AC&P inženirski biro d.o.o.
podjetje za geotehniko, infrastrukturo in raziskave
tovarniška c. 26, 5270 ajdovščina | +386(0)5 8500740 | info@acap.si

PRILOGA 1C

NASLOVNA STRAN NAČRTA
Vodilni načrt - Načrt gradbeništva
2.1 Načrt ceste

PODATKI O GRADNJI		
naziv gradnje		**Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023**
kratek opis gradnje		
VRSTE GRADNJE	☐	**NOVOGRADNJA - NOVOZGRAJEN OBJEKT**
označiti vse ustrezne vrste gradnje	☐	**NOVOGRADNJA - PRIZIDAVA**
	☑	**REKONSTRUKCIJA**
	☐	**SPREMEMBA NAMEMBNOSTI**
	☐	**ODSTRANITEV CELOTNEGA OBJEKTA**
	☐	**LEGALIZACIJA**
	☐	**MANJŠA REKONSTRUKCIJA**
PODATKI O PROJEKTNI DOKUMENTACIJI		
vrsta dokumentacije		**PZI**
številka projekta		**077-24**
PODATKI O NAČRTU		
strokovno področje načrta		**Vodilni načrt - Načrt gradbeništva**
naziv načrta		**2.1 Načrt ceste**
številka načrta		**077-24-21**
datum izdelave		**september 2024**
datum spremembe		
PODATKI O PROJEKTANTU NAČRTA		
projektant načrta (naziv družbe)		**AC&P INŽENIRSKI BIRO d.o.o.**
naslov		**Tovarniška cesta 26 5270 Ajdovščina**
odgovorna oseba projektanta načrta		**ANDRAŽ CEKET**
podpis odgovorne osebe projektanta načrta		AC&P inženirski biro Tovarniška c. 26 / 5270 Ajdovščina
PODATKI O IZDELOVALCU NAČRTA		
ime in priimek pooblaščenega arhitekta, pooblaščenega inženirja		**KLEMEN SIMONČIČ**
identifikacijska številka		**G-4829**
podpis pooblaščenega arhitekta, pooblaščenega inženirja		KLEMEN SIMONČIČ mag.inž.grad. IZS PI G-4829

OSNOVNI PODATKI O PROJEKTU

Vodilni načrt - Načrt gradbeništva
2.1 Načrt ceste

INVESTITOR	**Mestna občina Slovenj Gradec** **Šolska ulica 5, 2380 Slovenj Gradec**
OBJEKT	**Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023**
VRSTA PROJEKTNE DOKUMENTACIJE ZA GRADNJO	**PZI** **Rekonstruckija**
PROJEKTANT IN ODGOVORNA OSEBA PROJEKTANTA	AC&P inženirski biro d.o.o. **Tovarniška cesta 26, 5270 Ajdovščina** **ANDRAŽ CEKET** AC&P inženirski biro Tovarniška c. 26 / 5270 Ajdovščina
POOBLAŠČENI INŽENIR	**KLEMEN SIMONČIČ, mag.inž.grad.** **G-4829** KLEMEN SIMONČIČ mag.inž.grad. IZS PI G-4829
VODJA PROJEKTA	**KLEMEN SIMONČIČ, mag.inž.grad.** **G - 4829** KLEMEN SIMONČIČ mag.inž.grad. IZS PI G-4829
ŠTEVILKA PROJEKTA	**077-24**
ŠTEVILKA NAČRTA	**077-24-21**
KRAJ IN DATUM IZDELAVE	**AJDOVŠČINA, september 2024**

KAZALO VSEBINE NAČRTA št. 077-24-21

OSNOVNI PODATKI O PROJEKTU **2**

KAZALO VSEBINE NAČRTA ŠT. 077-24-21 ..... **3**

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S.5.1 IZJAVA PROJEKTANTA IN VODJE PROJEKTA

PRILOGA 2B

IZJAVA PROJEKTANTA IN VODJE PROJEKTA

PROJEKTANT	
projektant (naziv družbe)	**AC&P INŽENIRSKI BIRO d.o.o.**
naslov	**Tovarniška cesta 26, 5270 Ajdovščina**
odgovorna oseba projektanta	**ANDRAŽ CEKET**

IN VODJA PROJEKTA	
vodja projekta	**KLEMEN SIMONČIČ, mag.inž.grad.**
identifikacijska številka	**G - 4829**

IZJAVLJAVA

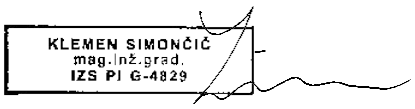
- da je projektna dokumentacija skladna z zahtevami prostorskega izvedbenega akta, gradbenimi in drugimi predpisi, da omogoča kakovostno izvedbo objekta in racionalnost rešitev v času gradnje in vzdrževanja objekta,

- da so izbrane tehnične rešitve, ki niso v nasprotju z zakonom, ki ureja graditev, drugimi predpisi, tehničnimi smernicami in pravili stroke,

- da so s projektno dokumentacijo izpolnjene bistvene in druge zahteve,

- da so bili pri izdelavi projektne dokumentacije vključeni vsi ustrezni pooblaščeni arhitekti, pooblaščeni inženirji ter drugi strokovnjaki, katerih strokovne rešitve so potrebne glede na glede na namen, vrsto, velikost, zmogljivost, predvidene vplive in druge značilnosti objekta tako, da je ta izdelana celovito in medsebojno usklajena.

vodja projekta	**KLEMEN SIMONČIČ, mag.inž.grad.**
identifikacijska številka	**G - 4829**
podpis vodje projekta	



odgovorna oseba projektanta	**ANDRAŽ CEKET, univ.dipl.inž.grad.**
podpis odgovorne osebe projektanta	



TEHNIČNI DEL

T.1 TEHNIČNI OPISI IN IZRAČUNI

T.1.1 SPLOŠNO

Na osnovi naročila naročnika Mestna občina Slovenj Gradec, smo za potrebe projekta Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023. Za zagotovitev stabilnosti ceste so predvidene podporne konstrukcije, predvidena pa je tudi ureditev celotnega odvodnjevanja vzdolž trase ceste.

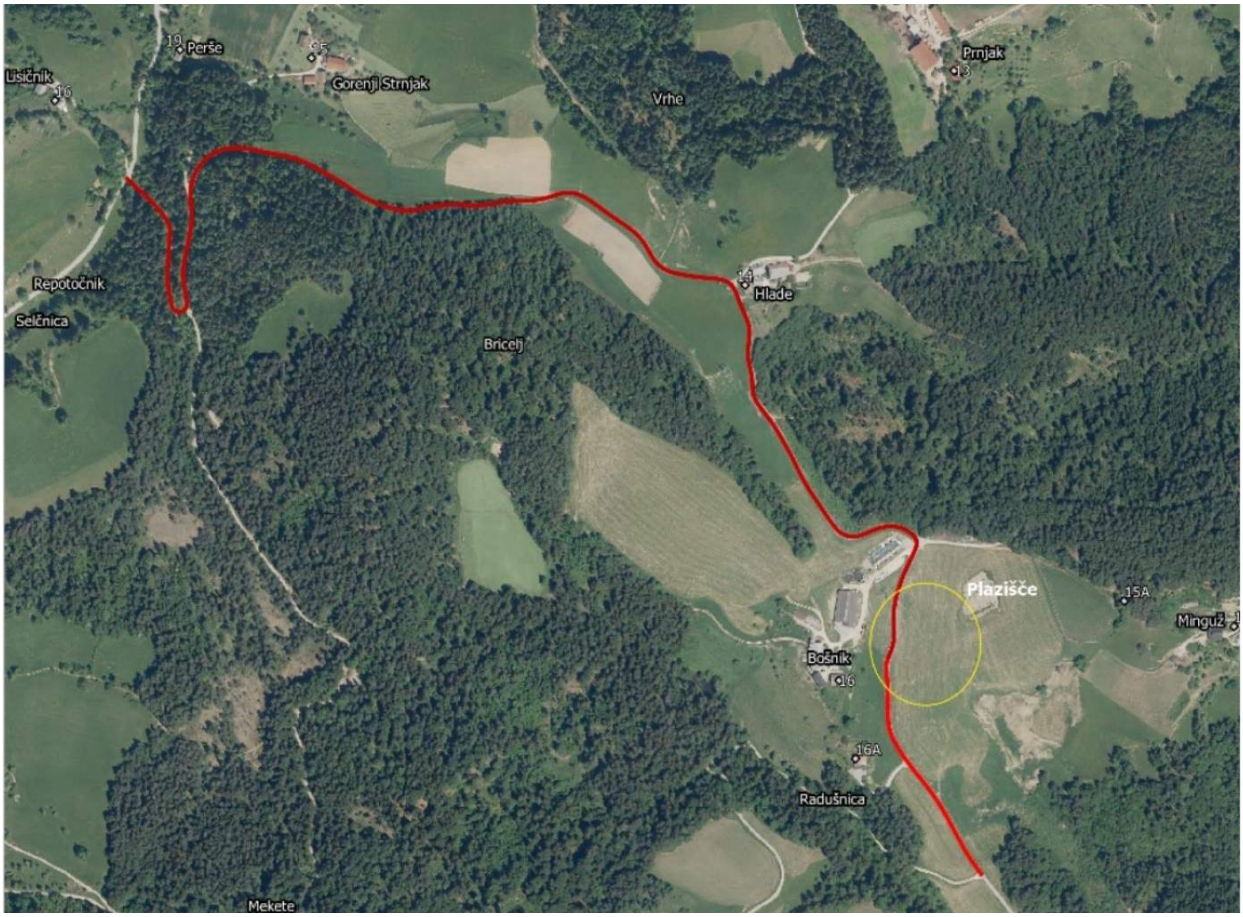
T.1.2 OPIS OBSTOJEČEGA STANJA

Lokalna cesta LC 377021 Mežnik – Anžič; Bošnik, predstavlja dostop do stanovanjskih in kmetijskih ter gozdnih zemljišč vzdolž trase.

Lokalna cesta LC 377021 predstavlja navezavo vasi Raduše z okolico. Omogoča dostop do stanovanjskih objektov in kmetijskih ter gozdnih zemljišč vzdolž trase.

Obstoječa cesta je na začetku trase makadamska, na koncu trase pa asfaltirana. Širina obstoječe ceste je na makadamskem odseku 3m in 3,5 m na območju asfalta.

Trasa poteka po geomorfološko rahlo razgibanem terenu. Poteka izmenično v nekaterih delih ob robu kmetijskih zemljišč in ob stanovanjskih objektih, v drugih delih pa čez gozd. Tekom celotne trase imamo 13 že obstoječih prepustov.



Slika 1: Ortofoto posnetek območja (vir: Atlas okolja, 2.10.2024)



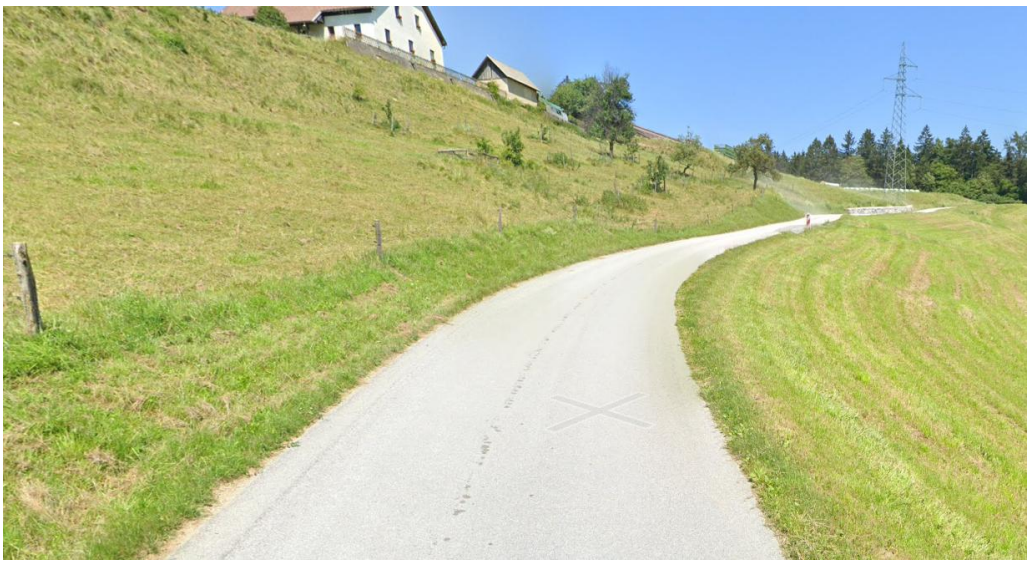
Slika 2: Začetek obravnavanega odseka



Slika 3: Del trase, ki poteka ob stanovanjskih objektih



Slika 4: Del trase, ki poteka ob robu travnika in gozdu



Slika 5: Del trase kjer je cesta asfaltirana



Slika 6: Del trase, ki je na plazovitem območju

T.1.2.1 Funkcija in vrsta ceste

Lokalna cesta 377021 Mežnik – Anžič; Bošnik predstavlja navezavo vasi Raduše z okolico. Cesta omogoča dostop do stanovanjskih objektov in kmetijskih zemljišč vzdolž trase.

T.1.2.2 Komunalni vodi

Traso prečkajo elektro-komunikacijski vodi – prostozračni daljnovod v upravljanju podjetja Eles d.o.o. in polizoliran daljnvod v upravljanju Elektro Celje d.d..

T.1.3 OSNOVE ZA PROJEKTIRANJE

Osnova za projektiranje je predhoden pregled terena. Pridobljene so bile tudi ostale podloge za izdelavo dokumentacije:

- TTN, DOF podloge v merilu 1:5000 in 1:10000
- LIDAR posnetek območja (letalsko snemanje območja), Agencija RS za okolje – portal Lidar
- Geodetski načrt št.: 054-2024, Javno podjetje Komunala Slovenj Gradec, d.o.o.

T.1.3.1 Uporabljeni predpisi

Gradbeni zakon (Uradni list RS, št. 199/21 in 105/22 – ZZNŠPP)

Zakon o vodah (Uradni list RS, št. 67/02, 2/04 – ZZdrI-A, 41/04 – ZVO-1, 57/08, 57/12, 100/13, 40/14, 56/15, 65/20, 35/23 – odl. US in 78/23 – ZUNPEOVE),

Zakon o cestah (Uradni list RS, št. 132/22, 140/22 – ZSDH-1A, 29/23 in 78/23 – ZUNPEOVE)

Uredba o kategorizaciji državnih cest (Uradni list RS, št. 102/12, 35/15, 38/15, 78/15, 21/16, 52/16, 64/16, 41/17, 63/17, 78/19 in 89/20)

Pravilnik o projektiranju cest (Uradni list RS, št. 91/05, 26/06, 109/10 – ZCes-1 in 36/18)

Pravilnik o cestnih priključkih na javne ceste (Uradni list RS, št. 86/09 in 109/10 – ZCes-1)

Pravilnik o prometni signalizaciji in prometni opremi na cestah (Uradni list RS, št. 99/15, 46/17, 59/18 in 63/19)

Tehnični pogoji za prometno signalizacija in prometna ogledala (DRSC, 17.7 .2015)

Pravilnik o projektni in drugi dokumentaciji ter obrazcih pri graditvi objektov (Uradni list RS, št. 30/23)

Klasifikacijski načrt za projektno dokumentacijo (oktober 2021)

Zakon o varstvu okolja (Uradni list RS, št. 39/06 – uradno prečiščeno besedilo, 49/06 – ZMetD, 66/06 – odl. US, 33/07 – ZPNačrt, 57/08 – ZFO-1A, 70/08, 108/09, 108/09 – ZPNačrt-A, 48/12, 57/12, 92/13, 56/15, 102/15, 30/16, 61/17 – GZ, 21/18 – ZNOrg, 84/18 – ZIURKOE, 158/20 in 44/22 – ZVO-2)

TSC 06 300 410 2009 Smernice in tehnični pogoji za graditev asfaltnih plasti

TSC 06 512 2003 Projektiranje Klimatski in hidrološki pogoji

TSC 02 401 2010 Označbe na vozišču Oblika in mere

TSC 02 210 2010 Varnostne ograje Pogoji in način postavitve

TSC 09 000 Popisi del pri gradnji cest

Veljavni prostorski akti ter ostala veljavna zakonodaja z spremembami in dopolnitvami, tehnične specifikacije in standardi.

T.1.3.2 Geološko geomehansko poročilo z kartiranjem (povzetek)

T.1.3.2.1 Geološki opis

a Geološka zgradba v območju ceste

Kamninsko podlago vzdolž celote predvidene trase tvorijo temni filitoidni skrilavci. Te plasti predstavljajo spodnji člen štalenogorske serije, zastopan je temnosiv filitoiden skrilavec, ki se sestoji iz glinaste sericitizirane snovi in mikrokristalnega kremena. Občasno se pojavlja tudi rahlo metamorfozirana subgrauvaka. V filitu se pojavljajo pole kislega tufa in tufita pelitnega značaja.

Filitoidni skrilavci so narinjeni na starejše plasti, ki jih tvore muskovitno – biotitovi gnajsi s prehodi v blestnik (Gbm). Gnajs predstavlja najbolj razširjeni člen Pohorske serije, ki je zastopana na vzhodnemu Pohorju in Kobanskome. V gnajsu se mestoma pojavljajo vložki eklogita s prehodi v amfibolit.

Geotektonsko ozemlje spada v Kobanski blok (Vzhodne Alpe). Lineacije in osi gub so usmerjene od jugozahoda proti severovzhodu, oziroma v manjšemu obsegu od zahoda proti vzhodu. Skupno z usmeritvijo SZ-JV, navedene smeri raztegovanja osi gub (in lineacije) nakazujejo na tri različna tektonska dogodka. In sicer; od najstarejših do najmlajših: 1) Bajkalska orogenetska faza, 2) Kaldonsko – Variskična orogenetska faza in 3) Sudetska do Asturijska orogenetska faza.

Na samemu začetku trase je na metamorfne sklade odložena dokaj tenka (do 10,0 m) skladovnica miocenskih aluvialnih sedimentov. Le ti se pojavljajo v obliki glinovcev, peskov in peščenjakov ter mestoma konglomeratov.

T.1.3.2.2 Inženirsko geološko kartiranje

Predvidena trasa se začne z navezavo na lokalno cesto s šifro odseka 377021. Na samemu začetku trasa prečka manjši potok po betonskemu prepustu, potem nadaljuje po vkopani obstoječi makadamski cesti do stacionaže 0.4+00.00 Od 0,4+00.00 do 2,0+40.00 trasa poteka v mešanemu profilu. Po desni strani poteka ob trasi blag vkop na levi pa večinoma po nizkem nasipu oziroma nad podpornimi konstrukcijami. Pri km 0.1+120 in km 0.1+580 trasa poteka mimo stanovanjskih hiš. Trasa je vzdolž opisanega odseka na nekaterih mesti nestabilna, zato se na teh območjih predvidi podporno kamnito zložbo. Cestišče je makadamsko širine do 4,0 m v zadnjem delu trase od km 1.8+20 je trasa asfaltirana. V delu kjer trasa poteka po gozdnatem območju in vkopu (od km 0.0+20 do km 0.4+80) so vklopne brežine pod naklonom 45°. Nakloni brežin nakazujejo na precej visoke geomehanske karakteristike zemljin in hribine na lokaciji gradnje. V nadaljevanju kjer je trasa v nasipu so nakloni brežin 45°. Zadnji del trase od km 1.6+00 trasa poteka na plazovitem območju, zato se na delu od km 1.6+00 do 1.9+80 predvidi podporna kamnita zložba ter druge ukrepe za sanacijo plazov. Na območju se zaradi slabe podlage predvidi tudi podporna konstrukcija od km 1.1+85.00 do km 1.4+90.00. Trasa na začetku poteka ob potoku, kjer se je struga zajedla v nosilne plasti ceste zato se tudi na temu območju predvidi podporni ukrep ceste od km 0.0+60.00 do 0.0+80.00. Na območju od km 0.2+80.00 do km 0.3+50.00 se zaradi strmega terena predvidi podporna konstrukcija.

Teren je gričevnat. Morfologija terena je pogojena z izmenjavo grabnov in vmesnih sotesk/grap. Teren na lokaciji vpada proti proti vodotoku v generalnemu naklonu 17° oziroma 30° v območju vmesnih grap. Ob izvedbi inženirsko-geološkega kartiranja smo opazovali in merili naklone posameznih brežin vzdolž trase. Maksimalni nakloni brežin variirajo med 45° in 55°. Merjene so le višje brežine (5m in več). Z upoštevanjem pregleda naravnih naklonov brežin lahko določimo karakteristike materialov na lokaciji ob upoštevanju variabilnosti. Večje naklone smo zsledili v območju hudourniških grap in mestoma v območju višjih nasipov mešanega profila, takšni nakloni se pojavljajo v območjih kjer se podlaga (pretrta in preperela) nahaja v bližini površja (do 2,5 m).

Filitna podlaga je neobstojna na površju terena, kjer hitro razpade v preperino – zemljino, tako smo izdanke le te zasledili le mestoma, na vkopnih brežinah – območja izdanjanja podlage so označena na geološki situaciji.

T.1.3.2.3 Terenske raziskave

a Splošno

Za potrebe optimalne zasnove objektov in vozišče konstrukcije, so bile izvedene terenske in laboratorijske raziskave.

b Terenske raziskave

Program geološko – geotehničnih raziskav je obsegal:

- izvedbo sedmih (7) DPL testov
- Izvedbo petnajstih (15) sondažnih jaškov
- Izvedbo inženirsko geološkega kartiranja
- Izvedbo meritvi parametra Evd z krožno dinamično ploščo

Lokacije raziskovalnih jaškov, vrtin in ostalih raziskav ter geološki profili so prikazani v grafičnih prilogah. V nadaljevanju podajamo splošen geomehanski model.

- Deluvij – zameljeni zaglinjeni grušč (siGr) (0,5 – 3,0 m)
- Preperina skalne podlage (ClH – siGr) (0,5 – 1,5 m)
- Skalna podlaga – filitoidni skrilavec/ gnajs s prehodi v blestnik

Teren smo opisali s tri (3) plastnim geološkim modelom.

T.1.3.3 Dimenzioniranje vozišče konstrukcije (povzetek)

a Prometni podatki števnega mesta

Glede na povezovalno funkcijo ceste in strukturo prometa (kmetijski stroji, tovorna vozila,…) smo cesto uvrstili v kategorijo malo prometnih cest. Ocenili smo, da PLDP znaša od 100 do 300 vozil.

b Prometna obremenitev

Sestav vozišča je dimenzioniran na **LAHKO – ZELO LAHKO prometno obremenitev.**

c Hidrološki klimatski pogoji

Globina zmrzovanja na obravnavanem področju je hm = 95 cm (tehnična regulativa TSC 06.512/2003 - KARTA informativnih globin prodiranja mraza). Hidrološke pogoje upoštevamo kot ugodne, material pod vozišče konstrukcijo pa kot neodporen proti učinkom zmrzovanja. Nadmorska višina lokacije ceste je nižja od 600 m.

Potrebna debelina vozišče konstrukcije na nadmorski višini < 600 m je $h_{min} > 0,7 * h_m = 66.5$ cm.

Globina zmrzovanja (hm)		95
Hidrološki pogoji	ugodni	
Material pod voziščno konstrukcijo	neodporen	0.7
h (cm) hmin > 0,7 * hm		**66.5**

Preglednica: Debelina voziščne konstrukcije z upoštevanjem klimatskih pogojev.

d Kvaliteta in vgradljivost materialov ter zgostitev

Na planumu nevezane nosilne plasti (NNP) je zahtevana nosilnost Ev2 = 100 MPa in zgoščenost > 98 %po modificiranem Proctorjevem postopku. Kakovost materiala NNP mora ustrezati zahtevam TSC 06.200. Na planumu posteljice (kamniti material) je potrebno zadostiti nosilnosti CBR > 15 %. Prav tako je zahtevana nosilnost (Ev2 > 80 MPa) in zgoščenost > 98 % po modificiranem Proctorjevem postopku. Kakovost kamnitega materiala plasti mora ustrezati zahtevam TSC 06.100.

e Zgostitev in nosilnost slojev konstrukcije

Zagotovijo naj se naslednje nosilnosti:

- planum kamnite grede $E_{v2} \geq 80$ MPa (CBR ≥ 15 %), zgoščenost ≥ 98 %
- planum tampona $E_{v2} \geq 100$ MPa ($E_{v2} / E_{v1} \leq 2,2$), zgoščenost ≥ 98 %

T.1.4 NAVODILA MNENJODAJALCEV

Dela je potrebno izvajati ob upoštevanju pogojev in navodil, ki so jih podali pristojni mnenjedajalci.

T.1.4.1 Elektro Celje

Na območju predvidene ureditve ceste potekajo SN in NN nadzemni in podzemni vodi Elektra . V projektno dokumentacijo je potrebno vrisati obstoječe elektroenergetske vode in naprave.

Pred pričetkom del je potrebno vode zakoličiti. Podatke o zakoličbi je potrebno vpisati v gradbeni dnevnik, s čimer se predstavnik izvajalca zemeljskih del zaveže, da so mu podatki o zakoličenih vodih predani.

Obstoječe kable je potrebno na mestih križanj in približevanj ročno odkopati in urediti križanja ter po potrebi prestaviti. Izvedba mora ustrezati standardu SIST EN 50423-3 in določilom navedenih v: »Smernice in navodila za izbiro, polaganja in prevzem elektroenergetskih kablov nazivne napetosti 1-35kV (Študija 2090, Elektroinštitut Milan Vidmar)«.

Zemeljska dela v bližini električnih vodov morajo biti izvedena pod nadzorom in po navodilih predstavnika Elektro Celje d.d. - nadzorništvo Slovenj Gradec. Dela na samih elektro napravah bo izvajalo Elektro Celje, d.d. V primeru poškodbe vodov ali ozemljitvenih naprav, je potrebno le-to takoj prijaviti nadzorništvu Elektro Celje d.d..

Vsa dela v zvezi s prestavitvami, mehanskimi zaščitami ali popravili poškodb na elektro napravah povzročenih zaradi gradnje, stroški zakoličenja in stroški nadzora nad izvedbo križanj bremenijo investitorja.

V kolikor bodo gradbena dela posegala v območje stojnih mest obstoječih električnih vodov, je potrebno upoštevati naslednje: pri izvedbi ceste ob drogovih nadzemnih vodov, je potrebno zagotoviti oddaljenost od drogov 5 m, v izjemnih primerih, ko je obstoječa razdalja med cesto in stojnim mestom že sedaj manjša, pa se cesta ne sme še bolj približati. Pri križanjih ceste z nadzemnimi vodi morajo ostati varnostne višine minimalno 6,6 m.

Vsa križanja z električnimi vodi je potrebno geodetsko posneti in izmeriti varnostne višine nadzemnih vodov na mestih križanj. Podatke je potrebno predati Elektro Celju pred tehničnim pregledom.

Vso elektroenergetsko infrastrukturo (morebitne prestavitve vodov, ureditve mehanskih zaščit), je potrebno projektno obdelati v skladu s temi projektnimi pogoji, veljavnimi tipizacijami distribucijskih podjetij, veljavnimi tehničnimi predpisi in standardi, ter pridobiti upravno dokumentacijo. Obdelati je potrebno prestavitve električnih vodov, lokacije križanj in približevanj ter detajle križanj. Pred pridobitvijo gradbenega dovoljenja si mora investitor pridobiti soglasje k projektnim rešitvam. Soglasje bo možno izdati na podlagi izpolnjenih projektnih pogojev.

V primeru prestavitve vodov priporočamo, da v izogib kasnejšim popravkom soglasij in projektne dokumentacije, investitor že pred začetkom projektiranja pridobi dokazila o pravici gradnje elektroenergetske infrastrukture, kar pomeni, da morajo biti za prestavljene trase pridobljene overjene tripartitne služnostne pogodbe z lastniki zemljišč, kjer bo navedeno, da ima ELEKTRO CELJE, d.d. pravico vpisa služnostne pravice gradnje in vzdrževanja omenjene infrastrukture v zemljiško knjigo.

Investitorja bremenijo vsi stroški prestavitve ali predelave elektroenergetske infrastrukture, ki jih povzroča z omenjeno gradnjo.

T.1.4.2 Zavod RS za varstvo narave

Na ponikovalnikih in prepustih med km 1,160 in km 1.580 ter med km 1,760 in km 2,040 je treba zagotoviti tehnične ukrepe za preprečitev odtekanja odpadnih voda in drugih nečistoč v tla in okolico z ustreznimi (peščenimi) filtri, da ne pride do posrednega zastrupljanja in onesnaženja močvirnih predelov gozda in vodotokov; Ukrep preprečuje posreden vpliv uničenja habitata kvalifikacijskih vrst zaradi prekomernega onesnaženja zaradi morebitnega spiranja olj in drugih onesnažil s ceste ter koncentriranega sproščanja preko prepusta na močvirne predele gozda in posredno vodotoka v varovanem območju;

V času gradnje je treba zagotoviti tehnične in druge ukrepe za preprečitev odtekanja odpadnih voda in drugih nečistoč (zemljina, olja, goriva) v tla in okolico, da ne pride do zastrupljanja in daljinskega onesnaženja vodotokov; Ukrep preprečuje posreden vpliv uničenja dela habitata kvalifikacijskih vrst zaradi prekomernega onesnaženja vodotokov in močvirnih predelov gozda;

Pri izvajanju del je treba izvajati ukrepe za preprečitev širjenja tujerodnih vrst in ukrepe za preprečevanje širjenja račje kuge. Delovne stroje je potrebno pred premiki na lokacijo sprati in ustrezno očistiti. Predvsem stroje, ki bodo imeli stik z vodo, je treba pred premikom na lokacijo 48 ur sušiti ali jih ustrezno razkužiti, da ne pride do prenosa bolezni račje kuge oz. drugih bolezni v vodotok. Zemljine, ki je morebiti onesnažena z invazivnimi tujerodnimi rastlinami se ne sme uporabljati pri sanaciji. Leto po posegu je treba izvesti kontrolo morebitnega pojava tujerodnih invazivnih vrst, ter v primeru pojava invazivne tujerodne rastline odstraniti; Ukrep preprečuje spremembo lastnosti in struktur habitata vrst zaradi razširjanja invazivnih vrst in bolezni račje kuge, ki se lahko prenaša z mokro opremo med lokacijami posegov.

T.1.5 UREDITEV CESTE

T.1.5.1 Vrsta in pomen ceste

a Prometna funkcija

Lokalna cesta 377021 Mežnik – Anžič; Bošnik predstavlja navezavo vasi Raduše z okolico. Cesta omogoča dostop do stanovanjskih objektov in kmetijskih zemljišč vzdolž trase.. Cesta omogoča dostop do stanovanjskih objektov in kmetijskih zemljišč vzdolž trase.

b Vrsta ceste

Lokalna cesta (LC) je namenjena lokalnemu prometu, saj služi kot povezovalna cesta med vasjo Raduše in Sele preko katere se dostopa do regionalne ceste. Cesta je namenjena je pretežno za prebivalce okoliških krajev, šolski avtobus in kmetijske stroje.

T.1.5.2 Vrsta in zahtevnost terena

Glede na topografske značilnosti se teren na obravnavnem odseku uvršča kot hribovit teren.

T.1.5.3 Projektna hitrost

Javna pot je zasnovana kot dvopasovna cesta namenjena prometu z motornimi vozili izven naselja. Glede na lokacijo ter konfiguracijo terena (hribovit teren) se za vertikalne in horizontalne tehnične elemente upošteva projektna hitrost 30 km/h.

T.1.5.4 Minimalni tehnični in geometrijski elementi ceste

Minimalni tehnični in geometrijski elementi za lokalno cesto s projektno hitrostjo 30 km/h znašajo:

Elementi ceste	Kritične vrednosti (iz pravilnika)	Uporabljene vrednosti
	30 km/h	30 km/h
prečni nagib vozišča	q_{min} = 2,5 %, q_{max} = 7 %	q_{min} = 2,5 %, q_{max} = 5 %
polmer krožne krivine	R_{min} = 25 m	R_{min} = 8,50 m
vzdolžni nagib nivelete	S_{max} = 12 %	S_{max} = 11,5%; S_{min} = 0,14 %
polmer vertikalne zaokrožitve	Rkv_{min} = 400 m, Rkk_{min} = 300 m	Rkv_{min} = 400, Rkk_{min} = 300 m

Minimalni zahtevani tehnični in geometrijski elementi javne poti

T.1.5.5 Normalni prečni profil

Skladno s Pravilnikom o projektiranju cest ter glede na prometno funkcijo in vrsto ceste smo izbrali sledeči karakteristični prečni profil:

MP	30 km/h	1 x 3,50 m	–	3,50 m	–	2 x 0,75 m	5,00

Bankina	0,50 m
Mulda (povozna)	0,50 m
Vozni pas	3.50 m
Bankina	0,50 m
Skupaj	**5,0 m**

T.1.5.6 Razširitve

V krivinah se upoštevajo razširitve za triosno tovorno vozilo.

T.1.5.7 Preglednost

Pri projektirani hitrosti 30 km/h je pri priključkih na glavni prometni smeri zaustavitvena razdalja odvisna od nagiba vzdolžne nivelete. Zaustavitvena razdalja znaša od 37 m (nagib nivelete -12%) do 27 m pri nagibu nivelete 12%.

T.1.5.8 Potek projektirane trase

Trasa v celoti sledi poteku obstoječe ceste.

a Horizontalni potek

Trasa se začne, ko prečkamo most z navezavo na obstoječe stanje. Izmenično poteka z zaokrožitvami in premami. Zaokrožitve imajo radije med minimalno 8,50 m in maksimalno 350 m.

Trasa se v zaključku naveže na obstoječo cesto pri priključku na gozdno cesto 112198.

b Vertikalni potek

Rekonstruirana trasa glavne ceste se v prvi polovici vzpenja v sklonu od minimalno 1,9% do maksimalno 11,5%. Nato se trasa prične spuščati v sklonu od minimalno 1,4% do maksimalno 6,5% do nanjnižje točkke na stacionaži 1550 od koder se trasa dviguje do križišča na stacionaži 1590. V zadnjem delu se trasa spušča s skloni od minimalno 1,6% do maksimalno 10,7%.

c Potek v prečni smeri

Vrednosti prečnih nagibov znašajo od 2,5% do 5% z maksimalno spremembo Δs=1,0%

T.1.5.9 Križišča in priključki

V sklopu projekta smo obravnavali 4 križišča, pri vseh se izvede navezava na obstoječe stanje ceste, ki se priključuje. Pri vseh križiščih smo uredili odvodnjavanje, da bi preprečili zamakanje ceste.

T.1.5.10 Površine za pešce

Na območju obdelave ni predvidenih površin za pešce.

T.1.5.11 Avtobusna postajališča

Na obdelovalnem odseku ni predvidenih avtobusnih postajališč.

T.1.5.12 Dostopi do parcel

Dostopi do parcel se nahajajo na več lokacijah pri vseh objektih, nekaj je tudi dostopnih poti do kmetijskih in gozdnih zemljišč.

T.1.5.13 Konstrukcijski elementi ceste

T.1.5.13.1 Vozišča konstrukcija

a Vozišča konstrukcija ceste

Predvidena sestava na regionalni cesti

- 4 cm obrabna plast AC 11 surf B70/100, A4, Z3
- 6 cm nosilna plast AC 22 base B70/100, A4, Z6
- 20 cm nevezana nosilna plast (NNP) kamniti drobljenec TD32
- 40 cm kamnita greda iz zmrzlinsko odpornega materiala 0/63

skupaj: 70 cm

b Kvaliteta in vgradljivost materialov ter zgostitev

Na planumu nevezane nosilne plasti (NNP) je zahtevana nosilnost Ev2 = 100 MPa in zgoščenost > 98 %po modificiranem Proctorjevem postopku. Kakovost materiala NNP mora ustrezati zahtevam TSC 06.200. Na planumu posteljice (kamniti material) je potrebno zadostiti nosilnosti CBR > 15 %. Prav tako je zahtevana nosilnost (Ev2 > 80 MPa) in zgoščenost > 98 % po modificiranem Proctorjevem postopku. Kakovost kamnitega materiala plasti mora ustrezati zahtevam TSC 06.100.

c Zgostitev in nosilnost slojev konstrukcije

Zagotovijo naj se naslednje nosilnosti:

- planum kamnite grede $E_{v2} \geq 80$ MPa (CBR ≥ 15 %), zgoščenost ≥ 98 %
- planum tampona $E_{v2} \geq 100$ MPa ($E_{v2} / E_{v1} \leq 2,2$), zgoščenost ≥ 98 %

T.1.5.14 Robni elementi vozišča

Vzdolž celotne trase so predvidene bankine na obeh straneh cestišča. Te se ne izvedejo le v območjih, kjer bodo izvedeni oporni ter podporni konstrukcijski elementi.

T.1.5.15 Bankine, berme

Bankine ob lokalni cesti se izvedejo v debelini 10 cm iz tamponskega drobljenca v nagibu 4%. Širina bankine je 0,50 m.

Tamponskemu drobljencu se lahko primeša rezkanec.

T.1.5.16 Nasipi, vkopi

Vkopi in nasipi v območju celotnega vozišča so minimalni. Izvedeni so v naklonu 1:1. Vse vkope in nasipe se zatravi.

Na delih trase se izvede jarek s kanaletami. Na notranji strani bo ločen od cestišča z bankino.

T.1.5.17 Odvodnjevanje

T.1.5.17.1 Splošno

Površinsko odvodnjavanje lastnih in zalednih vod cestišča se bo izvedlo s sistemom muld, prepustov, razpršenim prelivanjem in jarkov - kanaletami. Voda z vozišča se zbira v asfaltnih muldah ali jarkih, preko katerih odteče direktno v prepust. Na nekaternih območjih poteka razpršeno odvajanje preko roba cestišča.

V stacionaži Km 0,200 trasa ceste prečka neimenovan vodotok, za katerega so bile določene ustrezne dimenzije prepusta.

T.1.5.17.2 Prečenje neimenovanega vodotoka

a Določitev kritičnih pretokov

Prispevno območje neimenovanega vodotoka smo določili na 630.139 m^2 (0,63 km^2). Kritični pretok za prispevno območje smo izračunali po enačbi Kresnika, ki je splošno uveljavljena enačba za določitev maksimalnih odtokov hudourniških vodotokov:

$$Q_{100} = \alpha F \frac{32}{0.5 + \sqrt{F}}$$

Kjer je:

Q_{100}… Kritični odtok zalednega območja s povratno dobo 100 let [m^3/s]

α… Odtočni koeficient, uporabljajo se vrednosti od 0,6 – 1,0.

F… Površina zalednega območja [km^2]

Glede na enačbo in določitev odtočnega koeficienta (0,6) smo določili maksimalni pretok vodotoka Q_{100}:

Q_{100} = 9,35 m^3/s

b Določitev dimenzij škatlastega prepusta

Hidravlični izračun prepusta smo izvedli na podlagi Manningove enačbe:

$$v = \frac{1}{n} R_h^{2/3} S^{1/2}$$

Kjer je:

v… hitrost pretoka vode [m/s]

n… Manningov koeficient hrapavosti

R_h… Hidravlični radij (razmerje med površino preseka in omočenim obsegom cevi)

S… Naklon cevi

Glede na vhodne podatke in konfiguracijo terena naj se izvede premostitev vodotoka s škatlastim prepustom dimenzij š x V x d = 200 x 150 x 200.

T.1.5.17.3 Odvodnjavanje ceste

Površinsko odvodnjavanje z se bo izvedlo s sistemom muld, prepustov, razpršenim prelivanjem in jarkov - kanaletami. Voda z vozišča se zbira v asfaltnih muldah ali jarkih, preko katerih odteče direktno v prepust. Na nekaternih območjih poteka razpršeno odvajanje preko roba cestišča.

Na lokaciji imamo že nekaj obstoječih prepustov, ki se jim uredi iztočne glave in primerno uredi oziroma po potrebi zamenja. Obstoječih prepustov je 13 in niso enakomerno porazdeljeni po celotni trasi. Dodatno se bo za boljše odvodnjavanje izdelalo 3 prepuste vzdolž celotne trase.

Iz prepusta 9 se izvede pobočne kanalete, ki se jih pripelje do grape in uredi izpust.

Med posameznimi obstoječimi prepusti se uredi kanalizacija v obliki muld in jarkov - kanalet, ki se navežejo na prepuste.

Jarke umestimo na tistih lokacijah, kjer imamo več zaledne vode in dovolj prostora. Nahajajo se na naslednjih odsekih:

- Na desni strani od km 0.3+55.00 do km 1.0+30.00,
- Na desni strani od km 1.6+07.00 do km 1.7+77.00

Za boljšo stabilnost ceste in odvodnjo zaledne vode se na dveh območjih izvede drenažo s pranim gramozom frakcije 4-3 32 mm v globini 1 m in cevjo PVC DKC DN 200.

Območja drenaž:

- od km 1.1+84.40 do km 1.5+43.00
- od km 1.6+07.00 do km 2.0+30.00

T.1.5.17.4 Dimenzioniranje prepustov

T.1.5.17.4.1 Padavine

Za potrebe določitve modelne količine padavin različnega trajanja na območju predvidene novogradnje trase, smo uporabili izvrednotene ekstremne nalive. Analizo so izvedli na Agenciji RS za okolje in sicer v sklopu projekta CROSSRISK, ki se izvaja v okviru Programa sodelovanja Interreg V-A Slovenija – Avstrija. Metoda in analize so bolj podrobno opisane v članki "Časovno in prostorsko glajeni povratni nivoji ekstremnih nalivov" (Kozjek, 2020), končne rezultate analize (dejanske vrednosti padavin/nalivov po posameznih kvadratkih) pa smo pridobili neposredno s strani Agencije RS za okolje. Rezultati so na voljo tudi preko spleta (https://meteo.arso.gov.si/met/sl/climate/tables/). Končni rezultat so izvrednoteni nalivi za posamezne povratne dobe, ki so podani v obliki mreže velikosti 1x1km.

V nadaljevanju podajamo tabelo uporabljenih podatkov za analizo:

Padavine [mm]

Časovni interval	Povratna doba					
	5 let	10 let	25 let	50 let	100 let	250 let
5 min	11	12	14	16	17	19
10 min	16	19	23	26	29	33
15 min	19	23	28	32	36	41
20 min	22	26	31	36	41	47
30 min	26	30	37	42	48	56
45 min	30	35	43	49	55	64
60 min	33	39	47	53	60	70
90 min	38	44	52	59	67	78
2 h	41	48	57	65	73	84
3 h	48	55	65	73	82	95
4 h	53	61	71	80	90	103
5 h	57	65	76	85	95	109
6 h	61	69	80	90	100	114

Preglednica: Višine padavin za različne povratne dobe (vir: https://crossrisk.eu/sl/climate?period=100y)

Za izračun in dimenzioniranje prepustov, meteorne kanalizacije, ter površinskih elementov odvodnje je bil privzet naliv z povratno dobo 10 let. Trajanje naliva je bilo določeno glede na čas koncentracije prispevne površine in se od površine do površine spreminja.

T.1.5.17.4.2 Prispevne površine za odvodnjo

Določene so bile prispevne površine, ki gravitirajo na območje obnovljene ceste. Maksimalne odtoke smo določili na podlagi časov koncentracije, ki se od prispevnega območja do prispevnega območja razlikujejo in na podlagi koeficientov odtoka pobočja. Določili smo dva odtočna koeficienta:

1. K_{cesta} = 0,95
2. $K_{zaledje}$ = 0,20

Maksimalne odtoke smo izračunali na podlagi racionalne metode:

$$Qp = C*i*A$$

A površina odvodnje

C koeficient odtoka

i gradient odtoka

t_c čas koncentracije

T.1.5.17.5 Vplivi podnebnih sprememb

V sklopu projekta predvidimo porast ekstremnih padavinskih dogodkov v velikosti 7% na desetletje. Tako smo za obravnavano območje povzeli porast padavin v velikosti 17,5% za obdobje 25 let.

Z vidika emisij v okolje (glede na Uredbo o emisiji snovi pri odvajanju padavinske vode z javnih cest (UL RS, št. 47/2005) in Uredbo o emisiji snovi in toplote pri odvajanju odpadnih voda v vode in javno kanalizacijo (UL RS, št. 47/2005, 45/2005, 79/2009, 64/2012), ni potrebno določiti dodatnih ukrepov zadrževanja, saj kriterij 12.000 EOV/dan ni dosežen. Za odvodnjo cestiščne vode so tako predvideni le peskolovi na vtočnih jaških in s tem razpršena odvodnja.

Prepust	ø cevi	padec i	Q zaledje + cesta	Q2050 (podnebne spremembe)	Pretočnost prepusta
	[mm]	[%]	[l/s]	[l/s]	[l/s]
PR2_1	600	3,6	7,0	8,2	1261,0
PR3 ob-1	600	1,7	35,0	41,1	867,0
PR4 ob-1	600	1,7	33,0	38,8	867,0
PR6 ob-1	600	1,7	133,0	156,3	867,0
PR7_1	600	3,5	48,0	56,4	1244,0
PR8 ob-1	600	3,7	361,0	424,2	1279,0
PR9 ob-1	400	1,9	109,0	128,1	916,0
PR10_1	600	2,9			1132,0
PR11 ob-1	600	2	27,0	31,7	940,0
PR12_1	600	3	138,0	162,2	1152,0
PR13 ob-1	600	4	84,0	98,7	1330,0
PR14-1	600	4,4	14,0	16,5	1395,0
PR15-1	600	3	9,0	10,6	1152,0
PR16 ob-1	600	3	17,0	20,0	1152,0

Tabela: Lastnosti prepustov, izračunani pretoki glede na prispevna območja, pretoki z upoštevanjem vplivov podnebnih sprememb in pretočnost prepustov

T.1.5.18 Prometna signalizacija in oprema

Prometna signalizacija in oprema je prikazana v gradbeni situaciji.

T.1.5.19 Vertikalna signalizacija

Prometni znaki morajo glede materialov, velikosti, barv in svetlobno odbojnih lastnostih ustrezati Pravilniku o prometni signalizaciji in opremi na cestah in Tehničnim pogojem za prometno signalizacijo in prometna ogledala. Način postavitve znakov je razviden in karakterističnih prečnih profilov. Temelje se izvede iz cementnega betona C15/20 in z uporabo betonskih cevi premera 30 cm in dolžine 80cm.

Podporna konstrukcija znakov:

Konstrukcija prometnega znaka mora skladno s standardom SIST EN 12899-1 :2008 glede mehanske odpornosti dosegati naslednje minimalne zahteve:

- faktor varnosti za obremenitve – razred PAF1,

- pritisk vetra – razred WL5,
- dinamični pritisk pri čiščenju snega – razred DSL1,
- najmanjša dopustna deformacija pri upogibanju – razred TDB4,
- prebadanje znaka – razred P3 in
- robovi plošče znaka – razred E.

Tabelarični seznam nove vertikalne signalizacije je priložen (glej T.1.3.)

T.1.5.20 Komunalni vodi

T.1.5.20.1 Obstoječi komunalni vodi

Na obravnvani lokaciji je več obstoječih komunalnih vodov:

- Traso prečkajo elektro-komunikacijski vodi
- elektro vodi – prostozračni daljnovod v upravljanju podjetja Eles d.o.o. in polizoliran daljnvod v upravljanju Elektro Celje d.d..

Če se pri gradnji naleti na obstoječe komunalne vode, je potrebno kable oz. cevi ustrezno zaščititi.

Zaščita kabla oz. kanalizacijske cevi obsega sledeče ukrepe:

- 30 dni pred pričetkom del je potrebno obvestiti upravljavca voda.

- Ob pričetku del je potrebno z ročnim sondažnim izkopom določiti dejanski potek vodnikov na terenu.

- V kolikor kabli niso v zaščitnih ceveh se izvede zaščita z dvoplastnimi cevmi, prerazanimi po dolžini, katere se natakne na kabel in obbetonira z betonom C16/20, debeline vsaj 20 cm. Vgradi se tudi opozorilni trak.

- V kolikor so kabli v zaščitnih ceveh se izvede obbetoniranje z betonom C16/20, debeline vsaj 20 cm, polaganje opozorilnega traku.

-Zagotoviti se mora, da so obstoječi kabli in cevi po izvedbi min. 60 cm pod končno koto terena. V kolikor imajo projektirani prepusti isto koto kot obstoječi vodi, se le te prestavi nad prepuste.

T.1.5.21 Organizacija prometa med gradnjo

Na celotnem delu trase bo vzpostavljena polovična zapora ceste na več odsekih. Zapora se uredi s postavitvijo predpisanih znakov, zapornih desk, obvestilnih tabel in semaforjev. Zaporo skladno s potrjenim elaboratom uredi pristojno cestno podjetje.

T.1.5.22 Predizmere in popis

Popis del je izdelan na osnovi Splošnih tehničnih pogojev ter Popisa del in posebnih tehničnih pogojev za preddela, zemeljska dela, vozišče konstrukcije, odvodnjavanje, gradbena in obrtniška dela ter opremo cest oz. sprejetih TSC, ki urejajo posamezna področja gradnje cest.

T.1.6 GEOTEHNIČNE KONSTRUKCIJE

T.1.6.1 Splošno

Pri zasnovi in izboru elementov rekonstrukcije, so poleg tehničnih in naravnih pogojev lokacije bistveno vplivali pogoji, ki izhajajo iz tehnologije izvedbe. Pod cesto se izvedejo kamnite zložbe (kamen-beton).

Vse konstrukcije bodo morale biti temeljenje na kompaktni in prepereli hribinski podlagi.

Izvedena bodo rekonstrukcija na območjih plazenja (pri kmetiji Raduše 16 in med Vrhe 14 in Raduše 16), s katero bomo dosegali maksimalno možno razbremenitev nestabilnih tal in optimizacijo poteka trase.

Za zagotavljanje stabilnosti območja plazu so predvidene podporne kamnite zložbe. Dodatno se izvede drenaža v zaledju predvidenih podpornih konstrukcij in razbremenitev (odkop) materiala v ospredju konstrukcij. Pri izdelavi projektne dokumentacije smo zaradi zelo zahtevnega terena posebno pozornost posvetili tehnologiji gradnje.

Za izgradnjo konstrukcij bodo izvedeni začasni delovni platoji in ukrepi za začasno varovanje izkopov, ki bodo omogočali varno izvedbo.

T.1.6.2 Zasnova projektne rešitve

Za potrebe sanacije plazine smo predvideli izdelavo kamnite zložbe.

T.1.6.3 Opis konstrukcij

T.1.6.3.1 Podporne kamnite zložbe

T.1.6.3.1.1 Opis konstrukcije

Na nestabilnih območjih pod dostopno cesto je na petih mestih umeščena podporna kamnita zložba PKZ. Štiri zložbe so do višine 4,00 m na enem območju pa je zložba višine do 3,00m. Temeljena je na prepereli hribinski podlagi. Konstrukcija je nagnjena proti zaledju in sicer zaledna stran v naklonu 7:1, lice pa v naklonu 3:1. Na vrhu konstrukcije se izvede AB krona, širina krone znaša 80cm. Konstrukcije se gradi iz zmrzlinsko odporne kamnine premera najmanj 50cm, prostor med njimi pa se zapolni s pustim betonom. Po dograditvi se fuge med kamni zapolni. Za odvajanje zaledne vode so predvidene izcednice Ø100 mm v rastru 2,0m. Izcednice morajo biti umeščene 50cm nad koto končnega zasipa. Kamnite zložbe se gradi kampadno, z maksimalno dolžino kampade 6m.

Za odvajanje zaledne vode se izvede tudi drenaža s kamnitim drobljencem frakcije 4-32 mmin cevjo PVC DKC DN fi 200.

Lokacije izvdedbe PKZ:

- Od km 0.0+60.00 do km 0.1+00.00, L=42,10m,
- Od km 0.2+63.00 do km 0.3+49.00, L=85,10 m,
- Od km 0.5+23.00 do km 0.6+30.00, L=107,20 m,
- Od km 1.1+94.00 do km 1.4+91.50, L=293,00 m,
- Od km 1.6+20.00 do km 1.9+86.50, L=364,30 m.

T.1.6.3.1.2 Material

beton	podložni beton	C 12/15 X0
	pozidava kamnite zložbe	C 30/37
	krona	C 30/37 XC4 XD3 XF4 PV-II Dmax 16
armatura		B500 B
zaščitna plast	krona	4,5 cm
kamenje kamnite zložbe		karbonatne kamenine, zmrzlinsko odporne

T.1.6.4 Tehnologija gradnje

T.1.6.4.1 Splošno

Najprej se vzpostavi gradbišče z ustreznimi provizoriji, instalacijami in označbami. Objekte se zakoliči, odstrani se drevje, grmovje in očistiti teren. Izvesti je potrebno vse začasne prestavitve instalacij ter zagotoviti ustrezno odvodnjavanja gradbišča.

T.1.6.4.2 Kamnite zložbe

Za izdelavo podpornih in opornih kamnitih zložb je potrebno najprej urediti delovni plato, maksimalno 4m nad koto temeljenja. Začasno varovanje cestišča se po potrebi izvede z začasno berlinsko steno. Dostop do delovnega platoja se izvede s ceste. Zagotoviti je potrebno širino platoja 3,5m, za kar se uporabi širino cestišča, po potrebi pa se izvede nasip pod cestiščem. Vsa zemeljska dela se izvedejo s pomočjo mehanizacije pri pogojih, ki veljajo za III., IV. in V. kategorijo zemljine. Izkopani material se transportira na začasno ali trajno deponijo, pri čemer se na začasni deponiji skladišči material, ki bo kasneje porabljen za zasipe, na trajno deponijo pa se odlaga preostali material.

Izkope iz platoja do temeljev kamnitih zložb se izvaja v kampadah. Zid mora biti temeljen v kompaktno ali deloma preperelo hribinsko osnovo, dela morajo potekati ob geomehanski spremljavi. Kamnite zložbe se izvedejo direktno na primernih tleh brez izvedbe temeljev ali plasti podložnega betona.

Kamnita zložba se zida kontaktno v kamenju in betonu. Zida se s kamenjem premera nad 50 cm (nad 0,1m3) in betonom. Uporabi se avtohtono kamenje in sicer na način poglobljenega stičenja, brez vidnega betona. Na koti 0,5m nad končno ureditvijo na svetli strani se v konstrukcijo vgradi izcednice. Lice kamnitih zložb se fugira s cementno malto. Zasip zaledja se izvede s prepustnim, gruščnatim materialom po plasteh debelin 40 cm, ki se jih zgosti do vrednosti 95% po Proctorju. Zaledje opornih zložb se lahko zasipa z izkopnim materialom ustrezne kvalitete, kar mora pred zasipom potrditi geomehanik. Podporno kamnite zložbe se zaključi z AB krono.

T.1.6.5 Program monitoringa

Vizualni monitoring je potrebno izvajati med gradnjo in o tem voditi zapisnik. Vizualni monitoring naj obsega pregled brežin, začasnih podpor delovnih platojev in pregled cestišča v obratovanju. V primeru pojavov kot so razpoke, prekomerne deformacije, dotoki vode, je potrebno obvestiti geomehanika in projektanta. Pred začetkom izvedbe je treba izdelati poročilo o stanju stanovanjskega objekta s fotodokumentacijo. Na gredo se montirajo trije reperji za meritev premikov pilotne stene.

T.1.6.5.1 Geodetski monitoring

Po dokončanju podpornih konstrukcij je potrebno vzpostaviti geodetski monitoring. V ta namen je predvidena vgradnja treh 3D merskih točk. Meritve se izvaja ob vgradnji, 1x med gradnjo in ob predaji objekta v uporabo.

T.1.7 ZAKLJUČEK

Izvajalec je pred začetkom izvajanja del dolžan izdelati Tehnološki elaborat izvedbo podpornih konstrukcij. Iz elaborata mora biti razvidna tehnologija in faznost del. Navedeni morajo biti proizvajalci ključnih materialov za zagotavljanje trajnosti in stabilnosti konstrukcij, priloženi pa morajo biti ustrezni certifikati. Del elaborata mora biti tudi program notranje kontrole kakovosti. Tehnološki elaborat morata potrditi projektant podporne konstrukcije in nadzor.

