

104 學年度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

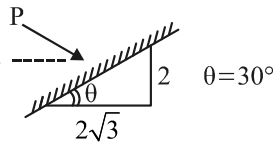
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
C	B	D	D	A	B	D	C	B	A	A	C	D	C	B	D	B	A	C	A
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
A	A	A	D	A	C	B	B	C	D	D	D	B	D	B	C	A	B	C	B

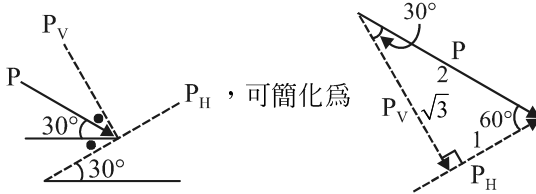
第一部分：工程力學

1. 剛體受力後，其體內各質點間之距離保持不變，意即受力後不產生變形，為靜力學討論的對象

2. 取屋頂斜面的自由體圖



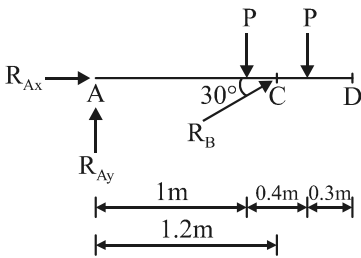
設垂直屋頂斜面為 P_V ，沿屋頂斜面為 P_H



$$\frac{P}{2} = \frac{P_V}{\sqrt{3}} = \frac{P_H}{1}, \therefore P_V = 15\sqrt{3} \text{ kN}, P_H = 15 \text{ kN}$$

3. ① BC 桿件為二力桿

② 取 ACD 桿自由體分析

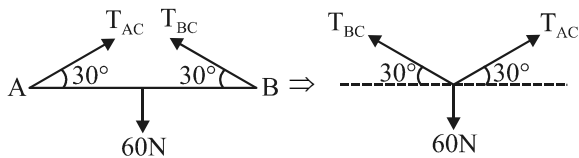


$$+\curvearrowright \Sigma M_A = 0, P = 1.5 \text{ kN}$$

$$P \times 1 + P \times 1.4 - R_B \times \sin 30^\circ \times 1.2 = 0$$

$$\therefore R_B = 6 \text{ kN}$$

4. AB 樑重為 $10 \text{ N/m} \times 6 \text{ m} = 60 \text{ N}$ ，作用於中點取 AB 樑自由體分析

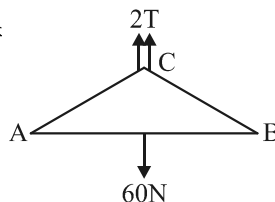


$$\therefore T_{AC} = T_{BC} = 60 \text{ N}$$

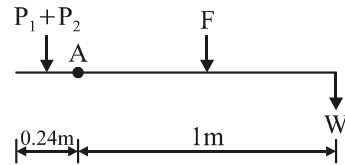
取 ACB 系統自由體圖分析

$$2T = 60 \text{ N}$$

$$\therefore T = 30 \text{ N}$$



5. 取剖面簡圖說明



玻璃帷幕遮雨棚重量 F ，假設作用於其重心位置

$$F = 25 \text{ kN/m}^3 \times (1 \times 4 \times 0.07) = 7 \text{ kN}$$

達平衡狀態，不繞 A 軸翻覆

$$(P_1 + P_2) \times 0.12 = F \times 0.5 + W \times 1$$

$$\Rightarrow (8.4 + 57.6) \times 0.12 = 7 \times 0.5 + W \times 1$$

$$\therefore W = 4.42 \text{ kN}$$

6. 風壓 = $500 \text{ N/m}^2 \times (2 \times 1.5 \text{ m}^2) = 1500 \text{ N}$

作用於 S 標示牌中心

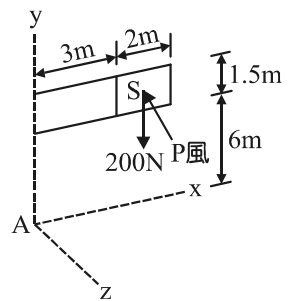
僅討論信號標示標的外系統

$$\therefore R_{Ax} = 0 \text{ N}, R_{Ay} = 200 \text{ N}, R_{Az} = 1500 \text{ N}$$

