University Of Technology
Building and Construction Eng. Dept.
Final Exam – First Attempt – 2010/2011

Branch : Structural Engineering | Class: Third Year
subject : Advanced Strength of Materials | Time : 3 Hours
Examiner : Prof. Dr. Hisham M. AL-Hassani | Date : 8 / 6 / 2011

Closed book & Notes

Note: Answer Four Questions Only

Q1: A thin walled cylindrical pressure vessel with closed ends, of internal diameter 300*mm* and thickness of wall 6*mm*, is subjected to the combined action of an internal pressure of value 8 MPa and an external pressure on each end of value (p_e) as shown in Fig.(1). Find the value of p_e that initiates yielding in the vessel according to:

1- Tresca's theory **2- Von Mises' theory**

Use yield stress σ_y=250 MPa

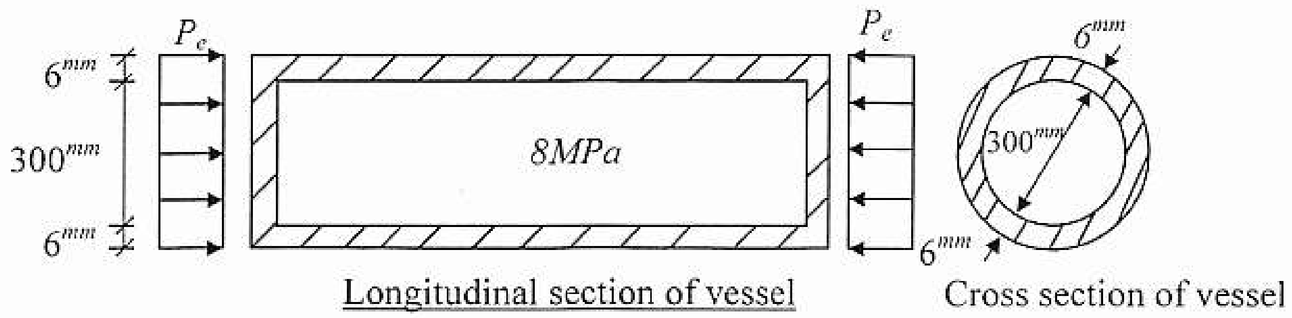


Fig. (1)

Q2: For the two rigid column system shown in Fig. (2), Find the critical buckling load (P_{cr}) an draw the correct buckling mode.

Use K_1 = 10 kN/m (axial spring constant)

K_2 = 20 kN.m (torsional spring constant)

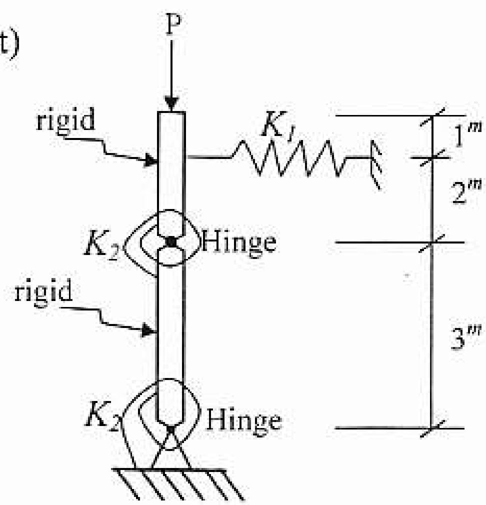


Fig.(2)

Q3: The elastic –rigid column ABCD shown in Fig. (3) has portion AB elastic while portion BCD rigid. Support A is hinge while support C is roller. The column is subjected to an axial compressive load (P) at the top end D as shown. For this column establish the following:

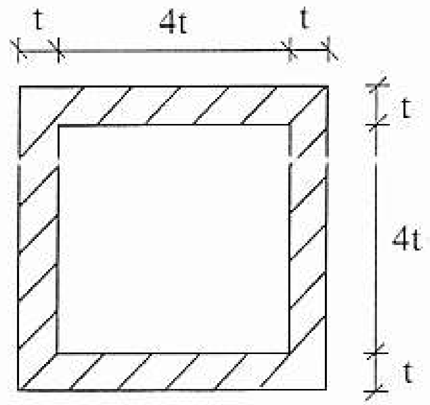
i) Starting from the second order differential equation $EI\frac{d^2v}{dx^2} = M_{(x)}$, derive an equation for the buckling load of the column .

ii) If the elastic portion AB of the column has the following properties;

Hollow square cross section of dimensions shown in figure,

$L=3^m$, σ_y=250 MPa, E=200*10^3 MPa , $\frac{L}{r} = 160$ (slenderness ratio)

Find the dimension (t) of the column cross section, then find out whether the column fails by buckling or yielding.



