# Verifica nominale della traversa, dei lamoni e dei piastroni

$G_u := 55000\ kgf$

$G_i := 227\ kgf$

$G_g := 180\ kgf$

Dalle tabelle 4.5a - 4.1b

$d_t := 105\ mm$

$A_1 := 220\ mm$

$s_1 := 25\ mm$

$s_2 := 6\ mm$

$l_1 := 190\ mm$

$S_1 := s_1 \cdot \langle A_1 - d_t \rangle = 2875\ mm^2$

$\sigma := \frac{G_u + G_g + G_i}{2 \cdot S_1} = 9.636\ \frac{kgf}{mm^2}$

$\frac{d_t}{A_1} = 0.477$

$\frac{l_1}{A_1} = 0.864$

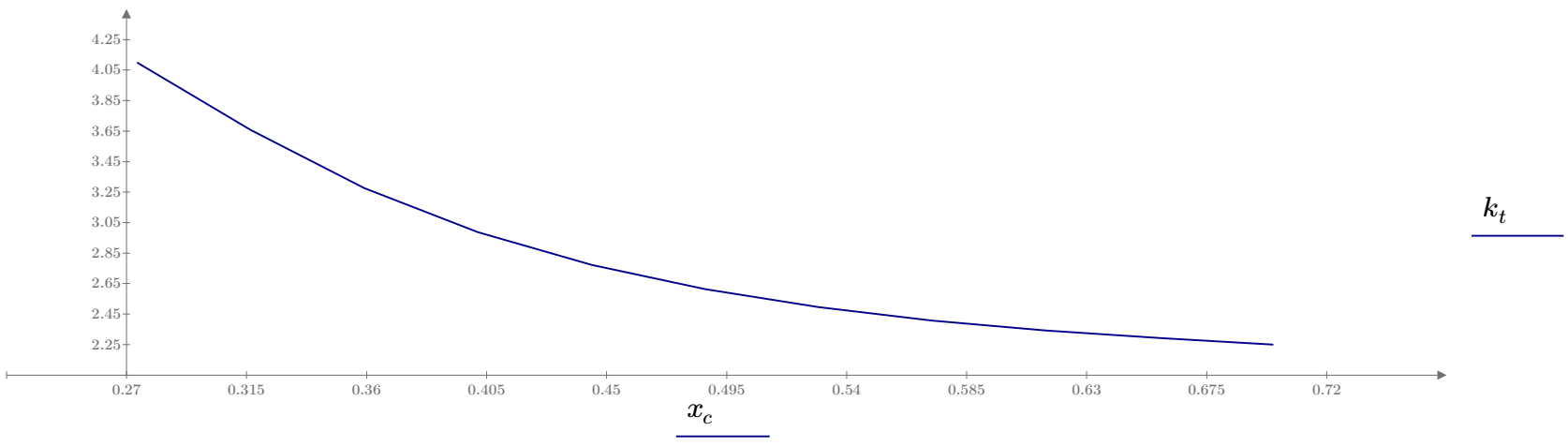
$x := \begin{bmatrix} 0.274 \\ 0.350 \\ 0.450 \\ 0.550 \\ 0.650 \\ 0.7 \end{bmatrix} \qquad y := \begin{bmatrix} 4.1 \\ 3.35 \\ 2.75 \\ 2.45 \\ 2.3 \\ 2.25 \end{bmatrix}$

$y_S := \text{lspline}(x, y)$

$k_t := \text{interp}\left(y_S, x, y, \frac{d_t}{A_1}\right) = 2.647$

$x_c := x_0, x_0 + \frac{x_5 - x_0}{10} .. x_5 = \begin{bmatrix} 0.274 \\ 0.317 \\ 0.359 \\ 0.402 \\ 0.444 \\ 0.487 \\ 0.53 \\ 0.572 \\ 0.615 \\ 0.657 \\ 0.7 \end{bmatrix}$

