SUGGESTIONS FOR IMPROVING THE STRUCTURAL STEEL SHOP DRAWING PROCESS

SEAC/ RMSCA Steel Liaison Committee

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The following is a discussion of the current status of the process of preparing structural steel shop drawings.

This paper was prepared by the SEAC/ RMSCA Steel Liaison Committee, a coalition of Front Range Fabricators, Detailers, Erectors and Structural Engineers (EOR) dedicated to improving the steel construction industry. The intent of this paper is to propose suggestions for improving the structural steel shop drawing process. The process of preparing shop drawings has become the most time consuming and unpredictable part of the fabrication process.

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I. PURPOSE of Shop Drawings – there are different view point perspectives from:

A. Fabricator – The transfer of information from the Contract Documents into accurate and complete shop and erection drawings and the development of accurate, detailed dimensional information to provide for the fit up of parts in the field. AISC – Code of Standard Practice for Steel Buildings and Bridges, March 18, 2005.

B. GC - To confirm that the system is in general conformance with the Contract Documents and with the GC/ Sub-contractor agreement and to coordinate with the other affected trades.

C. Erector – To understand how to erect the steel frame construction and to make sure the structure is safely and economically erectable.

D. EOR – To confirm that the structural steel system is in conformance with the intent of the Contract Documents.

II. The Normal Shop Drawing PROCESS

While the normal process is described following, standard practice within any EOR or Architectural office can vary significantly. Additionally, the GC may prefer his own approach to the process. The process for any given project must be discussed and agreed upon. The normal shop drawing process is shown so that problems can be identified with the process and then the problems can have suggested solutions.

A. The GC makes the Contract Documents available to the Fabricator. Specifications, while a part of the Contract Documents, often are not included. An increasing trend is for electronic versions of the Contract Documents to be sent to the Fabricator. While this is done to expedite delivery of the shop drawings, the actual printed documents are considered to be the Contract Documents.

B. The scope of the work is then discussed between the Fabricator and the GC and then a structural steel bid/ proposal is submitted by the Fabricator to the GC.

C. The Fabricator and GC negotiate the contract. Once an arrangement is made, the Fabricator compares the bid/ pricing drawings to the CD’s furnished.

D. Detailing is usually started right away, usually under a tight schedule. Then the Fabricator, Erector and GC discuss the fabrication and erection sequence.
E. When questions arise or conflicts are found during the preparation of the shop drawings, questions are asked to determine direction. Often, RFI’s result from these questions. The timing of the shop drawing submittal is often delayed by this part of the process, since numerous RFI’s are generally indicative of unclear or incomplete Contract Documents. Thus the time and possibly the cost required to prepare the shop drawings will likely increase.

F. Multiple copies of the shop drawings are submitted to the GC. In order to help expedite the review turn-around time, a concurrent copy can be sent to the EOR and/or Architect, with the GC’s permission, to help expedite the process.

G. The GC processes the shop drawings and then passes them on to the Architect. In practice, the GC review is often a cursory review that only verifies that the submittal actually relates to the scope of work.

H. The Architect reviews and then sends the shop drawings on to the EOR. In practice, the Architect often performs their review simultaneous with the EOR or after the EOR and adds their comments to the shop drawings after the EOR returns the set with their copy.

I. The EOR reviews and makes comments on the shop drawings, keeps one set, and returns the remainder back to the Architect.

J. The Architect reviews the shop drawings and then returns them to the GC.

K. The GC reviews the shop drawings and then returns them to the Fabricator.

L. The review process typically consists of reviewing parties taking various actions. These actions tell the Fabricator how to next proceed with the shop drawings. The typical actions are:

1. No Exceptions Taken
2. Exceptions as Noted
3. Revise and Resubmit
4. Rejected

The first two actions allow the Fabricator to proceed and fabricate the material without a re-submittal. The later two actions require a re-submittal.

M. The Fabricator reviews all comments, calls the appropriate party with questions and/or RFI’s, and returns them to the detailer to complete and correct them for fabrication.

