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steel interchange

Holes in Baseplates

The 9th Edition of the AISC *Manual of Steel Construction* contained hole sizes for baseplates that are smaller than those shown in the 14th Edition *Manual*. Can the hole sizes in the 9th Edition still be used? If so can they be used with standard washers instead of the plate washers shown in the 14th Edition *Manual*?

The answer to both questions is yes. There is nothing that prohibits the use of holes smaller than the maximums recommended in Table 14-2 of the 14th Edition *Steel Construction Manual*. It should be noted, however, that using the smaller holes will require more exacting placement of the anchors and that misplaced anchors are a relatively common issue—the reason larger holes were adopted since the 1989 publication you cite. The larger washer plates are necessary due to the larger hole sizes. ASTM F844 washers are sufficient when used with the hole sizes provided in the 9th Edition *Manual*. The information provided in the *Manual* has been reproduced here.

9th Ed. Manual Recommended Hole Sizes	
Anchor Rod Diamer (in.)	Hole Diameter (in.)
¾	1 1/16
⅞	1 3/16
1	1½
1¼	1¾
1½	2
1¾	2¼
2	2½
2½	3½

Larry S. Muir, P.E.

Design of Structures Outside the Scope of the *Specification*

I am trying to design the face of a hopper, which is in compression. I have found many examples that appear to be based on ASD and can calculate the nominal strength of the plate from these. How do I determine the compressive strength of the plate using LRFD?

The design of hoppers falls outside the scope of the AISC *Specification*, which "sets forth criteria for the design, fabrication and erection of structural steel buildings and other structures, where other structures are defined as structures designed, fabricated and erected in a manner similar to buildings, with building-like vertical and lateral load resisting-elements." I will, however, try to provide some guidance.

You state that you have determined the nominal strength of the plate. The AISC *Specification* defines nominal strength as: "Strength of a structure or component (without the resistance factor or safety factor applied) to resist load effects, as determined in accordance with this *Specification*." The nominal strength will be the same regardless of whether the design is done using LRFD or ASD. The plate will also have the same nominal strength, when subjected to the same loading and restraints, regardless of whether it is in a building, a hopper, an airplane or a ship.

Once the nominal strength has been determined, the engineer need only multiply by a resistance factor, ϕ, or divide by a safety factor, Ω, to get the available strength in LRFD or ASD, respectively. However, the ϕ and Ω factors in the AISC *Specification* have been developed for use with buildings in conjunction with the loads and load factors defined in ASCE-7. It may not be appropriate to apply these factors, intended for buildings, to the design of a hopper. It seems the demand side is much more of a problem than the resistance side, though the two are not mutually exclusive. Your ability to define the demand will have an effect on the load factors used.

The Commentary to Chapter B of the AISC *Specification* provides some background related to the development of LRFD as it relates to structural steel building construction. It also provides references to other related papers and texts. By reading these documents you should be able to develop a better understanding of how ASD and LRFD are related and how best to "convert" from one to the other. For the design of buildings considered in the *Specification*, a simple conversion of 1.5 is usually deemed sufficient to move from ASD to LRFD. This would not necessarily apply to other applications.

The Eurocode devotes significant space to the development of resistance factors and/or load factors and considers such variables as location, type of infill and loading (eccentric discharge, local patch loading and unsymmetrical filling), the structural type and the size and type of operation. It also provides very specific requirements related to analysis assumptions and procedures. These are the sorts of factors that need to be taken into account. The AISC *Specification* does not consider these factors because hoppers fall outside its scope. You must use your own engineering knowledge and judgment to determine the appropriate design methods for your application. I suspect various sectors have developed their own guidelines based on their own experiences, conditions and needs.

It is not unusual for engineers to base the design of steel structures other than buildings on the provisions in the *Specification*. However, care, based on understanding of the *Specification* provisions, must be exercised when this done.

Larry S. Muir, P.E.

