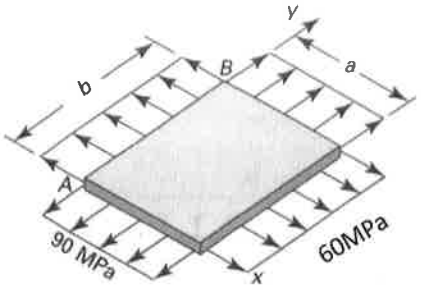
國立交通大學 102 學年度第 2 學期

博士班資格考筆試考試試題

土木工程學系 結構組(甲)　科目：**高等材料力學**　選考學生數：1　考試時間：90min

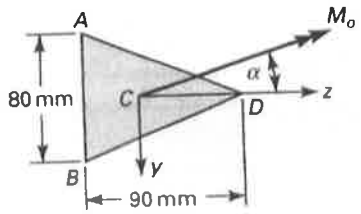
1. An aluminum alloy plate ($E = 70GPa,\ \nu = 1/3$) of dimensions $a = 300mm$, $b = 400mm$, and thickness $t = 10mm$ is subjected to biaxial stresses shown as follows:



Calculate (a) the state of strain at a point in the plate; (b) the change in length AB; (c) the change in volume of the plate. (30%)

2. A thin-walled cylindrical pressure vessel of diameter $d = 0.5m$ and wall thickness $t = 5mm$ is fabricated of a material with $280MPa$ tensile yield strength. Determine the internal pressure p required according to the following theories of failure: (a) maximum distortion energy and (b) maximum shear stress. (30%)

3. A beam with cross section is acted on by a moment $M_0 = 3kN \cdot m$ with its vector forming an angle $\alpha = 20^\circ$. Determine (a) the orientation of the neutral axis, and (b) the maximum bending stress. (40%)



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選三題作答，作答超過三題以解題順序前三題給分。

1. Please calculate M_y and M_P of the section in Figure 1 corresponding to its neutral axis.

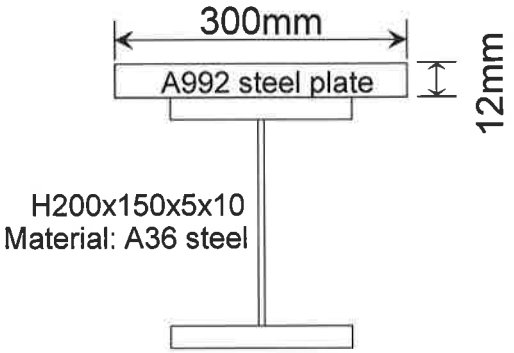

Figure 1

2. The concept of Capacity Design is commonly used for structural design. Please explain what the Capacity Design is. In the design of steel plate shear wall system, how do you apply Capacity Design?

3. A BRB frame system is shown in Figure 2. We need to design the BRBs in the marked story. Considering seismic force only, we use 500 kips as the seismic design base shear. Assume the BRBs are pin-connected on both ends and takes 80% of the story shear.
   (1) Please calculate the required steel core area ($A_{g,BRB}$) to resist the story shear. Tension strength modification factor $\omega = 1.25$, compression strength modification factor $\beta = 1.03$, $F_y = 36$ ksi.
   (2) If you have determined the core area of a BRB, how do you design the steel casing for confinement? Please describe the design philosophy.

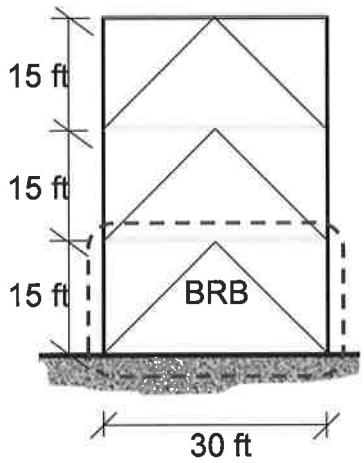

Figure 2

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4. Please describe the design philosophy of the RBS connections. Also, please derive the design equations for the cutting size.

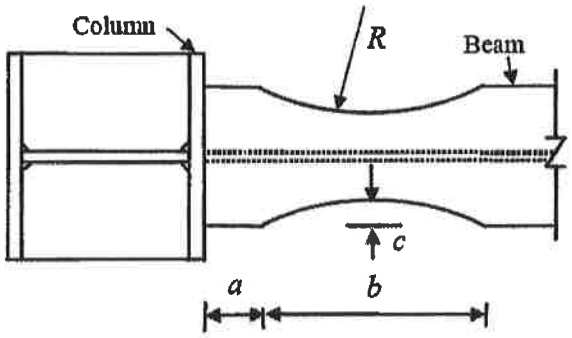
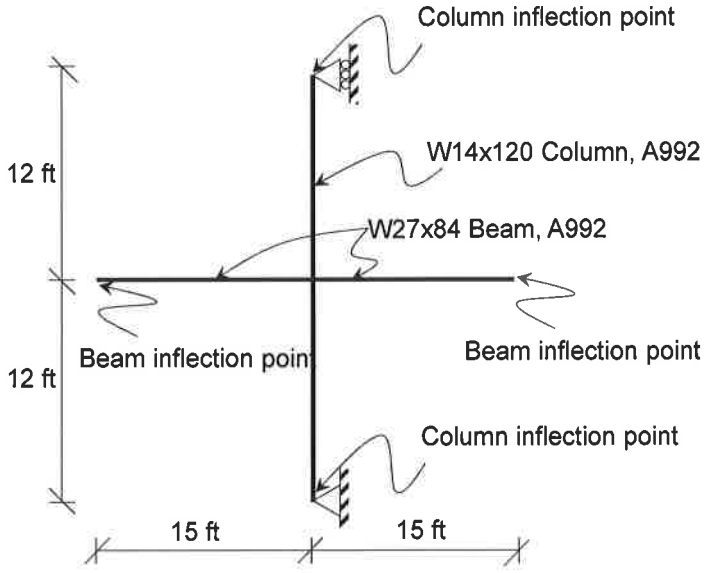


Figure 3

5. A beam-column sub-assemblage of a MRF is shown in Figure 4. Use load combination: 1.2D+1.0E+L.
   (1) The given loads are the demands in beams and columns. What is the shear demand of the panel zone (R_u)?
   (2) Use the following equation to estimate the capacity of the panel zone and design the thickness of the doubler plate in the beam-column connection. Reduction factor φ=0.9

$$R_n = 0.60 F_y d_c t_w \left(1 + \frac{3 b_{cf} t_{cf}^2}{d_b d_c t_w}\right)$$



W14x120	W27x84
d x b_f x t_w x t_f = 14.5x14.7x0.59x0.94 (unit: inch)	d x b_f x t_w x t_f = 26.7x10x0.46x0.64 (unit: inch)
I_x = 1380 in^4	I_x = 2850 in^4
S_x = 190 in^3	S_x = 213 in^3
r_x = 6.24 in	r_x = 10.7 in
Z_x = 212 in^3	Z_x = 244 in^3
I_y = 495 in^4	I_y = 106 in^4
S_y = 67.5 in^3	S_y = 21.2 in^3
r_y = 3.74 in	r_y = 2.07 in
Z_y = 102 in^3	Z_y = 33.2 in^3

The loads in the column face:
Earthquake Load: $M_{E,left} = 0.4M_P$, $M_{E,right} = 0.45M_P$
Gravity Load: $M_{D,left} = 0.25M_P$, $M_{D,right} = 0.2M_P$
$M_{L,left} = 0.15M_P$, $M_{L,right} = 0.1M_P$

Figure 4