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PROSTOR ZA OVJERU TIJELA NADLEŽNOG ZA IZDAVANJE DOZVOLE

Investitor: **HRVATSKE VODE**,
10 000 Zagreb**,** Ulica grada Vukovara 220,
OIB: 28921383001

Naziv zahvata: **IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA:**

4. faza izgradnje – nastavak iskopa glinenog materijala u cijelom gabaritu prokopa za izgradnju nasipa sustava obrane od poplava karlovačkog područja, prokop Korana – Kupa, nasipi uz lijevu i desnu obalu prokopa, desnu obalu Kupe, lijevu obalu Korane i uz ispusnu ustavu (N1 – N5), upusna i ispusna ustava, građevine za odvodnju zaobalnih voda, uklanjanje dijela nasipa u sklopu zahvata dionice državne ceste D1 (splitski pravac, brza cesta kroz Karlovac, II. etapa I. faze) i 5. faza izgradnje - most preko prokopa na nerazvrstanoj cesti NC 340720 Gornje Mekušje – Kamensko)

Naziv projektiranog dijela građevine: **CESTOVNI MOST PREKO PROKOPA - KONSTRUKCIJA**

Lokacija: Grad Karlovac, K.O. Gornje Mekušje, K.O. Kamensko i K.O. Karlovac II

Razina razrade **Glavni projekt**

Strukovna odrednica **Građevinski projekt**

Zajednička oznaka projekta: **GP-5986/23**

Oznaka mape: **72120 – GP – 285 – 2020**

Mapa br: **24**

Glavni projektant: **Darko Jelašić, mag.ing.aedif. (VPB d.d.)**

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Projektant: **Mate Pezer dipl. ing. grad. (Institut IGH d.d.)**

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dipl. ing. grad.
Ovlašteni inženjer građevinarstva
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Mate Pezer
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Direktor zavoda za projektiranje: **Igor Grginić, Mag.ing.aedif. (Institut IGH d.d.)**

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Mjesto i datum: **Zagreb, rujan 2024. – ispravak 1**

Revident za mehaničku otpornost i stabilnost betonskih i zidanih konstrukcija:

Pregledao ovlašteni revident za:
MEHANIČKU OTPORNOST I STABILNOST BETONSKIH I ZIDANIH KONSTRUKCIJA (BK)
ovlaštenje broj: 108
mr. sc. Damir Matokić, mag.ing.aedif.

broj izvješća: R-108-10/2024
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Popis projektanata i suradnika koji su sudjelovali u izradi projekta

Projektant: Mate Pezer, dipl. ing. građ.
Broj ovlaštenja 3079

Suradnici: Marina Markotić, mag.ing.aedif.
Jasna Matejaš, mag.ing.aedif.

Izradio: **INSTITUT IGH d.d.**

Zavod za projektiranje

10 000 Zagreb, J. Rakuše 1

Građevina: **IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA:**

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Knjiga: **CESTOVNI MOST PREKO PROKOPA – konstrukcija**

Vrsta projekta (razina i struka): GLAVNI GRAĐEVINSKI PROJEKT

Zajednička oznaka projekta: GP-5986/23

Oznaka projekta: 72120-GP-285-2020

I OPĆI DIO

Mjesto i datum: Zagreb, travanj 2023.

Izradio: **INSTITUT IGH d.d.**

Zavod za projektiranje

10 000 Zagreb, J. Rakuše 1

Građevina: **IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA:**

4. faza izgradnje – nastavak iskopa glinenog materijala u cijelom gabaritu prokopa za izgradnju nasipa sustava obrane od poplava karlovačkog područja, prokop Korana – Kupa, nasipi uz lijevu i desnu obalu prokopa, desnu obalu Kupe, lijevu obalu Korane i uz ispusnu ustavu (N1 – N5), upusna i ispusna ustava, građevine za odvodnju zaobalnih voda, uklanjanje dijela nasipa u sklopu zahvata dionice državne ceste D1 (splitski pravac, brza cesta kroz Karlovac, II. etapa I. faze) i 5. faza izgradnje - most preko prokopa na nerazvrstanoj cesti NC 340720 Gornje Mekušje – Kamensko)

Knjiga: **CESTOVNI MOST PREKO PROKOPA – konstrukcija**

Vrsta projekta (razina i struka): GLAVNI GRAĐEVINSKI PROJEKT

Zajednička oznaka projekta: GP-5986/23

Oznaka projekta: 72120-GP-285-2020

0101 POPIS SVIH MAPA GLAVNOG PROJEKTA

Mjesto i datum: Zagreb, travanj 2023.

POPIS MAPA GLAVNOG PROJEKTA

Mapa	Naziv mape	Strukovna odrednica	Oznaka mape	Projektant	Tvrtka
1	Opća mapa	Građevinski projekt	VPB-TGP-20-0003	Darko Jelašić, dipl.ing.građ.	Vodoprivredno-projektni biro d.d. Zagreb
2	Prokop s pratećim objektima: preljevnim pragom - stepenicom i uljevnim objektom u Kupu	Građevinski projekt	72160-GP-022-2023	Ante Ljubičić, dipl. ing. građ.	Institut IGH d.d. Zagreb
3	Nasip N1 - nasip uz desnu obalu prokopa i nasip N2 - nasip uz lijevu obalu prokopa	Građevinski projekt	I - 2165/22	Hrvoje Kero, dipl. ing. građ.	Hidroing d.o.o. Osijek
4	Nasip N1 - nasip uz desnu obalu prokopa i nasip N2 - nasip uz lijevu obalu prokopa, geotehnički projekt	Građevinski projekt	72150-GP-034-2023	Zoran Županić, dipl. ing. građ.	Institut IGH d.d. Zagreb
5	Nasip uz desnu obalu Kupe (Nasip N3) - građevinski dio	Građevinski projekt	G3-O91.01.01-G01.0	Janja Kelić, mag.ing.aedif.	Elektroprojekt d.d. Zagreb
6	Nasip uz desnu obalu Kupe (Nasip N3) - geotehnički dio	Građevinski projekt	G3-O91.01.01-G02.0	dr.sc. Krešo Ivandić, dipl. ing. građ.	Elektroprojekt d.d. Zagreb
7	Nasip 4 - nasip uz lijevu obalu Korane s nasutom pregradom korita rijeke	Građevinski projekt	VPB-TGP-20-0003	Ante Jerković, mag.ing.aedif.	Vodoprivredno-projektni biro d.d. Zagreb
8	Nasip 4 - nasip uz lijevu obalu Korane s nasutom pregradom korita rijeke - geotehnički projekt nasipa i nasute pregrade	Građevinski projekt	E-155-18-08	Bojan Ninčević, mag.ing.aedif.	Geokon-Zagreb d.d.
9	Nasip 5 - nasip uz desnu obalu Korane	Građevinski projekt	E-155-18-02	Marko Kaić, dipl.ing.građ.	Geokon-Zagreb d.d.
10	Upusna ustava	Građevinski projekt	VPB-TGP-20-0003	Robert Alar mag.ing.aedif.	Vodoprivredno-projektni biro d.d. Zagreb
11	Upusna ustava – geotehnički projekt zaštite građevinske jame, temeljenja i potpornih zidova	Građevinski projekt	E-155-18-04	Ivan Mihaljević, dipl.ing.građ.	Geokon-Zagreb d.d.
12	Upusna ustava	Strojarski projekt	E-155-18-05	Davorin Gržan, dipl. ing str.	Geokon-Zagreb d.d.
13	Upusna ustava - elektrotehnički dio	Elektrotehnički projekt	E3-O91.00.01-E02.0	Marko Grčić, struč.spec.ing.el.	Elektroprojekt d.d. Zagreb
14	Ispusna ustava	Građevinski projekt	E-155-18-06	Robert Alar mag.ing.aedif.	Geokon-Zagreb d.d.
15	Ispusna ustava – geotehnički projekt zaštite građevinske jame, temeljenja i potpornih zidova	Građevinski projekt	E-155-18-03	Ivan Mihaljević, dipl.ing.građ.	Geokon-Zagreb d.d.
16	Ispusna ustava	Strojarski projekt	E-155-18-07	Davorin Gržan, dipl. ing str.	Geokon-Zagreb d.d.

17	Ispusna ustava - elektrotehnički dio	Elektrotehnički projekt	E3-O91.00.01-E01.0	Marko Grčić, struč.spec.ing.el.	Elektroprojekt d.d. Zagreb
18	Crpna stanica Sajevac - konstrukcija	Građevinski projekt	G3-O91.02.01-G01.0	Ivor Joksović, mag.ing.aedif.	Elektroprojekt d.d. Zagreb
19	Crpna stanica Sajevac - geotehnički dio	Građevinski projekt	G3-O91.02.01-G02.0	Ivan Mališa, mag.ing.aedif.	Elektroprojekt d.d. Zagreb
20	Crpna stanica Sajevac - strojarski dio	Strojarski projekt	S3-O91.02.01-S01.0	Marko Išek, mag.ing.mech.	Elektroprojekt d.d. Zagreb
21	Crpna stanica Sajevac - elektrotehnički dio	Elektrotehnički projekt	E3-O91.02.01-E01.0	Marko Grčić, struč.spec.ing.el.	Elektroprojekt d.d. Zagreb
22	Trafostanica – građevinski dio	Građevinski projekt	G3-O91.02.01-G03.0	Darko Šilec, Dipl.ing.građ.	Proing d.o.o. Varaždin
23	Trafostanica - elektrotehnički dio	Elektrotehnički projekt	E3-O91.02.01-E02.0	Damir Hodak, struč.spec.ing.el.	Elektroprojekt d.d. Zagreb
24	Cestovni most preko prokopa - konstrukcija	Građevinski projekt	72120 – GP – 285 – 2020	Mate Pezer, dipl. ing. građ.	Institut IGH d.d. Zagreb
25	Cestovni most preko prokopa - geotehnički dio	Građevinski projekt	72150 – GP – 035 – 2023	Zoran Županić, dipl. ing. građ.	Institut IGH d.d. Zagreb
26	Cestovni most preko prokopa - odvodnja mosta	Građevinski projekt	72150 – GP – 032 – 2023	Ante Ljubičić, dipl.ing.građ.	Institut IGH d.d. Zagreb
27	Cestovni most preko prokopa - javna rasvjeta	Građevinski projekt	RP2862G1	Dražen Raspudić, mag.ing.aedif.	Dalekovod-projekt d.o.o. Zagreb
28	Cestovni most preko prokopa - javna rasvjeta	Elektrotehnički projekt	RP2862E1	Deana Brujić Ilijašević, dipl. ing. el.	Dalekovod-projekt d.o.o. Zagreb
29	Cestovni most preko prokopa - uzemljenje	Elektrotehnički projekt	RP2863	Kristijan Stublić, dipl. ing. el.	Dalekovod-projekt d.o.o. Zagreb
30	Cestovni most preko prokopa – prometnica s pristupnim cestama	Građevinski projekt	GP2274-22	Antun Štefanić, dipl. ing. građ.	Projektni biro P45 d.o.o. Zagreb
31	Izmještanje SN i NN mreže	Elektrotehnički projekt	E3-O91.00.01-E03.0	Damir Hodak, struč.spec.ing.el.	Elektroprojekt d.d. Zagreb
32	Rekonstrukcija postojećeg kolektora φ1100 Duga Resa - Karlovac	Građevinski projekt	72160-GP-023-2023	Ante Ljubičić, dipl.ing.građ.	Institut IGH d.d. Zagreb
33	Rekonstrukcija postojećeg vodoopskrbnog cjevovoda φ150	Građevinski projekt	72160-GP-024-2023	Ante Ljubičić, dipl.ing.građ.	Institut IGH d.d. Zagreb
34	Rekonstrukcija postojećeg plinovoda φ110	Strojarski projekt	S3-O91.00.01-S01.0	Mislav Crnković dipl.ing.stroj.	Elektroprojekt d.d. Zagreb
35	Rekonstrukcija postojećeg plinovoda φ110	Građevinski projekt	72160-GP-120-2023	Ante Ljubičić, dipl.ing.građ.	Institut IGH d.d. Zagreb
36	Izmještanje SN i NN mreže	Građevinski projekt	72160-GP-121-2023	Ante Ljubičić, dipl.ing.građ.	Institut IGH d.d. Zagreb

Izradio:

INSTITUT IGH d.d.

Zavod za projektiranje

10 000 Zagreb, J. Rakuše 1

Građevina:

IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA:

4. faza izgradnje – nastavak iskopa glinenog materijala u cijelom gabaritu prokopa za izgradnju nasipa sustava obrane od poplava karlovačkog područja, prokop Korana – Kupa, nasipi uz lijevu i desnu obalu prokopa, desnu obalu Kupe, lijevu obalu Korane i uz ispusnu ustavu (N1 – N5), upusna i ispusna ustava, građevine za odvodnju zaobalnih voda, uklanjanje dijela nasipa u sklopu zahvata dionice državne ceste D1 (splitski pravac, brza cesta kroz Karlovac, II. etapa I. faze) i 5. faza izgradnje - most preko prokopa na nerazvrstanoj cesti NC 340720 Gornje Mekušje – Kamensko)

Građevina:

IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA – 4. i 5. faza izgradnje: PROKOP KORANA-KUPA S PRATEĆIM OBJEKTIMA

Knjiga:

CESTOVNI MOST PREKO PROKOPA – konstrukcija

Vrsta projekta (razina i struka):

GLAVNI GRAĐEVINSKI PROJEKT

Zajednička oznaka projekta:

GP-5986/23

Oznaka projekta:

72120-GP-285-2020

0102 SADRŽAJ KNJIGE

Mjesto i datum:

Zagreb, travanj 2023.

SADRŽAJ KNJIGE

I OPĆI DIO 3

0101 POPIS SVIH MAPA GLAVNOG PROJEKTA 4
0102 SADRŽAJ KNJIGE 7
0103 IZJAVA PROJEKTANTA I POPIS PRIMIJENJENIH PROPISA 9

II TEHNIČKI DIO 13

0201 TEHNIČKI OPIS 14
0. UVOD 16
1. OPĆENITO 18
2. PODACI ZA IZRAČUN VODNOG I KOMUNALNOG DOPRIONOSA 18
3. OSNOVNI PODACI O TLU I TEMELJENJU 18
4. OPIS NOSIVOG SKLOPA 18
5. OPREMA, POMOST 19
6. STATIČKI PRORAČUN 21
7. GRAĐENJE 21
8. UREĐENJE OKOLIŠA 21
9. NAMJENA, NAČIN UPORABE OBJEKTA I UTJECAJ OKOLIŠA – 22
10. PROVEDBA POKUSNOG RADA - PROBNO OPTEREĆENJE 23
11. PROJEKTIRANI VIJEK GRAĐEVINE I UVJETI ZA NJENO ODRŽAVANJE 23
0301 PROGRAM KONTROLA I OSIGURANJA KVALITETE 25
0401 PRORAČUN KONSTRUKCIJE 35
1. OPĆENITO 37
2. ANALIZA OPTEREĆENJA 62
3. RASPONSKI SKLOP 105
4 LEŽAJEVI I PRIJELAZNE NAPRAVE 185
5. STUPOVI 209
6 NAGLAVNICA STUPOVA 220
7 NAGLAVNICE PILOTA STUPOVA 228
8 PILOTI 239
9. UPORNJAK 255
10 PRIJELAZNA PLOČA 288
0501 ISKAZ PROCJENJENIH TROŠKOVA GRAĐENJA 290

III GRAFIČKI DIO 292

1. PREGLEDNA SITUACIJA	1:25000	0901
2. SITUACIJA NA HOK-U	1:5000	0902
3. SITUACIJA NA GEOD PODLOZI	1:1000	0903
4. UZDUŽNI PROFIL	1:1000/100	1001
5. POGLEDI SA STRANE I ODOZGO	1:200	1301
6. TLOCRTI	1:200	1201
7. UZDUŽNI PRESJEK	1:200	1401
8. KARAKTERISTIČNI POPREČNI PRESJEK	1:50	1501
9. NOSAČI	1:50,1:25	2301
10. UPORNJAK U0	1:100	2401
11. UPORNJAK U14	1:100	2402
12. STUPIŠTA	1:100	2501
13. HODNIK I VIJENAC	1:20	2701

Izradio: **INSTITUT IGH d.d.**

Zavod za projektiranje

10 000 Zagreb, J. Rakuše 1

Građevina: **IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA:**

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Knjiga: **CESTOVNI MOST PREKO PROKOPA – konstrukcija**

Vrsta projekta (razina i struka): GLAVNI GRAĐEVINSKI PROJEKT

Zajednička oznaka projekta: GP-5986/23

Oznaka projekta: 72120-GP-285-2020

0103 IZJAVA PROJEKTANTA I POPIS PRIMIJENJENIH PROPISA

Mjesto i datum: Zagreb, travanj 2023.

Temeljem članka 70. stavka 1., točke 1 Zakona o gradnji (NN 153/13, 20/17, 39/19, 125/19) daje se

IZJAVA PROJEKTANTA

da je glavni projekt u skladu s propisanim uvjetima, da je građevina projektirana u skladu s dobivenim posebnim uvjetima i uvjetima priključenja te da ispunjava temeljne zahtjeve za građevinu i druge propisane zahtjeve i uvjete.

Investitor:	HRVATSKE VODE Ulica grada Vukovara 220, 10 000 Zagreb OIB: 28921383001
Građevina:	IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA: 4. faza izgradnje – nastavak iskopa glinenog materijala u cijelom gabaritu prokopa za izgradnju nasipa sustava obrane od poplava karlovačkog područja, prokop Korana – Kupa, nasipi uz lijevu i desnu obalu prokopa, desnu obalu Kupe, lijevu obalu Korane i uz ispusnu ustavu (N1 – N5), upusna i ispusna ustava, građevine za odvodnju zaobalnih voda, uklanjanje dijela nasipa u sklopu zahvata dionice državne ceste D1 (splitski pravac, brza cesta kroz Karlovac, II. etapa I. faze) i 5. faza izgradnje - most preko prokopa na nerazvrstanoj cesti NC 340720 Gornje Mekušje – Kamensko)
Projektirani dio građevine:	CESTOVNI MOST PREKO PROKOPA – konstrukcija
Razina i struka :	Glavni građevinski projekt
Zajednička oznaka projekta:	**GP-5986/23**
Red.br. mape:	24
Oznaka mape:	72120 – GP – 285 – 2020.

Izjavljujem da je ovaj glavni projekt izrađen u skladu s:

- Lokacijskom dozvolom Ministarstva zaštite okoliša, prostornog uređenja i graditeljstva (Klasa: UP/I-350-05/09-01/59, ur.br.: 531-06-10-13 od 29. srpnja 2010.),
- Izmjenom i dopunom lokacijske dozvole Ministarstva zaštite okoliša, prostornog uređenja i graditeljstva (Klasa UP/I-350-05/10-01/138, Ur. broj: 531-06-10-2 od 21. listopada 2010.),
- II. Izmjenom i dopunom lokacijske dozvole Ministarstva graditeljstva i prostornog uređenja (Klasa: UP/I-350-05/14-01/10, Ur. broj: 531-05-14-2 od 24. ožujka 2014.),
- III. Izmjenom i dopunom lokacijske dozvole Ministarstva prostornog uređenja, graditeljstva i državne imovine(Klasa: UP/1-350-05/20-01/000035, Ur. broj: 531-06—02-02/02-22-0018 od 23.02.2022), i lokacijskim uvjetima određenima tom dozvolom.
- Rješenjem o prihvatljivosti izgradnje sustava obrane od poplava Srednjeg posavlja za okoliš, Ministarstvo zaštite okoliša, prostornog uređenja i graditeljstva, klasa: UP/I-351-03/07-02/54, urbroj: 531-08-1-1-2-6-08-11 od 20. svibnja 2008.
- Rješenjem o prihvatljivosti sustava zaštite od poplava karlovačko-sisačkog područja, I. faza – karlovačko područje za okoliš i ekološku mrežu (Ministarstvo zaštite okoliša i energetike, klasa: UP/I-351-03/18-02/49, urbroj: 517-03-1-2-19-35 od 06.08.2019.

- Rješenjem o prihvatljivosti sustava zaštite od poplava karlovačko-sisačkog područja, II. faza – sisačko područje za okoliš i ekološku mrežu (Ministarstvo gospodarstva i održivog razvoja, klasa: UP/I-351-03/19-08/18, urbroj: 517-03-1-2-20-43 od 05.10.2020.
- Zakonima i propisima navedenim u popisu ove izjave i drugim propisima, uvjetima i pravilima iz članka 68. stavka 2. Zakona o gradnji (NN 153/13, 20/17, 39/19, 125/19).

  - Zakon o gradnji (NN 153/13 i 20/17, 39/19, 125/19)
  - Zakon o komori arhitekata i komorama inženjera u graditeljstvu i prostornom uređenju (NN 78/15, 114/18, 110/19)
  - Zakon o poslovima i djelatnostima prostornog uređenja i gradnje (NN 78/15, 118/18, 110/19),
  - Zakon o građevnim proizvodima (NN 76/13, 30/14, 130/17, 39/19, 118/20)
  - Zakon o cestama (NN 84/11, 22/13 i 54/13, 148/13, 92/14, 110/19, 144/21)
  - Zakon o sigurnosti prometa na cestama (NN 67/08, 48/10, 74/11, 80/13, 158/13, 92/14, 64/15, 89/15, 108/17, 70/19, 42/20)
  - Zakon o vodama (NN 66/19, 16/20, 84/21)
  - Zakon o gospodarenju otpadom (NN 84/21)
  - Zakon o zaštiti od požara (NN 92/10, 114/2022)
  - Zakon o zaštiti na radu (NN 71/14, 118/14, 154/14, 94/18, 96/18)
  - Zakon o zaštiti od buke (NN 30/09, 55/13, 153/13, 41/16, 114/18, 14/21)
  - Zakon o zaštiti okoliša (NN 80/13, 153/13, 12/18, 118/18)
  - Zakon o tehničkim zahtjevima za proizvode i ocjenjivanju sukladnosti (NN 126/21)
  - Zakon o zemljišnim knjigama (NN 63/19)
  - Pravilnik o obveznom sadržaju i opremanju projekata građevina (NN 118/19, 65/20)
  - Pravilnik o osnovnim uvjetima kojima javne ceste izvan naselja i njihovi elementi moraju udovoljavati sa stajališta sigurnosti prometa (NN 110/01, 105/04, 84/11)
  - Pravilnik o razvrstavanju građevina u skupine po zahtjevnosti mjera zaštite od požara (NN 56/12)
  - Pravilnik o vrsti i sadržaju projekata za javne ceste (NN 53/02, 20/17)
  - Pravilnik o tehničkom pregledu građevine (NN 46/18, 98/19)
  - Pravilnik o postupanju s viškom iskopa koji predstavlja mineralnu sirovinu kod izvođenja građevinskih radova (NN 79/14)
  - Pravilnik o kontroli projekata (NN 32/14, 72/20)
  - Pravilnik o mjernim jedinicama (NN 88/15, 16/20)
  - Pravilnik o nadzoru građevnih proizvoda (NN 113/08)
  - Pravilnik o ocjenjivanju sukladnosti, ispravama o sukladnosti i označavanju građevnih proizvoda (NN 103/08, 147/09, 87/10, 129/11, 118/19)
  - Pravilnik o zaštiti na radu za mjesta rada (NN 105/20)
  - Pravilnik o zaštiti na radu na privremenim gradilištima (NN 48/18)
  - Pravilnik o odlagalištima otpada (NN 04/23)
  - Pravilnik o građevnom otpadu i otpadu koji sadrži azbest (NN 69/2016)
  - Pravilnik o tijelima, dokumentaciji i postupcima tržišta građevnih proizvoda (NN 118/19)
  - Pravilnik o hrvatskim normama (NN 22/96)
  - Pravilnik o održavanju cesta (NN 90/14, 03/21)
  - Pravilnik o uvjetima za vatrogasne pristupe (NN 55/94, 142/03)
  - Pravilnik o prometnim znakovima, opremi i signalizaciji na cestama (NN 92/19)
  - Pravilnik o katastru zemljišta (NN 84/07, 148/09, 112/18)
  - Pravilnik o obračunu i naplati vodnog doprinosa (NN 107/14)
  - Pravilnik o način utvrđivanja obujma građevine za obračun komunalnog doprinosa (NN 15/19)
  - Tehnički propis za građevinske konstrukcije (NN 17/17, 75/20, 07/22)
  - Tehnički propis o građevnim proizvodima (NN 35/18, 104/19)

- Tehnički propis kojim se utvrđuju tehničke specifikacije za građevne proizvode u usklađenom području (NN 4/15, 24/15, 93/15, 133/15, 36/16, 58/16, 104/16, 28/17, 88/17, 29/18, 43/19)
- Opći tehnički uvjeti za radove na cestama, Hrvatske ceste, 2001. primjenjuju se u dijelu koji nije u suprotnosti s tehničkim propisom za građevinske konstrukcije, tehničkim propisom za građevne proizvode, i drugim važećim propisima i normama za to područje. Izjava se odnosi na cijelu mapu

te ostali važeći zakonski i podzakonski propisi i dokumenti na koje upućuju navedeni propisi ili su na temelju njih doneseni.

Zagreb, rujan 2024. – ispravak 1

Projektant:
Mate Pezer, dipl.ing.građ.

Izradio: **INSTITUT IGH d.d.**

Zavod za projektiranje

10 000 Zagreb, J. Rakuše 1

Građevina: **IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA:**

4. faza izgradnje – nastavak iskopa glinenog materijala u cijelom gabaritu prokopa za izgradnju nasipa sustava obrane od poplava karlovačkog područja, prokop Korana – Kupa, nasipi uz lijevu i desnu obalu prokopa, desnu obalu Kupe, lijevu obalu Korane i uz ispusnu ustavu (N1 – N5), upusna i ispusna ustava, građevine za odvodnju zaobalnih voda, uklanjanje dijela nasipa u sklopu zahvata dionice državne ceste D1 (splitski pravac, brza cesta kroz Karlovac, II. etapa I. faze) i 5. faza izgradnje - most preko prokopa na nerazvrstanoj cesti NC 340720 Gornje Mekušje – Kamensko)

Knjiga: **CESTOVNI MOST PREKO PROKOPA – konstrukcija**

Vrsta projekta (razina i struka): GLAVNI GRAĐEVINSKI PROJEKT

Zajednička oznaka projekta: GP-5986/23

Oznaka projekta: 72120-GP-285-2020

II TEHNIČKI DIO

Mjesto i datum: Zagreb, travanj 2023.

Izradio: **INSTITUT IGH d.d.**

Zavod za projektiranje

10 000 Zagreb, J. Rakuše 1

Građevina: **IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA:**

4. faza izgradnje – nastavak iskopa glinenog materijala u cijelom gabaritu prokopa za izgradnju nasipa sustava obrane od poplava karlovačkog područja, prokop Korana – Kupa, nasipi uz lijevu i desnu obalu prokopa, desnu obalu Kupe, lijevu obalu Korane i uz ispusnu ustavu (N1 – N5), upusna i ispusna ustava, građevine za odvodnju zaobalnih voda, uklanjanje dijela nasipa u sklopu zahvata dionice državne ceste D1 (splitski pravac, brza cesta kroz Karlovac, II. etapa I. faze) i 5. faza izgradnje - most preko prokopa na nerazvrstanoj cesti NC 340720 Gornje Mekušje – Kamensko)

Knjiga: **CESTOVNI MOST PREKO PROKOPA – konstrukcija**

Vrsta projekta (razina i struka): GLAVNI GRAĐEVINSKI PROJEKT

Zajednička oznaka projekta: GP-5986/23

Oznaka projekta: 72120-GP-285-2020

0201 TEHNIČKI OPIS

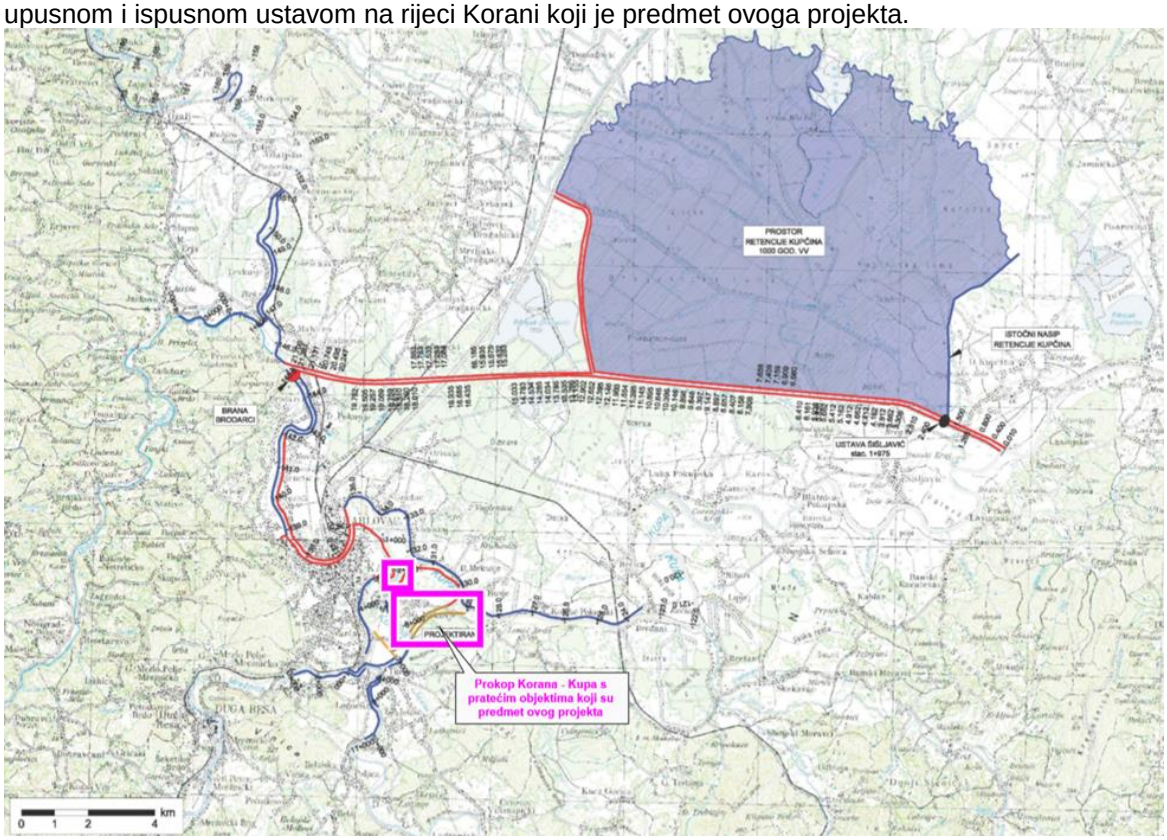
Mjesto i datum: Zagreb, travanj 2023

TEHNIČKI OPIS

0201 TEHNIČKI OPIS 14
0. UVOD 16
1. OPĆENITO 18
2. PODACI ZA IZRAČUN VODNOG I KOMUNALNOG DOPRIONOSA 18
3. OSNOVNI PODACI O TLU I TEMELJENJU 18
4. OPIS NOSIVOG SKLOPA 18
5. OPREMA, POMOST 19
6. STATIČKI PRORAČUN 21
7. GRAĐENJE 21
8. UREĐENJE OKOLIŠA 21
9. NAMJENA, NAČIN UPORABE OBJEKTA I UTJECAJ OKOLIŠA – 22
10. PROVEDBA PROBNOG OPTEREĆENJE 23
11. PROJEKTIRANI VIJEK GRAĐEVINE I UVJETI ZA NJENO ODRŽAVANJE 23

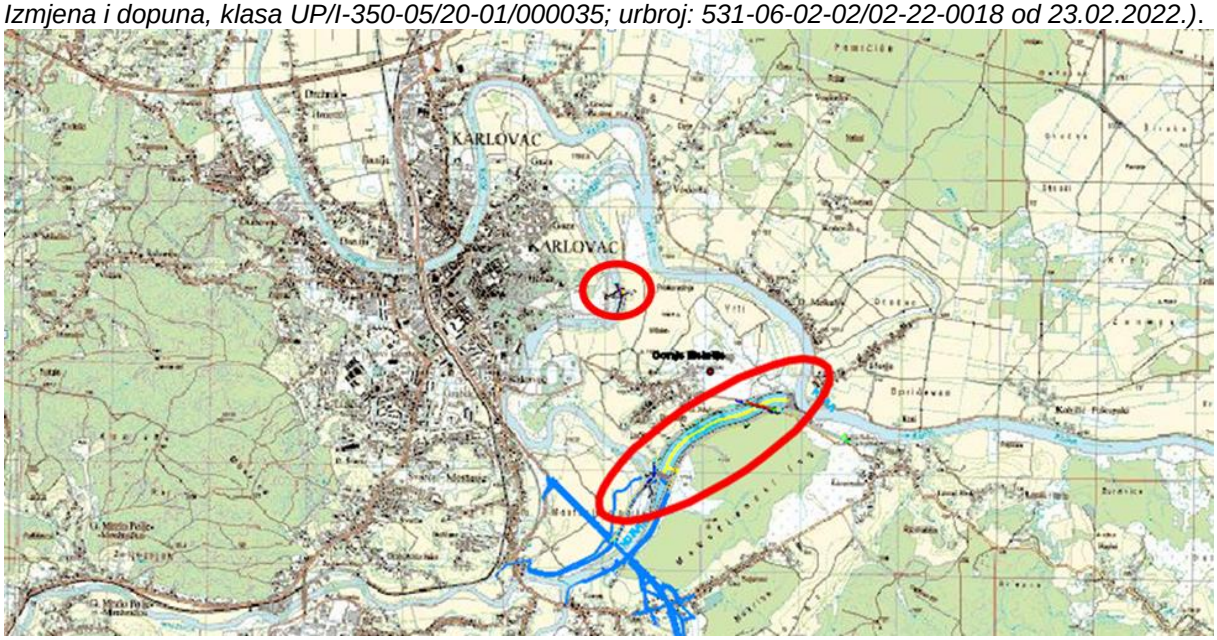
0. UVOD

Izgradnja i dovršetak cjelovitog sustava zaštite Grada Karlovca od poplava kao stalna i dugogodišnja potreba osobito se našla u središtu pozornosti nakon velikovodnih događaja u 2013. i 2014. godini. Ključne građevine ovoga sustava čine pregrada Brodarci na Kupi, oteretni kanal Kupa-Kupa s retencijom Kupčinom i ustavom Šišljavić, zaštitni nasipi i zidovi na rijekama Kupi, Dobri i Korani te prokop kanala Korana-Kupa s upusnom i ispusnom ustavom na rijeci Korani koji je predmet ovoga projekta.



Sustav obrane od poplava Grada Karlovca.

Planirani zahvat prokopa s pratećim građevinama je smješten na području Karlovačke županije odnosno Grada Karlovca, na zemljištu k.o. Gornje Mekušje, k.o. Kamensko i k.o. Karlovac II. te čini četvrtu i petu fazu izgradnje zahvata u prostoru *Desnog nasipa Korane, desnog nasipa Kupe i prokopa Korana-Kupa s nasipima i rješenjem odvodnje na području Gornjeg Mekušja te izgradnje cestovnog mosta preko prokopa (Lokacijska dozvola – III. Izmjena i dopuna, klasa UP/I-350-05/20-01/000035; urbroj: 531-06-02-02/02-22-0018 od 23.02.2022.)*.



Lokacija zahvata prokopa s pratećim objektima

Namjena zahvata je preusmjeravanje velikih voda rijeke Korane prokopom u rijeku Kupu čime bi se izbjegli prolasci visokih vodnih valova kroz gradsko središte i postigla zaštita istočnog dijela Karlovca površine od oko 190 ha. Regulacijom protoka Korane planiranim ustavama, gradskim središtem bi se propuštali mali i srednji protoci vode do 112 m^3/s što je unutar kapaciteta korita na tom dijelu.
Zahvat se sastoji od sljedećih građevina:

Prokop korita Korana-Kupa,
prateći nasipi: nasip N1 uz desnu obalu prokopa, nasip N2 uz lijevu obalu prokopa, nasip N3 uz desnu obalu Kupe, nasip N4 uz lijevu obalu Korane i nasip N5 uz ispusnu ustavu,
2 ustave: upusna i ispusna ustava Korane,
građevine za odvodnju zaobalnih voda: crpna stanica "Sajevac" s trafostanicom uz nasip N1 i propust Ø 100 kroz nasip N3 s automatskim zatvaračem i
cestovni most preko prokopa na nerazvrstanoj cesti NC 340720 Gornje Mekušje – Kamensko

Ovim projektom obrađene su i rekonstrukcije postojeće infrastrukturne građevine u obuhvatu zahvata:

- izmještanje SN i NN elektroenergetske mreže
- rekonstrukcija postojećeg kolektora odvodnje otpadnih voda Ø1100 Duga Resa – Karlovac
- rekonstrukcija postojećeg vodoopskrbnog cjevovoda Ø150
- rekonstrukcija postojećeg plinovoda Ø 110



Građevine zahvata

1. OPĆENITO

OSNOVNE IZMJERE MOSTA
Rasponi: 19,3 + 12x20,0 + 14,0= 273,30 m
Širina: 11,80 m
Ukupna duljina: 283,20 m
Tip konstrukcije: prednapeti spregnuti montažni nosači

Kolnik ceste na mjestu mosta ukupne je širine 7,1 m, a sastoji se od dva vozna traka širine po 3,25 m i rubnih trakova od 0,3m. Na lijevo i desno od rubova voznih trakova smješteni su zaštitne širine 50 cm do zaštitnih odbojnih ograda. Zatim slijedi visoki predgotovljeni rubnjak dimenzija 18x24 cm, iznad čega je smještena zaštitna odbojna ograda za koju je predviđen prostor od 50cm. Odbojna ograda sidri se u betonsku pješačku stazu minimalne debljine 25 cm. Ima poprečni pad od minimalno 2,5% kako bi se osigurala brza odvodnja vode prema slivnicima. Odbojna ograda tipa je H2-W3-B. Pješačka staza s lijeve strane je širine 1,6 m, a s desne strane servisna od 0,6 m. Pješačka staza zaštićena je pješačkom ogradom visine 1,2 m. Pješačka ograda sidri se u betonsku stazu i vijenac. Na ovaj način došlo se do ukupne širine mosta simetrične poprečne dispozicije od 25 + 160 + 50 + 50+ 30 +325 + 325 + 30 + 50 + 50+ 60 + 25 = 1180 cm = 11,8m.
Niveleta na mostu u potpunosti je u vertikalnoj konveksnoj kružnoj krivini radijusa 1400 m s tim da se najviša točka kružne krivine nalazi na objektu u stacionaži u km 0+250,33. Tlocrtno cijeli most se nalazi u pravcu. Poprečni pad kolnika na cijelom mostu iznosi -2,5%.
Odvodnja je zatvorena, pa se na nižim rubovima mosta ugrađuju slivnici povezani cijevima za odvod oborinske vode kojima se voda odvodi do prihvatnih šahtova.

2. PODACI ZA IZRAČUN VODNOG I KOMUNALNOG DOPRIONOSA

Površina objekta prema kojoj se obračunavaju doprinosi iznosi 283,20 m x 11,80 m = 3.342 m^2.

3. OSNOVNI PODACI O TLU I TEMELJENJU

Temeljenje objekta određeno je na osnovi građevinskog projekta temeljenja obrađenog u mapi 25 Cestovni most preko prokopa - geotehnički projekt. Tlo na kojem se temelji most su - pijesci, slabo do dobro graduirani, mjestimično s udjelom gline, anorganske gline niske do visoke plastičnosti lakognječivog sdo polučvrstog konzistentnog stanja prašinasti slojevi registrirani su na kraju do provedene dubine istraživanja, šljunkoviti slojevi, pjeskoviti šljunak pretežno slabo graduiran, vezan prahom, rahle do srednje zbijenosti , a sve detaljnije se nalazi u istražnim radovima geotehničkog projekta.
Čitav objekt temeljen je na pilotima. Na ovaj način djelovanja se prenose u dublje slojeve tla.
Upornjaci su temeljeni na po tri pilota promjera Φ150 cm koji djelomično pri vrhu pilota prolaze kroz nasip. Piloti su pri vrhu spojeni naglavnicama, koje ujedno služe i kao ležajna greda upornjaka. Duljine pilota upornjaka su 22,0m na upornjaku U0 i U14.
Stupišta su temeljena na naglavnici pilota od 4 pilota promjera Φ150 cm, duljine pilota su : S1 18m, S2 20m,S3 20m; S4,S5,S6 18m ; S7 20m; S8-S13 18m. Naglavnica je tlocrtnih dimenzija 5,8x7,4 m, visine 1,5 m. Osni razmak pilota je 3,8 m u uzdužnom i 5,2 u poprečnom smjeru. Materijali za izvedbu temeljenja su:beton pilota i naglavnice C 30/37; armatura B500B;

Svi tehnički uvjeti za izvedbu pilota navedeni su u normi HRN EN 1536 (Bušeni piloti). Potrebna ispitivanja pilota obrađena su programom kontrole i osiguranja kvalitete u mapi 72150-GP-035-2023 Cestovni most preko prokopa - geotehnički projekt. Svi upotrijebljeni materijali i postupci izvedbe moraju imati dokaze kvalitete u skladu s važećim zakonima, tehničkim propisima i normama. Za sve izmjene i dopune potrebna je prethodna suglasnost projektanata konstrukcije i temeljenja te Investitora.

4. OPIS NOSIVOG SKLOPA

Rasponski sklop
Most se izvodi u dva dilatacijska odsječka, sastoji se od četrnaest polja raspona 19,3+20x12+14 m, duljine između osi upornjaka L=273,30 m, a ukupne duljine 283,20 m. Odabrani rasponski sklop je roštilj statičkog sustava niz prostih greda, sastavljen od šest predgotovljenih prednapetih nosača, visine 1,10 m, s betoniranom pločom 25 cm. Osni je razmak nosača konstantne širine 1,82. Poprečni nosači su predviđeni iznad ležajeva, širine 40 cm i visine 100 cm do ploče. Prednapeti su nosači od betona C40/50, prednapinju se naknadno, nategama od žica 0,62“ od visokovrijednog čelika za prednapinjanje f_{pk}=1860 N/mm^2 (Y1860S7) niske relaksacije, i armira se rebrastom armaturom B 500 B.
Ležajevi
Prednapeti nosači se oslanjaju preko elastomernih usidrenih ležajeva Tip V (C), na svakom osloncu. Visina predviđena za smještaj ležajeva iznosi 35,0 cm mjereno u osi upornjaka i stupišta. Ležajevi su dimenzija 300x400x138(88) mm.
Sve ležajeve potrebno je postaviti na projektom određene betonske klupice koje su glatke i vodoravne te visinski precizno iznivelirane, a izvedene su od betona razreda čvrstoće C45/55. Izmjena ležajeva može se jednostavno

riješiti odizanjem rasponskog sklopa uz pomoć hidrauličnih preša koje se umeću na mjestu poprečnih nosača između ležajnih klupica. Prilikom najjačih potresa može doći do mnjihovog oštećenja te ih je potrebno nakon potresa uvijek pregledati.

Stupišta

Stupišta mosta se sastoje od dva stupa ϕ 120 cm povezana naglavnom gredom b x h=240 x160 cm.
Temeljenje stupišta predviđeno na naglavnicama pilota sa 4 pilota promjera Φ150 cm, duljine su S1 18m, S2 20m, S3 20m; S4,S5,S6 18m ; S7 20m; S8-S13 18m, kako je to opisano u jednom od sljedećih poglavlja. Stupovi i naglavne grede se izvode od betona C30/37. Stupišta se armiraju čelikom B500B. Za izvođenje stupova, predviđena je kvalitetna glatka oplata koja može osigurati pouzdanu ugradnju betona i primjeren izgled vanjskih ploha betona. Posebnu pažnju treba posvetiti ispravnoj ugradnji betona i nastavcima betoniranja. Nastavke betoniranja treba dobro očistiti i neposredno prije betoniranja dobro navlažiti, a sve sukladno kontroli kvalitete. Za vrijeme izrade stupova potrebna je stalna geodetska kontrola njihove geometrije.

Upornjaci

Prijelaz sa ceste na most odvija se preko upornjaka temeljenih na pilotima u nasipu. Piloti promjera Φ150 cm su pri vrhu spojeni naglavnicom, koja ujedno služi i kao ležajna greda upornjaka. Širine ležajne grede upornjaka je 2,35m, a visina joj je promjenjiva te iznosi u osi upornjaka 3,0 m (U0) odnosno 2,0m (U14). Visina zidića upornjaka je oko 1,72m, a širina zidića 50cm. Oba upornjaka imaju konzole na zidiću upornjaka za oslanjanje prijelazne ploče duljine 4,0 m, debljine 30,0 cm. Oba upornjaka duboko su temeljena na po tri pilota promjera Φ150 cm. Duljina pilota na upornjaku U0 je 22m, a na upornjaku U14 22m. Piloti se nalaze na osnim razmacima 3,8 m. Oba upornjaka imaju prostor za smještaj ležajeva i ležajnih klupica visine 35,0 cm. Pad vrha zida upornjaka je 5%, a eventualna se procjedna voda odvodi se cjevčicom promjera 10,0 cm.
Duljine konzolnih krila upornjaka su 4,35 m (U0) i 3,15 m (U14), a debljine 50,0 cm. Krila nose konzolne istake za pješačku stazu, ograde, vijenac i rubnjak.
Oba upornjaka imaju bočnu zaštitnu masku debljine 25,0 cm.
Upornjaci se izvode od betona C35/45 i armiraju s B500B.
Hidroizolacija vanjskih betonskih ploha upornjaka koji su u dodiru s tlom i izvodi se pomoću dva vruća premaza i jednoslojne ljepenke. Osobitu pažnju treba posvetiti pravilnoj pripremi ploha i polaganju izolacije.

Klinovi iza upornjaka i uređenje čunjeva nasipa

Iza upornjaka izvode se „šljunčani klinovi“ u nagibu 1:3. Svaki se sloj razastire vodoravno u debljini od 50 cm, te sabija odgovarajućim sredstvima na stupanj zbijenosti ME=80 MN/m^2 pri vrhu prema OTU II 2-13.
Čunjevi nasipa su od probranog kamenog materijala (OTU II, 2-09.3) u nagibu 1:1.5. Pokosi se trebaju zaštititi vegetacijskim pokrivačem. Prednji dio pokosa nasipa ispod rasponskog sklopa treba obložiti betonskim pločama od betona C25/30 (XC2, XF2). Predviđena je i berma na nasipu ispod rasponskog sklopa širine 1,0 m.

5. OPREMA, POMOST

Prijelazne naprave

Na osnovi predviđenih pomaka, izazvanih skupljanjem i puzanjem betona, te temperaturnim promjenama i kočenjem, na upornjacima je predviđena ugradnja prijelaznih naprava koje omogućavaju ukupne uzdužne pomake ±80 mm (D160), u poprečnom smjeru ±10 mm. Na dilatiranom stupu će se upotrijebiti prijelazna naprava ±120 mm (D240), a poprečni smjer isto ±10 mm. Poprečni smjer je ograničen sa bočnim graničnicima koji sprječavaju veće pomake pri potresu. Prilikom najjačih potresa može doći do mnjihovog oštećenja te ih je potrebno nakon potresa uvijek pregledati.
Upotrijebit će se elastomerne prijelazne naprave s aluminijskim dijelovima i čeličnim ojačanjima koje se vijcima pričvršćuju na rasponski sklop i upornjak. Ugradnju naprava potrebno je prilagoditi zahtjevima proizvođača prijelaznih naprava, što treba imati na umu kod betoniranja ovih elemenata.
Naprave treba ugraditi što kasnije, kad se obavi što veći iznos deformacija skupljanja.
Budući da prijelazna naprava predstavlja sekundarni element konstrukcije čiji slom ne utječe na svojstva nosivosti konstrukcije, dopušta se da se prilikom najvećeg proračunatog potresa ošteti, a potom zamijeni.

Hidroizolacija

Hidroizolacija koja će se upotrijebiti za prenapetu ploču sastoji se od temeljnog i sloja za brtvljenje. Temeljni sloj izrađuje se od dvokomponentne reakcijske epoksidne smole bez otapala i punila, obrađen kvarcnim pijeskom. Sloj za brtvljenje sastoji se od jedne zavarene polimerne bitumenske trake s uloškom od poliesterskog filca, nominalne debljine 5 mm. Ovakva hidroizolacija postavlja se po cijeloj širini prednapete ploče i na horizontalne plohe na vrhu krila upornjaka. Hidroizolacija se postavlja u dvije faze, prvo ispod rubnih trakova, a nakon njihove izvedbe na dijelu ispod asfaltnog zastora. Naročita pažnja mora se obratiti na pravilnu pripremu ploha i polaganje izolacije, uvažavajući upute proizvođača, zatim OTU IV st.7-01.9.1, kao i važeće hrvatske norme.
Hidroizolacija se smije postavljati samo u povoljnim vremenskim uvjetima (nipošto u velikoj vlazi i po hladnoći), jer od kakvoće izvedbe ovisi trajnost mosta. Postavljanju prethodi površinska obrada ploha koja obuhvaća

čišćenje cementne skramice, mrlja od ulja i uklanjanje stršećih zrna agregata većih od 2mm, te sušenje. Naročitu pažnju je potrebno posvetiti izvođenju završetka hidroizolacije na početku i kraju mosta.
Hidroizolacija vanjskih betonskih ploha upornjaka i stupišta koji su u dodiru s tlom izvodi se pomoću dva vruća premaza i jednoslojne ljepenke. Osobitu pažnju treba posvetiti pravilnoj pripremi ploha i polaganju izolacije

Kolnički zastor

Kolnički zastor sastoji se od dva sloja ukupne debljine 7,5 cm. Prvi, zaštitni sloj debljine 4,0 cm izrađuje se od asfaltbetona AC 11 bin 35/50 AG4 M2. Završni, habajući sloj debljine 3,5 cm izrađuje se od asfaltbetona AC 11 surf 50/70 AG3 M3. Uz prijelazne naprave ugrađuje se kolnički zastor duljine 1,0 m, u punoj širini kolnika od lijevanog asfalta radi ublažavanja dinamičkog udara vozila na prijelaznu napravu.
Između asfaltnog zastora i rubnjaka, oko slivnika te uz prijelazne naprave treba ostaviti urednu rešku širine 2,0 cm koja se ispunjava posebnom smjesom predviđenom za to.
U donjem, veznom, sloju ispravljaju se eventualne manje neravnosti ploče tako da završni sloj bude besprijekorno ravan. Zato treba prije asfaltiranja provjeriti visinske kote ploče na dovoljno gustoj mreži. Time se osigurava udobnost prijelaza preko mosta i pravilno funkcioniranje sustava odvodnje.

Vijenci, hodnici, rubnjaci

Predgotovljeni betonski rubnjaci dimenzija 24x18 cm se izvode od betona C40/50, i postavljaju na sloj cementnog morta 1:1. Služe i kao oplata betonske staze. Najmanja debljina betonske pješačke staze od betona C35/45 iznosi 26 cm, a ima na vrhu pad od minimalno 2,5% kako bi se pospješila odvodnja.
Betonsku stazu i vijenac treba zaštititi zaštitnim premazom na bazi silana ili drugih biokemijski modificiranih silikatnih otopina.
Svi uzdužni spojevi montažnih rubnjaka i veze s lijevanim asfaltom zapunjuju se masom za zalijevanje spojnica. Masom za ispunu spojnica također se zapunjavaju reške između pojedinih komada montažnih rubnjaka.

Odbojne i zaštitne ograde

Zaštita korisnika u eksploataciji provedena je projektiranjem čelične odbojne ograde i pješačke ograde.
Na betonskoj pješačkoj u prostoru širine 50,0 cm predviđeno je usidrenje čelične odbojne ograde za vozila klase zadržavanja H2W3B.
Unutar betonske pješačke staze sidri se pješačka ograda s vertikalnom ispunom visine 120,0 cm. Razmaci stupića ispune pješačke ograde su min. 12cm. Stupci ograda su vertikalni u prostoru, a rukohvati i prečka prate nagib nivelete. Ograda je podijeljena u samostalne dilatacijske cjeline, s adekvatnim rješenjima na mjestu dilatacija. Osobito treba paziti na preciznu izvedbu ograde, jer o njoj umnogome ovisi dojam o kvaliteti izvedbe čitavog objekta. Detalji ograde prikazat će se u izvedbenom projektu. Antikorozivna zaštita svih ograda izvodi se vrućim pocinčavanjem. Prilikom najjačih potresa može doći do njihovog oštećenja te ih je potrebno nakon potresa uvijek pregledati.
Operećenja i djelovanja od pješačke i odbojne ograde je uračunato u proračunu mosta , a navedno u analizi opterećenja proračuna konstrukcije.

Rasvjeta mosta i elek. instalacije

Na mostu prekopa Kupa-Korana se nalaze električne instalacije za rasvjetu prometnice koja se nalazi na mostu kao i druge elek. instalacije koje su predviđene posebnim uvjetima. Sve je obrađeno u knjigama Cestovni most preko prokopa – javne projekt rasvjet elektrotehnički RP2862G1 i pripadajući građevinski RP2862E1. U ovom projektu je predviđen prostor za dotične stupove kao i zadovoljavajuća čvrstoća temeljnih postolja za naveden stupove. Sile koje proizvode dotični stupovi su ukalkulirani u projekt mosta.
Na most u hodničke staze, te ispod njih postavljeni su, a sve prema zahtjevima iz uvjeta lokacijske dozvole što je zatražio HEP ODS Elektra Karlovac, PVC cijevi za prolaz NN i SN elektroenergetskih kabela 2xØ200 i 2xØ150 mm te Ø50 mm za optički kabel.

Zaštitno uzemljenje

Zaštitno uzemljenje svih čeličnih dijelova opreme mosta (ograde) sastoji se od gromobranske instalacije s pomoću koje će se svi metalni dijelovi biti spojeni s uzemljivačima. Uzemljenje mosta predmet je posebnog projekta u mapi Cestovni most preko prokopa - projekt uzemljenja broj RP2863.

Odvodnja

Predviđen je zatvoreni sustav odvodnje oborinskih voda s kolnika, pa se na nižim rubovima mosta uz betonski rubnjak ugrađuju slivnici. Oborinska voda odvodi se slivnicima i sabirnim cijevima odvodnje slobodnim padom s prometne površine. Detalji su obrađeni u knjizi 72160-GP-032-2023. Cestovni most preko prokopa - projekt odvodnje. U ovoj knjizi su samo shematske skice prokazane.

6. PRORAČUN KONSTRUKCIJE

Proračun i dimenzioniranje nosivih elemenata konstrukcije mosta je proveden u skladu s hrvatskim normama HRN EN 1991, HRN EN 1992, HRN EN 1997 i HRN EN 1998 i pripadajućim nacionalnim dodacima te pripadajućim normama vezanim za mostove. Za proračun unutarnjih sila i dimenzioniranje je korišteno više računskih modela na bazi konačnih elemenata, u kojima su definirane mehaničke karakteristike materijala i djelovanja u skladu s navedenim normama.
Statički proračun mosta proveden je na elektroničnom računalu koristeći programski paket Sofistik. Svi su proračuni provedeni na strani veće sigurnosti.

7. GRAĐENJE

Izvođač radova treba izvesti betonske i armirano-betonske radove u skladu sa zahtjevima norme HRN EN 13670 - Izvedba betonskih konstrukcija. Odabran je montažni način građenja nosača rasponskog sklopa, a monolitni način građenja donjeg ustroja zbog jednostavnosti izvedbe navedenoga.
Najprije se izvode pripremni radovi na gradilištu s čišćenjem terena, nakon čega počnu zemljani radovi na iskopu jama za temelje i pripremu platoa za strojeve koji izvode bušene pilote. Kada se iskopa i pripreme platoi, započinje bušenje pilota, redom kako se završavaju, prelazi se od stupnog do stupnog mjesta. Nakon toga izvode se naglavne ploče temelja za pilote. Kada beton poprimi dovoljnu čvrstoću, započinje izvedba stupova i zidova upornjaka. Na kraju se izvode naglavnice stupova sa ležajnim klupčicama. Paralelno s radovima na gradilištu potrebno je započeti i radove u radionici gdje se izrađuju montažni betonski/čelični nosači i okrupnjuju do određene veličine. Nakon toga se dovoze na gradilište gdje se dodatno okrupnjuju ovisno o tehnologiju izvođača. Maksimalno se postavljaju u projektirani položaj po 2 glavna nosača povezana poprečnim nosačima, a završno se povezivanje izvodi kad se svi nosači postave u projektirani položaj.
Kad se postave nosači rasponskog sklopa na predviđena mjesta započinje izvedba monolitnog dijela AB ploče. Betoniranje ploče se izvodi na način da se betoniraju dva susjedna raspona jedan za drugim, ali da se prostor iznad stupišta između njih (u duljini 0,15L od osi) ne betonira. To se izvodi tek nakon stvrdnjavanja betona prethodno navedena. Nakon toga se betonira sredina narednog polja pa prostor iznad stupišta i tako redom do kraja objekta. Sve je prikazano u nacrtu tehnologija gradnje.
Kad se nosivi dijelovi objekta u potpunosti izvedu s dilatacijskim napravama, počinje ugradnja ostale opreme objekta (ograde, hidroizolacije, asfalta, hodnika…). Nakon završetka svih radova može se izvršiti probno opterećenje. Zemljane radove i temeljenje izvoditi u periodu manjih oborina i niskim voda.
Svi se radovi moraju uskladiti s odgovarajućim propisima i odredbama za radove na cestama.
Svi se ovi radovi moraju geodetski pratiti, a u slučaju većeg odstupanja od predviđenih dimenzija, mora se pravovremeno obavijestiti projektant, kako bi mogao poduzeti mjere za otklanjanje pogrešaka. Svi se radovi moraju uskladiti s odgovarajućim propisima i odredbama za radove na cestama. Pješačka ograda i vijenac moraju se ugraditi i betonirati precizno jer o njihovom točnom položaju ovisi ukupni oblikovni dojam objekta.
Sve oplate trebaju biti glatke i čiste kako bi se osigurala kvalitetna ugradba i estetski prihvatljiv izgled ploha.

8. UREĐENJE OKOLIŠA

Nakon izgradnje predmetne građevine, potrebno je izvršiti sanaciju okoliša gradilišta kako bi se građevina što bolje uklopila u postojeći prirodni ambijent. Na taj bi se način smanjio osjećaj devastacije okoliša, te udovoljilo ekološkim aspektima. Zahvaćeni i devastirani okoliš potrebno je biološki sanirati. Stoga je potrebno sve nasipe, iskope i ostale površine ozeleniti autohtonim biljnim vrstama. Prilikom sanacije okoliša gradilišta, posebnu pozornost potrebno je obratiti na slijedeće:

- Posječena stabla i panjeve ukloniti, te zatrpati sve udubine materijalom kao na okolnom terenu.
- Sve putne prilaze gradilištu urediti prema vizualnim zahtjevima okoliša, a one putove koji trajno ostaju u funkciji sanirati i urediti sukladno potrebama.
- Prethodno oformljene deponije i pozajmišta urediti i sanirati kako bi se u što većoj mjeri uklopili u prirodni okoliš, a u što manjoj mjeri ugrozili susjedne građevine.
- Sve privremene građevine, opremu gradilišta, neutrošeni materijal, otpad i slično treba ukloniti, a predmetno zemljište adekvatno sanirati - dovesti u prvotno stanje.
- Kompletnu zonu, devastiranu zahvatom, dostatno urediti i dovesti na razinu blisku izvornom stanju.

U cilju zaštite životinjskog svijeta, potrebno je sve devastirane površine oko objekta zasaditi autohtonom vegetacijom, odnosno potrebno je poduzeti sve mjere da se omogući životinjskim vrstama brže privikavanje na nove pravce kretanja i očuvanje njihovog opstanka u novim uvjetima

9. NAMJENA, NAČIN UPORABE OBJEKTA I UTJECAJ OKOLIŠA – - razredi izloženosti i proračunski vijek uporabe djelovanja okoliša na konstrukciju

Objekt služi cestovno pješačkom prometu i prelazi vodotok. Dominantne vrste djelovanja kojima je izložena betonska konstrukcija objekta iz okoliša su karbonatizacija, djelovanje klorida koji nisu iz mora (soli za odmrzavanje) i ciklus smrzavanje/odmrzavanje, bez posebnih slučajeva kemijske korozije.
Razredba agresivnog djelovanja okoliša za pojedine konstrukcijske elemente provedena je u skladu s HRN EN 206 i EC2 i pripadajućim nacionalnim dodatcima prikazana u tablici niže.
Zahtijevani proračunski uporabni vijek ovog objekta je 100 godina prema HRN EN 1990 pripadajućim nacionalnim dodatcima.

PODACI O MATERIJALIMA

BETON
SVOJSTVA U SKLADU S HRN EN 206:2016, HRN EN 13670:2010; HRI CEN/TR 15739
ARMATURA - SVOJSTVA U SKLADU S HRN EN 10080:2012

Konstrukcijski elementi	Granične vrijednosti za sastav betona											
	Min. Razred tlačne čvrstoće C (N/mm^2)	Razred izloženosti (HRN EN 1992-1-1)	Maks. udio klorida (HRN EN 206) %	min. Količina cementa (kg/m3)	Vodone-propusnost (VDP) HRN EN 12390-8 i HRN 1128, prodor vode srednja vrijednost cm	vodo/ cementn i faktor (w/c^c)	Dmax agregata mm	Otpornost na smrzavanje M (HRN 1128; HRN CEN/TS 15177 br. ciklusa smrzavanja i odmrzavanja)	Otpornost na smrzavanje i soli MS (prema HRN 1128 i HRS CEN/TS 12390-9 najveći gubitak mase) kg/m3	Razred konstr. (HRN EN 1992-1-1)	Armatura	Zaštitni sloj (HRN EN 1992-1-1) cm
Podložni beton	C12/15	X0	-	-	-	-	16	-	-	-	-	-
Piloti	C30/37	XC2/XA1	0,2	300	3,0 (VDP2)	0,55	32	-	-	S6	B 500-B	8,0
Naglavnice pilota	C30/37	XC2/XA1	0,2	300	3,0 (VDP2)	0,55	32	-	-	S5	B 500-B	5,5
Prijelazna ploča	C30/37	XC2/XA1/XF2	0,2	300	3,0 (VDP2)	0,55	32	-	1,0 (MS28)	S5	B 500-B	5,5
Upornjaci	C35/45	XC4/XD3/XF2	0,2	320	3,0 (VDP2)	0,45	32	-	1,0 (MS28)	S6	B 500-B	6,5
Stupovi	C30/37	XC4/XD1/XF1	0,2	300	3,0 (VDP2)	0,50	32	M28	-	S6	B 500-B	5,5
Naglavne grede stupova	C30/37	XC4/XD1/XF1	0,2	300	3,0 (VDP2)	0,50	32	M28	-	S6	B 500-B	5,5
Klupice ležajeva i preša	C45/55	XC3/XD1/XF4	0,2	340	3,0 (VDP2)	0,45	16	M56	-	S5	B 500-B	5,0
Montažni nosači	C40/50	XC3/XD1/XF1	0,1	300	3,0 (VDP2)	0,50	16	M28	-	S5	B 500-B Y1860 S7	5,5 (4,5)
Poprečni nosači	C30/37	XC3/XD1/XF3	0,2	320	3,0 (VDP2)	0,50	16	M56	-	S5	B 500-B	5,0
Kolnička ploča	C30/37	XC3/XD1/XF3	0,2	320	3,0 (VDP2)	0,50	16	M56	-	S5	B 500-B	5,0
Kontinuitetna ploča	C35/45	XC3/XD1/XF3	0,2	340	3,0 (VDP2)	0,45	16	-	0,5 (MS56)	S5	B 500-B	5,0
Hodnici i vijenci	C35/45	XC4/XD3/XF4	0,2	340	3,0 (VDP2)	0,45	16	-	0,5 (MS56)	S6	B 500-B	6,0/2,5
Beton ugradnje prijelaznih naprava i rubnjaci	C40/50	XC4/XD3/XF4	0,2	340	3,0 (VDP2)	0,45	16	-	0,5 (MS56)	S5	B 500-B	6,0

Mogu se koristiti distanceri od vlaknastih betona ili običnog betona. Distanceri se mogu napraviti od vlaknastog betona ili običnog betona i ne smiju sadržavati azbest. Moraju biti otporni na starenje i moraju osigurati min. tlačna čvrstoća do 700 kPa, posebno se projektiraju za nosivi i vidljivi beton, mora zadovoljiti zahtjeve za beton i armirani beton u skladu s HRN EN 206: 2013 i protupožarnim propisima HRN EN 1991-1-2 i DIN 4201. Također moraju imati koeficijent proširenja kao i ostali beton.

ČELIK ZA PREDNAPINJANJE
SVOJSTVA U SKLADU S nkHRN EN 10138-1, nHRN EN 10138-3, HRN EN ISO 15630-3 I ETA PROIZVODIMA

KABLOVI ili UŽADI		Y 1860 S7		150 mm^2	∅ kabla, < 8,5cm ili 5,5 / 6,5cm

KONSTRUKCIJSKI ČELIK
SVOJSTVA U SKLADU S HRN EN 10025, HRN EN 10210 I HRN EN 10219, IZVOĐENJE U SKLADU S HRN EN 1090

KONSTRUKCIJSKI ELEMENT	Vrsta ČELIKA		Način zaštite protiv korozije	ostalo
ZAVARENE OGRADE ZA PJEŠAKE	S 235 JR		Vruće cinčano min 85 µm	
ZAŠTITNE OGRADE ZA VOZILA	U skladu s tehničkim dopuštenjem u HR			

Zaštita od korozije vrućim pocinčavanjem vrši se na gotovim elementima. Naknadno bušenje, rezanje, brušenje, poliranje, zavarivanje… nije dopušteno! Spajanje pojedinih elemenata samo s mehaničkim spojevima. Izrada i montaža čeličnih dijelova izvodi se u skladu s HRN EN 1090-2, proizvodnom klasom EXC2 EN 1090-2, razred izvedbe EXC2

10. PROVEDBA PROBNOG OPTEREĆENJA

Prije stavljanja objekta u uporabu, potrebno je izvršiti probno ispitivanje glavne rasponske konstrukcije objekta, a sukladno važećim propisima, članku 8. TPGK (17/17; 75/20) i normi HRN U.M1.046. Pokusnom opterećenju može se pristupiti tek kada se prikupe svi dokazi o kvaliteti ugrađenih materijala. Ispitivanja treba obaviti prema prethodno izrađenom programu, od strane mjerodavne institucije - akreditirane ustanove za tu normu prema normi za ispitne laboratorije HRN EN ISO/IEC 17025. Svrha probnog ispitivanja je utvrđivanje da li se izvedena konstrukcija ponaša u skladu s projektiranim stanjem. U tom smislu, nužno je utvrđivanje stanja pomaka, deformacija i naprezanja tipičnih glavnih nosača objekta, te utvrđivanje dinamičkih karakteristika objekta.
Dokaz nosivosti i uporabljivosti konstrukcije objekta treba na kraju izvesti iz dokumentacije:

- zapisa u građevinskom dnevniku o podacima i svojstvima ugrađenih građevinskih proizvoda.
- rezultata nadzornih radnji i kontrola provedenih sukladno TPGK i TPGP prije ugradnje građevnih proizvoda.
- način, vrsta i intenzitet pokusnog opterećenja
- faze opterećenja pri statičkom opterećenju
- rezultata ispitivanja konstrukcije građevine pokusnim opterećenjem.
- usporedba statičkih djelovanja pri pokusnom opterećenju s onima iz statičkog proračuna
- položaj mjernih mjesta, opseg i način mjerenja deformacija, a posredno i unutarnjih sila, pri statičkom opterećenju
- plan provedbe dinamičkog ispitivanja u svrhu određivanja osnovnih dinamičkih karakteristika konstrukcije
- ostalih relevantnih podataka od djelovanja na tehnička svojstva rasponske konstrukcije zabilježenih na građevini tijekom njezine izvedbe.

Po završenom pokusnom opterećenju institucija koja ga je obavila dužna je izraditi elaborat u kojem će biti svi navedeni dobiveni podaci, komentari i konačna ocjena građevine (zabilježeno početno – nulto stanje s detaljnim prikazom eventualnih napuklina, pukotina ili drugih oštećenja bitnih za očuvanje mehaničke otpornosti i stabilnosti konstrukcije).

11. PROJEKTIRANI VIJEK GRAĐEVINE I UVJETI ZA NJENO ODRŽAVANJE

Projektirani vijek uporabe građevine ovisi o vrsti njenih glavnih nosivih dijelova konstrukcije. Minimalni vijek trajanja AB stupova i AB kolovozne ploče mora biti minimalno 100 godina, dok trajnost ležajeva, prijelaznih naprava i drugih elemenata koji su lako zamjenjivi i iznosi minimalno 30 godina.
Vijek trajanje jedne konstrukcije prvenstveno ovisi o kvaliteti njene izvedbe, a onda i o redovitom održavanje iste kao i okolini u kojoj se nalazi. U svrhu osiguranja stalnog korištenja objekta te njegove ispravnosti u pogledu sigurnosti i funkcionalnosti, potrebno je vršiti opću kontrolu stanja konstrukcije, odnosno građevine i održavanje iste. To će se obavljati u obliku pregleda građevine u određenim vremenskim intervalima, koji ovise o vrsti konstrukcije i građevine. Pregled konstrukcije građevine moraju obavljati za to ovlaštene osobe.
Rezultat ovih pregleda je otklanjanje nedostataka i oštećenja poslije čega se građevina dovodi u predviđeno stanje. Prema potrebama i različitosti građevine, odnosno konstrukcije, određuje se tip i redovitost pregleda i prema tome se obavljaju: redovni, glavni, dopunski i izvanredni pregledi.
Redovni kontrolni pregledi moraju se provoditi svake dvije (2) godine. Ovim pregledom su obično obuhvaćeni stupišta, konstrukcija, instalacije, zaštita od korozije i geometrijska kontrola. Obim pregleda se može proširiti ili smanjiti prema nahođenju nadležnog organa koji rukovodi pregledom. Pri svakom pregledu posebnu pozornost posvetiti snimanju možebitnih pukotina i zona drobljenja betona, te svih drugih oštećenja i deformacija bitnih za sigurnost konstrukcije. Ako se vizualnim pregledom stanja konstrukcije uoče promjene i defekti koji mogu umanjiti ili ugroziti sigurnost objekta u uporabi, treba odmah izmjeriti deformacije glavnih elemenata pod stalnim opterećenjem. Na osnovu povećanja deformacija u odnosu na početno stanje, treba utvrditi eventualno smanjenje sigurnosti i propisati daljnje mjere za održavanje projektirane i propisane sigurnosti.
Glavni pregledi vrše se u vremenskim intervalima od 5 godina, na isti način kao i redovni pregledi. Obvezno se radi prvi glavni pregled nakon 1 godine uporabe objekta ili poslije prve zime. Na glavnom pregledu se kontroliraju svi spojni dijelovi konstrukcije. Obavezno se kontroliraju oblici pojedinih dijelova konstrukcije, naročito pritegnutih, kao i oštećenja prouzročena zamorom materijala
Izvanredni pregledi se vrše obvezno poslije elementarnih nepogoda, poplave, vjetra, požara, potresa, poslije značajnih promjena na konstrukciji ili promjeni opterećenja ili po zahtjevu inspekcije. Nakon potresa obvezno je potrebno pregledati ležajeve i dilatacijsku napravu, te zaštitne ograde i drugu opremu na objektu i po potrebi ih popraviti ili zamijeniti. Pregled je obično isti kao i redovni pregled i prema procjeni stručne osobe može se smanjiti ili povećati. Nakon svih pregleda svi nastali nedostaci i oštećenja se moraju pravovremeno otkloniti i sanirati zbog sigurnosti, funkcionalnosti i daljnje uporabe građevine.

Tekućim (kontrolnim) pregledima potrebno je naročito kontrolirati:

-stanje pukotina, progiba / deformacija (slijeganja) i eventualnih oštećenja rasponske konstrukcije, stupova i upornjaka (sa svim dijelovima)
- stanje zaštitnog sloja armature na vidljivim plohama armiranobetonskih elemenata
- stanje antikorozivne zaštite na metanim dijelovima objekta
- stanje i funkcija ležajeva
- stanje zastora i stupanj ugroženosti hidroizolacije kolničke ploče
- stanje i funkcioniranje prijelaznih naprava
- stanje ograde, zaštitne mreže i barijera za buku
- stanje svih instalacija
- deformabilnost (slijeganje) kolnika ceste na nasipu ispred prijelaza na rasponsku konstrukciju

Posebnu pažnju potrebno je obratiti na izmjenu ležajeva nakon dotrajalosti. Predviđen je postupak izmjene na način da se ispod poprečnih nosača postave hidrauličke preše koje moraju biti ujednačene kako ne bi došlo do diferencijalnih pomaka koji mogu nepovoljno opteretiti kolničku ploču i poprečni nosač.
Guma ugrađena u prijelaznu napravu vremenom se može ispuniti pijeskom i drugim nečistoćama čime je moguća spriječenost pomaka. Kako ne bi zbog toga došlo do pritiska rasponske konstrukcije na prsni zid upornjaka, potrebno je periodički kontrolirati i čistiti prijelaznu napravu.
Sve uočene nedostatke i oštećenja potrebno je što hitnije otkloniti, kako bi se postiglo projektirano stanje, odnosno povećala sigurnost, trajnost i funkcionalnost građevine. Da bi se što više smanjili troškovi održavanja objekta i povećala njegova uporabna vrijednost, odabrana su takva rješenja, materijali i oprema koji imaju dostatnu kvalitetu i trajnost.
Osim građevinskih mjera za održavanje objekta potrebne su i redovne mjere održavanja:

- čišćenje prometnih površina od snijega, blata, prašine, smeća i dr.
- odstranjivanjem posipanog materijala nakon završetka Zimske službe
- košenje trave zelenog pojasa
- održavanja odvodnje (slivnika, sabirnih cijevi, kanalica i separatora)
- radovi na kolniku (ispunjavanje pukotina asfaltnom masom, zalijevanje razdjelnica na betonskim kolnicima).

Svu dokumentaciju (izvješća o probnom ispitivanju, pregledima i održavanju) dužan je trajno čuvati vlasnik građevine.

Zagreb, travanj 2023.

Projektant:

Mate Pezer, dipl.ing.građ.

Izradio: **INSTITUT IGH d.d.**

Zavod za projektiranje

10 000 Zagreb, J. Rakuše 1

Građevina: **IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA:**

4. faza izgradnje – nastavak iskopa glinenog materijala u cijelom gabaritu prokopa za izgradnju nasipa sustava obrane od poplava karlovačkog područja, prokop Korana – Kupa, nasipi uz lijevu i desnu obalu prokopa, desnu obalu Kupe, lijevu obalu Korane i uz ispusnu ustavu (N1 – N5), upusna i ispusna ustava, građevine za odvodnju zaobalnih voda, uklanjanje dijela nasipa u sklopu zahvata dionice državne ceste D1 (splitski pravac, brza cesta kroz Karlovac, II. etapa I. faze) i 5. faza izgradnje - most preko prokopa na nerazvrstanoj cesti NC 340720 Gornje Mekušje – Kamensko)

Knjiga: **CESTOVNI MOST PREKO PROKOPA – konstrukcija**

Vrsta projekta (razina i struka): GLAVNI GRAĐEVINSKI PROJEKT

Zajednička oznaka projekta: GP-5986/23

Oznaka projekta: 72120-GP-285-2020

0301 PROGRAM KONTROLA I OSIGURANJA KVALITETE

Mjesto i datum: Zagreb, travanj 2023.

A. OPĆE NAPOMENE

Sve radove trebaju obavljati za to stručno osposobljene osobe, uz stalni stručni nadzor. Za početak svake faze radova potrebna je prethodna suglasnost nadzornog inženjera. Za svako odstupanje od projekta, te u slučaju nepredviđenih okolnosti, potrebno je konzultirati Projektanta. Izvoditelj je dužan u potpunosti poštivati sve mjere osiguranja i kontrole kvalitete. Sva upotrjebljena gradiva i svi izvedeni radovi trebaju udovoljavati zahtjevima važećih normi, propisa i pravila struke. Osobito se u svemu treba pridržavati "Općih tehničkih uvjeta za radove na cestama" (Knjiga I do VII, Hrvatske autoceste, Zagreb 2001.), te rješenja detalja prema uputama HIMK-a (Zagreb 1998.) i SODOC-a. Sve navedeno se primjenjuju u dijelu koji je na snazi, tj., primjenjuju se u dijelu koji nije u suprotnosti s Tehničkim propisom za građevinske konstrukcije, Tehničkim propisom o građevnim proizvodima, i drugim važećim propisima i normama za to područje. Za vrijeme izvođenja radova potrebna je stalna nazočnost nadzornog inženjera, kontinuirani geodetski nadzor, te povremeni projektantski nadzor.

B. ISKOLČENJE I ZAHTJEVANA GEOMETRIJA

Od iskolčenja građevine, preko svih faza izgradnje, do završetka građevine treba provoditi stalan geodetski nadzor, što uključuje:

- stalnu kontrolu iskolčene trase i druge geometrije svih konstruktivnih elemenata
- kontrolu osiguranja svih točaka
- kontrolu postavljenih profila
- kontrolu repera i poligonih točaka

Osobitu pažnju posvetiti kontroli zahtijevanog položaja kolničke betonske ploče i projektirane geometrije ograde i vijenca.

C. ZEMLJANI RADOVI

1. Iskopi

Iskope za temelje treba pregledati nadzorni inženjer (i geotehničar) i upisom u građevinski dnevnik odobriti daljnju izvedbu temelja. Prema zahtjevu nadzornog inženjera predviđa se i mogućnost inženjerskogeološkog kartiranja iskopa.
Iskop građevinskih jama obavlja se strojno. Iskopi se obavljaju s pokosom nagiba 1:1. Za trajanja gradnje izvoditelj je dužan osigurati pokose iskopa na način koji odredi nadzorni inženjer zadužen za zemljane radove. Iskop treba izvesti uz poduzete mjere zaštite građevnih jama od podzemnih voda. Zaštita građevnih jama predmet je posebnog projekta.
Dio iskopanog materijala se koristi za zatrpavanje građevnih jama, a višak odvozi na mjesto stalne deponije ili u nasip. Zatrpavanje građevnih jama izvodi se nasipavanjem materijala iz iskopa, grubim planiranjem i sabijanjem prema projektom postavljenim zahtjevima.

Tijekom radova na iskopima kontrolirati:

- da se iskop obavlja prema profilima i visinskim kotama iz projekta, te propisanim nagibima pokosa iskopa (uzimajući u obzir geomehanička svojstva tla),
- da tijekom rada ne dođe do potkopavanja ili oštećenja okolnih građevina ili okolnog tla,
- da se ne obavljaju nepotrebno povećani ili štetni iskopi,
- da se ne degradira ili oštećuje temeljno tlo zbog neadekvatnih iskopa,
- za vrijeme rada na iskopu pa do završetka svih radova na objektu Izvoditelj je dužan osigurati pravilnu odvodnju,
- ne smije se dozvoliti zadržavanje vode u iskopima,
- vrstu i karakteristiku temeljnog tla kontrolirati prema geotehničkom projektu, a dubine i gabarite iskopa prema građevinskom projektu građevine.

Ako se pri iskopu pojavljuju prepreke kao što su kanali, kabeli, drenaže, ostaci objekata, izvođač je dužan o tome obavijestiti nadzornog inženjera koji odlučuje na koji će način izvođač odstraniti ili osigurati takve prepreke, poštujući sve propise i upute vezano za njihovo djelovanje i upravljanje.

2. Nasipi

Nagibi pokosa trebaju odgovarati projektu.
Nasipavanje izvoditi u propisanim debljinama slojeva i s propisanom zbijenošću. Osobito posvetiti pažnju izvedbi pokosa nasipa.
Kontrolu kvalitete materijala za izradu nasipa vršiti prema važećim normama.
Kontrolom i tekućim ispitivanjima obuhvatiti:

• određivanje stupnja zbijenosti u odnosu na Proctorov postupak (Sz) ili određivanje modula stišljivosti (MS),
• ispitivanje granulometrije nasipnog materijala.

Kontrola geometrije vrši se kontinuirano, vizualno i mjerenjem. Kontrola zbijenosti vrši se probno po slojevima i obvezno na vrhu (ispod prijelazne ploče, odnosno kolničke konstrukcije ceste).
Iza upornjaka objekta izvest će se šljunčani klinovi u nagibu 1:3 do nivelete objekta (Šljunčani se klinovi izrađuju iz dobro graduiranog drobljenog kamenog materijala u slojevima debljine 50 cm s najmanjom zbijenošću od MS = 80 MPa na vrhu i MS = 70 MPa na dubini od 4,0 m (mjereno kružnom pločom ø 30 cm). Njihova izvedba treba u svemu biti prema OTU II 2-13, a kvaliteta ugrađenog materijala mora odgovarati propisanoj u OTU III 5-01. (Primjenjuje se u dijelu koji je na snazi, tj., primjenjuju se u dijelu koji nije u suprotnosti s Tehničkim propisom za građevinske konstrukcije, Tehničkim propisom o građevnim proizvodima, i drugim važećim propisima i normama za to područje.) Kontrolu kvalitete materijala za izradu šljunčanih klinova vršiti prema važećim normama.

