (e.g. bridge deck).
  - Letters or numbers.
  - A (main deck) to H (bridge).

Bulkheads

- Transverse watertight bulkheads
  - Subdivide the ship into independent compartments.
  - Limit flooding in case the hull is punctured or ruptured.
- Other bulkheads
  - Provide separate spaces for cargo, tanks, engines, and quarters.



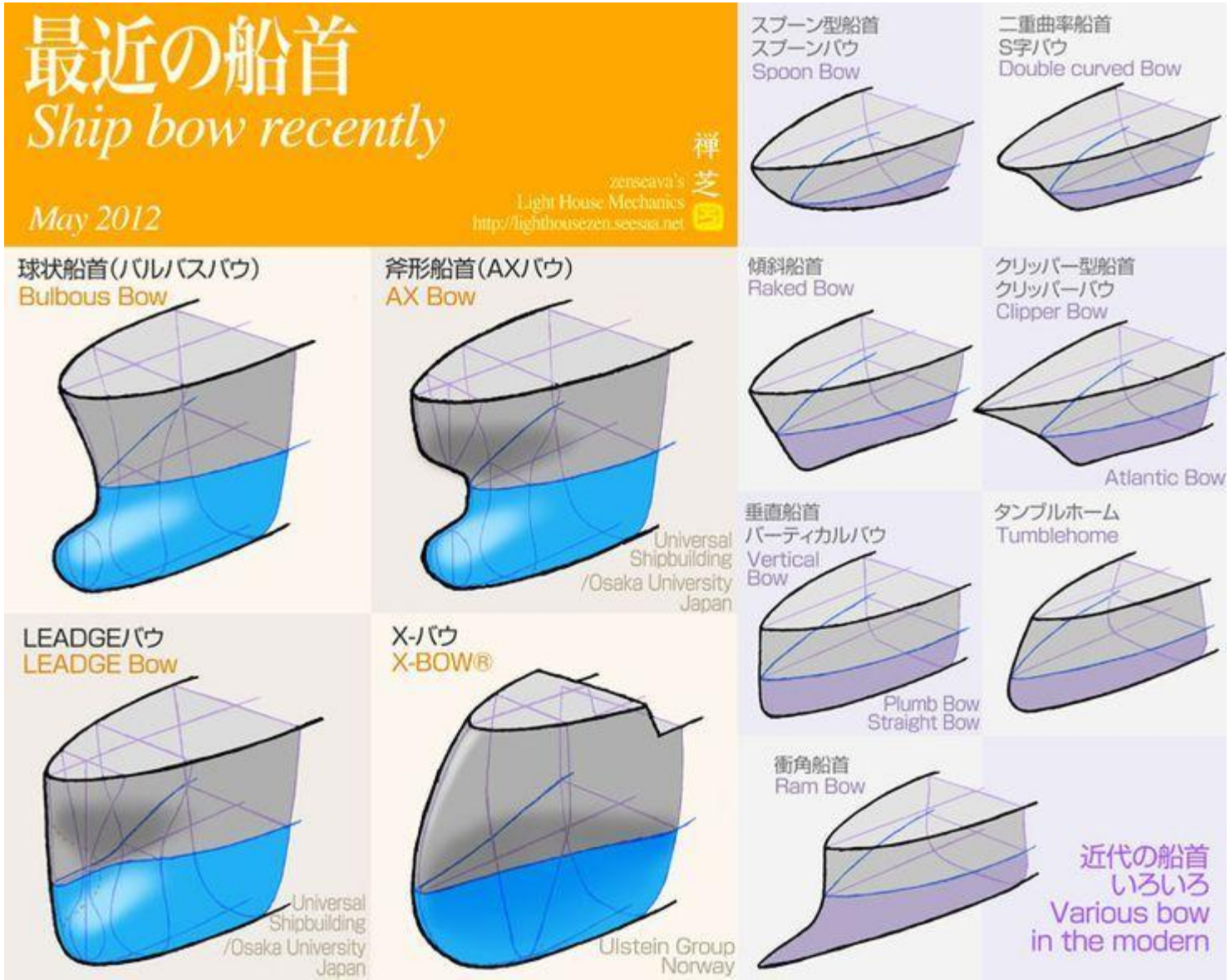
Hull Shapes

- Hull speed factors
  - Hull or underwater body of a ship affects the power needed to reach design speeds.
  - Beam:
    - Maximum width of the hull.
    - Usually at the halfway point between bow and stern.
  - Middle-body section:
    - Parallel middle body section where hull shape is unchanged.
  - Entrance:
    - Narrowing part of underwater body forward of the middle–body section.
  - Run:
    - Narrowing part of underwater body aft of the middle-body section.

Hull Shapes

- Ship with “Fine Lines”
  - Long and tapering entrance and run
  - Short middle-body section.
  - Designed for speed.
- Ship with “Full Form”
  - Long parallel middle body section.
  - Short entrance and run.
  - Designed for cargo hold.

