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STEEL INTERCHANGE

Steel Interchange is an open forum for *Modern Steel Construction* readers 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. If you have a question or problem that your fellow readers might help you to solve, please forward it to *Modern Steel Construction*. At the same time, feel free to respond to any of the questions that you have read here. Please send them to:

Steel Interchange
Modern Steel Construction
One East Wacker Dr., Suite 3100
Chicago, IL 60601-2001

Answers and/or questions should be typewritten and double-spaced. Submittals that have been prepared by word-processing are appreciated on computer diskette (either as a Wordperfect file or in ASCII format).

The opinions expressed in *Steel Interchange* do not necessarily represent an official position of the American Institute of Steel Construction, Inc. and have not been reviewed. It is recognized that the design of structures is within the scope and expertise of a competent licensed structural engineer, architect or other licensed professional for the application of principals to a particular structure.

Information on ordering AISC publications mentioned in this article can be obtained by calling AISC at 312/670-2400 ext. 433.

The following responses from previous Steel Interchange columns have been received:

Specifications currently exist which require minimum pretensioning loads for slip critical connections. There is, however, no guidance regarding minimum pre-loading of anchor bolts which occur at column bases. While in most situations this issue is academic since the anchor bolt nut and thread projection are below the plane of the concrete slab on grade and are eventually embedded in concrete at the slab isolation joint, there are instances where the nut and thread projection remain exposed. Is tightening the nut to "snug tight" and tack welding the nut to the bolt thread the only solution in preventing the nut from backing off?

In general, anchor bolts are selected from material meeting ASTM A307 specifications. A307 specifications require material that conforms to the A36 specification. The lower strength of this material compared to high-strength bolts, such as A325, does not lend itself to high pretension loads for a given bolt diameter. When your anchor requirements call for resistance to high tension or conditions where slippage due to shear is not permitted then pretensioning using high strength bolts may be used. Other methods, such as shear keys may be used to prevent slip. High-strength anchor bolts are heat treated and quenched which increases their load carrying capabilities. A307 bolt material is not treated and therefore cannot be expected to produce high, consistent preloads for a given bolt diameter.

In most cases anchor bolts are used in locations where a small clamping force in conjunction with the combined friction from deadweight and or shear keys is all that is required to resist the occasional shear and tensile forces. The design tension loads at column bases are usually a result of large wind forces that the structure seldom experiences with the presence of large dead loads. Therefore, the net tension that the anchor bolts experience does not exceed the clamping force that results from "snug tight" tightening of the nuts. Kulak, Fisher, and Struik in their book Guide to Design Criteria for Bolted and Riveted Joints indicate that this clamping force from "snug tight" nuts in A307 anchor bolts is not very great and should not be considered to have any influence on the connection design. The preloads that result from "snug tight" nuts on A307 bolts are usually in the elastic range (somewhere in the sloping portion of the stress-strain curve) where minor variations in the starting point, amount, and accuracy of the nut rotation have a greater influence on the amount of preload. On the other hand, pretensioning high-strength bolts to the specified values actually stretches the bolt (called set) and produces a large, constant clamping force that is basically unaffected by the conditions at the starting point of nut tightening (snug tight).

Tall, lighter structures where large lateral and tensile forces frequently occur depend on their anchor bolts to carry tension and prevent upward or horizontal movement at the foundation interface. Other examples would be anchor bolts used for large equipment foundations, such as paper machine foundation anchor bolts. In these cases, high-strength anchor can be specified and pretensioned to resist any large dynamic and thermal loads. These loads can produce large, lateral forces that are present at all times. These "slip critical" connections are designed to prevent any slip which can cause misalignment in the precision equipment. These anchors are usually pretensioned to meet the equipment supplier' specifications.

Another method of preventing loosening of a "snug tight" anchor bolt nut (besides tack welding) is to furnish two nuts and torque the second nut against the first nut.

