

# 技術系問題演習講座 記述 総合職B

2019年 国家総合職 2次記述 No.18

構造力学（土木）

(2)(f)～(h)

(3)(c)～(e)

(2)(f)

せん断応力の公式

$$\tau = \frac{VQ}{bI}$$

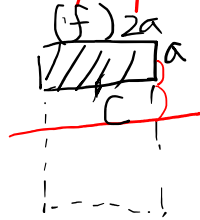
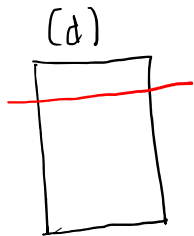
V: せん断力  $\frac{W}{4}$

b: 幅  $2a$

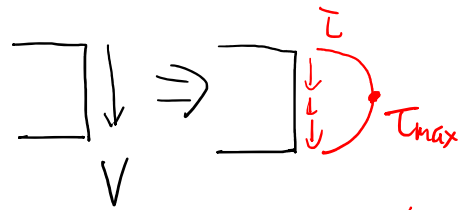
I = 図心軸の断面二次モーメント  $\frac{9}{2}a^4$

Q: 考えうる点より上(下)の図心

軸の断面二次モーメント



$$Q = 2a^3$$



$$\tau_{max} = 1.5 \frac{V}{bh}$$

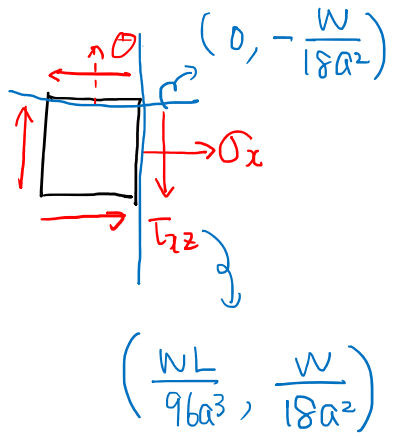
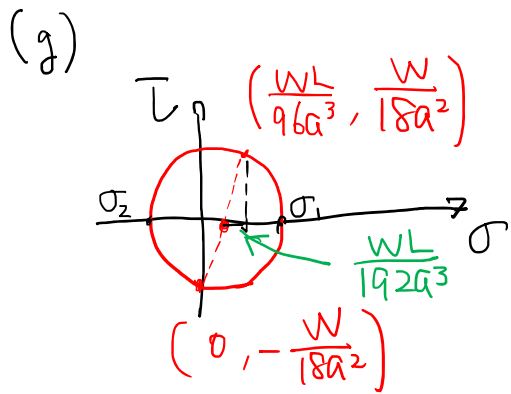
$$\tau_{x,z} = \frac{\frac{W}{24} \times 2a^3}{2a \times \frac{9}{2}a^4}$$

$$= \frac{W}{18a^2}$$

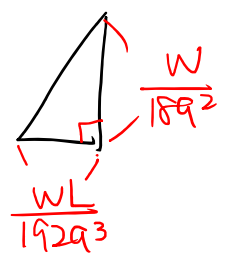
$Q : m^3$   
 $b : m$   
 $I : m^4$

]  $m^5$

$$\tau = \frac{N}{m^2}$$



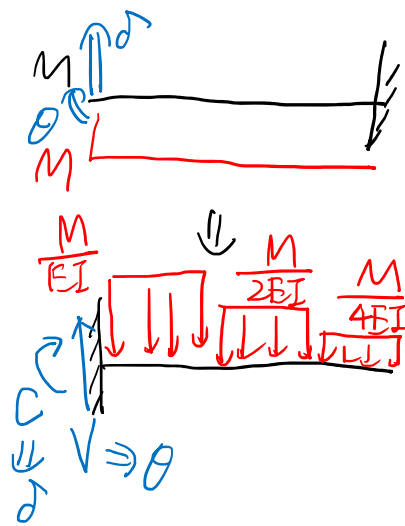
(h)  $\sigma_1 = \frac{WL}{192a^2} + r$



$$\sigma_1 = \frac{WL}{192a^2} + \frac{W}{6a^2} \sqrt{\left(\frac{L}{32a}\right)^2 + \left(\frac{L}{3}\right)^2}$$

