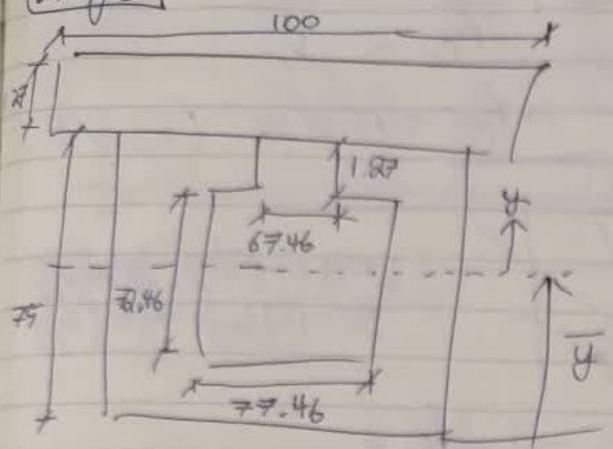
Bridge

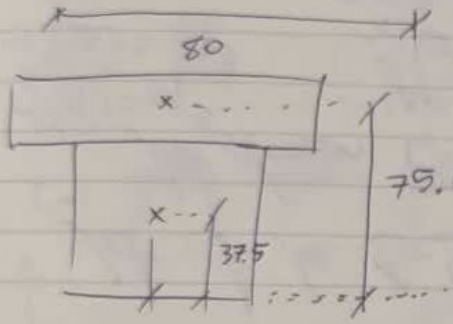
11/05/25

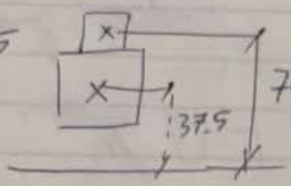


$$\bar{y} = \frac{\sum A_i y_i}{\sum A_i} = \frac{1}{A}\sum A_i y_i$$

$$A = (1.27 \times 100) + (75 \times 80) - 1.27(67.46) - 77.46(72.46)$$
$$= 428.5742 \text{ mm}^2$$

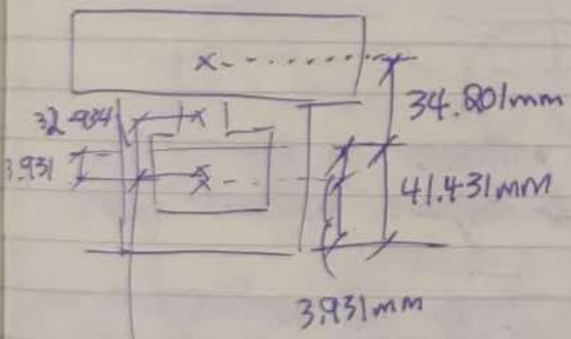
$$\sum A_i y_i = 75(80)(37.5) + 1.27(100)(75.635) - 72.46(77.46)(37.5) - 1.27(67.46)(74.365)$$
$$= 17756.298$$

