

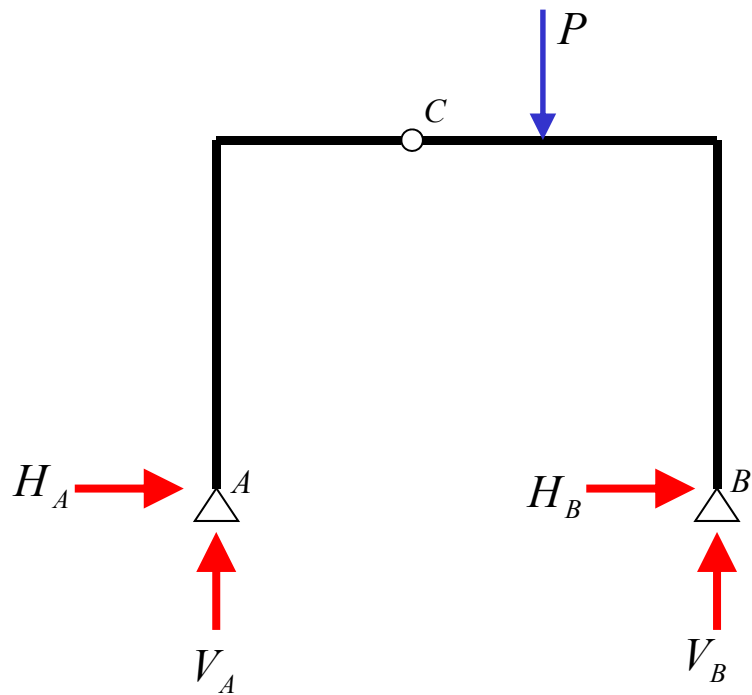


# 静定力学講義(10)

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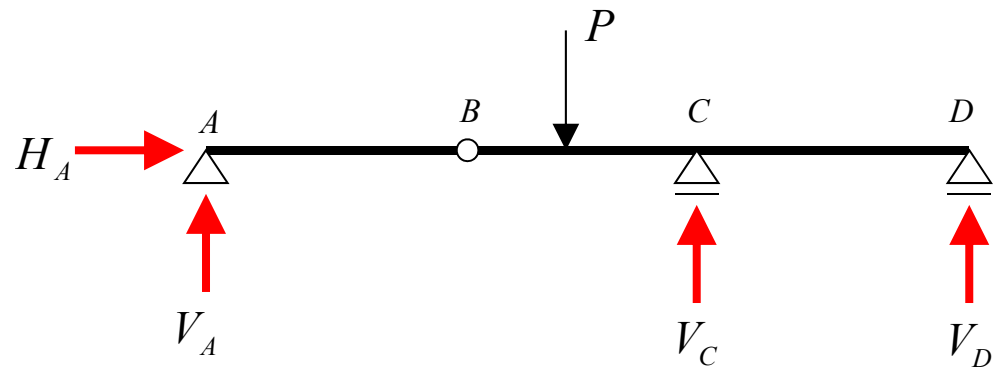
## 静定ラーメンの応力(2)

