Cape Cod Canal

This project proved the feasibility of a sea-level canal without locks that is subject to out-of-phase tidal cycles at its ends, and fostered coastal trade.

H. HOBART HOLLY

THE NEED for a canal across Cape Cod was recognized from early colonial times. Available sea routes around the tip of Cape Cod were hazardous due to shoals and fogs. In order to avoid these dangerous voyages, Pilgrim traders under Myles Standish began using a natural valley route across the Cape in 1623. These traders ascended the Scusset River, a small stream that flowed into Cape Cod Bay approximately 20 miles south of the Pilgrim settlement at Plymouth, and crossed three miles over a low ridge of sand to meet up with Dutch traders from New Amsterdam who had ascended the Manomet River from Buzzards Bay. Four years later, Governor William Bradford built the Aptuxcet trading post on the south bank of the Manomet River to further facilitate trade with the Dutch. Eliminating the portage section of this trade route prompted the first thoughts of a canal connecting the two bays.

For nearly 300 years various schemes were formulated for building a canal across the Cape. Possible routes were examined in 1676. By 1697 the public need was such that the General Court of Massachusetts appointed a committee to investigate the feasibility of a canal. During the War for Independence, General George Washington saw a military necessity for such a waterway and ordered the examination of a new route proposal in 1776. From that time to the end of the nineteenth century efforts escalated to build a canal. Some fifteen projects were considered, one in 1824 that included a survey by the U.S. Army Corps of Engineers. Some thirty companies considered the undertaking before 1899 when the Boston, Cape Cod and New York Canal Company was incorporated.

Construction

The real start of the project was in 1906 when DeWitt C. Flanagan, President of Boston, Cape Cod and New York Canal Company, persuaded August Perry Belmont to organize a syndicate that successfully raised the capital for the $12 million project. Belmont was drawn to the canal project because the canal would provide a safer passage, shorten the coastwise distance, serve the nation in time of war, return a reasonable profit, and be a memorial to his maternal ancestors, the Perrys of naval fame. He had furnished the financial backing for New York City's first subway, the IRT. William Barclay Parsons was his chief engineer on the IRT project and Belmont selected him for the Cape Cod Canal.

Parsons was faced with significant problems. Most important was the appreciable tidal difference between the two ends of the

proposed route. There was a 4.5± foot difference in sea level and a three hour difference in tide at either end. In the past, such a condition had been handled by means of locks to control the tidal currents. In 1906, he arrived at the Cape and, with Charles M. Thompson who had previously made test borings and tidal studies in the area, determined that a canal could be built.

Parsons developed a design for an open sea-level canal without locks in which tidal flows were kept within tolerable limits. He argued that this design could handle tidal differences, and that the currents in the canal would provide some scouring of the channel and inhibit ice formation, thereby reducing maintenance costs. The design was for a channel with two turns following the contour of the shore in order to avoid what would have been the difficult dredging of boulders in the Buzzards Bay shallows. The design that utilized the tidal currents rather than restricting them was based on new hydraulic data that Parsons published in a landmark technical paper in the Proceedings of the American Society of Civil Engineers (ASCE), for which he received the society's Norman Medal.

In 1907, a contract was signed with the Cape Cod Construction Company to perform the canal construction and ground was broken that year. With a second groundbreaking in 1909, construction was begun in earnest. The project required the removal of 15 million cubic yards of material — an undertaking of enormous proportions at that time. The principal methods in cutting the canal were suction or clam-shell "dipper" excavators. More effective dragline systems were developed too late to be used in the early stages of the canal construction. Work on "dry-dredging" the center section of the canal then began. Huge shovels removed the overburden, and loaded it onto small sidedumping single-truck cars that were hauled by saddle-back locomotives to a dumping area. The three shovels used for excavation proved so efficient that they were used for work beyond the original plan despite the fact that narrow gauge track had to be laid and relaid as the work progressed.

Construction included an 8-foot high breakwater, consisting of granite blocks quarried in Maine, that stretched 3,000 feet out into Cape Cod Bay in order to prevent the littoral current from blocking the canal's entrance as well as providing a sheltered approach along this shoreline exposed to northeasterly gales. A blanket of rip-rap 5 feet below and 5 feet above the waterline was constructed to prevent bank erosion. A ferry slip was constructed at Bournemouth and three bridges were built spanning the canal — a single leaf bascule for the New Haven Railroad at the mouth of Buzzards Bay, a highway drawbridge at Bourne with two 80-foot leaves, and a small draw span at Sagamore.

