

100 學年四技二專第四次聯合模擬考試 土木與建築群 專業科目 (一) 詳解

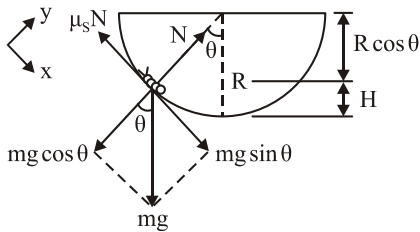
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
C	D	B	B	D	D	A	B	C	B	B	D	C	A	B	B	C	B	B	A
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
A	B	C	D	A	C	C	A	B	B	B	D	A	B	B	B	C	A	D	C

第一部份：工程力學

1. ①、⑤ $\begin{cases} \Sigma F = 0 \Rightarrow \text{不移動} \\ \Sigma M = 0 \Rightarrow \text{不轉動} \end{cases}$
- ② $\Sigma F \neq 0 \Rightarrow \text{會移動}$
- ③、④ $\begin{cases} \Sigma F = 0 \\ \Sigma M \neq 0 \end{cases} \Rightarrow \text{會轉動，不會移動}$

2. 爬到最高處時，即恰要下滑時



重力下滑分力 = 最大靜摩擦力

$$\Sigma F_x = 0 \Rightarrow mg \sin \theta = F_{S(\max)} = \mu_s N$$

$$\Sigma F_y = 0 \Rightarrow N = mg \cos \theta$$

$$\therefore mg \sin \theta = \mu_s N = \mu_s mg \cos \theta$$

$$mg \sin \theta = \sqrt{3} mg \cos \theta$$

$$\tan \theta = \sqrt{3}, \theta = 60^\circ$$

$$\text{此時，} \frac{\text{下滑力}}{\text{正向力}} = \frac{mg \sin \theta}{mg \cos \theta} = \tan \theta = \sqrt{3}$$

$$\text{爬升最大高度 } H = R - R \cos \theta = R - R \cos 60^\circ = \frac{R}{2}$$

3. 設梯長為 L

以梯子與地面的接觸點 A 為支點

$$\text{取 } \Sigma M_A = 0 \Rightarrow F_1 \times L \cos \theta = W \times X \sin \theta$$

$$F_1 = \left(\frac{W}{L} \tan \theta\right) X$$

$\therefore W、L、\theta$ 皆不變

$\therefore F_1 \propto X \Rightarrow$ 在上爬過程中，

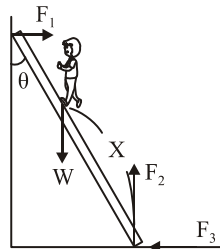
F_1 隨 X 增加而增加

$$\Sigma F_y = 0 \Rightarrow F_2 = W$$

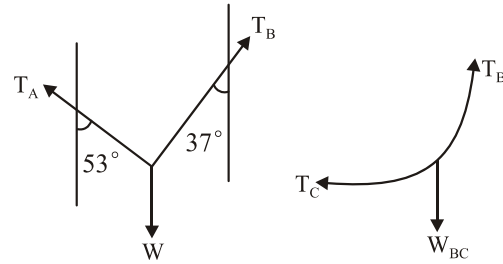
F_2 不變，不隨 X 而變化

$$\Sigma F_x = 0 \Rightarrow F_3 = F_1$$

在上爬過程中，隨 X 增加而增加



$$4. \frac{T_A}{\sin 143^\circ} = \frac{T_B}{\sin 127^\circ} = \frac{W}{\sin 90^\circ}$$

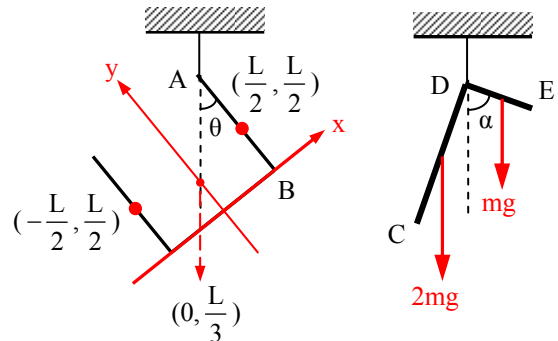


$$\Rightarrow T_A = \frac{3}{5} W, T_B = \frac{4}{5} W \Rightarrow T_C = T_B \sin 37^\circ = \frac{12}{25} W$$

$$W_{BC} = T_B \cos 37^\circ = \frac{16}{25} W$$

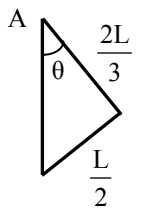
$$5. L_{AC} : L_{BC} = \left(W - \frac{16}{25} W\right) : \frac{16}{25} W = 9 : 16$$

6.