$k_t := \text{interp}\langle y_S, x, y, x_c \rangle$



# Verifica nominale della traversa, dei lamoni e dei piastroni

$$k_t := \text{interp}\left(y_S, x, y, \frac{d_t}{A_1}\right) = 2.647$$

$$\sigma_{max} := k_t \cdot \sigma = 25.504 \ \frac{kgf}{mm^2}$$

Maggioro s1 e s2 a sensibilità personale

$$k_t = 2.647$$

$$s_1 := 40 \ mm$$

$$s_2 := 30 \ mm$$

$$S_1 := s_1 \cdot \langle A_1 - d_t \rangle = 4600 \ mm^2$$

$$S_2 := s_2 \cdot \langle A_1 - d_t \rangle = 3450 \ mm^2$$

$$\sigma := \frac{G_u + G_i + G_g}{2 \cdot \langle S_1 + S_2 \rangle} = 3.441 \ \frac{kgf}{mm^2}$$

$$\sigma_{max} := k_t \cdot \sigma = 9.109 \ \frac{kgf}{mm^2}$$

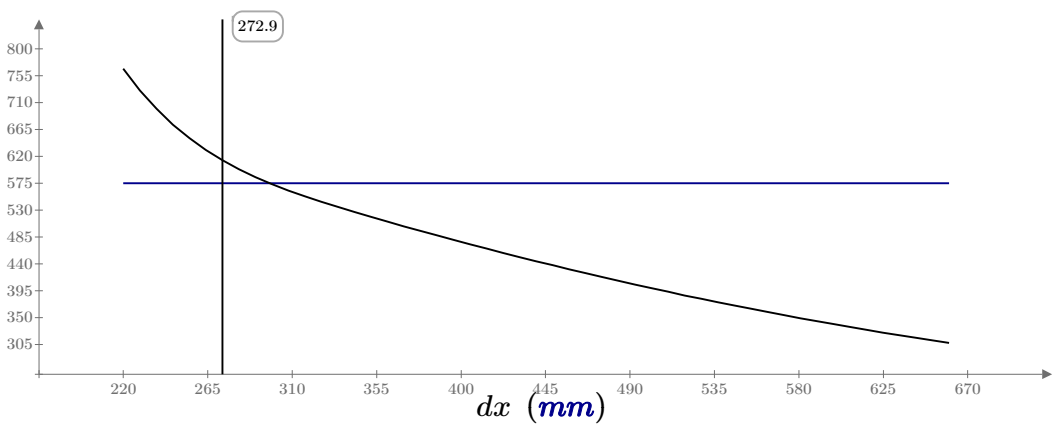
$$f(dx) := \frac{\text{interp}\left(y_S, x, y, \frac{d_t}{A_1}\right)}{s_1 \cdot \langle A_1 - d_t \rangle} - \frac{\text{interp}\left(y_S, x, y, \frac{d_t}{dx}\right)}{s_2 \cdot \langle dx - d_t \rangle}$$

$$dx_1 := A_1 = 220 \ mm$$

$$dx_2 := 3 \ A_1 = 660 \ mm$$

$$dx_S := \text{root}\left(f(dx), dx, dx_1, dx_2\right) = 297.862 \ mm$$

$$dx := dx_1, dx_1 + \frac{dx_2 - dx_1}{50} .. dx_2$$




$$\frac{\text{interp}\left(y_S, x, y, \frac{d_t}{A_1}\right)}{s_1 \cdot \langle A_1 - d_t \rangle} \left(\frac{1}{mm^2}\right)$$

$$\frac{\text{interp}\left(y_S, x, y, \frac{d_t}{dx}\right)}{s_2 \cdot \langle dx - d_t \rangle} \left(\frac{1}{mm^2}\right)$$

$$\sigma_l := \frac{G_u + G_g + G_i}{4 \cdot s_1 \cdot \langle A_1 - d_t \rangle} = 3.011 \ \frac{kgf}{mm^2}$$

$$\sigma_p := \frac{G_u + G_g + G_i}{4 \cdot s_2 \cdot \langle dx_S - d_t \rangle} = 2.394 \ \frac{kgf}{mm^2}$$

$$kt_l := \text{interp}\left(y_S, x, y, \frac{d_t}{A_1}\right) = 2.647$$

$$kt_p := \text{interp}\left(y_S, x, y, \frac{d_t}{dx_S}\right) = 3.329$$

$$\sigma_{maxl} := kt_l \cdot \sigma_l = 7.97 \ \frac{kgf}{mm^2}$$

$$\sigma_{maxp} := kt_p \cdot \sigma_p = 7.97 \ \frac{kgf}{mm^2}$$

$$\alpha := \frac{\pi}{2} - \text{atan}\left(\frac{dx_S - A_1}{2 \cdot l_1}\right) = 78.42 \ deg$$

