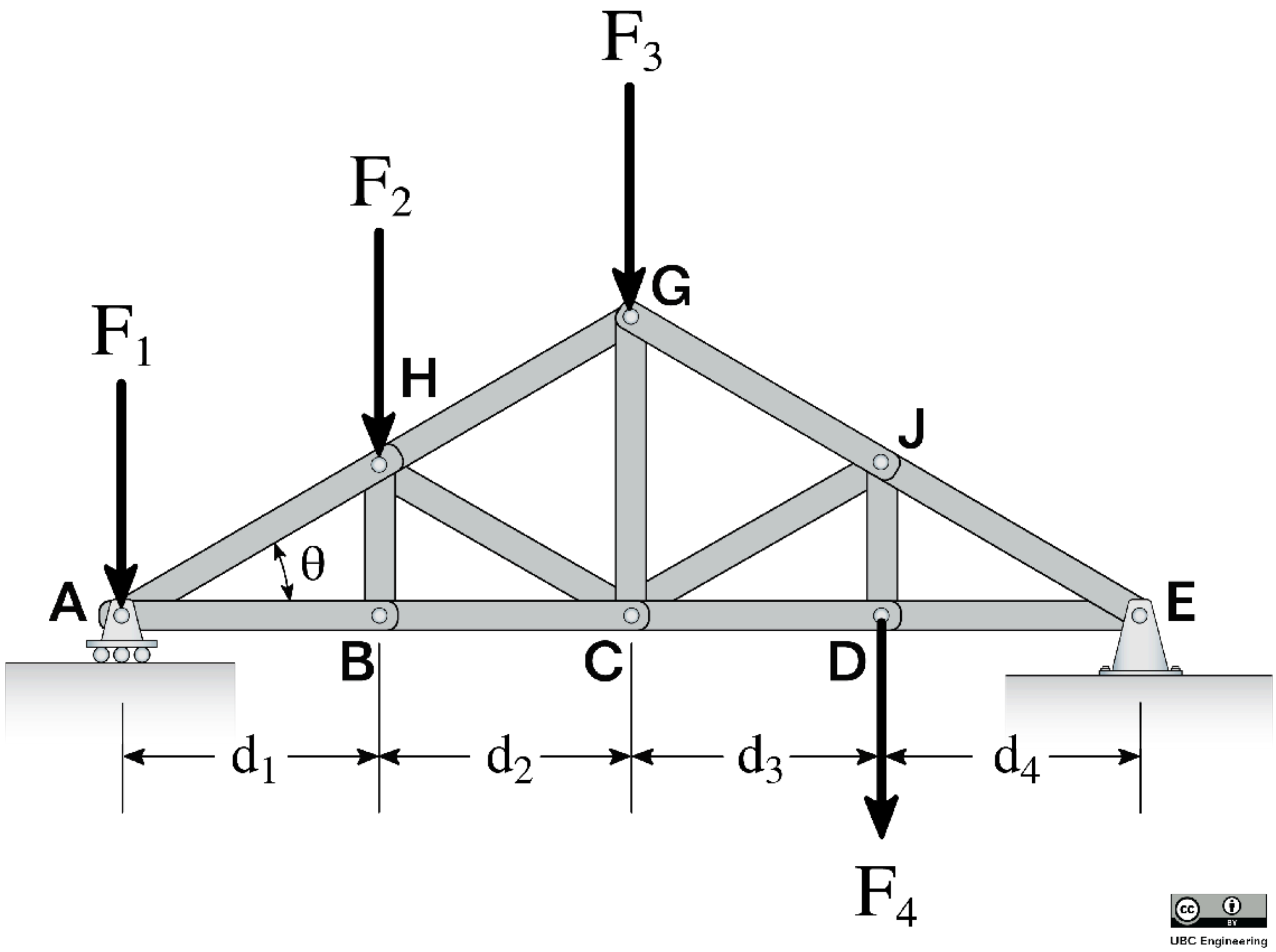

A simple truss carries 4 loads F_1, F_2, F_3, and F_4. If the truss is supported by a roller at A and a pin at E, using the method of joints, find the magnitude of the internal force in each member and determine whether it is tensile, compressive, or a zero-force member. Assume all joints are pin connected and $d_1 = d_2 = d_3 = d_4$.

Find the reaction forces at A and E.