# 3ヒンジラーメン、ゲルバー梁も反力さえ求めれば、後のプロセスは同じ



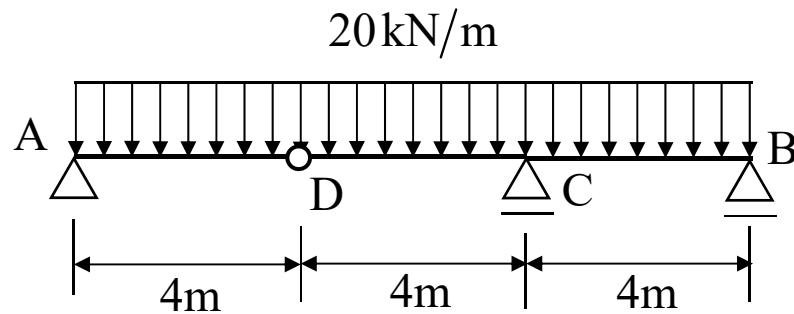
3ヒンジラーメン

反力が4つある問題

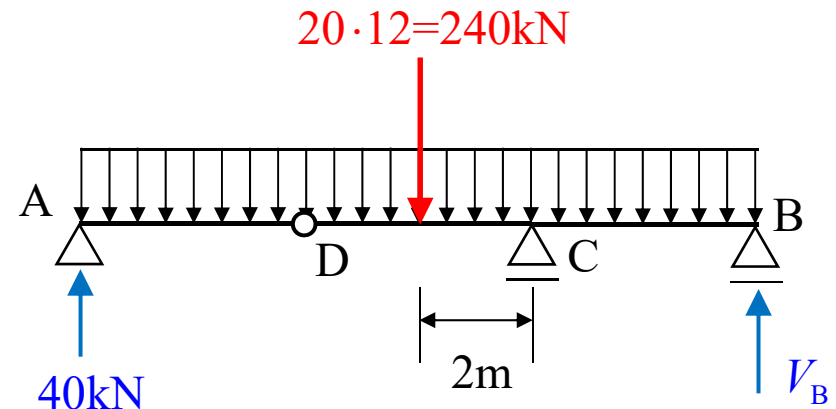
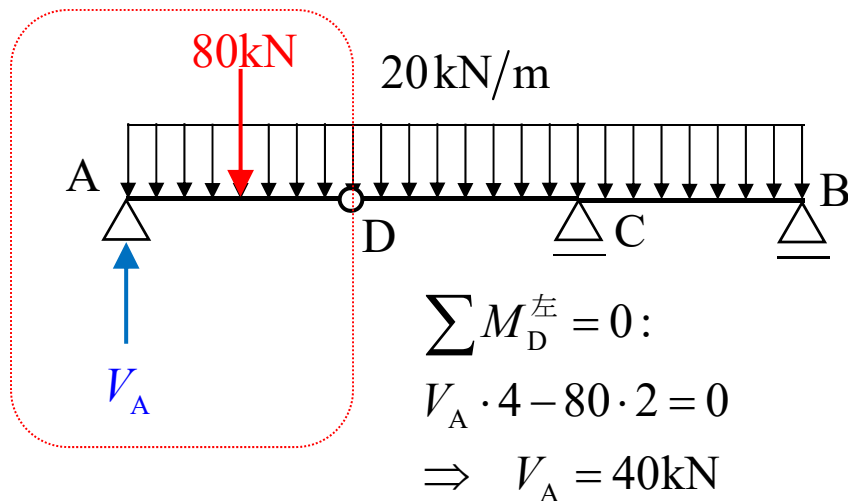


ゲルバー梁

# 演習問題1の解き方(その1)

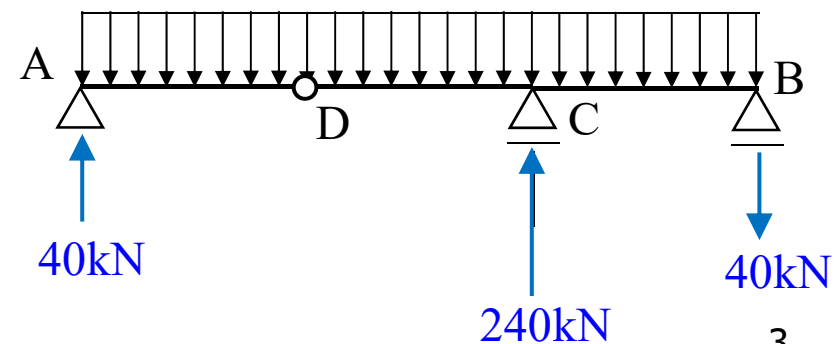


反力計算

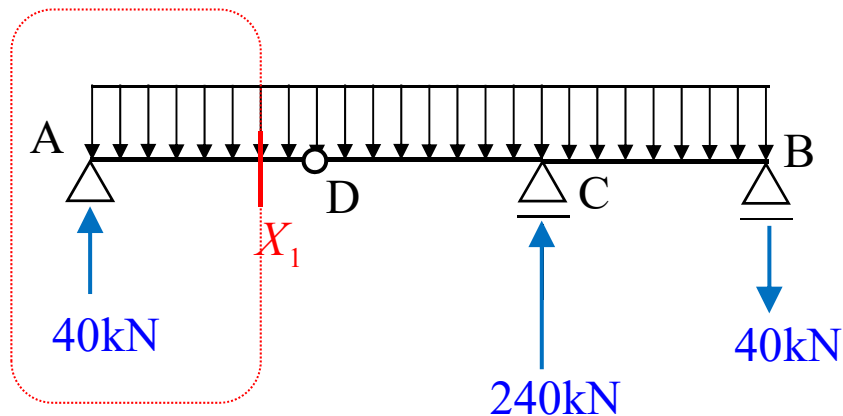
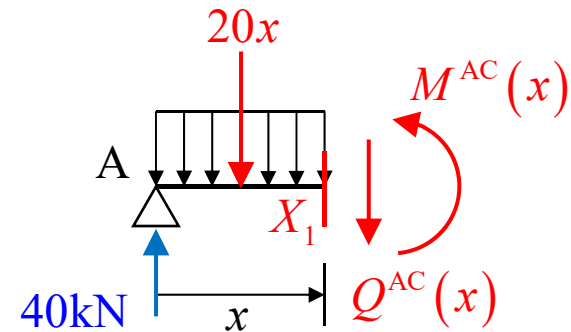
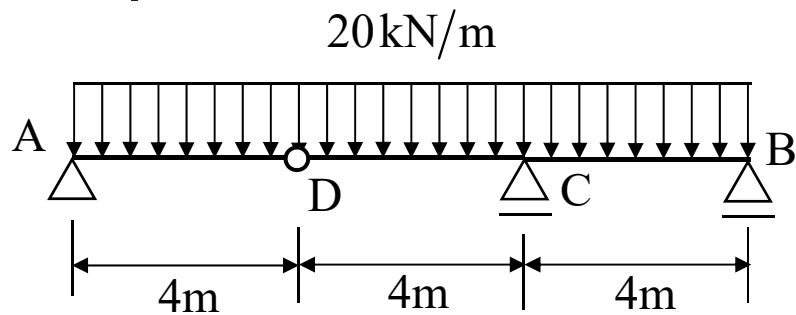


