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UNIVERSITY OF SPLIT



DIGITALNI AKADEMSKI ARHIVI I REPOZITORIJ

SVEUČILIŠTE U SPLITU
FAKULTET GRAĐEVINARSTVA ARHITEKTURE I GEODEZIJE

DIPLOMSKI RAD

Mario Šarčević

Split, 2015.

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STUDIJ: **DIPLOMSKI SVEUČILIŠNI STUDIJ GRAĐEVINARSTVA**
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PREDMET: Metalne konstrukcije

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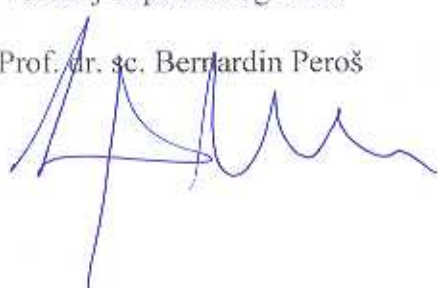
Tema: Projekt nadstrešnice - Zračna luka Dubrovnik

Opis zadatka: Zadatak diplomskog rada je projektirati nadstrešnicu ispred objekata B i C Zračne luke Dubrovnik. Nadstrešnica pokriva kompletnu prometnu površinu za putnike u dolasku (zgrada B) i putnike u odlasku (zgrada C) i ima tlocrtnu površinu od 4500 m² i proteže se cijelom duljinom zgrada „B“ i „C“. Čelična nadstrešnica je zasebna dilatacijska cjelina. Prometnica pod nadstrešnicom se sastoji od prometnih traka širina 3,0 + 4,5 m, otoka, te dviju traka od 3,5 m. Nadstrešnica se mora moći izvoditi u fazama, a konstruktivno je odvojena od ostalih zgrada.

U Splitu, 20. ožujka 2015.

Voditelj Diplomskog rada:

Prof. dr. sc. Bernardin Peroš



Predsjednik Povjerenstva
za završne i diplomske ispite;
Prof. dr. sc. Ivica Boko

Projekt nadstrešnice – Zračna luka Dubrovnik

Sažetak:

Prema zadanim arhitektonskim podlogama, napravljen je projekt konstrukcije čelične nadstrešnice ispred putničkih terminala Zračne luke Dubrovnik. Arhitektonskim podlogama su bile zadane visinske kote i oblik obloge nadstrešnice kao i tlocrtna dispozicija i oblik stupova. Na temelju zadanih gabarita, napravljen je prostorni proračunski model konstrukcije na kojemu je izvršeno dimenzioniranje svih nosivih elemenata. Nakon toga je napravljeno oblikovanje i proračun priključaka, te je izrađena radionička dokumentacija pojedinih elemenata pomoću računalnog programa *Autocad Structural Detailing*.

Na kraju su dati iskazi materijala pojedinih elemenata i ukupne količine materijala potrebne za izgradnju predmetne konstrukcije.

Ključne riječi:

Zračna luka Dubrovnik, nadstrešnica, čelična konstrukcija, priključci, nacrti

The Project of Canopy – Dubrovnik Airport

Abstract:

Based on architectural drawings, was made a steel construction project for canopy in front of the passenger terminal of Dubrovnik airport. Height of the roof, the shape of canopy, ground disposition and shape of the columns was defined with the architectural drawings. Based on given dimensions, a designing model was made on which was autodesign for all support elements performed. Design of joints was made and workshop drawings for particular elements with the software *Autocad Structural Detailing*.

At the end, the bill of material for particular elements was given and also a total quantity of material needed to build present construction.

Keywords:

Dubrovnik Airport, Canopy, Steel Construction, Joints, Drawings

Zahvale:

Zahvaljujem svom mentoru, prof. dr. sc. Bernardinu Perošu na ukazanom povjerenju i pruženoj pomoći tijekom izrade diplomskog rada.

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Od srca zahvaljujem svojoj obitelji na bezuvjetnoj pruženoj potpori tijekom studija, a posebno roditelima Zvonimiru i Janji.

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1. UVOD

1.1. OPĆENITO

Investitor Zračna luka Dubrovnik Čilipi – Konavle na postojećoj lokaciji zračne luke rekonstruira i nadograđuje Pristanišnu zgradu a u sklopu nje i zgradu „C“ – putnički terminal, kao i južnu nadstešnicu koja je obuhvaćena ovim projektom.

Predmet ovog projekta je izrada glavnog projekta i izvedbenog projekta nosivih konstrukcija: Južne nadstrešnice.

U ovoj knjizi, prikazan je cjeloviti dokaz nosivosti i stabilnosti građevine u skladu s Tehničkim propisom za čelične konstrukcije (NN 112/08, NN125/10, NN73/12 i NN136/12) i Tehničkim propisom za betonske konstrukcije (NN 139/09, NN14/10, NN125/10 i NN136/12).

1.2. LOKACIJA

Kao što je gore navedeno, novoprojektirana zgrada „C“ bit će locirana na lokaciji zračne luke Dubrovnik na k.č. 2361/1 k.o. Močići, općina Konavle, na mjestu stare uklonjene zgrade „C“.

Za lokaciju građevine odabrano je da se nalazi u II. području opterećenja vjetrom ($v_{ref,0} = 30\text{m/s}$) prema HRN EN 1991-1-4:2005, području C opterećenja snijegom s krovom na otprilike 175 m n.m. ($s_k = 0,80\text{ kN/m}^2$), prema HRN EN 1991-1-3:2005, te sa potresom intenziteta ($a_g = 2,8\text{ m/s}^2$) očitano na seizmološkoj karti za mikrolokaciju zračne luke, prema HRN EN 1998-1:2011/NA:2011.

Građevina će biti locirana na stabiliziranom autohtonom tlu relativno dobre nosivosti na što ukazuju svi podaci iz geomehaničkih elaborata, koji su citirani u nastavku.

1.3. TEMELJENJE GRAĐEVINE

Detaljan opis svojstava tla na lokaciji građevine dan je u geotehničkim elaboratima koje je izradio Conex-ST d.o.o. iz Splita kojima je određeno dopušteno naprezanje na kontaktu temelj/tlo ispod jače opterećenih temelja samaca od $\delta_{dop} = 500\text{ kPa}$. Prije početka (ili u

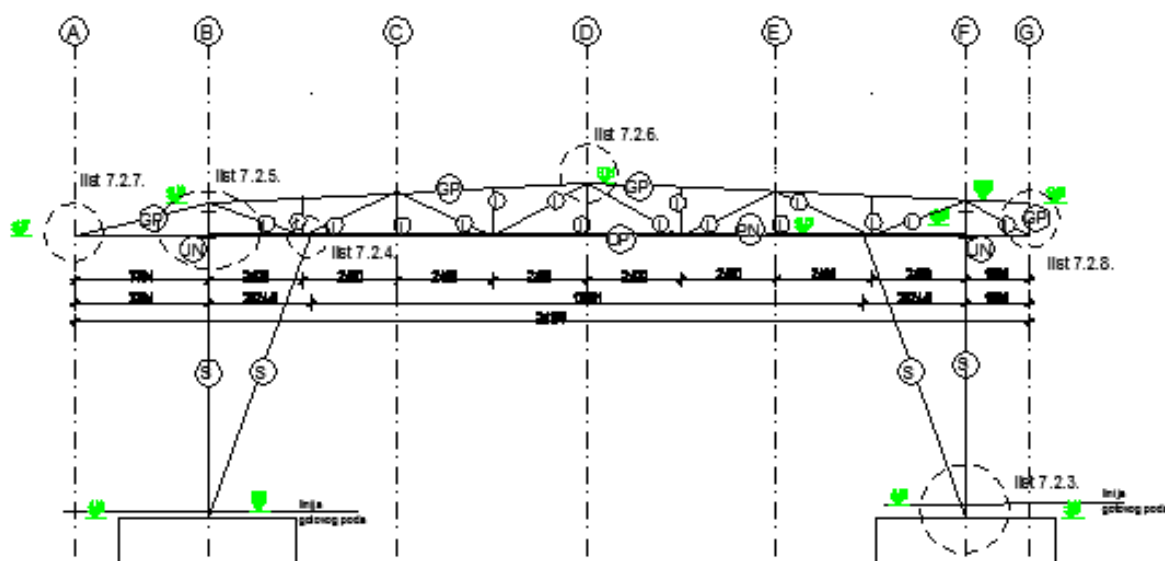
tijeku ukoliko se tlo pokaže lošijim od predviđenog) iskopa predlaže se izvedba prospektorskih i sondažnih bušotina ispod svakog jače opterećenog temelja (svi temelji samci). Ukoliko se na pojedinim mjestima pojavi tlo manje nosivosti predlaže se iskop istog te zamjena tucanikom ili mršavim betonom prema prijedlogu geomehaničara i uz odobrenje nadzornog inženjera.

2. TEHNIČKI OPIS

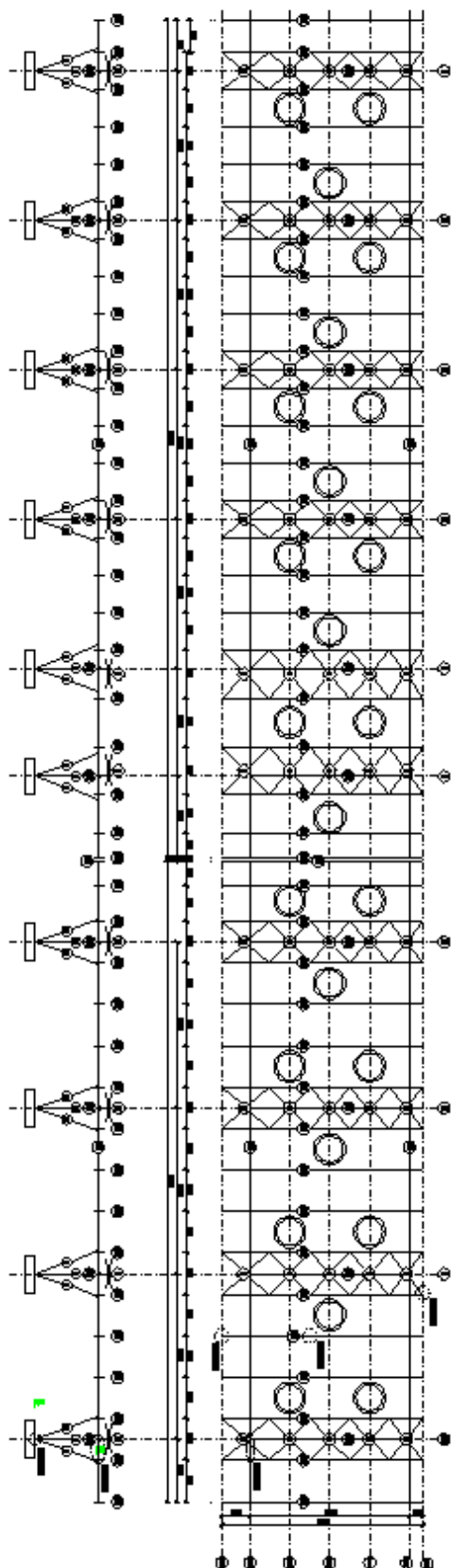
2.1. UVOD

Programski zadatak je dizajnirati nadstrešnicu ispred objekata B i C. Nadstrešnica pokriva kompletnu prometnu površinu za putnike u dolasku (zgrada B) i putnike u odlasku (zgrada C) i ima tlocrtnu površinu od 4500 m² (dilatacija B= 2000 m² , dilatacija C= 2500 m²). Čelična konstrukcija južne nadstrešnice proteže se cijelom duljinom zgrade „B“ i cijelom duljinom zgrade „C“, te je uzdužno prepuštena izvan njenog gabarita za otprilike 10.0 m prema istoku iza osi 9 zgrade „C“, te otprilike 9.0 m prema zapadu iza osi 1 zgrade „B“. Čelična nadstrešnica je zasebna dilatacijska cjelina neovisna o zgradi „B“ i „C“. Nadstrešnica je tlocrtnih dimenzija otprilike 180 (m) x 25 (m). Čini ju nosivi sustav poprečno postavljenih rešetkastih nosača na međusobnom razmaku od 3,0 (m) do 6,0 (m).

Prometnica pod nadstrešnicom se sastoji od prometnih traka širina 3,0 + 4,5 m, otoka, te dviju traka od 3,5 m. Nadstrešnica se mora moći izvoditi u fazama, a konstruktivno je odvojena od ostalih zgrada. Dispozicija nadstrešnice prikazana je na slici 2.1. i slici 2.2.



Slika 2.1: Poprečna dispozicija nadstrešnice



Slika 2.2: Uzdužna dispozicija nadstrešnice

2.2. KONSTRUKTIVNI SUSTAV

Osnovna konstrukcija nadstrešnice sastoji iz krutih uzdužnih greda na koje se priključuju kosi pendl stupovi (po dva na uzdužnu prečku i jedan na poprečnu na svakom stupnom mjestu).

Razmaci glavnih nosivih okvira su različiti i iznose od cca 18,0 do 20,0 m (zbog usklađenja rastera sa zgradama B i C, a poprečni rasponi glavnih nosivih okvira su 19,2 m. Trodijelni stupovi su zglobno vezani za temelje samce i sastoje se od cijevnih profila, visine oko 7.8 m. Iz svakog temelja se iz jedne točke uzdižu tri okrugla stupa presjeka Ø278/8, pod kutom od 20° koji se spajaju na glavni uzdužni nosač presjeka HE 700 A u koje je upeto oslonjen glavni poprečni rešetkasti nosač u poprečnom smjeru nadstrešnice. Glavni uzdužni nosač je u osima glavnih nosivih okvira poprečno povezan u roštiljni sustav preko grede HE 300 A profila.

Limena obloga gornje i donje površine nadstrešnice osigurava se preko sekundarnih elemenata prihvaćenih za poprečne rešetkaste nosače koji se oslanjaju na uzdužni nosač na razmacima od cca 3,0 - 6,0 m. Pojasevi rešetkastih nosača su su iz profila 140/140, a ispuna od 90/90 profila. Uzdužne veze rešetki i stabilizacija se osigurava preko trapeznog lima na gornjem pojasu i spregova iz punih kružnih profila, promjera Ø16.

U limenoj krovnoj i stropnoj oblozi projektirani su okrugli svjetlarnici (26 komada) za koje je predviđena posebna sekundarna konstrukcija.

2.3. MATERIJALI OBLOGE

Pokrov je izveden u dvostranom padu prema olucima dimenzije 45 x 20/15. Izveden je na čeličnom rebrastom limu koji služi i kao poprečna ukruta i podkonstrukcija. Na lim dolaze ploče od mineralne vune debljine 10 cm, a završni materijal je aluminijski lim s preklopima u smjeru okomitom na oluke. Lim je pričvršćen preko klipova, kao sustav KALZIP.

Vidljivi dijelovi nadstrešnice (pogled, zabati i gornji dio „kljuna“ s južne strane do oluka izvedeni su od ravnih aluminijskih ploča na podkonstrukciji od U-profila sa što manjim utorom. Debljina lima je 3 mm. Ploče prema detaljnom izvedbenom projektu.

Sam zaobljeni detalj „kljuna“ na južnoj strani izveden je od inox lima u čitavoj duljini.

2.4. TEMELJI

Južna nadstrešnica temeljiti će se na posebnim temeljnim stopama, tlocrtnih dimenzija 4,5 (m) x 4,5 (m), visine temeljne stope 1,5 (m) iz razloga da velika težina betonske stope bude u stanju oduprijeti se djelovanju vlačne reakcije uslijed djelovanja odižućeg vjetra.

2.5. UTJECAJ NA SUSJEDNE GRAĐEVINE

U polju 8* – 9* s južne i zapadne strane, kao i iza osi 9 na istoku, te uz os C' na sjeveru, temelji građevine će se izvoditi neposredno uz temelje postojećih konstrukcija. Prilikom obavljanja radova na iskopima za temelje potreban je pojačan nadzor da se ne ugrozi stabilnost kosine uz postojeće objekte. Projektom je predviđeno da se novi temelji dovoljno udalje od zidova postojećih građevina zgrade B, tunela T tako da se prilikom obavljanja radova na iskopima ne zadire u temelje postojećih građevina.

S obzirom na karakteristike temeljnog tla, ne očekuje se izraženije dodatno slijeganje tla uslijed dodatnog opterećenja od nove konstrukcije, pa se utjecaj na susjednu građevinu u tom smislu može se zanemariti.

2.6. OPTEREĆENJA

Vrijednosti za proračun opterećenja čelične konstrukcije uzete su prema HRN EN 1991 i HRN EN 1998.

Proračunom čeličnih konstrukcija su obuhvaćena sljedeća opterećenja:

- opterećenje vlastitom težinom
- dodatno stalno opterećenje
- opterećenje vjetrom
- opterećenje uslijed promjene temperature
- opterećenje uslijed djelovanja potresa

2.7. PRORAČUN I DIMENZIONIRANJE

Proračuni su provedeni na prostornim linearno elastičnim KE modelima, programskim paketom Scia Engineer 2015, a dimenzioniranje prema normama na koje se pozivaju Tehnički propis za čelične konstrukcije (NN 112/08, 125/10, 73/12 i NN136/12) i Tehnički propis za betonske konstrukcije (NN 139/09, 14/10, 125/10 i NN136/12) i to prema „eurocode“ pravilima.

2.8. GRADIVA – OSNOVNI MATERIJAL

Čelični materijal za sve nosive elemente predviđen je iz S235J2. Sav okrugli čelik (sidra i zatege) predviđa se iz S355J2 kako za unutarnje, tako i za vanjske elemente. Svi ostali elementi se predviđaju iz S235J2.

Svi čelični profili predviđaju se kao toplovaljani. Nije dopuštena uporaba hladnovaljanih profila.

2.9. VAROVI

Varovi specijalne kvalitete se primjenjuju na dijelovima građevine gdje se pojavljuju sučeoni zavari. Sučeone zavare je potrebno sve ispitati (kontrola 80% ultrazvukom ili sličnom metodom)

Varovi I kvalitete (kontrola 20% ultrazvukom ili sličnom metodom)

varovi cijevi rešetke

varovi pločica na koje se spajaju stupovi.

Svi ostali varovi izvest će se kao varovi II kvalitete.

Konstrukcija je pretežno izvedena kao zavarena, a njeni sastavni dijelovi se spajaju montažno na gradilištu vijcima.

2.10. VIJCI

Svi vijčani spojevi su montažnog karaktera i izvesti će vijcima klase čvrstoće 10.9, osim ako je drugačije naznačeno na nacrtima.

2.11. ZAŠTITA ČELIČNE KONSTRUKCIJE

Zbog važnosti građevine, ovdje se propisuje najviši zahtjev trajnosti sustava antikorozivne zaštite prema HRN EN ISO 12944-1:1998 i to „High durability - more than 15 years“. U smislu agresivnosti sredine propisuje se „C2 low“ zahtjev za zaštitu svih čeličnih konstrukcija, prema tablici 1 iz HRN EN ISO 12944-2:1998.

Prije aplikacije antikorozivne zaštite, metalna podloga mora biti očišćena u stupnju Sa 2.5 (pjeskarenje), prema ISO 8501-1.

U normi HRN EN ISO 12944 navode se uvjeti (tablično) koje sustavi u smislu odabira materijala, broja i debljina slojeva premaza moraju zadovoljiti. Svaki proizvođač sredstva i izvođač radova premazivanja mora dokazati da odabrani sustav udovoljava gore postavljenim zahtjevima od strane projektanta konstrukcija.

U poglavlju „uvjeti održavanja građevine“ koje se nalazi u sklopu „završnog izvješća izvođača radova“ potrebno je navesti da je obnova antikorozivna premaza obavezna najmanje svakih 15 godina. U tom istom izvješću potrebno je navesti koji sustav premaza se koristio, u kojem broju i debljinama slojeva.

Gdje je to regulirano „glavnim arhitektonskim projektom“ i „projektom zaštite od požara“, protupožarna zaštita odgovarajuće klase izvest će se sustavom koji se sastoji od temeljnog premaza, debeloslojnog premaza za protupožarnu zaštitu i završnog premaza ili temeljnog premaza i završnog premaza s odgovarajućim obložnim protupožarnim sustavom.

Propisuje se stalna kontrola procesa izvedbe antikorozivnog premaza, od pripreme podloge, uvjeta prostora za obavljanje ovih radova, do aplikacije odabranog sustava zaštite na elemente konstrukcije. O svim ovim postupcima izvođač je obavezan voditi dnevnik za dio izvedbe u radionici i popravke nakon montaže. U dnevnik je potrebno evidentirati sva oštećenja sustava prilikom transporta i montaže, kao i mjere koje su poduzete u otklanjanju

tih nedostataka.

Zaštita premazima obavlja se u svrhu sprječavanja da kisik i vlaga dođu u dodir s čelikom. Premazivanje se obično vrši bojanjem u dva sloja: osnovni premaz i zaštitni premaz. Osnovni premaz neposredno štiti čelik, a potrebno je da bude izrađen od tvari koje nisu štetne po ljudsko zdravlje. Zaštitni sloj služi za zaštitu osnovnog premaza.

Prerano propadanje konstrukcije najčešće nastaje usljed loših detalja u konstrukciji (nepristupačna mjesta za bojenje, mjesta gdje se zadržava voda, oštri bridovi gdje se nemože nanijeti zahtjevana debljina premaza i sl.) koje treba nastojati izbjegavati.

Sistem zaštite bojenjem sastoji se iz:

- Priprema površine – trajnost premaza ovisi o prionjivosti boje za metalnu površinu, što ovisi o čistoći površine prije bojanja. Čišćenje se vrši četkama, pijeskarenjem, plamenikom ili kemijskim sredstvima.
- Nanošenje boje – bojenje se vrši četkom, valjkom ili prskanjem. Treba paziti na ograničenja za pojedine boje. Broj slojeva premaza obično se sastoji od dva a specifično od četiri ili više slojeva. Novi premaz može se vršiti tek kad je prethodni potpuno suh. Debljini premaza potrebno je posvetiti posebnu pažnju. Općenito, deblji premaz povećava trajnost zaštite. Ukupna debljina suhih premaza treba se kretati između 200-400 µm.

Dobro izvedeni premazi traju:

- do 30 godina u zatvorenoj prostoriji
- do 20 godina kod konstrukcija zaštićenih od kiše
- do 10 godina u prirodi
- 2-3 godine u zagađenom okolišu

Zaštita pocinčavanjem podrazumijeva vrste zaštite koje se ostvaruju nanošenjem prevlake cinka i po toplom postupku. Mase i debljine prevlaka cinka za pojedine elemente određene su prema Pravilniku o tehničkim mjerama i uvjetima za zaštitu čeličnih konstrukcija od korozije i ne mogu biti manje od 500g/m² elementa debljine 5 mm. Sve čelične konstrukcije prethodno treba odmastiti, očistiti razblaženom otopinom klorovodične

kiseline te isprati hladnom vodom. Neposredno prije pocinčavanja čelična konstrukcija se stavlja u taljevinu ili otopinu za flusiranje.

Toplo pocinčavanje se izvodi stavljanjem tekućine u rastopljeni cink. Cink mora biti kvaliteta Zn 97,5 do Zn 99,5 prema HRN EN ISO 14713:2001. Prevlaka cinka dobivena toplim postupkom mora biti homogena i mora prekrivati osnovicu. Prevlaka cinka mora čvrsto prijanjati za čeličnu površinu i ne smije se ljuštiti niti pucati pri uporabi. Prije montaže potrebno je izvršiti kontrolu prevlake cinka prema HRN C.A1. 558, odnosno mase prevlake cinka prema HRN A6.021.

2.12. GRADIVA – ARMIRANO-BETONSKA KONSTRUKCIJA

Sva potrebna gradiva, te njihovi sastojci, trebaju udovoljavati zahtjevima važećih propisa, normi i pravila struke. Ukratko će se navesti osnovna svojstva i zahtjevi na osnovna gradiva (beton, betonski čelik) za glavne konstruktivne elemente.

Predviđena klasa betona za sve armirano-betonske konstrukcije je C 30/37.

Sav betonski čelik predviđa se iz čelika B500B, u svemu prema serijama normi HRN 1130-1:2008 i HRN EN 10080:2005.

2.13. PRIMJENJENI PROPISI

U ovoj knjizi, prikazan je cjelovit dokaz nosivosti i stabilnosti građevine u skladu s Tehničkim propisom za čelične konstrukcije (NN 112/08, 125/10 i 73/12) i Tehničkim propisom za betonske konstrukcije (NN 139/09, 14/10 i 125/10). Zbog usvajanja jednakih proračunskih koncepata prilikom projektiranja čeličnih i armirano-betonskih konstrukcija, dokaz nosivosti i stabilnosti vršen je koristeći se nizom „eurocode“ pravila, a ne pomoću nekih „priznatih tehničkih pravila“.

2.14. UTJECAJ OKOLINE I NAMJENE KONSTRUKCIJSKIH ELEMENATA GRAĐEVINE NA KARAKTERISTIKE NOSIVE KONSTRUKCIJE

Obzirom na namjenu građevine i utjecaje okoliša, te odabranu nosivu konstrukciju, možemo kazati da su utjecaji na karakteristike njenih unutarnjih elemenata tijekom vremena zanemarivi kako za pojedine elemente, tako i za konstrukcijske cjeline. U tom

smislu potrebni su jedino pravovremeni radovi održavanja u smislu antikorozivnih radnji (redovito obnavljanje antikorozivnih i protupožarnih premaza kod čelika i oštećenih zaštitnih slojeva armature po potrebi).

2.15. POSEBNE NAPOMENE

Iskopi

Iskop se djelomično vrši neposredno uz postojeće građevine zračne luke. Na svim kontaktima s postojećim građevinama pretpostavlja se da zaštita građevne jame nije potrebna osim na istočnom dijelu prema zgradi G. Kao mjera zaštite susjednih građevina u ovom projektu je priložen prijedlog stabilizacije pokosa iskopa. Na geomehaničaru i nadzornom inženjeru je da potvrdi i razradi predloženo rješenje nakon uvida stvarnih prilika na terenu prilikom izvedbe iskopa.

Temelji

Svii konstrukcijski elementi temelje se na temeljnim stopama. Preporuča se ispitivanje temeljnog tla ispod svake pojedine stope izvođenjem prospektorske bušotine.

Čelične konstrukcije

Zbog relativno visokog stupnja složenosti čeličnih konstrukcija iz ovog projekta, prije izvođenja čeličnih radova, traži se od Izvođača radova izrada elaborata „Tehnologije izvedbe čelične konstrukcije“, koju trebaju odobriti nadzorni inženjer i projektant konstrukcija.

Uz svaki radionički nacrt čelične konstrukcije potrebno je definirati kvalitetu spojnih sredstava (vijaka). Ovdje se posebno skreće pažnja na sidrene vijke koji osiguravpvezanos cielkostrukcij s temljima, a samim time i sa temeljnim tlom.

2.16. IZVOĐENJE KONSTRUKCIJE – OPĆE NAPOMENE

Predmetni je projekt izrađen sukladno Zakonu o prostornom uređenju i gradnji (NN 76/07, NN 38/09, NN 55/11, NN 90/11 i 55/12).

Sve radove trebaju obavljati za to stručno osposobljene osobe, uz stalni stručni nadzor, konstruktorski projektantski nadzor, te nadzor od strane geomehaničara prilikom radova iskopa, i temeljenja građevine. Prije prelaska na iduću fazu radova, nužno je odobrenje nadzornog inženjera. Za svako odstupanje od projekta, te u slučaju nepredviđenih okolnosti, potrebna je konzultacija i odobrenje projektanta. Izvoditelj je dužan u potpunosti poštivati sve mjere osiguranja i kontrole kvalitete. Svi upotrijebljeni materijali i svi izvedeni radovi trebaju udovoljavati zahtjevima važećih normi, propisa i pravila struke.

2.17. ISKOLČENJE I ZAHTIJEVANA GEOMETRIJA

Od faze iskolčenja građevine, preko svih faza izgradnje, do završetka građevine, nužan je stalni geodetski nadzor.

Tijekom građenja vršiti stalnu kontrolu iskolčenja i druge geometrije svih elemenata, kontrolu osiguranja svih točaka, kontrolu repera i poligonih točaka.

2.18. IZVOĐENJE ČELIČNE KONSTRUKCIJE

Čelična konstrukcija izvesti će se prema Izvedbenom projektu čeličnih konstrukcija, koji će biti izrađen u skladu s ovim Glavnim projektom čeličnih konstrukcija, i u skladu sa svim odredbama priloga „I“ Tehničkog propisa za čelične konstrukcije (TPČK) NN 112/08 , NN125/10, NN73/12 i NN136/12 . U slučaju eventualne neuskađenosti potrebno je bez odgode konzultirati projektanta konstrukcija. Elementi čelične konstrukcije proizvesti će se u radionici prema izvedbenim nacrtima iz izvedbenog projekta u cjelinama, kao predgotovljeni elementi, pod uvjetima kako to predviđa Izvedbeni projekt. Na gradilištu se previđa montaža predgovljenih elemenata, prema detaljima iz izvedbenog projekta. Predgovotvljeni elementi moraju biti proizvedeni, dopremljeni i ugrađeni u skladu s odredbama priloga „F“ TPČK NN 112/08, NN125/10, NN73/12 i NN136/12.

Posebnu pažnju kod izrade čelične konstrukcije posvetiti zavarivanju osnovnih struktura, čišćenju podloge, protupožarnoj i korozivnoj zaštiti.

2.19. KONTROLNI POSTUPCI PRI IZVOĐENJU ČELIČNIH KONSTRUKCIJA

Općenito

Prilikom radova u radionici, tokom montaže i prije puštanja konstrukcije u upotrebu potrebno je vršiti stalne kontrole:

- kontrole kvalitete materijala
- kontrole izrade konstrukcija

Sva ispitivanja za dokazivanje kvalitete materijala i izrade konstrukcija potrebno je povjeriti ovlaštenoj osobi za takva ispitivanja.

Kontrola materijala

Sav upotrijebljeni materijal mora udovoljavati uvjetima iz TPČK i normi na koje se TPČK poziva u prilogima „A“, „B“, „C“, „D“ i „E“.

Materijal za čelične konstrukcije mora biti pažljivo pregledan i ispitan kod nabave i prije preuzimanja, po svim zahtjevima u pogledu čvrstoće, granice razvlačenja, kemijskog sastava, žilavosti, zavarljivosti, tolerancija mjera i dimenzija, strukture, a sve u skladu sa normama iz navedenih priloga TPČK.

Vijci, podložne pločice, matice i tome slični materijali moraju u pogledu kvalitete i dimenzija biti u skladu sa specifikacijama iz ovog projekta i normama iz navedenih priloga TPČK.

Ovi materijali moraju biti ispitani i posjedovati valjanu ispravu o sukladnosti, a ukoliko nisu obaveza je nadzornog inženjera da ih ukloni i zamjeni odgovarajućima. Sve gore navedeno vrijedi za elektrode i žice za zavarivanje.

Nadzorni inženjer mora imati uvid u svaku fazu izrade i montaže, kako na gradilištu tako i u radionici.

Kontrola izrade

Svi elementi konstrukcije, pojedinačno i u cjelini, moraju biti izvedeni oblikom i dimenzijama po ovom projektu.

Izvedba mora biti u skladu s normama koje se odnose na za toleranciju mjera i oblika kod nosivih čeličnih konstrukcija u prilogima iz TPČK.

Kontrola varova

Kontrola kvalitete zavarenih spojeva mora pokriti sve faze izrade konstrukcije tj. preuzimanje materijala, kontrolu i pripremu elektroda, izvođenje te pregled zavarenih spojeva nakon varenja i obrade. O kontroli u svim fazama treba voditi dnevnik zavarivanja. Kontrolu mora vršiti za to kvalificirana i ovlaštena osoba.

Svi varovi ispituju se vizualno, a po dovršenju vara nakon obrade vara i čišćenja, utvrđuju se pukotine i druge nepravilnosti. Nepravilni varovi ne smiju se dodatno navarivati već ih je potrebno ukloniti i ponovno izvesti.

Ovim projektom predviđa se obaveza ispitivanja čeličnih zavarenih spojeva od strane ovlaštene osobe prema „Plan ispitivanja zavarenih spojeva“, koji predlaže Izvođač, a odobravaju nadzorni inženjer i projektant konstrukcija i to:

Varovi specijalne kvalitete: (kontrola: 80% ultrazvučno ili sličnom metodom, 20% radiografsko snimanje)

- sučeoni varovi nastavaka vlačnih lamela glavnih nosača krovne konstrukcije
- sučeoni nastavci glavnih nosača svih mostova

Varovi I kvalitete (kontrola 20% ultrazvukom ili sličnom metodom)

- ostali varovi glavnog nosača krovne konstrukcije
- ostali varovi konstrukcija svih mostova
- varovi konstrukcija tetiva čeličnih stubišta

Svi ostali su varovi II kvalitete (vizualni pregled).

Kontrola vijčanih spojeva

Kontrola vijčanih spojeva podrazumijeva kontrolu klase vijaka, dimenzija vijaka, te eventualno sila prednapinjanja gdje su prednapeti vijci projektom predviđeni. Glave vijaka i matice moraju uredno nalijegati cijelom svojom površinom. Kod kosih spojeva potrebno je ugraditi klinaste podložne pločice, a sve prema normama koje su citirane prilogom „B“ TPČK.

Izrada i montaža konstrukcije

Ovim projektom određena je vrsta i kvaliteta materijala za izradu konstrukcija.

Izvođač radova dužan je, prije izvođenja, predložiti nadzornom inženjeru:

- plan zavarivanja sa rasporedom i redoslijedom zavarivanja
- plan montaže sa načinom i redoslijedom montaže
- isprave o sukladnosti materijala za izradu konstrukcije
- isprave o sukladnosti spojnih sredstava (vijčane robe, elektroda i dr.)
- ateste varioca koji će raditi na izradi konstrukcije

Za vrijeme izrade konstrukcije izvođač je dužan voditi :

- radionički dnevnik (proizvodnja nosača, izvedba antikorozivne zaštite)
- dnevnik zavarivanja
- dnevnik montaže

Svi sastavni dijelovi konstrukcije moraju biti izrađeni prema radioničkim nacrtima u skladu s Glavnim i Izvedbenim projektom čeličnih konstrukcija. Sve izmjene i dopune moraju se evidentirati, a za njih je potrebno ishoditi dokaze nosivosti i stabilnosti i suglasnost projektanta.

Svi varovi i montažni spojevi moraju se očistiti i ispraviti nepravilno izvedeni dijelovi, te je tek nakon obavljenih kontrola, dopušteno izvoditi korozivnu i protupožarnu zaštitu.

Korozivna i protupožarna zaštita

Čelične konstrukcije korozivno i protupožarno će se štititi premazivanjem.

Zbog važnosti građevine, ovdje se propisuje najviši zahtjev trajnosti sustava antikorozivne zaštite prema HRN EN ISO 12944-1:1998 i to „High durability - more than 15 years“.

U smislu agresivnosti sredine propisuje se „C1 low“ zahtjev za zaštitu svih unutrašnjih čeličnih konstrukcija, a „C3 medium“ zahtjev za zaštitu vanjskih elemenata konstrukcija (čelične konstrukcije aviomostova i južne nadstrešnice) prema tablici 1 iz HRN EN ISO 12944-2:1998.

Prije aplikacije korozivne zaštite, metalna podloga mora biti očišćena u stupnju Sa 2.5 (pjeskarenje), prema ISO 8501-1.

U normi HRN EN ISO 12944 navode se uvjeti (tablično) koje sustavi u smislu odabira materijala, broja i debljina slojeva premaza moraju zadovoljiti. Svaki proizvođač sredstva i izvođač radova premazivanja mora dokazati da odabrani sustav udovoljava gore postavljenim zahtjevima od strane projektanta konstrukcija.

Gdje je to regulirano „glavnim arhitektonskim projektom“ i „projektom zaštite od požara“, protupožarna zaštita odgovarajuće klase izvest će se sustavom koji se sastoji od temeljnog premaza, debeloslojnog premaza za protupožarnu zaštitu i završnog premaza ili temeljnog premaza i završnog premaza s odgovarajućim obložnim protupožarnim sustavom.

U poglavlju „Uvjeti održavanja građevine“ koje se nalazi u sklopu „završnog izvješća izvođača radova“ potrebno je navesti da je obnova antikorozivna premaza obavezna najmanje svakih 15 godina, a protupožarnog svakih 5 godina. U tom istom izvješću potrebno je navesti koji sustav premaza se koristio, u kojem broju i debljinama slojeva.

Propisuje se stalna kontrola procesa izvedbe antikorozivnog i protupožarnog premaza, od pripreme podloge, uvjeta u prostoru za obavljanje ovih radova, do aplikacije odabranog sustava zaštite na elemente konstrukcije. O svim ovim postupcima izvođač je obavezan voditi dnevnik za dio izvedbe u radionici i popravke nakon montaže. U dnevnik je potrebno evidentirati sva oštećenja sustava prilikom transporta i montaže, kao i mjere koje su poduzete u otklanjanju tih nedostataka.

Obračun čelične konstrukcije

Obračun radova na izradi i montaži konstrukcije utvrđuje se ugovorom između naručioca i izvođača radova.

Ako ugovorom nije drukčije definirano dijelovi čelične konstrukcije čija je izmjerena težina veća od računske težine, i to za više od 6% za dijelove iz topljenog čelika, odnosno za više od 10% za dijelove od lijevanog čelika, kao i svi dijelovi čija je izmjerena težina manja od računske za više od 2% mogu se odbaciti.

Za one elemente koji nisu standardizirani u pogledu težine, uzimaju se slijedeće vrijednosti:

- 1) 8000 kg/m³ za čelične limove i plosnate čelike
- 2) 7850 kg/m³ za lijevano željezo

Na težinu materijala iz projekta dodaju se težine spojnih sredstava i to :

- 1) 3% za obične vijke
- 2) 1,5% za zavarenu konstrukciju
- 3) 2% za više različitih spojnih sredstava

Ukoliko dodatak za spojna sredstva nije obračunat u specifikaciji iz projekta, smatra se obračunatim u jediničnoj cijeni.

Ukoliko projektom ili ugovorom između investitora i izvođača nije drukčije ugovoreno, antikorozivna zaštita obračunata je u jediničnoj cijeni izrade i montaže konstrukcije.

2.20. NAČIN ODRŽAVANJA I PROJEKTIRANI VIJEK UPORABE GRAĐEVINE

Radnje u okviru održavanja čeličnih i betonskih konstrukcija treba provoditi prema odredbama TEHNIČKOG PROPISA ZA ČELIČNE KONSTRUKCIJE NN112/08 i NN125/10, NN73/12 i NN136/12, te TEHNIČKOG PROPISA ZA BETONSKE KONSTRUKCIJE NN139/09, NN14/10, NN125/10 i NN 136/12. Izjavu o izvedenim radovima i uvjetima održavanja građevine dužan je prirediti Izvođač u skladu s pozitivnom regulativom RH, tehničkim propisima, normama na koje se oni pozivaju, te Glavnim i Izvedbenim projektom.

Redovite preglede u svrhu održavanja čelične i a-b konstrukcije iz ovog projekta potrebno je provoditi najmanje svakih 5 godina.

Način obavljanja pregleda je slijedeći:

- a) vizualni pregled konstrukcija, u kojeg je uključeno utvrđivanje položaja i veličine progiba, pukotina, relativnih pomaka pojedinih elemenata konstrukcije, potencijalnih prodora vode koji dugoročno ugrožavaju pojedine elemente konstrukcija, te drugih oštećenja kao što su naknadno izvedeni proboji i intervencije u nekim elementima konstrukcija i slično, a koji su bitni za očuvanje mehaničke otpornosti i stabilnosti građevine
- b) utvrđivanje stanja zaštitnih slojeva
- c) utvrđivanje stanja montažnih nastavaka, spojeva (spojnih sredstava: varova, pločevina, vijaka)
- d) utvrđivanje gubitaka inicijalnih sila (minimalna zategnutost vlačnih elemenata, zategnutost vlačnih elemenata kod prednapetih konstrukcija ostakljenja)
- e) utvrđivanja stanja korozivne i protupožarne zaštite

Način održavanja:

- a) redovito obnavljanje antikorozivnih premaza minimalno svakih 15 godina
- b) redovito obnavljanje protupožarnih premaza minimalno svakih 5 godina
- c) obnavljanje oštećenih elemenata ab konstrukcije (zaštitnih slojeva armature)

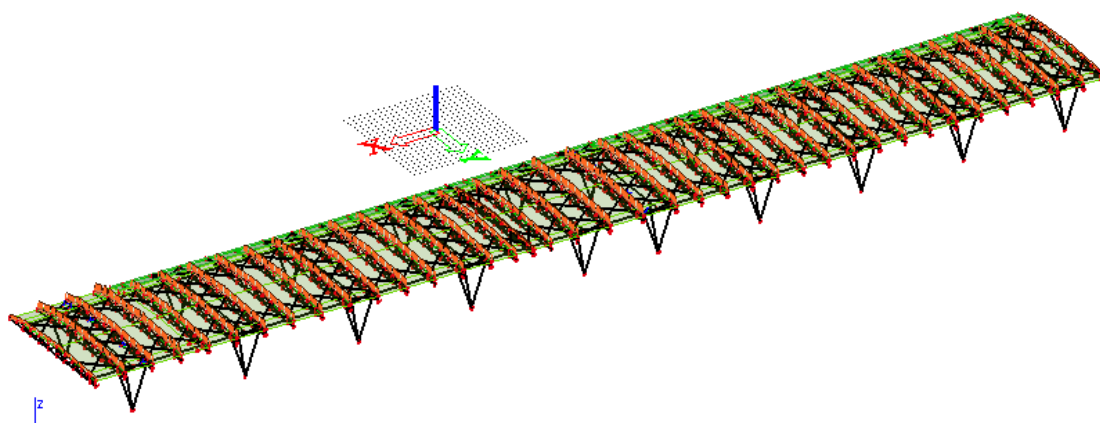
Dokumentaciju o izvršenim pregledima i drugu dokumentaciju o održavanju čelične konstrukcije dužan je trajno čuvati vlasnik građevine. Uporabni vijek predmetnih konstrukcija je najmanje 50 godina.

3. ANALIZA OPTEREĆENJA

3.1. DODATNO STALNO OPTEREĆENJE (Δg)

- sendvič panel $0,20 \text{ kN/m}^2$
- sekundarna konstrukcija + spregovi $0,20 \text{ kN/m}^2$
- instalacije $0,10 \text{ kN/m}^2$
- opterećenje svjetlarnicama $0,50 \text{ kN/m}^2$

$$\Delta g = 1,0 \text{ kN/m}^2$$



Slika 3.1: Prikaz dodatnog stalnog opterećenja na konstrukciju

3.2. OPTEREĆENJEJ SNIJEGOM (s)

Opterećenje snijegom na krovu

$$s = \mu_i \cdot C_e \cdot C_t \cdot s_k$$

- μ_i - koef. oblika za opterećenje snijegom

$$\text{krov nagiba } \alpha_1 = \alpha_2 \cong 0^\circ \Rightarrow \mu_1 = \mu_2 = 1,0$$

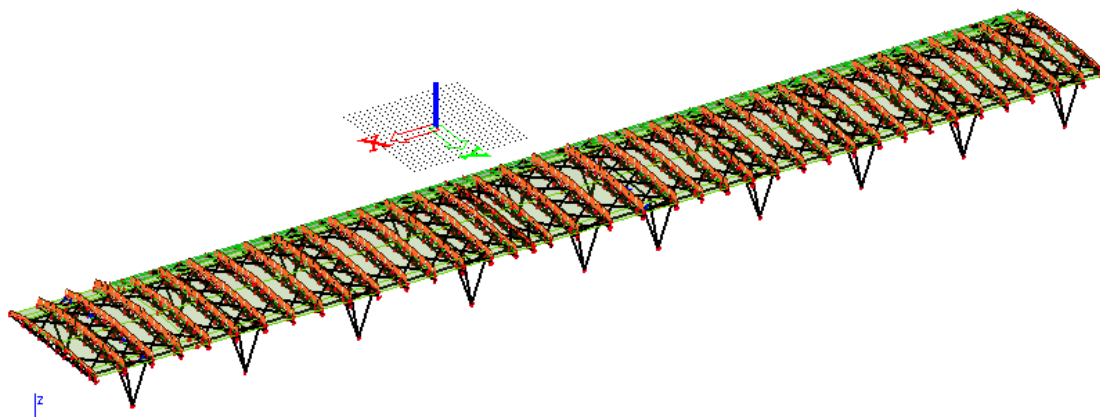
- s_k - karakteristična vrijednost opterećenja na tlu u (kN/m^2)

$$\text{zona Dubrovnik, područje C, nadmorska visina do 200 m n.v.} \Rightarrow s_k = 0,8 (\text{kN/m}^2)$$

- C_e - koef. izloženosti $\Rightarrow C_e = 1,0$

- C_t - toplinski koef. $\Rightarrow C_t = 1,0$

$$\Rightarrow s_1 = 1,0 \cdot 1,0 \cdot 1,0 \cdot 0,8 = 0,8 (\text{kN/m}^2)$$



Slika 3.2: Prikaz opterećenja snijegom na konstrukciju

3.3. OPTEREĆENJE VJETROM

Opterećenje vjetrom okomito na površinu

$w_e = q_{ref} \cdot c_e(z_e) \cdot c_{pe}$ – (kN/m²) - pritisak vjetra na vanjske površine

q_{ref} - poredbeni tlak pri srednjoj brzini vjetra

$c_e(z_e)$, $c_e(z_i)$ - koef. izloženosti koji uzimaju u obzir neravnine terena

z_e , z_i - poredbene visine za lokalni ili unutarnji tlak

c_{pe} , c_{pi} - koef. vanjskog i unutarnjeg tlaka

$$- q_{ref} = \frac{\rho}{2} \cdot v_{ref}^2$$

- ρ - gustoća zraka

- $v_{ref} = c_{DIR} \cdot c_{TEM} \cdot c_{ALT} \cdot v_{ref,0}$ - poredbena brzina vjetra

$v_{ref,0} = 30(m/s)$ - osnovna poredbena brzina vjetra za II. zonu

$c_{DIR} = 1,0$ - koef. smjera vjetra

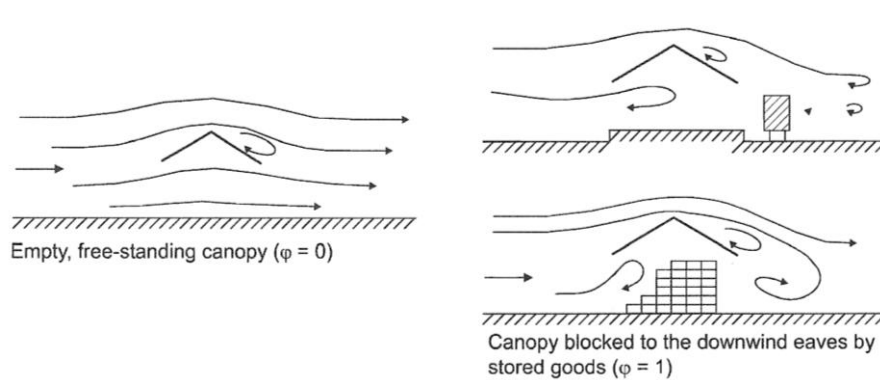
$c_{TEM} = 1,0$ - koef. ovisan o godišnjem dobu

$c_{ALT} = 1 + 0,001 \cdot a_s = 1 + 0,001 \cdot 170 = 1,2$ - koef. nadmorske visine,

a_s - nadmorska visina (m)

$$\Rightarrow v_{ref} = 1,0 \cdot 1,0 \cdot 1,2 \cdot 30 = 36,0(m/s)$$

koeficijent zapunjenosti $\varphi = 1,0$



Slika 3.3: Koeficijent zapunjenosti ispod nadstrešnice

zona Dubrovnik; II. kategorija zemljišta;

visina objekta $h \approx 9,0(m)$; $v_{ref} = 36,0(m/s)$; $\rho = 1,25(kg/m^3)$

$$\Rightarrow q_{ref} = \frac{1,25}{2} \cdot 36,0^2 = 450,0(N/m^2) = 0,45(kN/m^2)$$

$$\Rightarrow c_e(z_e) = c_e(z_i) = 3,0$$

Pritisak vjetra na vanjske površine računa se po izrazu:

$$w_e = q_{ref} \cdot c_e(z_e) \cdot c_{pe} = 0,45 \cdot 3,0 \cdot c_{pe} = 1,35 \cdot c_{pe}(kN/m^2)$$

3.3.1. Odižući vjetar (w_d)

			Net Pressure coefficients $c_{p,net}$ Key plan		
Roof angle α	Blockage φ	Overall Force Coefficients c_f	Zone A	Zone B	Zone C
0°	Maximum all φ	+ 0,2	+ 0,5	+ 1,8	+ 1,1
	Minimum $\varphi = 0$	- 0,5	- 0,6	- 1,3	- 1,4
	Minimum $\varphi = 1$	- 1,3	- 1,5	- 1,8	- 2,2

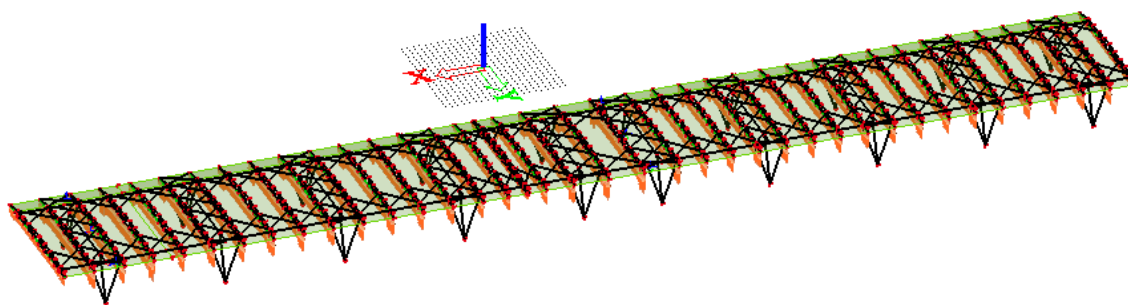
Slika 3.4: Koeficijenti pritisaka vjetra na nadstrešnicu prema HRN EN 1991-1-4:2005

- koef. vanjskog tlaka $\alpha_1 = \alpha_2 \cong 0^\circ$

d=25 m; b = 180 m

PODRUČJE	A	B	C
c_{pe}	-1,50	-1,80	-2,20
w_e (kN/m ²)	-1,95	-2,34	-2,86

Tablica 3.1: Rezultirajuće djelovanje vjetra na konstrukciju po zonama



Slika 3.5: Prikaz opterećenja vjetrom odozdo na konstrukciju

3.3.2. Vjetar odozgo (w_g)

			Net pressure coefficients $c_{p,net}$			
			Key plan			
Roof angle α [°]	Blockage φ	Overall Force Coefficient c_t	Zone A	Zone B	Zone C	Zone D
+ 5	Maximum all φ	+ 0,3	+ 0,6	+ 1,8	+ 1,3	+ 0,4
	Minimum $\varphi = 0$	- 0,6	- 0,6	- 1,4	- 1,4	- 1,1
	Minimum $\varphi = 1$	- 1,3	- 1,3	- 2,0	- 1,8	- 1,5

Slika 3.6 Koeficijenti pritiska vjetra na nadstrešnicu prema HRN EN 1991-1-4:2005

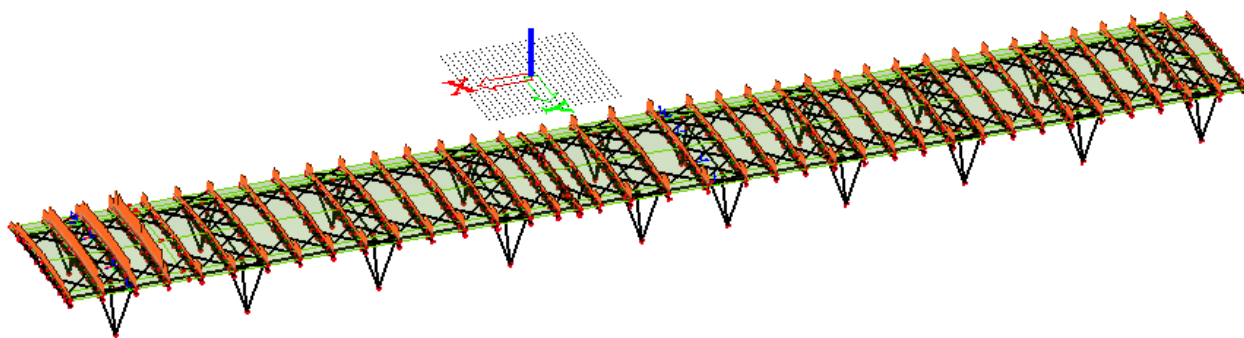
- koef. vanjskog tlaka za krov nagiba $\alpha_1 = \alpha_2 \cong 5^\circ$

d=25 m; b = 180 m

PODRUČJE	A	B	C
c_{pe}	+0,60	+1,80	+1,30
w_e (kN/m ²)	+0,78	+2,34	+1,69

Tablica 3.2: Rezultirajuće djelovanje vjetra na konstrukciju po zonama

Područje zone D je uzeto u proračun sa koeficijentima zone C.



