

30 October 2020

10. Describe the functions of a watertight bulkhead. (10)

A watertight bulkhead serves two critical functions on a ship:

1. **Compartmentalization and Damage Control:** Watertight bulkheads subdivide the ship's interior into watertight compartments. This compartmentalization is essential for damage control in case of a hull breach. If the hull is punctured in one compartment, the water ingress will be contained within that compartment, limiting the spread of flooding and preventing the entire ship from sinking.
2. **Maintaining Buoyancy and Stability:** By confining floodwater to a specific compartment, watertight bulkheads help to maintain the ship's overall buoyancy and stability. If flooding were to spread throughout the ship, it could compromise the vessel's ability to stay afloat and upright.

Here are some additional points to consider:

- **Placement:** Watertight bulkheads are strategically positioned throughout the ship based on floodable length calculations and damage survival requirements. Regulations specify the minimum number and placement of watertight bulkheads for different ship types and sizes.
- **Construction:** Watertight bulkheads are typically made of high-strength steel plates welded together to form a watertight barrier. They may also incorporate watertight doors and openings that can be closed shut in case of an emergency.
- **Maintenance:** Regular inspection and maintenance of watertight bulkheads are crucial to ensure their integrity and effectiveness in case of an incident. This includes checking for any damage, corrosion, or leakage around the seams, doors, and other openings.

Watertight bulkheads are a vital safety feature on ocean-going vessels, contributing significantly to the overall survivability of the ship in the event of a hull breach.

feb 2021

Feb 2021

10. (a) Explain the meaning of EACH of the following terms:
- (i) camber; (2)
  - (ii) sheer. (2)
- (b) Describe how EACH of the terms explained in part (a) improve seaworthiness. (6)

## Ship Features and Seaworthiness:

(a) Meaning of Terms:

(i) **Camber:** Camber refers to the slight upward curvature of a ship's deck from the centerline towards the sides. Imagine a very subtle arch across the width of the deck.

(ii) **Sheer:** Sheer refers to the longitudinal curvature of a vessel's deck from bow to stern. The deck is typically higher at the bow and stern compared to the midships section. Imagine a gentle curve running along the length of the deck, with the bow and stern slightly elevated.

**(b) How They Improve Seaworthiness:**

Both camber and sheer contribute to a vessel's seaworthiness in several ways:

**(i) Camber:**

- **Improved Drainage:** The camber on the deck helps to shed water overboard more effectively. As waves wash over the deck, the curvature directs water towards the sides and drains it through scuppers (drainage holes) located along the bulwarks (vertical walls on the sides). This minimizes water accumulation on deck, reducing the risk of icing in cold conditions and improving crew footing during rough seas.
- **Enhanced Strength:** The slight upward curvature of the deck adds some longitudinal stiffness to the structure. This can help the vessel better resist bending forces experienced in heavy seas.

**(ii) Sheer:**

- **Improved Buoyancy:** The higher sheer at the bow helps to increase buoyancy forward. This additional buoyancy helps the vessel to rise over waves more effectively and prevents excessive water ingress during head-on seas.
- **Reduced Wave Impact:** The sheer angle of the bow deflects waves outwards, minimizing water washing over the deck during rough conditions. This improves weather handling and keeps the deck safer for crew operations.
- **Enhanced Stability:** In some cases, a slight sheer can improve the vessel's initial stability. The wider beam at the waterline created by the sheer can help the vessel resist rolling motions caused by waves.

In conclusion, both camber and sheer are subtle design features that contribute significantly to a vessel's seaworthiness by improving drainage, enhancing buoyancy, reducing wave impact, and increasing stability. These features work together to ensure safer operation and crew well-being at sea.

nov 2020

Nov 2020

10. (a) With reference to ship construction, define a bulkhead. (2)
- (b) State the functions of bulkheads. (8)

oct 2018

Oct 2018

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## Bulkheads in Ship Construction:

### (a) Definition:

A bulkhead in ship construction is a vertical wall-like structure that extends from the bottom of the vessel (usually the keel) up to the deck(s) above. These walls subdivide the ship's interior into separate compartments. Bulkheads can be made of various materials, typically steel plates welded together to form a strong and watertight barrier.

