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Securing the Sea Giants: Inside the World of Anchoring and Mooring

Trashbh Baghel[1], Durai V.[2], Ravikumar T.[3] and Semina Yasmin[1]
[1]PG Scholar, Department of Fishing Technology and Fisheries Engineering, Fisheries College and Research Institute, Thoothukudi
[2]Assistant Professor, Dr.MGR.Fisheries College and Research Institute, Thalainayeru, Nagapattinam
[3]Assistant Professor, Department of Fishing Technology and Fisheries Engineering, Fisheries College and Research Institute, Thoothukudi

SUMMARY

Anchoring and mooring are essential practices for holding and securing vessels in desired positions at sea or in port. Anchoring uses a metal device called an anchor that digs into the seabed to prevent drifting, with modern systems incorporating chains, hawse pipes, stoppers, and lockers for secure deployment and retrieval. Various anchor types such as plow, Danforth, mushroom, and admiralty are used depending on vessel size and seabed conditions. Anchoring methods include the Let Go method for large vessels and the Walk Back method for maneuvering in restricted waters. Mooring involves securing vessels using mooring lines, chains, buoys, fenders, winches, and anchors. Types of mooring include single-point, multi-point, standing, running, Mediterranean, and canal mooring, each suited for specific operational requirements. Mooring line arrangements head, stern, breast, spring, and cross lines ensure stability against wind, current, and tidal forces. Automated Mooring Systems (AMS), including vacuum-based systems, are modern innovations that reduce manual labor, increase safety, and improve efficiency by securing vessels through sensors, electric winches, automated arms, or vacuum pads, all controlled from shore. These technologies are shaping the future of mooring in ports worldwide.

INTRODUCTION

Anchoring refers to holding and maintaining a fishing vessel in a planned, desired location. This is done using a metal device called an anchor, which prevents the vessel from drifting under the influence of wind, waves, and currents. Suspended from the outer body of the vessel, the anchor is dropped into the sea and digs into the seabed floor with its pointed projections or flukes. Anchors have been used for ages to hold a vessel in a position. In ancient times, large stones tied with ropes, sacks filled with sand, and logs of wood were used as anchors to keep boats stationary. Today's large vessels require advanced anchors for the anchoring procedures, which involve iron-made anchors with flukes for effectively digging into the seabed. Additionally, the anchor is equipped with a stock, which is set up perpendicular to the arms of the anchor, and is used for maintaining the vertical positioning of the arms for efficient digging of fluke. Mooring refers to the process of fixing a vessel in a position using ropes, cables, chains, or similar devices. This temporarily anchors the vessel in specific locations, such as a harbour, dock, or designated mooring area, by fastening it to a stationary object or floating structure. Mooring is essential to industries like shipping, offshore construction, and recreational boating. It is commonly used for berthing overnight, brief dock visits, or storing the vessel for extended periods when not in use. The mooring of a ship is done using mooring lines, cables, chains, winches, fenders, and buoys.

Parts of the anchor system

1. Anchor

It is the major component of the anchoring system. used to hold the ship in its position by digging into the seabed. Generally, there are three anchors onboard a vessel: two on the forecastle and one is for spare, if any are lost.

2. Chain cable

It is the connecting medium between the anchor and the vessel. It allows sufficient weight for easier horizontal deployment and gains maximum holding force by the anchor in the sea.

3. Hawse pipe

Hawse pipe is the tubular structure that guides the chain from the deck level to the outside of the side plating. It is essential for secure stowage and smooth running of the chain and anchor.

4. Anchor lashing

Lashes are used to secure the chains when the anchor is stowed. It is essential for preventing any banging or damage to the hull while stowing. The method used for lashing is known as devil's claw.

5. Chain stopper

It's a safety device that secures an anchor chain, relieving the load on the windlass and preventing it from running out while the vessel is at anchor or when the anchor is stowed.

6. Chain locker

The chain locker is the compartment under the deck used for the storage of anchor chain cable when it is not in use.

