ΑΚΑΔΗΜΙΑ ΕΜΠΟΡΙΚΟΥ ΝΑΥΤΙΚΟΥ

ΑΕΝ ΜΑΚΕΔΟΝΙΑΣ

ΠΤΥΧΙΑΚΗ ΕΡΓΑΣΙΑ

ΕΠΙΒΛΕΠΩΝ ΚΑΘΗΓΗΤΗΣ: ΠΑΝΑΓΟΠΟΥΛΟΥ ΜΑΡΙΑ

ΘΕΜΑ: «PARTS OF THE SHIP»

ΤΗΣ ΣΠΟΥΔΑΣΤΡΙΑΣ: ΨΥΛΛΑΚΗ ΣΤΑΜΑΤΙΑ

ΑΓΜ: 4127

ΗΜΕΡΟΜΗΝΙΑ ΑΝΑΛΗΨΗΣ ΤΗΣ ΕΡΓΑΣΙΑΣ: 17/05/2019

ΗΜΕΡΟΜΗΝΙΑ ΠΑΡΑΔΩΣΗΣ ΤΗΣ ΕΡΓΑΣΙΑΣ: 15/07/2020

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Ο ΔΙΕΥΘΥΝΤΗΣ ΤΗΣ ΣΧΟΛΗΣ: ΤΣΟΥΛΗΣ Β. ΝΙΚΟΛΑΟΣ

ABSTRACT

The main subject of this thesis is the reference on the Parts of a Ship. A ship is a watercraft that travels all over the world's seas in order to transfer the cargo or the passengers from one place to another or in order to execute its designated mission. From ship to ship, the size, shape or load capacity can be different. Through the years, ships have evolved from small floating vessels made of wood to big ships made of steel. In the early years people used their hands or later oars to move the craft, while after steamships were invented. Despite the fact that many of the parts of a ship are common such as the Hull, the Navigation Bridge and the Engine room to all the types of ships, there are a many other that change such as cargo holds on the Bulk Carriers or the Container ships that carry their cargo stored in containers.

CONTENTS

CHAPTER 1

1.1 HISTORY OF THE SHIPS

A ship is a large watercraft that travels around the world's oceans and deep waterways, carrying goods or passengers, or in support of specialized missions, such as research, fishing and defense. Ships differ from boats, on size, shape, load capacity, and tradition. Ships have been important to human migration and they are responsible for the largest portion of world commerce. Also, they have supported the spread of colonization, served scientific, cultural, and humanitarian needs.

The first sailing vessels were developed for use in the South China Sea and the western Mediterranean Sea by the 2nd millennium BCE. In the Mediterranean, vessels were powered downwind by square sails that supplemented propulsion by oars. The Age of Sail reached its peak in the 18th and 19th centuries with large, heavily armed battleships and merchant sailing ships that were able to travel at speeds that exceeded those of the newly introduced steamships. Ultimately, the steamships' independence from the wind and their ability to take shorter routes, passing through the Suez and Panama Canals, made sailing ships uneconomical.

More specifically, in ancient marine times, people used rafts, logs of bamboo, bundles of reeds, air filled animal skins and asphalt covered baskets to traverse small water bodies. The first boat was a simple frame of sticks lashed together and covered expertly with sewn hides. These boats could carry large and heavy loads easily. At the very beginning people used their hands to move the boats before even oars where even discovered. Also, they moved the rafts by pushing poles against the bottom of the rivers. Later on, sails were invented and as a result sails boats could carry heavier loads on longer trips. As the trade overseas became more important, ships continued to develop. In the late 1100's stern post was added to ships in order to facilitate the hanging rudder which improved the handling characteristics of the ship. As a result, larger ships were created and higher free boards were built. Through the years, cargo was transported in large gallon barrels called tuns in order to avoid water damage.

Later on, Steamships gradually replaced sailing ships for commercial shipping through the 19th century, when on 1815 steamships increased significantly in speed and size and finally were superseded by diesel-driven ships in the second half of the 20th century.

Ironclads are steam-propelled warships of the later 19th century, protected by iron or steel armor plates and were developed as a result of the vulnerability of wooden warships to explosive or incendiary shells.

After 1850, Iron-hulled sailing ships represented the final evolution of sailing ships at the end of the Age of Sail. They were built to carry bulk cargo for long distances in the 19th and early 20th centuries and were the largest of merchant sailing ships, with three to five masts and square sails, as well as other sail plans. Later examples had steel hulls. Iron-hulled sailing ships were mainly built from the 1870s to 1900, when steamships began to outpace them economically, due to their ability to keep a schedule regardless of the wind. Steel hulls also replaced iron hulls at around the same time.

The four-masted, iron-hulled ship, introduced in 1875 with the full-rigged *«County of Peebles»*, represented an especially efficient configuration that prolonged the competitiveness of sail against steam in the later part of the 19th century. The largest example of such ships was the five-masted, full-rigged ship *«Preussen»*, which had a load capacity of 7,800 tonnes. Ships transitioned from all sail to all steam-power during from the middle 19th century into the 20th. In the 20th century, the ***internal combustion engine*** and ***gas turbine*** came to replace the ***steam engine*** in most ship applications. In the latter half of the 20th century, various vessels, notably ***aircraft carriers, nuclear submarines,*** and ***nuclear-powered icebreakers,*** made use of ***nuclear marine propulsion. Sonar*** and ***radio*** augmented existing navigational technology.

Finally, since the turn of the millennium, the construction of ***stealth ships*** occurred. These ships employ stealth technology construction techniques in an effort to ensure that they are harder to be detected by radar, visual, sonar or infrared methods.

CHAPTER 2

2.1 TYPES OF SHIPS

Ships are constructed based on the principles of naval architecture that require same structural components and their classification is based on their function such as that suggested by Paulet and Presles, which requires modification of the components.

