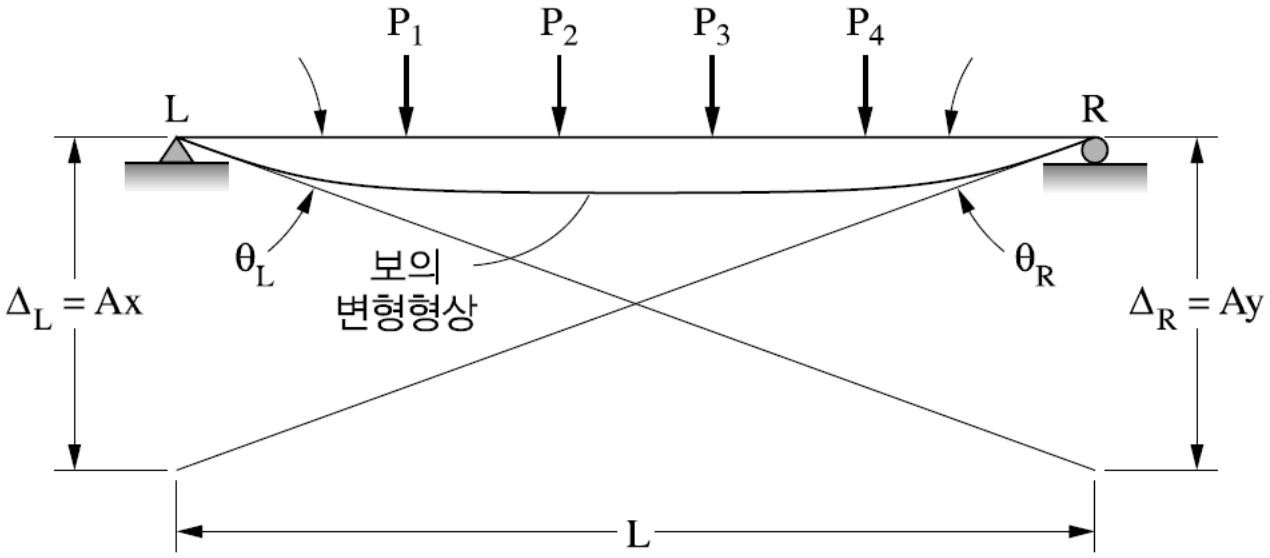
제 12장 기하학적 기법을 이용한 처짐 및 처짐각-II

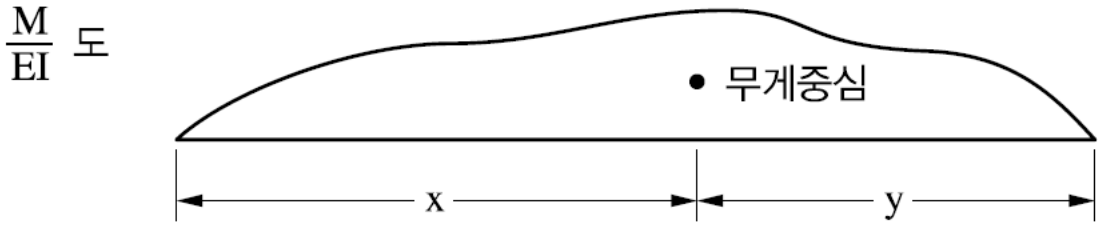
(1) 탄성하중법 : 단순보에만 적용

(2) 공액보법 : 내민보, 외팔보, 연속보에 적용 가능하지만

뼈대(Frame)에 적용의 어려움



(a)



(b)

그림 12.1 • 탄성하중법을 논의하기 위한 보

공액구조법(Conjugate structure method)

(1) 하중강도(w), 전단력(V), 휨모멘트(M) : 힘의 평형

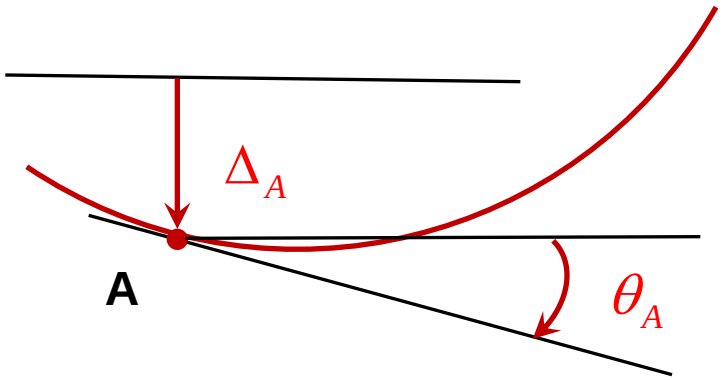
$$w = \frac{dV}{dx} \quad , \quad V = \frac{dM}{dx}$$

