

# What's Wrong with Steel Drawings?

February 2006, STRUCTURE® magazine

I read the February 2006 STRUCTURE magazine article "What's Wrong with Steel Drawings" with a renewed sense of frustration.

What I have found is that structural engineers and steel fabricators have much the same issues, frustrations and probably more in common than with other members of the construction team. Expecting to have all of the dimensional information on the structural drawings can create an adversarial position between the Fabricator and the Structural Engineer.

What many fail to acknowledge is that the Structural Engineer completing the steel drawings is working within a team of Owner, Contractor or Construction Manager, Architect and Mechanical Engineer that sometimes will not provide to the Structural Engineer the information requested in a timely manner.

Let's go through the entities:

- Owners will delay the decision to build until the last minute to receive financing, upper echelon approval or resolve other internal issues. The Architect or Construction Manager who wants to do the project is the one who tells the Owner that they can meet the unrealistic schedule. If the costs for lack of decisions or early bid packages are truly portrayed to the Owner, Owners who may be working with a tight budget will merely challenge the team to do better or "shoot the messenger".
- Many Construction Managers will freely admit that they lose money during the pre-construction services. The Construction Manager wants to have a package out for bid as soon as possible to start charging General Conditions. Generally, the first bid package is the structural steel. Steel bid packages are issued while other design team members are in design phases. The Construction Manager makes more money when changes occur, as mark-ups on the subcontractor costs are Construction Manager profit. The Construction Manager's goal is to get a bid package out the door, whether sufficient time is provided for design team coordination or not.



- The Architect's push is to put everything on CAD right from the beginning, drawn to exact scale that sometimes has no room for tolerances. When a Structural Engineer requests a dimension to note on the drawings for a bearing wall or slab opening, the Architect often says "scale it from the CAD files." So the Structural Engineer is requested to take liability for a dimension that the Architect cannot take the time to figure out or determine if it works with the detailed assembly, much less with adequate construction tolerances. As the architectural drawing package is being completed, the Architect is still refining details, making changes, asking whether the Structural Engineer can move beams or offset columns. Often, the method used by the Structural Engineer to save time is to change the dimension on the CAD file without actually moving the object in the file. The Fabricator must not scale the structural drawings nor assume a CAD file is exact.

Mr. Hazelton has identified some areas of contention with the structural drawings. Let's review the issues in these and other areas.

- Mechanical unit and duct locations. I challenge anyone to find a dimension on a Mechanical drawing. Mechanical units are generally bid to multiple suppliers, with dimensions unique to that manufacturer. Only the mechanical unit supplier will know the actual dimensions. A good Construction Manager will facilitate a meeting of: "Steel Detailer, please meet the Mechanical Contractor". Chances are, the steel design in the area of a mechanical unit is +/- 12 inches minimum, with at least a 20% load factor added to whatever estimated weight the Mechanical Engineer provided in the design phase. The steel beam Sizes will work. Just figure out the dimensions with the Mechanical Contractor and let us confirm the dimensions when established.
- Stairs. Many Architects do not provide good stair details. The drawings a steel fabricator receives from the Architect can sometimes show a door through a channel stringer, with no concept that the coped stringer destroys the stringers load carrying capacity. The Architect may not truly understand the landing details and the interior finishes that need to pass by the slab edge when establishing the stair opening. The Structural Engineer does not receive fee to detail stairs, since stairs are supposed to be an Architectural "performance specification" item. The steel fabricator assumes the Architect has shown something exact, when the architectural stair details are only the design intent.
- Elevators. Elevator suppliers will not provide design dimensions or other information until after their contract is signed. Elevator suppliers have generic pre-bid drawings that may or may not apply to the particular project. There is little chance of knowing the exact elevator structural requirements prior to steel bids.
- Brick support. The establishment of the brick shelf exact dimension in brick coursing is the Architect's responsibility. We have shown a detail on the structural drawings with erection bolts and field welding to allow adjustment to achieve the brick shelf tolerance. Most Fabricators will

## Author Response

I am in general agreement with the content of Mr. Chute's letter. I would, however, like to respond to two comments:

