

Bridge collapse in minnesota



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The collapse of bridge I-35W in Minnesota during the rush hour of August 1 put tremendous pressure on the reliability and safety of our bridges nationwide. Countless investigations and precautionary measures were done to make all bridges pass standard procedures and render it safe for both the vehicles and passengers. At the same time it gave dent to our structural designers ability to come up with a truly sound structure and bridge design. In this research paper we will try to dwell into the process involving bridge design, the different design loads, proper bridge repair and the type of bridge design used by engineers on the I-35W.

After the collapse, we shall also try to decipher the expert opinion on the real cause and give credence to their theory on the failure of the gusset plate. We will also discuss the implication of the collapse of the bridge to the engineering profession, particularly if the failure was caused by defective design theories. And lastly after all is said and done, I will try to give my assessment on the matter based on the materials culled from the different websites of the Internet. The Design Process The design of a structure (buildings or bridges) follows a tedious and complex process.

Bridges for example needs extra meticulous observation because it carries moving loads and design flaws could only be accurately gauged if the sequence is subjected to a computer generated simulated stress diagrams. In this way structural designers can pinpoint the areas within the structure that is most likely to suffer fracture in extreme cases of bridge overload (BridgeArt). In the case of Bridge I-35W in Minneapolis, the designer may have been correct in all his assumptions as guided by the Design Manual of the American Institute of Steel Construction (AISC).

From the dead load to the perceived moving loads, to the snow load and impact loads and also the necessary factor of safety were all incorporated in his design observation. Proof of the matter is the said bridge continued to thrive since its erection in 1967 and only collapsed four decades later. What may have caused the collapse of the bridge? Serious design errors could not be faulted because it should have failed at the onset – when the bridge was first used by the commuting public. Certainly the culprit could be poor maintenance procedures or bridge repairs.

The Bridge Repair Data gathered from MN-DOT reveals that the bridge underwent major deck paving in 1970 and 1990. This twin repairs has already added tremendous dead load to the structure. Prior to the collapse of the bridge another paving was underway and materials were stockpiled on the deck plus the various equipment doing the repair job (Obi-Akpere). The recent resurfacing of the bridge placed an additional deadweight to the structure, roughly about 300 tons and may have triggered the demise of bridge I-35W (Obi-Akpere).

The Bridge Design Design Engineers from the University of Minnesota in its report, found the bridge to be a non-redundant structure – meaning that all structural components act together and if one member fails the entire structure would collapse. Besides, the arched structure rests on only four pylons and failure of one especially during tremors would be catastrophic (Week III). The bridge I-35W is a typical three p continuous deck truss with a jargon of steel members and with the roadway on top.

To protect the bridge from lateral movement because of extreme temperature changes (expansion and contraction), bridge bearings were

used to allow the structure free movement (Week III). The Investigation From the wreckage of the collapsed bridge, investigators found several fractured gusset plates. Calculations were made on the stress capacity of the gusset plates and were found to be way deficient and the loads applied on the bridge were over their design limit. But no design imperfections were observed on the structural members (Samuel).

This goes to show that failure of the structure emanates from too thin gusset plates, which could have been a construction error rather than a design flaw. Common sense dictates that a gusset plate should not be lesser in cross sectional area to a particular member served. In this case if proper construction procedure could have been followed, then structural failure should have been evident in the structural members (Roy). Or structure failure could be manifested in the welded joints or on the construction rivets and bolts.

But such is not the case, then blame should be shouldered by the contractor for possibly undertaking stringent cost cutting measures or on his failure to notify the design engineer of the undersized gusset plates. And the MN-DOT field engineers likewise for its failure to spot the defective components installed in the structure (Gilbert). Also inspections were made by MN-DOT personnel on the bridge, but sad to say that they were unable to spot the defective gusset plates.

Any ocular inspection would be useless unless field engineers would dutifully check each structural member by using calipers, particularly the thickness of the structural members. All the data are feed to their computer design software and only then can they be certain about their structural assessment

(ArtiFactor). Implication to Engineering The collapse of bridge I-35W is a slap to the engineering profession, because it will tend to show that structural designers failed to provide safety nets to our structures not only on bridges but also buildings.

It will put into question and scrutiny the methods and theories put forth by icons of the industry. For over 100 years our structural designers have practiced the profession based on the tenets of the formulas perfected by pioneers of the profession and a miscue like the collapse of the bridge will render all of these to naught. This will have a global effect, because everybody will now put to test the safety of our structures. With a disaster of this magnitude, people will now question the relevance of our structural design principles.

Have we really made an accurate engineering theory and formula that could be fundamentally applied to bridge design? Or do we need to further hone our skills in order to come up with a design principle that will truly address such structural deficiencies? Engineers will now be irrelevant because what they have studied and practiced through the centuries will be rendered useless. It will be back to square one since all structures will now be deemed unfit for human habitation.

What will now become of the human population - probably live in tents and simple lean-to structures? Development will be in a stand still as everybody will be wary of building structures, much more live in it. But initial finding from investigators is a breath of fresh air to structural designers. They only found errors in judgment in the use of materials and components not on the structural design. This will prove beyond doubt that they have practiced

sound design principles and that resulting structures are safer than ever.

Conclusion

In the ensuing investigation, it is my opinion that what caused the collapse of bridge I-35W is not the design flaws (although evident) but the haphazard repair on the bridge made by personnel of the MN-DOT. Take note that resurfacing was made on the bridge for three occasions, one in 1970, 1990, and the one prior to the collapse of the bridge. Each time the bridge was resurfaced, almost 15, 000 cubic feet of material was poured over it. This is only for the longest p of 458 feet and a width of 113 feet or roughly 8 road lanes, the one p directly over the river.

This alone constitutes over 2, 500 tons added to the original design load, and since this is done three times, the additional deadweight is tremendous. At the time of the incident equipment and materials were stockpiled making the structure grossly overloaded, no wonder the bridge collapsed (Week III). By the way repairs have been made on the bridge, it was actually an accident waiting to happen. It was never the fault of the structural designer, not even the contractor for he knew his responsibilities.

But had they followed the steel design manual on gusset plate design, the structure could have survived the additional deadweight imposed on it. References American Institute of Steel Construction, Inc. 1967. Manual of Steel Construction. sixth ed. American Institute of Steel Construction: United States. Artifactor. “ I-35W Bridge over Mississippi River collapsed! ” ScienceBuzz. 2 August 2007. Science Museum of Minnesota. 4 February 2008. .

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