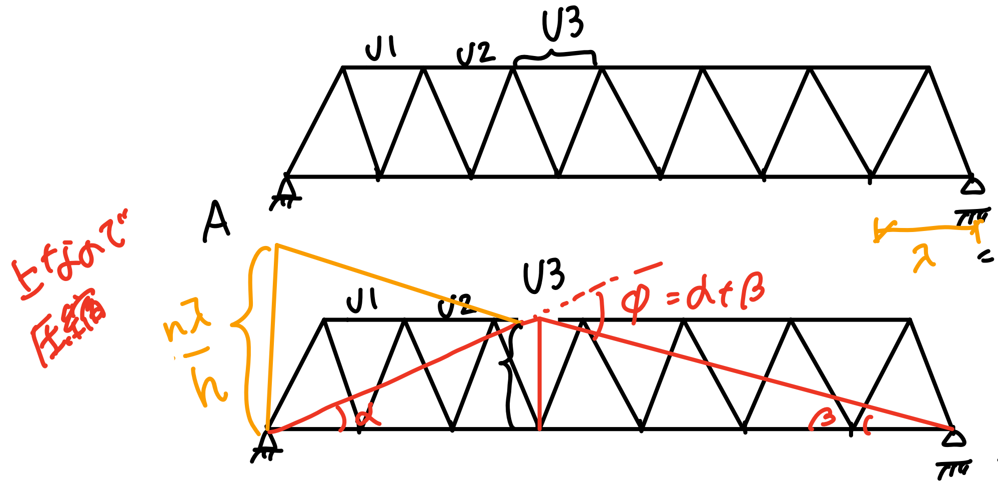
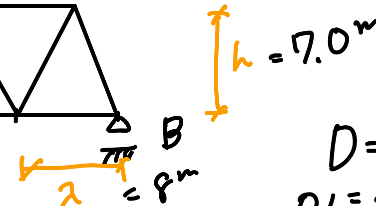
第15回 鋼構造

トラス橋の設計

単純ワーレントラス



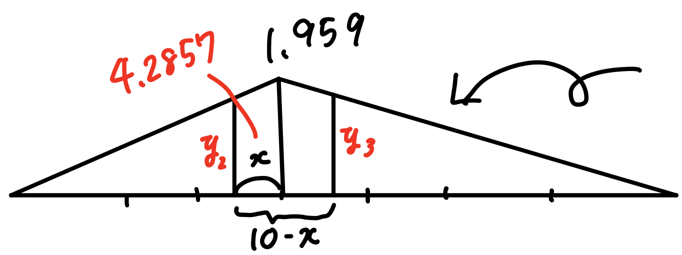


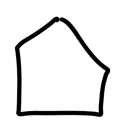
$D = 45\,kN/m$

$p_1 = 40\,kN/m$ ← 10mで橋軸

$p_2 = 10\,kN/m$

$\frac{3\lambda}{h} : 7\lambda = y_1 : 4\lambda$ $\quad y_1 = 4\lambda \cdot \frac{3\lambda}{h} \cdot \frac{1}{7\lambda} = \frac{12\lambda}{7h} = \frac{12 \cdot 8}{7 \cdot 7} = 1.959$





Max → $y_2 = y_3$

$1.959 : 3\lambda = y_2 : 3\lambda - x$ ← λ=8を代入

$1.959 : 4\lambda = y_3 : 4\lambda - (10 - x)$

$y_2 = \frac{(24 - x)}{24} \times 1.959$ $\quad y_3 = \frac{\{32 - (10 - x)\}}{32} \times 1.959$

← $y_2 = y_3$として解く.

$x = 4.2857$ これをy_2, y_3の式に戻してy_2とy_3の値を計算する

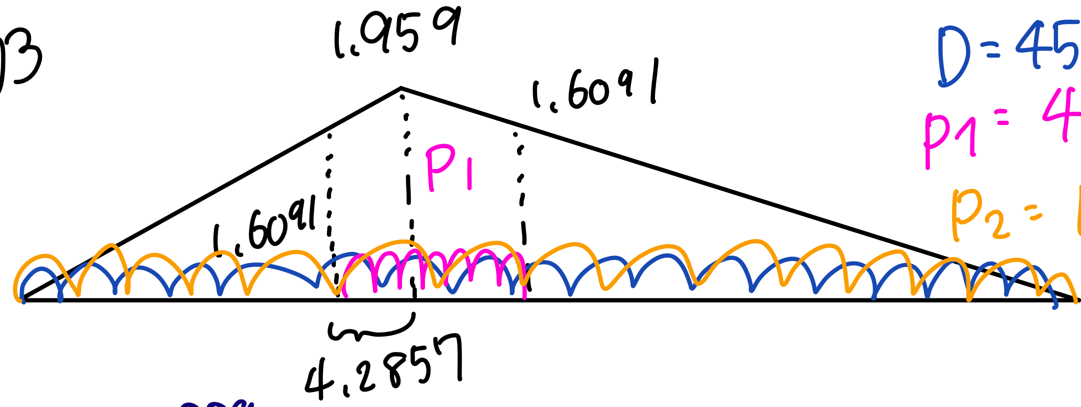
$y_2 = \frac{(24 - 4.2857)}{24} \times 1.959 = 1.6091$