The categories accepted in general by naval architects are:

- High-speed crafts.
- Off shore oil vessels, Platform supply vessels, pipe layers, drilling rigs and production platforms.
- Fishing vessels.
- Harbour work craft, Cable layers, Tugboats, dredgers, salvage vessels, tenders and Pilot boats.
- Dry cargo ships: tramp freighters, bulk carriers, cargo liners, container vessels, barge carriers, Ro-Ro ships, refrigerated cargo ships and timber carriers.
- Liquid cargo ships: Oil tankers, liquefied gas carrier sand chemical carriers.
- Passenger vessels: Liners, cruise, coastal and harbour ferries, Luxury & cruising yachts and sail training and multi-masted ships.
- Recreational boats and craft.
- Special-purpose vessels: weather and research vessels, deep sea survey vessels, and icebreakers.
- Submersibles: industrial exploration, scientific research, tourist and hydrographic survey.
- Warships and other surface combatants: aircraft carriers, destroyers, frigates, corvettes and minesweepers.

Some of the above will be explained in the text below.

2.2 MERCHANT SHIPS

A *merchant ship*, *merchant vessel*, *trading vessel*, or *merchantman* is a watercraft that is used for commercial purposed and can be divided into four categories: cargo ships, passenger ships, fishing ships and special-purpose ships. This is in contrast to pleasure craft, which are used for personal recreation, and naval ships, which are used for military purposes. They come in many sizes and shapes and most countries of the world operate fleets of merchant ships, including the Greek merchant marine which is the largest in the world. Modern merchant vessels are typically powered by a single propeller driven by a diesel or, gas turbine engine, but until the middle of 19th century they were predominantly square sail rigged. Hulls are usually made of steel, although aluminum can be used on faster craft, and fiberglass on the smallest service vessels.

- *Cargo ships* or *freighters* can be distinguished by the type of cargo they carry.

  Dry cargo ships today are mainly bulk carriers and container ships.

  Bulk carriers or bulkers are used for the transportation of homogeneous cargo such as coal, rubber, copra, tin, and wheat.

- A *bulk carrier* is a ship used to transport bulk cargo items such as iron ore, bauxite, coal, cement, grain and similar cargo. They can be recognized by large box-like hatches on deck, designed to slide outboard or fold fore-and-aft to enable access for loading or discharging cargo and their dimensions are often determined by the ports and sea routes that they need to serve, and by the maximum width of the Panama Canal. Most lakes are too small to accommodate bulk carriers. Types of Bulk carrier based on size:

  - Mini Bulk Carrier
  - Small Bulk Carrier
  - Handy Size Carrier
  - Handymax Carrier
  - Panamax Carrier
  - Capesize Bulk Carrier

- A *Container ship* is cargo ship that carries all of it load in truck-size containers, in a technique called containerization. Types of Container ships based on size:

  - Panamax
  - Suezmax
  - Post-Panamax
  - Post-Suezmax
  - Post-Malaccamax

- A *tanker* is a ship designed to transport liquids in bulk, they can range in size from several hundred tons, designed to serve small harbours and coastal settlements, to several hundred thousand tons, with these being designed for long-range haulage.

  A wide range of products are carried by tankers, including:

  - Hydrocarbon products such as oil, LPG, and LNG
  - Chemicals, such as ammonia, chlorine, and styrene monomer
  - Fresh water
  - Wine

On the basis of their size, tankers are further divided into varies types such as:

- VLCC
- ULCC
- Panamax
- Aframax
- Suezmax
- Capesize
- Handymax
- Lighters
- Handy

- A *passenger* ship is a ship whose primary function is to carry passengers. The category does not include cargo vessels which have accommodations for limited numbers of passengers, such as the formerly ubiquitous twelve-passenger freighters in which the transport of passengers is secondary to the carriage of freight. It does however include many classes of ships which are designed to transport substantial numbers of passengers as well as freight. Modern cruise ferries have car decks for Lorries as well as the passengers' cars. Only in more recent ocean liners and in virtually all cruise ships has this cargo capacity been removed.
- A *ferry* is a boat or ship carrying passengers and sometimes their vehicles. Ferries are also used to transport freight and even railroad cars.

2.3 SPECIAL PURPOSE VESSELS

A *weather ship* or *ocean station vessel* was a ship stationed in the ocean as a platform for surface and upper air meteorological observations for use in marine weather forecasting. It was also meant to aid in search and rescue operations and to support transatlantic flights. Weather ship observations proved to be helpful in wind and wave studies, as they did not avoid weather systems like other ships tended to for safety reasons. They were also helpful in monitoring storms at sea, such as tropical cyclones. The removal of a weather ship became a negative factor in forecasts leading up to the Great Storm of 1987.

2.4 NAVAL VESSELS

Naval vessels are used by navy for military purposes. There are many types of naval vessels. Modern naval vessels can be divided into three categories: surface warships, submarines, and auxiliary ships.

CHAPTER 3

3.1 MAIN PARTS OF THE SHIP

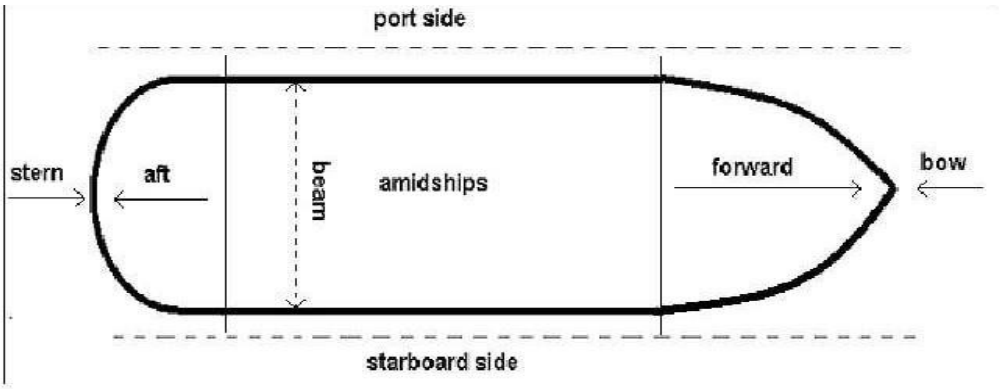
All of the ships, no matter the size or type have some common parts. Three of the most important parts are: The Hull, the Engine Room and the Navigation Bridge.

