# Projector Test Screen

# Slides Ready

# Railroad Bridges on The River Rouge

HistoricBridges.org

Promoting the preservation of our transportation heritage.

Presented By: Nathan Holth

# Introduction: About Me

- Website created and maintained by me.
- Photos, Advocacy, & Documentation
- 32 States
- 4 Canadian Provinces
- 4475 Bridges Listed Currently
- 14 Years

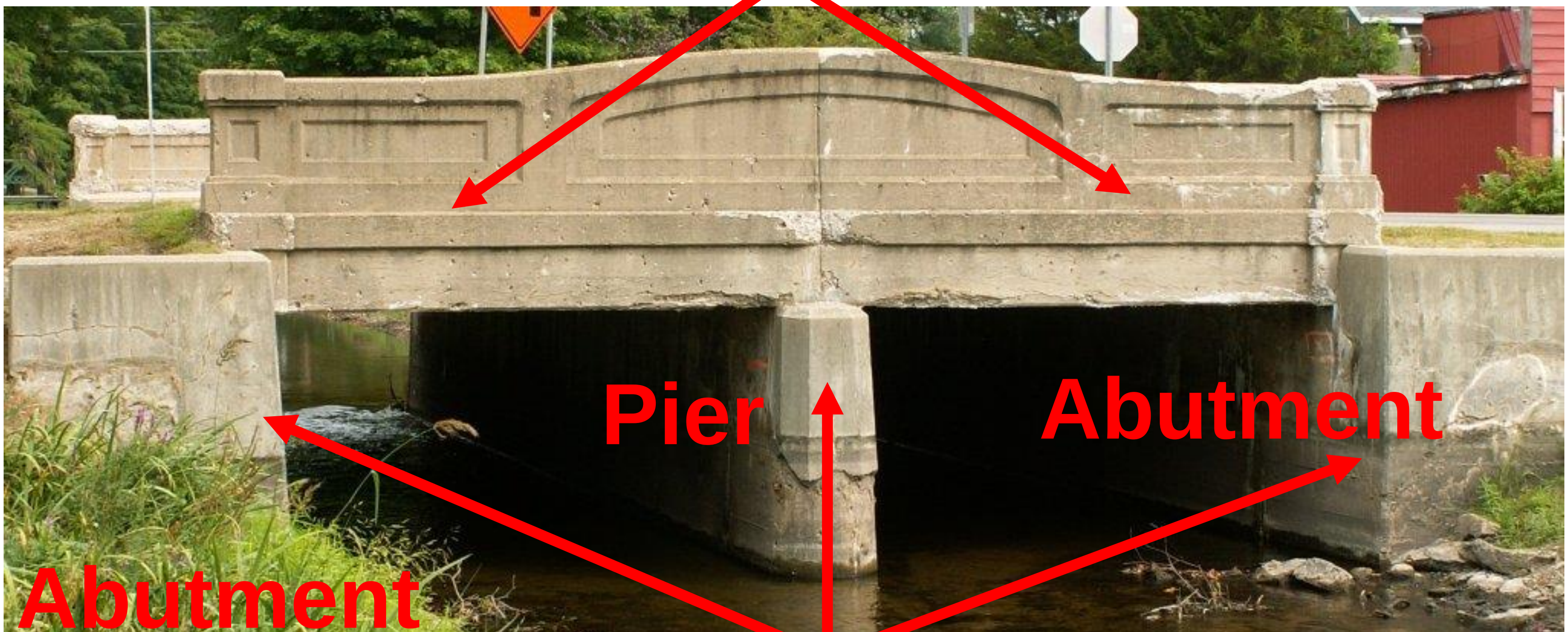
- I work in the office and also handle historic bridge matters.
- Steel Fabricator
- Restoration/Relocation of Historic Bridges &
- Hot Rivets

# Rouge River

Wabash Railroad Bridge
Michigan Central
Railroad Bridge
Rouge River
Fordson Island
OAKWOOD HEIGHTS
Woodmere Cemetery
DELRAY
Zug Island
Detroit Produce Terminal
ContainerPort Group Detroit
Sunoco Logistics Partners LP
Marathon Petroleum Corporation
St Marys Cement
Detroit Salt
Detroit Water & Sewerage
Delray Recreation Center
Central Transport
Goch & Son's Towing
River Rouge School District
Waterman Substation-DTE Energy
Giovanni's
Dearborn St
W Fort St
Dix Ave
Miller Rd
Industrial St
W Jefferson Ave
Schaefer Hwy
Coolidge Hwy
Detroit River

# Bridge Structure Basics

**Superstructure**



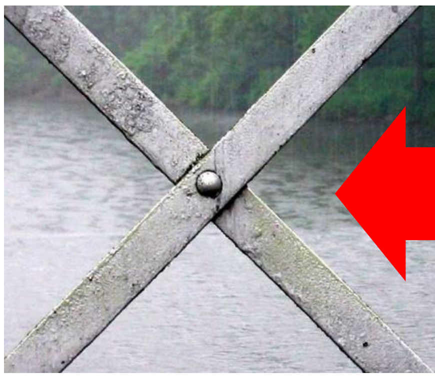

**Substructure**

The part of the bridge that spans the obstacle is the superstructure. The part of the bridge that holds the superstructure up is the substructure (piers and abutments)

# Iron and Steel

Beam

Channel



Bars

Rods

Plate

Angle

Rolled iron and steel comes in several basic forms, including beams, bars, angles, rods, channels, and plates.

# Built-Up Iron and Steel

Before the ability to roll larger and stronger beams arrived, iron and steel elements were often riveted together to form larger and stronger beams. Such beams that are formed from smaller elements are **built-up**, sometimes called “**fabricated**” as well.

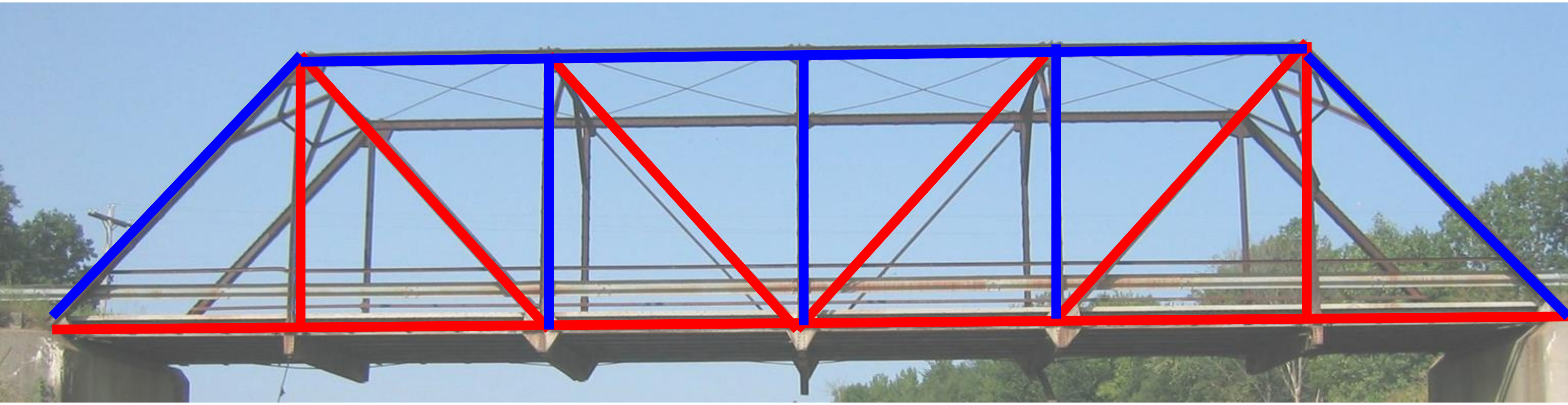
# Truss Bridges

A metal truss bridge is a bridge whose main structure comes from a triangular framework of structural steel or iron.

# Truss Bridge Forces

**Compression**

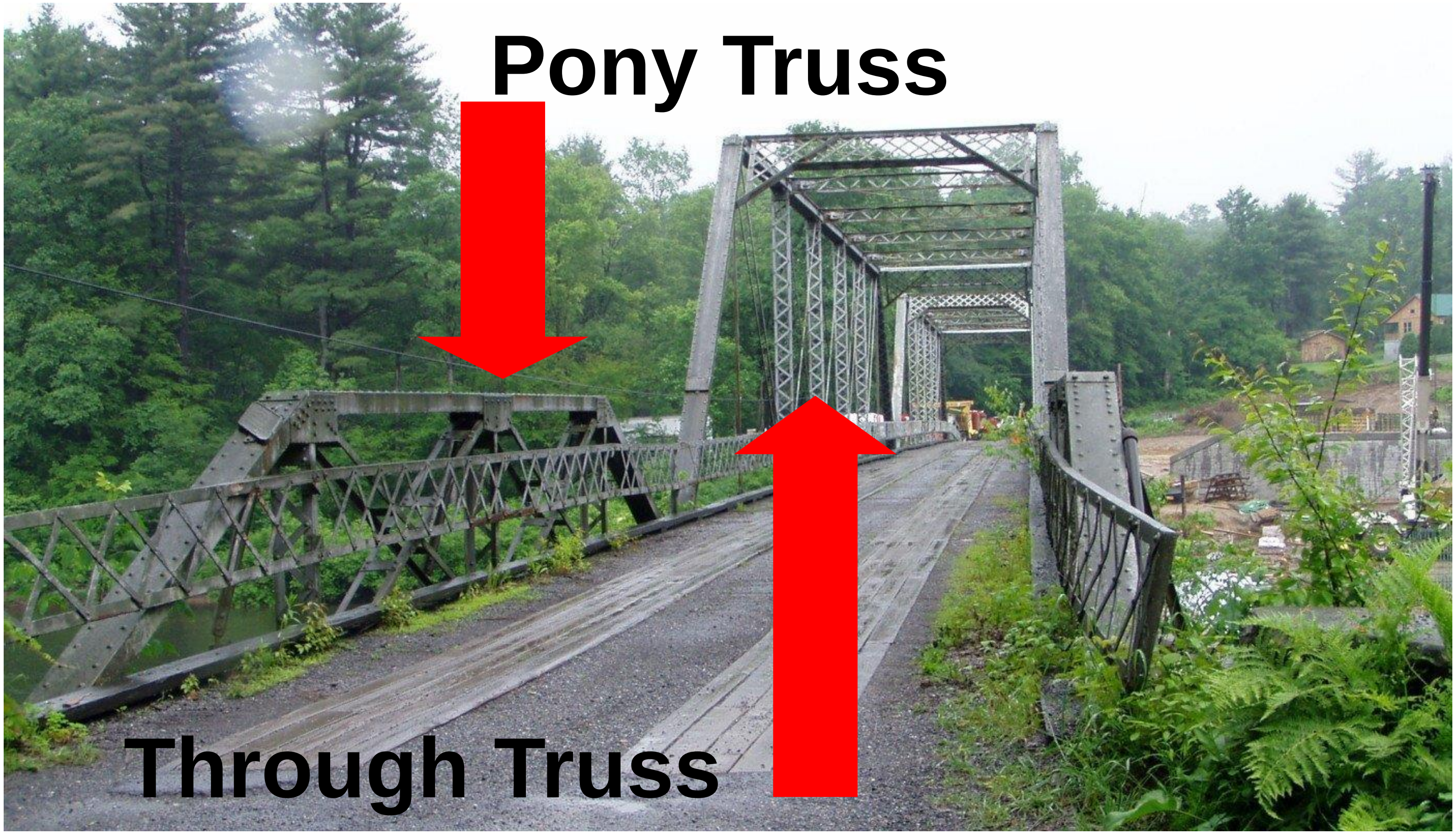
**Tension**



The parts of a truss bridge experience forces in the form of tension (stretching apart) and compression (squeezing together). Engineers often picked different types of materials and designs for the different parts of a bridge based on these forces. An example is shown above.

