(1) Describe the pattern of the first crack of a circular concrete shaft when the only loading is axial torque at both ends increasing from zero to the first crack. Also explain why this pattern will be formed? (20分)

(2) A cantilever wood beam is made of two semi-circular sections joined by one nail on every cross section at a certain spacing. When a load P is applied at the perimeter of the beam as shown in Fig. 1, calculate the following: (40分)

(a)The largest deflection of the beam in the Y axis .

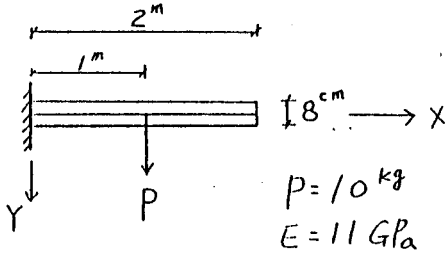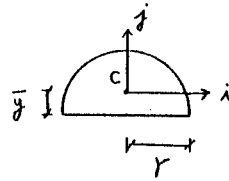(b)Minimum spacing of nails at the fixed end if each nail has a shear strength of 64 kg?

$P = 10^{kg}$
$E = 11\ GPa$

Fig. 1

C : Centroid
$I_i \fallingdotseq a.1098\ r^4$
$\bar{y} = \dfrac{4r}{3\pi}$

SECTION PROPERTY OF A SEMI-CIRCLE

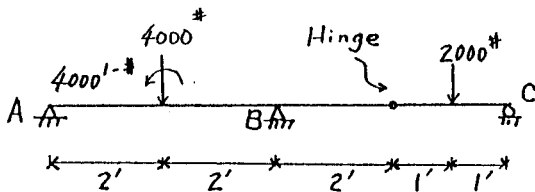(3) Find the inflection point of the beam in section AB of Fig.2. (20分)

Fig. 2

(4) Answer the following two questions: (20分)

(a)The inverse matrix of :

$$\begin{bmatrix} 1 & 1 & 0 \\ 2 & 2 & 1 \\ 1 & 2 & 3 \end{bmatrix}$$

(b)The solution of the following equation:

$$y'' - y = e^x + 2e^{2x}$$