

Sinking of the aircraft carrier Taiho caused by one hit of a torpedo

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KOBAYASHI, Hideo (Tokyo Institute of Technology)

(Summary)

On June 19th, 1944, the aircraft carrier Taiho participated in the battle of Mariana as the main flag ship of the Japanese first fleet and launched its first attack team. Soon after the start of the battle, a torpedo launched by the U.S. submarine Albacore hit the Taiho. This hit caused some of the fitting of the gasoline tank to become loose, and volatile gas began to leak. Unfortunately, the aircraft hanger became filled by volatile gas because the front side elevator was broken by the shock of the torpedo hit and its aperture blocked off. After a few hours, the volatile gas caught fire and exploded. Finally the carrier became engulfed in flames and sank.

The Taiho was constructed to be an unsinkable aircraft carrier. However, the defense on flight deck was of no use whatsoever. The defense method of gasoline tanks and countermeasure volatile gas leaking was inadequate. Just after this accident, an emergency measure beyond naval engineer's wildest dreams was adopted to all fleets of Japanese imperial navy.

1. Component

Here is the specification of the Taiho.

Displacement capacity : 34,200 t

Length water line : 253 m

Speed : 33.3 knot

Aircraft capacity : 53

The Taiho was called the strongest aircraft carrier ever made by the Japanese Imperial Navy. Kawasaki Heavy Industry began construction of the Taiho in July 1941 at their dock in Kobe. For the construction of the Taiho, the engineers implemented countermeasures obtained from lessons learned during combat in the war.

As a result of the construction as rapidly as possible, the Taiho was finished in March 1944. Therefore, the Taiho was expected to be the most effective vessel for actual combat in all regards.

2. Event

Kawasaki Heavy Industry began construction of the Taiho in July 1941 at their dock in Kobe. For the construction of the Taiho, the engineers implemented countermeasures obtained from lessons learned during combat in the war. As a result of the construction as rapidly as possible, Taiho was finished in March 1944. Therefore, Taiho is expected as the most effective for a actual fight at all points. The Taiho is a defensive aircraft carrier, and its duty was to continue an operation in the battlefield longer than other

aircraft carriers. The Taiho was designed carry such a large amount of bombs and gasoline that it could supply them to airplanes carried in other aircraft carriers. As a result, the aircraft capacity of the Taiho was decreased in exchange for the capacity to carry bombs and gasoline.

In June 19th, 1944, the aircraft carrier Taiho participated in the battle of Mariana as the main flag ship of the Japan first fleet and launched its first attack team. Soon after that, at 8:10, a torpedo launched by the US submarine Albacore hit the Taiho. The torpedo hit the outer plate of the Taiho's front gasoline tank, and its explosion ease away the deck joint on the tank, causing volatile gas to begin to leak and fill the hanger space. However, this hit did not result in critical damage to the Taiho herself, and the Taiho's speed did not decline.

Unfortunately, the front elevator was broken by that torpedo hit so that it was stopped on the way to the deck while carrying aircraft for the second attack team. As the elevator placed at front side of the flight deck was opening its hatch, it was impossible to either launch the second attack team or accommodate returning aircraft of the first attack team until the hatch was closed. Because of the haste in closing the hatch by using possible running repairs, the ventilation in the hanger was restricted and volatile gas filled the hanger. After a few hours, the volatile gas was ignited by some ignition source, and the resulting explosion blew apart the ship in an instant, engulfing the ship in flames. All fire extinguishing devices were also destroyed by the explosion, and as the fire spread, the ship gradually leaned and sank.

The Taiho was constructed to be an unsinkable aircraft carrier. But the defense on flight deck was of no use whatsoever. However, this was not the main cause of the wrecking of the Taiho. The measures taken to protect the gasoline tanks and prevent volatile gas for leaking were inadequate. Just after this accident, an emergency measure beyond naval engineer's wildest dreams was adopted to all fleets of Japanese imperial navy. The method called sink-preventing method or buoyancy-keeping method in order to change engineer's way of thinking.

