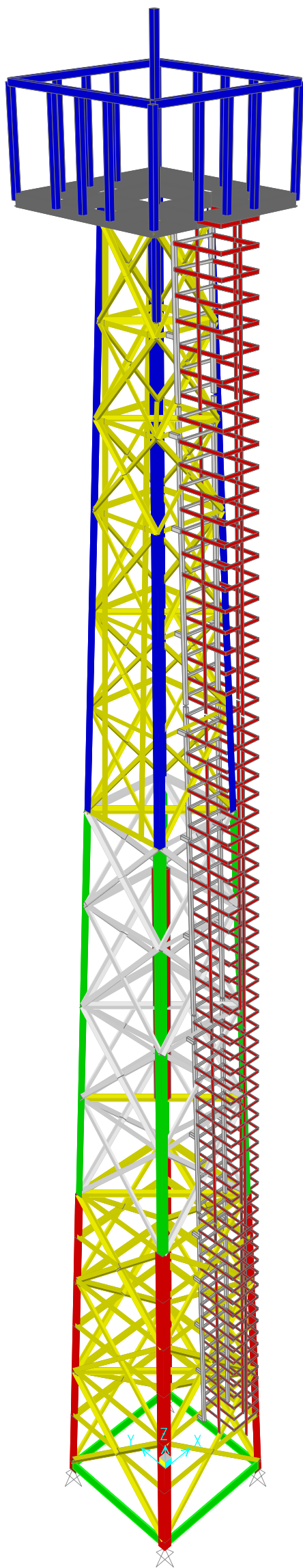
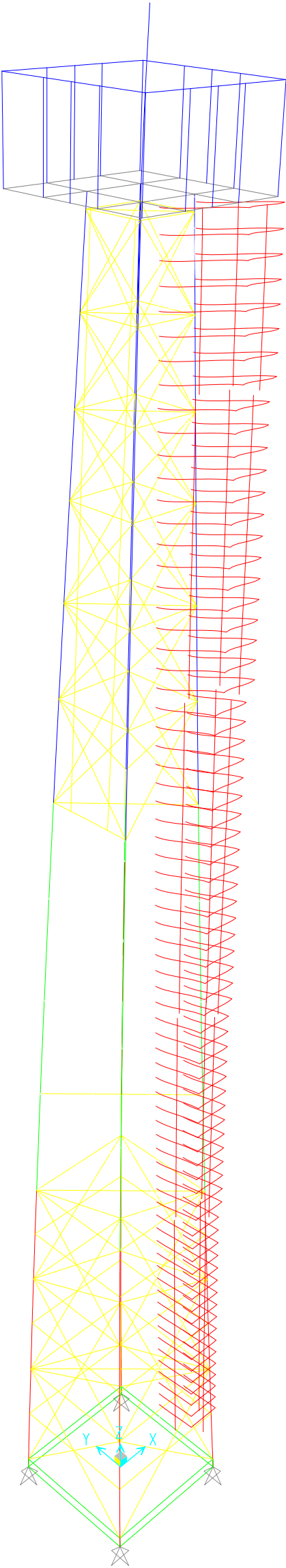


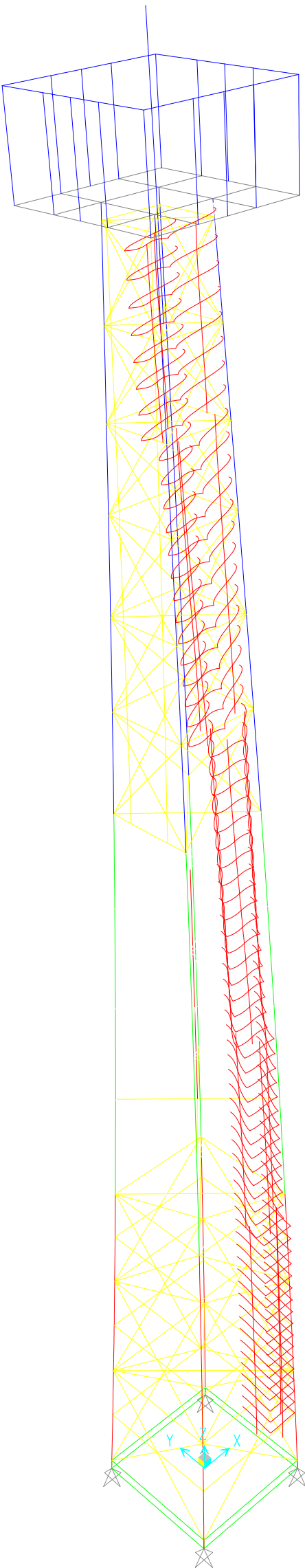
СТАТИЧЕСКИ ИЗЧИСЛЕНИЯ



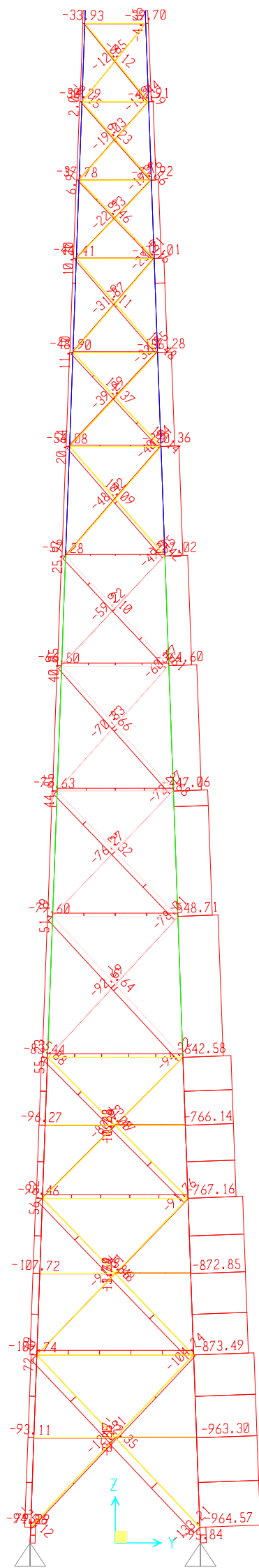
File:Kula 25m, v-25ms - 3-D View - KN, m, C Units



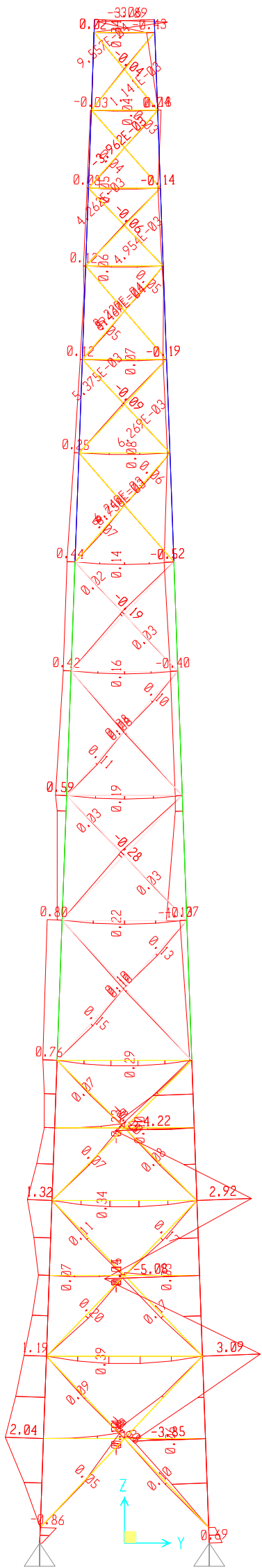
File:Kula 25m, v-25ms - Deformed Shape (MODAL) - Mode 1 - T = 0.30993; f = 3.22652 - KN, m, C Units



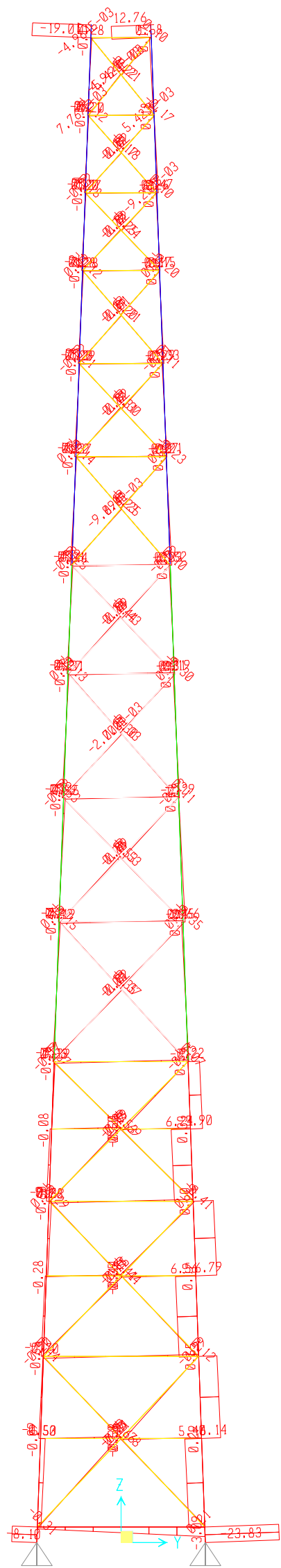
File:Kula 25m, v-25ms - Deformed Shape (MODAL ICE) - Mode 1 - T = 0.89725; f = 1.11451 - KN, m, C Units



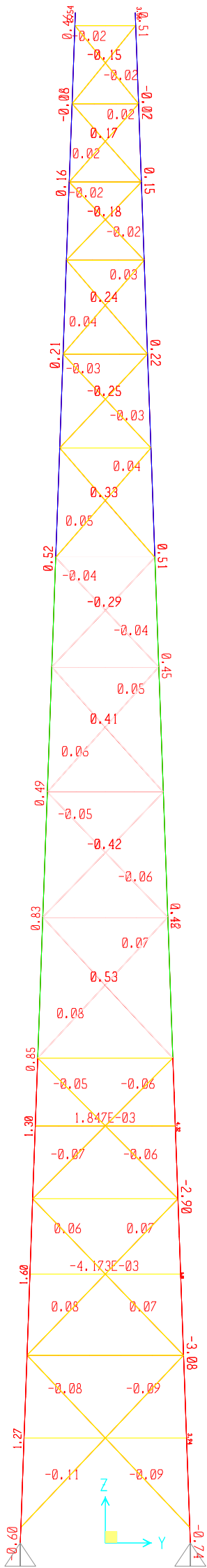
File:Kula 25m, v-25ms - Axial Force Diagram (COMB_Wind(Ice)_45o+TEMP) - KN, m, C Units



