(Column 2) Steering impact of following waves

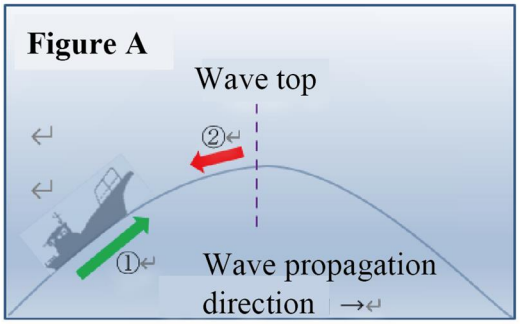
When sea conditions deteriorate rapidly, vessels may encounter surf waves as "following waves" from the stern not only during offshore navigation but also when returning to shore in coastal areas. If this occurs, maintaining a low speed that preserves steering control (scudding) can help reduce vessel movement. However, improper handling may result in capsizing or sinking in an instant.

When waves come from behind, there are two significant risks: "Pooping Down," where waves crash over the stern, possibly damaging the rudder and stern structures, and "Broaching," which happens when waves strike at an angle from behind. Of these, "**Broaching" poses the greatest danger.**

【Broaching】

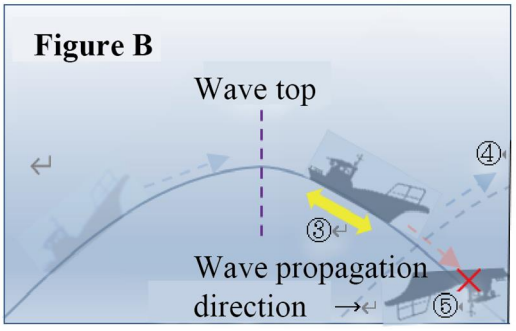
Broaching is a phenomenon that occurs when a vessel encounters "following waves" from the stern, where the wave speed slightly exceeds the ship's speed. As the vessel surfs down the wave slope, its speed nearly matches the wave speed, resulting in a loss of steering control. This leads to sudden yawing and severe heeling, causing the vessel to lose stability and increasing the risk of capsizing. Broaching is more likely to occur in a "diagonal following wave" condition, where waves approach the stern at approximately 20 to 40 degrees.

To avoid this phenomenon, the following maneuvering techniques are necessary:



As shown in Figure A, just before the wave crest, "increase speed ①" while climbing the wave slope, keeping the vessel attached to the wave's surface. "Reduce speed ②" just before reaching the wave top.

* Ensure **frequent speed adjustments** to avoid plunging into the wave trough (descending slope).



As shown in Figure B, if the vessel enters the descending wave slope, adjust speed to "minimum steerageway" and allow the wave to pass ③. Then, increase speed ④ to climb the next wave slope.

* If the vessel remains on the descending slope with speed nearly matching the wave, it may lose steering control, leading to sudden yawing, excessive heeling, and ultimately capsizing ⑤.

A fundamental preventive measure is to thoroughly adjust the course to **avoid receiving diagonal following waves** from the stern.

In contrast to following waves, when encountering rough seas from the bow, methods such as "Heave-To" (a maneuver to maintain the vessel's position in rough seas) or using a "sea anchor" (a parachute-like device deployed to the sea to resist the waves and keep the bow facing them. We can also call parachute anchor) can be used to drift.

Note: "Heave-To" refers to a maneuver in rough seas or during a tsunami, where the ship's bow is angled 2-3 points (about 30 degrees) to the waves. This technique maintains the vessel's posture and minimal rudder speed while riding out the waves.

BACK TO BASICS!

Accidents where small vessels of various types are flooded, capsized, or sunk due to surf waves and other following waves are common. Especially in the operation of small passenger vessels carrying lives, it is essential to avoid careless departure decisions based on overconfidence or complacency, and to always prioritize safety by adhering to the basic principles of safe navigation.

- Do you have a good understanding of the weather and sea conditions, areas, and points where high waves are likely to occur in the operating area?
- Are departure decisions made with safety as the top priority, considering the weather and sea conditions at the planned return time?
- Do you check the watertightness of openings, such as verifying the closure status of access points, during pre-departure inspections?
- Is there any vulnerability in your vessel's hull structure when facing waves coming from the stern?
- Does the master have the knowledge and skills for rough weather navigation, including avoiding broaching phenomena?

(2) Risks related to seabed topography

1) Presence of reefs, rock formations, and tidal effects in coastal navigation areas 【risk of grounding/stranded】

- In coastal waters with sunken rocks, rock which covers and uncovers, other rocky formations or exposed reefs factors such as dense fog, deviation from designated routes leading to position misjudgment, and wind or tidal currents may increase the risk of grounding or stranded.

- In shallow waters, spring tides can reduce the under keel clearance (UKC), increasing the risk of stranded.

- The visual representation of sunken rocks, rock which covers and uncovers, rock awash, which are key components of reef structures, is shown in Figure 15 below.