D. BETONSKI RADOVI

1. Općenito

Program kontrole i osiguranja kvalitete osnovni je uvjet za postizanje zahtijevanih svojstava betona i konstruktivnih elemenata u fazi građenja i eksploatacije. Upravljanje kvalitetom definirano je Tehničkim propisom za građevinske konstrukcije (NN 17/17, 75/20), II. Dio (Posebna pravila za betonske konstrukcije), uključivo norme na koje se poziva.
Potvrđivanje sukladnosti betona provodi se prema kriterijima normi HRN EN 206 i HRN 1128 te Pravilniku o tijelima, dokumentaciji i postupcima tržišta građevnih proizvoda (NN 118/19). Unutarnja kontrola proizvodnje betona provodi se prema normi HRN EN 206 i mora obuhvatiti sve mjere nužne za održavanje i osiguranje svojstava betona sukladno zahtjevima norme HRN EN 206. Sustav ocjenjivanja i provjere stalnosti svojstava betona je 2+. Na gradilištu se smije prihvatiti i ugraditi isključivo beton s pravovaljanom Izjavom o svojstvima.

2. Beton i njegova sastavna gradiva

Beton će se na gradilište dopremati iz stacionarnih pogona ili iz betonara instaliranih na gradilištu. Za svaku vrstu betona i svaku isporuku na gradilište, beton mora imati pravovaljanu izjavu o svojstvima izdanu od strane proizvođača. Još prije prve isporuke za svaki novi proizvod, koji će se ugrađivati u građevinu, nadzornom inženjeru treba za njega dostaviti sve potrebne podatke i potvrde o kvaliteti i ishoditi njegovu suglasnost za ugradnju.
Nadzornom inženjeru treba mjesec dana prije početka ugradnje za svaki sastav betona dostaviti od proizvođače sve podatke o sastavu, sastavnim materijalima i početnim ispitivanjima svih uvjetovanih svojstava, uključivo izjavu o sukladnosti i potvrdu ovlaštenog tijela, sve prema TPGK (NN 17/17, 75/20) i norme HRN EN 206.
Ako se bilo koji sastav betona, bude proizvodio na gradilištu, pogon za njegovu proizvodnju će se tretirati kao sastavni dio gradilišta, a u organizaciji, kontroli i potvrđivanju sukladnosti kvalitete proizvodnje morati će u potpunosti zadovoljiti specifikacije iz Drugog dijela Tehničkog propisa za građevinske konstrukcije (NN 17/17, 75/20) i norme HRN EN 206. Beton pilota treba izvesti prema normi HRN EN 1536 (količina cementa u betonu ≥375 kg/m^3). Za izgradnju objekta koristit će se betoni prikazani u tablici.

PODACI O MATERIJALIMA

BETON
SVOJSTVA U SKLADU S HRN EN 206:2016, HRN EN 13670:2010; HRI CEN/TR 15739
ARMATURA - SVOJSTVA U SKLADU S HRN EN 10080:2012

Konstrukcijski elementi	Granične vrijednosti za sastav betona											
	Min. Razred tlačne čvrstoće C (N/mm^2)	Razred izloženosti (HRN EN 1992-1-1)	Maks. udio klorida (HRN EN 206) %	min. Količina cementa (kg/m3)	Vodone-propusnost (VDP) HRN EN 12390-8 i HRN 1128, prodor vode srednja vrijednost cm	vodo/ cementn i faktor (w/c^c)	D_{max} agregata mm	Otpornost na smrzavanje M (HRN 1128; HRN CEN/TS 15177 br. ciklusa smrzavanja i odmrzavanja)	Otpornost na smrzavanje i soli MS (prema HRN 1128 i HRS CEN/TS 12390-9 najveći gubitak mase) kg/m3	Razred konstr. (HRN EN 1992-1-1)	Armatura	Zaštitni sloj (HRN EN 1992-1-1) cm
Podložni beton	C12/15	X0	-	-	-	-	16	-	-	-	-	-
Piloti	C30/37	XC2/XA1	0,2	300	3,0 (VDP2)	0,55	32	-	-	S6	B 500-B	8,0
Naglavnice pilota	C30/37	XC2/XA1	0,2	300	3,0 (VDP2)	0,55	32	-	-	S5	B 500-B	5,5
Prijelazna ploča	C30/37	XC2/XA1/XF2	0,2	300	3,0 (VDP2)	0,55	32	-	1,0 (MS28)	S5	B 500-B	5,5
Upornjaci	C35/45	XC4/XD3/XF2	0,2	320	3,0 (VDP2)	0,45	32	-	1,0 (MS28)	S6	B 500-B	6,5
Stupovi	C30/37	XC4/XD1/XF1	0,2	300	3,0 (VDP2)	0,50	32	M28	-	S6	B 500-B	5,5
Naglavne grede stupova	C30/37	XC4/XD1/XF1	0,2	300	3,0 (VDP2)	0,50	32	M28	-	S6	B 500-B	5,5
Klupice ležajeva i preša	C45/55	XC3/XD1/XF4	0,2	340	3,0 (VDP2)	0,45	16	M56	-	S5	B 500-B	5,0
Montažni nosači	C40/50	XC3/XD1/XF1	0,1	300	3,0 (VDP2)	0,50	16	M28	-	S5	B 500-B Y1860 S7	5,5 (4,5)
Poprečni nosači	C30/37	XC3/XD1/XF3	0,2	320	3,0 (VDP2)	0,50	16	M56	-	S5	B 500-B	5,0
Kolnička ploča	C30/37	XC3/XD1/XF3	0,2	320	3,0 (VDP2)	0,50	16	M56	-	S5	B 500-B	5,0
Kontinuitetna ploča	C35/45	XC3/XD1/XF3	0,2	340	3,0 (VDP2)	0,45	16	-	0,5 (MS56)	S5	B 500-B	5,0
Hodnici i vijenci	C35/45	XC4/XD3/XF4	0,2	340	3,0 (VDP2)	0,45	16	-	0,5 (MS56)	S6	B 500-B	6,0/2,5
Beton ugradnje prijelaznih naprava i rubnjaci	C40/50	XC4/XD3/XF4	0,2	340	3,0 (VDP2)	0,45	16	-	0,5 (MS56)	S5	B 500-B	6,0

Mogu se koristiti distanceri od vlaknastih betona ili običnog betona. Distanceri se mogu napraviti od vlaknastog betona ili običnog betona i ne smiju sadržavati azbest. Moraju biti otporni na starenje i moraju osigurati min. tlačna čvrstoća do 700 kPa, posebno se projektiraju za nosivi i vidljivi beton, mora zadovoljiti zahtjeve za beton i armirani beton u skladu s HRN EN 206: 2013 i protupožarnim propisima HRN EN 1991-1-2 i DIN 4201. Također moraju imati koeficijent proširenja kao i ostali beton.

ČELIK ZA PREDNAPINJANJE
SVOJSTVA U SKLADU S nkHRN EN 10138-1, nHRN EN 10138-3, HRN EN ISO 15630-3 I ETA PROIZVODIMA

KABLOVI ili UŽADI		Y 1860 S7		150 mm^2	∅ kabla, < 8,5cm ili 5,5 / 6,5cm

KONSTRUKCIJSKI ČELIK
SVOJSTVA U SKLADU S HRN EN 10025, HRN EN 10210 I HRN EN 10219, IZVOĐENJE U SKLADU S HRN EN 1090

KONSTRUKCIJSKI ELEMENT	Vrsta ČELIKA		Način zaštite protiv korozije	ostalo
ZAVARENE OGRADE ZA PJEŠAKE	S 235 JR		Vruće cinčano min 85 µm	
ZAŠTITNE OGRADE ZA VOZILA	U skladu s tehničkim dopuštenjem u HR			

Zaštita od korozije vrućim pocinčavanjem vrši se na gotovim elementima. Naknadno bušenje, rezanje, brušenje, poliranje, zavarivanje… nije dopušteno! Spajanje pojedinih elemenata samo s mehaničkim spojevima. Izrada i montaža čeličnih dijelova izvodi se u skladu s HRN EN 1090-2, proizvodnom klasom EXC2 EN 1090-2, razred izvedbe EXC2

Cement.

Za betone specificiranih razreda tlačne čvrstoće ispod C 20/25 mogu se koristiti cementi CEM I ili CEM II/A ili B (s dodatkom S ili V ili M) razreda tlačne čvrstoće 32,5, a za sve ostale betone, cementi CEM I ili CEM II/A ili B razreda tlačne čvrstoće 42,5 ili 52,5. Cementi CEM II/A ili B kao mineralne dodatke smiju sadržavati samo šljaku visokih peći (S) ili lebdeći pepeo (V) ili njihovu kombinaciju. Za beton prednapetih nosača razreda tlačne čvrstoće C 40/50 može se koristiti samo cement CEM I 52,5. Sve vrste cementa moraju biti u skladu s HRN EN 197-1 do 4 i imati važeću Izjavu o svojstvima.

Agregat.

Mora zadovoljavati sva svojstva i njihove najviše razrede kvalitete specificirane normom HRN EN 12620. Najveće nominalno zrno ne smije biti veće od ¼ najmanje dimenzije poprečnog presjeka elementa, od ⅓ debljine ploče odnosno od 0,8 horizontalnih razmaka šipki armature.

Optimalni granulometrijski sastav agregata u betonu mora biti unutar područja omeđenog krivuljama A i B definiranim u normi HRN 1128 (dodatak L). Za smanjenje skupljanja i povećanje trajnosti betona bolji je granulometrijski sastava agregata u donjem dijelu tog područja (što bliže krivulji A). U tom smislu frakcija agregata 4-8 mm ne bi smjela biti iznad 10 % (preporučljivo je oko 5 %).

Voda za pripremu betona. Mora biti u skladu sa zahtjevima danim u normi HRN EN 1008.

Kemijski dodaci betonu. Mogu se koristiti dodaci koji zadovoljavaju zahtjeve norme HRN EN 934-2 i imaju važeću Izjavu o svojstvima.

Beton.
Svi betoni koji se ugrađuju u konstrukciju moraju imati Izjavu o svojstvima u skladu s HRN EN 206 i HRN 1128. Prije početka betonskih radova na gradilištu, potrebo je izraditi Plan kontrole i osiguranja kvalitete betona kojim će biti definirana vrsta i količina betonskih uzoraka za dokazivanje tlačne čvrstoće i posebnih svojstava betona. Na temelju rezultata provedenih ispitivanja, a po završetku svih betonskih radova potrebno je ocijeniti sukladnost betona s uvjetima projekta. Uzorci za dokazivanje projektiranih svojstava betona uzimaju se na gradilištu u skladu s HRN EN 12350-1 i njeguju u skladu sa zahtjevima HRN EN 12390-2 Uzorci za dokazivanje tlačne čvrstoće betona uzimaju se na gradilištu to najmanje jedan uzorak dnevno i/ili jedan uzorak na svakih 100 m^3 pojedinog sastava betona. Jedan ispitni uzorak čine dva ispitna tijela (dvije kocke), a rezultat je srednja vrijednost njihovih tlačnih čvrstoća. Rezultati ispitivanja moraju zadovoljavati kriterije ispitivanja identičnosti tlačne čvrstoće betona specificirane Dodatkom B norme HRN EN 206. U protivnom, na dijelu konstrukcije na kojemu ti kriteriji nisu zadovoljeni, treba dokazati razred tlačne čvrstoće betona u skladu sa zahtjevima danim u normi HRN EN 13791.
Pored toga potrebno je na gradilištu u skladu s normom HRN EN 12390-8 utvrditi vodonepropusnost betona tako da se na svakih 250 m^3 svakog sastava betona ispita po jedan uzorak. Dopušteni prodor vode je 30 mm (VDP2). Svi betoni koji moraju zadovoljiti neki od razreda XF, a razreda tlačne čvrstoće su iznad C 16/20, moraju se aerirati s 3 do 5 % mikropora uvučenog zraka kod maksimalnog zrna agregata 32 mm i 5 do 7 % kod maksimalnog zrna agregata 16 mm.

Materijali za popravak grešaka izvedbe.
Popravke grešaka, koje se dogode u izvedbi (segregacije, pukotine, razna oštećenja i sl.) i zaštitu betona od agresivnog djelovanja okoliša, treba izvoditi postupcima i materijalima specificiranim serijom normi HRN EN 1504-1 do 10 i normama na koje one upućuju. Smiju se koristiti samo materijali koji imaju pravovaljanu Izjavu o svojstvima izdanu od strane proizvođača.

Predgotovljeni betonski elementi.
Predgotovljeni betonski elementi, tj. uzdužni nosači (konstrukcijska uporaba) moraju imati odgovarajuća projektna rješenja (izvedbene projekte) i proizvodnju organiziranu i kontroliranu jednako kao i ostali betonski elementi konstrukcije građevine (s razrađenim planom kontrole i nadzorom razreda 3 prema HRN EN 13670). Svim predgotovljenim elementima moraju se dokazati svojstva zahtijevana gore navedenom tablicom tijekom proizvodnje.

Tehnička svojstva predgotovljenih betonskih elemenata (bilo za konstrukcijsku ili nekonstrukcijsku uporabu) moraju ispunjavati opće i posebne zahtjeve bitne za krajnju namjenu u građevini, i moraju biti specificirana prema članku 18. Tehničkog propisa za građevinske konstrukcije (NN 17/17, 75/20) tehničkoj specifikaciji odnosno prema normi HRN EN 13369: 2018.

Svi korišteni predgotovljeni betonski elementi u građevini moraju imati adekvatnu izjavu o svojstvima ili odgovarajuće tehničko dopuštenje. Potvrđivanje sukladnosti dužan je provoditi proizvođač betona prema TPGK (NN 17/17, 75/20), normi HRN EN 206 i posebnim propisima.

Predgotovljeni betonski element (bilo za konstrukcijsku ili nekonstrukcijsku uporabu) ugrađuje se u betonsku konstrukciju prema projektu betonske konstrukcije, normi HRN EN 13670, normama na koje ta norma upućuje i odredbama TPGK (NN 17/17, 75/20).

3. Izvođenje betonskih radova

3.1. Općenito

Izvođač radova treba izvesti betonske i armirano-betonske radove u skladu sa zahtjevima norme HRN EN 13670 - Izvedba betonskih konstrukcija općenito i TPGK (NN 17/17, 75/20) dio III.
Za razrede izvedbe 2 i 3 izvođač mora izraditi Plan izvedbe betonske konstrukcije prije početka izvođenja radova.
Pogon za proizvodnju betona mora ispunjavati zahtjeve norme HRN EN 206 - Specifikacija, svojstva, proizvodnja i sukladnost. Za svaku vrstu betona proizvođač odnosno izvođač je dužan dostaviti odgovarajuću Izjavu o svojstvima.

3.2. Temeljenje

Prvo se izvode bušeni piloti promjera 120 cm. Naglavnice upornjaka, betoniraju se na samom mjestu, u oplati. Prijelazna ploča može se izvesti tek pošto se nasip dobro zbije.

Naglavnice pilota treba izvesti bez prekida betoniranja, ali tako da temperatura u jezgri betona ne prijeđe 60ºC, što znači da u vrijeme kad je temperatura ugrađenog betona iznad 15ºC treba koristiti cement niske topline hidratacije. Ako se kao takav cement bude koristio šljako cement s oko 70 % šljake visokih peći u sastavu, zaštitni sloj betona treba biti najmanje 7 do 10 cm.
Prilikom izvedbe pilota u svemu se treba pridržavati tehničkih uvjeta izvedbe iz Programa kontrole kvalitete iz Geotehničkog projekta objekta.

3.3. Izrada betonske konstrukcije

Plan izvedbe betonske konstrukcije treba izraditi i detaljno razraditi u izvedbenom projektu i to tako da u njemu bude jasno vidljivo što se kontrolira, tko to i kada kontrolira, koja se dokumentacija o tome vodi i što se poduzima u slučaju pojave bilo koje ili bilo kakve nesukladnosti. Plan mora biti izrađen u skladu sa zahtjevima norme HRN EN 13670.
Glavni, odnosno građevinski i izvedbeni projekt moraju biti na gradilištu, dostupni i nadzoru i izvođaču. Sve eventualne izmjene i dopune treba unijeti u izvedbeni projekt. Ovjeriti ih mora odgovorni projektant.
Posebnim projektnim dijelom izvedbenog projekta mora biti riješena doprema, preuzimanje, skladištenje, postavljanje i monolitizacija predgotovljenih betonskih elemenata, koji se dopremaju iz udaljenih pogona ili centralnih pogona.

Treba posvetiti posebnu pažnju oplati svih vanjskih, vidljivih površina betona. I materijal i oplatna ulja moraju ostaviti zatvorenu površinu jednolika izgleda, bez mrlja, segregacija i velikih zračnih pora. Posebnu pažnju treba posvetiti dobrom brtvljenju oplatnih elemenata na spojevima.
Oplata zidova i stupova ne smije se skidati dok beton ne dostigne 30 % uvjetovanog razreda tlačne čvrstoće (najmanje 24 sata normalnog njegovanja).

Beton dopremljen na gradilište mora biti proizveden i specificiran prema HRN EN 206. Nadzorni inženjer ili njegov pomoćnik-specijalist za kontrolu proizvodnje i ugradnje betona mora izvršiti vizualnu kontrolu svake isporuke betona i njegove popratne dokumentacije (otpremnice i izjave o svojstvima). Ispitivanje svježih svojstava betona na gradilištu treba provoditi minimalno tijekom prve isporuke betona, tijekom uzorkovanja uzoraka za dokazivanje svojstava betona u očvrslom stanju ili ukoliko se posumnja u kvalitetu betona. Korekcija konzistencije dodavanjem vode nije dopuštena. Dopuštena je samo dodavanjem dodatka betonu u količini i na način koji utvrdi proizvođač betona i na gradilištu potvrdi njegov ovlašteni predstavnik. Proizvođač betona mora izdati tehničku uputu kojom je definirana vrsta dodatka kojim se vrši korekcija konzistencije kao i svi potrebni tehnički parametri za primjenu na gradilištu.

Za kontrolu specificiranih razreda tlačne čvrstoće betona na građevini treba svaki dan na svakih 100 m^3 ugrađenog betona uzrokovati po jedan kontrolni uzorak betona (jedan uzorak čine dva ispitna tijela, srednja vrijednost rezultata ispitivanja predstavlja rezultat ispitivanja tlačne čvrstoće betona). Ostala svojstva betona (VDP, M28, M56, MS28, MS56 i sl.) potrebno je uzrokovati u skladu s Planom izvedbe betonske konstrukcije. Uzorkovanju mora prisustvovati i zapisnik supotpisati nadzorni inženjer ili njegov pomoćnik specijalist za kontrolu proizvodnje i ugradnje betona. Ispitivanje ovih uzoraka mora se ispitati u laboratoriju koji je opremljen i osposobljen za provedbu svih navedenih ispitivanja. Obradu i ocjenu rezultata ispitivanja prema kriterijima ispitivanja identičnosti tlačne čvrstoće betona, danih u Dodatku B norme HRN EN 206 vrši institucija ovlaštena za nadzor i potvrđivanje sukladnosti kvalitete proizvodnje betona.

Ugrađeni beton treba na odgovarajući način, precizno specificiran u izvedbenom projektu te zaštiti:

- od neumjerenog skupljanja
- od štetnih vibracija, udara ili bilo kakvih oštećivanja.

Način vlažne zaštite betona treba precizno specificirati izvedbenim projektom i Planom izvedbe betonske konstrukcije. Trajanje takvog njegovanja treba biti sukladno tablici F.1 dodatka F HRN EN 13670.
Površinska temperatura betona ne smije pasti ispod 0ºC dok čvrstoća betona ne dosegne 10 N/mm^2. Temperatura ugrađenog betona ne smije prijeći 60 ºC.
Specifikacije za rukovanje, skladištenje, zaštitu, postavljanje i prilagodbu predgotovljenih elemenata monolitno izvedenom dijelu konstrukcije treba dati u izvedbenom projektu i izvedbu provesti skladno sa specifikacijama. Moraju biti dane upute za skladištenje i shema dizanja s naznačenim točkama i silama ovješenja i opisom načina dizanja. Tijekom postavljanja treba kontrolirati ispravnost položaja, dimenzijsku točnost oslonaca, stanje spojnica i cjelokupni sklop konstrukcije.
Dovršenje konstrukcije mora biti unutar dopuštenih geometrijski tolerancija danih točkom 10 i dodatkom G HRN EN 13670.
Ovdje uvjetovani nadzor razreda 3 za kontrolu kvalitete izvedbe betonske konstrukcije građevine mora u cjelini (u svim fazama izvedbe) djelovati prema specifikacijama danim točkom 4 HRN EN 13670.

4. Čelik za armiranje i prednapinjanje

Mogu se koristiti čelici prema normama HRN 1130 1 do 5 i HRN EN 10080 za čelik za armiranje i HRN EN 10138 1 do 4 za čelik za prednapinjanje.
Armiranje treba izvesti prema normi HRN EN 1992-1-1, čiji uvjeti moraju biti precizno naznačeni u nacrtima armature u izvedbenom projektu.

Površina armature mora biti očišćena od slobodne hrđe i tvari koje mogu štetno djelovati na čelik, beton ili vezu između njih.
Armatura će se na gradilište dovesti u savijenom stanju, a bit će rezana i savijena u armiračkom pogonu. Čelik za armiranje betona treba rezati i savijati prema projektnim specifikacijama. Pri tome:

- savijanje treba izvoditi jednolikom brzinom,
- savijanje čelika pri temperaturi ispod -5 °C, ako je dopušteno projektnim specifikacijama, treba izvoditi uz poduzimanje odgovarajućih posebnih mjera osiguranja,
- savijanje armature grijanjem smije se izvoditi samo uz posebno odobrenje u projektnim specifikacijama.

Šipke čelične armature, zavarene mreže i predgotovljeni armaturni koševi ne smiju se oštetiti tijekom prijevoza, skladištenja, rukovanja i postavljanja u projektiranu poziciju.
Prije postavljanja armature, mora se ista očistiti od prljavštine, masnoće i ljusaka od korozije. Ispod armature koja se postavlja na tlo potrebno je izvesti sloj za izravnanje.

F. ASFALTERSKI RADOVI

Svi sastojci asfaltnih mješavina, te asfalt kao cjelina, trebaju u potpunosti zadovoljavati zahtjeve važećih normi, propisa i pravila struke. Kontrolna ispitivanja izvedenog sloja asfaltbetona obuhvaćaju provjeru debljine sloja, ravnosti, hrapavosti i nagiba gornje plohe, te fizikalno- mehaničkih svojstava materijala.

G. HIDROIZOLATERSKI RADOVI

Kontrolu kvalitete materijala koji se ugrađuju treba vršiti sukladno važećim normativima. Priprema površine i sva ostala rješenja hidroizolacije trebaju u potpunosti odgovarati projektu i pravilima struke. Pri izvedbi radova nužan je stalni i aktivni stručni nadzor.

H. OSTALA GRADIVA I OPREMA GRAĐEVINE

Za sva gradiva i elemente koji nisu izrijekom spomenuti ovim Programom, a ugraditi će se u objekt, potrebno je prije ugradbe pribaviti pripadne Izjave o sukladnosti kao dokaz standardne kvalitete.
Izvođač radova osigurati će po tri primjerka dokazne dokumentacije o kakvoći iz svog opsega posla i predati Naručitelju posla po izvršenju svoje ugovorene obveze.

I. NADZOR

Odgovorni inženjer stručnog nadzora i odgovorni rukovoditelj izvedbe građevine moraju biti imenovani sukladno Zakonu o gradnji. I jedan i drugi moraju imati visoku stručnu spremu, najmanje 5 godina radnog iskustva i položen stručni ispit. Inženjer za tehnički nadzor mora pored toga biti i član Komore arhitekata i inženjera Republike Hrvatske.
Kontrolu izvedbe betonske konstrukcije građevine treba u cjelini izvesti prema specifikacijama norme HRN EN 13670 i za nju osigurati razred nadzora 3. Takav nadzor osigurava Investitor. Nadzor treba u cjelini djelovati prema specifikacijama točke 4 i norme HRN EN 13670 što se odnosi na kontrolu dijelova konstrukcije koji se izvode na gradilištu.
Pregledi i nadzor trebaju osigurati da se radovi završavaju u skladu s ovim Tehničkim uvjetima i zahtjevima projektnih specifikacija. Nadzor u ovom kontekstu odnosi se na verifikaciju (potvrđivanje) sukladnosti svojstava proizvoda i materijala koji će se upotrijebiti i na nadzor nad izvedbom radova.

1. Nadzor materijala i proizvoda

Koji će se nadzor svojstava materijala i proizvoda primijeniti u radovima prikazanje sljedećom tablicom.

PREDMET	VRSTA NADZORA
Materijali oplate	Vizualni nadzor
Armaturni čelik	Prema HRN 1130 i HRN EN 10080 i zahtjevima projekta[3)]
Svježi beton proizveden u tvornici ili na gradilištu.	Prema HRN EN 206, I prema ovim tehničkim uvjetima[1)] . Pri preuzimanju betona treba postojati otpremnica.
Ostali materijali[2)]	Prema projektnim specifikacijama i normama
Nadzorni izvještaj	Treba
1) Na gradilištu izrađeni sastavni dijelovi smatraju se kao sastavni dijelovi proizvedeni sa "svježim betonom, tvorničkim ili gradilišnim", osim ako nisu proizvedeni prema normi. 2) Npr. element ugrađenog čelika, opeka i si. 3) Proizvode s potvrdom sukladnosti treće osobe treba vizualno pregledati i provjeriti otpremnicu. U slučaju sumnje treba poduzeti daljnje provjere sukladnosti sa specifikacijama. Ostale proizvode treba provjeriti i ispitati prema projektnim specifikacijama.	

Područje nadzora izvedbe

Područje nadzora koji treba provesti prikazano je u tablici

PREDMET	VRSTA NADZORA
Kalupi, oplata i skele	Glavne kalupe i oplatu pregledati prije betoniranja
Obična armatura	Glavnu armaturu pregledati prije betoniranja
Ugrađeni elementi	Prema projektnim specifikacijama i ovim tehničkim uvjetima
Gradilišni prijevoz i ugradnja betona	Prema ovim tehničkim uvjetima
Završna obrada i njegovanje betona	Prema ovim tehničkim uvjetima
Geometrija	Prema projektnim specifikacijama
Nadzorna dokumentacija	Kako se traži ovim uvjetima

2. Nadzor prije betoniranja

Prije početka betoniranja nadzor treba uključivati:

- geometriju oplate,
- stabilnost oplate, skela i njihovih temelja,
- nepropusnost oplate,
- uklanjanje nečistoća (kao što su prašina, snijeg i/ili led i ostaci žice) s dijela koji će se betonirati,
- obradu lica konstrukcijskih spojnica,
- pripremu površine oplate,
- otvore u oplati
- potvrdu sukladnosti ugrađene armature sa svojstvima uvjetovanim u HRN 1130 1 do 5 i HRN EN 10080 i HRN EN 10138
- provjeru projektirane pozicije armature prema iskazima u nacrtima,
- provjeru zaštitnog sloja,
- čistoću armature (da je nezagađena uljem, mastima, bojom ili drugim štetnim materijalima),
- učvršćenje i osiguranje armature od pomicanja tijekom betoniranja,
- provjeru dovoljnog razmaka između šipki armature za ugradnju i zbijanje betona
- ispravno postavljanje geotekstila te brtvenih traka na spojnicama dilatacija

3. Nadzor postupka betoniranja

Nadzor i ispitivanje postupka betoniranja treba planirati, izvoditi i dokumentirati prema tablici

PREDMET	VRSTA NADZORA
Planiranje nadzora	Plan nadzora, procedure i instrukcije prema specifikacijama Aktivnosti kod nesukladnosti
Nadzor	Osnovni i povremeni detaljni nadzor
Dokumentacija	Svi dokumenti planiranja, Izvještaji o svim nadzorima Izvještaji o svim nesukladnostima i popravnim mjerama

Plan nadzora treba identificirati sve nadzore, motrenja i ispitivanja za potrebne dokaze kvalitete.
Najbolji nadzor je kontinuirani nadzor sukladnosti i uobičajene dobre prakse.

J. MJERE U SLUČAJU NESUKLADNOSTI

Kad nadzor otkrije nesukladnost, treba poduzeti odgovarajuće radnje koje će osigurati uvjetovanu stabilnost i sigurnost konstrukcije i zadovoljiti namjeravanu uporabu.
Kad je nesukladnost potvrđena, treba istražiti sljedeće:

- utjecaj nesukladnosti na izvedbu i uporabu,
- mjere potrebne da bi se nesukladni element ili dio konstrukcije učinili prihvatljivima,
- potrebu zabrane i zamjene nepopravljivog nesukladnog elementa ili dijela konstrukcije.

Veličina nesukladnosti uvjetovanih svojstava betona utvrđuje se naknadnim ispitivanjima istih svojstava na uzorcima betona iz konstrukcijskog elementa prema važećim normama. Ispitivanja se odlukom nadzornog inženjera povjeravaju odgovarajućoj ovlaštenoj instituciji.
Nesukladnost tlačne čvrstoće (postignute i uvjetovane klase) betona rješava se naknadnim ispitivanjem uzoraka betona izvađenih iz dijela konstrukcije u koji je ugrađen nesukladni beton.
Ispitivanja treba provesti prema HRN EN 12504 - 1 do 4, a ocjenu rezultata prema HRN EN 13791. Treba utvrditi klasu tlačne čvrstoće kojoj ugrađeni beton odgovara u vrijeme ispitivanja, te približnu klasu kojoj je odgovarao pri 28-dnevnoj starosti. Prva služi za kontrolu stabilnosti i sigurnosti predmetnog konstrukcijskog dijela a druga za reguliranje ugovornih odnosa između proizvođača i kupca betona.
Ako su neispravnosti i nesukladnosti zanemarive za izvedbu i uporabu element treba preuzeti. Ako se nesukladnost može popraviti, element treba preuzeti nakon popravka.
Ocjenu sukladnosti elemenata nakon popravka trebaju dati nadzorni inženjer i ovlaštena institucija koja je utvrdila veličinu nesukladnosti i uvjetovala popravak.

Rektifikacija nesukladnosti mora biti u skladu s projektnim specifikacijama i ovim Tehničkim uvjetima.
Dokumentaciju postupka i materijala koji će se upotrijebiti treba prije popravka odobriti nadzorni inženjer.

K. ODRŽAVANJE

Radnje u okviru održavanja konstrukcije treba provoditi prema odredbama Tehničkog propisa za građevinske konstrukcije (NN 17/17, 75/20), članak 36. i normama na koje upućuje, te odgovarajućom primjenom odredaba važećih ostalih propisa. Detaljnije je opisano u tehničkom opisu poglavlju Projektirani vijek građevine i uvjeti za njeno održavanje.

L. ISPITIVANJA I POSTUPCI DOKAZIVANJA NOSIVOSTI I UPORABLJIVOSTI KONSTRUKCIJE

Obvezno je ispitati probnim opterećenjem cestovne i pješačke mostove raspona ≥ 15,0m te željezničke raspona ≥10 m ili na zahtjev naručitelja.
Ocjenu ponašanja konstrukcije građevine u odnosu na ovim projektom usvojene pretpostavke treba utvrditi pokusnim opterećenjem, prema članku 8. TPGK (17/17, 75/20) i prilogu I.10 Ispitivanje konstrukcije pokusnim opterećenjem te normi HRN EN U.M1.046 od strane akreditirane ustanove za normu HRN EN U.M1.046 prema normi za ispitne laboratorije HRN EN ISO/IEC 17025. Detaljnije je opisano u tehničkom opisu poglavlju Pokusni rad – probno opterećenje.

M. NAČIN ZBRINJAVANJA GRAĐEVINSKOG OTPADA

Način zbrinjavanja građevnog otpada mora biti u skladu s propisima o otpadu.
Osnovni propisi iz tog područja su:

- Zakon o održivom gospodarenju otpadom
- Zakon o otpadu
- Pravilnik o gospodarenju otpadom
- Pravilnik o vrstama otpada

S građevnim otpadom treba postupiti u skladu s Pravilnikom o gospodarenju otpadom.
Nakon završetka radova gradilište treba očistiti od otpada i suvišnog materijala, postupiti prema iznesenom, a okolni dio terena dovesti u uredno stanje prije izdavanja uporabne dozvole.

Zagreb, travanj 2023.

Projektant:

Mate Pezer, dipl.ing.građ.

Izradio: **INSTITUT IGH d.d.**

Zavod za projektiranje

10 000 Zagreb, J. Rakuše 1

Građevina: **IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA:**

4. faza izgradnje – nastavak iskopa glinenog materijala u cijelom gabaritu prokopa za izgradnju nasipa sustava obrane od poplava karlovačkog područja, prokop Korana – Kupa, nasipi uz lijevu i desnu obalu prokopa, desnu obalu Kupe, lijevu obalu Korane i uz ispusnu ustavu (N1 – N5), upusna i ispusna ustava, građevine za odvodnju zaobalnih voda, uklanjanje dijela nasipa u sklopu zahvata dionice državne ceste D1 (splitski pravac, brza cesta kroz Karlovac, II. etapa I. faze) i 5. faza izgradnje - most preko prokopa na nerazvrstanoj cesti NC 340720 Gornje Mekušje – Kamensko)

Knjiga: **CESTOVNI MOST PREKO PROKOPA – konstrukcija**

Vrsta projekta (razina i struka): GLAVNI GRAĐEVINSKI PROJEKT

Zajednička oznaka projekta: GP-5986/23

Oznaka projekta: 72120-GP-285-2020

0401 PRORAČUN KONSTRUKCIJE

Mjesto i datum: Zagreb, travanj 2023.

PRORAČUN KONSTRUKCIJE

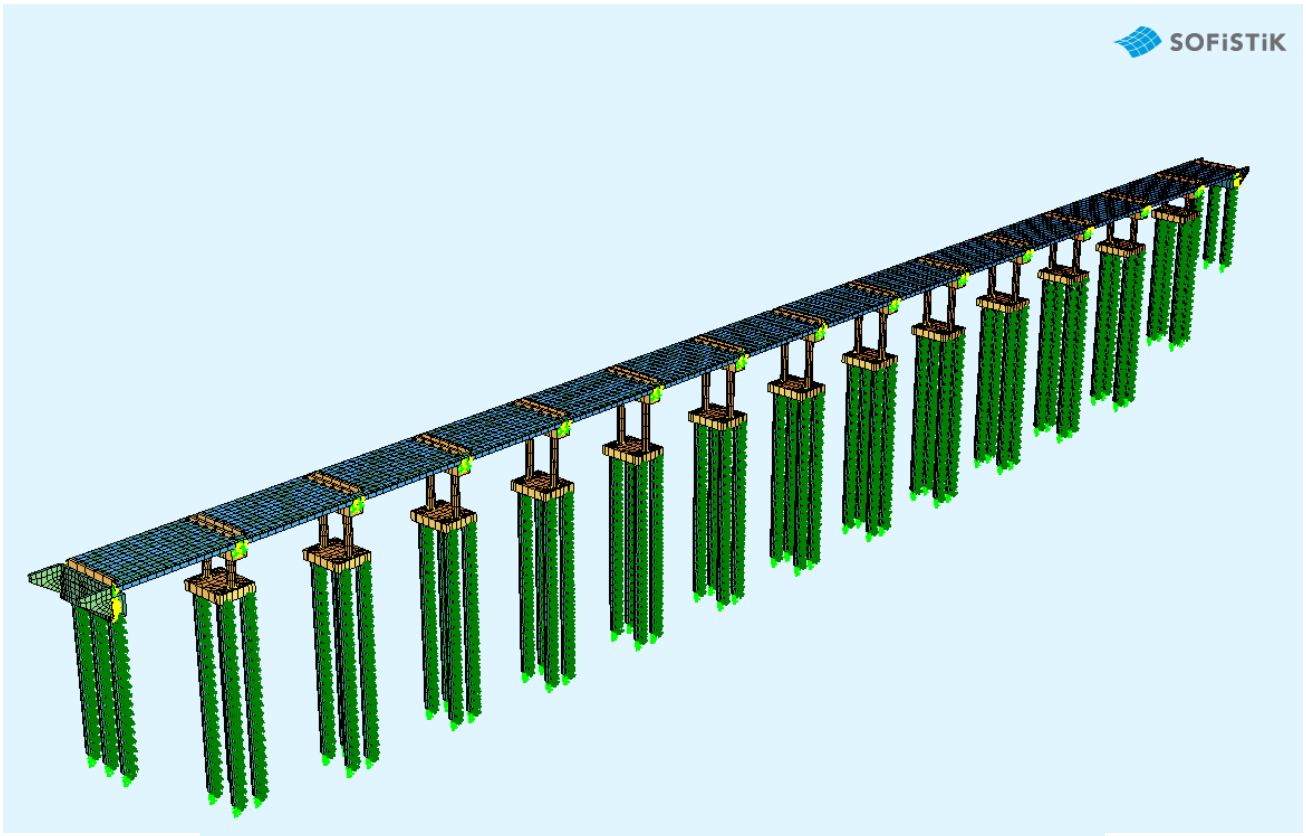
0401 PRORAČUN KONSTRUKCIJE 35

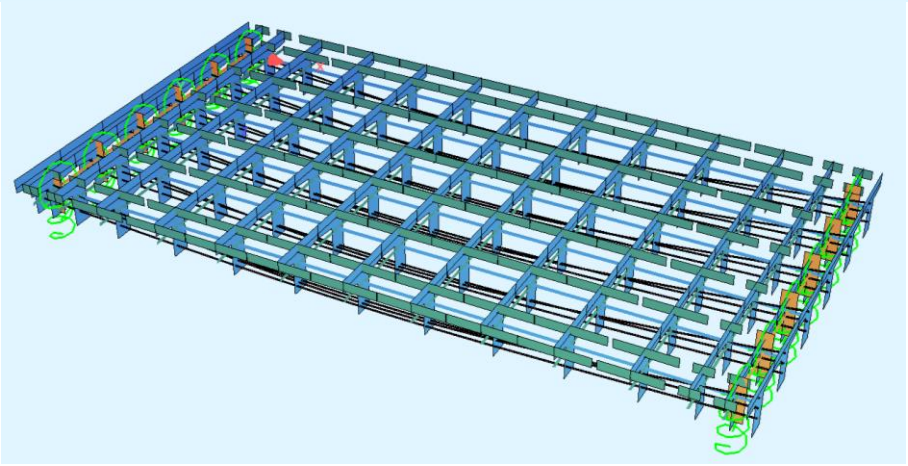
1. OPĆENITO 37
2. ANALIZA OPTEREĆENJA 62
3. RASPONSKI SKLOP 105
4 LEŽAJEVI I PRIJELAZNE NAPRAVE 185
5. STUPOVI 209
6 NAGLAVNICA STUPOVA 220
7 NAGLAVNICE PILOTA STUPOVA 228
8 PILOTI 239
9. UPORNJAK 255
10 PRIJELAZNA PLOČA 288

1. OPĆENITO

1.1. Opći podaci i model

Most se sastoji od 14 polja raspona 19,3+12x20,0+14,0 = 273,3 m. Odabrani rasponski sklop je roštilj statičkog sustava niz prostih greda, sastavljen od šest predgotovljenih prednapetih nosača visine 110 cm s dobetoniranom pločom debljine 25 cm. Osni je razmak nosača konstante širine 182 cm. Poprečni nosači su predviđeni samo nad ležajevima. Prednapeti su nosači od betona C40/50, dobetonirana kolnička ploča i poprečni nosači C30/37. Nosači se prednapinju visokovrijednim čelikom za prednapinjanje fpk=1860 N/mm2, i armiraju armaturom B500B.





Stupišta se izvode u betonu C30/37, oslanjaju se na naglavne grede pilota. Sastoje se od dva stupa Φ 120 cm povezana naglavnom gredom. Naglavne ploče pilota stupova oslonjene su na po četiri pilota Φ 120 cm. Tlocrtnih su dimenzija 580x740 cm, debljine 150 cm. Naglavne grede upornjaka oslonjene su na tri pilota Φ 120 cm. Naglavne grede upornjaka su b x h=235x200 cm, odnosno b x h=235x300 cm od betona C30/37. Armatura svih elemenata donjeg ustroja je B500B.

Statički proračun mosta proveden je na elektroničkom računalu koristeći programski paket Sofistik. Za proračun mosta korišten je globalni prostorni model koji uključuje upornjake, roštilj prednapetih

nosača i linijski model ploče u poprečnom smjeru. Nosači, poprečni nosači, naglavne grede i stupovi su modelirani pomoću štapnih elemenata. Naglavna ploča pilota, ploča između nosača i kontinuitetna ploče su modelirani sa plošnim elementima. Krila i zidić upornjaka su modelirani pomoću pločastih elemenata. Tlo je predstavljeno oprugama odgovarajuće krutosti prema geotehničkom projektu. Elastomerni ležajevi ispod svakog nosača modelirani su spring elementima. Dva karakteristična raspona (najveći i najmanji) modelirani su kao roštilj od prednapetih nosača povezanih u poprečnom smjeru štapovima koji predstavljaju ploče i na ležaju poprečnim nosačima. Proračun ploče u poprečnom smjeru je proveden na štapnom modelu za ploču širine 1m. Most je proračunat na slijedeća opterećenja/djelovanja prema Eurokodovima:

- vlastita težina
- dodatna stalna opterećenja
- opterećenje tlom
- puzanje i skupljanje betona
- prometno opterećenje mostova
- temperaturno opterećenje
- opterećenje vjetrom
- slijeganje oslonaca
- potresno opterećenje

Vlastita težina rasponskog sklopa zadana je u programu Sofistik preko zadanih poprečnih presjeka. Ostali stalni teret zadan je kao kontinuirano ili koncentrirano opterećenje. Zapreminska težina armiranog betona računata je s 25,0 kN/m3. Prometno opterećenje zadano je dijelom kao kontinuirano plošno, a dijelom kao koncentrirane sile.

Uzeti su u obzir najnepovoljniji položaji prometnog opterećenja za svaki presjek. Skupljanje i puzanje betona definirano je pomoću modula CSM unutar samog kompjuterskog proračuna.
Potresne sile određene su prema Eurokodu. Kod proračuna na opterećenje potresom korišten je prostorni model konstrukcije i višemodalna spektralna analiza. Ukupne sile i pomaci su izračunati prema CQC metodi. Računsko ubrzanje tla iznosi ag=0,156g. Objekt je prosječne važnosti (faktor važnosti Ψ=1), a tlo je C kategorije. Faktor ponašanja je uzet q = 1 za rasponski sklop oslonjen preko elastomernih ležajeva na donji ustroj, u biti elastično ponašanje.

U izlaznim rezultatima su prikazana uzeta opterećenja, osnovni geometrijski oblici modela, podaci o elementima. Potom su priloženi rezultati proračuna u grafičkom obliku. Proveden je kompletan proračun unutarnjih sila u elementima, analiza naprezanja po presjecima i dimenzioniranje.
Vertikalni i horizontalni moduli reakcije tla su preuzeti iz geotehničkog projekta. Oni su korišteni u računskom modelu kao linijske i točkaste opruge. Svi parametri i utjecaji tla su izračunati u geotehničkom projektu i preuzeti iz njega.

1.2. Kombinacije djelovanja

Ove kombinacije su kombinacije za trajna i prijelazna proračunska stanja za provjeru graničnog stanja nosivosti prema EC1.

Računska vrijednost djelovanja za stalnu ili prolaznu kombinaciju je:

$$S_d = S_d \cdot \left[\sum_j \left(\gamma_{G,j} \cdot G_{k,j} \right) + \gamma_Q \cdot Q_{k,1} + \sum_{i>1} \left(\gamma_Q \cdot \psi_{0,i} \cdot Q_{k,i} \right) \right]$$

Računska vrijednost djelovanja za izvanrednu kombinaciju je:

$$S_d = S_d \cdot \left[\sum_j \left(\gamma_{G,j} \cdot G_{k,j} \right) + \psi_{1,1} \cdot Q_{k,1} + \sum_{i>1} \left(\psi_{2,i} \cdot Q_{k,i} \right) + A_d \right]$$

Računska vrijednost djelovanja za seizmičku kombinaciju je:

$$S_d = S_d \cdot \left[\sum_j \left(G_{k,j} \right) + \gamma_I \cdot E_{Ed} + \psi_{21} \cdot Q_{k,1} \right]$$

OZNAKA KOMBINACIJE LC	Raspisane kombinacije korištene za dimenzioniranje rasponskog sklopa, stupova, naglavnica pilota i pilota	NAZIV KOMBINACIJE	Oznaka armature
2100 – 2199** 9900 – 9999*	$1{,}35\ (1{,}0)\cdot G+1{,}35(1{,}0)\cdot R+1{,}35\cdot(Q_{oso}+Q_{jed})+1{,}0\cdot P+1{,}0\cdot C+1{,}5\cdot ZW_{opt}+0{,}75\cdot ZT+1{,}0\cdot ZF$	PROMET+VJETAR	Lcr 1
	$1{,}35\ (1{,}0)\cdot G+1{,}35(1{,}0)\cdot R+1{,}5\cdot ZT+1{,}35\cdot(0{,}75\cdot Q_{oso}+0{,}4\cdot Q_{jed})+1{,}0\cdot P+1{,}0\cdot C+1{,}0\cdot ZF$	TEMPERATURA	
	$1{,}35(1{,}0)\cdot G+1{,}35(1{,}0)\cdot R+1{,}5\cdot K+0{,}75\cdot ZT\ 1{,}35\cdot(0{,}75\cdot Q_{oso}+0{,}4\cdot Q_{jed})+1{,}0\cdot P+1{,}0\cdot C+1{,}0\cdot ZF+1{,}5\cdot ZW_{opt}$	KOČENJE	
9800 – 9899	$1{,}0\cdot G+1{,}0\cdot R+A+0{,}75\cdot Q_{oso}+0{,}4\cdot Q_{jed}+1{,}0\cdot C+1{,}0\cdot ZF+1{,}0\cdot ZW_{opterećen}+0{,}5\cdot ZT$	UDAR	Lcr 4
	$1{,}0\cdot G+1{,}0\cdot R+A+0{,}2\cdot Q_{oso}+0{,}2\cdot Q_{jed}+1{,}0\cdot C+1{,}0\cdot ZF+1{,}0\cdot ZW_{opterećen}+0{,}6\cdot ZT$		
7500 – 7599	$1{,}0\cdot G+1{,}0\cdot C+1{,}0\cdot R+E_X+0{,}3\cdot E_Y+0{,}3\cdot Ez$	POTRES	Lcr 7
8500 – 8599	$1{,}0\cdot G+1{,}0\cdot C+1{,}0\cdot R+0{,}3\cdot E_X+E_Y+0{,}3\cdot Ez$		Lcr 8

*Kombinacija opterećenja vrijede za sve elemente mosta stupove, upornjake, naglavnice pilota i pilote osim rasponskog sklopa.

**Kombinacija opterećenja vrijede za samo za rasponski sklop (nosači).

1.3. Materijali

C 40/50 (HRN EN 1992)- AB montažni nosači

Youngs-modulus	E	34525	[MPa]	Safetyfactor		1.50	[-]
Poisson-Ratio	mu	0.20	[-]	Strength	fc	34.00	[MPa]
Shear-modulus	G	14386	[MPa]	Nomin. strength	fcn	40.00	[MPa]
Compression modulus		19181	[MPa]	Tens. strength	fctm	3.51	[MPa]
Weight		25.0	[kN/m3]	Tens. strength	fctk,05	2.46	[MPa]
Weight buoyancy		25.0	[kN/m3]	Tens. strength	fctk,95	4.56	[MPa]
Temp.elongat.coeff.		1.00E-05	[1/°K]	Bond strength	fbd	3.68	[MPa]
Tens.des strength	fctd	1.64	[MPa]	Service strength		48.00	[MPa]
Tens.failure energy	Gf	0.15	[Nmm]	Fatigue strength		19.04	[MPa]

C 30/37 (HRN ENV 1992) beton ploče, poprečnih nosača, stupovi, naglavnice stupa i pilota, piloti, kolnička ploča

Youngs-modulus	E	31939	[MPa]	Safetyfactor	γc	1.50	[-]
Poisson-Ratio	mu	0.20	[-]	Strength	fc	25.50	[MPa]
Shear-modulus	G	13308	[MPa]	Nomin. strength	fcn	30.00	[MPa]
Compression modulus		17744	[MPa]	Tens. strength	fctm	2.90	[MPa]
Weight		25.0	[kN/m3]	5 % t.strength	fctk	2.03	[MPa]
Weight buoyancy		25.0	[kN/m3]	95 % t.strength	fctk	3.77	[MPa]
Temp.elongat.coeff.		1.00E-05	[1/°K]	Bond strength	fbd	3.04	[MPa]
Tens.des strength	fctd	1.35	[MPa]	Service strength		38.00	[MPa]
Tens.failure energy	Gf	0.14	[Nmm]	Fatigue strength		14.96	[MPa]

Za pilote se dodatno uvećava γc s **k**f =1,1

C 35/45 (HRN EN 1992) upornjaci:

Youngs-modulus	E	34525	[MPa]	Safetyfactor		1.50	[-]
Poisson-Ratio	mu	0.20	[-]	Strength	fc	40.00	[MPa]
Shear-modulus	G	14386	[MPa]	Nomin. strength	fcn	40.00	[MPa]
Tlak modulus		19181	[MPa]	Tens. strength	fctm	3.51	[MPa]
Weight		25.0	[kN/m3]	5 % t.strength	fctk	2.46	[MPa]
Weight buoyancy		25.0	[kN/m3]	95 % t.strength	fctk	4.56	[MPa]
Temp.elongat.coeff.		1.00E-05	[1/°K]	Bond strength	fbd	3.68	[MPa]
Tens.des strength	fctd	1.5	[MPa]	Service strength		48.00	[MPa]
Tens.failure energy	Gf	0.14	[Nmm]	Fatigue strength		22.40	[MPa]

B500B (HRN ENV 1992)- armatura

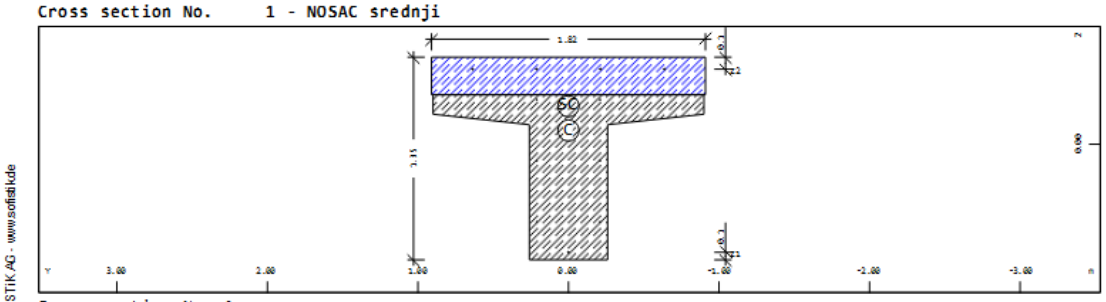
Youngs-modulus	E	200000	[MPa]	Safetyfactor		1.15	[-]
Poisson-Ratio	mu	0.30	[-]	Yield stress	fy	500.00	[MPa]
Shear-modulus	G	76923	[MPa]	Compr.yield val.	fyc	500.00	[MPa]
Compression modulus		166667	[MPa]	Tens. strength	ft	550.00	[MPa]
Weight		78.5	[kN/m3]	Compr. strength	fc	550.00	[MPa]
Weight buoyancy		78.5	[kN/m3]	Ultim. plast. strain		50.00	[o/oo]
Temp.elongat.coeff.		1.20E-05	[1/°K]	relative bond coeff.		1.00	[-]
max. thickness		32.00	[mm]	EC2 bondcoeff. K1		0.80	[-]
				Hardening modulus		0.00	[MPa]
				Proportional limit		500.00	[MPa]
				Dynamic stress range		152.17	[MPa]

Y 1860 A (EN 1992) – prednapeti čelik (kablovi)

Young's modulus	E	195000	[N/mm2]	Safetyfactor		1.15	[-]
Poisson's ratio	μ	0.30	[-]	Yield stress	fy	1600.00	[MPa]
Shear modulus	G	75000	[N/mm2]	Compressive yield	fyc	1600.00	[MPa]
Compression modulus	K	162500	[N/mm2]	Tensile strength	ft	1860.00	[MPa]
Nominal Weight	γ	78.5	[kN/m3]	Compressive strength	fc	1860.00	[MPa]
Mean density	ρ	7850.0	[kg/m3]	Ultimate strain		60.00	[o/oo]
Elongation coefficient	α	1.20E-05	[1/K]	relative bond coeff.		0.75	[-]
max. thickness	t-max	18.00	[mm]	EN 1992 bond coeff.	k1	1.60	[-]
Relaxation	EN-1992	Class 2		Hardening modulus	Eh	0.00	[MPa]
Relaxation	ρ(1000h)	2.50	[%]	Proportional limit	fp	1600.00	[MPa]
				Dynamic allowance	σ-dyn	160.87	[MPa]

1.4 Poprečni presjeci

Cross section No. 1 - NOSAC srednji



Cross section No. 1

Static properties of cross section

SNo	Mat MRf	A[m2] It[m4]	Ay[m2] Az[m2] Ayz[m2]	Iy[m4] Iz[m4] Iyz[m4]	yc[m] zc[m]	ysc[m] zsc[m]	E[MPa] G[MPa]	g[kg/m]	I-1[m4] I-2[m4] α[°]
1	1	1.1840E+00	7.396E-01	1.738E-01	0.000	0.000	37278	1958.0	1.962E-01
	3	8.830E-03	5.797E-01	1.962E-01	-0.092	-0.253	15532	(BEAM)	1.738E-01
	= NOSAC srednji = Composit with materials: 1 4								
1.1	1	7.8320E-01	4.179E-01	9.173E-02	0.000	0.000	37278	1958.0	
	3	3.976E-03	4.122E-01	8.560E-02	0.094	-0.093	15532	(BEAM)	
	= CS 5								

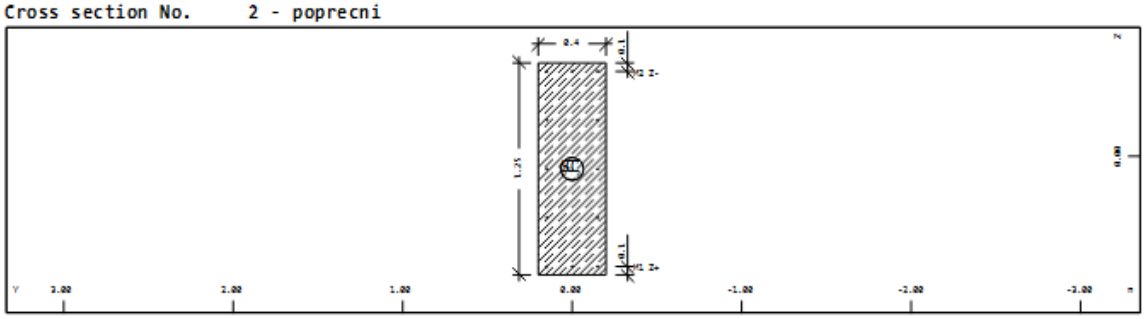
SNo	section number	yc[m],zc[m]	ordinate of elastic centroid
Mat	material number	ysc[m],zsc[m]	ordinate of shear centre
A[m2]	sectional area	E[MPa]	Young's modulus
Ay[m2],Az[m2],Ayz[m2]	transverse shear deformation area	g[kg/m]	weight per length
Iy[m4],Iz[m4],Iyz[m4]	bending moment of inertia		
I-1[m4],I-2[m4],α[°]	principal moments of inertia and angle of the principal axes		
MRf	reinforcement material number		
It[m4]	torsional moment of inertia		
G[MPa]	Shear modulus		

Reinforcement global values

Layer	Mref	Mat	As [cm2]	As-min [cm2]	As-max [cm2]	D [mm]	yr [m]	zr [m]	L-tors [m]	N-p [kN]	My-p [kNm]	Mz-p [kNm]
Z1	1	3	1.00	0.00		12	0.000	0.720				
Z2	4	3	4.00	0.00		12	0.000	-0.500				
Z3	1	3	1.22	0.00		12	-0.210	0.110				
Z4	1	3	1.22	0.00		12	0.210	0.110				

Layer	layer of reinforcement	D	bar diameter
Mref	embedding reference material	yr,zr	ordinate of elastic centroid
Mat	material number	L-tors	torsional effective length
As	reinforcement area	N-p	prestress normal force

Cross section No. 2 - poprecni



Cross section No. 2 - poprecni

Static properties of cross section

SNo	Mat MRf	A[m2] It[m4]	Ay[m2] Az[m2] Ayz[m2]	Iy[m4] Iz[m4] Iyz[m4]	yc[m] zc[m]	ysc[m] zsc[m]	E[MPa] G[MPa]	g[kg/m]	I-1[m4] I-2[m4] α[°]
2	2	5.0000E-01	4.167E-01	6.510E-02	0.000	0.000	32837	1250.0	
	3	2.129E-02	4.167E-01	6.667E-03	0.075	0.075	13682	(BEAM)	
= poprecni									

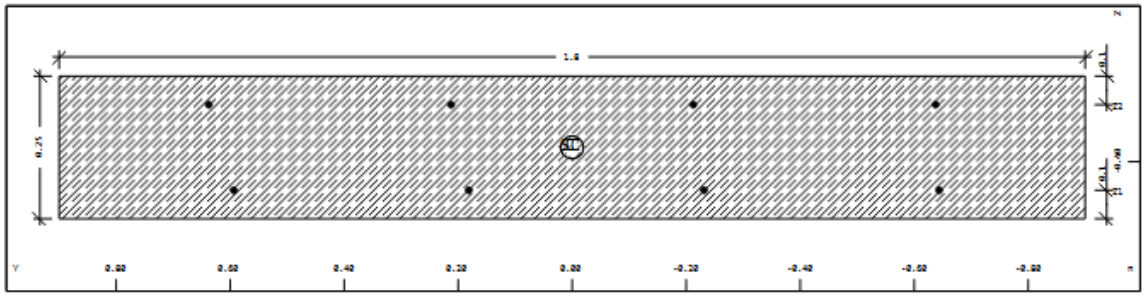
SNo	section number	yc[m],zc[m]	ordinate of elastic centroid
Mat	material number	ysc[m],zsc[m]	ordinate of shear centre
A[m2]	sectional area	E[MPa]	Young's modulus
Ay[m2],Az[m2],Ayz[m2]	transverse shear deformation area	g[kg/m]	weight per length
Iy[m4],Iz[m4],Iyz[m4]	bending moment of inertia		
I-1[m4],I-2[m4],α[°]	principal moments of inertia and angle of the principal axes		
MRf	reinforcement material number		
It[m4]	torsional moment of inertia		
G[MPa]	Shear modulus		

Reinforcement global values

Layer	Mref	Mat	As [cm2]	As-min [cm2]	As-max [cm2]	D [mm]	yr [m]	zr [m]	L-tors [m]	N-p [kN]	My-p [kNm]	Mz-p [kNm]
M1 Z+	2	3	2.37	0.00		10	0.000	0.650	0.300			
M2 Z-	2	3	2.37	0.00		10	0.000	-0.500	0.300			
M3 Y+-	2	3	4.74	0.00	4.74	10	0.000	0.075	2.300			

Layer	layer of reinforcement	D	bar diameter
Mref	embedding reference material	yr,zr	ordinate of elastic centroid
Mat	material number	L-tors	torsional effective length
As	reinforcement area	N-p	prestress normal force
As-min	minimum reinforcement area	My-p,Mz-p	prestress bending moment
As-max	maximum reinforcement area		

Cross section No. 3 - PLOCA1.8M



Cross section No. 3 - PLOCA1.8M

Static properties of cross section

SNo	Mat	A[m2]	Ay[m2]	Iy[m4]	yc[m]	ysc[m]	E[MPa]	g[kg/m]	I-1[m4]
	MRf	It[m4]	Az[m2]	Iz[m4]	zc[m]	zsc[m]	G[MPa]		I-2[m4]
			Ayz[m2]	Iyz[m4]					α[°]
3	4	4.5000E-01	3.754E-01	2.344E-03	0.000	0.000	32837	0.0	1.215E-01
	3	8.632E-03	3.944E-01	1.215E-01	-0.425	-0.425	13682	(BEAM)	2.344E-03
= PLOCA1.8M									

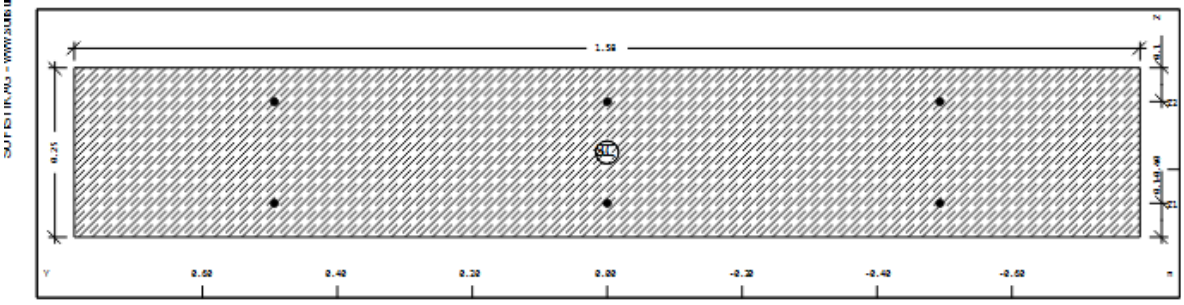
SNo	section number	yc[m],zc[m]	ordinate of elastic centroid
Mat	material number	ysc[m],zsc[m]	ordinate of shear centre
A[m2]	sectional area	E[MPa]	Young's modulus
Ay[m2],Az[m2],Ayz[m2]	transverse shear deformation area	g[kg/m]	weight per length
Iy[m4],Iz[m4],Iyz[m4]	bending moment of inertia		
I-1[m4],I-2[m4],α[°]	principal moments of inertia and angle of the principal axes		
MRf	reinforcement material number		
It[m4]	torsional moment of inertia		
G[MPa]	Shear modulus		

Reinforcement global values

Layer	Mref	Mat	As	As-min	As-max	D	yr	zr	L-tors	N-p	My-p	Mz-p
			[cm2]	[cm2]	[cm2]	[mm]	[m]	[m]	[m]	[kN]	[kNm]	[kNm]
Z1	4	3	4.00	0.00		12	-0.025	-0.350				
Z2	4	3	4.00	0.00		12	0.000	-0.500				

Layer	layer of reinforcement	D	bar diameter
Mref	embedding reference material	yr,zr	ordinate of elastic centroid
Mat	material number	L-tors	torsional effective length
As	reinforcement area	N-p	prestress normal force
As-min	minimum reinforcement area	My-p,Mz-p	prestress bending moment
As-max	maximum reinforcement area		

Cross section No. 4 - PLOCA1.58M



Cross section No. 4 - PLOCA1.58M

Static properties of cross section

SNo	Mat	A[m2]	Ay[m2]	Iy[m4]	yc[m]	ysc[m]	E[MPa]	g[kg/m]	I-1[m4]
	MRf	It[m4]	Az[m2]	Iz[m4]	zc[m]	zsc[m]	G[MPa]		I-2[m4]
			Ayz[m2]	Iyz[m4]					α[°]
4	4	3.9500E-01	3.296E-01	2.057E-03	0.000	0.000	32837	0.0	8.217E-02
	3	7.504E-03	3.462E-01	8.217E-02	-0.425	-0.425	13682	(BEAM)	2.057E-03
= PLOCA1.58M									

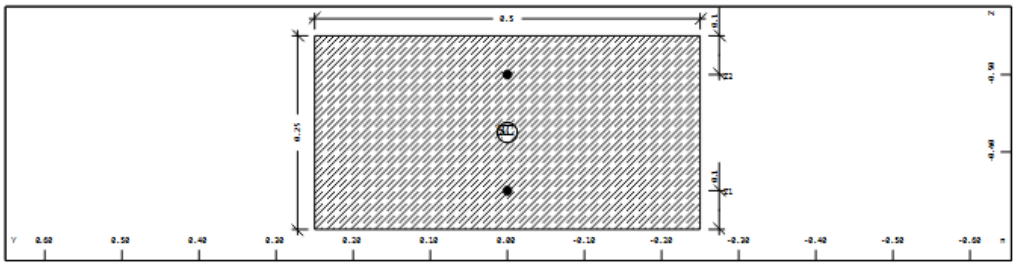
SNo	section number	yc[m],zc[m]	ordinate of elastic centroid
Mat	material number	ysc[m],zsc[m]	ordinate of shear centre
A[m2]	sectional area	E[MPa]	Young's modulus
Ay[m2],Az[m2],Ayz[m2]	transverse shear deformation area	g[kg/m]	weight per length
Iy[m4],Iz[m4],Iyz[m4]	bending moment of inertia		
I-1[m4],I-2[m4],α[°]	principal moments of inertia and angle of the principal axes		
MRf	reinforcement material number		
It[m4]	torsional moment of inertia		
G[MPa]	Shear modulus		

Reinforcement global values

Layer	Mref	Mat	As	As-min	As-max	D	yr	zr	L-tors	N-p	My-p	Mz-p
			[cm2]	[cm2]	[cm2]	[mm]	[m]	[m]	[m]	[kN]	[kNm]	[kNm]
Z1	4	3	3.00	0.00		12	0.000	-0.350				
Z2	4	3	3.00	0.00		12	0.000	-0.500				

Layer	layer of reinforcement	D	bar diameter
Mref	embedding reference material	yr,zr	ordinate of elastic centroid
Mat	material number	L-tors	torsional effective length

Cross section No. 5 - PLOCA0.5



Cross section No. 5 - PLOCA0.5

Static properties of cross section

SNo	Mat MRf	A[m2] It[m4]	Ay[m2] Az[m2] Ayz[m2]	Iy[m4] Iz[m4] Iyz[m4]	yc[m] zc[m]	ysc[m] zsc[m]	E[MPa] G[MPa]	g[kg/m]	I-1[m4] I-2[m4] α[°]
5	4	1.2500E-01	1.053E-01	6.510E-04	0.000	0.000	32837	0.0	2.604E-03
	3	1.850E-03	1.151E-01	2.604E-03	-0.425	-0.425	13682	(BEAM)	6.510E-04
= PLOCA0.5									

SNo	section number	yc[m],zc[m]	ordinate of elastic centroid
Mat	material number	ysc[m],zsc[m]	ordinate of shear centre
A[m2]	sectional area	E[MPa]	Young's modulus
Ay[m2],Az[m2],Ayz[m2]	transverse shear deformation area	g[kg/m]	weight per length
Iy[m4],Iz[m4],Iyz[m4]	bending moment of inertia		
I-1[m4],I-2[m4],α[°]	principal moments of inertia and angle of the principal axes		
MRf	reinforcement material number		
It[m4]	torsional moment of inertia		
G[MPa]	Shear modulus		

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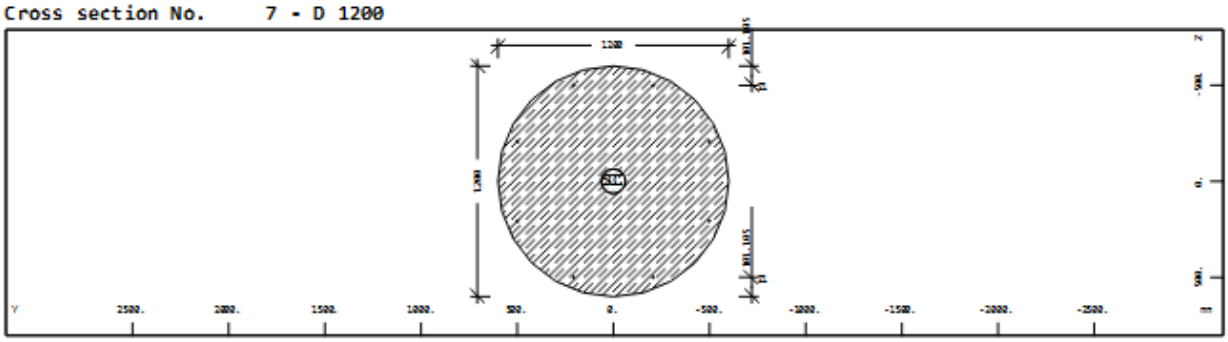
Reinforcement global values

Layer	Mref	Mat	As [cm2]	As-min [cm2]	As-max [cm2]	D [mm]	yr [m]	zr [m]	L-tors [m]	N-p [kN]	My-p [kNm]	Mz-p [kNm]
Z1	4	3	1.00	0.00		12	0.000	-0.350				
Z2	4	3	1.00	0.00		12	0.000	-0.500				

Layer	layer of reinforcement	D	bar diameter
Mref	embedding reference material	yr,zr	ordinate of elastic centroid
Mat	material number	L-tors	torsional effective length
As	reinforcement area	N-p	prestress normal force
As-min	minimum reinforcement area	My-p,Mz-p	prestress bending moment
As-max	maximum reinforcement area		

Cross section No. 7 - D 1200



Cross section No. 7 - D 1200

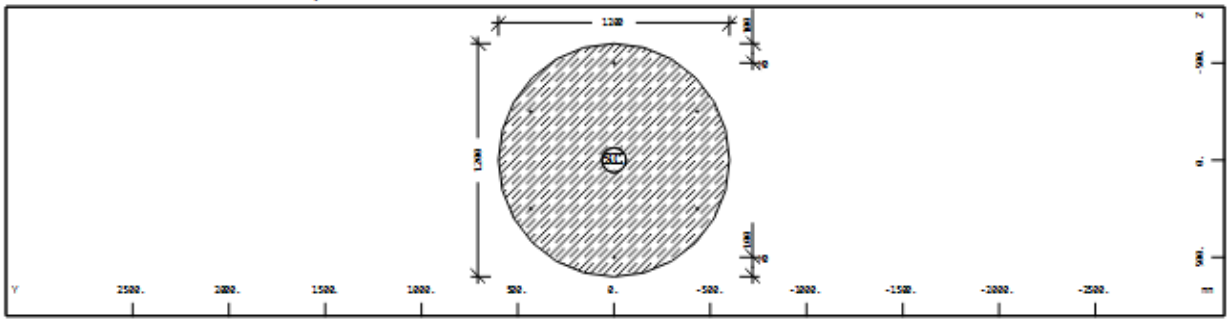
Static properties of cross section

Mat MRf	A[m2] It[m4]	Ay[m2] Az[m2] Ayz[m2]	Iy[m4] Iz[m4] Iyz[m4]	yc[mm] zc[mm]	ysc[mm] zsc[mm]	E[N/mm2] G[N/mm2]	g[kg/m]
7	1.1310E+00	9.698E-01	1.018E-01	0.0	0.0	34077	2827.4
2	2.036E-01	9.697E-01	1.018E-01	0.0	0.0	14199	(BEAM)

Additional static properties of cross section

α-T[1/K]	ymin[mm] ymax[mm]	zmin[mm] zmax[mm]	hymin[mm] hzmin[mm]	AK[m2] AB[m2]	MRs	1/WT[1/m3] 1/WT2[1/m3]	1/WVy[1/m2] 1/WVz[1/m2]
1.0E-05	-600.0	-600.0	1020.0	6.555E-01	2	3.046E+00	1.326E+00
	600.0	600.0	1020.0	1.131E+00		8.146E+02	1.326E+00

Cross section No. 8 - pilot



Cross section No. 8 - pilot

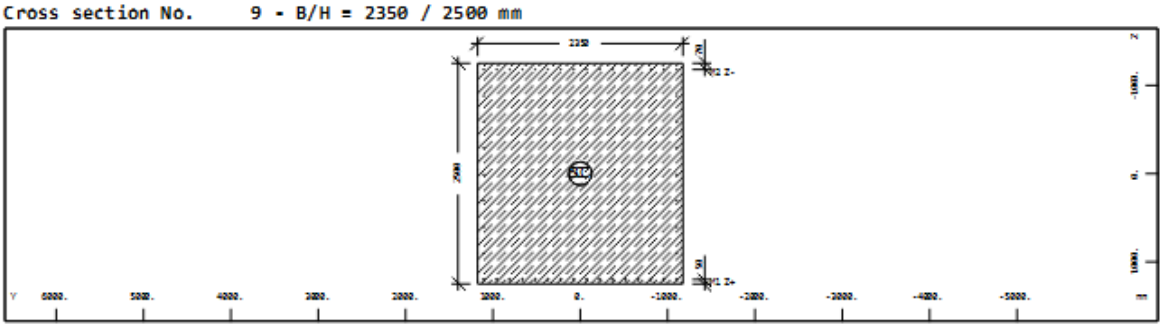
Static properties of cross section

Mat MRf	A[m2] It[m4]	Ay[m2] Az[m2] Ayz[m2]	Iy[m4] Iz[m4] Iyz[m4]	yc[mm] zc[mm]	ysc[mm] zsc[mm]	E[N/mm2] G[N/mm2]	g[kg/m]
3	1.1310E+00		1.018E-01	0.0	0.0	31939	2827.4
2	2.036E-01		1.018E-01	0.0	0.0	13308	(COMPR)

Additional static properties of cross section

α-T[1/K]	ymin[mm] ymax[mm]	zmin[mm] zmax[mm]	hymin[mm] hzmin[mm]	AK[m2] AB[m2]	MRs	1/WT[1/m3] 1/WT2[1/m3]	1/WVy[1/m2] 1/WVz[1/m2]
1.0E-05	-600.0	-600.0	706.9	7.854E-01	2	2.947E+00	1.179E+00
	600.0	600.0	706.9	1.131E+00			1.179E+00

Cross section No. 9 - B/H = 2350 / 2500 mm



Cross section No. 9 - B/H = 2350 / 2500 mm

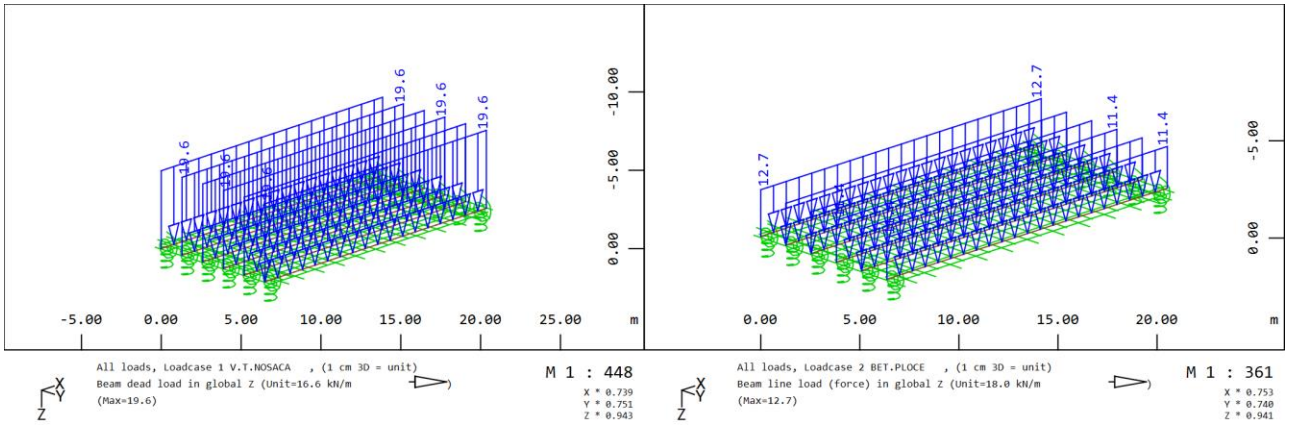
Static properties of cross section

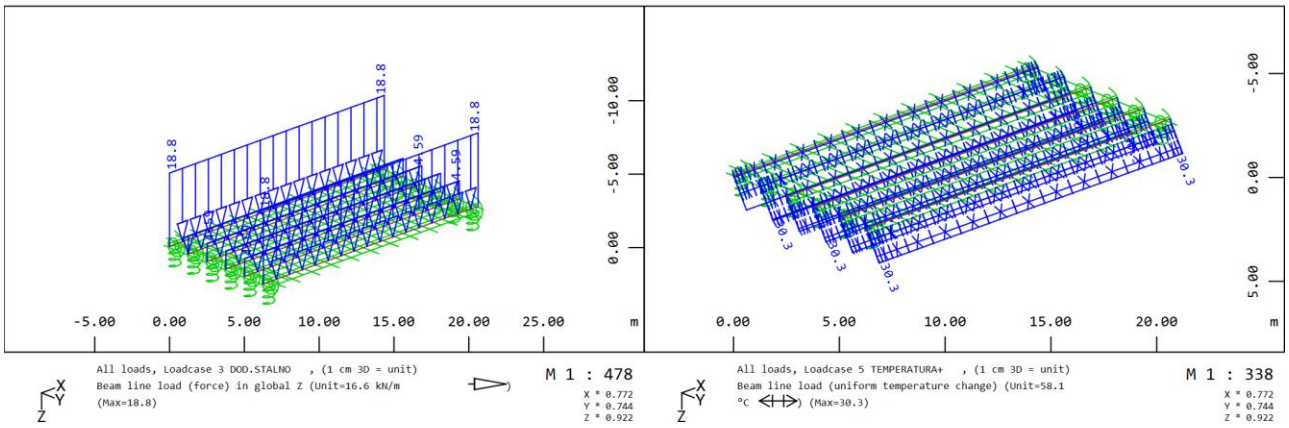
Mat MRf	A[m2] It[m4]	Ay[m2] Az[m2] Ayz[m2]	Iy[m4] Iz[m4] Iyz[m4]	yc[mm] zc[mm]	ysc[mm] zsc[mm]	E[N/mm2] G[N/mm2]	g[kg/m]
3	5.8750E+00	4.896E+00	3.060E+00	0.0	0.0	31939	14687.5
2	4.843E+00	4.896E+00	2.704E+00	0.0	0.0	13308	(CENTR)

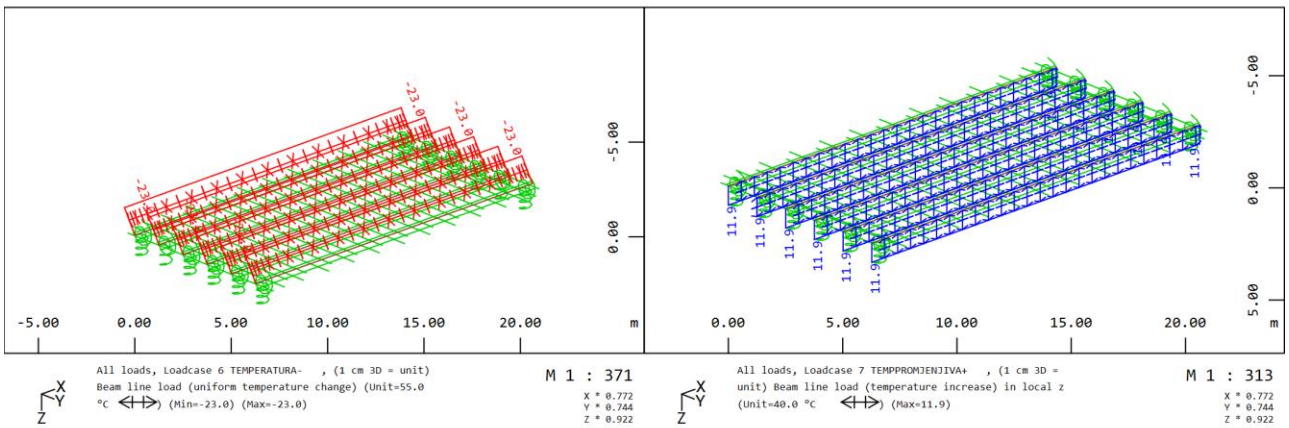
Additional static properties of cross section

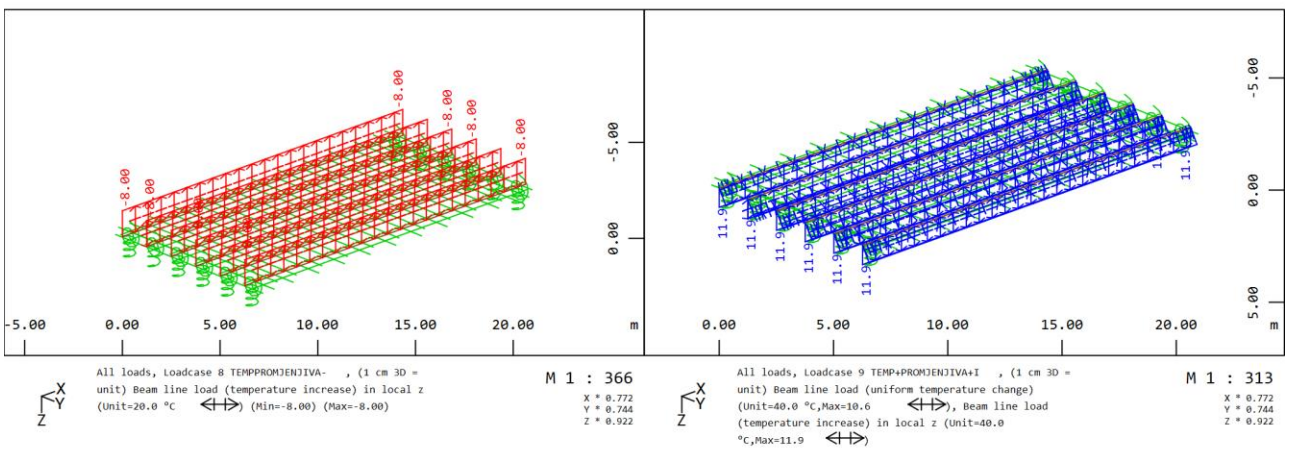
α-T[1/K]	ymin[mm] ymax[mm]	zmin[mm] zmax[mm]	hymin[mm] hzmin[mm]	AK[m2] AB[m2]	MRs	1/WT[1/m3] 1/WT2[1/m3]	1/WVy[1/m2] 1/WVz[1/m2]
1.0E-05	-1175.0	-1250.0	1566.7	3.304E+00	2	2.498E-01	2.553E-01
	1175.0	1250.0	1666.7	5.875E+00			2.553E-01

