PRILOGA 1B

# NASLOVNA STRAN NAČRTA
# 2/2 NAČRT GRADBENIH KONSTRUKCIJ

## OSNOVNI PODATKI O GRADNJI

| | |
|---|---|
| naziv gradnje | **UREDITEV KOLESARSKIH POVRŠIN<br>SANACIJA VOZIŠČA NA LC 069 030 MED LITIJO IN POGONIKOM** |
| kratek opis gradnje | **Ureditev kolesarskih površin, delna rekonstrukcija vozišča (deloma se cesta širi in dogradi kolesarske pasove v obe smeri, deloma se cesta samo rekonstruira in opremi z označbami za souporabo vozišča, deloma se jo samo opremi z označbami za souporabo vozišča.** |

*Seznam objektov, ureditev površin in komunalnih naprav z navedbo vrste gradnje.*

| | | |
|---|---|---|
| vrste gradnje | ☐ | **novogradnja - novozgrajen objekt** |
| *Označiti vse ustrezne vrste gradnje* | ☐ | **novogradnja - prizidava** |
| | ☑ | **rekonstrukcija** |
| | ☐ | **sprememba namembnosti** |
| | ☐ | **odstranitev** |

## DOKUMENTACIJA

| | |
|---|---|
| vrsta dokumentacije<br>*(IZP, DGD, PZI, PID)* | **PZI** |
| številka projekta | **51/19** |
| ☐ | **sprememba dokumentacije** |

## PODATKI O NAČRTU

| | |
|---|---|
| strokovno področje načrta | **2/2 NAČRT GRADBENIH KONSTRUKCIJ** |
| številka načrta | **51/19** |
| datum izdelave | **november 2019** |

## PODATKI O IZDELOVALCU NAČRTA

| | |
|---|---|
| ime in priimek pooblaščenega arhitekta, pooblaščenega inženirja | **Jože Poglajen, univ.dipl.inž.gr.** |
| identifikacijska številka | **IZS G 1091** |
| podpis pooblaščenega arhitekta, pooblaščenega inženirja | JOŽE POGLAJEN univ. dipl. inž. grad. IZS G-1091 2 |

## PODATKI O PROJEKTANTU

| | |
|---|---|
| projektant (naziv družbe) | **PINO d.o.o.** |
| naslov | **Ulica Mire Pregljeve 4, 1270 Litija** |
| vodja projekta | **Jože Poglajen, univ.dipl.inž.gr.** |
| identifikacijska številka | **IZS G 1091** |
| podpis vodje projekta | PINO 2 d.o.o. gradbeni inženiring Ul. Mire Pregljeve 4, 1270 Litija |
| odgovorna oseba projektanta | **Jože Poglajen, univ.dipl.inž.gr.** |
| podpis odgovorne osebe projektanta | JOŽE POGLAJEN univ. dipl. inž. grad. IZS G-1091 2 |

# STATIČNI IZRAČUN
# PODPORNIH ZIDOV ZA UREDITEV KOLESARSKIH POVRŠIN, SANACIJA VOZIŠČA NA LC069030 MED LITIJO IN POGONIKOM

Investitor: OBČINA LITIJA
JEREBOVA ULICA 14
1270 LITIJA

Objekt: UREDITEV KOLESARSKIH POVRŠIN, SANACIJA VOZIŠČA NA LC069030 MED LITIJO IN POGONIKOM

Litija, januar 2020

Strokovni sodelavec:
Miha Tomažič, mag.inž.grad.

Pooblaščeni inženir:
Jože Poglajen, univ.dipl.inž.grad.

# *Tehnično poročilo h gradbenim konstrukcijam*

## Zasnova nosilnih konstrukcij

Obravnavani objekti so kamnite zložbe iz kamna v betonu, z AB temeljem in AB steno za ojačitev kamnite zložbe med krajema Podšentjur in Pogonik.

Podporne konstrukcije podpirajo cestno telo pod brežino in zagotavljajo stabilnost terena ter varujejo obstoječo brežino. Debeline temeljev so za posamezno podporno konstrukcijo različne. Za podpornimi zidovi je stena v debelini 30 cm, ki prenaša natezne obremenitve zidu. Na vrhu podpornih zidov je AB kamnita kapa, v katero se pritrdi jekleno varnostno ograjo, kjer je potrebno, obenem pa kapa povezuje celoten podporni zid. Glavno obtežbo na zid predstavljajo mirni zemeljski pritiski in prometna obtežba.

## Uporabljeni predpisi

Izračun je izveden po veljavnih predpisih:

- SIST EN 1990: Osnove projektiranja (2004),
- SIST EN 1991: Vplivi na konstrukcije (2004),
- SIST EN 1992: Projektiranje betonskih konstrukcij (2005),
- SIST EN 1997: Geotehnično projektiranje (2005).

## Uporabljeni nosilni materiali

Armiran beton:

- beton **C25/30**, vodotesen; XC4, XD3, XF4 ($f_{ck}$ *= 2,50 kN/cm²*)
- armaturno jeklo v palicah **RA S500-B** ($f_{yk}$ *= 50,0 kN/cm²*)
- armaturne mreže **MA S500-B** ($f_{yk}$ *= 50,0 kN/cm²*)

## Karakteristike temeljnih tal

Za sestavo temeljnih tal predpostavim naslednje karakteristike:

$\varphi' = 35°$
$c' = 3{,}0\ kN/m^2$
$\gamma_z = 23{,}0\ kN/m^3$
$k = 45.000\ kN/m^3$

**Ob izkopu gradbene jame mora pooblaščeni geomehanik ponovno preveriti nosilnost zemljine in temeljnih tal! Če ugotovi, da so karakteristike zemljine slabše od predpostavljenih, je potrebno temelje objekta na novo dimenzionirati!**

*Statični izračun*

# 1 PODPORNI ZID NA STACIONAŽI P2000, H = 4,00 m

## 1.1 Zasnova

Zasnova je prikazana v grafičnem izpisu iz programa, in sicer pod poglavji:

- Geotehnical Model (Geotehnični model)
- Loads (Obtežbe)
- Soil Model (Prečni profil)

## 1.2 Materiali

| | | |
|---|---|---|
| *Beton* | *C 25/30* | |
| $f_{ck}$ | *2,50* | $kN/cm^2$ |
| $f_{ctk,\ 0,05}$ | *0,18* | $kN/cm^2$ |
| *E* | *3100* | $kN/cm^2$ |
| $\rho_{mean}$ | *25,0* | $kN/m^3$ |
| *Rebrasta armatura (RA)* | *S500-B* | |
| $f_{yk}$ | *50,0* | $kN/cm^2$ |
| *E* | *20000* | $kN/cm^2$ |

Karakteristike tal so navedene v izpisih iz programa, v poglavjih Geotehnical model.

## 1.3 Izračun

### 1.3.1 Stabilnost in nosilnost

Varnosti morajo biti večje od $F_{req} = 1,00$, saj so v rezultatih že upoštevani varnostni faktorji:

| **Podporni zid** | prevrnitev | zdrs | nosilnost |
|---|---|---|---|
| H = 4,00 m | $F_{ex}$ = 8,86 | $F_{ex}$ = 1,56 | $F_{ex}$ = 1,00 |

Največji dovoljeni zasuk znaša $\beta_{max} = 2,00$ ‰. Dejanski zasuki znašajo:

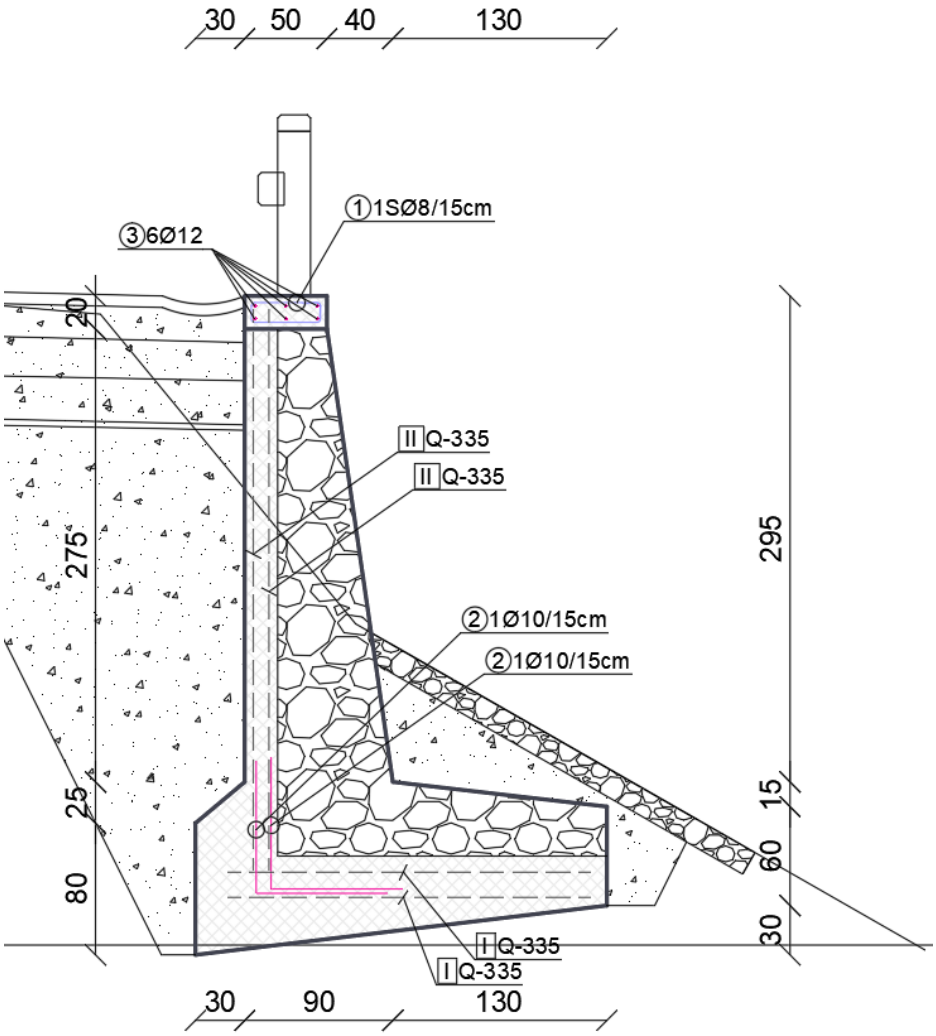
| **Podporni zid** | zasuk |
|---|---|
| H = 4,00 m | $\beta_{ex}$ = 0,17 ‰ |

### 1.3.2 Armatura

Notranje obremenitve, ki narekujejo armaturo (upogibni momenti, strižne sile in osne sile) so podane s standardnimi oznakami v izpisu iz programa (Limit values): Bending moments, Shear forces in Normal forces ter diagramu Limit state values. Glavna armatura je navedena v naslednji preglednici (računski odmiki armature od roba betona znašajo *a = 5,0 cm*).

| | | |
|---|---|---|
| *Stena – zadaj, spodaj:* | | |
| *$A_{s,\,max}$ (RA S500)* | *0,38* | *$cm^2/m$* |
| *Temelj – spodaj:* | | |
| *$A_{s,\,bot}$ (RA S500)* | *1,18* | *$cm^2/m$* |
| *Temelj – zgoraj:* | | |
| *$A_{s,\,top}$ (RA S500)* | *0,10* | *$cm^2/m$* |

### 1.3.3 Prečni prerez podpornega zidu (H = 4,00 m)



# 2 PODPORNI ZID NA STACIONAŽI P2350, H = 4,70 m

## 2.1 Zasnova

Zasnova je prikazana v grafičnem izpisu iz programa, in sicer pod poglavji:

- Geotehnical Model (Geotehnični model)
- Loads (Obtežbe)
- Soil Model (Prečni profil)

## 2.2 Materiali

| | | |
|---|---|---|
| *Beton* | *C 25/30* | |
| $f_{ck}$ | *2,50* | *kN/cm²* |
| $f_{ctk,\ 0,05}$ | *0,18* | *kN/cm²* |
| *E* | *3100* | *kN/cm²* |
| $\rho_{mean}$ | *25,0* | *kN/m³* |
| *Rebrasta armatura (RA)* | *S500-B* | |
| $f_{yk}$ | *50,0* | *kN/cm²* |
| *E* | *20000* | *kN/cm²* |

Karakteristike tal so navedene v izpisih iz programa, v poglavjih Geotehnical model.