7. Bitter end

It is the end part of the anchor chain, which is connected inside the chain locker to secure the chain to the hull. It is equipped with a quick-release system.

8. Spurling pipe

It is the tubular opening in the deck to the chain locker, which is used to carry the anchor chain from gypsy to the chain locker.

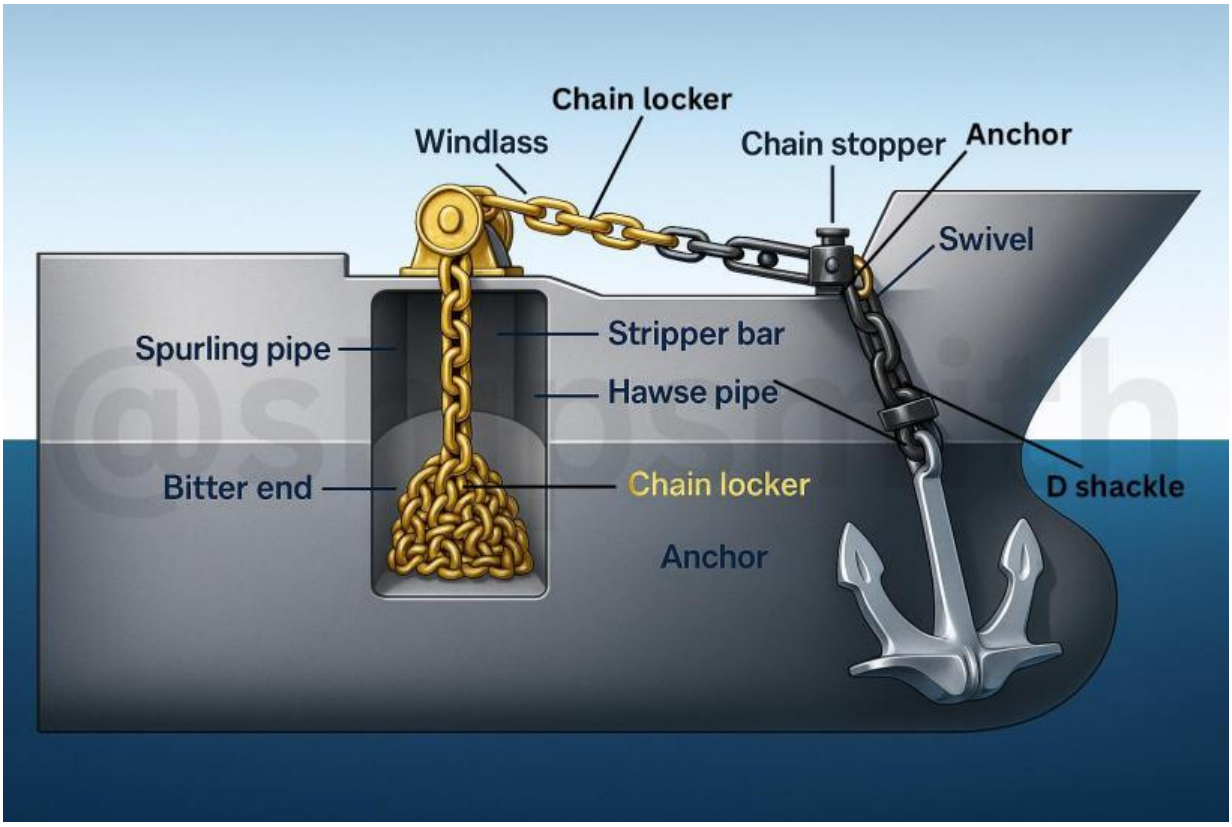

Fig. Parts of anchor system

Types of anchors

1. Plow Anchor
2. Danforth Anchor
3. Bruce Anchor
4. CQR (Plow) Anchor
5. Kedge Anchor
6. Fisherman's Anchor
7. Mushroom Anchor
8. Admiralty Anchor
9. Screw Anchor
10. Bruce or Claw Anchor