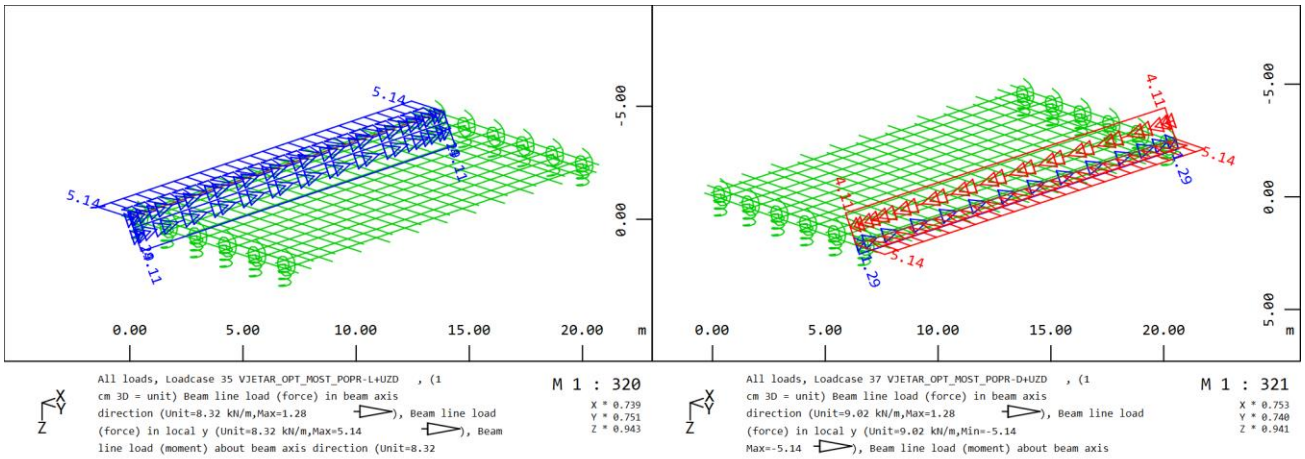
1.5 Prikaz modela



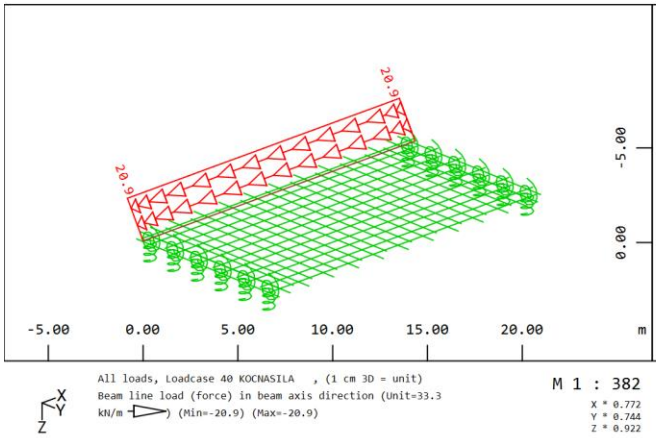


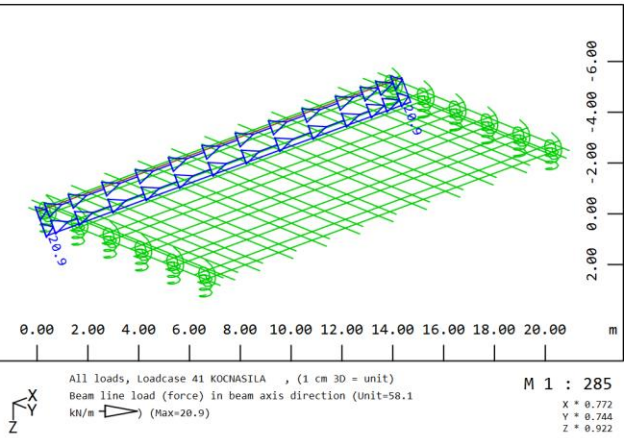


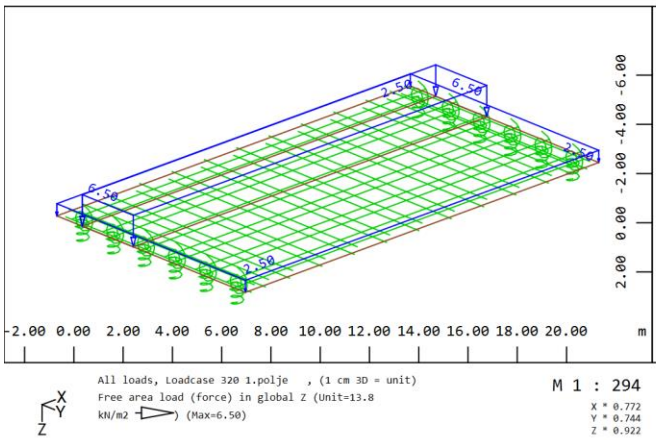


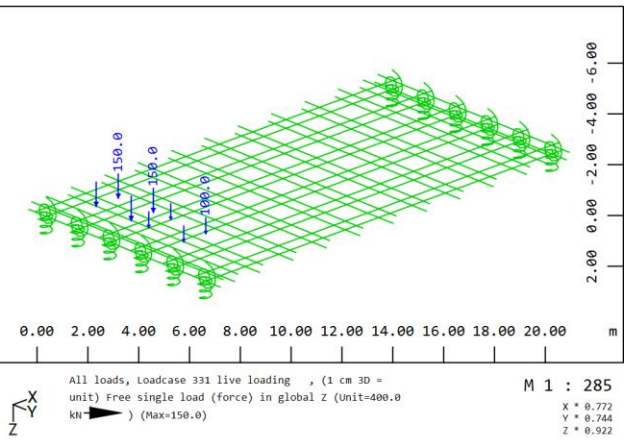

5.14
5.14
-10.11
-10.11
0.00
5.00
10.00
15.00
20.00
m
-5.00
0.00
All loads, Loadcase 35 VJETAR_OPT_MOST_POPR-L+UZD , (1 cm 3D = unit) Beam line load (force) in beam axis direction (Unit=8.32 kN/m,Max=1.28), Beam line load (force) in local y (Unit=8.32 kN/m,Max=5.14), Beam line load (moment) about beam axis direction (Unit=8.32
M 1 : 320
X * 0.739
Y * 0.751
Z * 0.943

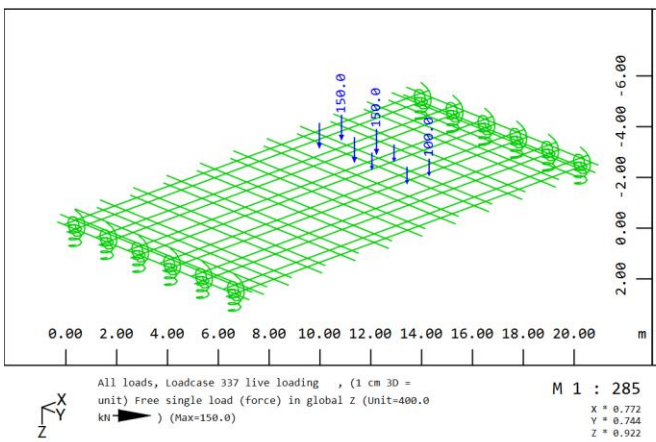
4.11
5.14
-4.29
-4.11
-5.14
-4.29
0.00
5.00
10.00
15.00
20.00
m
-5.00
0.00
5.00
All loads, Loadcase 37 VJETAR_OPT_MOST_POPR-D+UZD , (1 cm 3D = unit) Beam line load (force) in beam axis direction (Unit=9.02 kN/m,Max=1.28), Beam line load (force) in local y (Unit=9.02 kN/m,Min=-5.14 Max=-5.14), Beam line load (moment) about beam axis
M 1 : 321
X * 0.753
Y * 0.740
Z * 0.941

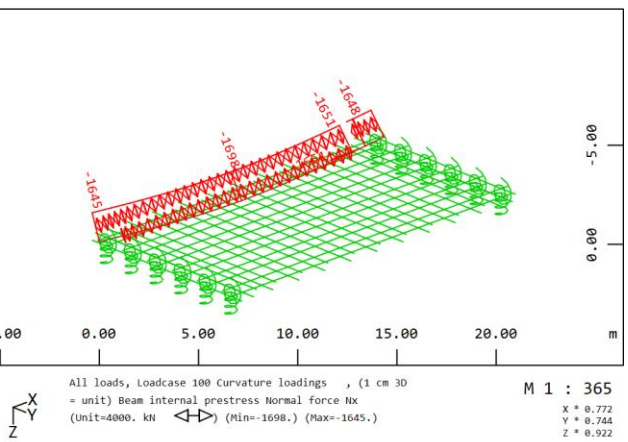

-20.9
-20.9
-5.00
0.00
5.00
10.00
15.00
20.00
m
-5.00
0.00
All loads, Loadcase 40 KOCNASILA , (1 cm 3D = unit) Beam line load (force) in beam axis direction (Unit=33.3 kN/m) (Min=-20.9) (Max=-20.9)
M 1 : 382
X * 0.772
Y * 0.744
Z * 0.922

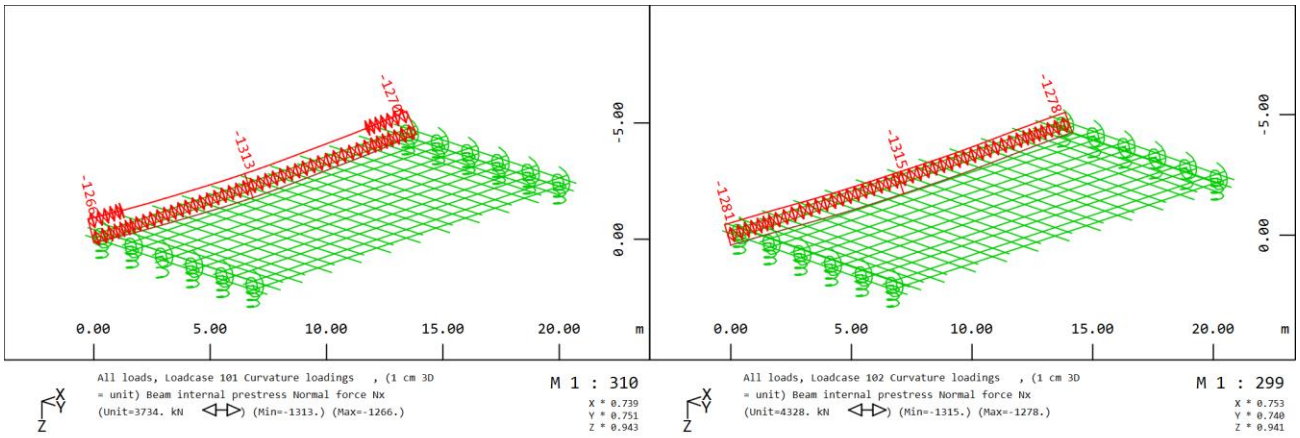

20.9
-20.9
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
m
2.00
0.00
-2.00
-4.00
-6.00
All loads, Loadcase 41 KOCNASILA , (1 cm 3D = unit) Beam line load (force) in beam axis direction (Unit=58.1 kN/m) (Max=20.9)
M 1 : 285
X * 0.772
Y * 0.744
Z * 0.922

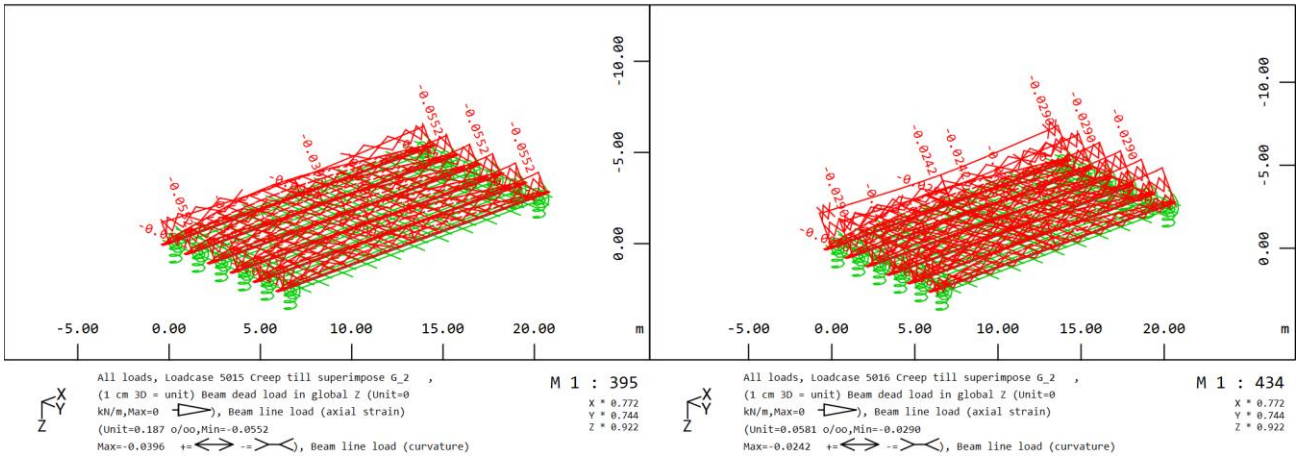

2.50
6.50
6.50
2.50
-2.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
m
2.00
0.00
-2.00
-4.00
-6.00
All loads, Loadcase 320 1.polje , (1 cm 3D = unit) Free area load (force) in global Z (Unit=13.8 kN/m2) (Max=6.50)
M 1 : 294
X * 0.772
Y * 0.744
Z * 0.922

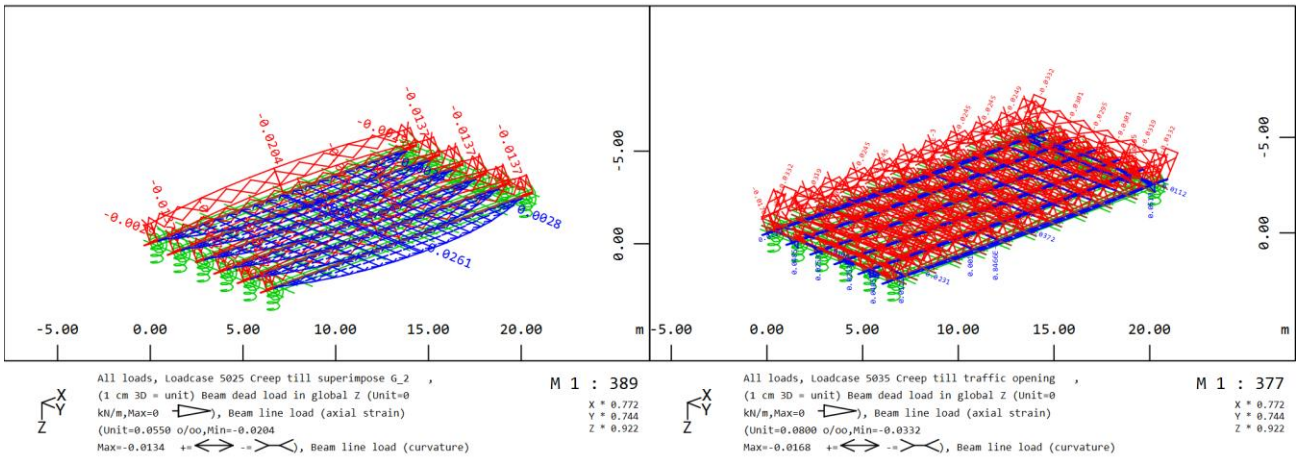

-150.0
-150.0
-100.0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
m
2.00
0.00
-2.00
-4.00
-6.00
All loads, Loadcase 331 live loading , (1 cm 3D = unit) Free single load (force) in global Z (Unit=400.0 kN) (Max=150.0)
M 1 : 285
X * 0.772
Y * 0.744
Z * 0.922

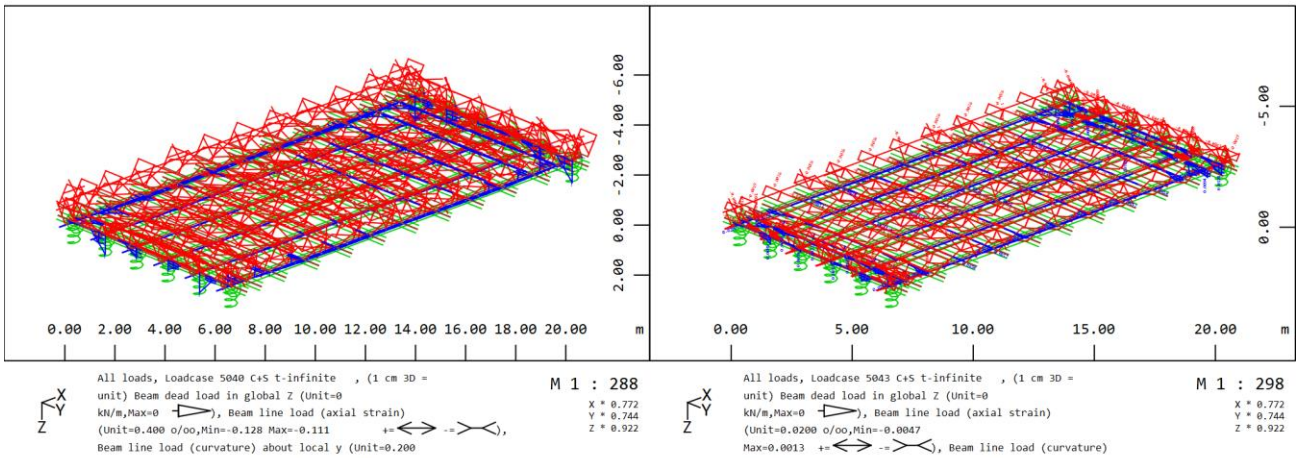

-150.0
-150.0
-100.0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
m
2.00
0.00
-2.00
-4.00
-6.00
All loads, Loadcase 337 live loading , (1 cm 3D = unit) Free single load (force) in global Z (Unit=400.0 kN) (Max=150.0)
M 1 : 285
X * 0.772
Y * 0.744
Z * 0.922

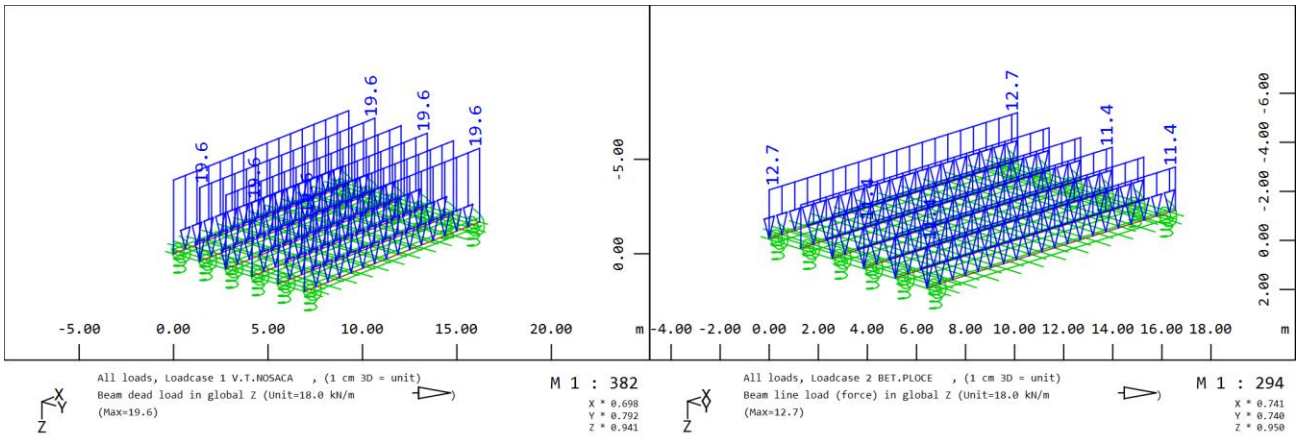

-1648
-1651
-1698
-1645
-5.00
0.00
5.00
10.00
15.00
20.00
m
0.00
-5.00
All loads, Loadcase 100 Curvature loadings , (1 cm 3D = unit) Beam internal prestress Normal force Nx (Unit=4000. kN) (Min=-1698.) (Max=-1645.)
M 1 : 365
X * 0.772
Y * 0.744
Z * 0.922

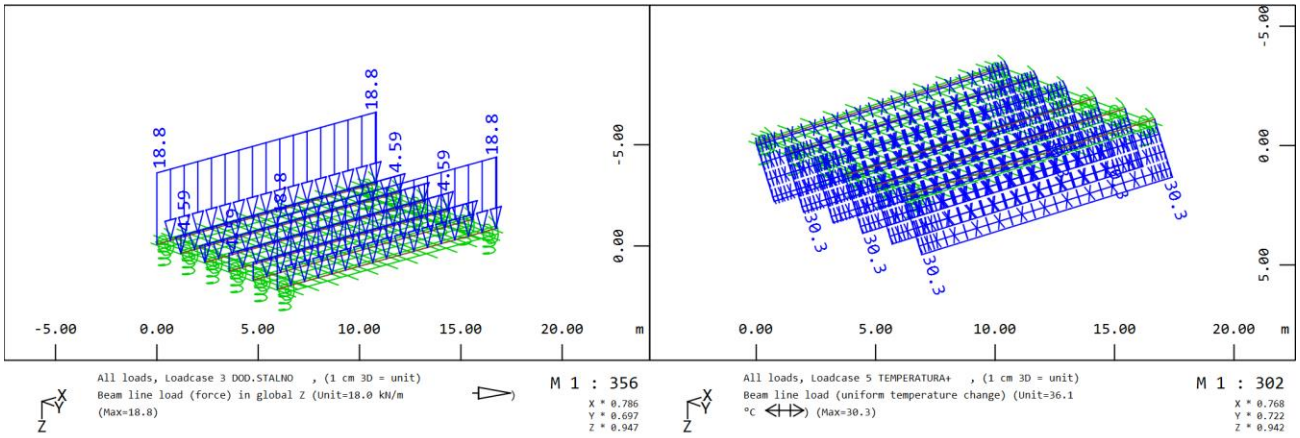

All loads, Loadcase 101 Curvature loadings , (1 cm 3D = unit) Beam internal prestress Normal force Nx
(Unit=3734. kN) (Min=-1313.) (Max=-1266.)
M 1 : 310
All loads, Loadcase 102 Curvature loadings , (1 cm 3D = unit) Beam internal prestress Normal force Nx
(Unit=4328. kN) (Min=-1315.) (Max=-1278.)
M 1 : 299

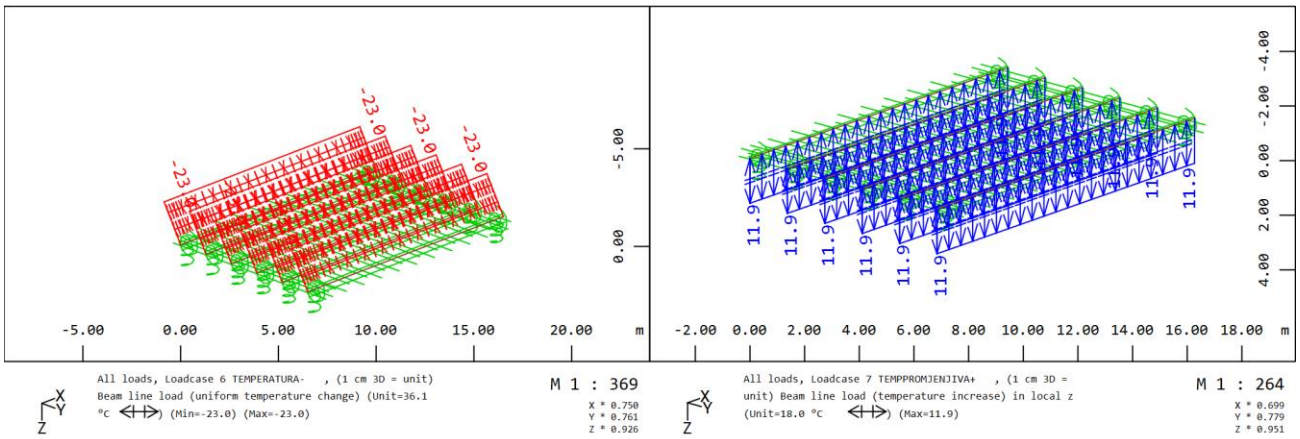

All loads, Loadcase 5015 Creep till superimpose G_2 ,
(1 cm 3D = unit) Beam dead load in global Z (Unit=0
kN/m,Max=0), Beam line load (axial strain)
(Unit=0.187 o/oo,Min=-0.0552
Max=-0.0396), Beam line load (curvature)
M 1 : 395
All loads, Loadcase 5016 Creep till superimpose G_2 ,
(1 cm 3D = unit) Beam dead load in global Z (Unit=0
kN/m,Max=0), Beam line load (axial strain)
(Unit=0.0581 o/oo,Min=-0.0290
Max=-0.0242), Beam line load (curvature)
M 1 : 434

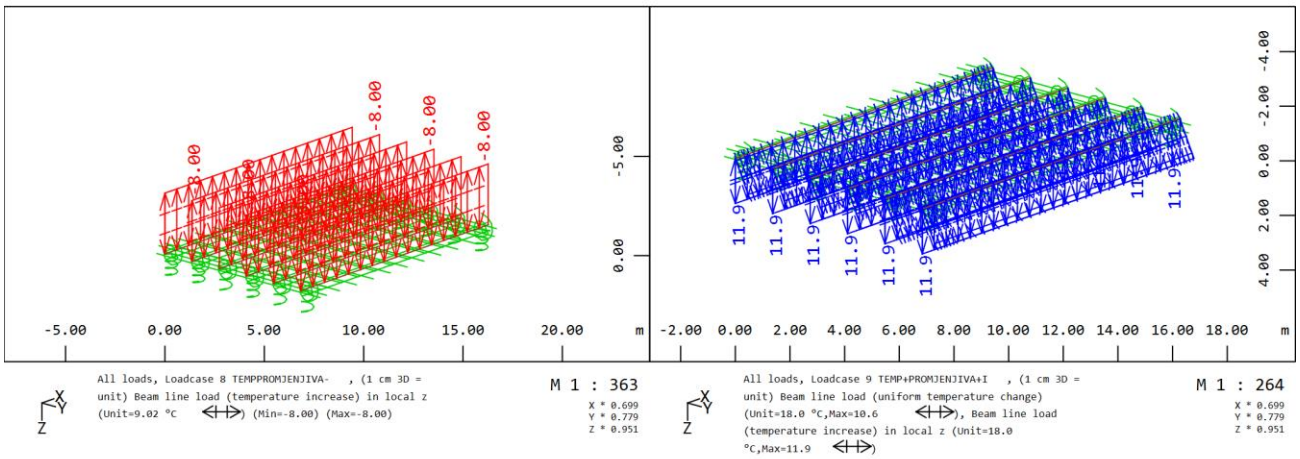

All loads, Loadcase 5025 Creep till superimpose G_2 ,
(1 cm 3D = unit) Beam dead load in global Z (Unit=0
kN/m,Max=0), Beam line load (axial strain)
(Unit=0.0550 o/oo,Min=-0.0204
Max=-0.0134), Beam line load (curvature)
M 1 : 389
All loads, Loadcase 5035 Creep till traffic opening ,
(1 cm 3D = unit) Beam dead load in global Z (Unit=0
kN/m,Max=0), Beam line load (axial strain)
(Unit=0.0800 o/oo,Min=-0.0332
Max=-0.0168), Beam line load (curvature)
M 1 : 377

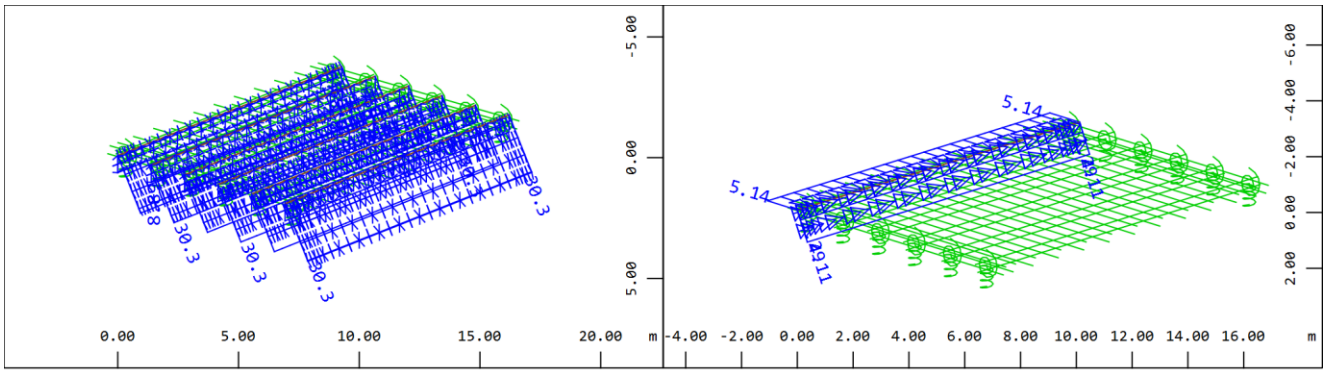

All loads, Loadcase 5040 C+S t-infinite , (1 cm 3D = unit) Beam dead load in global Z (Unit=0
kN/m,Max=0), Beam line load (axial strain)
(Unit=0.400 o/oo,Min=-0.128 Max=-0.111),
Beam line load (curvature) about local y (Unit=0.200
M 1 : 288
All loads, Loadcase 5043 C+S t-infinite , (1 cm 3D = unit) Beam dead load in global Z (Unit=0
kN/m,Max=0), Beam line load (axial strain)
(Unit=0.0200 o/oo,Min=-0.0047
Max=0.0013), Beam line load (curvature)
M 1 : 298


All loads, Loadcase 1 V.T.NOSACA , (1 cm 3D = unit)
Beam dead load in global Z (Unit=18.0 kN/m
(Max=19.6)
M 1 : 382
All loads, Loadcase 2 BET.PLOCE , (1 cm 3D = unit)
Beam line load (force) in global Z (Unit=18.0 kN/m
(Max=12.7)
M 1 : 294


All loads, Loadcase 3 DOD.STALNO , (1 cm 3D = unit)
Beam line load (force) in global Z (Unit=18.0 kN/m
(Max=18.8)
M 1 : 356
All loads, Loadcase 5 TEMPERATURA+ , (1 cm 3D = unit)
Beam line load (uniform temperature change) (Unit=36.1
°C (Max=30.3)
M 1 : 302


All loads, Loadcase 6 TEMPERATURA- , (1 cm 3D = unit)
Beam line load (uniform temperature change) (Unit=36.1
°C (Min=-23.0) (Max=-23.0)
M 1 : 369
All loads, Loadcase 7 TEMPPROMJENJIVA+ , (1 cm 3D =
unit) Beam line load (temperature increase) in local z
(Unit=18.0 °C (Max=11.9)
M 1 : 264


All loads, Loadcase 8 TEMPPROMJENJIVA- , (1 cm 3D =
unit) Beam line load (temperature increase) in local z
(Unit=9.02 °C (Min=-8.00) (Max=-8.00)
M 1 : 363
All loads, Loadcase 9 TEMP+PROMJENJIVA+I , (1 cm 3D =
unit) Beam line load (uniform temperature change)
(Unit=18.0 °C,Max=10.6), Beam line load
(temperature increase) in local z (Unit=18.0
°C,Max=11.9
M 1 : 264

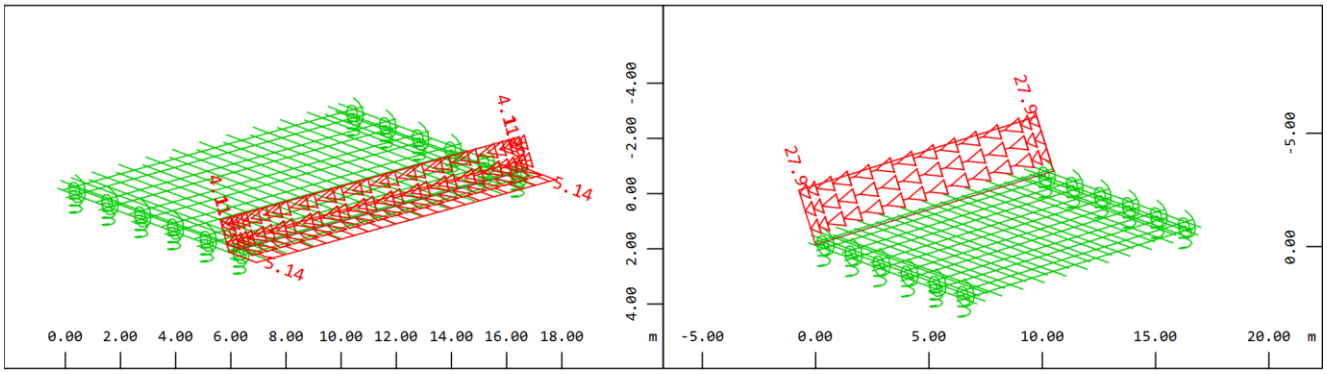


All loads, Loadcase 10 TEMP+PROMJENJIVA+II , (1 cm 3D = unit) Beam line load (uniform temperature change) (Unit=36.1 °C,Max=30.3), Beam line load (temperature increase) in local z (Unit=36.1 °C,Max=8.89)

M 1 : 305
X * 0.698
Y * 0.792
Z * 0.941

All loads, Loadcase 35 VJETAR_OPT_MOST_POPR-L+UZD , (1 cm 3D = unit) Beam line load (force) in beam axis direction (Unit=9.02 kN/m,Max=1.28), Beam line load (force) in local y (Unit=9.02 kN/m,Max=5.14), Beam line load (moment) about beam axis direction (Unit=9.02

M 1 : 264
X * 0.741
Y * 0.740
Z * 0.950

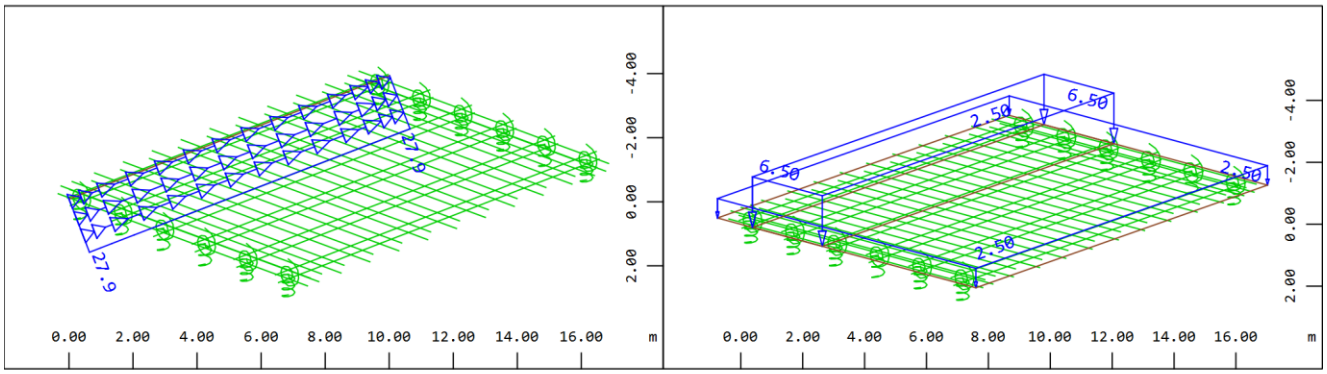


All loads, Loadcase 38 VJETAR_OPT_MOST_POPR-D-UZD , (1 cm 3D = unit) Beam line load (force) in beam axis direction (Unit=9.02 kN/m,Min=-1.28 Max=-1.28), Beam line load (force) in local y (Unit=9.02 kN/m,Min=-5.14 Max=-5.14), Beam line load (moment)

M 1 : 267
X * 0.786
Y * 0.697
Z * 0.947

All loads, Loadcase 40 KOCNASILA , (1 cm 3D = unit) Beam line load (force) in beam axis direction (Unit=36.1 kN/m) (Min=-27.9) (Max=-27.9)

M 1 : 325
X * 0.768
Y * 0.722
Z * 0.942

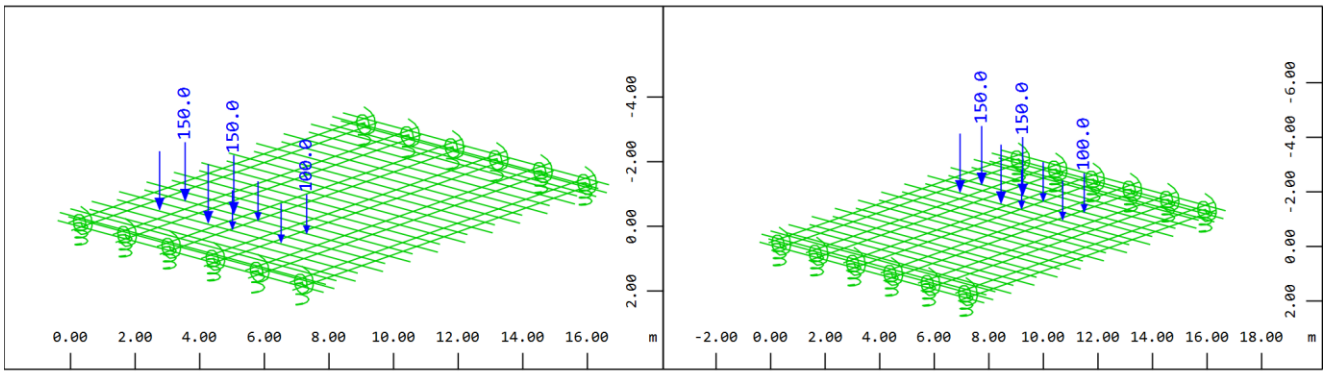


All loads, Loadcase 41 KOCNASILA , (1 cm 3D = unit) Beam line load (force) in beam axis direction (Unit=36.1 kN/m) (Max=27.9)

M 1 : 230
X * 0.750
Y * 0.761
Z * 0.926

All loads, Loadcase 320 1.polje , (1 cm 3D = unit) Free area load (force) in global Z (Unit=9.02 kN/m2) (Max=6.50)

M 1 : 238
X * 0.699
Y * 0.779
Z * 0.951

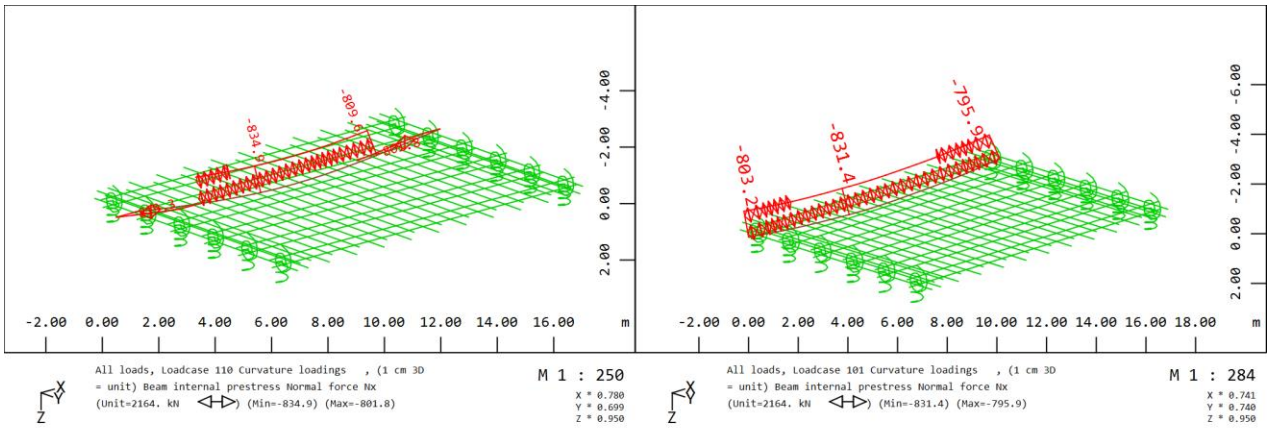


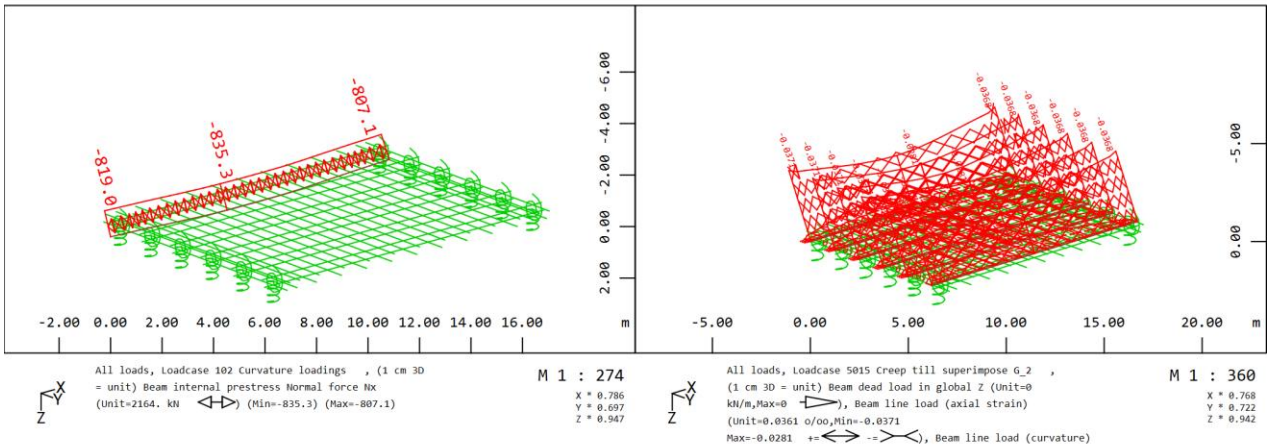
All loads, Loadcase 332 live loading , (1 cm 3D = unit) Free single load (force) in global Z (Unit=180.5 kN) (Max=150.0)

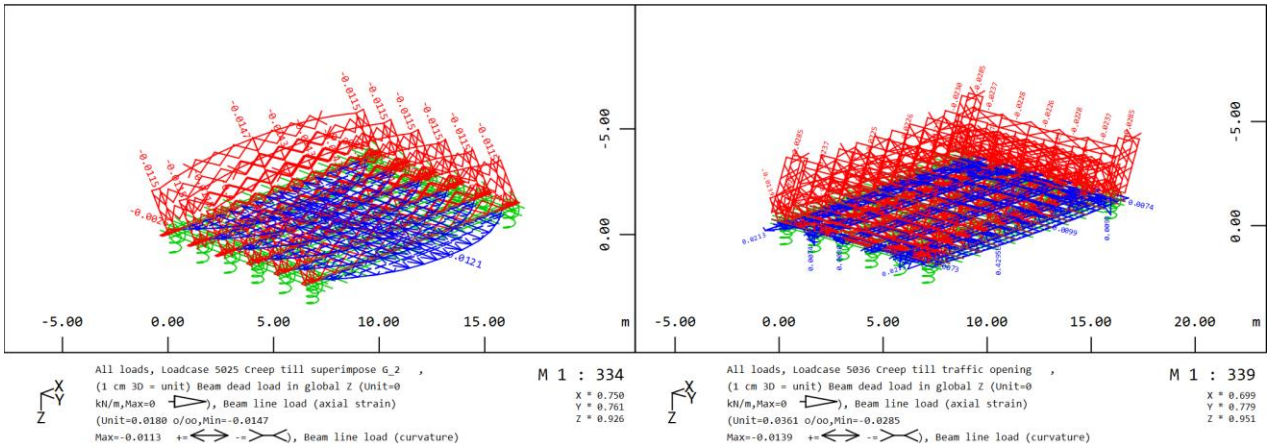
M 1 : 228
X * 0.699
Y * 0.779
Z * 0.951

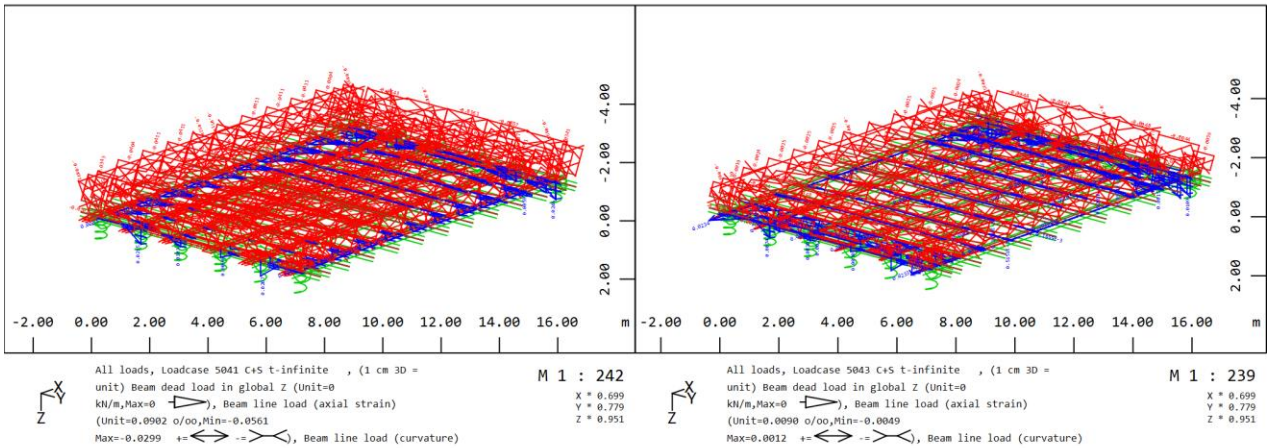
All loads, Loadcase 337 live loading , (1 cm 3D = unit) Free single load (force) in global Z (Unit=180.5 kN) (Max=150.0)

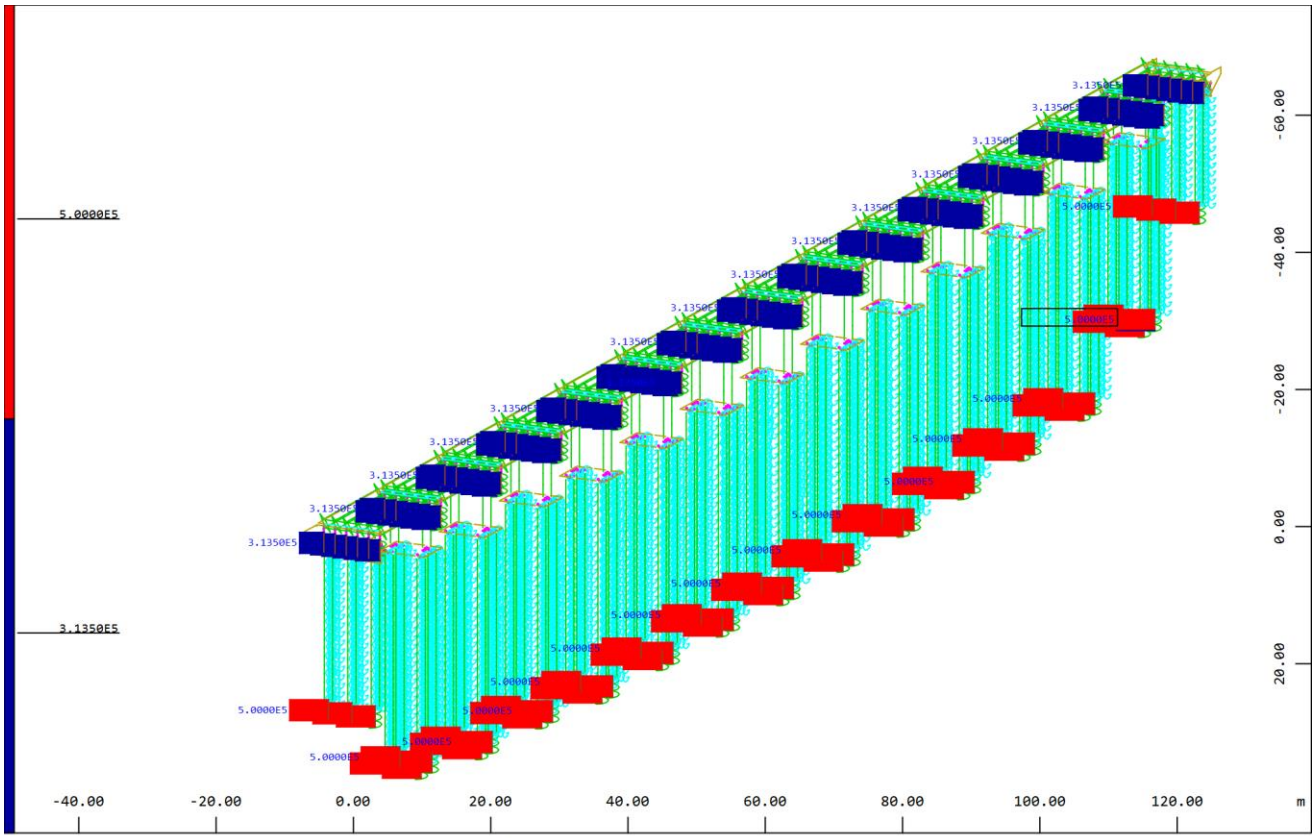
M 1 : 270
X * 0.699
Y * 0.779
Z * 0.951

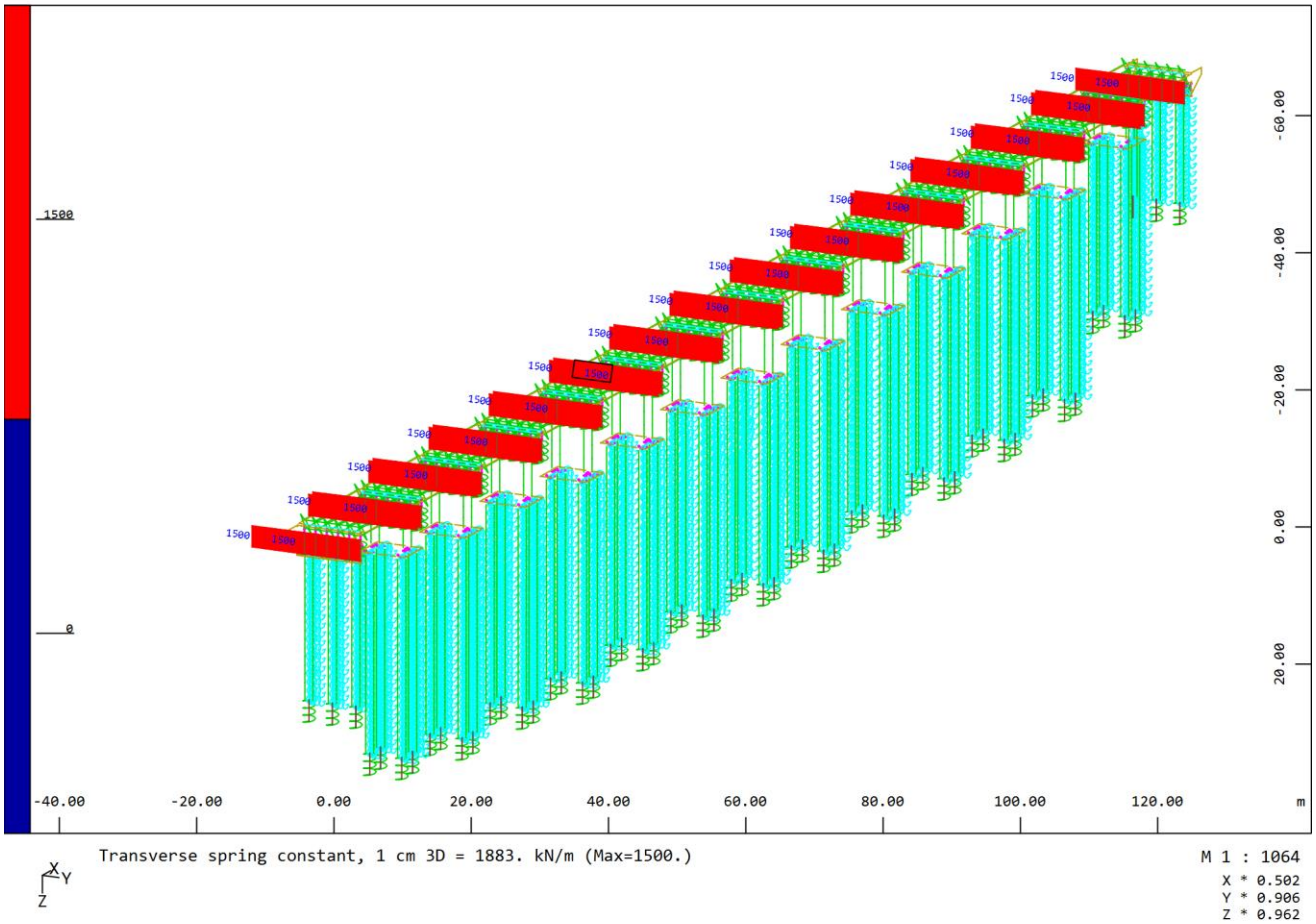

All loads, Loadcase 110 Curvature loadings , (1 cm 3D = unit) Beam internal prestress Normal force Nx
(Unit=2164. kN) (Min=-834.9) (Max=-801.8)
M 1 : 250
All loads, Loadcase 101 Curvature loadings , (1 cm 3D = unit) Beam internal prestress Normal force Nx
(Unit=2164. kN) (Min=-831.4) (Max=-795.9)
M 1 : 284

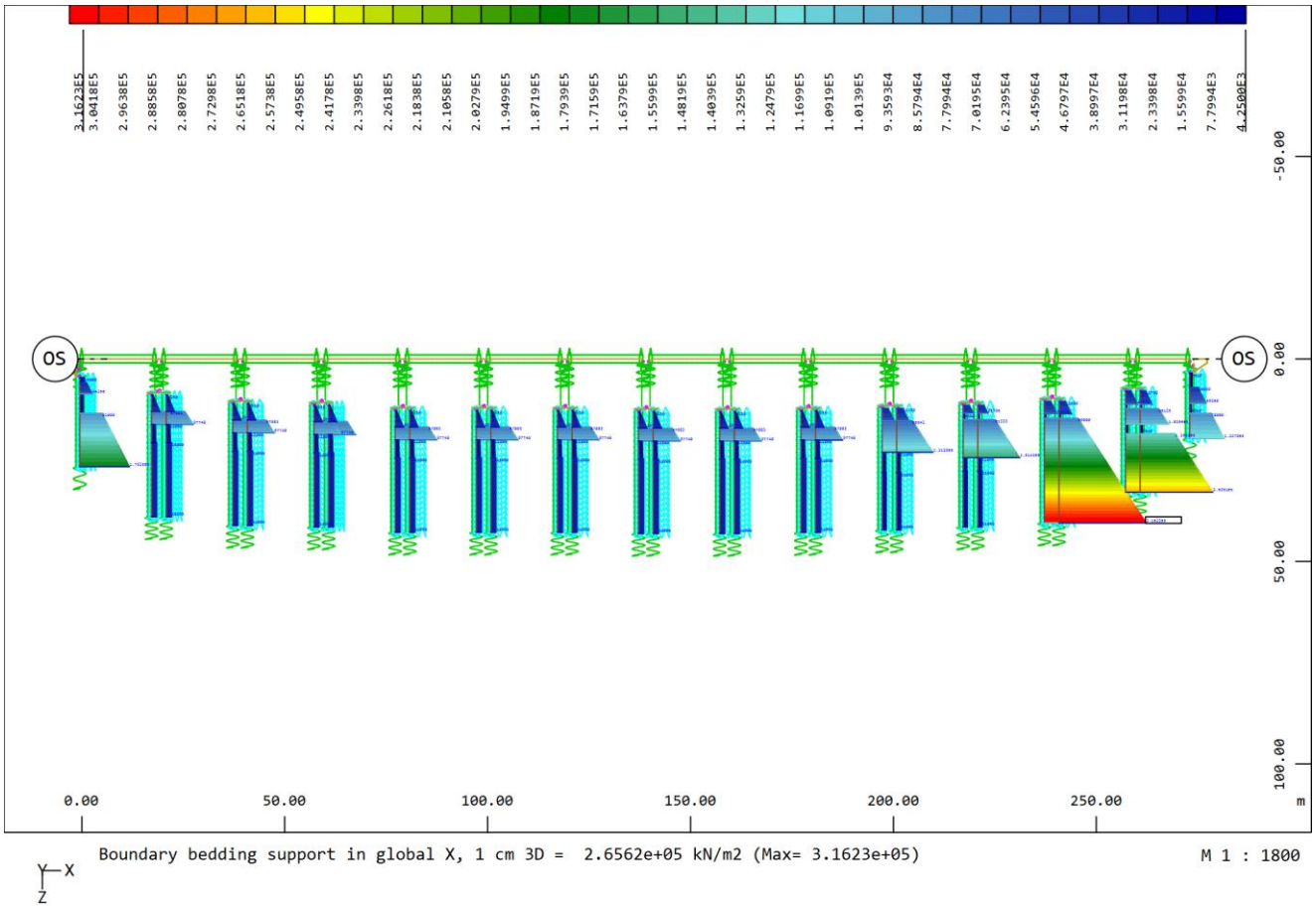

All loads, Loadcase 102 Curvature loadings , (1 cm 3D = unit) Beam internal prestress Normal force Nx
(Unit=2164. kN) (Min=-835.3) (Max=-807.1)
M 1 : 274
All loads, Loadcase 5015 Creep till superimpose G_2 , (1 cm 3D = unit) Beam dead load in global Z (Unit=0
kN/m,Max=0), Beam line load (axial strain)
(Unit=0.0361 o/oo,Min=-0.0371
Max=-0.0281), Beam line load (curvature)
M 1 : 360

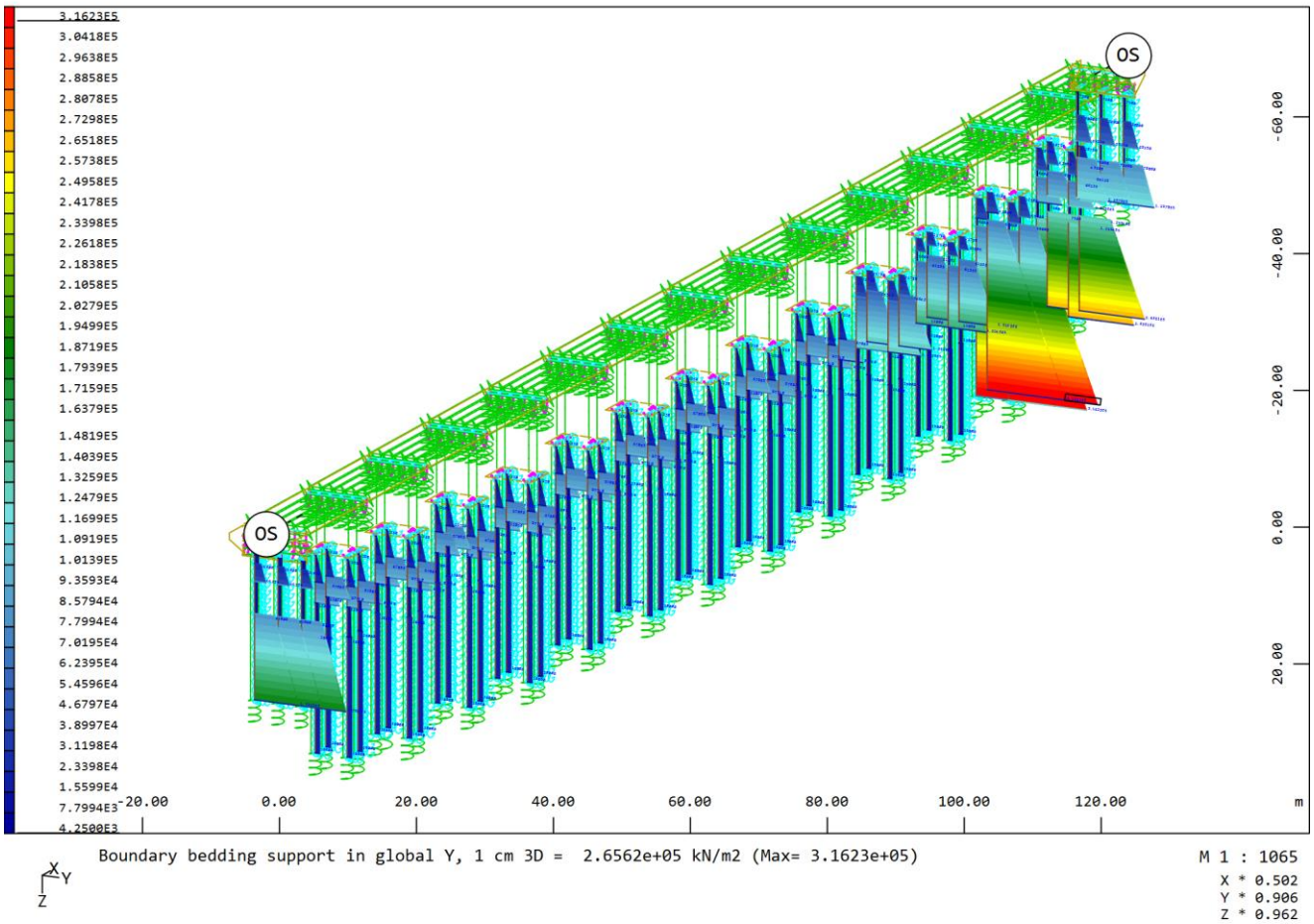

All loads, Loadcase 5025 Creep till superimpose G_2 , (1 cm 3D = unit) Beam dead load in global Z (Unit=0
kN/m,Max=0), Beam line load (axial strain)
(Unit=0.0180 o/oo,Min=-0.0147
Max=-0.0113), Beam line load (curvature)
M 1 : 334
All loads, Loadcase 5036 Creep till traffic opening , (1 cm 3D = unit) Beam dead load in global Z (Unit=0
kN/m,Max=0), Beam line load (axial strain)
(Unit=0.0361 o/oo,Min=-0.0285
Max=-0.0139), Beam line load (curvature)
M 1 : 339

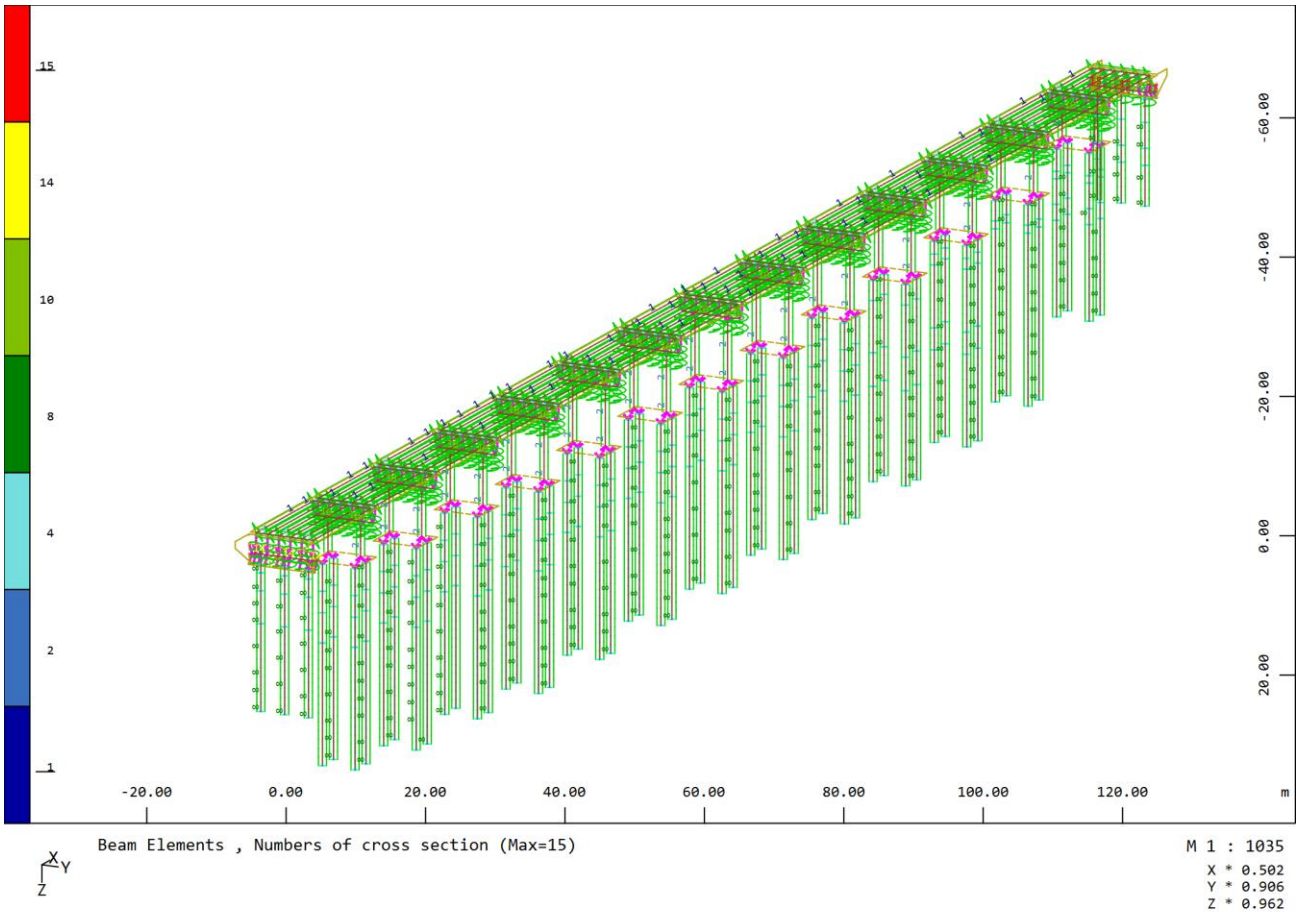

All loads, Loadcase 5041 C+S t-infinite , (1 cm 3D = unit) Beam dead load in global Z (Unit=0
kN/m,Max=0), Beam line load (axial strain)
(Unit=0.0902 o/oo,Min=-0.0561
Max=-0.0299), Beam line load (curvature)
M 1 : 242
All loads, Loadcase 5043 C+S t-infinite , (1 cm 3D = unit) Beam dead load in global Z (Unit=0
kN/m,Max=0), Beam line load (axial strain)
(Unit=0.0090 o/oo,Min=-0.0049
Max=0.0012), Beam line load (curvature)
M 1 : 239

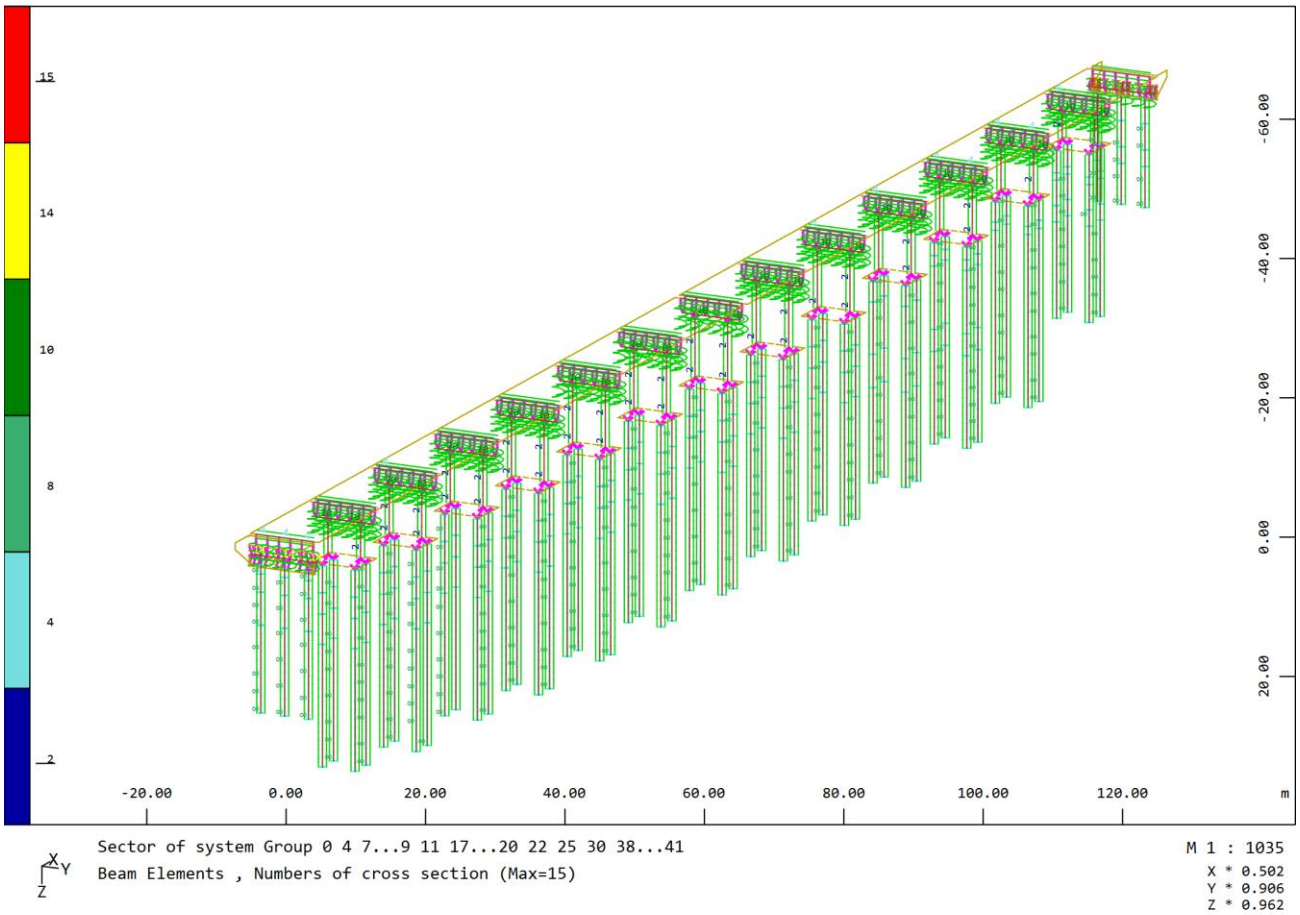

5.0000E5
3.1350E5
-40.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
m
-60.00
-40.00
-20.00
0.00
20.00
Spring constant, 1 cm 3D = 9.4141e+05 kN/m (Max= 5.0000e+05)
M 1 : 1064
X * 0.502
Y * 0.906
Z * 0.962

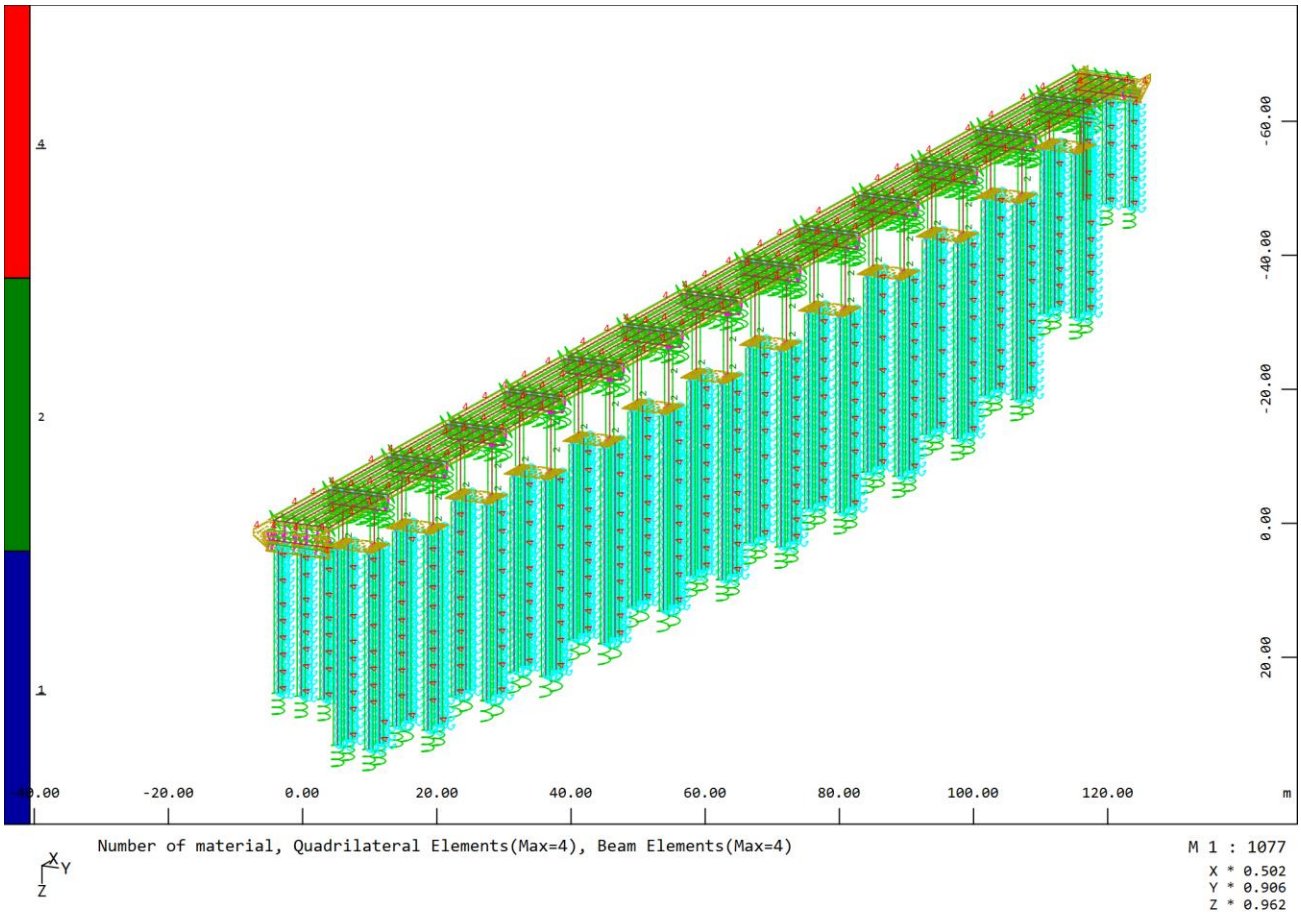

1500
0
-40.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
m
-60.00
-40.00
-20.00
0.00
20.00
Transverse spring constant, 1 cm 3D = 1883. kN/m (Max=1500.)
M 1 : 1064
X * 0.502
Y * 0.906
Z * 0.962

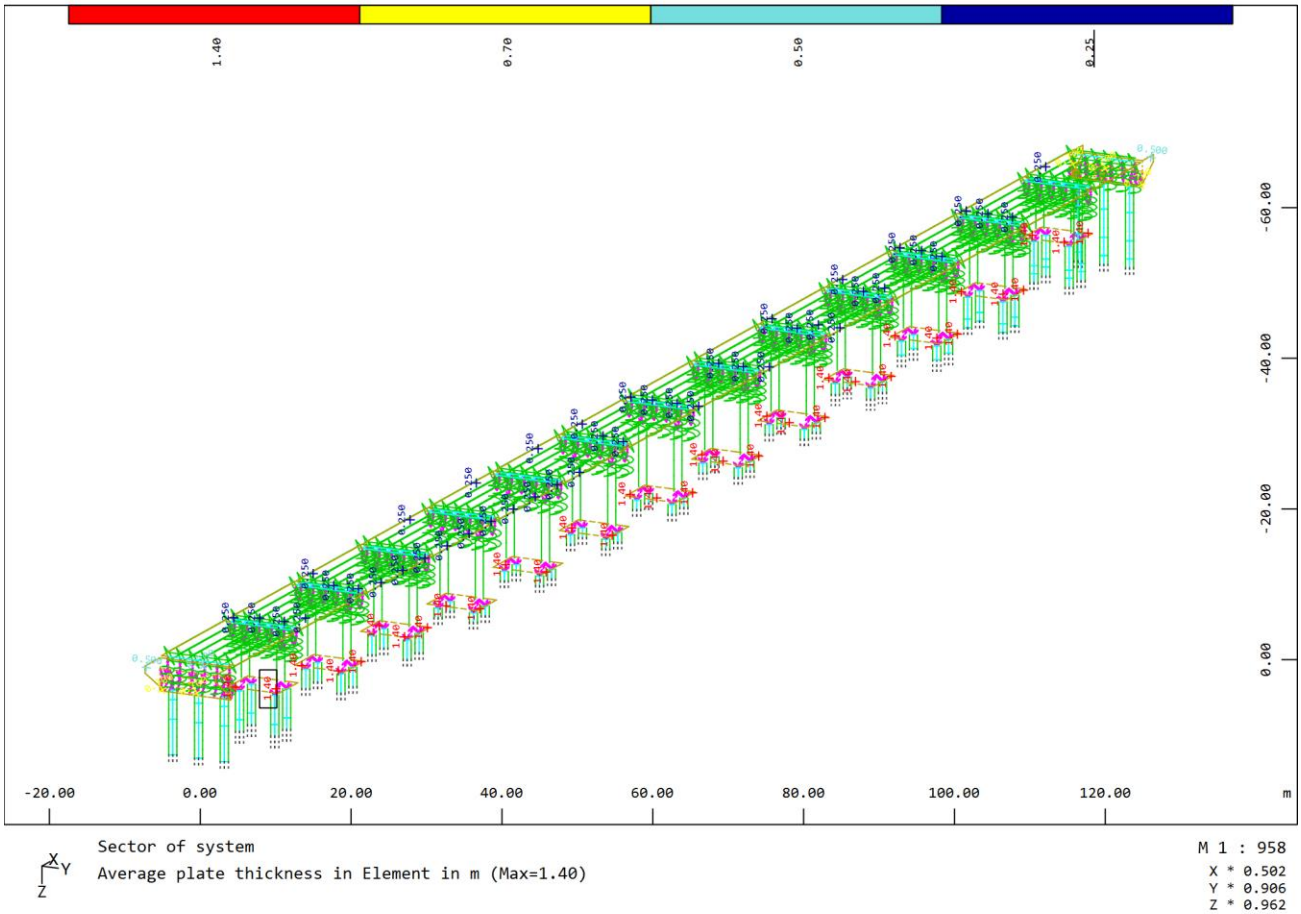

3.1623E5
3.0418E5
2.9638E5
2.8858E5
2.8078E5
2.7298E5
2.6518E5
2.5738E5
2.4958E5
2.4178E5
2.3398E5
2.2618E5
2.1838E5
2.1058E5
2.0279E5
1.9499E5
1.8719E5
1.7939E5
1.7159E5
1.6379E5
1.5599E5
1.4819E5
1.4039E5
1.3259E5
1.2479E5
1.1699E5
1.0919E5
1.0139E5
9.3593E4
8.5794E4
7.7994E4
7.0195E4
6.2395E4
5.4596E4
4.6797E4
3.8997E4
3.1198E4
2.3398E4
1.5599E4
7.7994E3
4.2500E3
OS
OS
-50.00
0.00
50.00
100.00
0.00
50.00
100.00
150.00
200.00
250.00
m
Boundary bedding support in global X, 1 cm 3D = 2.6562e+05 kN/m2 (Max= 3.1623e+05)
M 1 : 1800
Y
X
Z