Slika 3.7: Prikaz opterećenja vjetrom odozgo na konstrukciju

3.4. TEMPERATURNO DJELOVANJE (t)

Temperaturno djelovanje se promatra kao linearna promjena temperature cijele konstrukcije odjednom, dok je nelinearna promjena temperature pojedinih dijelova konstrukcije zanemarena zbog činjenice da je cijela konstrukcija obložena, tj zatvorena sendvič panelima koji su ispunjeni termoizolacijskim materijalom.

Za proračun temperaturnog djelovanja uzeto je da se montaža obavlja na +10 °C, a mjerodavna maksimalna i minimalna temperatura je uzeta prema HRN EN 1991-1-5:2003

Tablica NAD.1 – Najviše temperature zraka u hladu u ovisnosti o nadmorskoj visini

Nadmorska visina do [m]	I. područje [°C]	II. područje [°C]	III. područje [°C]	IV. područje [°C]
100	39	38	42	39
400	36	36	39	39
800	33	34	36	39
1200	30	32	34	--
1600	28	30	31	--

Tablica NAD.2 – Najniže temperature zraka u hladu u ovisnosti o nadmorskoj visini

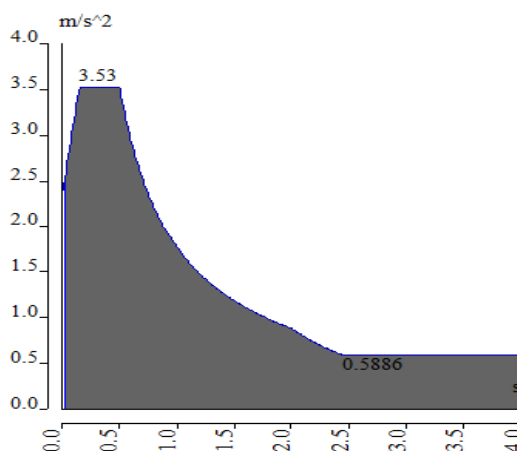
Nadmorska visina do [m]	I. područje [°C]	II. područje [°C]	III. područje [°C]	IV. područje [°C]	V. područje [°C]
100	-26	-26	-17	-10	-16
400	-23	-26	-19	-13	-18
800	-20	-26	-21	-17	-19
1200	-17	-26	-23	-20	-21
1600	--	-26	-24	-24	-23
>1600	--	-26	--	-26	-24

Tablica 3.3: Mjerodavne temperature zraka po zonama

Za područje Dubrovnika, uzeto je područje II. za maksimalnu temperaturu $T_{\max} = +38\text{ °C}$, a područje IV. za minimalnu temperaturu $T_{\min} = -10\text{ °C}$, te tome pripadajuće razlike temperatura $\Delta T_{\max} = +38 - (-10) = +48\text{ °C}$ i $\Delta T_{\min} = -10 - (-20) = +10\text{ °C}$.

3.5. OPTEREĆENJE POTRESOM (e)

Opterećenje potresom je zadano prema seizmološkoj karti Hrvatske za područje Dubrovnika kao vrijednost horizontalnog ubrzanja tla $a_g = 0,28g$. Temeljno tlo na kojemu se građevina nalazi je kategorije A, a faktor ponašanja je uzet $q = 2,5$ za linearno ponašanje čelične konstrukcije, te je prema tim podacima automatski izrađen proračunski spektar odgovora konstrukcije.



Slika 3.8: Proračunski spektar odgovora konstrukcije

Potres je zadan u računalnom programu, te generiran automatski na temelju sudjelujućih masa generiranih iz opterećenja vlastitom težinom i dodatnog stalnog opterećenja.

Na temelju tih ulaznih podataka napravljena je modalna analiza iz koje su dobiveni vlastiti oblici konstrukcije i njima prpadajući periodi sa sudjelujućim masama. Proračunom je obuhvaćeno prvih 50 vlastitih oblika koji skupa obuhvaćaju 91% mase u smjeru osi x, 99% mase u smjeru osi y, te 35% mase u smjeru osi z.

Daljnijim postupkom, računate su rezne sile od potresnog opterećenja, tako da je u analizi potresa iz jednog smijera uzeto da potres djeluje sa 30% svoga intenziteta i u dva ostala otrogonalna smijera.

Mode	Omega [rad/s]	Period [s]	Freq. [Hz]	Wxi / Wxtot	Wyi / Wytot	Wzi / Wztot	Wxi_R / Wxtot_R	Wyi_R / Wytot_R	Wzi_R / Spectral
1	6.8085	0.9228	1.0836	0.0000	0.4170	0.0000	0.0001	0.0000	0.3443
2	7.2900	0.8619	1.1602	0.0000	0.5651	0.0000	0.0002	0.0000	0.2889
3	7.9548	0.7899	1.2660	0.0001	0.0094	0.0000	0.0000	0.0000	0.1448
4	8.0934	0.7763	1.2881	0.0000	0.0005	0.0000	0.0000	0.0000	0.1972
5	10.9036	0.5762	1.7354	0.0000	0.0004	0.0000	0.0000	0.0000	0.0007
6	12.4702	0.5039	1.9847	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002
7	13.6061	0.4618	2.1655	0.0991	0.0000	0.0001	0.0000	0.0000	0.0000
8	14.0677	0.4466	2.2385	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
9	14.8198	0.4240	2.3586	0.0001	0.0003	0.0000	0.0000	0.0000	0.0027
10	16.4659	0.3816	2.6206	0.2396	0.0000	0.0013	0.0000	0.0004	0.0000
11	17.8473	0.3521	2.8405	0.0024	0.0000	0.0000	0.0001	0.0000	0.0012
12	19.4914	0.3224	3.1022	0.2961	0.0000	0.0027	0.0000	0.0008	0.0000
13	19.6160	0.3203	3.1220	0.0786	0.0000	0.0007	0.0000	0.0002	0.0000
14	22.1618	0.2835	3.5272	0.0002	0.0000	0.0001	0.0010	0.0000	0.0030
15	22.7073	0.2767	3.6140	0.0001	0.0000	0.0241	0.0014	0.0002	0.0000
16	23.2179	0.2706	3.6953	0.0002	0.0000	0.0213	0.0010	0.0482	0.0000
17	23.3106	0.2695	3.7100	0.0001	0.0001	0.0007	0.0003	0.0000	0.0011
18	23.4531	0.2679	3.7327	0.0000	0.0000	0.0001	0.0000	0.0004	0.0000
19	23.4898	0.2675	3.7385	0.0002	0.0000	0.0000	0.0000	0.0038	0.0000
20	23.5619	0.2667	3.7500	0.0001	0.0000	0.0675	0.0033	0.0499	0.0000
21	24.3511	0.2580	3.8756	0.0149	0.0000	0.0364	0.0014	0.0002	0.0000
22	24.3625	0.2579	3.8774	0.0000	0.0000	0.0003	0.0000	0.0008	0.0000
23	24.4948	0.2565	3.8985	0.0000	0.0000	0.0003	0.0000	0.0011	0.0000
24	24.5861	0.2556	3.9130	0.0236	0.0000	0.0008	0.0001	0.0030	0.0000
25	24.6110	0.2553	3.9170	0.0000	0.0000	0.0031	0.0003	0.0219	0.0000
26	24.6926	0.2545	3.9299	0.0022	0.0000	0.0525	0.0021	0.0318	0.0000
27	24.8334	0.2530	3.9524	0.0000	0.0000	0.0033	0.0002	0.0036	0.0000
28	24.8637	0.2527	3.9572	0.0001	0.0000	0.0001	0.0000	0.0100	0.0000
29	24.8927	0.2524	3.9618	0.0000	0.0000	0.0948	0.0048	0.1057	0.0000
30	25.1676	0.2497	4.0056	0.0066	0.0000	0.0018	0.0000	0.0004	0.0000
31	25.2524	0.2488	4.0190	0.0025	0.0000	0.0112	0.0007	0.0025	0.0000
32	25.3029	0.2483	4.0271	0.0203	0.0000	0.0046	0.0003	0.0000	0.0000
33	25.5496	0.2459	4.0663	0.0001	0.0000	0.0000	0.0000	0.0005	0.0000
34	25.6256	0.2452	4.0784	0.0151	0.0000	0.0048	0.0000	0.0002	0.0000
35	25.7017	0.2445	4.0906	0.0000	0.0000	0.0000	0.0000	0.0007	0.0000
36	25.7659	0.2439	4.1008	0.0096	0.0000	0.0002	0.0000	0.0006	0.0000
37	25.9865	0.2418	4.1359	0.0019	0.0000	0.0001	0.0000	0.0009	0.0000
38	25.9893	0.2418	4.1363	0.0101	0.0000	0.0021	0.0002	0.0037	0.0001
39	26.2335	0.2395	4.1752	0.0002	0.0000	0.0093	0.0007	0.0150	0.0000
40	26.3902	0.2381	4.2001	0.0028	0.0000	0.0003	0.0000	0.0000	0.0000
41	26.5413	0.2367	4.2242	0.0005	0.0000	0.0014	0.0005	0.0031	0.0026
42	26.8143	0.2343	4.2676	0.0142	0.0000	0.0001	0.0008	0.0004	0.0022
43	26.8650	0.2339	4.2757	0.0008	0.0000	0.0000	0.0000	0.0001	0.0000
44	27.0368	0.2324	4.3030	0.0014	0.0000	0.0002	0.0001	0.0018	0.0001
45	27.2431	0.2306	4.3359	0.0010	0.0000	0.0006	0.0000	0.0005	0.0000
46	27.2516	0.2306	4.3372	0.0012	0.0000	0.0002	0.0001	0.0000	0.0000
47	27.5044	0.2284	4.3775	0.0019	0.0000	0.0006	0.0001	0.0019	0.0000
48	27.8478	0.2256	4.4321	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
49	27.9611	0.2247	4.4501	0.0005	0.0000	0.0002	0.0000	0.0012	0.0000
50	28.4262	0.2210	4.5242	0.0006	0.0000	0.0005	0.0000	0.0013	0.0000
				0.9092	0.9929	0.3482	0.0196	0.3162	0.9895

Tablica 3.4: Vlastiti oblici konstrukcije

3.6. KOMBINACIJE DJELOVANJA

Prema nabrojenim i prikazanim opterećenjima, zaključeno je da su četiri kombinacije mjerodavne za dimenzioniranje svih elemenata konstrukcije, pa su tako u obzir uzete samo te četiri kombinacije za krajnje granično stanje i te iste četiri za granično stanje uporabe.

Kombinacije krajnjeg graničnog stanja:

$$GSN_1 - 1,0 (g + \Delta g) + 1,5 w_d$$

$$GSN_2 - 1,35 (g + \Delta g) + 1,5 w_g + 1,5 \cdot 0,9 s$$

$$GSN_3 - 1,0 (g + \Delta g) + 1,0 e_x + 0,3 e_y + 0,3 e_z$$

$$GSN_4 - 1,0 (g + \Delta g) + 0,3 e_x + 1,0 e_y + 0,3 e_z$$

Kombinacije za granično stanje uporabe:

$$GSU_1 - 1,0 (g + \Delta g) + 1,0 w_d$$

$$GSU_2 - 1,0 (g + \Delta g) + 1,0 w_g + 1,0 \cdot 0,9 s$$

$$GSU_3 - 1,0 (g + \Delta g) + 1,0 e_x + 0,3 e_y + 0,3 e_z$$

$$GSU_4 - 1,0 (g + \Delta g) + 0,3 e_x + 1,0 e_y + 0,3 e_z$$

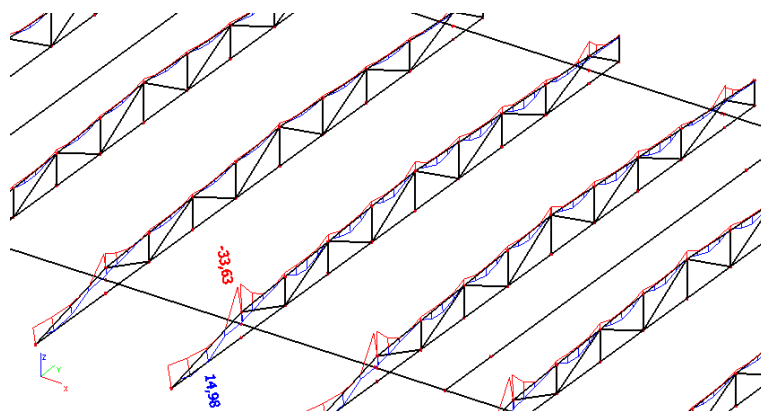
4. DIJAGRAMI REZNIH SILA I POMAKA

4.1. UVOD

Prikaz reznih sila rađen je tako da su prikazane anvelope dijagrama reznih sila za sve kombinacije opterećenja za pojedine nosive elemente (gornji pojas, donji pojas, ispuna, uzdužna greda, poprečna greda, stupovi i spreg)

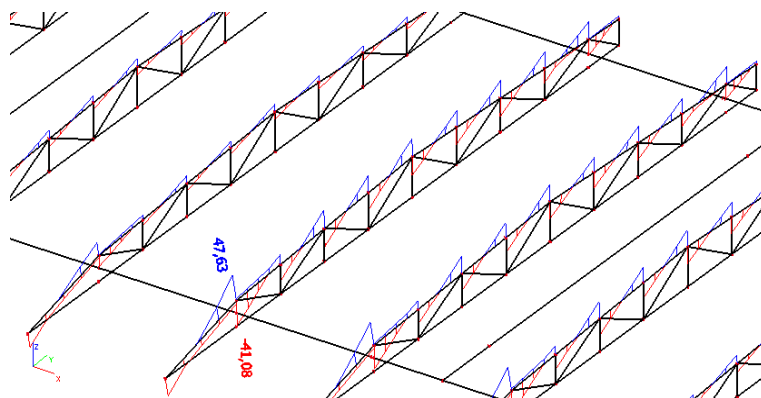
4.2. PRIKAZ REZNIH SILA GORNJEG POJASA REŠETKE

M_y (kNm)

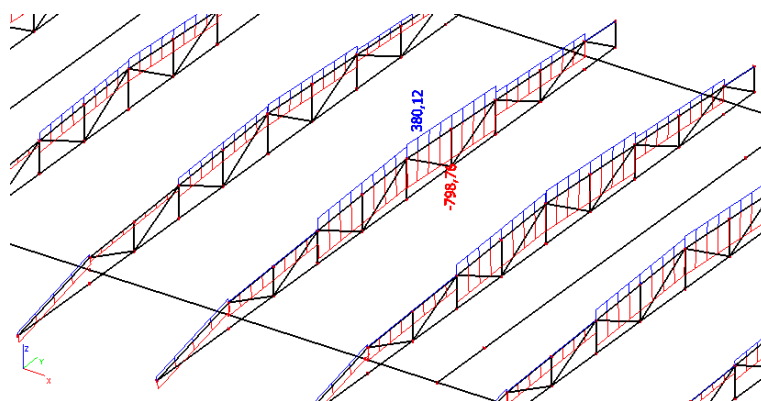
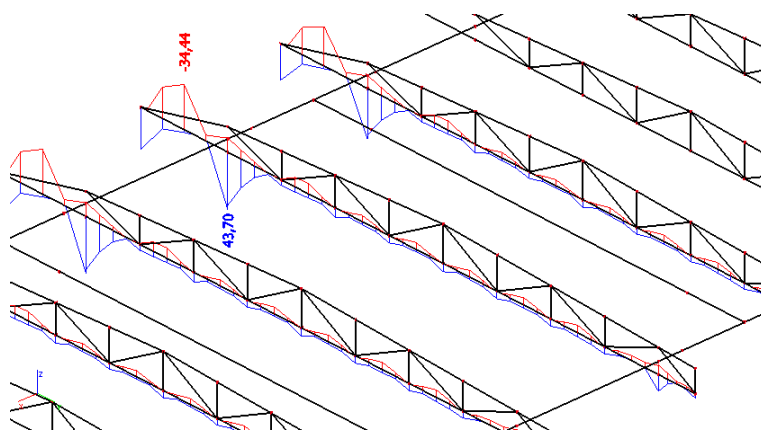
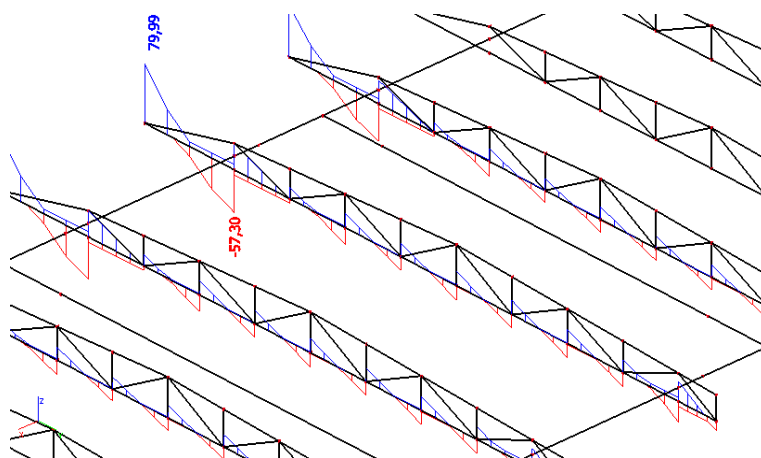


Slika 4.1: Proračunski moment savijanja gornjeg pojasa rešetke

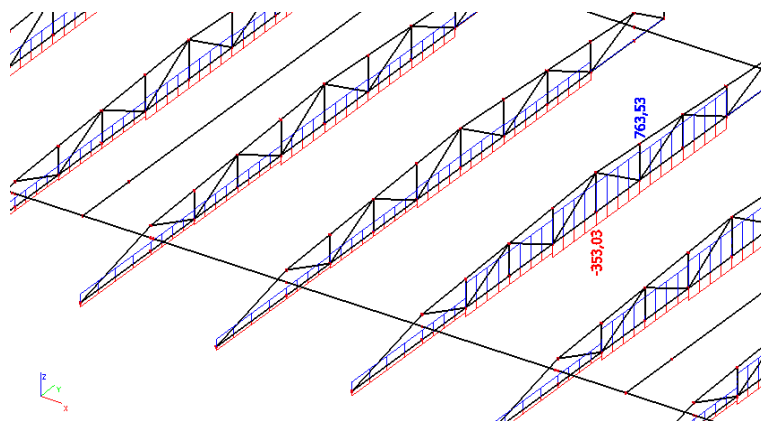
V_z (kN)



Slika 4.2: Proračunska poprečna sila u gornjem pojasu rešetke

N (kN)**Slika 4.3:** Proračunska uzdužna sila u gornjem pojasu rešetke**4.3. PRIKAZ REZNIH SILA DORNJEG POJASA REŠETKE****My (kNm)****Slika 4.4:** Proračunski moment savijanja donjeg pojasa rešetke**Vz (kN)****Slika 4.5:** Proračunska poprečna sila u donjem pojasu rešetke

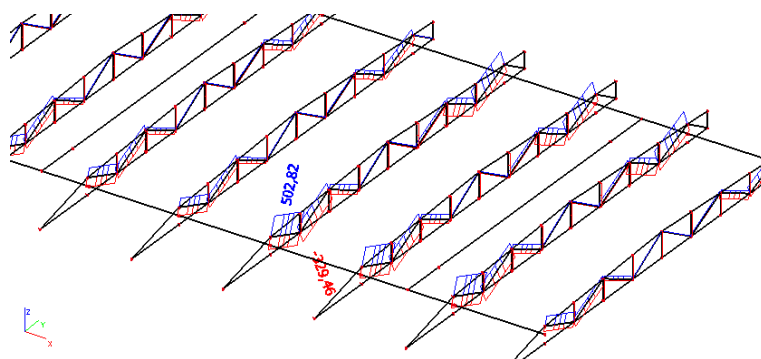
N (kN)



Slika 4.6: Proračunska uzdužna sila u donjem pojava rešetke

4.4. PRIKAZ REZNIH SILA ISPUNE REŠETKE

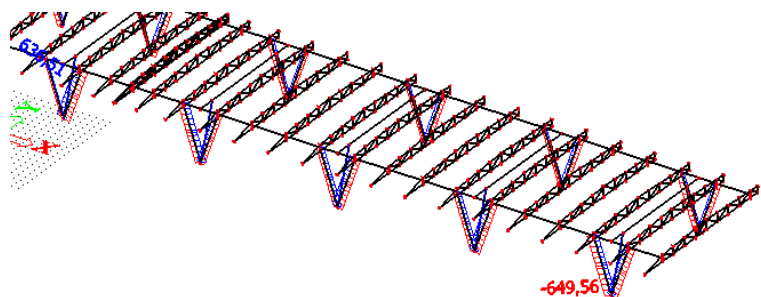
N (kN)



Slika 4.7: Proračunska uzdužna sila u ispuni rešetke

4.5. PRIKAZ REZNIH SILA STUPA

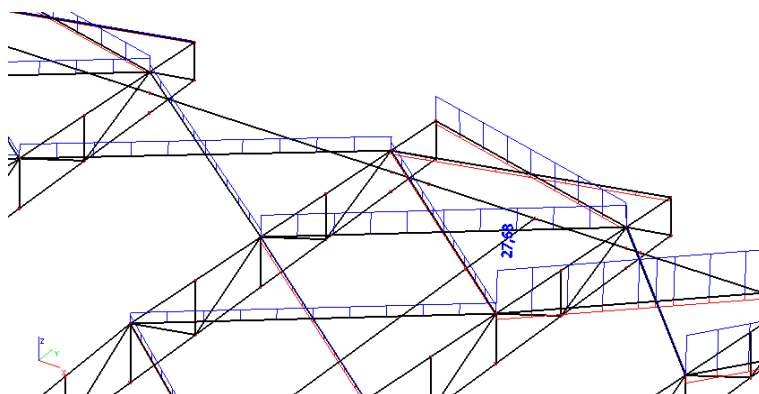
N (kN)



Slika 4.8: Proračunska uzdužna sila u stupovima

4.6. PRIKAZ REZNIH SILA SPREGA ZA STABILIZACIJU

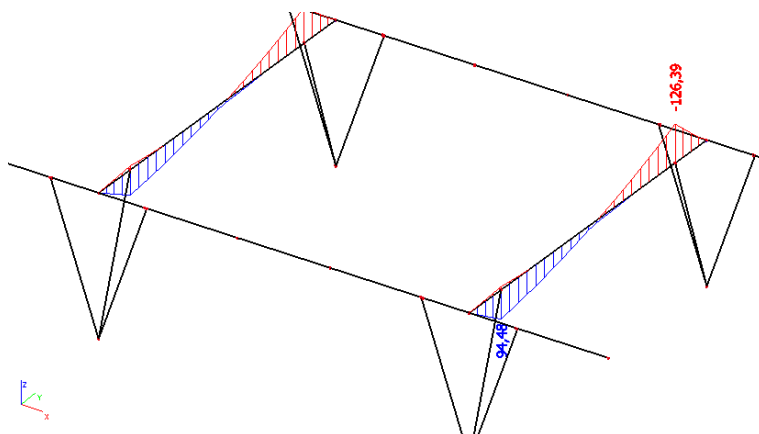
N (kN)



Slika 4.9: Proračunska uzdužna sila u spregovima

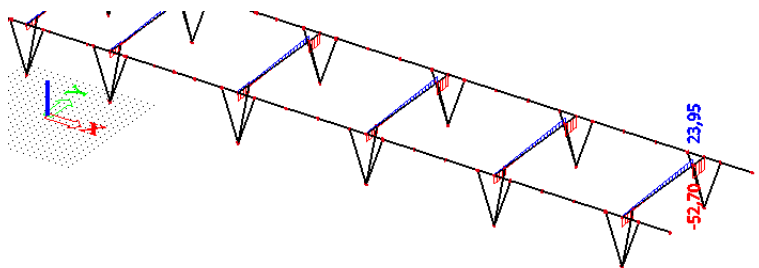
4.7. PRIKAZ REZNIH SILA POPREČNOG NOSAČA

My (kNm)

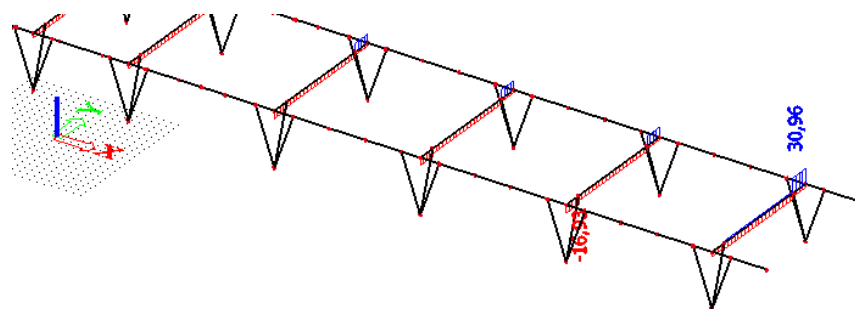


Slika 4.10: Proračunski moment savijanja poprečnog nosača

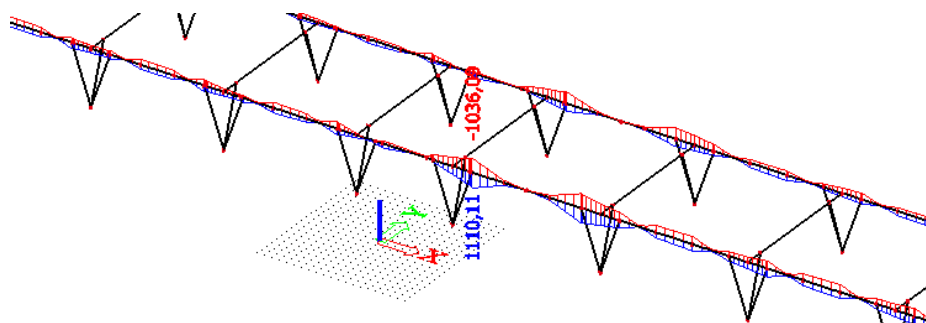
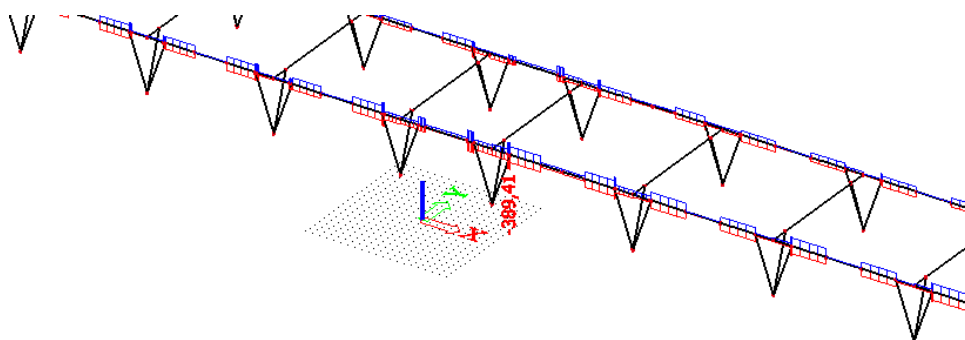
Vz (kN)



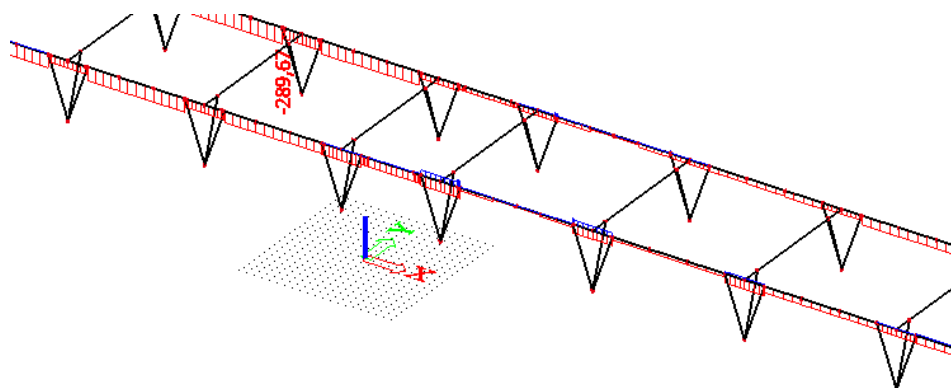
Slika 4.11: Proračunska poprečna sila poprečnog nosača

N (kN)*Slika 4.12:* Proračunska uzdužna sila poprečnog nosača

4.8. PRIKAZ REZNIH SILA UZDUŽNOG NOSAČA

My (kNm)*Slika 4.13:* Proračunski moment savijanja uzdužnog nosača**Vz (kN)***Slika 4.14:* Proračunska poprečna sila uzdužnog nosača

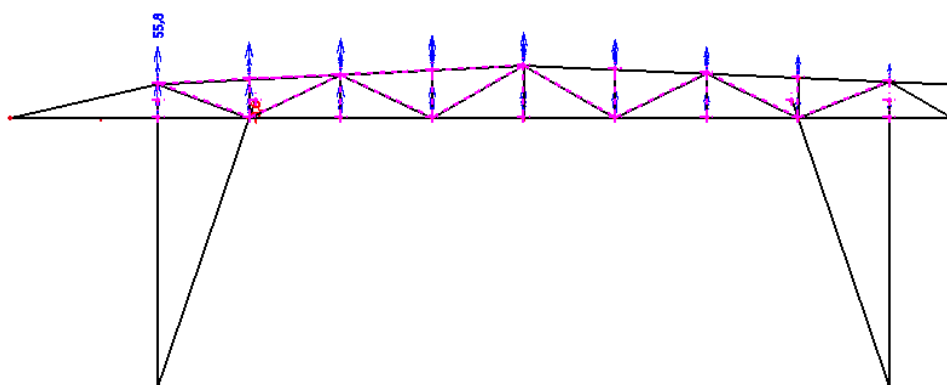
N (kN)



Slika 4.15: Proračunska uzdužna sila uzdužnog nosača

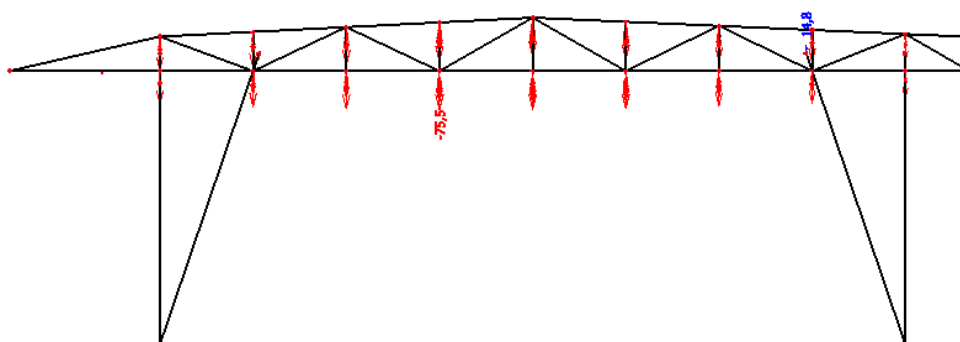
4.9. PRIKAZ MJERODAVNIH POMAKA ZA POJEDINI ELEMENT I NJIHOVA KONTROLA

Maksimalni pomak u prema gore rešetkastog poprečnog nosača



Slika 4.16: Anvelopa pomaka prema gore rešetkastog nosača

Maksimalni pomak prema dolje rešetkastog poprečnog nosača

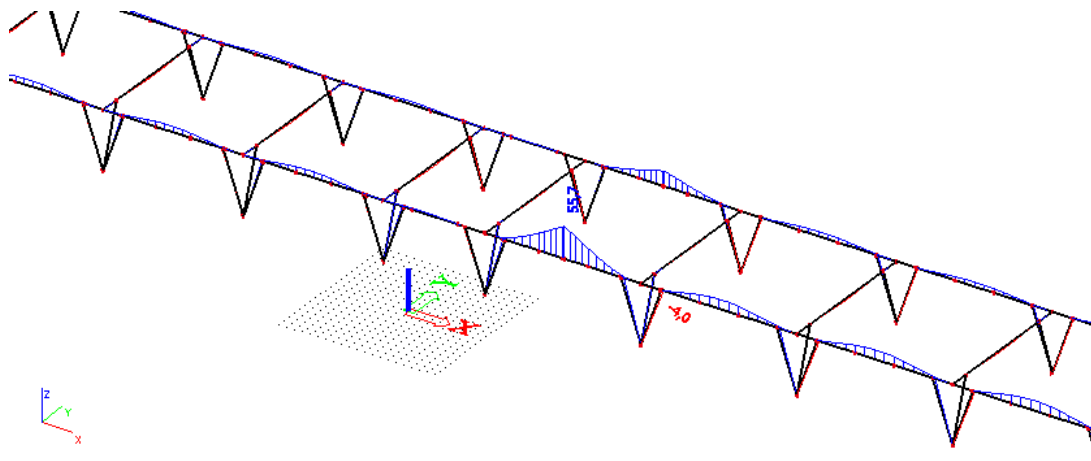


Slika 4.17: Anvelopa pomaka prema dolje rešetkastog nosača

Kontrola pomaka rešetkastog poprečnog nosača:

$$u_{z,\max} = 75,9 \text{ mm} < l/200 = 15200/200 = 80 \text{ mm} \dots \text{zadovoljava}$$

Maksimalni pomak uzdužnog nosača



Slika 4.18: Anvelopa pomaka uzdužnog nosača

Kontrola pomaka uzdužnog nosača:

$$u_{z,\max} = 55,7 \text{ mm} < l/250 = 20000/200 = 100 \text{ mm} \dots \text{zadovoljava}$$

5. PRORAČUN I DIMENZIONIRANJE KONSTRUKCIJE

5.1. PRORAČUNSKI MODEL

Proračun konstrukcije je rađen pomoću software-a *Scia Engineer 15* na temelju prostornog štapnog modela. Svaki element u modelu modeliran je kao jedan štap koji svojom krutošću i modulom elastičnosti materijala simulira svoje stvarne karakteristike presjeka.

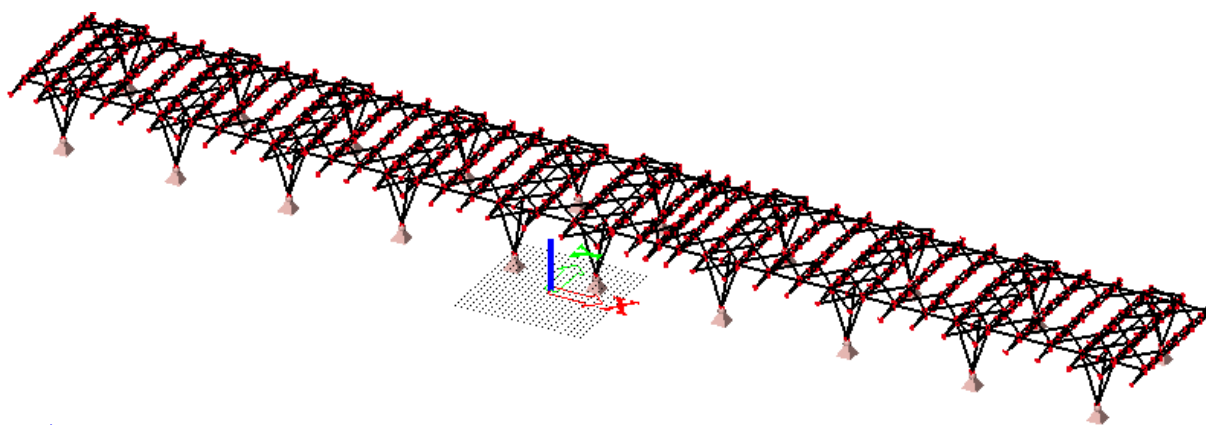
Za potrebe modela, kosi stupovi su uzeti kao elementi koji prenose samo uzdužnu silu, a kao ležajevi su im uzeti točkasti oslonci nepomični u sva tri ortogonalna smjera na donjoj strani i sglobalni spoj sa uzdužnim, odnosno poprečnim nosačem na gornjoj strani.

Na stupove se veže roštiljni sustav od dva paralelna udužna nosača koji su na mjestima stupova vezani poprečnim nosačem.

Roštiljni sustav greda čini oslonac poprečnim rešetkastim nosačima koji se oslanjaju na uzdužni nosač. Rešetkasti nosači su modelirani preko pojaseva i ispuna rešetke. Pojasevi su modelirani kao nosači koji nose i na savijanje i na uzdužnu silu, dok su ispune modelirane kao nosači koji nose samo na uzdužnu silu..

Poprečni rešetkasti nosači su na mjestu stupa uhvaćeni, tj stabilizirani mekim zategama koje su prihvaćene za gornji pojas rešetke i koje su modelirane kao elementi koji nose samo na djelovanje vlačne sile.

Proračun je rađen linearno elastičnom analizom za sve konačne elemente konstrukcije.



Slika 5.1: Proračunski model konstrukcije

2. Dimenzioniranje gornjeg pojasa rešetke pozicije R1

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN2

Cross-section : G_Pojas1 - CFRHS140X140X4

EN 1993-1-1 Code Check

National annex: Standard EN

Member B408	11,261 m	CFRHS140X140X4	S 235	GSN2/1	0,61 -
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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.

Partial safety factors		
Gamma M0 for resistance of cross-sections		1,00
Gamma M1 for resistance to instability		1,00
Gamma 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:....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	32,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	44,37

=> Section classified as Class 1 for cross-section design

The critical check is on position 6.456 m

Internal forces	Calculated	Unit
$N_{y,Ed}$	-149,18	kN
$V_{y,Ed}$	-3,90	kN
$V_{z,Ed}$	4,50	kN
$T_{,Ed}$	-0,29	kNm
$M_{y,Ed}$	-1,20	kNm
$M_{z,Ed}$	5,92	kNm

Compression check

According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	2,1350e-03	m ²
$N_{c,Rd}$	501,73	kN
Unity check	0,30	-

Bending moment check for M_y

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,y}$	1,0815e-04	m ³
$M_{pl,y,Rd}$	25,42	kNm
Unity check	0,05	-

Bending moment check for M_z

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,z}$	1,0815e-04	m ³
$M_{pl,z,Rd}$	25,42	kNm
Unity check	0,23	-

Shear check for V_y

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η_a	1,20	
A_v	1,0675e-03	m ²
$V_{pl,y,Rd}$	144,84	kN
Unity check	0,03	-

Shear check for V_z

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η_a	1,20	
A_v	1,0675e-03	m ²
$V_{pl,z,Rd}$	144,84	kN
Unity check	0,03	-

Torsion check

According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Tau,t,Ed	2,0	MPa
Tau,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)

MN,y,Rd	23,43	kNm
Alpha	1,84	
MN,z,Rd	23,43	kNm
Beta	1,84	

Unity check (6.41) = 0,00 + 0,08 = 0,08 -

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: 6,456 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	32,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	44,37

=> Section classified as Class 1 for member buckling design

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	2,402	2,402	m
Buckling factor k	1,00	1,00	
Buckling length Lcr	2,402	2,402	m
Critical Euler load Ncr	2340,23	2340,23	kN
Slenderness Lambda	43,48	43,48	
Relative slenderness Lambda,rel	0,46	0,46	
Limit slenderness - Lambda,rel,0	0,20	0,20	
Buckling curve	c	c	
Imperfection Alpha	0,49	0,49	
Reduction factor Chi	0,86	0,86	
Buckling resistance Nb,Rd	433,21	433,21	kN

Flexural Buckling verification		
Cross-section area A	2,1350e-03	m²
Buckling resistance Nb,Rd	433,21	kN
Unity check	0,34	-

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	2,1350e-03	m²
Cross-section plastic modulus Wpl,y	1,0815e-04	m³
Cross-section plastic modulus Wpl,z	1,0815e-04	m³
Design compression force N,Ed	149,18	kN
Design bending moment (maximum) My,Ed	1,65	kNm
Design bending moment (maximum) Mz,Ed	5,92	kNm
Characteristic compression resistance N,Rk	501,73	kN
Characteristic moment resistance My,Rk	25,42	kNm
Characteristic moment resistance Mz,Rk	25,42	kNm
Reduction factor Chi,y	0,86	
Reduction factor Chi,z	0,86	
Reduction factor Chi,LT	1,00	
Interaction factor k,y,y	1,00	
Interaction factor k,y,z	0,59	

Bending and axial compression check parameters		
Interaction factor k _{zy}	0,62	
Interaction factor k _{zz}	0,96	

Maximum moment M_{y,Ed} is derived from beam B408 position 7,657 m.

Maximum moment M_{z,Ed} is derived from beam B408 position 0,000 m.

Interaction method 1 parameters		
Critical Euler load N _{cr,y}	2340,23	kN
Critical Euler load N _{cr,z}	2340,23	kN
Elastic critical load N _{cr,T}	136458,58	kN
Cross-section plastic modulus W _{pl,y}	1,0815e-04	m ³
Cross-section elastic modulus W _{el,y}	9,3090e-05	m ³
Cross-section plastic modulus W _{pl,z}	1,0815e-04	m ³
Cross-section elastic modulus W _{el,z}	9,3090e-05	m ³
Second moment of area I _y	6,5162e-06	m ⁴
Second moment of area I _z	6,5162e-06	m ⁴
Torsional constant I _t	1,0233e-05	m ⁴
Method for equivalent moment factor C _{my,0}	Table A.2 Line 2 (General)	
Design bending moment (maximum) M _{y,Ed}	1,65	kNm
Maximum relative deflection delta _z	-0,7	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}	5,92	kNm
Maximum relative deflection delta _y	-0,8	mm
Equivalent moment factor C _{mz,0}	0,96	
Factor mu _y	0,99	
Factor mu _z	0,99	
Factor epsilon _y	0,25	
Factor a _{LT}	0,00	
Critical moment for uniform bending M _{cr,0}	1396,18	kNm
Relative slenderness Lambda _{rel,0}	0,13	
Limit relative slenderness Lambda _{rel,0,lim}	0,21	
Equivalent moment factor C _{my}	1,00	
Equivalent moment factor C _{mz}	0,96	
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}	0,30	
Maximum relative slenderness Lambda _{rel,max}	0,46	
Factor C _{yy}	1,05	
Factor C _{yz}	1,03	
Factor C _{zy}	1,03	
Factor C _{zz}	1,06	

Unity check (6.61) = 0,34 + 0,07 + 0,14 = 0,55 -

Unity check (6.62) = 0,34 + 0,04 + 0,22 = 0,61 -

The member satisfies the stability check.