(1) 設 U 型邊長為 L

$$\frac{y}{x} = \frac{(L \times \frac{L}{2}) + (L \times \frac{L}{2})}{3L} = \frac{L}{3}, \tan \theta = \frac{\frac{L}{2}}{\frac{2L}{3}} = \frac{3}{4}$$



(2) 設 \overline{CD} 邊長為 L, $\overline{DE} = \frac{L}{2}$

以 D 為支點，取 $\Sigma M_D = 0$

$$\Rightarrow 2mg \times L \sin(90^\circ - \alpha) = mg \times \frac{L}{2} \sin \alpha$$

$$2mg \times L \cos \alpha = mg \times \frac{L}{2} \sin \alpha$$

$$\tan \alpha = 4, \therefore \tan \theta \times \tan \alpha = \frac{3}{4} \times 4 = 3$$

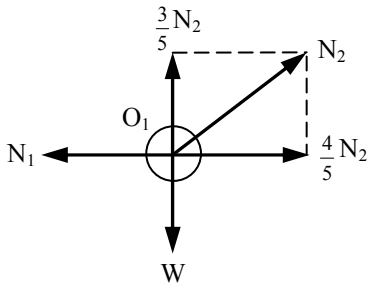
7. 取球 O_1 為自由體

假設鉛直光滑牆面對球 O_1 之接觸力為 N_1

半圓柱體 O_2 對球 O_1 之接觸力為 N_2

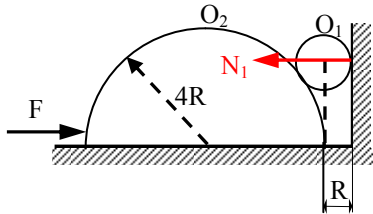
$$\Sigma F_y = 0 \Rightarrow \frac{3}{5} N_2 = W \Rightarrow N_2 = \frac{5}{3} W$$

$$\Sigma F_x = 0 \Rightarrow \frac{4}{5} N_2 = N_1 \Rightarrow N_1 = \frac{4}{3} W$$

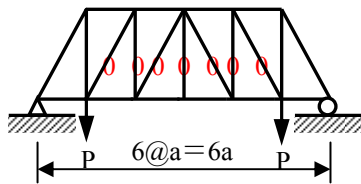
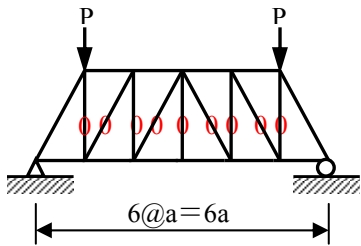


取整體為自由體

$$\Sigma F_x = 0 \Rightarrow F = N_1 = \frac{4}{3} W$$

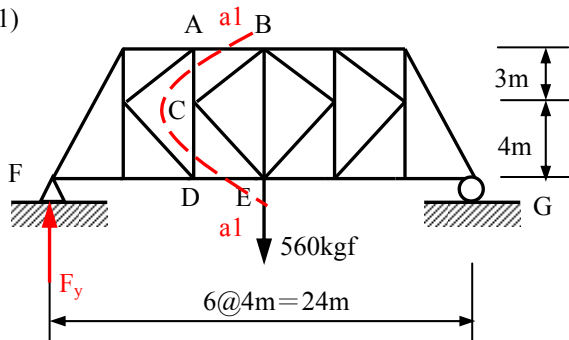


8.



如圖所示， $X=9$ ， $Y=7 \Rightarrow (X-Y)=2$

9. (1)

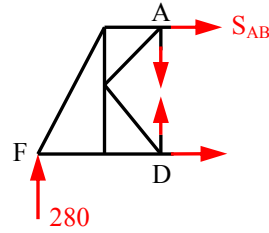


以 G 為支點

$$\Sigma M_G = 0 \Rightarrow F_y \times 24 = 560 \times 12$$

$$F_y = 280 \text{ kgf}(\uparrow)$$

(2)



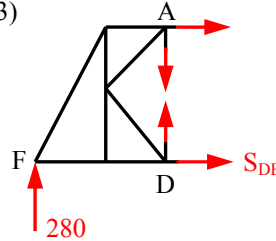
取切面 a1-a1 左部為自由體圖

以 D 為支點，取 $\Sigma M_D = 0 (\curvearrowright)$

$$\Rightarrow (S_{AB} \times 7) + (280 \times 8) = 0$$

$$\therefore S_{AB} = -320 \text{ kgf}(C)$$

(3)