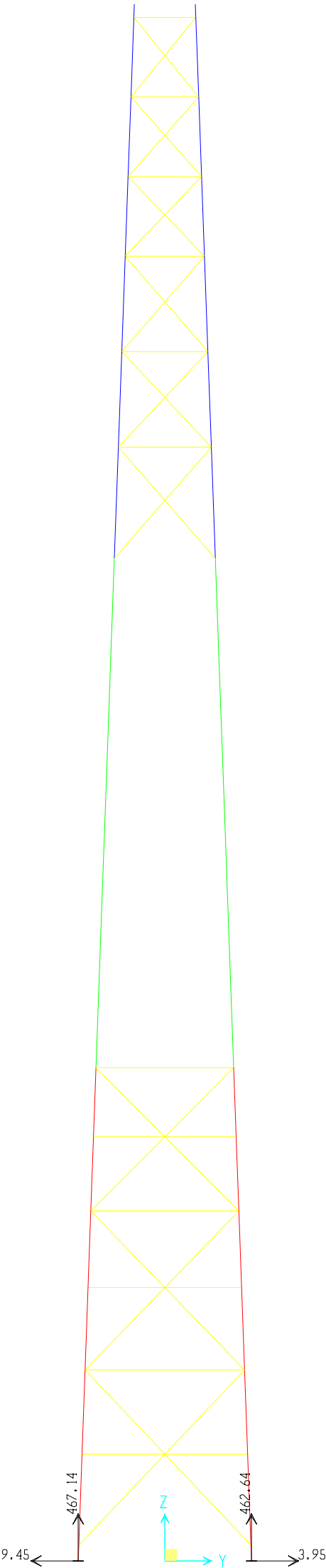
File:Kula 25m, v-25ms - Moment 3-3 Diagram (COMB_Wind(Ice)_45o+TEMP) - KN, m, C Units



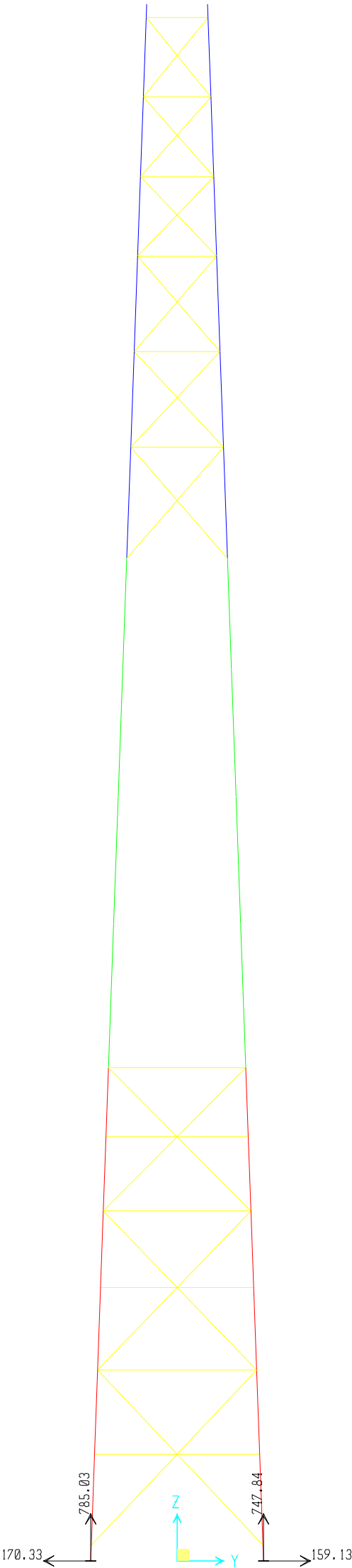
File:Kula 25m, v=25m/s - Shear Force 2-2 Diagram (COMB_Wind(Ice)_45o) - KN, m, C Units



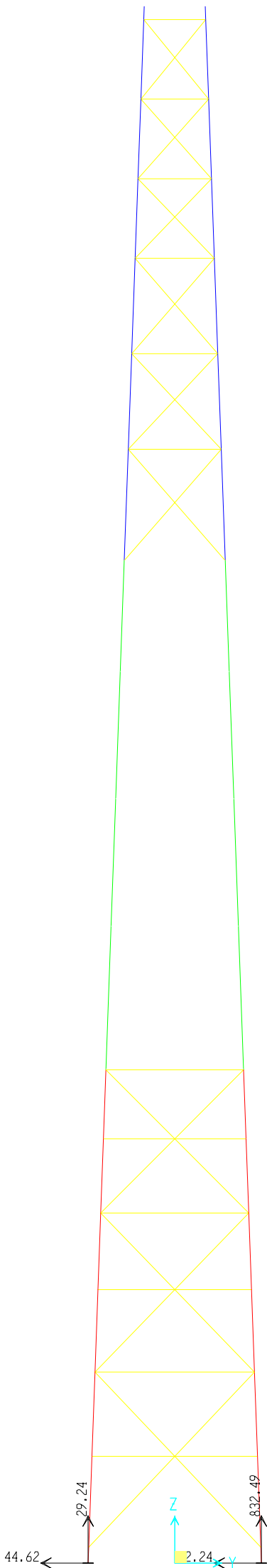
File:Kula 25m, v-25ms - Moment 2-2 Diagram (COMB_Wind(Ice)_45o+TEMP) - KN, m, C Units



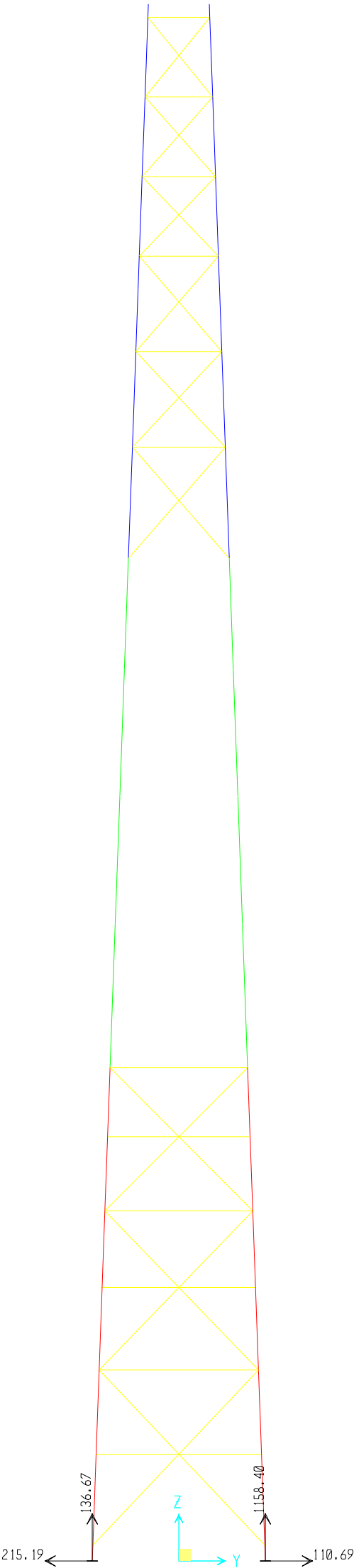
File:Kula 25m, v-25ms - Joint Reactions (COMB_Wind_X) - KN, m, C Units



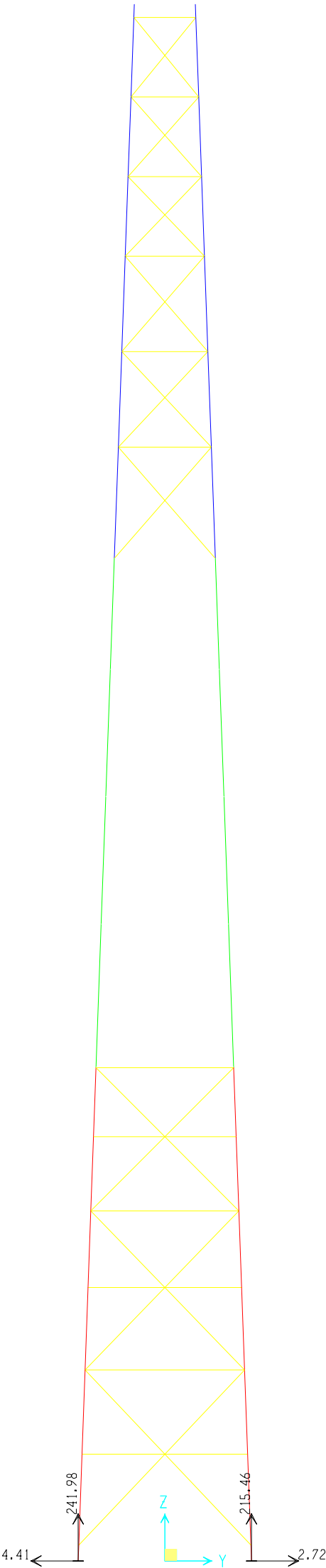
File:Kula 25m, v-25ms - Joint Reactions (COMB_Wind(Ice)_X+TEMP) - KN, m, C Units



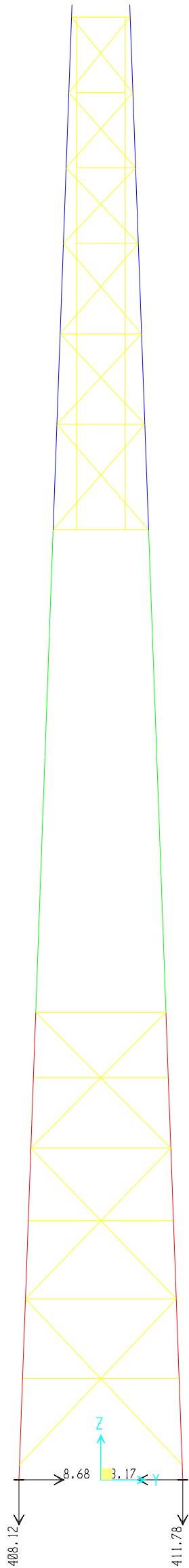
File:Kula 25m, v-25ms - Joint Reactions (COMB_Wind_45o) - KN, m, C Units



