

# 材料力學教學與活動成果

# 1. 課程講義重新編排

## 舊版講義

- (1) Center of curvature
- (2) Radius of curvature  $\rho$
- (3) Curvature  $\kappa$

$$\kappa = \frac{1}{\rho} \quad (5-1)$$

From the geometry of triangle O'm (Fig. 5-5b) we obtain

$$\rho d\theta = ds \quad (5-2)$$

Combining Eq. (5-2) with Eq. (5-1), we get

$$\kappa = \frac{1}{\rho} = \frac{d\theta}{ds} \quad (5-3)$$

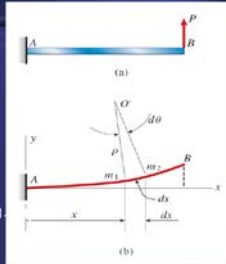


FIG. 5-5 Curvature of a bent beam: (a) beam with load, and (b) deflection curve

## Location of Neutral Axis

The force acting on the element is

$$\int_A \sigma_x dA = - \int_A E \kappa y dA = 0 \quad (5-9a)$$

We can drop them from the equation and obtain

$$\int_A y dA = 0 \quad (5-9b)$$

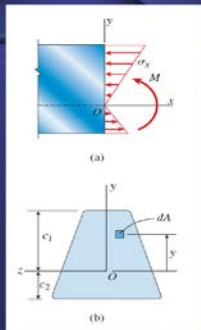


FIG. 5-9 Normal stresses in a beam of linearly elastic material: (a) side view of beam showing distribution of normal stresses, and (b) cross section of beam showing the neutral axis

## 新版講義

### Special Cases of Plane Stress

By setting  $\sigma_y$  and  $\tau_{xy}$  equal to zero in Eqs. (7-4a) and (7-4b), are

$$\sigma_{x_1} = \frac{\sigma_x}{2} (1 + \cos 2\theta) \quad \tau_{x_1 y_1} = -\frac{\sigma_x}{2} (\sin 2\theta) \quad (7-7a, b)$$

For **pure shear (純剪)**

$$\sigma_{x_1} = \tau_{xy} \sin 2\theta \quad \tau_{x_1 y_1} = \tau_{xy} \cos 2\theta \quad (7-8a, b)$$

For **biaxial stress (雙軸應力)**

$$\sigma_{x_1} = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2} \cos 2\theta \quad (7-9a)$$

$$\tau_{x_1 y_1} = -\frac{\sigma_x - \sigma_y}{2} \sin 2\theta \quad (7-9b)$$



Summing the expressions for  $\sigma_{x_1}$  and  $\sigma_{y_1}$ , we obtain

$$\sigma_{x_1} + \sigma_{y_1} = \sigma_x + \sigma_y \quad (7-6)$$

This equation shows that the sum of the normal stresses acting on perpendicular faces of plane-stress elements is constant and independent of the angle  $\theta$ .

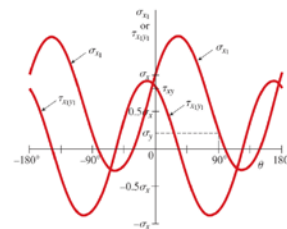


Fig. 7-3

Graph of normal stress  $\sigma_{x_1}$  and shear stress  $\tau_{x_1 y_1}$  versus the angle  $\theta$  (for  $\sigma_y = 0.2\sigma_x$  and  $\tau_{xy} = 0.8\sigma_x$ )



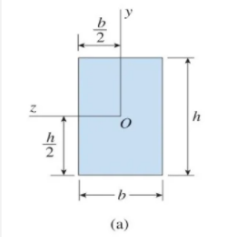
## 教學成果

- 授課內容去蕪存菁
- 調整紊亂的排版
- 調整圖片位置避免蓋過文字
- 加入中文專有名詞解釋
- 標註重要內容，快速抓住重點
- 講義適時留白，給予筆記空間
- 提供教師手寫筆記幫助複習

## 2. 課程中加入Kahoot互動式遊戲

What is the moment of inertia of rectangular cross section?