Bow Shapes

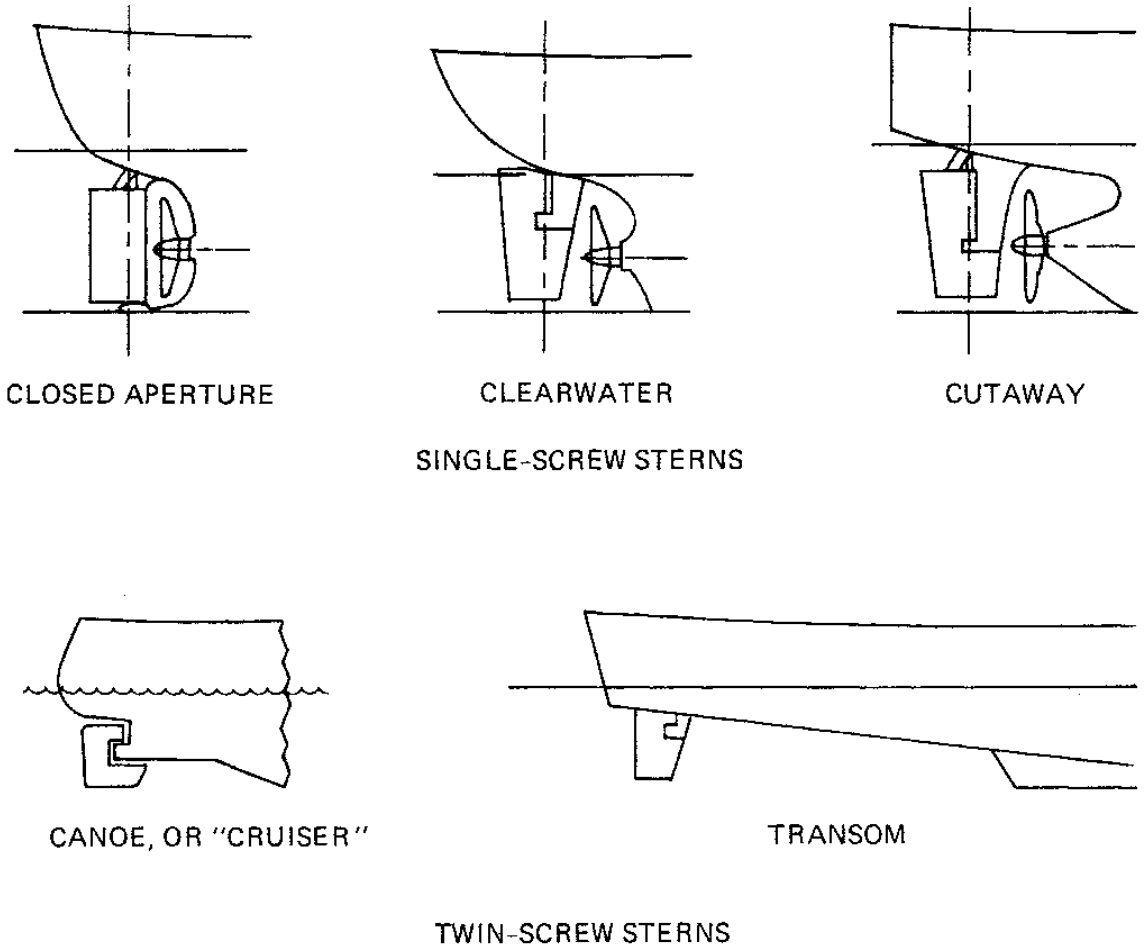

最近の船首
Ship bow recently
May 2012
禅芝
zenseava's
Light House Mechanics
http://lighthousezen.seesaa.net
スプーン型船首
スプーンバウ
Spoon Bow
二重曲率船首
S字バウ
Double curved Bow
球状船首(バルバスバウ)
Bulbous Bow
斧形船首(AXバウ)
AX Bow
Universal
Shipbuilding
/Osaka University
Japan
傾斜船首
Raked Bow
クリッパー型船首
クリッパーバウ
Clipper Bow
Atlantic Bow
垂直船首
バーティカルバウ
Vertical
Bow
Plumb Bow
Straight Bow
タンブルホーム
Tumblehome
LEADGEバウ
LEADGE Bow
Universal
Shipbuilding
/Osaka University
Japan
X-バウ
X-BOW®
Ulstein Group
Norway
衝角船首
Ram Bow
近代の船首
いろいろ
Various bow
in the modern

Bow Shapes

- Bulbous Bow
  - Enables a ship to attain greater speed at full power by decreasing water resistance.
  - Reduce fuel consumption by around 15%.
  - Increase forward buoyancy and stability.
  - Additional risk if a collision.

Stern Shapes

- Depend on:
  - Single or multiple screw?
  - Design speed of ship.
  - Flow pattern needed to optimize propeller performance.