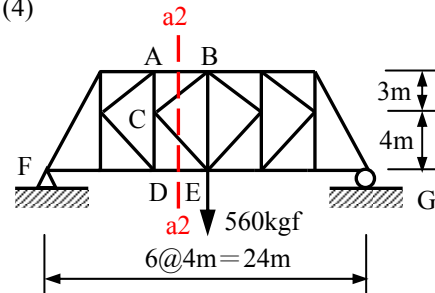
取切面 a1-a1 左部為自由體圖

以 A 為支點，取 $\Sigma M_A = 0 (\curvearrowright)$

$$\Rightarrow (-S_{DE} \times 7) + (280 \times 8) = 0$$

$$\therefore S_{DE} = +320 \text{ kgf}(T)$$

(4)

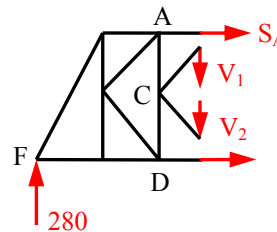


取切面 a2-a2 左部為自由體圖

$$\textcircled{1} \Sigma F_y = 0 (\uparrow) \Rightarrow V_1 + V_2 = 280$$

$$\frac{V_1}{V_2} = \frac{3}{4}, \quad V_1 = \frac{3}{3+4} \times 280 = 120 \text{ kgf}$$

$$\textcircled{2} S_{BC} = V_1 \times \frac{5}{3} = -120 \times \frac{5}{3} = -200 \text{ kgf}(C)$$



$$10. (1) \because \delta = \frac{PL}{AE} \Rightarrow L = \frac{\delta AE}{P}$$

$$\Rightarrow \frac{L_1}{L_2} = \frac{\delta_1}{\delta_2} \times \frac{A_1}{A_2} \times \frac{E_1}{E_2} \times \frac{P_2}{P_1} = \frac{2}{1} \times \frac{3}{1} \times \frac{1}{4} \times \frac{1}{1} = \frac{3}{2} = 1.5$$

$$(2) \because \delta_1 = \frac{PL_1}{A_1 E_1} = \frac{PL_2}{A_2 E_2} = 2\delta_2$$

$$\therefore \frac{PL_1}{3AE} = 2 \times \frac{PL_2}{A(4E)} \Rightarrow L_1 : L_2 = 3 : 2, \text{ 即 } \frac{L_1}{L_2} = 1.5$$

11. $\therefore E_V = \frac{E}{3(1-2\mu)} \Rightarrow \frac{5}{9}E = \frac{E}{3(1-2\mu)}, \therefore \mu = 0.2$

又 $\mu = \frac{bl}{D\delta} \Rightarrow 0.2 = \frac{b \times 100}{5(0.2)} \Rightarrow \therefore b = 0.002 \text{ cm}$

12. $\therefore \delta = \alpha L \Delta T \Rightarrow \epsilon = \frac{\delta}{L} = \alpha \Delta T$

$$\therefore \sigma = E\epsilon = E\alpha \Delta T = 600 \times 10^9 \times 15 \times 10^{-6} \times 20$$

$$= 180 \times 10^6 \frac{\text{N}}{\text{mm}^2} = 180 \times 10^6 \text{ Pa} = 180 \text{ MPa}$$

13. $\therefore \sigma = E\alpha \Delta T$, 又 E, α 皆不變

$$\therefore \sigma \propto \Delta T \Rightarrow \sigma_2 = 2\sigma_1 = 360 \text{ MPa}$$

14. $M_A : M_B : M_C = \frac{\omega L^2}{8} : \frac{\omega L^2}{2} : \frac{\omega L^2}{6} = 3 : 12 : 4$

15. (1) 設大的載重位於 A 點右側 $x\text{m}$, 求反力 R_A
 $\Sigma M_B = 0 (\curvearrowright)$

$$\Rightarrow (-R_A \times 10) + 2000(10-x) + 1000(7-x) = 0$$

$$\Rightarrow R_A = 2700 - 300x$$

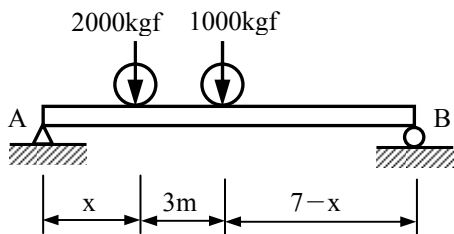
(2) 設距 A 點右側 $x\text{m}$ 之彎矩函數為 $M(x)$

$$\Rightarrow \text{令 } M'(x) = 0 \text{ 即可求解}$$

$$\therefore M(x) = R_A \times x = (2700 - 300x)x = -300x^2 + 2700x$$

$$M'(x) = -600x + 2700 = 0 \Rightarrow x = 4.5 \text{ m}$$

$$M_{\max} = -300(4.5)^2 + 2700(4.5) = 6075 \text{ kgf}\cdot\text{m} (\curvearrowright)$$



