



FIGURE 9-16

Stress-Concentration Factors for an End-Milled Keyseat in Bending (K_t) and Torsion (K_{ts}) Source: R. C. Peterson, *Stress Concentration Factors*, 1974, Figures 182 and 183, pp. 266–267, reprinted by permission of John Wiley & Sons, Inc.

If an end-mill is used, the keyway will look like Figure 9-15a and will have sharp corners in the side view at one or both ends as well as along each side. If, instead, a sled-runner keyway is cut as shown in Figure 9-15c, the sharp corner at the end is eliminated and the stress concentration reduced. A Woodruff keyseat in the shaft also has a large radius in the side view but it (and every keyseat) suffers from sharp corners on the sides.

Peterson^[7] shows experimentally derived stress-concentration curves for end-milled keyseats in shafts under either bending or torsional loading. These are reproduced in Figure 9-16. These factors range from about 2 to about 4 depending on the ratio of the corner radius to the shaft diameter. Curve-fits to Figure 9-16 have been done and *TKSolver* and *Mathcad* functions created for these curves so that the stress-concentration factor can be determined “on the fly” during a shaft-design computation. See the file SHFTDES for example. These factors should be applied to the bending and shear stresses in the shaft at the keyway location as was done in Examples 9-1 and 9-2.

EXAMPLE 9-4

Designing Shaft Keys

Problem Design the keys for the shaft in Examples 9-2 (p. 556) and 9-3 (p. 560) and refine the estimate of the shaft’s safety factors based on the preliminary design dimensions from that earlier example in conjunction with refined stress-concentration factors.

Given The loading is the same as in Example 9-2. The peak torque is 146 lb-in. Figure 9-9 (p. 557) shows the distribution of the peak moment over the shaft length. The values are 65.6 lb-in at point B and 18.3 lb-in at