(2) 곡률(Curvature) : $\kappa = \frac{M}{EI}$

$$\kappa = \frac{d\theta}{dx} \quad , \quad \theta = \frac{dy}{dx}$$

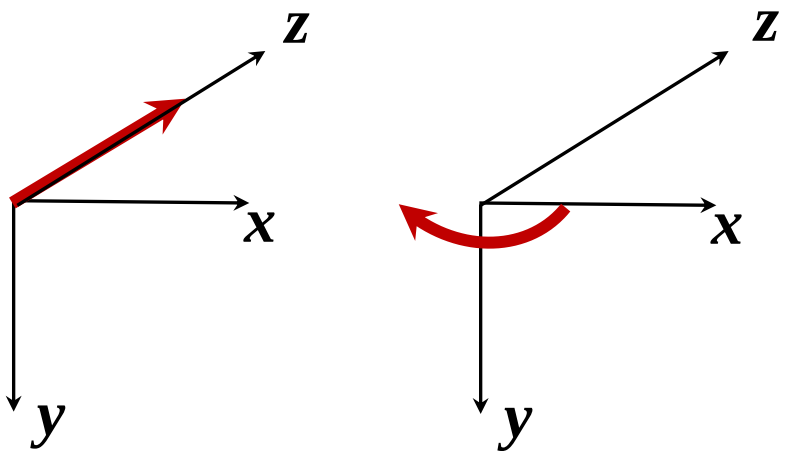
실제구조	공액구조
곡률	분포하중
처짐	모멘트
처짐각	힘

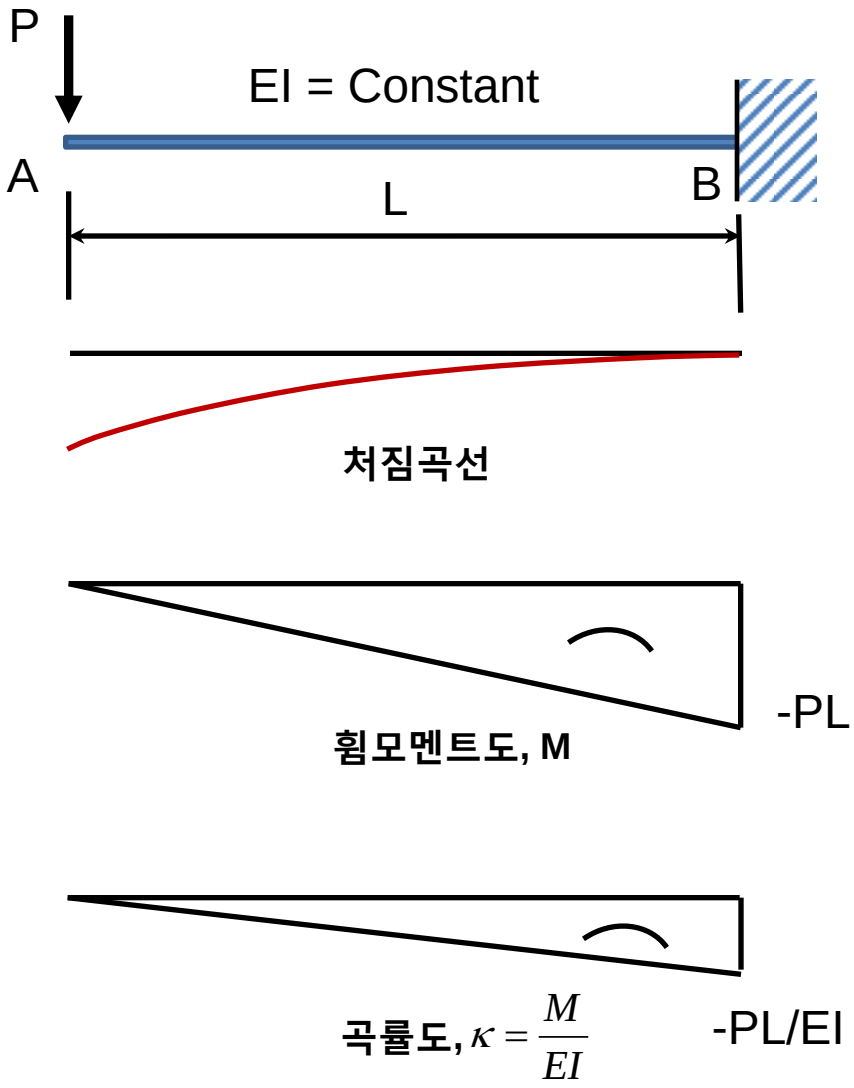
(1) 실제구조 : 처짐각 , 처짐

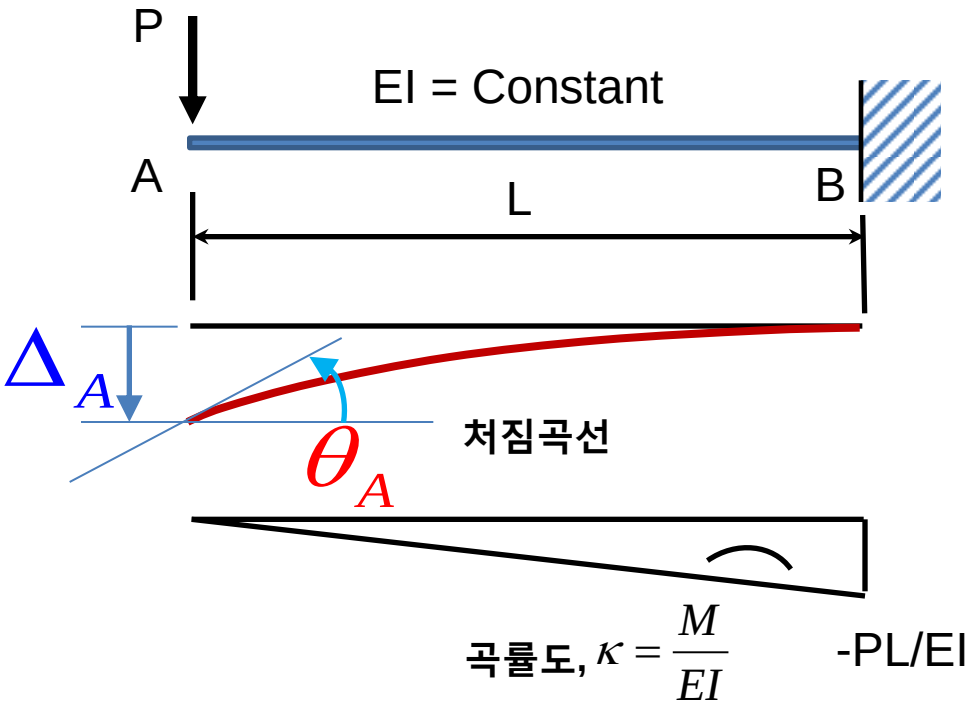


실제구조	공액구조
곡률	분포하중
처짐	모멘트
처짐각	힘

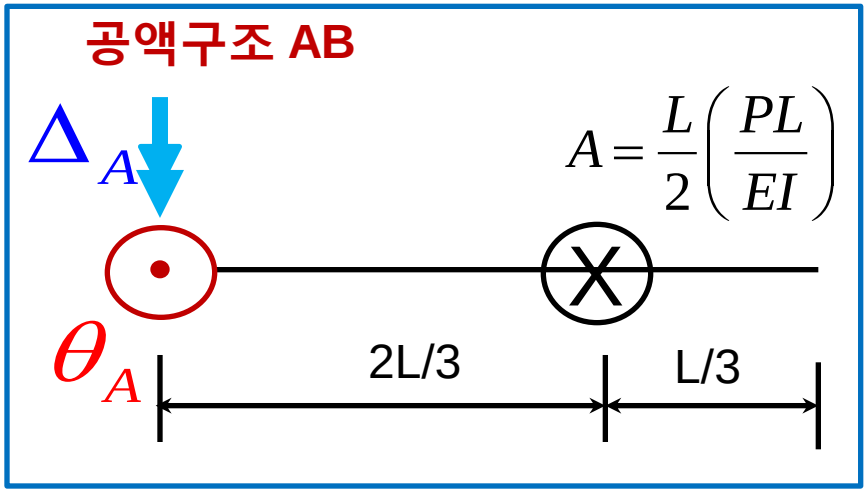
(2) 공액구조: 힘, 모멘트




P
EI = Constant
A
B
L
처짐곡선
-PL
휨모멘트도, M
곡률도, $\kappa = \frac{M}{EI}$
