The 4th Fleet incident

Sep. 26th,1935, Offshore east of Sanriku in the Pacific Ocean

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(Summary)

On September 26th, 1935, the Japanese 4th Fleet encountered an abnormal typhoon while they were conducting maneuvers 250 miles east of Sanriku coast in the Pacific Ocean. The typhoon damaged many vessels seriously and took a heavy toll of human lives. The most serious damage to these vessels was the breaking off of the bow portions of the Hatsuyuki and the Yugiri, which were Japanese Special-Class Destroyers.

The 4th Fleet incident occurred because the fleet was confronted with waves larger than they had expected. The cause of this incident was investigated and some new facts were discovered. As a consequence, these vessels were reinforced and were thereafter able to fulfill their missions without any further problems.

1. Component

Vessels of the 4th Fleet, especially the two Special-Class Destroyers Hatsuyuki (Fig. 1) and Yugiri (Fig. 2).

2. Event

The Japanese Navy's large-scale maneuver in 1935 was put in to operation between the Standing Combined Fleet (Blue Fleet) and the Red Fleet. The Blue Fleet consisted of the 1st and 2nd fleets. The Red Fleet, which contained the 4th Fleet, was assembled temporarily. The maneuver started in July, and it was supposed to end after the competition between the Red and Blue Fleets in the late September. Two remodeled battleships (Yamashiro, Haruna), and new and powerful cruisers (Mogami Class, Hatsuharu Class) participated in this maneuver, and therefore a considerable result was expected.

In the late September, the Red Fleet crossed over the Tsugaru Straits and cruised toward the east. The Red fleet was expected to advance to the east of Honshu Island and reach position for the battle against the Blue fleet at there. However, the weather became extraordinary rough from 14:00 on September 26th, due to a typhoon. During the storm, the bridges of two destroyers (Hatsuyuki, Yugiri) were knocked off by huge waves. In addition to this, the bridge of the destroyer Mutsu was smashed, the front side of the bridge of the aircraft carrier Ryujo was damaged, aircraft carrier Hosho plunged into waves and crashed her deck so it became uncontrollable, and all of the other vessels suffered slight or heavy damages. Consequently the Red fleet abandoned its maneuver. The vessels in the fleets except for the heavily damaged vessels conducted a maneuver off Sanriku, and after that maneuver, they gathered off Shinagawa in Tokyo bay. At the end of the maneuver, on October 7th, a review took place on the Hiei, which was the observing vessel of the maneuver, in the presence of the president of the headquarters Hushiminomiya.

The 4th Fleet incident was unprecedented and so serious that the authorities strictly concealed the facts (in addition, Japan withdrew from the London Naval Conference the next year). It was the first time that the hull of a vessel was knocked off since the British destroyer Cobra (370 tons) was split in half during her first cruise in 1899. This incident, together with the capsize of torpedo boat Tomozuru, called into doubt the quality of the Japanese Navy's shipbuilding technologies.

According to the investigation, the principal cause of this incident was a lack of strength of the Special-Class destroyers. Although the vessels had operated for seven years without any problems, the investigators concluded that their strength was insufficient. As a result, it was decided that reinforcement was needed for the cruisers, destroyers and even aircraft carriers. As a result of the detailed investigation, it became clear that the Special-Class destroyers were damaged because of the deterioration of strength after several years of operation. However, these facts were not considered carefully, and they were treated as political matters instead of technical ones. That was one of the reasons why the 4th Fleet incident could not be prevented.

In the 1930's, welding was used for assembling many newly built vessels. Although welding was not the immediate cause of this incident, ships that were constructed using welding for assembling the main parts often proved not to have enough strength.

The 4th Fleet incident occurred because the vessels in the fleet were confronted by unexpectedly large waves. An intensive investigation revealed several new facts. As the result, all of the vessels were reinforced and were able to fulfill their missions without failure since then. In this case, shipbuilders can be considered to be responsible for the incident.The 4th Fleet incident and the case of the Tomozuru, were the worst scandals in the eighty years of the Japanese Navy's history. Just before the crisis in 1936, many people doubted the Japanese Navy's combat power as a result of these incidents. However, these doubts were completely removed by extraordinary efforts and proper treatment of the persons concerned.

