NAVIGATION

Lighthouse 'Knee Deep' in Sea

The flashing light that beacons a way to safe harbor for ships and the plaintive foghorn mourning for clear weather both now come from structures straddling the sea

➤ THE LIGHT that sings bass—the lighthouse with its deep and sonorous foghorn—is making another one of its few great historic advances.

From a headland high above the sea the mariner's beacon of antiquity moved to lighthouses built on wave-swept rocks as far as a mile off shore. Then it was moved to perch high on the mast of a bobbing lightship moored at a fixed station in the open sea, sometimes 35 miles from land, marking the approach to a harbor.

The U.S. Coast Guard has now adopted the first basically new idea in deepwater structures to aid navigation since the original lightship was moored in the estuary of the Thames in 1732. It is using all-steel structures as lighthouses.

Thanks to modern high-strength steels, these sturdy four-legged platforms can stand in water "up to their knees," with their legs securely buried as deep as 270 feet below the ocean floor.

The lighthouse, with its imperturbable light—slowly revolving, blinking or steady—and its plaintive foghorn mourning for clear weather, has grown more sophisticated through the many years during which it has beaconed sailors to a safe harbor.

U.S. Coast Guard

LATEST 'LIGHTHOUSE'—This picture shows the new U.S. Coast Guard tower, a permanent structure anchored to the ocean floor, on a station 25 miles southeast of Cape Fear, N.C. The vessel that previously guarded this harbor is circling the lighttower in a farewell salute before departing.

The earliest lighthouses of recorded history were probably constructed about 700 years B.C. by the sea-roving Greeks. However, the lighthouse to which historians point with greatest pride was one of the legendary eight wonders of the ancient world—the famous Pharos of Alexandria, reputedly built in the third century before Christ by Sostratus of Cnidus in the reign of Ptolemy II.

Although there is no reliable evidence to support the supposed facts, the Alexandrian Pharos was reportedly a tower 600 feet tall, about three times higher than any lighthouse of modern times. Some remains of the tower were said to have been visible on the Isle of Pharos as late as the 14th century. Pharos has now become the general term for all lighthouses, and pharology is the science of lighthouse construction.

The oldest and probably one of the highest lighthouses still in existence is the waveswept 196-foot-tall Cordouan lighthouse built in 1584 on a rock in the Bay of Biscay near the mouth of the Gironde River in France.

High on Promontories

Many lighthouses are built on promontories above the sea. They are the easiest to build and maintain, and on clear nights can be seen for the greatest distance because of their height. However, among the most colorful lighthouses are those called waveswept because they are built in the open sea, fully exposed to the hazards of wave and wind.

Waveswept towers are usually constructed of masonry, sometimes of dovetailed granite blocks weighing up to two tons. They stand on rocks or shoals or similar outcropping, and at high tide or during the height of a storm may have their foundations entirely submerged. Occasionally waves sweep completely over them.

The United States has its share of waveswept lighthouses, many of them famous. These include such typical lights as Minots Ledge off Cohasset, Mass.; Race Rock in Long Island Sound; American Shoal at Saddlebunch Keys in Florida; Mile Rocks off Landsend in the Golden Gate and

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Lighthouse

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St. George Reef near Crescent City, Calif.; Spectacle Reef Lighthouse at the eastern end of the Straits of Mackinaw in Lake Huron, and Stannard Rock, southeast of Manitou Island in Lake Superior.

The site for a waveswept lighthouse depends upon finding close to shore a suitable outcropping or one near the surface of the sea on which a strong structure can be built.

Until quite recently, the only known alternative, was to use a lightship, particularly when the function of the light was to mark a harbor approach. Lightships are moored as far as 10 to 35 miles from shore, where water is too deep to construct a conventional lighthouse.

The first lightship was moored in the estuary of the Thames in 1732. The U.S. Coast Guard, which has responsibility for maintaining the necklace of 400 lighthouses among 42,000 aids to navigation along our 40,000 miles of coastline, established its first lightship in 1820 off Craney Island in the Elizabeth River near Norfolk, Va.

Lightships must be extremely seaworthy vessels. They are operated by men of great stamina and courage, since the vessels must be moored at sea in all kinds of weather. When lightship service was inaugurated, the ships were wood and the crew members were described as men of steel. Today the ships are also made of steel.

The vessels range in length from 110 to 138 feet and displace from 190 to 560 tons, their size depending upon whether they are moored in sheltered positions and estuaries or at exposed stations.

The vessels are reliable, but more than a strong hull and resolute crew are required to withstand the wind. The old wooden schooner-rigged Pollock Rip lightship was blown miles from her station near Nantucket by gale force winds in a famous storm of 1887.

