DRŽAVNI UNIVERZITET U NOVOM PAZARU
DEPARTMAN: TEHNIČKIH NAUKA
Studijski program: GRADEVINARSTVO
Predmet: FUNDIRANJE

II grafički

Kandidat: Zekovic Džemal *Br. indeksa:* 008-023/20

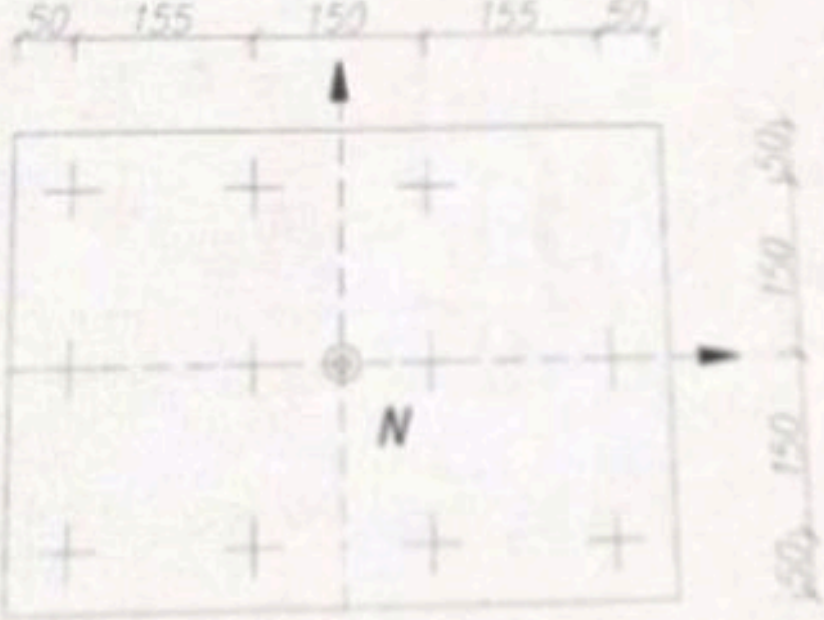
1. Prema podacima iz projekta, stub preseka 50/55cm prenosi na temelj sledeće opterećenje:

$N = 2200+20\alpha+50\beta$ kN
$M_y = -(350-(\beta+2\alpha))$ kNm
$H_x = -(55-\alpha+\beta)$ kN
$M_x = -(270+\alpha/2+\beta/3)$ kNm
$H_y = -(80+\beta+\alpha/2)$ kN

Stub je fundiran, na gotovim AB šipovima, prečnika Ø30, u tlu sledećih karakteristika:

- I sloj, dubine **4.0m** ***γ =15.0kN/m³***, *c =70kN/m²*, *φ=27°*
- II sloj: ***γ =22.5kN/m³, c =12kN/m², φ=29°***

Raspored i broj šipova (4x3) je prethodno određen, međutim, prilikom polaganja šipova došlo je do otkazivanja pojedinih šipova. Sračunati dužinu šipova za dispoziciju prikazanu na slici:



Debljina naglavne grede iznosi 80cm, a njena gornja površina je na 30cm ispod površine terena.

Broj indeksa 008-_ α β /XX

Predmetni asistent:
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Predmetni nastavnik:
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008-023/20 $\alpha=2$; $\beta=3$

$N = 2200 + 20\cdot\alpha + 50\cdot\beta\ kN = 2200 + 20\cdot 2 + 50\cdot 3 = 2390\ kN$

$M_y = -(350-(\beta+2\alpha))\ kNm = -(350-(3+2\cdot 2))\ kNm = -343\ kNm$

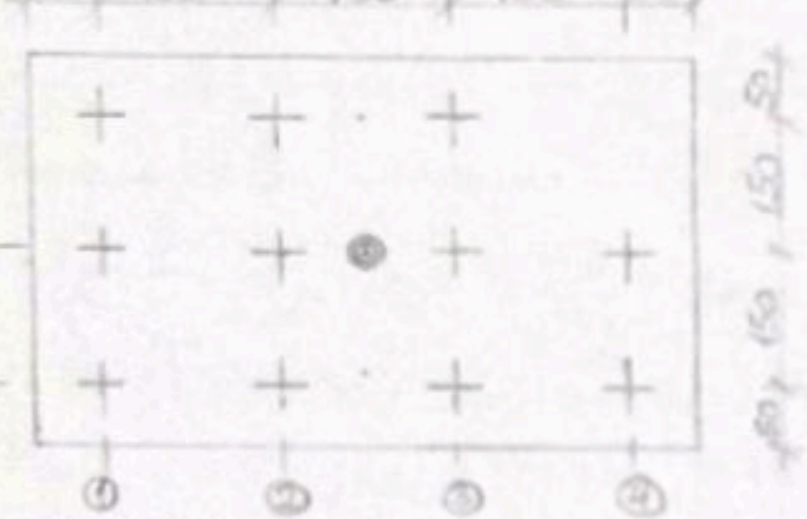
$H_y = -(55-\alpha+\beta)\ kN = -(55-2+3)\ kN = -56\ kN$

