Construction Issues

discussion of construction issues and techniques

Contract Plans to Erection Drawings

By Kevin Jacques

The journey from Contract Plans (CDs) to Erection Drawings (EDs) is a time consuming and tedious process. To best explain the process, one must understand a few concepts. First, how do they differ?

CDs in general specify the standards with which to measure a project's materials, tolerances and performance (AISC, ASTM, IBC, etc.). They also illustrate the "Designers intent", plan dimensions, elevations and material sizes to name a few.

The EDs are very similar to the CDs. They also show the plan view, etc. However, they differ in content by eliminating non-pertinent items to the job at hand. For example, rebar is not commonly detailed on a steel ED since the erector is only concerned with assembling the structural steel.

They also differ by showing the material's piece marks, greater detail in dimensions with respect to the steel and carefully noted field weld symbols. Where a CD will show shop welds, an ED will not. This weld is already in place on the material. Showing it now would be redundant and confusing.

One other area that CDs and EDs may differ is in the depiction of the "Designer's Intent". It is this part of the detailer's job that is often the most difficult and confusing. It is also the greatest area worthy of the designer's review. This will become more apparent later in this article.

It is also important to note that the ED is used for two very different purposes. First, it is used as a platform from which to make the shop details of the members. It has been said that a good set of shop drawings can only originate from a good set of plans. The other use is rather obvious, to give the erector a map as to where all of the material on site belongs and to which member it connects. Bear in mind that the erector's job is more than a technical job, it is dangerous. A detailer scrutinizes the plans to make sure that the only thoughts the erector has while making the connection is safety.

In some cases, for complex projects, the EDs may also specify an order of installation that may not be immediately obvious to the erector. When a crane is moving the correctly sequenced member into place at the correct time, crane time, safety and costly bottlenecks are reduced.

One of the stumbling blocks to getting the EDs completed is the RFI. While they are a necessary part of the construction process, they cost money and time, and they create project delays. So, how does one reduce the number of RFIs? Quite often it falls under the detailers ability to interpret the "Designer's Intent". Below are some points that may reduce the number of RFI's generated and thus save the designer time which may be to allocated to billable hours.

Beam reactions not shown on the plans. This issue usually pertains to the shallow and short beams.

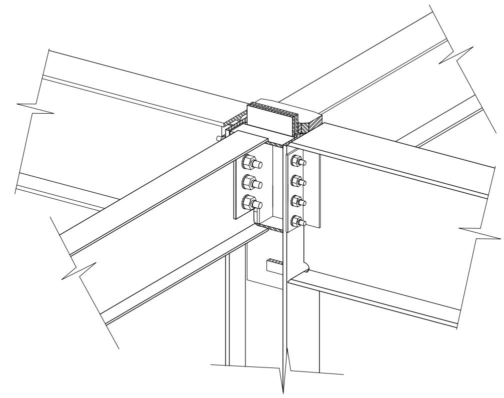

Figure 1: Moment connection detailed with no load provided.

A w8x10 spanning 3 feet can support 53.7kips (26.8 k end reaction). A very costly eight bolt connection can be detailed. But really, is that the designer's intent? Specifying the end reactions be equal to ½ the maximum uniform load per the AISC is counter intuitive. A short beam may have more bolts than one twice its length.

Moment connections that do not show a detail, don't provide a load or the detail given does not fit the project are problematic. See *Figure 1* for a moment connection detailed using a 3D modeling software. This connection (un-buildable) was using the maximum moment for the beam. Now see *Figure 2*. This moment connection is the result of having the actual design moment provided. A very clean, buildable and erectable connection that does exactly what the designer desired. Naturally, an RFI had to be generated to get the desired outcome.

Hung lintels are of particular concern for the erector. Welds should be considered also, as they are usually related. All too often the detailer is given a detail that does not allow for the proper adjustment and safe installation that an erector requires. A designer should bear in mind that these details need to consider mill tolerances, material availability, fabrication tolerances and what the strike of a welder's arc can do to steel. Both vertical and horizontal adjustment should be planned. And using slip critical connections

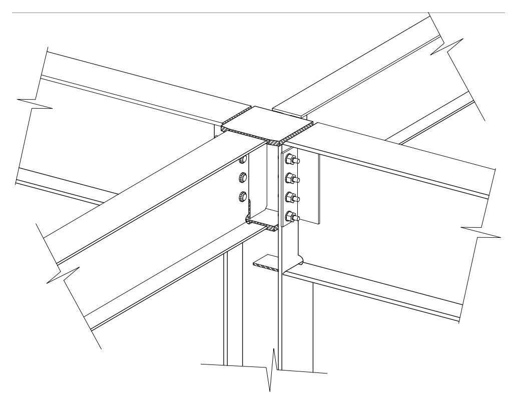

Figure 2: Moment connection detailed with the load provided.