3. Dimenzioniranje gornjeg pojasa rešetke pozicije R2

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN2

Cross-section : G_Pojas2 - CFRHS140X140X5

EN 1993-1-1 Code Check

National annex: Standard EN

Member B358	11,261 m	CFRHS140X140X5	S 235	GSN2/1	0,82 -
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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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma 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:.....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	25,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	46,74

=> Section classified as Class 1 for cross-section design

The critical check is on position 6.456 m

Internal forces	Calculated	Unit
N _{Ed}	-309,84	kN
V _{y,Ed}	-4,45	kN
V _{z,Ed}	12,22	kN
T _{Ed}	-0,44	kNm
M _{y,Ed}	-3,81	kNm
M _{z,Ed}	5,42	kNm

Compression check

According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	2,6360e-03	m ²
N _{c,Rd}	619,46	kN
Unity check	0,50	-

Bending moment check for M_y

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

W _{pl,y}	1,3230e-04	m ³
M _{pl,y,Rd}	31,09	kNm
Unity check	0,12	-

Bending moment check for M_z

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

W _{pl,z}	1,3230e-04	m ³
M _{pl,z,Rd}	31,09	kNm
Unity check	0,17	-

Shear check for V_y

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η _t	1,20	
A _v	1,3180e-03	m ²
V _{pl,y,Rd}	178,82	kN
Unity check	0,02	-

Shear check for V_z

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η _t	1,20	
A _v	1,3180e-03	m ²
V _{pl,z,Rd}	178,82	kN
Unity check	0,07	-

Torsion check

According to EN 1993-1-1 article 6.2.7 and formula (6.23)

τ _{u,t,Ed}	2,4	MPa
τ _{u,Rd}	135,7	MPa
Unity check	0,02	-

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)

MN _{y,Rd}	20,30	kNm
α	2,31	
MN _{z,Rd}	20,30	kNm
β	2,31	

Unity check (6.41) = 0,02 + 0,05 = 0,07 -

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: 6,456 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	25,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	46,74

=> Section classified as Class 1 for member buckling design

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	2,402	2,402	m
Buckling factor k	1,00	1,00	
Buckling length L _{cr}	2,402	2,402	m
Critical Euler load N _{cr}	2839,24	2839,24	kN
Slenderness Lambda	43,87	43,87	
Relative slenderness Lambda _{rel}	0,47	0,47	
Limit slenderness Lambda _{rel,0}	0,20	0,20	
Buckling curve	c	c	
Imperfection Alpha	0,49	0,49	
Reduction factor Chi	0,86	0,86	
Buckling resistance N _{b,Rd}	533,48	533,48	kN

Flexural Buckling verification		
Cross-section area A	2,6360e-03	m ²
Buckling resistance N _{b,Rd}	533,48	kN
Unity check	0,58	-

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	2,6360e-03	m ²
Cross-section plastic modulus W _{pl,y}	1,3230e-04	m ³
Cross-section plastic modulus W _{pl,z}	1,3230e-04	m ³
Design compression force N _{Ed}	309,84	kN
Design bending moment (maximum) M _{y,Ed}	3,92	kNm
Design bending moment (maximum) M _{z,Ed}	5,42	kNm
Characteristic compression resistance N _{Rk}	619,46	kN
Characteristic moment resistance M _{y,Rk}	31,09	kNm
Characteristic moment resistance M _{z,Rk}	31,09	kNm
Reduction factor Chi _y	0,86	
Reduction factor Chi _z	0,86	
Reduction factor Chi _{LT}	1,00	
Interaction factor k _{yy}	1,00	
Interaction factor k _{yz}	0,56	
Interaction factor k _{zy}	0,62	
Interaction factor k _{zz}	0,90	

Maximum moment M_{y,Ed} is derived from beam B358 position 7,657 m.

Maximum moment M_{z,Ed} is derived from beam B358 position 0,000 m.

Interaction method 1 parameters		
Critical Euler load N _{cr,y}	2839,24	kN
Critical Euler load N _{cr,z}	2839,24	kN
Elastic critical load N _{cr,T}	170437,70	kN
Cross-section plastic modulus W _{pl,y}	1,3230e-04	m ³
Cross-section elastic modulus W _{el,y}	1,1294e-04	m ³
Cross-section plastic modulus W _{pl,z}	1,3230e-04	m ³
Cross-section elastic modulus W _{el,z}	1,1294e-04	m ³
Second moment of area I _y	7,9056e-06	m ⁴
Second moment of area I _z	7,9056e-06	m ⁴
Torsional constant I _t	1,2558e-05	m ⁴
Method for equivalent moment factor C _{my,0}	Table A.2 Line 2 (General)	
Design bending moment (maximum) M _{y,Ed}	3,92	kNm
Maximum relative deflection delta _z	-1,3	mm
Equivalent moment factor C _{my,0}	0,99	
Method for equivalent moment factor C _{mz,0}	Table A.2 Line 2 (General)	
Design bending moment (maximum) M _{z,Ed}	5,42	kNm
Maximum relative deflection delta _y	-0,3	mm
Equivalent moment factor C _{mz,0}	0,91	
Factor mu _y	0,98	

Interaction method 1 parameters		
Factor μ_z	0,98	
Factor ϵ_{LT}	0,29	
Factor a_{LT}	0,00	
Critical moment for uniform bending $M_{\text{cr},0}$	1703,70	kNm
Relative slenderness $\lambda_{\text{rel},0}$	0,14	
Limit relative slenderness $\lambda_{\text{rel},0,\text{lim}}$	0,21	
Equivalent moment factor C_{my}	0,99	
Equivalent moment factor C_{mz}	0,91	
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}	0,50	
Maximum relative slenderness $\lambda_{\text{rel},\text{max}}$	0,47	
Factor C_{yy}	1,09	
Factor C_{yz}	1,07	
Factor C_{zy}	1,05	
Factor C_{zz}	1,11	

Unity check (6.61) = $0,58 + 0,13 + 0,10 = 0,80$ -

Unity check (6.62) = $0,58 + 0,08 + 0,16 = 0,82$ -

The member satisfies the stability check.

4. Dimenzioniranje gornjeg pojasa rešetke pozicije R3

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN2

Cross-section : G_Pojas3 - CFRHS140X140X10

EN 1993-1-1 Code Check

National annex: Standard EN

Member B508	11,261 m	CFRHS140X140X10	S 235	GSN2/1	0,80 -
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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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma 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:....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	11,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	48,03

=> Section classified as Class 1 for cross-section design

The critical check is on position **6.456 m**

Internal forces	Calculated	Unit
N_{Ed}	-410,23	kN
$V_{y,\text{Ed}}$	2,86	kN
$V_{z,\text{Ed}}$	15,13	kN
T_{Ed}	-0,08	kNm
$M_{y,\text{Ed}}$	-4,04	kNm
$M_{z,\text{Ed}}$	-2,31	kNm

Compression check

According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	4,8570e-03	m ²
$N_{\text{c},\text{Rd}}$	1141,40	kN
Unity check	0,36	-

Bending moment check for My

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Wpl,y	2,3038e-04	m ³
Mpl,y,Rd	54,14	kNm
Unity check	0,07	-

Bending moment check for Mz

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Wpl,z	2,3038e-04	m ³
Mpl,z,Rd	54,14	kNm
Unity check	0,04	-

Shear check for Vy

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Eta	1,20	
Av	2,4285e-03	m ²
Vpl,y,Rd	329,49	kN
Unity check	0,01	-

Shear check for Vz

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Eta	1,20	
Av	2,4285e-03	m ²
Vpl,z,Rd	329,49	kN
Unity check	0,05	-

Torsion check

According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Tau,t,Ed	0,2	MPa
Tau,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)

MN,y,Rd	44,00	kNm
Alpha	1,94	
MN,z,Rd	44,00	kNm
Beta	1,94	

Unity check (6.41) = 0,01 + 0,00 = 0,01 -

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: 4,054 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	11,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	46,52

=> Section classified as Class 1 for member buckling design

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	4,805	4,805	m
Buckling factor k	1,00	1,00	
Buckling length Lcr	4,805	4,805	m
Critical Euler load Ncr	1177,68	1177,68	kN
Slenderness Lambda	92,45	92,45	
Relative slenderness Lambda,rel	0,98	0,98	
Limit slenderness Lambda,rel,0	0,20	0,20	
Buckling curve	c	c	
Imperfection Alpha	0,49	0,49	
Reduction factor Chi	0,55	0,55	
Buckling resistance Nb,Rd	626,63	626,63	kN

Flexural Buckling verification		
Cross-section area A	4,8570e-03	m ²
Buckling resistance Nb,Rd	626,63	kN
Unity check	0,65	-

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	4,8570e-03	m ²
Cross-section plastic modulus Wpl,y	2,3038e-04	m ³
Cross-section plastic modulus Wpl,z	2,3038e-04	m ³
Design compression force N,Ed	410,23	kN
Design bending moment (maximum) My,Ed	5,56	kNm
Design bending moment (maximum) Mz,Ed	4,56	kNm
Characteristic compression resistance N,Rk	1141,40	kN
Characteristic moment resistance My,Rk	54,14	kNm
Characteristic moment resistance Mz,Rk	54,14	kNm
Reduction factor Chi,y	0,55	
Reduction factor Chi,z	0,55	
Reduction factor Chi,LT	1,00	
Interaction factor k,yy	1,00	
Interaction factor k,yz	0,53	
Interaction factor k,zy	0,69	
Interaction factor k,zz	0,81	

Maximum moment My,Ed is derived from beam B508 position 5,255 m.

Maximum moment Mz,Ed is derived from beam B508 position 8,858 m.

Interaction method 1 parameters		
Critical Euler load N _{cr,y}	1177,68	kN
Critical Euler load N _{cr,z}	1177,68	kN
Elastic critical load N _{cr,T}	340785,68	kN
Cross-section plastic modulus Wpl,y	2,3038e-04	m ³
Cross-section elastic modulus Wel,y	1,8738e-04	m ³
Cross-section plastic modulus Wpl,z	2,3038e-04	m ³
Cross-section elastic modulus Wel,z	1,8738e-04	m ³
Second moment of area Iy	1,3117e-05	m ⁴
Second moment of area Iz	1,3117e-05	m ⁴
Torsional constant It	2,2739e-05	m ⁴
Method for equivalent moment factor C _{my,0}	Table A.2 Line 2 (General)	
Design bending moment (maximum) My,Ed	5,56	kNm
Maximum relative deflection delta,z	-2,4	mm
Equivalent moment factor C _{my,0}	0,83	
Method for equivalent moment factor C _{mz,0}	Table A.2 Line 2 (General)	
Design bending moment (maximum) Mz,Ed	4,56	kNm
Maximum relative deflection delta,y	0,5	mm
Equivalent moment factor C _{mz,0}	0,69	
Factor mu,y	0,81	
Factor mu,z	0,81	
Factor epsilon,y	0,35	
Factor a _{LT}	0,00	
Critical moment for uniform bending M _{cr,0}	1472,31	kNm
Relative slenderness Lambda _{rel,0}	0,19	
Limit relative slenderness Lambda _{rel,0,lim}	0,20	
Equivalent moment factor C _{my}	0,83	
Equivalent moment factor C _{mz}	0,69	
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	1,23	
Factor w,z	1,23	
Factor n _{pl}	0,36	
Maximum relative slenderness Lambda _{rel,max}	0,98	
Factor C _{yy}	1,02	
Factor C _{yz}	0,97	
Factor C _{zy}	0,89	
Factor C _{zz}	1,06	

Unity check (6.61) = 0,65 + 0,10 + 0,04 = 0,80 -
 Unity check (6.62) = 0,65 + 0,07 + 0,07 = 0,79 -

The member satisfies the stability check.

5. Dimenzioniranje gornjeg pojasa rešetke pozicije R4

Linear calculation, Extreme : Global
 Selection : All
 Combinations : GSN2
 Cross-section : G_Pojas4 - CFRHS140X140X6

EN 1993-1-1 Code Check
 National annex: Standard EN

Member B334	9,612 m	CFRHS140X140X6	S 235	GSN2/1	0,93 -
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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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma M2 for resistance of net sections	1,25

Material		
Yield strength fy	235,0	MPa
Ultimate strength fu	360,0	MPa
Fabrication	Cold formed	

.....SECTION CHECK:....

Classification for cross-section design
 According to EN 1993-1-1 article 5.5.2
Classification of Internal Compression parts
 According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	20,33
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	47,76

=> Section classified as Class 1 for cross-section design

The critical check is on position 4.806 m

Internal forces	Calculated	Unit
N,Ed	-333,80	kN
Vy,Ed	3,09	kN
Vz,Ed	-13,36	kN
T,Ed	0,15	kNm
My,Ed	-4,38	kNm
Mz,Ed	3,02	kNm

Compression check
 According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	3,1230e-03	m²
Nc,Rd	733,90	kN
Unity check	0,45	-

Bending moment check for My
 According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Wpl,y	1,5533e-04	m³
Mpl,y,Rd	36,50	kNm
Unity check	0,12	-

Bending moment check for Mz
 According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Wpl,z	1,5533e-04	m³
Mpl,z,Rd	36,50	kNm
Unity check	0,08	-

Shear check for Vy
 According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Eta	1,20	
Av	1,5615e-03	m²
Vpl,y,Rd	211,86	kN
Unity check	0,01	-

Shear check for Vz
 According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Eta	1,20	
Av	1,5615e-03	m²

Vpl,z,Rd	211,86	kN
Unity check	0,06	-

Torsion check

According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Tau,t,Ed	0,7	MPa
Tau,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)

MN,y,Rd	25,88	kNm
Alpha	2,17	
MN,z,Rd	25,88	kNm
Beta	2,17	

Unity check (6.41) = 0,02 + 0,01 = 0,03 -

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: 2,403 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	20,33
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	47,36

=> Section classified as Class 1 for member buckling design

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	4,806	4,806	m
Buckling factor k	0,90	0,90	
Buckling length Lcr	4,326	4,326	m
Critical Euler load Ncr	1019,60	1019,60	kN
Slenderness Lambda	79,68	79,68	
Relative slenderness Lambda,rel	0,85	0,85	
Limit slenderness Lambda,rel,0	0,20	0,20	
Buckling curve	c	c	
Imperfection Alpha	0,49	0,49	
Reduction factor Chi	0,63	0,63	
Buckling resistance Nb,Rd	463,69	463,69	kN

Flexural Buckling verification		
Cross-section area A	3,1230e-03	m²
Buckling resistance Nb,Rd	463,69	kN
Unity check	0,72	-

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	3,1230e-03	m²
Cross-section plastic modulus Wpl,y	1,5533e-04	m³
Cross-section plastic modulus Wpl,z	1,5533e-04	m³
Design compression force N,Ed	333,80	kN
Design bending moment (maximum) My,Ed	5,23	kNm
Design bending moment (maximum) Mz,Ed	-4,40	kNm
Characteristic compression resistance N,Rk	733,90	kN
Characteristic moment resistance My,Rk	36,50	kNm
Characteristic moment resistance Mz,Rk	36,50	kNm

Bending and axial compression check parameters		
Reduction factor $\chi_{i,y}$	0,63	
Reduction factor $\chi_{i,z}$	0,63	
Reduction factor $\chi_{i,LT}$	1,00	
Interaction factor k_{yy}	0,98	
Interaction factor k_{yz}	0,60	
Interaction factor k_{zy}	0,67	
Interaction factor k_{zz}	0,90	

Maximum moment $M_{y,Ed}$ is derived from beam B334 position 6,008 m.

Maximum moment $M_{z,Ed}$ is derived from beam B334 position 0,000 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	1019,60	kN
Critical Euler load $N_{cr,z}$	1019,60	kN
Elastic critical load $N_{cr,T}$	203036,57	kN
Cross-section plastic modulus $W_{pl,y}$	1,5533e-04	m ³
Cross-section elastic modulus $W_{el,y}$	1,3149e-04	m ³
Cross-section plastic modulus $W_{pl,z}$	1,5533e-04	m ³
Cross-section elastic modulus $W_{el,z}$	1,3149e-04	m ³
Second moment of area I_y	9,2043e-06	m ⁴
Second moment of area I_z	9,2043e-06	m ⁴
Torsional constant I_t	1,4788e-05	m ⁴
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{y,Ed}$	5,23	kNm
Maximum relative deflection $\delta_{a,z}$	-2,8	mm
Equivalent moment factor $C_{my,0}$	0,82	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{z,Ed}$	-4,40	kNm
Maximum relative deflection $\delta_{a,y}$	-1,4	mm
Equivalent moment factor $C_{mz,0}$	0,76	
Factor $\mu_{y,y}$	0,85	
Factor $\mu_{y,z}$	0,85	
Factor $\epsilon_{y,y}$	0,37	
Factor $a_{i,LT}$	0,00	
Critical moment for uniform bending $M_{cr,0}$	994,19	kNm
Relative slenderness $\lambda_{rel,0}$	0,19	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,20	
Equivalent moment factor C_{my}	0,82	
Equivalent moment factor C_{mz}	0,76	
Equivalent moment factor C_{mLT}	1,00	
Factor $b_{i,LT}$	0,00	
Factor $c_{i,LT}$	0,00	
Factor $d_{i,LT}$	0,00	
Factor $e_{i,LT}$	0,00	
Factor $w_{y,y}$	1,18	
Factor $w_{y,z}$	1,18	
Factor n_{pl}	0,45	
Maximum relative slenderness $\lambda_{rel,max}$	0,85	
Factor C_{yy}	1,05	
Factor C_{yz}	0,96	
Factor C_{zy}	0,92	
Factor C_{zz}	1,06	

Unity check (6.61) = $0,72 + 0,14 + 0,07 = 0,93$ -

Unity check (6.62) = $0,72 + 0,10 + 0,11 = 0,92$ -

The member satisfies the stability check.

6. Dimenzioniranje gornjeg pojasa rešetke pozicije R5

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN2

Cross-section : G_Pojas5 - CFRHS140X140X10

EN 1993-1-1 Code Check

National annex: Standard EN

Member B33	11,261 m	CFRHS140X140X10	S 235	GSN2/1	0,98 -
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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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma M2 for resistance of net sections	1,25

Material		
Yield strength f_y	235,0	MPa
Ultimate strength f_u	360,0	MPa

Material		
Fabrication	Cold formed	

.....SECTION CHECK:.....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	11,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	49,03

=> Section classified as Class 1 for cross-section design

The critical check is on position 6.456 m

Internal forces	Calculated	Unit
N _{Ed}	-716,91	kN
V _{y,Ed}	6,03	kN
V _{z,Ed}	26,74	kN
T _{Ed}	0,61	kNm
M _{y,Ed}	-7,08	kNm
M _{z,Ed}	-7,62	kNm

Compression check

According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	4,8570e-03	m ²
N _{c,Rd}	1141,40	kN
Unity check	0,63	-

Bending moment check for M_y

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

W _{pl,y}	2,3038e-04	m ³
M _{pl,y,Rd}	54,14	kNm
Unity check	0,13	-

Bending moment check for M_z

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

W _{pl,z}	2,3038e-04	m ³
M _{pl,z,Rd}	54,14	kNm
Unity check	0,14	-

Shear check for V_y

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

E _t	1,20	
A _v	2,4285e-03	m ²
V _{pl,y,Rd}	329,49	kN
Unity check	0,02	-

Shear check for V_z

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

E _t	1,20	
A _v	2,4285e-03	m ²
V _{pl,z,Rd}	329,49	kN
Unity check	0,08	-

Torsion check

According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Tau _{t,Ed}	1,8	MPa
Tau _{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)

MN _{y,Rd}	25,54	kNm
Alpha	3,00	
MN _{z,Rd}	25,54	kNm
Beta	3,00	

Unity check (5.41) = 0,02 + 0,03 = 0,05 -

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: 6,456 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	11,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	49,03

=> Section classified as Class 1 for member buckling design

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	2,402	2,402	m
Buckling factor k	1,00	1,00	
Buckling length L _{cr}	2,402	2,402	m
Critical Euler load N _{cr}	4710,73	4710,73	kN
Slenderness Lambda	46,23	46,23	
Relative slenderness Lambda _{rel}	0,49	0,49	
Limit slenderness Lambda _{rel,0}	0,20	0,20	
Buckling curve	c	c	
Imperfection Alpha	0,49	0,49	
Reduction factor Chi	0,85	0,85	
Buckling resistance N _{b,Rd}	967,13	967,13	kN

Flexural Buckling verification		
Cross-section area A	4,8570e-03	m ²
Buckling resistance N _{b,Rd}	967,13	kN
Unity check	0,74	-

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	4,8570e-03	m ²
Cross-section plastic modulus W _{pl,y}	2,3038e-04	m ³
Cross-section plastic modulus W _{pl,z}	2,3038e-04	m ³
Design compression force N _{Ed}	716,91	kN
Design bending moment (maximum) M _{y,Ed}	9,34	kNm
Design bending moment (maximum) M _{z,Ed}	-7,62	kNm
Characteristic compression resistance N _{Rk}	1141,40	kN
Characteristic moment resistance M _{y,Rk}	54,14	kNm
Characteristic moment resistance M _{z,Rk}	54,14	kNm
Reduction factor Chi _y	0,85	
Reduction factor Chi _z	0,85	
Reduction factor Chi _{LT}	1,00	
Interaction factor k _{yy}	0,98	
Interaction factor k _{yz}	0,52	
Interaction factor k _{zy}	0,61	
Interaction factor k _{zz}	0,85	

Maximum moment M_{y,Ed} is derived from beam B33 position 7,657 m.

Maximum moment M_{z,Ed} is derived from beam B33 position 0,000 m.

Interaction method 1 parameters		
Critical Euler load N _{cr,y}	4710,73	kN
Critical Euler load N _{cr,z}	4710,73	kN
Elastic critical load N _{cr,T}	343020,78	kN
Cross-section plastic modulus W _{pl,y}	2,3038e-04	m ³
Cross-section elastic modulus W _{el,y}	1,8738e-04	m ³
Cross-section plastic modulus W _{pl,z}	2,3038e-04	m ³
Cross-section elastic modulus W _{el,z}	1,8738e-04	m ³
Second moment of area I _y	1,3117e-05	m ⁴
Second moment of area I _z	1,3117e-05	m ⁴
Torsional constant I _t	2,2739e-05	m ⁴
Method for equivalent moment factor C _{my,0}	Table A.2 Line 2 (General)	
Design bending moment (maximum) M _{y,Ed}	9,34	kNm

Interaction method 1 parameters		
Maximum relative deflection $\delta_{a,z}$	-1,8	mm
Equivalent moment factor $C_{my,0}$	0,99	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{z,Ed}$	-7,62	kNm
Maximum relative deflection $\delta_{a,y}$	0,3	mm
Equivalent moment factor $C_{mz,0}$	0,87	
Factor μ_y	0,97	
Factor μ_z	0,97	
Factor $\epsilon_{pl,y}$	0,34	
Factor a_{LT}	0,00	
Critical moment for uniform bending $M_{cr,0}$	2954,25	kNm
Relative slenderness $\lambda_{rel,0}$	0,14	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,21	
Equivalent moment factor C_{my}	0,99	
Equivalent moment factor C_{mz}	0,87	
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	1,23	
Factor w_z	1,23	
Factor n_{pl}	0,63	
Maximum relative slenderness $\lambda_{rel,max}$	0,49	
Factor C_{yy}	1,15	
Factor C_{yz}	1,16	
Factor C_{zy}	1,12	
Factor C_{zz}	1,18	

Unity check (6.61) = $0,74 + 0,17 + 0,07 = 0,98$ -

Unity check (6.62) = $0,74 + 0,11 + 0,12 = 0,97$ -

The member satisfies the stability check.

7. Dimenzioniranje donjeg pojasa rešetke pozicije R1

Linear calculation, Extreme : Global

Selection : AI

Combinations : GSN1

Cross-section : D_Pojas1 - CFRHS140X140X4

EN 1993-1-1 Code Check

National annex: Standard EN

Member B981	24,725 m	CFRHS140X140X4	S 235	GSN1/2	0,59 -
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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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma 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:.....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	32,00
Class 1 Limit	96,92
Class 2 Limit	111,73
Class 3 Limit	217,15

=> Section classified as Class 1 for cross-section design

The critical check is on position 20.850 m

Internal forces	Calculated	Unit
N_{Ed}	90,05	kN
$V_{y,Ed}$	-0,15	kN
$V_{z,Ed}$	-19,40	kN
T_{Ed}	0,06	kNm
$M_{y,Ed}$	14,95	kNm
$M_{z,Ed}$	0,41	kNm

Tension check

According to EN 1993-1-1 article 6.2.3 and formula (6.5)

A	2,1350e-03	m ²
N _{pl,Rd}	501,73	kN
N _{u,Rd}	553,39	kN
N _{t,Rd}	501,73	kN
Unity check	0,18	-

Bending moment check for M_y

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

W _{pl,y}	1,0815e-04	m ³
M _{pl,y,Rd}	25,42	kNm
Unity check	0,59	-

Bending moment check for M_z

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

W _{pl,z}	1,0815e-04	m ³
M _{pl,z,Rd}	25,42	kNm
Unity check	0,02	-

Shear check for V_y

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

E _{ta}	1,20	
A _v	1,0675e-03	m ²
V _{pl,y,Rd}	144,84	kN
Unity check	0,00	-

Shear check for V_z

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

E _{ta}	1,20	
A _v	1,0675e-03	m ²
V _{pl,z,Rd}	144,84	kN
Unity check	0,13	-

Torsion check

According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Tau _{t,Ed}	0,4	MPa
Tau _{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)

MN _{y,Rd}	25,42	kNm
Alpha	1,72	
MN _{z,Rd}	25,42	kNm
Beta	1,72	

Unity check (6.41) = 0,40 + 0,00 = 0,40 -

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: 20,850 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	32,00
Class 1 Limit	96,92
Class 2 Limit	111,73
Class 3 Limit	217,15

=> Section classified as Class 1 for member buckling design

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 tension check

According to EN 1993-1-3 article 6.3

Design tension force N _{Ed}	90,05	kN
Design bending moment M _{y,Ed}	14,95	kNm
Design bending moment M _{z,Ed}	0,41	kNm

Tension resistance Nt,Rd	501,73	kN
Bending resistance Mb,y,Rd	25,42	kNm
Bending resistance Mc,z,Rd,com	25,42	kNm

Unity check = $0,59 + 0,02 - 0,18 = 0,42$

The member satisfies the stability check.

8. Dimenzioniranje donjeg pojasa rešetke pozicije R2

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN1

Cross-section : D_Pojas2 - CFRHS140X140X7.1

EN 1993-1-1 Code Check

National annex: Standard EN

Member B356	24,725 m	CFRHS140X140X7.1	S 235	GSN1/2	0,88 -
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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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma M2 for resistance of net sections	1,25

Material		
Yield strength fy	235,0	MPa
Ultimate strength fu	360,0	MPa
Fabrication	Cold formed	

.....SECTION CHECK:....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	16,72
Class 1 Limit	95,43
Class 2 Limit	110,01
Class 3 Limit	211,16

=> Section classified as Class 1 for cross-section design

The critical check is on position **20.850 m**

Internal forces	Calculated	Unit
N,Ed	214,98	kN
Vy,Ed	-0,39	kN
Vz,Ed	-46,49	kN
T,Ed	0,07	kNm
My,Ed	36,49	kNm
Mz,Ed	1,20	kNm

Tension check

According to EN 1993-1-1 article 6.2.3 and formula (6.5)

A	3,6010e-03	m ²
Npl,Rd	846,24	kN
Nu,Rd	933,38	kN
Nt,Rd	846,24	kN
Unity check	0,25	-

Bending moment check for My

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Wpl,y	1,7627e-04	m ³
Mpl,y,Rd	41,42	kNm
Unity check	0,88	-

Bending moment check for Mz

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Wpl,z	1,7627e-04	m ³
Mpl,z,Rd	41,42	kNm
Unity check	0,03	-

Shear check for Vy

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Eta	1,20	
Av	1,8005e-03	m ²
Vpl,y,Rd	244,29	kN
Unity check	0,00	-

Shear check for Vz

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Eta	1,20	
Av	1,8005e-03	m ²
Vpl,z,Rd	244,29	kN
Unity check	0,19	-

Torsion check

According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Tau,t,Ed	0,3	MPa
Tau,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)

MN,y,Rd	39,82	kNm
Alpha	1,79	
MN,z,Rd	39,82	kNm
Beta	1,79	

Unity check (6.41) = 0,86 + 0,00 = 0,86 -

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: 20,850 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	16,72
Class 1 Limit	95,43
Class 2 Limit	110,01
Class 3 Limit	211,16

=> Section classified as Class 1 for member buckling design

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 tension check

According to EN 1993-1-3 article 6.3

Design tension force N _{Ed}	214,98	kN
Design bending moment M _{y,Ed}	36,49	kNm
Design bending moment M _{z,Ed}	1,20	kNm
Tension resistance N _{t,Rd}	846,24	kN
Bending resistance M _{b,y,Rd}	41,42	kNm
Bending resistance M _{c,z,Rd,com}	41,42	kNm

Unity check = 0,88 + 0,03 - 0,25 = 0,66 -

The member satisfies the stability check.

9. Dimenzioniranje donjeg pojasa rešetke pozicije R3

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN1

Cross-section : D_Pojas3 - CFRHS140X140X10

EN 1993-1-1 Code Check

National annex: Standard EN

Member B531	24,725 m	CFRHS140X140X10	S 235	GSN1/2	0,81 -
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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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma 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:....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	11,00
Class 1 Limit	100,98
Class 2 Limit	116,41
Class 3 Limit	233,65

=> Section classified as Class 1 for cross-section design

The critical check is on position 20.850 m

Internal forces	Calculated	Unit
N_{Ed}	268,26	kN
$V_{y,Ed}$	-0,18	kN
$V_{z,Ed}$	-57,30	kN
T_{Ed}	0,14	kNm
$M_{y,Ed}$	43,70	kNm
$M_{z,Ed}$	0,49	kNm

Tension check

According to EN 1993-1-1 article 6.2.3 and formula (6.5)

A	4,8570e-03	m ²
$N_{pl,Rd}$	1141,40	kN
$N_{u,Rd}$	1258,93	kN
$N_{t,Rd}$	1141,40	kN
Unity check	0,24	-

Bending moment check for M_y

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,y}$	2,3038e-04	m ³
$M_{pl,y,Rd}$	54,14	kNm
Unity check	0,81	-

Bending moment check for M_z

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,z}$	2,3038e-04	m ³
$M_{pl,z,Rd}$	54,14	kNm
Unity check	0,01	-

Shear check for V_y

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η_a	1,20	
A_v	2,4285e-03	m ²
$V_{pl,y,Rd}$	329,49	kN
Unity check	0,00	-

Shear check for V_z

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η_a	1,20	
A_v	2,4285e-03	m ²
$V_{pl,z,Rd}$	329,49	kN
Unity check	0,17	-

Torsion check

According to EN 1993-1-1 article 6.2.7 and formula (6.23)

$\tau_{a,t,Ed}$	0,4	MPa
$\tau_{a,Rd}$	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)

$MN_{y,Rd}$	52,54	kNm
α	1,77	
$MN_{z,Rd}$	52,54	kNm
β	1,77	

Unity check (6.41) = $0,72 + 0,00 = 0,72$ -

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: 20,850 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	11,00
Class 1 Limit	100,98
Class 2 Limit	116,41
Class 3 Limit	233,65

=> Section classified as Class 1 for member buckling design

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 tension check

According to EN 1993-1-3 article 6.3

Design tension force N_{Ed}	268,26	kN
Design bending moment $M_{y,Ed}$	43,70	kNm
Design bending moment $M_{z,Ed}$	0,49	kNm
Tension resistance $N_{t,Rd}$	1141,40	kN
Bending resistance $M_{b,y,Rd}$	54,14	kNm
Bending resistance $M_{c,z,Rd,com}$	54,14	kNm

Unity check = $0,81 + 0,01 - 0,24 = 0,58$

The member satisfies the stability check.

10. Dimenzioniranje donjeg pojasa rešetke pozicije R4

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN1

Cross-section : D Pojas4 - CFRHS140X140X8

EN 1993-1-1 Code Check

National annex: Standard EN

Member B131	24,725 m	CFRHS140X140X8	S 235	GSN1/2	0,85 -
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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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma 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**.....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	14,50
Class 1 Limit	105,14
Class 2 Limit	121,20
Class 3 Limit	250,93

=> Section classified as Class 1 for cross-section design

The critical check is on position 20.850 m

Internal forces	Calculated	Unit
N_{Ed}	229,84	kN
$V_{y,Ed}$	0,30	kN
$V_{z,Ed}$	-49,72	kN
T_{Ed}	0,05	kNm
$M_{y,Ed}$	38,88	kNm
$M_{z,Ed}$	-0,91	kNm

Tension check

According to EN 1993-1-1 article 6.2.3 and formula (6.5)

A	4,0040e-03	m ²
N _{pl,Rd}	940,94	kN
N _{u,Rd}	1037,84	kN
N _{t,Rd}	940,94	kN
Unity check	0,24	-

Bending moment check for M_y

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

W _{pl,y}	1,9418e-04	m ³
M _{pl,y,Rd}	45,63	kNm
Unity check	0,85	-

Bending moment check for M_z

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

W _{pl,z}	1,9418e-04	m ³
M _{pl,z,Rd}	45,63	kNm
Unity check	0,02	-

Shear check for V_y

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

E _t	1,20	
A _v	2,0020e-03	m ²
V _{pl,y,Rd}	271,63	kN
Unity check	0,00	-

Shear check for V_z

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

E _t	1,20	
A _v	2,0020e-03	m ²
V _{pl,z,Rd}	271,63	kN
Unity check	0,18	-

Torsion check

According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Tau _{t,Ed}	0,2	MPa
Tau _{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)

MN _{y,Rd}	44,23	kNm
Alpha	1,78	
MN _{z,Rd}	44,23	kNm
Beta	1,78	

Unity check (6.41) = 0,79 + 0,00 = 0,80 -

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: 20,850 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	14,50
Class 1 Limit	105,14
Class 2 Limit	121,20
Class 3 Limit	250,93

=> Section classified as Class 1 for member buckling design

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 tension check

According to EN 1993-1-3 article 6.3

Design tension force N _{Ed}	229,84	kN
Design bending moment M _{y,Ed}	38,88	kNm
Design bending moment M _{z,Ed}	-0,91	kNm

Tension resistance Nt,Rd	940,94	kN
Bending resistance Mb,y,Rd	45,63	kNm
Bending resistance Mc,z,Rd,com	45,63	kNm

Unity check = $0,85 + 0,02 - 0,24 = 0,63$

The member satisfies the stability check.

11. Dimenzioniranje donjeg pojasa rešetke pozicije R5

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN1

Cross-section : D_Pojas5 - CFRHS140X140X10

EN 1993-1-1 Code Check

National annex: Standard EN

Member B81	24,725 m	CFRHS140X140X10	S 235	GSN1/2	0,79 -
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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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma M2 for resistance of net sections	1,25

Material		
Yield strength fy	235,0	MPa
Ultimate strength fu	360,0	MPa
Fabrication	Cold formed	

.....SECTION CHECK:....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	11,00
Class 1 Limit	97,48
Class 2 Limit	112,37
Class 3 Limit	219,38

=> Section classified as Class 1 for cross-section design

The critical check is on position **20.850 m**

Internal forces	Calculated	Unit
N,Ed	249,00	kN
Vy,Ed	-0,26	kN
Vz,Ed	-56,86	kN
T,Ed	0,13	kNm
My,Ed	42,77	kNm
Mz,Ed	0,82	kNm

Tension check

According to EN 1993-1-1 article 6.2.3 and formula (6.5)

A	4,8570e-03	m ²
Npl,Rd	1141,40	kN
Nu,Rd	1258,93	kN
Nt,Rd	1141,40	kN
Unity check	0,22	-

Bending moment check for My

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Wpl,y	2,3038e-04	m ³
Mpl,y,Rd	54,14	kNm
Unity check	0,79	-

Bending moment check for Mz

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

Wpl,z	2,3038e-04	m ³
Mpl,z,Rd	54,14	kNm
Unity check	0,02	-

Shear check for Vy

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Eta	1,20	
Av	2,4285e-03	m ²
Vpl,y,Rd	329,49	kN
Unity check	0,00	-

Shear check for Vz

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Eta	1,20	
Av	2,4285e-03	m ²
Vpl,z,Rd	329,49	kN
Unity check	0,17	-

Torsion check

According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Tau,t,Ed	0,4	MPa
Tau,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)

MN,y,Rd	53,70	kNm
Alpha	1,75	
MN,z,Rd	53,70	kNm
Beta	1,75	

Unity check (6.41) = 0,67 + 0,00 = 0,67 -

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: 20,850 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	11,00
Class 1 Limit	97,48
Class 2 Limit	112,37
Class 3 Limit	219,38

=> Section classified as Class 1 for member buckling design

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 tension check

According to EN 1993-1-3 article 6.3

Design tension force N _{Ed}	249,00	kN
Design bending moment M _{y,Ed}	42,77	kNm
Design bending moment M _{z,Ed}	0,82	kNm
Tension resistance N _{t,Rd}	1141,40	kN
Bending resistance M _{b,y,Rd}	54,14	kNm
Bending resistance M _{c,z,Rd,com}	54,14	kNm

Unity check = 0,79 + 0,02 - 0,22 = 0,59 -

The member satisfies the stability check.

12. Dimenzioniranje ispune rešetke pozicije R1

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN1

Cross-section : Ispuna1 - CFRHS90X90X4

EN 1993-1-1 Code Check

National annex: Standard EN

Member B368	2,581 m	CFRHS90X90X4	S 235	GSN1/2	0,76 -
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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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma 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:....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	19,50
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	42,00

=> Section classified as Class 1 for cross-section design

The critical check is on position 0.000 m

Internal forces	Calculated	Unit
N_{Ed}	-159,47	kN
$V_{y,Ed}$	0,00	kN
$V_{z,Ed}$	0,00	kN
T_{Ed}	0,00	kNm
$M_{y,Ed}$	0,00	kNm
$M_{z,Ed}$	0,00	kNm

Compression check

According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	1,3350e-03	m ²
$N_{c,Rd}$	313,73	kN
Unity check	0,51	-

The member satisfies the section check.

.....STABILITY CHECK:....

Classification for member buckling design

Decisive position for stability classification: 0,000 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	19,50
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	42,00

=> Section classified as Class 1 for member buckling design

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	2,581	2,581	m
Buckling factor k	1,00	1,00	
Buckling length L_{cr}	2,581	2,581	m
Critical Euler load N_{cr}	503,80	503,80	kN
Slenderness λ	74,11	74,11	
Relative slenderness λ_{rel}	0,79	0,79	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	c	c	
Imperfection α	0,49	0,49	
Reduction factor χ	0,67	0,67	
Buckling resistance $N_{b,Rd}$	209,88	209,88	kN

Flexural Buckling verification		
Cross-section area A	1,3350e-03	m ²
Buckling resistance $N_{b,Rd}$	209,88	kN
Unity check	0,76	-

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.

The member satisfies the stability check.

13. Dimenzioniranje ispune rešetke pozicije R2

Linear calculation, Extreme : Global

Selection : AI

Combinations : GSN1

Cross-section : Ispuna2 - CFRHS90X90X5

EN 1993-1-1 Code Check

National annex: Standard EN

Member B361	2,557 m	CFRHS90X90X5	S 235	GSN1/2	0,84 -
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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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma M2 for resistance of net sections	1,25

Material		
Yield strength fy	235,0	MPa
Ultimate strength fu	360,0	MPa
Fabrication	Cold formed	

.....SECTION CHECK:....**Classification for cross-section design**

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	15,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	42,00

=> Section classified as Class 1 for cross-section design

The critical check is on position 2.557 m

Internal forces	Calculated	Unit
N,Ed	-215,95	kN
Vy,Ed	0,00	kN
Vz,Ed	0,00	kN
T,Ed	0,00	kNm
My,Ed	0,00	kNm
Mz,Ed	0,00	kNm

Compression check

According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	1,6360e-03	m ²
Nc,Rd	384,45	kN
Unity check	0,56	-

The member satisfies the section check.

.....STABILITY CHECK:....**Classification for member buckling design**

Decisive position for stability classification: 0,000 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	15,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	42,00

=> Section classified as Class 1 for member buckling design

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	2,557	2,557	m
Buckling factor k	1,00	1,00	
Buckling length Lcr	2,557	2,557	m
Critical Euler load Ncr	611,36	611,36	kN
Slenderness Lambda	74,47	74,47	
Relative slenderness Lambda,rel	0,79	0,79	
Limit slenderness Lambda,rel,0	0,20	0,20	
Buckling curve	c	c	
Imperfection Alpha	0,49	0,49	
Reduction factor Chi	0,67	0,67	
Buckling resistance Nb,Rd	256,26	256,26	kN

Flexural Buckling verification		
Cross-section area A	1,6360e-03	m ²
Buckling resistance Nb,Rd	256,26	kN
Unity check	0,84	-

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.

The member satisfies the stability check.

14. Dimenzioniranje ispune rešetke pozicije R3

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN1

Cross-section : Ispuna3 - CFRHS90X90X6

EN 1993-1-1 Code Check

National annex: Standard EN

Member B536	2,557 m	CFRHS90X90X6	S 235	GSN1/2	0,88 -
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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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma M2 for resistance of net sections	1,25

Material		
Yield strength fy	235,0	MPa
Ultimate strength fu	360,0	MPa
Fabrication	Cold formed	

.....SECTION CHECK:....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	12,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	42,00

=> Section classified as Class 1 for cross-section design

The critical check is on position 2.557 m

Internal forces	Calculated	Unit
N,Ed	-262,85	kN
Vy,Ed	0,00	kN
Vz,Ed	0,00	kN
T,Ed	0,00	kNm
My,Ed	0,00	kNm
Mz,Ed	0,00	kNm

Compression check

According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	1,9230e-03	m ²
Nc,Rd	451,90	kN
Unity check	0,58	-

The member satisfies the section check.

.....STABILITY CHECK:....

Classification for member buckling design

Decisive position for stability classification: 0,000 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	12,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	42,00

=> Section classified as Class 1 for member buckling design

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	2,557	2,557	m
Buckling factor k	1,00	1,00	
Buckling length Lcr	2,557	2,557	m
Critical Euler load Ncr	698,67	698,67	kN
Slenderness Lambda	75,53	75,53	

Buckling parameters	yy	zz	
Relative slenderness Λ_{rel}	0,80	0,80	
Limit slenderness $\Lambda_{rel,0}$	0,20	0,20	
Buckling curve	c	c	
Imperfection α	0,49	0,49	
Reduction factor χ	0,66	0,66	
Buckling resistance $N_{b,Rd}$	298,03	298,03	kN

Flexural Buckling verification		
Cross-section area A	1,9230e-03	m ²
Buckling resistance $N_{b,Rd}$	298,03	kN
Unity check	0,88	-

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.

The member satisfies the stability check.

15. Dimenzioniranje ispune rešetke pozicije R4

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN1

Cross-section : Ispuna4 - CFRHS90X90X5

EN 1993-1-1 Code Check

National annex: Standard EN

Member B236	2,557 m	CFRHS90X90X5	S 235	GSN1/2	0,90 -
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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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma 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:....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	15,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	42,00

=> Section classified as Class 1 for cross-section design

The critical check is on position 2.557 m

Internal forces	Calculated	Unit
N_{Ed}	-229,86	kN
$V_{y,Ed}$	0,00	kN
$V_{z,Ed}$	0,00	kN
T_{Ed}	0,00	kNm
$M_{y,Ed}$	0,00	kNm
$M_{z,Ed}$	0,00	kNm

Compression check

According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	1,6360e-03	m ²
$N_{c,Rd}$	384,46	kN
Unity check	0,60	-

The member satisfies the section check.

.....STABILITY CHECK:....

Classification for member buckling design

Decisive position for stability classification: 0,000 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	15,00
Class 1 Limit	33,00
Class 2 Limit	38,00

Class 3 Limit	42,00
---------------	-------

=> Section classified as Class 1 for member buckling design

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	2,557	2,557	m
Buckling factor k	1,00	1,00	
Buckling length Lcr	2,557	2,557	m
Critical Euler load Ncr	611,36	611,36	kN
Slenderness Lambda	74,47	74,47	
Relative slenderness Lambda,rel	0,79	0,79	
Limit slenderness Lambda,rel,0	0,20	0,20	
Buckling curve	c	c	
Imperfection Alpha	0,49	0,49	
Reduction factor Chi	0,67	0,67	
Buckling resistance Nb,Rd	256,26	256,26	kN

Flexural Buckling verification		
Cross-section area A	1,6360e-03	m ²
Buckling resistance Nb,Rd	256,26	kN
Unity check	0,90	-

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.

The member satisfies the stability check.

16. Dimenzioniranje ispune rešetke pozicije R5

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN1

Cross-section : Ispuna5 - CFRHS90X90X6

EN 1993-1-1 Code Check

National annex: Standard EN

Member B61 **2,557 m** **CFRHS90X90X6** **S 235** **GSN1/2** **0,92 -**

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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma M2 for resistance of net sections	1,25

Material		
Yield strength fy	235,0	MPa
Ultimate strength fu	360,0	MPa
Fabrication	Cold formed	

.....SECTION CHECK:....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	12,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	42,00

=> Section classified as Class 1 for cross-section design

The critical check is on position 2.557 m

Internal forces	Calculated	Unit
N,Ed	-273,56	kN
Vy,Ed	0,00	kN
Vz,Ed	0,00	kN
T,Ed	0,00	kNm
My,Ed	0,00	kNm
Mz,Ed	0,00	kNm

Compression check

According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	1,9230e-03	m ²
Nc,Rd	451,90	kN

Unity check	0,61	-
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The member satisfies the section check.

.....STABILITY CHECK:....

Classification for member buckling design

Decisive position for stability classification: 0,000 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	12,00
Class 1 Limit	33,00
Class 2 Limit	38,00
Class 3 Limit	42,00

=> Section classified as Class 1 for member buckling design

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	2,557	2,557	m
Buckling factor k	1,00	1,00	
Buckling length Lcr	2,557	2,557	m
Critical Euler load Ncr	698,67	698,67	kN
Slenderness Lambda	75,53	75,53	
Relative slenderness Lambda,rel	0,80	0,80	
Limit slenderness Lambda,rel,0	0,20	0,20	
Buckling curve	c	c	
Imperfection Alpha	0,49	0,49	
Reduction factor Chi	0,66	0,66	
Buckling resistance Nb,Rd	298,03	298,03	kN

Flexural Buckling verification		
Cross-section area A	1,9230e-03	m²
Buckling resistance Nb,Rd	298,03	kN
Unity check	0,92	-

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.

The member satisfies the stability check.

17. Dimenzioniranje uzdužnog nosača pozicije UN

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN1

Cross-section : Uzd_greda - HEA700

EN 1993-1-1 Code Check

National annex: Standard EN

Member B1012	77,400 m	HEA700	S 235	GSN1/2	0,74 -
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Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma M2 for resistance of net sections	1,25

Material		
Yield strength fy	235,0	MPa
Ultimate strength fu	360,0	MPa
Fabrication	Rolled	

.....SECTION CHECK:....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	40,14
Class 1 Limit	65,95
Class 2 Limit	75,94
Class 3 Limit	114,67

=> Internal Compression parts Class 1

Classification of Outstand Flanges

According to EN 1993-1-1 Table 5.2 Sheet 2

Maximum width-to-thickness ratio	4,29
Class 1 Limit	9,00
Class 2 Limit	10,00

Class 3 Limit	13,80
---------------	-------

=> Outstand Flanges Class 1

=> Section classified as Class 1 for cross-section design

The critical check is on position 70.000 m

Internal forces	Calculated	Unit
N _{Ed}	-154,07	kN
V _{y,Ed}	2,50	kN
V _{z,Ed}	98,81	kN
T _{Ed}	0,22	kNm
M _{y,Ed}	1052,71	kNm
M _{z,Ed}	4,47	kNm

Compression check

According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	2,6100e-02	m ²
N _{c,Rd}	6133,50	kN
Unity check	0,03	-

Bending moment check for M_y

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

W _{pl,y}	7,0417e-03	m ³
M _{pl,y,Rd}	1654,79	kNm
Unity check	0,64	-

Bending moment check for M_z

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

W _{pl,z}	1,2583e-03	m ³
M _{pl,z,Rd}	295,71	kNm
Unity check	0,02	-

Shear check for V_y

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

E _t	1,20	
A _v	1,6802e-02	m ²
V _{pl,y,Rd}	2279,62	kN
Unity check	0,00	-

Shear check for V_z

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

E _t	1,20	
A _v	1,1750e-02	m ²
V _{pl,z,Rd}	1594,14	kN
Unity check	0,06	-

Torsion check

According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Tau _{t,Ed}	1,2	MPa
Tau _{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)

M _{pl,y,Rd}	1654,79	kNm
Alpha	2,00	
M _{pl,z,Rd}	295,71	kNm
Beta	1,00	

Unity check (6.41) = 0,40 + 0,02 = 0,42 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

Note: Since the axial force satisfies both criteria (6.33) and (6.34) of EN 1993-1-1 article 6.2.9.1(4) its effect on the moment resistance about the y-y axis is neglected.