A ship has both visible as well as invisible parts. Common visible parts of a ship are: rudder, anchor, bow, keel, accommodation, propeller, mast, bridge, hatch coves and bow thrusters. Common invisible parts of the ship are: bulkheads, frames, cargo holds, hopper tank, double bottom, girders, cofferdams, side shell etc.

To understand the parts of a ship, one must have to go through some common terms. The most forward part of a ship is called a **bow**, the left-hand side of the ship is called **port** and the right side is called **starboard**. Likewise, the front side is termed as forward and back side as **astern**.

3.1.1 THE HULL

The main structure of a ship is the hull. It is the body of the ship; excluding fittings. The keel is the backbone of the hull. It extends from the front to the bottom of the vessel. It is divided into three parts: Fore end known as bow, amidships and after end known as stern.



Hull 1

The hull of a ship is responsible for the floatation of the ship. In order for the ship to float, the weight of it must be less than the displaced water of the hull.

Generally ships are single hulled, but there are other vessels like Catamarans with two hulls and Trimarans with three hulls. Vessels with more than three hulls are rare, but some experiments have been conducted with designs such as Pentamarans. The multiple hulls are parallel to each other and connected by rigid aims. Hull is the watertight part of any vessel or even boat and it is defined as the water tight enclosure of a ship that protects the cargo and the machinery of the ship and also protects the boat from flooding or other structural damage.

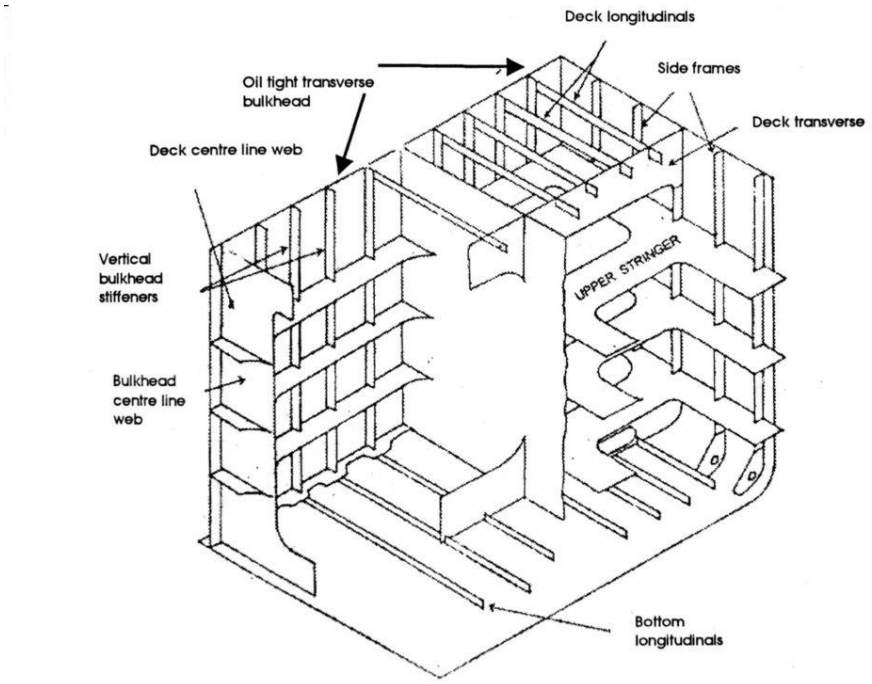
Hulls need to be designed very thoroughly because they are always subjected to stress and strains and the failure of the hull will lead to disastrous results. Hulls are subject to various hydrostatic and hydrodynamic constraints. The key hydrostatic constraint is that it must be able to support the entire weight of the boat, and maintain stability even with often unevenly distributed weight. Hydrodynamic constraints include the ability to withstand shock waves, weather collisions and groundings.

The hull of a ship varies depending on the size or the type of the ship or vessel. Older ships and pleasure craft often have or had wooden hulls and steel is used for most commercial vessels. Aluminum is frequently used for fast vessels, and composite materials are often found in sailboats and pleasure craft. Some ships have been made with concrete hulls.

The depth of ship's bottom or keel below the waterline is **draught**. The beam of the ship is the distance between the two sides. The frames, bulkheads, floors and beams complete the skeleton of hull.

Frames are ribs of the ship covered by plating.

Bulkheads are the vertical partitions separating compartments or spaces on a ship.



Bulkheads and Frames 1

Finally, hulls consist of several elements such as:

- ***Bow and Stern:*** The bow is defined as the forward part of the hull. Normally, it is the forward-most part of the ship when the vessel is underway.

  The stern of a ship is the exact opposite of a bow. It is the back part of the ship or the aft-most part. It extends upwards from the counter rail to the taffrail and lies opposite to the bow.

- ***Forward perpendicular:*** Is an imaginary perpendicular line. A perpendicular line is defined as the line which touches or intersects another line with an angle of 90°. It is also called a right angle. The forward perpendicular of a ship is the perpendicular drawn from the point where the bow of the ship intersects the waterline.
- ***Length between perpendiculars:*** If a perpendicular is drawn from the forward end of the ship that is the bow and another perpendicular is drawn from the aft end that is the stern, then the length between the two perpendiculars is known as the length between perpendiculars.
- ***Sheer:*** Sheer is a term used in naval architecture and is the length of the longitudinal main deck curvature of the ship. The main purpose of it is to allow the flow of green water from the bow or the stern of the ship to the middle of it and to allow the drainage to go to the bilges. The forward end of the ship usually has more sheer in order to protect the machinery there from the waves of the ocean.
- ***Summer Load Line:*** It is defined as the water line of a ship when it is at its full weight that is it is fully loaded. It is also called the design draft. The summer load line acts as a reference for all the other load lines on a vessel or a ship.
- ***Length of waterline:*** The length of the hull of the ship when it is fully loaded that is it is at the summer load line of the ship is referred to as the length of waterline. The length of waterline is a very important factor in calculations related to propeller designs and other hydrostatics of the ship.
- ***Length overall or overall length:*** Is the total distance between the forward most point of the hull of the ship and the aft-most point of the hull of the ship. This length plays a vital role in planning the docking and undocking of the ship.

