D G

Specification

You should not assume 50 ksi for the entire section, as that would be unconservative.

The simplest approach is to assume 36 ksi for everything. However, it must be noted that this approach is conservative and results in a reduction in the assumed design strength of the original section, and may require you to add more reinforcing than is strictly necessary. However, that is not always the primary concern. Oftentimes, the costs associated with reinforcing an existing member are largely influenced by the labor involved, and the material costs are minor in comparison. In such cases, being conservative and adding a little extra material, in order to simplify the design process, may not really burden the project. Judgment must be exercised to ensure an economical outcome.

e

the four limit states that "work" before reinforcing the beam should not be negatively impacted by the addition of the beam reinforcing and need not be rechecked.

Next, you would need to determine the plastic neutral axis location—M

$_p$, S_{xc} and S_{xt}—for the built-up shape. In order to maintain equilibrium, you would need $\Sigma F_{yc}A_c = \Sigma F_{yt}A_t$ where the "c" and "t" subscripts represent compression and tension, respectively. You will need to perform an analysis using the plastic force distribution method, distinguishing between the 50-ksi sections and the 36-ksi sections, in order to locate your plastic neutral axis and determine what portion of the built-up member contributes to S_{xc} or S_{xt}. When you calculate M_p for this member, you would need to perform a plastic moment capacity analysis that accounts for the portion of the section that is 36 ksi and not simply use the equation given for the definition of M_p in Equation F4-9.

In Sections F4.1 and F4.4 - Compression Flange Yielding or Tension Flange Yielding: For this limit state, you could use the

F_y of each component, as applicable. You would simply use M

the entire area in compression is within the 5ksi material, you could use 5ksi for this check. Otherwise, I would use 3 ksi for the check.

Susan Burmeister, P.E.

C

W ×

The answer to this question is more involved than the effects of bending on strength, and the strength concern is slightly different than what you are picturing.

Torsional effects usually govern a design like this. Lateral-torsional buckling is usually not the controlling limit state. For torsional stresses, AISC Design Guide 9 is a good reference.

Concerning the effect of the rolling process on the material properties, there are two things to consider: residual stresses induced by the rolling process and the potential reduction in ductility due to cold working.

Generally, residual stresses have no effect on the ultimate strength of a member but can affect stability. For a wide-flange member rolled the easy way, the tension residual stress at the inner edge of the flange will be about 50% of the yield stress. The compression residual stress at the outer edge of the flange will also be about 50% of the yield stress. This is comparable

Riviezzi also recommended that "galvanizing after cold bending is not advisable."

Below is a reference list for horizontally curved members. The most designer-friendly reference is *Design of Curved Steel* published by the Steel Construction Institute. The publications provide equations for lateral-torsional buckling of curved members, though again, lateral-torsional buckling is usually not the controlling limit state.