1. One of the strengthening methods of existing structures is to use the composite material concept. Assuming that a simply supported beam 3 m long carries a uniformly distributed load of intensity q = 6.4 KN/m was damaged in earthquake. The beam was originally constructed of a wood member 100 mm wide by 150 mm deep, and is now reinforced on its lower side by a steel plate 8 mm thick and 100 mm wide. Find the maximum bending stress in the wood and steel due to the uniform load if the moduli of elasticity are E_w = 10 GPa for the wood and E_s = 210 GPa for the steel. (25 分)

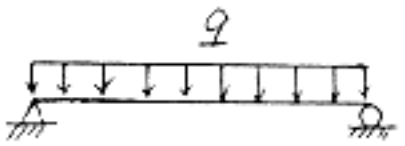
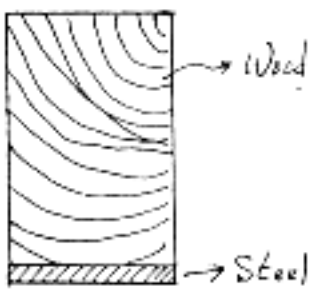


Fig. 1



SECTION

2. Calculate the moments of inertia of the shaded area with respect to the Y axis in Fig. 2 (20 分)

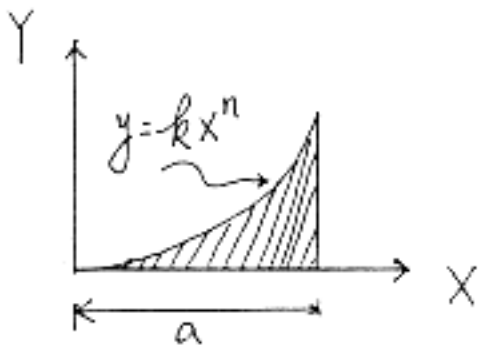


Fig. 2

3. 簡答題(30 分)

i) Describe briefly the relationship between the buckling load and the geometry of the member.

ii) A pedestrian walk bridge between two buildings was designed to be a simply supported structure. However, during the construction stage, the roller end was mistakenly welded and the structure became a pin-pin condition. Discuss the acceptability of such a condition from a structure point of view.

iii) What are the members in Fig. 3 will have to consider the their buckling strength in design?

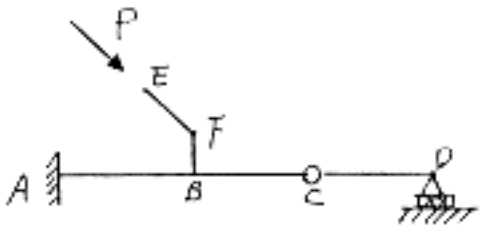


Fig. 3

4、

(i) Solve the initial value problem :

$$y'' + 2y' + 5y = 15e^{-2t} \qquad (10\%)$$

$y(t) = 2$ and $y'(t) = -1$ when $t = 0$

(ii) Find the matrix multiplication of $[A]\ [B]^T$ and $[B]^T\ [A]$, where

$$[A] = \begin{bmatrix} 1 & -2 & 1 \\ 3 & 5 & 2 \\ 4 & 1 & -3 \end{bmatrix} \qquad [B] = \begin{bmatrix} 2 & 0 & -3 \end{bmatrix} \qquad (5\%)$$

(iii) Find the inverse matrix of (C) as following:

$$[C] = \begin{bmatrix} 2 & 1 & -3 \\ 0 & -1 & 2 \\ 3 & 2 & 1 \end{bmatrix} \qquad (10\%)$$