# Verifica nominale della traversa, dei lamoni e dei piastroni

$a := s_1 + s_2 = 70\ mm$

$B_t := 245\ mm$

$d_2 := 130\ mm$

$c := \frac{B_t + d_2}{2} = 187.5\ mm$

$T := 84\ mm$

$b := \frac{3 \cdot T + 5\ mm - c}{2} = 34.75\ mm$

$I := 3 \cdot T + 5\ mm + 2 \cdot a = 397\ mm$

$q := \frac{G_u + G_g + G_i}{c} = 295.504\ \frac{kgf}{mm}$

$q_p := \frac{G_u + G_g + G_i}{2\ a} = 395.764\ \frac{kgf}{mm}$

$M_{CC} := q_p \cdot \frac{a^2}{2} = 969622.5\ kgf \cdot mm$

$M_{BB} := -q \cdot \frac{c^2}{8} + a \cdot q_p \cdot \left[\frac{c}{2} + b + \frac{a}{2}\right] = 3230920.688\ kgf \cdot mm$

$T_{CC} := q_p \cdot a = 27703.5\ kgf$

$H_t := 130\ mm$

$A_t := 400\ mm$

$d_f := 145\ mm$

$s := \frac{\langle A_t - d_f \rangle}{2}$

$J_{XX} := 2 \cdot \frac{s \cdot H_t^{\ 3}}{12} = 46686250\ mm^4$

$\sigma_{maxBB} := \frac{M_{BB}}{\frac{J_{XX}}{\frac{H_t}{2}}} = 4.498\ \frac{kgf}{mm^2}$

$\sigma_{maxCC} := \frac{M_{CC}}{\pi \cdot \frac{d_t^{\ 3}}{32}} = 8.532\ \frac{kgf}{mm^2}$

$\tau_{maxCC} := \frac{4}{3}\ \frac{T_{CC}}{\pi \cdot \frac{d_t^{\ 2}}{4}} = 4.266\ \frac{kgf}{mm^2}$

$z := 0\ mm, \frac{60}{50}\ mm .. 50\ mm = \begin{bmatrix} 0 \\ \vdots \end{bmatrix} mm$

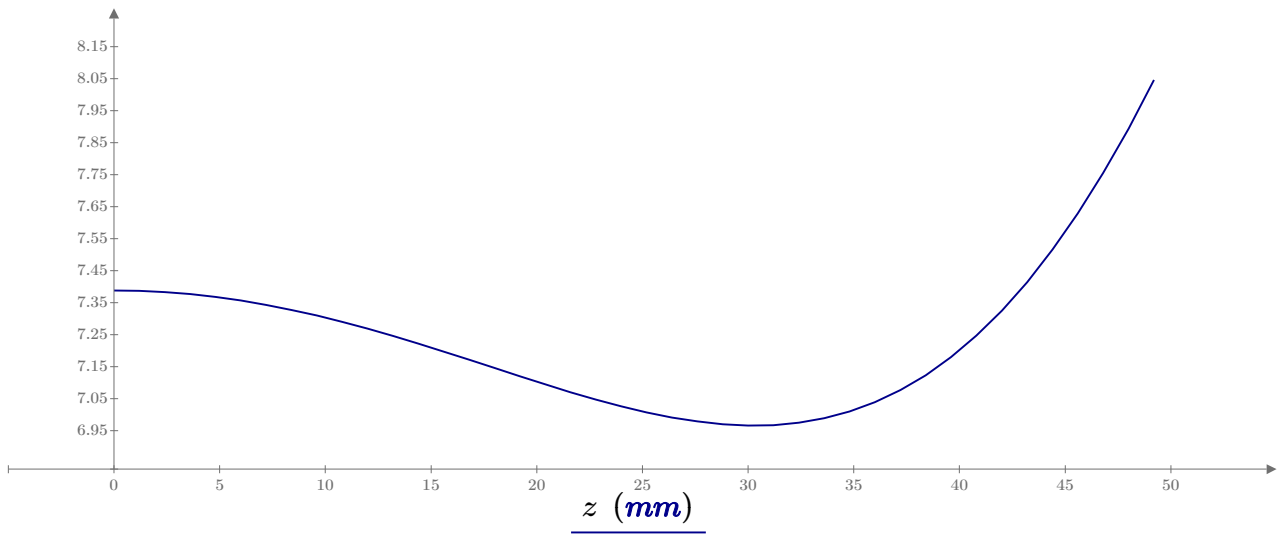
$\tau_{sCC}(z) := \left[\frac{4 \cdot T_{CC}}{3 \cdot \pi \cdot \left(\frac{d_t}{2}\right)^2}\right] \cdot \left[1 - \left(\frac{z}{\frac{d_t}{2}}\right)^2\right]$