LINES AND SHAPES OF THE HULL: The first and the most essential part of building the hull of the boat is planning the design of the ship and form of the vessel. To do this, several mathematical calculations are carried out.

Following are some of the mathematical quantities that help us do the same:

- ***Block Coefficient:*** The block coefficient of a ship is a numerical quantity which is obtained by dividing the underwater volume of displacement of any vessel by the volume of a block which has the same length, breadth, and height as the draught of the ship. It highly depends on the lines of the ship. It is abbreviated as Cb. For a typical ship, the block coefficient has to be less than one. The higher the value of the block coefficient, the fuller is the hull form of the ship. Container Ships or warships generally have a low value of block coefficient.

- ***Midship Coefficient:*** The midship coefficient of a vessel is defined as the ratio of the submerged midship area to the product of the beam at mixture and the draft of the ship.

- ***Prismatic Coefficient:*** The prismatic coefficient of a ship is the ratio of the volume of displacement at the draft to the volume of a prism. The prism is assumed to have the same length as the length of the ship and the same area of cross-section as the area of the midship of the vessel.

- ***Waterplane Coefficient:*** The water plane coefficient of a ship or the water plane area coefficient of a ship is defined as the ratio of the actual area of the water plane of the ship to the product of the length and the breadth of the ship. There are several such other coefficients which are used as parameters to carry out important calculations on ships. These calculations help to develop the hull lines.

BUTTOCKS AND WATERLINES: If we longitudinally cut the entire hull of a ship into several sections, the boundary of each of the sections is called as a buttock line. The *waterline* of a ship, as stated before, is the line at which the hull of the ship meets the surface of the ocean. If the entire hull of the ship is cut along the water line, then a distinctive part or area will be produced by every water line. A diagrammatic representation of the same is known as the body plan of the ship. It is also known as

the half breadth plan of the ship. Thus, the body plan of a ship is obtained by slicing the hull of a ship at equal intervals. It is very important to note that in order to have a proper shape of the hull of the ship and to make the propeller efficient, the shape of the water lines play a very important role. The body plan is the most important as well as the most useful representation of the hull lines of the ship. It is so important that the body plan and the reference lines are sufficient to develop the entire profile plan and half breadth plan of the ship. The body plan of a ship can also be used to develop a sectional area curve and Bonjean curves of the vessel.

3.1.2 ENGINE ROOM

On a ship, the ***Engine Room (ER***) is the propulsion machinery spaces of the vessel. In order to increase the safety and damage survivability of a vessel, the machinery necessary for operations may be segregated into various spaces for the ship's operation may be segregated into various spaces. The engine room is the largest compartment of the machinery space. It houses the vessel's prime mover, usually some variations of a heat engine; diesel engine, gas or steam turbine. In many ships, there may be more than one engine room, such as forward and aft, or port or starboard engine rooms, or may be simply numbered. The engine room is usually located near the bottom, at the rear or aft end of the vessel, and comprises few compartments. This design maximizes the cargo carrying capacity of the vessel and situates the prime mover close to the propeller, minimizing equipment cost and problems posed from long shaft lines. The engine room on some ships may be situated mid-ship, especially on vessels built from 1900 to the 1960s. With the increased use of diesel electric propulsion packages, the engine room may be located well forward, low or high on the vessel, depending on the vessel use.

Equipment and spaces of the Engine Room:

- ***ENGINES:***

The engine room of a motor vessel typically contains several engines for different purposes. Main or propulsion engines are used to turn the ship's propeller and move

the ship through the water. Whether it's of a small ship plying in the coastal areas or of a massive one voyaging international waters, a marine engine of either 4-stroke or 2-stroke is fitted onboard ship for the propulsion purpose. They typically burn *diesel oil* or *heavy fuel oil*, and may be able to switch between the two. There are many propulsion arrangements for motor vessels, some including multiple engines, propellers, and gearboxes. Smaller, but still large engines drive electrical generators that provide power for the ship's electrical systems. Large ships typically have three or more synchronized generators to ensure smooth operation. The combined output of a ship's generators is well above the actual power requirement to accommodate maintenance or the loss of one generator. The engines used onboard ships are internal combustion engines, in which, the combustion of fuel takes place inside the engine cylinder and the heat is generated post the combustion process.

On a steamship, power for both electricity and propulsion is provided by one or more large boilers giving rise to the alternate name **boiler room**. High pressure steam from the boiler is used to drive reciprocating engines or turbines for propulsion, and also turbo generators for electricity. Besides propulsion and auxiliary engines, a typical engine room contains many smaller engines, including generators, air compressors, feed pumps, and fuel pumps. Today, these machines are usually powered by small diesel engines or electric motors, but may also use low-pressure steam.

- **ENGINE COOLING:**

The engines get required cooling from liquid-to-liquid heat exchangers connected to fresh seawater or divertible to recirculate through tanks of seawater in the engine room. Both supplies draw heat from the engines via the coolant and oil lines. Heat exchangers are plumbed in so that oil is represented by a yellow mark on the flange of the pipes, and relies on paper type gaskets to seal the mating faces of the pipes. Sea water, or brine, is represented by a green mark on the flanges and internal coolant is represented by blue marks on the flanges.

Internal combustion engine cooling uses either air or liquid to remove the waste heat from an internal combustion engine. For small or special purpose engines, cooling using air from the atmosphere makes for a lightweight and relatively simple system. Watercraft can use water directly from the surrounding environment to cool their engines. Higher-power engines generate more waste heat, but can move more weight, meaning they are generally water-cooled.

- **THRUSTERS:**

In addition to this array of equipment is the ship's thruster system, typically operated by electric motors controlled from the bridge. These are mounted propellers that can suck or blow water from port to starboard. They are normally used only in maneuvering, docking operations, and are often banned in tight confines, drydocks.

Like main propellers, thrusters are reversible by hydraulic operation. Small embedded hydraulic motors rotate the blades up to 180 degrees to reverse the direction of the thrust. A variant on this is the azipod, which are propellers mounted in a swiveling pod that can rotate to direct thrust in any direction, making fine steering easier, and allowing a ship to move sideways up to a dock, when used in conjunction with a bow thruster.

