

1 국제단위계 변환규정

[MKS]단위에서 [SI]단위로 환산

■ 읽기

- G (giga : 기가), M (mega : 메가), k (kilo : 킬로), N (newton)
- GPa : gigapascal, MPa : megapascal, kPa : kilopascal,
kN : kilonewton

■ 힘 하중

- $1\text{kgf} = 9.8\text{N} = 10\text{N}$
- $1\text{tf} = 9.8\text{kN} = 10\text{kN}$



■ 모멘트

- $1\text{kgf} \cdot \text{mm} = 10\text{N} \cdot \text{mm} = 10\text{N} \cdot \text{cm}$
- $1\text{kgf} \cdot \text{cm} = 10\text{N} \cdot \text{cm} = 100\text{N} \cdot \text{mm}$
- $1\text{kgf} \cdot \text{m} = 10\text{N} \cdot \text{m} = 1000\text{N} \cdot \text{cm} = 1\text{kN} \cdot \text{cm}$
- $1\text{tf} \cdot \text{cm} = 10\text{kN} \cdot \text{cm} = 100\text{N} \cdot \text{m}$
- $1\text{tf} \cdot \text{m} = 10\text{kN} \cdot \text{m} = 10000\text{N} \cdot \text{m} = 1000\text{kN} \cdot \text{cm}$

■ 길이당 하중(단위 하중)

- $1\text{kgf}/\text{cm} = 9.8\text{N}/\text{cm} = 10\text{N}/\text{cm} = 1\text{kN}/\text{m}$
- $1\text{kgf}/\text{m} = 9.8\text{N}/\text{m} = 10\text{N}/\text{m}$
- $1\text{tf}/\text{m} = 9800\text{N}/\text{m} = 10000\text{N}/\text{m} = 10\text{kN}/\text{m}$

■ 응력 또는 압력(단위면적당 하중)

- $1\text{kgf/cm}^2 = 9.8\text{N/cm}^2 = 10\text{N/cm}^2 = 0.1\text{N/mm}^2$
 $= 0.1\text{MPa} = 100\text{kN/m}^2 = 100\text{kPa}$
- $1\text{kN/mm}^2 = 1\text{GPa} = 1000\text{N/mm}^2 = 1000\text{MPa}$
- $1\text{kgf/cm}^2 = 9.8\text{N/m}^2 = 10\text{N/m}^2 = 10\text{Pa}(\text{pascal})$
- $1\text{tf/m}^2 = 9.8\text{kN/m}^2 = 10\text{kN/m}^2 = 10\text{kPa}$
- 탄성계수
 $E = 2.1 \times 10^5 \text{kg/cm}^2 \Rightarrow E = 2.1 \times 10^4 \text{MPa}$
 $E = 2.1 \times 10^4 \text{MPa} = 21 \times 10^3 \text{N/mm}^2$
 $E = 21 \times 10^3 \text{MPa} = 21\text{kN/mm}^2 = 21\text{GPa}$

■ 단위 부피당 하중(단위중량)

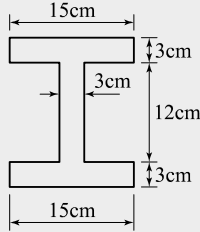
- $1\text{kgf/cm}^3 = 9.8\text{N/cm}^3 = 10\text{N/cm}^3$
- $1\text{kgf/m}^3 = 9.8\text{N/m}^3 = 10\text{N/m}^3$
- $1\text{tf/m}^3 = 9.8\text{kN/m}^2 = 10\text{kN/m}^3$
- $1\text{t/m}^3 = 1\text{g/cm}^3 = 9.8\text{kN/m}^3 = 10\text{kN/m}^3$
- 물의 단위중량 $\gamma_w = 9.8\text{kN/m}^3 = 9.81\text{kN/m}^3$
- 물의 밀도 $\rho_w = 1\text{g/cm}^3 = 1000\text{kg/m}^3$

2 SI단위 변환예시

□□□

01 그림과 같은 단면에 1500kg의 전단력이 작용할 때 최대전단응력의 크기는?

