ROLL NECK STRESS CALCULATION

Shearing Stresses In A Roll Neck - Ss:

When a torque is applied to one end of a roll neck, a shear stress (Ss) exists at all points on that roll neck. In addition to these stresses, elongation of the outer fibers due to twisting causes longitudinal tension over the outer half of the transverse cross section and longitudinal compression over the inner half of the transverse cross section. The maximum shear stress that can be sustained by the roll material before rupture is given by:

$$Ss = 16\ T\ Kt/(\pi\ d^3)$$

Where:

T = Torque (inch pounds)
Kt = Stress Concentration Factor (defined below)
d = Roll Neck Diameter (inches)

Bending Stresses In A Roll Neck- Sb:

When a radial force is applied to a roll neck, as in the case of back-up rolls (work rolls in a two-high mill) or by the application of roll bending forces to achieve control of flatness of the rolled product, cyclical bending stresses are introduced into the roll neck. The maximum bending stress in the outer fiber of the roll neck cross section at the location of maximum resultant bending stress (usually located in the form/fillet area) is given by:

$$Sb = 10.19\ P\ L\ Kb/d^3$$

Where:

P = Applied Load (pounds)
L = Lever Arm (inches)
Kb = Form/Fillet Stress Concentration Factor (defined below)
d = Roll Neck Diameter (inches)

Maximum Resultant Shear Stress - SMax:

The maximum resultant shear stress due to bending and torsion is given by:

$$Smax = (0.25\ Sb^2 + Ss^2)^{1/2}$$

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Stress Concentration Factor - Kt and Kb:

The stress concentration factor is a function of the following parameters:

d = Roll Neck Diameter

h = $\frac{\text{body diameter - neck diameter}}{2}$

r = Form/Fillet Radius

Figures 1 and 2 can be used to determine the stress concentration factors Kt and Kb.

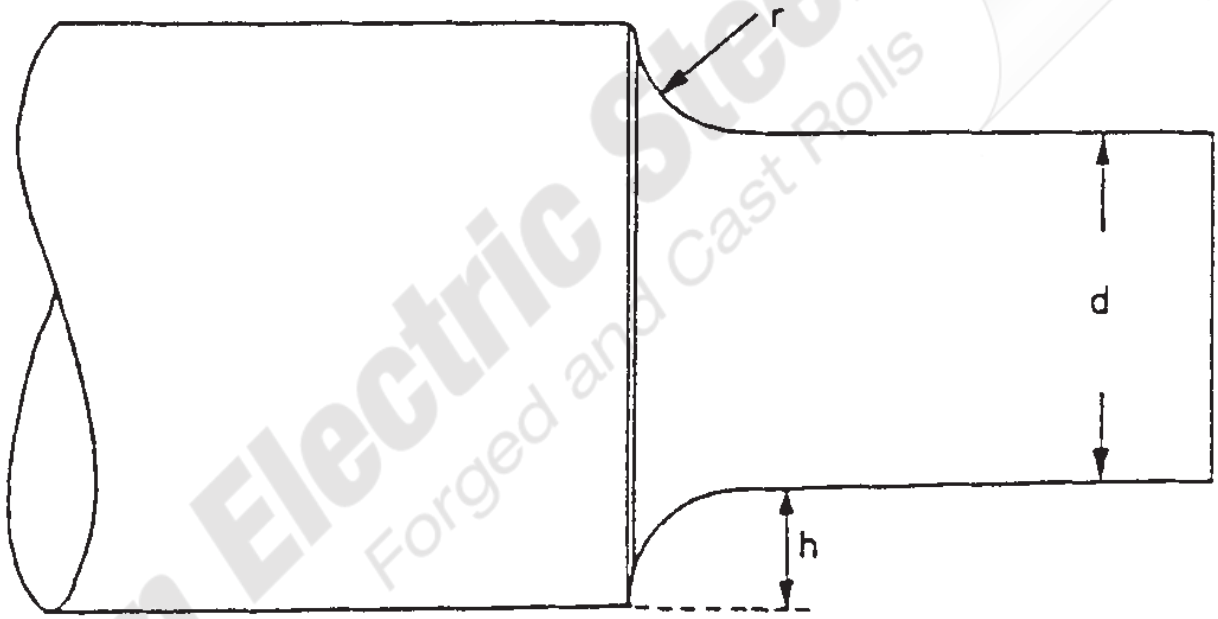

FIGURE 1

ROLL NECK STRESS CALCULATION

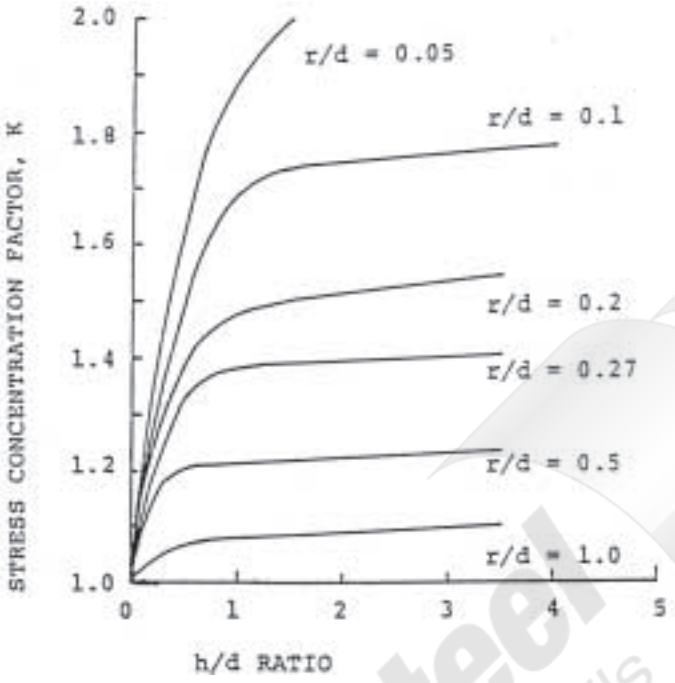

FIGURE 2

Safety Factor - Sf:

The safety factor is a ratio of the yield strength of the roll material to the maximum resultant shear stress. The minimum desired value for Sf is 2.0.

Yield Strength - Y.S.:

The yield strength is an indication of the maximum stress that can be developed in a material without causing plastic (permanent) deformation.

Note: The yield strength of a material in a state of shear is approximately half the yield strength in a state of tension