-PL/EI

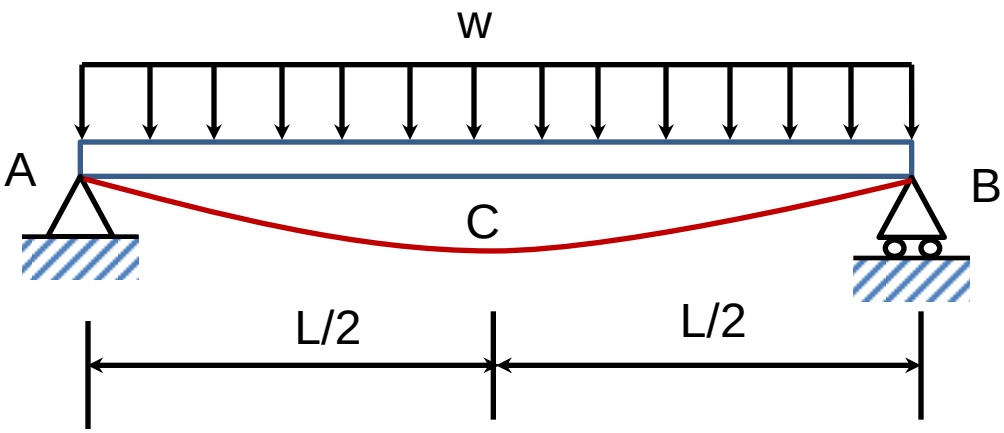


실제구조	공액구조
곡률	분포하중
처짐각	힘
처짐	모멘트



$$\sum F = 0 \quad \therefore \theta_A = A = \frac{PL^2}{2EI}$$

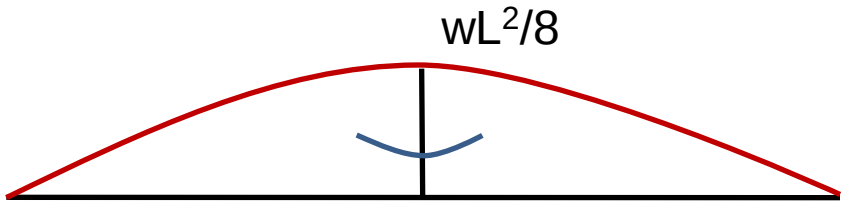
$$\sum M_A = 0 \quad \therefore \Delta_A = A\left(\frac{2L}{3}\right) = \frac{PL^3}{3EI}$$



EI = Constant

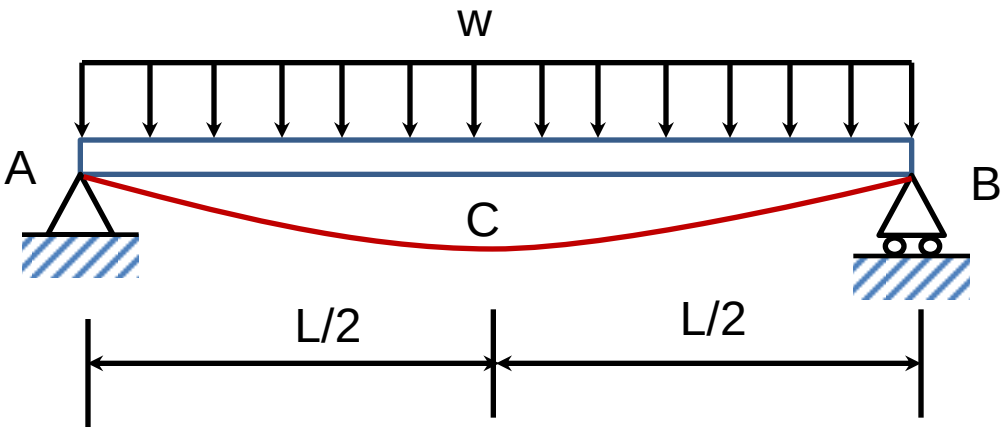
$$M_C = \frac{wL}{2}\left(\frac{L}{2}\right) - \frac{wL}{2}\left(\frac{L}{4}\right)$$

