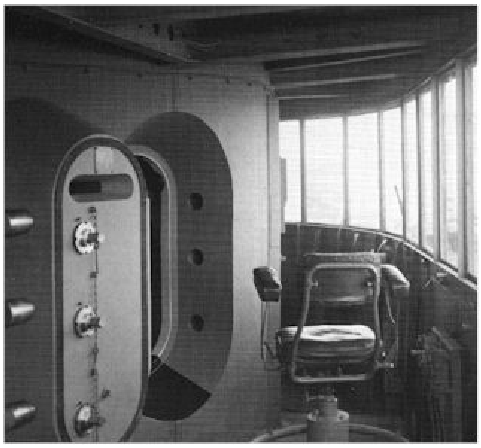
battleship.org
News
Current
Archive
Missouri to Pearl
ICPA Goes to Sea
Ship Check
Spare Guns
Missouri VJ Day
Articles
History
US Battleships
Santiago de Cuba
Leyte Gulf
A Sailor's Log
Iowa Class
Statistics
Cutaway
Main Armament
Sec. Armament
Missile Battery
Aircraft
Armor
Propulsion
Barbette Crack
Features
Mystery Ship
Battleship Quiz
Book Review
Build a Better BB
Scale Drawings
Photo Gallery
Museums
USS Texas
USS North Carolina
USS Massachusetts

Iowa Class: Armor Protection



The interior of the ships bridge. At 17.3 inches, the conning tower armor is among the thickest in the ship. Notice the viewing slit in the door.

One of the main characteristics of a battleship is its ability to withstand an attack. Few ships from the past and no modern ships can equal the survivability of the Iowa Class Battleships. The decision of where to armor and how much armor to use is a very complicated and sometimes frustrating process. Simply adding armor can not be done since this greatly increases weight and reduces the top speed of the ship. The process of protecting a battleship is an art that has been perfected over decades of battleship design. Iowa Class Battleships are an excellent example of superior armor protection and high top speed.

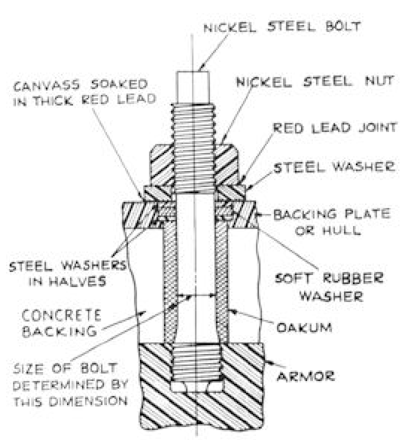
The armor systems of the Iowa Class ships can be divided into two basic sections. First is the above water armor, which is designed to protect the ship against gun fire and aerial bombing. The second is the below water armor (side protective and triple bottom armor), which is designed to protect the vessel from mines, near miss bombs and of course, torpedoes.

All the systems needed to keep these ship's combat effective such as magazines, engineering spaces, steering, plotting rooms, command & control, weapons, etc. are protected by heavy armor. The armor box, referred to as the citadel, extends from just forward of Turret 1 to just aft of Turret III. The top, sides and ends of the citadel are heavily armored, however the bottom is not ballistically protected. Critical systems located outside the citadel such as the turrets, conning tower, fire control, directors, etc. are armored extensions of the citadel.

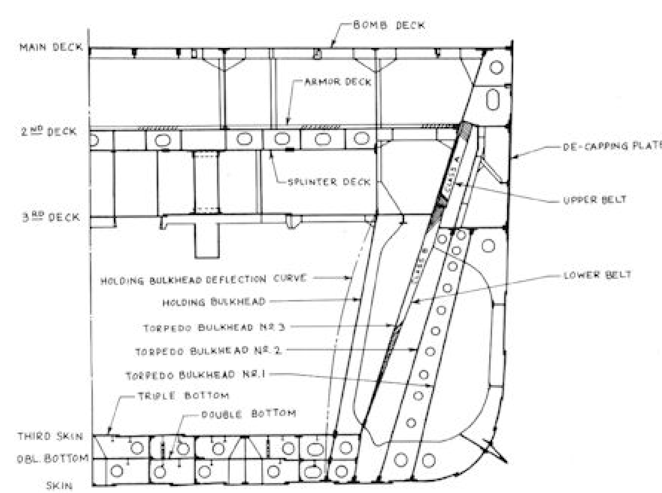
Generally, a ship is armored to withstand hits from weapons equal to or smaller than its own main guns. The Iowa's mount 16 inch main guns and are designed for optimal performance at ranges between 19,000 and 30,000 yards. With this in mind, the deck and side armor is designed to defeat the armor piercing shells fired by a ship mounting equal armament at these same ranges.

