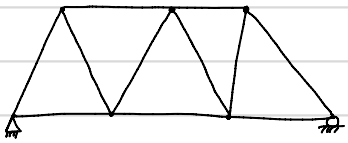
January 20, 2026
Statics Review
Part II - Trusses

Truss - a structure made of straight, slender bars joined together at end points

Assumptions
1. weight of the members are negligible
2. all joints are pins, i.e. no moment/bending
3. applied forces act at joints

* key point: truss members carry only axial force - tension (+) / compression (-)



m = member = 11

r = reaction = 3

j = joint = 7

m + r = 14 = 2j

∴ determinate

only 2 (force) equilibrium equations since moment condition automatically satisfied by pin connection

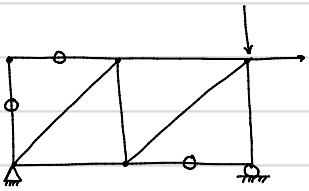
$m + r \leq 2j$ statically determinate

$m + r > 2j$ indeterminate

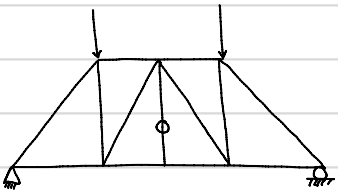
$m + r < 2j$ unstable

Zero force members

* zero force members provide added stability/redundancy

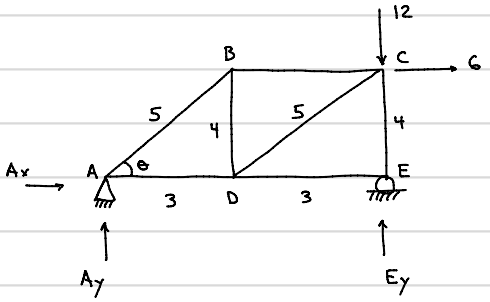


Rule # 1 : if only two members form a joint and no external loading is applied, zero force members



Rule # 2 : if three members form a joint and two are colinear, the third member is a zero force member if no loading or reaction supports

Method of Joints - equilibrium at each joint $\Sigma F_x = \Sigma F_y = 0$



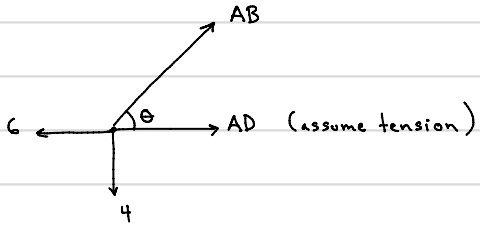
Overall Structural Equilibrium

$\Sigma F_x = 0 \quad A_x + 6 = 0 \quad A_x = -6$

$\Sigma F_y = 0 \quad A_y + E_y - 12 = 0 \quad A_y = -4$

$\Sigma M_A = 0 \quad E_y(6) - 6(4) - 12(6) = 0 \quad E_y = 16$

* At each joint maximum of two unknown forces (members/reactions) on account of two joint equilibrium equations



$\Sigma F_x = 0 \quad AB\cos\theta + AD - 6 = 0$

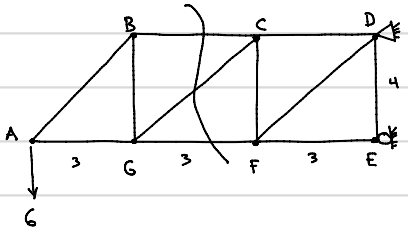
$\Sigma F_y = 0 \quad AB\sin\theta - 4 = 0$

$AB(4/5) = 4 \quad AB = 5 \quad (+ \therefore \text{Tension}) \longrightarrow (T)$

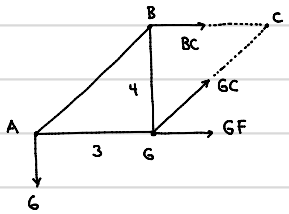
$5(3/5) + AD = 6 \quad AD = 3\,(T)$

Method of Sections - if a structure is in equilibrium then any portion of that structure is also in equilibrium

$\Sigma F_x = \Sigma F_y = \Sigma M = 0$ 3 equations



Find member force GF



$\Sigma F_x = 0$

$\Sigma F_y = 0$

$\Sigma M_{\cdot} = 0 \quad \Sigma M_c = 0 \quad GF(4) + 6(6) = 0 \quad GF = -9 \quad \therefore \quad GF = 9\,(C)$