FACTUAL SUMMARY OF INTERVIEWS WITH EMPLOYEES

WORKING ON BRIDGE PROJECTS IN THE 1960's

(7 pages including this cover sheet)

NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF HIGHWAY SAFETY
WASHINGTON, D.C. 20594

FACTUAL SUMMARY OF INTERVIEWS WITH EMPLOYEES WORKING ON BRIDGE PROJECTS IN THE 1960's

A. ACCIDENT

NTSB #: HWY-07-MH-024

Date and Time:	August 1, 2007 at 6:05 p.m.
Description:	Interstate 35W Bridge collapse
Location:	Interstate Highway 35W Bridge over the Mississippi River, Minneapolis, Hennepin County, MN.
Fatalities:	13
Injuries:	145

B. REPORT GROUP

Mark Bagnard, [redacted]
NTSB *Chief, Investigations Division* Group Chairman
624 Six Flags Drive, Suite #150, Arlington, TX 76011 [redacted]

C. ACCIDENT SUMMARY

About 6:05 p.m. (CDT), on Wednesday, August 1, 2007, the 35W Interstate Highway Bridge over the Mississippi River, in Minneapolis, Minnesota experienced a catastrophic failure in the main span of the deck truss portion of the 1907-foot-long bridge. As a result, approximately 1,000 feet of the deck truss collapsed with about 456 feet of the main span falling into the river. An assessment of the gusset plates within the deck truss revealed that the connections at U10, U10 prime, L11 and L11 prime were under-designed. The bridge was comprised of eight traffic lanes, with four lanes in each direction. At the time of the collapse, a roadway construction project was underway that resulted in the closure of two northbound and two southbound traffic lanes causing traffic queues on the bridge. A total of 111 vehicles were documented as being on the portion of the bridge that collapsed. Of these, 17 vehicles were recovered from the water. As a result of the bridge collapse, 13 people died and 145 people were injured.

D. DETAILS OF THE REPORT

On February 21, 2008, investigators interviewed staff from the Minnesota Department of Transportation (MnDOT) about the department's current process for bridge design and review as well as how this process may have occurred during the 1960's. Following this interview, a decision was made to identify and locate former employees who would have been involved in the design and construction process in the 1960's. A list of personnel was developed that included one current MnDOT employee as well as eleven retired employees and one retired contractor. Working from this list, records for four of the retirees listed them as being deceased. Additionally, the individual identified as being a contractor was located and determined to have to have been employed by the erection contractor for the I-35W Bridge project. In all, nine interviews were conducted. The interviews included topics such as the interviewee's involvement with the I-35W Bridge project, issues concerning MnDOT's design review process, issues with structural steel and gusset plates and other bridge issues such as construction and fatigue.

1. INVOLVEMENT WITH THE I-35W BRIDGE (#9340)

Of the nine interviewees, only two had direct involvement with the I-35W Bridge during the design or construction phases. One other participated in some design work associated with the Interstate 35W project, but was not involved in the design of the bridge.

One former employee started working for MnDOT in 1960, and he was originally assigned to the Department of Signing and Lighting. However, a short time later, he was transferred to the Structural Metals Department, which was located within the Bridge Office. While in that department, he spent 10- years as an inspector and following that, worked the remaining 20- years within the Bridge Office where he retired in 1990, as a Principal Engineer in charge of shop details. While working as an inspector in the Structural Metals Department, he was assigned to the I-35W Bridge project and was responsible for monitoring the work being performed by the fabricator at the fabricator's shop.

He would travel to the fabricator's shop, which for the I-35W Bridge project was Allied Steel, in Hammond Indiana and as best he could recall, the inspection work for this project required several months to complete. He worked closely with the fabrication shop's inspection personnel and his duties included inspecting all steel items listed on the design plans, ensuring that the correct steel was used in the various pieces used to create the truss members and ensuring that the fabricator complied with the information on the plan details. Primarily, he would spot check items and felt that the primary responsibilities for detailed inspections were with the shop's inspectors.

He reported that at the fabricator's shop, the truss members were laid out on the shop floor in the same configuration as they would be when assembled to construct the bridge. References (or layout lines) were then placed on the pieces as an aid for assembly during construction. Once each member for a connection had been laid out and marked, holes for the connections were made (sub-punching) and then reamed to their final size. Once everything had been marked and pre-fit the members were disassembled and shipped to the contractor.