$\sigma_{CC}(z) := \frac{M_{CC}}{\pi \cdot \frac{d_t^{\ 4}}{64}} \cdot z$

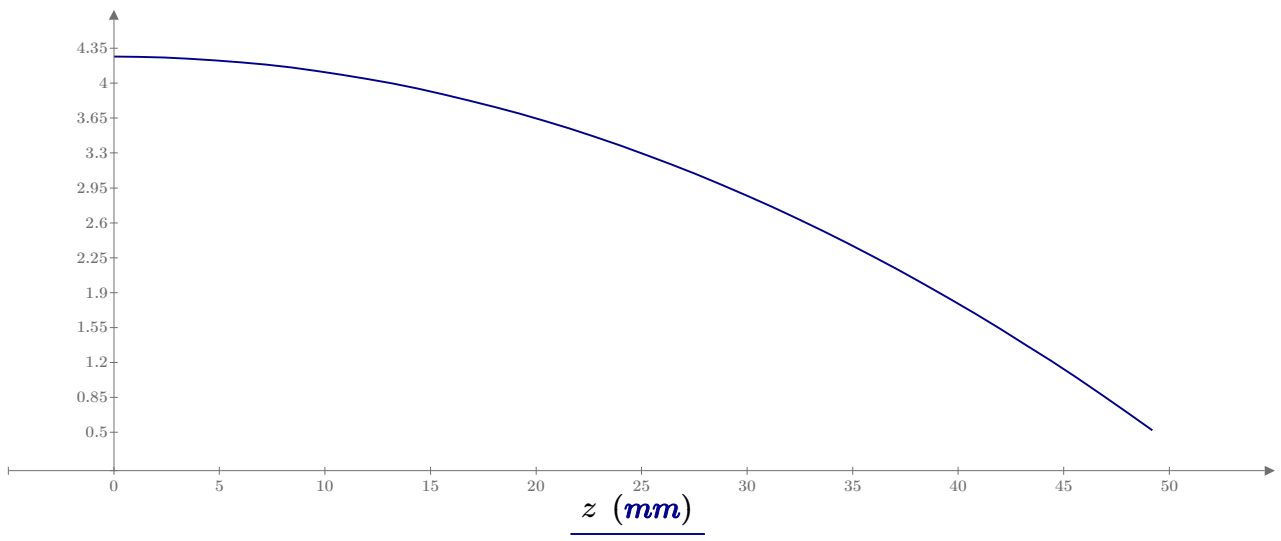
$\sigma_{id}(z) := \sqrt{\sigma_{CC}(z)^2 + 3\ \tau_{sCC}(z)^2}$