## 2.3 Izračun

### 2.3.1 Stabilnost in nosilnost

Varnosti morajo biti večje od $F_{req} = 1,00$, saj so v rezultatih že upoštevani varnostni faktorji:

| **Podporni zid** | prevrnitev | zdrs | nosilnost |
|---|---|---|---|
| H = 4,70 m | $F_{ex}$ = 11,21 | $F_{ex}$ = 1,59 | $F_{ex}$ = 1,06 |

Največji dovoljeni zasuk znaša $\beta_{max} = 2,00$ ‰. Dejanski zasuki znašajo:

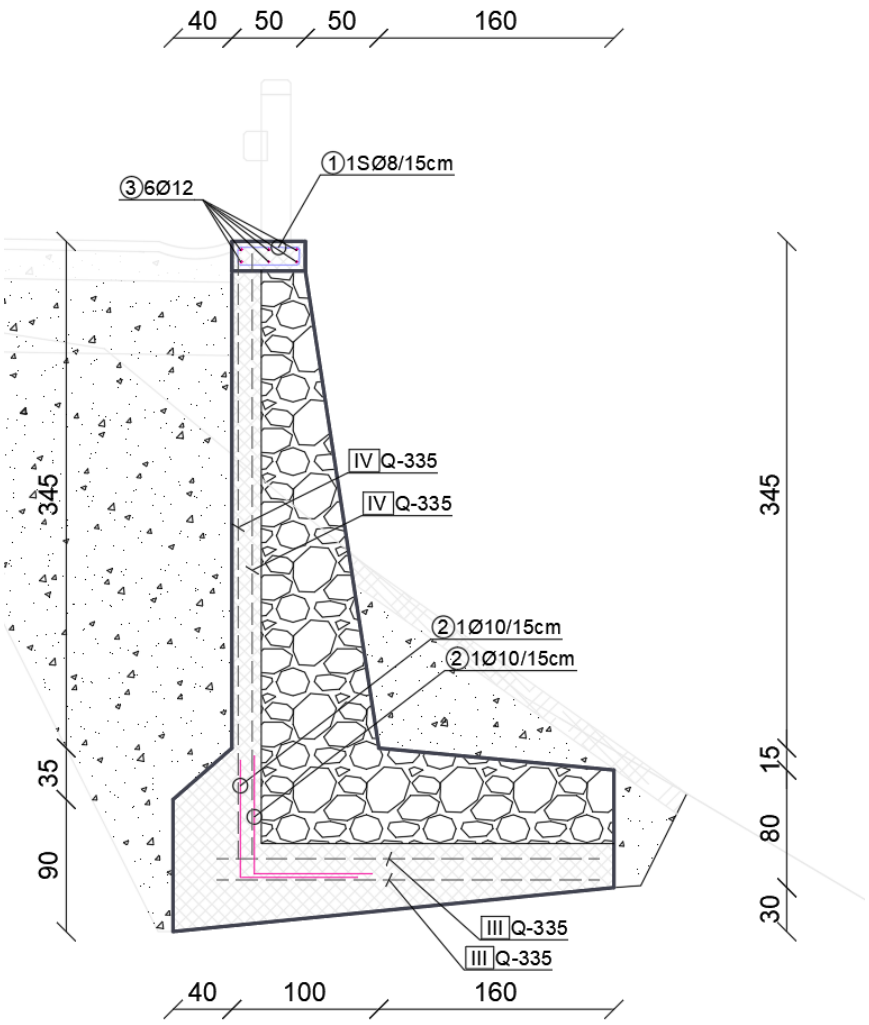
| **Podporni zid** | zasuk |
|---|---|
| H = 4,70 m | $\beta_{ex}$ = 0,18 ‰ |

### 2.3.2 Armatura

Notranje obremenitve, ki narekujejo armaturo (upogibni momenti, strižne sile in osne sile) so podane s standardnimi oznakami v izpisu iz programa (Limit values): Bending moments, Shear forces in Normal forces ter diagramu Limit state values. Glavna armatura je navedena v naslednji preglednici (računski odmiki armature od roba betona znašajo *a = 5,0 cm*).

| | | |
|---|---|---|
| *Stena – zadaj, spodaj:* | | |
| $A_{s,\,max}$ *(RA S500)* | *0,55* | *cm²/m* |
| *Temelj – spodaj:* | | |
| $A_{s,\,bot}$ *(RA S500)* | *1,52* | *cm²/m* |
| *Temelj – zgoraj:* | | |
| $A_{s,\,top}$ *(RA S500)* | *0,16* | *cm²/m* |

### 2.3.3 Prečni prerez podpornega zidu (H = 4,70 m)



# 3 PODPORNI ZID NA STACIONAŽI P2875, H = 3,40 m

## 3.1 Zasnova

Zasnova je prikazana v grafičnem izpisu iz programa, in sicer pod poglavji:

- Geotehnical Model (Geotehnični model)
- Loads (Obtežbe)
- Soil Model (Prečni profil)

## 3.2 Materiali

| | | |
|---|---|---|
| *Beton* | *C 25/30* | |
| $f_{ck}$ | *2,50* | $kN/cm^2$ |
| $f_{ctk,\ 0,05}$ | *0,18* | $kN/cm^2$ |
| *E* | *3100* | $kN/cm^2$ |
| $\rho_{mean}$ | *25,0* | $kN/m^3$ |
| *Rebrasta armatura (RA)* | *S500-B* | |
| $f_{yk}$ | *50,0* | $kN/cm^2$ |
| *E* | *20000* | $kN/cm^2$ |

Karakteristike tal so navedene v izpisih iz programa, v poglavjih Geotehnical model.

## 3.3 Izračun

### 3.3.1 Stabilnost in nosilnost

Varnosti morajo biti večje od $F_{req} = 1,00$, saj so v rezultatih že upoštevani varnostni faktorji:

| **Podporni zid** | prevrnitev | zdrs | nosilnost |
|---|---|---|---|
| H = 3,40 m | $F_{ex}$ = 2,88 | $F_{ex}$ = 1,90 | $F_{ex}$ = 1,00 |

Največji dovoljeni zasuk znaša $\beta_{max} = 2,00$ ‰. Dejanski zasuki znašajo:

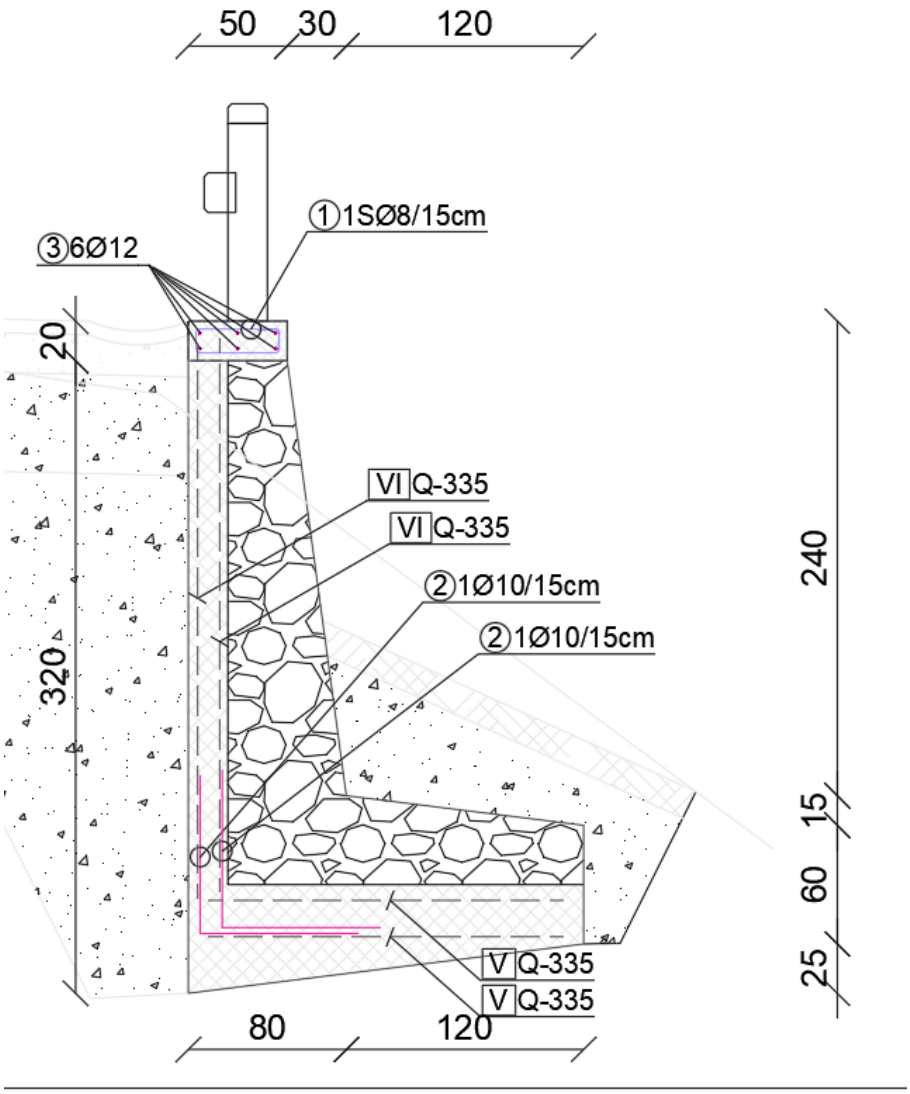
| **Podporni zid** | zasuk |
|---|---|
| H = 3,40 m | $\beta_{ex}$ = 0,49 ‰ |

### 3.3.2 Armatura

Notranje obremenitve, ki narekujejo armaturo (upogibni momenti, strižne sile in osne sile) so podane s standardnimi oznakami v izpisu iz programa (Limit values): Bending moments, Shear forces in Normal forces ter diagramu Limit state values. Glavna armatura je navedena v naslednji preglednici (računski odmiki armature od roba betona znašajo *a = 5,0 cm*).

| | | |
|---|---|---|
| *Stena – zadaj, spodaj:* | | |
| *$A_{s,\,max}$ (RA S500)* | *0,17* | *$cm^2/m$* |
| *Temelj – spodaj:* | | |
| *$A_{s,\,bot}$ (RA S500)* | *0,89* | *$cm^2/m$* |
| *Temelj – zgoraj:* | | |
| *$A_{s,\,top}$ (RA S500)* | *0,00* | *$cm^2/m$* |

