ENGINEERING

Air Key to Ocean Tunnel

Man's technical achievements in spanning open ocean with man-made islands and mile-long tunnels make the new bridge-tunnel an engineering wonder of the world.

By ELIZABETH HALL

See Front Cover

➤ AIR FOR BREATHING—not depth of water—was the biggest problem in building one of the greatest engineering feats of all time, the nearly completed Chesapeake Bay Bridge-Tunnel, seen on this week's front cover, that goes over and under a 17.5-mile stretch of open ocean at Virginia Beach, Va.

The shortest and most logical route for the bridge-tunnel—between Cape Henry and Cape Charles at the bay's mouth—was discarded, primarily because the shipping channel between the capes was too wide.

A tunnel running underneath the entire channel would have been too long to ventilate, necessitating the building of an island in the middle of the channel. Engineers decided instead to move the Cape Henry end farther into the bay where the channel splits into two lanes.

Four man-made islands provide ventilation and access to two mile-long tunnels beneath the major shipping lanes. The rest of the structure consists of prestressed concrete trestles 30 feet above the ocean surface and two bridge spans.

Each of the four man-made islands in the $200 million bridge-tunnel, scheduled to open April 15, holds a seven-story ventilation building. Inside each building are three huge blower fans and three exhaust fans that can change air in the tunnels at the rate of 1,800,000 cubic feet per minute.

Measuring devices inside each tunnel continuously relay the levels of carbon monoxide gas to the south ventilation building, where fans can be adjusted to handle the load.

Eye to Safety

The whole structure has been built with an eye to safety and safeguarded against 105-mile-per-hour hurricane winds and a 10-foot rise in sea level, in addition to 14½ foot waves.

Should a vehicle careen against the side of the bridge, the 18-inch curbing along each side of the road will keep it from crashing the guard rail. Suction created by the way in which the curb is constructed and by the "weep holes" for drainage will prevent vehicles from turning over on the bridge.

Telephones are placed every 3,000 feet on the bridge. Emergency equipment on each island will go to the rescue of stalled cars.

The structure will be well-lighted at night and red warning lights on top of each pole will prevent airplanes from trying to land on the bridge, which unfortunately, lines up perfectly with the Norfolk airport runways.

An ancient mining superstition that women in a tunnel mean a disaster and construction men's aversion to having women disrupt work previously had limited bridge visitors to men. However, I finally was allowed to go as far as the second Island from the Norfolk-Virginia Beach side.

Disguised as a construction engineer, I crossed the trestle and rode 90 feet under the ocean while tramp steamers and tankers passed overhead bound for Africa. I climbed on the rocks where a fishing pier will eventually be built and watched the water birds frolicking on a man-made island soon to become a sportsman's paradise.

I heard the mournful toot of a Little Creek-Kiptopeke Beach ferry boat as it bemoaned the progress of the bridge-tunnel that is putting the largest and one of the oldest ferry systems out of business.

And off to the right of the second island, I saw the red buoy marking the spot where the first "Big D"—a $1.5-million pile driver especially built for the project—capsized and sank two years ago. This is a constant reminder, to all who cross this engineering wonder, of the struggle waged with nature in constructing it.

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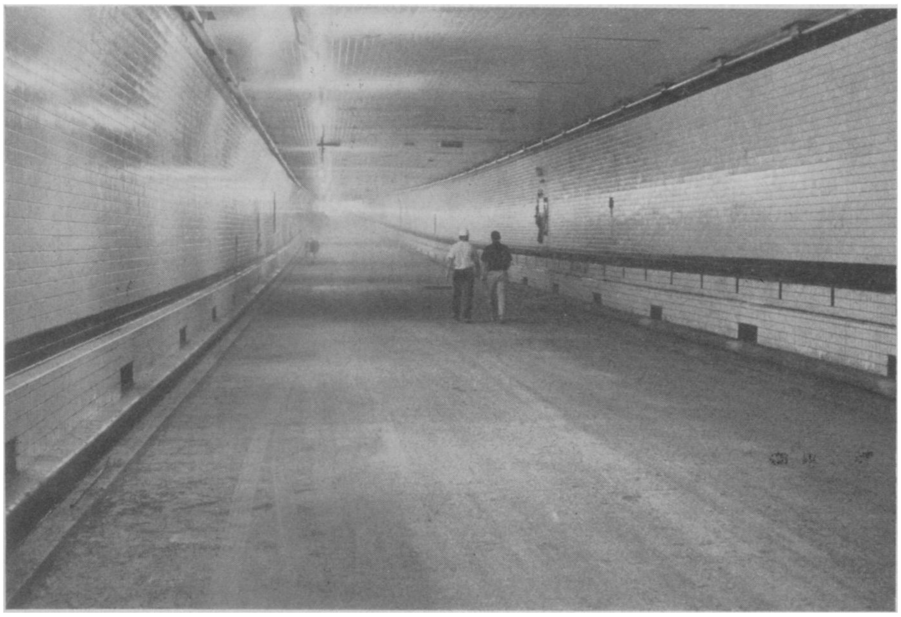

Neal Clark, Jr.

90 FEET DOWN IN THE OCEAN—These Chesapeake Bay Bridge-Tunnel engineers walk far below a busy shipping channel at the mouth of the Chesapeake Bay. This 17.5-mile-long man-made wonder will be open for traffic April 15.