- **MECHANICAL ROOM:**

A ***mechanical room*** or a ***boiler room*** is a room or space in a building for the mechanical equipment and its associated electrical equipment, as opposed to rooms intended for human occupancy or storage.

Unless a building is served by a centralized heating plant, the size of the mechanical room is usually proportional to the size of the building. A small building or home may have at most a utility room but in large buildings mechanical rooms can be of considerable size, often requiring multiple rooms throughout the building, or even occupying one or more complete floors.

- **ELECTRICAL ROOM:**

Electrical room is a room or space in a building dedicated to electrical equipment. The size of it is usually proportional to the size of the building. That means that large buildings may have a main electrical room and subsidiary electrical rooms. Electrical equipment may be for power distribution equipment, or for communications equipment. In large building complexes, the primary electrical room may house an indoor electrical substation.

Electrical rooms typically house the following equipment:

- Electric switchboards
- Distribution boards
- Circuit breakers and disconnects
- Electricity meter
- Transformers
- Busbars
- Backup batteries in a Battery room
- Fire alarm control panels
- Distribution frames

Engine Room 1

3.1.3 NAVIOGATION BRIDGE

The bridge of a ship is the main control centre of a vessel, the room or platform where the ship is commanded by the captain and the officers. The ship's bridge also serves as a control and command station for the entire ship including mechanical and electronic functions.

It is constructed in a position with an unrestricted view, where the navigator should get clear vision of 255° or more and from the conning position, vision should be from 112.5° Port to 112.5° Starboard. The navigation bridge is situated on the uppermost deck with a clear view of the sea ahead and abeam. Forward windows are designed to provide a clear view without reflections and immediate access to the essential areas of a ship.

Historically, the bridge was a structure connected to the paddle house that housed the steering equipment. As it closely resembled an actual bridge, this name was given. Even after paddle wheels became obsolete and were replaced with the latest technological advents, the term "bridge" still stuck.

Layout and Design of the Bridge

The bridge of a ship is intended to be the heart of the vessel and must provide a clear and unobstructed view of the surrounding area. Even though a host of electronic and navigational equipment is found on the bridge, the primary purpose must be fulfilled.

The bridge is separated into two areas. The area at the fore intended for observation, and the remaining area for controls and communications. The observation region is enclosed at the fore by large glass panes, built to withstand storms and adverse weather conditions such as hale. Often, Plexiglass structures are used and supported on steel or aluminum frames. Shades which can be lowered are also used so that visibility is not reduced when there is a bright light.

Bridge wings: Along with the central observation deck, there are also *bridge wings.* A bridge wing is a narrow walkway extending from both sides of a pilothouse to the full width of a ship or slightly beyond, to allow bridge personnel a full view to aid in the maneuvering of the ship. It is presented on the port and starboard side.

The bridge wings can be either open or closed depending on the type of ship. In most cases, the wings are kept open to allow for maximum visibility.

They also house the controls to the individual bow and stern thrusters present on each side. Thrusters are propellers located deep within the hull that provide a higher degree of control to the captain for precise turns and adjustments. There is communication equipment found on the wings so that information can be relayed back to the main bridge section.

The remaining area of the bridge houses the main navigational, steering and communication equipment. Along with this, there are numerous controls that operate various parts of the ship remotely.

Navigation station: It may be located on the bridge or in a separate chart room, nearby. It includes a table sized for nautical charts where calculations of course and location are made. Besides the desk and the navigation charts, the area contains navigational instruments that may include electronic equipment.

CHAPTER 4

4.1 COMPARTMENT

A **compartment** is a portion of the space within a ship defined vertically between decks and horizontally between bulkheads. It may provide **watertight subdivision** of the ship's hull. Subdivision of a ship's hull into watertight compartments is called **compartmentation**.

4.2 SUPESRTRUCTURE

Superstructure is an extended construction of any building or platform that rises above the rest of the building or platform in a distinct manner. Superstructure meaning is to add a construction to an already existing structure. In ships this is the name given to the part of the ship that emerges from the deck and it serves many purposes.

The size of the superstructure has a great influence on the mobility of the vessels. They are designed in a manner, so that, they add value and hinder the speed and mobility in the least. The design may differ from ship to ship. Therefore in some ships we may find it to be sticking out vertically and strongly from a relatively flat deck.

In many ships the superstructure is broader and bigger in size and area. For example, the structure of a cruise ship is extended from the base that is flat and covers the entire deck in many layers or floors. The extended structure would be spread all over the lower floors with a few floors added on the top. At the final extension, one would find a towering construction which would act the crown of the beautiful vessel.

4.3 ACCOMMODATION

It is a place on ship where the crew resides or live. Together with offices, crew cabins, gym, recreation room, laundry, hospital and galley it is the heart of a ship next to engine room and bridge.

Accommodation accounts for major systems on board including; fresh water system, refrigeration system, garbage disposal system, sewage treatment plant and air conditioning for accommodation block. Under international and local maritime laws of flag state it is required to have accommodation of all vessels including; passenger ship, cargo ship, salvage ship, tug and dredger above the summer load line situated aft or amidships of the ship structure.

An accommodation accounts for the living space of the ship and it is required by law to provide adequate accommodation facilities to ships crew and officers along with proper recreational facilities.

4.4 DECK

The **deck** is a permanent covering over a compartment or a hull of a ship. It forms a singular central construction, acting as a ceiling-of-sorts to the hull of the vessel strengthening it and serving as the primary working surface. Vessels often have more than one level both within the hull and in the superstructure above the primary deck, similar to the floors of a multi-storey building, that are also referred to as decks, as are certain compartments and decks built over specific areas of the superstructure. Decks for some purposes have specific names. A ship has a number of different types of decks which are located at different levels and places on the ship.

Some of the main and known decks are:

- ***POOP DECK:*** The poop deck is located on the vessel's stern. It is basically used by the vessel's commanding superiors to observe the work and navigational proceedings. It serves as a roof to the cabin constructed in the aft of the ship.