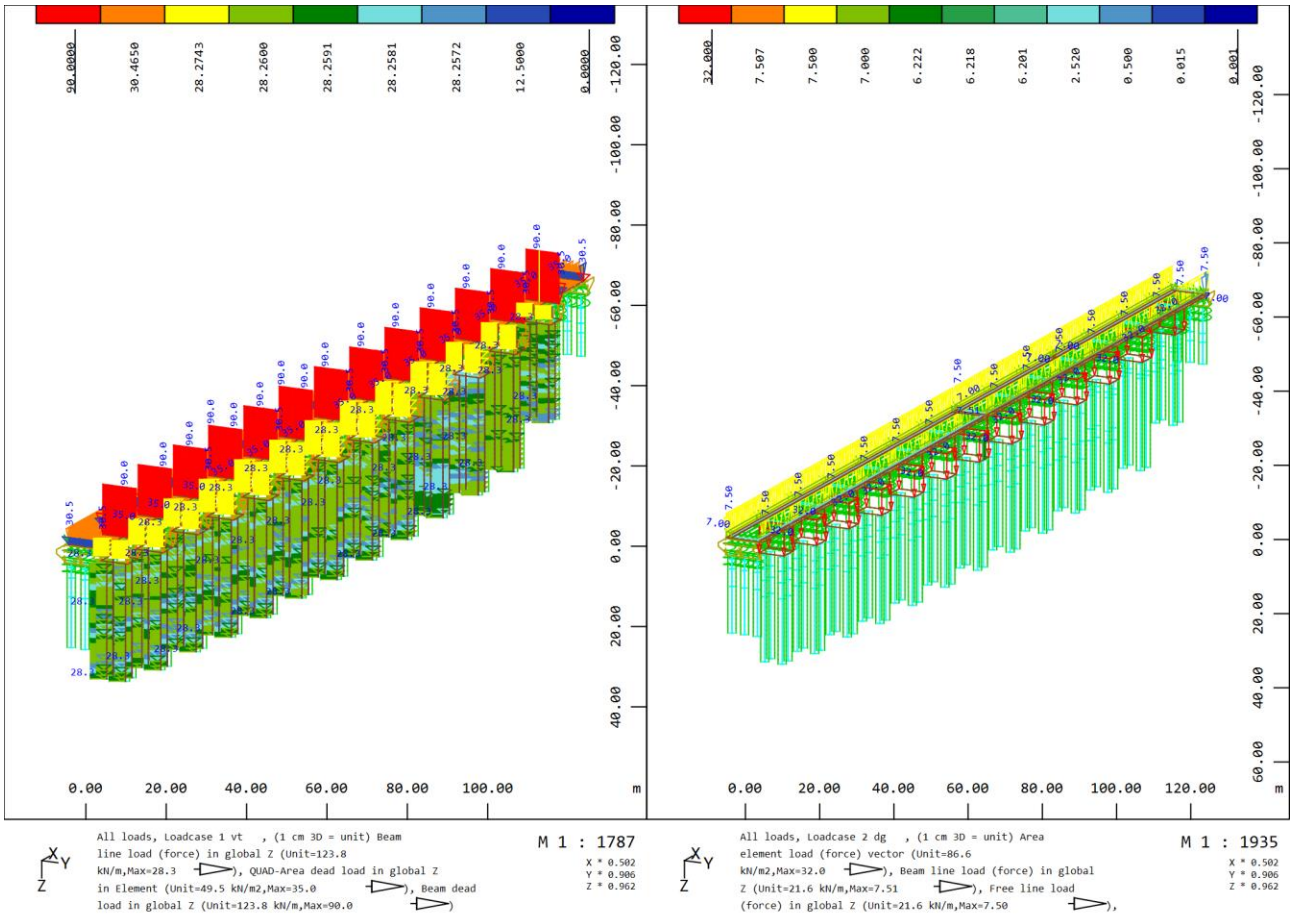

3.1623E5
3.0418E5
2.9638E5
2.8858E5
2.8078E5
2.7298E5
2.6518E5
2.5738E5
2.4958E5
2.4178E5
2.3398E5
2.2618E5
2.1838E5
2.1058E5
2.0279E5
1.9499E5
1.8719E5
1.7939E5
1.7159E5
1.6379E5
1.4819E5
1.4039E5
1.3259E5
1.2479E5
1.1699E5
1.0919E5
1.0139E5
9.3593E4
8.5794E4
7.7994E4
7.0195E4
6.2395E4
5.4596E4
4.6797E4
3.8997E4
3.1198E4
2.3398E4
1.5599E4
7.7994E3
4.2500E3
OS
OS
-60.00
-40.00
-20.00
0.00
20.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
m
Boundary bedding support in global Y, 1 cm 3D = 2.6562e+05 kN/m2 (Max= 3.1623e+05)
M 1 : 1065
X * 0.502
Y * 0.906
Z * 0.962
X
Y
Z

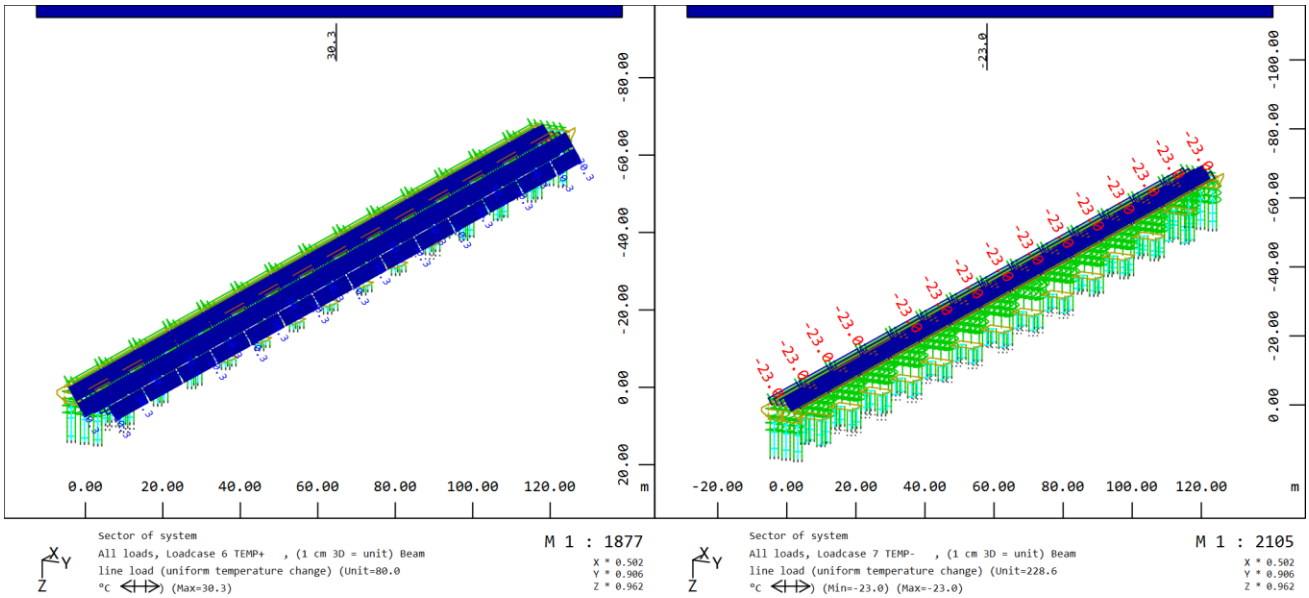

15
14
10
8
4
2
1
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
m
-60.00
-40.00
-20.00
0.00
20.00
Beam Elements , Numbers of cross section (Max=15)
M 1 : 1035
X * 0.502
Y * 0.906
Z * 0.962


15
14
10
8
4
2
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
m
-60.00
-40.00
-20.00
0.00
20.00
Sector of system Group 0 4 7...9 11 17...20 22 25 30 38...41
Beam Elements , Numbers of cross section (Max=15)
M 1 : 1035
X * 0.502
Y * 0.906
Z * 0.962

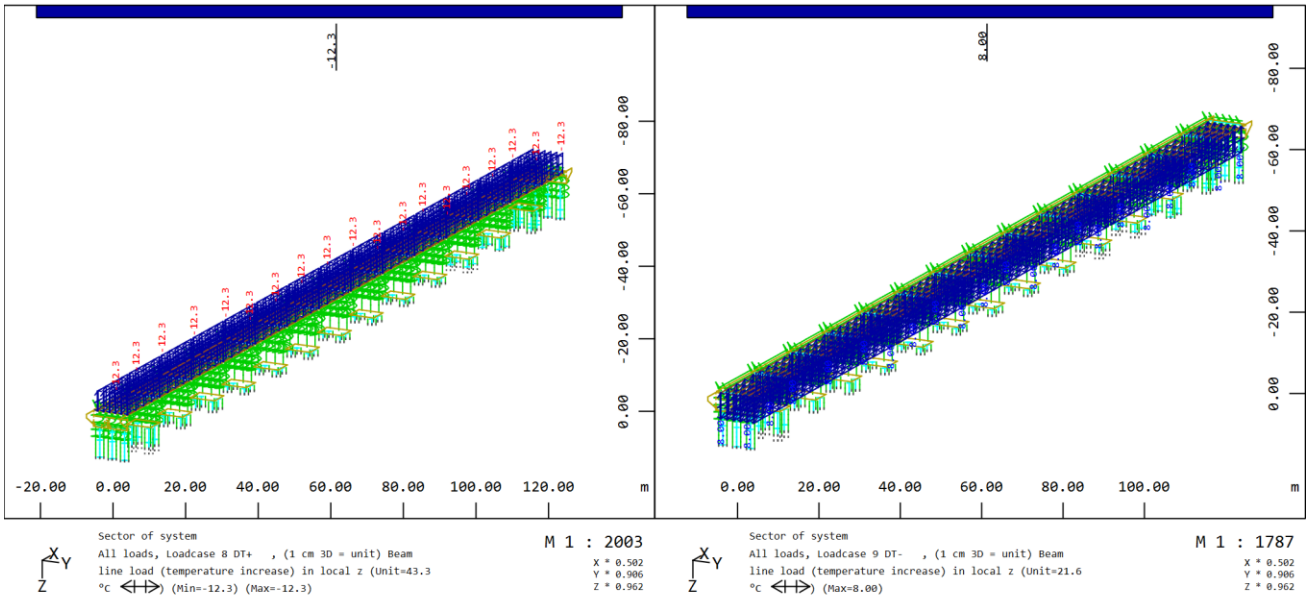

4
2
1
-60.00
-40.00
-20.00
0.00
20.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
m
Number of material, Quadrilateral Elements(Max=4), Beam Elements(Max=4)
M 1 : 1077
X * 0.502
Y * 0.906
Z * 0.962


1.40
0.70
0.50
0.25
-60.00
-40.00
-20.00
0.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
m
Sector of system
Average plate thickness in Element in m (Max=1.40)
M 1 : 958
X * 0.502
Y * 0.906
Z * 0.962

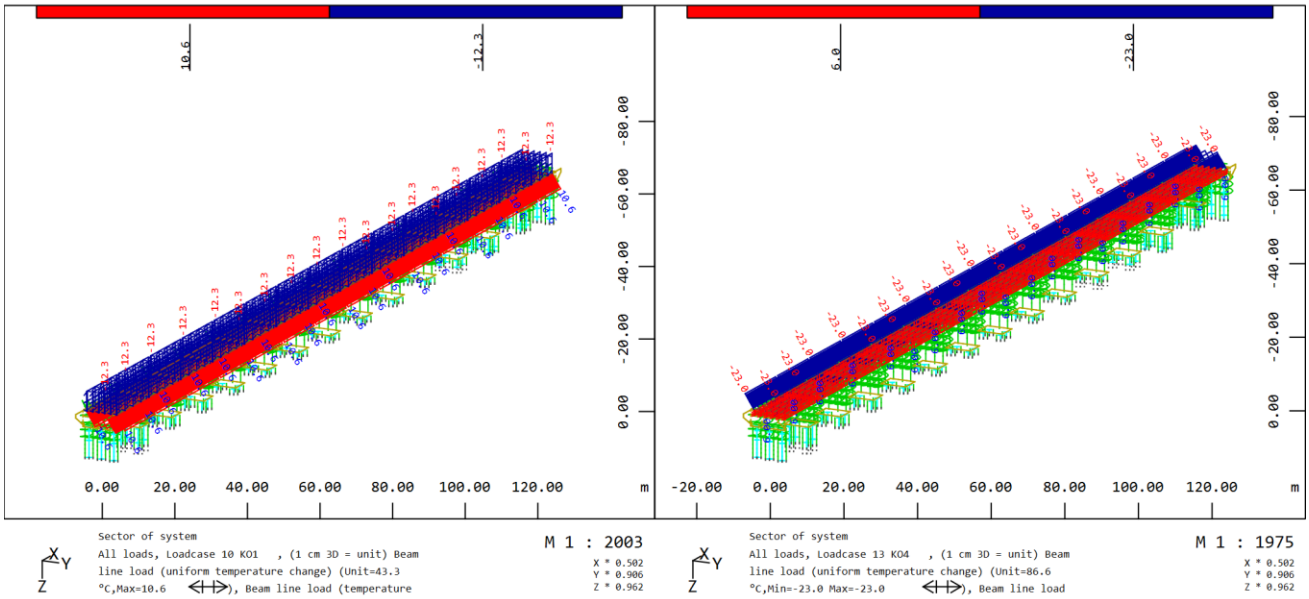

All loads, Loadcase 1 vt , (1 cm 3D = unit) Beam line load (force) in global Z (Unit=123.8 kN/m,Max=28.3), QUAD-Area dead load in global Z in Element (Unit=49.5 kN/m2,Max=35.0), Beam dead load in global Z (Unit=123.8 kN/m,Max=90.0)
M 1 : 1787
All loads, Loadcase 2 dg , (1 cm 3D = unit) Area element load (force) vector (Unit=86.6 kN/m2,Max=32.0), Beam line load (force) in global Z (Unit=21.6 kN/m,Max=7.51), Free line load (force) in global Z (Unit=21.6 kN/m,Max=7.50),
M 1 : 1935
All loads, Loadcase 3 tlo , (1 cm 3D = unit) Free area load (force) in global X (Unit=74.2 kN/m2,Min=-29.7 Max=47.5), Free area load (force) in global Y (Unit=74.2 kN/m2,Min=-42.0 Max=42.0)
M 1 : 2037
All loads, Loadcase 4 vt-up , (1 cm 3D = unit) Area element load (force) vector (Unit=43.3 kN/m2,Max=17.5), Beam line load (force) in global Z (Unit=432.8 kN/m,Max=176.2), Free line load (force) in global Z (Unit=432.8 kN/m,Max=25.0)
M 1 : 1971


30.3
-80.00
-60.00
-40.00
-20.00
0.00
20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
m
Sector of system
All loads, Loadcase 6 TEMP+ , (1 cm 3D = unit) Beam
line load (uniform temperature change) (Unit=80.0
°C) (Max=30.3)
M 1 : 1877
X * 0.502
Y * 0.906
Z * 0.962

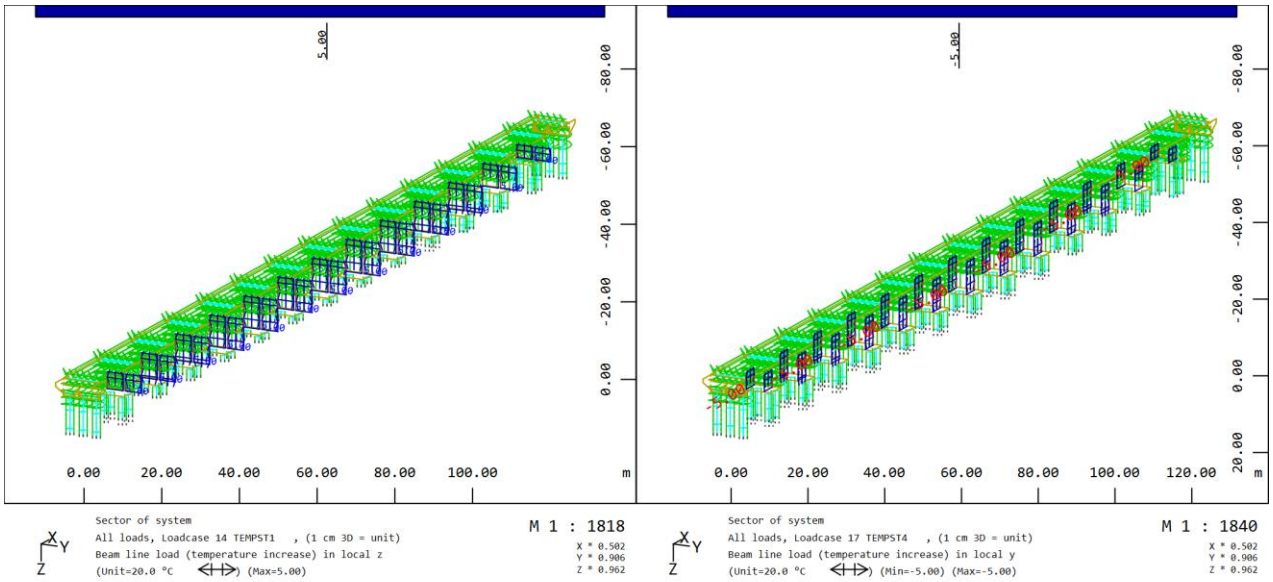
-23.0
-100.00
-80.00
-60.00
-40.00
-20.00
0.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
m
Sector of system
All loads, Loadcase 7 TEMP- , (1 cm 3D = unit) Beam
line load (uniform temperature change) (Unit=228.6
°C) (Min=-23.0) (Max=-23.0)
M 1 : 2105
X * 0.502
Y * 0.906
Z * 0.962


-12.3
-80.00
-60.00
-40.00
-20.00
0.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
m
Sector of system
All loads, Loadcase 8 DT+ , (1 cm 3D = unit) Beam
line load (temperature increase) in local z (Unit=43.3
°C) (Min=-12.3) (Max=-12.3)
M 1 : 2003
X * 0.502
Y * 0.906
Z * 0.962

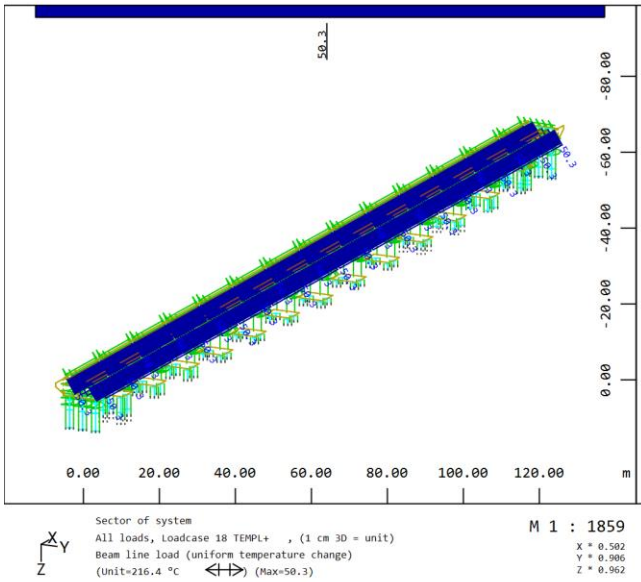
8.00
-80.00
-60.00
-40.00
-20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
m
Sector of system
All loads, Loadcase 9 DT- , (1 cm 3D = unit) Beam
line load (temperature increase) in local z (Unit=21.6
°C) (Max=8.00)
M 1 : 1787
X * 0.502
Y * 0.906
Z * 0.962

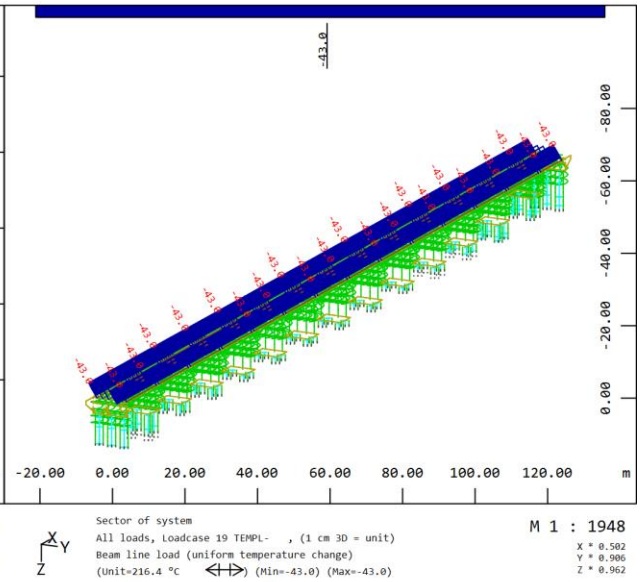

10.6
-12.3
-80.00
-60.00
-40.00
-20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
m
Sector of system
All loads, Loadcase 10 KO1 , (1 cm 3D = unit) Beam
line load (uniform temperature change) (Unit=43.3
°C,Max=10.6), Beam line load (temperature
increase) in local z (Unit=43.3 °C,Min=-12.3
M 1 : 2003
X * 0.502
Y * 0.906
Z * 0.962

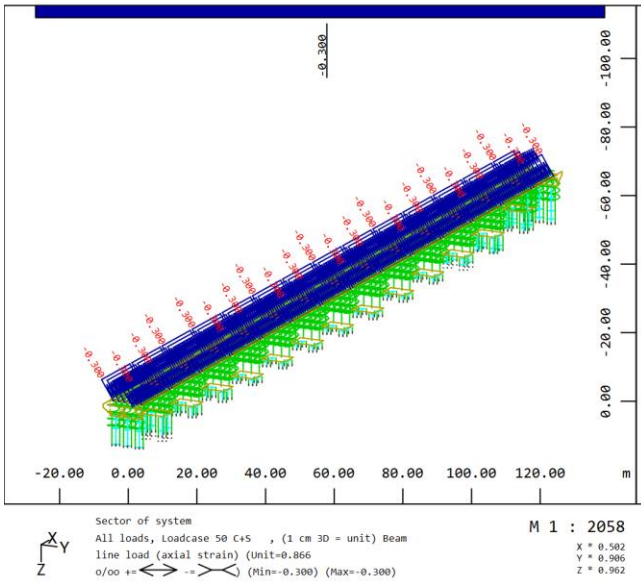
6.0
-23.0
-80.00
-60.00
-40.00
-20.00
0.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
m
Sector of system
All loads, Loadcase 13 KO4 , (1 cm 3D = unit) Beam
line load (uniform temperature change) (Unit=86.6
°C,Min=-23.0 Max=-23.0), Beam line load
(temperature increase) in local z (Unit=86.6
M 1 : 1975
X * 0.502
Y * 0.906
Z * 0.962

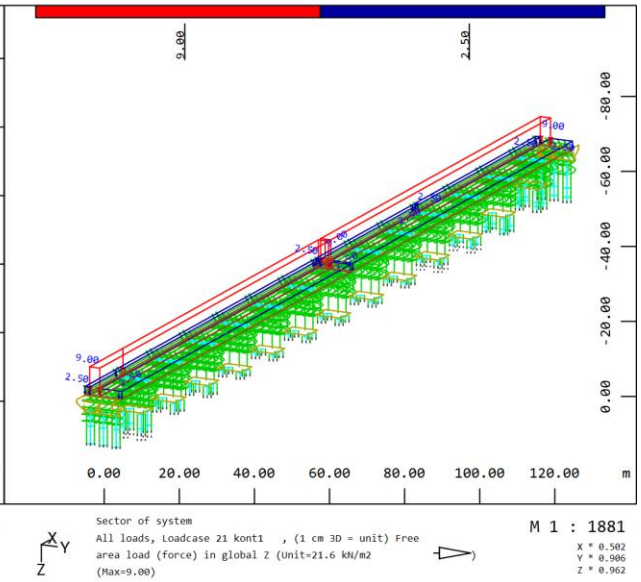

5.00
-80.00
-60.00
-40.00
-20.00
0.00
0.00 20.00 40.00 60.00 80.00 100.00 m
Sector of system
All loads, Loadcase 14 TEMPST1 , (1 cm 3D = unit)
Beam line load (temperature increase) in local z
(Unit=20.0 °C) (Max=5.00)
M 1 : 1818
X * 0.502
Y * 0.906
Z * 0.962

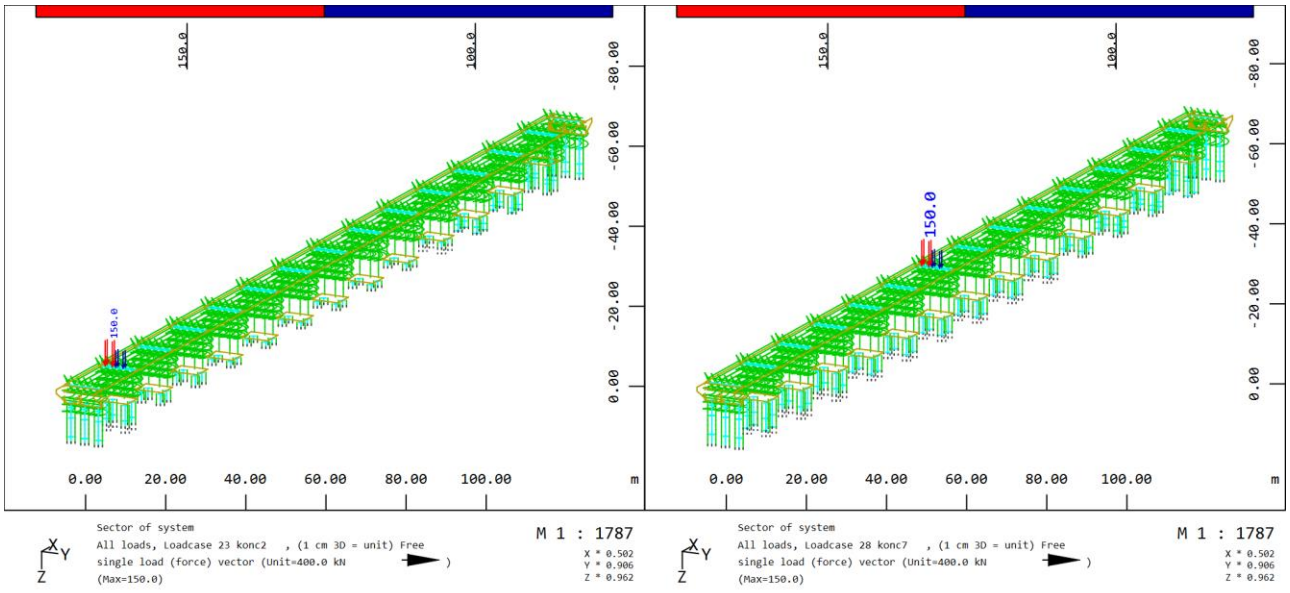
-5.00
-80.00
-60.00
-40.00
-20.00
0.00
20.00
0.00 20.00 40.00 60.00 80.00 100.00 120.00 m
Sector of system
All loads, Loadcase 17 TEMPST4 , (1 cm 3D = unit)
Beam line load (temperature increase) in local y
(Unit=20.0 °C) (Min=-5.00) (Max=-5.00)
M 1 : 1840
X * 0.502
Y * 0.906
Z * 0.962

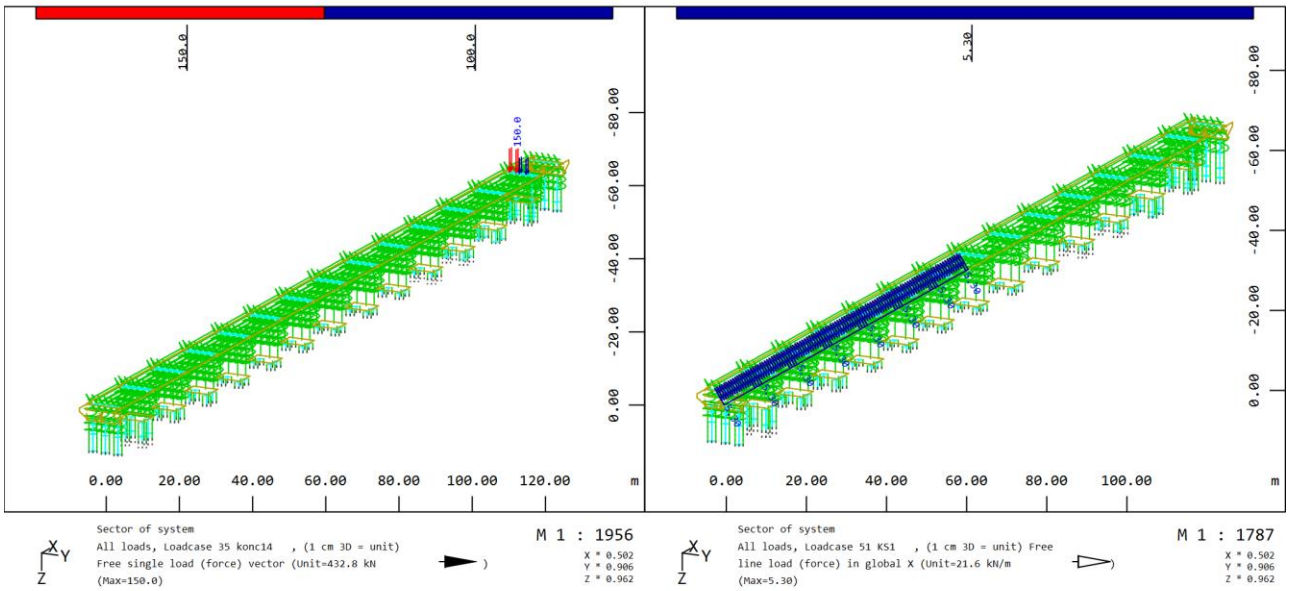

50.3
-80.00
-60.00
-40.00
-20.00
0.00
0.00 20.00 40.00 60.00 80.00 100.00 120.00 m
Sector of system
All loads, Loadcase 18 TEMPL+ , (1 cm 3D = unit)
Beam line load (uniform temperature change)
(Unit=216.4 °C) (Max=50.3)
M 1 : 1859
X * 0.502
Y * 0.906
Z * 0.962

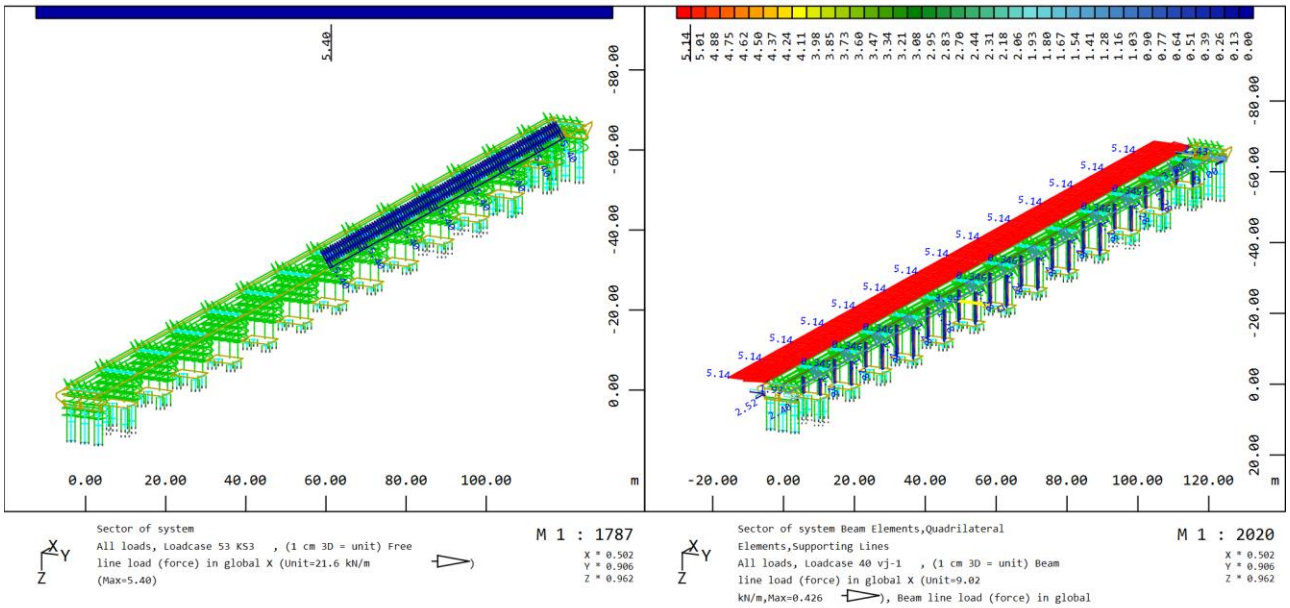

-43.0
-80.00
-60.00
-40.00
-20.00
0.00
-20.00 0.00 20.00 40.00 60.00 80.00 100.00 120.00 m
Sector of system
All loads, Loadcase 19 TEMPL- , (1 cm 3D = unit)
Beam line load (uniform temperature change)
(Unit=216.4 °C) (Min=-43.0) (Max=-43.0)
M 1 : 1948
X * 0.502
Y * 0.906
Z * 0.962

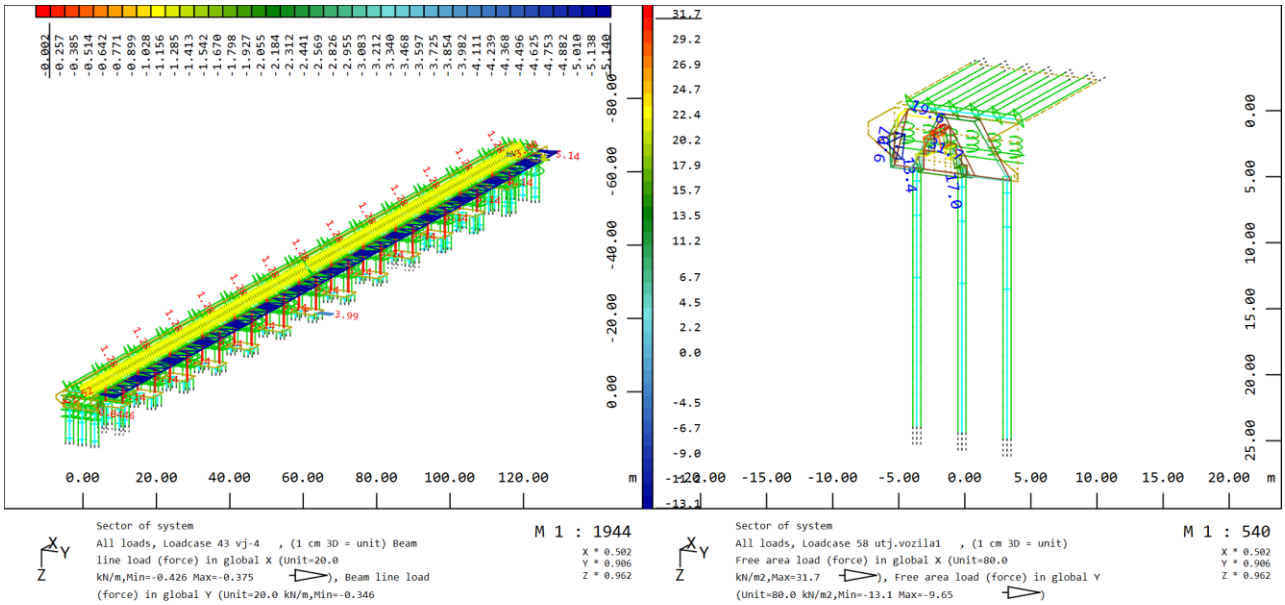

-0.300
-100.00
-80.00
-60.00
-40.00
-20.00
0.00
-20.00 0.00 20.00 40.00 60.00 80.00 100.00 120.00 m
Sector of system
All loads, Loadcase 50 C+S , (1 cm 3D = unit) Beam
line load (axial strain) (Unit=0.866
o/oo +=) (Min=-0.300) (Max=-0.300)
M 1 : 2058
X * 0.502
Y * 0.906
Z * 0.962

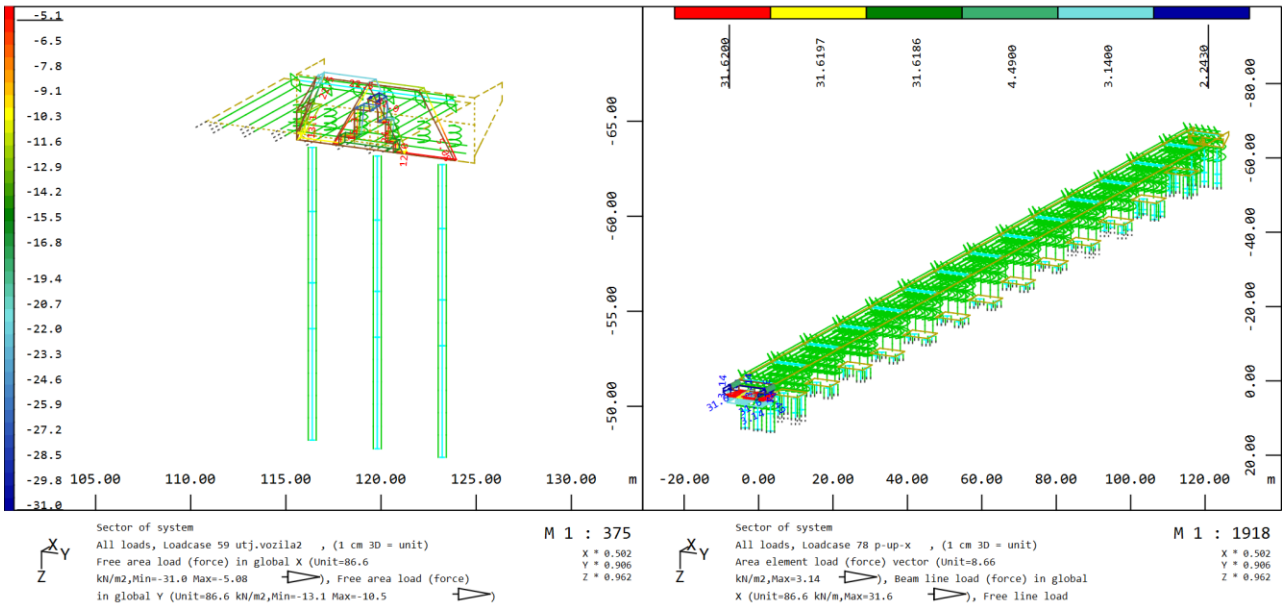

9.00
2.50
-80.00
-60.00
-40.00
-20.00
0.00
0.00 20.00 40.00 60.00 80.00 100.00 120.00 m
Sector of system
All loads, Loadcase 21 kont1 , (1 cm 3D = unit) Free
area load (force) in global Z (Unit=21.6 kN/m2
(Max=9.00)
M 1 : 1881
X * 0.502
Y * 0.906
Z * 0.962

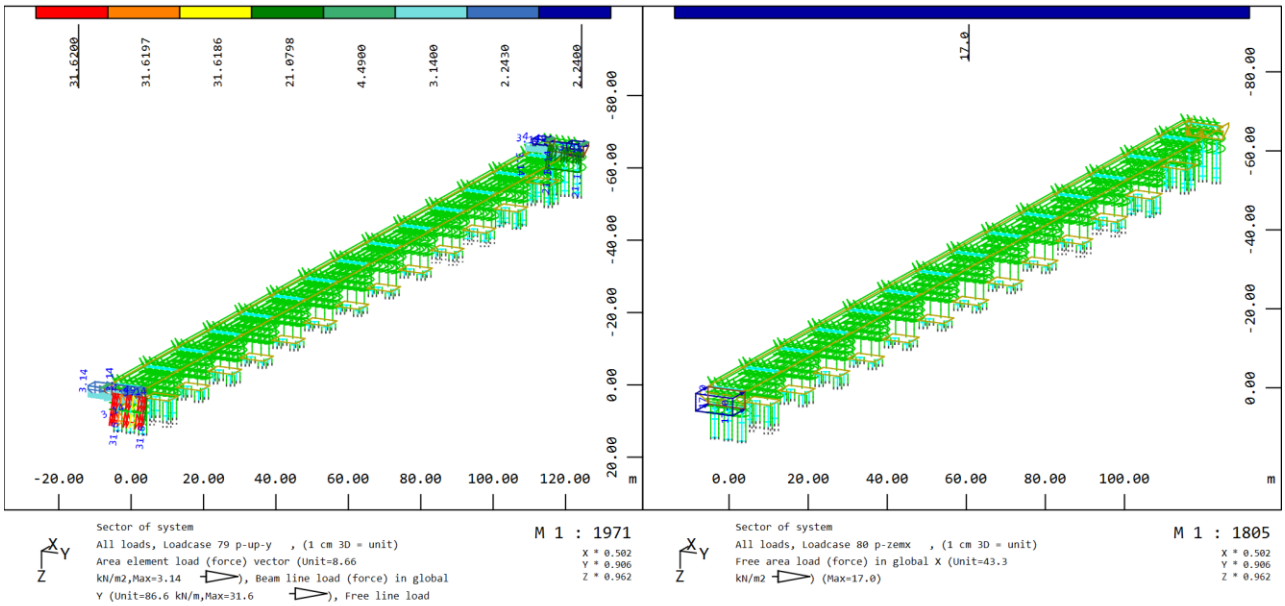

Sector of system
All loads, Loadcase 23 konc2 , (1 cm 3D = unit) Free
single load (force) vector (Unit=400.0 kN
(Max=150.0)
M 1 : 1787
X * 0.502
Y * 0.906
Z * 0.962
Sector of system
All loads, Loadcase 28 konc7 , (1 cm 3D = unit) Free
single load (force) vector (Unit=400.0 kN
(Max=150.0)
M 1 : 1787
X * 0.502
Y * 0.906
Z * 0.962

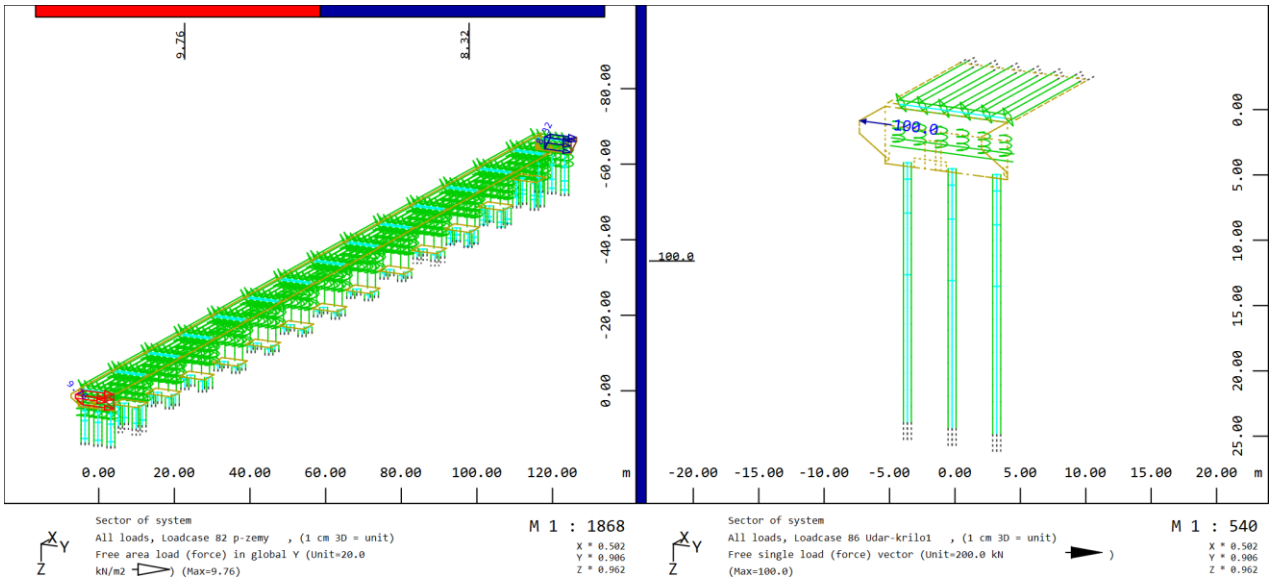

Sector of system
All loads, Loadcase 35 konc14 , (1 cm 3D = unit)
Free single load (force) vector (Unit=432.8 kN
(Max=150.0)
M 1 : 1956
X * 0.502
Y * 0.906
Z * 0.962
Sector of system
All loads, Loadcase 51 KS1 , (1 cm 3D = unit) Free
line load (force) in global X (Unit=21.6 kN/m
(Max=5.30)
M 1 : 1787
X * 0.502
Y * 0.906
Z * 0.962

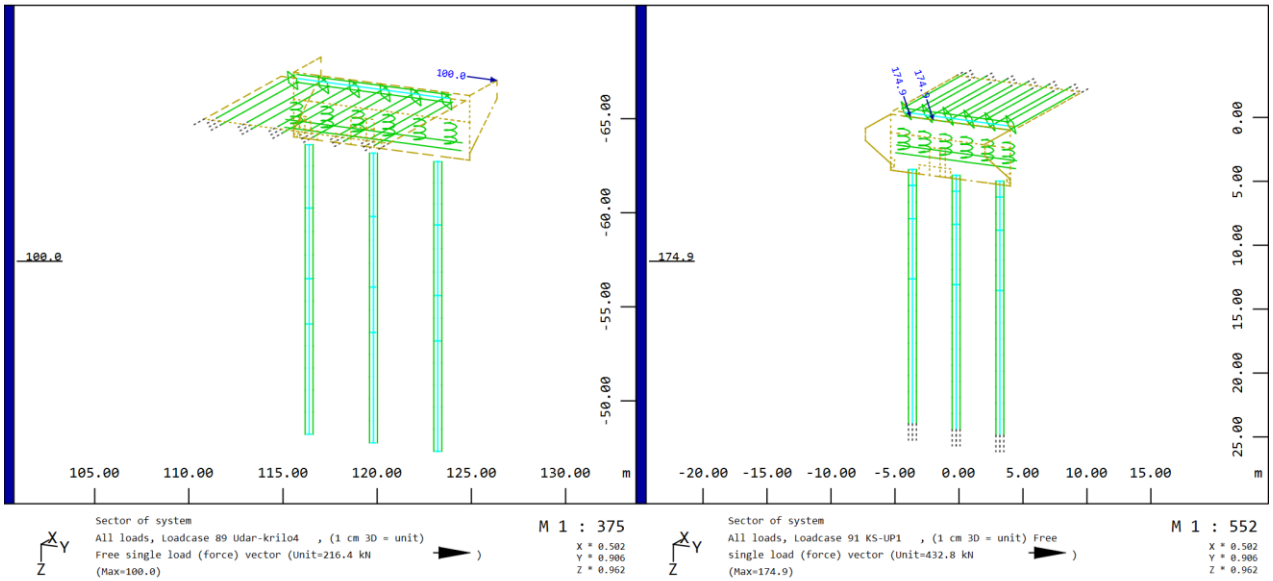

Sector of system
All loads, Loadcase 53 KS3 , (1 cm 3D = unit) Free
line load (force) in global X (Unit=21.6 kN/m
(Max=5.40)
M 1 : 1787
X * 0.502
Y * 0.906
Z * 0.962
Sector of system Beam Elements,Quadrilateral
Elements,Supporting Lines
All loads, Loadcase 40 vj-1 , (1 cm 3D = unit) Beam
line load (force) in global X (Unit=9.02
kN/m,Max=0.426
), Beam line load (force) in global
M 1 : 2020
X * 0.502
Y * 0.906
Z * 0.962

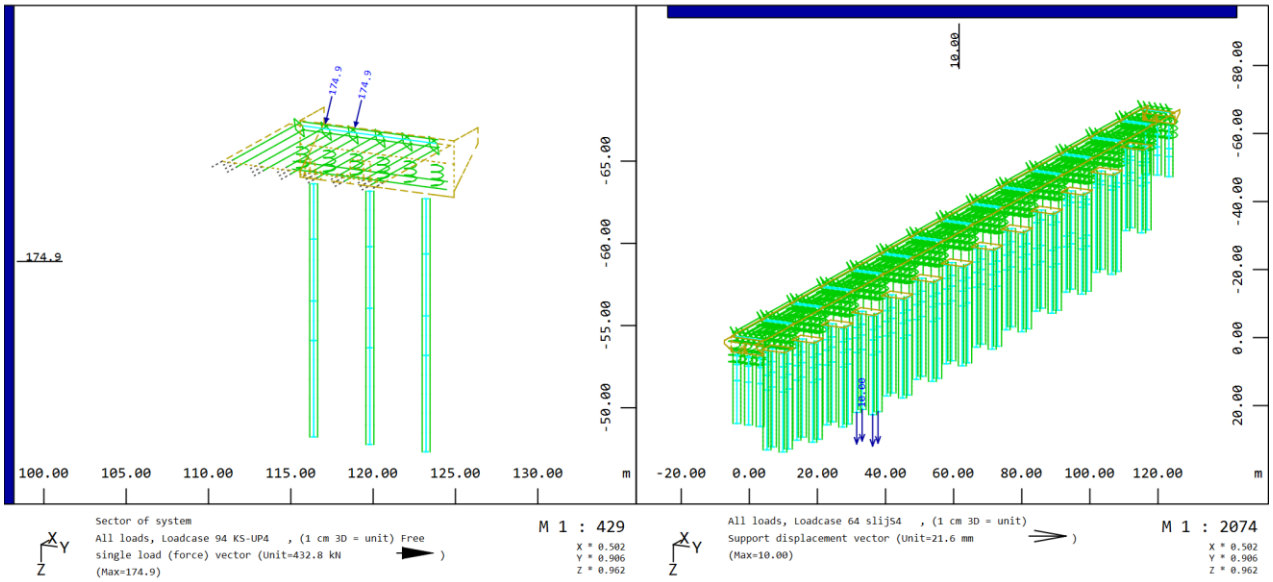

Sector of system
All loads, Loadcase 43 vj-4 , (1 cm 3D = unit) Beam line load (force) in global X (Unit=20.0 kN/m,Min=-0.426 Max=-0.375), Beam line load (force) in global Y (Unit=20.0 kN/m,Min=-0.346
M 1 : 1944
X * 0.502
Y * 0.906
Z * 0.962
Sector of system
All loads, Loadcase 58 utj.vozila1 , (1 cm 3D = unit)
Free area load (force) in global X (Unit=80.0 kN/m2,Max=31.7), Free area load (force) in global Y (Unit=80.0 kN/m2,Min=-13.1 Max=-9.65)
M 1 : 540
X * 0.502
Y * 0.906
Z * 0.962


Sector of system
All loads, Loadcase 59 utj.vozila2 , (1 cm 3D = unit)
Free area load (force) in global X (Unit=86.6 kN/m2,Min=-31.0 Max=-5.08), Free area load (force) in global Y (Unit=86.6 kN/m2,Min=-13.1 Max=-10.5)
M 1 : 375
X * 0.502
Y * 0.906
Z * 0.962
Sector of system
All loads, Loadcase 78 p-up-x , (1 cm 3D = unit)
Area element load (force) vector (Unit=8.66 kN/m2,Max=3.14), Beam line load (force) in global X (Unit=86.6 kN/m,Max=31.6), Free line load
M 1 : 1918
X * 0.502
Y * 0.906
Z * 0.962


Sector of system
All loads, Loadcase 79 p-up-y , (1 cm 3D = unit)
Area element load (force) vector (Unit=8.66 kN/m2,Max=3.14), Beam line load (force) in global Y (Unit=86.6 kN/m,Max=31.6), Free line load
M 1 : 1971
X * 0.502
Y * 0.906
Z * 0.962
Sector of system
All loads, Loadcase 80 p-zemx , (1 cm 3D = unit)
Free area load (force) in global X (Unit=43.3 kN/m2) (Max=17.0)
M 1 : 1805
X * 0.502
Y * 0.906
Z * 0.962


9.76
8.32
0.00 20.00 40.00 60.00 80.00 100.00 120.00 m
-80.00 -60.00 -40.00 -20.00 0.00
Sector of system
All loads, Loadcase 82 p-zemy , (1 cm 3D = unit)
Free area load (force) in global Y (Unit=20.0 kN/m2) (Max=9.76)
M 1 : 1868
X * 0.502
Y * 0.906
Z * 0.962
100.0
-20.00 -15.00 -10.00 -5.00 0.00 5.00 10.00 15.00 20.00 m
0.00 5.00 10.00 15.00 20.00 25.00
Sector of system
All loads, Loadcase 86 Udar-krilo1 , (1 cm 3D = unit)
Free single load (force) vector (Unit=200.0 kN) (Max=100.0)
M 1 : 540
X * 0.502
Y * 0.906
Z * 0.962


100.0
105.00 110.00 115.00 120.00 125.00 130.00 m
-65.00 -60.00 -55.00 -50.00
Sector of system
All loads, Loadcase 89 Udar-krilo4 , (1 cm 3D = unit)
Free single load (force) vector (Unit=216.4 kN) (Max=100.0)
M 1 : 375
X * 0.502
Y * 0.906
Z * 0.962
174.9
-20.00 -15.00 -10.00 -5.00 0.00 5.00 10.00 15.00 m
0.00 5.00 10.00 15.00 20.00 25.00
Sector of system
All loads, Loadcase 91 KS-UP1 , (1 cm 3D = unit) Free single load (force) vector (Unit=432.8 kN) (Max=174.9)
M 1 : 552
X * 0.502
Y * 0.906
Z * 0.962


174.9
174.9
100.00 105.00 110.00 115.00 120.00 125.00 130.00 m
-65.00 -60.00 -55.00 -50.00
Sector of system
All loads, Loadcase 94 KS-UP4 , (1 cm 3D = unit) Free single load (force) vector (Unit=432.8 kN) (Max=174.9)
M 1 : 429
X * 0.502
Y * 0.906
Z * 0.962
10.00
-20.00 0.00 20.00 40.00 60.00 80.00 100.00 120.00 m
-80.00 -60.00 -40.00 -20.00 0.00 20.00
All loads, Loadcase 64 slijs4 , (1 cm 3D = unit)
Support displacement vector (Unit=21.6 mm) (Max=10.00)
M 1 : 2074
X * 0.502
Y * 0.906
Z * 0.962

2. ANALIZA OPTEREĆENJA

2.1 Stalna opterećenja

2.1.1 Vlastita težina (LC 1)

Vlastita težina je izračunata programskim paketom Sofistik, stoga se ne računa ručno.
Za zapreminsku težinu betonskih elemenata uzeto je γ=25,0 kN/m^3.

2.1.2 Dodatno stalno (LC 2 ,LC3)

Globalni model:

- slojevi asfalta (3,5+4,0 cm)	0,075*24 = 1,8 kN/m^2
- izravnavajući sloj asfalta (2,0 cm)	0,02*24 = 0,48 kN/m^2
- hidroizolacija (1,0 cm)	0,01*24 = 0,24 kN/m^2
	Δg = 2,52 kN/m^2

- pješačka staza (27,0 cm)	0,27*25 = 6,75 kN/m'
- hidroizolacija (1,0 cm)	0,01*24 = 0,24 kN/m^2
	Δg = 7,0 kN/m^2

- odbojna ograda 0,5 kN/m'

- monolitni vijenac+pješačka ograda (0,35*0,8*25+0,5) = 7,5 kN/m'

Težina zemlje na naglavnici pilota stupova

- nadsloj zemlje (1,6 m) 32,0 kN/m^2

➢ Na hodniku upornjaka:

- monolitni vijenac+ograda+konzole 25 kN/m

Roštilj:

srednji nosač

- slojevi asfalta (3,5+4,0 cm)	0,075*24*1,82 = 3,28 kN/m'
- izravnavajući sloj asfalta (2,0 cm)	0,02*24*1,82 = 0,87 kN/m'
- hidroizolacija (1,0 cm)	0,01*24*1,82 = 0,44 kN/m'
	Δg = 4,59 kN/m'

rubni nosač

- slojevi asfalta (3,5+4,0 cm)	0,075*24*0,41 = 0,74 kN/m'
- izravnavajući sloj asfalta (2,0 cm)	0,02*24*0,41 = 0,20 kN/m'
- hidroizolacija (1,0 cm)	0,01*24*1,82 = 0,44 kN/m'
- pješačka staza (27,0 cm)	0,27*25*1,4 = 9,45 kN/m'
- odbojna ograda	0,5 = 0,5 kN/m'
- monolitni vijenac+ograda	(0,35*0,8*25+0,5) = 7,5 kN/m'
	Δg = 18,83 kN/m'

2.1.3 Beton ploče (LC 2)

Roštilj:

RUBNI I SREDNJI NOSAČI: $g_1 = 0,25 * 25 * 1,82 = 11,38$ kN/m^1

2.1.4 Puzanje i skupljanje betona (LC 5015-5017, 5025-5027, 5035-5037, 5040-5042), Lc 50

Globalni model:

Puzanje i skupljanje uzeto je kao deformacija samo gornjeg ustroja 0,3mm/m.

Roštilj:

Puzanje i skupljanje uzeto je preko faza gradnje u modulu CSM unutar modela.

Pretpostavljene su slijedeće faze gradnje:

- 5 – betoniranje nosača
- 10 – prednapinjanje
- 15-17 – puzanje i skupljanje (t=28 dana)
- 20 – betoniranje kolničke ploče
- 25-27 – puzanje i skupljanje (t=28 dana)
- 30 – postavljanje pomosta (dodatno stalno opterećenje)
- 35-37 – puzanje i skupljanje (t=40 dana) do puštanja u promet
- puštanje u promet
- 40-42 – puzanje i skupljanje do 100 g

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Construction Stages

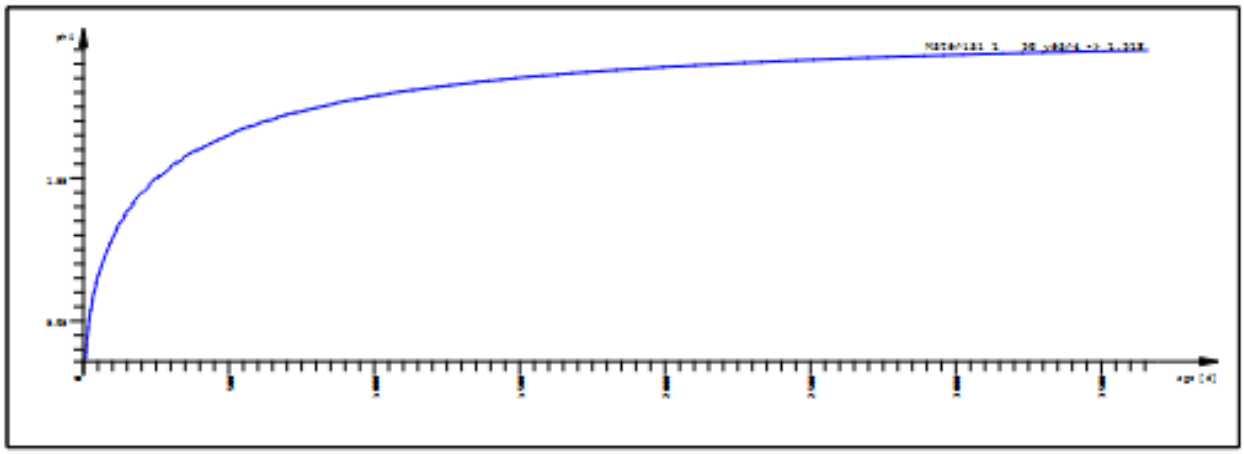
CS	Type	t [d]	RH [%]	T [°C]	laun_1 [m]	laun_2 [m]	Designation
5	G_1						G_1
10	P						Prestress
15	C_1	5	80	20			Creep till superimpose G_2
16	C_1	8	80	20			Creep till superimpose G_2
17	C_1	15	80	20			Creep till superimpose G_2
20	G_2						G_2, beton ploče
25	C_1	8	80	20			Creep till superimpose G_2
26	C_1	9	80	20			Creep till superimpose G_2
27	C_1	11	80	20			Creep till superimpose G_2
30	G_2						G_2, Asphalt, capping
35	C_1	11	80	20			Creep till traffic opening
36	C_1	13	80	20			Creep till traffic opening
37	C_1	16	80	20			Creep till traffic opening
40	C_2	344	80	20			C+S t-infinite
41	C_2	1495	80	20			C+S t-infinite
42	C_2	6488	80	20			C+S t-infinite
43	C_2	28173	80	20			C+S t-infinite

CS number of the construction stage
Type type of the action
t effective duration of creep interval
laun_1 launching distance of this construction stage for launching from side 1
laun_2 launching distance of this construction stage for launching from side 2
RH relative humidity
T temperature in creep interval

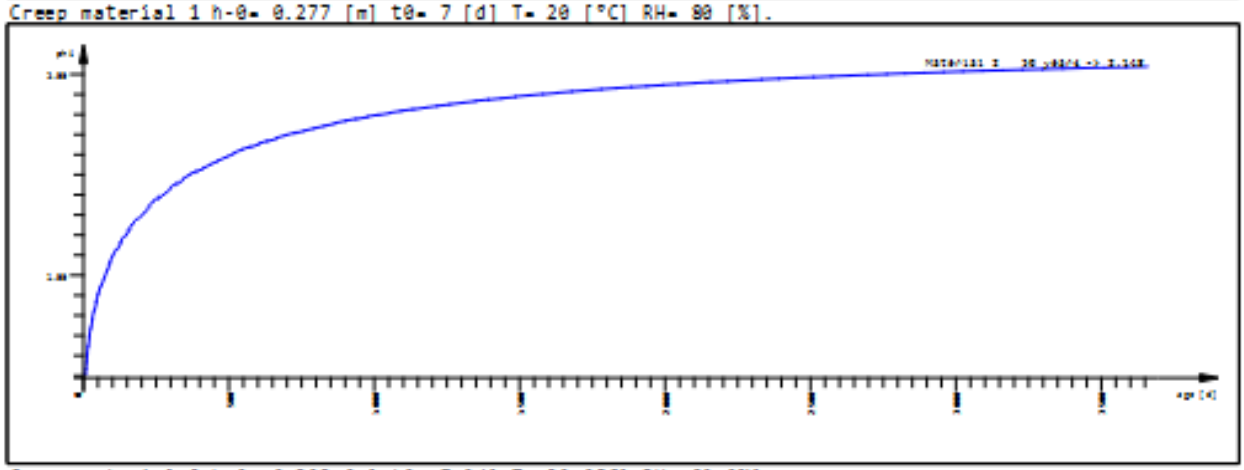
Group Properties

Grp	active from CS	active until CS	deadload from CS	Hfix from	Bedd from	Deck from	ASTI until	t0 [d]	ts [d]	FAC1	PHIF	QUEA	QEMX	FACD
0	5	9999	5					7	3		1.00			
1	5	9999	5					7	3		1.00			
3	30	9999	30					7	3		1.00			
5	30	9999	30					7	3		1.00			
6	30	9999	30					7	3		1.00			
7	30	9999	30					7	3		1.00			
8	5	29	5					7	3		1.00			

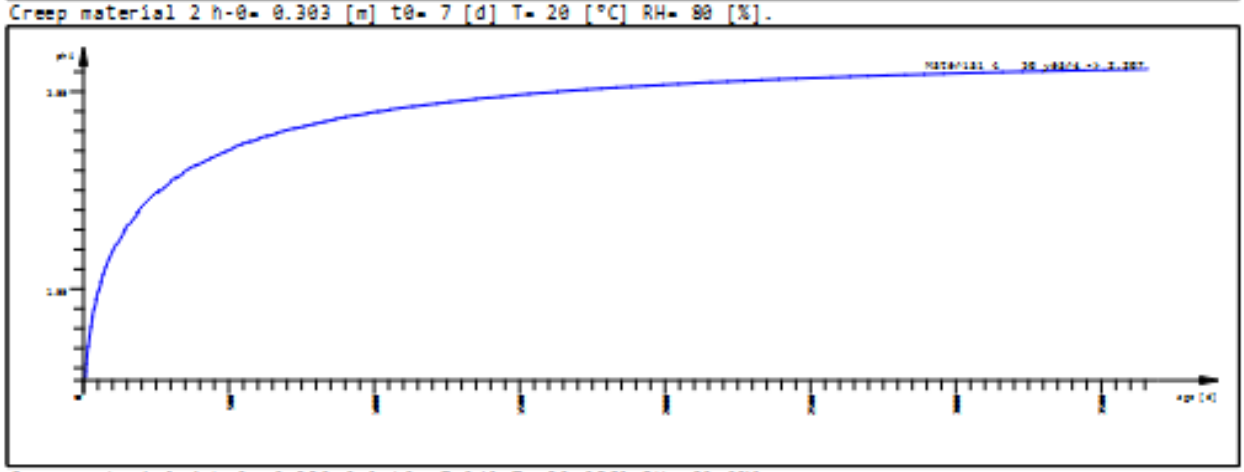
Grp group number
active active from / until construction stage number
deadload construction stage number from which the dead load of a group is activated
Hfix construction stage number at which hinges are fixed
Bedd construction stage number from which QUAD bedding is activated
Deck construction stage number from which the in situ concrete load of a AQUA CS is activated
ASTI stiffness active till construction stage number
t0 age of concrete at time of loading
ts start time of drying (from t0-ts shrinkage without effect)
FAC1 stiffness factor for first activation (e.g. cable prestress)
PHIF factor for creep of springs and beddings
QUEA component of the normal force stiffness of QUAD elements
QEMX factor of Young's modulus of QUAD elements in local x direction
FACD factor dead load



Creep material 1 h-0= 0.277 [m] t0= 7 [d] T= 20 [°C] RH= 80 [%].



Creep material 2 h-0= 0.303 [m] t0= 7 [d] T= 20 [°C] RH= 80 [%].



Creep material 4 h-0= 0.220 [m] t0= 7 [d] T= 20 [°C] RH= 80 [%].

Creep Values — Construction Stages 15 - 40

Grp	Mat	Type	h-0 [m]	t0 [d]	CS 15	CS 16	CS 17	CS 25	CS 26	CS 27	CS 35	CS 36	CS 37	CS 40
			t[d]	--->	5	8	15	8	9	11	11	13	16	344
			RH[%]	--->	80	80	80	80	80	80	80	80	80	80
			T[°C]	--->	20	20	20	20	20	20	20	20	20	20
0	1	beam	0.277¹	7	0.33	0.11	0.11	0.04	0.04	0.04	0.03	0.04	0.04	0.34
			RCRE	12	-	0.35	0.13	0.04	0.04	0.04	0.03	0.03	0.04	0.32

Creep Values — Construction Stages 15 - 40

Grp	Mat	Type	h-0 [m]	t0 [d]	CS 15	CS 16	CS 17	CS 25	CS 26	CS 27	CS 35	CS 36	CS 37	CS 40
				20	-	-	0.38	0.05	0.04	0.04	0.03	0.03	0.04	0.30
				35	-	-	-	0.28	0.07	0.06	0.04	0.04	0.04	0.29
				43	-	-	-	-	0.28	0.07	0.05	0.04	0.04	0.30
				52	-	-	-	-	-	0.29	0.07	0.05	0.05	0.30
				63	-	-	-	-	-	-	0.28	0.07	0.06	0.32
				74	-	-	-	-	-	-	-	0.28	0.08	0.34
				87	-	-	-	-	-	-	-	-	0.29	0.38
				103	-	-	-	-	-	-	-	-	-	0.64
				447	-	-	-	-	-	-	-	-	-	-
				1942	-	-	-	-	-	-	-	-	-	-
				8430	-	-	-	-	-	-	-	-	-	-
0	4	beam	0.220¹	7	-	-	-	-	-	-	0.63	0.16	0.13	0.70
			RCRE	7	-	-	-	-	-	-	0.63	0.16	0.13	0.70
				7	-	-	-	-	-	-	0.63	0.16	0.13	0.70
				7	-	-	-	-	-	-	0.63	0.16	0.13	0.70
				7	-	-	-	-	-	-	0.63	0.16	0.13	0.70
				7	-	-	-	-	-	-	0.63	0.16	0.13	0.70
				7	-	-	-	-	-	-	0.63	0.16	0.13	0.70
				18	-	-	-	-	-	-	-	0.56	0.15	0.65
				31	-	-	-	-	-	-	-	-	0.53	0.68
				47	-	-	-	-	-	-	-	-	-	1.11
				391	-	-	-	-	-	-	-	-	-	-
				1886	-	-	-	-	-	-	-	-	-	-
				8374	-	-	-	-	-	-	-	-	-	-
1	1	beam	0.277¹	7	0.33	0.11	0.11	0.04	0.04	0.04	0.03	0.04	0.04	0.34
			RCRE	12	-	0.35	0.13	0.04	0.04	0.04	0.03	0.03	0.04	0.32
				20	-	-	0.38	0.05	0.04	0.04	0.03	0.03	0.04	0.30
				35	-	-	-	0.28	0.07	0.06	0.04	0.04	0.04	0.29
				43	-	-	-	-	0.28	0.07	0.05	0.04	0.04	0.30
				52	-	-	-	-	-	0.29	0.07	0.05	0.05	0.30
				63	-	-	-	-	-	-	0.28	0.07	0.06	0.32
				74	-	-	-	-	-	-	-	0.28	0.08	0.34
				87	-	-	-	-	-	-	-	-	0.29	0.38
				103	-	-	-	-	-	-	-	-	-	0.64
				447	-	-	-	-	-	-	-	-	-	-
				1942	-	-	-	-	-	-	-	-	-	-
				8430	-	-	-	-	-	-	-	-	-	-
1	4	beam	0.220¹	7	-	-	-	-	-	-	0.63	0.16	0.13	0.70
			RCRE	7	-	-	-	-	-	-	0.63	0.16	0.13	0.70
				7	-	-	-	-	-	-	0.63	0.16	0.13	0.70
				7	-	-	-	-	-	-	0.63	0.16	0.13	0.70
				7	-	-	-	-	-	-	0.63	0.16	0.13	0.70
				7	-	-	-	-	-	-	0.63	0.16	0.13	0.70
				7	-	-	-	-	-	-	0.63	0.16	0.13	0.70
				18	-	-	-	-	-	-	-	0.56	0.15	0.65
				31	-	-	-	-	-	-	-	-	0.53	0.68
				47	-	-	-	-	-	-	-	-	-	1.11
				391	-	-	-	-	-	-	-	-	-	-
				1886	-	-	-	-	-	-	-	-	-	-
				8374	-	-	-	-	-	-	-	-	-	-
3	4	beam	0.201¹	7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
			RCRE	7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71

Creep Values — Construction Stages 15 - 40

Grp	Mat	Type	h-0 [m]	t0 [d]	CS 15	CS 16	CS 17	CS 25	CS 26	CS 27	CS 35	CS 36	CS 37	CS 40
				18	-	-	-	-	-	-	-	0.57	0.15	0.66
				31	-	-	-	-	-	-	-	-	0.55	0.69
				47	-	-	-	-	-	-	-	-	-	1.13
				391	-	-	-	-	-	-	-	-	-	-
				1886	-	-	-	-	-	-	-	-	-	-
				8374	-	-	-	-	-	-	-	-	-	-
5	4	beam	0.201[1]	7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
			RCRE	7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				18	-	-	-	-	-	-	-	0.57	0.15	0.66
				31	-	-	-	-	-	-	-	-	0.55	0.69
				47	-	-	-	-	-	-	-	-	-	1.13
				391	-	-	-	-	-	-	-	-	-	-
				1886	-	-	-	-	-	-	-	-	-	-
				8374	-	-	-	-	-	-	-	-	-	-
6	4	beam	0.201[1]	7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
			RCRE	7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				7	-	-	-	-	-	-	0.65	0.17	0.13	0.71
				18	-	-	-	-	-	-	-	0.57	0.15	0.66
				31	-	-	-	-	-	-	-	-	0.55	0.69
				47	-	-	-	-	-	-	-	-	-	1.13
				391	-	-	-	-	-	-	-	-	-	-
				1886	-	-	-	-	-	-	-	-	-	-
				8374	-	-	-	-	-	-	-	-	-	-
7	2	beam	0.303[1]	7	-	-	-	-	-	-	0.58	0.15	0.12	0.67
			RCRE	7	-	-	-	-	-	-	0.58	0.15	0.12	0.67
				7	-	-	-	-	-	-	0.58	0.15	0.12	0.67
				7	-	-	-	-	-	-	0.58	0.15	0.12	0.67
				7	-	-	-	-	-	-	0.58	0.15	0.12	0.67
				7	-	-	-	-	-	-	0.58	0.15	0.12	0.67
				7	-	-	-	-	-	-	0.58	0.15	0.12	0.67
				18	-	-	-	-	-	-	-	0.51	0.13	0.62
				31	-	-	-	-	-	-	-	-	0.49	0.64
				47	-	-	-	-	-	-	-	-	-	1.03
				391	-	-	-	-	-	-	-	-	-	-
				1886	-	-	-	-	-	-	-	-	-	-
				8374	-	-	-	-	-	-	-	-	-	-

[1] The real used values for h-0 and the real used creep values are finally calculated in AQB exactly in dependance of the individual height (haunches) and stages (precast concrete with in situ deck) (h-0 can vary for each creep stage due to changing air contact).
The values h-0 and the creep values in this table are only printed averaged for simple comparison.

Grp group number
h-0 notional size (2A/U)
t0 age of concrete at time of loading
CS construction stage creep part Δφ-eff
RCRE Creep value for a later (at t0) acting load part (backward creeping)
t effective duration creep interval
RH relative humidity
T temperature in creep interval

Creep Values — Construction Stages 41 - 43

Grp	Mat	Type	h-0 [m]	t0 [d]	CS 41	CS 42	CS 43	total φ-eff
			t[d]	--->	1495	6488	28173	36596
			RH[%]	--->	80	80	80	

Creep Values — Construction Stages 41 - 43

Grp	Mat	Type	h-0 [m]	t0 [d]	CS 41	CS 42	CS 43	total φ-eff
			T[°C]	--->	20	20	20	
0	1	beam	0.277¹	7	0.26	0.11	0.03	1.53 / 1.05²
			RCRE	12	0.24	0.10	0.03	1.38 / 1.05²
				20	0.22	0.09	0.03	1.25 / 1.05²
				35	0.20	0.08	0.02	1.13 / 1.05²
				43	0.20	0.08	0.02	1.08 / 1.05²
				52	0.19	0.08	0.02	1.04 / 1.05²
				63	0.19	0.08	0.02	1.01 / 1.05²
				74	0.19	0.07	0.02	0.98 / 1.05²
				87	0.19	0.07	0.02	0.95 / 1.05²
				103	0.19	0.07	0.02	0.92 / 1.05²
				447	0.61	0.06	0.02	0.69 / 1.05²
				1942	-	0.50	0.01	0.52 / 1.05²
				8430	-	-	0.39	0.39 / 1.05²
0	4	beam	0.220¹	7	0.40	0.15	0.04	2.22 / 1.05²
			RCRE	7	0.40	0.15	0.04	2.22 / 1.05²
				7	0.40	0.15	0.04	2.22 / 1.05²
				7	0.40	0.15	0.04	2.22 / 1.05²
				7	0.40	0.15	0.04	2.22 / 1.05²
				7	0.40	0.15	0.04	2.22 / 1.05²
				7	0.40	0.15	0.04	2.22 / 1.05²
				18	0.34	0.13	0.04	1.86 / 1.05²
				31	0.32	0.12	0.03	1.68 / 1.05²
				47	0.30	0.11	0.03	1.55 / 1.05²
				391	0.92	0.09	0.02	1.03 / 1.05²
				1886	-	0.74	0.02	0.76 / 1.05²
				8374	-	-	0.56	0.56 / 1.05²
1	1	beam	0.277¹	7	0.26	0.11	0.03	1.53 / 1.05²
			RCRE	12	0.24	0.10	0.03	1.38 / 1.05²
				20	0.22	0.09	0.03	1.25 / 1.05²
				35	0.20	0.08	0.02	1.13 / 1.05²
				43	0.20	0.08	0.02	1.08 / 1.05²
				52	0.19	0.08	0.02	1.04 / 1.05²
				63	0.19	0.08	0.02	1.01 / 1.05²
				74	0.19	0.07	0.02	0.98 / 1.05²
				87	0.19	0.07	0.02	0.95 / 1.05²
				103	0.19	0.07	0.02	0.92 / 1.05²
				447	0.61	0.06	0.02	0.69 / 1.05²
				1942	-	0.50	0.01	0.52 / 1.05²
				8430	-	-	0.39	0.39 / 1.05²
1	4	beam	0.220¹	7	0.40	0.15	0.04	2.22 / 1.05²
			RCRE	7	0.40	0.15	0.04	2.22 / 1.05²
				7	0.40	0.15	0.04	2.22 / 1.05²
				7	0.40	0.15	0.04	2.22 / 1.05²
				7	0.40	0.15	0.04	2.22 / 1.05²
				7	0.40	0.15	0.04	2.22 / 1.05²
				7	0.40	0.15	0.04	2.22 / 1.05²
				18	0.34	0.13	0.04	1.86 / 1.05²
				31	0.32	0.12	0.03	1.68 / 1.05²
				47	0.30	0.11	0.03	1.55 / 1.05²
				391	0.92	0.09	0.02	1.03 / 1.05²
				1886	-	0.74	0.02	0.76 / 1.05²
				8374	-	-	0.56	0.56 / 1.05²
3	4	beam	0.201¹	7	0.39	0.15	0.04	2.24 / 1.05²
			RCRE	7	0.39	0.15	0.04	2.24 / 1.05²
				7	0.39	0.15	0.04	2.24 / 1.05²
				7	0.39	0.15	0.04	2.24 / 1.05²

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Creep Values — **Construction Stages 41 - 43**

Grp	Mat	Type	h-0 [m]	t0 [d]	CS 41	CS 42	CS 43	total φ-eff
				7	0.39	0.15	0.04	2.24 / 1.05²
				7	0.39	0.15	0.04	2.24 / 1.05²
				7	0.39	0.15	0.04	2.24 / 1.05²
				18	0.34	0.12	0.03	1.87 / 1.05²
				31	0.31	0.11	0.03	1.69 / 1.05²
				47	0.30	0.11	0.03	1.56 / 1.05²
				391	0.93	0.09	0.02	1.04 / 1.05²
				1886	-	0.74	0.02	0.76 / 1.05²
				8374	-	-	0.57	0.57 / 1.05²
5	4	beam	0.201¹	7	0.39	0.15	0.04	2.24 / 1.05²
			RCRE	7	0.39	0.15	0.04	2.24 / 1.05²
				7	0.39	0.15	0.04	2.24 / 1.05²
				7	0.39	0.15	0.04	2.24 / 1.05²
				7	0.39	0.15	0.04	2.24 / 1.05²
				7	0.39	0.15	0.04	2.24 / 1.05²
				7	0.39	0.15	0.04	2.24 / 1.05²
				18	0.34	0.12	0.03	1.87 / 1.05²
				31	0.31	0.11	0.03	1.69 / 1.05²
				47	0.30	0.11	0.03	1.56 / 1.05²
				391	0.93	0.09	0.02	1.04 / 1.05²
				1886	-	0.74	0.02	0.76 / 1.05²
				8374	-	-	0.57	0.57 / 1.05²
6	4	beam	0.201¹	7	0.39	0.15	0.04	2.24 / 1.05²
			RCRE	7	0.39	0.15	0.04	2.24 / 1.05²
				7	0.39	0.15	0.04	2.24 / 1.05²
				7	0.39	0.15	0.04	2.24 / 1.05²
				7	0.39	0.15	0.04	2.24 / 1.05²
				7	0.39	0.15	0.04	2.24 / 1.05²
				7	0.39	0.15	0.04	2.24 / 1.05²
				18	0.34	0.12	0.03	1.87 / 1.05²
				31	0.31	0.11	0.03	1.69 / 1.05²
				47	0.30	0.11	0.03	1.56 / 1.05²
				391	0.93	0.09	0.02	1.04 / 1.05²
				1886	-	0.74	0.02	0.76 / 1.05²
				8374	-	-	0.57	0.57 / 1.05²
7	2	beam	0.303¹	7	0.42	0.18	0.05	2.16 / 1.05²
			RCRE	7	0.42	0.18	0.05	2.16 / 1.05²
				7	0.42	0.18	0.05	2.16 / 1.05²
				7	0.42	0.18	0.05	2.16 / 1.05²
				7	0.42	0.18	0.05	2.16 / 1.05²
				7	0.42	0.18	0.05	2.16 / 1.05²
				7	0.42	0.18	0.05	2.16 / 1.05²
				18	0.36	0.15	0.04	1.81 / 1.05²
				31	0.33	0.14	0.04	1.63 / 1.05²
				47	0.32	0.13	0.04	1.51 / 1.05²
				391	0.88	0.10	0.02	1.00 / 1.05²
				1886	-	0.71	0.02	0.74 / 1.05²
				8374	-	-	0.55	0.55 / 1.05²

¹ The real used values for h-0 and the real used creep values are finally calculated in AQB exactly in dependance of the individual height (haunches) and stages (precast concrete with in situ deck) (h-0 can vary for each creep stage due to changing air contact).
The values h-0 and the creep values in this table are only printed averaged for simple comparison.