He believed that when the gusset plates were shipped from the fabricator, they would have been free from any distortion. However, since his job did not require him to be at the work site, he did not know the anything about the condition of the gusset plates on the I-35W Bridge. He also recalled having at least two conversations with personnel working for the construction contractor. He stated that they were complaining about the fit up of some members and that the connections were not lining up. He believed the problem was later determined to have resulted from the way the contractor was attempting to align the vertical members that were located over the piers (although, he could not recall which piers).

Another interview was conducted with a former employee who worked for the erection contractor. He was employed full time with Industrial Construction's Structural Division from 1953 through 1974. While he attended college, he had worked several summers at the company as a part-time employee. He obtained a degree in civil engineering and after graduating, he began working full time managing the company's erection services. Eventually, he became the vice president managing both general construction and steel erection services. As vice president, he was responsible for items such as purchases, contracts and personnel issues. However, he stated that for the most part, his time was evenly split between being in the office and working out in the field. As part of Allied Steel, he worked on projects involving the construction of buildings, bridges and power plants.

He stated that Allied Steel was involved in projects all over the country and typically, company personnel were not satisfied with the contractors involved in the construction and steel erection aspects of these projects. During the 1950's Industrial Construction was involved in several *joint ventures* with Allied, and they eventually merged with the Allied Steel so that they could take over the construction and steel erection duties, thus assuring uniform quality.

He believed that the erection and construction of the I-35W Bridge began in July of 1964, and the only problem he could recall during construction was the late delivery of the steel to the job site. Aside from that, he believed that the job progressed very quickly. In addition, he did not believe that the steel was shipped from the fabricator to the job site by truck, but instead was transported by rail or barge. One other problem he recalled was that they had trouble getting a sufficient number of riveters for the job. They had recently completed a bridge project over the Saint Johns River in Jacksonville, Florida, and had to recruit riveters that had been on that job to come work on the I-35W Bridge.

In addition to the MnDOT inspector who had inspected the steel components at the fabricator’s shop, one other former MnDOT employee stated that he had been involved with the I-35W project. He recalled that originally, he was working on other design jobs and was later moved to the I-35W project. However, despite being assigned to the I-35W project he was not involved in any design work associated with the I-35W bridge.

2. BRIDGE DESIGN AND REVIEW

Eight of the former MnDOT described working within a design squad during the 1960's. Their recollection of the number of these squads within the Bridge Office varied but their descriptions of the squads and their duties were consistent. A design squad was comprised of a squad leader and several graduate engineers. The graduate engineers were primarily responsible for reviewing plans; however, for large or complex projects the squad leader would also perform reviews.

During several interviews, the review process was described in some level of detail. One employee reported that the design squads were instructed not to spend a lot of time reviewing the design aspects of consultant-based plans, "*Not to look too closely at the design*" and that their primary responsibility was to prepare the plans for letting. In those days, the biggest problem was getting the consultant plans to conform to MnDOT's policies and specifications. The items they examined included issues of quantities and constructability and he felt that these items were part of the concerns related to getting the consultants up to speed with MnDOT's processes and procedures. He also stated they were not expected to look too closely at some design issues like checking calculations because the plans were created by a professional engineer (PE).

Several other employees described the review process as one where items were reviewed but not to a level of detail where items like the design calculations were checked (although some things like the members were routinely spot-checked). They also stated that things like the main members and the geometry were also routinely checked.

One of the employees believed that much of the review work for complex bridges related to the interstate highway projects was performed by personnel from the Department of Public Roads (the predecessor to the FHWA) as this type of work exceeded the design squad's level of experience. However, the design squads would review these plans for such things as geometry and constructability. They also performed spot checks on the members coming into the connections. However, he did not recall ever checking calculations for a gusset plate.

One of the employees had worked in a design squad that was primarily involved with in-house designs. He recalled that at that during the early 1960's, MnDOT did not have many consultant based design projects. However, as projects for the interstate system began to be developed, this created an increase in the department's workload and a need for more of the design work to be performed by consultants. He also recalled that even before the interstate projects most if not all complex bridge designs were performed by consultants (he described this as being a resource issue). Another employee reported that after he became a PE, he became more involved in design projects for the interstate system and completed some design work for bridges on the interstate system. In this capacity, his assignments were dependant on the type and size of the bridge and typically only involved stream crossings or grade separations.