3. Course

On October 10th, 1935, a commission of inquiry was formed. Admiral Kichisaburo Nomura was appointed as the commission chairman. Vice Admiral Isoroku Yamamoto and Rear Admiral Mineichi Koga (both of them were later to hold the position of commander-in-chief of the Japanese Grand-Fleet) were also members of the committee. In the cases of the Hatsuyuki and the Yugiri, a huge wave caused a pitching motion of the vessels to occur. Then wrinkles appeared on the steel board of the front decks of the vessels, and the decks began to buckle. The committee concluded that as the vessels' pitching motion occurred again and again, wrinkles become cracks and finally divided the vessel into two parts (Fig. 3). In addition to the wrinkles on the front desks, both of the vessels had wrinkles also on the quarterdeck, and wrinkles could even be found on some of the other vessels that might cause parts of the vessels to break off.

On July 1935, Special-Class Destroyers, including the Murakumo, had cruised at high speed in a heaving sea near Tokyo Bay before this incident, and the same type of slight wrinkles were found in the Murakumo. One major who investigated the cause of the wrinkles in the Murakumo at Yokosuka came to the conclusion that the primary factor leading to the occurrence of the wrinkles was a serious lack of the

vessel's strength. He reported that they must reconsider the participation of these Special-Class Destroyers in the maneuver. However, his superior officer rejected his proposal for fear that if the problem came to the surface just before the maneuver then it might be perceived as a complete blunder of the authorities, so they reinforced the Murakumo only. The 4th Fleet incident occurred just after this case, but the defects of these vessels had already existed before the incident.

On October 21st, 1935, the Japanese Navy established a special investigative committee for the improvement of the efficiency of naval vessels. Admiral Seizo Kobayashi became the chairman, and the committee went into action to find out the cause of the incident and decide the most effective measures to deal with the cause. Investigations and discussion continued night and day for five months, and finally a full and detailed report was made in April 1936.

The 4th Fleet incident, as well as the capsize of the torpedo boat Tomozuru, was such a serious example of a case that they had never experienced before that authorities decided to completely conceal the facts.

4. Cause

Although it turned out to be true that the cause of the 4th Fleet incident was the lack of strength of the Special-Class Destroyers, all the destroyers of this class had been in commission without any problems for seven years. Since these vessels that had been thought to be perfect were acknowledged as defective, all the cruisers, destroyers, and even air carriers that were constructed later than these vessels had to be reinforced immediately. A similar case happened with types of vessels that were heavier than the designs or had become remarkably heavy as a result of some alterations. They investigated the situation regarding the Special-Class Destroyers in detail and found that many problems caused by the defect appeared several years after the vessels were constructed. However, these facts were not considered seriously, and some political matters blocked technical investigations. As a result, the 4th Fleet incident occurred.

Additionally, most of the bodies of newly constructed vessels were welded at that time. As the investigation went on, vessels whose bodies were welded proved to have reduced body strength (although this fact was not the direct cause of the incident).

5. Immediate Action

Figure 5 shows the definition of the wave length T and the wave height H. During the heavy weather, the heavy Cruiser Nachi, one of the vessels of the 4th Fleet, recorded that the wave length T was 100~150m and the wave height H was 10~15m. The ratio of T to H was approximately 10. The battleships of the 4th Fleet recorded the same ratio, but a torpedo boat in another area reported that T was 200m and H was 15m. In that case the ratio was about 13.3. This wave was not a chopping wave which the Special-Class Destroyers drove into; it was just a result of an observation of a big wave. Based on these records and other investigations, investigate committee came to the conclusion that in the sea near Japan, when the wind velocity is more than 70m/s the average wave length T is 500m and the average wave height H is 23~26m, when the wind velocity is approximately 50 m/s, T is 280m and H is 15~18m (these conditions usually occur twice a year) and when the wind velocity is 40m/s, T is 180m and H is 11~14m (these conditions occur about ten times a year). According to this report, the ratio of T to H ranged between 10~13, and it

was almost always around 10 during a typhoon.

In this investigation, many records of the Hydrographic Department and other national archives referring to sea waves were consulted. However, it is difficult to observe sea waves accurately, and so few reports are reliable.

Shipbuilders in those days used the following standard for the calculation of the vessel's strength: the ratio of T to H is 20 and T is not longer than the length of the vessel. It can be calculated that the torque applied to a vessel is largest when the wave length and the vessel's length are the same (this calculation treats the shape of the wave as a trochoidal wave). This calculation result was used universally. The bending stress curves based on this method made it easy to calculate the bending stress on each cross section of the vessel in order to decide the size and the structure method of the reinforcement. The problem was the value of the bending stress itself because it was required to be far less than that of the failure stress.