Note: Since the axial force satisfies criteria (6.35) of EN 1993-1-1 article 6.2.9.1(4) its effect on the moment resistance about the z-z axis is neglected.

The member satisfies the section check.

.....STABILITY CHECK:....

Classification for member buckling design

Decisive position for stability classification: 65,000 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	40,14
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Class 1 Limit	65,95
Class 2 Limit	75,94
Class 3 Limit	108,14

=> Internal Compression parts Class 1

Classification of Outstand Flanges

According to EN 1993-1-1 Table 5.2 Sheet 2

Maximum width-to-thickness ratio	4,29
Class 1 Limit	9,00
Class 2 Limit	10,00
Class 3 Limit	13,81

=> Outstand Flanges Class 1

=> Section classified as Class 1 for member buckling design

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	5,000	5,000	m
Buckling factor k	2,00	2,00	
Buckling length L _{cr}	10,000	10,000	m
Critical Euler load N _{cr}	44561,26	2528,59	kN
Slenderness Lambda	34,84	146,26	
Relative slenderness Lambda _{rel}	0,37	1,56	
Limit slenderness Lambda _{rel,0}	0,20	0,20	
Buckling curve	a	b	
Imperfection Alpha	0,21	0,34	
Reduction factor Chi	0,96	0,32	
Buckling resistance N _{b,Rd}	5889,78	1974,53	kN

Flexural Buckling verification		
Cross-section area A	2,6100e-02	m ²
Buckling resistance N _{b,Rd}	1974,53	kN
Unity check	0,08	-

Torsional(-Flexural) Buckling check

According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Note: For this I-section the Torsional(-Flexural) buckling resistance is higher than the resistance for Flexural buckling. Therefore Torsional(-Flexural) buckling is not printed on the output.

Lateral Torsional Buckling check

According to EN 1993-1-1 article 6.3.2.1 & 6.3.2.3 and formula (6.54)

LTB parameters		
Method for LTB curve	Alternative case	
Cross-section plastic modulus W _{pl,y}	7,0417e-03	m ³
Elastic critical moment M _{cr}	5091,13	kNm
Relative slenderness Lambda _{rel,LT}	0,57	
Limit slenderness Lambda _{rel,LT,0}	0,40	
LTB curve	c	
Imperfection Alpha _{LT}	0,49	
LTB factor Beta	0,75	
Reduction factor Chi _{LT}	0,90	
Correction factor k _c	0,88	
Correction factor f	0,95	
Modified reduction factor Chi _{LT,mod}	0,96	
Design buckling resistance M _{b,Rd}	1581,33	kNm
Unity check	0,67	-

Mcr parameters		
LTB length L	5,000	m
Influence of load position	no influence	
Correction factor k	1,00	
Correction factor k _w	1,00	
LTB moment factor C ₁	1,30	
LTB moment factor C ₂	0,00	
LTB moment factor C ₃	1,00	
Shear center distance d _z	0	mm
Distance of load application z _g	0	mm
Mono-symmetry constant beta _y	0	mm
Mono-symmetry constant z _j	0	mm

Note: C parameters are determined according to ECCS 119 2006 / Galea 2002.

Note: The correction factor k_c is determined from C₁.

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	2,6100e-02	m ²
Cross-section plastic modulus Wpl,y	7,0417e-03	m ³
Cross-section plastic modulus Wpl,z	1,2583e-03	m ³
Design compression force N,Ed	154,07	kN
Design bending moment (maximum) My,Ed	1052,71	kNm
Design bending moment (maximum) Mz,Ed	4,47	kNm
Characteristic compression resistance N,Rk	6133,50	kN
Characteristic moment resistance My,Rk	1654,79	kNm
Characteristic moment resistance Mz,Rk	295,71	kNm
Reduction factor Chi,y	0,96	
Reduction factor Chi,z	0,32	
Modified reduction factor Chi,LT,mod	0,96	
Interaction factor k,yy	1,05	
Interaction factor k,yz	0,82	
Interaction factor k,zy	0,55	
Interaction factor k,zz	0,99	

Maximum moment My,Ed is derived from beam B1012 position 70,000 m.

Maximum moment Mz,Ed is derived from beam B1012 position 70,000 m.

Interaction method 1 parameters		
Critical Euler load N,cr,y	44561,26	kN
Critical Euler load N,cr,z	2528,59	kN
Elastic critical load N,cr,T	17485,27	kN
Cross-section plastic modulus Wpl,y	7,0417e-03	m ³
Cross-section elastic modulus Wel,y	6,2400e-03	m ³
Cross-section plastic modulus Wpl,z	1,2583e-03	m ³
Cross-section elastic modulus Wel,z	8,1200e-04	m ³
Second moment of area Iy	2,1500e-03	m ⁴
Second moment of area Iz	1,2200e-04	m ⁴
Torsional constant It	5,1400e-06	m ⁴
Method for equivalent moment factor C,my,0	Table A.2 Line 2 (General)	
Design bending moment (maximum) My,Ed	1052,71	kNm
Maximum relative deflection delta,z	-5,5	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) Mz,Ed	4,47	kNm
Maximum relative deflection delta,y	0,0	mm
Equivalent moment factor C,mz,0	0,95	
Factor mu,y	1,00	
Factor mu,z	0,96	
Factor epsilon,y	28,58	
Factor a,LT	1,00	
Critical moment for uniform bending Mcr,0	3923,64	kNm
Relative slenderness Lambda,rel,0	0,65	
Limit relative slenderness Lambda,rel,0,lim	0,22	
Equivalent moment factor C,my	1,00	
Equivalent moment factor C,mz	0,95	
Equivalent moment factor C,mLT	1,03	
Factor b,LT	0,00	
Factor c,LT	0,26	
Factor d,LT	0,00	
Factor e,LT	0,12	
Factor w,y	1,13	
Factor w,z	1,50	
Factor n,pl	0,03	
Maximum relative slenderness Lambda,rel,max	1,56	
Factor C,yy	0,99	
Factor C,yz	0,85	
Factor C,zy	0,95	
Factor C,zz	0,98	

Unity check (6.61) = 0,03 + 0,70 + 0,01 = 0,74 -

Unity check (6.62) = 0,08 + 0,36 + 0,01 = 0,46 -

Shear Buckling check

According to EN 1993-1-5 article 5 & 7.1 and formula (5.10) & (7.1)

Shear Buckling parameters		
Buckling field length a	77,400	m
Web	unstiffened	
Web height hw	636	mm
Web thickness t	15	mm
Material coefficient epsilon	1,00	
Shear correction factor Eta	1,20	

Shear Buckling verification	
Web slenderness hw/t	43,86
Web slenderness limit	60,00

Note: The web slenderness is such that Shear Buckling effects may be ignored according to EN 1993-1-5 article 5.1(2).

The member satisfies the stability check.

18. Dimenzioniranje poprečnog nosača pozicije PN

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN2

Cross-section : Pop_greda - HEA300

EN 1993-1-1 Code Check

National annex: Standard EN

Member B1011	19,200 m	HEA300	S 235	GSN2/1	0,39 -
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Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma M2 for resistance of net sections	1,25

Material		
Yield strength fy	235,0	MPa
Ultimate strength fu	360,0	MPa
Fabrication	Rolled	

.....SECTION CHECK:....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	24,47
Class 1 Limit	74,86
Class 2 Limit	86,29
Class 3 Limit	133,93

=> Internal Compression parts Class 1

Classification of Outstand Flanges

According to EN 1993-1-1 Table 5.2 Sheet 2

Maximum width-to-thickness ratio	8,48
Class 1 Limit	9,00
Class 2 Limit	10,00
Class 3 Limit	13,77

=> Outstand Flanges Class 1

=> Section classified as Class 1 for cross-section design

The critical check is on position 2.557 m

Internal forces	Calculated	Unit
N _{Ed}	30,96	kN
V _{y,Ed}	-0,01	kN
V _{z,Ed}	-52,70	kN
T _{Ed}	0,00	kNm
M _{y,Ed}	-126,39	kNm
M _{z,Ed}	0,06	kNm

Tension check

According to EN 1993-1-1 article 6.2.3 and formula (6.5)

A	1,1300e-02	m ²
N _{pl,Rd}	2655,50	kN
N _{u,Rd}	2928,96	kN
N _{t,Rd}	2655,50	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)

W _{pl,y}	1,3833e-03	m ³
M _{pl,y,Rd}	325,08	kNm
Unity check	0,39	-

Bending moment check for M_z

According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

W _{pl,z}	6,4167e-04	m ³
M _{pl,z,Rd}	150,79	kNm
Unity check	0,00	-

Shear check for V_y

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Eta	1,20	
Av	8,7017e-03	m ²
Vpl,y,Rd	1180,63	kN
Unity check	0,00	-

Shear check for Vz

According to EN 1993-1-1 article 6.2.6 and formula (6.17)

Eta	1,20	
Av	3,7750e-03	m ²
Vpl,z,Rd	512,18	kN
Unity check	0,10	-

Combined bending, axial force and shear force check

According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

Mpl,y,Rd	325,08	kNm
Alpha	2,00	
Mpl,z,Rd	150,79	kNm
Beta	1,00	

Unity check (6.41) = 0,15 + 0,00 = 0,15 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

Note: Since the axial force satisfies both criteria (6.33) and (6.34) of EN 1993-1-1 article 6.2.9.1(4) its effect on the moment resistance about the y-y axis is neglected.

Note: Since the axial force satisfies criteria (6.35) of EN 1993-1-1 article 6.2.9.1(4) its effect on the moment resistance about the z-z axis is neglected.

The member satisfies the section check.

.....STABILITY CHECK:....

Classification for member buckling design

Decisive position for stability classification: 0,639 m

Classification of Internal Compression parts

According to EN 1993-1-1 Table 5.2 Sheet 1

Maximum width-to-thickness ratio	24,47
Class 1 Limit	87,30
Class 2 Limit	100,64
Class 3 Limit	179,49

=> Internal Compression parts Class 1

Classification of Outstand Flanges

According to EN 1993-1-1 Table 5.2 Sheet 2

Maximum width-to-thickness ratio	8,48
Class 1 Limit	9,00
Class 2 Limit	10,00
Class 3 Limit	13,78

=> Outstand Flanges Class 1

=> Section classified as Class 1 for member buckling design

Lateral Torsional Buckling check

According to EN 1993-1-1 article 6.3.2.1 & 6.3.2.3 and formula (6.54)

LTB parameters		
Method for LTB curve	Alternative case	
Cross-section plastic modulus Wpl,y	1,3833e-03	m ³
Elastic critical moment M _{cr}	5482,81	kNm
Relative slenderness Lambda _{rel,LT}	0,24	
Limit slenderness Lambda _{rel,LT,0}	0,40	

Note: The slenderness or bending moment is such that Lateral Torsional Buckling effects may be ignored according to EN 1993-1-1 article 6.3.2.2(4).

Mcr parameters		
LTB length L	2,557	m
Influence of load position	no influence	
Correction factor k	1,00	
Correction factor k _w	1,00	
LTB moment factor C1	1,83	
LTB moment factor C2	0,01	
LTB moment factor C3	1,00	
Shear center distance d _z	0	mm
Distance of load application z _g	0	mm
Mono-symmetry constant beta _y	0	mm
Mono-symmetry constant z _j	0	mm

Note: C parameters are determined according to ECCS 119 2006 / Galea 2002.

Bending and axial tension check

According to EN 1993-1-3 article 6.3

Design tension force N _{Ed}	30,96	kN
Design bending moment M _{y,Ed}	-126,39	kNm
Design bending moment M _{z,Ed}	0,06	kNm
Tension resistance N _{t,Rd}	2655,50	kN
Bending resistance M _{b,y,Rd}	325,08	kNm
Bending resistance M _{c,z,Rd,com}	150,79	kNm

Unity check = $0,39 + 0,00 - 0,01 = 0,38$ -

Shear Buckling check

According to EN 1993-1-5 article 5 & 7.1 and formula (5.10) & (7.1)

Shear Buckling parameters		
Buckling field length a	19,200	m
Web	unstiffened	
Web height h _w	262	mm
Web thickness t	9	mm
Material coefficient epsilon	1,00	
Shear correction factor Eta	1,20	

Shear Buckling verification	
Web slenderness h _w /t	30,82
Web slenderness limit	60,00

Note: The web slenderness is such that Shear Buckling effects may be ignored according to EN 1993-1-5 article 5.1(2).

The member satisfies the stability check.

19. Dimenzioniranje stupa

Linear calculation, Extreme : Global

Selection : All

Combinations : GSN2

Cross-section : Stup - CFCHS273X8

EN 1993-1-1 Code Check

National annex: Standard EN

Member B1016	7,924 m	CFCHS273X8	S 235	GSN2/1	0,73 -
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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.

Partial safety factors	
Gamma M0 for resistance of cross-sections	1,00
Gamma M1 for resistance to instability	1,00
Gamma 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:....

Classification for cross-section design

According to EN 1993-1-1 article 5.5.2

Classification for Tubular Sections

According to EN 1993-1-1 Table 5.2 Sheet 3

Maximum width-to-thickness ratio	34,13
Class 1 Limit	50,00
Class 2 Limit	70,00
Class 3 Limit	90,00

=> Section classified as Class 1 for cross-section design

The critical check is on position 0.000 m

Internal forces	Calculated	Unit
N _{Ed}	-649,56	kN
V _{y,Ed}	0,00	kN
V _{z,Ed}	0,00	kN
T _{Ed}	0,00	kNm
M _{y,Ed}	0,00	kNm
M _{z,Ed}	0,00	kNm

Compression check

According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	6,6600e-03	m ²
N _{c,Rd}	1565,10	kN
Unity check	0,42	-

The member satisfies the section check.

.....**STABILITY CHECK:...**

Classification for member buckling design

Decisive position for stability classification: 0,000 m

Classification for Tubular Sections

According to EN 1993-1-1 Table 5.2 Sheet 3

Maximum width-to-thickness ratio	34,13
Class 1 Limit	50,00
Class 2 Limit	70,00
Class 3 Limit	90,00

=> Section classified as Class 1 for member buckling design

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	7,924	7,924	m
Buckling factor k	1,06	1,06	
Buckling length L _{cr}	8,420	8,420	m
Critical Euler load N _{cr}	1710,54	1710,54	kN
Slenderness Lambda	89,83	89,83	
Relative slenderness Lambda _{rel}	0,96	0,96	
Limit slenderness Lambda _{rel,0}	0,20	0,20	
Buckling curve	c	c	
Imperfection Alpha	0,49	0,49	
Reduction factor Chi	0,57	0,57	
Buckling resistance N _{b,Rd}	885,12	885,12	kN

Flexural Buckling verification		
Cross-section area A	6,6600e-03	m ²
Buckling resistance N _{b,Rd}	885,12	kN
Unity check	0,73	-

Torsional(-Flexural) Buckling check

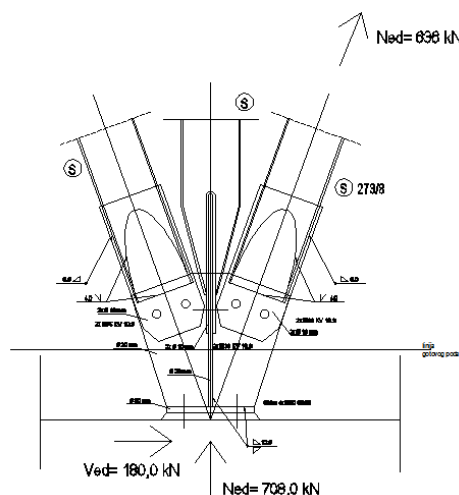
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Note: The cross-section concerns a CHS section which is not susceptible to Torsional(-Flexural) Buckling.

The member satisfies the stability check.

6. PRORAČUN SPOJEVA

6.1. SPOJ STUPOVA S TEMELJEM



Provjera nosivosti vertikalnih čvornih limova:

debljina lima $t = 20 \text{ mm}$

Nosivost na uzdužnu silu:

Otpornost poprečnog presjeka

Otpornost na djelovanje uzdužne sile

$$N_{c,Rd} = N_{pl,Rd} = \frac{A \cdot f_y}{\gamma_{M_0}} = \frac{2 \cdot 40 \cdot 23,5}{1,1} = 1709,0 (\text{kN})$$

Nosivost premašuje djelovanje, a izvijanje nije moguće zbog ukrućenja iz drugog smjera.

Slika 6.1: Skica spoja stup - temelj

Kontrola varova u spoju

Duljina vara za uzdužnu silu

$$l_{uzd} = 2 \cdot 60 = 120 \text{ cm}$$

Otpornost zavaru u uvali za var $a = 12 \text{ mm}$

$$F_{w,Rd} = \frac{f_u}{\sqrt{3} \cdot \beta_w \cdot \gamma_M} \cdot a \cdot l = \frac{36,0}{\sqrt{3} \cdot 0,8 \cdot 1,25} \cdot 1,2 \cdot 240 = 3000 (\text{kN})$$

Duljina vara za poprečnu silu

$$l_{uzd} = 2 \cdot 40 = 80 \text{ cm}$$

Otpornost zavaru u uvali za var $a = 12 \text{ mm}$

$$F_{w,Rd} = \frac{f_u}{\sqrt{3} \cdot \beta_w \cdot \gamma_M} \cdot a \cdot l = \frac{36,0}{\sqrt{3} \cdot 0,8 \cdot 1,25} \cdot 0,8 \cdot 240 = 2000 (\text{kN})$$

Kontrola nosivosti vijaka

Vijci u stupu 2xM36 kv. 10.9.

Djelujuća sila – posmična sila $N_{Ed} = 354 \text{ kN}$ /po jednom vijku

- otpornost vijaka na posmik:

$$F_{v,Rd} = \frac{F_{v,Rk}}{\gamma_{M1}} = \frac{408,5}{1,25} = 364,4 (\text{kN}) \dots \text{zadovoljava}$$

- pritisak po omotaču rupe čvornog lima:

$$F_{v,Rd} = \frac{F_{v,Rk}}{\gamma_{M1}} = \frac{324,0 \cdot 2}{1,25} = 518,4 (kN) \dots \text{zadovoljava}$$

Provjera nosivosti horizontalne pločice:

Kontrola nosivosti vijaka

Vijci u pločici – sidra 4xM30 kv. S355

Djelujuća sila – vlačna sila $N_{Ed} = 708 \text{ kN} \rightarrow 177 \text{ kN}$ / po jednom sidru

– posimična sila $N_{Fd} = 180 \text{ kN} \rightarrow 45 \text{ kN} / \text{po jednom sidru}$

- otpornost sidara na vlak:

$$F_{v,Rd} = \frac{F_{v,Rk}}{\gamma_{M1}} = \frac{0,9 \frac{d^2 \pi}{4} \cdot f_u}{\gamma_{M1}} = \frac{0,9 \frac{3,0^2 \cdot \pi}{4} \cdot 46,0}{1,25} = 234,1 (kN) \dots \text{zadovoljava}$$

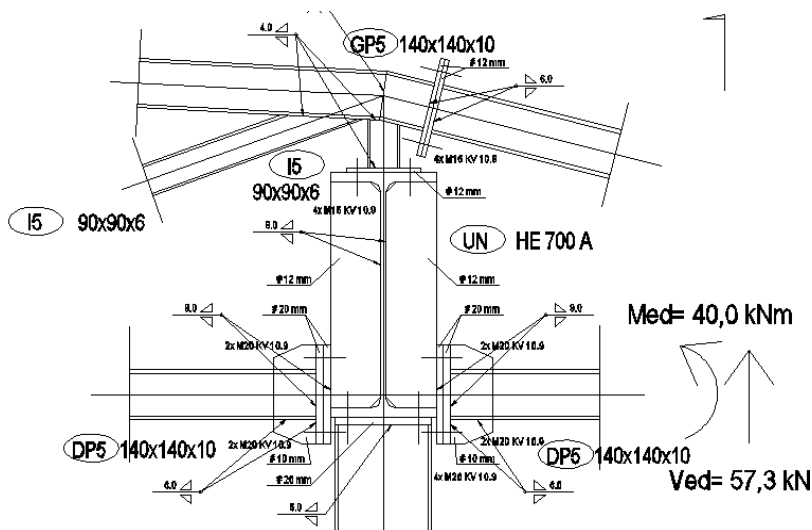
- odpornost sidra na posmik:

$$F_{v,Rd} = \frac{F_{v,Rk}}{\gamma_{M1}} = \frac{0,6 \cdot 46 \cdot 7,1}{1,25} = 156,0 \text{ (kN)} \dots \text{zadovoljava}$$

- pritisak po omotaču rupe pločice:

$$F_{v,Rd} = \frac{F_{v,Rk}}{\gamma_{M1}} = \frac{2,5 \cdot \alpha \cdot f_u \cdot d \cdot t}{1,25} = \frac{2,5 \cdot 1,0 \cdot 46 \cdot 3 \cdot 3}{1,25} = 828,0 \text{ (kN)} \dots \text{zadovoljava}$$

6.2. OSLOMAC REŠETKE NA UZDUŽNI NOSAČ UN



Rezne sile:

$$M_{Ed,max}=40 \text{ kNm}$$

krak sile $d = 21 \text{ cm}$

Spreg sila od momenta:

$$F_{Ed} = M_{Ed}/d = 4000/21$$

$$F_{Ed} = 190 \text{ kN}$$

Slika 6.2: Skica oslonca rešetke

Kontrola nosivosti vijaka:

Vijci u spoju 4xM20 kv. 10.9.

Djelujuća sila – uzdužna sila $N_{Ed} = 95 \text{ kN}$ /po jednom vijku

Djelujuća sila – posmična sila $V_{Ed} = 15 \text{ kN}$ /po jednom vijku

- otpornost sidara na vlak:

$$F_{v,Rd} = \frac{F_{v,Rk}}{\gamma_{M1}} = \frac{220,5}{1,25} = 176,4 \text{ (kN)} \dots \text{zadovoljava}$$

- otpornost vijaka na posmik:

$$F_{v,Rd} = \frac{F_{v,Rk}}{\gamma_{M1}} = \frac{122,5}{1,25} = 98 \text{ (kN)} \dots \text{zadovoljava}$$

- pritisak po omotaču rupe čvornog lima:

$$F_{v,Rd} = \frac{F_{v,Rk}}{\gamma_{M1}} = \frac{2,5 \cdot \alpha \cdot f_u \cdot d \cdot t}{1,25} = \frac{2,5 \cdot 0,53 \cdot 23,5 \cdot 2 \cdot 2}{1,25} = 99,64 \text{ (kN)} \dots \text{zadovoljava}$$

Kontrola nosivosti pločice:

Savijanje pločice uslijed vlačne sile u vijcima

$F_{Ed} = 190 \text{ kN}$

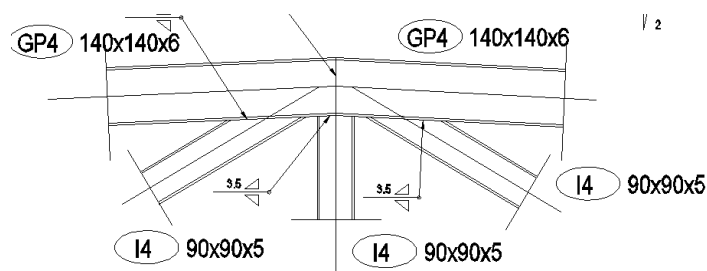
Moment savijanja u pločici za krak $d = 3,5 \text{ cm}$

$M_{Ed} = F_{Ed} \cdot d = 190 \cdot 3,5 = 665 \text{ kNcm}$

$$M_{Ed} \leq \frac{W_{min} \cdot f_y}{1,1} \Rightarrow W_{min} = \frac{1,1 \cdot M_{Ed}}{f_y} = \frac{b_{pl} \cdot t_{pl}^2}{6}$$

$$t_{pl}^{min} = \sqrt{\frac{1,1 \cdot M_{Ed} \cdot 6}{b_{pl} \cdot f_y}} = \sqrt{\frac{1,1 \cdot 665 \cdot 6}{16 \cdot 23,5}} = 1,94 \text{ (cm)}$$

$$t_{pl} \geq 1,94 \text{ (cm)} \rightarrow t_{pl, odabrano} = 20 \text{ (mm)}$$

6.3. SPOJEVI POJASEVA I ISPUNA REŠETKI

Slika 6.3: Skica priključka ispuna na pojas rešetke

Osnovni materijal: Čelik S235

Geometrija poprečnih presjeka:

$$\begin{aligned} h_0 &= 140 \text{ mm} & b_0 &= 140 \text{ mm} & t_0 &= \\ h_1 &= 90 \text{ mm} & b_1 &= 90 \text{ mm} & t_1 &= \text{varijabilno} \\ h_2 &= 90 \text{ mm} & b_2 &= 90 \text{ mm} & t_2 &= \end{aligned}$$

Kontrola priključaka je obavljena tabelarno za cijelu krovnu rešetku jer je geometrija profila ista po segmentima, a rezne sile su uzete iz proračunskog modela. Popisani su priključci te su uneseni u novu tablicu s geometrijom i reznim silama. Nakon toga su provjereni uvjeti za primjenu EN 1993-1-8, tablica 7.8 i tablica 7.9. Pošto su svi uvjeti bili zadovoljeni, provjerena su dva moda otkazivanja, plastifikacija površine pojasa te otkazivanje ispune.

Popis spojeva i njima pripadajućih reznih sila

popis spojeva	$N_{0,Ed}(\text{tlak})$	$N_{0,Ed}(\text{vlak})$	$N_{pl,Ed}$	$N_{1,Ed}(\text{tlak})$	$N_{2,Ed}(\text{vlak})$
90x5 - 140x5	309	314	314	216	222
90x5 - 140x6	267	349	349	230	236
90x6 - 140x10	763	800	800	330	380

Tablica 6.1: Popis priključaka i mjerodavnih reznih sila

Kriteriji za primjenu EN 1993-1-8, tablica 7.8 i 7.9. (uvjeti su dani u prvom redu tablice)

b_0	t_0	b_i	t_i	$b_i/t_i < 35$	$b_i/b_0 > 0,26$	$0,5 < h_0/b_0 < 2,0$	$0,5 < h_i/b_i < 2,0$	$b_0/t_0 < 35$
140	5,0	90	5,0	18,00	0,64	1,00	1,00	30,00
140	5,0	90	5,0	18,00	0,64	1,00	1,00	30,00
140	6,0	90	6,0	15,00	0,64	1,00	1,00	30,00

Tablica 6.2: Kontrola uvjeta za primjenu norme

Plastifikacija površine pojasa

$$N_{i,Rd} = \left[\frac{8,9 \cdot \gamma^{0,5} \cdot k_n \cdot f_y \cdot t_0^2}{(1 - \beta) \cdot \sin \theta_i} \cdot \left(\frac{2 \cdot \beta}{\sin \theta_i} + 4 \cdot \sqrt{1 - \beta} \right) / \gamma_{M5} \right] \cdot 0,9$$

$$\gamma = \frac{b_0}{2t_0} \quad \beta = \frac{b_i}{b_0} \quad k_n = 1,3 - \frac{0,4n}{\beta} < 1,0 \quad n = \left(\frac{\sigma_{0,Ed}}{f_{y0}} \right) / \gamma_{M5} \quad k_n = 1,0 \text{ ..za}$$

vlak

γ	θ	$\sin\theta$	f_y	β	$A(\text{cm}^2)$	σ	n	kn	$N1,Rd$	usporedba
14,00	0,884882	0,7738	23,5	0,533	33,5	9,37	0,40	1,00	309,633	0,70
14,00	0,884882	0,7738	23,5	0,533	33,5	10,42	0,44	0,97	299,574	0,77
11,67	1,471313	0,9951	23,5	0,467	43,5	17,54	0,75	0,79	386,21	0,98

Tablica 6.3: Kontrola nosivosti za mod otkazivanja koji se odnosi na plastifikaciju površine pojasa

4. Lom ispune

$$N_{i,Rd} = \left[f_{yi} \cdot t_i \cdot \left(b_{eff} + b_{e,ov} + \frac{\lambda_{ov}}{50} \cdot (2h_i - 4t_i) \right) / \gamma_{M5} \right] \cdot 0.9$$

$$b_{eff} = \frac{10}{b_0/t_0} \frac{f_{y0} \cdot t_0}{f_{yi} \cdot t_i} b_i \leq b_i \quad b_{e,ov} = \frac{10}{b_j/t_j} \frac{f_{yj} \cdot t_j}{f_{yi} \cdot t_i} b_i \leq b_i$$

b_{eff}	$b_{e,ov}$	λ_{ov}	$N1,Rd$	usporedba
32,14	50	0,55	303,32	0,73
32,14	50	0,55	303,32	0,78
38,57	72	0,55	397,86	0,96

Tablica 6.4: Kontrola nosivosti za mod otkazivanja koji se odnosi na lom ispune

Debljine varova

Varovi su proračunati da preuzimaju vlačne sile u priključku, ali su ograničeni tako da minimalna debljina bude 3 mm

duljina vara	debljina vara	F_w, rk	F_w, Rd	usporedba
320	3,5	2619	2095	0,23
320	3,5	2619	2095	0,23
320	4	2993	2394	0,14

Tablica 6.5: Debljine varova u pojedinim priključcima

7. GRAĐEVINSKI NACRTI

7.1. GRAĐEVINSKI NACRTI ZA GLAVNI PROJEKT

7.1.1. Plan pozicija – Tlocrt i uzdužni presjek nadstrešnice **M 1:200**

7.1.2. Plan pozicija – Poprečni presjek nadstrešnice **M 1:100**

7.2. GRAĐEVINSKI NACRTI ZA IZVEDBENI PROJEKT

7.2.1. Plan pozicija kompletne nadstrešnice **M 1:100**

7.2.2. Plan pozicija dilatacije C1 **M 1:100**

7.2.3. Detalj spoja stupova i temelja **M 1:10**

7.2.4. Detalj oslanjanja poprečnog nosača pozicije PN na uzdužni nosač pozicije UN i detalj spoja stupa i poprečnog nosača **M 1:10**

7.2.5. Detalj oslanjanja rešetke na uzdužni nosač pozicije UN **M 1:10**

7.2.6. Detalj čvora rešetke u osi D **M 1:10**

7.2.7. Detalj čvora rešetke u osi A **M 1:10**

7.2.8. Detalj čvora rešetke u osi G **M 1:10**

7.2.9. Montažni nastavak uzdužnog nosača pozicije UN **M 1:10**

7.2.10. Montažni nastavak poprečnog nosača pozicije PN **M 1:10**

7.2.11. Stupovi pozicije S1, S2 i S3 **M 1:10 1:20**

7.2.12. Uzdužni nosač pozicije UN1 **M 1:10 1:20**

7.2.13. Poprečni nosač nosač pozicije PN1 i PN2 **M 1:10 1:20**

7.2.14. Kljunovi rešetki **M 1:10 1:20**

7.2.15. Rešetka pozicije R1 **M 1:10 1:20**

7.2.16. Rešetka pozicije R3 **M 1:10 1:20**

7.2.13. Zatege **M 1:10 1:20**

7.2.14. Pločice **M 1:10 1:20**

7.3. ISKAZ MATERIJALA

7.3.1. Iskaz materijala za cijelu nadstrešnicu

Iskaz profila

Section	Grade	Length (mm)	Mass	
			Unit (kg/m)	Total (kg)
CHS 273x8	S 235	415398,90	52,300	21725,37
HEA 300	S 235	191400,00	88,334	16907,19
HEA 700	S 235	357520,04	204,475	73103,91
L 110x110x10	S 235	25040,00	16,600	415,66
Q 140x140x10	S 235	395626,49	38,851	15370,56
Q 140x140x5	S 235	625451,26	21,108	13202,10
Q 140x140x6	S 235	252235,79	24,983	6301,62
Q 140x140x8	S 235	681814,47	32,019	21831,08
Q 90x90x4	S 235	85988,82	10,707	920,68
Q 90x90x5	S 235	831225,31	13,052	10849,46
Q 90x90x6	S 235	229303,53	15,398	3530,75
ROND 16	S 235	629080,00	1,580	993,95

Tablica 7.1: Sumarni iskaz profila cijele nadstrešnice

Iskaz pločica

Position	Section	Length (mm)	Number	material	Mass	
					of element (kg)	Total (kg)
pl 1	Plate 10x112	182,43	4	S 235	0,94	3,78
pl 2	Plate 10x95	184,61	16	S 235	0,92	14,71
pl 3	Plate 10x90	184,75	16	S 235	0,88	14,14
pl 4	Plate 10x97	185,28	16	S 235	0,93	14,81
pl 5	Plate 10x90	189,93	8	S 235	0,93	7,48
pl 6	Plate 70x23	190,00	200	S 235	1,08	215,21
pl 7	Plate 10x100	192,39	4	S 235	0,97	3,87
pl 8	Plate 10x90	192,80	16	S 235	0,90	14,35
pl 9	Plate 10x90	192,80	16	S 235	0,90	14,35
pl 10	Plate 10x90	193,47	16	S 235	0,90	14,44
pl 11	Plate 10x90	193,54	16	S 235	0,91	14,52
pl 12	Plate 10x94	194,81	32	S 235	0,88	28,19
pl 13	Plate 6x200	200,00	40	S 235	1,81	72,58
pl 14	Plate 10x90	201,90	8	S 235	0,94	7,55
pl 15	Plate 10x102	204,37	16	S 235	0,91	14,50
pl 16	Plate 10x110	205,11	16	S 235	0,88	14,05
pl 17	Plate 12x160	210,00	80	S 235	3,07	245,82
pl 18	Plate 8x420	257,00	120	S 235	5,17	620,45
pl 19	Plate 10x146	262,00	80	S 235	2,93	234,24
pl 20	Plate 10x120	280,00	160	S 235	2,23	356,83
pl 21	Plate 12x160	280,00	80	S 235	4,13	330,26
pl 22	Plate 20x160	280,00	320	S 235	6,80	2177,09
pl 23	Plate 8x300	340,00	40	S 235	6,22	248,87
pl 24	Plate 8x115	340,00	80	S 235	2,36	189,06
pl 25	Plate 8x143	400,00	20	S 235	3,51	70,12
pl 26	Plate 30x390	440,00	20	S 235	39,33	786,59
pl 27	Plate 20x300	500,00	60	S 235	23,33	1399,55
pl 28	Plate 16x300	560,00	64	S 235	20,33	1301,01
pl 29	Plate 16x115	560,00	128	S 235	7,70	985,79
pl 30	Plate 10x240	560,00	64	S 235	10,32	660,58
pl 31	Plate 20x356	609,47	20	S 235	24,41	488,29
pl 32	Plate 20x150	609,47	20	S 235	12,47	249,44
pl 33	Plate 12x143	636,00	248	S 235	8,47	2100,71
pl 34	Plate 8x143	636,00	20	S 235	5,64	112,74
pl 35	Plate 300x41	650,50	60	S 235	29,86	1791,64
pl 36	Plate 20x693	666,84	20	S 235	51,42	1028,42

Tablica 7.2: Sumarni iskaz pločica cijele nadstrešnice

Iskaz po sklopovima

Position	Element name	Number	Length [mm]	Mass	
				of element [kg]	Total [kg]
1	Sub part - profile L 110x110x10	20	626,00	10,39	207,83
2	Sub part - profile L 110x110x10	20	626,00	10,39	207,83
D 1	D R0 H0 16	100	2130,00	4,24	423,61
D 2	D R0 H0 16	8	3470,00	6,35	50,83
D 3	D R0 H0 16	8	3030,00	6,92	55,30
D 4	D R0 H0 16	24	4080,00	7,32	175,61
D 5	D R0 H0 16	24	4430,00	7,87	188,88
D 6	D R0 H0 16	8	6510,00	8,00	63,97
D 7	D R0 H0 16	4	4560,00	8,00	32,30
D 8	D R0 H0 16	12	5080,00	8,90	106,76
D 9	D R0 H0 16	8	5130,00	8,98	71,81
D 10	D R0 H0 16	4	5780,00	10,00	40,01
KR 1	KR R 160x160x5	3	3370,97	151,01	453,03
KR 2	KR R 160x160x5	10	3370,97	185,99	1859,90
KR 3	KR R 160x160x5	4	3370,97	186,87	747,67
KR 4	KR R 160x160x5	4	3370,97	186,87	747,67
KR 5	KR R 160x160x5	1	3370,97	186,90	186,90
KR 6	KR R 160x160x6	5	3370,97	198,87	994,36
KR 7	KR R 160x160x6	3	3370,97	199,78	599,34
KR 8	KR R 160x160x6	2	3370,97	199,78	399,56
KR 9	KR R 160x160x10	2	3370,97	266,88	533,77
KR 10	KR R 160x160x10	1	3370,97	267,79	267,79
KR 11	KR R 160x160x10	1	3370,97	267,79	267,79
KR 12	KR R 160x160x10	2	3370,97	267,83	535,65
KR 13	KR R 160x160x10	2	3370,97	267,83	535,65
PR 1	PR HEA 300	20	6000,00	561,72	10834,36
PR 2	PR HEA 300	10	7160,00	630,71	6307,07
PI 1	Plate Plate 6x200	60	200,00	1,81	72,58
PI 2	Plate Plate 8x300	60	360,00	6,22	248,87
PI 3	Plate Plate 8x115	80	360,00	2,36	189,06
PI 4	Plate Plate 16x300	66	560,00	20,33	1301,01
PI 5	Plate Plate 16x115	128	560,00	7,70	985,79
PI 6	Plate Plate 10x240	66	560,00	10,32	660,58
PI 7	Plate Plate 20x693	20	70154	127,64	2552,73
R 1	R R 160x160x5	3	21053,54	1240,70	3722,30
R 2	R R 160x160x8	10	21053,54	1529,47	15294,70
R 3	R R 160x160x8	4	21053,54	1537,63	6149,73
R 4	R R 160x160x8	4	21053,54	1537,63	6149,73
R 5	R R 160x160x8	1	21053,54	1537,64	1537,64
R 6	R R 160x160x8	5	21053,54	1616,33	8071,63
R 7	R R 160x160x8	2	21053,54	1622,50	3245,00
R 8	R R 160x160x8	3	21053,54	1622,50	4867,50
R 9	R R 160x160x10	2	21053,54	2123,97	4247,95
R 10	R R 160x160x10	1	21053,54	2132,15	2132,15
R 11	R R 160x160x10	1	21053,54	2132,15	2132,15
R 12	R R 160x160x10	2	21053,54	2132,38	4264,75
R 13	R R 160x160x10	2	21053,54	2132,38	4264,75
S 1	S CHS 273x8	20	7101,10	425,62	8512,33
S 2	S CHS 273x8	20	7101,23	425,62	8512,33
S 3	S CHS 273x8	20	7104,07	425,62	8512,36
UH 1	UH HEA 700	2	3280,01	670,68	1341,36
UH 2	UH HEA 700	6	8000,00	1616,90	10181,38
UH 3	UH HEA 700	2	8000,00	1616,90	3393,79
UH 4	UH HEA 700	2	10000,00	2168,87	4297,74
UH 5	UH HEA 700	1	10000,00	2165,01	2165,01
UH 6	UH HEA 700	6	10000,00	2105,85	12635,08
UH 7	UH HEA 700	2	10000,00	2168,87	4297,74
UH 8	UH HEA 700	2	10000,00	2168,87	4297,74
UH 9	UH HEA 700	2	10000,00	2168,87	4297,74
UH 10	UH HEA 700	1	10000,00	2168,87	2168,87
UH 11	UH HEA 700	1	10000,00	2168,87	2168,87
UH 12	UH HEA 700	1	10000,00	2165,01	2165,01
UH 13	UH HEA 700	1	11000,00	2383,89	2383,89
UH 14	UH HEA 700	1	11000,00	2383,89	2383,89
UH 15	UH HEA 700	1	12600,01	2686,52	2686,52
UH 16	UH HEA 700	1	12600,01	2686,52	2686,52
UH 17	UH HEA 700	1	15000,00	3232,34	3232,34
UH 18	UH HEA 700	1	15000,00	3232,34	3232,34
UH 19	UH HEA 700	1	15000,00	3249,28	3249,28
UH 20	UH HEA 700	1	15000,00	3249,28	3249,28
Total mass [kg]					200998,36
Element mass [kg]				74951,54	
Weld mass addition [kg]					4019,97
Total mass [kg]					205018,33

Tablica 7.3: Sumarni iskaz materijala
po sklopovima cijele nadstrešnice

Utrošak materijala po m² nadstrešnice:

$$g = 205018 / (179,0 \times 24,2) = 47,3 \text{ kg/m}^2$$

7.3.1. Iskaz materijala dilatacije C1

Iskaz profila

Section	Grade	Length (mm)	Mass	
			Unit (kg/m)	Total (kg)
CHS 273x8	S 235	166159,78	52,300	8690,15
HEA 300	S 235	76560,00	88,334	6762,87
HEA 700	S 235	154960,02	204,475	31685,45
L 110x110x10	S 235	10016,00	16,600	166,27
Q 140x140x10	S 235	197381,91	38,851	7668,52
Q 140x140x5	S 235	99181,58	21,108	2093,54
Q 140x140x6	S 235	252235,79	24,983	6301,62
Q 140x140x8	S 235	282130,13	32,019	9033,55
Q 90x90x4	S 235	28662,94	10,707	306,89
Q 90x90x5	S 235	343955,30	13,052	4489,43
Q 90x90x6	S 235	114651,77	15,398	1765,38
ROND 16	S 235	252800,00	1,580	399,42

Tablica 7.4: Sumarni iskaz profila dilatacije C1

Iskaz pločica

Position	Section	Length (mm)	Number	Mass	
				of element (kg)	Total (kg)
pl 1	Plate 10x97	185,28	16	0,93	14,81
pl 2	Plate 70x23	190,00	80	1,08	86,09
pl 3	Plate 10x90	192,80	16	0,90	14,35
pl 4	Plate 10x90	193,47	16	0,90	14,44
pl 5	Plate 10x90	193,54	16	0,91	14,52
pl 6	Plate 6x200	200,00	16	1,81	29,03
pl 7	Plate 10x102	204,37	16	0,91	14,50
pl 8	Plate 12x160	210,00	34	3,07	104,47
pl 9	Plate 8x420	257,00	48	5,17	248,18
pl 10	Plate 10x146	262,00	32	2,93	93,70
pl 11	Plate 10x120	280,00	68	2,23	151,65
pl 12	Plate 12x160	280,00	34	4,13	140,36
pl 13	Plate 20x160	280,00	136	6,80	925,27
pl 14	Plate 8x300	340,00	16	6,22	99,55
pl 15	Plate 8x115	340,00	32	2,36	75,62
pl 16	Plate 8x143	400,00	8	3,51	28,05
pl 17	Plate 30x390	440,00	8	39,33	314,64
pl 18	Plate 20x300	500,00	24	23,33	559,82
pl 19	Plate 16x300	560,00	24	20,33	487,88
pl 20	Plate 16x115	560,00	48	7,70	369,67
pl 21	Plate 10x240	560,00	24	10,32	247,72
pl 22	Plate 20x356	609,47	8	24,41	195,31
pl 23	Plate 20x150	609,47	8	12,47	99,77
pl 24	Plate 12x143	636,00	100	8,47	847,06
pl 25	Plate 8x143	636,00	8	5,64	45,10
pl 26	Plate 300x41	650,50	24	29,86	716,66
pl 27	Plate 20x693	666,84	8	51,42	411,37

Tablica 7.5: Sumarni iskaz pločica dilatacije C1

Iskaz po sklopovima

Position	Element name	Number	Length (mm)	Mass	
				of element (kg)	Total (kg)
1	Sub part - profile L 110x110x10	8	626,00	10,39	83,13
2	Sub part - profile L 110x110x10	8	626,00	10,39	83,13
D 1	D ROND 16	40	2130,00	4,24	169,44
D 2	D ROND 16	8	3830,00	6,92	55,38
D 3	D ROND 16	24	4430,00	7,87	188,88
D 4	D ROND 16	8	5130,00	8,98	71,81
KR 1	KR Q 140x140x5	1	3370,97	151,01	151,01
KR 2	KR Q 140x140x5	1	3370,97	185,99	185,99
KR 3	KR Q 140x140x5	1	3370,97	186,90	186,90
KR 4	KR Q 140x140x6	5	3370,97	198,87	994,36
KR 5	KR Q 140x140x6	3	3370,97	199,78	599,34
KR 6	KR Q 140x140x6	2	3370,97	199,78	399,56
KR 7	KR Q 140x140x10	2	3370,97	266,88	533,77
KR 8	KR Q 140x140x10	1	3370,97	267,79	267,79
KR 9	KR Q 140x140x10	1	3370,97	267,79	267,79
PN 1	PN HEA 300	8	6000,00	541,72	4333,74
PN 2	PN HEA 300	4	7140,00	630,71	2522,83
PI 1	Plate Plate 6x200	16	200,00	1,81	29,03
PI 2	Plate Plate 8x300	16	340,00	6,22	99,55
PI 3	Plate Plate 8x115	32	340,00	2,36	75,62
PI 4	Plate Plate 16x300	24	560,00	20,33	487,88
PI 5	Plate Plate 16x115	48	560,00	7,70	369,67
PI 6	Plate Plate 10x240	24	560,00	10,32	247,72
PI 7	Plate Plate 20x693	8	701,54	127,64	1021,09
R 1	R Q 140x140x5	1	21053,54	1240,70	1240,70
R 2	R Q 140x140x8	1	21053,54	1529,47	1529,47
R 3	R Q 140x140x8	1	21053,54	1537,64	1537,64
R 4	R Q 140x140x8	5	21053,54	1614,33	8071,63
R 5	R Q 140x140x8	2	21053,54	1622,50	3245,00
R 6	R Q 140x140x8	3	21053,54	1622,50	4867,50
R 7	R Q 140x140x10	2	21053,54	2123,97	4247,95
R 8	R Q 140x140x10	1	21053,54	2132,15	2132,15
R 9	R Q 140x140x10	1	21053,54	2132,15	2132,15
S 1	S CHS 273x8	8	7181,18	425,62	3404,93
S 2	S CHS 273x8	8	7181,23	425,62	3404,93
S 3	S CHS 273x8	8	7184,07	425,62	3404,94
UN 1	UN HEA 700	2	10000,00	2148,87	4297,74
UN 2	UN HEA 700	6	10000,00	2105,85	12635,08
UN 3	UN HEA 700	2	10000,00	2148,87	4297,74
UN 4	UN HEA 700	1	12480,01	2686,52	2686,52
UN 5	UN HEA 700	1	15000,00	3232,34	3232,34
UN 6	UN HEA 700	1	12480,01	2686,52	2686,52
UN 7	UN HEA 700	1	15000,00	3232,34	3232,34
Total mass: (kg)					85712,68
Element mass: (kg)				38395,95	
Weld mass addition (kg)					1714,25
Total mass (kg)					87426,93