$$\sum M_C = 0: 40 \cdot 8 - 240 \cdot 2 - V_B \cdot 4 = 0$$

$$\Rightarrow V_B = -40\text{kN}$$



# 演習問題1の解き方(その2)

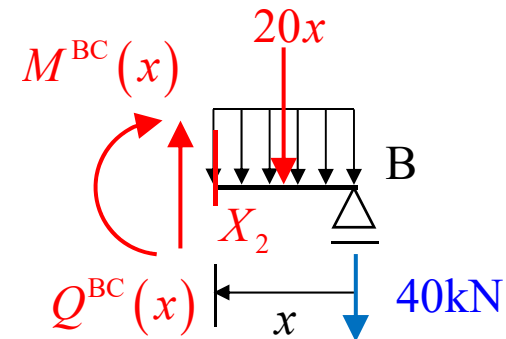
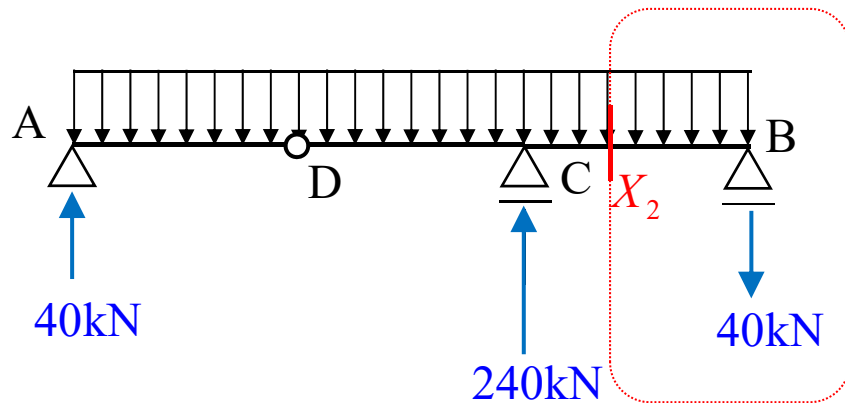
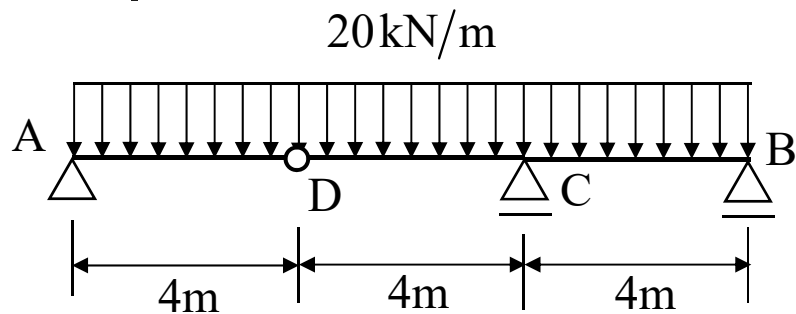


$$\sum Y = 0: Q^{AC}(x) = -20x + 40 \quad \begin{cases} Q^{AC}(0) = 40\text{kN} \\ Q^{AC}(8) = -120\text{kN} \end{cases}$$

$$\sum M_{x_1} = 0: -M^{AC}(x) + 40x - 20x \cdot \frac{x}{2} = 0$$

$$\Rightarrow M^{AC}(x) = -10x^2 + 40x \quad \begin{cases} M^{AC}(0) = 0\text{kNm} \\ M^{AC}(2) = 40\text{kNm} \\ M^{AC}(8) = -320\text{kNm} \end{cases}$$

# 演習問題1の解き方(その3)

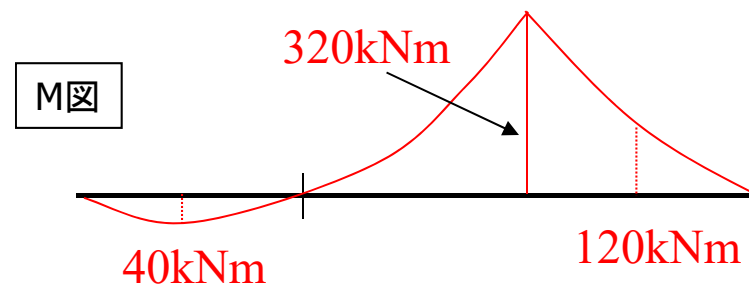
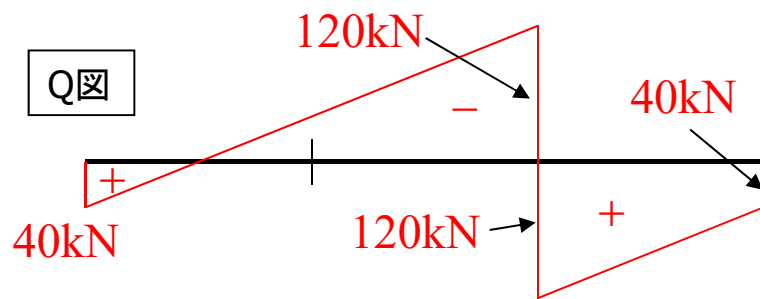
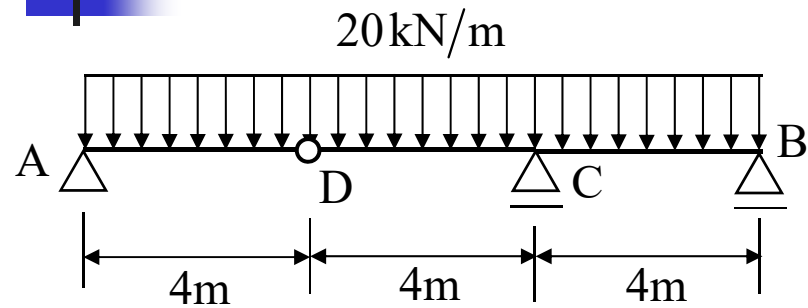