Verifica nominale della traversa, dei lamoni e dei piastroni

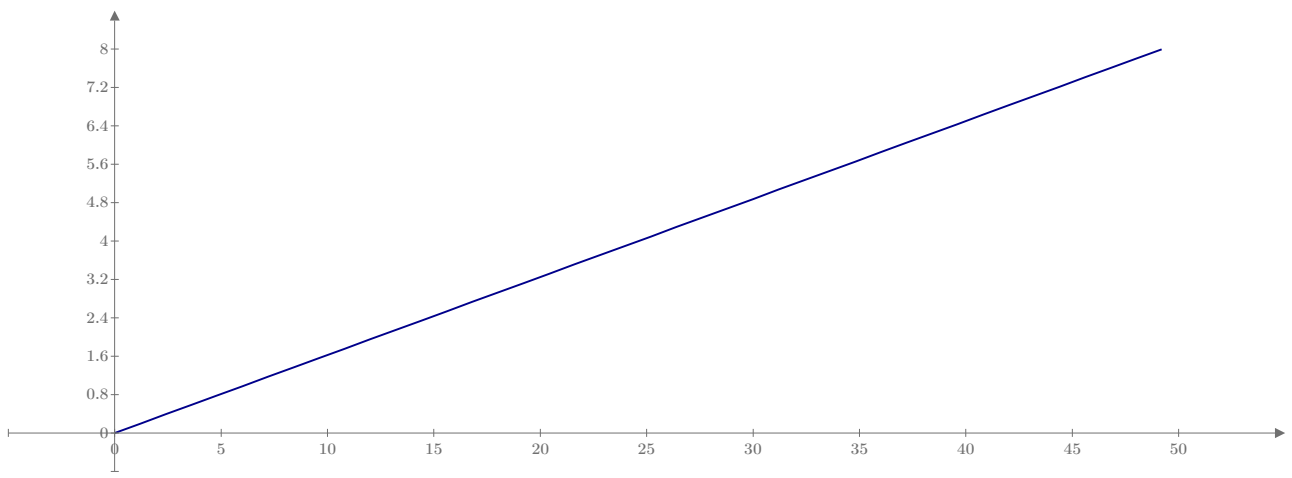
$$\sigma_{id}(z) = \begin{bmatrix} 72457976.31 \\ \vdots \end{bmatrix} \frac{kg}{m \cdot s^2} \qquad \tau_{sCC}(z) = \begin{bmatrix} 41833632.128 \\ \vdots \end{bmatrix} \frac{kg}{m \cdot s^2} \qquad \sigma_{CC}(z) = \begin{bmatrix} 0 \\ \vdots \end{bmatrix} \frac{kg}{m \cdot s^2}$$




$\sigma_{id}(z) \left(\frac{kgf}{mm^2}\right)$




$\tau_{sCC}(z) \left(\frac{kgf}{mm^2}\right)$




$\sigma_{CC}(z) \left(\frac{kgf}{mm^2}\right)$

$$\sigma_{id}\left(\frac{d_t}{2}\right) = 8.532 \ \frac{kgf}{mm^2}$$

$$\frac{a}{d_t} = 0.667$$

$$p := \frac{G_u + G_g + G_i}{2 \cdot a \cdot d_t} = 3.769 \ \frac{kgf}{mm^2}$$

$$\tau_{maxl} := \frac{3}{2} \cdot \frac{G_g + G_u + G_i}{4 \cdot s_1 \cdot \left(l_1 - \frac{d_t}{2}\right)} = 3.778 \ \frac{kgf}{mm^2} \qquad \tau_{maxp} := \frac{3}{2} \cdot \frac{G_g + G_u + G_i}{4 \cdot s_2 \cdot \left(l_1 - \frac{d_t}{2}\right)} = 5.037 \ \frac{kgf}{mm^2}$$

# Verifica nominale della traversa, dei lamoni e dei piastroni

$d_c := 120\ mm$

$\frac{l_1}{A_1} = 0.864 \qquad \frac{d_c}{A_1} = 0.545$

$k_t := \text{interp}\left(\left\langle y_S, x, y, \frac{d_c}{A_1}\right\rangle\right)$

$\sigma := \frac{G_u + G_g + G_i}{2\ \langle s_1 + s_2\rangle \cdot \langle A_1 - d_c\rangle} = 3.958\ \frac{kgf}{mm^2}$

