

國立臺灣科技大學103學年度碩士班招生試題

系所組別：機械工程系碩士班甲組

科目：材力與動力

(總分為100分)

- 壹、 (25分) 有一簡支樑 $L = 5\text{ m}$ ，受力(q 及 P)如圖1所示，假設其最大容許應力 $\sigma_{allow} = 110\text{ MPa}$ ，試計算其所需的 section modulus S 。請利用下表 E-1，設計最經濟的 wide-flange beam (HE shape)，需將樑的重量 w (weight per meter) 以均於分佈力的方式考慮進去。

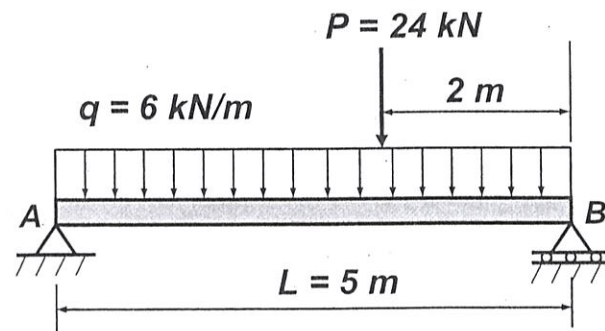


圖 1

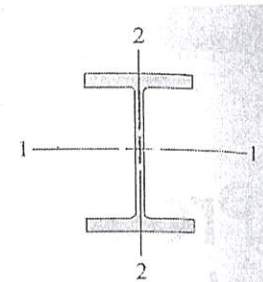


TABLE E-1

Properties of European Wide-Flange Beams

Designation	Mass per meter	Area of section	Depth of section	Width of section	Thickness		Strong axis 1-1			Weak axis 2-2		
	G	A	h	b	t_w	t_f	I_1	S_1	r_1	I_2	S_2	r_2
	kg/m	cm ²	mm	mm	mm	mm	cm ⁴	cm ³	cm	cm ⁴	cm ³	cm
HE 320 A	97.6	124.4	310	300	9	15.5	22930	1479	13.58	6985	465.7	7.49
HE 260 B	93	118.4	260	260	10	17.5	14920	1148	11.22	5135	395	6.58
HE 240 B	83.2	106	240	240	10	17	11260	938.3	10.31	3923	326.9	6.08
HE 280 A	76.4	97.26	270	280	8	13	13670	1013	11.86	4763	340.2	7
HE 220 B	71.5	91.04	220	220	9.5	16	8091	735.5	9.43	2843	258.5	5.59
HE 260 A	68.2	86.82	250	260	7.5	12.5	10450	836.4	10.97	3668	282.1	6.5
HE 240 A	60.3	76.84	230	240	7.5	12	7763	675.1	10.05	2769	230.7	6
HE 180 B	51.2	65.25	180	180	8.5	14	3831	425.7	7.66	1363	151.4	4.57
HE 160 B	42.6	54.25	160	160	8	13	2492	311.5	6.78	899.2	111.2	4.05
HE 140 B	33.7	42.96	140	140	7	12	1509	215.6	5.93	549.7	78.52	3.58
HE 120 B	26.7	34.01	120	120	6.5	11	864.4	144.1	5.04	317.5	52.92	3.06
HE 140 A	24.7	31.42	133	140	5.5	8.5	1033	155.4	5.73	389.3	55.62	3.52
HE 100 B	20.4	26.04	100	100	6	10	449.5	89.91	4.16	167.3	33.45	2.53
HE 100 A	16.7	21.24	96	100	5	8	349.2	72.76	4.06	133.8	26.76	2.51

Note: Axes 1-1 and 2-2 are principal centroidal axes.



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貳、簡答題 (共 25 分)

1. (5分) 以下各項，何者屬於 **Plane stress** 的性質與公式：(複選，需答案全對才得分)

(a) $\tau_{xy} = 0$

(b) $\gamma_{yz} = 0$

(c) $\tau_{xz} = 0$

(d) $\tan 2\theta_p = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$

2. (5分) 在斷面積相同的情況下，以下哪一種斷面形狀的樑對於抵抗 bending 較有效率？(a) 直徑 d 的圓形；(b) 邊長為 a 的正方形；(c) 寬為 b ，高為 $2b$ 的長方形。
3. 實心圓形斷面與圓管狀斷面的結構件(structural member)，在下列情況時，哪種斷面較佳？
- (a) (5分) 承受純扭矩(pure torsion)
- (b) (5分) 承受 bending moment 時，考慮 τ_{\max} (maximum shear stress)
4. (5分) 對於靜不定結構，溫度的改變是否會產生熱應力(thermal stress)?



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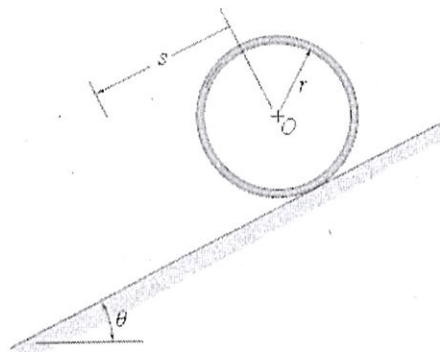
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參、(25%) There are a solid sphere and a spherical thin shell with the same radius r . Both are made of same material of density ρ . Initially, both objects are at rest and at the same height of the slope. When they are released at the same time, both will roll down without slipping.

- (a) (10%) Which objects will roll down faster? Please explain in details without any calculation.
- (b) (15%) What are their respective angular velocities after both have traveled a distance of s down the slope.



肆、(25%) The motorcycle has a mass of 125 kg and a center of mass at G_1 , while the rider has a mass of 75 kg and a center of mass at G_2 . The coefficient of static friction between the wheels and the pavement is 0.85. Neglect the mass of wheels and assume that the front wheel is free to roll.

- (a) (13%) In order for the rider to do a “**wheelie**,”(翹孤輪), what acceleration is necessary to do this?
- (b) (12%) If a “**wheelie**” cannot be done in this way, how would the rider do to make it happen? Please explain it based on the suitable equation.

