



Rethinking Shop Drawings

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By providing shop drawings to bidders, WisDOT was able to shorten steel delivery times for a complex interchange reconstruction project.

THE MARQUETTE INTERCHANGE RECONSTRUCTION PROJECT in Milwaukee constitutes the largest and most complex highway project ever undertaken by the Wisconsin Department of Transportation (WisDOT). The original interchange, constructed in the late 1960s, is the cornerstone of the state's southeast freeway system. Providing intersections among Interstates 43, 94, and 794, it carries more than 300,000 vehicles per day, making it vital to regional auto transportation.

Located near downtown Milwaukee, the interchange also provides access to residential areas, downtown businesses, the lakefront, and festival grounds. As such, WisDOT vowed to maintain two lanes of traffic in each major direction throughout the project's duration and is committed to finishing the project within four years; it's expected to be completed by November 2008.

Delays Threaten Schedule

The project includes completely removing the existing bridges and rebuilding them with a combination of steel plate I-girders, steel box girders, and pre-stressed concrete beams, and consists of four main contracts. The West Leg contract, granted in November 2004, involved construction of a 920-ft double box girder structure of 70-psi grade high-performance steel. However, in March 2005 the prime contractor notified WisDOT of an unanticipated eight-week delay in steel delivery to the fabricator.



A rendering of Milwaukee's Marquette Interchange in its reconstructed form. The interchange will connect I-43, I-94, and I-794. Courtesy WisDOT.

While the delay for this contract was problematic, similar delays for an upcoming larger core contract could have catastrophic effects on the project schedule. The core project would be two months or more behind schedule before it even began, and WisDOT had scheduled this contract to be assigned in August 2005.

Rethinking Steel Procurement

In typical projects, the prime contractor

takes responsibility for procuring the steel, arranging for fabrication, and ultimately building the structure. The contractor first selects the shop drawing detailer and the steel fabricator. The detailer develops preliminary shop drawings, used for ordering steel from the mill for delivery to the fabricator. Thus, the prime contractor assumes the risk for availability and delivery of steel to meet the contract schedule. This highly linear process can add six to eight weeks to

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the project schedule for a complex structure.

As such a delay would, again, wreak havoc on the Marquette Interchange project schedule, WisDOT considered some alternatives for shortening the steel delivery times, including:

- Preparing separate bidding documents for procuring steel directly from the mill. WisDOT would then provide the steel to the prime contractor's fabricator.
- Preparing plans and specifications for procuring structural steel directly from the fabricator for delivery to the site for erection.

However, WisDOT was reluctant to take on the significant economic risk associated with these alternatives. The first alternative would put the department squarely in the middle between two major contractors. It would make WisDOT responsible for delivery schedules, quality of the product delivered, and additional contract administration costs. With the second alternative, WisDOT would risk ordering steel plates with dimensions that did not work efficiently for a particular fabricator.

A Solution Emerges

With the clock ticking, WisDOT turned to the steel industry for advice. One innovative suggestion promised to speed steel delivery while minimizing economic risk. It involved having the department procuring preliminary shop drawings from a detailer for the critical structures. WisDOT would then provide the drawings to all prospective bidders at the bid letting.

This procurement strategy also presented some risk. WisDOT would be responsible for the ordered steel based upon these drawings and for any subsequent delays caused by errors. To minimize risk, the department decided to contract for preliminary shop drawings only on structures that were critical to the schedule. For the remaining structures, the winning contractor would take responsibility for all aspects of the steel procurement, as usual.

WisDOT decided on this option and immediately began procuring preliminary shop drawings from Tensor Engineering for the critical structures that required steel erection in the first 12 months of the project. These activities included making calculation plans, web camber diagrams, flange-cutting diagrams, and diaphragm layouts to the stage, permitting material orders from the steel mills. The shop drawings were to comply with NSBA/AASHTO (National Steel Bridge Alliance/American Association

of State Highway and Transportation Officials) standards and be sufficiently generic in nature so that any steel fabricator could use them. All prospective bidders received the shop drawings for bid preparation.

WisDOT awarded the project on September 1, 2005. PDM Bridge, the fabricator, placed the initial steel order eight days later. PDM began fabrication of the critical steel members on November 8 and delivered the fabricated steel to the project in April of 2006.

The procurement decision paid off. Having preliminary shop drawings available to the bidders cut about eight weeks from the steel delivery schedule and helped put the entire Marquette Interchange project ahead of schedule.

Added Benefits

This procurement strategy provided other benefits as well. During development of the preliminary shop drawings, several design issues emerged and were handled by phone and with follow-up documents in the form of Requests for Information (RFIs). Communication regarding RFIs took place within 24 hours. Under conventional contract conditions, these RFIs would have gone to a contractor, then on to the project management team, and then to the designer. The answer would return via this same communication protocol, usually taking a week at best. But the close working relationships among WisDOT, the designer, and Tensor Engineering created a situation where issues were resolved in record time, all prior to the bid date.

Since Tensor Engineering could accurately calculate and lay out all sizes of material, the fabricators received exact sizes for ordering, which reduced the amount of scrap. Estimated scrap savings amounted to hundreds of thousands of dollars.

In several instances, addenda plan sheets provided more accurate structure plans and bidding documents to the contractors. Using the conventional design-bid process, these questions would have had to be researched and answered before shop drawings could be completed and steel ordered, further extending the project schedule.

In addition, the steel mills became aware of data on the amount and size of plates to be ordered ahead of the bid, based on the preliminary shop drawing results. They then tentatively reserved space on their rolling schedules to accommodate the anticipated steel order. This avoided the risk of delay in the event that the fabricator



Steel plate girders being erected. Photo by Robert Wazniak, WisDOT.

could not get on a mill's rolling schedule in timely fashion.

The Right Choice

In short, WisDOT's advance procurement of preliminary shop drawings proved to be a highly effective strategy for shortening steel delivery times while minimizing risk, and eliminated two months of unanticipated delays to the Marquette Interchange Reconstruction project. **MSC**

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Owner

Wisconsin Department of Transportation

Designer

Milwaukee Transportation Partners, a consortium led by the Milwaukee offices of HNTB and CH2M Hill

Prime Contractor

Marquette Constructors, Milwaukee, Wisc., a joint venture of Lunda Construction Co., Black River Falls, Wis.; Zenith Tech, Waukesha, Wis.; and Edward Kraemer & Sons, Plain, Wis.

Fabricator

PDM Bridge, Eau Claire, Wis. (AISC member)

Detailer

Tensor Engineering Co., Indian Harbour Beach, Fla. (AISC member)