# Truss Basics

If the trusses run beside the deck, with no cross bracing above the deck, it is called a pony truss bridge.



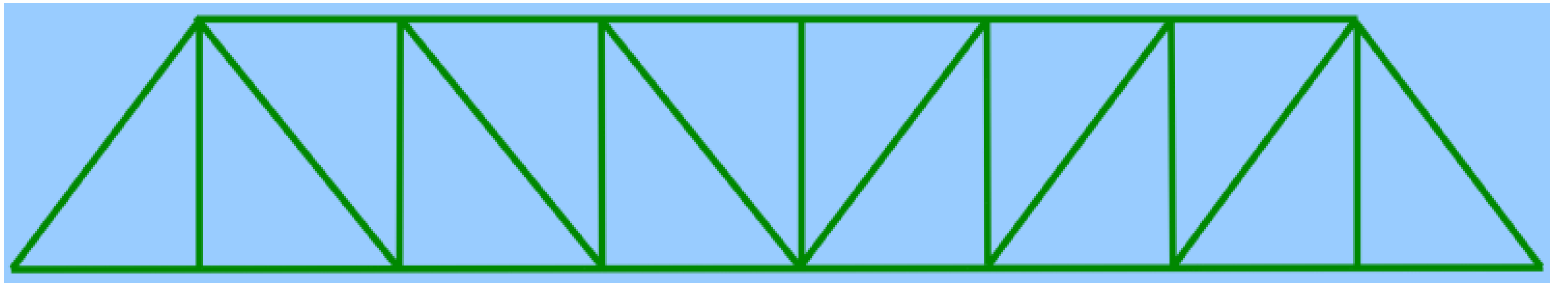

If cross-bracing is present above the deck of the bridge, then the bridge is referred to as a “through truss.”

# Deck Truss

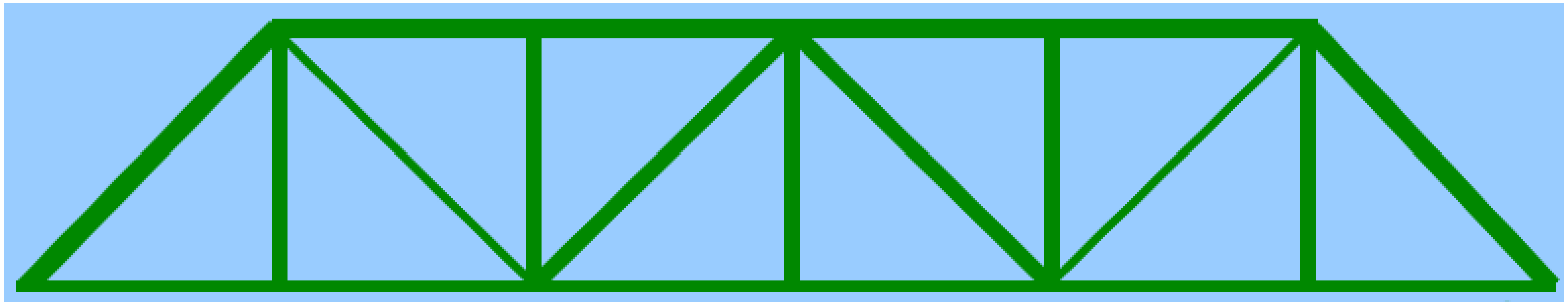
Trusses may run under the deck: these are called simply Deck truss bridges.

# Truss Configurations

## Pratt



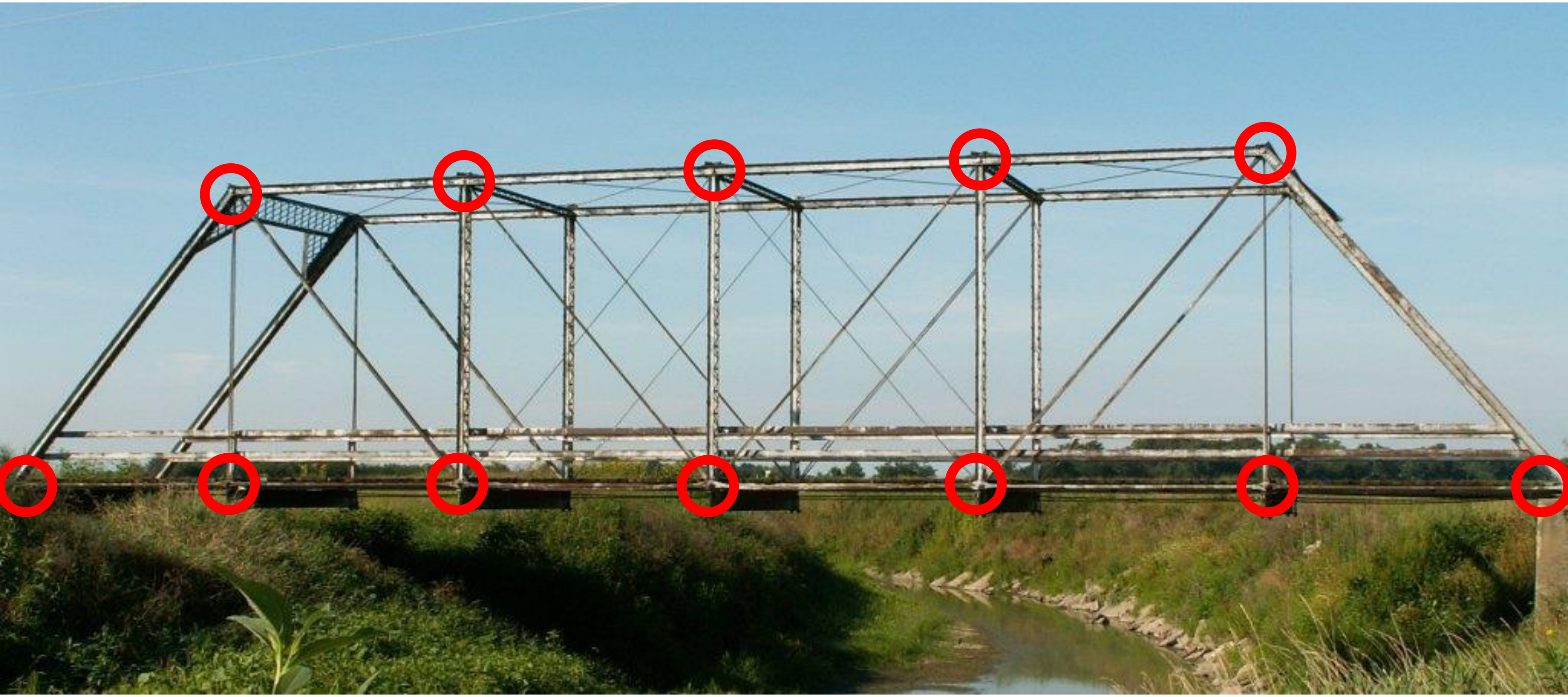
## Warren



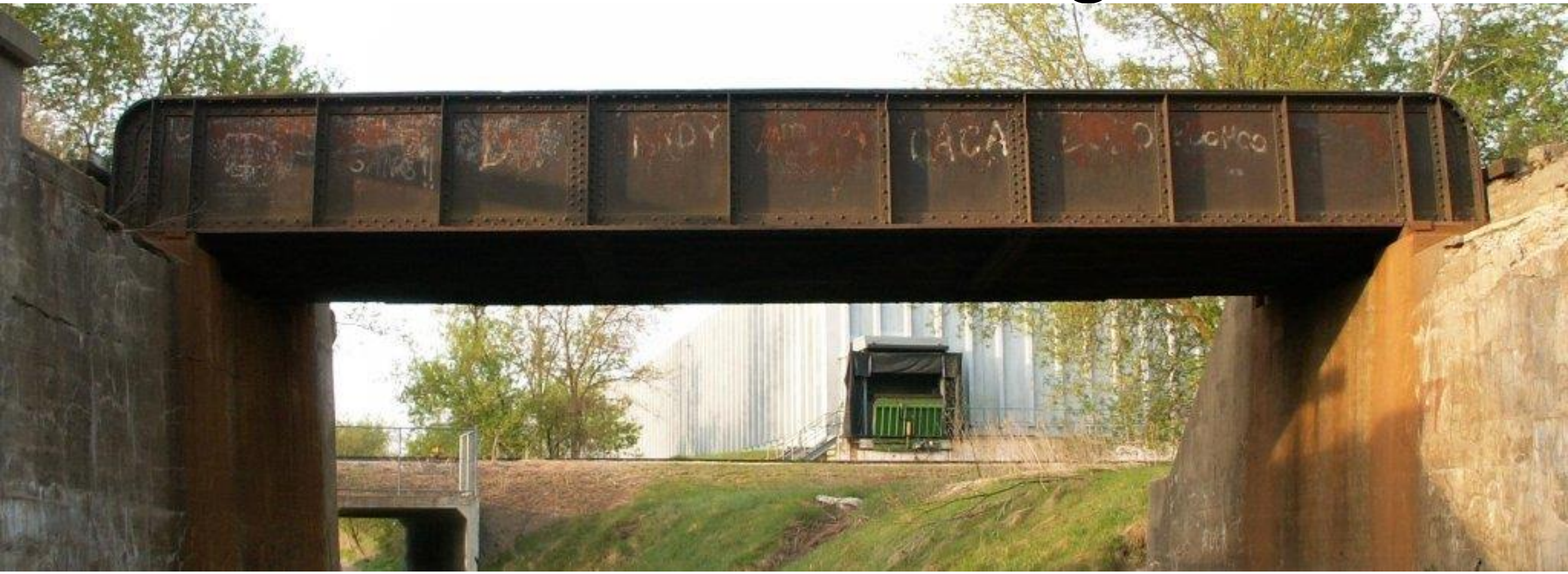
The two most common truss configurations are shown above.

# Truss Bridge Connections

The pieces of the framework of a truss bridge are held together by **connections**, sometimes also called joints. Most connections on historic bridges are either riveted or pinned, but can also be bolted or welded.



# Metal Girder Bridges

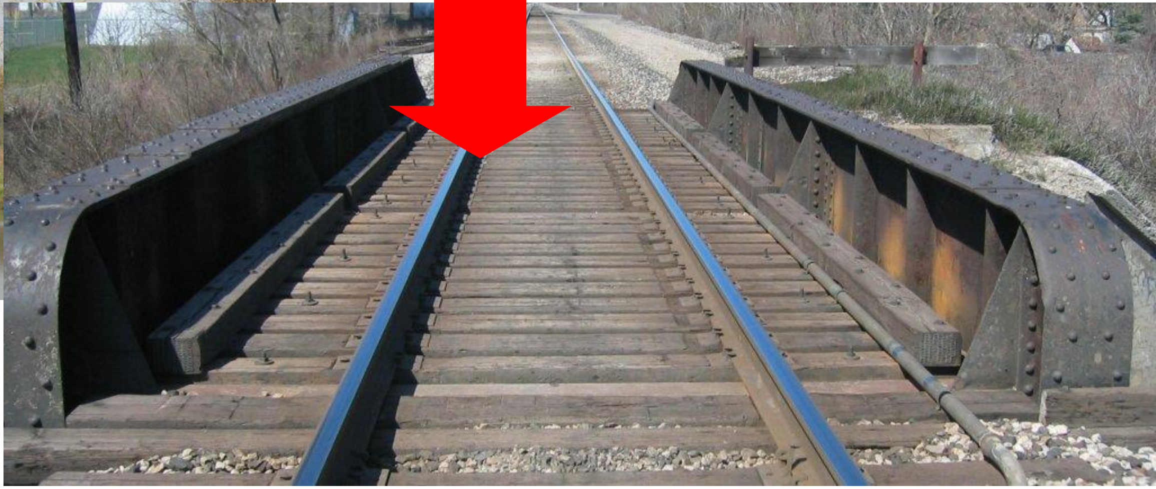


Metal girder bridges are often called **plate girder** bridges. The were common on railroads and some states built them on highways frequently as well. They generally date from 1900 on.

