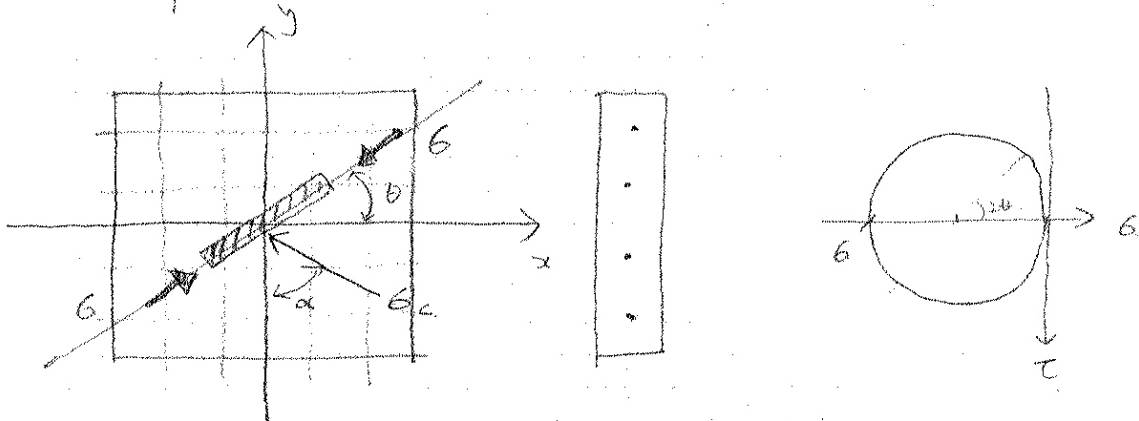


* Find second principal stress, direction of uniaxial compressive stress in reinforced disk



$$\sigma_x = \sigma \cos^2 \theta$$

$$\sigma_y = \sigma \sin^2 \theta$$

$$\tau_{xy} = -\sigma \sin \theta \cos \theta$$

- ①

- ②

- ③

Yield condition for orthotropic disk

→ $\sigma < 0$ (compression), assume

$$\sigma_x + \sigma_y = \sigma (\cos^2 \theta + \sin^2 \theta) \leq -(1-\Phi) f_c$$

$$-(f_c + \sigma_x)(f_c + \sigma_y) + \tau_{xy}^2 = 0$$

$$-(f_c + \sigma \cos^2 \theta)(f_c + \sigma \sin^2 \theta) + \sigma^2 \sin^2 \theta \cos^2 \theta = 0$$

$$-f_c^2 - f_c \sigma = 0$$

$$\underline{\underline{\sigma = -f_c}}$$

- ⑤ (yield condition in case of ④)

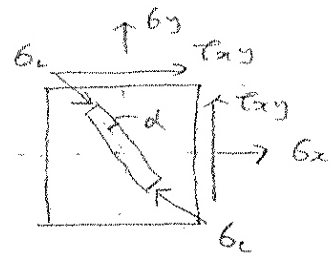
- ⑥

▣ In Reinforced Prism (assuming x, y rebars in compressive yielding)

$$\sigma_x = -\sigma_c \sin^2 \alpha - \frac{A_s x f_y}{t} \quad - (1)$$

$$\sigma_y = -\sigma_c \cos^2 \alpha - \frac{A_s y f_y}{t}$$

$$\tau_{xy} = \sigma_c \sin \alpha \cdot \cos \alpha \quad - (8)$$



- from (1), (8)

$$\sigma_x = -\frac{\sin \alpha}{\cos \alpha} \tau_{xy} - \frac{A_s x f_y}{t}$$

$$\tan \alpha = \frac{-1}{\tau_{xy}} \left[\sigma_x + \frac{A_s x f_y}{t} \right]$$

$$= + \frac{f_c \cos^2 \theta + f_{tx}}{f_c \sin \theta \cos \theta}$$

$$= \tan^{-1} \theta + \frac{\Phi_x}{\sin \theta \cos \theta} \quad - (9)$$

▣ Second principal stress σ_c

from (2), (8)

$$\sigma_c = \frac{-\sigma \sin \theta \cos \theta}{\sin \theta \cos \theta} = f_c \left(\frac{\sin \alpha}{\cos \alpha} + \frac{\cos \alpha}{\sin \alpha} \right) \sin \theta \cos \theta$$

$$= f_c \left[\frac{\cos \theta}{\sin \theta} + \frac{\Phi_x}{\sin \theta \cos \theta} + \frac{\cos \theta}{\sin \theta} + \frac{\Phi_x}{\sin \theta \cos \theta} \right] \sin \theta \cos \theta$$

$$= f_c \left[\cos^2 \theta + \Phi_x + \frac{1}{\cos^2 \theta + \Phi_x} \right] \quad - (10)$$

▣ x방향, y방향의 변위량이 다른 orthotropic 변형률, yield condition은 압축영역에서 좌의 압축력 σ_{xf}, σ_{yf} 을 무시하여 (4)

식 (5) 와 같이 표현된다. 하지만, 콘크리트의 second principal stress 는 좌의 압축력을 고려하여 식 (1), (8) 로 표현되기 때문에,

식 (5) 를 이용해 계산한 α, β_c 는 오류가 있다.

이를 해결하기엔 orthotropic disk 에서 좌의 압축력을 고려한 yield condition을 사용해야 할 것이다.