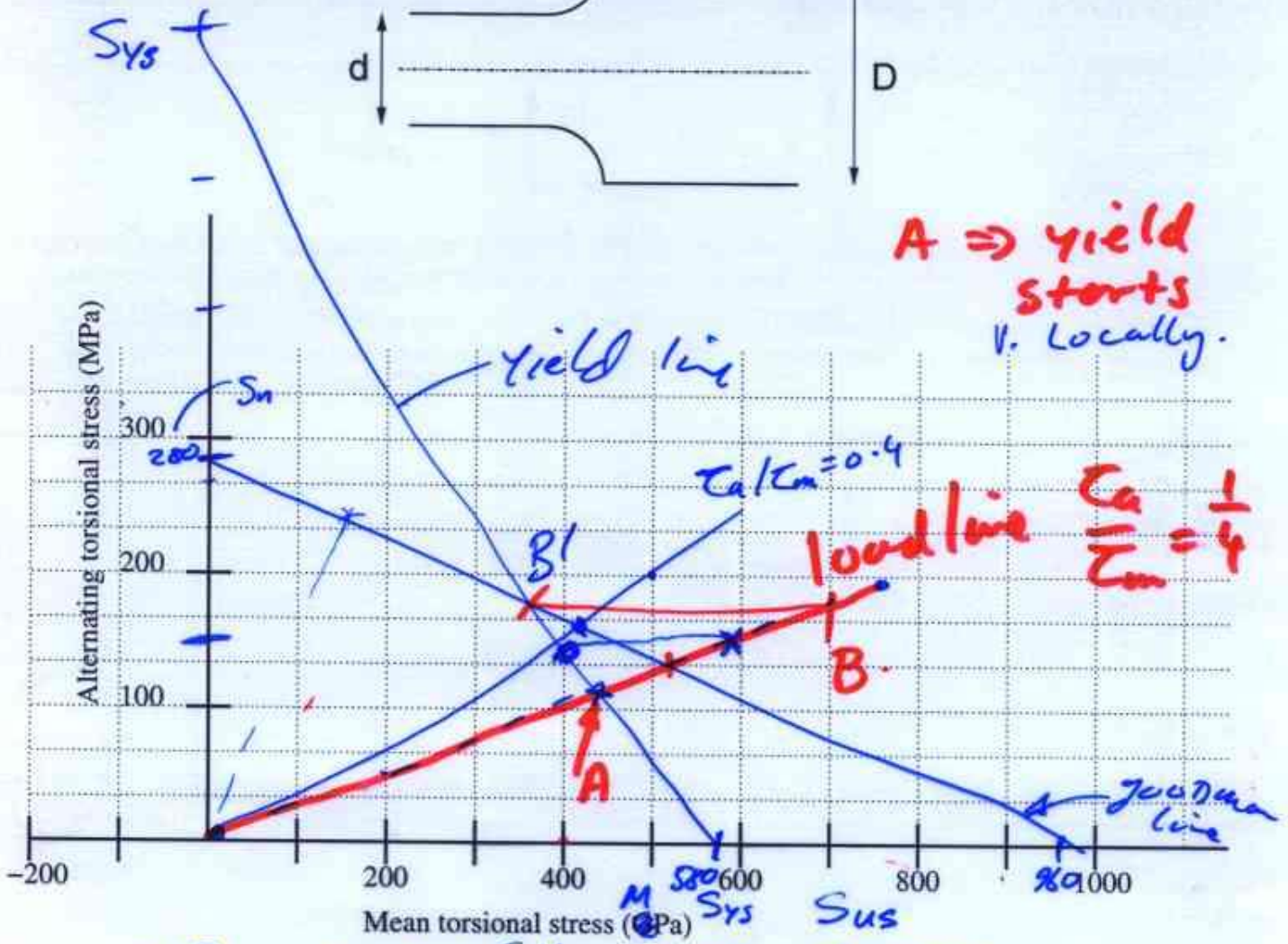
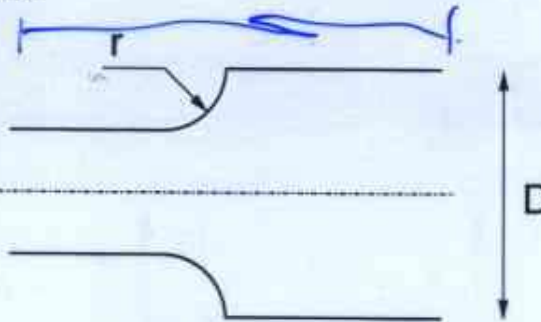


9th-January-2004

Problem A shaft must transmit a torque of 1000 Nm, with superimposed torsional vibrations causing an alternating torque of 250 Nm. A safety factor of 2 should be applied to both loads.

A heat treated alloy steel is to be used, with $S_u = 1.2 \text{ GPa}$ and $S_y = 1.0 \text{ GPa}$. The shaft will have a shoulder, with $D/d = 1.2$ and $r/d = 0.05$ as show in the diagram. A good quality commercial ground finish is to be specified, what diameter is required for infinite life?



$S_n = ? \quad S_n' \approx \frac{S_u}{2} = \frac{1200}{2} = 600 \text{ MPa}$

$S_n = C_L C_D C_S S_n'$
 Torsion $\Rightarrow C_L = 0.58$; $C_S = 0.9$ (ground).

C_D depends on d assume $10 < \phi < 50 \text{ mm}$
 $C_D = 0.9$ (for torsion).

$S_n = (600)(0.58)(0.9)(0.9) \approx 280 \text{ MPa}$

$S_{us} = (0.8)(S_u) = 960 \text{ MPa}$ $S_{ys} \approx (0.58) S_y = 580 \text{ MPa}$ MConry