

ВХОДНИ ДАННИ / ADDITIONAL INFORMATION**Нормативни натоварвания от вятър / Wind load**

Съгласно наредба №3 за основни положения за проектиране на конструкциите на строежите и за въздействията върху тях от 2004г, раздел VI, чл. 94

Acc. to Regulation No3 for Basic conditions for building constructions design and interferences, published 2004, section VI, article. 94

Нормативното натоварване от вятър при скорост на вятъра:

$$W_m := \frac{v^2}{1600} \cdot \frac{1000 \cdot \text{kg}}{\text{m}^3}$$

$$W_m = 0.77 \frac{\text{kN}}{\text{m}^2}$$

$$v := 35 \cdot \frac{\text{m}}{\text{s}}$$

Определяне на сеизмичната сила / Earthquake load

Съгласно "Наредба №РД-02-20-2 за проектиране на сгради и съоръжения в земетръсни райони" от 2012
Acc.to " Regulation №РД-02-20-2 for building design in seismic areas", published 2012

изчислителната сеизмична сила е/ the calculated earthquake load is: $E_{ik} = E_{ik} = C \cdot R \cdot K_C \cdot \beta_1 \cdot \eta_{ik} \cdot Q_k = a_h \cdot Q_k = a_v \cdot Q_k$,
където/ where:

$C_s := 1.5$ коефициент на значимост на сградите и съоръженията за електро и термични централи от общонационално значение с мощност над 100MW;
coefficient for building and equipment priority of electrical and thermal power plants, rated over 100MW

$R := 0.33$ коефициент на реагиране на конструкцията;

$K_C := 0.27$ сеизмичен коефициент/ seismic coefficient

$\beta_1 := 2.5$ динамичен коефициент за трета група почви;

$\eta_{ik} := 1$ коефициент за разпределение на изчислителното сеизмично натоварване;

$a_h := C \cdot R \cdot K_C \cdot \beta_1 \cdot \eta_{ik}$

$a_v := a_h$

$a_h = 0.33$

$a_v = 0.33$

Модул на еластичност на профилна стомана ВСт3 / Elastic modulus steel ВСт3

$E_{St3} := 210000 \cdot \text{MPa}$

Модул на еластичност на бетон клас В20/ Elastic modulus concrete class В20

$E_b := 27500 \cdot \text{MPa}$

Модул на еластичност на стомана А III/ Elastic modulus stell AIII

$E_s := 200000 \cdot \text{MPa}$

КОЕФИЦИЕНТИ ЗА НАТОВАРВАНЕ/PARTIAL SAFETY FACTORS

$\gamma_M := 1.10$ коефициент за натоварване за стомана/
partial safety factor for steel

$\gamma_C := 1.20$ коефициент за натоварване за бетон/
partial safety factor for concretel

Максимални напрежения/ Maximum stresses:

S235 JRG2 (DIN 18800):

C380/230 (ВСт3сп5) (БДС2592-71)

$$f_{Y24} := 240 \cdot \frac{\text{N}}{\text{mm}^2}$$

$$f_{Sta24} := \frac{f_{Y24}}{\gamma_M}$$

$$f_{Sta24} = 218.18 \frac{\text{N}}{\text{mm}^{2.00}}$$

S355 JRG3 (DIN 18800):

C500/360 (10Г2СФ) (БДС4880-74)

$$f_{Y36} := 360 \cdot \frac{\text{N}}{\text{mm}^2}$$

$$f_{Sta36} := \frac{f_{Y36}}{\gamma_M}$$

$$f_{Sta36} = 327.27 \frac{\text{N}}{\text{mm}^{2.00}}$$

Максимални напрежения на смачкване/ Maximum stresses:

S235JRG2:
(DIN 18800):

C380/230

(ВСт3сп5)

(БДС2592-71)

M12

$e_{12} := 25\text{mm}$

$d_{12} := 14\text{mm}$

$$f_{ba2412} := \frac{f_{Y24}}{\gamma_M} \left(1.1 \frac{e_{12}}{d_{12}} - 0.3 \right)$$

$$f_{ba2412} = 363.12 \frac{\text{N}}{\text{mm}^2}$$

M16

$e_{16} := 35\text{mm}$

$d_{16} := 18\text{mm}$

$$f_{ba2416} := \frac{f_{Y24}}{\gamma_M} \left(1.1 \frac{e_{16}}{d_{16}} - 0.3 \right)$$

$$f_{ba2416} = 401.21 \frac{\text{N}}{\text{mm}^{2.00}}$$

M20

$e_{20} := 40\text{mm}$

$d_{20} := 22\text{mm}$

$$f_{ba2420} := \frac{f_{Y24}}{\gamma_M} \left(1.1 \frac{e_{20}}{d_{20}} - 0.3 \right)$$

$$f_{ba2420} = 370.91 \frac{\text{N}}{\text{mm}^{2.00}}$$

M24	$e_{24} := 50\text{mm}$	$d_{24} := 27\text{mm}$	$f_{ba2424} := \frac{f_{Y24}}{\gamma M} \left(1.1 \frac{e_{24}}{d_{24}} - 0.3 \right)$	$f_{ba2424} = 378.99 \frac{\text{N}}{\text{mm}^{2.00}}$
S355 JRG3 (DIN 18800): C500/360 (10Г2СФ) (БДС4880-74)	M12		$f_{ba3612} := \frac{f_{Y36}}{\gamma M} \left(1.1 \frac{e_{12}}{d_{12}} - 0.3 \right)$	$f_{ba3612} = 544.68 \frac{\text{N}}{\text{mm}^{2.00}}$
	M16		$f_{ba3616} := \frac{f_{Y36}}{\gamma M} \left(1.1 \frac{e_{16}}{d_{16}} - 0.3 \right)$	$f_{ba3616} = 601.82 \frac{\text{N}}{\text{mm}^{2.00}}$
	M20		$f_{ba3620} := \frac{f_{Y36}}{\gamma M} \left(1.1 \frac{e_{20}}{d_{20}} - 0.3 \right)$	$f_{ba3620} = 556.36 \frac{\text{N}}{\text{mm}^{2.00}}$
	M24		$f_{ba3624} := \frac{f_{Y36}}{\gamma M} \left(1.1 \frac{e_{24}}{d_{24}} - 0.3 \right)$	$f_{ba3624} = 568.48 \frac{\text{N}}{\text{mm}^{2.00}}$

За HV гайки 10.9 с 0.5 Fv начално усилие/ For HV-screws 10.9 with 0.5 Fv initial stressing:

S235JRG2:(DIN 18800): C380/230 (ВСт3сп5) (БДС2592-71)	M12	$f_{ba24Fv} := 1.35 \frac{f_{Y24}}{\gamma M} \left(1.1 \frac{e_{12}}{d_{12}} - 0.3 \right)$	$f_{ba24Fv} = 490.21 \frac{\text{N}}{\text{mm}^{2.00}}$
S355 JRG3 (DIN 18800): C500/360 (10Г2СФ) (БДС4880-74)	M12	$f_{ba36Fv} := 1.35 \frac{f_{Y36}}{\gamma M} \left(1.1 \frac{e_{12}}{d_{12}} - 0.3 \right)$	$f_{ba36Fv} = 735.31 \frac{\text{N}}{\text{mm}^{2.00}}$

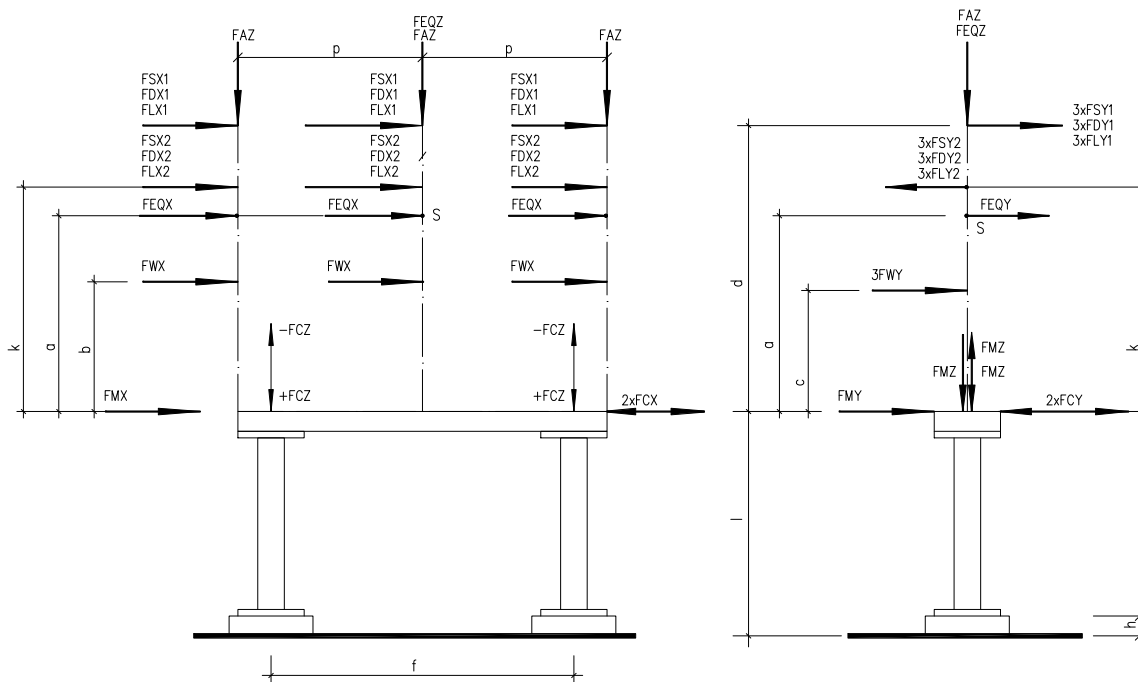
Максимално усилие на срязване/ Maximum shearing stress: максимална якост на скъсване/
tensile breaking stress: f_K

$\alpha_{a4.6} := 0.60$	$f_{K4.6} := 400 \frac{\text{N}}{\text{mm}^2}$	$f_{a4.6} := \frac{f_{K4.6} \cdot \alpha_{a4.6}}{\gamma M}$	$f_{a4.6} = 218.18 \frac{\text{N}}{\text{mm}^{2.00}}$
$\alpha_{a5.6} := 0.60$	$f_{K5.6} := 500 \frac{\text{N}}{\text{mm}^2}$	$f_{a5.6} := \frac{f_{K5.6} \cdot \alpha_{a5.6}}{\gamma M}$	$f_{a5.6} = 272.73 \frac{\text{N}}{\text{mm}^{2.00}}$
$\alpha_{a8.8} := 0.60$	$f_{K8.8} := 800 \frac{\text{N}}{\text{mm}^2}$	$f_{a8.8} := \frac{f_{K8.8} \cdot \alpha_{a8.8}}{\gamma M}$	$f_{a8.8} = 436.36 \frac{\text{N}}{\text{mm}^{2.00}}$
$\alpha_{a10.9} := 0.55$	$f_{K10.9} := 1000 \frac{\text{N}}{\text{mm}^2}$	$f_{a10.9} := \frac{f_{K10.9} \cdot \alpha_{a10.9}}{\gamma M}$	$f_{a10.9} = 500.00 \frac{\text{N}}{\text{mm}^{2.00}}$

Максимални усилия на опън/ Maximum tensile stress:

$f_{Y4.6} := 240 \frac{\text{N}}{\text{mm}^2}$	$f_{ta4.6} := 0.9 \frac{f_{Y4.6}}{\gamma M}$	$f_{ta4.6} = 196.36 \frac{\text{N}}{\text{mm}^{2.00}}$
$f_{Y5.6} := 300 \frac{\text{N}}{\text{mm}^2}$	$f_{ta5.6} := 0.9 \frac{f_{Y5.6}}{\gamma M}$	$f_{ta5.6} = 245.45 \frac{\text{N}}{\text{mm}^{2.00}}$
$f_{Y8.8} := 640 \frac{\text{N}}{\text{mm}^2}$	$f_{ta8.8} := 0.9 \frac{f_{Y8.8}}{\gamma M}$	$f_{ta8.8} = 523.64 \frac{\text{N}}{\text{mm}^{2.00}}$
$f_{Y10.9} := 900 \frac{\text{N}}{\text{mm}^2}$	$f_{ta10.9} := 0.9 \frac{f_{Y10.9}}{\gamma M}$	$f_{ta10.9} = 736.36 \frac{\text{N}}{\text{mm}^{2.00}}$

ОПРЕДЕЛЯНЕ НА УСИЛИЯТА НА ГОРЕН РЪБ ФУНДАМЕНТ ПОД ПРЕКЪСВАЧ.
СХЕМА НА НАТОВАРВАНИЯТА
CACULATION OF UPPER EDGE FOUNDATION STRESS UNDER CIRCUIT BREAKER.
LOAD DIAGRAM



Дименсии / Dimensions:

$l := 2500 \cdot \text{mm}$ $h := 150 \cdot \text{mm}$ $a := 1770 \cdot \text{mm}$ $b := 1674 \cdot \text{mm}$ $c := 1674 \cdot \text{mm}$ $d := 3348 \cdot \text{mm}$ $k := 1770 \cdot \text{mm}$
 $e_1 := 0 \cdot \text{mm}$ $e_2 := 0 \cdot \text{mm}$ $f := 2530 \cdot \text{mm}$ $n := l - h$ $n = 2.35 \text{ m}$ $p := 1750 \cdot \text{mm}$

диаметър на съоръжението/ equipment diameter: $d_k := 350 \cdot \text{mm}$

Товари от съоръжението/ Equipment loads:

ОСНОВНИ/ NORMAL:

Собствено тегло на съоръжението/
Dead load of equipment:

$$F_{AZn} := 4.0 \cdot \text{kN}$$

$$F_{AZc} := 1.2 \cdot F_{AZn}$$

$$F_{AZc} = 4.80 \text{ kN}$$

Вятър върху съоръженията/ Windload on equipments:

k_z - коефициент за отчитане на вятъра по височина/
windload height coefficient

по табл.9 на Наредба 3/
acc.to Regulation No3,tab.9

$$k_z := 0.8$$

$$\gamma_{fw} := 1.4$$

по схема 12а табл.8.2 на Наредба 3
acc.to diagram 12a,tab.8.2 of
Regulation No3

$$R_e := 0.88 \cdot d_k \cdot \sqrt{W_m \cdot k_z \cdot \gamma_{fw}} \cdot 10^5$$

$$R_e = 9.02 \times 10^5 \frac{\text{m}^{0.5} \cdot \text{kg}^{0.5}}{\text{s}}$$

по схема 13 (т 1) табл.8.2 на Наредба 3 за/
acc.to Regulation No3,tab.8.2

$$\lambda_e := \frac{d}{d_k}$$

$$\lambda_e = 9.57$$

$k := 0.647$ - за стоманени конструкции/
 $\Delta := 0.001$ for steel constructions:

$$\frac{\Delta}{d_k} = 2.86 \times 10^{-3} \frac{1}{\text{m}}$$

c_w - аеродинамичен коефициент/
streamline coefficient

$c_{\chi 001} := 0.72$ по схема 14 табл.8.2 на Наредба 3/
acc.to Regulation
No3,diaagram14,tab.8.2

$$c_w := k \cdot c_{\chi 001}$$

$$c_w = 0.47$$

нормативна стойност на статичната компонента на натоварване от вятър/
static winload:

$$W_n := W_m \cdot k_z \cdot c_w \quad W_n = 0.29 \frac{\text{kN}}{\text{m}^2}$$

$$F_{WXn} := d_k \cdot W_n \cdot d \quad F_{WXn} = 0.33 \text{ kN} \quad F_{WXc} := \gamma_{fw} F_{WXn} \quad F_{WXc} = 0.47 \text{ kN}$$

$$F_{WYn} := d_k \cdot W_n \cdot d \quad F_{WYn} = 0.33 \text{ kN} \quad F_{WYc} := \gamma_{fw} F_{WYn} \quad F_{WYc} = 0.47 \text{ kN}$$

Опъвателна сила на проводник: Static conductor tension

$$F_{SX1n} := 0.00 \cdot \text{kN} \quad F_{SX1c} := 1.3 F_{SX1n} \quad F_{SX1c} = 0.00 \text{ kN}$$

$$F_{SY1n} := 0.2 \cdot \text{kN} \quad F_{SY1c} := 1.3 F_{SY1n} \quad F_{SY1c} = 0.26 \text{ kN}$$

$$F_{SX2n} := 0.00 \cdot \text{kN} \quad F_{SX2c} := 1.3 F_{SX2n} \quad F_{SX2c} = 0.00 \text{ kN}$$

$$F_{SY2n} := 0.2 \cdot \text{kN} \quad F_{SY2c} := 1.3 F_{SY2n} \quad F_{SY2c} = 0.26 \text{ kN}$$

Вятър върху проводник/Windload on conductor:

$$F_{LX1n} := 0.1 \cdot \text{kN} \quad F_{LX1c} := 1.4 F_{LX1n} \quad F_{LX1c} = 0.14 \text{ kN}$$

$$F_{LY1n} := 0.0 \cdot \text{kN} \quad F_{LY1c} := 1.4 F_{LY1n} \quad F_{LY1c} = 0.00 \text{ kN}$$

$$F_{LX2n} := 0.1 \cdot \text{kN} \quad F_{LX2c} := 1.4 F_{LX2n} \quad F_{LX2c} = 0.14 \text{ kN}$$

$$F_{LY2n} := 0.0 \cdot \text{kN} \quad F_{LY2c} := 1.4 F_{LY2n} \quad F_{LY2c} = 0.00 \text{ kN}$$

Монтажен товар/ Errection load:

$$F_{MXn} := 1.00 \cdot \text{kN} \quad F_{MXc} := 1.3 F_{MXn} \quad F_{MXc} = 1.30 \text{ kN}$$

$$F_{MYn} := 1.00 \cdot \text{kN} \quad F_{MYc} := 1.3 F_{MYn} \quad F_{MYc} = 1.30 \text{ kN}$$

$$F_{MZn} := 1.00 \cdot \text{kN} \quad F_{MZc} := 1.3 F_{MZn} \quad F_{MZc} = 1.30 \text{ kN}$$

ОСОБЕНИ/EXCEPTIONAL

Късо съединение/ Short-circuit forces:

$$F_{DX1n} := 0.00 \cdot \text{kN} \quad F_{DY1n} := 2.0 \cdot \text{kN}$$

$$F_{DX2n} := 0.00 \cdot \text{kN} \quad F_{DY2n} := 2.0 \cdot \text{kN}$$

Сили от превключване/
Switching forces:

$$F_{CXn} := 1.50 \cdot \text{kN} \quad F_{CYn} := 1.50 \cdot \text{kN} \quad F_{CZmaxn} := 12 \cdot \text{kN}$$

$$F_{CZminn} := -12 \cdot \text{kN}$$

Сеизмични сили/
Earthquake load:

$$F_{EQXn} := a_h \cdot F_{AZn} \quad F_{EQXn} = 1.34 \text{ kN}$$

$$F_{EQYn} := a_h \cdot F_{AZn} \quad F_{EQYn} = 1.34 \text{ kN}$$

$$F_{EQZn} := a_v \cdot F_{AZn} \quad F_{EQZn} = 1.34 \text{ kN}$$

Опорна конструкция/ Supporting structures

Колона/ Column

Собствено тегло/Dead load:

$$q_{uczn} := 1.0 \cdot \frac{\text{kN}}{\text{m}} \quad F_{UCZn} := q_{uczn} \cdot n \quad F_{UCZn} = 2.35 \text{ kN}$$

$$q_{uczc} := 1.1 q_{uczn} \quad F_{UCZc} := q_{uczc} \cdot n \quad F_{UCZc} = 2.59 \text{ kN}$$

Вятър върху опорна конструкция/Windload on support structure:

$$b_{cx} := 200 \cdot \text{mm} \quad b_{cy} := 200 \cdot \text{mm}$$

$$q_{cwxn} := b_{cx} \cdot (0.6 + 0.8) \cdot W_m \quad q_{cwxn} = 0.21 \frac{\text{kN}}{\text{m}} \quad q_{cwyn} := b_{cy} \cdot (0.6 + 0.8) \cdot W_m \quad q_{cwyn} = 0.21 \frac{\text{kN}}{\text{m}}$$

$$F_{UCWXn} := q_{cwxn} \cdot n \quad F_{UCWXn} = 0.50 \text{ kN} \quad F_{UCWYn} := q_{cwyn} \cdot n \quad F_{UCWYn} = 0.50 \text{ kN}$$

$$F_{UCWXc} := \gamma_{fw} \cdot F_{UCWXn} \quad F_{UCWXc} = 0.71 \text{ kN} \quad F_{UCWYc} := \gamma_{fw} \cdot F_{UCWYn} \quad F_{UCWYc} = 0.71 \text{ kN}$$

Сеизмични сили/
Earthquake load:

$$F_{UCEQXn} := a_h \cdot F_{UCZn} \quad F_{UCEQXn} = 0.79 \text{ kN}$$

$$F_{UCEQYn} := a_h \cdot F_{UCZn} \quad F_{UCEQYn} = 0.79 \text{ kN}$$

$$F_{UCEQZn} := a_v \cdot F_{UCZn} \quad F_{UCEQZn} = 0.79 \text{ kN}$$

Греда/ Beam

Собствено тегло/Dead load: $q_{ugzn} := 0.5 \cdot \frac{\text{kN}}{\text{m}}$ $F_{UGZn} := q_{ugzn} \cdot 2p$ $F_{UGZc} := 1.1 \cdot F_{UGZn}$ $F_{UGZc} = 1.93 \text{ kN}$