Tablica 7.6: Sumarni iskaz materijala
po sklopovima dilatacije C1

Utrošak materijala po m² dilatacije C1:

$$g = 87426,93 / (77,3 \times 24,2) = 46,7 \text{ kg/m}^2$$

8. LITERATURA

Androić B., Dujmović D., Džeba I. (1994), *Metalne konstrukcije 2*, Institut građevinarstva Hrvatske

Androić B., Dujmović D., Džeba I. (1994), *Metalne konstrukcije 3: brzi proračun prema Eurocode : europski, britanski i američki profili: tablice otpornosti oresjeka i elemenata*, Institut građevinarstva Hrvatske

Leko V. (2013), *EC 3-1-8: Proračun spojeva: Komentar s primjerima*, Ogranak Sajema, Beograd

Androić B., Dujmović D., Džeba I. (2003), *Metalne konstrukcije 4*, Institut građevinarstva Hrvatske, Zagreb

Kahlmeyer E., Hebestreit K., Vogt W. (2012.), *Stahlbau nach EC3: Bemessung und Konstruktion: Träger – Stützen – Verbindungen*, Wolters Klumer Deutschland GmbH, Köln

Šimić V. (2002.), *Otpornost materijala 1*, Školska knjiga, Zagreb

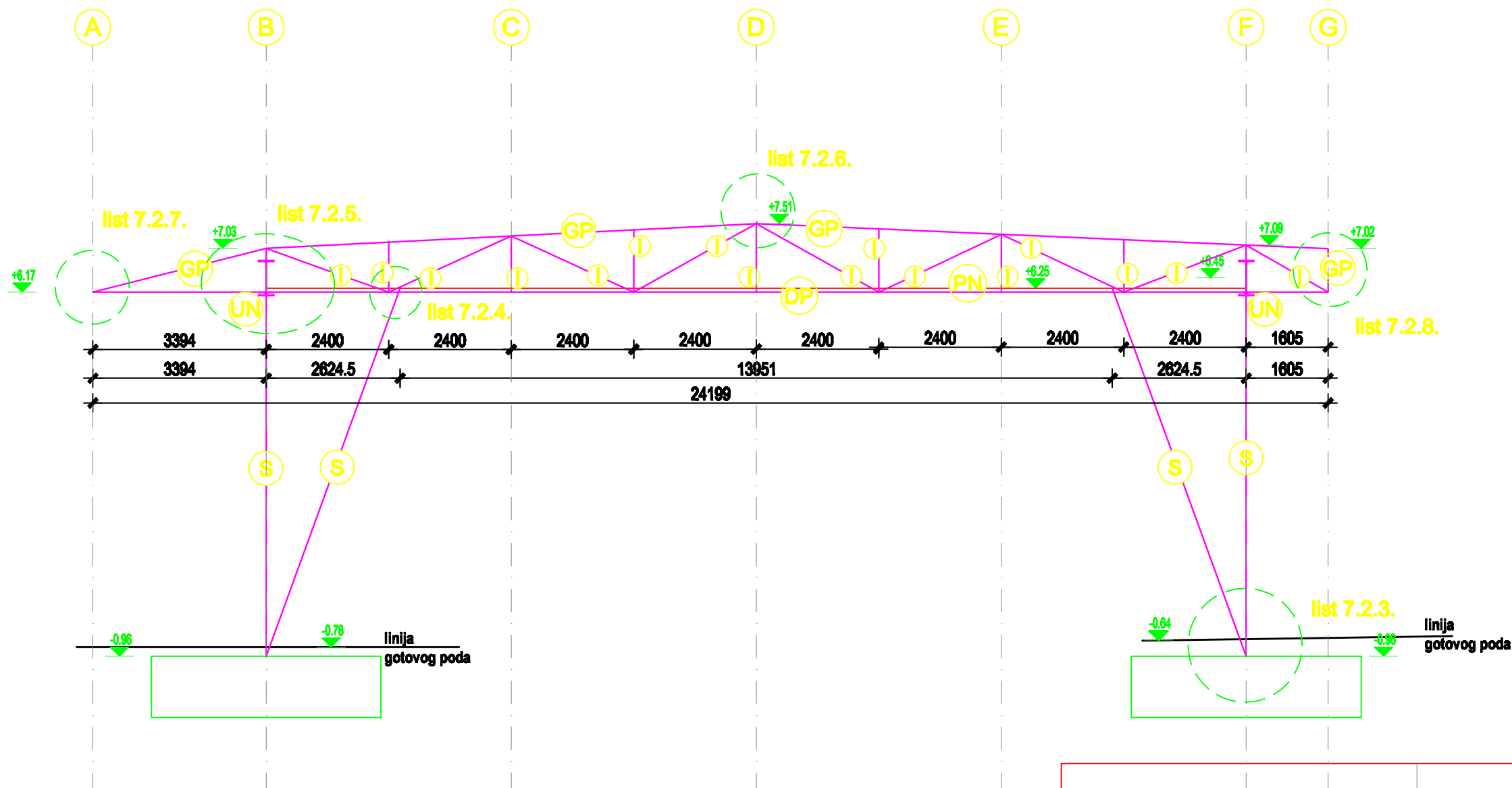
Mihanović A. (1993), *Stabilnost konstrukcija*, Društvo hrvatskih građevinskih konstruktora, Zagreb

Nonveiller, E. (1979.), *Mehanika tla i temeljenje građevina*, Školska knjiga, Zagreb

Roje-Bonacci, T. (2007.), *Mehanika tla*, Građevinsko – arhitektonski fakultet, Split

R1	DP1 140x140x4
I1	90x90x4
GP2 140x140x5	
R2	DP2 140x140x7.1
I2	90x90x5
GP3 140x140x10	
R3	DP3 140x140x10
I3	90x90x8
GP4 140x140x8	
R4	DP4 140x140x8
I4	90x90x5
GP5 140x140x10	
R5	DP5 140x140x10
I5	90x90x8

UN HEA 700
PN HEA 300
UV 90x90x4
S 273x8
D Ø18



FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I
GEODEZJE
KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE
21000 SPLIT, MATICE HRVATSKE 15

GRAĐEVINA:
Pristanišna zgrada zračne luke Dubrovnik
Zgrada "ABC" - Sortirnica / Putnički terminal

PROJEKT:
Građenje južne nadstrešnice ispred zgrade
"B" i zgrade "C"

STUDENT:
Mario Šarčević

MENTOR:
Prof.dr.sc. Bernardin Peroš

FAZA PROJEKTA:
GLAVNI PROJEKT

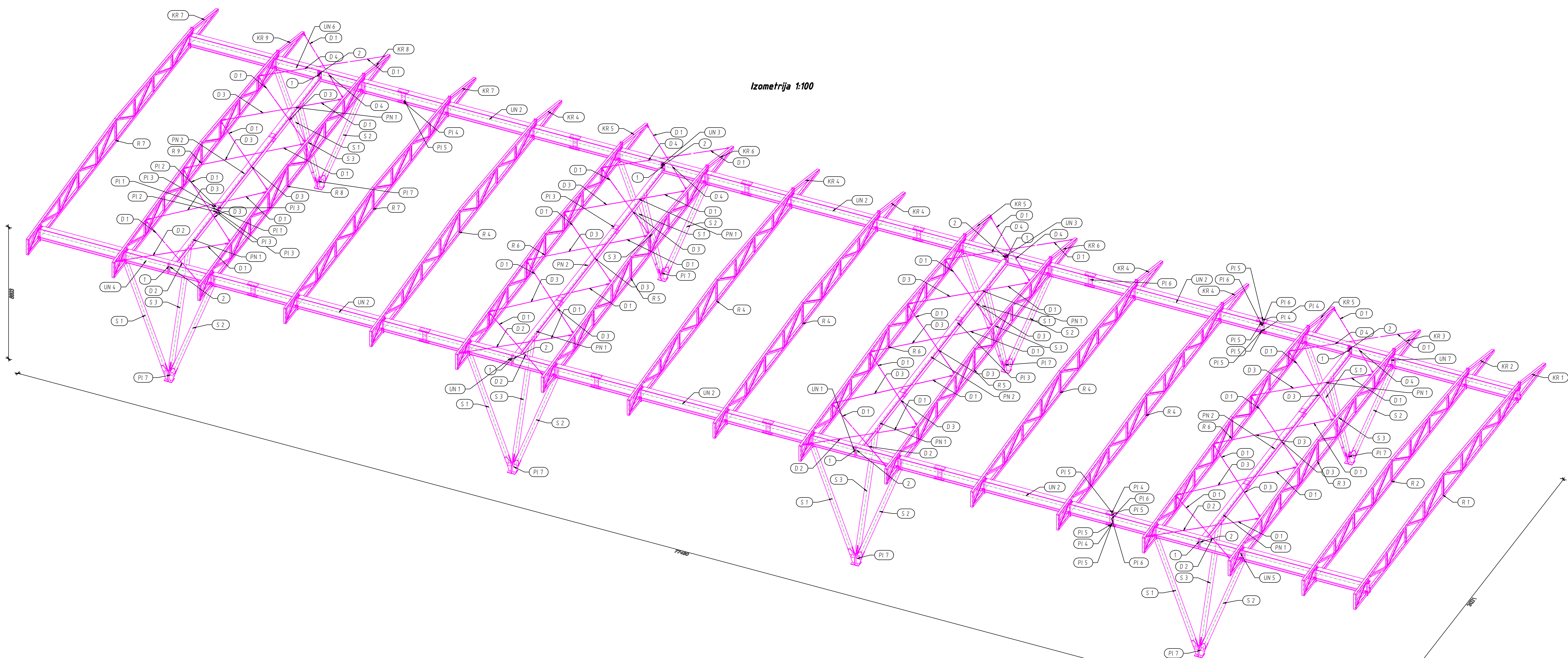
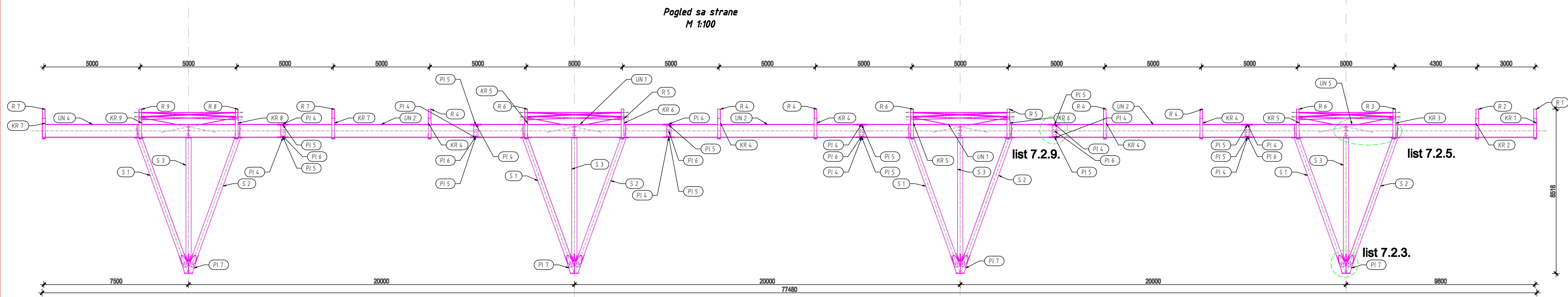
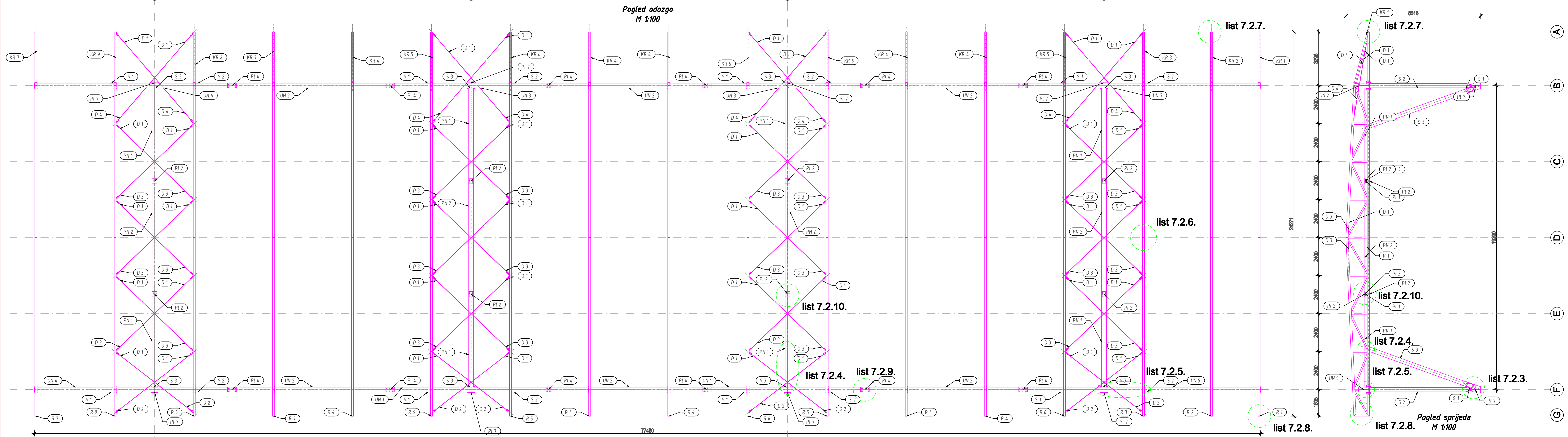
PLAN POZICIJA -
POPREČNI PRESJEK
NADSTREŠNICE

M 1:100

SADRŽAJ:
7.1. GRAĐEVINSKI NACRTI:
KONSTRUKCIJA JUŽNE
NADSTREŠNICE

DATUM:
lipanj, 2015. god.

[illegible]



Position	Element name	Number	Length (m)	Mass	
				of element (kg)	Total (kg)
1	Sub part - profile L 110x10x10	8	626.00	10.39	83.13
2	Sub part - profile L 110x10x10	8	626.00	10.39	83.13
D 1	D ROND 16	40	2100.00	4.24	169.64
D 2	D ROND 16	8	3850.00	6.92	55.38
D 3	D ROND 16	24	4430.00	7.87	188.88
D 4	D ROND 16	8	5190.00	8.98	71.81
KR 1	KR Q 140x140x5	1	3370.97	151.01	151.01
KR 2	KR Q 140x140x5	1	3370.97	185.99	185.99
KR 3	KR Q 140x140x5	1	3370.97	186.96	186.96
KR 4	KR Q 140x140x5	5	3370.97	199.36	997.36
KR 5	KR Q 140x140x5	3	3370.97	199.36	598.36
KR 6	KR Q 140x140x5	2	3370.97	199.36	398.36
KR 7	KR Q 140x140x5	2	3370.97	266.88	533.77
KR 8	KR Q 140x140x5	1	3370.97	267.79	267.79
KR 9	KR Q 140x140x5	1	3370.97	267.79	267.79
PN 1	PN HEA 300	8	6000.00	541.72	4333.74
PN 2	PN HEA 300	4	7140.00	630.71	2522.83
PI 1	Plate Plate 6x200	16	206.00	1.81	29.03
PI 2	Plate Plate 8x300	16	340.00	6.22	99.55
PI 3	Plate Plate 8x115	32	340.00	2.36	75.62
PI 4	Plate Plate 16x300	24	560.00	20.33	487.88
PI 5	Plate Plate 16x115	48	560.00	7.10	340.67
PI 6	Plate Plate 16x240	24	560.00	10.32	247.72
PI 7	Plate Plate 20x495	8	791.54	127.64	1021.09
R 1	R Q 140x140x5	1	21053.54	1254.70	1254.70
R 2	R Q 140x140x5	1	21053.54	1529.67	1529.67
R 3	R Q 140x140x5	1	21053.54	1537.64	1537.64
R 4	R Q 140x140x5	5	21053.54	1614.33	8071.63
R 5	R Q 140x140x5	2	21053.54	1622.58	3245.00
R 6	R Q 140x140x5	3	21053.54	1622.58	4867.59
R 7	R Q 140x140x5	2	21053.54	2123.97	4247.95
R 8	R Q 140x140x5	1	21053.54	2102.15	2102.15
R 9	R Q 140x140x5	1	21053.54	2102.15	2102.15
S 1	S CHS 273x8	8	781.18	425.62	3404.93
S 2	S CHS 273x8	8	781.18	425.62	3404.93
S 3	S CHS 273x8	8	781.18	425.62	3404.93
UN 1	UN HEA 700	2	16000.00	2146.87	4293.74
UN 2	UN HEA 700	6	9000.00	2146.87	12881.08
UN 3	UN HEA 700	2	10000.00	2146.87	4293.74
UN 4	UN HEA 700	1	12480.01	2686.52	2686.52
UN 5	UN HEA 700	1	15000.00	3232.34	3232.34
UN 6	UN HEA 700	1	12480.01	2686.52	2686.52
UN 7	UN HEA 700	1	15000.00	3232.34	3232.34
Total mass (kg)				85712.68	
Element mass (kg)				38395.95	
Valid mass addition (kg)				1716.25	
Total mass (kg)				87424.89	

PROTUPUŽARNA I ANTIKOROZIVNA ZAŠTITA: PREMAZIVANJE
ZANJELJEV TRAJNOSTI ANTIKOROZIVNE ZAŠTITE: HIGH DURABILITY (prema EN ISO 12944-1:1999)
AGRESIVNOST OKOLNE OKOLNE: C1 (prema EN ISO 12944-2:1999)
ZANJELJEV PROTUPUŽARNE OTPORNOSTI:



GRAĐEVINA:
Prilazna zgrada zračne luke Dubrovnik
Zgrada "ABC" - Borbenica / Putnički terminal
PROJEKT:
Građenje južne nadstrešnice ispred zgrade
"B" i zgrade "C"

STUDENT:
Mario Bočević
MAYOR:
Prof. dr. sc. Bernardin Perić

FAZA PROJEKTA:
IZVEDBENI PROJEKT

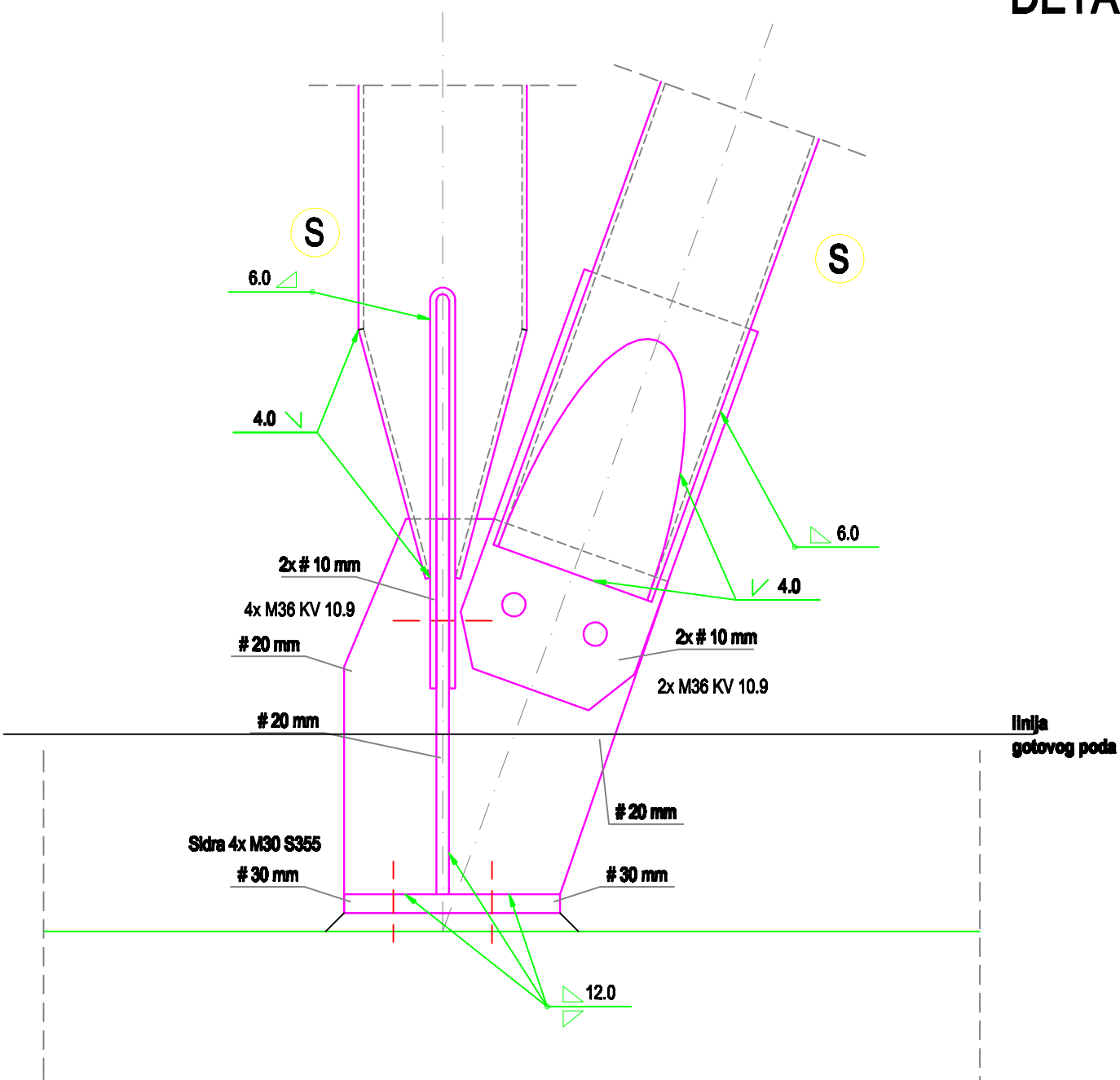
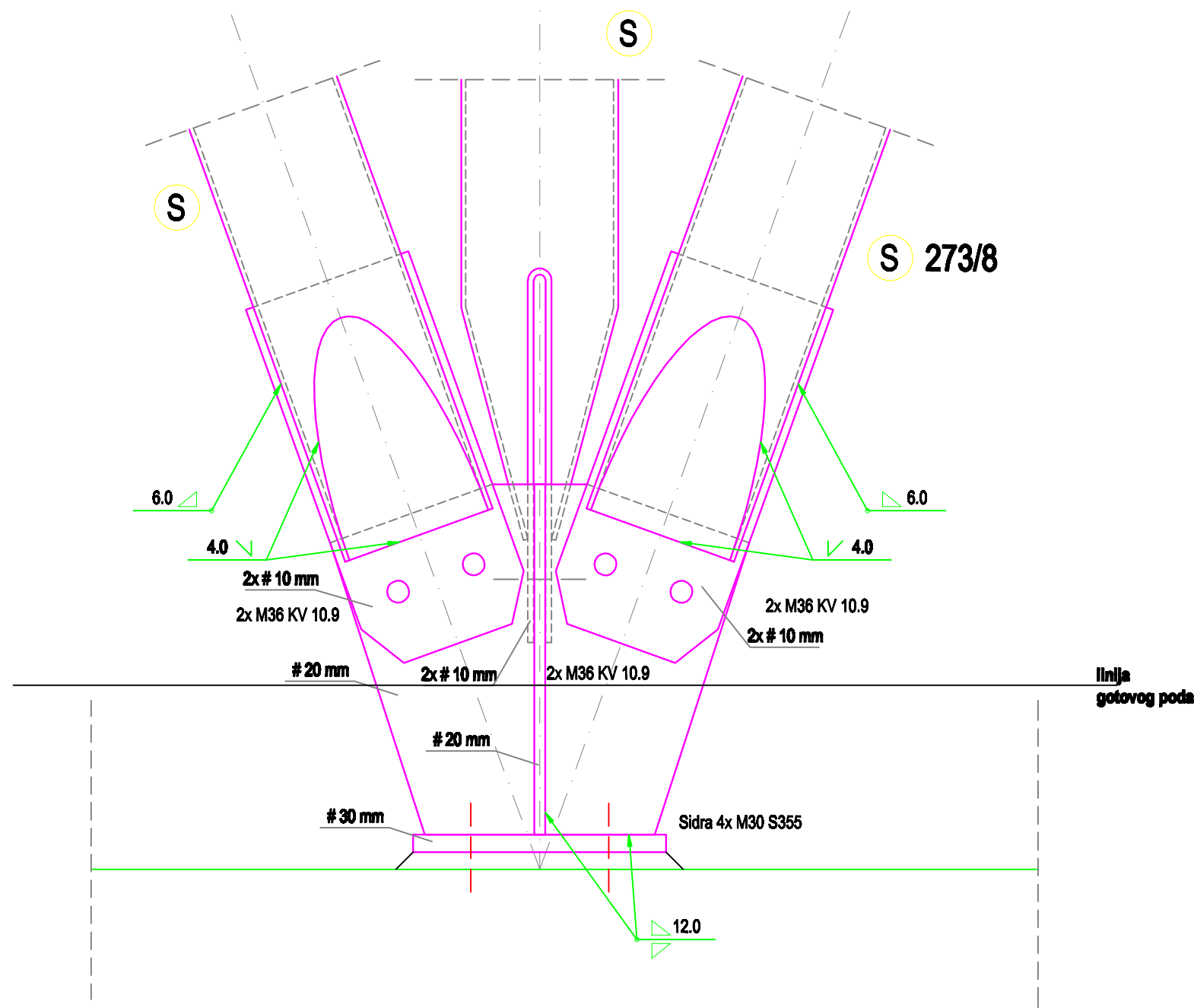
PLAN POZICIJA -
DILATACIJA C1

M 1:100

SADRŽAJ:
7.2. GRAĐEVINSKI NACRTI:
KONSTRUKCIJA, JUŽNE
NADSTREŠNICE

DATUM:
lipnja 2015. god.

list 7.2.3.



Napomena:
Debljina vara u čvorovima rešetke se mijenja
s obzirom na debljine stijenke cijevi u čvoru.
Varove uvijek izvoditi sa debljinom
 $t=0,7 \times (\text{minimalna debljina stijenke u spoju})$



FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I
GEODEZIJE
KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE
21000 SPLIT, MATICE HRVATSKE 15

GRAĐEVINA:
**Pristanišna zgrada zračne luke Dubrovnik
Zgrada "ABC" - Sortirnica / Putnički terminal**

PROJEKT:
**Građenje južne nadstrešnice ispred zgrade
"B" i zgrade "C"**

STUDENT:
Mario Šarčević

MENTOR:
Prof.dr.sc. Bernardin Peroš

FAZA PROJEKTA:
IZVEDBENI PROJEKT

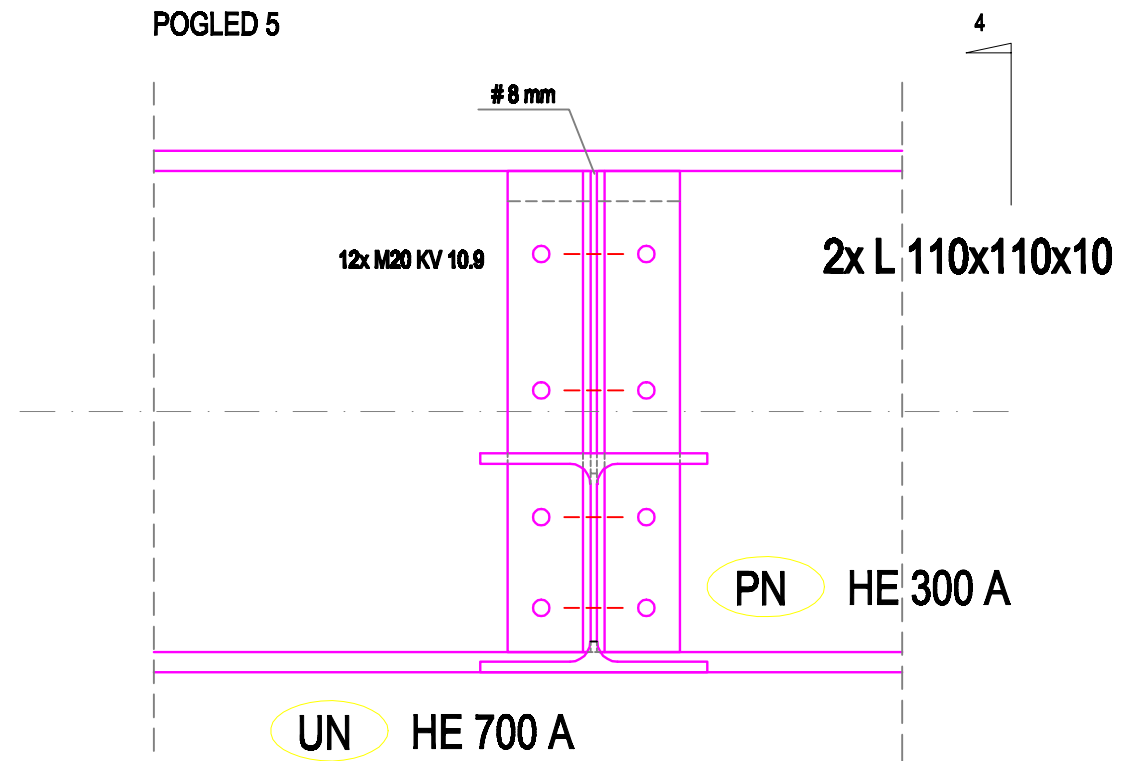
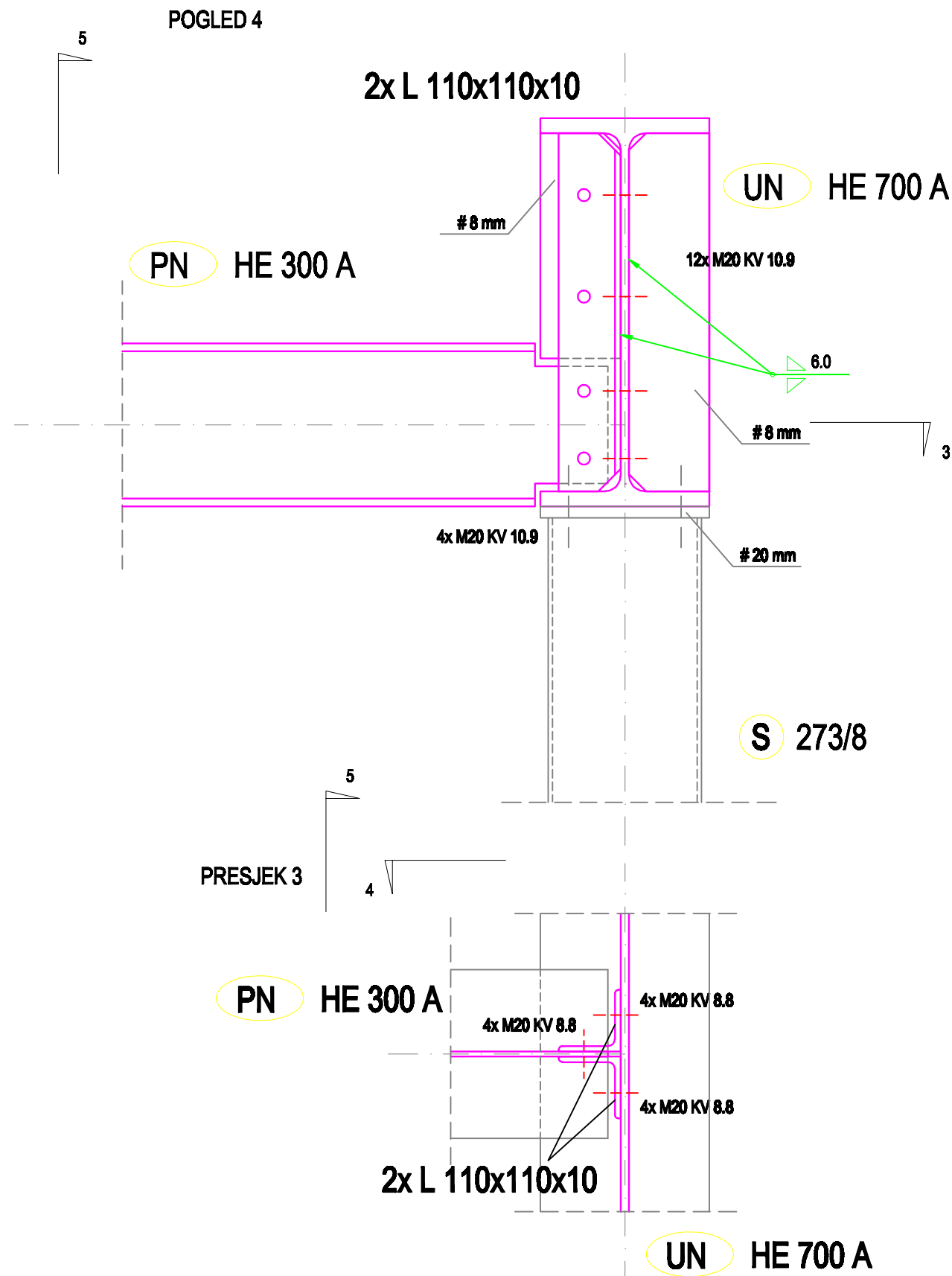
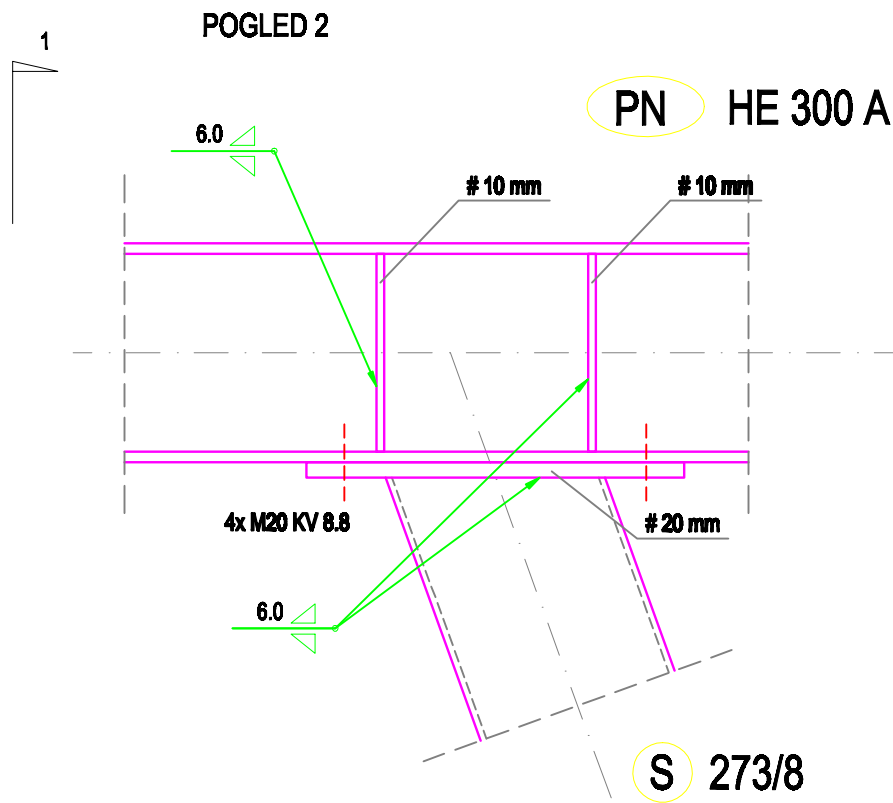
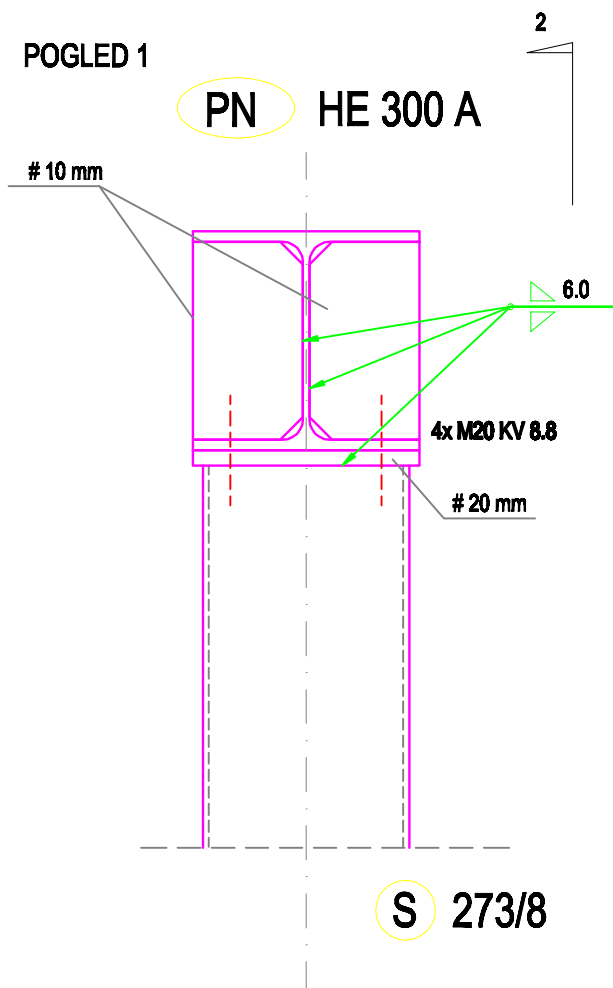
SADRŽAJ:
**7.2. GRAĐEVINSKI NACRTI:
KONSTRUKCIJA JUŽNE
NADSTREŠNICE**

DATUM:
lipanj, 2015. god.

SADRŽAJ LISTA:

DETALJ SPOJA STUPOVA I TEMELJA

M 1:10



Napomena:
Debljina vara u čvorovima rešetke se mijenja
s obzirom na debljine stijenki cijevi u čvoru.
Varove uvijek izvoditi sa debljinom
 $t=0,7x$ (minimalna debljina stijenke u spoju)



FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I
GEODEZIJE
KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE
21000 SPLIT, MATICE HRVATSKE 15

GRAĐEVINA:
Pristanišna zgrada zračne luke Dubrovnik
Zgrada "ABC" - Sortirnica / Putnički terminal

PROJEKT:
Građenje južne nadstrešnice ispred zgrade
"B" i zgrade "C"

STUDENT:
Mario Šarčević

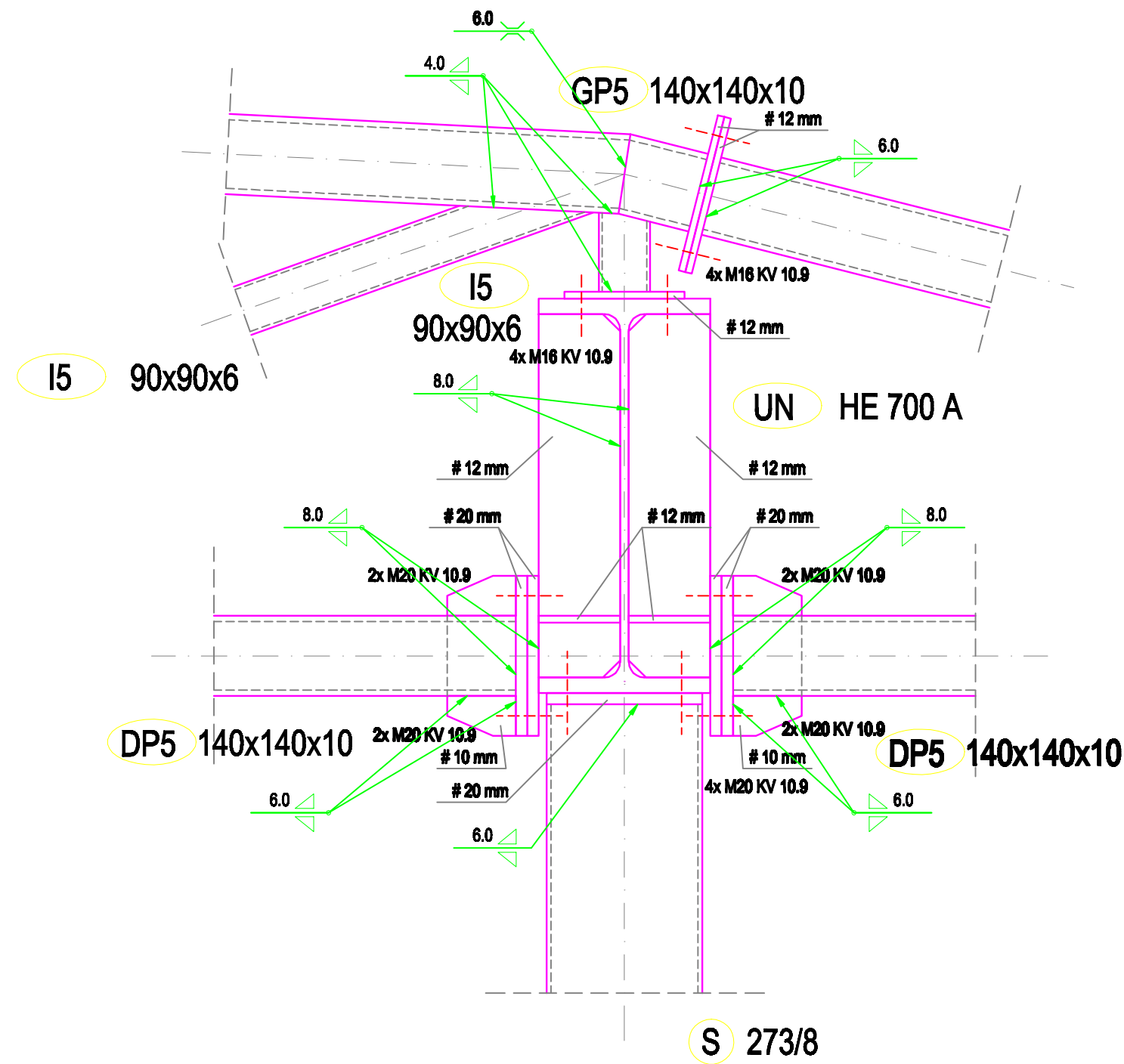
MENTOR:
Prof.dr.sc. Bernardin Peroš

FAZA PROJEKTA:
IZVEDBENI PROJEKT

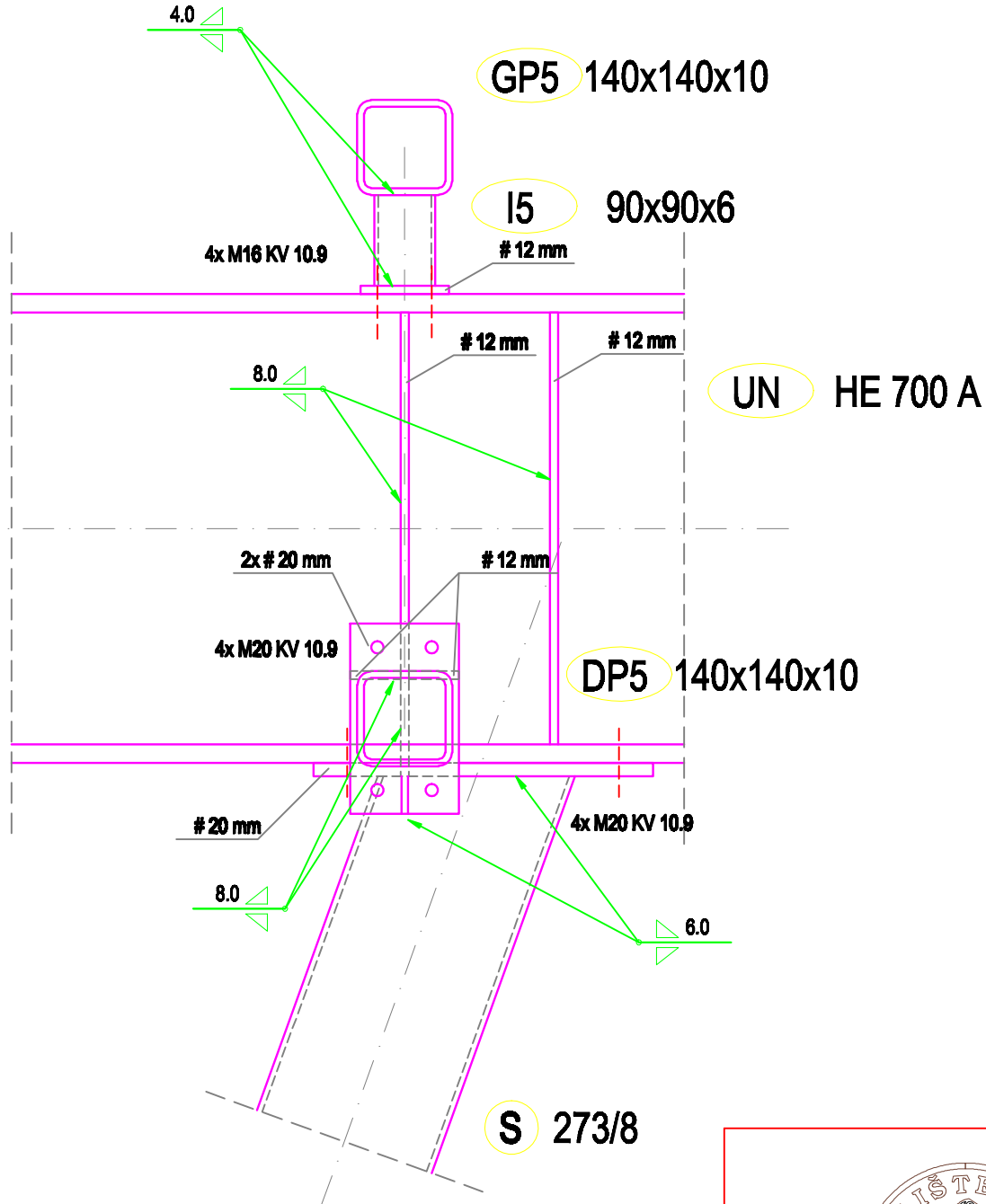
SADRŽAJ:
7.2. GRAĐEVINSKI NACRTI:
KONSTRUKCIJA JUŽNE
NADSTREŠNICE

DATUM:
lipanj, 2015. god.