P PRILOGE

P.1 Tabelarični prikaz vertikalne signalizacije

Tabelarični prikaz prometne signalizacije in opreme 1/1

Številka pozicije	Oznaka	Stacionaža	Dimenzija	Vrsta folije	Skica	Višina od tal	Št. stebrov	Višina stebra	Št. znakov	Komentar
	2207-2	0.000	0.60	RA2		2.00	1	2.60	1	
	4201-7	0.000	0.60	RA2		2.00	1	2.60	1	
	2102	0.000	0.60	RA2		2.00	1	2.60	1	

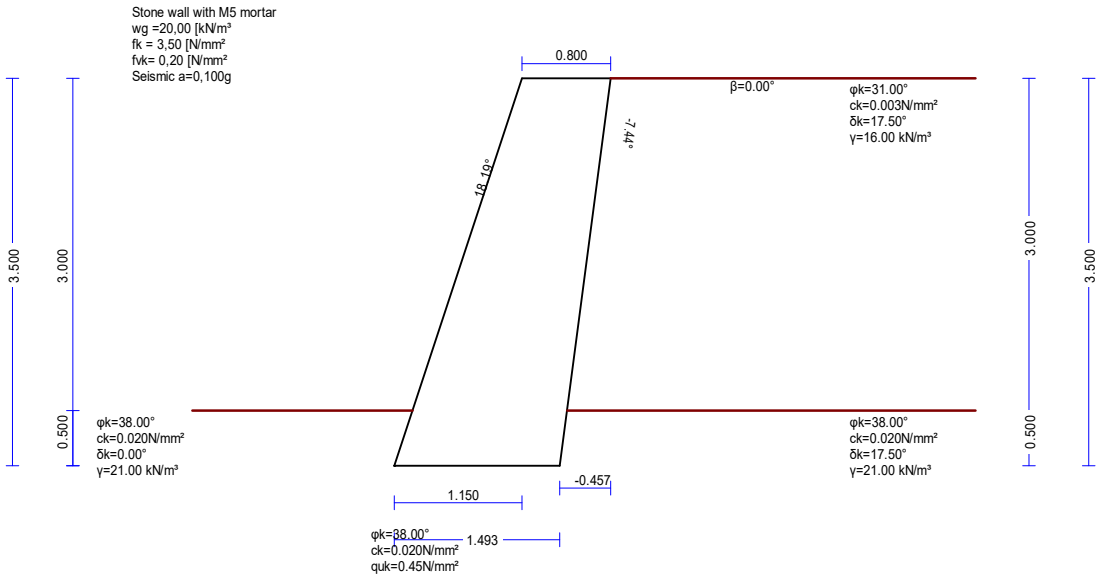
P.2 STATIČNA IN STABILNOSTNA ANALIZA GEOTEHNIČNIH KONSTRUKCIJ

Podporne kamnite zložbe

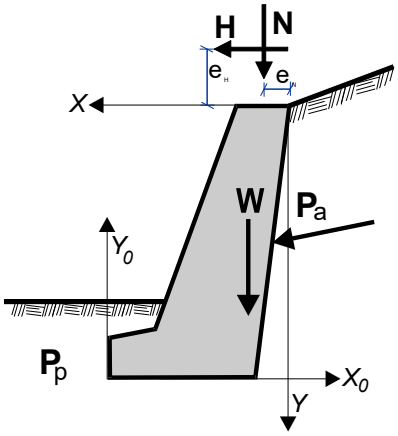
1. PKZ-1

Gravity retaining wall

(EC2 EN1992-1-1:2004, EC0 EN1990:2002, EC7 EN1997-1-1:2004, EC8 EN1998-5:2004,)



1.1. Wall properties-Parameters-Code requirements



Dimensions

Height of wall	h= 3,500 m
Transverse length of wall	L=10,000 m
Stem thickness at top	B1= 0,800 m
Stem thickness at bottom	B2= 1,493 m
Width of wall base	B= 1,493 m
Width of wall toe	0,000 m
Height of wall stem	ho= 3,500 m
Thickness of wall footing	0,000 m
Front thickness of wall toe	0,000 m
Slope (batter) at front face	18,189° (1:3,04)
Slope (batter) at back face	-7,439° (1:7,66)

Weight of wall

Unit weight of wall material	γg=20,000 kN/m³
Cross section area of wall	A= 4,013 m²
Self weight per meter of wall	W= 4,013x20,000= 80,26 kN/m
Center of gravity of wall at	x=0,842 m, y=1,926 m (xo=1,108 m, yo=1,574 m)

Wall materials

Compressive strength	3,50 N/mm²
Shear strength	0,20 N/mm²

1.2. Partial factors for actions and soil properties (EC7 Tab. A.1-A.4, EC8-5 §3.1)

Equilibrium limit state (EQU), Structural limit state (STR), Geotechnical limit state (GEO)

				(EQU)	(STR/GEO) (A1+M1)	(STR/GEO) (A2+M2)	(Seismic)
Actions	Permanent	Unfavorable	γGdst:	1,10	1,35	1,00	1,00
	Permanent	Favorable	γGstb:	0,90	1,00	1,00	1,00
	Variable	Unfavorable	γQdst:	1,50	1,50	1,30	1,00
	Variable	Favorable	γQstb:	0,00	0,00	0,00	0,00
Soil parameters	Angle of shearing resistance		γφ:	1,25	1,00	1,25	1,25
	Effective cohesion		γc:	1,25	1,00	1,25	1,25
	Undrained shear strength		γcu:	1,40	1,00	1,40	1,40
	Unconfined strength		γqu:	1,40	1,00	1,40	1,40
	Weight density		γw:	1,00	1,00	1,00	1,00

γR,v(R1)=1,00, γR,h(R1)=1,00, γR,e(R1)=1,00

1.3. Properties of foundation soil

Bearing capacity of foundation soil qu=0,45 N/mm²
Friction angle between wall footing and soil φ=38,00°, friction coefficient tan(φ)=0,781
Cohesion between wall footing and soil c=0,020 N/mm²

1.4. Seismic coefficients (EC8 EN1998-5:2004, §7.3.2)

Design ground acceleration ratio	αg=αxg, α=0,10	(EC8-5 §7.3.2)
Verti./horiz. acceleration	αvg/αg=0,90	(EC8 §3.2.2.3)
Soil factor	S=1,00	(EC8 §3.2.2.2)
Importance factor	γI=1,00	(EC8 §3.2.1, T.4.3)
Reduction factor for seismic coefficient	r=1,50	(EC8-5 Table 7.1)
Coefficient for horisontal seismic force	kh=1,00x0,10x1,00/1,500=0,067	(EC8-5 Eq.7.1)
Coefficient for vertical seismic force	kv=0,50x0,067=0,034	(EC8-5 Eq.7.2)

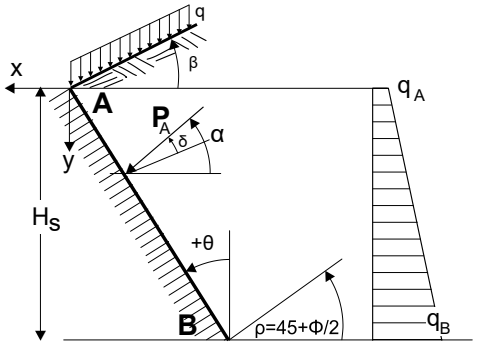
Forces due to seismic load (except from earth pressure)

Horisontal seismic force due to self weight Fwx= 80,26x0,067= 5,38 kN/m
Vertical seismic force due to self weight Fwy= 80,26x0,034= 2,73 kN/m

1.5. Computation of active earth pressure (Coulomb theory)

1.5.1. Wall part from Y=0,000 m to Y=3,000 m, Hs=3,000 m

Top point A x= 0,000 m y= 0,000 m
Bottom point B x= 0,392 m y= 3,000 m



Soil properties

Soil type : Thin gravel
Unit weight of soil γ =16,00 kN/m³
Unit weight of soil (saturated) γs=19,00 kN/m³
Unit weight of water γw=10,00 kN/m³
Angle of shearing resistance of ground φ=31,00°
Cohesion of ground c=0,003 N/mm²
Slope angle of ground surface β= 0,00°
Inclination angle of the wall backface θ=-7,44°
Angle of shear resist. between ground-wall δ=17,50°

Earth pressure according to Coulomb theory

	EQU	A1+M1	A2+M2
Angle of rupture plane ρ=45°+φ/2	= 57,40	60,50	57,40°
Coefficient of active earth pressure Ka=	0,318	0,239	0,318

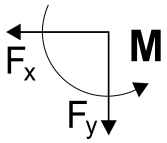
Earth pressure q(y)=qA+γ·y·Ka

$$K_A = \frac{\cos^2(\varphi-\theta)}{\cos^2\theta\,\cos(\theta+\delta)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\beta)}{\cos(\theta+\delta)\cos(\theta-\beta)}}\right]^2}$$

Permanent actions

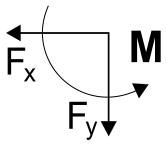
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	0,00	0,00	0,00	kN/m²
Earth pressure at the bottom (y=yA+ 3,00m)	qB=	15,26	11,47	15,26	kN/m²
Earth force Pa= ½(qA+qB)H	Pa=	22,89	17,20	22,89	kN/m
Angle of earth force	α =	6,56	10,06	6,56	°
Earth force in x direction	Pax=	22,74	16,94	22,74	kN/m
Earth force in y direction	Pay=	2,62	3,00	2,62	kN/m
Moment of earth force at top point (x=0,y=0)	M =	-44,80	-33,10	-44,80	kNm/m

Point of application of earth force x= 0,261 m, y= 2,000 m



Total forces and moments

Forces and moments at bottom point B (x=0,392 m, y=3,000 m)



Permanent actions

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	22,74	16,94	22,74	kN/m
Total vertical earth force	Fsy=	2,62	3,00	2,62	kN/m
Total moment of earth force	Ms =	22,40	16,55	22,40	kNm/m

Seismic loading (EC8 EN1998-5:2004, §7.3.2, Annex E)

Horizontal seismic coefficient kh=1,00x0,10x1,00/1,500=0,067 (EC8-5 Eq.7.1, T.7.1)
Vertical seismic coefficient kv=0,50x0,067=0,034 (EC8-5 Eq.7.2)
Soil above the water table (EC8-5 Annex E.5)
tan(ω)=kh/(1-kv)=0,067/(1-0,034)=0,069, ω=3,97°

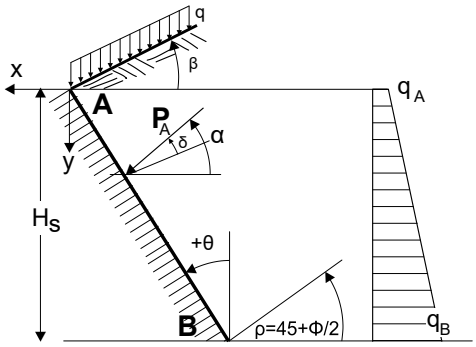
Method Mononobe-Okabe (EC8-5 Annex E.4)
for active earth force during seismic loading
Coefficient of active earth pressure, Ke*(STR)= 0,358
Additional earth pressure due to seismic load
over STR load case ξ=(Ke*/Ke-1)=(0,358/0,239-1)=0,498

$$K_E=\frac{\cos^2(\varphi-\omega-\theta)}{\cos\omega\cos^2\theta\cos(\delta+\theta+\omega)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\omega-\beta)}{\cos(\theta+\omega+\delta)\cos(\theta-\beta)}}\right]^2}$$

Earth force due to seismic load (Permanent actions) Fx=1,498x16,94=25,38 kN/m

1.5.2. Wall part from Y=3,000 m to Y=3,500 m, Hs=0,500 m

Top point A x= 0,392 m y= 3,000 m
Bottom point B x= 0,457 m y= 3,500 m



Soil properties

Soil type : Dense sand		
Unit weight of soil	γ	=21,00 kN/m³
Unit weight of soil (saturated)	γs	=22,50 kN/m³
Unit weight of water	γw	=10,00 kN/m³
Angle of shearing resistance of ground	φ	=38,00°
Cohesion of ground	c	=0,020 N/mm²
Slope angle of ground surface	β	= 0,00°
Inclination angle of the wall backface	θ	=-7,44°
Angle of shear resist. between ground-wall	δ	=17,50°

Loads on soil surface

Permanent uniform load	g=	48,00 kN/m²
Variable uniform load	q=	0,00 kN/m²

Earth pressure according to Coulomb theory

	EQU	A1+M1	A2+M2	
Angle of rupture plane ρ=45°+φ/2	=	60,20	64,00	60,20°
Coefficient of active earth pressure	Ka=	0,250	0,172	0,250

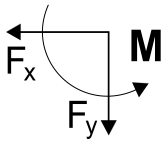
Earth pressure q(y)=qA+γ·y·Ka

$$K_A=\frac{\cos^2(\varphi-\theta)}{\cos^2\theta\cos(\theta+\delta)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\beta)}{\cos(\theta+\delta)\cos(\theta-\beta)}}\right]^2}$$

Permanent actions

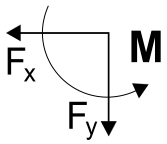
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	12,00	8,26	12,00	kN/m²
Earth pressure at the bottom (y=yA+ 0,50m)	qB=	14,62	10,07	14,62	kN/m²
Earth force Pa= ½(qA+qB)H	Pa=	6,65	4,58	6,65	kN/m
Angle of earth force	α =	6,56	10,06	6,56	°
Earth force in x direction	Pax=	6,61	4,51	6,61	kN/m
Earth force in y direction	Pay=	0,76	0,80	0,76	kN/m
Moment of earth force at top point (x=0,y=0)	M =	-21,21	-14,35	-21,21	kNm/m

Point of application of earth force x= 0,426 m, y= 3,258 m



Total forces and moments

Forces and moments at bottom point B (x=0,457 m, y=3,500 m)



Permanent actions

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	29,35	21,45	29,35	kN/m
Total vertical earth force	Fsy=	3,38	3,80	3,38	kN/m
Total moment of earth force	Ms =	35,18	25,89	35,18	kNm/m

Seismic loading (EC8 EN1998-5:2004, §7.3.2, Annex E)

Horizontal seismic coefficient kh=1,00x0,10x1,00/1,500=0,067 (EC8-5 Eq.7.1, T.7.1)
Vertical seismic coefficient kv=0,50x0,067=0,034 (EC8-5 Eq.7.2)
Soil above the water table (EC8-5 Annex E.5)
tan(ω)=kh/(1-kv)=0,067/(1-0,034)=0,069, ω=3,97°

Method Mononobe-Okabe (EC8-5 Annex E.4)
for active earth force during seismic loading
Coefficient of active earth pressure, Ke*(STR)= 0,283
Additional earth pressure due to seismic load
over STR load case ξ=(Ke*/Ke-1)=(0,283/0,172-1)=0,645

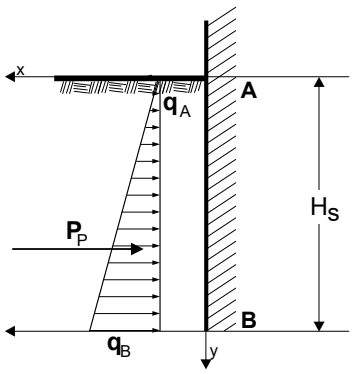
$$K_E = \frac{\cos^2(\varphi-\omega-\theta)}{\cos\omega\,\cos^2\theta\,\cos(\delta+\theta+\omega)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\omega-\beta)}{\cos(\theta+\omega+\delta)\cos(\theta-\beta)}}\right]^2}$$

Earth force due to seismic load (Permanent actions) Fx=1,645x 4,51= 7,42 kN/m

1.6. Computation of passive earth pressure (Rankine theory)

1.6.1. Wall part from Y=3,000 m to Y=3,500 m, Hs=0,500 m

Top point A x= 1,950 m y= 3,000 m
Bottom point B x= 1,950 m y= 3,500 m



Soil properties

Soil type : Dense sand

Unit weight of soil	γ	=21,00 kN/m³
Unit weight of soil (saturated)	γs	=22,50 kN/m³
Unit weight of water	γw	=10,00 kN/m³
Angle of shearing resistance of ground	φ	=38,00°
Cohesion of ground	c	=0,020 N/mm²
Slope angle of ground surface	β	= 0,00°
Earth pressure on vertical surface	θ	= 0,00°
Angle of shear resist. between ground-wall	δ	= 0,00°

Earth pressure according to Coulomb theory

	EQU	A1+M1	A2+M2	
Angle of rupture plane ρ=45°-φ/2	=	29,80	26,00	29,80°
Coefficient of passive earth pressure	Kp=	3,049	4,204	3,049

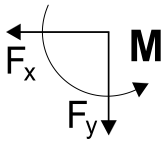
Earth pressure q(y)=qA+γ·y·Kp

$$K_p = \frac{\cos^2(\varphi+\theta)}{\cos^2\theta\,\cos(\theta-\delta)\left[1-\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi+\beta)}{\cos(\theta-\delta)\cos(\theta-\beta)}}\right]^2}$$

Permanent actions

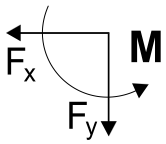
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	0,00	0,00	0,00	kN/m²
Earth pressure at the bottom (y=yA+ 0,50m)	qB=	-32,01	-44,14	-32,01	kN/m²
Earth force Pa= ½(qA+qB)H	Pp=	8,00	11,03	8,00	kN/m
Angle of earth force	α =	0,00	0,00	0,00	°
Earth force in x direction	Ppx=	-8,00	-11,03	-8,00	kN/m
Earth force in y direction	Ppy=	0,00	0,00	0,00	kN/m
Moment of earth force at top point (x=0,y=0)	M =	26,66	36,76	26,66	kNm/m

Point of application of earth force x= 1,950 m, y= 3,333 m



Total forces and moments

Forces and moments at bottom point B (x=1,950 m, y=3,500 m)



Permanent actions

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	-8,00	-11,03	-8,00	kN/m
Total vertical earth force	Fsy=	0,00	0,00	0,00	kN/m
Total moment of earth force	Ms =	-1,34	-1,84	-1,34	kNm/m

Seismic loading (EC8 EN1998-5:2004, §7.3.2, Annex E)

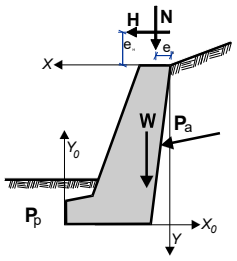
tan(ω)=kh/(1-kv)=0,067/(1-0,034)=0,069, ω=3,97°
Coefficient of passive earth pressure Kp*(STR)= 2,953
ξ=(Kp*/Kp)=(2,953/4,204)=0,702

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	-5,62	-7,75	-5,62	

1.7. Checks of wall stability (EQU)

1.7.1. Forces (driving and resisting) on the wall (EQU)

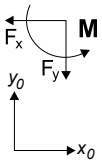
Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0,00- 3,00	22,74	2,62	0,261	2,000
Active earth pressure	Pa	3,00- 3,50	6,61	0,76	0,426	3,258
Passive earth pressure	Pp	3,00- 3,50	-8,00	0,00	1,950	3,333
Wall weight	W		0,00	80,26	0,842	1,926



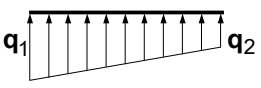
1.7.2. Check of soil bearing capacity (EQU) (EC7 EN1997-1-1:2004, §6.5.2)

Check for 0,90x(self weight+top vertical dead load)+0,00x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1,10	0,00- 3,00	25,01	2,88	1,689	1,500	32,65
Active earth pressure	Pax1,10	3,00- 3,50	7,27	0,84	1,524	0,242	0,48
Wall weight	W x0,90		0,00	72,23	1,108	1,574	-80,04
			Sum=	75,95			-46,91



Sum of vertical forces = 75,95 kN/m
Sum of moments at front toe = -46,91 kNm/m
Sum of moments at middle of base = 9,79 kNm/m
Eccentricity ec=9,79/75,95=0,129m, ec<=1,493/6=0,249m
Soil pressure q1=0,077 N/mm² q2=0,025 N/mm²

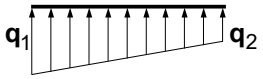


Effective footing L'=1,493-2x0,129= 1,235 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1,235x(1000x0,45)/1,40= 396,96 kN/m
Bearing resistance check Vd=75,95 < Rd=396,96 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1,10x(self weight+top vertical dead load)+1,50x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1,10	0,00- 3,00	25,01	2,88	1,689	1,500	32,65
Active earth pressure	Pax1,10	3,00- 3,50	7,27	0,84	1,524	0,242	0,48
Wall weight	W x1,10		0,00	88,29	1,108	1,574	-97,82
			Sum=	92,01			-64,69

Sum of vertical forces = 92,01 kN/m
Sum of moments at front toe = -64,69 kNm/m
Sum of moments at middle of base = 4,00 kNm/m
Eccentricity ec=4,00/92,01=0,043m, ec<=1,493/6=0,249m

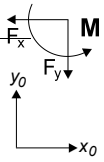


Soil pressure q1=0,072 N/mm² q2=0,051 N/mm²
Effective footing L'=1,493-2x0,043= 1,406 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1,406x(1000x0,45)/1,40= 451,93 kN/m
Bearing resistance check Vd=92,01 < Rd=451,93 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

1.7.3. Failure check due to overturning (EQU)

(EC7 EN1997-1-1:2004, §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=1,950,y=3,500 m)

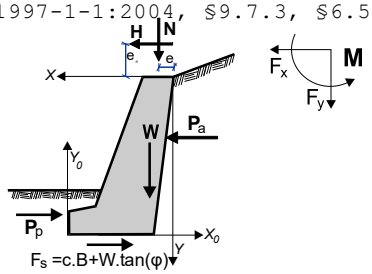


Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1,10	0,00- 3,00	25,01	2,88	1,689	1,500	37,52	4,87
Active earth pressure	Pax1,10	3,00- 3,50	7,27	0,84	1,524	0,242	1,76	1,28
Wall weight	W x0,90		0,00	72,23	1,108	1,574	0,00	80,04
		Sum=		75,95			39,28	86,19

Sum of overturning moments = 39,28 kNm/m
Sum of moments resisting overturning = 86,19 kNm/m
Overturning check Med=39,28 < Mrd=86,19 kNm/m, Is verified
Eccentricity ec=(1,493/2)-(86,19-39,28)/75,95=0,129m, ec<=1,493/3=0,498m

1.7.4. Failure check against sliding (EQU)

(EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)

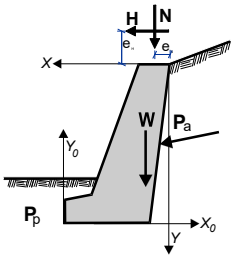


Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1,10	0,00- 3,00	25,01	0,00	2,88
Active earth pressure	Pax1,10	3,00- 3,50	7,27	0,00	0,84
Passive earth pressure	Ppx0,90	3,00- 3,50	0,00	7,20	0,00
Wall weight	W x0,90		0,00	0,00	72,23
		Sum=	32,28	7,20	75,95

Soil friction Rd=Nd·tanφ/γM = 75,95xtan(38,00°)/1,25= 47,47 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1,493x0,020/1,25= 23,89 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 32,28 kN/m
Sum of resisting forces (7,20/1,00+47,47) = 54,67 kN/m
Sliding resistance check Hd=32,28 < Rd=54,67 kN/m, Is verified

1.8. Checks of wall stability (STR/GEO A1+M1)

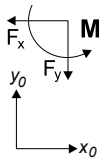
1.8.1. Forces (driving and resisting) on the wall (STR/GEO A1+M1)



Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0,00- 3,00	16,94	3,00	0,261	2,000
Active earth pressure	Pa	3,00- 3,50	4,51	0,80	0,426	3,258
Passive earth pressure	Pp	3,00- 3,50	-11,03	0,00	1,950	3,333
Wall weight	W		0,00	80,26	0,842	1,926

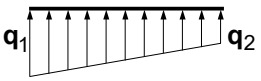
1.8.2. Check of soil bearing capacity (STR/GEO A1+M1) (EC7 EN1997-1-1:2004, §6.5.2)

Check for 1,00x(self weight+top vertical dead load)+0,00x(top vertical live load)



Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1,35	0,00- 3,00	22,87	4,05	1,689	1,500	27,46
Active earth pressure	Pax1,35	3,00- 3,50	6,09	1,08	1,524	0,242	-0,18
Wall weight	W x1,00		0,00	80,26	1,108	1,574	-88,93
			Sum=	85,39			-61,65

Sum of vertical forces = 85,39 kN/m
Sum of moments at front toe = -61,65 kNm/m
Sum of moments at middle of base = 2,09 kNm/m
Eccentricity ec=2,09/85,39=0,024m, ec<=1,493/6=0,249m

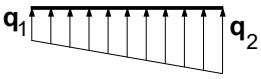


Soil pressure q1=0,063 N/mm² q2=0,052 N/mm²
Effective footing L'=1,493-2x0,024= 1,444 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1,444x(1000x0,45)/1,00= 649,80 kN/m
Bearing resistance check Vd=85,39 < Rd=649,80 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1,35x(self weight+top vertical dead load)+1,50x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1,35	0,00- 3,00	22,87	4,05	1,689	1,500	27,46
Active earth pressure	Pax1,35	3,00- 3,50	6,09	1,08	1,524	0,242	-0,18
Wall weight	W x1,35		0,00	108,35	1,108	1,574	-120,06
			Sum=	113,48			-92,78

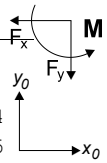
Sum of vertical forces = 113,48 kN/m
Sum of moments at front toe = -92,78 kNm/m
Sum of moments at middle of base = -8,07 kNm/m



Eccentricity ec=-8,07/113,48=-0,071m, ec<=1,493/6=0,249m
Soil pressure q1=0,054 N/mm² q2=0,098 N/mm²
Effective footing L'=1,493-2x0,071= 1,351 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1,351x(1000x0,45)/1,00= 607,95 kN/m
Bearing resistance check Vd=113,48 < Rd=607,95 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

1.8.3. Failure check due to overturning (STR/GEO A1+M1) (EC7 EN1997-1-1:2004, §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=1,950,y=3,500 m)

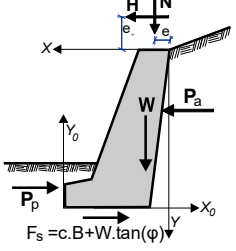


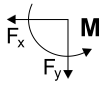
Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1,35	0,00- 3,00	22,87	4,05	1,689	1,500	34,30	6,84
Active earth pressure	Pax1,35	3,00- 3,50	6,09	1,08	1,524	0,242	1,47	1,65
Wall weight	W x1,00		0,00	80,26	1,108	1,574	0,00	88,93
		Sum=		85,39			35,77	97,42

Sum of overturning moments = 35,77 kNm/m
Sum of moments resisting overturning = 97,42 kNm/m
Overturning check Med=35,77 < Mrd=97,42 kNm/m, Is verified
Eccentricity ec=(1,493/2)-(97,42-35,77)/85,39=0,025m, ec<=1,493/3=0,498m

1.8.4. Failure check against sliding (STR/GEO A1+M1) (EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)

Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1,35	0,00- 3,00	22,87	0,00	4,05
Active earth pressure	Pax1,35	3,00- 3,50	6,09	0,00	1,08
Passive earth pressure	Ppx1,00	3,00- 3,50	0,00	11,03	0,00
Wall weight	W x1,00		0,00	0,00	80,26
		Sum=	28,96	11,03	85,39



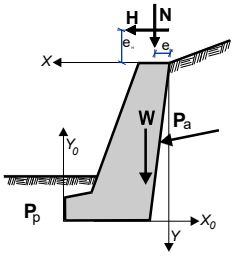


Soil friction Rd=Nd·tanφ/γM = 85,39xtan(38,00°)/1,00= 66,71 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1,493x0,020/1,00= 29,86 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 28,96 kN/m
Sum of resisting forces (11,03/1,00+66,71) = 77,74 kN/m
Sliding resistance check Hd=28,96 < Rd=77,74 kN/m, Is verified

1.9. Checks of wall stability (STR/GEO A2+M2)

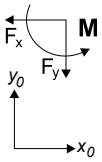
1.9.1. Forces (driving and resisting) on the wall (STR/GEO A2+M2)

Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0,00- 3,00	22,74	2,62	0,261	2,000
Active earth pressure	Pa	3,00- 3,50	6,61	0,76	0,426	3,258
Passive earth pressure	Pp	3,00- 3,50	-8,00	0,00	1,950	3,333
Wall weight	W		0,00	80,26	0,842	1,926



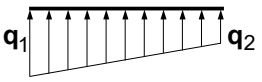
1.9.2. Check of soil bearing capacity (STR/GEO A2+M2) (EC7 EN1997-1-1:2004, §6.5.2)

Check for 1,00x(self weight+top vertical dead load)+0,00x(top vertical live load)



Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1,00	0,00- 3,00	22,74	2,62	1,689	1,500	29,68
Active earth pressure	Pax1,00	3,00- 3,50	6,61	0,76	1,524	0,242	0,44
Wall weight	W x1,00		0,00	80,26	1,108	1,574	-88,93
			Sum=	83,64			-58,81

Sum of vertical forces = 83,64 kN/m
Sum of moments at front toe = -58,81 kNm/m
Sum of moments at middle of base = 3,63 kNm/m
Eccentricity ec=3,63/83,64=0,043m, ec<=1,493/6=0,249m
Soil pressure q1=0,066 N/mm² q2=0,046 N/mm²

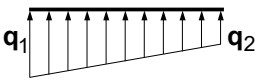


Effective footing L'=1,493-2x0,043= 1,406 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1,406x(1000x0,45)/1,40= 451,93 kN/m
Bearing resistance check Vd=83,64 < Rd=451,93 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1,00x(self weight+top vertical dead load)+1,30x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1,00	0,00- 3,00	22,74	2,62	1,689	1,500	29,68
Active earth pressure	Pax1,00	3,00- 3,50	6,61	0,76	1,524	0,242	0,44
Wall weight	W x1,00		0,00	80,26	1,108	1,574	-88,93
			Sum=	83,64			-58,81

Sum of vertical forces = 83,64 kN/m
Sum of moments at front toe = -58,81 kNm/m
Sum of moments at middle of base = 3,63 kNm/m
Eccentricity ec=3,63/83,64=0,043m, ec<=1,493/6=0,249m
Soil pressure q1=0,066 N/mm² q2=0,046 N/mm²

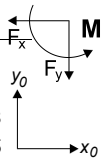


Effective footing L'=1,493-2x0,043= 1,406 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1,406x(1000x0,45)/1,40= 451,93 kN/m
Bearing resistance check Vd=83,64 < Rd=451,93 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

1.9.3. Failure check due to overturning (STR/GEO A2+M2)

(EC7 EN1997-1-1:2004, §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=1,950,y=3,500 m)

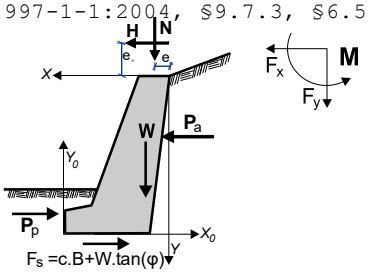


Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1,00	0,00- 3,00	22,74	2,62	1,689	1,500	34,11	4,43
Active earth pressure	Pax1,00	3,00- 3,50	6,61	0,76	1,524	0,242	1,60	1,16
Wall weight	W x1,00		0,00	80,26	1,108	1,574	0,00	88,93
		Sum=		83,64			35,71	94,52

Sum of overturning moments = 35,71 kNm/m
Sum of moments resisting overturning = 94,52 kNm/m
Overturning check Med=35,71 < Mrd=94,52 kNm/m, Is verified
Eccentricity ec=(1,493/2)-(94,52-35,71)/83,64=0,043m, ec<=1,493/3=0,498m

1.9.4. Failure check against sliding (STR/GEO A2+M2)

(EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)



Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1,00	0,00- 3,00	22,74	0,00	2,62
Active earth pressure	Pax1,00	3,00- 3,50	6,61	0,00	0,76
Passive earth pressure	Ppx1,00	3,00- 3,50	0,00	8,00	0,00
Wall weight	W x1,00		0,00	0,00	80,26
		Sum=	29,35	8,00	83,64

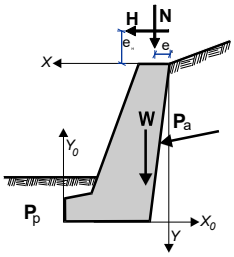
Soil friction Rd=Nd·tanφ/γM = 83,64xtan(38,00°)/1,25= 52,28 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1,493x0,020/1,25= 23,89 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 29,35 kN/m
Sum of resisting forces (8,00/1,00+52,28) = 60,28 kN/m
Sliding resistance check Hd=29,35 < Rd=60,28 kN/m, Is verified

1.10. Seismic design

(EC8 EN1998-5:2004)

Checks of wall stability (with seismic loading)

1.10.1. Forces (driving and resisting) on the wall



Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0,00- 3,00	16,94	3,00	0,261	1,500
Active earth pressure	Pa	3,00- 3,50	4,51	0,80	0,426	3,250
Passive earth pressure	Pp	3,00- 3,50	-7,75	0,00	1,950	3,333
Wall weight	W		0,00	80,26	0,842	1,926

1.10.2. Additional forces due to seismic load

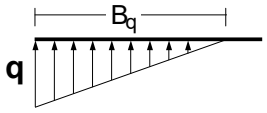
Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0,00- 3,00	8,44		0,261	1,500
Active earth pressure	Pa	3,00- 3,50	2,91		0,426	3,250
Wall weight	W		5,38	±2,73	0,842	1,926

1.10.3. Check of soil bearing capacity (with seismic loading)

(EC7 §6.5.2)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1,00	0,00- 3,00	25,38	3,00	1,689	2,000	45,68
Active earth pressure	Pax1,00	3,00- 3,50	7,42	0,80	1,524	0,250	0,63
Wall weight	W x1,00		5,38	77,53	1,108	1,574	-77,44
			Sum=	81,33			-31,13

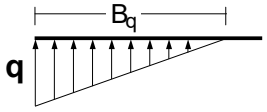
Sum of vertical forces = 81,33 kN/m
Sum of moments at front toe = -31,13 kNm/m
Sum of moments at middle of base = 29,58 kNm/m
Eccentricity ec=29,58/81,33=0,364m, ec>1,493/6=0,249m
Soil pressure q=0,142 N/mm² Bq=1,148 m
Effective footing L'=1,493-2x0,364= 0,766 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=0,766x(1000x0,45)/1,40= 246,21 kN/m
Bearing resistance check Vd=81,33 < Rd=246,21 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)



1.10.4. Check of soil bearing capacity (with seismic loading) (EC7 §6.5.2)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1,00	0,00- 3,00	25,38	3,00	1,689	2,000	45,68
Active earth pressure	Pax1,00	3,00- 3,50	7,42	0,80	1,524	0,250	0,63
Wall weight	W x1,00		5,38	82,99	1,108	1,574	-83,49
			Sum=	86,79			-37,18

Sum of vertical forces = 86,79 kN/m
Sum of moments at front toe = -37,18 kNm/m
Sum of moments at middle of base = 27,61 kNm/m
Eccentricity ec=27,61/86,79=0,318m, ec>1,493/6=0,249m
Soil pressure q=0,135 N/mm² Bq=1,285 m
Effective footing L'=1,493-2x0,318= 0,857 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=0,857x(1000x0,45)/1,40= 275,46 kN/m
Bearing resistance check Vd=86,79 < Rd=275,46 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)



1.10.5. Failure check due to overturning (with seismic loading) (EC7 §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=1,950,y=3,500 m)

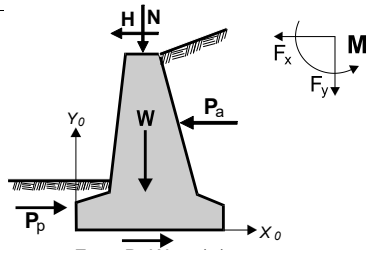
Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1,00	0,00- 3,00	25,38	3,00	1,689	2,000	50,75	5,07
Active earth pressure	Pax1,00	3,00- 3,50	7,42	0,80	1,524	0,250	1,85	1,22
Wall weight	W x1,00		5,38	80,26	1,108	1,574	8,47	88,93
Wall weight	W x1,00		0,00	-2,73	1,108	1,574	3,02	0,00*
		Sum=		81,33			64,09	95,22

(*moments of negative seismic vertical loads, are added to the overturning moments)

Sum of overturning moments = 64,09 kNm/m
Sum of moments resisting overturning = 95,22 kNm/m
Overturning check Med=64,09 < Mrd=95,22 kNm/m, Is verified
Eccentricity ec=(1,493/2)-(95,22-64,09)/81,33=0,364m, ec<=1,493/3=0,498m

1.10.6. Failure check against sliding (with seismic loading) (EC7 §9.7.3, §6.5.3, EC8-5 §5.4.1.1)

Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1,00	0,00- 3,00	25,38	0,00	3,00
Active earth pressure	Pax1,00	3,00- 3,50	7,42	0,00	0,80
Passive earth pressure	Ppx1,00	3,00- 3,50	0,00	7,75	0,00
Wall weight	W x1,00		5,38	0,00	77,53
		Sum=	38,18	7,75	81,33



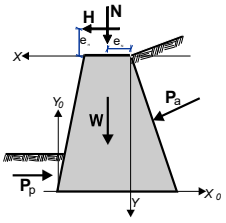
Soil friction Rd=Nd·tanφ/γM = 81,33xtan(38,00°)/1,25= 50,83 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1,148x0,020/1,25= 18,37 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 38,18 kN/m
Sum of resisting forces (7,75/1,00+50,83) = 58,58 kN/m
Sliding resistance check Hd=38,18 < Rd=58,58 kN/m, Is verified

1.11. Design of wall stem

1.11.1. Loading 1,35x(permanent unfavorable)+1,00x(permanent favorable)+1,50x(variable unfav.)

Forces (at centroid of cross section) and stresses at wall stem
x, y:cross section centroid, b:cross section width, e:eccentricity
Fx:horizontal force, Fy:vertical force, M:moment, e/b:relative eccentricity
σ1, σ2, τ :cross section normal and shear stress, Bq:effective cross section width

y [m]	x [m]	b [m]	Fx [kN/m]	Fy [kN/m]	M [kNm/m]	e/b	σ1 [N/mm²]	σ2 [N/mm²]	Bq/B	τ [N/mm²]
0,50	0,515	0,899	0,63	8,60	-0,43	0,055	-0,006	-0,013	1,000	0,001
1,00	0,630	0,998	2,54	18,43	-1,38	0,075	-0,010	-0,027	1,000	0,003
1,50	0,744	1,097	5,71	29,47	-2,40	0,074	-0,015	-0,039	1,000	0,005
2,00	0,859	1,196	10,17	41,73	-3,03	0,061	-0,022	-0,048	1,000	0,008
2,50	0,974	1,295	15,89	55,20	-2,74	0,038	-0,033	-0,052	1,000	0,012
3,00	1,089	1,394	22,88	69,88	-1,09	0,011	-0,047	-0,054	1,000	0,016
3,50	1,203	1,493	28,96	85,39	2,13	-0,017	-0,063	-0,051	1,000	0,019



1.11.2. Strength check according toEC6 EN1996-1-1:2005

Strength check in normal stresses Ned<=Nrd (EC6 §6.1.2)
Vertical resistance load Nrd=Φ.fk.t/γM, Vertical design load Ned (EC6 §6.1.2)
Φ=1-2e/t, Φ capacity reduction factor for slenderness and eccentricity of loading
e=load eccentricity+es, es=accidental eccentricity=h/450, h=wall height
fk characteristic compressive strength fk= 3,50 N/mm²
γM= 2,50, γM partial safety factor for the material

y [m]	t [m]	Fy [kN/m]	M [kNm/m]	e/t	Φ	Ned [kN/m]	Nrd [kN/m]	
0,50	0,899	8,60	-0,43	0,056	0,888	8,60	1117,64	(Ned<=Nrd)
1,00	0,998	18,43	-1,38	0,077	0,846	18,43	1182,03	(Ned<=Nrd)
1,50	1,097	29,47	-2,40	0,077	0,846	29,47	1299,29	(Ned<=Nrd)
2,00	1,196	41,73	-3,03	0,065	0,870	41,73	1456,73	(Ned<=Nrd)
2,50	1,295	55,20	-2,74	0,042	0,916	55,20	1660,71	(Ned<=Nrd)
3,00	1,394	69,88	-1,09	0,016	0,968	69,88	1889,15	(Ned<=Nrd)
3,50	1,493	85,39	2,13	0,022	0,956	85,39	1998,23	(Ned<=Nrd)

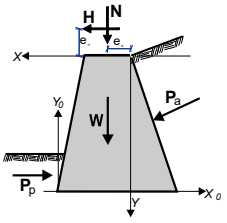
Design for shear strength Ved<=Vrd (EC6 §6.2.1)
Shear resistance Vrd=fvk·t/γM, design shear load Ved (EC6 §6.2.1)
fvk=fvko+0.40xσd ,σd design compressive stress (EC6 §3.6.2)
fvko shear strength under zero compressive stress fvko= 0,20 N/mm²
γM= 2,50, γM partial safety factor for the material

y [m]	t [m]	Fx [kN/m]	σd [N/mm²]	Ved [kN/m]	Vrd [kN/m]	
0,50	0,899	0,63	0,010	0,63	73,36	(Ved<=Vrd)
1,00	0,998	2,54	0,018	2,54	82,71	(Ved<=Vrd)
1,50	1,097	5,71	0,027	5,71	92,50	(Ved<=Vrd)
2,00	1,196	10,17	0,035	10,17	102,38	(Ved<=Vrd)
2,50	1,295	15,89	0,043	15,89	112,51	(Ved<=Vrd)
3,00	1,394	22,88	0,050	22,88	122,67	(Ved<=Vrd)
3,50	1,493	28,96	0,057	28,96	133,06	(Ved<=Vrd)

1.11.3. Loading 1,00x(permanent unfav.)+1,00x(permanent favor.)+0,30x(variable)+1,00x(seismic)

Forces (at centroid of cross section) and stresses at wall stem (with seismic loading)
x, y:cross section centroid, b:cross section width, e:eccentricity
Fx:horizontal force, Fy:vertical force, M:moment, e/b:relative eccentricity
σ1, σ2, τ :cross section normal and shear stress, Bq:effective cross section width

y [m]	x [m]	b [m]	Fx [kN/m]	Fy [kN/m]	M [kNm/m]	e/b	σ1 [N/mm²]	σ2 [N/mm²]	Bq/B	τ [N/mm²]
0,50	0,515	0,899	1,27	8,29	-0,19	0,024	-0,008	-0,011	1,000	0,001
1,00	0,630	0,998	4,02	17,70	-0,11	0,006	-0,018	-0,019	1,000	0,004
1,50	0,744	1,097	8,24	28,24	1,17	-0,036	-0,033	-0,021	1,000	0,008
2,00	0,859	1,196	13,95	39,90	4,59	-0,092	-0,054	-0,016	1,000	0,012
2,50	0,974	1,295	21,14	52,68	11,13	-0,156	-0,082	-0,003	1,000	0,016
3,00	1,089	1,394	29,80	66,59	21,70	-0,223	-0,121	0,000	0,832	0,021
3,50	1,203	1,493	38,18	81,33	16,93	-0,133	-0,103	-0,012	1,000	0,026



1.11.4. Strength check according toEC6 EN1996-1-1:2005 (with seismic loading)

Strength check in normal stresses Ned<=Nrd (with seismic loading) (EC6 §6.1.2)
Vertical resistance load Nrd=Φ.fk.t/γM, Vertical design load Ned (EC6 §6.1.2)
Φ=1-2e/t, Φ capacity reduction factor for slenderness and eccentricity of loading
e=load eccentricity+es, es=accidental eccentricity=h/450, h=wall height
fk characteristic compressive strength fk= 3,50 N/mm²
γM= 2,50, γM partial safety factor for the material

y [m]	t [m]	Fy [kN/m]	M [kNm/m]	e/t	Φ	Ned [kN/m]	Nrd [kN/m]	
0,50	0,899	8,29	-0,19	0,025	0,950	8,29	1195,67	(Ned<=Nrd)
1,00	0,998	17,70	-0,11	0,008	0,984	17,70	1374,84	(Ned<=Nrd)
1,50	1,097	28,24	1,17	0,039	0,922	28,24	1416,01	(Ned<=Nrd)
2,00	1,196	39,90	4,59	0,096	0,808	39,90	1352,92	(Ned<=Nrd)
2,50	1,295	52,68	11,13	0,160	0,680	52,68	1232,84	(Ned<=Nrd)
3,00	1,394	66,59	21,70	0,228	0,544	66,59	1061,67	(Ned<=Nrd)
3,50	1,493	81,33	16,93	0,138	0,724	81,33	1513,30	(Ned<=Nrd)

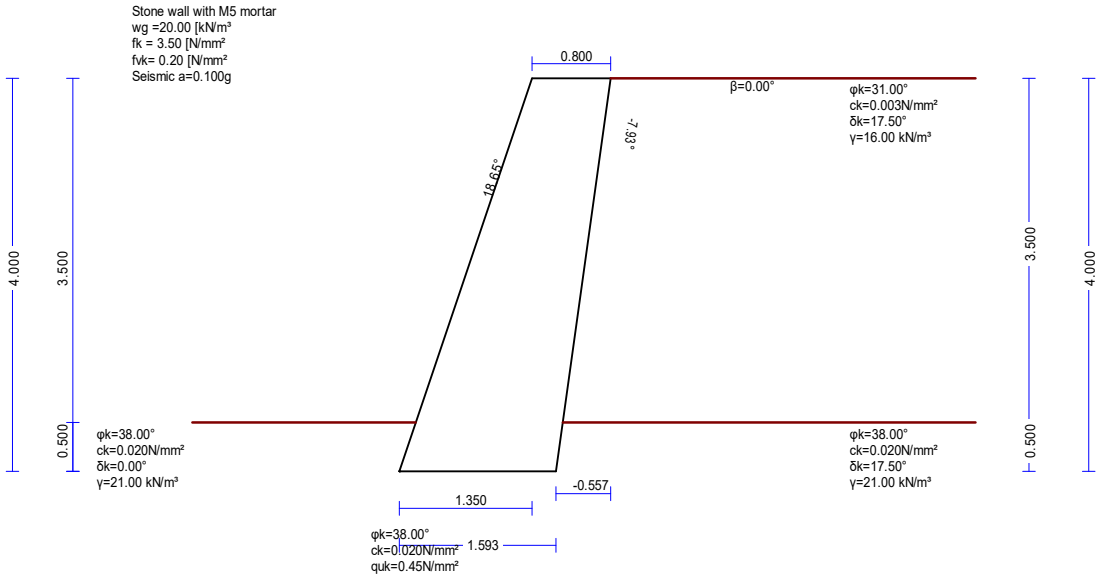
Design for shear strength Ved<=Vrd (with seismic loading) (EC6 §6.2.1)
Shear resistance Vrd=fvk·t/γM, design shear load Ved (EC6 §6.2.1)
fvk=fvko+0.40xσd ,σd design compressive stress (EC6 §3.6.2)
fvko shear strength under zero compressive stress fvko= 0,20 N/mm²
γM= 2,50, γM partial safety factor for the material

y [m]	t [m]	Fx [kN/m]	σd [N/mm²]	Ved [kN/m]	Vrd [kN/m]	
0,50	0,899	1,27	0,009	1,27	73,21	(Ved<=Vrd)
1,00	0,998	4,02	0,018	4,02	82,71	(Ved<=Vrd)
1,50	1,097	8,24	0,026	8,24	92,32	(Ved<=Vrd)
2,00	1,196	13,95	0,033	13,95	101,99	(Ved<=Vrd)
2,50	1,295	21,14	0,041	21,14	112,10	(Ved<=Vrd)
3,00	1,394	29,80	0,048	29,80	122,23	(Ved<=Vrd)
3,50	1,493	38,18	0,054	38,18	132,34	(Ved<=Vrd)

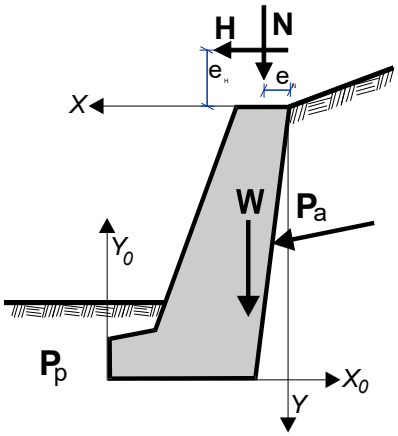
2. PKZ-2

Gravity retaining wall

(EC2 EN1992-1-1:2004, EC0 EN1990:2002, EC7 EN1997-1-1:2004, EC8 EN1998-5:2004,)



2.1. Wall properties-Parameters-Code requirements



Dimensions

Height of wall	h= 4.000 m
Transverse length of wall	L=10.000 m
Stem thickness at top	B1= 0.800 m
Stem thickness at bottom	B2= 1.593 m
Width of wall base	B= 1.593 m
Width of wall toe	0.000 m
Height of wall stem	ho= 4.000 m
Thickness of wall footing	0.000 m
Front thickness of wall toe	0.000 m
Slope (batter) at front face	18.650° (1:2.96)
Slope (batter) at back face	-7.927° (1:7.18)

Weight of wall

Unit weight of wall material	γg=20.000 kN/m³
Cross section area of wall	A= 4.786 m²
Self weight per meter of wall	W= 4.786x20.000= 95.72 kN/m
Center of gravity of wall at	x=0.929 m, y=2.221 m (xo=1.221 m, yo=1.779 m)

Wall materials

Compressive strength	3.50 N/mm²
Shear strength	0.20 N/mm²

2.2. Partial factors for actions and soil properties (EC7 Tab. A.1-A.4, EC8-5 §3.1)

Equilibrium limit state (EQU), Structural limit state (STR), Geotechnical limit state (GEO)

				(EQU)	(STR/GEO) (A1+M1)	(STR/GEO) (A2+M2)	(Seismic)
Actions	Permanent	Unfavorable	γGdst:	1.10	1.35	1.00	1.00
	Permanent	Favorable	γGstb:	0.90	1.00	1.00	1.00
	Variable	Unfavorable	γQdst:	1.50	1.50	1.30	1.00
	Variable	Favorable	γQstb:	0.00	0.00	0.00	0.00
Soil parameters	Angle of shearing resistance		γφ:	1.25	1.00	1.25	1.25
	Effective cohesion		γc:	1.25	1.00	1.25	1.25
	Undrained shear strength		γcu:	1.40	1.00	1.40	1.40
	Unconfined strength		γqu:	1.40	1.00	1.40	1.40
	Weight density		γw:	1.00	1.00	1.00	1.00

γR,v(R1)=1.00, γR,h(R1)=1.00, γR,e(R1)=1.00

2.3. Properties of foundation soil

Bearing capacity of foundation soil qu=0.45 N/mm²
Friction angle between wall footing and soil φ=38.00°, friction coefficient tan(φ)=0.781
Cohesion between wall footing and soil c=0.020 N/mm²

2.4. Seismic coefficients (EC8 EN1998-5:2004, §7.3.2)

Design ground acceleration ratio	αg=αxg, α=0.10	(EC8-5 §7.3.2)
Verti./horiz. acceleration	αvg/αg=0.90	(EC8 §3.2.2.3)
Soil factor	S=1.00	(EC8 §3.2.2.2)
Importance factor	γI=1.00	(EC8 §3.2.1, T.4.3)
Reduction factor for seismic coefficient	r=1.50	(EC8-5 Table 7.1)
Coefficient for horisontal seismic force	kh=1.00x0.10x1.00/1.500=0.067	(EC8-5 Eq.7.1)
Coefficient for vertical seismic force	kv=0.50x0.067=0.034	(EC8-5 Eq.7.2)

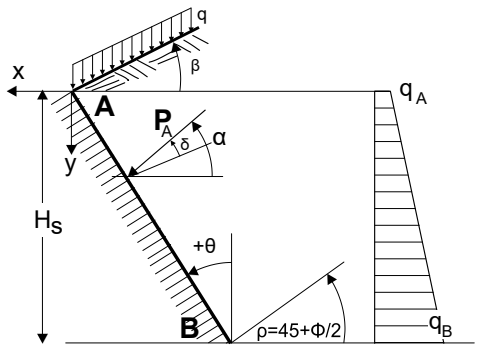
Forces due to seismic load (except from earth pressure)

Horisontal seismic force due to self weight Fwx= 95.72x0.067= 6.41 kN/m
Vertical seismic force due to self weight Fwy= 95.72x0.034= 3.25 kN/m

2.5. Computation of active earth pressure (Coulomb theory)

2.5.1. Wall part from Y=0.000 m to Y=3.500 m, Hs=3.500 m

Top point A x= 0.000 m y= 0.000 m
Bottom point B x= 0.487 m y= 3.500 m



Soil properties

Soil type : Thin gravel
Unit weight of soil γ =16.00 kN/m³
Unit weight of soil (saturated) γs=19.00 kN/m³
Unit weight of water γw=10.00 kN/m³
Angle of shearing resistance of ground φ=31.00°
Cohesion of ground c=0.003 N/mm²
Slope angle of ground surface β= 0.00°
Inclination angle of the wall backface θ=-7.93°
Angle of shear resist. between ground-wall δ=17.50°

Earth pressure according to Coulomb theory

	EQU	A1+M1	A2+M2
Angle of rupture plane ρ=45°+φ/2	= 57.40	60.50	57.40°
Coefficient of active earth pressure Ka=	0.315	0.236	0.315

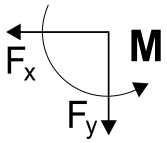
Earth pressure q(y)=qA+γ·y·Ka

$$K_A = \frac{\cos^2(\varphi-\theta)}{\cos^2\theta\,\cos(\theta+\delta)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\beta)}{\cos(\theta+\delta)\cos(\theta-\beta)}}\right]^2}$$

Permanent actions

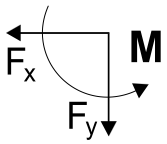
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	0.00	0.00	0.00	kN/m²
Earth pressure at the bottom (y=yA+ 3.50m)	qB=	17.64	13.22	17.64	kN/m²
Earth force Pa= ½(qA+qB)H	Pa=	30.87	23.14	30.87	kN/m
Angle of earth force	α =	6.07	9.57	6.07	°
Earth force in x direction	Pax=	30.70	22.82	30.70	kN/m
Earth force in y direction	Pay=	3.27	3.85	3.27	kN/m
Moment of earth force at top point (x=0,y=0)	M =	-70.56	-51.99	-70.56	kNm/m

Point of application of earth force x= 0.325 m, y= 2.333 m



Total forces and moments

Forces and moments at bottom point B (x=0.487 m, y=3.500 m)



Permanent actions

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	30.70	22.82	30.70	kN/m
Total vertical earth force	Fsy=	3.27	3.85	3.27	kN/m
Total moment of earth force	Ms =	35.30	26.01	35.30	kNm/m

Seismic loading (EC8 EN1998-5:2004, §7.3.2, Annex E)

Horizontal seismic coefficient kh=1.00x0.10x1.00/1.500=0.067 (EC8-5 Eq.7.1, T.7.1)
Vertical seismic coefficient kv=0.50x0.067=0.034 (EC8-5 Eq.7.2)
Soil above the water table (EC8-5 Annex E.5)
tan(ω)=kh/(1-kv)=0.067/(1-0.034)=0.069, ω=3.97°

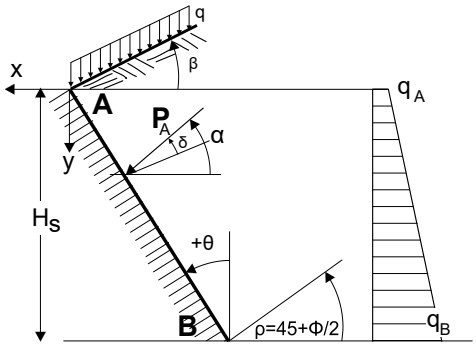
Method Mononobe-Okabe (EC8-5 Annex E.4)
for active earth force during seismic loading
Coefficient of active earth pressure, Ke*(STR)= 0.355
Additional earth pressure due to seismic load
over STR load case ξ=(Ke*/Ke-1)=(0.355/0.236-1)=0.504

$$K_E=\frac{\cos^2(\varphi-\omega-\theta)}{\cos\omega\cos^2\theta\cos(\delta+\theta+\omega)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\omega-\beta)}{\cos(\theta+\omega+\delta)\cos(\theta-\beta)}}\right]^2}$$

Earth force due to seismic load (Permanent actions) Fx=1.504x22.82=34.32 kN/m

2.5.2. Wall part from Y=3.500 m to Y=4.000 m, Hs=0.500 m

Top point A x= 0.487 m y= 3.500 m
Bottom point B x= 0.557 m y= 4.000 m



Soil properties

Soil type : Dense sand		
Unit weight of soil	γ	=21.00 kN/m³
Unit weight of soil (saturated)	γs	=22.50 kN/m³
Unit weight of water	γw	=10.00 kN/m³
Angle of shearing resistance of ground	φ	=38.00°
Cohesion of ground	c	=0.020 N/mm²
Slope angle of ground surface	β	= 0.00°
Inclination angle of the wall backface	θ	=-7.93°
Angle of shear resist. between ground-wall	δ	=17.50°

Loads on soil surface

Permanent uniform load	g=	56.00 kN/m²
Variable uniform load	q=	0.00 kN/m²

Earth pressure according to Coulomb theory

	EQU	A1+M1	A2+M2	
Angle of rupture plane ρ=45°+φ/2	=	60.20	64.00	60.20°
Coefficient of active earth pressure Ka=		0.247	0.169	0.247

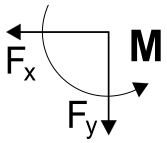
Earth pressure q(y)=qA+γ·y·Ka

$$K_A=\frac{\cos^2(\varphi-\theta)}{\cos^2\theta\cos(\theta+\delta)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\beta)}{\cos(\theta+\delta)\cos(\theta-\beta)}}\right]^2}$$

Permanent actions

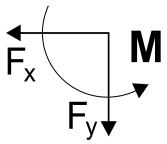
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	13.83	9.46	13.83	kN/m²
Earth pressure at the bottom (y=yA+ 0.50m)	qB=	16.42	11.23	16.42	kN/m²
Earth force Pa= ½(qA+qB)H	Pa=	7.56	5.17	7.56	kN/m
Angle of earth force	α =	6.07	9.57	6.07	°
Earth force in x direction	Pax=	7.52	5.10	7.52	kN/m
Earth force in y direction	Pay=	0.80	0.86	0.80	kN/m
Moment of earth force at top point (x=0,y=0)	M =	-27.83	-18.71	-27.83	kNm/m

Point of application of earth force x= 0.523 m, y= 3.757 m



Total forces and moments

Forces and moments at bottom point B (x=0.557 m, y=4.000 m)



Permanent actions

	EQU	A1+M1	A2+M2	
Total horizontal earth force Fsx=	38.22	27.92	38.22	kN/m
Total vertical earth force Fsy=	4.07	4.71	4.07	kN/m
Total moment of earth force Ms =	52.22	38.36	52.22	kNm/m

Seismic loading (EC8 EN1998-5:2004, §7.3.2, Annex E)

Horizontal seismic coefficient kh=1.00x0.10x1.00/1.500=0.067 (EC8-5 Eq.7.1, T.7.1)
Vertical seismic coefficient kv=0.50x0.067=0.034 (EC8-5 Eq.7.2)
Soil above the water table (EC8-5 Annex E.5)
tan(ω)=kh/(1-kv)=0.067/(1-0.034)=0.069, ω=3.97°

Method Mononobe-Okabe (EC8-5 Annex E.4)
for active earth force during seismic loading
Coefficient of active earth pressure, Ke*(STR)= 0.280
Additional earth pressure due to seismic load
over STR load case ξ=(Ke*/Ke-1)=(0.280/0.169-1)=0.657

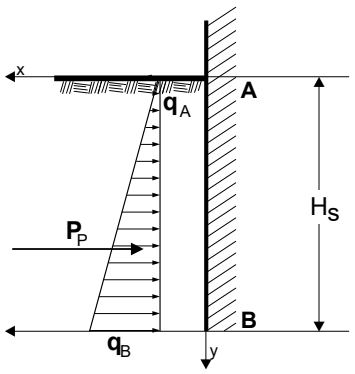
$$K_E = \frac{\cos^2(\varphi-\omega-\theta)}{\cos\omega\,\cos^2\theta\,\cos(\delta+\theta+\omega)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\omega-\beta)}{\cos(\theta+\omega+\delta)\cos(\theta-\beta)}}\right]^2}$$

Earth force due to seismic load (Permanent actions) Fx=1.657x 5.10= 8.45 kN/m

2.6. Computation of passive earth pressure (Rankine theory)

2.6.1. Wall part from Y=3.500 m to Y=4.000 m, Hs=0.500 m

Top point A x= 2.150 m y= 3.500 m
Bottom point B x= 2.150 m y= 4.000 m



Soil properties

Soil type : Dense sand

Unit weight of soil	γ =	21.00 kN/m³
Unit weight of soil (saturated)	γs=	22.50 kN/m³
Unit weight of water	γw=	10.00 kN/m³
Angle of shearing resistance of ground	φ=	38.00°
Cohesion of ground	c=	0.020 N/mm²
Slope angle of ground surface	β=	0.00°
Earth pressure on vertical surface	θ=	0.00°
Angle of shear resist. between ground-wall	δ=	0.00°

Earth pressure according to Coulomb theory

	EQU	A1+M1	A2+M2	
Angle of rupture plane ρ=45°-φ/2	=	29.80	26.00	29.80°
Coefficient of passive earth pressure Kp=	3.049	4.204	3.049	

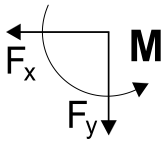
Earth pressure q(y)=qA+γ·y·Kp

$$K_p = \frac{\cos^2(\varphi+\theta)}{\cos^2\theta\,\cos(\theta-\delta)\left[1-\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi+\beta)}{\cos(\theta-\delta)\cos(\theta-\beta)}}\right]^2}$$

Permanent actions

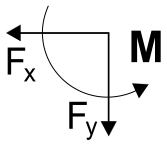
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	0.00	0.00	0.00	kN/m²
Earth pressure at the bottom (y=yA+ 0.50m)	qB=	-32.01	-44.14	-32.01	kN/m²
Earth force Pa= ½(qA+qB)H	Pp=	8.00	11.03	8.00	kN/m
Angle of earth force	α =	0.00	0.00	0.00	°
Earth force in x direction	Ppx=	-8.00	-11.03	-8.00	kN/m
Earth force in y direction	Ppy=	0.00	0.00	0.00	kN/m
Moment of earth force at top point (x=0,y=0)	M =	30.66	42.28	30.66	kNm/m

Point of application of earth force x= 2.150 m, y= 3.833 m



Total forces and moments

Forces and moments at bottom point B (x=2.150 m, y=4.000 m)



Permanent actions

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	-8.00	-11.03	-8.00	kN/m
Total vertical earth force	Fsy=	0.00	0.00	0.00	kN/m
Total moment of earth force	Ms =	-1.34	-1.84	-1.34	kNm/m

Seismic loading (EC8 EN1998-5:2004, §7.3.2, Annex E)

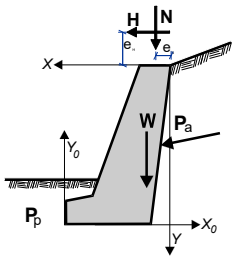
tan(ω)=kh/(1-kv)=0.067/(1-0.034)=0.069, ω=3.97°
Coefficient of passive earth pressure Kp*(STR)= 2.953
ξ=(Kp*/Kp)=(2.953/4.204)=0.702

		EQU	A1+M1	A2+M2
Total horizontal earth force	Fsx=	-5.62	-7.75	-5.62

2.7. Checks of wall stability (EQU)

2.7.1. Forces (driving and resisting) on the wall (EQU)

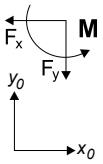
Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 3.50	30.70	3.27	0.325	2.333
Active earth pressure	Pa	3.50- 4.00	7.52	0.80	0.523	3.757
Passive earth pressure	Pp	3.50- 4.00	-8.00	0.00	2.150	3.833
Wall weight	W		0.00	95.72	0.929	2.221



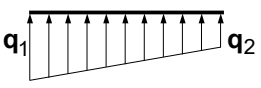
2.7.2. Check of soil bearing capacity (EQU) (EC7 EN1997-1-1:2004, §6.5.2)

Check for 0.90x(self weight+top vertical dead load)+0.00x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.10	0.00- 3.50	33.77	3.60	1.825	1.667	49.73
Active earth pressure	Pax1.10	3.50- 4.00	8.27	0.88	1.627	0.243	0.58
Wall weight	W x0.90		0.00	86.15	1.221	1.779	-105.18
			Sum=	90.63			-54.87



Sum of vertical forces = 90.63 kN/m
Sum of moments at front toe = -54.87 kNm/m
Sum of moments at middle of base = 17.32 kNm/m
Eccentricity ec=17.32/90.63=0.191m, ec<=1.593/6=0.266m
Soil pressure q1=0.098 N/mm² q2=0.016 N/mm²

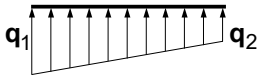


Effective footing L'=1.593-2x0.191= 1.211 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.211x(1000x0.45)/1.40= 389.25 kN/m
Bearing resistance check Vd=90.63 < Rd=389.25 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1.10x(self weight+top vertical dead load)+1.50x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.10	0.00- 3.50	33.77	3.60	1.825	1.667	49.73
Active earth pressure	Pax1.10	3.50- 4.00	8.27	0.88	1.627	0.243	0.58
Wall weight	W x1.10		0.00	105.29	1.221	1.779	-128.56
			Sum=	109.77			-78.25

Sum of vertical forces = 109.77 kN/m
Sum of moments at front toe = -78.25 kNm/m
Sum of moments at middle of base = 9.18 kNm/m
Eccentricity ec=9.18/109.77=0.084m, ec<=1.593/6=0.266m

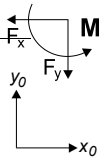


Soil pressure q1=0.091 N/mm² q2=0.047 N/mm²
Effective footing L'=1.593-2x0.084= 1.426 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.426x(1000x0.45)/1.40= 458.36 kN/m
Bearing resistance check Vd=109.77 < Rd=458.36 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

2.7.3. Failure check due to overturning (EQU)

(EC7 EN1997-1-1:2004, §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=2.150,y=4.000 m)

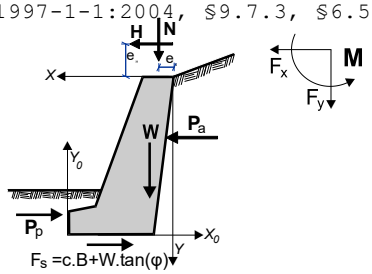


Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.10	0.00- 3.50	33.77	3.60	1.825	1.667	56.30	6.57
Active earth pressure	Pax1.10	3.50- 4.00	8.27	0.88	1.627	0.243	2.01	1.43
Wall weight	W x0.90		0.00	86.15	1.221	1.779	0.00	105.18
		Sum=		90.63			58.31	113.18

Sum of overturning moments = 58.31 kNm/m
Sum of moments resisting overturning = 113.18 kNm/m
Overturning check Med=58.31 < Mrd=113.18 kNm/m, Is verified
Eccentricity ec=(1.593/2)-(113.18-58.31)/90.63=0.191m, ec<=1.593/3=0.531m

2.7.4. Failure check against sliding (EQU)

(EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)

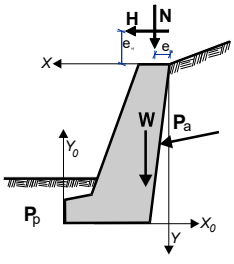


Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.10	0.00- 3.50	33.77	0.00	3.60
Active earth pressure	Pax1.10	3.50- 4.00	8.27	0.00	0.88
Passive earth pressure	Ppx0.90	3.50- 4.00	0.00	7.20	0.00
Wall weight	W x0.90		0.00	0.00	86.15
		Sum=	42.04	7.20	90.63

Soil friction Rd=Nd·tanφ/γM = 90.63xtan(38.00°)/1.25= 56.65 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1.593x0.020/1.25= 25.49 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 42.04 kN/m
Sum of resisting forces (7.20/1.00+56.65) = 63.85 kN/m
Sliding resistance check Hd=42.04 < Rd=63.85 kN/m, Is verified

2.8. Checks of wall stability (STR/GEO A1+M1)

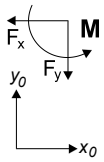
2.8.1. Forces (driving and resisting) on the wall (STR/GEO A1+M1)



Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 3.50	22.82	3.85	0.325	2.333
Active earth pressure	Pa	3.50- 4.00	5.10	0.86	0.523	3.757
Passive earth pressure	Pp	3.50- 4.00	-11.03	0.00	2.150	3.833
Wall weight	W		0.00	95.72	0.929	2.221

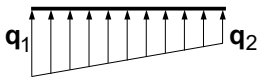
2.8.2. Check of soil bearing capacity (STR/GEO A1+M1) (EC7 EN1997-1-1:2004, §6.5.2)

Check for 1.00x(self weight+top vertical dead load)+0.00x(top vertical live load)



Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.35	0.00- 3.50	30.81	5.20	1.825	1.667	41.86
Active earth pressure	Pax1.35	3.50- 4.00	6.89	1.16	1.627	0.243	-0.22
Wall weight	W x1.00		0.00	95.72	1.221	1.779	-116.87
			Sum=	102.08			-75.23

Sum of vertical forces = 102.08 kN/m
Sum of moments at front toe = -75.23 kNm/m
Sum of moments at middle of base = 6.08 kNm/m
Eccentricity ec=6.08/102.08=0.060m, ec<=1.593/6=0.266m

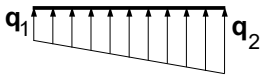


Soil pressure q1=0.078 N/mm² q2=0.050 N/mm²
Effective footing L'=1.593-2x0.060= 1.474 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.474x(1000x0.45)/1.00= 663.30 kN/m
Bearing resistance check Vd=102.08 < Rd=663.30 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1.35x(self weight+top vertical dead load)+1.50x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.35	0.00- 3.50	30.81	5.20	1.825	1.667	41.86
Active earth pressure	Pax1.35	3.50- 4.00	6.89	1.16	1.627	0.243	-0.22
Wall weight	W x1.35		0.00	129.22	1.221	1.779	-157.77
			Sum=	135.58			-116.13

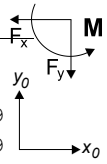
Sum of vertical forces = 135.58 kN/m
Sum of moments at front toe = -116.13 kNm/m
Sum of moments at middle of base = -8.14 kNm/m
Eccentricity ec=-8.14/135.58=-0.060m, ec<=1.593/6=0.266m