$$= \frac{wL^2}{8}$$



휨모멘트도, M

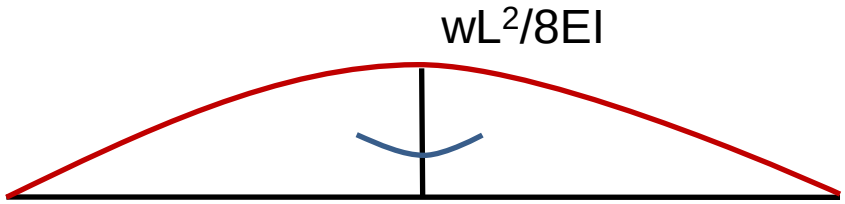
곡률도, M/EI



좌우대칭 구조물이므로

$$\theta_A = \theta_B$$

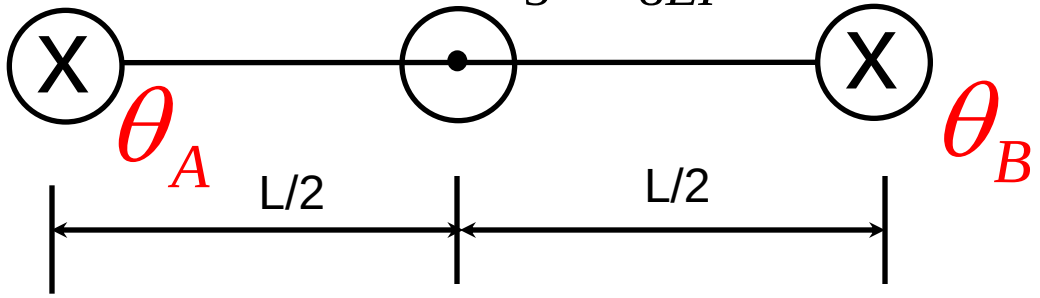
$$\theta_C = 0$$



곡률도, M/EI

공액구조 AB

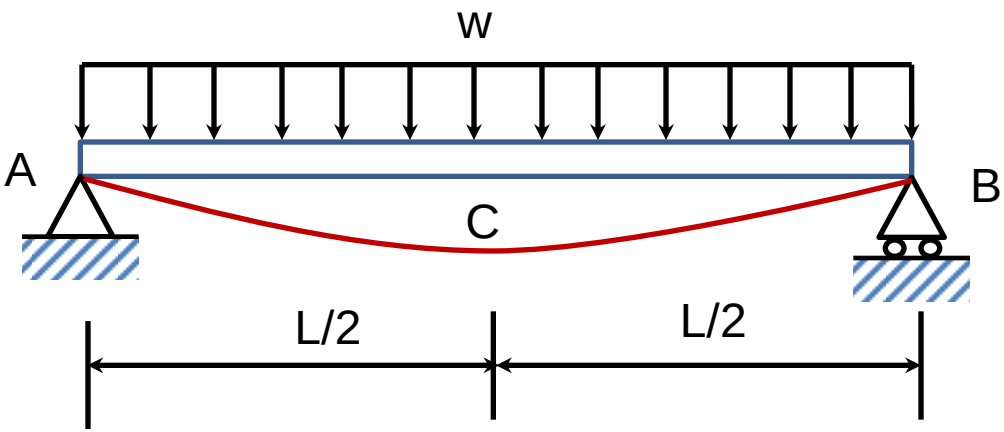
$$A = \frac{2}{3}(L)\frac{wL^2}{8EI}$$



$$\sum F = 0$$

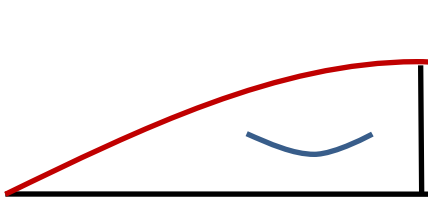
$$\theta_A + \theta_C = A$$

$$\theta_A = \theta_C = \frac{A}{2} = \frac{wL^3}{24EI}$$



EI = Constant

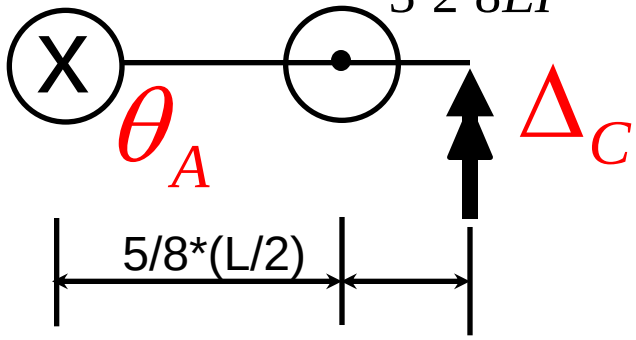
$$\theta_C = 0$$



곡률도, M/EI

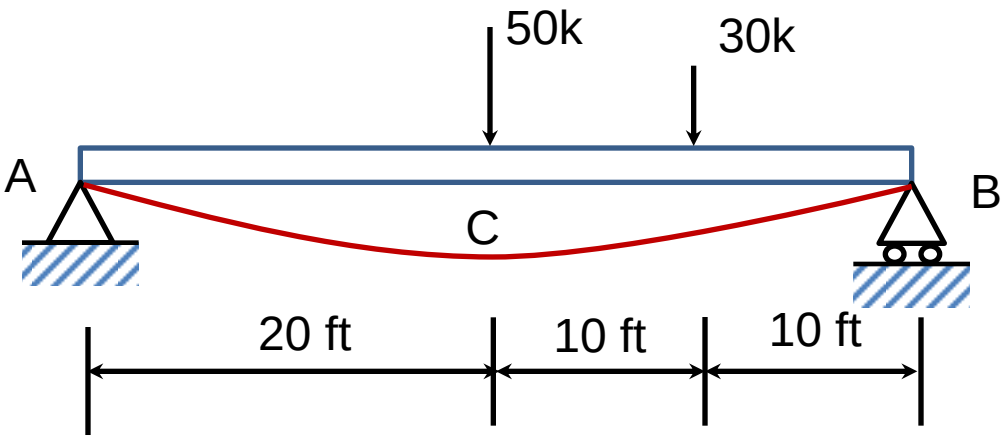
공액구조 AC

$$A = \frac{2}{3}\frac{L}{2}\frac{wL^2}{8EI}$$



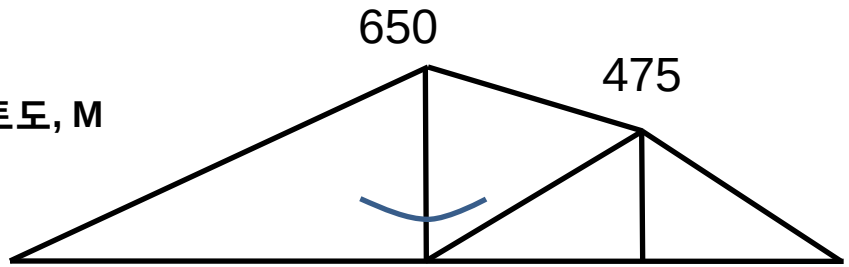