Вятър върху опорна конструкция/Windload: $b_g := 0.36 \cdot m$ $q_{gwxn} := b_g \cdot 1.4 \cdot W_m$ $q_{gwxn} = 0.39 \frac{\text{kN}}{\text{m}}$ $q_{gwyn} := b_g \cdot 1.4 \cdot W_m$ $q_{gwyn} = 0.39 \frac{\text{kN}}{\text{m}}$

$$F_{UGWXn} := 0 \quad F_{UGWXn} = 0.00 \text{ kN} \quad F_{UGWYn} := q_{gwyn} \cdot 2p \quad F_{UGWYn} = 1.35 \text{ kN}$$

$$F_{UGWXc} := \gamma_{fw} F_{UGWXn} \quad F_{UGWXc} = 0.00 \text{ kN} \quad F_{UGWYc} := \gamma_{fw} F_{UGWYn} \quad F_{UGWYc} = 1.89 \text{ kN}$$

Сеизмични сили/
Earthquake load: $F_{UGEQXn} := a_h \cdot F_{UGZn}$ $F_{UGEQXn} = 0.58 \text{ kN}$

$$F_{UGEQYn} := a_h \cdot F_{UGZn} \quad F_{UGEQYn} = 0.58 \text{ kN}$$

$$F_{UGEQZn} := a_v \cdot F_{UGZn} \quad F_{UGEQZn} = 0.58 \text{ kN}$$

ОПРЕДЕЛЯНЕ НА УСИЛИЯТА НА ГОРЕН РЪБ ФУНДАМЕНТ.**CALCULATION OF THE STRESS ON THE UPPER EDGE FOUNDATION.****A: Собствено тегло / Dead load:**

нормативни натоварвания/normative loads

$$F_{ZmaxAn} := \frac{3}{2} F_{AZn} + F_{UCZn} + \frac{1}{2} F_{UGZn} \quad F_{ZmaxAn} = 9.22 \text{ kN}$$

$$F_{ZminAn} := \frac{3}{2} F_{AZn} + F_{UCZn} + \frac{1}{2} F_{UGZn} \quad F_{ZminAn} = 9.22 \text{ kN}$$

$$F_{XAn} := 0.00 \cdot \text{kN} \quad M_{YAn} := 0.00 \cdot \text{kN} \quad F_{YAn} := 0.00 \cdot \text{kN} \quad M_{XAn} := 0.00 \cdot \text{kN}$$

изчислителни натоварвания/calculating loads

$$F_{ZmaxAc} := \frac{3}{2} F_{AZc} + F_{UCZc} + \frac{1}{2} F_{UGZc} \quad F_{ZmaxAc} = 10.75 \text{ kN}$$

$$F_{ZminAc} := \frac{3}{2} F_{AZc} + F_{UCZc} + \frac{1}{2} F_{UGZc} \quad F_{ZminAc} = 10.75 \text{ kN}$$

$$F_{XAc} := 0.00 \cdot \text{kN} \quad M_{YAc} := 0.00 \cdot \text{kN} \quad F_{YAc} := 0.00 \cdot \text{kN} \quad M_{XAc} := 0.00 \cdot \text{kN}$$

C.1: Вятър по ос X / Windload direction X

нормативни натоварвания/normative loads

$$F_{ZmaxC1n} := 3 \cdot F_{WXn} \cdot \frac{b}{f} + 3 F_{LX1n} \cdot \frac{d}{f} + 3 F_{LX2n} \cdot \frac{k}{f} \quad F_{ZmaxC1n} = 1.27 \text{ kN}$$

$$F_{ZminC1n} := -3 \cdot F_{WXn} \cdot \frac{b}{f} - 3 F_{LX1n} \cdot \frac{d}{f} - 3 F_{LX2n} \cdot \frac{k}{f} \quad F_{ZminC1n} = -1.27 \text{ kN}$$

$$F_{XC1n} := \frac{3}{2} F_{WXn} + F_{UCWXn} + \frac{3}{2} F_{LX1n} + \frac{3}{2} F_{LX2n}$$

$$M_{YC1n} := \frac{3}{2} F_{WXn} \cdot (n + b) + F_{UCWXn} \cdot \frac{n}{2} + \frac{3}{2} F_{LX1n} \cdot (n + d) + \frac{3}{2} F_{LX2n} \cdot (n + k) \quad F_{XC1n} = 737.46 \frac{\text{kg}}{2} \text{ k}$$

$$M_{YC1n} = 4.08 \text{ kN} \cdot \text{m} \quad F_{YC1n} := 0.00 \cdot \text{kN} \quad F_{YC1n} = 0.00 \text{ kN}$$

$$M_{XC1n} := 0.00 \cdot \text{kN} \cdot \text{m} \quad M_{XC1n} = 0.00 \text{ kN} \cdot \text{m}$$

изчислителни натоварвания/calculating loads

$$F_{ZmaxC1c} := 3 \cdot F_{WXc} \cdot \frac{b}{f} + 3F_{LX1c} \cdot \frac{d}{f} + 3F_{LX2c} \cdot \frac{k}{f}$$

$$F_{ZmaxC1c} = 1.78 \text{ kN}$$

$$F_{ZminC1c} := -3 \cdot F_{WXc} \cdot \frac{b}{f} - 3 \cdot F_{LX1c} \cdot \frac{d}{f} - 3F_{LX2c} \cdot \frac{k}{f}$$

$$F_{ZminC1c} = -1.78 \text{ kN}$$

$$F_{XC1c} := \frac{3}{2} F_{WXc} + F_{UCWXc} + \frac{3}{2} F_{LX1c} + \frac{3}{2} F_{LX2c}$$

$$F_{XC1c} = 1.03 \times 10^3 \frac{\text{kg}}{\text{s}^2} \text{ k}$$

$$M_{YC1c} := \frac{3}{2} F_{WXc} \cdot (n + b) + F_{UCWXc} \cdot \frac{n}{2} + \frac{3}{2} F_{LX1c} \cdot (n + d) + \frac{3}{2} F_{LX2c} \cdot (n + k)$$

$$M_{YC1c} = 5.72 \text{ kN} \cdot \text{m}$$

$$F_{YC1c} := 0.00 \cdot \text{kN}$$

$$F_{YC1c} = 0.00 \text{ kN}$$

$$M_{XC1c} := 0.00 \cdot \text{kN} \cdot \text{m}$$

$$M_{XC1c} = 0.00 \text{ kN} \cdot \text{m}$$

C.2: Вятър по ос Y / Windload direction Y

нормативни натоварвания/normative loads

$$F_{ZmaxC2n} := 0.00 \cdot \text{kN}$$

$$F_{ZmaxC2n} = 0.00 \text{ kN}$$

$$F_{ZminC2n} := 0.00 \cdot \text{kN}$$

$$F_{ZminC2n} = 0.00 \text{ kN}$$

$$F_{XC2n} := 0.00 \cdot \text{kN}$$

$$F_{XC2n} = 0.00 \text{ kN}$$

$$M_{YC2n} := 0.00 \cdot \text{kN} \cdot \text{m}$$

$$M_{YC2n} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YC2n} := \frac{3}{2} F_{LY1n} + \frac{3}{2} F_{WYn} + F_{UCWYn} + \frac{1}{2} F_{UGWYn} - \frac{3}{2} F_{LY2n}$$

$$F_{YC2n} = 1.68 \text{ kN}$$

$$M_{XC2n} := \frac{3}{2} F_{LY1n} \cdot (n + d) + \frac{3}{2} F_{WYn} \cdot (n + c) + F_{UCWYn} \cdot \frac{n}{2} + \frac{1}{2} F_{UGWYn} \cdot n - \frac{3}{2} F_{LY2n} \cdot (n + k)$$

$$M_{XC2n} = 4.20 \text{ kN} \cdot \text{m}$$

изчислителни натоварвания/calculating loads

$$F_{ZmaxC2c} := 0.00 \cdot \text{kN}$$

$$F_{ZmaxC2c} = 0.00 \text{ kN}$$

$$F_{ZminC2c} := 0.00 \cdot \text{kN}$$

$$F_{ZminC2c} = 0.00 \text{ kN}$$

$$F_{XC2c} := 0.00 \cdot \text{kN}$$

$$F_{XC2c} = 0.00 \text{ kN}$$

$$M_{YC2c} := 0.00 \cdot \text{kN} \cdot \text{m}$$

$$M_{YC2c} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YC2c} := \frac{3}{2} F_{LY1c} + \frac{3}{2} F_{WYc} + F_{UCWYc} + \frac{1}{2} F_{UGWYc} - \frac{3}{2} F_{LY2c}$$

$$F_{YC2c} = 2.35 \text{ kN}$$

$$M_{XC2c} := \frac{3}{2} F_{LY1c} \cdot (n + d) + \frac{3}{2} F_{WYc} \cdot (n + c) + F_{UCWYc} \cdot \frac{n}{2} + \frac{1}{2} F_{UGWYc} \cdot n - \frac{3}{2} F_{LY2c} \cdot (n + k)$$

$$M_{XC2c} = 5.88 \text{ kN} \cdot \text{m}$$

D: Опъвателна сила от проводник / Static conductor tension

нормативни натоварвания/normative loads

$$F_{ZmaxDn} := 3 \cdot F_{SX1n} \cdot \frac{d}{f} - 3 \cdot F_{SX2n} \cdot \frac{k}{f}$$

$$F_{ZmaxDn} = 0.00 \text{ kN}$$

$$F_{ZminDn} := -3 \cdot F_{SX1n} \cdot \frac{d}{f} + 3 \cdot F_{SX2n} \cdot \frac{k}{f}$$

$$F_{ZminDn} = 0.00 \text{ kN}$$

$$F_{XDn} := \frac{3}{2} F_{SX1n} - \frac{3}{2} F_{SX2n}$$

$$F_{XDn} = 0.00 \text{ kN}$$

$$M_{YDn} := \frac{3}{2} F_{SX1n} \cdot (n + d) - \frac{3}{2} F_{SX2n} \cdot (n + k)$$

$$M_{YDn} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YDn} := \frac{3}{2} \cdot F_{SY1n}$$

$$F_{YDn} = 0.30 \text{ kN}$$

$$M_{XDn} := \frac{3}{2} \cdot F_{SY1n} \cdot (n + d)$$

$$M_{XDn} = 1.71 \text{ kN} \cdot \text{m}$$

изчислителни натоварвания/calculating loads

$$F_{ZmaxDc} := 3 \cdot F_{SX1c} \cdot \frac{d}{f} - 3 \cdot F_{SX2c} \cdot \frac{k}{f}$$

$$F_{ZmaxDc} = 0.00 \text{ kN}$$

$$F_{ZminDc} := -3 \cdot F_{SX1c} \cdot \frac{d}{f} + 3 \cdot F_{SX2c} \cdot \frac{k}{f}$$

$$F_{ZminDc} = 0.00 \text{ kN}$$

$$F_{XDc} := \frac{3}{2} \cdot F_{SX1c} - \frac{3}{2} \cdot F_{SX2c}$$

$$F_{XDc} = 0.00 \text{ kN}$$

$$M_{YDc} := \frac{3}{2} \cdot F_{SX1c} \cdot (n + d) - \frac{3}{2} \cdot F_{SX2c} \cdot (n + k)$$

$$M_{YDc} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YDc} := \frac{3}{2} \cdot F_{SY1c}$$

$$F_{YDc} = 0.39 \text{ kN}$$

$$M_{XDc} := \frac{3}{2} \cdot F_{SY1c} \cdot (n + d)$$

$$M_{XDc} = 2.22 \text{ kN} \cdot \text{m}$$

Е: Късо съединение / Short-circuit forces

нормативни натоварвания/normative loads

$$F_{ZmaxEn} := \frac{3}{2} \cdot F_{DX1n} \cdot \frac{d}{f} + \frac{3}{2} \cdot F_{DX2n} \cdot \frac{k}{f}$$

$$F_{ZmaxEn} = 0.00 \text{ kN}$$

$$F_{ZminEn} := -\frac{3}{2} \cdot F_{DX1n} \cdot \frac{d}{f} - \frac{3}{2} \cdot F_{DX2n} \cdot \frac{k}{f}$$

$$F_{ZminEn} = 0.00 \text{ kN}$$

$$F_{XEn} := \frac{3}{2} \cdot F_{DX1n} + \frac{3}{2} \cdot F_{DX2n}$$

$$F_{XEn} = 0.00 \text{ kN}$$

$$M_{YEn} := \frac{3}{2} \cdot F_{DX1n} \cdot (n + d) + \frac{3}{2} \cdot F_{DX2n} \cdot (n + k)$$

$$M_{YEn} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YEn} := \frac{3}{2} \cdot F_{DY1n}$$

$$F_{YEn} = 3.00 \text{ kN}$$

$$M_{XEn} := \frac{3}{2} \cdot F_{DY1n} \cdot (n + d)$$

$$M_{XEn} = 17.09 \text{ kN} \cdot \text{m}$$

Н: Монтажен товар / Erection load

нормативни натоварвания/normative loads

$$F_{ZmaxHn} := F_{MZn}$$

$$F_{ZmaxHn} = 1.00 \text{ kN}$$

$$F_{ZminHn} := 0.00 \cdot \text{kN}$$

$$F_{ZminHn} = 0.00 \text{ kN}$$

$$F_{XHn} := F_{MXn}$$

$$F_{XHn} = 1.00 \text{ kN}$$

$$M_{YHn} := F_{MXn} \cdot n$$

$$M_{YHn} = 2.35 \text{ kN} \cdot \text{m}$$

$$F_{YHn} := F_{MYn}$$

$$F_{YHn} = 1.00 \text{ kN}$$

$$M_{XHn} := F_{MYn} \cdot n$$

$$M_{XHn} = 2.35 \text{ kN} \cdot \text{m}$$

изчислителни натоварвания/calculating loads

$$F_{ZmaxHc} := F_{MZc}$$

$$F_{ZmaxHc} = 1.30 \text{ kN}$$

$$F_{ZminHc} := 0.00 \cdot \text{kN}$$

$$F_{ZminHc} = 0.00 \text{ kN}$$

$$F_{XHc} := F_{MXc}$$

$$F_{XHc} = 1.30 \text{ kN}$$

$$M_{YHc} := F_{MXc} \cdot n$$

$$M_{YHc} = 3.06 \text{ kN} \cdot \text{m}$$

$$F_{YHc} := F_{MYc}$$

$$F_{YHc} = 1.30 \text{ kN}$$

$$M_{XHc} := F_{MYc} \cdot n$$

$$M_{XHc} = 3.06 \text{ kN} \cdot \text{m}$$

F: Превключвателни сили / Switching forces

нормативни натоварвания/normative loads

$$F_{ZmaxFn} := F_{CZmaxn}$$

$$F_{ZmaxFn} = 12.00 \text{ kN}$$

$$F_{ZminFn} := F_{CZminn}$$

$$F_{ZminFn} = -12.00 \text{ kN}$$

$$F_{XFn} := F_{CXn}$$

$$F_{XFn} = 1.50 \text{ kN}$$

$$M_{YFn} := F_{CXn} \cdot n$$

$$M_{YFn} = 3.53 \text{ kN} \cdot \text{m}$$

$$F_{YFn} := F_{CYn}$$

$$F_{YFn} = 1.50 \text{ kN}$$

$$M_{XFn} := F_{CYn} \cdot n$$

$$M_{XFn} = 3.53 \text{ kN} \cdot \text{m}$$

G1: Земетресение по ос X / Earthquake load direction X

нормативни натоварвания/normative loads

$$F_{ZmaxG1n} := 3F_{EQXn} \cdot \frac{a}{f}$$

$$F_{ZmaxG1n} = 2.81 \text{ kN}$$

$$F_{ZminG1n} := -3F_{EQXn} \cdot \frac{a}{f}$$

$$F_{ZminG1n} = -2.81 \text{ kN}$$

$$F_{XG1n} := \frac{3}{2}F_{EQXn} + F_{UCEQXn} + \frac{1}{2}F_{UGEQXn}$$

$$F_{XG1n} = 3.08 \text{ kN}$$

$$M_{YG1n} := \frac{3}{2}F_{EQXn} \cdot (n + a) + F_{UCEQXn} \cdot \frac{n}{2} + \frac{1}{2}F_{UGEQXn} \cdot n$$

$$M_{YG1n} = 9.87 \text{ kN} \cdot \text{m}$$

$$F_{YG1n} := 0.00 \cdot \text{kN}$$

$$F_{YG1n} = 0.00 \text{ kN}$$

$$M_{XG1n} := 0.00 \cdot \text{kN} \cdot \text{m}$$

$$M_{XG1n} = 0.00 \text{ kN} \cdot \text{m}$$

G2: Земетресение по ос Y / Earthquake load direction YX

нормативни натоварвания/normative loads

$$F_{ZmaxG2n} := 0.00 \cdot \text{kN}$$

$$F_{ZmaxG2n} = 0.00 \text{ kN}$$

$$F_{ZminG2n} := 0.00 \cdot \text{kN}$$

$$F_{ZminG2n} = 0.00 \text{ kN}$$

$$F_{XG2n} := 0.00 \cdot \text{kN}$$

$$F_{XG2n} = 0.00 \text{ kN}$$

$$M_{YG2n} := 0.00 \cdot \text{kN} \cdot \text{m}$$

$$M_{YG2n} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YG2n} := \frac{3}{2}F_{EQYn} + F_{UCEQYn} + \frac{1}{2}F_{UGEQYn}$$

$$F_{YG2n} = 3.08 \text{ kN}$$

$$M_{XG2n} := \frac{3}{2}F_{EQYn} \cdot (n + a) + F_{UCEQYn} \cdot \frac{n}{2} + \frac{1}{2}F_{UGEQYn} \cdot n$$

$$M_{XG2n} = 9.87 \text{ kN} \cdot \text{m}$$

G3: Земетресение по ос Z / Earthquake load direction Z

нормативни натоварвания/normative loads

$$F_{ZmaxG3n} := \frac{3}{2}F_{EQZn} + F_{UCEQZn} + \frac{1}{2}F_{UGEQZn}$$

$$F_{ZmaxG3n} = 3.08 \text{ kN}$$

$$F_{ZminG3n} := -F_{ZmaxG3n}$$

$$F_{ZminG3n} = -3.08 \text{ kN}$$

$$F_{XG3n} := 0.00 \cdot \text{kN}$$

$$F_{XG3n} = 0.00 \text{ kN}$$

$$M_{YG3n} := 0.00 \cdot \text{kN} \cdot \text{m}$$

$$M_{YG3n} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YG3n} := 0.00 \cdot \text{kN}$$

$$F_{YG3n} = 0.00 \text{ kN}$$

$$M_{XG3n} := 0.00 \cdot \text{kN} \cdot \text{m}$$

$$M_{XG3n} = 0.00 \text{ kN} \cdot \text{m}$$

Комбинации от натоварванията/ Foundation loadcases
ОСНОВНИ КОМБИНАЦИИ/ NORMAL LOADCASES**Комбинация 1: Собствено тегло (A)/ Loadcase 1: Dead load (A)**

нормативни натоварвания/normative loads

$$F_{Zmax1n} := F_{ZmaxAn}$$

$$F_{Zmax1n} = 9.22 \text{ kN}$$

$$F_{Zmin1n} := F_{ZminAn}$$

$$F_{Zmin1n} = 9.22 \text{ kN}$$

$$F_{X1n} := F_{XAn}$$

$$F_{X1n} = 0.00 \text{ kN}$$

$$M_{Y1n} := M_{YAn}$$

$$M_{Y1n} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{Y1n} := F_{YAn}$$

$$F_{Y1n} = 0.00 \text{ kN}$$

$$M_{X1n} := M_{XAn}$$

$$M_{X1n} = 0.00 \text{ kN} \cdot \text{m}$$

изчислителни натоварвания/calculating loads

$$F_{Zmax1c} := F_{ZmaxAc}$$

$$F_{Zmax1c} = 10.75 \text{ kN}$$

$$F_{Zmin1c} := F_{ZminAc}$$

$$F_{Zmin1c} = 10.75 \text{ kN}$$

$$F_{X1c} := F_{XAc}$$

$$F_{X1c} = 0.00 \text{ kN}$$

$$M_{Y1c} := M_{YAc}$$

$$M_{Y1c} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{Y1c} := F_{YAc}$$

$$F_{Y1c} = 0.00 \text{ kN}$$

$$M_{X1c} := M_{XAc}$$

$$M_{X1c} = 0.00 \text{ kN} \cdot \text{m}$$

Комбинация 2: СТ(A)+Опъвателна сила от проводник(D)+Монтажен товар(H)**Loadcase СТ(A)+ Static conductor tension (D)+ Erection load (H)**