# Girder Types

Through

Deck



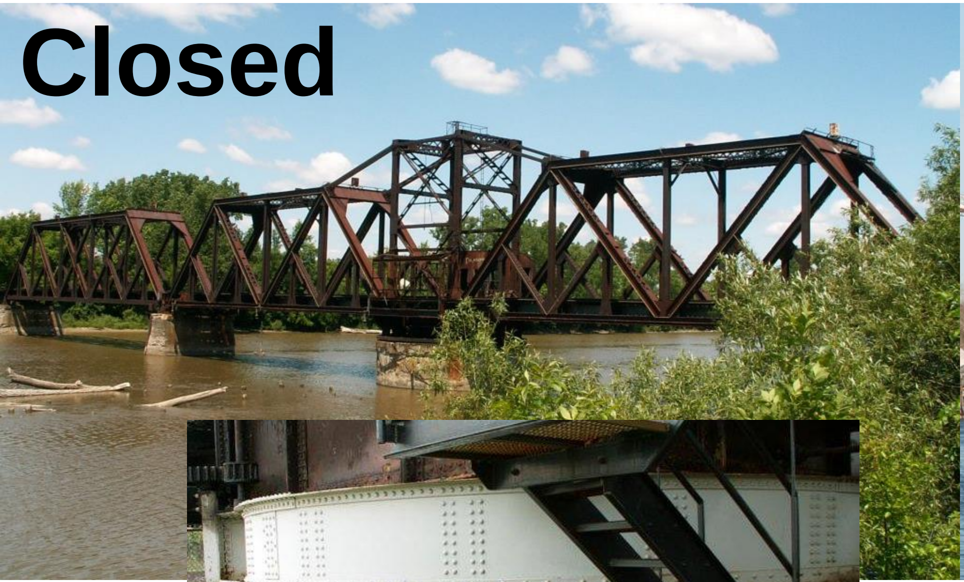
Similar to truss bridges, the girders can be beside the road or below. Typically metal girders do not have overhead bracing, and those with girders beside the roadway are usually considered through girders.

# Movable Bridges



Bridges may be movable, which means they are designed to open to make way for boats. Movable bridges are defined by the way they move. The actual structure type may vary, including metal truss, girder, and stringer.

# Movable Bridges: Swing

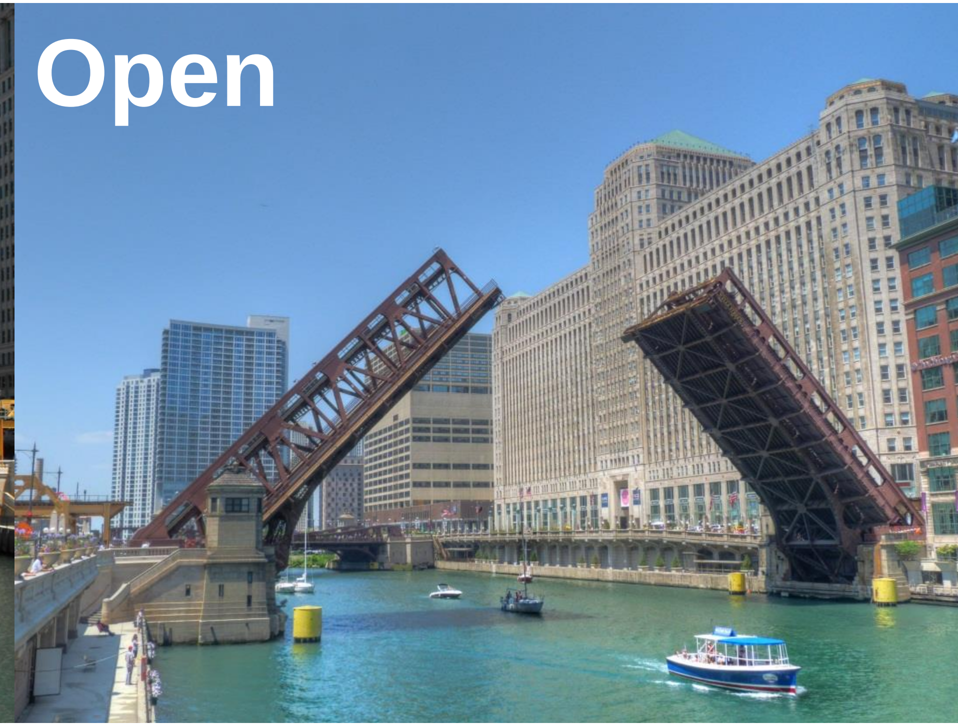




Swing Pier

**Overview:** The swing bridge is the oldest of the common movable bridge designs. In these, the movable span turns on a pier 90 degrees to open a channel for the boats. They fell from favor because their central pier limited the width of the channel.

# Bascule Basics


**Overview:** Bascule literally means “seesaw.” A bascule bridge operates by rotating up to open the channel. Counterweights provide the balance to make this motion possible. Offering good channel clearance, they are a popular type of movable bridge.

# Bascule Basics

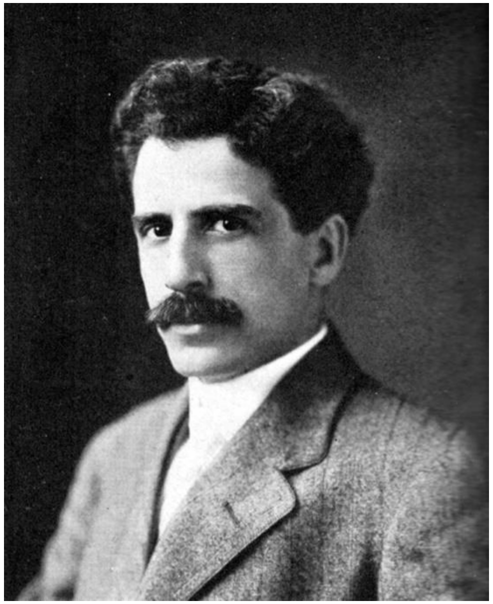
**Double Leaf Highway Bridge**

**Single Leaf Railroad Bridge**

Because they are more stable, railroads almost always built single leaf bascule spans rather than the double-leaf type more common with highway bridges, where each leaf is a structurally independent cantilever functioning like holding your arm out.

# Joseph Strauss

The Strauss Bascule Bridge Company was run by famous Chicago engineer Joseph Strauss.



## The Strauss Trunnion Bascule Bridge

has been adopted for the world's largest bascule bridge structures because of its simplicity, economy in first cost and operation, and its efficiency under the most severe operating and traffic conditions.

Strauss Heel Trunnion Bascule Bridge over the Calumet River at South Chicago. Movable Span, 235 feet. Double Track. Designed by the Strauss Bascule Bridge Co. for the Baltimore & Ohio Railway Co. F. L. Stuart, Chief Engineer; J. E. Greiner, Consulting Engineer; W. S. Bouton, Engineer of Bridges.

This Strauss Trunnion Bascule Bridge is the longest Single-Leaf Bascule Bridge in the World.

Strauss Heel Trunnion Bascule Bridge over the United States Ship Canal at Sault Ste. Marie. Movable Span, 336 feet. Single Track. The only double-leaf bascule acting as a simple span for live load. Designed by the Strauss Bascule Bridge Co. for the Canadian Pacific Ry. Co. P. B. Motley, Engineer of Bridges; C. C. Schneider, Consulting Engineer.

This Strauss Trunnion Bascule Bridge is the longest Double-Leaf Bascule Bridge in the World.

## The Strauss Bascule Bridge Co.

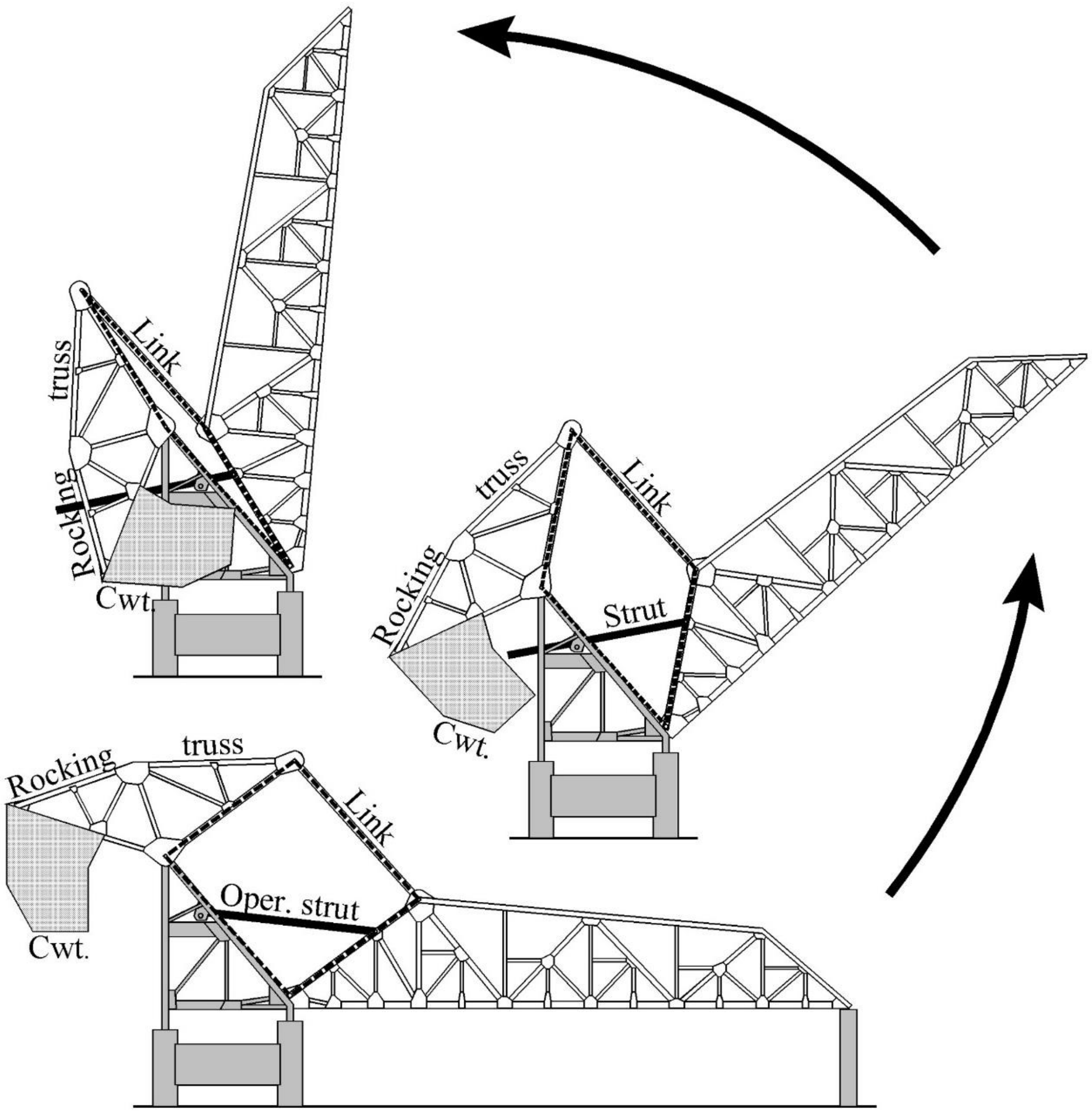
Main Office, CHICAGO, U. S. A.