The T to H ratio of the wave that the 4th Fleet encountered was much higher than the standard ratio of 20. However, this is a relatively common phenomenon in the seas near Japan. Thus the conventional method to calculate the permissible range of the bending stress needed to be reconsidered carefully. Moreover, the strength of the vessel must be calculated even in the case that the T to H ratio is 10.

The cause of the 4th Fleet incident was obviously the imperfection in the structure of the Japanese Navy's vessels. However, it was found that sometimes waves were much larger than had been previously observed, and the authorities decided to strictly conceal the meteorological situation itself during the incident in addition to the cause and the measures of the incident.

Some of the other Special-Class Destroyers also had wrinkles on their foredecks that might have caused the breaking off of parts of the vessel, and some of them even had wrinkles on their quarterdecks.

The cruiser Mogami had some wrinkles on the welded bow since the time that it was constructed, but after the incident the wrinkles became enlarged and the main structure started to break down. During the storm, the Mogami made strange noises near the main battery and the bow vibrated terribly, causing all of the sailors to become terror-stricken. The submarine depot ship Taigei, whose weight exceeded 10,000 tons, inclined more than 50 degrees, and seawater leaked into the vessel. As a result, one of the electric motors was broken, and the vessel became temporally uncontrollable. Like the Mogami, the Taigei also had some wrinkles on some of the plates on the deck in front of the bridge. Some walls around the bridge of the aircraft carrier Ryujo were crushed by rough waves since the foredeck was slightly low. Finally, the rivets in the middle of the heavy cruiser Myoko were loosened.

Huge waves destroyed a lot of rigs as well as vessels themselves. In summary, all of the vessels in the storm were damaged to some degree.

The strength of the Special-Class Destroyers was calculated carefully, and as a result the maximum stress applied by normal waves was not so high if the vessel was constructed according to the plan. However, the weight was increased considerably in comparison to the original plan, and some other adaptations also altered the weight of the vessels. In normal vessels, the applied stress on the front and back of the vessel is decreased remarkably because longitudinal steel reinforcements share the external force. However, the Special-Class Destroyer used relatively thin reinforcement at the front and the back, so the

stresses on the vessel's front and back became same level as those at middle. The shipbuilders thought that this might contribute to the reduction of the weight of the vessel. When the vessel encountered waves that were larger than expected the stress on the middle part of the vessel was increased, although the proportion of the stress increase on the front and back parts varied between each vessels depending on the distribution of the reserve buoyancy and the flotage. The stress of the Special-Class Destroyer increased 45% on the middle part and 69% on the front part when the T to H ratio changed from 20 to 10. This stress was mainly due to the compressive stress that occurs when the vessel is located between waves (subbing); the stress on the top of a wave (hogging) was not so large as the subbing one. Fig. 6 shows examples of subbing and hogging. In other words, the Special-Class Destroyer was constructed without careful consideration of the stress distribution in order to reduce her weight.

As a result of the above considerations, the Special-Class Destroyer was constructed to have good seaworthiness, but the foredeck was higher by one step than other vessels. As a result, a large compressive stress was applied on the deck when the vessel encountered a big wave. Although shipbuilders considered the permissible limitation of the buckling against the compressive stress carefully, some of the considerations were inappropriate. These issues contributed to the cause of the breaking off of the parts of the destroyers due to the repeated compressive stress. That is to say, it was clear that the thinness of the steel plates and the heights of the waves were the causes of the 4th Fleet incident. And detailed calculations of all other vessels' strength were done as same way.

6. Countermeasure

It was not so difficult to find the way of reinforcement of the vessel by calculating the applied stresses of the vessels in severe conditions. However, the reinforcement of existing vessels is much different from changing the structure of a new vessel. Moreover, the reinforcement must affect the other vessel's performance as little as possible. Time consuming works for reinforcement could endanger National defense at that time, and of course the government wanted to keep costs as low as possible. However, the situation was so serious that the Japanese Navy took extraordinary bold and thorough measures to repair the situation.

Most of the small vessels went into dock and almost all of their plates and decks were stripped. Bridges were separated from the bodies of the vessels, and sustained by logs then all of the required reinforcement was conducted.

Although welding at that time was not well understood, shipbuilders overused this in complete technology. Designing and methods of constructing welded structures are insufficient in many regards. Consequently, welding between parts critical to the strength of a vessel was discontinued and rivets were used again.

With these countermeasures and through great efforts of the people concerned, the reinforced vessels were able to accomplish their missions without any further problems related to strength deficiency since then.