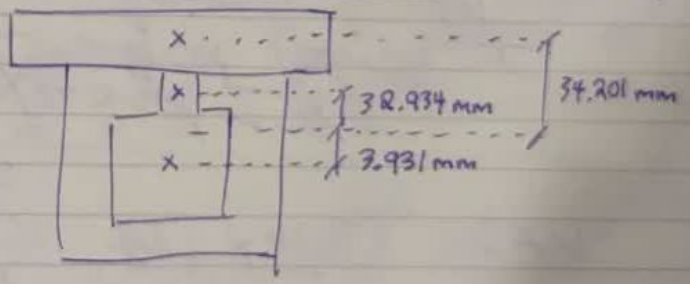




$$\bar{y} = \frac{17756.298}{428.5742} = 41.431094 \text{ mm}$$

$$\boxed{\bar{y} = 41.4 \text{ mm}}$$



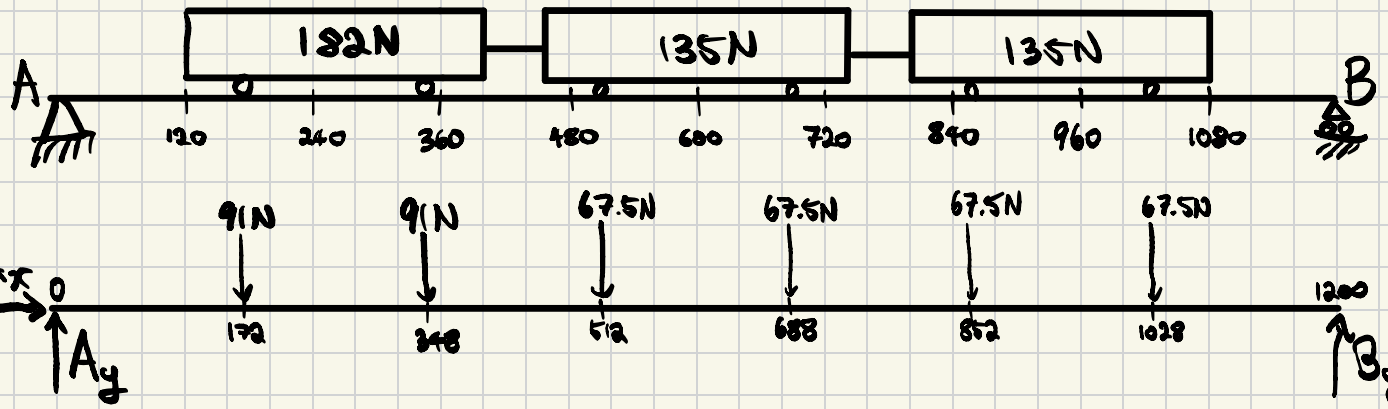


$$I = \frac{1.27^3(100)}{12} + 1.27(100)(34.201)^2 + \frac{80(75)^3}{12} + 80(75)(3.931)^2 - \frac{77.46(72.46)^3}{12} - 77.46(72.46)(3.931)^2$$
$$- \frac{67.46(1.27)^3}{12} - 67.46(1.27)(32.934)^2$$

$$= 418326.14 \text{ mm}^4$$
$$\approx 0.4183 \times 10^6 \text{ mm}^4$$

$$\boxed{I \approx 0.418 \times 10^6 \text{ mm}^4}$$

Check Calculations: $\frac{80(1.27+75)^3}{12} = 2.9 \times 10^6 \text{ mm}^4$ ⇕ seems about right...



