Repairing Bent Anchor Rods

I am currently working on a project where an installed anchor rod was bent during backfilling against a concrete wall. The anchor rod projection from the concrete was bent to a 45 degree angle and the contractor would like to "slowly heat the rod and straighten it." Is this an acceptable repair? It seems that this may weaken the rod. Is it better to remove the anchor rod in its entirety from the concrete? What is the typical repair for this type of damage?

Question sent to AISC's Steel Solutions Center

The subject of remedial repair for bent anchor rods is not stipulated in the 2005 AISC specification. When determining how to address the subject of anchor rod remediation, two prime considerations should be the type of rod material and the function of the rods in the final structure. One of the first things to look at is if there is apparent cracking in the bend area or severe "kinks" in the rod profile. If there is, you may consider requiring replacement.

ASTM F1554, the preferred material for anchor rods, is available in three grades: 36, 55, and 105 ksi. The ASTM 1554 limitations for bending of rods (to manufacture hooked anchor rods) are a good guide for both hot and cold bending repairs. Some conditions require special attention to determine the absence of cracking in the straightened condition:

- Bends that occur in the threaded area, since the threads tend to create notch effects and reduce the bend severity required to cause cracking
- Rods made from grades with higher strength (and lower ductility for bending)
- Bends of more than 45 degrees

Another important consideration may be the function of the rod in the final structure. If the rods serve only for construction and do not resist design forces in the completed structure, repair issues may be simplified or eliminated.

There was an article in the May 2004 issue of *Modern Steel Construction* titled "An Ounce of Prevention" (**www.modernsteel.com**) by Jim Fisher and Larry Kloiber, which discusses common anchor rod installation problems with suggested fixes.

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Translating Between ASD and LRFD

I thought the LRFD values for bending should be F_yZ_x rather than F_yS_x as shown in the web site document "Basic Design Values" (available at www.aisc.org/2005spec). How are the ASD and LRFD bending design values derived?

Question sent to AISC's Steel Solutions Center

The basic design values for bending shown on the web site document are in the correct numerical format for both ASD and LRFD, although this fact may not be readily apparent because S_x is used where the corresponding 2005 specification formula used Z_x.

For the sake of simplicity, we can re-write Z_x as the shape factor multiplied by S_x. The shape factor about the strong axis is Z_x/S_x. For wide-flange beams, the lower bound value for this shape factor is approximately 1.1, which is conservatively incorporated in the basic design tables. Hence, $Z_x/S_x = 1.1$, or $Z_x = 1.1S_x$. The factor of safety for flexure is $\Omega = 1.67$ and the resistance factor is $\phi = 0.9$. Therefore,

Shop and Erection Drawings

Is there an AISC requirement that structural steel shop and erection drawings be prepared under the supervision of and stamped by a licensed professional engineer in the applicable jurisdiction, or that the drawings are to be reviewed and stamped by a P.E.? Is either of these criteria a requirement of AISC?

Question sent to AISC's Steel Solutions Center

There is no AISC requirement that shop drawings be prepared under the supervision of and stamped by a licensed professional engineer. The AISC *Code of Standard Practice*