This incident, together with the case of the Tomozuru, was completely settled under the leadership of

Rear Admiral Keiji Fukuda (he was promoted to Technical Vice Admiral later) and Prof. Yuzuru Hiraga, dean of the Faculty of Engineering at the University of Tokyo. Many technicians from other dockyards assisted them in their investigations and calculations. Most of the reinforcement was finished by the end of 1936, and all the reinforcement was completed at the end of 1938.

7. Knowledge

Unexpected and unusual rough weather taught that technologies were still incomplete. Due to this lesson, shipbuilders nowadays have a certain confidence based on precious experience about a vessel's strength. We should make the most of this experience in order to give our respect for the victims of the 4th Fleet incident.

8. Background

One of the reasons that the strength of these vessels became weakened was the demand for an increase of each individual vessel's combat power within the limited vessel's structural mass because the Conference on the Limitation of Armament in Washington limited the total weight of whole vessels. This conference was held by the U.S.A, the British Empire, France, Italy, and Japan in November 1921.

Following this conference, the London Naval Conference also limited the number of support vessels and submarines after many twists and turns. In this treaty, Japan appeared to have had her demands from the U.S.A and the British Empire fulfilled, but in fact the U.S.A gained an advantage over Japan in constructing support vessels under the restriction. Thus the Japanese naval vessels had to mount many guns at the cost of their structural strength, which led to the exposure of major defects. The 4th Fleet incident forces us to recognize that inconsistency between policy and technology will cause unexpected tragedy.

9. Sequel

The U.S. Navy's 3rd fleet, which was under the command of Admiral Halsey, was heavily damaged by two typhoons during the Pacific War.

On December 18th, 1944, one of the units of the 3rd fleet encountered a rough typhoon near Philippine. Three destroyers were capsized and sank; 18 vessels were badly damaged and 9 were slightly damaged; and 183 aircrafts and over 700 lives were lost. The fact that the fuel tanks of the three sunken destroyers were all empty worsened the situation.

The second typhoon encounter took place on the sea near Kyushu on June 4th and 5th, 1945. General Halsey wanted to attack Kyusyu to halt the Kamikaze attacks, so some units moved northward and carried out an attack on June 2nd, but the military results were not sufficient. After the attack, an enormous typhoon approached the sea area near Kyusyu and Okinawa and heavily damaged some units. The 3rd fleet's four battleships, two aircraft carriers, two light aircraft carriers, four escort carriers, three heavy cruisers, four light cruisers, and seventeen other vessels were seriously damaged, and most of the aircraft were destroyed.

The 3rd fleet was unfortunate, but it is doubtful that the U.S. Navy had considered that typhoons or storms might damage the vessels (of course the cause of the 4th Fleet incident was the top secret of the

Japanese Navy, and the U.S. Navy could not have know it). In contrast, no vessels in the Japanese Navy were damaged due to encountering a typhoon after the 4th Fleet incident. In military situations, sharing knowledge of failure cases between enemy nations cannot be realized.

10. Primary Scenario

01.Organizational Problems
02. Inflexible Management Structure
03. Acceptance of Unreasonable Demands
04. Unknown Cause
05. Occurrence of Abnormal Phenomenon
0 6. Typhoon
07. Insufficient Analysis or Research
08. Insufficient Prior Research
09. Insufficient Judgments/Rethinking
10. Planning and Design
11. Poor Planning
12. Bad Design
13. Warships/Vessels
14. Lack of Vessel's Strength
15. Usage
16. Operation/Use
17. Cruise
18. Possible Damage
19. Potential Hazard
20. Huge Wave
21. Failure
22. Deformation
23. Buckling
24. Loss to Organization
25. Social Loss
26.Defense Deterioration

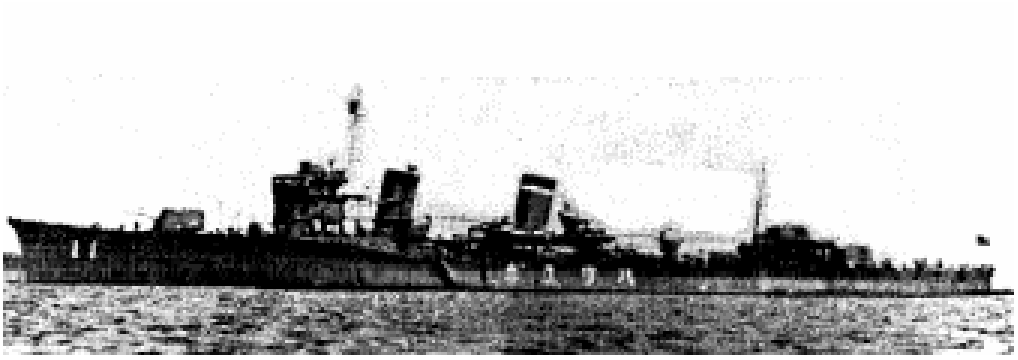


Fig. 1　Destroyer Hatsuyuki.