NEW YORK
SEATTLE

MONTREAL
WINNIPEG

Commonly known for being Chief Engineer of the Golden Gate Bridge, although University of Michigan professor Charles Alton Ellis did most of that work.

# Bascule Span




This is an drawing of Joseph Strauss' "heel trunnion" type of bascule, where there are two axels (trunnions) around which rotation occurs, one for the leaf, the other for the counterweight.

# Strauss Heel-Trunnion

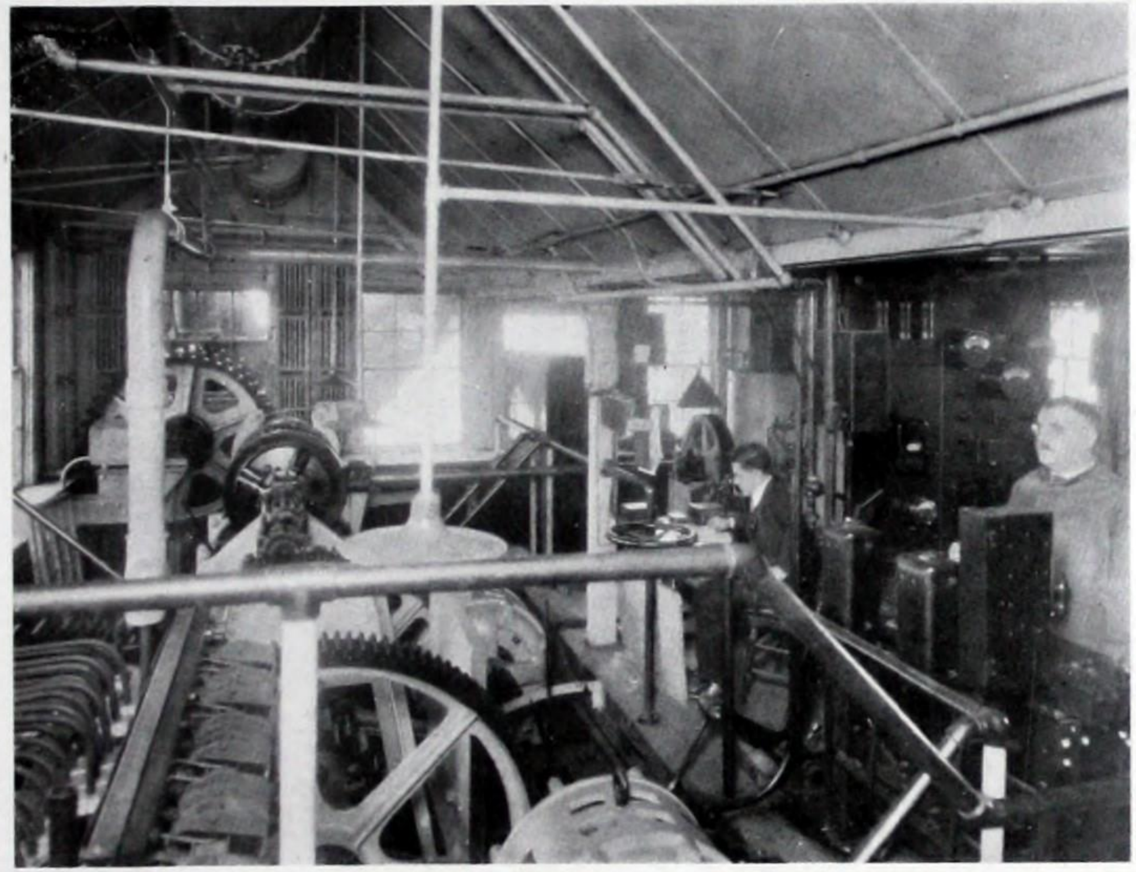


FIGURE 31. INTERIOR OF OPERATOR'S HOUSE, CHICAGO & NORTHWESTERN RY. THREE TRACK BRIDGE OVER CHICAGO RIVER, DEERING STATION.

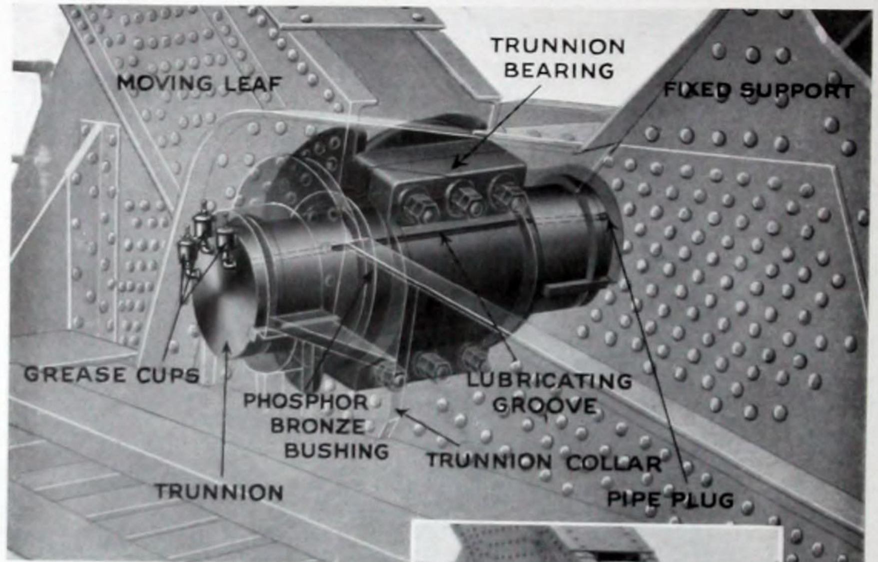
Original interior of a 1920 heel-trunnion bascule machinery room.

# Strauss Heel-Trunnion

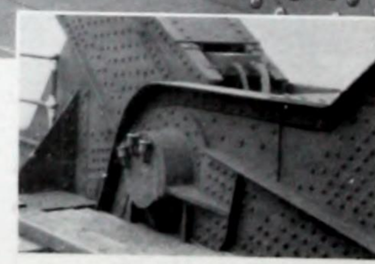
## The Trunnion—The Keystone of Bascule Efficiency

The Strauss Bascule Bridge may truly be considered as built around the "trunnion." The trunnion is a short shaft upon which the leaf, so called, i. e., the movable section of the bridge, is mounted, and about which it rotates. It is the "element of movement," the vital element of every bascule, upon which the efficiency of the entire structure depends.

Self-evidently, the element of movement of a bascule bridge must be of unquestionable integrity. This is true of the trunnion because the stresses to which it is subjected can be definitely determined and provided for. The trunnion carries its load in surface bearing. It is only necessary, therefore, to fix a safe pressure per square inch in order to determine the extent of surface, i. e., the size of the trunnion required, which at once guarantees that it will carry the load imposed upon it *without overstress*. In




Phantom View



Actual View

A period drawing showing the trunnion design of a Strauss bascule.

# Michigan Central Bridge

An excellent example of a typical Strauss heel-trunnion bascule bridge, as designed by famous engineer Joseph Strauss.

# Michigan Central Bridge

Bridge in raised position.

# Michigan Central Bridge

Difficult-to-access views of the bridge.

# Michigan Central Bridge



The Detroit Historical Society holds a detailed set of historical and construction photos.

# Michigan Central Bridge

The bridge replaced a previous pin-connected through truss swing bridge shown here.

