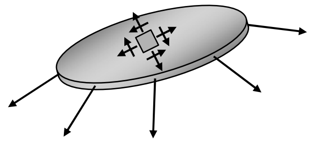
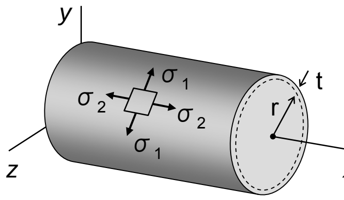
Stresses in Thin-Walled Pressure Vessels
薄肉の圧力容器の応力

球形タンクや円筒形タンク，あるいはパイプライン

内圧としてかかる力は壁に対して直角と考えられる



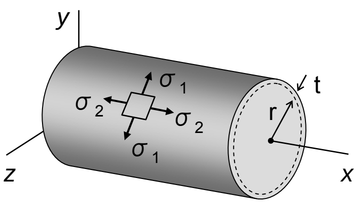
内圧を受けるタンク：内径がr，板厚がt

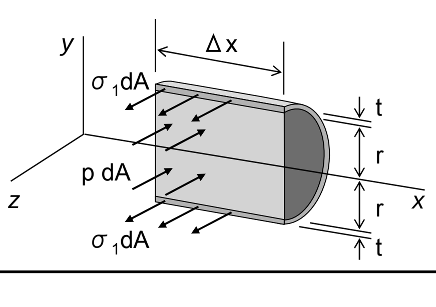


σ_1はhoop stressと呼ばれる
木樽の締め付けバンドに作用する力のよう

Stresses in Thin-Walled Pressure Vessels
薄肉の圧力容器の応力

Hoop stressを求める





$$\sum F_z = 0$$

$$\sigma_1(2t \cdot \Delta x) - p(2r \cdot \Delta x) = 0$$

$$\sigma_1 = \frac{pr}{t}$$

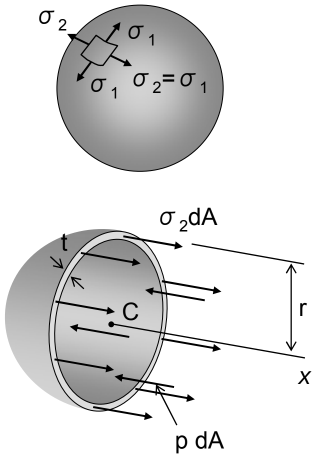
$$\sum F_x = 0$$

$$\sigma_2(2\pi r t) - p(\pi r^2) = 0$$

$$\sigma_2 = \frac{pr}{2t}$$

Stresses in Thin-Walled Pressure Vessels
薄肉の圧力容器の応力

Hoop stressを求める



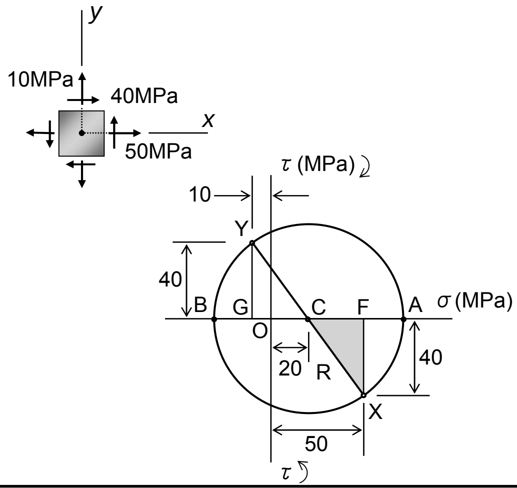
$$\sum F_x = 0$$

$$\sigma_2(2\pi r t) - p(\pi r^2) = 0$$

$$\sigma_1 = \sigma_2 = \frac{pr}{2t}$$

Mohr's Circle for Plane Stress
平面応力下のモールの応力円

Example 7.02
(a) Example 7.01に対してMohrの応力円を描く



$$\sigma_{ave} = \frac{\sigma_x + \sigma_y}{2}$$

$$= \frac{50 + (-10)}{2} = 20\text{MPa}$$

三角形CFXで

$CF = 50 - 20 = 30\text{MPa}$

$FX = 40\text{MPa}$

$$\therefore R = CX = \sqrt{30^2 + 40^2}$$

$$= 50\text{MPa}$$

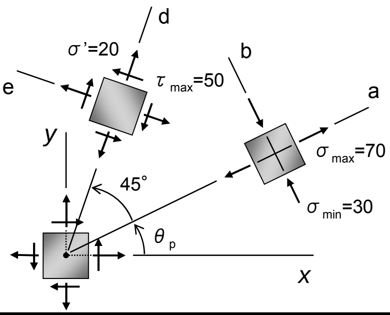
Mohr’s Circle for Plane Stress
平面応力下のモールの応力円