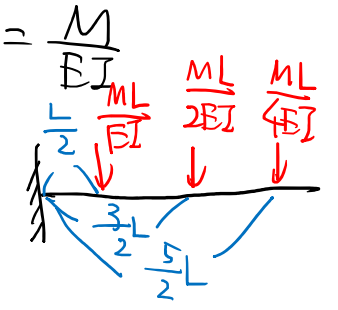
$$\sigma_2 = \frac{WL}{192a^2} - \frac{W}{6a^2} \sqrt{\left(\frac{L}{32a}\right)^2 + \left(\frac{L}{3}\right)^2} \quad r = \frac{W}{6a^2} \sqrt{\left(\frac{L}{32a}\right)^2 + \left(\frac{L}{3}\right)^2}$$

(3)(c) ~ (e)  
弹性荷重法



弯矩图  
图 ↔ 图  
单 ↔ 移  
冲 ↔ 移  
弹性荷重

(d)  $V = \frac{ML}{EI} + \frac{ML}{2EI} + \frac{ML}{4EI}$   
 $= \frac{7ML}{4EI} = 0$



(e)  $C = \frac{ML^2}{2EI} + \frac{3ML^2}{4EI} + \frac{5ML^2}{8EI}$   
 $= \frac{15ML^2}{8EI} //$



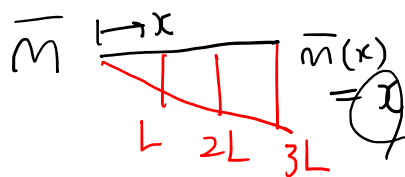
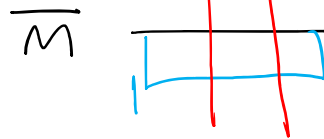
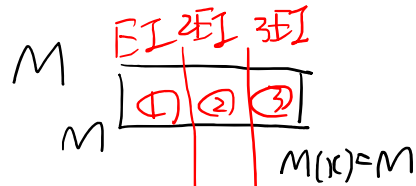
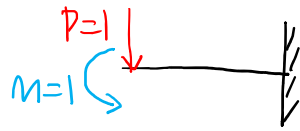
0 单位荷载定理

(d)

$$\theta = \int_0^L \frac{M}{EI} dx + \frac{1}{2EI} \int_0^L M dx + \frac{1}{4EI} \int_0^L M dx$$

$$= \frac{M}{EI} \int_0^L dx + \frac{M}{2EI} \int_0^L dx + \frac{1}{4EI} \int_0^L dx$$

$$= \frac{7ML}{4EI}$$

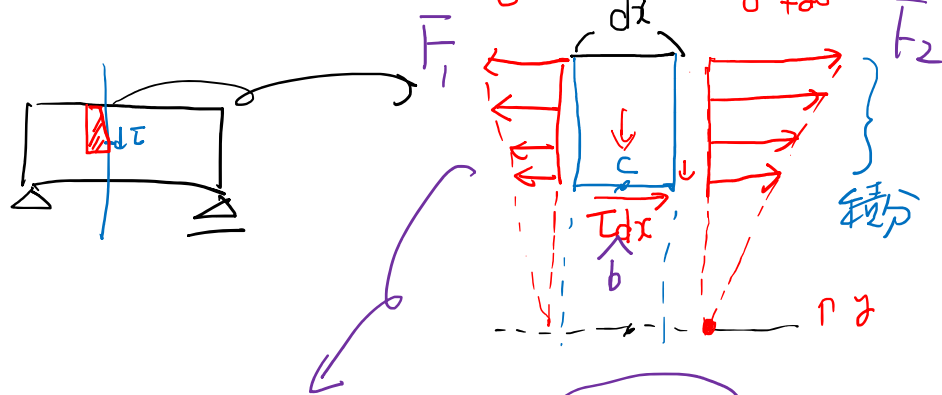


$$\delta = \frac{1}{EI} \int_0^L M dx + \frac{1}{2EI} \int_0^L M dx + \frac{1}{4EI} \int_0^L M dx$$

$$\delta = \frac{1}{EI} \int_0^L M dx + \frac{1}{2EI} \int_L^{2L} M dx + \frac{1}{4EI} \int_{2L}^{3L} M dx$$



< 力の導出 >



$$F_1 = \frac{M}{I} \int y b y dy$$

$$= \frac{M Q}{I}$$

$$F_2 = \frac{(M + dM) Q}{I}$$

$$\sigma = \frac{M}{I} y$$

$$\sigma + d\sigma = \frac{M + dM}{I} y$$

$$F_1 + \tau b dx = F_2$$

$$\tau b dx = \frac{Q}{I} dM$$

$$\therefore \tau = \frac{Q}{I b} \frac{dM}{dx} \quad \checkmark$$