DETALJ OSLANJANJA REŠETKE NA
UZDUŽNI NOSAČ POZICIJE UN



POGLED 2



Napomena:
Debljina vara u čvorovima rešetke se mijenja
s obzirom na debljine stijenke cijevi u čvoru.
Varove uvijek izvoditi sa debljinom
 $t=0,7 \times (\text{minimalna debljina stijenke u spoju})$



FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I
GEODEZIJE
KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE
21000 SPLIT, MATICE HRVATSKE 15

GRAĐEVINA:
Pristanišna zgrada zračne luke Dubrovnik
Zgrada "ABC" - Sortirnica / Putnički terminal

PROJEKT:
Građenje južne nadstrešnice ispred zgrade
"B" i zgrade "C"

STUDENT:
Mario Šarčević

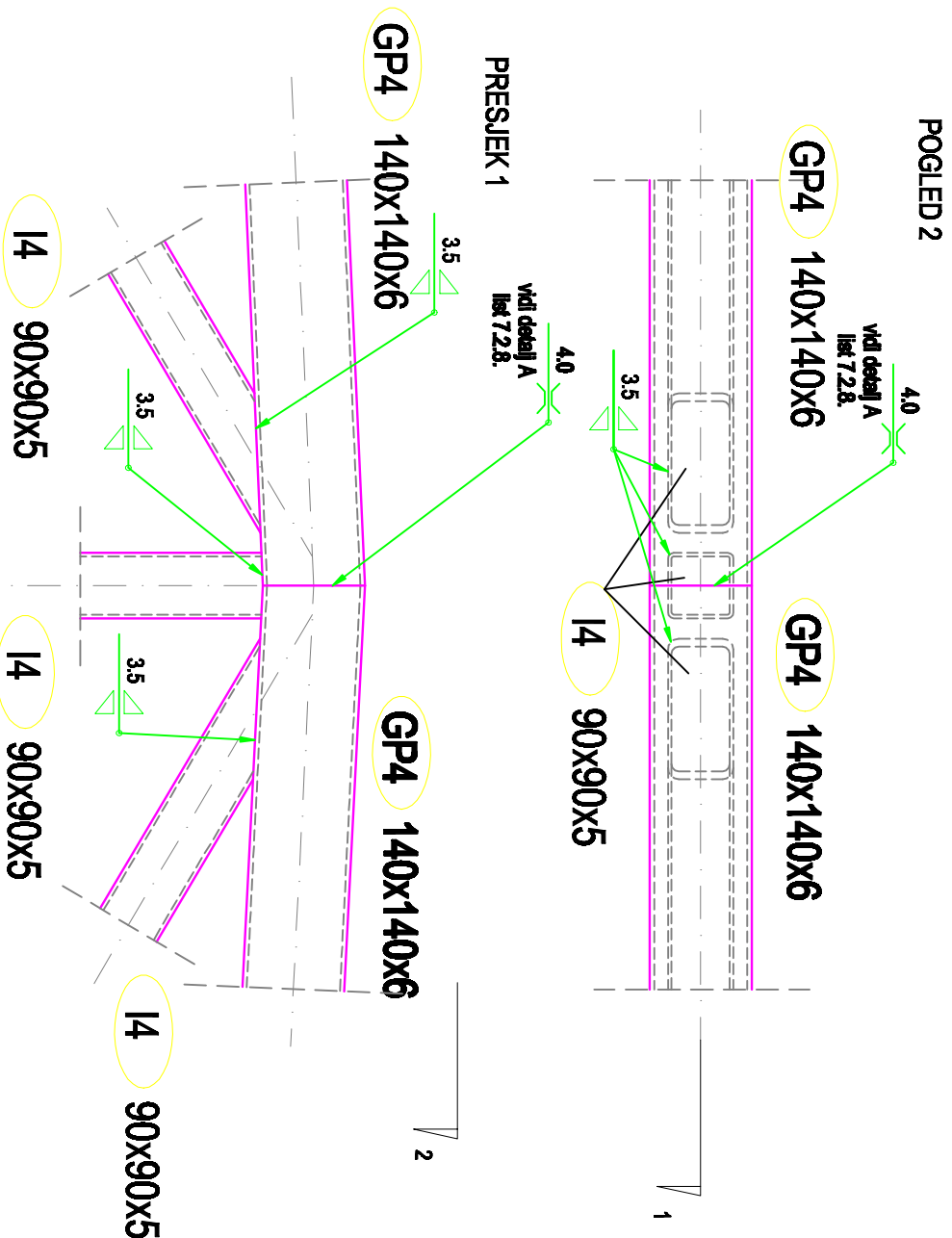
MENTOR:
Prof.dr.sc. Bernardin Peroš

DATUM:
lipanj, 2015. god.

FAZA PROJEKTA:
IZVEDBENI PROJEKT

SADRŽAJ:
7.2. GRAĐEVINSKI NACRTI:
KONSTRUKCIJA JUŽNE
NADSTREŠNICE

DETALJ ČVORA REŠETKE U OSI D

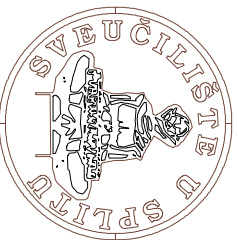


Napomena:
Debljina vara u čvorovima rešetke se mijenja s obzirom na debljine stijenki cijevi u čvoru. Varove uvijek izvoditi sa debljinom t=0,7x(minimalna debljina stijenke u spoju)

SAVRŠENA LISTA:

DETALJ ČVORA REŠETKE U OSI D

FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I
GEODEZIJE
KATEDRA ZA METALNE I DRYVNE KONSTRUKCIJE
21000 SPLIT, MATICE HRVATSKE 15



M 1:10

GRAĐEVINA:

Pristanišna zgrada zračne luke Dubrovnik
Zgrada "ABC" - Sortirница / Putnički terminal

PROJEKT:

Građenje južne nadstrešnice ispred zgrade
"B" i zgrade "C"

STUDENT:

Mario Šarčević

MENTOR:

Prof.dr.sc. Bernardin Perić

SAVRŠENA:

7.2. GRAĐEVINSKI NACRTI:
KONSTRUKCIJA JUŽNE
NADSTREŠNICE

DATUM:

lipanj, 2015. god.

FAZA PROJEKTA:
IZVEDBENI PROJEKT

list 7.2.6.

DETALJ ČVORA REŠETKE U OSI A

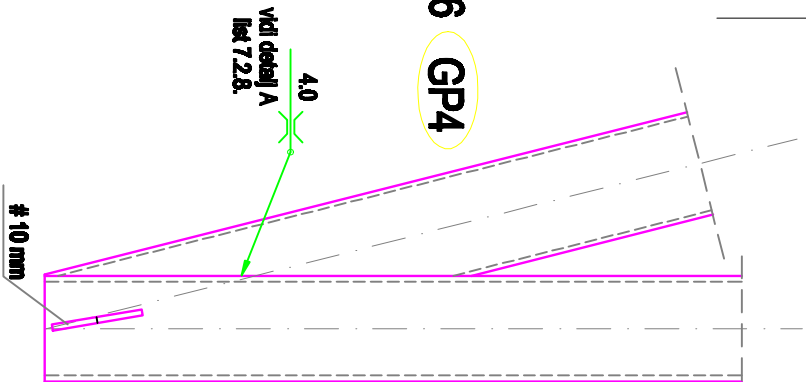
PRESJEK 1

2

140x140x8 DP4

140x140x8 DP4

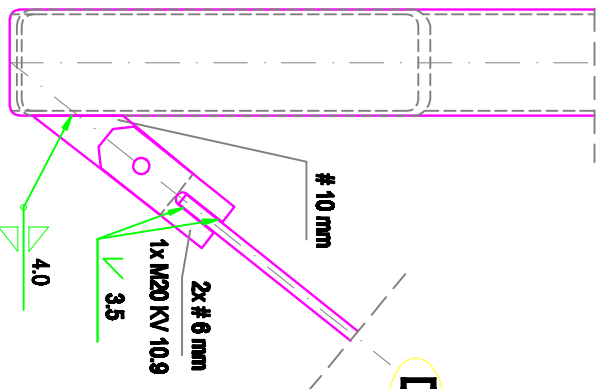
140x140x6 GP4



POGLED 2

1

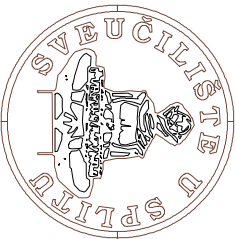
D16



140x140x6 GP4

Napomena:
Debljina vara u čvorovima rešetke se mijenja s obzirom na debljine stijenki cijevi u čvoru. Varove uvijek izvoditi sa debljinom t=0,7x(minimalna debljina stijenke u spoju)

SAHRŽAJ LİSTÄ



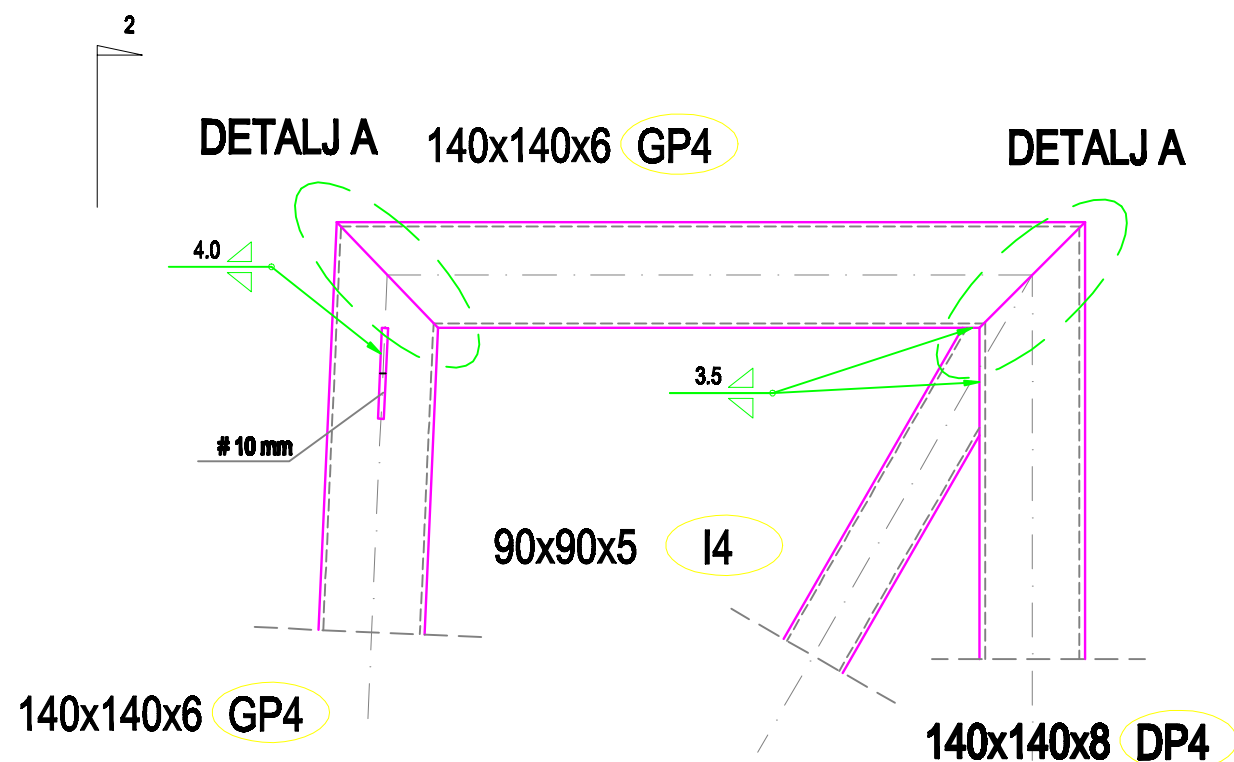
FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I
GEODEZIJE
KATEDRA ZA METALNE I DRYVENE KONSTRUKCIJE
21000 ŠPILIT, MATICE HRVATISKE 18

M 1:10

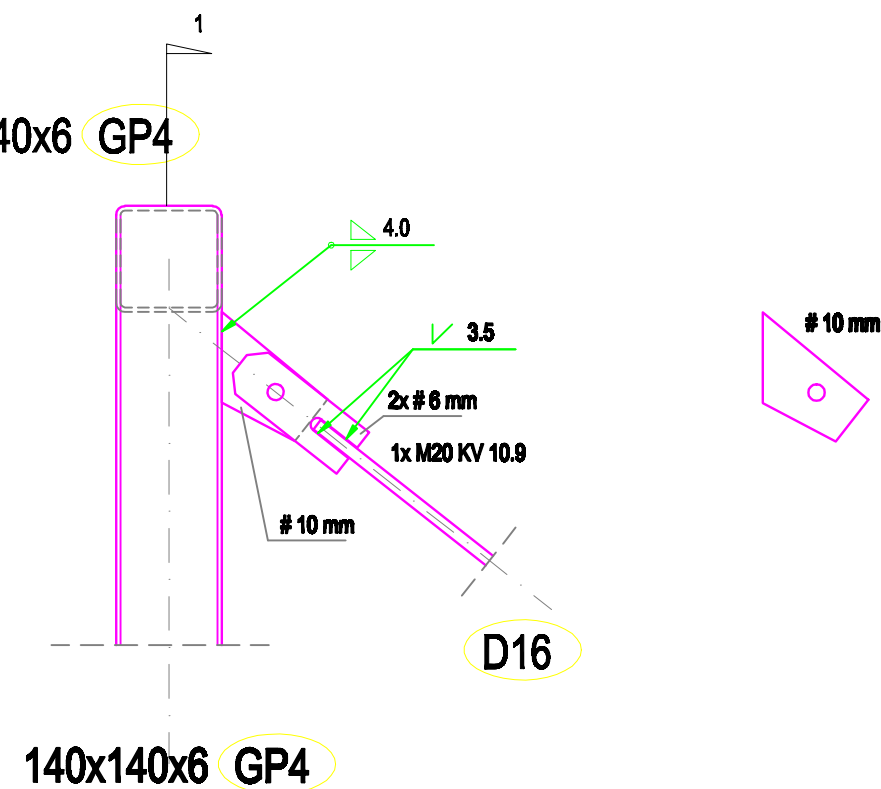
DETALJ ČVORA REŠETKE U OSI A

GRAĐEVINA: Pristanišna zgrada zračne luke Dubrovnik Zgrada "ABC" - Sortirница / Putnički terminal PROJEKT: Građenje južne nadstrešnice ispred zgrade "B" i zgrade "C"	STUDENT: Mario Šarčević MENTOR: Prof.dr.sc. Bernardin Perić FAZA PROJEKTA: IZVEDBENI PROJEKT	SAHRŽAJ: 7.2. GRAĐEVINSKI NACRTI: KONSTRUKCIJA JUŽNE NADSTREŠNICE DATUM: lipanj, 2015. god.
		list 7.2.7.

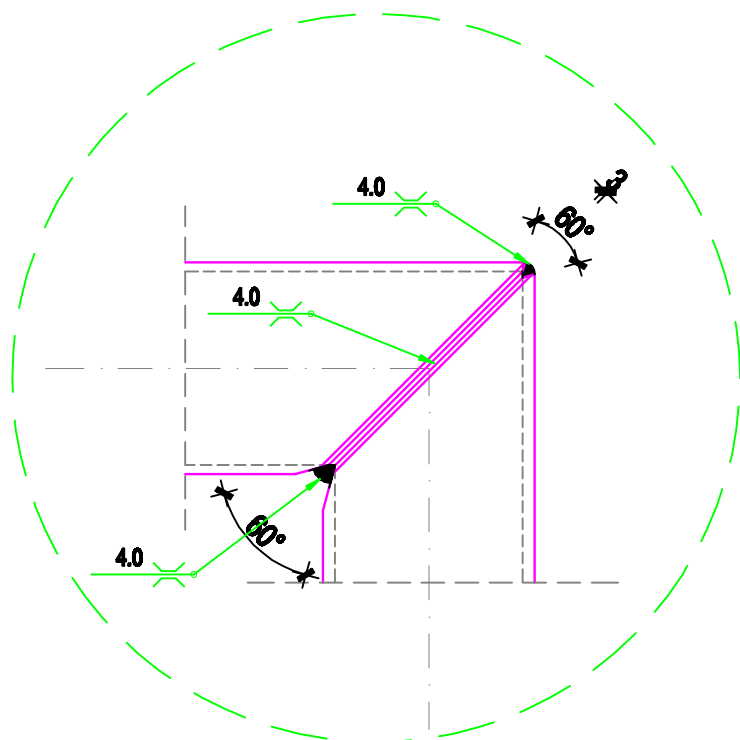
PRESJEK 1



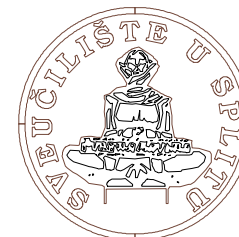
POGLED 2



DETALJ A M 1:5



Napomena:
Debljina vara u čvorovima rešetke se mijenja
s obzirom na debljine stijenki cijevi u čvoru.
Varove uvijek izvoditi sa debljinom
 $t=0,7 \times$ (minimalna debljina stijenke u spoju)



FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I
GEODEZIJE
KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE
21000 SPLIT, MATICE HRVATSKE 15

GRAĐEVINA:
Pristanišna zgrada zračne luke Dubrovnik
Zgrada "ABC" - Sortirnica / Putnički terminal

PROJEKT:
Građenje južne nadstrešnice ispred zgrade
"B" i zgrade "C"

STUDENT:
Mario Šarčević

MENTOR:
Prof.dr.sc. Bernardin Peroš

FAZA PROJEKTA:
IZVEDBENI PROJEKT

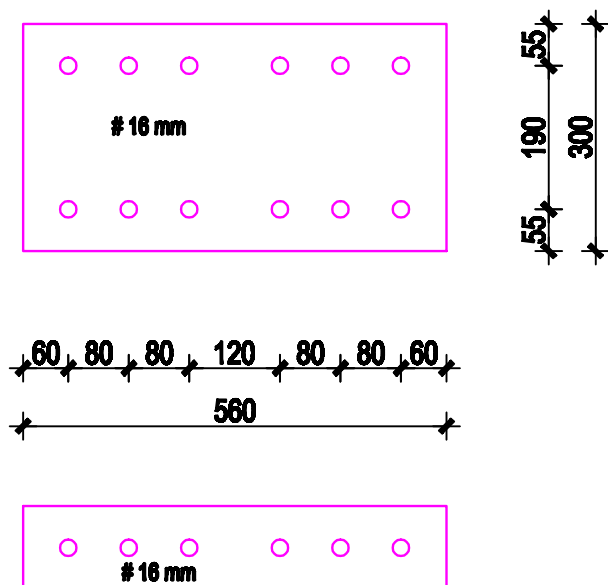
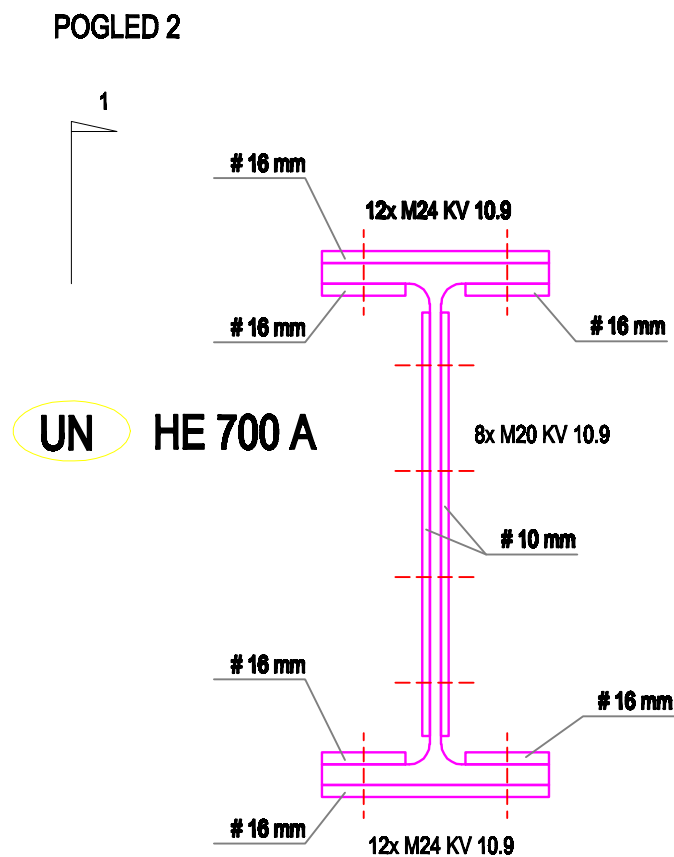
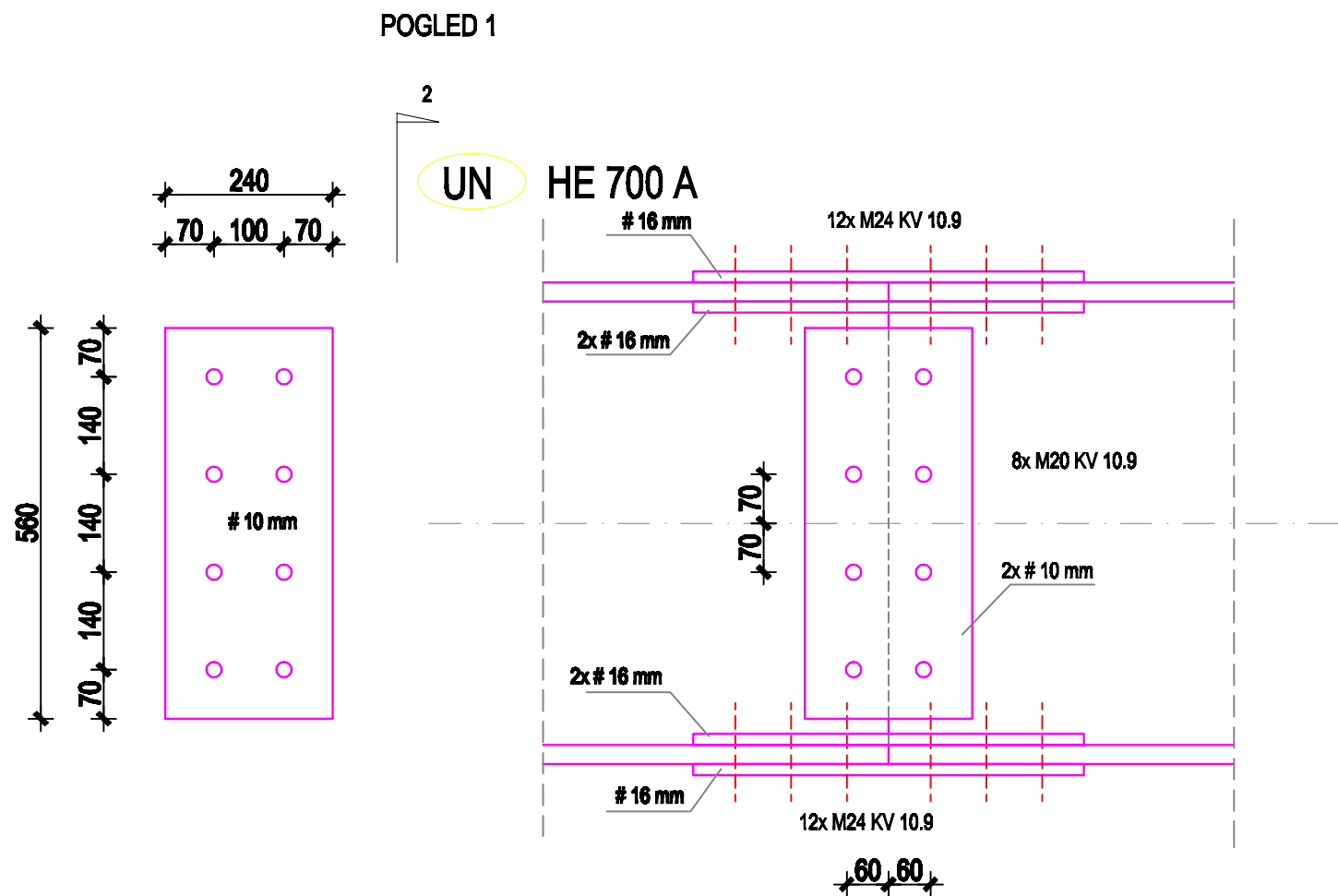
SADRŽAJ:
7.2. GRAĐEVINSKI NACRTI:
KONSTRUKCIJA JUŽNE
NADSTREŠNICE

DATUM:
lipanj, 2015. god.

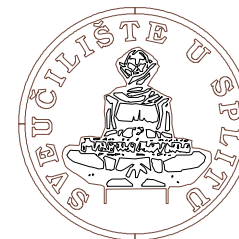
SADRŽAJ LISTA:

DETALJ ČVORA REŠETKE U OSI G

M 1:10



Napomena:
Debljina vara u čvorovima rešetke se mijenja s obzirom na debljine stijenki cijevi u čvoru. Varove uvijek izvoditi sa debljinom $t=0,7x$ (minimalna debljina stijenke u spoju)



FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I
GEODEZIJE
KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE
21000 SPLIT, MATICE HRVATSKE 15

GRAĐEVINA:
**Pristanišna zgrada zračne luke Dubrovnik
Zgrada "ABC" - Sortirnica / Putnički terminal**

PROJEKT:
**Građenje južne nadstrešnice ispred zgrade
"B" i zgrade "C"**

STUDENT:
Mario Šarčević

MENTOR:
Prof.dr.sc. Bernardin Peroš

FAZA PROJEKTA:
IZVEDBENI PROJEKT

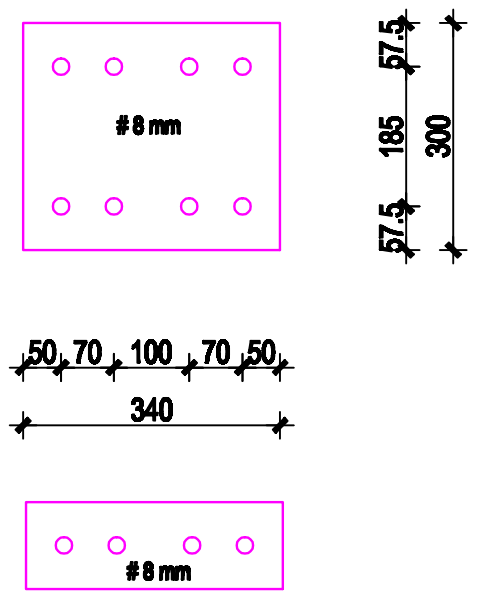
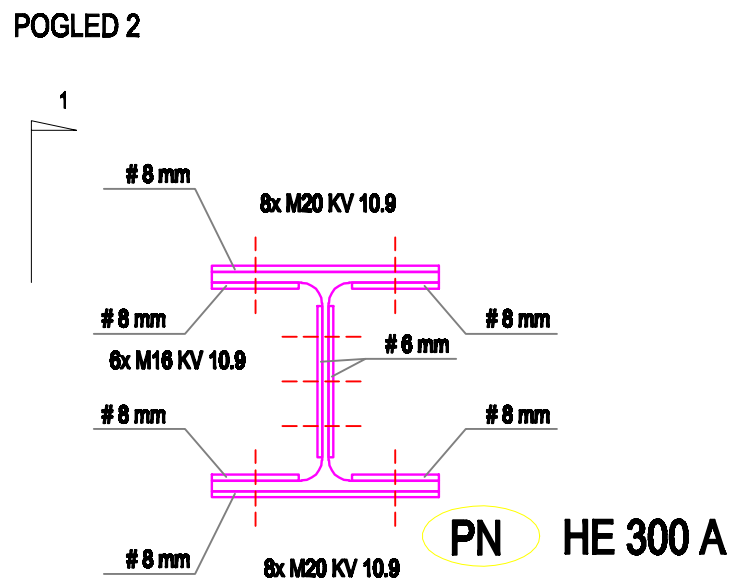
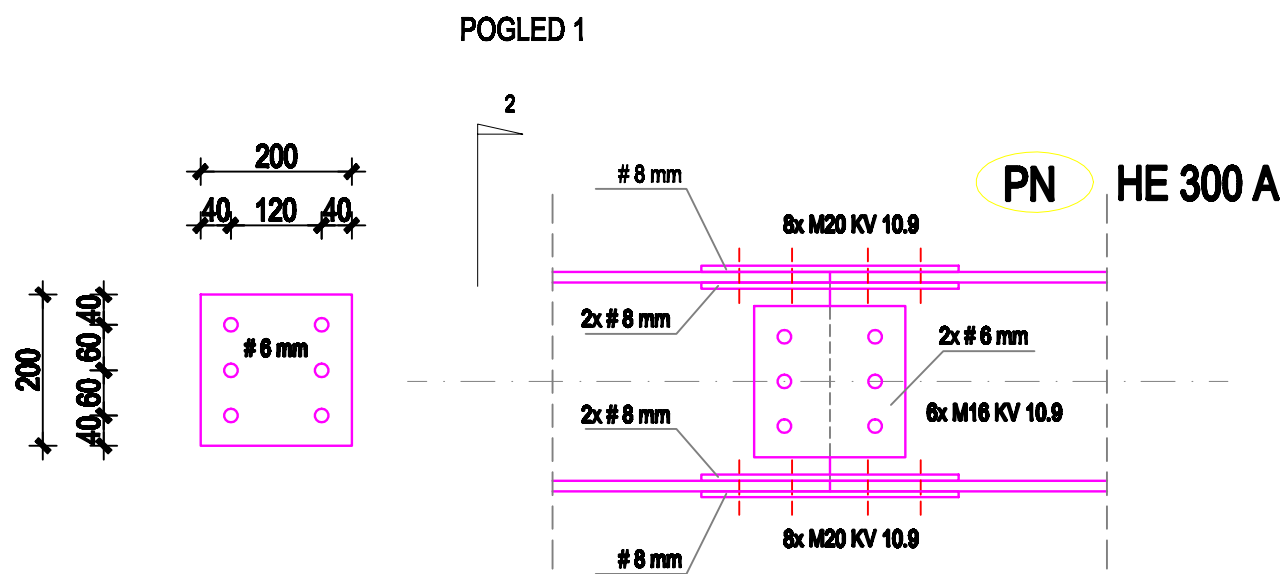
SADRŽAJ:
**7.2. GRAĐEVINSKI NACRTI:
KONSTRUKCIJA JUŽNE
NADSTREŠNICE**

DATUM:
lipanj, 2015. god.

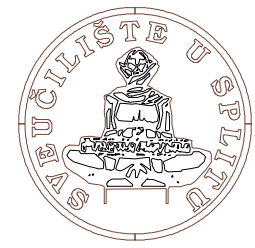
SADRŽAJ LISTA:

MONTAŽNI NASTAVAK UZDUŽNE GREDE POZICIJE UN

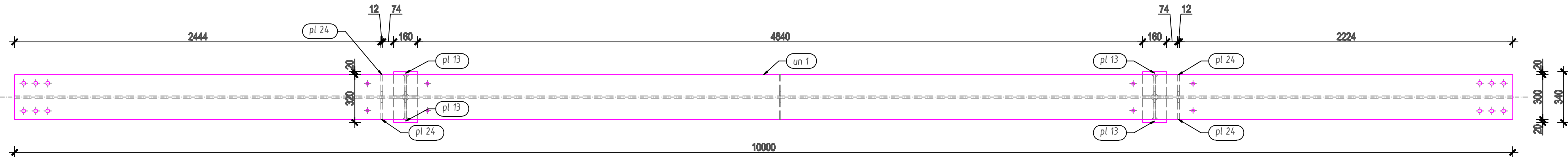
M 1:10



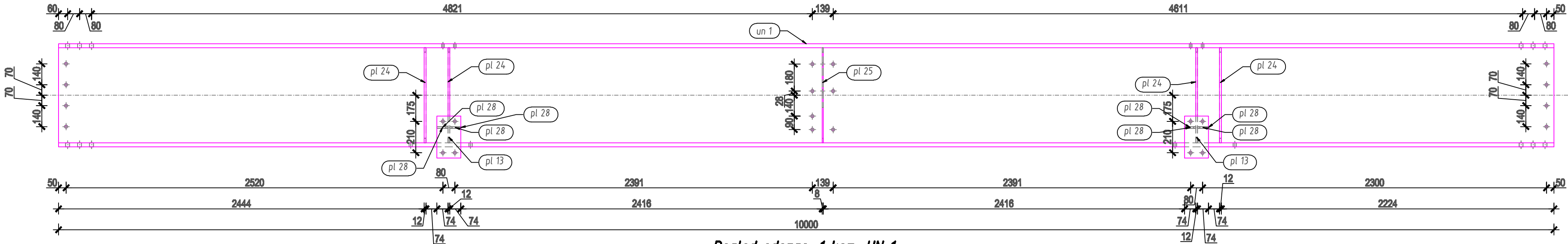
Napomena:
Debljina vara u čvorovima rešetke se mijenja s obzirom na debljine stijenki cijevi u čvoru. Varove uvijek izvoditi sa debljinom $t=0,7 \times$ (minimalna debljina stijenke u spoju)

SADRŽAJ LISTA:		
 FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I GEODEZIJE KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE 21000 SPLIT, MATICE HRVATSKE 15 MONTAŽNI NASTAVAK POPREČNE GREDE POZICIJE PN		
GRAĐEVINA: Pristanišna zgrada zračne luke Dubrovnik Zgrada "ABC" - Sortirnica / Putnički terminal	STUDENT: Mario Šarčević	SADRŽAJ: 7.2. GRAĐEVINSKI NACRTI: KONSTRUKCIJA JUŽNE NADSTREŠNICE
PROJEKT: Građenje južne nadstrešnice ispred zgrade "B" i zgrade "C"	MENTOR: Prof.dr.sc. Bernardin Peroš	
	FAZA PROJEKTA: IZVEDBENI PROJEKT	DATUM: lipanj, 2015. god.
		list 7.2.10.

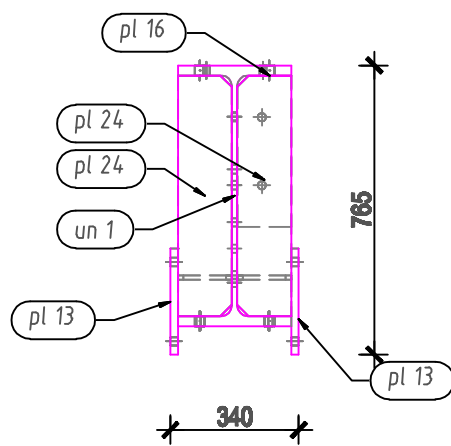
Pogled odozdo, 1 kom, UN 1
M 1:20



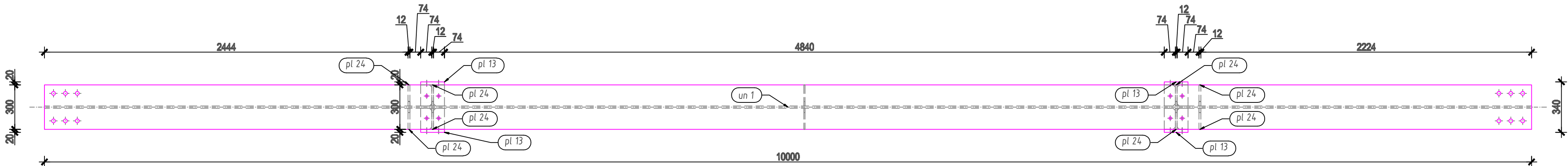
Pogled sprijeda, 1 kom, UN 1
M 1:20



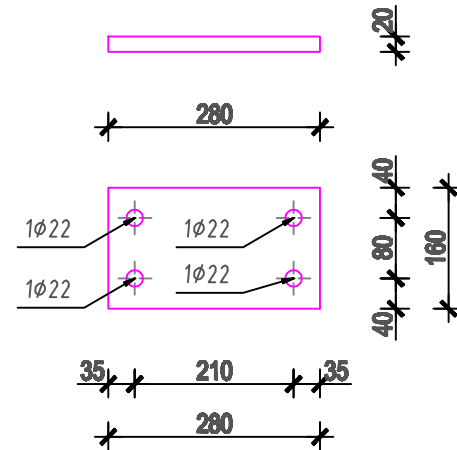
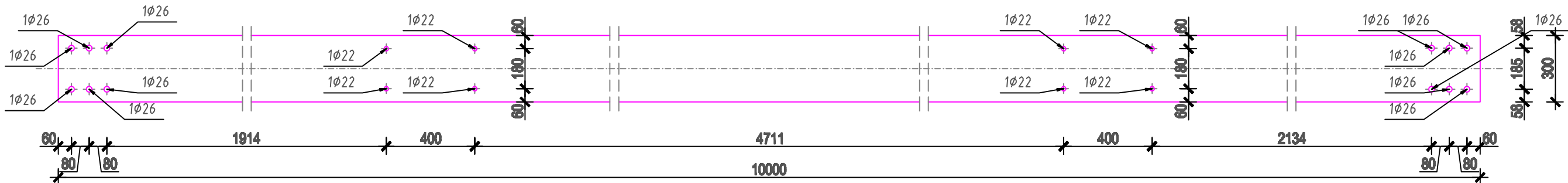
Pogled sa strane, 1 kom, UN 1
M 1:20



Pogled odozgo, 1 kom, UN 1
M 1:20



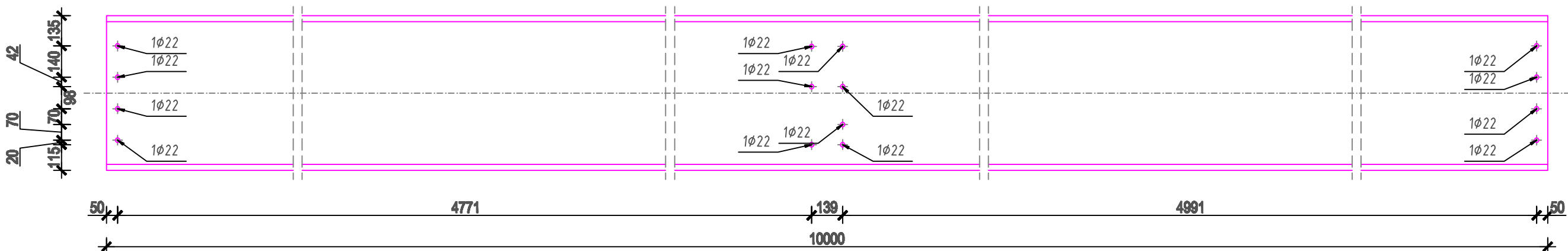
Pogled sprijeda, 136 kom pl 13, Plate 20x160
M 1:10



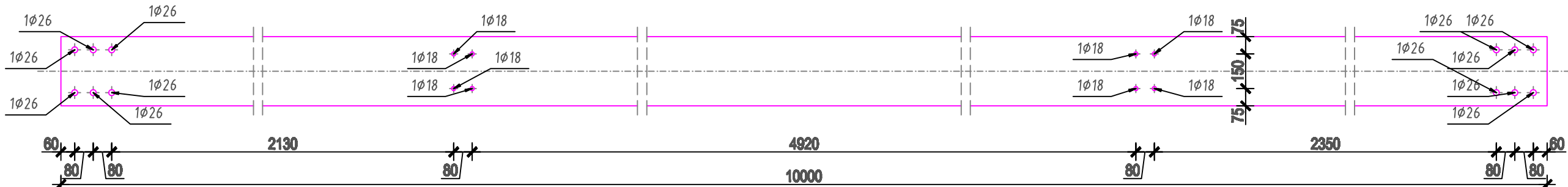
Pogled odozgo, 136 kom pl 13, Plate 20x160
M 1:10

Pogled odozdo, 4 kom, un 1
M 1:20

Pogled sprijeda, 4 kom, un 1
M 1:20



Pogled sa strane, 4 kom, un 1
M 1:20



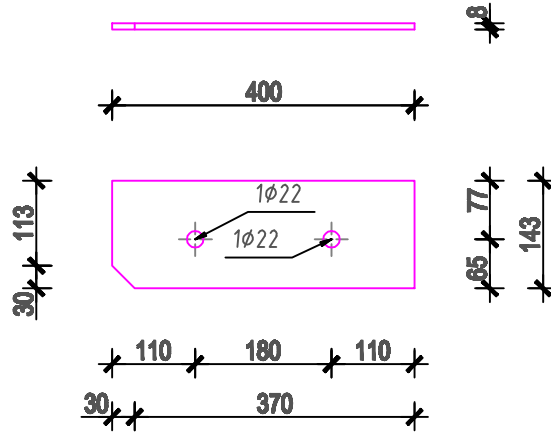
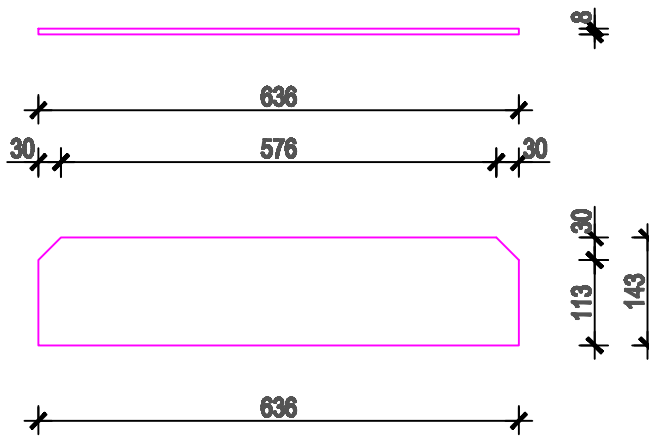
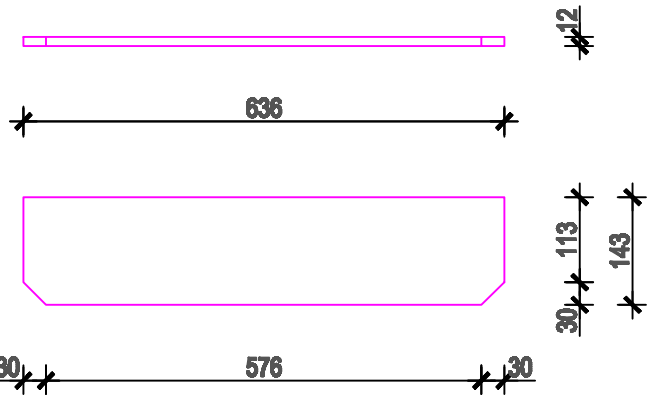
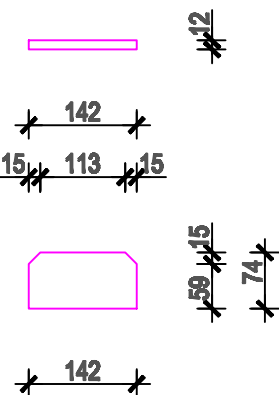
Pogled odozgo, 4 kom, un 1
M 1:20

Pogled sprijeda, 16 kom pl 28, Plate 12x74
M 1:10

Pogled sprijeda, 100 kom pl 24, Plate 12x143
M 1:10

Pogled sprijeda, 8 kom pl 25, Plate 8x143
M 1:10

Pogled sprijeda, 8 kom pl 16, Plate 8x143
M 1:10



Pogled odozgo, 16 kom pl 28, Plate 12x74
M 1:10

Pogled odozgo, 100 kom pl 24, Plate 12x143
M 1:10

Pogled odozgo, 8 kom pl 25, Plate 8x143
M 1:10

Pogled odozgo, 8 kom pl 16, Plate 8x143
M 1:10

Position	Section	Number	Grade	Length (mm)	Mass	
					Unit (kg/m)	Total (kg)
Position=UN 1	Number=1	Mass-Total=2156,65(kg)				
pl 13	Plate 20x160	4	S 235	280,00		27,21
pl 16	Plate 8x143	1	S 235	400,00		3,51
pl 24	Plate 12x143	8	S 235	636,00		67,76
pl 25	Plate 8x143	1	S 235	636,00		5,64
pl 28	Plate 12x74	8	S 235	142,50		7,78
un 1	HEA 700	1	S 235	10000,00	204,475	2044,75
						2156,65
PROTUPOŽARNA I ANTIKOROZIVNA ZAŠTITA: PREMAZIVANJE						
ZAHTEJ TRAJNOSTI ANTIKOROZIVNE ZAŠTITE: HIGH DURABILITY (prema HRN EN ISO 12944-1:1998)						
AGRESIVNOST SREDINE: C1 - LOW (prema tablici 1 iz HRN EN ISO 12944-2:1998)						
ZAHTEJ PROTUPOŽARNE OTPORNOSTI:						



FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I
POSREDOVANJE U PROMETU NEPOKRETNOSTI
KATEDRA ZA METALNE I ODRŽIVE KONSTRUKCIJE
20000 SPLIT, MATICE HRVATSKIE 16

SAHRZAJ LSTA:

UZDUŽNI NOSAČ - POZ UN1

M 1:20 1:10

GRABEVNIK:
Pristanišna zgrada zračne luke Dubrovnik
Zgrada "ABC" - Sortirnica / Putnički terminal

STUDENT:
Mario Šarčević

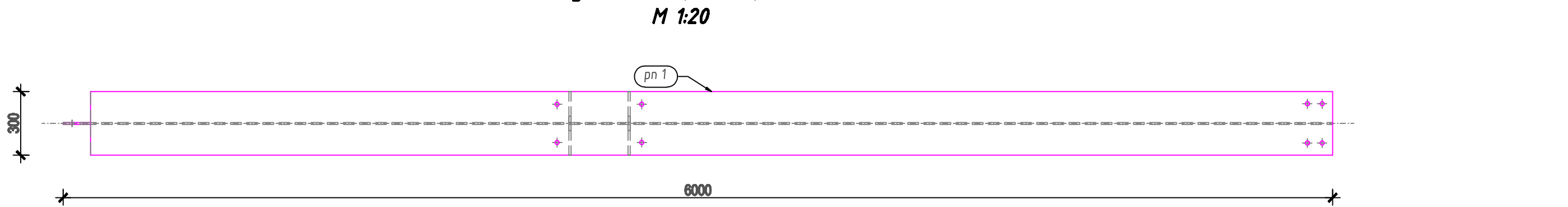
MENTOR:
Prof.dr.sc. Bernardin Perić

FAZA PROJEKTA:
IZVEDBENI PROJEKT

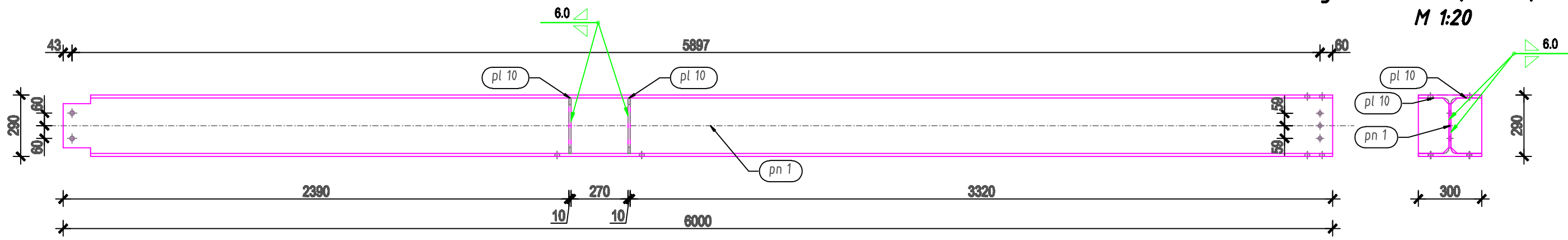
SAHRZAJ:
7.2. GRABEVINSKI NACRTI:
KONSTRUKCIJA JUŽNE
NADSTREŠNICE

DATUM:
lipanj, 2015. god.

list 7.2.12.