$$\sum M_A = 0$$

$$\Delta_C = A\left(\frac{5}{8}\frac{L}{2}\right) = \frac{5wL^4}{384EI}$$

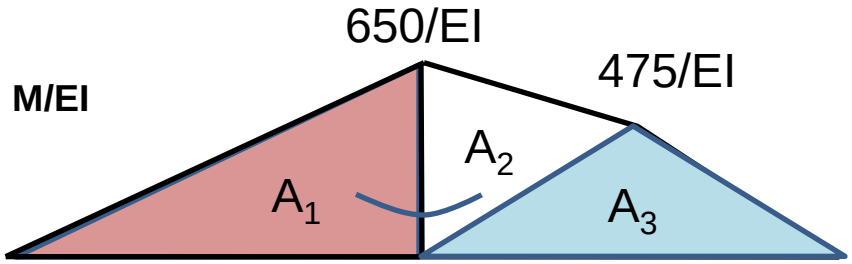


EI = Constant

휨모멘트도, M



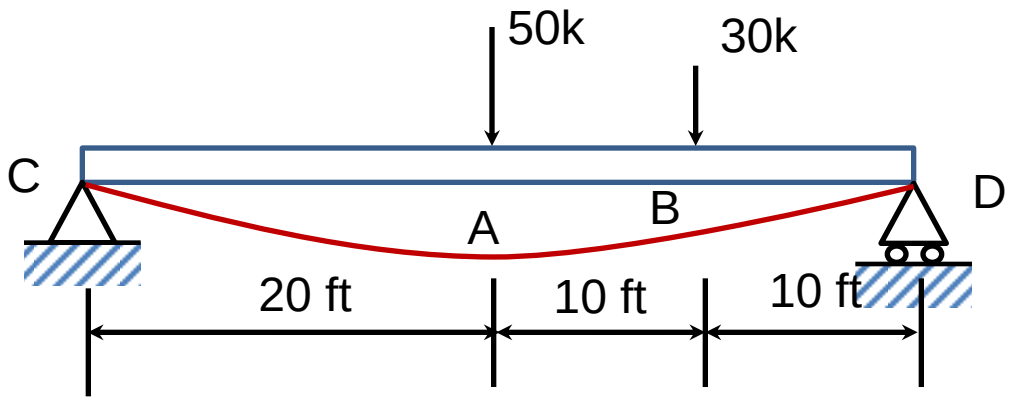
곡률도, M/EI



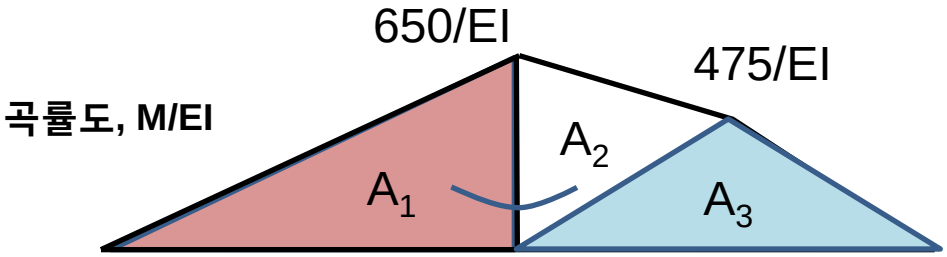
$$A_1 = \frac{1}{2}(20)\left(\frac{650}{EI}\right) = \frac{6500}{EI}$$

$$A_2 = \frac{1}{2}(10)\left(\frac{650}{EI}\right) = \frac{3250}{EI}$$

$$A_1 = \frac{1}{2}(20)\left(\frac{475}{EI}\right) = \frac{4750}{EI}$$

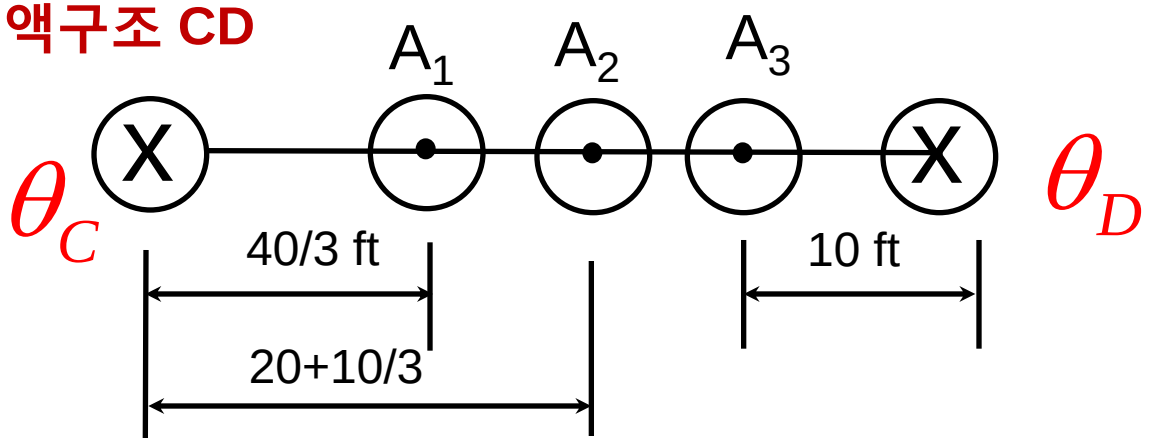


EI = Constant



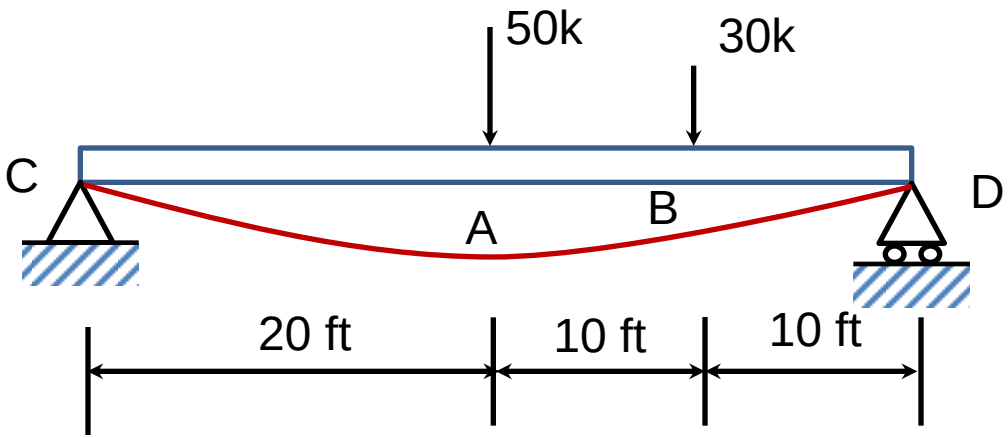
$$A_1 = \frac{6500}{EI}\ ,\ A_2 = \frac{3250}{EI}\ ,\ A_3 = \frac{4750}{EI}$$