$$\sum Y = 0: Q^{BC}(x) = 20x + 40 \quad \begin{cases} Q^{BC}(0) = 40\text{kN} \\ Q^{BC}(4) = 120\text{kN} \end{cases}$$

$$\sum M_{X_2} = 0: M^{BC}(x) + 40x + 20x \cdot \frac{x}{2} = 0$$

$$\Rightarrow M^{BC}(x) = -10x^2 - 40x \quad \begin{cases} M^{BC}(0) = 0\text{kNm} \\ M^{BC}(2) = -120\text{kNm} \\ M^{BC}(4) = -320\text{kNm} \end{cases}$$

# 演習問題1の解き方(その4)



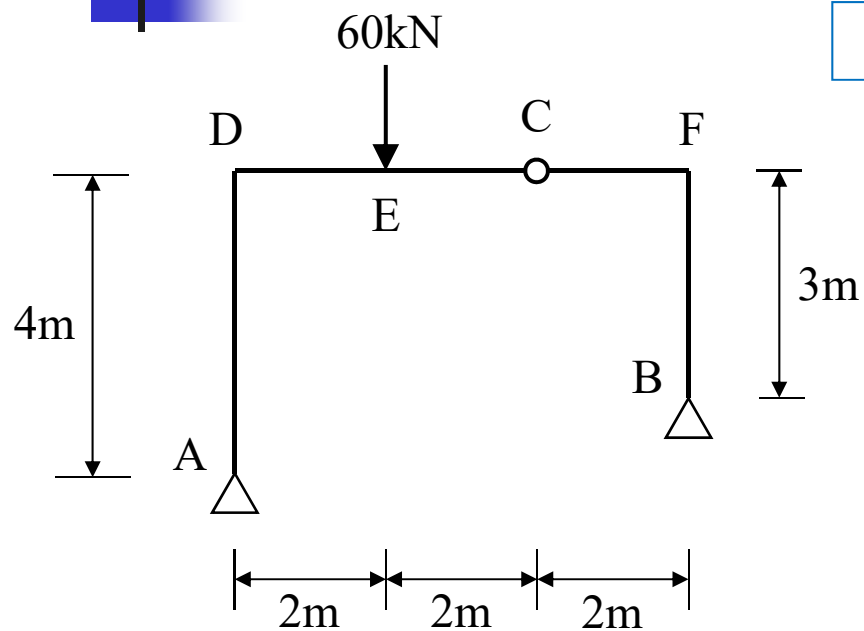
$$Q^{AC}(x) = -20x + 40 \quad \begin{cases} Q^{AC}(0) = 40\text{kN} \\ Q^{AC}(8) = -120\text{kN} \end{cases}$$

$$M^{AC}(x) = -10x^2 + 40x \quad \begin{cases} M^{AC}(0) = 0\text{kNm} \\ M^{AC}(2) = 40\text{kNm} \\ M^{AC}(8) = -320\text{kNm} \end{cases}$$

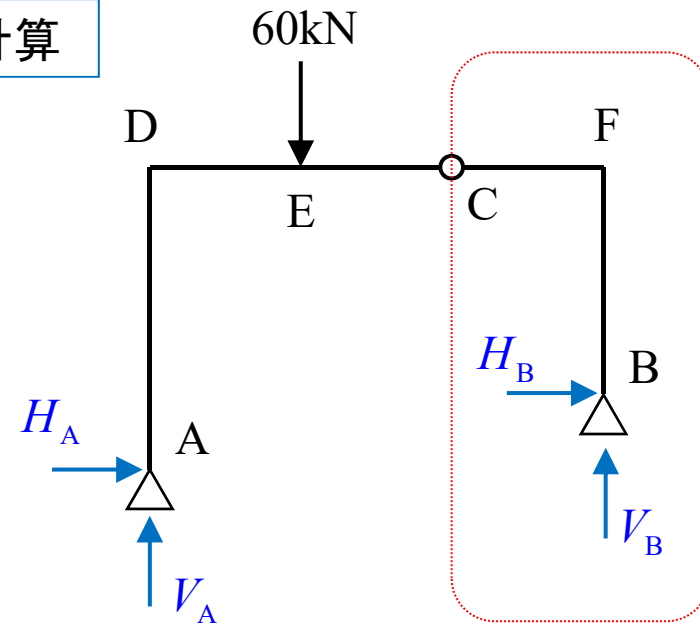
$$Q^{BC}(x) = 20x + 40 \quad \begin{cases} Q^{BC}(0) = 40\text{kN} \\ Q^{BC}(4) = 120\text{kN} \end{cases}$$

$$M^{BC}(x) = -10x^2 - 40x \quad \begin{cases} M^{BC}(0) = 0\text{kNm} \\ M^{BC}(2) = -120\text{kNm} \\ M^{BC}(4) = -320\text{kNm} \end{cases}$$