# Michigan Central Bridge

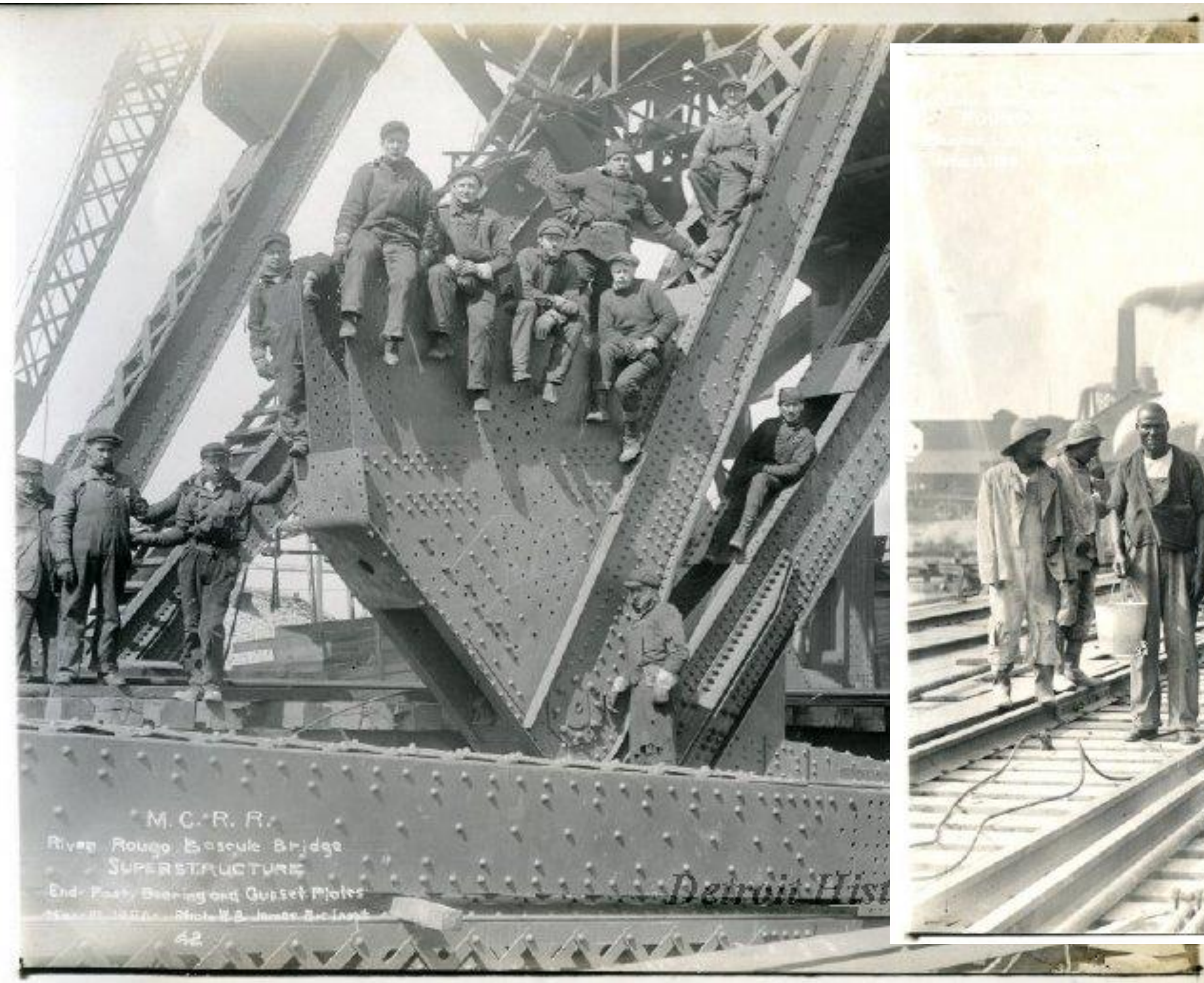


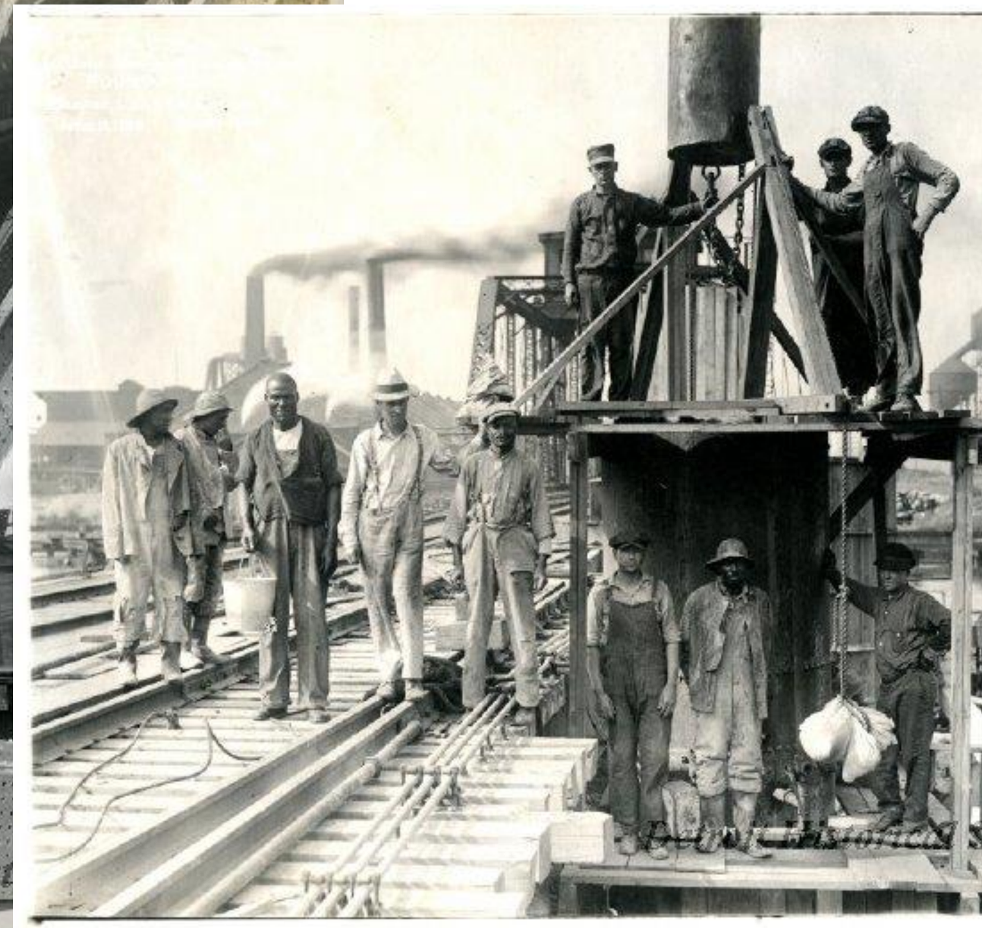
The bascule was built in the raised position. Shown here is substructure and counterweight frame construction.

# Michigan Central Bridge

Here the bascule leaf erection is shown with the swing bridge to the left.

# Michigan Central Bridge



The construction crew is shown posing for photographs.

# Michigan Central Bridge



Operation of the swing bridge shortly prior to its removal. Railroad traffic was maintained throughout construction.

# Michigan Central Bridge

Removal: The swing bridge was placed onto barges by pumping water out of barges to raise them up to carry the bridge.

# Abt Bascule Bridges

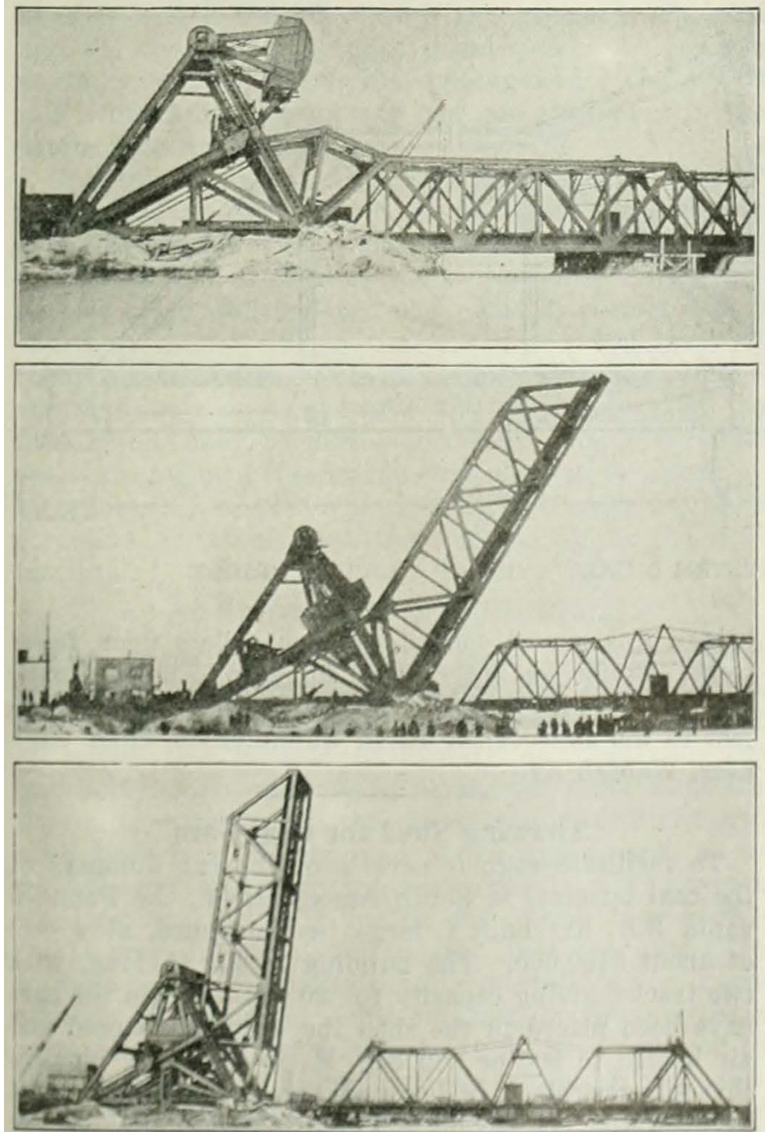


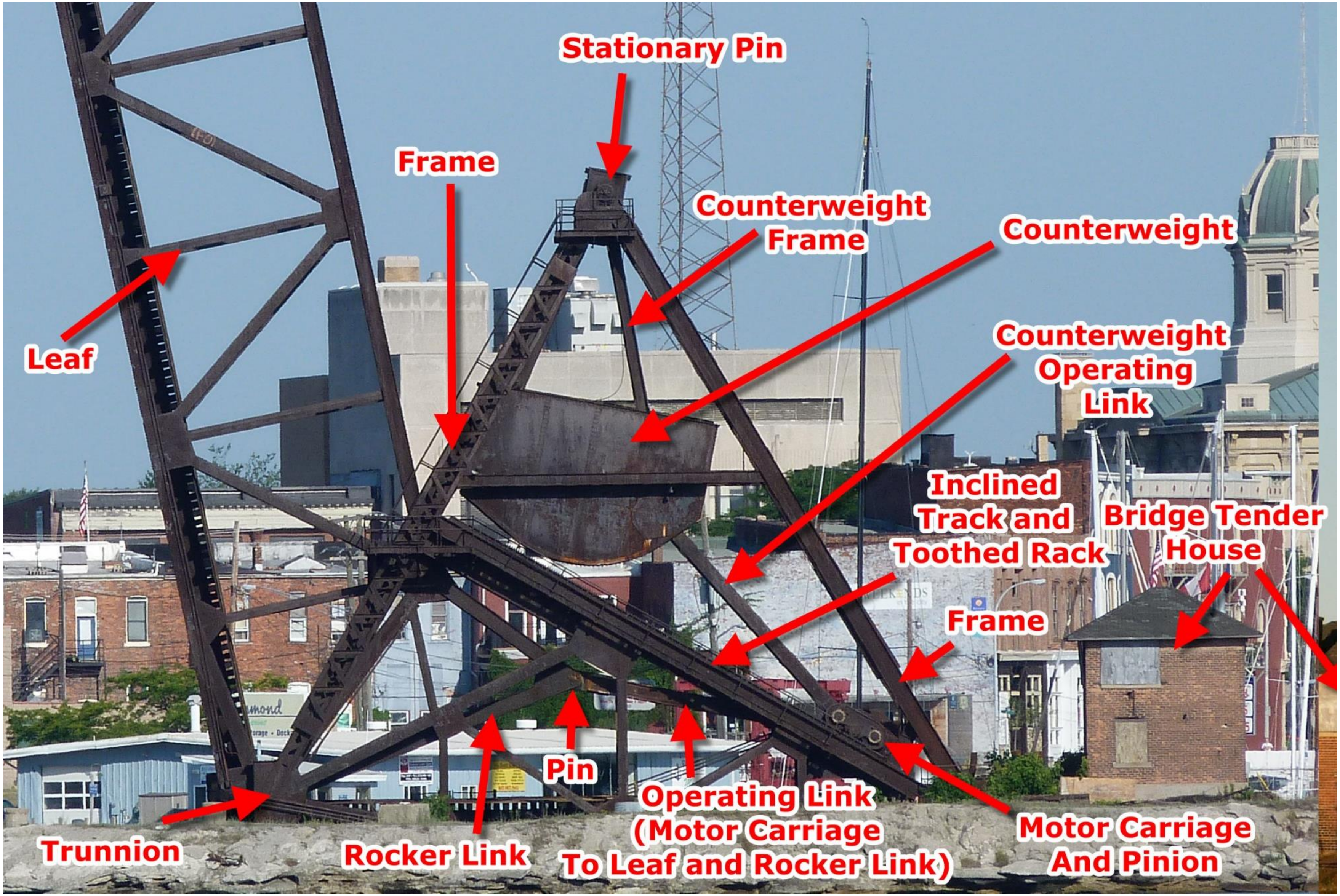
FIG. 1. WABASH RY. BASCULE BRIDGE OVER RIVER ROUGE, DETROIT

A movable type patented by Hugo A.F. Abt of the American Bridge Company.