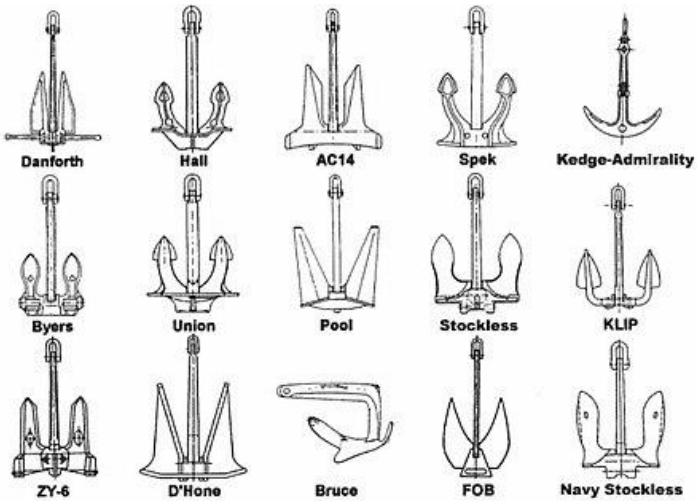

Fig. Types of anchors

Methods of anchoring

An anchor can be dropped to the seafloor in one of two ways:

1. Walk back method.
2. Let go method.

Each of these methods has benefits. Additionally, masters typically have the freedom to choose how they want to anchor. In some situations, however, there is no choice but to select a specific approach.

Let Go Method

Mainly used for very large ships (like VLCCs). The anchor is lowered slowly using the windlass instead of letting it fall freely. The ship moves gently astern so the anchor sets firmly. This method gives better control over cable tension and avoids sudden loads.

"Let Go Anchor" steps

Step 1: Getting ready

Ascertain that the cable or chain and anchor are ready. Remove anything obstructing the anchor.

Step 2: Carry out: Switch off the anchor winch or windlass brake. Let out the designated length of chain or cable (for example, 20 meters) and let the anchor fall by gravity until it touches the seafloor.

Step 3: Get safe: Use the windlass's brake to stop the anchor from moving farther after it has touched the seafloor. To confirm that the anchor is correctly placed, make sure the boat is maintaining its position and look for a taut chain.

Step 4: Observation: Make sure the anchor is held firmly in place by keeping an eye on its location and retaining power.

Walk Back Method

Used during maneuvering in narrow channels or when tugs are unavailable. The anchor is lowered lightly to drag along the seabed, helping to steady the bow and control movement. The cable should be short (1.5–2 times the water depth) to prevent damage and excessive strain.

Walk back method steps:

Step 1: Preparation: Verify that the cable or chain and anchor are ready for deployment. Remove everything that is in the way of the anchor.

Step 2: Implementation. Release the anchor from its stowed position and start lowering it. Slowly walk the anchor chain or cable back as the anchor is dropped. This entails controlling the rate at which the chain or cable is paid out using the windlass or anchor winch.

Step 3: Positioning: To find the anchor on the seafloor, carefully go back using the anchor chain or cable. A proper anchor placement and settling time are essential.

Step 4: Securing: To stop additional movement after the anchor has struck the seafloor, apply the brake on the windlass or anchor winch. Verify sure the anchor is correctly positioned and maintaining the vessel's position.

Step 5: Monitoring: To make sure the anchor stays firmly in place, keep an eye on its location and holding. Maintaining a stable mooring requires routine inspections and adjustments as needed.

Components of the mooring system

1. Mooring line

The mooring line is a primary element that ties and fixes vessels to bollards at the shore. Modern lines use steel or high-grade synthetic materials, offering essential strength and elasticity to withstand direct force transmissions from the ship.

2**. Mooring chain**

A mooring chain is a component consisting of interconnected chain links, widely used in mooring systems due to its high strength, wear resistance, and weight. Mooring chains, which are primarily buried below, are used for both anchoring and mooring. They join mooring anchors to floating buoys.