V3

$D = 45\,\mathrm{kN/m}$

$P_1 = 40\,\mathrm{kN/m}$

$P_2 = 10\,\mathrm{kN/m}$

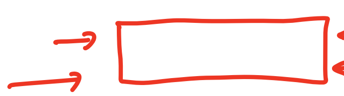


$D = $ (1.959, 7x) $\times 45\,\mathrm{kN/m} = 2468.34\,\mathrm{kN}$

$NL_{p2} = \times 10\,\mathrm{kN/m} = 548.52\,\mathrm{kN}$

$NL_{p1} = $ (1956, 1.609, 10) $\times 40\,\mathrm{kN/m} = \{$ (10) $+$ (1.609, 10) $\} \times 40\,\mathrm{kN/m}$

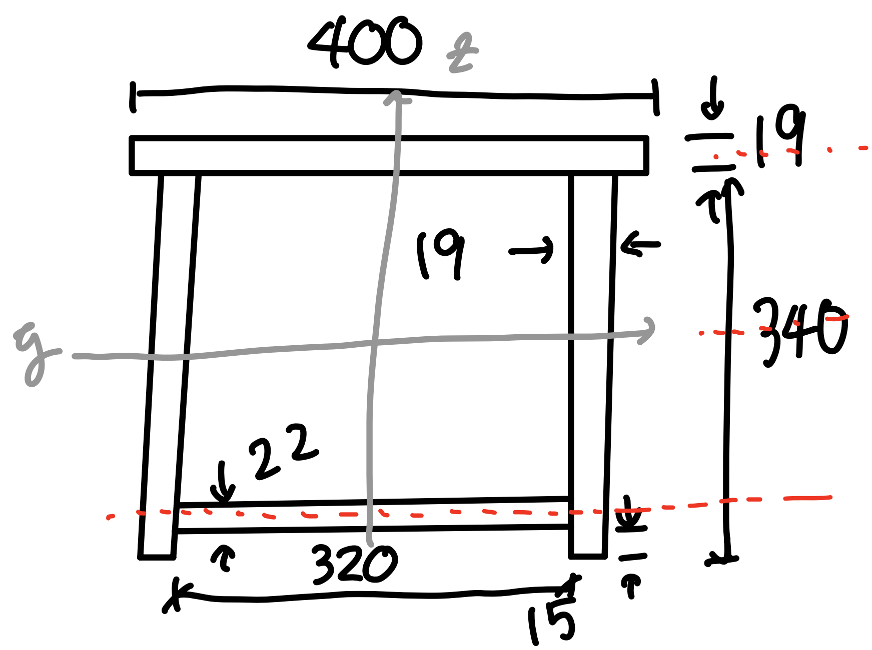
$= 713.60\,\mathrm{kN}$



$\leftarrow D = 2468.34\,\mathrm{kN}$

$\leftarrow L = NL_{p1} + NL_{p2} = 713.60 + 548.52 = 1262.12\,\mathrm{kN}$

SM490Y（降伏応力 355 MPa）



	A	y	Ay	Ay² (I_y)
UFlg (400×19)	7600	-179.5	-1364000	244,874,000
2×Web (2×340×19)	12920	0	0	124,463,000
LFlg (320×22)	7040	144	1014000	145,981,000
SUM	27560		-350000	☆515318000

中立軸を修正する Ay / A (断面一次 / 断面)

$$e = -350000 / 27560 = -12.7^{mm}$$

断面二次モーメントも修正

$$I_y - A \cdot e^2 = 510873000 mm^4$$ ☆ 修正した断面二次

有効座屈長 ⇒ $l_y = 8000^{mm}$

断面二次半径 $r_y = \sqrt{\dfrac{I_y}{A}} = \sqrt{\dfrac{510873000}{27560}} = 136^{mm}$

細長比 $\dfrac{l_y}{r_y} = \dfrac{8000^{mm}}{136^{mm}} = 58.8 < 120$

作用応力 $\sigma = \dfrac{F}{A}$

$$= \frac{\gamma_{p1}\gamma_{q1} N_D + \gamma_{p2}\gamma_{q2} N_L}{A}$$

$$= \frac{1.0 \times 1.05 (2468.34^{kN} \cdot 1000^{N}) + 1.0 \times 1.25 \times (1262.12^{kN} \times 1000^{N})}{27560}$$

$$= 151.28^{N/mm^2}$$

制限値σ_{cud}

$$= \underbrace{\xi_1}_{0.90} \underbrace{\xi_2}_{1.0} \underbrace{\Phi_U}_{0.85} \underbrace{\rho_{crg}}_{0.737} \underbrace{\rho_{crl}}_{1.0} \underbrace{\sigma_{yk}}_{355}$$

E: ヤング率
= 200GPA

$$\lambda = \frac{1}{\pi}\sqrt{\frac{\sigma_{yk}}{E}} \cdot \frac{l_g}{r_g}$$

$$= \frac{1}{\pi}\sqrt{\frac{355\,N/mm^2}{200000\,N/mm^2}} \; \frac{8000}{136} = 0.788$$

$$\rho_{crg} \begin{cases} 1.00 & (\lambda \leqq 0.2) \\ ★\,1.059 - 0.258\lambda - 0.19\lambda^2 & (0.2 \leqq \lambda \leqq 1.0) \\ 1.427 - 1.039\lambda - 0.223\lambda^2 & (\lambda > 1.0) \end{cases}$$

$$\rho_{crg} = 1.059 - 0.258 \cdot (0.788) - 0.19(0.788)^2$$

$$= 0.737$$

$$\sigma_{cud} = 200.1\ N/mm^2$$

$\sigma_{cd} < \sigma_{cud}$

限界状態3を満足する.