$$M_{Ay} = P_{\text{風}} \times (3 + \frac{2}{2}) = 1500 \times 4 = 6000 \text{ N-m}$$

$$M_{Ax} = P_{\text{風}} \times (6 + \frac{1.5}{2}) = 1500 \times 6.75 = 10125 \text{ N-m}$$

$$M_{Az} = 200 \text{ N} \times (3 + \frac{2}{2}) = 8000 \text{ N-m}$$



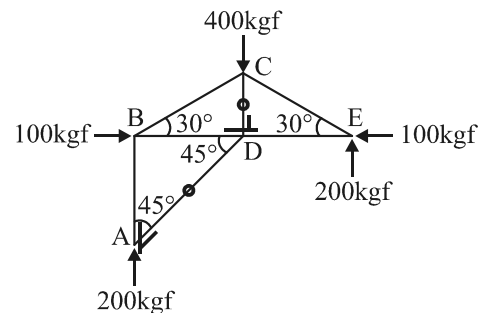
7. ① 計算反力

$$\Sigma F_x = 0, \therefore R_{Ex} = 100 \text{ kgf} \leftarrow$$

$$\Sigma M_B = 0, 400 \cdot l = R_{Ey} \cdot 2l, \therefore R_{Ey} = 200 \text{ kgf} \uparrow$$

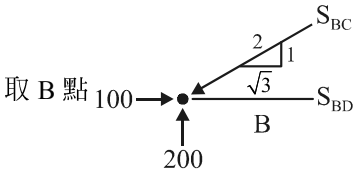
$$\Sigma F_y = 0, \therefore R_A = 200 \text{ kgf} \uparrow$$

② 判斷零桿



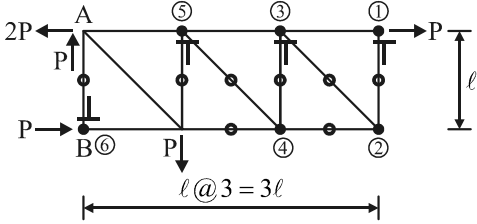
由 T 型法則判別，獲知 $S_{AD} = 0 \Rightarrow S_{CD} = 0$

③取 A 點，得 $S_{AB} = -200 \text{ kgf}$



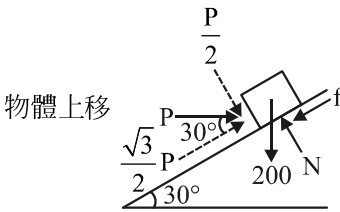
$S_{BC} = -400 \text{ kgf}$, $S_{BD} = 200\sqrt{3} - 100 = 246.41 \text{ kgf}$
 構件 BCDE 對稱, $\therefore S_{CE} = -400 \text{ kgf}$, $S_{DE} = 246.41 \text{ kgf}$
 故零桿有 2 根, 拉力桿有 2 根, 壓力桿有 3 根

8. 先計算反力, 標示於構件上



$\Sigma M_A = 0$, $P \cdot l = R_B \cdot l$, $\therefore R_B = P$
 $\Sigma F_x = 0$, $\therefore R_{Ax} = 2P \leftarrow$
 利用「T 形法則」及「一節點僅 2 根桿件而無外力作用」判別零桿, \therefore 共有 8 根零桿

9. 設 P 為未知數, 討論不沿斜面上下移動的範圍



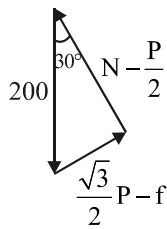
將 P 力分解沿斜面及垂直斜面的分力為 $\frac{\sqrt{3}}{2}P$ 及 $\frac{P}{2}$

① $N - \frac{P}{2} = +100\sqrt{3}$

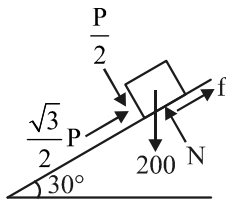
$\therefore N = 100\sqrt{3} + 0.5P$
 $f = 0.2N = 20\sqrt{3} + 0.1P$