# 演習問題2の解き方(その1)



反力計算



$$\sum X = 0: H_A + H_B = 0 \dots (1)$$

$$\sum Y = 0: V_A + V_B = 60 \dots (2)$$

$$\sum M_A = 0: -6V_B + H_B = -120 \dots (3)$$

$$\sum M_C^{\text{右}} = 0: -2V_B - 3H_B = 0 \dots (4)$$

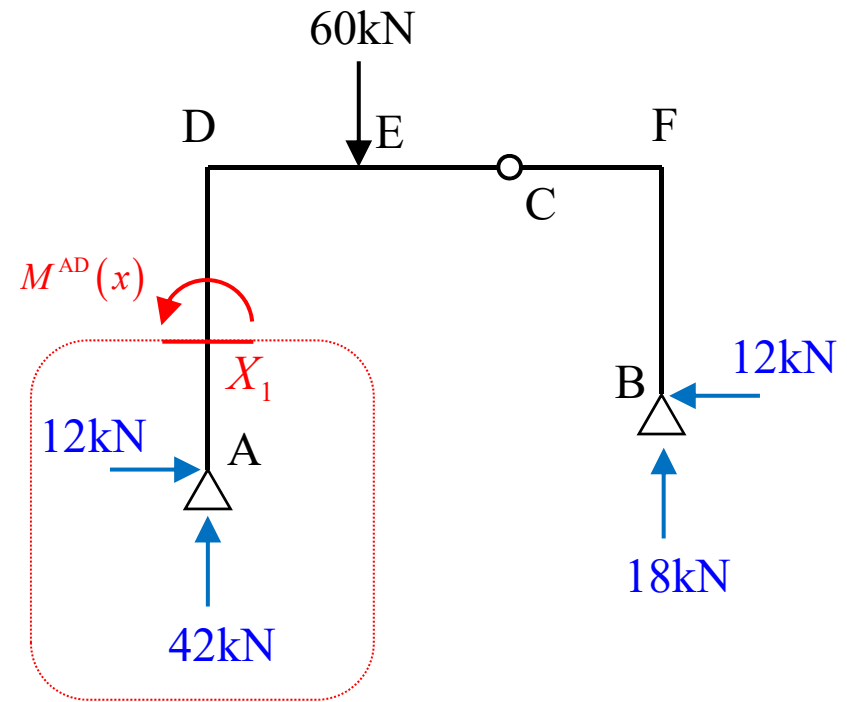
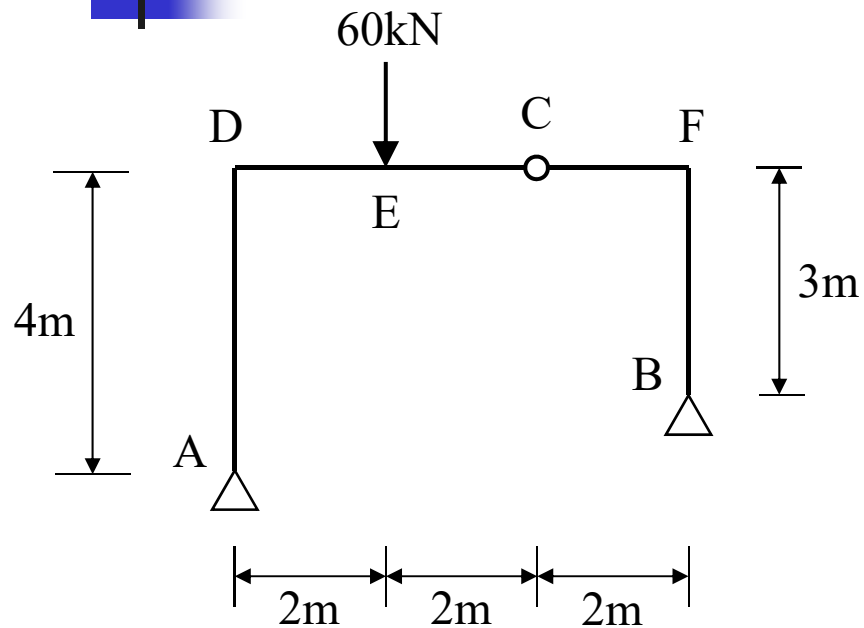
$$(3) \times 3 + (4) \text{より } V_B = 18 \text{ kN}$$