### (b) Functions of Bulkheads:

Bulkheads serve several critical purposes in a ship:

- 1. Compartmentalization and Damage Control:** The primary function of bulkheads is to subdivide the ship's interior into watertight compartments. This compartmentalization plays a vital role in damage control. If the ship's hull is punctured in one compartment due to a collision or grounding, the water ingress will be contained within that specific compartment. By limiting flooding to a confined space, the bulkheads help prevent the entire ship from sinking and improve the vessel's survivability.
- 2. Maintaining Buoyancy and Stability:** By restricting floodwater to a specific compartment, bulkheads help the ship maintain overall buoyancy and stability. Uncontrolled flooding throughout the vessel could compromise its ability to stay afloat and upright. The contained water in a damaged compartment can be pumped out to restore buoyancy and improve vessel stability.
- 3. Structural Support:** Bulkheads also contribute to the overall structural strength of the ship. They help the hull resist bending forces experienced during rough seas and can add longitudinal stiffness to the vessel.
- 4. Functional Separation:** In some cases, bulkheads can be used to separate different functional areas of the ship. For example, a fire-resistant bulkhead might separate the engine room from accommodation areas to contain a potential fire.

Aug 2021

2. Describe the immediate action that should be taken in the event of EACH of the following occurring, stating a possible consequence if the action is not carried out:
- (a) a high pressure fuel leak on the main engine; (4)
  - (b) severe vibration from the main engine; (3)
  - (c) high cooling water temperature alarm on generator engine. (3)

Here's a breakdown of the immediate actions and potential consequences for each scenario:

**(a) High Pressure Fuel Leak on the Main Engine:**

- **Immediate Action:**
  - Shut down the main engine immediately. This removes the source of the fuel leak and minimizes the risk of fire or explosion.
  - Identify the source of the leak and isolate it if possible.
  - Activate the appropriate fire alarm system if necessary.
  - Inform the bridge and other relevant personnel about the situation.
- **Possible Consequence of Not Taking Action:**
  - Continued operation with a high-pressure fuel leak can lead to a fire or explosion. This could cause serious injury or death to personnel onboard, significant damage to the engine, and potential loss of propulsion control.

**(b) Severe Vibration from the Main Engine:**

- **Immediate Action:**
  - Reduce engine speed gradually if possible. Excessive vibration can damage engine components.
  - Investigate the cause of the vibration. This might involve checking for loose components, misalignment, or mechanical issues.
  - If the vibration persists or worsens, shut down the main engine as a precaution.
  - Inform the bridge and other relevant personnel about the situation.
- **Possible Consequence of Not Taking Action:**
  - Severe vibration can lead to component failures within the engine, potentially causing further damage and downtime. In extreme cases, it could result in a catastrophic engine seizure, leaving the vessel without propulsion.

**(c) High Cooling Water Temperature Alarm on Generator Engine:**

- **Immediate Action:**
  - Investigate the cause of the high temperature. This might involve checking coolant levels, inspecting for blockages in the cooling system, or verifying proper functioning of pumps and thermostats.
  - Reduce engine load if possible, allowing the engine to cool down.
  - If the temperature remains high or continues to rise, shut down the generator engine as a precaution to prevent overheating and potential damage.
  - Inform the bridge and other relevant personnel about the situation.
- **Possible Consequence of Not Taking Action:**

- Continued operation with high cooling water temperature can lead to engine overheating, potential component seizure, and even engine failure. This could leave the vessel without a secondary source of electricity, impacting critical systems onboard.

nov 2020

Nov 2020

2. State the purpose of infra red photography, explaining where it could be used as part of a condition monitoring programme. (10)

Infra-red (IR) photography has several advantages that make it valuable for condition monitoring programs, particularly for ships. Here's a breakdown of its purpose and applications:

#### **Purpose:**

- IR photography captures radiation beyond the visible spectrum, primarily heat radiation emitted by objects.
- Unlike standard photography, IR images show variations in temperature rather than reflected light.