3. **Mooring buoy**

A mooring buoy is an intermediary component attached to the mooring line and chain, providing a fixed floating point for vessels.

4. **Mooring fender**

A mooring fender is placed between the vessel and the dock or buoy to absorb impact and protect both surfaces within the mooring setup.

5. **Mooring winches**

The winch system controls the tension and extension of the mooring lines. In order to maintain the tension and traction forces on the mooring lines, electro-hydraulic power often uses hydraulic pressure. Cable drums, arranged either vertically or horizontally, are the primary part of the winches. Once more, the ropes determine the drum's size.

6. **Mooring anchor**

Mooring anchors serve as fixed points to stabilize ships or boats during mooring, preventing drift and ensuring stability in ports, harbors, or open waters.

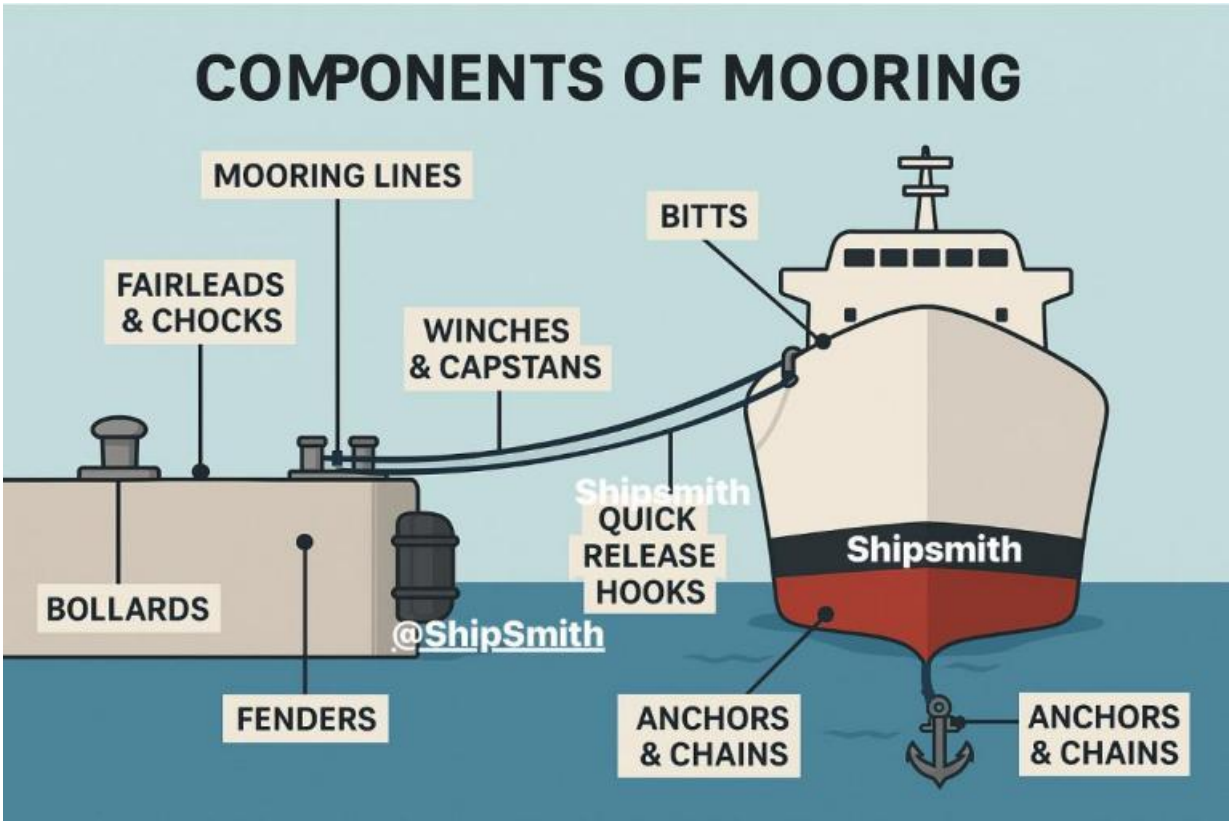

Fig. Components of mooring

Types of mooring

1. **Single-Point Mooring (SPM)**

A floating buoy system that allows vessels to load or unload cargo while anchored offshore. It connects to the ship through hoses and swivels, enabling it to rotate freely with wind and current. Commonly used for large oil tankers at sea.