17



0 Answers

▲  $\frac{bh^3}{12}$

◆  $\frac{bh^3}{6}$

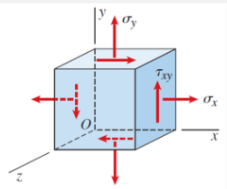
●  $\frac{bh^2}{6}$

■  $\frac{bh^3}{8}$

1/1 kahoot.it Game PIN: 650265

Which is the  $\varepsilon_x$  of the element in plane stress ?

13



0 Answers

▲  $\varepsilon_x = \frac{1}{E} (\sigma_x + \nu\sigma_y)$

◆  $\varepsilon_x = \frac{1}{E} (\sigma_x - \nu\sigma_y)$

●  $\varepsilon_x = \frac{1}{E^2} (\sigma_x + \nu\sigma_y)$

■  $\varepsilon_x = \frac{1}{E^2} (\sigma_x - \nu\sigma_y)$

1/1 kahoot.it Game PIN: 2367252

### 教學成果

- 課程中加入互動式遊戲檢驗學習狀況
- 答對者獲得加分，提升學習欲望
- 用簡單的題目提醒重要觀念
- 增加學生對於課程認同感
- 緩和課堂氣氛，增進師生情誼
- 同時適用於線上授課與實體授課
- 有效增加學生出席率

# 3. 每週定時助教課程

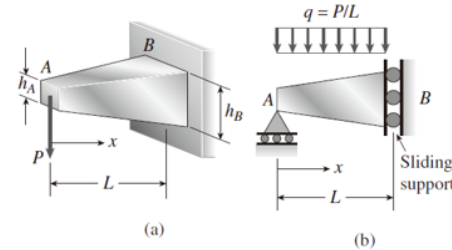
## TA Course 1215

### Nonprismatic Beams

**Problem 5.7-1** A tapered cantilever beam  $AB$  of length  $L$  has square cross sections and supports a concentrated load  $P$  at the free end (see figure part a). The width and height of the beam vary linearly from  $h_A$  at the free end to  $h_B$  at the fixed end.

Determine the distance  $x$  from the free end  $A$  to the cross section of maximum bending stress if  $h_B = 3h_A$ .

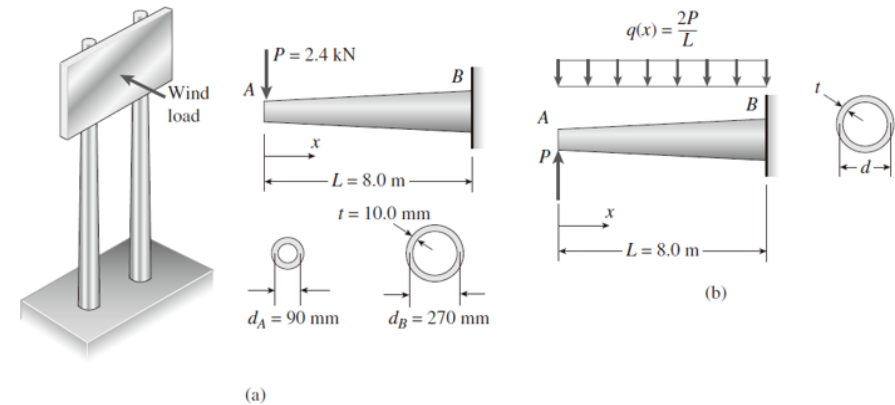
- What is the magnitude  $\sigma_{\max}$  of the maximum bending stress? What is the ratio of the maximum stress to the largest stress  $\sigma_B$  at the support?
- Repeat part (a) if load  $P$  is now applied as a uniform load of intensity  $q = P/L$  over the entire beam.  $A$  is restrained by a roller support and  $B$  is a sliding support (see figure part b).