Soil pressure q1=0.066 N/mm² q2=0.104 N/mm²
Effective footing L'=1.593-2x0.060= 1.473 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.473x(1000x0.45)/1.00= 662.85 kN/m
Bearing resistance check Vd=135.58 < Rd=662.85 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

2.8.3. Failure check due to overturning (STR/GEO A1+M1) (EC7 EN1997-1-1:2004, §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=2.150,y=4.000 m)

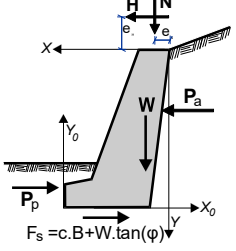


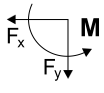
Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.35	0.00- 3.50	30.81	5.20	1.825	1.667	51.35	9.49
Active earth pressure	Pax1.35	3.50- 4.00	6.89	1.16	1.627	0.243	1.67	1.89
Wall weight	W x1.00		0.00	95.72	1.221	1.779	0.00	116.87
		Sum=		102.08			53.02	128.25

Sum of overturning moments = 53.02 kNm/m
Sum of moments resisting overturning = 128.25 kNm/m
Overturning check Med=53.02 < Mrd=128.25 kNm/m, Is verified
Eccentricity ec=(1.593/2)-(128.25-53.02)/102.08=0.060m, ec<=1.593/3=0.531m

2.8.4. Failure check against sliding (STR/GEO A1+M1) (EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)

Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.35	0.00- 3.50	30.81	0.00	5.20
Active earth pressure	Pax1.35	3.50- 4.00	6.89	0.00	1.16
Passive earth pressure	Ppx1.00	3.50- 4.00	0.00	11.03	0.00
Wall weight	W x1.00		0.00	0.00	95.72
		Sum=	37.70	11.03	102.08



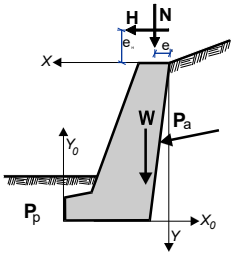


Soil friction Rd=Nd·tanφ/γM = 102.08xtan(38.00°)/1.00= 79.75 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1.593x0.020/1.00= 31.86 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 37.70 kN/m
Sum of resisting forces (11.03/1.00+79.75) = 90.78 kN/m
Sliding resistance check Hd=37.70 < Rd=90.78 kN/m, Is verified

2.9. Checks of wall stability (STR/GEO A2+M2)

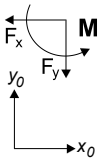
2.9.1. Forces (driving and resisting) on the wall (STR/GEO A2+M2)

Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 3.50	30.70	3.27	0.325	2.333
Active earth pressure	Pa	3.50- 4.00	7.52	0.80	0.523	3.757
Passive earth pressure	Pp	3.50- 4.00	-8.00	0.00	2.150	3.833
Wall weight	W		0.00	95.72	0.929	2.221



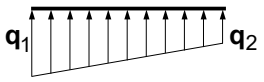
2.9.2. Check of soil bearing capacity (STR/GEO A2+M2) (EC7 EN1997-1-1:2004, §6.5.2)

Check for 1.00x(self weight+top vertical dead load)+0.00x(top vertical live load)



Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.00	0.00- 3.50	30.70	3.27	1.825	1.667	45.21
Active earth pressure	Pax1.00	3.50- 4.00	7.52	0.80	1.627	0.243	0.53
Wall weight	W x1.00		0.00	95.72	1.221	1.779	-116.87
			Sum=	99.79			-71.13

Sum of vertical forces = 99.79 kN/m
Sum of moments at front toe = -71.13 kNm/m
Sum of moments at middle of base = 8.35 kNm/m
Eccentricity ec=8.35/99.79=0.084m, ec<=1.593/6=0.266m
Soil pressure q1=0.082 N/mm² q2=0.043 N/mm²

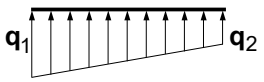


Effective footing L'=1.593-2x0.084= 1.426 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.426x(1000x0.45)/1.40= 458.36 kN/m
Bearing resistance check Vd=99.79 < Rd=458.36 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1.00x(self weight+top vertical dead load)+1.30x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.00	0.00- 3.50	30.70	3.27	1.825	1.667	45.21
Active earth pressure	Pax1.00	3.50- 4.00	7.52	0.80	1.627	0.243	0.53
Wall weight	W x1.00		0.00	95.72	1.221	1.779	-116.87
			Sum=	99.79			-71.13

Sum of vertical forces = 99.79 kN/m
Sum of moments at front toe = -71.13 kNm/m
Sum of moments at middle of base = 8.35 kNm/m
Eccentricity ec=8.35/99.79=0.084m, ec<=1.593/6=0.266m
Soil pressure q1=0.082 N/mm² q2=0.043 N/mm²

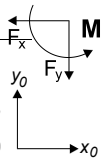


Effective footing L'=1.593-2x0.084= 1.426 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.426x(1000x0.45)/1.40= 458.36 kN/m
Bearing resistance check Vd=99.79 < Rd=458.36 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

2.9.3. Failure check due to overturning (STR/GEO A2+M2)

(EC7 EN1997-1-1:2004, §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=2.150,y=4.000 m)

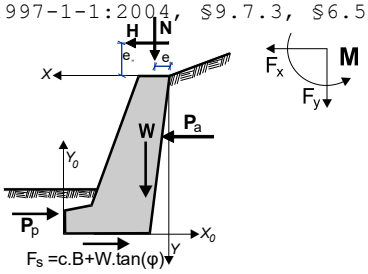


Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.00	0.00- 3.50	30.70	3.27	1.825	1.667	51.18	5.97
Active earth pressure	Pax1.00	3.50- 4.00	7.52	0.80	1.627	0.243	1.83	1.30
Wall weight	W x1.00		0.00	95.72	1.221	1.779	0.00	116.87
		Sum=		99.79			53.01	124.14

Sum of overturning moments = 53.01 kNm/m
Sum of moments resisting overturning = 124.14 kNm/m
Overturning check Med=53.01 < Mrd=124.14 kNm/m, Is verified
Eccentricity ec=(1.593/2)-(124.14-53.01)/99.79=0.084m, ec<=1.593/3=0.531m

2.9.4. Failure check against sliding (STR/GEO A2+M2)

(EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)



Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.00	0.00- 3.50	30.70	0.00	3.27
Active earth pressure	Pax1.00	3.50- 4.00	7.52	0.00	0.80
Passive earth pressure	Ppx1.00	3.50- 4.00	0.00	8.00	0.00
Wall weight	W x1.00		0.00	0.00	95.72
		Sum=	38.22	8.00	99.79

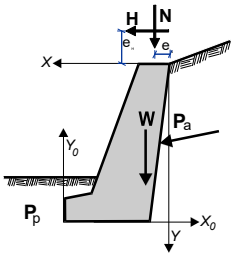
Soil friction Rd=Nd·tanφ/γM = 99.79xtan(38.00°)/1.25= 62.37 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1.593x0.020/1.25= 25.49 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 38.22 kN/m
Sum of resisting forces (8.00/1.00+62.37) = 70.37 kN/m
Sliding resistance check Hd=38.22 < Rd=70.37 kN/m, Is verified

2.10. Seismic design

(EC8 EN1998-5:2004)

Checks of wall stability (with seismic loading)

2.10.1. Forces (driving and resisting) on the wall



Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 3.50	22.82	3.85	0.325	1.750
Active earth pressure	Pa	3.50- 4.00	5.10	0.86	0.523	3.750
Passive earth pressure	Pp	3.50- 4.00	-7.75	0.00	2.150	3.833
Wall weight	W		0.00	95.72	0.929	2.221

2.10.2. Additional forces due to seismic load

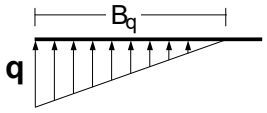
Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 3.50	11.50		0.325	1.750
Active earth pressure	Pa	3.50- 4.00	3.35		0.523	3.750
Wall weight	W		6.41	±3.25	0.929	2.221

2.10.3. Check of soil bearing capacity (with seismic loading)

(EC7 §6.5.2)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.00	0.00- 3.50	34.32	3.85	1.825	2.250	70.19
Active earth pressure	Pax1.00	3.50- 4.00	8.45	0.86	1.627	0.250	0.71
Wall weight	W x1.00		6.41	92.47	1.221	1.779	-101.50
			Sum=	97.18			-30.60

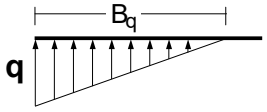
Sum of vertical forces = 97.18 kN/m
Sum of moments at front toe = -30.60 kNm/m
Sum of moments at middle of base = 46.80 kNm/m
Eccentricity ec=46.80/97.18=0.482m, ec>1.593/6=0.266m
Soil pressure q=0.206 N/mm² Bq=0.945 m
Effective footing L'=1.593-2x0.482= 0.630 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=0.630x(1000x0.45)/1.40= 202.50 kN/m
Bearing resistance check Vd=97.18 < Rd=202.50 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)



2.10.4. Check of soil bearing capacity (with seismic loading) (EC7 §6.5.2)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.00	0.00- 3.50	34.32	3.85	1.825	2.250	70.19
Active earth pressure	Pax1.00	3.50- 4.00	8.45	0.86	1.627	0.250	0.71
Wall weight	W x1.00		6.41	98.97	1.221	1.779	-109.43
			Sum=	103.68			-38.53

Sum of vertical forces = 103.68 kN/m
Sum of moments at front toe = -38.53 kNm/m
Sum of moments at middle of base = 44.05 kNm/m
Eccentricity ec=44.05/103.68=0.425m, ec>1.593/6=0.266m
Soil pressure q=0.186 N/mm² Bq=1.115 m
Effective footing L'=1.593-2x0.425= 0.743 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=0.743x(1000x0.45)/1.40= 238.82 kN/m
Bearing resistance check Vd=103.68 < Rd=238.82 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)



2.10.5. Failure check due to overturning (with seismic loading) (EC7 §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=2.150,y=4.000 m)

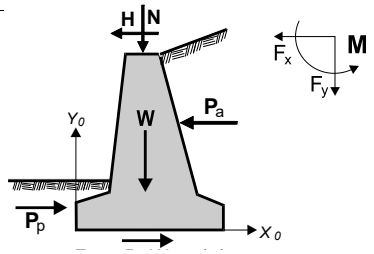
Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.00	0.00- 3.50	34.32	3.85	1.825	2.250	77.22	7.03
Active earth pressure	Pax1.00	3.50- 4.00	8.45	0.86	1.627	0.250	2.11	1.40
Wall weight	W x1.00		6.41	95.72	1.221	1.779	11.40	116.87
Wall weight	W x1.00		0.00	-3.25	1.221	1.779	3.97	0.00*
		Sum=		97.18			94.70	125.30

(*moments of negative seismic vertical loads, are added to the overturning moments)

Sum of overturning moments = 94.70 kNm/m
Sum of moments resisting overturning = 125.30 kNm/m
Overturning check Med=94.70 < Mrd=125.30 kNm/m, Is verified
Eccentricity ec=(1.593/2)-(125.30-94.70)/97.18=0.482m, ec<=1.593/3=0.531m

2.10.6. Failure check against sliding (with seismic loading) (EC7 §9.7.3, §6.5.3, EC8-5 §5.4.1.1)

Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.00	0.00- 3.50	34.32	0.00	3.85
Active earth pressure	Pax1.00	3.50- 4.00	8.45	0.00	0.86
Passive earth pressure	Ppx1.00	3.50- 4.00	0.00	7.75	0.00
Wall weight	W x1.00		6.41	0.00	92.47
		Sum=	49.18	7.75	97.18



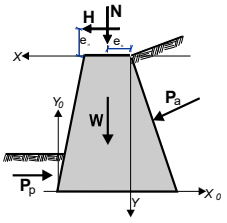
Soil friction Rd=Nd·tanφ/γM = 97.18xtan(38.00°)/1.25= 60.74 kN/m
Soil cohesion Rd=A·cu/γM = 1000x0.945x0.020/1.25= 15.12 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 49.18 kN/m
Sum of resisting forces (7.75/1.00+60.74) = 68.49 kN/m
Sliding resistance check Hd=49.18 < Rd=68.49 kN/m, Is verified

2.11. Design of wall stem

2.11.1. Loading 1.35x(permanent unfavorable)+1.00x(permanent favorable)+1.50x(variable unfav.)

Forces (at centroid of cross section) and stresses at wall stem
x, y:cross section centroid, b:cross section width, e:eccentricity
Fx:horizontal force, Fy:vertical force, M:moment, e/b:relative eccentricity
σ1, σ2, τ :cross section normal and shear stress, Bq:effective cross section width

y [m]	x [m]	b [m]	Fx [kN/m]	Fy [kN/m]	M [kNm/m]	e/b	σ1 [N/mm²]	σ2 [N/mm²]	Bq/B	τ [N/mm²]
0.50	0.519	0.899	0.62	8.60	-0.44	0.057	-0.006	-0.013	1.000	0.001
1.00	0.638	0.998	2.51	18.40	-1.45	0.079	-0.010	-0.027	1.000	0.003
1.50	0.758	1.097	5.66	29.42	-2.58	0.080	-0.014	-0.040	1.000	0.005
2.00	0.877	1.197	10.04	41.63	-3.37	0.068	-0.021	-0.049	1.000	0.008
2.50	0.996	1.296	15.71	55.04	-3.31	0.046	-0.031	-0.054	1.000	0.012
3.00	1.115	1.395	22.61	69.66	-2.00	0.021	-0.044	-0.056	1.000	0.016
3.50	1.234	1.494	30.79	85.49	1.09	-0.009	-0.060	-0.054	1.000	0.021
4.00	1.354	1.593	37.71	102.08	6.13	-0.038	-0.079	-0.050	1.000	0.024



2.11.2. Strength check according toEC6 EN1996-1-1:2005

Strength check in normal stresses Ned<=Nrd (EC6 §6.1.2)
Vertical resistance load Nrd=Φ.fk.t/γM, Vertical design load Ned (EC6 §6.1.2)
Φ=1-2e/t, Φ capacity reduction factor for slenderness and eccentricity of loading
e=load eccentricity+es, es=accidental eccentricity=h/450, h=wall height
fk characteristic compressive strength fk= 3.50 N/mm²
γM= 2.50, γM partial safety factor for the material

y [m]	t [m]	Fy [kN/m]	M [kNm/m]	e/t	Φ	Ned [kN/m]	Nrd [kN/m]	
0.50	0.899	8.60	-0.44	0.058	0.884	8.60	1112.60	(Ned<=Nrd)
1.00	0.998	18.40	-1.45	0.081	0.838	18.40	1170.85	(Ned<=Nrd)
1.50	1.097	29.42	-2.58	0.083	0.834	29.42	1280.86	(Ned<=Nrd)
2.00	1.197	41.63	-3.37	0.072	0.856	41.63	1434.48	(Ned<=Nrd)
2.50	1.296	55.04	-3.31	0.050	0.900	55.04	1632.96	(Ned<=Nrd)
3.00	1.395	69.66	-2.00	0.026	0.948	69.66	1851.44	(Ned<=Nrd)
3.50	1.494	85.49	1.09	0.014	0.972	85.49	2033.04	(Ned<=Nrd)
4.00	1.593	102.08	6.13	0.044	0.912	102.08	2033.94	(Ned<=Nrd)

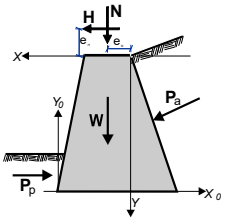
Design for shear strength Ved<=Vrd (EC6 §6.2.1)
Shear resistance Vrd=fvk·t/γM, design shear load Ved (EC6 §6.2.1)
fvk=fvko+0.40xσd ,σd design compressive stress (EC6 §3.6.2)
fvko shear strength under zero compressive stress fvko= 0.20 N/mm²
γM= 2.50, γM partial safety factor for the material

y [m]	t [m]	Fx [kN/m]	σd [N/mm²]	Ved [kN/m]	Vrd [kN/m]	
0.50	0.899	0.62	0.010	0.62	73.36	(Ved<=Vrd)
1.00	0.998	2.51	0.018	2.51	82.71	(Ved<=Vrd)
1.50	1.097	5.66	0.027	5.66	92.50	(Ved<=Vrd)
2.00	1.197	10.04	0.035	10.04	102.46	(Ved<=Vrd)
2.50	1.296	15.71	0.042	15.71	112.39	(Ved<=Vrd)
3.00	1.395	22.61	0.050	22.61	122.76	(Ved<=Vrd)
3.50	1.494	30.79	0.057	30.79	133.15	(Ved<=Vrd)
4.00	1.593	37.71	0.064	37.71	143.75	(Ved<=Vrd)

2.11.3. Loading 1.00x(permanent unfav.)+1.00x(permanent favor.)+0.30x(variable)+1.00x(seismic)

Forces (at centroid of cross section) and stresses at wall stem (with seismic loading)
x, y:cross section centroid, b:cross section width, e:eccentricity
Fx:horizontal force, Fy:vertical force, M:moment, e/b:relative eccentricity
σ1, σ2, τ :cross section normal and shear stress, Bq:effective cross section width

y [m]	x [m]	b [m]	Fx [kN/m]	Fy [kN/m]	M [kNm/m]	e/b	σ1 [N/mm²]	σ2 [N/mm²]	Bq/B	τ [N/mm²]
0.50	0.519	0.899	1.26	8.29	-0.21	0.027	-0.008	-0.011	1.000	0.001
1.00	0.638	0.998	4.00	17.68	-0.18	0.010	-0.017	-0.020	1.000	0.004
1.50	0.758	1.097	8.21	28.20	0.99	-0.031	-0.032	-0.022	1.000	0.007
2.00	0.877	1.197	13.87	39.83	4.22	-0.085	-0.052	-0.017	1.000	0.012
2.50	0.996	1.296	21.02	52.57	10.54	-0.148	-0.080	-0.005	1.000	0.016
3.00	1.115	1.395	29.60	66.44	20.75	-0.214	-0.116	0.000	0.859	0.021
3.50	1.234	1.494	39.69	81.41	35.91	-0.281	-0.174	0.000	0.656	0.027
4.00	1.354	1.593	49.20	97.18	26.85	-0.165	-0.128	-0.001	1.000	0.031



2.11.4. Strength check according toEC6 EN1996-1-1:2005 (with seismic loading)

Strength check in normal stresses Ned<=Nrd (with seismic loading) (EC6 §6.1.2)
Vertical resistance load Nrd=Φ.fk.t/γM, Vertical design load Ned (EC6 §6.1.2)
Φ=1-2e/t, Φ capacity reduction factor for slenderness and eccentricity of loading
e=load eccentricity+es, es=accidental eccentricity=h/450, h=wall height
fk characteristic compressive strength fk= 3.50 N/mm²
γM= 2.50, γM partial safety factor for the material

y [m]	t [m]	Fy [kN/m]	M [kNm/m]	e/t	Φ	Ned [kN/m]	Nrd [kN/m]	
0.50	0.899	8.29	-0.21	0.028	0.944	8.29	1188.12	(Ned<=Nrd)
1.00	0.998	17.68	-0.18	0.012	0.976	17.68	1363.67	(Ned<=Nrd)
1.50	1.097	28.20	0.99	0.034	0.932	28.20	1431.37	(Ned<=Nrd)
2.00	1.197	39.83	4.22	0.089	0.822	39.83	1377.51	(Ned<=Nrd)
2.50	1.296	52.57	10.54	0.152	0.696	52.57	1262.82	(Ned<=Nrd)
3.00	1.395	66.44	20.75	0.219	0.562	66.44	1097.59	(Ned<=Nrd)
3.50	1.494	81.41	35.91	0.286	0.428	81.41	895.20	(Ned<=Nrd)
4.00	1.593	97.18	26.85	0.171	0.658	97.18	1467.47	(Ned<=Nrd)

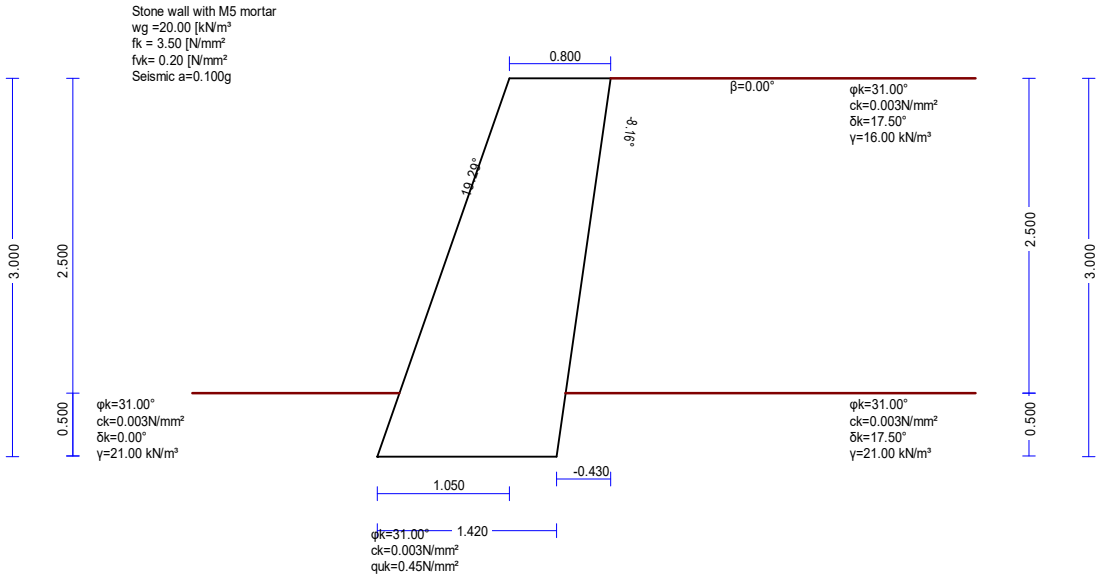
Design for shear strength Ved<=Vrd (with seismic loading) (EC6 §6.2.1)
Shear resistance Vrd=fvk·t/γM, design shear load Ved (EC6 §6.2.1)
fvk=fvko+0.40xσd ,σd design compressive stress (EC6 §3.6.2)
fvko shear strength under zero compressive stress fvko= 0.20 N/mm²
γM= 2.50, γM partial safety factor for the material

y [m]	t [m]	Fx [kN/m]	σd [N/mm²]	Ved [kN/m]	Vrd [kN/m]	
0.50	0.899	1.26	0.009	1.26	73.21	(Ved<=Vrd)
1.00	0.998	4.00	0.018	4.00	82.71	(Ved<=Vrd)
1.50	1.097	8.21	0.026	8.21	92.32	(Ved<=Vrd)
2.00	1.197	13.87	0.033	13.87	102.08	(Ved<=Vrd)
2.50	1.296	21.02	0.041	21.02	112.18	(Ved<=Vrd)
3.00	1.395	29.60	0.048	29.60	122.31	(Ved<=Vrd)
3.50	1.494	39.69	0.054	39.69	132.43	(Ved<=Vrd)
4.00	1.593	49.20	0.061	49.20	142.99	(Ved<=Vrd)

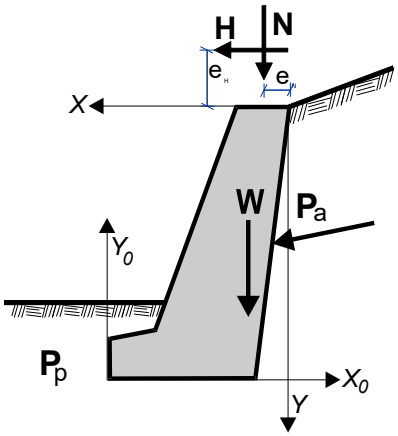
3. PKZ-3

Gravity retaining wall

(EC2 EN1992-1-1:2004, EC0 EN1990:2002, EC7 EN1997-1-1:2004, EC8 EN1998-5:2004,)



3.1. Wall properties-Parameters-Code requirements



Dimensions

Height of wall	h= 3.000 m
Transverse length of wall	L=10.000 m
Stem thickness at top	B1= 0.800 m
Stem thickness at bottom	B2= 1.420 m
Width of wall base	B= 1.420 m
Width of wall toe	0.000 m
Height of wall stem	ho= 3.000 m
Thickness of wall footing	0.000 m
Front thickness of wall toe	0.000 m
Slope (batter) at front face	19.290° (1:2.86)
Slope (batter) at back face	-8.157° (1:6.98)

Weight of wall

Unit weight of wall material	γg=20.000 kN/m³
Cross section area of wall	A= 3.330 m²
Self weight per meter of wall	W= 3.330x20.000= 66.60 kN/m
Center of gravity of wall at	x=0.804 m, y=1.640 m (xo=1.046 m, yo=1.360 m)

Wall materials

Compressive strength	3.50 N/mm²
Shear strength	0.20 N/mm²

3.2. Partial factors for actions and soil properties (EC7 Tab. A.1-A.4, EC8-5 §3.1)

Equilibrium limit state (EQU), Structural limit state (STR), Geotechnical limit state (GEO)

				(EQU)	(STR/GEO) (A1+M1)	(STR/GEO) (A2+M2)	(Seismic)
Actions	Permanent	Unfavorable	γGdst:	1.10	1.35	1.00	1.00
	Permanent	Favorable	γGstb:	0.90	1.00	1.00	1.00
	Variable	Unfavorable	γQdst:	1.50	1.50	1.30	1.00
	Variable	Favorable	γQstb:	0.00	0.00	0.00	0.00
Soil parameters	Angle of shearing resistance		γφ:	1.25	1.00	1.25	1.25
	Effective cohesion		γc:	1.25	1.00	1.25	1.25
	Undrained shear strength		γcu:	1.40	1.00	1.40	1.40
	Unconfined strength		γqu:	1.40	1.00	1.40	1.40
	Weight density		γw:	1.00	1.00	1.00	1.00

γR,v(R1)=1.00, γR,h(R1)=1.00, γR,e(R1)=1.00

3.3. Properties of foundation soil

Bearing capacity of foundation soil qu=0.45 N/mm²
Friction angle between wall footing and soil φ=31.00°, friction coefficient tan(φ)=0.601
Cohesion between wall footing and soil c=0.003 N/mm²

3.4. Seismic coefficients (EC8 EN1998-5:2004, §7.3.2)

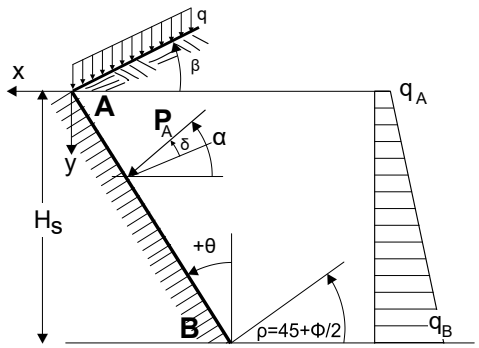
Design ground acceleration ratio	αg=αxg, α=0.10	(EC8-5 §7.3.2)
Verti./horiz. acceleration	αvg/αg=0.90	(EC8 §3.2.2.3)
Soil factor	S=1.00	(EC8 §3.2.2.2)
Importance factor	γI=1.00	(EC8 §3.2.1, T.4.3)
Reduction factor for seismic coefficient	r=1.50	(EC8-5 Table 7.1)
Coefficient for horisontal seismic force	kh=1.00x0.10x1.00/1.500=0.067	(EC8-5 Eq.7.1)
Coefficient for vertical seismic force	kv=0.50x0.067=0.034	(EC8-5 Eq.7.2)

Forces due to seismic load (except from earth pressure)
Horisontal seismic force due to self weight Fwx= 66.60x0.067= 4.46 kN/m
Vertical seismic force due to self weight Fwy= 66.60x0.034= 2.26 kN/m

3.5. Computation of active earth pressure (Coulomb theory)

3.5.1. Wall part from Y=0.000 m to Y=2.500 m, Hs=2.500 m

Top point A x= 0.000 m y= 0.000 m
Bottom point B x= 0.358 m y= 2.500 m



Soil properties
Soil type : Thin gravel
Unit weight of soil γ =16.00 kN/m³
Unit weight of soil (saturated) γs=19.00 kN/m³
Unit weight of water γw=10.00 kN/m³
Angle of shearing resistance of ground φ=31.00°
Cohesion of ground c=0.003 N/mm²
Slope angle of ground surface β= 0.00°
Inclination angle of the wall backface θ=-8.16°
Angle of shear resist. between ground-wall δ=17.50°

Earth pressure according to Coulomb theory

	EQU	A1+M1	A2+M2
Angle of rupture plane ρ=45°+φ/2	= 57.40	60.50	57.40°
Coefficient of active earth pressure Ka=	0.314	0.235	0.314

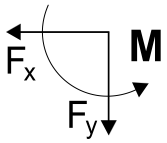
Earth pressure q(y)=qA+γ·y·Ka

$$K_A = \frac{\cos^2(\varphi-\theta)}{\cos^2\theta\,\cos(\theta+\delta)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\beta)}{\cos(\theta+\delta)\cos(\theta-\beta)}}\right]^2}$$

Permanent actions

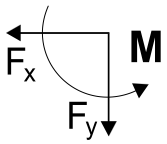
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	0.00	0.00	0.00	kN/m²
Earth pressure at the bottom (y=yA+ 2.50m)	qB=	12.56	9.40	12.56	kN/m²
Earth force Pa= ½(qA+qB)H	Pa=	15.70	11.75	15.70	kN/m
Angle of earth force	α =	5.84	9.34	5.84	°
Earth force in x direction	Pax=	15.62	11.59	15.62	kN/m
Earth force in y direction	Pay=	1.60	1.91	1.60	kN/m
Moment of earth force at top point (x=0,y=0)	M =	-25.66	-18.86	-25.66	kNm/m

Point of application of earth force x= 0.239 m, y= 1.667 m



Total forces and moments

Forces and moments at bottom point B (x=0.358 m, y=2.500 m)



Permanent actions

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	15.62	11.59	15.62	kN/m
Total vertical earth force	Fsy=	1.60	1.91	1.60	kN/m
Total moment of earth force	Ms =	12.82	9.43	12.82	kNm/m

Seismic loading (EC8 EN1998-5:2004, §7.3.2, Annex E)

Horizontal seismic coefficient kh=1.00x0.10x1.00/1.500=0.067 (EC8-5 Eq.7.1, T.7.1)
Vertical seismic coefficient kv=0.50x0.067=0.034 (EC8-5 Eq.7.2)
Soil above the water table (EC8-5 Annex E.5)
tan(ω)=kh/(1-kv)=0.067/(1-0.034)=0.069, ω=3.97°

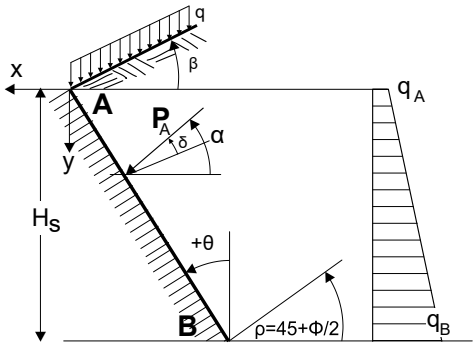
Method Mononobe-Okabe (EC8-5 Annex E.4)
for active earth force during seismic loading
Coefficient of active earth pressure, Ke*(STR)= 0.353
Additional earth pressure due to seismic load
over STR load case ξ=(Ke*/Ke-1)=(0.353/0.235-1)=0.502

$$K_E=\frac{\cos^2(\varphi-\omega-\theta)}{\cos\omega\cos^2\theta\cos(\delta+\theta+\omega)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\omega-\beta)}{\cos(\theta+\omega+\delta)\cos(\theta-\beta)}}\right]^2}$$

Earth force due to seismic load (Permanent actions) Fx=1.502x11.59=17.41 kN/m

3.5.2. Wall part from Y=2.500 m to Y=3.000 m, Hs=0.500 m

Top point A x= 0.358 m y= 2.500 m
Bottom point B x= 0.430 m y= 3.000 m



Soil properties

Soil type : Dense sand		
Unit weight of soil	γ	=21.00 kN/m³
Unit weight of soil (saturated)	γs	=19.00 kN/m³
Unit weight of water	γw	=10.00 kN/m³
Angle of shearing resistance of ground	φ	=31.00°
Cohesion of ground	c	=0.003 N/mm²
Slope angle of ground surface	β	= 0.00°
Inclination angle of the wall backface	θ	=-8.16°
Angle of shear resist. between ground-wall	δ	=17.50°

Loads on soil surface

Permanent uniform load	g=	40.00 kN/m²
Variable uniform load	q=	0.00 kN/m²

Earth pressure according to Coulomb theory

	EQU	A1+M1	A2+M2	
Angle of rupture plane ρ=45°+φ/2	=	57.40	60.50	57.40°
Coefficient of active earth pressure Ka=		0.314	0.235	0.314

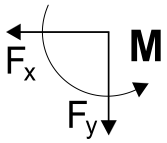
Earth pressure q(y)=qA+γ·y·Ka

$$K_A=\frac{\cos^2(\varphi-\theta)}{\cos^2\theta\cos(\theta+\delta)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\beta)}{\cos(\theta+\delta)\cos(\theta-\beta)}}\right]^2}$$

Permanent actions

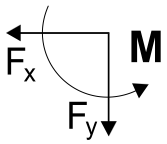
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	12.56	9.40	12.56	kN/m²
Earth pressure at the bottom (y=yA+ 0.50m)	qB=	15.86	11.87	15.86	kN/m²
Earth force Pa= ½(qA+qB)H	Pa=	7.11	5.32	7.11	kN/m
Angle of earth force	α =	5.84	9.34	5.84	°
Earth force in x direction	Pax=	7.07	5.25	7.07	kN/m
Earth force in y direction	Pay=	0.72	0.86	0.72	kN/m
Moment of earth force at top point (x=0,y=0)	M =	-19.23	-14.15	-19.23	kNm/m

Point of application of earth force x= 0.395 m, y= 2.760 m



Total forces and moments

Forces and moments at bottom point B (x=0.430 m, y=3.000 m)



Permanent actions

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	22.69	16.84	22.69	kN/m
Total vertical earth force	Fsy=	2.32	2.77	2.32	kN/m
Total moment of earth force	Ms =	22.19	16.32	22.19	kNm/m

Seismic loading (EC8 EN1998-5:2004, §7.3.2, Annex E)

Horizontal seismic coefficient kh=1.00x0.10x1.00/1.500=0.067 (EC8-5 Eq.7.1, T.7.1)
Vertical seismic coefficient kv=0.50x0.067=0.034 (EC8-5 Eq.7.2)
Soil above the water table (EC8-5 Annex E.5)
tan(ω)=kh/(1-kv)=0.067/(1-0.034)=0.069, ω=3.97°

Method Mononobe-Okabe (EC8-5 Annex E.4)
for active earth force during seismic loading
Coefficient of active earth pressure, Ke*(STR)= 0.353
Additional earth pressure due to seismic load
over STR load case ξ=(Ke*/Ke-1)=(0.353/0.235-1)=0.502

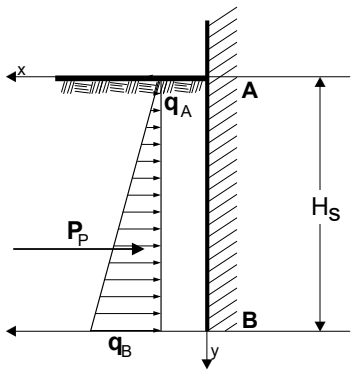
$$K_E = \frac{\cos^2(\varphi-\omega-\theta)}{\cos\omega\,\cos^2\theta\,\cos(\delta+\theta+\omega)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\omega-\beta)}{\cos(\theta+\omega+\delta)\cos(\theta-\beta)}}\right]^2}$$

Earth force due to seismic load (Permanent actions) Fx=1.502x 5.25= 7.89 kN/m

3.6. Computation of passive earth pressure (Rankine theory)

3.6.1. Wall part from Y=2.500 m to Y=3.000 m, Hs=0.500 m

Top point A x= 1.850 m y= 2.500 m
Bottom point B x= 1.850 m y= 3.000 m



Soil properties

Soil type : Dense sand

Unit weight of soil	γ	=21.00 kN/m³
Unit weight of soil (saturated)	γs	=19.00 kN/m³
Unit weight of water	γw	=10.00 kN/m³
Angle of shearing resistance of ground	φ	=31.00°
Cohesion of ground	c	=0.003 N/mm²
Slope angle of ground surface	β	= 0.00°
Earth pressure on vertical surface	θ	= 0.00°
Angle of shear resist. between ground-wall	δ	= 0.00°

Earth pressure according to Coulomb theory

	EQU	A1+M1	A2+M2	
Angle of rupture plane ρ=45°-φ/2	=	32.60	29.50	32.60°
Coefficient of passive earth pressure Kp=		2.445	3.124	2.445

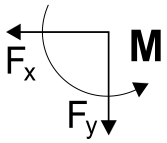
Earth pressure q(y)=qA+γ·y·Kp

$$K_p = \frac{\cos^2(\varphi+\theta)}{\cos^2\theta\,\cos(\theta-\delta)\left[1-\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi+\beta)}{\cos(\theta-\delta)\cos(\theta-\beta)}}\right]^2}$$

Permanent actions

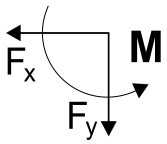
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	0.00	0.00	0.00	kN/m²
Earth pressure at the bottom (y=yA+ 0.50m)	qB=	-25.67	-32.80	-25.67	kN/m²
Earth force Pa= ½(qA+qB)H	Pp=	6.42	8.20	6.42	kN/m
Angle of earth force	α =	0.00	0.00	0.00	°
Earth force in x direction	Ppx=	-6.42	-8.20	-6.42	kN/m
Earth force in y direction	Ppy=	0.00	0.00	0.00	kN/m
Moment of earth force at top point (x=0,y=0)	M =	18.19	23.23	18.19	kNm/m

Point of application of earth force x= 1.850 m, y= 2.833 m



Total forces and moments

Forces and moments at bottom point B (x=1.850 m, y=3.000 m)



Permanent actions

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	-6.42	-8.20	-6.42	kN/m
Total vertical earth force	Fsy=	0.00	0.00	0.00	kN/m
Total moment of earth force	Ms =	-1.07	-1.37	-1.07	kNm/m

Seismic loading (EC8 EN1998-5:2004, §7.3.2, Annex E)

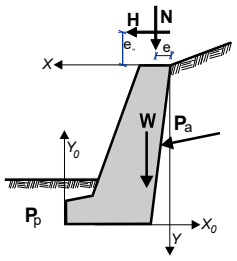
tan(ω)=kh/(1-kv)=0.067/(1-0.034)=0.069, ω=3.97°
Coefficient of passive earth pressure Kp*(STR)= 2.358
ξ=(Kp*/Kp)=(2.358/3.124)=0.755

		EQU	A1+M1	A2+M2
Total horizontal earth force	Fsx=	-4.85	-6.19	-4.85

3.7. Checks of wall stability (EQU)

3.7.1. Forces (driving and resisting) on the wall (EQU)

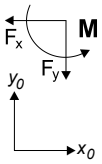
Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 2.50	15.62	1.60	0.239	1.667
Active earth pressure	Pa	2.50- 3.00	7.07	0.72	0.395	2.760
Passive earth pressure	Pp	2.50- 3.00	-6.42	0.00	1.850	2.833
Wall weight	W		0.00	66.60	0.804	1.640



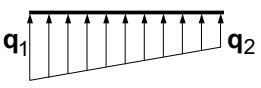
3.7.2. Check of soil bearing capacity (EQU) (EC7 EN1997-1-1:2004, §6.5.2)

Check for 0.90x(self weight+top vertical dead load)+0.00x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.10	0.00- 2.50	17.18	1.76	1.611	1.333	20.06
Active earth pressure	Pax1.10	2.50- 3.00	7.78	0.79	1.455	0.240	0.72
Wall weight	W x0.90		0.00	59.94	1.046	1.360	-62.69
			Sum=	62.49			-41.91



Sum of vertical forces = 62.49 kN/m
Sum of moments at front toe = -41.91 kNm/m
Sum of moments at middle of base = 2.46 kNm/m
Eccentricity ec=2.46/62.49=0.039m, ec<=1.420/6=0.237m
Soil pressure q1=0.051 N/mm² q2=0.037 N/mm²

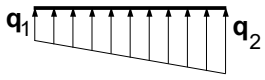


Effective footing L'=1.420-2x0.039= 1.341 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.341x(1000x0.45)/1.40= 431.04 kN/m
Bearing resistance check Vd=62.49 < Rd=431.04 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1.10x(self weight+top vertical dead load)+1.50x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.10	0.00- 2.50	17.18	1.76	1.611	1.333	20.06
Active earth pressure	Pax1.10	2.50- 3.00	7.78	0.79	1.455	0.240	0.72
Wall weight	W x1.10		0.00	73.26	1.046	1.360	-76.63
			Sum=	75.81			-55.85

Sum of vertical forces = 75.81 kN/m
Sum of moments at front toe = -55.85 kNm/m
Sum of moments at middle of base = -2.02 kNm/m

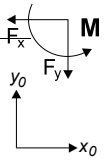


Eccentricity ec=-2.02/75.81=-0.027m, ec<=1.420/6=0.237m
Soil pressure q1=0.047 N/mm² q2=0.059 N/mm²
Effective footing L'=1.420-2x0.027= 1.367 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.367x(1000x0.45)/1.40= 439.39 kN/m
Bearing resistance check Vd=75.81 < Rd=439.39 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

3.7.3. Failure check due to overturning (EQU)

(EC7 EN1997-1-1:2004, §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=1.850,y=3.000 m)

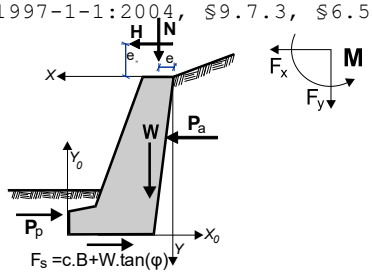


Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.10	0.00- 2.50	17.18	1.76	1.611	1.333	22.90	2.84
Active earth pressure	Pax1.10	2.50- 3.00	7.78	0.79	1.455	0.240	1.87	1.16
Wall weight	W x0.90		0.00	59.94	1.046	1.360	0.00	62.69
		Sum=		62.49			24.77	66.69

Sum of overturning moments = 24.77 kNm/m
Sum of moments resisting overturning = 66.69 kNm/m
Overturning check Med=24.77 < Mrd=66.69 kNm/m, Is verified
Eccentricity ec=(1.420/2)-(66.69-24.77)/62.49=0.039m, ec<=1.420/3=0.473m

3.7.4. Failure check against sliding (EQU)

(EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)

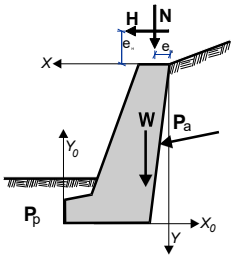


Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.10	0.00- 2.50	17.18	0.00	1.76
Active earth pressure	Pax1.10	2.50- 3.00	7.78	0.00	0.79
Passive earth pressure	Ppx0.90	2.50- 3.00	0.00	5.78	0.00
Wall weight	W x0.90		0.00	0.00	59.94
		Sum=	24.96	5.78	62.49

Soil friction Rd=Nd·tanφ/γM = 62.49xtan(31.00°)/1.25= 30.04 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1.420x0.003/1.25= 3.41 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 24.96 kN/m
Sum of resisting forces (5.78/1.00+30.04) = 35.82 kN/m
Sliding resistance check Hd=24.96 < Rd=35.82 kN/m, Is verified

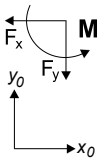
3.8. Checks of wall stability (STR/GEO A1+M1)

3.8.1. Forces (driving and resisting) on the wall (STR/GEO A1+M1)



Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 2.50	11.59	1.91	0.239	1.667
Active earth pressure	Pa	2.50- 3.00	5.25	0.86	0.395	2.760
Passive earth pressure	Pp	2.50- 3.00	-8.20	0.00	1.850	2.833
Wall weight	W		0.00	66.60	0.804	1.640

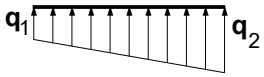
3.8.2. Check of soil bearing capacity (STR/GEO A1+M1) (EC7 EN1997-1-1:2004, §6.5.2)



Check for 1.00x(self weight+top vertical dead load)+0.00x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.35	0.00- 2.50	15.65	2.58	1.611	1.333	16.70
Active earth pressure	Pax1.35	2.50- 3.00	7.09	1.16	1.455	0.240	0.01
Wall weight	W x1.00		0.00	66.60	1.046	1.360	-69.66
			Sum=	70.34			-52.95

Sum of vertical forces = 70.34 kN/m
Sum of moments at front toe = -52.95 kNm/m
Sum of moments at middle of base = -3.01 kNm/m

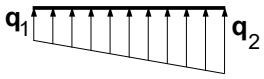


Eccentricity ec=-3.01/70.34=-0.043m, ec<=1.420/6=0.237m
Soil pressure q1=0.041 N/mm² q2=0.058 N/mm²
Effective footing L'=1.420-2x0.043= 1.334 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.334x(1000x0.45)/1.00= 600.30 kN/m
Bearing resistance check Vd=70.34 < Rd=600.30 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1.35x(self weight+top vertical dead load)+1.50x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.35	0.00- 2.50	15.65	2.58	1.611	1.333	16.70
Active earth pressure	Pax1.35	2.50- 3.00	7.09	1.16	1.455	0.240	0.01
Wall weight	W x1.35		0.00	89.91	1.046	1.360	-94.04
			Sum=	93.65			-77.33

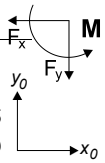
Sum of vertical forces = 93.65 kN/m
Sum of moments at front toe = -77.33 kNm/m
Sum of moments at middle of base = -10.84 kNm/m



Eccentricity ec=-10.84/93.65=-0.116m, ec<=1.420/6=0.237m
Soil pressure q1=0.034 N/mm² q2=0.098 N/mm²
Effective footing L'=1.420-2x0.116= 1.188 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.188x(1000x0.45)/1.00= 534.60 kN/m
Bearing resistance check Vd=93.65 < Rd=534.60 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

3.8.3. Failure check due to overturning (STR/GEO A1+M1) (EC7 EN1997-1-1:2004, §9.7.4)

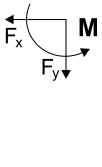
Overturning with respect to the toe (xo=0,yo=0) (x=1.850,y=3.000 m)

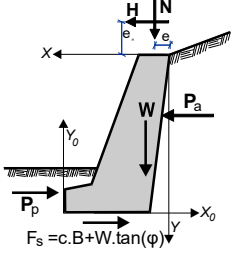


Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.35	0.00- 2.50	15.65	2.58	1.611	1.333	20.86	4.16
Active earth pressure	Pax1.35	2.50- 3.00	7.09	1.16	1.455	0.240	1.70	1.69
Wall weight	W x1.00		0.00	66.60	1.046	1.360	0.00	69.66
		Sum=		70.34			22.56	75.51

Sum of overturning moments = 22.56 kNm/m
Sum of moments resisting overturning = 75.51 kNm/m
Overturning check Med=22.56 < Mrd=75.51 kNm/m, Is verified
Eccentricity ec=(1.420/2)-(75.51-22.56)/70.34=-0.043m OK

3.8.4. Failure check against sliding (STR/GEO A1+M1) (EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)





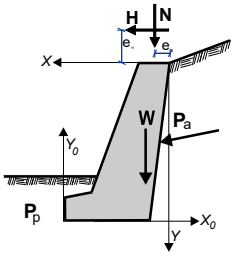
Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.35	0.00- 2.50	15.65	0.00	2.58
Active earth pressure	Pax1.35	2.50- 3.00	7.09	0.00	1.16
Passive earth pressure	Ppx1.00	2.50- 3.00	0.00	8.20	0.00
Wall weight	W x1.00		0.00	0.00	66.60
		Sum=	22.74	8.20	70.34

Soil friction Rd=Nd·tanφ/γM = 70.34xtan(31.00°)/1.00= 42.26 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1.420x0.003/1.00= 4.26 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 22.74 kN/m
Sum of resisting forces (8.20/1.00+42.26) = 50.46 kN/m
Sliding resistance check Hd=22.74 < Rd=50.46 kN/m, Is verified

3.9. Checks of wall stability (STR/GEO A2+M2)

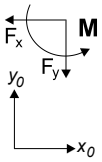
3.9.1. Forces (driving and resisting) on the wall (STR/GEO A2+M2)

Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 2.50	15.62	1.60	0.239	1.667
Active earth pressure	Pa	2.50- 3.00	7.07	0.72	0.395	2.760
Passive earth pressure	Pp	2.50- 3.00	-6.42	0.00	1.850	2.833
Wall weight	W		0.00	66.60	0.804	1.640



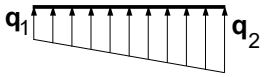
3.9.2. Check of soil bearing capacity (STR/GEO A2+M2) (EC7 EN1997-1-1:2004, §6.5.2)

Check for 1.00x(self weight+top vertical dead load)+0.00x(top vertical live load)



Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.00	0.00- 2.50	15.62	1.60	1.611	1.333	18.24
Active earth pressure	Pax1.00	2.50- 3.00	7.07	0.72	1.455	0.240	0.65
Wall weight	W x1.00		0.00	66.60	1.046	1.360	-69.66
			Sum=	68.92			-50.77

Sum of vertical forces = 68.92 kN/m
Sum of moments at front toe = -50.77 kNm/m
Sum of moments at middle of base = -1.84 kNm/m
Eccentricity ec=-1.84/68.92=-0.027m, ec<=1.420/6=0.237m
Soil pressure q1=0.043 N/mm² q2=0.054 N/mm²

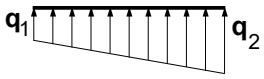


Effective footing L'=1.420-2x0.027= 1.367 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.367x(1000x0.45)/1.40= 439.39 kN/m
Bearing resistance check Vd=68.92 < Rd=439.39 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1.00x(self weight+top vertical dead load)+1.30x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.00	0.00- 2.50	15.62	1.60	1.611	1.333	18.24
Active earth pressure	Pax1.00	2.50- 3.00	7.07	0.72	1.455	0.240	0.65
Wall weight	W x1.00		0.00	66.60	1.046	1.360	-69.66
			Sum=	68.92			-50.77

Sum of vertical forces = 68.92 kN/m
Sum of moments at front toe = -50.77 kNm/m
Sum of moments at middle of base = -1.84 kNm/m
Eccentricity ec=-1.84/68.92=-0.027m, ec<=1.420/6=0.237m
Soil pressure q1=0.043 N/mm² q2=0.054 N/mm²

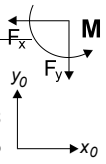


Effective footing L'=1.420-2x0.027= 1.367 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.367x(1000x0.45)/1.40= 439.39 kN/m
Bearing resistance check Vd=68.92 < Rd=439.39 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

3.9.3. Failure check due to overturning (STR/GEO A2+M2)

(EC7 EN1997-1-1:2004, §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=1.850,y=3.000 m)

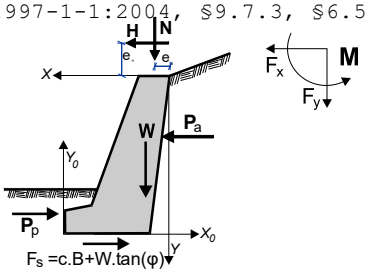


Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.00	0.00- 2.50	15.62	1.60	1.611	1.333	20.82	2.58
Active earth pressure	Pax1.00	2.50- 3.00	7.07	0.72	1.455	0.240	1.70	1.05
Wall weight	W x1.00		0.00	66.60	1.046	1.360	0.00	69.66
		Sum=		68.92			22.52	73.29

Sum of overturning moments = 22.52 kNm/m
Sum of moments resisting overturning = 73.29 kNm/m
Overturning check Med=22.52 < Mrd=73.29 kNm/m, Is verified
Eccentricity ec=(1.420/2)-(73.29-22.52)/68.92=-0.027m OK

3.9.4. Failure check against sliding (STR/GEO A2+M2)

(EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)



Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.00	0.00- 2.50	15.62	0.00	1.60
Active earth pressure	Pax1.00	2.50- 3.00	7.07	0.00	0.72
Passive earth pressure	Ppx1.00	2.50- 3.00	0.00	6.42	0.00
Wall weight	W x1.00		0.00	0.00	66.60
		Sum=	22.69	6.42	68.92

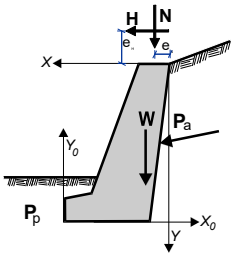
Soil friction Rd=Nd·tanφ/γM = 68.92xtan(31.00°)/1.25= 33.13 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1.420x0.003/1.25= 3.41 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 22.69 kN/m
Sum of resisting forces (6.42/1.00+33.13) = 39.55 kN/m
Sliding resistance check Hd=22.69 < Rd=39.55 kN/m, Is verified

3.10. Seismic design

(EC8 EN1998-5:2004)

Checks of wall stability (with seismic loading)

3.10.1. Forces (driving and resisting) on the wall



Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 2.50	11.59	1.91	0.239	1.250
Active earth pressure	Pa	2.50- 3.00	5.25	0.86	0.395	2.750
Passive earth pressure	Pp	2.50- 3.00	-6.19	0.00	1.850	2.833
Wall weight	W		0.00	66.60	0.804	1.640

3.10.2. Additional forces due to seismic load

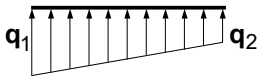
Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 2.50	5.82		0.239	1.250
Active earth pressure	Pa	2.50- 3.00	2.64		0.395	2.750
Wall weight	W		4.46	±2.26	0.804	1.640

3.10.3. Check of soil bearing capacity (with seismic loading)

(EC7 §6.5.2)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.00	0.00- 2.50	17.41	1.91	1.611	1.750	27.38
Active earth pressure	Pax1.00	2.50- 3.00	7.89	0.86	1.455	0.250	0.72
Wall weight	W x1.00		4.46	64.34	1.046	1.360	-61.23
			Sum=	67.11			-33.13

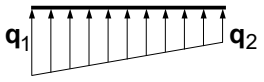
Sum of vertical forces = 67.11 kN/m
Sum of moments at front toe = -33.13 kNm/m
Sum of moments at middle of base = 14.52 kNm/m
Eccentricity ec=14.52/67.11=0.216m, ec<=1.420/6=0.237m
Soil pressure q1=0.090 N/mm² q2=0.004 N/mm²
Effective footing L'=1.420-2x0.216= 0.987 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=0.987x(1000x0.45)/1.40= 317.25 kN/m
Bearing resistance check Vd=67.11 < Rd=317.25 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)



3.10.4. Check of soil bearing capacity (with seismic loading) (EC7 §6.5.2)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.00	0.00- 2.50	17.41	1.91	1.611	1.750	27.38
Active earth pressure	Pax1.00	2.50- 3.00	7.89	0.86	1.455	0.250	0.72
Wall weight	W x1.00		4.46	68.86	1.046	1.360	-65.96
			Sum=	71.63			-37.86

Sum of vertical forces = 71.63 kN/m
Sum of moments at front toe = -37.86 kNm/m
Sum of moments at middle of base = 13.00 kNm/m
Eccentricity ec=13.00/71.63=0.181m, ec<=1.420/6=0.237m
Soil pressure q1=0.089 N/mm² q2=0.012 N/mm²
Effective footing L'=1.420-2x0.181= 1.057 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.057x(1000x0.45)/1.40= 339.75 kN/m
Bearing resistance check Vd=71.63 < Rd=339.75 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)



3.10.5. Failure check due to overturning (with seismic loading) (EC7 §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=1.850,y=3.000 m)

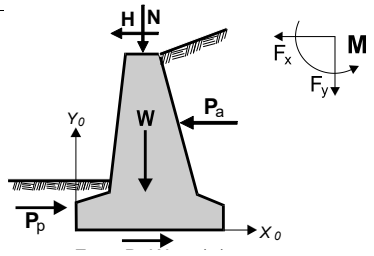
Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.00	0.00- 2.50	17.41	1.91	1.611	1.750	30.46	3.08
Active earth pressure	Pax1.00	2.50- 3.00	7.89	0.86	1.455	0.250	1.97	1.25
Wall weight	W x1.00		4.46	66.60	1.046	1.360	6.07	69.66
Wall weight	W x1.00		0.00	-2.26	1.046	1.360	2.36	0.00*
		Sum=		67.11			40.86	73.99

(*moments of negative seismic vertical loads, are added to the overturning moments)

Sum of overturning moments = 40.86 kNm/m
Sum of moments resisting overturning = 73.99 kNm/m
Overturning check Med=40.86 < Mrd=73.99 kNm/m, Is verified
Eccentricity ec=(1.420/2)-(73.99-40.86)/67.11=0.216m, ec<=1.420/3=0.473m

3.10.6. Failure check against sliding (with seismic loading) (EC7 §9.7.3, §6.5.3, EC8-5 §5.4.1.1)

Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.00	0.00- 2.50	17.41	0.00	1.91
Active earth pressure	Pax1.00	2.50- 3.00	7.89	0.00	0.86
Passive earth pressure	Ppx1.00	2.50- 3.00	0.00	6.19	0.00
Wall weight	W x1.00		4.46	0.00	64.34
		Sum=	29.76	6.19	67.11



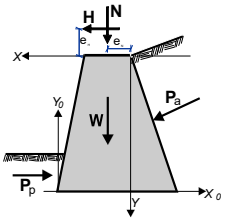
Soil friction Rd=Nd·tanφ/γM = 67.11xtan(31.00°)/1.25= 32.26 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1.420x0.003/1.25= 3.41 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 29.76 kN/m
Sum of resisting forces (6.19/1.00+32.26) = 38.45 kN/m
Sliding resistance check Hd=29.76 < Rd=38.45 kN/m, Is verified

3.11. Design of wall stem

3.11.1. Loading 1.35x(permanent unfavorable)+1.00x(permanent favorable)+1.50x(variable unfav.)

Forces (at centroid of cross section) and stresses at wall stem
x, y:cross section centroid, b:cross section width, e:eccentricity
Fx:horizontal force, Fy:vertical force, M:moment, e/b:relative eccentricity
σ1, σ2, τ :cross section normal and shear stress, Bq:effective cross section width

y [m]	x [m]	b [m]	Fx [kN/m]	Fy [kN/m]	M [kNm/m]	e/b	σ1 [N/mm²]	σ2 [N/mm²]	Bq/B	τ [N/mm²]
0.25	0.462	0.852	0.16	4.16	-0.12	0.035	-0.004	-0.006	1.000	0.000
0.50	0.523	0.903	0.62	8.62	-0.46	0.059	-0.006	-0.013	1.000	0.001
0.75	0.585	0.955	1.42	13.39	-0.95	0.074	-0.008	-0.020	1.000	0.001
1.00	0.647	1.007	2.51	18.49	-1.54	0.083	-0.009	-0.027	1.000	0.002
1.25	0.708	1.058	3.92	23.88	-2.16	0.085	-0.011	-0.034	1.000	0.004
1.50	0.770	1.110	5.63	29.58	-2.77	0.084	-0.013	-0.040	1.000	0.005
1.75	0.832	1.162	7.67	35.60	-3.32	0.080	-0.016	-0.045	1.000	0.007
2.00	0.893	1.213	10.02	41.91	-3.73	0.073	-0.019	-0.050	1.000	0.008
2.25	0.955	1.265	12.68	48.55	-3.97	0.065	-0.023	-0.053	1.000	0.010
2.50	1.017	1.317	15.65	55.49	-3.96	0.054	-0.028	-0.056	1.000	0.012
2.75	1.078	1.368	18.98	62.76	-3.66	0.043	-0.034	-0.058	1.000	0.014
3.00	1.140	1.420	22.73	70.34	-2.97	0.030	-0.041	-0.058	1.000	0.016



3.11.2. Strength check according toEC6 EN1996-1-1:2005

Strength check in normal stresses Ned<=Nrd (EC6 §6.1.2)
Vertical resistance load Nrd=Φ.fk.t/γM, Vertical design load Ned (EC6 §6.1.2)
Φ=1-2e/t, Φ capacity reduction factor for slenderness and eccentricity of loading
e=load eccentricity+es, es=accidental eccentricity=h/450, h=wall height
fk characteristic compressive strength fk= 3.50 N/mm²
γM= 2.50, γM partial safety factor for the material

y [m]	t [m]	Fy [kN/m]	M [kNm/m]	e/t	Φ	Ned [kN/m]	Nrd [kN/m]	
0.25	0.852	4.16	-0.12	0.036	0.928	4.16	1106.92	(Ned<=Nrd)
0.50	0.903	8.62	-0.46	0.060	0.880	8.62	1112.50	(Ned<=Nrd)
0.75	0.955	13.39	-0.95	0.076	0.848	13.39	1133.78	(Ned<=Nrd)
1.00	1.007	18.49	-1.54	0.085	0.830	18.49	1170.13	(Ned<=Nrd)
1.25	1.058	23.88	-2.16	0.088	0.824	23.88	1220.51	(Ned<=Nrd)
1.50	1.110	29.58	-2.77	0.087	0.826	29.58	1283.60	(Ned<=Nrd)
1.75	1.162	35.60	-3.32	0.083	0.834	35.60	1356.75	(Ned<=Nrd)
2.00	1.213	41.91	-3.73	0.077	0.846	41.91	1436.68	(Ned<=Nrd)
2.25	1.265	48.55	-3.97	0.069	0.862	48.55	1526.60	(Ned<=Nrd)
2.50	1.317	55.49	-3.96	0.058	0.884	55.49	1629.92	(Ned<=Nrd)
2.75	1.368	62.76	-3.66	0.047	0.906	62.76	1735.17	(Ned<=Nrd)
3.00	1.420	70.34	-2.97	0.035	0.930	70.34	1848.84	(Ned<=Nrd)

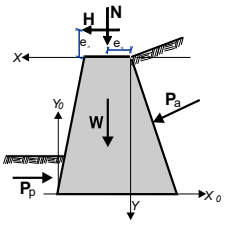
Design for shear strength Ved<=Vrd (EC6 §6.2.1)
Shear resistance Vrd=fvk·t/γM, design shear load Ved (EC6 §6.2.1)
fvk=fvko+0.40xσd ,σd design compressive stress (EC6 §3.6.2)
fvko shear strength under zero compressive stress fvko= 0.20 N/mm²
γM= 2.50, γM partial safety factor for the material

y [m]	t [m]	Fx [kN/m]	σd [N/mm²]	Ved [kN/m]	Vrd [kN/m]	
0.25	0.852	0.16	0.005	0.16	68.84	(Ved<=Vrd)
0.50	0.903	0.62	0.010	0.62	73.68	(Ved<=Vrd)
0.75	0.955	1.42	0.014	1.42	78.54	(Ved<=Vrd)
1.00	1.007	2.51	0.018	2.51	83.46	(Ved<=Vrd)
1.25	1.058	3.92	0.023	3.92	88.53	(Ved<=Vrd)
1.50	1.110	5.63	0.027	5.63	93.60	(Ved<=Vrd)
1.75	1.162	7.67	0.031	7.67	98.72	(Ved<=Vrd)
2.00	1.213	10.02	0.035	10.02	103.83	(Ved<=Vrd)
2.25	1.265	12.68	0.038	12.68	108.89	(Ved<=Vrd)
2.50	1.317	15.65	0.042	15.65	114.21	(Ved<=Vrd)
2.75	1.368	18.98	0.046	18.98	119.51	(Ved<=Vrd)
3.00	1.420	22.73	0.050	22.73	124.96	(Ved<=Vrd)

3.11.3. Loading 1.00x(permanent unfav.)+1.00x(permanent favor.)+0.30x(variable)+1.00x(seismic)

Forces (at centroid of cross section) and stresses at wall stem (with seismic loading)
x, y:cross section centroid, b:cross section width, e:eccentricity
Fx:horizontal force, Fy:vertical force, M:moment, e/b:relative eccentricity
σ1, σ2, τ :cross section normal and shear stress, Bq:effective cross section width

y [m]	x [m]	b [m]	Fx [kN/m]	Fy [kN/m]	M [kNm/m]	e/b	σ1 [N/mm²]	σ2 [N/mm²]	Bq/B	τ [N/mm²]
0.25	0.462	0.852	0.46	4.01	-0.07	0.021	-0.004	-0.005	1.000	0.001
0.50	0.523	0.903	1.26	8.31	-0.22	0.029	-0.008	-0.011	1.000	0.001
0.75	0.585	0.955	2.46	12.88	-0.32	0.025	-0.012	-0.016	1.000	0.003
1.00	0.647	1.007	4.00	17.76	-0.26	0.014	-0.017	-0.020	1.000	0.004
1.25	0.708	1.058	5.91	22.92	0.07	-0.003	-0.023	-0.022	1.000	0.006
1.50	0.770	1.110	8.18	28.37	0.79	-0.024	-0.030	-0.023	1.000	0.007
1.75	0.832	1.162	10.83	34.10	2.01	-0.049	-0.040	-0.022	1.000	0.009
2.00	0.893	1.213	13.84	40.12	3.86	-0.076	-0.050	-0.019	1.000	0.011
2.25	0.955	1.265	17.22	46.43	6.43	-0.105	-0.063	-0.014	1.000	0.014
2.50	1.017	1.317	20.95	53.03	9.87	-0.135	-0.076	-0.008	1.000	0.016
2.75	1.078	1.368	25.12	59.92	4.61	-0.054	-0.061	-0.031	1.000	0.018
3.00	1.140	1.420	29.76	67.11	7.30	-0.073	-0.071	-0.028	1.000	0.021



3.11.4. Strength check according toEC6 EN1996-1-1:2005 (with seismic loading)

Strength check in normal stresses Ned<=Nrd (with seismic loading) (EC6 §6.1.2)
Vertical resistance load Nrd=Φ.fk.t/γM, Vertical design load Ned (EC6 §6.1.2)
Φ=1-2e/t, Φ capacity reduction factor for slenderness and eccentricity of loading
e=load eccentricity+es, es=accidental eccentricity=h/450, h=wall height
fk characteristic compressive strength fk= 3.50 N/mm²
γM= 2.50, γM partial safety factor for the material

y [m]	t [m]	Fy [kN/m]	M [kNm/m]	e/t	Φ	Ned [kN/m]	Nrd [kN/m]	
0.25	0.852	4.01	-0.07	0.022	0.956	4.01	1140.32	(Ned<=Nrd)
0.50	0.903	8.31	-0.22	0.030	0.940	8.31	1188.35	(Ned<=Nrd)
0.75	0.955	12.88	-0.32	0.027	0.946	12.88	1264.80	(Ned<=Nrd)
1.00	1.007	17.76	-0.26	0.016	0.968	17.76	1364.69	(Ned<=Nrd)
1.25	1.058	22.92	0.07	0.006	0.988	22.92	1463.43	(Ned<=Nrd)
1.50	1.110	28.37	0.79	0.027	0.946	28.37	1470.08	(Ned<=Nrd)
1.75	1.162	34.10	2.01	0.052	0.896	34.10	1457.61	(Ned<=Nrd)
2.00	1.213	40.12	3.86	0.080	0.840	40.12	1426.49	(Ned<=Nrd)
2.25	1.265	46.43	6.43	0.109	0.782	46.43	1384.92	(Ned<=Nrd)
2.50	1.317	53.03	9.87	0.139	0.722	53.03	1331.22	(Ned<=Nrd)
2.75	1.368	59.92	4.61	0.058	0.884	59.92	1693.04	(Ned<=Nrd)
3.00	1.420	67.11	7.30	0.078	0.844	67.11	1677.87	(Ned<=Nrd)

Design for shear strength Ved<=Vrd (with seismic loading) (EC6 §6.2.1)

Shear resistance Vrd=fvk·t/γM, design shear load Ved (EC6 §6.2.1)

fvk=fvko+0.40xσd ,σd design compressive stress (EC6 §3.6.2)

fvko shear strength under zero compressive stress fvko= 0.20 N/mm²

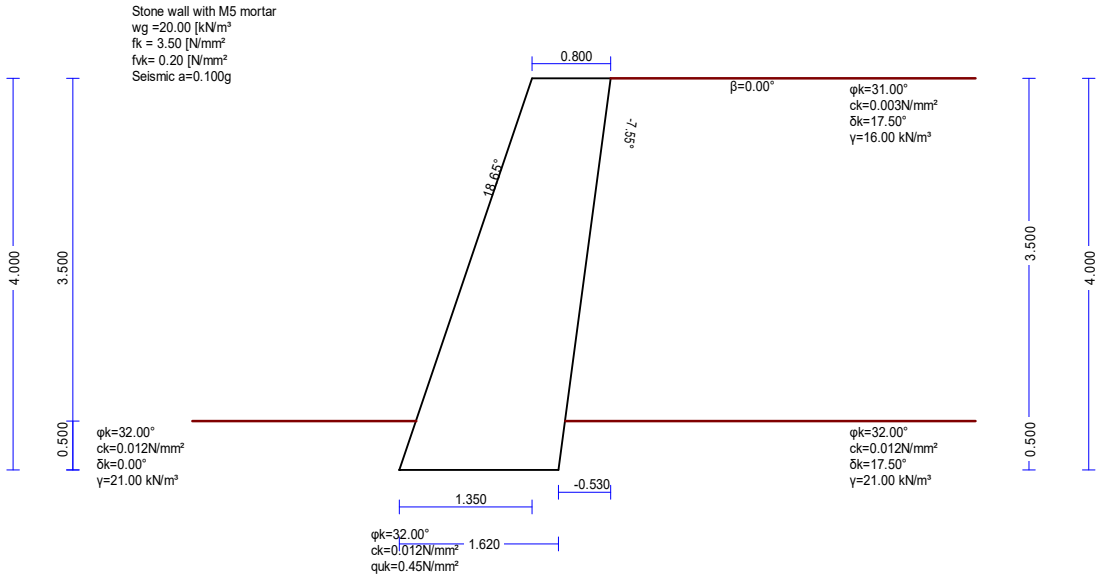
γM= 2.50, γM partial safety factor for the material

y [m]	t [m]	Fx [kN/m]	σd [N/mm²]	Ved [kN/m]	Vrd [kN/m]	
0.25	0.852	0.46	0.005	0.46	68.84	(Ved<=Vrd)
0.50	0.903	1.26	0.009	1.26	73.54	(Ved<=Vrd)
0.75	0.955	2.46	0.013	2.46	78.39	(Ved<=Vrd)
1.00	1.007	4.00	0.018	4.00	83.46	(Ved<=Vrd)
1.25	1.058	5.91	0.022	5.91	88.36	(Ved<=Vrd)
1.50	1.110	8.18	0.026	8.18	93.42	(Ved<=Vrd)
1.75	1.162	10.83	0.029	10.83	98.35	(Ved<=Vrd)
2.00	1.213	13.84	0.033	13.84	103.44	(Ved<=Vrd)
2.25	1.265	17.22	0.037	17.22	108.69	(Ved<=Vrd)
2.50	1.317	20.95	0.040	20.95	113.79	(Ved<=Vrd)
2.75	1.368	25.12	0.044	25.12	119.07	(Ved<=Vrd)
3.00	1.420	29.76	0.047	29.76	124.28	(Ved<=Vrd)

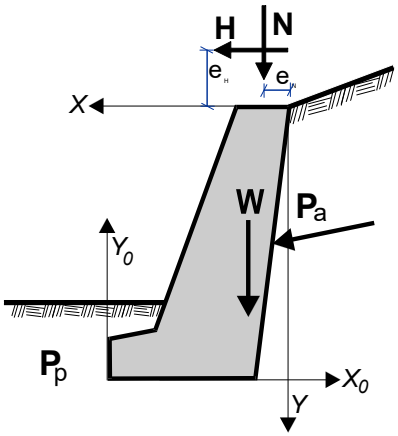
4. PKZ-4

Gravity retaining wall

(EC2 EN1992-1-1:2004, EC0 EN1990:2002, EC7 EN1997-1-1:2004, EC8 EN1998-5:2004,)



4.1. Wall properties-Parameters-Code requirements



Dimensions

Height of wall	h= 4.000 m
Transverse length of wall	L=10.000 m
Stem thickness at top	B1= 0.800 m
Stem thickness at bottom	B2= 1.620 m
Width of wall base	B= 1.620 m
Width of wall toe	0.000 m
Height of wall stem	ho= 4.000 m
Thickness of wall footing	0.000 m
Front thickness of wall toe	0.000 m
Slope (batter) at front face	18.650° (1:2.96)
Slope (batter) at back face	-7.548° (1:7.55)

Weight of wall

Unit weight of wall material	γg=20.000 kN/m³
Cross section area of wall	A= 4.840 m²
Self weight per meter of wall	W= 4.840x20.000= 96.80 kN/m
Center of gravity of wall at	x=0.923 m, y=2.226 m (xo=1.227 m, yo=1.774 m)

Wall materials

Compressive strength	3.50 N/mm²
Shear strength	0.20 N/mm²

4.2. Partial factors for actions and soil properties (EC7 Tab. A.1-A.4, EC8-5 §3.1)

Equilibrium limit state (EQU), Structural limit state (STR), Geotechnical limit state (GEO)

				(EQU)	(STR/GEO) (A1+M1)	(STR/GEO) (A2+M2)	(Seismic)
Actions	Permanent	Unfavorable	γGdst:	1.10	1.35	1.00	1.00
	Permanent	Favorable	γGstb:	0.90	1.00	1.00	1.00
	Variable	Unfavorable	γQdst:	1.50	1.50	1.30	1.00
	Variable	Favorable	γQstb:	0.00	0.00	0.00	0.00
Soil parameters	Angle of shearing resistance		γφ:	1.25	1.00	1.25	1.25
	Effective cohesion		γc:	1.25	1.00	1.25	1.25
	Undrained shear strength		γcu:	1.40	1.00	1.40	1.40
	Unconfined strength		γqu:	1.40	1.00	1.40	1.40
	Weight density		γw:	1.00	1.00	1.00	1.00

γR,v(R1)=1.00, γR,h(R1)=1.00, γR,e(R1)=1.00

4.3. Properties of foundation soil

Bearing capacity of foundation soil qu=0.45 N/mm²
Friction angle between wall footing and soil φ=32.00°, friction coefficient tan(φ)=0.625
Cohesion between wall footing and soil c=0.012 N/mm²

4.4. Seismic coefficients (EC8 EN1998-5:2004, §7.3.2)

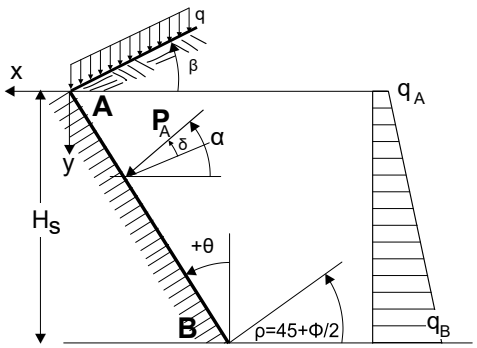
Design ground acceleration ratio	αg=αxg, α=0.10	(EC8-5 §7.3.2)
Verti./horiz. acceleration	αvg/αg=0.90	(EC8 §3.2.2.3)
Soil factor	S=1.00	(EC8 §3.2.2.2)
Importance factor	γI=1.00	(EC8 §3.2.1, T.4.3)
Reduction factor for seismic coefficient	r=1.50	(EC8-5 Table 7.1)
Coefficient for horisontal seismic force	kh=1.00x0.10x1.00/1.500=0.067	(EC8-5 Eq.7.1)
Coefficient for vertical seismic force	kv=0.50x0.067=0.034	(EC8-5 Eq.7.2)

Forces due to seismic load (except from earth pressure)
Horisontal seismic force due to self weight Fwx= 96.80x0.067= 6.49 kN/m
Vertical seismic force due to self weight Fwy= 96.80x0.034= 3.29 kN/m

4.5. Computation of active earth pressure (Coulomb theory)

4.5.1. Wall part from Y=0.000 m to Y=3.500 m, Hs=3.500 m

Top point A x= 0.000 m y= 0.000 m
Bottom point B x= 0.464 m y= 3.500 m



Soil properties
Soil type : Thin gravel
Unit weight of soil γ =16.00 kN/m³
Unit weight of soil (saturated) γs=19.00 kN/m³
Unit weight of water γw=10.00 kN/m³
Angle of shearing resistance of ground φ=31.00°
Cohesion of ground c=0.003 N/mm²
Slope angle of ground surface β= 0.00°
Inclination angle of the wall backface θ=-7.55°
Angle of shear resist. between ground-wall δ=17.50°

Earth pressure according to Coulomb theory

	EQU	A1+M1	A2+M2
Angle of rupture plane ρ=45°+φ/2	= 57.40	60.50	57.40°
Coefficient of active earth pressure Ka=	0.318	0.238	0.318

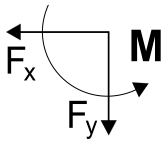
Earth pressure q(y)=qA+γ·y·Ka

$$K_A = \frac{\cos^2(\varphi-\theta)}{\cos^2\theta\,\cos(\theta+\delta)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\beta)}{\cos(\theta+\delta)\cos(\theta-\beta)}}\right]^2}$$

Permanent actions

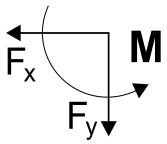
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	0.00	0.00	0.00	kN/m²
Earth pressure at the bottom (y=yA+ 3.50m)	qB=	17.81	13.33	17.81	kN/m²
Earth force Pa= ½(qA+qB)H	Pa=	31.17	23.33	31.17	kN/m
Angle of earth force	α =	6.45	9.95	6.45	°
Earth force in x direction	Pax=	30.97	22.98	30.97	kN/m
Earth force in y direction	Pay=	3.50	4.03	3.50	kN/m
Moment of earth force at top point (x=0,y=0)	M =	-71.17	-52.37	-71.17	kNm/m

Point of application of earth force x= 0.309 m, y= 2.333 m



Total forces and moments

Forces and moments at bottom point B (x=0.464 m, y=3.500 m)



Permanent actions

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	30.97	22.98	30.97	kN/m
Total vertical earth force	Fsy=	3.50	4.03	3.50	kN/m
Total moment of earth force	Ms =	35.60	26.19	35.60	kNm/m

Seismic loading (EC8 EN1998-5:2004, §7.3.2, Annex E)

Horizontal seismic coefficient kh=1.00x0.10x1.00/1.500=0.067 (EC8-5 Eq.7.1, T.7.1)
Vertical seismic coefficient kv=0.50x0.067=0.034 (EC8-5 Eq.7.2)
Soil above the water table (EC8-5 Annex E.5)
tan(ω)=kh/(1-kv)=0.067/(1-0.034)=0.069, ω=3.97°

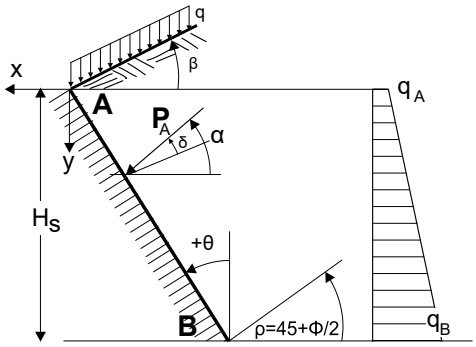
Method Mononobe-Okabe (EC8-5 Annex E.4)
for active earth force during seismic loading
Coefficient of active earth pressure, Ke*(STR)= 0.357
Additional earth pressure due to seismic load
over STR load case ξ=(Ke*/Ke-1)=(0.357/0.238-1)=0.500

$$K_E=\frac{\cos^2(\varphi-\omega-\theta)}{\cos\omega\cos^2\theta\cos(\delta+\theta+\omega)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\omega-\beta)}{\cos(\theta+\omega+\delta)\cos(\theta-\beta)}}\right]^2}$$

Earth force due to seismic load (Permanent actions) Fx=1.500x22.98=34.47 kN/m

4.5.2. Wall part from Y=3.500 m to Y=4.000 m, Hs=0.500 m

Top point A x= 0.464 m y= 3.500 m
Bottom point B x= 0.530 m y= 4.000 m



Soil properties

Soil type : Dense sand		
Unit weight of soil	γ	=21.00 kN/m³
Unit weight of soil (saturated)	γs	=22.50 kN/m³
Unit weight of water	γw	=10.00 kN/m³
Angle of shearing resistance of ground	φ	=32.00°
Cohesion of ground	c	=0.012 N/mm²
Slope angle of ground surface	β	= 0.00°
Inclination angle of the wall backface	θ	=-7.55°
Angle of shear resist. between ground-wall	δ	=17.50°

Loads on soil surface

Permanent uniform load	g=	56.00 kN/m²
Variable uniform load	q=	0.00 kN/m²

Earth pressure according to Coulomb theory

	EQU	A1+M1	A2+M2	
Angle of rupture plane ρ=45°+φ/2	=	57.80	61.00	57.80°
Coefficient of active earth pressure	Ka=	0.307	0.228	0.307

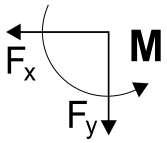
Earth pressure q(y)=qA+γ·y·Ka

$$K_A=\frac{\cos^2(\varphi-\theta)}{\cos^2\theta\cos(\theta+\delta)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\beta)}{\cos(\theta+\delta)\cos(\theta-\beta)}}\right]^2}$$

Permanent actions

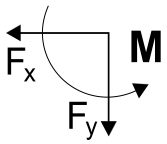
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	17.19	12.77	17.19	kN/m²
Earth pressure at the bottom (y=yA+ 0.50m)	qB=	20.41	15.16	20.41	kN/m²
Earth force Pa= ½(qA+qB)H	Pa=	9.40	6.98	9.40	kN/m
Angle of earth force	α =	6.45	9.95	6.45	°
Earth force in x direction	Pax=	9.34	6.87	9.34	kN/m
Earth force in y direction	Pay=	1.06	1.21	1.06	kN/m
Moment of earth force at top point (x=0,y=0)	M =	-34.56	-25.21	-34.56	kNm/m

Point of application of earth force x= 0.498 m, y= 3.757 m



Total forces and moments

Forces and moments at bottom point B (x=0.530 m, y=4.000 m)



Permanent actions

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	40.31	29.85	40.31	kN/m
Total vertical earth force	Fsy=	4.56	5.24	4.56	kN/m
Total moment of earth force	Ms =	53.09	39.04	53.09	kNm/m

Seismic loading (EC8 EN1998-5:2004, §7.3.2, Annex E)

Horizontal seismic coefficient kh=1.00x0.10x1.00/1.500=0.067 (EC8-5 Eq.7.1, T.7.1)
Vertical seismic coefficient kv=0.50x0.067=0.034 (EC8-5 Eq.7.2)
Soil above the water table (EC8-5 Annex E.5)
tan(ω)=kh/(1-kv)=0.067/(1-0.034)=0.069, ω=3.97°

Method Mononobe-Okabe (EC8-5 Annex E.4)
for active earth force during seismic loading
Coefficient of active earth pressure, Ke*(STR)= 0.346
Additional earth pressure due to seismic load
over STR load case ξ=(Ke*/Ke-1)=(0.346/0.228-1)=0.518

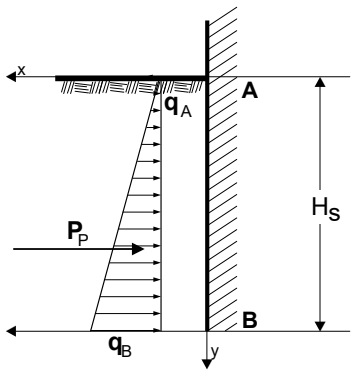
$$K_E = \frac{\cos^2(\varphi-\omega-\theta)}{\cos\omega\,\cos^2\theta\,\cos(\delta+\theta+\omega)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\omega-\beta)}{\cos(\theta+\omega+\delta)\cos(\theta-\beta)}}\right]^2}$$

Earth force due to seismic load (Permanent actions) Fx=1.518x 6.87=10.43 kN/m

4.6. Computation of passive earth pressure (Rankine theory)

4.6.1. Wall part from Y=3.500 m to Y=4.000 m, Hs=0.500 m

Top point A x= 2.150 m y= 3.500 m
Bottom point B x= 2.150 m y= 4.000 m



Soil properties

Soil type : Dense sand

Unit weight of soil	γ	=21.00 kN/m³
Unit weight of soil (saturated)	γs	=22.50 kN/m³
Unit weight of water	γw	=10.00 kN/m³
Angle of shearing resistance of ground	φ	=32.00°
Cohesion of ground	c	=0.012 N/mm²
Slope angle of ground surface	β	= 0.00°
Earth pressure on vertical surface	θ	= 0.00°
Angle of shear resist. between ground-wall	δ	= 0.00°

Earth pressure according to Coulomb theory

	EQU	A1+M1	A2+M2	
Angle of rupture plane ρ=45°-φ/2	=	32.20	29.00	32.20°
Coefficient of passive earth pressure Kp=		2.522	3.255	2.522

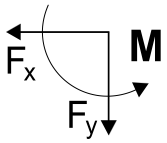
Earth pressure q(y)=qA+γ·y·Kp

$$K_p = \frac{\cos^2(\varphi+\theta)}{\cos^2\theta\,\cos(\theta-\delta)\left[1-\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi+\beta)}{\cos(\theta-\delta)\cos(\theta-\beta)}}\right]^2}$$

Permanent actions

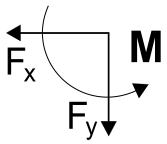
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	0.00	0.00	0.00	kN/m²
Earth pressure at the bottom (y=yA+ 0.50m)	qB=	-26.48	-34.18	-26.48	kN/m²
Earth force Pa= ½(qA+qB)H	Pp=	6.62	8.55	6.62	kN/m
Angle of earth force	α =	0.00	0.00	0.00	°
Earth force in x direction	Ppx=	-6.62	-8.55	-6.62	kN/m
Earth force in y direction	Ppy=	0.00	0.00	0.00	kN/m
Moment of earth force at top point (x=0,y=0)	M =	25.37	32.77	25.37	kNm/m

Point of application of earth force x= 2.150 m, y= 3.833 m



Total forces and moments

Forces and moments at bottom point B (x=2.150 m, y=4.000 m)



Permanent actions

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	-6.62	-8.55	-6.62	kN/m
Total vertical earth force	Fsy=	0.00	0.00	0.00	kN/m
Total moment of earth force	Ms =	-1.11	-1.43	-1.11	kNm/m

Seismic loading (EC8 EN1998-5:2004, §7.3.2, Annex E)

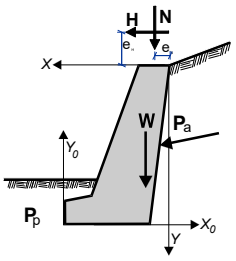
tan(ω)=kh/(1-kv)=0.067/(1-0.034)=0.069, ω=3.97°
Coefficient of passive earth pressure Kp*(STR)= 2.434
ξ=(Kp*/Kp)=(2.434/3.255)=0.748

		EQU	A1+M1	A2+M2
Total horizontal earth force	Fsx=	-4.95	-6.39	-4.95

4.7. Checks of wall stability (EQU)

4.7.1. Forces (driving and resisting) on the wall (EQU)

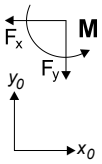
Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 3.50	30.97	3.50	0.309	2.333
Active earth pressure	Pa	3.50- 4.00	9.34	1.06	0.498	3.757
Passive earth pressure	Pp	3.50- 4.00	-6.62	0.00	2.150	3.833
Wall weight	W		0.00	96.80	0.923	2.226



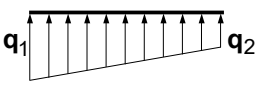
4.7.2. Check of soil bearing capacity (EQU) (EC7 EN1997-1-1:2004, §6.5.2)

Check for 0.90x(self weight+top vertical dead load)+0.00x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.10	0.00- 3.50	34.07	3.85	1.841	1.667	49.71
Active earth pressure	Pax1.10	3.50- 4.00	10.27	1.17	1.652	0.243	0.57
Wall weight	W x0.90		0.00	87.12	1.227	1.774	-106.89
			Sum=	92.14			-56.61



Sum of vertical forces = 92.14 kN/m
Sum of moments at front toe = -56.61 kNm/m
Sum of moments at middle of base = 18.02 kNm/m
Eccentricity ec=18.02/92.14=0.196m, ec<=1.620/6=0.270m
Soil pressure q1=0.098 N/mm² q2=0.016 N/mm²

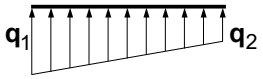


Effective footing L'=1.620-2x0.196= 1.229 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.229x(1000x0.45)/1.40= 395.04 kN/m
Bearing resistance check Vd=92.14 < Rd=395.04 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1.10x(self weight+top vertical dead load)+1.50x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.10	0.00- 3.50	34.07	3.85	1.841	1.667	49.71
Active earth pressure	Pax1.10	3.50- 4.00	10.27	1.17	1.652	0.243	0.57
Wall weight	W x1.10		0.00	106.48	1.227	1.774	-130.65
			Sum=	111.50			-80.37

Sum of vertical forces = 111.50 kN/m
Sum of moments at front toe = -80.37 kNm/m
Sum of moments at middle of base = 9.95 kNm/m
Eccentricity ec=9.95/111.50=0.089m, ec<=1.620/6=0.270m

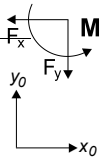


Soil pressure q1=0.092 N/mm² q2=0.046 N/mm²
Effective footing L'=1.620-2x0.089= 1.442 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.442x(1000x0.45)/1.40= 463.50 kN/m
Bearing resistance check Vd=111.50 < Rd=463.50 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

4.7.3. Failure check due to overturning (EQU)

(EC7 EN1997-1-1:2004, §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=2.150,y=4.000 m)

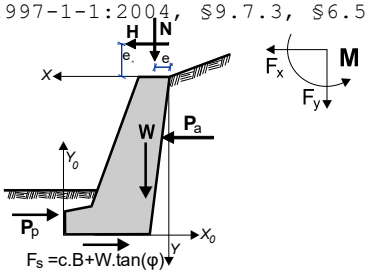


Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.10	0.00- 3.50	34.07	3.85	1.841	1.667	56.79	7.08
Active earth pressure	Pax1.10	3.50- 4.00	10.27	1.17	1.652	0.243	2.50	1.93
Wall weight	W x0.90		0.00	87.12	1.227	1.774	0.00	106.89
		Sum=		92.14			59.29	115.90

Sum of overturning moments = 59.29 kNm/m
Sum of moments resisting overturning = 115.90 kNm/m
Overturning check Med=59.29 < Mrd=115.90 kNm/m, Is verified
Eccentricity ec=(1.620/2)-(115.90-59.29)/92.14=0.196m, ec<=1.620/3=0.540m

4.7.4. Failure check against sliding (EQU)

(EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)

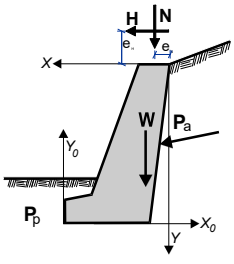


Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.10	0.00- 3.50	34.07	0.00	3.85
Active earth pressure	Pax1.10	3.50- 4.00	10.27	0.00	1.17
Passive earth pressure	Ppx0.90	3.50- 4.00	0.00	5.96	0.00
Wall weight	W x0.90		0.00	0.00	87.12
		Sum=	44.34	5.96	92.14

Soil friction Rd=Nd·tanφ/γM = 92.14xtan(32.00°)/1.25= 46.06 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1.620x0.012/1.25= 15.55 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 44.34 kN/m
Sum of resisting forces (5.96/1.00+46.06) = 52.02 kN/m
Sliding resistance check Hd=44.34 < Rd=52.02 kN/m, Is verified

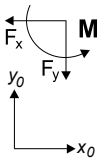
4.8. Checks of wall stability (STR/GEO A1+M1)

4.8.1. Forces (driving and resisting) on the wall (STR/GEO A1+M1)



Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 3.50	22.98	4.03	0.309	2.333
Active earth pressure	Pa	3.50- 4.00	6.87	1.21	0.498	3.757
Passive earth pressure	Pp	3.50- 4.00	-8.55	0.00	2.150	3.833
Wall weight	W		0.00	96.80	0.923	2.226

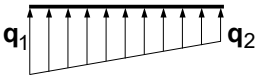
4.8.2. Check of soil bearing capacity (STR/GEO A1+M1) (EC7 EN1997-1-1:2004, §6.5.2)



Check for 1.00x(self weight+top vertical dead load)+0.00x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.35	0.00- 3.50	31.02	5.44	1.841	1.667	41.70
Active earth pressure	Pax1.35	3.50- 4.00	9.27	1.63	1.652	0.243	-0.45
Wall weight	W x1.00		0.00	96.80	1.227	1.774	-118.77
			Sum=	103.87			-77.52

Sum of vertical forces = 103.87 kN/m
Sum of moments at front toe = -77.52 kNm/m
Sum of moments at middle of base = 6.61 kNm/m
Eccentricity ec=6.61/103.87=0.064m, ec<=1.620/6=0.270m

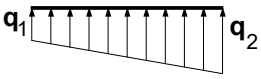


Soil pressure q1=0.079 N/mm² q2=0.049 N/mm²
Effective footing L'=1.620-2x0.064= 1.493 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.493x(1000x0.45)/1.00= 671.85 kN/m
Bearing resistance check Vd=103.87 < Rd=671.85 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1.35x(self weight+top vertical dead load)+1.50x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.35	0.00- 3.50	31.02	5.44	1.841	1.667	41.70
Active earth pressure	Pax1.35	3.50- 4.00	9.27	1.63	1.652	0.243	-0.45
Wall weight	W x1.35		0.00	130.68	1.227	1.774	-160.34
			Sum=	137.75			-119.09

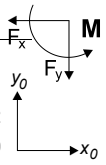
Sum of vertical forces = 137.75 kN/m
Sum of moments at front toe = -119.09 kNm/m
Sum of moments at middle of base = -7.51 kNm/m



Eccentricity ec=-7.51/137.75=-0.055m, ec<=1.620/6=0.270m
Soil pressure q1=0.068 N/mm² q2=0.102 N/mm²
Effective footing L'=1.620-2x0.055= 1.511 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.511x(1000x0.45)/1.00= 679.95 kN/m
Bearing resistance check Vd=137.75 < Rd=679.95 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

4.8.3. Failure check due to overturning (STR/GEO A1+M1) (EC7 EN1997-1-1:2004, §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=2.150,y=4.000 m)

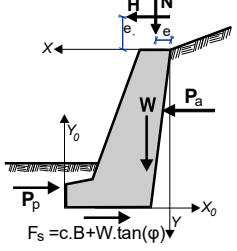


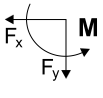
Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.35	0.00- 3.50	31.02	5.44	1.841	1.667	51.72	10.02
Active earth pressure	Pax1.35	3.50- 4.00	9.27	1.63	1.652	0.243	2.25	2.70
Wall weight	W x1.00		0.00	96.80	1.227	1.774	0.00	118.77
		Sum=		103.87			53.97	131.49

Sum of overturning moments = 53.97 kNm/m
Sum of moments resisting overturning = 131.49 kNm/m
Overturning check Med=53.97 < Mrd=131.49 kNm/m, Is verified
Eccentricity ec=(1.620/2)-(131.49-53.97)/103.87=0.064m, ec<=1.620/3=0.540m

4.8.4. Failure check against sliding (STR/GEO A1+M1) (EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)

Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.35	0.00- 3.50	31.02	0.00	5.44
Active earth pressure	Pax1.35	3.50- 4.00	9.27	0.00	1.63
Passive earth pressure	Ppx1.00	3.50- 4.00	0.00	8.55	0.00
Wall weight	W x1.00		0.00	0.00	96.80
		Sum=	40.29	8.55	103.87



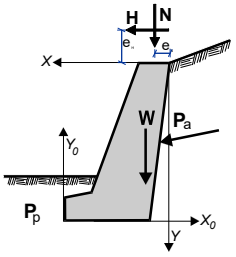


Soil friction Rd=Nd·tanφ/γM = 103.87xtan(32.00°)/1.00= 64.91 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1.620x0.012/1.00= 19.44 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 40.29 kN/m
Sum of resisting forces (8.55/1.00+64.91) = 73.46 kN/m
Sliding resistance check Hd=40.29 < Rd=73.46 kN/m, Is verified

4.9. Checks of wall stability (STR/GEO A2+M2)

4.9.1. Forces (driving and resisting) on the wall (STR/GEO A2+M2)

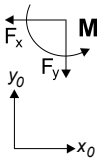
Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 3.50	30.97	3.50	0.309	2.333
Active earth pressure	Pa	3.50- 4.00	9.34	1.06	0.498	3.757
Passive earth pressure	Pp	3.50- 4.00	-6.62	0.00	2.150	3.833
Wall weight	W		0.00	96.80	0.923	2.226



4.9.2. Check of soil bearing capacity (STR/GEO A2+M2)

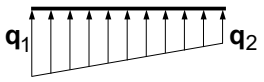
(EC7 EN1997-1-1:2004, §6.5.2)

Check for 1.00x(self weight+top vertical dead load)+0.00x(top vertical live load)



Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.00	0.00- 3.50	30.97	3.50	1.841	1.667	45.19
Active earth pressure	Pax1.00	3.50- 4.00	9.34	1.06	1.652	0.243	0.52
Wall weight	W x1.00		0.00	96.80	1.227	1.774	-118.77
			Sum=	101.36			-73.06

Sum of vertical forces = 101.36 kN/m
Sum of moments at front toe = -73.06 kNm/m
Sum of moments at middle of base = 9.04 kNm/m
Eccentricity ec=9.04/101.36=0.089m, ec<=1.620/6=0.270m
Soil pressure q1=0.083 N/mm² q2=0.042 N/mm²

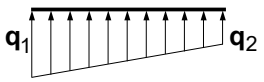


Effective footing L'=1.620-2x0.089= 1.442 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.442x(1000x0.45)/1.40= 463.50 kN/m
Bearing resistance check Vd=101.36 < Rd=463.50 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1.00x(self weight+top vertical dead load)+1.30x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.00	0.00- 3.50	30.97	3.50	1.841	1.667	45.19
Active earth pressure	Pax1.00	3.50- 4.00	9.34	1.06	1.652	0.243	0.52
Wall weight	W x1.00		0.00	96.80	1.227	1.774	-118.77
			Sum=	101.36			-73.06

Sum of vertical forces = 101.36 kN/m
Sum of moments at front toe = -73.06 kNm/m
Sum of moments at middle of base = 9.04 kNm/m
Eccentricity ec=9.04/101.36=0.089m, ec<=1.620/6=0.270m
Soil pressure q1=0.083 N/mm² q2=0.042 N/mm²

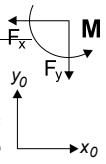


Effective footing L'=1.620-2x0.089= 1.442 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.442x(1000x0.45)/1.40= 463.50 kN/m
Bearing resistance check Vd=101.36 < Rd=463.50 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

4.9.3. Failure check due to overturning (STR/GEO A2+M2)

(EC7 EN1997-1-1:2004, §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=2.150,y=4.000 m)

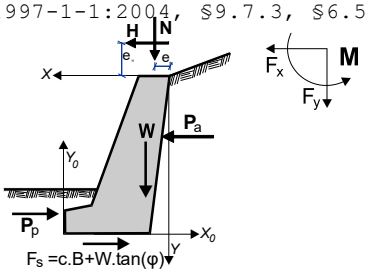


Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.00	0.00- 3.50	30.97	3.50	1.841	1.667	51.63	6.44
Active earth pressure	Pax1.00	3.50- 4.00	9.34	1.06	1.652	0.243	2.27	1.75
Wall weight	W x1.00		0.00	96.80	1.227	1.774	0.00	118.77
		Sum=		101.36			53.90	126.96

Sum of overturning moments = 53.90 kNm/m
Sum of moments resisting overturning = 126.96 kNm/m
Overturning check Med=53.90 < Mrd=126.96 kNm/m, Is verified
Eccentricity ec=(1.620/2)-(126.96-53.90)/101.36=0.089m, ec<=1.620/3=0.540m

4.9.4. Failure check against sliding (STR/GEO A2+M2)

(EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)



Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.00	0.00- 3.50	30.97	0.00	3.50
Active earth pressure	Pax1.00	3.50- 4.00	9.34	0.00	1.06
Passive earth pressure	Ppx1.00	3.50- 4.00	0.00	6.62	0.00
Wall weight	W x1.00		0.00	0.00	96.80
		Sum=	40.31	6.62	101.36

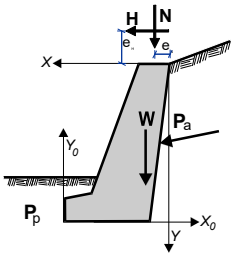
Soil friction Rd=Nd·tanφ/γM = 101.36xtan(32.00°)/1.25= 50.67 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1.620x0.012/1.25= 15.55 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 40.31 kN/m
Sum of resisting forces (6.62/1.00+50.67) = 57.29 kN/m
Sliding resistance check Hd=40.31 < Rd=57.29 kN/m, Is verified

4.10. Seismic design

(EC8 EN1998-5:2004)

Checks of wall stability (with seismic loading)

4.10.1. Forces (driving and resisting) on the wall



Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 3.50	22.98	4.03	0.309	1.750
Active earth pressure	Pa	3.50- 4.00	6.87	1.21	0.498	3.750
Passive earth pressure	Pp	3.50- 4.00	-6.39	0.00	2.150	3.833
Wall weight	W		0.00	96.80	0.923	2.226

4.10.2. Additional forces due to seismic load

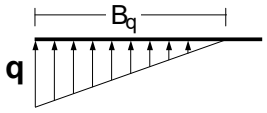
Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 3.50	11.49		0.309	1.750
Active earth pressure	Pa	3.50- 4.00	3.56		0.498	3.750
Wall weight	W		6.49	±3.29	0.923	2.226

4.10.3. Check of soil bearing capacity (with seismic loading)

(EC7 §6.5.2)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.00	0.00- 3.50	34.47	4.03	1.841	2.250	70.14
Active earth pressure	Pax1.00	3.50- 4.00	10.43	1.21	1.652	0.250	0.61
Wall weight	W x1.00		6.49	93.51	1.227	1.774	-103.22
			Sum=	98.75			-32.47

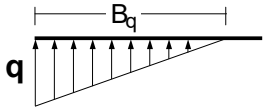
Sum of vertical forces = 98.75 kN/m
Sum of moments at front toe = -32.47 kNm/m
Sum of moments at middle of base = 47.52 kNm/m
Eccentricity ec=47.52/98.75=0.481m, ec>1.620/6=0.270m
Soil pressure q=0.200 N/mm² Bq=0.986 m
Effective footing L'=1.620-2x0.481= 0.658 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=0.658x(1000x0.45)/1.40= 211.50 kN/m
Bearing resistance check Vd=98.75 < Rd=211.50 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)



4.10.4. Check of soil bearing capacity (with seismic loading) (EC7 §6.5.2)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.00	0.00- 3.50	34.47	4.03	1.841	2.250	70.14
Active earth pressure	Pax1.00	3.50- 4.00	10.43	1.21	1.652	0.250	0.61
Wall weight	W x1.00		6.49	100.09	1.227	1.774	-111.29
			Sum=	105.33			-40.54

Sum of vertical forces = 105.33 kN/m
Sum of moments at front toe = -40.54 kNm/m
Sum of moments at middle of base = 44.78 kNm/m
Eccentricity ec=44.78/105.33=0.425m, ec>1.620/6=0.270m
Soil pressure q=0.182 N/mm² Bq=1.155 m
Effective footing L'=1.620-2x0.425= 0.770 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=0.770x(1000x0.45)/1.40= 247.50 kN/m
Bearing resistance check Vd=105.33 < Rd=247.50 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)



4.10.5. Failure check due to overturning (with seismic loading) (EC7 §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=2.150,y=4.000 m)

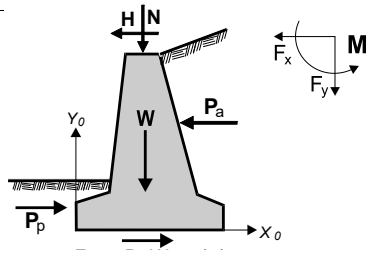
Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.00	0.00- 3.50	34.47	4.03	1.841	2.250	77.56	7.42
Active earth pressure	Pax1.00	3.50- 4.00	10.43	1.21	1.652	0.250	2.61	2.00
Wall weight	W x1.00		6.49	96.80	1.227	1.774	11.51	118.77
Wall weight	W x1.00		0.00	-3.29	1.227	1.774	4.04	0.00*
		Sum=		98.75			95.72	128.19

(*moments of negative seismic vertical loads, are added to the overturning moments)

Sum of overturning moments = 95.72 kNm/m
Sum of moments resisting overturning = 128.19 kNm/m
Overturning check Med=95.72 < Mrd=128.19 kNm/m, Is verified
Eccentricity ec=(1.620/2)-(128.19-95.72)/98.75=0.481m, ec<=1.620/3=0.540m

4.10.6. Failure check against sliding (with seismic loading) (EC7 §9.7.3, §6.5.3, EC8-5 §5.4.1.1)

Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.00	0.00- 3.50	34.47	0.00	4.03
Active earth pressure	Pax1.00	3.50- 4.00	10.43	0.00	1.21
Passive earth pressure	Ppx1.00	3.50- 4.00	0.00	6.39	0.00
Wall weight	W x1.00		6.49	0.00	93.51
		Sum=	51.39	6.39	98.75



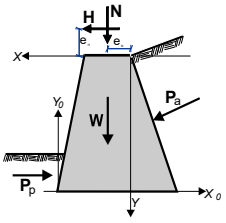
Soil friction Rd=Nd·tanφ/γM = 98.75xtan(32.00°)/1.25= 49.36 kN/m
Soil cohesion Rd=A·cu/γM = 1000x0.986x0.012/1.25= 9.47 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 51.39 kN/m
Sum of resisting forces (6.39/1.00+49.36) = 55.75 kN/m
Sliding resistance check Hd=51.39 < Rd=55.75 kN/m, Is verified

4.11. Design of wall stem

4.11.1. Loading 1.35x(permanent unfavorable)+1.00x(permanent favorable)+1.50x(variable unfav.)

Forces (at centroid of cross section) and stresses at wall stem
x, y:cross section centroid, b:cross section width, e:eccentricity
Fx:horizontal force, Fy:vertical force, M:moment, e/b:relative eccentricity
σ1, σ2, τ :cross section normal and shear stress, Bq:effective cross section width

y [m]	x [m]	b [m]	Fx [kN/m]	Fy [kN/m]	M [kNm/m]	e/b	σ1 [N/mm²]	σ2 [N/mm²]	Bq/B	τ [N/mm²]
0.50	0.518	0.903	0.63	8.62	-0.44	0.056	-0.006	-0.013	1.000	0.001
1.00	0.635	1.005	2.52	18.50	-1.45	0.078	-0.010	-0.027	1.000	0.003
1.50	0.753	1.108	5.70	29.61	-2.54	0.077	-0.014	-0.039	1.000	0.005
2.00	0.870	1.210	10.14	41.98	-3.28	0.065	-0.021	-0.048	1.000	0.008
2.50	0.988	1.313	15.82	55.59	-3.21	0.044	-0.031	-0.054	1.000	0.012
3.00	1.105	1.415	22.79	70.45	-1.83	0.018	-0.044	-0.055	1.000	0.016
3.50	1.223	1.518	31.01	86.55	1.31	-0.010	-0.060	-0.054	1.000	0.020
4.00	1.340	1.620	40.30	103.87	6.62	-0.039	-0.079	-0.049	1.000	0.025



4.11.2. Strength check according toEC6 EN1996-1-1:2005

Strength check in normal stresses Ned<=Nrd (EC6 §6.1.2)
Vertical resistance load Nrd=Φ.fk.t/γM, Vertical design load Ned (EC6 §6.1.2)
Φ=1-2e/t, Φ capacity reduction factor for slenderness and eccentricity of loading
e=load eccentricity+es, es=accidental eccentricity=h/450, h=wall height
fk characteristic compressive strength fk= 3.50 N/mm²
γM= 2.50, γM partial safety factor for the material

y [m]	t [m]	Fy [kN/m]	M [kNm/m]	e/t	Φ	Ned [kN/m]	Nrd [kN/m]	
0.50	0.903	8.62	-0.44	0.057	0.886	8.62	1120.08	(Ned<=Nrd)
1.00	1.005	18.50	-1.45	0.080	0.840	18.50	1181.88	(Ned<=Nrd)
1.50	1.108	29.61	-2.54	0.080	0.840	29.61	1303.01	(Ned<=Nrd)
2.00	1.210	41.98	-3.28	0.069	0.862	41.98	1460.23	(Ned<=Nrd)
2.50	1.313	55.59	-3.21	0.048	0.904	55.59	1661.73	(Ned<=Nrd)
3.00	1.415	70.45	-1.83	0.023	0.954	70.45	1889.87	(Ned<=Nrd)
3.50	1.518	86.55	1.31	0.015	0.970	86.55	2061.44	(Ned<=Nrd)
4.00	1.620	103.87	6.62	0.044	0.912	103.87	2068.42	(Ned<=Nrd)

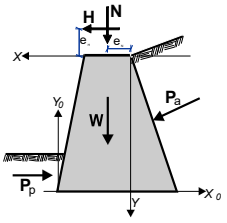
Design for shear strength Ved<=Vrd (EC6 §6.2.1)
Shear resistance Vrd=fvk·t/γM, design shear load Ved (EC6 §6.2.1)
fvk=fvko+0.40xσd ,σd design compressive stress (EC6 §3.6.2)
fvko shear strength under zero compressive stress fvko= 0.20 N/mm²
γM= 2.50, γM partial safety factor for the material

y [m]	t [m]	Fx [kN/m]	σd [N/mm²]	Ved [kN/m]	Vrd [kN/m]	
0.50	0.903	0.63	0.010	0.63	73.68	(Ved<=Vrd)
1.00	1.005	2.52	0.018	2.52	83.29	(Ved<=Vrd)
1.50	1.108	5.70	0.027	5.70	93.43	(Ved<=Vrd)
2.00	1.210	10.14	0.035	10.14	103.58	(Ved<=Vrd)
2.50	1.313	15.82	0.042	15.82	113.86	(Ved<=Vrd)
3.00	1.415	22.79	0.050	22.79	124.52	(Ved<=Vrd)
3.50	1.518	31.01	0.057	31.01	135.28	(Ved<=Vrd)
4.00	1.620	40.30	0.064	40.30	146.19	(Ved<=Vrd)

4.11.3. Loading 1.00x(permanent unfav.)+1.00x(permanent favor.)+0.30x(variable)+1.00x(seismic)

Forces (at centroid of cross section) and stresses at wall stem (with seismic loading)
x, y:cross section centroid, b:cross section width, e:eccentricity
Fx:horizontal force, Fy:vertical force, M:moment, e/b:relative eccentricity
σ1, σ2, τ :cross section normal and shear stress, Bq:effective cross section width

y [m]	x [m]	b [m]	Fx [kN/m]	Fy [kN/m]	M [kNm/m]	e/b	σ1 [N/mm²]	σ2 [N/mm²]	Bq/B	τ [N/mm²]
0.50	0.518	0.903	1.28	8.30	-0.20	0.025	-0.008	-0.011	1.000	0.001
1.00	0.635	1.005	4.01	17.77	-0.17	0.009	-0.017	-0.019	1.000	0.004
1.50	0.753	1.108	8.25	28.38	1.04	-0.032	-0.032	-0.022	1.000	0.007
2.00	0.870	1.210	13.96	40.15	4.35	-0.086	-0.053	-0.017	1.000	0.012
2.50	0.988	1.313	21.12	53.08	10.69	-0.146	-0.080	-0.005	1.000	0.016
3.00	1.105	1.415	29.77	67.15	21.02	-0.211	-0.115	0.000	0.868	0.021
3.50	1.223	1.518	39.89	82.39	36.25	-0.276	-0.170	0.000	0.672	0.026
4.00	1.340	1.620	51.38	98.75	27.41	-0.163	-0.127	-0.001	1.000	0.032



4.11.4. Strength check according toEC6 EN1996-1-1:2005 (with seismic loading)

Strength check in normal stresses Ned<=Nrd (with seismic loading) (EC6 §6.1.2)
Vertical resistance load Nrd=Φ.fk.t/γM, Vertical design load Ned (EC6 §6.1.2)
Φ=1-2e/t, Φ capacity reduction factor for slenderness and eccentricity of loading
e=load eccentricity+es, es=accidental eccentricity=h/450, h=wall height
fk characteristic compressive strength fk= 3.50 N/mm²
γM= 2.50, γM partial safety factor for the material

y [m]	t [m]	Fy [kN/m]	M [kNm/m]	e/t	Φ	Ned [kN/m]	Nrd [kN/m]	
0.50	0.903	8.30	-0.20	0.026	0.948	8.30	1198.46	(Ned<=Nrd)
1.00	1.005	17.77	-0.17	0.011	0.978	17.77	1376.05	(Ned<=Nrd)
1.50	1.108	28.38	1.04	0.035	0.930	28.38	1442.62	(Ned<=Nrd)
2.00	1.210	40.15	4.35	0.090	0.820	40.15	1389.08	(Ned<=Nrd)
2.50	1.313	53.08	10.69	0.150	0.700	53.08	1286.74	(Ned<=Nrd)
3.00	1.415	67.15	21.02	0.216	0.568	67.15	1125.21	(Ned<=Nrd)
3.50	1.518	82.39	36.25	0.281	0.438	82.39	930.84	(Ned<=Nrd)
4.00	1.620	98.75	27.41	0.168	0.664	98.75	1505.95	(Ned<=Nrd)

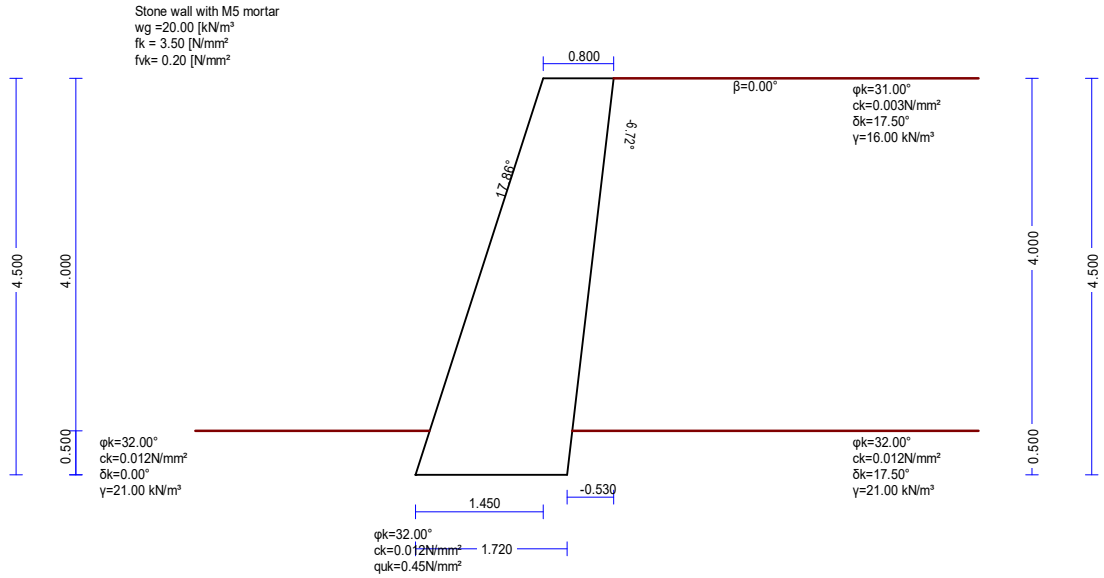
Design for shear strength Ved<=Vrd (with seismic loading) (EC6 §6.2.1)
Shear resistance Vrd=fvk·t/γM, design shear load Ved (EC6 §6.2.1)
fvk=fvko+0.40xσd ,σd design compressive stress (EC6 §3.6.2)
fvko shear strength under zero compressive stress fvko= 0.20 N/mm²
γM= 2.50, γM partial safety factor for the material

y [m]	t [m]	Fx [kN/m]	σd [N/mm²]	Ved [kN/m]	Vrd [kN/m]	
0.50	0.903	1.28	0.009	1.28	73.54	(Ved<=Vrd)
1.00	1.005	4.01	0.018	4.01	83.29	(Ved<=Vrd)
1.50	1.108	8.25	0.026	8.25	93.25	(Ved<=Vrd)
2.00	1.210	13.96	0.033	13.96	103.19	(Ved<=Vrd)
2.50	1.313	21.12	0.040	21.12	113.44	(Ved<=Vrd)
3.00	1.415	29.77	0.047	29.77	123.84	(Ved<=Vrd)
3.50	1.518	39.89	0.054	39.89	134.56	(Ved<=Vrd)
4.00	1.620	51.38	0.061	51.38	145.41	(Ved<=Vrd)

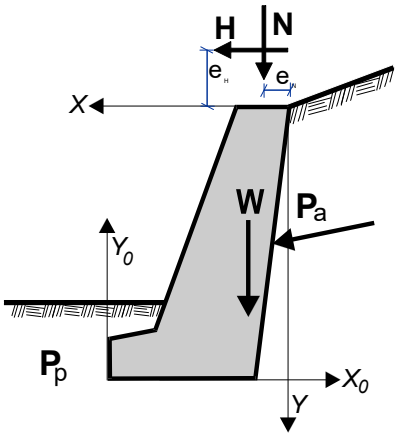
5. PKZ-5

Gravity retaining wall

(EC2 EN1992-1-1:2004, EC0 EN1990:2002, EC7 EN1997-1-1:2004, EC8 EN1998-5:2004,)



5.1. Wall properties-Parameters-Code requirements



Dimensions

Height of wall	h= 4.500 m
Transverse length of wall	L=10.000 m
Stem thickness at top	B1= 0.800 m
Stem thickness at bottom	B2= 1.720 m
Width of wall base	B= 1.720 m
Width of wall toe	0.000 m
Height of wall stem	ho= 4.500 m
Thickness of wall footing	0.000 m
Front thickness of wall toe	0.000 m
Slope (batter) at front face	17.860° (1:3.10)
Slope (batter) at back face	-6.717° (1:8.49)

Weight of wall

Unit weight of wall material	γg=20.000 kN/m³
Cross section area of wall	A= 5.670 m²
Self weight per meter of wall	W= 5.670x20.000= 113.40 kN/m
Center of gravity of wall at	x=0.955 m, y=2.524 m (xo=1.295 m, yo=1.976 m)

Wall materials

Compressive strength	3.50 N/mm²
Shear strength	0.20 N/mm²

5.2. Partial factors for actions and soil properties (EC7 Tab. A.1-A.4, EC8-5 §3.1)

Equilibrium limit state (EQU), Structural limit state (STR), Geotechnical limit state (GEO)

				(EQU)	(STR/GEO) (A1+M1)	(STR/GEO) (A2+M2)
Actions	Permanent	Unfavorable	γGdst:	1.10	1.35	1.00
	Permanent	Favorable	γGstb:	0.90	1.00	1.00
	Variable	Unfavorable	γQdst:	1.50	1.50	1.30
	Variable	Favorable	γQstb:	0.00	0.00	0.00
Soil parameters	Angle of shearing resistance		γφ:	1.25	1.00	1.25
	Effective cohesion		γc:	1.25	1.00	1.25
	Undrained shear strength		γcu:	1.40	1.00	1.40
	Unconfined strength		γqu:	1.40	1.00	1.40
	Weight density		γw:	1.00	1.00	1.00

γR,v(R1)=1.00, γR,h(R1)=1.00, γR,e(R1)=1.00

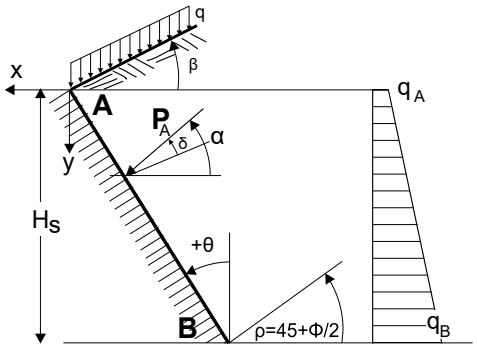
5.3. Properties of foundation soil

Bearing capacity of foundation soil qu=0.45 N/mm²
Friction angle between wall footing and soil φ=32.00°, friction coefficient tan(φ)=0.625
Cohesion between wall footing and soil c=0.012 N/mm²

5.4. Computation of active earth pressure (Coulomb theory)

5.4.1. Wall part from Y=0.000 m to Y=4.000 m, Hs=4.000 m

Top point A x= 0.000 m y= 0.000 m
Bottom point B x= 0.471 m y= 4.000 m



Soil properties

Soil type : Thin gravel
Unit weight of soil γ =16.00 kN/m³
Unit weight of soil (saturated) γs=19.00 kN/m³
Unit weight of water γw=10.00 kN/m³
Angle of shearing resistance of ground φ=31.00°
Cohesion of ground c=0.003 N/mm²
Slope angle of ground surface β= 0.00°
Inclination angle of the wall backface θ=-6.72°
Angle of shear resist. between ground-wall δ=17.50°

Earth pressure according to Coulomb theory

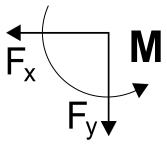
	EQU	A1+M1	A2+M2
Angle of rupture plane ρ=45°+φ/2	= 57.40	60.50	57.40°
Coefficient of active earth pressure Ka=	0.323	0.243	0.323

$$K_A = \frac{\cos^2(\varphi-\theta)}{\cos^2\theta\,\cos(\theta+\delta)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\beta)}{\cos(\theta+\delta)\cos(\theta-\beta)}}\right]^2}$$

Earth pressure q(y)=qA+γ·y·Ka

Permanent actions

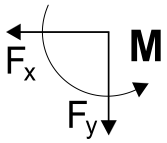
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	0.00	0.00	0.00	kN/m²
Earth pressure at the bottom (y=yA+ 4.00m)	qB=	20.67	15.55	20.67	kN/m²
Earth force Pa= ½(qA+qB)H	Pa=	41.34	31.10	41.34	kN/m
Angle of earth force	α =	7.28	10.78	7.28	°
Earth force in x direction	Pax=	41.01	30.55	41.01	kN/m
Earth force in y direction	Pay=	5.24	5.82	5.24	kN/m
Moment of earth force at top point (x=0,y=0)	M =	-107.73	-79.65	-107.73	kNm/m



Point of application of earth force x= 0.314 m, y= 2.667 m

Total forces and moments

Forces and moments at bottom point B (x=0.471 m, y=4.000 m)

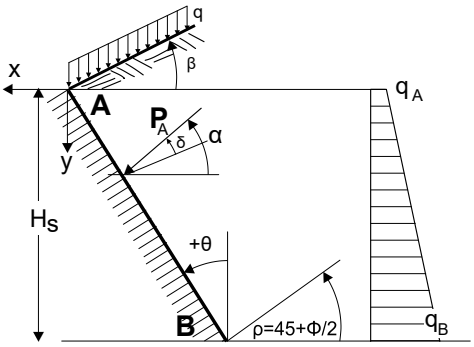


Permanent actions

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	41.01	30.55	41.01	kN/m
Total vertical earth force	Fsy=	5.24	5.82	5.24	kN/m
Total moment of earth force	Ms =	53.84	39.81	53.84	kNm/m

5.4.2. Wall part from Y=4.000 m to Y=4.500 m, Hs=0.500 m

Top point A x= 0.471 m y= 4.000 m
Bottom point B x= 0.530 m y= 4.500 m



Soil properties

Soil type : Dense sand

Unit weight of soil	γ	=21.00 kN/m³
Unit weight of soil (saturated)	γs	=22.50 kN/m³
Unit weight of water	γw	=10.00 kN/m³
Angle of shearing resistance of ground	φ	=32.00°
Cohesion of ground	c	=0.012 N/mm²
Slope angle of ground surface	β	= 0.00°
Inclination angle of the wall backface	θ	=-6.72°
Angle of shear resist. between ground-wall	δ	=17.50°

Loads on soil surface

Permanent uniform load	g=	64.00 kN/m²
Variable uniform load	q=	0.00 kN/m²

Earth pressure according to Coulomb theory

$$K_A = \frac{\cos^2(\varphi-\theta)}{\cos^2\theta\,\cos(\theta+\delta)\left[1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\beta)}{\cos(\theta+\delta)\cos(\theta-\beta)}}\right]^2}$$

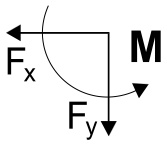
	EQU	A1+M1	A2+M2
Angle of rupture plane ρ=45°+φ/2 =	57.80	61.00	57.80°
Coefficient of active earth pressure Ka=	0.312	0.233	0.312

Earth pressure q(y)=qA+γ·y·Ka

Permanent actions

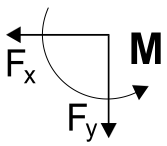
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	19.97	14.91	19.97	kN/m²
Earth pressure at the bottom (y=yA+ 0.50m)	qB=	23.25	17.36	23.25	kN/m²
Earth force Pa= ½(qA+qB)H	Pa=	10.81	8.07	10.81	kN/m
Angle of earth force	α =	7.28	10.78	7.28	°
Earth force in x direction	Pax=	10.72	7.93	10.72	kN/m
Earth force in y direction	Pay=	1.37	1.51	1.37	kN/m
Moment of earth force at top point (x=0,y=0)	M =	-44.94	-32.99	-44.94	kNm/m

Point of application of earth force x= 0.501 m, y= 4.256 m



Total forces and moments

Forces and moments at bottom point B (x=0.530 m, y=4.500 m)



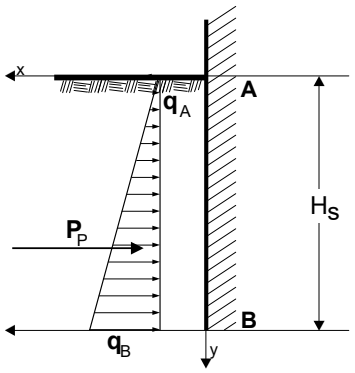
Permanent actions

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	51.73	38.48	51.73	kN/m
Total vertical earth force	Fsy=	6.61	7.33	6.61	kN/m
Total moment of earth force	Ms =	76.61	56.63	76.61	kNm/m

5.5. Computation of passive earth pressure (Rankine theory)

5.5.1. Wall part from Y=4.000 m to Y=4.500 m, Hs=0.500 m

Top point A x= 2.250 m y= 4.000 m
Bottom point B x= 2.250 m y= 4.500 m



Soil properties

Soil type : Dense sand

Unit weight of soil	γ =21.00 kN/m³
Unit weight of soil (saturated)	γs=22.50 kN/m³
Unit weight of water	γw=10.00 kN/m³
Angle of shearing resistance of ground	φ=32.00°
Cohesion of ground	c=0.012 N/mm²
Slope angle of ground surface	β= 0.00°
Earth pressure on vertical surface	θ= 0.00°
Angle of shear resist. between ground-wall	δ= 0.00°

Earth pressure according to Coulomb theory

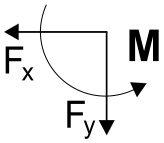
$$K_p = \frac{\cos^2(\varphi+\theta)}{\cos^2\theta\,\cos(\theta-\delta)\left[1-\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi+\beta)}{\cos(\theta-\delta)\,\cos(\theta-\beta)}}\right]^2}$$

	EQU	A1+M1	A2+M2	
Angle of rupture plane ρ=45°-φ/2	= 32.20	29.00	32.20	°
Coefficient of passive earth pressure Kp=	2.522	3.255	2.522	

Earth pressure q(y)=qA+γ·y·Kp

Permanent actions

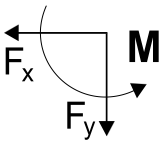
		EQU	A1+M1	A2+M2	
Earth pressure at the top (y=yA)	qA=	0.00	0.00	0.00	kN/m²
Earth pressure at the bottom (y=yA+ 0.50m)	qB=	-26.48	-34.18	-26.48	kN/m²
Earth force Pa= ½(qA+qB)H	Pp=	6.62	8.55	6.62	kN/m
Angle of earth force	α =	0.00	0.00	0.00	°
Earth force in x direction	Ppx=	-6.62	-8.55	-6.62	kN/m
Earth force in y direction	Ppy=	0.00	0.00	0.00	kN/m
Moment of earth force at top point (x=0,y=0)	M =	28.68	37.05	28.68	kNm/m



Point of application of earth force x= 2.250 m, y= 4.333 m

Total forces and moments

Forces and moments at bottom point B (x=2.250 m, y=4.500 m)



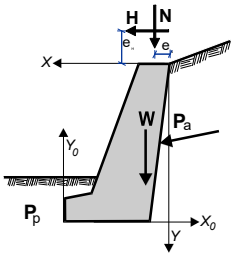
Permanent actions

		EQU	A1+M1	A2+M2	
Total horizontal earth force	Fsx=	-6.62	-8.55	-6.62	kN/m
Total vertical earth force	Fsy=	0.00	0.00	0.00	kN/m
Total moment of earth force	Ms =	-1.11	-1.43	-1.11	kNm/m

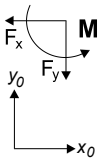
5.6. Checks of wall stability (EQU)

5.6.1. Forces (driving and resisting) on the wall (EQU)

Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 4.00	41.01	5.24	0.314	2.667
Active earth pressure	Pa	4.00- 4.50	10.72	1.37	0.501	4.256
Passive earth pressure	Pp	4.00- 4.50	-6.62	0.00	2.250	4.333
Wall weight	W		0.00	113.40	0.955	2.524



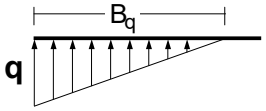
5.6.2. Check of soil bearing capacity (EQU) (EC7 EN1997-1-1:2004, §6.5.2)



Check for 0.90x(self weight+top vertical dead load)+0.00x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.10	0.00- 4.00	45.11	5.76	1.936	1.833	71.53
Active earth pressure	Pax1.10	4.00- 4.50	11.79	1.51	1.749	0.244	0.24
Wall weight	W x0.90		0.00	102.06	1.295	1.976	-132.16
			Sum=	109.33			-60.39

Sum of vertical forces = 109.33 kN/m
Sum of moments at front toe = -60.39 kNm/m
Sum of moments at middle of base = 33.63 kNm/m
Eccentricity ec=33.63/109.33=0.308m, ec>1.720/6=0.287m
Soil pressure q=0.132 N/mm² Bq=1.657 m

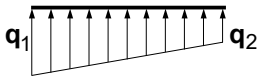


Effective footing L'=1.720-2x0.308= 1.105 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.105x(1000x0.45)/1.40= 355.18 kN/m
Bearing resistance check Vd=109.33 < Rd=355.18 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1.10x(self weight+top vertical dead load)+1.50x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.10	0.00- 4.00	45.11	5.76	1.936	1.833	71.53
Active earth pressure	Pax1.10	4.00- 4.50	11.79	1.51	1.749	0.244	0.24
Wall weight	W x1.10		0.00	124.74	1.295	1.976	-161.54
			Sum=	132.01			-89.77

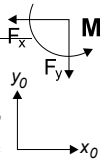
Sum of vertical forces = 132.01 kN/m
Sum of moments at front toe = -89.77 kNm/m
Sum of moments at middle of base = 23.76 kNm/m
Eccentricity ec=23.76/132.01=0.180m, ec<=1.720/6=0.287m
Soil pressure q1=0.125 N/mm² q2=0.029 N/mm²



Effective footing L'=1.720-2x0.180= 1.360 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.360x(1000x0.45)/1.40= 437.14 kN/m
Bearing resistance check Vd=132.01 < Rd=437.14 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

5.6.3. Failure check due to overturning (EQU) (EC7 EN1997-1-1:2004, §9.7.4)

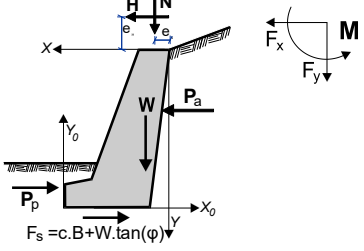
Overturning with respect to the toe (xo=0,yo=0) (x=2.250,y=4.500 m)



Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.10	0.00- 4.00	45.11	5.76	1.936	1.833	82.69	11.15
Active earth pressure	Pax1.10	4.00- 4.50	11.79	1.51	1.749	0.244	2.88	2.64
Wall weight	W x0.90		0.00	102.06	1.295	1.976	0.00	132.16
		Sum=		109.33			85.57	145.95

Sum of overturning moments = 85.57 kNm/m
Sum of moments resisting overturning = 145.95 kNm/m
Overturning check Med=85.57 < Mrd=145.95 kNm/m, Is verified
Eccentricity ec=(1.720/2)-(145.95-85.57)/109.33=0.308m, ec<=1.720/3=0.573m

5.6.4. Failure check against sliding (EQU) (EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)



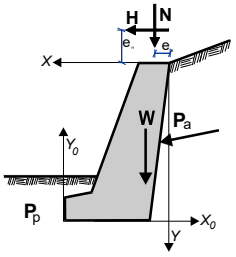
Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.10	0.00- 4.00	45.11	0.00	5.76
Active earth pressure	Pax1.10	4.00- 4.50	11.79	0.00	1.51
Passive earth pressure	Ppx0.90	4.00- 4.50	0.00	5.96	0.00
Wall weight	W x0.90		0.00	0.00	102.06
		Sum=	56.90	5.96	109.33

Soil friction Rd=Nd·tanφ/γM = 109.33xtan(32.00°)/1.25= 54.65 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1.657x0.012/1.25= 15.91 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 56.90 kN/m
Sum of resisting forces (5.96/1.00+54.65) = 60.61 kN/m
Sliding resistance check Hd=56.90 < Rd=60.61 kN/m, Is verified

5.7. Checks of wall stability (STR/GEO A1+M1)

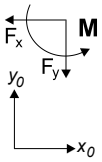
5.7.1. Forces (driving and resisting) on the wall (STR/GEO A1+M1)

Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 4.00	30.55	5.82	0.314	2.667
Active earth pressure	Pa	4.00- 4.50	7.93	1.51	0.501	4.256
Passive earth pressure	Pp	4.00- 4.50	-8.55	0.00	2.250	4.333
Wall weight	W		0.00	113.40	0.955	2.524



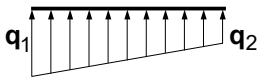
5.7.2. Check of soil bearing capacity (STR/GEO A1+M1) (EC7 EN1997-1-1:2004, §6.5.2)

Check for 1.00x(self weight+top vertical dead load)+0.00x(top vertical live load)



Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.35	0.00- 4.00	41.24	7.86	1.936	1.833	60.39
Active earth pressure	Pax1.35	4.00- 4.50	10.71	2.04	1.749	0.244	-0.96
Wall weight	W x1.00		0.00	113.40	1.295	1.976	-146.85
			Sum=	123.30			-87.42

Sum of vertical forces = 123.30 kN/m
Sum of moments at front toe = -87.42 kNm/m
Sum of moments at middle of base = 18.62 kNm/m
Eccentricity ec=18.62/123.30=0.151m, ec<=1.720/6=0.287m
Soil pressure q1=0.109 N/mm² q2=0.034 N/mm²

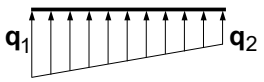


Effective footing L'=1.720-2x0.151= 1.418 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.418x(1000x0.45)/1.00= 638.10 kN/m
Bearing resistance check Vd=123.30 < Rd=638.10 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1.35x(self weight+top vertical dead load)+1.50x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.35	0.00- 4.00	41.24	7.86	1.936	1.833	60.39
Active earth pressure	Pax1.35	4.00- 4.50	10.71	2.04	1.749	0.244	-0.96
Wall weight	W x1.35		0.00	153.09	1.295	1.976	-198.25
			Sum=	162.99			-138.82

Sum of vertical forces = 162.99 kN/m
Sum of moments at front toe = -138.82 kNm/m
Sum of moments at middle of base = 1.35 kNm/m
Eccentricity ec=1.35/162.99=0.008m, ec<=1.720/6=0.287m
Soil pressure q1=0.097 N/mm² q2=0.092 N/mm²

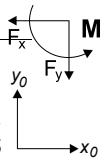


Effective footing L'=1.720-2x0.008= 1.703 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.703x(1000x0.45)/1.00= 766.35 kN/m
Bearing resistance check Vd=162.99 < Rd=766.35 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

5.7.3. Failure check due to overturning (STR/GEO A1+M1)

(EC7 EN1997-1-1:2004, §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=2.250,y=4.500 m)

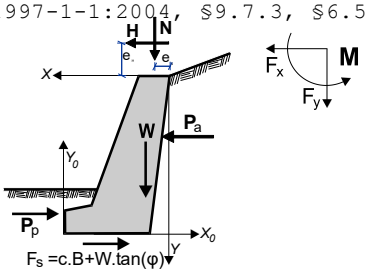


Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.35	0.00- 4.00	41.24	7.86	1.936	1.833	75.60	15.21
Active earth pressure	Pax1.35	4.00- 4.50	10.71	2.04	1.749	0.244	2.61	3.56
Wall weight	W x1.00		0.00	113.40	1.295	1.976	0.00	146.85
		Sum=		123.30			78.21	165.62

Sum of overturning moments = 78.21 kNm/m
Sum of moments resisting overturning = 165.62 kNm/m
Overturning check Med=78.21 < Mrd=165.62 kNm/m, Is verified
Eccentricity ec=(1.720/2)-(165.62-78.21)/123.30=0.151m, ec<=1.720/3=0.573m

5.7.4. Failure check against sliding (STR/GEO A1+M1)

(EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)

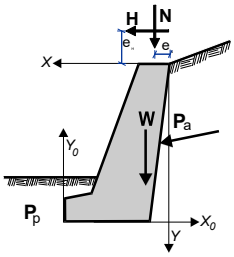


Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.35	0.00- 4.00	41.24	0.00	7.86
Active earth pressure	Pax1.35	4.00- 4.50	10.71	0.00	2.04
Passive earth pressure	Ppx1.00	4.00- 4.50	0.00	8.55	0.00
Wall weight	W x1.00		0.00	0.00	113.40
		Sum=	51.95	8.55	123.30

Soil friction Rd=Nd·tanφ/γM = 123.30xtan(32.00°)/1.00= 77.05 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1.720x0.012/1.00= 20.64 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 51.95 kN/m
Sum of resisting forces (8.55/1.00+77.05) = 85.60 kN/m
Sliding resistance check Hd=51.95 < Rd=85.60 kN/m, Is verified

5.8. Checks of wall stability (STR/GEO A2+M2)

5.8.1. Forces (driving and resisting) on the wall (STR/GEO A2+M2)

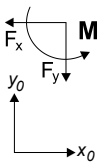


Action		y1 - y2	Fx [kN/m]	Fy [kN/m]	x [m]	y [m]
Active earth pressure	Pa	0.00- 4.00	41.01	5.24	0.314	2.667
Active earth pressure	Pa	4.00- 4.50	10.72	1.37	0.501	4.256
Passive earth pressure	Pp	4.00- 4.50	-6.62	0.00	2.250	4.333
Wall weight	W		0.00	113.40	0.955	2.524

5.8.2. Check of soil bearing capacity (STR/GEO A2+M2)

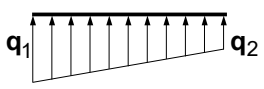
(EC7 EN1997-1-1:2004, §6.5.2)

Check for 1.00x(self weight+top vertical dead load)+0.00x(top vertical live load)



Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.00	0.00- 4.00	41.01	5.24	1.936	1.833	65.03
Active earth pressure	Pax1.00	4.00- 4.50	10.72	1.37	1.749	0.244	0.22
Wall weight	W x1.00		0.00	113.40	1.295	1.976	-146.85
			Sum=	120.01			-81.60

Sum of vertical forces = 120.01 kN/m
Sum of moments at front toe = -81.60 kNm/m
Sum of moments at middle of base = 21.61 kNm/m
Eccentricity ec=21.61/120.01=0.180m, ec<=1.720/6=0.287m
Soil pressure q1=0.114 N/mm² q2=0.026 N/mm²

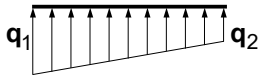


Effective footing L'=1.720-2x0.180= 1.360 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.360x(1000x0.45)/1.40= 437.14 kN/m
Bearing resistance check Vd=120.01 < Rd=437.14 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

Check for 1.00x(self weight+top vertical dead load)+1.30x(top vertical live load)

Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	M [kNm/m]
Active earth pressure	Pax1.00	0.00- 4.00	41.01	5.24	1.936	1.833	65.03
Active earth pressure	Pax1.00	4.00- 4.50	10.72	1.37	1.749	0.244	0.22
Wall weight	W x1.00		0.00	113.40	1.295	1.976	-146.85
			Sum=	120.01			-81.60

Sum of vertical forces = 120.01 kN/m
Sum of moments at front toe = -81.60 kNm/m
Sum of moments at middle of base = 21.61 kNm/m
Eccentricity ec=21.61/120.01=0.180m, ec<=1.720/6=0.287m

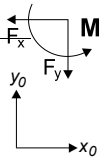


Soil pressure q1=0.114 N/mm² q2=0.026 N/mm²
Effective footing L'=1.720-2x0.180= 1.360 m (EC7 Annex D)
Soil bearing capacity Rd=L'·quk/γM=1.360x(1000x0.45)/1.40= 437.14 kN/m
Bearing resistance check Vd=120.01 < Rd=437.14 kN/m, Is verified (EC7 Eq.2.2, Eq.6.1)

5.8.3. Failure check due to overturning (STR/GEO A2+M2)

(EC7 EN1997-1-1:2004, §9.7.4)

Overturning with respect to the toe (xo=0,yo=0) (x=2.250,y=4.500 m)

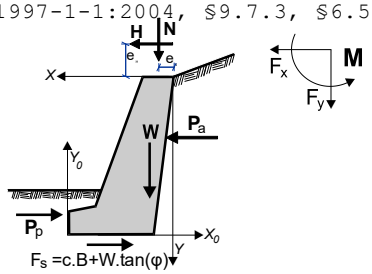


Action	(P.γ)	y1 - y2	Fx [kN/m]	Fy [kN/m]	xo [m]	yo [m]	Mo+ [kNm/m]	Mo- [kNm/m]
Active earth pressure	Pax1.00	0.00- 4.00	41.01	5.24	1.936	1.833	75.17	10.14
Active earth pressure	Pax1.00	4.00- 4.50	10.72	1.37	1.749	0.244	2.62	2.40
Wall weight	W x1.00		0.00	113.40	1.295	1.976	0.00	146.85
		Sum=		120.01			77.79	159.39

Sum of overturning moments = 77.79 kNm/m
Sum of moments resisting overturning = 159.39 kNm/m
Overturning check Med=77.79 < Mrd=159.39 kNm/m, Is verified
Eccentricity ec=(1.720/2)-(159.39-77.79)/120.01=0.180m, ec<=1.720/3=0.573m

5.8.4. Failure check against sliding (STR/GEO A2+M2)

(EC7 EN1997-1-1:2004, §9.7.3, §6.5.3)



Action	(P.γ)	y1 - y2	Fx+ [kN/m]	Fx- [kN/m]	Fy [kN/m]
Active earth pressure	Pax1.00	0.00- 4.00	41.01	0.00	5.24
Active earth pressure	Pax1.00	4.00- 4.50	10.72	0.00	1.37
Passive earth pressure	Ppx1.00	4.00- 4.50	0.00	6.62	0.00
Wall weight	W x1.00		0.00	0.00	113.40
		Sum=	51.73	6.62	120.01

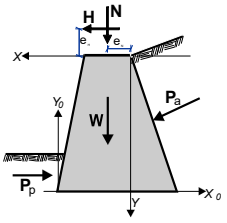
Soil friction Rd=Nd·tanφ/γM = 120.01xtan(32.00°)/1.25= 59.99 kN/m
Soil cohesion Rd=A·cu/γM = 1000x1.720x0.012/1.25= 16.51 kN/m
(resisting forces from effective cohesion are neglected) (EC7 §6.5.3. 10)
Sum of driving forces = 51.73 kN/m
Sum of resisting forces (6.62/1.00+59.99) = 66.61 kN/m
Sliding resistance check Hd=51.73 < Rd=66.61 kN/m, Is verified

5.9. Design of wall stem

5.9.1. Loading 1.35x(permanent unfavorable)+1.00x(permanent favorable)+1.50x(variable unfav.)

Forces (at centroid of cross section) and stresses at wall stem
x, y:cross section centroid, b:cross section width, e:eccentricity
Fx:horizontal force, Fy:vertical force, M:moment, e/b:relative eccentricity
σ1, σ2, τ :cross section normal and shear stress, Bq:effective cross section width

y [m]	x [m]	b [m]	Fx [kN/m]	Fy [kN/m]	M [kNm/m]	e/b	σ1 [N/mm²]	σ2 [N/mm²]	Bq/B	τ [N/mm²]
0.50	0.510	0.902	0.65	8.63	-0.41	0.053	-0.007	-0.013	1.000	0.001
1.00	0.620	1.004	2.58	18.53	-1.31	0.070	-0.011	-0.026	1.000	0.003
1.50	0.730	1.107	5.79	29.71	-2.25	0.068	-0.016	-0.038	1.000	0.005
2.00	0.840	1.209	10.31	42.15	-2.70	0.053	-0.024	-0.046	1.000	0.009
2.50	0.950	1.311	16.12	55.84	-2.23	0.030	-0.035	-0.050	1.000	0.012
3.00	1.060	1.413	23.21	70.81	-0.32	0.003	-0.049	-0.051	1.000	0.016
3.50	1.170	1.516	31.58	87.05	3.49	-0.026	-0.067	-0.048	1.000	0.021
4.00	1.280	1.618	41.24	104.57	9.63	-0.057	-0.087	-0.043	1.000	0.025
4.50	1.390	1.720	51.95	123.30	18.64	-0.088	-0.109	-0.034	1.000	0.030



5.9.2. Strength check according toEC6 EN1996-1-1:2005

Strength check in normal stresses Ned<=Nrd (EC6 §6.1.2)
Vertical resistance load Nrd=Φ.fk.t/γM, Vertical design load Ned (EC6 §6.1.2)
Φ=1-2e/t, Φ capacity reduction factor for slenderness and eccentricity of loading
e=load eccentricity+es, es=accidental eccentricity=h/450, h=wall height
fk characteristic compressive strength fk= 3.50 N/mm²
γM= 2.50, γM partial safety factor for the material

y [m]	t [m]	Fy [kN/m]	M [kNm/m]	e/t	Φ	Ned [kN/m]	Nrd [kN/m]	
0.50	0.902	8.63	-0.41	0.054	0.892	8.63	1126.42	(Ned<=Nrd)
1.00	1.004	18.53	-1.31	0.072	0.856	18.53	1203.19	(Ned<=Nrd)
1.50	1.107	29.71	-2.25	0.071	0.858	29.71	1329.73	(Ned<=Nrd)
2.00	1.209	42.15	-2.70	0.057	0.886	42.15	1499.64	(Ned<=Nrd)
2.50	1.311	55.84	-2.23	0.034	0.932	55.84	1710.59	(Ned<=Nrd)
3.00	1.413	70.81	-0.32	0.008	0.984	70.81	1946.55	(Ned<=Nrd)
3.50	1.516	87.05	3.49	0.031	0.938	87.05	1990.81	(Ned<=Nrd)
4.00	1.618	104.57	9.63	0.062	0.876	104.57	1984.32	(Ned<=Nrd)
4.50	1.720	123.30	18.64	0.094	0.812	123.30	1955.30	(Ned<=Nrd)

Design for shear strength Ved<=Vrd (EC6 §6.2.1)
Shear resistance Vrd=fvk·t/γM, design shear load Ved (EC6 §6.2.1)
fvk=fvko+0.40xσd ,σd design compressive stress (EC6 §3.6.2)
fvko shear strength under zero compressive stress fvko= 0.20 N/mm²
γM= 2.50, γM partial safety factor for the material

y [m]	t [m]	Fx [kN/m]	σd [N/mm²]	Ved [kN/m]	Vrd [kN/m]	
0.50	0.902	0.65	0.010	0.65	73.60	(Ved<=Vrd)
1.00	1.004	2.58	0.018	2.58	83.21	(Ved<=Vrd)
1.50	1.107	5.79	0.027	5.79	93.34	(Ved<=Vrd)
2.00	1.209	10.31	0.035	10.31	103.49	(Ved<=Vrd)
2.50	1.311	16.12	0.043	16.12	113.90	(Ved<=Vrd)
3.00	1.413	23.21	0.050	23.21	124.34	(Ved<=Vrd)
3.50	1.516	31.58	0.057	31.58	135.11	(Ved<=Vrd)
4.00	1.618	41.24	0.065	41.24	146.27	(Ved<=Vrd)
4.50	1.720	51.95	0.072	51.95	157.41	(Ved<=Vrd)

P.3 ZAKOLIČBENE TOČKE

P.3.1 Zakoličba ceste

OZ.	X	Y	Z
DR1	502406.2	150814.2	512.64
OS1	502407.6	150815.7	512.59
LR1	502409	150817.1	512.54
DR2	502420.5	150800.3	512.51
OS2	502421.9	150801.7	512.46
LR2	502423.3	150803.2	512.41
DR3	502434.9	150786.4	514.06
OS3	502436.3	150787.8	514.01
LR3	502437.7	150789.3	513.96
DR4	502449.2	150772.5	515.85
OS4	502450.6	150773.9	515.80
LR4	502452	150775.3	515.75
DR5	502458.5	150756.2	518.06
OS5	502460.5	150756.7	518.01
LR5	502462.4	150757.2	517.96
DR6	502459.2	150737.1	520.00
OS6	502461.2	150736.9	519.95
LR6	502463.2	150736.6	519.90
DR7	502456.9	150717.2	521.84
OS7	502458.9	150717	521.79
LR7	502460.9	150716.8	521.74
DR8	502455.5	150697	523.26
OS8	502457.5	150697.1	523.21
LR8	502459.5	150697.1	523.16
DR9	502457.9	150676.9	524.17
OS9	502459.9	150677.3	524.12
LR9	502461.9	150677.6	524.07
DR10	502461.1	150657	525.26
OS10	502464.1	150657.7	525.19
LR10	502465.5	150658.1	525.15

OZ.	X	Y	Z
LR11	502477.9	150652.8	526.49
OS11	502478.9	150651.7	526.53
DR11	502481.8	150648.7	526.63
LR12	502478.2	150670.6	527.37
OS12	502479.7	150670.8	527.37
DR12	502481.7	150671.1	527.37
LR13	502476.1	150690.7	528.06
OS13	502478.1	150690.8	528.01
DR13	502480.1	150690.9	527.96
LR14	502476.5	150711	528.70
OS14	502478.5	150710.7	528.65
DR14	502480.4	150710.5	528.60
LR15	502480.7	150730.7	529.34
OS15	502482.6	150730.3	529.29
DR15	502484.6	150729.8	529.24
LR16	502485.2	150750.2	529.98
OS16	502487.1	150749.8	529.93
DR16	502489.1	150749.4	529.88
LR17	502486	150769.6	530.62
OS17	502488	150769.7	530.57
DR17	502490	150769.8	530.52
LR18	502485.3	150789.6	531.30
OS18	502487.3	150789.7	531.25
DR18	502489.3	150789.8	531.20
LR19	502486.4	150810.1	532.18
OS19	502488.3	150809.6	532.13
DR19	502490.2	150809.1	532.08
LR20	502493.8	150829.1	533.09
OS20	502495.6	150828.2	533.04
DR20	502497.3	150827.3	532.99

OZ.	X	Y	Z
LR21	502507.2	150844.9	534.04
OS21	502508.4	150843.3	533.99
DR21	502509.6	150841.7	533.94
LR22	502526.1	150853.4	535.20
OS22	502526.5	150851.4	535.15
DR22	502526.9	150849.5	535.10
DR23	502546.3	150851.6	536.51
OS23	502546.3	150853.6	536.56
LR23	502546.3	150855.6	536.61
DR24	502565.8	150849.3	537.95
OS24	502566.2	150851.3	538.00
LR24	502566.5	150853.3	538.05
DR25	502585.5	150845.6	539.54
OS25	502585.8	150847.6	539.54
LR25	502586.2	150849.6	539.54
DR26	502605.1	150842	541.28
OS26	502605.5	150843.9	541.23
LR26	502605.9	150845.9	541.18
DR27	502624.1	150836.8	542.78
OS27	502624.8	150838.6	542.73
LR27	502625.4	150840.5	542.68
DR28	502641.9	150828.5	544.06
OS28	502642.9	150830.3	544.01
LR28	502643.9	150832	543.96
DR29	502659.3	150818.7	545.26
OS29	502660.3	150820.5	545.21
LR29	502661.3	150822.2	545.16
DR30	502676.8	150808.9	546.25
OS30	502677.7	150810.7	546.20
LR30	502678.7	150812.4	546.15

OZ.	X	Y	Z
DR31	502693.3	150798	546.93
OS31	502694.4	150799.6	546.88
LR31	502695.5	150801.2	546.83
DR32	502710.1	150786.8	547.56
OS32	502711.1	150788.6	547.51
LR32	502712.1	150790.3	547.46
DR33	502728.7	150778.6	548.13
OS33	502729.3	150780.5	548.08
LR33	502730	150782.4	548.03
DR34	502748.6	150774.1	548.58
OS34	502748.8	150776.1	548.53
LR34	502749.1	150778.1	548.48
LR35	502768.6	150777.7	548.90
OS35	502768.8	150775.7	548.95
DR35	502768.9	150773.7	549.00
LR36	502788	150781.1	549.51
OS36	502788.5	150779.2	549.56
DR36	502788.9	150777.2	549.61
LR37	502807.9	150784.9	550.14
OS37	502808.1	150782.9	550.19
DR37	502808.2	150780.9	550.24
DR38	502828	150780.7	550.88
OS38	502828.1	150782.7	550.83
LR38	502828.1	150784.7	550.78
LR39	502848	150783.9	551.41
OS39	502848	150781.9	551.46
DR39	502848.1	150779.9	551.51
LR40	502867.5	150786.4	552.03
OS40	502867.9	150784.4	552.08
DR40	502868.2	150782.5	552.13
LR41	502887.5	150789.3	552.60
OS41	502887.6	150787.3	552.65
DR41	502887.8	150785.3	552.70

OZ.	X	Y	Z
LR42	502907.6	150790	553.10
OS42	502907.6	150788	553.15
DR42	502907.7	150786	553.20
LR43	502927.1	150791.9	553.54
OS43	502927.5	150790	553.59
DR43	502927.9	150788	553.64
LR44	502946	150797.7	553.97
OS44	502946.6	150795.8	554.02
DR44	502947.2	150793.8	554.07
DR45	502966.1	150796.5	554.32
OS45	502966.3	150798.5	554.37
LR45	502966.5	150800.5	554.42
DR46	502983.7	150790.1	554.60
OS46	502984.8	150791.7	554.65
LR46	502986	150793.4	554.70
DR47	502999.8	150778.4	555.15
OS47	503001	150780	555.10
LR47	503002.2	150781.6	555.05
DR48	503016	150766.6	555.93
OS48	503017.2	150768.2	555.88
LR48	503018.4	150769.8	555.83
DR49	503032.2	150754.8	557.06
OS49	503033.4	150756.5	557.01
LR49	503034.6	150758.1	556.96
DR50	503048.1	150743	558.04
OS50	503049.4	150744.5	558.09
LR50	503050.8	150746.1	558.14
DR51	503059.4	150727.6	558.55
OS51	503061.2	150728.6	558.57
LR51	503063	150729.5	558.59
DR52	503069.9	150710.1	558.82
OS52	503071.4	150711.4	558.77
LR52	503072.9	150712.7	558.72

OZ.	X	Y	Z
DR53	503086.4	150697.6	559.26
OS53	503087.2	150699.5	559.21
LR53	503088.1	150701.3	559.16
DR54	503106.4	150693.1	559.72
OS54	503106.6	150695.1	559.67
LR54	503106.9	150697.1	559.62
DR55	503126.3	150691	560.50
OS55	503126.5	150693	560.45
LR55	503126.8	150695	560.40
DR56	503146.1	150688.6	561.93
OS56	503146.4	150690.5	561.88
LR56	503146.6	150692.5	561.83
DR57	503163.6	150683	563.36
OS57	503165	150684.4	563.41
LR57	503166.3	150685.9	563.46
DR58	503172.7	150666.2	563.53
OS58	503174.6	150667	563.58
LR58	503176.4	150667.9	563.63
DR59	503181	150648	563.19
OS59	503182.8	150648.8	563.24
LR59	503184.6	150649.6	563.29
DR60	503187.9	150629.8	562.61
OS60	503189.8	150630.2	562.66
LR60	503191.8	150630.5	562.71
DR61	503187.2	150610.5	561.99
OS61	503189.2	150610.3	561.94
LR61	503191.2	150610	561.89
DR62	503186.7	150590.1	561.31
OS62	503188.7	150590.3	561.26
LR62	503190.7	150590.5	561.21
DR63	503190.8	150570.4	560.84
OS63	503192.8	150570.8	560.79
LR63	503194.8	150571.1	560.74

OZ.	X	Y	Z
DR64	503193.3	150550.7	559.86
OS64	503195.3	150550.9	559.81
LR64	503197.2	150551.1	559.76
DR65	503199.4	150531	559.28
OS65	503201.2	150532	559.23
LR65	503202.9	150532.9	559.18
DR66	503212.1	150515	558.75
OS66	503213.6	150516.4	558.70
LR66	503215.1	150517.7	558.65
DR67	503223.7	150499.3	558.00
OS67	503225.5	150500.3	557.95
LR67	503227.2	150501.3	557.90
DR68	503233.1	150481.7	556.91
OS68	503234.9	150482.7	556.86
LR68	503236.6	150483.6	556.81
DR69	503242.3	150464	555.76
OS69	503244.1	150464.9	555.71
LR69	503245.9	150465.9	555.66
DR70	503251.6	150446.3	554.76
OS70	503253.4	150447.2	554.71
LR70	503255.1	150448.1	554.66
DR71	503260.8	150428.5	554.02
OS71	503262.6	150429.5	553.97
LR71	503264.4	150430.4	553.92
DR72	503271.9	150411.6	553.42
OS72	503273.5	150412.7	553.37
LR72	503275.2	150413.9	553.32
DR73	503283.2	150395.1	552.79
OS73	503284.9	150396.2	552.74
LR73	503286.5	150397.4	552.69
DR74	503294.5	150378.6	551.77
OS74	503296.2	150379.8	551.77
LR74	503297.8	150380.9	551.77

OZ.	X	Y	Z
DR75	503310.9	150365.6	550.56
OS75	503311.4	150367.5	550.61
LR75	503312	150369.5	550.66
LR76	503330.1	150371.4	549.49
OS76	503330.9	150369.6	549.44
DR76	503331.6	150367.7	549.39
LR77	503348.7	150378.8	548.29
OS77	503349.4	150377	548.32
DR77	503350.2	150375.1	548.35
DR78	503368.8	150378.3	547.34
OS78	503368.9	150380.3	547.39
LR78	503369.1	150382.3	547.44
DR79	503386.8	150372.3	547.32
OS79	503387.7	150374	547.27
LR79	503388.5	150375.3	547.23
DR80	503398.9	150359.9	547.90
OS80	503400.9	150360.2	547.85
LR80	503402.9	150360.5	547.80
DR81	503393.1	150342.4	547.78
OS81	503394.9	150341.5	547.73
LR81	503396.7	150340.6	547.68
DR82	503384.3	150324.4	546.38
OS82	503386.1	150323.5	546.33
LR82	503387.9	150322.7	546.28
DR83	503376.1	150306	544.57
OS83	503378	150305.3	544.52
LR83	503379.8	150304.6	544.47
DR84	503370.9	150286.3	542.71
OS84	503372.9	150286	542.66
LR84	503374.8	150285.6	542.61
DR85	503370.2	150266	540.86
OS85	503372.2	150266	540.81
LR85	503374.2	150266.1	540.76

OZ.	X	Y	Z
DR86	503369.9	150246.1	539.09
OS86	503371.9	150246	539.04
LR86	503373.9	150246	538.99
DR87	503367.5	150226.8	537.56
OS87	503369.4	150226.3	537.51
LR87	503371.4	150225.7	537.46
DR88	503360.9	150207.8	536.12
OS88	503362.8	150207.4	536.07
LR88	503364.8	150206.9	536.02
DR89	503360.5	150187.4	534.63
OS89	503362.5	150187.5	534.58
LR89	503364.5	150187.5	534.53
DR90	503361.1	150167.5	532.82
OS90	503363.1	150167.5	532.77
LR90	503365.1	150167.4	532.72
DR91	503360.9	150147.5	530.90
OS91	503362.9	150147.5	530.85
LR91	503364.9	150147.5	530.80
DR92	503362.4	150127.2	528.97
OS92	503364.4	150127.6	528.92
LR92	503366.3	150128	528.87
DR93	503368.8	150107.8	527.03
OS93	503370.6	150108.6	526.98
LR93	503372.4	150109.5	526.93
DR94	503379.8	150090.6	525.02
OS94	503381.4	150091.8	524.97
LR94	503382.9	150093	524.92
DR95	503392.1	150074.8	522.93
OS95	503393.7	150076.1	522.88
LR95	503395.3	150077.3	522.83
DR96	503404.5	150059.1	520.76
OS96	503406.1	150060.3	520.71
LR96	503407.6	150061.6	520.66

OZ.	X	Y	Z
DR97	503416.2	150043.1	518.60
OS97	503417.8	150044.2	518.55
LR97	503419.5	150045.3	518.50
DR98	503426.8	150026.3	516.54
OS98	503428.5	150027.3	516.49
LR98	503430.2	150028.3	516.44

OZ.	X	Y	Z
DR99	503436.9	150009	514.71
OS99	503438.6	150010	514.66
LR99	503440.3	150011	514.61
DR100	503447	149991.7	513.49
OS100	503448.7	149992.7	513.44
LR100	503450.4	149993.8	513.39

OZ.	X	Y	Z
DR101	503457.2	149974.5	512.58
OS101	503458.9	149975.5	512.53
LR101	503460.4	149976.5	512.49
DR102	503468.2	149957.6	511.80
OS102	503469.8	149958.8	511.75
LR102	503471.1	149959.7	511.71

P.3.2 Zakoličba geotehničnih konstrukcij

OZ	X	Y
PKZ1_1	502452.035449	150775.268554
PKZ1_2	502453.341849	150776.538812
PKZ1_3	502462.384755	150757.246843
PKZ1_4	502464.021737	150757.702168
PKZ1_5	502463.221995	150736.643390
PKZ1_6	502464.985398	150736.440129
PKZ2_1	502477.012265	150714.368412
PKZ2_2	502475.44255	150714.682517
PKZ2_3	502480.690866	150730.732864
PKZ2_4	502478.966592	150731.130457
PKZ2_5	502485.156360	150750.163372
PKZ2_6	502483.114085	150750.567202
PKZ2_7	502486.012785	150769.624197
PKZ2_8	502484.245624	150769.561728
PKZ2_9	502485.306228	150789.611712
PKZ2_10	502483.630277	150789.552468
PKZ2_11	502485.050680	150798.563500
PKZ2_12	502483.352961	150798.561613
PKZ3_1	502628.106753	150839.517784
PKZ3_2	502628.729011	150840.963944
PKZ3_3	502643.863204	150832.000795
PKZ3_4	502644.644022	150833.395075
PKZ3_5	502661.297289	150822.200149
PKZ3_6	502662.092301	150823.619677
PKZ3_7	502678.738391	150812.393585
PKZ3_8	502679.537468	150813.795907
PKZ3_9	502695.540498	150801.239813
PKZ3_10	502696.467952	150802.575313
PKZ3_11	502712.060621	150790.303469
PKZ3_12	502712.836393	150791.677138
PKZ3_13	502720.817898	150785.919801
PKZ3_14	502721.462097	150787.385478

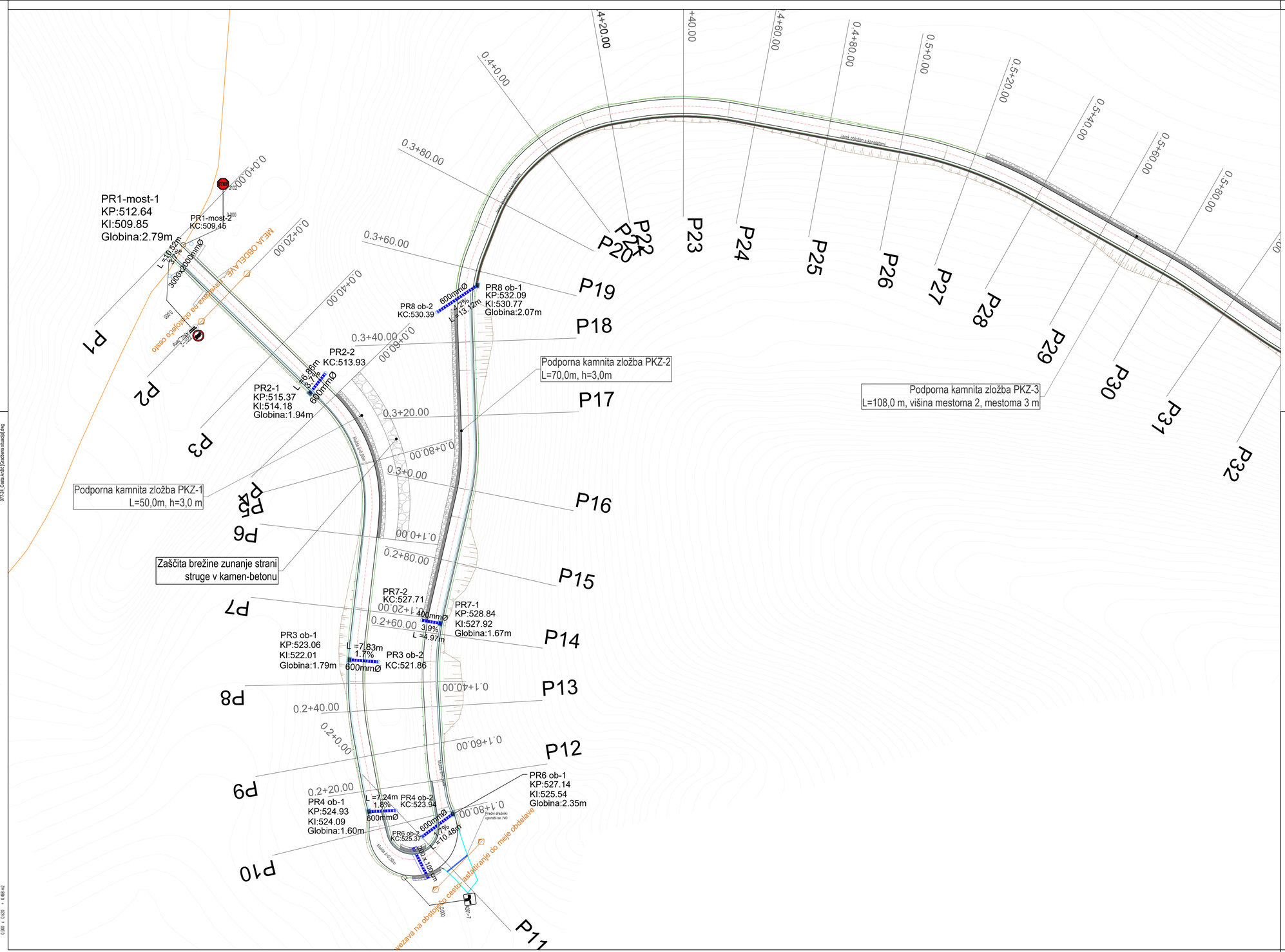
OZ	X	Y
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PKZ4_2	503193.691507	150615.797644
PKZ4_3	503191.211525	150610.032674
PKZ4_4	503193.039684	150609.828790
PKZ4_5	503190.653807	150590.527013
PKZ4_6	503192.444570	150590.719024
PKZ4_7	503194.766711	150571.143584
PKZ4_8	503196.537221	150571.483149
PKZ4_9	503197.242160	150551.147774
PKZ4_10	503199.094116	150551.392713
PKZ4_11	503202.935473	150532.924476
PKZ4_12	503204.549945	150533.812638
PKZ4_13	503215.076550	150517.704984
PKZ4_14	503216.441310	150518.943422
PKZ4_15	503227.188511	150501.331987
PKZ4_16	503228.728166	150502.248447
PKZ4_17	503236.632330	150483.577691
PKZ4_18	503238.227881	150484.410179
PKZ4_19	503245.883882	150465.846115
PKZ4_20	503247.480427	150466.679121
PKZ4_21	503255.135434	150448.114539
PKZ4_22	503256.746425	150448.955083
PKZ4_23	503264.384750	150430.387248
PKZ4_24	503265.972815	150431.290674
PKZ4_25	503275.184824	150413.853866
PKZ4_26	503276.690245	150414.888842
PKZ4_27	503286.515401	150397.373027
PKZ4_28	503288.036554	150398.418820
PKZ4_29	503297.845977	150380.892189
PKZ4_30	503299.372852	150381.941915
PKZ4_31	503311.982381	150369.450577
PKZ4_32	503312.492862	150371.193113
PKZ4_33	503322.844885	150368.947009
PKZ4_34	503322.502261	150370.706438

OZ	X	Y
PKZ5_1	503387.936274	150322.644914
PKZ5_2	503389.624440	150321.826902
PKZ5_3	503379.836666	150304.622480
PKZ5_4	503381.572879	150304.013495
PKZ5_5	503374.847618	150285.597949
PKZ5_6	503376.603760	150285.282399
PKZ5_7	503374.154149	150266.054692
PKZ5_8	503375.898906	150266.093374
PKZ5_9	503373.948260	150245.959545
PKZ5_10	503375.673260	150245.928968
PKZ5_11	503371.349981	150225.684705
PKZ5_12	503373.010287	150225.196583
PKZ5_13	503364.796567	150206.943958
PKZ5_14	503366.493970	150206.565098
PKZ5_15	503364.459763	150187.528661
PKZ5_16	503366.207589	150187.597386
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PKZ5_18	503366.901176	150167.431208
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PKZ5_20	503366.684323	150147.425549
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PKZ5_22	503368.075011	150128.286878
PKZ5_23	503372.448674	150109.479848
PKZ5_24	503374.060489	150110.246854
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PKZ5_27	503395.290425	150077.299949
PKZ5_28	503396.696966	150078.404027
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PKZ5_30	503409.040556	150062.656715
PKZ5_31	503419.500012	150045.297849
PKZ5_32	503420.945020	150046.279178
PKZ5_33	503430.248539	150028.276323
PKZ5_34	503431.761365	150029.160950
PKZ5_35	503440.344230	150011.011415
PKZ5_36	503441.784194	150011.861382
PKZ5_37	503450.439920	149993.746507
PKZ5_38	503451.880796	149994.588909
PKZ5_39	503453.801686	149987.997461
PKZ5_40	503455.241626	149988.839465

G RISBE

	Vsebina	merilo	oznaka
1	Gradbena situacija (1/5)	M 1:500	G.102.1
2	Gradbena situacija (2/5)	M 1:500	G.102.2
3	Gradbena situacija (3/5)	M 1:500	G.102.3
4	Gradbena situacija (4/5)	M 1:500	G.102.4
5	Gradbena situacija (5/5)	M 1:500	G.102.5
6	Zakoličbena situacija (1/5)	M 1:500	G.106.1
7	Zakoličbena situacija (2/5)	M 1:500	G.106.2
8	Zakoličbena situacija (3/5)	M 1:500	G.106.3
9	Zakoličbena situacija (4/5)	M 1:500	G.106.4
10	Zakoličbena situacija (5/5)	M 1:500	G.106.5
11	Karakteristični prečni prerez	M 1:50	G.131
12	Prečni prerezi (1/11)	M 1:100	G.132.1
13	Prečni prerezi (2/11)	M 1:100	G.132.2
14	Prečni prerezi (3/11)	M 1:100	G.132.3
15	Prečni prerezi (4/11)	M 1:100	G.132.4
16	Prečni prerezi (5/11)	M 1:100	G.132.5
17	Prečni prerezi (6/11)	M 1:100	G.132.6
18	Prečni prerezi (7/11)	M 1:100	G.132.7
19	Prečni prerezi (8/11)	M 1:100	G.132.8
20	Prečni prerezi (9/11)	M 1:100	G.132.9
21	Prečni prerezi (10/11)	M 1:100	G.132.10
22	Prečni prerezi (11/11)	M 1:100	G.132.11
23	Vzdolžni profil ceste od km 0+000 do km 0+760	M 1:1000/100	G.142.1
24	Vzdolžni profil ceste od km 0+760 do km 1+520	M 1:1000/100	G.142.2
25	Vzdolžni profil ceste od km 1+520 do km 2+110	M 1:1000/100	G.142.3
26	Detajl mulde	M 1:50	G.151.1
27	Detajl iztočne glave	/	G.151.2
28	Detajl pobočne kanalete	M 1:50	G.151.3
29	Detajl polaganja kanalizacijskih cevi in drenaže	M 1:50	G.151.4
30	Detajl peskolova z vtočno rešetko	M 1:25	G.151.5
31	Detajl postavitve prometnih znakov	/	G.151.6
32	Detajl priključka mulde na jašek	M 1:20	G.151.7
33	Vzdolžni prerez PKZ1	M 1:100	G.242.1

34	Vzdolžni prerez PKZ2	M 1:100	G.242.2
35	Vzdolžni prerez PKZ3	M 1:100	G.242.3
36	Vzdolžni prerez PKZ4 (1/2)	M 1:100	G.242.4
37	Vzdolžni prerez PKZ4 (2/2)	M 1:100	G.242.5
38	Vzdolžni prerez PKZ5 (1/2)	M 1:100	G.242.6
39	Vzdolžni prerez PKZ5 (2/2)	M 1:100	G.242.7
40	Armaturni načrt krone podporne kamnite zložbe	M 1:50	G.271



NN - podzemni kabelski (v obratovanju)
NN nadzemni kabelski (v obratovanju)
SN - KB (ni v obratovanju)
SN - KB (v obratovanju)
SN-DV (v obratovanju)
Kanalizacija - optika (v obratovanju)

Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

02 GRADBENA SITUACIJA
Gradbena situacija 1/5

merilo: 1 : 500

MESTNA OBČINA SLOVENJ GRADEC
ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC

AC&P inženirski biro d.o.o.
podjetje za geotehniko, infrastrukturo in raziskave
tovarniška c. 26, 5270 ajdovščina | +386(0)5 8500740 | info@acap.si

vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	ANDREJ BRICMAN, dipl.inž.geol. (UN) .
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina risbe:	02 GRADBENA SITUACIJA Gradbena situacija 1/5

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 500	**G.102.1**

AC&P
077-24_Cesta Anžič [Gradbena situacija].dwg
0.900 x 0.520 = 0.468 m2

Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

02 GRADBENA SITUACIJA
Gradbena situacija 2/5

merilo: 1 : 500

NN - podzemni kabelski (v obratovanju)
NN nadzemni kabelski (v obratovanju)
SN - KB (ni v obratovanju)
SN - KB (v obratovanju)
SN-DV (v obratovanju)
Kanalizacija - optika (v obratovanju)

MESTNA OBČINA SLOVENJ GRADEC
ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC

AC&P inženirski biro d.o.o.
podjetje za geotehniko, infrastruktura in raziskave
tovarniška c. 26, 5270 ajdovščina | +386(0)5 8500740 | info@acap.si

vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	ANDREJ BRICMAN, dipl.inž.geol. (UN)	.
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt ceste	
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina risbe:	02 GRADBENA SITUACIJA Gradbena situacija 2/5	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 500	G.102.2

ACAP
077-24_Cesta Anžič (Gradbena situacija).dwg
0.000 x 0.297 = 0.267 m2

Iztok iz globoke drenaže
urejen v oblogi iz kamen-betona

Sistem globokega
odvodnjavanja

Iztok iz prepusta
v pobočne kanalete

PR9 ob-1
KP:559.02
Kl:557.95
Globina:1.82m

PR9 ob-2
KC:557.82

156.83m
1.9%
225mmØ

PR10-1
KP:563.25
Kl:562.00
Globina:2.01m

PR10-2
KC:561.86

600mmØ
1.9%
L=35.80m

PR11 ob-1
KP:562.43
Kl:561.25
Globina:1.93m

PR11 ob-2
KC:561.08

182m
2.1%
500mmØ

Vzdolžna drenaža
PVC DKN DN200

Podporna kamnita zložba PKZ-4
L=300,0m, višina naraščujoča od 3 do 4

OP ŠT.01349

OP ŠT.01349/2

OP ŠELE HLADE

PMO_040930

Meja ENS 50 m

Meja ENS 50 m

P49 P50 P51 P52 P53 P54 P55 P56 P57 P58 P59 P60 P61 P62 P63 P64 P65

0+40.00 0+60.00 0+80.00 1.0+00.00 1.0+20.00 1.0+40.00 1.0+60.00 1.0+80.00 1.1+00.00 1.1+20.00 1.1+40.00 1.1+60.00 1.2+00.00 1.2+20.00 1.2+40.00 1.2+60.00 1.2+80.00 1.3+00.00 1.3+20.00 1.3+40.00

NN - podzemni kabelski (v obratovanju)
NN nadzemni kabelski (v obratovanju)
SN - KB (ni v obratovanju)
SN - KB (v obratovanju)
SN-DV (v obratovanju)
Kanalizacija - optika (v obratovanju)

Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

02 GRADBENA SITUACIJA
Gradbena situacija 3/5

merilo: 1 : 500

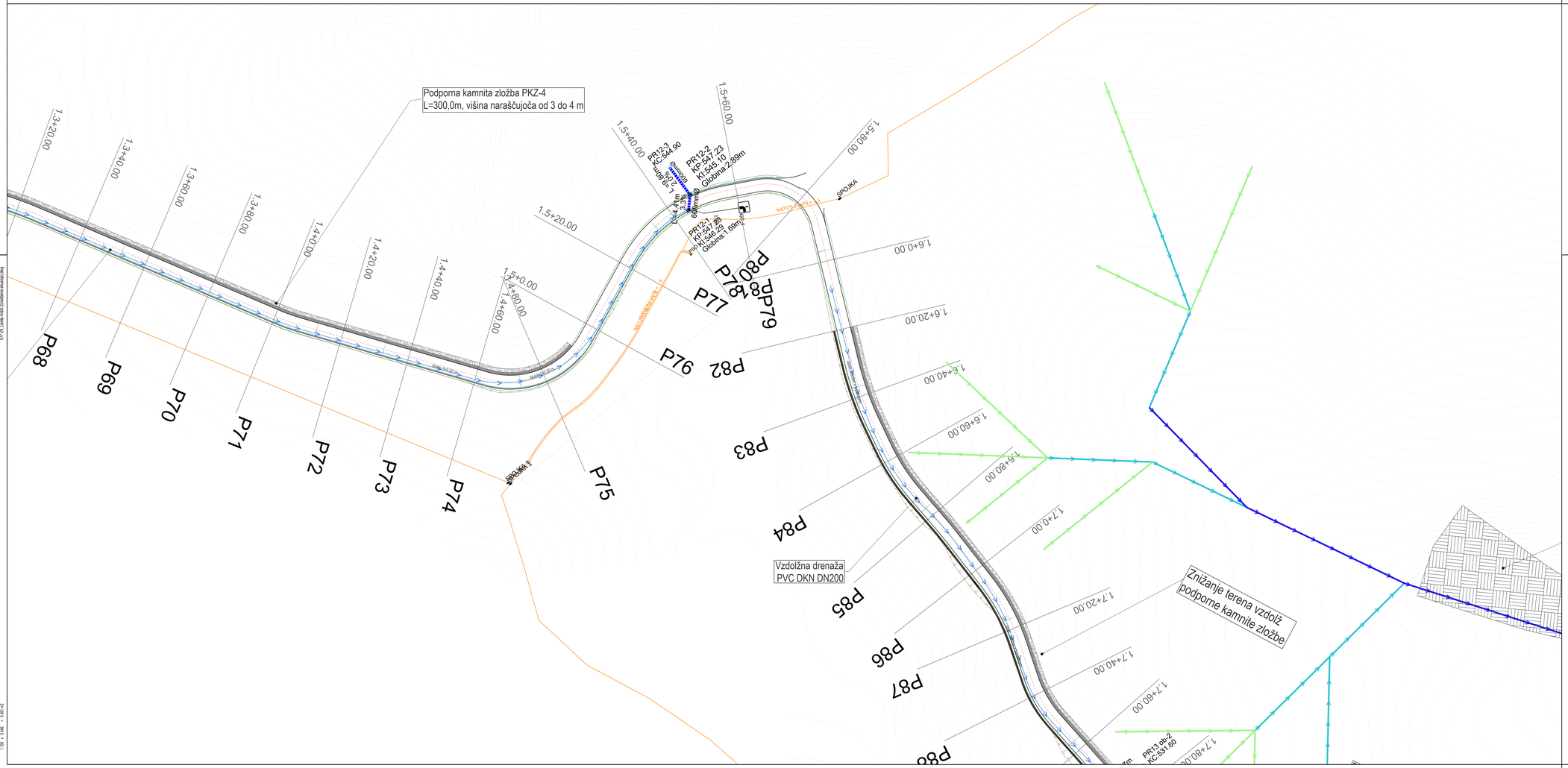
MESTNA OBČINA SLOVENJ GRADEC
ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC

AC&P inženirski biro d.o.o.
podjetje za geotehniko, infrastrukturo in raziskave
tovarniška c. 26, 5270 ajdovščina | t +386(0)5 8500740 | info@acap.si

vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	ANDREJ BRICMAN, dipl.inž.geol. (UN)	.
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt ceste	
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina risbe:	02 GRADBENA SITUACIJA Gradbena situacija 3/5	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 500	**G.102.3**

AC&P
077-24_Cesta Anžič [Gradbena situacija].dwg
0.000 x 0.520 x 0.468 m2



Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

2.1 Načrt ceste
Gradbena situacija 4/5

merilo: 1 : 500

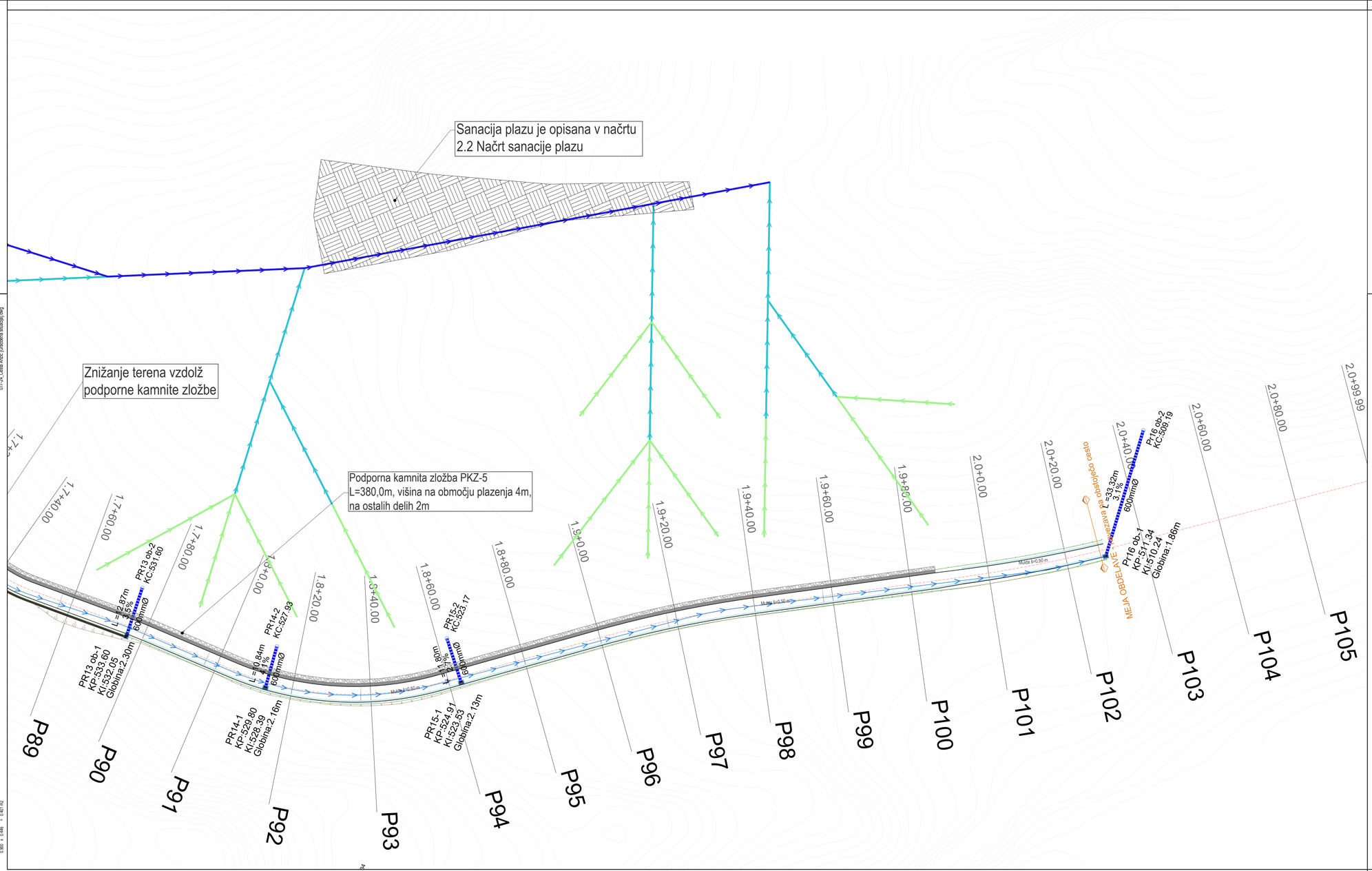
MESTNA OBČINA SLOVENJ GRADEC
ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC

AC&P inženirski biro d.o.o.
podjetje za podrtnino, infrastrukturo in nanizanje
tovarniška c. 26, 5270 ajdovščina | +38665358 9500740 | info@acap.si

vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
podsklačeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	ANDREJ BRICMAN, dipl.inž.geol. (UN)	-
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt gradbeništva - cesta	
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina načrta:	2.1 Načrt ceste Gradbena situacija 4/5	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 500	**G.102.4**

KGP
077-24_Cesta 4x5C (Gradbena situacija).dwg
1:500 = 0.446 = 0.491+2



Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

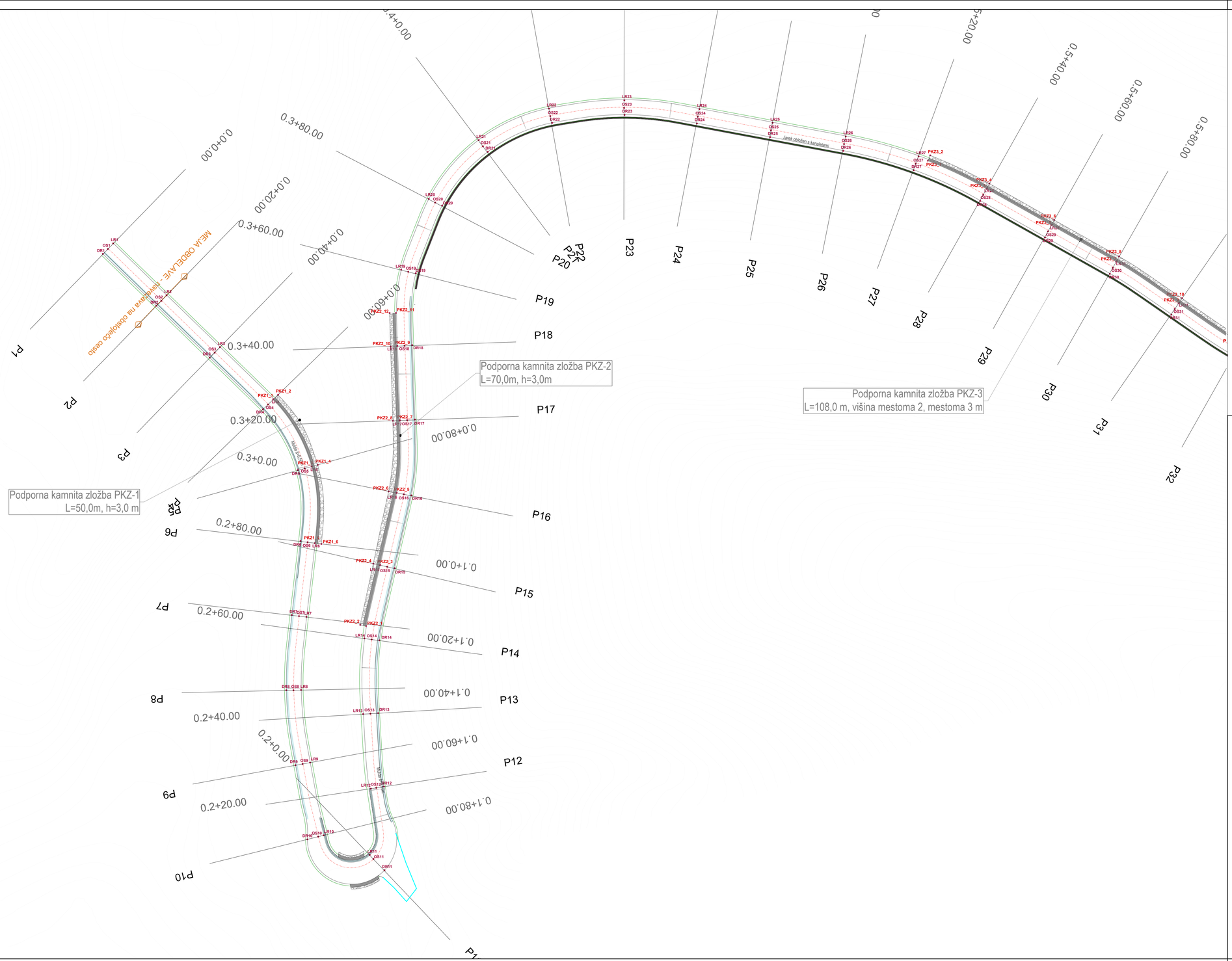
02 GRADBENA SITUACIJA
Gradbena situacija 5/5

merilo: 1 : 500

MESTNA OBČINA SLOVENJ GRADEC ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC	AC&P inženirski biro d.o.o. podjetje za geotehniko, infrastrukturo in raziskave tovarniška c. 26, 5270 ajdovščina, t +386(0)5 8500740, info@acap.si	
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	ANDREJ BRICMAN, dipl.inž.geol. (UN)	.
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt ceste	
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina risbe:	02 GRADBENA SITUACIJA Gradbena situacija 5/5	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 500	**G.102.5**

AC&P
077-24, Cesta Anžič (Gradbena situacija).dwg
0.000 x 0.446 x 0.401 m2





Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

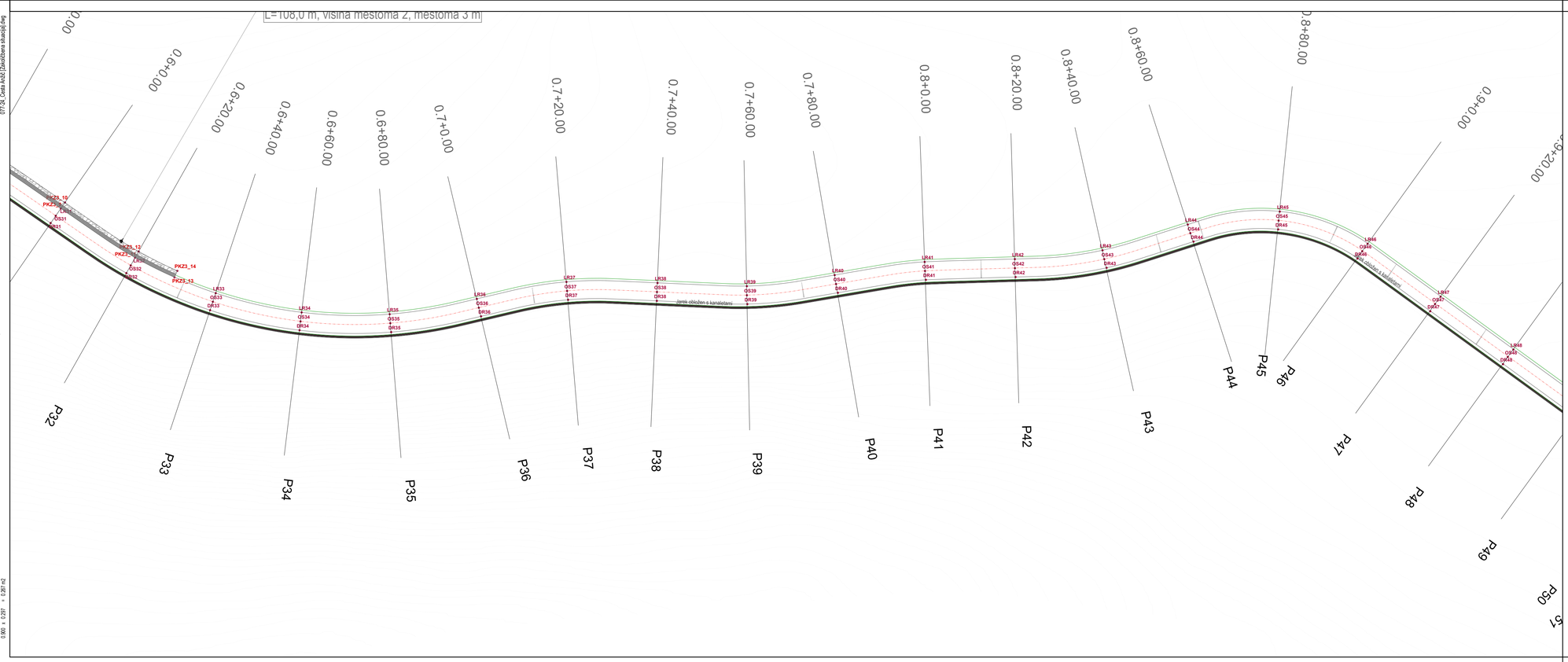
06 ZAKOLIČBENA SITUACIJA
Zakoličbena situacija 1/5

merilo: 1 : 500

MESTNA OBČINA SLOVENJ GRADEC ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC		AC&P inženirski biro d.o.o. podjetje za geotehniko, infrastrukturo in raziskave tovarniška c. 26, 5270 ajdovščina | +386(0)5 8500740 | info@acap.si			
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.				IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.				IZS PI G-4829
izdelal:	NIKO ROVTAR				.
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec				
vrsta projekta:	PZI				
vrsta načrta:	2.1 Načrt ceste				
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023				
vsebina risbe:	06 ZAKOLIČBENA SITUACIJA Zakoličbena situacija 1/5				
	datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
	09.2024	077-24	077-24-21	1 : 500	**G.106.1**

ACAP
077-24_Cesta Anžič [Zakoličbena situacija].dwg
0.900 x 0.520 = 0.468 m2

ACAP
077-24_Cesta Anžič (Zakoličbena situacija).dwg



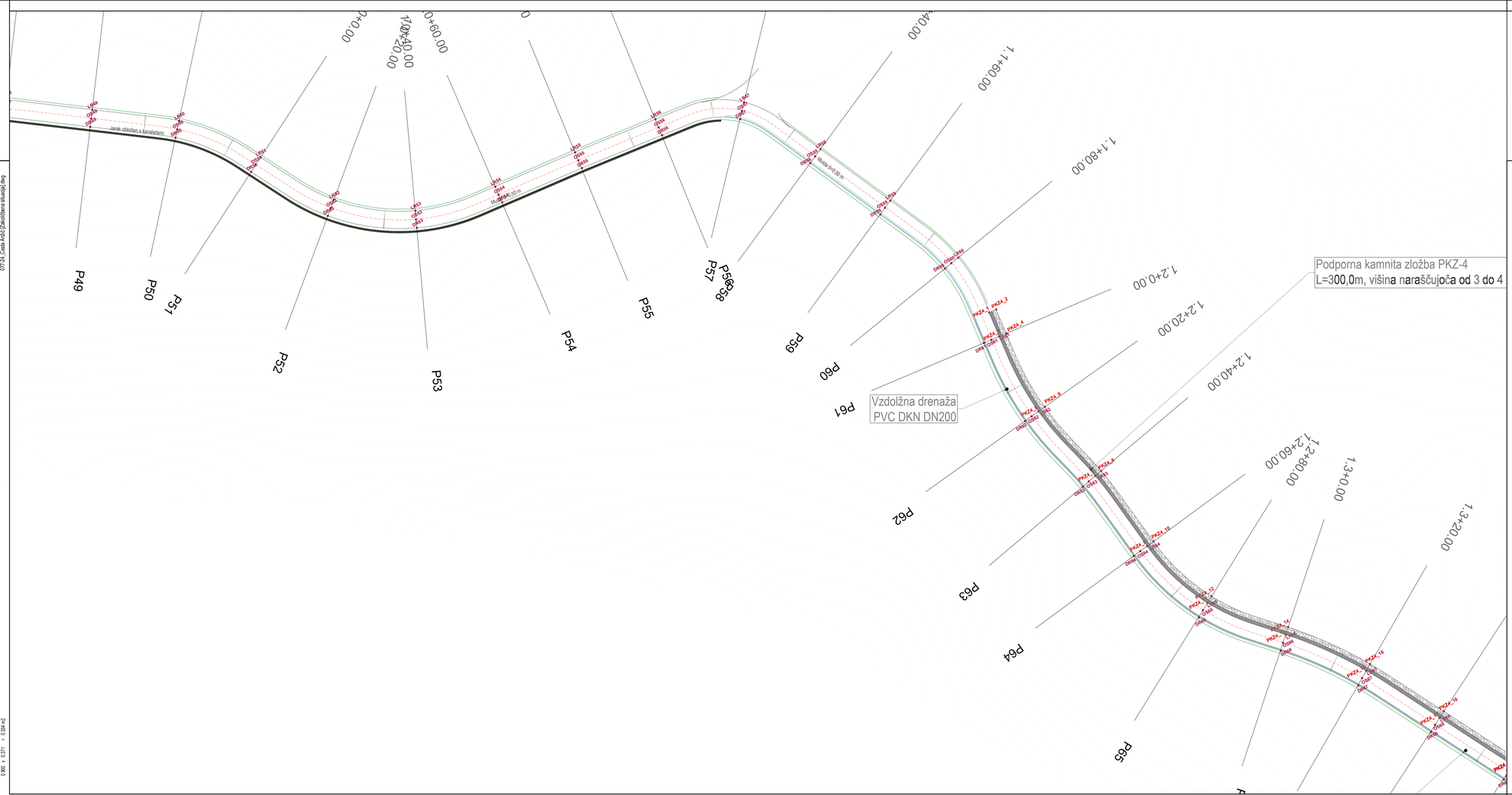
Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

06 ZAKOLIČBENA SITUACIJA
Zakoličbena situacija 2/5

merilo: 1 : 500

	MESTNA OBČINA SLOVENJ GRADEC ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC	AC&P inženirski biro d.o.o. podjetje za geotehniko, infrastruktura in razlikave tovarniška c. 26, 5270 ajdovščina | +386(0)5 8500740 | info@acap.si
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	NIKO ROVTAR	
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt ceste	
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina risbe:	06 ZAKOLIČBENA SITUACIJA Zakoličbena situacija 2/5	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 500	**G.106.2**



Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

06 ZAKOLIČBENA SITUACIJA
Zakoličbena situacija 3/5

merilo: 1 : 500

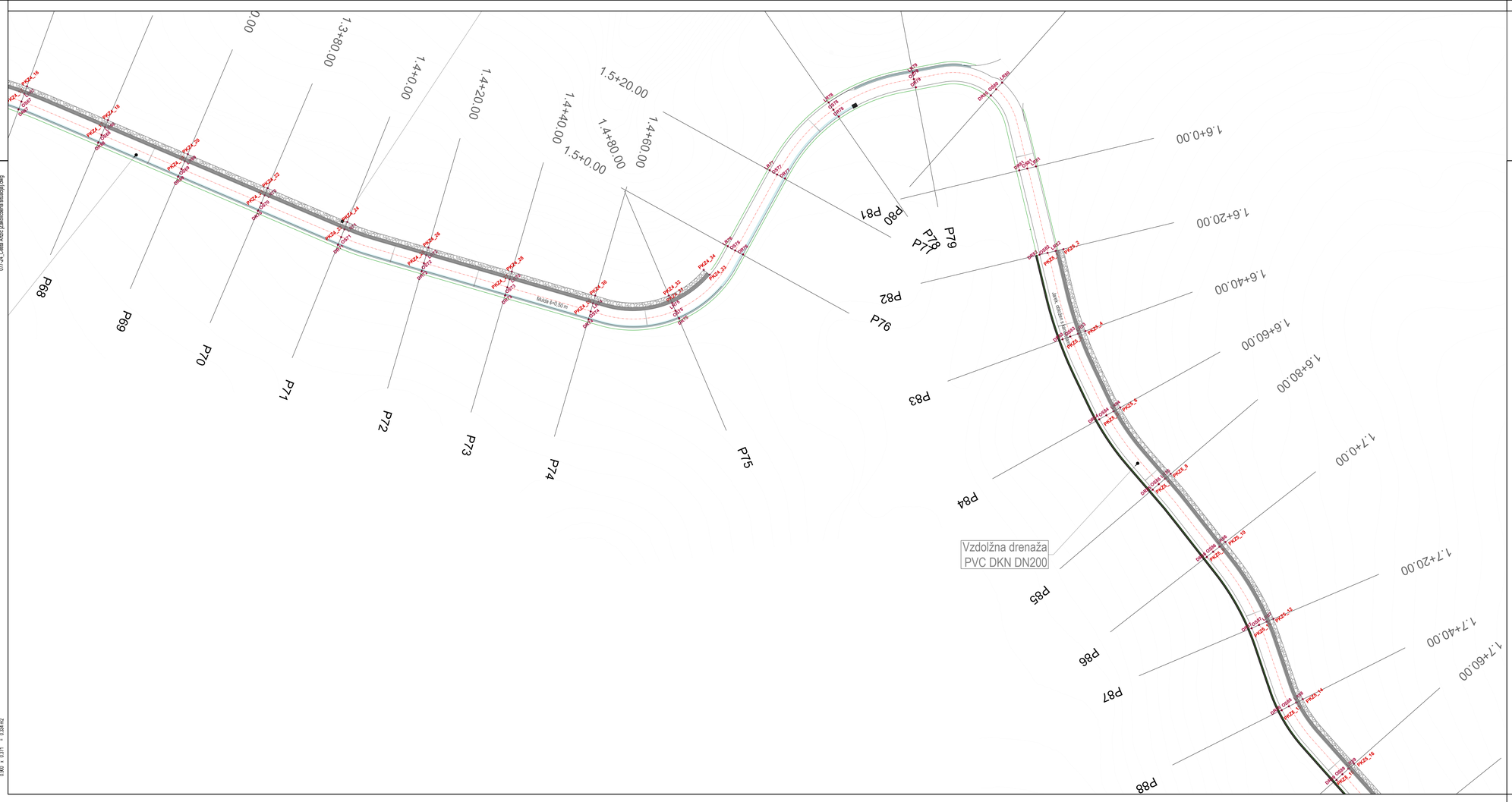
MESTNA OBČINA SLOVENJ GRADEC
ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC

AC&P inženirski biro d.o.o.
podjetje za geotehniko, infrastrukturo in raziskave
tovarniška c. 26, 5270 ajdovščina | +386(0)5 8500740 | info@acap.si

vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	NIKO ROVTAR	-
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt ceste	
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina risbe:	06 ZAKOLIČBENA SITUACIJA Zakoličbena situacija 3/5	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 500	**G.106.3**

AC&P
077-24_Cesta Anžič\Zakoličbena situacija\.dwg
0.000 x 0.371 x 0.394 m2



Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

06 ZAKOLIČBENA SITUACIJA
Zakoličbena situacija 4/5

merilo: 1 : 500

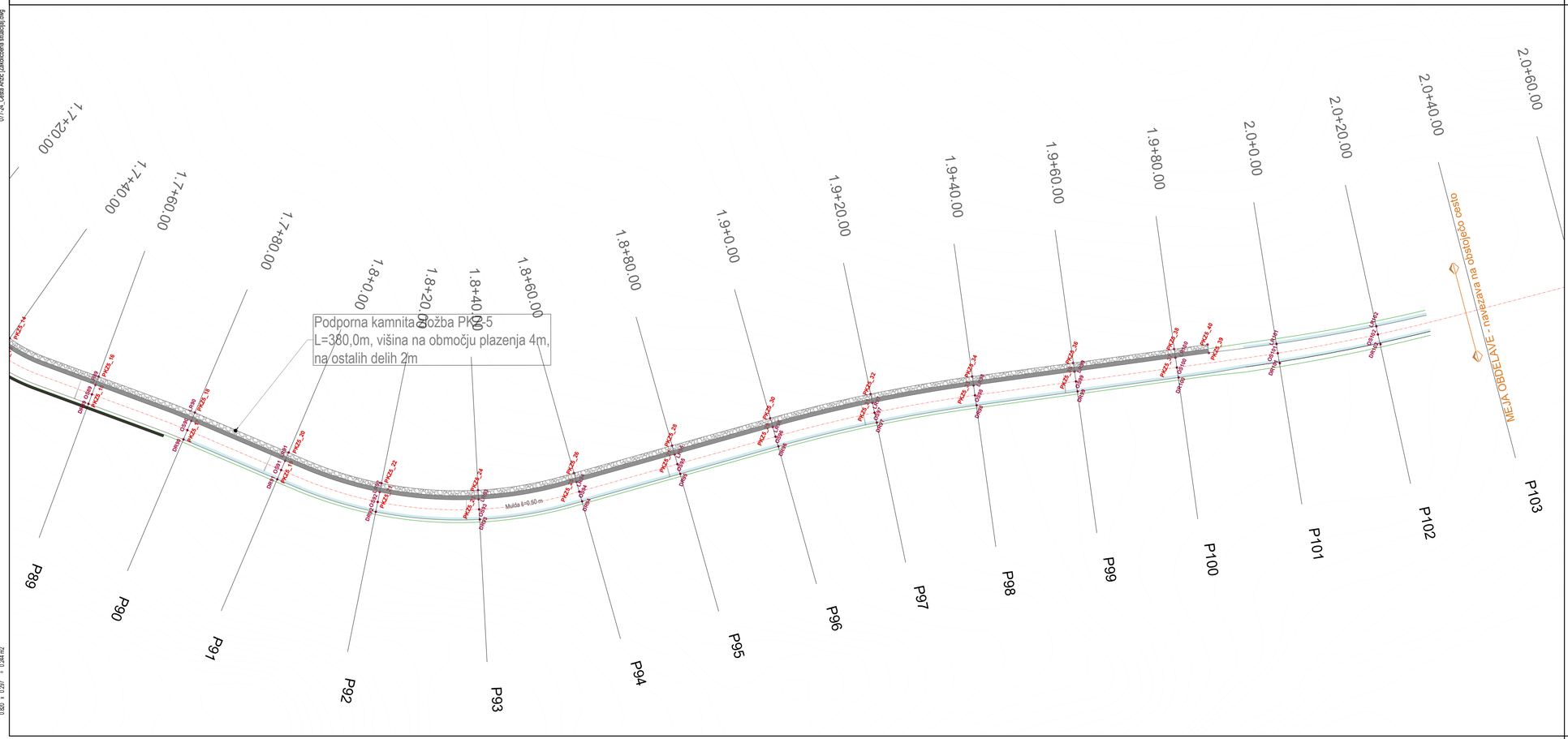
MESTNA OBČINA SLOVENJ GRADEC
ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC

AC&P inženirski biro d.o.o.
podjetje za geotehniko, infrastrukturo in raziskave
tovarniška c. 26, 5270 ajdovščina | +3865(0)5 8500740 | info@acap.si

vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	NIKO ROVTAR	-
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt ceste	
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina risbe:	06 ZAKOLIČBENA SITUACIJA Zakoličbena situacija 4/5	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 500	**G.106.4**

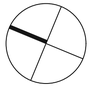
AC&P
077-24_Cesta Anžič (Zakoličbena situacija).dwg
0.000 x 0.371 = 0.384 m2

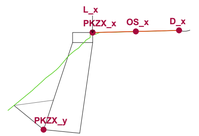


Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

06 ZAKOLIČBENA SITUACIJA
Zakoličbena situacija 5/5

merilo: 1 : 500



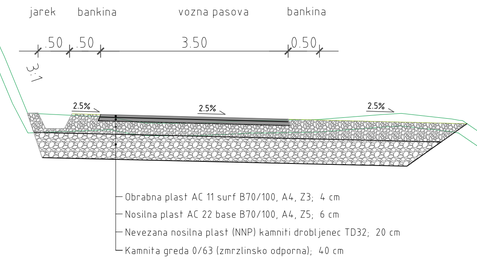


MESTNA OBČINA SLOVENJ GRADEC ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC		AC&P inženirski biro d.o.o. podjetje za geotehniko, infrastrukturo in raziskave tovarniška c. 26, 5270 ajdovščina | +386(0)5 8500740 | info@acap.si		
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.			IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.			IZS PI G-4829
izdelal:	NIKO ROVTAR			.
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec			
vrsta projekta:	PZI			
vrsta načrta:	2.1 Načrt ceste			
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023			
vsebina risbe:	06 ZAKOLIČBENA SITUACIJA Zakoličbena situacija 5/5			
datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 500	**G.106.5**

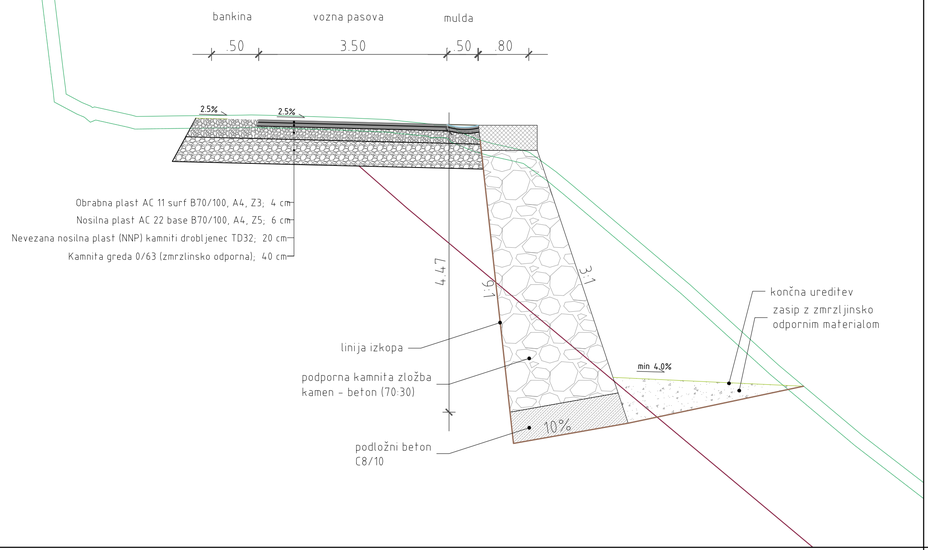
ACAP
077-24_Cesta Anžič (Zakoličbena situacija).dwg
0.800 x 0.297 = 0.24 m2

ACAP
077-24_Cesta Anžič(BOŠ).dwg

KARAKTERISTIČNI PREČNI PREREZ
tip I



KARAKTERISTIČNI PREČNI PREREZ
tip II



Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

31 KARAKTERISTIČNI PREREZ
Karakteristični prečni prerezi

merilo: 1 : 50

MESTNA OBČINA SLOVENJ GRADEC
ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC

AC&P inženirski biro d.o.o.
podjetje za geotehniko, infrastrukturo in raziskave
tovarniška c. 26, 5270 ajdovščina | +386(0)5 8500740 | info@acap.si

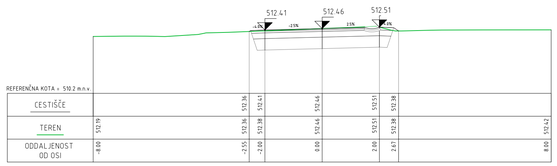
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	Neja Katič, dipl.inž.grad.(UN) .
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina risbe:	31 KARAKTERISTIČNI PREREZ Karakteristični prečni prerezi

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09. 2024	077-24	077-24-21	1 : 50	**G.131**

0.820 x 0.297 = 0.244 m2

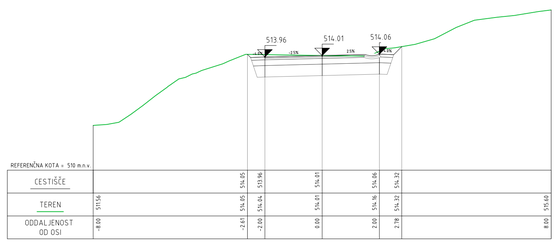
Seif
077-24_Cesta Anžič Prečni profili.dwg

0.000 x 0.446 x 0.401 m2



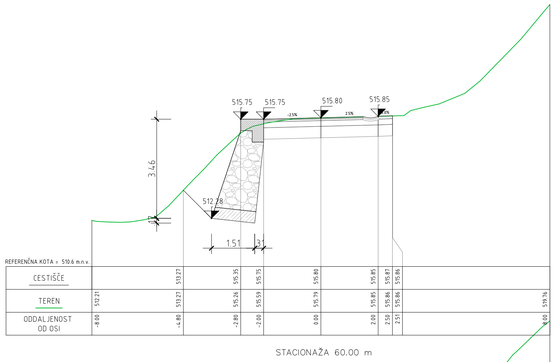
STACIONAŽA 20.00 m

P2



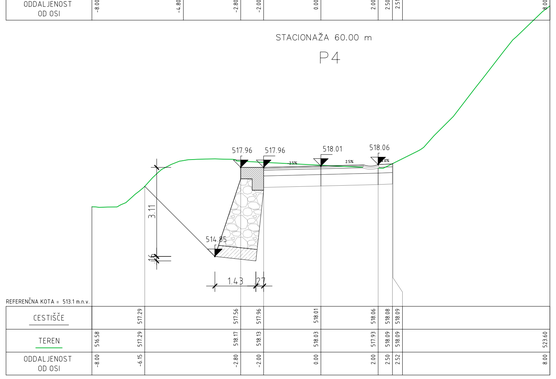
STACIONAŽA 40.00 m

P3



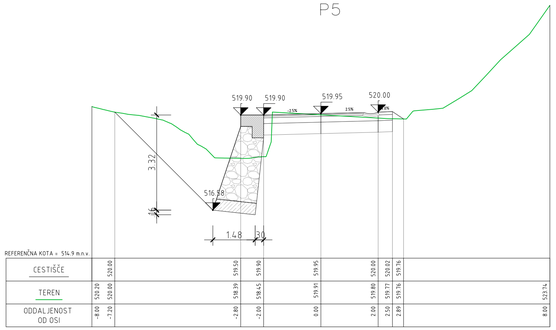
STACIONAŽA 60.00 m

P4



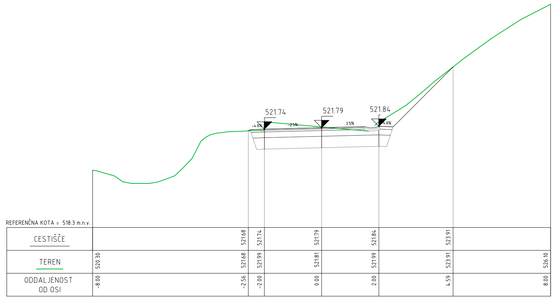
STACIONAŽA 80.00 m

P5



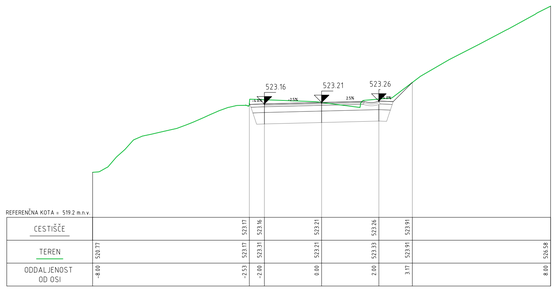
STACIONAŽA 100.00 m

P6



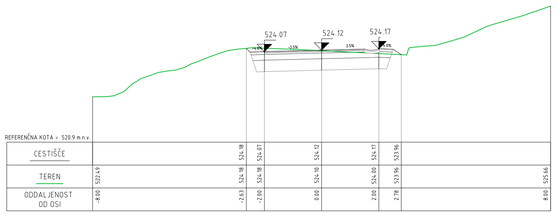
STACIONAŽA 120.00 m

P7



STACIONAŽA 140.00 m

P8



STACIONAŽA 160.00 m

P9

Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

32 PREČNI PREREZI

merilo: 1 : 100

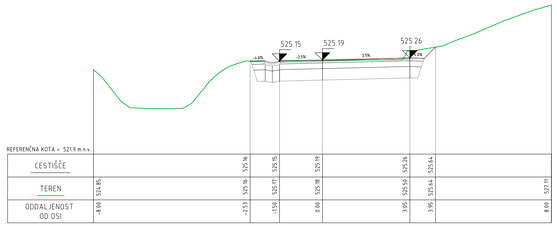
MESTNA OBČINA SLOVENJ GRADEC
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podjetje za geotehniko, infrastrukturo in raziskave
tovarniška c. 26, 5270 ajdovščina | +38605 8500740 | info@acap.si

vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	SEIF GRITLI
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina risbe:	32 PREČNI PREREZI Prečni profili P2 - P9

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.132.1**

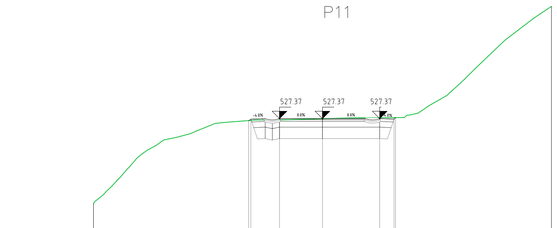
Seif
077-24_Cesta Anžič,Plhovi profili.dwg



REFERENČNA KOTA = 521.9 m.n.v.							
CESTIŠČE		525.36	525.35	525.39		525.26	525.44
TEREN		525.36	525.37	525.38		525.56	525.54	527.01
ODDALJENOST OD OSI	-8.00	525.49	-2.53	-1.50	0.00	3.95	5.95	8.00

STACIONAŽA 180.00 m

P10



REFERENČNA KOTA = 524 m.n.v.							
CESTIŠČE		526.60	526.49	526.53		526.63	526.90	
TEREN		526.60	526.38	526.50		526.84	526.90	527.03
ODDALJENOST OD OSI	-8.00	525.59	-2.43	-1.50	0.00	4.20	6.98	8.00

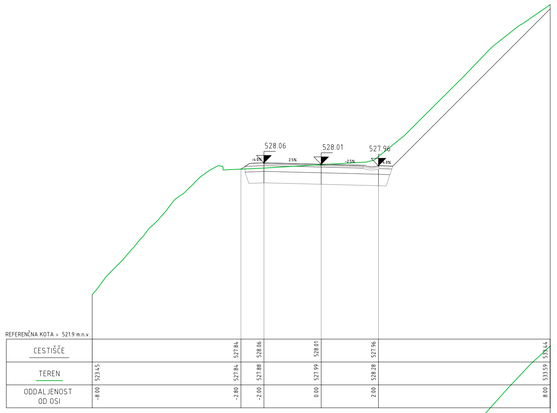
STACIONAŽA 200.00 m

P11

REFERENČNA KOTA = 524 m.n.v.								
CESTIŠČE		527.38	527.35	527.37		527.37	527.37	527.35	527.40	
TEREN		527.38	527.30	527.32	527.37		527.37	527.40	527.40	527.25
ODDALJENOST OD OSI	-8.00	524.40	-2.58	-2.50	-1.50	0.00	2.00	2.50	2.55	8.00

STACIONAŽA 220.00 m

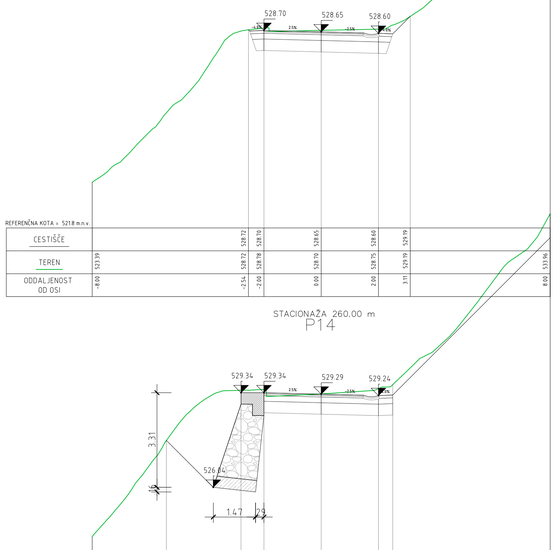
P12



REFERENČNA KOTA = 521.9 m.n.v.							
CESTIŠČE		527.84	527.84	527.88		527.96	528.14	
TEREN		527.84	527.88	527.99		528.28	527.96	529.44
ODDALJENOST OD OSI	-8.00	523.43	-2.60	-2.50	0.00	2.00	2.50	8.00

STACIONAŽA 240.00 m

P13



REFERENČNA KOTA = 521.8 m.n.v.							
CESTIŠČE		528.72	528.70	528.65		528.60	529.70	
TEREN		528.72	528.78	528.70	528.65		528.75	529.70	529.96
ODDALJENOST OD OSI	-8.00	523.39	-2.54	-2.00	0.00	2.00	3.71	8.00

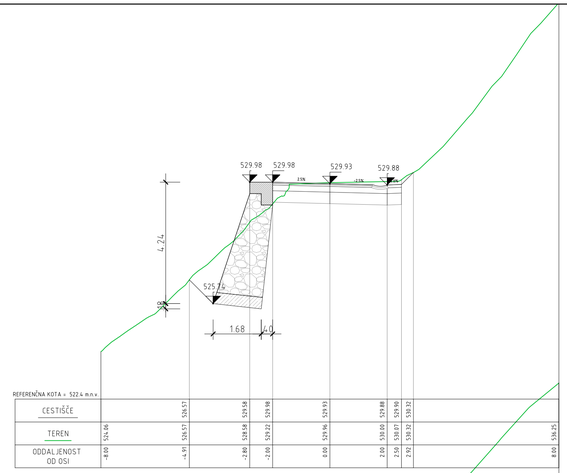
STACIONAŽA 260.00 m

P14

REFERENČNA KOTA = 522.7 m.n.v.								
CESTIŠČE		527.67	527.67	528.96	529.34	529.29	529.24	529.26	
TEREN		527.67	528.96	529.34	529.29		529.24	529.26	530.76
ODDALJENOST OD OSI	-8.00	524.31	-5.41	-2.80	-2.00	0.00	2.00	2.50	8.00

STACIONAŽA 280.00 m

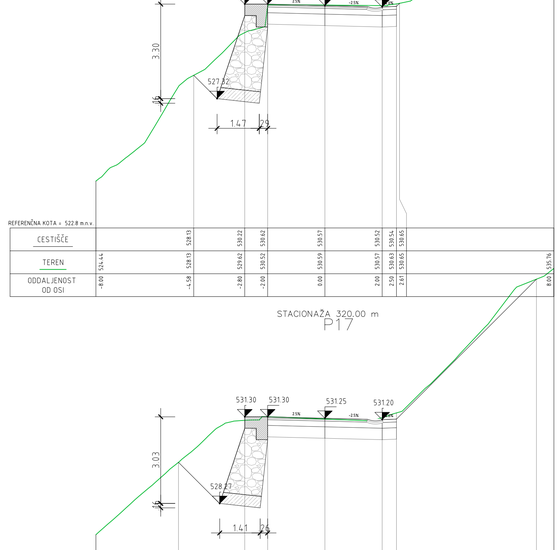
P15



REFERENČNA KOTA = 522.4 m.n.v.								
CESTIŠČE		526.57	529.58	529.98	529.93		529.88	529.90	530.32	
TEREN		526.57	529.58	529.72	529.96		530.00	530.07	530.32	530.75
ODDALJENOST OD OSI	-8.00	526.46	-4.45	-2.80	-2.00	0.00	2.00	2.50	2.50	8.00

STACIONAŽA 300.00 m

P16



REFERENČNA KOTA = 522.8 m.n.v.								
CESTIŠČE		528.13	528.02	528.42	528.57		528.52	528.54	528.66	
TEREN		528.13	528.42	528.52	528.59		528.57	528.63	528.65	530.76
ODDALJENOST OD OSI	-8.00	524.44	-4.58	-2.80	-2.00	0.00	2.00	2.50	2.61	8.00

STACIONAŽA 320.00 m

P17

REFERENČNA KOTA = 525.5 m.n.v.								
CESTIŠČE		529.71	529.90	530.30	531.25		531.20	531.22	536.11	
TEREN		529.71	529.90	530.30	531.25		531.20	531.44	536.11	536.45
ODDALJENOST OD OSI	-8.00	527.78	-5.15	-2.80	-2.00	0.00	2.00	2.50	7.39	8.00

STACIONAŽA 340.00 m

P18

Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

32 PREČNI PREREZI

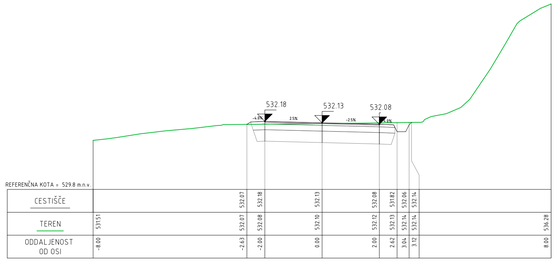
merilo: 1 : 100

MESTNA OBČINA SLOVENJ GRADEC Šolska ulica 5, 2380 Slovenj Gradec	AC&P inženirski biro d.o.o. podjetje za geotehniko, infrastrukturo in raziskave tovarniška c. 26, 5270 ajdovščina T +386(0)5 8500740 E info@acap.si
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	SEIF GRITLI .
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina risbe:	32 PREČNI PREREZI Prečni profili P10 - P18

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.132.2**

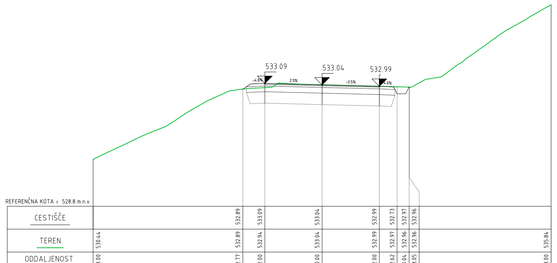
0.000 x 0.446 x 0.401 m2

Self
077-24_Cesta Anžič (Prečni profili).dwg
0.800 x 0.371 = 0.334 m2



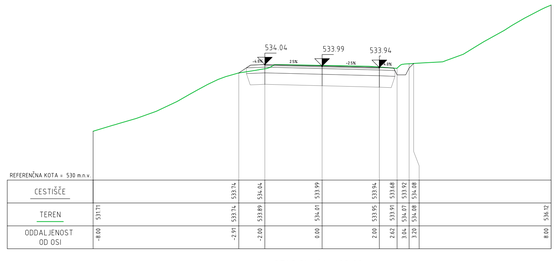
STACIONAŽA 360.00 m

P19



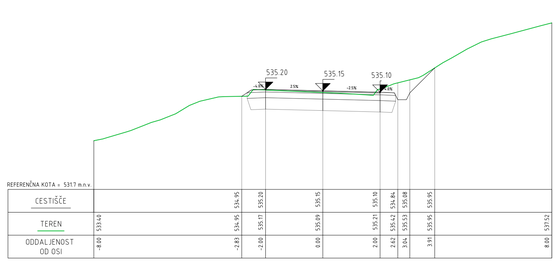
STACIONAŽA 380.00 m

P20



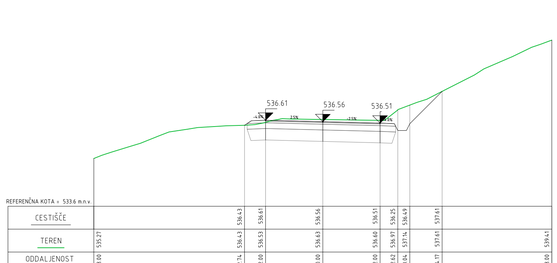
STACIONAŽA 400.00 m

P21



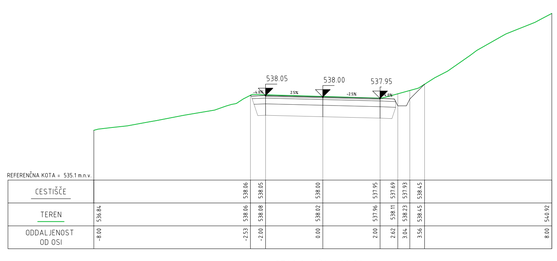
STACIONAŽA 420.00 m

P22



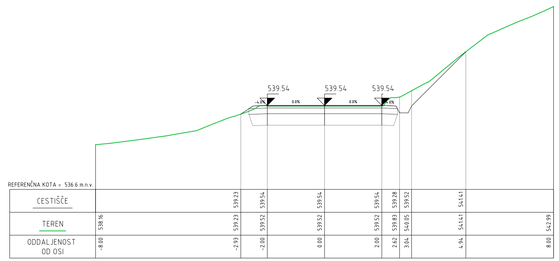
STACIONAŽA 440.00 m

P23



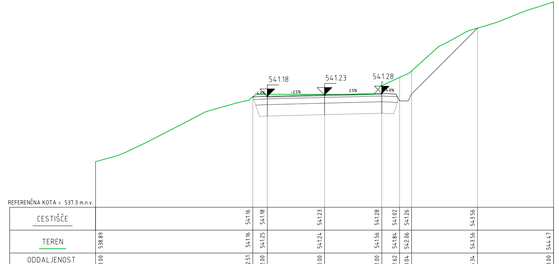
STACIONAŽA 460.00 m

P24



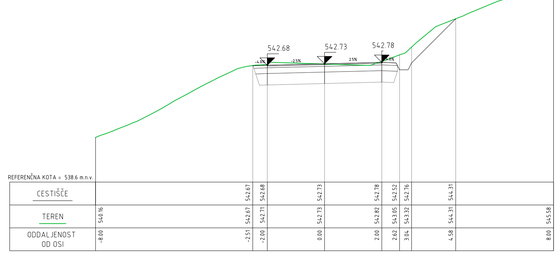
STACIONAŽA 480.00 m

P25



STACIONAŽA 500.00 m

P26



STACIONAŽA 520.00 m

P27

Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

32 PREČNI PREREZI

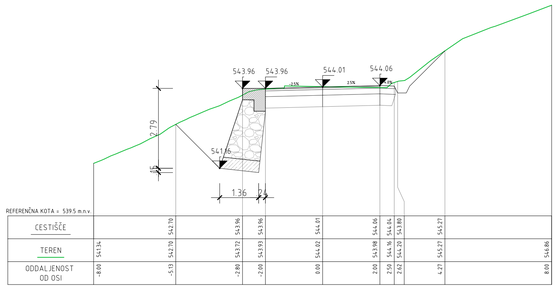
merilo: 1 : 100

MESTNA OBČINA SLOVENJ GRADEC
Šolska ulica 5, 2380 Slovenj Gradec

AC&P inženirski biro d.o.o.
podjetje za geotehniko, infrastrukturo in razskave
tovarniška c. 26, 5270 ajdovščina | +3866(0)5 8500740 | info@acap.si

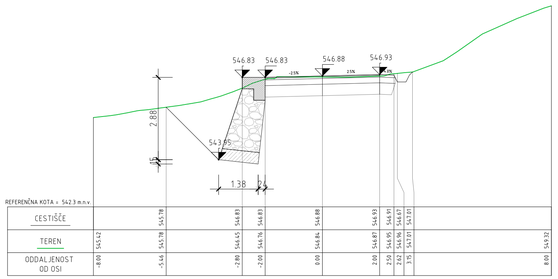
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	SEIF GRITLI	-
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt ceste	
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina risbe:	32 PREČNI PREREZI Prečni profili P19 - P27	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.132.3**



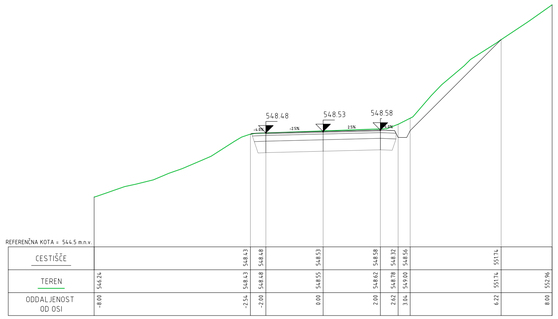
STACIONAŽA 540.00 m

P28



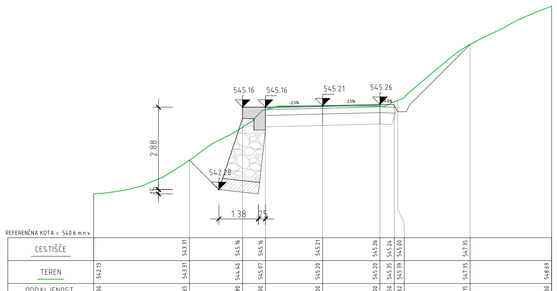
STACIONAŽA 600.00 m

P31



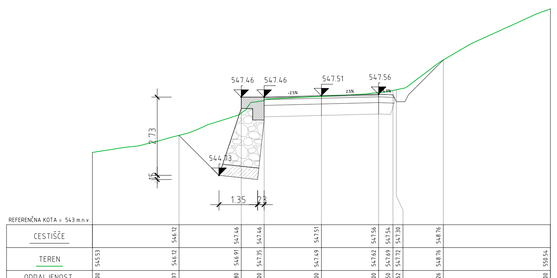
STACIONAŽA 660.00 m

P34



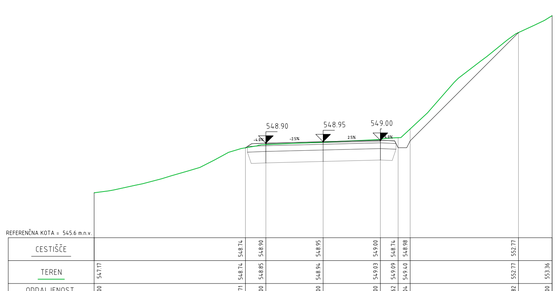
STACIONAŽA 560.00 m

P29



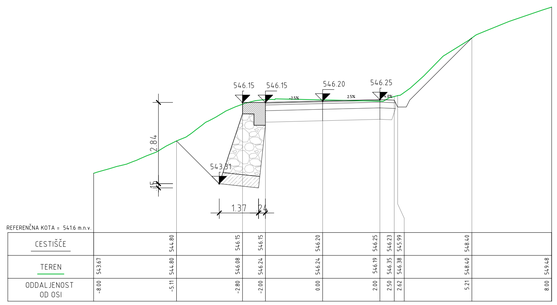
STACIONAŽA 620.00 m

P32



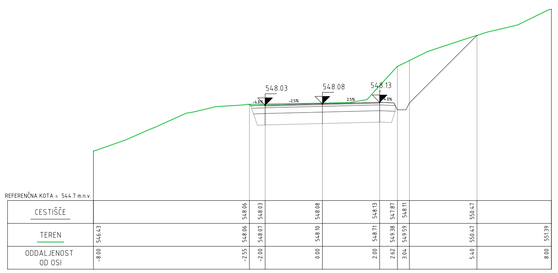
STACIONAŽA 680.00 m

P35



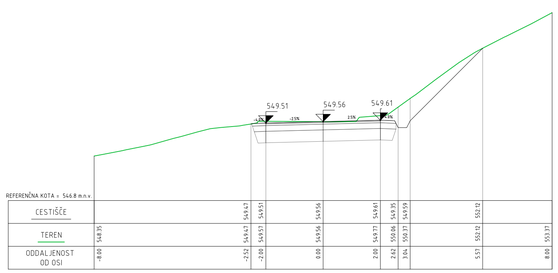
STACIONAŽA 580.00 m

P30



STACIONAŽA 640.00 m

P33



STACIONAŽA 700.00 m

P36

Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

32 PREČNI PREREZI

merilo: 1 : 100

MESTNA OBČINA SLOVENJ GRADEC
Šolska ulica 5, 2380 Slovenj Gradec

AC&P inženirski biro d.o.o.
podjetje za geotehniko, infrastrukturo in raziskave
tovarniška c. 26, 5270 ajdovščina | +38605 8500740 | info@acap.si

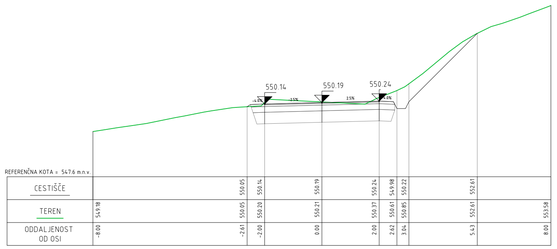
vodja projekta: KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir: KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal: SEIF GRITLI

investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina risbe:	32 PREČNI PREREZI Prečni profili P28 - P36

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.132.4**

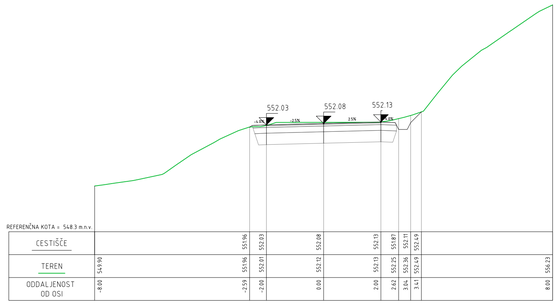
Seif
077-24_Cesta Anžič Prhoki profili.dwg

0.000 x 0.446 x 0.401 m2



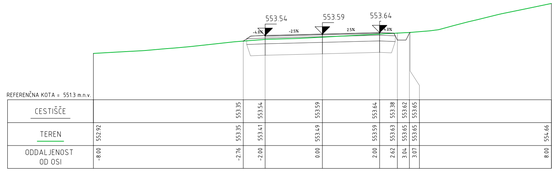
STACIONAŽA 720.00 m

P37



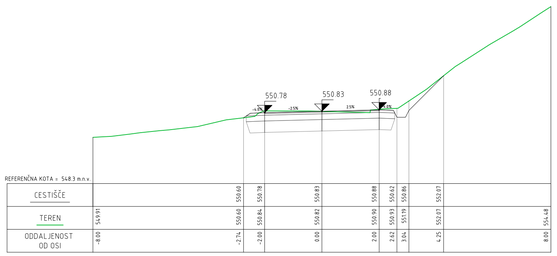
STACIONAŽA 780.00 m

P40



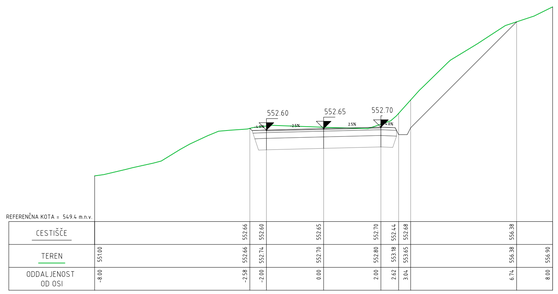
STACIONAŽA 840.00 m

P43



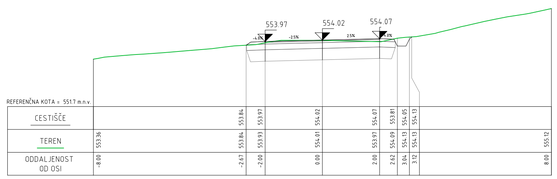
STACIONAŽA 740.00 m

P38



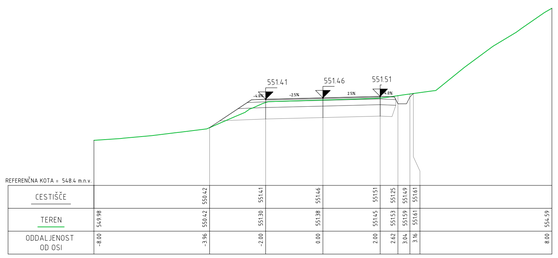
STACIONAŽA 800.00 m

P41



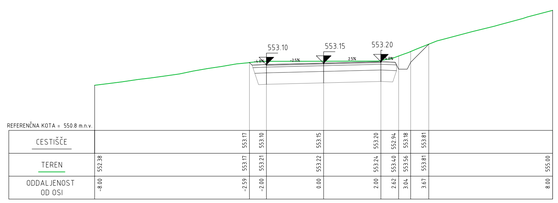
STACIONAŽA 860.00 m

P44



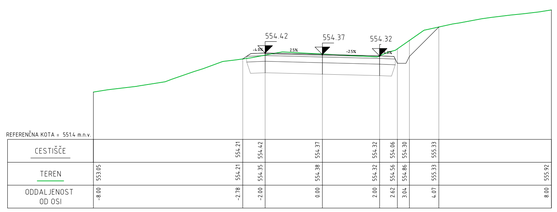
STACIONAŽA 760.00 m

P39



STACIONAŽA 820.00 m

P42



STACIONAŽA 880.00 m

P45

Self
077-24_Cesta Anžič,Preds profili.dwg

0.000 - 0.446 - h 0.401 m2

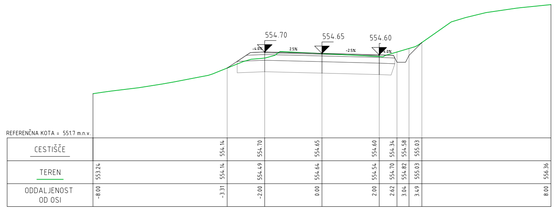
Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

32 PREČNI PREREZI

merilo: 1 : 100

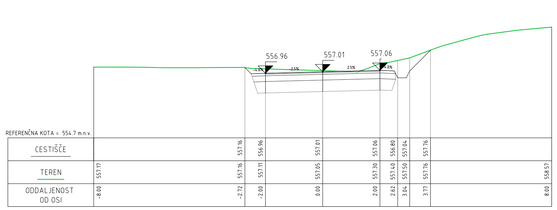
	MESTNA OBČINA SLOVENJ GRADEC Šolska ulica 5, 2380 Slovenj Gradec	AC&P inženirski biro d.o.o. podjetje za geotehniko, infrastrukturo in raziskave tovarniška c. 26, 5270 ajdovščina t +386(0)5 8500740 i info@acap.si
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	SEIF GRITLI	.
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt ceste	
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina risbe:	32 PREČNI PREREZI Prečni profili P37 - P45	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.132.5**



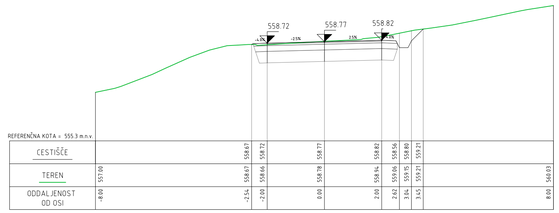
STACIONAŽA 900.00 m

P46



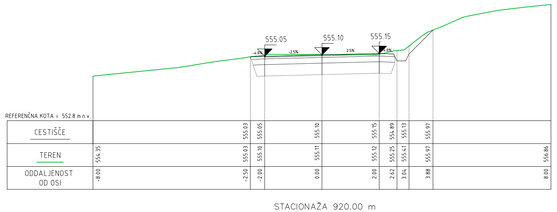
STACIONAŽA 960.00 m

P49



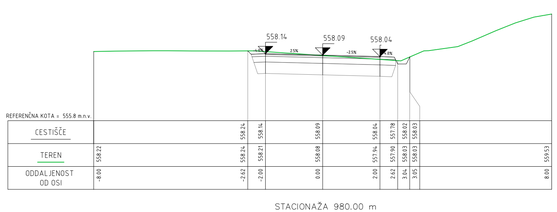
STACIONAŽA 1020.00 m

P52



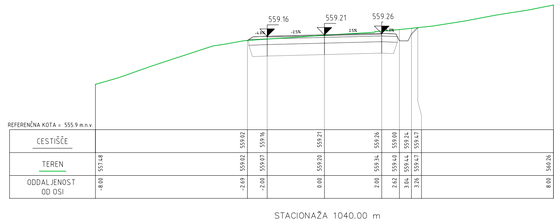
STACIONAŽA 920.00 m

P47



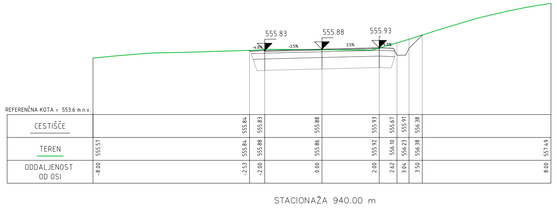
STACIONAŽA 980.00 m

P50



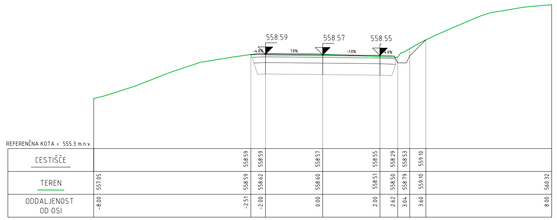
STACIONAŽA 1040.00 m

P53



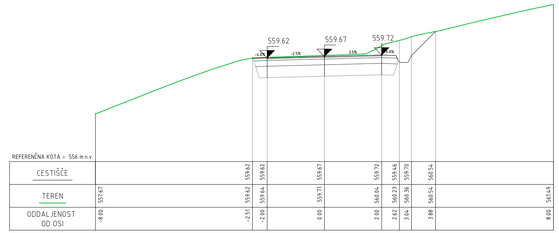
STACIONAŽA 940.00 m

P48



STACIONAŽA 1000.00 m

P51



STACIONAŽA 1060.00 m

P54

Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

32 PREČNI PREREZI

merilo: 1 : 100

MESTNA OBČINA SLOVENJ GRADEC
Šolska ulica 5, 2380 Slovenj Gradec

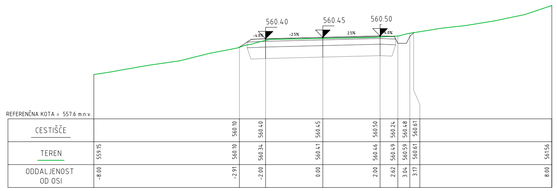
AC&P inženirski biro d.o.o.
podjetje za geotehniko, infrastrukturo in razskave
tovarniška c. 26, 5270 ajdovščina | t +386(0)5 8500740 | info@acap.si

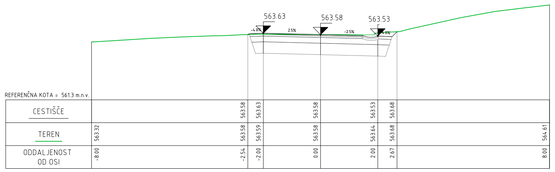
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	SEIF GRITLI
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina risbe:	32 PREČNI PREREZI Prečni profili P46 - P54

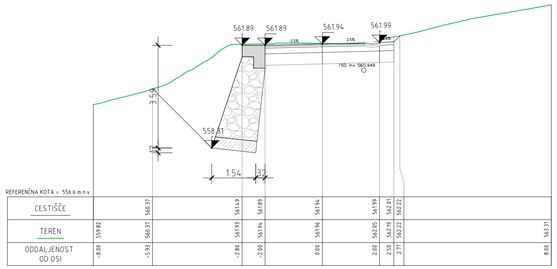
datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.132.6**

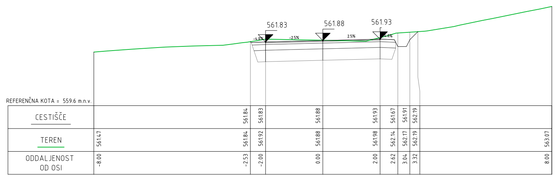
Seif
077-24_Cesta Anžič (Prečni profili).dwg

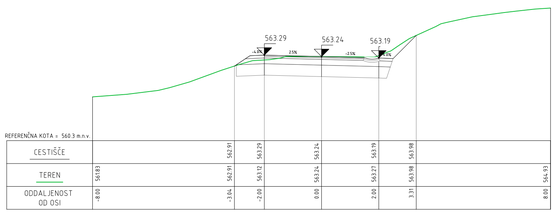
0.800 x 0.371 = 0.284 m2

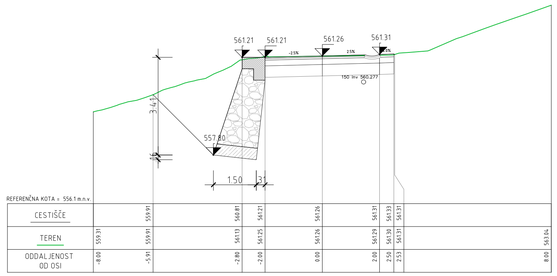


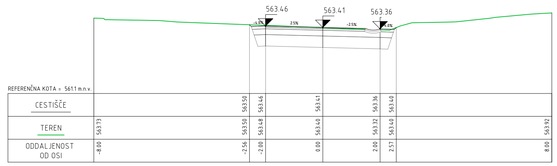


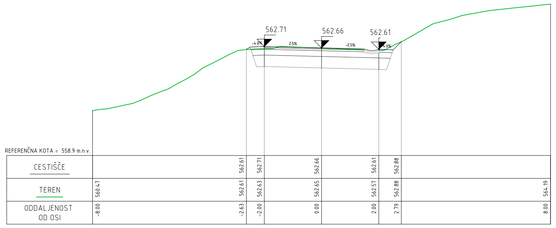


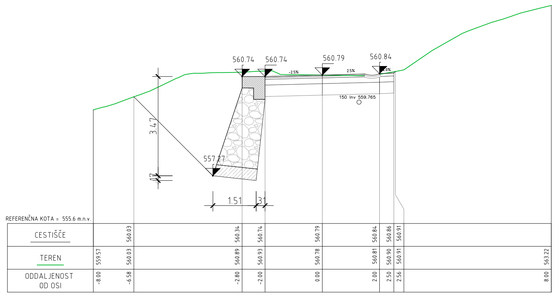












Self
077-24_Cesta Anžič,Plnačni profili.dwg

0.000 x 0.446 x 0.401 m2

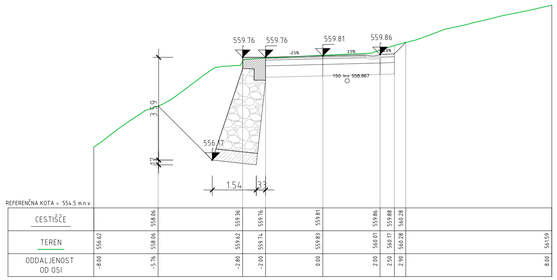
Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

32 PREČNI PREREZI

merilo: 1 : 100

	MESTNA OBČINA SLOVENJ GRADEC Šolska ulica 5, 2380 Slovenj Gradec
	AC&P inženirski biro d.o.o. podjetje za geotehniko, infrastrukturo in raziskave tovarniška c. 26, 5270 ajdovščina T +386(0)5 8500740 I info@acap.si
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	SEIF GRITLI
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina risbe:	32 PREČNI PREREZI Prečni profili P55 - P63

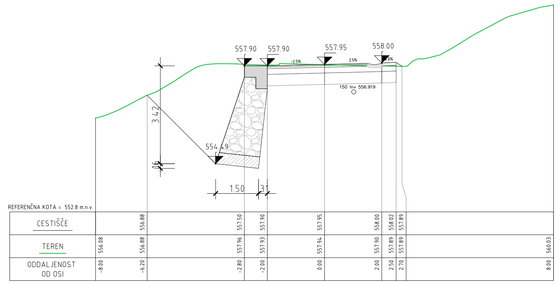
datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.132.7**



REFERENČNA KOTA = 554.5 m.n.v.										
CESTIŠČE										
TEREN	556.42	558.06	559.42	559.76	559.81	559.86	559.88	560.28		
ODDALJENOST OD OSI	-8.00	-5.76	-2.80	-2.00	0.00	2.00	2.50	3.56		8.00
	556.59	558.06	559.42	559.76	559.81	560.01	560.07	560.28		564.59

STACIONAŽA 1260.00 m

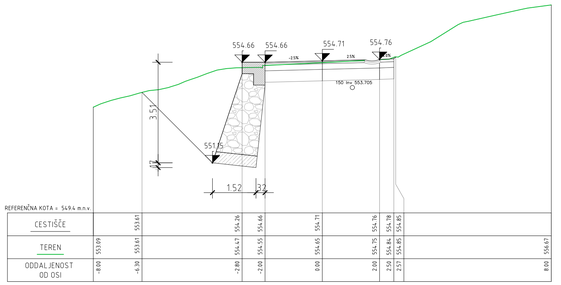
P64



REFERENČNA KOTA = 552.8 m.n.v.										
CESTIŠČE										
TEREN	556.08	556.88	557.26	557.50	557.90	557.95	558.00	558.02	557.89	
ODDALJENOST OD OSI	-8.00	-4.29	-2.80	-2.00	0.00	2.00	2.50	2.70		8.00
	556.08	556.88	557.26	557.50	557.90	557.95	558.00	558.02	557.89	566.83

STACIONAŽA 1320.00 m

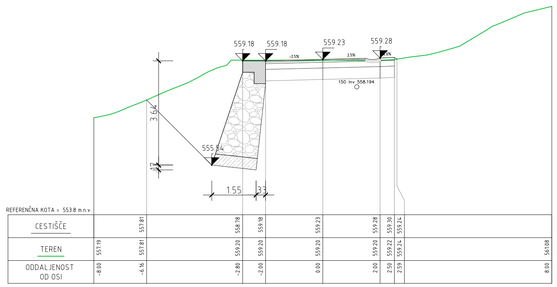
P67



REFERENČNA KOTA = 549.4 m.n.v.										
CESTIŠČE										
TEREN	553.09	553.61	554.26	554.46	554.66	554.71	554.76	554.78	554.85	
ODDALJENOST OD OSI	-8.00	-4.30	-2.80	-2.00	0.00	2.00	2.50	2.70		8.00
	553.09	553.61	554.26	554.46	554.66	554.71	554.76	554.78	554.85	564.67

STACIONAŽA 1380.00 m

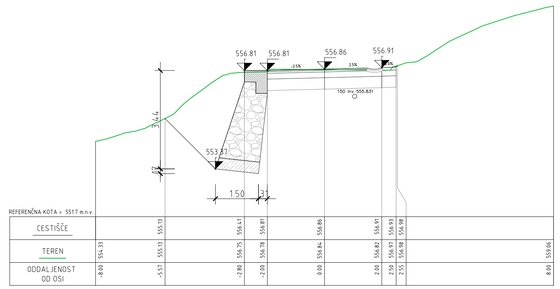
P70



REFERENČNA KOTA = 553.8 m.n.v.										
CESTIŠČE										
TEREN	557.79	557.81	558.78	559.18	559.23	559.28	559.30	559.24		
ODDALJENOST OD OSI	-8.00	-6.16	-2.80	-2.00	0.00	2.00	2.50	2.76		8.00
	557.79	557.81	559.00	559.20	559.23	559.28	559.30	559.24		564.68

STACIONAŽA 1280.00 m

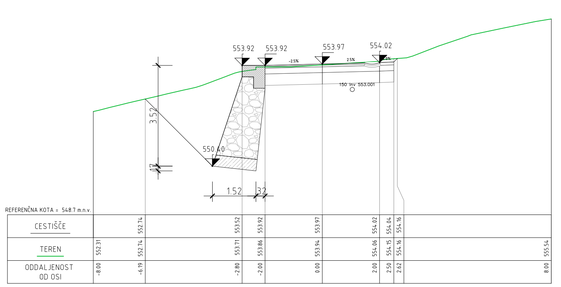
P65



REFERENČNA KOTA = 551.7 m.n.v.										
CESTIŠČE										
TEREN	554.33	555.13	556.75	556.41	556.81	556.86	556.91	556.93	556.98	
ODDALJENOST OD OSI	-8.00	-5.51	-2.80	-2.00	0.00	2.00	2.50	2.70		8.00
	554.33	555.13	556.75	556.41	556.78	556.86	556.91	556.93	556.98	565.96

STACIONAŽA 1340.00 m

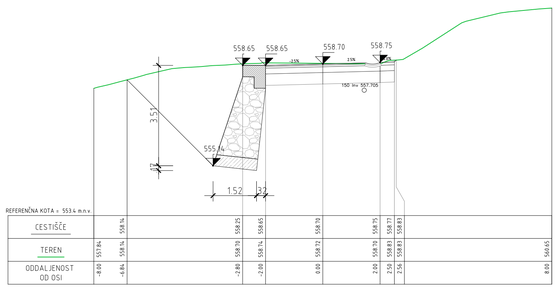
P68



REFERENČNA KOTA = 548.7 m.n.v.										
CESTIŠČE										
TEREN	552.31	552.74	553.17	553.52	553.92	553.97	554.02	554.04	553.94	
ODDALJENOST OD OSI	-8.00	-4.70	-2.80	-2.00	0.00	2.00	2.50	2.72		8.00
	552.31	552.74	553.17	553.52	553.92	553.97	554.02	554.04	553.94	563.54

STACIONAŽA 1400.00 m

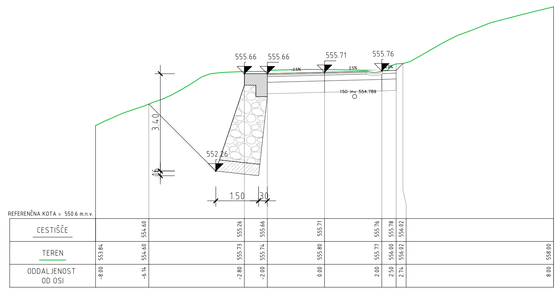
P71



REFERENČNA KOTA = 553.4 m.n.v.										
CESTIŠČE										
TEREN	557.84	558.16	558.25	558.65	558.70	558.75	558.77	558.83		
ODDALJENOST OD OSI	-8.00	-6.86	-2.80	-2.00	0.00	2.00	2.50	2.56		8.00
	557.84	558.16	558.78	558.74	558.72	558.70	558.75	558.83		566.65

STACIONAŽA 1300.00 m

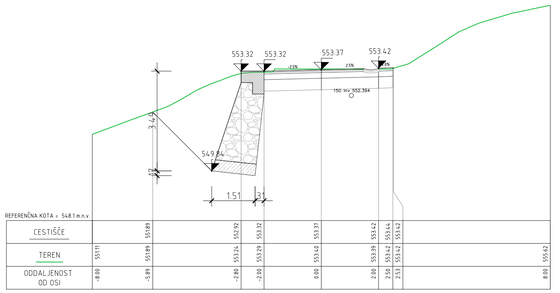
P66



REFERENČNA KOTA = 550.6 m.n.v.										
CESTIŠČE										
TEREN	553.84	554.60	555.26	555.66	555.71	555.76	555.78	556.42		
ODDALJENOST OD OSI	-8.00	-6.16	-2.80	-2.00	0.00	2.00	2.50	2.74		8.00
	553.84	554.60	555.73	555.74	555.80	555.71	555.77	556.42		566.00

STACIONAŽA 1360.00 m

P69



REFERENČNA KOTA = 548.1 m.n.v.										
CESTIŠČE										
TEREN	551.11	551.89	552.52	553.12	553.37	553.42	553.44	553.42		
ODDALJENOST OD OSI	-8.00	-5.89	-2.80	-2.00	0.00	2.00	2.50	2.53		8.00
	551.11	551.89	552.26	553.29	553.40	553.39	553.42	553.42		559.62

STACIONAŽA 1420.00 m

P72

Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

32 PREČNI PREREZI

merilo: 1 : 100

MESTNA OBČINA SLOVENJ GRADEC
Šolska ulica 5, 2380 Slovenj Gradec

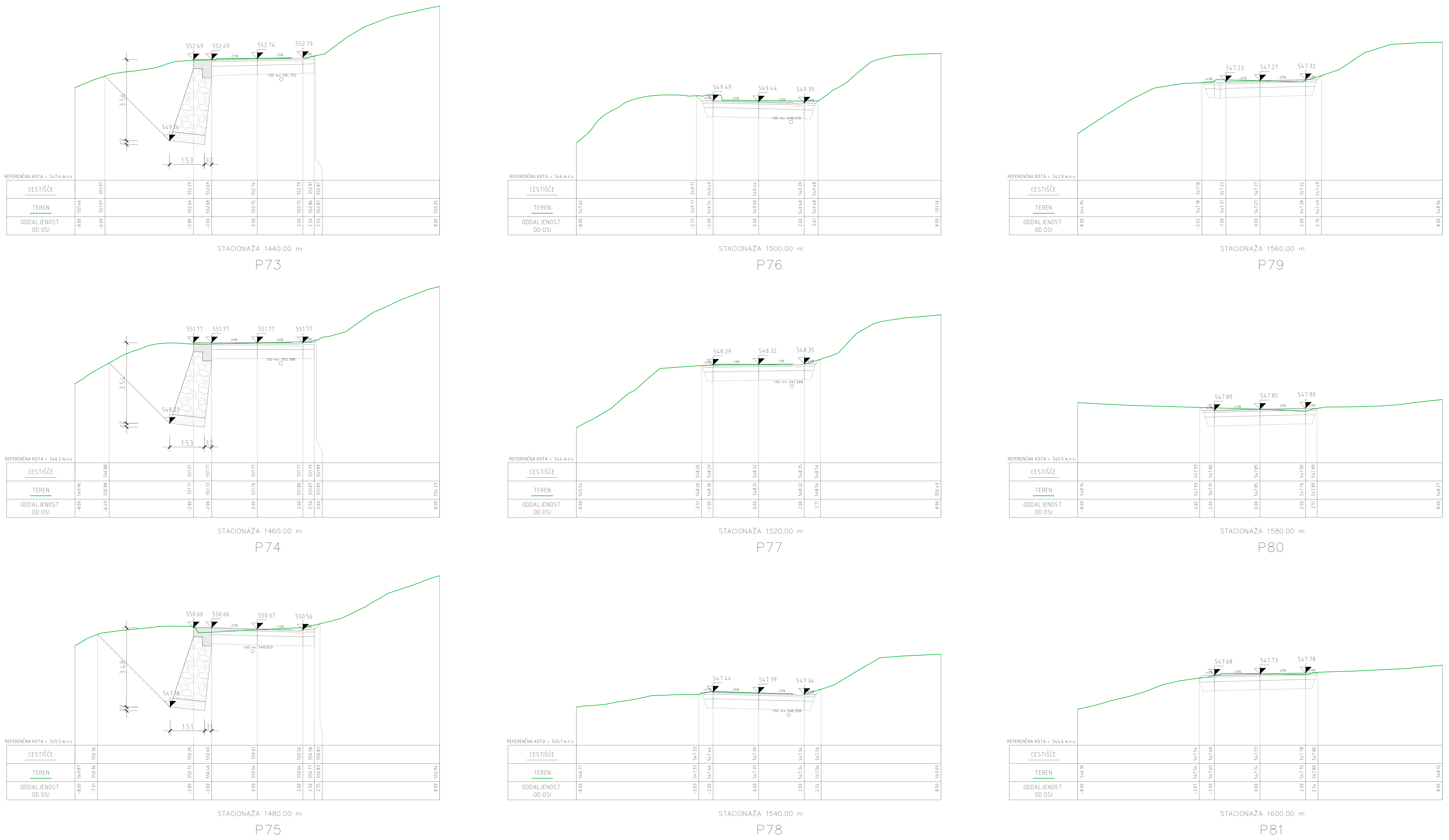
AC&P inženirski biro d.o.o.
podjetje za geotehniko, infrastrukturo in raziskave
tovarniška c. 26, 5270 ajdovščina | t +386(0)5 8500740 | info@acap.si

vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	SEIF GRITLI .
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina risbe:	32 PREČNI PREREZI Prečni profili P64 - P72

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.132.8**

Seif
077-24_Cesta Anžič Prečni profili.dwg

0.000 x 0.446 x 0.401 m2



Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

32 PREČNI PREREZI

merilo: 1 : 100

MESTNA OBČINA SLOVENJ GRADEC
Šolska ulica 5, 2380 Slovenj Gradec

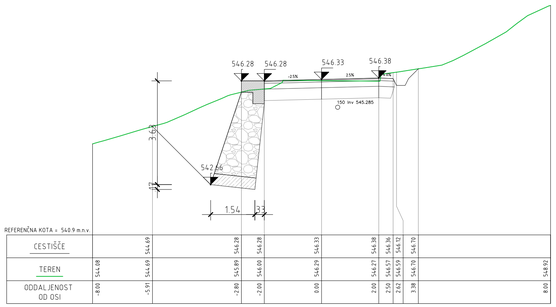
AC&P inženirski biro d.o.o.
podjetje za geotehniko, infrastrukturo in raziskave
tovarniška c. 26, 5270 ajdovščina | +386(0)5 8500740 | info@acap.si

vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	SEIF GRITLI	.
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt ceste	
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina risbe:	32 PREČNI PREREZI Prečni profili P73 - P81	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.132.9**

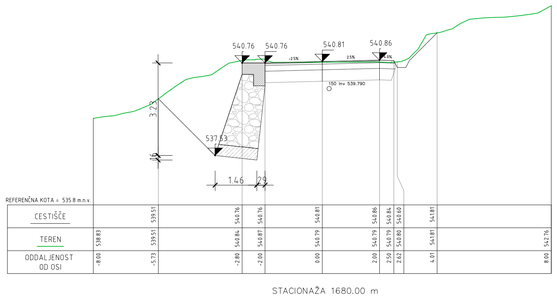
Seif
077-24_Cesta Anžič [Prečni profili].dwg

0.900 x 0.446 = 0.401 m2



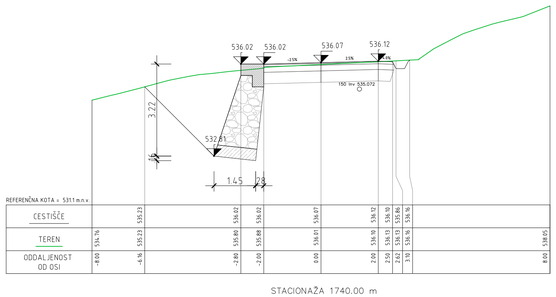
STACIONAŽA 1620.00 m

P82



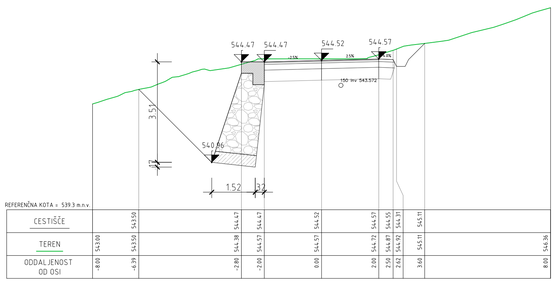
STACIONAŽA 1680.00 m

P85



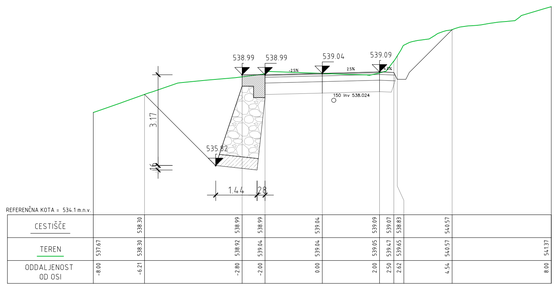
STACIONAŽA 1740.00 m

P88



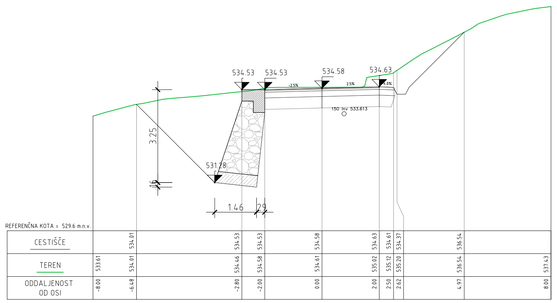
STACIONAŽA 1640.00 m

P83



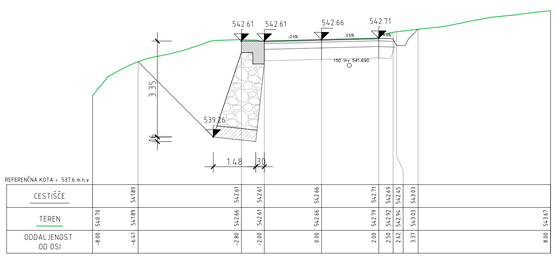
STACIONAŽA 1700.00 m

P86



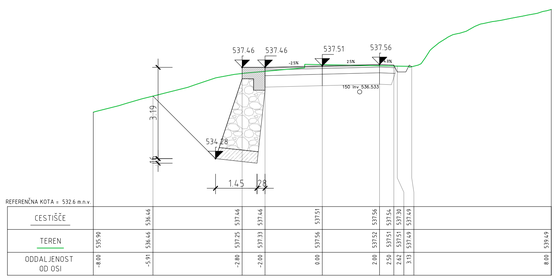
STACIONAŽA 1760.00 m

P89



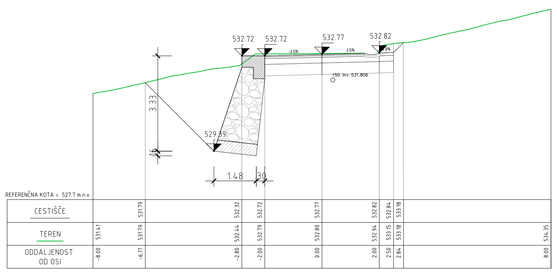
STACIONAŽA 1660.00 m

P84



STACIONAŽA 1720.00 m

P87



STACIONAŽA 1780.00 m

P90

Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

32 PREČNI PREREZI

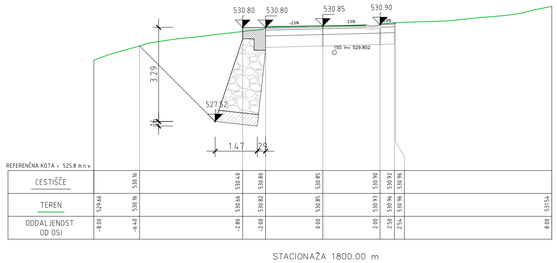
merilo: 1 : 100

	MESTNA OBČINA SLOVENJ GRADEC Šolska ulica 5, 2380 Slovenj Gradec	AC&P inženirski biro d.o.o. podjetje za geotehniko, infrastrukturo in raziskave tovarniška c. 26, 5270 ajdovščina T +386(0)5 8500740 E info@acap.si
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	SEIF GRITLI	.
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt ceste	
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina risbe:	32 PREČNI PREREZI Prečni profili P82 - P90	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.132.10**

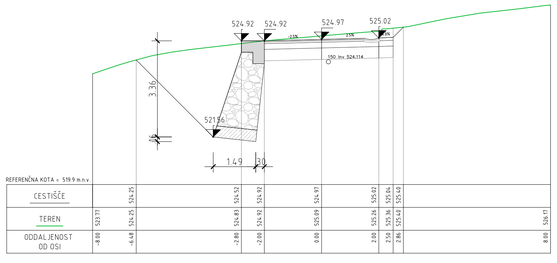
Seif
077-24_Cesta Anžič Prečni profili.dwg

0.000 x 0.446 x 0.401 m2



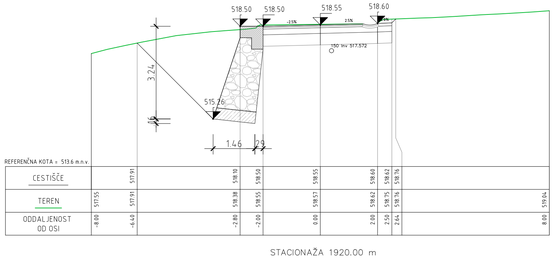
STACIONAŽA 1800.00 m

P91



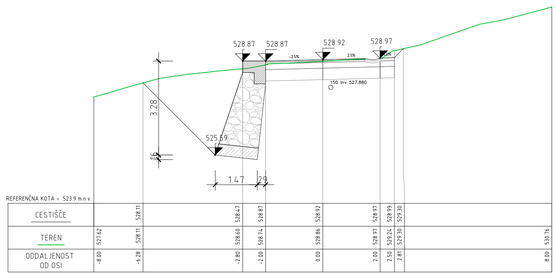
STACIONAŽA 1860.00 m

P94



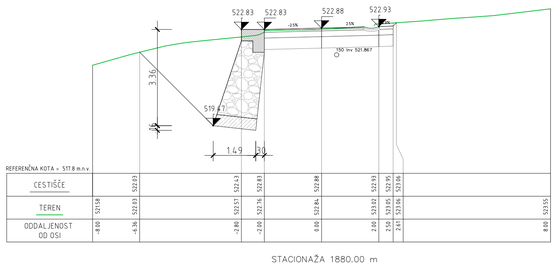
STACIONAŽA 1920.00 m

P97



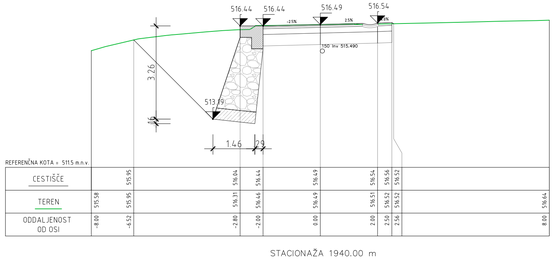
STACIONAŽA 1820.00 m

P92



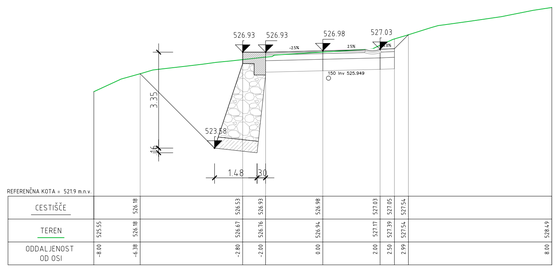
STACIONAŽA 1880.00 m

P95



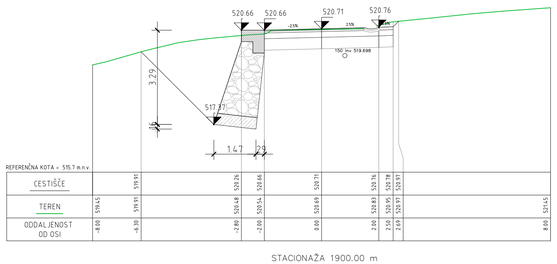
STACIONAŽA 1940.00 m

P98



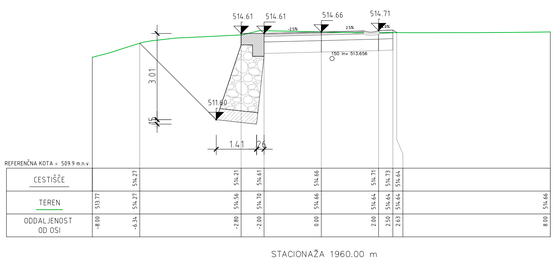
STACIONAŽA 1840.00 m

P93



STACIONAŽA 1900.00 m

P96



STACIONAŽA 1960.00 m

P99

Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

32 PREČNI PREREZI

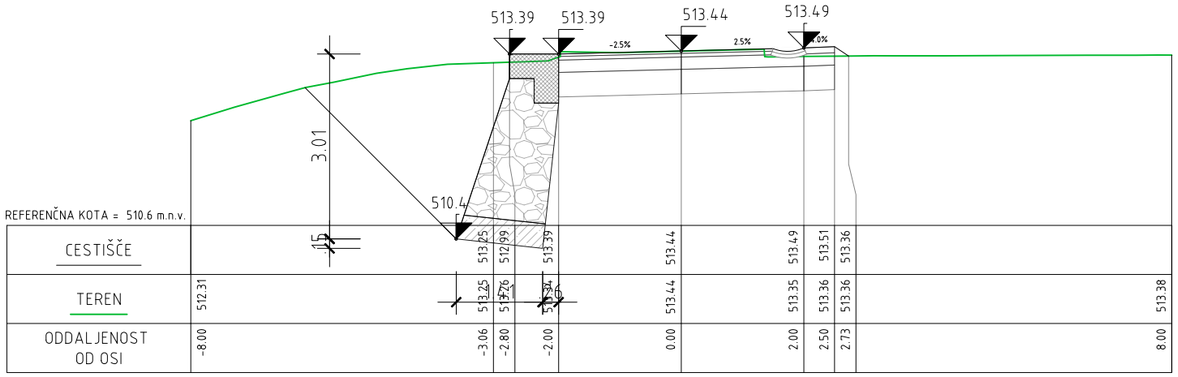
merilo: 1 : 100

MESTNA OBČINA SLOVENJ GRADEC Šolska ulica 5, 2380 Slovenj Gradec	AC&P inženirski biro d.o.o. podjetje za geotehniko, infrastrukturo in raziskave tovarniška c. 26, 5270 ajdovščina T +386(0)5 8500740 I info@acap.si
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	SEIF GRITLI
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina risbe:	32 PREČNI PREREZI Prečni profili P91 - P99

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.132.11**

Seif
077-24_Cesta Anžič Prečni profili.dwg
0.000 x 0.446 x 0.401 m2

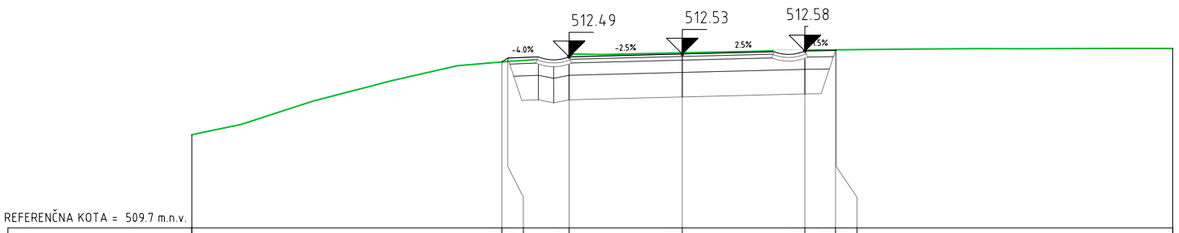
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077-24_Cesta Anžič [Prečni profili].dwg



REFERENČNA KOTA = 510.6 m.n.v.

CESTIŠČE		513.25	512.99	513.39	513.44	513.49	513.51	513.36
TEREN	512.31	513.25	513.76	513.24	513.44	513.35	513.36	513.36	513.38
ODDALJENOST OD OSI	-8.00	-3.06	-2.80	-2.00	0.00	2.00	2.50	2.73	8.00

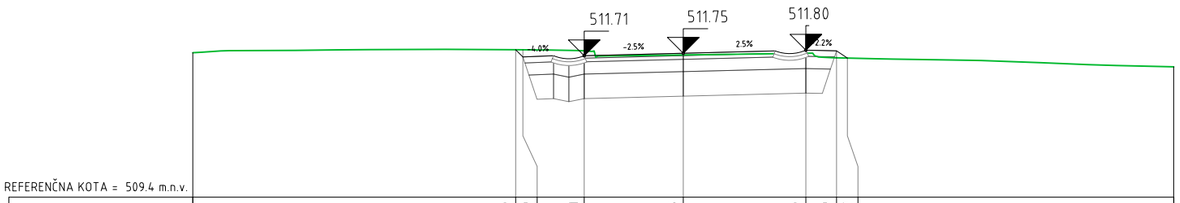
P100 STACIONAŽA 1980.00 m



REFERENČNA KOTA = 509.7 m.n.v.

CESTIŠČE		512.40	512.47	512.49	512.53	512.58	512.59	512.60
TEREN	511.22	512.40	512.41	512.50	512.55	512.60	512.60	512.60	512.62
ODDALJENOST OD OSI	-8.00	-2.94	-2.85	-1.85	0.00	2.00	2.50	2.51	8.00

P101 STACIONAŽA 2000.00 m



REFERENČNA KOTA = 509.4 m.n.v.

CESTIŠČE		511.80	511.69	511.71	511.75	511.80	511.79	511.67
TEREN	511.75	511.80	511.80	511.79	511.72	511.75	511.67	511.67	511.52
ODDALJENOST OD OSI	-8.00	-2.73	-2.62	-1.62	0.00	2.00	2.50	2.68	8.00

P102 STACIONAŽA 2020.00 m

Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

32 PREČNI PREREZI

merilo: 1 : 100

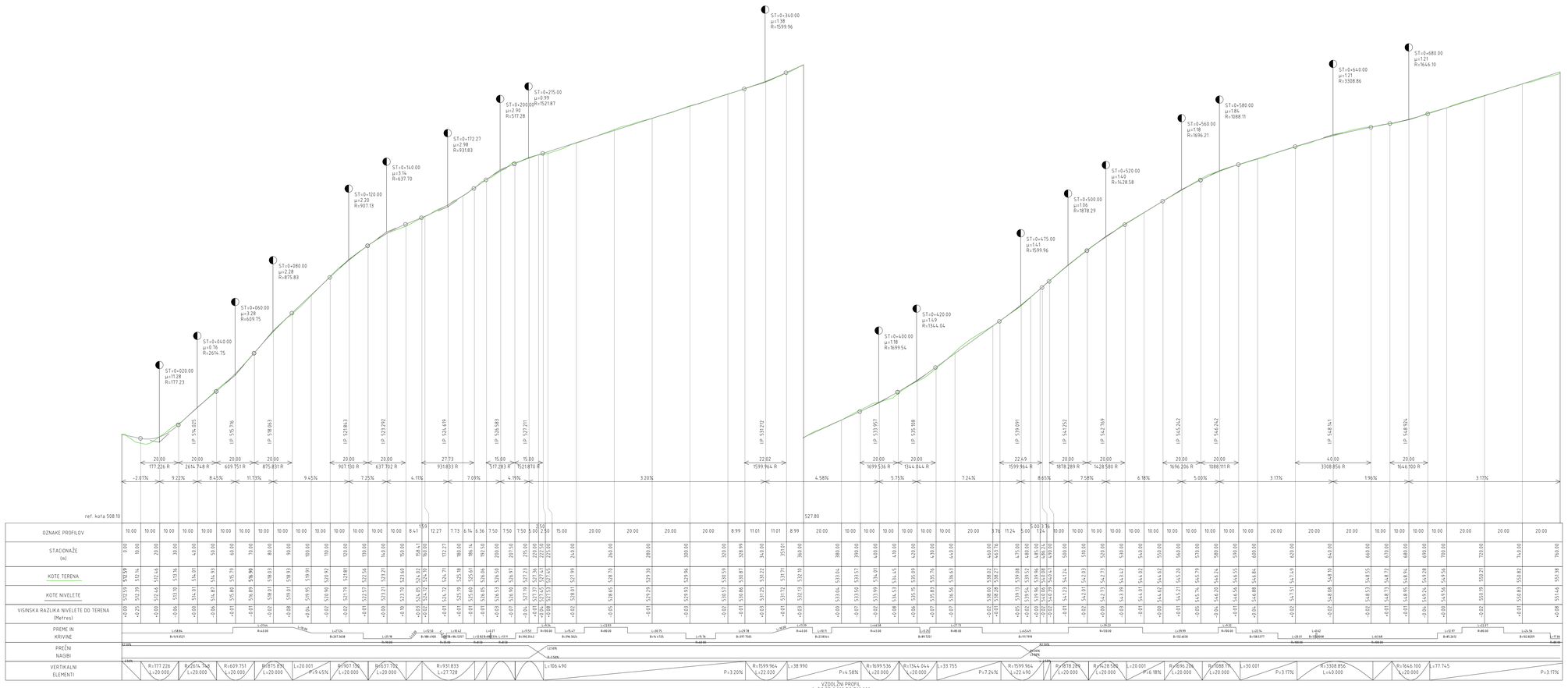
MESTNA OBČINA SLOVENJ GRADEC
Šolska ulica 5, 2380 Slovenj Gradec

AC&P inženirski biro d.o.o.
podjetje za geotehniko, infrastrukturo in raziskave
tovarniška c. 26, 5270 ajdovščina | +386(0)5 8500740 | info@acap.si

vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	SEIF GRITLI	.
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt ceste	
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina risbe:	32 PREČNI PREREZI Prečni profili P100 - P103	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.132.12**

0.420 x 0.297 = 0.125 m2



Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. august 2023

42 VZDOLŽNI PROFIL

merilo: 1 : 1000/100

MESTNA OBČINA SLOVENJ GRADEC
Šolska ulica 5, 2380 Slovenj Gradec

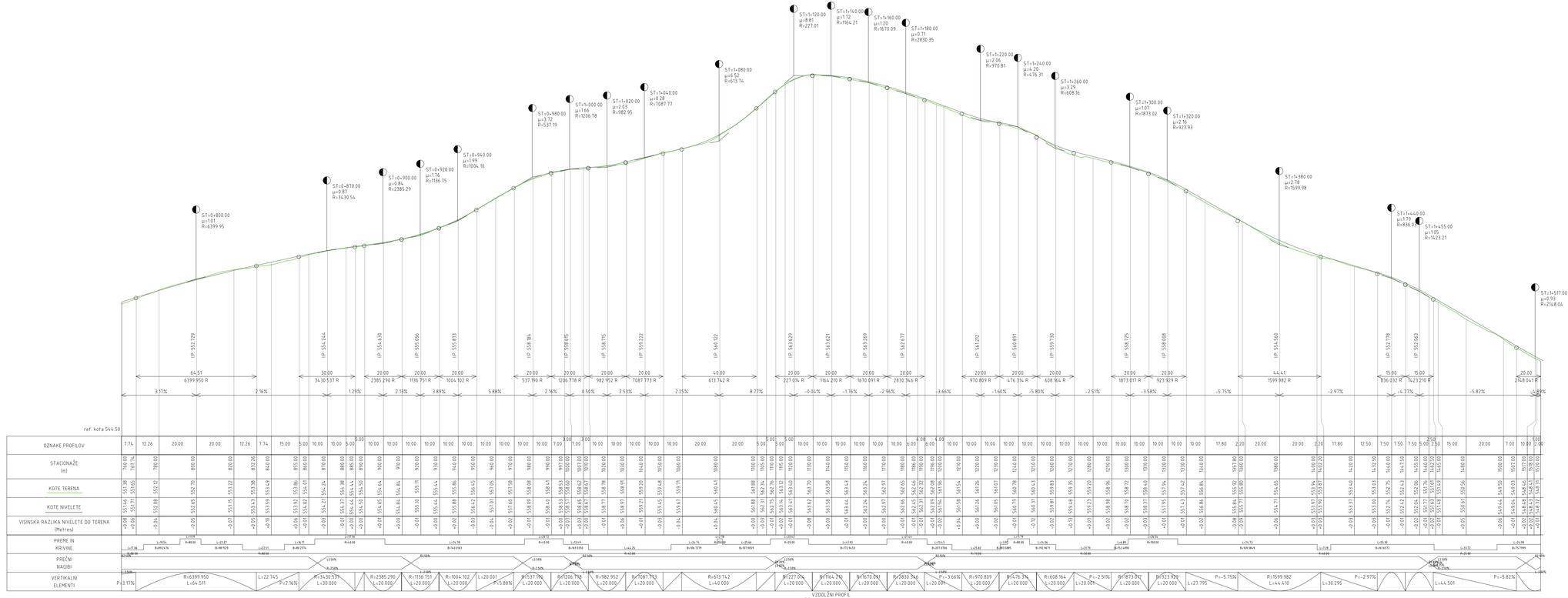
AC&P inženirski biro d.o.o.
podjetje za geotehniko, infrastrukturo in razvijanje
tovarniška c. 26, 5270 ajdovščina | +38653351500740 | info@acap.si

vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	SEIF GRITLI
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina nabe:	42 VZDOLŽNI PROFIL VP od km 0+000 do km 0+760

datum:	št. projekta:	št. načrta:	merilo:	št. nabe:
09. 2024	077-24	077-24-21	1 : 1000/100	**G.142.1**

Def
077-24_Cesta A4/5/7/20.dwg

1.000 x 0.446 = 0.4Ø1 m2



Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. august 2023

42 VZDOLŽNI PROFIL

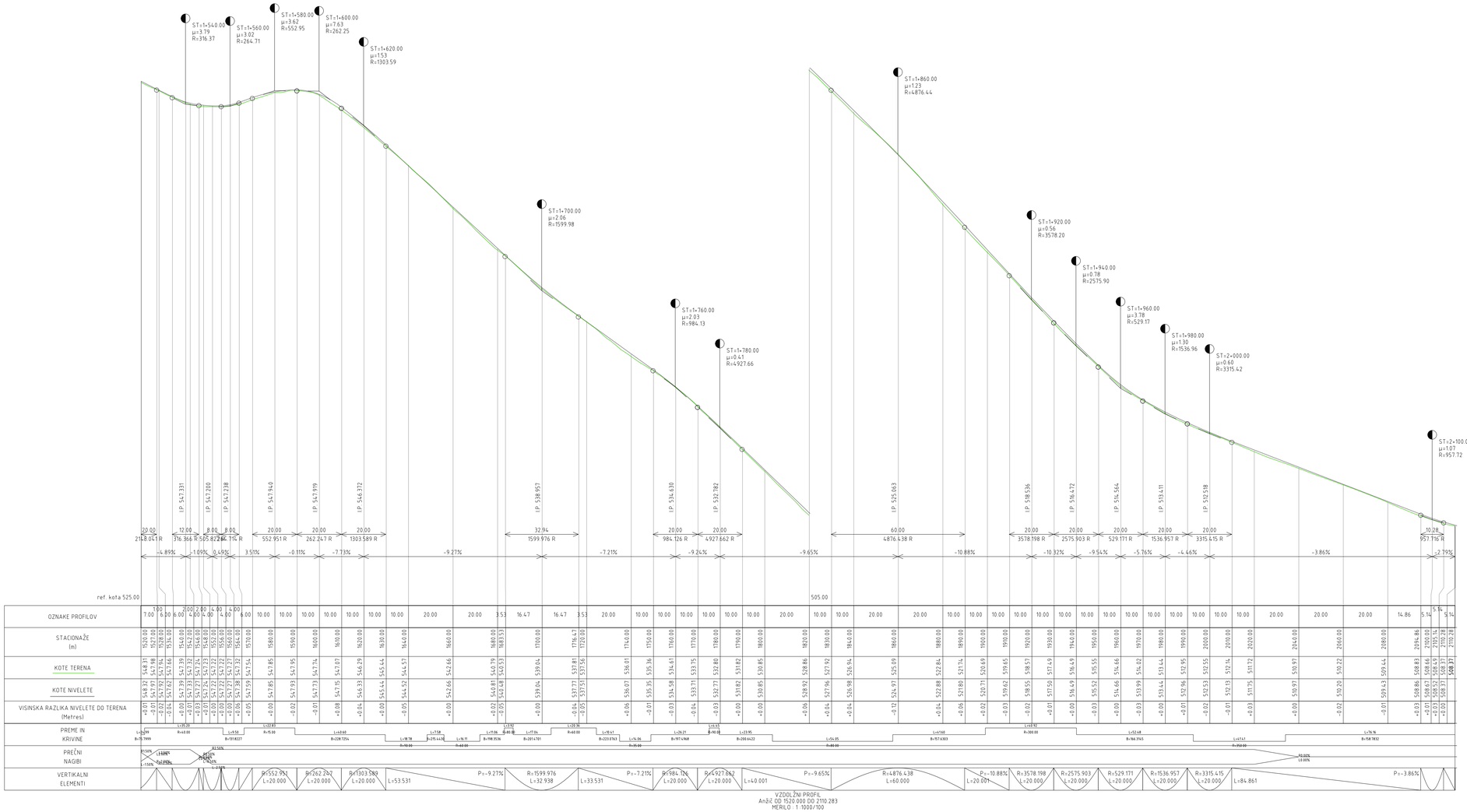
merilo: 1 : 1000/100

MESTNA OBČINA SLOVENJ GRADEC Šolska ulica 5, 2380 Slovenj Gradec	AC&P inženirski biro d.o.o. podjetje za geotehniko, infrastrukturo in razvoj tovarniška c. 26, 5270 ajdovščina | +38653551500740 | info@acap.si
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	SEIF GRITLI
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina nabe:	42 VZDOLŽNI PROFIL VP od km 0+760 do km 1+520

datum:	št. projekta:	št. načrta:	merilo:	št. nabe:
09. 2024	077-24	077-24-21	1 : 1000/100	G.142.2

Def
077-24_Ceste_Acad_17_07.dwg

1:1000 - A: 0.3711 - X: 8.8811 mZ



VZDOLŽNI PROFIL
Anžič OD 1520.000 DO 2110.283
MERILO : 1:1000/100

Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

42 VZDOLŽNI PROFIL

merilo: 1 : 1000/100

	MESTNA OBČINA SLOVENJ GRADEC Šolska ulica 5, 2380 Slovenj Gradec
	AC&P inženirski biro d.o.o. podjetje za geotehniko, infrastrukturo in raziskave tovarniška c. 26, 5270 ajdovščina T +386(0)5 8500740 I info@acap.si
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	SEIF GRITLI
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik – Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina risbe:	42 VZDOLŽNI PROFIL VP od km 1+520 do km 2+110

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09. 2024	077-24	077-24-21	1 : 1000/100	G.142.3

Seif
077-24_Cesta Anžič (VZD).dwg

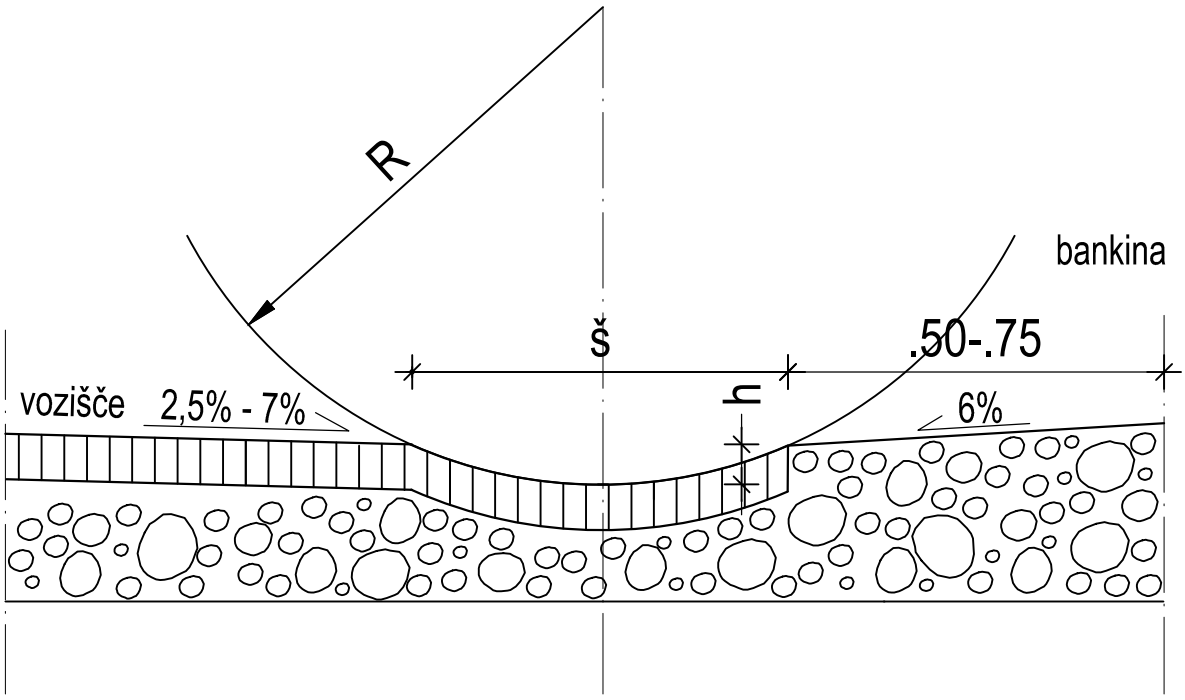
0.000 x 0.446 x 0.401 m2

A4: 210x297
A: 0.0625 m²

POVOZNA ASFALTNA MULDA

M 1:10

Š (cm)	h (cm)	R (cm)
50	5	62
60	6	75
70	7	87
80	8	100



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merilo: 1 : 50

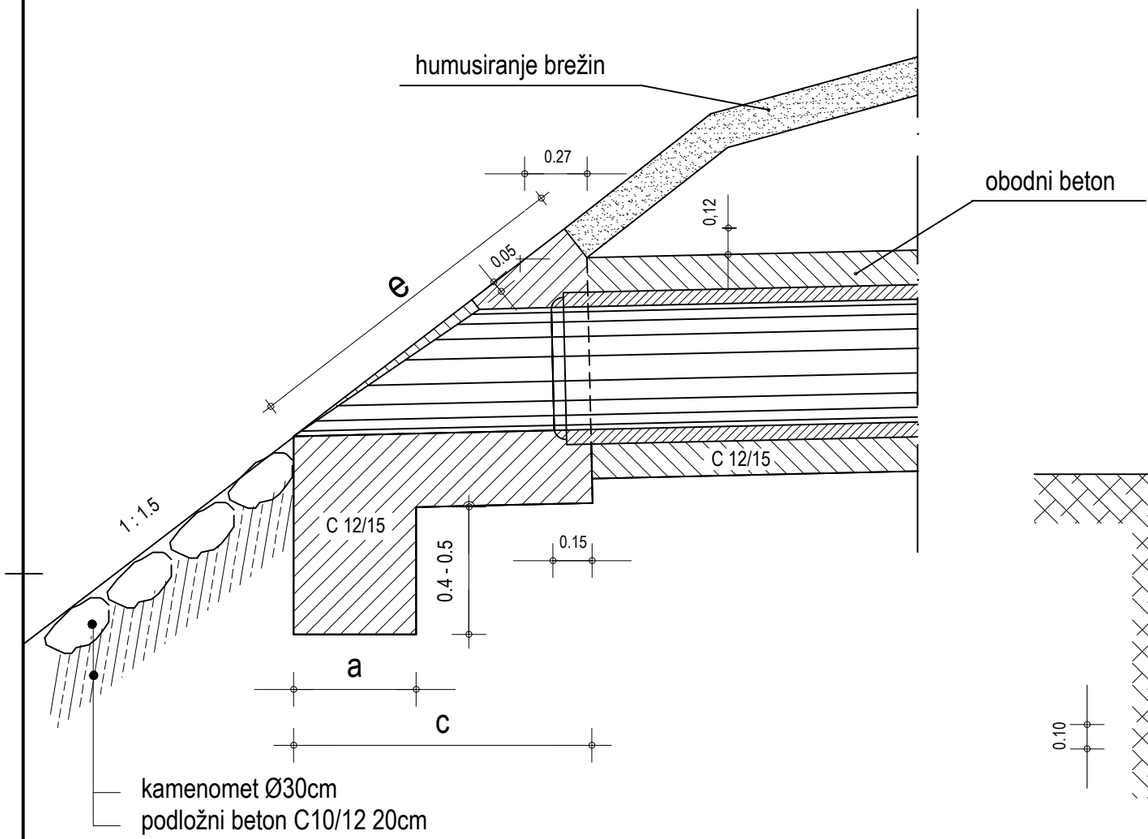
vsebina risbe: Detajl mulde

G.151.1

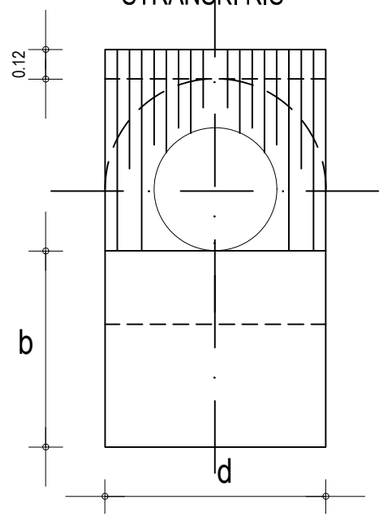
A3: 297x420
A: 0.125 m²

DETAJL IZTOČNE GLAVE IN PROPUSTA

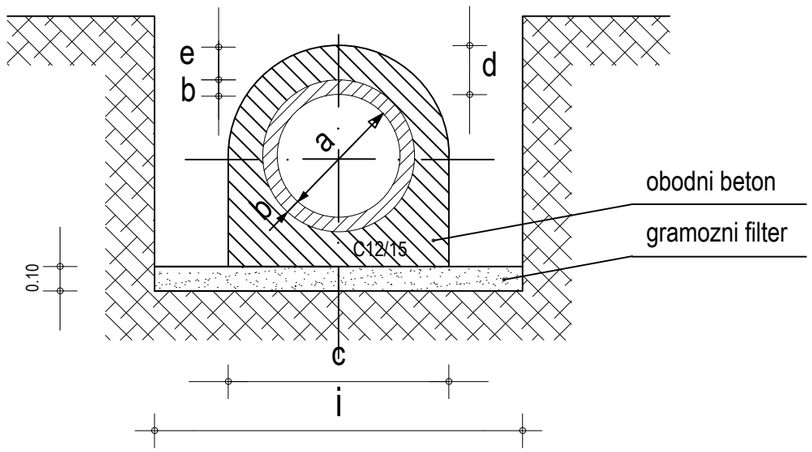
VZDOLŽNI PREREZ



STRANSKI RIS



PREREZ CEVI PROPUSTA



Faktorji za reduciranje horizontalnih dimenzij in poševne glave c, e in dolžin cevi od osi levo - desno

Nagib cevi %	faktor za c, e in dolžine cevi	
	iztočna glava	vtočna glava
1	1,01523	0,98522
2	1,03093	0,97087
3	1,04712	0,95694
4	1,06383	0,94340
5	1,08108	0,93023
6	1,09890	0,91743
7	1,11732	0,90498
8	1,13636	0,89286
9	1,15607	0,88106
10	1,17647	0,86957
11	1,19760	0,85837
12	1,21951	0,84746
13	1,24224	0,83682
14	1,26582	0,82647
15	1,29032	0,81633
16	1,31579	0,80645
17	1,34228	0,79681
18	1,36986	0,78740
19	1,39860	0,77821
20	1,42857	0,76923

TABELA PODATKOV ZA CEVNE PROPUSTE

OSNOVNE MERE							PREDIZMERE ZA 1 m cevi				
Profil cevi ∅	Teža 1 m cevi	Debelina cevi	širina propusta	Obodni beton in cev	Debelina obodnega betona	širina gažkopa na dnu	Obodni beton	Opaž z obeh	Zunanji obod	Zunanja površina	
										pripusta	cevi
cm	1/m	cm	m	cm	cm	m	m³/m	m²/m	m/m	m²	m²
a		b	c	d	e	i	B	O	Z	P	P
20	0,06	3,6	0,6	20	16,4	1,20	0,263	1,07	1,54	0,320	0,057
30	0,12	4,4	0,7	20	15,6	1,3	0,319	1,25	1,80	0,437	1,118
40	0,20	5,2	0,8	20	14,8	1,4	0,372	1,43	2,06	0,571	0,199
50	0,28	5,8	0,9	20	14,2	1,5	0,424	1,60	2,31	0,723	0,299
60	0,39	6,5	1,0	20	13,5	1,6	0,473	1,79	2,57	0,893	0,420
80	0,60	8,5	1,4	30	21,5	2,0	1,010	2,50	3,60	1,749	0.739
90	0,75	9,5	1,5	30	20,5	2,1	1.075	2,63	3,86	2,008	0,933
100	0,96	10,5	1,6	30	119,5	2,2	1,135	2,85	4,11	2,285	1,150

TABELA PODATKOV ZA POŠEVNE GLAVE PROPUSTOV

OSNOVNE MERE pri nagibu 0%									PREDIZMERE				
Profil cevi ∅	Temelj glave				Glava				Beton temelja	Beton glave	Omet vidnih površin	Ravni opaž	Okrogli opaž
	Peta temelja	Višina temelja	Dolžina temelja	širina temelja	Poševni na glave	Cevi d	Prerez cevi	Zunanji obod cevi					
cm	m	m	m	m	m	m	m²	m	m³	m³	m²	m²	m²
	a	b	c	d	e	t	E	O	T	G	O	R	P
20	0,5	0,8	0,87	0.60	0,94	0,40	0,058	0,85	0,12	0,26	0,52	0,62	0,37
30	0,5	0,8	1,02	0.70	1,12	0.50	0,118	1,22	0.14	0,37	0,73	0,93	0,63
40	0,5	0,8	1,17	0,80	1,30	0,60	0,199	1,58	0,16	0,50	0,98	1,30	0,94
50	0,5	0,8	1,32	0,90	1,48	0,70	0,299	1,93	0,18	0,66	1,26	1,72	1,29
60	0,5	0,8	1,47	1,00	1,67	0.80	0,420	2,29	0,20	0,84	1,59	2,21	1,72
80	0,5	0,8	1,92	1,40	2,20	1,10	0.739	3,04	0,28	1,73	2,98	4,03	2,96
90	0,5	0,8	2,07	1,50	2,38	1.20	0,933	3,42	0,30	2,05	3,46	4,75	3,59
100	0,5	0,8	2,22	1,60	2,57	1.30	1,150	3,80	0,32	2,40	3,98	5,60	4,26

AC&P inženirski biro, d.o.o.
tovarniška c. 26, 5270 ajdovščina

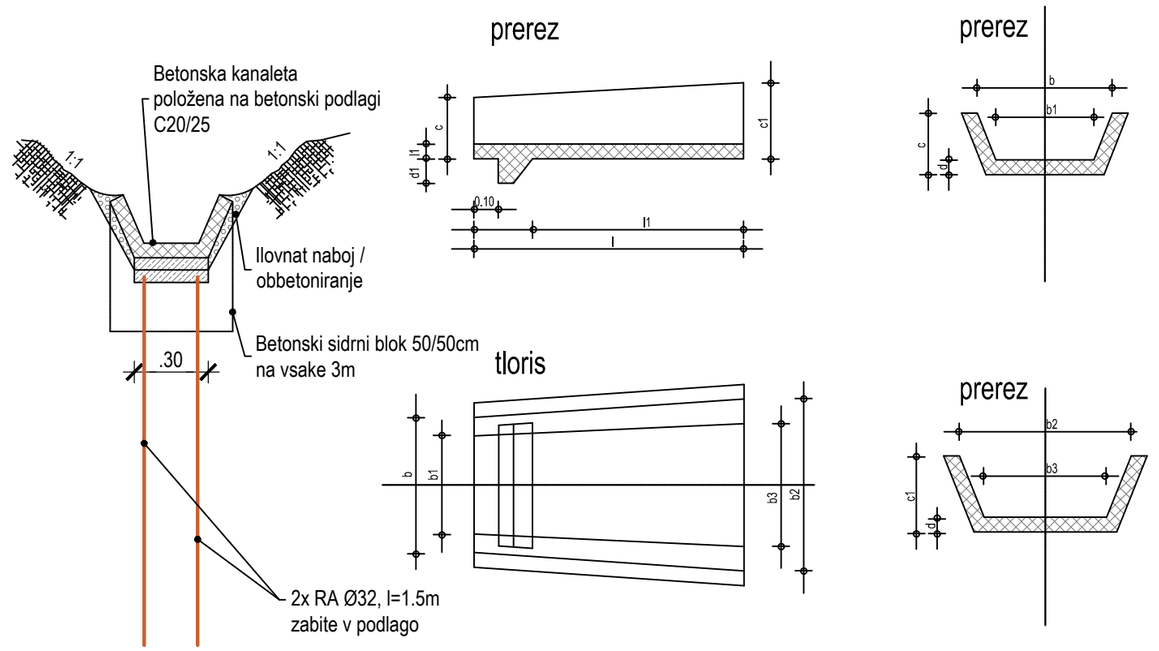
merilo: /

vsebina risbe: Detajl iztočne glave

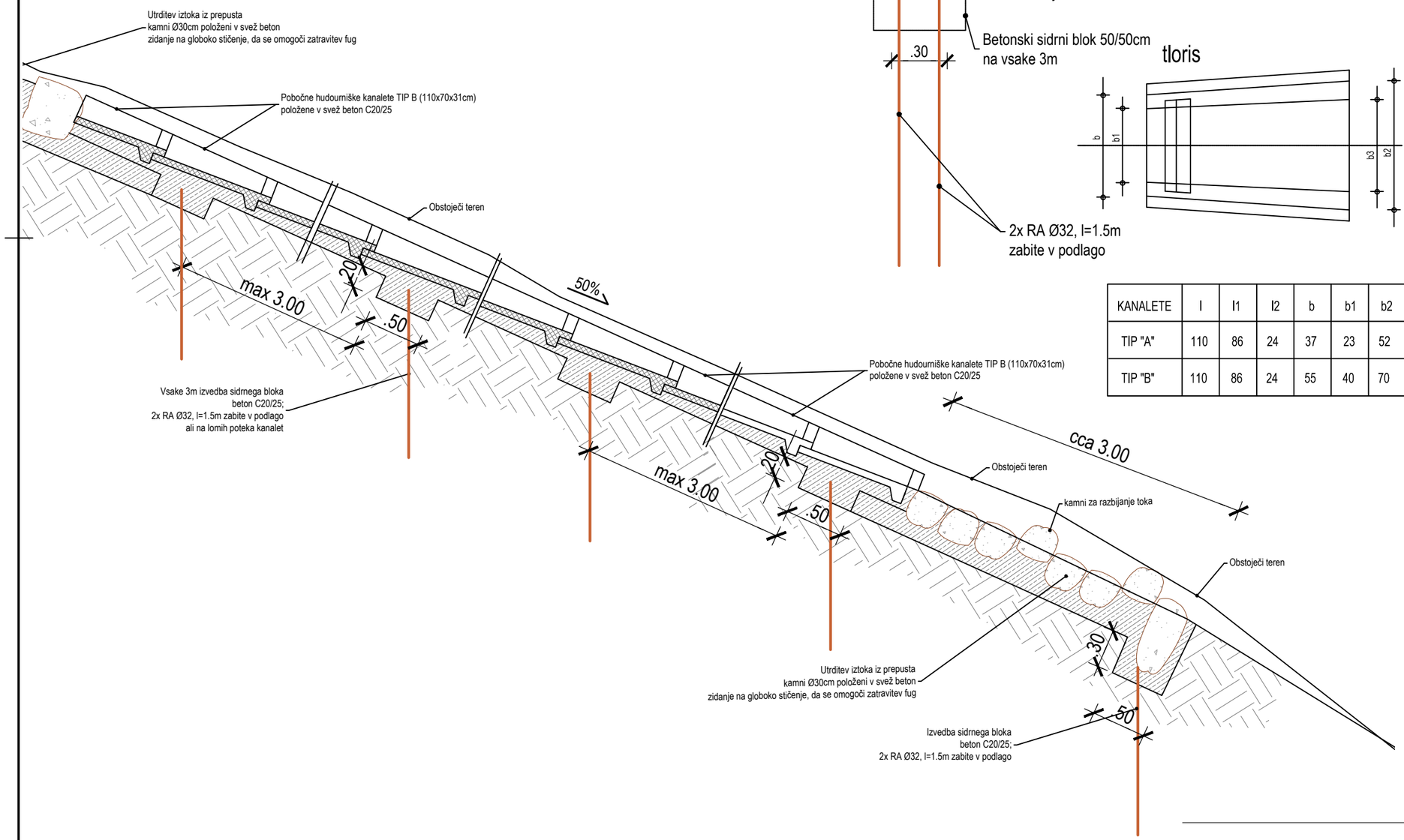
G.151.2

A3: 297x420
A: 0.125 m²

DETAJL KANALETE "A" IN "B"
M 1:25



KANALETE	l	l1	l2	b	b1	b2	b3	c	c1	d	d1	teža (kg)
TIP "A"	110	86	24	37	23	52	37	23	29	6	10	142
TIP "B"	110	86	24	55	40	70	50	25	31	6	10	173



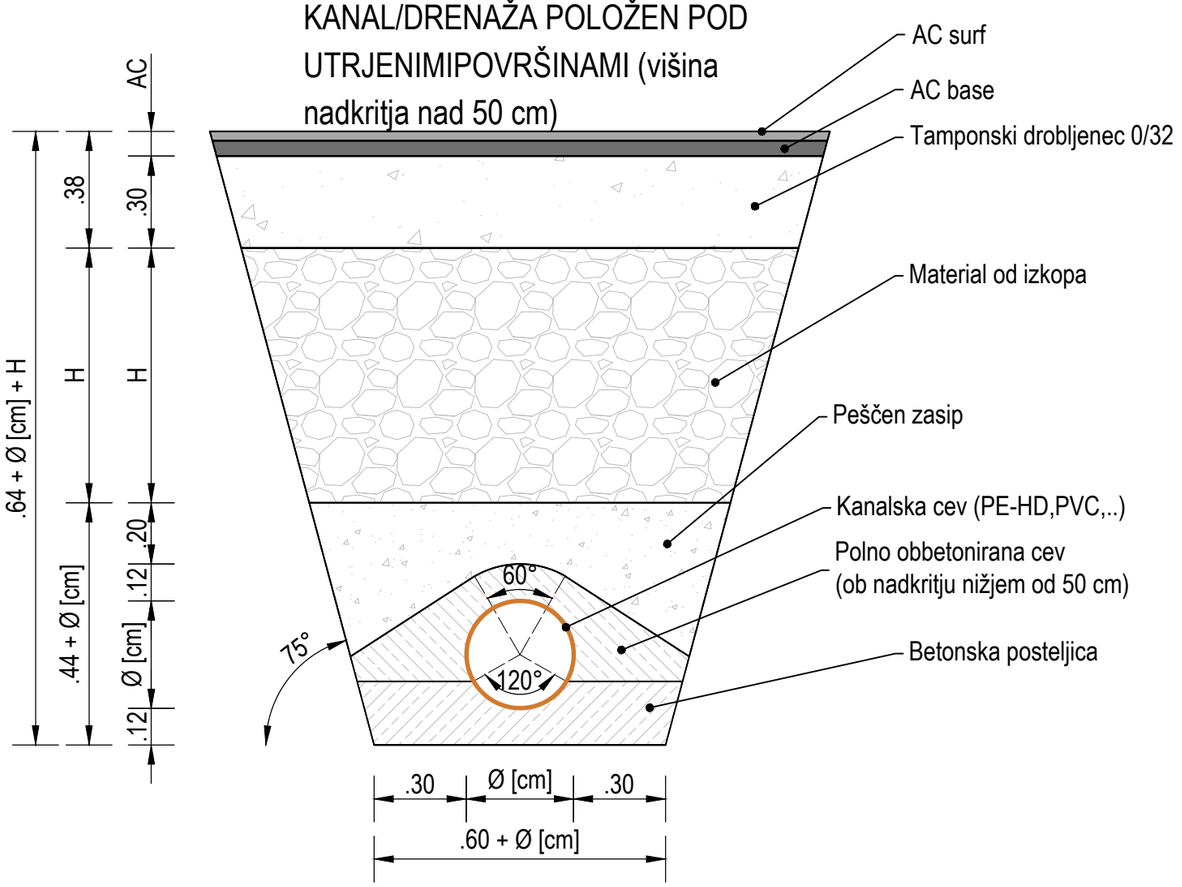
AC&P inženirski biro, d.o.o.
tovarniška c. 26, 5270 ajdovščina

merilo: 1 : 50

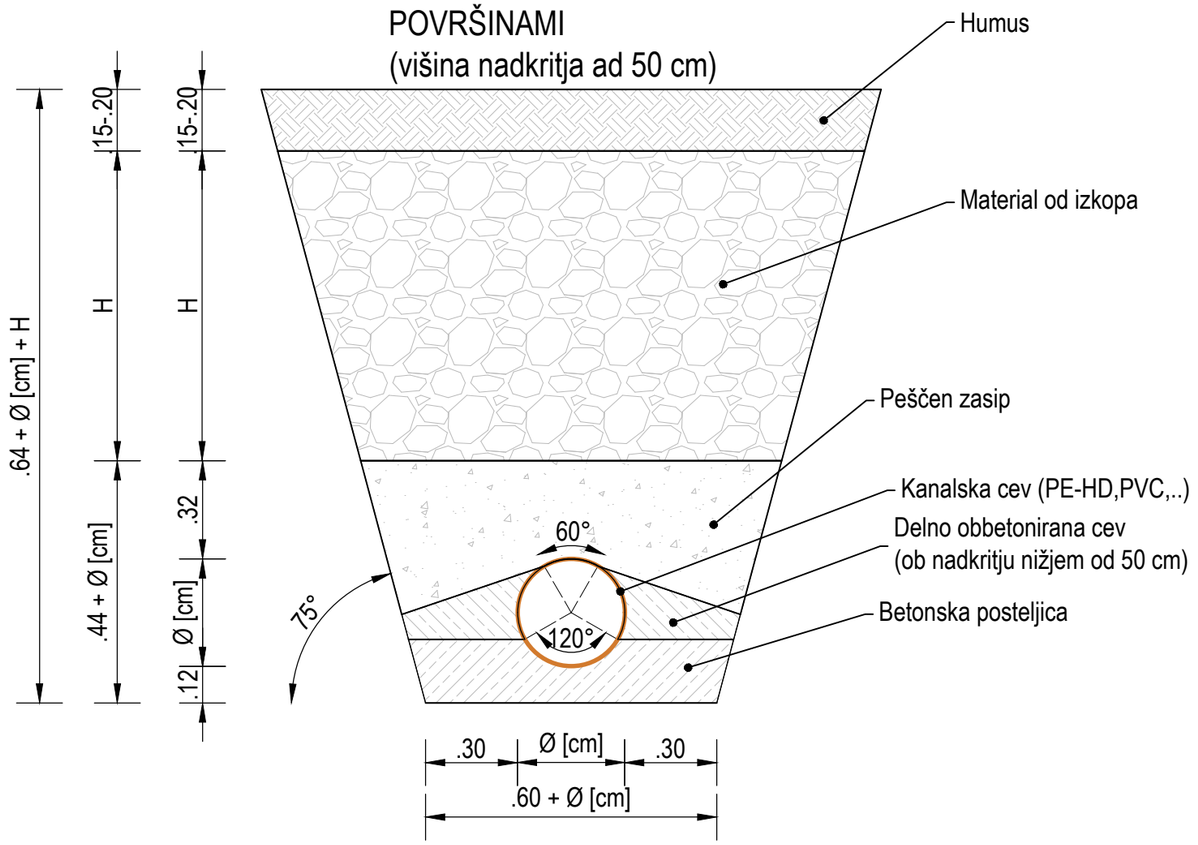
vsebina risbe: Detajl pobočne kanalete

G.151.3

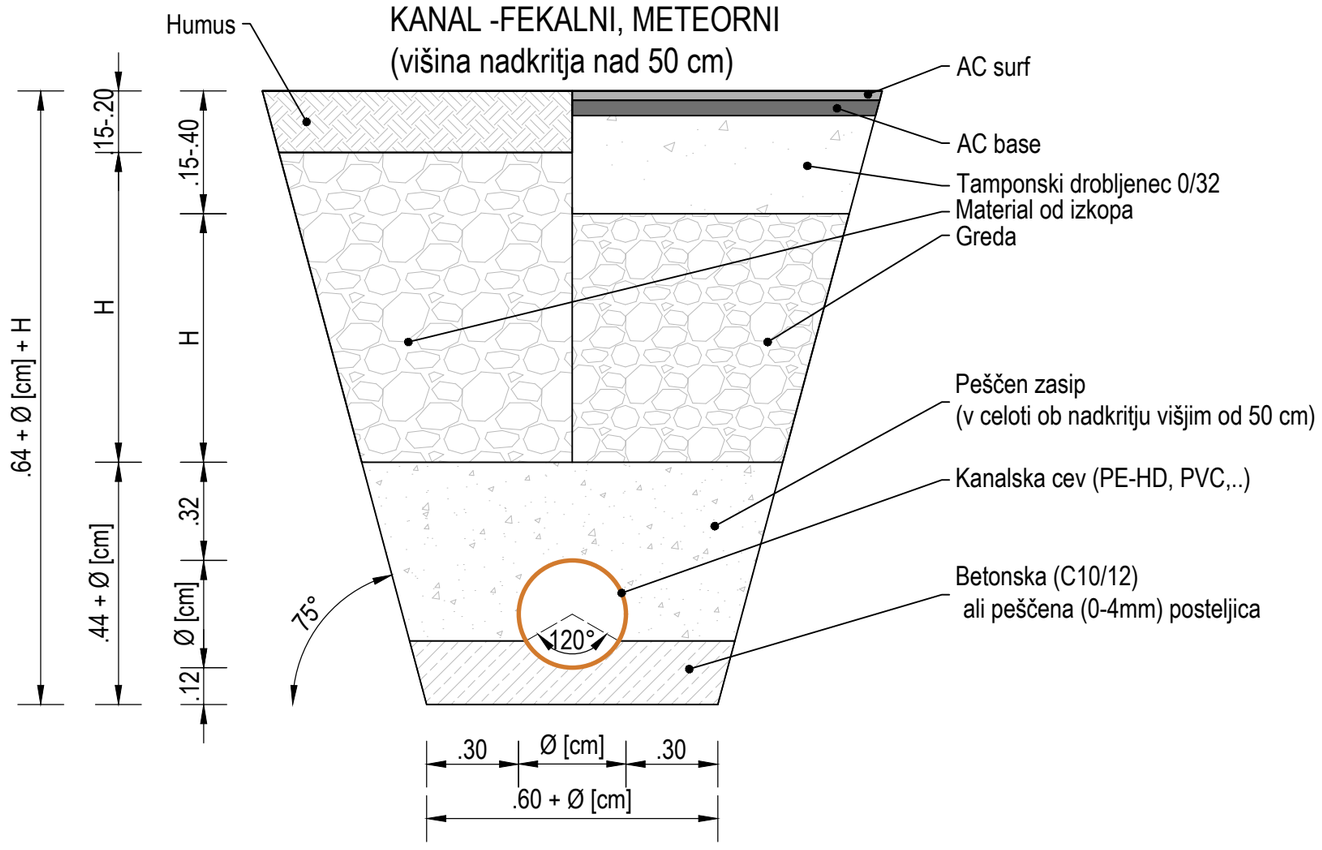
KANAL/DRENAŽA POLOŽEN POD UTRJENIMIPOVRŠINAMI (višina nadkritja nad 50 cm)



KANAL POLOŽEN POD ZELENIMI POVRŠINAMI (višina nadkritja ad 50 cm)



KANAL -FEKALNI, METEORNI (višina nadkritja nad 50 cm)



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tovarniška c. 26, 5270 ajdovščina

merilo: 1 : 50

vsebina risbe: Detajl polaganja kanalizacijskih cevi in drenaže

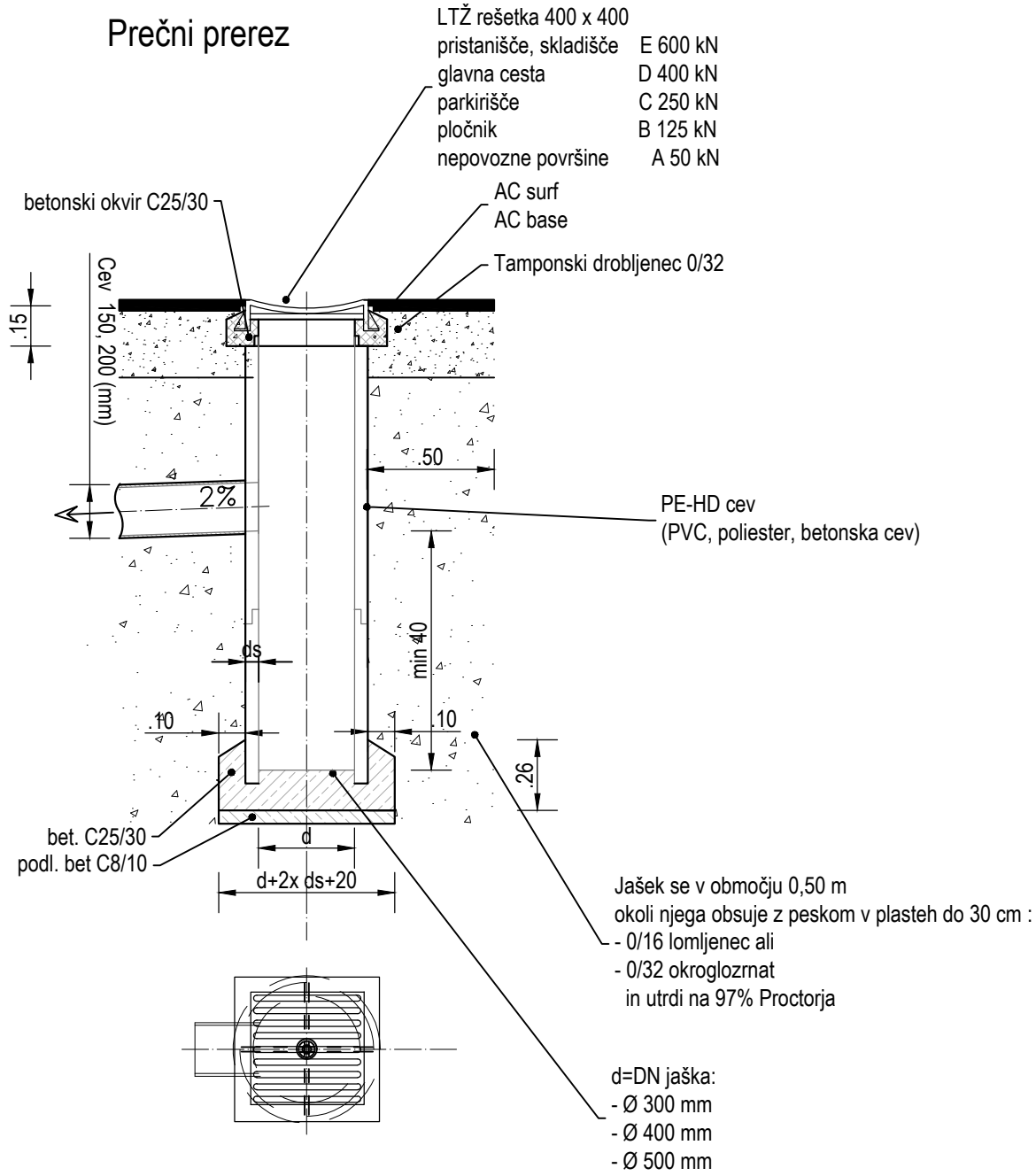
G.151.4

0,420 x 0,297 = 0,125 m2

A4: 210x297
A: 0.0625 m²

Cestni peskolov

Prečni prerez



AC&P inženirski biro, d.o.o.
tovarniška c. 26, 5270 ajdovščina

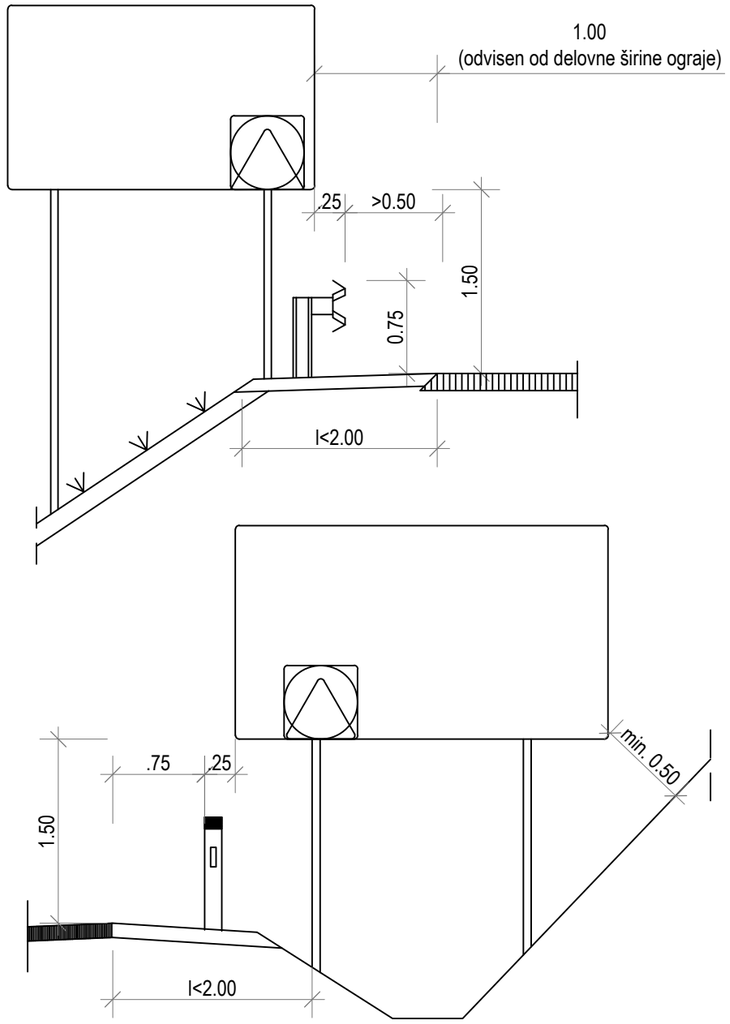
merilo: 1:25

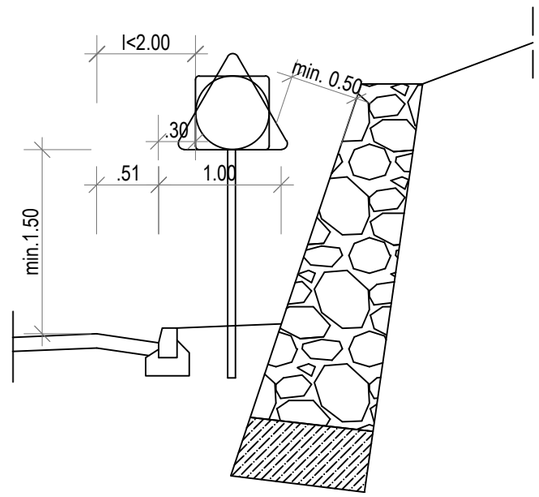
vsebina risbe: Detajl peskolova z vtočno rešetko

G.151.5

A3: 297x420
A: 0.125 m²

POSTAVITEV ZNAKOV V PREČNEM PROFILU CESTE





OPOMBA: na cestah brez smernikov in na cestah z bankino ožjo od 0,75 m se znaki postavljajo na razdalji 0,75 m od roba vozišča.

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tovarniška c. 26, 5270 ajdovščina

merilo: /

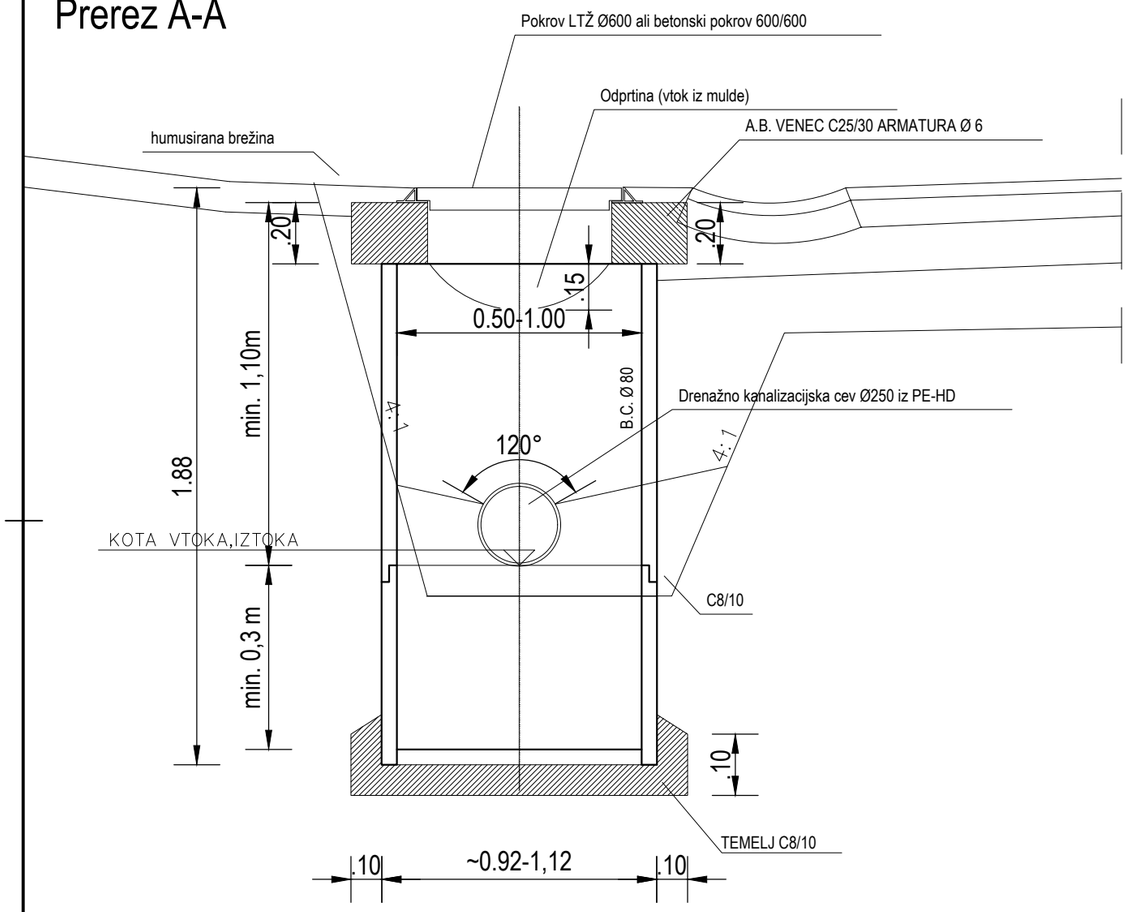
vsebina risbe: Detajl postavitve prometnih znakov

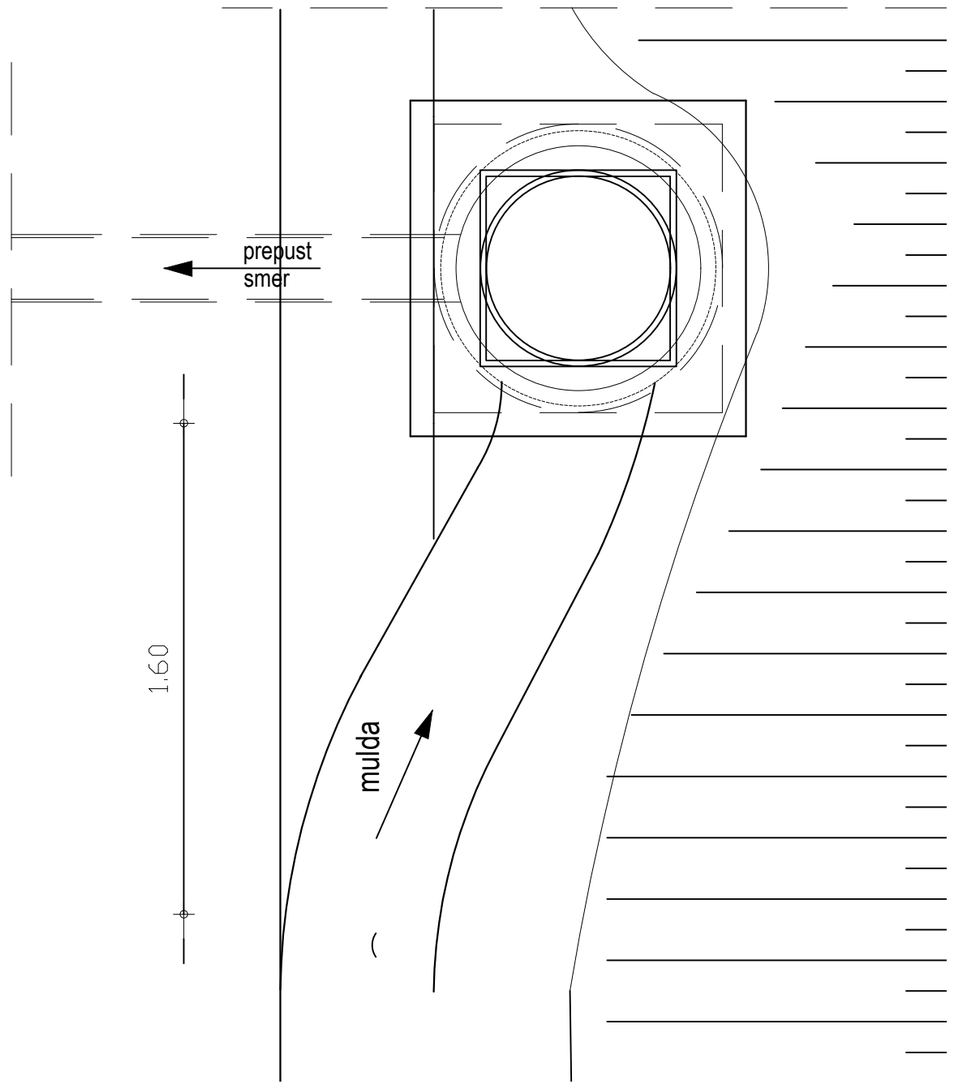
G.151.6

A3: 297x420
A: 0.125 m²

VTOČNI JAŠEK Ø 80-100 Z VTOKOM IZ MULDE

Prerez A-A





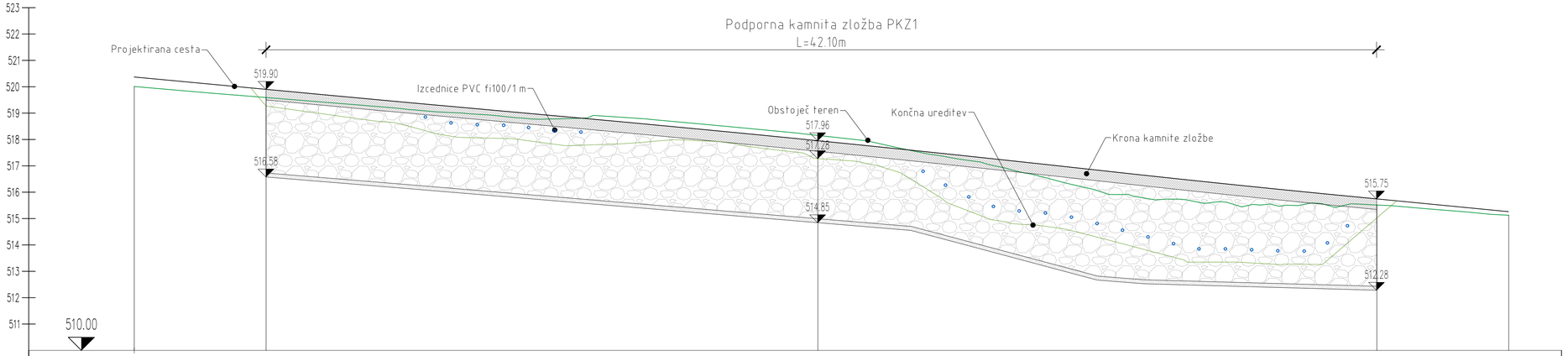
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tovarniška c. 26, 5270 ajdovščina

merilo: 1:20

vsebina risbe: Detajl priključka mulde na jašek

G.151.7

ACAP
OS_datoteki\2_konstrukcije.dwg



OZNAKE PROFILOV		5.00	P6*	20.93	P5*	21.20	P4*	5.00
STACIONAŽE			5.00		25.92		47.12	52.13
KOTE TERENA	520.01		519.59		518.15		515.51	515.12

PROFIL-1: PKZ1_A
MERILO 1:100/100

Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

40 VZDOLŽNI PREREZI
Vzdolžni prerez PKZ1

merilo: 1 : 100

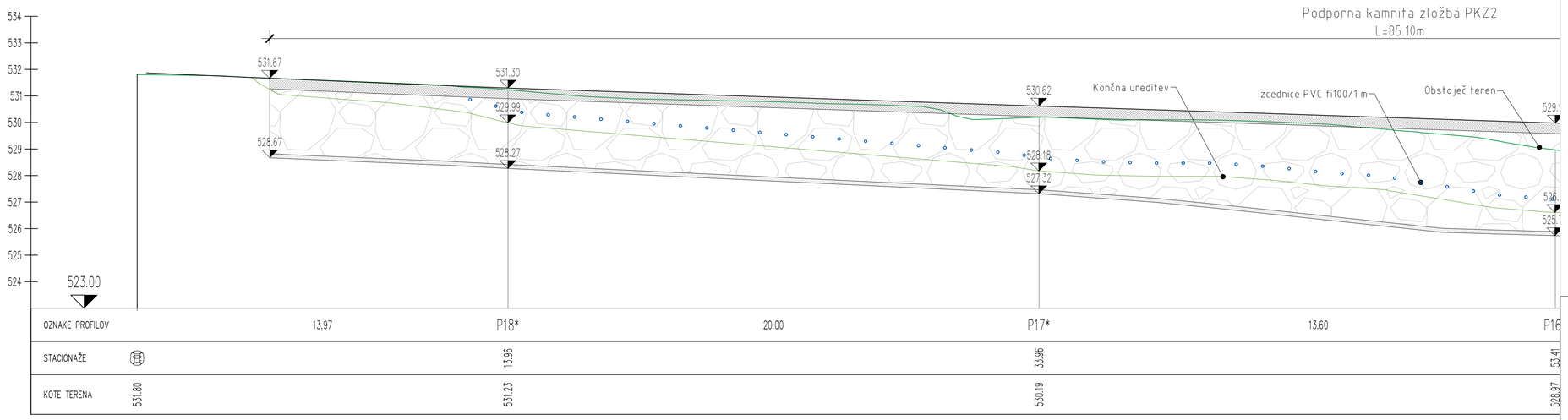
MESTNA OBČINA SLOVENJ GRADEC,
ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC

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podjetje za geotehniko, infrastrukturo in raziskave
tovarniška c. 26, 5270 ajdovščina | +386(0)5 8500740 | info@acap.si

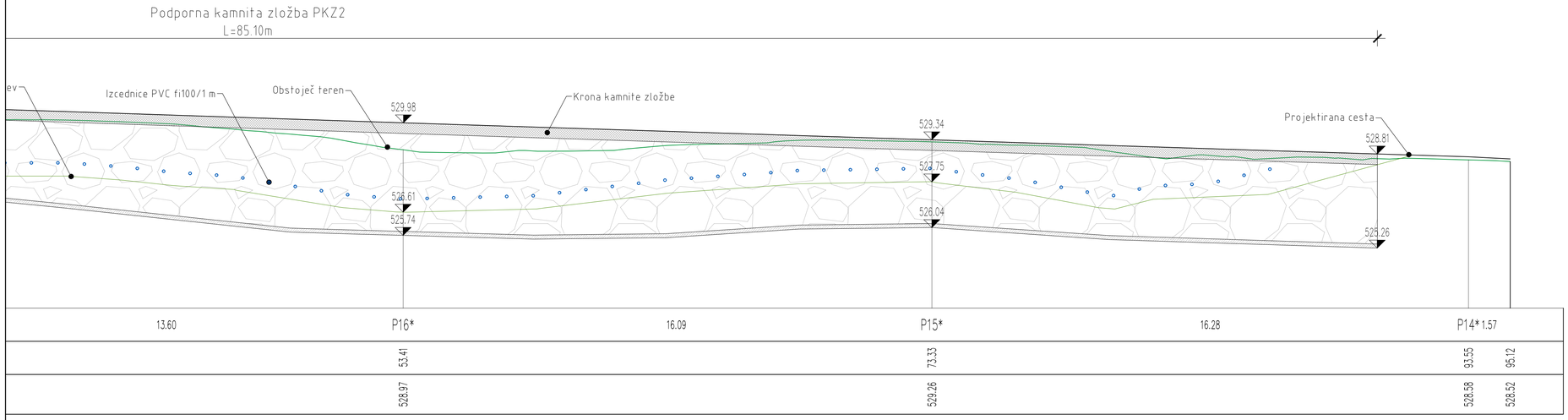
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	ANDREJ BRICMAN, dipl.inž.geol. (UN) .
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina risbe:	40 VZDOLŽNI PREREZI Vzdolžni prerez PKZ1

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.242.1**

0.820 x 0.297 = 0.244 m2



PROFIL-2: PKZ2_A
MERILO 1:100/100



PROFIL-2: PKZ2_A
MERILO 1:100/100

Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

40 VZDOLŽNI PREREZI
Vzdolžni prerez PKZ2

merilo: 1 : 100

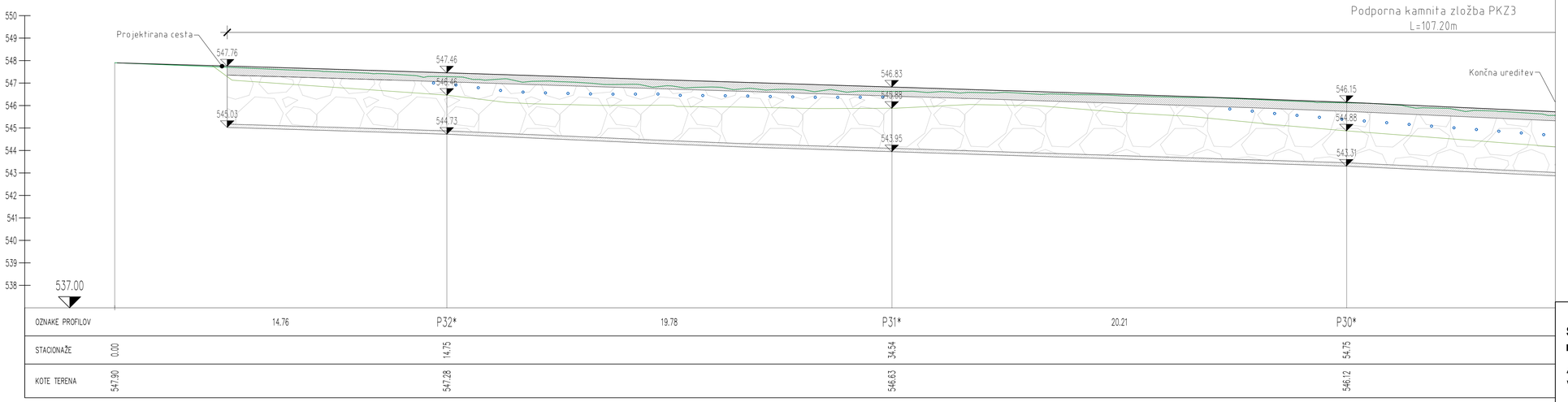
MESTNA OBČINA SLOVENJ GRADEC,
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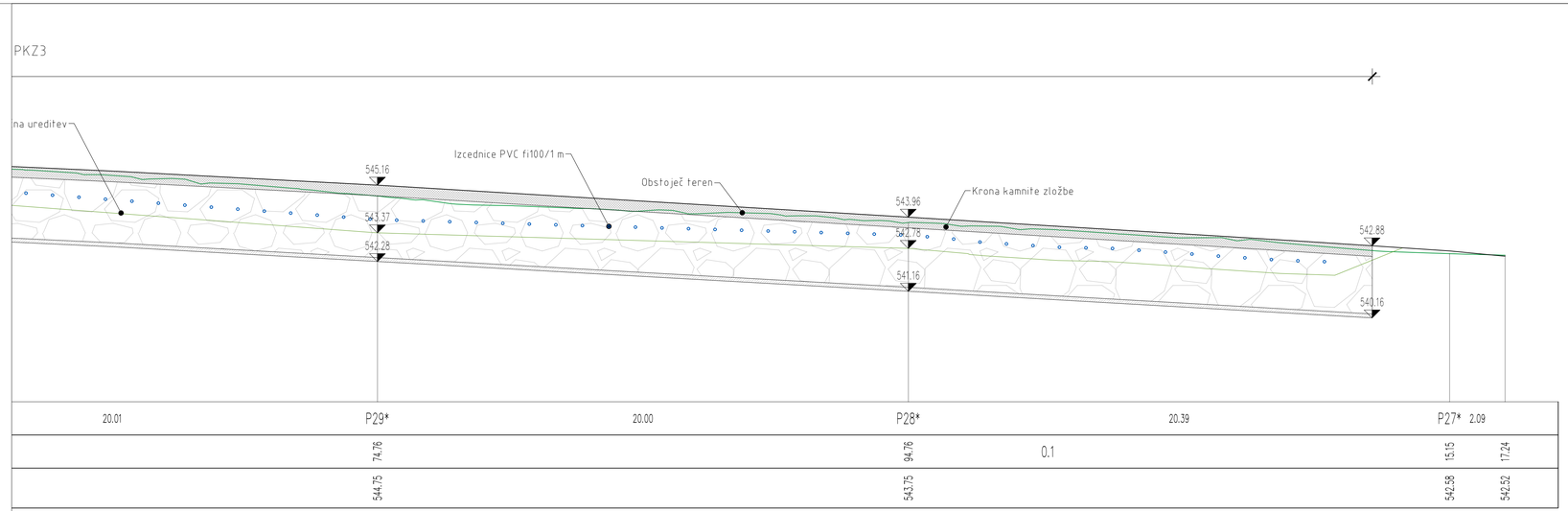
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	ANDREJ BRICMAN, dipl.inž.geol. (UN) .
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina risbe:	40 VZDOLŽNI PREREZI Vzdolžni prerez PKZ2

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.242.2**

ACAP
OS_glbleV2_konstrukcije.dwg
0.820 x 0.446 x 0.366 m2



PROFIL-3: PKZ3_A
MERILO 1:100/100



Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

40 VZDOLŽNI PREREZI
Vzdolžni prerez PKZ3

merilo: 1 : 100

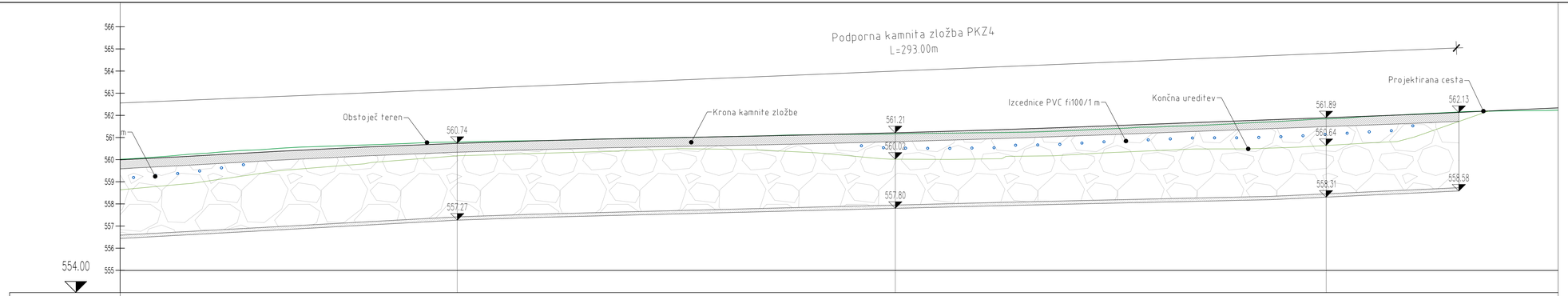
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ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC

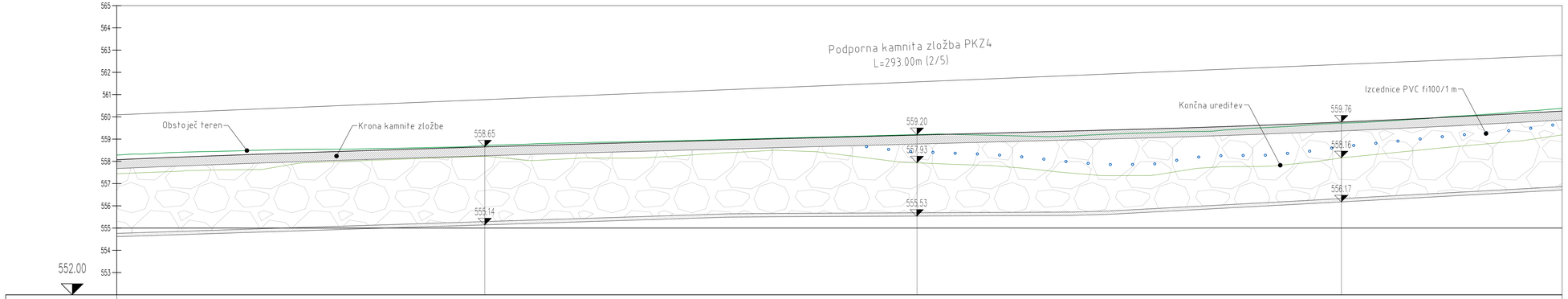
AC&P inženirski biro d.o.o.
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vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	ANDREJ BRICMAN, dipl.inž.geol. (UN)
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina risbe:	40 VZDOLŽNI PREREZI Vzdolžni prerez PKZ3

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.242.3**

AC&P
DS_platnoV2_konstrukcija.dwg
2m 0.415 x 0.448 x 0.810





Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

40 VZDOLŽNI PREREZI
Vzdolžni prerez PKZ4 (1/2)

merilo: 1 : 100

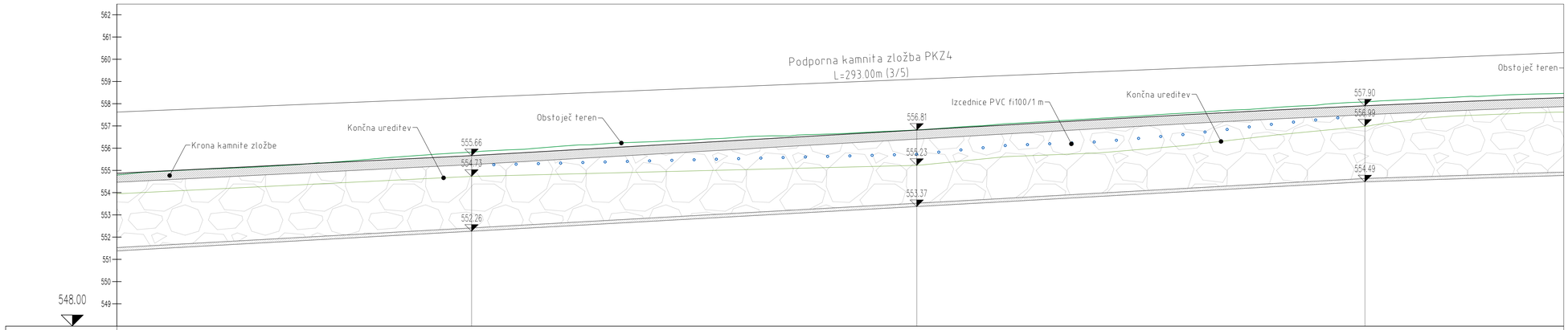
MESTNA OBČINA SLOVENJ GRADEC,
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tovarniška c. 26, 5270 ajdovščina | +38660(0)5 8500740 | info@acap.si

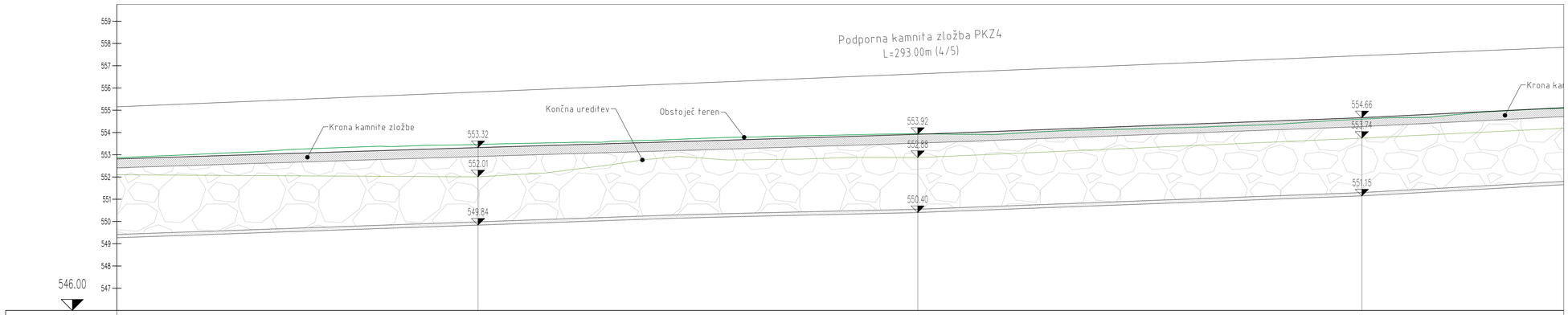
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	ANDREJ BRICMAN, dipl.inž.geol. (UN)	.
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt ceste	
naziv objekta:	Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina risbe:	40 VZDOLŽNI PREREZI Vzdolžni prerez PKZ4 (1/2)	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.242.4**

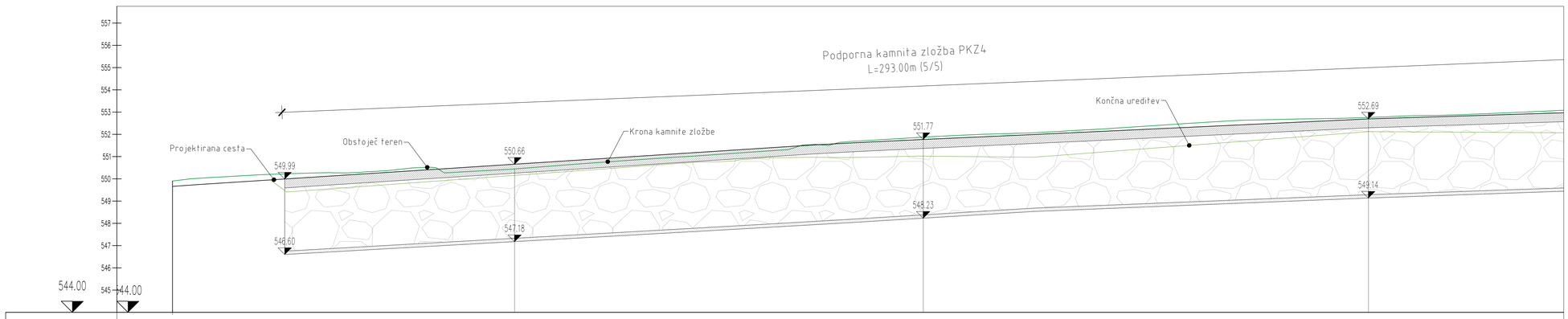
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OS_platnoVP2_konstrukcija.dwg
0.000 x 0.371 = 0.345 m2



OZNAKE PROFILOV		20.00	P69*	20.00	P68*	20.13	P67*
STACIONAŽE			33.43		53.43		73.57
KOTE TERENA			555.82		556.82		558.07



OZNAKE PROFILOV		20.00	P72*	19.75	P71*	19.96	P70*
STACIONAŽE			73.72		93.48	0.1	113.43
KOTE TERENA			553.46		553.94		554.60



OZNAKE PROFILOV		15.37	P75*	18.36	P74*	20.00	P73*
STACIONAŽE			15.36		33.72		53.72
KOTE TERENA			550.44		551.87		552.76

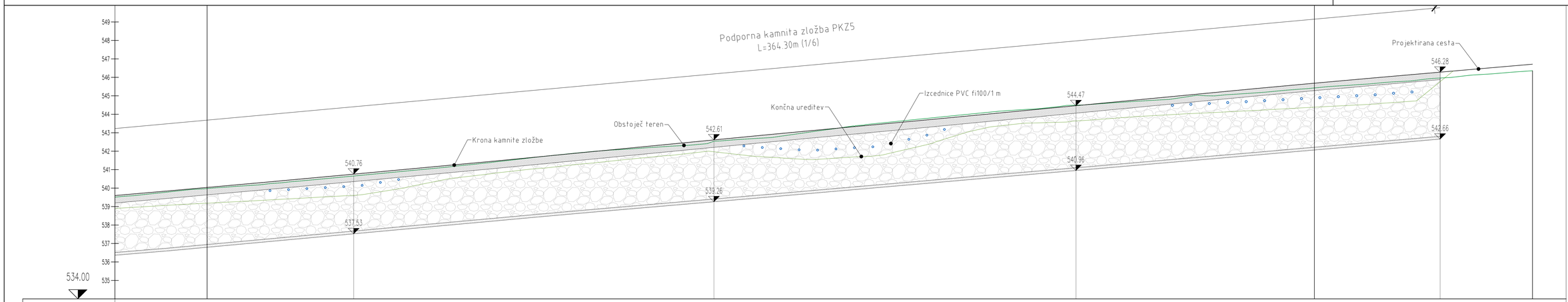
Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

40 VZDOLŽNI PREREZI
Vzdolžni prerez PKZ4 (2/2)

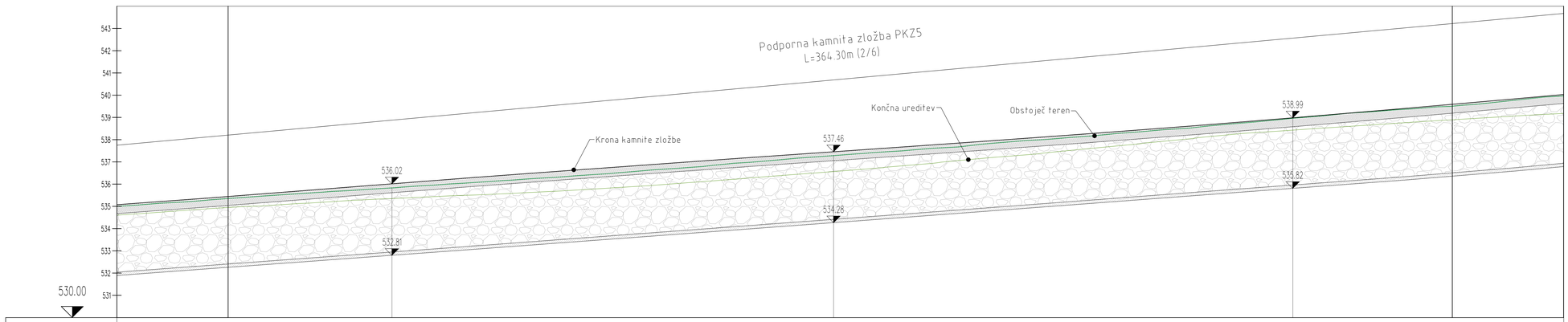
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MESTNA OBČINA SLOVENJ GRADEC, ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC		AC&P inženirski biro d.o.o. podjetje za geotehniko, infrastrukturo in raziskave tovarniška c. 26, 5270 ajdovščina | +38660255 8500740 | info@acap.si			
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.				IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.				IZS PI G-4829
izdelal:	ANDREJ BRICMAN, dipl.inž.geol. (UN)				-
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec				
vrsta projekta:	PZI				
vrsta načrta:	2.1 Načrt ceste				
naziv objekta:	Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023				
vsebina risbe:	40 VZDOLŽNI PREREZI Vzdolžni prerez PKZ4 (2/2)				
	datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
	09.2024	077-24	077-24-21	1 : 100	**G.242.5**

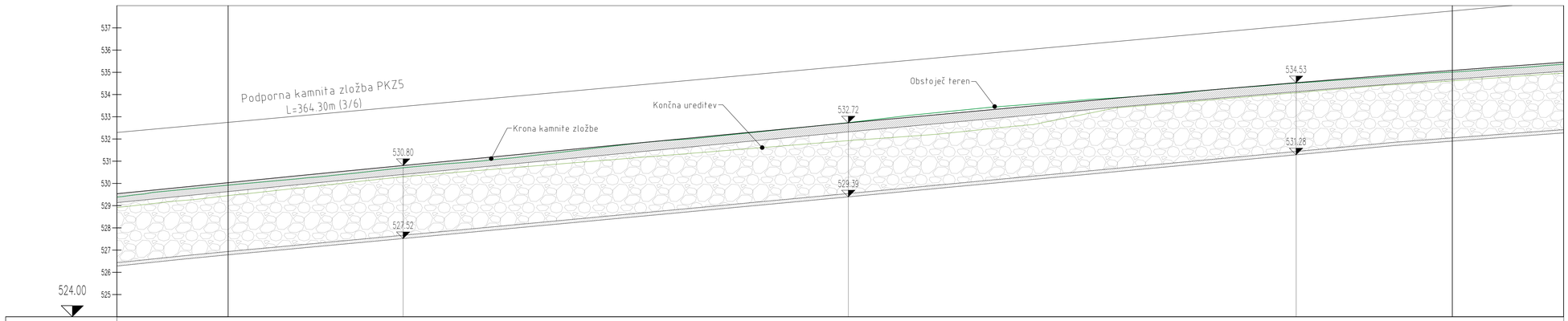
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0.000 x 0.914 x 0.610 m2



OZNAKE PROFILOV	20.11	P85*	19.52	P84*	19.62	P83*	19.73	P82*	5.01
STACIONAŽE	0.3	10.43		29.95		49.57		69.30	74.30
KOTE TERENA		540.66		542.54		544.49		545.96	546.36



OZNAKE PROFILOV	19.38	P88*	19.84	P87*	20.63	P86*	20.11
STACIONAŽE		49.65		69.69		90.32	0.3
KOTE TERENA		535.84		537.29		538.97	



OZNAKE PROFILOV	19.51	P91*	20.00	P90*	20.12	P89*	19.38
STACIONAŽE		90.36	0.2	110.36		130.47	
KOTE TERENA		530.70		532.73		534.51	

Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

40 VZDOLŽNI PREREZI
Vzdolžni prerez PKZ5 (1/2)

merilo: 1 : 100

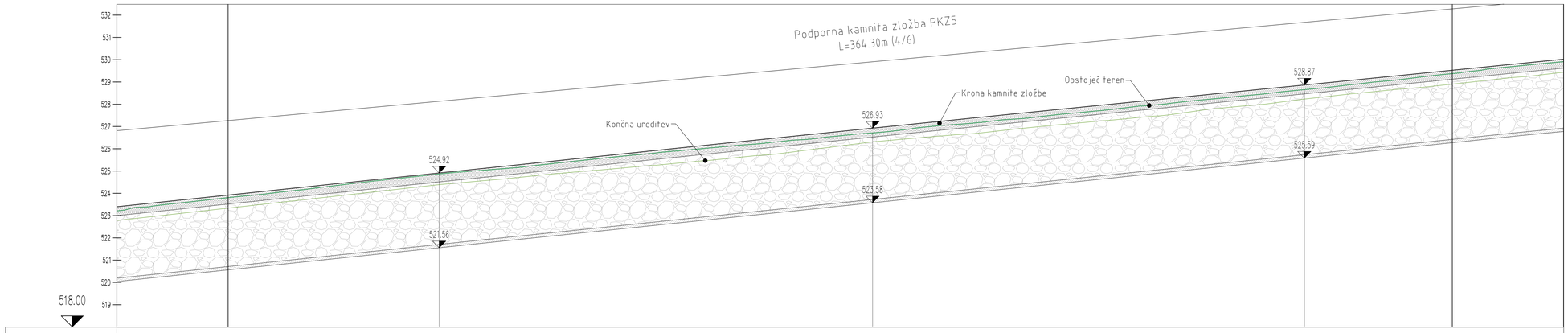
MESTNA OBČINA SLOVENJ GRADEC,
ŠOLSKA ULICA 5, 2380 SLOVENJ GRADEC

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podjetje za geotehniko, infrastrukturo in razskave
tovarniška c. 26, 5270 ajdovščina | +386(0)5 8500740 | info@acap.si

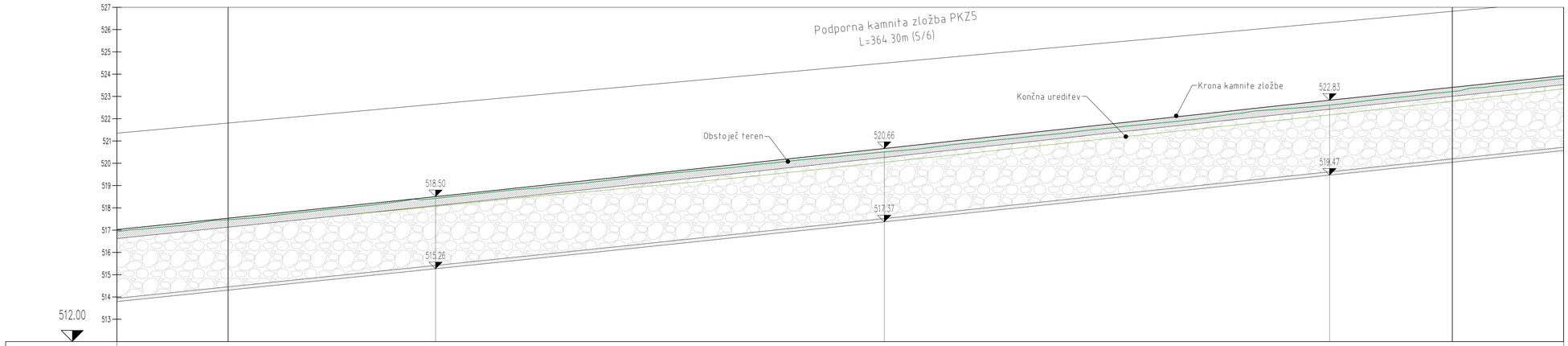
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	ANDREJ BRICMAN, dipl.inž.geol. (UN)	.
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt ceste	
naziv objekta:	Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina risbe:	40 VZDOLŽNI PREREZI Vzdolžni prerez PKZ5 (1/2)	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.242.6**

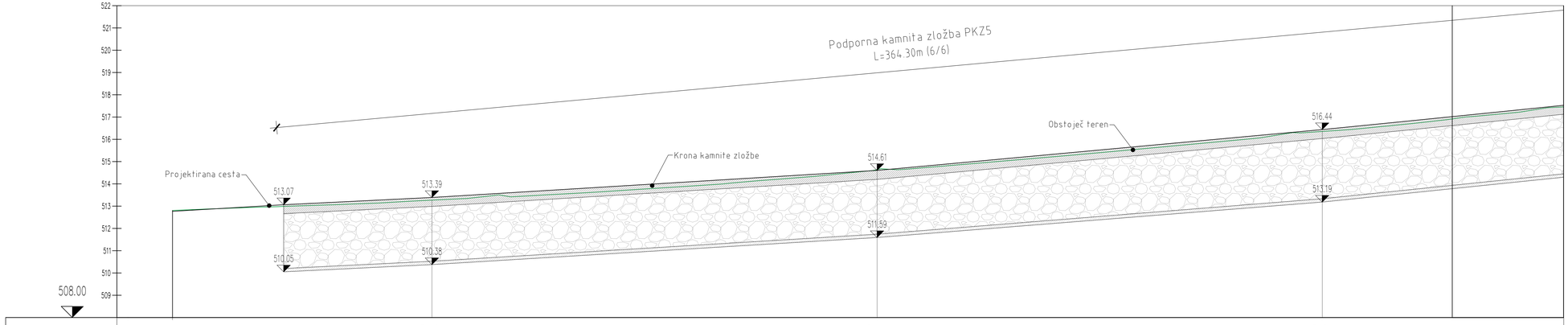
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OZNAKE PROFILOV		P94*	19.47	P93*	19.40	P92*	19.51
STACIONAŽE		31.98		51.45		70.85	
KOTE TERENA		524.87		526.72		528.66	



OZNAKE PROFILOV		P97*	20.16	P96*	20.01	P95*	20.00
STACIONAŽE		71.81		91.97	0.1	11.98	
KOTE TERENA		518.42		520.51		522.61	



OZNAKE PROFILOV		P100*	20.00	P99*	20.00	P98*	20.16
STACIONAŽE	0.00	11.65		31.65		51.65	
KOTE TERENA	512.81	513.27		514.64		516.36	

Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

40 VZDOLŽNI PREREZI
Vzdolžni prerez PKZ5 (2/2)

merilo: 1 : 100

MESTNA OBČINA SLOVENJ GRADEC,
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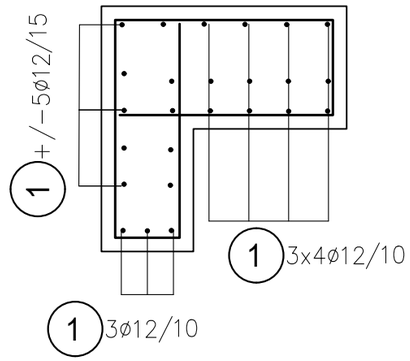
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podjetje za geotehniko, infrastrukturo in raziskave
tovarniška c. 26, 5270 ajdovščina | +38605 8500740 | info@acap.si

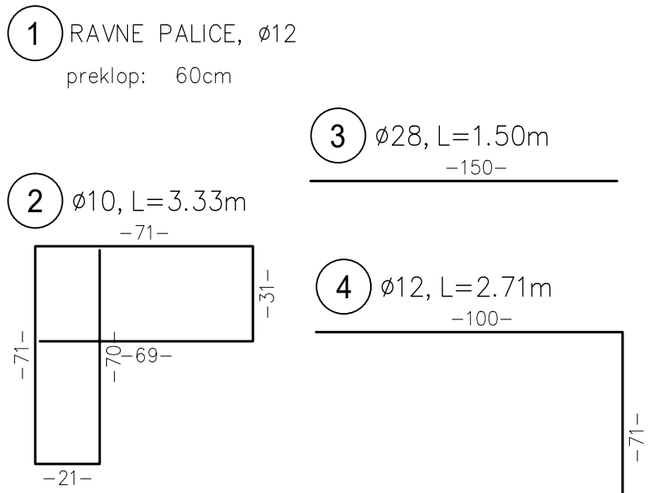
vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad. IZS PI G-4829
izdelal:	ANDREJ BRICMAN, dipl.inž.geol. (UN) .
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec
vrsta projekta:	PZI
vrsta načrta:	2.1 Načrt ceste
naziv objekta:	Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023
vsebina risbe:	40 VZDOLŽNI PREREZI Vzdolžni prerez PKZ5 (2/2)

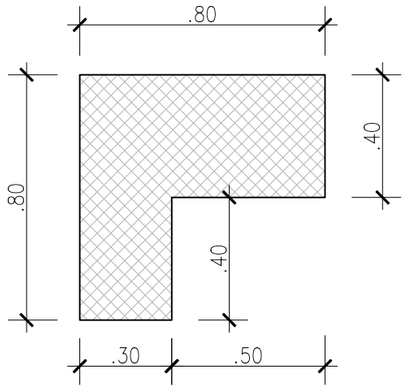
datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 100	**G.242.7**

ACAP
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0.000 x 0.984 = 0.582.m2

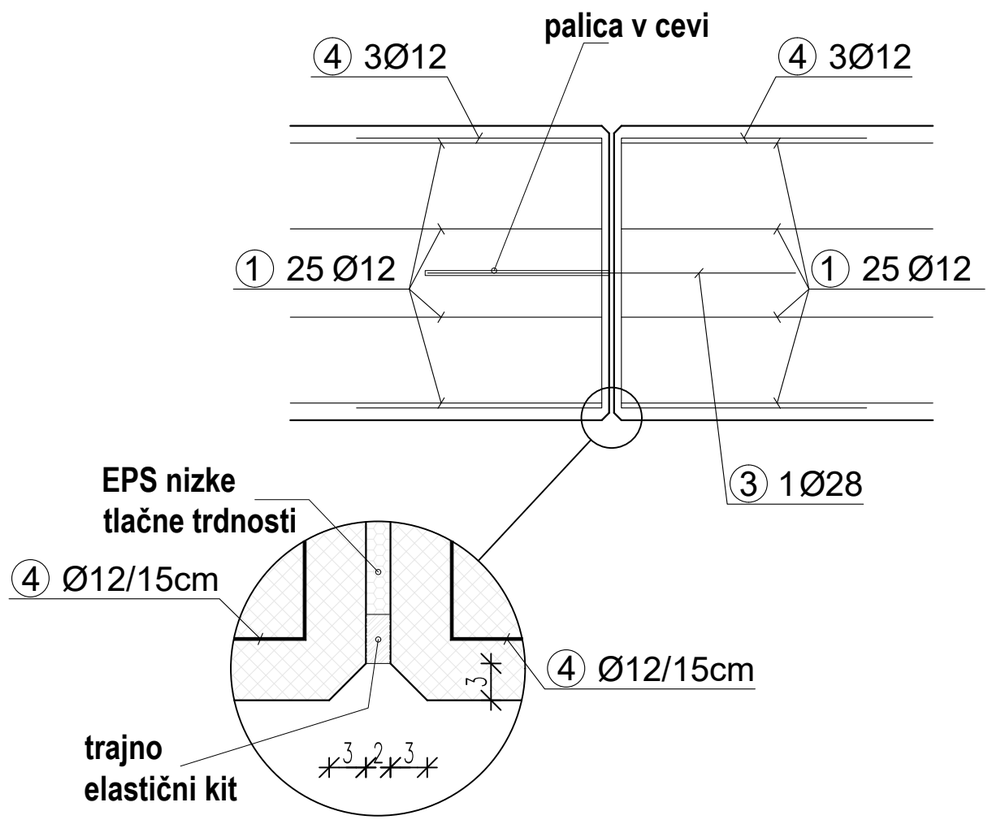
13.1.2025
AC&P







Tloris dilatacije krone



0.420 x 0.297 = 0.125 m2

Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023

71 ARMATURNE RISBE
Krona podporne kamnite zložbe

merilo: 1 : 50

OPOMBA:
- poz 2 na 15cm
- izvedba navideznih reg na 12m, zatesnitev s trajno elastičnim kitom (po navodilih proizvajalca)

MATERIALI			
	ELEMENT	MATERIAL	ZAŠČITNA PLAST
BETON	greda	C 30/37 XC3 XD2 XF4 PV−II Dmax16	4,5 cm
ARMATURA	palice	B 500B	

MESTNA OBČINA SLOVENJ GRADEC
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tovarniška c. 26, 5270 ajdovščina | +386(0)5 8500740 | info@acap.si

vodja projekta:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
pooblaščeni inženir:	KLEMEN SIMONČIČ, mag.inž.grad.	IZS PI G-4829
izdelal:	ANDREJ BRICMAN, dipl.inž.geol.(UN)	.
investitor:	Mestna občina Slovenj Gradec, Šolska ulica 5, 2380 Slovenj Gradec	
vrsta projekta:	PZI	
vrsta načrta:	2.1 Načrt ceste	
naziv objekta:	Sanacija LC 377021 (Mežnik - Anžič; Bošnik); ID 1236576, po neurju in poplavah 17. julij do 3. avgust 2023	
vsebina risbe:	71 ARMATURNE RISBE Krona podporne kamnite zložbe	

datum:	št. projekta:	št. načrta:	merilo:	št. risbe:
09.2024	077-24	077-24-21	1 : 50	**G.271**

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ARMATURNI IZVLEČEK

PKZ 1

poz.	Φ [mm]	Dolžina [m]	št. kosov	Teža na m [kg/m]	Skupaj [kg]
1	12	1169	1	0.920	1,075.89
2	10	3.33	282	0.638	599.12
3	28	1.5	3	4.956	22.30
4	12	3.33	24	0.920	73.53
				Skupaj:	**1,770.84**

PKZ 2

poz.	Φ [mm]	Dolžina [m]	št. kosov	Teža na m [kg/m]	Skupaj [kg]
1	12	2364	1	0.920	2,174.78
2	10	3.33	569	0.638	1,208.86
3	28	1.5	7	4.956	52.04
4	12	3.33	48	0.920	147.05
				Skupaj:	**3,582.73**

PKZ 3

poz.	Φ [mm]	Dolžina [m]	št. kosov	Teža na m [kg/m]	Skupaj [kg]
1	12	2978	1	0.920	2,739.56
2	10	3.33	716	0.638	1,521.17
3	28	1.5	8	4.956	59.47
4	12	3.33	54	0.920	165.43
				Skupaj:	**4,485.63**

PKZ 4

poz.	Φ [mm]	Dolžina [m]	št. kosov	Teža na m [kg/m]	Skupaj [kg]
1	12	8139	1	0.920	7,487.78
2	10	3.33	1955	0.638	4,153.48
3	28	1.5	24	4.956	178.42
4	12	3.33	150	0.920	459.54
				Skupaj:	**12,279.21**

PKZ 5

poz.	Φ [mm]	Dolžina [m]	št. kosov	Teža na m [kg/m]	Skupaj [kg]
1	12	10119	1	0.920	9,309.89
2	10	3.33	2430	0.638	5,162.63
3	28	1.5	30	4.956	223.02
4	12	3.33	186	0.920	569.83
				Skupaj:	**15,265.37**