

Cleveland I-90 Inner Belt Bridge Vs Minneapolis I-35W Bridge

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Abstract

The Minneapolis I-35W Bridge's collapse and its causes are observed and briefly discussed. The main cause stated for the collapse of the Minneapolis Bridge is the thin gusset plates used in its structure. A description of the Cleveland I-90 Inner Belt Bridge's early and more recent problems are provided. The I-90 Bridge suffers from three main problems: a jammed expansion joint, corroded steel chords, and being incorrectly anchored into the bedrock. Following the problems, the two bridges are compared and contrasted based on their minor and specific details, such as amount of salt it is exposed to, width, and age. Lastly, a discussion on each bridge's significance and their impact on Cleveland is provided.

The Minneapolis I-35W Bridge

The I-35W bridge was designed as a non-redundant structure, meaning that if any member fails, the entire bridge can collapse. Unfortunately the bridge collapsed in 2007 across the Mississippi River during rush hour as shown in figure 1. The bridge was about 40 years old. What fate does that leave for the almost 50 year old I-90 Inner Belt Bridge?



Fig. 1: The collapsed Minneapolis I-35W Bridge

The collapse of the Minneapolis bridge was possibly caused by a design flaw. The U10 and L11 gusset plates pictured in figure 2 were too thin adding an allotted amount of pressure. At the time of the collapse, these gusset plates were considerably overstressed. The bridge was also located over the Mississippi River. This exposure to water could have dramatically increased the corrosion process.

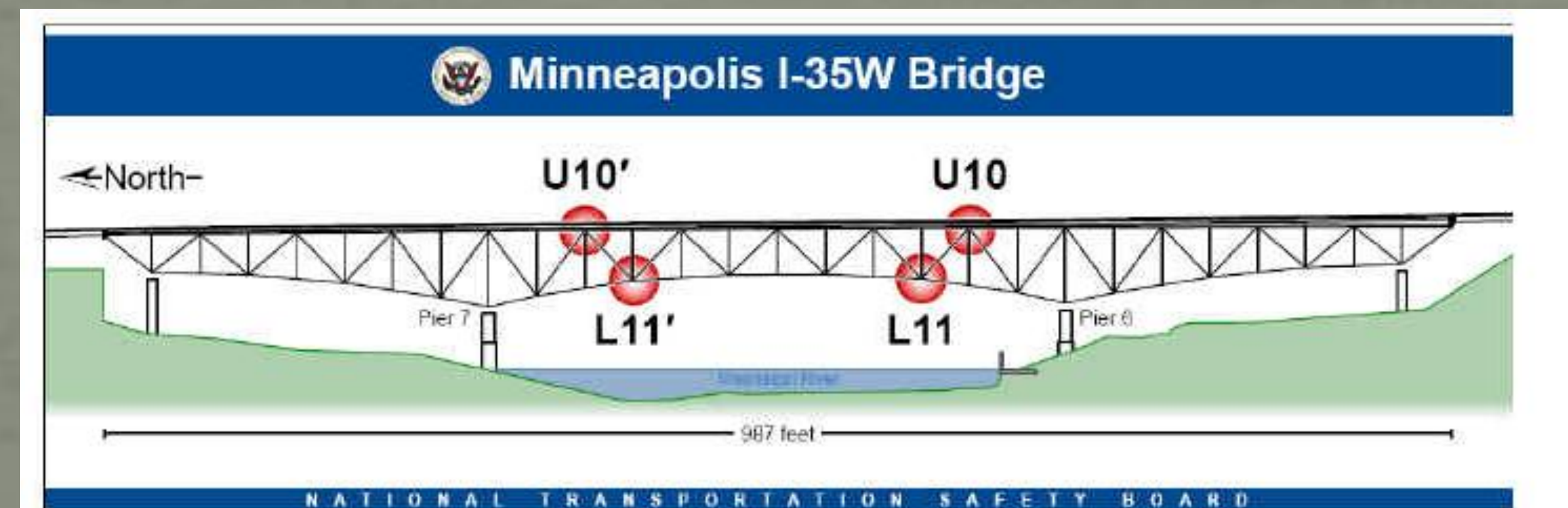


Fig. 2: U10 and L11 Gusset Plates

Table 1: Bridge Comparison

Bridge	I-90 Bridge	I-35W Bridge
Width	Eight lanes	Eight lanes
Age	50 years old	40 years old
Gusset Plate Problems	Two had buckled, 34 corroded	Two gusset plates 50% too thin
Traffic	119,000 vehicles daily	140,000 vehicles daily
Structure Type	Deck Truss	Deck Truss
Built over water	Cuyahoga River	Mississippi River

