

Dimensions ... $t_1 := 5\cdot\text{mm}$... and ... $t_2 := 5\cdot\text{mm}$

$L_1 := 50\cdot\text{mm}$

Let ... $x_b := 20\cdot\text{mm}$... length along beam

$L(x) := t_1 + x$

Let ... $L_x := L(x_b)$ $L_x = 25\text{ mm}$

Lengths ...

$$s_1 := L_1 - t_2$$

$$s_1 = 45 \text{ mm}$$

$$s_2 := L_1 - 0.5 \cdot t_2$$

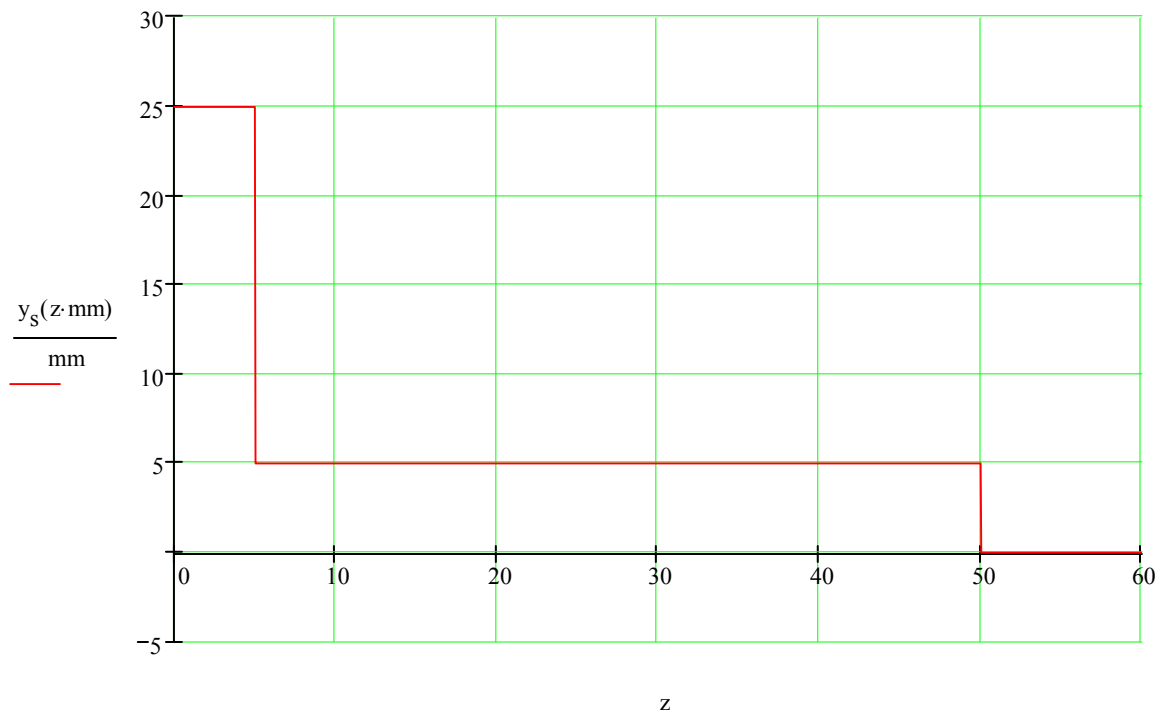
$$s_2 = 47.5 \text{ mm}$$

$$s_3 := L_1 + 0.5 \cdot (t_1 - t_2)$$

$$s_3 = 50 \text{ mm}$$

$$s_4 := L_1 + L_x - 0.5 \cdot (t_1 + t_2) \quad s_4 = 70 \text{ mm}$$

$$y_s(z) := \begin{cases} L_x & \text{if } 0 \cdot \text{mm} \leq z \leq t_2 \\ t_1 & \text{if } t_2 < z \leq L_1 \\ 0 \cdot \text{mm} & \text{otherwise} \end{cases}$$



$$A_S := \int_0^{L_1} y_S(z) \, dz \quad A_S = 350.000 \, \text{mm}^2$$

$$A'_S := (L_1 - t_2) \cdot t_1 + L_X \cdot t_2 \quad A'_S = 350 \, \text{mm}^2$$

$$Ay_S := \int_0^{L_1} \int_0^{y_S(z)} y \, dy \, dz \quad Ay_S = 2125.00 \, \text{mm}^3$$

$$y_{\text{bar}} := \frac{Ay_S}{A_S} \quad y_{\text{bar}} = 6.071 \, \text{mm}$$

$$A'y_S := \frac{(L_1 - t_2) \cdot t_1^2 + L_X^2 \cdot t_2}{2 \cdot [(L_1 - t_2) \cdot t_1 + L_X \cdot t_2]} \quad A'y_S = 6.071 \, \text{mm}$$