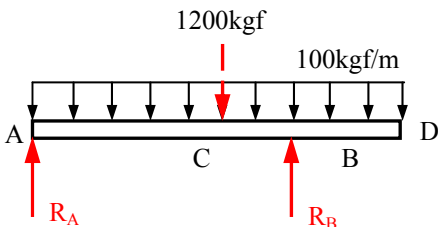
16. (1) 求 A、B 支承點反力

$$\Sigma M_A = 0 (\curvearrowright) \Rightarrow (1200 \times 6) - (R_B \times 8) = 0$$

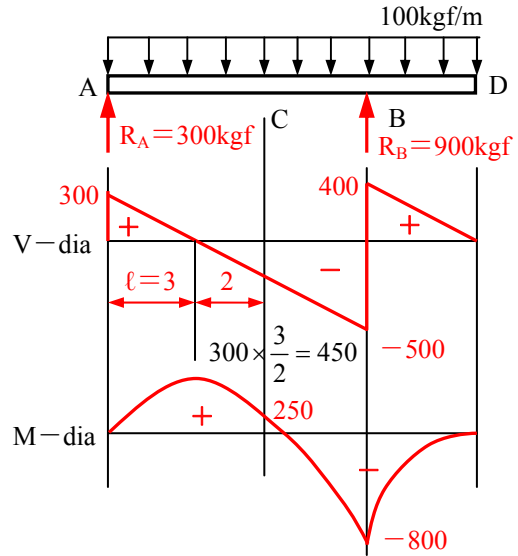
$$\Rightarrow R_B = 900 \text{ kgf} (\uparrow)$$

$$\Sigma F_y = 0 (\uparrow) \Rightarrow R_A - 1200 + 900 = 0$$

$$\Rightarrow R_A = 300 \text{ kgf} (\uparrow)$$



(2) 繪出剪力圖(V-dia)及彎矩圖(M-dia)



$$\Rightarrow \ell = \frac{3}{(3+5)} \times 8 = 3 \text{ m}$$

$$\Rightarrow V_C = 300 - 100 \times 5 = -200 \text{ kgf}$$

$$\Rightarrow |M_{\max}| = |M_B| = |-800| = 800$$

$$\Rightarrow |M_C| = |250| = 250 \Rightarrow \frac{|M_{\max}|}{|M_C|} = \frac{800}{250} = \frac{16}{5}$$

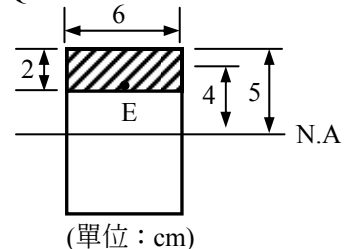
17. (1) 求 C 點剪力 $\Rightarrow V_C = 300 - 100 \times 5 = -200 \text{ kgf}$

(2) 求慣性矩 I 及面積一次矩 Q

$$I = \frac{bh^3}{12} = \frac{6 \times 10^3}{12} = 500 \text{ cm}^4$$

$$Q = (6 \times 2) \times 4 = 48 \text{ cm}^3$$

$$\Rightarrow \tau_E = \frac{VQ}{Ib} = \frac{200 \times 48}{500 \times 6} = 3.2 \text{ kgf/cm}^2$$

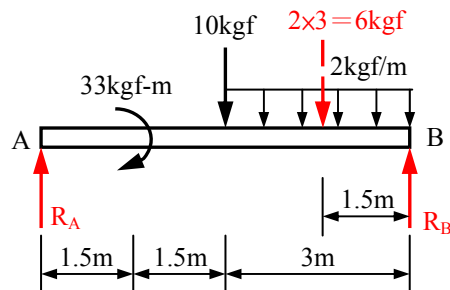


18. (1) 求 A、B 支承點反力

$$\Sigma M_A = 0 (\curvearrowright) \Rightarrow 33 + (10 \times 3) + (6 \times 4.5) - (R_B \times 6) = 0$$