2. **Multi-Point Mooring (MPM)**

Involves securing a vessel with multiple anchors or mooring lines at several points. Provides greater stability and reduces vessel movement during rough conditions. Often used for offshore platforms or large ships needing fixed positions.

3. **Standing Mooring**

The ship remains fixed using anchors or permanent mooring lines at a single location. Used in harbors, ports, or sheltered waters where long-term anchorage is required. Ensures the vessel stays steady without frequent adjustments.

4. **Running Mooring**

Used for temporary stops where the ship is held by two anchors one at the bow and one at the stern. Allows easy repositioning and movement along the mooring area.Ideal for smaller vessels and short-duration anchoring.

5. **Mediterranean Mooring**

The vessel is secured stern-to the quay while the bow is anchored out in the harbor. Saves dock space and allows easy access to shore facilities. Commonly used in crowded marinas and ports with limited berthing space.

6. **Canal Mooring**

Used when vessels stop or pass through narrow waterways or canals. The boat is tied parallel to the canal bank using short mooring lines. Ensures stability and prevents drifting due to passing traffic or currents.

Mooring Line Arrangements

Mooring line arrangements are essential for keeping a vessel securely positioned at a berth. They counter external forces such as wind, currents, and tides. The number and placement of lines depend on the vessel's size, design, and environmental conditions to ensure maximum stability and safety.

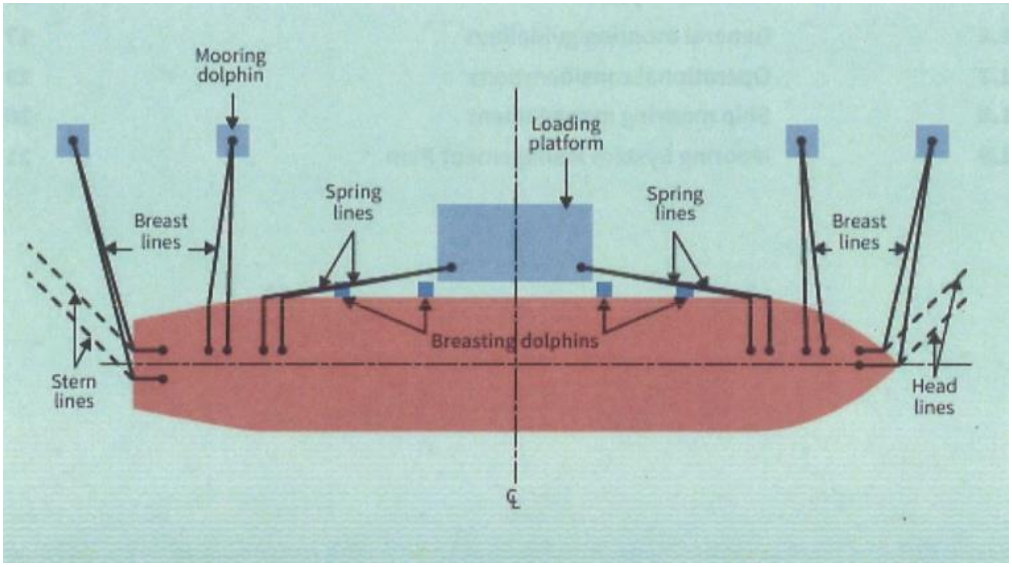

Fig.Mooring lines arrangements

1. Head Lines

Position: Run from the bow (front) of the ship forward to the dock.