The disaster of the first fleet was not the only example of this failure. At 11:20 a.m., after the launching the second attack team, the aircraft carrier Sho-kaku was also torpedoed by the US submarine Cavilla, and a hit of three torpedoes caused catastrophic fires. The Sho-kaku sank at 2:01 p.m., before the sinking of the Taiho.

3. Course

The primary requirement for the Taiho by the Japanese Imperial Navy was to be an aircraft carrier that could participate in a battle for a long time at the front line without losing its flight deck function even if the ship were to be attacked.

Because an aircraft carrier has a large body, its flight deck is a good target for enemy aircraft. Just one direct hit of a bomb on the flight deck is adequate to destroy the function of the aircraft carrier. In fact, this was proven to be true with the regular aircraft carriers of the Japanese Imperial Navy in the Battle of the Coral Sea, the Battle of Midway, and the Battle of Santa Cruz Island.

The requirements for the Taiho also included the ability to accommodate the aircraft from other aircraft carriers were damaged, which meant that the Taiho had to be able to load enough fuel and weapons to

relaunch the aircraft that had lost their own mother ship. An ordinary aircraft carrier only carries enough fuel and weapons for its own aircrafts, so this point is a big difference between the Taiho and other aircraft carriers before her. In summary, the Taiho was constructed as a novel aircraft carrier that could carry a large amount of fuel and weapons and that could maintain the function of its flight deck even when under attack. In order to accommodate these new features, the Taiho's aircraft capacity was reduced to 52. This number is slightly less than that of regular aircraft carriers.

In the construction of the Taiho, the dock engineers focused on the defense of the flight deck. In those days, the weapons assumed to be used by the enemy were armor piercing bombs. This kind of bomb could destroy the ability to launch and land aircraft if it exploded on the flight deck. Initially, the Taiho was required to survive hits by 250kg armor piercing bombs, but later in the project the requirement was changed to 500kg bombs. In order to fulfill this requirement, thick armor had to be attached to the flight deck. The flight deck of the Taiho had a length of 257m and a maximum width of 30m. It is impossible to attach the armor on this large area from a stability and mobility standpoint. Therefore, the engineers attached armor plates on minimum area that was used as the airstrip (length:150m, width:18m). In order to survive a hit by a 500kg bomb, 75mm armor was required. The engineers also attached 20mm special steel plates below the armor.

Aircraft were lifted from the hanger to the flight deck by elevator. The elevator space on the flight deck was a square area 14 meters in length, and this area was the weakest point of the Taiho. Regular aircraft carriers have three elevators, but the Taiho had only two elevators placed on the front side and the rear side, and armor plates were attached to those elevators. The armor attached on the elevators was 50mm thick and weighed 100tonnes. That is an unimaginable weight for a land elevator.

Attaching armor on the flight deck raised the center of gravity of the ship. Thus the height from the water surface was designed to be 12.51m.

The side armors were designed to hold against the horizontal hit of a 500kg bomb. The defense of the ammunition storage area was designed to endure hits by the 8 inch cannon of heavy cruisers. Double walls containing a space filled with liquid were used as defense against torpedo attack. Oil or water was used for the liquid. Liquid is an incompressible fluid, unlike gases. When a torpedo hits the outer wall, the impact of the hit is propagated by the liquid to a large area of the inner wall. Then the inner wall receives the force of the impact distributed over a large surface area and this effect declines about 30% so we can say that the liquid layer requires 90cm thickness. The explosive of a torpedo is usually 400kg, and the Taiho's underwater diffuse was enough to survive a hit by such an explosive.

The armor of the ship belly was edge wise with an upper-side thickness of 185mm and a lower-side thickness of 70mm. Under draft-line part of the hull were the armor angles against center line of the ship. This armor prevented a torpedo from hitting the ship vertically, which reduced the damage of the hit.

The bridge was island shaped and placed on the center of the ship. In addition, an angled vertical chimney structure integrated with the bridge structure was adopted.