  It facilitates the captain and helmsman to supervise the entire working crew.

  But in modern ships, the poop decks are provided either in the centre of the ship or on the starboard.

- ***MAIN DECK:*** As the name suggests, the main deck is the primary deck in any vessel. The main deck however is not the topmost deck in a vessel which is referred to as the weather deck.

- ***UPPER DECK:*** The deck that covers the hull of the vessel from its fore to its aft is the upper deck. It is the topmost deck on a ship. In all vessels, the upper deck is the biggest deck amongst all other decks.

- ***LOWER DECK:*** It is located below the primary or main deck is the lower deck. Generally the lower deck comprises of more than one deck. It is just next to the lowest deck

- ***TWEEN DECK:*** In a ship, the tween deck actually means an empty space separating or between (tween) two other decks in the hull of a vessel.

- ***FLUSH DECK:*** The deck that extends without any constructional breaks from the frontal part of the ship to the aft is referred to as the flush deck. On such decks there is no raised forecastle or lowered quarterdeck.

- ***WEATHER DECK:*** A deck that is not roofed and thus is open to the ever-changing weather conditions of the sea is referred to as the weather deck. It is the upper most deck on the ship which is exposed to environment.

- ***BRIDGE DECK:*** Bridge deck is the deck on which the navigational equipments of the ships are housed.

Except from the above, there are plenty other decks that have their own unique identity.

4.5 DIFFERENT PARTS OF THE SHIP

- ***ANCHOR:*** An anchor is a heavy metal piece attached to the chain cables and is stored or secured in the hose pipe during the voyage / ship operation. It is used in order to secure the ship in a stationary position at the sea. When the anchor is lowered to the seabed, the anchor holds the long chain attached to it in place, while the weight of the chain and its resistance on the seabed hold the ship in place.

An anchor is made of five major parts: shank, crown, stock, flute and tripping ring.

Anchor gear: chain cables, connecting devices, windlass and chain stopper. Together, these connecting structures along with stack are known as anchor crowns

Anchor chain/Anchor cable: The chain that connects the anchor to the ship.

- ***BOW:*** A bow is the front most part of a ship which cuts the water along its sides as the ship proceeds. Is the one that you will see in most ships including that used for commercial shipping and is easily identified by its distinct bulging bulb like shape just under the waterline.

- ***BOW THRUSTERS:*** A bow thruster is a propeller like device fitted on both side of ships bow. It is used to increase the maneuverability of a ship in congested waters under very slow speed like that in canals or near ports. For most designs you will only found a tunnel passing through ships bow with an impeller in place. Having bow thrusters greatly affects the overall running cost of a ship by reducing part of port cost for tug assistance. For ships having bow thrusters it is required to have proper markings on both sides above waterline. These thrusters are mostly powered electrically using a prime mover attached to the impeller shaft using a bevel gear assembly. For some ships they are also powered hydraulically where electrical option is not possible or is unfeasible.

- ***KEEL:*** A keel is a part of ships hull that is responsible for providing strength to the ships structure by spreading stress and load equally along its longitudinal sides. Due to its property to hold and support ship structure it is often termed as the backbone of the ship.

There are three main types of keels used in marine industry: flat keel, duct keel and bar keel. A flat keel is used in all major ships in operation. Bar keels are used when the ship has to work in shallow water and duct keels are preferred for offshore vessels and double hull tankers.

- ***FREEBOARD:*** Is the distance measured from the waterline to the higher edge of the freeboard plating/deck plating at sides of amidships. Or else, The part of the hull above the water.

The minimum freeboard calculation for a vessel must be approved by the classification society. It is usually given in meters and the more cargo the ship is carrying, the less will be her freeboard.

- ***FUNNEL:*** Is a casing used for the exhaust pipes from engines. The exhaust gasses pass from the engines and generators through pipes in the funnel. Shipowners usually paint the funnel of their ships in the company's colours and some put the company logo on the funnel. The cross section or width of these funnel largely depends on the amount of exhaust engine room produce.

In early days of shipping it was used to release everything that the ship emits but nowadays it is used within the limits of controlled emission with shoot collection in place to reduce pollution. The entire shoot that is collected in the shoot collection tank is then later discharged to the port authorities. If not possible they are discharged overboard via an eductor recording the time and amount in garbage record book.

If you look up-close carefully; will find that these funnels are in fact not that straight but inclined to an angle. This is done deliberately to assist the flow of flue gas away from the navigation bridge and ships deck.

- ***DECK CRANE:*** Derricks or Cranes are used to lift and carry the safe working load on a ship. Other than that they are also used to load and unload hose, tools, and machinery from the ship. Cranes are electrically or hydraulically operated equipment for easier operations.

  There are two sets of cranes close together. These are designed to work either on their own, or the two cranes can work together. The lifting capacity nearly doubles if cranes are working in tandem. Some older ships have derricks to lift cargo.

- ***FORECASTLE:*** The forecastle is one of the foremost parts of the ship of length less than 7% of total deck length. It can be easily identified on a ship structure by a sudden rise in the fore deck near the ships bow.

- ***PROPELLER:*** Is a mechanical device that has blades fitted on a central shaft. These blades rotate and their rotational energy is converted into pressure energy and due to this, the propeller produces thrust required for propulsion. It pushes the sea water backwards and, in turn, the sea water helps the ship in moving forward. There can be one, two or three propellers. The main function of propeller is to propel the ship in the forward direction by producing thrust on water.

A propeller can be divided in four main types based on its number of blades; while of two main types based on its pitch. Based upon its pitch a propeller can be of either fixed pitch propeller or controllable pitch propeller. Similarly based upon number of its blades; it can be of three blade, four blade, five or six blade type.

On some ships, the propeller shaft and therefore the propeller can turn in the opposite direction, causing the ship to go astern. In other ships, the propeller keeps turning in the same direction, but if the ship should need to go astern, the angle of the blades can be altered to change the propulsion, causing the ship to go astern. This is called a *variable-pitch propeller.*

- ***RUDDER:*** Is turned by the steering engine at the steering gear compartment. Without steering, we can't move a vehicle in the desired direction; so the propeller propels the ship and rudder steer the ship. The rudder is a flat hollow structure, housed in the aft of the propeller. It consists of following parts: rudder trunk, moveable flap, main rudder blade, hinge system, links and rudder carrier bearing.