### 3.3.3 Prečni prerez podpornega zidu (H = 3,40 m)



# IZPIS IZ PROGRAMA LARIX - STABILNOSTNA ANALIZA

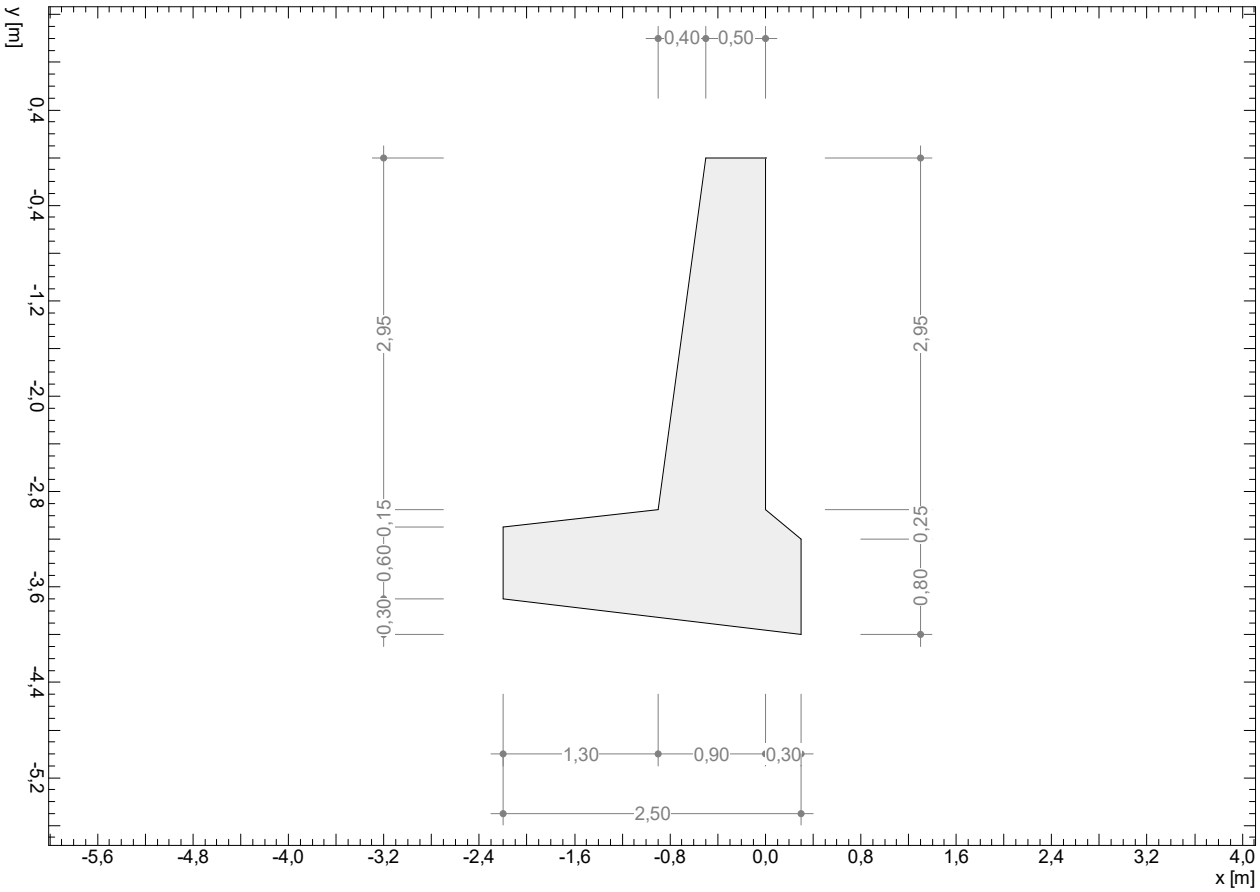
# PODPORNI ZID NA STACIONAŽI P2000 H = 4,00 m

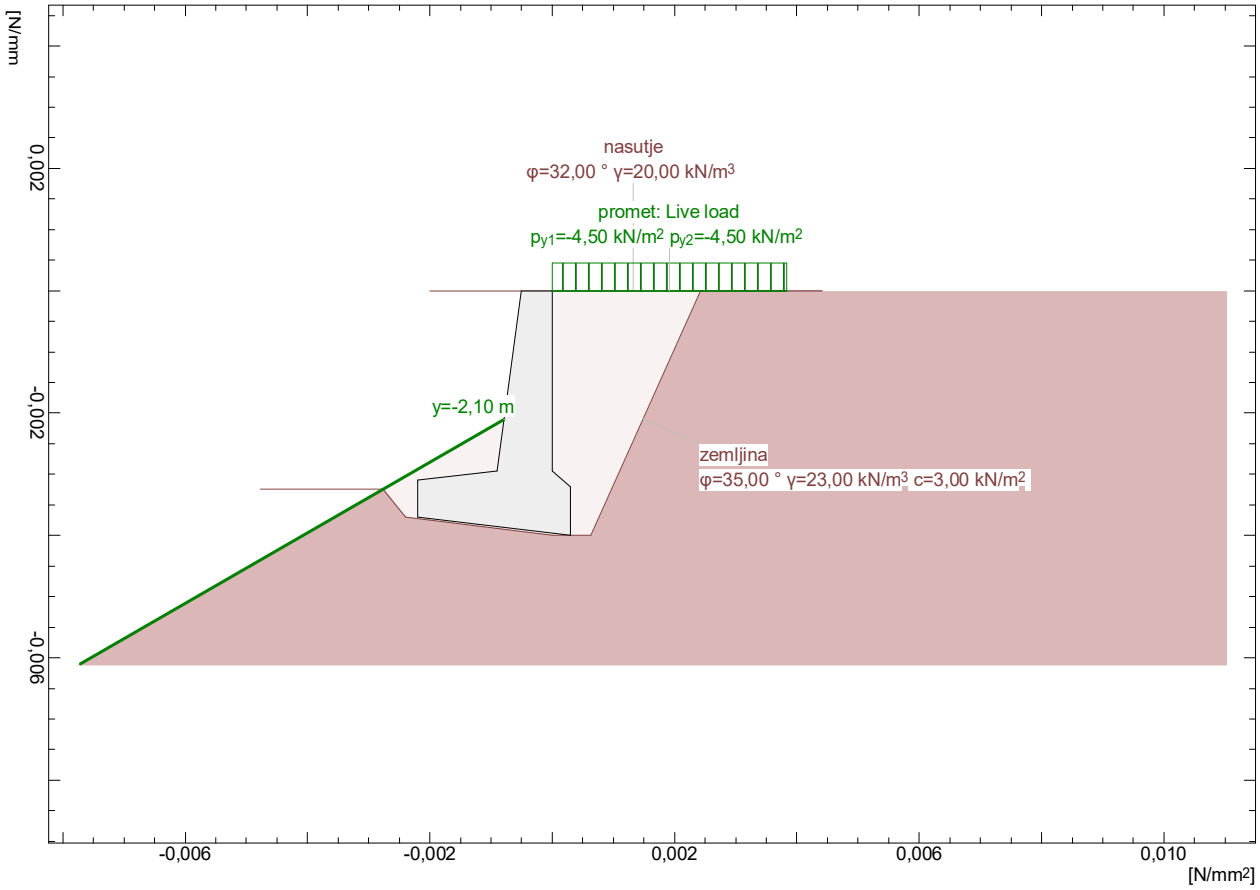
Litija, januar 2020

Strokovni sodelavec:
Miha Tomažič, mag.inž.grad.

Pooblaščeni inženir:
Jože Poglajen, univ.dipl.inž.grad.

soil model




Nr.:

## GEOTECHNICAL MODEL

### Soil layer boundaries

| Description | Parameters | | | Polygon points | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\phi$ [°] | $\gamma$ [kN/m$^3$] | c [kN/m$^2$] | Point | x [m] | y [m] | Point | x [m] | y [m] | |
| nasutje | 32,00 | 20,00 | 0 | 1 | 0 | 0 | 2 | 2,42 | 0 | |
| zemljina | 35,00 | 23,00 | 3,00 | 1 | -2,77 | -3,24 | 2 | -2,40 | -3,70 | |
| | | | | 3 | 0,00 | -4,00 | 4 | 0,63 | -4,00 | |
| | | | | 5 | 2,42 | 0 | | | | |

### Ground surface below wall

| y [m] | dx [m] | $\beta$ [°] | |
|---|---|---|---|
| -2,10 | 0 | 30,00 | |

dx : Horizontal part of berm
$\beta$ : Slope of berm

## LOADS

### Distributed load (ground)

| Description | Action | $x_1$ [m] | $y_1$ [m] | $x_2$ [m] | $y_2$ [m] | $p_1$ [kN/m$^2$] | $p_2$ [kN/m$^2$] | Orientation |
|---|---|---|---|---|---|---|---|---|
| promet | Live load | 0 | 0 | 3,83 | 0 | -4,50 | -4,50 | y |

### Resistance factor (1)

| Name | LS 1 [-] | LS 2 [-] | LS 3 [-] | Serviceability [-] | global [-] |
|---|---|---|---|---|---|
| ME value | | | | 1,00 | 1,00 |
| Shear force in key | | 1,40 | | 1,00 | 1,00 |
| Friction angle $\gamma_{M\phi}$ | | 1,20 | | 1,00 | 1,00 |
| Unit weight $\gamma_{M\gamma}$ | | 1,00 | | 1,00 | 1,00 |
| Cohesion $\gamma_{Mc}$ | | 1,50 | | 1,00 | 1,00 |
| Partial safety factor overturning $\gamma_R$ | 1,00 | | | | 1,50 |
| Partial safety factor sliding $\gamma_R$ | | 1,00 | | | 1,50 |
| Partial safety factor bearing capacity $\gamma_R$ | | 1,00 | | | 2,00 |

### Analysis parameters (1)

| Name | LS 1 | LS 2 | LS 3 | Serviceability | global | |
|---|---|---|---|---|---|---|
| Part due to earth pressure at rest | 0 | 0 | | 1,000 | 0 | - |
| Base rotation | | | | 2,000 | 2,000 | ‰ |
| Minimum earth pressure | 5,000 | 5,000 | | 0 | 0 | kN/m$^2$ |
| Enlargement fact. for section forces $\gamma_L$ | | | | | 1,500 | - |

### Analysis options (1)

| Name | LS 1 | LS 2 | LS 3 | Serviceability | global |
|---|---|---|---|---|---|
| Active wall friction angle | Yes | Yes | | Yes | Yes |

### Actions (1)

| Name | Type | Set | LS Type 1 | | LS Type 2 | | LS Type 3 | | $\psi$-Factors |
|---|---|---|---|---|---|---|---|---|---|
| | | | $\gamma$ [-] | $\gamma$ inf [-] | $\gamma$ [-] | $\gamma$ inf [-] | $\gamma$ [-] | $\gamma$ inf [-] | $\psi$ 0 [-] |
| Dead load | permanent | | 1,10 | 0,90 | 1,35 | 0,80 | 1,00 | 1,00 | |
| Live load | variable | | 1,50 | | 1,50 | | 1,30 | | 0,70 |
| Earth pressure permanent | permanent | | 1,35 | 0,80 | 1,35 | 0,70 | 1,00 | 1,00 | |

LS Type 1 : Limit state type 1
LS Type 2 : Limit state type 2
LS Type 3 : Limit state type 3
$\psi$-Factors : Reduction factors

### Actions (2)

| Name | ψ-Factors ψ 1 [-] | ψ 2 [-] | ψ 1' [-] | u |
|---|---|---|---|---|
| Dead load | | | | Yes |
| Live load | 0,70 | 0,70 | 1,00 | Yes |
| Earth pressure permanent | | | | Yes |

ψ-Factors : Reduction factors
u : Action is used

## CALCULATION OPTIONS

### Earth pressure

| Description | Action | $\delta_A$ | |
|---|---|---|---|
| | Earth pressure permane | 0,667 | |

$\delta_A$ : Wall friction angle as fraction of soil friction angle

### Dead weight of wall

| Description | Action | Unit weight [kN/m³] | |
|---|---|---|---|
| | Dead load | 25,00 | |

### Dimensioning of reinforcement

| aR [mm] | |
|---|---|
| 40,0 | |

aR : Outer edge of concrete to axis of axial reinforcement

### Verifications

| | Analysis method | Cohesion comp. | Shear force in key [kN/m] | |
|---|---|---|---|---|
| Ultimate bearing capacity | Brinch Hansen | with | | |
| Forward sliding | | with | 0 | |
| Overturning | (1) Soft ground (subgrade) | | | |

Shear force in key : Additional resistance in the verification of safety against sliding due to a key
(1) : The safety against overturning is verified via the allowable eccentricity of the resultant force

### Settlements

| ME value [kN/m²] | $f_t$ | $t_{max}$ [m] | |
|---|---|---|---|
| 45000,00 | 3,000 | 20,00 | |

$f_t$ : Depth factor

## LIMIT VALUES

### Safety Factors

| Verification | F ex [-] | F req [-] | β ex [‰] | β max [‰] | Values from |
|---|---|---|---|---|---|
| Overturning | 8,86 | 1,00 | | | !ULS type 1, AC 5 |
| "Forward slidin | 1,56 | 1,00 | | | !ULS type 2, AC 5 |
| "Bearing capaci | 1,00 | 1,00 | | | !ULS type 2, AC 5 |
| Base rotation | | | 0,17 | 2,00 | !SLS occasional, AC 1 |

F ex : Existing safety factor
F req : Required safety factor
β ex : Existing wall rotation
β max : Maximum allowable wall rotation