공액구조 CD

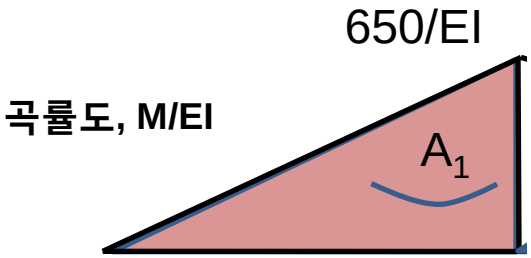


$$\sum M_D = 0$$

$$\theta_C = \frac{6875}{EI}$$

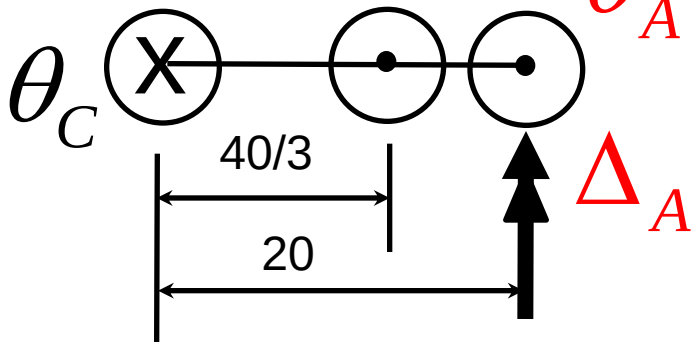


EI = Constant



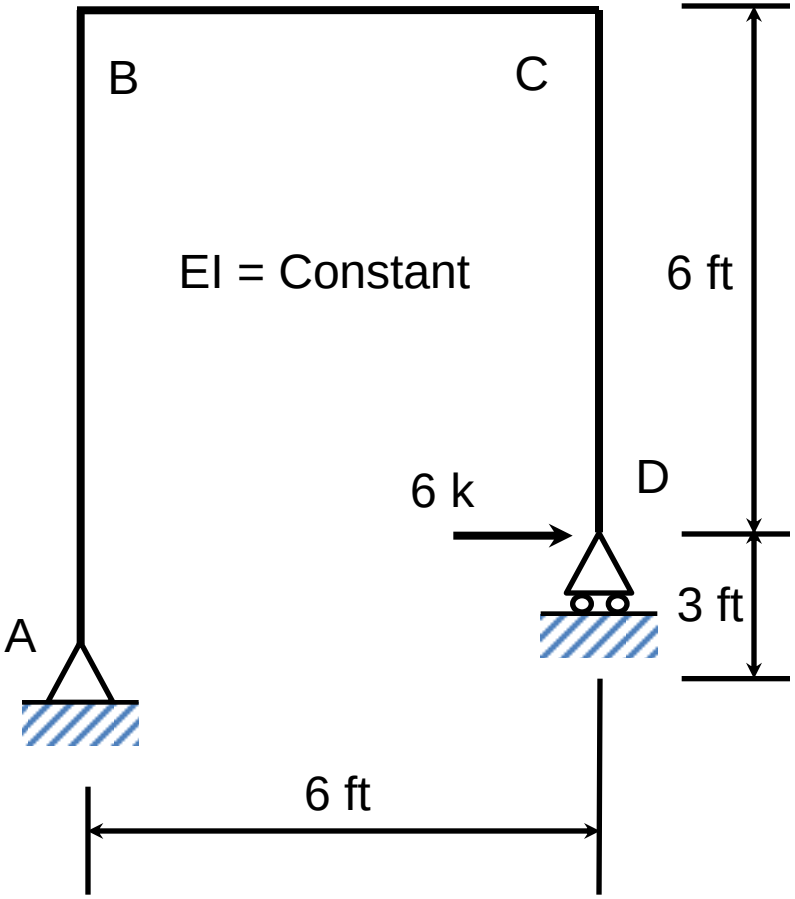
$$A_1 = \frac{1}{2}(20)\left(\frac{650}{EI}\right) = \frac{6500}{EI}$$