$$(4) \text{より } H_B = -12 \text{ kN}$$

$$(1) \text{より } H_A = 12 \text{ kN}$$

$$(2) \text{より } V_A = 42 \text{ kN}$$

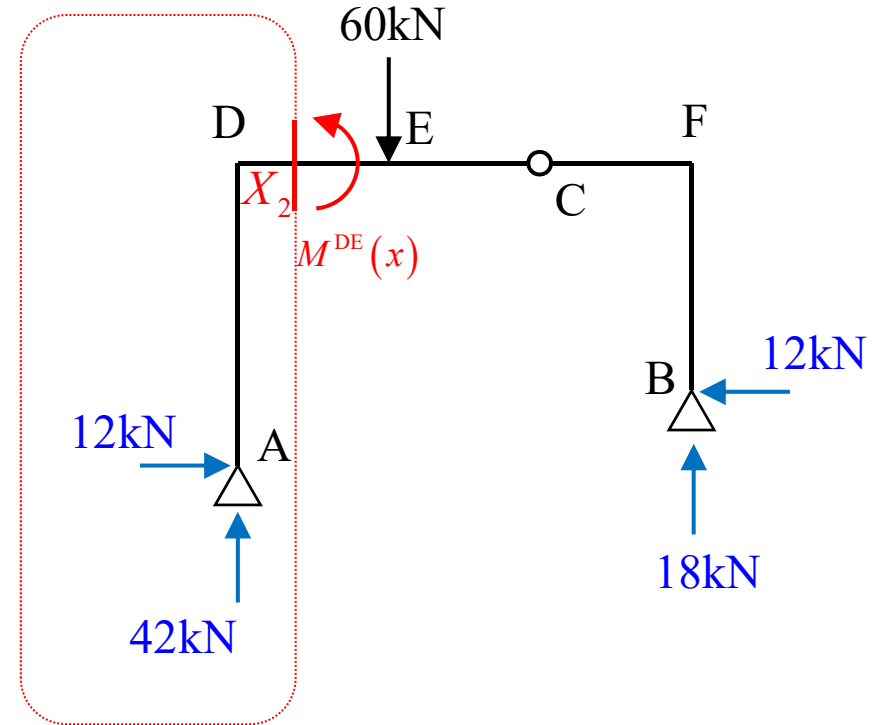
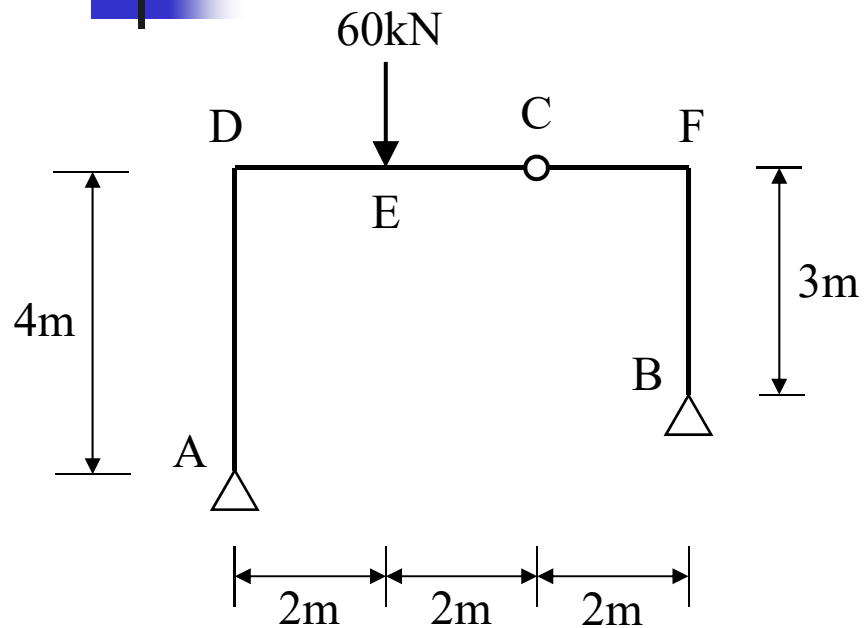
# 演習問題2の解き方(その2)



$$\sum M_{x_1} = 0: M^{AD}(x) = -12x \quad \begin{cases} M^{AD}(0) = 0 \\ M^{AD}(4) = -48\text{kNm} \end{cases}$$

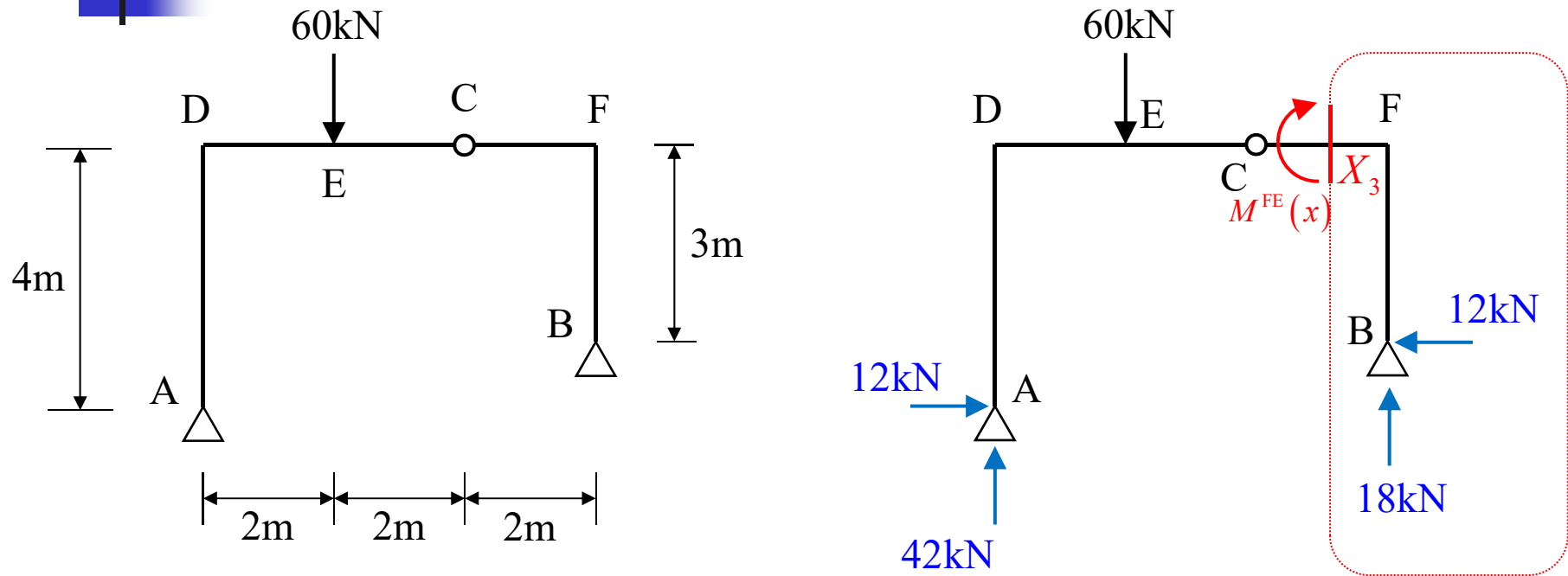


# 演習問題2の解き方(その3)



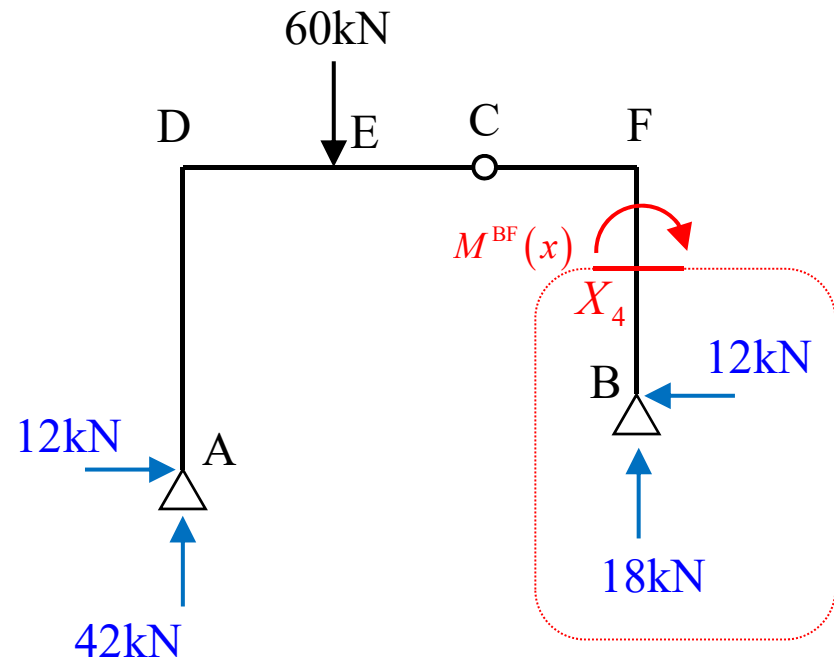
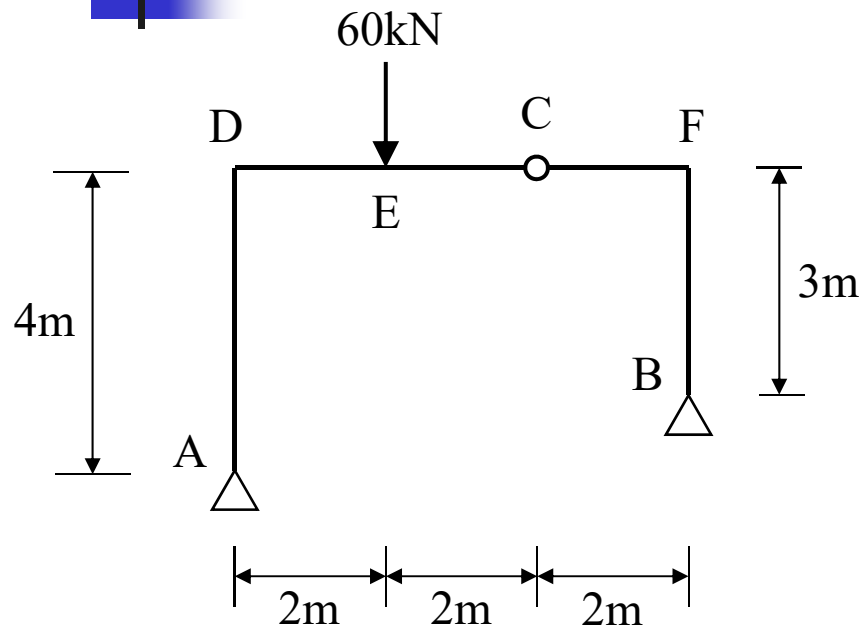
$$\sum M_{x_2} = 0: \quad M^{DE}(x) = 42x - 48 \quad \begin{cases} M^{DE}(0) = -48\text{kNm} \\ M^{DE}(2) = 36\text{kNm} \end{cases}$$

# 演習問題2の解き方(その4)



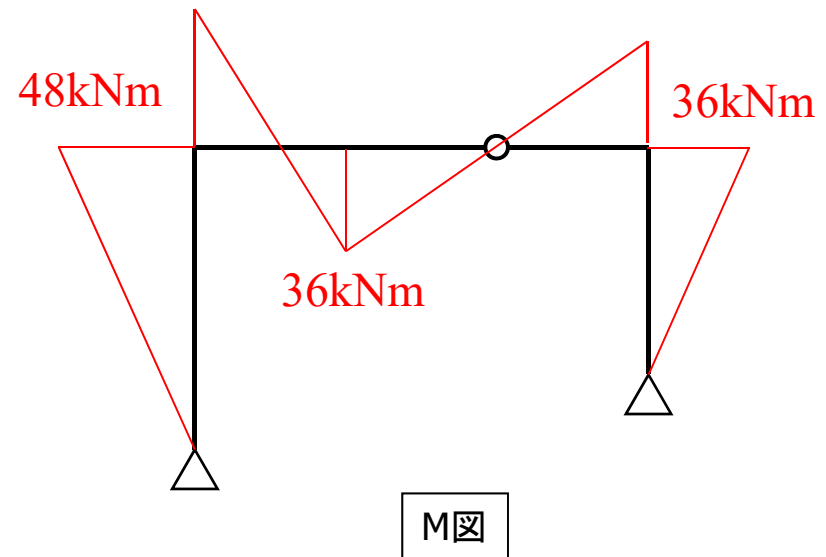
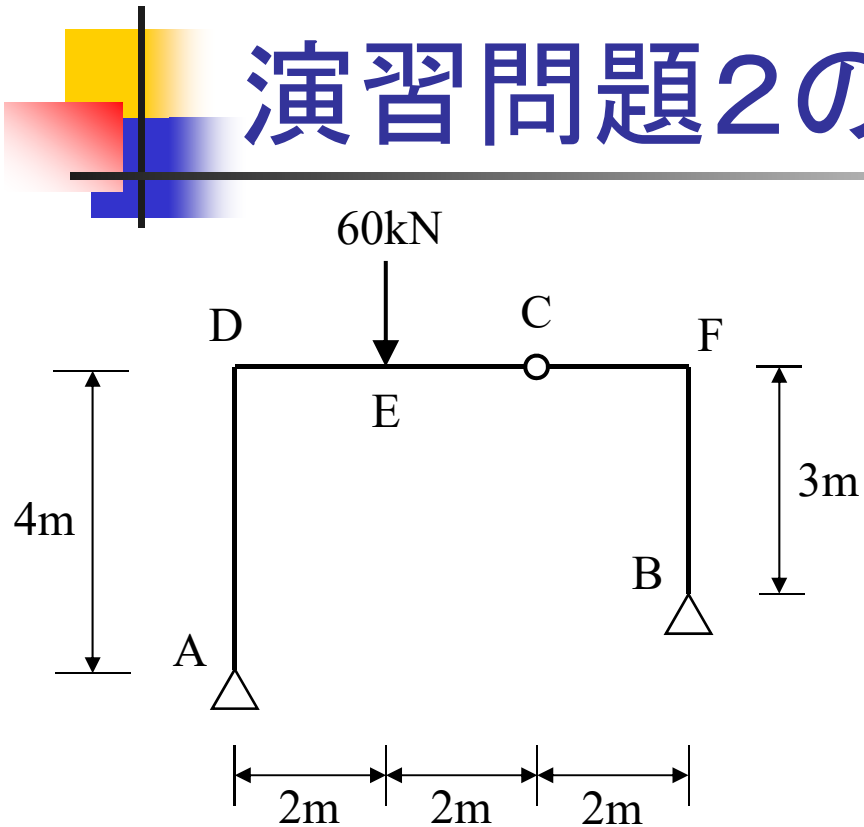
$$\sum M_{x3} = 0: \quad M^{FE}(x) = 18x - 36 \quad \begin{cases} M^{FE}(0) = -36\text{kNm} \\ M^{FE}(4) = 36\text{kNm} \end{cases}$$

# 演習問題2の解き方(その5)



$$\sum M_{x4} = 0: \quad M^{\text{BF}}(x) = -12x \quad \begin{cases} M^{\text{FE}}(0) = 0 \text{ kNm} \\ M^{\text{FE}}(4) = -36 \text{ kNm} \end{cases}$$

# 演習問題2の解き方(その6)



$$M^{AD}(x) = -12x \quad \begin{cases} M^{AD}(0) = 0 \\ M^{AD}(4) = -48\text{kNm} \end{cases}$$

$$M^{DE}(x) = 42x - 48 \quad \begin{cases} M^{DE}(0) = -48\text{kNm} \\ M^{DE}(2) = 36\text{kNm} \end{cases}$$

$$M^{FE}(x) = 18x - 36 \quad \begin{cases} M^{FE}(0) = -36\text{kNm} \\ M^{FE}(4) = 36\text{kNm} \end{cases}$$

$$M^{BF}(x) = -12x \quad \begin{cases} M^{BF}(0) = 0\text{kNm} \\ M^{BF}(4) = -36\text{kNm} \end{cases}$$