Blown by Gale

As recently as Jan. 31, 1966, the 1,000-ton Ambrose lightship, normally moored east of Sandy Hook, was blown a mile from her station by gale force winds. Even her 7,500-pound mushroom anchor—as large as the anchors used by the largest battleships—could not keep her on station. Throughout the time the Ambrose lightship was not on station, the Coast Guard radioed her position to all ships at sea.

Lightships have various shortcomings, the principal one being their constantly growing cost. Also one lightship at a station is not enough. A relief lightship and a relief crew must be provided for each three stations. The crew of a lightship varies from 12 to 20 men.

After studying the problem for a number of years, the Coast Guard found a way to reduce the cost and improve the reliability of its expensive lightship service. It has adapted structures similar to the oil industry's offshore drilling rigs. A new kind of 2low alloy steel is used to provide virtually maintenance-free structures.

The Coast Guard's all-steel light structures cost about 35% less than the one and one-third lightships required for each station, and require only one-third as large a crew as a single lightship.

When exposed to the atmosphere, the steel used in the light structures forms a thin, tight russet skin of oxide on its surface, thus, in effect, sealing itself against further corrosion. Known to engineers as ASTM A-242, the new steel has a resistance to atmospheric corrosion four times greater than that of ordinary steel. It is also about one and one-half times stronger.

The Coast Guard uses a coal tar epoxy coating on the waveswept portions of its light structures, which are four-legged platforms that stand on sturdy steel legs securely buried as deep as 270 feet below the ocean floor. Unlike lightships that can drift away from station, the new light structures remain in place despite the strongest gales.

The light structures stand from four to 35 miles off shore in from 40 to 85 feet of water. The four tubular legs range in size from 30 to 42 inches in diameter, depending upon the size of the structure, which can be built to accommodate a crew of six or can be unmanned.

The Coast Guard is now conducting a long-range program to automate as many lighthouses as possible, including some experimental work in this area in Long Island Sound.

Typical of the new structures is the $2.8 million Ambrose Channel offshore lighthouse that will mark the entrance to lower New York Bay. It will stand in 75 feet of water about 7.4 miles east of Sandy Hook, N.J., with its legs anchored 170 feet into the Atlantic Ocean floor.

The entire structure is of steel, except for the procelain-on-steel walls enclosing the housing. The superstructure framing will be constructed of the strong steel used in most skyscrapers, although such miscellaneous parts as hand rails, walkways, window and door frames that would normally require painting will be made of stainless steel.

An 18-million-candlepower light will flash a beacon from atop the lantern tower in the southeast corner of the structure, with the light located 133 feet above mean low water.

The Ambrose Lightship and Channel are named for John W. Ambrose, a New York engineer who devoted the last 18 years of his life to securing a Federal appropriation that finally totaled $8 million, in order to widen to 2,000 feet one of the two channels to New York Harbor and to dredge it to a depth of 40 feet for a distance of nearly seven miles.

When the job was completed, the Port of New York had one of the world's greatest harbors. In 1914, by act of the New York State Legislature, the name of both the channel and the lighthouse marking it, were changed from Sandy Hook to Ambrose.

The new light structure, when it is completed in 1967, will continue to be called Ambrose, one of the world's most famous harbor entrance beacons.

From a one-time high of 48 lightships, only 13 remain. Eight of these are expected to be replaced by light structures by 1972.

The remaining five lightships will continue in service because they are stationed in water too deep for economical use of light structures.

The lightships to be replaced by light structures and the dates are:

NAME	DATE	ESTABLISHED	LOCATION
Portland	1968	1903	12 m. SE of Portland, Me.
Boston	1969	1894	12 m. E. of Boston. Mass.
Pollock Rip	1972	1852	3 m. NE of Pollock Rip Ch., Mass.
Ambrose	1967	1908	10 m. SE of Brooklyn, N.Y.
Barnegat	1971	1927	7 m. E of Barnegat Inlet, N.J.
Five Fathom	1970	1849	16 m. SE of Cape May, N.J.
Delaware	1970	1961	21 m. E of Fenwick Island, Del.
Diamond Shoal	1966	1897	12 m. SE of Cape Hatteras, N.C.

The following five deep water lightships will continue in service:

NAME	ESTABLISHED	LOCATION
Nantucket	1854	48 m. SE of Nantucket Island
San Francisco	1898	12 m. W of San Francisco, Calif.
Blunts Reef	1905	4 m. W of Cape Mendicino, Calif.
Umatilla	1898	6 m. W of Cape Alava, Wash.
Columbia	1892	Entrance to Columbia River

The following lightships have been replaced by light structures:

Buzzards Bay	1961	West Entrance Buzzards Bay
Brenton Reef	1962	Narragansett Bay, off Newport, R. I.
Chesapeake	1965	12 m. E of Cape Henry, Va.
Frying Pan Shoals	1964	25 m. SE of Cape Fear, N.C.
Savannah	1964	23 m. E of Savannah, Ga.