

Dry Dock

Dry dock is a structured area wherein construction, repairs and maintenance of merchant vessels and boats are carried out. The unique construction allows the water to be filled up in that area, also known as lock, so that vessels can be maneuvered in and out of the area. Once the vessel enters the dry dock, the gates are closed and the seawater is drained out so that hull and other areas of the ship which have been exposed to sea water for a long time are available for carrying out maintenance and repair works.

Purpose of Dry Dock:

As per SOLAS requirement all Merchant vessels requires a complete inspection of hull in a dry dock twice within 5 year period and the intermediate survey must not be more than 36 months. This includes maintenance of hull, propeller, rudder etc. and other parts which are immersed in water and are normally inaccessible by ship staff at normal sailing period, it is necessary for various ship's certificate renewal.

For Passenger vessel the inspection of the ship's bottom is to be done annually. Two of such inspection in a period of five year must be carried in dry dock and the maximum interval between these inspections is 3 years.

In cases like collision or under water damage the vessel will be brought in for unplanned dry docking for repairs.

It becomes important to carry out repairs in the underwater portion of the hull. Such repairs may include renewal of the sacrificial anodes, refit of the propellers, overhauling of the propulsion shafts, repair of rudders, underwater hull blasting to remove fouling, etc. In order to carry out these repairs, the underwater portion of the hull needs to be made accessible, which is the purpose served by a dry dock

Types of Dry Dock Procedures:

There are mainly two types of dry dock procedure:

1) Gravity dock:

This type is normally constructed on a land near the coastal water with a rectangular solid concrete construction with blocks, walls and gates. Vessel is shifted inside the dock and rested in the blocks. After the ship is in required position, gate is closed and water is removed.

2) Floating dock:

A floating dock is a "U" structure used in salvage, to carry ship, which has met with an accident, from mid sea and which is damaged and unable to sail further to go to a coastal dock. Several "U" type floating docks can be joined to carry a large vessel.

A valve is provided which can be opened to fill up the chambers with water and which will make the dock immersed in water so that the ship can sail out. The water is pumped out of the chamber which will allow the dock to rise, exposing the underwater area of the ship for maintenance or carrying the ship to repair facility.

preparations to be done on board prior to dry dock

- 1- Making a repair and maintenance list, obtain a dry-dock check list, prepare docking plan. Divide staff into groups to oversee the work carried out by yard gangs.
- 2- All spare parts must be checked and repair items kept ready for use → *Handwritten note: 1. All spare parts must be checked and repair items kept ready for use*
- 3- All heavy weights secured prior to dry dock.
- 4- All tanks and cofferdams must be sounded and recorded.
- 5- Firefighting plans and safety measures discussed before dry dock
- 6- the following stability requirement must be provided:

a) Adequate Initial G.M:

When the ship touches the blocks, there is a reaction at the point of contact which raises the centre of gravity "G" and reduces the metacentric height "G.M" so that adequate initial metacentric height is required to compensate the same.

b) Vessel to be Upright:

While entering the dock the vessel needs to be upright which means there should be no port or starboard list when the ship touches the blocks, the point of contact will be outside the centre line of vessel, which may force the vessel to tip over.

c) Small or Moderate Trim Aft:

The slight trim allows the accenting of stern and bow in tandem rather than simultaneously as it will reduce the load and pressure on hull and the keel of vessel.

Stability during Docking:

When the ship enters a dry dock, it must have a positive metacentric height; and is usually trimmed by stern. The floor of the dry dock is lined with keel blocks, which are so arranged such that they can bear the weight of the ship.

The interval of time from when the stern takes the blocks to the moment when the entire ship's weight is borne by the blocks is called **Critical Period**.

So what happens during the critical period and why?