N. The Detailer “scrubs” the shop drawings and asks questions for clarification from the EOR, Architect, GC, Fabricator, or Erector.
O. Drawings are released to the shop. Final “For Construction” copies are sent to the GC. The Erector is sometimes copied at this time.

P. Frequently the “For Construction” shop drawings arrive on the first delivery truck at the job site.

III. **PROBLEMS** in preparing the shop drawings

A. Incomplete Contract Documents
   1. Opposing expectations in level of completion. The Detailer expects every issue of a structural drawing to be 100% complete. However, sometimes drawings are issued for information due to accelerated schedules and the EOR does not intend for these drawings to be considered as complete. This can present problems for long lead items and sequencing.
   2. Specifications often are not supplied with the bid drawings. When specifications are available, they often are not thoroughly coordinated with the Design Drawings.
   3. Inconsistent industry guidelines for production of drawings
      c. There is a general misconception that the EOR knows the answers to all questions raised. This is not the case. Common problem areas are: (1) stair dimensions (2) Canopies and entrances (3) Edge of slab or roof deck (4) Mechanical unit sizes, weights, locations and openings through the structure.

B. Poor Communications
   1. The shop drawing submittal and review process is unclearly specified. Because of this, the GC and/or Architect decide on a project specific process. Different EOR offices have different practices with regard to the timeliness and completeness of their review methods.
   2. The participants in the process (Detailer, Fabricator, GC, Architect, EOR) often do not communicate adequately. RFI’s, while the typical vehicle used to clarify missing and conflicting information, are frustrating to all parties.
      d. There can be multiple questions asked in a single RFI.
      e. Unclear questions without a verbal discussion or sketches are a set up for misunderstanding and a delay in a response.
      f. 3rd and 4th generation faxes are unreadable.
      g. No solution proposed.
      h. References to problem area(s) are not defined.
i. Sometimes an RFI requests a very short turn-around time for an answer, due to scheduling.

j. Numerous RFI’s are usually an indication of incomplete drawings and positions the respondent to become defensive.

3. Construction Schedule is not clear
   a. The GC often is changing the schedule and not keeping the affected parties informed. Unannounced changes in priorities often present timing problems for the shop drawing submittal.
   b. The EOR is often out of the loop, not understanding or appreciating the milestones. The EOR is not typically informed about the construction schedule.
   c. The Fabricator’s schedule requirements are unknown.
   d. The reviewers have no idea how large submittal packages will be or when they will arrive. The EOR often requests a submittal schedule in the specifications. This schedule is seldom provided to the EOR.

C. Shop Drawing Review Comments – The review comments are sometimes:
   1. Vague, unclear, cryptic or unreadable.
   2. Do not adequately address or completely answer questions raised.
   3. Making changes outside of the scope of work, answered RFI’s or PR’s which affect costs or schedule.
   4. Deferred by an upstream reviewer to someone else to address and thus left unanswered.
   5. Due to a concern on the part of the EOR that they will become liable for fit up and dimensional issues beyond their typical scope, the EOR is often unwilling to provide specific corrections on the shop drawings.

D. Coordination With Other Trades
   1. The burden of coordination responsibility is often unfairly placed on the Fabricator by the GC. The Fabricator is generally not provided needed documents and is not generally equipped to effectively coordinate.
   2. Timing of coordination can be an issue, since other trades are working under their own schedule.
   3. The Fabricator usually does not have contractual authority over the other trades, which dilutes obligations, incentives and cooperation.

IV. **PANACEA** (Solutions to improve the shop drawing process)
   A. Incomplete Contract Documents must be avoided.
      1. See the AISC “Code of Standard Practice for Buildings and Bridges”, March 18, 2005, Section 3 for the recommended information needed in the Contract Documents.
2. Specifications must be provided with the bid drawings. They also must be customized for the specific project requirements and should have the project indicated on each page.

