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steel interchange

Unless specifically stated, all AISC publications mentioned in the questions and/or answers reference the current edition and can be found at ***www.aisc.org/specifications****.*

Welding in the K-Area

Is it correct to say that welding in the curved transition between the flange and web of a wide-flange section is not welding in the k-area? Is welding in the k-area prohibited?

The answer to your first question is yes. The Commentary to the *AISC Specification for Structural Steel Buildings* (ANSI/AISC 360) states: "The k-area is defined as the region of the web that extends from the tangent point of the web and the flange-web fillet (AISC k dimension) a distance 1½ in. (38 mm) into the web beyond the k dimension."

The answer to your second question is no. The *Specification* does not prohibit welding in this location, and there are times where welding in this area is unavoidable. The issue with the k-area is that when a wide flange is rotary straightened at the mill, the k-area of the web undergoes cold working and loses some ductility as a result. When you place residual stresses in the area (resulting from weld cooling and restraint) there is a possibility that a crack can form. This crack only occurs during fabrication and, as stated in an advisory statement from 1997, "the number of examples reported has been limited and these have occurred during construction or laboratory tests, with no evidence of difficulties with steel members in service." This is why a simple visual inspection requirement after welding is sufficient. The footnote in Table N5.4-3 states: "When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks within 3 in. (75 mm) of the weld."

The 1997 advisory statement can be found here: **www.aisc.org/manualadvisory**

Jonathan Tavarez, PE

Staggered Bolts

What is the origin of the factor, $s^2/4g$, in Section B4.3b of the *Specification*, and why is the length not simply taken as the geometric distance between the centers of the holes?

The term, $s^2/4g$, goes back a long way. It was developed by V.H. Cochrane and was presented in *Engineering New Record* in 1922. The formula is a simplification of a theoretical approach he proposed in 1908. The concern was that the stress along the hypotenuse was a combination of shear and tension, so using this as the tension area might be unsafe since the shear strength is less than the tensile strength. Several alternatives have been proposed over the years. But despite the competitors, the formulation has held on for nearly one hundred years, and seeing that the *Specification* will not be updated again until 2022, it will very likely see its centennial in use.

Larry S. Muir, PE

Anchors in Base Plates

I seem to remember that AISC requires at least four anchor rods in base plates, but I cannot seem to find this requirement in the *Specification*. Is this no longer a requirement?

This is still a requirement, but to my knowledge it was never a requirement in the AISC *Specification*. It is an OSHA requirement. Some of the OSHA requirements are summarized in Part 2 of the AISC *Steel Construction Manual*, including:

1. All column base plates must be designed and fabricated with a minimum of four anchor rods. (This is required by OSHA 1926.755(a)(1).)
2. Posts (which weigh less than 300 lb essentially vertical and axially loaded) are distinguished from columns and excluded from the four-anchor-rod requirement

You can find the OSHA requirements at **www.osha.gov** (search for standard 1926 Subpart R).

Carlo Lini, PE

Who Provides Backing?

Who is responsible for supplying ceramic backing for field welding?

Ceramic backing is non-steel backing and is furnished by the erector per the AISC *Code of Standard Practice for Steel Buildings and Bridges* (ANSI/AISC 303).

Section 7.8.3 in the *Code* states: "When the erection of the structural steel is not performed by the fabricator, the fabricator shall furnish the following field connection material… (c) Steel backing and run-off tabs that are required for field welding."

Section 7.8.4 states: "The erector shall furnish all welding electrodes, fit-up bolts and drift pins used for the erection of the structural steel. Non-steel backing, if used, shall be furnished by the erector."

Carlo Lini, PE

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Nondestructive Testing Performed by the Fabricator

It is my understanding that AISC certified fabricators must demonstrate the ability to perform nondestructive testing (NDT) including UT and MT. This means that they are required to perform NDT for structural steel that they fabricate. Please confirm my understanding.

Your understanding is not correct.

1. AISC certified building fabricators are not required to demonstrate the ability to perform NDT.

AISC provides certification to several different categories. Only AISC certified bridge fabricators are required to have NDT personnel on staff or available under contract. This is required per Section 4.5.4.1 of the *Certification Standard for Steel Fabrication and Erection, and Manufacturing of Metal Components* (AISC 207-16) which you can download for free at **www.aisc.org/certification**.

2. Fabricators are not required to perform NDT—unless this is required by the contract.

Section N6 of the *Specification* states: "NDT of welds completed in an approved fabricator's shop is permitted to be performed by that fabricator when approved by the AHJ. When the fabricator performs the NDT, the QA agency shall review the fabricator's NDT reports." Section A1 states: "The phrases 'is permitted' and 'are permitted' in these Provisions identify provisions that comply with the *Specification*, but are not mandatory." Therefore, the fabricator can but is not required to, perform NDT.

A User Note in Chapter J of the AISC *Seismic Provisions for Structural Steel Buildings* (ANSI/AISC 341) states: "All requirements of *Specification* Chapter N also apply unless specifically modified by these Provisions." Section J1 of the *Seismic Provisions* states: "Nondestructive testing (NDT) shall be performed by the agency or firm responsible for Quality Assurance, except as permitted in accordance with *Specification* Section N6."

In my experience, many building fabricators do not possess the personnel or the equipment to perform NDT. The request to permit a fabricator to perform NDT, in lieu of an outside agency, often originates with the fabricator—not the owner's representatives. Some fabricators who employ NDT personnel see logistical advantages to being able to perform NDT in-house and also may offer this as an additional service to their customers.

The fact that NDT must be performed (is required) is a matter addressed in the *Specification*. Who is permitted to perform NDT is also a matter addressed in the *Specification*. Who will actually perform the NDT is a contractual issue. The *Specification* does not address contractual issues. Contractual issues are addressed in the *Code*.

Section 8.1.1 states: "The fabricator shall maintain a quality control program to ensure that the work is performed in accordance with the requirements in this *Code* and the contract documents. The fabricator shall have the option to use the AISC Quality Certification Program to establish and administer the quality control program."

Section 8.1.3 states: "When the owner requires more extensive quality control procedures, or independent inspection by qualified personnel, or requires that the fabricator must be certified under the AISC Quality Certification Program and/or requires that the erector must be certified under the AISC Erector Certification Program, this shall be clearly stated in the contract documents, including a definition of the scope of such inspection.

Performance of NDT by the fabricator is a more extensive quality control procedure that must be clearly stated in the contract documents if it is to be required for the project.

Larry S. Muir, PE