² In AQB and ASE the creep values will be devided by the printed factor due to the problem of the reference E-modulus [Ec/Ecm]
Please refer to basic document EN 1992-1-1 Eq.3.14

Grp	group number	φ-eff	sum construction stage creep parts
h-0	notional size (2A/U)	t	effective duration creep interval
t0	age of concrete at time of loading	RH	relative humidity
CS	construction stage creep part Δφ-eff	T	temperature in creep interval
RCRE	Creep value for a later (at t0) acting load part (backward creeping)		

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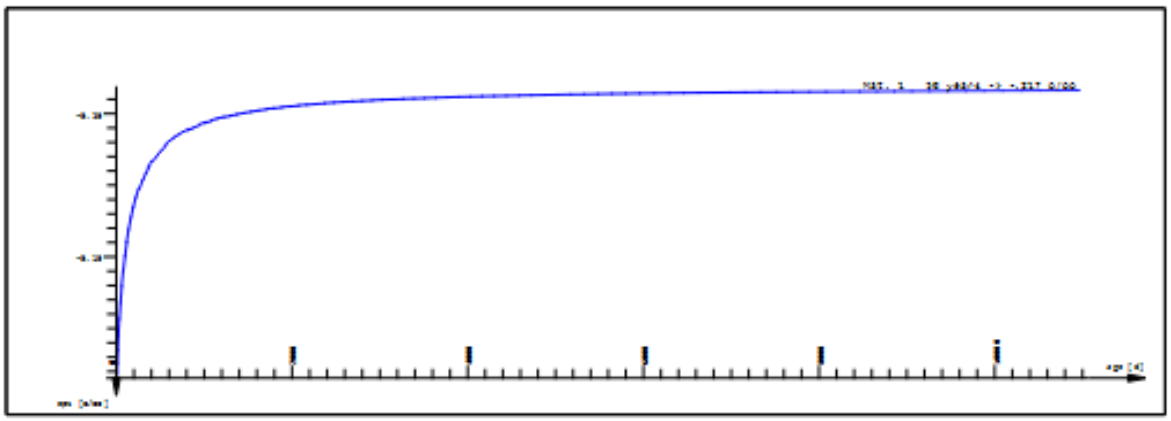
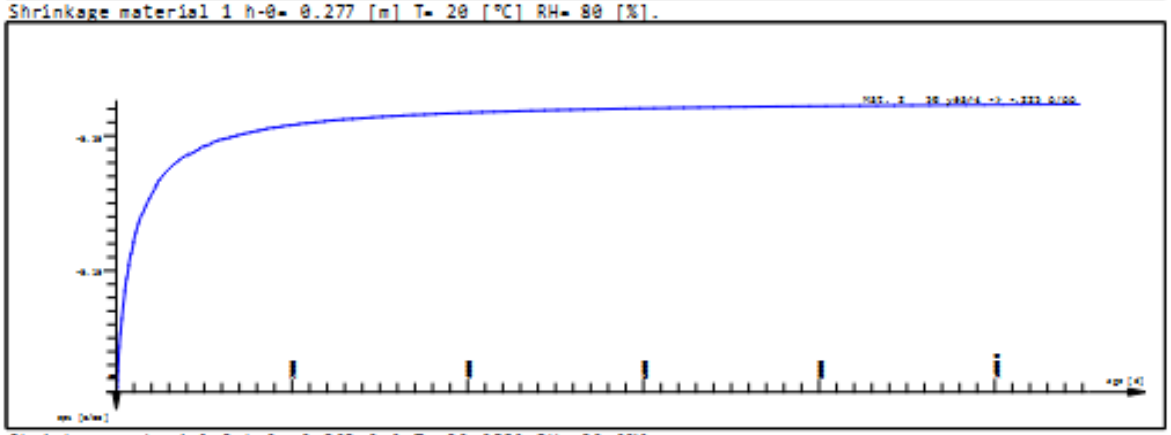
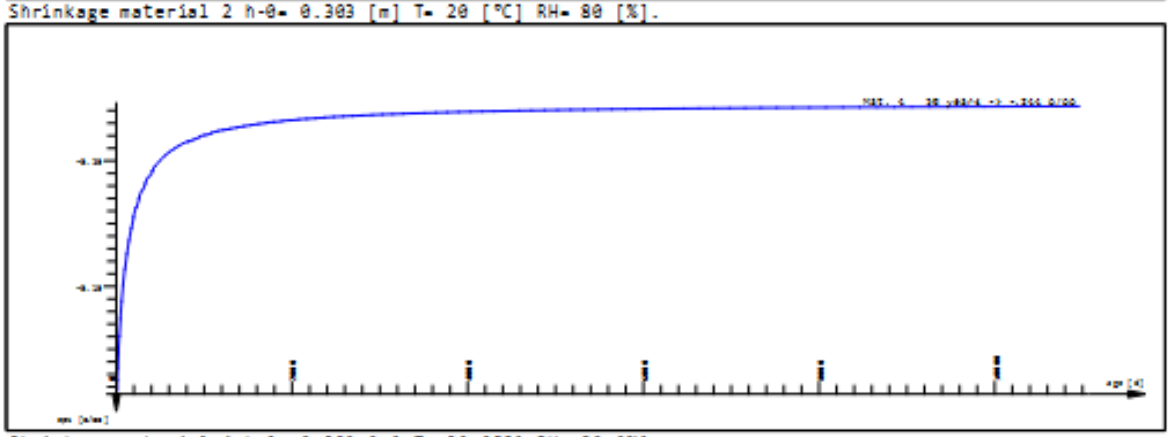
Construction sequence



Shrinkage material 1 h-0= 0.277 [m] T= 20 [°C] RH= 80 [%].



Shrinkage material 2 h-0= 0.303 [m] T= 20 [°C] RH= 80 [%].



Shrinkage material 4 h-0= 0.220 [m] T= 20 [°C] RH= 80 [%].

Shrinkage Values *10^-6 Construction Stages 15 - 41

Grp	Mat	Type	h-0 [m]	ts [d]	CS 15	CS 16	CS 17	CS 25	CS 26	CS 27	CS 35	CS 36	CS 37	CS 40	CS 41
			t[d]	--->	5	8	15	8	9	11	11	13	16	344	1495
			RH[%]	--->	80	80	80	80	80	80	80	80	80	80	80
			T[°C]	--->	20	20	20	20	20	20	20	20	20	20	20
0	1	beam	0.277[1]	3	-13.0	-15.3	-20.6	-8.7	-8.5	-9.0	-7.9	-8.1	-8.7	-69.7	-35.2
0	4	beam	0.220[1]	3	-	-	-	-	-	-	-24.4	-21.4	-20.6	-122.	-42.7
1	1	beam	0.277[1]	3	-13.0	-15.3	-20.6	-8.7	-8.5	-9.0	-7.9	-8.1	-8.7	-69.7	-35.2
1	4	beam	0.220[1]	3	-	-	-	-	-	-	-24.4	-21.4	-20.6	-122.	-42.7
3	4	beam	0.201[1]	3	-	-	-	-	-	-	-26.9	-23.5	-22.3	-125.	-39.8
5	4	beam	0.201[1]	3	-	-	-	-	-	-	-26.9	-23.5	-22.3	-125.	-39.8
6	4	beam	0.201[1]	3	-	-	-	-	-	-	-26.9	-23.5	-22.3	-125.	-39.8
7	2	beam	0.303[1]	3	-	-	-	-	-	-	-17.7	-15.2	-14.9	-107.	-51.6

[1] The real used values for h-0 and the real used creep values are finally calculated in AQB exactly in dependance of the individual height (haunches) and stages (precast concrete with in situ deck) (h-0 can vary for each creep stage due to changing air contact).
The values h-0 and the creep values in this table are only printed averaged for simple comparison.

Grp group number
h-0 notional size (2A/U)
ts start time of drying
CS construction stage shrinkage part Δε-cs
t effective duration creep interval
RH relative humidity
T temperature in creep interval

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Shrinkage Values *10^-6 **Construction Stages 42 - 43**

Grp	Mat	Type	h-0 [m]	ts [d]	CS 42	CS 43	total ε-cs
			t[d]	--->	6488	28173	36596
			RH[%]	--->	80	80	
			T[°C]	--->	20	20	
0	1	beam	0.277¹	3	-10.7	-2.7	-218.
0	4	beam	0.220¹	3	-11.0	-2.6	-245.
1	1	beam	0.277¹	3	-10.7	-2.7	-218.
1	4	beam	0.220¹	3	-11.0	-2.6	-245.
3	4	beam	0.201¹	3	-10.0	-2.4	-249.
5	4	beam	0.201¹	3	-10.0	-2.4	-249.
6	4	beam	0.201¹	3	-10.0	-2.4	-249.
7	2	beam	0.303¹	3	-15.4	-3.8	-226.

¹ The real used values for h-0 and the real used creep values are finally calculated in AQB exactly in dependance of the individual height (haunches) and stages (precast concrete with in situ deck) (h-0 can vary for each creep stage due to changing air contact).
The values h-0 and the creep values in this table are only printed averaged for simple comparison.

Grp	group number	ε-cs	sum of construction stage parts
h-0	notional size (2A/U)	t	effective duration creep interval
ts	start time of drying	RH	relative humidity
CS	construction stage shrinkage part Δε-cs	T	temperature in creep interval

In case of ts lower t0, shrinkage from ts-t0 is not taken into account!
(Losses due to shrinkage are calculated starting at time t0)

Overview loadcases. (see also CSM manual chapter 2 loadcases)

```
-------------------------------------------------------------------------
Total CS displacements and forces starting   at loadcase number.  4000
Difference displacements and forces starting at loadcase number.  5000
AQB inner stresses from creep and shrinkage  at loadcase number.  6000
Stress results of the AQB-LCST-evaluation    at loadcase number.  7000
  [to check prestress normal force after creep and shrinkage :
   -> WINGRAF beam normal force LC 7000ff                      ]
Primary part of prestress in construction stages      at  LC-no. 15000
Secondary effect of prestress in construction stages  at  LC-no. 16000
```

Skupljanje je opisano kroz vrijeme preko relativne deformacije $\varepsilon_{cs}(t,t_s)$ koja je izračunata za pojedine faze gradnje pomoću izraza datih Eurokodom 2:

$\varepsilon_{cs} = \varepsilon_{cd} + \varepsilon_{ca}$ relativna deformacija skupljanja u vremenskom intervalu (zbroj skupljanja od sušenja i autogenog skupljanja)

$\varepsilon_{cd} = \beta_{ds}(t,t_s) \cdot k_h \cdot \varepsilon_{cd,0}$ skupljanje od sušenja

$\beta_{ds}(t,t_s) = (t-t_s)/[(t-t_s)+0{,}04h_0^{3/2}]$ koeficijent koji opisuje vremensku promjenu skupljanja

k_h = koeficijent ovisan o srednjem polumjeru

$\varepsilon_{cd,0} = 0{,}85[(220+110 \cdot \alpha_{ds1}) \cdot \exp(-\alpha_{ds2} \cdot f_{cm}/f_{cm0})] \cdot 10^{-6} \cdot \beta_{RH}$ osnovna vrijednost koeficijenta skupljanja

$\beta_{RH} = 1{,}55 \cdot [1-(RH/RH_0)^3]$

$\varepsilon_{ca}(t) = \beta_{as}(t) \cdot \varepsilon_{ca}(\infty)$ autogeno skupljanje

$\beta_{as}(t) = 1- \exp(-0{,}2 \cdot t^{0,5})$

$\varepsilon_{ca}(\infty) = 2{,}5 \cdot (f_{ck} -10) \cdot 10^{-6}$

Puzanje betona je opisano u vremenu koeficijentom puzanja $\varphi(t,t_o)$ koji je izračunat za pojedine faze gradnje pomoću izraza datih Eurocodeom 2:

$\varphi(t,t_0) = \varphi_0 \cdot \beta_c(t,t_0)$ – ukupni koeficijent puzanja u trenutku t za beton koji je opterećen od trenutka t_o

$\varphi_0 = \varphi_{RH} \cdot \beta(f_{cm}) \cdot \beta(t_0)$ osnovna vrijednost koeficijenta puzanja

$\varphi_{RH} = 1+(1-RH/100)/(0{,}1 \cdot h_0^{1/3} \cdot \alpha_1) \cdot \alpha_2$

$\beta(f_{cm}) = 16{,}8/(f_{cm}^{0,5})$

$\beta(t_0) = 1{,}0/(0{,}1 + t_0^{0,20})$

$\beta_c(t,t_0) = [(t-t_0)/(\beta_H + t - t_0)]^{0,3}$

$\beta_H = 1{,}5 \cdot [1+(0{,}012 \cdot RH)^{0,18}] \cdot h_0 + 250 \cdot \alpha_3 \leq 1500 \cdot \alpha_3$

A – površina betonskog poprečnog presjeka

u – opseg presjeka izložen djelovanju okoline

$h_o = 2A/u$ – srednji polumjer presjeka

RH – relativna vlažnost zraka u %

t – starost betona

t_o – starost betona u početku djelovanja opterećenja

t_s – starost betona u početku promatranja skupljanja

Relaksacija čelika za prednapinjanje je uzeta iz kataloga proizvođača dobivena eksperimentalnim ispitivanjem i odnosi se na relaksaciju nakon 1000 sati.

Kako se prema preporukama CEB-FIP-a relaksacija čelika završava nakon 50000 sati i tada je tri puta veća nego ona za 1000 sati, relaksacija čelika za pojedine vremenske intervale može se izračunati prema izrazu:

$$\Delta\sigma_{rel}(t) = \Delta\sigma_{rel}(1000h) \cdot k_{rel}(t) = \Delta\sigma_{rel}(1000h) \cdot \left(\frac{t}{1000}\right)^{0,177}$$

2.1.5 Određivanje sile prednapinjanja

Prednapinjanje se vrši na ploči sa užadi sastavljenima od žica Φ0,62", a korištene su kabeli prema katalogu sustava za prednapinjanje Dywdag (Dywidag bonded multistrand tendons).

Sila prednapinjanja se određuje prema Eurokodu tako da se ne premaše maksimalni dopušteni naponi na preši i maksimalni dopušteni naponi nakon početnih gubitaka te uvjet dekompresije i širine pukotina. Za uvjet dekompresije treba biti ispunjeno da za nazovistalnu (quasi-permanent) kombinaciju opterećenja nema vlaka u nijednoj fazi gradnje, a pukotine se kontroliraju za čestu (frequent) kombinaciju opterećenja.

Na ovaj način, most je svrstan u most **klase C (ograničeno prednapinjanje).**

Beton C40/50

Rubni dopušteni naponi za C40/50		
	Vlak	tlak
Faza prednapinjanja i rijetka komb.	σ_{ct} = 3,5 N/mm^2	σ_{cc} = 24,0 N/mm^2
Eksploatacija – česta komb	σ_{ct} = 2,5 N/mm^2	σ_{cc} = 24,0 N/mm^2
Nazovistalna komb.	σ_{ct} = 0,0 N/mm^2	σ_{cc} = 18,5 N/mm^2

Čelik za prednapinjanje $f_{p0.1,k}/f_{pk}$ = 1600/1860 N/mm^2
Kabeli Dywidag: 0,62"; 6807; A_1 = 10,5 cm^2
$\sigma_{p0} \le 0,8\ f_{pk} = 0,8 \cdot 1860 = 1488,0$ N/mm^2
$\sigma_{p0} \le 0,9\ f_{p0.1,k} = 0,9 \cdot 1600 = 1440,0$ N/mm^2
$\sigma_{pm0} \le 0,75\ f_{pk} = 0,75 \cdot 1860 = 1395,0$ N/mm^2
$\sigma_{pm0} \le 0,85\ f_{p0.1,k} = 0,85 \cdot 1600 = 1360,0$ N/mm^2

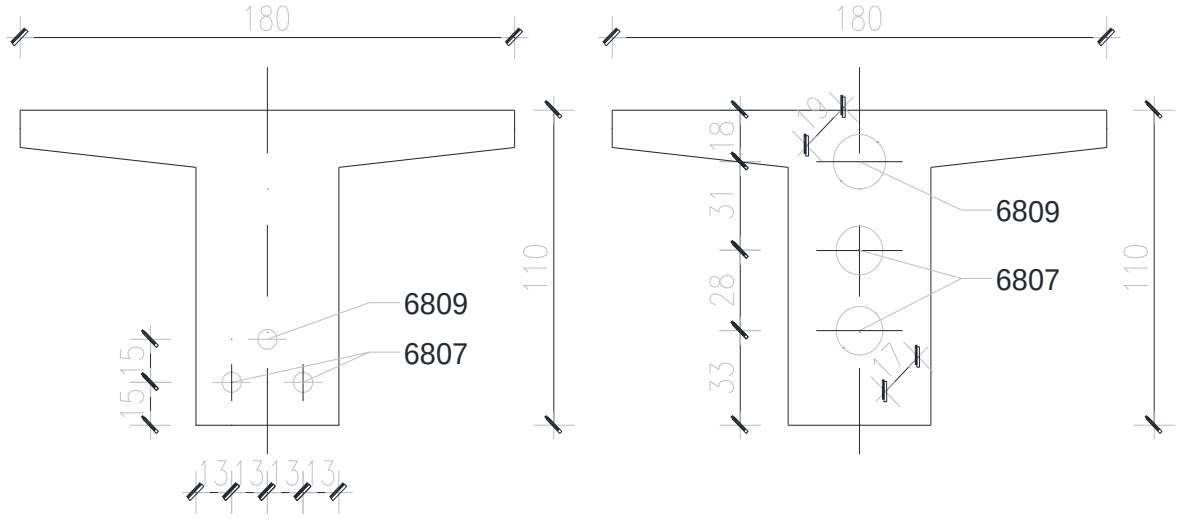
Tip kabela	**6809**	**6807**	**6805**
Tip sidra	MA	MA	MA
Promjer cijevi $\Phi_{unutarnji}/\ \Phi_{vanjski}$ (mm)	75/80	65/70	60/65
Linijska masa užadi (kg/m)	10,8	8,4	6,0
Koeficijent trenja μ	0,19	0,19	0,2
Koeficijent valovitosti kabela β (˚/m)	0,3	0,3	0,3
Prokliznuće klina (mm)	2,0	2,0	2,0
Minimalna osna udaljenost kabela (mm)	117	117	108
Promjer sidra (mm)	190	170	150
Minimalni osna udaljenost sidara (mm)	305	270	230
Minimalni osna udaljenost sidara od ruba (mm)	175	155	135
Površina poprečnog presjeka (cm^2)	13,5	10,5	7,5

Nosači od prvog do predzadnjeg raspona prednapinju se s 2 kabela 6807 i 1 kabelom 6809.
Nosači zadnjeg raspona L=14m prednapinju se s 3 kabela 6805.

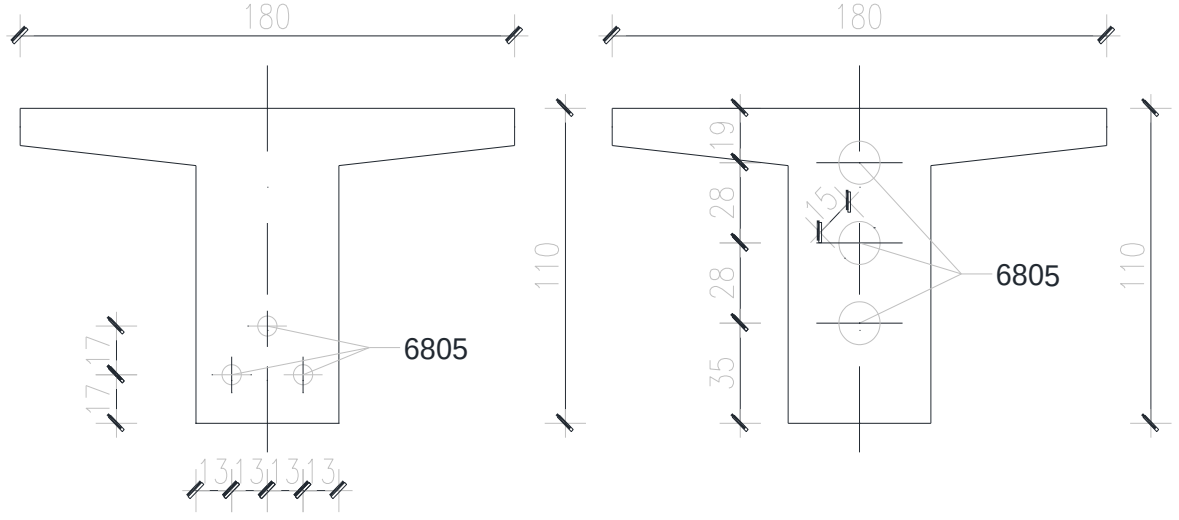
	6809	**6807**	**6805**
Sila prednapinjanja pojedinog kabela P_0 (kN)	1838,0	1428,0	916,0
Napon na preši za pojedini kabel (N/mm^2) σ_{p0}	1361,0	1360,0	1221,0

Svi nosači se prednapinju nakon postizanja čvrstoće pri prednapinjanju od 80% tlačne čvrstoće, odnosno za razred betona C 50/60 srednja tlačna čvrstoća $f_{cm} \geq 48$ N/mm^2.

NOSAČI DULJINE 19,6m I 19,8m

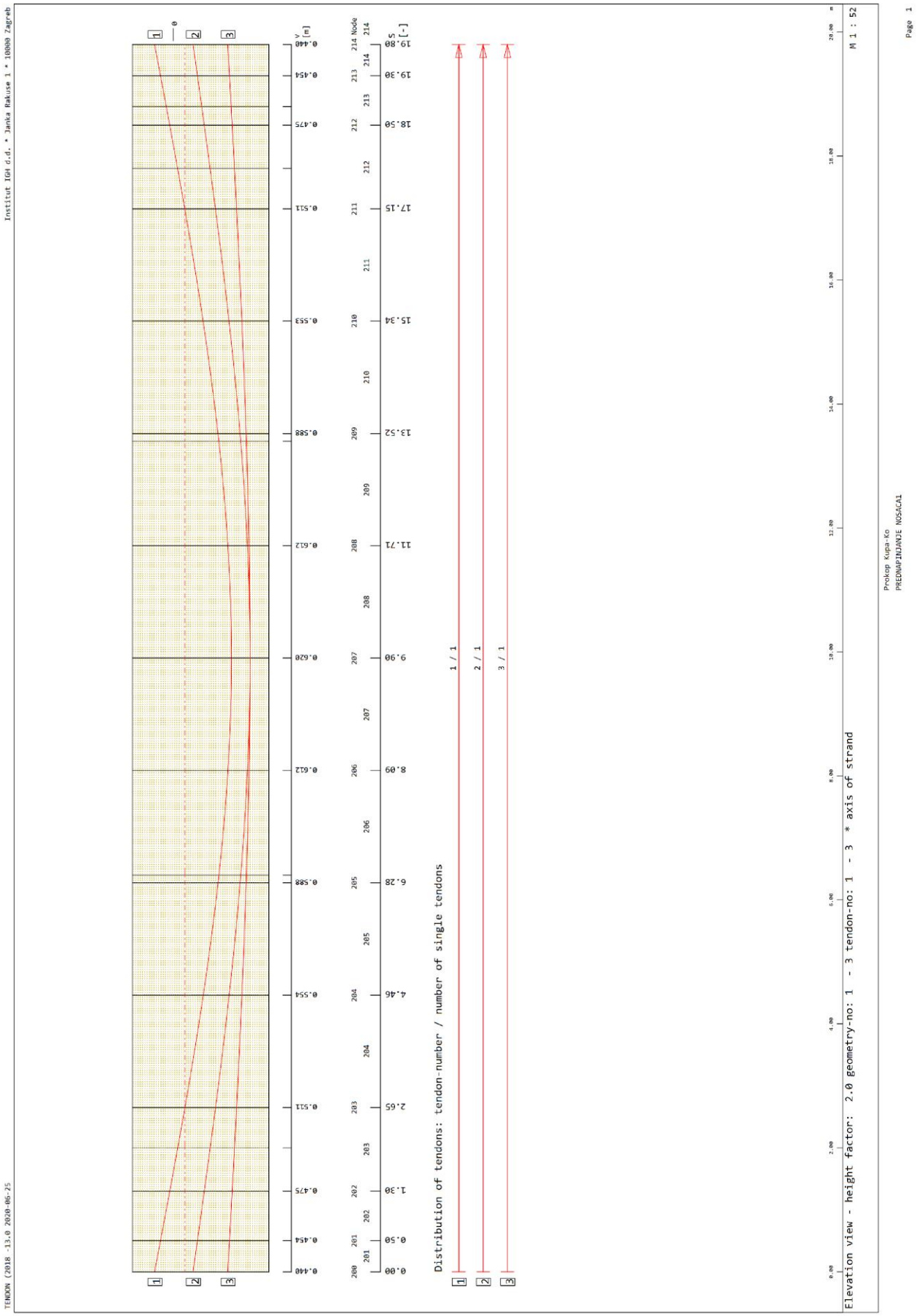


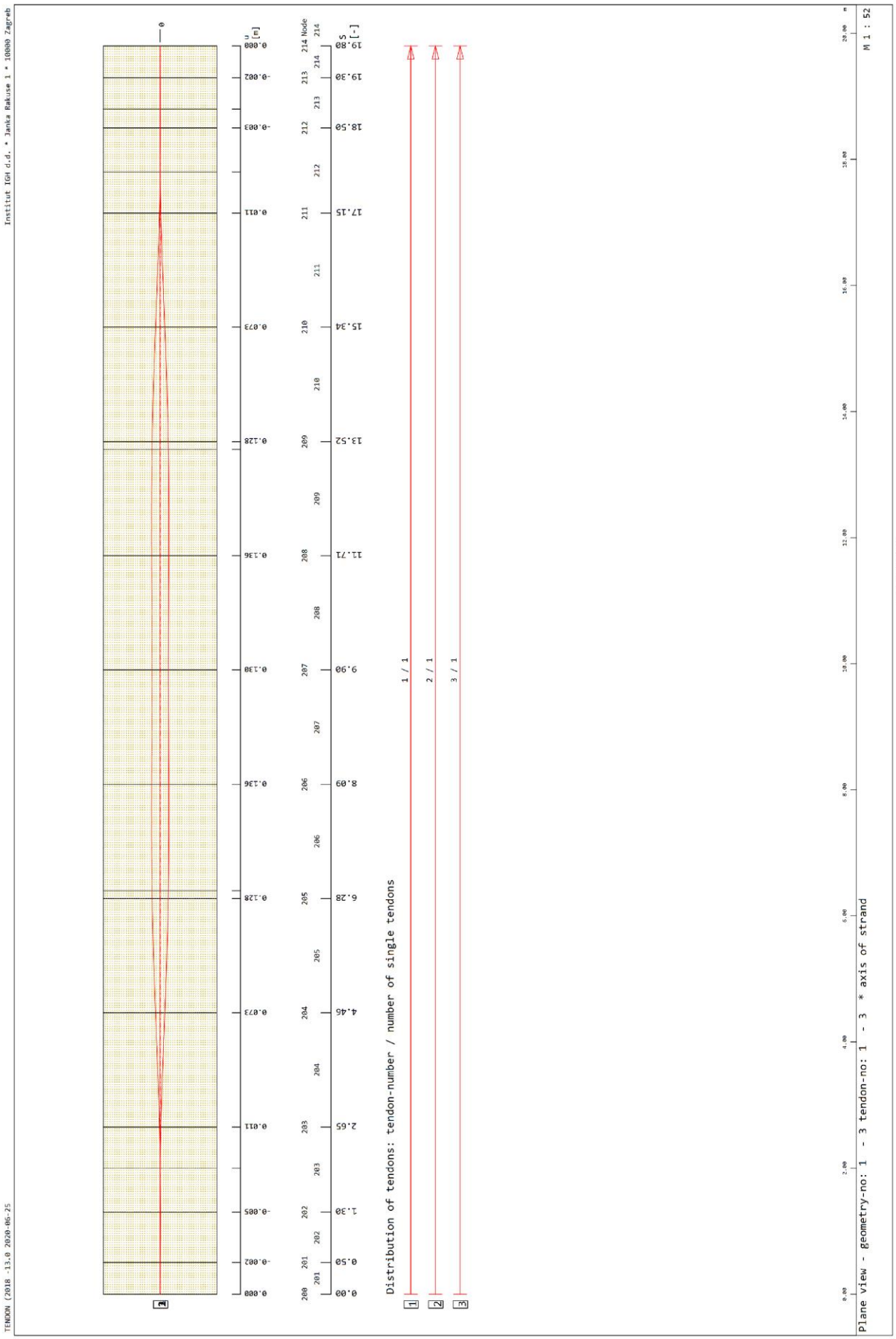
NOSAČI DULJINE 14,3m



Slika: skica položaja kabela u sredini polja i na čelu nosača

SLIJEDE SKICE POLOŽAJA KABELA ZA PREDNAPINJANJE

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TENDON (2018 -13.0 2020-06-25
Distribution of tendons: tendon-number / number of single tendons
1 / 1
2 / 1
3 / 1
Plane view - geometry-no: 1 - 3 tendon-no: 1 - 3 * axis of strand
M 1 : 52
Prokop Kupa-Ko
PREDNAPINJANJE NOSAČA1
Page 2

PRESTRESSING SYSTEM **TENDON 1:**

Prestressing System No	: 2				
Tendon geometry	: 1	Tendons per group	:	1	pcs
		Kappa	:	0.00	
Nominal/extremal force Po	: 1746 kN	Corresponding stress	:	1293	N/mm2
Max. perm. force Po,max	: 1746 kN	Corresponding stress	:	1293	N/mm2
Mean permiss. force Pmo	: 1746 kN	Corresponding stress	:	1293	N/mm2
Area of each tendon	: 1350 mm2	Number of wires	:	9	pcs
Yield strength	: 1660 N/mm2	Permissible radius	:	4.80	m
Tensile strength	: 1860 N/mm2	Diameters of duct DI/DA	:	73/ 80	mm
Young's Modulus	: 195000 N/mm2	Max. of eccentricity	:	0.0	mm

Coefficients:

MUE due to overstress	: 0.190	MUE due to release	:	0.190	
Wobble coefficient BETA	: 0.300 deg/m	Alternative wobble coeff.	:	0.300	deg/m
Wedge slip at prest.anchor	: 2.0 mm	Losses at pres. anchor	:	0.7	%
Wedge slip at dead anchor	: 0.0 mm	Losses at dead anchor	:	0.0	%
Wedge slip at coupler	: 0.0 mm	Losses st coupler	:	1.7	%
Length of tendon	: 19.85 m	Angular displacement	:	10.748	Grad
Range on reference axis	: 0.00 - 19.80				
Effective diameter DZ	: 41.5 mm	Force transition length	:	0.00	m
Effective circumfer. UZ	: 184.7 mm	Associated eff. area AR	:	1350	mm2

Construction/Prestress.Stage:

Fitting/grouting/removing	: 10/ 11/ 0		
Sequence of Prestressing	: from right		
Given Prestressing ZVi/ZVdsgn		Given Prestressing	
general	: 1.000	Overstress	:
due to overstress	: 1.000	Release	:
at prestressing anchor	: 1.000	Restress	:
at dead anchor	: 1.000	Wedge slip	:
at end of slip	: 1.000		

Prestressing from right

Station	Beam	Section	+Frict	-Frict	Overst.	Releas	Restres	Slip	activ
0.00	201	0.000	0.946	1.057	0.946	0.946	0.946	0.946	0.946
19.80	214	0.500	1.000	1.000	1.000	1.000	1.000	0.946	0.946
Elongation in mm:			128.1	135.4	128.1	128.1	128.1	125.9	125.9

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PRESTRESSING SYSTEM **TENDON 2:**

Prestressing System No	: 1				
Tendon geometry	: 2	Tendons per group	:	1	pcs
		Kappa	:	0.00	
Nominal/extremal force Po	: 1358 kN	Corresponding stress	:	1293	N/mm2
Max. perm. force Po,max	: 1358 kN	Corresponding stress	:	1293	N/mm2
Mean permiss. force Pmo	: 1358 kN	Corresponding stress	:	1293	N/mm2
Area of each tendon	: 1050 mm2	Number of wires	:	7	pcs
Yield strength	: 1660 N/mm2	Permissible radius	:	4.80	m
Tensile strength	: 1860 N/mm2	Diameters of duct DI/DA	:	63/ 70	mm
Young's Modulus	: 195000 N/mm2	Max. of eccentricity	:	0.0	mm

Coefficients:

MUE due to overstress	: 0.190	MUE due to release	:	0.190	
Wobble coefficient BETA	: 0.300 deg/m	Alternative wobble coeff.	:	0.300	deg/m
Wedge slip at prest.anchor:	2.0 mm	Losses at pres. anchor	:	0.7	%
Wedge slip at dead anchor	: 0.0 mm	Losses at dead anchor	:	0.0	%
Wedge slip at coupler	: 0.0 mm	Losses st coupler	:	1.7	%
Length of tendon	: 19.83 m	Angular displacement	:	14.523	Grad
Range on reference axis	: 0.00 - 19.80				
Effective diameter DZ	: 36.6 mm	Force transition length	:	0.00	m
Effective circumfer. UZ	: 162.9 mm	Associated eff. area AR	:	1050	mm2

Construction/Prestress.Stage:

Fitting/grouting/removing	: 10/ 11/ 0		
Sequence of Prestressing	: from right		
Given Prestressing ZVi/ZVdsgn		Given Prestressing	
general	: 1.000	Overstress	:
due to overstress	: 1.000	Release	:
at prestressing anchor	: 1.000	Restress	:
at dead anchor	: 1.000	Wedge slip	:
at end of slip	: 1.000		

Prestressing from right

Station	Beam	Section	+Frict	-Frict	Overst.	Releas	Restres	Slip	activ
0.00	201	0.000	0.934	1.070	0.934	0.934	0.934	0.934	0.934
19.80	214	0.500	1.000	1.000	1.000	1.000	1.000	0.938	0.938
Elongation in mm:			127.2	136.1	127.2	127.2	127.2	125.1	125.1

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PRESTRESSING SYSTEM **TENDON 3:**

Prestressing System No	: 1				
Tendon geometry	: 3		Tendons per group	: 1	pcs
			Kappa	: 0.00	
Nominal/extremal force Po	: 1358	kN	Corresponding stress	: 1293	N/mm2
Max. perm. force Po,max	: 1358	kN	Corresponding stress	: 1293	N/mm2
Mean permiss. force Pmo	: 1358	kN	Corresponding stress	: 1293	N/mm2
Area of each tendon	: 1050	mm2	Number of wires	: 7	pcs
Yield strength	: 1660	N/mm2	Permissible radius	: 4.80	m
Tensile strength	: 1860	N/mm2	Diameters of duct DI/DA	: 63/ 70	mm
Young's Modulus	: 195000	N/mm2	Max. of eccentricity	: 0.0	mm

Coefficients:

MUE due to overstress	: 0.190		MUE due to release	: 0.190	
Wobble coefficient BETA	: 0.300	deg/m	Alternative wobble coeff.	: 0.300	deg/m
Wedge slip at prest.anchor	: 2.0	mm	Losses at pres. anchor	: 0.7	%
Wedge slip at dead anchor	: 0.0	mm	Losses at dead anchor	: 0.0	%
Wedge slip at coupler	: 0.0	mm	Losses st coupler	: 1.7	%
Length of tendon	: 19.81	m	Angular displacement	: 11.485	Grad
Range on reference axis	: 0.00 - 19.80				
Effective diameter DZ	: 36.6	mm	Force transition length	: 0.00	m
Effective circumfer. UZ	: 162.9	mm	Associated eff. area AR	: 1050	mm2

Construction/Prestress.Stage:

Fitting/grouting/removing	: 10/ 11/ 0		
Sequence of Prestressing	: from right		
Given Prestressing ZVi/ZVdsgn		Given Prestressing	
general	: 1.000	Overstress	:
due to overstress	: 1.000	Release	:
at prestressing anchor	: 1.000	Restress	:
at dead anchor	: 1.000	Wedge slip	:
at end of slip	: 1.000		

Prestressing from right

Station	Beam	Section	+Frict	-Frict	Overst.	Releas	Restres	Slip	activ
0.00	201	0.000	0.944	1.059	0.944	0.944	0.944	0.944	0.944
19.80	214	0.500	1.000	1.000	1.000	1.000	1.000	0.941	0.941
Elongation in mm:			127.7	135.2	127.7	127.7	127.7	125.7	125.7

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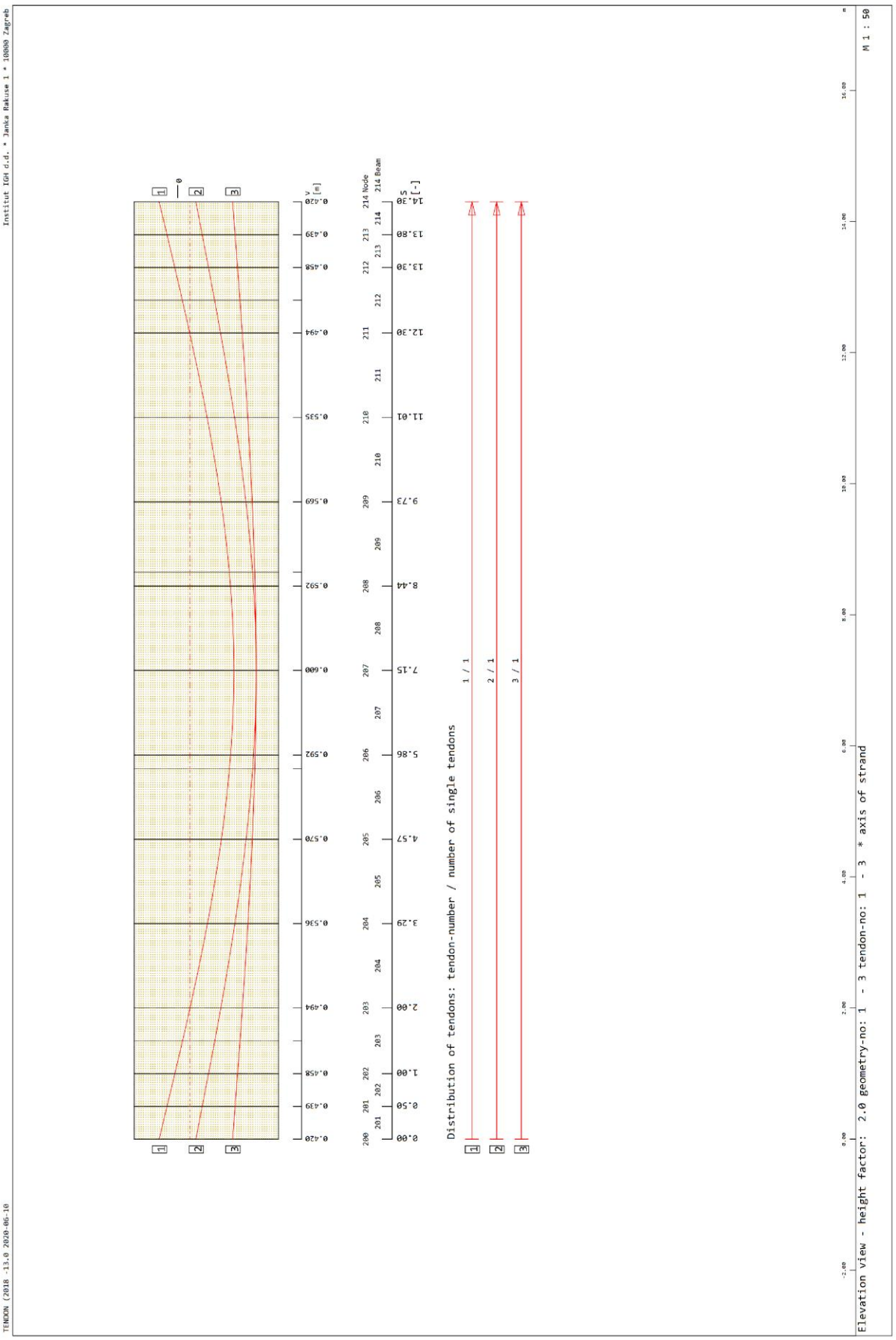
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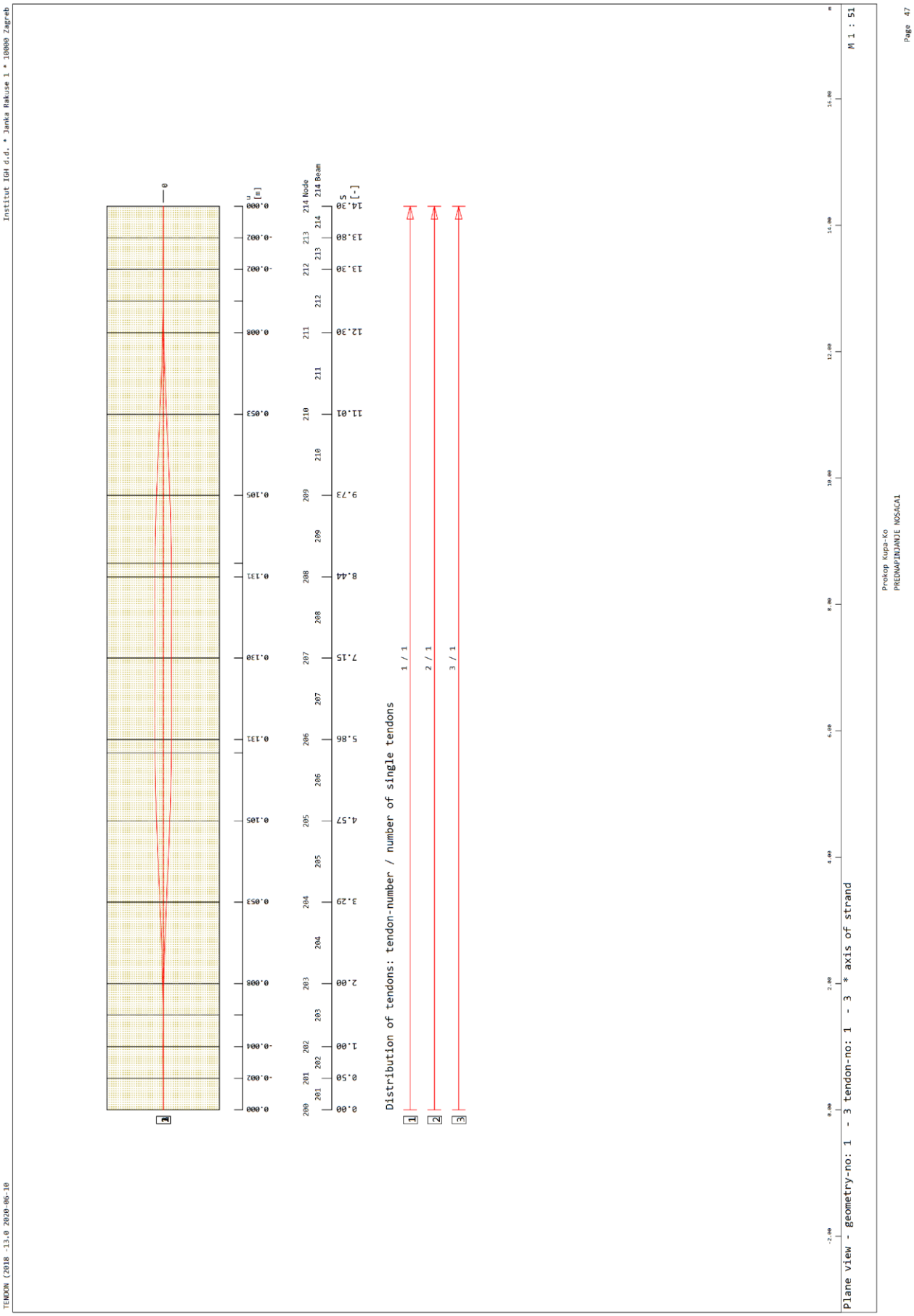
TENDON (2018 -13.0 2020-06-10
Elevation view - height factor: 2.0 geometry-no: 1 - 3 tendon-no: 1 - 3 * axis of strand
M 1 : 50
Page 46
Prokop Kupa-Ko
PREDNAPINJANJE NOSAČA1
Distribution of tendons: tendon-number / number of single tendons
1 / 1
2 / 1
3 / 1
214 Node
214 Beam
s [-]
y [m]


Plane view - geometry-no: 1 - 3 tendon-no: 1 - 3 * axis of strand
M 1 : 51
Distribution of tendons: tendon-number / number of single tendons
1 / 1
2 / 1
3 / 1
Prokop Kupa-Ko
PREDNAPINJANJE NOSAČA1
Page 47
TENDON (2018 -13.0 2020-06-10
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PRESTRESSING SYSTEM **TENDON 1:**

Prestressing System No	: 1				
Tendon geometry	: 1	Tendons per group	:	1	pcs
		Kappa	:	0.00	
Nominal/extremal force Po	: 870 kN	Corresponding stress	:	1160	N/mm2
Max. perm. force Po,max	: 870 kN	Corresponding stress	:	1160	N/mm2
Mean permiss. force Pmo	: 870 kN	Corresponding stress	:	1160	N/mm2
Area of each tendon	: 750 mm2	Number of wires	:	5	pcs
Yield strength	: 1660 N/mm2	Permissible radius	:	4.80	m
Tensile strength	: 1860 N/mm2	Diameters of duct DI/DA	:	58/ 65	mm
Young's Modulus	: 195000 N/mm2	Max. of eccentricity	:	0.0	mm

Coefficients:

MUE due to overstress	: 0.200		MUE due to release	: 0.200	
Wobble coefficient BETA	: 0.300	deg/m	Alternative wobble coeff.	: 0.300	deg/m
Wedge slip at prest.anchor	: 2.0	mm	Losses at pres. anchor	: 0.7	%
Wedge slip at dead anchor	: 0.0	mm	Losses at dead anchor	: 0.0	%
Wedge slip at coupler	: 0.0	mm	Losses st coupler	: 1.7	%
Length of tendon	: 14.35	m	Angular displacement	: 13.673	Grad
Range on reference axis	: 0.00 - 14.30				
Effective diameter DZ	: 30.9	mm	Force transition length	: 0.00	m
Effective circumfer. UZ	: 137.7	mm	Associated eff. area AR	: 750	mm2

Construction/Prestress.Stage:

Fitting/grouting/removing	: 10/ 11/ 0		
Sequence of Prestressing	: from right		
Given Prestressing ZVi/ZVdsgn		Given Prestressing	
general	: 1.000	Overstress	:
due to overstress	: 1.000	Release	:
at prestressing anchor	: 1.000	Restress	:
at dead anchor	: 1.000	Wedge slip	:
at end of slip	: 1.000		

Prestressing from right

Station	Beam	Section	+Frict	-Frict	Overst.	Releas	Restres	Slip	activ
0.00	201	0.000	0.939	1.065	0.939	0.939	0.939	0.939	0.939
14.30	214	0.500	1.000	1.000	1.000	1.000	1.000	0.928	0.928
Elongation in mm:			82.8	88.1	82.8	82.8	82.8	80.6	80.6

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PRESTRESSING SYSTEM **TENDON 2:**

Prestressing System No	: 1				
Tendon geometry	: 2		Tendons per group	: 1	pcs
			Kappa	: 0.00	
Nominal/extremal force Po	: 870	kN	Corresponding stress	: 1160	N/mm2
Max. perm. force Po,max	: 870	kN	Corresponding stress	: 1160	N/mm2
Mean permiss. force Pmo	: 870	kN	Corresponding stress	: 1160	N/mm2
Area of each tendon	: 750	mm2	Number of wires	: 5	pcs
Yield strength	: 1660	N/mm2	Permissible radius	: 4.80	m
Tensile strength	: 1860	N/mm2	Diameters of duct DI/DA	: 58/ 65	mm
Young's Modulus	: 195000	N/mm2	Max. of eccentricity	: 0.0	mm

Coefficients:

MUE due to overstress	: 0.200		MUE due to release	: 0.200	
Wobble coefficient BETA	: 0.300	deg/m	Alternative wobble coeff.	: 0.300	deg/m
Wedge slip at prest.anchor:	2.0	mm	Losses at pres. anchor	: 0.7	%
Wedge slip at dead anchor	: 0.0	mm	Losses at dead anchor	: 0.0	%
Wedge slip at coupler	: 0.0	mm	Losses st coupler	: 1.7	%
Length of tendon	: 14.34	m	Angular displacement	: 17.259	Grad
Range on reference axis	: 0.00 - 14.30				
Effective diameter DZ	: 30.9	mm	Force transition length	: 0.00	m
Effective circumfer. UZ	: 137.7	mm	Associated eff. area AR	: 750	mm2

Construction/Prestress.Stage:
Fitting/grouting/removing : 10/ 11/ 0
Sequence of Prestressing : from right

Given Prestressing ZVi/ZVdsgn		Given Prestressing	
general	: 1.000	Overstress	:
due to overstress	: 1.000	Release	:
at prestressing anchor	: 1.000	Restress	:
at dead anchor	: 1.000	Wedge slip	:
at end of slip	: 1.000		

Prestressing from right

Station	Beam	Section	+Frict	-Frict	Overst.	Releas	Restres	Slip	activ
0.00	201	0.000	0.927	1.078	0.927	0.927	0.927	0.927	0.927
14.30	214	0.500	1.000	1.000	1.000	1.000	1.000	0.919	0.919
Elongation in mm:			82.2	88.5	82.2	82.2	82.2	80.1	80.1

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PRESTRESSING SYSTEM **TENDON 3:**

Prestressing System No	: 1				
Tendon geometry	: 3		Tendons per group	:	1 pcs
			Kappa	:	0.00
Nominal/extremal force Po	: 870	kN	Corresponding stress	:	1160 N/mm2
Max. perm. force Po,max	: 870	kN	Corresponding stress	:	1160 N/mm2
Mean permiss. force Pmo	: 870	kN	Corresponding stress	:	1160 N/mm2
Area of each tendon	: 750	mm2	Number of wires	:	5 pcs
Yield strength	: 1660	N/mm2	Permissible radius	:	4.80 m
Tensile strength	: 1860	N/mm2	Diameters of duct DI/DA	:	58/ 65 mm
Young's Modulus	: 195000	N/mm2	Max. of eccentricity	:	0.0 mm

Coefficients:

MUE due to overstress	: 0.200		MUE due to release	:	0.200
Wobble coefficient BETA	: 0.300	deg/m	Alternative wobble coeff.	:	0.300 deg/m
Wedge slip at prest.anchor:	2.0	mm	Losses at pres. anchor	:	0.7 %
Wedge slip at dead anchor	: 0.0	mm	Losses at dead anchor	:	0.0 %
Wedge slip at coupler	: 0.0	mm	Losses st coupler	:	1.7 %
Length of tendon	: 14.31	m	Angular displacement	:	12.821 Grad
Range on reference axis	: 0.00 - 14.30				
Effective diameter DZ	: 30.9	mm	Force transition length	:	0.00 m
Effective circumfer. UZ	: 137.7	mm	Associated eff. area AR	:	750 mm2

Construction/Prestress.Stage:

Fitting/grouting/removing	: 10/ 11/ 0		
Sequence of Prestressing	: from right		
Given Prestressing ZVi/ZVdsgn		Given Prestressing	
general	: 1.000	Overstress	:
due to overstress	: 1.000	Release	:
at prestressing anchor	: 1.000	Restress	:
at dead anchor	: 1.000	Wedge slip	:
at end of slip	: 1.000		

Prestressing from right

Station	Beam	Section	+Frict	-Frict	Overst.	Releas	Restres	Slip	activ
0.00	201	0.000	0.942	1.062	0.942	0.942	0.942	0.942	0.942
14.30	214	0.500	1.000	1.000	1.000	1.000	1.000	0.928	0.928
Elongation in mm:			82.7	87.7	82.7	82.7	82.7	80.7	80.7

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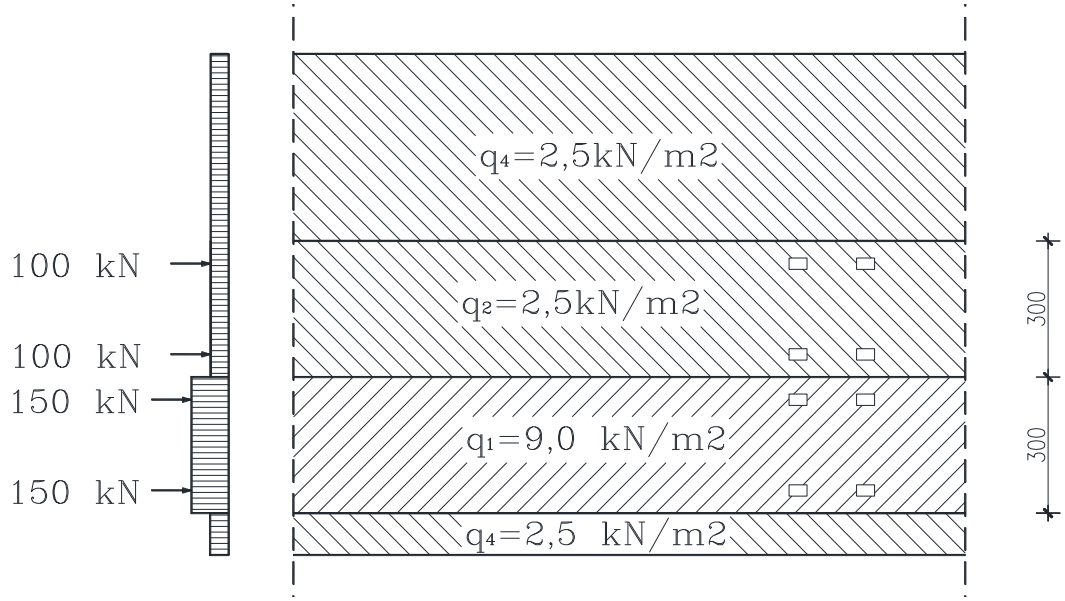
2.2 Prometno opterećenje

2.2.1 Vertikalno prometno opterećenje (LC 330-340;320),(LC 22-36,101-127;21)

Model opterećenja sastoji se od dvije prometne trake i preostale površine. Svaki prometni trak opterećuje se s dva osovinska tereta Q_{ik} na razmaku kotača od 2,0 m i jednoliko rasprostrtim opterećenjem q_{ik}. Površina nalijeganja kotača je 40x40 cm. Preostala površina opterećuje se jednoliko rasprostrtim opterećenjem q_k.

- 1. prometni trak se opterećuje s q_1 = 9,0 kN/m^2, a osovinska opterećenja iznose Q_1 = 300,0 kN
- 2. prometni trak se opterećuje s q_2 = 2,5 kN/m^2 , a osovinska opterećenja su Q_2 = 200,0 kN
- ostale površine se opterećuju s q_3 = 2,5 kN/m^2

Prometno opterećenje se postavlja u više kritičnih položaja na konstrukciju.



Dane su anvelope prometa za roštilj u LC 1702-1705.

2.2.2 Horizontalno prometno opterećenje (LC 40,41) ,(LC 51-54)

Prema Eurokodu, kočna sila iznosi 60% koncentrirane i 10% kontinuiranog prometnog opterećenja, s tim da je opterećenje u granicama K_{min} = 180 kN, a K_{max} = 900 kN.

$K_{min} \leq K \leq K_{max}$

K = 0,60 · (300 · 2) + 0,10 · 9,0 · 3,0 ·139,3 = 736,1 kN – 1. Dilatacija rasponskog sklopa
K = 0,60 · (300 · 2) + 0,10 · 9,0 · 3,0 ·134,0 = 721,8 kN – 2. Dilatacija rasponskog sklopa

$K_{min} \leq K \leq K_{max}$

2.3 Temperaturno djelovanje (LC 5-14), (LC 6-19)

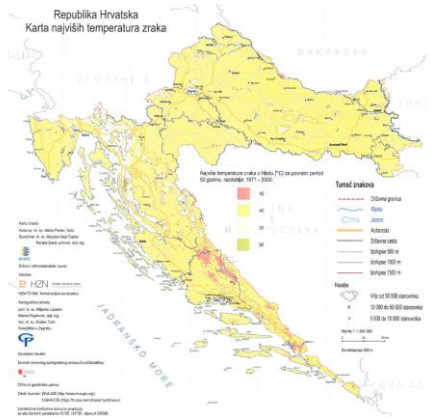
TEMPERATURNA DJELOVANJA

h = 117,50 m nadmorska visina mosta

JEDNOLIKA TEMPERATURNA KOMPONENTA

Jednolika temperaturna komponenta ovisi o najvišoj i najnižoj računskoj temperaturi mosta koju most može dosegnuti u propisanom razdoblju

NAJVEĆA TEMPERATURA ZRAKA

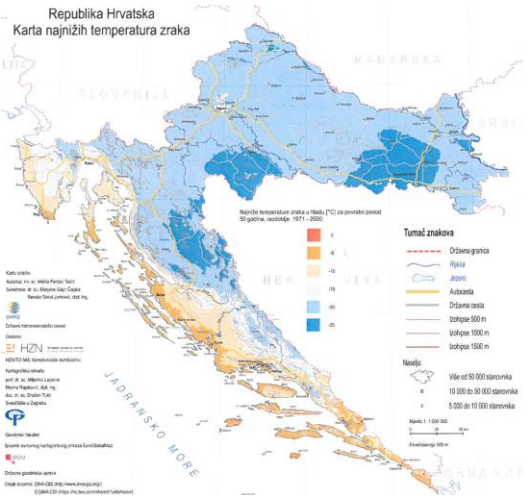


KLIMATSKA ZONA NAJVEĆIH TEMPERATURA II.

I. T=42 (dalmatinsko zaleđe)
II. T=40 (najveći dio Hrvatske)
III. T=35 (Gorski kotar i više planine kontinentalne Hrvatske)
IV. T=30 (najviši djelovi Gorskog kotara)

$T_{max,50}$ = 40-1/100m = 38,825 °C

NAJMANJA TEMPERATURA ZRAKA



KLIMATSKA ZONA NAJMANJIH TEMPERATURA V.

I. T=0 (vanjski otoci Dalmacije)
II. T=-5 (dijelovi Dalmacije, Istre i Primorja uz more)
III. T=-10 (dijelovi Dalmacije, Istre i Primorja)
IV. T=-15 (unutrašnjost Istre, Dalmacije i Primorja)
V. T=-20 (veći dio kontinentalne Hrvatske, Gorski kotar)
VI. T=-25 (Lika, Banovina, središnja i dio istočne Slavonije)

$T_{min,50}$ = -20-0,5/100m = -20,5875 °C

KOLNIČKE PLOČE MOSTOVA

Kolnička ploča može biti, u ovisnosti od rasponskog sklopa: 3.

1. čelična kolnička ploča na čeličnim sandučastim nosačima, rešetkastom ili limenom nosaču
2. betonska kolnička ploča na čeličnim sandučastim nosačima, rešetkastom ili limenom nosaču
3. betonska ploča ili betonska kolnička ploča na betonskim gredama ili sandučastim nosačima

NAJVIŠA I NAJNIŽA RAČUNSKA TEMPERATURA MOSTA

$T_{e,max}$ = 40,285 °C

$T_{e,min}$ = -12,9575 °C

ZA PRORAČUN SILA OD SPRIJEČENIH POMAKA

T_0 = 10,00 °C vjerovatna računska temperatura ugradnje nosača

$\Delta T_{N,con} = T_0 - T_{e,min}$ =	-22,96	°C	skupljanje mosta
$\Delta T_{N,exp} = T_{e,max} - T_0$ =	30,29	°C	širenje mosta

ZA PRORAČUN POMAKA

$T_{0,pos;neg}$ =	20,00 °C	temperatura ugradbe ležajeva i prijelaznih naprava	nije poznata
$\Delta T_{N,con} = T_0 - T_{e,min}$ =	-42,96 °C	skupljanje mosta	
$\Delta T_{N,exp} = T_{e,max} - T_0$ =	50,29 °C	širenje mosta	

LINEARNO PROMIJENJIVA TEMPERATURNA KOMPONENTA

SKUPINE RASPONSKOG SKLOPA

Kolnička ploča može biti, u ovisnosti od rasponskog sklopa: 3.b)

1. čelična kolnička ploča na čeličnim sandučastim nosačima, rešetkastom ili limenom nosaču
2. betonska kolnička ploča na čeličnim sandučastim nosačima, rešetkastom ili limenom nosaču

3.a) betonski sandučasti nosač

3.b) betonska greda ili betonska ploča

KARAKTERISTIČNE VRIJEDNOSTI LINEARNIH TEMPERATURNIH RAZLIKA

$\Delta T_{M,heat}$ =	15,0 °C	gornji rub topliji	
$\Delta T_{M,cool}$ =	-8,0 °C	donji rub topliji	

Karakteristične vrijednosti se množe s faktorom utjecaja debljine zastora k_{sur}.

d(mm) = 85,0 mm debljina zastora

GORNJI RUB TOPLIJI

k_{sur} =	0,79	za gornji rub topliji
$\Delta T_{M,heat} \cdot k_{sur}$ =	11,85 °C	

DONJI RUB TOPLIJI

k_{sur} =	1,00	za donji rub topliji
$\Delta T_{M,heat} \cdot k_{sur}$ =	-8,00 °C	

ISTODOBNO DJELOVANJE JEDNOLIKE I LINEARNE TEMPERATURNE KOMPONENTE

FAKTORI KOMBINACIJE

ω_N = 0,35

ω_M = 0,75

$\Delta T_{M,heat}+\omega_N \cdot \Delta T_{N,exp}$ =	11,85	+	0,35	x	30,29
$\Delta T_{M,cool}+\omega_N \cdot \Delta T_{N,con}$ =	-8,00	+	0,35	x	-22,96
$\omega_M \cdot \Delta T_{M,heat}+\Delta T_{N,exp}$ =	0,75	x	11,85	+	30,29
$\omega_M \cdot \Delta T_{M,cool}+\Delta T_{N,con}$ =	0,75	x	-8,00	+	-22,96

STUPOVI

Karakteristične vrijednosti linearnih temperaturnih razlika uzimaju se, u nedostatku točnih vrijednosti 5 °C

2.4 Opterećenje vjetrom (LC 40-43), (LC 35-38)

OPTEREĆENJE VJETROM NA RASPONSKI SKLOP

REZULTIRAJUĆA SILA VJETRA NA RASPONSKI SKLOP

$F_w = 0,5 \cdot \rho \cdot v_b^2 \cdot C \cdot A_{ref,y} = q_b \cdot C \cdot A_{ref,y}$

OSNOVNA BRZINA VJETRA v_b

Prema normi HRN EN 1991-1-4, Hrvatska je podijeljena u 7 područja, gdje svakom od njih pripada određena osnovna brzina vjetra.

$v_b = c_{dir} \cdot c_{season} \cdot v_{b,0} = 1,0 \cdot 1,0 \cdot v_{b,0} = v_{b,0}$



PODRUČJE (I - VII)	$v_{b,0}$(m/s)
I.	20,0
II.	25,0
III.	30,0
IV.	35,0
V.	40,0
VI.	45,0
VII.	48,0

OSNOVNI TLAK VJETRA (kN/m^2) ZA PODRUČJE I.

za neopterećeni most

$q_b = 0,5 \cdot \rho \cdot v_b^2 =$ 0,2500 kN/m^2

za opterećeni most v_b(m/s) = 23,0 m/s

$q_b = 0,5 \cdot \rho \cdot v_b^2 =$ 0,3306 kN/m^2

$\rho = 1,25$ kg/m^3 gustoća zraka

KOEFICIJENT OPTEREĆENJA VJETROM C

$C = c_e \cdot c_{f,y}$

KOEFICIJENT IZLOŽENOSTI $c_e(z)$

$c_e(z) = [1 + 7I_v(z)] \cdot c_r(z)^2 \cdot c_o^2$

KATEGORIJA TERENA JE III

0	obalno područje izloženo vjetru s otvorenog mora
I	jezero ili gladak teren sa zanemarivom vegetacijom i bez prepreka
II	manja vegetacija uz povremene kuće i drveće sa razmakom prepreka od 20 visina prepreke
III	sela, predgrađa ili industrijske zone i stalne šume
IV	urbane zone s najmanje 15% površine prekrivene zgradama srednje visine veće os 15,0 m

z =	9,90	m	visina od najniže točke tla do težišta konstrukcije
z_0 =	0,3	m	dužina hrapavosti terena
z_{min} =	5,00	m	minimalna visina

INTENZITET TURBULENCIJE $I_v(z)$

$I_v(z) = k_I/[c_o(z) \cdot \ln(z/z_0)]$ za $z \in [z_{min}, z_{max}]$

$I_v(z) = I_v(z_{min})$ za $z < z_{min}$

k_I =	1,00	koeficijent turbulencije (preporučeni ako nema nacionalnog dodatka)
$c_o(z)$ =		koeficijent topografije
Most se nalazi na		izoliranoj visinskoj prepreci, s ravničarskim područjem oko nje

$\Phi=H/L_u$ =	0	odnos visine brijega i projicirane duljine padine
$c_o(z)$ =	1,00	okolni teren je nagnut manje od 3% ili $\Phi=H/L < 0,05$
s =	0	faktor topografske lokacije, može se očitati iz tablica

$c_o(z) = 1+ 2 \cdot s \cdot \Phi =$ 1,000 za $0,05 < \Phi < 0,3$

$c_o(z) = 1+ 0,6 \cdot s =$ 1,000 za $\Phi > 0,3$

$c_o(z) =$ 1,000

$I_v(z) = k_I/[c_o(z) \cdot \ln(z/z_0)] =$ 0,2860

HRAPAVOST TERENA $c_r(z)$

$c_r(z) = k_r \cdot \ln(z/z_0)$ za $z \in [z_{min}, z_{max}]$

$c_r(z) = c_r(z_{min})$ za $z \le z_{min}$

$k_r = 0,19 \cdot (z_0/z_{0,II})^{0,07} =$ 0,215389 faktor terena koji ovisi o duljini hrapavosti z_0

$c_r(z) = k_r \cdot \ln(z/z_0) =$ 0,7531

$c_e(z) = [1 + 7I_v(z)] \cdot c_r(z)^2 \cdot c_o^2 =$ 1,7027

AERODINAMIČKI KOEFICIJENT SILE VJETRA POPREČNO NA MOST c_{fy}

$c_{fy} = c_{fy,0}$

d =	1,65	m	visina konstrukcije ili visina konstrukcije sa punom zaštitnom ogradom
d_{tot} =	3,45	m	visine konstrukcije i vozila na njoj
b =	11,60	m	širina konstrukcije
b/d =	7,0303		za neopterećeni most
b/d_{tot} =	3,3623		za opterećeni most
tip mosta	A		faza građenja ili otvorena ograda na mostu

c_{fy} =	1,3	za neopterećeni most
c_{fy} =	1,489581	za opterećeni most

α_1 =	0,00	°, kut nagiba napadnute plohe vjetra u odnosu na vertikalu
p =	2,50	%, najveći poprečni pad kolnika na mostu

$c_{fy} =$ 1 x 1,042963 $\cdot c_{fy} =$ 1,355852 za neopterećeni most

$c_{fy} =$ 1 x 1,042963 $\cdot c_{fy} =$ 1,553578 za opterećeni most

$C = c_e \cdot c_{f,y} =$ 2,3086 za neopterećeni most

$C = c_e \cdot c_{f,y} =$ 2,6452 za opterećeni most

REFERENTNA POVRŠINA IZLOŽENA VJETRU POPREČNO NA MOST $A_{ref,y}$

b =	1,65	m	visina konstrukcije
b_1 =	0,00	m	visina pune ograde ako postoji

NEOPTEREĆEN MOST

vrsta i tip ograde:

otvorena ograda i otvorena zaštitna ograda na obe strane b+1,2 m b+1,2 m

b_{ukupno} = b+1,2 m= 2,85 m

OPTEREĆENI MOST

na kolnik se doda 2,0 m i izmjeri se

b_{ukupno} = 3,45 m

REZULTIRAJUĆA SILA VJETRA NA RASPONSKI SKLOP F_w (po metru duljine)

ZA NEOPTEREĆENI MOST

poprečno	$F_w = q_b \cdot C \cdot A_{ref,y}$ =	2,801	kN/m
uzdužno	25% poprečne sile na most =	0,700	kN/m

ZA OPTEREĆENI MOST

poprečno	$F_w = q_b \cdot C \cdot A_{ref,y}$ =	5,137	kN/m
uzdužno	25% poprečne sile na most =	1,284	kN/m

OPTEREĆENJE VJETROM NA STUPOVE

REZULTIRAJUĆA SILA VJETRA NA STUPOVE

$F_w = 0,5 \cdot \rho \cdot v_b^2 \cdot C \cdot A_{ref,y} = q_b \cdot C \cdot A_{ref,y}$

OSNOVNI TLAK VJETRA q_b

POREDBENI TLAK VJETRA (kN/m^2)

za neopterećeni most

$q_b = 0,5 \cdot \rho \cdot v_b^2 =$ 0,25 kN/m^2

za opterećeni most

$q_b = 0,5 \cdot \rho \cdot v_b^2 =$ 0,3306 kN/m^2

KOEFICIJENT OPTEREĆENJA VJETROM C

$C = c_e \cdot c_{f,y}$

KOEFICIJENT IZLOŽENOSTI $c_e(z)$

$c_e(z) = [1 + 7l_v(z)] \cdot c_r(z)^2 \cdot c_o^2$

KATEGORIJA TERENA JE III

0	obalno područje izloženo vjetru s otvorenog mora
I	jezero ili gladak teren sa zanemarivom vegetacijom i bez prepreka
II	manja vegetacija uz povremene kuće i drveće sa razmakom prepreka od 20 visina prepreke
III	sela, predgrađa ili industrijske zone i stalne šume
IV	urbane zone s najmanje 15% površine prekrivene zgradama srednje visine veće os 15,0 m

$z =$	7,10	m	visina od najniže točke tla do najviše točke stupa
$z_0 =$	0,3	m	dužina hrapavosti terena
$z_{min} =$	5,00	m	minimalna visina

INTENZITET TURBULENCIJE $l_v(z)$

$l_v(z) = k_I/[c_o(z) \cdot \ln(z/z_0)]$ za $z \in [z_{min}, z_{max}]$

$l_v(z) = l_v(z_{min})$ za $z < z_{min}$

$k_I =$	1,00	koeficijent turbulencije (preporučeni ako nema nacionalnog dodatka)
$c_o(z) =$	1,000	koeficijent topografije

$l_v(z) = k_I/[c_o(z) \cdot \ln(z/z_0)] =$ 0,3160 za z = 7,10 m

$l_v(z_{min}) = k_I/[c_o(z) \cdot \ln(z/z_0)] =$ 0,3554 za z = z_{min} = 5,00 m

HRAPAVOST TERENA $c_r(z)$

$c_r(z) = k_r \cdot \ln(z/z_0)$ za $z \in [z_{min}, z_{max}]$

$c_r(z) = c_r(z_{min})$ za $z \le z_{min}$

$k_r = 0,19 \cdot (z_0/z_{0,II})^{0,07} =$ 0,215389 faktor terena koji ovisi o duljini hrapavosti z_0

$c_r(z) = k_r \cdot \ln(z/z_0) =$ 0,6815 za z = 7,10 m

$c_r(z) = c_r(z_{min}) =$ 0,6060 za z = z_{min} = 5,00 m (dno stupa)

$c_e(z) = [1 + 7l_v(z)] \cdot c_r(z)^2 \cdot c_o^2 =$ 1,4920 za z = 7,10 m

$c_e(z) = [1 + 7l_v(z)] \cdot c_r(z)^2 \cdot c_o^2 =$ 1,2809 za z = z_{min} = 5,00 m (dno stupa)

AERODINAMIČKI KOEFICIJENT SILE VJETRA POPREČNO NA MOST c_{fy}

STUPOVI KRUŽNOG POPREČNOG PRESJEKA

b =	1,20	m	promjer stupa	
L =	8,65	m	visina stupa	
k =	1,000	mm	za hrapavi beton	ekvivalentna hrapavost površine
k/b =	8,333E-04			
λ =	1,000	· L/b =	7,2083	efektivna vitkost

$q_p = c_e(z) \cdot q_b$ =	0,3730	kN/m^2	za vrh stupa za neopterećeni most
$q_p = c_e(z) \cdot q_b$ =	0,3202	kN/m^2	za dno stupa za neopterećeni most
$q_p = c_e(z) \cdot q_b$ =	0,4933	kN/m^2	za vrh stupa za opterećeni most
$q_p = c_e(z) \cdot q_b$ =	0,4235	kN/m^2	za dno stupa za opterećeni most
$v(z_e) = (2 \cdot q_p/\rho)^{0,5}$ =	24,43	m/s	za vrh stupa za neopterećeni most
$v(z_e) = (2 \cdot q_p/\rho)^{0,5}$ =	22,64	m/s	za dno stupa za neopterećeni most
$v(z_e) = (2 \cdot q_p/\rho)^{0,5}$ =	28,09	m/s	za vrh stupa za opterećeni most
$v(z_e) = (2 \cdot q_p/\rho)^{0,5}$ =	26,03	m/s	za dno stupa za opterećeni most
Re = b · $v(z_e)$/v =	1,954E+06		za vrh stupa za neopterećeni most
Re = b · $v(z_e)$/v =	1,811E+06		za dno stupa za neopterećeni most
Re = b · $v(z_e)$/v =	2,247E+06		za vrh stupa za opterećeni most
Re = b · $v(z_e)$/v =	2,082E+06		za dno stupa za opterećeni most

$c_{f,y} = c_{f,0} \cdot \psi_\lambda$

$c_{f,0}$ = koeficijent sile za valjke, očitava se iz tablica

$c_{f,0}$ =	0,8648	za vrh stupa za neopterećeni most
$c_{f,0}$ =	0,8607	za dno stupa za neopterećeni most
$c_{f,0}$ =	0,8719	za vrh stupa za opterećeni most
$c_{f,0}$ =	0,8680	za dno stupa za opterećeni most

ψ_λ = 0,6832 koeficijent redukcije za elemente s konačnom vitkošću

$c_{f,y} = c_{f,0} \cdot \psi_\lambda$ =	0,5908	za vrh stupa za neopterećeni most
$c_{f,y} = c_{f,0} \cdot \psi_\lambda$ =	0,5881	za dno stupa za neopterećeni most
$c_{f,y} = c_{f,0} \cdot \psi_\lambda$ =	0,5957	za vrh stupa za opterećeni most
$c_{f,y} = c_{f,0} \cdot \psi_\lambda$ =	0,5931	za dno stupa za opterećeni most

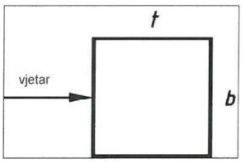
$C = c_e \cdot c_{f,y}$ =	0,8815	za vrh stupa za neopterećeni most
$C = c_e \cdot c_{f,y}$ =	0,7533	za dno stupa za neopterećeni most
$C = c_e \cdot c_{f,y}$ =	0,8888	za vrh stupa za opterećeni most
$C = c_e \cdot c_{f,y}$ =	0,7597	za dno stupa za opterećeni most

AERODINAMIČKI KOEFICIJENT SILE VJETRA UZDUŽNO SA MOSTOM C_{fy}

STUPOVI KRUŽNOG POPREČNOG PRESJEKA

b =	1,20	m	dimenzija stupa okomita na smjer vjetra (poprečno na most)
t =	1,20	m	dimenzija stupa paralelna sa smjerom vjetra (uzdužno sa mostom)
r =	0,6000	m	radijus zaobljenja rubova poprečnog presjeka
L =	8,65	m	visina stupa

Tablica 6(HR) – Koeficijent sile C_{fp} za stupove

Tlocrtni oblik	t/b	C_{fp} za stupove omjera visina/širina						
		1	2	4	6	10	20	40
	≤ 0,25	1,3	1,4	1,4	1,5	1,6	1,8	1,9
	0,333	1,4	1,4	1,5	1,5	1,7	1,8	2,0
	0,50	1,4	1,5	1,6	1,6	1,7	1,9	2,1
	0,667	1,5	1,6	1,6	1,7	1,8	2,0	2,2
	1,0	1,4	1,4	1,5	1,5	1,6	1,8	2,0
	1,5	1,2	1,2	1,3	1,4	1,4	1,6	1,7
	2	1,0	1,1	1,2	1,2	1,3	1,4	1,6
NAPOMENA: b je dimenzija okomita na smjer djelovanja vjetra.	3	0,9	0,9	1,0	1,0	1,1	1,2	1,3
	≥ 4	0,8	0,8	0,8	0,9	1,0	1,0	1,1
Pravokutnik u smjeru dijagonale (NAPOMENA: Dimenzija b u tom je slučaju dimenzija dijagonale.)		1,0	1,1	1,1	1,2	1,2	1,4	1,5
Osmerokut		0,83	0,87	0,91	0,94	1,00	1,10	1,21
Dvanaesterokut		0,72	0,75	0,79	0,81	0,87	0,96	1,05
Krug s glatkom površinom ako je 1,5 $tV_m(z) \geq 6$ m^2/s		0,48	0,50	0,53	0,56	0,60	0,66	0,72
Krug s glatkom površinim ako je 1,5 $tV_m(z) < 6$ m^2/s i krug s hrapavom površinom ili istacima		0,75	0,78	0,82	0,84	0,91	1,00	1,09

NAPOMENA 1: Nakon izvedbe rasponskoga sklopa C_{fp} treba odrediti za omjer visina/širina 40.

NAPOMENA 2: Za pravokutni stup sa zaobljenim uglovima vrijednost određena iz tablice 6(HR) treba pomnožiti s većom od vrijednosti (1-2,5 r/b) i 0,5.

NAPOMENA 3: Za stup s trokutastim istacima C_{fp} treba odrediti kao za pravokutnik koji obuhvaća vanjske rubove stupa.

NAPOMENA 4: Za stup koji se sužava po visini C_{fp} treba odrediti za svaki od horizontalnih trakova na koje je podijeljen (vidjeti sliku 7.4 norme HRN EN 1991-1-4:2012). Za određivanje omjera t/b treba upotrijebiti srednje vrijednosti t i b za svaki trak. Omjer visina/širina za svaki pojedini trak treba odrediti kao omjer ukupne visine stupa i srednje širine traka.

NAPOMENA 5: Za dijelove za koje bi djelovanje vjetra proizvelo povoljan učinak treba upotrijebiti F_w umjesto F_w, pri čemu je $F_w = 0{,}5\rho v_m^2(z) C_f A_{ref}$, a $v_m(z)$ je srednja brzina vjetra (vidjeti točku 4.3.1 norme HRN EN 1991-1-4:2012).

$q_p(z) = c_e(z) \cdot q_b$

ZA NEOPTEREĆENI MOST

$q_p(z)$ = 0,373 m/s za vrh stupa

$q_p(z)$ = 0,320 m/s za dno stupa

ZA OPTEREĆENI MOST

$q_p(z)$ = 0,493 m/s za vrh stupa

$q_p(z)$ = 0,423 m/s za dno stupa

ZA NEOPTEREĆENI MOST

$v_m(z) = c_r \cdot c_0(z) \cdot v_b$

$v_m(z)$ = 13,63 m/s za vrh stupa

$v_m(z)$ = 12,12 m/s za dno stupa

$1{,}5 \cdot t \cdot v_m(z)$ = 24,53 m^2/s za vrh stupa

$1{,}5 \cdot t \cdot v_m(z)$ = 21,82 m^2/s za vrh stupa

ZA OPTEREĆENI MOST

$v_m(z) = c_r \cdot c_0(z) \cdot v_b$

$v_m(z)$ = 15,67 m/s za vrh stupa

$v_m(z)$ = 13,94 m/s za dno stupa

$1{,}5 \cdot t \cdot v_m(z)$ = 28,21 m^2/s za vrh stupa

$1{,}5 \cdot t \cdot v_m(z)$ = 25,09 m^2/s za vrh stupa

C_{fp} = 0,72 koeficijent sile iz tablice 6(HR)

REZULTIRAJUĆA SILA VJETRA NA STUPOVE F_w (po metru duljine)

ZA NEOPTEREĆENI MOST

poprečno	vrh stupa	$F_w = 0,5 \cdot \rho \cdot v_b^2 \cdot C \cdot A_{ref,y}$ =	0,264	kN/m
	dno stupa	$F_w = 0,5 \cdot \rho \cdot v_b^2 \cdot C \cdot A_{ref,y}$ =	0,226	kN/m
uzdužno	vrh stupa	$F_{Ly} = q_p(z) \cdot A_{ref} \cdot C_{fp}$ =	0,322	kN/m
	dno stupa	$F_{Ly} = q_p(z) \cdot A_{ref} \cdot C_{fp}$ =	0,277	kN/m

ZA OPTEREĆENI MOST

poprečno	vrh stupa	$F_w = 0,5 \cdot \rho \cdot v_b^2 \cdot C \cdot A_{ref,y}$ =	0,353	kN/m
	dno stupa	$F_w = 0,5 \cdot \rho \cdot v_b^2 \cdot C \cdot A_{ref,y}$ =	0,301	kN/m
uzdužno	vrh stupa	$F_{Ly} = q_p(z) \cdot A_{ref} \cdot C_{fp}$ =	0,426	kN/m
	dno stupa	$F_{Ly} = q_p(z) \cdot A_{ref} \cdot C_{fp}$ =	0,366	kN/m

(kako opterećenje vjetrom općenito nije mjerodavno horizontalno opterećenje dalje će se u proračunu koristiti samo slučajevi opterećenja od vjetra na opterećeni most)

2.5 Slijeganje oslonaca (LC 60-74)

Proračunom je obuhvaćeno slijeganje oslonaca 1,0 cm. Utjecaj je zanemariv budući da se radi o sustavu prostih greda.