Three of the employees raised concerns about the amount of time they were allowed for performing design reviews. One stated that during the 1960's and 1970's there was a push to complete the interstate system and in his opinion, there was not time to check everything on the plans because of the rush to get things done. He also recalled rarely having the time to look at items such as design calculations. Another believed that during the time of the interstate projects (mid 1960's into the 1970's) there was a lot of pressure for the department to maintain an adherence to schedules and timetables. Because of this, he felt that they might not have been afforded all of the time needed for complete project reviews. The other stated that he had spent his entire career with MnDOT working within the Bridge Office. While he had not been involved in the I-35W interstate project, he was involved in other interstate projects during the 1960's. During that time, he felt there was a push to get these projects completed and that as such they were not afforded sufficient time to review project specifications. Two other employees commented on the time allowances provided for design reviews. They felt that the time allotted for performing the reviews was adequate. However, one acknowledged that there were occasions when they had to meet scheduling milestones but he did not believe those situations created any issues concerning the quality of the reviews.

3. STRUCTURAL STEEL AND GUSSET PLATES

The MnDOT inspector responsible for inspecting steel components at the fabricator's shop could not recall the specific types of steel used in the I-35W Bridge. He stated that it was his responsibility to ensure that the steel listed on the plans was used to fabricate each particular component. To identify the different types of alloys, as the steel left the mill it was color coded by applying paint to it. The steel was also marked with a heat number. When the steel arrived at the fabricator's yard the color-coding was used to sort and store the material. While not specific to the I-35W Bridge, he did recall instances where the wrong type of steel was used during fabrication.

Several of the employees recalled that back in the 1960's, MnDOT had a Structural Metals Division. Among other things, personnel in this division was responsible for reviewing plan details (including gusset plate details) to ensure that they contained sufficient information for the fabrication of the various components. This division was managed by a structural metals engineer who was responsible for knowing which type of steel would be used at different locations on a bridge. This individual was reported as having an inclination to use nontraditional steel alloys in bridge projects at that time.

Another employee claimed that during the 1960's MnDOT had begun to use different steel alloys in bridge construction and was moving away from the standard A36 steel that had traditionally been used. The reason for this was to save weight and to bring some bridge members into reasonable dimensions. One example he gave was a gusset plate on bridge 9330. He stated that had the usual A36 steel been used, the plate would have required a thickness of 4-inches. However, by using an alloy steel the thickness of the gusset plate could be substantially reduced. He also stated that both the 9320 and 9330 bridges were constructed with an extensive use of alloy steel. This concerned him because in the 1960's they were experiencing a lot of trouble with that type of steel. He recalled that they rejected an enormous amount of alloy steel for the 9320 bridge because it did not meet their specifications. He described the problem as the steel not containing enough copper and that resulted in it becoming brittle.

4. OTHER BRIDGE ISSUES

One of the former employees had worked for MnDOT as a Project Construction Engineer. He was the project construction engineer for the I-35W Bridge and reported that he had performed these same duties for other complex steel bridges including the Dartmouth Bridge and the Washington Avenue Bridge.

His primary responsibilities as the project construction engineer were to ensure that the bridge was constructed in accordance with the design plans and that the construction sequence was followed. He believed that Industrial Construction Company was the erection contractor for the I-35W Bridge and he had worked with them on other projects both prior to and following the completion of the I-35W Bridge. He described them as a well-managed and competent company and he felt that they always employed good crews. He was not able to recall any problems or unusual circumstances about the I-35W Bridge project and stated that the bridge went together without any difficulties.

When asked if he had ever encountered any situations that would have resulted in construction or erection induced deformation to gusset plates, he could not recall any time in his career when a gusset plate was bent or damaged during either construction or erection. He went on to say that, if something like that had happened the situation would have been reported to the bridge engineer in the Central Office. He routinely communicated with the bridge engineer so he felt he would have been aware of any problems of that nature. Also, when asked about any discussions regarding the design or type of steel used for the gusset plates on the I-35W Bridge, he could not recall those items ever being discussed or raised as a matter for concern.

Another employee brought up another issue concerning bridge designs from that time. In the 1960's bridge designs resulted in many structures having "fatigue prone details". Because of this, MnDOT gave special attention to these older bridges and monitored them for signs of fatigue. He recalled that one bridge (he believed it was structure number 9320) almost collapsed because of a significant fatigue related crack that had formed in one of the main span girders. The crack had propagated along the interior of the girder and had split about 90 percent of the girder.

Mark Bagnard
Chief, Investigations Division