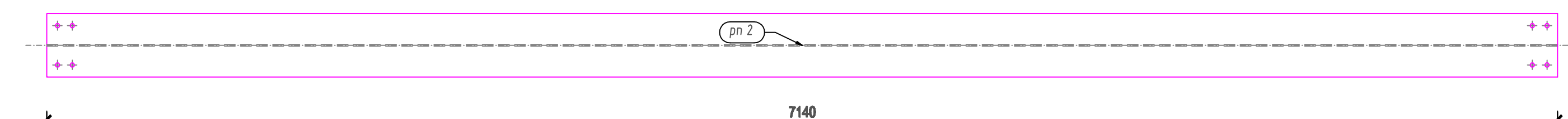


Pogled sprijeda, 8 kom, PN 1
M 1:20

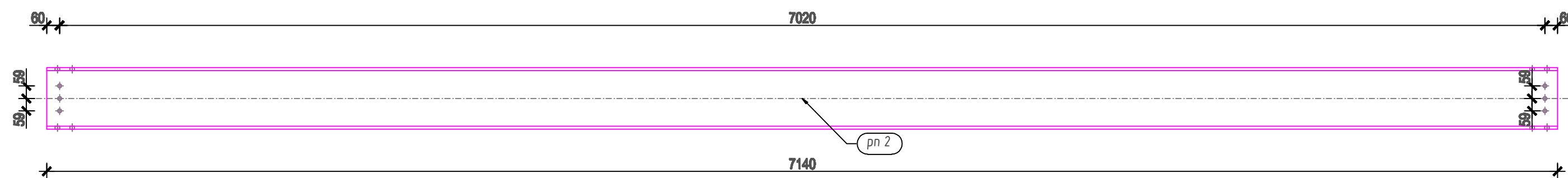


Pogled sa strane, 8 kom, PN 1
M 1:20

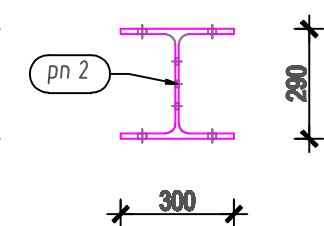
Pogled odozdo, 4 kom, PN 2
M 1:20



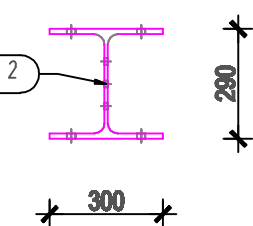
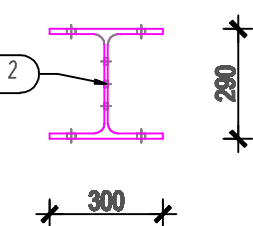
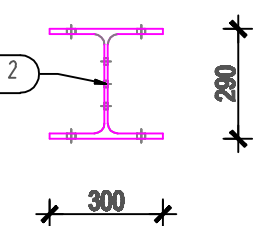
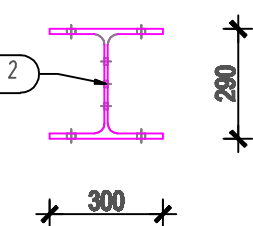
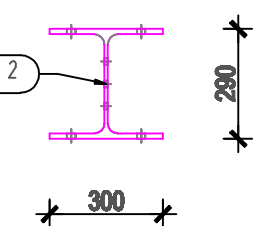
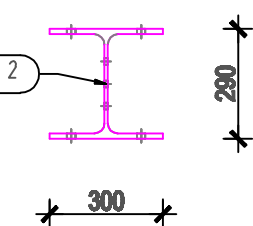
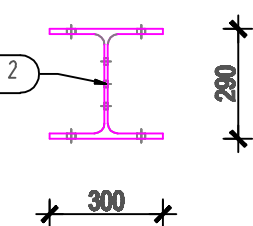
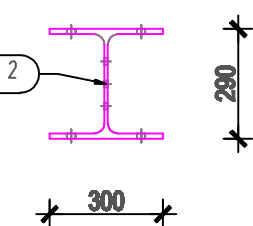
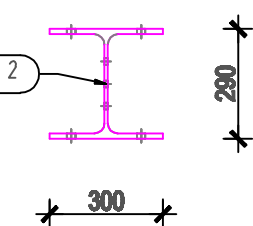
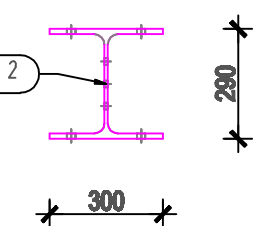
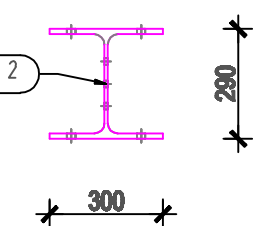
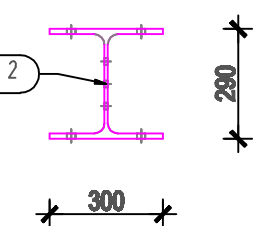
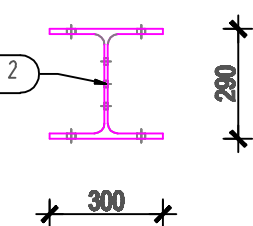
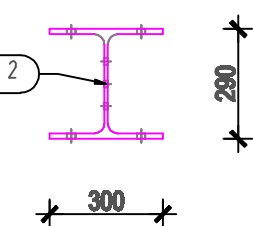
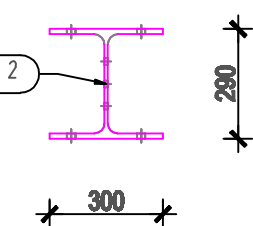
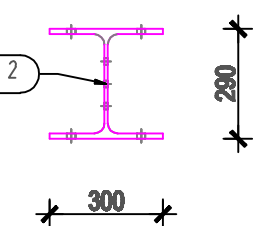
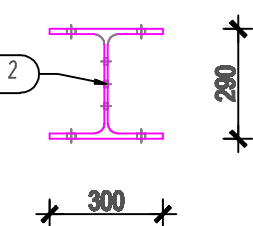
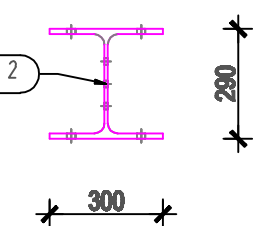
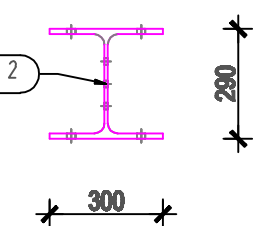
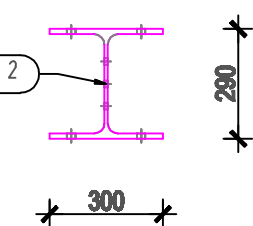
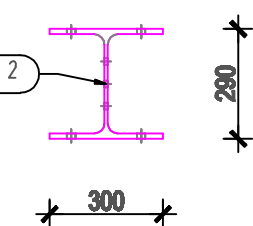
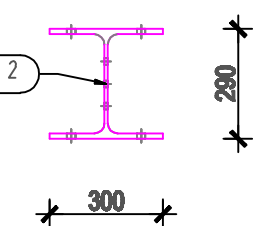
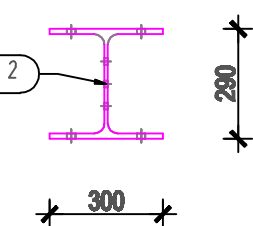
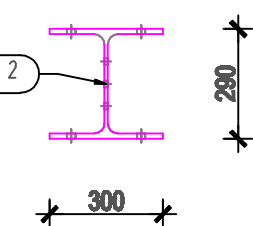
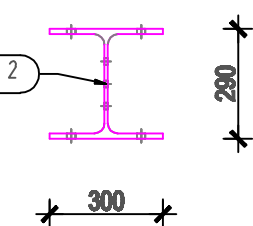
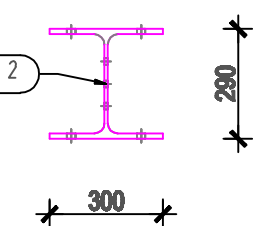
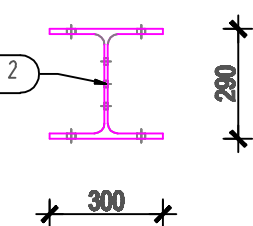
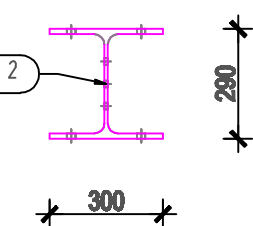
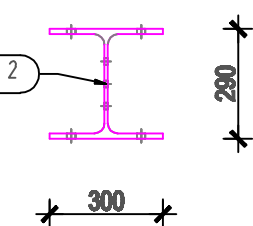
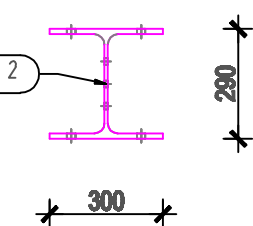
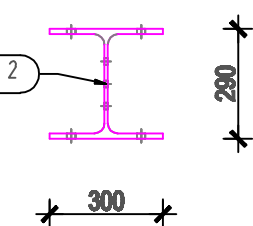
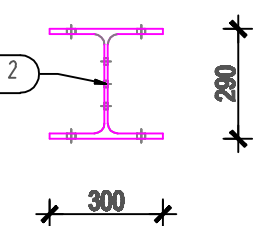
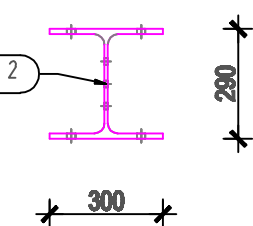
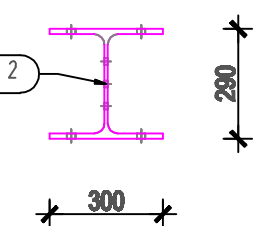
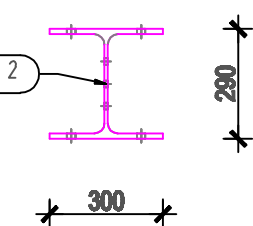
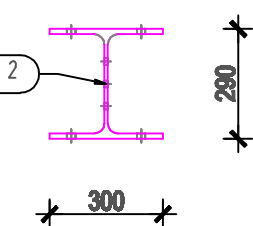
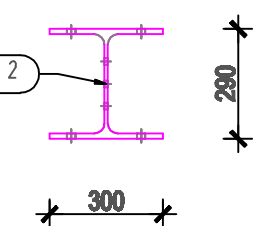
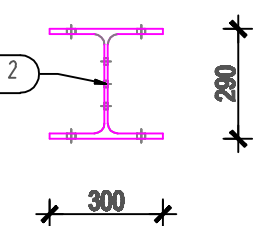
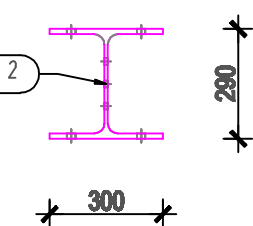
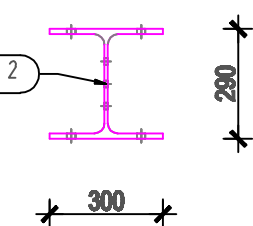
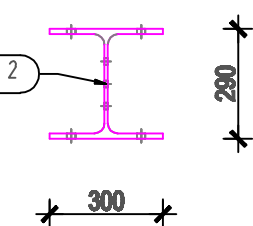
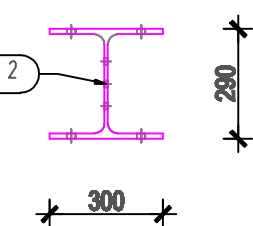
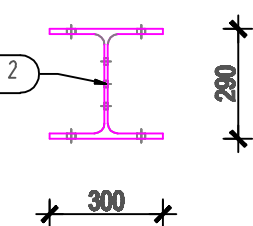
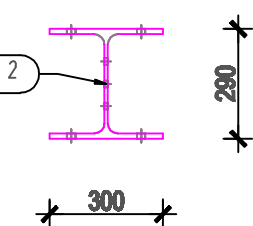
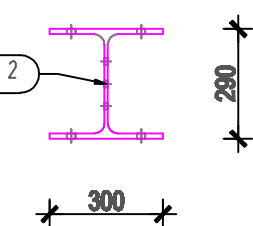
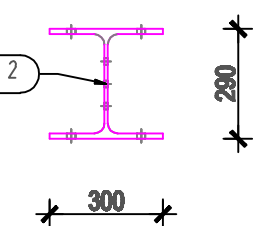
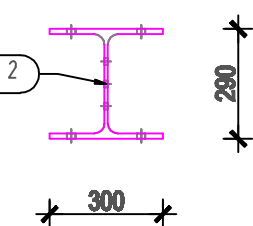
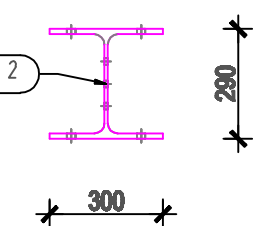
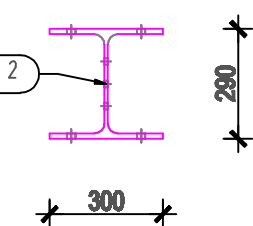
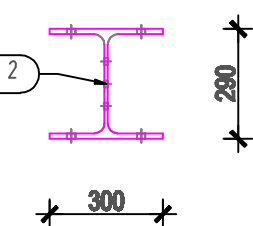
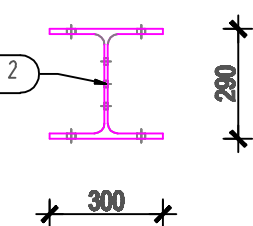
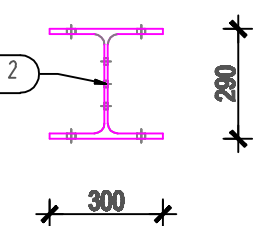
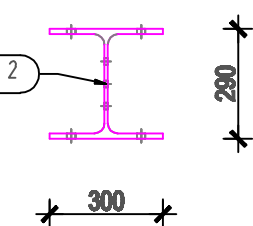
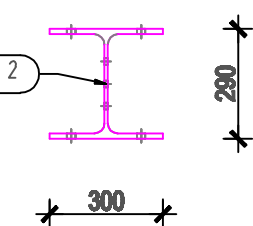
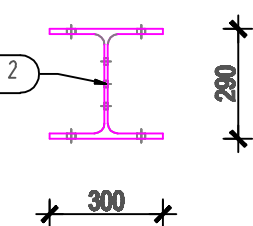
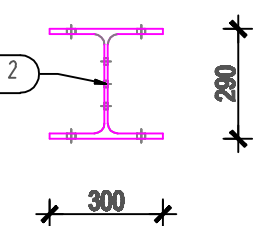
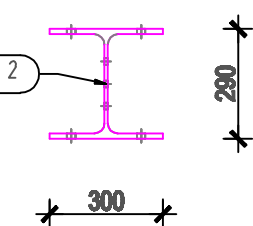
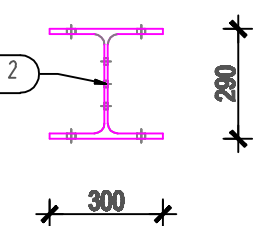
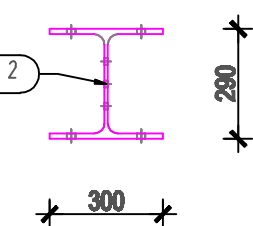
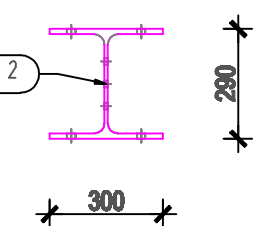
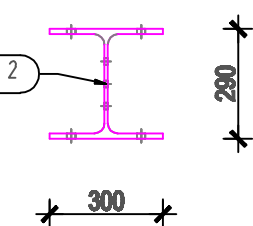
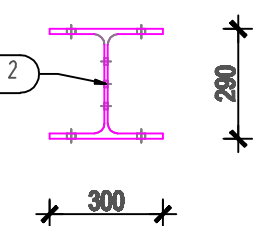
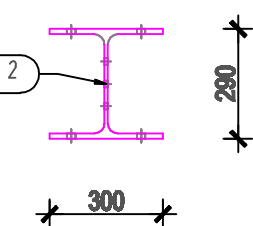
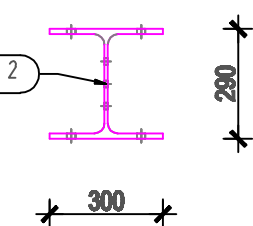
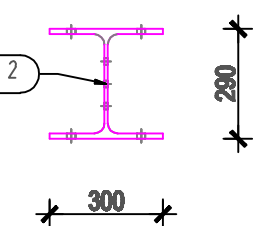
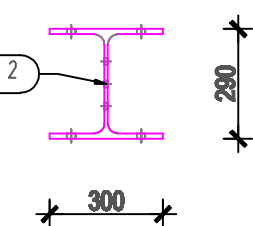
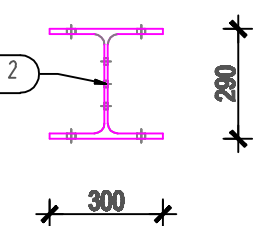
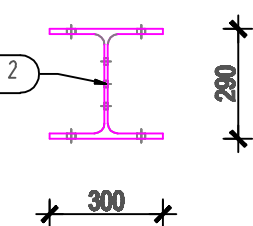
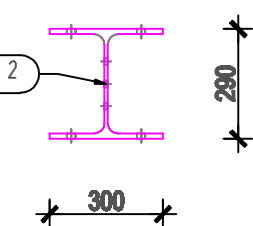
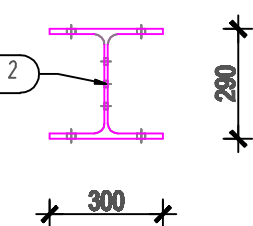
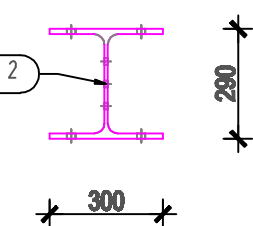
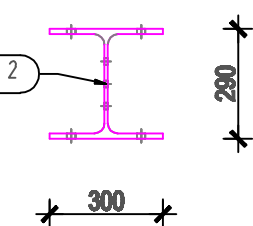
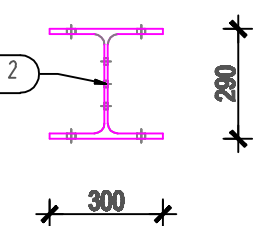
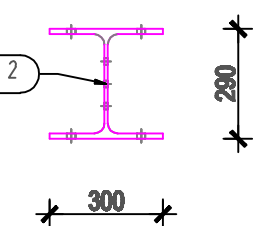
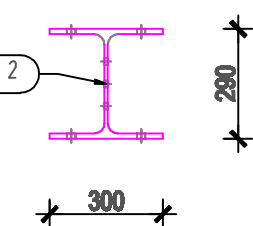
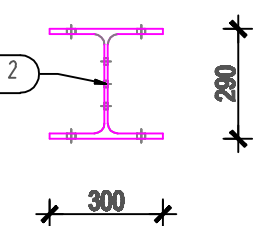
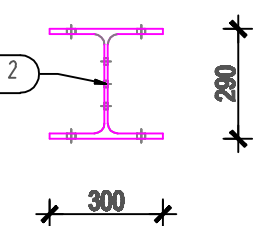
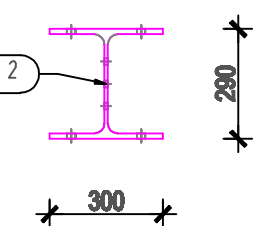
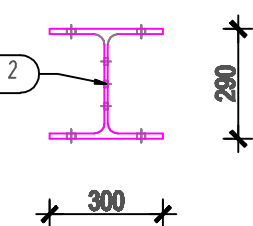
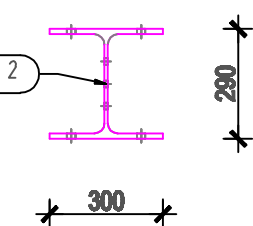
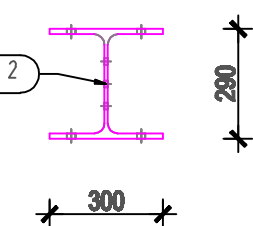
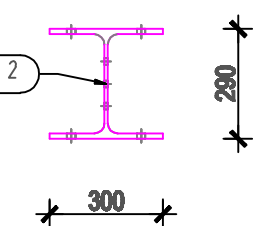
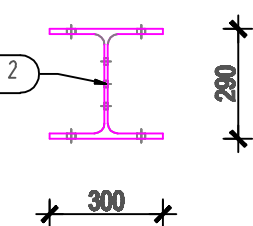
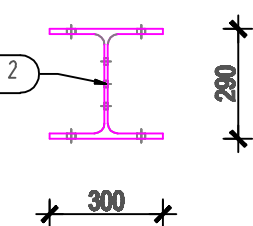
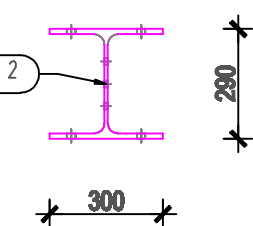
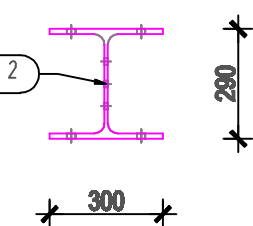
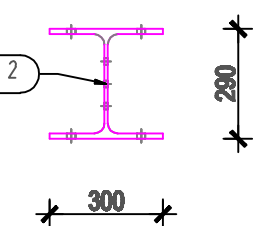
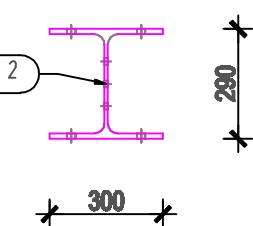
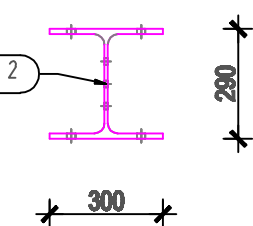
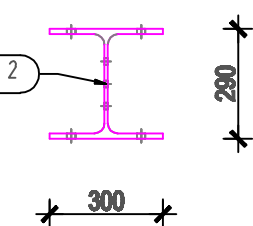
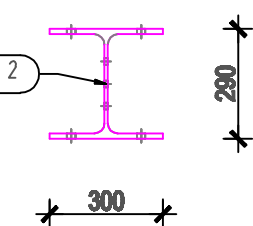
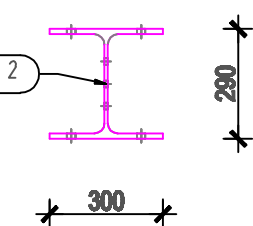
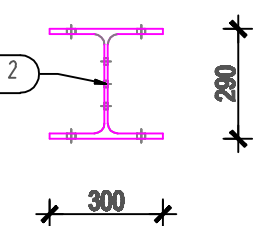
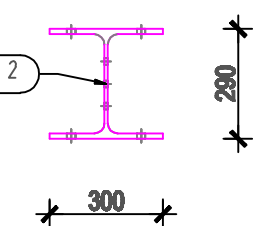
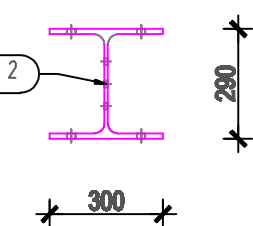
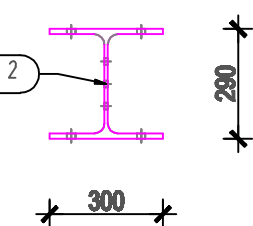
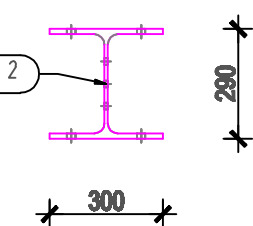
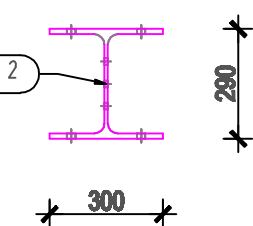
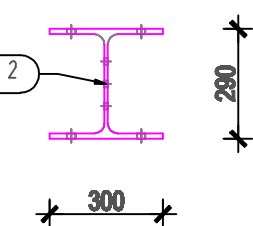
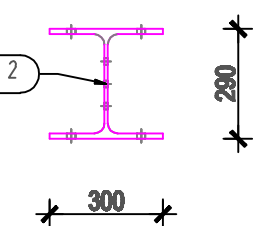
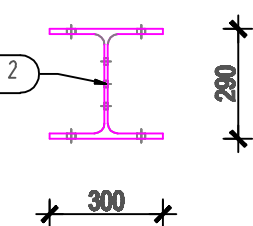
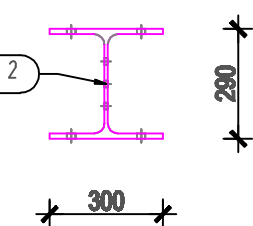
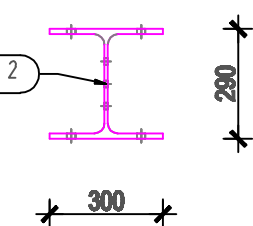
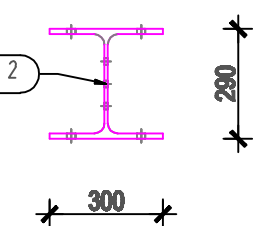
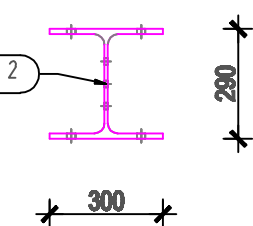
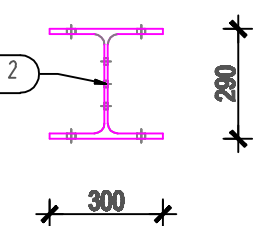
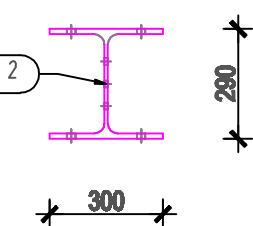
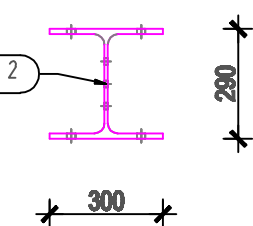
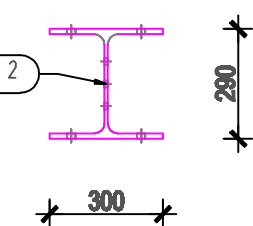
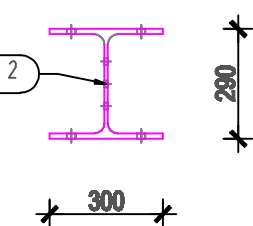
Pogled sprijeda, 4 kom, PN 2
M 1:20

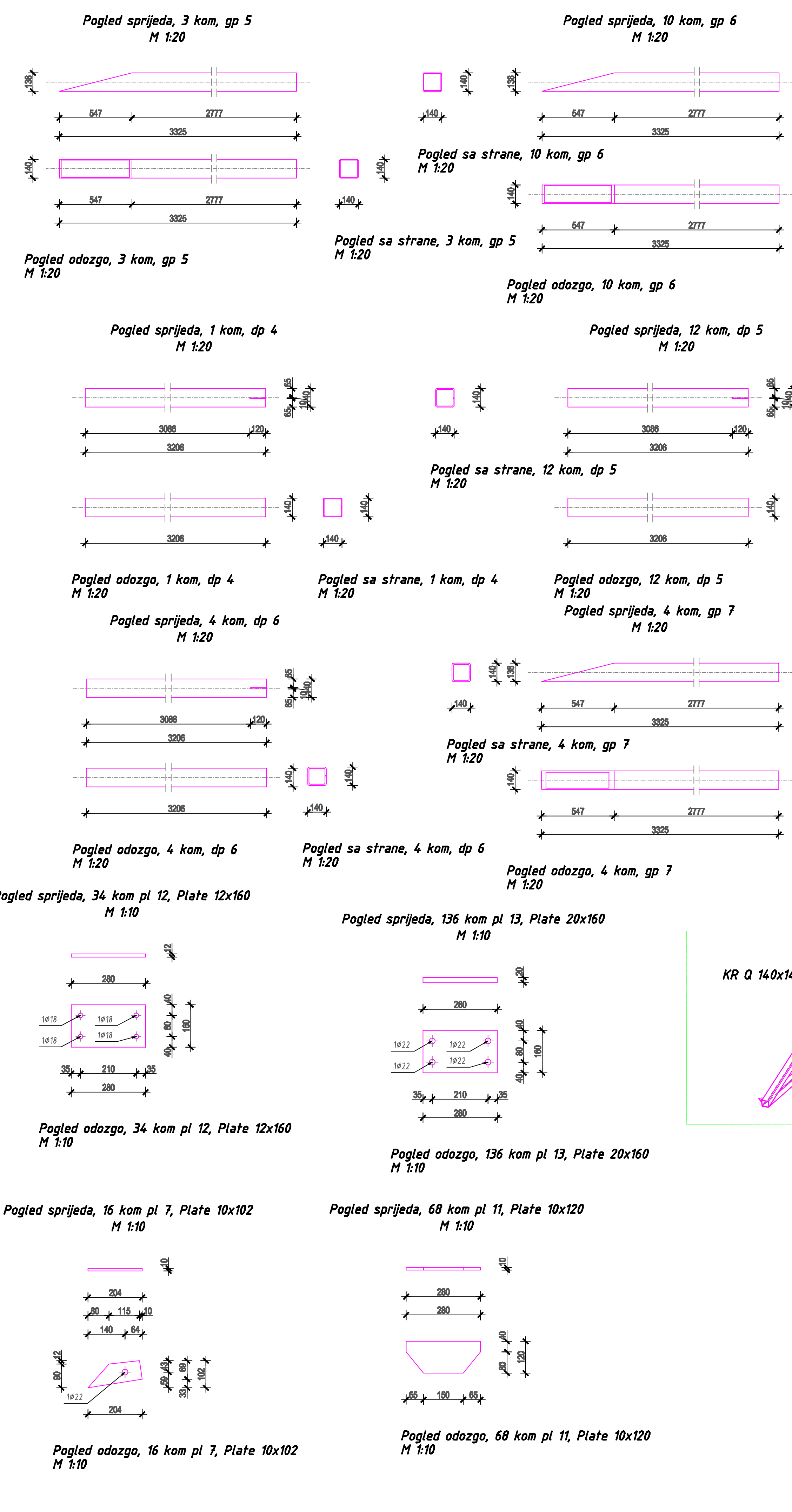
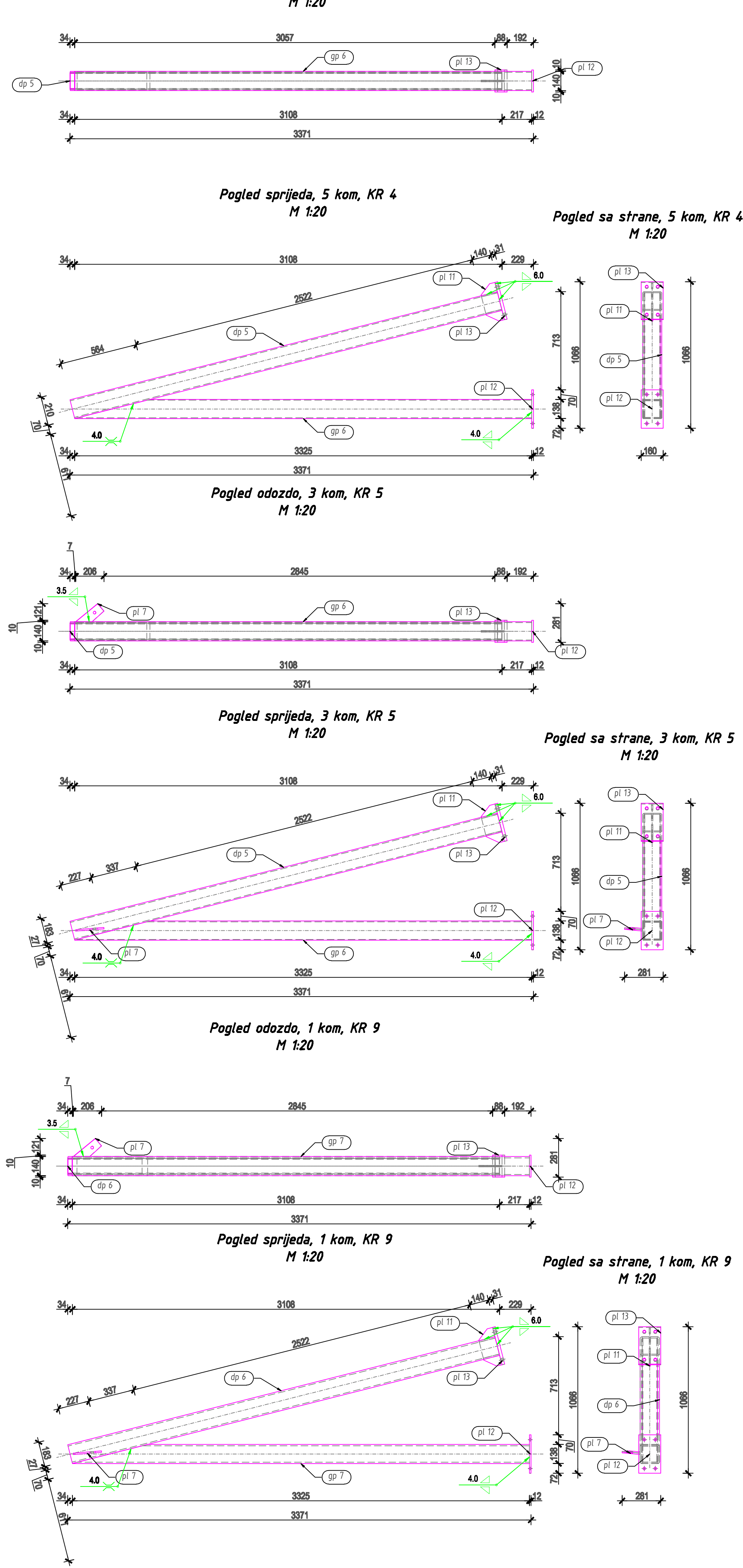
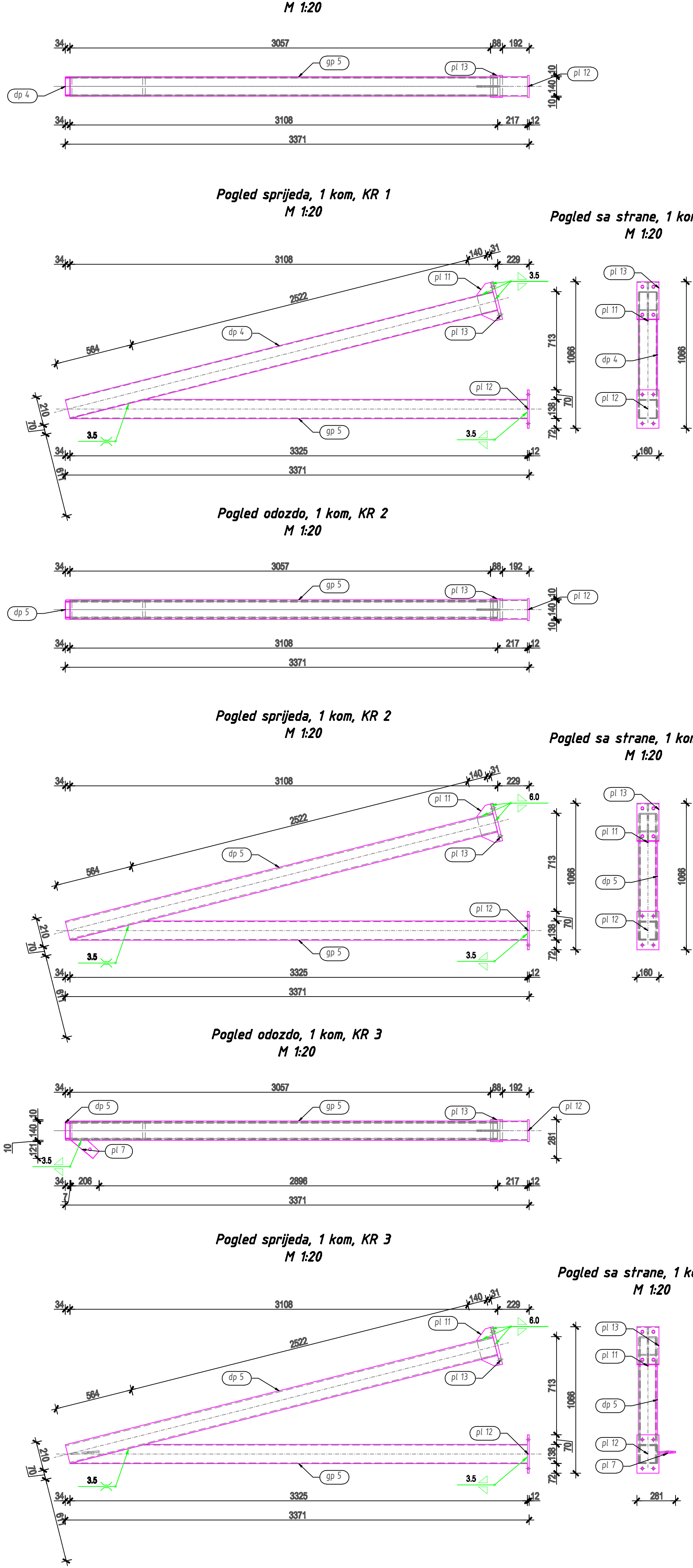


Pogled sa strane, 4 kom, PN 2
M 1:20



pn 2





Position=KR 1	Number=1	Mass-Total=15,00(kg)	Unit	kg/m	Total	kg
dp 4	Q 140x140x5	1	S 235	3205,94	21,008	67,67
gp 5	Q 140x140x5	1	S 235	3324,65	21,008	70,18
pl 11	Plate 10x120	1	S 235	280,00		2,23
pl 12	Plate 12x160	1	S 235	280,00		4,13
pl 13	Plate 20x160	1	S 235	280,00		6,80
						15,01
Position=KR 2						
dp 5	Q 140x140x8	1	S 235	3205,94	32,019	102,65
gp 5	Q 140x140x5	1	S 235	3324,65	21,008	70,18
pl 11	Plate 10x120	1	S 235	280,00		2,23
pl 12	Plate 12x160	1	S 235	280,00		4,13
pl 13	Plate 20x160	1	S 235	280,00		6,80
						185,99
Position=KR 3						
dp 5	Q 140x140x8	1	S 235	3205,94	32,019	102,65
gp 5	Q 140x140x5	1	S 235	3324,65	21,008	70,18
pl 7	Plate 10x102	1	S 235	204,37		0,91
pl 11	Plate 10x120	1	S 235	280,00		2,23
pl 12	Plate 12x160	1	S 235	280,00		4,13
pl 13	Plate 20x160	1	S 235	280,00		6,80
						186,90
Position=KR 4						
dp 5	Q 140x140x8	1	S 235	3205,94	32,019	102,65
gp 6	Q 140x140x5	1	S 235	3324,65	24,983	83,86
pl 11	Plate 10x120	1	S 235	280,00		2,23
pl 12	Plate 12x160	1	S 235	280,00		4,13
pl 13	Plate 20x160	1	S 235	280,00		6,80
						198,87
Position=KR 5						
dp 5	Q 140x140x8	1	S 235	3205,94	32,019	102,65
gp 6	Q 140x140x5	1	S 235	3324,65	24,983	83,86
pl 7	Plate 10x102	1	S 235	204,37		0,91
pl 11	Plate 10x120	1	S 235	280,00		2,23
pl 12	Plate 12x160	1	S 235	280,00		4,13
pl 13	Plate 20x160	1	S 235	280,00		6,80
						199,78
Position=KR 6						
dp 5	Q 140x140x8	1	S 235	3205,94	32,019	102,65
gp 6	Q 140x140x5	1	S 235	3324,65	24,983	83,86
pl 7	Plate 10x102	1	S 235	204,37		0,91
pl 11	Plate 10x120	1	S 235	280,00		2,23
pl 12	Plate 12x160	1	S 235	280,00		4,13
pl 13	Plate 20x160	1	S 235	280,00		6,80
						199,78
Position=KR 7						
dp 6	Q 140x140x10	1	S 235	3205,94	38,851	124,55
gp 7	Q 140x140x10	1	S 235	3324,65	38,851	129,17
pl 11	Plate 10x120	1	S 235	280,00		2,23
pl 12	Plate 12x160	1	S 235	280,00		4,13
pl 13	Plate 20x160	1	S 235	280,00		6,80
						266,88
Position=KR 8						
dp 6	Q 140x140x10	1	S 235	3205,94	38,851	124,55
gp 7	Q 140x140x10	1	S 235	3324,65	38,851	129,17
pl 7	Plate 10x102	1	S 235	204,37		0,91
pl 11	Plate 10x120	1	S 235	280,00		2,23
pl 12	Plate 12x160	1	S 235	280,00		4,13
pl 13	Plate 20x160	1	S 235	280,00		6,80
						267,79
Position=KR 9						
dp 6	Q 140x140x10	1	S 235	3205,94	38,851	124,55
gp 7	Q 140x140x10	1	S 235	3324,65	38,851	129,17
pl 7	Plate 10x102	1	S 235	204,37		0,91
pl 11	Plate 10x120	1	S 235	280,00		2,23
pl 12	Plate 12x160	1	S 235	280,00		4,13
pl 13	Plate 20x160	1	S 235	280,00		6,80
						267,79
PROTUPUŽARNA I ANTIKOROZIVNA ZAŠTITA: PREMAZIVANJE						
ZAHTEV TRAJNOSTI ANTIKOROZIVNE ZAŠTITE: HIGH DURABILITY (prema HRN EN ISO 12944-1:1994)						
AGRESIVNOST SREDINE: C1 - LOW (prema ISO 11811:1994)						
ZAHTEV PROTUPUŽARNE OTPORNOSTI:						

KLJUNOVI REŠETKI

M 1:20 1:10

GRADJEVNA:
Pristanišna zgrada zračne luke Dubrovnik
Zgrada "ABC" - Sortirnica / Putnički terminal

PROJEKT:
Građevna južna nadstrešnica ispred zgrade
"B" i zgrade "C"

STUDENT:
Mario Šarčević

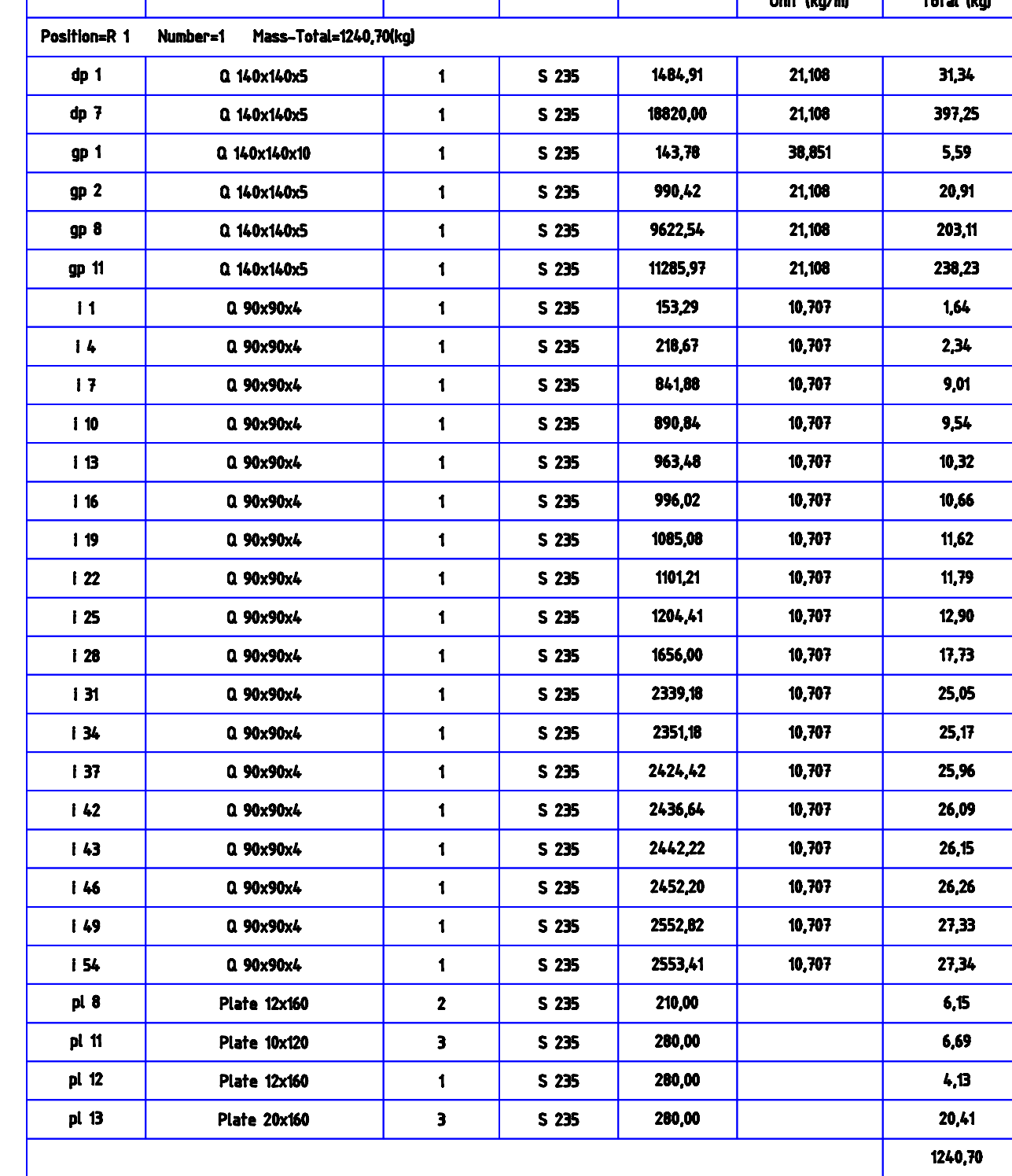
MENTOR:
Prof.dr.sc. Bernardin Perić

FAZA PROJEKTA:
IZVEDBENI PROJEKT

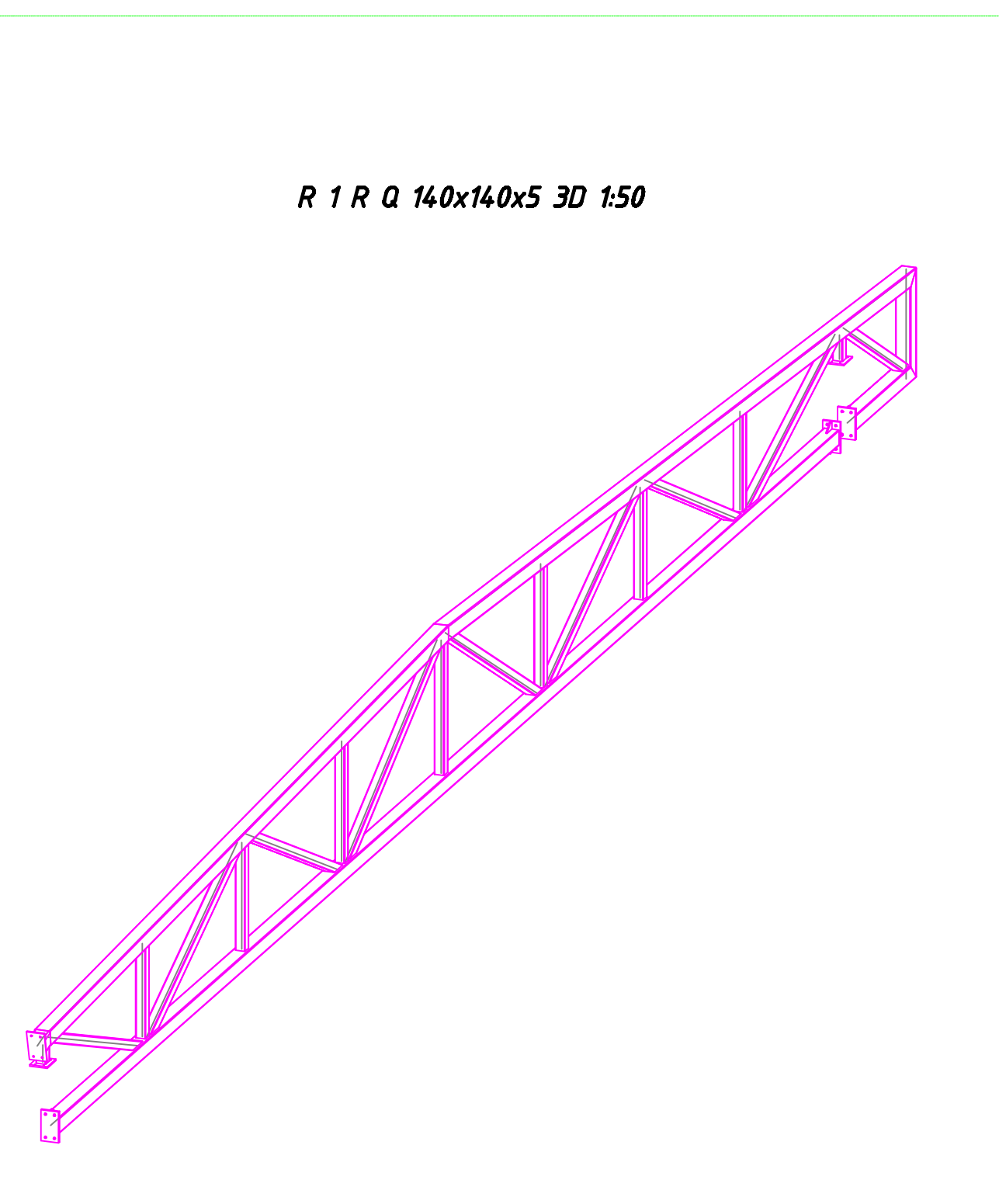
SADRŽAJ:
7.2. GRAĐEVINSKI NACRTI:
KONSTRUKCIJA JUŽNE
NADSTREŠNICE

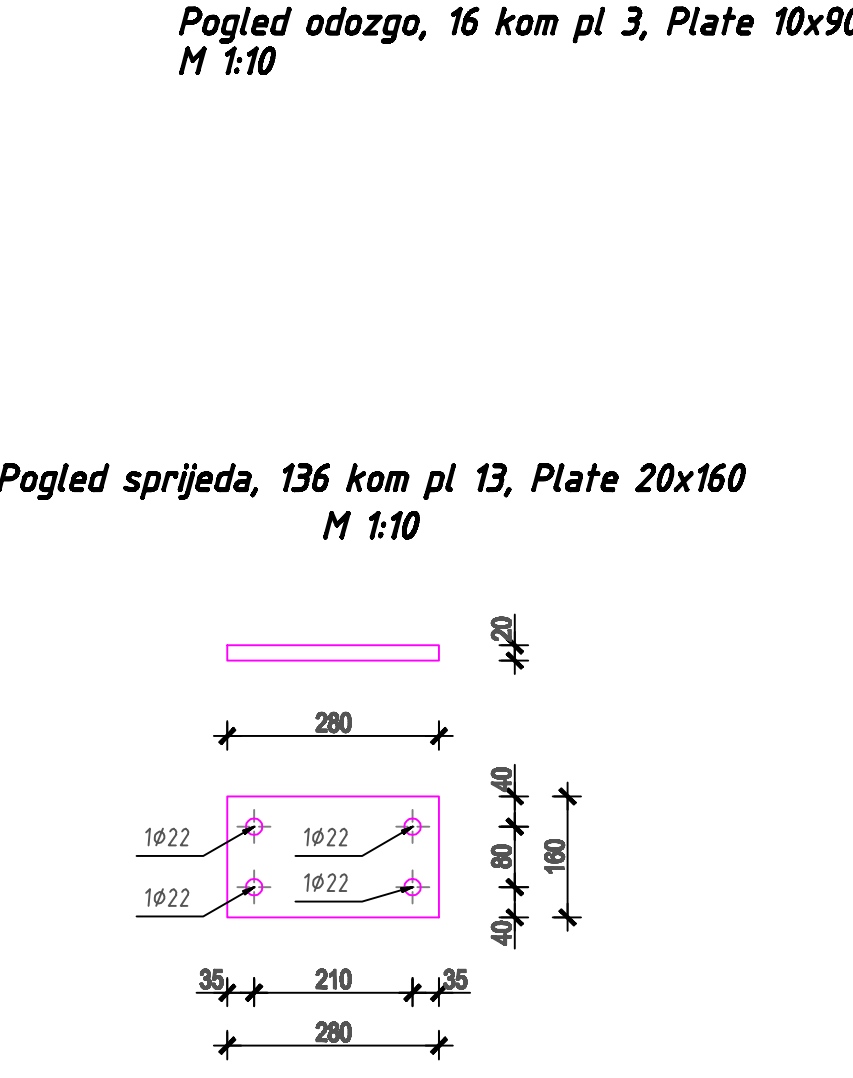
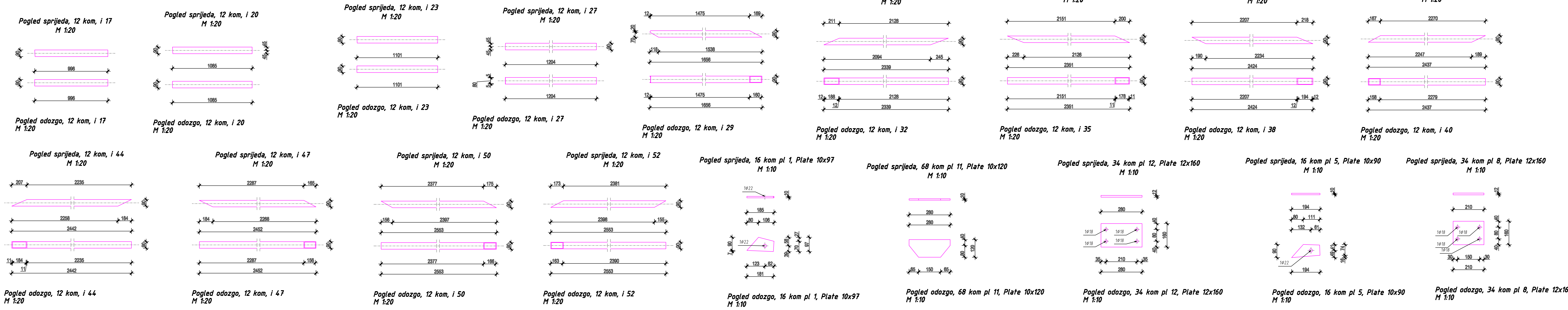
DATUM:
lipanj, 2015. god.

list 7.2.14.