One factor in the original building of the Iowa's was the availability of armor plating. In 1939, when armor production began for the Iowa's, the United States could produce 75,000,000 tons of steel per a year. This may seem like plenty, however the United States ability to produce armor, given the special manufacturing and testing procedures, meant the steel mills could only produce 19,000 tons of armor per year.

In addition to the factors of weight and availability of armor, there was the matter of urgency. Due to the onset of war in Europe and the Pacific, assembly time of different armor types was taken into consideration. Another problem arose with the change from 2,240 pound. projectile to the new 2,700 pound. shell. First, the armor for BB61 and BB62 was already on order and besides, the increase in armor to protect the ship from this new shell would have drastically increased displacement (small changes were made to the armor of BB63 and newer battleships).



Typical armor bolt used for securing the Class A upper bel to its STS backing plate. One bolt per every 5 square feet of armor plate.



BB61-64 Arrangement of protection for torpedo defense and triple bottom systems. (Robert Sumrall)

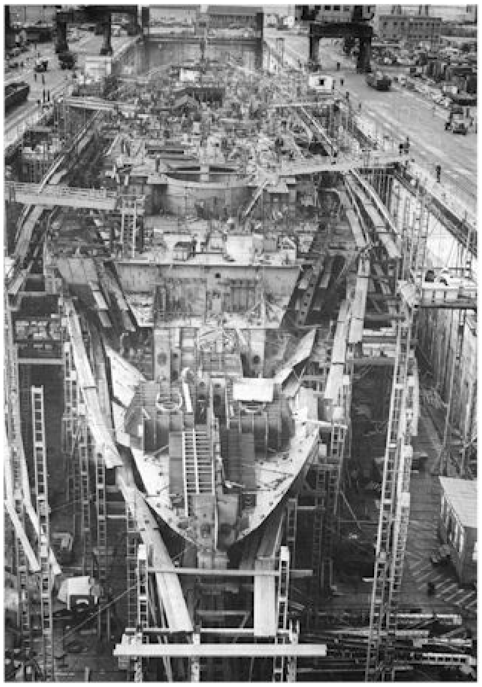
With the exception of its guns, the most awe inspiring aspect of the battleship is the huge amount of armor employed to protect the ship. The overall design of the *Iowa* class armor system is essentially the same as that of their predecessors, the four *South Dakota* class battleships. Both feature an internal main belt which represents a

USS Alabama
USS Iowa
USS New Jersey
USS Missouri
USS Wisconsin
IJN Mikasa
Links
Guest Book
Ship's Store
Contact Info
Help
Navigation
Who We Are
Join Us

Page Last Modified
28 Jun 2000

significant change from the previous two *North Carolina* class battleships and was adopted only with reluctance. First of all, an internal belt is difficult and costly to install and secondly, it is difficult to reach for repairs. The armor on the *North Carolinas* was designed with an external belt designed to protect against a 14in shell. The *South Dakotas* and later the *Iowas* were designed to have protection against the 16in shell. To achieve this level of protection, the belt incline would have to be increased to 19 degrees. An external belt inclined at the steeper angle would have required a wider beam to maintain stability, but would have precluded passage through the Panama Canal. Therefore, an internal belt was adopted.

Armor distribution on any warship is a trade-off between protection and weight. If the armor is increased, the weight also increases, which results in slower top end speed and maneuverability. The vertical side armor consists of an upper and lower belt which is inclined to an angle of 19 degrees. The total depth of the belt is 38 feet 6 inches and extends from just before turret 1 to just aft of turret 3. The upper belt is Class A armor, 12.1 inches thick, while the lower belt is Class B armor, 12.1 inches thick at the top and tapered to 1.62 inches at the bottom.