нормативни натоварвания/normative loads

$$F_{Zmax2n} := F_{ZmaxAn} + F_{ZmaxDn} + F_{ZmaxHn}$$

$$F_{Zmax2n} = 10.22 \text{ kN}$$

$$F_{Zmin2n} := F_{ZminAn} + F_{ZminDn} + F_{ZminHn}$$

$$F_{Zmin2n} = 9.22 \text{ kN}$$

$$F_{X2n} := F_{XAn} + F_{XDn} + F_{XHn}$$

$$F_{X2n} = 1.00 \text{ kN}$$

$$M_{Y2n} := M_{YAn} + M_{YDn} + M_{YHn}$$

$$M_{Y2n} = 2.35 \text{ kN} \cdot \text{m}$$

$$F_{Y2n} := F_{YAn} + F_{YDn} + F_{YHn}$$

$$F_{Y2n} = 1.30 \text{ kN}$$

$$M_{X2n} := M_{XAn} + M_{XDn} + M_{XHn}$$

$$M_{X2n} = 4.06 \text{ kN} \cdot \text{m}$$

изчислителни натоварвания/calculating loads

$$\begin{aligned}
 F_{Zmax2c} &:= F_{ZmaxAc} + F_{ZmaxDc} + F_{ZmaxHc} & F_{Zmax2c} &= 12.05 \text{ kN} \\
 F_{Zmin2c} &:= F_{ZminAc} + F_{ZminDc} + F_{ZminHc} & F_{Zmin2c} &= 10.75 \text{ kN} \\
 F_{X2c} &:= F_{XAc} + F_{XDc} + F_{XHc} & F_{X2c} &= 1.30 \text{ kN} \\
 M_{Y2c} &:= M_{YAc} + M_{YDc} + M_{YHc} & M_{Y2c} &= 3.06 \text{ kN}\cdot\text{m} \\
 F_{Y2c} &:= F_{YAc} + F_{YDc} + F_{YHc} & F_{Y2c} &= 1.69 \text{ kN} \\
 M_{X2c} &:= M_{XAc} + M_{XDc} + M_{XHc} & M_{X2c} &= 5.28 \text{ kN}\cdot\text{m}
 \end{aligned}$$

Комбинация 3: СТ(А)+Вятър по ос Х(С1)+Опъвателна сила от проводник(D)**Loadcase 3: CT(A)+Wind direction X(C1)+Static conductor tension (D)**

нормативни натоварвания/normative loads

$$\begin{aligned}
 F_{Zmax3n} &:= F_{ZmaxAn} + 0.9F_{ZmaxC1n} + 0.95F_{ZmaxDn} & F_{Zmax3n} &= 10.37 \text{ kN} \\
 F_{Zmin3n} &:= F_{ZminAn} + 0.9F_{ZminC1n} + 0.95F_{ZminDn} & F_{Zmin3n} &= 8.08 \text{ kN} \\
 F_{X3n} &:= F_{XAn} + 0.9F_{XC1n} + 0.95F_{XDn} & F_{X3n} &= 1.17 \text{ kN} \\
 M_{Y3n} &:= M_{YAn} + 0.9M_{YC1n} + 0.95M_{YDn} & M_{Y3n} &= 3.67 \text{ kN}\cdot\text{m} \\
 F_{Y3n} &:= F_{YAn} + 0.9F_{YC1n} + 0.95F_{YDn} & F_{Y3n} &= 0.29 \text{ kN} \\
 M_{X3n} &:= M_{XAn} + 0.9M_{XC1n} + 0.95M_{XDn} & M_{X3n} &= 1.62 \text{ kN}\cdot\text{m}
 \end{aligned}$$

изчислителни натоварвания/calculating loads

$$\begin{aligned}
 F_{Zmax3c} &:= F_{ZmaxAc} + 0.9F_{ZmaxC1c} + 0.95F_{ZmaxDc} & F_{Zmax3c} &= 12.35 \text{ kN} \\
 F_{Zmin3c} &:= F_{ZminAc} + 0.9F_{ZminC1c} + 0.95F_{ZminDc} & F_{Zmin3c} &= 9.15 \text{ kN} \\
 F_{X3c} &:= F_{XAc} + 0.9F_{XC1c} + 0.95F_{XDc} & F_{X3c} &= 1.64 \text{ kN} \\
 M_{Y3c} &:= M_{YAc} + 0.9M_{YC1c} + 0.95M_{YDc} & M_{Y3c} &= 5.14 \text{ kN}\cdot\text{m} \\
 F_{Y3c} &:= F_{YAc} + 0.9F_{YC1c} + 0.95F_{YDc} & F_{Y3c} &= 0.37 \text{ kN} \\
 M_{X3c} &:= M_{XAc} + 0.9M_{XC1c} + 0.95M_{XDc} & M_{X3c} &= 2.11 \text{ kN}\cdot\text{m}
 \end{aligned}$$

Комбинация 4: СТ(А)+Вятър по ос Y(С2)+Опъвателна сила от проводник(D)**Loadcase 4: CT(A)+Wind direction Y(C2)+Static conductor tension (D)**

нормативни натоварвания/normative loads

$$\begin{aligned}
 F_{Zmax4n} &:= F_{ZmaxAn} + 0.9F_{ZmaxC2n} + 0.95F_{ZmaxDn} & F_{Zmax4n} &= 9.22 \text{ kN} \\
 F_{Zmin4n} &:= F_{ZminAn} + 0.9F_{ZminC2n} + 0.95F_{ZminDn} & F_{Zmin4n} &= 9.22 \text{ kN} \\
 F_{X4n} &:= F_{XAn} + 0.9F_{XC2n} + 0.95F_{XDn} & F_{X4n} &= 0.00 \text{ kN} \\
 M_{Y4n} &:= M_{YAn} + 0.9M_{YC2n} + 0.95M_{YDn} & M_{Y4n} &= 0.00 \text{ kN}\cdot\text{m} \\
 F_{Y4n} &:= F_{YAn} + 0.9F_{YC2n} + 0.95F_{YDn} & F_{Y4n} &= 1.80 \text{ kN} \\
 M_{X4n} &:= M_{XAn} + 0.9M_{XC2n} + 0.95M_{XDn} & M_{X4n} &= 5.40 \text{ kN}\cdot\text{m}
 \end{aligned}$$

изчислителни натоварвания/calculating loads

$$\begin{aligned}
 F_{Zmax4c} &:= F_{ZmaxAc} + 0.9F_{ZmaxC2c} + 0.95F_{ZmaxDc} & F_{Zmax4c} &= 10.75 \text{ kN} \\
 F_{Zmin4c} &:= F_{ZminAc} + 0.9F_{ZminC2c} + 0.95F_{ZminDc} & F_{Zmin4c} &= 10.75 \text{ kN} \\
 F_{X4c} &:= F_{XAc} + 0.9F_{XC2c} + 0.95F_{XDc} & F_{X4c} &= 0.00 \text{ kN} \\
 M_{Y4c} &:= M_{YAc} + 0.9M_{YC2c} + 0.95M_{YDc} & M_{Y4c} &= 0.00 \text{ kN}\cdot\text{m}
 \end{aligned}$$

$$F_{Y4c} := F_{YAc} + 0.9F_{YC2c} + 0.95F_{YDc}$$

$$F_{Y4c} = 2.49 \text{ kN}$$

$$M_{X4c} := M_{XAc} + 0.9M_{XC2c} + 0.95M_{XDc}$$

$$M_{X4c} = 7.40 \text{ kN}\cdot\text{m}$$

ОСОБЕНИ КОМБИНАЦИИ/ EXCEPTIONAL LOADCASES

от нормативни натоварвания / from normative loads

Комбинация 5: СТ(А)+Късо съединение(Е)/ Loadcase 5: СТ(А)+Short circuit forces

$$F_{Zmax5n} := F_{ZmaxAn} + F_{ZmaxEn}$$

$$F_{Zmax5n} = 9.22 \text{ kN}$$

$$F_{Zmin5n} := F_{ZminAn} + F_{ZminEn}$$

$$F_{Zmin5n} = 9.22 \text{ kN}$$

$$F_{X5n} := F_{XAn} + F_{XEn}$$

$$F_{X5n} = 0.00 \text{ kN}$$

$$M_{Y5n} := M_{YAn} + M_{YEn}$$

$$M_{Y5n} = 0.00 \text{ kN}\cdot\text{m}$$

$$F_{Y5n} := F_{YAn} + F_{YEn}$$

$$F_{Y5n} = 3.00 \text{ kN}$$

$$M_{X5n} := M_{XAn} + M_{XEn}$$

$$M_{X5n} = 17.09 \text{ kN}\cdot\text{m}$$

Комбинация 6: СТ(А)+Опъвателна сила от проводник(Д)+Превключване(Е)

Loadcase 6: СТ(А)+Static conductor tension(Д)+Switching (Е)

$$F_{Zmax6n} := F_{ZmaxAn} + 0.95F_{ZmaxDn} + F_{ZmaxFn}$$

$$F_{Zmax6n} = 21.23 \text{ kN}$$

$$F_{Zmin6n} := F_{ZminAn} + 0.95F_{ZminDn} + F_{ZminFn}$$

$$F_{Zmin6n} = -2.78 \text{ kN}$$

$$F_{X6n} := F_{XAn} + 0.95F_{XDn} + F_{XFn}$$

$$F_{X6n} = 1.50 \text{ kN}$$

$$M_{Y6n} := M_{YAn} + 0.95M_{YDn} + M_{YFn}$$

$$M_{Y6n} = 3.53 \text{ kN}\cdot\text{m}$$

$$F_{Y6n} := F_{YAn} + 0.95F_{YDn} + F_{YFn}$$

$$F_{Y6n} = 1.79 \text{ kN}$$

$$M_{X6n} := M_{XAn} + 0.95M_{XDn} + M_{XFn}$$

$$M_{X6n} = 5.15 \text{ kN}\cdot\text{m}$$

Комбинация 7: СТ(А)+Опъвателна сила от проводник(Д)+Сеизмични сили по Х(Г.1)+/-З(Г.3)

Loadcase 7: СТ(А)+Static conductor tension(Д)+Earthquake load direction X(Г.1)+/-Z(Г.3)

$$F_{Zmax7n} := F_{ZmaxAn} + 0.95F_{ZmaxDn} + F_{ZmaxG1n} + F_{ZmaxG3n}$$

$$F_{Zmax7n} = 15.11 \text{ kN}$$

$$F_{Zmin7n} := F_{ZminAn} + 0.95F_{ZminDn} + F_{ZminG1n} + F_{ZminG3n}$$

$$F_{Zmin7n} = 3.34 \text{ kN}$$

$$F_{X7n} := F_{XAn} + 0.95F_{XDn} + F_{XG1n} + F_{XG3n}$$

$$F_{X7n} = 3.08 \text{ kN}$$

$$M_{Y7n} := M_{YAn} + 0.95M_{YDn} + M_{YG1n} + M_{YG3n}$$

$$M_{Y7n} = 9.87 \text{ kN}\cdot\text{m}$$

$$F_{Y7n} := F_{YAn} + 0.95F_{YDn} + F_{YG1n} + F_{YG3n}$$

$$F_{Y7n} = 0.29 \text{ kN}$$

$$M_{X7n} := M_{XAn} + 0.95M_{XDn} + M_{XG1n} + M_{XG3n}$$

$$M_{X7n} = 1.62 \text{ kN}\cdot\text{m}$$

Комбинация 8: СТ(1)+Опъвателна сила от проводник(Д)+Сеизмични сили по Y(Г.2)+/-З(Г.3)

Loadcase 8: СТ(1)+Static conductor tension(Д)+Earthquake load direction Y(Г.2)+/-Z(Г.3)

$$F_{Zmax8n} := F_{ZmaxAn} + 0.95F_{ZmaxDn} + F_{ZmaxG2n} + F_{ZmaxG3n}$$

$$F_{Zmax8n} = 12.31 \text{ kN}$$

$$F_{Zmin8n} := F_{ZminAn} + 0.95F_{ZminDn} + F_{ZminG2n} + F_{ZminG3n}$$

$$F_{Zmin8n} = 6.14 \text{ kN}$$

$$F_{X8n} := F_{XAn} + 0.95F_{XDn} + F_{XG2n} + F_{XG3n}$$

$$F_{X8n} = 0.00 \text{ kN}$$

$$M_{Y8n} := M_{YAn} + 0.95M_{YDn} + M_{YG2n} + M_{YG3n}$$

$$M_{Y8n} = 0.00 \text{ kN}\cdot\text{m}$$

$$F_{Y8n} := F_{YAn} + 0.95F_{YDn} + F_{YG2n} + F_{YG3n}$$

$$F_{Y8n} = 3.37 \text{ kN}$$

$$M_{X8n} := M_{XAn} + 0.95M_{XDn} + M_{XG2n} + M_{XG3n}$$

$$M_{X8n} = 11.49 \text{ kN}\cdot\text{m}$$

Комбинация 9.1: СТ(А)+Вятър по ос X(C.1)+Късо съединение (E)
Loadcase 9.1: CT(A)+Windload direction X(C.1)+Short-circuit forces (E)

$$F_{Zmax91n} := F_{ZmaxAn} + 0.8F_{ZmaxC1n} + F_{ZmaxEn}$$

$$F_{Zmax91n} = 10.24 \text{ kN}$$

$$F_{Zmin91n} := F_{ZminAn} + 0.8F_{ZminC1n} + F_{ZminEn}$$

$$F_{Zmin91n} = 8.21 \text{ kN}$$

$$F_{X91n} := F_{XAn} + 0.8F_{XC1n} + F_{XEn}$$

$$F_{X91n} = 1.04 \text{ kN}$$

$$M_{Y91n} := M_{YAn} + 0.8M_{YC1n} + M_{YEn}$$

$$M_{Y91n} = 3.27 \text{ kN}\cdot\text{m}$$

$$F_{Y91n} := F_{YAn} + 0.8F_{YC1n} + F_{YEn}$$

$$F_{Y91n} = 3.00 \text{ kN}$$

$$M_{X91n} := M_{XAn} + 0.8M_{XC1n} + M_{XEn}$$

$$M_{X91n} = 17.09 \text{ kN}\cdot\text{m}$$

Комбинация 9.2: СТ(А)+Вятър по ос Y(C.2)+Късо съединение (E)
Loadcase 9.2: CT(A)+Wind load direction Y(C.2)+Short-circuit forces (E)

$$F_{Zmax92n} := F_{ZmaxAn} + 0.8F_{ZmaxC2n} + F_{ZmaxEn}$$

$$F_{Zmax92n} = 9.22 \text{ kN}$$

$$F_{Zmin92n} := F_{ZminAn} + 0.8F_{ZminC2n} + F_{ZminEn}$$

$$F_{Zmin92n} = 9.22 \text{ kN}$$

$$F_{X92n} := F_{XAn} + 0.8F_{XC2n} + F_{XEn}$$

$$F_{X92n} = 0.00 \text{ kN}$$

$$M_{Y92n} := M_{YAn} + 0.8M_{YC2n} + M_{YEn}$$

$$M_{Y92n} = 0.00 \text{ kN}\cdot\text{m}$$

$$F_{Y92n} := F_{YAn} + 0.8F_{YC2n} + F_{YEn}$$

$$F_{Y92n} = 4.34 \text{ kN}$$

$$M_{X92n} := M_{XAn} + 0.8M_{XC2n} + M_{XEn}$$

$$M_{X92n} = 20.45 \text{ kN}\cdot\text{m}$$

Комбинация 10.1: СТ(А)+Сеизмични сили по оси X(G.1)+/-Z(G.3)
Loadcase 10.1: CT(A)+Earthquake load direction X(G.1)+/-Z(G.3)

$$F_{Zmax101n} := F_{ZmaxAn} + F_{ZmaxG1n} + F_{ZmaxG3n}$$

$$F_{Zmax101n} = 15.11 \text{ kN}$$

$$F_{Zmin101n} := F_{ZminAn} + F_{ZminG1n} + F_{ZminG3n}$$

$$F_{Zmin101n} = 3.34 \text{ kN}$$

$$F_{X101n} := F_{XAn} + F_{XG1n} + F_{XG3n}$$

$$F_{X101n} = 3.08 \text{ kN}$$

$$M_{Y101n} := M_{YAn} + M_{YG1n} + M_{YG3n}$$

$$M_{Y101n} = 9.87 \text{ kN}\cdot\text{m}$$

$$F_{Y101n} := F_{YAn} + F_{YG1n} + F_{YG3n}$$

$$F_{Y101n} = 0.00 \text{ kN}$$

$$M_{X101n} := M_{XAn} + M_{XG1n} + M_{XG3n}$$

$$M_{X101n} = 0.00 \text{ kN}\cdot\text{m}$$

Комбинация 10.2: СТ(А)+Сеизмични сили по ос Y(G.2)+/-Z(G.3)
Loadcase 10.2: CT(A)+Earthquake load direction Y(G.2)+/-Z(G.3)

$$F_{Zmax102n} := F_{ZmaxAn} + F_{ZmaxG2n} + F_{ZmaxG3n}$$

$$F_{Zmax102n} = 12.31 \text{ kN}$$

$$F_{Zmin102n} := F_{ZminAn} + F_{ZminG2n} + F_{ZminG3n}$$

$$F_{Zmin102n} = 6.14 \text{ kN}$$

$$F_{X102n} := F_{XAn} + F_{XG2n} + F_{XG3n}$$

$$F_{X102n} = 0.00 \text{ kN}$$

$$M_{Y102n} := M_{YAn} + M_{YG2n} + M_{YG3n}$$

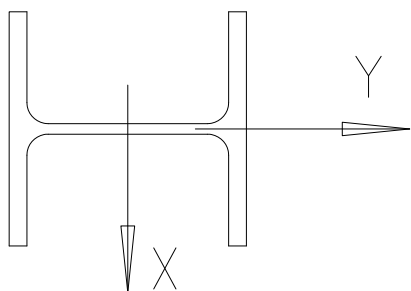
$$M_{Y102n} = 0.00 \text{ kN}\cdot\text{m}$$

$$F_{Y102n} := F_{YAn} + F_{YG2n} + F_{YG3n}$$

$$F_{Y102n} = 3.08 \text{ kN}$$

$$M_{X102n} := M_{XAn} + M_{XG2n} + M_{XG3n}$$

$$M_{X102n} = 9.87 \text{ kN}\cdot\text{m}$$

Оразмеряване на стойката/Dimensioning of the standизбран профил/ chosen **HEB140 S235**

$$h_T := 140\text{mm} \quad b_T := 140\text{mm}$$

$$W_x := 216000 \cdot \text{mm}^3 \quad A_T := 4300 \cdot \text{mm}^2$$

$$W_y := 78600 \cdot \text{mm}^3$$

$$f_{c2} := \frac{M_{Y2c}}{W_y} + \frac{M_{X2c}}{W_x} + \frac{F_{Zmax2c}}{A_T}$$

$$f_{c2} = 66.10 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{c2}}{f_{Sta24}} = 0.30 \quad \blacksquare < 1$$

$$f_{c3} := \frac{M_{Y3c}}{W_y} + \frac{M_{X3c}}{W_x} + \frac{F_{Zmax3c}}{A_T}$$

$$f_{c3} = 78.09 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{c3}}{f_{Sta24}} = 0.36 \quad \blacksquare < 1$$

$$f_{c4} := \frac{M_{Y4c}}{W_y} + \frac{M_{X4c}}{W_x} + \frac{F_{Zmax4c}}{A_T}$$

$$f_{c4} = 36.76 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{c4}}{f_{Sta24}} = 0.17 \quad \blacksquare < 1$$

$$f_{c5} := \frac{M_{Y5n}}{W_y} + \frac{M_{X5n}}{W_x} + \frac{F_{Zmax5n}}{A_T}$$

$$f_{c5} = 81.28 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{c5}}{f_{Sta24}} = 0.37 \quad \blacksquare < 1$$

$$f_{c6} := \frac{M_{Y6n}}{W_y} + \frac{M_{X6n}}{W_x} + \frac{F_{Zmax6n}}{A_T}$$

$$f_{c6} = 73.62 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{c6}}{f_{Sta24}} = 0.34 \quad \blacksquare < 1$$

$$f_{c7} := \frac{M_{Y7n}}{W_y} + \frac{M_{X7n}}{W_x} + \frac{F_{Zmax7n}}{A_T}$$

$$f_{c7} = 136.60 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{c7}}{f_{Sta24}} = 0.63 \quad \blacksquare < 1$$

$$f_{c8} := \frac{M_{Y8n}}{W_y} + \frac{M_{X8n}}{W_x} + \frac{F_{Zmax8n}}{A_T}$$

$$f_{c8} = 56.07 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{c8}}{f_{Sta24}} = 0.26 \quad \blacksquare < 1$$

$$f_{c91} := \frac{M_{Y91n}}{W_y} + \frac{M_{X91n}}{W_x} + \frac{F_{Zmax91n}}{A_T}$$

$$f_{c91} = 123.08 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{c91}}{f_{Sta24}} = 0.56 \quad \blacksquare < 1$$

$$f_{c92} := \frac{M_{Y92n}}{W_y} + \frac{M_{X92n}}{W_x} + \frac{F_{Zmax92n}}{A_T}$$

$$f_{c92} = 96.83 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{c92}}{f_{Sta24}} = 0.44 \quad \blacksquare < 1$$

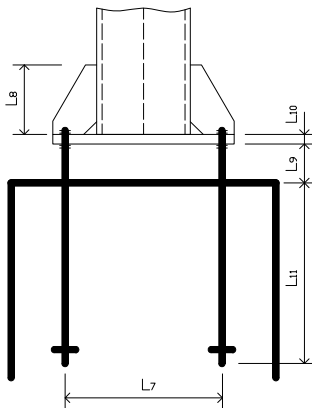
$$f_{c101} := \frac{M_{Y101n}}{W_y} + \frac{M_{X101n}}{W_x} + \frac{F_{Zmax101n}}{A_T}$$

$$f_{c101} = 129.08 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{c101}}{f_{Sta24}} = 0.59 \quad \blacksquare < 1$$

$$f_{c102} := \frac{M_{Y102n}}{W_y} + \frac{M_{X102n}}{W_x} + \frac{F_{Zmax102n}}{A_T}$$

$$f_{c102} = 48.55 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{c102}}{f_{Sta24}} = 0.22 \quad \blacksquare < 1$$