There are three types of rudder: balanced type, semi-balanced type and unbalanced type rudder.
A ***balanced rudder*** is the one which have more than 20% of its part forward to its turning axis.
A ***semi balanced*** is the one with less than 20% of its part outside or forward to its turning axis.
An ***unbalanced*** has none of its parts outside or forward.

As a vital part of the ship, the rudder is provided with a steering gear system which controls the movement of the rudder. When the ship needs to turn, the rudder turns to port or to starboard in response to the ship's steering mechanism. The ship then turns in that direction.

It moves to a direction producing resistance to water flow forcing them to move to the other side. In this very process it produce much needed resultant force for the ship to turn it to the opposite side of the altered water flow.

- ***MAST:*** A mast is a vertical ship structure mounted on top of bridge and forward of the forecastle towards the ships bow. It accounts for the support platform for the ships derrick and hold necessary equipments. It has several purposes which include carrying derricks and also giving fundamental height to the navigation light, salient yards, radio or radar aerials and scanners.

The mast carries important lights for night-time navigation and some electronic equipment is mounted on the mast. Other than that a ships main mast is also used to hoist ships flag.

- ***MONKEY ISLAND:*** Monkey Island is a sort of deck located at a topmost accessible height of the ship and just above the bridge. This part of the ship is sometimes also referred to as a flying bridge and it houses a magnetic compass.

- ***BOAT DECK:*** Ship hull structure is covered by the deck floor. There can be multiple decks or deck sections on a ship. The deck at the top which bears maximum exposure to weather is referred to as the main deck or weather deck. The boat deck's main function is holding the hull structure and providing floor to work, and standing and guard them against outside weather.

- ***PAINT ROOM:*** Is a small area required in marine vessels to handle and store paint. Special provisions are there for the paint room to cater explosion and release of chemical gases and vapors from these enamels. There should be explosion proof lighting in the paint room and brackets should be available to provide flexible mounting and storage of paints.

- ***BALLAST TANKS:*** These are compartments maintained specially to carry water, which serves the purpose of ballasting and stabilizing the vessel. These tanks should be provided with proper care to prevent them from corrosion, as sea water is highly corrosive.

- ***BUNKER TANKS:*** These are the tanks on the ships which are used to store fuel and lube oils on ships are known as bunker tanks. They can store sludge, diesel, oils etc. which can catch fire immediately, so they are provided separately and far from ignition prone areas.

- ***CARGO HOLD:*** Is an enclosed space that retains and stores cargo or freight container carrying coal, grain and salt is referred to as a cargo hold. It is located under the deck of the ship and has a holding capacity ranging from 20 tons to 200000 tons and the main function of the cargo hold is to preserve cargo when it is transported to the destination.

In ships that carry liquid cargoes, the "holds" are tanks in which the liquid cargo is carried. Therefore, we call ships that carry liquid cargoes **tankers**.

- ***EMERGENCY GENERATOR ROOM:*** It is located above the topmost deck, away from main and secondary machinery and collision bulkhead, and has its own switchboard in its surroundings. This generator should be easily operable and can be started at even 0°C

When the main supply goes out of order then, small separate generator supplies electricity for emergency loads. This is called an ***emergency generator***.

- ***HATCH COVER:*** Is used in order to prevent the cargo storage from any kind of spoilage, especially to make storage spaces air as well as watertight. The design changes according to the type of the vessel, but the only requirement is that it should be quick enough to provide faster cargo handling processes.

In the past, these hatch covers were crane or winch driven, but today, mainly hydraulically driven hatch covers are used.

- ***FORE DECK:*** The foredeck is the forward part of a weather deck, between the superstructure and the forecastle superstructure. Basically, it is a part of the vessel forward of the mast.

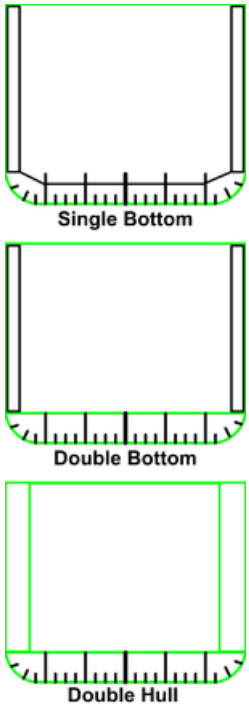
- ***DOUBLE BOTTOM:*** A double bottom is a ship hull design and construction method where the bottom of the ship has two complete layers of watertight hull surface: one outer layer forming the normal hull of the ship, and a second inner hull which is somewhat higher in the ship, which forms a redundant barrier to seawater in case the outer hull is damaged and leaks.

Double bottoms are significantly safer than single bottoms. In case of grounding or other underwater damage, most of the time the damage is limited to flooding the bottom compartment, and the main occupied areas of the ship remain intact..

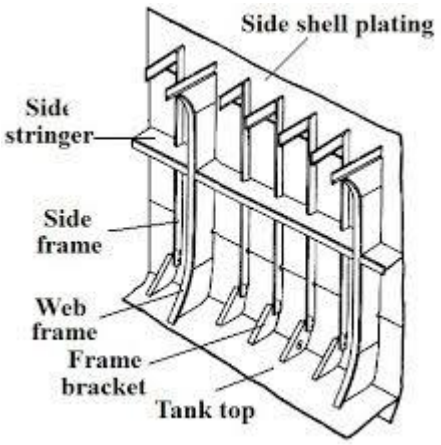
- ***BILGES:*** The bilge of a ship or boat is the part of the hull that would rest on the ground if the vessel were unsupported by water.

Internally, the bilges are the lowest compartment on a ship or seaplane, on either side of the keel and between the floors.