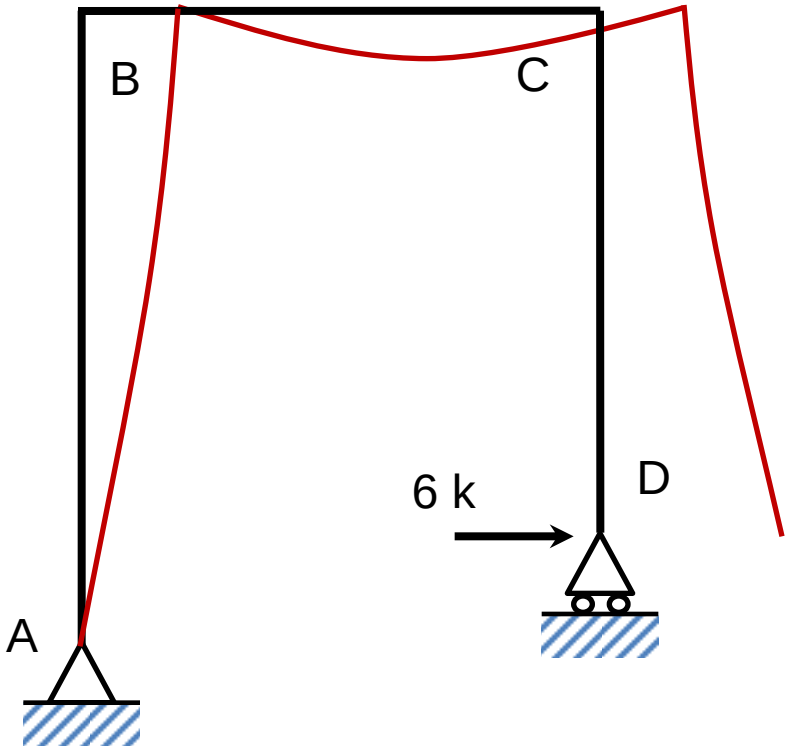
공액구조 CA

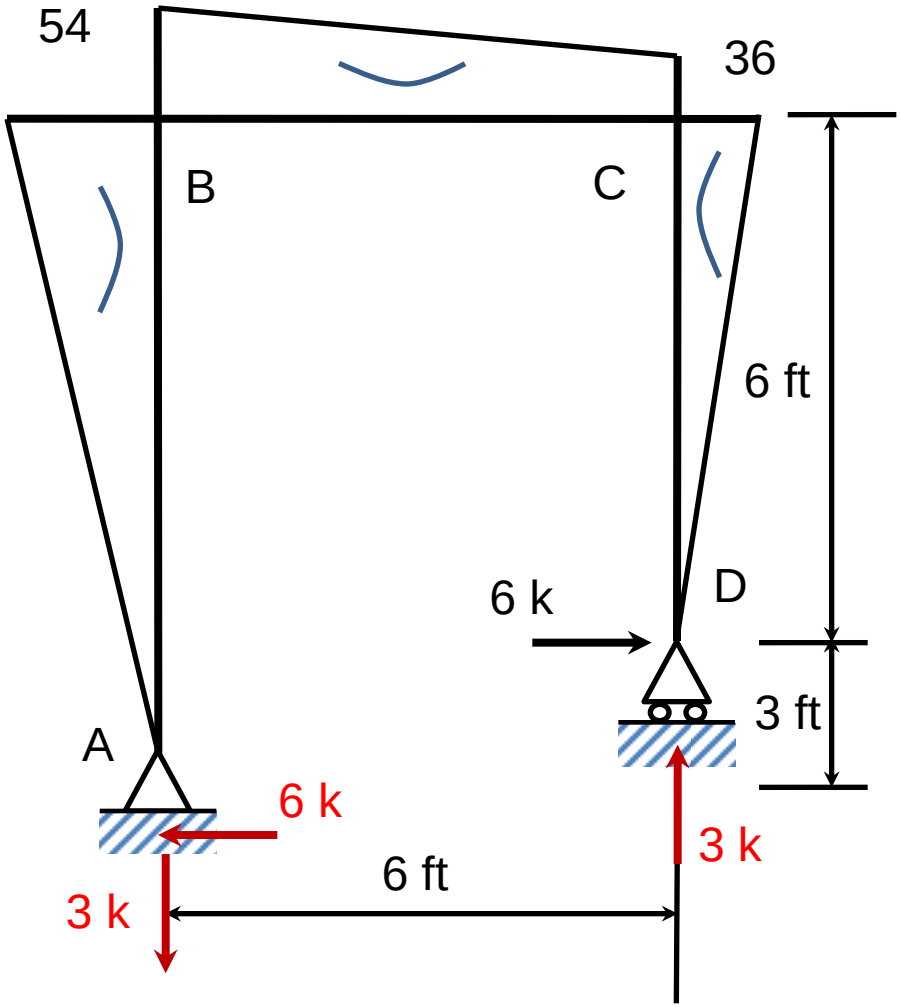


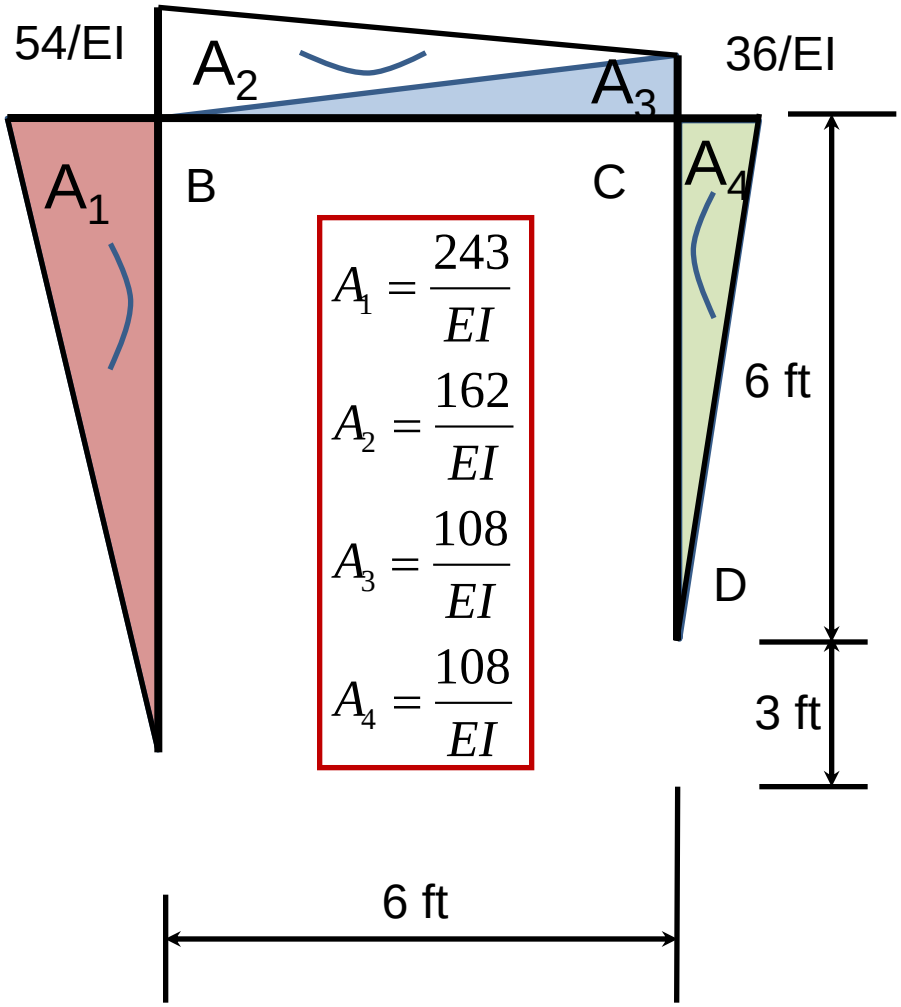
$$\sum F = 0 \qquad \therefore \theta_A = \frac{375}{EI}$$

