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steel interchange

Tensile Strength of PJP Groove Welds vs. CJP Groove Welds

The AISC *Specification* allows the strength of a CJP groove weld to be taken as the strength of the base metal. However, the tensile strength of a PJP groove weld is limited to 0.6 times the tensile strength of the filler metal. As a result, the design strength of the PJP groove weld is significantly reduced even when the volume of weld is nearly the same as a CJP groove weld. What are the differences between CJP and PJP groove welds that explain this strength reduction?

This is addressed in Section J2.4 in the Commentary to the AISC *Specification*, which states:

"The factor of 0.6 on F_{EXX} for the tensile strength of PJP groove welds is an arbitrary reduction that has been used since the early 1960s to compensate for the notch effect of the unfused area of the joint, uncertain quality in the root of the weld due to the inability to perform nondestructive evaluation and the lack of a specific notch toughness requirement for filler metal."

A CJP groove weld is defined in the AISC *Specification* as a "groove weld in which weld metal extends through the joint thickness, except as permitted for HSS connections." A PJP groove weld is defined as a "groove weld in which the penetration is intentionally less than the complete thickness of the connected element." The notch that is referred to in the Commentary is due to a PJP stopping short, not fusing the entire thickness—i.e., the part that is not welded in PJP is viewed as a notch or crack.

Also, the root of a CJP groove weld can be readily UT inspected, and such inspection is addressed in Chapter N of the *Specification*. Inspecting the root of a PJP weld is not as straightforward since it has a natural flaw that will always be evident in the inspection.

Carlo Lini

Preinstallation Verification of Items Bolted to Ship

If pieces are bolted to ship during shop assembly, but the joints are not pretensioned until the assembly is erected, should preinstallation verification be performed at the shop, where the bolts were first installed, or in the field, where the bolts will be pretensioned?

The preinstallation verification needs to be performed in the field at the job site with the crews that will be pretensioning the bolts and using a "representative sample" of bolts.

The Commentary to Section 7.2 of the RCSC *Specification* states: "Preinstallation verification testing clarifies for the bolting crew and the inspector the proper implementation of the selected pretensioning method and the adequacy of the installation equipment." In order to satisfy this intent, the preinstallation verification must be done in the field by the crew responsible for pretensioning the joints.

The Commentary also states: "The preinstallation verification requirements in this Section presume that fastener assemblies so verified will be pretensioned before the condition of the fastener assemblies, the equipment and the steelwork have changed significantly… When time of exposure between the placement of fastener assemblies in the field work and the subsequent pretensioning of those fastener assemblies is of concern, preinstallation verification can be performed on fastener assemblies removed from the work or on extra fastener assemblies that, at the time of placement, were set aside to experience the same degree of exposure." Since the assemblies may be exposed to the environment for some time before being erected, in addition to sampling from each combination of diameter, length, grade and lot, you might also perform the preinstallation verification using bolts taken from the assemblies.

Larry S. Muir, P.E.

L'_p for Shapes with Noncompact Flanges

Section F3.1 of the AISC *Specification* refers to Section F2.2 for lateral-torsional buckling of doubly symmetric I-shaped members bent about their major axis having compact webs and non-compact or slender flanges. Section F2.2 includes Equation F2-5:

$$L_p = 1.76 r_y \sqrt{\frac{E}{F_y}}$$

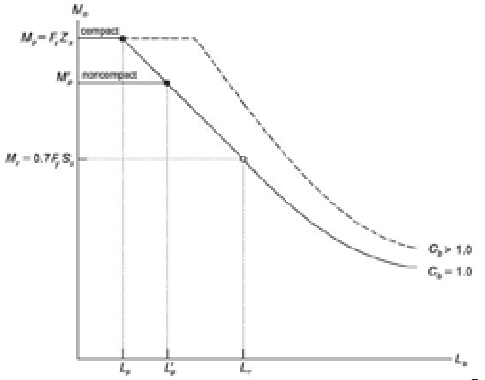
However, this equation does not always produce the same value given for L_p in *Manual* Table 3-2. For example, Table 3-2 lists L_p = 15.1 for a W14×90 but Equation F2-5 results in a value of 13.1.

What is the difference between these two values and which should be used in the calculation of M_n?

Table 3-2 allows a simplified approach to the design. Though the two values will provide different results, either can be used if applied appropriately.

A W14×90 has non-compact flanges. Since the flanges are non-compact, the section is not capable of reaching its plastic strength and the flanges will buckle locally before a plastic hinge can be formed. Table 3-2 reports a value that is referred to as L'_p in the *Manual* discussion. Using this value to calculate M_n, rather than L_p, will limit the value to the local buckling strength of the member, M'_p. This can be viewed as a shortcut to the *Specification* approach, which requires separate checks for lateral-torsional buckling and compression flange local buckling.

The difference between the two approaches can be seen most clearly by looking at *Manual* Figure 3-1 reproduced below. Using L_p from Equation F2-5 in Equation F2-2 will produce a result somewhere along the line (L_p, M_p), (L_r, M_r). Values that exceed M'_p are not possible, since Equation F3-1 will govern. This is the approach in the AISC *Specification*. The shortcut limits results to those along the line (L'_p, M'_p), (L_r, M_r), rendering the explicit check for compression flange local buckling redundant.



Carlo Lini

Toughness Testing

Are all rolled jumbo sections subject to toughness requirements? Does Charpy V-notch impact testing have to be specified in the contract documents, or is this automatically done for all jumbo sections?

First, a clarification: The AISC *Specification* does not refer to jumbo shapes. Instead, it refers to rolled and built-up heavy shapes. ASTM A6/A6M hot-rolled shapes with a flange thickness exceeding 2 in. are considered to be rolled heavy shapes. Built-up cross sections consisting of plates with a thickness exceeding 2 in. are considered built-up heavy shapes.

Not all heavy shapes are subject to toughness requirements, and Charpy V-notch impact testing is typically only performed when required in the contract documents.

Generally, ASTM standards contain supplemental requirements related to Charpy testing. Testing to other toughness requirements is also possible. Some materials, like A913, have toughness requirements in the standard and supplemental requirements that can apply as well.

Section A3.1c in the AISC *Specification* addresses this issue, stating that rolled heavy shapes used as members subject to primary (computed) tensile forces due to tension or flexure and spliced or connected using CJP groove welds that fuse through the thickness of the flange or the web would require that shapes be supplied with Charpy V-notch toughness in accordance with supplementary requirement S30. The key statement in this section relative to your second question is "The structural design documents shall require that such shapes be supplied with Charpy…"

Section A4 addresses structural design drawings and specifications and states that the structural design drawings and specifications shall meet the requirements in the *Code of Standard Practice*. The user note in this section states: "Provisions in this *Specification* contain information that is to be shown on design drawings. These include: Section A3.1c Rolled heavy shapes where alternate core Charpy V-notch toughness (CVN) is required."

The AISC *Seismic Provisions* contain similar requirements in Section A3.3 and also require that locations of connection plates requiring CVN, in accordance with Section A3.3(b), be indicated in the structural design drawings and specification.

This all falls under *Code of Standard Practice* Section 3.1, which requires that the structural design drawings clearly indicate the work to be performed. The commentary for this section states that "…critical requirements that are necessary to protect the owner's interest, that affect the integrity of the structure or that are necessary for the fabricator and the erector to proceed with their work must be included in the contract documents. Some examples of critical information may include, when applicable, special material requirements to be reported on the material test reports."

There is a cost associated with providing specified toughness, and therefore it should not be specified indiscriminately.

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