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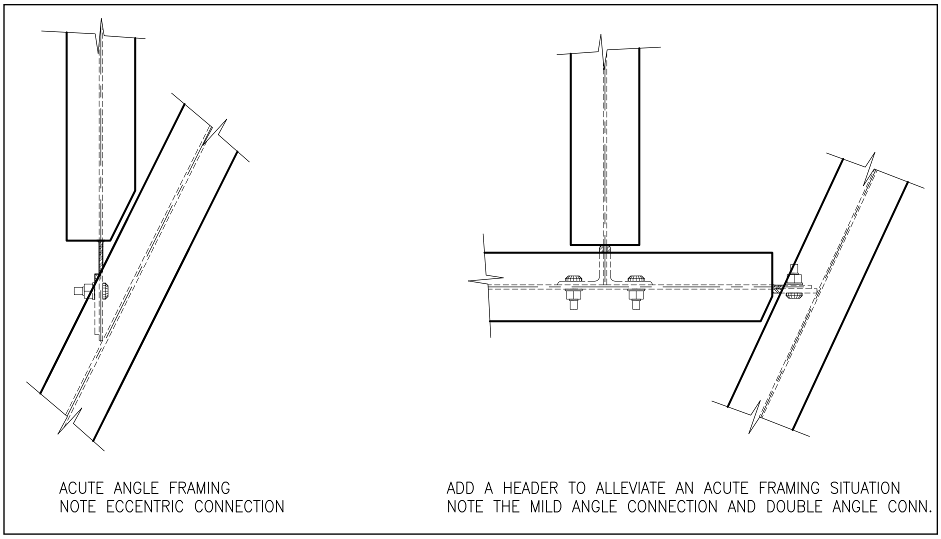

Figure 3.

may not be a viable option, as galvanizing does not meet the surface standards.

Also, welding symbols that show a continuous weld rather than a stitch weld can create even more field problems. One last thought to entertain when specifying welds is one that would place the welder below the surfaces to be welded (called an overhead weld). This is not only unsafe for the welder but anyone working below. It also creates a weld quality issue as the welder, rightfully so, is more concerned with his/her safety than the welding operation being done properly.

Roof/Floor frames are the Achilles heel to any project. If they are located and sized, Murphy's Law dictates that they will change. More often than not, they are the last piece of the puzzle and must be placed from below the deck. This creates many time consuming hazards (see overhead weld).

Considering the automation that has evolved in recent years, it may be more advantageous to use Wf beam sections with single clip angle connections (with the end reactions noted) rather than angles with saddles. If a frame has to move, new holes made with a Mag drill will make short work of the fix. And the weight difference is not too great (w8x10 vs. L4x4x5/16 @ 8.2 lbs./ft.).

Acute angle framing is a tough connection to detail and greatly reduces the capacity of the beam. See *Figure 3* for a suggested alternative. In this case, a picture is really worth a thousand words.

While there are many more issues to cover, it is equally important to note the qualifications of a detailer. As mentioned, being able to interpret the designer's intent is very important. They are also a translator of engineering jargon into pictorial details that are easily deciphered by the fabricator or erector on the fly. Remember, the detailer is supposed to do all of the thinking for the fabricator/erector whose job is to build the product. A detailer would also have a thorough knowledge of welding symbols and how to apply them (not necessarily able to weld). Probably the most significant skill to have as a detailer is exceptional drafting skills. Remember, a beam only has a 1⁄16-inch of tolerance for bolted connections. This is a relatively tight tolerance that requires a skilled draftsperson.

One skill or qualification that was not mentioned is a degree in engineering. While detailers may understand and speak fluently in this area of knowledge, don't rely on them to have the education, training or credentials of an engineer (although some are PE's). However, one can rely on their experience and knowledge of making things buildable and erectable.

One final point to reduce RFIs is this: get the steel detailers involved early in the project. After reviewing the list of a detailer's qualifications, the almost sickening attention to detail (hence the job title) and their ability to make things buildable and erectable, it only seems natural to have them as part of the design team. It would all but eliminate the RFI process as the detailer would iron out all of the issues well before the bidding begins. It would also greatly reduce change orders and possibly the overall cost of the project. The fabricator would no longer guess during bidding; they would have everything in front of them. The software exists to tailor the connections to the fabricator's shop and, in this economy, what business person would turn away a fast moving job due to some small nuances. At the very least, call upon the local detailers to get advice on the details that keep engineers up at night and answering RFIs. Clearly they have better things to do.▪