Bridge Comparison

The similarities between the bridges are that they have comparable forces acting against them. Both bridges had about the same time to rust, gusset plate problems, a similar amount of traffic, and are further corroding from an under passing river. The Minneapolis bridge had a problem with black ice because its deck was so thin. In dealing with this problem, loads of salt were dumped on the bridge. The I-90 bridge does not suffer from this issue but due to its location in the north, much salt is also used to avoid black ice and snow accumulation. This massive use of salt increases the rate of corrosion.

Bridge Contrast

Though the basic details of the bridges are similar, the problems that led to the collapse of the Minneapolis I-35W and the current problems of the Cleveland I-90 bridge are not so comparable.

The problem, as stated previously, with the Minneapolis bridge was concluded to be the failure of two gusset plates. The problems with the I-90 Bridge include corroded chords and the original design flaw of not anchoring the bridge's piers deep enough into the bedrock.

Cleveland I-90 Inner Belt Bridge Problems

When the bridge was built in 1959, the bridge piers installed on the slope of the Cuyahoga River were not anchored deep enough into the bedrock. As the slope naturally slid toward the river -- about an inch every decade -- the piers shifted. This closed the expansion joint and increased the pressure on the bridge.

An **expansion joint** absorbs movement caused by contractions and expansion from temperature variations. During the summer, the already closed expansion joint jams from expanding in the heat and causes more pressure on the bridge.

After an inspection, ODOT (Ohio Department of Transportation) discovered corroded steel chords. **Chords** are found where the truss meets the arch as represented in figure 3. They rated 19% of lower chords "very bad" with large deformation or holes in them, and 47% were rated "bad." They found corrosion on three dozen gusset plates, and two gusset plates had buckled about an inch. **Corrosion** is the deterioration of a material, normally a metal that results from a reaction with its environment. In the case of the I-90 bridge, the Cuyahoga river below and the required amount of salt dumped on the bridge every winter raises the rate of corrosion.

