Discussion

Simplified Design for Torsional Loading of Rolled Steel Members

Paper presented by PHILIP H. LIN (3rd Quarter, 1977)

Discussion by **Nirmal Maitra**

The author has done a good service by presenting tables to accelerate design work for beams subjected to torsional moment. The long calculation to convert torsional moment to equivalent lateral moment for obtaining torsional bending stress can very well be avoided by using the author's tables.

The author has, however, neglected one very important element, i.e., torsional shear stress. The reason, he states: "In most practical steel design situations, the shear stress contributions are normally not of significance; therefore, only the normal stresses from vertical and torsional bending are computed and combined in order to check the design adequacy of a beam."

The writer does not agree with him. As a case for checking, take author's Example 1. The author's calculation shows that summation of bending stresses does not exceed $0.6F_y$ and he concludes "use W10 × 54". But the calculation presented below shows that summation of shear stresses exceeds the allowable limit by 60% and W10 × 54 is no good.

Equipment supporting structures usually have the torsional loading concentrated at points similar to what is shown in author's Examples 1, 2, and 4, and in such cases shear stresses usually govern. A check on the author's examples will prove that.

A prevalent design office practice is to check torsional shear stress before taking up calculations for torsional bending stress for equipment supporting beams; the merit of this practice is obvious.

Calculation:

For W10 × 54:

$t_w/t_f = 0.368/0.618 = 0.6$

$R/t_f = 0.5/0.618 = 0.8$

From chart,* $\delta = 1.25$

Neglecting warping restraint:

$f_{vT} = \delta T t_f / J = 1.25 \times 4.5 \times 12 \times 0.618/1.84$
$= 22.67$ ksi

$f_v = V/A_w = 9/(10.12 \times 0.368)$
$= 2.42$ ksi

Summation:

$22.67 + 2.42 = 25.09$ ksi > 14.5 ksi **n.g.**

Try W10 × 77 and repeat checking in above manner.

Found **o.k.**

Use: W10 × 77

Nirmal Maitra is Senior Structural Engineer, American Lurgi Corporation, Hasbrouck Heights, N.J.