Заклучение: Всички напрежения са по-малки от $\sigma_{\max} = 218.18 \text{ MPa}$



$$l_{7x} := 230\text{mm} \quad l_{7y} := 310\text{mm} \quad l_g := 200\text{mm} \quad l_g := 100.00\text{mm} \quad l_{10} := 25\text{mm}$$

$$l_{11\min} := 600\text{mm} \quad A_{b24} := 353\text{mm}^2 \quad W_{b24} := 935.46\text{mm}^3$$

избрани: **A4 Анкерни болтове M24 S355**

chosen: **A4 anchorbolts M24 S355**

$$f_{ta5.6} = 245.45 \frac{\text{N}}{\text{mm}^{2.00}}$$

нормална сила/
normal force:

$$N_{\max 2} := \frac{M_{X2c}}{2 \cdot l_{7y}} + \frac{M_{Y2c}}{2 l_{7x}} + \frac{F_{Z\max 2c}}{2 \cdot 2}$$

$$N_{\max 2} = 18.16 \text{ kN}$$

срязваща сила/
shearing force:

$$Q_{\max 2} := \sqrt{\left(\frac{F_{X2c}}{4}\right)^2 + \left(\frac{F_{Y2c}}{4}\right)^2}$$

$$Q_{\max 2} = 0.53 \text{ kN}$$

огъващ момент/
bending moment:

$$M_{\max 2} := Q_{\max 2} \cdot l_g \cdot 0.5$$

$$M_{\max 2} = 0.03 \text{ kN} \cdot \text{m}$$

напрежение на натиск/
compression stress:

$$f_{cb2} := \frac{N_{\max 2}}{A_{b24}} + \frac{M_{\max 2}}{W_{b24}} \quad f_{cb2} = 79.95 \text{ MPa}$$

$$\frac{f_{cb2}}{f_{ta5.6}} = 0.33 \quad \blacksquare < 1$$

Комбинация 3/ Loadcase 3:

нормална сила/
normal force:

$$N_{\max 3} := \frac{M_{X3c}}{2 l_{7y}} + \frac{M_{Y3c}}{2 \cdot l_{7x}} + \frac{F_{Z\max 3c}}{2 \cdot 2}$$

$$N_{\max 3} = 17.68 \text{ kN}$$

срязваща сила/
shearing force:

$$Q_{\max 3} := \sqrt{\left(\frac{F_{X3c}}{4}\right)^2 + \left(\frac{F_{Y3c}}{4}\right)^2}$$

$$Q_{\max 3} = 0.42 \text{ kN}$$

огъващ момент/
bending moment:

$$M_{\max 3} := Q_{\max 3} \cdot l_g \cdot 0.5$$

$$M_{\max 3} = 0.02 \text{ kN} \cdot \text{m}$$

напрежение на натиск/
compression stress:

$$f_{cb3} := \frac{N_{\max 3}}{A_{b24}} + \frac{M_{\max 3}}{W_{b24}} \quad f_{cb3} = 72.60 \text{ MPa}$$

$$\frac{f_{cb3}}{f_{ta5.6}} = 0.30 \quad \blacksquare < 1$$

Комбинация 4/ Loadcase 4:

нормална сила/
normal force:

$$N_{\max 4} := \frac{M_{X4c}}{2 l_{7y}} + \frac{M_{Y4c}}{2 \cdot l_{7x}} + \frac{F_{Z\max 4c}}{2 \cdot 2}$$

$$N_{\max 4} = 14.62 \text{ kN}$$

срязваща сила/
shearing force:

$$Q_{\max 4} := \sqrt{\left(\frac{F_{X4c}}{4}\right)^2 + \left(\frac{F_{Y4c}}{4}\right)^2}$$

$$Q_{\max 4} = 0.62 \text{ kN}$$

огъващ момент/
bending moment:

$$M_{\max 4} := Q_{\max 4} \cdot l_g \cdot 0.5$$

$$M_{\max 4} = 0.03 \text{ kN} \cdot \text{m}$$

напрежение на натиск/
compression stress:

$$f_{cb4} := \frac{N_{\max 4}}{A_{b24}} + \frac{M_{\max 4}}{W_{b24}} \quad f_{cb4} = 74.67 \text{ MPa}$$

$$\frac{f_{cb4}}{f_{ta5.6}} = 0.30 \quad \blacksquare < 1$$

Комбинация 5/ Loadcase 5:

нормална сила/
normal force:

$$N_{\max 5} := \frac{M_{X5n}}{2l_{7y}} + \frac{M_{Y5n}}{2 \cdot l_{7x}} + \frac{F_{Z\max 5n}}{2 \cdot 2}$$

$$N_{\max 5} = 29.88 \text{ kN}$$

срязваща сила/
shearing force:

$$Q_{\max 5} := \sqrt{\left(\frac{F_{X5n}}{4}\right)^2 + \left(\frac{F_{Y5n}}{4}\right)^2}$$

$$Q_{\max 5} = 0.75 \text{ kN}$$

огъващ момент/
bending moment:

$$M_{\max 5} := Q_{\max 5} \cdot l_g \cdot 0.5$$

$$M_{\max 5} = 0.04 \text{ kN} \cdot \text{m}$$

напрежение на натиск/
compression stress:

$$f_{cb5} := \frac{N_{\max 5}}{A_{b24}} + \frac{M_{\max 5}}{W_{b24}} \quad f_{cb5} = 124.73 \text{ MPa}$$

$$\frac{f_{cb5}}{f_{ta5.6}} = 0.51 \quad \blacksquare < 1$$

Комбинация 6/ Loadcase 6:

нормална сила/
normal force:

$$N_{\max 6} := \frac{M_{X6n}}{2l_{7y}} + \frac{M_{Y6n}}{2 \cdot l_{7x}} + \frac{F_{Z\max 6n}}{2 \cdot 2}$$

$$N_{\max 6} = 21.27 \text{ kN}$$

срязваща сила/
shearing force:

$$Q_{\max 6} := \sqrt{\left(\frac{F_{X6n}}{4}\right)^2 + \left(\frac{F_{Y6n}}{4}\right)^2}$$

$$Q_{\max 6} = 0.58 \text{ kN}$$

огъващ момент/
bending moment:

$$M_{\max 6} := Q_{\max 6} \cdot l_g \cdot 0.5$$

$$M_{\max 6} = 0.04 \text{ kN} \cdot \text{m}$$

напрежение на натиск/
compression stress:

$$f_{cb6} := \frac{N_{\max 6}}{A_{b24}} + \frac{M_{\max 6}}{W_{b24}} \quad f_{cb6} = 100.35 \text{ MPa}$$

$$\frac{f_{cb6}}{f_{ta5.6}} = 0.41 \quad \blacksquare < 1$$

Комбинация 7/ Loadcase 7:

нормална сила/
normal force:

$$N_{\max 7} := \frac{M_{X7n}}{2l_{7y}} + \frac{M_{Y7n}}{2 \cdot l_{7x}} + \frac{F_{Z\max 7n}}{2 \cdot 2}$$

$$N_{\max 7} = 27.85 \text{ kN}$$

срязваща сила/
shearing force:

$$Q_{\max 7} := \sqrt{\left(\frac{F_{X7n}}{4}\right)^2 + \left(\frac{F_{Y7n}}{4}\right)^2}$$

$$Q_{\max 7} = 0.77 \text{ kN}$$

огъващ момент/
bending moment:

$$M_{\max 7} := Q_{\max 7} \cdot l_g \cdot 0.5$$

$$M_{\max 7} = 0.04 \text{ kN} \cdot \text{m}$$

напрежение на натиск/
compression stress:

$$f_{cb7} := \frac{N_{\max 7}}{A_{b24}} + \frac{M_{\max 7}}{W_{b24}} \quad f_{cb7} = 120.26 \text{ MPa}$$

$$\frac{f_{cb7}}{f_{ta5.6}} = 0.49 \quad \blacksquare < 1$$

Комбинация 8/ Loadcase 8:

нормална сила/
normal force:

$$N_{\max 8} := \frac{M_{X8n}}{2l_{7y}} + \frac{M_{Y8n}}{2 \cdot l_{7x}} + \frac{F_{Z\max 8n}}{2 \cdot 2}$$

$$N_{\max 8} = 21.61 \text{ kN}$$

срязваща сила/
shearing force:

$$Q_{\max 8} := \sqrt{\left(\frac{F_{X8n}}{4}\right)^2 + \left(\frac{F_{Y8n}}{4}\right)^2}$$

$$Q_{\max 8} = 0.84 \text{ kN}$$

огъващ момент/
bending moment:

$$M_{\max 8} := Q_{\max 8} \cdot l_g \cdot 0.5$$

$$M_{\max 8} = 0.04 \text{ kN} \cdot \text{m}$$

напрежение на натиск/
compression stress:

$$f_{cb8} := \frac{N_{\max 8}}{A_{b24}} + \frac{M_{\max 8}}{W_{b24}} \quad f_{cb8} = 106.23 \text{ MPa}$$

$$\frac{f_{cb8}}{f_{ta5.6}} = 0.43 \quad \blacksquare < 1$$

Комбинация 9.1/ Loadcase 9.1:**нормална сила/
normal force:**

$$N_{\max 91} := \frac{M_{X91n}}{2l_{7y}} + \frac{M_{Y91n}}{2 \cdot l_{7x}} + \frac{F_{Z\max 91n}}{2 \cdot 2}$$

$$N_{\max 91} = 37.23 \text{ kN}$$

**срязваща сила/
shearing force:**

$$Q_{\max 91} := \sqrt{\left(\frac{F_{X91n}}{4}\right)^2 + \left(\frac{F_{Y91n}}{4}\right)^2}$$

$$Q_{\max 91} = 0.79 \text{ kN}$$

**огъващ момент/
bending moment:**

$$M_{\max 91} := Q_{\max 91} \cdot l_g \cdot 0.5$$

$$M_{\max 91} = 0.04 \text{ kN} \cdot \text{m}$$

**напрежение на натиск/
compression stress:**

$$f_{cb91} := \frac{N_{\max 91}}{A_{b24}} + \frac{M_{\max 91}}{W_{b24}} \quad f_{cb91} = 147.92 \text{ MPa}$$

$$\frac{f_{cb91}}{f_{ta5.6}} = 0.60 \quad \blacksquare < 1$$

Комбинация 9.2/ Loadcase 9.2:**нормална сила/
normal force:**

$$N_{\max 92} := \frac{M_{X92n}}{2l_{7y}} + \frac{M_{Y92n}}{2 \cdot l_{7x}} + \frac{F_{Z\max 92n}}{2 \cdot 2}$$

$$N_{\max 92} = 35.29 \text{ kN}$$

**срязваща сила/
shearing force:**

$$Q_{\max 92} := \sqrt{\left(\frac{F_{X92n}}{4}\right)^2 + \left(\frac{F_{Y92n}}{4}\right)^2}$$

$$Q_{\max 92} = 1.09 \text{ kN}$$

**огъващ момент/
bending moment:**

$$M_{\max 92} := Q_{\max 92} \cdot l_g \cdot 0.5$$

$$M_{\max 92} = 0.05 \text{ kN} \cdot \text{m}$$

**напрежение на натиск/
compression stress:**

$$f_{cb92} := \frac{N_{\max 92}}{A_{b24}} + \frac{M_{\max 92}}{W_{b24}} \quad f_{cb92} = 158.03 \text{ MPa}$$

$$\frac{f_{cb92}}{f_{ta5.6}} = 0.64 \quad \blacksquare < 1$$

Комбинация 10.1/ Loadcase 10.1:**нормална сила/
normal force:**

$$N_{\max 101} := \frac{M_{X101n}}{2l_{7y}} + \frac{M_{Y101n}}{2 \cdot l_{7x}} + \frac{F_{Z\max 101n}}{2 \cdot 2}$$

$$N_{\max 101} = 25.23 \text{ kN}$$

**срязваща сила/
shearing force:**

$$Q_{\max 101} := \sqrt{\left(\frac{F_{X101n}}{4}\right)^2 + \left(\frac{F_{Y101n}}{4}\right)^2}$$

$$Q_{\max 101} = 0.77 \text{ kN}$$

**огъващ момент/
bending moment:**

$$M_{\max 101} := Q_{\max 101} \cdot l_g \cdot 0.5$$

$$M_{\max 101} = 0.04 \text{ kN} \cdot \text{m}$$

**напрежение на натиск/
compression stress:**

$$f_{cb101} := \frac{N_{\max 101}}{A_{b24}} + \frac{M_{\max 101}}{W_{b24}} \quad f_{cb101} = 112.67 \text{ MPa}$$

$$\frac{f_{cb101}}{f_{ta5.6}} = 0.46 \quad \blacksquare < 1$$

Комбинация 10.2/ Loadcase 10.2:**нормална сила/
normal force:**

$$N_{\max 102} := \frac{M_{X102n}}{2l_{7y}} + \frac{M_{Y102n}}{2 \cdot l_{7x}} + \frac{F_{Z\max 102n}}{2 \cdot 2}$$

$$N_{\max 102} = 18.99 \text{ kN}$$

**срязваща сила/
shearing force:**

$$Q_{\max 102} := \sqrt{\left(\frac{F_{X102n}}{4}\right)^2 + \left(\frac{F_{Y102n}}{4}\right)^2}$$

$$Q_{\max 102} = 0.77 \text{ kN}$$

**огъващ момент/
bending moment:**

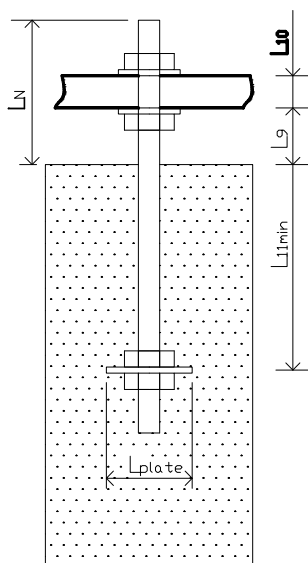
$$M_{\max 102} := Q_{\max 102} \cdot l_g \cdot 0.5$$

$$M_{\max 102} = 0.04 \text{ kN} \cdot \text{m}$$

**напрежение на натиск/
compression stress:**

$$f_{cb102} := \frac{N_{\max 102}}{A_{b24}} + \frac{M_{\max 102}}{W_{b24}} \quad f_{cb102} = 95.00 \text{ MPa}$$

$$\frac{f_{cb102}}{f_{ta5.6}} = 0.39 \quad \blacksquare < 1$$

**Анкерни планки/ Anchor plates**

напрежение на натиск/ срязваща сила бетон B20
compression stress/ shearing stress concrete B20

избрани/
chosen:

pl. 10/100x100

$$l_{plate} := 100.00 \text{ mm}$$

$$f_{conpa} := 12.3 \cdot \frac{N}{\text{mm}^2}$$

$$l_{11min} = 0.60 \text{ m}$$

$$f_{consa} := 1.80 \cdot \frac{N}{\text{mm}^2}$$

Комбинация 2/ Loadcase 2:

$$f_{comp2} := \frac{N_{max2}}{l_{plate}^2 - A_{b24}} \quad f_{comp2} = 1.88 \text{ MPa}$$

$$\frac{f_{comp2}}{f_{conpa}} = 0.15 \quad \blacksquare < 1$$

$$f_{cons2} := \frac{N_{max2}}{4 \cdot l_{plate} \cdot l_{11min}} \quad f_{cons2} = 0.08 \text{ MPa}$$

$$\frac{f_{cons2}}{f_{consa}} = 0.04 \quad \blacksquare < 1$$

Комбинация 3/ Loadcase 3:

$$f_{comp3} := \frac{N_{max3}}{l_{plate}^2 - A_{b24}} \quad f_{comp3} = 1.83 \text{ MPa}$$

$$\frac{f_{comp3}}{f_{conpa}} = 0.15 \quad \blacksquare < 1$$

$$f_{cons3} := \frac{N_{max3}}{4 \cdot l_{plate} \cdot l_{11min}} \quad f_{cons3} = 0.07 \text{ MPa}$$

$$\frac{f_{cons3}}{f_{consa}} = 0.04 \quad \blacksquare < 1$$

Комбинация 4/ Loadcase 4:

$$f_{comp4} := \frac{N_{max4}}{l_{plate}^2 - A_{b24}} \quad f_{comp4} = 1.52 \text{ MPa} \quad \frac{f_{comp4}}{f_{conpa}} = 0.12 \quad \blacksquare < 1$$

$$f_{cons4} := \frac{N_{max4}}{4 \cdot l_{plate} \cdot l_{11min}} \quad f_{cons4} = 0.06 \text{ MPa} \quad \frac{f_{cons4}}{f_{consa}} = 0.03 \quad \blacksquare < 1$$

Комбинация 5/ Loadcase 5:

$$f_{comp5} := \frac{N_{max5}}{l_{plate}^2 - A_{b24}} \quad f_{comp5} = 3.10 \text{ MPa} \quad \frac{f_{comp5}}{f_{conpa}} = 0.25 \quad \blacksquare < 1$$

$$f_{cons5} := \frac{N_{max5}}{4 \cdot l_{plate} \cdot l_{11min}} \quad f_{cons5} = 0.12 \text{ MPa} \quad \frac{f_{cons5}}{f_{consa}} = 0.07 \quad \blacksquare < 1$$

Комбинация 7/ Loadcase 7:

$$f_{comp7} := \frac{N_{max7}}{l_{plate}^2 - A_{b24}} \quad f_{comp7} = 2.89 \text{ MPa} \quad \frac{f_{comp7}}{f_{conpa}} = 0.23 \quad \blacksquare < 1$$

$$f_{cons7} := \frac{N_{max7}}{4 \cdot l_{plate} \cdot l_{11min}} \quad f_{cons7} = 0.12 \text{ MPa} \quad \frac{f_{cons7}}{f_{consa}} = 0.06 \quad \blacksquare < 1$$

Комбинация 8/ Loadcase 8:

$$f_{comp8} := \frac{N_{max8}}{l_{plate}^2 - A_{b24}} \quad f_{comp8} = 2.24 \text{ MPa} \quad \frac{f_{comp8}}{f_{conpa}} = 0.18 \quad \blacksquare < 1$$

$$f_{cons8} := \frac{N_{max8}}{4 \cdot l_{plate} \cdot l_{11min}} \quad f_{cons8} = 0.09 \text{ MPa} \quad \frac{f_{cons8}}{f_{consa}} = 0.05 \quad \blacksquare < 1$$

Комбинация 9.1/ Loadcase 9.1:

$$f_{\text{comp91}} := \frac{N_{\text{max91}}}{l_{\text{plate}}^2 - A_{\text{b24}}} \quad f_{\text{comp91}} = 3.86 \text{ MPa} \quad \frac{f_{\text{comp91}}}{f_{\text{compa}}} = 0.31 \quad \blacksquare < 1$$

$$f_{\text{cons91}} := \frac{N_{\text{max91}}}{4 \cdot l_{\text{plate}} \cdot l_{11\text{min}}} \quad f_{\text{cons91}} = 0.16 \text{ MPa} \quad \frac{f_{\text{cons91}}}{f_{\text{consa}}} = 0.09 \quad \blacksquare < 1$$

Комбинация 9.2/ Loadcase 9.2:

$$f_{\text{comp92}} := \frac{N_{\text{max92}}}{l_{\text{plate}}^2 - A_{\text{b24}}} \quad f_{\text{comp92}} = 3.66 \text{ MPa} \quad \frac{f_{\text{comp92}}}{f_{\text{compa}}} = 0.30 \quad \blacksquare < 1$$

$$f_{\text{cons92}} := \frac{N_{\text{max92}}}{4 \cdot l_{\text{plate}} \cdot l_{11\text{min}}} \quad f_{\text{cons92}} = 0.15 \text{ MPa} \quad \frac{f_{\text{cons92}}}{f_{\text{consa}}} = 0.08 \quad \blacksquare < 1$$

Комбинация 10.1/ Loadcase 10.1:

$$f_{\text{comp101}} := \frac{N_{\text{max101}}}{l_{\text{plate}}^2 - A_{\text{b24}}} \quad f_{\text{comp101}} = 2.62 \text{ MPa} \quad \frac{f_{\text{comp101}}}{f_{\text{compa}}} = 0.21 \quad \blacksquare < 1$$

$$f_{\text{cons101}} := \frac{N_{\text{max101}}}{4 \cdot l_{\text{plate}} \cdot l_{11\text{min}}} \quad f_{\text{cons101}} = 0.11 \text{ MPa} \quad \frac{f_{\text{cons101}}}{f_{\text{consa}}} = 0.06 \quad \blacksquare < 1$$

Комбинация 10.2/ Loadcase 10.2:

$$f_{\text{comp102}} := \frac{N_{\text{max102}}}{l_{\text{plate}}^2 - A_{\text{b24}}} \quad f_{\text{comp102}} = 1.97 \text{ MPa} \quad \frac{f_{\text{comp102}}}{f_{\text{compa}}} = 0.16 \quad \blacksquare < 1$$

$$f_{\text{cons102}} := \frac{N_{\text{max102}}}{4 \cdot l_{\text{plate}} \cdot l_{11\text{min}}} \quad f_{\text{cons102}} = 0.08 \text{ MPa} \quad \frac{f_{\text{cons102}}}{f_{\text{consa}}} = 0.04 \quad \blacksquare < 1$$

Опорна планка/ Supporting plate

pl. 25/350x430 S335

$$l_{\text{suppY}} := (l_{7Y} - h_T) \cdot 0.5 + 20 \cdot \text{mm} \quad l_{\text{suppY}} = 105.00 \text{ mm} \quad l_{\text{bolt}} := 24 \cdot \text{mm} \quad l_{10} = 25.00 \text{ mm}$$

$$W_{\text{pl}} := \frac{l_{10}^2}{6} (2 \cdot l_{\text{suppY}} + l_{\text{bolt}}) \quad W_{\text{pl}} = 2.44 \times 10^4 \text{ mm}^3$$