4. Cause

It is impossible for a defensive aircraft carrier such as the Taiho to be sunk by the hit of a single torpedo. The main cause of the sinking of the Taiho was the fire disaster.

The Taiho was constructed to be unsinkable; however, its special flight deck defense turned out to be of no use whatsoever. But this is not an accident. The defense methods used to protect the gasoline tanks and the fire precautions taken against leaking volatile gas were insufficient.

5. Immediate Action

Before the sinking of the Taiho, the issue of appropriate fire defense measures was brought up. The fire defense measures considered were removing combustible materials and installation of a completely equipped fire extinguish system. Those measures were not uncommon for fighting ships, and conceivable countermeasures were thought to be done. However, after the beginning of the Pacific War, no limit that indicates adequate fire defense level were found from the investigations of a large number of damaged ships. Since the beginning of war, at first paint was considered to be a problem. Initially, there were some cases where soldiers pealed off the paint before a ship participated in a battle. After a short time incombustible paint was developed, but it was insufficient in stickiness and rust prevention.

The aircraft carrier Jun-yo that participated in the battle of Mariana in June 1944 was based on a kind of passenger boat, and it used a lot of wood for structure. Before the battle, almost all things of Jun-yo considered to be combustible were discarded.

After the battle of Mariana, a study group consisting of experts from all divisions developed groundbreaking countermeasures that were to be adopted in the inhabited area and so on. These ideas were suggested by Major Hisaemon Sakuraba and were unimaginable in ordinary times. More specifically, they were as follows:

- Do not use wooden products
- Peel off all paint and coat with Art Metal Cement
- Dispose of all linoleum without a few exception.
- Hanging-floor storage are to be water-proof and used as fire defense water tank.
- Public room is to have only a side table for surgery, and all other furniture are to be detachable.
- Beds in private rooms are to be folding type made from canvas.
- Curtains are all to be disposed.
- Soldiers room has only a table combined with a bed.
- Soldiers place a mat on steel plates on which they take their meals and sleep.

Enhancements of fire extinguishing capabilities were also carried out. Movable pumps were added and fire extinguishing tubes were extended in areas that were easily flammable. Concerning aircraft carriers, there were many examples where fires caused critical damage. As a result of the disabling of a large number of aircraft carriers in the battle of Midway, a bubble fire extinguishing system was adopted as a drastic countermeasure. A carbon-dioxide gas fire extinguishing system was adopted for the hanger, but

when hanger was damaged, there were also opened hole then the effect of the system was little. Therefore, the bubble fire extinguishing system that sprinkles bubbles of soap liquid into hanger from a nozzle of a pump in order to put out fires was adopted.

6. Countermeasure

The clearance of combustible materials and completion of fire control equipment as fire precautions was reviewed. In addition, the defense measures for protecting gasoline tanks in aircraft carriers were reviewed from the lesson of the Taiho.

Gasoline tanks in aircraft carriers were basically armored, but after the battle of Midway water was filled around the tanks. However, as a result of the loss of the Taiho at the battle of Mariana, the fact that those methods were inadequate was revealed. Then engineers build up rebar structure in this space and fulfilled concretes. In the case of the aircraft carrier Zuikaku, an emergency countermeasure that local bulge were made at the outside of outer plate of gasoline tanks and fulfilled with concrete was taken.

At the same time, an instruction to minimize the load of gasoline and to dry completely empty gasoline tank and close the gasoline tube was ordered. The ventilation system in the hanger was reinforced in order to avoid accumulation of volatile gas.

After those countermeasures listed above were implemented, the battle of Philippine sea took place. In the battle, the Japan Imperial Navy lost four aircraft carriers, but each of the ships seemed to have been remarkably well reinforced against damage.

7. Knowledge

The cause of the wreck of the Taiho was inadequate protection of the gasoline tanks and inadequate fire prevention measures against volatile gas. Soon after this accident, an emergency measure beyond naval engineer's wildest dreams was adopted to all fleets of Japanese imperial navy. The method called sink-preventing method or buoyancy-keeping method in order to change engineer's way of thinking.