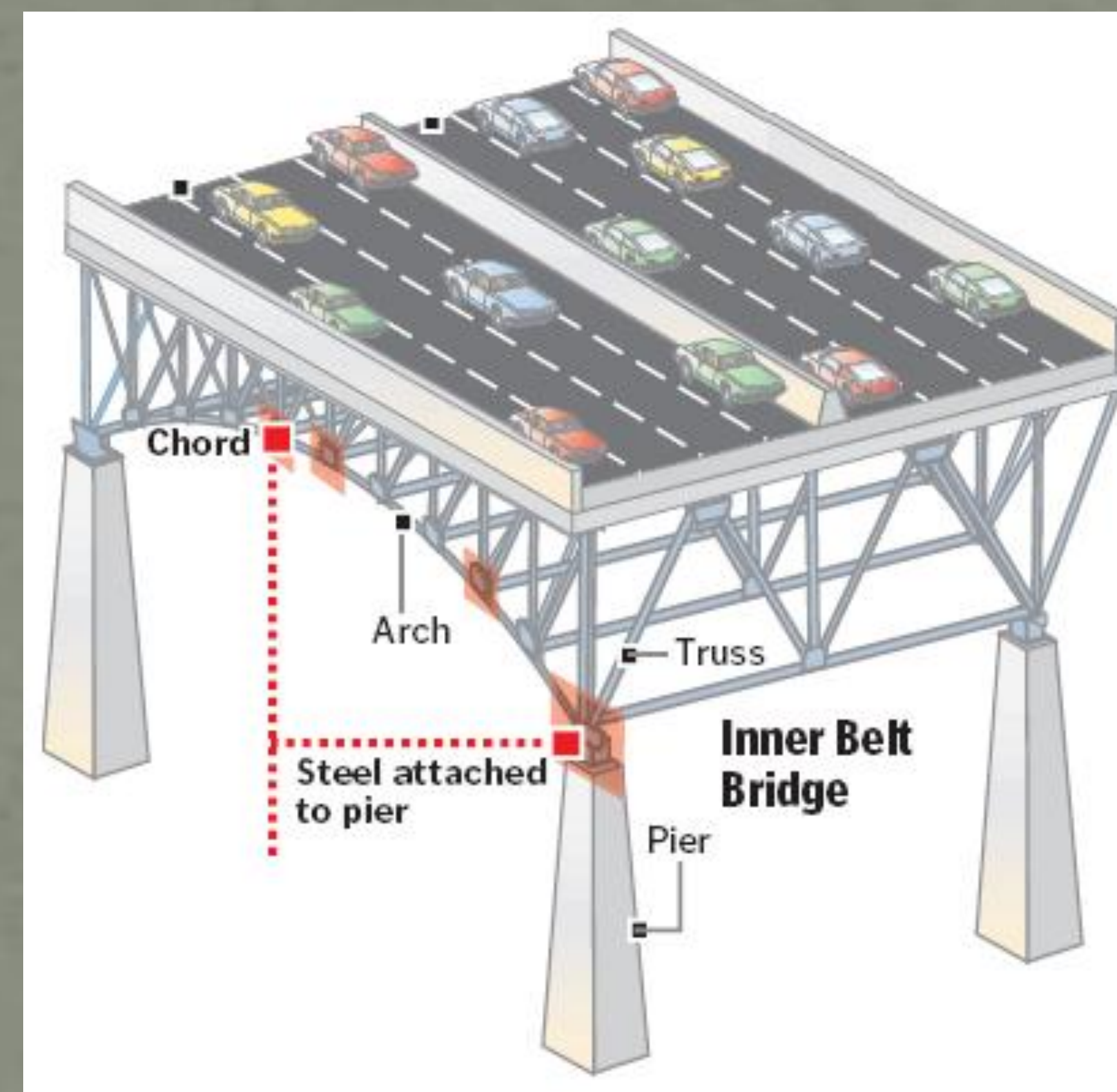


Fig. 3: Section of I-90 Bridge

Significance of the Bridges

Minneapolis Bridge – Upon the failure of this bridge, several hundred bridges of the same structure across the United States were inspected to make sure the problems that appeared in the Minneapolis Bridge did not appear in those bridges. With this act, the Cleveland I-90 Bridge was made that much safer.

Cleveland I-90 Inner Belt Bridge – While many residents and workers of Cleveland take the bridge for granted, the rest of us are knowledgeable of its significance. Not only do over 100,000 vehicles use the bridge everyday, but 50,000 cars were taken off downtown Cleveland's streets. This is because travelers were now able to use this bridge that connected the previously unlinked I-77, I-71, and I-90 rather than travel through the city to their destination.

Acknowledgements

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- Figure 1: *Wreckage of the Collapsed Minneapolis Bridge*. 2007. Photograph. *Bridge Collapse Cases*. Norbert Delatte. Web. 16 Mar. 2010. <http://matdl.org/failurecases/Bridge%20Cases/minneapolis_i.htm>.
- Figure 2: *Minneapolis I-35W Bridge U10 and L11 gusset plates*. 2007. Photograph. *Bridge Collapse Cases*. Norbert Delatte. Web. 16 Mar. 2010. <http://matdl.org/failurecases/Bridge%20Cases/minneapolis_i.htm>.
- Figure 3: *Inner Belt Bridge*. Photograph. *More Bridge Repairs Needed*. By James Owens and Karen Farkas. Ohio Department of Transportation. Web. 18 Mar. 2010. <<http://blog.cleveland.com/pdgraphics/2008/10/03CGBRIDGE.pdf>>.