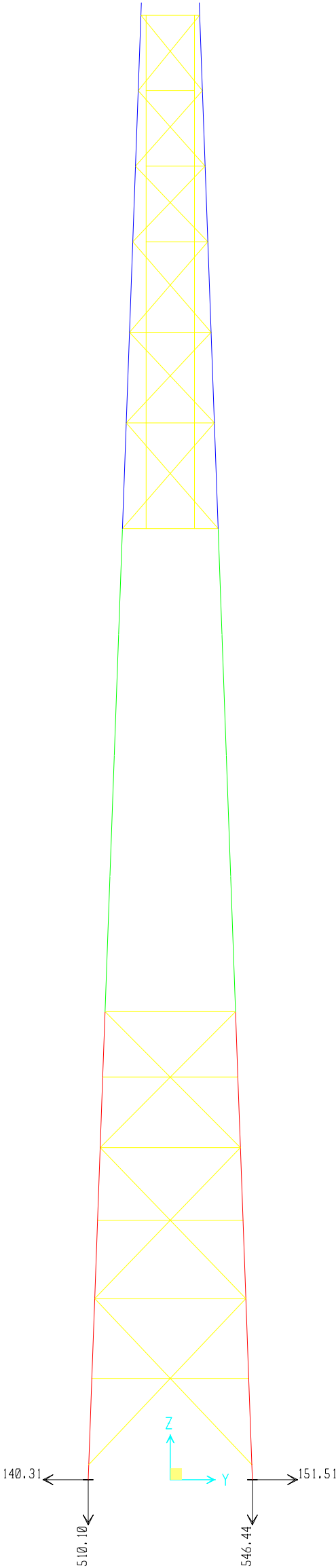
Kula 25m, v-25ms - Joint Reactions (COMB_Wind(Ice)_45o+TEMP) - KN, m, C Units



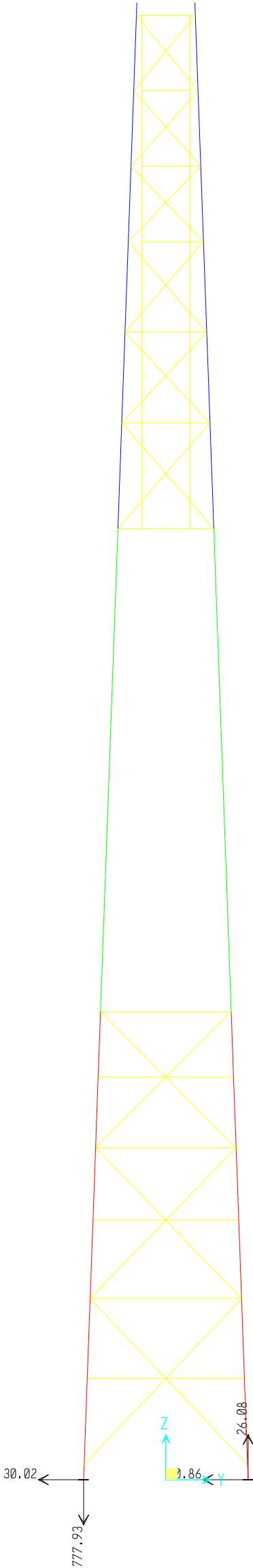
File:Kula 25m, v-25ms - Joint Reactions (SEIZM_COMB) - KN, m, C Units



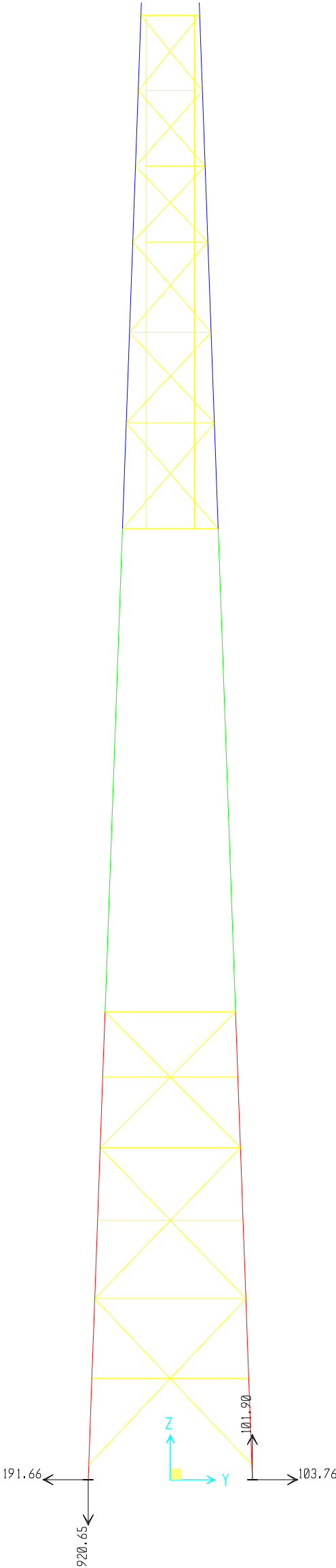
File:Kula 25m, v-25ms - Joint Reactions (COMB_Wind_X) - KN, m, C Units



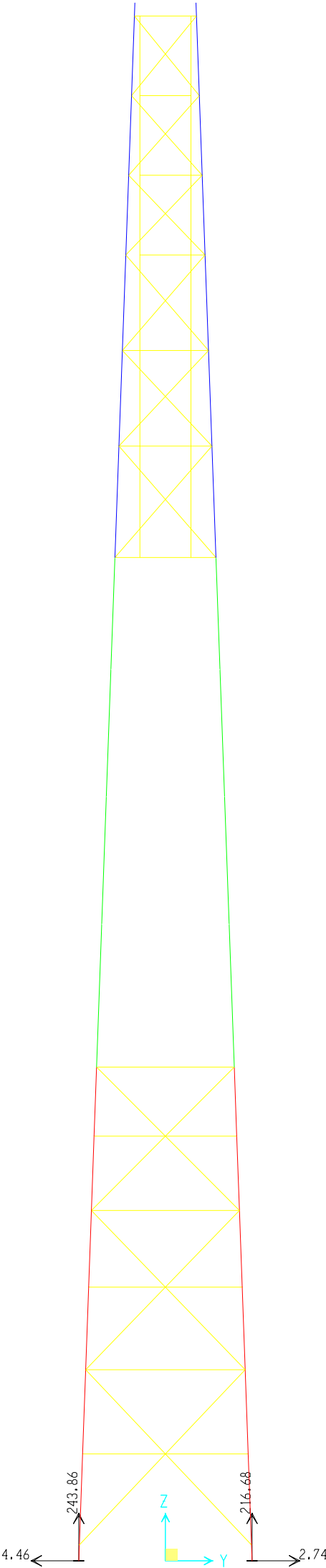
File:Kula 25m, v-25ms - Joint Reactions (COMB_Wind(Ice)_X+TEMP) - KN, m, C Units



File:Kula 25m, v-25ms - Joint Reactions (COMB_Wind_45o) - KN, m, C Units



File:Kula 25m, v-25ms - Joint Reactions (COMB_Wind(lce)_45o+TEMP) - KN, m, C Units



File:Kula 25m, v-25ms - Joint Reactions (SEIZM_COMB) - KN, m, C Units

Оразмеряване на първият дял на колоната

$$R_y := 35.5 \frac{\text{kN}}{\text{cm}^2}$$

$$E := 2.06 \times 10^8 \frac{\text{kN}}{\text{m}^2}$$

$$N_{on} := 810 \text{ kN}$$

$$N_H := 964.2 \text{ kN}$$

$$M_x := 5.45 \text{ kN} \cdot \text{m}$$

$$M_y := 0 \text{ kN} \cdot \text{m}$$

Прието сечение L - 180.180.14

$$\gamma_c := 0.9$$

$$A_w := 48.8 \text{ cm}^2$$

$$W_x := 96.13 \text{ cm}^3$$

$$W_y := 0 \text{ cm}^3$$

$$i := 3.54 \text{ cm}$$

Проверка на якост

$$A_{nt} := A$$

$$W_{xnt.min} := W_x$$

$$W_{ynt.min} := W_y$$

$$A_f := 18 \text{ cm} \cdot 1.4 \text{ cm}$$

$$A_f = 25.2 \text{ cm}^2$$

$$A_w := 18 \text{ cm} \cdot 1.4 \text{ cm}$$

$$A_w = 25.2 \text{ cm}^2$$

$$\frac{A_f}{A_w} = 1$$

$n := 1.5$ - виж: Чл.111, Таблица 8 от [НПСК]

$$c_x := 1.12$$

$$c_y := 1.6$$

$$\left(\frac{\max(N_{on}, N_H)}{A_{nt} \cdot \gamma_c \cdot R_y} \right)^n + \frac{M_x}{c_x \cdot W_{xnt.min} \cdot \gamma_c \cdot R_y} + \frac{M_y}{c_y \cdot W_{ynt.min} \cdot \gamma_c \cdot R_y} = 0.64 < 1$$

Проверка на устойчивост

$$L_{ef} := 1.7 \text{ m}$$

$$\lambda := \frac{L_{ef}}{i}$$

$$\lambda = 48$$

$$\lambda_- := \lambda \cdot \sqrt{\frac{R_y}{E}}$$

$$\lambda_- = 1.99$$

$$M := \sqrt{M_x^2 + M_y^2}$$

$$e := \frac{M}{N_H}$$

$$e = 0.6 \text{ cm}$$

$$W_c := 96.13 \text{ cm}^3$$

- съпротивителен момент за най-силно натиснатото влакно

$$m_1 := e \cdot \frac{A}{W_c}$$

$$\frac{A_f}{A_w} = 1$$

$$m_1 = 0.29$$

$$\lambda_- = 1.99$$

- виж: виж Таблица 60 на приложение 4 от [НПСК]

$$\eta := 1.28$$

$$m_{ef} := \eta \cdot m_1$$

$$m_{ef} = 0.37$$

$$\lambda_- = 1.99$$

		m_{ef1}	m_{ef}	m_{ef2}
		0.25	0.37	0.5
λ_{-1}	1.50	0.804	0.762	0.716
λ_-	1.99	0.743	0.701	0.654
λ_{-2}	2.00	0.742	0.699	0.653