The great damage caused by the lost of four aircraft carriers at the battle of Midway and the loss of the Taiho was avoidable if commanders did not find out but engineers did. This affair revealed a critical breach in which engineers tend to respond only to the requirements of the commanders. Engineers must study, have insightful view, and do things with a great deal of subtlety. The result of the wreck of the Taiho tells us that the insights, foresights and subtlety of the engineers dominate the destiny of a nation.

If you generalized this affair, you can find the facts that there were diremption between the affairs countermeasured and the affairs really happened. There was the highly defensive countermeasure that enables the aircraft carrier to battle and cruising even a torpedo hit the ship, but there was no attention to the hit causes leak of volatile gas and that cause fire disaster which diminish the most important functions. A lot of phenomenon are chained process and discovery of worst scenario is engineers' insight and foresight. They identified the danger of volatile gas, but they had no countermeasures that focused on the process like leak, congestion, inflaming, and explosion.

In order to help engineers to study and have foresight, we need the establishment and treatment that enable those things. In addition, the opinions of the engineers should be given considerable attention. We

should not repeat the failures in history. If we replace commanders with employers, this lesson can be applied to the engineers of today's business world.

8. Primary Scenario

01. Poor Value Perception
02. Poor Safety Awareness
03. Lack of Awareness of the Risk
04. Insufficient Analysis or Research
05. Insufficient Practice
06. Planning and Design
07. Poor Planning
08. Mismatching of Expertness
09. Usage
10. Operation/Use
11. Aircraft Carrier
12. Battle
13. Failure
14. Fracture/Damage
15. Hitting of a Torpedo
16. Secondary Damage
17. External Damage
18. Fuel Tank
19. Leakage
20. Explosion
21. Failure
22. Large-Scale Damage
23. Wreck
24. Loss to Organization
25. Social Loss
26. Weakening national defense

Ws 29.300T
Wt 34.200t
V 33.3K
A 長10CM 6HAX6
25MM 6X17
Y X 84

〔附圖2-8〕
Aircraft Carrier Taiho
(昭和19年)

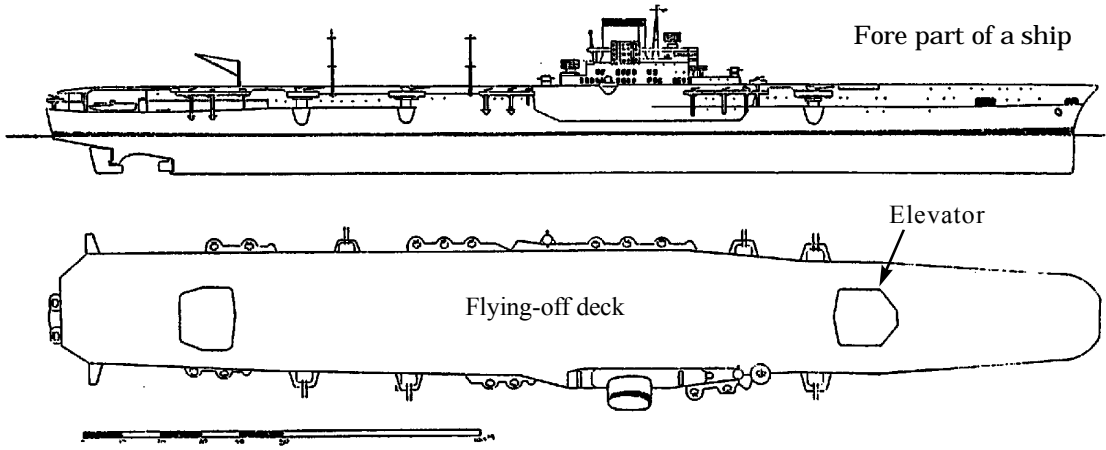


Fig. 1 The Draft of the Aircraft Carrier Taiho.