$$\sum M_A = 0 \qquad \therefore \Delta_A = \frac{94167}{EI}$$


B
C
EI = Constant
6 ft
6 k
D
3 ft
A
6 ft


B
C
6 k
D
A


54
36
B
C
6 ft
6 k
D
3 ft
A
6 k
3 k
6 ft
3 k



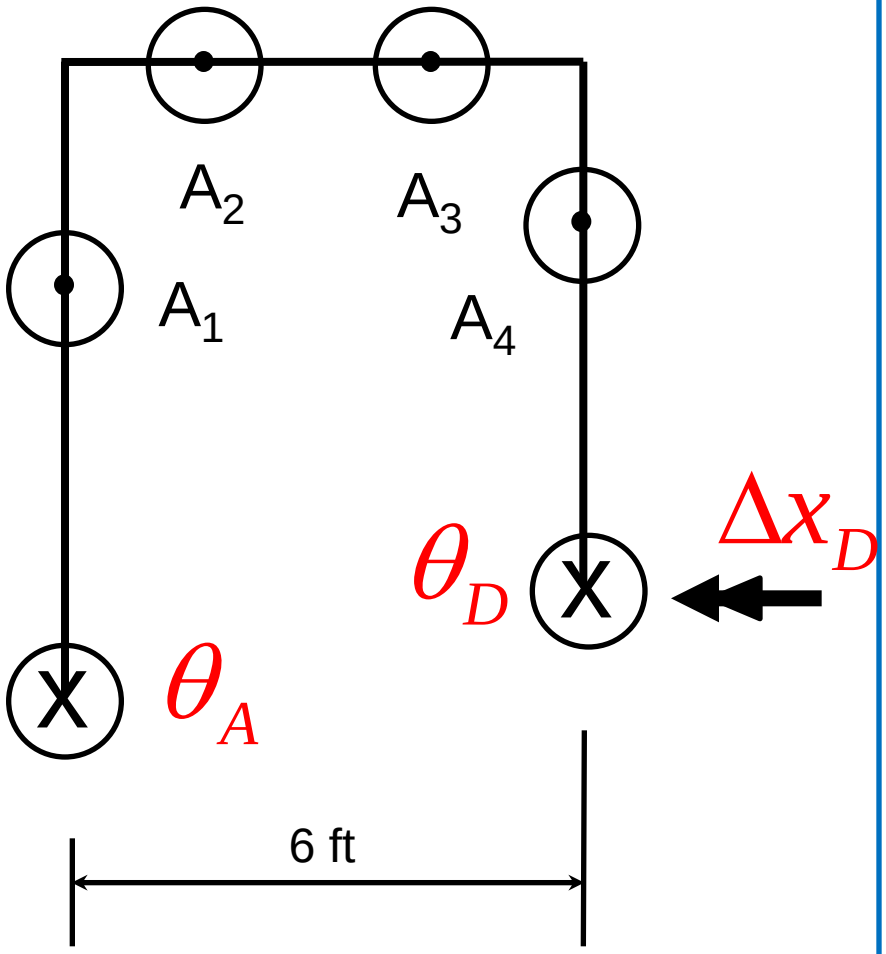
$$A_1 = \frac{243}{EI}$$

$$A_2 = \frac{162}{EI}$$

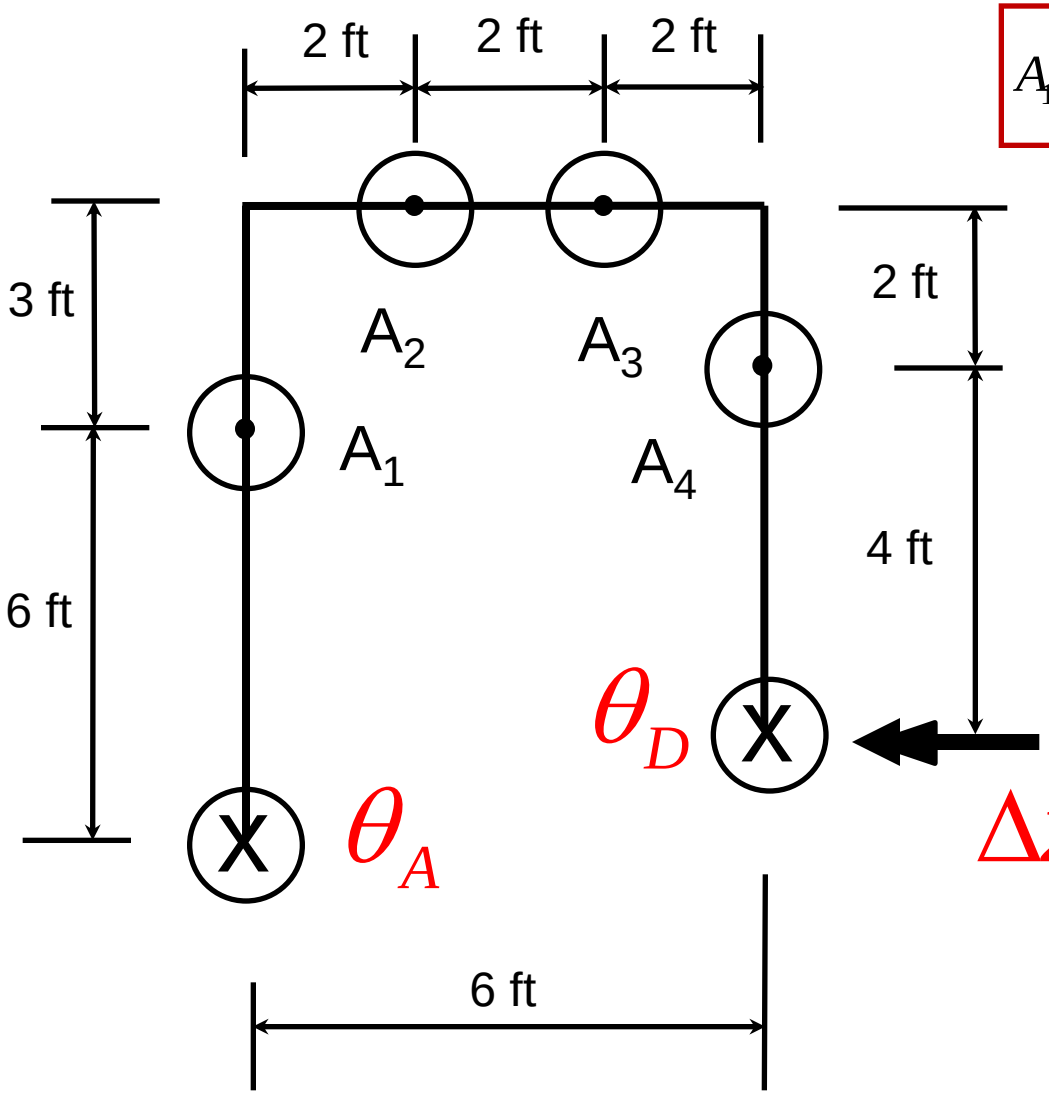
$$A_3 = \frac{108}{EI}$$

$$A_4 = \frac{108}{EI}$$

공액구조 AD



공액구조 AD



$$A_1 = \frac{243}{EI},\ A_2 = \frac{162}{EI},\ A_3 = \frac{108}{EI},\ A_4 = \frac{108}{EI}$$

$$\sum M_{D,Y} = 0 \quad \therefore \theta_A = \frac{387}{EI}$$

$$\sum F = 0 \quad \therefore \theta_D = \frac{234}{EI}$$

$$\sum M_{D,X} = 0 \quad \therefore \Delta x_D = \frac{3942}{EI}$$