Since there are no horizontal forces acted on the truss, $E_x = 0 \rightarrow N_E = E_y$

$$\Sigma M_A = 0 \rightarrow 4d_1 \cdot N_E - 3d_1 \cdot F_4 - 2d_1 \cdot F_3 - d_1 \cdot F_2 = 0 \rightarrow N_E = \frac{F_2 + 2F_3 + 3F_4}{4}$$

$$+\uparrow \Sigma F_y = 0 \rightarrow N_A + N_E - F_1 - F_2 - F_3 - F_4 = 0 \rightarrow N_A = F_1 + \frac{3F_2 + 2F_3 + F_4}{4}$$

Find the magnitude of the internal force in each member and determine if the member is in tension, in compression, or a zero-force member.

$$+\uparrow \Sigma B_y = 0$$
$$\Rightarrow F_{BH} = 0$$ (Zero-force member)

$$+\uparrow \Sigma A_y = 0 \rightarrow N_A - F_1 + F_{AH}\sin(\theta) = 0$$
$$\Rightarrow F_{AH} = -\frac{3F_2 + 2F_3 + F_4}{4\sin(\theta)}$$

$$+\rightarrow \Sigma A_x = 0 \rightarrow F_{AB} + F_{AH}\cos(\theta) = 0$$
$$\Rightarrow F_{AB} = \frac{3F_2 + 2F_3 + F_4}{4\tan(\theta)}$$

$$+\rightarrow \Sigma B_x = 0 \rightarrow F_{BC} - F_{AB} = 0$$
$$\Rightarrow F_{BC} = F_{AB} = \frac{3F_2 + 2F_3 + F_4}{4\tan(\theta)}$$

$$+\uparrow \Sigma E_y = 0 \rightarrow N_E + F_{EJ}\sin(\theta) = 0$$
$$\Rightarrow F_{EJ} = -\frac{F_2 + 2F_3 + 3F_4}{4\sin(\theta)}$$

$$+\rightarrow \Sigma E_x = 0 \rightarrow -F_{DE} - F_{EJ}\cos(\theta) = 0$$
$$\Rightarrow F_{DE} = \frac{F_2 + 2F_3 + 3F_4}{4\tan(\theta)}$$

$$+\uparrow \Sigma D_y = 0 \rightarrow F_{DJ} - F_4 = 0$$
$$\Rightarrow F_{DJ} = F_4$$

$$+\rightarrow \Sigma D_x = 0 \rightarrow F_{DE} - F_{CD} = 0$$
$$\Rightarrow F_{CD} = F_{DE} = \frac{F_2 + 2F_3 + 3F_4}{4\tan(\theta)}$$

$$+\rightarrow \Sigma H_x = 0 \rightarrow F_{GH}\cos(\theta) + F_{CH}\cos(\theta) - F_{AH}\cos(\theta) = 0 \rightarrow F_{CH} = F_{AH} - F_{GH}$$

$$+\uparrow \Sigma H_y = 0 \rightarrow F_{GH}\sin(\theta) - F_{AH}\sin(\theta) - F_{CH}\sin(\theta) - F_2 = 0 \rightarrow F_{GH} - F_{AH} - F_{CH} - \frac{F_2}{\sin(\theta)} = 0$$

$$\rightarrow F_{GH} - F_{AH} - (F_{AH} - F_{GH}) - \frac{F_2}{\sin(\theta)} = 0$$

$$\rightarrow 2(F_{GH} - F_{AH}) = \frac{F_2}{\sin(\theta)}$$

$$\rightarrow F_{GH} = F_{AH} + \frac{F_2}{2\sin(\theta)}$$

$$\Rightarrow F_{GH} = -\frac{F_2 + 2F_3 + F_4}{4\sin(\theta)}$$

$$F_{CH} = F_{AH} - F_{GH}$$

$$\Rightarrow F_{CH} = -\frac{F_2}{2\sin(\theta)}$$

$$+\rightarrow \Sigma G_x = 0 \rightarrow F_{GJ}\cos(\theta) - F_{GH}\cos(\theta) = 0$$

$$\Rightarrow F_{GJ} = F_{GH} = -\frac{F_2 + 2F_3 + F_4}{4\sin(\theta)}$$

$$+\uparrow \Sigma G_y = 0 \rightarrow -F_{GH}\sin(\theta) - F_{GJ}\sin(\theta) - F_{CG} - F_3 = 0 \rightarrow F_{CG} = \frac{F_2 + 2F_3 + F_4}{2} - F_3$$

$$\Rightarrow F_{CG} = \frac{F_2 + F_4}{2}$$

$$+\rightarrow \Sigma J_x = 0 \rightarrow F_{EJ}\cos(\theta) - F_{GJ}\cos(\theta) - F_{CJ}\cos(\theta) = 0 \rightarrow F_{CJ} = F_{EJ} - F_{GJ}$$

$$\Rightarrow F_{CJ} = -\frac{F_4}{2\sin(\theta)}$$