② $\frac{\sqrt{3}}{2}P - (20\sqrt{3} + 0.1P) = 100$

$\therefore P = 175.77 \text{ kgf}$



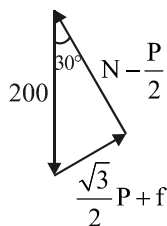
物體下移



① $N - \frac{P}{2} = 100\sqrt{3}$

$\therefore N = 100\sqrt{3} + \frac{P}{2}$
 $f = 0.2N = 20\sqrt{3} + 0.1P$

② $\frac{\sqrt{3}}{2}P + f = 100$



$\frac{\sqrt{3}}{2}P + (20\sqrt{3} + 0.1P) = 100$

$\therefore P = 67.66 \text{ kgf}$

故不沿斜面上下移動的狀況
 $67.66 \text{ kgf} \leq P \leq 175.77 \text{ kgf}$

10. $\rightarrow \Sigma F_x = 0$

$N_A - f_B - P = 0 \dots\dots ①$

$\uparrow \Sigma F_y = 0$

$N_B + f_A - 200 = 0 \dots\dots ②$

$\curvearrowright \Sigma M_o = 0$

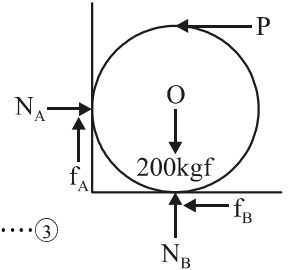
$P \times 10 - f_A \times 10 - f_B \times 10 = 0 \dots\dots ③$

由③得, $P = f_A + f_B$

且 $f_A = 0.2N_A$; $f_B = 0.2N_B \dots\dots ④$

將 P 及④帶回

①~②解聯立, 可得 $P = 54.55 \text{ kgf}$



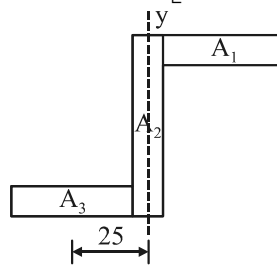
11. (B) 密度均勻的材料, 其重心與形心共點

(C) 重力場均勻的物體之重心與質心共點

(D) 物體是由無數質點組合而成, 每一質點所受地心引力的合力作用點, 稱為該物體的重心

12. $I_x = 2 \times \left(\frac{5 \times 3^3}{3} - \frac{4 \times 2^3}{3} \right) = \frac{206}{3} = 68.67$

$I_y = \frac{6 \times 1^3}{12} + 2 \times \left[\frac{1 \times 4^3}{12} + 4 \times \left(\frac{5}{2} \right)^2 \right] = \frac{367}{6} = 61.17$



13. $\sigma_x = \frac{P_x}{A_x} = \frac{1600}{16} = 100 \text{ kgf/cm}^2 = 1 \times 10^6 \text{ kgf/m}^2$

$\sigma_y = \frac{P_y}{A_y} = \frac{12000}{80} = 150 \text{ kgf/cm}^2 = 1.5 \times 10^6 \text{ kgf/m}^2$

$\sigma_z = \frac{P_z}{A_z} = \frac{-14400}{80} = -180 \text{ kgf/cm}^2 = -1.8 \times 10^6 \text{ kgf/m}^2$

$\mu = \frac{1}{m} = \frac{1}{2.5} = 0.4$

$\epsilon_x = \frac{\sigma_x}{E} - \mu \left(\frac{\sigma_y}{E} + \frac{\sigma_z}{E} \right) = +0.0112$

$\epsilon_y = \frac{\sigma_y}{E} - \mu \left(\frac{\sigma_x}{E} + \frac{\sigma_z}{E} \right) = +0.0182$