Комбинация 2/ Loadcase 2:

$$f_{\text{tGp2}} := \frac{N_{\text{max2}} \cdot l_{\text{suppY}}}{W_{\text{pl}}} \quad f_{\text{tGp2}} = 78.25 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{\text{tGp2}}}{f_{\text{Sta36}}} = 0.24 \quad \blacksquare < 1$$

Комбинация 3/ Loadcase 3:

$$f_{\text{tGp3}} := \frac{N_{\text{max3}} \cdot l_{\text{suppY}}}{W_{\text{pl}}} \quad f_{\text{tGp3}} = 76.14 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{\text{tGp3}}}{f_{\text{Sta36}}} = 0.23 \quad \blacksquare < 1$$

Комбинация 4/ Loadcase 4:

$$f_{\text{tGp4}} := \frac{N_{\text{max4}} \cdot l_{\text{suppY}}}{W_{\text{pl}}} \quad f_{\text{tGp4}} = 62.98 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{\text{tGp4}}}{f_{\text{Sta36}}} = 0.19 \quad \blacksquare < 1$$

Комбинация 5/ Loadcase 5:

$$f_{\text{tGp5}} := \frac{N_{\text{max5}} \cdot l_{\text{suppY}}}{W_{\text{pl}}} \quad f_{\text{tGp5}} = 128.70 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{\text{tGp5}}}{f_{\text{Sta36}}} = 0.39 \quad \blacksquare < 1$$

Комбинация 6/ Loadcase 6:

$$f_{tGp6} := \frac{N_{max6} \cdot l_{suppY}}{W_{pl}} \quad f_{tGp6} = 91.64 \frac{N}{mm^2} \quad \frac{f_{tGp6}}{f_{Sta36}} = 0.28 \quad \blacksquare < 1$$

Комбинация 7/ Loadcase 7:

$$f_{tGp7} := \frac{N_{max7} \cdot l_{suppY}}{W_{pl}} \quad f_{tGp7} = 119.98 \frac{N}{mm^2} \quad \frac{f_{tGp7}}{f_{Sta36}} = 0.37 \quad \blacksquare < 1$$

Комбинация 8/ Loadcase 8:

$$f_{tGp8} := \frac{N_{max8} \cdot l_{suppY}}{W_{pl}} \quad f_{tGp8} = 93.11 \frac{N}{mm^2} \quad \frac{f_{tGp8}}{f_{Sta36}} = 0.28 \quad \blacksquare < 1$$

Комбинация 9.1/ Loadcase 9.1:

$$f_{tGp91} := \frac{N_{max91} \cdot l_{suppY}}{W_{pl}} \quad f_{tGp91} = 160.38 \frac{N}{mm^2} \quad \frac{f_{tGp91}}{f_{Sta36}} = 0.49 \quad \blacksquare < 1$$

Комбинация 9.2/ Loadcase 9.2:

$$f_{tGp92} := \frac{N_{max92} \cdot l_{suppY}}{W_{pl}} \quad f_{tGp92} = 152.03 \frac{N}{mm^2} \quad \frac{f_{tGp92}}{f_{Sta36}} = 0.46 \quad \blacksquare < 1$$

Комбинация 10.1/ Loadcase 10.1:

$$f_{tGp101} := \frac{N_{max101} \cdot l_{suppY}}{W_{pl}} \quad f_{tGp101} = 108.70 \frac{N}{mm^2} \quad \frac{f_{tGp101}}{f_{Sta36}} = 0.33 \quad \blacksquare < 1$$

Комбинация 10.2/ Loadcase 10.2:

$$f_{tGp102} := \frac{N_{max102} \cdot l_{suppY}}{W_{pl}} \quad f_{tGp102} = 81.82 \frac{N}{mm^2} \quad \frac{f_{tGp102}}{f_{Sta36}} = 0.25 \quad \blacksquare < 1$$

ОПРЕДЕЛЯНЕ НА УСИЛИЯТА НА ГОРЕН РЪБ КОЛОНА.

CALCULATION OF THE STRESS ON THE UPPER EDGE COLUMN.

A: Собствено тегло / Dead load:

нормативни натоварвания/normative loads

$$F_{ZmaxAun} := \frac{3}{2} F_{AZn} + \frac{1}{2} F_{UGZn} \quad F_{ZmaxAun} = 6.88 \text{ kN}$$

$$F_{ZminAun} := \frac{3}{2} F_{AZn} + \frac{1}{2} F_{UGZn} \quad F_{ZminAun} = 6.88 \text{ kN}$$

$$F_{XAun} := 0.00 \cdot \text{kN} \quad M_{YAun} := 0.00 \cdot \text{kN} \quad F_{YAun} := 0.00 \cdot \text{kN} \quad M_{XAun} := 0.00 \cdot \text{kN}$$

изчислителни натоварвания/calculating loads

$$F_{ZmaxAuc} := \frac{3}{2} F_{AZc} + \frac{1}{2} F_{UGZc} \quad F_{ZmaxAuc} = 8.16 \text{ kN}$$

$$F_{ZminAuc} := \frac{3}{2} F_{AZc} + \frac{1}{2} F_{UGZc} \quad F_{ZminAuc} = 8.16 \text{ kN}$$

$$F_{XAuc} := 0.00 \cdot \text{kN} \quad M_{YAuc} := 0.00 \cdot \text{kN} \quad F_{YAuc} := 0.00 \cdot \text{kN} \quad M_{XAuc} := 0.00 \cdot \text{kN}$$

С.1: Вятър по ос X / Windload direction X

нормативни натоварвания/normative loads

$$F_{ZmaxC1un} := 3 \cdot F_{WXn} \cdot \frac{b}{f} + 3F_{LX1n} \cdot \frac{d}{f} + 3F_{LX2n} \cdot \frac{k}{f} \quad F_{ZmaxC1un} = 1.27 \text{ kN}$$

$$F_{ZminC1un} := -3 \cdot F_{WXn} \cdot \frac{b}{f} - 3 \cdot F_{LX1n} \cdot \frac{d}{f} - 3F_{LX2n} \cdot \frac{k}{f} \quad F_{ZminC1un} = -1.27 \text{ kN}$$

$$F_{XC1un} := \frac{3}{2} F_{WXn} + \frac{3}{2} \cdot F_{LX1n} + \frac{3}{2} \cdot F_{LX2n} \quad F_{XC1un} = 0.80 \text{ kN}$$

$$M_{YC1un} := \frac{3}{2} \cdot F_{WXn} \cdot b + \frac{3}{2} \cdot F_{LX1n} \cdot d + \frac{3}{2} \cdot F_{LX2n} \cdot k \quad M_{YC1un} = 1.61 \text{ kN} \cdot \text{m}$$

$$F_{YC1un} := 0.00 \cdot \text{kN} \quad F_{YC1un} = 0.00 \text{ kN}$$

$$M_{XC1un} := 0.00 \cdot \text{kN} \cdot \text{m} \quad M_{XC1un} = 0.00 \text{ kN} \cdot \text{m}$$

изчислителни натоварвания/calculating loads

$$F_{ZmaxC1uc} := 3 \cdot F_{WXc} \cdot \frac{b}{f} + 3F_{LX1c} \cdot \frac{d}{f} + 3F_{LX2c} \cdot \frac{k}{f} \quad F_{ZmaxC1uc} = 1.78 \text{ kN}$$

$$F_{ZminC1uc} := -3 \cdot F_{WXc} \cdot \frac{b}{f} - 3 \cdot F_{LX1c} \cdot \frac{d}{f} - 3F_{LX2c} \cdot \frac{k}{f} \quad F_{ZminC1uc} = -1.78 \text{ kN}$$

$$F_{XC1uc} := \frac{3}{2} F_{WXc} + \frac{3}{2} \cdot F_{LX1c} + \frac{3}{2} \cdot F_{LX2c} \quad F_{XC1uc} = 1.12 \text{ kN}$$

$$M_{YC1uc} := \frac{3}{2} \cdot F_{WXc} \cdot b + \frac{3}{2} \cdot F_{LX1c} \cdot d + \frac{3}{2} \cdot F_{LX2c} \cdot k \quad M_{YC1uc} = 2.25 \text{ kN} \cdot \text{m}$$

$$F_{YC1uc} := 0.00 \cdot \text{kN} \quad F_{YC1uc} = 0.00 \text{ kN}$$

$$M_{XC1uc} := 0.00 \cdot \text{kN} \cdot \text{m} \quad M_{XC1uc} = 0.00 \text{ kN} \cdot \text{m}$$

С.2: Вятър по ос Y / Windload direction Y

нормативни натоварвания/normative loads

$$F_{ZmaxC2un} := 0.00 \cdot \text{kN} \quad F_{ZmaxC2un} = 0.00 \text{ kN}$$

$$F_{ZminC2un} := 0.00 \cdot \text{kN} \quad F_{ZminC2un} = 0.00 \text{ kN}$$

$$F_{XC2un} := 0.00 \cdot \text{kN} \quad F_{XC2un} = 0.00 \text{ kN}$$

$$M_{YC2un} := 0.00 \cdot \text{kN} \cdot \text{m} \quad M_{YC2un} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YC2un} := \frac{3}{2} \cdot F_{LY1n} + \frac{3}{2} F_{WYn} + \frac{1}{2} F_{UGWYn} - \frac{3}{2} \cdot F_{LY2n} \quad F_{YC2un} = 1.18 \text{ kN}$$

$$M_{XC2un} := \frac{3}{2} \cdot F_{LY1n} \cdot d + \frac{3}{2} F_{WYn} \cdot c - \frac{3}{2} \cdot F_{LY2n} \cdot k \quad M_{XC2un} = 0.84 \text{ kN} \cdot \text{m}$$

изчислителни натоварвания/calculating loads

$$F_{ZmaxC2uc} := 0.00 \cdot \text{kN} \quad F_{ZmaxC2uc} = 0.00 \text{ kN}$$

$$F_{ZminC2uc} := 0.00 \cdot \text{kN} \quad F_{ZminC2uc} = 0.00 \text{ kN}$$

$$F_{XC2uc} := 0.00 \cdot \text{kN} \quad F_{XC2uc} = 0.00 \text{ kN}$$

$$M_{YC2uc} := 0.00 \cdot \text{kN} \cdot \text{m} \quad M_{YC2uc} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YC2uc} := \frac{3}{2} \cdot F_{LY1c} + \frac{3}{2} F_{WYc} + \frac{1}{2} F_{UGWYc} - \frac{3}{2} \cdot F_{LY2c} \quad F_{YC2uc} = 1.65 \text{ kN}$$

$$M_{XC2uc} := \frac{3}{2} \cdot F_{LY1c} \cdot d + \frac{3}{2} F_{WYc} \cdot c - \frac{3}{2} \cdot F_{LY2c} \cdot k \quad M_{XC2uc} = 1.18 \text{ kN} \cdot \text{m}$$

D: Опъвателна сила от проводник / Static conductor tension

нормативни натоварвания/normative loads

$$F_{ZmaxDun} := 3 \cdot F_{SX1n} \cdot \frac{d}{f} - 3 \cdot F_{SX2n} \cdot \frac{k}{f} \quad F_{ZmaxDun} = 0.00 \text{ kN}$$

$$F_{ZminDun} := -3 \cdot F_{SX1n} \cdot \frac{d}{f} + 3 \cdot F_{SX2n} \cdot \frac{k}{f} \quad F_{ZminDun} = 0.00 \text{ kN}$$

$$F_{XDun} := \frac{3}{2} \cdot F_{SX1n} - \frac{3}{2} \cdot F_{SX2n} \quad F_{XDun} = 0.00 \text{ kN}$$

$$M_{YDun} := \frac{3}{2} \cdot F_{SX1n} \cdot d - \frac{3}{2} \cdot F_{SX2n} \cdot k \quad M_{YDun} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YDun} := \frac{3}{2} \cdot F_{SY1n} \quad F_{YDun} = 0.30 \text{ kN}$$

$$M_{XDun} := \frac{3}{2} \cdot F_{SY1n} \cdot d \quad M_{XDun} = 1.00 \text{ kN} \cdot \text{m}$$

изчислителни натоварвания/calculating loads

$$F_{ZmaxDuc} := 3 \cdot F_{SX1c} \cdot \frac{d}{f} - 3 \cdot F_{SX2c} \cdot \frac{k}{f} \quad F_{ZmaxDuc} = 0.00 \text{ kN}$$

$$F_{ZminDuc} := -3 \cdot F_{SX1c} \cdot \frac{d}{f} + 3 \cdot F_{SX2c} \cdot \frac{k}{f} \quad F_{ZminDuc} = 0.00 \text{ kN}$$

$$F_{XDuc} := \frac{3}{2} \cdot F_{SX1c} - \frac{3}{2} \cdot F_{SX2c} \quad F_{XDuc} = 0.00 \text{ kN}$$

$$M_{YDuc} := \frac{3}{2} \cdot F_{SX1c} \cdot d - \frac{3}{2} \cdot F_{SX2c} \cdot k \quad M_{YDuc} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YDuc} := \frac{3}{2} \cdot F_{SY1c} \quad F_{YDuc} = 0.39 \text{ kN}$$

$$M_{XDuc} := \frac{3}{2} \cdot F_{SY1c} \cdot d \quad M_{XDuc} = 1.31 \text{ kN} \cdot \text{m}$$

E: Късо съединение / Short-circuit forces

нормативни натоварвания/normative loads

$$F_{ZmaxEun} := \frac{3}{2} \cdot F_{DX1n} \cdot \frac{d}{f} + \frac{3}{2} \cdot F_{DX2n} \cdot \frac{k}{f} \quad F_{ZmaxEun} = 0.00 \text{ kN}$$

$$F_{ZminEun} := -\frac{3}{2} \cdot F_{DX1n} \cdot \frac{d}{f} - \frac{3}{2} \cdot F_{DX2n} \cdot \frac{k}{f} \quad F_{ZminEun} = 0.00 \text{ kN}$$

$$F_{XEun} := \frac{3}{2} \cdot F_{DX1n} + \frac{3}{2} \cdot F_{DX2n} \quad F_{XEun} = 0.00 \text{ kN}$$

$$M_{YEun} := \frac{3}{2} \cdot F_{DX1n} \cdot d + \frac{3}{2} \cdot F_{DX2n} \cdot k \quad M_{YEun} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YEun} := \frac{3}{2} \cdot F_{DY1n} \quad F_{YEun} = 3.00 \text{ kN}$$

$$M_{XEun} := \frac{3}{2} \cdot F_{DY1n} \cdot d \quad M_{XEun} = 10.04 \text{ kN} \cdot \text{m}$$

H: Монтажен товар / Erection load

нормативни натоварвания/normative loads

$$F_{ZmaxHun} := F_{MZn}$$

$$F_{ZmaxHun} = 1.00 \text{ kN}$$

$$F_{ZminHun} := 0.00 \cdot \text{kN}$$

$$F_{ZminHun} = 0.00 \text{ kN}$$

$$F_{XHun} := F_{MXn}$$

$$F_{XHun} = 1.00 \text{ kN}$$

$$M_{YHun} := 0$$

$$M_{YHun} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YHun} := F_{MYn}$$

$$F_{YHun} = 1.00 \text{ kN}$$

$$M_{XHun} := 0$$

$$M_{XHun} = 0.00 \text{ kN} \cdot \text{m}$$

изчислителни натоварвания/calculating loads

$$F_{ZmaxHuc} := F_{MZc}$$

$$F_{ZmaxHuc} = 1.30 \text{ kN}$$

$$F_{ZminHuc} := 0.00 \cdot \text{kN}$$

$$F_{ZminHuc} = 0.00 \text{ kN}$$

$$F_{XHuc} := F_{MXc}$$

$$F_{XHuc} = 1.30 \text{ kN}$$

$$M_{YHuc} := 0$$

$$M_{YHuc} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YHuc} := F_{MYc}$$

$$F_{YHuc} = 1.30 \text{ kN}$$

$$M_{XHuc} := 0$$

$$M_{XHuc} = 0.00 \text{ kN} \cdot \text{m}$$

F: Превключвателни сили / Switching forces

нормативни натоварвания/normative loads

$$F_{ZmaxFun} := F_{CZmaxn}$$

$$F_{ZmaxFun} = 12.00 \text{ kN}$$

$$F_{ZminFun} := F_{CZminn}$$

$$F_{ZminFun} = -12.00 \text{ kN}$$

$$F_{XFun} := F_{CXn}$$

$$F_{XFun} = 1.50 \text{ kN}$$

$$M_{YFun} := 0$$

$$M_{YFun} = 0.00 \text{ kN} \cdot \text{m}$$

$$F_{YFun} := F_{CYn}$$

$$F_{YFun} = 1.50 \text{ kN}$$

$$M_{XFun} := 0$$

$$M_{XFun} = 0.00 \text{ kN} \cdot \text{m}$$

G1: Земетресение по ос X / Earthquake load direction X

нормативни натоварвания/normative loads

$$F_{ZmaxG1un} := 3F_{EQXn} \cdot \frac{a}{f}$$

$$F_{ZmaxG1un} = 2.81 \text{ kN}$$

$$F_{ZminG1un} := -3F_{EQXn} \cdot \frac{a}{f}$$

$$F_{ZminG1un} = -2.81 \text{ kN}$$

$$F_{XG1un} := \frac{3}{2}F_{EQXn} + \frac{1}{2}F_{UGEQXn}$$

$$F_{XG1un} = 2.30 \text{ kN}$$

$$M_{YG1un} := \frac{3}{2}F_{EQXn} \cdot a$$

$$M_{YG1un} = 3.55 \text{ kN} \cdot \text{m}$$

$$F_{YG1un} := 0.00 \cdot \text{kN}$$

$$F_{YG1un} = 0.00 \text{ kN}$$

$$M_{XG1un} := 0.00 \cdot \text{kN} \cdot \text{m}$$

$$M_{XG1un} = 0.00 \text{ kN} \cdot \text{m}$$

G2: Земетресение по ос Y / Earthquake load direction YX

нормативни натоварвания/normative loads

$$F_{ZmaxG2un} := 0.00 \cdot kN$$

$$F_{ZmaxG2un} = 0.00 \text{ kN}$$

$$F_{ZminG2un} := 0.00 \cdot kN$$

$$F_{ZminG2un} = 0.00 \text{ kN}$$

$$F_{XG2un} := 0.00 \cdot kN$$

$$F_{XG2un} = 0.00 \text{ kN}$$

$$M_{YG2un} := 0.00 \cdot kN \cdot m$$

$$M_{YG2un} = 0.00 \text{ kN} \cdot m$$

$$F_{YG2un} := \frac{3}{2} F_{EQYn} + \frac{1}{2} F_{UGEQYn}$$

$$F_{YG2un} = 2.30 \text{ kN}$$

$$M_{XG2un} := \frac{3}{2} F_{EQYn} \cdot a$$

$$M_{XG2un} = 3.55 \text{ kN} \cdot m$$

G3: Земетресение по ос Z / Earthquake load direction Z

нормативни натоварвания/normative loads

$$F_{ZmaxG3un} := \frac{3}{2} F_{EQZn} + \frac{1}{2} F_{UGEQZn}$$

$$F_{ZmaxG3un} = 2.30 \text{ kN}$$

$$F_{ZminG3un} := -F_{ZmaxG3n}$$

$$F_{ZminG3un} = -3.08 \text{ kN}$$

$$F_{XG3un} := 0.00 \cdot kN$$

$$F_{XG3un} = 0.00 \text{ kN}$$

$$M_{YG3un} := 0.00 \cdot kN \cdot m$$

$$M_{YG3un} = 0.00 \text{ kN} \cdot m$$

$$F_{YG3un} := 0.00 \cdot kN$$

$$F_{YG3un} = 0.00 \text{ kN}$$

$$M_{XG3un} := 0.00 \cdot kN \cdot m$$

$$M_{XG3un} = 0.00 \text{ kN} \cdot m$$

Комбинации от натоварванията/ Foundation loadcases**ОСНОВНИ КОМБИНАЦИИ/ NORMAL LOADCASES****Комбинация 1: Собствено тегло (A)/ Loadcase 1: Dead load (A)**

изчислителни натоварвания/calculating loads

$$F_{Zmax1uc} := F_{ZmaxAuc}$$

$$F_{Zmax1uc} = 8.16 \text{ kN}$$

$$F_{Zmin1uc} := F_{ZminAuc}$$

$$F_{Zmin1uc} = 8.16 \text{ kN}$$

$$F_{X1uc} := F_{XAuc}$$

$$F_{X1uc} = 0.00 \text{ kN}$$

$$M_{Y1uc} := M_{YAuc}$$

$$M_{Y1uc} = 0.00 \text{ kN} \cdot m$$

$$F_{Y1uc} := F_{YAuc}$$

$$F_{Y1uc} = 0.00 \text{ kN}$$

$$M_{X1uc} := M_{XAuc}$$

$$M_{X1uc} = 0.00 \text{ kN} \cdot m$$

Комбинация 2: СТ(А)+Опъвателна сила от проводник(Д)+Монтажен товар(Н)**Loadcase СТ(А)+ Static conductor tension (D)+ Erection load (H)**