English Channel Tunnel

➤ WHEN AND IF engineers build the long-planned tunnel connecting France with Britain under the English Channel, the new U.S. Chesapeake Bay Bridge-Tunnel, about to carry traffic, will receive some of the credit for making it possible.

What has been learned about tunnel ventilation in constructing the gigantic U.S. carrier of traffic between Virginia and Virginia's Eastern Shore will help the Channel tunnel plans.

England sent two engineers to work on the mammoth bridge-tunnel which has been called one of the five future wonders of the world.

The other four are the New York Narrows suspension bridge, the Mont Blanc tunnel underneath the Alps linking France and Italy, the one billion dollar Snowy Mountains scheme in Australia to divert 650 billion gallons of wasted water a year from east to west and the Netherlands' $750-million Delta Plan to hold back the sea.

The recent agreement between British and French Governments to build the Channel tunnel calls for twin 32-mile-long tubes in which electric trains will speed back and forth under more than 20 miles of open ocean carrying passengers, autos and freight.

The ventilation problem of exhaust fumes in such a long tunnel would be too difficult to permit auto traffic. Additional hazards are accidents, breakdowns and claustrophobia.

The tunnel will run between Sangatte near Calais, France, and Westenhanger, England, near Dover.

The project has been blocked by technical as well as political considerations since its birth in 1802. A French engineer, Mathieu-Favier, submitted a tunnel plan to Napoleon in which horse-drawn carriages lighted by smoking oil lamps would cross the channel.

It was feared that the oil fumes would asphyxiate the travelers. The tunnel and its massive ventilation problems were forgotten as England and France went to war.

More than 100 years ago, another French engineer, Thome de Gamond, who dedicated his life and entire fortune to reviving the tunnel project, submitted a plan to Napoleon III and the French Government, similar to the Chesapeake Bay Bridge-Tunnel.

His plan called for 13 artificial islands across the Channel to be used as dumps for the excavated material. The islands would have "chimneys" for ventilating the tunnel. Claiming that Channel navigation was bad enough due to frequent storms and fog without 13 artificial obstacles, officials rejected the plan.

Since then the project has run the gamut of everything from submerged, watertight trains to twin dams with a canal in the middle and 1,000-foot-long bridges on either end for navigation.

Politically, the idea has always been blocked by the British, who felt the addition of this "dry border" would ruin their insular security and isolation.

Even after 1909, when the French aviator Bleriot flew across the Channel in a monoplane, the English insisted the tunnel would be the spot for an invasion and envisioned enemy soldiers pouring into London.

During World War I, the British were willing to build the tunnel if its electric power plant were located in England, its entrance placed a long distance from the coast, and constructed in such a way that they could flood it or fill it with poison gas in time of war.

The French were satisfied with a heavy iron door, a half dozen field guns and a number of machine gun nests.

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ENGINEERING

Gas Turbine Car Feasible

➤ NEW LOW-COST materials especially developed to withstand high temperatures and stress have played an important role in turning the powerful gas turbine engine or jet aircraft into a practical automobile powerplant.

A series of iron-base superalloys having equivalent or superior life to aircraft type alloys, heat resisting iron aluminum alloys and long life rubbing seal materials that operate satisfactorily from surrounding temperatures up to 1,200 degrees Fahrenheit and above have contributed in turning the "dream car" prophesied for the future into an economic possibility today.

The only gas turbine cars now being produced for experimental test driving by a cross-section of automobile drivers in the United States belong to the Chrysler Corporation. Twenty have been produced so far, of the 50 turbine cars scheduled for consumer experimental use.

The Firebird III, an experimental passenger turbine car built by General Motors, is still in a laboratory experimental stage, as are turbine engines for buses and trucks. The Ford Motor Company is developing a 600 horsepower engine for the U.S. Navy and a 300 horsepower version of this engine for commercial application in trucks.

Although it has no fiery exhaust tail, the gas turbine is a real jet engine. Hot gases generated in the combustion chamber are harnessed by a turbine instead of being shot out the rear as in turbojet planes.

Air taken in from the grillwork at the front of the car is compressed and drawn into the engine's combustion chamber where it mixes with fuel and burns with a very hot flame, expanding the volume of the gas. The hot, compressed air from the combustion chamber then flows over the turbine, an efficient fan that converts the jet blasts to a turning motion, much like a pinwheel in the breeze.

In addition to the new low-cost materials, Chrysler engineers attribute the reality of their car to two other advances in this field. Twin regenerators situated vertically act as heat exchangers in preheating air entering the combustion chamber and removing the heat from the exhaust gases.

Another technical advance is a variable nozzle system that regulates the flow of the gases over the turbine blades. When the driver presses down on the accelerator pedal, the nozzles change the pitch of the blades to increase the efficiency of the gas flow and the speed of the car. The nozzles help solve the problems of braking and acceleration that using a gas turbine engine formerly presented for passenger car use.

The gas turbine car offers to the driver of the future a smaller, lightweight engine, more miles per gallon of gas, the replacement of high octane gasoline by other cheaper liquid fuels, a smooth, vibration-free ride and less maintenance costs. The turbine engine has no pistons and no cooling system.

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CHEMISTRY

New Builders' Caulk Does Not Freeze in Cold

➤ "UNFRIENDLY" SILICONE molecules that refuse to lump together and freeze in cold weather have been developed by General Electric researchers in Waterford, N. Y., into a year-round sealing material that spreads like soft butter at temperatures 35 degrees below zero.

Silicone rubber building sealants are used to seal curtain walls, glass, expansion joints and other points in construction.

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