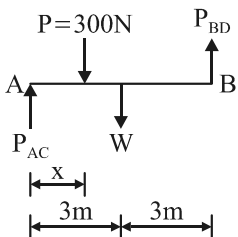
$\epsilon_z = \frac{\sigma_z}{E} - \mu \left(\frac{\sigma_x}{E} + \frac{\sigma_y}{E} \right) = -0.028$

$f_x = \epsilon_x \cdot l_x = (+0.0112)(20) = +0.224 \text{ cm}$

$f_y = \epsilon_y \cdot l_y = (+0.0182)(4) = +0.0728 \text{ cm}$

$f_z = \epsilon_z \cdot l_z = (-0.028)(4) = -0.112 \text{ cm}$

14. 取 AB 桿件自由體圖分析



$W = 10 \text{ N/m} \times 6 \text{ m} = 60 \text{ N}$

① $\Sigma F_y = 0$

$P_{BD} + P_{AC} = P + W$, $\therefore P_{BD} + P_{AC} = 360 \text{ N}$ ①

② $f_{AC} = f_{BD}$ (BD 桿伸長量和 AC 桿壓縮量相同)

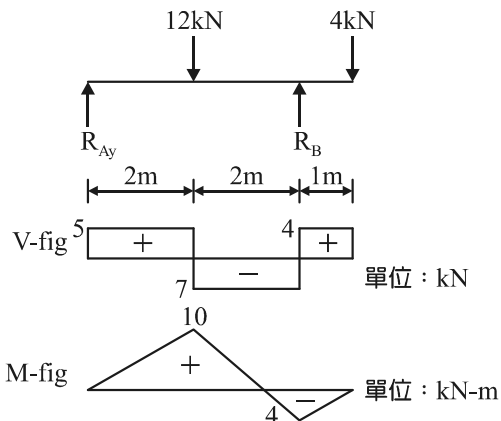
$\frac{P_{AC} \times 2}{AE} = \frac{P_{BD} \times 4}{AE}$, $\therefore P_{AC} = 2P_{BD}$ ②

由①、②聯立得 $P_{AC} = 240 \text{ N}$, $P_{BD} = 120 \text{ N}$

$\Sigma M_A = 0$

$300x + 60 \times 3 - 120 \times 6 = 0$, $\therefore x = 1.8 \text{ m}$

16. (A) 若樑上承受之載重為均佈載重，則其剪力圖為一傾斜直線，彎矩圖為一兩次拋物線
 (B) 樑上任何兩彎矩之差值，為兩斷面間之剪力圖涵蓋之面積
 (C) 所謂樑之危險斷面發生在彎矩最大值處
17. 取樑之自由體圖分析，並繪製剪力圖及彎矩圖



$\Sigma M_A = 0$

$12 \times 2 - R_B \times 4 + 4 \times 5 = 0$, $\therefore R_B = 11 \text{ kN}$

$\Sigma F_y = 0$, $\therefore R_{Ay} = 5 \text{ kN}$

由圖可知 $b = 200 \text{ mm}$

$V_{\max} = 7 \text{ kN}$, $M_{\max} = 10 \text{ kN-m}$

$\sigma_{\max} = \frac{My}{I} = \frac{10 \times 10^6 \cdot 100}{\frac{b \times 200^3}{12}} = \frac{1500}{b}$

$\sigma_{\max} \leq 12 \text{ MPa} \Rightarrow \frac{1500}{b} \leq 12$, $\therefore b \geq 125 \text{ mm}$

$\tau_{\max} = \frac{3V}{2A} = \frac{3 \times 7 \times 10^3}{2 \times b \times 200} = \frac{52.5}{b}$

$\tau_{\max} \leq 0.5 \text{ MPa} \Rightarrow \frac{52.5}{b} \leq 0.5$

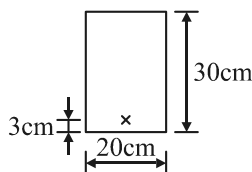
$\therefore b \geq 105 \text{ mm}$, 故採用 125 mm

