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Engineering & Research

AISC Advisory Statement on Mechanical Properties Near the Fillet of Wide Flange Shapes and Interim Recommendations

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In recent months there have been reports to AISC indicating the potential for crack initiation at, or near, connections in the "k" area of wide flange rotary straightened members. The "k" area is the region extending from approximately the mid point of the radius of the fillet into the web approximately 1 to 1½ inches beyond the point of tangency between the fillet and web. Most of the incidents occurred at highly restrained joints with welds in this area. To gather further information, AISC's Research Subcommittee on Shape Material and Design conducted a workshop on January 8-9, 1997 to systematically review concerns that had been raised.

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Welding of highly restrained joints, such as those associated with continuity plates and/or doubler plates in columns, induces residual stresses in steel members. It is generally understood that steel is not entirely homogeneous, and that variations in mechanical properties exist. In addition to normal variations, the process of mill rotary straightening alters the mechanical properties by cold working (strain hardening) in the "k" area. Material variations in the "k" area may include: a reduction in ductility and toughness (in some cases Charpy V Notch toughness below 5 ft-lbs at 70° F); an increase in hardness, yield strength and ultimate strength; and an increase in the ratio of yield to ultimate strength. Such variations have been reported in material from all steel making practices, both domestic and international sources of rotary straightened shapes.

Based on the review conducted at the AISC January workshop, 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.

The AISC Research Subcommittee on Shape Material and Design continues to evaluate all submitted concerns in order to recommend necessary research, and will take appropriate action. In the interim AISC recommends the following fabrication and design practices for rolled wide flange shapes:

- Welds should be stopped short of the "k" area for transverse stiffeners (continuity plates).
- For continuity plates, fillet welds and/or partial joint penetration welds proportioned to transfer the calculated stresses to the column web should be considered instead of complete joint penetration welds. Weld volume should be minimized.
- Residual stresses in highly restrained joints may be decreased by increased preheat and proper weld sequencing.
- Magnetic particle or dye penetrant inspection should be considered for weld areas in or near the "k" area of highly restrained connections after the final welding has completely cooled.
- When possible, eliminate the need for column web doubler plates by increasing column size.

Good fabrication and quality control practices, such as inspection for cracks, gouges, etc., at flame-cut access holes or copes, should continue to be followed and any defects repaired and ground smooth. All structural wide flange members for normal service use in building construction should continue to be designed per AISC Specifications and the material furnished per ASTM standards.

AISC will issue further information on this subject as it becomes available.