When the ship's stern just touches the keel blocks, part of the ship's weight is being borne by the keel blocks. The contact between the stern and the keel block creates a normal reaction or upthrust. The magnitude of this upward normal reaction increases as the water level in the dry dock reduces. It is this upthrust that creates a virtual reduction in the metacentric height of the ship. Hence it is very crucial to maintain sufficient positive metacentric height before docking, lacking which, the ship may heel over to either side, or even slip off the keel blocks and capsize.

Follow the figure underneath, which shows a ship that has just touched the keel block by its stern. The location of the center of floatation (F) is known from the hydrostatic curves at the given displacement. Since the location of the stern is a known point, its distance from the center of floatation (l) can be calculated instantly.

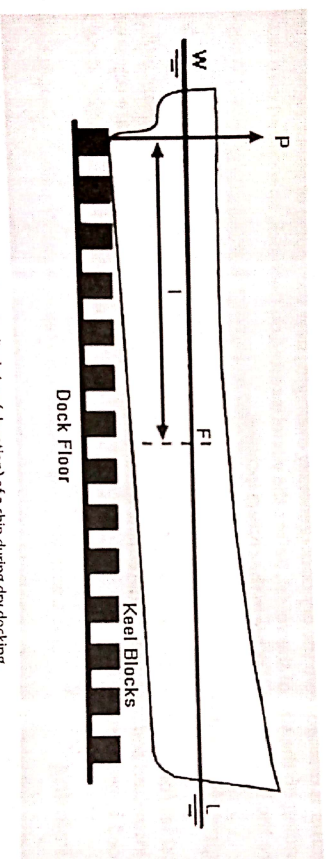


Figure 1: Longitudinal view (elevation) of a ship during dry docking.

The moment to change trim by 1 cm (MCTC) is a hydrostatic parameter that is obtained from the hydrostatic curves. So, for a known value of trim, the following equation is obtained:

$$\text{Upthrust at stern (P)} = \frac{MCTC \times \text{Trim}}{l}$$

Docking Plans:

A docking plan is a document that is prepared for every ship during its preliminary design phase. All the information required to bring a ship to a dry dock are included in its docking plan. While most of the information is condensed into drawings, one must also refer to the textual references and notes provided, because they also inform us about the type of dry dock that is being used, and technical specifications of dry dock that should be met before the ship is docked.

Arrival at Yard and Entering the Dry-dock

After completing all necessary preparatory work, the vessel arrives at the shipyard. On completion of port formalities, the vessel proceeds to the dry-dock with assistance from tug boats and shipyard personnel. Prior to this, the blocks are arranged by the shipyards as per each vessel's specific docking plan.

Pumping Down the Dock and Vessel "Taking" the Blocks

The water is drained from the dry-dock (generally overnight) over the course of about eight to ten hours, depending on the size of the vessel. Before the vessel is rested on the block, specialized dive teams ensure the block structures are in the correct location.

Ranging the Cables

The cables (or anchor chains) are ranged on the dock bottom once the dock is dry. Anchors and cables are then inspected and measured to determine the quality/ condition and defective parts are repaired or replaced as required.

Hull Painting

The hull painting consists of washing, blasting and painting of the vessel and is one of the main reasons for dry-docking, as it ensures efficient vessel operations for the next five years. After extended periods of sailing and service, it is not uncommon for marine growth such as algae or slime to build up on the sides of the vessel. This buildup has a direct impact on the efficiency of the vessel and ultimately leads to higher fuel consumption.

Washing

Shipyard personnel use (fresh water) high-pressure washers to remove marine growth and chlorides from the ship side.

Blasting

Blasting is done primarily to remove rust or defective paint from the ship side. Depending on the need of each vessel, blasting may be localized or carried out along the entire side of the vessel. In this process, old paint in the defective areas is removed entirely to expose the bare steel.

Painting

During this period, teams take the opportunity to carry out maintenance work on engines, pumps, tanks and cargo spaces as needed. Repairs on the rudder, propeller or shafting are made if any defects are identified.