3. The EOR should reference and use the AISC Code of Standard Practice of Buildings and Bridges whenever appropriate. By the same token, the Fabricator should become familiar with SEAC Guide for Consulting Structural Engineering Services in Colorado.
   a. Concerning mechanical openings – The EOR should define the primary structure around openings and allow for field installed frames, field fabricated from stock material, if possible. This detail should be shown in the Structural Drawings.
   b. To deal fairly with mechanical changes, the EOR should consider adding language to the Contract Documents placing responsibility for additional costs, including EOR fees, on the party instituting the changes.

B. Poor Communications – Communication: Is defined “To clearly convey information, to have an interchange”
   1. A Pre-Detailing Conference is essential for larger complicated projects and should be specified in the Contract Documents. See the “Pre-Detailing Meeting” paper previously written by this committee.
      a. Face to face meetings help initiate effective communications.
      b. Appropriate people should attend.
      c. The Detailer and Fabricator must be familiar with the project ahead of this meeting so that issues can be discussed. Questions should be made available prior to the meeting.
      d. Procedural issues can be established or confirmed (submittals, RFI’s, paper flow of updated Contract Documents, coordination with other trades)
      e. Lotting and special ordering should be discussed.
   2. RFI’s should: (See 10/05 Modern Steel Magazine + Code 4.6)
      a. Be asked in a timely way so as to not require an immediate response.
      b. Be used as a confirmation of a previously discussed and agreed upon topic, especially if a pre-detailing meeting is held that identifies and solves problems.
      c. Only ask questions about issues not clearly shown in the Contract Documents
      d. Be clearly written
      e. Address only one question or issue
      f. Reference the problem area(s), using excerpts from the Contract Documents.
      g. Ask a question with a proposed sketched solution that can be answered yes or no.
      h. Be clearly answered by the respondent. Example question – “What is the top of steel at the roof ridge on drawing S2.5?”
Inappropriate answer – “The top of steel is at the underside of the steel roof deck.”

i. State schedule and cost impacts, if appropriate, or at least indicate that there may be cost and schedule impacts.

j. Be handled wisely in emails and faxes. These tools are only part of a means for obtaining information. A verbal communication will help convey the nature of the issue, if the email or fax was received, and how the problem is affecting the project. Any issue that involves input from multiple parties will take longer to answer due to the coordination required.

k. Be addressed at timely pre-construction meetings on all projects where procedures, coordination, erection sequence, access, testing, etc. may be discussed.

3. Construction Schedule
   a. A GC generated schedule with regular updates should be provided to all affected parties.
   b. Key Fabricator milestone dates should be made available to all affected parties and updated on a regular basis.
   c. The EOR should be informed ahead of time by means of a submittal schedule provided by the GC, and the GC should be informed ahead of time by the Fabricator, when shop drawings will arrive. This should help expedite the review time. Also, the normal 2 week turn-around time frame requires that all involved parties in the review process be expeditious in their turn-around time.
   d. An advance copy of a shop drawing submittal to the EOR should be allowed. It should be marked “For Information Only” to avoid confusion.

C. Suggestions For Improving Shop Drawing Review Comments
   1. Comments must be readable and clear. All questions must be addressed. The comments must address specific issues and locations.
   2. The reviewer should not finish his design on the shop drawings.
   3. The reviewer should call the Detailer to discuss comments and questions before the shop drawings are passed on.
   4. The reviewer should also call the appropriate parties where questions raised on the shop drawings need answers by others and to explain why the EOR cannot answer the question(s).
   5. Changes or changes in scope should be expeditiously and separately documented, not on the shop drawings.

D. Coordination With Other Trades
   1. The GC must be held responsible for coordinating the trades, with cooperation from the affected trades. This is contrary to what GC’s prefer to do. The Fabricator should refuse to become an unauthorized project manager for the GC.
2. Sometimes it is appropriate to have a shop drawing review meeting where all affected parties can jointly participate at the same time, thereby saving valuable time in phone calls and emails.