Construction of *USS Kentucky* in 1946. Construction intermittently
continued until she was about 75% complete. The *Kentucky* was never completed, and she was scrapped in 1958. Her machinery was carefully removed and used to power *two* fast Combat Support Ships - the *USS Sacramento* (AOE1) and *USS Camden* (AOE 2). (Iowa Class BB's / Sumrall)

The deck consists of three parts, the bomb deck, the main armor deck, and the splinter deck. The bomb deck is 1.5 inches STS plate, the main armor deck is 4.75 inches Class B armor laid on 1.25 inches STS plate and the splinter deck is 0.625 inches STS plate. The bomb deck is designed to detonate general purpose bombs on contact and arm armor piercing bombs so they will explode between the bomb deck and the main armor deck. Within the immune zone, the main armor deck is designed to defeat plunging shells which may penetrate the bomb deck. The splinter deck is designed to contain any fragments and pieces of armor which might be broken off from the main armor deck.

Turret armor is constructed from a combination of Class A and Class B armor and STS plate. The faces of the turrets are 17I inches Class B armor over 2.5 inches STS plate. The side plates are 9.5 inches Class A armor on .75 inch STS plate. The back plates are 12 inches Class A armor and the turret roofs are 7.25 inches Class B armor.

The conning tower is constructed from segments of Class B armor 17.3 inches thick. BB61 is three levels and BB62 on had 2 levels (the flag level was omitted). Roof plates are 7.25 inches Class B and the floor is 4 inches STS. The conning tower is connected to the citadel by a communications tube with a wall thickness of 16 inches of Class B armor.

The most notable difference between modern warships and the Iowa Class battleships is the huge amount of armor protection the Iowas employ. Modern warships are hardly armored at all, instead relying on their ability to stop incoming threats before they can hit the ship. Newer warships have only a few inches of armor plating and in an effort to save weight, have even used aluminum in their superstructures. In contrast, the Iowas were built at a time before missiles and since you could not shoot down or destroy an incoming projectile, the ships were built to withstand the tremendous force of impact produced by naval gunfire.

The installation of heavy armor plates was no easy task and the method of fastening them to the ship structure is worth mentioning. A typical upper armor belt plate is 30 feet wide and 10' 6" high. The upper plate fits directly over three of the lower belt plates and is bolted to a backing plate with specially designed watertight bolts. Since it is impossible to fit the belt snugly against the backing plate, the bolts stand off the armor about 2 inches, creating a small void between the belt and the plate. After the installation is complete, the void space is filled with concrete, which provides support for the armor over the entire surface. One bolt for every five square feet of surface area is used to secure the plate. This method, along with welding and heavy rivets is used in the armor belt assembly process.

The side protection (torpedo defense) and the triple bottom systems provide protection against underwater threats such as torpedoes, mines and near-miss explosions. Both of these multi-layered systems are intended to absorb the energy from an underwater explosion equivalent to a 700 pound charge of TNT. The Navy derived at this amount of protection based on intelligence information gathered in the 1930's. At that time, US Naval Intelligence was unaware of the advances the Japanese had made in torpedo technology. One of these advances was the Japanese 24 inch diameter "Long Lance" torpedo, which carried a charge equivalent to 891 pounds of TNT. A Long Lance torpedo essentially defeated the *USS North Carolina's* side protective system. The ship was hit by chance at its narrowest, and therefore most vulnerable part of the side protection system. An Iowa Class battleship would have taken lighter damage from the torpedo due to an improved torpedo protection system over the North Carolina Class.

However, the Iowa Class torpedo defense system is virtually the same as in the previous South Dakota Class battleships. The side protection system consists of four tanks on the outboard side of the hull extending from the 3rd deck to the bottom of the ship. The two outboard tanks are liquid loaded with fuel oil or ballast and the two inboard tanks are kept void. The liquid layers are intended to deform and absorb the shock from the explosion and contain most of the shards from the damaged structure. The innermost void is expected to contain any leakage into the interior ship spaces. The armor belt is designed to stop fragments that penetrate the second torpedo bulkhead. This method should contain the damage and protect the machinery and other vital spaces. Torpedo bulkheads #1, #2 and the inner holding bulkhead are 5/8" thick steel. Bulkhead #3 is 12.1" thick armor tapering to 1" thick at the bottom and is attached to a 1.5" special treated steel (STS) plate. Additional tests in 1943 showed certain structural defects in the system. Changes were made to BB65 and BB66 that would have improved system performance by as much as 20 percent, but unfortunately, neither ship was ever completed.

The USS Missouri under construction. Her sleek external lines provide no evidence of the massive armor belts that lie underneath.