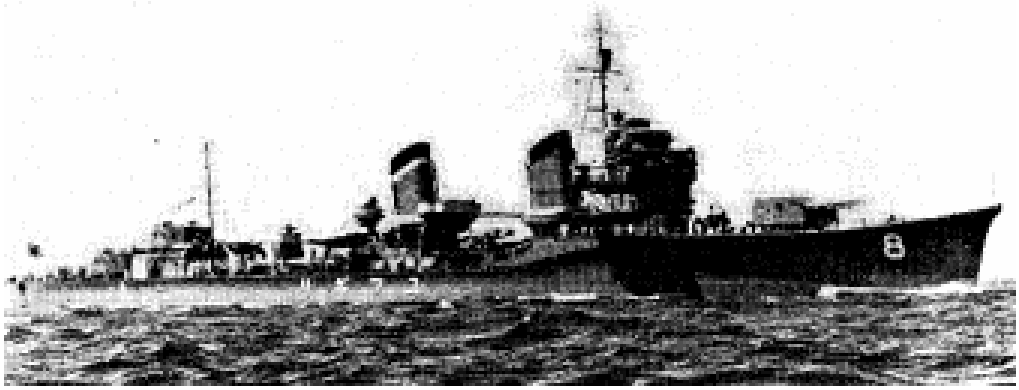


Fig. 2　Destroyer Yugiri.

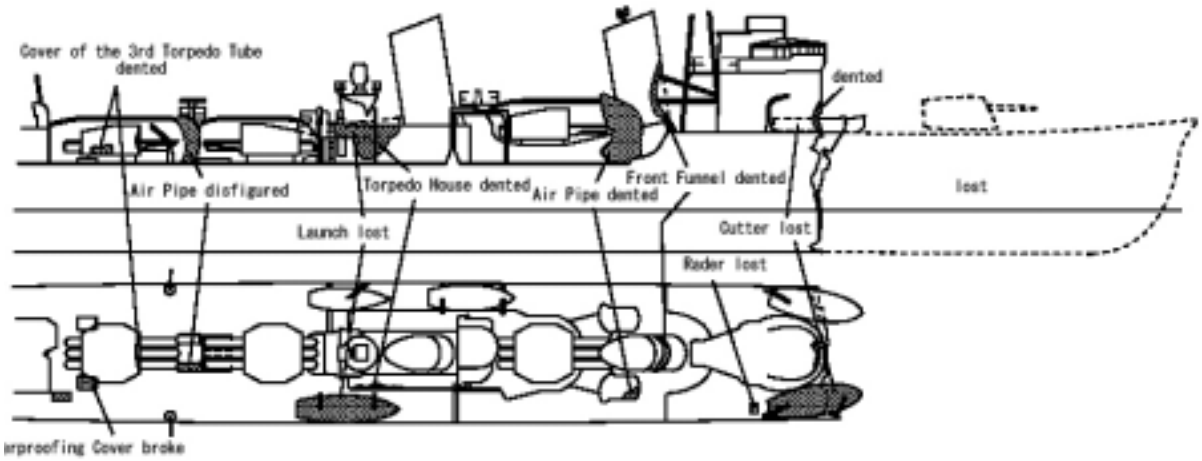


Fig. 3 Damages of Destroyer Hatsuyuki.

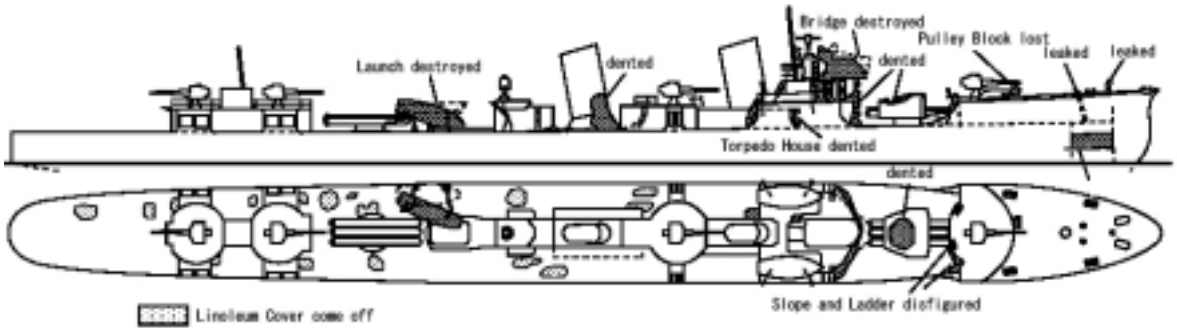


Fig. 4 Damages of Destroyer Mutsuki.