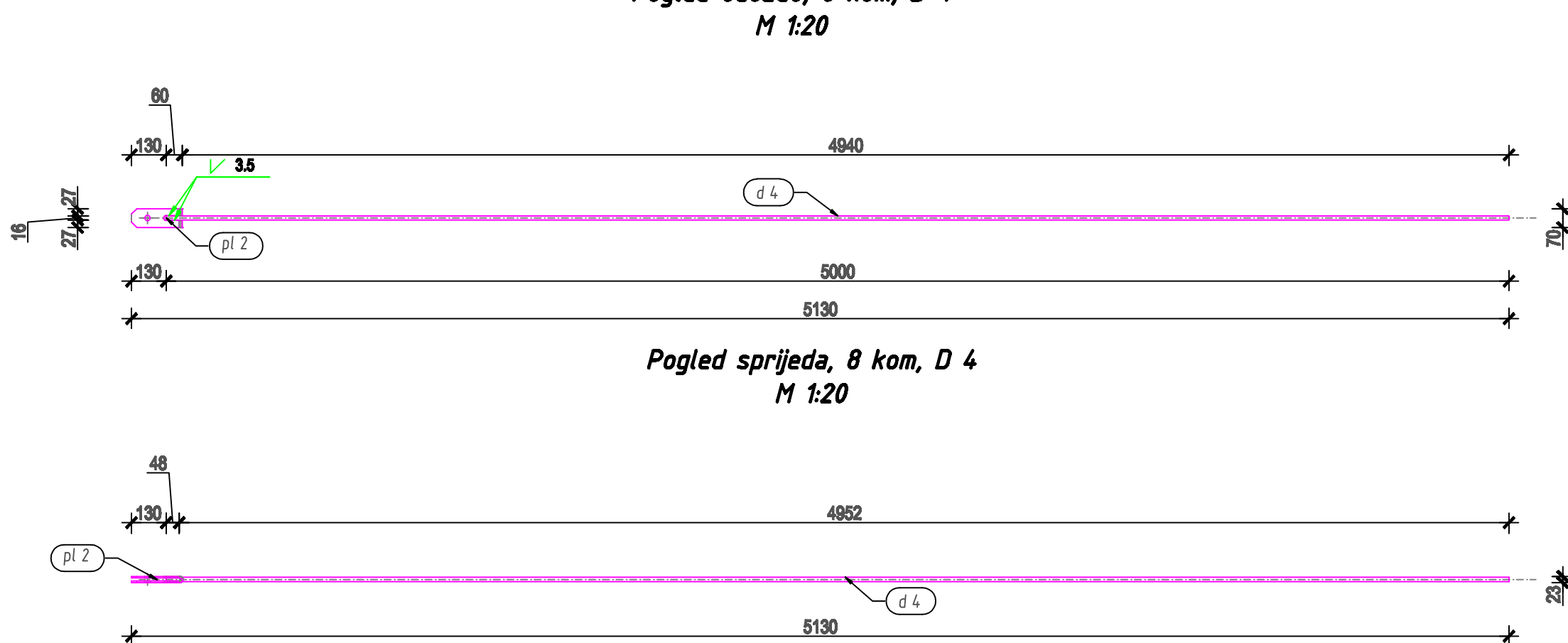
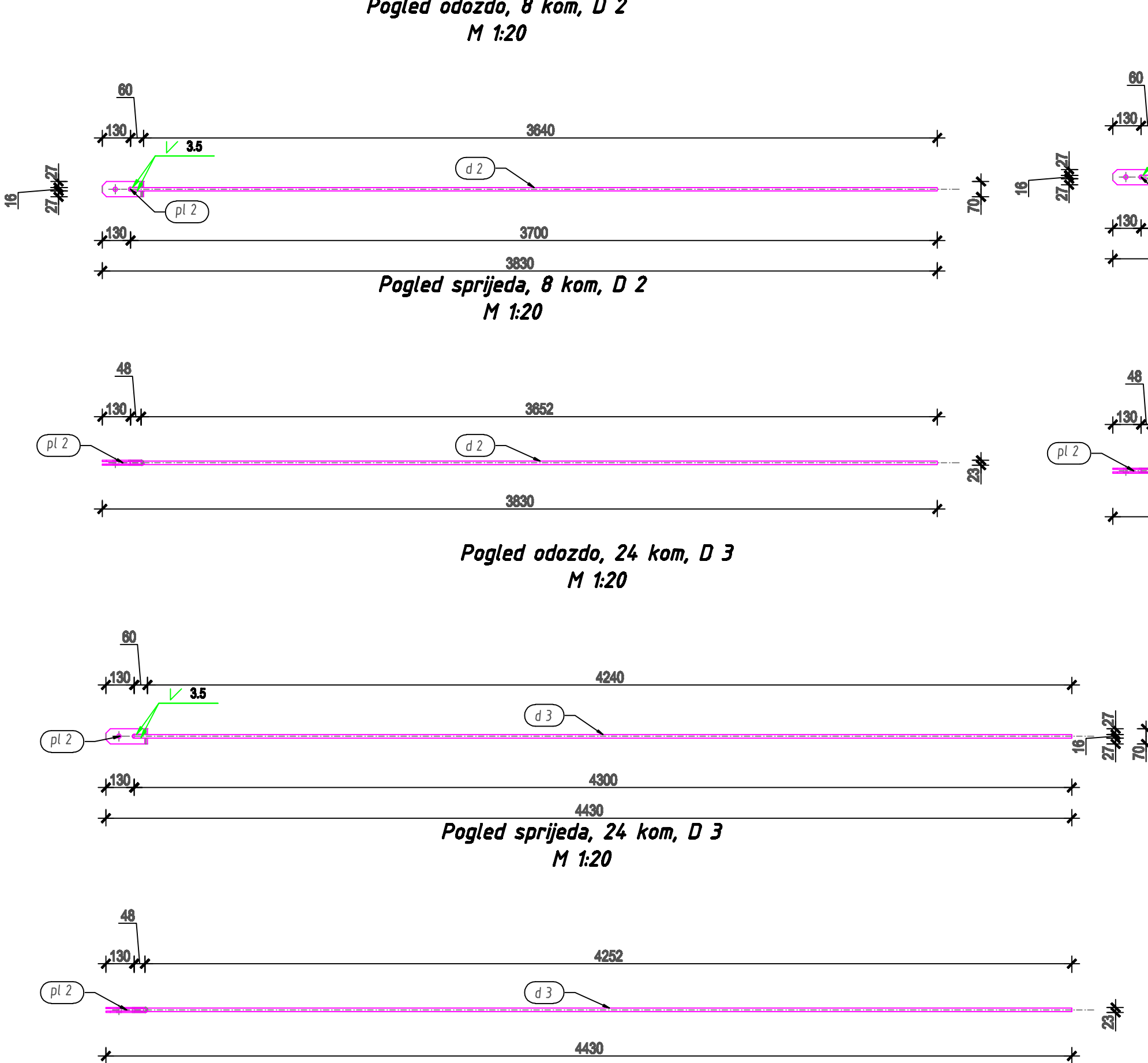
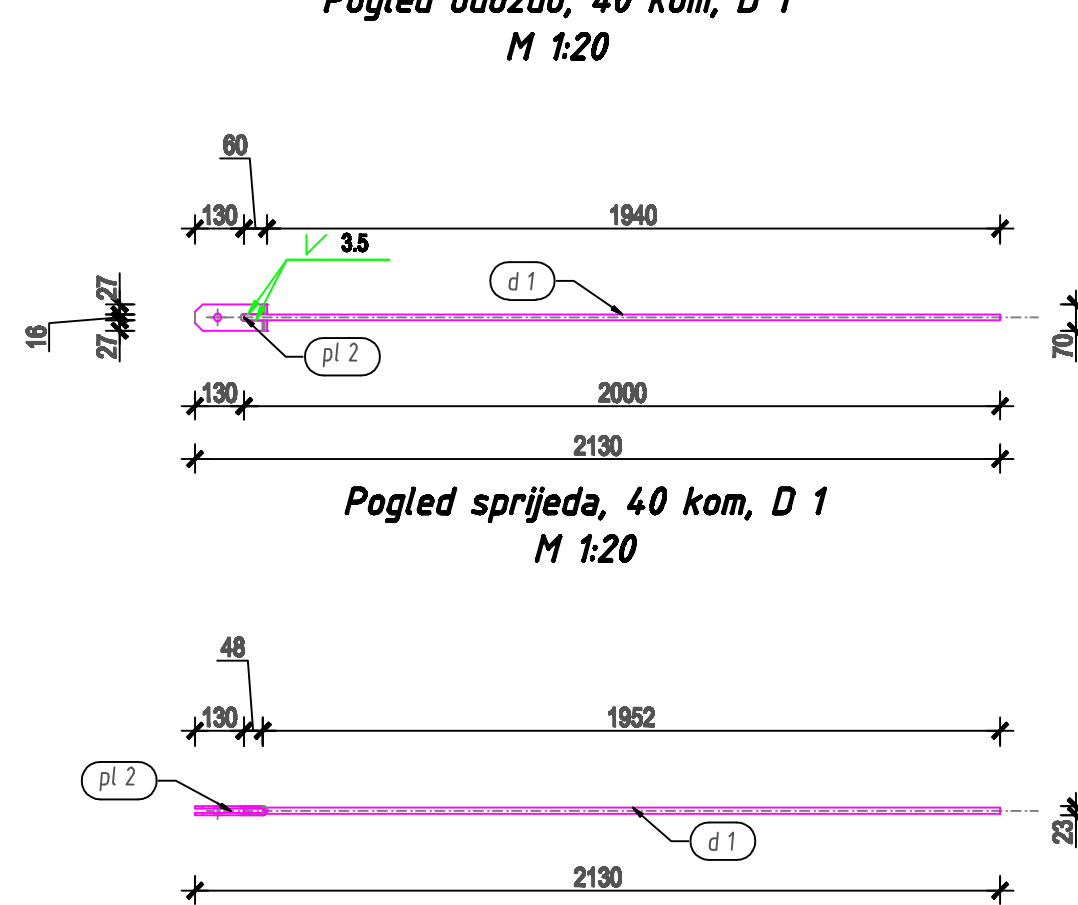


ZAHTEJEV PROTUPOŽARNE OTPORNOSTI:

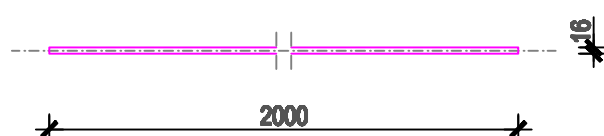




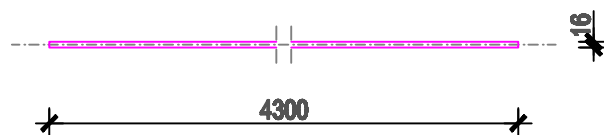
PROTUPUŽARNA I ANTIKOROZIVNA ZAŠTITA: PREMAZIVANJE
ZAHTJEV TRAJNOSTI ANTIKOROZIVNE ZAŠTITE: HIGH DURABILITY (prema HRN EN ISO 12944-1:2000)
AGRESIVNOST SREDINE: C1 - LOW (prema tablici 1 iz HRN EN ISO 12944-2:2000)
ZAHTJEV PROTUPUŽARNE OTPORNOSTI:



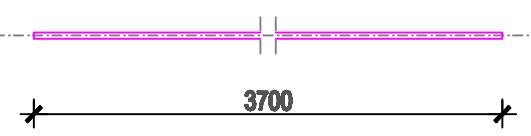
Pogled sprijeda, 40 kom, d 1
M 1:20



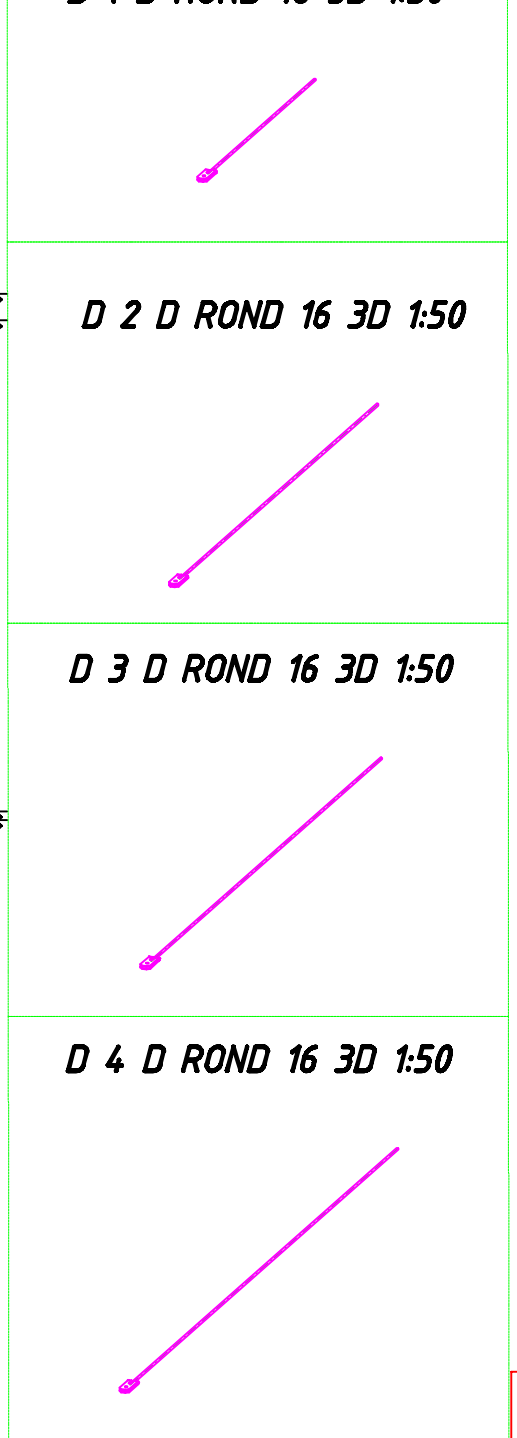
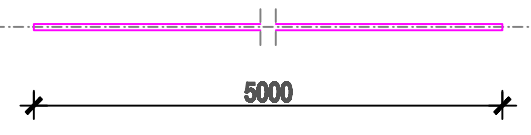
Pogled sprijeda, 24 kom, d 3
M 1:20



Pogled sprijeda, 8 kom, d 2
M 1:20



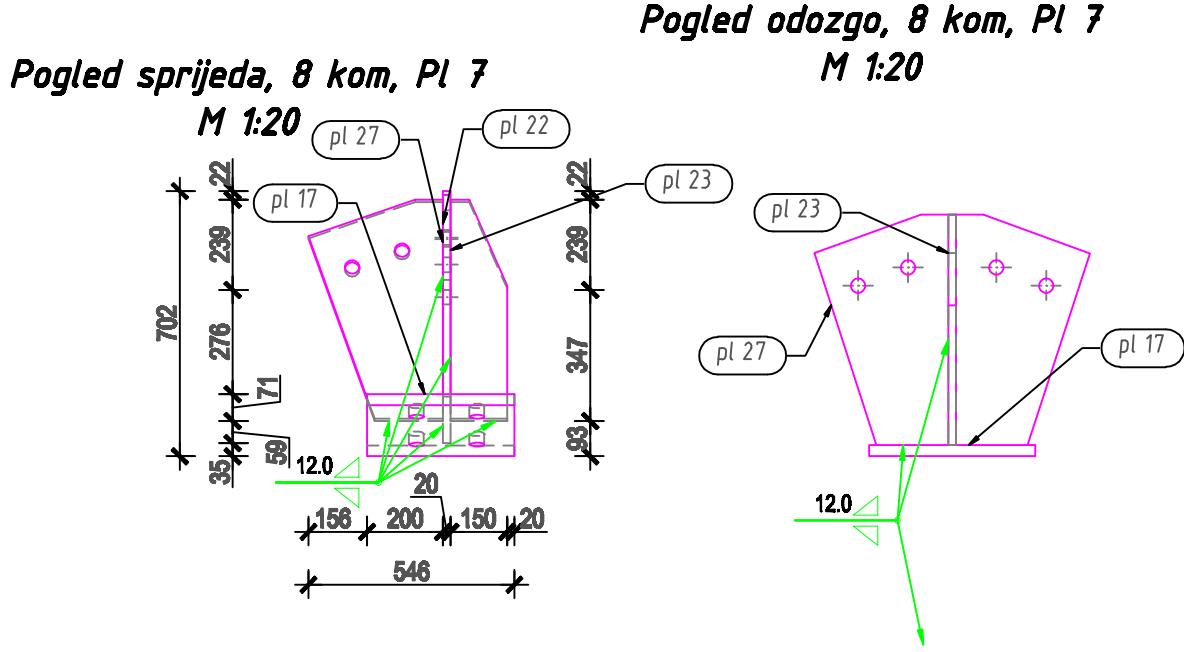
Pogled sprijeda, 8 kom, d 4
M 1:20



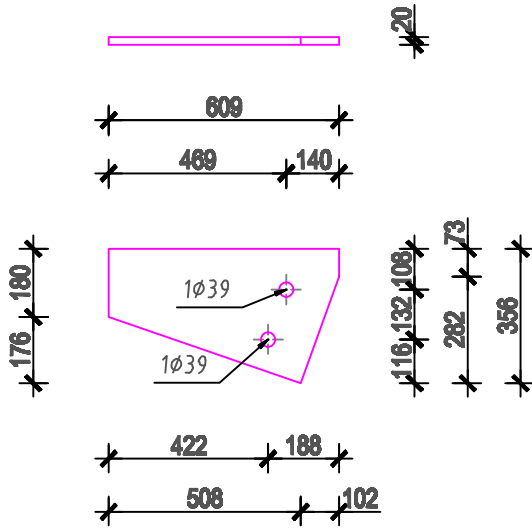
Position=D 1	Number=40	Mass-Total=169,44(kg)			Unit (kg/m)	Total (kg)
d 1	ROND 16	1	S 235	2000,00	1,580	3,16
pl 2	Plate 70x23	1	S 235	190,00		1,08
						4,24
Position	Section	Number	Grade	Length (mm)	Mass	
					Unit (kg/m)	Total (kg)
Position=D 2	Number=8	Mass-Total=55,36(kg)				
d 2	ROND 16	1	S 235	3700,00	1,580	5,85
pl 2	Plate 70x23	1	S 235	190,00		1,08
						6,92
Position	Section	Number	Grade	Length (mm)	Mass	
					Unit (kg/m)	Total (kg)
Position=D 3	Number=24	Mass-Total=188,88(kg)				
d 3	ROND 16	1	S 235	4300,00	1,580	6,79
pl 2	Plate 70x23	1	S 235	190,00		1,08
						7,87
Position	Section	Number	Grade	Length (mm)	Mass	
					Unit (kg/m)	Total (kg)
Position=D 4	Number=8	Mass-Total=71,81(kg)				
d 4	ROND 16	1	S 235	5000,00	1,580	7,90
pl 2	Plate 70x23	1	S 235	190,00		1,08
						8,98

PROTUPOŽARNA I ANTIKOROZIVNA ZAŠTITA: PREMAZIVANJE
ZAHTJEV TRAJNOSTI ANTIKOROZIVNE ZAŠTITE: HIGH DURABILITY (prema HRN EN ISO 12944-1:1998)
AGRESIVNOST SREDINE: C1 - LOW (prema tablici 1 iz HRN EN ISO 12944-2:1998)
ZAHTJEV PROTUPOŽARNE OTPORNOSTI:

 FAKULTET GRAĐEVINARSTVA I ARHITEKTURE I GEODIZIJE KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE 21000 SPLIT, MATICE HRVATSKE 15	SAHRŽAJ LISTA:	
	ZATEGE	
GRAĐEVINA: Pristanišna zgrada zračne luke Dubrovnik Zgrada "ABC" - Sortirnica / Putnički terminal PROJEKT: Građenje južne nadstrešnice ispred zgrade "B" i zgrade "C"	STUDENT: Mario Šarčević MENTOR: Prof.dr.sc. Bernardin Peroš FAZA PROJEKTA: IZVEDBENI PROJEKT	SAHRŽAJ: 7.2. GRAĐEVINSKI NACRTI: KONSTRUKCIJA JUŽNE NADSTREŠNICE DATUM: lipanj, 2015. god.
		list 7.2.17.

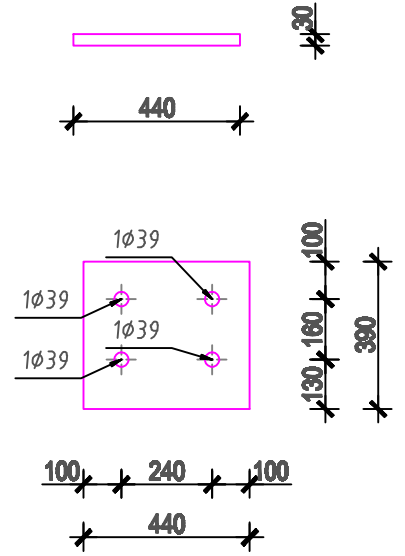


Pogled sprijeda, 8 kom pl 22, Plate 20x356
M 1:20



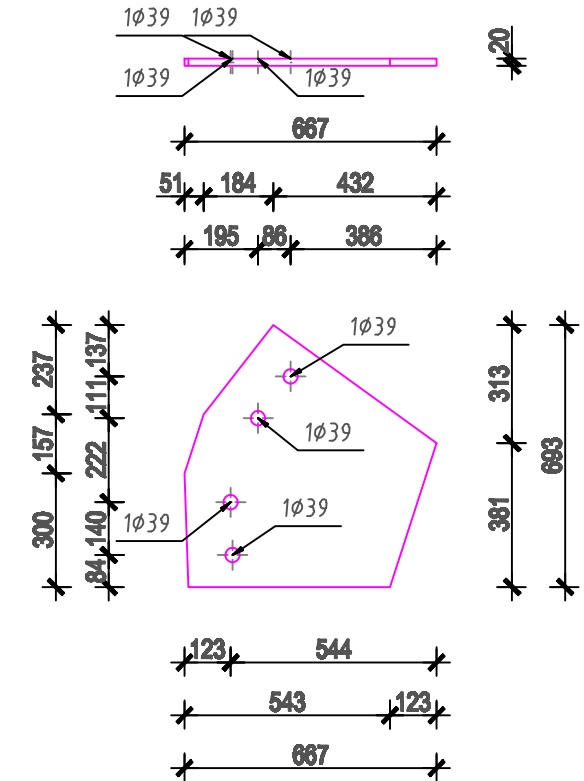
Pogled odozgo, 8 kom pl 22, Plate 20x356
M 1:20

Pogled sprijeda, 8 kom pl 17, Plate 30x390
M 1:20



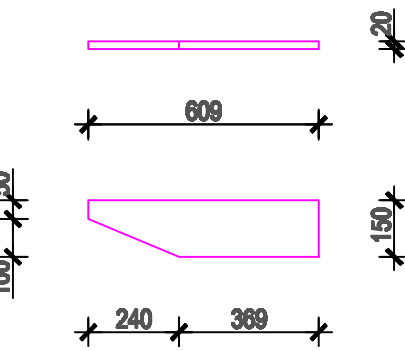
Pogled odozgo, 8 kom pl 17, Plate 30x390
M 1:20

Pogled sprijeda, 8 kom pl 27, Plate 20x693
M 1:20



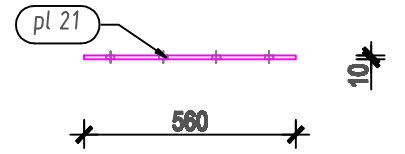
Pogled odozgo, 8 kom pl 27, Plate 20x693
M 1:20

Pogled sprijeda, 8 kom pl 23, Plate 20x150
M 1:20

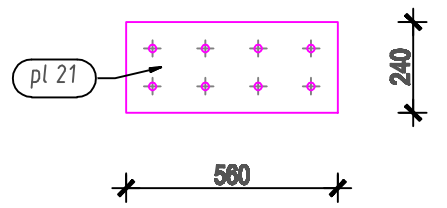


Pogled odozgo, 8 kom pl 23, Plate 20x150
M 1:20

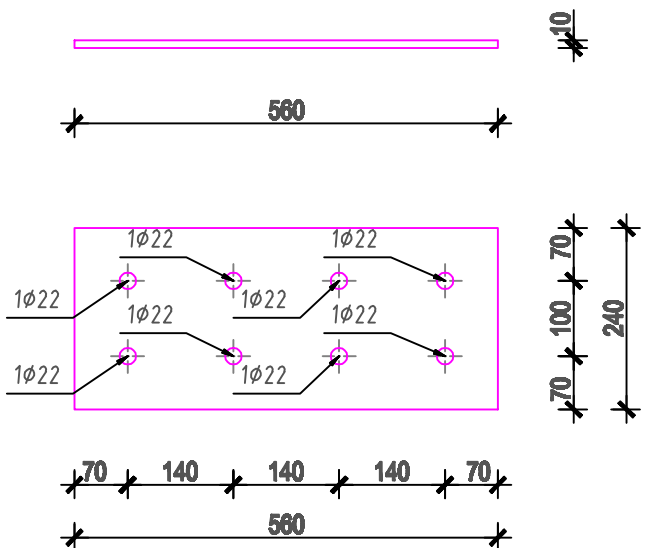
Pogled sprijeda, 24 kom, Pl 6
M 1:20



Pogled odozdo, 24 kom, Pl 6
M 1:20

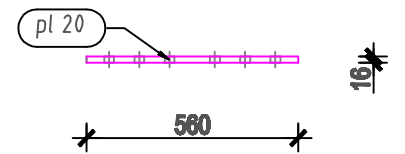


Pogled sprijeda, 24 kom pl 21, Plate 10x240
M 1:10

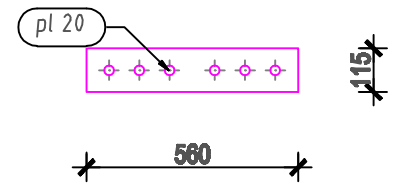


Pogled odozgo, 24 kom pl 21, Plate 10x240
M 1:10

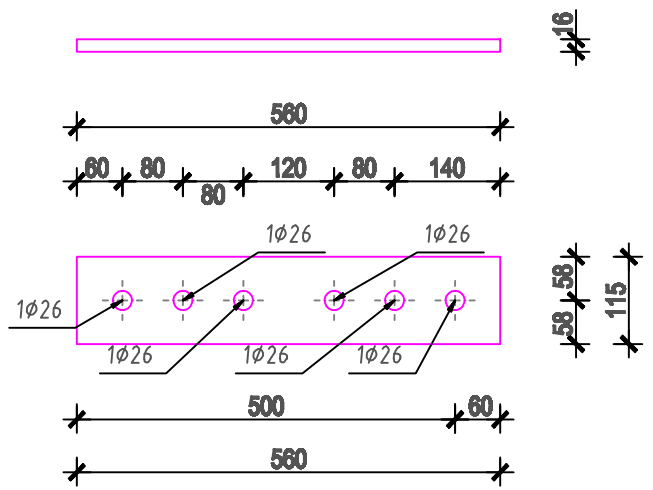
Pogled sprijeda, 48 kom, Pl 5
M 1:20



Pogled odozdo, 48 kom, Pl 5
M 1:20

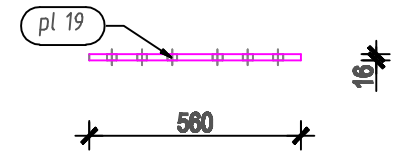


Pogled sprijeda, 48 kom pl 20, Plate 16x115
M 1:10

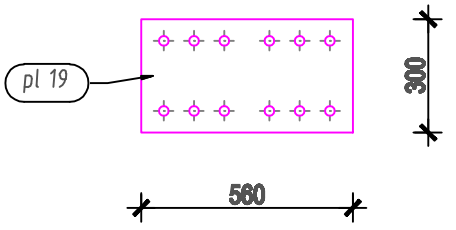


Pogled odozgo, 48 kom pl 20, Plate 16x115
M 1:10

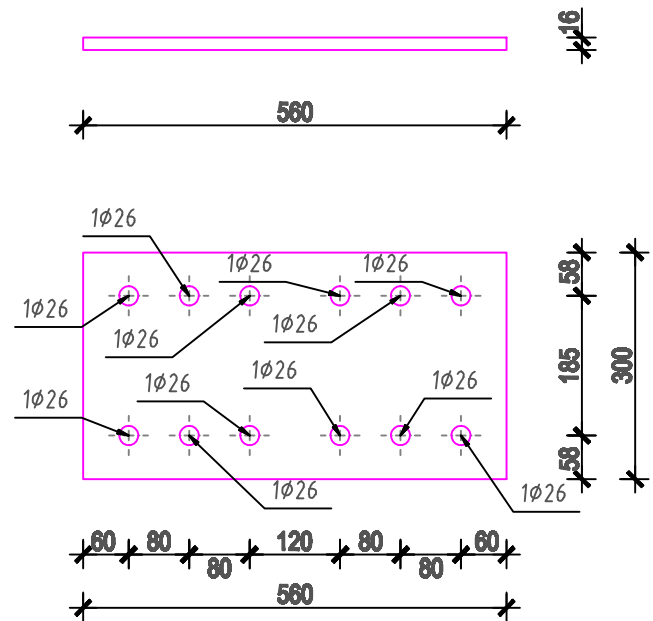
Pogled sprijeda, 24 kom, Pl 4
M 1:20



Pogled odozdo, 24 kom, Pl 4
M 1:20

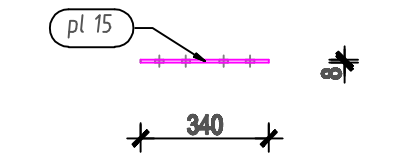


Pogled sprijeda, 24 kom pl 19, Plate 16x300
M 1:10

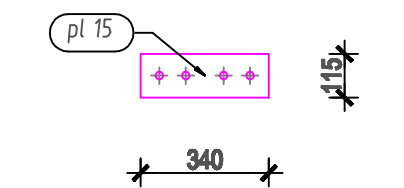


Pogled odozgo, 24 kom pl 19, Plate 16x300
M 1:10

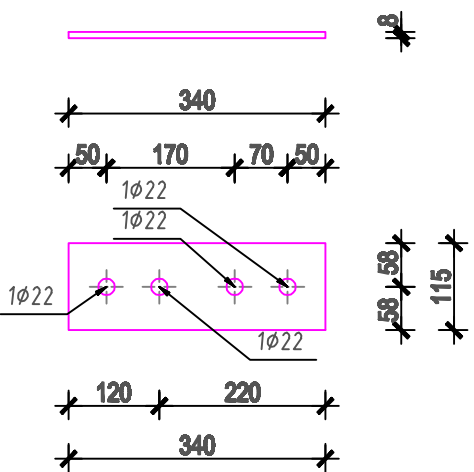
Pogled sprijeda, 32 kom, Pl 3
M 1:20



Pogled odozdo, 32 kom, Pl 3
M 1:20

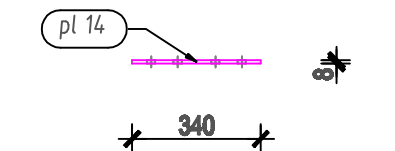


Pogled sprijeda, 32 kom pl 15, Plate 8x115
M 1:10

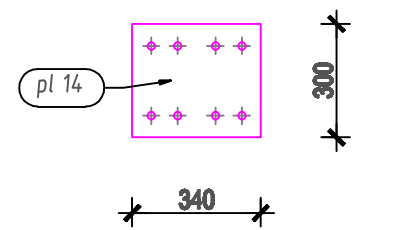


Pogled odozgo, 32 kom pl 15, Plate 8x115
M 1:10

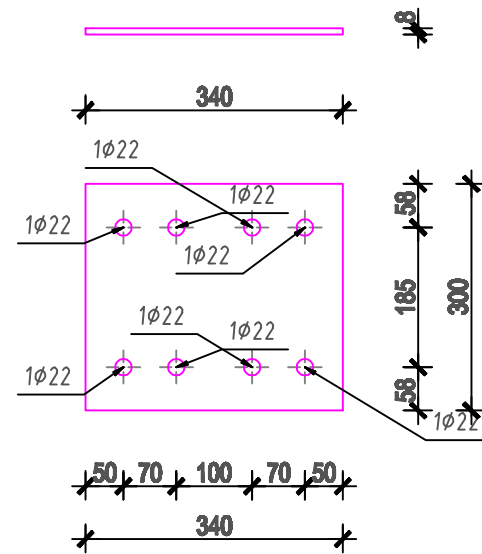
Pogled sprijeda, 16 kom, Pl 2
M 1:20



Pogled odozdo, 16 kom, Pl 2
M 1:20

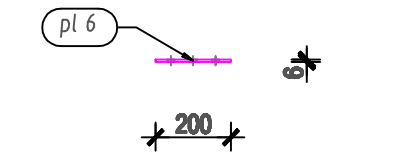


Pogled sprijeda, 16 kom pl 14, Plate 8x300
M 1:10

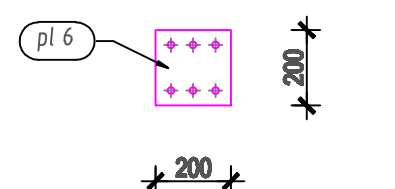


Pogled odozgo, 16 kom pl 14, Plate 8x300
M 1:10

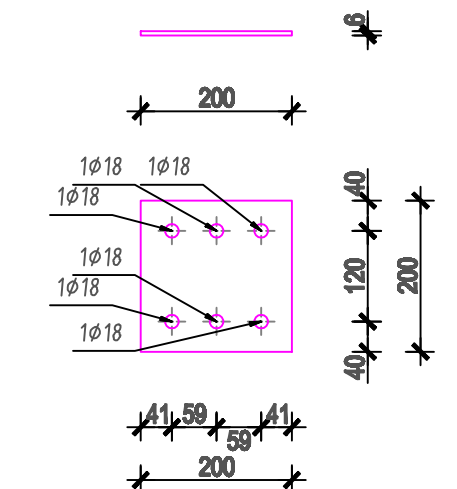
Pogled sprijeda, 16 kom, Pl 1
M 1:20



Pogled odozdo, 16 kom, Pl 1
M 1:20

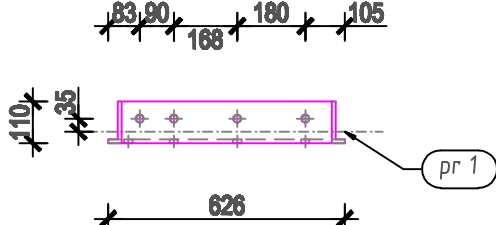


Pogled sprijeda, 16 kom pl 6, Plate 6x200
M 1:10

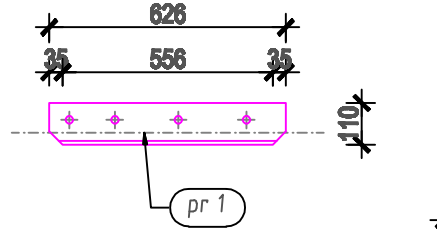


Pogled odozgo, 16 kom pl 6, Plate 6x200
M 1:10

Pogled sprijeda, 8 kom, 1
M 1:20

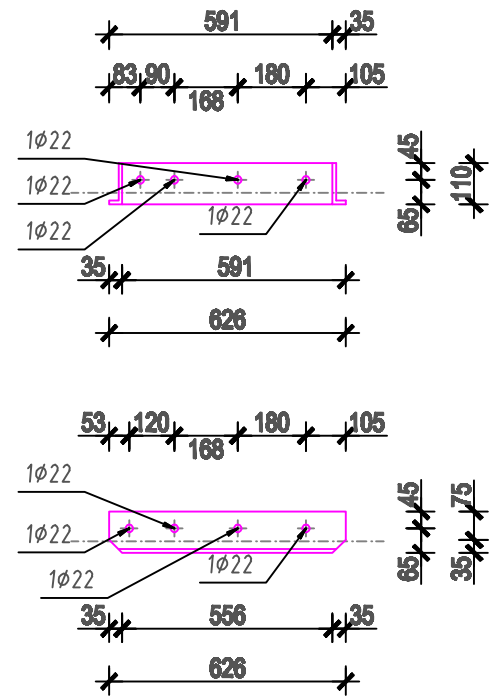


Pogled odozgo, 8 kom, 1
M 1:20



Pogled sa strane, 8 kom, 1
M 1:20

Pogled sprijeda, 8 kom, pr 1
M 1:20

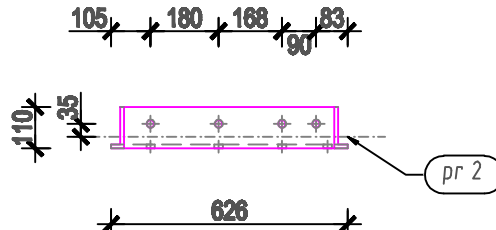


Pogled sa strane, 8 kom, pr 1
M 1:20

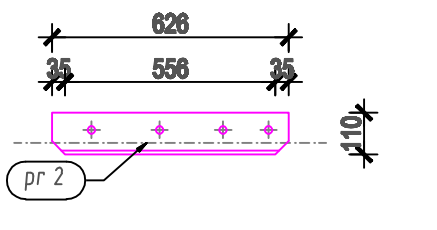
Pogled odozgo, 8 kom, pr 1
M 1:20



Pogled sprijeda, 8 kom, 2
M 1:20

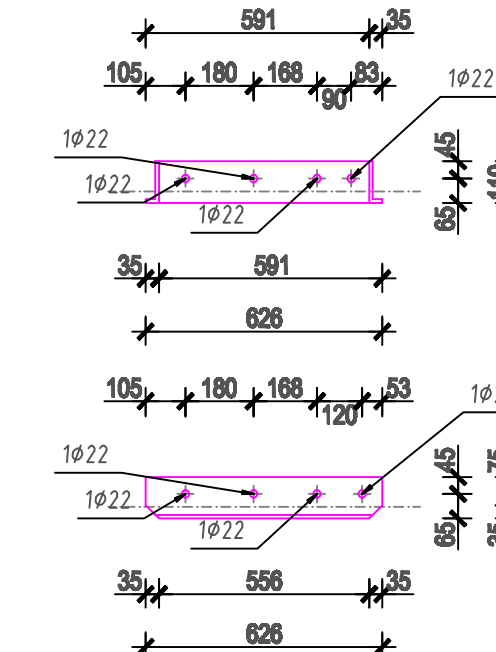


Pogled odozgo, 8 kom, 2
M 1:20



Pogled sa strane, 8 kom, 2
M 1:20

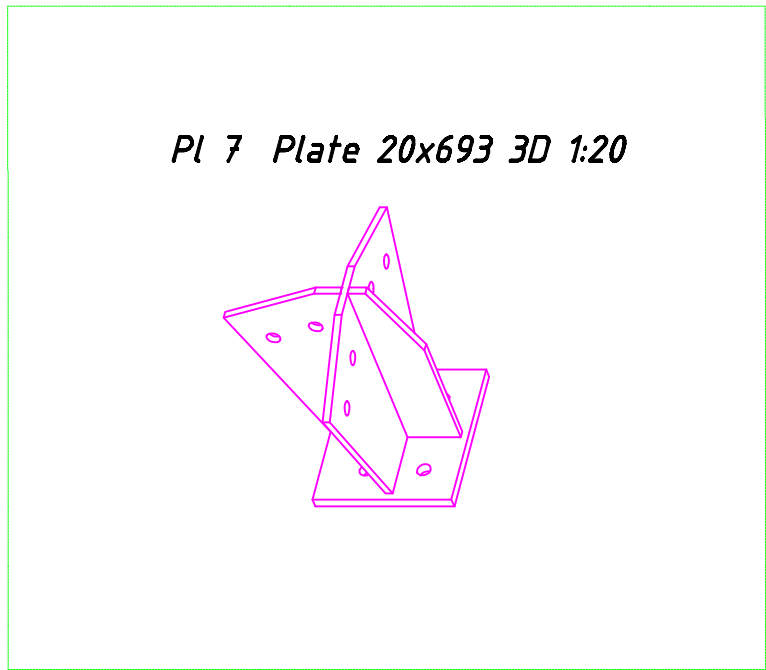
Pogled sprijeda, 8 kom, pr 2
M 1:20



Pogled sa strane, 8 kom, pr 2
M 1:20

Pogled odozgo, 8 kom, pr 2
M 1:20

Position=Pl 1					Number=16	Mass-Total=29,530kg		Unit (kg/m)	Total (kg)
pl 6		Plate 6x200		1	S 235	200,00		1,81	
								1,81	
Position	Section		Number	Grade	Length (mm)	Mass			
						Unit (kg/m)	Total (kg)		
Position=Pl 2	Number=16	Mass-Total=99,550kg							
pl 14		Plate 6x300		1	S 235	340,00		6,22	
								6,22	
Position	Section		Number	Grade	Length (mm)	Mass			
						Unit (kg/m)	Total (kg)		
Position=Pl 3	Number=32	Mass-Total=75,620kg							
pl 15		Plate 6x115		1	S 235	340,00		2,36	
								2,36	
Position	Section		Number	Grade	Length (mm)	Mass			
						Unit (kg/m)	Total (kg)		
Position=Pl 4	Number=24	Mass-Total=487,880kg							
pl 19		Plate 16x300		1	S 235	560,00		20,33	
								20,33	
Position	Section		Number	Grade	Length (mm)	Mass			
						Unit (kg/m)	Total (kg)		
Position=Pl 5	Number=48	Mass-Total=369,670kg							
pl 20		Plate 16x115		1	S 235	560,00		7,70	
								7,70	
Position	Section		Number	Grade	Length (mm)	Mass			
						Unit (kg/m)	Total (kg)		
Position=Pl 6	Number=24	Mass-Total=247,720kg							
pl 21		Plate 10x240		1	S 235	560,00		10,32	
								10,32	
Position	Section		Number	Grade	Length (mm)	Mass			
						Unit (kg/m)	Total (kg)		
Position=Pl 7	Number=8	Mass-Total=1021,090kg							
pl 17		Plate 30x390		1	S 235	440,00		39,33	
pl 22		Plate 20x256		1	S 235	609,47		24,41	
pl 23		Plate 20x150		1	S 235	609,47		12,47	
pl 27		Plate 20x693		1	S 235	666,84		51,42	
								127,64	
Position	Section		Number	Grade	Length (mm)	Mass			
						Unit (kg/m)	Total (kg)		
Position=1	Number=8	Mass-Total=43,130kg							
pr 1		L 110x16x10		1	S 235	626,00	16,600	10,39	
								10,39	
Position	Section		Number	Grade	Length (mm)	Mass			
						Unit (kg/m)	Total (kg)		
Position=2	Number=8	Mass-Total=43,130kg							
pr 2		L 110x16x10		1	S 235	626,00	16,600	10,39	
								10,39	



PROTUPUŽARNA I ANTIKOROZIVNA ZAŠTITA: PREMAZIVANJE
ZAHTEVJ TRAJNOSTI ANTIKOROZIJNE ZAŠTITE: HIGH DURABILITY (prema HRN EN ISO 12944-2:2000)
AGRESIVNOST SREDINE: C1 - LOW (prema medic 1 iz HRN EN ISO 12944-2:2000)
ZAHTEVJ PROTUPUŽARNE OTPORNOSTI:

	SADRŽAJ LISTA:
GRAĐEVNA: Pristanišna zgrada zračne luke Dubrovnik Zgrada "ABC" - Sortirnica / Putnički terminal	STUDENT: Mario Šurčić MENTOR: Prof.dr.sc. Bernardin Perić
PROJEKT: Građenje južne nadstrešnice ispred zgrade "B" i zgrade "C"	FAZA PROJEKTA: IZVEDBENI PROJEKT
	SADRŽAJ: 7.2. GRAĐEVINSKI NACRTI: KONSTRUKCIJA JUŽNE NADSTREŠNICE
	DATUM: lipnja, 2015. god.
	list 7.2.18.