Process Steps:

1: Exaggerate and draw any displacements
2: FBD of external forces known and unknown
  2a: write equilibrium eqn(s)
3: Cut each member and create FBD for internal forces
  3a: determine cross sectional area ALONG cut
4: Write stress/strain eqn(s) for each member
  4a: re-express stress and strain
5: Constraints: (compatibility eqns)
6: define any unexpected or new terms
7: Count unknowns and equations

2a: Equilibrium Eqn(s):

$$F_{A\text{-}Al} + F_{A\_S} - F_C = 0$$

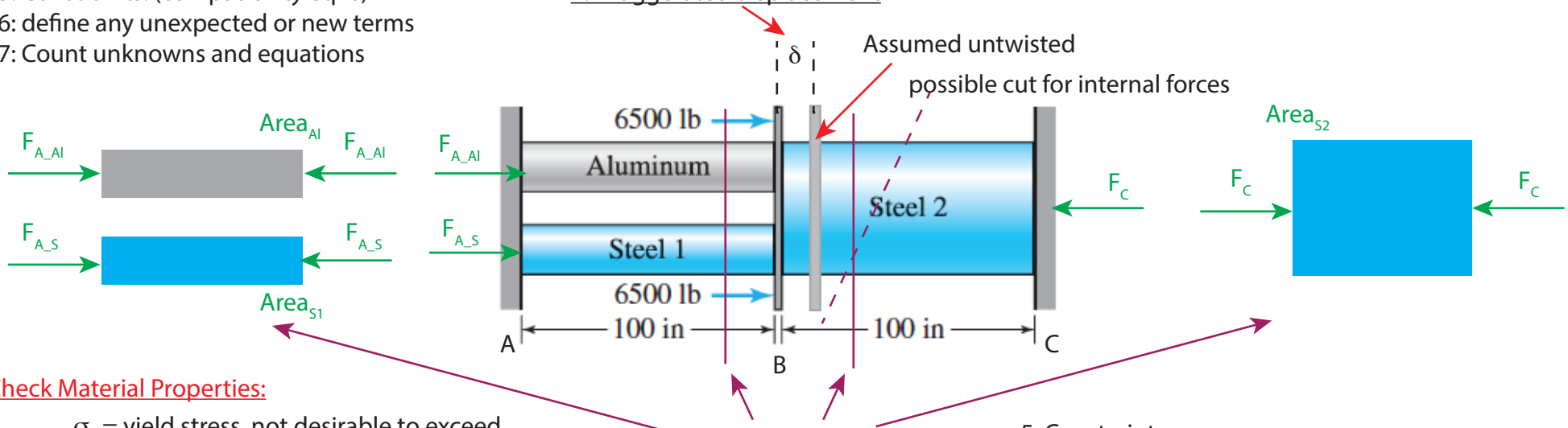
Other Useful Relationships:

lateral vs longitudinal strain (Poisson's Ratio) $\nu = \frac{-\varepsilon_{lateral}}{\varepsilon_{longitudinal}}$

Axial Loads: $\delta = \Sigma \frac{N_i L_i}{A_i E_i}$ $(N = F_N)$

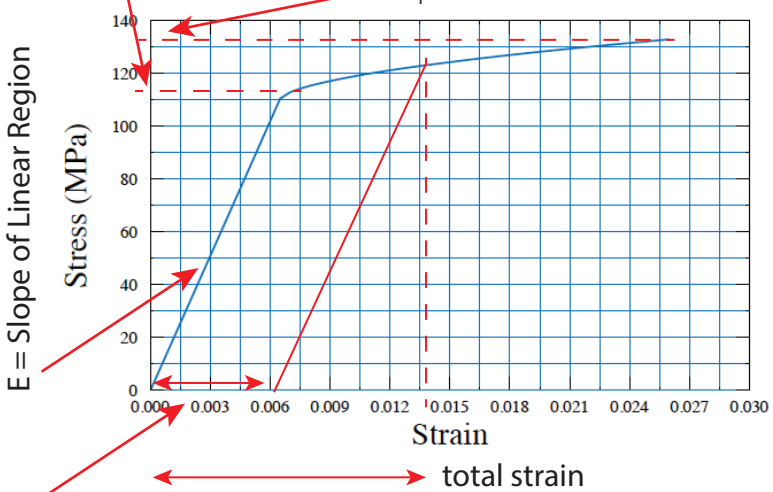
For torsion problems:
Same process different symbols!

1: Exaggerated displacement



Check Material Properties:

σ_Y = yield stress, not desirable to exceed
σ_f = fracture stress, total failure



4: Stress/Strain Eqn(s):

$$\frac{F_{AL}}{A_{Al}} = \sigma_{Al} = E_{Al}\,\varepsilon_{Al} = \frac{\delta_{AL}}{L_{Al}}$$

$$\frac{F_{S1}}{A_{S1}} = \sigma_{S1} = E_{S1}\,\varepsilon_{S1} = \frac{\delta_{S1}}{L_{S1}}$$

$$\frac{F_{S2}}{A_{S2}} = \sigma_{S2} = E_{S2}\,\varepsilon_{S2} = \frac{\delta_{S2}}{L_{S2}}$$

5: Constraints:
In this case total length is constrained by walls. Other problems lead to other constraints. Write then down using the labels you have developed to this point.

$\delta_{Al} = \delta_{S1}$; plate is untwisted

$|\delta_{AL}| = |\delta_{S2}|$; total length is fixed