+ive

$\sum F_x = 0$

$0 = A_x$

$\sum F_y = 0$

$0 = A_y - 91N - 91N - 67.5N - 67.5N - 67.5N - 67.5N - B_y$

$A_y + B_y = 452N$

$\sum M_A = 0$

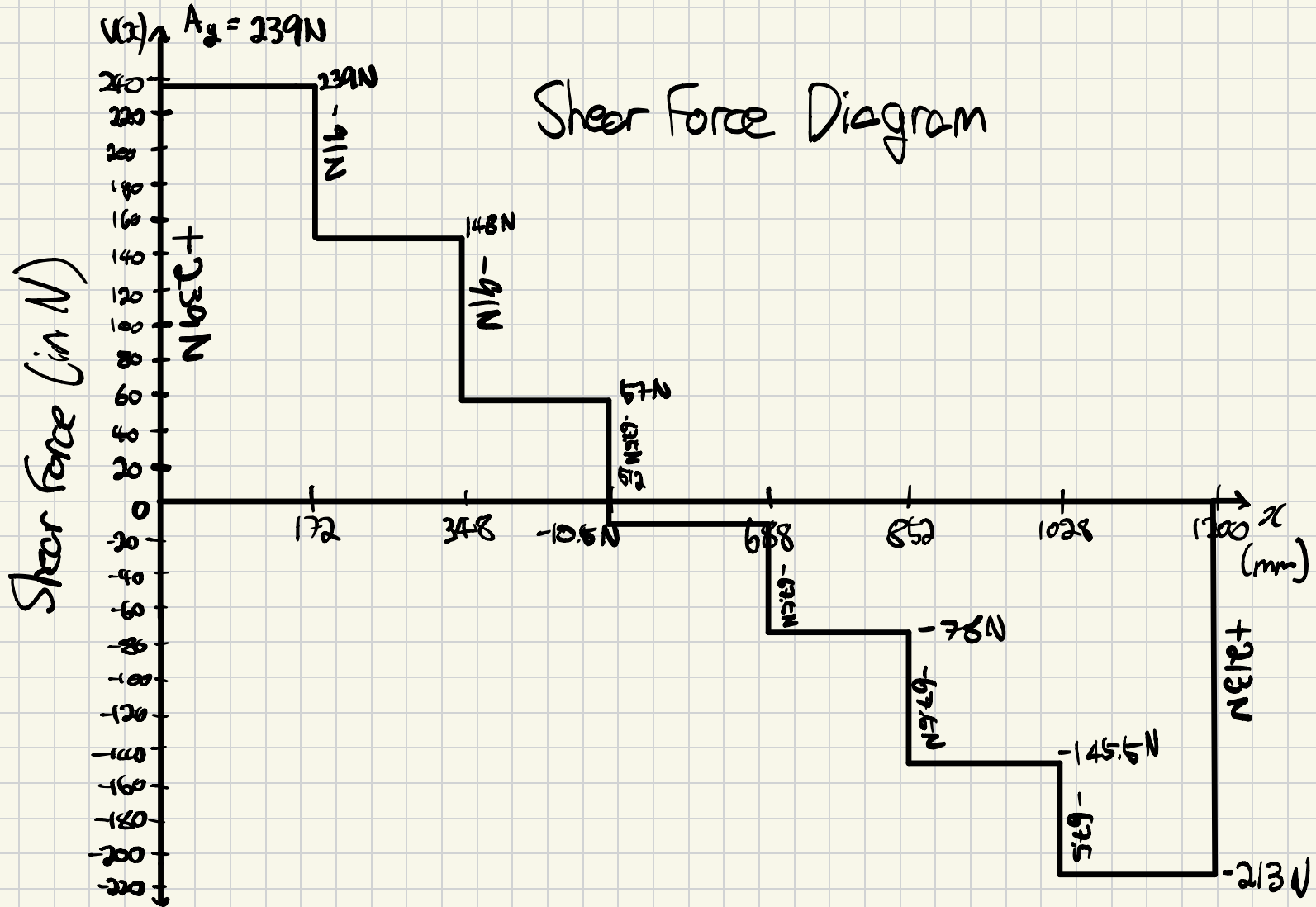
$0 = 91N \cdot 172mm - 91N \cdot 348mm - 67.5N \cdot 512mm - 67.5 \cdot 688mm - 67.5N \cdot 852mm - 67.5N \cdot 1028mm + B_y \cdot 1200mm$

$B_y = \frac{-91N \cdot 172mm - 91N \cdot 348mm - 67.5N \cdot 512mm - 67.5 \cdot 688mm - 67.5N \cdot 852mm - 67.5N \cdot 1028mm}{-1200mm}$