## Bending moments and corresponding values

*(Compact view)*

| y [m] | Md max Md [kNm/m] | Nd [kN/m] | Vd [kN/m] | LSS,AC | Md min Md [kNm/m] | Nd [kN/m] | Vd [kN/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 2, 1 | **0** | 0 | 0 | 2, 1 |
| -2,95 | **38,37** | -54,60 | -40,93 | 2, 5 | 12,06 | -75,41 | -15,23 | 2, 4 |

LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Shear forces and corresponding values

*(Compact view)*

| y [m] | Vd max Vd [kN/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC | Vd min Vd [kN/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | **0** | 0 | 0 | 2, 1 | 0 | 0 | 0 | 2, 1 |
| -2,95 | -15,23 | -75,41 | 12,06 | 2, 4 | **-40,93** | -54,60 | 38,37 | 2, 5 |

LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Normal forces and corresponding values

*(Compact view)*

| y [m] | Nd max Nd [kN/m] | Vd [kN/m] | Md [kNm/m] | LSS,AC | Nd min Nd [kN/m] | Vd [kN/m] | Md [kNm/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | **0** | 0 | 0 | 2, 1 | 0 | 0 | 0 | 2, 1 |
| -2,95 | -47,08 | -17,15 | 14,63 | 2, 8 | **-82,93** | -39,01 | 35,80 | 2, 1 |

LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Reinforcement on back side of wall

*(Compact view)*

| y [m] | As As,back max As As,back [cm²/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC | As As,back min As As,back [cm²/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | 0,00 | 0 | 0 | 2, 1 | **0,00** | 0 | 0 | 2, 1 |
| -2,95 | **0,38** | -54,60 | 38,37 | 2, 5 | 0,00 | -49,14 | 21,32 | 2, 7 |

LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Reinforcement on front side of wall

*(Compact view)*

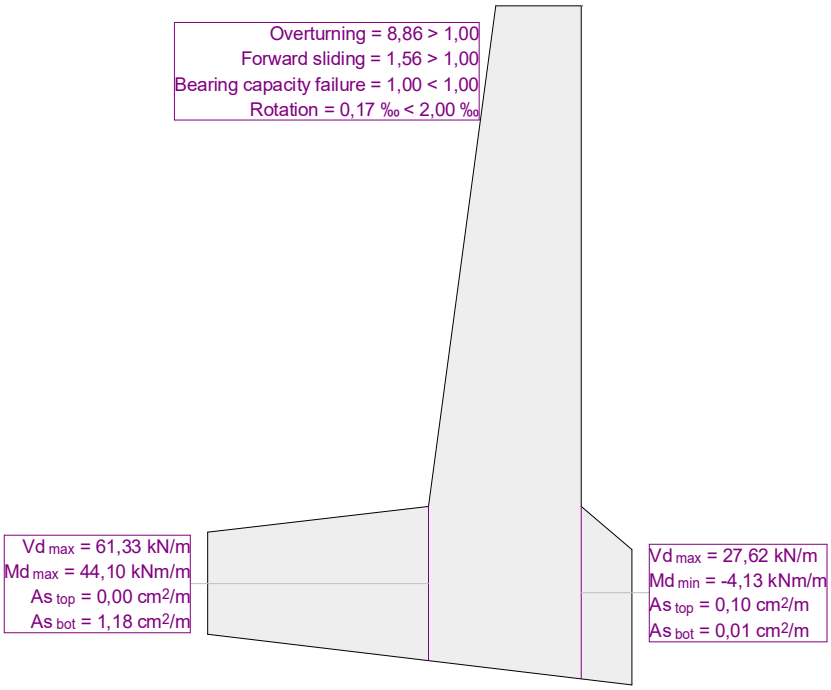
| y [m] | As As,front max As As,front [cm²/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC | As As,front min As As,front [cm²/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | **-0,00** | 0 | 0 | 2, 1 | **-0,00** | 0 | 0 | 2, 1 |

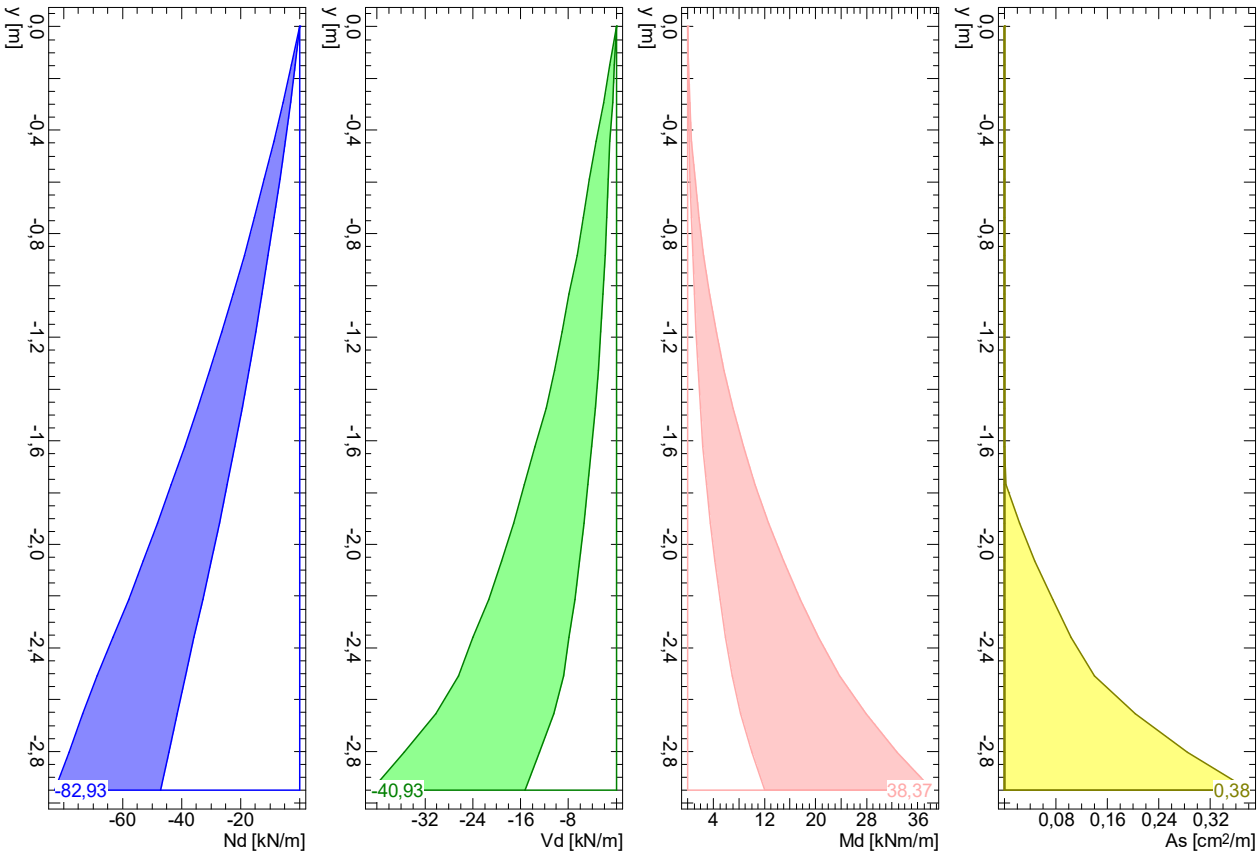
LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Stressing of foundation

| | Breadth [m] | Section forces Vd max [kN/m] | Vd min [kN/m] | Md max [kNm/m] | Md min [kNm/m] | As above [cm²/m] | As below [cm²/m] |
|---|---|---|---|---|---|---|---|
| front side | 1,30 | 61,33 | 27,24 | 44,10 | 20,59 | 0,00 | 1,18 |
| back side | 0,30 | 27,62 | -0,87 | 0,24 | -4,13 | 0,10 | 0,01 |

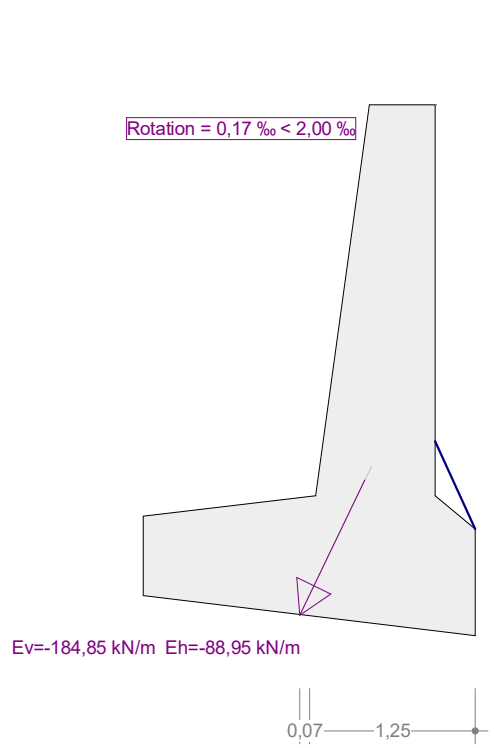
Limit state values

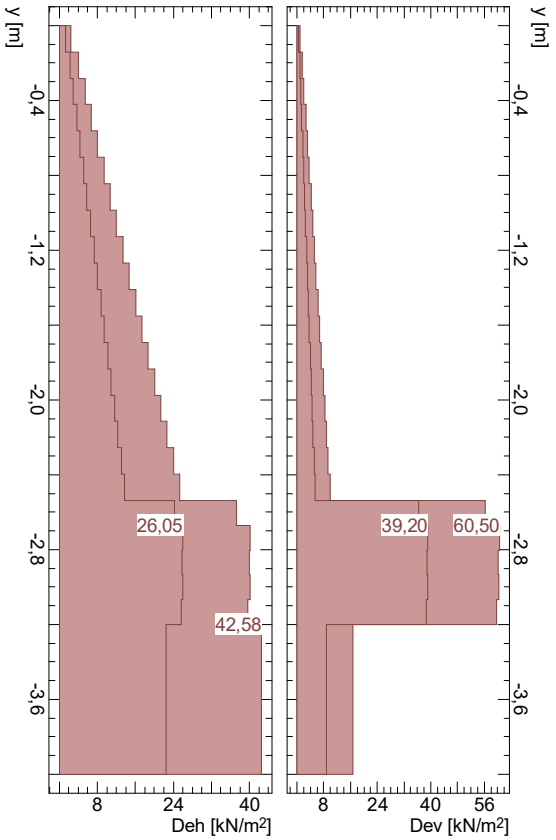


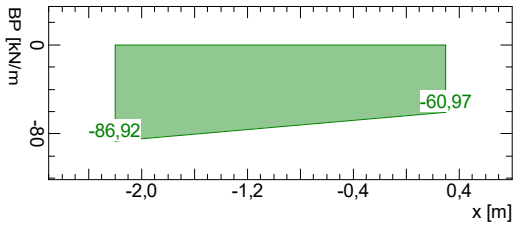



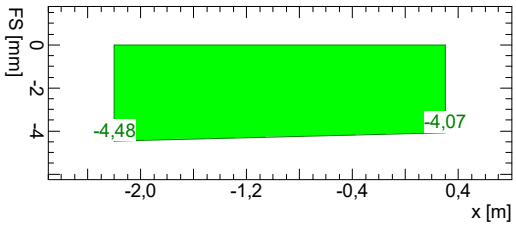

Nr.:

!SLS occasional / AC 1



# IZPIS IZ PROGRAMA LARIX - STABILNOSTNA ANALIZA

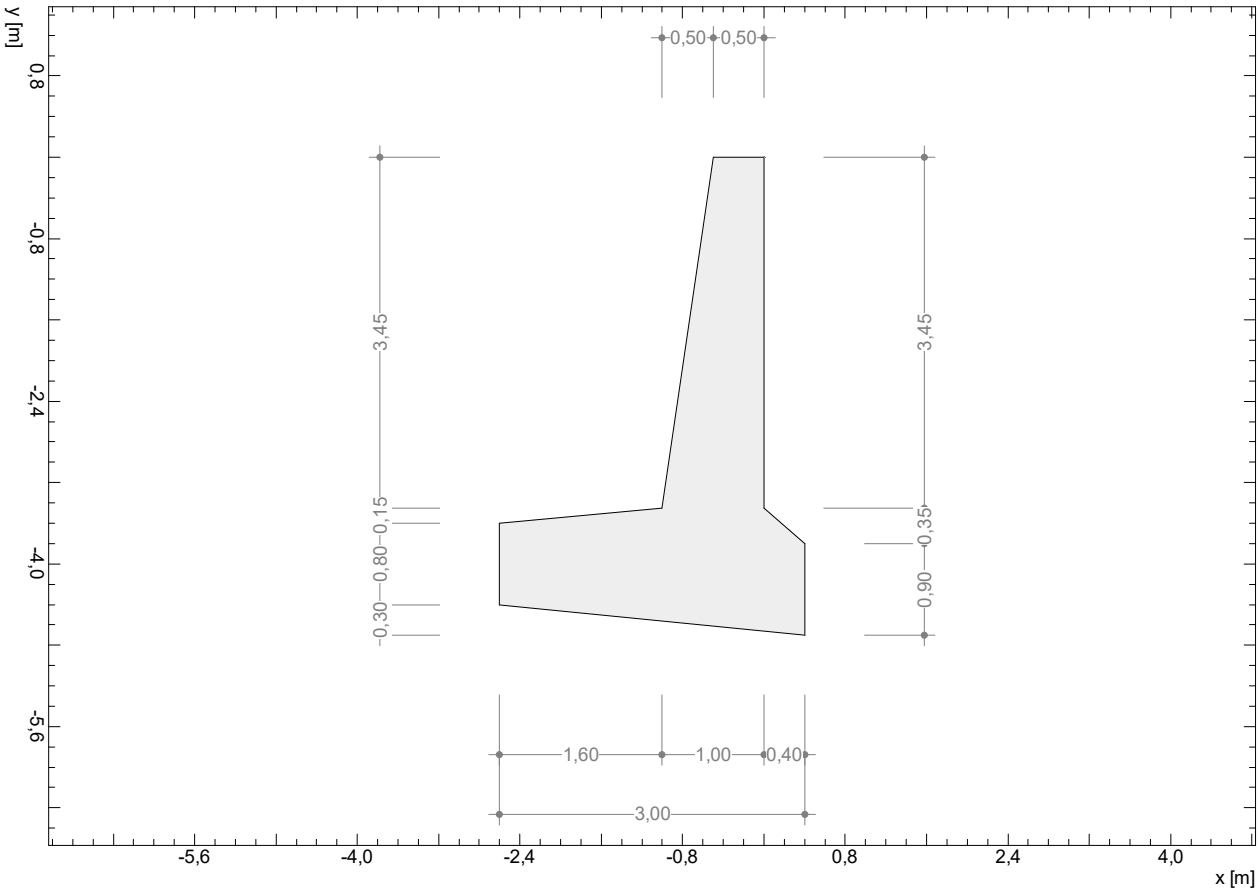
# PODPORNI ZID NA STACIONAŽI P2350 H = 4,70 m

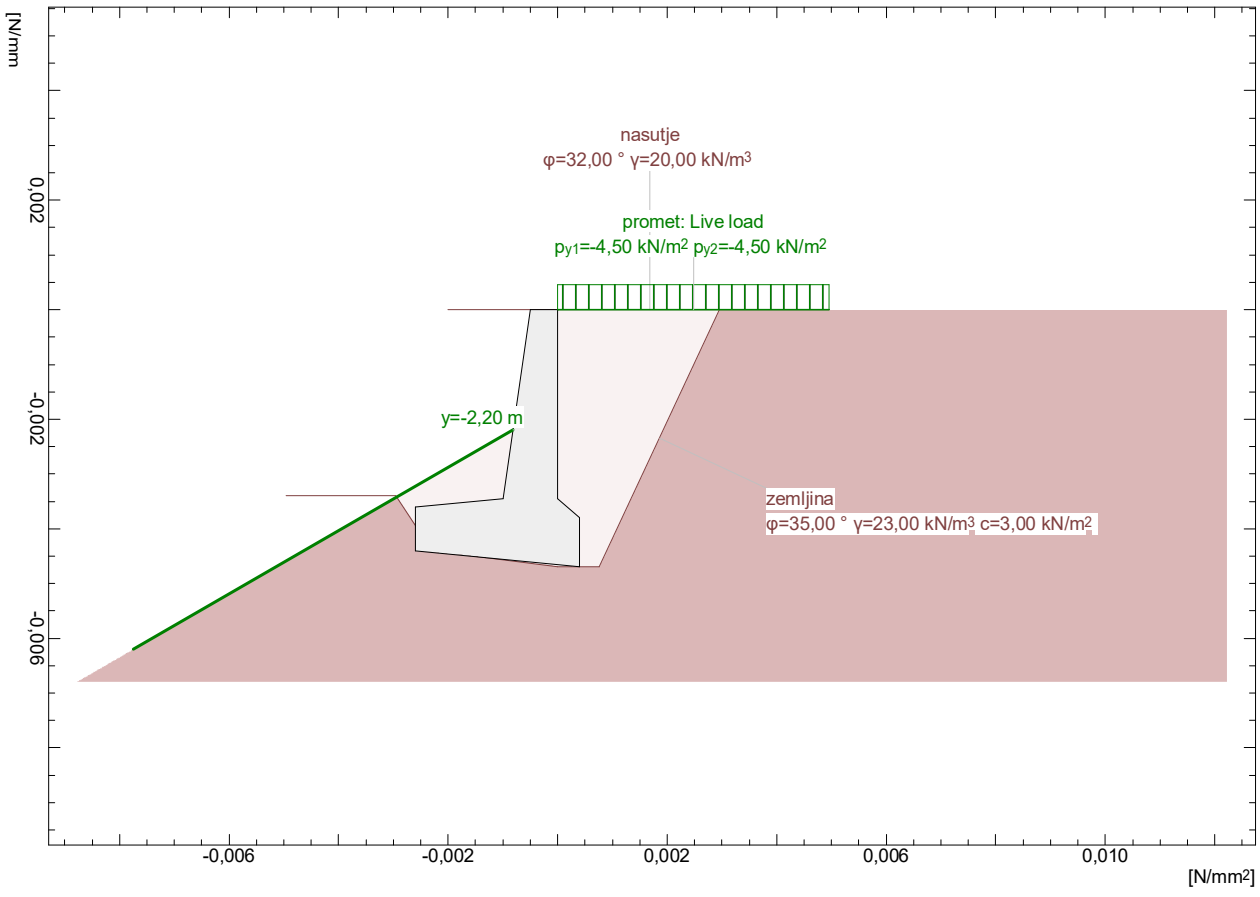
Litija, januar 2020

Strokovni sodelavec:
Miha Tomažič, mag.inž.grad.

Pooblaščeni inženir:
Jože Poglajen, univ.dipl.inž.grad.

soil model




Nr.:

## GEOTECHNICAL MODEL

### Soil layer boundaries

| Description | Parameters | | | Polygon points | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\phi$ [°] | $\gamma$ [kN/m$^3$] | c [kN/m$^2$] | Point | x [m] | y [m] | Point | x [m] | y [m] | |
| nasutje | 32,00 | 20,00 | 0 | 1 | 0 | 0 | 2 | 2,96 | 0 | |
| zemljina | 35,00 | 23,00 | 3,00 | 1 | -2,95 | -3,40 | 2 | -2,30 | -4,40 | |
| | | | | 3 | 0,00 | -4,70 | 4 | 0,75 | -4,70 | |
| | | | | 5 | 2,96 | 0 | | | | |

### Ground surface below wall

| y [m] | dx [m] | $\beta$ [°] | |
|---|---|---|---|
| -2,20 | 0 | 30,00 | |

dx : Horizontal part of berm
$\beta$ : Slope of berm

## LOADS

### Distributed load (ground)

| Description | Action | $x_1$ [m] | $y_1$ [m] | $x_2$ [m] | $y_2$ [m] | $p_1$ [kN/m$^2$] | $p_2$ [kN/m$^2$] | Orientation |
|---|---|---|---|---|---|---|---|---|
| promet | Live load | 0 | 0 | 4,96 | 0 | -4,50 | -4,50 | y |

### Resistance factor (1)

| Name | LS 1 [-] | LS 2 [-] | LS 3 [-] | Serviceability [-] | global [-] |
|---|---|---|---|---|---|
| ME value | | | | 1,00 | 1,00 |
| Shear force in key | | 1,40 | | 1,00 | 1,00 |
| Friction angle $\gamma_{M\phi}$ | | 1,20 | | 1,00 | 1,00 |
| Unit weight $\gamma_{M\gamma}$ | | 1,00 | | 1,00 | 1,00 |
| Cohesion $\gamma_{Mc}$ | | 1,50 | | 1,00 | 1,00 |
| Partial safety factor overturning $\gamma_R$ | 1,00 | | | | 1,50 |
| Partial safety factor sliding $\gamma_R$ | | 1,00 | | | 1,50 |
| Partial safety factor bearing capacity $\gamma_R$ | | 1,00 | | | 2,00 |

### Analysis parameters (1)

| Name | LS 1 | LS 2 | LS 3 | Serviceability | global | |
|---|---|---|---|---|---|---|
| Part due to earth pressure at rest | 0 | 0 | | 1,000 | 0 | - |
| Base rotation | | | | 2,000 | 2,000 | ‰ |
| Minimum earth pressure | 5,000 | 5,000 | | 0 | 0 | kN/m$^2$ |
| Enlargement fact. for section forces $\gamma_L$ | | | | | 1,500 | - |

### Analysis options (1)

| Name | LS 1 | LS 2 | LS 3 | Serviceability | global |
|---|---|---|---|---|---|
| Active wall friction angle | Yes | Yes | | Yes | Yes |

### Actions (1)

| Name | Type | Set | LS Type 1 | | LS Type 2 | | LS Type 3 | | $\psi$-Factors |
|---|---|---|---|---|---|---|---|---|---|
| | | | $\gamma$ [-] | $\gamma$ inf [-] | $\gamma$ [-] | $\gamma$ inf [-] | $\gamma$ [-] | $\gamma$ inf [-] | $\psi$ 0 [-] |
| Dead load | permanent | | 1,10 | 0,90 | 1,35 | 0,80 | 1,00 | 1,00 | |
| Live load | variable | | 1,50 | | 1,50 | | 1,30 | | 0,70 |
| Earth pressure permanent | permanent | | 1,35 | 0,80 | 1,35 | 0,70 | 1,00 | 1,00 | |

LS Type 1 : Limit state type 1
LS Type 2 : Limit state type 2
LS Type 3 : Limit state type 3
$\psi$-Factors : Reduction factors

### Actions (2)

| Name | ψ-Factors ψ 1 [-] | ψ 2 [-] | ψ 1' [-] | u |
|---|---|---|---|---|
| Dead load | | | | Yes |
| Live load | 0,70 | 0,70 | 1,00 | Yes |
| Earth pressure permanent | | | | Yes |

ψ-Factors : Reduction factors
u : Action is used

## CALCULATION OPTIONS

### Earth pressure

| Description | Action | $\delta_A$ | |
|---|---|---|---|
| | Earth pressure permane | 0,667 | |

$\delta_A$ : Wall friction angle as fraction of soil friction angle

### Dead weight of wall

| Description | Action | Unit weight [kN/m³] | |
|---|---|---|---|
| | Dead load | 25,00 | |

### Dimensioning of reinforcement

| aR [mm] | |
|---|---|
| 40,0 | |

aR : Outer edge of concrete to axis of axial reinforcement

### Verifications

| | Analysis method | Cohesion comp. | Shear force in key [kN/m] | |
|---|---|---|---|---|
| Ultimate bearing capacity | Brinch Hansen | with | | |
| Forward sliding | | with | 0 | |
| Overturning | (1) Soft ground (subgrade) | | | |

Shear force in key : Additional resistance in the verification of safety against sliding due to a key
(1) : The safety against overturning is verified via the allowable eccentricity of the resultant force

### Settlements

| ME value [kN/m²] | $f_t$ | $t_{max}$ [m] | |
|---|---|---|---|
| 45000,00 | 3,000 | 20,00 | |