изчислителни натоварвания/calculating loads

$$F_{Zmax2uc} := F_{ZmaxAuc} + F_{ZmaxDuc} + F_{ZmaxHuc}$$

$$F_{Zmax2uc} = 9.46 \text{ kN}$$

$$F_{Zmin2uc} := F_{ZminAuc} + F_{ZminDuc} + F_{ZminHuc}$$

$$F_{Zmin2uc} = 8.16 \text{ kN}$$

$$F_{X2uc} := F_{XAuc} + F_{XDuc} + F_{XHuc}$$

$$F_{X2uc} = 1.30 \text{ kN}$$

$$M_{Y2uc} := M_{YAuc} + M_{YDuc} + M_{YHuc}$$

$$M_{Y2uc} = 0.00 \text{ kN} \cdot m$$

$$F_{Y2uc} := F_{YAuc} + F_{YDuc} + F_{YHuc}$$

$$F_{Y2uc} = 1.69 \text{ kN}$$

$$M_{X2uc} := M_{XAuc} + M_{XDuc} + M_{XHuc}$$

$$M_{X2uc} = 1.31 \text{ kN} \cdot m$$

Комбинация 3: СТ(А)+Вятър по ос Х(С1)+Опъвателна сила от проводник(D)**Loadcase 3: CT(A)+Wind direction X(C1)+Static conductor tension (D)**

изчислителни натоварвания/calculating loads

$$\begin{aligned}
 F_{Zmax3uc} &:= F_{ZmaxAuc} + 0.9F_{ZmaxC1uc} + 0.95F_{ZmaxDuc} & F_{Zmax3uc} &= 9.76 \text{ kN} \\
 F_{Zmin3uc} &:= F_{ZminAuc} + 0.9F_{ZminC1uc} + 0.95F_{ZminDuc} & F_{Zmin3uc} &= 6.56 \text{ kN} \\
 F_{X3uc} &:= F_{XAuc} + 0.9F_{XC1uc} + 0.95F_{XDuc} & F_{X3uc} &= 1.01 \text{ kN} \\
 M_{Y3uc} &:= M_{YAuc} + 0.9M_{YC1uc} + 0.95M_{YDuc} & M_{Y3uc} &= 2.03 \text{ kN}\cdot\text{m} \\
 F_{Y3uc} &:= F_{YAuc} + 0.9F_{YC1uc} + 0.95F_{YDuc} & F_{Y3uc} &= 0.37 \text{ kN} \\
 M_{X3uc} &:= M_{XAuc} + 0.9M_{XC1uc} + 0.95M_{XDuc} & M_{X3uc} &= 1.24 \text{ kN}\cdot\text{m}
 \end{aligned}$$

Комбинация 4: СТ(А)+Вятър по ос Y(С2)+Опъвателна сила от проводник(D)**Loadcase 4: CT(A)+Wind direction Y(C2)+Static conductor tension (D)**

изчислителни натоварвания/calculating loads

$$\begin{aligned}
 F_{Zmax4uc} &:= F_{ZmaxAuc} + 0.9F_{ZmaxC2uc} + 0.95F_{ZmaxDuc} & F_{Zmax4uc} &= 8.16 \text{ kN} \\
 F_{Zmin4uc} &:= F_{ZminAuc} + 0.9F_{ZminC2uc} + 0.95F_{ZminDuc} & F_{Zmin4uc} &= 8.16 \text{ kN} \\
 F_{X4uc} &:= F_{XAuc} + 0.9F_{XC2uc} + 0.95F_{XDuc} & F_{X4uc} &= 0.00 \text{ kN} \\
 M_{Y4uc} &:= M_{YAuc} + 0.9M_{YC2uc} + 0.95M_{YDuc} & M_{Y4uc} &= 0.00 \text{ kN}\cdot\text{m} \\
 F_{Y4uc} &:= F_{YAuc} + 0.9F_{YC2uc} + 0.95F_{YDuc} & F_{Y4uc} &= 1.85 \text{ kN} \\
 M_{X4uc} &:= M_{XAuc} + 0.9M_{XC2uc} + 0.95M_{XDuc} & M_{X4uc} &= 2.30 \text{ kN}\cdot\text{m}
 \end{aligned}$$

ОСОБЕНИ КОМБИНАЦИИ/ EXCEPTIONAL LOADCASES

от нормативни натоварвания / from normative loads

Комбинация 5: СТ(А)+Късо съединение(E)/ Loadcase 5: CT(A)+Short circuit forces

$$\begin{aligned}
 F_{Zmax5un} &:= F_{ZmaxAun} + F_{ZmaxEun} & F_{Zmax5un} &= 6.88 \text{ kN} \\
 F_{Zmin5un} &:= F_{ZminAun} + F_{ZminEun} & F_{Zmin5un} &= 6.88 \text{ kN} \\
 F_{X5un} &:= F_{XAun} + F_{XEun} & F_{X5un} &= 0.00 \text{ kN} \\
 M_{Y5un} &:= M_{YAun} + M_{YEun} & M_{Y5un} &= 0.00 \text{ kN}\cdot\text{m} \\
 F_{Y5un} &:= F_{YAun} + F_{YEun} & F_{Y5un} &= 3.00 \text{ kN} \\
 M_{X5un} &:= M_{XAun} + M_{XEun} & M_{X5un} &= 10.04 \text{ kN}\cdot\text{m}
 \end{aligned}$$

Комбинация 6: СТ(А)+Опъвателна сила от проводник(D)+Превключване(F)**Loadcase 6: CT(A)+Static conductor tension(D)+Switching (F)**

$$\begin{aligned}
 F_{Zmax6un} &:= F_{ZmaxAun} + 0.95F_{ZmaxDun} + F_{ZmaxFun} & F_{Zmax6un} &= 18.88 \text{ kN} \\
 F_{Zmin6un} &:= F_{ZminAun} + 0.95F_{ZminDun} + F_{ZminFun} & F_{Zmin6un} &= -5.13 \text{ kN} \\
 F_{X6un} &:= F_{XAun} + 0.95F_{XDun} + F_{XFun} & F_{X6un} &= 1.50 \text{ kN} \\
 M_{Y6un} &:= M_{YAun} + 0.95M_{YDun} + M_{YFun} & M_{Y6un} &= 0.00 \text{ kN}\cdot\text{m} \\
 F_{Y6un} &:= F_{YAun} + 0.95F_{YDun} + F_{YFun} & F_{Y6un} &= 1.79 \text{ kN} \\
 M_{X6un} &:= M_{XAun} + 0.95M_{XDun} + M_{XFun} & M_{X6un} &= 0.95 \text{ kN}\cdot\text{m}
 \end{aligned}$$

Комбинация 7: СТ(А)+Опъвателна сила от проводник(D)+Сеизмични сили по X(G.1)+/-Z(G.3)**Loadcase 7: CT(A)+Static conductor tension(D)+Earthquake load direction X(G.1)+/-Z(G.3)**

$$\begin{aligned}
 F_{Zmax7un} &:= F_{ZmaxAun} + 0.95F_{ZmaxDun} + F_{ZmaxG1un} + F_{ZmaxG3un} & F_{Zmax7un} &= 11.98 \text{ kN} \\
 F_{Zmin7un} &:= F_{ZminAun} + 0.95F_{ZminDun} + F_{ZminG1un} + F_{ZminG3un} & F_{Zmin7un} &= 0.99 \text{ kN} \\
 F_{X7un} &:= F_{XAun} + 0.95F_{XDun} + F_{XG1un} + F_{XG3un} & F_{X7un} &= 2.30 \text{ kN} \\
 M_{Y7un} &:= M_{YAun} + 0.95M_{YDun} + M_{YG1un} + M_{YG3un} & M_{Y7un} &= 3.55 \text{ kN}\cdot\text{m} \\
 F_{Y7un} &:= F_{YAun} + 0.95F_{YDun} + F_{YG1un} + F_{YG3un} & F_{Y7un} &= 0.29 \text{ kN} \\
 M_{X7un} &:= M_{XAun} + 0.95M_{XDun} + M_{XG1un} + M_{XG3un} & M_{X7un} &= 0.95 \text{ kN}\cdot\text{m}
 \end{aligned}$$

Комбинация 8: СТ(1)+Опъвателна сила от проводник(D)+Сеизмични сили по Y(G.2)+/-Z(G.3)**Loadcase 8: CT(1)+Static conductor tension(D)+Earthquake load direction Y(G.2)+/-Z(G.3)**

$$\begin{aligned}
 F_{Zmax8un} &:= F_{ZmaxAun} + 0.95F_{ZmaxDun} + F_{ZmaxG2un} + F_{ZmaxG3un} & F_{Zmax8un} &= 9.17 \text{ kN} \\
 F_{Zmin8un} &:= F_{ZminAun} + 0.95F_{ZminDun} + F_{ZminG2un} + F_{ZminG3un} & F_{Zmin8un} &= 3.79 \text{ kN} \\
 F_{X8un} &:= F_{XAun} + 0.95F_{XDun} + F_{XG2un} + F_{XG3un} & F_{X8un} &= 0.00 \text{ kN} \\
 M_{Y8un} &:= M_{YAun} + 0.95M_{YDun} + M_{YG2un} + M_{YG3un} & M_{Y8un} &= 0.00 \text{ kN}\cdot\text{m} \\
 F_{Y8un} &:= F_{YAun} + 0.95F_{YDun} + F_{YG2un} + F_{YG3un} & F_{Y8un} &= 2.58 \text{ kN} \\
 M_{X8un} &:= M_{XAun} + 0.95M_{XDun} + M_{XG2un} + M_{XG3un} & M_{X8un} &= 4.50 \text{ kN}\cdot\text{m}
 \end{aligned}$$

Комбинация 9.1: СТ(А)+Вятър по ос X(C.1)+Късо съединение (E)**Loadcase 9.1: CT(A)+Windload direction X(C.1)+Short-circuit forces (E)**

$$\begin{aligned}
 F_{Zmax91un} &:= F_{ZmaxAun} + 0.8F_{ZmaxC1un} + F_{ZmaxEun} & F_{Zmax91un} &= 7.89 \text{ kN} \\
 F_{Zmin91un} &:= F_{ZminAun} + 0.8F_{ZminC1un} + F_{ZminEun} & F_{Zmin91un} &= 5.86 \text{ kN} \\
 F_{X91un} &:= F_{XAun} + 0.8F_{XC1un} + F_{XEun} & F_{X91un} &= 0.64 \text{ kN} \\
 M_{Y91un} &:= M_{YAun} + 0.8M_{YC1un} + M_{YEun} & M_{Y91un} &= 1.29 \text{ kN}\cdot\text{m} \\
 F_{Y91un} &:= F_{YAun} + 0.8F_{YC1un} + F_{YEun} & F_{Y91un} &= 3.00 \text{ kN} \\
 M_{X91un} &:= M_{XAun} + 0.8M_{XC1un} + M_{XEun} & M_{X91un} &= 10.04 \text{ kN}\cdot\text{m}
 \end{aligned}$$

Комбинация 9.2: СТ(А)+Вятър по ос Y(C.2)+Късо съединение (E)**Loadcase 9.2: CT(A)+Wind load direction Y(C.2)+Short-circuit forces (E)**

$$\begin{aligned}
 F_{Zmax92un} &:= F_{ZmaxAun} + 0.8F_{ZmaxC2un} + F_{ZmaxEun} & F_{Zmax92un} &= 6.88 \text{ kN} \\
 F_{Zmin92un} &:= F_{ZminAun} + 0.8F_{ZminC2un} + F_{ZminEun} & F_{Zmin92un} &= 6.88 \text{ kN} \\
 F_{X92un} &:= F_{XAun} + 0.8F_{XC2un} + F_{XEun} & F_{X92un} &= 0.00 \text{ kN} \\
 M_{Y92un} &:= M_{YAun} + 0.8M_{YC2un} + M_{YEun} & M_{Y92un} &= 0.00 \text{ kN}\cdot\text{m} \\
 F_{Y92un} &:= F_{YAun} + 0.8F_{YC2un} + F_{YEun} & F_{Y92un} &= 3.94 \text{ kN} \\
 M_{X92un} &:= M_{XAun} + 0.8M_{XC2un} + M_{XEun} & M_{X92un} &= 10.72 \text{ kN}\cdot\text{m}
 \end{aligned}$$

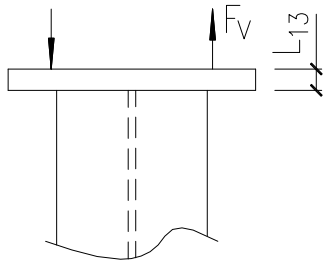
Комбинация 10.1: СТ(А)+Сеизмични сили по оси X(G.1)+/-Z(G.3)+Късо съединение (E)**Loadcase 10.1: CT(A)+Earthquake load direction X(G.1)+/-Z(G.3)+Short-circuit forces (E)**

$$\begin{aligned}
 F_{Zmax101un} &:= F_{ZmaxAun} + F_{ZmaxG1un} + F_{ZmaxG3un} + 0.8F_{ZmaxEun} & F_{Zmax101un} &= 11.98 \text{ kN} \\
 F_{Zmin101un} &:= F_{ZminAun} + F_{ZminG1un} + F_{ZminG3un} + 0.8F_{ZminEun} & F_{Zmin101un} &= 0.99 \text{ kN} \\
 F_{X101un} &:= F_{XAun} + F_{XG1un} + F_{XG3un} + 0.8F_{XEun} & F_{X101un} &= 2.30 \text{ kN} \\
 M_{Y101un} &:= M_{YAun} + M_{YG1un} + M_{YG3un} + 0.8M_{YEun} & M_{Y101un} &= 3.55 \text{ kN}\cdot\text{m} \\
 F_{Y101un} &:= F_{YAun} + F_{YG1un} + F_{YG3un} + 0.8F_{YEun} & F_{Y101un} &= 2.40 \text{ kN} \\
 M_{X101un} &:= M_{XAun} + M_{XG1un} + M_{XG3un} + 0.8M_{XEun} & M_{X101un} &= 8.04 \text{ kN}\cdot\text{m}
 \end{aligned}$$

Комбинация 10.2: СТ(А)+Сеизмични сили по ос Y(G.2)+/-Z(G.3)+Късо съединение (E)

Loadcase 10.2: CT(A)+Earthquake load direction Y(G.2)+/-Z(G.3)+Short-circuit forces (E)

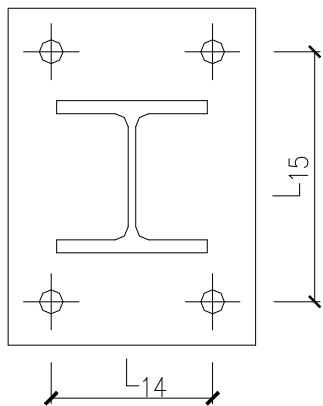
$$\begin{aligned} F_{Zmax102un} &:= F_{ZmaxAun} + F_{ZmaxG2un} + F_{ZmaxG3un} + 0.8F_{ZmaxEun} & F_{Zmax102un} &= 9.17 \text{ kN} \\ F_{Zmin102un} &:= F_{ZminAun} + F_{ZminG2un} + F_{ZminG3un} + 0.8F_{ZminEun} & F_{Zmin102un} &= 3.79 \text{ kN} \\ F_{X102un} &:= F_{XAun} + F_{XG2un} + F_{XG3un} + 0.8F_{XEun} & F_{X102un} &= 0.00 \text{ kN} \\ M_{Y102un} &:= M_{YAun} + M_{YG2un} + M_{YG3un} + 0.8M_{YEun} & M_{Y102un} &= 0.00 \text{ kN}\cdot\text{m} \\ F_{Y102un} &:= F_{YAun} + F_{YG2un} + F_{YG3un} + 0.8F_{YEun} & F_{Y102un} &= 4.70 \text{ kN} \\ M_{X102un} &:= M_{XAun} + M_{XG2un} + M_{XG3un} + 0.8M_{XEun} & M_{X102un} &= 3.55 \text{ kN}\cdot\text{m} \end{aligned}$$



Горна планка/Upper plate pl. 20/230x310 S335

$$\begin{aligned} l_{13} &:= 20 \cdot \text{mm} & l_{14} &:= 150 \cdot \text{mm} & l_{15} &:= 230 \cdot \text{mm} \\ l_{17} &:= \sqrt{\left(\frac{l_{14} - b_T}{2}\right)^2 + \left(\frac{l_{15} - h_T}{2}\right)^2} & l_{17} &= 45.28 \text{ mm} \\ W_{plH} &:= \frac{2l_{17} \cdot l_{13}^2}{6} & W_{plH} &= 6.04 \text{ cm}^3 \end{aligned}$$

Комбинация 3/ Loadcase 3:



$$\begin{aligned} F_{Vmax3} &:= \frac{F_{Zmax3uc}}{4} + \frac{M_{X3uc}}{2 \cdot l_{15}} + \frac{M_{Y3uc}}{2 \cdot l_{14}} & F_{Vmax3} &= 11.89 \text{ kN} \\ f_{tpl3} &:= \frac{F_{Vmax3} \cdot l_{17}}{W_{plH}} & f_{tpl3} &= 89.16 \frac{\text{N}}{\text{mm}^2} & \frac{f_{tpl3}}{f_{Sta36}} &= 0.27 & \blacksquare < 1 \end{aligned}$$

Комбинация 4/ Loadcase 4:

$$\begin{aligned} F_{Vmax4} &:= \frac{F_{Zmax4uc}}{4} + \frac{M_{X4uc}}{2 \cdot l_{15}} + \frac{M_{Y4uc}}{2 \cdot l_{14}} & F_{Vmax4} &= 7.04 \text{ kN} \\ f_{tpl4} &:= \frac{F_{Vmax4} \cdot l_{17}}{W_{plH}} & f_{tpl4} &= 52.78 \frac{\text{N}}{\text{mm}^2} & \frac{f_{tpl4}}{f_{Sta36}} &= 0.16 & \blacksquare < 1 \end{aligned}$$

Комбинация 5/ Loadcase 5:

$$\begin{aligned} F_{Vmax5} &:= \frac{F_{Zmax5un}}{4} + \frac{M_{X5un}}{2 \cdot l_{15}} + \frac{M_{Y5un}}{2 \cdot l_{14}} & F_{Vmax5} &= 23.55 \text{ kN} \\ f_{tpl5} &:= \frac{F_{Vmax5} \cdot l_{17}}{W_{plH}} & f_{tpl5} &= 176.65 \frac{\text{N}}{\text{mm}^2} & \frac{f_{tpl5}}{f_{Sta36}} &= 0.54 & \blacksquare < 1 \end{aligned}$$

Комбинация 6/ Loadcase 6:

$$\begin{aligned} F_{Vmax6} &:= \frac{F_{Zmax6un}}{4} + \frac{M_{X6un}}{2 \cdot l_{15}} + \frac{M_{Y6un}}{2 \cdot l_{14}} & F_{Vmax6} &= 6.79 \text{ kN} \\ f_{tpl6} &:= \frac{F_{Vmax6} \cdot l_{17}}{W_{plH}} & f_{tpl6} &= 50.95 \frac{\text{N}}{\text{mm}^2} & \frac{f_{tpl6}}{f_{Sta36}} &= 0.16 & \blacksquare < 1 \end{aligned}$$

Комбинация 7/ Loadcase 7:

$$F_{Vmax7} := \frac{F_{Zmax7un}}{4} + \frac{M_{X7un}}{2 \cdot l_{15}} + \frac{M_{Y7un}}{2 \cdot l_{14}} \quad F_{Vmax7} = 16.90 \text{ kN}$$

$$f_{tpl7} := \frac{F_{Vmax7} \cdot l_{17}}{W_{plH}} \quad f_{tpl7} = 126.72 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{tpl7}}{f_{Sta36}} = 0.39 \quad \blacksquare < 1$$

Комбинация 8/ Loadcase 8:

$$F_{Vmax8} := \frac{F_{Zmax8un}}{4} + \frac{M_{X8un}}{2 \cdot l_{15}} + \frac{M_{Y8un}}{2 \cdot l_{14}} \quad F_{Vmax8} = 12.08 \text{ kN}$$

$$f_{tpl8} := \frac{F_{Vmax8} \cdot l_{17}}{W_{plH}} \quad f_{tpl8} = 90.61 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{tpl8}}{f_{Sta36}} = 0.28 \quad \blacksquare < 1$$

Комбинация 9.1/ Loadcase 9.1:

$$F_{Vmax91} := \frac{F_{Zmax91un}}{4} + \frac{M_{X91un}}{2 \cdot l_{15}} + \frac{M_{Y91un}}{2 \cdot l_{14}} \quad F_{Vmax91} = 28.09 \text{ kN}$$

$$f_{tpl91} := \frac{F_{Vmax91} \cdot l_{17}}{W_{plH}} \quad f_{tpl91} = 210.70 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{tpl91}}{f_{Sta36}} = 0.64 \quad \blacksquare < 1$$

Комбинация 9.2/ Loadcase 9.2:

$$F_{Vmax92} := \frac{F_{Zmax92un}}{4} + \frac{M_{X92un}}{2 \cdot l_{15}} + \frac{M_{Y92un}}{2 \cdot l_{14}} \quad F_{Vmax92} = 25.01 \text{ kN}$$

$$f_{tpl92} := \frac{F_{Vmax92} \cdot l_{17}}{W_{plH}} \quad f_{tpl92} = 187.60 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{tpl92}}{f_{Sta36}} = 0.57 \quad \blacksquare < 1$$

Комбинация 10.1/ Loadcase 10.1:

$$F_{Vmax101} := \frac{F_{Zmax101un}}{4} + \frac{M_{X101un}}{2 \cdot l_{15}} + \frac{M_{Y101un}}{2 \cdot l_{14}} \quad F_{Vmax101} = 32.29 \text{ kN}$$

$$f_{tpl101} := \frac{F_{Vmax101} \cdot l_{17}}{W_{plH}} \quad f_{tpl101} = 242.18 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{tpl101}}{f_{Sta36}} = 0.74 \quad \blacksquare < 1$$