$M_x = -(270+\alpha/2+\beta/3)\ kNm = -(270+2/2+3/3)\ kNm = -272\ kNm$

$H_x = -(80+\beta+\alpha/2)\ kN = -(80+3+2/2)\ kN = -84\ kN$

I sloj: debljine 4,0m; $\gamma = 19,0\ kN/m^3$; $c = \_\_\ kN/m^2$; $\varphi = 27°$

II sloj: $\gamma = 22,5\ kN/m^3$; $c = 92\ kN/m^2$; $\varphi = 29°$



$X_T = \frac{3\cdot 1,55 + 3\cdot 3,05 + 2\cdot 4,6}{11} = 2,091\ m$

$Y_T = \frac{4\cdot 1,5 + 3\cdot 3,0}{11} = 1,3636\ m$

U odnosu na XOy:

$e_x = 2,3 - 2,091 = 0,209$

$e_y = 1,5 - 1,3636 = 0,1364\ m$

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$M_x^N = N \cdot e_y = 2390 \cdot 0{,}136 = 325{,}196$ kNm

$M_y^N = N \cdot e_x = 2390 \cdot 0{,}203 = 499{,}51$ kNm

* Koordinate položaja šipova u odnosu na težište šipova

$x_{1-1} = -2{,}091$m $\quad y_{A-A} = 1{,}6364$m

$x_{2-2} = -0{,}541$m $\quad y_{B-B} = 0{,}1364$m

$x_{3-3} = 0{,}959$m $\quad y_{C-C} = -1{,}3636$m

$x_{4-4} = 2{,}509$m

$\sum x_i^2 = 3 \cdot 2{,}091^2 + 3 \cdot 0{,}541^2 + 3 \cdot 0{,}541^2 + 3 \cdot 0{,}959^2 + 2 \cdot 2{,}509^2 = 23{,}344 m^2$

$\sum y_i^2 = 3 \cdot 1{,}6364^2 + 4 \cdot 0{,}1364^2 + 4 \cdot 1{,}3636^2 = 15{,}55 m^2$

* Proračun sila u šipovima

$$S_i = \frac{\sum V}{n} \pm \frac{\sum M_y}{\sum x_i^2} \cdot x_{max} \pm \frac{\sum M_x}{\sum y_i^2} \cdot y_{max}$$

$\sum V = N + G_t = 2390 + 20 \cdot 4 \cdot 5{,}6 \cdot (0{,}8 + 0{,}3) = 2882{,}8$ kN

$\sum M_x = -V_x + H_y \cdot h_t - N \cdot e_y = -272 + 56 \cdot 0{,}8 - 2390 \cdot 0{,}136 = -313{,}136$ kNm

$\sum M_y = -V_y - H_x \cdot h_t + N \cdot e_x = -343 - 24 \cdot 0{,}8 + 2390 \cdot 0{,}203 = 80{,}31$ kNm

Šip A3

$$S_{A-3} = \frac{2882{,}8}{11} + \frac{80{,}31}{23{,}344} \cdot 0{,}959 + \frac{313{,}136}{15{,}55} \cdot 1{,}6364 = 323{,}207$$

Šip B4

$$S_{B-4} = \frac{2882{,}8}{11} + \frac{80{,}31}{23{,}344} \cdot 2{,}509 + \frac{313{,}136}{15{,}55} \cdot 0{,}1364 = 274{,}561$$

- Horizontalne sile

$$S_H = \frac{\sqrt{84^2+56^2}}{11} = 9.178\,kN < 20\,kN$$

$S_{\check{s}.dosv} = Q \cdot A_g + P \cdot A_P$

$Q = \gamma \cdot r \cdot N_{\gamma R} + \sigma_D \cdot K_S \cdot N_{qR} + C_m \cdot N_{cR}$