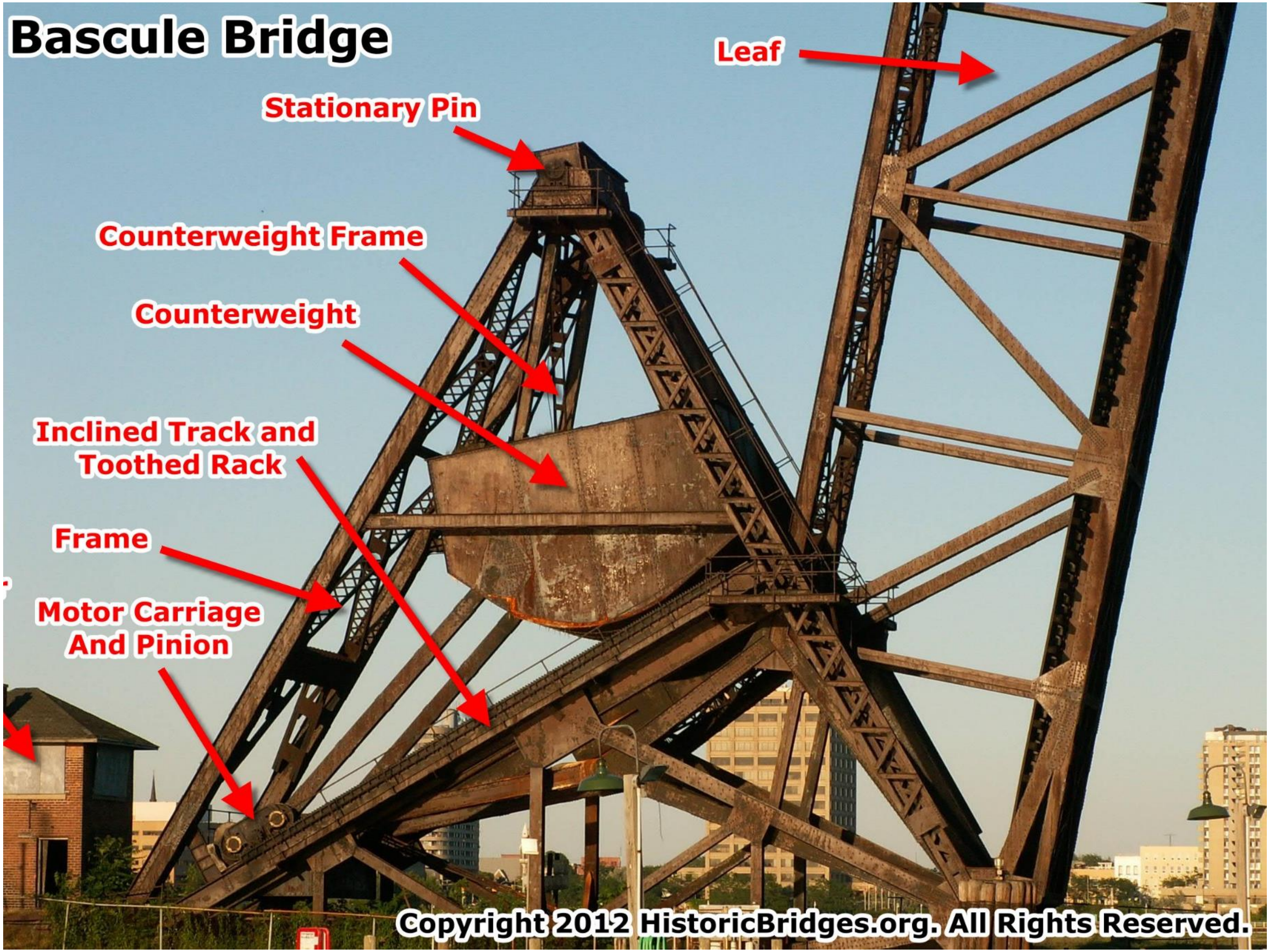
Counterweight kept above the tracks so bridge could be erected in raised position while traffic continued on a former bridge.

First example: Wabash Railway over Rouge River, 1922

# Abt Bascule Bridges



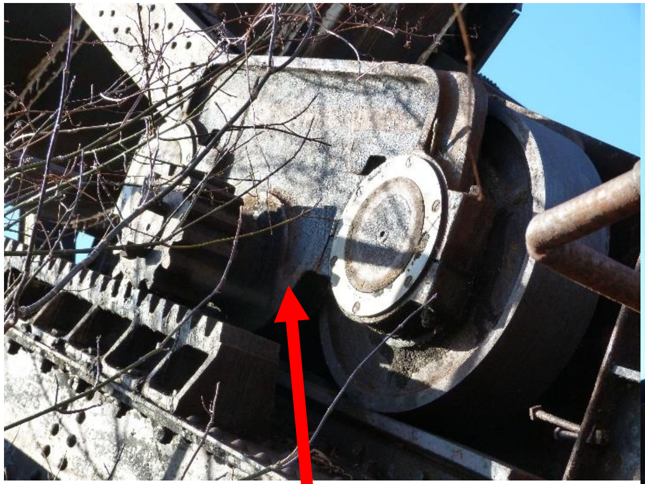
# Abt Bascule Bridges



# Abt Bascule Details

Port Huron’s Abt bascule bridge provided unique photo angles not open to the public on the Wabash Bridge.

# Abt Bascule Details



**Roller Train and Pinion**

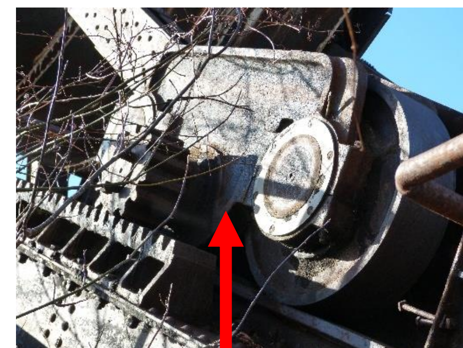
**Motor Carriage**

The bridge's motor carriage provides power and moves along a track as the bridge is opened and closed.

# Abt Bascule Details

Overview of the machinery on the motor carriage.

# Abt Bascule Details



**Roller Train and Pinion**

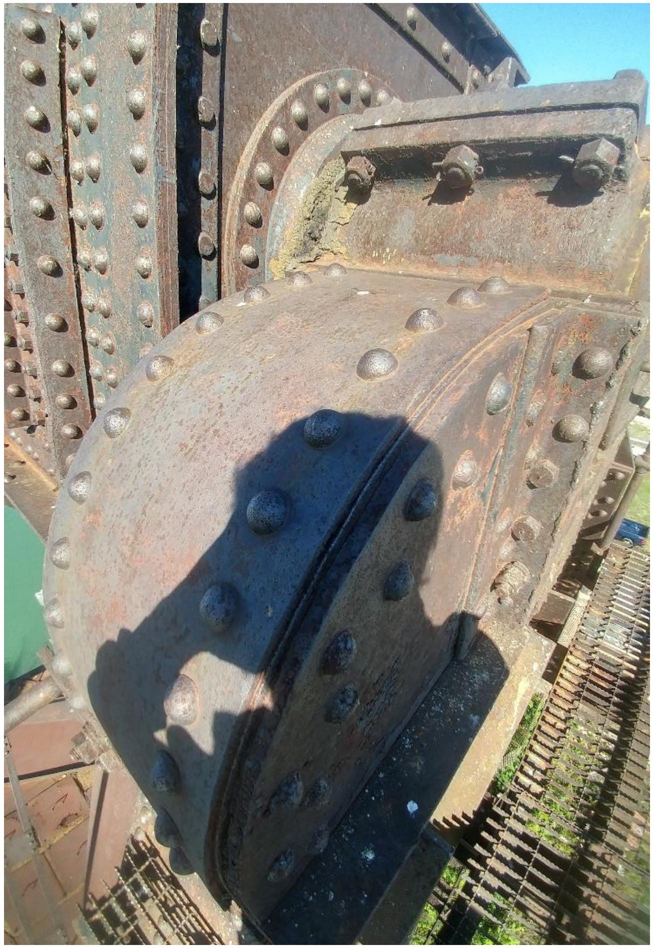
Drive shaft sends power to the pinion and the roller train and motor carriage move on track.

# Abt Bascule Details

Surface of counterweight showing access hatches likely for adjusting the weight of the counterweight. Photo Courtesy Bach Steel

# Abt Bascule Details





Stationary pin at top of counterweight frame. The counterweight rotates around this point. Photo Courtesy Bach Steel.

# Abt Bascule Details

Link pins provide rotation for the link. A link is a beam that transfers the motion/energy to the parts of the bridge that move.

# Abt Bascule Details

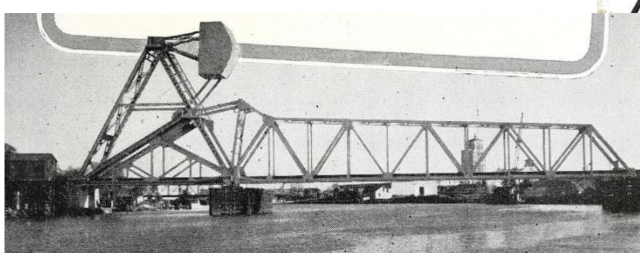

The actual bascule leaf (truss span) rotates around the main trunnion shown here.

# Abt Bascule Bridges

Manitowoc County, WI
Demolished 2011

San Joaquin County, CA

Beaumont, TX
Demolished 1969



**Only eight of this type were ever built. Two have been demolished.**

# Abt Bascule Bridges

**Pere Marquette, Black River, Port Huron. Largest surviving Abt bascule span. No longer used, at risk for demolition. Built 1931, 173 Foot span.**

1972 Photo Credit: Craig Gardner

Michigan has three of the six surviving Abt bascule bridges!

# Abt Bascule Bridges

**Pere Marquette, Saginaw River, Saginaw. Youngest surviving Abt bascule span. No longer raises for boats. Built 1944, 160 Foot span.**

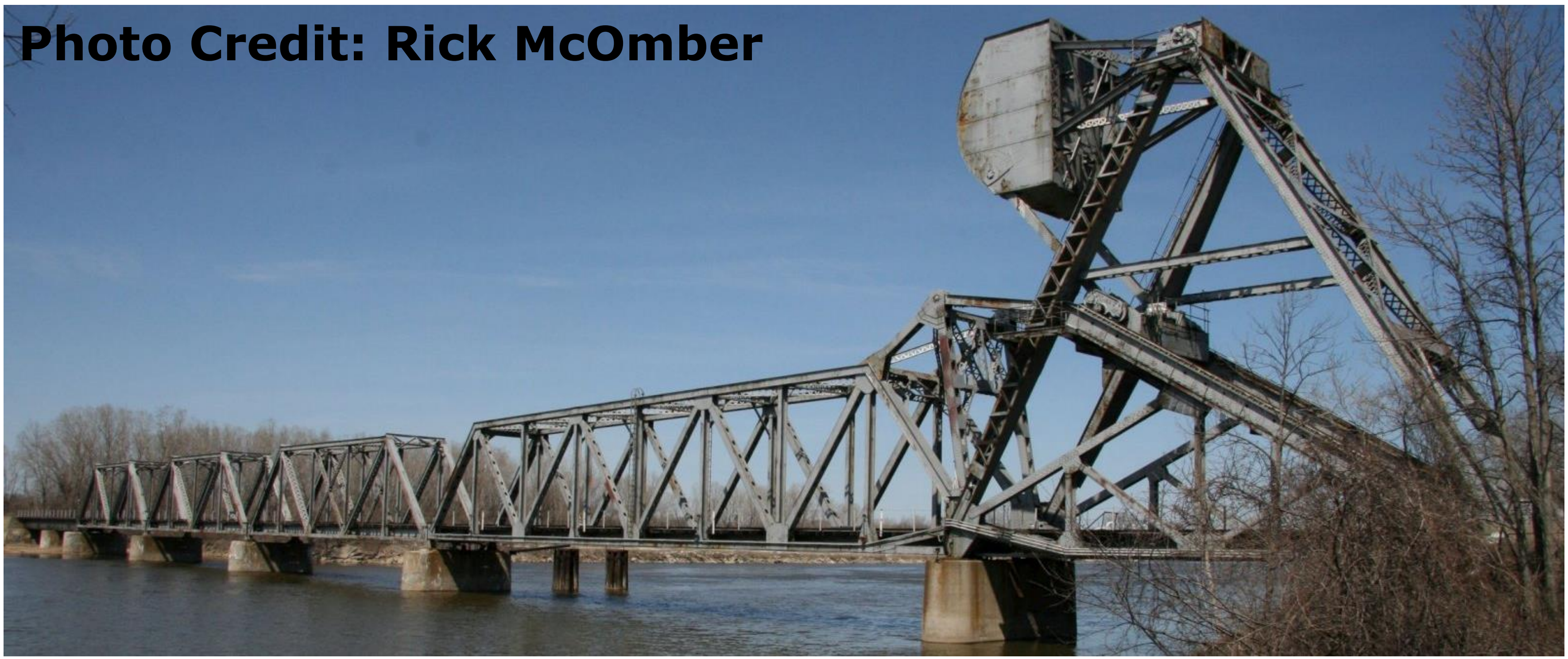


**Photo Credit: Rick McOmber**

Michigan has three of the six surviving Abt bascule bridges!