- виж: виж Таблица 61 на приложение 4 от [НПСК]

$$\phi_e := 0.743$$

$$\frac{N_H}{\phi_e \cdot A \cdot \gamma_c \cdot R_y} = 0.83 < 1$$

Проверка на елемента, като центрично натиснат

Проверка на якост

$$A_{nt} := A$$

$$\frac{\max(N_{on}, N_H)}{A_{nt} \cdot \gamma_c \cdot R_y} = 0.62 < 1$$

Проверка на устойчивост

$$L_{ef} := 1.7m$$

$$\lambda := \frac{L_{ef}}{i} \quad \lambda = 48$$

$$\lambda_- := \lambda \cdot \sqrt{\frac{R_y}{E}} \quad \lambda_- = 1.99$$

$$\phi := \begin{cases} \left[1 - \left(0.073 - 5.53 \cdot \frac{R_y}{E} \right) \lambda_- \cdot \sqrt{\lambda_-} \right] & \text{if } 0 < \lambda_- \leq 2.5 \\ \left[1.47 - 13 \cdot \frac{R_y}{E} - \left(0.371 - 27.3 \cdot \frac{R_y}{E} \right) \cdot \lambda_- + \left(0.0275 - 5.53 \cdot \frac{R_y}{E} \right) \cdot \lambda_-^2 \right] & \text{if } 2.5 < \lambda_- \leq 4.5 \\ \frac{332}{\lambda_-^2 \cdot (51 - \lambda_-)} & \text{otherwise} \end{cases}$$

$$\phi = 0.82$$

$$\frac{N_H}{A \cdot \phi \cdot \gamma_c \cdot R_y} = 0.75 < 1$$

Оразмеряване на вторият дял на колоната

Сечение 1

$$R_y := 35.5 \frac{\text{kN}}{\text{cm}^2}$$

$$E := 2.06 \times 10^8 \frac{\text{kN}}{\text{m}^2}$$

$$N_{on} := 505 \text{ kN}$$

$$N_H := 642.6 \text{ kN}$$

$$M_x := 0.6 \text{ kN} \cdot \text{m}$$

$$M_y := 0 \text{ kN} \cdot \text{m}$$

Прието сечение

$$L - 140.140.14$$

$$\gamma_c := 0.9$$

$$A_w := 37.03 \text{ cm}^2$$

$$W_x := 48.93 \text{ cm}^3$$

$$W_y := 0 \text{ cm}^3$$

$$i := 2.72 \text{ cm}$$

Проверка на якост

$$A_{nt} := A$$

$$W_{xnt.min} := W_x$$

$$W_{ynt.min} := W_y$$

$$A_f := 14 \text{ cm} \cdot 1.4 \text{ cm}$$

$$A_f = 19.6 \text{ cm}^2$$

$$A_w := 14 \text{ cm} \cdot 1.4 \text{ cm}$$

$$A_w = 19.6 \text{ cm}^2$$

$$\frac{A_f}{A_w} = 1$$

$$n := 1.5 \quad - \text{виж: Чл.111, Таблица 8 от [НПСК]}$$

$$c_x := 1.12$$

$$c_y := 1.6$$

$$\left(\frac{\max(N_{on}, N_H)}{A_{nt} \cdot \gamma_c \cdot R_y} \right)^n + \frac{M_x}{c_x \cdot W_{xnt.min} \cdot \gamma_c \cdot R_y} + \frac{M_y}{c_y \cdot W_{ynt.min} \cdot \gamma_c \cdot R_y} = 0.43 < 1$$

Проверка на устойчивост

$$L_{ef} := 2.24 \text{ m}$$

$$\lambda := \frac{L_{ef}}{i}$$

$$\lambda = 82$$

$$\lambda_- := \lambda \cdot \sqrt{\frac{R_y}{E}}$$

$$\lambda_- = 3.42$$

$$M := \sqrt{M_x^2 + M_y^2}$$

$$e := \frac{M}{N_H}$$

$$e = 0.1 \text{ cm}$$

$$W_c := 48.93 \text{ cm}^3$$

- съпротивителен момент за най-силно натиснатото влакно

$$m_1 := e \cdot \frac{A}{W_c}$$

$$\frac{A_f}{A_w} = 1$$

$$m_1 = 0.07$$

$$\lambda_- = 3.42$$

- виж: виж Таблица 60 на приложение 4 от [НПСК]

$$\eta := 1.154$$

$$m_{ef} := \eta \cdot m_1$$

$$m_{ef} = 0.08$$

$$\lambda_- = 3.42$$

		m_{ef1}	m_{ef}	m_{ef2}
		0.1	0.1	0.25
λ_{-1}	3.00	0.667	0.667	0.597
λ_-	3.42	0.600	0.600	0.534
λ_{-2}	3.50	0.587	0.587	0.522

- виж: виж Таблица 61 на приложение 4 от [НПСК]

$$\phi_e := 0.6$$

$$\frac{N_H}{\phi_e \cdot A \cdot \gamma_c \cdot R_y} = 0.91 < 1$$

Сечение 2

$$R_y := 35.5 \frac{\text{kN}}{\text{cm}^2}$$

$$E := 2.06 \times 10^8 \frac{\text{kN}}{\text{m}^2}$$

$$N_{on} := 505 \text{ kN}$$

$$N_H := 548 \text{ kN}$$

$$M_x := 1.56 \text{ kN} \cdot \text{m}$$

$$M_y := 0 \text{ kN} \cdot \text{m}$$

Прието сечение

$$L - 140.140.14$$

$$\gamma_a := 0.9$$

$$A := 37.03 \text{ cm}^2$$

$$W_x := 48.93 \text{ cm}^3$$

$$W_y := 0 \text{ cm}^3$$

$$i := 2.72 \text{ cm}$$

Проверка на якост

$$A_{nt} := A$$

$$W_{xnt.min} := W_x$$

$$W_{ynt.min} := W_y$$

$$A_f := 14 \text{ cm} \cdot 1.4 \text{ cm}$$

$$A_f = 19.6 \text{ cm}^2$$

$$A_w := 14 \text{ cm} \cdot 1.4 \text{ cm}$$

$$A_w = 19.6 \text{ cm}^2$$

$$\frac{A_f}{A_w} = 1$$

$$\eta := 1.5 \quad - \text{ виж: Чл.111, Таблица 8 от [НПСК]}$$

$$c_x := 1.12$$

$$c_y := 1.6$$

$$\left(\frac{\max(N_{on}, N_H)}{A_{nt} \cdot \gamma_c \cdot R_y} \right)^n + \frac{M_x}{c_x \cdot W_{xnt.min} \cdot \gamma_c \cdot R_y} + \frac{M_y}{c_y \cdot W_{ynt.min} \cdot \gamma_c \cdot R_y} = 0.4 < 1$$

Проверка на устойчивост

$$L_{ef} := 2.24 \text{ m}$$

$$\lambda := \frac{L_{ef}}{i}$$

$$\lambda = 82$$

$$\lambda_{cr} := \lambda \cdot \sqrt{\frac{R_y}{E}}$$

$$\lambda_{cr} = 3.42$$

$$M := \sqrt{M_x^2 + M_y^2}$$

$$e := \frac{M}{N_H}$$

$$e = 0.3 \text{ cm}$$

$$W_{ex} := 48.93 \text{ cm}^3$$

- съпротивителен момент за най-силно натиснатото влакно

$$m_1 := e \cdot \frac{A}{W_c}$$

$$\frac{A_f}{A_w} = 1$$

$$m_1 = 0.22$$

$$\lambda_{cr} = 3.42$$

- виж: виж Таблица 60 на приложение 4 от [НПСК]

$$\eta := 1.154$$

$$m_{ef} := \eta \cdot m_1$$

$$m_{ef} = 0.25$$

$$\lambda_{cr} = 3.42$$

	m_{ef1}	m_{ef}	m_{ef2}
	0.25	0.25	0.5
λ_{cr1}	3.00	0.597	0.597
λ_{cr}	3.42	0.534	0.534
λ_{cr2}	3.50	0.522	0.522

- виж: виж Таблица 61 на приложение 4 от [НПСК]

$$\phi_{ex} := 0.534$$

$$\frac{N_H}{\phi_e \cdot A \cdot \gamma_c \cdot R_y} = 0.87 < 1$$

Проверка на елемента, като центрично натиснат

Проверка на якост

$$A_{nt} := A$$

$$\frac{\max(N_{on}, N_H)}{A_{nt} \cdot \gamma_c \cdot R_y} = 0.46 < 1$$

Проверка на устойчивост

$$L_{ef} := 1.7m \quad \lambda := \frac{L_{ef}}{i} \quad \lambda = 62$$

$$\lambda_- := \lambda \cdot \sqrt{\frac{R_y}{E}} \quad \lambda_- = 2.59$$

$$\phi := \begin{cases} \left[1 - \left(0.073 - 5.53 \cdot \frac{R_y}{E} \right) \lambda_- \cdot \sqrt{\lambda_-} \right] & \text{if } 0 < \lambda_- \leq 2.5 \\ \left[1.47 - 13 \cdot \frac{R_y}{E} - \left(0.371 - 27.3 \cdot \frac{R_y}{E} \right) \cdot \lambda_- + \left(0.0275 - 5.53 \cdot \frac{R_y}{E} \right) \cdot \lambda_-^2 \right] & \text{if } 2.5 < \lambda_- \leq 4.5 \\ \frac{332}{\lambda_-^2 \cdot (51 - \lambda_-)} & \text{otherwise} \end{cases}$$

$$\phi = 0.73$$

$$\frac{N_H}{A \cdot \phi \cdot \gamma_c \cdot R_y} = 0.64 < 1$$

Оразмеряване на третият дял на колоната

$$R_y := 35.5 \frac{\text{kN}}{\text{cm}^2}$$

$$E := 2.06 \times 10^8 \frac{\text{kN}}{\text{m}^2}$$

$$N_{on} := 187 \text{ kN}$$

$$N_H := 287 \text{ kN}$$

$$M_x := 0.74 \text{ kN} \cdot \text{m}$$

$$M_y := 0 \text{ kN} \cdot \text{m}$$

Прието сечение

L - 120.120.12

$$\gamma_c := 0.9$$

$$A_w := 18.7 \text{ cm}^2$$

$$W_x := 24.2 \text{ cm}^3$$

$$W_y := 0 \text{ cm}^3$$

$$i := 2.37 \text{ cm}$$

Проверка на якост

$$A_{nt} := A$$

$$W_{xnt.min} := W_x$$

$$W_{ynt.min} := W_y$$

$$A_f := 10 \text{ cm} \cdot 1 \text{ cm}$$

$$A_f = 10 \text{ cm}^2$$

$$A_w := 10 \text{ cm} \cdot 1 \text{ cm}$$

$$A_w = 10 \text{ cm}^2$$

$$\frac{A_f}{A_w} = 1$$

$$n := 1.5 \quad - \text{виж: Чл.111, Таблица 8 от [НПСК]}$$

$$c_x := 1.12$$

$$c_y := 1.6$$

$$\left(\frac{\max(N_{on}, N_H)}{A_{nt} \cdot \gamma_c \cdot R_y} \right)^n + \frac{M_x}{c_x \cdot W_{xnt.min} \cdot \gamma_c \cdot R_y} + \frac{M_y}{c_y \cdot W_{ynt.min} \cdot \gamma_c \cdot R_y} = 0.42 < 1$$