**Problem 5.7-2** A tall signboard is supported by two vertical beams consisting of thin-walled, tapered circular tubes (see figure part a). For purposes of this analysis, each beam may be represented as a cantilever  $AB$  of length  $L = 8.0$  m subjected to a lateral load  $P = 2.4$  kN at the free end. The tubes have constant thickness  $t = 10.0$  mm and average diameters  $d_A = 90$  mm and  $d_B = 270$  mm at ends  $A$  and  $B$ , respectively.

Because the thickness is small compared to the diameters, the moment of inertia at any cross section may be obtained from the formula  $I = \pi d^3 t / 8$  (see Case 22, Appendix D), and therefore, the section modulus may be obtained from the formula  $S = \pi d^2 t / 4$ .

- At what distance  $x$  from the free end does the maximum bending stress occur? What is the magnitude  $\sigma_{\max}$  of the maximum bending stress? What is the ratio of the maximum stress to the largest stress  $\sigma_B$  at the support?
- Repeat part (a) if concentrated load  $P$  is applied upward at  $A$  and downward uniform load  $q(x) = 2P/L$  is applied over the entire beam as shown. What is the ratio of the maximum stress to the stress at the location of maximum moment?



## 教學成果：

- 深入講解材料力學解題觀念
- 根據課程進度設計題目

- 提前上傳於課程網站，方便學生預習
- 課後提供正確解答與助教手寫筆記
- 提供學生與助教討論解題的機會

## 4. 整理完善教學資源於課程網站

### 課程講義上傳區

🔍 課程講義

▲ 為保護老師及著作人之智慧財產權，敬請老師及同學勿使用非法影印教科書  
教師資源合理使用規範DM

名稱	附件	異動時間	功能	刪除
Week 13 Course ppt	week13 (7.1~7.3).pdf week13 (7.1~7.3).pptx	2021/12/21 13:00	[檢視] [QR code] [修改]	[刪除]
Week 11 Course ppt	week11 (5.1~5.5).pdf week11 (5.1~5.5).pptx	2021/12/06 15:33	[檢視] [QR code] [修改]	[刪除]
Week 12 Course ppt	week12 (5.6~5.10).pptx week12 (5.6~5.10)(1).pdf	2021/12/21 13:00	[檢視] [QR code] [修改]	[刪除]
Week 14 Course ppt	week14 (7.4~7.5).pdf week14 (7.4~7.5).pptx	2022/01/08 18:36	[檢視] [QR code] [修改]	[刪除]
Week 15 Course ppt	week15 (7.6~7.7).pdf week15 (7.6~7.7).pptx	2022/01/08 18:36	[檢視] [QR code] [修改]	[刪除]

### 課程錄影上傳區

我的雲端硬碟 > Meet Recordings

名稱	擁有者	上次修改時間
9/14	我	2021年9月14日 我
9/28	我	2021年9月29日 我
9/30	我	2021年10月3日 我
10/04	我	2021年10月10日 我
10/12	我	2021年10月12日 我
10/14	我	2021年10月18日 我
10/21	我	2021年10月28日 我
10/26	我	2021年10月28日 我
11/18	我	2021年11月18日 我

### 參考資料上傳區

🔍 參考資料

名稱	附件	異動時間	功能	刪除
CH5_Problems	CH5.pdf	2021/12/13 14:05	[檢視] [QR code] [修改]	[刪除]
1215 TA Course	Answer 1215.docx TA Course 1215.docx	2021/12/26 16:05	[檢視] [QR code] [修改]	[刪除]
1208 TA Course	Answer 1208.docx TA Course 1208.docx	2021/12/15 21:38	[檢視] [QR code] [修改]	[刪除]
1222 TA Course	Answer 1222.docx TA Course 1222.docx 詳述計算過程.jpg	2021/12/28 22:42	[檢視] [QR code] [修改]	[刪除]
1229 TA Course	Answer 1229.docx TA Course 1229.docx	2021/12/30 13:24	[檢視] [QR code] [修改]	[刪除]

### 教學成果：

- 集中整理教學資源，學生方便使用
- 定時更新課程內容供學生學習
- 快速上傳當天上課內容，幫助學生複習