Cross section of column within portion AB

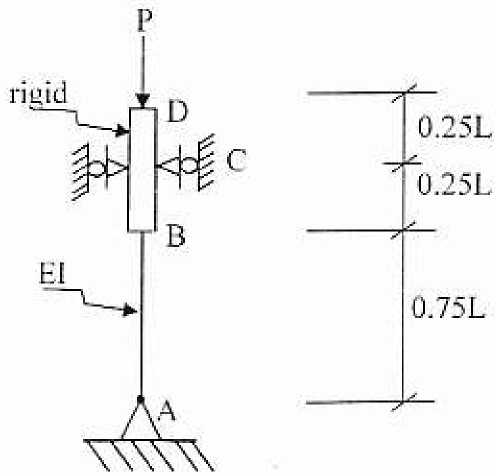


Fig.(3)

Q4: Using the plastic method of analysis, find the collapse load w_u (kN/m) of the continuous beam shown in Fig. (4).

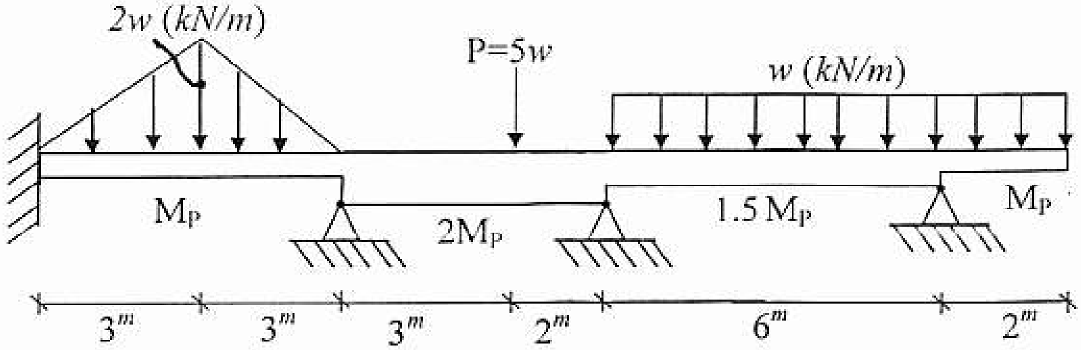


Fig.(4)

Q5: An overhang beam with H cross section is shown in Fig.(5) . The beam is subjected to an increasing uniformly distributed load w (kN/m) until fully plastic condition is reached. Using σ_y=250 MPa ,

i) Find the shape factor (λ) of the beam cross section .

ii) Determine the limiting elastic uniform load w_y (kN/m).

iii) Determine the collapse uniform load w_u (kN/m).

iv) Sketch the collapse mechanism.

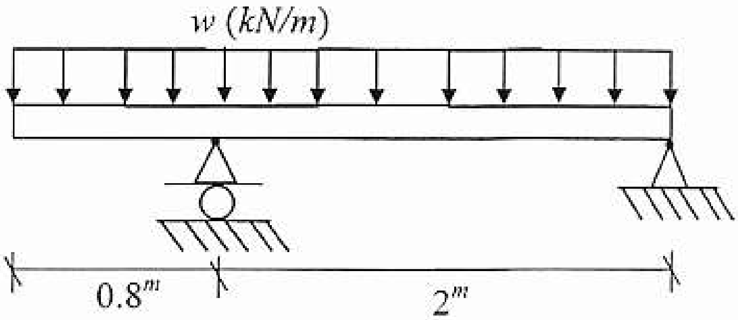
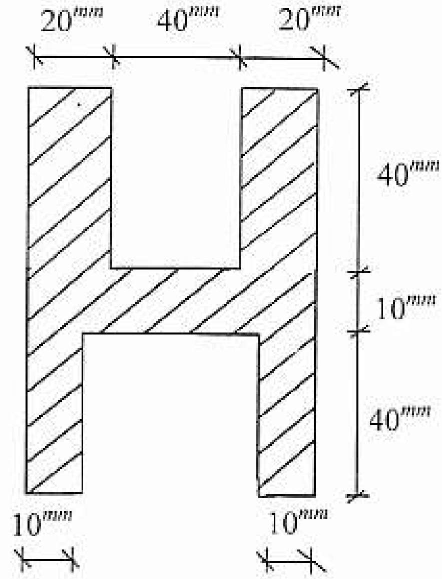


Fig.(5)



Cross section