1. Electronic files are admissible in a court of law, and may become more prevalent in the future. I am not familiar with every jurisdiction, but in California the value of electronic files as exculpatory evidence is dependant on the instructions in the transmittal more than the actual data contained in the file. There is big difference between "For Reference Only" and "Issued for Construction". Although the AISC Code of Standard Practice (COSP) clearly defines the use of CAD files as it applies to the fabricator, it does not address the relationship between the various members of the design team. Contract documents often reference specific language in the COSP that will not apply to a specific project. The Disney Hall is an example of a design that could not be communicated efficiently on paper. The only practical way to detail the project was to import the wire frame into the detailing model. The only practical way to coordinate the structure with the balance of trades was to import the detailed solid frame back onto the design model.
2. Although I cannot speak for all detailers and fabricators, Herrick submits shop drawings, shop connection drawings, field connection drawings, and erection drawings on every project. To say they exist only in cyberspace may be considered inflammatory to fabricators who follow NISD guidelines. Depending on the nature of the project, the expectations in terms of shop drawings are often detailed in the project specifications. Absent specific language to the contrary, the COSP is followed.

After reading Mr. Chutes letter, it leads me to believe another article is in order. It should be entitled "Whose job is it anyway?" Coordination is thrown around in contract language as though it were a defined set of procedures. It is not, and one party or another is going to take a hit in added hours or back charges on every project until we have a responsibility matrix included with the front end documents. It sounds like this would benefit the members of the design team as much as it would those responsible for construction. ■

Robert (Bob) Hazelton  
Herrick Steel



ignore this detail, because it costs more, and then send in multiple RFI's when the shelf angle is not exactly defined to the closest inch.

- Field verification of existing construction. Structural Engineers receive original drawings and visit the site to confirm general configuration, if the structure is visible. Many times, the structure is not visible and covered by finishes to be demolished. There comes the "Catch-22". The Owner and Construction Manager do not want to pay for partial demolition and temporary protection during the design phase or during the shop drawing preparation phase. The intent is to have the existing finishes removed and new building work added in a short period of time. So how does anyone obtain accurate existing configuration or dimensions? The only solution is for the Fabricator to field survey after partial demolition prior to shop drawings, along with a good discussion between the Structural Engineer, Fabricator and Construction Manager as to possible field connections and other methods of accommodating field tolerances.
- Detailers and Fabricators shop drawing quality. What ever happened to erection details? With computer detailing, erection details may only exist in the cyberspace of a program that cannot print sections. A lawyer stated that only paper copies are admissible evidence, not computer files. Therefore, any comments to be made to a connection detail need to be made on the paper copy of a shop drawing. But without erection drawings, it takes the Structural Engineer far longer to figure out what the Detailer has done, whether the pieces agree with the Contract Document details or whether the Detailer tried to slip a change in the details, hoping the Structural Engineer will approve or miss the change. The note stating that approval of the shop drawings constitutes approval of the Fabricator's hidden changes is in violation of most Contract Document General Conditions, and certainly does not engender trust between the parties.

The "bottom line" to this whole discussion is a basic business principal: There is no such thing as responsibility without authority. The Structural Engineer has no authority over the Owner, Architect, Con-

struction Manager, Mechanical Engineer, Mechanical Supplier, etc. Therefore, there is no way that the Structural Engineer can be held responsible for dimensions established by the other design and construction team members. The Structural Engineer should not have to take the blame for other trades feeling that steel dimensions and RFI's are not important, or "not their problem".

Architecture, engineering and construction have always been accomplished by a Team effort. We have had many very successful projects with excellent Architects, Construction Managers and Fabricators. We have had the best success working with Fabricators that have Detailers working for them in their shop, or in a close working relationship so the Detailer is not isolated from the construction team, just generating RFI's.

Structural Engineers try to establish target deadlines of required information, and try to get other trades to coordinate. There are so many other economic realities of the project; the steel is a minor cost related to the other systems, such as mechanical and exterior wall. Our requests many times go unheeded, as the economies of the other systems and the architectural design features take precedence.

Structural Engineers, Detailers and Fabricators can work together well. Most Structural Engineers welcome constructability comments, and have flexibility to modify some details upon input from the Fabricator. We need to and can work together, as long as there is the recognition that coordination with other construction team members needs to occur. Methods can be established to work together to make the coordination happen. ■

Lawrence R. Chute, P.E., S.E.  
Desai/Nasr Consulting Engineers, Inc.

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