Ordering Steel

The fabricator ordered columns cut to length based on the construction documents, but before the shop drawings were submitted and reviewed. Subsequently, a significant portion of the structure was revised to include a sloped roof instead of the flat roof originally shown, which increased the lengths of almost every column and led to more complex details.

The fabricator has issued a change order that includes re-detailing the steel and the cost of six columns that were ordered but could not be used. Is the fabricator allowed to order steel "early," before shop drawings have been reviewed?

There are two separate phases that must be considered:

1. Ordering and detailing of steel; this happens as soon as the design drawings are released for construction
2. Fabrication of steel; this can only proceed after approval of shop and erection drawings

These are distinct events that happen at separate times. Release for construction happens at the beginning. Start of fabrication happens later and upon shop drawing approval.

Ordering of steel is addressed in Section 5.1 of the AISC *Code of Standard Practice*. It happens as soon as release for construction is received (as shop and erection drawings are produced and well before they are approved). This is done so that the material can be obtained and fabrication can begin as soon as shop drawings are approved. This is *not* ordering early.

Release for construction is a defined term in the AISC *Code of Standard Practice*, and it has a very specific and important meaning. It's when the owner's money starts being spent on material and detailing. If the contract documents were released for construction, the fabricator *should* have ordered the steel and done the detailing based upon the drawings they were given. They are asking for compensation for detailing hours wasted and columns made useless by the changes made later to drawings that were released for construction.

If the fabricator ordered steel and did the detailing without release for construction, they were taking a risk and the cost is theirs to bear.

Charles J. Carter, S.E., P.E., Ph.D.

Erection Aids

Who is responsible (erector, fabricator, owner or engineer) for the design and supply of erection aids on a project?

Per the *Code of Standard Practice* Section 1.8.1, the erector is responsible for means methods and safety of erection of the steel frame. Erection aids fall under means and methods. Neither the owner nor the engineer of record is responsible for showing, designing or providing erection aids in the contract documents.

Responsibility for designing and providing erection aids is not addressed specifically in the AISC *Code of Standard Practice*, and therefore is a contractual issue between the erector and fabricator. In our experience, when addressed in the contract, erection aids are shown on the shop drawings and furnished by the steel fabricator.

Section 7.8.2 states: "When the fabricator is responsible for erecting the structural steel, the fabricator shall furnish all materials that are required for both temporary and permanent connections of the component parts." This would include the erection aids.

When the fabricator is not responsible for erecting the structural steel, erection aids, like column splice aids, are not mentioned in Section 7.8.3 so they would not be included in the fabricator's bid unless they are in the contract between the owner and the fabricator. The erector would have to tell the fabricator what is required. The required aids would then typically be shown on the shop drawings and supplied by the fabricator.

Larry S. Muir, P.E.

Thermally Cut Holes in the Field

The fire sprinkler contractor torch-cut holes in the steel beams. The holes satisfy the checks for web penetrations provided in AISC Design Guide 2. Is torch-cutting of beams allowed for web penetrations? If so, do the thermally cut edges need to meet any requirements or do they need to be ground smooth and tested?

AISC *Specification* Section M2.2 addresses thermal cutting of steel. The *Specification* defers to AWS D1.1 clause 5 for acceptance criteria, which is found in sub-clause 5.15.4.3. For this case, the AWS code refers to a visual comparator and requires that the cut edge be equal to or better than a "sample three;" it does not provide a means of measuring thermal cut edges. Since the contractor performed the thermal cutting, he should have the roughness gauge which governs his work. If not, the special inspector should be able to provide hers.

If repairs are required, they can be accomplished by grinding, or welding and grinding.

Keith Landwehr

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Steel Interchange is a forum to exchange useful and practical professional ideas and information on all phases of steel building and bridge construction. Opinions and suggestions are welcome on any subject covered in this magazine.

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If you have a question or problem that your fellow readers might help you solve, please forward it to us. At the same time, feel free to respond to any of the questions that you have read here. Contact Steel Interchange via AISC's Steel Solutions Center:

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