Проверка на устойчивост

$$L_{ef} := 1.75 \text{ m}$$

$$\lambda := \frac{L_{ef}}{i}$$

$$\lambda = 74$$

$$\lambda_- := \lambda \cdot \sqrt{\frac{R_y}{E}}$$

$$\lambda_- = 3.07$$

$$M := \sqrt{M_x^2 + M_y^2}$$

$$e := \frac{M}{N_H}$$

$$e = 0.3 \text{ cm}$$

$$W_c := 24.2 \text{ cm}^3$$

- съпротивителен момент за най-силно натиснатото влакно

$$m_1 := e \cdot \frac{A}{W_c}$$

$$\frac{A_f}{A_w} = 1$$

$$m_1 = 0.2$$

$$\lambda_- = 3.07$$

- виж: виж Таблица 60 на приложение 4 от [НПСК]

$$\eta := 1.23$$

$$m_{ef} := \eta \cdot m_1$$

$$m_{ef} = 0.25$$

$$\lambda_- = 3.07$$

	m_{ef1}	m_{ef}	m_{ef2}
	0.1	0.25	0.25
λ_{-1}	2.50	0.742	0.672
λ_-	2.67	0.717	0.647
λ_{-2}	3.00	0.667	0.597

- виж: виж Таблица 61 на приложение 4 от [НПСК]

$$\phi_e := 0.647$$

$$\frac{N_H}{\phi_e \cdot A \cdot \gamma_c \cdot R_y} = 0.74 < 1$$

Проверка на елемента, като центрично натиснат

Проверка на якост

$$A_{nt} := A$$

$$\frac{\max(N_{on}, N_H)}{A_{nt} \cdot \gamma_c \cdot R_y} = 0.48 < 1$$

Проверка на устойчивост

$$L_{ef} := 1.7m \quad \lambda := \frac{L_{ef}}{i} \quad \lambda = 72$$

$$\lambda_- := \lambda \cdot \sqrt{\frac{R_y}{E}} \quad \lambda_- = 2.98$$

$$\phi := \begin{cases} \left[1 - \left(0.073 - 5.53 \cdot \frac{R_y}{E} \right) \lambda_- \cdot \sqrt{\lambda_-} \right] & \text{if } 0 < \lambda_- \leq 2.5 \\ \left[1.47 - 13 \cdot \frac{R_y}{E} - \left(0.371 - 27.3 \cdot \frac{R_y}{E} \right) \cdot \lambda_- + \left(0.0275 - 5.53 \cdot \frac{R_y}{E} \right) \cdot \lambda_-^2 \right] & \text{if } 2.5 < \lambda_- \leq 4.5 \\ \frac{332}{\lambda_-^2 \cdot (51 - \lambda_-)} & \text{otherwise} \end{cases}$$

$$\phi = 0.64$$

$$\frac{N_H}{A \cdot \phi \cdot \gamma_c \cdot R_y} = 0.75 < 1$$

Оразмеряване на X връзки на първо ниво

Проверка 1

Профил L100x100x8

$$R_y := 35.5 \frac{\text{kN}}{\text{cm}^2}$$

$$E := 2.06 \times 10^8 \frac{\text{kN}}{\text{m}^2}$$

$$N_{on} := 133.2 \text{ kN}$$

$$N_H := 133.2 \text{ kN}$$

$$\gamma_c := 0.9$$

$$i_y := 1.96 \text{ cm}$$

$$i_z := 3.06 \text{ cm}$$

$$A_w := 15.5 \text{ cm}^2$$

$$L_{ef.y} := 1.96 \text{ m}$$

$$L_{ef.z} := 1.96 \text{ m}$$

Проверка на якост

$$A_{nt} := A$$

$$\frac{\max(N_{on}, N_H)}{A_{nt} \cdot \gamma_c \cdot R_y} = 0.27 < 1$$

Проверка на устойчивост по Y

$$\lambda_y := \frac{L_{ef.y}}{i_y} \quad \lambda_y = 100$$

$$\lambda_{-y} := \lambda_y \cdot \sqrt{\frac{R_y}{E}} \quad \lambda_{-y} = 4.15$$

$$\phi_y := \begin{cases} 1 - \left(0.073 - 5.53 \cdot \frac{R_y}{E} \right) \lambda_{-y} \sqrt{\lambda_{-y}} & \text{if } 0 < \lambda_{-y} \leq 2.5 \\ 1.47 - 13 \cdot \frac{R_y}{E} - \left(0.371 - 27.3 \cdot \frac{R_y}{E} \right) \cdot \lambda_{-y} + \left(0.0275 - 5.53 \cdot \frac{R_y}{E} \right) \cdot \lambda_{-y}^2 & \text{if } 2.5 < \lambda_{-y} \leq 4.5 \\ \frac{332}{\lambda_{-y}^2 \cdot (51 - \lambda_{-y})} & \text{otherwise} \end{cases} \quad \phi_y = 0.41$$

$$\frac{N_H}{A \cdot \phi_y \cdot \gamma_c \cdot R_y} = 0.65 < 1$$

Проверка на устойчивост по Z

$$\lambda_z := \frac{L_{ef.z}}{i_z} \quad \lambda_z = 64$$

$$\lambda_{-z} := \lambda_z \cdot \sqrt{\frac{R_y}{E}} \quad \lambda_{-z} = 2.66$$

$$\phi_z := \begin{cases} 1 - \left(0.073 - 5.53 \cdot \frac{R_y}{E} \right) \lambda_{-z} \sqrt{\lambda_{-z}} & \text{if } 0 < \lambda_{-z} \leq 2.5 \\ 1.47 - 13 \cdot \frac{R_y}{E} - \left(0.371 - 27.3 \cdot \frac{R_y}{E} \right) \cdot \lambda_{-z} + \left(0.0275 - 5.53 \cdot \frac{R_y}{E} \right) \cdot \lambda_{-z}^2 & \text{if } 2.5 < \lambda_{-z} \leq 4.5 \\ \frac{332}{\lambda_{-z}^2 \cdot (51 - \lambda_{-z})} & \text{otherwise} \end{cases} \quad \phi_z = 0.71$$

$$\frac{N_H}{A \cdot \phi_z \cdot \gamma_c \cdot R_y} = 0.38 < 1$$

Оразмеряване на X връзки на второ ниво

Профил L90x90x7

$$R_y := 35.5 \frac{\text{kN}}{\text{cm}^2}$$

$$E := 2.06 \times 10^8 \frac{\text{kN}}{\text{m}^2}$$

$$N_{on} := 94.2 \text{ kN}$$

$$N_H := 94.2 \text{ kN}$$

$$\gamma_c := 0.9$$

$$i_y := 2.75 \text{ cm}$$

$$i_z := 1.76 \text{ cm}$$

$$A_w := 12.2 \text{ cm}^2$$

$$L_{ef.y} := 3.08 \text{ m}$$

$$L_{ef.z} := 1.54 \text{ m}$$

Проверка на якост

$$A_{nt} := A$$

$$\frac{\max(N_{on}, N_H)}{A_{nt} \cdot \gamma_c \cdot R_y} = 0.24 < 1$$

Проверка на устойчивост по Y

$$\lambda_y := \frac{L_{ef.y}}{i_y} \quad \lambda_y = 112$$

$$\lambda_{-y} := \lambda_y \cdot \sqrt{\frac{R_y}{E}} \quad \lambda_{-y} = 4.65$$

$$\phi_y := \begin{cases} 1 - \left(0.073 - 5.53 \cdot \frac{R_y}{E} \right) \lambda_{-y} \cdot \sqrt{\lambda_{-y}} & \text{if } 0 < \lambda_{-y} \leq 2.5 \\ 1.47 - 13 \cdot \frac{R_y}{E} - \left(0.371 - 27.3 \cdot \frac{R_y}{E} \right) \cdot \lambda_{-y} + \left(0.0275 - 5.53 \cdot \frac{R_y}{E} \right) \cdot \lambda_{-y}^2 & \text{if } 2.5 < \lambda_{-y} \leq 4.5 \\ \frac{332}{\lambda_{-y}^2 \cdot (51 - \lambda_{-y})} & \text{otherwise} \end{cases} \quad \phi_y = 0.33$$

$$\frac{N_H}{A \cdot \phi_y \cdot \gamma_c \cdot R_y} = 0.73 < 1$$

Проверка на устойчивост по Z

$$\lambda_z := \frac{L_{ef.z}}{i_z} \quad \lambda_z = 88$$

$$\lambda_{-z} := \lambda_z \cdot \sqrt{\frac{R_y}{E}} \quad \lambda_{-z} = 3.63$$

$$\phi_z := \begin{cases} 1 - \left(0.073 - 5.53 \cdot \frac{R_y}{E} \right) \lambda_{-z} \cdot \sqrt{\lambda_{-z}} & \text{if } 0 < \lambda_{-z} \leq 2.5 \\ 1.47 - 13 \cdot \frac{R_y}{E} - \left(0.371 - 27.3 \cdot \frac{R_y}{E} \right) \cdot \lambda_{-z} + \left(0.0275 - 5.53 \cdot \frac{R_y}{E} \right) \cdot \lambda_{-z}^2 & \text{if } 2.5 < \lambda_{-z} \leq 4.5 \\ \frac{332}{\lambda_{-z}^2 \cdot (51 - \lambda_{-z})} & \text{otherwise} \end{cases} \quad \phi_z = 0.51$$

$$\frac{N_H}{A \cdot \phi_z \cdot \gamma_c \cdot R_y} = 0.48 < 1$$

Оразмеряване на X връзки на трето ниво

Проверка 1

Профил L65x65x6

$$R_y := 35.5 \frac{\text{kN}}{\text{cm}^2}$$

$$E := 2.06 \times 10^8 \frac{\text{kN}}{\text{m}^2}$$

$$N_{on} := 45.8 \text{ kN}$$

$$N_H := 45.8 \text{ kN}$$

$$\gamma_c := 0.9$$

$$i_y := 1.26 \text{ cm}$$

$$i_z := 1.97 \text{ cm}$$

$$A_w := 7.53 \text{ cm}^2$$

$$L_{ef.y} := 1.21 \text{ m}$$

$$L_{ef.z} := 2.42 \text{ m}$$

Проверка на якост

$$A_{nt} := A$$

$$\frac{\max(N_{on}, N_H)}{A_{nt} \cdot \gamma_c \cdot R_y} = 0.19 < 1$$

Проверка на устойчивост по Y

$$\lambda_y := \frac{L_{ef.y}}{i_y} \quad \lambda_y = 96$$

$$\lambda_{-y} := \lambda_y \cdot \sqrt{\frac{R_y}{E}} \quad \lambda_{-y} = 3.99$$