The nation's first major sea-level canal was opened to lighter draft vessels on July 29, 1914, and was completed in April 1916 at a cost of $12.9 million. Its dimensions provided a canal 25 feet deep over a bottom width of 100 feet, widening to 300 feet at the east end and 250 feet at the west end and through the approach channel in Buzzards Bay. The land cut of the canal was 8 miles, with dredged approaches of 5 miles in Buzzards Bay and one-half mile in Cape Cod Bay.

William Barclay Parsons

William Barclay Parsons (1859-1932) was born in New York City, and received his engineering education at Columbia University. He began his professional career on the Erie Railroad, advancing to district engineer in three years. From this experience, he wrote two books, *Tracks,* and, *Turnouts.* In 1885, he founded his engineering firm with his brother. Six years later, he was appointed deputy chief engineer to the New York Rapid Transit Commission, advancing to chief engineer three years later. While there, he prepared designs for a New York subway, but political and financial problems caused the Commission to suspend activities in 1898. Later that year, Parsons accepted the task of planning a 1,000-mile railroad in China from Hankow to Canton.

He was summoned back from China to work from 1899 to 1904 on the planning and construction of New York's first subway. As chief engineer, he solved problems of how to

rearrange the maze of underground pipes and conduits without disrupting utility service and how to tunnel through a busy metropolis without weakening building foundations and without closing Broadway to traffic. His solutions became the standards of subway engineering for the next half century. Parsons returned to private consulting in 1904 after the first leg of the subway had opened.

In 1904, as a member of the Isthmanian Canal Commission and the Board of Consulting Engineers for the Panama Canal, Parsons conducted a survey of the Canal Zone and reported to President Theodore Roosevelt on the practicality of building a sea-level canal at Panama. This design was rejected and a design with locks was selected.

The following year Parsons was named chief engineer of the Cape Cod Canal, providing him with the opportunity to prove the feasibility of a sea-level canal. He dedicated the next nine years of his life to the design and construction of the canal. Its successful completion demonstrated that a canal without locks, such as he had advocated for Panama, could be built between bodies of water having considerable tidal differences. As soon as the canal had opened, he set up ten observation posts along the length of the waterway where detailed measurements were taken throughout each tidal cycle.

When the U.S. entered World War I in 1917, he served as a senior member of a three-man commission of engineers appointed to report and make recommendations on the condition of French ports and railroads. Soon after he rejoined the 11th U.S. Engineers, serving as a major, lieutenant colonel and colonel. He served with his regiment when the engineers held the lines at Cambrai with picks and shovels. A major accomplishment was the construction of a four-track railway that carried American troops from the French coast to the front. His services during the war brought him honors from the U.S., Belgian, British and French governments.

He published many books and scholarly papers, both on technical subjects and his cross-cultural experiences. He recounted his adventures while making a survey for the 1,000-mile long railroad across China in *An American Engineer in China;* and he described his regiment's activities during World War I in *The American Engineers in France.* He wrote a book about Robert Fulton. His final work, *Engineers and Engineering in the Renaissance,* was published after his death and represented some 20 years of research in his own library, the British Museum, the Bibliothèque Nationale in Paris and the Vatican Library. Finding the Vatican collection difficult to use, he persuaded the Carnegie Endowment for International Peace to help modernize the library. With the cooperation of Pope Pius XI, the library was reorganized.

FIGURE 1. The unveiling of the ASCE plaque. From left to right: Col. Thomas A. Rhen, Rodney P. Plourde, and Robert A. Perrault, Jr.

The Canal Today

The canal did not prove to be the financial success that the Boston, Cape Cod and New York Company believed it would be. The federal government purchased the canal for $11.5 million on March 31, 1928, and transferred it to the U.S. Army Corps of Engineers which has operated the canal as a toll-free waterway. From 1928 to 1940 the Corps of Engineers undertook a series of canal improvements while retaining the original basic design

