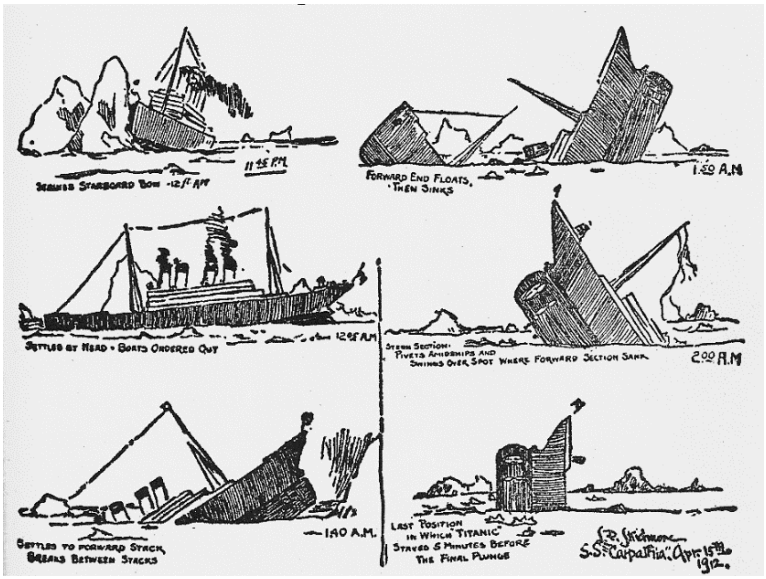
A QUIET SEA

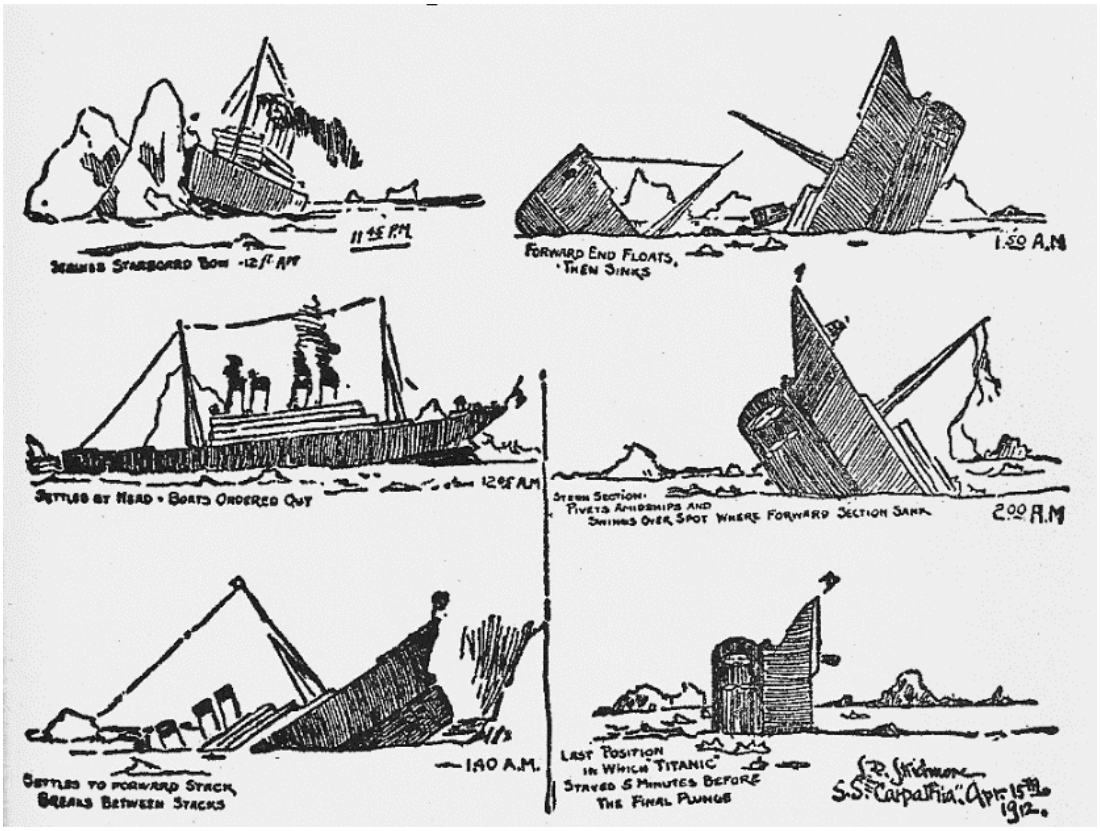
RMS TITANIC



HULL FAILURE

TITANIC HULL FAILURE

It wasn't until Titanic was discovered in 1986 by a Woods Hole Oceanographic Institute expedition, led by Robert Ballard, that it became known for certain that the ship experienced a total structural failure and broke in two. When she came to rest, the hull sections were separated by over 2,000 feet of ocean floor. Until that discovery, it was assumed that Titanic sank in one piece. Although there were eyewitness accounts describing the breakup of the hull, the Boards of Inquiry accepted the testimony of the four surviving officers that Titanic sank intact. Explosive sounds were attributed to boiler explosions and machinery tearing loose and crashing into the bow. However, the most compelling description of the catastrophic hull failure came from 17-year-old Jack Thayer, who found himself in the water near the ship. "It was like standing under a steel railway bridge while an express train passes overhead mingled with the noise of a pressed steel factory and the wholesale breakage of china. Suddenly the whole superstructure of the ship appeared to split, well forward to midship, and bow or buckle upwards."



Survivor Jack Thayer's Illustration of the sinking
Credit: Wiki Commons

During Titanic's cataclysmic self-destruction, the stern slowly settled back. As her bow sank deeper, the upper midship portion of the hull remained partially attached, the fore section hauling the still floating stern down until the dwindling connection between bow and stern finally ruptured. During this convulsion, the stern twisted violently around to port, floated briefly on its own, then disappeared under the sea.

Although the hull failure was included in James Cameron's 1997 Titanic film, the sequence of the top to bottom hull failure was determined to be incorrect. Subsequent investigations by William Garzke, J.W. Stettler, B.S. Thomas (M), Richard Woytowich, Roy Mendot and others strongly point to a bottom-up failure.

There are various ways to rivet ship's plates together, but the two basic methods are butt laps and butt joints. Simply put, for a butt lap, the plate ends overlap each other and are riveted; in the butt joint, the plate ends bear on each other and are connected with a third piece, the butt strap, that is riveted to both plates. The bottom plating of riveted merchant ships after the 1880s was usually connected with butt laps. These were simpler to construct and required less material and labor. However, the advantage of added compressive strength derived from the plate edges bearing upon one another in a butt joint, was lost. This was of less importance with a well-designed, multiple-riveted butt lap and the support offered by internal framing and internal double bottom tank top plating. Still, the butt lap joints in Titanic may have contributed in some degree to the failure of the bottom plating under those extreme conditions.

A detailed failure sequence of the double bottom structure is beyond the scope of this post, but calculations revealed that the bottom possessed about 83% of the strength of the heavily constructed, doubled upper hull plating, known as the sheer strake and strength deck. Suffice it to say that various structural features contributed to the ship's bottom failure: the reduction of the double bottom depth from about 6 to 5 feet between the reciprocating engine room and Boiler Room #1; the presence of 3 manholes transversely across the inner bottom plating in Boiler Rm. #1, forming natural weak spots; the abrupt ends of longitudinal framing to support the reciprocating engines; and so forth. While Titanic was well designed to withstand the rigors of extreme winter North

Atlantic conditions, the hull wasn't able to resist the huge stresses imposed upon it by lifting thousands of tons of steel and machinery out of the sea.

Below is the sequence of failure as shown in the paper, "The Breakup of Titanic, A Progress Report from the Marine Forensics Panel," by Roy F. Mengot, UGS, and Richard T. Woytowich, NYC College of Technology.

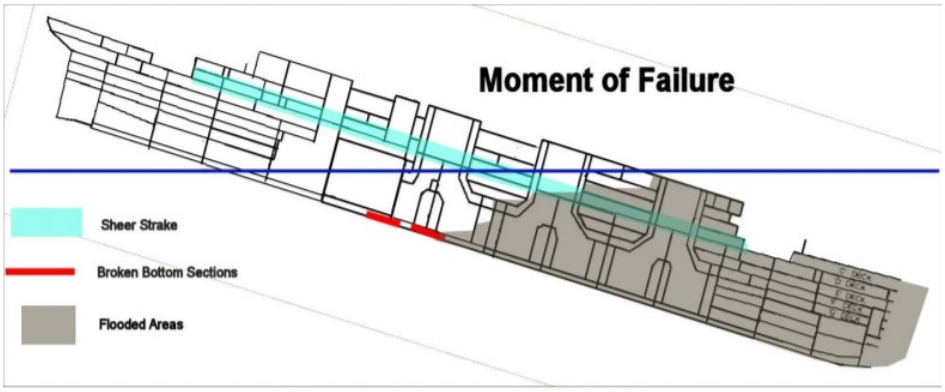


Figure 8 – Moment of Initial failure

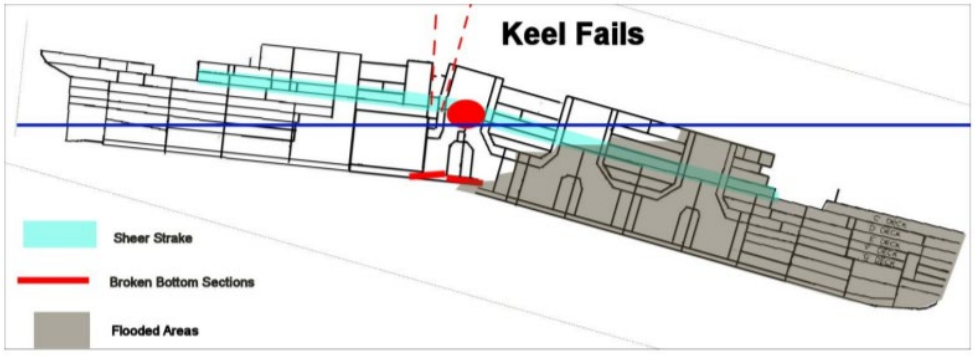


Figure 9 - Initial failure of the double bottom

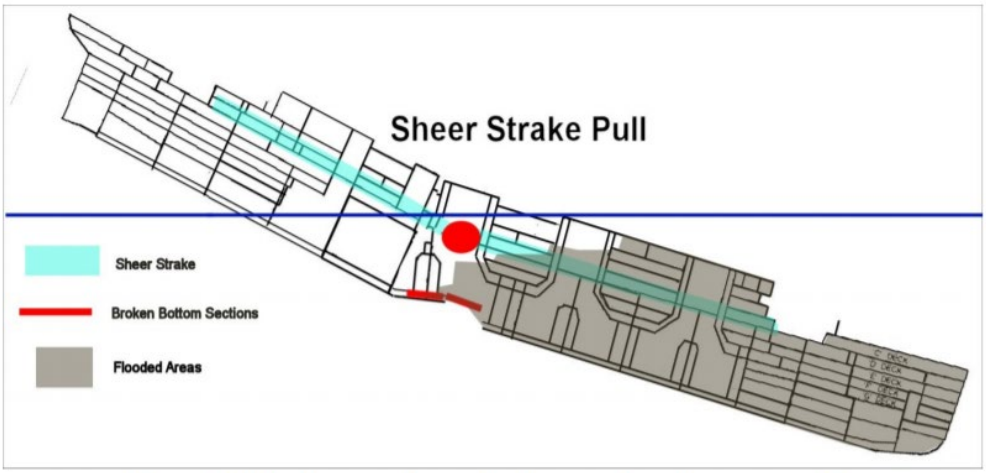


Figure 10 - The bow section pulls downward on the stern section

Sequence of Titanic's hull failure as illustrated by Mengot and Woytowich