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 ρ
(3)Curvature κ

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

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

$$\rho\, d\theta = ds \quad (5\text{-}2)$$

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

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

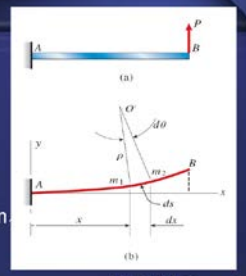


FIG. 5-5 Curvature of a bent beam: (a) beam with load, and (b) deflection curve

6

Location of Neutral Axis

The force acting on the element is

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

We can drop them from the equation and obtain

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

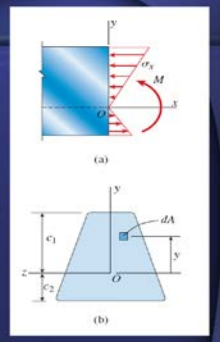


FIG. 5-9 Normal stresses in a beam of linearly elastic material: (a) side view of beam showing distribution of normal stresses, and (b) cross section of beam

13

新版講義

Special Cases of Plane Stress

By setting σ_y and τ_{xy} equal to zero in Eqs. (7-4a) and (7-4b), are

$$\sigma_{x_1} = \frac{\sigma_x}{2}(1+\cos 2\theta) \qquad \tau_{x_1y_1} = -\frac{\sigma_x}{2}(\sin 2\theta) \quad (7\text{-}7a,b)$$

For **pure shear (純剪)**

$$\sigma_{x_1} = \tau_{xy} \sin 2\theta \qquad \tau_{x_1y_1} = \tau_{xy} \cos 2\theta \quad (7\text{-}8a,b)$$

For **biaxial stress (雙軸應力)**

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

$$\tau_{x_1y_1} = -\frac{\sigma_x - \sigma_y}{2}\sin 2\theta \quad (7-9b)$$

Summing the expressions for σ_{x_1} and σ_{y_1}, we obtain

$$\sigma_{x1} + \sigma_{y1} = \sigma_x + \sigma_y \quad (7-6)$$

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 θ.

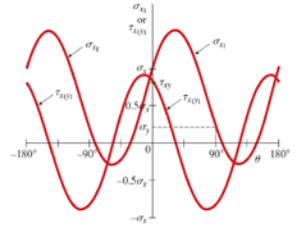
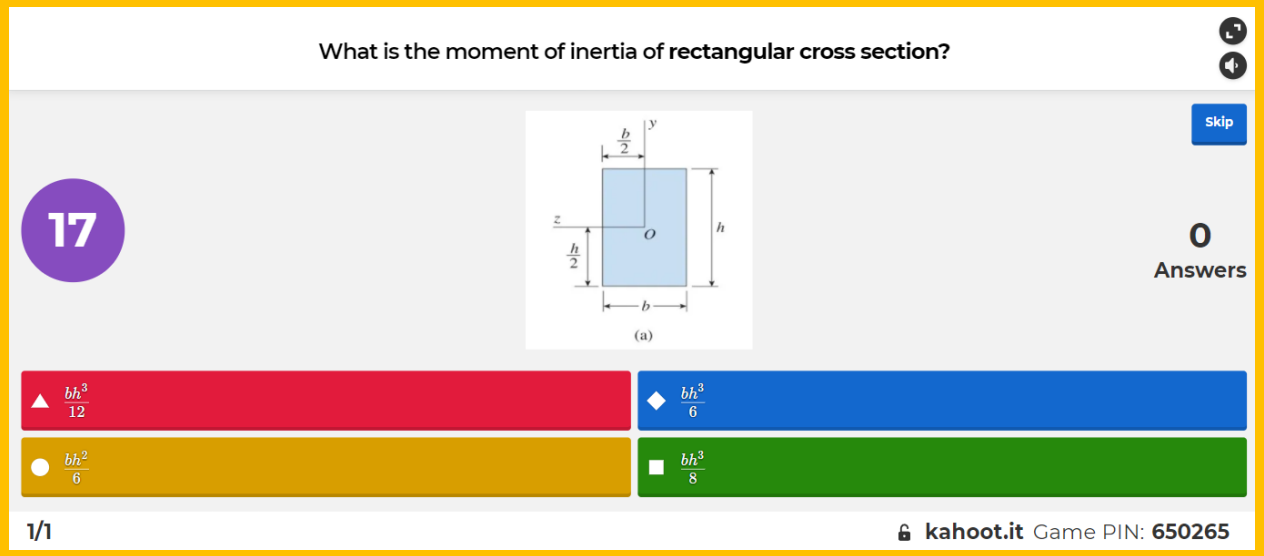


