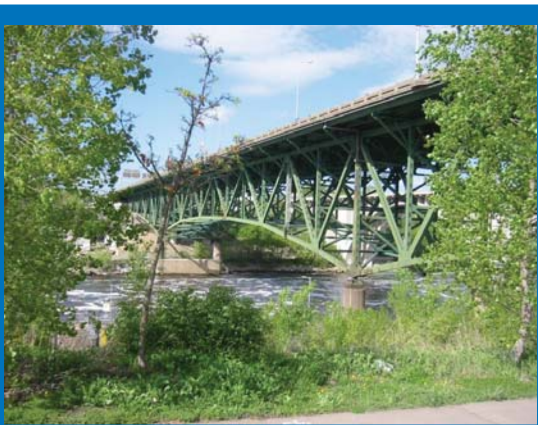
Forensic Analysis of I-35 Bridge Failure

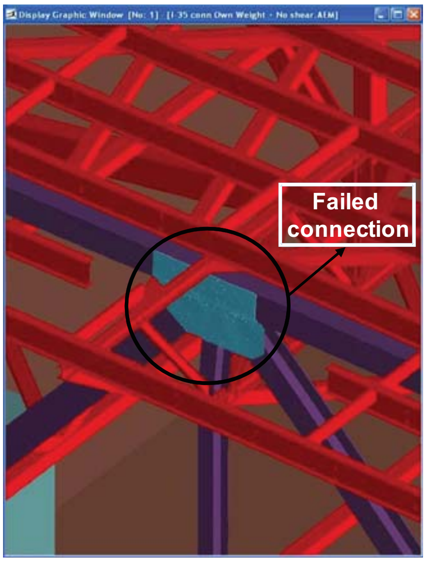
Minnesota, 2008

The I-35 Bridge in Minneapolis, Minnesota was built in 1967. It was a truss-arched bridge 1907 feet long and 108 feet wide. The 8-lane bridge used to serve 140,000 daily traffic counts. The bridge height above the river was 64 feet.

The bridge catastrophically failed during the evening rush hour on August 1, 2007, collapsing to the river and riverbanks beneath. Thirteen people died and 145 were injured. 117 cars were damaged including a school bus and 17 cars fell in the river. The compensation for people who were on the bridge at the time of the collapse, as well as family members of the 13 victims was around $37 million.

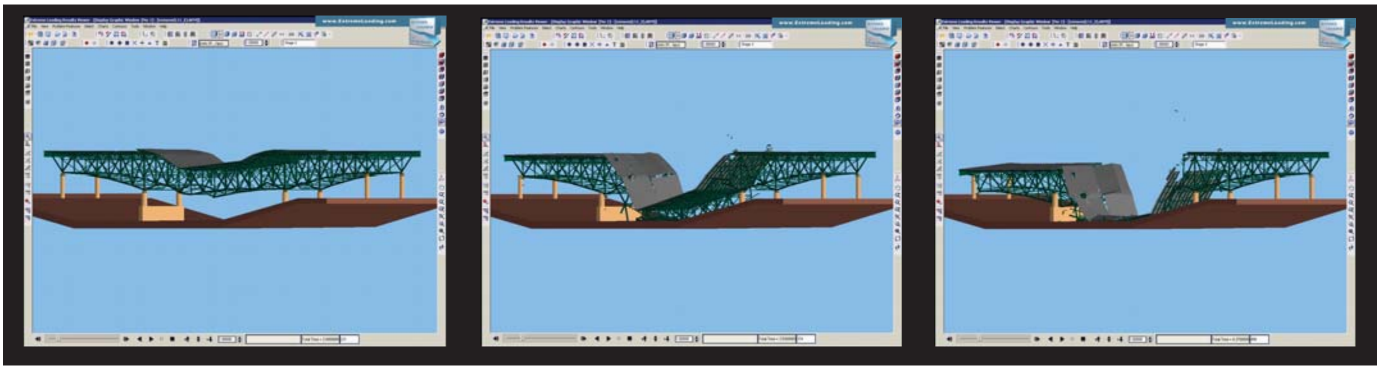


In the years prior to the collapse, several reports cited problems with the bridge structure. In 1990, the federal government gave the I-35W bridge a rating of "structurally deficient," citing significant corrosion in its bearings. Maintenance work was taking place in the weeks prior to the collapse included joint work and replacing lighting, concrete and guard rails. At the time of the collapse, four of the eight lanes were closed for resurfacing.



Raths, Raths and Johnoson Inc tasked ASI to use the Applied Element method for providing a forensic analysis to identify the reason of collapse. The bridge was modeled using original construction drawings. All the structural details were taken into consideration (steel truss, concrete slabs, concrete piers and ramps…etc). All the loads were taken into consideration such as gravity loads, traffic loads and construction loads.

ASI created a three dimensional model of the bridge using its patented structural analysis software Extreme Loading for Structures (ELS). In the preliminary analysis it was assumed that all the connection were rigid. The preliminary Bridge model contained 44,000 elements; however, the run time is two days which is a short time relative to any other Finite Element Method program with comparable accuracy.



According to the earliest observations of the collapsed bridge, the reason for the bridge collapse was thought to be a joint failure near to one of the intermediate piers. Five different preliminary dynamic scenarios were done. Each scenario had eight different weakened connections in the bridge. At this stage, the connection failure was modeled by a total removal of the connection. Based on those scenarios a sophisticated model was created for some of the most probable scenarios of failure.

The sophisticated model was done by modeling the connections in detail (gusset plate and bolts). In these runs the weakening in the connection, caused by the corrosion, was modeled by using a gusset plate with reduced thickness. The results of these analyses helped identify the cause of failure of the bridge. The mode of failure in the ELS model created by ASI engineers was very close to the mode of failure observed in the actual failure demonstrating that ELS is a reliable tool for forensic analysis of structural failures.

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Demolition Sequence