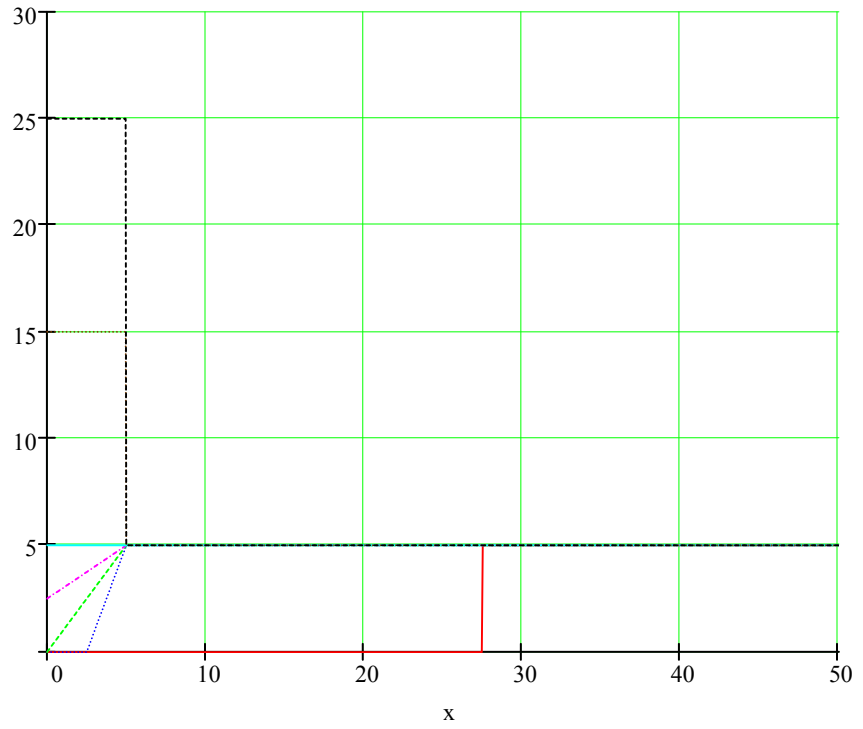
$$Az_S := \int_0^{L_1} \int_0^{y_S(z)} z \, dy \, dz \quad Az_S = 6500 \, \text{mm}^3$$

$$z_{\text{bar}} := \frac{Az_S}{A_S} \quad z_{\text{bar}} = 18.571 \, \text{mm}$$

$$A'z_S := \frac{(L_1 - t_2) \cdot t_1 \cdot (L_1 + t_2) + L_X \cdot t_2^2}{2 \cdot [(L_1 - t_2) \cdot t_1 + L_X \cdot t_2]} \quad A'z_S = 18.571 \, \text{mm}$$