- ① 28.6kg/cm²
- ② 35.2kg/cm²
- ③ 47.4kg/cm²
- ④ 59.5kg/cm²



! 해답 ! ②

$$\tau_{\max} = \frac{G_x S}{I b}$$

$$S = 1500 \text{ kg}, \quad b = 3 \text{ cm}$$

$$\bullet G_x = A_1 y_1 + A_2 y_2$$

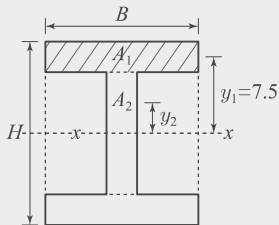
$$= 15 \times 3 \times 7.5 + 3 \times \frac{12}{2} \times \frac{6}{2} = 391.5 \text{ cm}^3$$

$$\bullet I_x = \frac{BH^3}{12} - \frac{bh^3}{12} = \frac{15 \times 18^3}{12} - \frac{12 \times 12^3}{12}$$

$$= 5562 \text{ cm}^4$$

$$\therefore \tau_{\max} = \frac{391.5 \times 1500}{5562 \times 3}$$

$$= 35.2 \text{ kg/cm}^2$$

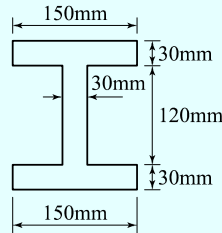


변환
예시

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01 그림과 같은 단면에 15kN의 전단력이 작용할 때 최대전단응력의 크기는?

- ① 2.86MPa
- ② 3.52MPa
- ③ 4.74MPa
- ④ 5.95MPa



! 해답 ! ②

$$\tau_{\max} = \frac{G_x S}{I b}$$

$$S = 15 \text{ kN} = 15 \times 10^3 \text{ N}, \quad b = 30 \text{ mm}$$

$$\bullet G_x = A_1 y_1 + A_2 y_2$$

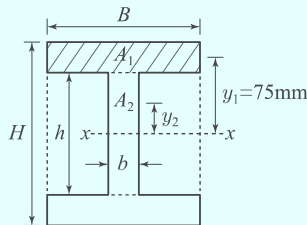
$$= 150 \times 30 \times 75 + 30 \times \frac{120}{2} \times \frac{60}{2} = 391500 \text{ mm}^3$$

$$\bullet I_x = \frac{BH^3}{12} - \frac{bh^3}{12} = \frac{150 \times 180^3}{12} - \frac{120 \times 120^3}{12}$$

$$= 55620000 \text{ mm}^4$$

$$\therefore \tau_{\max} = \frac{391500 \times 15 \times 10^3}{55620000 \times 30}$$

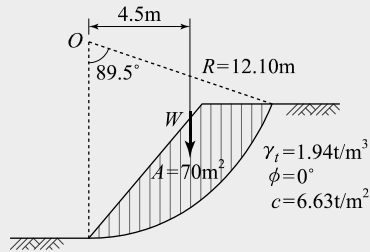
$$= 3.52 \text{ N/mm}^2 = 3.52 \text{ MPa}$$



3 SI단위 변환예시

□□□

01 아래 그림에서 활동에 대한 안전율은?



- ① 1.30 ② 2.05
- ③ 2.15 ④ 2.48

【해답】 ④

$\phi_u = 0$ 일 때 사면의 안전율

$$F_s = \frac{L_a \cdot c_u \cdot R}{W \cdot x}$$

• $W = \text{면적} \times \text{단위 중량}$
 $= 70 \times 1.94 = 135.8 \text{t/m}$

• $L_a : 89.5^\circ = 2\pi R : 360^\circ$

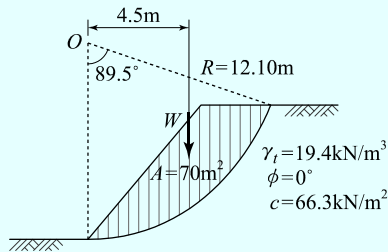
$$L_a = \frac{2\pi \times 12.10 \times 89.5^\circ}{360^\circ} = 18.90 \text{m}$$

$$\therefore F_s = \frac{18.90 \times 6.63 \times 12.10}{135.8 \times 4.5} = 2.48$$

변환
예시

□□□

01 아래 그림에서 활동에 대한 안전율은?



- ① 1.30 ② 2.05
 ③ 2.15 ④ 2.48

| 해답 | ④

$\phi_u = 0$ 일 때 사면의 안전율

$$F_s = \frac{L_a \cdot c_u \cdot R}{W \cdot x}$$

• $W = \text{면적} \times \text{단위 중량}$
 $= 70 \times 19.4 = 1358 \text{ kN/m}$

• $L_a : 89.5^\circ = 2\pi R : 360^\circ$

$$L_a = \frac{2\pi \times 12.10 \times 89.5^\circ}{360^\circ} = 18.90 \text{ m}$$

$$\therefore F_s = \frac{18.90 \times 66.3 \times 12.10}{1358 \times 4.5} = 2.48$$