(1) The simply supported joist is used in the construction of a floor for a building. In order to keep the floor low with respect to the sill beams C and D, the ends of the joists are notched as shown in Fig. 1. If the allowable shear stress for the wood is $\tau_{allow} = 350$ psi and the allowable bending stress is $\sigma_{allow} = 1500$ psi, determine the height h that will cause the beam to reach both allowable stressed at the same time.(30 分)
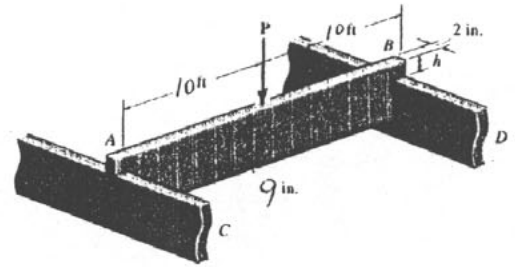

Fig. 1

(2) Determine if the frame in Fig. 2 can support a load of $w = 6$ kN/m if the factor of safety with respect to buckling of member AB is 3. Assume that AB is made of steel and is pinned at its ends for x-x axis buckling and fixed at its ends for y-y axis buckling. $E_{st} = 200$ GPa, $\sigma_y = 360$ MPa (25 分)
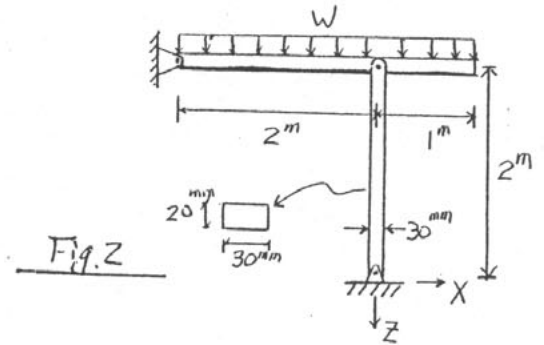

Fig. 2

(3) A tower crane lifts materials (W) in the construction site can be simplified as shown in Fig.3. The counter weight (CW) on the left provides a mass to reduce moment in the crane tower AB. When an earthquake happens, the supporting end A experiences horizontal acceleration so do everything in the crane system. A horizontal inertia force equals to the product of the mass and the acceleration is thus generated in the crane system. Discuss the differences of internal forces in the crane tower before and during an earthquake. (25 分) (Neglect Crane Weight)
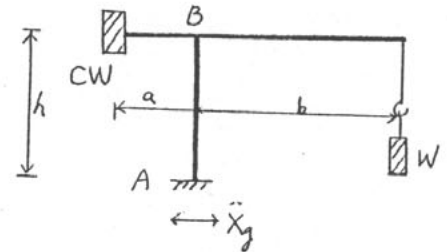

Fig. 3

(4) Find the values of the determinant. (10 分)

$$\begin{vmatrix} 3 & 1 & -1 & 2 & 1 \\ 0 & 3 & 1 & 4 & 2 \\ 1 & 4 & 2 & 3 & 1 \\ 5 & -1 & -3 & 2 & 5 \\ -1 & 1 & 2 & 3 & 2 \end{vmatrix}$$

(5) Find the particular solution of the following equation: (10 分)

$$\dot{y} + y = e^x \quad , \quad x = 0 \; . \; y = 2$$