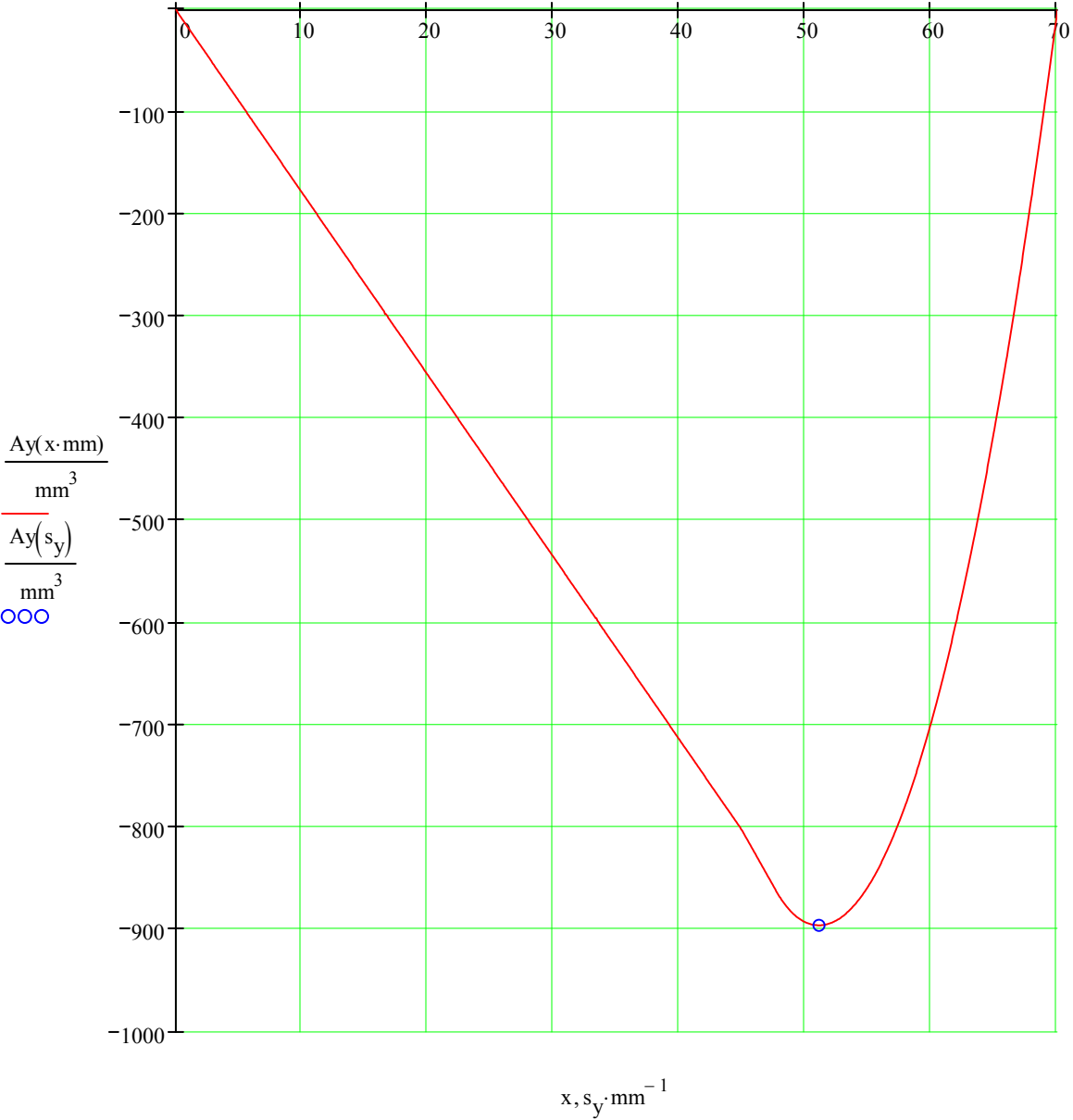
$$\begin{aligned}
 y_s(z, s) := & \left| \begin{array}{l} \text{if } s \leq s_1 \\ \quad \left| \begin{array}{l} 0 \cdot \text{mm} \text{ if } z < L_1 - s \\ t_1 \text{ otherwise} \end{array} \right. \\ \text{if } (s_1 < s \leq s_2) \\ \quad \left| \begin{array}{l} 0 \cdot \text{mm} \text{ if } z < t_2 - 2 \cdot (s - s_1) \\ t_1 \cdot \frac{z - \lceil t_2 - 2 \cdot (s - s_1) \rceil}{2 \cdot (s - s_1)} \text{ if } t_2 - 2 \cdot (s - s_1) \leq z < t_2 \\ t_1 \text{ otherwise} \end{array} \right. \\ \text{if } (s_2 < s \leq s_3) \\ \quad \left| \begin{array}{l} 2 \cdot (s - s_2) + \lceil t_1 - 2 \cdot (s - s_2) \rceil \cdot \frac{z}{t_2} \text{ if } z < t_2 \\ t_1 \text{ otherwise} \end{array} \right. \\ \text{otherwise} \\ \quad \left| \begin{array}{l} s - s_3 + t_1 \text{ if } z < t_2 \\ t_1 \text{ otherwise} \end{array} \right. \end{array} \right.
 \end{aligned}$$

$$\begin{aligned}
 & \text{red line} \quad y_s(x \cdot \text{mm}, 0.5 \cdot s_1) \cdot \text{mm}^{-1} \\
 & \text{blue dotted line} \quad y_s \lceil x \cdot \text{mm}, 0.5 \cdot (s_1 + s_2) \rceil \cdot \text{mm}^{-1} \\
 & \text{green dashed line} \quad \frac{y_s(x \cdot \text{mm}, s_2)}{\text{mm}} \\
 & \text{magenta dash-dot line} \quad y_s \lceil x \cdot \text{mm}, 0.5 \cdot (s_2 + s_3) \rceil \cdot \text{mm}^{-1} \\
 & \text{cyan solid line} \quad y_s(x \cdot \text{mm}, s_3) \cdot \text{mm}^{-1} \\
 & \text{brown dotted line} \quad y_s \lceil x \cdot \text{mm}, 0.5 \cdot (s_3 + s_4) \rceil \cdot \text{mm}^{-1} \\
 & \text{black dashed line} \quad y_s(x \cdot \text{mm}, s_4) \cdot \text{mm}^{-1}
 \end{aligned}$$



$$A_y(s) := \int_0^{L_1} \int_0^{y_s(z,s)} (y - y_{\text{bar}}) \, dy \, dz$$

$$s_y := y_{\text{bar}} - 0.5 \cdot t_1 + s_2 \qquad s_y = 51.071 \text{ mm} \qquad A_y(s_y) = -895.727 \text{ mm}^3$$



$$Az(s) := \int_0^{L_1} \int_0^{y_s(z,s)} (z - z_{\text{bar}}) \, dy \, dz$$

$$s_z := L_1 - z_{\text{bar}} \qquad s_z = 31.429 \text{ mm} \qquad Az(s_z) = 2469.388 \text{ mm}^3$$

