Study on Safety Measures of Ship Anchoring against Typhoon

Qiong-qiong HU, Hai-hao XU, Tian-ming DING and Wan-zheng AI
Marine College of Zhejiang Ocean University, Zhoushan 316000, P. R. China

Keywords: Typhoon, Ship anchoring, Typhoon resistance.

Abstract. This paper mainly discusses the harm caused by typhoon to ship, and the aspects that should be paid attention to preventing and resisting the ship in anchoring, so as to ensure the safety of the ship in anchoring. At the same time, it analyzes the possibility and danger of anchoring, and adopts the correct anchoring method to ensure the safety of ship anchoring.

Introduction
Typhoons are strong cyclone vortices that occur in tropical oceans. The northern South China Sea, Taiwan Haixia, Taiwan Province and its eastern seaboard, the West China Sea and the Yellow Sea are high frequency zones through typhoons. Typhoon is considered one of the main disastrous weather, and every year, it causes a lot of ship schedule loss and poses great threat and harm to the safety of navigation and personal safety, which causes great loss to national property. The coastal waters of China are affected by typhoons every year.

The severe impact of the sea hull and ship equipment is caused by typhoon, which will lead to small and medium-sized ships in the hull of a more violent sway movement and spin-off, course instability and other phenomena. In addition, when the ship is in the anchoring anti-typhoon, if the operation is improper, the anchor accident will also often occurred[1]. Therefore, it is necessary to systematically analyze the influencing factors of ship anchoring and anti-typhoon, discuss the operation method of anchoring anti-typhoon, mitigate the danger of typhoon on ship anchoring, and ensure the safety and anti-typhoon of ship anchoring.

Several Options for Safety Precautions for Anchoring and Anti-typhoon
With the development of science and technology, the instrument on board is more and more precise, and the ship will work more efficiently to ensure the safety of navigation. Before the typhoon arrives, the leader of the ship should make relevant preparations according to the weather forecast, and reduce the harm caused by typhoon to ship. The captain should give the corresponding anti-typhoon measures according to the characteristics of typhoon, so as to make the ship anchor safe and anti-typhoon. There are several options for safety precautions for anchoring and anti-typhoon.

Selection of Anchorage
(1) Try to avoid the typhoon path;
(2) Should choose the place which can avoid many directions of wind and waves, as far as possible to avoid typhoon to the long wave invasion;
(3) As far as possible to choose the convenient, wide area of the place to anchor, to avoid the ship is too dense and close to the culture zone anchor;
(4) Keep away from the water with obstacles, in case the ship's safety is affected by the anchor;
(5) Try to choose a bay anchor that has no back wave impact and a small flow rate;
(6) Anchorage depth can be referred to the ship's draft twice times higher than half of the wave height selection, the substrate to clay, mud is preferred; and the minimum depth of anchorage required at the lowest tide can be calculated according to the following formula $h = k \cdot D$ ($h$ stands for chart depth; $D$ means the maximum draft of the ship at anchor; $K$ is the coefficient, 1.2 is taken when no surge or shelter is good; Instead, take 1.5) [3].

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(7) When anchoring, the length of the anchor chain can be referred to the following empirical formula. When the typhoon is less than or equal to seven, the formula $D+90m$ should be selected; otherwise, choosing $4D+145m(D$-depth $)^{(3)}$;

(8) A ship with a mooring against typhoon shall have a host and a value voyage class.

Selection of Anchoring Modes

Anchoring is the key to ship anchoring and anti-typhoon. Open mooring used to be used. Practice has shown that such anchorage mode is more of a disadvantage than a benefit. Two anchor chain struggling unevenly and grasping small are occurred frequently, moreover the anchor chain is easy to get entangled with. Riding to both anchors universally is used to prevent and resistance typhoon at present. Riding to both anchors should be adopted as soon as possible before the typhoon strikes or the wind has reached level six. Riding to both anchors is well suited for anchoring in the rough sea, and is a good anchor for strong winds, rapids and typhoons. It operates in the same way as a single anchor, with the bow facing the waves and throwing the two-sided anchor, when the two anchor chains move forward and begin to struggle, two-side anchor chain are thrown loose the same length of anchor chain at the same time, as if the two anchors are thrown at a point. Weigh anchor is also the same as the single anchor. The advantage of riding to both anchors is that the retention force is very large, because of its double anchor almost at a point at the same time and the chain out of the same length, the double chain is always equal and balanced force, its double-chain angle equals zero. So riding to both anchors is twice times the force of a single anchor. Riding to both anchors anchor is effected by the wind and waves a little. It is generally said that the bow deflection is the main cause of the broken anchor chain, riding to both anchors can reduce the chances of damage$^{[1]}$. The biggest advantage of riding to both anchors is that after the wind and waves turn, the bow will also turn, and the double chain will not occur kinking, because the double anchor chain is thrown at a point at the same time. Therefore, in the face of wind and waves, as well as with the wind and waves, two anchors and chains will be accompanied by a large ship to meet the wind or waves together, and two anchors and two chains will not cross or kinking, which is obviously better than the place of the open mooring. Although riding to both anchors anchoring and weighing anchor are simple, but if not, improper operation will also occur kinking situation. Therefore, the opportunity of anchoring is seized well, being in the boat because of the flow is not chosen to turn the anchor, and the direction of the airflow effect is mastered. Anchor when the typhoon or strong winds begin to weaken, that is, in the current to the ship's role greater than the wind, in time to twist the double anchor, and the single anchor is re-thrown$^{[1]}$. Anchor the two anchors at the same time, and as far as possible, the left anchor to the port of the bow, right anchor on the starboard side of the bow, when necessary, with the rudder. Before the double anchor is to leave the bottom (the general two sections), an anchor should be stopped twisting, continue to twist another anchor until the water after the end of the stranded anchor, or the anchor will be suspended to a suitable length to become a single anchorage. The following four figure is shown for riding to both anchors.
The Preparations before the Typhoon