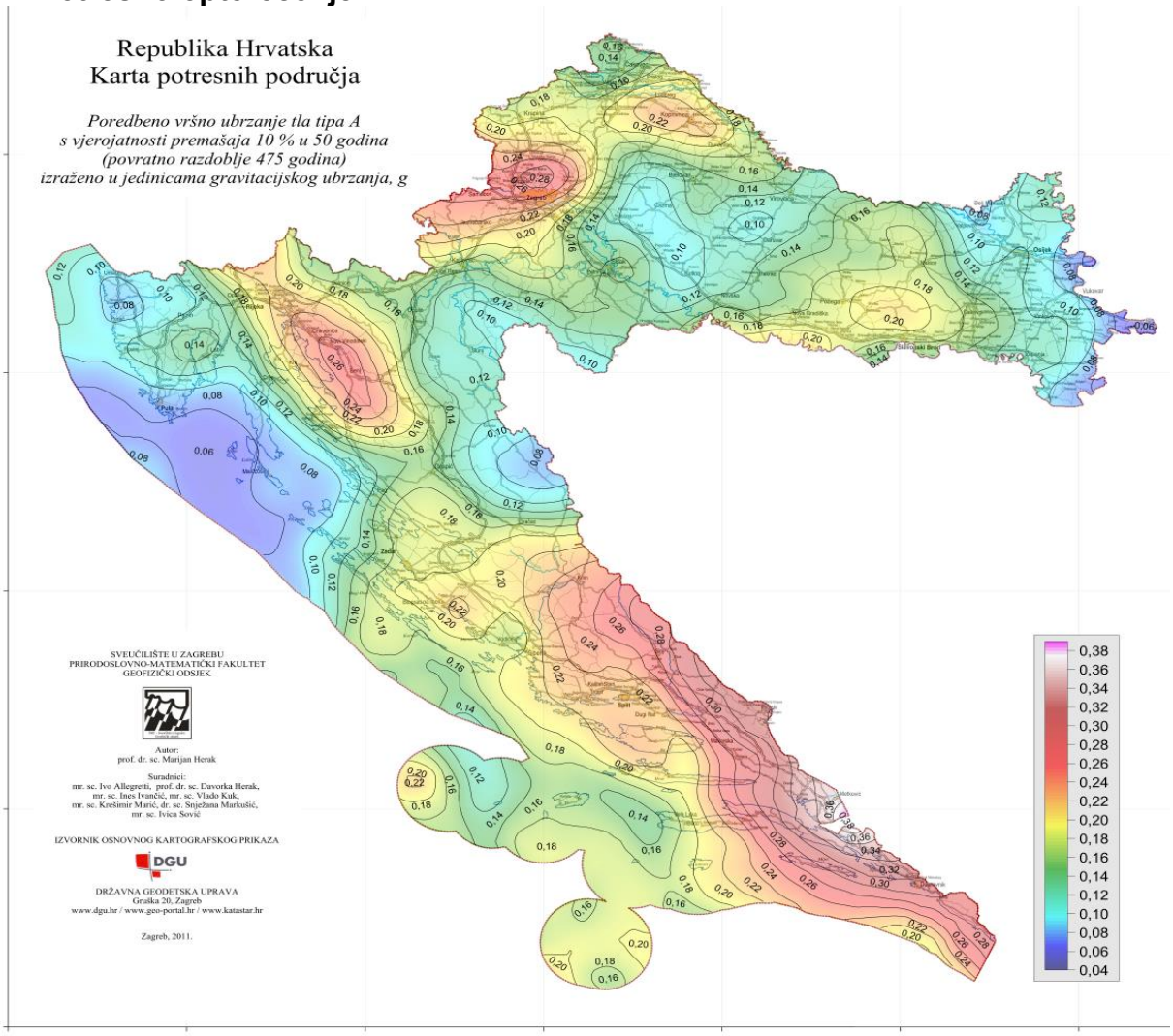
2.6. Sila udara u rubnjak

Prema 4.7.3.2 norme HRN EN 1991-2 horizontalna sila udara u rubnjak iznosi 100 kN i djeluje na visini 0,05 cm ispod gornjeg dijela rubnjaka i rasprostire se u širini 0,5 m duž rubnjaka. Djeluje istovremeno s vertikalnom silom $0,75 \cdot \alpha_{Q1} \cdot Q_{1k} = 0,75 \cdot 300 = 225,0$ kN

2.7. Sila udara u zaštitni sustav vozila

Prema 4.7.3.3 norme HRN EN 1991-2 horizontalna sila udara iznosi 100 kN (za razred A krutosti spoja pričvršćenja sustava što odgovara H2 zaštitnoj odbojnoj ogradi) i djeluje na visini 10 cm ispod najviše točke odabranog zaštitnog sustava ili 1,0 m iznad plohe kolnika ili pješačke staze (što je već manja visina) i rasprostire se u širini 0,5 m duž odabranog zaštitnog sustava. Budući da odbojnik nije izmaknut od rubnjaka ne uzima se da horizontalna sila djeluje istovremeno s vertikalnom silom $0,75 \cdot \alpha_{Q1} \cdot Q_{1k} = 0,75 \cdot 300 = 225,0$ kN. Ova sila s pripadajućim momentom kraka 1,09 m postavlja se na krajeve krila upornjaka, te na rubove i sredinu zidova, te duž objekta

2.7 Potresno opterećenje



Djelovanje potresa se opisuje pomoću vršnog ubrzanja tla tipa A s vjerojatnošću premašaja 10% u 50 godina (povratno razdoblje 475 godina). Za ovaj most uzima se a_g=0,156g, a povratno razdoblje 95 godina). Za ovaj most uzima se a_g=0,085g
Za vertikalni smjer potresa je $a_{vg} = 0,9a_g$. Odabran je Tip 1 spektra, kojim se opisuju vrijednosti perioda T_B, T_C, T_D i faktora S.

parametri elastičnog spektra odgovora u ovisnosti o vrsti tla				
kategorija tla	S	T_B (s)	T_C (s)	T_D (s)
A	1	0,10	0,4	2
B	1,2	0,15	0,5	2
C	1,15	0,20	0,6	2
D	1,35	0,20	0,8	2
E	1,4	0,15	0,5	2

Kategorija tla za koju se u ovom projektu uzimaju parametri je C. Parametri su:
- S = 1,15 (soil modification factor)
- T_B = 0,20, T_C = 0,6 (granice intervala konstantnog spektralnog ubrzanja)
- T_D = 2 (granica koja definira početak spektra s konstantnim pomakom)

Razred važnosti mosta je IIB pa su faktori važnosti:

"Ne smije nastupiti rušenje" – GSN (Non collapse ULS); γ_I = 1,0

$a_{g,h}$ = 0,156x1,0xg =1,53 m/sec^2 → horizontalno računsko ubrzanje tla

$a_{g,v} = a_{g,h}$ x 0,9 =1,377 m/sec^2 → vertikalno računsko ubrzanje tla

"Ograničeno oštećenje" – GSU (Minimiation of damage SLS) γ_I = 0,85 - faktor važnosti ,

$a_{g,h}$ = 0,085x0,85xg =0,709 m/sec^2 → horizontalno računsko ubrzanje tla

$a_{g,v} = a_{g,h}$ x 0,9 =0,638 m/sec^2 → vertikalno računsko ubrzanje tla

- $\eta = \sqrt{\frac{7}{2+\xi}} = \sqrt{\frac{2}{1+5}} = 1 \geq 0.7$ (korekcijski faktor prigušenja, koji je jednak 1 za viskozno prigušenje 5%)
- ξ = 5% (vrijednost viskoznog prigušenja dana u postotku)

Odabire se faktor ponašanja za sustav u kojem kompletan gornji ustroj se oslanja na elastomernim ležajevima:

- q = 1 za smjer x, y
- q = 1 za smjer z

Ovi podaci uneseni su u Sofistik na temelju čega se izračuna spektar odgovora konstrukcije. Unijete su i dodatne mase od dodatnog stalnog opterećenja duž rasponskog sklopa.

Računa se prvih 200 vlastitih frekvencija.

unos u Sofistik		
naziv opterećenja	vrijednost opterećenja	Oznaka
potres smjer x	Maksimalni momenti, poprečne sile i pomaci od spektra odziva	lc 501 – lc 599
potres smjer y		lc 601 – lc 699
potres smjer z		lc 701 – lc 799

Svi stupovi prenose seizmičke sile. Predviđa se elastično ponašanje konstrukcije.

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Modal masses - activated mass

No.	LC	frequency [Hertz]	effective modal Mass X[t]	Y[t]	Z[t]	factor X[%]	Y[%]	Z[%]	activated mass [%]*
1	200	0.707	6951	0	0	58.73	0.00	0.00	31.39242
2	201	0.750	1023	0	0	8.64	0.00	0.00	29.71631
3	202	0.801	0	4684	0	0.00	39.58	0.00	16.88074
4	203	0.820	0	22	0	0.00	0.19	0.00	21.42613
5	204	0.856	0	1693	0	0.00	14.30	0.00	20.59666
6	205	0.878	0	58	0	0.00	0.49	0.00	16.95888
7	206	0.915	0	877	0	0.00	7.41	0.00	17.53667
8	207	0.949	0	69	0	0.00	0.58	0.00	14.40116
9	208	0.992	0	180	0	0.00	1.52	0.00	14.18331
10	209	1.042	0	94	0	0.00	0.79	0.00	12.71211
11	210	1.096	0	53	0	0.00	0.44	0.00	10.84662
12	211	1.102	0	10	0	0.00	0.08	0.00	10.26234
13	212	1.118	0	1	0	0.00	0.01	0.00	9.61245
14	213	1.168	0	64	0	0.00	0.54	0.00	9.94906
15	214	1.234	0	29	0	0.00	0.24	0.00	8.69875
16	215	1.285	0	7	0	0.00	0.06	0.00	8.77734
17	216	1.328	0	15	0	0.00	0.13	0.00	8.51960
18	217	1.443	0	0	0	0.00	0.00	0.00	3.26140
19	218	1.492	0	0	0	0.00	0.00	0.00	2.08299
20	219	1.667	0	2	0	0.00	0.01	0.00	1.26500
21	220	2.940	73	0	0	0.61	0.00	0.00	0.88477
22	221	3.091	2	0	17	0.02	0.00	0.15	2.41510
23	222	3.114	72	0	1	0.61	0.00	0.01	1.40683
24	223	3.197	18	0	0	0.15	0.00	0.00	1.00263
25	224	3.211	0	0	0	0.00	0.00	0.00	1.22060
26	225	3.216	42	0	0	0.36	0.00	0.00	0.95417
27	226	3.333	0	747	0	0.00	6.31	0.00	6.29772
28	227	3.345	0	18	0	0.00	0.15	0.00	4.95173
29	228	3.390	15	0	2	0.13	0.00	0.02	0.89833
30	229	3.394	0	4	0	0.00	0.03	0.00	4.80898
31	230	3.407	49	0	0	0.42	0.00	0.00	0.99000
32	231	3.427	0	149	0	0.00	1.26	0.00	5.66241
33	232	3.439	531	0	10	4.49	0.00	0.09	1.90414
34	233	3.471	304	0	0	2.57	0.00	0.00	0.97066
35	234	3.473	0	3	0	0.00	0.03	0.00	5.31199
36	235	3.511	0	80	0	0.00	0.68	0.00	3.38654
37	236	3.548	0	175	0	0.00	1.48	0.00	6.04406
38	237	3.554	16	0	55	0.13	0.00	0.46	3.00050
39	238	3.568	338	0	13	2.85	0.00	0.11	3.72874
40	239	3.574	0	5	0	0.00	0.04	0.00	5.74318
41	240	3.606	0	219	0	0.00	1.85	0.00	4.10790
42	241	3.645	0	0	0	0.00	0.00	0.00	3.90959
43	242	3.736	0	62	0	0.00	0.52	0.00	4.69829

Modal masses - activated mass

No.	LC	frequency [Hertz]	effective modal Mass X[t]	Y[t]	Z[t]	factor X[%]	Y[%]	Z[%]	activated mass [%]*
44	243	3.738	0	1	0	0.00	0.00	0.00	5.08966
45	244	3.756	32	0	31	0.27	0.00	0.26	1.34674
46	245	3.850	200	0	12	1.69	0.00	0.10	1.31611
47	246	3.878	0	54	0	0.00	0.46	0.00	3.56843
48	247	3.927	0	36	0	0.00	0.31	0.00	2.69174
49	248	4.167	267	0	0	2.25	0.00	0.00	1.35687
50	249	4.288	0	64	0	0.00	0.54	0.00	2.19714
51	250	4.380	0	0	4277	0.00	0.00	36.14	6.07573
52	251	4.420	0	0	114	0.00	0.00	0.97	8.23514
53	252	4.435	1	0	3029	0.01	0.00	25.59	7.42216
54	253	4.459	0	0	152	0.00	0.00	1.28	7.15220
55	254	4.510	3	0	320	0.03	0.00	2.71	9.07474
56	255	4.566	0	0	0	0.00	0.00	0.00	8.77684
57	256	4.600	1	0	28	0.00	0.00	0.24	0.38910
58	257	4.608	0	0	0	0.00	0.00	0.00	0.36841
59	258	4.629	1	0	147	0.01	0.00	1.24	7.16822
60	259	4.693	0	0	53	0.00	0.00	0.45	0.42273
61	260	4.703	1	0	6	0.00	0.00	0.05	0.39025
62	261	4.754	0	3	0	0.00	0.02	0.00	0.21280
63	262	4.760	3	0	26	0.02	0.00	0.22	3.95384
64	263	4.782	0	0	71	0.00	0.00	0.60	0.44534
65	264	4.819	0	10	0	0.00	0.08	0.00	1.03296
66	265	4.824	1	0	10	0.01	0.00	0.09	7.60644
67	266	4.867	0	0	17	0.00	0.00	0.14	6.56644
68	267	4.886	0	232	0	0.00	1.96	0.00	0.90336
69	268	4.890	0	40	0	0.00	0.34	0.00	1.77718
70	269	4.920	0	1	0	0.00	0.01	0.00	2.60083
71	270	4.936	0	0	0	0.00	0.00	0.00	5.07045
72	271	4.940	1	0	20	0.01	0.00	0.17	5.93782
73	272	4.943	0	44	0	0.00	0.37	0.00	2.68183
74	273	4.962	0	0	0	0.00	0.00	0.00	3.21339
75	274	4.980	0	8	0	0.00	0.06	0.00	2.65998
76	275	4.995	0	2	0	0.00	0.01	0.00	2.00748
77	276	4.998	0	2	0	0.00	0.02	0.00	1.80177
78	277	5.033	0	64	0	0.00	0.54	0.00	1.28377
79	278	5.039	0	104	0	0.00	0.87	0.00	1.20744
80	279	5.066	0	66	0	0.00	0.56	0.00	1.18074
81	280	5.121	0	205	0	0.00	1.73	0.00	1.20011
82	281	5.215	0	282	0	0.00	2.38	0.00	1.32503
83	282	5.425	0	0	0	0.00	0.00	0.00	0.43623
84	283	5.441	0	0	0	0.00	0.00	0.00	0.13261
85	284	5.448	0	0	0	0.00	0.00	0.00	0.49976
86	285	5.515	0	0	0	0.00	0.00	0.00	0.26157
87	286	5.547	0	0	0	0.00	0.00	0.00	0.51891
88	287	5.549	0	0	0	0.00	0.00	0.00	0.69099
89	288	5.555	0	0	0	0.00	0.00	0.00	0.58366
90	289	5.568	0	0	0	0.00	0.00	0.00	0.76940
91	290	5.847	302	0	0	2.55	0.00	0.00	2.95094
92	291	5.957	0	0	0	0.00	0.00	0.00	0.44830
93	292	5.969	0	0	0	0.00	0.00	0.00	0.45036
94	293	5.986	0	0	0	0.00	0.00	0.00	0.35360
95	294	6.074	148	0	0	1.25	0.00	0.00	3.15203
96	295	6.074	0	0	0	0.00	0.00	0.00	0.48085
97	296	6.112	389	0	0	3.28	0.00	0.00	4.24585
98	297	6.144	96	0	0	0.82	0.00	0.00	4.33973
99	298	6.177	0	0	0	0.00	0.00	0.00	7.03006
100	299	6.188	37	0	0	0.31	0.00	0.00	3.51601

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Modal masses - activated mass

No.	LC	frequency [Hertz]	effective modal Mass X[t]	Y[t]	Z[t]	factor X[%]	Y[%]	Z[%]	activated mass [%]*
101	300	6.218	0	0	0	0.00	0.00	0.00	6.55094
102	301	6.256	14	0	0	0.11	0.00	0.00	4.98467
103	302	6.295	0	0	0	0.00	0.00	0.00	0.57733
104	303	6.352	0	0	0	0.00	0.00	0.00	0.74447
105	304	6.383	0	0	0	0.00	0.00	0.00	0.50615
106	305	6.398	35	0	0	0.29	0.00	0.00	0.57581
107	306	6.425	0	0	0	0.00	0.00	0.00	0.51742
108	307	6.511	0	0	132	0.00	0.00	1.11	1.30491
109	308	6.521	0	0	227	0.00	0.00	1.92	3.28848
110	309	6.529	0	0	3	0.00	0.00	0.02	5.07991
111	310	6.533	0	0	0	0.00	0.00	0.00	0.74298
112	311	6.536	1	0	70	0.01	0.00	0.59	3.31274
113	312	6.547	5	0	0	0.04	0.00	0.00	2.67612
114	313	6.553	4	0	6	0.04	0.00	0.05	3.24290
115	314	6.554	7	0	13	0.06	0.00	0.11	2.55534
116	315	6.568	25	0	1	0.21	0.00	0.01	2.30397
117	316	6.589	3	0	24	0.03	0.00	0.20	1.54466
118	317	6.590	2	0	5	0.01	0.00	0.04	1.47520
119	318	6.599	1	0	0	0.01	0.00	0.00	3.91507
120	319	6.653	67	0	0	0.56	0.00	0.00	3.99390
121	320	6.707	9	0	0	0.07	0.00	0.00	2.16326
122	321	6.745	255	0	2	2.16	0.00	0.02	1.66660
123	322	6.759	0	0	1	0.00	0.00	0.01	0.80133
124	323	6.766	0	0	0	0.00	0.00	0.00	0.39294
125	324	6.771	0	0	0	0.00	0.00	0.00	0.41735
126	325	6.787	20	0	3	0.17	0.00	0.02	0.46880
127	326	6.792	0	0	0	0.00	0.00	0.00	0.91224
128	327	6.808	21	0	1	0.18	0.00	0.00	0.38133
129	328	6.829	0	0	0	0.00	0.00	0.00	0.60865
130	329	6.838	25	0	0	0.21	0.00	0.00	0.28590
131	330	6.838	4	0	0	0.03	0.00	0.00	0.32228
132	331	6.839	0	0	0	0.00	0.00	0.00	0.37274
133	332	6.849	6	0	0	0.05	0.00	0.00	0.48474
134	333	6.851	4	0	1	0.03	0.00	0.01	0.40766
135	334	6.865	0	0	4	0.00	0.00	0.03	0.34832
136	335	6.890	0	0	0	0.00	0.00	0.00	0.28061
137	336	6.922	2	0	46	0.01	0.00	0.39	3.66482
138	337	6.960	0	0	0	0.00	0.00	0.00	2.57965
139	338	7.030	43	0	29	0.36	0.00	0.25	2.60598
140	339	7.038	1	0	222	0.01	0.00	1.88	2.31787
141	340	7.078	0	0	0	0.00	0.00	0.00	0.43436
142	341	7.118	0	0	0	0.00	0.00	0.00	0.39362
143	342	7.129	0	0	0	0.00	0.00	0.00	0.44574
144	343	7.153	0	0	0	0.00	0.00	0.00	0.42830
145	344	7.247	0	0	0	0.00	0.00	0.00	0.27908
146	345	7.399	34	0	1	0.28	0.00	0.01	5.45201
147	346	7.490	0	0	0	0.00	0.00	0.00	0.97393
148	347	7.505	19	0	3	0.16	0.00	0.03	5.42536
149	348	7.533	0	15	0	0.00	0.13	0.00	0.64022
150	349	7.652	9	0	3	0.08	0.00	0.02	1.42518
151	350	7.661	31	0	14	0.26	0.00	0.12	7.36284
152	351	7.843	5	0	13	0.05	0.00	0.11	11.15300
153	352	7.917	0	20	0	0.00	0.17	0.00	4.13173
154	353	7.956	0	158	0	0.00	1.33	0.00	4.14362
155	354	8.043	0	1	0	0.00	0.01	0.00	9.52395
156	355	8.064	8	0	21	0.07	0.00	0.18	16.62172
157	356	8.072	0	1	0	0.00	0.01	0.00	1.08094

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Modal masses - activated mass

No.	LC	frequency [Hertz]	effective modal Mass X[t]	Y[t]	Z[t]	factor X[%]	Y[%]	Z[%]	activated mass [%]*
158	357	8.073	0	149	0	0.00	1.26	0.00	3.33373
159	358	8.100	0	42	0	0.00	0.36	0.00	5.85749
160	359	8.124	0	76	0	0.00	0.64	0.00	3.96539
161	360	8.152	0	238	0	0.00	2.01	0.00	5.51291
162	361	8.224	0	0	0	0.00	0.00	0.00	1.30314
163	362	8.322	0	0	5	0.00	0.00	0.04	20.20696
164	363	8.369	0	3	0	0.00	0.02	0.00	4.60351
165	364	8.587	0	0	26	0.00	0.00	0.22	20.88104
166	365	8.695	51	0	14	0.43	0.00	0.12	1.13153
167	366	8.773	0	0	0	0.00	0.00	0.00	3.80997
168	367	8.822	0	38	0	0.00	0.32	0.00	3.04892
169	368	8.883	1	0	3	0.01	0.00	0.02	7.44374
170	369	8.907	0	1	0	0.00	0.00	0.00	1.01452
171	370	8.914	0	184	0	0.00	1.56	0.00	4.40033
172	371	8.969	0	0	0	0.00	0.00	0.00	1.01823
173	372	9.092	0	0	0	0.00	0.00	0.00	0.93376
174	373	9.124	0	0	0	0.00	0.00	0.00	1.20587
175	374	9.126	0	3	0	0.00	0.02	0.00	1.46050
176	375	9.127	0	2	0	0.00	0.01	0.00	1.52356
177	376	9.140	0	103	0	0.00	0.87	0.00	3.13149
178	377	9.142	2	0	19	0.02	0.00	0.16	8.39583
179	378	9.348	0	0	1	0.00	0.00	0.01	0.17734
180	379	9.389	0	0	3	0.00	0.00	0.02	3.31625
181	380	9.410	0	0	0	0.00	0.00	0.00	0.17296
182	381	9.411	0	0	0	0.00	0.00	0.00	0.17055
183	382	9.414	0	0	0	0.00	0.00	0.00	0.18266
184	383	9.447	0	1	0	0.00	0.00	0.00	2.43795
185	384	9.484	0	0	0	0.00	0.00	0.00	0.30029
186	385	9.484	0	0	0	0.00	0.00	0.00	0.32143
187	386	9.587	0	86	0	0.00	0.73	0.00	2.62161
188	387	9.618	0	0	1	0.00	0.00	0.01	1.52688
189	388	9.743	4	0	69	0.03	0.00	0.59	2.43020
190	389	9.799	0	0	0	0.00	0.00	0.00	5.62090
191	390	9.900	0	0	87	0.00	0.00	0.73	14.14368
192	391	9.922	0	0	0	0.00	0.00	0.00	0.99412
193	392	9.986	1	0	1538	0.00	0.00	12.99	10.56592
194	393	10.057	0	0	419	0.00	0.00	3.54	3.41272
195	394	10.099	0	0	0	0.00	0.00	0.00	0.58655
196	395	10.105	0	0	0	0.00	0.00	0.00	0.58357
197	396	10.159	0	83	0	0.00	0.70	0.00	2.04152
198	397	10.246	0	0	3	0.00	0.00	0.03	2.86337
199	398	10.404	0	2	0	0.00	0.02	0.00	3.45571
200	399	10.405	13	0	240	0.11	0.00	2.03	1.71117
		sum	11647	11744	11686	98.41	99.23	98.74	
		System activ	11835	11835	11835				

The modal masses are evaluated for the global X, Y and Z direction,
the "activated mass" also includes torsional and opposite movements
without a global displacement (tuning fork):
 * activated mass in % = product u^2*M = displacement^2*mass, in relation to the
   sum of active mass, u scaled on a maximum displacement or rotation of 1.00.
(this activated mass is often also called generalized modal mass)

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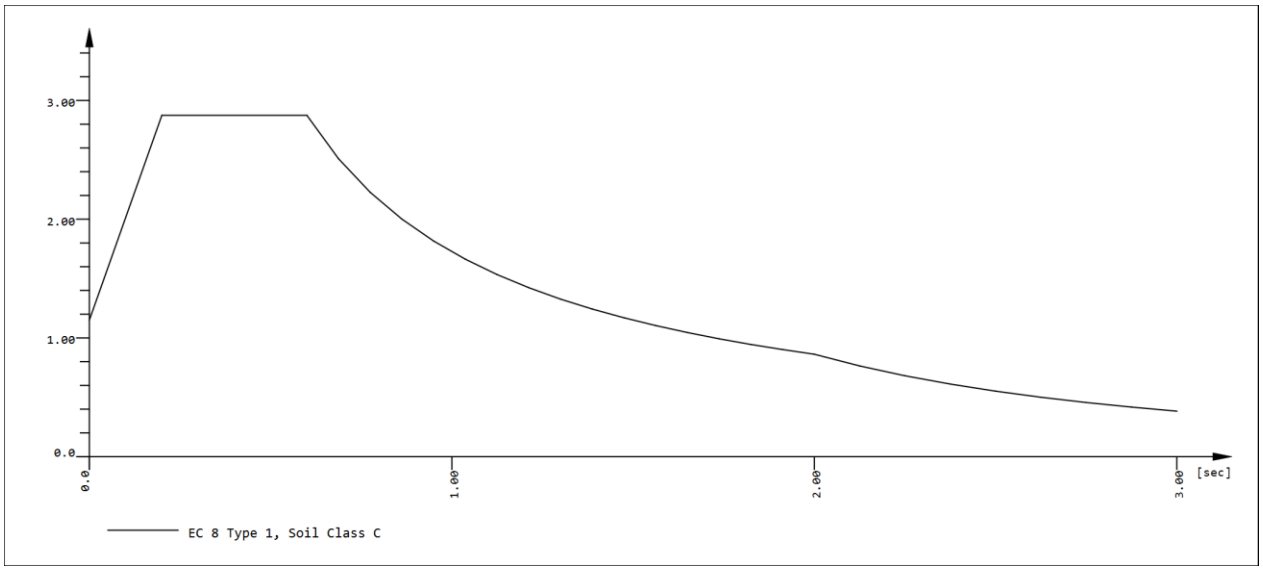
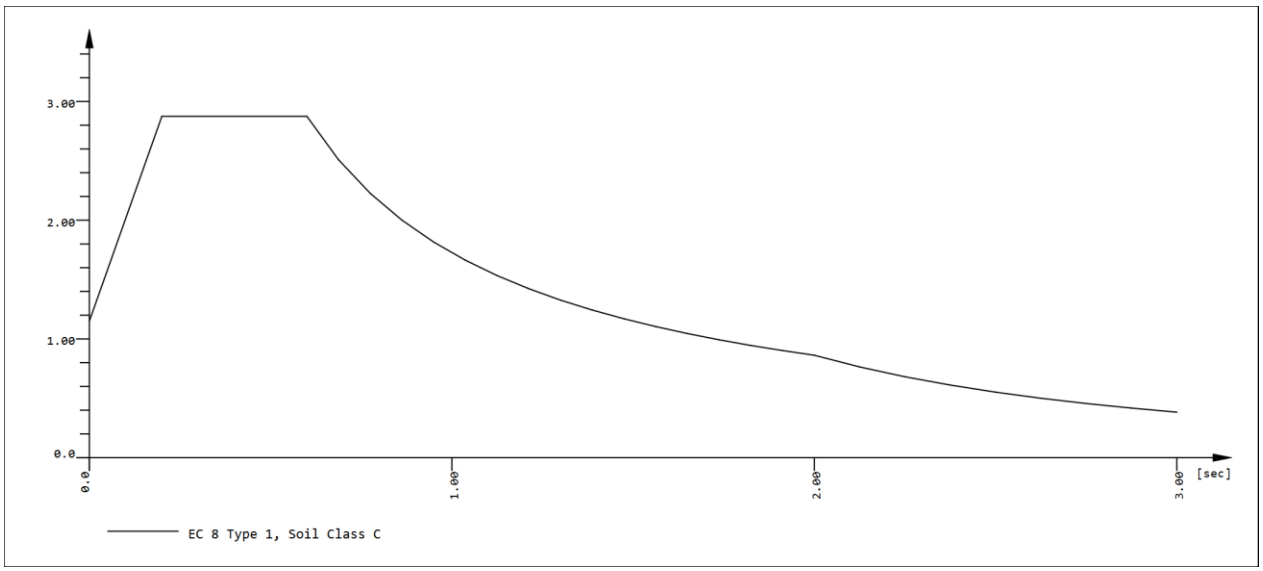


Sum of forces (Base-Shear)

LC	Z-lvl [m]	Mode	Forces PX[kN]	PY[kN]	PZ[kN]	Moments MX[kNm]	MY[kNm]	MZ[kNm]
501	-12.380	CQC[1]	17353.7	3.6	396.2	43.21	122834.79	478.82
501	-2.330	CQC[1]	13570.8	1.2	335.6	19.94	59034.12	184.49
501	0.000	CQC[1]	11729.3	1.1	319.4	18.61	52719.95	147.12

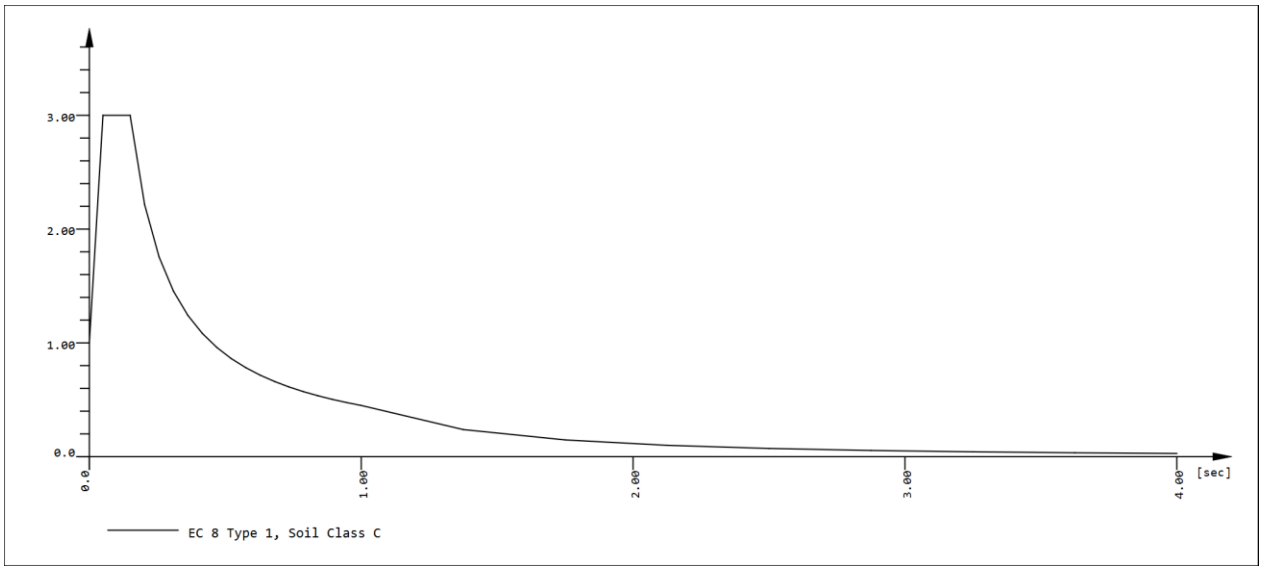
[1] Total Vb and Mb obtained by the given modal superposition rule.



Sum of forces (Base-Shear)

LC	Z-lvl [m]	Mode	Forces PX[kN]	PY[kN]	PZ[kN]	Moments MX[kNm]	MY[kNm]	MZ[kNm]
601	-12.380	CQC[1]	3.3	17175.9	8.5	90327.34	1277.32	2300382.0
601	-2.330	CQC[1]	1.2	13552.3	6.0	33429.94	895.56	1798038.9
601	0.000	CQC[1]	1.1	11806.3	5.9	32536.62	859.41	1563834.1

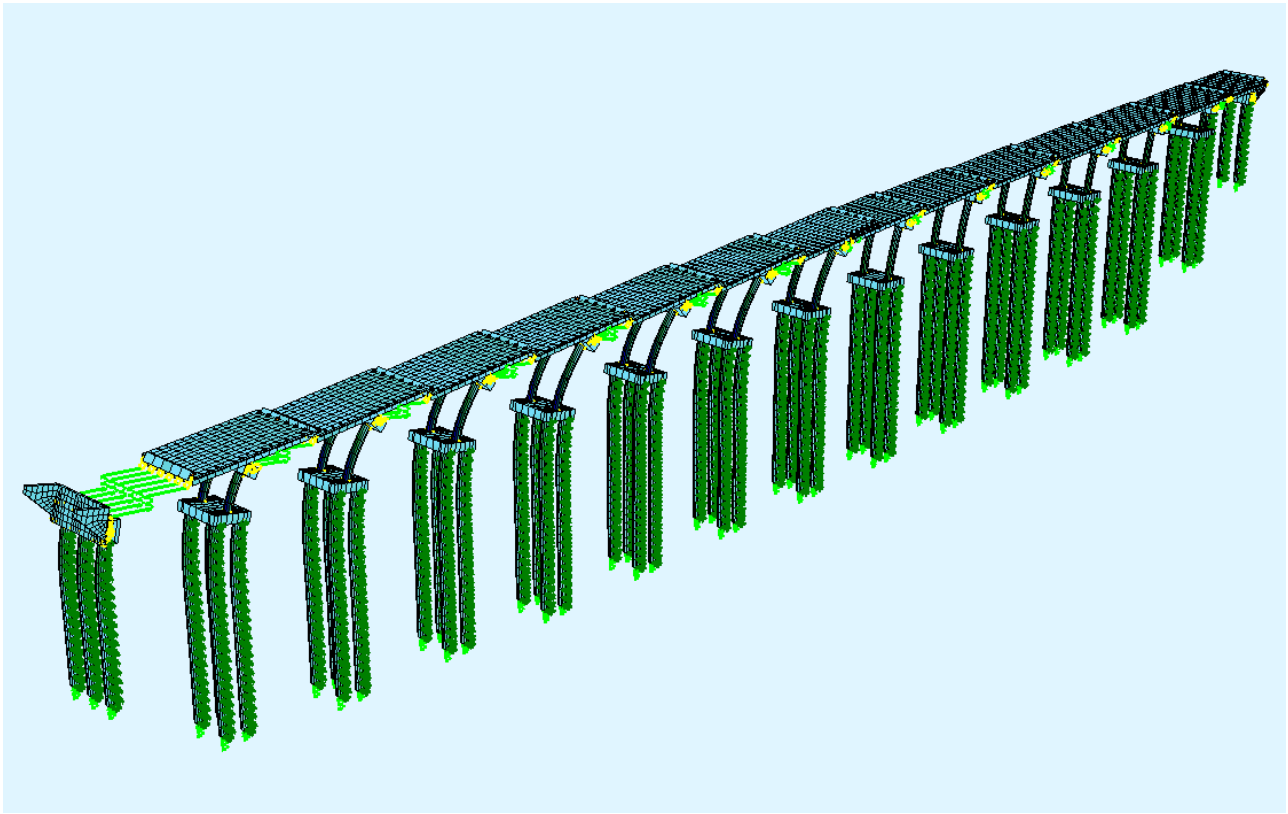
[1] Total Vb and Mb obtained by the given modal superposition rule.



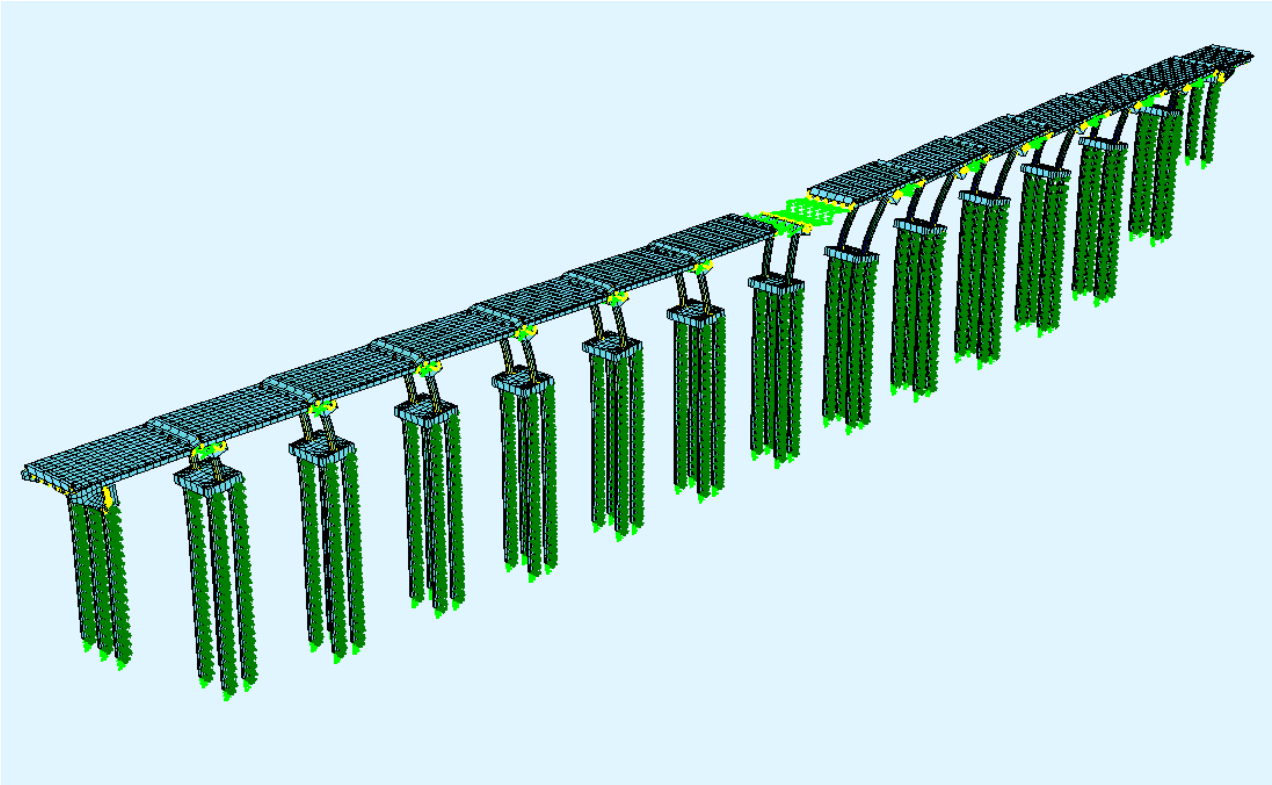
Sum of forces (Base-Shear)

LC	Z-lvl [m]	Mode	Forces PX[kN]	Forces PY[kN]	Forces PZ[kN]	Moments MX[kNm]	Moments MY[kNm]	Moments MZ[kNm]
701	-12.380	CQC[1]	306.6	5.8	25363.2	66.20	3402612.2	839.32
701	-2.330	CQC[1]	48.4	0.8	18362.3	57.70	2427571.0	126.93
701	0.000	CQC[1]	41.8	0.8	17022.8	28.66	2242614.5	122.64

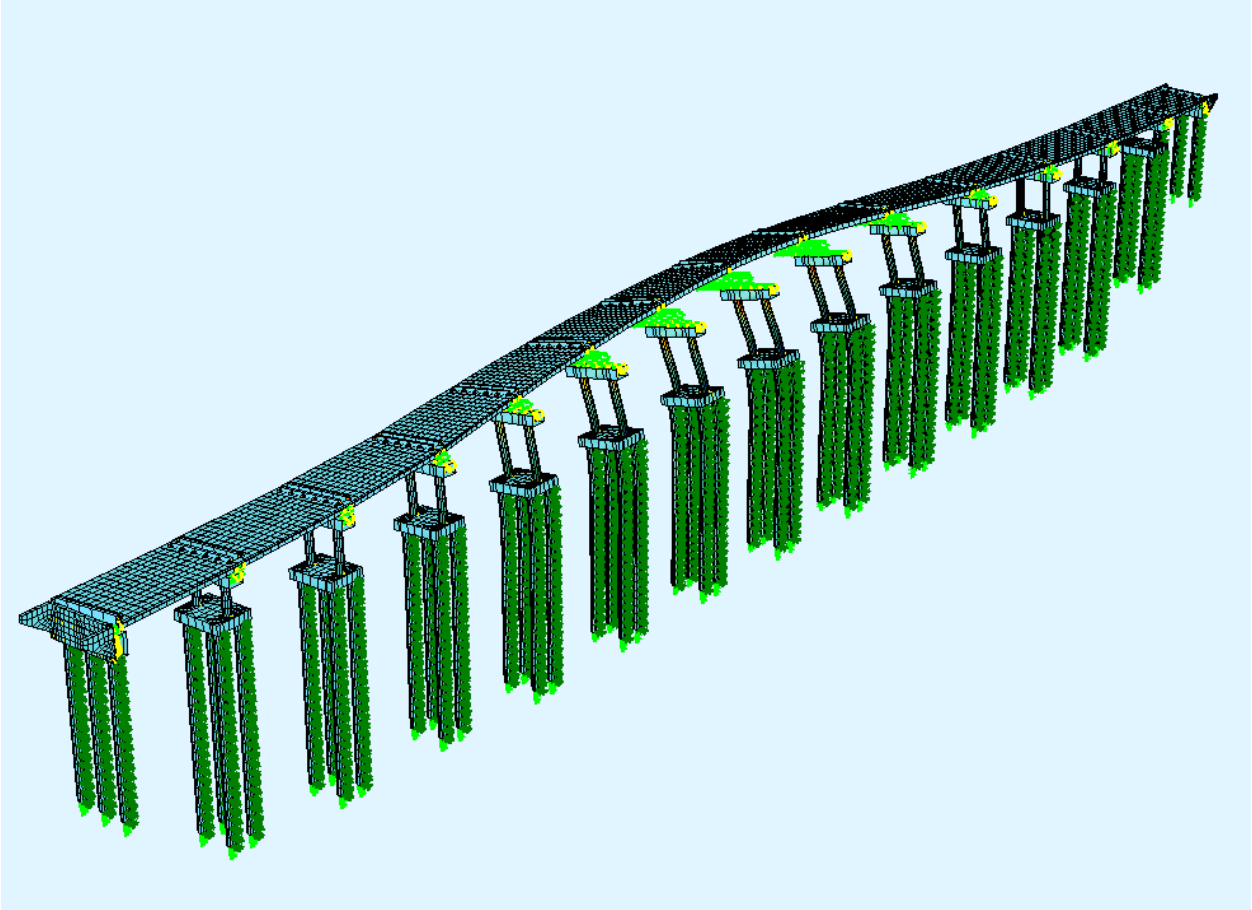
[1] Total Vb and Mb obtained by the given modal superposition rule.



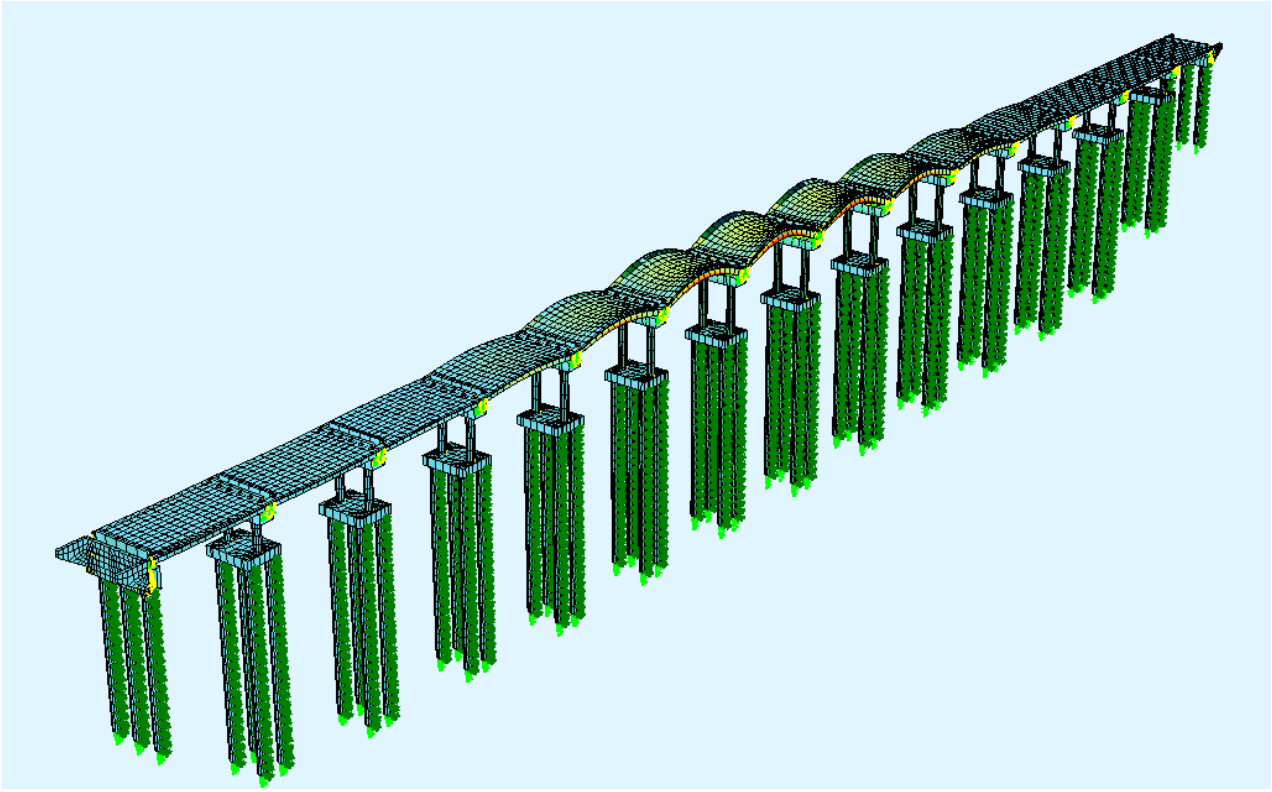
1.ton



2.ton



3.ton



51.ton

2.8 Opterećenje zemljom LC3

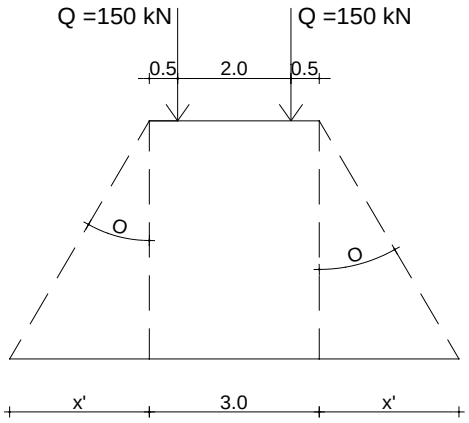
Mirni pritisak zemlje

Opterećenje tlom uzima se u obzir za krila, zid i zidić upornjaka.
Zapreminska težina uzima se kao γ_{tlo} = 20 kN/m^3, a koeficijent mirnog pritiska kao
k = 1 – sinφ = 1 – sin30º = 0,5.
Na dubini:

0,22 m	p_{hg} = 2,2 kN/m^2
4,75 m	p_{hg} = 47,5 kN/m^2
3,73 m	p_{hg} = 37,3 kN/m^2

2.9 Prometno opterećenje od utjecaja vozila na upornjak LC75-76

Bočni pritisak tla povećava se uslijed kontinuiranog i koncentriranog opterećenja ispred okvirne konstrukcije. Prema HRN EN 1991-2 NA za opterećenje od utjecaja vozila na upornjake uzima se zamjenska površina vozila 3,0x5,0 m.



Slika 3 Shema rasprostiranja opterećenja

k_0 = 1-sin φ = 0,5

Bočno opterećenje na dubini 0,22 m:
- 1. traka $q'_{h=0,22}$ = 0,5x(9+600/((3+2x0,22xtan30°)x(5+0,22xtan30°)) = 22,48 kN/m^2
- 2. traka $q'_{h=0,22}$ = 0,5x(2,5+400/((3+2x0,22xtan30°)x(5+0,22xtan30°)) = 13,24 kN/m^2

Bočno opterećenje na dubini 4,75 m:
- 1. traka $q'_{h=4,75}$ = 0,5x(9+600/((3+2x4,75xtan30°)x(5+4,75xtan30°))) = 9,07 kN/m^2
- 2. traka $q'_{h=4,75}$ = 0,5x(2,5+400/((3+2x4,75xtan30°)x(5+4,75xtan30°))) = 4,29 kN/m^2

Bočno opterećenje na dubini 3,73 m:
- 1. traka $q'_{h=3,73}$ = 0,5x(9+600/((3+2x3,73xtan30°)x(5+3,73xtan30°))) = 10,24 kN/m^2
- 2. traka $q'_{h=3,73}$ = 0,5x(2,5+400/((3+2x3,73xtan30°)x(5+3,73xtan30°))) = 5,08 kN/m^2

Osovinsko opterećenje se postavlja u 2 položaja.

2.10 Iznimno opterećenje bočnog udara na rubu krila LC80 - 83

Horizontalna sila H=100 kN koja djeluje u vrhu krila.

2.11 Sila kočenja na upornjaku LC85 - 90

Sila kočenja na upornjaku se uzima kao $0,6 \cdot \alpha_{Q1} \cdot Q_{1k}$ koja djeluje skupa s osovinskim opterećenjem modela 1. Postavlja se na tri različita položaja: bliže krilima i u sredinu upornjaka.

2.12 Seizmičko djelovanje na upornjak LC93 - 96

Potresno djelovanje od nasipa na upornjak uzima se prema EN 1998-5:2004 - tlak zemlje za krute konstrukcije za seizmičko ubrzanje 0,156g.

- dinamičko djelovanje prouzročeno tlakom zemlje

$E_d = \alpha \cdot S \cdot \gamma \cdot H$ = 0,156 x 1,15 x 20,0 x H = 3,588 x H kN/m^2

Djelovanje tlaka zemlje zadano je u x i y smjerovima

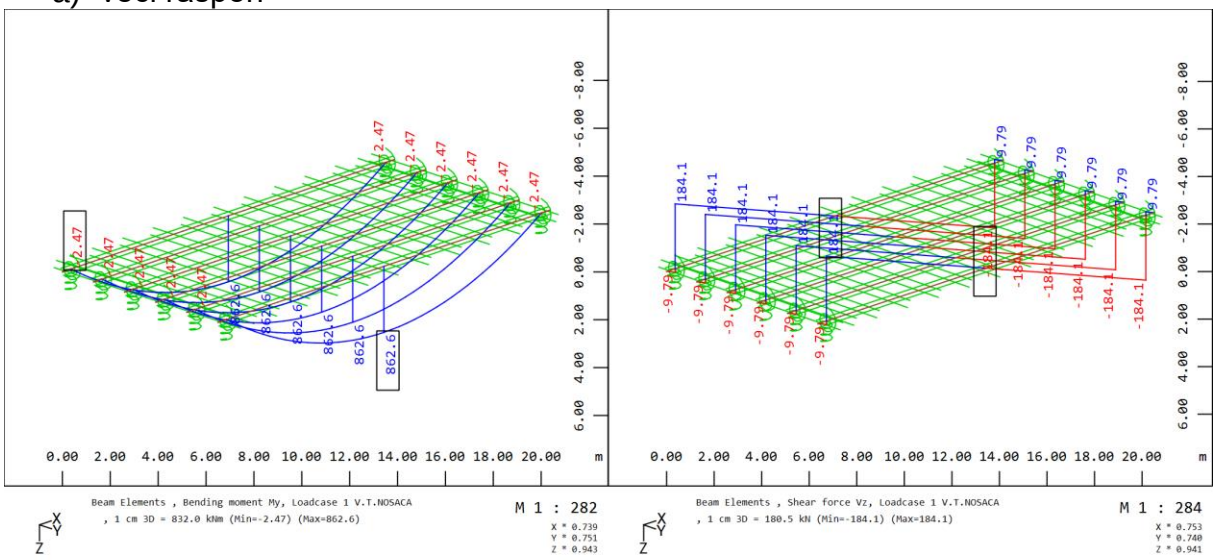
2.13 Sila koje djeluju na pješačku ogradu

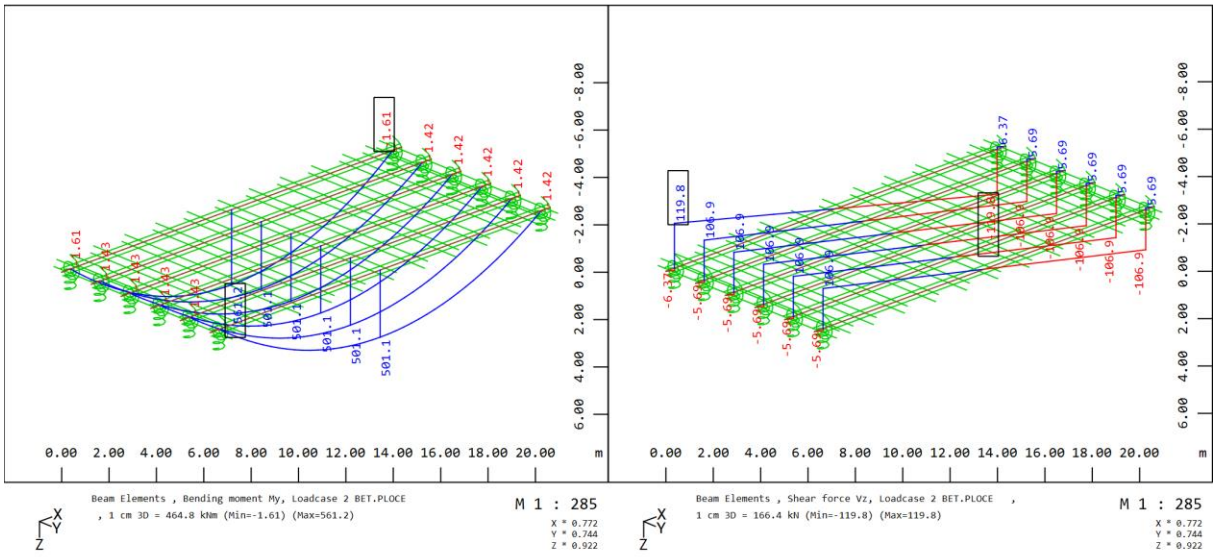
Po rukohvatu čelične ograde zadaje se u najnepovoljnijim kombinacijama 1 kN/m horizontalno i 1 kN/m vertikalno linijsko opterećenje.

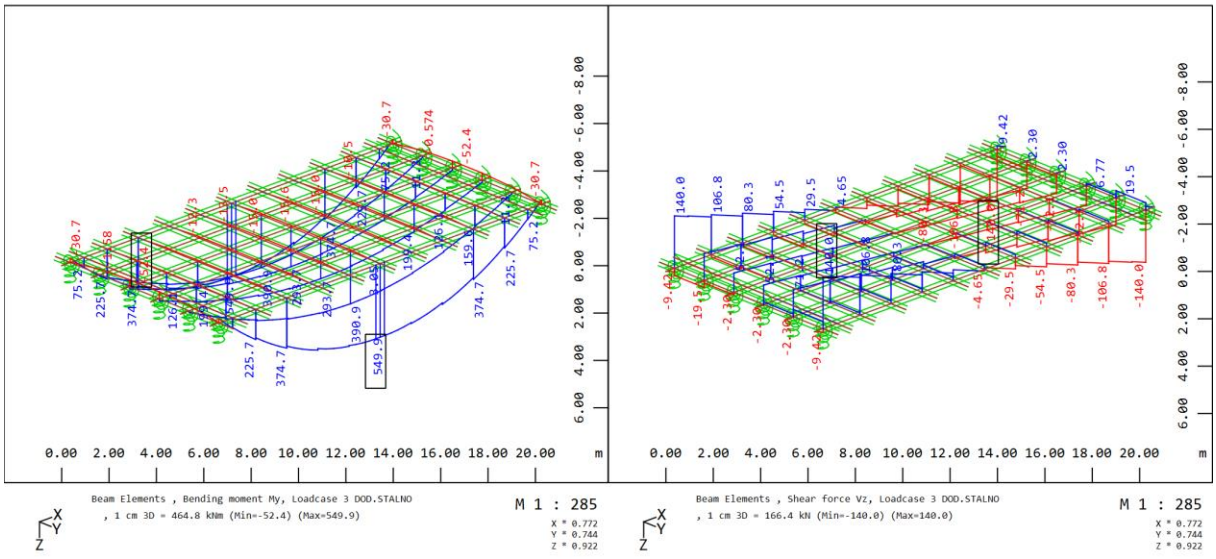
3. RASPONSKI SKLOP

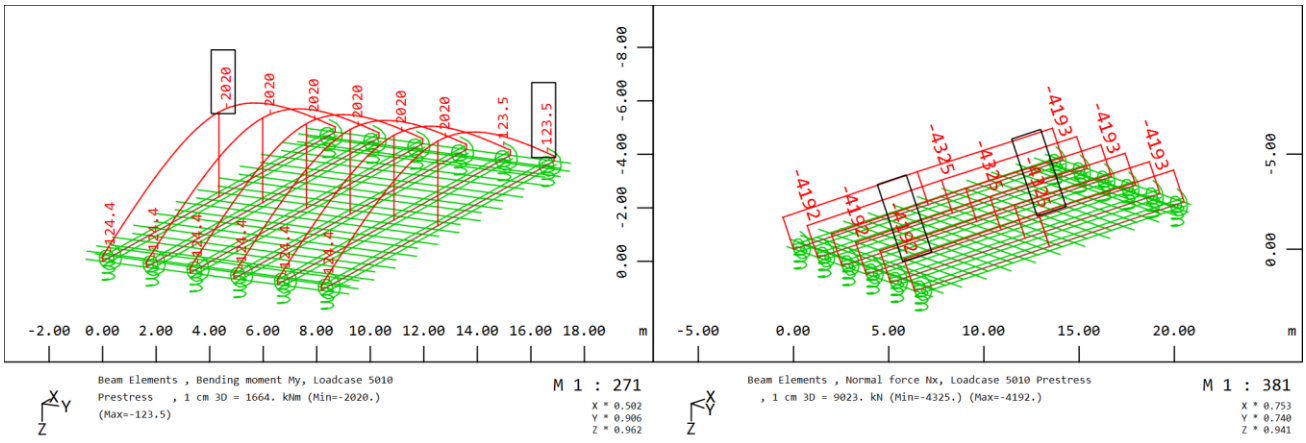
3.1 Prikaz reznih sila od osnovnih opterećenja za rasponski sklop

a) veći raspon







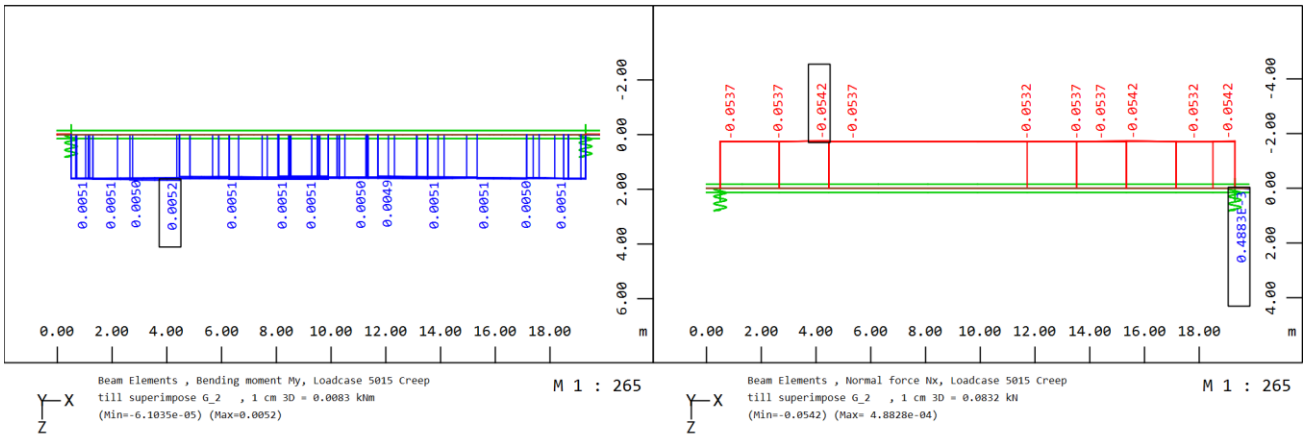


Beam Elements , Bending moment My, Loadcase 5010
Prestress , 1 cm 3D = 1664. kNm (Min=-2020.)
(Max=-123.5)

M 1 : 271

Beam Elements , Normal force Nx, Loadcase 5010 Prestress
, 1 cm 3D = 9023. kN (Min=-4325.) (Max=-4192.)

M 1 : 381

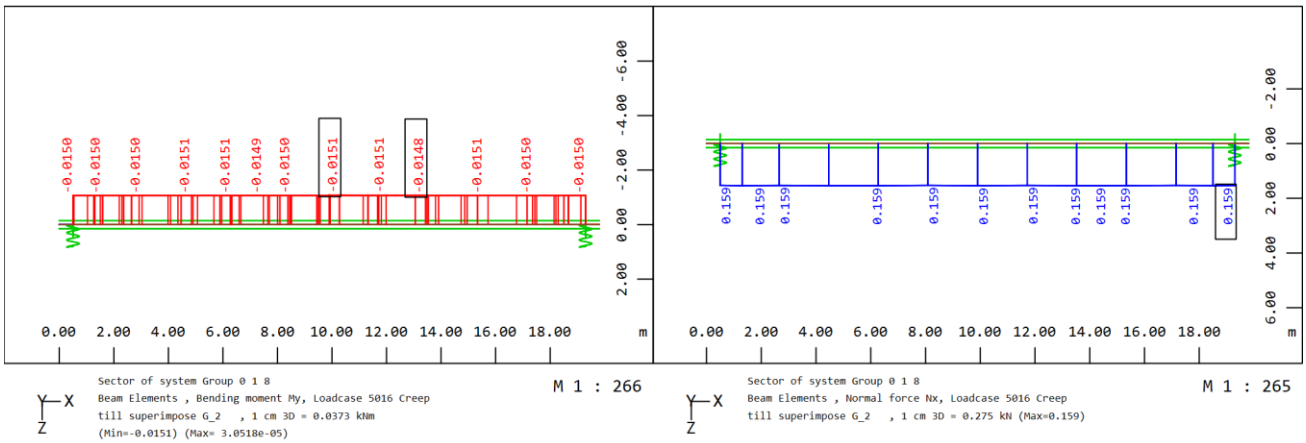


Beam Elements , Bending moment My, Loadcase 5015 Creep
till superimpose G_2 , 1 cm 3D = 0.0083 kNm
(Min=-6.1035e-05) (Max=0.0052)

M 1 : 265

Beam Elements , Normal force Nx, Loadcase 5015 Creep
till superimpose G_2 , 1 cm 3D = 0.0832 kN
(Min=-0.0542) (Max= 4.8828e-04)

M 1 : 265

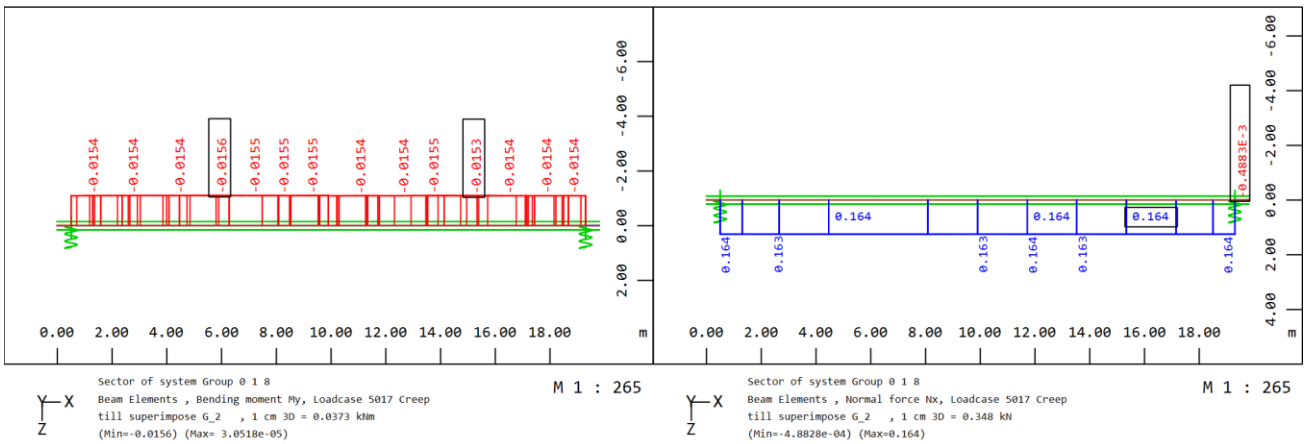


Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5016 Creep
till superimpose G_2 , 1 cm 3D = 0.0373 kNm
(Min=-0.0151) (Max= 3.0518e-05)

M 1 : 266

Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5016 Creep
till superimpose G_2 , 1 cm 3D = 0.275 kN (Max=0.159)

M 1 : 265

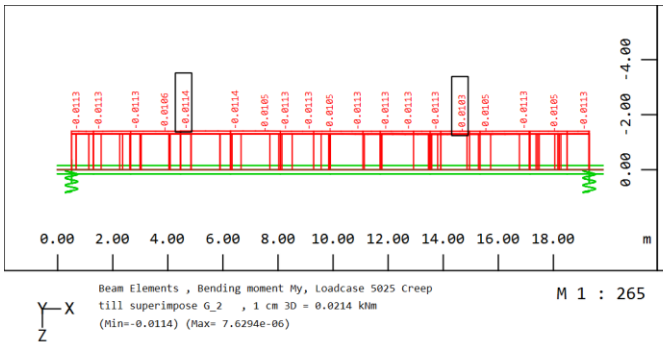


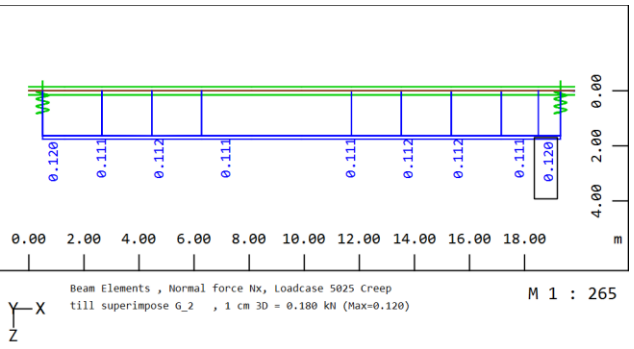
Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5017 Creep
till superimpose G_2 , 1 cm 3D = 0.0373 kNm
(Min=-0.0156) (Max= 3.0518e-05)

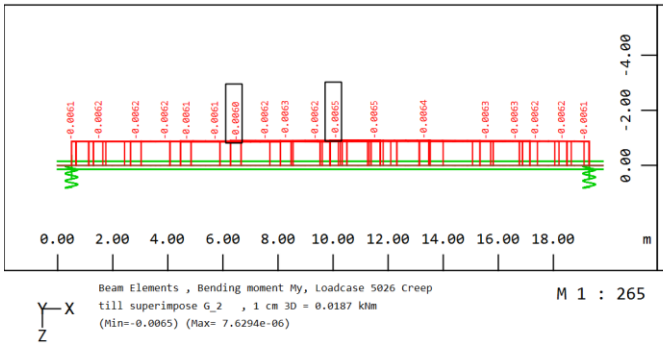
M 1 : 265

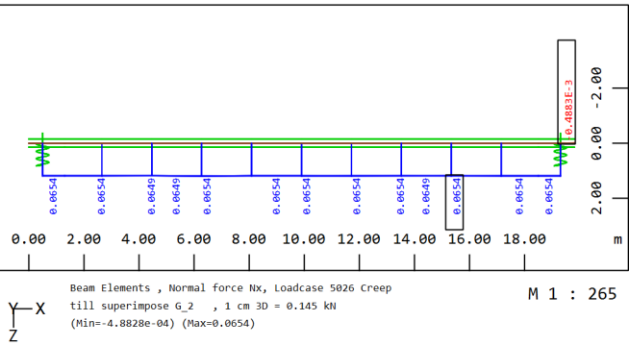
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5017 Creep
till superimpose G_2 , 1 cm 3D = 0.348 kN
(Min=-4.8828e-04) (Max=0.164)

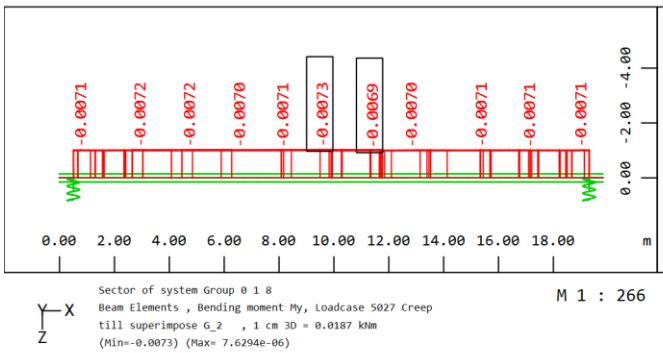
M 1 : 265

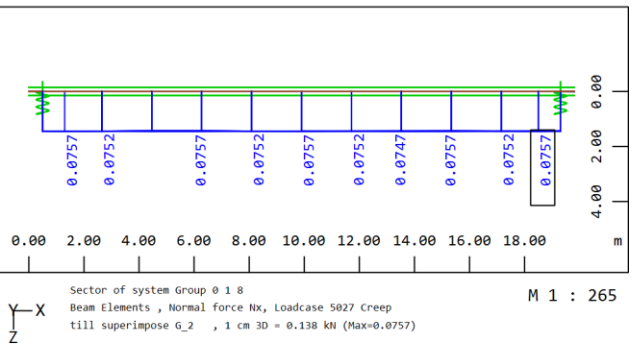

-0.0113 -0.0113 -0.0113 -0.0106 -0.0114 -0.0114 -0.0105 -0.0113 -0.0113 -0.0105 -0.0113 -0.0113 -0.0113 -0.0103 -0.0105 -0.0113 -0.0105 -0.0113
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 16.00 18.00 m
0.00 -2.00 -4.00
Beam Elements , Bending moment My, Loadcase 5025 Creep
till superimpose G_2 , 1 cm 3D = 0.0214 kNm
(Min=-0.0114) (Max= 7.6294e-06)
M 1 : 265

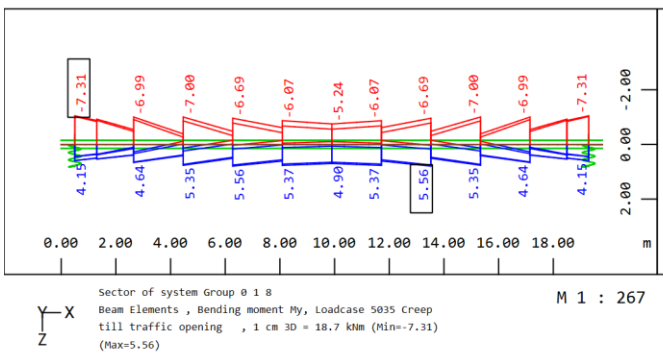

0.120 0.111 0.112 0.111 0.111 0.112 0.112 0.111 0.120
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 16.00 18.00 m
0.00 2.00 4.00
Beam Elements , Normal force Nx, Loadcase 5025 Creep
till superimpose G_2 , 1 cm 3D = 0.180 kN (Max=0.120)
M 1 : 265

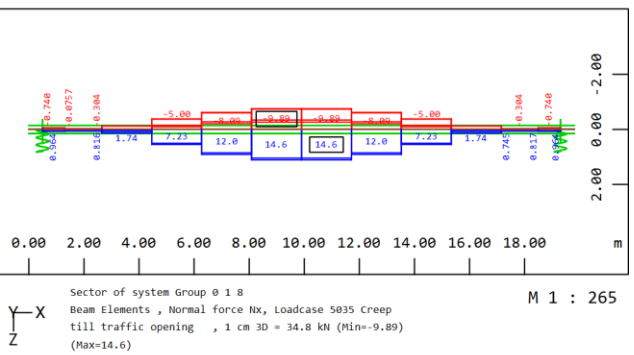

0.0061 -0.0062 -0.0062 -0.0062 -0.0061 -0.0061 -0.0060 -0.0062 -0.0063 -0.0062 -0.0065 -0.0065 -0.0064 -0.0063 -0.0063 -0.0062 -0.0062 -0.0061
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 16.00 18.00 m
0.00 -2.00 -4.00
Beam Elements , Bending moment My, Loadcase 5026 Creep
till superimpose G_2 , 1 cm 3D = 0.0187 kNm
(Min=-0.0065) (Max= 7.6294e-06)
M 1 : 265

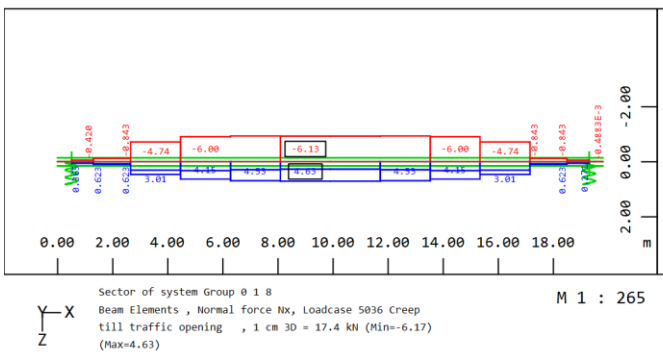

0.0654 0.0654 0.0649 0.0649 0.0654 0.0654 0.0654 0.0654 0.0654 0.0649 0.0654 0.0654 0.0654 -0.4883E-3
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 16.00 18.00 m
0.00 -2.00
Beam Elements , Normal force Nx, Loadcase 5026 Creep
till superimpose G_2 , 1 cm 3D = 0.145 kN
(Min=-4.8828e-04) (Max=0.0654)
M 1 : 265

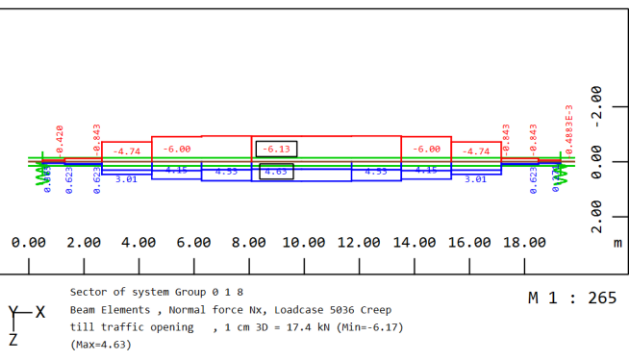

-0.0071 -0.0072 -0.0072 -0.0070 -0.0071 -0.0073 -0.0069 -0.0070 -0.0071 -0.0071 -0.0071
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 16.00 18.00 m
0.00 -2.00 -4.00
Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5027 Creep
till superimpose G_2 , 1 cm 3D = 0.0187 kNm
(Min=-0.0073) (Max= 7.6294e-06)
M 1 : 266

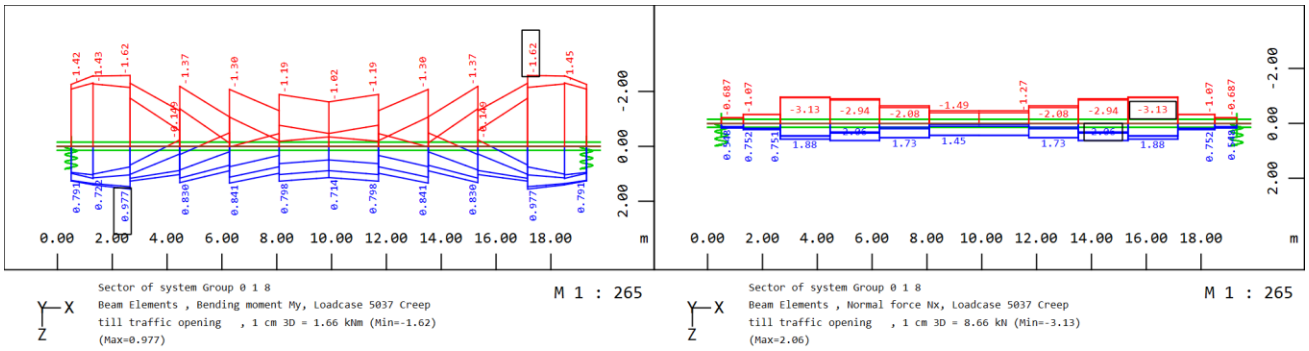

0.0757 0.0752 0.0757 0.0752 0.0757 0.0752 0.0747 0.0757 0.0752 0.0757
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 16.00 18.00 m
0.00 2.00 4.00
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5027 Creep
till superimpose G_2 , 1 cm 3D = 0.138 kN (Max=0.0757)
M 1 : 265

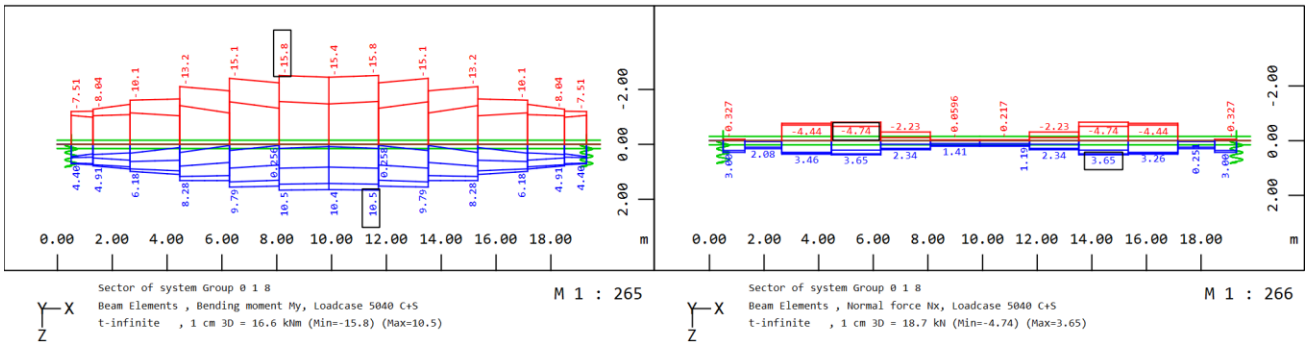

-7.31 -6.99 -7.00 -6.69 -6.07 -5.24 -6.07 -6.69 -7.00 -6.99 -7.31
4.15 4.64 5.35 5.56 5.37 4.90 5.37 5.56 5.35 4.64 4.15
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 16.00 18.00 m
2.00 0.00 -2.00
Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5035 Creep
till traffic opening , 1 cm 3D = 18.7 kNm (Min=-7.31)
(Max=5.56)
M 1 : 267

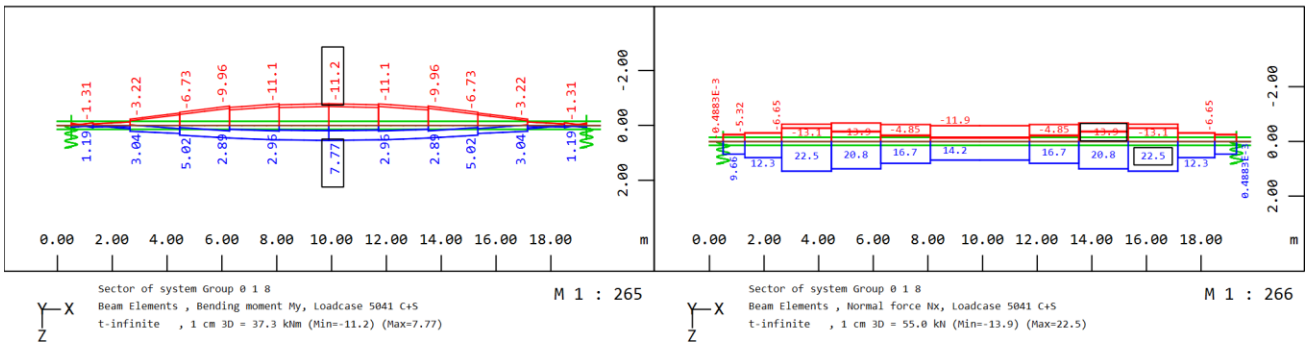

-5.00 -9.89 -9.89 -9.89 -5.00
1.74 7.23 12.0 14.6 14.6 12.0 7.23 1.74
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 16.00 18.00 m
2.00 0.00 -2.00
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5035 Creep
till traffic opening , 1 cm 3D = 34.8 kN (Min=-9.89)
(Max=14.6)
M 1 : 265

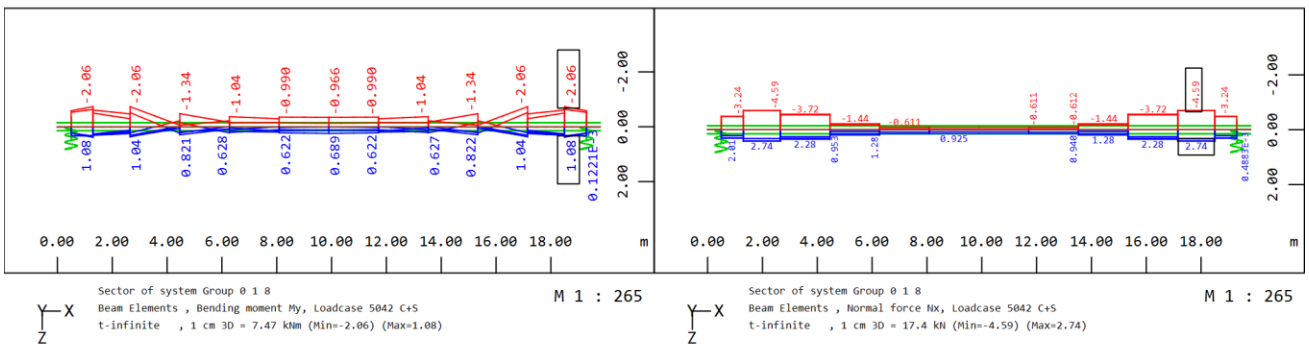

-4.74 -6.00 -6.13 -6.00 -4.74
3.01 4.45 4.63 4.45 3.01
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 16.00 18.00 m
2.00 0.00 -2.00
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5036 Creep
till traffic opening , 1 cm 3D = 17.4 kN (Min=-6.17)
(Max=4.63)
M 1 : 265