# Wabash Bridge

Completed for Wabash Railroad in 1922 by the American Bridge Company of New York, NY. Steel fabricated at the Gary Works in Indiana. First Abt bascule ever built!

162 foot Abt bascule span, 180 foot overall length. Designed for Cooper's E50 Loading.

# Wabash Bridge

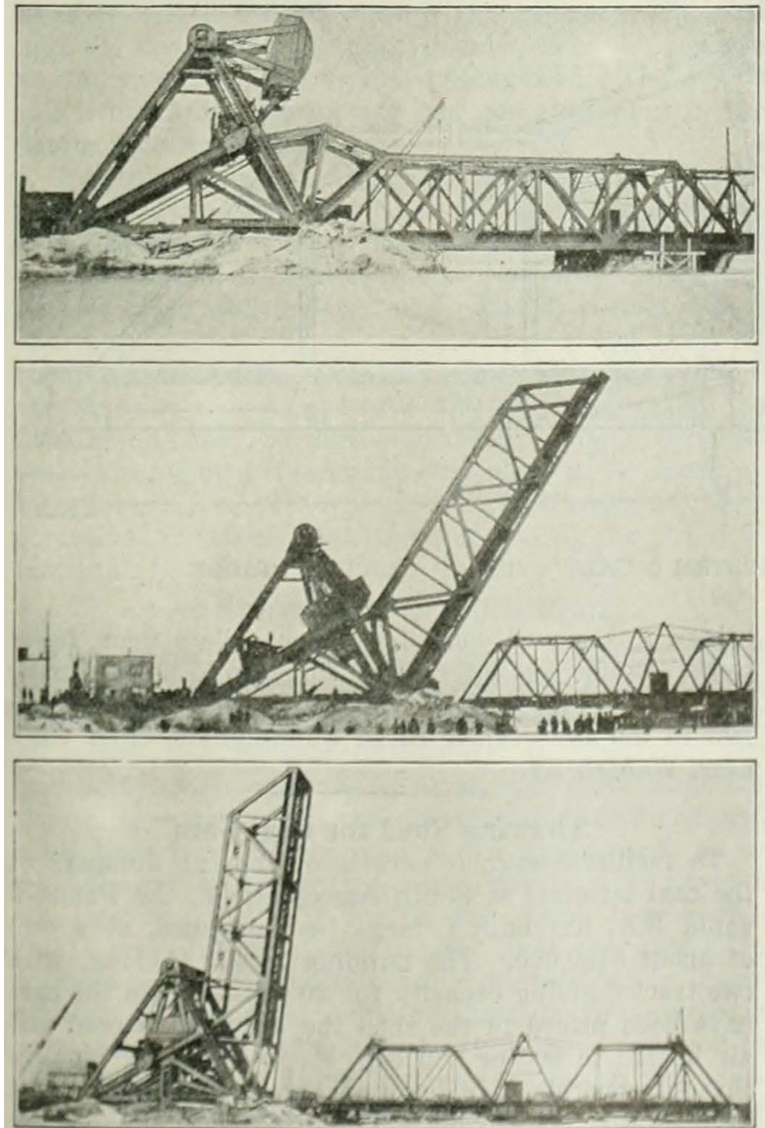


FIG. 1. WABASH RY. BASCULE BRIDGE OVER RIVER ROUGE, DETROIT

This series of photos shows the newly completed bridge being raised. The previous bridge is still present here.

The previous bridge was a 180 foot metal pin-connected Pratt through truss center pier swing bridge. It appears to have been a very lightweight railroad bridge.

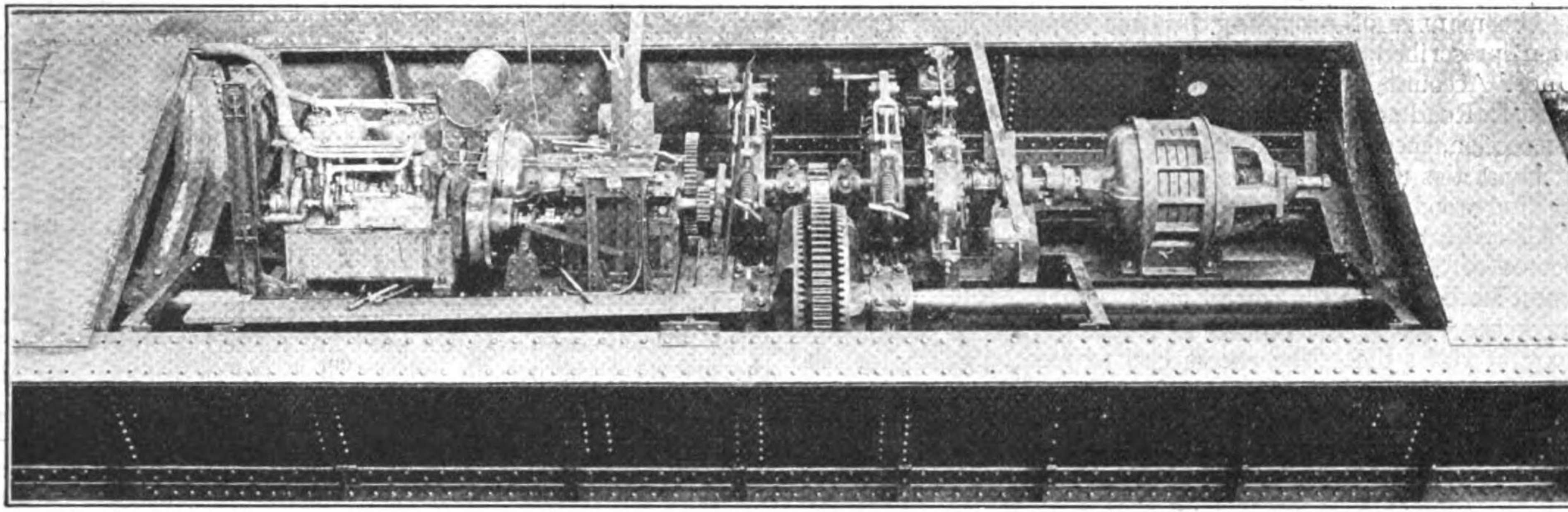
# Wabash Bridge

The bridge was also used by Baltimore & Ohio, Detroit & Toledo Shore Line, Pere Marquette, and Pennsylvania RR. A 3 day count shows 113 trains in 24 hours, or a train every 13 minutes.

# Wabash Bridge

Erected in raised position, with the lower part of the deck left out so trains could continue to cross the river. Closure time to lower bascule, install deck, and switch to new bridge: only 7.5 hours!

# Wabash Bridge



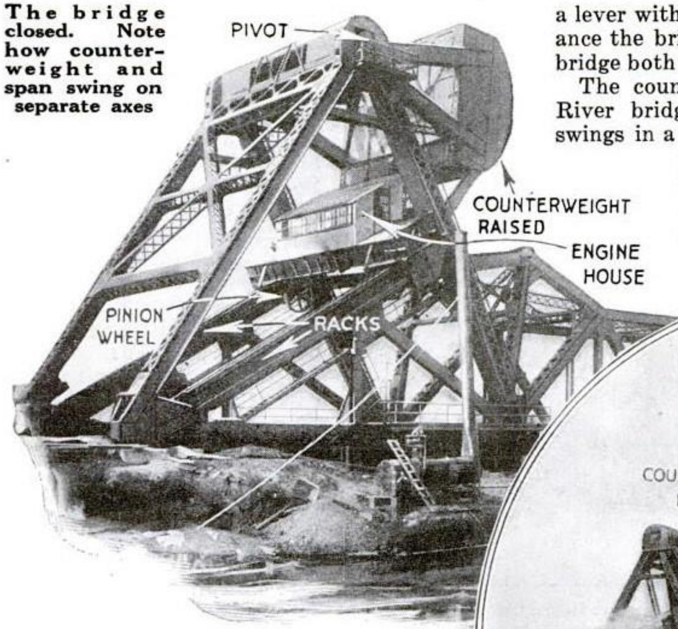
This view shows the original configuration of the motor carriage. Although installed with two 100HP motors, only one was needed to operate the bridge.

# Wabash Bridge

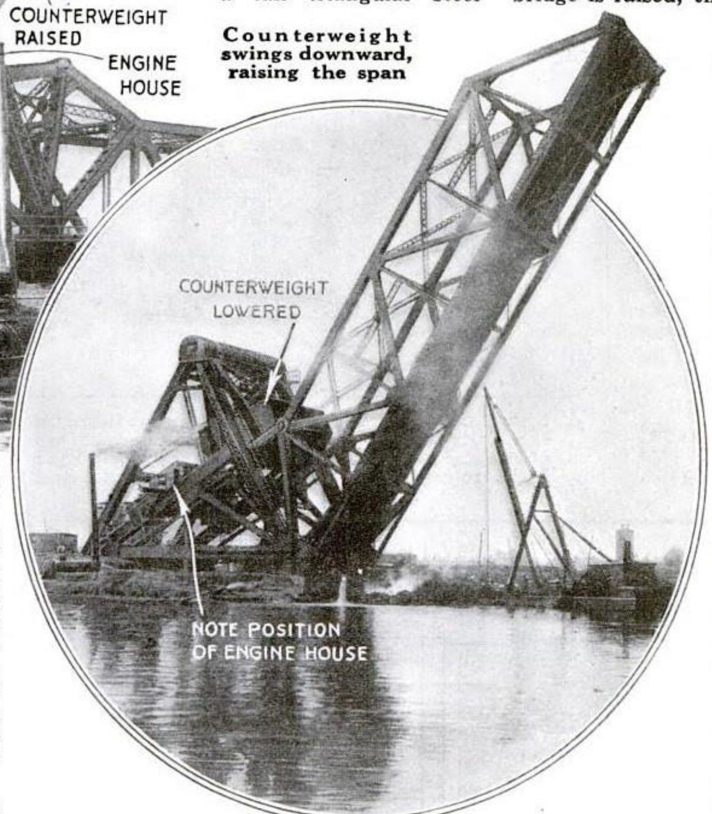
The bridge’s counterweight is 1,000 tons, and has interchangeable 2,500 pound concrete blocks for adjustments.

# Wabash Bridge

## Novel Counterweight Bridge Opens in 90 Seconds




**The bridge closed. Note how counterweight and span swing on separate axes**




**Counterweight swings downward, raising the span**

A REMARKABLE railway bascule bridge, in which the counterweight and the bridge span swing on different axes, is now in operation across the Rouge River, where the tracks of the Pennsylvania and Wabash railroads lead into Detroit, Mich. The structure, called the "cross-rotating" type of bascule, is said to be the only one of its kind in the world. One of its extraordinary features is the motor house, which travels up and down an inclined track, following the movement of the counterweight, and which actually forms part of the weight itself.

The ordinary bascule operates simply as a lever with a counterweight to balance the bridge proper. Weight and bridge both swing on the same axis.

The counterweight of the Rouge River bridge, on the other hand, swings in a quarter circle on a pivot just beneath the apex of a tall triangular steel frame, while the bridge proper is pivoted at the base of the frame. Bridge and counterweight are connected by jointed girders.

When the bridge is down, the counterweight is suspended in a horizontal plane, where it is locked against movement by racks and cogs of the incline. When the bridge is raised, the counterweight swings downward in a half circle, while the motor house moves down the incline in front of it.

### *Less Power Needed*

This arrangement is said to require less power for operation than the ordinary bascule and is quicker in opening and closing the bridge. A 100-horsepower electric motor opens and closes the bridge in 90 seconds.