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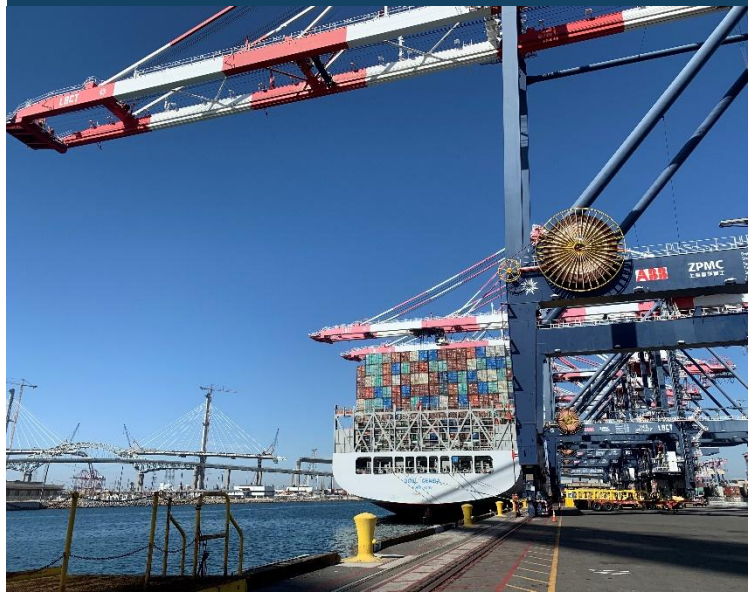