Function: Prevent the vessel from drifting backward and help steady the bow.

2. Stern Lines

Position: Extend from the stern (rear) of the ship aft to the dock.

Function: Stop the vessel from moving forward and keep the stern secure.

3. Breast Lines

Position: Lead out perpendicularly from the ship's side (midship) to the dock.

Function: Keep the vessel close to the dock and limit sideways movement.

4. Spring Lines

Position: Run diagonally along the ship's length, connecting the bow or stern to the dock.

Forward Spring Lines: Go from the bow to a point farther aft on the dock.

Aft Spring Lines: Go from the stern to a point farther forward on the dock.

Function: Prevent the vessel from surging forward or backward along the dock.

5. Cross and Additional Lines

Position: Added when extra securing points are required, often crossing over other lines.

Function: Provide extra stability and resistance in areas with strong currents or tidal changes.

Automatic mooring system

In an attempt to replace conventional mooring techniques with advanced, automated systems, Automated Mooring Systems (AMS) have entered the maritime sector. By securing ships to docks with electric winches, sensors, and occasionally vacuum-based technologies, these systems increase efficiency and lessen the need for manual labor. AMS may play a significant role in improving mooring operations as ports and ships seek to update and implement safer, greener procedures. Let's see how AMS functions on board the ship as well as in the port.

Working of vacuum based AMS

The vacuum-based AMS is activated from the shore when a vessel approaches the dock. To establish a safe connection between the dock and the ship's hull, the technology makes use of strong vacuum pads. The ship is drawn toward the dock by these vacuum pads, which securely keep it in place without the use of conventional mooring lines or ship-based winches. There is no need for crew members to be on board because the entire operation is managed from the port.

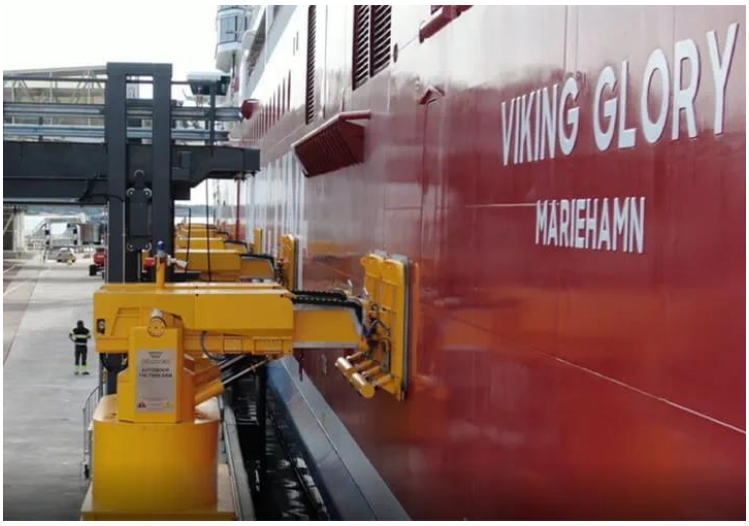

Fig. Automatic vaccum mooring system

AMS uses automated technologies at ports to eliminate the need for heavy machinery and manned mooring lines.

This is how it operates:

1. **Control systems and sensors:** When a ship gets close to the dock, sensors on the ship and the port exchange information to direct the ship into the proper mooring position.
2. **Automated Arms and Electric Winches**: In certain AMS configurations, the vessel is secured using automated arms or electric winches. Even as the tides fluctuate, these devices automatically modify the strain to hold the ship in place.
3. **Vacuum-Based Systems (Optional):** Vacuum-based mooring systems, such as Cavotec's MoorMaster, are utilized in specific ports. Without the need for lines or manual modifications, these systems provide a fast and safe connection by creating a vacuum to secure the ship to the port.
4. **Centralized Control**: Operators can keep an eye on the operation and make any modifications thanks to a single interface at the port that controls the entire system.

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