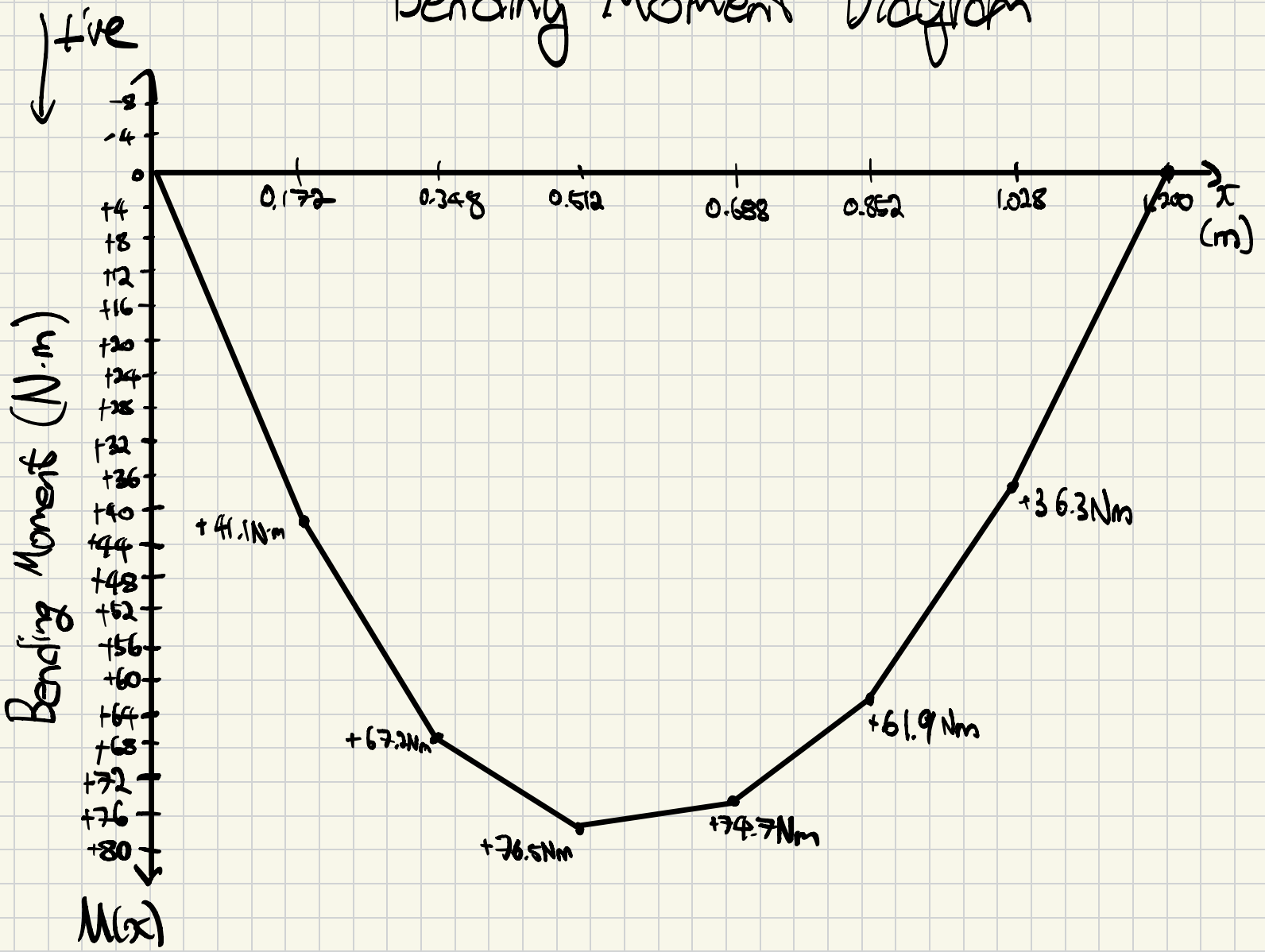
$= 213N$

$A_y = 239N$

Sheer Force Diagram



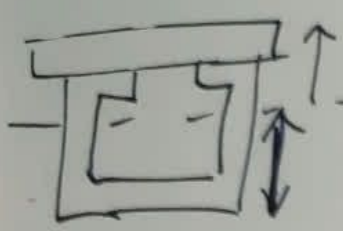
Bending Moment Diagram



11/11/25

CIV Bridge

$\sigma_+ = 30MPa$ $\sigma_c = 6MPa$ $M_{max} = +76.5$



$\bar{y} = 41.4mm$

$75+1.27 = 76.27$

$h - \bar{y} = 76.27 - 41.4$
$= 34.87mm$
$\approx 34.9mm$

M is +ve ∴ top side is in compression.

$$\sigma_{top} = \frac{My}{I} = \frac{76.5\,Nm \times 1000\frac{mm}{m} \times 34.9mm}{0.418 \times 10^6 mm^4}$$

$= 6.3872MPa$

$\approx 6.39MPa$ in compression

$$\sigma_{bot} = \frac{My}{I} = \frac{76.5 \times 1000 \times 41.4}{0.418 \times 10^6}$$

$\sigma_{bot} = 7.5767MPa \approx 7.58MPa$ in tension

$$FoS_{top\ C} = \frac{\sigma_c}{\sigma_{top}} = \frac{6\,MPa}{6.39MPa}$$

$FoS_{comp} \approx 0.93896$

$$FoS_{bot} = \frac{\sigma_c}{\sigma_{bot}} = \frac{30MPa}{7.58MPa} = 3.9577$$

$FoS_{tension} = 3.96$

$FoS_{compression} = 0.939$