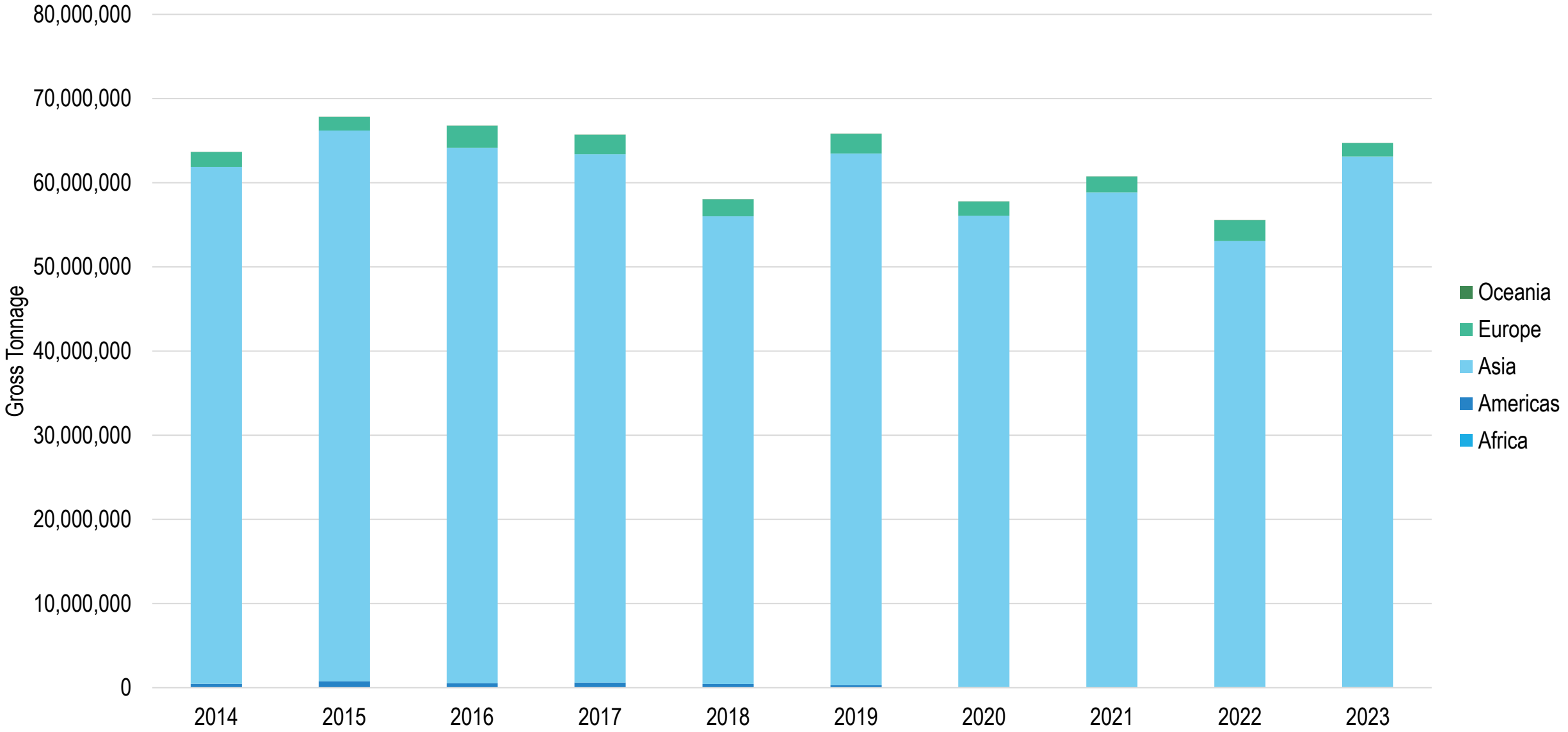
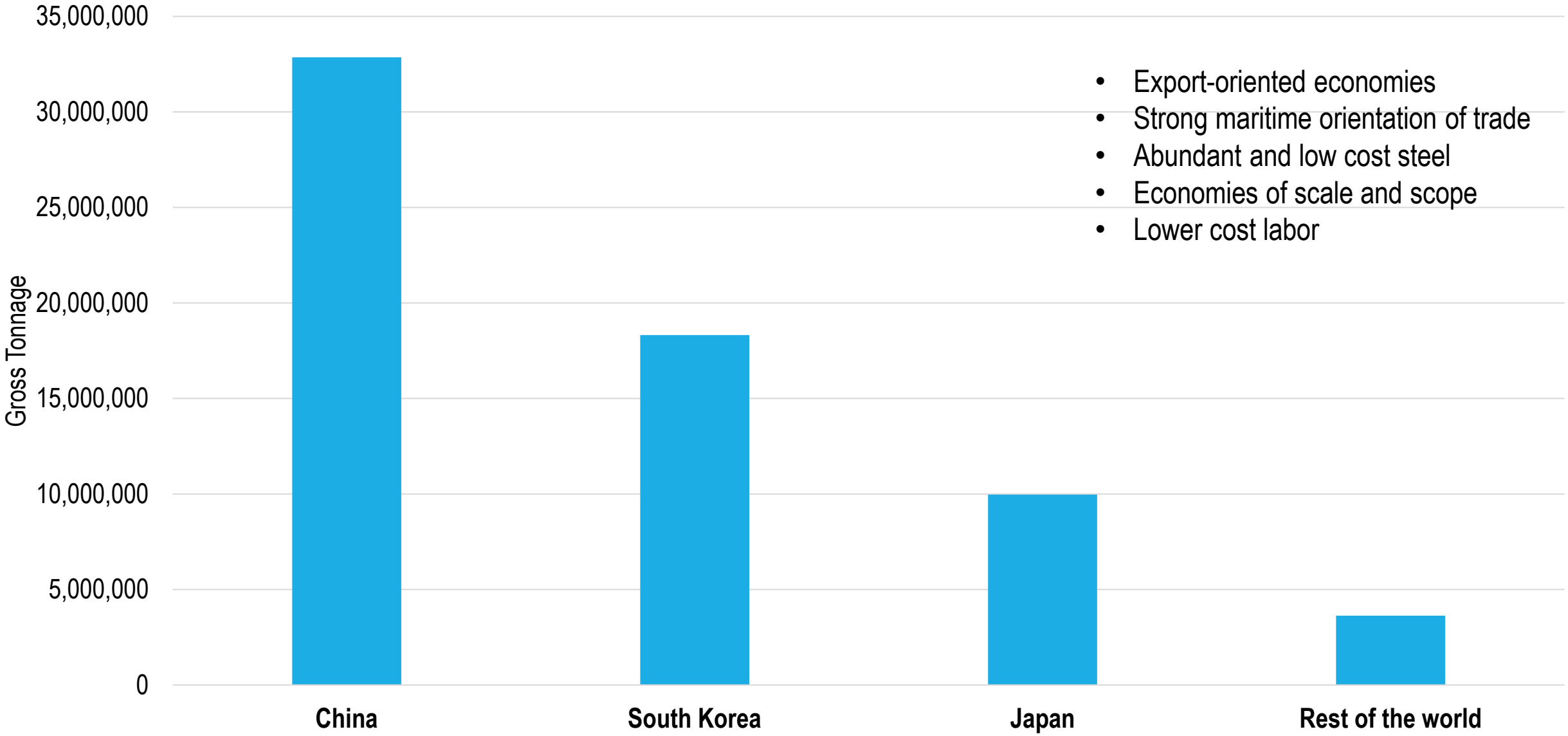