$$\phi_y := \begin{cases} 1 - \left(0.073 - 5.53 \cdot \frac{R_y}{E} \right) \lambda_{-y} \sqrt{\lambda_{-y}} & \text{if } 0 < \lambda_{-y} \leq 2.5 \\ 1.47 - 13 \cdot \frac{R_y}{E} - \left(0.371 - 27.3 \cdot \frac{R_y}{E} \right) \cdot \lambda_{-y} + \left(0.0275 - 5.53 \cdot \frac{R_y}{E} \right) \cdot \lambda_{-y}^2 & \text{if } 2.5 < \lambda_{-y} \leq 4.5 \\ \frac{332}{\lambda_{-y}^2 \cdot (51 - \lambda_{-y})} & \text{otherwise} \end{cases} \quad \phi_y = 0.44$$

$$\frac{N_H}{A \cdot \phi_y \cdot \gamma_c \cdot R_y} = 0.43 < 1$$

Проверка на устойчивост по Z

$$\lambda_z := \frac{L_{ef.z}}{i_z} \quad \lambda_z = 123$$

$$\lambda_{-z} := \lambda_z \cdot \sqrt{\frac{R_y}{E}} \quad \lambda_{-z} = 5.1$$

$$\phi_z := \begin{cases} 1 - \left(0.073 - 5.53 \cdot \frac{R_y}{E} \right) \lambda_{-z} \sqrt{\lambda_{-z}} & \text{if } 0 < \lambda_{-z} \leq 2.5 \\ 1.47 - 13 \cdot \frac{R_y}{E} - \left(0.371 - 27.3 \cdot \frac{R_y}{E} \right) \cdot \lambda_{-z} + \left(0.0275 - 5.53 \cdot \frac{R_y}{E} \right) \cdot \lambda_{-z}^2 & \text{if } 2.5 < \lambda_{-z} \leq 4.5 \\ \frac{332}{\lambda_{-z}^2 \cdot (51 - \lambda_{-z})} & \text{otherwise} \end{cases} \quad \phi_z = 0.28$$

$$\frac{N_H}{A \cdot \phi_z \cdot \gamma_c \cdot R_y} = 0.68 < 1$$

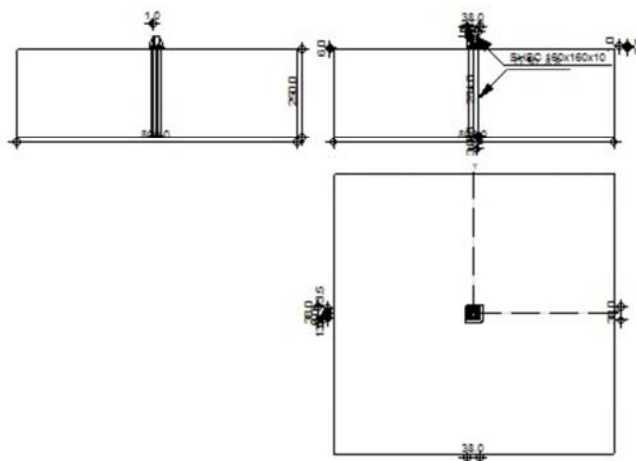


ОРАЗМЕРЯВАНЕ НА АНКЕРНОТО УСТРОЙСТВО

Eurocode 3: EN 1993-1-8:2005/AC:2009 + CEB Design Guide: Design of fastenings on concrete

OK

Ratio
0,86



GENERAL

Connection no.: 1
Connection name: Fixed column base

GEOMETRY

COLUMN

Section: SHSC 160x160x10

L_c	=	5,00	[m]	Column length
α	=	0,0	[Deg]	Inclination angle
h_c	=	16,0	[cm]	Height of column section
b_{fc}	=	16,0	[cm]	Width of column section
t_{wc}	=	1,0	[cm]	Thickness of the web of column section
t_{fc}	=	1,0	[cm]	Thickness of the flange of column section
r_c	=	1,5	[cm]	Radius of column section fillet
A_c	=	56,6	[cm ²]	Cross-sectional area of a column
I_{yc}	=	2048,0	[cm ⁴]	Moment of inertia of the column section

Material: S 235

f_{yc}	=	23,50	[kN/cm ²]	Resistance
f_{uc}	=	36,00	[kN/cm ²]	Yield strength of a material

COLUMN BASE

l_{pd}	=	38,0	[cm]	Length
b_{pd}	=	38,0	[cm]	Width
t_{pd}	=	2,5	[cm]	Thickness

Material: S 235

f_{ypd}	=	23,50	[kN/cm ²]	Resistance
f_{upd}	=	36,00	[kN/cm ²]	Yield strength of a material

ANCHORAGE

Class =	8.8		Anchor class
f _{yb} =	64,00	[kN/cm ²]	Yield strength of the anchor material
f _{ub} =	80,00	[kN/cm ²]	Tensile strength of the anchor material
d =	3,0	[cm]	Bolt diameter
A _b =	5,6	[cm ²]	Effective anchor area
n _H =	3		Number of bolt columns
n _V =	3		Number of bolt rows

Horizontal spacing $e_{Hl} = 13,5$ [cm]

Vertical spacing $e_{Vi} = 13,5$ [cm]

Anchor dimensions

$L_1 = 5,0$ [cm]

$L_2 = 254,0$ [cm]

$L_3 = 3,0$ [cm]

Anchor plate

$l_p = 12,0$ [cm] Length

$b_p = 12,0$ [cm] Width

$t_p = 2,5$ [cm] Thickness

Material: S 235

$f_y = 23,50$ [kN/cm²] Resistance

Washer

$l_{wd} = 6,0$ [cm] Length

$b_{wd} = 6,0$ [cm] Width

$t_{wd} = 1,0$ [cm] Thickness

STIFFENER

$l_s = 38,0$ [cm] Length

$h_s = 20,0$ [cm] Height

$t_s = 1,0$ [cm] Thickness

$d_1 = 5,0$ [cm] Cut

$d_2 = 5,0$ [cm] Cut

MATERIAL FACTORS

$j_{M0} = 1,00$ Partial safety factor

$j_{M2} = 1,25$ Partial safety factor

$j_C = 1,50$ Partial safety factor

SPREAD FOOTING

$L = 800,0$ [cm] Spread footing length

$B = 800,0$ [cm] Spread footing width

$H = 250,0$ [cm] Spread footing height

Concrete

Class C20/25

$f_{ck} = 2,00$ [kN/cm²] Characteristic resistance for compression

Grout layer

$t_g = 6,0$ [cm] Thickness of leveling layer (grout)

$f_{ck,g} = 1,20$ [kN/cm²] Characteristic resistance for compression

$C_{f,d} = 0,30$ Coeff. of friction between the base plate and concrete

WELDS

$a_p = 0,8$ [cm] Footing plate of the column base

$a_s = 0,8$ [cm] Stiffeners

LOADS

Case: Manual calculations.

$N_{j,Ed} = 921$ [kN] Axial force

$V_{j,Ed,y} = 55,50$ [kN] Shear force

$V_{j,Ed,z} = 63,10$ [kN] Shear force

RESULTS

TENSION ZONE

STEEL FAILURE

$A_b = 5,6$ [cm²] Effective anchor area

[Table 3.4]

$f_{ub} = 80,00$ [kN/cm²] Tensile strength of the anchor material

[Table 3.4]

Beta = 0,85 Reduction factor of anchor resistance

[3.6.1.(3)]

$F_{t,Rd,s1} = \beta \cdot 0,9 \cdot f_{ub} \cdot A_b / j_{M2}$

[kN] Anchor resistance to steel failure

[Table 3.4]

