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Precast concrete enables rapid replacement of Minneapolis bridge

Traffic flowed across the Mississippi River on Interstate 35W (I-35W) in Minneapolis, Minn., at 5 a.m. on September 18, 2008, just 11 months after the Minnesota Department of Transportation (Mn/DOT) gave notice to proceed on the new design-build bridge to replace the structure that collapsed August 1, 2007.

The new 1223-ft-long (372.8 m) St. Anthony Falls Bridge features high-strength, high-performance concrete for the post-tensioned box girder superstructure with a precast concrete main span of 504 ft (154 m). Separate parallel structures carry northbound and southbound traffic, each comprising two box girders joined together to provide a 90 ft 4 in.–wide (28 m) deck. Together, the structures accommodate 10 lanes of traffic and are designed to add rapid bus or light-rail transit in the future.

The team of Flatiron-Manson Joint Venture, with FIGG as the design engineer, was selected by Mn/DOT in a best-value process, which included the cost, schedule, and technical quality for best achieving the project goals. Although the requirements called for this emergency replacement bridge to be completed in about 15 months (by December 24, 2008), the Flatiron-Manson and FIGG team focused on achieving an even faster schedule while providing a high-strength structure designed to last more than 100 years. The strategy was to work in multiple areas simultaneously, with three shifts seven days a week.

Eight long-line casting beds were established on the unused Interstate 35W roadbed, just south of the St. Anthony Falls Bridge site in Minneapolis, Minn. Rolling, heated enclosures facilitated casting segments through Minnesota winter weather. Courtesy of FIGG, Tim Davis photographer.

The new St. Anthony Falls Bridge opened to traffic on September 18, 2008, just 339 days after notice to proceed. The 10-lane interstate bridge is a major commuter route in Minneapolis and provides the main trucking link through the state. Courtesy of FIGG, Tim Davis photographer.

Precasting the four lines of box girders for the 504 ft (154 m) main span allowed the majority of the work for the river span to be completed offline while work was under way for the substructure and cast-in-place spans over land. Taking advantage of the site to save time, Flatiron-Manson set up a casting yard on the closed interstate highway pavement just south of the bridge and immediately constructed the majority of the formwork with tim-

Erection began on the 504 ft (154 m) main span of the St. Anthony Falls Bridge over the Mississippi River in Minneapolis, Minn., on May 25, 2008, and was completed on July 10, just 47 days later. Typically, four segments were set each day. **Courtesy of FIGG, Tim Davis photographer.**

The four parallel box girders in the 504 ft (154 m) main span of the St. Anthony Falls Bridge required 120 precast concrete segments. Upon completion of casting, the segments, weighing up to 200 tons (180 tonnes), were moved to a site next to the river, then loaded onto barges for erection in the main span. **Courtesy of FIGG, Tim Davis photographer.**

ber. Prefabricated metal buildings on rollers were used to provide shelter for the precasting operations through the cold Minnesota winter.

The first segment was cast on January 30, 2008, just 107 days after construction started, when the high temperature was -2 °F (-19 °C). A total of 120 precast concrete box girder segments, varying from 25 ft to 11 ft (7.6 m to 3.4 m) in depth, were produced in eight long-line segment casting beds in 128 days.