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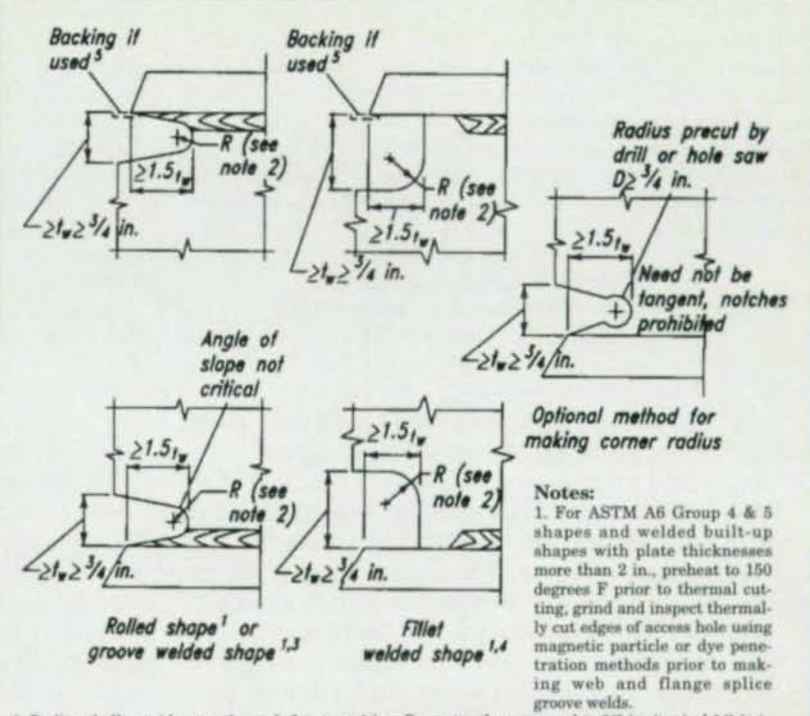
The AISC Manual includes examples and figures in the connection sections, some of these connections include weld access holes in the beam member. What are the dimensioning requirement for these weld access holes? They are not given in the example problems.

All of the examples and details in the manual follow the requirements of the AISC Specification for Structural Steel Buildings. Section J1.6 of the LRFD Specification and Section J1.8 of the ASD Specification include requirements for beam copes and weld access holes. These dimensioning requirements are for all weld access holes and copes. The commentary to each section includes drawings which demonstrate this weld access hole and cope geometry. The figure at right is repeated from the AISC Commentary.

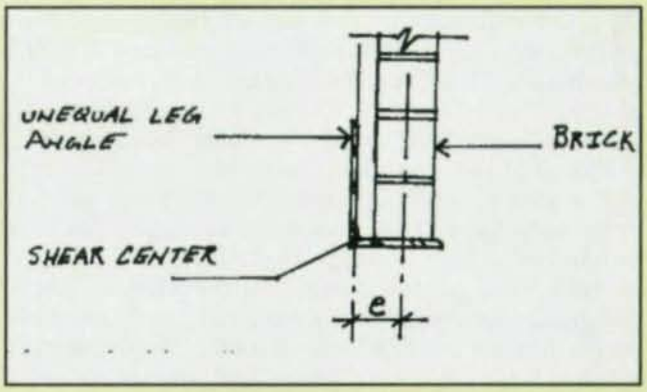


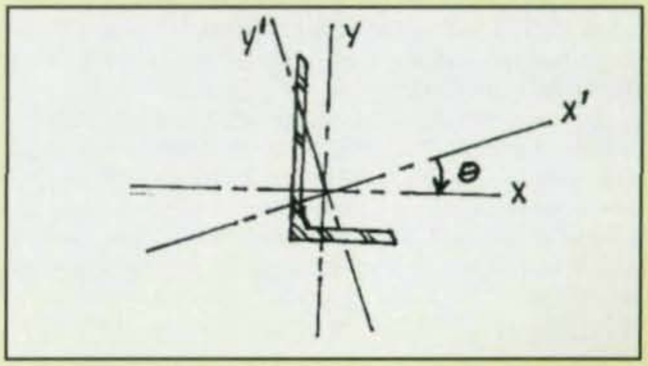
Notes:
1. For ASTM A6 Group 4 & 5 shapes and welded built-up shapes with plate thicknesses more than 2 in., preheat to 150 degrees F prior to thermal cutting, grind and inspect thermally cut edges of access hole using magnetic particle or dye penetration methods prior to making web and flange splice groove welds.
2. Radius shall provide smooth notch-free transition; R greater than or equal to 3/8-in. (typical 1/2-in.).
3. Access opening made after welding web to flange.
4. Access opening made before welding web to flange.
5. These are typical details for joints welded from one side against steel backing. Alternative joint designs should be considered.

NEW QUESTIONS

Listed below are questions that we would like the readers to answer or discuss.

If you have an answer or suggestion please send it to the Steel Interchange Editor, Modern Steel Construction, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001. Questions and responses will be printed in future editions of Steel Interchange. Also, if you have a question or problem that readers might help solve, send these to the Steel Interchange Editor.





Is the method of determining the flexural design strength of a single angle with unequal legs as outlined in the Specification for Load and Resistance Factor Design of Single-Angle Members, (December 1, 1993) valid when the angle is not loaded through its shear center?

If the method is valid, what effect does the load eccentricity to the shear center have on the flexural strength?

If the method is valid and M_n has been determined about the principle axes, should the moment (M_u) about the x-axis be broken into its components about the minor and major axes by multiplying the moment (M_{ux}) by the sin θ or by cos θ?

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