#### **Applications in Ship Condition Monitoring:**

- **Early Detection of Issues:** IR cameras can detect temperature anomalies that might be invisible to the naked eye. This allows for early identification of potential problems before they escalate into major failures.
- **Examples of Detectable Issues:**
  - **Overheated bearings or machinery components:** Friction from wear and tear can cause components to heat up. IR images can reveal these hot spots, indicating potential bearing failure or lubrication issues.
  - **Electrical faults:** Loose or corroded electrical connections can generate heat. IR can identify these areas before they cause sparking or electrical fires.
  - **Structural defects:** In some cases, cracks or delamination in bulkheads or decks can cause uneven heat distribution. IR might reveal these defects as temperature variations on the surface.
  - **Moisture ingress:** Water infiltration behind walls or ceilings can affect thermal properties of the area. IR imaging might help identify areas of moisture accumulation before it leads to more serious problems like mold growth or corrosion.

#### **Benefits of IR for Ship Condition Monitoring:**

- **Non-destructive Testing:** IR inspections are non-destructive, meaning they don't require dismantling equipment or damaging surfaces. This makes them ideal for routine checks and preventive maintenance.
- **Remote Monitoring:** IR cameras can be mounted in strategic locations and connected to a monitoring system. This allows for remote inspections and data collection, improving efficiency and reducing risk of direct exposure to potential hazards.
- **Improved Safety:** Early detection of potential issues using IR can help prevent accidents, injuries, and equipment failures onboard ships.

#### **Limitations of IR:**

- **Interpretation Required:** IR images require trained personnel to interpret the temperature variations and identify potential problems.
- **Environmental Factors:** External factors like sunlight, wind, and air temperature can influence IR readings. Careful consideration of these factors is necessary for accurate interpretation.

Overall, IR photography is a valuable tool for condition monitoring programs on ships. Its ability to detect temperature anomalies allows for early identification of potential problems, enhancing preventive maintenance practices and improving overall ship safety and operational efficiency.

oct 2018

Oct 2018

3. (a) Explain what is meant by the term *Machinery Abstract*. (4)
- (b) List SIX items which would be recorded in a typical Machinery Abstract. (6)

may 2021

May 2021

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## Machinery Abstract Explained:

A Machinery Abstract is a concise document summarizing the essential information about a ship's main propulsion and auxiliary machinery systems. It serves as a quick reference guide for crew members, surveyors, and other personnel who need to understand the vessel's propulsion plant and other important machinery onboard.

Here are some key points about a Machinery Abstract:

- **Content:** It typically includes technical specifications, drawings, diagrams, and performance data for the main engines, generators, pumps, compressors, boilers, and other significant onboard machinery.
- **Purpose:** The Machinery Abstract helps with:
  - **Operational Efficiency:** Providing essential information for optimal machinery operation.
  - **Maintenance and Repair:** Facilitating troubleshooting, maintenance procedures, and repair activities.
  - **Regulatory Compliance:** Meeting regulatory requirements for ship surveying and certification.

## Typical Items Recorded in a Machinery Abstract:

1. **Engine Details:** This section would include information about the main propulsion engine(s), such as type (e.g., diesel, gas turbine), manufacturer, model, power output, rated speed, fuel consumption data, and lubrication oil specifications.

2. **Generator Details:** Similar to engine details, this section would list information about the ship's generator sets, including type, manufacturer, model, power output, and auxiliary engine data if applicable.
3. **Auxiliary Machinery:** This section would detail other important machinery onboard, such as pumps (bilge pumps, cooling water pumps, fire pumps), compressors (air compressors, refrigeration compressors), and boilers (if applicable). Information would include type, capacity, and operational parameters.
4. **Piping Systems:** The Machinery Abstract might include diagrams or descriptions of the main piping systems onboard, such as fuel oil piping, lubrication oil piping, cooling water piping, and compressed air piping.
5. **Control Systems:** In some cases, the abstract might include a brief overview of the machinery control systems, specifying whether manual or automated control is used and highlighting any important control features.
6. **Alarm Systems:** The Machinery Abstract may list the main alarms associated with the machinery plant, including a description of the alarm condition each one triggers. This information helps crew members understand and respond to alarm situations effectively.

**Note:** The specific content of a Machinery Abstract may vary depending on the size and complexity of the vessel and the regulatory requirements of the flag state.