$\sigma_{maxDD} := \sigma \cdot k_t = 9.734\ \frac{kgf}{mm^2}$

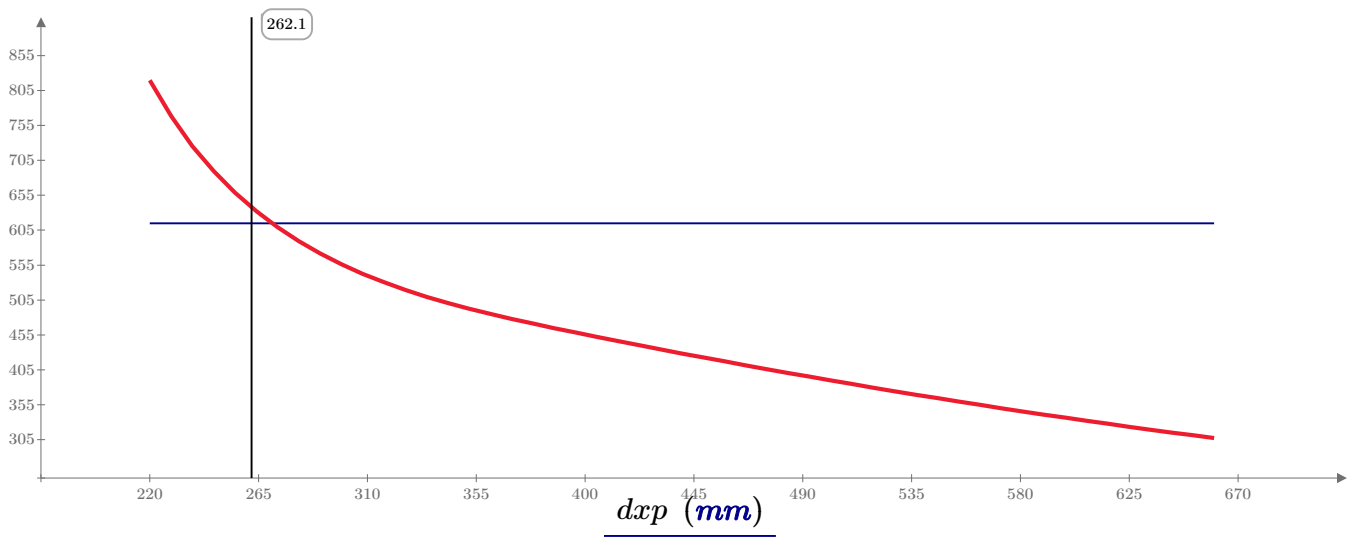
$dx1 := A_1 = 220\ mm$

$dx2 := 3\ A_1 = 660\ mm$

$dxp := dx1, dx1 + \frac{dx2 - dx1}{50} .. dx2$

$f(dxp) := \frac{\text{interp}\left(\left\langle y_S, x, y, \frac{d_c}{A_1}\right\rangle\right)}{s_1 \cdot \langle A_1 - d_c\rangle} - \frac{\text{interp}\left(\left\langle y_S, x, y, \frac{d_c}{dxp}\right\rangle\right)}{s_2 \cdot \langle dxp - d_c\rangle}$

$dxs := \text{root}(f(dxp), dxp, dx1, dx2) = 270.561\ mm$




$\frac{\text{interp}\left(\left\langle y_S, x, y, \frac{d_c}{A_1}\right\rangle\right)}{s_1 \cdot \langle A_1 - d_c\rangle}\ \left(\frac{1}{m^2}\right)$

$\frac{\text{interp}\left(\left\langle y_S, x, y, \frac{d_c}{dxp}\right\rangle\right)}{s_2 \cdot \langle dxp - d_c\rangle}\ \left(\frac{1}{m^2}\right)$

$\sigma_l := \frac{G_u + G_g + G_i}{4 \cdot s_1 \cdot \langle A_1 - d_c\rangle} = 3.463\ \frac{kgf}{mm^2}$

$\sigma_p := \frac{G_u + G_g + G_i}{4 \cdot s_2 \cdot \langle dxs - d_c\rangle} = 3.067\ \frac{kgf}{mm^2}$

$kt_l := \text{interp}\left(\left\langle y_S, x, y, \frac{d_c}{A_1}\right\rangle\right) = 2.46$

$kt_p := \text{interp}\left(\left\langle y_S, x, y, \frac{d_c}{dxs}\right\rangle\right) = 2.777$

$\sigma_{lmax} := kt_l \cdot \sigma_l = 8.517\ \frac{kgf}{mm^2}$

$\sigma_{pmax} := kt_p \cdot \sigma_p = 8.517\ \frac{kgf}{mm^2}$

$y_p := \frac{dxs - A_1}{2} = 25.281\ mm$

# Verifica nominale della traversa, dei lamoni e dei piastroni

$l_2 := 225\ mm$

$\alpha_p := \operatorname{atan}\left(\left|\frac{l_2}{y_p}\right|\right) = 83.589\ deg$

Verifica della sezione E-E

$l_2 = 225\ mm$

$l_2 := 235\ mm$

$s_1 = 40\ mm$

$s_2 = 30\ mm$

$\tau_{maxp} := \frac{3}{2} \cdot \frac{G_g + G_u + G_i}{4 \cdot s_2 \cdot \left(l_2 - \frac{d_c}{2}\right)} = 3.958\ \frac{kgf}{mm^2}$

$\tau_{maxl} := \frac{3}{2} \cdot \frac{G_g + G_u + G_i}{4 \cdot s_1 \cdot \left(l_2 - \frac{d_c}{2}\right)} = 2.968\ \frac{kgf}{mm^2}$