$F_{t,Rd,s1} =$	274,67			
$j_{Ms} =$	1,20	Partial safety factor		CEB [3.2.3.2]
$f_{yb} =$	64,00	[kN/cm ²]	Yield strength of the anchor material	CEB [9.2.2]
$F_{t,Rd,s2} = f_{yb} \cdot A_b / j_{Ms}$				
$F_{t,Rd,s2} =$	299,20	[kN]	Anchor resistance to steel failure	CEB [9.2.2]
$F_{t,Rd,s} = \min(F_{t,Rd,s1}, F_{t,Rd,s2})$				
$F_{t,Rd,s} =$	274,67	[kN]	Anchor resistance to steel failure	
PULL-OUT FAILURE				
$f_{ck} =$	2,00	[kN/cm ²]	Characteristic compressive strength of concrete	EN 1992-1:[3.1.2]
$A_h =$	136,9	[cm ²]	Bearing area of the head	CEB [15.1.2.3]
$p_k =$	14,00	[kN/cm ²]	Characteristic strength of concrete (pull-out)	CEB [15.1.2.3]
$j_{Mp} =$	2,16		Partial safety factor	CEB [3.2.3.1]
$F_{t,Rd,p} = p_k \cdot A_h / j_{Mp}$				
$F_{t,Rd,p} =$	950,91	[kN]	Design uplift capacity	CEB [9.2.3]
CONCRETE CONE FAILURE				
$h_{ef} =$	250,0	[cm]	Effective anchorage depth	CEB [9.2.4]
$N_{Rk,c}^0 = 7.5[N^{0.5}/mm^{0.5}] \cdot f_{ck} \cdot h_{ef}^{1.5}$				
$N_{Rk,c}^0 =$	4192,63	[kN]	Characteristic resistance of an anchor	CEB [9.2.4]
$s_{cr,N} =$	750,0	[cm]	Critical width of the concrete cone	CEB [9.2.4]
$c_{cr,N} =$	375,0	[cm]	Critical edge distance	CEB [9.2.4]
$A_{c,N0} =$	603729,0	[cm ²]	Maximum area of concrete cone	CEB [9.2.4]
$A_{c,N} =$	603729,0	[cm ²]	Actual area of concrete cone	CEB [9.2.4]
$\lambda_{A,N} = A_{c,N} / A_{c,N0}$				
$\lambda_{A,N} =$	1,00		Factor related to anchor spacing and edge distance	CEB [9.2.4]
$c =$	375,0	[cm]	Minimum edge distance from an anchor	CEB [9.2.4]
$\lambda_{s,N} = 0.7 + 0.3 \cdot c / c_{cr,N} \leq 1.0$				
$\lambda_{s,N} =$	1,00		Factor taking account the influence of edges of the concrete member on the distribution of stresses in the concrete	CEB [9.2.4]
$\lambda_{ec,N} =$	1,00		Factor related to distribution of tensile forces acting on anchors	CEB [9.2.4]
$\lambda_{re,N} = 0.5 + h_{ef}[mm] / 200 \leq 1.0$				
$\lambda_{re,N} =$	1,00		Shell spalling factor	CEB [9.2.4]
$\lambda_{ucr,N} =$	1,00		Factor taking into account whether the anchorage is in cracked or non-cracked concrete	CEB [9.2.4]
$j_{Mc} =$	2,16		Partial safety factor	CEB [3.2.3.1]
$F_{t,Rd,c} = N_{Rk,c}^0 \cdot \lambda_{A,N} \cdot \lambda_{s,N} \cdot \lambda_{ec,N} \cdot \lambda_{re,N} \cdot \lambda_{ucr,N} / j_{Mc}$				
$F_{t,Rd,c} =$	1941,03	[kN]	Design anchor resistance to concrete cone failure	EN 1992-1:[8.4.2.(2)]
SPLITTING FAILURE				
$h_{ef} =$	250,0	[cm]	Effective anchorage depth	CEB [9.2.5]
$N_{Rk,c}^0 = 7.5[N^{0.5}/mm^{0.5}] \cdot f_{ck} \cdot h_{ef}^{1.5}$				
$N_{Rk,c}^0 =$	4192,63	[kN]	Design uplift capacity	CEB [9.2.5]
$s_{cr,N} =$	500,0	[cm]	Critical width of the concrete cone	CEB [9.2.5]
$c_{cr,N} =$	250,0	[cm]	Critical edge distance	CEB [9.2.5]
$A_{c,N0} =$	277729,0	[cm ²]	Maximum area of concrete cone	CEB [9.2.5]
$A_{c,N} =$	277729,0	[cm ²]	Actual area of concrete cone	CEB [9.2.5]
$\lambda_{A,N} = A_{c,N} / A_{c,N0}$				
$\lambda_{A,N} =$	1,00		Factor related to anchor spacing and edge distance	CEB [9.2.5]
$c =$	250,0	[cm]	Minimum edge distance from an anchor	CEB [9.2.5]
$\lambda_{s,N} = 0.7 + 0.3 \cdot c / c_{cr,N} \leq 1.0$				
$\lambda_{s,N} =$	1,00		Factor taking account the influence of edges of the concrete member on the distribution of stresses in the concrete	CEB [9.2.5]
$\lambda_{ec,N} =$	1,00		Factor related to distribution of tensile forces acting on anchors	CEB [9.2.5]
$\lambda_{re,N} = 0.5 + h_{ef}[mm] / 200 \leq 1.0$				
$\lambda_{re,N} =$	1,00		Shell spalling factor	CEB [9.2.5]
$\lambda_{ucr,N} =$	1,00		Factor taking into account whether the anchorage is in cracked or non-cracked concrete	CEB [9.2.5]
$\lambda_{h,N} = (h / (2 \cdot h_{ef}))^{2/3} \leq 1.2$				

$l_{h,N} =$	0,63	Coeff. related to the foundation height	CEB [9.2.5]
$j_{M,sp} =$	2,16	Partial safety factor	CEB [3.2.3.1]
$F_{t,Rd,sp} = N_{Rk,c}^{0*} l_{A,N}^{*} l_{s,N}^{*} l_{ec,N}^{*} l_{re,N}^{*} l_{ucr,N}^{*} l_{h,N} / j_{M,sp}$			
$F_{t,Rd,sp} =$	1222,77	[kN] Design anchor resistance to splitting of concrete	CEB [9.2.5]

TENSILE RESISTANCE OF AN ANCHOR

$F_{t,Rd} = \min(F_{t,Rd,s}, F_{t,Rd,p}, F_{t,Rd,c}, F_{t,Rd,sp})$			
$F_{t,Rd} =$	274,67	[kN] Tensile resistance of an anchor	

BENDING OF THE BASE PLATE

$l_{eff,1} =$	19,0	[cm] Effective length for a single bolt for mode 1	[6.2.6.5]
$l_{eff,2} =$	19,0	[cm] Effective length for a single bolt for mode 2	[6.2.6.5]
$m =$	4,9	[cm] Distance of a bolt from the stiffening edge	[6.2.6.5]
$M_{pl,1,Rd} =$	6,98	[kN*m] Plastic resistance of a plate for mode 1	[6.2.4]
$M_{pl,2,Rd} =$	6,98	[kN*m] Plastic resistance of a plate for mode 2	[6.2.4]
$F_{T,1,Rd} =$	574,20	[kN] Resistance of a plate for mode 1	[6.2.4]
$F_{T,2,Rd} =$	572,13	[kN] Resistance of a plate for mode 2	[6.2.4]
$F_{T,3,Rd} =$	824,00	[kN] Resistance of a plate for mode 3	[6.2.4]
$F_{t,pl,Rd} = \min(F_{T,1,Rd}, F_{T,2,Rd}, F_{T,3,Rd})$			
$F_{t,pl,Rd} =$	572,13	[kN] Tension resistance of a plate	[6.2.4]

TENSILE RESISTANCE OF A COLUMN WEB

$t_{wc} =$	1,0	[cm] Effective thickness of the column web	[6.2.6.3.(8)]
$b_{eff,t,wc} =$	17,9	[cm] Effective width of the web for tension	[6.2.6.3.(2)]
$A_{vc} =$	28,6	[cm ²] Shear area	EN1993-1-1:[6.2.6.(3)]
$z =$	0,81	Reduction factor for interaction with shear	[6.2.6.3.(4)]
$F_{t,wc,Rd} = z b_{eff,t,wc} t_{wc} f_{yc} / j_{M0}$			
$F_{t,wc,Rd} =$	342,50	[kN] Column web resistance	[6.2.6.3.(1)]

RESISTANCES OF SPREAD FOOTING IN THE TENSION ZONE

$N_{j,Rd} =$	1066,43	[kN] Resistance of a spread footing for axial tension	[6.2.8.3]
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CONNECTION CAPACITY CHECK

$N_{j,Ed} / N_{j,Rd} \leq 1,0$ (6.24)	0,86 < 1,00	verified	(0,86)
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SHEAR

BEARING PRESSURE OF AN ANCHOR BOLT ONTO THE BASE PLATE

Shear force $V_{j,Ed,y}$

$\alpha_{d,y} =$	0,57	Coeff. taking account of the bolt position - in the direction of shear	[Table 3.4]
$\alpha_{b,y} =$	0,57	Coeff. for resistance calculation $F_{1,vb,Rd}$	[Table 3.4]
$k_{1,y} =$	2,50	Coeff. taking account of the bolt position - perpendicularly to the direction of shear	[Table 3.4]
$F_{1,vb,Rd,y} = k_{1,y} \alpha_{d,y} \alpha_{b,y} f_{up} d^2 t_p / j_{M2}$			
$F_{1,vb,Rd,y} =$	309,37	[kN] Resistance of an anchor bolt for bearing pressure onto the base plate	[6.2.2.(7)]

Shear force $V_{j,Ed,z}$

$\alpha_{d,z} =$	0,57	Coeff. taking account of the bolt position - in the direction of shear	[Table 3.4]
$\alpha_{b,z} =$	0,57	Coeff. for resistance calculation $F_{1,vb,Rd}$	[Table 3.4]
$k_{1,z} =$	2,50	Coeff. taking account of the bolt position - perpendicularly to the direction of shear	[Table 3.4]
$F_{1,vb,Rd,z} = k_{1,z} \alpha_{d,z} \alpha_{b,z} f_{up} d^2 t_p / j_{M2}$			
$F_{1,vb,Rd,z} =$	309,37	[kN] Resistance of an anchor bolt for bearing pressure onto the base plate	[6.2.2.(7)]

SHEAR OF AN ANCHOR BOLT

$\alpha_b =$	0,25	Coeff. for resistance calculation $F_{2,vb,Rd}$	[6.2.2.(7)]
$A_{bv} =$	7,1	[cm ²] Effective anchor area	[6.2.2.(7)]
$f_{ub} =$	80,00	[kN/cm ²] Tensile strength of the anchor material	[6.2.2.(7)]
$j_{M2} =$	1,25	Partial safety factor	[6.2.2.(7)]
$F_{2,vb,Rd} = \alpha_b f_{ub} A_{bv} / j_{M2}$			
$F_{2,vb,Rd} =$	112,19	[kN] Shear resistance of a bolt - without lever arm	[6.2.2.(7)]
$\alpha_M =$	2,00	Factor related to the fastening of an anchor in the foundation	CEB [9.3.2.2]
$M_{Rk,s} =$	1,57	[kN*m] Characteristic bending resistance of an anchor	CEB [9.3.2.2]
$l_{sm} =$	8,0	[cm] Lever arm length	CEB [9.3.2.2]

