Portage Lake Bridge

ASCE Historic Civil Engineering Landmark

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Outline

- The ASCE Historic Civil Engineering Landmark
- History of the Portage Lake crossing
- History of the current bridge
 - Critical people
- Unique features
 - O Civil engineering perspectiveO Social and economic perspective
- Conclusions



Goals





• Get the lift bridge on the ASCE National Historic Civil Engineering Landmark list- **SUCCESS**

 Through the process of contacting ASCE MI, they requested the bridge be submitted for the *State* Historic Landmark award-SUCCESS

 Historic Landmark Award process required a package with information on:

- Historic significance
- Unique features and comparable projects
- Contribution to the civil engineering profession
- Contribution to the nation or large region
- Supplementary documents

History of the region

- The nation's first mining boom

 Copper in the mid-1840s
- Rapid Growth
 - 1848 Keweenaw produced 1 million lbs. (92% of all U.S. copper production)
- Keweenaw led production in US, peaking in late-1800s
- The early 1900s saw many ups and downs in production
 - \odot Still leader in quality of ore
- Mined into 1970s





History of the Portage Lake crossing

- Early crossings:
 - \circ Ferry service 1850
 - Floating Bridge 1873
 - \circ Wooden swing bridge
 - Single deck, carried animal carts and pedestrians – 1875
 - Adapted to double deck for rail 1892
- Steel swing bridge
 - $\,\circ\,$ Steel bridge with wooden swing span 1895
 - \circ Wooden swing replaced with steel 1898







Portage Lake crossing – Steel Swing Bridge

- Accommodated 4 modes of transportation

 Why replace?
- Structurally deficient
 - \circ Failing foundation
 - \circ Rotting members
 - o Falling concrete
- Geometrically deficient
 - Narrow lanes
 - \circ Opened for all boats
 - $\,\circ\,$ Narrow openings 107 and 118 ft
- Increases in all modes of traffic





When did the current Portage Lake (lift) Bridge open to traffic?

a. 1925
b. 1940
c. 1959
d. 1972

- 1940s Carl Winkler spearheads investigations
- Different bridge solutions proposed by others
 - $\,\circ\,$ Different location east of swing bridge
 - \circ Different types:
 - Fixed bridge wouldn't gain enough clearance
 - Bascule too long of a span
 - Swing bridge proven ineffective
- 1953 Once a design was chosen, funding needed to be secured
 - Required to be "unreasonably obstruct the free navigation" of the waterway
 - $\,\circ\,$ Lake Carriers Association carried weight in classifying this
- 1956 Hazelet & Erdal hired to design new lift bridge

- Dec 18, 1957 Construction began
- Winter 1957 to winter 1958 Caisson and pier construction
 - $\circ\,$ Built sand island
 - $\,\circ\,$ Sink caisson by excavating underneath
 - Mechanical buckets first, then people
 - $\,\circ\,$ Piers built on top
- Feb, 1959 Steel components arrive and steel erection begins
 - \circ Field rivets
 - Lift span and structure built separate to allow full operation of swing bridge









- Sept 9, 1959 Lift span floated into place
 - $\circ\,$ Closed waterway for day
 - Immediately lifted to highest position for most of finishing construction
- 3 months of equipment testing
- 8:00am Dec. 20, 1959 Lift bridge opens to traffic
- Dec. 21, 1959 Demolition of swing bridge begins
 - Automobile approaches first removed
 - $\odot\,$ Feb 16 Rail switched to lift bridge
 - $\circ\,$ Swing span removed following spring







- June 25, 1960- Ribbon cutting ceremony
- Completed lift bridge
 - Triple car capacity
 - Shorter and fewer delays
 - Intermediate position
 - \circ More than double canal width clearance
 - $\,\circ\,$ Full rail and pedestrian access
- Sept. 28, 1982- Last train • used for snowmobiles now
- June, 2009- 50 years old
- 2015 to 2016- First major rehabilitation
 - \circ 50 year fix on structure
 - $\,\circ\,$ 20 year fix on electrical and painting



The People who made it happen

Carl Winkler – Houghton Co. Commissioner

Tom D'Arcy – design engineer at Hazelet & Erdal

John Michaels – MDOT

And so many more...



How heavy is the lift span?

a. 250,000 lbs.
b. 1.5 million lbs.
c. 4.5 million lbs.
d. 10 million lbs.

Unique features



- Double-deck vertical lift bridge

 Only one of its type in Michigan
 Uncommon nationwide
 Well-maintained
- High level of use in comparison to other notable Michigan bridges:
 - Portage Lake Bridge AADT 30,600
 - Mackinac Bridge AADT 8,120
 - Blue Water Bridge AADT 13,550
 - International Bridge AADT 4,850
- Heaviest lift span in the world at the time of construction 4,584,000 lbs.

Unique Features

Accommodates many modes of transportation

- $\,\circ\,$ Vehicles, watercraft, pedestrians, snowmobiles and formerly rail
- $\,\circ\,$ Did this using the double deck and intermediate position



<u>Fully closed position</u> Upper deck open for vehicles Lower deck open for rail Waterway closed Intermediate position

Upper deck open for vehicles Lower deck closed Waterway open for small craft <u>Open position</u> Upper and lower decks closed Waterway open for all marine traffic

Civil engineering significance



- First of its kind intermediate position
 - Lift span is partially raised so the bottom deck functions as part of the upper roadway
 - Reduced the number of bridge openings by 63% in comparison to the previous swing bridge

Civil engineering significance

- Intermediate position required additional innovations to function:
 - Lower lift span deck had to be useable by rail and automobiles
 - Movable intermediate bridge seats



How long did it take for the lift span to be installed?

a. 1 day
b. 1 week
c. 1 month
d. 1 year

Civil engineering significance

- Early example of a "bridge slide"
 - Needed to use the swing bridge during construction
 - $\,\circ\,$ Floated the lift span into place on barges
 - Only had 4 inches of clearance on each end of the 260 foot lift span





Social and economic significance

- Copper and lumber to nation
 - $\circ\,$ Crucial to the development of country
- Much more efficient crossing at a transportation bottleneck
 - Auto copper, logging, people, tourism
 - $\,\circ\,$ Waterway copper industry and iron industry in western Superior
 - Shortcut and harbor of refuge
 - $\,\circ\,$ Pedestrian social between two important towns
 - Rail copper, people
- Today
 - \circ Tourism
 - Historic/industrial
 - Nature/activity focused





Conclusions



- The Portage Lake Bridge is a unique double-deck vertical lift bridge
- Replaced an aging and deficient steel swing bridge in 1959
- Had the heaviest lift span in the world at the time of its construction
- Revolutionary intermediate position increased its efficiency
- Played a key role in connecting the Keweenaw Peninsula's local industries to the rest of the nation
- Recognized as a ASCE Michigan Historic Civil Engineering Landmark and accepted as a National ASCE Landmark

Questions?