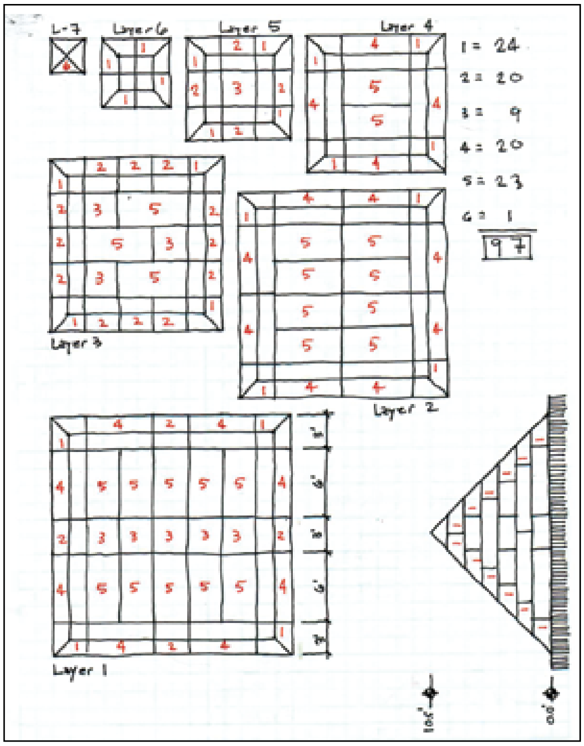
After curing, segments were removed from the forms and transported by tractor trailer to a nearby staging area at the bank of the Mississippi River. There, they were prepared for erection, loaded onto a barge, and floated to the bridge location, where a barge-mounted ringer crane lifted the segments into position. Main-span construction proceeded from the banks toward the center of the river in one-direction cantilever, with a maximum of six segments weighing up to 200 tons (180 tonnes) each erected in a single day. The last segment was placed on July 10, 2008, completing the main span in only 47 days.

Durability for the new I-35W bridge is provided by the high-performance concrete containing silica fume and fly ash for low permeability, post-tensioning in two directions to provide residual compression, an integral concrete wearing surface, and other features. In addition, Smart Bridge technology comprising 323 sensors is installed on the structure to enhance bridge inspections, including corrosion-potential sensors embedded in the wearing surface.

The record speed in which the I-35W bridge was completed, more than three months ahead of schedule, was made possible through the combination of precast concrete segmental construction and the efforts of the Mn/DOT, Federal Highway Administration, Flatiron-Manson Joint Venture, design team, and many subcontractors and suppliers.
—Source: Figg Engineering Group

Students use beer, kite to erect concrete pyramid

There has been a theory for some time that the Egyptians, in addition to using slave labor, were able to harness the wind through the use of



This diagram shows the layout that students from California State Polytechnic University, Pomona, used to erect a pyramid to test the theory that Egyptians used beer and kites in their construction of the pyramids.

The top of a pyramid assembled by California State Polytechnic University, Pomona, students using kites to lift the stones is all that is left to complete the project. Courtesy of Doug Mooradian.

linen kites to help move the stones that became the pyramids we admire today.

In addition, beer is known to have been a valued commodity of the Egyptians, and it is believed that they used beer, in part, for the destabilization of their building pads supporting the pyramids. Permazyme, an enzyme developed by the military in World War II for temporary roads and runways, uses the same active ingredient found in beer: yeast.

California State Polytechnic University, Pomona, students use a kite to move precast concrete blocks while erecting a pyramid. Courtesy of Doug Mooradian.

In an attempt to prove the feasibility of using kites to move stones and beer to prepare the site, Maureen Cummings and Ed Van O'Linda, developers and proponents of the theory; Gary McGavin, a professor of architecture at California State Polytechnic University, Pomona; and Doug Mooradian of the Precast/Prestressed Concrete Manufacturers Association of California (PCMAC), among others, put the theory to test.

McGavin utilized and assigned his entire third-year Architectural Structures class, along with some graduate students, to work on this project for the spring quarter of 2008. The students formed teams to design and then build the forms that would be transported to the Coreslab Structures (L.A.) Inc. plant in Perris, Calif., for fabrication.

The students toured the Coreslab plant and watched the fabrication of the concrete blocks within their forms. For their final, students had to first prepare the erection site with beer and then erect the 106-ton (96 tonne) pyramid by harnessing the forces of the wind though the use of a kite. The kite was manufactured using a treated silk material to replicate the fine linens of that era because we no longer have the ability to weave fine linen as the Egyptians did.

The 97 precast concrete blocks are minimally reinforced and vary in size and weight, with 6 different forms or shapes forming the pyramid. Certain modifications were made for both safety and practicality from the stones that the Egyptians would have used.

—Source: Precast/Prestressed Concrete Manufacturers Association of California

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