Комбинация 10.2/ Loadcase 10.2:

$$F_{Vmax102} := \frac{F_{Zmax102un}}{4} + \frac{M_{X102un}}{2 \cdot l_{15}} + \frac{M_{Y102un}}{2 \cdot l_{14}} \quad F_{Vmax102} = 10.01 \text{ kN}$$

$$f_{tpl102} := \frac{F_{Vmax102} \cdot l_{17}}{W_{plH}} \quad f_{tpl102} = 75.05 \frac{\text{N}}{\text{mm}^2} \quad \frac{f_{tpl102}}{f_{Sta36}} = 0.23 \quad \blacksquare < 1$$

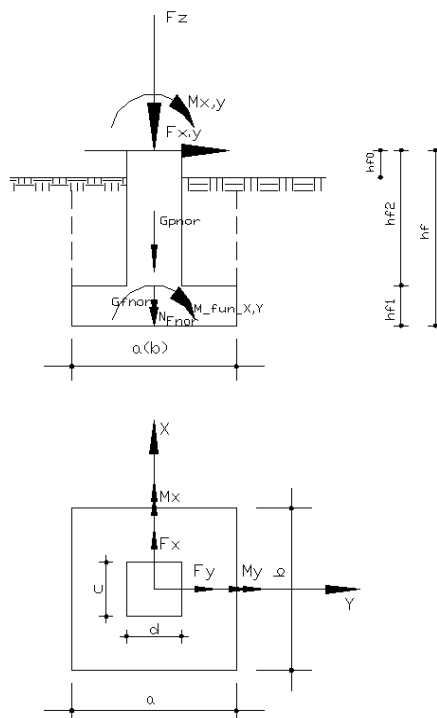
избрани: **Болтове за връзка греда-колона 4 M20 5.6**
 chosen: **Bolts for fixing beam on column 4 M20 5.6**

S355
S355

$$A_{12} := 245 \cdot \text{mm}^2$$

$f_{tS3} := \frac{F_{Vmax3}}{A_{12}}$	$f_{tS3} = 48.52 \frac{N}{\text{mm}^2}$	$\frac{f_{tS3}}{f_{ta5.6}} = 0.20$	■ < 1
$f_{tS4} := \frac{F_{Vmax4}}{A_{12}}$	$f_{tS4} = 28.72 \frac{N}{\text{mm}^2}$	$\frac{f_{tS4}}{f_{ta5.6}} = 0.12$	■ < 1
$f_{tS5} := \frac{F_{Vmax5}}{A_{12}}$	$f_{tS5} = 96.14 \frac{N}{\text{mm}^2}$	$\frac{f_{tS5}}{f_{ta5.6}} = 0.39$	■ < 1
$f_{tS7} := \frac{F_{Vmax7}}{A_{12}}$	$f_{tS7} = 68.97 \frac{N}{\text{mm}^2}$	$\frac{f_{tS7}}{f_{ta5.6}} = 0.28$	■ < 1
$f_{tS8} := \frac{F_{Vmax8}}{A_{12}}$	$f_{tS8} = 49.31 \frac{N}{\text{mm}^2}$	$\frac{f_{tS8}}{f_{ta5.6}} = 0.20$	■ < 1
$f_{tS91} := \frac{F_{Vmax91}}{A_{12}}$	$f_{tS91} = 114.67 \frac{N}{\text{mm}^2}$	$\frac{f_{tS91}}{f_{ta5.6}} = 0.47$	■ < 1
$f_{tS92} := \frac{F_{Vmax92}}{A_{12}}$	$f_{tS92} = 102.10 \frac{N}{\text{mm}^2}$	$\frac{f_{tS92}}{f_{ta5.6}} = 0.42$	■ < 1
$f_{tS101} := \frac{F_{Vmax101}}{A_{12}}$	$f_{tS101} = 131.80 \frac{N}{\text{mm}^2}$	$\frac{f_{tS101}}{f_{ta5.6}} = 0.54$	■ < 1
$f_{tS102} := \frac{F_{Vmax102}}{A_{12}}$	$f_{tS102} = 40.84 \frac{N}{\text{mm}^2}$	$\frac{f_{tS102}}{f_{ta5.6}} = 0.17$	■ < 1

ПРОВЕРКА НА ЗЕМНАТА ОСНОВА ПОД ФУНДАМЕНТ
CALCULATION OF SOIL BASE UNDER FOUNDATION



Входни данни за усилията на горен ръб фундамент, съгласно Табл. 2

Input data for the stress on upper edge foundation. acc.to Table 2

$$\begin{aligned}
 F_{X_{1.5}} &:= \begin{pmatrix} F_{X1n} \\ F_{X2n} \\ F_{X3n} \\ F_{X4n} \end{pmatrix} & F_{Y_{1.5}} &:= \begin{pmatrix} F_{Y1n} \\ F_{Y2n} \\ F_{Y3n} \\ F_{Y4n} \end{pmatrix} & F_{Zmax_{1.5}} &:= \begin{pmatrix} F_{Zmax1n} \\ F_{Zmax2n} \\ F_{Zmax3n} \\ F_{Zmax4n} \end{pmatrix} & F_{Zmin_{1.5}} &:= \begin{pmatrix} F_{Zmin1n} \\ F_{Zmin2n} \\ F_{Zmin3n} \\ F_{Zmin4n} \end{pmatrix} \\
 F_{X_{1.2}} &:= \begin{pmatrix} F_{X5n} \\ F_{X6n} \\ F_{X7n} \\ F_{X8n} \\ F_{X91n} \\ F_{X92n} \\ F_{X101n} \\ F_{X102n} \end{pmatrix} & F_{Y_{1.2}} &:= \begin{pmatrix} F_{Y5n} \\ F_{Y6n} \\ F_{Y7n} \\ F_{Y8n} \\ F_{Y91n} \\ F_{Y92n} \\ F_{Y101n} \\ F_{Y102n} \end{pmatrix} & F_{Zmax_{1.2}} &:= \begin{pmatrix} F_{Zmax5n} \\ F_{Zmax6n} \\ F_{Zmax7n} \\ F_{Zmax8n} \\ F_{Zmax91n} \\ F_{Zmax92n} \\ F_{Zmax101n} \\ F_{Zmax102n} \end{pmatrix} & F_{Zmin_{1.2}} &:= \begin{pmatrix} F_{Zmin5n} \\ F_{Zmin6n} \\ F_{Zmin7n} \\ F_{Zmin8n} \\ F_{Zmin91n} \\ F_{Zmin92n} \\ F_{Zmin101n} \\ F_{Zmin102n} \end{pmatrix} \\
 M_{X_{1.5}} &:= \begin{pmatrix} M_{X1n} \\ M_{X2n} \\ M_{X3n} \\ M_{X4n} \end{pmatrix} & M_{Y_{1.5}} &:= \begin{pmatrix} M_{Y1n} \\ M_{Y2n} \\ M_{Y3n} \\ M_{Y4n} \end{pmatrix}
 \end{aligned}$$

$$M_{X_1.2} := \begin{pmatrix} M_{X5n} \\ M_{X6n} \\ M_{X7n} \\ M_{X8n} \\ M_{X91n} \\ M_{X92n} \\ M_{X101n} \\ M_{X102n} \end{pmatrix} \quad M_{Y_1.2} := \begin{pmatrix} M_{Y5n} \\ M_{Y6n} \\ M_{Y7n} \\ M_{Y8n} \\ M_{Y91n} \\ M_{Y92n} \\ M_{Y101n} \\ M_{Y102n} \end{pmatrix}$$

Размери на фундамента. Foundation dimensions.

$b := 1.60\text{m}$	Ширина на основата на фундамента / Foundation width
$a := 1.60\text{m}$	Дължина на основата на фундамента / Foundation length
$d := 0.70\text{m}$	Ширина на подколонника / Foundation width over the base
$c := 0.70\text{m}$	Дължина на подколонника / Foundation length over the base
$h_{f0} := 0.15\text{m}$	Височина на подколонника над засипката / Foundation height above the embankment
$h_{f1} := 0.40\text{m}$	Височина на стъпката / Foundation base height
$h_{f2} := 1.15\text{m}$	Височина на подколонника / Height of the foundation over the base
$h_f := h_{f1} + h_{f2}$	$h_f = 1.55\text{m}$ Височина на фундамента / Foundation height

Определяне на вертикалната сила на долен ръб фундамент.

N_{F_nor}

$\rho := 0$

Vertical stress on lower edge foundation

$\gamma := 24 \cdot \frac{\text{kN}}{\text{m}^3}$	Обемно тегло на бетона. Concrete unit weight.	
$\gamma_z := 16.5 \cdot \frac{\text{kN}}{\text{m}^3}$	Обемно тегло на засипка/ Converse embankment unit weight	
$G_1 := a \cdot b \cdot h_{f1} \cdot \gamma$	Тегло на фундаментната плоча/ Foundation base weight	$G_1 = 24.58\text{ kN}$
$G_2 := c \cdot d \cdot h_{f2} \cdot \gamma$	Тегло на подколонникът/ Foundation weight over the base	$G_2 = 13.52\text{ kN}$
$G_{fnor} := G_1 + G_2$	Собствено тегло на фундамента/ Foundation dead weight	$G_{fnor} = 38.10\text{ kN}$
$G_{pnor} := (a \cdot b - c \cdot d) \cdot (h_{f2} - h_{f0}) \cdot \gamma_z$	Теглото на почвената засипка върху фундамента/ Soil embankment weight	$G_{pnor} = 34.16\text{ kN}$
$E_a := 0.5 \cdot \gamma_z \cdot a \cdot (h_{f1} - h_{f0})^2 \cdot \tan\left(45 \cdot \frac{\pi}{180} - \frac{\rho \cdot \pi}{2 \cdot 180}\right)^2$	$E_a = 0.82\text{ kN}$	
$N_{F_nor_max_1.5} := F_{Zmax_1.5} + G_{fnor} + G_{pnor}$	$N_{F_nor_max_1.2} := F_{Zmax_1.2} + G_{fnor} + G_{pnor}$	
$N_{F_nor_min_1.5} := F_{Zmin_1.5} + G_{fnor} + G_{pnor}$	$N_{F_nor_min_1.2} := F_{Zmin_1.2} + G_{fnor} + G_{pnor}$	
$N_{F_nor_max_1.5} = \begin{pmatrix} 81.48 \\ 82.48 \\ 82.623 \\ 81.48 \end{pmatrix} \text{ kN}$	$N_{F_nor_min_1.5} = \begin{pmatrix} 81.48 \\ 81.48 \\ 80.337 \\ 81.48 \end{pmatrix} \text{ kN}$	

$$N_{F_nor_max_1.2} = \begin{pmatrix} 81.48 \\ 93.48 \\ 87.367 \\ 84.562 \\ 82.496 \\ 81.48 \\ 87.367 \\ 84.562 \end{pmatrix} \text{ kN}$$

$$N_{F_nor_min_1.2} = \begin{pmatrix} 81.48 \\ 69.48 \\ 75.593 \\ 78.398 \\ 80.464 \\ 81.48 \\ 75.593 \\ 78.398 \end{pmatrix} \text{ kN}$$

Определяне на запъващите моменти в основната плоскост на фундамента. M_{fun}

Restraining moments on the foundation base. M_{fun}

Запъващ момент спрямо ос x в основната плоскост на фундамента./ Restraining moment direction X

$$M_{fun_X_1.5} := M_{X_1.5} + F_{Y_1.5} \cdot h_f - E_a \cdot \frac{h_{f1} - h_{f0}}{3} \quad M_{fun_X_1.2} := M_{X_1.2} + F_{Y_1.2} \cdot h_f - E_a \cdot \frac{h_{f1} - h_{f0}}{3}$$

Запъващ момент спрямо ос y в основната плоскост на фундамента./ Restraining moment direction Y

$$M_{fun_Y_1.5} := M_{Y_1.5} + F_{X_1.5} \cdot h_f - E_a \cdot \frac{h_{f1} - h_{f0}}{3} \quad M_{fun_Y_1.2} := M_{Y_1.2} + F_{X_1.2} \cdot h_f - E_a \cdot \frac{h_{f1} - h_{f0}}{3}$$

$$M_{fun_X_1.5} = \begin{pmatrix} -0.069 \\ 6.006 \\ 1.997 \\ 8.119 \end{pmatrix} \text{ kN} \cdot \text{m}$$

$$M_{fun_Y_1.5} = \begin{pmatrix} -0.069 \\ 3.831 \\ 5.427 \\ -0.069 \end{pmatrix} \text{ kN} \cdot \text{m}$$

$$M_{fun_X_1.2} = \begin{pmatrix} 21.675 \\ 7.847 \\ 1.997 \\ 16.644 \\ 21.675 \\ 27.117 \\ -0.069 \\ 14.578 \end{pmatrix} \text{ kN} \cdot \text{m}$$

$$M_{fun_Y_1.2} = \begin{pmatrix} -0.069 \\ 5.781 \\ 14.578 \\ -0.069 \\ 4.816 \\ -0.069 \\ 14.578 \\ -0.069 \end{pmatrix} \text{ kN} \cdot \text{m}$$

Определяне на напрежението на почвата под ъглите на фундамента/ soil stress under foundation corners. σ_{1_4}

$F_{fund} := a \cdot b$ Основна площ на фундамента. Basic area of the Foundation.

$$F_{fund} = 2.56 \text{ m}^2$$

$W_x := \frac{a^2 \cdot b}{6}$ W_x и W_y са съпротивителните моменти на основната плоскост на фундамента

$$W_x = 0.68 \text{ m}^{3.00}$$

$W_y := \frac{a \cdot b^2}{6}$ W_x and W_y are the resistance moments of the Foundation bed.

$$W_y = 0.68 \text{ m}^{3.00}$$

$$\sigma_{1_max_1.5} := \frac{N_{F_nor_max_1.5}}{F_{fund}} - \frac{M_{fun_X_1.5}}{W_x} - \frac{M_{fun_Y_1.5}}{W_y}$$

$$\sigma_{1_min_1.5} := \frac{N_{F_nor_min_1.5}}{F_{fund}} - \frac{M_{fun_X_1.5}}{W_x} - \frac{M_{fun_Y_1.5}}{W_y}$$

$$\sigma_{1_max_1.2} := \frac{N_{F_nor_max_1.2}}{F_{fund}} - \frac{M_{fun_X_1.2}}{W_x} - \frac{M_{fun_Y_1.2}}{W_y}$$

$$\sigma_{1_min_1.2} := \frac{N_{F_nor_min_1.2}}{F_{fund}} - \frac{M_{fun_X_1.2}}{W_x} - \frac{M_{fun_Y_1.2}}{W_y}$$

$$\sigma_{2_max_1.5} := \frac{N_{F_nor_max_1.5}}{F_{fund}} - \frac{M_{fun_X_1.5}}{W_x} + \frac{M_{fun_Y_1.5}}{W_y}$$

$$\sigma_{2_min_1.5} := \frac{N_{F_nor_min_1.5}}{F_{fund}} - \frac{M_{fun_X_1.5}}{W_x} + \frac{M_{fun_Y_1.5}}{W_y}$$

$$\sigma_{2_max_1.2} := \frac{N_{F_nor_max_1.2}}{F_{fund}} - \frac{M_{fun_X_1.2}}{W_x} + \frac{M_{fun_Y_1.2}}{W_y}$$

$$\sigma_{2_min_1.2} := \frac{N_{F_nor_min_1.2}}{F_{fund}} - \frac{M_{fun_X_1.2}}{W_x} + \frac{M_{fun_Y_1.2}}{W_y}$$

$$\sigma_{3_max_1.5} := \frac{N_{F_nor_max_1.5}}{F_{fund}} + \frac{M_{fun_X_1.5}}{W_x} + \frac{M_{fun_Y_1.5}}{W_y}$$

$$\sigma_{3_min_1.5} := \frac{N_{F_nor_min_1.5}}{F_{fund}} + \frac{M_{fun_X_1.5}}{W_x} + \frac{M_{fun_Y_1.5}}{W_y}$$

$$\sigma_{3_max_1.2} := \frac{N_{F_nor_max_1.2}}{F_{fund}} + \frac{M_{fun_X_1.2}}{W_x} + \frac{M_{fun_Y_1.2}}{W_y}$$

$$\sigma_{3_min_1.2} := \frac{N_{F_nor_min_1.2}}{F_{fund}} + \frac{M_{fun_X_1.2}}{W_x} + \frac{M_{fun_Y_1.2}}{W_y}$$

$$\sigma_{4_max_1.5} := \frac{N_{F_nor_max_1.5}}{F_{fund}} + \frac{M_{fun_X_1.5}}{W_x} - \frac{M_{fun_Y_1.5}}{W_y}$$

$$\sigma_{4_min_1.5} := \frac{N_{F_nor_min_1.5}}{F_{fund}} + \frac{M_{fun_X_1.5}}{W_x} - \frac{M_{fun_Y_1.5}}{W_y}$$

$$\sigma_{4_max_1.2} := \frac{N_{F_nor_max_1.2}}{F_{fund}} + \frac{M_{fun_X_1.2}}{W_x} - \frac{M_{fun_Y_1.2}}{W_y}$$

$$\sigma_{4_min_1.2} := \frac{N_{F_nor_min_1.2}}{F_{fund}} + \frac{M_{fun_X_1.2}}{W_x} - \frac{M_{fun_Y_1.2}}{W_y}$$

$$\sigma_{1_max_1.5} = \begin{pmatrix} 32.03 \\ 17.809 \\ 21.4 \\ 20.036 \end{pmatrix} \frac{\text{kN}}{\text{m}^2} \quad \sigma_{2_max_1.5} = \begin{pmatrix} 31.828 \\ 29.034 \\ 37.299 \\ 19.835 \end{pmatrix} \frac{\text{kN}}{\text{m}^2} \quad \sigma_{3_max_1.5} = \begin{pmatrix} 31.627 \\ 46.628 \\ 43.149 \\ 43.62 \end{pmatrix} \frac{\text{kN}}{\text{m}^2} \quad \sigma_{4_max_1.5} = \begin{pmatrix} 31.828 \\ 35.404 \\ 27.251 \\ 43.821 \end{pmatrix} \frac{\text{kN}}{\text{m}^2}$$

$$\sigma_{1_max_1.2} = \begin{pmatrix} 0.178 \\ 16.552 \\ 9.848 \\ 8.752 \\ -6.58 \\ -7.793 \\ 12.874 \\ 11.778 \end{pmatrix} \frac{\text{kN}}{\text{m}^2} \quad \sigma_{2_max_1.2} = \begin{pmatrix} -0.023 \\ 33.49 \\ 52.557 \\ 8.551 \\ 7.529 \\ -7.994 \\ 55.583 \\ 11.577 \end{pmatrix} \frac{\text{kN}}{\text{m}^2} \quad \sigma_{3_max_1.2} = \begin{pmatrix} 63.478 \\ 56.479 \\ 58.408 \\ 57.312 \\ 71.031 \\ 71.449 \\ 55.382 \\ 54.286 \end{pmatrix} \frac{\text{kN}}{\text{m}^2} \quad \sigma_{4_max_1.2} = \begin{pmatrix} 63.68 \\ 39.542 \\ 15.699 \\ 57.513 \\ 56.921 \\ 71.651 \\ 12.673 \\ 54.487 \end{pmatrix} \frac{\text{kN}}{\text{m}^2}$$

$$\sigma_{1_min_1.5} = \begin{pmatrix} 32.03 \\ 17.419 \\ 20.507 \\ 20.036 \end{pmatrix} \frac{\text{kN}}{\text{m}^2} \quad \sigma_{2_min_1.5} = \begin{pmatrix} 31.828 \\ 28.643 \\ 36.405 \\ 19.835 \end{pmatrix} \frac{\text{kN}}{\text{m}^2} \quad \sigma_{3_min_1.5} = \begin{pmatrix} 31.627 \\ 46.238 \\ 42.256 \\ 43.62 \end{pmatrix} \frac{\text{kN}}{\text{m}^2} \quad \sigma_{4_min_1.5} = \begin{pmatrix} 31.828 \\ 35.013 \\ 26.357 \\ 43.821 \end{pmatrix} \frac{\text{kN}}{\text{m}^2}$$

$$\sigma_{1_min_1.2} = \begin{pmatrix} 0.178 \\ 7.177 \\ 5.249 \\ 6.344 \\ -7.375 \\ -7.793 \\ 8.275 \\ 9.37 \end{pmatrix} \frac{\text{kN}}{\text{m}^2} \quad \sigma_{2_min_1.2} = \begin{pmatrix} -0.023 \\ 24.115 \\ 47.958 \\ 6.143 \\ 6.735 \\ -7.994 \\ 50.984 \\ 9.169 \end{pmatrix} \frac{\text{kN}}{\text{m}^2} \quad \sigma_{3_min_1.2} = \begin{pmatrix} 63.478 \\ 47.104 \\ 53.808 \\ 54.904 \\ 70.237 \\ 71.449 \\ 50.782 \\ 51.878 \end{pmatrix} \frac{\text{kN}}{\text{m}^2} \quad \sigma_{4_min_1.2} = \begin{pmatrix} 63.68 \\ 30.167 \\ 11.099 \\ 55.105 \\ 56.127 \\ 71.651 \\ 8.073 \\ 52.079 \end{pmatrix} \frac{\text{kN}}{\text{m}^2}$$

Заклучение: Удовлетворени са условията на чл. 57(4) от Наредба №1 за проектиране на плоско фундиране..

Ъгловите и ръбовите напрежения не надвишават 150 kN/m².

Conclusion: The requirements of article 57(4) of Regulation No1 are fulfilled.