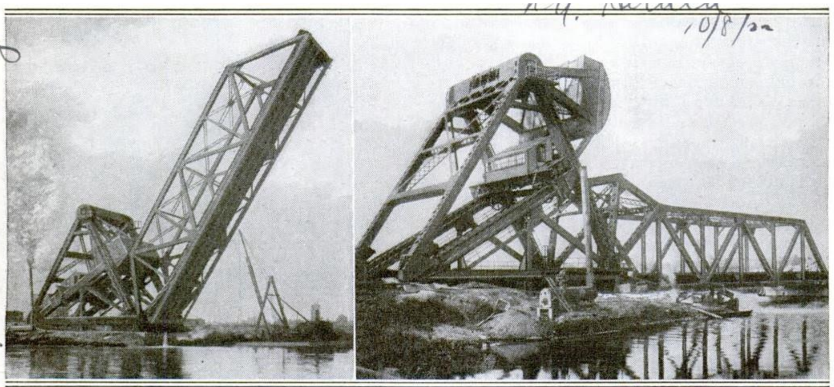
An extra motor is provided for use in case of a breakdown. A gasoline engine that will open the bridge in eight minutes is also available.

Concrete blocks, each weighing 2500 pounds, make up the 1000-ton counterweight. The movable span is 162 feet long. In the power house is mechanism that prevents operation of the bridge until all signals are set.

**Source: Popular Science, January 1923**

This bridge attracted the attention of Popular Science.

# Wabash Bridge



Left: New Type of Bascule Bridge Operated by a Moving Counterweight, Shown Open with the Counterweight Moved Down into the Supporting Tower. Right: The Bridge is Shown Closed with the Counterweight Moved Radially Upward, So That It Hangs Directly above the Bridge Trunnions

## BASCULE BRIDGE CONTROLLED BY MOVING COUNTERWEIGHT

A new bascule railroad bridge, with a span of 162 feet, across the Rouge River at Detroit, Mich., the first of its kind ever built, has a movable counterweight which controls the raising and lowering of the bridge. In every other respect it is like any trunnion bascule bridge. The counterweight weighs 1,000 tons, and is supported at a considerable height above the bridge in a strong steel tower, at the apex of which are bearings for trunnions, on which the counterweight swings at the end of connecting brackets radially at some distance from the center line of the trunnions. This movement of the counterweight is controlled by machinery installed inside a cabin on a transverse steel girder, that travels up and down two inclined steel supports moving the counterweight with it. The machinery is driven by a 50-horsepower motor, another similar one being provided for reserve power. Thus the counterweight is shifted with relation to the bridge trunnions so that, when it is directly above them, it holds the bridge closed, and when moved to a position at some angular distance from the bridge trunnions, opposite to the bridge, its downward pull forces the bridge upward, opening it. The tower supporting the counterweight is above the approach, which is 73½ feet long.

**Source: Popular Mechanics, December 1922**

This bridge also attracted the attention of Popular Mechanics.

# Abt Bascule Bridges

**Pere Marquette, Saginaw River, Saginaw. Youngest surviving Abt bascule span. No longer raises for boats. Built 1944, 160 Foot span.**

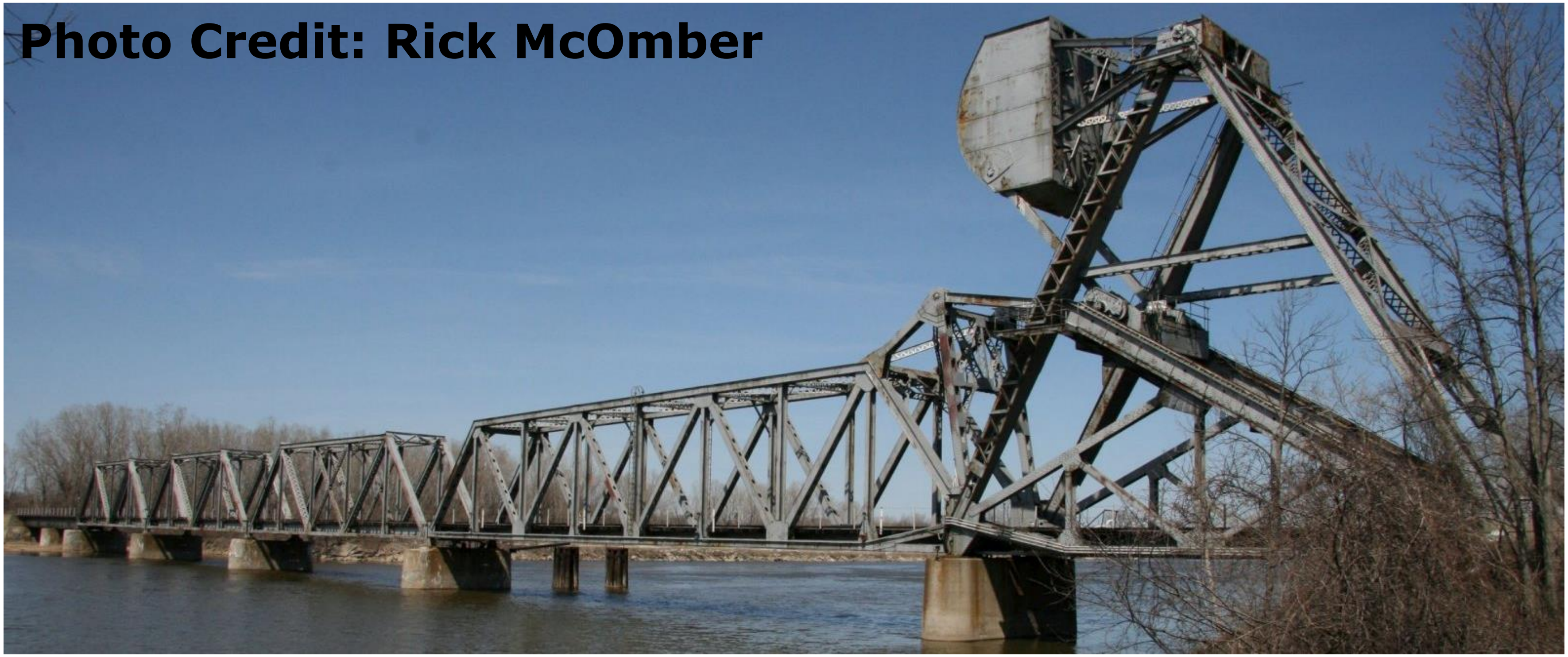


**Photo Credit: Rick McOmber**

The other three Abt bascule bridges are all in Michigan!

# Abt Bascule Bridges

**Wabash Railway, Rouge River, Detroit. First Abt bascule bridge. Still opens for boats. Built 1921, 162 Foot span.**

Photo Credit: Richard H. Scheel

The other three Abt bascule bridges are all in Michigan!

# Abt Bascule Bridges


**The Wabash Railway bridge drew attention because it was the first.**

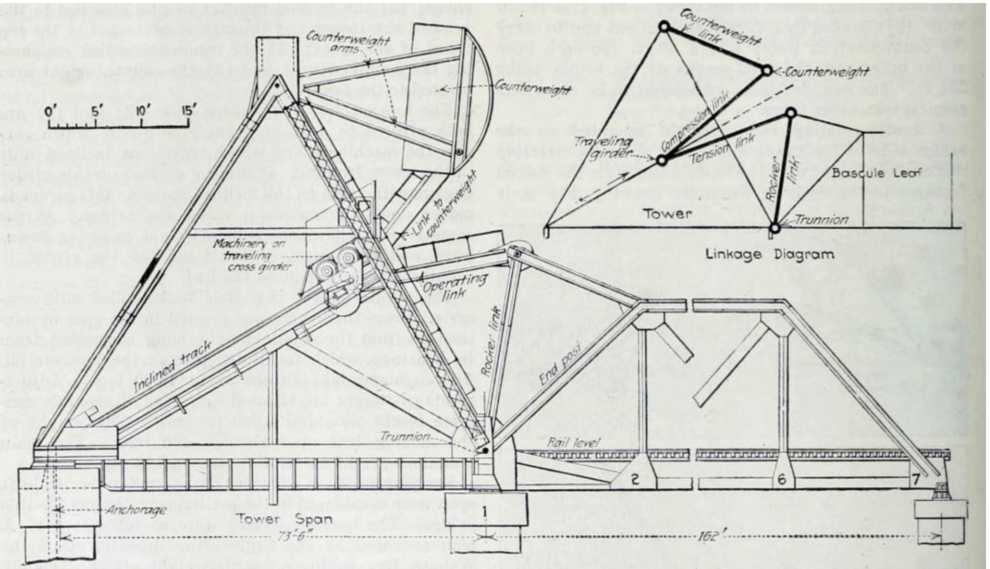



FIG. 2. OPERATING AND COUNTERWEIGHT SYSTEM OF ABT TYPE OF BASCULE BRIDGE

When the bascule span was completed, the old swing bridge was slid over, a new approach span installed, and the bascule open to traffic… with a closure to trains of only 7.5 hours!

# W. Grand Blvd RR Bridge

Located in Detroit, this is a stone-faced concrete arch bridge, built in 1896. The oldest known concrete bridge (RR or HWY) in Michigan!

# W. Grand Blvd RR Bridge

Built by Thomas J. Kennedy and designed by the W. H. Ashwell and Company. Berea stone and Amhurst buff stone used to face the bridge. Built for Mich Central RR and owned by NS today.

# W. Grand Blvd RR Bridge

This concrete bridge does not have rebar rods inside, instead solid or riveted steel beams strengthen the concrete. This is called Melan reinforcing after Josef Melan, the Austrian inventor of this process. A deteriorated bridge above reveals this design.

# W. Grand Blvd RR Bridge

All this information is thanks to one little news article, which also noted the 110 foot length bridge was the longest Melan arch at the time.

ING, AUGUST 2, 1896

**UNIQUE ARCH**

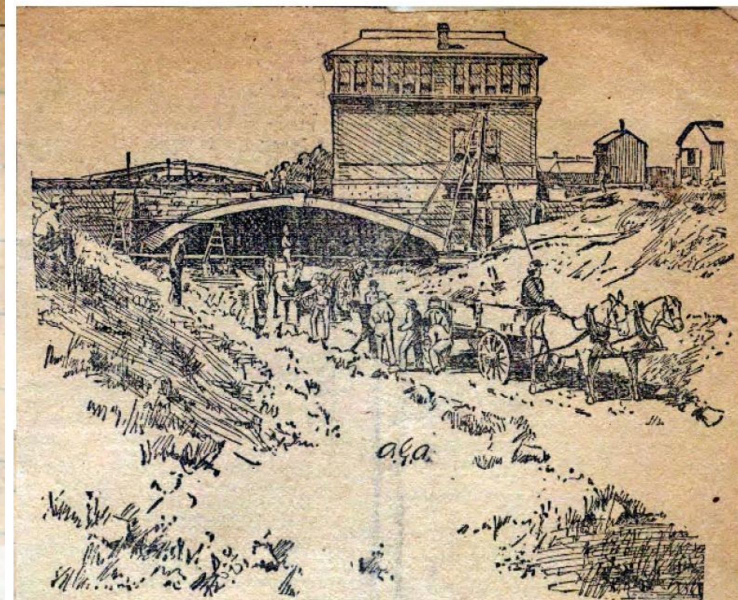
**Newest Link in Boulevard's Completion.**

**YEAR'S WORK ENDED**

**Largest Melan Arch Construction in the World.**

**AKIN TO ONE HUGE STONE**

**Remarkable Problem in Engineering Successfully Solved By the Park Board.**



WORKING AT THE BOULEVARD ROADWAY UNDER THE M. C. RAILROAD TRACKS.

**Courtesy Jen Klaus from the journals of her great grandmother, Elizabeth Jacquemain Kennedy**

# Conclusion/Questions

**Photo Credits/Sources:**

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- **Historic American Engineering Record**
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