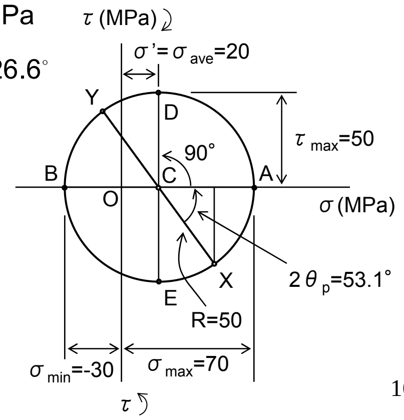
Example 7.02
(b) 主平面と主応力，(c) 最大せん断応力

$$\sigma_{max} = OA = OC + CA = 20 + 50 = 70\,MPa$$

$$\sigma_{min} = OB = OC + BC = 20 - 50 = -30\,MPa$$

$$\tan 2\theta_p = \frac{FX}{CF} = \frac{40}{30} \qquad 2\theta_p = 53.1^\circ \quad \theta_p = 26.6^\circ$$





Yield Criteria for Ductile Materials under Plane Stress　延性材料での降伏条件

Maximum Shearing Stress Criterion

Sec.1.11より，引張試験での最大せん断応力は $\frac{1}{2}\sigma_Y$

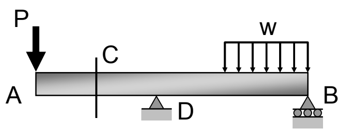
Fracture Criteria for Brittle Materials under Plane Stress　ぜい性材料での破壊条件

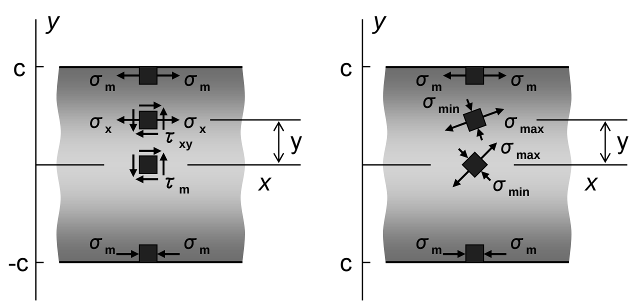
Maximum Normal Stress Criterion

Chapter 8. Principal Stresses under Given Loading

ある荷重下での主応力

Principal Stresses in a Beam
梁の中の主応力

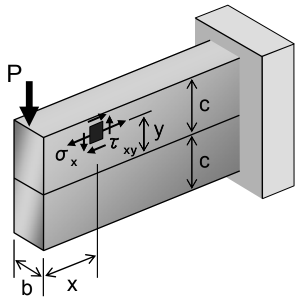




$$\sigma_x = -\frac{My}{I}$$

$$\tau_{xy} = -\frac{VQ}{It}$$

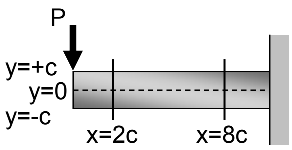
Principal Stresses in a Beam
梁の中の主応力

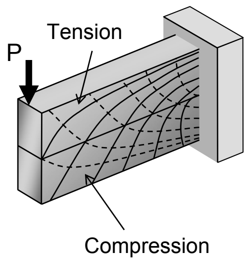


$$I = \frac{bh^3}{12} = \frac{Ac^2}{3}$$

$$\sigma_x = \frac{Pxy}{I} = \frac{Pxy}{Ac^2/3} = \frac{3P}{A}\frac{xy}{c^2}$$

$$\tau_{xy} = \frac{3}{2}\frac{P}{A}\left(1 - \frac{y^2}{c^2}\right)$$





	x=2c		x=8c	
y/c	σ_{min}/σ_m	σ_{max}/σ_m	σ_{min}/σ_m	σ_{max}/σ_m
1.0	0	1.000	0	1.000
0.8	-0.010	0.810	-0.001	0.801
0.6	-0.040	0.640	-0.003	0.603
0.4	-0.090	0.490	-0.007	0.407
0.2	-0.160	0.360	-0.017	0.217
0.0	-0.250	0.250	-0.063	0.063
-0.2	-0.360	0.160	-0.217	0.017
-0.4	-0.490	0.090	-0.407	0.007
-0.6	-0.640	0.040	-0.603	0.003
-0.8	-0.810	0.010	-0.801	0.001
-1.0	-1.000	0	-1.000	0