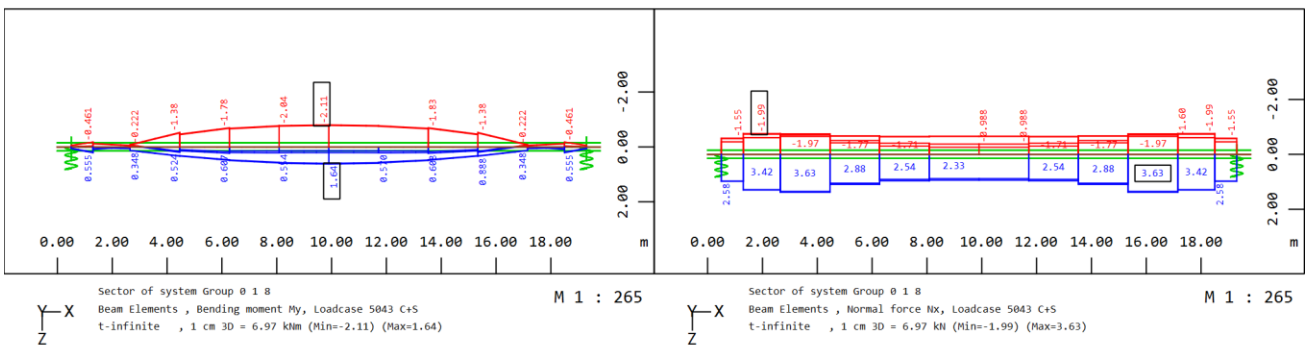

-4.74 -6.00 -6.13 -6.00 -4.74
3.01 4.45 4.63 4.45 3.01
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 16.00 18.00 m
2.00 0.00 -2.00
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5036 Creep
till traffic opening , 1 cm 3D = 17.4 kN (Min=-6.17)
(Max=4.63)
M 1 : 265

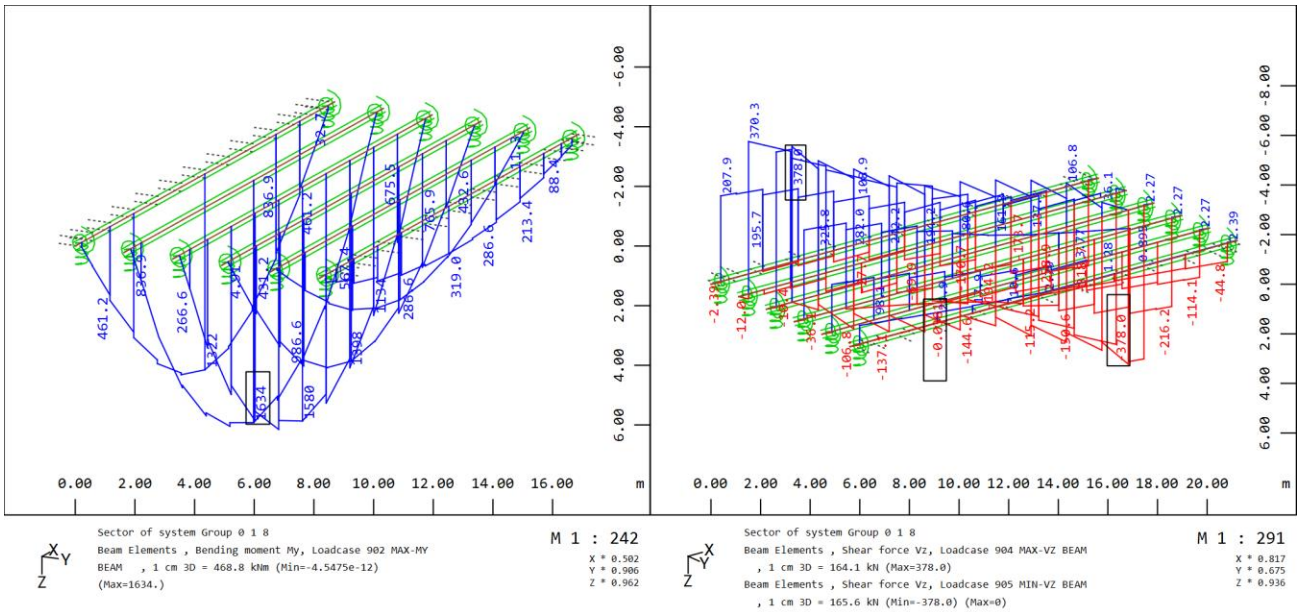

Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5037 Creep till traffic opening , 1 cm 3D = 1.66 kNm (Min=-1.62) (Max=0.977)
M 1 : 265
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5037 Creep till traffic opening , 1 cm 3D = 8.66 kN (Min=-3.13) (Max=2.06)
M 1 : 265

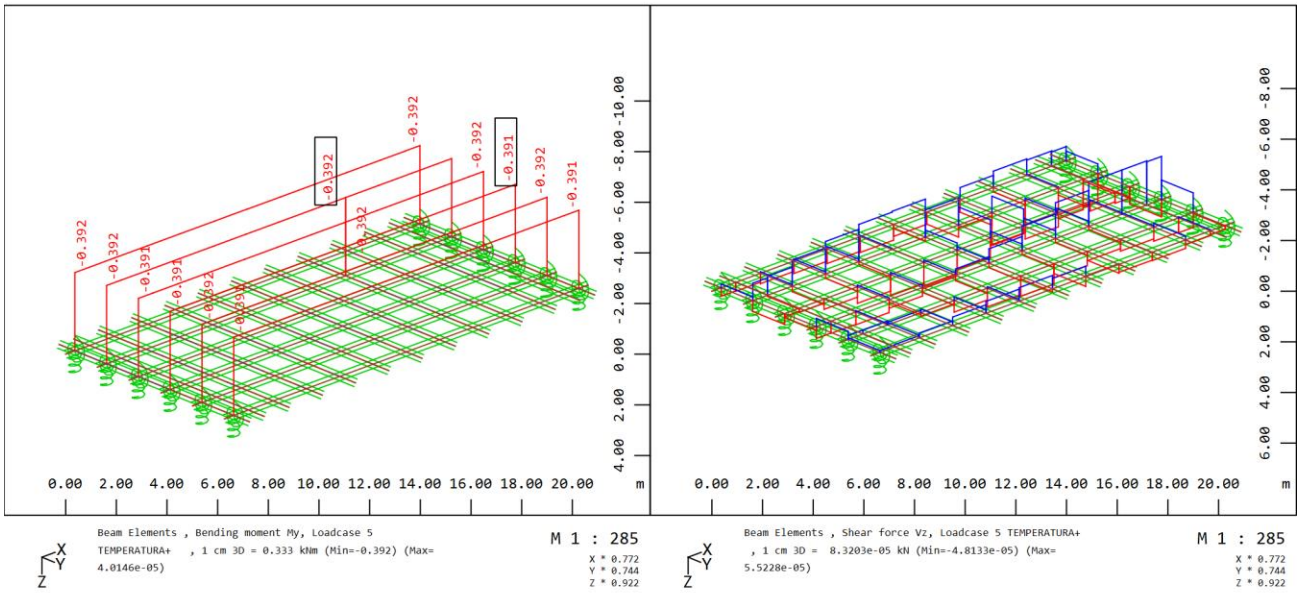

Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5040 C+S t-infinite , 1 cm 3D = 16.6 kNm (Min=-15.8) (Max=10.5)
M 1 : 265
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5040 C+S t-infinite , 1 cm 3D = 18.7 kN (Min=-4.74) (Max=3.65)
M 1 : 266

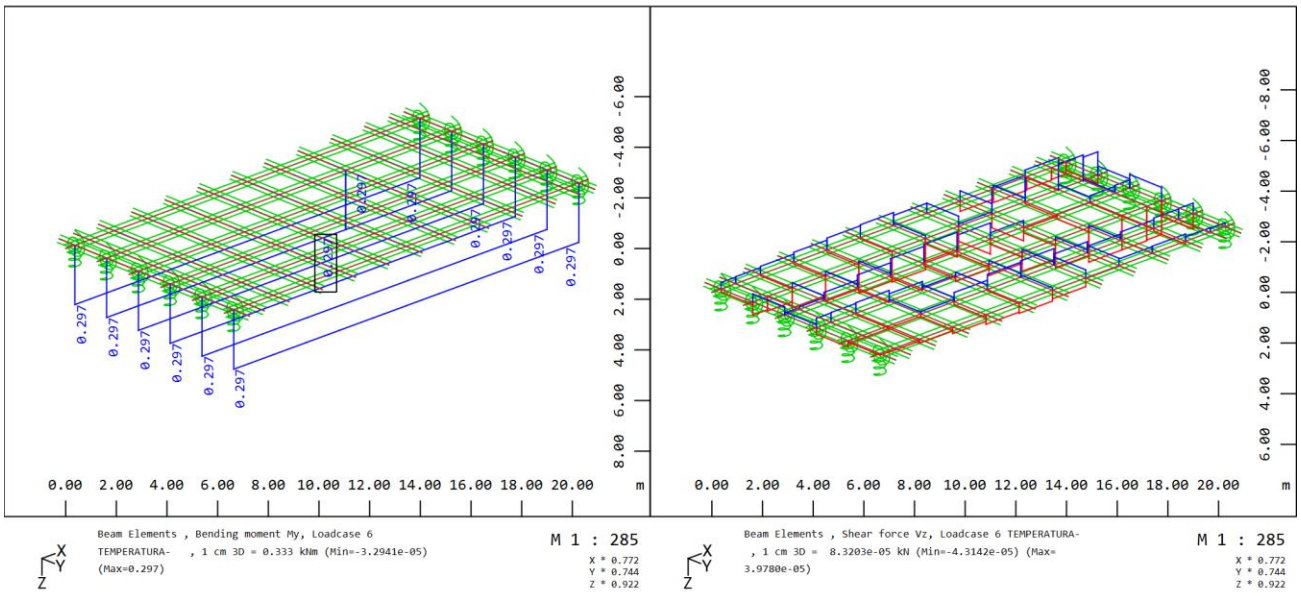

Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5041 C+S t-infinite , 1 cm 3D = 37.3 kNm (Min=-11.2) (Max=7.77)
M 1 : 265
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5041 C+S t-infinite , 1 cm 3D = 55.0 kN (Min=-13.9) (Max=22.5)
M 1 : 266

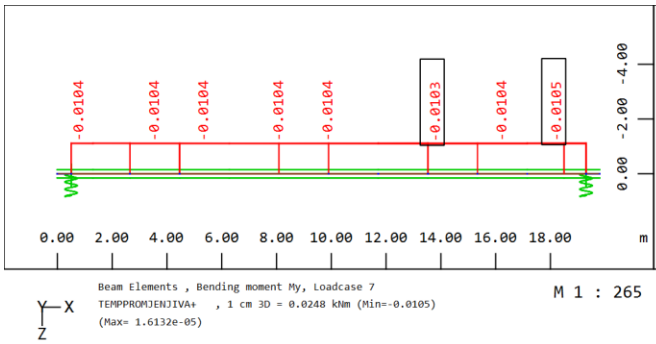

Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5042 C+S t-infinite , 1 cm 3D = 7.47 kNm (Min=-2.06) (Max=1.08)
M 1 : 265
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5042 C+S t-infinite , 1 cm 3D = 17.4 kN (Min=-4.59) (Max=2.74)
M 1 : 265

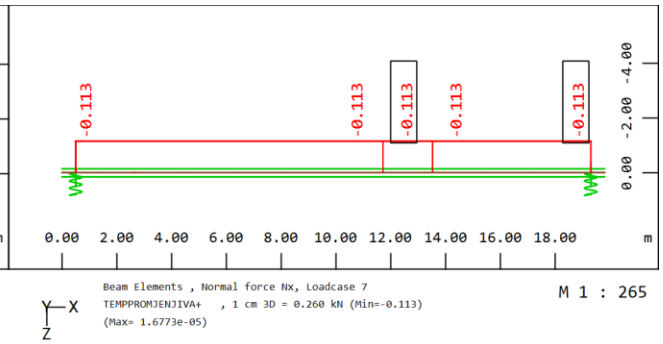

Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5043 C+S t-infinite , 1 cm 3D = 6.97 kNm (Min=-2.11) (Max=1.64)
M 1 : 265
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5043 C+S t-infinite , 1 cm 3D = 6.97 kN (Min=-1.99) (Max=3.63)
M 1 : 265

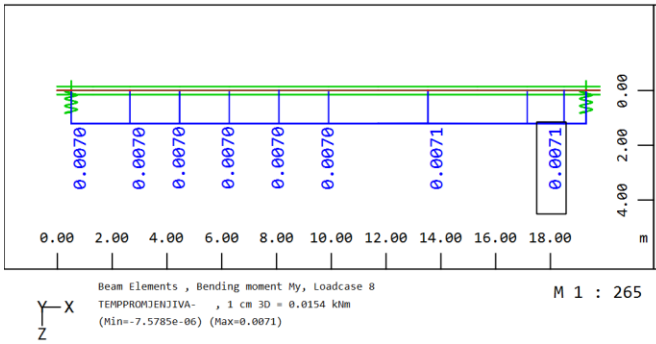

Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 902 MAX-MY
BEAM , 1 cm 3D = 468.8 kNm (Min=-4.5475e-12)
(Max=1634.)
M 1 : 242
X * 0.502
Y * 0.906
Z * 0.962
Sector of system Group 0 1 8
Beam Elements , Shear force Vz, Loadcase 904 MAX-VZ BEAM
, 1 cm 3D = 164.1 kN (Max=378.0)
Beam Elements , Shear force Vz, Loadcase 905 MIN-VZ BEAM
, 1 cm 3D = 165.6 kN (Min=-378.0) (Max=0)
M 1 : 291
X * 0.817
Y * 0.675
Z * 0.936

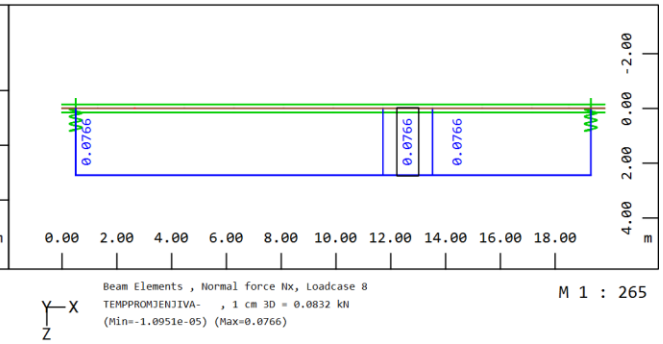

Beam Elements , Bending moment My, Loadcase 5
TEMPERATURA+ , 1 cm 3D = 0.333 kNm (Min=-0.392) (Max=
4.0146e-05)
M 1 : 285
X * 0.772
Y * 0.744
Z * 0.922
Beam Elements , Shear force Vz, Loadcase 5 TEMPERATURA+
, 1 cm 3D = 8.3203e-05 kN (Min=-4.8133e-05) (Max=
5.5228e-05)
M 1 : 285
X * 0.772
Y * 0.744
Z * 0.922

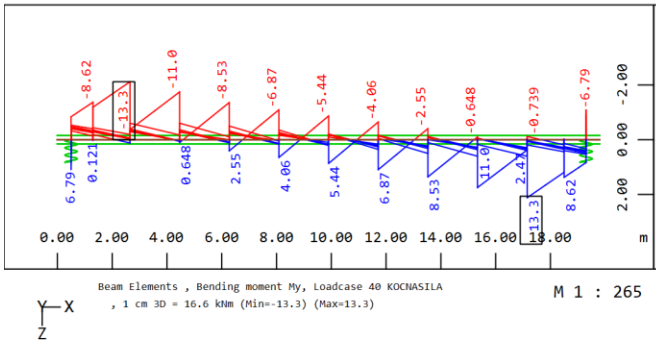

Beam Elements , Bending moment My, Loadcase 6
TEMPERATURA- , 1 cm 3D = 0.333 kNm (Min=-3.2941e-05)
(Max=0.297)
M 1 : 285
X * 0.772
Y * 0.744
Z * 0.922
Beam Elements , Shear force Vz, Loadcase 6 TEMPERATURA-
, 1 cm 3D = 8.3203e-05 kN (Min=-4.3142e-05) (Max=
3.9780e-05)
M 1 : 285
X * 0.772
Y * 0.744
Z * 0.922

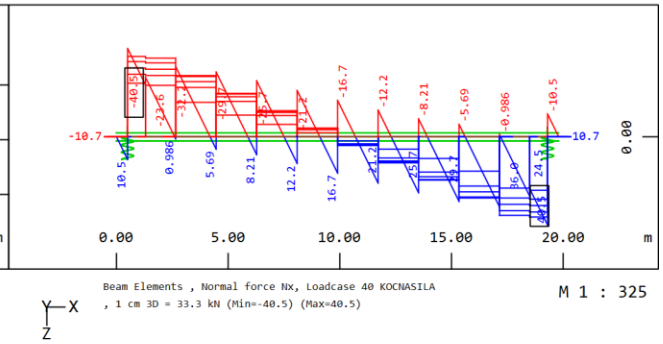

Beam Elements , Bending moment My, Loadcase 7
TEMPPROMJENJIVA+ , 1 cm 3D = 0.0248 kNm (Min=-0.0105)
(Max= 1.6132e-05)
M 1 : 265

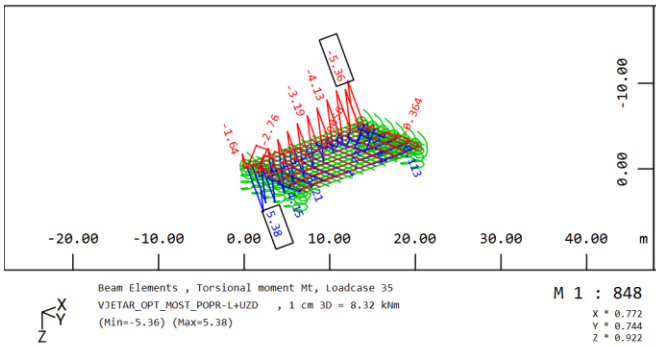

Beam Elements , Normal force Nx, Loadcase 7
TEMPPROMJENJIVA+ , 1 cm 3D = 0.260 kN (Min=-0.113)
(Max= 1.6773e-05)
M 1 : 265

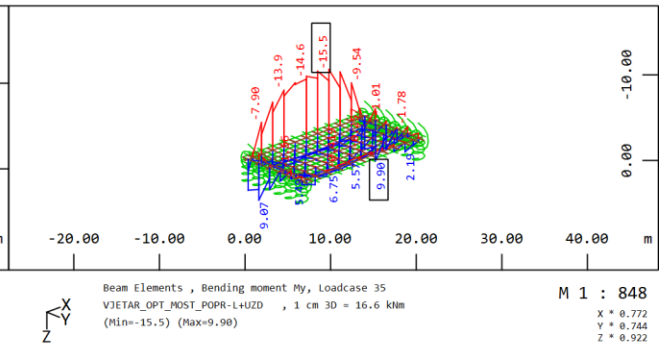

Beam Elements , Bending moment My, Loadcase 8
TEMPPROMJENJIVA- , 1 cm 3D = 0.0154 kNm
(Min=-7.5785e-06) (Max=0.0071)
M 1 : 265

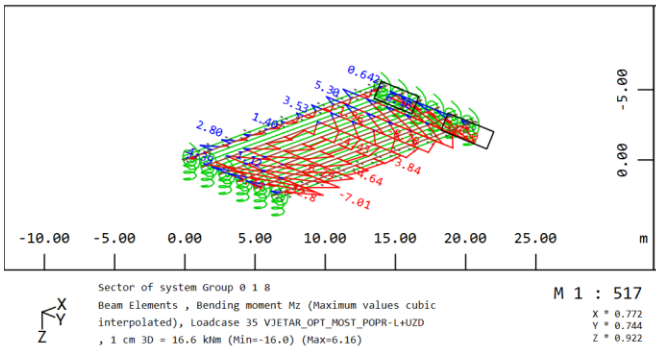

Beam Elements , Normal force Nx, Loadcase 8
TEMPPROMJENJIVA- , 1 cm 3D = 0.0832 kN
(Min=-1.0951e-05) (Max=0.0766)
M 1 : 265

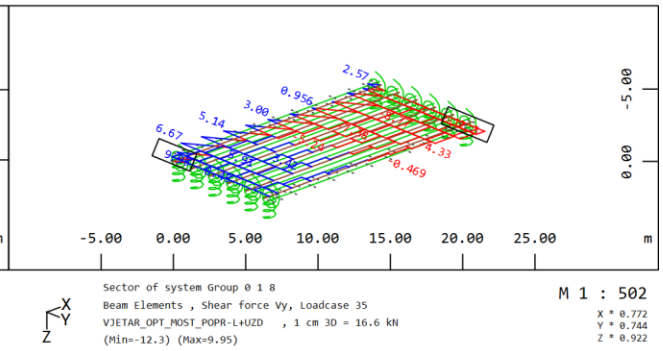

Beam Elements , Bending moment My, Loadcase 40 KOCNASILA
, 1 cm 3D = 16.6 kNm (Min=-13.3) (Max=13.3)
M 1 : 265


Beam Elements , Normal force Nx, Loadcase 40 KOCNASILA
, 1 cm 3D = 33.3 kN (Min=-40.5) (Max=40.5)
M 1 : 325

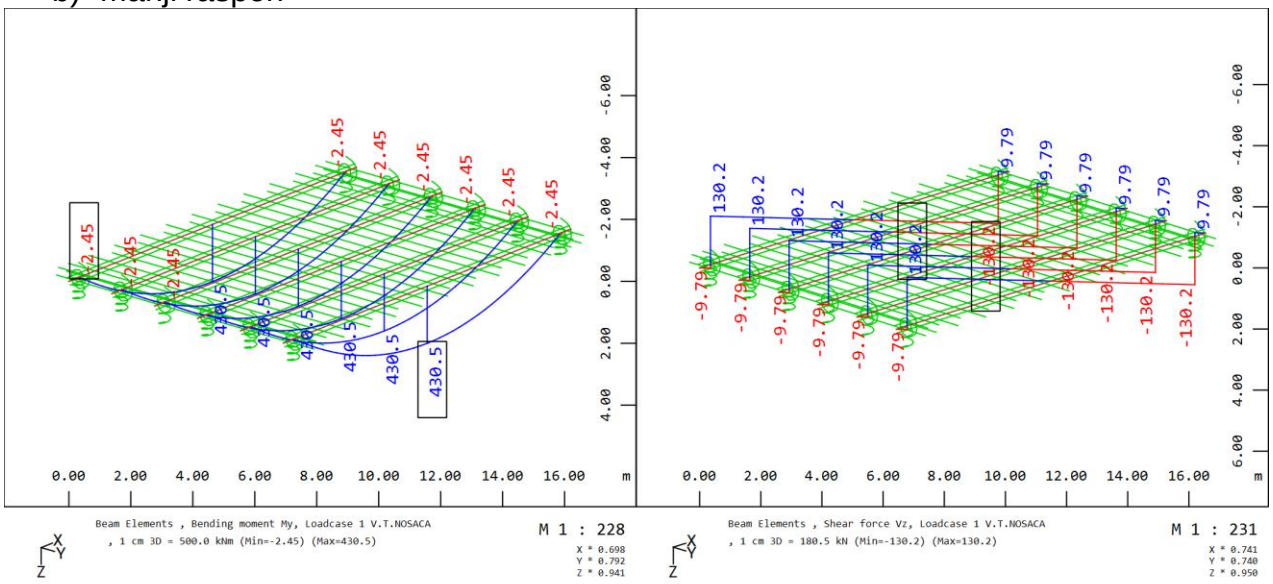

Beam Elements , Torsional moment Mt, Loadcase 35
VJETAR_OPT_MOST_POPR-L+UZD , 1 cm 3D = 8.32 kNm
(Min=-5.36) (Max=5.38)
M 1 : 848
X * 0.772
Y * 0.744
Z * 0.922

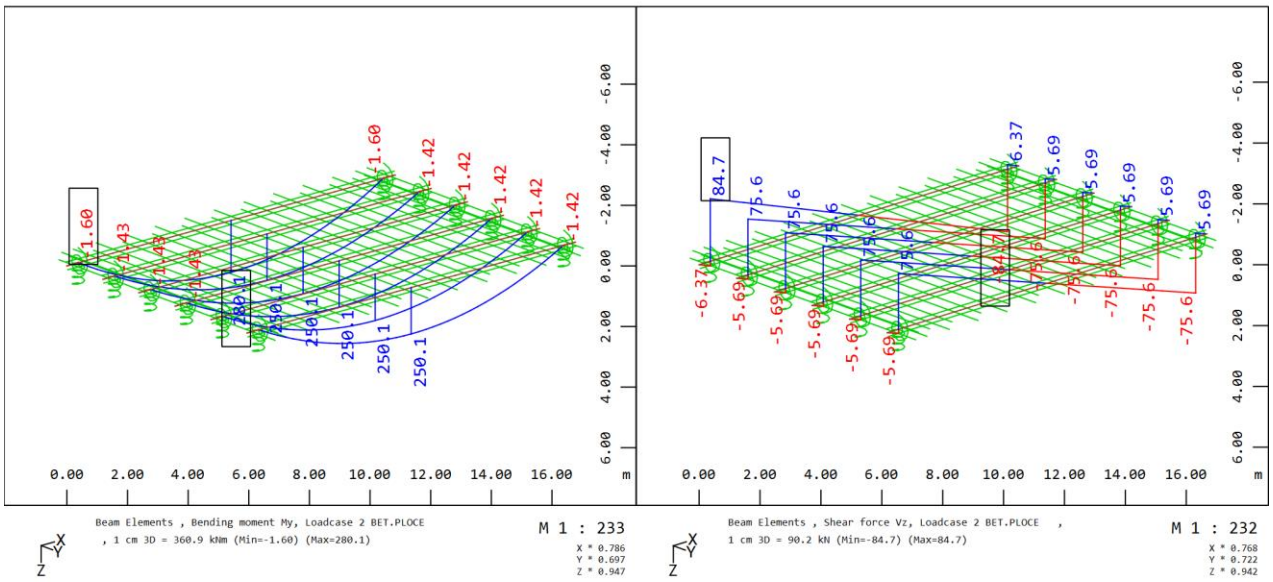

Beam Elements , Bending moment My, Loadcase 35
VJETAR_OPT_MOST_POPR-L+UZD , 1 cm 3D = 16.6 kNm
(Min=-15.5) (Max=9.90)
M 1 : 848
X * 0.772
Y * 0.744
Z * 0.922

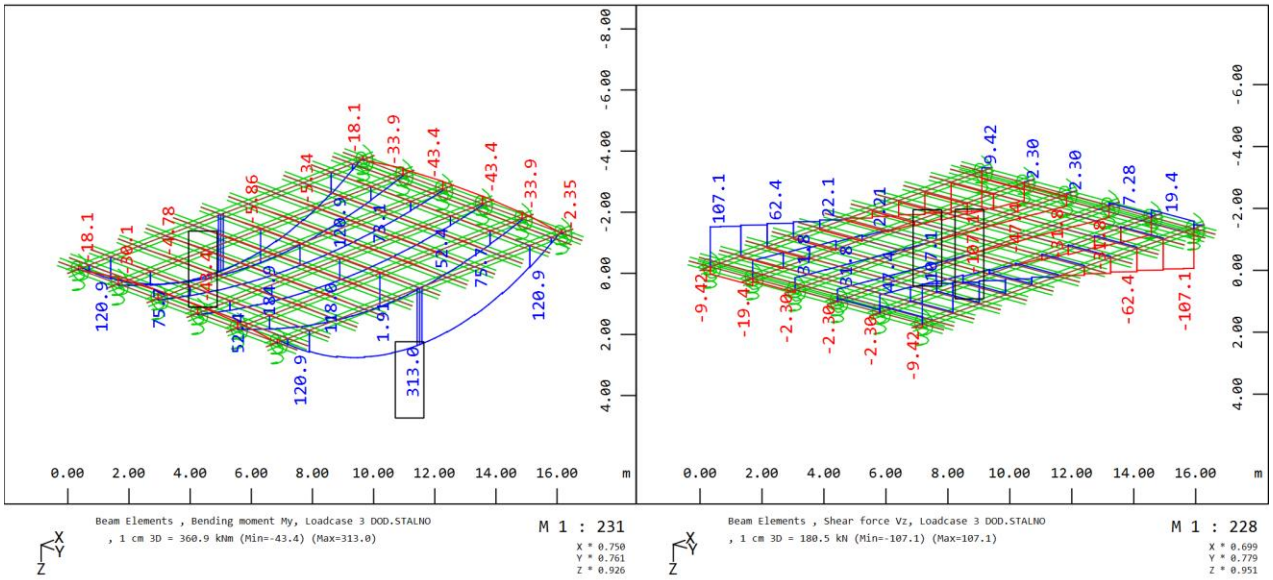

Sector of system Group 0 1 8
Beam Elements , Bending moment Mz (Maximum values cubic
interpolated), Loadcase 35 VJETAR_OPT_MOST_POPR-L+UZD
, 1 cm 3D = 16.6 kNm (Min=-16.0) (Max=6.16)
M 1 : 517
X * 0.772
Y * 0.744
Z * 0.922

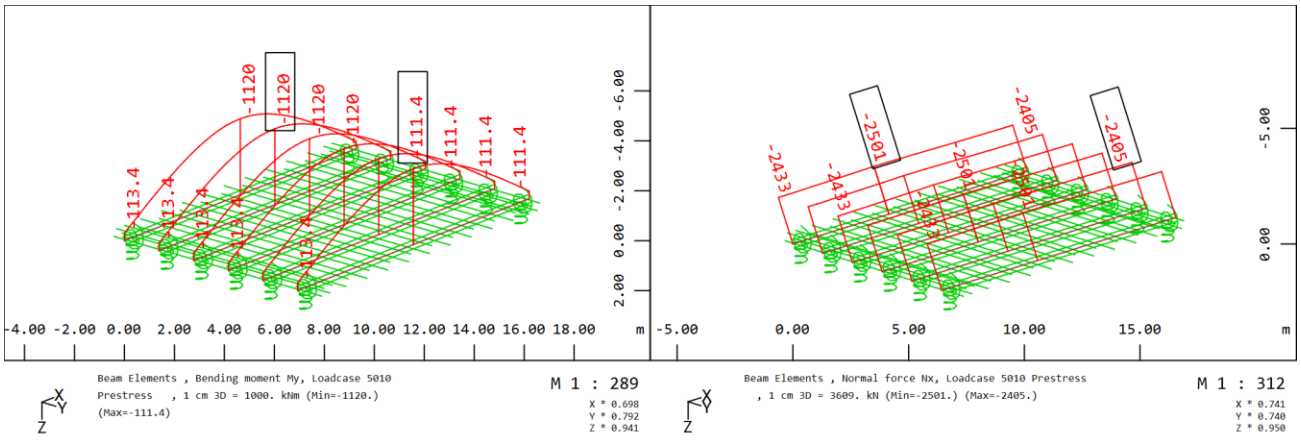

Sector of system Group 0 1 8
Beam Elements , Shear force Vy, Loadcase 35
VJETAR_OPT_MOST_POPR-L+UZD , 1 cm 3D = 16.6 kN
(Min=-12.3) (Max=9.95)
M 1 : 502
X * 0.772
Y * 0.744
Z * 0.922

b) manji raspon







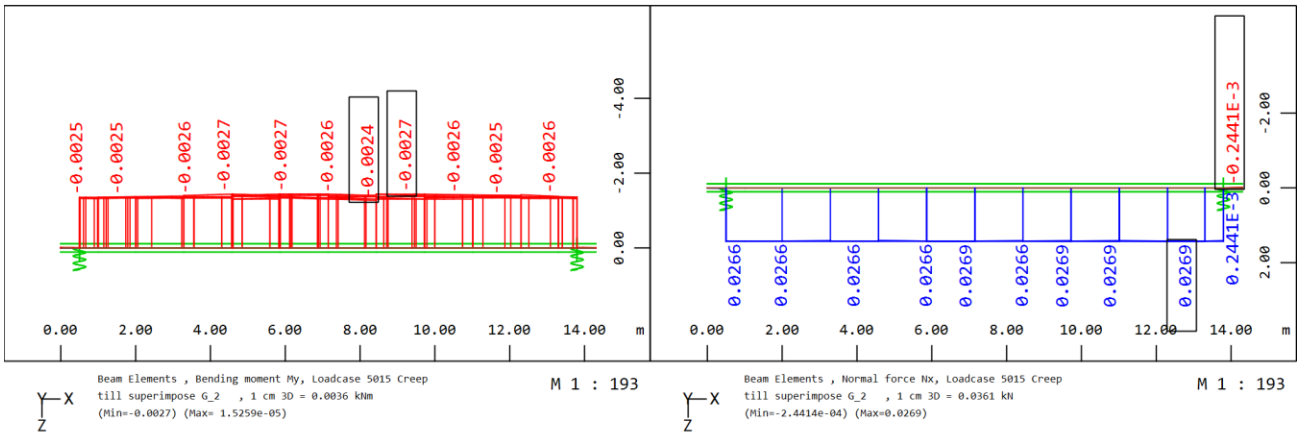


Beam Elements , Bending moment My, Loadcase 5010 Prestress , 1 cm 3D = 1000. kNm (Min=-1120.) (Max=-111.4)

M 1 : 289

Beam Elements , Normal force Nx, Loadcase 5010 Prestress , 1 cm 3D = 3609. kN (Min=-2501.) (Max=-2405.)

M 1 : 312

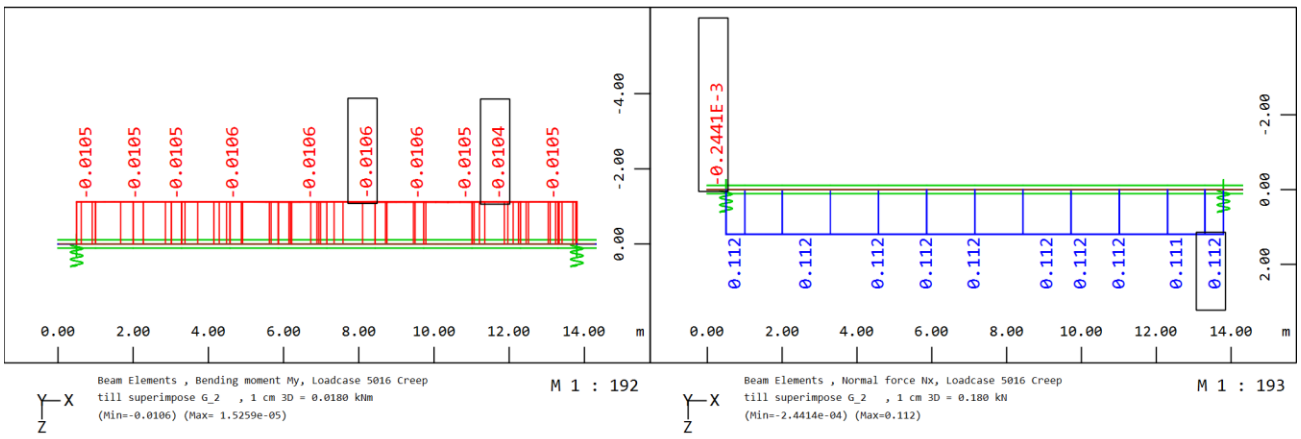


Beam Elements , Bending moment My, Loadcase 5015 Creep till superimpose G_2 , 1 cm 3D = 0.0036 kNm (Min=-0.0027) (Max= 1.5259e-05)

M 1 : 193

Beam Elements , Normal force Nx, Loadcase 5015 Creep till superimpose G_2 , 1 cm 3D = 0.0361 kN (Min=-2.4414e-04) (Max=0.0269)

M 1 : 193

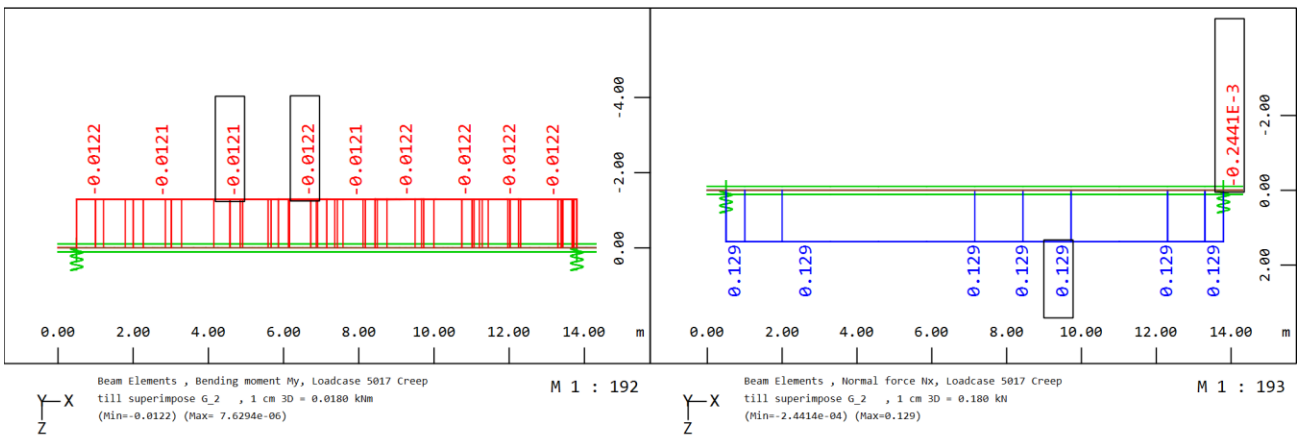


Beam Elements , Bending moment My, Loadcase 5016 Creep till superimpose G_2 , 1 cm 3D = 0.0180 kNm (Min=-0.0106) (Max= 1.5259e-05)

M 1 : 192

Beam Elements , Normal force Nx, Loadcase 5016 Creep till superimpose G_2 , 1 cm 3D = 0.180 kN (Min=-2.4414e-04) (Max=0.112)

M 1 : 193

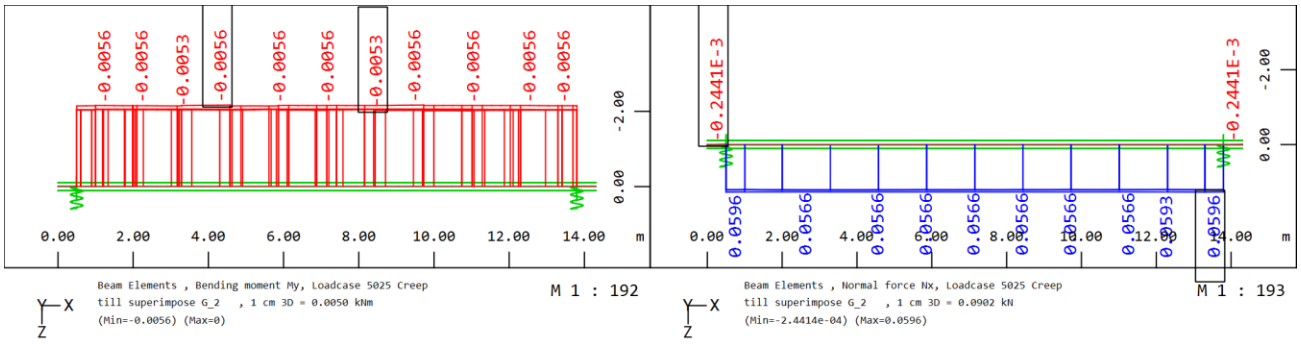


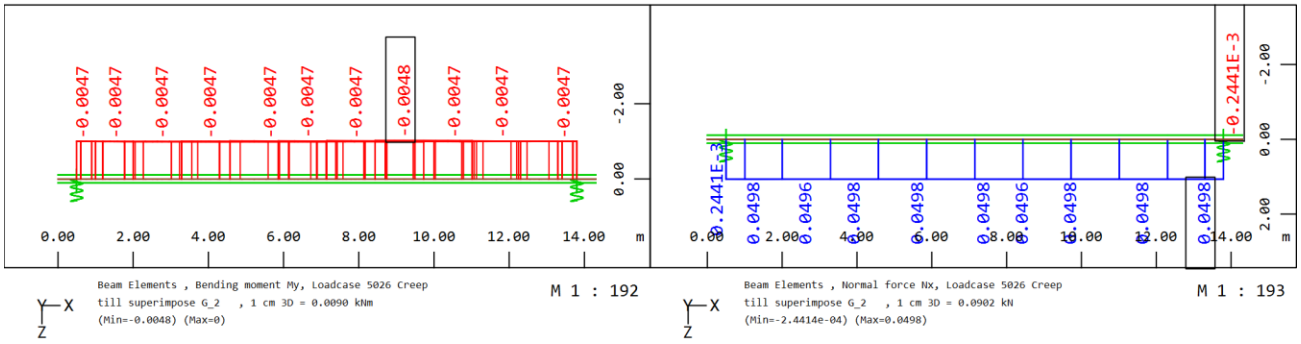
Beam Elements , Bending moment My, Loadcase 5017 Creep till superimpose G_2 , 1 cm 3D = 0.0180 kNm (Min=-0.0122) (Max= 7.6294e-06)

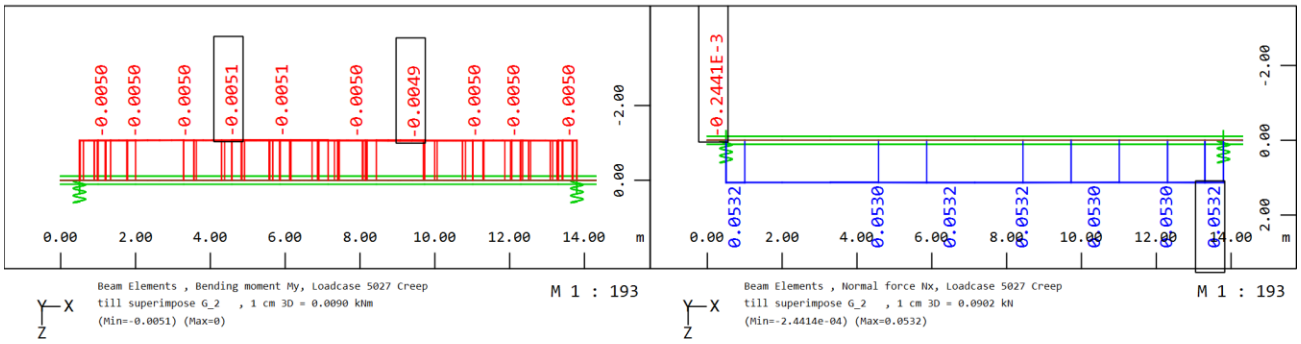
M 1 : 192

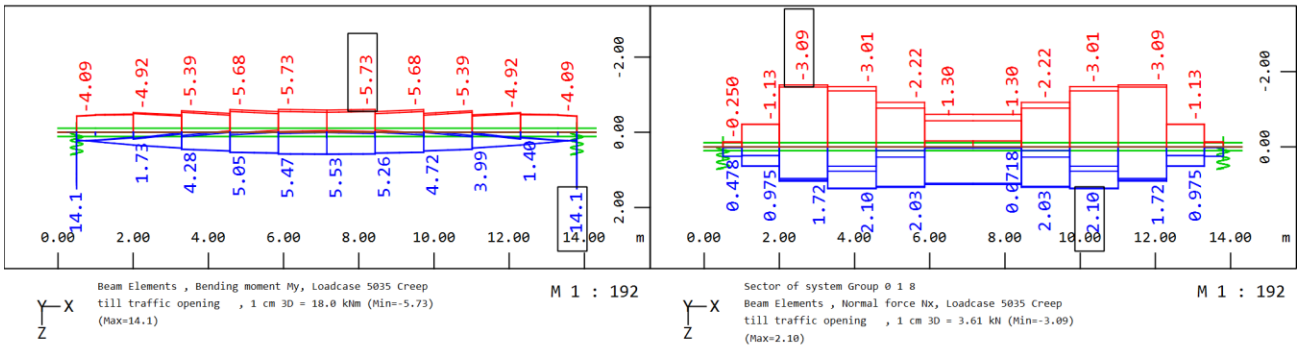
Beam Elements , Normal force Nx, Loadcase 5017 Creep till superimpose G_2 , 1 cm 3D = 0.180 kN (Min=-2.4414e-04) (Max=0.129)

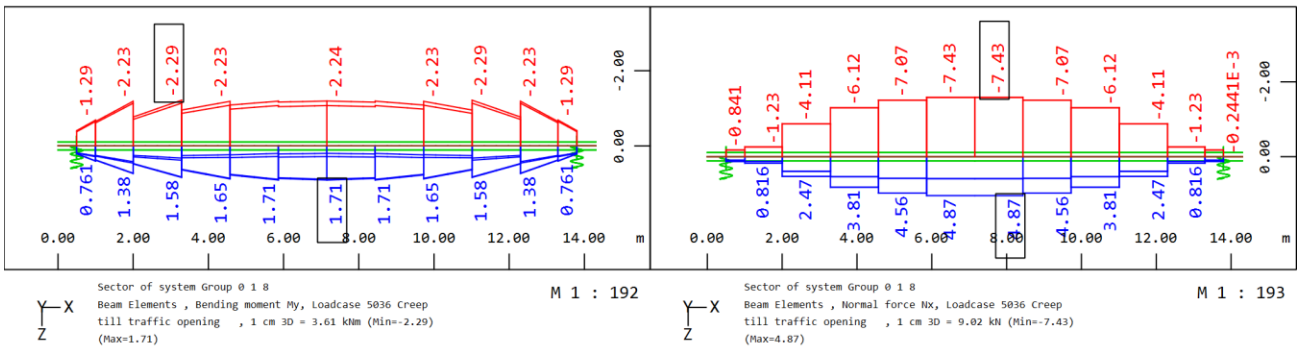
M 1 : 193

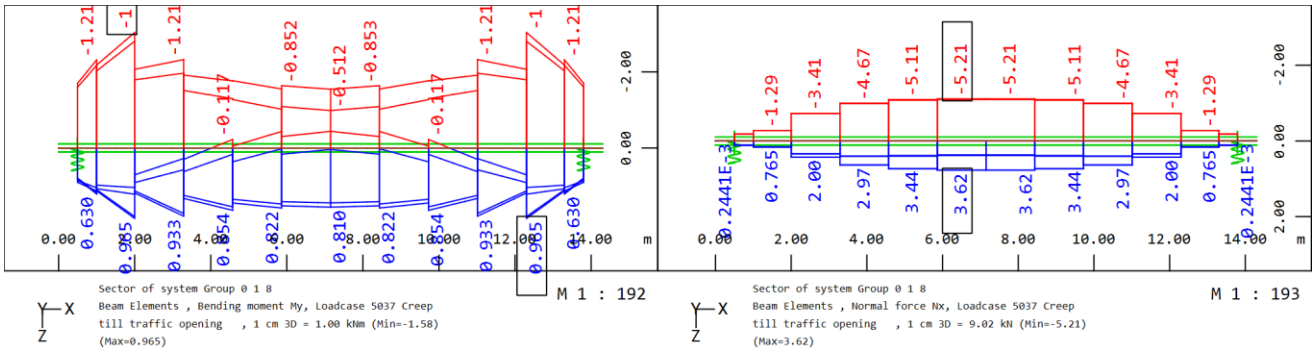

-0.0056 -0.0056 -0.0053 -0.0056 -0.0056 -0.0056 -0.0053 -0.0056 -0.0056 -0.0056 -0.0056
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 m
-2.00
0.00
Beam Elements , Bending moment My, Loadcase 5025 Creep
till superimpose G_2 , 1 cm 3D = 0.0050 kNm
(Min=-0.0056) (Max=0)
M 1 : 192
-0.2441E-3 0.0596 0.0566 0.0566 0.0566 0.0566 0.0566 0.0566 0.0593 0.0596 -0.2441E-3
Beam Elements , Normal force Nx, Loadcase 5025 Creep
till superimpose G_2 , 1 cm 3D = 0.0902 kN
(Min=-2.4414e-04) (Max=0.0596)
M 1 : 193

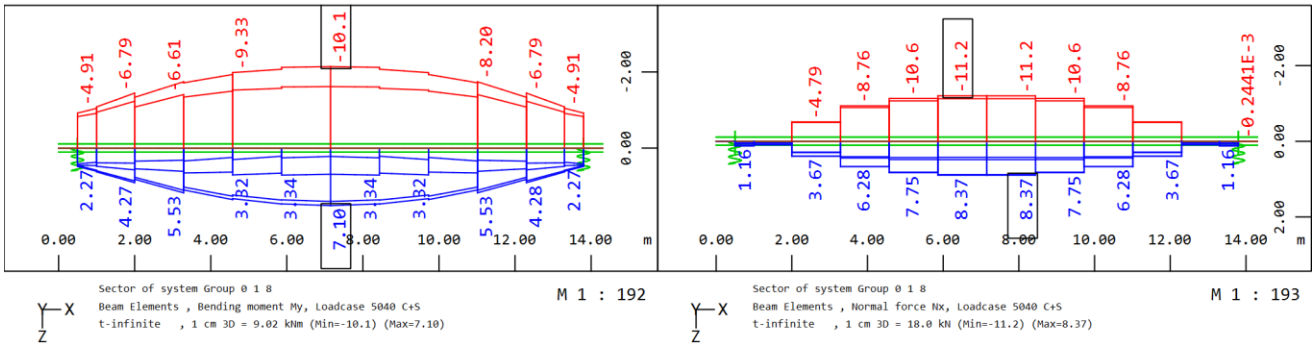

-0.0047 -0.0047 -0.0047 -0.0047 -0.0047 -0.0047 -0.0048 -0.0047 -0.0047 -0.0047
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 m
-2.00
0.00
Beam Elements , Bending moment My, Loadcase 5026 Creep
till superimpose G_2 , 1 cm 3D = 0.0090 kNm
(Min=-0.0048) (Max=0)
M 1 : 192
-0.2441E-3 -0.2441E-3 0.0498 0.0496 0.0498 0.0498 0.0498 0.0496 0.0498 0.0498 0.0498
2.00
Beam Elements , Normal force Nx, Loadcase 5026 Creep
till superimpose G_2 , 1 cm 3D = 0.0902 kN
(Min=-2.4414e-04) (Max=0.0498)
M 1 : 193

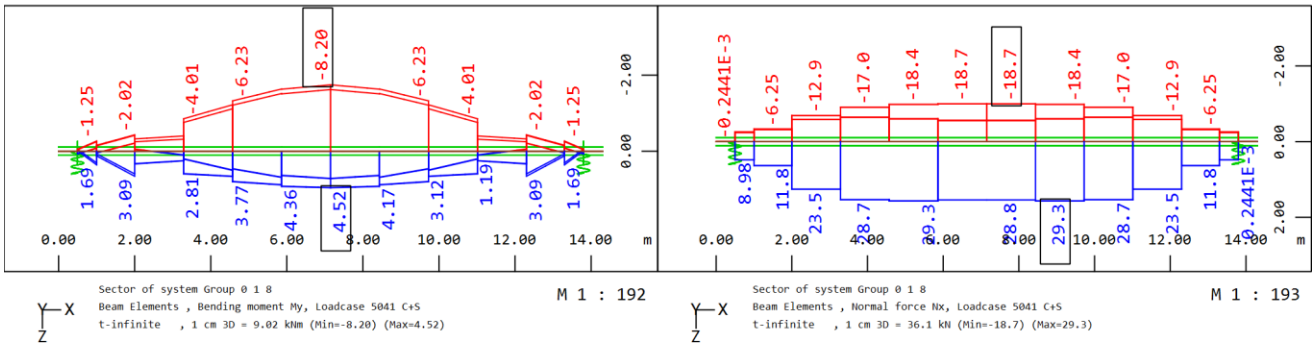

-0.0050 -0.0050 -0.0050 -0.0051 -0.0051 -0.0050 -0.0049 -0.0050 -0.0050 -0.0050
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 m
-2.00
0.00
Beam Elements , Bending moment My, Loadcase 5027 Creep
till superimpose G_2 , 1 cm 3D = 0.0090 kNm
(Min=-0.0051) (Max=0)
M 1 : 193
-0.2441E-3 0.0532 0.0530 0.0532 0.0532 0.0530 0.0530 0.0532 -0.2441E-3
2.00
Beam Elements , Normal force Nx, Loadcase 5027 Creep
till superimpose G_2 , 1 cm 3D = 0.0902 kN
(Min=-2.4414e-04) (Max=0.0532)
M 1 : 193

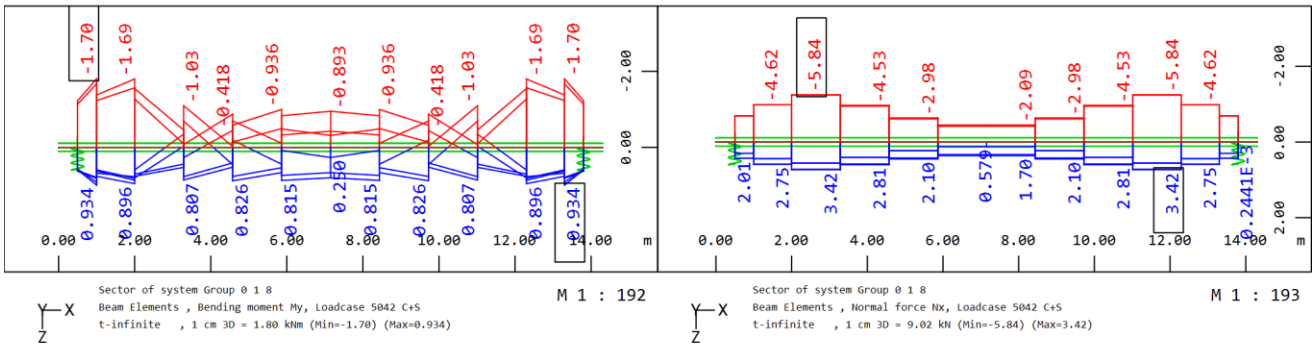

-4.09 -4.92 -5.39 -5.68 -5.73 -5.73 -5.68 -5.39 -4.92 -4.09
14.1 1.73 4.28 5.05 5.47 5.53 5.26 4.72 3.99 1.40 14.1
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 m
-2.00
0.00
2.00
Beam Elements , Bending moment My, Loadcase 5035 Creep
till traffic opening , 1 cm 3D = 18.0 kNm (Min=-5.73)
(Max=14.1)
M 1 : 192
-0.250 -1.13 -3.09 -3.01 -2.22 -1.30 -1.30 -2.22 -3.01 -3.09 -1.13
0.478 0.975 1.72 2.10 2.03 0.0718 2.03 2.10 1.72 0.975
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5035 Creep
till traffic opening , 1 cm 3D = 3.61 kN (Min=-3.09)
(Max=2.10)
M 1 : 192

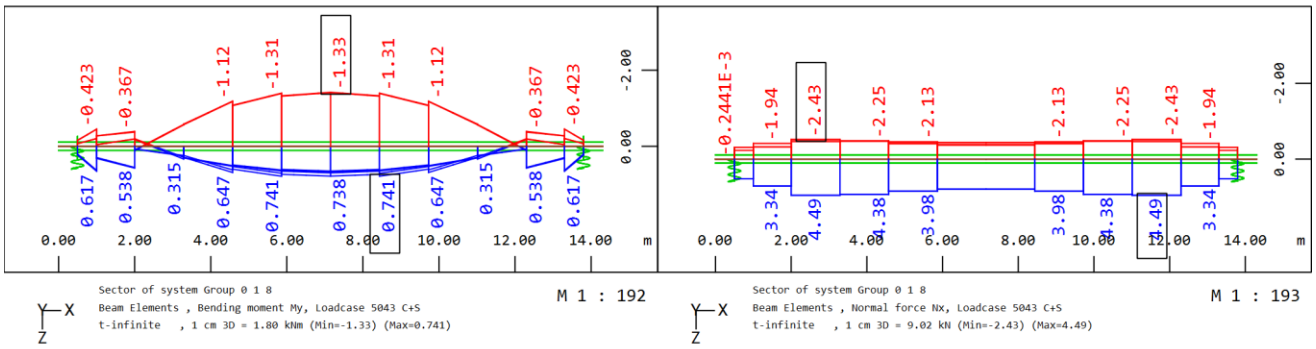

-1.29 -2.23 -2.29 -2.23 -2.24 -2.23 -2.29 -2.23 -1.29
0.761 1.38 1.58 1.65 1.71 1.71 1.71 1.65 1.58 1.38 0.761
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 m
-2.00
0.00
Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5036 Creep
till traffic opening , 1 cm 3D = 3.61 kNm (Min=-2.29)
(Max=1.71)
M 1 : 192
-0.841 -1.23 -4.11 -6.12 -7.07 -7.43 -7.43 -7.07 -6.12 -4.11 -1.23 -0.2441E-3
0.816 2.47 3.81 4.56 4.87 4.87 4.56 3.81 2.47 0.816
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5036 Creep
till traffic opening , 1 cm 3D = 9.02 kN (Min=-7.43)
(Max=4.87)
M 1 : 193

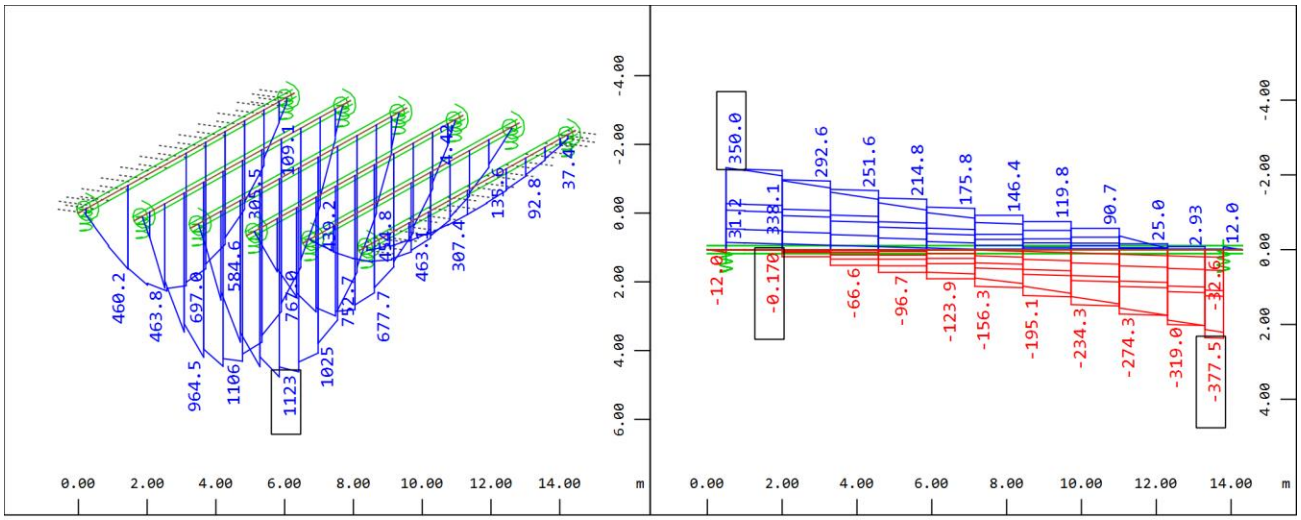

Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5037 Creep till traffic opening , 1 cm 3D = 1.00 kNm (Min=-1.58) (Max=0.965)
M 1 : 192
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5037 Creep till traffic opening , 1 cm 3D = 9.02 kN (Min=-5.21) (Max=3.62)
M 1 : 193

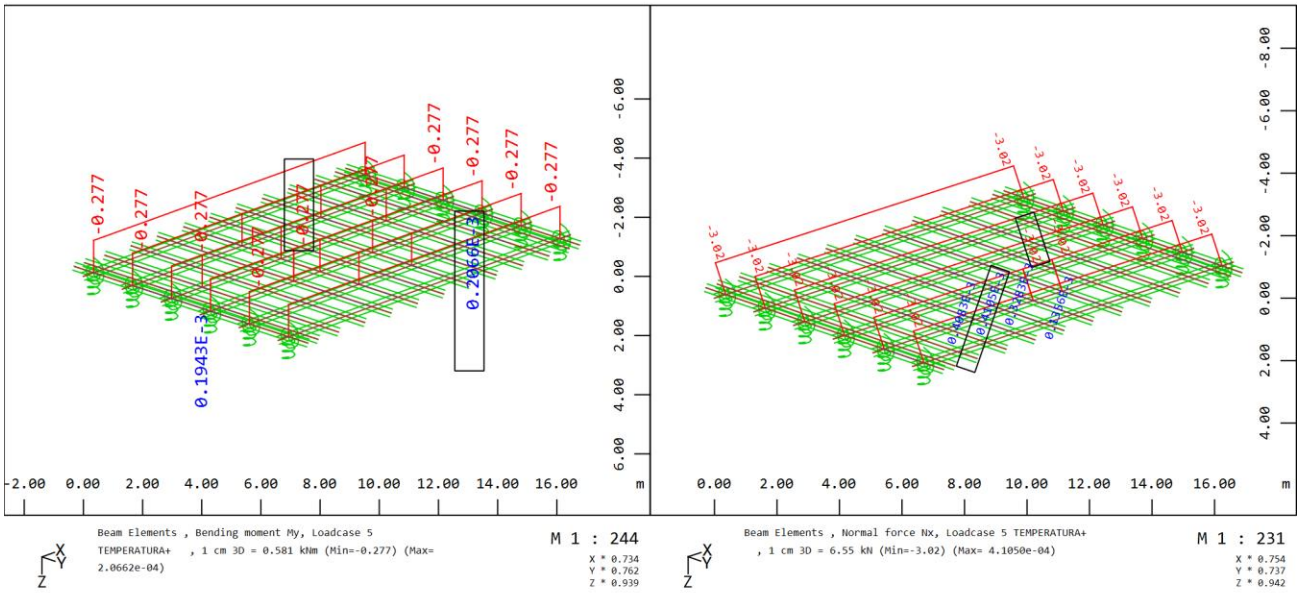

Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5040 C+S t-infinite , 1 cm 3D = 9.02 kNm (Min=-10.1) (Max=7.10)
M 1 : 192
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5040 C+S t-infinite , 1 cm 3D = 18.0 kN (Min=-11.2) (Max=8.37)
M 1 : 193

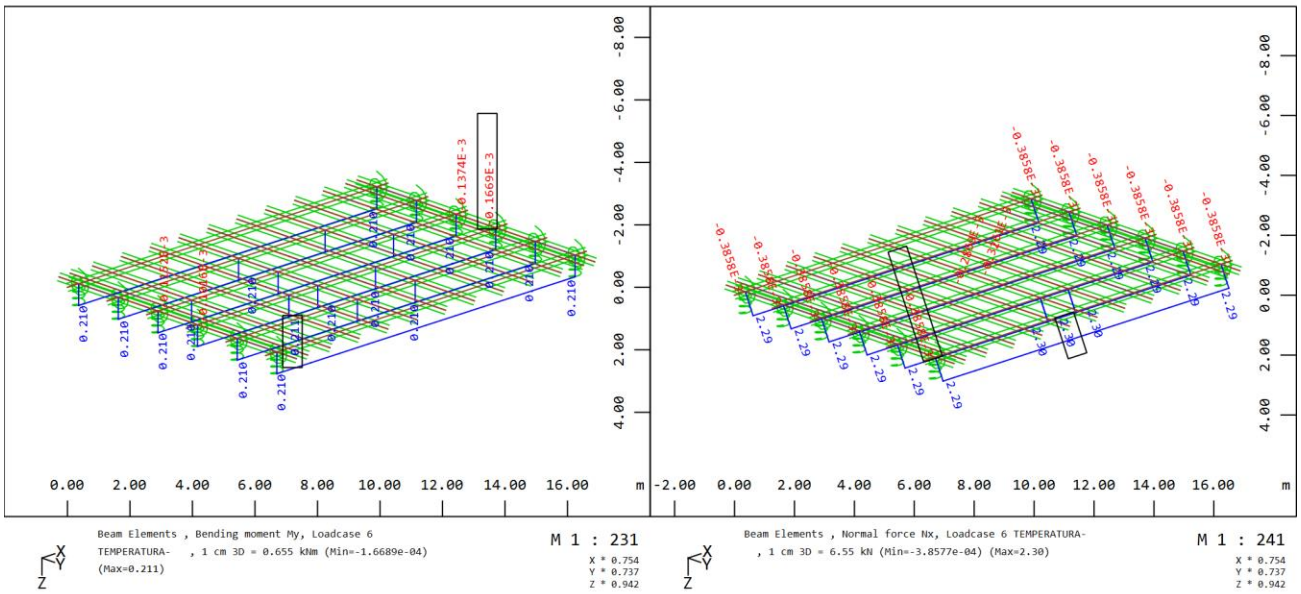

Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5041 C+S t-infinite , 1 cm 3D = 9.02 kNm (Min=-8.20) (Max=4.52)
M 1 : 192
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5041 C+S t-infinite , 1 cm 3D = 36.1 kN (Min=-18.7) (Max=29.3)
M 1 : 193

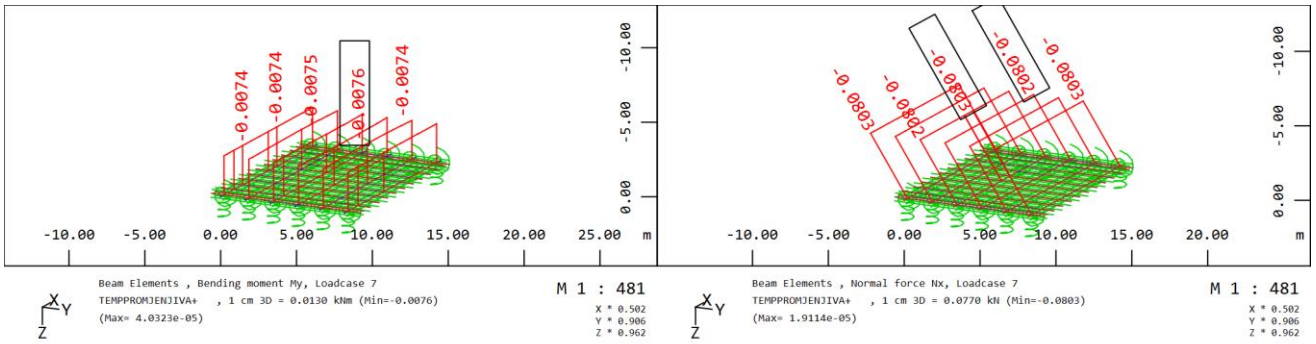

Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5042 C+S t-infinite , 1 cm 3D = 1.80 kNm (Min=-1.70) (Max=0.934)
M 1 : 192
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5042 C+S t-infinite , 1 cm 3D = 9.02 kN (Min=-5.84) (Max=3.42)
M 1 : 193

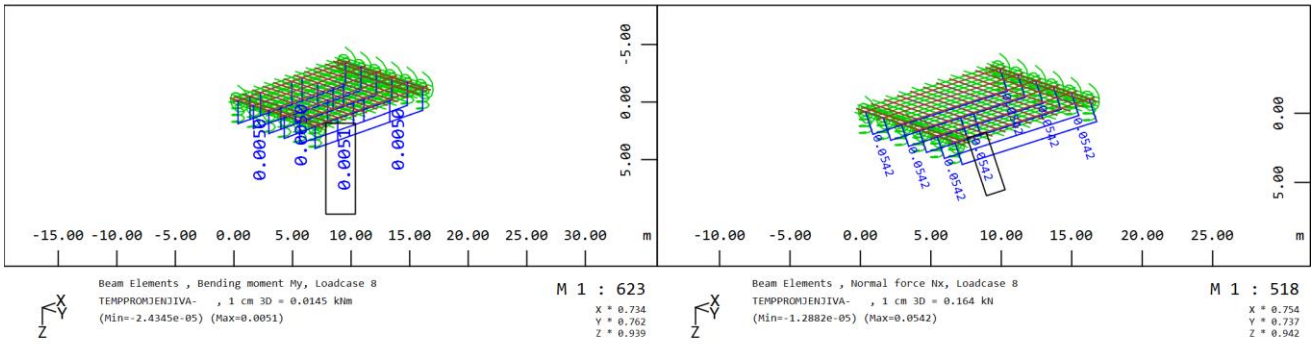

Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 5043 C+S t-infinite , 1 cm 3D = 1.80 kNm (Min=-1.33) (Max=0.741)
M 1 : 192
Sector of system Group 0 1 8
Beam Elements , Normal force Nx, Loadcase 5043 C+S t-infinite , 1 cm 3D = 9.02 kN (Min=-2.43) (Max=4.49)
M 1 : 193

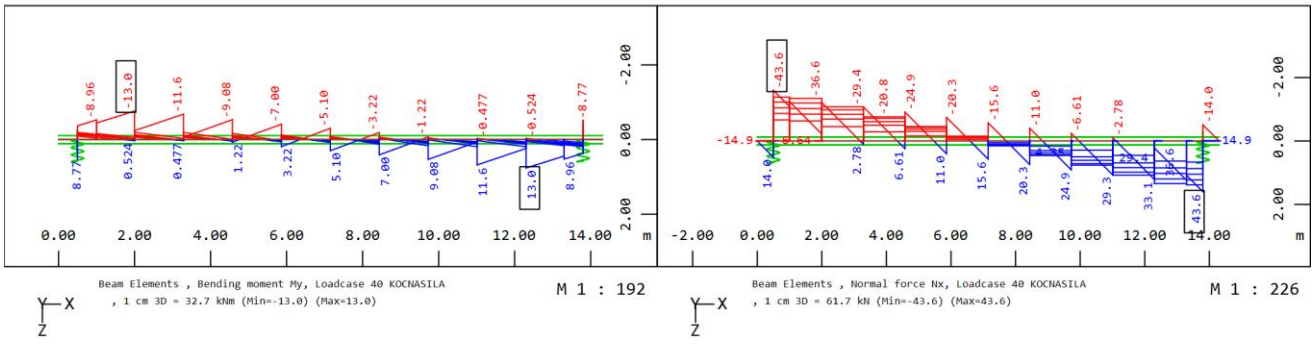

Sector of system Group 0 1 8
Beam Elements , Bending moment My, Loadcase 902 MAX-MY
BEAM , 1 cm 3D = 382.8 kNm (Min=-3.6380e-12)
(Max=1123.)
M 1 : 210
Sector of system Group 0 1 8
Beam Elements , Shear force Vz, Loadcase 904 MAX-VZ BEAM
, 1 cm 3D = 307.8 kN (Max=350.0)
Beam Elements , Shear force Vz, Loadcase 905 MIN-VZ BEAM
, 1 cm 3D = 307.8 kN (Min=-377.5) (Max=0)
M 1 : 193

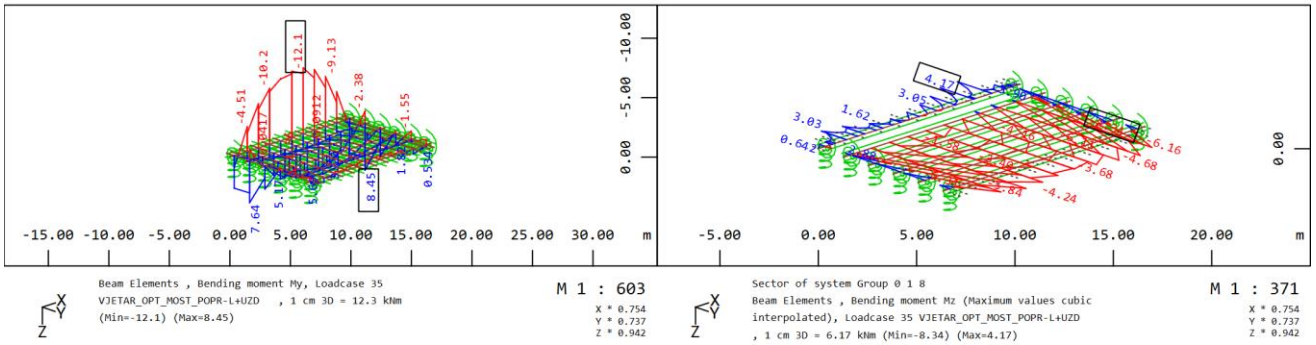

Beam Elements , Bending moment My, Loadcase 5
TEMPERATURA+ , 1 cm 3D = 0.581 kNm (Min=-0.277) (Max=
2.0662e-04)
M 1 : 244
Beam Elements , Normal force Nx, Loadcase 5 TEMPERATURA+
, 1 cm 3D = 6.55 kN (Min=-3.02) (Max= 4.1050e-04)
M 1 : 231

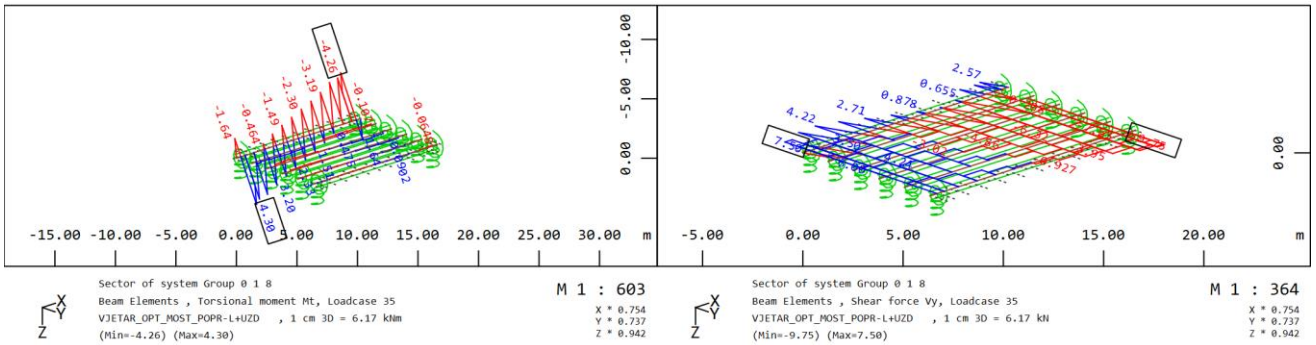

Beam Elements , Bending moment My, Loadcase 6
TEMPERATURA- , 1 cm 3D = 0.655 kNm (Min=-1.6689e-04)
(Max=0.211)
M 1 : 231
Beam Elements , Normal force Nx, Loadcase 6 TEMPERATURA-
, 1 cm 3D = 6.55 kN (Min=-3.8577e-04) (Max=2.30)
M 1 : 241


-0.0074
-0.0074
-0.0075
-0.0076
-0.0074
-0.0803
-0.0802
-0.0803
-0.0802
-0.0803
Beam Elements , Bending moment My, Loadcase 7
TEMPPROMJENJIVA+ , 1 cm 3D = 0.0130 kNm (Min=-0.0076)
(Max= 4.0323e-05)
M 1 : 481
Beam Elements , Normal force Nx, Loadcase 7
TEMPPROMJENJIVA+ , 1 cm 3D = 0.0770 kN (Min=-0.0803)
(Max= 1.9114e-05)
M 1 : 481


0.0050
0.0050
0.0051
0.0050
0.0542
0.0542
0.0542
0.0542
0.0542
Beam Elements , Bending moment My, Loadcase 8
TEMPPROMJENJIVA- , 1 cm 3D = 0.0145 kNm
(Min=-2.4345e-05) (Max=0.0051)
M 1 : 623
Beam Elements , Normal force Nx, Loadcase 8
TEMPPROMJENJIVA- , 1 cm 3D = 0.164 kN
(Min=-1.2882e-05) (Max=0.0542)
M 1 : 518

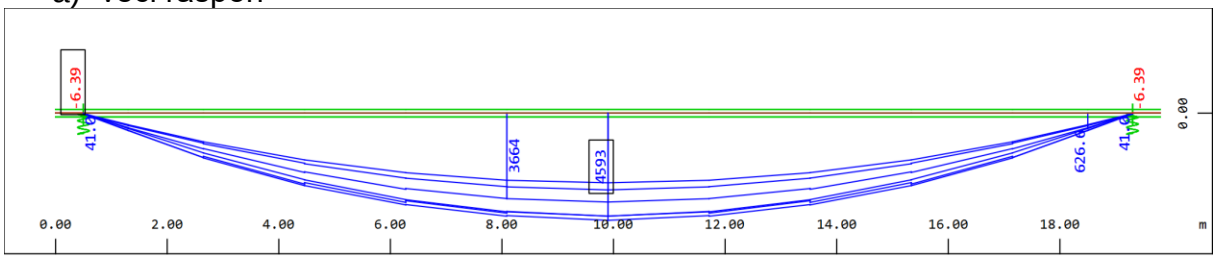

-8.96
-13.0
-11.6
-9.08
-7.00
-5.10
-3.22
-1.22
-0.477
-0.524
-8.77
-43.6
-36.6
-29.4
-20.8
-24.9
-20.3
-15.6
-11.0
-6.61
-2.78
-14.0
-14.9
14.9
Beam Elements , Bending moment My, Loadcase 40 KOCNASILA
, 1 cm 3D = 32.7 kNm (Min=-13.0) (Max=13.0)
M 1 : 192
Beam Elements , Normal force Nx, Loadcase 40 KOCNASILA
, 1 cm 3D = 61.7 kN (Min=-43.6) (Max=43.6)
M 1 : 226


-12.1
-10.2
-9.13
-4.51
-2.38
-1.55
8.45
4.17
3.03
1.62
0.642
6.16
4.68
3.68
Beam Elements , Bending moment My, Loadcase 35
VJETAR_OPT_MOST_POPR-L+UZD , 1 cm 3D = 12.3 kNm
(Min=-12.1) (Max=8.45)
M 1 : 603
Sector of system Group 0 1 8
Beam Elements , Bending moment Mz (Maximum values cubic
interpolated), Loadcase 35 VJETAR_OPT_MOST_POPR-L+UZD
, 1 cm 3D = 6.17 kNm (Min=-8.34) (Max=4.17)
M 1 : 371

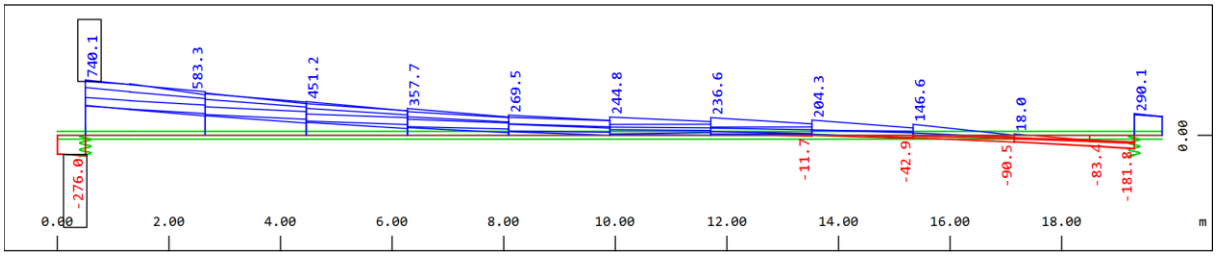

-4.26
4.30
2.57
0.878
4.22
2.71
Sector of system Group 0 1 8
Beam Elements , Torsional moment Mt, Loadcase 35
VJETAR_OPT_MOST_POPR-L+UZD , 1 cm 3D = 6.17 kNm
(Min=-4.26) (Max=4.30)
M 1 : 603
Sector of system Group 0 1 8
Beam Elements , Shear force Vy, Loadcase 35
VJETAR_OPT_MOST_POPR-L+UZD , 1 cm 3D = 6.17 kN
(Min=-9.75) (Max=7.50)
M 1 : 364

3.2 Prikaz reznih sila od mjerodavnih kombinacija opterećenja za rasponski sklop

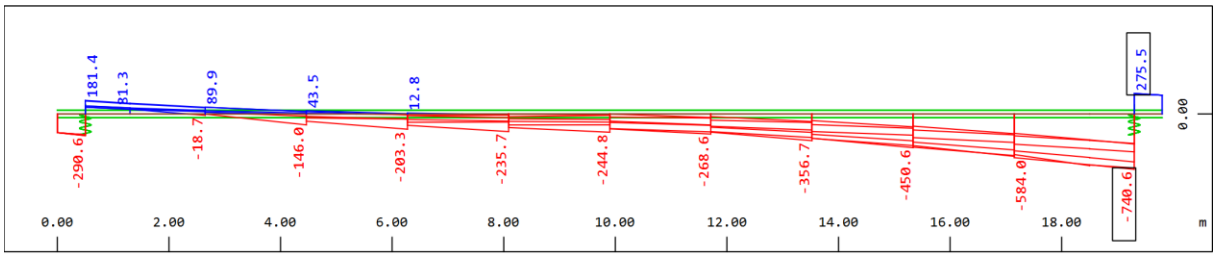
a) veći raspon



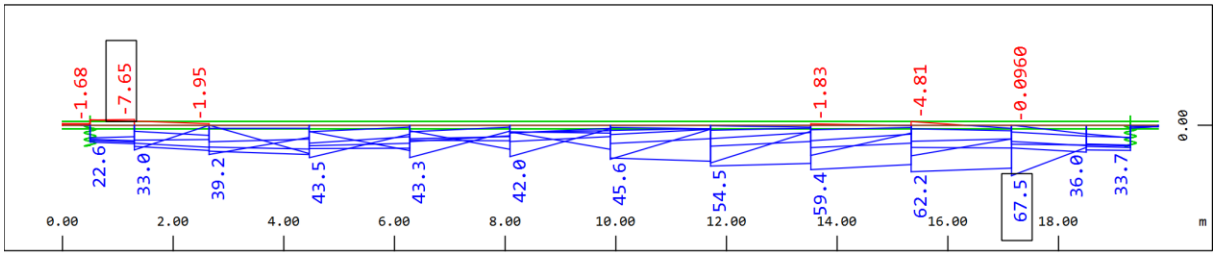
Sector of system Group 0 1 8 M 1 : 121
Beam Elements , Bending moment My, Loadcase 2107 ULS_design_max , 1 cm 3D = 2891. kNm
(Min=-6.39) (Max=4593.)