<u>Some of the parts are displayed below:</u>



Single Bottom/Double Bottom/ Double Hull 1



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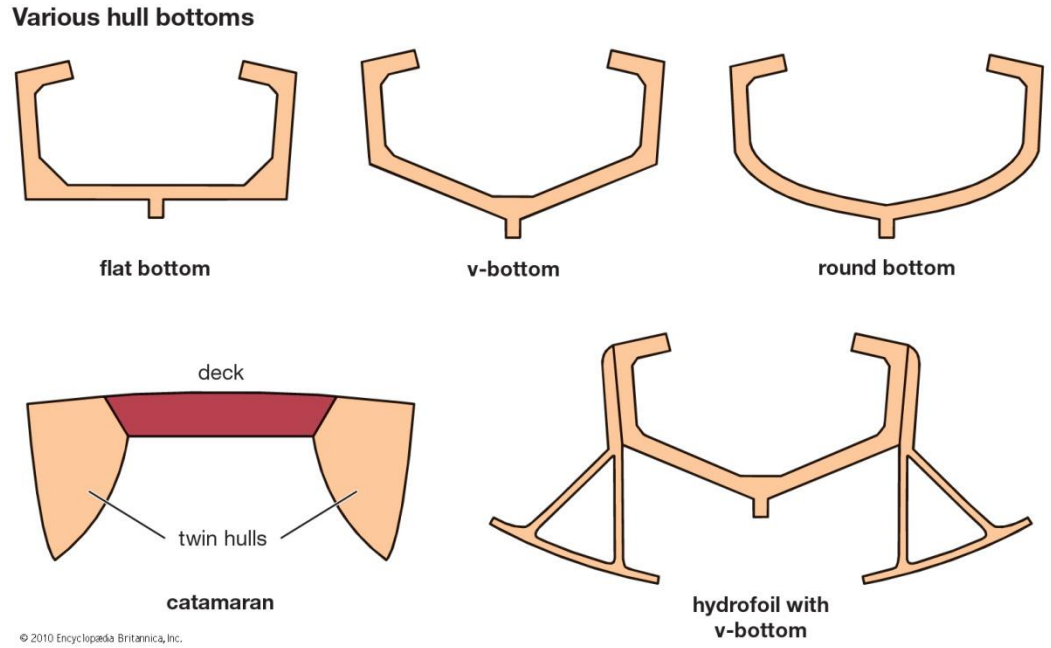

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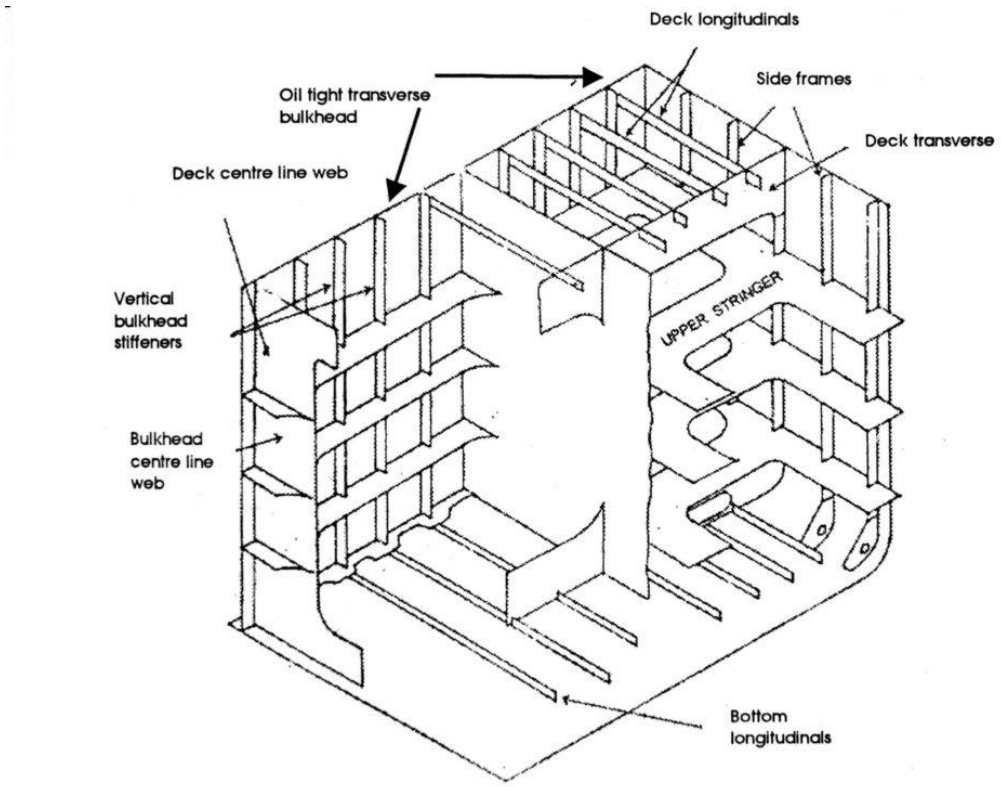
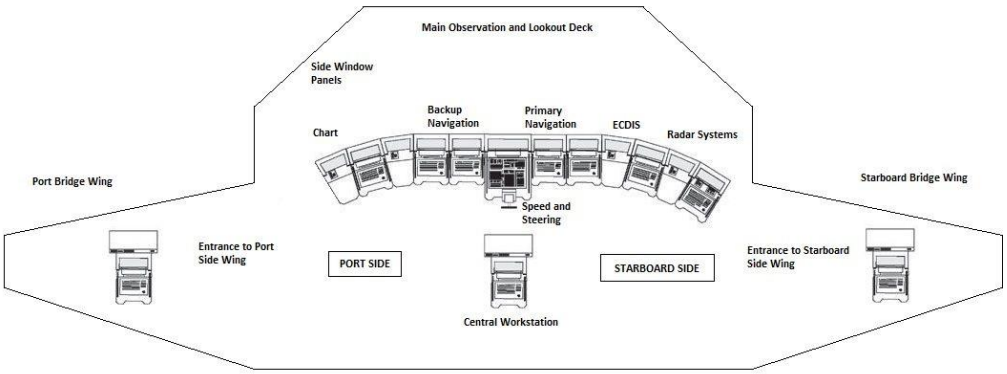


Bulkheads 1



Bridge 1

Rudder & Propeller 1

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