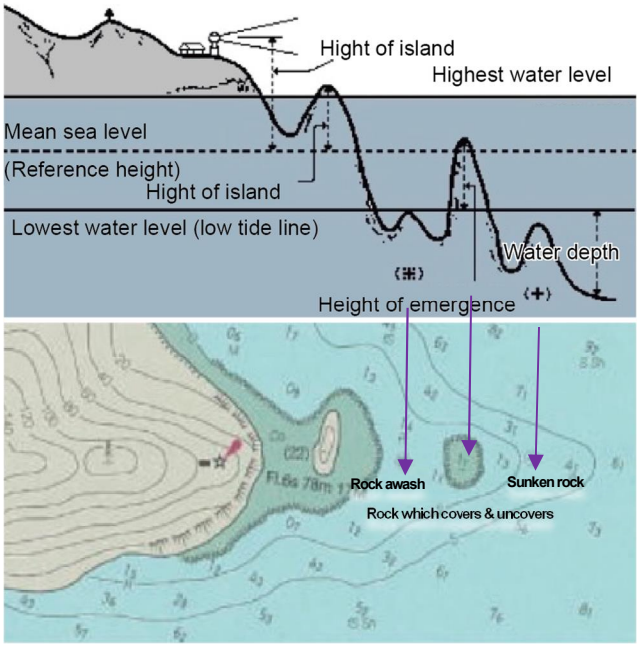


Figure 15-Source: "Depth and elevation reference chart" from Japan Coast Guard website (modified) https://www1.kaiho.mlit.go.jp/KAN1/soudan/kijun.html

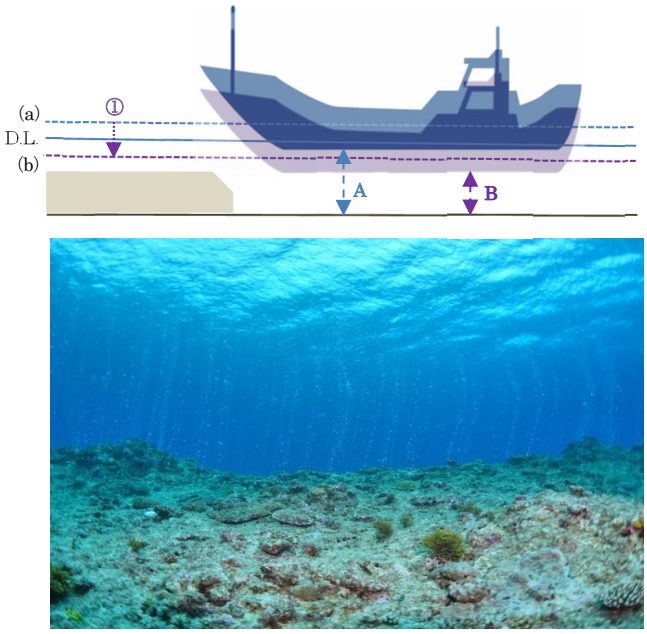
- "Sunken rock" is a rock located below the chart datum (lowest astronomical tide) and remain submerged at all times.

- "Rock which covers and uncovers" refers to rocks situated between the lowest and highest water levels, submerging at high tide and exposing their peaks above the surface at low tide.

- "Rock awash" describes a rock whose peak aligns with the lowest water level at low tide, making it continuously washed by waves.

・ The mechanism of contact in shallow waters due to tidal effects (spring tide) is as follows.

(Figure 16)



1. The draft of the vessel (blue silhouette) shown in Figure 16 is assumed to be the distance from the tidal level (a) above the datum level (D.L.) to the bottom of the hull.

2. The **under-keel clearance** (**UKC**) at that time, from the ship's bottom to the seabed, is represented by the vertical blue arrow A. In this case, the seabed elevation on the left side of the figure can be cleared.

3. However, if the water level drops below the datum level (b) due to the effect of a **spring tide** (purple arrow ①), the UKC of the same vessel (purple silhouette) is reduced to the vertical purple arrow B.

4. In this situation, continuing navigation would lead to contact with or grounding on the seabed elevation on the left side of the figure. Additionally, insufficient tidal planning can result in a low UKC against the D.L., increasing the risk of contact sunken rocks or grounding. Even when navigating at high tide, if the UKC above the peak of an uncovered rock is insufficient, there is a risk of contact or grounding.

BACK TO BASICS!

The year before the Shiretoko passenger ship sinking accident, the same vessel ran aground after deviating from the designated route without recognizing the presence of rocks and reefs. Grounding accidents can cause severe secondary damage beyond hull damage, including risks to human life and marine pollution. Therefore, a structured approach is necessary to ensure that masters and crew thoroughly understand the seabed topography, tidal currents, and tidal effects in the operating area.

- Does the master have a clear understanding of the location of reefs in shallow waters of the operating area?
- Are the positions of reefs registered in the vessel's GPS plotter?
- Are clearing lines for reefs registered in the GPS plotter?

- Are you operating the GPS plotter with an understanding of its positioning accuracy?
- Are you using the nautical electronic reference chart (new pec) with awareness of shoreline display errors?
- Can the master and crew identify reef locations using surrounding landmarks instead of relying solely on navigation aids?
- Can the crew steer and maintain course while considering the unique wind and tidal currents of the operating area?

- Does the designated route have sufficient clearance from the shore, considering shallow waters and wind/tidal effects?
- Are you deviating from the designated route to navigate closer to the shore for sightseeing or to shorten the route?
- Have you obtained tidal and current information for the day before starting operations?