Uniting a State with Steel

Five mile long suspension bridge brings together two peninsulas of Michigan to create a modern marvel of civil engineering

By **Colleen L. Hill-Stramsak,** P.E., *MI E '00*

The Mackinac Bridge is a modern civil engineering marvel. The five mile long bridge was the longest suspension bridge when construction was completed in 1957. The Mackinac Bridge is listed as a National Historic Civil Engineering Landmark by the American Society of Civil Engineers (ASCE), one of the youngest bridges to receive this honor.

The Mackinac (pronounced Mackinaw) Bridge connects Michigan's lower and upper peninsulas. The "Mighty Mac" spans the Straits of Mackinac and connects Mackinaw City in the south to the city of St. Ignace on the north.

The need for a connection between Michigan's peninsulas had been discussed since the late 1800s, with large stores of natural minerals and recreational areas in the Upper Peninsula (called the U.P. for short) and industrialized cities in the Lower Peninsula. It was logical to have a permanent all season connection between the two peninsulas.

The Straits of Mackinac was traversed by ferry service operated by the state highway department from 1923 to 1957, but all year service attempts were not successful, which continued the discussion for a permanent solution. Ferry service also had extreme backups in peak season, sometimes extending up to 15 miles from the ferry terminal on the Lower Peninsula side.

Suggested Floating Tunnel

In 1920, the highway commissioner suggested a submerged floating tunnel and asked for other suggestions to create a crossing. The counter proposal suggested a 17 mile route of causeways and bridges using several islands (including Mackinac Island) to connect the city of Cheboygan in the Lower Peninsula to St. Ignace in the U.P.

In 1934, the Mackinac Straits Bridge Authority was established to investigate the feasibility of a permanent crossing. After several applications to the public works administration for the Cheboygan to St. Ignace alignment were denied, a direct crossing was investigated and found feasible.

World War II halted progress on the new alignment until the Mackinac Bridge Authority was established in 1950.

Mackinac Minutiae

- *Total length of bridge: 26,372 feet*
- *Length of suspension bridge (including anchorages): 8,614 feet*
- *Main span length: 3,800 feet*
- *Total length of wire in main cables: 42,000 miles*
- *Number of wires in each cable: 12,580*
- *Diameter of main cables: 24 ½ inches*
- *Total weight of bridge: 1,024,500 tons*
- *Total number of engineering drawings: 4,000*
- *Total men employed, at the bridge site: 3,500*
- *Total number of engineers employed: 350*

The "Proposed Mackinac Straits Bridge Preliminary Report" was authored by the Board of Engineers of the Mackinac Bridge Authority: Othmar H. Ammann, *NY E 1902*, David B. Steinman, P.E., *NY A 1906*, and Glen B. Woodruff on January 10, 1951. This typewritten report gives concise and specific details about the preliminary investigations that led to the final design.

The report discusses the option to build a three lane bridge with a movable barrier to handle peak directional flow of traffic on the bridge. The report quickly rules out the three lane option due to the traffic analysis indicating that northbound traffic would be 1500 vehicles per hour and likely to triple in 50 years.

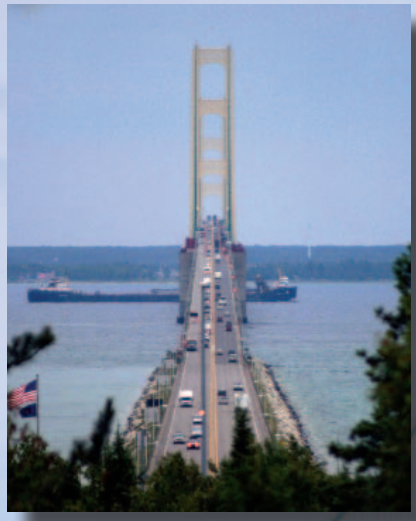
While the three lane option may have been able to handle the projected traffic, there would have been no provisions for emergency traffic during peak summer weekend periods. Today, peak for Bridge traffic is generally in July or August. In August 2012, 541,838 vehicles crossed the bridge.

Tacoma Bridge Failure

Steinman was an experienced bridge designer who had bid on and lost the contract to design the original Tacoma Narrows Bridge and went on record saying that it would fail. Due to the failure of the Tacoma Narrows Bridge, design features incorporated into the design of the Mackinac Bridge were strengthened:

- Stiffening trusses were increased to a depth of 45 feet
- Transverse floor beams were designed as open trusses instead of solid web girders
- Suspension deck designed with open grating on the inside lanes and proposed steel grating filled with lightweight concrete, covered with bituminous concrete (asphalt) to reduce the deck weight.
- The two truss structures that form the towers support the main span reach 552 feet above the water and 210 feet below the water.

Bridge construction began in May of 1954 and the Mighty Mac opened to traffic November 1, 1957.



Photos:
Main picture: The Mackinac Bridge seen from the south shore of the Lower Peninsula, with St. Ignace to the north.
Inset, left: A freighter passes beneath the main span.
Inset, right: A Mackinac Island ferry passes in front of the bridge.
Right: People make their way across during a Mackinac Bridge Walk.
Below: A panorama of the bridge, seen at sunset from Mackinac Island.

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