For the ship anti-typhoon, in addition to choose a good anchorage and anchoring method, A response measure and a preparative job of anti-Typhoon should be chosen. Let me first talk about the preparations before the typhoon.

3.1 Listen to the weather forecast and receive the weather fax and telex, the formation of typhoon and the direction of movement are paid close attention to. If the ship will be affected or threatened by the typhoon, the captain shall convene a Safety committee assembly consisting of the driver, engineer, sailor, foreman, and so on, to everyone is informed of the central position of the typhoon, the direction of movement, the speed of movement and so on\textsuperscript{[4]}. These are prepared adequately for avoiding the typhoon;

3.2 The engineers shall be organized to inspect the cabin movable spare parts, material lashing, such as the cylinder liner in the engine room, the barrels in the bow-tip cabin, the rudder chamber and so on by the chief engineer\textsuperscript{[4]}. The engineers find that the lashing is not in place or the lashing is not standard, which should be re-lashing, fixed. Must not only arrange does not implement, only listens to report not to the scene verification.

3.3 The chief officer shall organize deck personnel on the main deck, living area, kitchen and other parts of the movable spare parts, material lashing inspection. Something can be retracted into the material, such as on the main deck of the cable, life buoy, which must be recovered to the material. Those are found that the binding is not in place or the binding is not standard, and should be re-lashing, fixed.

3.4 Before the typhoon arrives, the anti-typhoon leadership group will be formed, which is responsible for the organization leadership, command, coordination and emergency disposal of the ship-shore anti-typhoon work by the shipping company. The general manager of the company is the head of anti-typhoon work, fully responsible for anti-typhoon work organization, coordination and implementation of work, and provide anti-typhoon work necessary resources and support. The designated person is responsible for monitoring the anti-typhoon related work. Marine Department Manager is responsible for the implementation of anti-typhoon work, analysis of Typhoon Dynamics, and proposes to the ship (affected by the typhoon) avoidance typhoon anti-typhoon measures. All other departments are in a methodical manner to prepare for the anti-typhoon. The company personnel and the ship personnel are anti-typhoon together, the ship safety is guaranteed.
3.5 If the typhoon will have a great influence or threat to the ship departing from the berth to the sea, it may postpone sailing or find a sheltered place for shelter or shelter, anchorage to anchor, and report the ship's actions to the shipowner and the tenant in time for the typhoon.

**A Response Measure of Anti-typhoon**

A preparative job of anti-Typhoon is chosen well, when anchoring is in emergency, response measures should be arranged in advance, the following is the response measures of dragging anchor. If dragging anchor is found by operator on duty, another anchor should be thrown immediately to bring the force, standby engine is requested at the same time and the Captain is called. While dealing with the problem of the dragging anchor, “Y” signal is necessary to be suspended and fired and use the voice communication equipment to announce the Leeward mooring ship in accordance with the rules of international signal and collision avoidance rules. When the anchor is overturned, the length of the anchor time and the surrounding environment is obstructed, which are not known, we do not take a risk to lose the chain to increase the length of the chain, so as to avoid collisions, stranding and other accidents. In the case of emergency, when the ship's anchoring safety is threatened by vessel to windward dragging anchor, the berth of ship have to be transferred, and the captain must be extremely cautious, because at this time the biggest danger is the ship in the bad weather conditions, the air pressure caused by the small draft and large wind area of the unloaded ship maneuvering capacity is weak[2]. Ships can be careful to shorten the chain, increase the rudder strength, increase the ability to manipulate, transfer anchoring maneuvering and choose another anchoring.

**Summary**

When the ship chooses anchorage, the conditions of the ship, the hydrological and meteorological conditions in the anchorage waters and the anchorage navigation environment and other factors should be analyzed fully. Suitable for the situation and the environment of mooring operation mode should be used, and the preparation of various anti-anchor measures and various anti-typhoon preparation work should be also applied to ensure the safety of the ship.

**References**