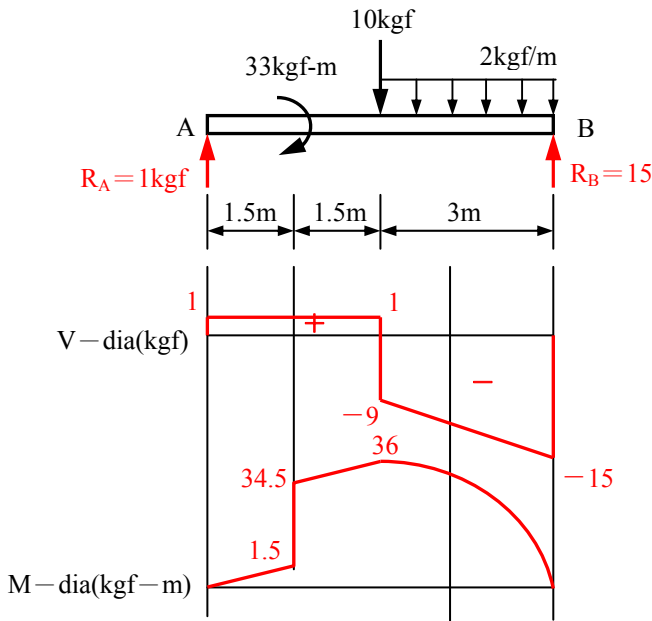
$$\Rightarrow R_B = 15 \text{ kgf} (\uparrow)$$

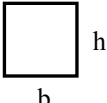
$$\Sigma F_y \Rightarrow R_A - 10 - 6 + 15 = 0 \Rightarrow R_A = 1 \text{ kgf} (\uparrow)$$



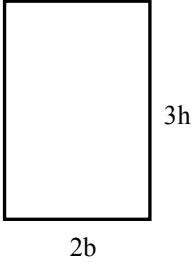
(2) 繪出剪力圖(V-dia)及彎矩圖(M-dia)

$$\Rightarrow \text{由 } M\text{-dia 可知 } M_{\max} \text{ 發生在樑中點} = 36 \text{ kgf}\cdot\text{m}$$



$$19. \sigma = \frac{M_1 y}{I} = \frac{M_1 \times \frac{h}{2}}{\frac{bh^3}{12}} = \frac{6M_1}{bh^2}$$


$$\Rightarrow M_1 = \frac{bh^2 \sigma}{6}$$

$$\sigma = \frac{M_2 y}{I} = \frac{M_2 \times \frac{3h}{2}}{\frac{54bh^3}{12}} = \frac{M_2}{3bh^2}$$


$$\Rightarrow M_2 = 3bh^2 \sigma$$

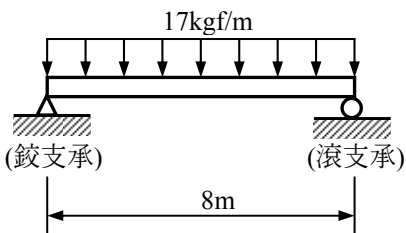
$$\therefore \frac{M_2}{M_1} = \frac{3}{\frac{1}{6}} = 18$$

$$20. (1) M_{\max} = \frac{\omega l^2}{8} = \frac{17 \times 8^2}{8} = 136 \text{ kgf-m}$$

$$I = \frac{2 \times 5^3}{3} + \frac{6 \times 3^3}{3} - 2 \times \frac{2 \times 1^3}{3} = 136 \text{ cm}^4$$

$$(2) \sigma_t = \frac{My_1}{I} = \frac{136 \times 100 \times 5}{136} = 500 \text{ kgf/cm}^2$$

$$\sigma_c = \sigma_c = \frac{My_2}{I} = \frac{136 \times 100 \times 3}{136} = 300 \text{ kgf/cm}^2$$



第二部份：工程材料

24. 瀝青材料係屬於複雜之碳氫化合物

26. 每立方米水泥鬆單位重為 1500 kg，故 $\frac{1500}{50} = 30$ 包

33. 防鏽塗料

34. 高性能混凝土優異性質有高強度、高耐久性、高體積穩定性、高水密性等等

36. 玻璃受熱，由固態轉變成液態之溫度稱為軟化點

37. 針入度乃以 $\frac{1}{100}$ cm 為一單位，如今針入度為 120 表示

貫入瀝青深度為 1.2 cm，又為 12 mm

39. 細度模數合乎規定者，篩分析不一定合格

40. 水泥細度單位通常以 cm^2/g 來表示