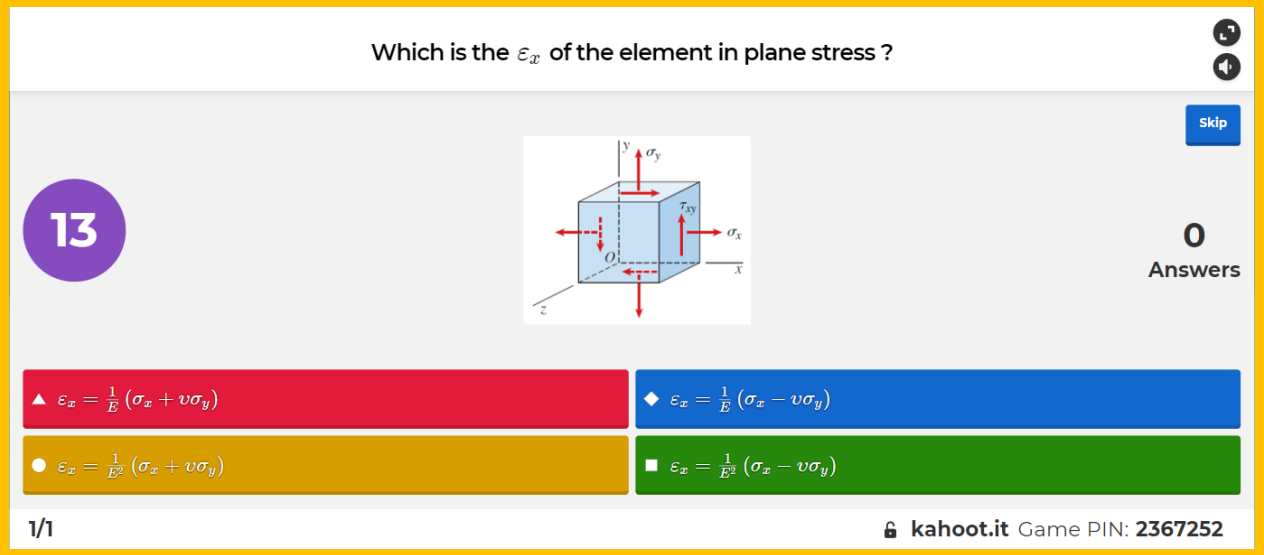
Fig. 7-3
Graph of normal stress σ_{x_1} and shear stress $\tau_{x_1y_1}$ versus the angle θ (for $\sigma_y = 0.2\sigma_x$ and $\tau_{xy} = 0.8\sigma_x$)

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





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

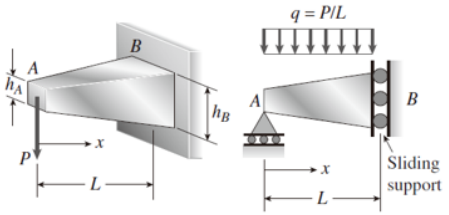
Nonprismatic Beams

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 $h_B = 3h_A$.

(a) What is the magnitude σ_{max} of the maximum bending stress? What is the ratio of the maximum stress to the largest stress B at the support?

(b) 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).

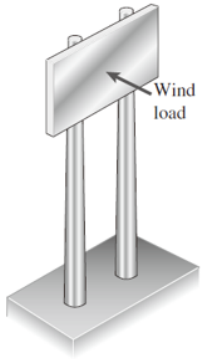


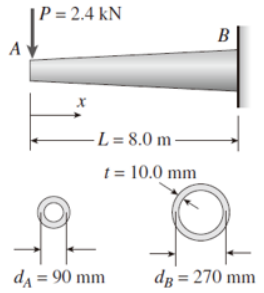
Problem 5.7-2 A tall signboard is supported by two vertical beams consisting of thin-walled, tapered circular tubes (see figure part a). For purposes of this analysis, each beam may be represented as a cantilever AB of length $L = 8.0$ m subjected to a lateral load $P = 2.4$ kN at the free end. The tubes 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.

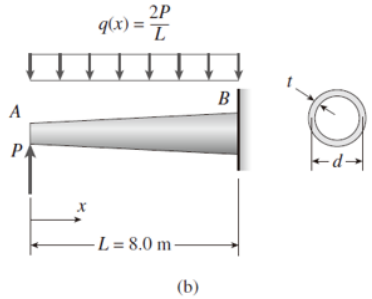
Because the thickness is small compared to the diameters, the moment of inertia at any cross section may be obtained from the formula $I = \pi d^3 t/8$ (see Case 22, Appendix D), and therefore, the section modulus may be obtained from the formula $S = \pi d^2 t/4$.

(a) At what distance x from the free end does the maximum bending stress occur? What is the magnitude σ_{max} of the maximum bending stress? What is the ratio of the maximum stress to the largest stress σ_B at the support?

(b) 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：

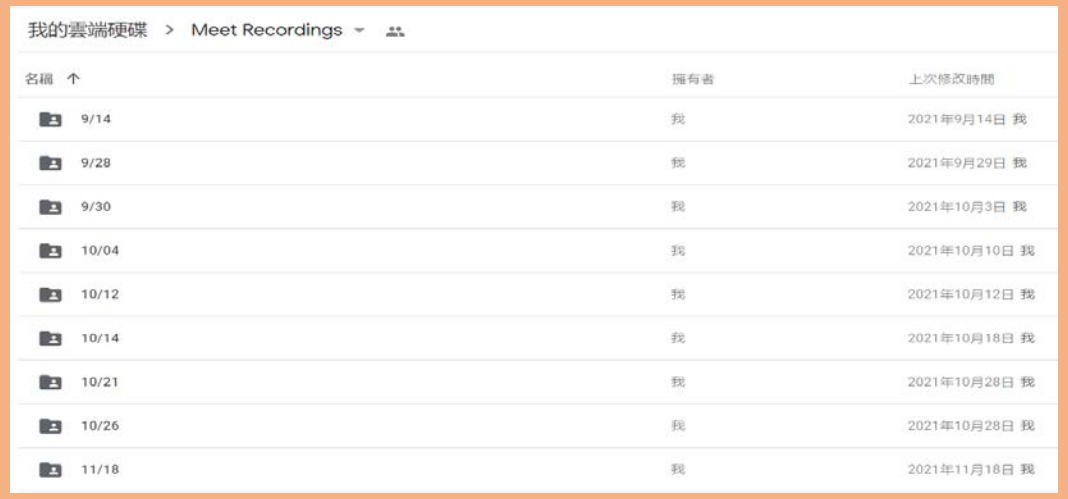
- 深入講解材料力學解題觀念
- 根據課程進度設計題目

- 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

課程錄影上傳區



參考資料上傳區

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