C. Ship Design and Construction

Shipbuilding by Region, 2023



Main Shipbuilding Countries, 2023



Seven Issues Concerning Ship Design

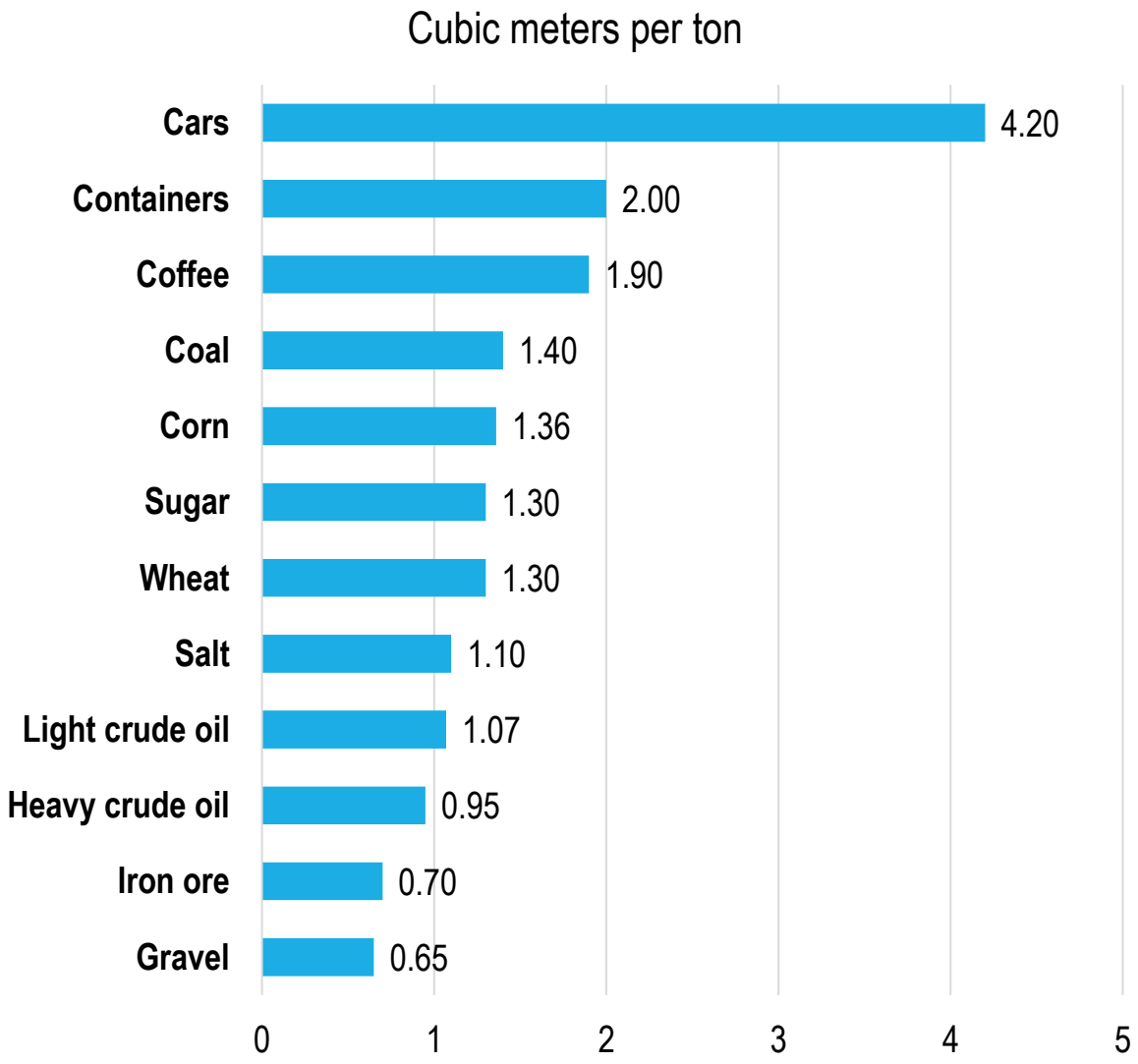
1. The type of cargo to carry
2. How the cargo will be stowed
3. How will the cargo be handled
4. The size of the ship
5. The service speed
6. The type of vessel
7. The business model of the shipowner

1. Types of Cargo

- Substantial heterogeneity in maritime cargoes
  - Bulk and break bulk the major distinction.
  - Bulk is homogeneous, but requires specialized ships.
  - Breakbulk is heterogeneous, but requires more versatile ships.

2. How the Cargo is Stowed

- Stowage factor
  - The volume of cargo (cubic meters or feet) occupied per ton.
  - A function of the density and nature of the cargo.
  - Weighting out (bulk ships) versus cubing out (breakbulk ships).
  - Calculate areas and volume needed to fulfill the mission of the ship.