$f_t$ : Depth factor

## LIMIT VALUES

### Safety Factors

| Verification | F ex [-] | F req [-] | β ex [‰] | β max [‰] | Values from |
|---|---|---|---|---|---|
| Overturning | 11,21 | 1,00 | | | !ULS type 1, AC 5 |
| "Forward slidin | 1,59 | 1,00 | | | !ULS type 2, AC 5 |
| "Bearing capaci | 1,06 | 1,00 | | | !ULS type 2, AC 5 |
| Base rotation | | | 0,18 | 2,00 | !SLS occasional, AC 1 |

F ex : Existing safety factor
F req : Required safety factor
β ex : Existing wall rotation
β max : Maximum allowable wall rotation

## Bending moments and corresponding values

*(Compact view)*

| y [m] | Md max Md [kNm/m] | Nd [kN/m] | Vd [kN/m] | LSS,AC | Md min Md [kNm/m] | Nd [kN/m] | Vd [kN/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 2, 1 | **0** | 0 | 0 | 2, 1 |
| -3,45 | **56,89** | -69,02 | -52,29 | 2, 5 | 18,00 | -94,89 | -19,58 | 2, 4 |

LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Shear forces and corresponding values

*(Compact view)*

| y [m] | Vd max Vd [kN/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC | Vd min Vd [kN/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | **0** | 0 | 0 | 2, 1 | 0 | 0 | 0 | 2, 1 |
| -3,45 | -19,58 | -94,89 | 18,00 | 2, 4 | **-52,29** | -69,02 | 56,89 | 2, 5 |

LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Normal forces and corresponding values

*(Compact view)*

| y [m] | Nd max Nd [kN/m] | Vd [kN/m] | Md [kNm/m] | LSS,AC | Nd min Nd [kN/m] | Vd [kN/m] | Md [kNm/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | **0** | 0 | 0 | 2, 1 | 0 | 0 | 0 | 2, 1 |
| -3,45 | -59,41 | -22,15 | 21,95 | 2, 8 | **-104,51** | -49,71 | 52,94 | 2, 1 |

LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Reinforcement on back side of wall

*(Compact view)*

| y [m] | As As,back max As As,back [cm²/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC | As As,back min As As,back [cm²/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | 0,00 | 0 | 0 | 2, 1 | **0,00** | 0 | 0 | 2, 1 |
| -3,45 | **0,55** | -69,02 | 56,89 | 2, 5 | 0,00 | -94,89 | 18,00 | 2, 4 |

LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Reinforcement on front side of wall

*(Compact view)*

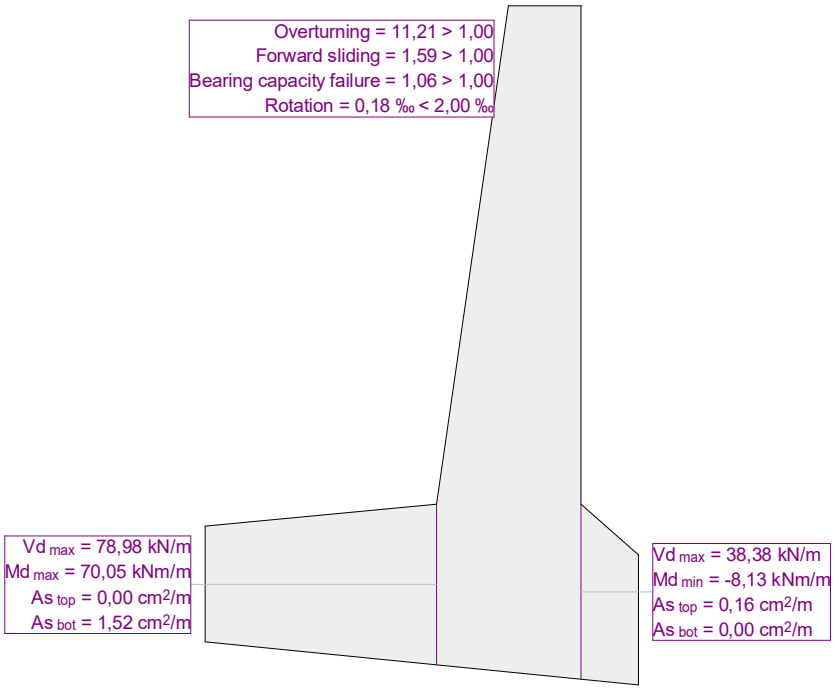
| y [m] | As As,front max As As,front [cm²/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC | As As,front min As As,front [cm²/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | **-0,00** | 0 | 0 | 2, 1 | **-0,00** | 0 | 0 | 2, 1 |

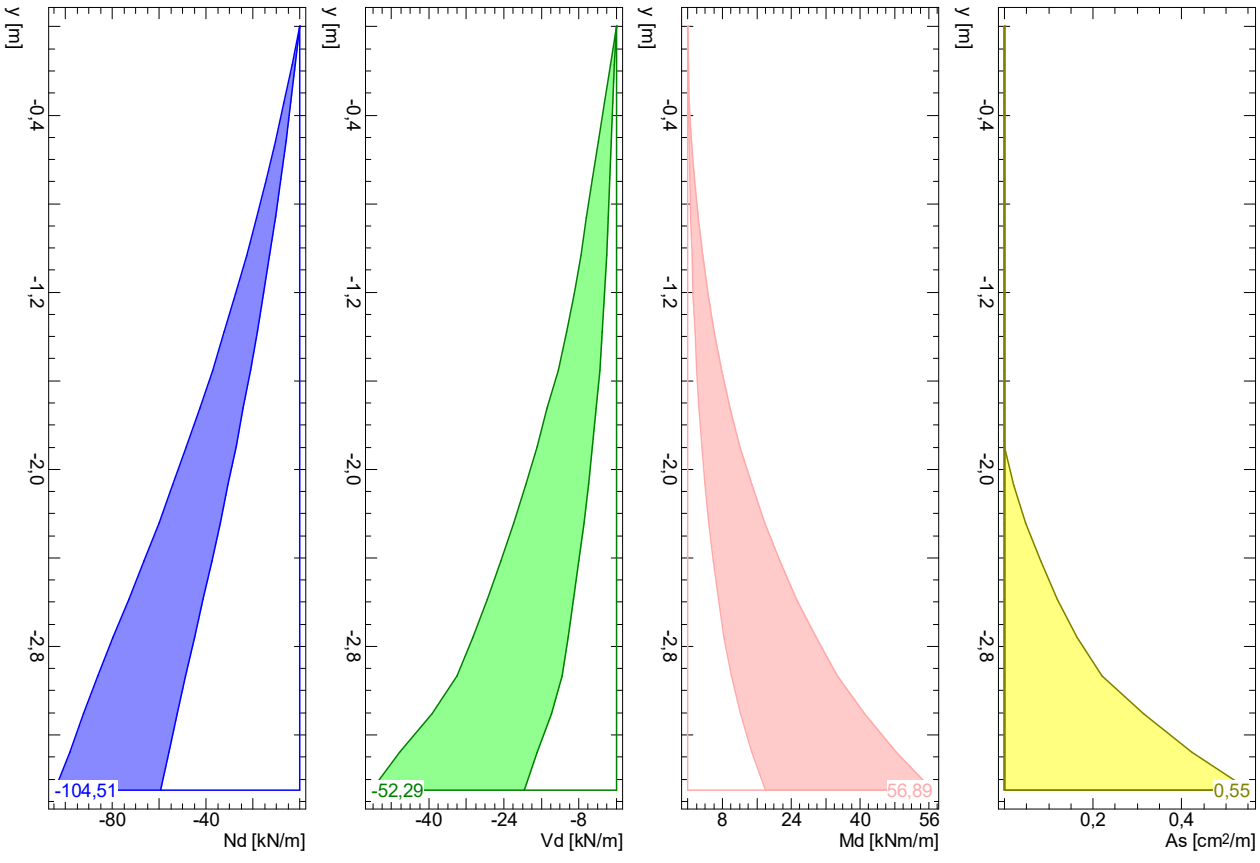
LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Stressing of foundation

| | Breadth [m] | Section forces Vd max [kN/m] | Vd min [kN/m] | Md max [kNm/m] | Md min [kNm/m] | As above [cm²/m] | As below [cm²/m] |
|---|---|---|---|---|---|---|---|
| front side | 1,60 | 78,98 | 34,80 | 70,05 | 33,20 | 0,00 | 1,52 |
| back side | 0,40 | 38,38 | -1,01 | 0,23 | -8,13 | 0,16 | 0,00 |

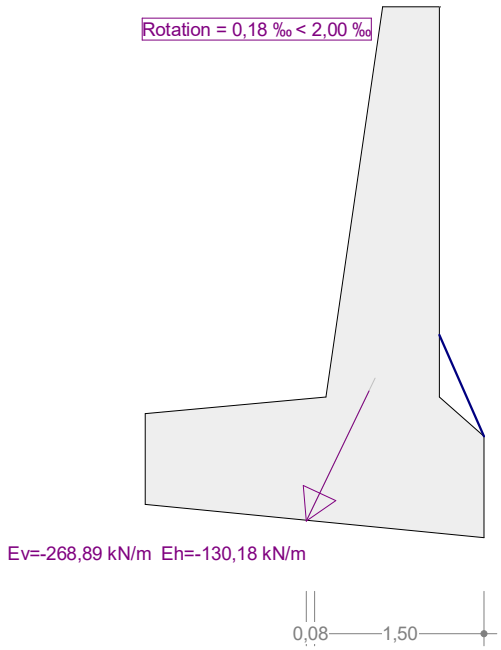
Limit state values

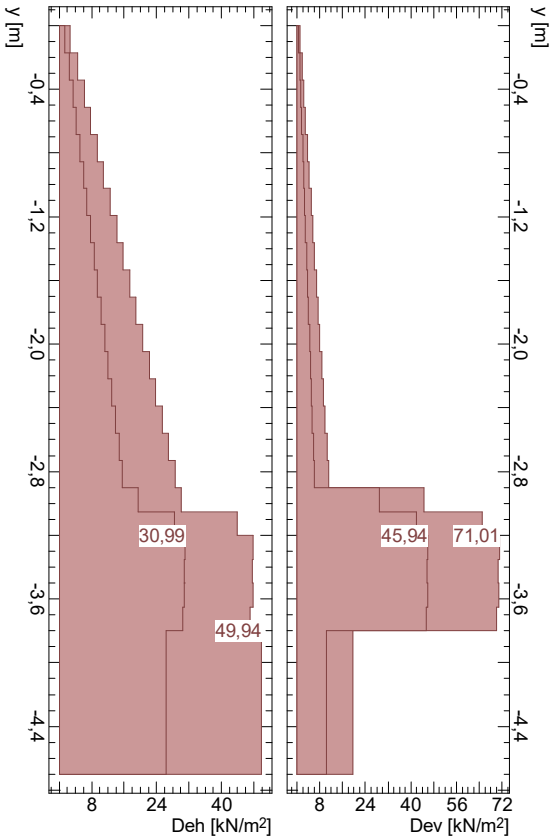


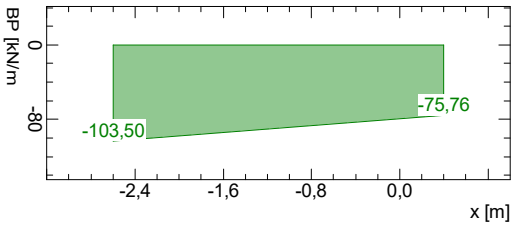



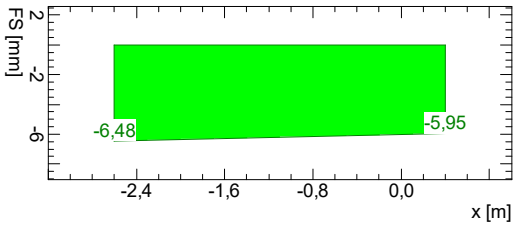

Nr.:

!SLS occasional / AC 1



# IZPIS IZ PROGRAMA LARIX - STABILNOSTNA ANALIZA

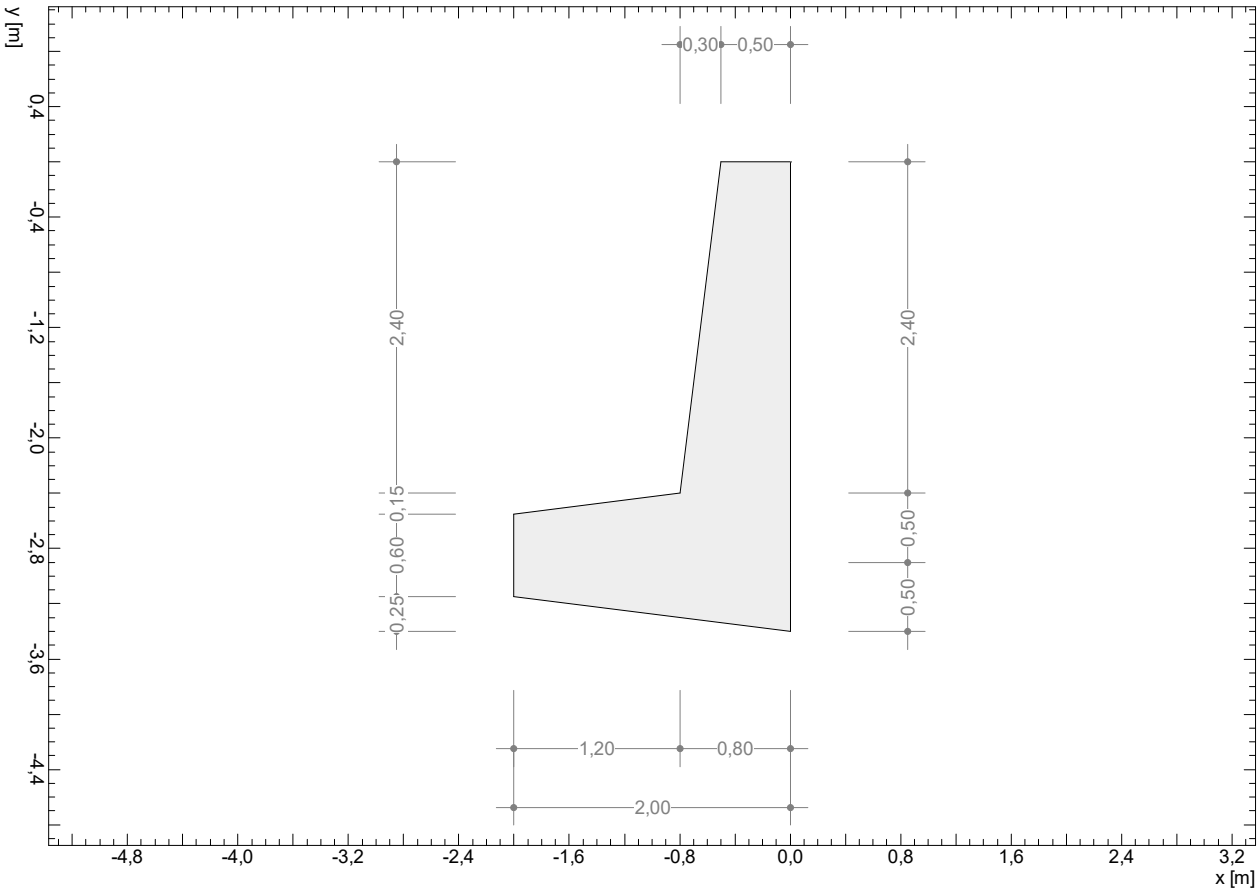
# PODPORNI ZID NA STACIONAŽI P2875 H = 3,40 m

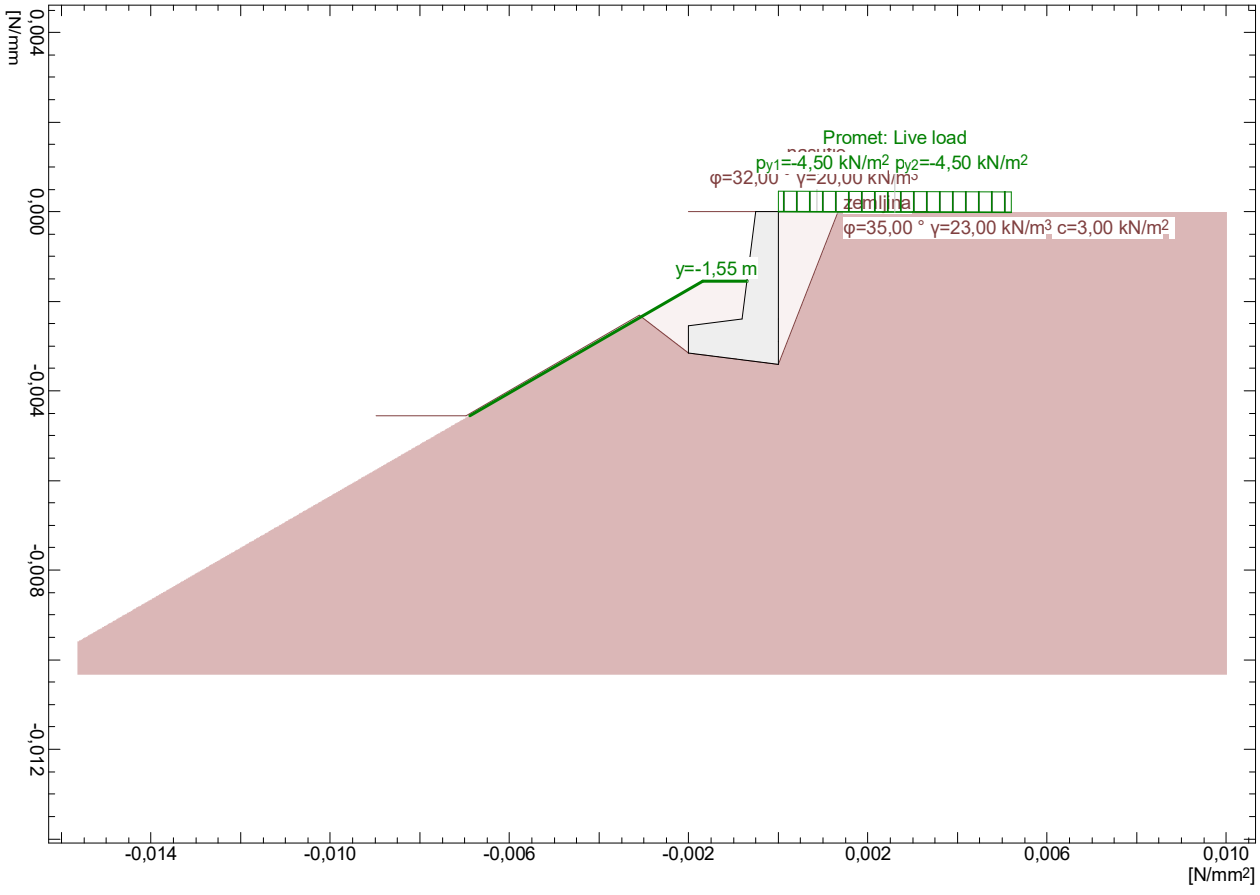
Litija, januar 2020

Strokovni sodelavec:
Miha Tomažič, mag.inž.grad.

Pooblaščeni inženir:
Jože Poglajen, univ.dipl.inž.grad.

soil model




Nr.:

## GEOTECHNICAL MODEL

### Soil layer boundaries

| Description | Parameters | | | Polygon points | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\phi$ [°] | $\gamma$ [kN/m$^3$] | c [kN/m$^2$] | Point | x [m] | y [m] | Point | x [m] | y [m] | |
| nasutje | 32,00 | 20,00 | 0 | 1 | 0 | 0 | 2 | 1,34 | 0 | |
| zemljina | 35,00 | 23,00 | 3,00 | 1 | -6,97 | -4,55 | 2 | -3,11 | -2,32 | |
| | | | | 3 | -2,00 | -3,15 | 4 | 0,00 | -3,40 | |
| | | | | 5 | 1,34 | 0 | | | | |

### Ground surface below wall

| y [m] | dx [m] | $\beta$ [°] | |
|---|---|---|---|
| -1,55 | 1,00 | 30,00 | |

dx : Horizontal part of berm
$\beta$ : Slope of berm

## LOADS

### Distributed load (ground)

| Description | Action | $x_1$ [m] | $y_1$ [m] | $x_2$ [m] | $y_2$ [m] | $p_1$ [kN/m$^2$] | $p_2$ [kN/m$^2$] | Orientation |
|---|---|---|---|---|---|---|---|---|
| Promet | Live load | 0 | 0 | 5,20 | -0,02 | -4,50 | -4,50 | y |

### Resistance factor (1)

| Name | LS 1 [-] | LS 2 [-] | LS 3 [-] | Serviceability [-] | global [-] |
|---|---|---|---|---|---|
| ME value | | | | 1,00 | 1,00 |
| Shear force in key | | 1,40 | | 1,00 | 1,00 |
| Friction angle $\gamma_{M\phi}$ | | 1,20 | | 1,00 | 1,00 |
| Unit weight $\gamma_{M\gamma}$ | | 1,00 | | 1,00 | 1,00 |
| Cohesion $\gamma_{Mc}$ | | 1,50 | | 1,00 | 1,00 |
| Partial safety factor overturning $\gamma_R$ | 1,00 | | | | 1,50 |
| Partial safety factor sliding $\gamma_R$ | | 1,00 | | | 1,50 |
| Partial safety factor bearing capacity $\gamma_R$ | | 1,00 | | | 2,00 |

### Analysis parameters (1)

| Name | LS 1 | LS 2 | LS 3 | Serviceability | global | |
|---|---|---|---|---|---|---|
| Part due to earth pressure at rest | 0 | 0 | | 1,000 | 0 | - |
| Base rotation | | | | 2,000 | 2,000 | ‰ |
| Minimum earth pressure | 5,000 | 5,000 | | 0 | 0 | kN/m$^2$ |
| Enlargement fact. for section forces $\gamma_L$ | | | | | 1,500 | - |

### Analysis options (1)

| Name | LS 1 | LS 2 | LS 3 | Serviceability | global |
|---|---|---|---|---|---|
| Active wall friction angle | Yes | Yes | | Yes | Yes |

### Actions (1)

| Name | Type | Set | LS Type 1 | | LS Type 2 | | LS Type 3 | | $\psi$-Factors |
|---|---|---|---|---|---|---|---|---|---|
| | | | $\gamma$ [-] | $\gamma$ inf [-] | $\gamma$ [-] | $\gamma$ inf [-] | $\gamma$ [-] | $\gamma$ inf [-] | $\psi$ 0 [-] |
| Dead load | permanent | | 1,10 | 0,90 | 1,35 | 0,80 | 1,00 | 1,00 | |
| Live load | variable | | 1,50 | | 1,50 | | 1,30 | | 0,70 |
| Earth pressure permanent | permanent | | 1,35 | 0,80 | 1,35 | 0,70 | 1,00 | 1,00 | |

LS Type 1 : Limit state type 1
LS Type 2 : Limit state type 2
LS Type 3 : Limit state type 3
$\psi$-Factors : Reduction factors

### Actions (2)

| Name | ψ-Factors ψ 1 [-] | ψ 2 [-] | ψ 1' [-] | u |
|---|---|---|---|---|
| Dead load | | | | Yes |
| Live load | 0,70 | 0,70 | 1,00 | Yes |
| Earth pressure permanent | | | | Yes |

ψ-Factors : Reduction factors
u : Action is used

## CALCULATION OPTIONS

### Earth pressure

| Description | Action | $\delta_A$ | |
|---|---|---|---|
| | Earth pressure permane | 0,667 | |

$\delta_A$ : Wall friction angle as fraction of soil friction angle

### Dead weight of wall

| Description | Action | Unit weight [kN/m³] | |
|---|---|---|---|
| | Dead load | 25,00 | |

### Dimensioning of reinforcement

| aR [mm] | |
|---|---|
| 40,0 | |

aR : Outer edge of concrete to axis of axial reinforcement

### Verifications

| | Analysis method | Cohesion comp. | Shear force in key [kN/m] | |
|---|---|---|---|---|
| Ultimate bearing capacity | Brinch Hansen | with | | |
| Forward sliding | | with | 0 | |
| Overturning | (1) Soft ground (subgrade) | | | |

