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$$\text{靜力平衡 } R_A = \frac{qL}{4} + \frac{P}{2} \quad M_{\max} = R_A \frac{L}{2} - q \frac{L}{4} \left( \frac{L}{4} + \frac{L}{8} \right) = \frac{L \left( \frac{P}{2} + \frac{Lq}{4} \right)}{2} - \frac{3L^2 q}{32}$$

$$\text{數值資料 } \sigma_a = 124 \text{ MPa} \quad L = 9.75 \text{ m} \quad P = 13 \text{ kN} \quad q = 66 \frac{\text{kN}}{\text{m}}$$

$$S_{\text{reqd}} = \frac{M_{\max}}{\sigma_a} \quad S_{\text{reqd}} = \frac{\frac{L \left( \frac{P}{2} + \frac{Lq}{4} \right)}{2} - \frac{3L^2 q}{32}}{\sigma_a} = 413.662 \text{ cm}^3 < \text{試 IPN 260 } (S_{\text{act}} = 442 \text{ cm}^3)$$

$$\text{包含樑自重, 重算 } M_{\max} = W = 41.9 \frac{\text{kg}}{\text{m}} \cdot g = 410.899 \frac{\text{N}}{\text{m}} \quad g = 9.807 \frac{\text{m}}{\text{s}^2}$$

$$R_A = \frac{qL}{4} + \frac{P}{2} + \frac{WL}{2} \quad \text{故 } M_{\max} = R_A \frac{L}{2} - q \frac{L}{4} \left( \frac{L}{4} + \frac{L}{8} \right) = W \frac{L}{2} \frac{L}{4} = 56.177 \text{ kN} \cdot \text{m}$$

$$S_{\text{reqd}2} = \frac{M_{\max}}{\sigma_a} = 453.038 \text{ cm}^3 < \text{大於 IPN 260 的 } S_{\text{act}}, \text{ 故 IPN 260 不適用}$$

TRIAL #2

$$\text{試 IPN 280, } S_{\text{act}} = 542 \text{ cm}^3 \quad W = 47.9 \frac{\text{kg}}{\text{m}} \cdot g = 469.739 \frac{\text{N}}{\text{m}}$$

$$R_A = \frac{qL}{4} + \frac{P}{2} + \frac{WL}{2} \quad \text{故 } M_{\max} = R_A \frac{L}{2} - q \frac{L}{4} \left( \frac{L}{4} + \frac{L}{8} \right) = W \frac{L}{2} \frac{L}{4} = 56.876 \text{ kN} \cdot \text{m}$$

$$S_{\text{reqd}2} = \frac{M_{\max}}{\sigma_a} = 458.679 \text{ cm}^3 < \text{小於 IPN 280 的 } S_{\text{act}}, \text{ 故 選用 IPN 280}$$