2. How the Cargo is Stowed

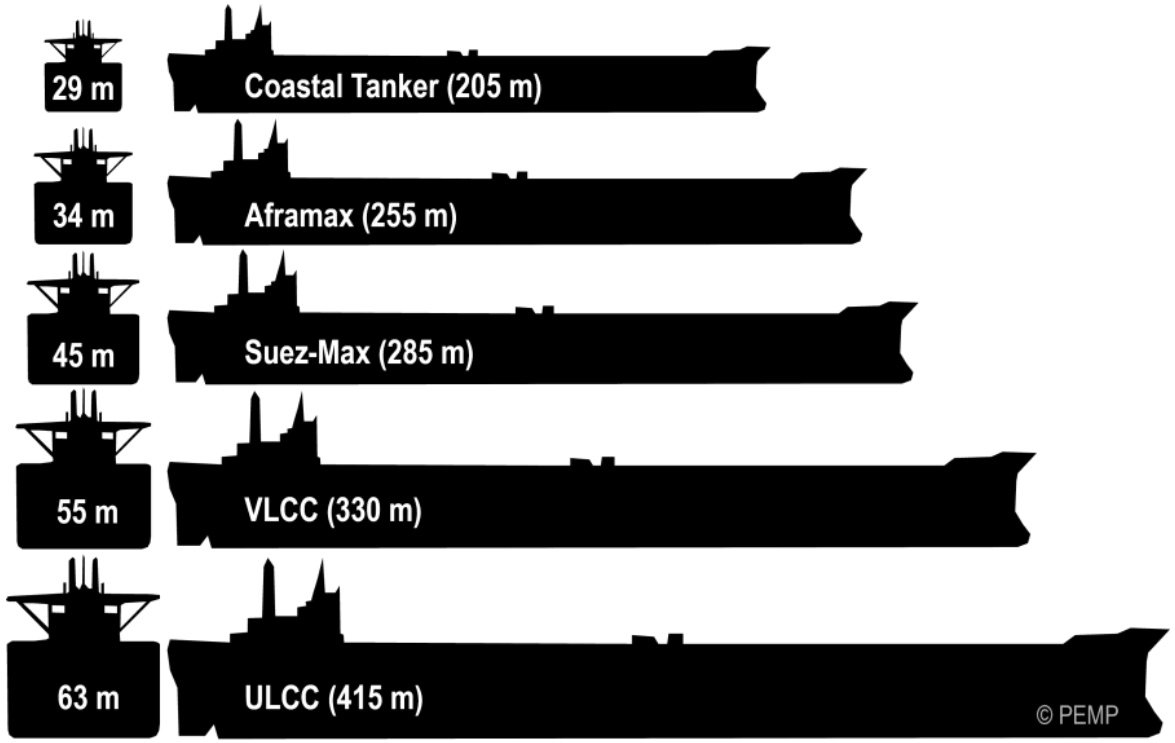
- Payload function
  - Carrying the payload safely from port to port.
  - All the resources needed to load, carry and unload cargo.
  - Include cargo spaces, cargo handling equipment, and refrigeration equipment.
- Deadweight displacement ratio (DWT)
  - The carrying capacity in relation to the total displacement.
  - The total volume of the vessel and the gross tonnage can be calculated.

3. How the Cargo is Handled

- Cargo handling gear
  - Geared versus non-geared ship.
  - Capacity of the pumps.
- Hatch design
  - Size of hatch, design of hatch that allows vertical access to cargo.
- Cell guides (for containerships)
  - Cell guides are fitted to the deck so containers do not need to be secured individually.
- Cargo access ramps
  - Ramps may be fitted to allow access to fork-lift and trucks.
- Tank segregations
  - Provision of self-contained tanks capable of handling many different liquid cargoes.
  - Installation of separate pumping systems for each tank and special coatings (zinc, stainless steel)

4. Ship Size

- Factors influencing ship size
  - Economies of scale.
  - The parcel size of the cargo.
  - Port draft and handling equipment.
- Larger ships have:
  - Wider beam.
  - Increased LOA.
  - More decks.
  - More draft and freeboard.



- Cost and benefits
  - Shipowners replace tonnage by larger vessels rather than provide additional sailings.
  - Lowers nautical ton per mile costs.
  - Places the focus on planning and the total logistics operation at the berth.

The Latest Containership Design, 27,500 TEUs

6. Ship type

- Diversification versus specialization
  - Diverse cargo options are ideal, but they cannot be practical.
  - Physical and commercial cargo properties set a limit on the ship type.
- Cargoes can be transported from several different ship types
  - Excluding LNG.
  - Crude oil can be transported by:
    - Specialist tanker.
    - Combined carrier.
    - Even in breakbulk (drums and liquid containers).
  - The appeal of the containership.

7. Business model

- Long-term charters
  - Shipowner has some knowledge from the charterer of the cargo to be carried and the port used.
- Spot charter market operations
  - Shipowner has only a general idea of the types of cargo to be carried and no knowledge of the ports visited.
- Liner operations
  - Shipowner has a specific knowledge of the ports to be visited and the likely cargo volume.
  - Both may change during the operational life of the vessel.
- Time horizon
  - Long term: concerned with optimizing the vessel for a specific operation.
  - Spot market: concerned with vessel's acceptability to charterers and its resale value.

7. Business model

- Commercial philosophy
  - One shipping company may prefer a fleet that is highly flexible, servicing several different markets and thus reducing risk.
  - Another may follow a specialization policy, preferring a vessel designed for the efficient carriage of a single cargo, offering greater efficiency or lower costs.