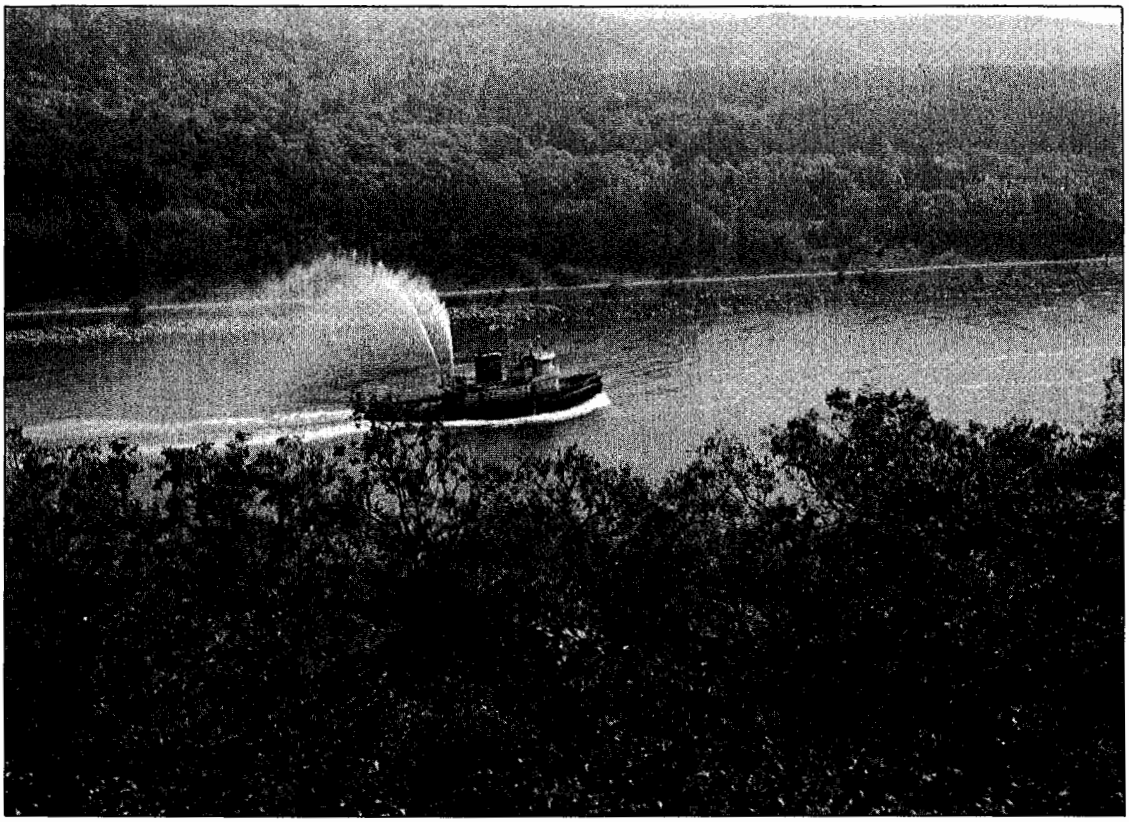

FIGURE 2. A salute from the U.S. Army Corps of Engineers to the new NHCE landmark at the close of the ceremonies.

features, thus adding a second chapter of distinction to the canal's history. The channel was somewhat realigned, widened to 480 feet and deepened to 32 feet, requiring the removal of an additional 40 million cubic yards of material. The overall length of the canal was extended to 17 miles. These improvements made the canal the widest sea-level canal in the world. During World War II, tremendous tonnage passed through the canal to avoid German submarines, providing an invaluable contribution to the national defense. The three original bridges across the canal were replaced in 1933 by two high-level highway bridges and a vertical lift railroad bridge, currently the second longest lift bridge in the world.

The Corps of Engineers has spent more than $138 million in improving, operating and maintaining the waterway since 1928. Currently, more than 15 million tons of commerce are shipped through the canal each year, reflecting 6,000 vessel trips. Another 15,000 recreational craft trips are recorded annually. The Corps of Engineers monitors the canal 24 hours per day using a network of computerized radar, closed circuit television and radio contact.

Landmark Dedication

The nomination and dedication of the Cape Cod Canal as a National Historic Civil Engineering Landmark (NHCEL) was a cooperative effort of the Boston Society of Civil Engineers Section/ASCE and the firm of Parsons Brinckerhoff Quade & Douglas, Inc., in conjunction with the centennial of the firm's founding by William Barclay Parsons. A member of the firm, Anthony C. Centore, handled the nomination presentation and his company's participation in the dedication. The dedication ceremonies were held on September 20, 1985, at the Belmont Rock Overlook at the canal where the ASCE plaque and one to Parsons now flank a plaque to August Perry Belmont,

the backer of the canal construction project.

Boston Society of Civil Engineers Section/ASCE President Rodney P. Plourde welcomed the guests and introduced the speakers. The Parsons plaque was presented by Paul H. Gilbert, Senior Vice-President of Parsons Brinckerhoff Quade & Douglas, Inc., who paid tribute to Parsons. The ASCE plaque was presented by Robert A. Perrault, Jr., Director of District 2 who spoke of the NHCEL program nationally and the particular significance of the landmarks in Massachusetts. The plaques were accepted by Colonel Thomas A. Rhen, Division Engineer, U.S. Army Corps of Engineers, who spoke on the canal and its operation today. Descendents of Parsons as well as representatives of local historical groups were in attendance. A salute from an Army fireboat concluded the ceremonies.

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