$j_{Ms} =$	1,20	Partial safety factor	CEB [3.2.3.2]
$F_{v,Rd,sm} = d_M \cdot M_{Rk,s} / (l_{sm} \cdot j_{Ms})$			
$F_{v,Rd,sm} =$	32,72 [kN]	Shear resistance of a bolt - with lever arm	CEB [9.3.1]
CONCRETE PRY-OUT FAILURE			
$N_{Rk,c} =$	4192,63 [kN]	Design uplift capacity	CEB [9.2.4]
$k_3 =$	2,00	Factor related to the anchor length	CEB [9.3.3]
$j_{Mc} =$	2,16	Partial safety factor	CEB [3.2.3.1]
$F_{v,Rd,cp} = k_3 \cdot N_{Rk,c} / j_{Mc}$			
$F_{v,Rd,cp} =$	3882,06 [kN]	Concrete resistance for pry-out failure	CEB [9.3.1]
CONCRETE EDGE FAILURE			
Shear force $V_{j,Ed,y}$			
$V_{Rk,c,y}^0 =$	29358,91 [kN]	Characteristic resistance of an anchor	CEB [9.3.4.(a)]
$ _{A,V,y} =$	0,29	Factor related to anchor spacing and edge distance	CEB [9.3.4]
$ _{h,V,y} =$	1,32	Factor related to the foundation thickness	CEB [9.3.4.(c)]
$ _{s,V,y} =$	0,90	Factor related to the influence of edges parallel to the shear load direction	CEB [9.3.4.(d)]
$ _{ec,V,y} =$	1,00	Factor taking account a group effect when different shear loads are acting on the individual anchors in a group	CEB [9.3.4.(e)]
$ _{d,V,y} =$	1,00	Factor related to the angle at which the shear load is applied	CEB [9.3.4.(f)]
$ _{ucr,V,y} =$	1,00	Factor related to the type of edge reinforcement used	CEB [9.3.4.(g)]
$j_{Mc} =$	2,16	Partial safety factor	CEB [3.2.3.1]
$F_{v,Rd,c,y} = V_{Rk,c,y}^0 \cdot _{A,V,y} \cdot _{h,V,y} \cdot _{s,V,y} \cdot _{ec,V,y} \cdot _{d,V,y} \cdot _{ucr,V,y} / j_{Mc}$			
$F_{v,Rd,c,y} =$	4654,83 [kN]	Concrete resistance for edge failure	CEB [9.3.1]
Shear force $V_{j,Ed,z}$			
$V_{Rk,c,z}^0 =$	29358,91 [kN]	Characteristic resistance of an anchor	CEB [9.3.4.(a)]
$ _{A,V,z} =$	0,29	Factor related to anchor spacing and edge distance	CEB [9.3.4]
$ _{h,V,z} =$	1,32	Factor related to the foundation thickness	CEB [9.3.4.(c)]
$ _{s,V,z} =$	0,90	Factor related to the influence of edges parallel to the shear load direction	CEB [9.3.4.(d)]
$ _{ec,V,z} =$	1,00	Factor taking account a group effect when different shear loads are acting on the individual anchors in a group	CEB [9.3.4.(e)]
$ _{d,V,z} =$	1,00	Factor related to the angle at which the shear load is applied	CEB [9.3.4.(f)]
$ _{ucr,V,z} =$	1,00	Factor related to the type of edge reinforcement used	CEB [9.3.4.(g)]
$j_{Mc} =$	2,16	Partial safety factor	CEB [3.2.3.1]
$F_{v,Rd,c,z} = V_{Rk,c,z}^0 \cdot _{A,V,z} \cdot _{h,V,z} \cdot _{s,V,z} \cdot _{ec,V,z} \cdot _{d,V,z} \cdot _{ucr,V,z} / j_{Mc}$			
$F_{v,Rd,c,z} =$	4654,83 [kN]	Concrete resistance for edge failure	CEB [9.3.1]
SPLITTING RESISTANCE			
$C_{f,d} =$	0,30	Coeff. of friction between the base plate and concrete	[6.2.2.(6)]
$N_{c,Ed} =$	0,00 [kN]	Compressive force	[6.2.2.(6)]
$F_{f,Rd} = C_{f,d} \cdot N_{c,Ed}$			
$F_{f,Rd} =$	0,00 [kN]	Slip resistance	[6.2.2.(6)]
SHEAR CHECK			
$V_{j,Rd,y} = n_b \cdot \min(F_{1,vb,Rd,y}, F_{2,vb,Rd,y}, F_{v,Rd,sm}, F_{v,Rd,cp}, F_{v,Rd,c,y}) + F_{f,Rd}$			
$V_{j,Rd,y} =$	261,78 [kN]	Connection resistance for shear	CEB [9.3.1]
$V_{j,Ed,y} / V_{j,Rd,y} \leq 1,0$	0,21 < 1,00	verified	(0,21)
$V_{j,Rd,z} = n_b \cdot \min(F_{1,vb,Rd,z}, F_{2,vb,Rd,z}, F_{v,Rd,sm}, F_{v,Rd,cp}, F_{v,Rd,c,z}) + F_{f,Rd}$			
$V_{j,Rd,z} =$	261,78 [kN]	Connection resistance for shear	CEB [9.3.1]
$V_{j,Ed,z} / V_{j,Rd,z} \leq 1,0$	0,24 < 1,00	verified	(0,24)
$V_{j,Ed,y} / V_{j,Rd,y} + V_{j,Ed,z} / V_{j,Rd,z} \leq 1,0$	0,45 < 1,00	verified	(0,45)
STIFFENER CHECK			
Oblique stiffeners			
$M_1 =$	9,45 [kN*m]	Bending moment acting on a stiffener	
$Q_1 =$	171,79 [kN]	Shear force acting on a stiffener	
$z_s =$	4,6 [cm]	Location of the neutral axis (from the plate base)	
$I_s =$	2472,7 [cm ⁴]	Moment of inertia of a stiffener	
$\sigma =$	0,80 [kN/cm ²]	Normal stress on the contact surface between stiffener and plate	EN 1993-1-1:[6.2.1.(5)]

$v_d =$				
$v_g =$	6,85	[kN/cm ²]	Normal stress in upper fibers	EN 1993-1-1:[6.2.1.(5)]
$w =$	8,59	[kN/cm ²]	Tangent stress in a stiffener	EN 1993-1-1:[6.2.1.(5)]
$v_z =$	14,90	[kN/cm ²]	Equivalent stress on the contact surface between stiffener and plate	EN 1993-1-1:[6.2.1.(5)]
$\max(v_g, w / (0.58), v_z) / (f_{yp} / j_{M0}) \leq 1.0 \text{ (6.1)}$				
	0,63	<	1,00	verified (0,63)

Stiffener perpendicular to the web (along the extension of the column flanges)

$M_1 =$	7,73	[kN*m]	Bending moment acting on a stiffener	
$Q_1 =$	171,79	[kN]	Shear force acting on a stiffener	
$z_s =$	4,6	[cm]	Location of the neutral axis (from the plate base)	
$I_s =$	2472,7	[cm ⁴]	Moment of inertia of a stiffener	
$v_d =$	0,65	[kN/cm ²]	Normal stress on the contact surface between stiffener and plate	EN 1993-1-1:[6.2.1.(5)]
$v_g =$	5,60	[kN/cm ²]	Normal stress in upper fibers	EN 1993-1-1:[6.2.1.(5)]
$w =$	8,59	[kN/cm ²]	Tangent stress in a stiffener	EN 1993-1-1:[6.2.1.(5)]
$v_z =$	14,89	[kN/cm ²]	Equivalent stress on the contact surface between stiffener and plate	EN 1993-1-1:[6.2.1.(5)]
$\max(v_g, w / (0.58), v_z) / (f_{yp} / j_{M0}) \leq 1.0 \text{ (6.1)}$				
	0,63	<	1,00	verified (0,63)

WELDS BETWEEN THE COLUMN AND THE BASE PLATE

$v_a =$	3,68	[kN/cm ²]	Normal stress in a weld	[4.5.3.(7)]
$w_a =$	3,68	[kN/cm ²]	Perpendicular tangent stress	[4.5.3.(7)]
$w_{yII} =$	0,62	[kN/cm ²]	Tangent stress parallel to $V_{j,Ed,y}$	[4.5.3.(7)]
$w_{zII} =$	0,73	[kN/cm ²]	Tangent stress parallel to $V_{j,Ed,z}$	[4.5.3.(7)]
$e_W =$	0,80		Resistance-dependent coefficient	[4.5.3.(7)]
$v_a / (0.9 * f_u / j_{M2}) \leq 1.0 \text{ (4.1)}$				
	0,14	<	1,00	verified (0,14)
$\sigma(v_a^2 + 3.0(w_{yII}^2 + w_{zII}^2)) / (f_u / (e_W * j_{M2})) \leq 1.0 \text{ (4.1)}$				
	0,21	<	1,00	verified (0,21)
$\sigma(v_a^2 + 3.0(w_{zII}^2 + w_{yII}^2)) / (f_u / (e_W * j_{M2})) \leq 1.0 \text{ (4.1)}$				
	0,21	<	1,00	verified (0,21)

VERTICAL WELDS OF STIFFENERS

Oblique stiffeners

$v_a =$	0,00	[kN/cm ²]	Normal stress in a weld	[4.5.3.(7)]
$w_a =$	0,00	[kN/cm ²]	Perpendicular tangent stress	[4.5.3.(7)]
$w_{II} =$	10,74	[kN/cm ²]	Parallel tangent stress	[4.5.3.(7)]
$v_z =$	0,00	[kN/cm ²]	Total equivalent stress	[4.5.3.(7)]
$e_W =$	0,80		Resistance-dependent coefficient	[4.5.3.(7)]
$\max(v_a, w_{II} * \sigma, v_z) / (f_u / (e_W * j_{M2})) \leq 1.0 \text{ (4.1)}$				
	0,52	<	1,00	verified (0,52)

Stiffener perpendicular to the web (along the extension of the column flanges)

$v_a =$	5,12	[kN/cm ²]	Normal stress in a weld	[4.5.3.(7)]
$w_a =$	5,12	[kN/cm ²]	Perpendicular tangent stress	[4.5.3.(7)]
$w_{II} =$	5,37	[kN/cm ²]	Parallel tangent stress	[4.5.3.(7)]
$v_z =$	13,84	[kN/cm ²]	Total equivalent stress	[4.5.3.(7)]
$e_W =$	0,80		Resistance-dependent coefficient	[4.5.3.(7)]
$\max(v_a, w_{II} * \sigma, v_z) / (f_u / (e_W * j_{M2})) \leq 1.0 \text{ (4.1)}$				
	0,38	<	1,00	verified (0,38)

TRANSVERSAL WELDS OF STIFFENERS

Oblique stiffeners

$v_a =$	6,90	[kN/cm ²]	Normal stress in a weld	[4.5.3.(7)]
$w_a =$	6,90	[kN/cm ²]	Perpendicular tangent stress	[4.5.3.(7)]
$w_{II} =$	7,49	[kN/cm ²]	Parallel tangent stress	[4.5.3.(7)]
$v_z =$	18,95	[kN/cm ²]	Total equivalent stress	[4.5.3.(7)]
$e_W =$	0,80		Resistance-dependent coefficient	[4.5.3.(7)]
$\max(v_a, w_{II} * \sigma, v_z) / (f_u / (e_W * j_{M2})) \leq 1.0 \text{ (4.1)}$				
	0,53	<	1,00	verified (0,53)

Stiffener perpendicular to the web (along the extension of the column flanges)

$v_a =$	7,59	[kN/cm ²]	Normal stress in a weld	[4.5.3.(7)]
$w_a =$	7,59	[kN/cm ²]	Perpendicular tangent stress	[4.5.3.(7)]

$\sigma_{ }$ =	7,61	[kN/cm ²]	Parallel tangent stress	[4.5.3.(7)]
σ_z =	20,10	[kN/cm ²]	Total equivalent stress	[4.5.3.(7)]
e_W =	0,80		Resistance-dependent coefficient	[4.5.3.(7)]
$\max(\sigma_a, \sigma_{ } * 3, \sigma_z) / (f_u / (e_W * j_{M2})) \leq 1.0$ (4.1)				
			0,56 < 1,00	verified (0,56)

WEAKEST COMPONENT:

COLUMN WEB - TENSION

Connection conforms to the code	Ratio	0,86
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