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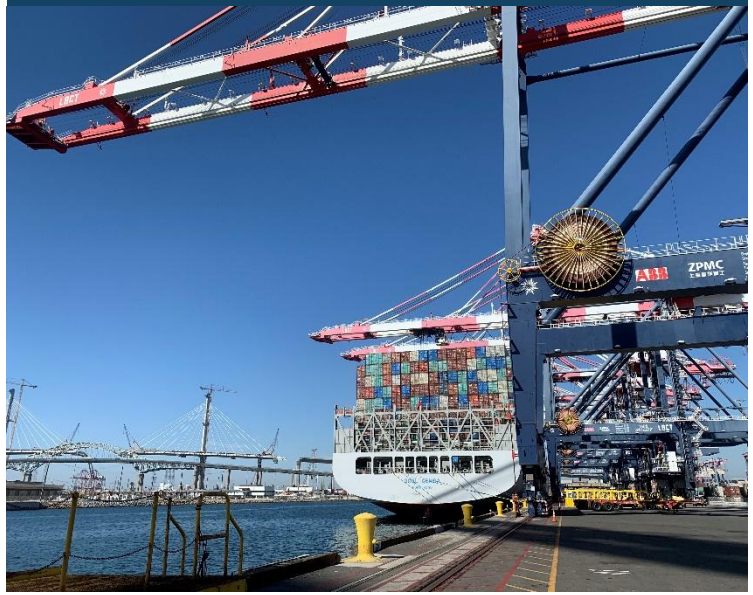
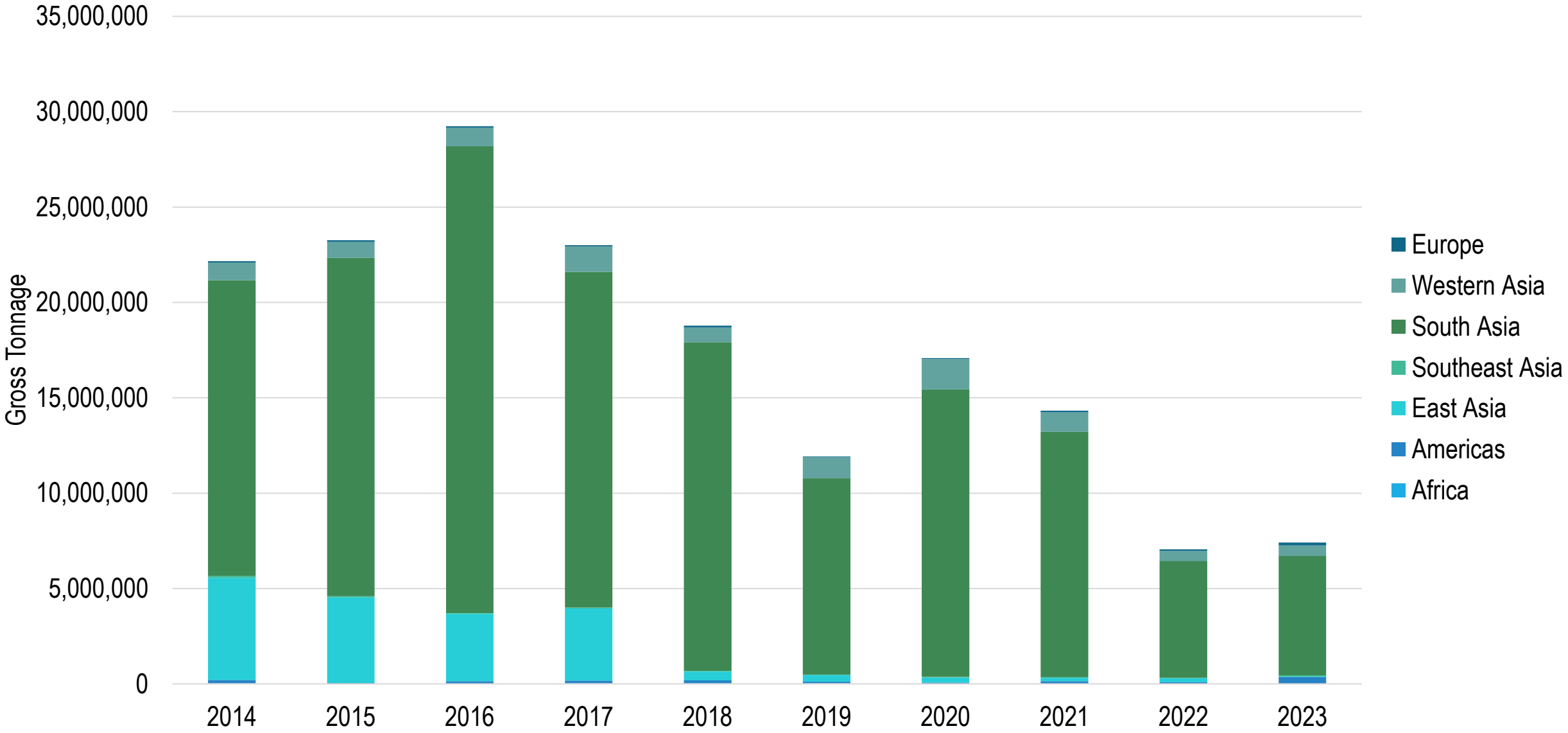