The stress on the edges and corners are below the limit of 150 kN/m².

Проверка за преобръщане на фундамента/ Foundation overturn check

Приемаме коефициент на сигурност 1,5 за основно съчетание и 1,2 за особено съчетание на натоварването съгласно чл. 75 от Наредба №1 за проектиране на плоско фундиране.

$k_{1.2} := 1.2$ Safety coefficient for exceptional loadcases $k_{1.5} := 1.5$ Safety coefficient for normal loadcases

$$M_{\text{zad_X_max_1.5}} := N_{\text{F_nor_max_1.5}} \cdot \frac{a}{2} \quad M_{\text{zad_X_max_1.2}} := N_{\text{F_nor_max_1.2}} \cdot \frac{a}{2}$$

Задържащ момент спрямо ос X в основната плоскост/ Restraining moment direction X

$$M_{\text{zad_X_min_1.5}} := N_{\text{F_nor_min_1.5}} \cdot \frac{a}{2} \quad M_{\text{zad_X_min_1.2}} := N_{\text{F_nor_min_1.2}} \cdot \frac{a}{2}$$

Задържащ момент спрямо ос Y в основната плоскост/ Restraining moment direction Y

$$M_{\text{zad_Y_max_1.5}} := N_{\text{F_nor_max_1.5}} \cdot \frac{b}{2} \quad M_{\text{zad_Y_max_1.2}} := N_{\text{F_nor_max_1.2}} \cdot \frac{b}{2}$$

$$M_{\text{zad_Y_min_1.5}} := N_{\text{F_nor_min_1.5}} \cdot \frac{b}{2} \quad M_{\text{zad_Y_min_1.2}} := N_{\text{F_nor_min_1.2}} \cdot \frac{b}{2}$$

Проверка за преобръщане по ос X.

$$M_{\text{check_X_1.5}} := M_{\text{fun_X_1.5}} \cdot k_{1.5} \quad M_{\text{check_X_1.2}} := M_{\text{fun_X_1.2}} \cdot k_{1.2}$$

Проверка за преобръщане по ос Y.

$$M_{\text{check_Y_1.5}} := M_{\text{fun_Y_1.5}} \cdot k_{1.5} \quad M_{\text{check_Y_1.2}} := M_{\text{fun_Y_1.2}} \cdot k_{1.2}$$

Условие за устойчивост на фундамента срещу преобръщане./ Conditions against overturn

$$\frac{M_{\text{zad_X_max_1.5}}}{M_{\text{fun_X_1.5}}} \geq k_{1.5} \quad \frac{M_{\text{zad_X_min_1.5}}}{M_{\text{fun_X_1.5}}} \geq k_{1.5} \quad \frac{M_{\text{zad_Y_max_1.5}}}{M_{\text{fun_Y_1.5}}} \geq k_{1.5} \quad \frac{M_{\text{zad_Y_min_1.5}}}{M_{\text{fun_Y_1.5}}} \geq k_{1.5}$$

$$\frac{M_{\text{zad_X_max_1.2}}}{M_{\text{fun_X_1.2}}} \geq k_{1.2} \quad \frac{M_{\text{zad_X_min_1.2}}}{M_{\text{fun_X_1.2}}} \geq k_{1.2} \quad \frac{M_{\text{zad_Y_max_1.2}}}{M_{\text{fun_Y_1.2}}} \geq k_{1.2} \quad \frac{M_{\text{zad_Y_min_1.2}}}{M_{\text{fun_Y_1.2}}} \geq k_{1.2}$$

$$M_{\text{check_X_1.5}} = \begin{pmatrix} -0.103 \\ 9.008 \\ 2.995 \\ 12.178 \end{pmatrix} \text{ kN} \cdot \text{m} \quad M_{\text{zad_X_max_1.5}} = \begin{pmatrix} 65.184 \\ 65.984 \\ 66.099 \\ 65.184 \end{pmatrix} \text{ kN} \cdot \text{m} \quad M_{\text{zad_X_min_1.5}} = \begin{pmatrix} 65.184 \\ 65.184 \\ 64.269 \\ 65.184 \end{pmatrix} \text{ kN} \cdot \text{m}$$

$$M_{\text{check_X_1.2}} = \begin{pmatrix} 26.01 \\ 9.416 \\ 2.396 \\ 19.972 \\ 26.01 \\ 32.54 \\ -0.082 \\ 17.494 \end{pmatrix} \text{ kN}\cdot\text{m} \quad M_{\text{zad_X_max_1.2}} = \begin{pmatrix} 65.184 \\ 74.784 \\ 69.894 \\ 67.65 \\ 65.997 \\ 65.184 \\ 69.894 \\ 67.65 \end{pmatrix} \text{ kN}\cdot\text{m} \quad M_{\text{zad_X_min_1.2}} = \begin{pmatrix} 65.184 \\ 55.584 \\ 60.474 \\ 62.718 \\ 64.371 \\ 65.184 \\ 60.474 \\ 62.718 \end{pmatrix} \text{ kN}\cdot\text{m}$$

$$M_{\text{check_Y_1.5}} = \begin{pmatrix} -0.103 \\ 5.747 \\ 8.14 \\ -0.103 \end{pmatrix} \text{ kN}\cdot\text{m} \quad M_{\text{zad_Y_max_1.5}} = \begin{pmatrix} 65.184 \\ 65.984 \\ 66.099 \\ 65.184 \end{pmatrix} \text{ kN}\cdot\text{m} \quad M_{\text{zad_Y_min_1.5}} = \begin{pmatrix} 65.184 \\ 65.184 \\ 64.269 \\ 65.184 \end{pmatrix} \text{ kN}\cdot\text{m}$$

$$M_{\text{check_Y_1.2}} = \begin{pmatrix} -0.082 \\ 6.938 \\ 17.494 \\ -0.082 \\ 5.779 \\ -0.082 \\ 17.494 \\ -0.082 \end{pmatrix} \text{ kN}\cdot\text{m} \quad M_{\text{zad_Y_max_1.2}} = \begin{pmatrix} 65.184 \\ 74.784 \\ 69.894 \\ 67.65 \\ 65.997 \\ 65.184 \\ 69.894 \\ 67.65 \end{pmatrix} \text{ kN}\cdot\text{m} \quad M_{\text{zad_Y_min_1.2}} = \begin{pmatrix} 65.184 \\ 55.584 \\ 60.474 \\ 62.718 \\ 64.371 \\ 65.184 \\ 60.474 \\ 62.718 \end{pmatrix} \text{ kN}\cdot\text{m}$$

$j := 0..3$

$$k_{X_max_1.5}(j) := \begin{cases} y \leftarrow M_{\text{fun_X_1.5}_j} \\ z \leftarrow \frac{M_{\text{zad_X_max_1.5}_j}}{y} \text{ if } y \neq 0 \\ z \leftarrow \infty \text{ otherwise} \\ z \end{cases} \quad k_{X_min_1.5}(j) := \begin{cases} y \leftarrow M_{\text{fun_X_1.5}_j} \\ z \leftarrow \frac{M_{\text{zad_X_min_1.5}_j}}{y} \text{ if } y \neq 0 \\ z \leftarrow \infty \text{ otherwise} \\ z \end{cases}$$

$$k_{X_max_1.2}(j1) := \begin{cases} y \leftarrow M_{\text{fun_X_1.2}_{j1}} \\ z \leftarrow \frac{M_{\text{zad_X_max_1.2}_{j1}}}{y} \text{ if } y \neq 0 \\ z \leftarrow \infty \text{ otherwise} \\ z \end{cases} \quad k_{Y_max_1.2}(j1) := \begin{cases} y \leftarrow M_{\text{fun_Y_1.2}_{j1}} \\ z \leftarrow \frac{M_{\text{zad_Y_max_1.2}_{j1}}}{y} \text{ if } y \neq 0 \\ z \leftarrow \infty \text{ otherwise} \\ z \end{cases}$$

$$k_{Y_max_1.5}(j) := \begin{cases} y \leftarrow M_{\text{fun_Y_1.5}_j} \\ z \leftarrow \frac{M_{\text{zad_Y_max_1.5}_j}}{y} \text{ if } y \neq 0 \\ z \leftarrow \infty \text{ otherwise} \\ z \end{cases} \quad k_{Y_min_1.5}(j) := \begin{cases} y \leftarrow M_{\text{fun_Y_1.5}_j} \\ z \leftarrow \frac{M_{\text{zad_Y_min_1.5}_j}}{y} \text{ if } y \neq 0 \\ z \leftarrow \infty \text{ otherwise} \\ z \end{cases}$$

$$k_{X_min_1.2}(j) := \begin{cases} y \leftarrow M_{fun_X_1.2,j} \\ M_{zad_X_min_1.2,j} \\ z \leftarrow \frac{M_{zad_X_min_1.2,j}}{y} \text{ if } y \neq 0 \\ z \leftarrow \infty \text{ otherwise} \\ z \end{cases} \quad k_{Y_min_1.2}(j) := \begin{cases} y \leftarrow M_{fun_Y_1.2,j} \\ M_{zad_Y_min_1.2,j} \\ z \leftarrow \frac{M_{zad_Y_min_1.2,j}}{y} \text{ if } y \neq 0 \\ z \leftarrow \infty \text{ otherwise} \\ z \end{cases}$$

$k_{X_max_1.5}(j) =$	$k_{X_min_1.5}(j) =$	$k_{Y_max_1.5}(j) =$	$k_{Y_min_1.5}(j) =$
-948.131	-948.131	-948.131	-948.131
10.987	10.854	17.223	17.014
33.1	32.184	12.18	11.843
8.029	8.029	-948.131	-948.131

$k_{X_max_1.2}(j1) =$	$k_{X_min_1.2}(j1) =$	$k_{Y_max_1.2}(j1) =$	$k_{Y_min_1.2}(j1) =$
3.007	3.007	-948.131	-948.131
9.53	7.084	12.936	9.615
35.001	30.284	4.794	4.148
4.065	3.768	-983.998	-912.264
3.045	2.97	13.704	13.366
2.404	2.404	-948.131	-948.131
-1.017·10 ³	-879.623	4.794	4.148
4.641	4.302	-983.998	-912.264

Заклучение: Минималният коефициент на преобръщане при основни комбинации е по-голям от 1.5.
Минималният коефициент на преобръщане при особени комбинации е по-голям 1.2.
Следователно фундамента е устойчив в експлоатационно отношение.

Conclusion: The min. overturn coefficient of normal loadcases is bigger than 1.5.
The min. overturn coefficient of exceptional loadcases is bigger than 1.2.
Hence the foundation is stable.

Изчисляване на земната основа по I-во гранично състояние - по носеща способност.
Calculation of the soil base acc.to the 1st limit condition - carrying ability

$$k_s := 1.2$$

$$e_{a_1.5} := \frac{k_s \cdot M_{fun_X_1.5}}{k_s \cdot \max(N_{F_nor_max_1.5})} \quad e_{b_1.5} := \frac{k_s \cdot M_{fun_Y_1.5}}{k_s \cdot \max(N_{F_nor_max_1.5})}$$

$$e_{a_1.2} := \frac{k_s \cdot M_{fun_X_1.2}}{k_s \cdot \max(N_{F_nor_max_1.2})} \quad e_{b_1.2} := \frac{k_s \cdot M_{fun_Y_1.2}}{k_s \cdot \max(N_{F_nor_max_1.2})}$$

$$e_{a_1.5} = \begin{pmatrix} -8.321 \times 10^{-4} \\ 0.073 \\ 0.024 \\ 0.098 \end{pmatrix} \text{ m} \quad e_{b_1.5} = \begin{pmatrix} -8.321 \times 10^{-4} \\ 0.046 \\ 0.066 \\ -8.321 \times 10^{-4} \end{pmatrix} \text{ m}$$

$$e_{a_{1.2}} = \begin{pmatrix} 0.232 \\ 0.084 \\ 0.021 \\ 0.178 \\ 0.232 \\ 0.29 \\ -7.355 \times 10^{-4} \\ 0.156 \end{pmatrix} \text{ m} \quad e_{b_{1.2}} = \begin{pmatrix} -7.355 \times 10^{-4} \\ 0.062 \\ 0.156 \\ -7.355 \times 10^{-4} \\ 0.052 \\ -7.355 \times 10^{-4} \\ 0.156 \\ -7.355 \times 10^{-4} \end{pmatrix} \text{ m}$$

$$\begin{aligned} \max(e_{a_{1.2}}) &\leq \frac{a}{3} \\ \max(e_{b_{1.2}}) &\leq \frac{b}{3} \\ \max(e_{a_{1.2}}) &= 0.29 \text{ m} \quad \frac{a}{3} = 0.53 \text{ m} \\ \max(e_{b_{1.2}}) &= 0.16 \text{ m} \quad \frac{b}{3} = 0.53 \text{ m} \end{aligned}$$

**НЕЦЕНТРИЧНО НАТИСНАТИ КОЛОНИ С ПРАВОЪГЪЛНО СЕЧЕНИЕ И СИМЕТРИЧНА
АРИМРОВКА ЗА ПОДКОЛОННИКА.
SIMETRICAL REINFORCEMENT FOR THE PEDESTAL.**

$$N_f := \max(F_{Z_{\max_{1.2}}}) + G_2 \quad N_f = 34.75 \text{ kN}$$

$$\gamma_{b2} := 1.0 \quad b_c := c \quad \xi_R := 0.537 \quad h_0 := c - 5 \cdot \text{cm}$$

$$R_b := 14.50 \cdot \text{MPa} \quad \text{за бетон клас B20 / concrete class B20}$$

$$R_{bt} := 1.05 \cdot \text{MPa} \quad \text{за бетон клас B20 / concrete class B20}$$

$$x_1 := \frac{N_f}{\gamma_{b2} \cdot R_b \cdot b_c} \quad x_1 = 0.34 \text{ cm}$$

$$x_R := \xi_R \cdot h_0 \quad x_R = 34.90 \text{ cm}$$

$$\omega := 0.5 \cdot (1 + \xi_R) \quad \omega = 0.77 \quad R_{sc} := 375 \cdot \text{MPa}$$

$$M_I := \max(M_{X_{1.2}}) + \max(F_{Y_{1.2}}) \cdot h_{f2}$$

$$e_0 := \frac{M_I}{N_f} \quad e_0 = 73.23 \text{ cm}$$

$$l_0 := 2 \cdot h_{f2}$$

$$e_a := \text{if}\left(\frac{c}{30} \geq \frac{l_0}{600}, \frac{c}{30}, \frac{l_0}{600}\right) \quad e_a = 2.33 \text{ cm}$$

$$A_{s_p_min} := 0.05\% \cdot c \cdot d$$

$$A_{s_min} := A_{s_p_min} \quad A_{s_p_min} = 2.45 \text{ cm}^{2.00}$$

$$J_s := A_{s_min} \cdot \left(\frac{c}{2} - 5 \cdot \text{cm}\right)^2 + A_{s_p_min} \cdot \left(\frac{c}{2} - 5 \cdot \text{cm}\right)^2 \quad J_s = 4410.00 \text{ cm}^{4.00}$$

$$\alpha := \frac{E_s}{E_b} \quad \alpha = 7.27 \quad \text{За бетон клас B20 и стомана A III / concrete class B20 an steel A III}$$

$$\delta_e := \frac{e_0}{c} \quad \delta_e = 1.05$$

$$M_{11} := M_{X_{1.5_1}} + F_{Y_{1.5_1}} \cdot h_{f2}$$

за/ $\frac{a}{b} = 1.00$ избираме/ $\beta := 0.70$ коефициент за изчисляване на слягането в зависимост от формата на фундамента. По Табл. 4.1 от НППФ-1996г. /
for chosen subsiding coefficient acc. to Table 4.1. НППФ-1996

$$\varphi_I := 1 + \beta \cdot \frac{M_{II}}{M_I}$$

$$J_i := \frac{c \cdot d^3}{12}$$

$$N_{Cr} := \frac{6.4 \cdot E_b}{l_0^2} \cdot \left[\frac{J_i}{\varphi_I} \left(\frac{0.11}{0.1 + \delta_e} \right) + \alpha \cdot J_s \right]$$

$$N_{Cr} = 66089.47 \text{ kN}$$

$$\eta := \frac{1}{\frac{N_f}{1 - \frac{N_f}{N_{Cr}}}}$$

$$\eta = 1.00$$

$$e_n := e_0 + e_a$$

$$e_{max} := e_n \cdot \eta + \frac{c}{2} + 5 \cdot \text{cm}$$

$$e_{max} = 1.16 \text{ m}$$

$$A_s := \frac{N_f \cdot e_{max} - \gamma_{b2} \cdot R_b \cdot x_1 \cdot b_c \cdot (h_0 - 0.5 \cdot x_1)}{R_{sc} \cdot (h_0 - 5 \cdot \text{cm})}$$

$$A_{s1} := \frac{N_f \cdot e_{max} - \gamma_{b2} \cdot R_b \cdot b_c \cdot h_0^2 \cdot \omega \cdot (1 - 0.5 \cdot \omega)}{R_{sc} \cdot (h_0 - 5 \cdot \text{cm})}$$

$$x_1 = 0.34 \text{ cm}$$

$$x_R = 34.90 \text{ cm}$$

$$\text{Reinforcement} := \text{if}(x_1 \leq x_R, A_s, A_{s1})$$

Опънна (натискова) армировка на подколонника -
Stretching (stress) reinforcement

$$\text{Reinforcement} = 0.78 \text{ cm}^{2.00}$$

ОПРЕДЕЛЯНЕ НА НОСЕЩАТА АРМИРОВКА НА СРЯЗВАНЕ - СТРЕМЕНА ЗА ПОДКОЛОННИКА. CALCULATION OF THE CARRYING REINFORCEMENT OF THE FOUNDATION TOP

$$Q := \text{if}(\max(F_{X_1.2}) > \max(F_{Y_1.2}), \max(F_{X_1.2}), \max(F_{Y_1.2}))$$

$$Q = 4.34 \text{ kN}$$

1. Проверка за достатъчност на сечението $Q \leq Q_{b1}$

1. Checking the reinf. section

$$Q_{b1} := 0.3 \cdot R_b \cdot d \cdot h_0$$

$$Q_{b1} = 1.98 \times 10^3 \text{ kN}$$

2. Проверка за способността на сечението само да понесе Q/ Q restrain check

$$Q \leq Q_{b2}$$

$$Q_{b2} := 0.6 \cdot R_{bt} \cdot d \cdot h_0$$

$$Q_{b2} = 286.65 \text{ kN}$$

Заклучение: Сечението е в състояние само да понесе срязването. Армировката е конструктивна - стремена ф8 през 20 см.

Conclusion: The requirements are fulfilled. The reinforcement is constructive ф8 through 20cm

ПРОВЕРКА НА ПРОДЪНВАНЕ/ COLLAPSE CHECK

$$\alpha_m := 1.2 \quad \text{за обикновен бетон клас B20 / concrete class B20}$$

$$u_m := 2 \cdot c + 2 \cdot d + 4 \cdot h_{f1}$$

$$N_{f_chk} := \alpha_m \cdot R_{bt} \cdot u_m \cdot h_0$$

$$N_f = 34.75 \text{ kN}$$

$$N_{f_chk} = 3603.60 \text{ kN}$$

ОПРЕДЕЛЯНЕ НА НОСЕЦА АРМИРОВКА ЗА ФУНДАМЕНТНАТА ПЛОЧА/ FOUNDATION REINFORCEMENT**1. Горна армировка/ Upper reinforcement**

$$q := (h_{f2} - h_{f0}) \gamma_z \quad q = 16.50 \text{ kN} \cdot \text{m}^{-2.00}$$

$$l_k := \frac{a - c}{2} \quad l_k = 0.45 \text{ m}$$

$$M_{ku} := \frac{q \cdot l_k^2 \cdot 1 \cdot \text{m}}{2} \quad M_{ku} = 1.67 \text{ kN} \cdot \text{m}$$

$$\alpha_u := \frac{M_{ku}}{R_b \cdot 100 \cdot \text{cm} \cdot (h_{f1} - 5 \cdot \text{cm})^2} \quad \alpha_u = 0.00094 \quad \eta_{ku} := 0.995$$

$$A_{su} := \frac{M_{ku}}{R_{sc} \cdot \eta_{ku} \cdot (h_{f1} - 5 \cdot \text{cm})} \quad A_{su} = 0.13 \text{ cm}^{2.00} \quad \text{за 1 линеен метър/ per linear meter}$$

2. Долна армировка/ Lower reinforcement

$$\sigma_{\max} := \max(\max(\sigma_{1_{\max_1.2}}), \max(\sigma_{2_{\max_1.2}}), \max(\sigma_{3_{\max_1.2}}), \max(\sigma_{4_{\max_1.2}})) \quad \sigma_{\max} = 71.65 \frac{\text{kN}}{\text{m}^{2.00}}$$

$$M_{kb} := \frac{\sigma_{\max} \cdot l_k^2 \cdot 1 \cdot \text{m}}{2} \quad M_{kb} = 7.25 \text{ kN} \cdot \text{m}$$

$$\alpha_b := \frac{M_{kb}}{R_b \cdot 100 \cdot \text{cm} \cdot (h_{f1} - 5 \cdot \text{cm})^2} \quad \alpha_b = 0.004 \quad \eta_{kb} := 0.9925$$

$$A_{sb} := \frac{M_{kb}}{R_{sc} \cdot \eta_{kb} \cdot (h_{f1} - 5 \cdot \text{cm})} \quad A_{sb} = 0.56 \text{ cm}^{2.00} \quad \text{за 1 линеен метър/ per linear meter}$$