Statics, mechanics of materials, material properties

FE CIVIL DUMP SHEET

Achievable

Static

- Basic equilibrium
  $\Sigma F_x = 0, \Sigma F_y = 0, \Sigma M = 0$
- Centroid
  rectangle: $\bar{x} = b/2, \bar{y} = h/2$
  Composite: $\bar{x} = \frac{(\Sigma A_i x_i)}{\Sigma A_i}$, $\bar{y} = \frac{(\Sigma A_i y_i)}{\Sigma A_i}$
- Area moment of inertia
  Rectangle: $I = bh^3/12$
  Parallel-axis theorem: $I = I_c + Ad^2$
- Trusses method of joints: $\Sigma F_x=0, \Sigma F_y=0$
  Zero-force members rules:
  - 2 noncollinear members → both zero
  - 3 members, 2 collinear → noncollinear = zero

Material properties

- E (Steel) = 29,000 ksi
- Unit weights:
  water 62.4,
  soil 100−130,
  concrete 150 lb/ft^3

Mechanics of materials

- Stress–strain
  $\sigma = P/A$
  $\tau = VQ / It$
  $\sigma b = P/Ab$
  $\sigma = E\varepsilon$
- Axial deformation
  $\Delta = PL / AE$
- Torsion
  $\tau = Tc/J$
  $\theta = TL/GJ$
- Solid $J = \pi d^4/32$
- Hollow $J = \pi(do^4 - di^4)/32$
- Bending $\sigma = Mc/I$
- Cantilever defl = $PL^3/3EI$
- Simple beam defl = $PL^3/48EI$
- Mohr's circle

$\sigma_{1,2} = (\sigma_x + \sigma_y)/2 \pm \text{sqrt}(((\sigma_x - \sigma_y)/2)^2 + \tau_{xy}^2)$
$\tau_{max} = (\sigma_1 - \sigma_2)/2$