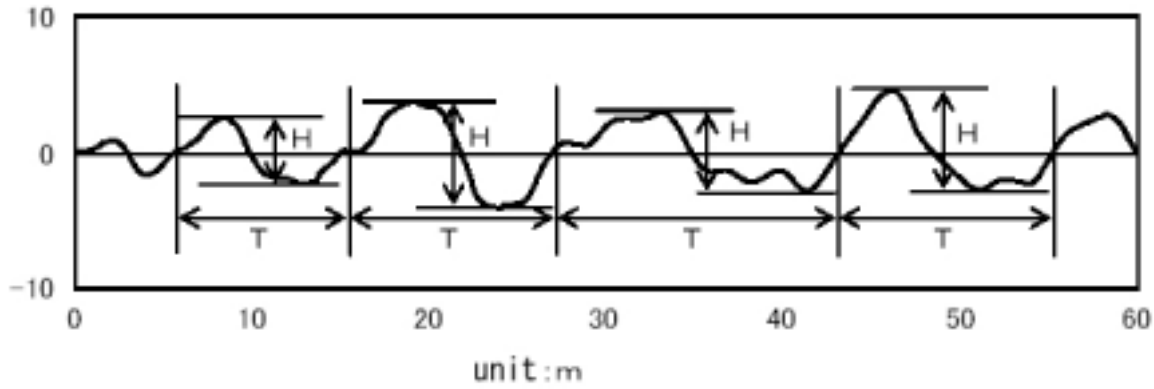
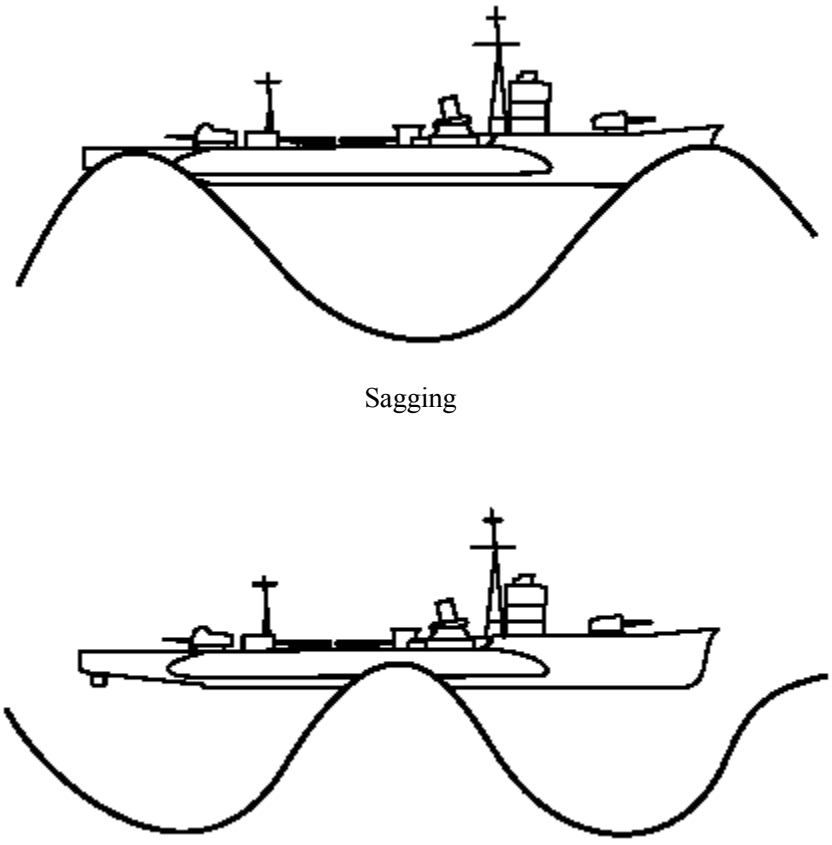


Fig. 5 Definition of Wave Length(T) and Wave Height(H).



Sagging

Hogging

Fig. 6 Subbing and Hogging.