18. 矩形樑之形心慣性矩 = $\frac{4 \times 10^3}{12} = 333.33 \text{ cm}^4$

I 型樑之形心慣性矩 = $(\frac{8 \times 8^3}{12} - \frac{6 \times 4^3}{12}) = 309.33$

$\frac{\sigma_{\text{矩}}}{\sigma_I} = \frac{M \times 5}{\frac{333.33}{M \times 4}} = 1.16$

19. 樑斷面承受 $M = 7.2 \text{ tf-m}$ 及 $V = -8 \text{ tf}$

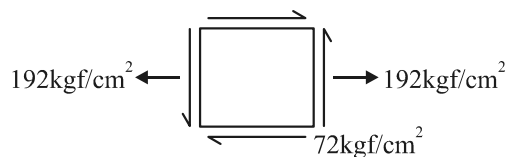


距底面 3 cm 高度之彎矩應力及剪應力為

$\sigma = \frac{My}{I} = \frac{7.2 \times 10^5 \times (15 - 3)}{\frac{20 \times 30^3}{12}} = 192 \text{ kgf/cm}^2$

$\tau = \frac{VQ}{Ib} = \frac{(-80 \times 10^3) [20 \times 3 \times (15 - 1.5)]}{\frac{20 \times 30^3}{12} \times 20} = -72 \text{ kgf/cm}^2$

平面應力分析

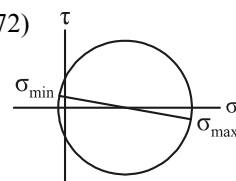


繪製莫耳圖 (192, -72) , (0, +72)

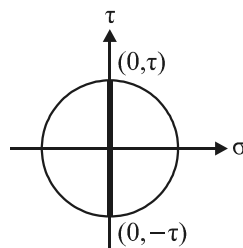
得圓心為 (96, 0) , 半徑為 120

$\sigma_{\max} = 96 + 120 = 216$

$\sigma_{\min} = 96 - 120 = -24$



20. 純剪應力作用之莫耳圖



(A) 最大正向應力值必與最大剪應力值相同

第二部分：工程材料

21. 力學性質：硬度、鬆弛
 化學性質：劣化現象
 物理性質：比重
22. 乳膠漆屬於水性塗料
23. 矽利康(Silicone)簡稱 SI
24. 汗(廢)水管多採用橘色 PVC 管。PVC 為聚氯乙烯
25. 花崗岩為火成岩之深成岩

26. 標準篩之篩號為：3"、3/2"、3/4"、3/8"、#4、#8、#16、#30、#50、#100
27. 此試體針入度為 90，屬於中硬度瀝青(85~150)
28. 圖(十四)石材寬度小於 3 倍厚度，且有一定長度者，稱為塊石
29. $\frac{(600 \text{ cm} \times 330 \text{ cm})}{(30 \text{ cm} \times 30 \text{ cm})} = 220 \text{ 才}$
 220 才 $\times 100 \text{ 元/才} = 22,000 \text{ 元}$
30. 車輛的前擋風玻璃多採用膠合玻璃
31. (D) 水硬性水泥為能在空氣中硬化，也能在水中硬化之水泥
32. 甲水灰比： $\frac{4}{4} = 1$
 乙水灰比： $\frac{5}{3} = 1.67$
 丙水灰比： $\frac{3}{5} = 0.6$
 混凝土抗壓強度與水灰比成反比，故其強度大小排列為丙 > 甲 > 乙
33. (B) 速凝劑可縮短混凝土的硬化時間，使用量只要不超過混凝土中水泥重量的 2%即可
34. (D) 沉積在湖底之黏土，一般稱為二次黏土
35. (A) 華格納氏濁度計：水泥細度
 (C) 薄餅試驗法：水泥健性
 (D) 費開針測試：水泥標準稠度、凝結時間
36. (C) 淬火可增加硬度
37. 透水性瀝青混凝土施作費用較一般瀝青混凝土昂貴
38. 系統櫥櫃多採用塑合板當作板材施工
39. 0.5 尺 \times 10 尺 \times 1 寸 \times 12 塊 = 60 才
40. (A) 竹節鋼筋稱號為 D10
 (C) 一般標示代號為 #3
 (D) 單位質量為 0.560 kg/m