Shear force in key : Additional resistance in the verification of safety against sliding due to a key
(1) : The safety against overturning is verified via the allowable eccentricity of the resultant force

### Settlements

| ME value [kN/m²] | $f_t$ | $t_{max}$ [m] | |
|---|---|---|---|
| 45000,00 | 3,000 | 20,00 | |

$f_t$ : Depth factor

## LIMIT VALUES

### Safety Factors

| Verification | F ex [-] | F req [-] | β ex [‰] | β max [‰] | Values from |
|---|---|---|---|---|---|
| Overturning | 2,88 | 1,00 | | | !ULS type 1, AC 5 |
| "Forward slidin | 1,90 | 1,00 | | | !ULS type 2, AC 5 |
| "Bearing capaci | 1,00 | 1,00 | | | !ULS type 2, AC 5 |
| Base rotation | | | 0,49 | 2,00 | !SLS occasional, AC 1 |

F ex : Existing safety factor
F req : Required safety factor
β ex : Existing wall rotation
β max : Maximum allowable wall rotation

## Bending moments and corresponding values

*(Compact view)*

| y [m] | Md max Md [kNm/m] | Nd [kN/m] | Vd [kN/m] | LSS,AC | Md min Md [kNm/m] | Nd [kN/m] | Vd [kN/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 2, 1 | **0** | 0 | 0 | 2, 1 |
| -2,40 | **22,88** | -43,56 | -27,64 | 2, 5 | 7,17 | -58,03 | -9,99 | 2, 4 |

LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Shear forces and corresponding values

*(Compact view)*

| y [m] | Vd max Vd [kN/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC | Vd min Vd [kN/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | **0** | 0 | 0 | 2, 1 | 0 | 0 | 0 | 2, 1 |
| -2,40 | -9,99 | -58,03 | 7,17 | 2, 4 | **-27,64** | -43,56 | 22,88 | 2, 5 |

LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Normal forces and corresponding values

*(Compact view)*

| y [m] | Nd max Nd [kN/m] | Vd [kN/m] | Md [kNm/m] | LSS,AC | Nd min Nd [kN/m] | Vd [kN/m] | Md [kNm/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | **0** | 0 | 0 | 2, 1 | 0 | 0 | 0 | 2, 1 |
| -2,40 | -36,62 | -11,32 | 8,66 | 2, 8 | **-64,97** | -26,30 | 21,40 | 2, 1 |

LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Reinforcement on back side of wall

*(Compact view)*

| y [m] | As As,back max As As,back [cm²/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC | As As,back min As As,back [cm²/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | 0,00 | 0 | 0 | 2, 1 | **0,00** | 0 | 0 | 2, 1 |
| -2,40 | **0,17** | -43,56 | 22,88 | 2, 5 | 0,00 | -38,47 | 12,84 | 2, 7 |

LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Reinforcement on front side of wall

*(Compact view)*

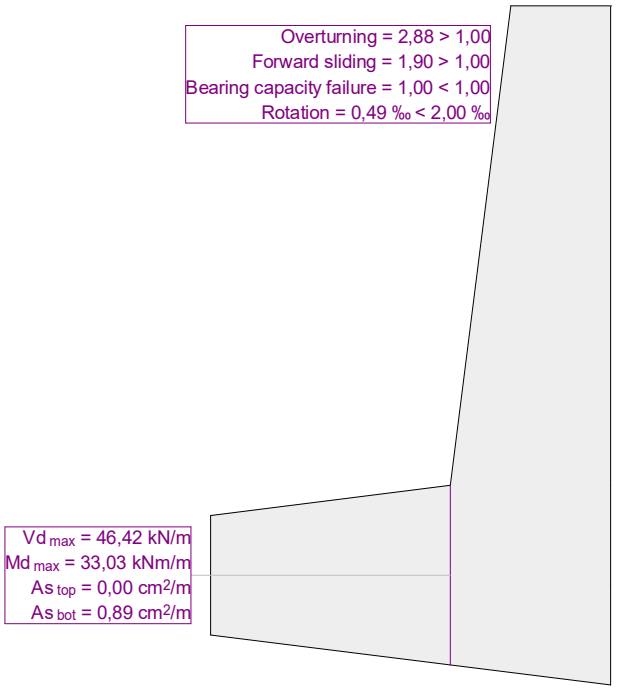
| y [m] | As As,front max As As,front [cm²/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC | As As,front min As As,front [cm²/m] | Nd [kN/m] | Md [kNm/m] | LSS,AC |
|---|---|---|---|---|---|---|---|---|
| 0 | **-0,00** | 0 | 0 | 2, 1 | **-0,00** | 0 | 0 | 2, 1 |

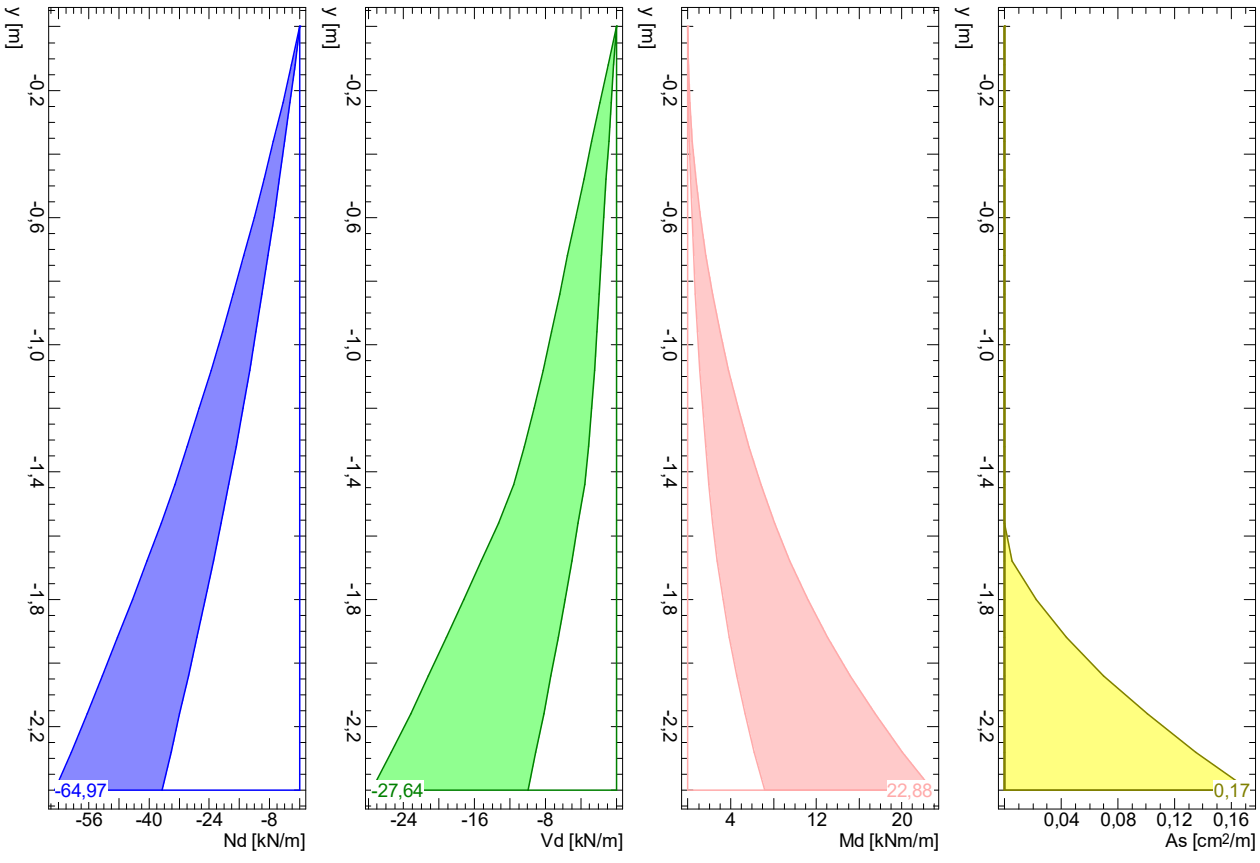
LSS,AC : Limit state specification, Action combination
LSS 1 = !SLS occasional,
LSS 2 = !ULS type 2,
LSS 3 = !ULS type 1

## Stressing of foundation

| | Breadth [m] | Section forces Vd max [kN/m] | Vd min [kN/m] | Md max [kNm/m] | Md min [kNm/m] | As above [cm²/m] | As below [cm²/m] |
|---|---|---|---|---|---|---|---|
| front side | 1,20 | 46,42 | 20,07 | 33,03 | 12,87 | 0,00 | 0,89 |

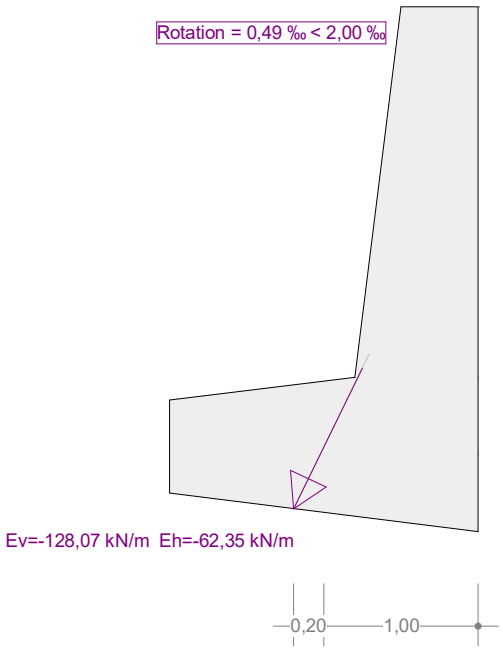
Limit state values

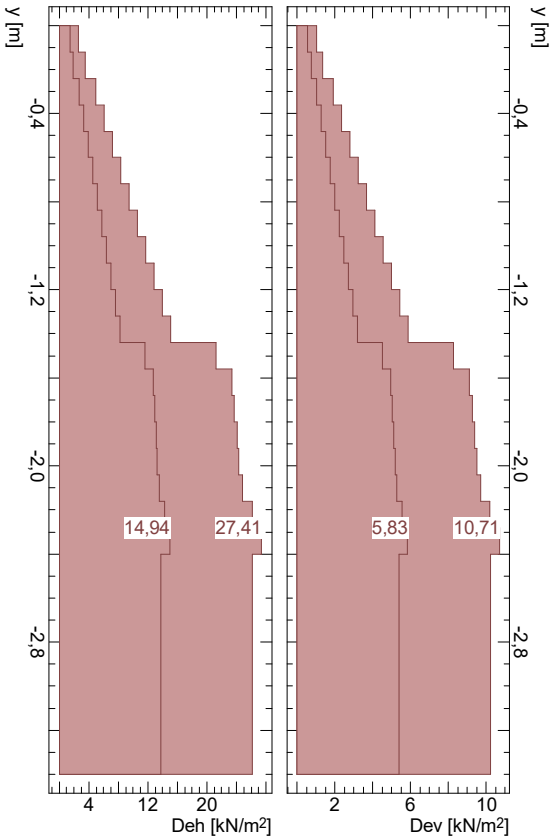


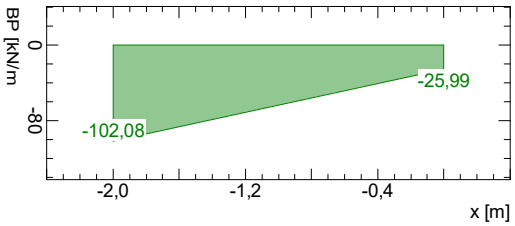



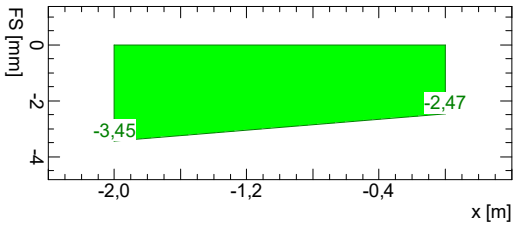

Nr.:

!SLS occasional / AC 1




Nr.: