URED OVLAŠTENOG INŽENJERA GRAĐEVINARSTVA ŠAPONJA ŽELJKO
Matije Gupca 159, 33520 Slatina, Tel: 091 313-2324, 033 401-684, fax: 033 401-684
E-mail adresa: saponja.ing.gradjevinarstva@vt.t-com.hr, OIB:92755191271

GLAVNI PROJEKT

- Građevinski projekt-

Za ishođenje građevinske dozvole

MAPA. 1/2

Broj projekta: 4/22-GP

ZOP 03/22

INVESTITOR: **Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599**

GRAĐEVINA: **Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova**

LOKACIJA GRAĐEVINE: **Slatina, k.č.br. 4366, k.o. Podravska Slatina**

GLAVNI PROJEKTANT: **Samanta Rešetar mag.ing.arch. A4562**

E-Potpis:
SAMANTA REŠETAR
Datum:
02.02.2022.
Vrijeme:
08:22:53

DN:
CN=SAMANTA REŠETAR
SERIALNUMBER=PNOHR-05634556341
GIVENNAME=SAMANTA
SURNAME=REŠETAR
OU=Signature
2.5.4.97=VATHR-85986018932
O=HRVATSKA KOMORA ARHITEKATA
C=HR

PROJEKTANT GRAĐEVINSKOG PROJEKTA: **Željko Šaponja dipl.ing.građ., G 2032**

ŽELJKO ŠAPONJA

Digitalno potpisao: ŽELJKO ŠAPONJA
DN: c=HR, o=HRVATSKA KOMORA INŽENJERA GRAĐEVINARSTVA, 2.5.4.97=VATHR-65080653676, ou=Identification, sn=ŠAPONJA, givenName=ŽELJKO, serialNumber=PNOHR-92755191271, cn=ŽELJKO ŠAPONJA
Datum: 2022.02.02 08:14:50 +01'00'

ODGOVORNA OSOBA UREDA: **Željko Šaponja dipl.ing.građ., G 2032**

Slatina, Veljača 2022.g.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

SADRŽAJ:

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

POPIS SURADNIKA I POPIS MAPA PROJEKTA, UZ NAVOĐENJE PROJEKTANATA KOJI SU IH IZRADILI

MAPA 1/2	**ARHITEKTONSKI PROJEKT** “MODEL**ARCH**” d.o.o., A. K. Zrinske 26, Slatina OIB: 94732757958 Projektant: Samanta Rešetar, mag.ing.arch., A 4562 Projektant suradnik: Domagoj Klement, mag.ing.arch. Tomislav Brnas, struč.spec.ing.građ.	**T.D. 03/22-AP**
MAPA 2/2	**GRAĐEVINSKI PROJEKT KONSTRUKCIJE** Ured ovlaštenog inženjera građevinarstva Šaponja Željko, Matije Gupca 159, Slatina OIB: 92755191271 Projektant: Željko Šaponja, dipl.ing.građ., G 2032	**T.D. 4/22-GP**

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

2

8. Skraćeni naziv Ureda je: ***URED OVLAŠTENOG INŽENJERA GRAĐEVINARSTVA ŠAPONJA ŽELJKO***

Obrazloženje

ŽELJKO ŠAPONJA, dipl.ing.građ., podnio je Hrvatskoj komori arhitekata i inženjera u graditeljstvu aktom od 26.07.2007. godine, Zahtjev za osnivanje Ureda za samostalno obavljanje poslova projektiranja i stručnog nadzora građenja ovlaštenog inženjera građevinarstva.

Sukladno članku 50. Zakona o gradnji ("Narodne novine", br. 175/03 i 100/04), ovlašteni arhitekt i ovlašteni inženjer mogu obavljati poslove projektiranja i/ili stručnog nadzora građenja samostalno u vlastitom uredu, zajedničkom uredu, projektantskom društvu ili drugoj pravnoj osobi registriranoj za tu djelatnost (u daljnjem tekstu: osoba registrirana za djelatnost projektiranja i/ili stručnog nadzora).

Osoba registrirana za djelatnost projektiranja i/ili stručnog nadzora dužna je u obavljanju tih poslova poštivati odredbe Zakona o gradnji i posebnih zakona, te osigurati da obavljanje poslova projektiranja i/ili stručnog nadzora bude u skladu s temeljnim načelima i pravilima koja trebaju poštivati ovlašteni arhitekti i ovlašteni inženjeri. Osoba registrirana za djelatnost projektiranja odgovorna je da projekt ili dio projekta kojeg je izradila odgovara propisanim zahtjevima.

U članku 52. Zakona o gradnji propisano je da ovlašteni arhitekt odnosno ovlašteni inženjer stječe pravo na samostalno obavljanje poslova projektiranja i/ili stručnog nadzora građenja upisom u Imenik ovlaštenih arhitekata, odnosno Imenike ovlaštenih inženjera Hrvatske komore arhitekata i inženjera u graditeljstvu.

Ured za samostalno obavljanje poslova projektiranja i/ili stručnog nadzora građenja, osniva se upisom u Upisnik ureda za samostalno obavljanje poslova projektiranja i/ili stručnog nadzora građenja Hrvatske komore arhitekata i inženjera u graditeljstvu.

Uvidom u službenu evidenciju Hrvatske komore arhitekata i inženjera u graditeljstvu utvrđeno je da je ŽELJKO ŠAPONJA, dipl.ing.građ. upisan u Imenik ovlaštenih inženjera građevinarstva Hrvatske komore arhitekata i inženjera u graditeljstvu pod rednim brojem 2032, s danom upisa 15.10.1999. godine, te je s tog osnova stekao pravo na samostalno obavljanje poslova projektiranja i stručnog nadzora građenja.

Ured za samostalno obavljanje poslova projektiranja i stručnog nadzora građenja ovlaštenog inženjera građevinarstva, osnovan je upisom u Upisnik ureda za samostalno obavljanje poslova projektiranja i/ili stručnog nadzora građenja Hrvatske komore arhitekata i inženjera u graditeljstvu, **s danom 03.09.2007. godine, pod rednim brojem 541**.

Uredu je Državni zavod za statistiku dodijelio Matični broj ureda, u skladu s Odlukom o sadržaju i načinu vođenja registra ovlaštenih organizacija.

Uredu je u skladu s Nacionalnom klasifikacijom djelatnosti dodjeljena pripadajuća šifra djelatnosti, za samostalnu djelatnost arhitekata i inženjera u graditeljstvu *74.20.0 – Arhitektonske djelatnosti i inženjerstvo te s njima povezano tehničko savjetovanje.*

Ured će poslovati pod skraćenim nazivom: *URED OVLAŠTENOG INŽENJERA GRAĐEVINARSTVA ŠAPONJA ŽELJKO*, te će se isti upisati u "inženjersku iskaznicu" i "pečat" koje izdaje Hrvatska komora arhitekata i inženjera u graditeljstvu.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

3

U članku 38. Statuta Hrvatske komore arhitekata i inženjera u graditeljstvu propisano je da ovlašteni arhitekti i ovlašteni inženjeri koji poslove projektiranja i/ili stručnog nadzora građenja obavljaju samostalno u vlastitom uredu, zajedničkom uredu ili projektantskom društvu, dužni su imati ploču ureda odnosno društva istaknutu pored ulaza u zgradu u kojem je smješten ured.

Upravni odbor Komore je temeljem ovlaštenja iz članka 38. stavka 3. Statuta Komore propisao obvezatni sadržaj ploče, na sjednici održanoj 14. lipnja 2007. godine donošenjem Pravilnika o obliku i sadržaju natpisne ploče ovlaštenih arhitekata i ovlaštenih inženjera.

Time su se stekli uvjeti koji su propisani u točki 4. dispozitiva ovog rješenja. Trošak korištenja natpisne ploče snosi ŽELJKO ŠAPONJA, dipl.ing.građ., koji jednokratno uplaćuje **iznos od 850,00 kn (slovima: osamstopedeset kuna) u korist osnovnog računa Komore broj: 2360000-1101366566.**

U skladu s člankom 52. stavcima 3. i 4. Zakona o gradnji, "propisano je da ovlašteni arhitekt, odnosno ovlašteni inženjer koji samostalno obavlja poslove projektiranja i/ili stučnog nadzora građenja može obavljati te poslove pod uvjetom da nije u radnom odnosu i može imati samo jedan ured".

Uvidom u dostavljenu dokumentaciju imenovanog, razvidno je da nije u radnom odnosu i da Izjavom potvrđuje da će raditi samo u jednom Uredu.

Sukladno svemu prethodno iznesenom, riješeno je kao u izreci ovoga Rješenja.

Pouka o pravnom lijeku

Protiv ovog Rješenja žalba nije dopuštena, ali se može pokrenuti upravni spor podnošenjem tužbe Upravnom sudu Republike Hrvatske, u roku 30 dana od dana primitka ovog Rješenja.

PREDSJEDNIK KOMORE

Damir Delač, dipl.ing.geod.

Dostaviti:

1. ŽELJKO ŠAPONJA, 33520 SLATINA, M. GUPCA 159
2. Područna služba HZMO Virovitica,Ispostava Slatina,Šet.Julija Bisigera 3,33520 SLATINA
3. HZZO Područni ured Virovitica,Ispostava Slatina,Šet.Julija Burgera 3,33520 SLATINA
4. Područni ured Porezne uprave Slatina,Braće Radića 7,33520 SLATINA
5. U Zbirku isprava Komore
6. Pismohrana Komore
7. Povrat potvrde o izvršenoj dostavi uz točke 1. do 4.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

REPUBLIKA HRVATSKA

HRVATSKA KOMORA ARHITEKATA
I INŽENJERA U GRADITELJSTVU

Klasa: UP/I-360-01/99-01/ 2032
Urbroj: 314-01-991
Zagreb, 14. listopada 1999.

Na temelju članka 24. i 50. Zakona o Hrvatskoj komori arhitekata i inženjera u graditeljstvu (Narodne novine, broj 47/98), Odbor za upise razreda inženjera građevinarstva, rješavajući po zahtjevu koji je podnio ŠAPONJA ŽELJKO, dipl.ing.građ., SLATINA, M. GUPCA 159, za upis u Imenik ovlaštenih inženjera građevinarstva, donio je sljedeće

RJEŠENJE

1. U Imenik ovlaštenih inženjera građevinarstva upisuje se ŠAPONJA ŽELJKO, dipl.ing.građ., SLATINA, pod rednim brojem 2032, s danom upisa 15.10.1999. godine.

2. Upisom u Imenik ovlaštenih inženjera građevinarstva, ŠAPONJA ŽELJKO, dipl.ing.građ., stječe pravo na uporabu strukovnog naziva "ovlašteni inženjer građevinarstva" i pravo na obavljanje poslova temeljem članka 25. Zakona o Hrvatskoj komori arhitekata i inženjera u graditeljstvu, a u svezi s člankom 4. stavkom 1. Statuta Hrvatske komore arhitekata i inženjera u graditeljstvu, te ostala prava i dužnosti sukladno posebnim propisima.

3. Ovlaštenom inženjeru izdaje se "inženjerska iskaznica" i stječe pravo na uporabu "pečata".

Obrazloženje

ŠAPONJA ŽELJKO, dipl.ing.građ., podnio je Zahtjev za upis u Imenik ovlaštenih inženjera građevinarstva.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

2

Odbor za upise razreda inženjera građevinarstva proveo je postupak u povodu dostavljenog Zahtjeva, te je temeljem članka 24. stavka 2. Zakona o Hrvatskoj komori arhitekata i inženjera u graditeljstvu (Narodne novine, broj 47/98), a u svezi s člankom 5. stavkom 4. i člankom 20. Statuta Hrvatske komore arhitekata i inženjera u graditeljstvu (Narodne novine, broj 40/99), riješeno kao u izreci.

Upisom u Imenik ovlaštenih inženjera građevinarstva imenovani stječe pravo na izradu i uporabu pečata, sukladno članku 35. Statuta Hrvatske komore arhitekata i inženjera u graditeljstvu i na izdavanje "inženjerske iskaznice".

Na temelju članka 141. stavka 1. točke 1. Zakona o općem upravnom postupku (Narodne novine, broj 53/91), predmet je riješen po skraćenom postupku.

Pouka o pravnom lijeku

Protiv ovog Rješenja žalba nije dopuštena, ali se može pokrenuti upravni spor podnošenjem tužbe Upravnom sudu Republike Hrvatske, u roku od 30 dana od primitka ovog Rješenja.

REPUBLIKA HRVATSKA 1 ZAGREB Hrvatska komora arhitekata i inženjera

PREDSJEDNIK KOMORE

Ivan Franić, dipl.ing.arh.,v.r.

Dostaviti:

1. ŽELJKO ŠAPONJA, 33520 SLATINA,M. GUPCA 159
2. U Zbirku isprava Komore
3. Pismohrana Komore

Zabilješka:
Istovjetnost ovog otpravka s izvornikom ovjerava

Tajnica Komore:

Sunčana Rudić, dipl.iur.

Broj. 04-02/04
Zagreb, 22.01.2004. godine

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Na temelju članka 51. Zakona o gradnji ("Narodne novine" broj 153/13, 20/17, 39/19 i 125/19) izdajem slijedeće

I M E N O V A N J E br. 1- 4/22-GP
o imenovanju projektanta Građevinskog projekta

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA GRAĐEVINE:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
BROJ PROJEKTA:	4/22-GP

Za projektanta Građevinskog projekta imenuje se:

ŽELJKO ŠAPONJA dipl.ing.građ., ovlašteni inženjer građevinarstva

Rješenje o upisu u imenik ovlaštenih inženjera građevinarstva Klasa UP/I-360-01/99-01/2032, Urbroj: 314-01-991 od 14 listopada 1999.g.

Imenovani projektant je osoba ovlaštena za projektiranje sukladno posebnom zakonu i propisima donesenim na temelju tog zakona i odgovoran je da projekti koje izrađuje zadovoljavaju uvjete iz Zakona o prostornom uređenju i gradnji i posebnih zakona i drugih propisa

U Slatini, veljača .2022.g.

Odgovorna osoba ureda:

Željko Šaponja dipl.inž.građ.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Na temelju članka 108. stavak 2. podstavak 2. Zakona o gradnji (NN 153/13, 20/17 19/19 i 125/19), donosi se:

IZJAVA PROJEKTANTA GRAĐEVINSKOG PROJEKTA br. 4/22 –GP

Ovaj Glavni projekt, izrađen je u skladu sa odredbama Prostornog plana i drugim propisima u skladu s kojima mora biti izrađen, a to su:

- Zakon o prostornom uređenju (NN 153/13, 65/17)
- Zakon o gradnji (NN 153/13, 20/17, 39/19, 125/19)
- Zakon o poslovima i djelatnostima prostornog uređenja i gradnje (NN 78/15)
- Zakon o zaštiti od požara (NN 92/10)
- Zakon o zaštiti okoliša (NN 80/13, 153/13)
- Zakon o zaštiti na radu (NN 71/14)
- Zakon o zaštiti od buke (NN 30/09, 55/13, 153/13, 41/16)
- Pravilnik o djelatnostima za koje je potrebno utvrditi provedbu mjera za zaštitu od buke (NN 91/07)
- Direktiva 2002/49/EZ
- Pravilnik o najvišim dopuštenima razinama buke u sredini u kojoj ljudi rade i borave (NN 145/04)
- Pravilnik o zaštiti na radu za radne i pomoćne prostorije (NN br. 6/84, 42/05)
- Zakon o građevnim proizvodima (30/14)
- Pravilnik o načinu obračuna površine i obujma u projektima zgrada (NN 90/10, 111/10)
- Pravilnik o obračunu i naplati vodnog doprinosa (NN 107/14)
- Tehnički propis za betonske konstrukcije (NN br. 139/09, 14/10, 125/10)
- Tehnički propis o izmjenama i dopunama Tehničkog propisa za betonske konstrukcije (NN 136/12)
- Tehnički propis za drvene konstrukcije (NN 121/07, 58/09, 125/10)
- Tehnički propis o izmjenama i dopunama Tehničkog propisa za drvene konstrukcije (NN 136/12)
- Tehnički propis za čelične konstrukcije (NN 112/08, 125/10, 73/12)
- Tehnički propis o izmjenama i dopunama Tehničkog propisa za čelične konstrukcije (NN 136/12)
- Tehnički propis za zidane konstrukcije (NN 01/07)
- Tehnički propis za aluminijske konstrukcije (NN 80/13)
- Tehnički propis za dimnjake u građevinama (NN 3/07)
- Tehnički propis o građevnim proizvodima (NN 33/10,87/10,146/10,81/11,100/11, 130/12)
- Tehnički propis o izmjenama i dopunama Tehničkog propisa o građevnim proizvodima (NN 81/13)
- Tehnički propis o racionalnoj uporabi energije i toplinskoj zaštiti u zgradama (NN 97/14)
- Zakon o normizaciji (NN 80/13)
- Pravilnik o osiguranju pristupačnosti građevina osobama s invaliditetom i smanjene pokretljivosti (NN 78/13)
- Zakon o hrani (NN 81/13, 14/14)
- Zakon o higijeni hrane i mikrobiološkim kriterijima za hranu (NN 81/13)
- Zakon o zaštiti pučanstva od zaraznih bolesti (NN 79/07, 113/08, 43/09, 130/17)
- Pravilnik o načinu provedbe obvezatne dezinfekcije, dezinsekcije i deratizacije (NN 35/07, 76/12)

Slatina, veljača 2022.g. Projektant:

Željko Šaponja dipl.ing.građ.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

PROJEKT KONSTRUKCIJE

- Plan pozicija
- Tehnički opis
- Dokaz mehaničke otpornosti i stabilnosti

Slatina, veljača 2022.g.

PROJEKTANT:

Željko Šaponja dipl.ing.građ.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

TEHNIČKI OPIS I PROGRAM KONTROLE

TEHNIČKI OPIS

POSTOJEĆE STANJE

PODATCI O AKTU NA TEMELJU KOJEG JE GRAĐEVINA STEKLA STATUS ZAKONITO IZGRAĐENE GRAĐEVINE

Igralište sportsko-rekreacijske namjene izgrađeno je u Slatini, na k.č.br.4366, k.o. Podravska Slatina.
Dokaz legalnosti igrališta je temeljem Uvjerenja da je građevina izgrađena prije 15.veljače 1968.godine klasa:938-08/22-02/11, urbroj: 541-21-03/4-22-2 od 26.01.2022.
Igralište je sportsko-rekreacijske namjene.
Navedeno Uvjerenje priloženo je u popratnim prilozima koji su sastavni dio glavnog projekta.

PODATCI O UTVRĐENOM ZATEČENOM STVARNOM STANJU POSTOJEĆE GRAĐEVINE

Postojeće stanje čine rukometno (sjeveroistočni dio čestice) i odbojkaško (zapadni dio čestice) igralište sa završnom asfaltnom oblogom. Sa sjeverne strane rukometnog igrališta izvedena je čelična nadstrešnica s klupama za igrače. Rukometno igralište je ograđeno čeličnom ogradom visine 90 cm sa sjeverne i južne strane, te ogradom visine 6,00 m s istočne i zapadne strane. Betonske tribine se nalaze cijelom dužinom južne strane rukometnog igrališta. Uz rukometno igralište izvedena je rasvjeta. Rukometno igralište je opremljeno golovima, a odbojkaško stupovima za odbojkašku mrežu. Oba igrališta su sa svojih južnih i istočnih strana omeđeni potpornim zidovima visine do 0,50 m.
Rukometno igralište je smješteno u sjeveroistočnom dijelu parcele, a odbojkaško u zapadnom dijelu parcele. Južni dio parcele je zelena površina.
Pješački i kolni pristup je omogućen sa sjeverozapadne strane parcele. Glavni kolni pristup izveden je s Trga sv. Josipa sa sjeverozapadne strane parcele. Točan položaj kolnog pristupa je prikazan u grafičkom dijelu.

DOKAZ O POSTOJEĆIM MATERIJALIMA I GRAĐEVNIM PROIZVODIMA

Postojeće rukometno i odbojkaško igralište izvedeno je sa završnom asfaltnom oblogom.

Popis slojeva postojećeg stanja:

- habajući sloj asfalta deb. 4 cm
- nosivi sloj asfalta deb. 7 cm
- tamponska podloga, kamen deb.30 cm

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

PROJEKTIRANO STANJE

Projektni zadatak je izrada glavnog projekta za Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova, na lokaciji; Slatina , k.č.br. 4366, k.o. Podravska Slatina.

Ulazni podaci za projektiranje definirani su parametrima iz Urbanističkog plana uređenja Grada Slatine (Sl. gl. Grada Slatine br. 2/07, 1/12, 1/15) i Prostornog plana uređenja Grada Slatine (Sl. gl. Grada Slatine br. 6/06, 1/15, 11/21, 13/21).

Svi opisani radovi izvest će se prema Pravilniku o jednostavnim i drugim građevinama i radovima (NN 112/17, 34/18, 36/19, 98/19, 31/20) bez građevinske dozvole, a u skladu s glavnim projektom.

OPIS ZAHVATA U PROSTORU

Investitor Grad Slatina planira Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova, na k.č.br. 4366, k.o. Podravska Slatina.
Postojeće stanje čine rukometno (sjeveroistočni dio čestice) i odbojkaško (zapadni dio čestice) igralište sa završnom asfaltnom oblogom. Na mjestu postojećeg rukometnog igrališta izvodi se novo multifunkcionalno igralište za rukomet, mali nogomet i tenis sa završnom akrilnom oblogom , u čijem se nastavku izvodi odbojkaško igralište također sa završnom akrilnom oblogom. Oko igrališta se predviđa izgradnja zaštitne ograde ukupne visine 4,00 do 6,00 m te izgradnja triju samostojećih čeličnih nadstrešnica uz sjeverni rub igrališta. Dimenzije pojedinačne nadstrešnice iznose 3,00 x 4,80 m (14,40 m2). Uz južni i istočni rub igrališta se izvodi armiranobetonski potporni zid visine 0,60-0,95 m. Uz jugoistočnu među se izvodi potporni zid visine 0,20 – 1,70 m. Panel ograda visine 1,00 m se izvodi na potpornom zidu uz jugoistočnu među te na potpornom zidu između igrališta i tribine. Oko igrališta se izvode nove pješačke staze sa završnom oblogom od betonskih opločnika. Na mjestu postojećeg odbojkaškog igrališta se izvodi polifunkcionalni plato sa završnom oblogom od betonskih opločnika. U sklopu platoa se predviđa izgradnja čelične nadstrešnice dimenzija 6,56 x 3,00 m (14,40 m2). Polifunkcionalni plato se sa istočne i južne strane omeđuje novim armiranobetonskim potpornim zidom visine 0,45-0,65 m. Postojeća betonska tribina se obnavlja. Pristup tribini se sa sjeveroistočne strane osigurava trima stubama, a s jugozapadne strane pomoću rampe nagiba 8,1%.

OPIS NAMJENE GRAĐEVINE

Namjena igrališta je sportsko – rekreacijska. Igrališta su multifunkcionalna, za rukomet tenis i odbojku.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

OBLIKOVANJE

Namjera ovog glavnog projekta je, uz suvremene elemente i materijale, formirati arhitektonsku cjelinu primjerenu zadanoj lokaciji i planiranom sadržaju.

Zahvatom se planira rekonstrukcija postojeće armiranobetonske tribine. Na novi habajući sloj asfalta debljine 4 cm će se postaviti završna multifunkcionalna akrilna obloga igrališta za rukomet, tenis i odbojku, debljine 2 cm. Igrališta će biti ograđena novom čeličnom panel ogradom visine 4,00 – 6,00 m. Pristup igralištima i tribini se ostvaruje pomoću novih pješačkih staza opločenih betonskim opločnicima dimenzije 20x20x8 cm. Polifunkcionalni plato se također opločuje betonskim opločnicima dimenzije 20x20x8 cm. Sa sjeverne strane multifunkcionalnog igrališta planira se izgradnja tri nadstrešnice za igrače i sudce, te nadstrešnica u sklopu polifunkcionalnog platoa. Sve nadstrešnice su od čelične konstrukcije u antracit boji s ispunom aluminijskim panelima. Panel čini potkonstrukcija u antracit boji za koju se pričvršćuju aluminijske letvice u boji drva. Pokrov nadstrešnica se izvodi od transparentnih polikarbonatnih ploča.

Svi opisani radovi izvest će se prema Pravilniku o jednostavnim i drugim građevinama i radovima (NN 112/17, 34/18, 36/19, 98/19, 31/20) bez građevinske dozvole, a u skladu s glavnim projektom.

PROMETNO RJEŠENJE - OPIS NAČINA PRIKLJUČENJA NA PROMETNU POVRŠINU

Glavni kolni i pješački pristup je postojeći, sa sjeverozapadne strane, s Trga sv. Josipa. Točan položaj kolnog pristupa je prikazan u grafičkom dijelu projekta.
Građevini je omogućen pristup u svako doba godine.

OPIS NAČINA PRIKLJUČENJA NA KOMUNALNU INFRASTRUKTURU

Vodovod i kanalizacija
Na parceli ne postoji vodovodna instalacija. Ovim projektom se ne predviđa izvođenje nove vodovodne instalacije.
Na parceli ne postoji instalacija kanalizacije. Ovim projektom se ne predviđa izvođenje nove instalacije kanalizacije.

Električna energija
Na parceli se nalazi postojeća elektroinstalacija rasvjetnih stupova. Ovim projektom se ne predviđa rekonstrukcija postojeće elektroinstalacije. Predmetna građevina nije ni u kakvom doticaju s HAKOM-ovom infrastrukturom.

Uređenje građevne čestice
Nakon izvedenih radova čestica će se urediti.

Manipulativne površine
Pješački i kolni pristup je omogućen sa sjeverozapadne strane parcele. Glavni kolni pristup izveden je s Trga sv. Josipa, sa sjeverozapadne strane parcele. Točan položaj kolnog pristupa je prikazan u grafičkom dijelu.
Građevini je omogućen pristup u svako doba godine.
Pristup igralištima i tribini se ostvaruje pomoću novih pješačkih staza opločenih betonskim opločnicima dimenzije 20x20x8 cm. Polifunkcionalni plato se također opločuje betonskim opločnicima dimenzije 20x20x8 cm.
Oborinske vode s horizontalnih ploha igrališta te oborinske vode staza i polifunkcionalnog platoa odvode se na zelenu površinu parcele, na način da ne pričinjavaju štetu susjednim parcelama i ne mijenjaju prirodni tok vode.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

1. OPĆENITO

Investitor je dužan tijekom građenja osigurati stručni nadzor izvedbe za građevinu u cijelosti i pojedinim segmentima.

Izvoditelj je dužan prije početka radova proučiti projektnu dokumentaciju i o svim eventualnim primjedbama i uočenim nedostacima obavijestiti Investitora ili nadzornog inženjera. Ukoliko se tokom gradnje ukaže opravdana potreba za manjim odstupanjima od projekta ili njegovim izmjenama, izvoditelj je dužan prethodno pribaviti suglasnost projektanta i nadzornog inženjera.

Izvoditelj je obavezan putem dnevnika registrirati sve izmjene i eventualna odstupanja od projekta, a po dovršetku gradnje obvezan je predati Investitoru projekt izvedenog stanja objekta koji se sastoji od svih projekata u kojima je došlo do izmjene.
Sav materijal koji se upotrijebi mora odgovarati hrvatskim standardima.
Pri dovoženju materijala na gradilište pregled materijala izvršit će nadzorni inženjer i njegovo stanje konstatirati u građevinski dnevnik. Ukoliko izvoditelj upotrijebi neodgovarajući materijal, na zahtjev nadzornog inženjera mora ga ukloniti i upotrijebiti drugi koji odgovara propisima.

Svi radovi moraju biti kvalitetno izvedeni. Sve nedostatke uočene u toku ili nakon radova izvoditelj je dužan ispraviti o svom trošku.
Svi ugrađeni materijali moraju biti kvalitetni i atestirani prema važećim propisima, a prema Zakonu o preuzimanju Zakona o standardizaciji NN RH br.53/91.

2. BETONSKI I ARMIRANO BETONSKI RADOVI

Izvoditelj je dužan sustavno pratiti izvedbu konstrukcije geodetskom kontrolom vertikalnosti i horizontalnosti elemenata, ponašanje konstrukcije spram slijeganja, te o svim pojavama koje nisu u skladu sa predviđenima u projektu odmah obavijestiti projektanta i nadzornog inženjera.

Izvoditelj je obvezan posjedovati atest o kvaliteti svih ugrađenih materijala.
Kvaliteta betona i čelika treba odgovarati Tehničkim propisima za betonske konstrukcije.
Ispitivanje betonskih uzoraka provesti kod nadležne institucije, prema odredbama pravilnika Tehnički propis za betonske konstrukcije (NN br. 139/09, 14/10).
Sukladno Tehničkom propisu za betonske konstrukcije (NN br. 139/09, 14/10) donosi se ovaj program kontrole i osiguranja kvalitete za betonske konstrukcije.
Sukladno članku 8. gore navedenog tehničkog propisa, tehnička svojstva betonske konstrukcije moraju biti takova da na građevini ne prouzroče:

- rušenje građevine ili njezinog djela
- deformacije nedopuštena stupnja
- nerazmjerno velika oštećenja građevine ili njezinog djela u odnosu na uzrok zbog kojih su nastala
- da se u slučaju požara očuva nosivost konstrukcije ili njezinog djela tjekom određenog vremena

Beton koji će se ugrađivati je obični beton gustoće 2400 kg/m3. Specifikacija, svojstva, proizvodnja i sukladnost betona je prema HRN EN 206-1. Beton će se proizvoditi na betonari.
Izvršiti ispitivanje tlačne čvrstoće betona sukladno HRN EN 12390-1, 12390-2 i 12390-3. Uzeti uzorke svježeg betona oblika valjaka dimenzija d/h=150/300 mm i kocke stranice a=500 mm.

- Beton će se izraditi od prirodnog agregata sukladno HRN EN 12620. Najveće zrno 31,5 mm.
- Koristiti vodu iz gradskog vodovoda koja zadovoljava zahtjeve HRN EN 1008
- Tlačna čvrstoća treba zadovoljiti zahtjev $f_{c,m} > f_{ck}$ + (6 do 12) N/mm².
- Razred izloženosti XC1
- Razred tlačne čvrstoće svih elemenata je 25/30, a temelja 20/25
- Može se koristiti cement razreda CEM 32,5 gustoće 3,00kg/dm³ sukladno HRN EN 197-1
- Najveći v/c je 0,65
- Neće se dodavati dodaci betonu
- Udio zraka u betonu je 2,5%

Kontrola betona:

- Kontrolu betona u tvornici betona mora biti u skladu sa zahtjevima 9. točke norme HRN 206-1
- Kontrolu betona na gradilištu obavlja izvođač radova od vremena preuzimanja betona od

proizvođača do završetka njege ugrađenog betona. Kontrola se vrši pregledom svake otpremnice, vizualnom kontrolom konzistencije betona kod svake dopreme betona, mjerenjem konzistencije betona, ispitivanja sadržaja zračnih pora, mjerenje temperature svježeg betona.

Nadzorni inženjer treba nadzirati:

- oplatu i stabilnost oplate
- geometrijska svojstva oplate
- nepropusnost oplate i njenih dijelova
- uklanjanje nečistoća iz presjeka koji će se betonirati
- obradu lica radnih spojnica
- uklanjanje vode s dna oplate
- pripremu površine oplate
- postavu armature prema projektu
- armatura ne smije sadržavati slobodnu hrđu i štetne tvari
- armatura ne smije biti zagađena uljima, mastima, ili drugim štetnim tvarima
- armatura mora biti ispravno učvršćena i osigurana od pomaka tjekom ugradnje
- razmak između šipki mora biti dovoljan za ugradnju betona
- svježi beton prije ugradnje, kao i popratne dokumente uz njega
- sve radnje prije ugradnje betona
- njegu i zaštitu beton
- temperaturu betona koja nesmije biti manja od 5^{o} niti veća od 25^{2}

3. ZIDARSKI RADOVI

Svi materijali koji se koriste za izvođenje zidarskih radova moraju biti u skladu sa uvjetima propisanim HRN. Dobavljači materijala dužni su isporučiti odgovarajuće ateste za sve tipove opeke koji se ugrađuju, a isto tako za cement, vapno, agregat za zidanje, pijesak za žbukanje i glazure. Primijeniti tehnički propis za zidane konstrukcije NN 34/2007.

4. DRVENE KONSTRUKCIJE

Drvena konstrukcija se izvodi sa građom II klase.

Primjenjeni su sljedeći propisi:

- za opterećenje HRN U.C7.123
- za drvenu konstrukciju HRN U D0.001 – materijal za izradu drvenih konstrukcija i tehnički uvjeti

HRN U.C9.400 – drvene skele i oplata
HRN U C.9.500 – zaštita drveta u konstrukcijama

5. ISPITIVANJE NOSIVOSTI TLA

Neće se raditi geomehanički elaborat. Kod izrade ovog statičkog računa uzeta je pretpostavljena minimalna nosivost tla od 15 N/cm2. Ukoliko se prilikom iskopa za temelje ustanovi drugačije stanje, investitor je o tome obavezan obavijestiti nadzornog inženjera i projektanta, koji će izvršiti kontrolu statičkog proračuna temeljne konstrukcije.

Slatina, veljača 2022.g. Projektant:

Željko Šaponja dipl.ing.građ.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

DOKAZ MEHANIČKE OTPORNOSTI I STABILNOSTI DRVENE KONSTRUKCIJE

- plan pozicija
- čelična konstrukcija
- temelji

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

KROVIŠTE

Odstupanje od projektne dokumentacije

- Bilo kakve promjene i odstupanja od projektne dokumentacije izvoditelj može izvesti jedino uz pismenu suglasnost nadzornog inženjera, koji procjenjuje u kojim je slučajevima potrebno pribaviti pisanu suglasnost projektanta, odnosno ishoditi izmjenu i dopunu projektne dokumentacije.

Kontrole svih materijala prije ugradnje

- Svi materijali, građevinski proizvodi i oprema mogu se ugrađivati ukoliko je njihova kvaliteta dokazana certifikatom sukladno posebnim propisima ili ispravama proizvođača - atestna dokumentacija.
- Atesti, mjerenja i ispitivanja koja je izvoditelj dužan posjedovati na gradilištu to priložiti uz Zahtjev za Tehnički pregled i Uporabnu dozvolu jesu ATESTI SVIH UGRADENIH MATERIJALA I OPREME.
- Kontrole se vrše osim preko navedenih proizvođačkih dokaza i vizualno priručnim probama, kontrolom oznake u pakiranju i drugim načinima.
- Kod dopreme materijala na gradilište nadzorni inženjer će ga pregledati i upisom u dnevnik izvijestiti o njegovom stanju. Ako se pri tome utvrdi da materijal ne udovoljava zahtjevima projekta i nije u skladu s odgovarajućim Hrvatskim normama, na zahtjev nadzornog inženjera izvoditelj je dužan otkloniti nedostatke ili nabaviti drugi odgovarajući materijal.
- Puno drvo potrebno je nakon sušenja pravilno skladištiti. Projektant konstrukcije u glavnom projektu propisuje dimenzije i klasu punog drva.
- Klasificiranje drva izvodi se vizualnom metodom prema normi HRN EN 14081-1.
- Klasifikaciju provodi osoba koja je educirana i osposobljena za provođenje radne operacije.
- Prilikom klasifikacije identificiraju se greške drva, mjere dimenzije drva i vlažnost drva te se nakon toga drvo razvrstava u pripadajući razred čvrstoće.
- Pri klasifikaciji vode se potrebni zapisi prema normi HRN EN 14081-1
- Prije izvođenja zaštite građevinskog drveta mora se svaki element potpuno završiti (bez okova), a poslije provedene zaštite nije dozvoljena nikakva dodatna obrada.

  Obavezno prije premazivanja očistiti građu od prašine, masnoća, prljavštine do stupnja da bude potpuno čist. Ukoliko je drvo ispucalo treba pukotine naročito dobro natopiti zaštitnim sredstvom. Premazivanje čelnih strana drveta dozvoljeno je samo sredstvima koja ne sprečavaju cirkulaciju zraka. Vrsta zaštitnog sredstva u pravilu se ne propisuje ali isti mora imati tražena svojstva. Drveni elementi iznad otvorene terase i krovne emplate dodatno de se zaštiti i mehanički kako elementi konstrukcije ne bi direktno bili izloženi utjecaju atmosferilija. Način zaštite propisat će se izvedbenim projektom.

  Oslanjanje drvenih nosača na zidove i stupove izvest će se preko podmetača (tvrdo drvo), a sve ostale površine su ventilirane.

Održavanje drvene konstrukcije

- Održavanje drvene konstrukcije mora biti takvo da se tijekom trajanja građevine očuvaju njezina tehnička svojstva i ispunjavaju zahtjevi određeni ovim projektom i u njemu primijenjenim Propisima.

  U okviru održavanja drvenu konstrukciju treba:

a) redovito pregledati svakih deset godina
b) izvanredno pregledati nakon kakvog izvanrednog događaja ili po zahtjevu inspekcije
c) na konstrukciji izvoditi radove kojima se drvena konstrukcija zadržava ili vraća u stanje određeno projektom.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

A.B. ELEMENTI

BETON

Beton je građevni proizvod izrađen od cementa, agregata, dodataka betonu i vode. TPBK propisuje tehnička svojstva i druge zahtjeve za beton koji se ugrađuje u betonsku konstrukciju te način potvrđivanja sukladnosti betona.

Tehnička svojstva betona i materijala o kojih se beton proizvodi moraju biti specificirana prema TPBK i normi HRN EN 206-1, te normama i specifikacijama za materijale.

Svojstva svježeg betona specificira izvođač radova, ili su prema potrebi specificirana u projektu betonske konstrukcije. Proizvođač je odgovoran za proizvodnju i transport, a izvođač za ugradnju, zbijanje i njegu svježeg betona. Postupak njege betona provodi se prema HRN ENV 13670-1.

Najčešći pojmovi kojima se definiraju i mjere svojstva svježeg betona jesu: konzistencija, izdvajanje vode, segregacija, vrijeme vezivanja, homogenost, temperatura, količina pora.

Osnovni je cilj pri projektiranju sastava betona ostvariti takvu konzistenciju svježeg betona, da se beton uz raspoloživa transportna sredstva i sredstva za zbijanje, može uspješno ugraditi do propisane gustoće.

Ispitivanja svježeg betona trebaju biti učestala u početku proizvodnje određenog betona. Redovita kontrolna ispitivanja obuhvaćaju sljedeća svojstva: konzistencija, gustoća, temperatura, količina zraka. Analizom svježeg betona provjerava se stvarni sastav betona nakon miješanja u miješalici ili nakon dopreme do gradilišta, a sastoji se od provjere:

- količine vode u uzorku
- količine cementa

Svojstva očvrslog betona specificiraju se u projektu betonske konstrukcije. Obavezno se specificira razred tlačne čvrstoće te ostala svojstva po potrebi (otpornost na cikluse smrzavanja i odmrzavanja, vodonepropusnost itd.)

Tlačna čvrstoća betona je obavezno svojstvo koje se definira kod očvrsnulog betona. Za razvrstavanje se mogu upotrijebiti čvrstoća valjka promjera 150 mm i visine 300 mm ($f_{ck,cyl}$) starosti 28 dana ili karakteristična čvrstoća kocke brida 150 mm ($f_{ck,cube}$) starosti 28 dana. Proizvođač treba prije početka betoniranja odrediti prihvaća li se tlačna čvrstoća na osnovi ispitivanja kocaka ili valjaka. Ukoliko je predviđen drugačiji postupak, trebaju se usuglasiti uvjetovatelj (sastavljač specifikacije) i proizvođač. U posebnim slučajevima može se zahtijevati tlačna čvrstoća betona pri starosti betona manjoj ili većoj od 28 dana.

Za predviđenu betonsku konstrukciju i njene dijelove beton mora biti razreda tlačne čvrstoće: - C25/30.

Prema TPBK i normi HRN EN 206-1 zaštita armature od korozije u betonu postiže se izvedbom zahtijevanog zaštitnog sloja betona, izborom vrste cementa i ograničenjem maksimalne količine kloridnih iona u betonu. Jedna je od glavnih mjera zaštite armature od korozije, ali i povećanja trajnosti ostvarivanje kvalitetnog betona u području zaštitnog sloja, te projektiranje i izvedba debljine zaštitnog sloja.

Minimalna debljina zaštitnog sloja betona utvrđuje se u ovisnosti o razredu izloženosti te načinu armiranja elementa.

Djelovanje okoliša na konstrukciju, odnosno njene dijelove svrstava se u sedam razreda izloženosti (prema HRN EN 206-1). Zahtjevi za svaki razred izloženosti određuju se:

- dopuštenim tipom i razredom sastavnog materijala
- najvećim omjerom v/c
- najmanjim sadržajem cementa
- najmanjom tlačnom čvrstoćom betona

Za svaki pojedini razred izloženosti dane su preporuke za izbor graničnih vrijednosti sastava za predviđeni uporabni vijek konstrukcije od 50 godina te odgovaraju cementu tipa CEM I agregatu nazivnog najvećeg zrna od 20 do 32 mm. Najmanji razredi čvrstoće su izvedeni iz odnosa omjera v/c i razreda čvrstoće betona proizvedenog s cementom razreda 32,50.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

S obzirom na uvjete okoliša u kojima će se nalaziti betonska konstrukcija i njeni dijelovi svrstavamo je u razred izloženosti XC1 (zatvorena građevina).

Na osnovu razreda izloženosti određujemo i nazivnu veličinu zaštitnog sloja betona (c_{nom}) prema izrazu:

$$c_{nom} = c_{min} + \Delta c \ \ (mm)$$

gdje je: c_{min} – najmanja debljina zaštitnog sloja ovisna o razredu agresivnog djelovanja iz okoliša

Δc – dopušteno odstupanje zaštitnog sloja

- debljina zaštitnog sloja betona c_{nom}:
  - betonska konstrukcija iznad zemlje 3 cm
  - beton temelja 5 cm

Potvrđivanje sukladnosti sastoji se od kontrole proizvodnje koju provodi proizvođač betona uz ovlašteno tijelo. Potvrđivanje sukladnosti je postupak kojim se potvrđuje da proizvedeni beton ima svojstva prema tehničkoj specifikaciji HRN EN 206-1, prema Prilogu ˝A˝ TPBK što je potrebno dokumentirati.

Za betone i betonske proizvode proizvedene na gradilištu, a u skladu sa projektom betonske konstrukcije, potrebno je dokazati uporabljivost u skladu sa projektom betonske konstrukcije i TPBK.

Osim isprave o sukladnosti isporučeni građevni proizvod mora pratiti otpremnica koja sadrži podatke propisane u Prilogu ˝A˝. Uzimanje uzoraka, priprema ispitnih uzoraka i ispitivanje svojstava svježeg betona provodi se prema normama niza HRN EN 12350, a ispitivanje svojstava očvrslog betona prema normama niza HRN EN 12390.

Kada se betonara nalazi na gradilištu pri uzimanju uzoraka i potvrđivanju sukladnosti betona u gradilišnoj dokumentaciji i ostaloj dokumentaciji ispitivanja navodi se obavezno oznaka pojedinačnog elementa betonske konstrukcije i mjesta u elementu betonske konstrukcije na kojem je ugrađen beton iz kojeg je uzet uzorak.

Označavanje betona u projektnim specifikacijama proizvođačevim izjavama i sličnim dokumentima treba provoditi prema uputama poglavlja 11 norme HRN EN 206-1 koje se svode na obavezno navođenje norme HRN EN 206-1 i skraćenica specificiranih svojstava (razred tlačne čvrstoće, granične vrijednosti prema razredima izloženosti, najveće količine klorida, najveće nazivne gornje veličine zrna agregata, gustoće, konzistencije itd.).

Izvođenje i održavanje betonskih konstrukcija obuhvaćeno je Prilogom ˝J˝ TPBK-a.

Pri izvođenju betonske konstrukcije izvođač je dužan pridržavati se projekta betonske konstrukcije i tehničkih uputa za ugradnju i uporabu građevnih proizvoda i odredaba TPK-a.

Postignuta propisana svojstva i uporabljivost građevnog proizvoda izrađenog na gradilištu izvođač treba zapisivati sukladno posebnim propisima o vođenju građevinskog dnevnika.

Zabranjena je ugradnja građevnog proizvoda koji je isporučen bez oznake s posebnim propisom, bez tehničke upute za ugradnju i uporabu i koji nema svojstva zahtijevana projektom ili mu je istekao rok uporabe, odnosno čiji podaci značajni za ugradnju, uporabu i utjecaj na svojstva i trajnost betonske konstrukcije nisu sukladni podacima određenim glavnim projektom.

Ugradnju građevnog proizvoda mora odobriti nadzorni inženjer što zapisuje u skladu s posebnim propisom o načinu vođenja građevinskog dnevnika.

ARMATURA I ČELIK ZA ARMIRANJE

Tehnička svojstva i drugi zahtjevi, te dokazivanje uporabljivosti armature provodi se prema projektu betonske konstrukcije.

Tehnička svojstva i drugi zahtjevi, te potvrđivanje sukladnosti armature proizvedene prema tehničkoj specifikaciji (normi ili tehničkom dopuštenju) provodi prema toj specifikaciji, prema normama iz Priloga ˝B˝ TPBK-a i normama na koje one upućuju, te u skladu s odredbama posebnog propisa.

Tehnička svojstva armature moraju ispunjavati opće i posebne zahtjeve bitne za krajnju namjenu i ovisno o vrsti čelika moraju biti specificirana prema normama nizova nHRN EN 10080 odnosno nHRN EN:10138 i odredbama Priloga ˝B˝ TPBK-a.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Armatura se izrađuje odnosno proizvodi kao armatura za armirane betonske konstrukcije, od čelika za armiranje.

Tehnička svojstva armature, čelika za armiranje specificiraju se u projektu betonske konstrukcije odnosno u tehničkoj specifikaciji za taj proizvod.

Dokazivanje uporabljivosti armature izrađene prema projektu betonske konstrukcije provodi se prema tom projektu te odredbama Priloga ˝B˝ TPBK-a, i uključuje zahtjeve za:

a) izvođačevom kontrolom izrade i ispitivanja armature

b) nadzorom proizvodnog pogona i nadzorom izvođačeve kontrole izrade armature, na način primjeren postizanju tehničkih svojstava betonske konstrukcije, a u skladu s ovim TPBK

Potvrđivanje sukladnosti armature proizvedene prema tehničkoj specifikaciji provodi se prema odredbama te specifikacije, te odredbama Priloga ˝B˝ TPBK-a i posebnog propisa. Potvrđivanje sukladnosti čelika za armiranje provodi se prema sustavu ocjenjivanja 1+ te prema normi HRN EN 10080.

Armatura proizvedena prema tehničkoj specifikaciji označava na otpremnici i na oznaci prema odredbama te specifikacije. Oznaka mora obvezno sadržavati upućivanje na tu specifikaciju, a u skladu s posebnim propisom.

Čelik za armiranje označava se na otpremnici i na oznaci prema odgovarajućim normama. Oznaka mora obvezno sadržavati upućivanje na tu normu, a u skladu s posebnim propisom.

Uzimanje uzoraka, priprema ispitnih uzoraka i ispitivanje svojstava čelika za armiranje provodi se prema odgovarajućim normama. Ako je armatura sklop čelika za armiranje i drugog čeličnog proizvoda (čelični lim, čelični profil, čelična cijev i sl.) uzimanje uzoraka i priprema ispitnih uzoraka za mehanička ispitivanja tih čeličnih proizvoda provodi se prema odgovarajućim normama.

Pri ugradnji armature treba odgovarajuće primijeniti pravila određena Prilogom »J« TPBK-a te:

– pojedinosti koje se odnose na ugradnju armature,

– pojedinosti koje se odnose na sastavne materijale od kojih se armatura izrađuje te norme kojima se potvrđuje sukladnost tih proizvoda,

– pojedinosti koje se odnose na uporabu i održavanje, dane projektom betonske konstrukcije i/ili tehničkom uputom za ugradnju i uporabu.

Pri izradi ili proizvodnji armature treba poštivati pravila armiranja prema Prilogu »I« TPBK-a.

Armatura od čelika za armiranje ima nastavke u obliku prijeklopa, zavara ili mehaničkog spoja. Oni se proizvode i potvrđuje im se sukladnost prema tehničkoj specifikaciji ili se izrađuju prema projektu betonske konstrukcije.

Armatura izrađena prema projektu betonske konstrukcije smije se ugraditi u betonsku konstrukciju ako je sukladnost čelika, zavara, mehaničkih spojeva, spojki potvrđena ili ispitana na način određen Prilogom ˝B˝ TPBK-a i ako ispunjava zahtjeve projekta betonske konstrukcije.

Prije ugradnje armature provode se odgovarajuće nadzorne radnje određene normom HRN ENV 13670-1, te druge kontrolne radnje određene Prilogom »J« TPBK-a.

CEMENT

Tehnička svojstva i drugi zahtjevi, te potvrđivanje sukladnosti cementa, određuje se odnosno provodi prilogu ˝C˝ TPBK.

Tehnička svojstva cementa specificiraju se u projektu betonske konstrukcije.

AGREGAT

Agregat je granulirani materijal koji se upotrebljava za izradu betona. Agregat može biti prirodni, umjetni (industrijski proizveden) ili recikliran od materijala prethodno upotrjebljenih u građenu.

Tehnička svojstva i drugi zahtjevi, te potvrđivanje sukladnosti agregata određuje se odnosno provodi, prema normama na koje upućuje prilog ˝D˝ TPBK-a.

Odredbe Priloga ˝D˝ TPBK-a primjenjuju se na agregat koji je sastavni dio betona iz Priloga ˝A˝ TPBK-a. Obični agregat je agregat je agregat za beton gustoće čestica veće od 2000 kg/m^3. Lagani agregat je agregat gustoće zrna ne veće od 2000 kg/m^3 ili nasipanom gustoćom ne većom od 1200 kg/m^3 proizveden preradom prirodnih, industrijski proizvedenih ili recikliranih materijala.

Tehnička svojstva agregata za beton moraju ispunjavati, ovisno o podrijetlu agregata, opće i posebne zahtjeve bitne za krajnju namjenu u betonu i moraju biti specificirana prema normama priloga ˝D˝ TPBK-a.

Potvrđivanje sukladnosti agregata za beton provodi se prema odredbama Dodatka ZA norme HRN EN 12620 i odredbama posebnog propisa ako Prilogom ˝D˝ TPBK-a nije drugačije određeno.

Potvrđivanje sukladnosti laganog agregata za beton provodi se prema odredbama Dodatka ZA norme HRN EN 13055-1 te odredbama Priloga ˝D˝ TPBK-a i posebnog propisa.

Agregat za beton označava se na otpremnici i na pakovini prema normi HRN EN 12620. Oznaka mora obvezno sadržavati upućivanje na tu normu, a u skladu s posebnim propisom.

Lagani agregat za beton označava se na otpremnici i na pakovini prema normi HRN EN 13055-1. Oznaka mora obvezno sadržavati upućivanje na tu normu, a u skladu s posebnim propisom.

Ispitivanje svojstava, ovisno o vrsti agregata za beton i laganog agregata za beton, provodi se prema normama niza HRN EN 932, HRN EN 933, HRN EN 1097, HRN EN 1367 i HRN EN 1744, i odredbama Priloga ˝D˝ TPBK-a

Uzimanje i priprema uzoraka za ispitivanje svojstava, ovisno o vrsti agregata za beton i laganog agregata za beton, provodi se prema normama niza HRN EN 932, HRN EN 933, HRN EN 1097, HRN EN 1367 i HRN EN 1744, i odredbama Priloga ˝D˝ TPBK-a.

Kontrola agregata provodi se u centralnoj betonari (tvornici betona), u betonari pogona za predgotovljene betonske elemente i u betonari na gradilištu prema normi HRN EN 206-1. Kontrola agregata provodi se odgovarajućom primjenom normi iz točke D.3.1. Priloga ˝D˝ TPBK-a.

Proizvođač i distributer agregata te proizvođač betona dužni su poduzeti odgovarajuće mjere u cilju održavanja svojstava agregata tijekom rukovanja, prijevoza, pretovara i skladištenja prema Dodatku ˝H˝ norme HRN EN 12620, odnosno Dodatku ˝F˝ norme HRN EN 13055-1.

VODA

Tehnička svojstva i drugi zahtjevi, te potvrđivanje prikladnosti vode određuju se odnosno provodi prema normi HRN EN 1008:2002.

Tehnička svojstva vode za primjenu u betonu moraju ispunjavati opće i posebne zahtjeve bitne za svojstva betona i moraju se specificirati prema normi HRN EN 1008, normama na koje ta norma upućuje i odredbama Priloga ˝F˝ TPBK-a.

Potvrđivanje prikladnosti provodi se u skladu s odredbama norme HRN EN 1008, i odredbama Priloga ˝F˝ TPBK-a. Za pitku vodu iz vodovoda nije potrebno provoditi potvrđivanje prikladnosti za pripremu betona. Morska i boćata voda nisu prikladne za pripremu betona za armirane betonske konstrukcije. Ispitivanje sadržaja i granične količine štetnih tvari u vodi i utjecaja tih voda na svojstva svježeg i očvrsnulog betona provodi se i određuje prema normi HRN EN 1008 i normama na koje ta norma upućuje, te odredbama Priloga ˝F˝ TPBK-a.

Ispitivanje uporabivosti prikladnosti vode provodi se prije prve uporabe, te u slučaju kada je došlo do promjene u koncentraciji štetnih tvari u vodi u slučaju kada postoji sumnja da je došlo do promjene u njenom sastavu.

Kontrola vode provodi se u centralnoj betonari (tvornici betona), betonari na gradilištu prije prve uporabe te u slučaju kada postoji sumnja da je došlo do promjene njezinih svojstava.

Kontrola u slučaju kada postoji sumnja da je došlo do promjene svojstava vode provodi se odgovarajućom primjenom norme HRN EN 1008 i normama na koje ta norma upućuje.

IZVOĐENJE BETONSKIH KONSTRUKCIJA

Izvođenje betonskih konstrukcija, nadzorne radnje i kontrolni postupci na gradilištu treba provoditi sukladno Prilogu ˝J.

PRIMJENA ZAKONSKIH ZAHTJEVA NA IZVEDBU BETONSKIH RADOVA

Izvođač betonskih radova sukladno odredbama važećeg Zakona o gradnji i odredbama TPBK dužan je provoditi sljedeće:

- ugrađivati beton u skladu sa Zakonom (prema TPBK-u – Prilog ˝J˝, normi HRN ENV 13670-1, normi HRN EN 206-1 i tehničkoj uputi proizvođača betona)

- osigurati dokaze o uporabljivosti ugrađenih betona (pribaviti proizvođačevu izjavu o sukladnosti betona i tehničku uputu za ugradnju i uporabu)

- provjeravati sadržavaju li dostavnice za isporučeni beton, oznaku i sve podatke o tehničkim svojstvima isporučenog betona prema TPBK-u, normi HRN EN 206-1 i pravilniku o ocjenjivanju sukladnosti, ispravama o sukladnosti i označavanju građevnih proizvoda te jesu li ti podaci u skladu s podacima o specifikaciji narudžbe betona

- podatke o isporuci i preuzimanju betona zapisivati u građevinski dnevnik

- izjave o sukladnosti betona, tehničke upute za ugradnju i uporabu, specifikacije narudžbi betona i dostavnice isporučenog betona pohranjivati među dokaze o sukladnosti građevnih proizvoda koje proizvođač treba imati na gradilištu

- osigurati isprave o sukladnosti betonske konstrukcije s bitnim zahtjevima za građevinu (izvještaj o ispitivanju mehaničke otpornosti i stabilnosti konstrukcije pokusnim opterećenjem za konstrukcije za koje je to propisano tehničkim propisom)

- osigurati dokaze kvalitete betona tijekom izvođenja betonskih radova (zapise rezultata, ispitivanja svježeg i očvrslog betona na mjesto ugradnje te zapise o provedenim procedurama kontrole kvalitete betona, najmanje u skladu s TPBK-om Prilog ˝J˝, točka J.2.1, ako projektom konstrukcije nisu određeni drugi zahtjevi za učestalost ispitivanja i/ili dodatna ispitivanja)

- sastaviti pisanu izjavu o izvedenim betonskim radovima (uz ostale vrste radova) i o uvjetima održavanja betonske konstrukcije

Obzirom da se radi o jednostavnoj građevini (< 2 kata) prema normi HRN EN 206-1 svrstavamo je u razred nadzora 1

Za jednostavne građevine u razredu nadzora 1 norma HRN ENV 13670-1 dodatak G predviđa provjeru otpremnice i vizualni pregled.

Prema zahtjevima Prilog ˝J˝ TPBK-a propisan je najmanji opseg kontrolnih postupaka utvrđivanja svojstava betona na gradilištu:

- pregled podataka na dostavnici, vizualni pregled isporučenog betona i ovjera dostavnice, neposredno prije ugradnje

- uzorkovanja i ispitivanja potrebna za utvrđivanje svojstava svježeg betona na mjestu ugradnje (u slučaju sumnje , konzistencija i količina zraka, uključujući zapis)

- uzorkovanja na mjestu ugradnje potrebna za laboratorijska ispitivanja tlačne čvrstoće betona (uključujući i zapis o uzorkovanju)

- laboratorijska ispitivanja tlačne čvrstoće betona

Kontrolni postupak utvrđivanja tlačne čvrstoće betona na gradilištu provodi se primjenom kriterija za utvrđivanja istovjetnosti tlačne čvrstoće prema prilogu J TPBK.

Kontrola kvalitete betona obuhvaća:

- kontrolu proizvodnje betona u tvornici betona koja se obavlja u skladu sa zahtjevima 9. točke norme HRN 206-1, prema planu uzorkovanja, a obavlja je proizvođač betona do vremena predaje betona izvođaču radova

- kontrola kvalitete na gradilištu obavlja izvođač radova od vremena preuzimanja betona od proizvođača do završetka njege ugrađenog betona. U okviru ove kontrole uključeno je i mjerenje konzistencije svježeg betona i kontrola istovjetnosti tlačne čvrstoće u skladu s normom HRN EN 206-1.

Kontrola svojstava svježeg betona na mjestu ugradnje obuhvaća sljedeće radnje:

- pregled svake otpremnice
- vizualna kontrola konzistencije kod svake dopreme betona
- u slučaju opravdane sumnje ispitivanje konzistencije prema normi HRN EN 12350-2 (ispitivanje svježeg betona slijeganjem) o čemu treba voditi evidenciju
    - o Ispitivanje očvrsnulog betona sastoji se:
- tlačne čvrstoće prema normi HRN EN 12390-2 (uzorci će se uzimati i njegovati u skladu s normom HRN EN 12390-2, oblika 15x15x15 cm, ispitivanja će se evidentirati redoslijedom uzimanja uzoraka)
- minimalni broj uzoraka je za svaku vrstu betona 1 uzorak na 100 m^3 betona

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Njega betona je jedan od najvažnijih koraka u izradi betona. To je međutim često jedan od najzanemarljivijih koraka. Nepravilna ili nezadovoljavajuća njega može rezultirati sa sniženjem čvrstoće betona i otpornosti na abraziju i atmosferilije.

Zaštita betona od naglog površinskog isušivanja mora započeti već u prvim satima nakon ugradbe. Intenzivna njega mora trajati najmanje sedam dana. Ako se njega provodi vodom onda njena temperatura ne smije biti niža od temperature betona jer će u suprotnom doći do stvaranja termičkih pukotina po površini.

Ako se zaštita provodi kemijskim premazima koji su obično na bazi voskova, onda se mora prethodno provjeriti njihovo djelovanje na beton i ako na taj beton dolaze neki novi slojevi ili ostaje vidljiv, da li i za koje vrijeme taj premaz razgrađuje beton.

Oplata

Oplata se mora projektirati i konstruirati (prema normi HRN ENV 13670-1) tako da je:

1. **otporna na svako djelovanje tijekom izvedbe**
2. **dovoljno čvrsta da osigurava zadovoljenje dopuštenih odstupanja specificiranih za konstrukciju i da ne utječe na cjelovitost zadanog konstruktivnog elementa**

Oplata mora držati beton u zahtijevanom obliku sve dok ne očvrsne. Spojevi između dasaka ili panela moraju dovoljno brtviti kako bi spriječili gubitak finog morta. Unutarnja površina oplate mora biti čista. Oplatu treba prije betoniranja navlažiti kako bi se spriječio gubitak vode iz betona

Armatura

Čelik za armiranje i armatura koja se od njega izrađuje moraju zadovoljavati niz normi na koje upućuje Prilog ˝B˝ TPBK-a.

Prilikom transporta i uskladištenja čelika ne smije doći do mehaničkih oštećenja, lomova na mjestu zavarivanja i prljavštine koja može smanjiti adheziju, kao i do gubitka oznaka i smanjenja presjeka zbog korozije. Armatura se savija u hladnom stanju i nastavlja na način određen projektom konstrukcije. Prije postavljanja, armatura se mora očistiti od prljavštine i masnoća.
Nastavljanje armature zavarivanjem dozvoljeno je samo na ravnim dijelovima. Udaljenost zavara od početka krivine mora iznositi najmanje 10 Ø presjeka.

Ako se armatura postavlja na tlo, postavlja se izravnavajući sloj betona debljine najmanje 10cm. Pri ugrađivanju pocinčanih elemenata ne smije doći do kontakta tih elemenata s armaturom. Prije početka betoniranja mora se zapisnički utvrditi da li montirana armatura zadovoljava uvijete u pogledu:

- Presjeka, broja šipki i geometrije ugrađene armature predviđene projektom konstrukcije
- Učvršćivanja armature u oplati
- Mehaničkih karakteristika (granica razvlačenja i granica kidanja)

Armaturu koja je umazana cementnim malterom ili betonom potrebno je prije ugradnje betona očistiti.

Ugradnja betona

Ako se ugrađivanje betona prekida zbog nepredviđenih prilika, moraju se poduzeti mjere da takav prekid ugrađivanja betona ne utječe štetno na nosivost i ostala svojstva konstrukcije, odnosno elemenata. Ako prekid ugrađivanja nije izveden na način predviđen u projektu, izvođač radova mora na mjestu prekida očistiti površinu betona, a po potrebi i ukloniti beton kako bi se dobila površina pogodna za nastavljanje daljnjeg ugrađivanja betona. Početna temperatura svježeg betona u fazi ugradnje ne smije biti niža od 5^0C. Najviša temperatura svježeg betona koji se ne ugrađuje posebnim postupcima predviđenim za temperirane betone ne smije biti viša od 30^0C.

Beton se mora transportirati i ubacivati u oplatu na način i pod uvjetima koji sprečavaju segregaciju betona i promjene u sastavu i svojstvima betona.

U konstrukciju se mora ugrađivati beton takove konzistencije da se može kvalitetno ugraditi do zahtijevane zapreminske mase i zbijati predviđenim mehaničkim sredstvima za ugrađivanje. Svježem betonu se ne smije naknadno dodavati voda.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Visina slobodnog pada betona ne smije biti veća od 1.50m, ako nisu poduzete potrebne mjere za sprječavanje segregacije betona.

Beton se unosi u slojevima ne višim od 70 cm. Naredni sloj mora se ugraditi u vremenu koje osigurava spajanje betona s prethodnim slojem. Ugrađivanje betona u više slojeva izvodi se tako da gornji sloj vibrira, a donji sloj revibrira.

Nadzor

Provođenje nadzora provodi se sukladno Zakonu o prostornom uređenju i gradnji NN 76/07, normom HRN ENV 13670-1 – izvedba betonskih konstrukcija, TPBK-om i svim ostalim normama i zakonima te pravilnicima koji su vezani uz građenje.

Norma HRN ENV 13670-1 definira:
- razred nadzora
- nadzor materijala i proizvoda
- područje nadzora izvedbe
- nadzor skele i oplate
- nadzor armature
- nadzor prije betoniranja
- nadzor predgotovljenih elemenata
- djelovanje u slučaju nesukladnosti

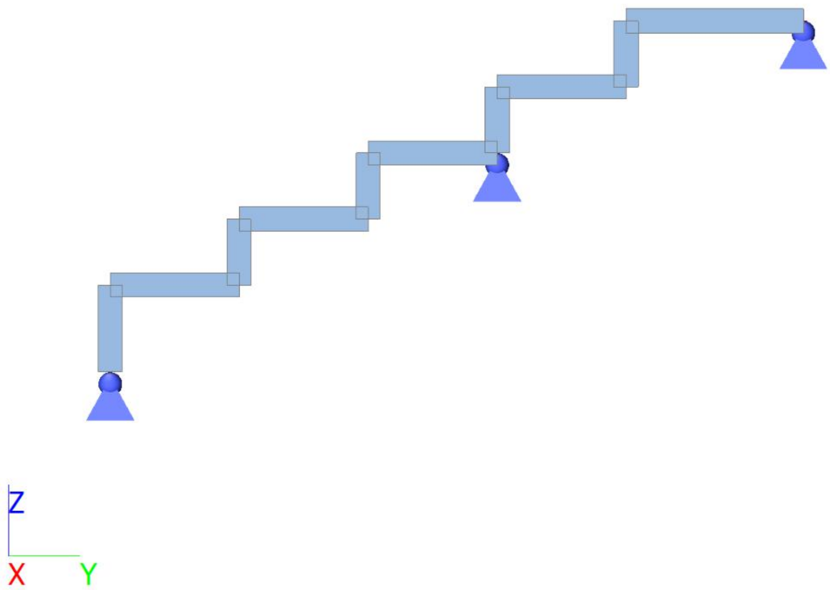
PROJEKTIRANI VIJEK I ODRŽAVANJE ARMIRANO BETONSKE KONSTRUKCIJE

Sukladno normi HRN ENV 1991-1:2005 projektirani vijek konstrukcije u ovisnosti o tlačnoj čvrstoći (C25/30) i razredu izloženosti (XC1) iznosi 50 godina.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

GLEDALIŠTE

1. Model konstrukcije



2. Materials

Name	Type	ρ [kg/m³]	Density in fresh state [kg/m³]	E_{mod} [MPa]	μ	α [m/mK]	$f_{c.k.28}$ [MPa]	Colour
C25/30	Concrete	2500.0	2600.0	3.1500e+04	0.2	0.00	25.00	

Explanations of symbols	
Density in fresh state	The value in the density in fresh state property is used only in case a composite deck is input and its self-weight load is taken into account.

Reinforcement EC2

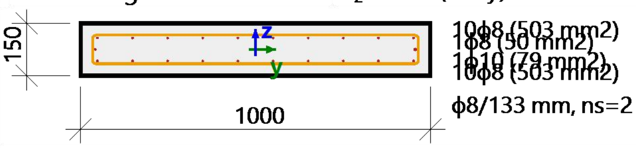
Name	Type	ρ [kg/m³]	E_{mod} [MPa]	G_{mod} [MPa]	α [m/mK]	$f_{y.k}$ [MPa]
B 500B	Reinforcement steel	7850.0	2.0000e+05	8.3333e+04	0.00	500.0

3. Check capacity-response

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Member
Extreme 1D: Global
Selection: B1, B2

Beam B2	**Rectangle (150; 1000)**
EC EN 1992-1-1:2004/AC:2008	Section 0 [dx = 0 m]

Member length: L = 0.8 m
Buckling y-y: L_y = 1.71 m (sway)
Buckling z-z: L_z = 8 m (sway)



Concrete: C25/30
Bi-linear stress-strain diagram
Exposure class: XC3

Longitudinal reinforcement: B 500B
Bi-linear with an inclined top branch
21ϕ8 mm + 1ϕ10 mm (A_s = 1134 mm^2)
ρ_l = 0.756 % (8.9 kg/m)

Shear reinforcement: B 500B
Bi-linear with an inclined top branch
ϕ8/133 mm (n_s = 2) (A_{sw} = 101 mm^2)
ρ_w = 0.503 % (5.92 kg/m) (A_{swm} = 754 mm^2/m)

Cover (stirrup)
Top: 30 mm
Bottom: 30 mm
Left: 30 mm
Right: 30 mm

Material characteristics

Design concrete compressive strength

$$f_{cd} = \frac{\alpha_{cc} \cdot f_{ck}}{\gamma_C} = \frac{1 \cdot 25}{1.5} = 16.7 \text{ MPa}$$

Design yield strength of longitudinal reinforcement

$$f_{yd} = \frac{f_{yk}}{\gamma_S} = \frac{500}{1.15} = 435 \text{ MPa} \quad (3.15)$$

Forces

Content of combination: 1.35*LC1+1.35*LC2+1.50*LC3

From FEM analysis:

N = -9.74 kN M_y = -5.26 kNm M_z = 0 kNm

Compression member

Limit axial force to consider member as compression:

$$N_{com} = -Coeff_{com} \cdot \left(f_{cd} \cdot A_c \right) = -0.1 \cdot \left(16.7 \cdot 10^6 \cdot 0.15 \right) = -250 \text{ kN}$$

Check condition:

$N_{Ed} \geq N_{com}$ = -10 kN ≥ -250 kN ...   not compression member

Note: The member is not considered as a compression member (normal force is relatively small or zero).

Recalculation of bending moments:

Moment reduction above support: No   Shear forces reduction above support: No

Use Shift rule: Yes

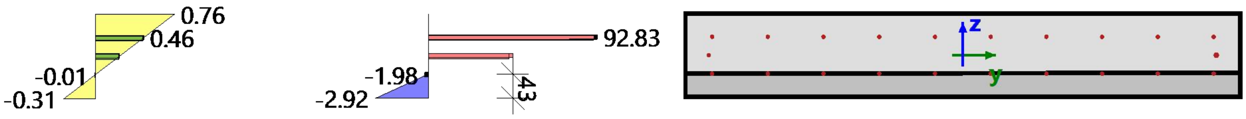
N_{Ed} = -9.74 kN M_{Edy} = -5.26 kNm M_{Edz} = 0 kNm

Summary of check

Type of component	Fibre / Bar	ε_{extr} [‰]	σ_{extr} [MPa]	Check strain [-]	Check stress [-]	UC [-]	Limit [-]	Status
Concrete	1	-0.306	-2.92	0.09	0.17	0.20	1	OK
Reinf.	20	0.464	92.8	0.01	0.20			

List of errors/warnings/notes: N2/1.

Stress and strain distribution



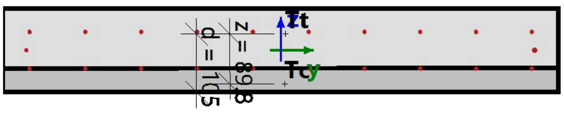
Extreme values of stress/strain in component

Type of component	Fibre / Bar	ε [‰]	ε_{lim} [‰]	σ [MPa]	σ_{lim} [MPa]	UC [-]	Status
Concrete - compression	1	-0.306	-3.5	-2.92	-16.7	0.17	OK
Concrete - tension	5	0.76	0	0	0	0.00	OK
Reinforcement - compression	10	$-9.91 \cdot 10^{-3}$	-45	-1.98	-466	0.00	OK
Reinforcement - tension	20	0.464	45	92.8	466	0.20	OK

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Plane of deformation

Strain in centre of gravity	ε_x = 0.227 ‰
Curvature around (y) axis	ε_y = 7.04 ‰
Curvature around (z) axis	ε_z = -0.01 ‰
Height of compression zone	x = 43 mm
Balanced height of compression zone	x_{bal} = 63 mm
Limit height of compression zone	x_{lim} = 8 mm
Declination of neutral axis	α_{NA} = 0.08 °
Height of cross-section perpendicular to neutral axis	h = 151 mm
Effective depth of the cross-section perpendicular to the neutral axis	d = 104 mm
Lever arm of the cross-section perpendicular to the neutral axis	z = 90 mm



Cross-section characteristics

Type of component	t_y [m]	t_z [m]	A [m^2]	I_y [m^4]	I_z [m^4]
Concrete - compression	$3 \cdot 10^{-3}$	-0.054	0.0427	$129 \cdot 10^{-6}$	$3.56 \cdot 10^{-3}$
Concrete - tension	$-1 \cdot 10^{-3}$	0.021	0.107	$152 \cdot 10^{-6}$	$8.94 \cdot 10^{-3}$
Reinforcement - compression	0	-0.033	$503 \cdot 10^{-6}$	$547 \cdot 10^{-9}$	$41.8 \cdot 10^{-6}$
Reinforcement - tension	0.02	0.026	$631 \cdot 10^{-6}$	$547 \cdot 10^{-9}$	$68.8 \cdot 10^{-6}$
Whole concrete	0	0	0.15	$281 \cdot 10^{-6}$	0.0125
All reinf. bars	0.011	0	$1.13 \cdot 10^{-3}$	$1.09 \cdot 10^{-6}$	$111 \cdot 10^{-6}$

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Forces in all cross-section components

Type of component	N_{res} [kN]	$M_{res,y}$ [kNm]	$M_{res,z}$ [kNm]	e_y [m]	e_z [m]
Concrete - compression	-61.2	-3.72	0.35	$6 \cdot 10^{-3}$	-0.061
Concrete - tension	0	0	0	0	0
Reinforcement - compression	-0.52	-0.02	0.09	0.167	-0.033
Reinforcement - tension	52	-1.52	-0.44	$8 \cdot 10^{-3}$	0.029
All in compression	-61.8	-3.74	0.44	$7 \cdot 10^{-3}$	-0.061
All in tension	52	-1.52	-0.44	$8 \cdot 10^{-3}$	0.029
Summary	-9.75	-5.26	0		

Detailed results of stresses and strains in concrete fibres

Fibre	Material	y_i [m]	z_i [m]	ε [‰]	ε_{lim} [‰]	σ [MPa]	σ_{lim} [MPa]	$\varepsilon / \varepsilon_{lim}$ [-]	σ / σ_{lim} [-]	Check
1	C25/30	0.5	-0.075	-0.31	-3.5	-2.92	-16.7	0.09	0.17	OK
2	C25/30	0.5	0	0.22	0	0	0	0	0	OK
3	C25/30	0.5	0.075	0.75	0	0	0	0	0	OK
4	C25/30	0	0.075	0.76	0	0	0	0	0	OK
5	C25/30	-0.5	0.075	0.76	0	0	0	0	0	OK
6	C25/30	-0.5	0	0.23	0	0	0	0	0	OK
7	C25/30	-0.5	-0.075	-0.3	-3.5	-2.82	-16.7	0.08	0.17	OK
8	C25/30	0	-0.075	-0.3	-3.5	-2.87	-16.7	0.09	0.17	OK

Detailed results of stresses and strains in reinforcement bars

Bar	Material	d_s [mm]	y_i [m]	z_i [m]	ε [‰]	$ε_{lim}$ [‰]	σ [MPa]	$σ_{lim}$ [MPa]	ε / $ε_{lim}$ [-]	σ / $σ_{lim}$ [-]	Check
1	B 500B	8	-0.452	-0.033	0	-45	-0.1	-466	0	0	OK
2	B 500B	8	-0.352	-0.033	0	-45	-0.31	-466	0	0	OK
3	B 500B	8	-0.251	-0.033	0	-45	-0.51	-466	0	0	OK
4	B 500B	8	-0.151	-0.033	0	-45	-0.72	-466	0	0	OK
5	B 500B	8	-0.05	-0.033	0	-45	-0.93	-466	0	0	OK
6	B 500B	8	0.05	-0.033	-0.01	-45	-1.14	-466	0	0	OK
7	B 500B	8	0.151	-0.033	-0.01	-45	-1.35	-466	0	0	OK
8	B 500B	8	0.251	-0.033	-0.01	-45	-1.56	-466	0	0	OK
9	B 500B	8	0.352	-0.033	-0.01	-45	-1.77	-466	0	0	OK
10	B 500B	8	0.452	-0.033	-0.01	-45	-1.98	-466	0	0	OK
11	B 500B	8	0.452	0.033	0.45	45	90.9	466	0.01	0.2	OK
12	B 500B	8	0.352	0.033	0.46	45	91.2	466	0.01	0.2	OK
13	B 500B	8	0.251	0.033	0.46	45	91.4	466	0.01	0.2	OK
14	B 500B	8	0.151	0.033	0.46	45	91.6	466	0.01	0.2	OK
15	B 500B	8	0.05	0.033	0.46	45	91.8	466	0.01	0.2	OK
16	B 500B	8	-0.05	0.033	0.46	45	92	466	0.01	0.2	OK
17	B 500B	8	-0.151	0.033	0.46	45	92.2	466	0.01	0.2	OK
18	B 500B	8	-0.251	0.033	0.46	45	92.4	466	0.01	0.2	OK
19	B 500B	8	-0.352	0.033	0.46	45	92.6	466	0.01	0.2	OK
20	B 500B	8	-0.452	0.033	0.46	45	92.8	466	0.01	0.2	OK
21	B 500B	8	-0.458	0	0.23	45	46.4	466	0.01	0.1	OK
22	B 500B	10	0.457	0	0.22	45	44.5	466	0	0.1	OK

Explanation of errors, warnings and notes

Index	Type	Description	Solution
N2/1	Note	The member is not considered as a compression member (normal force is relatively small or zero).	

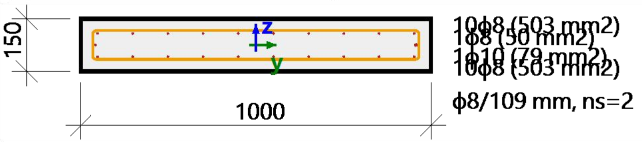
INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

4. Check Stress limitation

Linear calculation
Combination: SLS-Char (auto)
Coordinate system: Member
Extreme 1D: Global
Selection: B1, B2

Beam B1	**Rectangle (150; 1000)**
EC EN 1992-1-1:2004/AC:2008	Section 9 [dx = 0.54 m]

Member length: L = 0.54 m
Buckling y-y L_y = 5.4 m (sway)
Buckling z-z L_z = 5.4 m (sway)



Concrete: C25/30
Bi-linear stress-strain diagram
Exposure class: XC3

Longitudinal reinforcement: B 500B
Bi-linear with an inclined top branch
21ϕ8 mm + 1ϕ10 mm (A_s = 1134 mm^2)
ρ_l = 0.756 % (8.9 kg/m)

Shear reinforcement: B 500B
Bi-linear with an inclined top branch
ϕ8/109 mm (n_s = 2) (A_{sw} = 101 mm^2)
ρ_w = 0.615 % (7.25 kg/m) (A_{swm} = 923 mm^2/m)

Cover (stirrup)
Top: 30 mm
Bottom: 30 mm
Left: 30 mm
Right: 30 mm

Material characteristics

Characteristic concrete compressive strength

f_{ck} = 25 MPa

Characteristic yield strength of longitudinal reinforcement

f_{yk} = 500 MPa

Mean tensile concrete strength

f_{ctm} = 2.6 MPa

Modulus of elasticity of concrete:

E_c = 32 GPa

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Forces

From FEM analysis

Characteristic values:

LC1+LC2+LC3

$N = -11.8$ kN $M_y = -3.77$ kNm $M_z = 0$ kNm

Quasi-permanent values:

LC1+LC2+0.30*LC3

$N_{qp} = -9.17$ kN $M_{y,qp} = -2.97$ kNm $M_{z,qp} = 0$ kNm

Angle of bending moment resultant: $\alpha_M = -90$ °

Compression member

Limit axial force to consider member as compression:

$$N_{com} = -Coeff_{com} \cdot \left(f_{cd} \cdot A_c \right) = -0.1 \cdot \left(16.7 \cdot 10^6 \cdot 0.15 \right) = -250 \text{ kN}$$

Check condition:

$N_{Ed} \geq N_{com} = -12$ kN ≥ -250 kN ... not compression member

Note: The member is not considered as a compression member (normal force is relatively small or zero).

Characteristic values: $N_{char,r} = -11.8$ kN $M_{y,char,r} = -3.77$ kNm $M_{z,char,r} = 0$ kNm

Quasi-permanent values: $N_{qp,r} = -9.17$ kN $M_{y,qp,r} = -2.97$ kNm $M_{z,qp,r} = 0$ kNm

Angle of bending moment resultant: $\alpha_{M,r} = -90$ °

Summary of check

Load	E type	E_c [MPa]	UC §7.2(2) [-]	Status §7.2(2) Char.	UC §7.2(3) [-]	Status §7.2(3) Q.-P.	UC §7.2(5) [-]	Status §7.2(5) Char.	UC [-]	Limit [-]	Status
Short	E_c	31500	0.00	OFF	0.07	OK	0.01	OK	0.07	1	OK

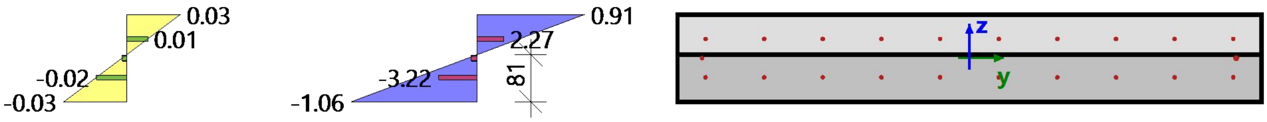
List of errors/warnings/notes: N2/1, N5/2.

Verification of cracks in cross-section

Load	Type of module	E_c [MPa]	Combi.	N_{Ed} [kN]	M_{Edy} [kNm]	M_{Edz} [kNm]	σ_{ct} [MPa]	h [mm]	$f_{ct,eff}$ [MPa]	Cracks appear
Short	E_c	31500	Char.	-11.8	-3.77	0	0.907	150	2.6	NO

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

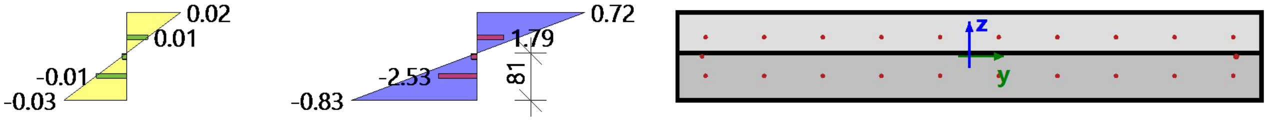
Stress-strain distribution before cracking (uncracked state) - short-term load



Cross-section characteristics

Load	Combi.	t_{iy} [m]	t_{iz} [m]	A_i [m^2]	I_{iy} [m^4]	I_{iz} [m^4]	x_i [m]	$\varepsilon_{c,max}$ [‰]	$\varepsilon_{c,min}$ [‰]	$\sigma_{c,max}$ [MPa]	$\sigma_{c,min}$ [MPa]
Short	Char.	$1 \cdot 10^{-3}$	0	0.157	$288 \cdot 10^{-6}$	0.0132	0.081	0.029	-0.034	0.91	-1.06
Short	Q.-P.	$1 \cdot 10^{-3}$	0	0.157	$288 \cdot 10^{-6}$	0.0132	0.081	0.023	-0.026	0.72	-0.83

Stress-strain distribution with concrete tensile strength under quasi-permanent combination - short-term load



Stress limitation in concrete

Check type	Load	N_{Ed} [kN]	M_{Edy} [kNm]	M_{Edz} [kNm]	y_i [mm]	z_i [mm]	σ_c [MPa]	$\sigma_{c,lim}$ [MPa]	$\sigma_c/\sigma_{c,lim}$ [-]	Status
§7.2(2) Char.	Short	-11.8	-3.77	0						OFF
§7.2(3) Q.-P.	Short	-9.17	-2.97	0	-0.5	-0.08	-0.832	-11.3	0.074	OK

Stress limitation in non-prestressed reinforcement

Check type	Load	N_{Ed} [kN]	M_{Edy} [kNm]	M_{Edz} [kNm]	y_i [mm]	z_i [mm]	σ_s [MPa]	$\sigma_{s,lim}$ [MPa]	$\sigma_s/\sigma_{s,lim}$ [-]	Status
§7.2(5) Char.	Short	-11.8	-3.77	0	0.45	0.03	2.27	400	$6 \cdot 10^{-3}$	OK

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Explanation of errors, warnings and notes

Index	Type	Description	Solution
N2/1	Note	The member is not considered as a compression member (normal force is relatively small or zero).	
N5/2	Note	Check of stress limitation is not required for the selected exposure class.	Change the exposure class to XD, XS or XF.

5. Check deflection

Linear calculation
Combination: SLS-Char (auto)
Coordinate system: Member
Extreme 1D: Global
Selection: All

Beam B2	**Rectangle (150; 1000)**
EC EN 1992-1-1:2004/AC:2008	Section 11 [dx = 0.8 m]

Short-term stiffnesses and curvatures under total load

Settings

Long-term part of applied load = 0%

Material characteristics

Characteristic concrete compressive strength

f_{ck} = 25 MPa

Characteristic yield strength of longitudinal reinforcement

f_{yk} = 500 MPa

Modulus of elasticity of concrete:

E_c = 32 GPa

Forces

From FEM analysis

Characteristic values:

LC1+LC2+LC3

$N = -6.98\ kN \quad M_y = 3.63\ kNm \quad M_z = 0.00\ kNm$

Quasi-permanent values:

LC1+LC2+0.30*LC3

$N_{qp} = -5.51\ kN \quad M_{y,qp} = 2.89\ kNm \quad M_{z,qp} = 0.00\ kNm$

Angle of bending moment resultant: $\alpha_M = 90\ °$

Compression member

Limit axial force to consider member as compression:

$$N_{com} = -Coeff_{com} \cdot \left(f_{cd} \cdot A_c \right) = -0.1 \cdot \left(16.7 \cdot 10^6 \cdot 0.15 \right) = -250\ kN$$

Check condition:

$N_{Ed} \geq N_{com} = -7\ kN \geq -250\ kN$ ... not compression member

Note: The member is not considered as a compression member (normal force is relatively small or zero).

Characteristic values: $N_{char,r} = -6.98\ kN \quad M_{y,char,r} = 3.63\ kNm \quad M_{z,char,r} = 0.00\ kNm$

Quasi-permanent values: $N_{qp,r} = -5.51\ kN \quad M_{y,qp,r} = 2.89\ kNm \quad M_{z,qp,r} = 0.00\ kNm$

Angle of bending moment resultant: $\alpha_{M,r} = 90\ °$

Calculation of $f_{ct,eff}$

Mean tensile concrete strength

$f_{ctm} = 2.6\ MPa$

$\alpha_M = 89.9\ °$

$h = 0.151\ m$

$f_{ct,eff} = f_{ctm} = 2.6\ MPa$

Strength in concrete, when crack is appeared

$f_{ct,eff} = 2.6\ MPa$

Cross-section characteristics

Type of component	t_y [m]	t_z [m]	A [m^2]	I_y [m^4]	I_z [m^4]	x_i [m]	A_{st} [m^2]	A_{sc} [m^2]	A_s [m^2]
Linear	0	0	0.15	$281 \cdot 10^{-6}$	0.0125	0.079	-	-	-
Uncracked	$1 \cdot 10^{-3}$	0	0.157	$288 \cdot 10^{-6}$	0.0132	0.08	$503 \cdot 10^{-6}$	$631 \cdot 10^{-6}$	$1.13 \cdot 10^{-3}$
Cracked	$5 \cdot 10^{-3}$	0.049	0.0355	$30.1 \cdot 10^{-6}$	$3.06 \cdot 10^{-3}$	0.029	$1.13 \cdot 10^{-3}$	0	$1.13 \cdot 10^{-3}$

Check of concrete stresses and calculation of cracking forces

Maximal tensile stress in concrete fibre

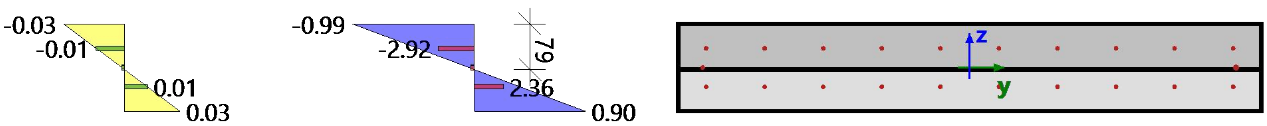
$\sigma_{ct} = 0.901$ MPa

Cracking status

$\sigma_{ct} < f_{ct,eff} = 0.901 \text{ MPa} < 2.6 \text{ MPa}$ => No cracks appear

$N_{cr,}$ [kN]	$M_{y,cr}$ [kNm]	$M_{z,cr}$ [kNm]	σ_{ct} [MPa]	$f_{ct,eff}$ [MPa]	Cracked section	σ_{sr} [MPa]	σ_s [MPa]	β [-]	ζ [-]	E_c [GPa]
0	0	0	0	2.6	**NO**	0	0	1	0	31.5

Stress and strain distribution for verification of crack appearance for short-term load



Stiffnesses

Axial stiffness EA

$$EA_{lin} = E_c \cdot A_c = 31.5 \cdot 0.15 = 4725 \text{ MN}$$

$$EA_{I} = E_c \cdot A_{c,I} = 31.5 \cdot 0.157 = 4952 \text{ MN}$$

$$EA_{II} = E_c \cdot A_{c,II} = 31.5 \cdot 0.0355 = 1117 \text{ MN}$$

$$EA = \frac{1}{\frac{\zeta}{EA_{II}} + \frac{1-\zeta}{EA_{I}}} = \frac{1}{\frac{0}{1117} + \frac{1-0}{4952}} = 4952 \text{ MN} \tag{7.18}$$

$$RatioEA = \frac{EA}{EA_{lin}} = \frac{4952}{4725} = 1.05$$

Bending stiffness EIy

$$EI_{y,lin} = E_c \cdot I_y = 31.5 \cdot 281 \cdot 10^6 = 8.86\ MNm^2$$

$$EI_{y,I} = E_c \cdot I_{y,I} = 31.5 \cdot 288 \cdot 10^6 = 9.08\ MNm^2$$

$$EI_{y,II} = E_c \cdot I_{y,II} = 31.5 \cdot 30.1 \cdot 10^6 = 0.948\ MNm^2$$

$$EI_y = \frac{1}{\frac{\zeta}{EI_{y,II}} + \frac{1-\zeta}{EI_{y,I}}} = \frac{1}{\frac{0}{0.948} + \frac{1-0}{9.08}} = 9.08\ MN{\bullet}m^2 \tag{7.18}$$

$$RatioEIy = \frac{EI_y}{EI_{y,lin}} = \frac{9.08}{8.86} = 1.02$$

Bending stiffness EIz

$$EI_{z,lin} = E_c \cdot I_z = 31.5 \cdot 12.5 \cdot 10^9 = 394\ MNm^2$$

$$EI_{z,I} = E_c \cdot I_{z,I} = 31.5 \cdot 13.2 \cdot 10^9 = 416\ MNm^2$$

$$EI_{z,II} = E_c \cdot I_{z,II} = 31.5 \cdot 3.06 \cdot 10^9 = 96.3\ MNm^2$$

$$EI_z = \frac{1}{\frac{\zeta}{EI_{z,II}} + \frac{1-\zeta}{EI_{z,I}}} = \frac{1}{\frac{0}{96.3} + \frac{1-0}{416}} = 416\ MN{\bullet}m^2 \tag{7.18}$$

$$RatioEIz = \frac{EI_z}{EI_{z,lin}} = \frac{416}{394} = 1.06$$

Curvatures

Concrete cross-section

$$\frac{1}{r_{y,lin}} = \frac{-M_{y,qp}}{E_c \cdot I_y} = \frac{-2.89}{32 \cdot 281 \cdot 10^6} = -326 \cdot 10^{-6}\ m^{-1}$$

Un-cracked cross-section

$$\frac{1}{r_{y,I}} = \frac{-M_{y,qp}}{E_c \cdot I_{y,I}} = \frac{-2.89}{32 \cdot 288 \cdot 10^6} = -318 \cdot 10^{-6}\ m^{-1}$$

Fully-cracked cross-section

$$\frac{1}{r_{y,II}} = \frac{-M_{y,qp}}{E_c \cdot I_{y,II}} = \frac{-2.89}{32 \cdot 30.1 \cdot 10^6} = -3.05 \cdot 10^{-3}\ m^{-1}$$

Resultant curvatures

$$\frac{1}{r_y} = \zeta \cdot \frac{1}{r_{y,II}} + \left(1-\zeta\right) \cdot \frac{1}{r_{y,I}} = 0 \cdot -3.05 \cdot 10^{-3} + \left(1-0\right) \cdot -318 \cdot 10^{-6} = -318 \cdot 10^{-6}\ m^{-1}$$

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Stiffness ratio

$$ratio_{ux} = \frac{1}{RatioEA} = \frac{1}{1.05} = 0.954$$

$$ratio_{uy} = \frac{1}{RatioElz} = \frac{1}{1.06} = 0.947$$

$$ratio_{uz} = \frac{1}{RatioEly} = \frac{1}{1.02} = 0.976$$

Explanation errors/warnings and notes

Index	Type	Description	Solution
N2/1	Note	The member is not considered as a compression member (normal force is relatively small or zero).	

Long-term stiffnesses and curvatures under total load

Settings

Long-term part of applied load = 70%

Creep coefficient $\varphi = 2.816$

Material characteristics

Characteristic concrete compressive strength

$f_{ck} = 25$ MPa

Characteristic yield strength of longitudinal reinforcement

$f_{yk} = 500$ MPa

Modulus of elasticity of concrete:

$$E_c = \frac{E_{cm}}{1 + \varphi_{ef}} = \frac{31.5 \cdot 10^9}{1 + 2.82} = 8.3 \text{ GPa} \quad (7.20)$$

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Forces

From FEM analysis

Characteristic values:

LC1+LC2+LC3

$N = -6.98$ kN $M_y = 3.63$ kNm $M_z = 0.00$ kNm

Quasi-permanent values:

LC1+LC2+0.30*LC3

$N_{qp} = -5.51$ kN $M_{y,qp} = 2.89$ kNm $M_{z,qp} = 0.00$ kNm

Angle of bending moment resultant: $\alpha_M = 90$ °

Compression member

Limit axial force to consider member as compression:

$$N_{com} = -Coeff_{com} \cdot \left(f_{cd} \cdot A_c \right) = -0.1 \cdot \left(16.7 \cdot 10^6 \cdot 0.15 \right) = -250 \text{ kN}$$

Check condition:

$N_{Ed} \geq N_{com} = -7$ kN ≥ -250 kN ...   not compression member

Note: The member is not considered as a compression member (normal force is relatively small or zero).

Characteristic values: $N_{char,r} = -6.98$ kN $M_{y,char,r} = 3.63$ kNm $M_{z,char,r} = 0.00$ kNm

Quasi-permanent values: $N_{qp,r} = -5.51$ kN $M_{y,qp,r} = 2.89$ kNm $M_{z,qp,r} = 0.00$ kNm

Angle of bending moment resultant: $\alpha_{M,r} = 90$ °

Calculation of $f_{ct,eff}$

Mean tensile concrete strength

$f_{ctm} = 2.6$ MPa

$\alpha_M = 89.9$ °

$h = 0.151$ m

$f_{ct,eff} = f_{ctm} = 2.6$ MPa

Strength in concrete, when crack is appeared

$f_{ct,eff} = 2.6$ MPa

Cross-section characteristics

Type of component	t_y [m]	t_z [m]	A [m^2]	I_y [m^4]	I_z [m^4]	x_i [m]	A_{st} [m^2]	A_{sc} [m^2]	A_s [m^2]
Linear	0	0	0.15	$281 \cdot 10^{-6}$	0.0125	0.079	-	-	-
Uncracked	$2 \cdot 10^{-3}$	0	0.177	$308 \cdot 10^{-6}$	0.0152	0.08	$503 \cdot 10^{-6}$	$631 \cdot 10^{-6}$	$1.13 \cdot 10^{-3}$
Cracked	$6 \cdot 10^{-3}$	0.033	0.0722	$81.1 \cdot 10^{-6}$	$6.4 \cdot 10^{-3}$	0.045	$631 \cdot 10^{-6}$	$503 \cdot 10^{-6}$	$1.13 \cdot 10^{-3}$

Check of concrete stresses and calculation of cracking forces

Maximal tensile stress in concrete fibre

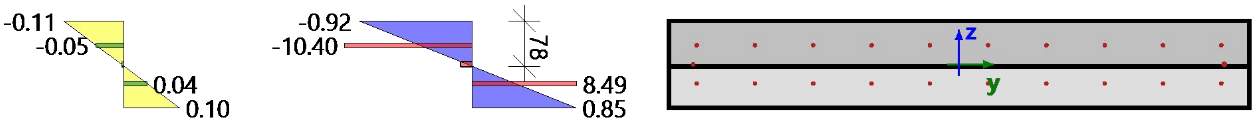
$\sigma_{ct} = 0.846$ MPa

Cracking status

$\sigma_{ct} < f_{ct,eff} = 0.846 \text{ MPa} < 2.6 \text{ MPa}$ => No cracks appear

$N_{cr,}$ [kN]	$M_{y,cr}$ [kNm]	$M_{z,cr}$ [kNm]	σ_{ct} [MPa]	$f_{ct,eff}$ [MPa]	Cracked section	σ_{sr} [MPa]	σ_s [MPa]	β [-]	ζ [-]	E_c [GPa]
0	0	0	0	2.6	**NO**	0	0	0.5	0	8.3

Stress and strain distribution for verification of crack appearance for long-term load



Stiffnesses

Axial stiffness EA

$$EA_{lin} = E_c \cdot A_c = 31.5 \cdot 0.15 = 4725 \text{ MN}$$

$$EA_I = E_{c,eff} \cdot A_{c,I} = 8.25 \cdot 0.177 = 1465 \text{ MN}$$

$$EA_{II} = E_{c,eff} \cdot A_{c,II} = 8.25 \cdot 0.0722 = 596 \text{ MN}$$

$$EA = \frac{1}{\frac{\zeta}{EA_{II}} + \frac{1-\zeta}{EA_I}} = \frac{1}{\frac{0}{596} + \frac{1-0}{1465}} = 1465 \text{ MN} \tag{7.18}$$

$$RatioEA = \frac{EA}{EA_{lin}} = \frac{1465}{4725} = 0.31$$

Bending stiffness EIy

$$EI_{y,lin} = E_c \cdot I_y = 31.5 \cdot 281 \cdot 10^6 = 8.86\ MNm^2$$

$$EI_{y,I} = E_{c,eff} \cdot I_{y,I} = 8.25 \cdot 308 \cdot 10^6 = 2.54\ MNm^2$$

$$EI_{y,II} = E_{c,eff} \cdot I_{y,II} = 8.25 \cdot 81.1 \cdot 10^6 = 0.67\ MNm^2$$

$$EI_y = \frac{1}{\frac{\zeta}{EI_{y,II}} + \frac{1-\zeta}{EI_{y,I}}} = \frac{1}{\frac{0}{0.67} + \frac{1-0}{2.54}} = 2.54\ MN \cdot m^2 \qquad (7.18)$$

$$RatioEIy = \frac{EI_y}{EI_{y,lin}} = \frac{2.54}{8.86} = 0.287$$

Bending stiffness EIz

$$EI_{z,lin} = E_c \cdot I_z = 31.5 \cdot 12.5 \cdot 10^9 = 394\ MNm^2$$

$$EI_{z,I} = E_{c,eff} \cdot I_{z,I} = 8.25 \cdot 15.2 \cdot 10^9 = 125\ MNm^2$$

$$EI_{z,II} = E_{c,eff} \cdot I_{z,II} = 8.25 \cdot 6.4 \cdot 10^9 = 52.8\ MNm^2$$

$$EI_z = \frac{1}{\frac{\zeta}{EI_{z,II}} + \frac{1-\zeta}{EI_{z,I}}} = \frac{1}{\frac{0}{52.8} + \frac{1-0}{125}} = 125\ MN \cdot m^2 \qquad (7.18)$$

$$RatioEIz = \frac{EI_z}{EI_{z,lin}} = \frac{125}{394} = 0.318$$

Curvatures

Concrete cross-section

$$\frac{1}{r_{y,lin}} = \frac{-M_{y,qp}}{E_{c,eff} \cdot I_y} = \frac{-2.89}{8 \cdot 281 \cdot 10^6} = -1.24 \cdot 10^{-3}\ m^{-1}$$

Un-cracked cross-section

$$\frac{1}{r_{y,I}} = \frac{-M_{y,qp}}{E_{c,eff} \cdot I_{y,I}} = \frac{-2.89}{8 \cdot 308 \cdot 10^6} = -1.14 \cdot 10^{-3}\ m^{-1}$$

Fully-cracked cross-section

$$\frac{1}{r_{y,II}} = \frac{-M_{y,qp}}{E_{c,eff} \cdot I_{y,II}} = \frac{-2.89}{8 \cdot 81.1 \cdot 10^6} = -4.31 \cdot 10^{-3}\ m^{-1}$$

Resultant curvatures

$$\frac{1}{r_y} = \zeta \cdot \frac{1}{r_{y,II}} + (1-\zeta) \cdot \frac{1}{r_{y,I}} = 0 \cdot -4.31 \cdot 10^{-3} + (1-0) \cdot -1.14 \cdot 10^{-3} = -1.14 \cdot 10^{-3}\ m^{-1}$$

Stiffness ratio

$$ratio_{ux} = \frac{1}{RatioEA} = \frac{1}{0.31} = 3.23$$

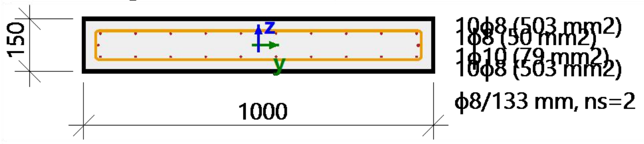
$$ratio_{uy} = \frac{1}{RatioEIz} = \frac{1}{0.318} = 3.14$$

$$ratio_{uz} = \frac{1}{RatioEIy} = \frac{1}{0.287} = 3.49$$

Explanation errors/warnings and notes

Index	Type	Description	Solution
N2/1	Note	The member is not considered as a compression member (normal force is relatively small or zero).	

Member length: L = 0.8 m
Buckling y-y: L_y = 1.71 m (sway)
Buckling z-z: L_z = 8 m (sway)



Concrete: C25/30
Bi-linear stress-strain diagram
Exposure class: XC3

Longitudinal reinforcement: B 500B
Bi-linear with an inclined top branch
21ϕ8 mm + 1ϕ10 mm (A_s = 1134 mm^2)
ρ_l = 0.756 % (8.9 kg/m)

Shear reinforcement: B 500B
Bi-linear with an inclined top branch
ϕ8/133 mm (n_s = 2) (A_{sw} = 101 mm^2)
ρ_w = 0.503 % (5.92 kg/m) (A_{swm} = 754 mm^2/m)

Cover (stirrup)
Top: 30 mm
Bottom: 30 mm
Left: 30 mm
Right: 30 mm

Ratios

Short-term ratios

Bending stiffness EIy

$$RatioEIys = \frac{EI_{y,s}}{EI_{y,lin}} = \frac{9.08 \cdot 10^6}{8.86 \cdot 10^6} = 1.02$$

Bending stiffness EIz

$$RatioEIzs = \frac{EI_{z,s}}{EI_{z,lin}} = \frac{416 \cdot 10^6}{394 \cdot 10^6} = 1.06$$

Ratios

$$ratio_{uys} = \frac{1}{RatioEIzs} = \frac{1}{1.06} = 0.947$$

$$ratio_{uzs} = \frac{1}{RatioEIys} = \frac{1}{1.02} = 0.976$$

Long-term ratios

Bending stiffness EIy

$$RatioEIyl = \frac{EI_{y,l}}{EI_{y,lin}} = \frac{2.54 \cdot 10^6}{8.86 \cdot 10^6} = 0.287$$

Bending stiffness EIz

$$RatioEIzl = \frac{EI_{z,l}}{EI_{z,lin}} = \frac{125 \cdot 10^6}{394 \cdot 10^6} = 0.318$$

Ratios

$$ratio_{uyl} = \frac{1}{RatioEIzl} = \frac{1}{0.318} = 3.14$$

$$ratio_{uzl} = \frac{1}{RatioEIyl} = \frac{1}{0.287} = 3.49$$

Deflections

Linear deflection

$$\delta_{lin,y} = u_{ys} + u_{yl} = 0 + 0 = 0 \text{ mm}$$

$$\delta_{lin,z} = u_{zs} + u_{zl} = -0.0542 + -0.126 = -0.181 \text{ mm}$$

Immediate deflection

$$\delta_{imm,y} = u_{yl} \cdot ratio_{uys} = 0 \cdot 0.947 = 0 \text{ mm}$$

$$\delta_{imm,z} = u_{zl} \cdot ratio_{uzs} = -0.126 \cdot 0.976 = -0.123 \text{ mm}$$

Short-term deflection

$$\delta_{short,y} = u_{ys} \cdot ratio_{uys} = 0 \cdot 0.947 = 0 \text{ mm}$$

$$\delta_{short,z} = u_{zs} \cdot ratio_{uzs} = -0.0542 \cdot 0.976 = -0.0529 \text{ mm}$$

Long-term + creep deflection

$$\delta_{long,creep,y} = u_{yl} \cdot ratio_{uyl} = 0 \cdot 3.14 = 0 \text{ mm}$$

$$\delta_{long,creep,z} = u_{zl} \cdot ratio_{uzl} = -0.126 \cdot 3.49 = -0.441 \text{ mm}$$

Creep deflection

$$\delta_{creep,y} = u_{yl} \cdot \left(ratio_{uyl} - ratio_{uys} \right) = 0 \cdot \left(3.14 - 0.947 \right) = 0 \text{ mm}$$

$$\delta_{creep,z} = u_{zl} \cdot \left(ratio_{uzl} - ratio_{uzs} \right) = -0.126 \cdot \left(3.49 - 0.976 \right) = -0.318 \text{ mm}$$

Long-term deflection

$$\delta_{long,y} = \delta_{long,creep,y} - \delta_{creep,y} = 0 - 0 = 0 \text{ mm}$$

$$\delta_{long,z} = \delta_{long,creep,z} - \delta_{creep,z} = -0.441 - -0.318 = -0.123 \text{ mm}$$

Additional deflection

$$\delta_{add,y} = \delta_{short,y} + \delta_{long,creep,y} - \delta_{imm,y} = 0 + 0 - 0 = 0 \text{ mm}$$

$$\delta_{add,z} = \delta_{short,z} + \delta_{long,creep,z} - \delta_{imm,z} = -0.0529 + -0.441 - -0.123 = -0.371 \text{ mm}$$

Limit additional deflection

$$\delta_{add,lim,y} = 0 \text{ mm}$$

$$\delta_{add,lim,z} = \frac{-l_{0z}}{Lim_{add}} = \frac{-0.8}{500} = -1.6 \text{ mm}$$

Total deflection

$$\delta_{tot,y} = \delta_{short,y} + \delta_{long,creep,y} = 0 + 0 = 0 \text{ mm}$$

$$\delta_{tot,z} = \delta_{short,z} + \delta_{long,creep,z} = -0.0529 + -0.441 = -0.494 \text{ mm}$$

Limit total deflection

$$\delta_{tot,lim,y} = 0 \text{ mm}$$

$$\delta_{tot,lim,z} = \frac{-l_{0z}}{Lim_{tot}} = \frac{-0.8}{250} = -3.2 \text{ mm}$$

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Basic values of deflections

Type of deflection	Ratio short [-]	Ratio long [-]	δ_{lin} [mm]	δ_{imm} [mm]	δ_{add} [mm]	δ_{short} [mm]	δ_{long} [mm]	$\delta_{long+creep}$ [mm]	δ_{creep} [mm]
u_y	0.95	3.14	0	0	0	0	0	0	0
u_z	0.98	3.49	-0.18	-0.12	-0.37	-0.05	-0.12	-0.44	-0.32

Check of additional and total deflections

Type of deflection	L [m]	δ_{add} [mm]	$\delta_{add,lim}$ [mm]	UC_{add} [-]	δ_{tot} [mm]	$\delta_{tot,lim}$ [mm]	UC_{tot} [-]	UC [-]	Limit [-]	Status
u_y	0.8	0	0	0	0	0	0	0	1	OK
u_z	0.8	-0.37	-1.6	0.23	-0.49	-3.2	0.15	0.23	1	OK

List of errors/warnings/notes: NO

TEMELJENJE

TT1

Materials and standards

Concrete structures : EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 : standard

Settlement

Analysis method : Analysis using oedometric modulus
Restriction of influence zone : by percentage of Sigma,Or
Coeff. of restriction of influence zone : 10,0 [%]

Spread Footing

Analysis for drained conditions : Standard approach
Analysis of uplift : Standard
Allowable eccentricity : 0,333
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor for vertical bearing capacity :	SF_v =	1,50	[–]
Safety factor for sliding resistance :	SF_h =	1,50	[–]

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
1	Glina (pretpostavka)		19,00	30,00	21,00	11,00	

All soils are considered as cohesionless for at rest pressure analysis.

Soil parameters

Glina (pretpostavka)

Unit weight : γ = 21,00 kN/m³
Angle of internal friction : φ_{ef} = 19,00 °
Cohesion of soil : c_{ef} = 30,00 kPa
Oedometric modulus : E_{oed} = 21,50 MPa
Saturated unit weight : γ_{sat} = 21,00 kN/m³

Foundation

Foundation type: strip footing

Depth from original ground surface h_z = 0,70 m
Depth of footing bottom d = 0,60 m
Foundation thickness t = 0,60 m
Incl. of finished grade s_1 = 0,00 °
Incl. of footing bottom s_2 = 0,00 °

Overburden

Type: from geological profile

Geometry of structure

Foundation type: strip footing

Overall strip footing length = 2,00 m
Strip footing width (x) = 0,50 m
Column width in the direction of x = 0,15 m

Inserted loading is considered per unit length of continuous footing span.

Volume of strip footing = 0,30 m³/m
Volume of excavation = 0,30 m³/m
Volume of fill = 0,00 m³/m

Material of structure

Unit weight γ = 23,00 kN/m^3
Analysis of concrete structures carried out according to the standard EN 1992-1-1 (EC2).
Concrete : C 25/30

Cylinder compressive strength	f_{ck} =	25,00	MPa
Tensile strength	f_{ctm} =	2,60	MPa
Elasticity modulus	E_{cm} =	31000,00	MPa

Longitudinal steel : B500
Yield strength f_{yk} = 500,00 MPa

Transverse steel: B500
Yield strength f_{yk} = 500,00 MPa

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	-	0,00 .. ∞	Glina (pretpostavka)	

Load

No.	Load new	Load change	Name	Type	N [kN/m]	M_y [kNm/m]	H_x [kN/m]
1	Yes		1	Design	10,04	0,00	-4,87
2	Yes		2	Design	19,12	0,00	-9,74
3	Yes		1 - service	Service	7,17	0,00	-3,48
4	Yes		2 - service	Service	13,66	0,00	-6,96
5	Yes		3	Design	7,47	0,00	-2,87
6	Yes		4	Design	2,96	0,00	-0,69

Global settings

Type of analysis : analysis for drained conditions

Settings of the stage of construction

Design situation : permanent

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Verification No. 1

Load case verification

Name	e_x [m]	e_y [m]	σ [kPa]	R_d [kPa]	Utilization [%]	Is satisfactory
1	-0,10	0,00	55,87	296,44	28,27	Yes
2	-0,13	0,00	110,95	229,98	72,37	Yes
3	-0,05	0,00	36,82	373,37	14,79	Yes
4	0,00	0,00	20,08	505,62	5,96	Yes

Analysis carried out with automatic selection of the most unfavourable load cases.

Computed self weight of strip foundation $G = 6{,}90$ kN/m
Computed weight of overburden $Z = 0{,}00$ kN/m

Vertical bearing capacity check

Shape of contact stress : rectangle
Most unfavorable load case No. 2. (2)
Parameters of slip surface below foundation:
Depth of slip surface $z_{sp} = 0{,}56$ m
Length of slip surface $l_{sp} = 1{,}45$ m

Design bearing capacity of found.soil $R_d = 229{,}98$ kPa
Extreme contact stress $\sigma = 110{,}95$ kPa

Factor of safety = 2,07 > 1,50
Bearing capacity in the vertical direction is SATISFACTORY

Verification of load eccentricity

Max. eccentricity in direction of base length $e_x = 0{,}265<0{,}333$
Max. eccentricity in direction of base width $e_y = 0{,}000<0{,}333$
Max. overall eccentricity $e_t = 0{,}265<0{,}333$

Eccentricity of load is SATISFACTORY

Horizontal bearing capacity check

Most unfavorable load case No. 2. (2)
Earth resistance: at rest
Design magnitude of earth resistance S_{pd} = 1,27 kN

Horizontal bearing capacity R_{dh} = 17,27 kN
Extreme horizontal force H = 9,74 kN

Factor of safety = 1,77 > 1,50
Bearing capacity in the horizontal direction is SATISFACTORY
Bearing capacity of foundation is SATISFACTORY

Verification No. 1

Settlement and rotation of foundation - input data

Analysis carried out with automatic selection of the most unfavourable load cases.
Analysis carried out with accounting for coefficient κ_1 (influence of foundation depth).
Stress at the footing bottom considered from the finished grade.

Computed self weight of strip foundation G = 6,90 kN/m
Computed weight of overburden Z = 0,00 kN/m

Settlement of mid point of longitudinal edge = 0,4 mm
Settlement of mid point of transverse edge 1 = 0,9 mm
Settlement of mid point of transverse edge 2 = 0,5 mm

(1-max.compressed edge; 2-min.compressed edge)

Settlement and rotation of foundation - results

Foundation stiffness:
Computed weighted average modulus of deformation E_{def} = 10,03 MPa
Foundation in the longitudinal direction is rigid (k=5339,00)
Foundation in the direction of width is rigid (k=667,38)

Verification of load eccentricity

Max. eccentricity in direction of base length e_x = 0,240<0,333
Max. eccentricity in direction of base width e_y = 0,000<0,333
Max. overall eccentricity e_t = 0,240<0,333

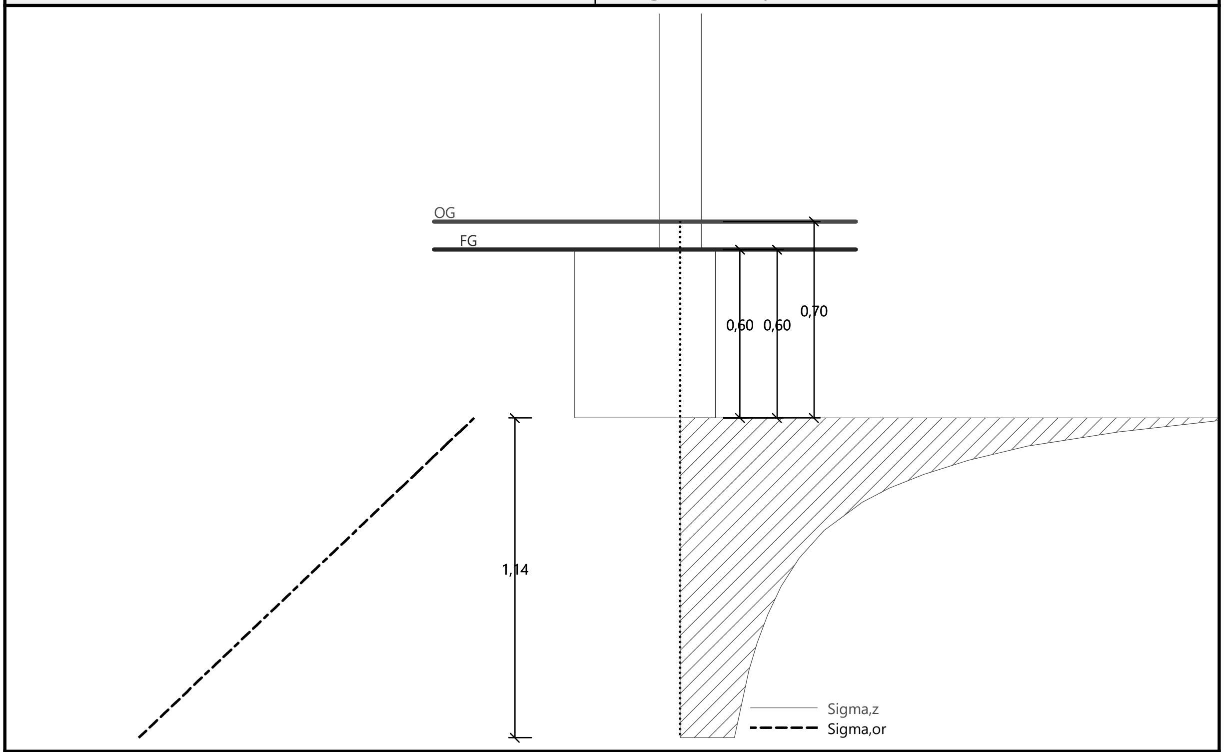
Eccentricity of load is SATISFACTORY

Overall settlement and rotation of foundation:

Foundation settlement = 0,6 mm
Depth of influence zone = 1,14 m

Rotation in direction of width = 0,836 (tan*1000); (4,8E-02 °)

Name : Settlement	Stage - analysis : 1 - 1



Dimensioning No. 1

Analysis carried out with automatic selection of the most unfavourable load cases.

Verification of longitudinal reinforcement of foundation in the direction of x

0,30 m ≤ 0,30 m
Maximum offset of the foundation is smaller than 0,50 * thickness of foundation.
Reinforcement is not requiered.

Spread footing for punching shear failure check

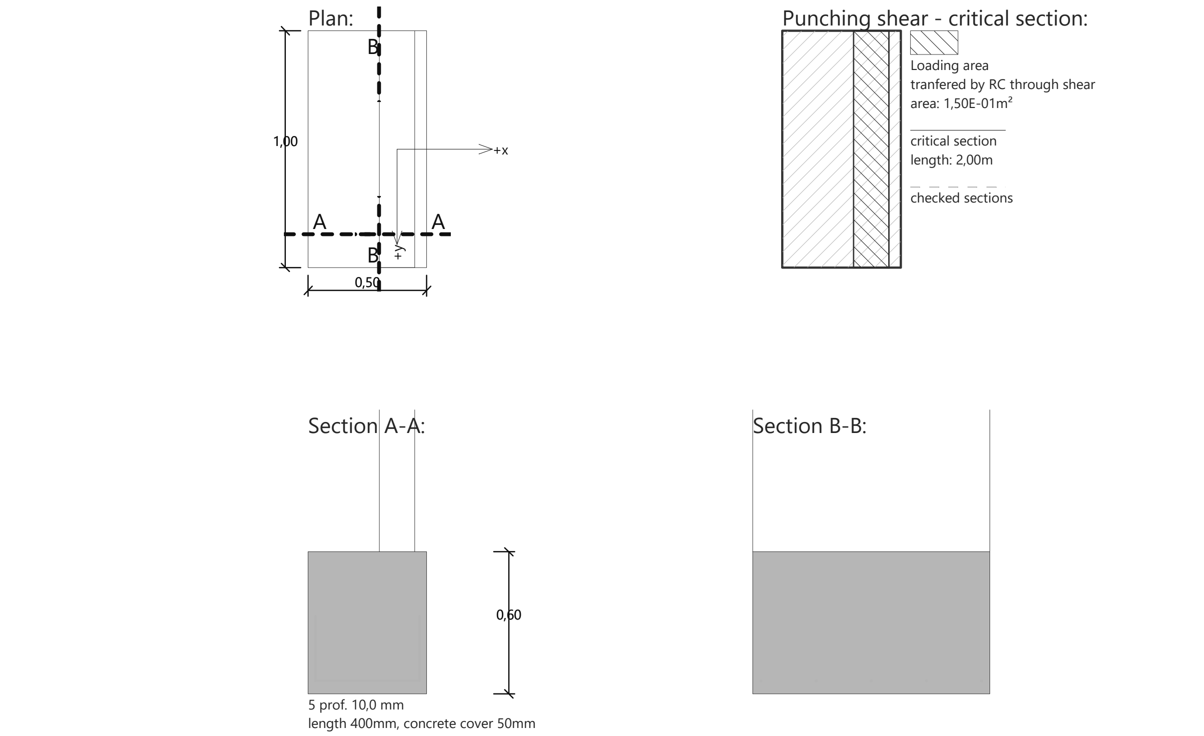
Column normal force = 19,12 kN

Maximum resistance at the column perimeter

Force transferred into found. soil		=	5,74	kN
Force transferred by shear strength of foundation		=	13,38	kN
Considered column perimeter	u_0	=	2,00	m
Shear resistance at the column perimeter	$v_{Ed,max}$	=	0,01	MPa
Resistance at the column perimeter	$v_{Rd,max}$	=	3,60	MPa

Spread footing for punching shear is SATISFACTORY

Name : Dimensioning	Stage - analysis : 1 - 1



TT2

Materials and standards

Concrete structures : EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 : standard

Settlement

Analysis method : Analysis using oedometric modulus
Restriction of influence zone : by percentage of Sigma,Or
Coeff. of restriction of influence zone : 10,0 [%]

Spread Footing

Analysis for drained conditions : Standard approach
Analysis of uplift : Standard
Allowable eccentricity : 0,333
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor for vertical bearing capacity :	SF_v =	1,50	[–]
Safety factor for sliding resistance :	SF_h =	1,50	[–]

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
1	Glina (pretpostavka)		19,00	30,00	21,00	11,00	

All soils are considered as cohesionless for at rest pressure analysis.

Soil parameters

Glina (pretpostavka)

Unit weight : γ = 21,00 kN/m³
Angle of internal friction : φ_{ef} = 19,00 °
Cohesion of soil : c_{ef} = 30,00 kPa
Oedometric modulus : E_{oed} = 21,50 MPa
Saturated unit weight : γ_{sat} = 21,00 kN/m³

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Foundation

Foundation type: strip footing

Depth from original ground surface	h_z	=	0,70	m
Depth of footing bottom	d	=	0,60	m
Foundation thickness	t	=	0,60	m
Incl. of finished grade	s_1	=	0,00	°
Incl. of footing bottom	s_2	=	0,00	°

Overburden

Type: from geological profile

Geometry of structure

Foundation type: strip footing

Overall strip footing length	=	2,00	m
Strip footing width (x)	=	0,35	m
Column width in the direction of x	=	0,15	m

Inserted loading is considered per unit length of continuous footing span.

Volume of strip footing	=	0,21	m^3/m
Volume of excavation	=	0,21	m^3/m
Volume of fill	=	0,00	m^3/m

Material of structure

Unit weight γ = 23,00 kN/m^3

Analysis of concrete structures carried out according to the standard EN 1992-1-1 (EC2).

Concrete : C 25/30

Cylinder compressive strength	f_{ck}	=	25,00	MPa
Tensile strength	f_{ctm}	=	2,60	MPa
Elasticity modulus	E_{cm}	=	31000,00	MPa

Longitudinal steel : B500

Yield strength f_{yk} = 500,00 MPa

Transverse steel: B500

Yield strength f_{yk} = 500,00 MPa

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	-	0,00 .. ∞	Glina (pretpostavka)	

Load

No.	Load new	Load change	Name	Type	N [kN/m]	M_y [kNm/m]	H_x [kN/m]
1	Yes		3	Design	7,47	0,00	-2,87
2	Yes		4	Design	2,96	0,00	-0,69
3	Yes		3 - service	Service	5,34	0,00	-2,05
4	Yes		4 - service	Service	2,11	0,00	-0,49

Global settings

Type of analysis : analysis for drained conditions

Settings of the stage of construction

Design situation : permanent

Verification No. 1

Load case verification

Name	e_x [m]	e_y [m]	σ [kPa]	R_d [kPa]	Utilization [%]	Is satisfactory
3	-0,11	0,00	94,09	355,41	39,71	Yes
4	-0,03	0,00	27,65	485,69	8,54	Yes

Analysis carried out with automatic selection of the most unfavourable load cases.

Computed self weight of strip foundation $G = 4{,}83$ kN/m
Computed weight of overburden $Z = 0{,}00$ kN/m

Vertical bearing capacity check

Shape of contact stress : rectangle
Most unfavorable load case No. 1. (3)
Parameters of slip surface below foundation:
Depth of slip surface $z_{sp} = 0{,}40$ m
Length of slip surface $l_{sp} = 1{,}02$ m

Design bearing capacity of found.soil R_d = 355,41 kPa
Extreme contact stress σ = 94,09 kPa

Factor of safety = 3,78 > 1,50
Bearing capacity in the vertical direction is SATISFACTORY

Verification of load eccentricity

Max. eccentricity in direction of base length e_x = 0,313<0,333
Max. eccentricity in direction of base width e_y = 0,000<0,333
Max. overall eccentricity e_t = 0,313<0,333

Eccentricity of load is SATISFACTORY

Horizontal bearing capacity check

Most unfavorable load case No. 1. (3)
Earth resistance: at rest
Design magnitude of earth resistance S_{pd} = 0,89 kN

Horizontal bearing capacity R_{dh} = 9,05 kN
Extreme horizontal force H = 2,87 kN

Factor of safety = 3,15 > 1,50
Bearing capacity in the horizontal direction is SATISFACTORY
Bearing capacity of foundation is SATISFACTORY

Verification No. 1

Settlement and rotation of foundation - input data

Analysis carried out with automatic selection of the most unfavourable load cases.
Analysis carried out with accounting for coefficient κ_1 (influence of foundation depth).
Stress at the footing bottom considered from the finished grade.

Computed self weight of strip foundation G = 4,83 kN/m
Computed weight of overburden Z = 0,00 kN/m

Settlement of mid point of longitudinal edge = 0,2 mm
Settlement of mid point of transverse edge 1 = 0,4 mm
Settlement of mid point of transverse edge 2 = 0,2 mm

(1-max.compressed edge; 2-min.compressed edge)

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Settlement and rotation of foundation - results

Foundation stiffness:

Computed weighted average modulus of deformation E_{def} = 10,03 MPa
Foundation in the longitudinal direction is rigid (k=15565,61)
Foundation in the direction of width is rigid (k=667,38)

Verification of load eccentricity

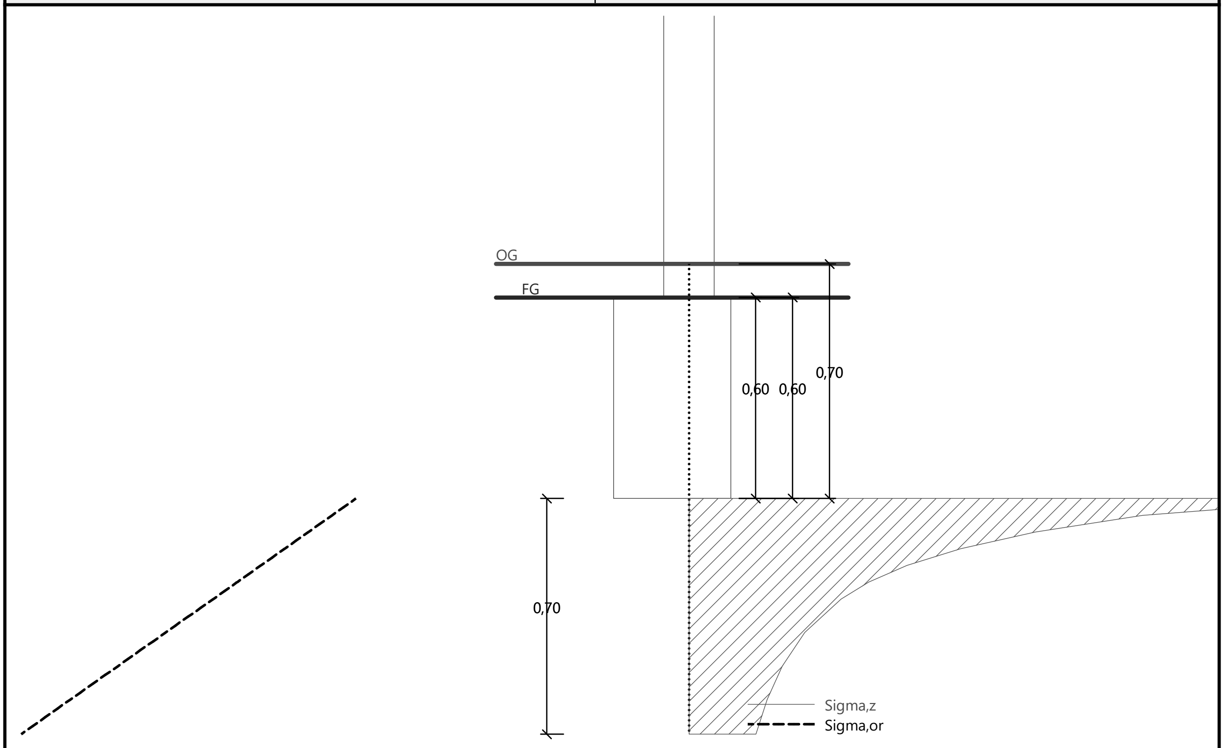
Max. eccentricity in direction of base length e_x = 0,271<0,333
Max. eccentricity in direction of base width e_y = 0,000<0,333
Max. overall eccentricity e_t = 0,271<0,333

Eccentricity of load is SATISFACTORY
Overall settlement and rotation of foundation:

Foundation settlement = 0,3 mm
Depth of influence zone = 0,70 m

Rotation in direction of width = 0,611 (tan*1000); (3,5E-02 °)

Name : Settlement	Stage - analysis : 1 - 1



Dimensioning No. 1

Analysis carried out with automatic selection of the most unfavourable load cases.

Verification of longitudinal reinforcement of foundation in the direction of x

0,15 m ≤ 0,30 m
Maximum offset of the foundation is smaller than 0,50 * thickness of foundation.
Reinforcement is not requiered.

Spread footing for punching shear failure check

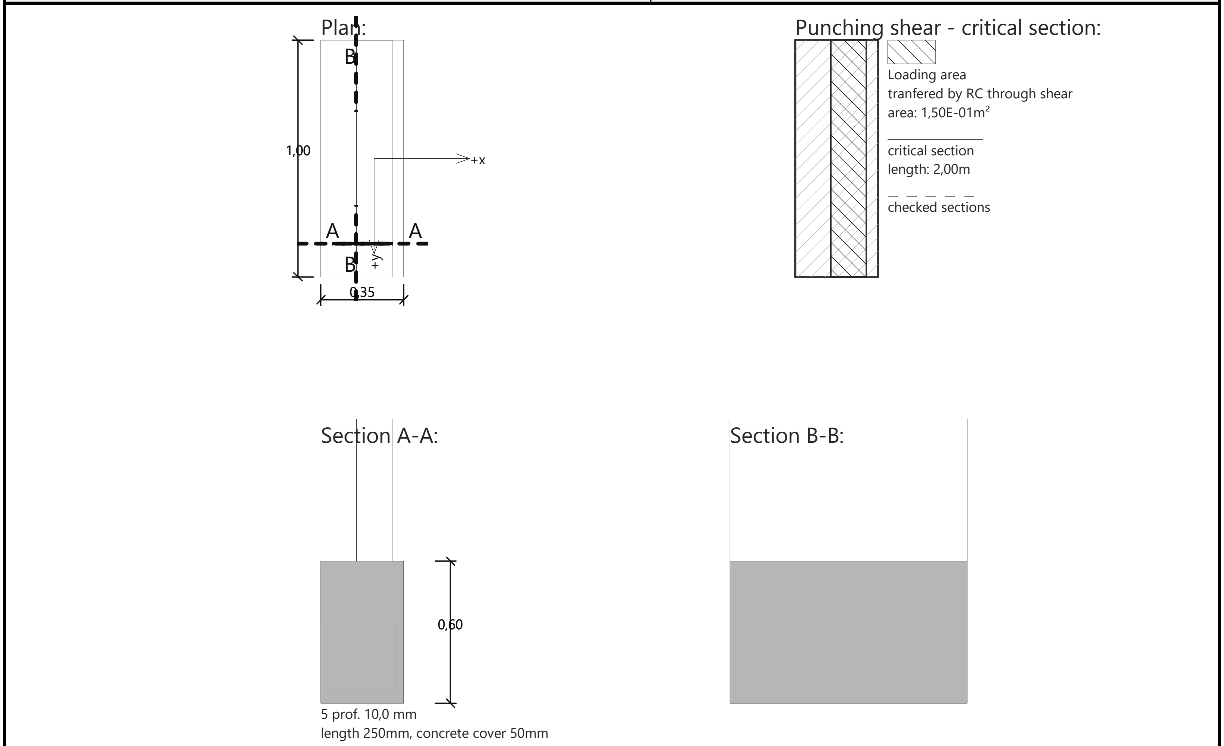
Column normal force = 7,47 kN

Maximum resistance at the column perimeter

Force transferred into found. soil		=	3,20	kN
Force transferred by shear strength of foundation		=	4,27	kN
Considered column perimeter	u_0	=	2,00	m
Shear resistance at the column perimeter	$v_{Ed,max}$	=	0,00	MPa
Resistance at the column perimeter	$v_{Rd,max}$	=	3,60	MPa

Spread footing for punching shear is SATISFACTORY

Name : Dimensioning	Stage - analysis : 1 - 1



POTPORNI ZIDOVI

PZ1

Materials and standards

Concrete structures : EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 : standard

Wall analysis

Active earth pressure calculation : Coulomb
Passive earth pressure calculation : Caquot-Kerisel
Earthquake analysis : Mononobe-Okabe
Shape of earth wedge : Calculate as skew
Base key : The base key is considered as inclined footing bottom
Allowable eccentricity : 0,333
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor for overturning :	SF_o =	1,50	[–]
Safety factor for sliding resistance :	SF_s =	1,50	[–]
Safety factor for bearing capacity :	SF_b =	1,50	[–]

Material of structure

Unit weight γ = 23,00 kN/m³
Analysis of concrete structures carried out according to the standard EN 1992-1-1 (EC2).
Concrete : C 20/25
Cylinder compressive strength f_{ck} = 20,00 MPa
Tensile strength f_{ctm} = 2,20 MPa

Longitudinal steel : B500
Yield strength f_{yk} = 500,00 MPa

Geometry of structure

No.	Coordinate X [m]	Depth Z [m]
1	0,00	0,00
2	0,00	1,13
3	0,00	1,63

No.	Coordinate X [m]	Depth Z [m]
4	-0,60	1,63
5	-0,60	1,13
6	-0,20	1,13
7	-0,20	0,00

The origin [0,0] is located at the most upper right point of the wall.
Wall section area = 0,53 m^2.

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
1	Glina (pretpostavka)		19,00	30,00	21,00	11,00	19,00
2	Nasip iza zida		35,50	0,00	20,00	10,00	19,00

All soils are considered as cohesionless for at rest pressure analysis.

Soil parameters

Glina (pretpostavka)

Unit weight : γ = 21,00 kN/m³
Stress-state : effective
Angle of internal friction : φ_{ef} = 19,00 °
Cohesion of soil : c_{ef} = 30,00 kPa
Angle of friction struc.-soil : δ = 19,00 °
Soil : cohesionless
Saturated unit weight : γ_{sat} = 21,00 kN/m³

Nasip iza zida

Unit weight : γ = 20,00 kN/m³
Stress-state : effective
Angle of internal friction : φ_{ef} = 35,50 °
Cohesion of soil : c_{ef} = 0,00 kPa
Angle of friction struc.-soil : δ = 19,00 °
Soil : cohesionless
Saturated unit weight : γ_{sat} = 20,00 kN/m³

Backfill

Assigned soil : Nasip iza zida
Slope = 60,00 °

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	-	0,00 .. ∞	Glina (pretpostavka)	

Foundation

Type of foundation : soil from geological profile

Terrain profile

No.	Coordinates x [m]	Depth z [m]
1	0,00	0,00
2	0,30	0,00
3	1,80	-1,00
4	2,80	-1,00

Origin [0,0] is located in upper right edge of construction.
Positive coordinate +z has downward direction.

Water influence

Ground water table is located below the structure.

Resistance on front face of the structure

Resistance on front face of the structure: at rest
Soil on front face of the structure - Nasip iza zida
Soil thickness in front of structure h = 0,50 m
Terrain surcharge f = 1,00 kN/m^2

Terrain in front of structure is flat.

Settings of the stage of construction

Design situation : permanent
The wall is free to move. Active earth pressure is therefore assumed.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Verification No. 1

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-0,60	12,10	0,39	1,000
FF resistance	-1,05	-0,17	0,00	0,00	1,000
Resistance on front face	-0,21	-0,25	0,00	0,00	1,000
Active pressure	4,29	-0,84	1,48	0,60	1,000

Verification of complete wall

Check for overturning stability

Resisting moment M_{res} = 5,55 kNm/m

Overturning moment M_{ovr} = 3,35 kNm/m

Safety factor = 1,66 > 1,50

Wall for overturning is SATISFACTORY

Check for slip

Resisting horizontal force H_{res} = 14,40 kN/m

Active horizontal force H_{act} = 3,03 kN/m

Safety factor = 4,76 > 1,50

Wall for slip is SATISFACTORY

Overall check - WALL is SATISFACTORY

Bearing capacity of foundation soil

Design load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [–]	Stress [kPa]
1	1,87	13,57	3,03	0,230	41,86

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	1,87	13,57	3,03

Spread footing verification

Input data

Settings

Standard - safety factors

Materials and standards

Concrete structures : EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 : standard

Settlement

Analysis method : Analysis using oedometric modulus
Restriction of influence zone : by percentage of Sigma,Or
Coeff. of restriction of influence zone : 10,0 [%]

Spread Footing

Analysis for drained conditions : Standard approach
Analysis of uplift : Standard
Allowable eccentricity : 0,333
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor for vertical bearing capacity :	SF_v =	1,50	[–]
Safety factor for sliding resistance :	SF_h =	1,50	[–]

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
1	Glina (pretpostavka)		19,00	30,00	21,00	11,00	19,00
2	Nasip iza zida		35,50	0,00	20,00	10,00	19,00

All soils are considered as cohesionless for at rest pressure analysis.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Soil parameters

Glina (pretpostavka)

Unit weight : γ = 21,00 kN/m³
Angle of internal friction : φ_{ef} = 19,00 °
Cohesion of soil : c_{ef} = 30,00 kPa
Oedometric modulus : E_{oed} = 21,50 MPa
Saturated unit weight : γ_{sat} = 21,00 kN/m³

Nasip iza zida

Unit weight : γ = 20,00 kN/m³
Angle of internal friction : φ_{ef} = 35,50 °
Cohesion of soil : c_{ef} = 0,00 kPa
Oedometric modulus : E_{oed} = 161,00 MPa
Saturated unit weight : γ_{sat} = 20,00 kN/m³

Foundation

Foundation type: strip footing

Depth from original ground surface h_z = 1,63 m
Depth of footing bottom d = 0,50 m
Foundation thickness t = 0,50 m
Incl. of finished grade s_1 = 0,00 °
Incl. of footing bottom s_2 = 0,00 °

Overburden

Type: input unit weight
Unit weight of soil above foundation = 21,00 kN/m³

Geometry of structure

Foundation type: strip footing

Overall strip footing length = 10,00 m
Strip footing width (x) = 0,60 m
Column width in the direction of x = 0,20 m

Inserted loading is considered per unit length of continuous footing span.

Volume of strip footing = 0,30 m³/m
Volume of excavation = 0,30 m³/m
Volume of fill = 0,00 m³/m

Material of structure

Unit weight γ = 23,00 kN/m^3
Analysis of concrete structures carried out according to the standard EN 1992-1-1 (EC2).
Concrete : C 20/25

Cylinder compressive strength	f_{ck}	=	20,00	MPa
Tensile strength	f_{ctm}	=	2,20	MPa
Elasticity modulus	E_{cm}	=	30000,00	MPa

Longitudinal steel : B500
Yield strength f_{yk} = 500,00 MPa

Transverse steel: B500
Yield strength f_{yk} = 500,00 MPa

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	-	0,00 .. ∞	Glina (pretpostavka)	

Load

No.	Load new	Load change	Name	Type	N [kN/m]	M_y [kNm/m]	H_x [kN/m]
1	Yes		LC 1	Design	6,67	0,36	-3,03
2	Yes		LC 2	Service	6,67	0,36	-3,03

Global settings

Type of analysis : analysis for drained conditions

Settings of the stage of construction

Design situation : permanent

Verification No. 1

Load case verification

Name	e_x [m]	e_y [m]	σ [kPa]	R_d [kPa]	Utilization [%]	Is satisfactory
LC 1	-0,04	0,00	26,06	328,21	11,91	Yes

Analysis carried out with automatic selection of the most unfavourable load cases.

Computed self weight of strip foundation $G = 6{,}90$ kN/m
Computed weight of overburden $Z = 0{,}00$ kN/m

Vertical bearing capacity check

Shape of contact stress : rectangle
Most unfavorable load case No. 1. (LC 1)
Parameters of slip surface below foundation:
Depth of slip surface $z_{sp} = 0{,}68$ m
Length of slip surface $l_{sp} = 1{,}74$ m

Design bearing capacity of found.soil $R_d = 328{,}21$ kPa
Extreme contact stress $\sigma = 26{,}06$ kPa

Factor of safety = 12,60 > 1,50
Bearing capacity in the vertical direction is SATISFACTORY

Verification of load eccentricity

Max. eccentricity in direction of base length $e_x = 0{,}066<0{,}333$
Max. eccentricity in direction of base width $e_y = 0{,}000<0{,}333$
Max. overall eccentricity $e_t = 0{,}066<0{,}333$

Eccentricity of load is SATISFACTORY

Horizontal bearing capacity check

Most unfavorable load case No. 1. (LC 1)
Earth resistance: not considered

Horizontal bearing capacity $R_{dh} = 20{,}30$ kN
Extreme horizontal force $H = 3{,}03$ kN

Factor of safety = 6,70 > 1,50
Bearing capacity in the horizontal direction is SATISFACTORY
Bearing capacity of foundation is SATISFACTORY

Verification No. 1

Settlement and rotation of foundation - input data

Analysis carried out with automatic selection of the most unfavourable load cases.
Analysis carried out with accounting for coefficient κ_1 (influence of foundation depth).
Stress at the footing bottom considered from the finished grade.

Computed self weight of strip foundation G = 6,90 kN/m
Computed weight of overburden Z = 0,00 kN/m

Settlement of mid point of longitudinal edge = 0,1 mm
Settlement of mid point of transverse edge 1 = 0,2 mm
Settlement of mid point of transverse edge 2 = 0,0 mm

(1-max.compressed edge; 2-min.compressed edge)

Settlement and rotation of foundation - results

Foundation stiffness:
Computed weighted average modulus of deformation E_{def} = 10,03 MPa
Foundation in the longitudinal direction is rigid (k=1730,34)
Foundation in the direction of width is rigid (k=373,75)

Verification of load eccentricity

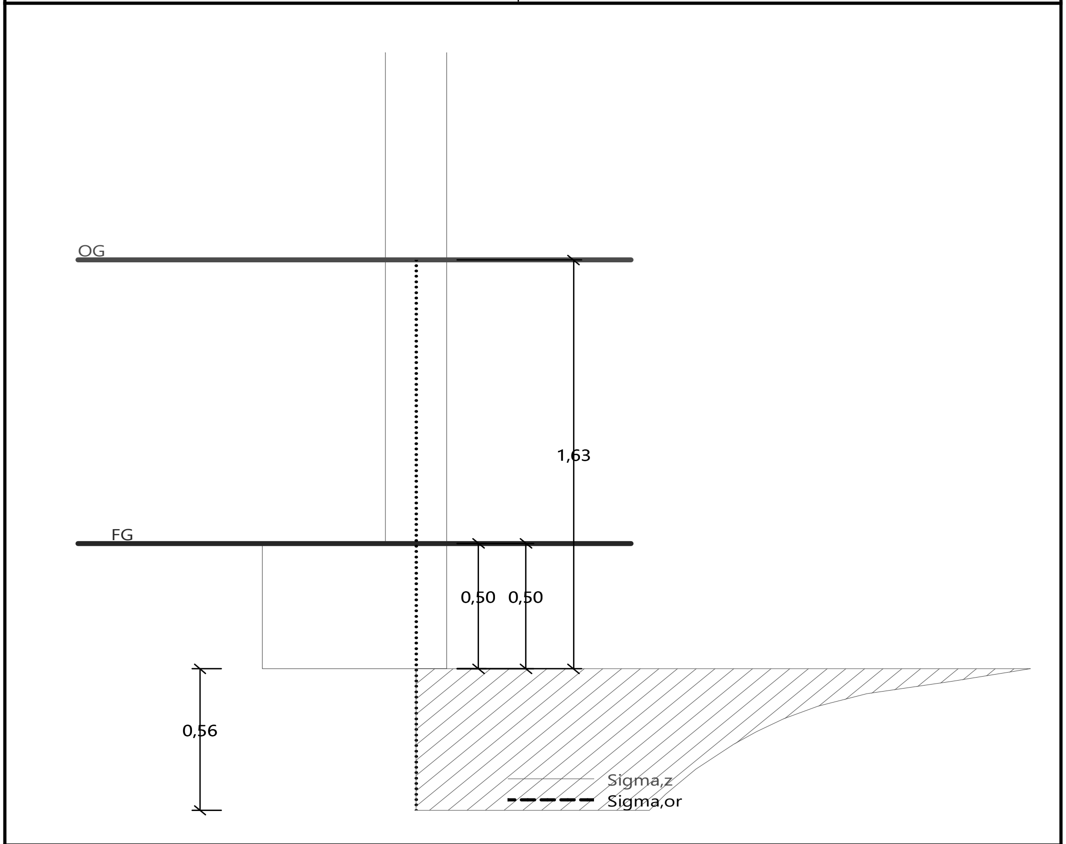
Max. eccentricity in direction of base length e_x = 0,066<0,333
Max. eccentricity in direction of base width e_y = 0,000<0,333
Max. overall eccentricity e_t = 0,066<0,333

Eccentricity of load is SATISFACTORY
Overall settlement and rotation of foundation:
Foundation settlement = 0,2 mm
Depth of influence zone = 0,56 m

Rotation in direction of width = 0,307 (tan*1000); (1,8E-02 °)

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Name : Settlement	**Stage - analysis : 1 - 1**



Dimensioning No. 1

Analysis carried out with automatic selection of the most unfavourable load cases.

Verification of longitudinal reinforcement of foundation in the direction of x

6 prof. 12,0 mm, cover 50,0 mm

Cross-section width = 1,00 m

Cross-section depth = 0,50 m

Reinforcement ratio	ρ	=	0,15 %	>	0,13 %	= ρ_{min}
Position of neutral axis	x	=	0,03 m	<	0,27 m	= x_{max}
Ultimate moment	M_{Rd}	=	127,73 kNm	>	1,09 kNm	= M_{Ed}

Cross-section is SATISFACTORY.

Spread footing for punching shear failure check

Column normal force = 6,67 kN

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Maximum resistance at the column perimeter

Force transferred into found. soil		=	2,22	kN
Force transferred by shear strength of foundation		=	4,45	kN
Considered column perimeter	u_0	=	1,00	m
Shear resistance at the column perimeter	$v_{Ed,max}$	=	0,01	MPa
Resistance at the column perimeter	$v_{Rd,max}$	=	2,94	MPa

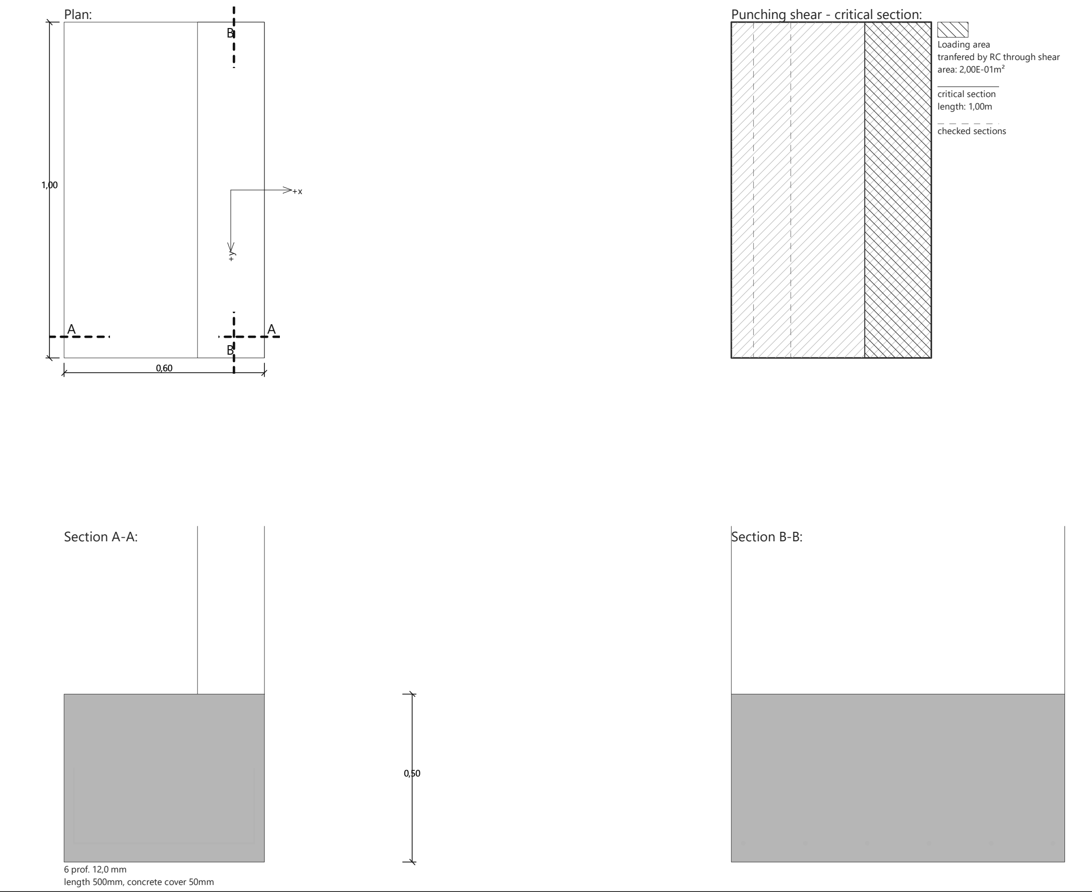
Critical section without shear reinforcement

Force transferred into found. soil		=	4,69	kN
Force transferred by shear strength of foundation		=	1,98	kN
Distance of section from the column		=	0,22	m
Section perimeter	u	=	1,00	m
Shear stress at section	v_{Ed}	=	0,00	MPa
Shear resistance of section without shear reinforcement	$v_{Rd,c}$	=	1,35	MPa

$v_{Ed} < v_{Rd,c}$ => Reinforcement is not required

Spread footing for punching shear is SATISFACTORY

Name : Dimensioning	**Stage - analysis : 1 - 1**



Dimensioning No. 1

Wall stem check - front reinf.

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-0,56	5,19	0,10	1,000
Pressure at rest	13,41	-0,29	0,00	0,20	1,000

Wall stem check - front reinf.

Front reinforcement is not required.

Wall stem check - back reinf.

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-0,56	5,19	0,10	1,000
Pressure at rest	13,41	-0,29	0,00	0,20	1,000

Wall stem check - back reinf.

Wall check at the construction joint 1,13 m from the wall crest
Reinforcement and dimensions of the cross-section
6,66 prof. 7,0 mm, cover 30,0 mm

Inputted reinforcement area	=	256,3	mm^2
Required reinforcement area	=	216,4	mm^2
Cross-section width	=	1,00	m
Cross-section height	=	0,20	m

Reinforcement ratio	ρ	=	0,15	%	>	0,13	%	=	ρ_{min}
Position of neutral axis	x	=	0,02	m	<	0,10	m	=	x_{max}
Ultimate shear force	V_{Rd}	=	73,71	kN	>	13,41	kN	=	V_{Ed}
Ultimate moment	M_{Rd}	=	20,40	kNm	>	3,83	kNm	=	M_{Ed}

Cross-section is SATISFACTORY.

Wall jump check

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-0,60	12,10	0,39	1,000
FF resistance	-1,05	-0,17	0,00	0,00	1,000
Resistance on front face	-0,21	-0,25	0,00	0,00	1,000
Active pressure	4,29	-0,84	1,48	0,60	1,000

Wall jump check

Reinforcement and dimensions of the cross-section
6 prof. 12,0 mm, cover 50,0 mm

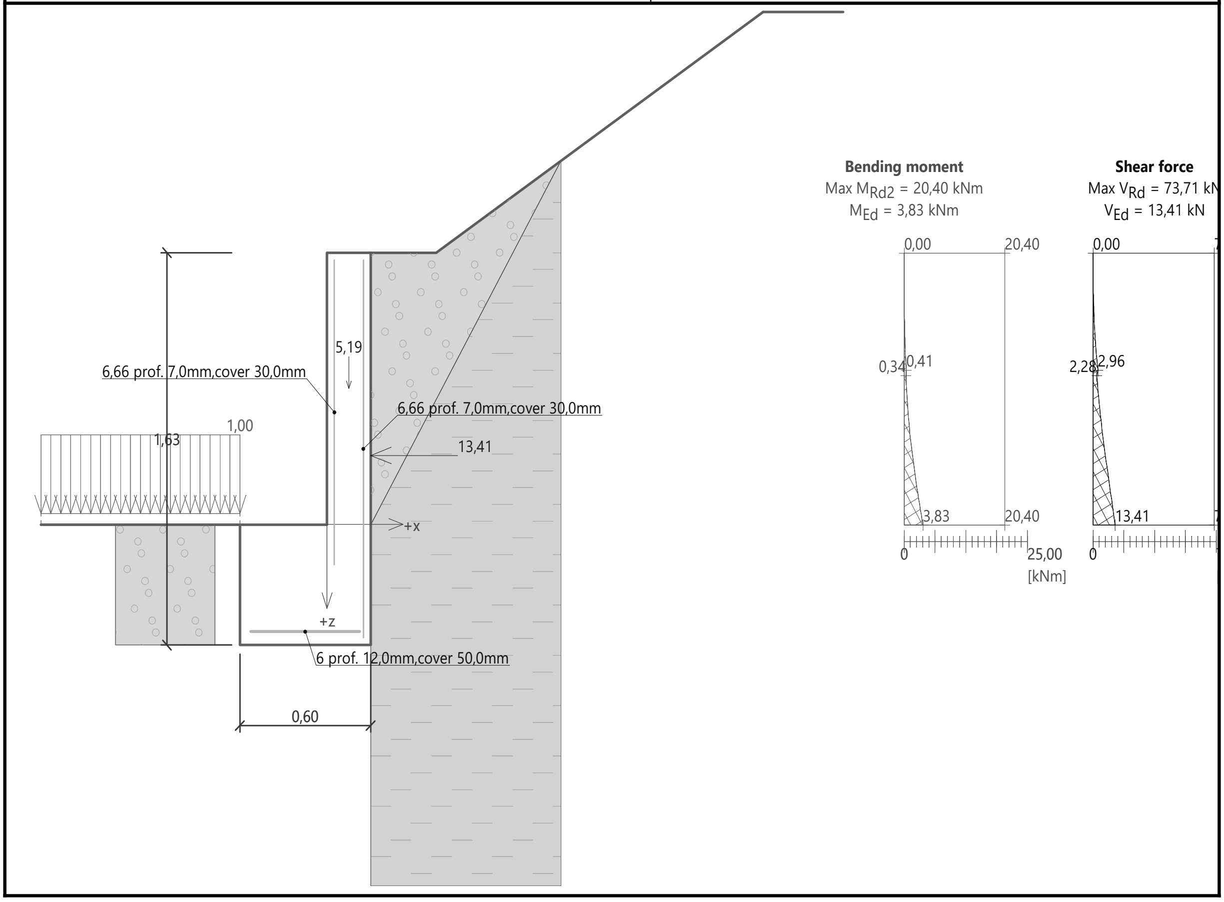
Inputted reinforcement area	=	678,6	mm^2
Required reinforcement area	=	577,2	mm^2
Cross-section width	=	1,00	m
Cross-section height	=	0,50	m

Reinforcement ratio	ρ	=	0,15	%	>	0,13	%	=	ρ_{min}
Position of neutral axis	x	=	0,03	m	<	0,27	m	=	x_{max}
Ultimate shear force	V_{Rd}	=	150,14	kN	>	8,55	kN	=	V_{Ed}
Ultimate moment	M_{Rd}	=	127,73	kNm	>	3,83	kNm	=	M_{Ed}

Cross-section is SATISFACTORY.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Name : Dimensioning	Stage - analysis : 1 - 1



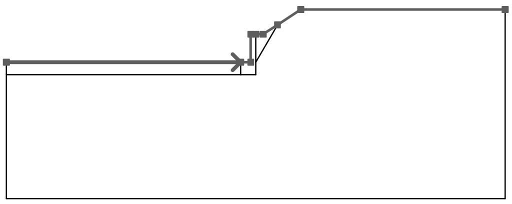
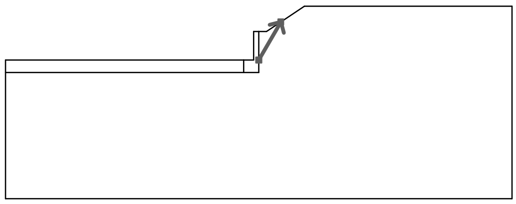
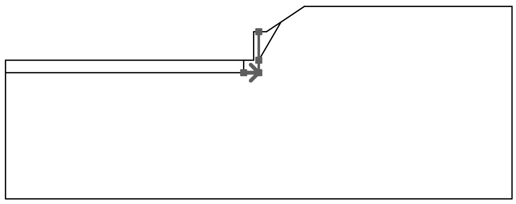
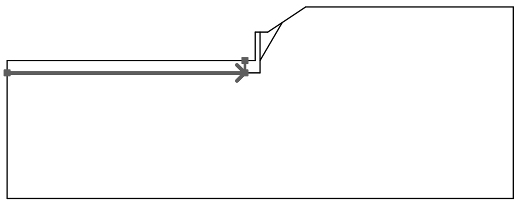
Slope stability analysis

Stability analysis

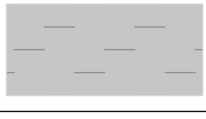
Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor :	SF_s =	1,50	[–]

Interface

No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
1		-10,00	-1,13	-0,60	-1,13	-0,20	-1,13
		-0,20	0,00	0,00	0,00	0,30	0,00
		0,87	0,38	1,80	1,00	10,00	1,00
2		0,00	-1,13	0,87	0,38		
3		-0,60	-1,63	0,00	-1,63	0,00	-1,13
		0,00	0,00				
4		-10,00	-1,63	-0,60	-1,63	-0,60	-1,13

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]
1	Glina (pretpostavka)		19,00	30,00	21,00
2	Nasip iza zida		35,50	0,00	20,00

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [kN/m³]	γ_s [kN/m³]	n [–]
1	Glina (pretpostavka)		21,00		
2	Nasip iza zida		20,00		

Soil parameters

Glina (pretpostavka)

Unit weight : γ = 21,00 kN/m³
Stress-state : effective
Angle of internal friction : φ_{ef} = 19,00 °
Cohesion of soil : c_{ef} = 30,00 kPa
Saturated unit weight : γ_{sat} = 21,00 kN/m³

Nasip iza zida

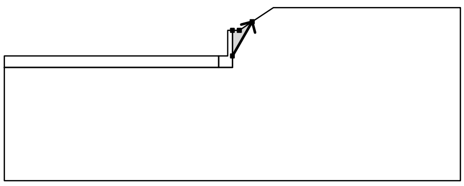
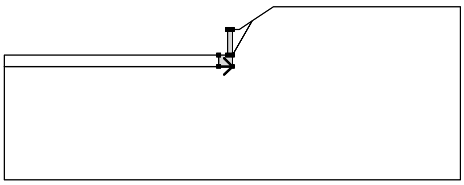
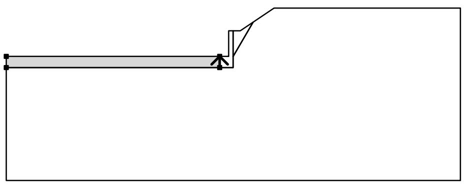
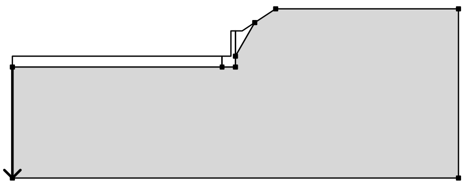
Unit weight : γ = 20,00 kN/m³
Stress-state : effective
Angle of internal friction : φ_{ef} = 35,50 °
Cohesion of soil : c_{ef} = 0,00 kPa
Saturated unit weight : γ_{sat} = 20,00 kN/m³

Rigid bodies

No.	Name	Sample	γ [kN/m³]
1	Material of structure		23,00

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Assigning and surfaces

No.	Surface position	Coordinates of surface points [m] x	z	x	z	Assigned soil
1		0,00	-1,13	0,87	0,38	Nasip iza zida
		0,30	0,00	0,00	0,00	
2		-0,60	-1,63	0,00	-1,63	Material of structure
		0,00	-1,13	0,00	0,00	
		-0,20	0,00	-0,20	-1,13	
		-0,60	-1,13			
3		-0,60	-1,63	-0,60	-1,13	Nasip iza zida
		-10,00	-1,13	-10,00	-1,63	
4		-10,00	-1,63	-10,00	-6,63	Glina (pretpostavka)
		10,00	-6,63	10,00	1,00	
		1,80	1,00	0,87	0,38	
		0,00	-1,13	0,00	-1,63	
		-0,60	-1,63			

Surcharge

No.	Type	Type of action	Location z [m]	Origin x [m]	Length l [m]	Width b [m]	Slope α [°]	Magnitude q, q_1, f, F	q_2	unit
1	strip	permanent	on terrain	x = -10,00	l = 9,40		0,00	1,00		kN/m^2

Water

Water type : No water

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 1)

Analysis 1

Circular slip surface

Slip surface parameters							
Center :	x =	0,01	[m]	Angles :	α_1 =	-30,64	[°]
	z =	2,26	[m]		α_2 =	71,35	[°]
Radius :	R =	3,94	[m]				
The slip surface after optimization.							

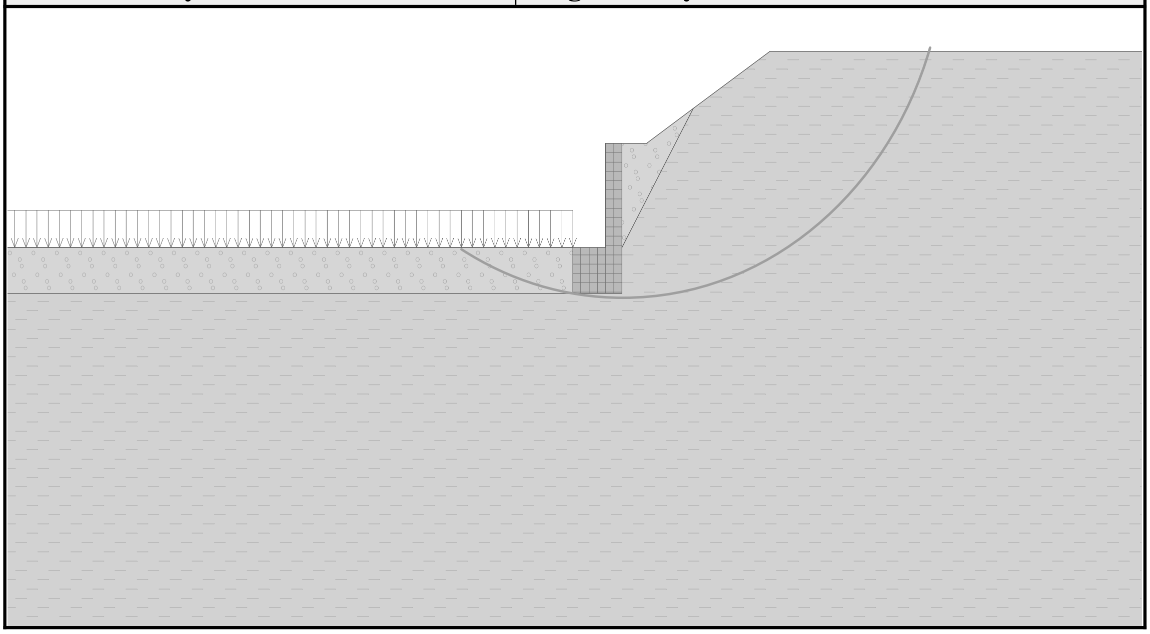
Slope stability verification (Bishop)

Sum of active forces : F_a = 51,05 kN/m
Sum of passive forces : F_p = 219,03 kN/m

Sliding moment : M_a = 201,15 kNm/m
Resisting moment : M_p = 862,97 kNm/m

Factor of safety = 4,29 > 1,50
Slope stability ACCEPTABLE

Name : Analysis	Stage - analysis : 1 - 1



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

PZ1'

Materials and standards

Concrete structures : EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 : standard

Wall analysis

Active earth pressure calculation : Coulomb
Passive earth pressure calculation : Caquot-Kerisel
Earthquake analysis : Mononobe-Okabe
Shape of earth wedge : Calculate as skew
Base key : The base key is considered as inclined footing bottom
Allowable eccentricity : 0,333
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor for overturning :	SF_o =	1,50	[–]
Safety factor for sliding resistance :	SF_s =	1,50	[–]
Safety factor for bearing capacity :	SF_b =	1,50	[–]

Material of structure

Unit weight γ = 23,00 kN/m³
Analysis of concrete structures carried out according to the standard EN 1992-1-1 (EC2).
Concrete : C 20/25
Cylinder compressive strength f_{ck} = 20,00 MPa
Tensile strength f_{ctm} = 2,20 MPa

Longitudinal steel : B500
Yield strength f_{yk} = 500,00 MPa

Geometry of structure

No.	Coordinate X [m]	Depth Z [m]
1	0,00	0,00
2	0,00	1,93
3	0,00	2,43
4	-1,20	2,43

No.	Coordinate X [m]	Depth Z [m]
5	-1,20	1,93
6	-0,20	1,93
7	-0,20	0,00

The origin [0,0] is located at the most upper right point of the wall.
Wall section area = 0,99 m^2.

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m^3]	γ_{su} [kN/m^3]	δ [°]
1	Glina (pretpostavka)		19,00	30,00	21,00	11,00	19,00
2	Nasip iza zida		35,50	0,00	20,00	10,00	19,00

All soils are considered as cohesionless for at rest pressure analysis.

Soil parameters

Glina (pretpostavka)
Unit weight : γ = 21,00 kN/m^3
Stress-state : effective
Angle of internal friction : φ_{ef} = 19,00 °
Cohesion of soil : c_{ef} = 30,00 kPa
Angle of friction struc.-soil : δ = 19,00 °
Soil : cohesionless
Saturated unit weight : γ_{sat} = 21,00 kN/m^3

Nasip iza zida
Unit weight : γ = 20,00 kN/m^3
Stress-state : effective
Angle of internal friction : φ_{ef} = 35,50 °
Cohesion of soil : c_{ef} = 0,00 kPa
Angle of friction struc.-soil : δ = 19,00 °
Soil : cohesionless
Saturated unit weight : γ_{sat} = 20,00 kN/m^3

Backfill

Assigned soil : Nasip iza zida
Slope = 60,00 °

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	-	0,00 .. ∞	Glina (pretpostavka)	

Foundation

Type of foundation : soil from geological profile

Terrain profile

No.	Coordinates x [m]	Depth z [m]
1	0,00	0,00
2	0,30	0,00
3	1,80	-1,00
4	2,80	-1,00

Origin [0,0] is located in upper right edge of construction.
Positive coordinate +z has downward direction.

Water influence

Ground water table is located below the structure.

Resistance on front face of the structure

Resistance on front face of the structure: at rest
Soil on front face of the structure - Nasip iza zida

Soil thickness in front of structure	h	=	0,50	m
Terrain surcharge	f	=	1,00	kN/m^2

Terrain in front of structure is flat.

Settings of the stage of construction

Design situation : permanent
The wall is free to move. Active earth pressure is therefore assumed.

Verification No. 1

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-0,73	22,68	0,80	1,000
FF resistance	-1,05	-0,17	0,00	0,00	1,000
Resistance on front face	-0,21	-0,25	0,00	0,00	1,000
Active pressure	13,30	-1,12	4,58	1,20	1,000

Verification of complete wall

Check for overturning stability

Resisting moment M_{res} = 23,54 kNm/m
Overturning moment M_{ovr} = 14,67 kNm/m

Safety factor = 1,60 > 1,50
Wall for overturning is SATISFACTORY

Check for slip

Resisting horizontal force H_{res} = 28,91 kN/m
Active horizontal force H_{act} = 12,05 kN/m

Safety factor = 2,40 > 1,50
Wall for slip is SATISFACTORY
Overall check - WALL is SATISFACTORY

Bearing capacity of foundation soil

Design load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [–]	Stress [kPa]
1	7,49	27,26	12,05	0,229	41,89

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	7,49	27,26	12,05

Spread footing verification

Materials and standards

Concrete structures : EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 : standard

Settlement

Analysis method : Analysis using oedometric modulus
Restriction of influence zone : by percentage of Sigma,Or
Coeff. of restriction of influence zone : 10,0 [%]

Spread Footing

Analysis for drained conditions : Standard approach
Analysis of uplift : Standard
Allowable eccentricity : 0,333
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor for vertical bearing capacity :	SF_v =	1,50	[–]
Safety factor for sliding resistance :	SF_h =	1,50	[–]

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
1	Glina (pretpostavka)		19,00	30,00	21,00	11,00	19,00
2	Nasip iza zida		35,50	0,00	20,00	10,00	19,00

All soils are considered as cohesionless for at rest pressure analysis.

Soil parameters

Glina (pretpostavka)

Unit weight : γ = 21,00 kN/m³
Angle of internal friction : φ_{ef} = 19,00 °
Cohesion of soil : c_{ef} = 30,00 kPa
Oedometric modulus : E_{oed} = 21,50 MPa
Saturated unit weight : γ_{sat} = 21,00 kN/m³

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Nasip iza zida

Unit weight :	γ	=	20,00 kN/m³
Angle of internal friction :	φ_{ef}	=	35,50 °
Cohesion of soil :	c_{ef}	=	0,00 kPa
Oedometric modulus :	E_{oed}	=	161,00 MPa
Saturated unit weight :	γ_{sat}	=	20,00 kN/m³

Foundation

Foundation type: strip footing

Depth from original ground surface	h_z	=	2,43	m
Depth of footing bottom	d	=	0,50	m
Foundation thickness	t	=	0,50	m
Incl. of finished grade	s_1	=	0,00	°
Incl. of footing bottom	s_2	=	0,00	°

Overburden

Type: input unit weight

Unit weight of soil above foundation = 21,00 kN/m³

Geometry of structure

Foundation type: strip footing

Overall strip footing length	=	10,00	m
Strip footing width (x)	=	1,20	m
Column width in the direction of x	=	0,20	m

Inserted loading is considered per unit length of continuous footing span.

Volume of strip footing	=	0,60	m³/m
Volume of excavation	=	0,60	m³/m
Volume of fill	=	0,00	m³/m

Material of structure

Unit weight γ = 23,00 kN/m³

Analysis of concrete structures carried out according to the standard EN 1992-1-1 (EC2).

Concrete : C 20/25

Cylinder compressive strength	f_{ck}	=	20,00	MPa
Tensile strength	f_{ctm}	=	2,20	MPa
Elasticity modulus	E_{cm}	=	30000,00	MPa

Longitudinal steel : B500
Yield strength f_{yk} = 500,00 MPa

Transverse steel: B500
Yield strength f_{yk} = 500,00 MPa

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	-	0,00 .. ∞	Glina (pretpostavka)	

Load

No.	Load new	Load change	Name	Type	N [kN/m]	M_y [kNm/m]	H_x [kN/m]
1	Yes		LC 1	Design	13,46	1,46	-12,05
2	Yes		LC 2	Service	13,46	1,46	-12,05

Global settings

Type of analysis : analysis for drained conditions

Settings of the stage of construction

Design situation : permanent

Verification No. 1

Load case verification

Name	e_x [m]	e_y [m]	σ [kPa]	R_d [kPa]	Utilization [%]	Is satisfactory
LC 1	-0,03	0,00	23,82	171,63	20,82	Yes

Analysis carried out with automatic selection of the most unfavourable load cases.

Computed self weight of strip foundation G = 13,80 kN/m
Computed weight of overburden Z = 0,00 kN/m

Vertical bearing capacity check

Shape of contact stress : rectangle
Most unfavorable load case No. 1. (LC 1)
Parameters of slip surface below foundation:
Depth of slip surface z_{sp} = 1,35 m
Length of slip surface l_{sp} = 3,49 m

Design bearing capacity of found.soil R_d = 171,63 kPa
Extreme contact stress σ = 23,82 kPa

Factor of safety = 7,21 > 1,50
Bearing capacity in the vertical direction is SATISFACTORY

Verification of load eccentricity

Max. eccentricity in direction of base length e_x = 0,023<0,333
Max. eccentricity in direction of base width e_y = 0,000<0,333
Max. overall eccentricity e_t = 0,023<0,333

Eccentricity of load is SATISFACTORY

Horizontal bearing capacity check

Most unfavorable load case No. 1. (LC 1)
Earth resistance: not considered

Horizontal bearing capacity R_{dh} = 43,72 kN
Extreme horizontal force H = 12,05 kN

Factor of safety = 3,63 > 1,50
Bearing capacity in the horizontal direction is SATISFACTORY
Bearing capacity of foundation is SATISFACTORY

Verification No. 1

Settlement and rotation of foundation - input data

Analysis carried out with automatic selection of the most unfavourable load cases.
Analysis carried out with accounting for coefficient κ_1 (influence of foundation depth).
Stress at the footing bottom considered from the finished grade.

Computed self weight of strip foundation G = 13,80 kN/m
Computed weight of overburden Z = 0,00 kN/m

Settlement of mid point of longitudinal edge = 0,1 mm
Settlement of mid point of transverse edge 1 = 0,2 mm
Settlement of mid point of transverse edge 2 = 0,0 mm

(1-max.compressed edge; 2-min.compressed edge)

Settlement and rotation of foundation - results

Foundation stiffness:

Computed weighted average modulus of deformation E_{def} = 10,03 MPa
Foundation in the longitudinal direction is rigid (k=216,29)
Foundation in the direction of width is rigid (k=373,75)

Verification of load eccentricity

Max. eccentricity in direction of base length e_x = 0,023<0,333
Max. eccentricity in direction of base width e_y = 0,000<0,333
Max. overall eccentricity e_t = 0,023<0,333

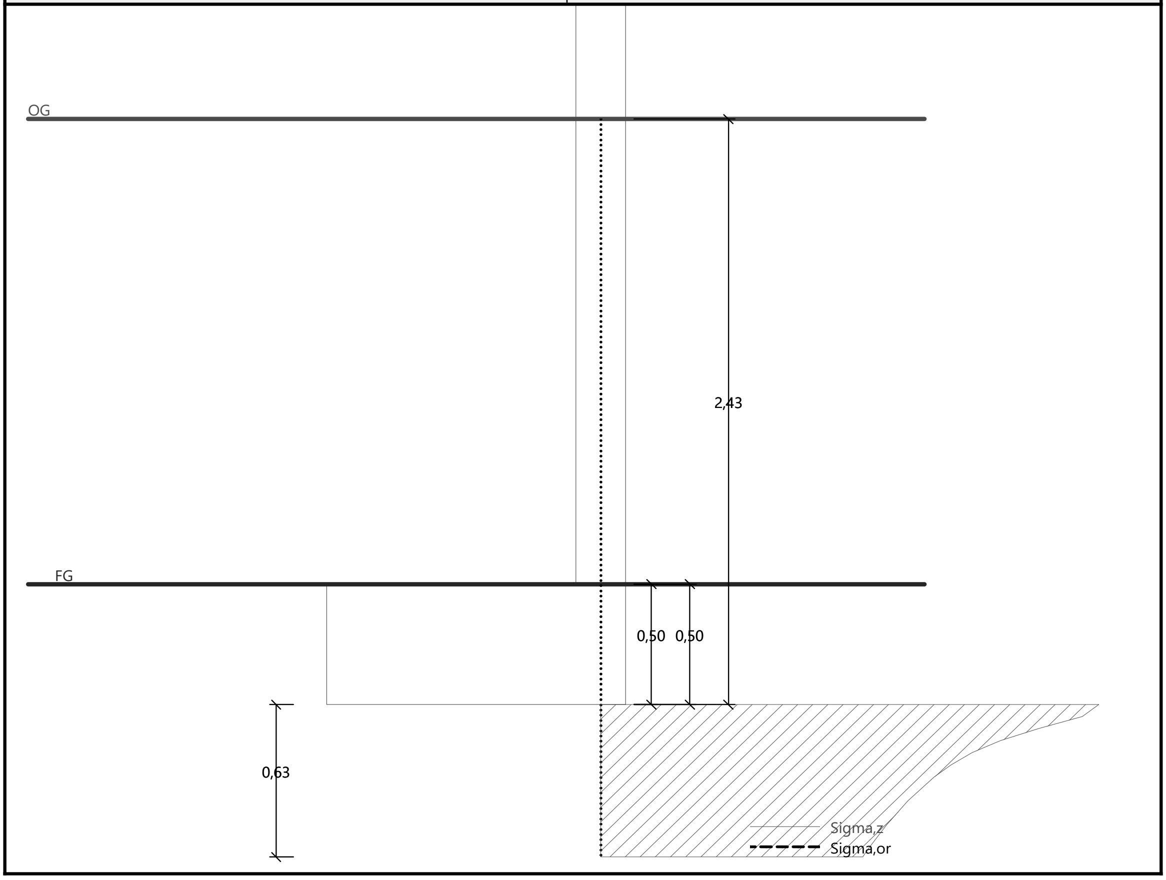
Eccentricity of load is SATISFACTORY

Overall settlement and rotation of foundation:

Foundation settlement = 0,2 mm
Depth of influence zone = 0,63 m

Rotation in direction of width = 0,136 (tan*1000); (7,8E-03 °)

Name : Settlement	**Stage - analysis : 1 - 1**



Dimensioning No. 1

Analysis carried out with automatic selection of the most unfavourable load cases.

Verification of longitudinal reinforcement of foundation in the direction of x

6 prof. 12,0 mm, cover 50,0 mm
Cross-section width = 1,00 m
Cross-section depth = 0,50 m

Reinforcement ratio	ρ	=	0,15	%	>	0,13 %	=	ρ_{min}
Position of neutral axis	x	=	0,03	m	<	0,27 m	=	x_{max}
Ultimate moment	M_{Rd}	=	127,73	kNm	>	5,95 kNm	=	M_{Ed}

Cross-section is SATISFACTORY.

Spread footing for punching shear failure check

Column normal force = 13,46 kN

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Maximum resistance at the column perimeter

Force transferred into found. soil		=	2,24	kN
Force transferred by shear strength of foundation		=	11,22	kN
Considered column perimeter	u_0	=	1,00	m
Shear resistance at the column perimeter	$v_{Ed,max}$	=	0,03	MPa
Resistance at the column perimeter	$v_{Rd,max}$	=	2,94	MPa

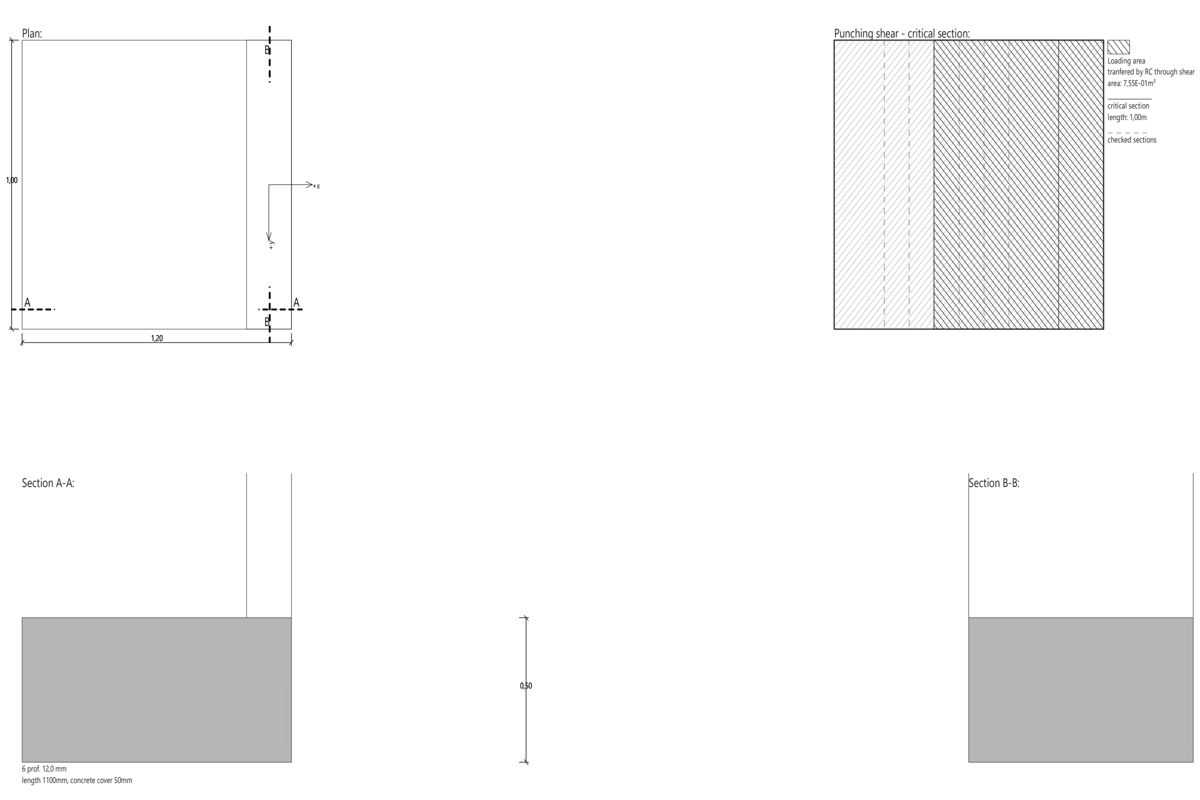
Critical section without shear reinforcement

Force transferred into found. soil		=	8,47	kN
Force transferred by shear strength of foundation		=	4,99	kN
Distance of section from the column		=	0,56	m
Section perimeter	u	=	1,00	m
Shear stress at section	v_{Ed}	=	0,01	MPa
Shear resistance of section without shear reinforcement	$v_{Rd,c}$	=	0,54	MPa

$v_{Ed} < v_{Rd,c}$ => Reinforcement is not required

Spread footing for punching shear is SATISFACTORY

Name : Dimensioning	**Stage - analysis : 1 - 1**



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Dimensioning No. 1

Wall stem check - front reinf.

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-0,96	8,87	0,10	1,000
Pressure at rest	29,74	-0,51	0,00	0,20	1,000

Wall stem check - front reinf.

Front reinforcement is not required.

Wall stem check - back reinf.

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-0,96	8,87	0,10	1,000
Pressure at rest	29,74	-0,51	0,00	0,20	1,000

Wall stem check - back reinf.

Wall check at the construction joint 1,93 m from the wall crest
Reinforcement and dimensions of the cross-section
6,66 prof. 8,0 mm, cover 30,0 mm

Inputted reinforcement area	=	334,8	mm^2
Required reinforcement area	=	215,8	mm^2
Cross-section width	=	1,00	m
Cross-section height	=	0,20	m

Reinforcement ratio	ρ	=	0,20	%	>	0,13	%	=	ρ_{min}
Position of neutral axis	x	=	0,02	m	<	0,10	m	=	x_{max}
Ultimate shear force	V_{Rd}	=	73,49	kN	>	29,74	kN	=	V_{Ed}
Ultimate moment	M_{Rd}	=	25,12	kNm	>	15,24	kNm	=	M_{Ed}

Cross-section is SATISFACTORY.

INVESTITOR: Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA: Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA: Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA: Glavni projekt – građevinski projekt
BROJ PROJEKTA: 4/22-GP
GLAVNI PROJEKTANT: Željko Šaponja dipl.ing.građ.

Wall jump check

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-0,73	22,68	0,80	1,000
FF resistance	-1,05	-0,17	0,00	0,00	1,000
Resistance on front face	-0,21	-0,25	0,00	0,00	1,000
Active pressure	13,30	-1,12	4,58	1,20	1,000

Wall jump check

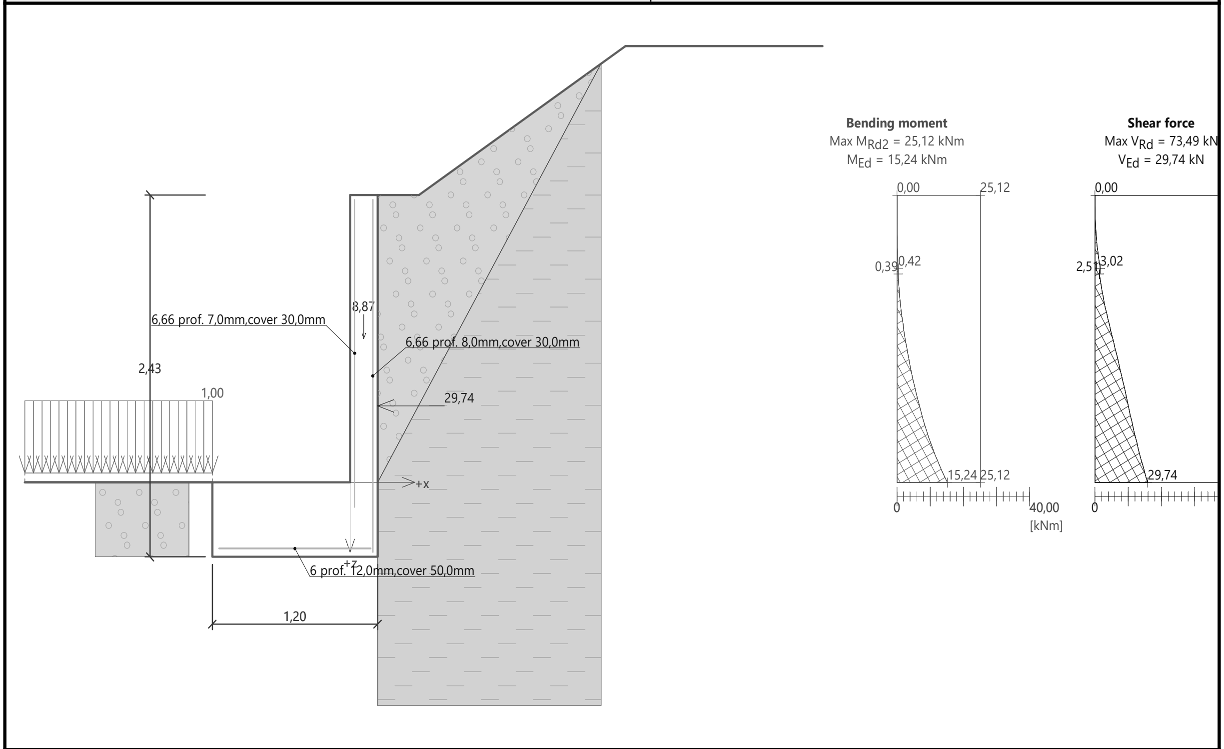
Reinforcement and dimensions of the cross-section
6 prof. 12,0 mm, cover 50,0 mm
Inputted reinforcement area = 678,6 mm^2
Required reinforcement area = 577,2 mm^2
Cross-section width = 1,00 m
Cross-section height = 0,50 m

Reinforcement ratio ρ = 0,15 % > 0,13 % = ρ_{min}
Position of neutral axis x = 0,03 m < 0,27 m = x_{max}
Ultimate shear force V_{Rd} = 150,14 kN > 15,76 kN = V_{Ed}
Ultimate moment M_{Rd} = 127,73 kNm > 15,24 kNm = M_{Ed}

Cross-section is SATISFACTORY.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Name : Dimensioning	Stage - analysis : 1 - 1



Slope stability analysis

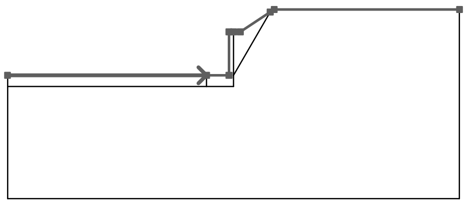
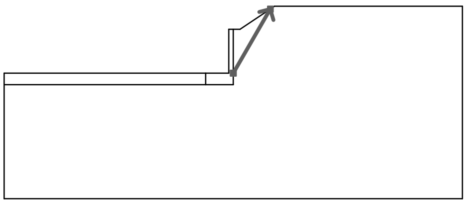
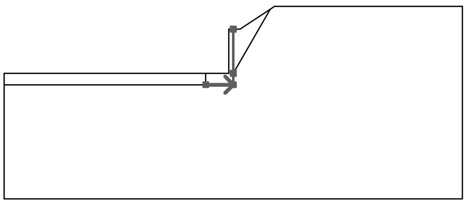
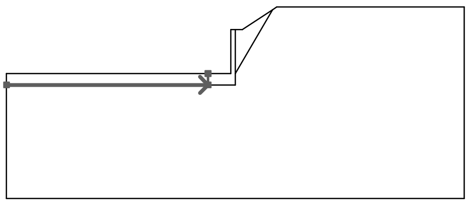
Stability analysis

Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

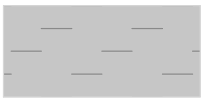
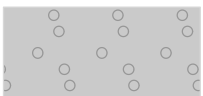
Safety factors			
Permanent design situation			
Safety factor :	SF_s =	1,50	[–]

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Interface

No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
1		-10,00	-1,93	-1,20	-1,93	-0,20	-1,93
		-0,20	0,00	0,00	0,00	0,30	0,00
		1,62	0,88	1,80	1,00	10,00	1,00
2		0,00	-1,93	1,62	0,88		
3		-1,20	-2,43	0,00	-2,43	0,00	-1,93
		0,00	0,00				
4		-10,00	-2,43	-1,20	-2,43	-1,20	-1,93

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]
1	Glina (pretpostavka)		19,00	30,00	21,00
2	Nasip iza zida		35,50	0,00	20,00

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [kN/m3]	γ_s [kN/m3]	n [–]
1	Glina (pretpostavka)		21,00		
2	Nasip iza zida		20,00		

Soil parameters

Glina (pretpostavka)

Unit weight : γ = 21,00 kN/m3
Stress-state : effective
Angle of internal friction : φ_{ef} = 19,00 °
Cohesion of soil : c_{ef} = 30,00 kPa
Saturated unit weight : γ_{sat} = 21,00 kN/m3

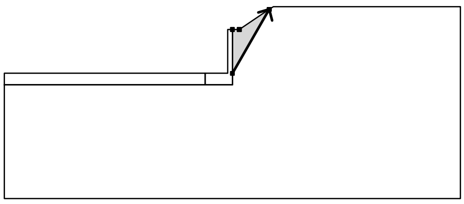
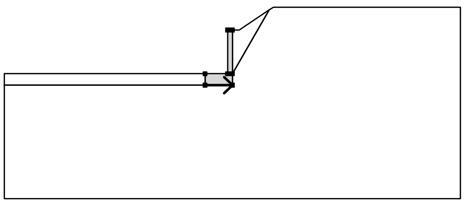
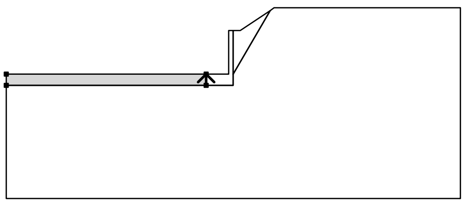
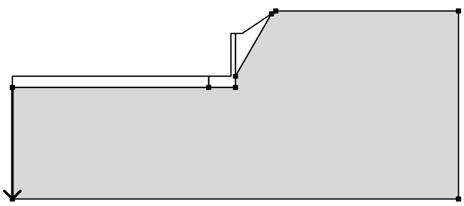
Nasip iza zida

Unit weight : γ = 20,00 kN/m3
Stress-state : effective
Angle of internal friction : φ_{ef} = 35,50 °
Cohesion of soil : c_{ef} = 0,00 kPa
Saturated unit weight : γ_{sat} = 20,00 kN/m3

Rigid bodies

No.	Name	Sample	γ [kN/m3]
1	Material of structure		23,00

Assigning and surfaces

No.	Surface position	Coordinates of surface points [m] x	z	x	z	Assigned soil
1		0,00	-1,93	1,62	0,88	Nasip iza zida
		0,30	0,00	0,00	0,00	
2		-1,20	-2,43	0,00	-2,43	Material of structure
		0,00	-1,93	0,00	0,00	
		-0,20	0,00	-0,20	-1,93	
		-1,20	-1,93			
3		-1,20	-2,43	-1,20	-1,93	Nasip iza zida
		-10,00	-1,93	-10,00	-2,43	
4		-10,00	-2,43	-10,00	-7,43	Glina (pretpostavka)
		10,00	-7,43	10,00	1,00	
		1,80	1,00	1,62	0,88	
		0,00	-1,93	0,00	-2,43	
		-1,20	-2,43			

Surcharge

No.	Type	Type of action	Location z [m]	Origin x [m]	Length l [m]	Width b [m]	Slope α [°]	Magnitude q, q_1, f, F	q_2	unit
1	strip	permanent	on terrain	x = -10,00	l = 8,80		0,00	1,00		kN/m2

Water

Water type : No water

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 1)

Analysis 1

Circular slip surface

Slip surface parameters							
Center :	x =	-0,37	[m]	Angles :	α_1 =	-29,08	[°]
	z =	2,09	[m]		α_2 =	76,29	[°]
Radius :	R =	4,60	[m]				
The slip surface after optimization.							

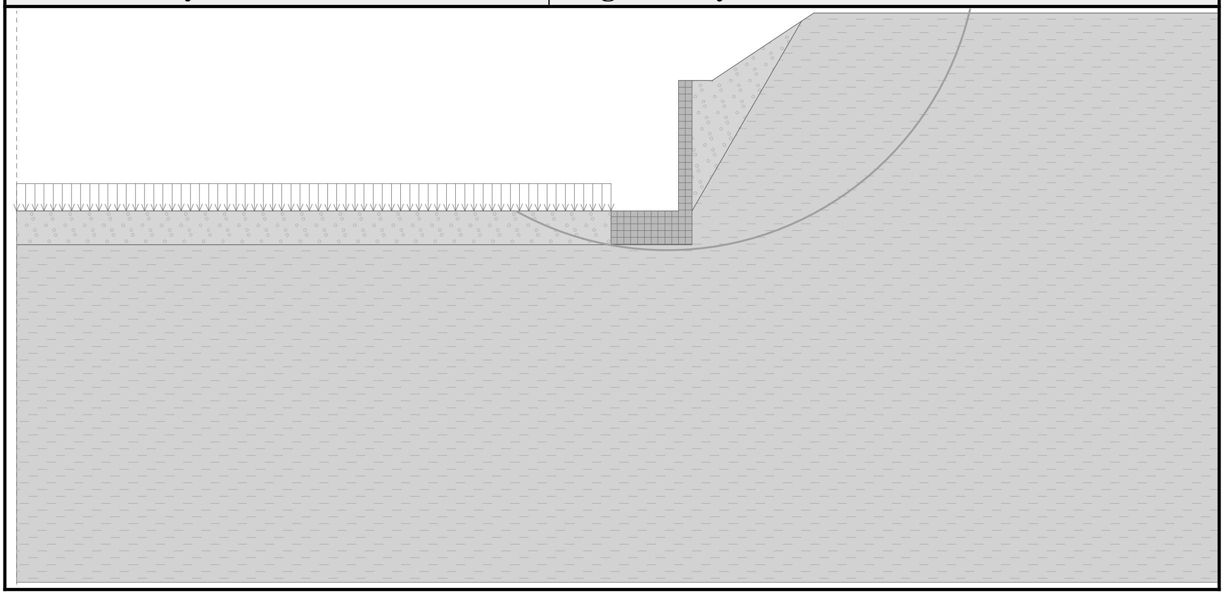
Slope stability verification (Bishop)

Sum of active forces : F_a = 86,70 kN/m
Sum of passive forces : F_p = 284,18 kN/m

Sliding moment : M_a = 398,81 kNm/m
Resisting moment : M_p = 1307,21 kNm/m

Factor of safety = 3,28 > 1,50
Slope stability ACCEPTABLE

Name : Analysis	Stage - analysis : 1 - 1



PZ 2

Materials and standards

Concrete structures : EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 : standard

Wall analysis

Active earth pressure calculation : Coulomb
Passive earth pressure calculation : Caquot-Kerisel
Earthquake analysis : Mononobe-Okabe
Shape of earth wedge : Calculate as skew
Base key : The base key is considered as inclined footing bottom
Allowable eccentricity : 0,333
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor for overturning :	SF_o =	1,50	[–]
Safety factor for sliding resistance :	SF_s =	1,50	[–]
Safety factor for bearing capacity :	SF_b =	1,50	[–]

Material of structure

Unit weight γ = 23,00 kN/m³
Analysis of concrete structures carried out according to the standard EN 1992-1-1 (EC2).
Concrete : C 20/25
Cylinder compressive strength f_{ck} = 20,00 MPa
Tensile strength f_{ctm} = 2,20 MPa

Longitudinal steel : B500
Yield strength f_{yk} = 500,00 MPa

Geometry of structure

No.	Coordinate X [m]	Depth Z [m]
1	0,00	0,00
2	0,00	1,13
3	0,00	1,63
4	-0,60	1,63
5	-0,60	1,13

No.	Coordinate X [m]	Depth Z [m]
6	-0,20	1,13
7	-0,20	0,00

The origin [0,0] is located at the most upper right point of the wall.
Wall section area = 0,53 m^2.

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
1	Glina (pretpostavka)		19,00	30,00	21,00	11,00	19,00
2	Nasip iza zida		35,50	0,00	20,00	10,00	19,00

All soils are considered as cohesionless for at rest pressure analysis.

Soil parameters

Glina (pretpostavka)

Unit weight :	γ = 21,00 kN/m³
Stress-state :	effective
Angle of internal friction :	φ_{ef} = 19,00 °
Cohesion of soil :	c_{ef} = 30,00 kPa
Angle of friction struc.-soil :	δ = 19,00 °
Soil :	cohesionless
Saturated unit weight :	γ_{sat} = 21,00 kN/m³

Nasip iza zida

Unit weight :	γ = 20,00 kN/m³
Stress-state :	effective
Angle of internal friction :	φ_{ef} = 35,50 °
Cohesion of soil :	c_{ef} = 0,00 kPa
Angle of friction struc.-soil :	δ = 19,00 °
Soil :	cohesionless
Saturated unit weight :	γ_{sat} = 20,00 kN/m³

Backfill

Assigned soil : Nasip iza zida
Slope = 60,00 °

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	-	0,00 .. ∞	Glina (pretpostavka)	

Foundation

Type of foundation : soil from geological profile

Terrain profile

Terrain behind the structure is flat.

Water influence

Ground water table is located below the structure.

Input surface surcharges

No.	Surcharge new	Surcharge change	Action	Mag.1 [kN/m²]	Mag.2 [kN/m²]	Ord.x x [m]	Length l [m]	Depth z [m]
1	Yes		permanent	2,00				on terrain
2	Yes		variable	3,00				on terrain

No.	Name
1	Dodatno stalno
2	Uporabno

Resistance on front face of the structure

Resistance on front face of the structure: at rest
Soil on front face of the structure - Nasip iza zida
Soil thickness in front of structure h = 0,50 m
Terrain surcharge f = 1,00 kN/m^2

Terrain in front of structure is flat.

Settings of the stage of construction

Design situation : permanent
The wall is free to move. Active earth pressure is therefore assumed.

Verification No. 1

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-0,60	12,10	0,39	1,000
FF resistance	-1,05	-0,17	0,00	0,00	1,000
Resistance on front face	-0,21	-0,25	0,00	0,00	1,000
Active pressure	2,90	-0,88	1,00	0,60	1,000
Dodatno stalno	0,51	-1,06	0,32	0,60	1,000
Uporabno	0,77	-1,06	0,48	0,60	1,000

Verification of complete wall

Check for overturning stability

Resisting moment M_{res} = 5,75 kNm/m
Overturning moment M_{ovr} = 3,69 kNm/m

Safety factor = 1,56 > 1,50
Wall for overturning is SATISFACTORY

Check for slip

Resisting horizontal force H_{res} = 13,69 kN/m
Active horizontal force H_{act} = 2,93 kN/m

Safety factor = 4,67 > 1,50
Wall for slip is SATISFACTORY
Overall check - WALL is SATISFACTORY

Bearing capacity of foundation soil

Design load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [–]	Stress [kPa]
1	2,11	13,90	2,93	0,253	46,82

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	2,11	13,90	2,93

Spread footing verification

Input data

Settings

Standard - safety factors

Materials and standards

Concrete structures :	EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 :	standard

Settlement

Analysis method :	Analysis using oedometric modulus
Restriction of influence zone :	by percentage of Sigma,Or
Coeff. of restriction of influence zone :	10,0 [%]

Spread Footing

Analysis for drained conditions :	Standard approach
Analysis of uplift :	Standard
Allowable eccentricity :	0,333
Verification methodology :	Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor for vertical bearing capacity :	SF_v =	1,50	[–]
Safety factor for sliding resistance :	SF_h =	1,50	[–]

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
1	Glina (pretpostavka)		19,00	30,00	21,00	11,00	19,00
2	Nasip iza zida		35,50	0,00	20,00	10,00	19,00

All soils are considered as cohesionless for at rest pressure analysis.

Soil parameters

Glina (pretpostavka)

Unit weight : γ = 21,00 kN/m³
Angle of internal friction : φ_{ef} = 19,00 °
Cohesion of soil : c_{ef} = 30,00 kPa
Oedometric modulus : E_{oed} = 21,50 MPa
Saturated unit weight : γ_{sat} = 21,00 kN/m³

Nasip iza zida

Unit weight : γ = 20,00 kN/m³
Angle of internal friction : φ_{ef} = 35,50 °
Cohesion of soil : c_{ef} = 0,00 kPa
Oedometric modulus : E_{oed} = 161,00 MPa
Saturated unit weight : γ_{sat} = 20,00 kN/m³

Foundation

Foundation type: strip footing

Depth from original ground surface h_z = 1,63 m
Depth of footing bottom d = 0,50 m
Foundation thickness t = 0,50 m
Incl. of finished grade s_1 = 0,00 °
Incl. of footing bottom s_2 = 0,00 °

Overburden

Type: input unit weight
Unit weight of soil above foundation = 21,00 kN/m³

Geometry of structure

Foundation type: strip footing

Overall strip footing length = 45,00 m
Strip footing width (x) = 0,60 m
Column width in the direction of x = 0,20 m

Inserted loading is considered per unit length of continuous footing span.

Volume of strip footing = 0,30 m³/m
Volume of excavation = 0,30 m³/m
Volume of fill = 0,00 m³/m

Material of structure

Unit weight γ = 23,00 kN/m³
Analysis of concrete structures carried out according to the standard EN 1992-1-1 (EC2).
Concrete : C 20/25

Cylinder compressive strength f_{ck} = 20,00 MPa
Tensile strength f_{ctm} = 2,20 MPa
Elasticity modulus E_{cm} = 30000,00 MPa

Longitudinal steel : B500
Yield strength f_{yk} = 500,00 MPa

Transverse steel: B500
Yield strength f_{yk} = 500,00 MPa

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	-	0,00 .. ∞	Glina (pretpostavka)	

Load

No.	Load new	Load change	Name	Type	N [kN/m]	M_y [kNm/m]	H_x [kN/m]
1	Yes		LC 1	Design	7,00	0,64	-2,93
2	Yes		LC 2	Service	7,00	0,64	-2,93

Global settings

Type of analysis : analysis for drained conditions

Settings of the stage of construction

Design situation : permanent

Verification No. 1

Load case verification

Name	e_x [m]	e_y [m]	σ [kPa]	R_d [kPa]	Utilization [%]	Is satisfactory
LC 1	-0,05	0,00	27,89	336,11	12,45	Yes

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Analysis carried out with automatic selection of the most unfavourable load cases.

Computed self weight of strip foundation	G	=	6,90	kN/m
Computed weight of overburden	Z	=	0,00	kN/m

Vertical bearing capacity check

Shape of contact stress : rectangle
Most unfavorable load case No. 1. (LC 1)
Parameters of slip surface below foundation:

Depth of slip surface	z_{sp}	=	0,68	m
Length of slip surface	l_{sp}	=	1,74	m

Design bearing capacity of found.soil	R_d	=	336,11	kPa
Extreme contact stress	σ	=	27,89	kPa

Factor of safety = 12,05 > 1,50
Bearing capacity in the vertical direction is SATISFACTORY

Verification of load eccentricity

Max. eccentricity in direction of base length	e_x	=	0,085<0,333
Max. eccentricity in direction of base width	e_y	=	0,000<0,333
Max. overall eccentricity	e_t	=	0,085<0,333

Eccentricity of load is SATISFACTORY

Horizontal bearing capacity check

Most unfavorable load case No. 1. (LC 1)
Earth resistance: not considered

Horizontal bearing capacity	R_{dh}	=	19,74	kN
Extreme horizontal force	H	=	2,93	kN

Factor of safety = 6,73 > 1,50
Bearing capacity in the horizontal direction is SATISFACTORY
Bearing capacity of foundation is SATISFACTORY

Verification No. 1

Settlement and rotation of foundation - input data

Analysis carried out with automatic selection of the most unfavourable load cases.
Analysis carried out with accounting for coefficient κ_1 (influence of foundation depth).

Stress at the footing bottom considered from the finished grade.

Computed self weight of strip foundation G = 6,90 kN/m
Computed weight of overburden Z = 0,00 kN/m

Settlement of mid point of longitudinal edge = 0,1 mm
Settlement of mid point of transverse edge 1 = 0,2 mm
Settlement of mid point of transverse edge 2 = 0,0 mm

(1-max.compressed edge; 2-min.compressed edge)

Settlement and rotation of foundation - results

Foundation stiffness:
Computed weighted average modulus of deformation E_{def} = 10,03 MPa
Foundation in the longitudinal direction is rigid (k=1730,34)
Foundation in the direction of width is rigid (k=373,75)

Verification of load eccentricity

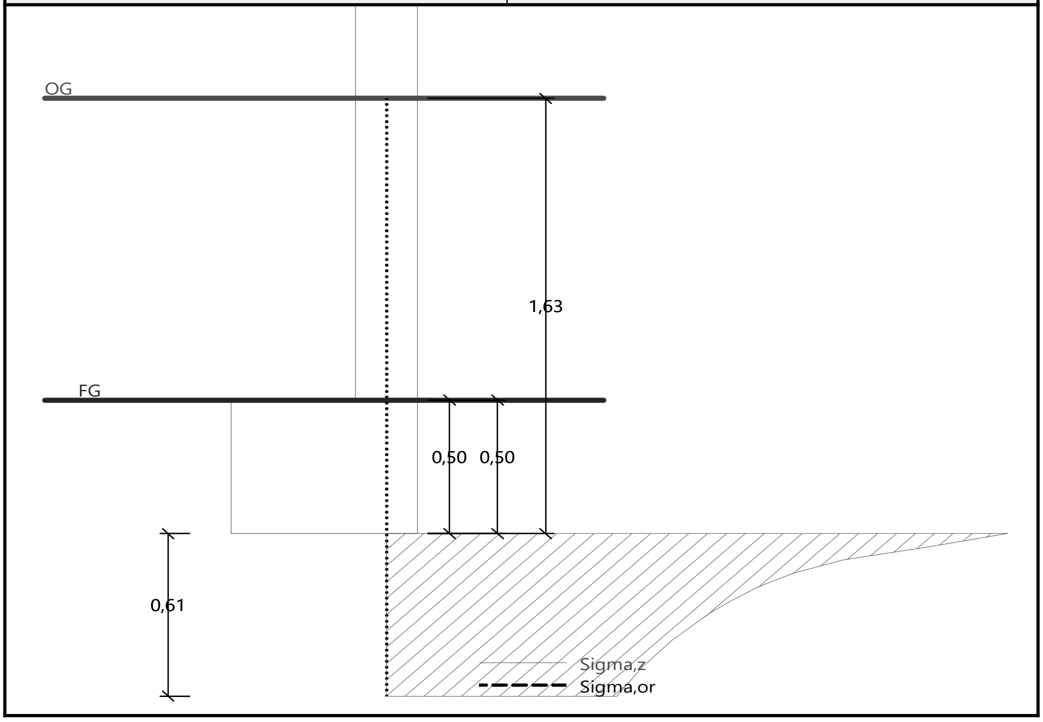
Max. eccentricity in direction of base length e_x = 0,085<0,333
Max. eccentricity in direction of base width e_y = 0,000<0,333
Max. overall eccentricity e_t = 0,085<0,333

Eccentricity of load is SATISFACTORY
Overall settlement and rotation of foundation:
Foundation settlement = 0,2 mm
Depth of influence zone = 0,61 m

Rotation in direction of width = 0,356 (tan*1000); (2,0E-02 °)

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Name : Settlement	**Stage - analysis : 1 - 1**



Dimensioning No. 1

Analysis carried out with automatic selection of the most unfavourable load cases.

Verification of longitudinal reinforcement of foundation in the direction of x

6 prof. 12,0 mm, cover 50,0 mm
Cross-section width = 1,00 m
Cross-section depth = 0,50 m

Reinforcement ratio	ρ	=	0,15	%	>	0,13 %	=	ρ_{min}
Position of neutral axis	x	=	0,03	m	<	0,27 m	=	x_{max}
Ultimate moment	M_{Rd}	=	127,73	kNm	>	1,20 kNm	=	M_{Ed}

Cross-section is SATISFACTORY.

Spread footing for punching shear failure check

Column normal force = 7,00 kN

Maximum resistance at the column perimeter

Force transferred into found. soil		=	2,33 kN
Force transferred by shear strength of foundation		=	4,67 kN
Considered column perimeter	u_0	=	1,00 m

Shear resistance at the column perimeter	$v_{Ed,max}$	=	0,01	MPa
Resistance at the column perimeter	$v_{Rd,max}$	=	2,94	MPa

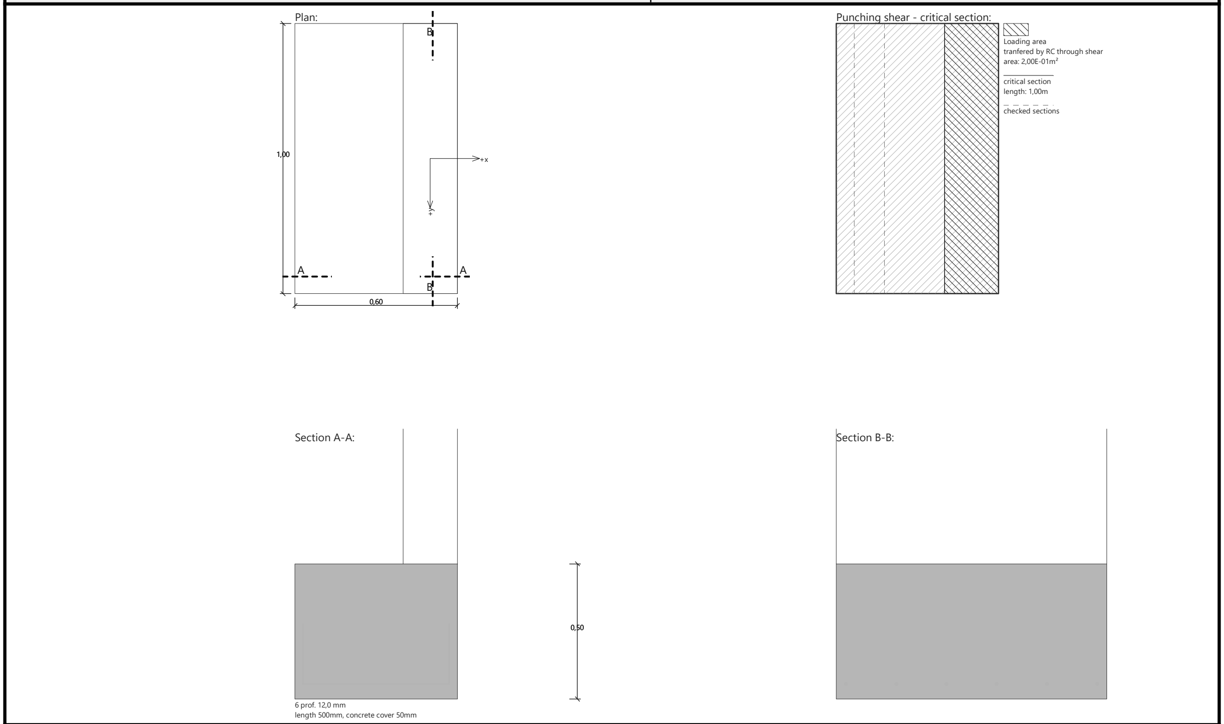
Critical section without shear reinforcement

Force transferred into found. soil		=	4,92	kN
Force transferred by shear strength of foundation		=	2,08	kN
Distance of section from the column		=	0,22	m
Section perimeter	u	=	1,00	m
Shear stress at section	v_{Ed}	=	0,00	MPa
Shear resistance of section without shear reinforcement	$v_{Rd,c}$	=	1,35	MPa

$v_{Ed} < v_{Rd,c}$ => Reinforcement is not required

Spread footing for punching shear is SATISFACTORY

Name : Dimensioning	**Stage - analysis : 1 - 1**



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Dimensioning No. 1

Wall stem check - front reinf.

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-0,56	5,19	0,10	1,000
Pressure at rest	7,67	-0,33	0,00	0,20	1,000
Dodatno stalno	1,20	-0,50	0,00	0,20	1,000
Uporabno	1,80	-0,50	0,00	0,20	1,000

Wall stem check - front reinf.

Front reinforcement is not required.

Wall stem check - back reinf.

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-0,56	5,19	0,10	1,000
Pressure at rest	7,67	-0,33	0,00	0,20	1,000
Dodatno stalno	1,20	-0,50	0,00	0,20	1,000
Uporabno	1,80	-0,50	0,00	0,20	1,000

Wall stem check - back reinf.

Wall check at the construction joint 1,13 m from the wall crest
Reinforcement and dimensions of the cross-section
6,66 prof. 7,0 mm, cover 30,0 mm

Inputted reinforcement area	=	256,3	mm^2
Required reinforcement area	=	216,4	mm^2
Cross-section width	=	1,00	m
Cross-section height	=	0,20	m

Reinforcement ratio	ρ	=	0,15	%	>	0,13	%	=	ρ_{min}
Position of neutral axis	x	=	0,02	m	<	0,10	m	=	x_{max}
Ultimate shear force	V_{Rd}	=	73,71	kN	>	10,67	kN	=	V_{Ed}
Ultimate moment	M_{Rd}	=	20,40	kNm	>	4,03	kNm	=	M_{Ed}

Cross-section is SATISFACTORY.

Wall jump check

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-0,60	12,10	0,39	1,000
FF resistance	-1,05	-0,17	0,00	0,00	1,000
Resistance on front face	-0,21	-0,25	0,00	0,00	1,000
Active pressure	2,90	-0,88	1,00	0,60	1,000
Dodatno stalno	0,51	-1,06	0,32	0,60	1,000
Uporabno	0,77	-1,06	0,48	0,60	1,000

Wall jump check

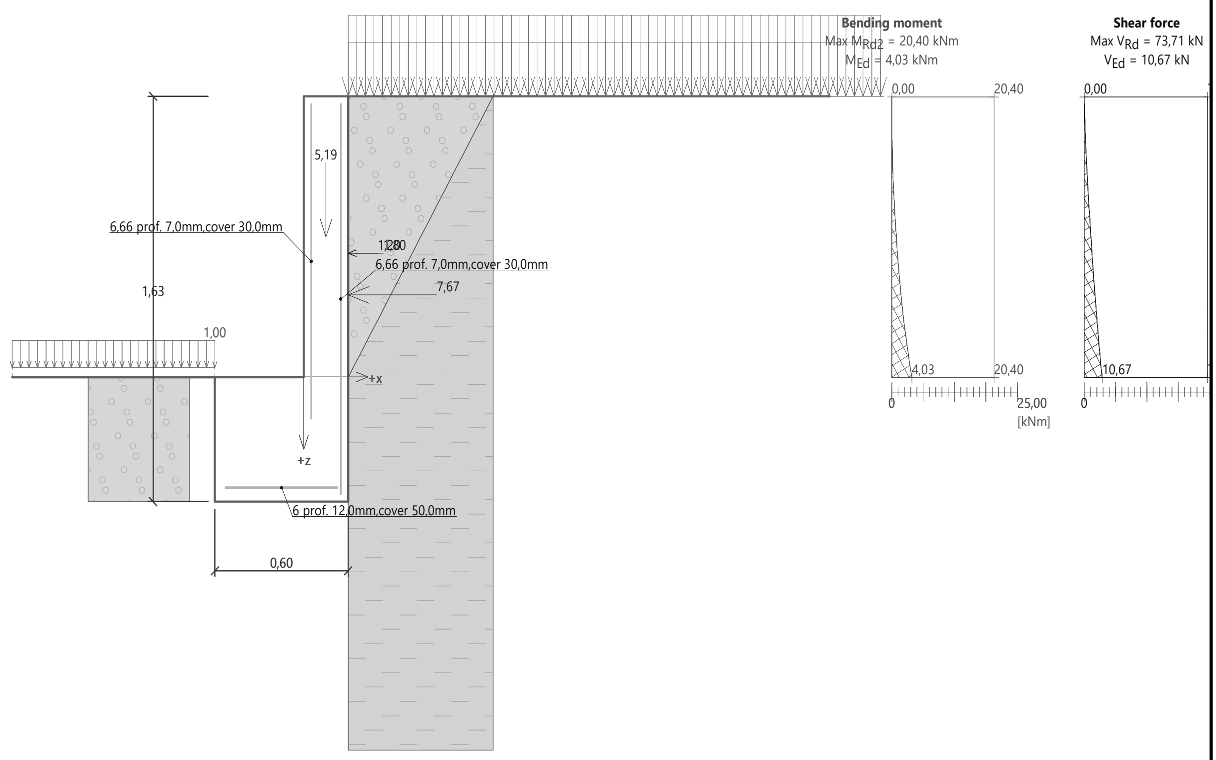
Reinforcement and dimensions of the cross-section
6 prof. 12,0 mm, cover 50,0 mm
Inputted reinforcement area = 678,6 mm^2
Required reinforcement area = 577,2 mm^2
Cross-section width = 1,00 m
Cross-section height = 0,50 m

Reinforcement ratio ρ = 0,15 % > 0,13 % = ρ_{min}
Position of neutral axis x = 0,03 m < 0,27 m = x_{max}
Ultimate shear force V_{Rd} = 150,14 kN > 9,16 kN = V_{Ed}
Ultimate moment M_{Rd} = 127,73 kNm > 4,03 kNm = M_{Ed}

Cross-section is SATISFACTORY.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Name : Dimensioning	Stage - analysis : 1 - 1



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

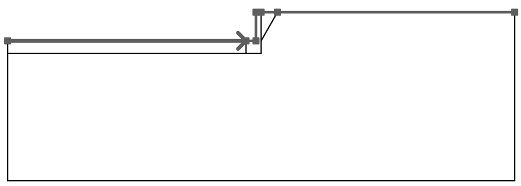
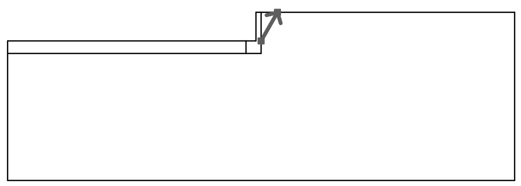
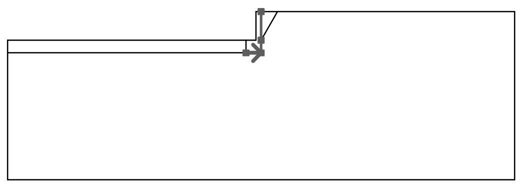
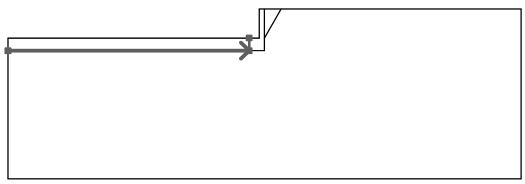
Slope stability analysis

Stability analysis

Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor :	$SF_s =$	1,50	[–]

Interface

No.	Interface location	Coordinates of interface points [m] x	z	x	z	x	z
1		-10,00	-1,13	-0,60	-1,13	-0,20	-1,13
		-0,20	0,00	0,00	0,00	0,65	0,00
		10,00	0,00				
2		0,00	-1,13	0,65	0,00		
3		-0,60	-1,63	0,00	-1,63	0,00	-1,13
		0,00	0,00				
4		-10,00	-1,63	-0,60	-1,63	-0,60	-1,13

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]
1	Glina (pretpostavka)		19,00	30,00	21,00
2	Nasip iza zida		35,50	0,00	20,00

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [kN/m³]	γ_s [kN/m³]	n [–]
1	Glina (pretpostavka)		21,00		
2	Nasip iza zida		20,00		

Soil parameters

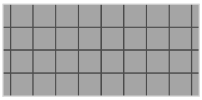
Glina (pretpostavka)

Unit weight :	γ =	21,00 kN/m³
Stress-state :	effective	
Angle of internal friction :	φ_{ef} =	19,00 °
Cohesion of soil :	c_{ef} =	30,00 kPa
Saturated unit weight :	γ_{sat} =	21,00 kN/m³

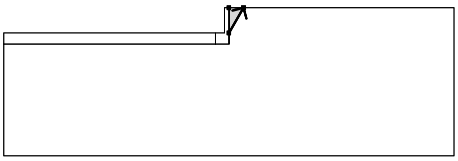
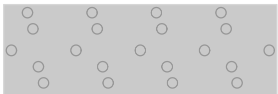
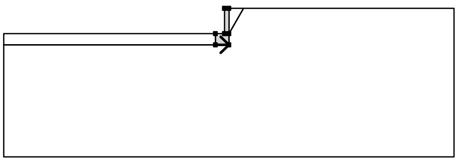
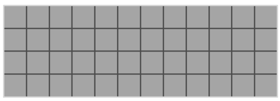
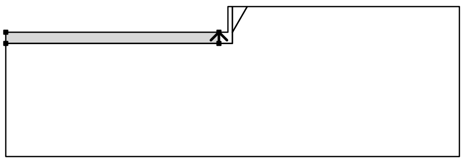
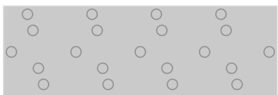
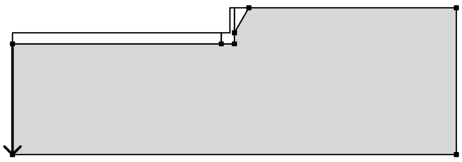
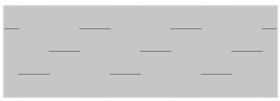
Nasip iza zida

Unit weight :	γ =	20,00 kN/m³
Stress-state :	effective	
Angle of internal friction :	φ_{ef} =	35,50 °
Cohesion of soil :	c_{ef} =	0,00 kPa
Saturated unit weight :	γ_{sat} =	20,00 kN/m³

Rigid bodies

No.	Name	Sample	γ [kN/m³]
1	Material of structure		23,00

Assigning and surfaces

No.	Surface position	Coordinates of surface points [m] x	z	x	z	Assigned soil
1		0,00	-1,13	0,65	0,00	Nasip iza zida
		0,00	0,00			
2		-0,60	-1,63	0,00	-1,63	Material of structure
		0,00	-1,13	0,00	0,00	
		-0,20	0,00	-0,20	-1,13	
		-0,60	-1,13			
3		-0,60	-1,63	-0,60	-1,13	Nasip iza zida
		-10,00	-1,13	-10,00	-1,63	
4		-10,00	-1,63	-10,00	-6,63	Glina (pretpostavka)
		10,00	-6,63	10,00	0,00	
		0,65	0,00	0,00	-1,13	
		0,00	-1,63	-0,60	-1,63	

Surcharge

No.	Type	Type of action	Location z [m]	Origin x [m]	Length l [m]	Width b [m]	Slope α [°]	Magnitude q, q_1, f, F	q_2	unit
1	strip	permanent	on terrain	x = 0,00	l = 10,00		0,00	2,00		kN/m²
2	strip	variable	on terrain	x = 0,00	l = 10,00		0,00	3,00		kN/m²
3	strip	permanent	on terrain	x = -10,00	l = 9,40		0,00	1,00		kN/m²

Surcharges

No.	Name
1	Dodatno stalno
2	Uporabno

Water

Water type : No water

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 1)

Analysis 1

Circular slip surface

Slip surface parameters							
Center :	x =	-0,32	[m]	Angles :	α_1 =	-41,21	[°]
	z =	0,48	[m]		α_2 =	77,04	[°]
Radius :	R =	2,14	[m]				
The slip surface after optimization.							

Slope stability verification (Bishop)

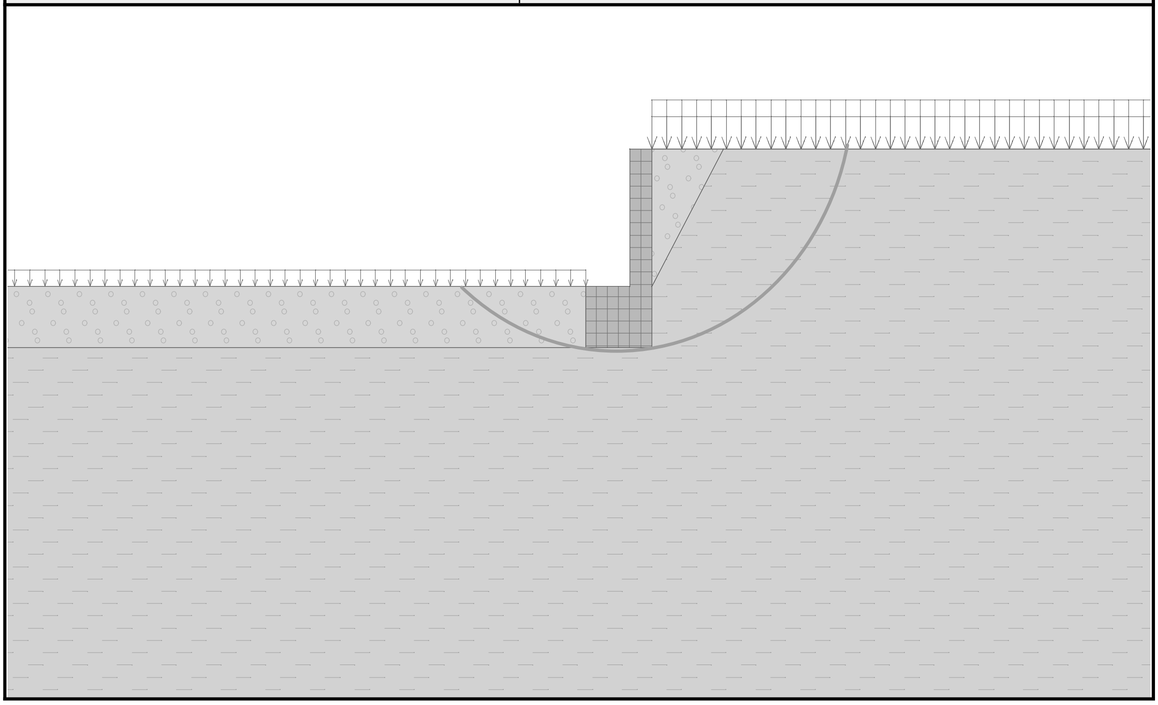
Sum of active forces : F_a = 23,10 kN/m
Sum of passive forces : F_p = 122,51 kN/m

Sliding moment : M_a = 49,43 kNm/m
Resisting moment : M_p = 262,18 kNm/m

Factor of safety = 5,30 > 1,50
Slope stability ACCEPTABLE

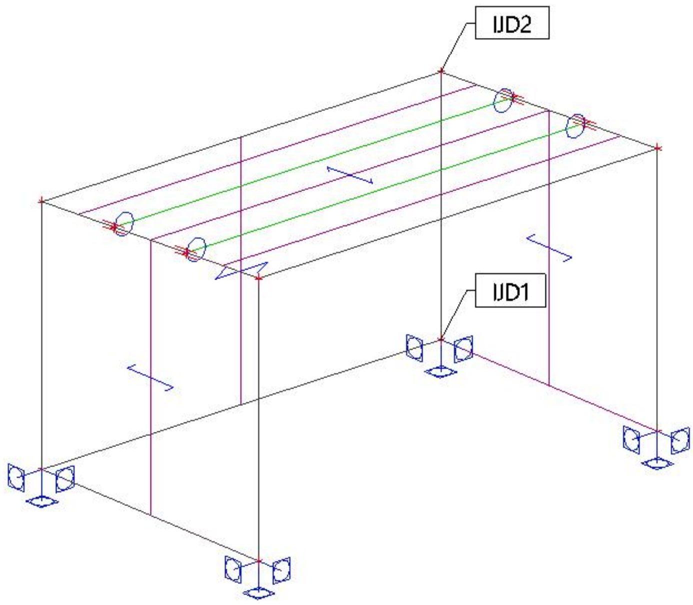
INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Name : Analysis	Stage - analysis : 1 - 1

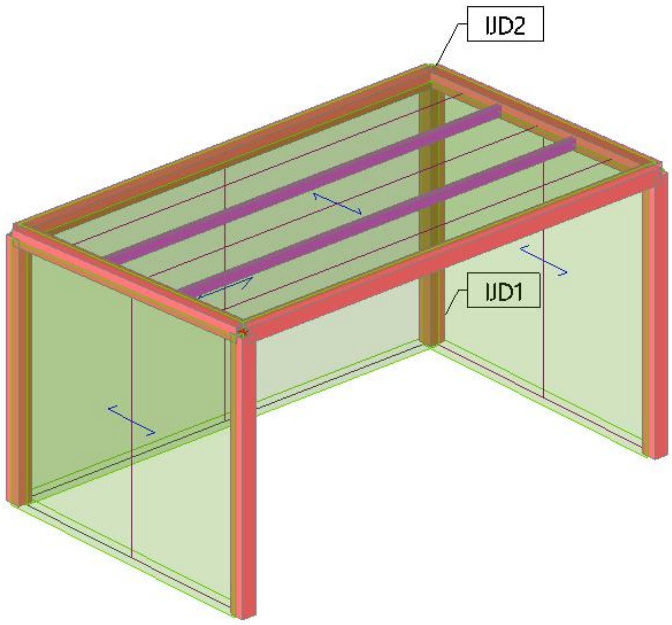


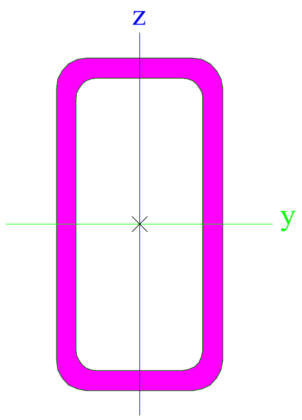
NADSTREŠNICA TIP A

1. Model konstrukcije

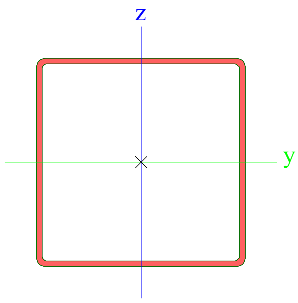


2. Poprečni presjeci



Sekundarci		
Type	RHSCF100/50/6.0	
Formcode	2 - Rectangular hollow section	
Shape type	Thin-walled	
Item material	S 235	
Fabrication	rolled	
Colour		
Flexural buckling y-y, Flexural buckling z-z	a	a
A [m^2]	1.5600e-03	
A_y [m^2], A_z [m^2]	5.3889e-04	1.0778e-03
A_L [m^2/m], A_D [m^2/m]	2.8300e-01	5.2613e-01
$c_{Y.UCS}$ [mm], $c_{Z.UCS}$ [mm]	25	50
α [deg]	0.00	
I_y [m^4], I_z [m^4]	1.7900e-06	5.8700e-07
i_y [mm], i_z [mm]	34	19
$W_{el.y}$ [m^3], $W_{el.z}$ [m^3]	3.5800e-05	2.3500e-05
$W_{pl.y}$ [m^3], $W_{pl.z}$ [m^3]	4.9413e-05	2.9679e-05
$M_{pl.y.+}$ [Nm], $M_{pl.y.-}$ [Nm]	1.16e+04	1.16e+04
$M_{pl.z.+}$ [Nm], $M_{pl.z.-}$ [Nm]	6.97e+03	6.97e+03
d_y [mm], d_z [mm]	0	0
I_t [m^4], I_w [m^6]	1.5400e-06	9.3750e-10
β_y [mm], β_z [mm]	0	0
Picture		

Okvir		
Type	SHS150/150/4.0	
Formcode	2 - Rectangular hollow section	
Shape type	Thin-walled	
Item material	S 235	
Fabrication	rolled	
Colour		
Flexural buckling y-y, Flexural buckling z-z	a	a
A [m^2]	2.2870e-03	
A_y [m^2], A_z [m^2]	1.1593e-03	1.1593e-03
A_L [m^2/m], A_D [m^2/m]	5.8965e-01	1.1508e+00
$c_{Y.UCS}$ [mm], $c_{Z.UCS}$ [mm]	75	75
α [deg]	0.00	
I_y [m^4], I_z [m^4]	8.0320e-06	8.0320e-06
i_y [mm], i_z [mm]	59	59
$W_{el.y}$ [m^3], $W_{el.z}$ [m^3]	1.0710e-04	1.0710e-04
$W_{pl.y}$ [m^3], $W_{pl.z}$ [m^3]	1.2659e-04	1.2659e-04
$M_{pl.y.+}$ [Nm], $M_{pl.y.-}$ [Nm]	2.97e+04	2.97e+04
$M_{pl.z.+}$ [Nm], $M_{pl.z.-}$ [Nm]	2.97e+04	2.97e+04
d_y [mm], d_z [mm]	0	0

I_t [m^4], I_w [m^6]	1.2680e-05	2.5312e-08
β_y [mm], β_z [mm]	0	0
Picture		

Explanations of symbols	
Formcode	h - Height b - Width s - Thickness r - Outer radius r1 - Inner radius
A	Area
A_y	Shear Area in principal y-direction
A_z	Shear Area in principal z-direction
A_L	Circumference per unit length
A_D	Drying surface per unit length
$c_{Y.UCS}$	Centroid coordinate in Y-direction of Input axis system
$c_{Z.UCS}$	Centroid coordinate in Z-direction of Input axis system
$I_{Y.LCS}$	Second moment of area about the YLCS axis
$I_{Z.LCS}$	Second moment of area about the ZLCS axis
$I_{YZ.LCS}$	Product moment of area in the LCS system
α	Rotation angle of the principal axis system
I_y	Second moment of area about the principal y-axis
I_z	Second moment of area about the principal z-axis
i_y	Radius of gyration about the principal y-axis
i_z	Radius of gyration about the principal z-axis
$W_{el.y}$	Elastic section modulus about the principal y-axis
$W_{el.z}$	Elastic section modulus about the principal z-axis
$W_{pl.y}$	Plastic section modulus about the principal y-axis
$W_{pl.z}$	Plastic section modulus about the principal z-axis
$M_{pl.y.+}$	Plastic moment about the principal y-axis for a positive My moment
$M_{pl.y.-}$	Plastic moment about the principal y-axis for a negative My moment
$M_{pl.z.+}$	Plastic moment about the principal z-axis for a positive Mz moment
$M_{pl.z.-}$	Plastic moment about the principal z-axis for a negative Mz moment

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

3. Load cases

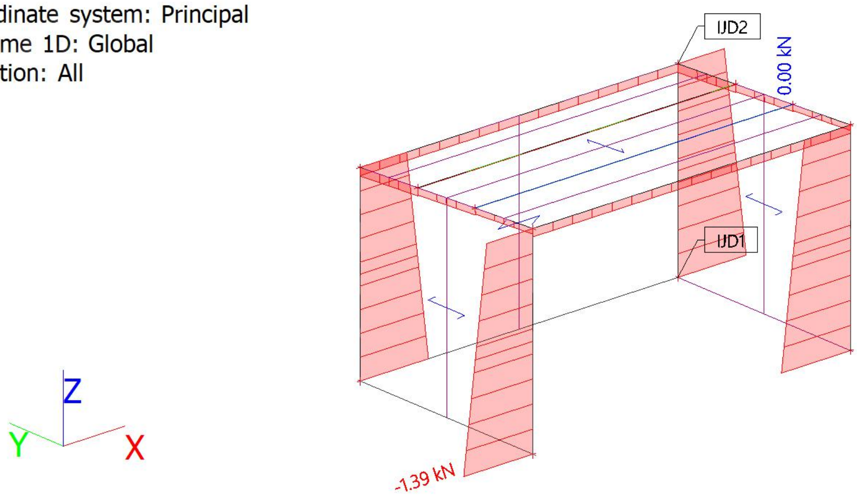
3.1. Load cases - LC1

Name	Description Spec	Action type Load type	Load group	Direction
LC1	Self weight	Permanent Self weight	LG1	-Z

3.1.

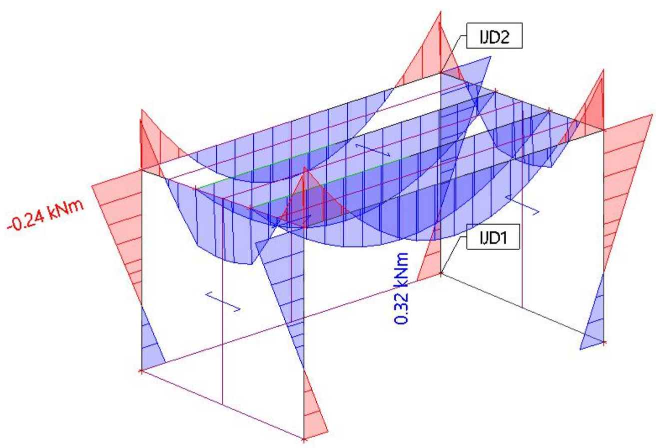
3.1.1. 1D internal forces; N

Values: **N**
Linear calculation
Load case: LC1
Coordinate system: Principal
Extreme 1D: Global
Selection: All



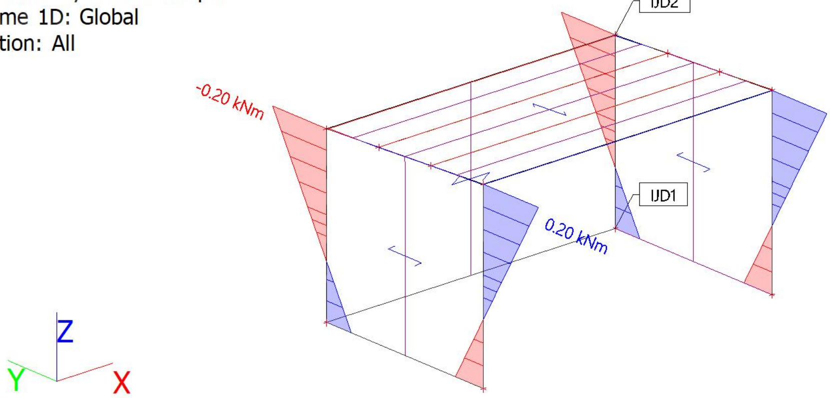
3.1.2. 1D internal forces; M_y

Values: $\mathbf{M_y}$
Linear calculation
Load case: LC1
Coordinate system: Principal
Extreme 1D: Global
Selection: All



3.1.3. 1D internal forces; M_z

Values: M_z
Linear calculation
Load case: LC1
Coordinate system: Principal
Extreme 1D: Global
Selection: All



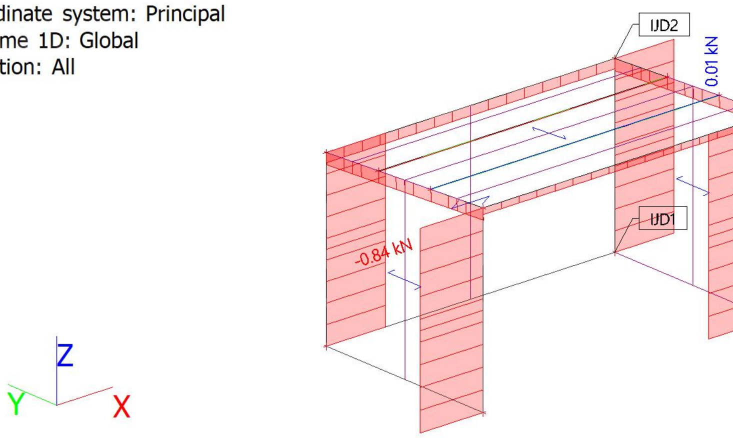
3.2. Load cases - LC2

Name	Description	Action type	Load group
	Spec	Load type	
LC2	Dodatno stalno	Permanent	LG1
		Standard	

3.2.

3.2.1. 1D internal forces; N

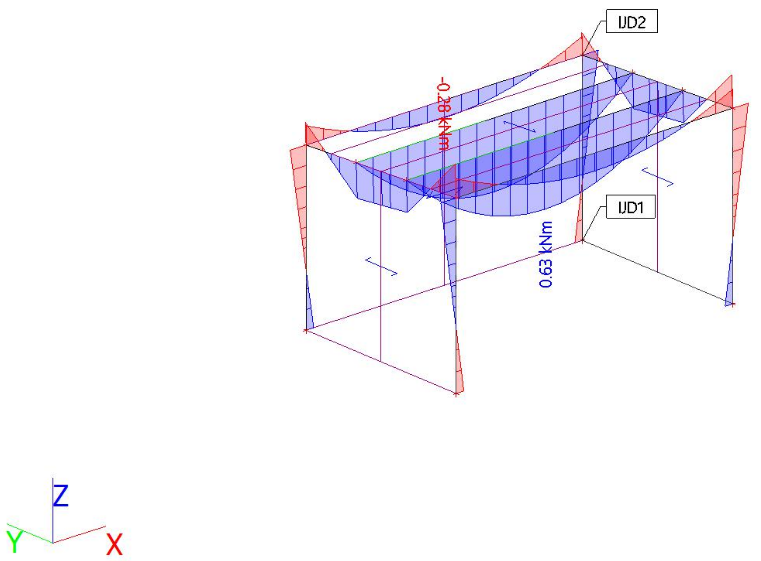
Values: **N**
Linear calculation
Load case: LC2
Coordinate system: Principal
Extreme 1D: Global
Selection: All



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

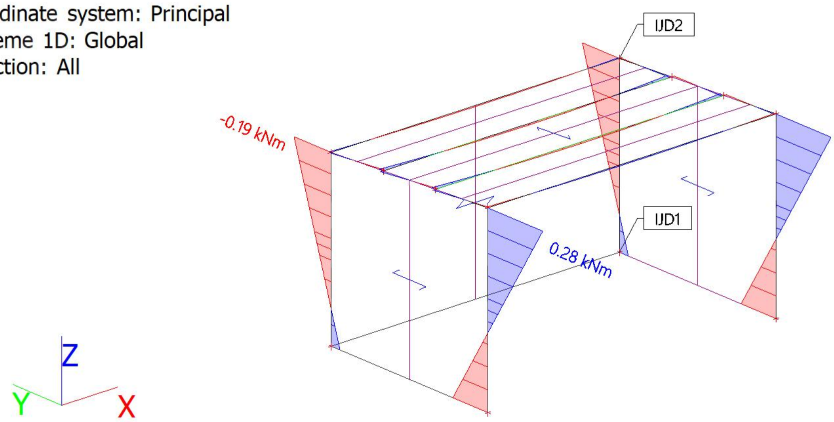
3.2.2. 1D internal forces; M_y

Values: M_y
Linear calculation
Load case: LC2
Coordinate system: Principal
Extreme 1D: Global
Selection: All



3.2.3. 1D internal forces; M_z

Values: M_z
Linear calculation
Load case: LC2
Coordinate system: Principal
Extreme 1D: Global
Selection: All



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

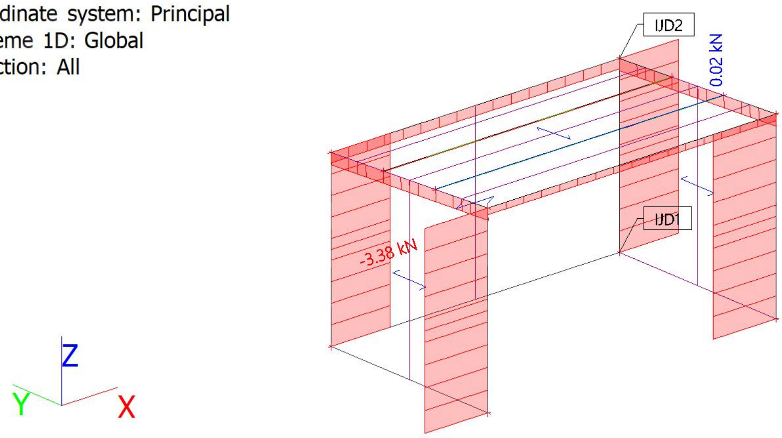
3.3. Load cases - LC3

Name	Description	Action type	Load group	Master load case
	Spec	Load type		
LC3	Snijeg	Variable	LG2	None
	Snow	Static		

3.3.

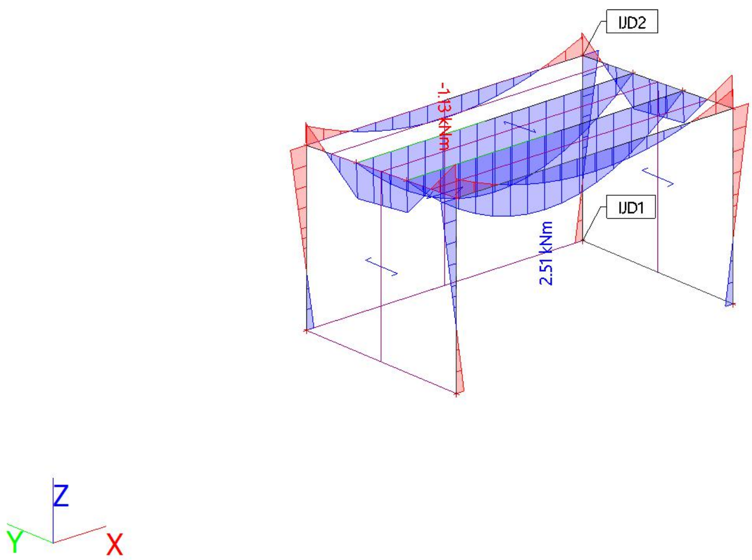
3.3.1. 1D internal forces; N

Values: **N**
Linear calculation
Load case: LC3
Coordinate system: Principal
Extreme 1D: Global
Selection: All



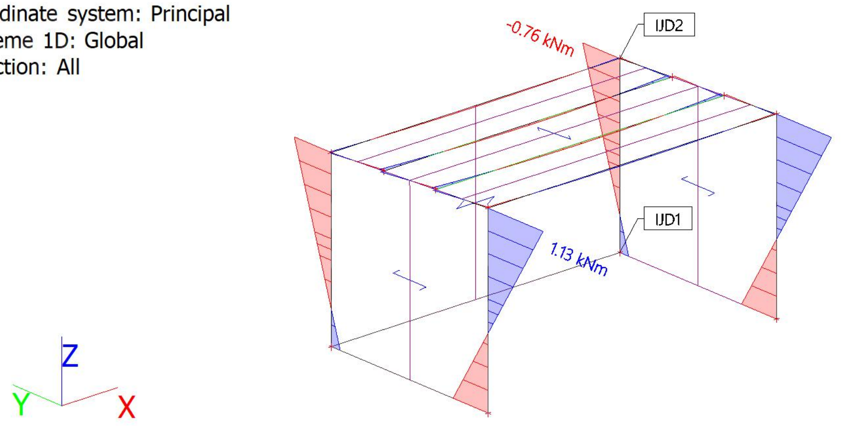
3.3.2. 1D internal forces; M_y

Values: **M_y**
Linear calculation
Load case: LC3
Coordinate system: Principal
Extreme 1D: Global
Selection: All



3.3.3. 1D internal forces; M_z

Values: M_z
Linear calculation
Load case: LC3
Coordinate system: Principal
Extreme 1D: Global
Selection: All



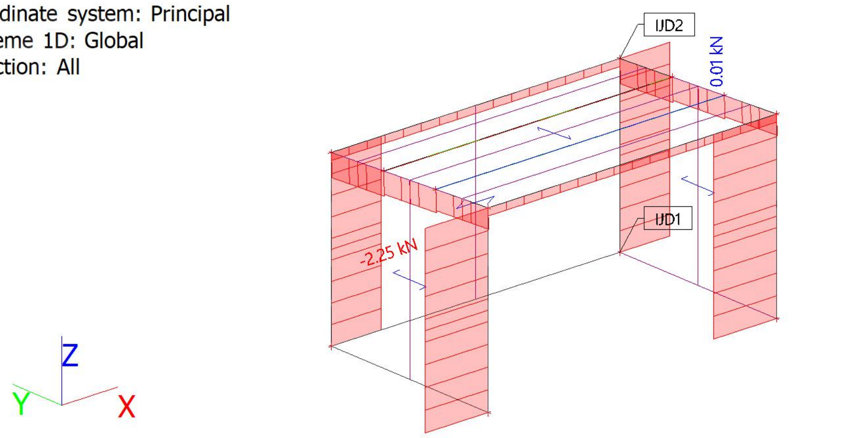
3.4. Load cases - LC4

Name	Description	Action type	Load group	Master load case
	Spec	Load type		
LC4	Vjetar +	Variable	LG3	None
	Static wind	Static		

3.4.

3.4.1. 1D internal forces; N

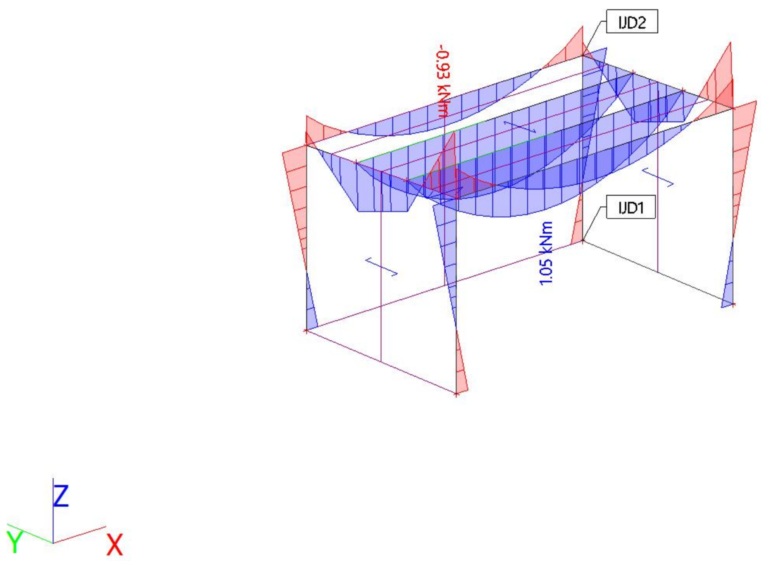
Values: **N**
Linear calculation
Load case: LC4
Coordinate system: Principal
Extreme 1D: Global
Selection: All



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

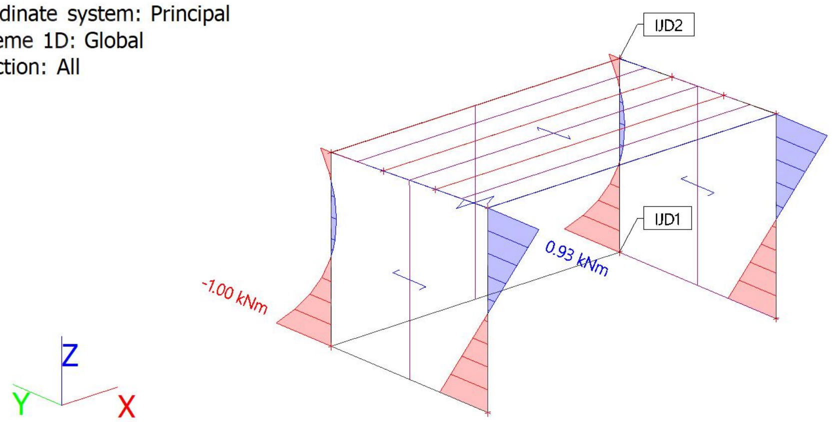
3.4.2. 1D internal forces; M_y

Values: **M_y**
Linear calculation
Load case: LC4
Coordinate system: Principal
Extreme 1D: Global
Selection: All



3.4.3. 1D internal forces; M_z

Values: **M_z**
Linear calculation
Load case: LC4
Coordinate system: Principal
Extreme 1D: Global
Selection: All



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

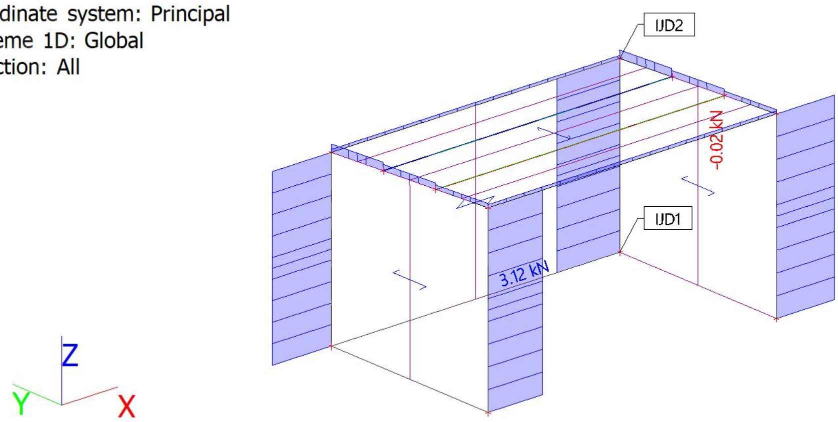
3.5. Load cases - LC5

Name	Description	Action type	Load group	Master load case
	Spec	Load type		
LC5	Vjetar - Static wind	Variable Static	LG3	None

3.5.

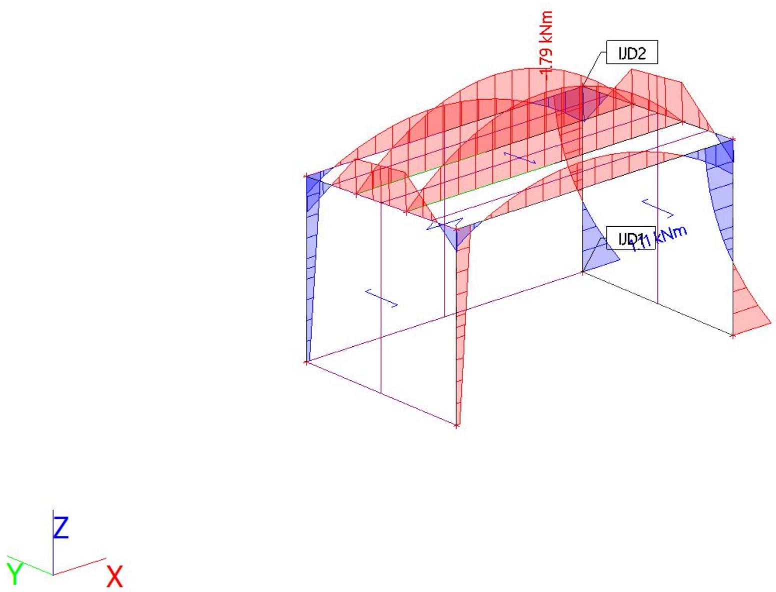
3.5.1. 1D internal forces; N

Values: **N**
Linear calculation
Load case: LC5
Coordinate system: Principal
Extreme 1D: Global
Selection: All



3.5.2. 1D internal forces; M_y

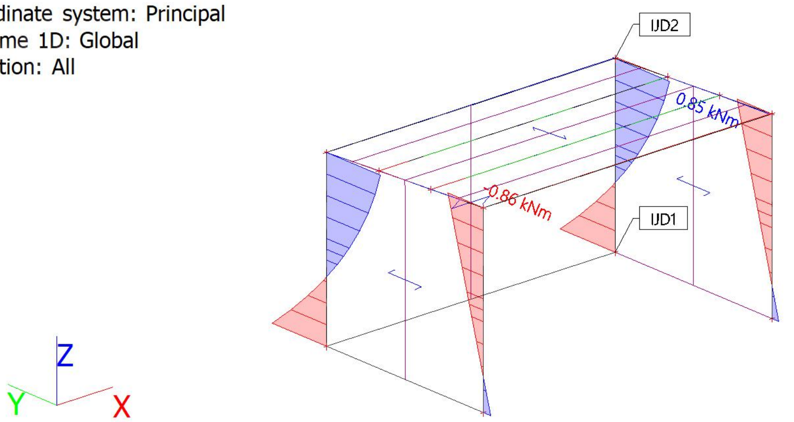
Values: **M_y**
Linear calculation
Load case: LC5
Coordinate system: Principal
Extreme 1D: Global
Selection: All



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

3.5.3. 1D internal forces; M_z

Values: M_z
Linear calculation
Load case: LC5
Coordinate system: Principal
Extreme 1D: Global
Selection: All



4. Dimenzioniranje glavnih okvira

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = Okvir - SHS150/150/4.0

EN 1993-1-1 Code Check
National annex: Standard EN

Member B4	0.000 / 2.500 m	SHS150/150/4.0	S 235	ULS-Set B (auto)	0.12 -

Combination key
ULS-Set B (auto) / LC1 + LC2 + 1.50*LC4 + 1.50*LC5

Partial safety factors	
γ_{M0} for resistance of cross-sections	1.00
γ_{M1} for resistance to instability	1.00
γ_{M2} for resistance of net sections	1.25

Material			
Yield strength	f_y	235.0	MPa
Ultimate strength	f_u	360.0	MPa
Fabrication		Rolled	

...::SECTION CHECK::...

The critical check is on position 0.000 m

Internal forces		Calculated	Unit
Normal force	N_{Ed}	-0.18	kN
Shear force	$V_{y,Ed}$	3.46	kN

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Internal forces		Calculated	Unit
Shear force	$V_{z,Ed}$	-1.50	kN
Torsion	T_{Ed}	0.00	kNm
Bending moment	$M_{y,Ed}$	1.17	kNm
Bending moment	$M_{z,Ed}$	-2.66	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m^2]	σ_2 [kN/m^2]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	138	4	1.203e+04	-3.265e+04	-2.71		0.27	34.50	133.72	154.15	379.44	1
3	I	138	4	-3.337e+04	-1.373e+04								
5	I	138	4	-1.187e+04	3.280e+04	-0.36		0.73	34.50	41.46	49.54	72.04	1
7	I	138	4	3.353e+04	1.389e+04	0.41		1.00	34.50	28.00	34.00	47.69	3

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 3

Semi-Comp+ properties			
Material coefficient	ε	1.00	
Flange class 2 slenderness limit	$\beta_{2,y,f}$	34.00	
Flange class 3 slenderness limit	$\beta_{3,y,f}$	38.00	
Web class 2 slenderness limit	$\beta_{2,y,w}$	83.00	
Web class 3 slenderness limit	$\beta_{3,y,w}$	124.00	
Web class 2 slenderness limit	$\beta_{2,z,w}$	34.00	
Web class 3 slenderness limit	$\beta_{3,z,w}$	38.00	
Web slenderness ratio	c/t_w	34.50	
Flange slenderness ratio	c/t_f	34.50	
Reference slenderness ratio	$c/t_{ref,y}$	0.12	
Reference slenderness ratio	$c/t_{ref,z}$	0.12	
Interpolated section modulus	$W_{3,y}$	1.2415e-04	m^3
Interpolated section modulus	$W_{3,z}$	1.2415e-04	m^3

Note: The resistance for this semi-compact section has been calculated according to Semi-Comp+.

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

Cross-section area	A	2.2870e-03	m^2
Compression resistance	$N_{c,Rd}$	537.45	kN
Unity check		0.00	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Interpolated section modulus	$W_{3,y}$	1.2415e-04	m^3
Interpolated bending resistance	$M_{3,y,Rd}$	29.18	kNm
Unity check		0.04	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Interpolated section modulus	$W_{3,z}$	1.2415e-04	m^3
Interpolated bending resistance	$M_{3,z,Rd}$	29.18	kNm
Unity check		0.09	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Shear correction factor	η	1.20	
Shear area	A_v	1.1435e-03	m^2
Plastic shear resistance for V_y	$V_{pl,y,Rd}$	155.15	kN
Unity check		0.02	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Shear correction factor	η	1.20	
Shear area	A_v	1.1435e-03	m^2
Plastic shear resistance for V_z	$V_{pl,z,Rd}$	155.15	kN
Unity check		0.01	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Index of fibre	Fibre	1	
Total torsional moment	τ_{Ed}	0.0	MPa
Elastic shear resistance	τ_{Rd}	135.7	MPa
Unity check		0.00	-

Note: The unity check for torsion is lower than the limit value of 0.05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

Interpolated moment resistance reduced due to N_{Ed}	$M_{N,3,y,Rd}$	29.17	kNm
Exponent of bending ratio y	α	1.66	
Interpolated moment resistance reduced due to N_{Ed}	$M_{N,3,z,Rd}$	29.17	kNm
Exponent of bending ratio z	β	1.66	

Unity check (6.41) = 0.00 + 0.02 = 0.02 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 0.000 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	138	4	1.203e+04	-3.265e+04	-2.71		0.27	34.50	133.72	154.15	379.44	1
3	I	138	4	-3.337e+04	-1.373e+04								
5	I	138	4	-1.187e+04	3.280e+04	-0.36		0.73	34.50	41.46	49.54	72.04	1

Id	Type	c [mm]	t [mm]	σ_1 [kN/m^2]	σ_2 [kN/m^2]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
7	I	138	4	3.353e+04	1.389e+04	0.41		1.00	34.50	28.00	34.00	47.69	3

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 3

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters		yy	zz	
Sway type		sway	non-sway	
System length	L	2.500	2.500	m
Buckling factor	k	1.29	0.58	
Buckling length	l_{cr}	3.214	1.441	m
Critical Euler load	N_{cr}	1611.67	8015.14	kN
Slenderness	λ	54.23	24.32	
Relative slenderness	λ_{rel}	0.58	0.26	
Limit slenderness	$\lambda_{rel,0}$	0.20	0.20	

Note: The slenderness or compression force is such that Flexural Buckling effects may be ignored according to EN 1993-1-1 article 6.3.1.2(4).

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters			
Interaction method		alternative method 1	
Cross-section area	A	2.2870e-03	m^2
Interpolated section modulus	$W_{3,y}$	1.2415e-04	m^3
Interpolated section modulus	$W_{3,z}$	1.2415e-04	m^3
Design compression force	N_{Ed}	0.18	kN
Design bending moment (maximum)	$M_{y,Ed}$	1.17	kNm
Design bending moment (maximum)	$M_{z,Ed}$	-2.66	kNm
Characteristic compression resistance	N_{Rk}	537.45	kN
Characteristic moment resistance	$M_{y,Rk}$	29.18	kNm
Characteristic moment resistance	$M_{z,Rk}$	29.18	kNm
Reduction factor	χ_y	1.00	
Reduction factor	χ_z	1.00	
Reduction factor	χ_{LT}	1.00	
Interaction factor	k_{yy}	1.00	
Interaction factor	k_{yz}	0.60	
Interaction factor	k_{zy}	0.60	
Interaction factor	k_{zz}	1.00	

Maximum moment $M_{y,Ed}$ is derived from beam B4 position 0.000 m.
Maximum moment $M_{z,Ed}$ is derived from beam B4 position 0.000 m.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Interaction method 1 parameters			
Critical Euler load	$N_{cr,y}$	1611.67	kN
Critical Euler load	$N_{cr,z}$	8015.14	kN
Elastic critical load	$N_{cr,T}$	147001.81	kN
Interpolated section modulus	$W_{3,y}$	1.2415e-04	m^3
Elastic section modulus	$W_{el,y}$	1.0710e-04	m^3
Interpolated section modulus	$W_{3,z}$	1.2415e-04	m^3
Elastic section modulus	$W_{el,z}$	1.0710e-04	m^3
Second moment of area	I_y	8.0320e-06	m^4
Second moment of area	I_z	8.0320e-06	m^4
Torsional constant	I_t	1.2680e-05	m^4
Method for equivalent moment factor $C_{my,0}$		Table A.2 Line 2 (General)	
Design bending moment (maximum)	$M_{y,Ed}$	1.17	kNm
Maximum relative deflection	δ_z	0.0	mm
Equivalent moment factor	$C_{my,0}$	1.00	
Method for equivalent moment factor $C_{mz,0}$		Table A.2 Line 2 (General)	
Design bending moment (maximum)	$M_{z,Ed}$	-2.66	kNm
Maximum relative deflection	δ_y	-0.1	mm
Equivalent moment factor	$C_{mz,0}$	1.00	
Factor	μ_y	1.00	
Factor	μ_z	1.00	
Factor	ε_y	135.84	
Factor	a_{LT}	0.00	
Critical moment for uniform bending	$M_{cr,0}$	1658.39	kNm
Relative slenderness	$\lambda_{rel,0}$	0.13	
Limit relative slenderness	$\lambda_{rel,0,lim}$	0.38	
Equivalent moment factor	C_{my}	1.00	
Equivalent moment factor	C_{mz}	1.00	
Equivalent moment factor	C_{mLT}	1.00	
Factor	b_{LT}	0.00	
Factor	c_{LT}	0.00	
Factor	d_{LT}	0.00	
Factor	e_{LT}	0.00	
Factor	w_y	1.16	
Factor	w_z	1.16	
Factor	n_{pl}	0.00	
Maximum relative slenderness	$\lambda_{rel,max}$	0.58	
Factor	C_{yy}	1.00	
Factor	C_{yz}	1.00	
Factor	C_{zy}	1.00	
Factor	C_{zz}	1.00	

Unity check (6.61) = 0.00 + 0.04 + 0.05 = 0.09 -
Unity check (6.62) = 0.00 + 0.02 + 0.09 = 0.12 -

The member satisfies the stability check.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

5. Dimenzioniranje sekundaraca

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = Sekundarci - RHSCF100/50/6.0

EN 1993-1-1 Code Check
National annex: Standard EN

Member B10	2.300 / 4.600 m	RHSCF100/50/6.0	S 235	ULS-Set B (auto)	0.53 -

Combination key
ULS-Set B (auto) / 1.35*LC1 + 1.35*LC2 + 1.50*LC3 + 0.90*LC4

Partial safety factors	
γ_{M0} for resistance of cross-sections	1.00
γ_{M1} for resistance to instability	1.00
γ_{M2} for resistance of net sections	1.25

Material			
Yield strength	f_y	235.0	MPa
Ultimate strength	f_u	360.0	MPa
Fabrication		Rolled	

...::SECTION CHECK::...

The critical check is on position 2.300 m

Internal forces		Calculated	Unit
Normal force	N_{Ed}	-0.09	kN
Shear force	$V_{y,Ed}$	0.00	kN
Shear force	$V_{z,Ed}$	0.00	kN
Torsion	T_{Ed}	0.00	kNm
Bending moment	$M_{y,Ed}$	5.99	kNm
Bending moment	$M_{z,Ed}$	-0.08	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m^2]	σ_2 [kN/m^2]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	32	6	-1.457e+05	-1.498e+05								
3	I	82	6	-1.317e+05	1.262e+05	-1.04		0.49	13.67	73.58	84.82	129.46	1
5	I	32	6	1.458e+05	1.499e+05	0.97		1.00	5.33	28.00	34.00	38.36	1
7	I	82	6	1.318e+05	-1.261e+05	-0.96		0.51	13.67	69.57	80.42	118.34	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

Cross-section area	A	1.5600e-03	m^2
Compression resistance	$N_{c,Rd}$	366.60	kN
Unity check		0.00	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,y}$	4.9413e-05	m^3
Plastic bending moment	$M_{pl,y,Rd}$	11.61	kNm
Unity check		0.52	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,z}$	2.9679e-05	m^3
Plastic bending moment	$M_{pl,z,Rd}$	6.97	kNm
Unity check		0.01	-

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

Design plastic moment resistance reduced due to N_{Ed}	$M_{N,y,Rd}$	11.61	kNm
Exponent of bending ratio y	α	1.66	
Design plastic moment resistance reduced due to N_{Ed}	$M_{N,z,Rd}$	6.97	kNm
Exponent of bending ratio z	β	1.66	

Unity check (6.41) = 0.33 + 0.00 = 0.33 -

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 2.300 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	32	6	-1.457e+05	-1.498e+05								
3	I	82	6	-1.317e+05	1.262e+05	-1.04		0.49	13.67	73.58	84.82	129.46	1
5	I	32	6	1.458e+05	1.499e+05	0.97		1.00	5.33	28.00	34.00	38.36	1
7	I	82	6	1.318e+05	-1.261e+05	-0.96		0.51	13.67	69.57	80.42	118.34	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters		yy	zz	
Sway type		sway	non-sway	
System length	L	4.600	4.600	m
Buckling factor	k	1.00	0.65	

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Buckling parameters		yy	zz	
Buckling length	l_{cr}	4.600	2.993	m
Critical Euler load	N_{cr}	175.33	135.81	kN
Slenderness	λ	135.80	154.30	
Relative slenderness	λ_{rel}	1.45	1.64	
Limit slenderness	$\lambda_{rel,0}$	0.20	0.20	

Note: The slenderness or compression force is such that Flexural Buckling effects may be ignored according to EN 1993-1-1 article 6.3.1.2(4).

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters			
Interaction method		alternative method 1	
Cross-section area	A	1.5600e-03	m^2
Plastic section modulus	$W_{pl,y}$	4.9413e-05	m^3
Plastic section modulus	$W_{pl,z}$	2.9679e-05	m^3
Design compression force	N_{Ed}	0.09	kN
Design bending moment (maximum)	$M_{y,Ed}$	5.99	kNm
Design bending moment (maximum)	$M_{z,Ed}$	0.15	kNm
Characteristic compression resistance	N_{Rk}	366.60	kN
Characteristic moment resistance	$M_{y,Rk}$	11.61	kNm
Characteristic moment resistance	$M_{z,Rk}$	6.97	kNm
Reduction factor	χ_y	1.00	
Reduction factor	χ_z	1.00	
Reduction factor	χ_{LT}	1.00	
Interaction factor	k_{yy}	1.00	
Interaction factor	k_{yz}	0.58	
Interaction factor	k_{zy}	0.63	
Interaction factor	k_{zz}	1.00	

Maximum moment $M_{y,Ed}$ is derived from beam B10 position 2.300 m.
Maximum moment $M_{z,Ed}$ is derived from beam B10 position 0.000 m.

Interaction method 1 parameters			
Critical Euler load	$N_{cr,y}$	175.33	kN
Critical Euler load	$N_{cr,z}$	135.81	kN
Elastic critical load	$N_{cr,T}$	81692.58	kN
Plastic section modulus	$W_{pl,y}$	4.9413e-05	m^3
Elastic section modulus	$W_{el,y}$	3.5800e-05	m^3
Plastic section modulus	$W_{pl,z}$	2.9679e-05	m^3
Elastic section modulus	$W_{el,z}$	2.3500e-05	m^3
Second moment of area	I_y	1.7900e-06	m^4
Second moment of area	I_z	5.8700e-07	m^4
Torsional constant	I_t	1.5400e-06	m^4
Method for equivalent moment factor $C_{my,0}$		Table A.2 Line 4 (Line load)	

Interaction method 1 parameters			
Equivalent moment factor	$C_{my,0}$	1.00	
Method for equivalent moment factor $C_{mz,0}$		Table A.2 Line 2 (General)	
Design bending moment (maximum)	$M_{z,Ed}$	0.15	kNm
Maximum relative deflection	δ_y	0.9	mm
Equivalent moment factor	$C_{mz,0}$	1.00	
Factor	μ_y	1.00	
Factor	μ_z	1.00	
Factor	ε_y	2982.56	
Factor	a_{LT}	0.14	
Critical moment for uniform bending	$M_{cr,0}$	84.60	kNm
Relative slenderness	$\lambda_{rel,0}$	0.37	
Limit relative slenderness	$\lambda_{rel,0,lim}$	0.21	
Equivalent moment factor	C_{my}	1.00	
Equivalent moment factor	C_{mz}	1.00	
Equivalent moment factor	C_{mLT}	1.00	
Factor	b_{LT}	0.00	
Factor	c_{LT}	0.01	
Factor	d_{LT}	0.00	
Factor	e_{LT}	0.01	
Factor	w_y	1.38	
Factor	w_z	1.26	
Factor	n_{pl}	0.00	
Maximum relative slenderness	$\lambda_{rel,max}$	1.64	
Factor	C_{yy}	1.00	
Factor	C_{yz}	1.00	
Factor	C_{zy}	1.00	
Factor	C_{zz}	1.00	

Unity check (6.61) = 0.00 + 0.52 + 0.01 = 0.53 -
Unity check (6.62) = 0.00 + 0.32 + 0.02 = 0.35 -

The member satisfies the stability check.

6. Reactions

Linear calculation
Combination: ULS-Set B (auto)
System: Global
Extreme: Global
Selection: All
Nodal reactions

Name	Case	R_x [kN]	R_y [kN]	R_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]	e_x [mm]	e_y [mm]
Sn3/N5	ULS-Set B (auto)/1	1.88	1.47	**-2.51**	-1.16	1.47	0.01	460.6	-586.1
Sn1/N4	ULS-Set B (auto)/2	1.06	2.06	**10.11**	-2.24	0.92	0.01	-221.8	90.7
Sn3/N5	ULS-Set B (auto)/3	1.50	**3.46**	0.18	**-2.66**	1.17	0.00	-14470.1	6361.5
Sn3/N5	ULS-Set B (auto)/4	-0.92	**-0.85**	7.69	**0.46**	-0.75	-0.01	59.6	-97.1
Sn4/N8	ULS-Set B (auto)/1	**1.88**	-0.08	-2.08	-0.13	**1.52**	0.01	60.2	-726.9
Sn3/N5	ULS-Set B (auto)/2	**-1.14**	0.35	9.31	-0.44	**-0.93**	**-0.02**	-47.4	-99.9
Sn2/N1	ULS-Set B (auto)/2	1.14	0.35	9.31	-0.44	0.93	**0.02**	-47.4	99.9

SPOJEVI

SPOJ TEMELJNE STOPE

Material

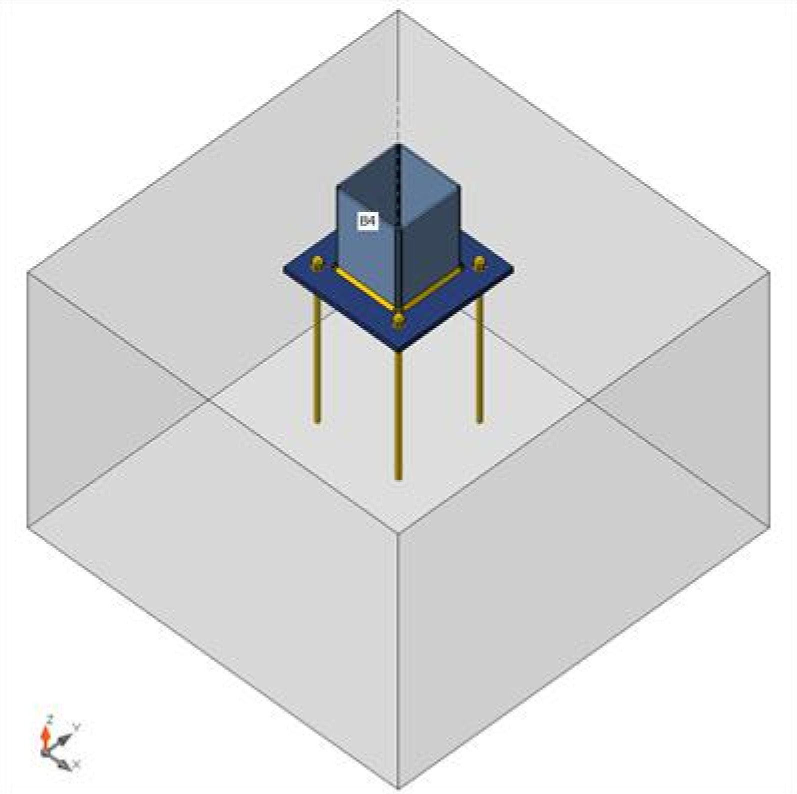
Steel	S 235
Concrete	C25/30

Design

Name	Con N5
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B4	1 - SHS150/150/4.0(RHS150x150)	0.0	0.0	0.0	0	0	0	Position



Cross-sections

Name	Material

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

1 - SHS150/150/4.0(RHS150x150)	S 235

Anchors

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm²]
M12 5.6	M12 5.6	12	500.0	113

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
ULS-Set(1)	B4	2.5	-1.5	1.9	0.0	-1.5	-1.2
ULS-Set(2)	B4	-9.3	-0.3	-1.1	0.0	0.9	-0.4
ULS-Set(3)	B4	-0.2	-3.5	1.5	0.0	-1.2	-2.7
ULS-Set(4)	B4	-7.7	0.8	-0.9	0.0	0.7	0.5
ULS-Set(5)	B4	-8.0	-1.4	-1.0	0.0	0.8	-1.2
ULS-Set(6)	B4	-3.3	-3.1	1.1	0.0	-0.9	-2.5
ULS-Set(7)	B4	-2.2	0.2	-0.2	0.0	0.2	0.1
ULS-Set(8)	B4	-2.9	0.3	-0.3	0.0	0.3	0.2
ULS-Set(9)	B4	-2.6	-3.2	1.2	0.0	-0.9	-2.5
ULS-Set(10)	B4	-6.5	-1.4	0.1	0.0	-0.1	-1.2
ULS-Set(11)	B4	-4.9	-1.8	-0.6	0.0	0.5	-1.4
ULS-Set(12)	B4	-0.6	-1.1	1.5	0.0	-1.2	-1.0
ULS-Set(13)	B4	-4.9	-0.2	0.4	0.0	-0.3	-0.3

Foundation block

Item	Value	Unit
CB 1		
Dimensions	870 x 870	mm
Depth	600	mm
Anchor	M12 5.6	
Anchoring length	350	mm
Shear force transfer	Anchors	

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Anchors	59.4 < 100%	OK
Welds	67.2 < 100%	OK
Concrete block	10.7 < 100%	OK
Buckling	Not calculated	

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Plates

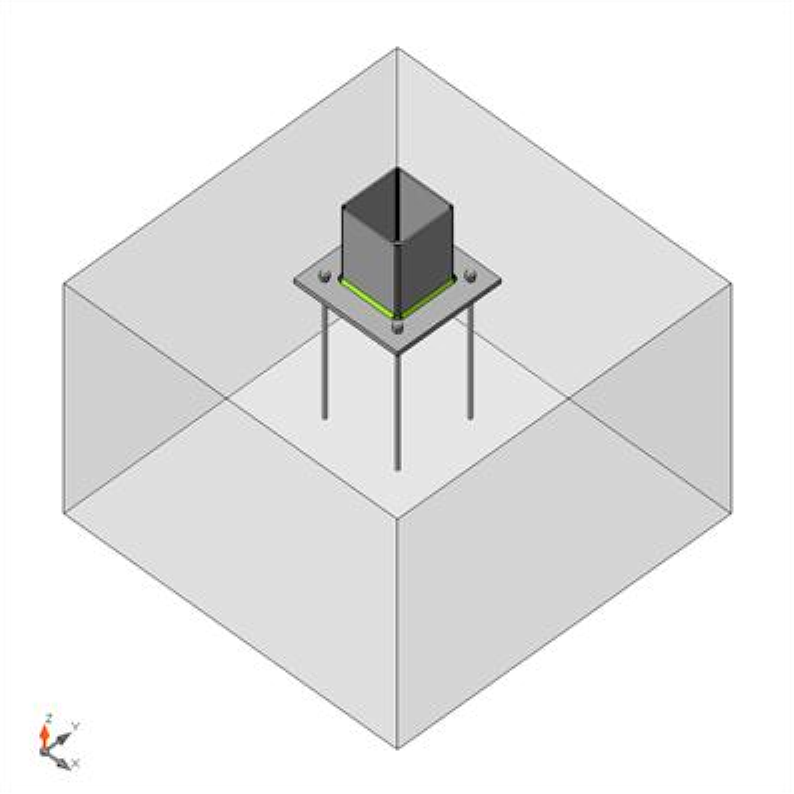
Name	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
B4	4.0	ULS-Set(3)	184.5	0.0	0.0	OK
BP1	12.0	ULS-Set(3)	87.5	0.0	0.0	OK

Design data

Material	f_y [MPa]	ε_{lim} [%]
S 235	235.0	5.0

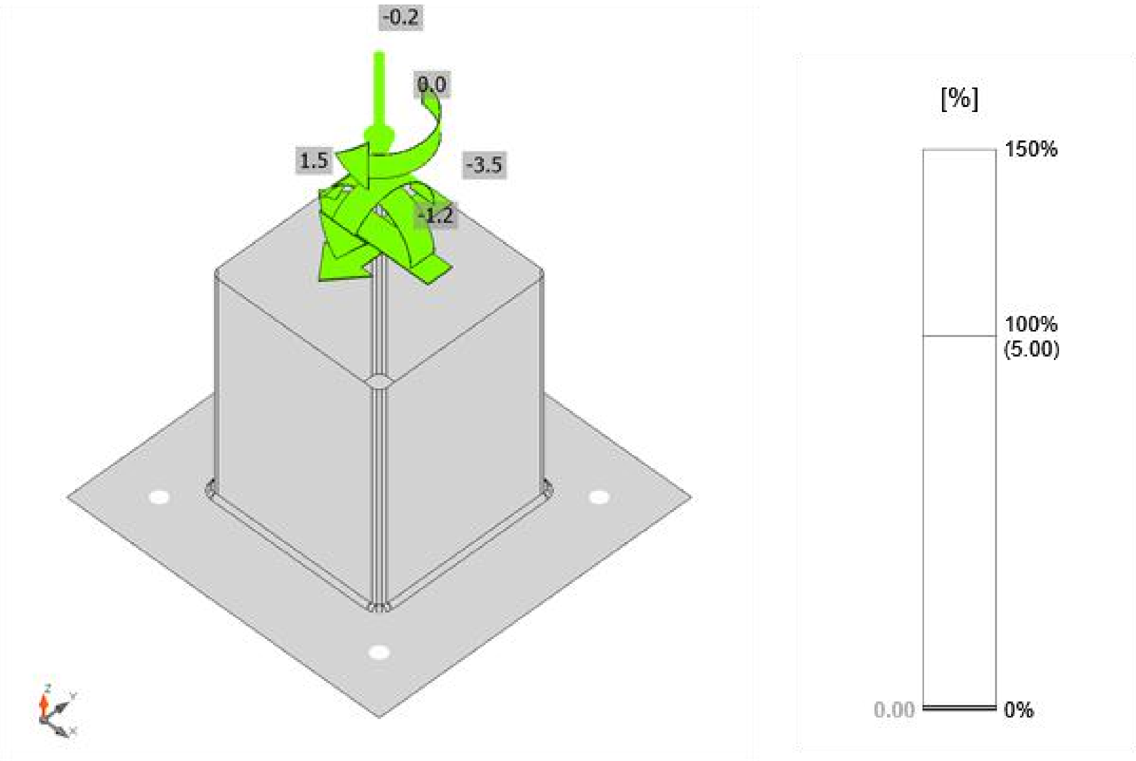
Symbol explanation

ε_{Pl}	Strain
σ_{Ed}	Eq. stress
σc_{Ed}	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

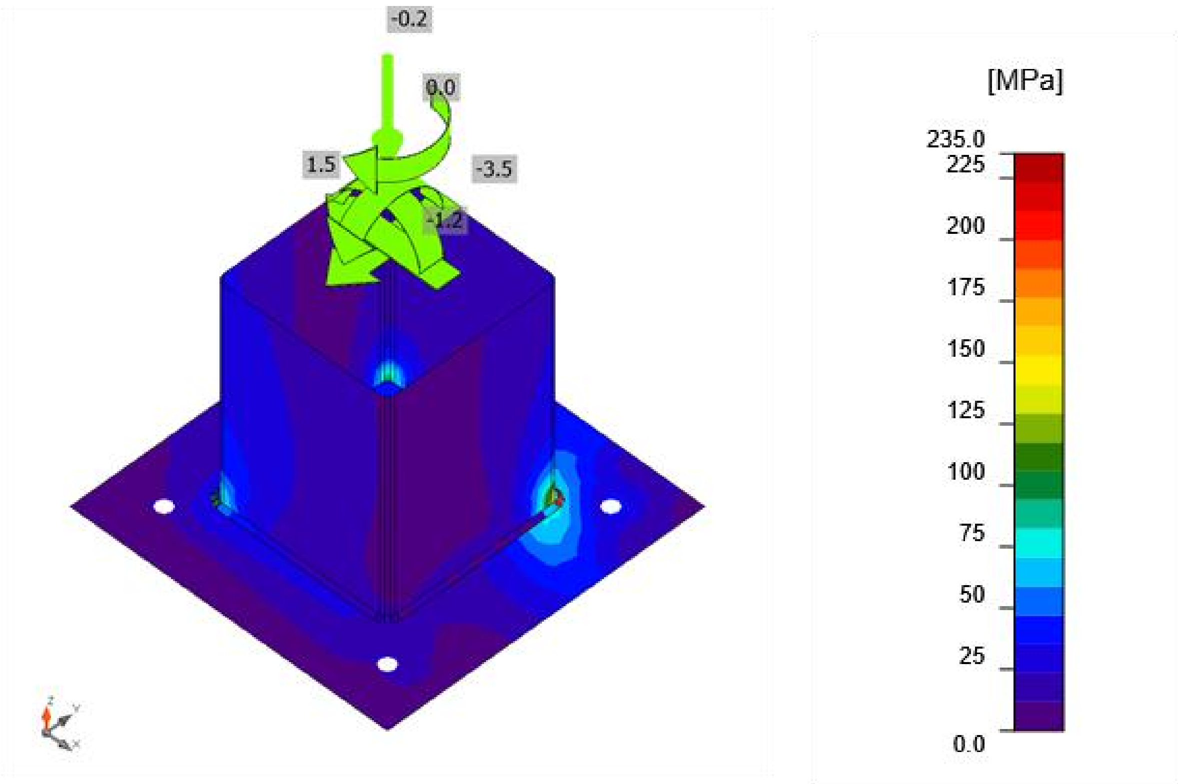


Overall check, ULS-Set(3)

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

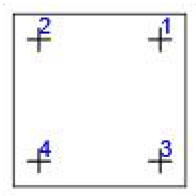


Strain check, ULS-Set(3)



Equivalent stress, ULS-Set(3)

Anchors

Shape	Item	Loads	N_{Ed} [kN]	V_{Ed} [kN]	$N_{Rd,c}$ [kN]	$V_{Rd,c}$ [kN]	$V_{Rd,cp}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	A1	ULS-Set(3)	6.3	0.9	152.8	62.4	286.1	35.0	7.2	12.7	OK
	A2	ULS-Set(3)	0.0	1.0	-	40.5	286.1	0.0	9.4	2.9	OK
	A3	ULS-Set(3)	10.7	1.0	152.8	-	286.1	59.4	7.7	35.9	OK
	A4	ULS-Set(1)	3.3	0.6	157.8	52.0	286.1	18.5	4.7	3.6	OK

Design data

Grade	$N_{Rd,s}$ [kN]	$V_{Rd,s}$ [kN]
M12 5.6 - 1	18.1	12.8

Symbol explanation

N_{Ed}	Tension force
V_{Ed}	Resultant of shear forces Vy, Vz in bolt
$N_{Rd,c}$	Design resistance in case of concrete cone failure under tension load - EN1992-4 - Cl. 7.2.1.4
$V_{Rd,c}$	Design resistance in case of concrete cone failure under shear load - EN1992-4 - Cl. 7.2.2.5
$V_{Rd,cp}$	Design resistance in case of concrete pryout failure - EN1992-4 - Cl. 7.2.2.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$N_{Rd,s}$	Design tensile resistance of a fastener in case of steel failure - EN1992-4 - Cl. 7.2.1.3
$V_{Rd,s}$	Design shear resistance in case of steel failure - EN1992-4 - Cl.7.2.2.3.1

Detailed result for A3

Anchor tensile resistance (EN1992-4 - Cl. 7.2.1.3)

$$N_{Rd,s} = \frac{N_{Rk,s}}{\gamma_{Ms}} = 18.1 \text{ kN} \geq N_{Ed} = 10.7 \text{ kN}$$

$$N_{Rk,s} = c \cdot A_s \cdot f_{uk} = 36.1 \text{ kN}$$

Where:

$c = 0.85$	– reduction factor for cut thread
$A_s = 85 \text{ mm}^2$	– tensile stress area
$f_{uk} = 500.0 \text{ MPa}$	– minimum tensile strength of the bolt
$\gamma_{Ms} = 2.00$	– safety factor for steel

$\gamma_{Ms} = 1.2 \cdot \frac{f_{uk}}{f_{yk}} \geq 1.4$

, where:

$f_{yk} =$

300.0 MPa – minimum yield strength of the bolt

Concrete breakout resistance of anchor in tension (EN1992-4 - Cl. 7.2.1.4)
The check is performed for group of anchors that form common tension breakout cone: A1, A3, A4

$N_{Rd,c} = \frac{N_{Rk,c}}{\gamma_{Mc}} =$ 152.8 kN $\geq$ $N_{Ed,g} =$ 17.9 kN

$N_{Rk,c} = N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec,N} \cdot \psi_{M,N} =$ 275.0 kN

Where:

$N_{Ed,g} = 17.9$ kN	– sum of tension forces of anchors with common concrete breakout cone area
$N^0_{Rk,c} = 131.4$ kN	– characteristic strength of a fastener, remote from the effects of adjacent fasteners or edges of the concrete member

$N^0_{Rk,c} = k_1 \cdot \sqrt{f_c} \cdot h_{ef}^{1.5}$

, where:

$k_1 =$

7.70 – parameter accounting for anchor type and concrete condition

$f_c =$

25.0 MPa – concrete compressive strength

$h_{ef} = \min(h_{emb}, \max(\frac{c_{a,max}}{1.5}, \frac{s_{max}}{3})) =$

227 mm – depth of embedment, where:

$h_{emb} =$

350 mm – anchor length embedded in concrete

$c_{a,max} =$

340 mm – maximum distance from the anchor to one of the three closest edges

$s_{max} =$

190 mm – maximum spacing between anchors

$A_{c,N} = 719061$ mm^2	– concrete breakout cone area for group of anchors
$A^0_{c,N} = 462400$ mm^2	– concrete breakout cone area for single anchor not influenced by edges

$A^0_{c,N} = (3 \cdot h_{ef})^2$

, where:

$h_{ef} =$

227 mm – depth of embedment

$\psi_{s,N} = 1.00$	– parameter related to the distribution of stresses in the concrete due to the proximity of the fastener to an edge of the concrete member:

$\psi_{s,N} = 0.7 + 0.3 \cdot \frac{c}{1.5 \cdot h_{ef}} \leq 1$

, where:

$c =$

340 mm – minimum distance from the anchor to the edge

$h_{ef} =$

227 mm – depth of embedment

$\psi_{re,N} = 1.00$ – parameter accounting for the shell spalling:

$\psi_{re,N} = 0.5 + \frac{h_{emb}}{200} \leq 1$

, where:

$h_{emb} =$

350 mm – anchor length embedded in concrete

$\psi_{ec,N} = 0.85$ – modification factor for anchor groups loaded eccentrically in tension:

$\psi_{ec,N} = \psi_{ecx,N} \cdot \psi_{ecy,N}$

, where:

$\psi_{ecx,N} = \frac{1}{1+\frac{2 \cdot e_{x,N}}{3 \cdot h_{ef}}} =$

0.99 – modification factor that depends on eccentricity in x-direction

$e_{x,N} =$

4 mm – tension load eccentricity in x-direction

$\psi_{ecy,N} = \frac{1}{1+\frac{2 \cdot e_{y,N}}{3 \cdot h_{ef}}} =$

0.86 – modification factor that depends on eccentricity in y-direction

$e_{y,N} =$

55 mm – tension load eccentricity in y-direction

$h_{ef} =$

227 mm – depth of embedment

$\psi_{M,N} = 1.58$ – parameter accounting for the effect of a compression force between the fixture and concrete; this parameter is equal to 1 if c < 1.5h_{ef} or the ratio of the compressive force (including the compression due to bending) to the sum of tensile forces in anchors is smaller than 0.8

$\psi_{M,N} = 2 - \frac{2 \cdot z}{3 \cdot h_{ef}} \geq 1$

, where:

$z =$

143 mm – internal lever arm

$h_{ef} =$

227 mm – depth of embedment

$\gamma_{Mc} = 1.80$ – safety factor for concrete

Shear resistance (EN1992-4 - Cl.7.2.2.3.1)

$V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{Ms}} =$ 12.8 kN $\geq$ $V_{Ed} =$ 1.0 kN

$V_{Rk,s} = k_7 \cdot V^0_{Rk,s} =$ 21.3 kN

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Where:

$k_7 = 1.00$ – coefficient for anchor steel ductility

$$k_7 = \begin{cases} 0.8, & A < 0.08 \\ 1.0, & A \geq 0.08 \end{cases}$$

, where:

$A =$

0.20 – bolt grade elongation at rupture

$V^0_{Rk,s} = 21.3\ \mathrm{kN}$ – the characteristic shear strength

$$V^0_{Rk,s} = k_6 \cdot A_s \cdot f_{uk}$$

, where:

$k_6 =$

0.50 – coefficient for anchor resistance in shear

$A_s =$

85 mm^2 – tensile stress area

$f_{uk} =$

500.0 MPa – specified ultimate strength of anchor steel

$\gamma_{Ms} = 1.67$ – safety factor for steel

Concrete pryout resistance (EN1992-4 - Cl. 7.2.2.4)

The check is performed for group of anchors on common base plate

$$V_{Rd,cp} = \frac{V_{Rk,cp}}{\gamma_{Mc}} = 286.1\ \mathrm{kN} \geq V_{Ed,g} = 3.8\ \mathrm{kN}$$

$$V_{Rk,cp} = k_8 \cdot N_{Rk,c} = 429.1\ \mathrm{kN}$$

Where:

$k_8 = 2.00$ – factor taking into account fastener embedment depth

$N_{Rk,c} = 214.6\ \mathrm{kN}$ – characteristic concrete cone strength for a single fastener or fastener in a group

$\gamma_{Mc} = 1.50$ – safety factor for concrete

Interaction of tensile and shear forces in steel (EN 1992-4 - Table 7.3)

$$\left(\frac{N_{Ed}}{N_{Rd,s}}\right)^2 + \left(\frac{V_{Ed}}{V_{Rd,s}}\right)^2 = 0.36 \leq 1.0$$

Where:

$N_{Ed} = 10.7\ \mathrm{kN}$ – design tension force

$N_{Rd,s} = 18.1\ \mathrm{kN}$ – fastener tensile strength

$V_{Ed} = 1.0\ \mathrm{kN}$ – design shear force

$V_{Rd,s} = 12.8\ \mathrm{kN}$ – fastener shear strength

Interaction of tensile and shear forces in concrete (EN 1992-4 - Table 7.3)

$(\frac{N_{Ed}}{N_{Rd,i}})^{1.5} + (\frac{V_{Ed}}{V_{Rd,i}})^{1.5} =$ 0.04 $\leq$ 1.0

Where:

$\frac{N_{Ed}}{N_{Rd,i}}$ – the largest utilization value for tension failure modes

$\frac{V_{Ed}}{V_{Rd,i}}$ – the largest utilization value for shear failure modes

$\frac{N_{Ed}}{N_{Rd,c}} = 11\%$ – concrete breakout failure of anchor in tension

$\frac{N_{Ed}}{N_{Rd,p}} = 0\%$ – concrete pullout failure

$\frac{N_{Ed}}{N_{Rd,cb}} = 0\%$ – concrete blowout failure

$\frac{V_{Ed}}{V_{Rd,c}} = 0\%$ – concrete edge failure

$\frac{V_{Ed}}{V_{Rd,cb}} = 1\%$ – concrete pryout failure

Welds (Plastic redistribution)

Item	Edge	Throat th. [mm]	Length [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_\perp$ [MPa]	$\tau_{\parallel}$ [MPa]	$\tau_\perp$ [MPa]	Ut [%]	Ut_c [%]	Status
BP1	B4	◢5.0	573	ULS-Set(3)	213.9	0.0	174.2	1.0	-71.7	67.2	7.1	OK

Design data

	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 235	0.80	360.0	259.2

Symbol explanation

ε_{Pl}	Strain
$\sigma_{w,Ed}$	Equivalent stress
$\sigma_{w,Rd}$	Equivalent stress resistance
$\sigma_\perp$	Perpendicular stress
$\tau_{\parallel}$	Shear stress parallel to weld axis
$\tau_\perp$	Shear stress perpendicular to weld axis
0.9 σ	Perpendicular stress resistance - 0.9*fu/γM2
β_w	Corelation factor EN 1993-1-8 tab. 4.1
Ut	Utilization
Utc	Weld capacity utilization

Detailed result for BP1 B4

Weld resistance check (EN 1993-1-8 4.5.3.2)

$\sigma_{w,Rd} = f_u/(\beta_w \gamma_{M2}) =$ 360.0 MPa $\geq$ $\sigma_{w,Ed} = [\sigma_\perp^2 + 3(\tau_\perp^2 + \tau_\parallel^2)]^{0.5} =$ 213.9 MPa

$\sigma_{\perp,Rd} = 0.9 f_u/\gamma_{M2} =$ 259.2 MPa $\geq$ $|\sigma_\perp| =$ 174.2 MPa

where:

f_u = 360.0 MPa – Ultimate strength

β_w = 0.80 – appropriate correlation factor taken from Table 4.1

γ_{M2} = 1.25 – Safety factor

Stress utilization

$U_t = \max(\frac{\sigma_{w,Ed}}{\sigma_{w,Rd}}; \frac{|\sigma_\perp|}{\sigma_{\perp,Rd}}) =$ 67.2 %

Concrete block

Item	Loads	c [mm]	A_{eff} [mm^2]	σ [MPa]	k_j [-]	F_{jd} [MPa]	Ut [%]	Status
CB 1	ULS-Set(3)	18	5309	3.6	3.00	33.5	10.7	OK

Symbol explanation

c Bearing width

A_{eff} Effective area

σ Average stress in concrete

k_j Concentration factor

F_{jd} The ultimate bearing strength of the concrete block

Ut Utilization

Detailed result for CB 1

Concrete block compressive resistance check (EN 1993-1-8 6.2.5)

$\sigma = \frac{N}{A_{eff}} =$ 3.6 MPa

$F_{jd} = \alpha_{cc}\beta_j k_j f_{ck}/\gamma_c =$ 33.5 MPa

where:

N = 19.0 kN – Design normal force

A_{eff} = 5309 mm^2 – Effective area, on which the column force N is distributed

α_{cc} = 1.00 – Long-term effects on Fcd

β_j = 0.67 – Joint coefficient βj

k_j = 3.00 – Concentration factor

f_{ck} = 25.0 MPa – Characteristic compressive concrete strength

γ_c = 1.50 – Safety factor

Stress utilization

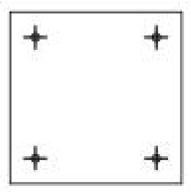
$U_t = \frac{\sigma}{F_{jd}} =$ 10.7 %

Buckling

Buckling analysis was not calculated.

Bill of material

Manufacturing operations

Name	Plates [mm]	Shape	Nr.	Welds [mm]	Length [mm]	Bolts	Nr.
BP1	P12.0x270.0-270.0 (S 235)		1	Fillet: a = 5.0	573.3	M12 5.6	4

Welds

Type	Material	Throat thickness [mm]	Leg size [mm]	Length [mm]
Fillet	S 235	5.0	7.1	573.3

Anchors

Name	Length [mm]	Drill length [mm]	Count
M12 5.6	362	350	4

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

SPOJ U SLJEMENU

Material

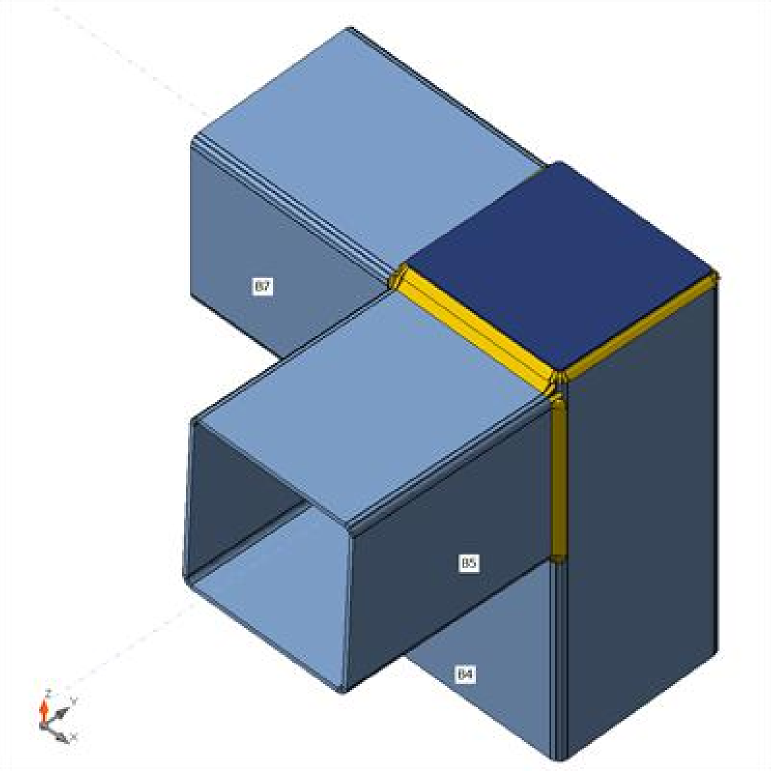
Steel	S 235

Design

Name	Con N6
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B4	1 - SHS150/150/4.0(RHS150 x150)	0.0	0.0	0.0	0	0	0	Position
B5	1 - SHS150/150/4.0(RHS150 x150)	0.0	0.0	0.0	0	0	0	Position
B7	1 - SHS150/150/4.0(RHS150 x150)	0.0	0.0	0.0	0	0	0	Position



Cross-sections

Name	Material
1 - SHS150/150/4.0(RHS150x150)	S 235

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
ULS-Set(1)	B4	-3.0	0.2	0.0	0.0	-0.9	-0.9
	B5	0.2	0.0	1.6	0.0	-0.9	0.0
	B7	-0.1	0.0	1.3	0.0	-0.9	0.0
ULS-Set(2)	B4	8.7	-1.5	1.1	0.0	1.9	1.8
	B5	-1.8	-0.1	-5.3	0.0	1.8	0.0
	B7	-1.2	0.1	-3.3	0.0	1.9	0.0
ULS-Set(3)	B4	-0.3	-0.9	0.4	0.0	-0.3	-0.6
	B5	-0.9	0.0	0.3	0.0	-0.6	0.0
	B7	-0.4	0.0	0.0	0.0	-0.3	0.0
ULS-Set(4)	B4	7.1	-0.8	0.9	0.0	1.5	1.7
	B5	-1.2	-0.1	-4.5	0.0	1.7	0.0
	B7	-1.0	0.1	-2.6	0.0	1.5	0.0
ULS-Set(5)	B4	7.4	-1.6	1.0	0.0	1.7	1.4
	B5	-1.9	0.0	-4.3	0.0	1.4	0.0
	B7	-1.0	0.1	-3.0	0.0	1.7	0.0
ULS-Set(6)	B4	2.7	-1.2	0.8	0.0	0.4	0.1
	B5	-1.4	-0.1	-1.7	0.0	0.1	0.0
	B7	-0.8	0.1	-1.0	0.0	0.4	0.0
ULS-Set(7)	B4	1.7	-0.2	0.2	0.0	0.4	0.4
	B5	-0.3	0.0	-1.0	0.0	0.4	0.0
	B7	-0.2	0.0	-0.7	0.0	0.4	0.0
ULS-Set(8)	B4	2.3	-0.3	0.3	0.0	0.6	0.5
	B5	-0.4	0.0	-1.4	0.0	0.5	0.0
	B7	-0.3	0.0	-0.9	0.0	0.5	0.0
ULS-Set(9)	B4	2.1	-1.1	0.7	0.0	0.2	0.0
	B5	-1.3	-0.1	-1.3	0.0	0.0	0.0
	B7	-0.8	0.1	-0.8	0.0	0.2	0.0
ULS-Set(10)	B4	5.9	-1.2	1.0	0.0	1.1	1.1
	B5	-1.5	-0.1	-3.7	0.0	1.1	0.0
	B7	-1.1	0.1	-2.1	0.0	1.1	0.1
ULS-Set(11)	B4	4.4	-1.2	0.6	0.0	1.0	0.7
	B5	-1.4	0.0	-2.4	0.0	0.7	0.0
	B7	-0.6	0.0	-2.0	0.0	1.0	0.0
ULS-Set(12)	B4	0.0	-0.2	0.4	0.0	-0.2	-0.2
	B5	-0.3	-0.1	-0.3	0.0	-0.2	-0.1
	B7	-0.5	0.1	0.3	0.0	-0.2	0.1

ULS-Set(13)	B4	4.3	-0.6	0.8	0.0	0.8	0.9
	B5	-0.9	-0.1	-2.9	0.0	0.9	-0.1
	B7	-0.9	0.1	-1.4	0.0	0.8	0.1
ULS-Set(14)	B4	-0.6	-0.1	0.3	0.0	-0.4	-0.3
	B5	-0.2	-0.1	0.1	0.0	-0.3	-0.1
	B7	-0.4	0.1	0.5	0.0	-0.4	0.1
ULS-Set(15)	B4	5.0	-1.3	0.7	0.0	1.2	0.8
	B5	-1.5	0.0	-2.8	0.0	0.8	0.0
	B7	-0.7	0.0	-2.2	0.0	1.2	0.0
ULS-Set(16)	B4	-2.3	0.1	0.1	0.0	-0.7	-0.8
	B5	0.1	0.0	1.3	0.0	-0.8	0.0
	B7	-0.2	0.0	1.1	0.0	-0.7	0.0

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Welds	24.8 < 100%	OK
Buckling	Not calculated	
GMNA	Calculated	

Plates

Name	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
B4	4.0	ULS-Set(2)	101.6	0.0	0.0	OK
B5	4.0	ULS-Set(2)	84.8	0.0	0.0	OK
B7	4.0	ULS-Set(2)	76.3	0.0	0.0	OK
STIFF1	8.0	ULS-Set(2)	17.3	0.0	0.0	OK

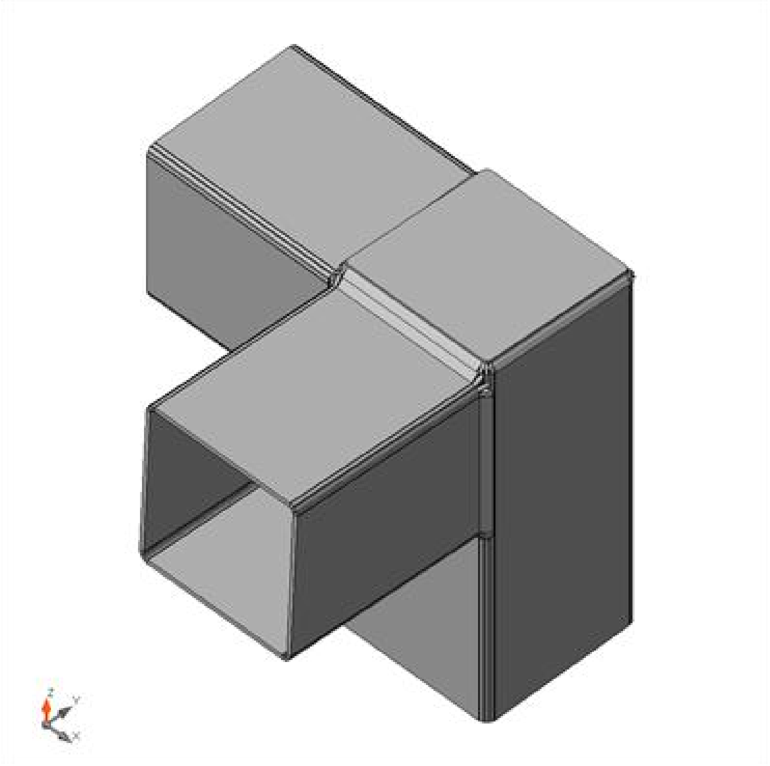
Design data

Material	f_y [MPa]	ε_{lim} [%]
S 235	235.0	5.0

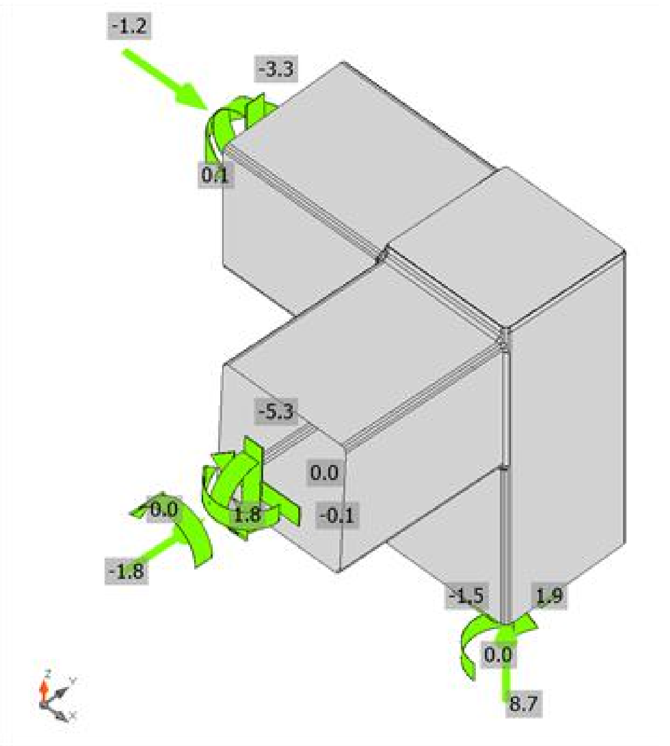
Symbol explanation

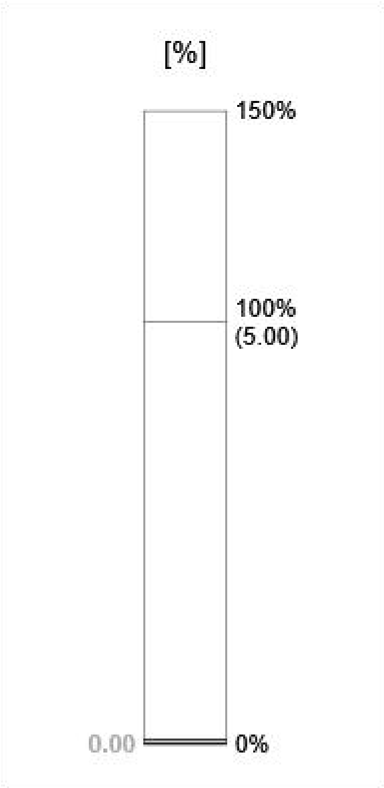
ε_{Pl}	Strain
σ_{Ed}	Eq. stress
σc_{Ed}	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.



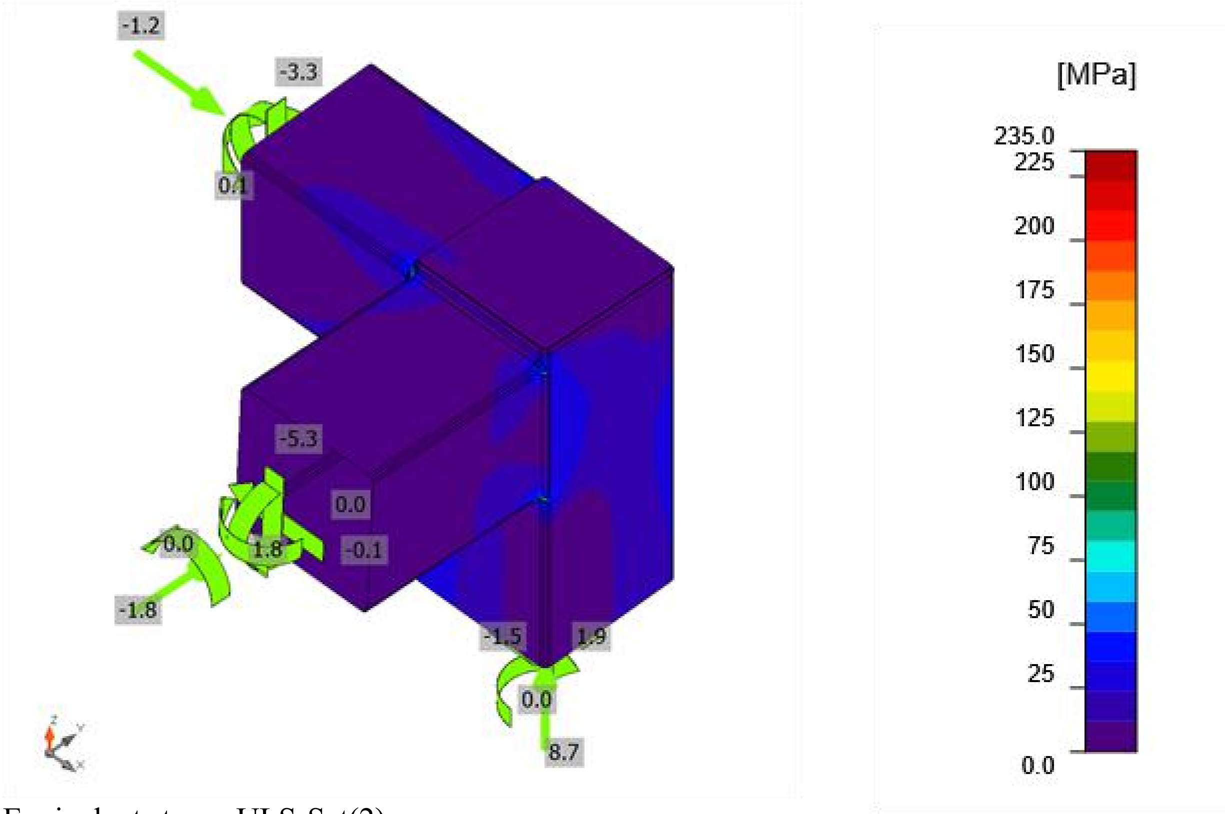
Overall check, ULS-Set(2)





Strain check, ULS-Set(2)

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.



Equivalent stress, ULS-Set(2)

Welds (Plastic redistribution)

Item	**Edge**	**Throat th. [mm]**	**Length [mm]**	**Loads**	**$\sigma_{w,Ed}$ [MPa]**	**ε_{Pl} [%]**	**$\sigma_{\perp}$ [MPa]**	**$\tau_{\parallel}$ [MPa]**	**$\tau_{\perp}$ [MPa]**	**Ut [%]**	**Ut_c [%]**	**Status**
B4-w 4	B5	◢5.0	574	ULS - Set(2)	79.0	0.0	-64.3	-16.8	20.5	24.8	3.6	OK
B4-w 3	B7	◢5.0	573	ULS - Set(2)	82.6	0.0	-49.8	-5.2	37.7	23.0	4.1	OK
STIF F1	B4	◢4.0 ◣	561	ULS - Set(2)	18.9	0.0	1.6	10.8	1.2	5.3	1.4	OK
		◢4.0 ◣	561	ULS - Set(2)	22.4	0.0	6.5	-12.3	1.2	6.2	1.4	OK

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Design data

	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 235	0.80	360.0	259.2

Symbol explanation

ε_{Pl}	Strain
$\sigma_{w,Ed}$	Equivalent stress
$\sigma_{w,Rd}$	Equivalent stress resistance
$\sigma_{\perp}$	Perpendicular stress
$\tau_{\parallel}$	Shear stress parallel to weld axis
$\tau_{\perp}$	Shear stress perpendicular to weld axis
0.9 σ	Perpendicular stress resistance - 0.9*fu/γM2
β_w	Corelation factor EN 1993-1-8 tab. 4.1
Ut	Utilization
Utc	Weld capacity utilization

Detailed result for B4-w 4 B5

Weld resistance check (EN 1993-1-8 4.5.3.2)

$\sigma_{w,Rd} = f_u/(\beta_w \gamma_{M2}) =$	360.0	MPa	≥	$\sigma_{w,Ed} = [\sigma_\perp^2 + 3(\tau_\perp^2 + \tau_\parallel^2)]^{0.5} =$	79.0	MPa
$\sigma_{\perp,Rd} = 0.9 f_u/\gamma_{M2} =$	259.2	MPa	≥	$\lvert\sigma_\perp\rvert =$	64.3	MPa

where:

$f_u =$ 360.0 MPa	– Ultimate strength
$\beta_w =$ 0.80	– appropriate correlation factor taken from Table 4.1
$\gamma_{M2} =$ 1.25	– Safety factor

Stress utilization

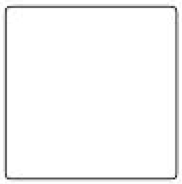
$U_t = \max(\frac{\sigma_{w,Ed}}{\sigma_{w,Rd}}; \frac{\lvert\sigma_\perp\rvert}{\sigma_{\perp,Rd}}) =$ 24.8 %

Buckling

Buckling analysis was not calculated.

Bill of material

Manufacturing operations

Name	Plates [mm]	Shape	Nr.	Welds [mm]	Length [mm]	Bolts	Nr.
CUT1				Fillet: a = 5.0	573.6		
CUT2				Fillet: a = 5.0	573.3		
CUT3							
STIFF1	P8.0x142.2-142.0 (S 235)		1	Double fillet: a = 4.0	560.8		

Welds

Type	Material	Throat thickness [mm]	Leg size [mm]	Length [mm]
Fillet	S 235	5.0	7.1	1146.9
Double fillet	S 235	4.0	5.7	560.8

TEMELJENJE

Materials and standards

Concrete structures : EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 : standard

Settlement

Analysis method : Analysis using oedometric modulus
Restriction of influence zone : by percentage of Sigma,Or
Coeff. of restriction of influence zone : 10,0 [%]

Spread Footing

Analysis for drained conditions : Standard approach
Analysis of uplift : Standard
Allowable eccentricity : 0,333
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor for vertical bearing capacity :	SF_v =	1,50	[–]
Safety factor for sliding resistance :	SF_h =	1,50	[–]

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
1	Glina (pretpostavka)		19,00	30,00	21,00	11,00	

All soils are considered as cohesionless for at rest pressure analysis.

Soil parameters

Glina (pretpostavka)

Unit weight : γ = 21,00 kN/m³
Angle of internal friction : φ_{ef} = 19,00 °
Cohesion of soil : c_{ef} = 30,00 kPa
Oedometric modulus : E_{oed} = 21,50 MPa
Saturated unit weight : γ_{sat} = 21,00 kN/m³

Foundation

Foundation type: centric spread footing

Depth from original ground surface	h_z	=	0,70	m
Depth of footing bottom	d	=	0,60	m
Foundation thickness	t	=	0,60	m
Incl. of finished grade	s_1	=	0,00	°
Incl. of footing bottom	s_2	=	0,00	°

Overburden

Type: from geological profile

Geometry of structure

Foundation type: centric spread footing

Spread footing length	x	=	0,70	m
Spread footing width	y	=	0,70	m
Column width in the direction of x	c_x	=	0,15	m
Column width in the direction of y	c_y	=	0,15	m

Spread footing volume	=	0,29	m^3
Volume of excavation	=	0,29	m^3
Volume of fill	=	0,00	m^3

Name : Geometry	**Stage - analysis : 1 - 0**

Material of structure

Unit weight γ = 23,00 kN/m^3
Analysis of concrete structures carried out according to the standard EN 1992-1-1 (EC2).
Concrete : C 25/30

Cylinder compressive strength	f_{ck} =	25,00 MPa
Tensile strength	f_{ctm} =	2,60 MPa
Elasticity modulus	E_{cm} =	31000,00 MPa

Longitudinal steel : B500
Yield strength f_{yk} = 500,00 MPa

Transverse steel: B500
Yield strength f_{yk} = 500,00 MPa

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	-	0,00 .. ∞	Glina (pretpostavka)	

Load

No.	Load new	Load change	Name	Type	N [kN]	M_x [kNm]	M_y [kNm]	H_x [kN]	H_y [kN]
1	Yes		1	Design	7,69	0,46	-0,75	-0,92	-0,85
2	Yes		2	Design	-2,51	-1,16	1,47	1,88	1,47
3	Yes		3	Design	0,18	-1,16	1,47	1,50	3,46
4	Yes		4	Design	9,31	-0,44	-0,93	-1,14	0,35
5	Yes		1 - service	Service	5,49	0,33	-0,54	-0,66	-0,61
6	Yes		2 - service	Service	-1,79	-0,83	1,05	1,34	1,05
7	Yes		3 - service	Service	0,13	-0,83	1,05	1,07	2,47
8	Yes		4 - service	Service	6,65	-0,31	-0,66	-0,81	0,25

Global settings

Type of analysis : analysis for drained conditions

Settings of the stage of construction

Design situation : permanent

Verification No. 1

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Load case verification

Name	e_x [m]	e_y [m]	σ [kPa]	R_d [kPa]	Utilization [%]	Is satisfactory
1	0,01	0,00	31,00	552,17	8,42	Yes
2	-0,08	0,07	13,85	127,65	16,28	Yes
3	-0,08	-0,13	29,71	136,14	32,73	Yes
4	0,02	0,01	35,76	569,96	9,41	Yes

Analysis carried out with automatic selection of the most unfavourable load cases.

Computed weight of spread footing $G = 6,76$ kN
Computed weight of overburden $Z = 0,00$ kN

Vertical bearing capacity check - spread footing in compression

Shape of contact stress : rectangle
Most unfavorable load case No. 3. (3)
Parameters of slip surface below foundation:
Depth of slip surface $z_{sp} = 0,79$ m
Length of slip surface $l_{sp} = 2,03$ m

Design bearing capacity of found.soil $R_d = 136,14$ kPa
Extreme contact stress $\sigma = 29,71$ kPa

Factor of safety = 4,58 > 1,50
Bearing capacity in the vertical direction - spread footing in compression is SATISFACTORY

Verification of load eccentricity

Max. eccentricity in direction of base length $e_x = 0,117<0,333$
Max. eccentricity in direction of base width $e_y = 0,189<0,333$
Max. overall eccentricity $e_t = 0,222<0,333$

Eccentricity of load is SATISFACTORY

Vertical bearing capacity check - spread footing in tension

Angle of internal friction $\varphi = 19,00$ °
Cohesion of soil $c = 30,00$ kPa

Max. tensile force $N_{t,max} = 2,51$ kN
Uplift resistance $R_t = 58,64$ kN

Factor of safety = 23,36 > 3,00
Bearing capacity in the vertical direction - spread footing in tension is SATISFACTORY

Horizontal bearing capacity check

Most unfavorable load case No. 3. (3)
Earth resistance: at rest
Design magnitude of earth resistance S_{pd} = 1,78 kN

Horizontal bearing capacity R_{dh} = 11,18 kN
Extreme horizontal force H = 3,77 kN

Factor of safety = 2,97 > 1,50
Bearing capacity in the horizontal direction is SATISFACTORY
Bearing capacity of foundation is SATISFACTORY

Verification No. 1

Settlement and rotation of foundation - input data

Analysis carried out with automatic selection of the most unfavourable load cases.
Analysis carried out with accounting for coefficient κ_1 (influence of foundation depth).
Stress at the footing bottom considered from the finished grade.

Computed weight of spread footing G = 6,76 kN
Computed weight of overburden Z = 0,00 kN

Settlement of mid point of edge x - 1 = 0,2 mm
Settlement of mid point of edge x - 2 = 0,1 mm
Settlement of mid point of edge y - 1 = 0,2 mm
Settlement of mid point of edge y - 2 = 0,1 mm
Settlement of foundation center point = 0,3 mm
Settlement of characteristic point = 0,2 mm

(1-max.compressed edge; 2-min.compressed edge)

Settlement and rotation of foundation - results

Foundation stiffness:
Computed weighted average modulus of deformation E_{def} = 10,03 MPa
Foundation in the longitudinal direction is rigid (k=1945,70)
Foundation in the direction of width is rigid (k=1945,70)

Verification of load eccentricity

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Max. eccentricity in direction of base length e_x = 0,084<0,333
Max. eccentricity in direction of base width e_y = 0,136<0,333
Max. overall eccentricity e_t = 0,160<0,333

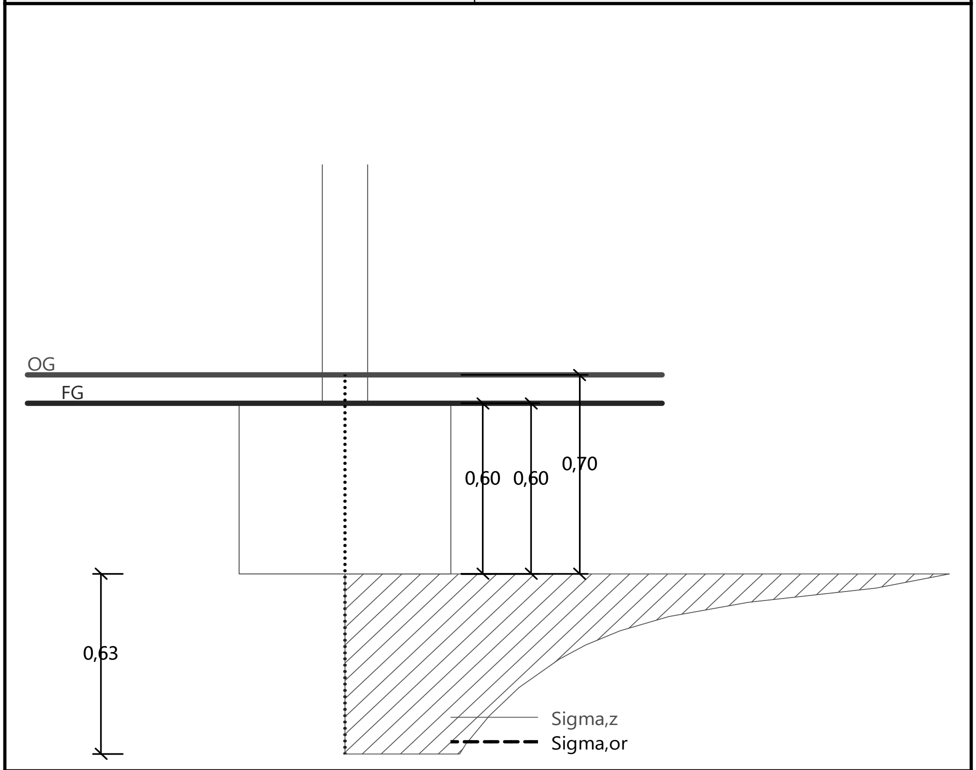
Eccentricity of load is SATISFACTORY

Overall settlement and rotation of foundation:

Foundation settlement = 0,2 mm
Depth of influence zone = 0,63 m

Rotation in direction of x = 0,065 (tan*1000); (3,7E-03 °)
Rotation in direction of y = 0,118 (tan*1000); (6,8E-03 °)

Name : Settlement	Stage - analysis : 1 - 1



Dimensioning No. 1

Analysis carried out with automatic selection of the most unfavourable load cases.

Verification of longitudinal reinforcement of foundation in the direction of x

0,28 m ≤ 0,30 m
Maximum offset of the foundation is smaller than 0,50 * thickness of foundation.
Reinforcement is not requiered.

Verification of longitudinal reinforcement of foundation in the direction of y

0,28 m ≤ 0,30 m
Maximum offset of the foundation is smaller than 0,50 * thickness of foundation.
Reinforcement is not requiered.

Spread footing for punching shear failure check

Column normal force = -2,51 kN

Maximum resistance at the column perimeter

Force transferred into found. soil		=	-0,12	kN
Force transferred by shear strength of foundation		=	-2,39	kN
Considered column perimeter	u_0	=	0,60	m
Shear resistance at the column perimeter	$v_{Ed,max}$	=	0,07	MPa
Resistance at the column perimeter	$v_{Rd,max}$	=	3,60	MPa

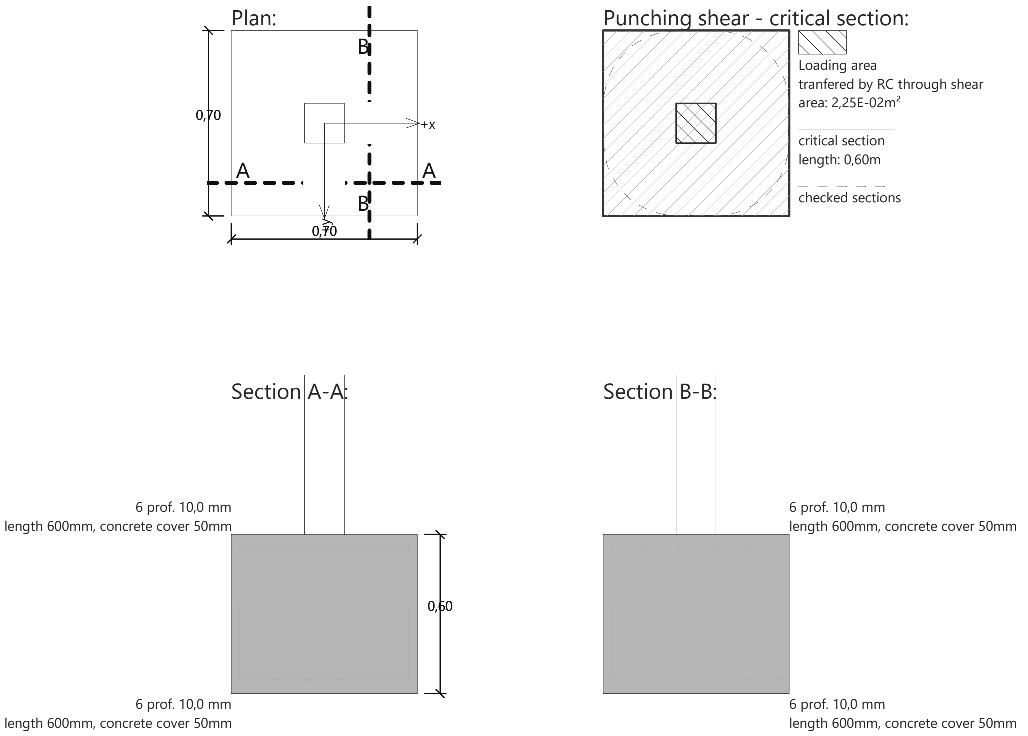
Critical section without shear reinforcement

Force transferred into found. soil		=	-2,15	kN
Force transferred by shear strength of foundation		=	-0,36	kN
Distance of section from the column		=	0,27	m
Section perimeter	u	=	2,31	m
Shear stress at section	v_{Ed}	=	0,00	MPa
Shear resistance of section without shear reinforcement	$v_{Rd,c}$	=	1,42	MPa

$v_{Ed} < v_{Rd,c}$ => Reinforcement is not required
Spread footing for punching shear is SATISFACTORY

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

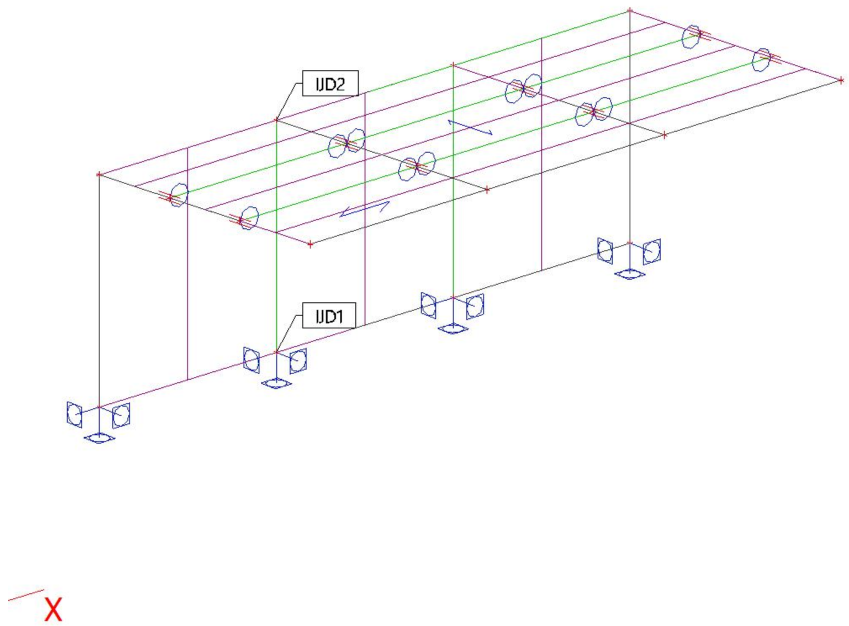
Name : Dimensioning	**Stage - analysis : 1 - 1**



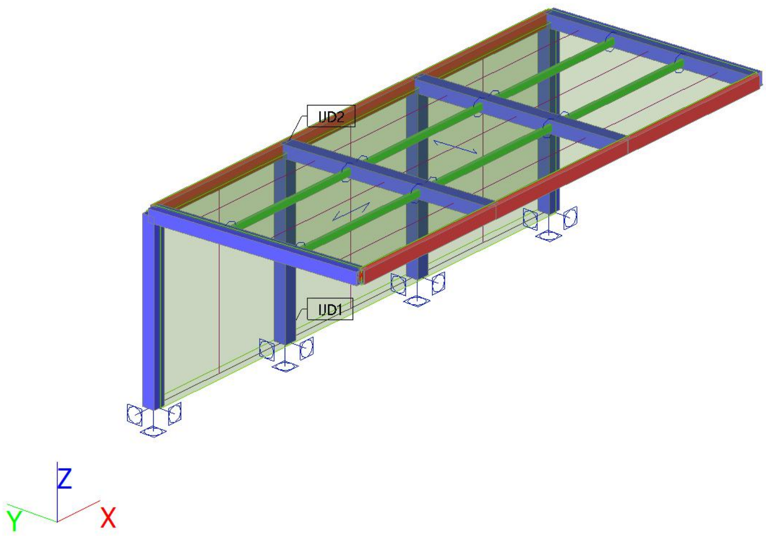
INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

NADSTREŠNICA TIP B

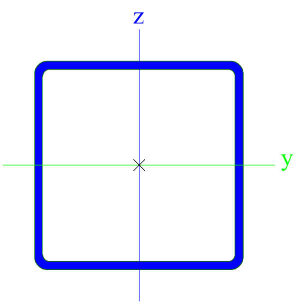
1. Model konstrukcije



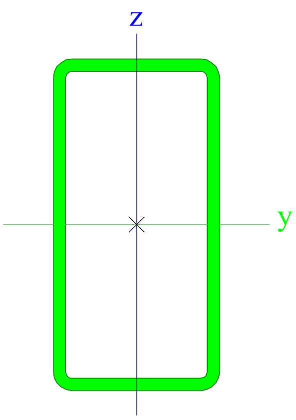
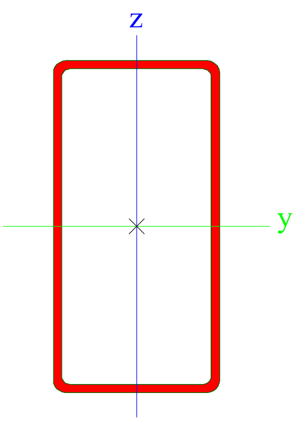
2. Poprečni presjeci



3. Cross-sections

Glavni nosač		
Type	SHS160/160/6.0	
Formcode	2 - Rectangular hollow section	
Shape type	Thin-walled	
Item material	S 235	
Fabrication	rolled	
Colour		
Flexural buckling y-y, Flexural buckling z-z	a	a
A [m^2]	3.6600e-03	
A_y [m^2], A_z [m^2]	1.8283e-03	1.8283e-03
A_L [m^2/m], A_D [m^2/m]	6.2500e-01	1.2061e+00
$c_{Y.UCS}$ [mm], $c_{Z.UCS}$ [mm]	80	80
α [deg]	0.00	
I_y [m^4], I_z [m^4]	1.4370e-05	1.4370e-05
i_y [mm], i_z [mm]	63	63
$W_{el.y}$ [m^3], $W_{el.z}$ [m^3]	1.8000e-04	1.8000e-04
$W_{pl.y}$ [m^3], $W_{pl.z}$ [m^3]	2.1000e-04	2.1000e-04
$M_{pl.y.+}$ [Nm], $M_{pl.y.-}$ [Nm]	4.94e+04	4.94e+04
$M_{pl.z.+}$ [Nm], $M_{pl.z.-}$ [Nm]	4.94e+04	4.94e+04
d_y [mm], d_z [mm]	0	0
I_t [m^4], I_w [m^6]	2.2330e-05	5.2429e-08
$β_y$ [mm], $β_z$ [mm]	0	0
Picture		

Sekundarci		
Type	RHS80/40/3.0	
Formcode	2 - Rectangular hollow section	
Shape type	Thin-walled	
Item material	S 235	
Fabrication	rolled	
Colour		
Flexural buckling y-y, Flexural buckling z-z	a	a
A [m^2]	6.7400e-04	
A_y [m^2], A_z [m^2]	2.2275e-04	4.4551e-04
A_L [m^2/m], A_D [m^2/m]	2.3200e-01	4.4565e-01
$c_{Y.UCS}$ [mm], $c_{Z.UCS}$ [mm]	20	40
α [deg]	0.00	
I_y [m^4], I_z [m^4]	5.4200e-07	1.8000e-07
i_y [mm], i_z [mm]	28	16
$W_{el.y}$ [m^3], $W_{el.z}$ [m^3]	1.3600e-05	9.0000e-06
$W_{pl.y}$ [m^3], $W_{pl.z}$ [m^3]	1.6836e-05	1.0311e-05
$M_{pl.y.+}$ [Nm], $M_{pl.y.-}$ [Nm]	3.96e+03	3.96e+03
$M_{pl.z.+}$ [Nm], $M_{pl.z.-}$ [Nm]	2.42e+03	2.42e+03
d_y [mm], d_z [mm]	0	0
I_t [m^4], I_w [m^6]	4.3800e-07	1.5360e-10
$β_y$ [mm], $β_z$ [mm]	0	0

Picture		
Rubni sekundarac		
Type	RHSCF160/80/4.0	
Formcode	2 - Rectangular hollow section	
Shape type	Thin-walled	
Item material	S 235	
Fabrication	cold formed	
Colour		
Flexural buckling y-y, Flexural buckling z-z	c	c
A [m^2]	1.8100e-03	
A_y [m^2], A_z [m^2]	6.1284e-04	1.2257e-03
A_L [m^2/m], A_D [m^2/m]	4.3600e-01	9.1075e-01
$c_{Y.UCS}$ [mm], $c_{Z.UCS}$ [mm]	40	80
α [deg]	0.00	
I_y [m^4], I_z [m^4]	5.9800e-06	2.0400e-06
i_y [mm], i_z [mm]	57	34
$W_{el.y}$ [m^3], $W_{el.z}$ [m^3]	7.4700e-05	5.0900e-05
$W_{pl.y}$ [m^3], $W_{pl.z}$ [m^3]	9.4729e-05	5.8295e-05
$M_{pl.y.+}$ [Nm], $M_{pl.y.-}$ [Nm]	2.23e+04	2.23e+04
$M_{pl.z.+}$ [Nm], $M_{pl.z.-}$ [Nm]	1.37e+04	1.37e+04
d_y [mm], d_z [mm]	0	0
I_t [m^4], I_w [m^6]	4.9400e-06	6.5536e-09
β_y [mm], β_z [mm]	0	0
Picture		

Explanations of symbols	
Formcode	h - Height b - Width

Explanations of symbols	
	s - Thickness r - Outer radius r1 - Inner radius
A	Area
A_y	Shear Area in principal y-direction
A_z	Shear Area in principal z-direction
A_L	Circumference per unit length
A_D	Drying surface per unit length
$c_{Y.UCS}$	Centroid coordinate in Y-direction of Input axis system
$c_{Z.UCS}$	Centroid coordinate in Z-direction of Input axis system
$I_{Y.LCS}$	Second moment of area about the YLCS axis
$I_{Z.LCS}$	Second moment of area about the ZLCS axis
$I_{YZ.LCS}$	Product moment of area in the LCS system
α	Rotation angle of the principal axis system
I_y	Second moment of area about the principal y-axis
I_z	Second moment of area about the principal z-axis
i_y	Radius of gyration about the principal y-axis
i_z	Radius of gyration about the principal z-axis
$W_{el.y}$	Elastic section modulus about the principal y-axis
$W_{el.z}$	Elastic section modulus about the principal z-axis
$W_{pl.y}$	Plastic section modulus about the principal y-axis
$W_{pl.z}$	Plastic section modulus about the principal z-axis
$M_{pl.y.+}$	Plastic moment about the principal y-axis for a positive My moment
$M_{pl.y.-}$	Plastic moment about the principal y-axis for a negative My moment
$M_{pl.z.+}$	Plastic moment about the principal z-axis for a positive Mz moment
$M_{pl.z.-}$	Plastic moment about the principal z-axis for a negative Mz moment
d_y	Shear center coordinate in principal y-direction measured from the centroid
d_z	Shear center coordinate in principal z-direction measured from the centroid
I_t	Torsional constant
I_w	Warping constant
β_y	Mono-symmetry constant about the principal y-axis
β_z	Mono-symmetry constant about the principal z-axis

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

4. Load cases

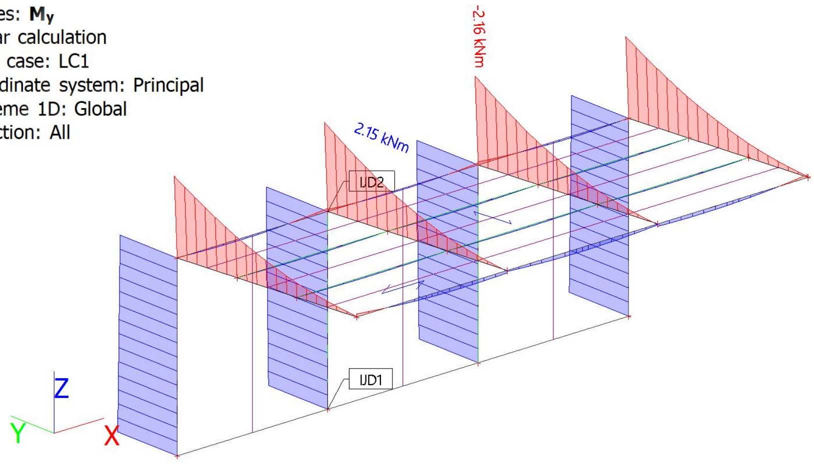
4.1. Load cases - LC1

Name	Description Spec	Action type Load type	Load group	Direction
LC1	Self weight	Permanent Self weight	LG1	-Z

4.1.

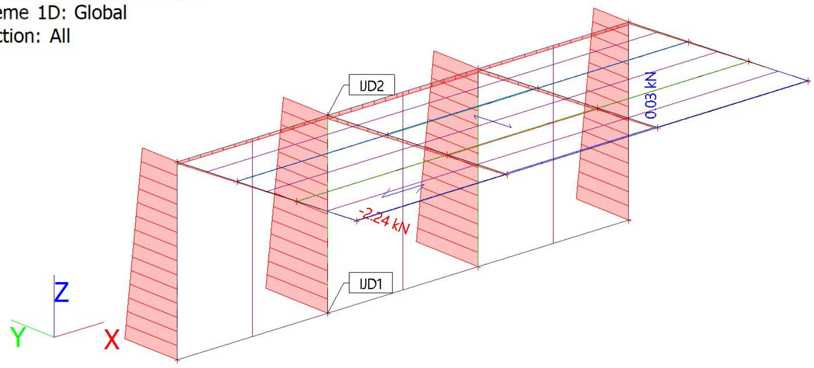
4.1.1. 1D internal forces; M_y

Values: M_y
Linear calculation
Load case: LC1
Coordinate system: Principal
Extreme 1D: Global
Selection: All



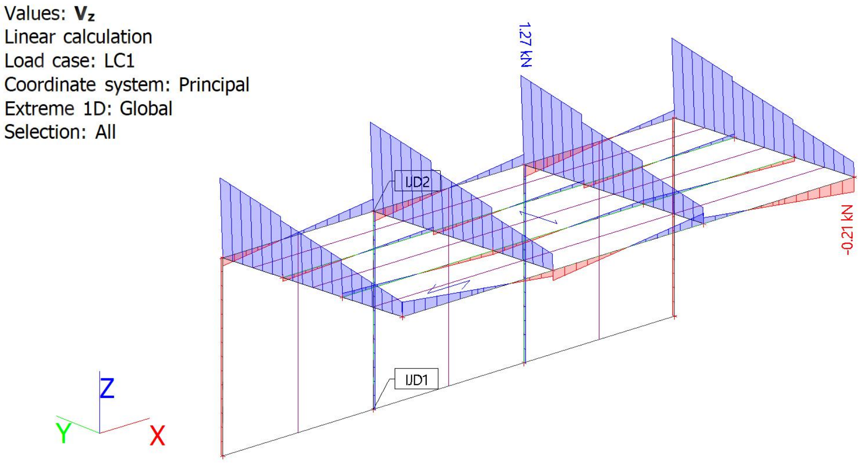
4.1.2. 1D internal forces; N

Values: **N**
Linear calculation
Load case: LC1
Coordinate system: Principal
Extreme 1D: Global
Selection: All



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

4.1.3. 1D internal forces; V_z

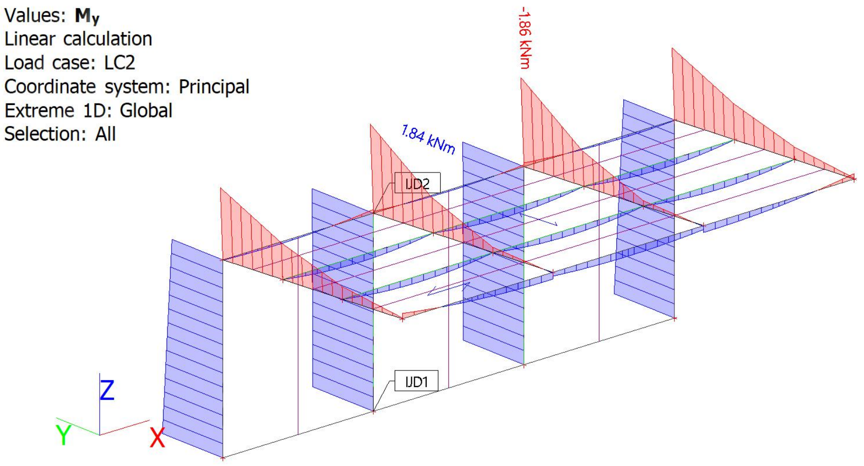


4.2. Load cases - LC2

Name	Description	Action type	Load group
	Spec	Load type	
LC2	Dodatno stalno	Permanent	LG1
		Standard	

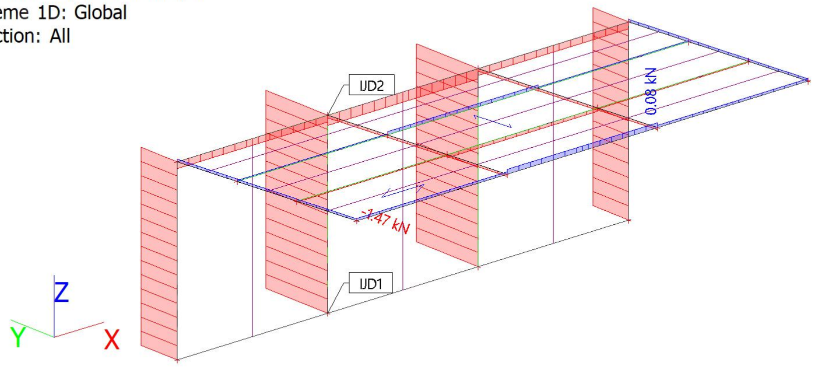
4.2.

4.2.1. 1D internal forces; M_y



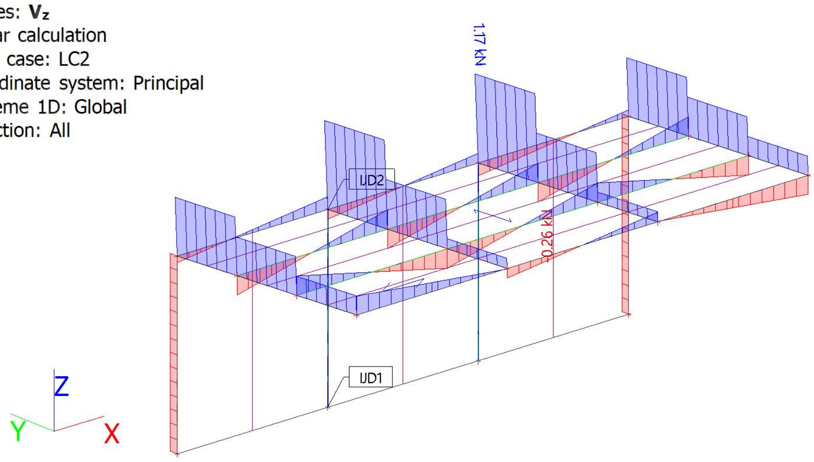
4.2.2. 1D internal forces; N

Values: **N**
Linear calculation
Load case: LC2
Coordinate system: Principal
Extreme 1D: Global
Selection: All



4.2.3. 1D internal forces; V_z

Values: **V_z**
Linear calculation
Load case: LC2
Coordinate system: Principal
Extreme 1D: Global
Selection: All



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

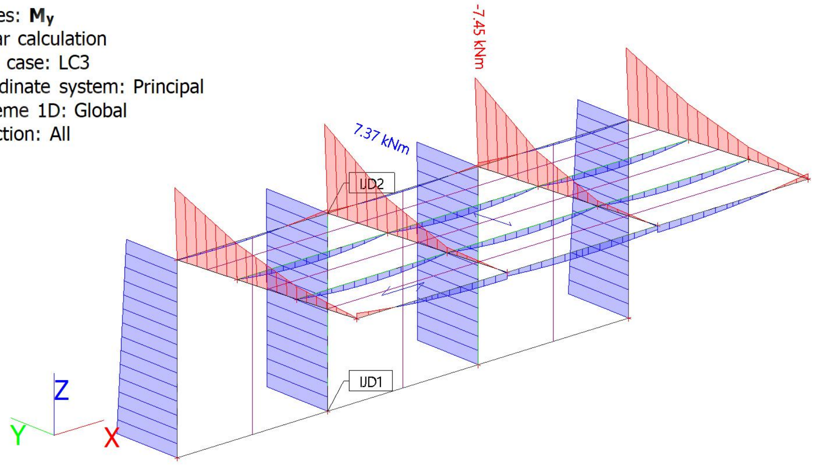
4.3. Load cases - LC3

Name	Description	Action type	Load group	Master load case
	Spec	Load type		
LC3	Snijeg	Variable	LG2	None
	Snow	Static		

4.3.

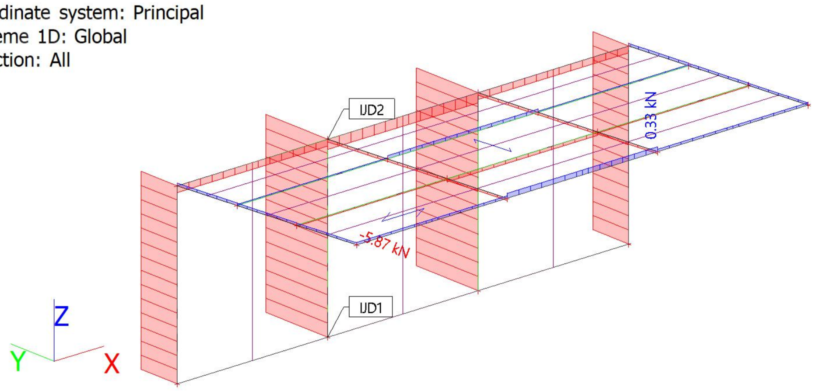
4.3.1. 1D internal forces; M_y

Values: $\mathbf{M_y}$
Linear calculation
Load case: LC3
Coordinate system: Principal
Extreme 1D: Global
Selection: All



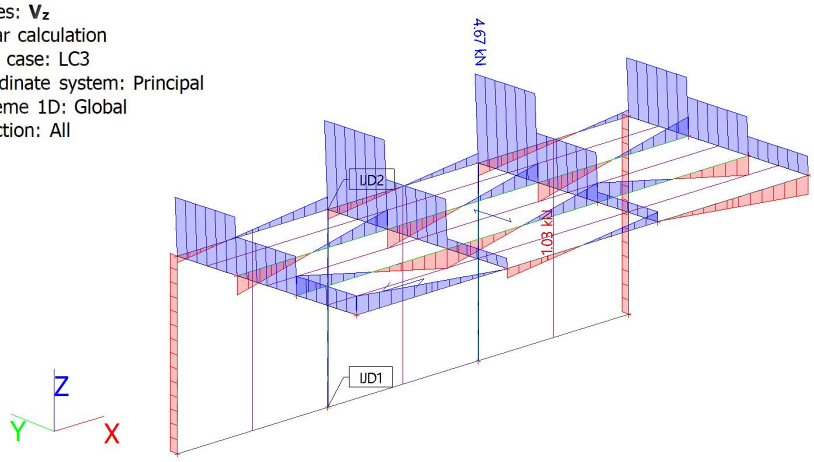
4.3.2. 1D internal forces; N

Values: **N**
Linear calculation
Load case: LC3
Coordinate system: Principal
Extreme 1D: Global
Selection: All



4.3.3. 1D internal forces; V_z

Values: V_z
Linear calculation
Load case: LC3
Coordinate system: Principal
Extreme 1D: Global
Selection: All



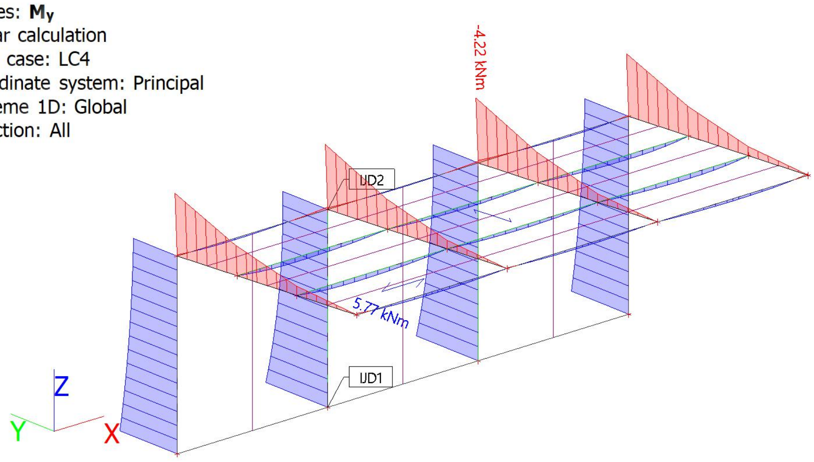
4.4. Load cases - LC4

Name	Description	Action type	Load group	Master load case
	Spec	Load type		
LC4	Vjetar + Static wind	Variable Static	LG3	None

4.4.

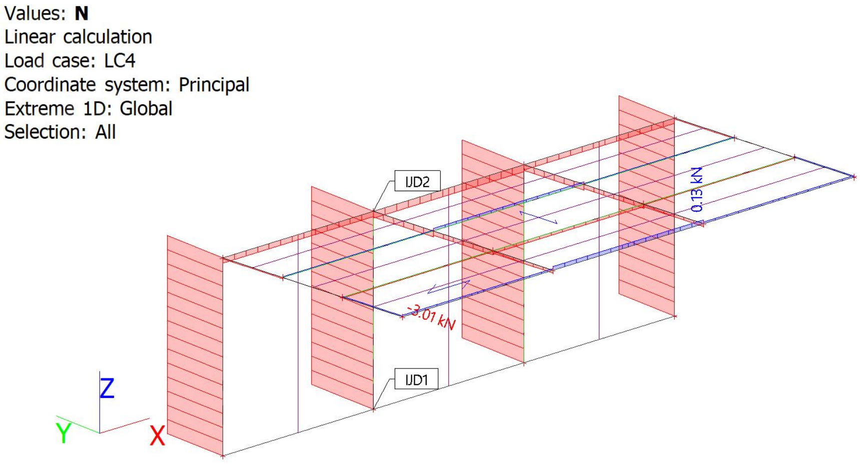
4.4.1. 1D internal forces; M_y

Values: M_y
Linear calculation
Load case: LC4
Coordinate system: Principal
Extreme 1D: Global
Selection: All

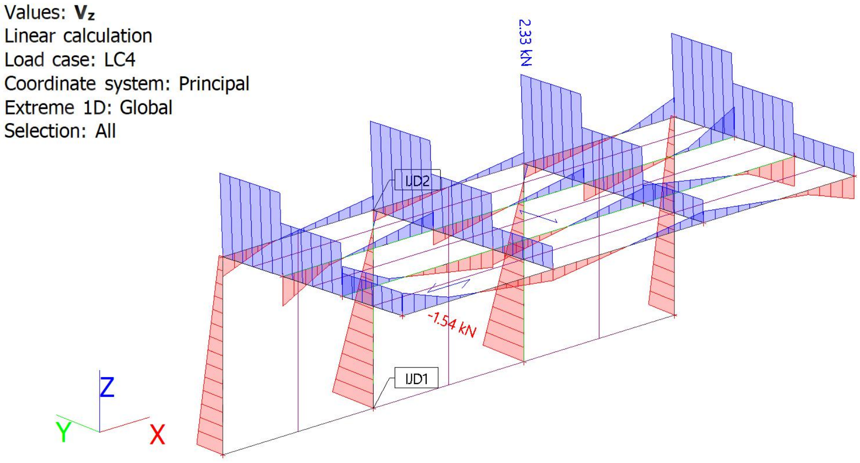


INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

4.4.2. 1D internal forces; N



4.4.3. 1D internal forces; V_z



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

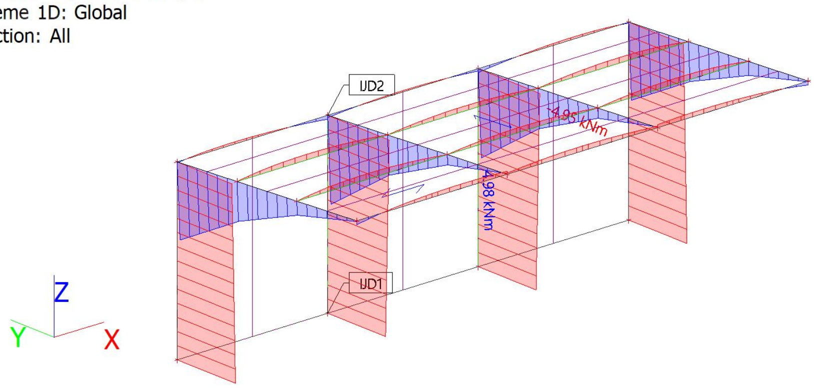
4.5. Load cases - LC5

Name	Description	Action type	Load group	Master load case
	Spec	Load type		
LC5	Vjetar - Static wind	Variable Static	LG3	None

4.5.

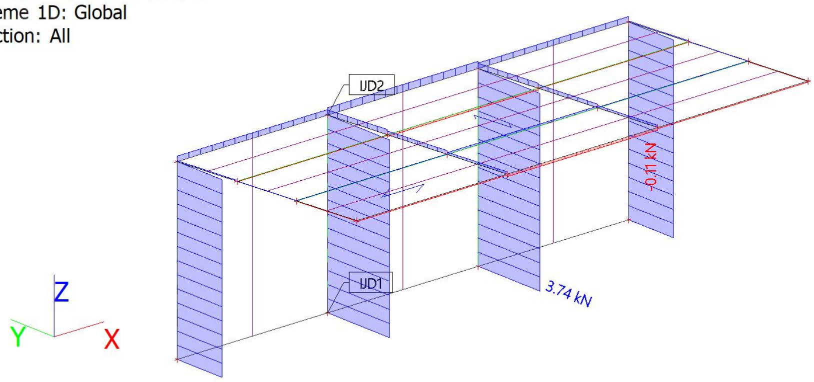
4.5.1. 1D internal forces; M_y

Values: M_y
Linear calculation
Load case: LC5
Coordinate system: Principal
Extreme 1D: Global
Selection: All



4.5.2. 1D internal forces; N

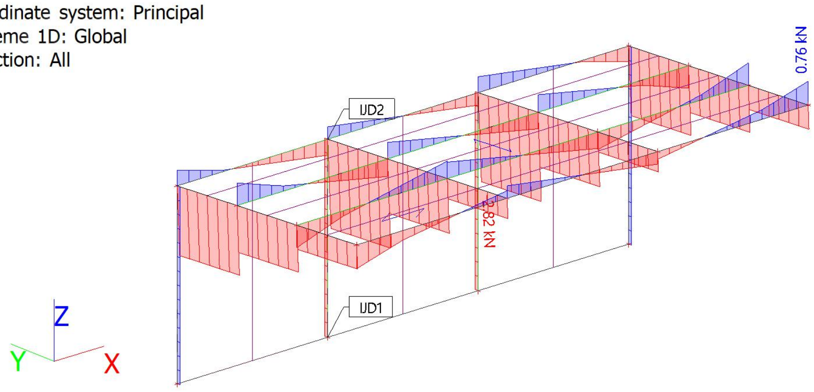
Values: **N**
Linear calculation
Load case: LC5
Coordinate system: Principal
Extreme 1D: Global
Selection: All



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

4.5.3. 1D internal forces; V_z

Values: **V_z**
Linear calculation
Load case: LC5
Coordinate system: Principal
Extreme 1D: Global
Selection: All



5. Dimenzioniranje glavnog okvira

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = Glavni nosač - SHS160/160/6.0

EN 1993-1-1 Code Check
National annex: Standard EN

Member B4	**0.000 / 2.904 m**	**SHS160/160/6.0**	**S 235**	**ULS-Set B (auto)**	**0.46 -**

Combination key
ULS-Set B (auto) / 1.35*LC1 + 1.35*LC2 + 1.50*LC3 + 0.90*LC4

Partial safety factors	
γ_{M0} for resistance of cross-sections	1.00
γ_{M1} for resistance to instability	1.00
γ_{M2} for resistance of net sections	1.25

Material			
Yield strength	f_y	235.0	MPa
Ultimate strength	f_u	360.0	MPa
Fabrication		Rolled	

...::SECTION CHECK::...

The critical check is on position 0.000 m

Internal forces		Calculated	Unit
Normal force	N_{Ed}	-0.62	kN
Shear force	$V_{y,Ed}$	0.38	kN
Shear force	$V_{z,Ed}$	12.38	kN
Torsion	T_{Ed}	-0.56	kNm

Internal forces		Calculated	Unit
Bending moment	$M_{y,Ed}$	-20.41	kNm
Bending moment	$M_{z,Ed}$	-0.35	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	142	6	1.113e+05	1.078e+05	0.97		1.00	23.67	28.00	34.00	38.42	1
3	I	142	6	9.912e+04	-1.026e+05	-1.03		0.49	23.67	73.25	84.45	128.34	1
5	I	142	6	-1.109e+05	-1.075e+05								
7	I	142	6	-9.878e+04	1.029e+05	-0.96		0.51	23.67	69.76	80.62	118.78	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

Cross-section area	A	3.6600e-03	m²
Compression resistance	$N_{c,Rd}$	860.10	kN
Unity check		0.00	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,y}$	2.1000e-04	m³
Plastic bending moment	$M_{pl,y,Rd}$	49.35	kNm
Unity check		0.41	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,z}$	2.1000e-04	m³
Plastic bending moment	$M_{pl,z,Rd}$	49.35	kNm
Unity check		0.01	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Shear correction factor	η	1.20	
Shear area	A_v	1.8300e-03	m²
Plastic shear resistance for V_y	$V_{pl,y,Rd}$	248.29	kN
Unity check		0.00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Shear correction factor	η	1.20	
Shear area	A_v	1.8300e-03	m²
Plastic shear resistance for V_z	$V_{pl,z,Rd}$	248.29	kN
Unity check		0.05	-

Torsion check

According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Index of fibre	Fibre	1	
Total torsional moment	τ_{Ed}	2.0	MPa
Elastic shear resistance	τ_{Rd}	135.7	MPa
Unity check		0.01	-

Note: The unity check for torsion is lower than the limit value of 0.05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

Design plastic moment resistance reduced due to N_{Ed}	$M_{N,y,Rd}$	49.35	kNm
Exponent of bending ratio y	α	1.66	
Design plastic moment resistance reduced due to N_{Ed}	$M_{N,z,Rd}$	49.35	kNm
Exponent of bending ratio z	β	1.66	

Unity check (6.41) = 0.23 + 0.00 = 0.23 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 0.000 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	142	6	1.113e+05	1.078e+05	0.97		1.00	23.67	28.00	34.00	38.42	1
3	I	142	6	9.912e+04	-1.026e+05	-1.03		0.49	23.67	73.25	84.45	128.34	1
5	I	142	6	-1.109e+05	-1.075e+05								
7	I	142	6	-9.878e+04	1.029e+05	-0.96		0.51	23.67	69.76	80.62	118.78	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters		yy	zz	
Sway type		sway	non-sway	
System length	L	2.904	0.968	m
Buckling factor	k	7.60	0.94	
Buckling length	l_{cr}	22.058	0.910	m
Critical Euler load	N_{cr}	61.21	35989.39	kN
Slenderness	λ	352.03	14.52	
Relative slenderness	λ_{rel}	3.75	0.15	
Limit slenderness	$\lambda_{rel,0}$	0.20	0.20	

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Note: The slenderness or compression force is such that Flexural Buckling effects may be ignored according to EN 1993-1-1 article 6.3.1.2(4).

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters			
Interaction method		alternative method 1	
Cross-section area	A	3.6600e-03	m^2
Plastic section modulus	$W_{pl,y}$	2.1000e-04	m^3
Plastic section modulus	$W_{pl,z}$	2.1000e-04	m^3
Design compression force	N_{Ed}	0.62	kN
Design bending moment (maximum)	$M_{y,Ed}$	-20.41	kNm
Design bending moment (maximum)	$M_{z,Ed}$	-0.35	kNm
Characteristic compression resistance	N_{Rk}	860.10	kN
Characteristic moment resistance	$M_{y,Rk}$	49.35	kNm
Characteristic moment resistance	$M_{z,Rk}$	49.35	kNm
Reduction factor	χ_y	1.00	
Reduction factor	χ_z	1.00	
Reduction factor	χ_{LT}	1.00	
Interaction factor	k_{yy}	1.11	
Interaction factor	k_{yz}	0.47	
Interaction factor	k_{zy}	0.67	
Interaction factor	k_{zz}	0.78	

Maximum moment $M_{y,Ed}$ is derived from beam B4 position 0.000 m.
Maximum moment $M_{z,Ed}$ is derived from beam B4 position 0.000 m.

Interaction method 1 parameters			
Critical Euler load	$N_{cr,y}$	61.21	kN
Critical Euler load	$N_{cr,z}$	35989.39	kN
Elastic critical load	$N_{cr,T}$	244452.70	kN
Plastic section modulus	$W_{pl,y}$	2.1000e-04	m^3
Elastic section modulus	$W_{el,y}$	1.8000e-04	m^3
Plastic section modulus	$W_{pl,z}$	2.1000e-04	m^3
Elastic section modulus	$W_{el,z}$	1.8000e-04	m^3
Second moment of area	I_y	1.4370e-05	m^4
Second moment of area	I_z	1.4370e-05	m^4
Torsional constant	I_t	2.2330e-05	m^4
Method for equivalent moment factor $C_{my,0}$		Table A.2 Line 2 (General)	
Design bending moment (maximum)	$M_{y,Ed}$	-20.41	kNm
Maximum relative deflection	δ_z	-58.9	mm
Equivalent moment factor	$C_{my,0}$	1.09	
Method for equivalent moment factor $C_{mz,0}$		Table A.2 Line 1 (Linear)	
Ratio of end moments	ψ_z	-0.05	
Equivalent moment factor	$C_{mz,0}$	0.78	

Interaction method 1 parameters			
Factor	μ_y	1.00	
Factor	μ_z	1.00	
Factor	ε_y	673.93	
Factor	a_{LT}	0.00	
Critical moment for uniform bending	$M_{cr,0}$	7811.44	kNm
Relative slenderness	$\lambda_{rel,0}$	0.08	
Limit relative slenderness	$\lambda_{rel,0,lim}$	0.23	
Equivalent moment factor	C_{my}	1.09	
Equivalent moment factor	C_{mz}	0.78	
Equivalent moment factor	C_{mLT}	1.00	
Factor	b_{LT}	0.00	
Factor	c_{LT}	0.00	
Factor	d_{LT}	0.00	
Factor	e_{LT}	0.00	
Factor	w_y	1.17	
Factor	w_z	1.17	
Factor	n_{pl}	0.00	
Maximum relative slenderness	$\lambda_{rel,max}$	3.75	
Factor	C_{yy}	1.00	
Factor	C_{yz}	0.99	
Factor	C_{zy}	0.99	
Factor	C_{zz}	1.00	

Unity check (6.61) = 0.00 + 0.46 + 0.00 = 0.46 -
Unity check (6.62) = 0.00 + 0.28 + 0.01 = 0.28 -

The member satisfies the stability check.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

6. Dimenzioniranje poprečnog okvira

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = Rubni sekundarac - RHSCF160/80/4.0

EN 1993-1-1 Code Check
National annex: Standard EN

Member B20	**1.067 / 2.133 m**	**RHSCF160/80/4.0**	**S 235**	**ULS-Set B (auto)**	**0.06 -**

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 1.35*LC2 + 1.50*LC3 + 0.90*LC4

Partial safety factors	
γ_{M0} for resistance of cross-sections	1.00
γ_{M1} for resistance to instability	1.00
γ_{M2} for resistance of net sections	1.25

Material			
Yield strength	f_y	235.0	MPa
Ultimate strength	f_u	360.0	MPa
Fabrication		Cold formed	

...::SECTION CHECK::...

The critical check is on position 1.067 m

Internal forces		Calculated	Unit
Normal force	N_{Ed}	0.76	kN
Shear force	$V_{y,Ed}$	0.00	kN
Shear force	$V_{z,Ed}$	0.00	kN
Torsion	T_{Ed}	0.00	kNm
Bending moment	$M_{y,Ed}$	1.36	kNm
Bending moment	$M_{z,Ed}$	-0.05	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m^2]	σ_2 [kN/m^2]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	68	4	-1.693e+04	-1.846e+04								
3	I	148	4	-1.767e+04	1.513e+04	-1.17		0.46	37.00	78.04	89.96	145.23	1
5	I	68	4	1.611e+04	1.764e+04	0.91		1.00	17.00	28.00	34.00	39.18	1
7	I	148	4	1.684e+04	-1.596e+04	-0.95		0.51	37.00	69.07	79.90	117.20	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Tension check
According to EN 1993-1-1 article 6.2.3 and formula (6.5)

Cross-section area	A	1.8100e-03	m^2
Plastic tension resistance	$N_{pl,Rd}$	425.35	kN
Ultimate tension resistance	$N_{u,Rd}$	469.15	kN
Tension resistance	$N_{t,Rd}$	425.35	kN
Unity check		0.00	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,y}$	9.4729e-05	m^3
Plastic bending moment	$M_{pl,y,Rd}$	22.26	kNm
Unity check		0.06	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,z}$	5.8295e-05	m^3
Plastic bending moment	$M_{pl,z,Rd}$	13.70	kNm
Unity check		0.00	-

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

Design plastic moment resistance reduced due to N_{Ed}	$M_{N,y,Rd}$	22.26	kNm
Exponent of bending ratio y	α	1.66	
Design plastic moment resistance reduced due to N_{Ed}	$M_{N,z,Rd}$	13.70	kNm
Exponent of bending ratio z	β	1.66	

Unity check (6.41) = 0.01 + 0.00 = 0.01 -

The member satisfies the section check.
...::STABILITY CHECK::...
Classification for member buckling design
Decisive position for stability classification: 1.067 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	68	4	-1.693e+04	-1.846e+04								
3	I	148	4	-1.767e+04	1.513e+04	-1.17		0.46	37.00	78.04	89.96	145.23	1
5	I	68	4	1.611e+04	1.764e+04	0.91		1.00	17.00	28.00	34.00	39.18	1
7	I	148	4	1.684e+04	-1.596e+04	-0.95		0.51	37.00	69.07	79.90	117.20	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

The member satisfies the stability check.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

7. Dimenzioniranje sekundaraca

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = Sekundarci - RHS80/40/3.0

EN 1993-1-1 Code Check
National annex: Standard EN

Member B14	**1.149 / 2.133 m**	**RHS80/40/3.0**	**S 235**	**ULS-Set B (auto)**	**0.35 -**

Combination key
ULS-Set B (auto) / 1.35*LC1 + 1.35*LC2 + 1.50*LC3 + 0.90*LC4

Partial safety factors	
γ_{M0} for resistance of cross-sections	1.00
γ_{M1} for resistance to instability	1.00
γ_{M2} for resistance of net sections	1.25

Material			
Yield strength	f_y	235.0	MPa
Ultimate strength	f_u	360.0	MPa
Fabrication		Rolled	

...::SECTION CHECK::...

The critical check is on position 1.149 m

Internal forces		Calculated	Unit
Normal force	N_{Ed}	-0.16	kN
Shear force	$V_{y,Ed}$	-0.05	kN
Shear force	$V_{z,Ed}$	-0.12	kN
Torsion	T_{Ed}	0.02	kNm
Bending moment	$M_{y,Ed}$	1.31	kNm
Bending moment	$M_{z,Ed}$	0.01	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	31	3	-9.508e+04	-9.257e+04								
3	I	71	3	-8.499e+04	8.846e+04	-0.96		0.51	23.67	69.81	80.68	118.90	1
5	I	31	3	9.555e+04	9.303e+04	0.97		1.00	10.33	28.00	34.00	38.35	1
7	I	71	3	8.546e+04	-8.800e+04	-1.03		0.49	23.67	73.07	84.23	127.69	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

Cross-section area	A	6.7400e-04	m^2
Compression resistance	$N_{c,Rd}$	158.39	kN
Unity check		0.00	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,y}$	1.6836e-05	m^3
Plastic bending moment	$M_{pl,y,Rd}$	3.96	kNm
Unity check		0.33	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,z}$	1.0311e-05	m^3
Plastic bending moment	$M_{pl,z,Rd}$	2.42	kNm
Unity check		0.01	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Shear correction factor	η	1.20	
Shear area	A_v	2.2467e-04	m^2
Plastic shear resistance for V_y	$V_{pl,y,Rd}$	30.48	kN
Unity check		0.00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Shear correction factor	η	1.20	
Shear area	A_v	4.4933e-04	m^2
Plastic shear resistance for V_z	$V_{pl,z,Rd}$	60.96	kN
Unity check		0.00	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Index of fibre	Fibre	1	
Total torsional moment	τ_{Ed}	1.2	MPa
Elastic shear resistance	τ_{Rd}	135.7	MPa
Unity check		0.01	-

Note: The unity check for torsion is lower than the limit value of 0.05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

Design plastic moment resistance reduced due to N_{Ed}	$M_{N,y,Rd}$	3.96	kNm
Exponent of bending ratio y	α	1.66	
Design plastic moment resistance reduced due to N_{Ed}	$M_{N,z,Rd}$	2.42	kNm
Exponent of bending ratio z	β	1.66	

Unity check (6.41) = 0.16 + 0.00 = 0.16 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 1.149 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	31	3	-9.508e+04	-9.257e+04								
3	I	71	3	-8.499e+04	8.846e+04	-0.96		0.51	23.67	69.81	80.68	118.90	1
5	I	31	3	9.555e+04	9.303e+04	0.97		1.00	10.33	28.00	34.00	38.35	1
7	I	71	3	8.546e+04	-8.800e+04	-1.03		0.49	23.67	73.07	84.23	127.69	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters		yy	zz	
Sway type		sway	non-sway	
System length	L	2.133	2.133	m
Buckling factor	k	1.00	1.00	
Buckling length	l_{cr}	2.133	2.133	m
Critical Euler load	N_{cr}	246.83	81.98	kN
Slenderness	λ	75.23	130.54	
Relative slenderness	λ_{rel}	0.80	1.39	
Limit slenderness	$\lambda_{rel,0}$	0.20	0.20	

Note: The slenderness or compression force is such that Flexural Buckling effects may be ignored according to EN 1993-1-1 article 6.3.1.2(4).

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters			
Interaction method		alternative method 1	
Cross-section area	A	6.7400e-04	m²
Plastic section modulus	$W_{pl,y}$	1.6836e-05	m³
Plastic section modulus	$W_{pl,z}$	1.0311e-05	m³
Design compression force	N_{Ed}	0.16	kN
Design bending moment	$M_{y,Ed}$	1.31	kNm

Bending and axial compression check parameters			
(maximum)			
Design bending moment (maximum)	$M_{z,Ed}$	-0.08	kNm
Characteristic compression resistance	N_{Rk}	158.39	kN
Characteristic moment resistance	$M_{y,Rk}$	3.96	kNm
Characteristic moment resistance	$M_{z,Rk}$	2.42	kNm
Reduction factor	χ_y	1.00	
Reduction factor	χ_z	1.00	
Reduction factor	χ_{LT}	1.00	
Interaction factor	k_{yy}	1.00	
Interaction factor	k_{yz}	0.58	
Interaction factor	k_{zy}	0.63	
Interaction factor	k_{zz}	1.00	

Maximum moment $M_{y,Ed}$ is derived from beam B14 position 1.149 m.
Maximum moment $M_{z,Ed}$ is derived from beam B14 position 2.133 m.

Interaction method 1 parameters			
Critical Euler load	$N_{cr,y}$	246.83	kN
Critical Euler load	$N_{cr,z}$	81.98	kN
Elastic critical load	$N_{cr,T}$	33090.30	kN
Plastic section modulus	$W_{pl,y}$	1.6836e-05	m^3
Elastic section modulus	$W_{el,y}$	1.3600e-05	m^3
Plastic section modulus	$W_{pl,z}$	1.0311e-05	m^3
Elastic section modulus	$W_{el,z}$	9.0000e-06	m^3
Second moment of area	I_y	5.4200e-07	m^4
Second moment of area	I_z	1.8000e-07	m^4
Torsional constant	I_t	4.3800e-07	m^4
Method for equivalent moment factor $C_{my,0}$		Table A.2 Line 4 (Line load)	
Equivalent moment factor	$C_{my,0}$	1.00	
Method for equivalent moment factor $C_{mz,0}$		Table A.2 Line 2 (General)	
Design bending moment (maximum)	$M_{z,Ed}$	-0.08	kNm
Maximum relative deflection	δ_y	-0.2	mm
Equivalent moment factor	$C_{mz,0}$	1.00	
Factor	μ_y	1.00	
Factor	μ_z	1.00	
Factor	ε_y	415.50	
Factor	a_{LT}	0.19	
Critical moment for uniform bending	$M_{cr,0}$	53.90	kNm
Relative slenderness	$\lambda_{rel,0}$	0.27	
Limit relative slenderness	$\lambda_{rel,0,lim}$	0.21	
Equivalent moment factor	C_{my}	1.00	
Equivalent moment factor	C_{mz}	1.00	
Equivalent moment factor	C_{mLT}	1.00	
Factor	b_{LT}	0.00	
Factor	c_{LT}	0.01	
Factor	d_{LT}	0.00	
Factor	e_{LT}	0.01	
Factor	w_y	1.24	
Factor	w_z	1.15	
Factor	n_{pl}	0.00	
Maximum relative slenderness	$\lambda_{rel,max}$	1.39	
Factor	C_{yy}	1.00	
Factor	C_{yz}	1.00	
Factor	C_{zy}	1.00	
Factor	C_{zz}	1.00	

Unity check (6.61) = 0.00 + 0.33 + 0.02 = 0.35 -
Unity check (6.62) = 0.00 + 0.21 + 0.03 = 0.24 -

The member satisfies the stability check.

8. Reactions

Linear calculation
Combination: ULS-Set B (auto)
System: Global
Extreme: Global
Selection: All
Nodal reactions

Name	Case	R_x [kN]	R_y [kN]	R_z [kN]	M_x [kNm]	M_y [kNm]	M_z [kNm]	e_x [mm]	e_y [mm]
Sn2/N4	ULS-Set B (auto)/1	-0.13	**-0.11**	13.80	-16.20	-0.09	-0.03	-1174.1	-6.7
Sn2/N4	ULS-Set B (auto)/2	0.01	**2.46**	2.61	-5.57	0.01	-0.01	-2135.9	2.9
Sn2/N4	ULS-Set B (auto)/3	0.00	0.15	**-1.91**	3.09	0.00	0.00	-1620.4	1.2
Sn2/N4	ULS-Set B (auto)/4	-0.13	1.28	**16.51**	**-21.40**	-0.09	-0.04	-1296.2	-5.3
Sn1/N1	ULS-Set B (auto)/3	-0.15	-0.03	-1.31	**3.14**	-0.11	-0.01	-2389.5	81.1
Sn3/N7	ULS-Set B (auto)/4	**-0.73**	1.87	11.26	-20.99	**-0.52**	**-0.06**	-1863.6	-46.1
Sn1/N1	ULS-Set B (auto)/4	**0.73**	1.87	11.26	-20.99	**0.52**	**0.06**	-1863.6	46.1

Name	Combination key
ULS-Set B (auto)/1	1.35*LC1 + 1.35*LC2 + 1.50*LC3
ULS-Set B (auto)/2	LC1 + LC2 + 1.50*LC4 + 1.50*LC5
ULS-Set B (auto)/3	LC1 + LC2 + 1.50*LC5
ULS-Set B (auto)/4	1.35*LC1 + 1.35*LC2 + 1.50*LC3 + 0.90*LC4

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

SPOJEVI

SPOJ TEMELJNE STOPE

Material

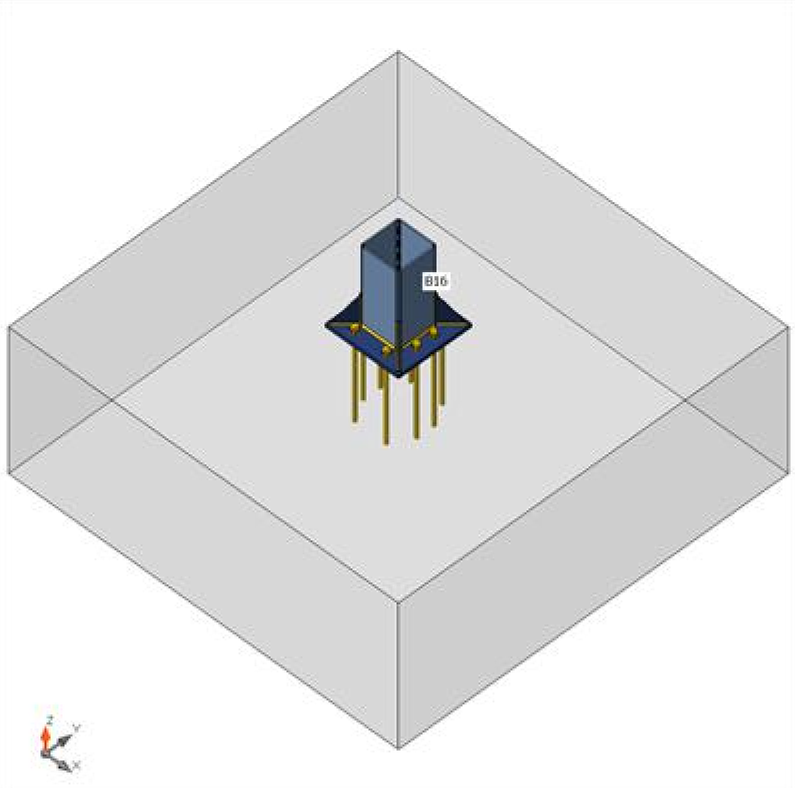
Steel	S 235
Concrete	C25/30

Design

Name	Con N18
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B16	1 - SHS160/160/6.0(RHS160 x160)	0.0	0.0	0.0	0	0	0	Position



Cross-sections

Name	Material

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

1 - SHS160/160/6.0(RHS160x160)	S 235

Anchors

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
M16 5.6	M16 5.6	16	500.0	201

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
ULS-Set(1)	B16	1.9	0.0	0.1	0.0	3.1	0.0
ULS-Set(2)	B16	-16.5	0.1	1.3	0.0	-21.4	0.1
ULS-Set(3)	B16	-2.6	0.0	2.5	0.0	-5.6	0.0
ULS-Set(4)	B16	-13.8	0.1	-0.1	0.0	-16.2	0.1
ULS-Set(5)	B16	-13.9	0.1	2.2	0.0	-19.4	0.0
ULS-Set(6)	B16	-8.3	0.0	2.4	0.0	-12.4	0.0
ULS-Set(7)	B16	-3.7	0.0	0.0	0.0	-3.9	0.0
ULS-Set(8)	B16	-3.8	0.1	0.1	0.0	-3.7	0.0
ULS-Set(9)	B16	-8.2	0.0	2.3	0.0	-12.6	0.0
ULS-Set(10)	B16	-10.4	0.1	0.0	0.0	-12.0	0.1

Foundation block

Item	Value	Unit
CB 1		
Dimensions	1600 x 1600	mm
Depth	600	mm
Anchor	M16 5.6	
Anchoring length	350	mm
Shear force transfer	Anchors	

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Anchors	88.2 < 100%	OK
Welds	40.9 < 100%	OK
Concrete block	21.1 < 100%	OK
Buckling	Not calculated	

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Plates

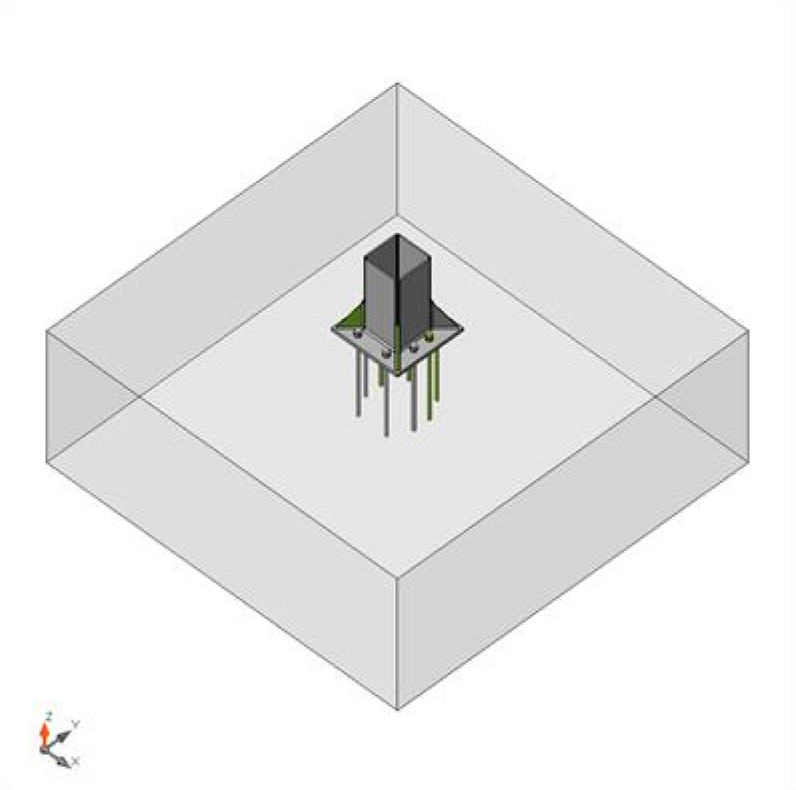
Name	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
B16	6.0	ULS-Set(2)	165.0	0.0	0.0	OK
BP1	15.0	ULS-Set(2)	133.9	0.0	0.0	OK
RIB1	6.0	ULS-Set(2)	139.9	0.0	0.0	OK
RIB2	6.0	ULS-Set(2)	182.9	0.0	0.0	OK
RIB3	6.0	ULS-Set(2)	181.2	0.0	0.0	OK
RIB4	6.0	ULS-Set(2)	140.5	0.0	0.0	OK

Design data

Material	f_y [MPa]	ε_{lim} [%]
S 235	235.0	5.0

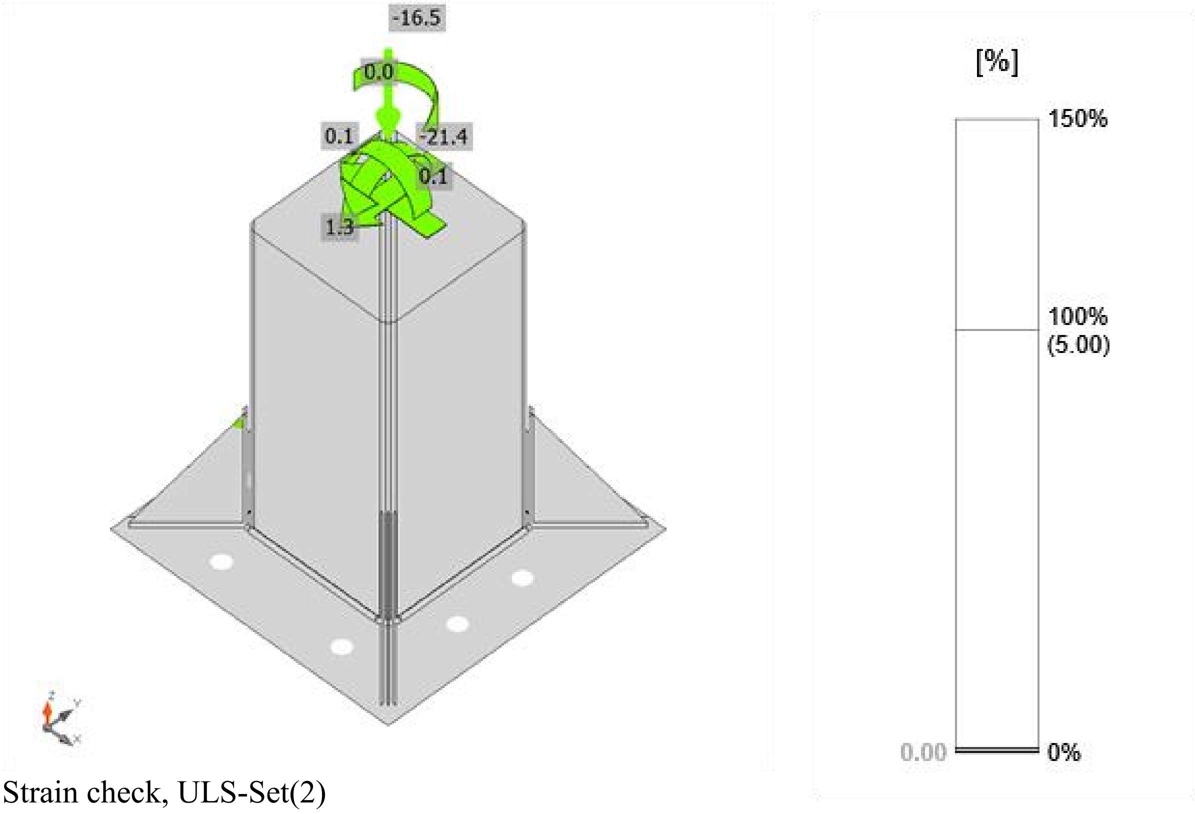
Symbol explanation

ε_{Pl}	Strain
σ_{Ed}	Eq. stress
σc_{Ed}	Contact stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

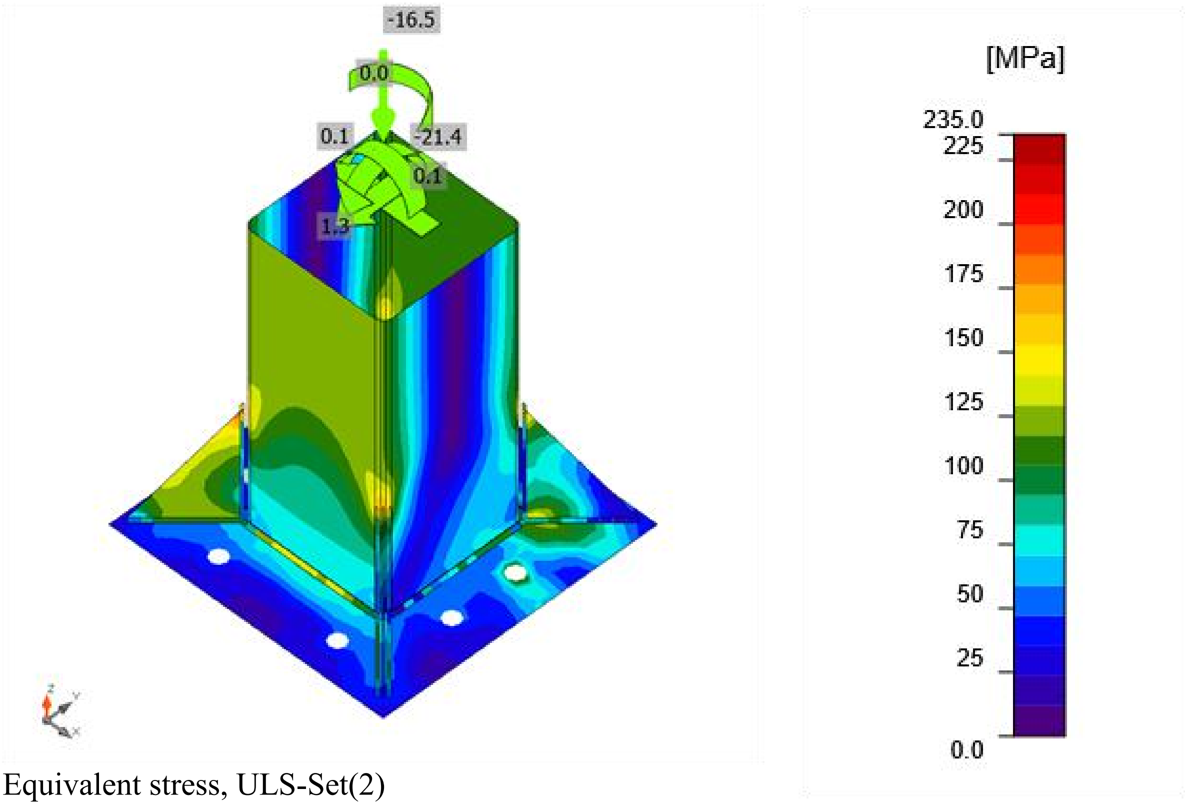


Overall check, ULS-Set(2)

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

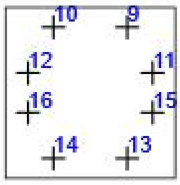


Strain check, ULS-Set(2)



Equivalent stress, ULS-Set(2)

Anchors

Shape	Item	Loads	N_{Ed} [kN]	V_{Ed} [kN]	$N_{Rd,c}$ [kN]	$V_{Rd,c}$ [kN]	$V_{Rd,cp}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	A9	ULS-Set(1)	5.4	0.0	290.5	86.7	490.5	16.3	0.1	2.6	OK
	A10	ULS-Set(1)	5.4	0.0	290.5	86.7	490.5	16.2	0.1	2.6	OK
	A11	ULS-Set(1)	3.4	0.0	290.5	-	490.5	10.3	0.1	1.5	OK
	A12	ULS-Set(1)	3.5	0.0	290.5	-	490.5	10.4	0.1	1.5	OK
	A13	ULS-Set(2)	29.4	0.2	298.0	-	490.5	88.2	0.7	77.8	OK
	A14	ULS-Set(2)	29.4	0.2	298.0	-	490.5	88.2	0.8	77.9	OK
	A15	ULS-Set(2)	25.7	0.1	298.0	143.7	490.5	76.9	0.9	59.2	OK
	A16	ULS-Set(2)	26.0	0.1	298.0	-	490.5	77.9	0.6	60.6	OK

Design data

Grade	$N_{Rd,s}$ [kN]	$V_{Rd,s}$ [kN]
M16 5.6 - 1	33.4	23.6

Symbol explanation

N_{Ed}	Tension force
V_{Ed}	Resultant of shear forces Vy, Vz in bolt
$N_{Rd,c}$	Design resistance in case of concrete cone failure under tension load - EN1992-4 - Cl. 7.2.1.4
$V_{Rd,c}$	Design resistance in case of concrete cone failure under shear load - EN1992-4 - Cl. 7.2.2.5
$V_{Rd,cp}$	Design resistance in case of concrete pryout failure - EN1992-4 - Cl. 7.2.2.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$N_{Rd,s}$	Design tensile resistance of a fastener in case of steel failure - EN1992-4 - Cl. 7.2.1.3
$V_{Rd,s}$	Design shear resistance in case of steel failure - EN1992-4 - Cl.7.2.2.3.1

Detailed result for A14

Anchor tensile resistance (EN1992-4 - Cl. 7.2.1.3)

$$N_{Rd,s} = \frac{N_{Rk,s}}{\gamma_{Ms}} = 33.4 \text{ kN} \geq N_{Ed} = 29.4 \text{ kN}$$

$N_{Rk,s} = c \cdot A_s \cdot f_{uk} =$ 66.7 kN

Where:

$c = 0.85$ – reduction factor for cut thread

$A_s = 157\ \text{mm}^2$ – tensile stress area

$f_{uk} = 500.0\ \text{MPa}$ – minimum tensile strength of the bolt

$\gamma_{Ms} = 2.00$ – safety factor for steel

$\gamma_{Ms} = 1.2 \cdot \frac{f_{uk}}{f_{yk}} \geq 1.4$

, where:

$f_{yk} =$

300.0 MPa – minimum yield strength of the bolt

Concrete breakout resistance of anchor in tension (EN1992-4 - Cl. 7.2.1.4)

The check is performed for group of anchors that form common tension breakout cone: A13, A14, A15, A16

$N_{Rd,c} = \frac{N_{Rk,c}}{\gamma_{Mc}} =$ 298.0 kN $\geq$ $N_{Ed,g} =$ 110.5 kN

$N_{Rk,c} = N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec,N} \cdot \psi_{M,N} =$ 536.4 kN

Where:

$N_{Ed,g} = 110.5\ \text{kN}$ – sum of tension forces of anchors with common concrete breakout cone area

$N^0_{Rk,c} = 252.1\ \text{kN}$ – characteristic strength of a fastener, remote from the effects of adjacent fasteners or edges of the concrete member

$N^0_{Rk,c} = k_1 \cdot \sqrt{f_c} \cdot h_{ef}^{1.5}$

, where:

$k_1 =$

7.70 – parameter accounting for anchor type and concrete condition

$f_c =$

25.0 MPa – concrete compressive strength

$h_{ef} = \min(h_{emb}, \max(\frac{c_{a,max}}{1.5}, \frac{s_{max}}{3})) =$

350 mm – depth of embedment, where:

$h_{emb} =$

350 mm – anchor length embedded in concrete

$c_{a,max} =$

690 mm – maximum distance from the anchor to one of the three closest edges

$s_{max} =$

80 mm – maximum spacing between anchors

$A_{c,N} = 1426719\ \text{mm}^2$ – concrete breakout cone area for group of anchors

$A^0_{c,N} = 1102500\ \text{mm}^2$ – concrete breakout cone area for single anchor not influenced by edges

$A^0_{c,N} = (3 \cdot h_{ef})^2$

, where:

h_{ef} =

350 mm – depth of embedment

$\psi_{s,N} = 1.00$ – parameter related to the distribution of stresses in the concrete due to the proximity of the fastener to an edge of the concrete member:

$\psi_{s,N} = 0.7 + 0.3 \cdot \frac{c}{1.5 \cdot h_{ef}} \leq 1$

, where:

c =

685 mm – minimum distance from the anchor to the edge

h_{ef} =

350 mm – depth of embedment

$\psi_{re,N} = 1.00$ – parameter accounting for the shell spalling:

$\psi_{re,N} = 0.5 + \frac{h_{emb}}{200} \leq 1$

, where:

h_{emb} =

350 mm – anchor length embedded in concrete

$\psi_{ec,N} = 0.99$ – modification factor for anchor groups loaded eccentrically in tension:

$\psi_{ec,N} = \psi_{ecx,N} \cdot \psi_{ecy,N}$

, where:

$\psi_{ecx,N} = \frac{1}{1+\frac{2 \cdot e_{x,N}}{3 \cdot h_{ef}}}$ =

1.00 – modification factor that depends on eccentricity in x-direction

$e_{x,N}$ =

0 mm – tension load eccentricity in x-direction

$\psi_{ecy,N} = \frac{1}{1+\frac{2 \cdot e_{y,N}}{3 \cdot h_{ef}}}$ =

1.00 – modification factor that depends on eccentricity in y-direction

$e_{y,N}$ =

3 mm – tension load eccentricity in y-direction

h_{ef} =

350 mm – depth of embedment

$\psi_{M,N} = 1.65$ – parameter accounting for the effect of a compression force between the fixture and concrete; this parameter is equal to 1 if c < $1.5h_{ef}$ or the ratio of the compressive force (including the compression due to bending) to the sum of tensile forces in anchors is smaller than 0.8

$\psi_{M,N} = 2 - \frac{2 \cdot z}{3 \cdot h_{ef}} \geq 1$

, where:

z =

182 mm – internal lever arm

h_{ef} =

350 mm – depth of embedment

γ_{Mc} = 1.80 – safety factor for concrete

Shear resistance (EN1992-4 - Cl.7.2.2.3.1)

$V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{Ms}} =$ 23.6 kN $\geq$ $V_{Ed} =$ 0.2 kN

$V_{Rk,s} = k_7 \cdot V^0_{Rk,s} =$ 39.3 kN

Where:

$k_7 = 1.00$ – coefficient for anchor steel ductility

$k_7 = \begin{cases} 0.8, & A < 0.08 \\ 1.0, & A \geq 0.08 \end{cases}$

, where:

$A =$

0.20 – bolt grade elongation at rupture

$V^0_{Rk,s}$ = 39.3 kN – the characteristic shear strength

$V^0_{Rk,s} = k_6 \cdot A_s \cdot f_{uk}$

, where:

$k_6 =$

0.50 – coefficient for anchor resistance in shear

$A_s =$

157 mm^2 – tensile stress area

$f_{uk} =$

500.0 MPa – specified ultimate strength of anchor steel

γ_{Ms} = 1.67 – safety factor for steel

Concrete pryout resistance (EN1992-4 - Cl. 7.2.2.4)

The check is performed for group of anchors on common base plate

$V_{Rd,cp} = \frac{V_{Rk,cp}}{\gamma_{Mc}} =$ 490.5 kN $\geq$ $V_{Ed,g} =$ 1.3 kN

$V_{Rk,cp} = k_8 \cdot N_{Rk,c} =$ 735.8 kN

Where:

$k_8 = 2.00$ – factor taking into account fastener embedment depth

$N_{Rk,c}$ = 367.9 kN – characteristic concrete cone strength for a single fastener or fastener in a group

γ_{Mc} = 1.50 – safety factor for concrete

Interaction of tensile and shear forces in steel (EN 1992-4 - Table 7.3)

$\left(\frac{N_{Ed}}{N_{Rd,s}}\right)^2 + \left(\frac{V_{Ed}}{V_{Rd,s}}\right)^2 =$ 0.78 $\leq$ 1.0

Where:

N_{Ed} = 29.4 kN – design tension force

$N_{Rd,s}$ = 33.4 kN – fastener tensile strength

V_{Ed} = 0.2 kN – design shear force

$V_{Rd,s}$ = 23.6 kN – fastener shear strength

Interaction of tensile and shear forces in concrete (EN 1992-4 - Table 7.3)

$$(\frac{N_{Ed}}{N_{Rd,i}})^{1.5} + (\frac{V_{Ed}}{V_{Rd,i}})^{1.5} = \quad 0.23 \quad \leq \quad 1.0$$

Where:

$\frac{N_{Ed}}{N_{Rd,i}}$ – the largest utilization value for tension failure modes

$\frac{V_{Ed}}{V_{Rd,i}}$ – the largest utilization value for shear failure modes

$\frac{N_{Ed}}{N_{Rd,c}}$ = 37% – concrete breakout failure of anchor in tension

$\frac{N_{Ed}}{N_{Rd,p}}$ = 0% – concrete pullout failure

$\frac{N_{Ed}}{N_{Rd,cb}}$ = 0% – concrete blowout failure

$\frac{V_{Ed}}{V_{Rd,c}}$ = 0% – concrete edge failure

$\frac{V_{Ed}}{V_{Rd,cb}}$ = 0% – concrete pryout failure

Welds (Plastic redistribution)

Item	**Edge**	**Throat th. [mm]**	**Length [mm]**	**Loads**	**$\sigma_{w,Ed}$ [MPa]**	**ε_{Pl} [%]**	**$\sigma_\perp$ [MPa]**	**$\tau_{\|\|}$ [MPa]**	**$\tau_\perp$ [MPa]**	**Ut [%]**	**Ut_c [%]**	**Status**
BP1	B16	◢5.0	600	ULS-Set(2)	134.0	0.0	-66.2	-11.3	66.3	37.2	24.3	OK
BP1	RIB 1	◢4.0◣	90	ULS-Set(5)	147.1	0.0	48.3	-68.0	42.6	40.9	20.7	OK
		◢4.0◣	90	ULS-Set(2)	104.0	0.0	44.2	-13.3	-52.7	28.9	15.7	OK
B16-arc 2	RIB 1	◢4.0◣	120	ULS-Set(2)	118.4	0.0	21.8	63.4	22.1	32.9	14.3	OK
		◢4.0◣	120	ULS-Set(2)	118.1	0.0	22.1	-63.3	-21.9	32.8	13.6	OK
BP1	RIB 2	◢4.0◣	90	ULS-Set(2)	101.3	0.0	-38.9	34.7	-41.3	28.1	22.2	OK

		◢4.0 ◣	90	ULS-Set(2)	113.5	0.0	-45.2	-43.9	41.1	31.5	28.4	OK
B16-arc5	RIB 2	◢4.0 ◣	120	ULS-Set(2)	147.2	0.0	-27.8	-78.8	-27.6	40.9	20.4	OK
		◢4.0 ◣	120	ULS-Set(2)	147.3	0.0	-27.5	78.8	27.8	40.9	20.7	OK
BP1	RIB 3	◢4.0 ◣	90	ULS-Set(2)	114.5	0.0	-39.2	50.7	-36.0	31.8	28.2	OK
		◢4.0 ◣	90	ULS-Set(2)	99.8	0.0	-38.7	-34.1	40.7	27.7	21.7	OK
B16-arc8	RIB 3	◢4.0 ◣	120	ULS-Set(2)	145.8	0.0	-27.6	-77.8	-27.9	40.5	20.4	OK
		◢4.0 ◣	120	ULS-Set(2)	145.7	0.0	-27.9	77.8	27.6	40.5	20.2	OK
BP1	RIB 4	◢4.0 ◣	90	ULS-Set(2)	102.1	0.0	43.8	14.9	51.1	28.4	16.2	OK
		◢4.0 ◣	90	ULS-Set(5)	138.7	0.0	50.9	58.7	-45.9	38.5	20.8	OK
B16-arc11	RIB 4	◢4.0 ◣	120	ULS-Set(2)	118.7	0.0	21.7	63.9	21.4	33.0	13.6	OK
		◢4.0 ◣	120	ULS-Set(2)	118.9	0.0	21.3	-64.0	-21.6	33.0	14.6	OK

Design data

	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 235	0.80	360.0	259.2

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Symbol explanation

ε_{Pl}	Strain
$\sigma_{w,Ed}$	Equivalent stress
$\sigma_{w,Rd}$	Equivalent stress resistance
$\sigma_{\perp}$	Perpendicular stress
$\tau_{\parallel}$	Shear stress parallel to weld axis
$\tau_{\perp}$	Shear stress perpendicular to weld axis
0.9 σ	Perpendicular stress resistance - 0.9*fu/γM2
β_w	Corelation factor EN 1993-1-8 tab. 4.1
Ut	Utilization
Utc	Weld capacity utilization

Detailed result for B16-arc 5 RIB2

Weld resistance check (EN 1993-1-8 4.5.3.2)

$\sigma_{w,Rd} = f_u/(\beta_w \gamma_{M2}) =$ 360.0 MPa $\geq$ $\sigma_{w,Ed} = [\sigma_\perp^2 + 3(\tau_\perp^2 + \tau_\parallel^2)]^{0.5} =$ 147.3 MPa

$\sigma_{\perp,Rd} = 0.9 f_u/\gamma_{M2} =$ 259.2 MPa $\geq$ $|\sigma_\perp| =$ 27.5 MPa

where:

$f_u =$ 360.0 MPa – Ultimate strength

$\beta_w =$ 0.80 – appropriate correlation factor taken from Table 4.1

$\gamma_{M2} =$ 1.25 – Safety factor

Stress utilization

$U_t = \max(\frac{\sigma_{w,Ed}}{\sigma_{w,Rd}}; \frac{|\sigma_\perp|}{\sigma_{\perp,Rd}}) =$ 40.9 %

Concrete block

Item	Loads	c [mm]	A_{eff} [mm^2]	σ [MPa]	k_j [-]	F_{jd} [MPa]	Ut [%]	Status
CB 1	ULS-Set(2)	23	18138	7.1	3.00	33.5	21.1	OK

Symbol explanation

c	Bearing width
A_{eff}	Effective area
σ	Average stress in concrete
k_j	Concentration factor
F_{jd}	The ultimate bearing strength of the concrete block
Ut	Utilization

Detailed result for CB 1

Concrete block compressive resistance check (EN 1993-1-8 6.2.5)

$\sigma = \frac{N}{A_{eff}} =$ 7.1 MPa

$F_{jd} = \alpha_{cc} \beta_j k_j f_{ck} / \gamma_c =$ 33.5 MPa

where:

$N =$ 128.2 kN – Design normal force

$A_{eff} =$ 18138 mm^2 – Effective area, on which the column force N is distributed

$\alpha_{cc} =$ 1.00 – Long-term effects on Fcd

$\beta_j =$ 0.67 – Joint coefficient βj

$k_j =$ 3.00 – Concentration factor

$f_{ck} =$ 25.0 MPa – Characteristic compressive concrete strength

$\gamma_c =$ 1.50 – Safety factor

Stress utilization

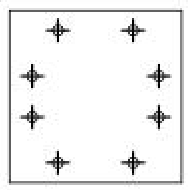
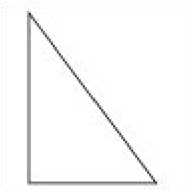
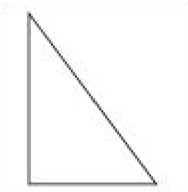
$U_t = \frac{\sigma}{F_{jd}} =$ 21.1 %

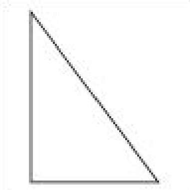
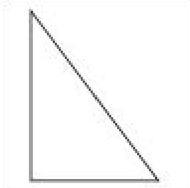
Buckling

Buckling analysis was not calculated.

Bill of material

Manufacturing operations

Name	**Plates [mm]**	**Shape**	**Nr.**	**Welds [mm]**	**Length [mm]**	**Bolts**	**Nr.**
BP1	P15.0x300.0-300.0 (S 235)		1	Fillet: a = 5.0	599.9	M16 5.6	8
RIB1	P6.0x90.0-120.0 (S 235)		1	Double fillet: a = 4.0	210.0		
RIB2	P6.0x90.0-120.0 (S 235)		1	Double fillet: a = 4.0	210.0		

RIB3	P6.0x90.0-120.0 (S 235)		1	Double fillet: a = 4.0	210.0		
RIB4	P6.0x90.0-120.0 (S 235)		1	Double fillet: a = 4.0	210.0		

Welds

Type	Material	Throat thickness [mm]	Leg size [mm]	Length [mm]
Fillet	S 235	5.0	7.1	599.9
Double fillet	S 235	4.0	5.7	840.0

Anchors

Name	Length [mm]	Drill length [mm]	Count
M16 5.6	365	350	8

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

SPOJ U VRHU

Material

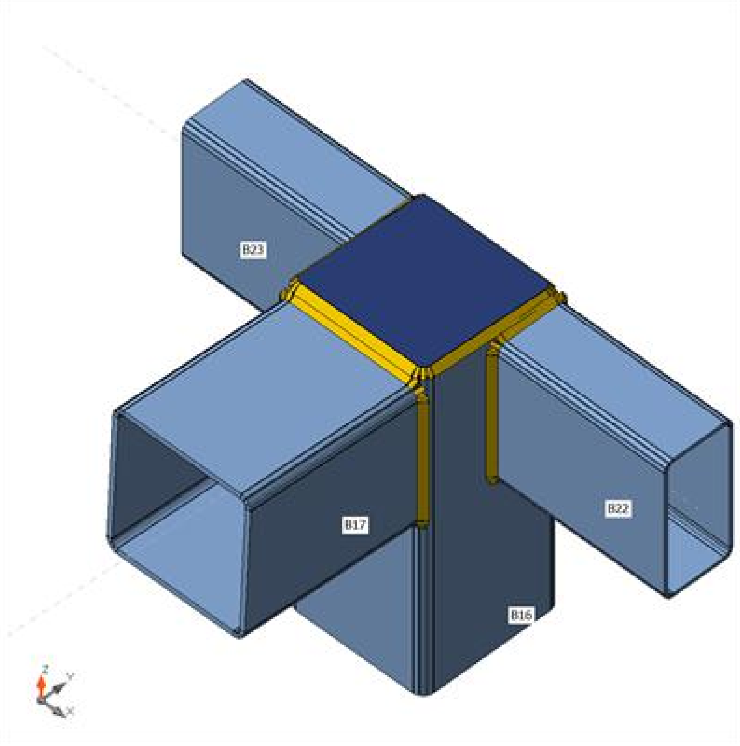
Steel	S 235

Design

Name	Con N19
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B16	1 - SHS160/160/6.0(RHS160x160)	0.0	0.0	0.0	0	0	0	Position
B17	1 - SHS160/160/6.0(RHS160x160)	0.0	0.0	0.0	0	0	0	Position
B22	2 - RHSCF160/80/4.0	0.0	0.0	0.0	0	-40	0	Position
B23	2 - RHSCF160/80/4.0	0.0	0.0	0.0	0	-40	0	Position



Cross-sections

Name	Material
1 - SHS160/160/6.0(RHS160x160)	S 235
2 - RHSCF160/80/4.0	S 235

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
ULS-Set(1)	B16	-2.5	0.0	-0.1	0.0	-3.4	0.0
	B17	0.2	0.0	1.8	0.1	-3.4	0.0
	B22	-0.2	0.0	0.3	0.0	0.1	0.0
	B23	0.2	0.0	0.4	0.0	-0.2	0.0
ULS-Set(2)	B16	15.7	-0.1	0.2	0.0	20.2	0.2
	B17	-0.6	0.4	-12.4	-0.6	20.4	0.4
	B22	1.6	0.0	-1.4	0.0	-0.5	0.0
	B23	-1.1	-0.3	-1.8	0.2	0.8	-0.4
ULS-Set(3)	B16	2.0	0.0	0.1	0.0	2.9	0.0
	B17	-0.1	0.1	-1.7	0.0	2.9	0.1
	B22	0.2	0.0	-0.1	0.0	0.0	0.0
	B23	-0.1	-0.1	-0.2	0.0	0.1	-0.1
ULS-Set(4)	B16	12.9	-0.1	0.1	0.0	16.4	0.2
	B17	-0.4	0.3	-10.3	-0.5	16.6	0.3
	B22	1.4	0.0	-1.1	0.0	-0.4	0.0
	B23	-0.9	-0.3	-1.5	0.2	0.7	-0.3
ULS-Set(5)	B16	13.1	-0.1	0.3	0.0	17.2	0.1
	B17	-0.6	0.3	-10.3	-0.4	17.4	0.3
	B22	1.2	0.0	-1.2	0.0	-0.4	0.0
	B23	-0.9	-0.3	-1.6	0.1	0.7	-0.3
ULS-Set(6)	B16	3.1	0.0	0.0	0.0	4.0	0.0
	B17	-0.1	0.1	-2.4	-0.1	4.0	0.1
	B22	0.3	0.0	-0.3	0.0	-0.1	0.0
	B23	-0.2	0.0	-0.3	0.0	0.2	-0.1
ULS-Set(7)	B16	12.3	-0.1	0.1	0.0	15.8	0.2
	B17	-0.4	0.3	-9.8	-0.5	15.9	0.3
	B22	1.3	0.0	-1.1	0.0	-0.3	0.0
	B23	-0.9	-0.3	-1.4	0.2	0.6	-0.3
ULS-Set(8)	B16	8.7	0.0	0.3	0.0	11.7	0.0
	B17	-0.5	0.2	-6.8	-0.2	11.8	0.2
	B22	0.7	0.0	-0.8	0.0	-0.3	0.0
	B23	-0.5	-0.2	-1.0	0.1	0.5	-0.2
ULS-Set(9)	B16	7.6	0.0	0.3	0.0	10.3	0.0
	B17	-0.4	0.2	-5.9	-0.2	10.4	0.1
	B22	0.6	0.0	-0.7	0.0	-0.3	0.0

	B23	-0.5	-0.1	-0.9	0.1	0.4	-0.2
ULS-Set(10)	B16	1.9	-0.1	-0.1	0.0	2.1	0.1
	B17	0.1	0.1	-1.7	-0.1	2.1	0.1
	B22	0.3	0.0	-0.1	0.0	0.0	0.0
	B23	-0.2	-0.1	-0.1	0.0	0.1	-0.1
ULS-Set(11)	B16	9.6	-0.1	0.0	0.0	12.0	0.2
	B17	-0.2	0.3	-7.7	-0.4	12.1	0.2
	B22	1.1	0.0	-0.8	0.0	-0.2	0.0
	B23	-0.7	-0.2	-1.0	0.1	0.5	-0.3
ULS-Set(12)	B16	4.1	0.0	0.1	0.0	5.4	0.1
	B17	-0.2	0.1	-3.3	-0.1	5.4	0.1
	B22	0.4	0.0	-0.4	0.0	-0.1	0.0
	B23	-0.3	-0.1	-0.5	0.0	0.2	-0.1
ULS-Set(13)	B16	6.4	0.0	0.1	0.0	8.4	0.1
	B17	-0.2	0.2	-5.2	-0.2	8.5	0.2
	B22	0.7	0.0	-0.5	0.0	-0.2	0.0
	B23	-0.4	-0.2	-0.7	0.1	0.3	-0.2

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.4 < 5.0%	OK
Welds	98.0 < 100%	OK
Buckling	17.52	
GMNA	Calculated	

Plates

Name	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
B16	6.0	ULS-Set(2)	235.3	0.1	0.0	OK
B17	6.0	ULS-Set(2)	235.9	0.4	0.0	OK
B22	4.0	ULS-Set(2)	123.0	0.0	0.0	OK
B23	4.0	ULS-Set(2)	126.6	0.0	0.0	OK
STIFF1	8.0	ULS-Set(2)	105.7	0.0	0.0	OK

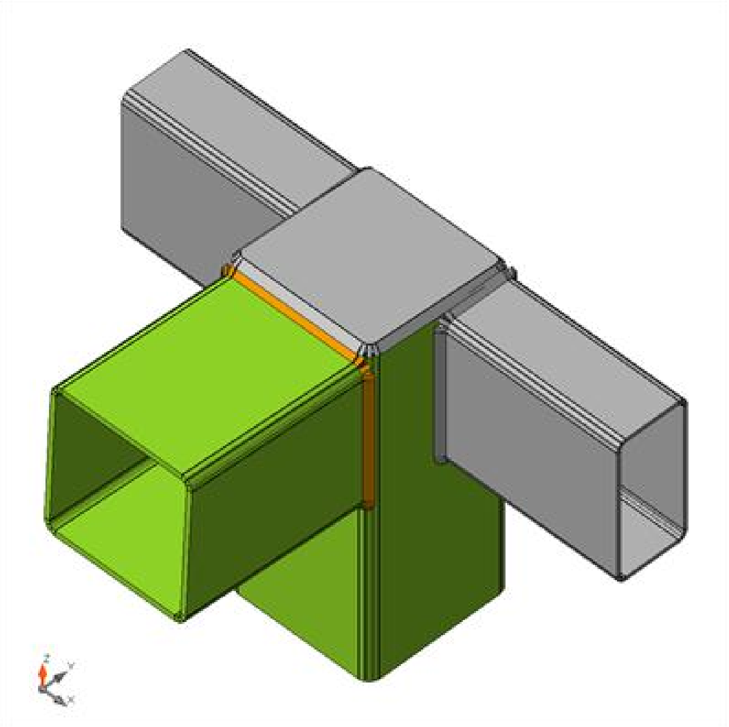
Design data

Material	f_y [MPa]	ε_{lim} [%]
S 235	235.0	5.0

Symbol explanation

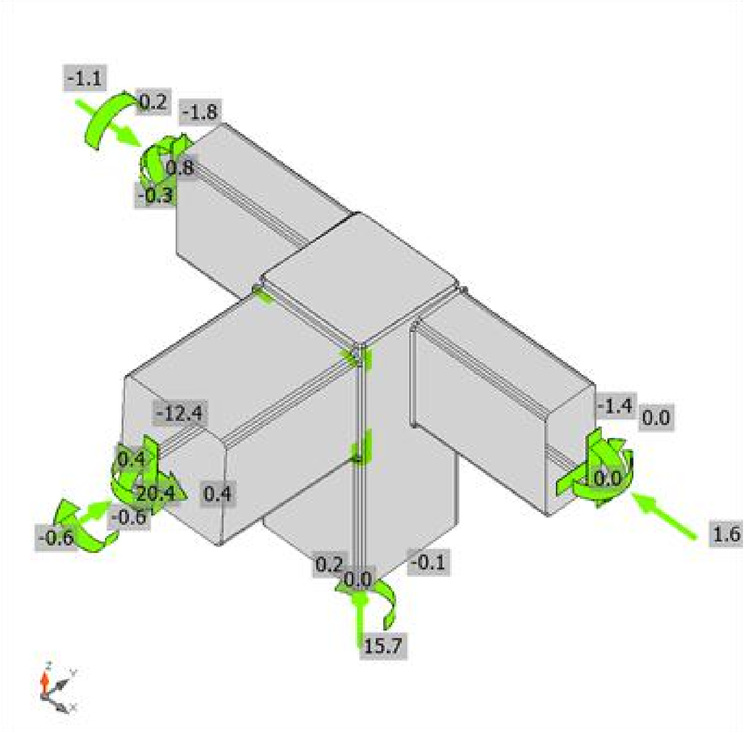
ε_{Pl}	Strain
σ_{Ed}	Eq. stress
σc_{Ed}	Contact stress
f_y	Yield strength

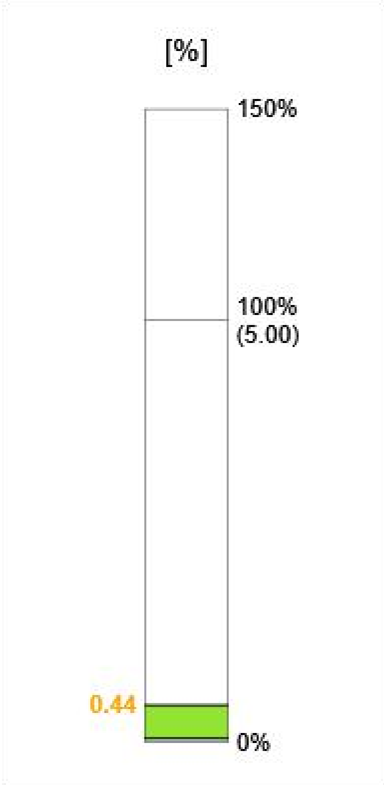
ε_{lim} Limit of plastic strain



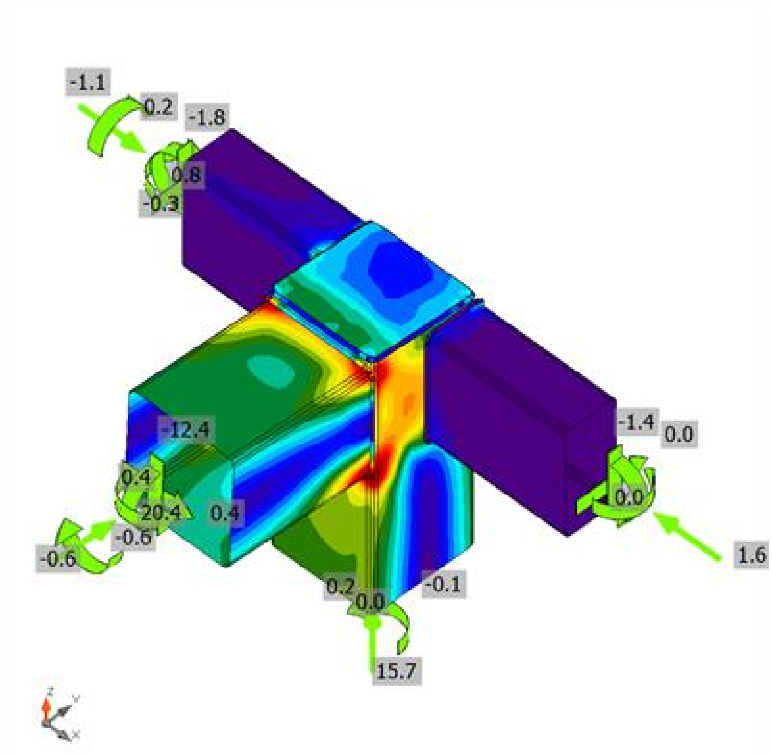
Overall check, ULS-Set(2)

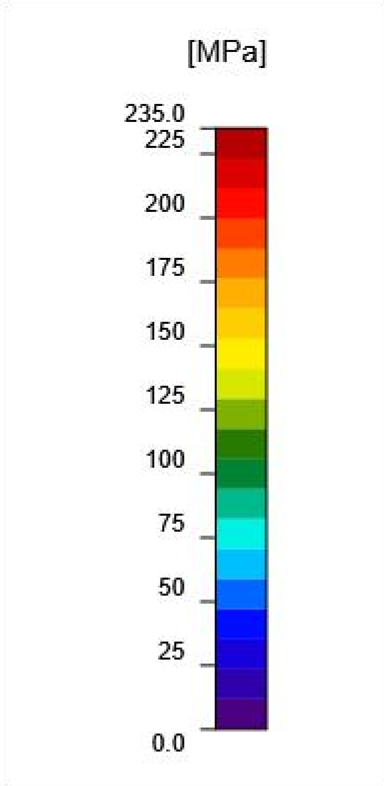
INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.





Strain check, ULS-Set(2)





Equivalent stress, ULS-Set(2)

Welds (Plastic redistribution)

Item	Edge	Throat th. [mm]	Length [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_\perp$ [MPa]	$\tau_\parallel$ [MPa]	$\tau_\perp$ [MPa]	Ut [%]	Ut_c [%]	Status
B16-w 3	B17	◢5.0 ◣	600	ULS - Set(2)	352.9	0.1	-133.7	25.5	-186.8	98.0	22.9	OK
STIFF1	B16	◢5.0 ◣	588	ULS - Set(2)	105.1	0.0	61.8	48.3	-8.7	29.2	10.3	OK
B16-w 4	B22	◢5.0 ◣	450	ULS - Set(2)	89.0	0.0	14.9	28.0	42.2	24.7	2.9	OK
B16-w 2	B23	◢5.0 ◣	450	ULS - Set(2)	77.7	0.0	13.1	-25.1	36.4	21.6	3.5	OK
		◢5.0 ◣	600	ULS - Set(2)	259.9	0.0	-179.6	-3.0	108.4	72.2	23.8	OK
		◢5.0 ◣	588	ULS - Set(2)	70.3	0.0	-8.6	36.4	17.2	19.5	9.0	OK
		◢5.0 ◣	450	ULS - Set(2)	57.1	0.0	7.7	32.6	-2.3	15.9	3.0	OK
		◢5.0 ◣	450	ULS - Set(2)	69.3	0.0	47.3	15.1	-25.0	19.2	3.6	OK

Design data

	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 235	0.80	360.0	259.2

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Symbol explanation

ε_{Pl}	Strain
$\sigma_{w,Ed}$	Equivalent stress
$\sigma_{w,Rd}$	Equivalent stress resistance
$\sigma_{\perp}$	Perpendicular stress
$\tau_{\parallel}$	Shear stress parallel to weld axis
$\tau_{\perp}$	Shear stress perpendicular to weld axis
0.9 σ	Perpendicular stress resistance - 0.9*fu/γM2
β_w	Corelation factor EN 1993-1-8 tab. 4.1
Ut	Utilization
Utc	Weld capacity utilization

Detailed result for B16-w 3 B17

Weld resistance check (EN 1993-1-8 4.5.3.2)

$\sigma_{w,Rd} = f_u/(\beta_w \gamma_{M2}) =$	360.0	MPa	≥	$\sigma_{w,Ed} = [\sigma_{\perp}^2 + 3(\tau_{\perp}^2 + \tau_{\parallel}^2)]^{0.5} =$	352.9	MPa
$\sigma_{\perp,Rd} = 0.9 f_u/\gamma_{M2} =$	259.2	MPa	≥	$\lvert\sigma_{\perp}\rvert =$	133.7	MPa

where:

$f_u =$ 360.0 MPa	– Ultimate strength
$\beta_w =$ 0.80	– appropriate correlation factor taken from Table 4.1
$\gamma_{M2} =$ 1.25	– Safety factor

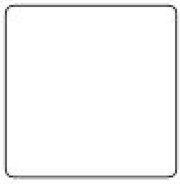
Stress utilization

$U_t = \max(\frac{\sigma_{w,Ed}}{\sigma_{w,Rd}}; \frac{\lvert\sigma_{\perp}\rvert}{\sigma_{\perp,Rd}}) =$ 98.0 %

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Bill of material

Manufacturing operations

Name	Plates [mm]	Shape	Nr.	Welds [mm]	Length [mm]	Bolts	Nr.
CUT1							
CUT2				Double fillet: a = 5.0	600.3		
STIFF1	P8.0x150.0-150.2 (S 235)		1	Double fillet: a = 5.0	587.5		
CUT3				Double fillet: a = 5.0	449.7		
CUT4				Double fillet: a = 5.0	449.7		

Welds

Type	Material	Throat thickness [mm]	Leg size [mm]	Length [mm]
Double fillet	S 235	5.0	7.1	2087.2

TEMELJENJE

Materials and standards

Concrete structures : EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 : standard

Settlement

Analysis method : Analysis using oedometric modulus
Restriction of influence zone : by percentage of Sigma,Or
Coeff. of restriction of influence zone : 10,0 [%]

Spread Footing

Analysis for drained conditions : Standard approach
Analysis of uplift : Standard
Allowable eccentricity : 0,333
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor for vertical bearing capacity :	SF_v =	1,50	[–]
Safety factor for sliding resistance :	SF_h =	1,50	[–]

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
1	Glina (pretpostavka)		19,00	30,00	21,00	11,00	

All soils are considered as cohesionless for at rest pressure analysis.

Soil parameters

Glina (pretpostavka)

Unit weight : γ = 21,00 kN/m³
Angle of internal friction : φ_{ef} = 19,00 °
Cohesion of soil : c_{ef} = 30,00 kPa
Oedometric modulus : E_{oed} = 21,50 MPa
Saturated unit weight : γ_{sat} = 21,00 kN/m³

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Foundation

Foundation type: eccentric spread footing with steps

Depth from original ground surface	h_z	=	0,70	m
Depth of footing bottom	d	=	0,60	m
Thickness of top step	t_v	=	0,60	m
Foundation thickness	t	=	0,60	m
Incl. of finished grade	s_1	=	0,00	°
Incl. of footing bottom	s_2	=	0,00	°

Overburden

Type: from geological profile

Geometry of structure

Foundation type: eccentric spread footing with steps

Spread footing length	x	=	1,30	m
Spread footing width	y	=	1,15	m
Length of top step	a_{vx}	=	0,29	m
Width of top step	a_{vy}	=	1,15	m
Column width in the direction of x	c_x	=	0,15	m
Column width in the direction of y	c_y	=	0,15	m

Dist. of column axis from spr.footing edge in direct. of x = 0,82 m
Dist. of column axis from spr.footing edge in direct. of y = 0,57 m

Spread footing volume	=	1,10	m^3
Volume of excavation	=	0,90	m^3
Volume of fill	=	0,00	m^3

Material of structure

Unit weight γ = 23,00 kN/m^3
Analysis of concrete structures carried out according to the standard EN 1992-1-1 (EC2).

Concrete : C 25/30

Cylinder compressive strength	f_{ck}	=	25,00	MPa
Tensile strength	f_{ctm}	=	2,60	MPa
Elasticity modulus	E_{cm}	=	31000,00	MPa

Longitudinal steel : B500

Yield strength f_{yk} = 500,00 MPa

Transverse steel: B500

Yield strength f_{yk} = 500,00 MPa

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	-	0,00 .. ∞	Glina (pretpostavka)	

Load

No.	Load new	Load change	Name	Type	N [kN]	M_x [kNm]	M_y [kNm]	H_x [kN]	H_y [kN]
1	Yes		1	Design	13,80	0,09	16,20	0,13	-0,11
2	Yes		2	Design	16,51	0,09	21,40	0,13	1,28
3	Yes		3	Design	2,61	0,01	5,57	0,01	2,46
4	Yes		4	Design	-1,91	0,00	3,09	0,00	0,15
5	Yes		1 - service	Service	9,86	0,06	11,57	0,09	-0,08
6	Yes		2 - service	Service	11,79	0,06	15,29	0,09	0,91
7	Yes		3 - service	Service	1,86	0,01	3,98	0,01	1,76
8	Yes		4 - service	Service	-1,36	0,00	2,21	0,00	0,11

Global settings

Type of analysis : analysis for drained conditions

Settings of the stage of construction

Design situation : permanent

Verification No. 1

Load case verification

Name	e_x [m]	e_y [m]	σ [kPa]	R_d [kPa]	Utilization [%]	Is satisfactory
1	-0,33	0,00	52,89	611,21	12,98	Yes
2	-0,42	-0,04	84,80	569,98	22,32	Yes
3	-0,15	-0,11	29,96	545,04	8,25	Yes
4	-0,11	-0,01	19,12	647,21	4,94	Yes

Analysis carried out with automatic selection of the most unfavourable load cases.

Computed weight of spread footing G = 25,23 kN
Computed weight of overburden Z = 0,00 kN

Vertical bearing capacity check - spread footing in compression

Shape of contact stress : rectangle
Most unfavorable load case No. 2. (2)
Parameters of slip surface below foundation:
Depth of slip surface z_{sp} = 1,30 m
Length of slip surface l_{sp} = 3,34 m

Design bearing capacity of found.soil R_d = 569,98 kPa
Extreme contact stress σ = 84,80 kPa

Factor of safety = 6,72 > 1,50
Bearing capacity in the vertical direction - spread footing in compression is SATISFACTORY

Verification of load eccentricity

Max. eccentricity in direction of base length e_x = 0,323<0,333
Max. eccentricity in direction of base width e_y = 0,093<0,333
Max. overall eccentricity e_t = 0,325<0,333

Eccentricity of load is SATISFACTORY

Vertical bearing capacity check - spread footing in tension

Angle of internal friction φ = 19,00 °
Cohesion of soil c = 30,00 kPa

Max. tensile force $N_{t,max}$ = 1,91 kN
Uplift resistance R_t = 116,01 kN

Factor of safety = 60,74 > 3,00
Bearing capacity in the vertical direction - spread footing in tension is SATISFACTORY

Horizontal bearing capacity check

Most unfavorable load case No. 3. (3)
Earth resistance: at rest
Design magnitude of earth resistance S_{pd} = 2,93 kN

Horizontal bearing capacity R_{dh} = 40,40 kN
Extreme horizontal force H = 2,46 kN

Factor of safety = 16,42 > 1,50
Bearing capacity in the horizontal direction is SATISFACTORY
Bearing capacity of foundation is SATISFACTORY

Verification No. 1

Settlement and rotation of foundation - input data

Analysis carried out with automatic selection of the most unfavourable load cases.
Analysis carried out with accounting for coefficient κ_1 (influence of foundation depth).
Stress at the footing bottom considered from the finished grade.

Computed weight of spread footing G = 25,23 kN
Computed weight of overburden Z = 0,00 kN

Tension was excluded during the analysis.
Dimensions of spread footing after excluding stretched edges:

Spread footing length (x) = 0,95 m
Spread footing width (y) = 1,15 m

Settlement of mid point of edge x - 1 = 0,4 mm
Settlement of mid point of edge x - 2 = 0,3 mm
Settlement of mid point of edge y - 1 = 0,8 mm
Settlement of mid point of edge y - 2 = -0,3 mm
Settlement of foundation center point = 0,7 mm
Settlement of characteristic point = 0,4 mm

(1-max.compressed edge; 2-min.compressed edge)

Settlement and rotation of foundation - results

Foundation stiffness:
Computed weighted average modulus of deformation E_{def} = 10,03 MPa
Foundation in the longitudinal direction is rigid (k=303,77)
Foundation in the direction of width is rigid (k=438,81)

Verification of load eccentricity

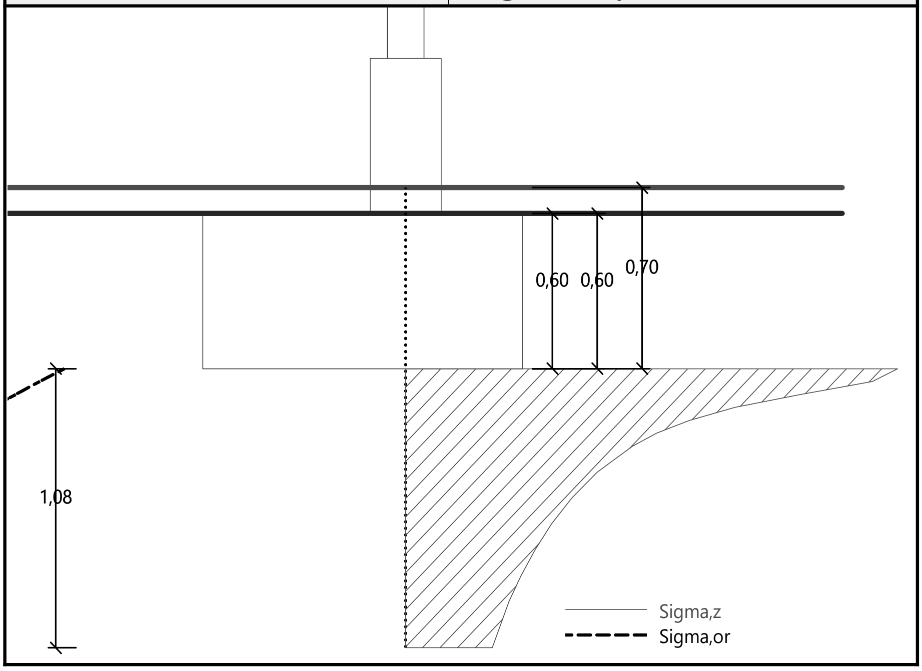
Max. eccentricity in direction of base length e_x = 0,256<0,333
Max. eccentricity in direction of base width e_y = 0,068<0,333
Max. overall eccentricity e_t = 0,257<0,333

Eccentricity of load is SATISFACTORY
Overall settlement and rotation of foundation:
Foundation settlement = 0,4 mm

Depth of influence zone = 1,08 m

Rotation in direction of x = 0,804 (tan*1000); (4,6E-02 °)
Rotation in direction of y = 0,119 (tan*1000); (6,8E-03 °)

Name : Settlement	Stage - analysis : 1 - 1



Dimensioning No. 1

Analysis carried out with automatic selection of the most unfavourable load cases.

Verification of longitudinal reinforcement of foundation in the direction of x

Bottom reinforcement

12 prof. 14,0 mm, cover 50,0 mm
Cross-section width = 1,15 m
Cross-section depth = 0,60 m

Reinforcement ratio	ρ	=	0,30	%	>	0,14	%	= ρ_{min}
Position of neutral axis	x	=	0,05	m	<	0,33	m	= x_{max}
Ultimate moment	M_{Rd}	=	419,29	kNm	>	7,44	kNm	= M_{Ed}

Cross-section is SATISFACTORY.

Upper reinforcement

8 prof. 12,0 mm, cover 50,0 mm

Reinforcement ratio	ρ	=	0,14	%	>	0,14	%	=	ρ_{min}
Position of neutral axis	x	=	0,03	m	<	0,34	m	=	x_{max}
Ultimate moment	M_{Rd}	=	209,96	kNm	>	4,49	kNm	=	M_{Ed}

Cross-section is SATISFACTORY.

Verification of longitudinal reinforcement of foundation in the direction of y

0,00 m ≤ 0,30 m
Maximum offset of the foundation is smaller than 0,50 * thickness of foundation.
Reinforcement is not requiered.

Spread footing for punching shear failure check

Column normal force = 16,51 kN

Maximum resistance at the column perimeter

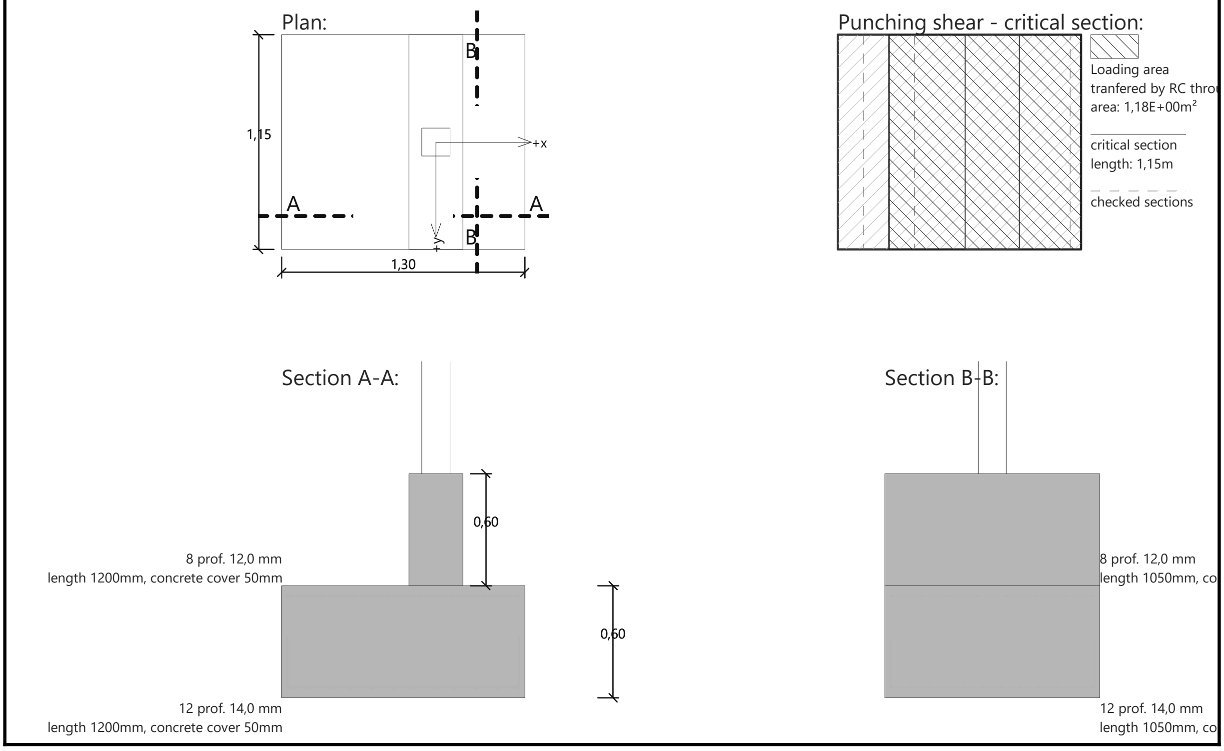
Force transferred into found. soil		=	3,68	kN
Force transferred by shear strength of foundation		=	12,83	kN
Considered column perimeter	u_0	=	2,30	m
Shear resistance at the column perimeter	$v_{Ed,max}$	=	0,06	MPa
Resistance at the column perimeter	$v_{Rd,max}$	=	3,60	MPa

Critical section without shear reinforcement

Force transferred into found. soil		=	13,05	kN
Force transferred by shear strength of foundation		=	3,46	kN
Distance of section from the column		=	0,41	m
Section perimeter	u	=	1,15	m
Shear stress at section	v_{Ed}	=	0,06	MPa
Shear resistance of section without shear reinforcement	$v_{Rd,c}$	=	0,95	MPa

$v_{Ed} < v_{Rd,c}$ => Reinforcement is not required
Spread footing for punching shear is SATISFACTORY

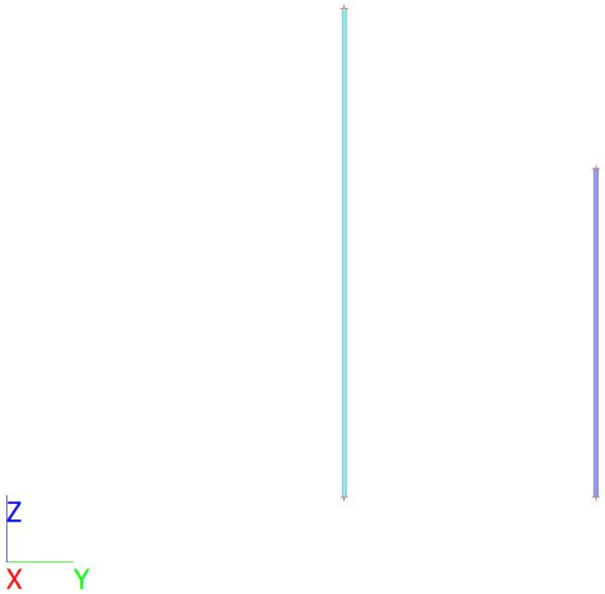
Name : Dimensioning	Stage - analysis : 1 - 1



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

OGRADA

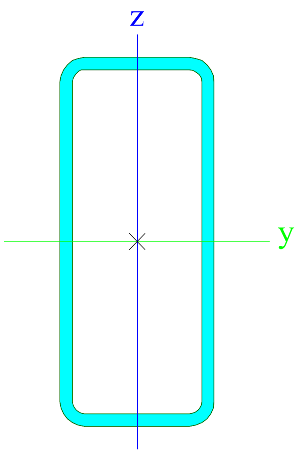
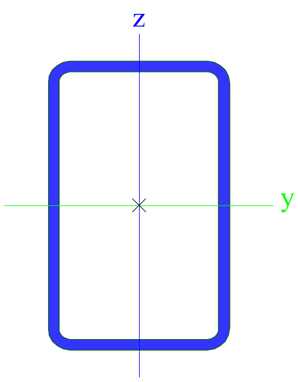
1. Model konstrukcije



2. Cross-sections

Visoki stup		
Type	CFRHS120X50X4	
Formcode	2 - Rectangular hollow section	
Shape type	Thin-walled	
Item material	S 235	
Fabrication	cold formed	
Colour		
Flexural buckling y-y, Flexural buckling z-z	c	c
A [m²]	1.2550e-03	
A_y [m²], A_z [m²]	3.6883e-04	8.8520e-04
A_L [m²/m], A_D [m²/m]	3.2600e-01	6.2730e-01
$c_{Y.UCS}$ [mm], $c_{Z.UCS}$ [mm]	25	60
α [deg]	0.00	
I_y [m⁴], I_z [m⁴]	2.1382e-06	5.3430e-07
i_y [mm], i_z [mm]	41	21
$W_{el.y}$ [m³], $W_{el.z}$ [m³]	3.5640e-05	2.1370e-05
$W_{pl.y}$ [m³], $W_{pl.z}$ [m³]	4.5850e-05	2.4610e-05
$M_{pl.y.+}$ [Nm], $M_{pl.y.-}$ [Nm]	1.08e+04	1.08e+04
$M_{pl.z.+}$ [Nm], $M_{pl.z.-}$ [Nm]	5.78e+03	5.78e+03
d_y [mm], d_z [mm]	0	0
I_t [m⁴], I_w [m⁶]	1.4422e-06	1.0200e-09
β_y [mm], β_z [mm]	0	0

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Picture		
Niži stup		
Type	RHSCF80/50/3.0	
Formcode	2 - Rectangular hollow section	
Shape type	Thin-walled	
Item material	S 235	
Fabrication	cold formed	
Colour		
Flexural buckling y-y, Flexural buckling z-z	c	c
A [m^2]	7.2082e-04	
A_y [m^2], A_z [m^2]	2.7707e-04	4.4332e-04
A_L [m^2/m], A_D [m^2/m]	2.4965e-01	4.8048e-01
$c_{Y.UCS}$ [mm], $c_{Z.UCS}$ [mm]	25	40
α [deg]	0.00	
I_y [m^4], I_z [m^4]	6.1085e-07	2.9397e-07
i_y [mm], i_z [mm]	29	20
$W_{el.y}$ [m^3], $W_{el.z}$ [m^3]	1.5271e-05	1.1759e-05
$W_{pl.y}$ [m^3], $W_{pl.z}$ [m^3]	1.8833e-05	1.3608e-05
$M_{pl.y.+}$ [Nm], $M_{pl.y.-}$ [Nm]	4.43e+03	4.43e+03
$M_{pl.z.+}$ [Nm], $M_{pl.z.-}$ [Nm]	3.20e+03	3.20e+03
d_y [mm], d_z [mm]	0	0
I_t [m^4], I_w [m^6]	6.3597e-07	2.6000e-10
$β_y$ [mm], $β_z$ [mm]	0	0
Picture		

Explanations of symbols	
Formcode	h - Height b - Width

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Explanations of symbols	
	s - Thickness r - Outer radius r1 - Inner radius
A	Area
A_y	Shear Area in principal y-direction
A_z	Shear Area in principal z-direction
A_L	Circumference per unit length
A_D	Drying surface per unit length
$c_{Y.UCS}$	Centroid coordinate in Y-direction of Input axis system
$c_{Z.UCS}$	Centroid coordinate in Z-direction of Input axis system
$I_{Y.LCS}$	Second moment of area about the YLCS axis
$I_{Z.LCS}$	Second moment of area about the ZLCS axis
$I_{YZ.LCS}$	Product moment of area in the LCS system
α	Rotation angle of the principal axis system
I_y	Second moment of area about the principal y-axis
I_z	Second moment of area about the principal z-axis
i_y	Radius of gyration about the principal y-axis
i_z	Radius of gyration about the principal z-axis
$W_{el.y}$	Elastic section modulus about the principal y-axis
$W_{el.z}$	Elastic section modulus about the principal z-axis
$W_{pl.y}$	Plastic section modulus about the principal y-axis
$W_{pl.z}$	Plastic section modulus about the principal z-axis
$M_{pl.y.+}$	Plastic moment about the principal y-axis for a positive My moment
$M_{pl.y.-}$	Plastic moment about the principal y-axis for a negative My moment
$M_{pl.z.+}$	Plastic moment about the principal z-axis for a positive Mz moment
$M_{pl.z.-}$	Plastic moment about the principal z-axis for a negative Mz moment
d_y	Shear center coordinate in principal y-direction measured from the centroid
d_z	Shear center coordinate in principal z-direction measured from the centroid
I_t	Torsional constant
I_w	Warping constant
β_y	Mono-symmetry constant about the principal y-axis
β_z	Mono-symmetry constant about the principal z-axis

3. EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Member
Selection: All

EN 1993-1-1 Code Check
National annex: Standard EN

Member B1	0.000 / 6.100 m	CFRHS120X50X4	S 235	ULS-Set B (auto)	0.35 -

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 1.50*LC2 + 1.35*LC3

Partial safety factors	
γ_{M0} for resistance of cross-sections	1.00
γ_{M1} for resistance to instability	1.00
γ_{M2} for resistance of net sections	1.25

Material			
Yield strength	f_y	235.0	MPa
Ultimate strength	f_u	360.0	MPa
Fabrication		Cold formed	

...::SECTION CHECK::...

The critical check is on position 0.000 m

Internal forces		Calculated	Unit
Normal force	N_{Ed}	-1.47	kN
Shear force	$V_{y,Ed}$	0.00	kN
Shear force	$V_{z,Ed}$	0.54	kN
Torsion	T_{Ed}	0.00	kNm
Bending moment	$M_{y,Ed}$	-3.29	kNm
Bending moment	$M_{z,Ed}$	0.00	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	38	4	9.055e+04	9.055e+04	1.00		1.00	9.50	28.00	34.00	38.00	1
3	I	108	4	8.439e+04	-8.204e+04	-0.97		0.51	27.00	70.44	81.35	120.39	1
5	I	38	4	-8.821e+04	-8.821e+04								
7	I	108	4	-8.204e+04	8.439e+04	-0.97		0.51	27.00	70.44	81.35	120.39	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

Cross-section area	A	1.2550e-03	m^2
Compression resistance	$N_{c,Rd}$	294.93	kN
Unity check		0.00	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,y}$	4.5850e-05	m^3
Plastic bending moment	$M_{pl,y,Rd}$	10.77	kNm
Unity check		0.31	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Shear correction factor	η	1.20	
Shear area	A_v	8.8588e-04	m^2
Plastic shear resistance for V_z	$V_{pl,z,Rd}$	120.19	kN
Unity check		0.00	-

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.31)

Design plastic moment resistance reduced due to N_{Ed}	$M_{N,y,Rd}$	10.77	kNm
Unity check		0.31	-

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 0.000 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	38	4	9.055e+04	9.055e+04	1.00		1.00	9.50	28.00	34.00	38.00	1
3	I	108	4	8.439e+04	-8.204e+04	-0.97		0.51	27.00	70.44	81.35	120.39	1
5	I	38	4	-8.821e+04	-8.821e+04								
7	I	108	4	-8.204e+04	8.439e+04	-0.97		0.51	27.00	70.44	81.35	120.39	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters		yy	zz	
Sway type		sway	non-sway	
System length	L	6.100	6.100	m
Buckling factor	k	2.00	0.70	

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Buckling parameters		yy	zz	
Buckling length	l_{cr}	12.215	4.270	m
Critical Euler load	N_{cr}	29.70	60.74	kN
Slenderness	λ	295.92	206.95	
Relative slenderness	λ_{rel}	3.15	2.20	
Limit slenderness	$\lambda_{rel,0}$	0.20	0.20	
Buckling curve		c	c	
Imperfection	α	0.49	0.49	
Reduction factor	χ	0.09	0.17	
Buckling resistance	$N_{b,Rd}$	25.62	48.89	kN

Flexural Buckling verification			
Cross-section area	A	1.2550e-03	m^2
Buckling resistance	$N_{b,Rd}$	25.62	kN
Unity check		0.06	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters			
Interaction method		alternative method 1	
Cross-section area	A	1.2550e-03	m^2
Plastic section modulus	$W_{pl,y}$	4.5850e-05	m^3
Design compression force	N_{Ed}	1.47	kN
Design bending moment (maximum)	$M_{y,Ed}$	-3.29	kNm
Design bending moment (maximum)	$M_{z,Ed}$	0.00	kNm
Characteristic compression resistance	N_{Rk}	294.93	kN
Characteristic moment resistance	$M_{y,Rk}$	10.77	kNm
Reduction factor	χ_y	0.09	
Reduction factor	χ_z	0.17	
Reduction factor	χ_{LT}	1.00	
Interaction factor	k_{yy}	0.97	
Interaction factor	k_{zy}	0.65	

Maximum moment $M_{y,Ed}$ is derived from beam B1 position 0.000 m.
Maximum moment $M_{z,Ed}$ is derived from beam B1 position 0.000 m.

Interaction method 1 parameters			
Critical Euler load	$N_{cr,y}$	29.70	kN
Critical Euler load	$N_{cr,z}$	60.74	kN
Elastic critical load	$N_{cr,T}$	54727.96	kN
Plastic section modulus	$W_{pl,y}$	4.5850e-05	m^3
Elastic section modulus	$W_{el,y}$	3.5640e-05	m^3
Plastic section modulus	$W_{pl,z}$	2.4610e-05	m^3
Elastic section modulus	$W_{el,z}$	2.1370e-05	m^3
Second moment of area	I_y	2.1382e-06	m^4
Second moment of area	I_z	5.3430e-07	m^4
Torsional constant	I_t	1.4422e-06	m^4

Interaction method 1 parameters			
Method for equivalent moment factor $C_{my,0}$		Table A.2 Line 1 (Linear)	
Ratio of end moments	ψ_y	0.00	
Equivalent moment factor	$C_{my,0}$	0.78	
Factor	μ_y	0.95	
Factor	μ_z	0.98	
Factor	ε_y	78.86	
Factor	a_{LT}	0.33	
Critical moment for uniform bending	$M_{cr,0}$	58.89	kNm
Relative slenderness	$\lambda_{rel,0}$	0.43	
Limit relative slenderness	$\lambda_{rel,0,lim}$	0.26	
Equivalent moment factor	C_{my}	0.94	
Equivalent moment factor	C_{mLT}	1.00	
Factor	b_{LT}	0.00	
Factor	d_{LT}	0.00	
Factor	w_y	1.29	
Factor	w_z	1.15	
Factor	n_{pl}	0.00	
Maximum relative slenderness	$\lambda_{rel,max}$	3.15	
Factor	C_{yy}	0.98	
Factor	C_{zy}	0.95	

Unity check (6.61) = 0.06 + 0.30 + 0.00 = 0.35 -
Unity check (6.62) = 0.03 + 0.20 + 0.00 = 0.23 -

The member satisfies the stability check.

EN 1993-1-1 Code Check
National annex: Standard EN

Member B2	**0.000 / 4.100 m**	**RHSCF80/50/3.0**	**S 235**	**ULS-Set B (auto)**	**0.38 -**

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 1.50*LC2 + 1.35*LC3

Partial safety factors	
γ_{M0} for resistance of cross-sections	1.00
γ_{M1} for resistance to instability	1.00
γ_{M2} for resistance of net sections	1.25

Material			
Yield strength	f_y	235.0	MPa
Ultimate strength	f_u	360.0	MPa
Fabrication		Cold formed	

...::SECTION CHECK::...

The critical check is on position 0.000 m

Internal forces		Calculated	Unit
Normal force	N_{Ed}	-0.98	kN
Shear force	$V_{y,Ed}$	0.00	kN
Shear force	$V_{z,Ed}$	0.41	kN

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Internal forces		Calculated	Unit
Torsion	T_{Ed}	0.00	kNm
Bending moment	$M_{y,Ed}$	-1.66	kNm
Bending moment	$M_{z,Ed}$	0.00	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	41	3	1.059e+05	1.059e+05	1.00		1.00	13.67	28.00	34.00	38.00	1
3	I	71	3	9.779e+04	-9.506e+04	-0.97		0.51	23.67	70.44	81.34	120.38	1
5	I	41	3	-1.032e+05	-1.032e+05								
7	I	71	3	-9.506e+04	9.779e+04	-0.97		0.51	23.67	70.44	81.34	120.38	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

Cross-section area	A	7.2082e-04	m²
Compression resistance	$N_{c,Rd}$	169.39	kN
Unity check		0.01	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Plastic section modulus	$W_{pl,y}$	1.8833e-05	m³
Plastic bending moment	$M_{pl,y,Rd}$	4.43	kNm
Unity check		0.38	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Shear correction factor	η	1.20	
Shear area	A_v	4.4358e-04	m²
Plastic shear resistance for V_z	$V_{pl,z,Rd}$	60.18	kN
Unity check		0.01	-

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.31)

Design plastic moment resistance reduced due to N_{Ed}	$M_{N,y,Rd}$	4.43	kNm
Unity check		0.38	-

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design

Decisive position for stability classification: 0.000 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	41	3	1.059e+05	1.059e+05	1.00		1.00	13.67	28.00	34.00	38.00	1
3	I	71	3	9.779e+04	-9.506e+04	-0.97		0.51	23.67	70.44	81.34	120.38	1
5	I	41	3	-1.032e+05	-1.032e+05								
7	I	71	3	-9.506e+04	9.779e+04	-0.97		0.51	23.67	70.44	81.34	120.38	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters		yy	zz	
Sway type		sway	non-sway	
System length	L	4.100	4.100	m
Buckling factor	k	2.00	0.70	
Buckling length	l_{cr}	8.210	2.870	m
Critical Euler load	N_{cr}	18.78	73.97	kN
Slenderness	λ	282.02	142.12	
Relative slenderness	λ_{rel}	3.00	1.51	
Limit slenderness	$\lambda_{rel,0}$	0.20	0.20	
Buckling curve		c	c	
Imperfection	α	0.49	0.49	
Reduction factor	χ	0.09	0.31	
Buckling resistance	$N_{b,Rd}$	16.08	52.56	kN

Flexural Buckling verification			
Cross-section area	A	7.2082e-04	m²
Buckling resistance	$N_{b,Rd}$	16.08	kN
Unity check		0.06	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters			
Interaction method		alternative method 1	
Cross-section area	A	7.2082e-04	m²
Plastic section modulus	$W_{pl,y}$	1.8833e-05	m³
Design compression force	N_{Ed}	0.98	kN
Design bending moment (maximum)	$M_{y,Ed}$	-1.66	kNm
Design bending moment (maximum)	$M_{z,Ed}$	0.00	kNm
Characteristic compression resistance	N_{Rk}	169.39	kN

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Bending and axial compression check parameters			
Characteristic moment resistance	$M_{y,Rk}$	4.43	kNm
Reduction factor	χ_y	0.09	
Reduction factor	χ_z	0.31	
Reduction factor	χ_{LT}	1.00	
Interaction factor	k_{yy}	0.80	
Interaction factor	k_{zy}	0.53	

Maximum moment $M_{y,Ed}$ is derived from beam B2 position 0.000 m.
Maximum moment $M_{z,Ed}$ is derived from beam B2 position 0.000 m.

Interaction method 1 parameters			
Critical Euler load	$N_{cr,y}$	18.78	kN
Critical Euler load	$N_{cr,z}$	73.97	kN
Elastic critical load	$N_{cr,T}$	40946.40	kN
Plastic section modulus	$W_{pl,y}$	1.8833e-05	m^3
Elastic section modulus	$W_{el,y}$	1.5271e-05	m^3
Plastic section modulus	$W_{pl,z}$	1.3608e-05	m^3
Elastic section modulus	$W_{el,z}$	1.1759e-05	m^3
Second moment of area	I_y	6.1085e-07	m^4
Second moment of area	I_z	2.9397e-07	m^4
Torsional constant	I_t	6.3597e-07	m^4
Method for equivalent moment factor $C_{my,0}$		Table A.2 Line 1 (Linear)	
Ratio of end moments	ψ_y	0.00	
Equivalent moment factor	$C_{my,0}$	0.78	
Factor	μ_y	0.95	
Factor	μ_z	0.99	
Factor	ε_y	79.79	
Factor	a_{LT}	0.00	
Critical moment for uniform bending	$M_{cr,0}$	43.16	kNm
Relative slenderness	$\lambda_{rel,0}$	0.32	
Limit relative slenderness	$\lambda_{rel,0,lim}$	0.27	
Equivalent moment factor	C_{my}	0.78	
Equivalent moment factor	C_{mLT}	1.00	
Factor	b_{LT}	0.00	
Factor	d_{LT}	0.00	
Factor	w_y	1.23	
Factor	w_z	1.16	
Factor	n_{pl}	0.01	
Maximum relative slenderness	$\lambda_{rel,max}$	3.00	
Factor	C_{yy}	0.99	
Factor	C_{zy}	0.97	

Unity check (6.61) = 0.06 + 0.30 + 0.00 = 0.36 -
Unity check (6.62) = 0.02 + 0.20 + 0.00 = 0.22 -

The member satisfies the stability check.

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

SPOJ S TEMELJEM

Material

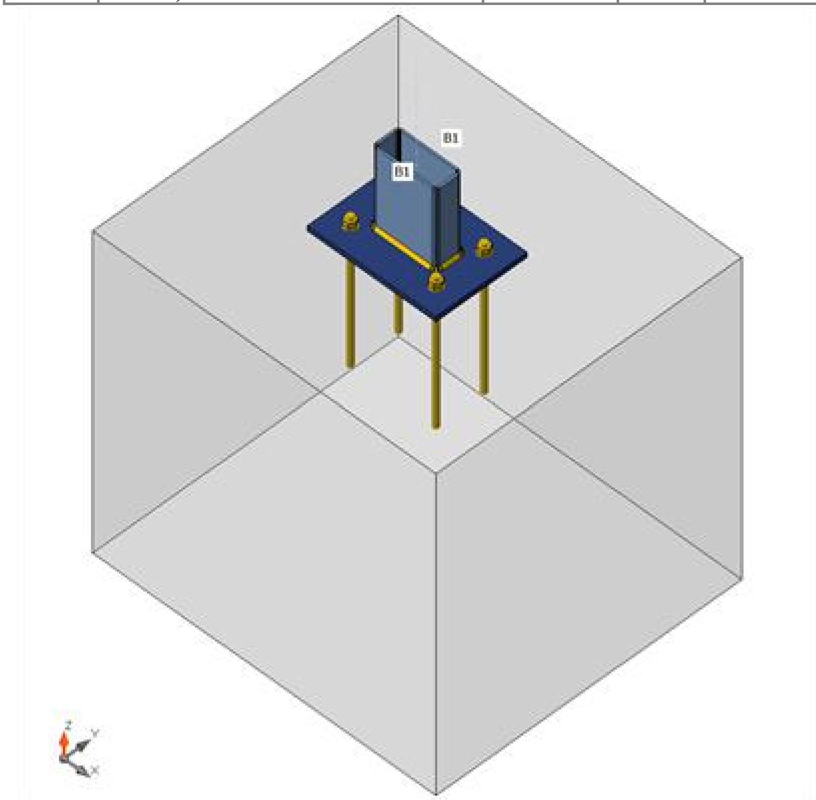
Steel	S 235
Concrete	C25/30

Design

Name	Con N1
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1	1 - CFRHS120X50X4(RHS120x50)	0.0	0.0	0.0	0	0	0	Position



INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Cross-sections

Name	Material
1 - CFRHS120X50X4(RHS120x50)	S 235

Anchors

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
M12 5.6	M12 5.6	12	500.0	113

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
ULS-Set(1)	B1	-1.1	0.0	0.0	0.0	0.0	0.0
ULS-Set(2)	B1	-1.5	0.0	0.0	0.0	0.0	0.0
ULS-Set(3)	B1	-1.5	0.0	-0.5	0.0	3.3	0.0
ULS-Set(4)	B1	-1.1	0.0	-0.5	0.0	3.3	0.0

Foundation block

Item	Value	Unit
CB 1		
Dimensions	570 x 640	mm
Depth	600	mm
Anchor	M12 5.6	
Anchoring length	250	mm
Shear force transfer	Anchors	

Check

Summary

Name	Value	Status
Analysis	100.0%	OK
Plates	0.0 < 5.0%	OK
Anchors	72.3 < 100%	OK
Welds	97.2 < 100%	OK
Concrete block	27.4 < 100%	OK
Buckling	Not calculated	

Plates

Name	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	σc_{Ed} [MPa]	Status
B1	4.0	ULS-Set(4)	222.4	0.0	0.0	OK
BP1	10.0	ULS-Set(4)	175.7	0.0	0.0	OK

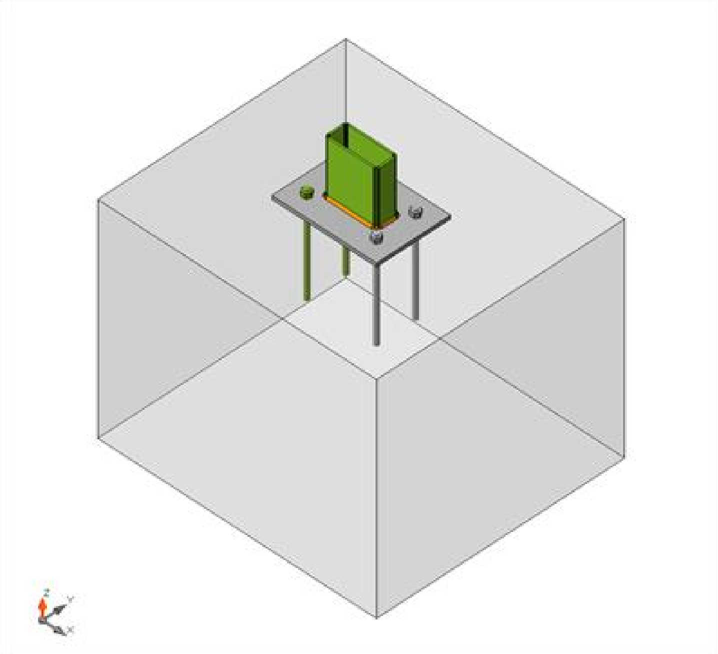
Design data

Material	f_y [MPa]	ε_{lim} [%]
S 235	235.0	5.0

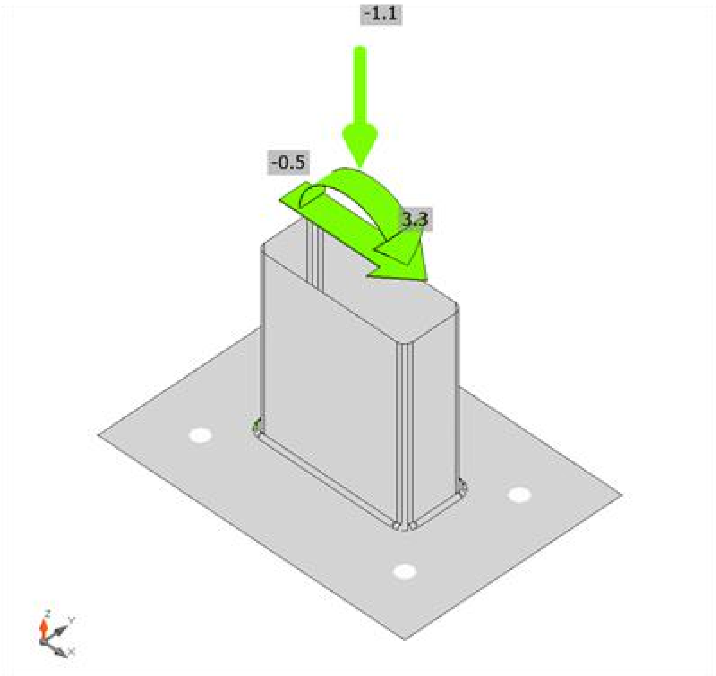
Symbol explanation

ε_{Pl} Strain

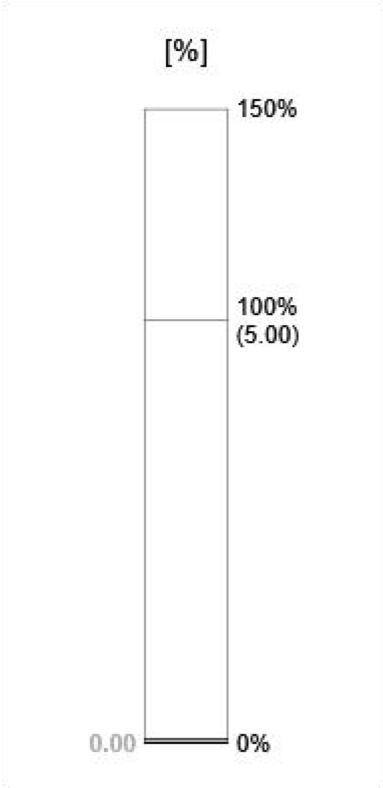
σ_{Ed} Eq. stress
σc_{Ed} Contact stress
f_y Yield strength
ε_{lim} Limit of plastic strain

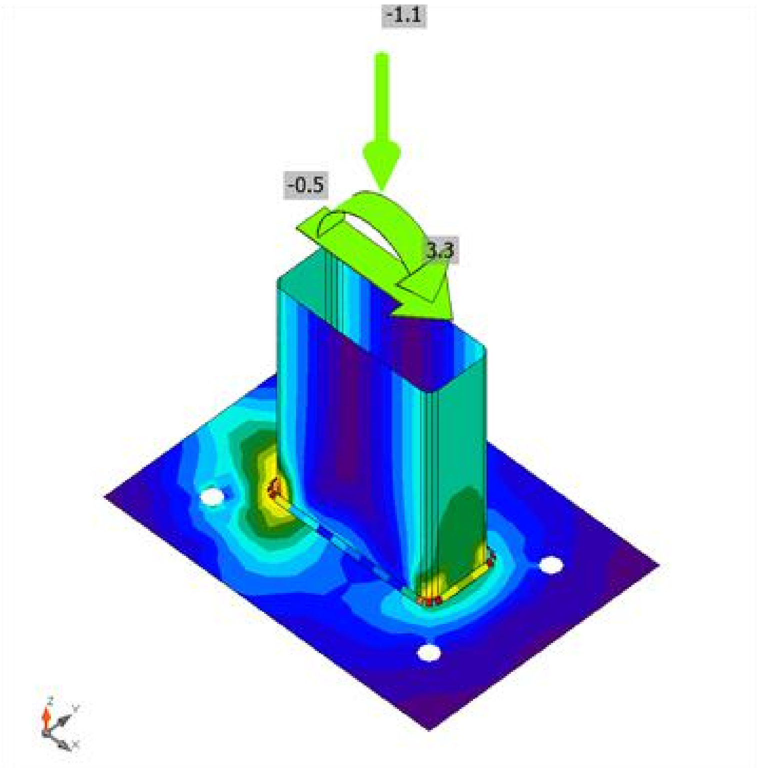


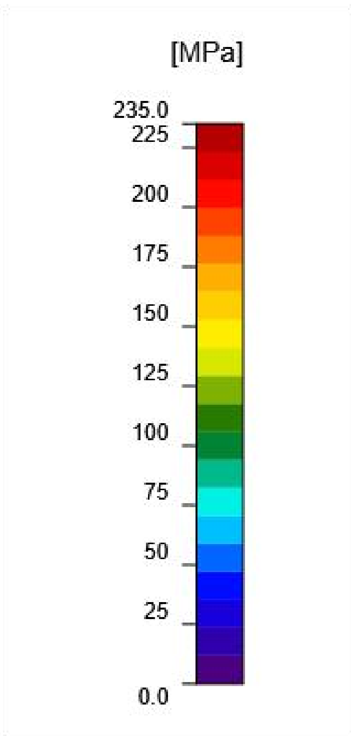
Overall check, ULS-Set(4)



Strain check, ULS-Set(4)

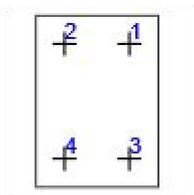






Equivalent stress, ULS-Set(4)

Anchors

Shape	Item	Loads	N_{Ed} [kN]	V_{Ed} [kN]	$N_{Rd,c}$ [kN]	$V_{Rd,c}$ [kN]	$V_{Rd,cp}$ [kN]	Ut_t [%]	Ut_s [%]	Ut_{ts} [%]	Status
	A1	ULS-Set(4)	13.0	0.2	51.4	-	164.5	72.2	1.2	52.2	OK
	A2	ULS-Set(4)	13.1	0.2	51.4	-	164.5	72.3	1.2	52.3	OK
	A3	ULS-Set(4)	0.0	0.1	-	18.2	164.5	0.0	2.8	0.5	OK
	A4	ULS-Set(4)	0.0	0.1	-	18.2	164.5	0.0	2.8	0.5	OK

Design data

Grade	$N_{Rd,s}$ [kN]	$V_{Rd,s}$ [kN]
M12 5.6 - 1	18.1	12.8

Symbol explanation

N_{Ed}	Tension force
V_{Ed}	Resultant of shear forces Vy, Vz in bolt
$N_{Rd,c}$	Design resistance in case of concrete cone failure under tension load - EN1992-4 - Cl. 7.2.1.4
$V_{Rd,c}$	Design resistance in case of concrete cone failure under shear load - EN1992-4 - Cl. 7.2.2.5
$V_{Rd,cp}$	Design resistance in case of concrete pryout failure - EN1992-4 - Cl. 7.2.2.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear
$N_{Rd,s}$	Design tensile resistance of a fastener in case of steel failure - EN1992-4 - Cl. 7.2.1.3
$V_{Rd,s}$	Design shear resistance in case of steel failure - EN1992-4 - Cl.7.2.2.3.1

Detailed result for A2

Anchor tensile resistance (EN1992-4 - Cl. 7.2.1.3)

$$N_{Rd,s} = \frac{N_{Rk,s}}{\gamma_{Ms}} = 18.1 \text{ kN} \geq N_{Ed} = 13.1 \text{ kN}$$

$$N_{Rk,s} = c \cdot A_s \cdot f_{uk} = 36.1 \text{ kN}$$

Where:

$c = 0.85$	– reduction factor for cut thread
$A_s = 85 \text{ mm}^2$	– tensile stress area
$f_{uk} = 500.0 \text{ MPa}$	– minimum tensile strength of the bolt
$\gamma_{Ms} = 2.00$	– safety factor for steel

$$\gamma_{Ms} = 1.2 \cdot \frac{f_{uk}}{f_{yk}} \geq 1.4$$

, where:
f_{yk} =
300.0 MPa – minimum yield strength of the bolt

Concrete breakout resistance of anchor in tension (EN1992-4 - Cl. 7.2.1.4)
The check is performed for group of anchors that form common tension breakout cone: A1, A2

$N_{Rd,c} = \frac{N_{Rk,c}}{\gamma_{Mc}} =$ 51.4 kN $\geq$ $N_{Ed,g} =$ 26.1 kN

$N_{Rk,c} = N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec,N} \cdot \psi_{M,N} =$ 92.5 kN

Where:

$N_{Ed,g} = 26.1$ kN – sum of tension forces of anchors with common concrete breakout cone area

$N^0_{Rk,c} = 77.9$ kN – characteristic strength of a fastener, remote from the effects of adjacent fasteners or edges of the concrete member

$N^0_{Rk,c} = k_1 \cdot \sqrt{f_c} \cdot h_{ef}^{1.5}$
, where:
k_1 =
7.70 – parameter accounting for anchor type and concrete condition
f_c =
25.0 MPa – concrete compressive strength
$h_{ef} = \min(h_{emb}, \max(\frac{c_{a,max}}{1.5}, \frac{s_{max}}{3})) =$
160 mm – depth of embedment, where:
h_{emb} =
250 mm – anchor length embedded in concrete
$c_{a,max}$ =
240 mm – maximum distance from the anchor to one of the three closest edges
s_{max} =
90 mm – maximum spacing between anchors

$A_{c,N} = 273600$ mm^2 – concrete breakout cone area for group of anchors

$A^0_{c,N} = 230400$ mm^2 – concrete breakout cone area for single anchor not influenced by edges

$A^0_{c,N} = (3 \cdot h_{ef})^2$
, where:
h_{ef} =
160 mm – depth of embedment

$\psi_{s,N} = 1.00$ – parameter related to the distribution of stresses in the concrete due to the proximity of the fastener to an edge of the concrete member:

$\psi_{s,N} = 0.7 + 0.3 \cdot \frac{c}{1.5 \cdot h_{ef}} \leq 1$
, where:
c =

240 mm – minimum distance from the anchor to the edge

h_{ef} =

160 mm – depth of embedment

$\psi_{re,N} = 1.00$ – parameter accounting for the shell spalling:

$\psi_{re,N} = 0.5 + \frac{h_{emb}}{200} \leq 1$

, where:

h_{emb} =

250 mm – anchor length embedded in concrete

$\psi_{ec,N} = 1.00$ – modification factor for anchor groups loaded eccentrically in tension:

$\psi_{ec,N} = \psi_{ecx,N} \cdot \psi_{ecy,N}$

, where:

$\psi_{ecx,N} = \frac{1}{1+\frac{2 \cdot e_{x,N}}{3 \cdot h_{ef}}} =$

1.00 – modification factor that depends on eccentricity in x-direction

$e_{x,N}$ =

0 mm – tension load eccentricity in x-direction

$\psi_{ecy,N} = \frac{1}{1+\frac{2 \cdot e_{y,N}}{3 \cdot h_{ef}}} =$

1.00 – modification factor that depends on eccentricity in y-direction

$e_{y,N}$ =

0 mm – tension load eccentricity in y-direction

h_{ef} =

160 mm – depth of embedment

$\psi_{M,N} = 1.00$ – parameter accounting for the effect of a compression force between the fixture and concrete; this parameter is equal to 1 if c < 1.5h_{ef} or the ratio of the compressive force (including the compression due to bending) to the sum of tensile forces in anchors is smaller than 0.8

$\psi_{M,N} = 2 - \frac{2 \cdot z}{3 \cdot h_{ef}} \geq 1$

, where:

z =

115 mm – internal lever arm

h_{ef} =

160 mm – depth of embedment

$\gamma_{Mc} = 1.80$ – safety factor for concrete

Shear resistance (EN1992-4 - Cl.7.2.2.3.1)

$V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{Ms}} =$ 12.8 kN $\geq$ $V_{Ed} =$ 0.2 kN

$V_{Rk,s} = k_7 \cdot V^0_{Rk,s} =$ 21.3 kN

Where:

$k_7 = 1.00$ – coefficient for anchor steel ductility

$$k_7 = \begin{cases} 0.8, & A < 0.08 \\ 1.0, & A \geq 0.08 \end{cases}$$

, where:
$A =$
0.20 – bolt grade elongation at rupture

$V^0_{Rk,s} = 21.3\ \mathrm{kN}$ – the characteristic shear strength

$V^0_{Rk,s} = k_6 \cdot A_s \cdot f_{uk}$

, where:
$k_6 =$
0.50 – coefficient for anchor resistance in shear
$A_s =$
85 mm^2 – tensile stress area
$f_{uk} =$
500.0 MPa – specified ultimate strength of anchor steel

$\gamma_{Ms} = 1.67$ – safety factor for steel

Concrete pryout resistance (EN1992-4 - Cl. 7.2.2.4)
The check is performed for group of anchors on common base plate

$V_{Rd,cp} = \frac{V_{Rk,cp}}{\gamma_{Mc}} =$ 164.5 kN $\geq$ $V_{Ed,g} =$ 0.5 kN

$V_{Rk,cp} = k_8 \cdot N_{Rk,c} =$ 246.7 kN

Where:

$k_8 = 2.00$ – factor taking into account fastener embedment depth

$N_{Rk,c} = 123.4\ \mathrm{kN}$ – characteristic concrete cone strength for a single fastener or fastener in a group

$\gamma_{Mc} = 1.50$ – safety factor for concrete

Interaction of tensile and shear forces in steel (EN 1992-4 - Table 7.3)

$\left(\frac{N_{Ed}}{N_{Rd,s}}\right)^2 + \left(\frac{V_{Ed}}{V_{Rd,s}}\right)^2 =$ 0.52 $\leq$ 1.0

Where:

$N_{Ed} = 13.1\ \mathrm{kN}$ – design tension force

$N_{Rd,s} = 18.1\ \mathrm{kN}$ – fastener tensile strength

$V_{Ed} = 0.2\ \mathrm{kN}$ – design shear force

$V_{Rd,s} = 12.8\ \mathrm{kN}$ – fastener shear strength

Interaction of tensile and shear forces in concrete (EN 1992-4 - Table 7.3)

$\left(\frac{N_{Ed}}{N_{Rd,i}}\right)^{1.5} + \left(\frac{V_{Ed}}{V_{Rd,i}}\right)^{1.5} =$ 0.36 $\leq$ 1.0

Where:

$\frac{N_{Ed}}{N_{Rd,i}}$ – the largest utilization value for tension failure modes

$\frac{V_{Ed}}{V_{Rd,i}}$ – the largest utilization value for shear failure modes

$\frac{N_{Ed}}{N_{Rd,c}} = 50\%$ – concrete breakout failure of anchor in tension

$\frac{N_{Ed}}{N_{Rd,p}} = 0\%$ – concrete pullout failure

$\frac{N_{Ed}}{N_{Rd,cb}} = 0\%$ – concrete blowout failure

$\frac{V_{Ed}}{V_{Rd,c}} = 0\%$ – concrete edge failure

$\frac{V_{Ed}}{V_{Rd,cb}} = 0\%$ – concrete pryout failure

Welds (Plastic redistribution)

Item	Edge	Throat th. [mm]	Length [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_{\perp}$ [MPa]	$\tau_{\parallel}$ [MPa]	$\tau_{\perp}$ [MPa]	Ut [%]	Ut_c [%]	Status
BP1	B1	◢4.0	313	ULS-Set(4)	328.3	0.0	252.0	-20.3	-119.8	97.2	29.0	OK

Design data

	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 235	0.80	360.0	259.2

Symbol explanation

ε_{Pl} Strain
$\sigma_{w,Ed}$ Equivalent stress
$\sigma_{w,Rd}$ Equivalent stress resistance
$\sigma_{\perp}$ Perpendicular stress
$\tau_{\parallel}$ Shear stress parallel to weld axis
$\tau_{\perp}$ Shear stress perpendicular to weld axis
0.9 σ Perpendicular stress resistance - 0.9*fu/γM2
β_w Corelation factor EN 1993-1-8 tab. 4.1
Ut Utilization
Utc Weld capacity utilization

Detailed result for BP1 B1

Weld resistance check (EN 1993-1-8 4.5.3.2)

$\sigma_{w,Rd} = f_u/(\beta_w \gamma_{M2}) =$ 360.0 MPa $\geq$ $\sigma_{w,Ed} = [\sigma_{\perp}^2 + 3(\tau_{\perp}^2 + \tau_{\parallel}^2)]^{0.5} =$ 328.3 MPa

$\sigma_{\perp,Rd} = 0.9 f_u/\gamma_{M2} =$ 259.2 MPa $\geq$ $|\sigma_{\perp}| =$ 252.0 MPa

where:

f_u = 360.0 MPa – Ultimate strength

β_w = 0.80 – appropriate correlation factor taken from Table 4.1

γ_{M2} = 1.25 – Safety factor

Stress utilization

$U_t = \max(\frac{\sigma_{w,Ed}}{\sigma_{w,Rd}}; \frac{|\sigma_\perp|}{\sigma_{\perp,Rd}}) =$ 97.2 %

Concrete block

Item	Loads	c [mm]	A_{eff} [mm^2]	σ [MPa]	k_j [-]	F_{jd} [MPa]	Ut [%]	Status
CB 1	ULS-Set(3)	15	3135	9.2	3.00	33.5	27.4	OK

Symbol explanation

c Bearing width

A_{eff} Effective area

σ Average stress in concrete

k_j Concentration factor

F_{jd} The ultimate bearing strength of the concrete block

Ut Utilization

Detailed result for CB 1

Concrete block compressive resistance check (EN 1993-1-8 6.2.5)

$\sigma = \frac{N}{A_{eff}} =$ 9.2 MPa

$F_{jd} = \alpha_{cc}\beta_j k_j f_{ck}/\gamma_c =$ 33.5 MPa

where:

N = 28.8 kN – Design normal force

A_{eff} = 3135 mm^2 – Effective area, on which the column force N is distributed

α_{cc} = 1.00 – Long-term effects on Fcd

β_j = 0.67 – Joint coefficient βj

k_j = 3.00 – Concentration factor

f_{ck} = 25.0 MPa – Characteristic compressive concrete strength

γ_c = 1.50 – Safety factor

Stress utilization

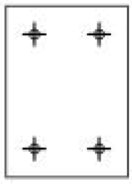
$U_t = \frac{\sigma}{F_{jd}} =$ 27.4 %

Buckling

Buckling analysis was not calculated.

Bill of material

Manufacturing operations

Name	Plates [mm]	Shape	Nr.	Welds [mm]	Length [mm]	Bolts	Nr.
BP1	P10.0x170.0-240.0 (S 235)		1	Fillet: a = 4.0	313.3	M12 5.6	4

Welds

Type	Material	Throat thickness [mm]	Leg size [mm]	Length [mm]
Fillet	S 235	4.0	5.7	313.3

Anchors

Name	Length [mm]	Drill length [mm]	Count
M12 5.6	260	250	4

TEMELJENJE

Materials and standards

Concrete structures : EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 : standard

Settlement

Analysis method : Analysis using oedometric modulus
Restriction of influence zone : by percentage of Sigma,Or
Coeff. of restriction of influence zone : 10,0 [%]

Spread Footing

Analysis for drained conditions : EC 7-1 (EN 1997-1:2003)
Analysis of uplift : Standard
Allowable eccentricity : 0,450
Verification methodology : according to EN 1997
Design approach : 2 - reduction of actions and resistances

Partial factors on actions (A)					
Permanent design situation					
		Unfavourable		Favourable	
Permanent actions :	$_G$ =	1,35	[–]	1,00	[–]

Partial factors for resistances (R)			
Permanent design situation			
Partial factor on vertical bearing capacity :	$_{Rvs}$ =	1,40	[–]
Partial factor on sliding resistance :	$_{Rhs}$ =	1,10	[–]

Basic soil parameters

No.	Name	Pattern	$_{ef}$ [°]	c_{ef} [kPa]	[kN/m³]	$_{su}$ [kN/m³]	[°]
1	Glina (pretpostavka)		19,00	30,00	21,00	11,00	

All soils are considered as cohesionless for at rest pressure analysis.

Soil parameters

Glina (pretpostavka)

Unit weight :		=	21,00 kN/m^3
Angle of internal friction :	$_{ef}$	=	19,00 °
Cohesion of soil :	c_{ef}	=	30,00 kPa
Oedometric modulus :	E_{oed}	=	21,50 MPa
Saturated unit weight :	$_{sat}$	=	21,00 kN/m^3

Foundation

Foundation type: centric spread footing

Depth from original ground surface	h_z	=	0,90	m
Depth of footing bottom	d	=	0,80	m
Foundation thickness	t	=	0,80	m
Incl. of finished grade	s_1	=	0,00	°
Incl. of footing bottom	s_2	=	0,00	°

Overburden

Type: from geological profile

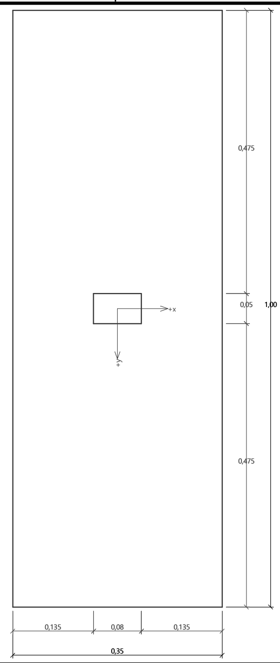
Geometry of structure

Foundation type: centric spread footing

Spread footing length	x	=	0,35	m
Spread footing width	y	=	1,00	m
Column width in the direction of x	c_x	=	0,08	m
Column width in the direction of y	c_y	=	0,05	m

Spread footing volume	=	0,28	m^3
Volume of excavation	=	0,28	m^3
Volume of fill	=	0,00	m^3

Name : Geometry	**Stage - analysis : 1 - 0**



Material of structure

Unit weight = 23,00 kN/m³

Analysis of concrete structures carried out according to the standard EN 1992-1-1 (EC2).

Concrete : C 25/30

Cylinder compressive strength	f_{ck}	=	25,00	MPa
Tensile strength	f_{ctm}	=	2,60	MPa
Elasticity modulus	E_{cm}	=	31000,00	MPa

Longitudinal steel : B500

Yield strength f_{yk} = 500,00 MPa

Transverse steel: B500

Yield strength f_{yk} = 500,00 MPa

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	-	0,00 ..	Glina (pretpostavka)	

Load

No.	Load new	Load change	Name	Type	N [kN]	M_x [kNm]	M_y [kNm]	H_x [kN]	H_y [kN]
1	Yes		1	Design	0,73	0,00	0,00	0,00	0,00
2	Yes		2	Design	1,47	0,00	-1,29	-0,54	0,00
3	Yes		1 - service	Service	0,52	0,00	0,00	0,00	0,00
4	Yes		2 - service	Service	1,05	0,00	-0,92	-0,39	0,00

Global settings

Type of analysis : analysis for drained conditions

Settings of the stage of construction

Design situation : permanent

Verification No. 1

Load case verification

Name	Self w. in favor	e_x [m]	e_y [m]	[kPa]	R_d [kPa]	Utilization [%]	Is satisfactory
1	Yes	0,00	0,00	20,49	424,95	4,82	Yes
1	No	0,00	0,00	26,93	424,95	6,34	Yes
2	Yes	0,11	0,00	59,45	366,43	16,22	Yes
2	No	0,08	0,00	56,10	380,00	14,76	Yes

Analysis carried out with automatic selection of the most unfavourable load cases.

Computed weight of spread footing G = 6,44 kN
Computed weight of overburden Z = 0,00 kN

Vertical bearing capacity check

Shape of contact stress : rectangle
Most unfavorable load case No. 2. (2)
Parameters of slip surface below foundation:
Depth of slip surface z_{sp} = 0,40 m
Length of slip surface l_{sp} = 1,02 m

Design bearing capacity of found.soil R_d = 366,43 kPa
Extreme contact stress = 59,45 kPa

Bearing capacity in the vertical direction is SATISFACTORY

Verification of load eccentricity

Max. eccentricity in direction of base length e_x = 0,310<0,450
Max. eccentricity in direction of base width e_y = 0,000<0,450
Max. overall eccentricity e_t = 0,310<0,450

Eccentricity of load is SATISFACTORY

Horizontal bearing capacity check

Most unfavorable load case No. 2. (2)
Earth resistance: at rest
Design magnitude of earth resistance S_{pd} = 1,59 kN

Horizontal bearing capacity R_{dh} = 7,55 kN
Extreme horizontal force H = 0,54 kN

Bearing capacity in the horizontal direction is SATISFACTORY
Bearing capacity of foundation is SATISFACTORY

Verification No. 1

Settlement and rotation of foundation - input data

Analysis carried out with automatic selection of the most unfavourable load cases.
Analysis carried out with accounting for coefficient $_1$ (influence of foundation depth).
Stress at the footing bottom considered from the finished grade.

Computed weight of spread footing G = 6,44 kN
Computed weight of overburden Z = 0,00 kN

Tension was excluded during the analysis.
Dimensions of spread footing after excluding stretched edges:

Spread footing length (x) = 0,28 m
Spread footing width (y) = 1,00 m

Settlement of mid point of edge x - 1 = 0,0 mm
Settlement of mid point of edge x - 2 = 0,0 mm
Settlement of mid point of edge y - 1 = 0,2 mm
Settlement of mid point of edge y - 2 = 0,1 mm
Settlement of foundation center point = 0,2 mm
Settlement of characteristic point = 0,1 mm

(1-max.compressed edge; 2-min.compressed edge)

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Settlement and rotation of foundation - results

Foundation stiffness:

Computed weighted average modulus of deformation E_{def} = 10,03 MPa
Foundation in the longitudinal direction is rigid (k=36896,25)
Foundation in the direction of width is rigid (k=1581,93)

Verification of load eccentricity

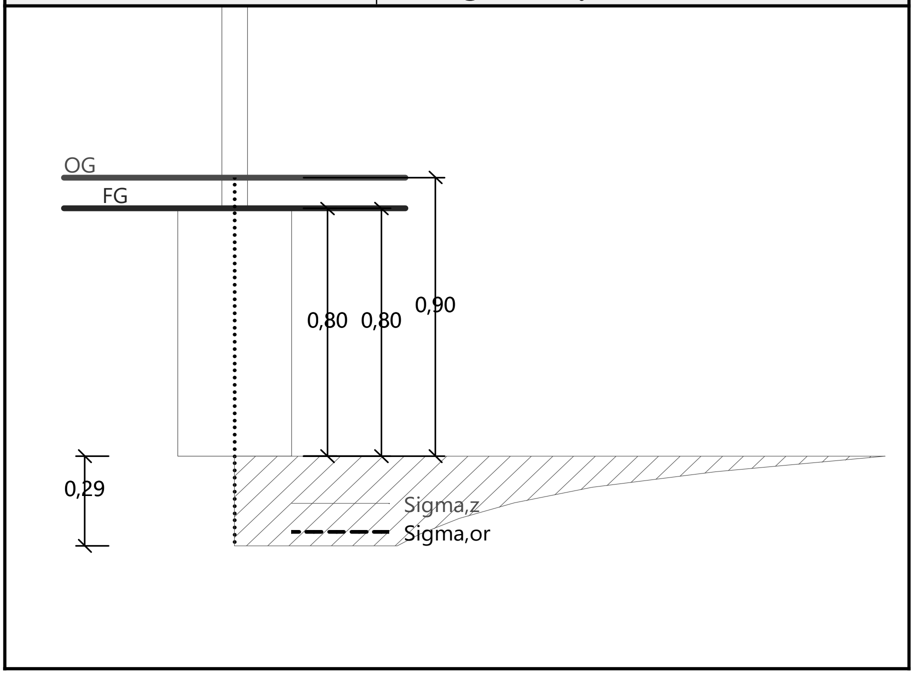
Max. eccentricity in direction of base length e_x = 0,234<0,450
Max. eccentricity in direction of base width e_y = 0,000<0,450
Max. overall eccentricity e_t = 0,234<0,450

Eccentricity of load is SATISFACTORY
Overall settlement and rotation of foundation:

Foundation settlement = 0,1 mm
Depth of influence zone = 0,29 m

Rotation in direction of x = 0,361 (tan*1000); (2,1E-02 °)
Rotation in direction of y = 0,000 (tan*1000); (0,0E+00 °)

Name : Settlement	Stage - analysis : 1 - 1



Dimensioning No. 1

Analysis carried out with automatic selection of the most unfavourable load cases.

Verification of longitudinal reinforcement of foundation in the direction of x

0,14 m 0,40 m
Maximum offset of the foundation is smaller than 0,50 * thickness of foundation.
Reinforcement is not requiered.

Verification of longitudinal reinforcement of foundation in the direction of y

5 prof. 10,0 mm, cover 50,0 mm
Cross-section width = 0,35 m
Cross-section depth = 0,80 m

Reinforcement ratio		=	0,15	%	>	0,14	%	=	$_{min}$
Position of neutral axis	x	=	0,04	m	<	0,46	m	=	x_{max}
Ultimate moment	M_{Rd}	=	124,70	kNm	>	0,17	kNm	=	M_{Ed}

Cross-section is SATISFACTORY.

Spread footing for punching shear failure check

Column normal force = 1,47 kN

Maximum resistance at the column perimeter

Force transferred into found. soil		=	0,02	kN
Force transferred by shear strength of foundation		=	1,45	kN
Considered column perimeter	u_0	=	0,26	m
Shear resistance at the column perimeter	$v_{Ed,max}$	=	0,07	MPa
Resistance at the column perimeter	$v_{Rd,max}$	=	3,60	MPa

Critical section without shear reinforcement

Force transferred into found. soil		=	1,17	kN
Force transferred by shear strength of foundation		=	0,30	kN
Distance of section from the column		=	0,37	m
Section perimeter	u	=	0,70	m
Shear stress at section	v_{Ed}	=	0,01	MPa
Shear resistance of section without shear reinforcement	$v_{Rd,c}$	=	1,31	MPa

$v_{Ed} < v_{Rd,c}$ => Reinforcement is not required
Spread footing for punching shear is SATISFACTORY

INVESTITOR:	Grad Slatina, Trg sv. Josipa 10, Slatina, OIB: 68254459599
GRAĐEVINA:	Postavljanje podloge i uređenje vanjskih sportskih igrališta za više sportova
LOKACIJA:	Slatina, k.č.br. 4366, k.o. Podravska Slatina
FAZA PROJEKTA:	Glavni projekt – građevinski projekt
BROJ PROJEKTA:	4/22-GP
GLAVNI PROJEKTANT:	Željko Šaponja dipl.ing.građ.

Name : Dimensioning	**Stage - analysis : 1 - 1**