HSS: DESIGNS FOR THE 21st CENTURY

A truss of HSS helped raise the Civil War submarine Hunley from the ocean floor.

STRENGTH, LIGHTER WEIGHT, EASE OF FABRICATION AND COATING MAKE HSS CHOICE TO RAISE HISTORIC SUBMARINE

Steel Hollow Structural Sections (HSS) recently helped write a postscript to the American Civil War—only a few miles from where the conflict began nearly 140 years earlier.

HSS played a key part in an innovative recovery operation that succeeded in raising a Confederate submarine, the H.L. Hunley, from the floor of the Atlantic ocean off Charleston Harbor in South Carolina.

The Hunley's recovery was planned and conducted by Oceaneering International, Inc., a marine operations firm which also designed the 75,000 gallon chiller tank where the submarine is now being preserved.

HSS Truss Instrumental in Recovery Operation

Oceaneering's recovery method consisted of two 18' diameter foundation suction piles which anchored a 63' long HSS truss equipped with nylon slings to support the submarine as it was raised to the surface.

The excellent strength-to-weight ratios of HSS was a key consideration in its selection for the truss, according to Perry L. Smith, P.E., a commercial diver and lead engineer for Oceaneering on the project.

Holding down the weight of the truss was a prime consideration, as the truss and its load had to be within the lifting limits of the two 20-ton cranes at the conservation lab where the sub would be placed in the chiller tank.

"Using HSS allowed us to get more bang for our bucks," Smith says. "We were able to get all the strength we needed and still remain well within our weight parameters." The truss weighed 17,400 pounds.

HSS Reduces Costs of Fabrication, Coating

HSS offered two other important advantages over other structurals, according to Smith—reduced fabrication costs and reduced coating costs.

Oceaneering required all connections in the truss to be welded to guard against

corrosion, since the truss would be submerged in seawater for several months and in fresh water in the lab for 8-10 years. "We felt that HSS was the most economical and most efficient for all welded connections," Smith says. "The connections are easy to design, particularly with square and rectangular HSS, and they're easy to weld. And most important to us, everything is sealed off from corrosion."

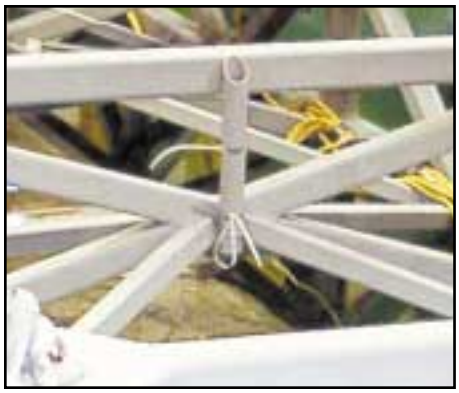
Another advantage was the ease of coating HSS. The truss received two layers of epoxy coating to protect against corrosion. The coating had to be compatible both with salt water and with the electrolyte solutions being used in the chiller tanks to preserve the submarine.

"It's a lot easier and quicker to coat HSS members than other structurals such as wide flanges, channels or angles, which have more surfaces," Smith says.

'Overall, HSS Offered Best Truss Design'

"Overall, HSS offered the best truss design for us, economically and from a standpoint of strength and weight," he concludes.

To raise the Hunley, Oceaneering first placed the two suction piles and sunk them so their tops were level with the seabed. Atop each pile was a caisson tower table, to which the truss was anchored by chains. Ratchets allowed



divers to adjust the horizontal and vertical position of the HSS truss. The truss was then positioned above the Hunley and divers began the task of removing sediment and placing the nylon slings under the sub.

When all had been placed, a 330-ton crane lifted the truss and its cargo to the surface and placed it on a material barge for its trip to a conservation lab at the former Charleston Navy Base. HSS legs attached to the truss kept the bottom of the sub's hull about 1' 6" above the deck of the barge.

Square, Rectangular HSS Used in Truss Design

The top chord of the truss was designed as a rigid frame of 5" x 5" HSS, allowing divers easy access during recovery operations. The bottom chord utilized 3" square chevron braces tied into lateral 4" square X-braces and the 8" x 6" HSS bottom chord. Wall thickness of the HSS ranged from 1/2" to 1/4".

The 3" square HSS braces were designed to take the lateral forces from current, wind and vessel motion and react against the slings' horizontal force component from the weight of the Hunley. They were in compression at all times. In addition to axial load, the bottom chord members were also under bending and torsion conditions due to sling placement.

The Hunley's role in Civil War history occurred in early 1864. In an attempt to help break the Union Navy's blockade of Charleston, the Hunley sank the Union ship Housatonic, becoming the first sub to destroy an enemy ship during wartime. Apart from a brief flashed signal to Confederates on nearby Sullivans Island, the sub and its crew of nine were never heard from afterwards. Years later it was found buried in the ocean floor about five miles east of the island.

The Hunley is now being treated with an electrolyte solution in the chiller tank so it can eventually be put on display. Several locations in the Charleston area are under consideration. And experts are looking at ways in which the metal preservation process might be speeded up.

In the meantime, archaeologists are seeking to unlock the mystery of why the Hunley sank.