$\gamma = \gamma_{II} = 22,5\ kN/m^3$; $r = \frac{d_{\check{s}}}{2} = \frac{30}{2} = 15\,cm$

$\sigma_D = \gamma_1 \cdot h_1 + \gamma_2 \cdot h_2 = 19 \cdot 4 + 22,5 \cdot h_2$

$tg\,\varphi_m = \frac{tg\,\varphi_2}{1,5} = \frac{tg\,29}{1,5} \Rightarrow \varphi_m = 20° \Rightarrow$

$N_{cR} = 75$
$N_{qR} = 12$
$N_{\gamma R} = 4$

$K_{S2} = 1 - \sin\varphi_m = 0,66$

$Q = 22,5 \cdot 0,15 \cdot 4 + (76 + 22,5 h_2) \cdot 0,66 \cdot 12 + \frac{12}{2,5} \cdot 75$

$Q = 975,42 + 178,2\,h_2$

$A_Q = \frac{0,3^2 \pi}{4} = 0,071\,m^2$

$Q A_Q = (975,42 + 178,2 h_2) \cdot 0,071\,m^2 = 69,255 + 12,652 h_2$

$P A_P = P_1 A_{P1} + P_2 A_{P2}$

$A_{P1} = d_{\check{s}} \cdot \pi \cdot h_3 = 0,3\pi \cdot (0,8 + 0,3 + \frac{4}{2})$

$A_{P2} = d_{\check{s}} \cdot \pi \cdot h_2 = 0,3\pi \cdot h_2 = 0,94 \cdot h_2\,m^2$

- Specifično trenje po omotaču šipa

$P = C_m + \sigma_D \cdot K_S \cdot tg\,\varphi_m$; $C_{m1} = \frac{C_1}{F_s} = \frac{7}{2,5} = 2,8\,kN/m^2$

$P_1 = C_{m1} + \sigma_{D1} \cdot K_S \cdot tg\,\varphi_{m1}$; $\sigma_{D1}\left(1,17 + 4 - \frac{1,1}{2}\right) \cdot 19 = 48,45\,kN/m^2$

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$tg\,\varphi_{m1} = \frac{tg\,\varphi_1}{1.5} = \frac{tg\,27°}{1,5} = 0,34 \Rightarrow \varphi_{m1} = 18°$

$K_{s1} = 1 - \sin\varphi_{m1} = 0,691$

$P_1 = 2,8 + 48,45 \cdot 0,691 \cdot 0,34 = 14,183\ kN/m^2$

$P_1 A_{P1} = 14,83 \cdot 2,92 = 41,41\ kN$

$P_2 = C_{m2} + \sigma_{q2} \cdot K_{s2} \cdot tg\,\varphi_{m2}$; $C_{m2} = \frac{C_2}{F_s} = \frac{12}{2,5} = 4,8$

$\sigma_{0,2} = 4 \cdot \gamma_1 + \frac{h_2}{2} \cdot \gamma_2 = 4 \cdot 19 + \frac{22,5}{2} \cdot h_2 = 76 + 11,25 h_2$

$K_{s2} = 1 - \sin\varphi_{m2} = 0,66$

$tg\,\varphi_m = \frac{tg\,\varphi_2}{1.5} = \frac{tg\,29}{1,5} = 0,37 \Rightarrow \varphi_m = 20°$

$P_2 = 4,8 + (76 + 11,25 h_2) \cdot 0,66 \cdot 0,37 = 23,36 + 2,75 h_2$

$P_2 A_{P2} = (23,36 + 2,75 h_2) \cdot 0,94 h_2 = 21,96 h_2 + 2,58 h_2^2$

$\Sigma A_P = P_1 A_{P1} + P_2 A_{P2} = 41,41 + 21,96 h_2 + 2,58 h_2^2$

$\underbrace{69,255 + 12,652 h_2}_{\Sigma A_Q} + \underbrace{41,41 + 21,96 h_2 + 2,58 h_2^2}_{\Sigma A_P} = 323,207$

$2,58 h^2 + 34,612 h_2 - 212,542 = 0$

$\Rightarrow h_2 = 4,578\ m$

$L\check{s} = 0,5 + h_1 + h_2 = 0,5 + 2,9 + 4,578 = 7,978\ m$

$\Rightarrow \boxed{L\check{s} = 8m}$

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