Flooding the Dock

After all planned work has been satisfactorily completed, the dock is flooded and prepared for the vessel's departure.

Departure and Trials

The vessel is towed out of the dry-dock with the assistance of tugs and shipyard personnel. Once the vessel reaches a safe anchorage area, sea trials are carried out to confirm the operation of all ship's machinery. On completion of sea trials, the vessel is commissioned back into service.

✓ safety precautions that are to be taken in a dry dock:

- 1- Firefighting plans and safety measures discussed before dry dock, Firefighting equipment on board should be checked and kept ready for use.
- 2- All tanks to be cleaned and gas freed.
- 3- Emergency lighting and generator should be tested.
- 4- Escape routes must be clearly marked.
- 5- Shore connections for cooling water and fire line are to be readied.
- 6- Hot work precaution to be followed.
- 7- Proper communication to be provided between ship and dock personnel.
- 8- proper safety and fire patrol to be maintained.

Shipboard Maintenance

Planned maintenance system on board(PMS) OR Planned maintenance program (PMP)

Maintenance is one thing that keeps any mechanical equipment or machinery going. efficient maintenance can help with prolonged life and favorable outcome. Each machine on board a ship requires maintenance which has to be carried out at regular intervals of time. On a ship crew carry out the maintenance for safe and efficient operation of the ship.

→ Purpose of maintenance
The purpose of the planned maintenance system:

- To ensure that all maintenance is carried out with adequate intervals, and in accordance with the schedule in the planned maintenance system.
- To maintain and keep all engines, machinery and technical components in good working order at all times, to avoid stoppages and to maintain charter party speed and consumption requirements.

planned maintenance

- To avoid interruption and oversight of work by covering all of the work.

• To make clear onboard and shore maintenance work. → *32 pbl 1010 body maintenance*
 The Chief Engineer, Chief Officer shall record the results of maintenance and inspection then proper report shall send to Technical Superintendent in charge accompanied with the vessel's comments for improvements. *32 pbl 1 shore body*

The software is beneficial in the sense that as you scroll down in the computer, it reminds you of what is due and what is overdue.

Types of Maintenance Procedures:

- 1) Preventive or Scheduled Maintenance System: In this type of system the maintenance is carried out as per the running hours like 4000 hrs, 8000 hrs etc., or by the calendar intervals like 6 monthly, yearly etc. (PMS)
- 2) Corrective or Breakdown Maintenance: In this system the maintenance is carried out when the machinery breaks down. (unplanned maintenance)

Chemistry of corrosion and the measures to prevent it on board

Corrosion is the deterioration of materials by chemical interaction with their environment. The consequences of corrosion are many and varied and the effects of these on the safe, reliable and efficient operation of equipment or structures are often more serious than the simple loss of a mass of metal. All corrosion reactions are electrochemical in nature. As iron atoms undergo oxidation to ions they release electrons whose negative charge would quickly build up in the metal and prevent further anodic reaction, or corrosion. Thus this dissolution will only continue if the electrons released can pass to a site on the metal surface where a cathodic reaction is possible. At a cathodic site the electrons react with some reducible component of the electrolyte and are themselves removed from the metal.

By retarding either the anodic or cathodic reactions the rate of corrosion can be reduced. This can be achieved in several ways:

- 1) Coating the metal, in order to interpose a corrosion resistant coating between metal and environment.
- 2) Alloying the metal to produce a more corrosion resistant alloy, e.g. stainless steel, in which ordinary steel is alloyed with chromium and nickel.
- 3) Use Sacrificial Anodic Protection: are metal or alloy attached to the hull, which have a more anodic potential than steel when immersed in seawater. These anode supply the cathodic protection current, but will be consumed in doing so and therefore required replacement for the protection to be maintained.
- 4) Impressed Current Cathodic Protection: The impress current system consist of a source of direct current, anodes, apparatus for measuring and controlling the current and a high quality inert protective coating around the area of the hull nearest to the anode.