D. Ship Scrapping and Recycling

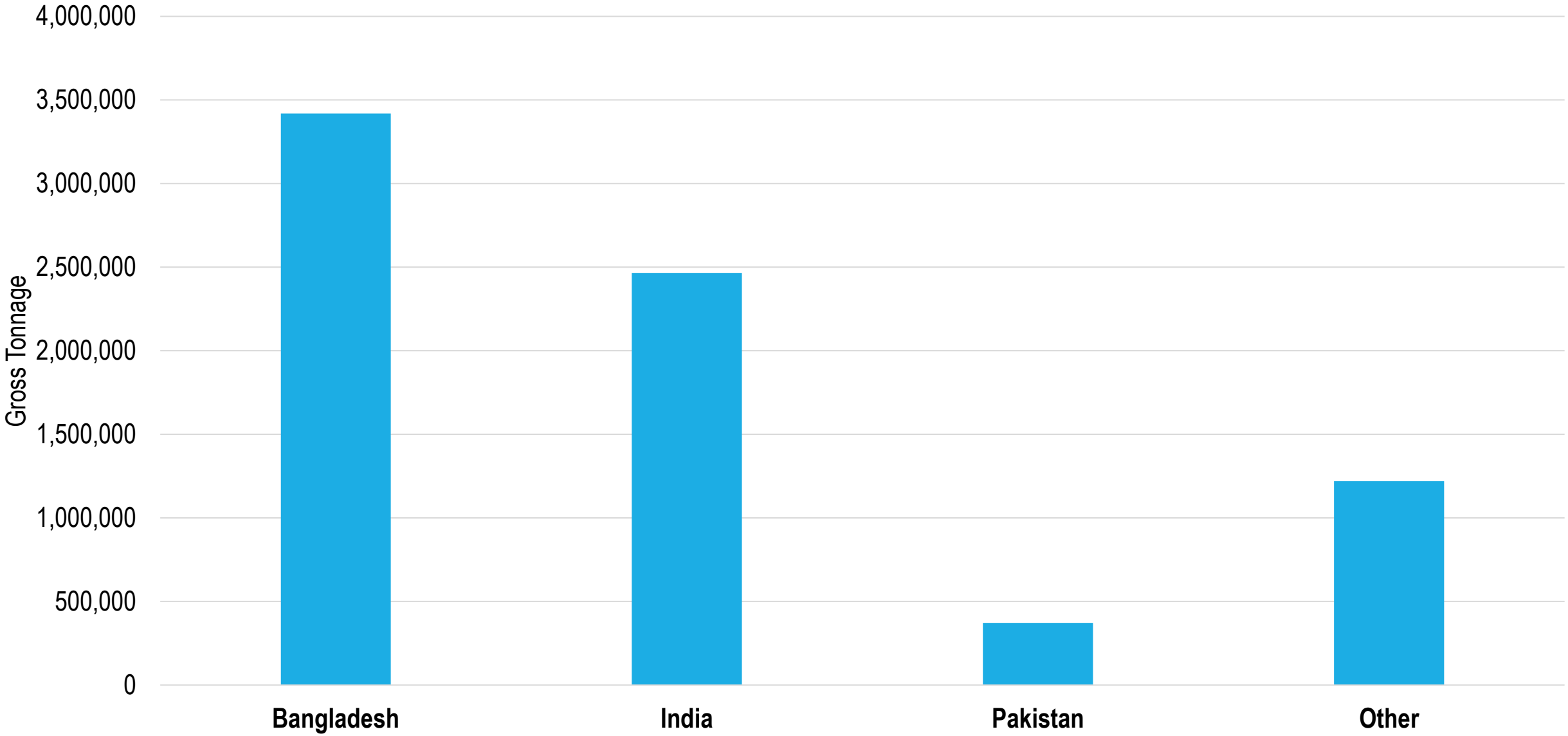
Conditions for Ship Scrapping and Recycling

- Life expectancy
  - Ship has reached the end of its useful life: 25-50 years.
  - Obsolete design and equipment.
  - Expensive refit costs.
- Ship classification
  - Ship fails crucial inspection by classification society (end-of-life damage and lack of maintenance).
  - Cannot be classified without expensive repairs.
- Market demand
  - Low market demand in the cargo sector.
  - Incites to scrap before the end-of-life expectancy and keep the most productive ships operating.
- Scrap price
  - High metal (steel) prices incite scrapping older ships.

Ship Scrapping and Recycling



Main Ship Scrapping and Recycling Countries, 2023



Ship Recycling Methods

Read this content

DRY DOCKING

PIER BREAKING / ALONGSIDE

LANDING / SLIPWAY

BEACHING

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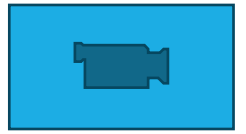
Ship Recycling Methods

- Dry docking
  - Ship is sailed into a dock, and the water is pumped out.
  - Workers dismantle the vessel, and upon termination, the dock is cleaned and flooded again.
  - Building and maintaining a dock is relatively costly.
  - Method is hardly used for ship recycling purposes.
  - Europe.
- Pier breaking/alongside
  - Ship is secured along a wharf or quay in calm waters.
  - A crane removes the pieces of the ship until the vessel is lifted or sent to a dry dock for final cutting.
  - China, Europe, and the US.

Ship Recycling Methods

- Landing/slipway
  - Ship sailed against the shore or a concrete slipway that extends into the sea.
  - Sites with little or no tides.
  - Ship is subsequently dismantled using a mobile crane located onshore or on barges.
  - Additionally, temporary quays or jetties are used on-site to use heavy lifting or cutting equipment.
  - Common in Turkey.
- Beaching
  - Sailing a lightened ship full steam onto a tidal beach.
  - Workers have access to the ship in order to cut it off into pieces.
  - Metal pieces are recycled in nearby processing plants and sold as ingots.
  - Bangladesh, India, and Pakistan.



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