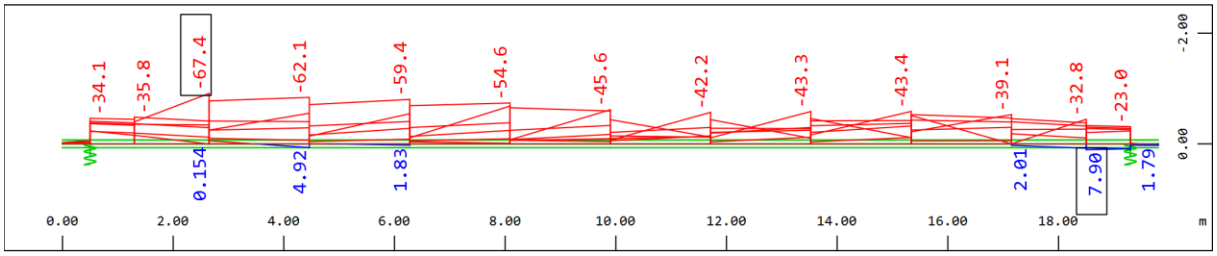
Sector of system Group 0 1 8 M 1 : 121
Beam Elements , Shear force Vz, Loadcase 2107 ULS_design_max , 1 cm 3D = 902.3 kN
(Min=-276.0) (Max=740.1)



Sector of system Group 0 1 8 M 1 : 121
Beam Elements , Shear force Vz, Loadcase 2108 ULS_design_min , 1 cm 3D = 902.3 kN
(Min=-740.6) (Max=275.5)

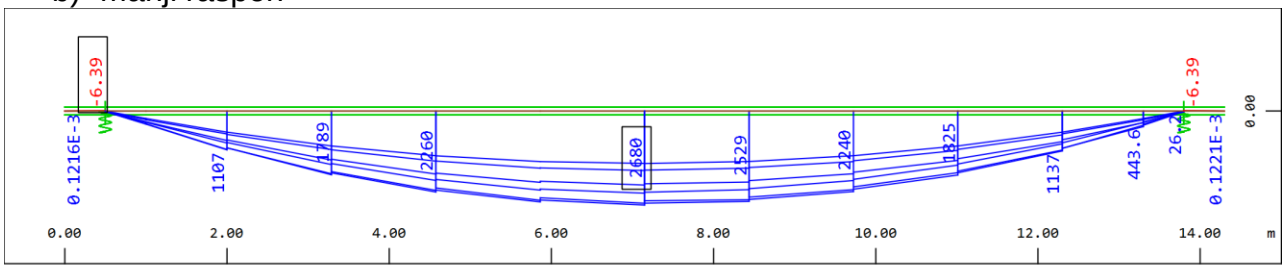


Sector of system Group 0 1 8 M 1 : 122
Beam Elements , Torsional moment Mt, Loadcase 2107 ULS_design_max , 1 cm 3D = 90.2 kNm
(Min=-7.65) (Max=67.5)

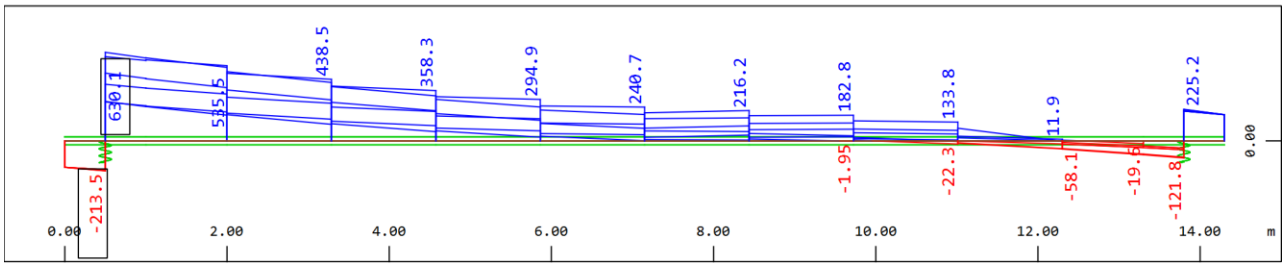


Sector of system Group 0 1 8 M 1 : 122
Beam Elements , Torsional moment Mt, Loadcase 2108 ULS_design_min , 1 cm 3D = 90.2 kNm
(Min=-67.4) (Max=7.90)

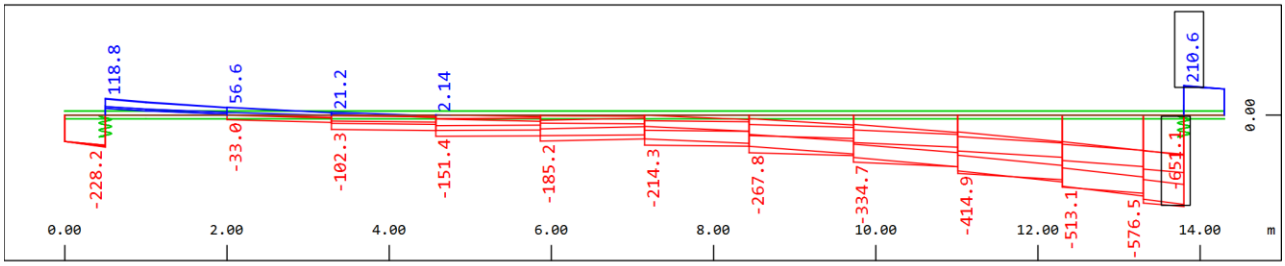
b) manji raspon



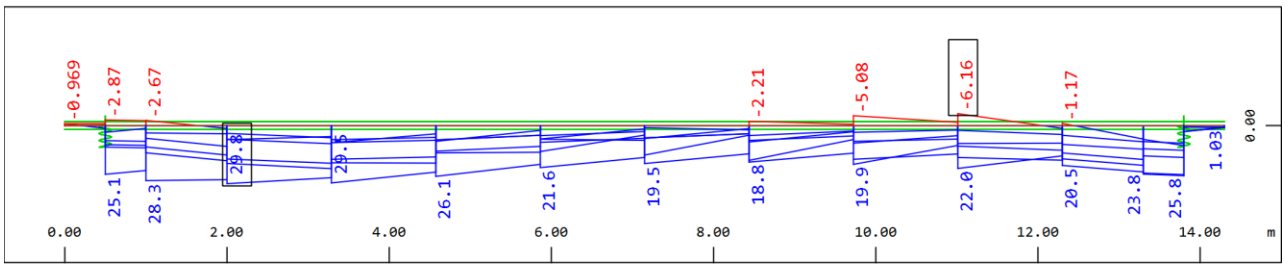
Sector of system Group 0 1 8 M 1 : 88
Beam Elements , Bending moment My, Loadcase 2105 ULS_design_maxMY , 1 cm 3D = 2000. kNm
(Min=-6.39) (Max=2680.)



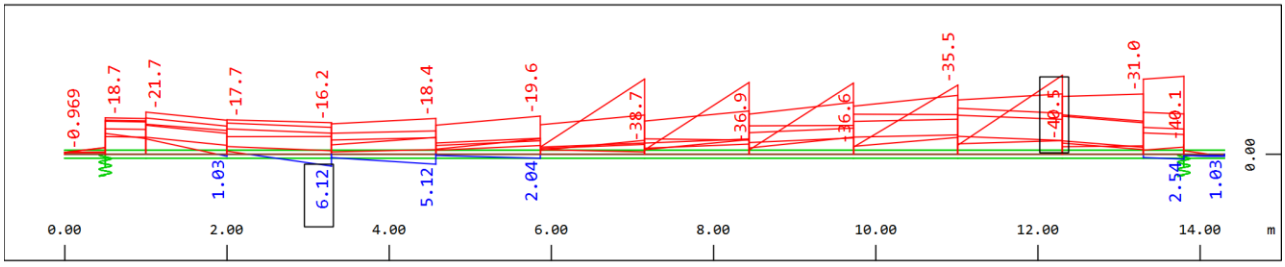
Sector of system Group 0 1 8 M 1 : 88
Beam Elements , Shear force Vz, Loadcase 2107 ULS_design_max , 1 cm 3D = 500.0 kN
(Min=-213.5) (Max=630.1)



Sector of system Group 0 1 8 M 1 : 88
Beam Elements , Shear force Vz, Loadcase 2108 ULS_design_min , 1 cm 3D = 500.0 kN
(Min=-651.1) (Max=210.6)



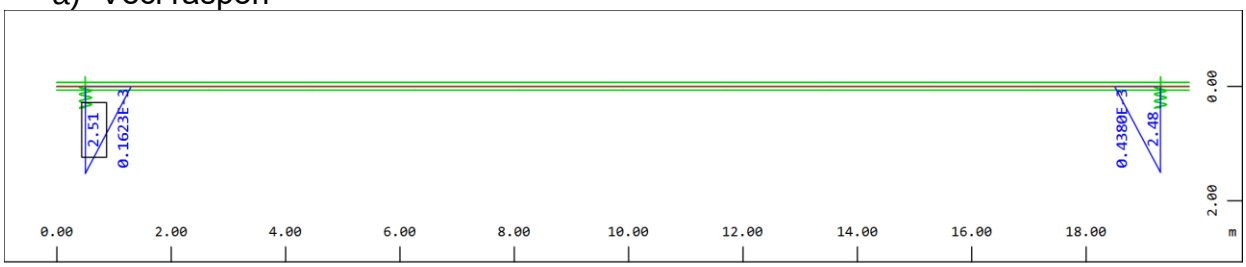
Sector of system Group 0 1 8 M 1 : 88
Beam Elements , Torsional moment Mt, Loadcase 2107 ULS_design_max , 1 cm 3D = 36.1 kNm
(Min=-6.16) (Max=29.8)



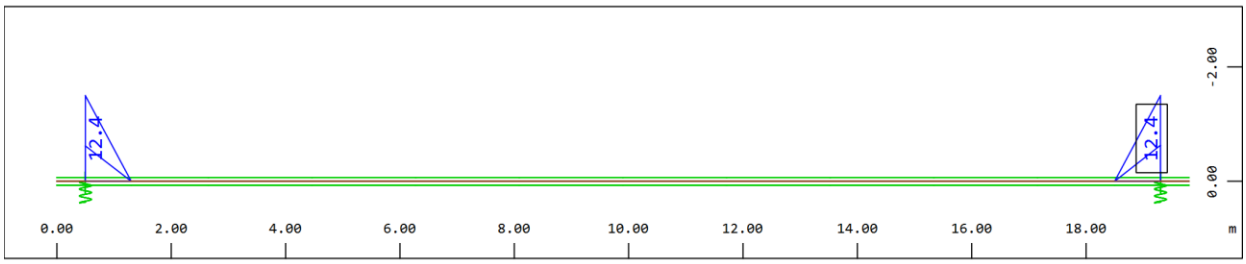
Sector of system Group 0 1 8 M 1 : 88
Beam Elements , Torsional moment Mt, Loadcase 2108 ULS_design_min , 1 cm 3D = 36.1 kNm
(Min=-40.5) (Max=6.12)

3.3 Prikaz armatura rasponskog sklopa

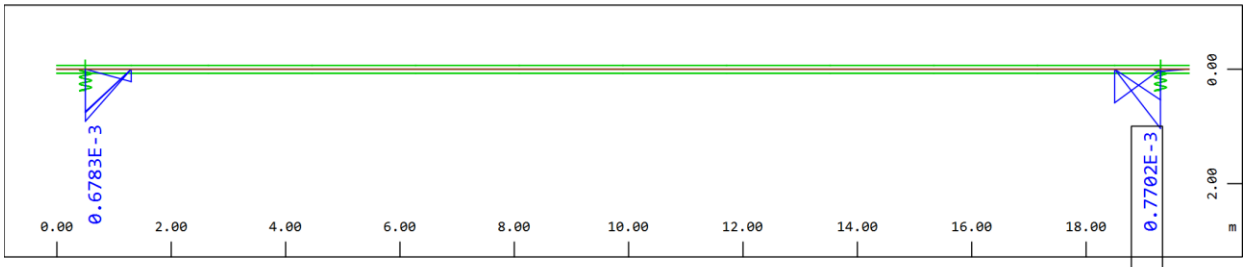
a) Veći raspon



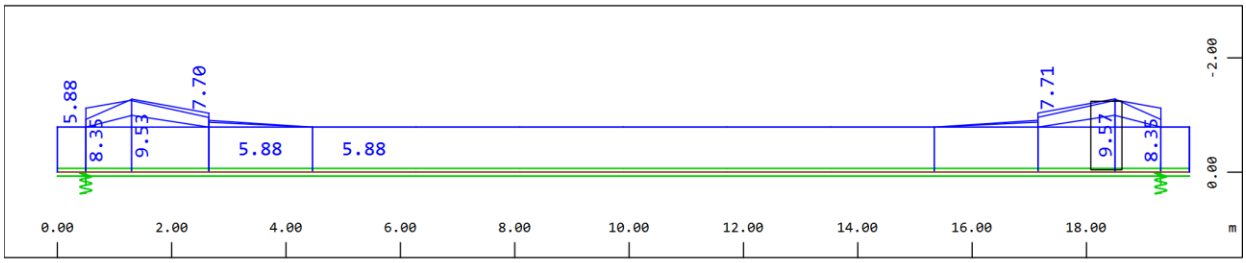
Sector of system Group 0 1 8 M 1 : 121
Beam Elements , Longitudinal Reinforcements Lay. Z1, Design Case 1 , 1 cm 3D = 2.00 cm2
(Max=2.51)



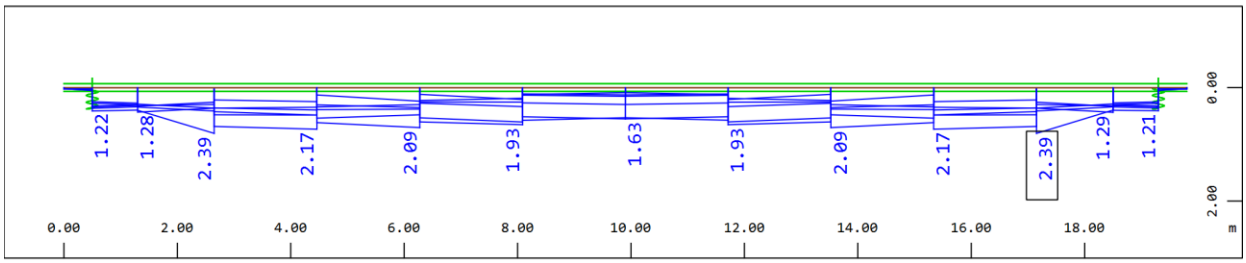
Sector of system Group 0 1 8 M 1 : 121
Beam Elements , Longitudinal Reinforcements Lay. Z2, Design Case 1 , 1 cm 3D = 10.0 cm2
(Max=12.4)



Sector of system Group 0 1 8 M 1 : 121
Beam Elements , Longitudinal Reinforcements Lay. Z3, Design Case 1 , 1 cm 3D =
9.0234e-04 cm2 (Max= 7.7022e-04)

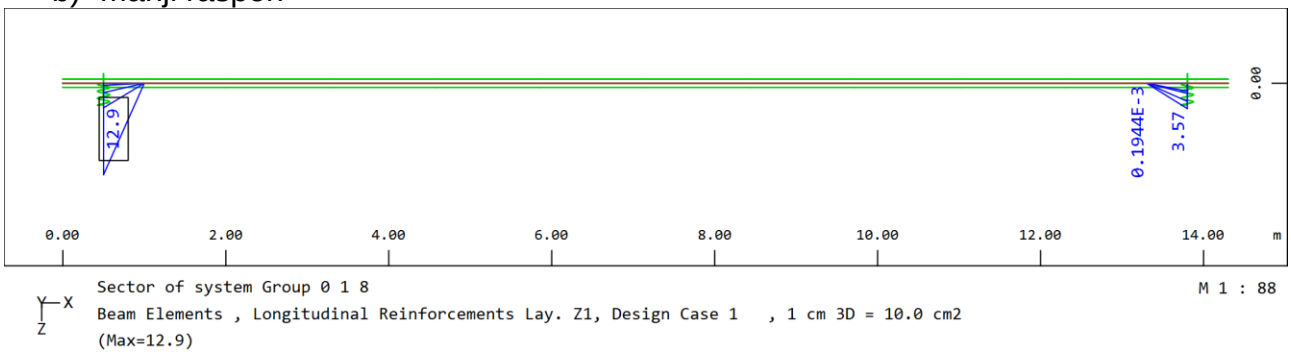


Sector of system Group 0 1 8 M 1 : 121
Shear reinforcements (maximum), Design Case 1 , (1 cm 3D = unit) Beam Elements
(Unit=9.02 cm2/m) (Max=9.57)

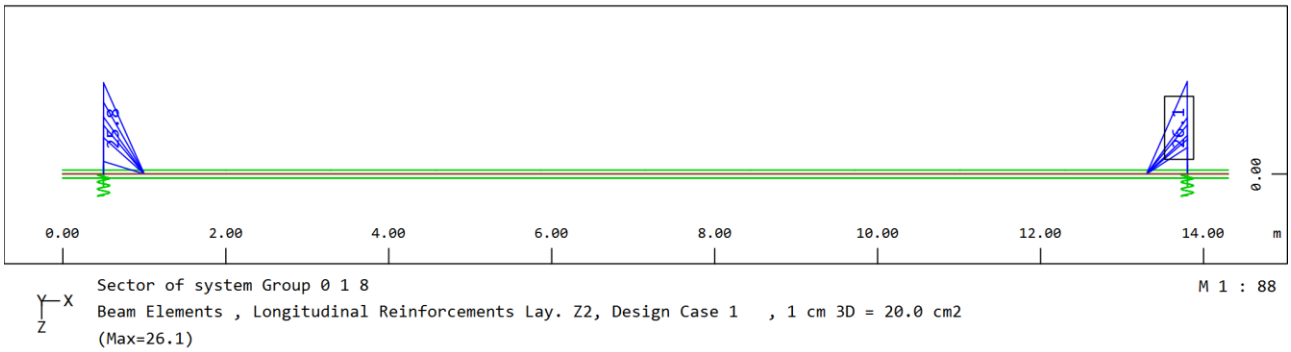


Sector of system Group 0 1 8 M 1 : 122
Beam Elements , Torsional contribution Lay. 1, Design Case 1 , 1 cm 3D = 3.61 cm2/m
(Max=2.39)

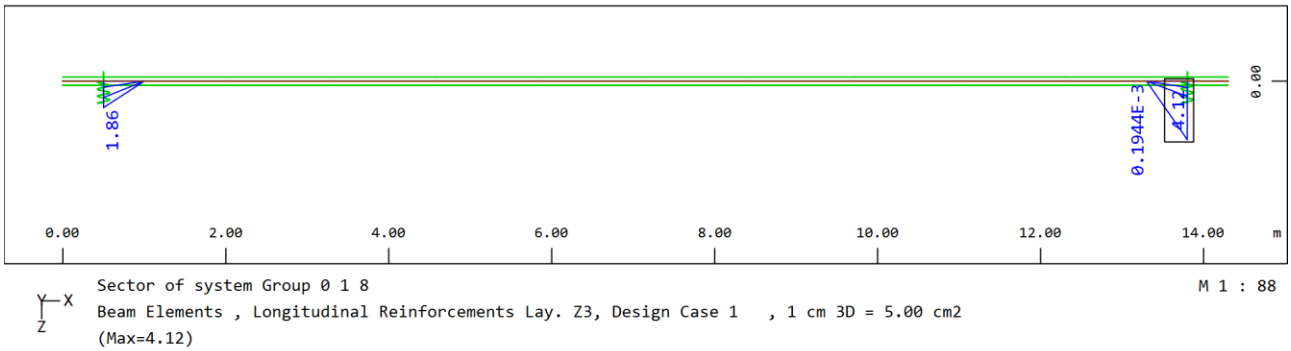
b) manji raspon



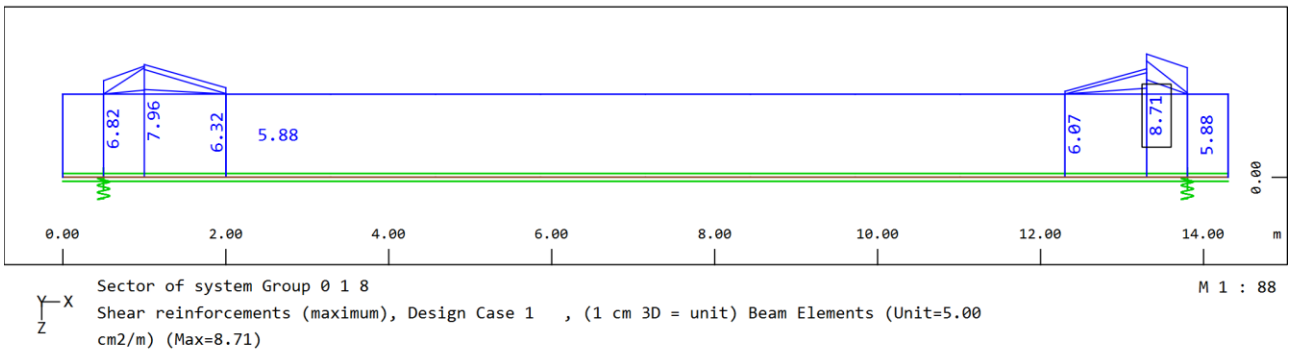
Sector of system Group 0 1 8 M 1 : 88
Beam Elements , Longitudinal Reinforcements Lay. Z1, Design Case 1 , 1 cm 3D = 10.0 cm2
(Max=12.9)



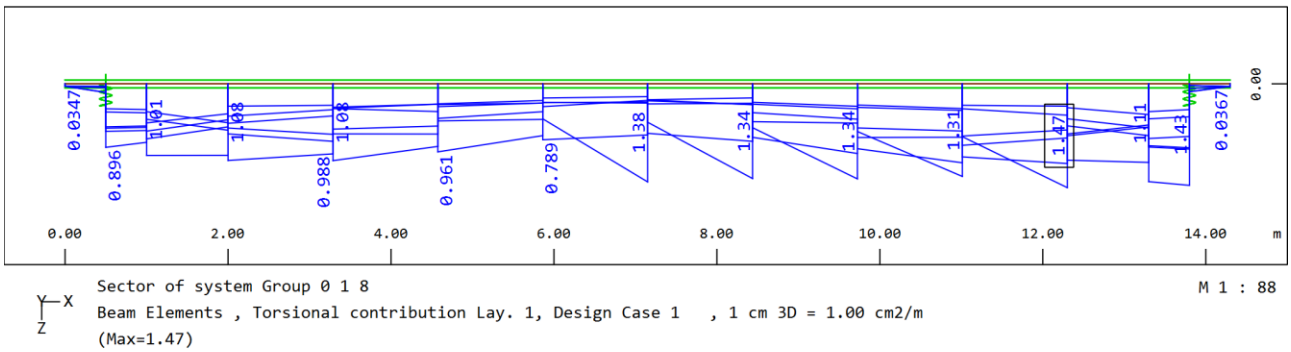
Sector of system Group 0 1 8 M 1 : 88
Beam Elements , Longitudinal Reinforcements Lay. Z2, Design Case 1 , 1 cm 3D = 20.0 cm2
(Max=26.1)



Sector of system Group 0 1 8 M 1 : 88
Beam Elements , Longitudinal Reinforcements Lay. Z3, Design Case 1 , 1 cm 3D = 5.00 cm2
(Max=4.12)

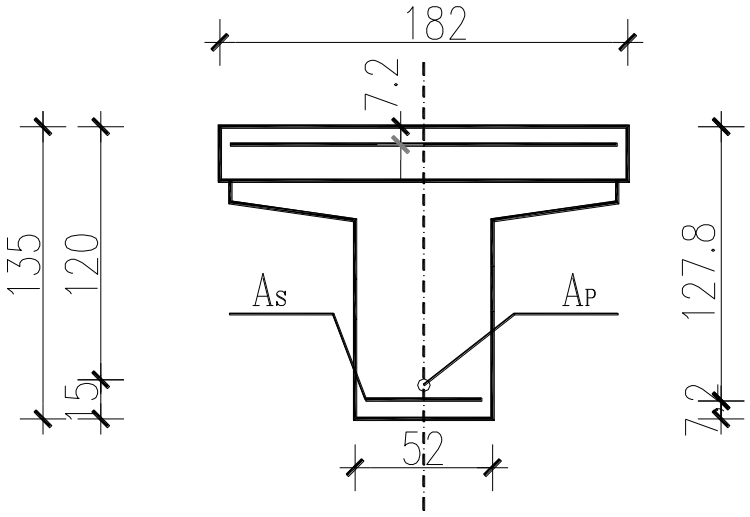


Sector of system Group 0 1 8 M 1 : 88
Shear reinforcements (maximum), Design Case 1 , (1 cm 3D = unit) Beam Elements (Unit=5.00
cm2/m) (Max=8.71)



Sector of system Group 0 1 8 M 1 : 88
Beam Elements , Torsional contribution Lay. 1, Design Case 1 , 1 cm 3D = 1.00 cm2/m
(Max=1.47)

3.4 Veličine za kontrolu armature



Statičke visine presjeka

POLJE I LEŽAJ

- Nenapeta armatura d_{1s} = c + Φ_v + ½*Φ_s = 4,5 + 1,4 + ½*2,5 = 7,2 cm (zaštitni sloj c = 4,5 cm, pretpostavljene vilice Φ_v 14, pretpostavljena uzdužna armatura Φ_s25)

$d_s = h - d_{1s} = 135,0 - 7,2 = 127,8$ cm

- Prednapeta armatura d_{1p} = 15,0 cm

$d_p = h - d_{1p} = 135,0 - 15,0 = 120,0$ cm

- Srednja vrijednost statičke visine $d = (d_s + d_p)\cdot 1/2 = 123,9$ cm

Računske čvrstoće gradiva

- *Računska čvrstoća betona C40/50*

$f_{cd} = 0,85 \cdot f_{ck}/\gamma_c = 0,85 \cdot 40/1,5 = 22,7$ N/mm^2 = 2,27 kN/cm^2

- *Računska granica popuštanja betonskog čelika B500B*

$f_{yd} = f_{yk}/\gamma_s = 500/1,15 = 434,78$ N/mm^2 = 43,478 kN/cm^2

3.5 Armatura nosača

3.5.1 Uzdužna armatura

Minimalna površina armature u presjeku h=135cm:

$$A_{s,min} = 0,0013 \cdot b \cdot d = 0,0013 \cdot 52 \cdot 123,9 = 8,38 \text{ cm}^2$$

$$A_{s,min} = 0,26 \cdot (f_{ctm} / f_{yk}) \cdot b \cdot d = 0,26 \cdot (4,1/500) \cdot 52 \cdot 123,9 = 13,74 \text{ cm}^2$$

Maksimalna površina armature u presjeku h=135cm:

$A_{s,max} = 0,04\ A_c = 0,04 \cdot 52 \cdot 135 = 280,8$ cm^2

Minimalna konstruktivna armatura prednapetih elemenata prema DIN 1045-1:

$$A_{s,min} = 1,0 \cdot \rho \cdot b \cdot h = 1,0 \cdot 1,31/1000 \cdot 52 \cdot 135 = 9,2 \text{ cm}^2$$

ρ = 1,31 za C40/50

Najveća uzdužna armatura u donjoj zoni (layer 1) iznosi: 12,9 cm^2

ODABRANO: 5Φ25 ($A_{s1,od}$ = 24,6 cm^2)

3.5.2 Armatura u krilcima nosača

ODABRANO (polje): Φ12/15,0 cm ($A_{s1,od}$ = 7,53 cm^2/m) - gore i dole uzdužno
ODABRANO: vilice m = 2, Φ10/10 cm ($A_{s,odabrano}$ = 22,6 cm^2/m') - ostalo

3.5.3 Uzdužna armatura u ploči

Najveća uzdužna armatura u gornjoj zoni (layer 2) na ležaju iznosi: 26,1 cm^2
26,1 cm^2/1,8 m = 14,34 cm^2/m

Najveća uzdužna armatura u gornjoj zoni (layer 2) u polju iznosi: 0,0 cm^2

Minimalna površina armature u presjeku h=135cm:

$A_{s,min} = 0{,}0013 \cdot b \cdot d =$ 0,0013·100·123,9 = 16,12 cm^2/m'

$A_{s,min} = 0{,}26 \cdot (f_{ctm} / f_{yk}) \cdot b \cdot d =$ 0,26·(2,9/500)·100·123,9 = 18,68 cm^2/m'

Maksimalna površina armature u presjeku h=135cm:

$A_{s,max}$ = 0,04 A_c = 0,04·100·135 = 540,0 cm^2/m'

ODABRANO (polje): Φ12/15,0 cm ($A_{s1,od}$ = 7,53 cm^2/m) – gore i dole uzdužno

3.5.4 Posmična armatura nosača

Najveća poprečna armatura dobivena je za osnovnu kombinaciju opterećenja i iznosi:

kod ležajeva 9,57cm^2/m'

ODABRANO: vilice m = 4, Φ12/10 cm ($A_{s,odabrano}$ = 45,24 cm^2/m') duljina L=4m

U polju 5,88 cm^2/m'

ODABRANO: vilice m = 2, Φ12/10 cm ($A_{s,odabrano}$ = 22,6 cm^2/m') - ostalo

Minimalna količina poprečne armature prema EC2 za elemente naprezane poprečnim silama:
$A_{smin} = \rho_{min} \cdot b_w =$ 0,0011 · 52,0 = 0,057 cm^2/cm

- $\rho_{min} = 0{,}0011$ za C40/50 i B500B

Minimalni razmak vilica prema EC2 za elemente naprezane poprečnim silama:
$s_{w,max}$ = max { 0,6·d, 20 cm }
$s_{w,max}$ = 20,0 cm

3.5.5 Bočne i torzijske armature

Torzijska armatura (ležaj):

2,39 cm^2/m

ODABRANO: vilice m = 4, Φ12/10 cm ($A_{s,odabrano}$ = 45,24 cm^2/m')

Torzijska armatura (polje):

1,63 cm^2/m

ODABRANO: vilice m = 2, Φ12/10 cm ($A_{s,odabrano}$ = 22,6 cm^2/m')

Bočna armatura ukupna (layer 3) na obje strane:

4,12 cm^2

ODABRANO: 6 Φ12/15 cm ($A_{s,odabrano}$ = 13,56 cm^2) – na svaku stranu

3.5.6 Armatura za sprezanje

Beton **C30/37**					
Karakt. tlačna čvrstoća betona	f_{ck} =	30	N/mm² =	3,00	kN/cm²
α_{cc}	α_{cc} =	0,85			
Proračunska vrijednost tlačne čvrstoće					
$f_{cd} = \alpha_{cc} \cdot f_{ck}/\gamma_C$	f_{cd} =	17,0	N/mm² =	1,70	kN/cm²
Srednja vrijednost srednje vlačne čvrstoće					
$f_{ctm} = 0,3 \cdot f_{ck}^{2/3}$	f_{ctm} =	2,896	N/mm² =	0,29	kN/cm²
$f_{ctk,0.05} = 0,7 \cdot f_{ctm}$	$f_{ctk,0.05}$ =	2,028	N/mm² =	0,20	kN/cm²
$f_{ctd} = f_{ck,0.05} / \gamma_C$	f_{ctd} =	1,352	N/mm² =	0,14	kN/cm²
Armatura **B500B**					
Karakteristična granica elastičnosti armature	f_{yk} =	500,0	N/mm² =	50,00	kN/cm²
Proračunska granica elastičnosti armature	f_{yd} =	434,8	N/mm² =	43,48	kN/cm²
Kut posmične arm. naspram uzdužne osi	α =	90,0	°		
$v = 0,6 \times (1 - f_{ck} / 250)$	v =	0,528			

Koeficijenti hrapovost spojne ploštine	most	
	c =	0,000
	μ =	0,5
redukcija koef. c radi dinamičkih opterećenja	=	0,5
	c_d =	0,000

Presjek			
Širina monolitne ploče po nosaču	b =	182,0	cm
Širina spojne površine	b_i =	180,0	cm
Visina/debljina ploče	h_1 =	25,0	cm
Visina nosača	h_n =	110,0	cm
Zaštitni sloj betona	a =	6,0	cm
Udaljenost rub-težište armature	d_1 =	9,0	cm
Statična visina spreg.presjeka	d =	126,0	cm
Krak unutarnjih sila	z =	113,4	cm
Površina popr.presjeka monolit.ploče	F_1 =	4550,0	cm^2
Površina popr.presjeka nosača u tlaku	F_2 =	180,0	cm^2
$\beta = F_1 / (F_1 + F_2)$	β =	0,96	

PRORAČUN

Poprečne sile $v_{Ed} = \beta x V_{Ed}/(z x b_i)$

- iznad oslonca	$V_{1,1}$ =	1.095 kN	$v_{Ed,1,1}$ = 0,052 kN/cm^2
- na 4m od oslonca	$V_{1,2}$ =	850 kN	$v_{Ed,1,2}$ = 0,040 kN/cm^2
- na 8m od oslonca	$V_{1,3}$ =	710 kN	$v_{Ed,1,3}$ = 0,033 kN/cm^2
	σ_n=	0,063 kN/cm^2	

$\rho=(v_{Edi} - c*fctd-\mu\sigma_n) / (fyd(\mu\sin\alpha-\cos\alpha)), \alpha=90°$

$\rho_{1,1}$ =	0,0009	$A_{s,1,1}$ =	16,8 cm^2/m
$\rho_{1,2}$ =	0,0004	$A_{s,1,2}$ =	7,2 cm^2/m
$\rho_{1,3}$ =	0,0001	$A_{s,1,3}$ =	1,7 cm^2/m

Armatura sprezanja uz poprečnu armaturu

Odabrana poprečna armatura nosača koja ulazi u monolitnu ploču

- ±4m oslonac	zona1	n=	4	Ø	12	/	10,0	($A_{s,p}$ =	45,2 cm2)
- 4m -8m	zona2	n=	2	Ø	12	/	10,0	($A_{s,p}$ =	22,6 cm2)
- 8m i dalje	ostalo	n=	2	Ø	12	/	10,0	($A_{s,p}$ =	22,6 cm2)

Potrebna armatura sprezanja

zona1	$A_{s,S,1,1} = A_{s,1,1} - A_{s,p}$	**$A_{s,S,1,1}$ =**	**0,0 cm^2/m**
zona2	$A_{s,S1,2} = A_{s,1,1} - A_{s,p}$	**$A_{s,S,1,2}$ =**	**0,0 cm^2/m**
ostalo	$A_{s,S,1,3} = A_{s,1,1} - A_{s,p}$	**$A_{s,S,2,1}$ =**	**0,0 cm^2/m**

ODABIR ARMATURE

$A_{s,S,min}$ = n= 4 , Ø 8 / 30,0 ; $A_{s,S,min}$ = 6,7 cm2

ODABRANA ARMATURA - As,S,o $A_{s,S,min}$ < $A_{s,S}$ < **$A_{s,S,o}$**

$\rho_{1.1,O}$ =	0,0033	**zona 1**	**6,7**	<	**0,0**	<	**13,4**	**,n=**	**4**	**, Ø**	**8**	**/**	**15,0**	($A_{s,p}$	**13,4 cm2/m)**
$\rho_{1.2,O}$ =	0,0016	**zona 1**	**6,7**	<	**0,0**	<	**6,7**	**,n=**	**4**	**, Ø**	**8**	**/**	**30,0**	($A_{s,p}$	**6,7 cm2/m)**
$\rho_{1.3,O}$ =	0,0016	**ostalo**	**6,7**	<	**0,0**	<	**6,7**	**,n=**	**4**	**, Ø**	**8**	**/**	**30,0**	($A_{s,p}$	**6,7 cm2/m)**

KONTROLA

$v_{Edi} \le v_{Rdi}$ $\quad v_{Rdi} = c f_{ctd} + \mu\sigma_n + \rho f_{yd}(\mu\sin\alpha + \cos\alpha) \le 0{,}5\nu f_{cd}$

$v_{Ed,1,1}$ =	**0,052 kN/cm^2**	**< $v_{Rd,1,1}$ =**	**0,102 kN/cm^2**	**<**	**0,5νf_{cd} =**	**0,449**	**kN/cm^2**
$v_{Ed,1,2}$ =	**0,040 kN/cm^2**	**< $v_{Rd,1,2}$ =**	**0,067 kN/cm^2**	**<**	**0,5νf_{cd} =**	**0,449**	**kN/cm^3**
$v_{Ed,1,3}$ =	**0,033 kN/cm^2**	**< $v_{Rd,1,3}$ =**	**0,067 kN/cm^2**	**<**	**0,5νf_{cd} =**	**0,449**	**kN/cm^4**

Dodatna lokalna ojačanja/prilagodbe će se napraviti u izvedbenom projektu kad se budu izrađivali nacrti armature prema armaturnim dijagramima, minimalnoj i maksimalnoj armaturi, i drugim pravilima za

3.6 Granično stanje uporabivosti

3.6.1 Granično stanje naprezanja i dekompresije

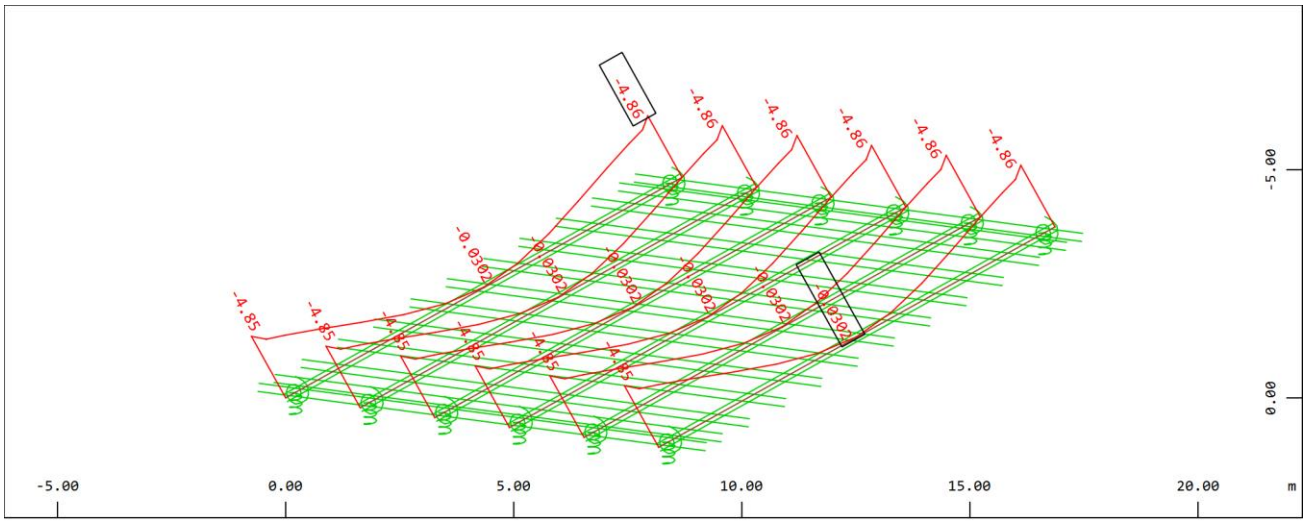
Prikazana su naprezanja ploče u različitim fazama gradnje i za različite slučajeve opterećenja. Za naprezanja pod kombinacijom opterećenja za granično stanje dekompresije $\Sigma G + 0{,}0 \cdot Q_{osovinsko} + 0{,}0 \cdot Q_{kontinuirano} + 0{,}5 \cdot ZT + 1{,}0 \cdot ZF$ treba vrijediti $\sigma_c \leq 0$, odnosno da nema vlačnih naprezanja. Iz dijagrama će se pokazati da je granično stanje dekompresije zadovoljeno u svim fazama opterećenja (EC).

kombinacija opterećenja za kontrolu naprezanja		
Slučaj opterećenja	opis opterećenja	Kombinacija opterećenja
LC 7010	Odmah po prednapinjanju	$G_1 + P$
LC 9305,9306, 9315,9316	Učestala kombinacija nakon puštanja u promet i nakon 100 godina	$\Sigma G_i + r_{inf} \cdot P + C + \psi_{1,1} Q_{k,1} + \Sigma \psi_{2,i} Q_{k,i}$
LC 9311,9312, 9321,9322	Učestala kombinacija nakon puštanja u promet i nakon 100 godina	$\Sigma G_i + r_{sup} \cdot P + C + \psi_{1,1} Q_{k,1} + \Sigma \psi_{2,i} Q_{k,i}$
LC 9405,9406, 9415,9416	Prividno stalna kombinacija nakon puštanja u promet i nakon 100 godina	$\Sigma G_i + r_{inf} \cdot P + C + \Sigma \psi_{2,i} Q_{k,i}$
LC 9411,9412, 9421,9422	Prividno stalna kombinacija nakon puštanja u promet i nakon 100 godina	$\Sigma G_i + r_{sup} \cdot P + C + \Sigma \psi_{2,i} Q_{k,i}$
LC 9105,9106, 9115,9116	Rijetka(karakteristična)kombinacija nakon puštanja u promet i nakon 100 godina	$\Sigma G_i + r_{inf} \cdot P + C + Q_{k,1} + \Sigma \psi_{o,i} Q_{k,i}$
LC 9111,9112, 9121,9122	Rijetka(karakteristična)kombinacija nakon puštanja u promet i nakon 100 godina	$\Sigma G_i + r_{sup} \cdot P + C + Q_{k,1} + \Sigma \psi_{o,i} Q_{k,i}$

$r_{sup} = 1{,}1$; $r_{inf} = 0{,}9$

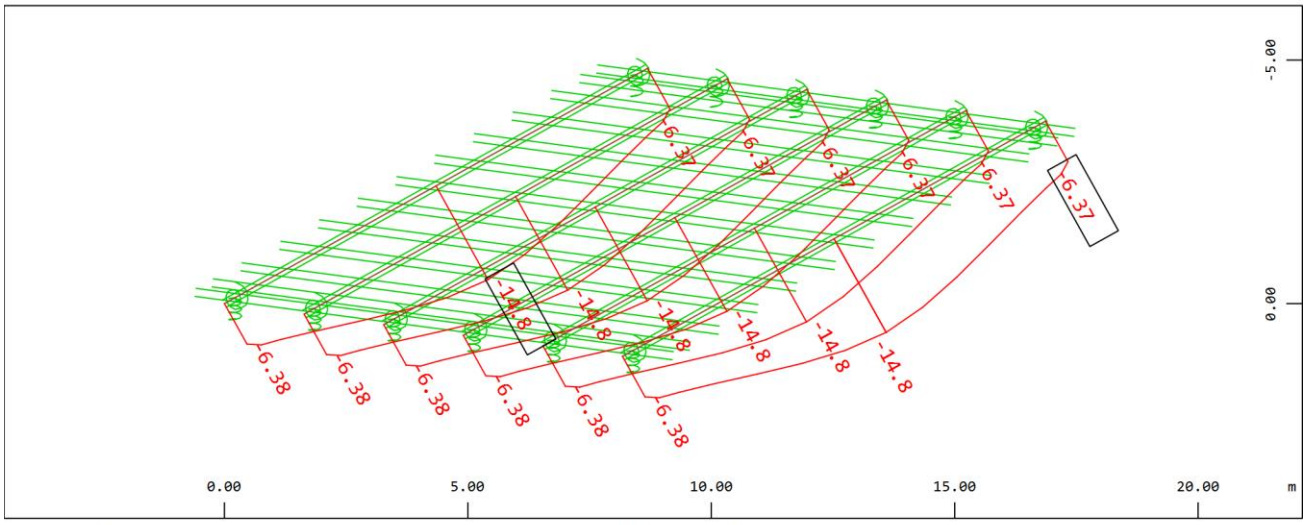
Na sljedećim stranicama prikazani su redom:

- Naprezanja na gornjem rubu
- Naprezanja na donjem rubu
- Maksimalno naprezanje u kabelu



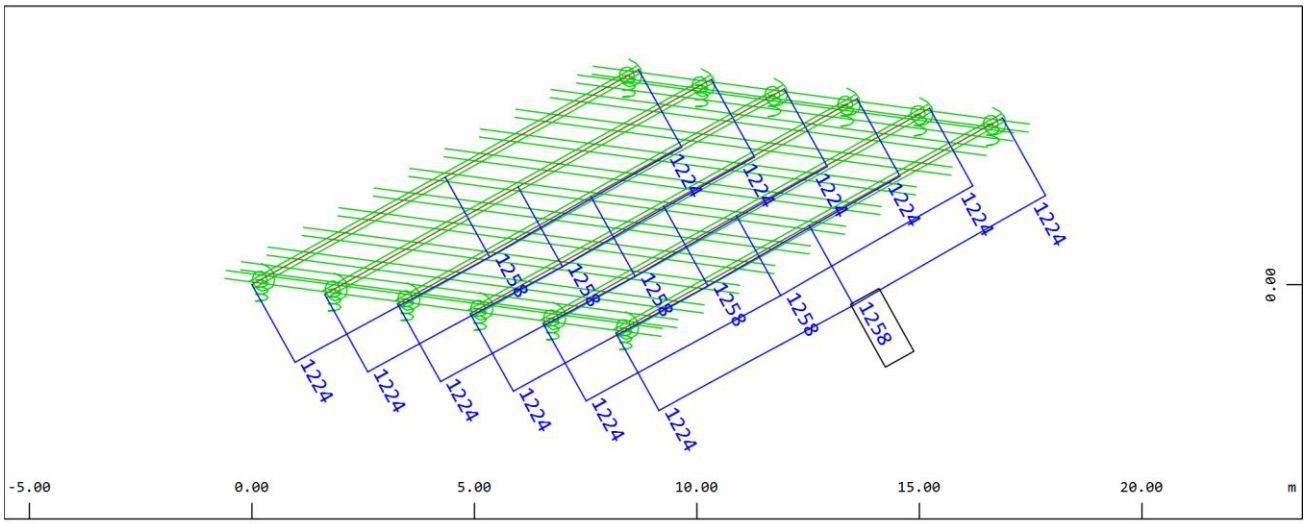
Beam Elements , Uniaxial top stress, Design Case 7010 Sum_10 Prestress, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-4.86) (Max=-0.0302)

M 1 : 159
X * 0.502
Y * 0.906
Z * 0.962



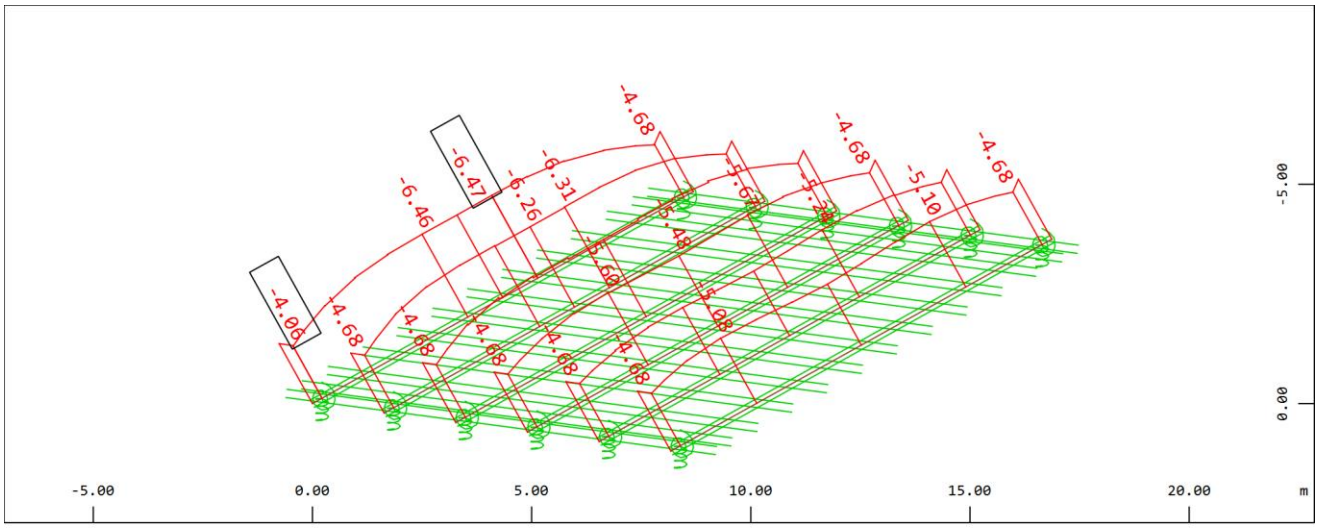
Beam Elements , Uniaxial bottom stress, Design Case 7010 Sum_10 Prestress, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 10.0 MPa (Min=-14.8) (Max=-6.37)

M 1 : 149
X * 0.502
Y * 0.906
Z * 0.962



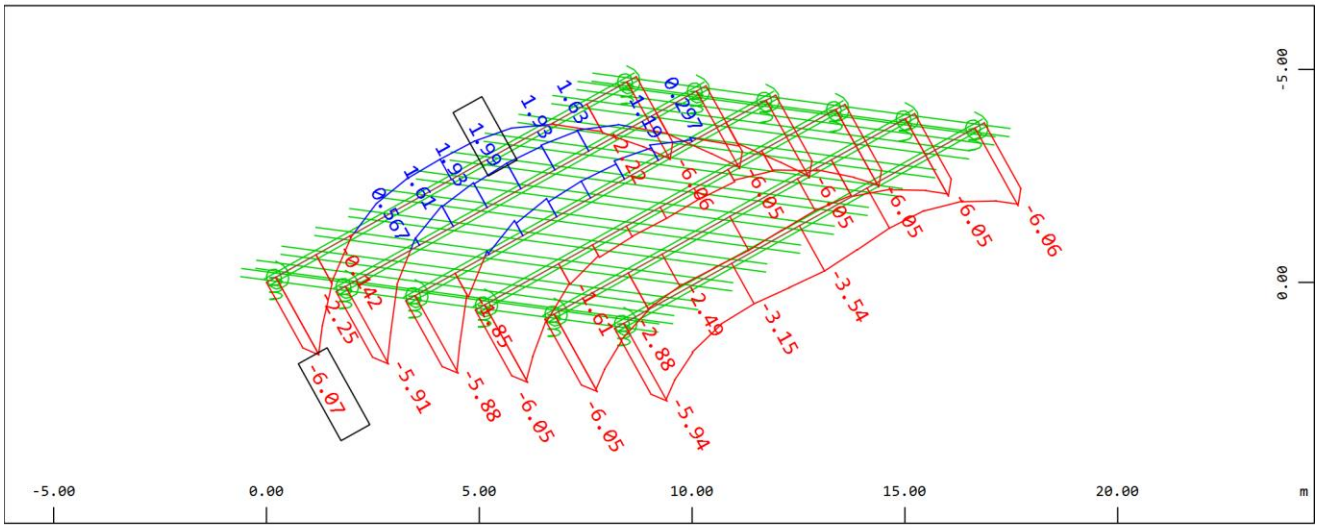
Beam Elements , Maximum stress in tendon, Design Case 7010 Sum_10 Prestress, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress (Unit=1000. MPa) (Max=1258.)

M 1 : 163
X * 0.502
Y * 0.906
Z * 0.962



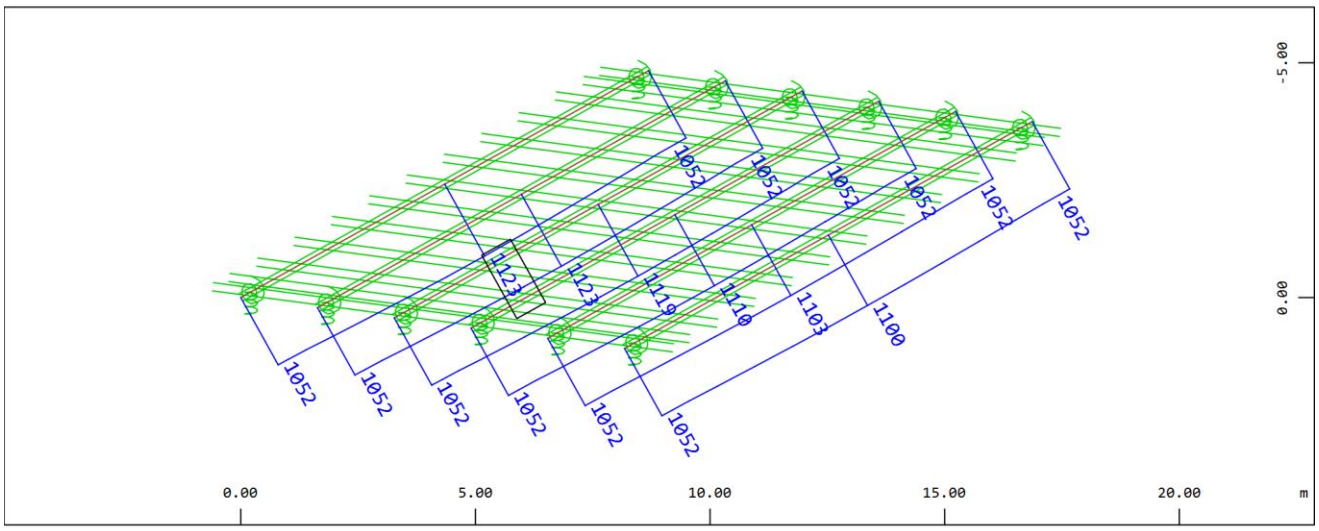
Beam Elements , Uniaxial top stress, Design Case 9105 Stress time t1 rare_Pk_inf_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-6.47) (Max=-4.06)

M 1 : 167
X * 0.502
Y * 0.906
Z * 0.962



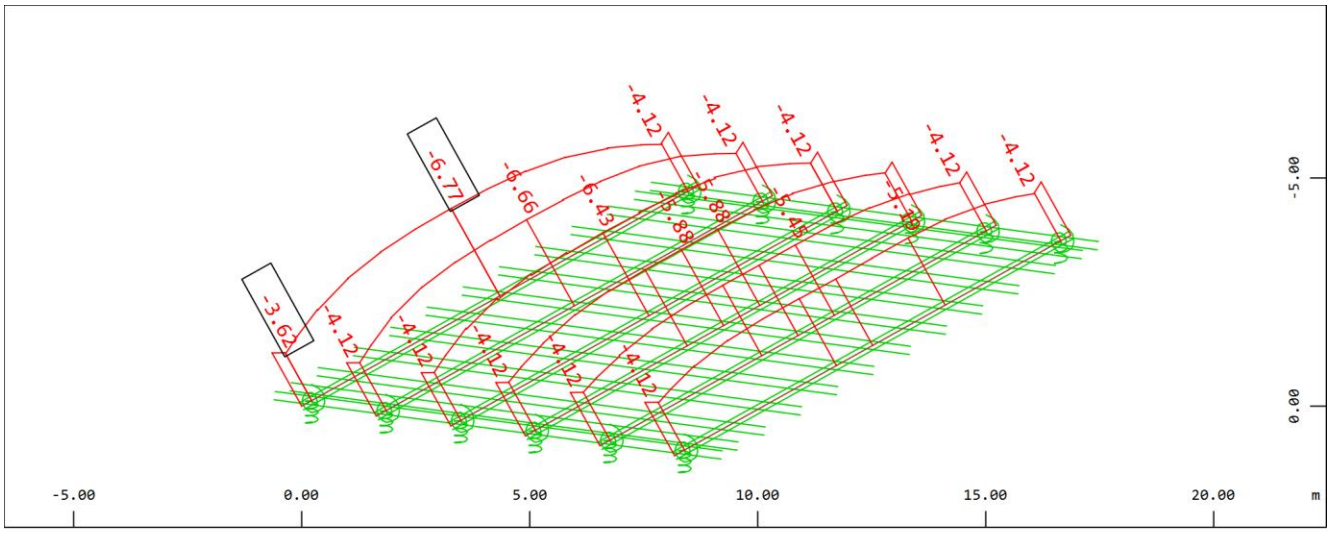
Beam Elements , Uniaxial bottom stress, Design Case 9105 Stress time t1 rare_Pk_inf_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-6.07) (Max=1.99)

M 1 : 172
X * 0.502
Y * 0.906
Z * 0.962



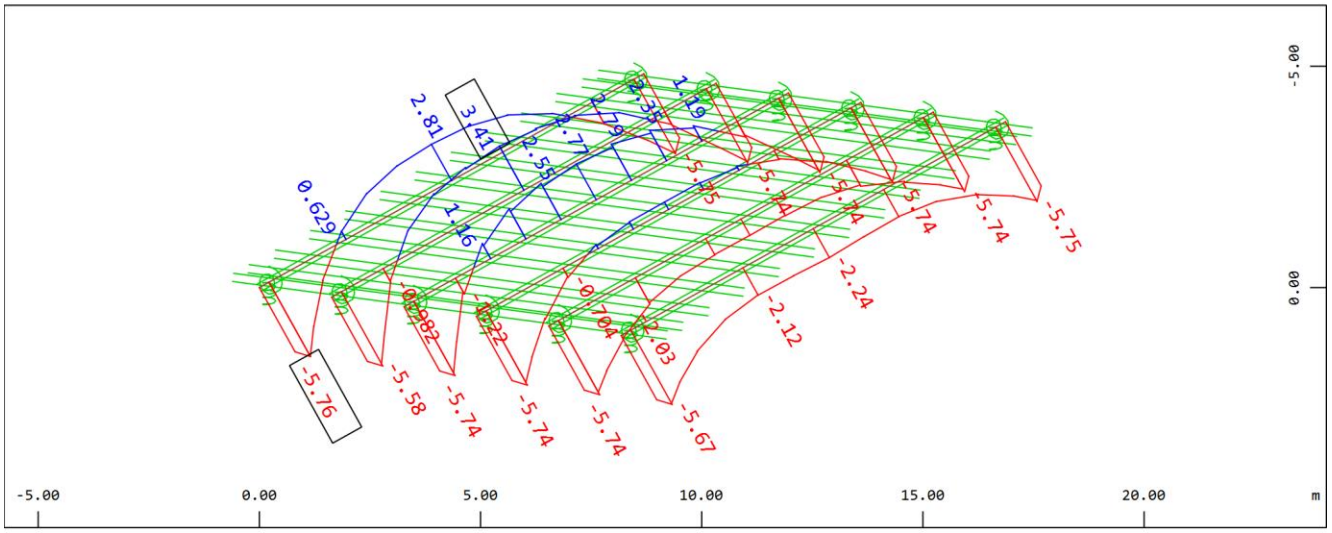
Beam Elements , Maximum stress in tendon, Design Case 9105 Stress time t1
rare_Pk_inf_maxMY, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements
, Maximum Stress (Unit=1000. MPa) (Max=1123.)

M 1 : 156
X * 0.502
Y * 0.906
Z * 0.962



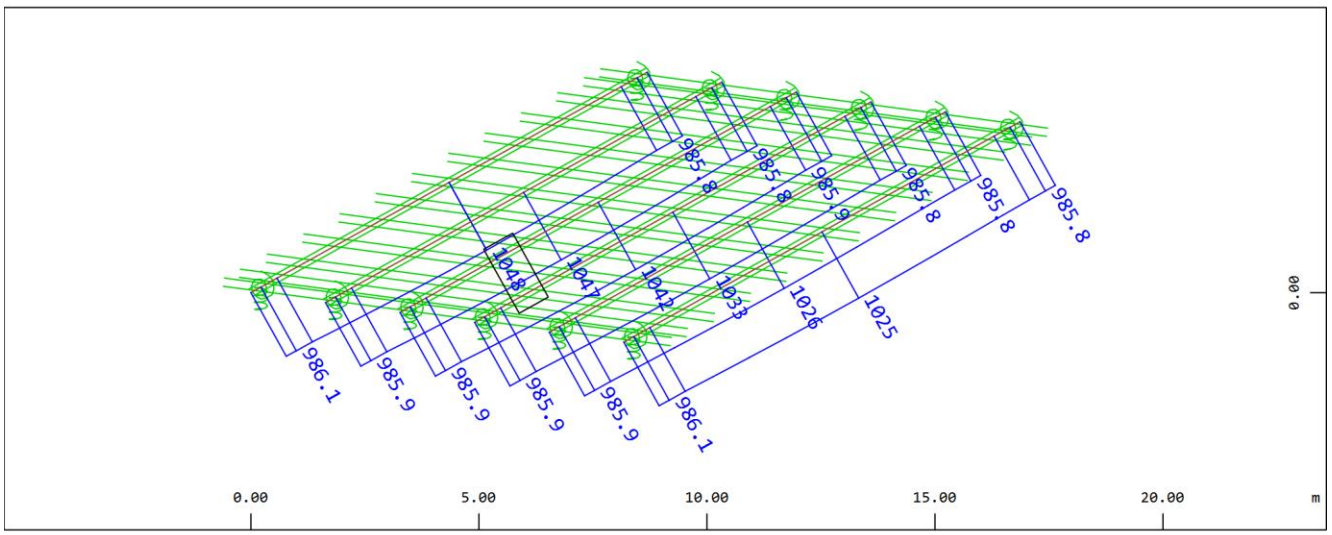
Beam Elements , Uniaxial top stress, Design Case 9115 Stress rare_Pk_inf_maxMY, Material 1
C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-6.77) (Max=-3.62)

M 1 : 162
X * 0.502
Y * 0.906
Z * 0.962



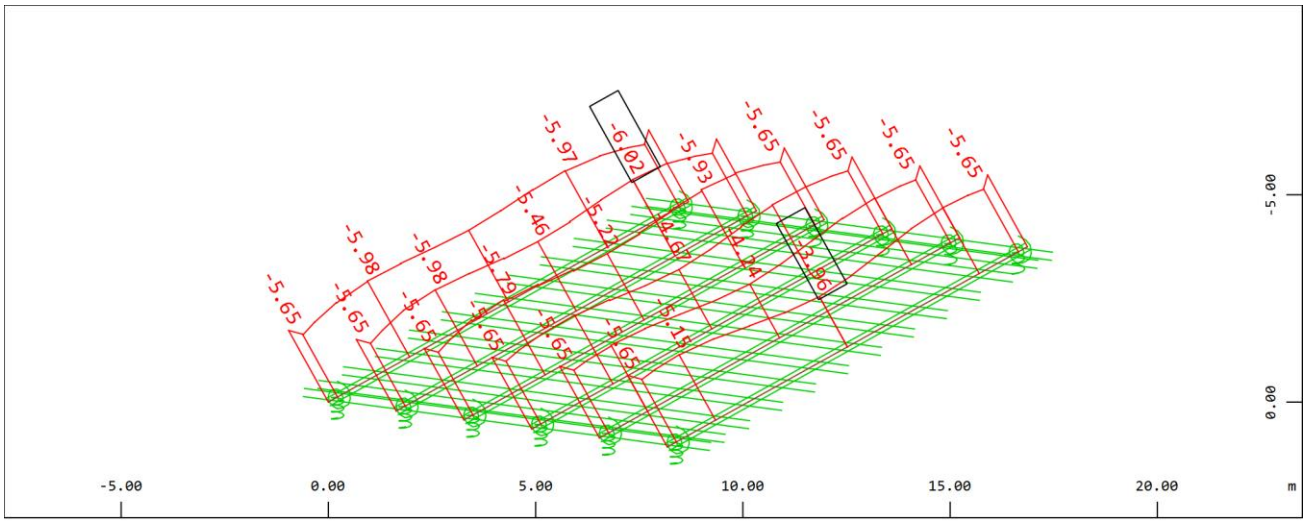
Beam Elements , Uniaxial bottom stress, Design Case 9115 Stress rare_Pk_inf_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-5.76) (Max=3.41)

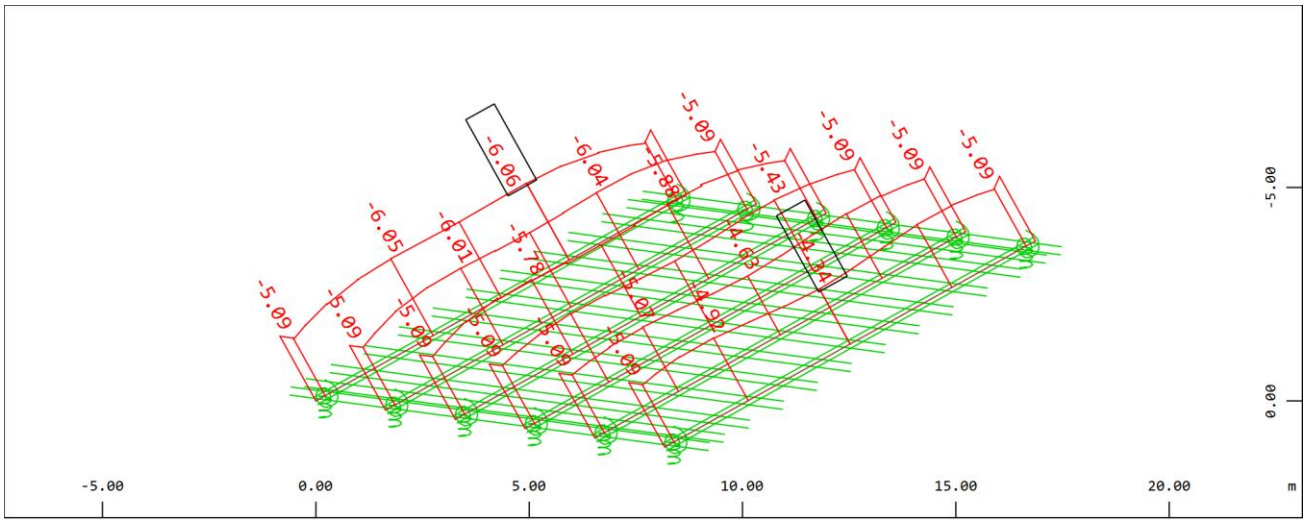
M 1 : 167
X * 0.502
Y * 0.906
Z * 0.962



Beam Elements , Maximum stress in tendon, Design Case 9115 Stress rare_Pk_inf_maxMY,
Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress
(Unit=1000. MPa) (Max=1048.)

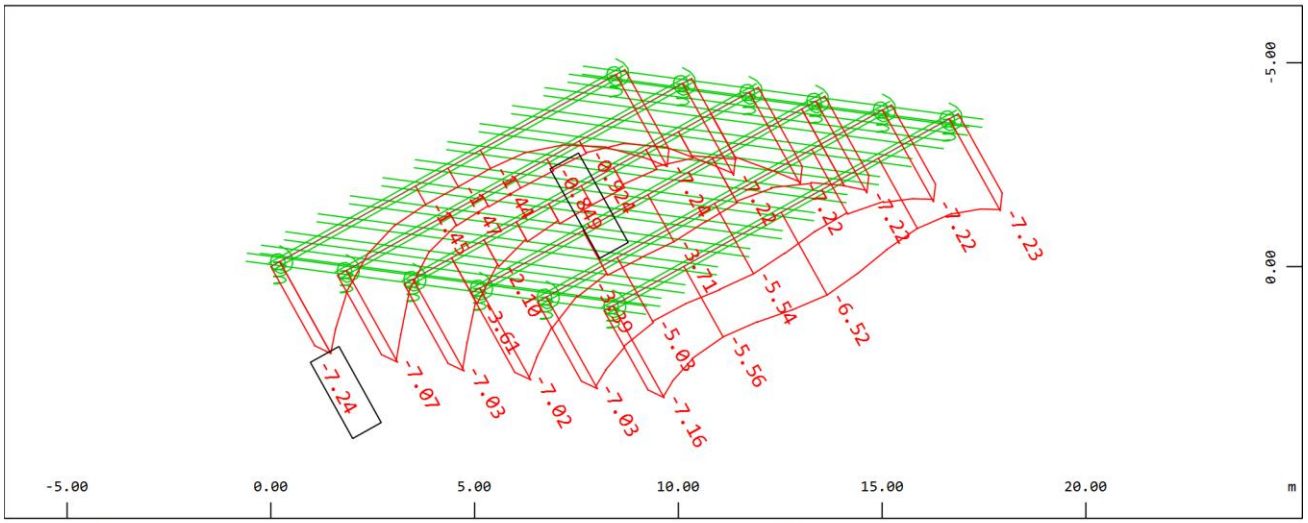
M 1 : 162
X * 0.502
Y * 0.906
Z * 0.962


-5.97
-6.02
-5.93
-5.65
-5.65
-5.65
-5.65
-5.46
-5.98
-5.98
-5.65
-5.65
-5.65
-5.65



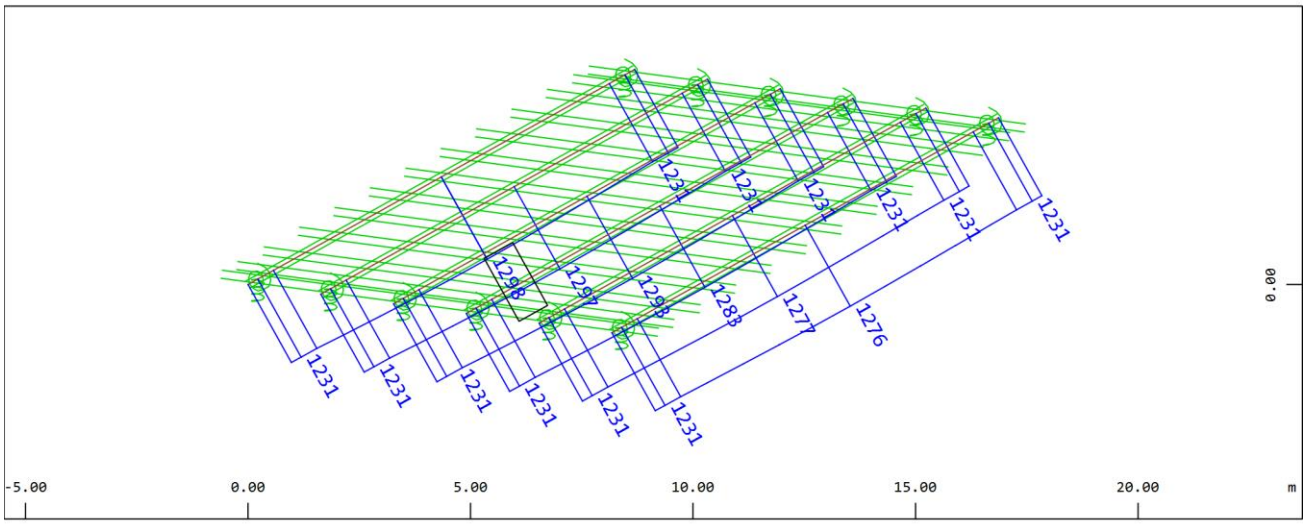
Beam Elements , Uniaxial top stress, Design Case 9121 Stress rare_Pk_sup_maxMY, Material 1
C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-6.06) (Max=-4.34)

M 1 : 170
X * 0.502
Y * 0.906
Z * 0.962



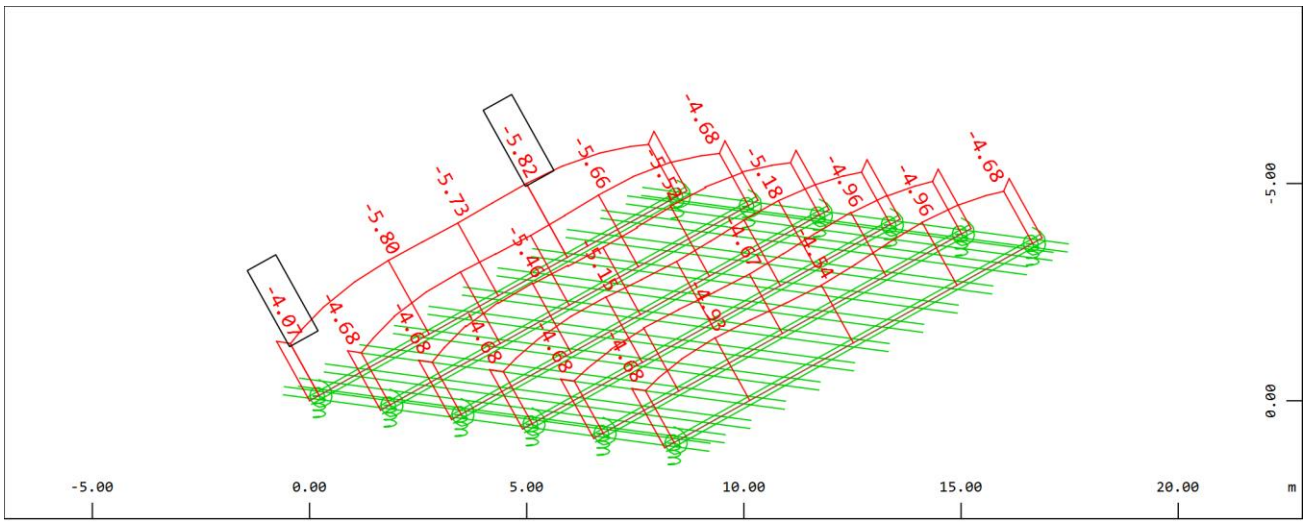
Beam Elements , Uniaxial bottom stress, Design Case 9121 Stress rare_Pk_sup_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-7.24) (Max=-0.849)

M 1 : 178
X * 0.502
Y * 0.906
Z * 0.962



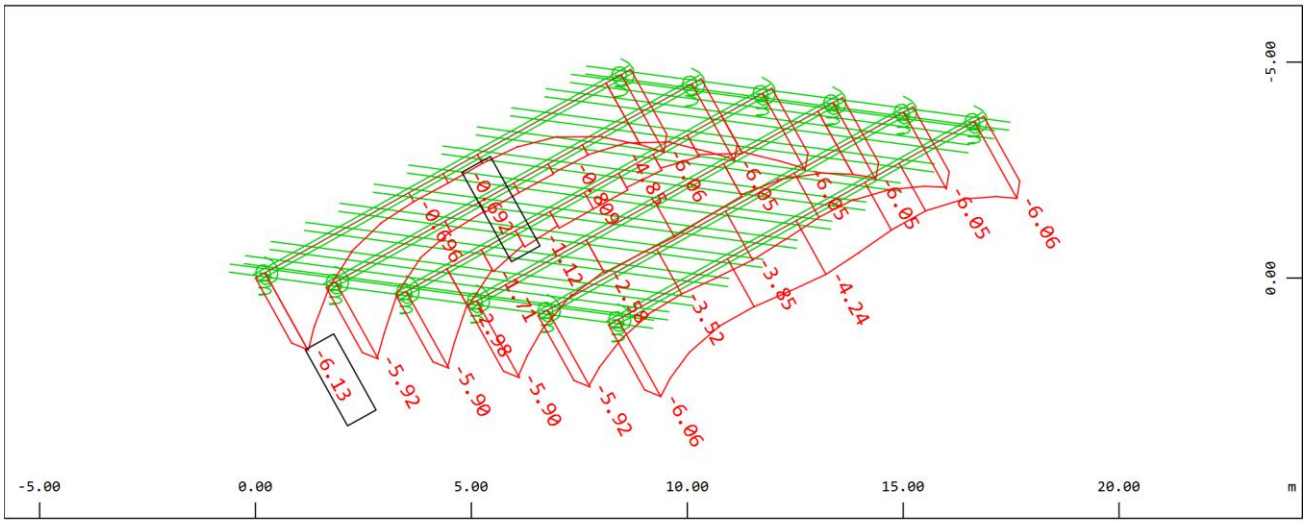
Beam Elements , Maximum stress in tendon, Design Case 9121 Stress rare_Pk_sup_maxMY,
Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress
(Unit=1000. MPa) (Max=1298.)

M 1 : 163
X * 0.502
Y * 0.906
Z * 0.962



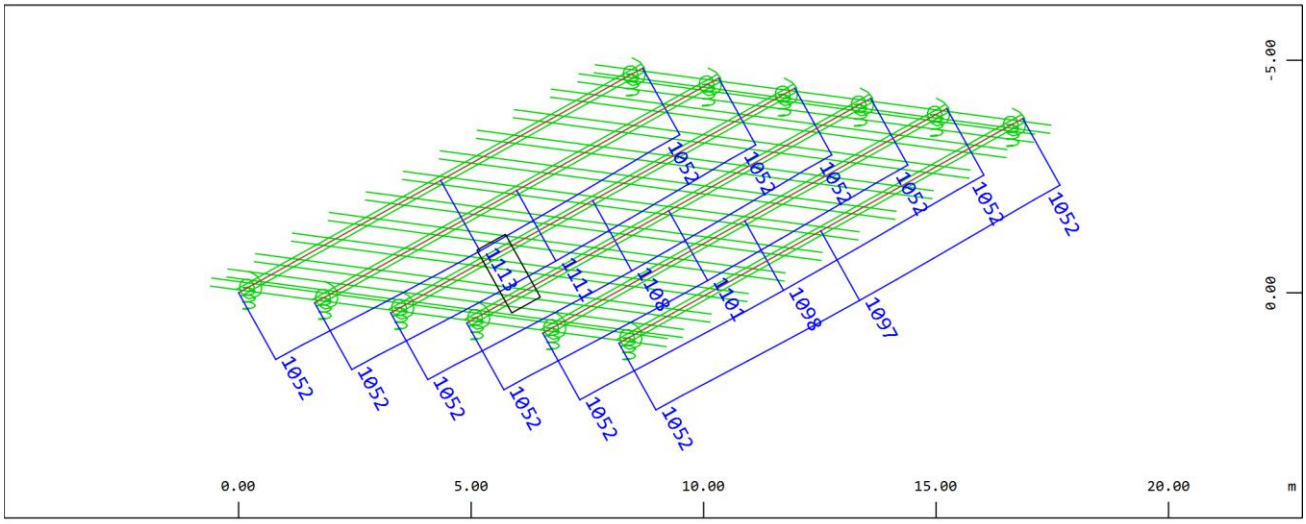
Beam Elements , Uniaxial top stress, Design Case 9305 Stress time t1 freq_Pk_inf_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-5.82) (Max=-4.07)

M 1 : 167
X * 0.502
Y * 0.906
Z * 0.962



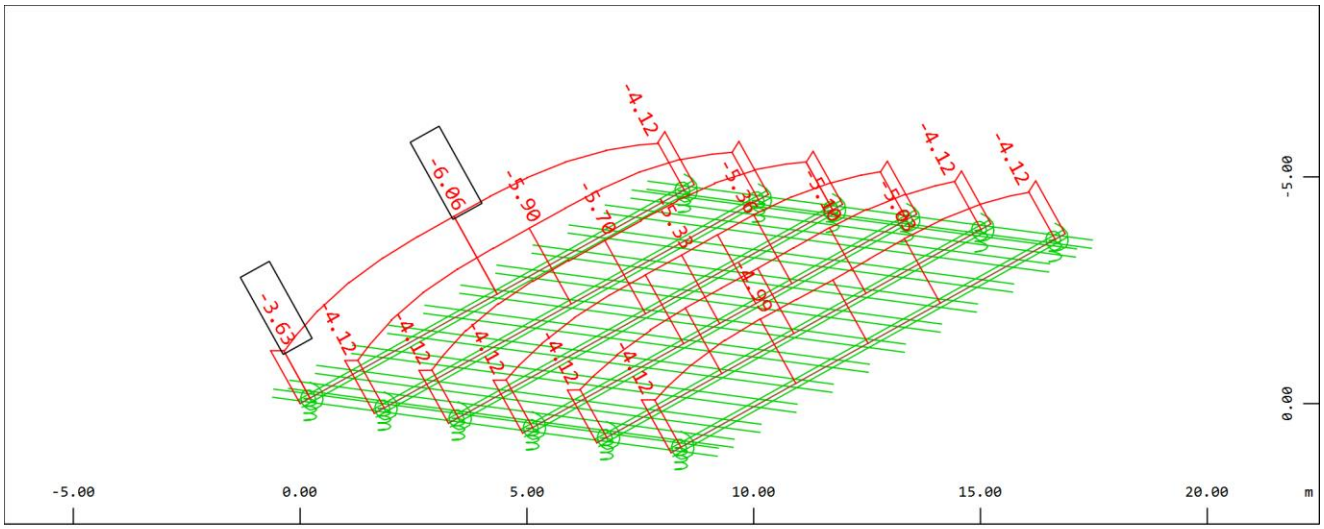
Beam Elements , Uniaxial bottom stress, Design Case 9305 Stress time t1 freq_Pk_inf_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-6.13) (Max=-0.692)

M 1 : 168
X * 0.502
Y * 0.906
Z * 0.962



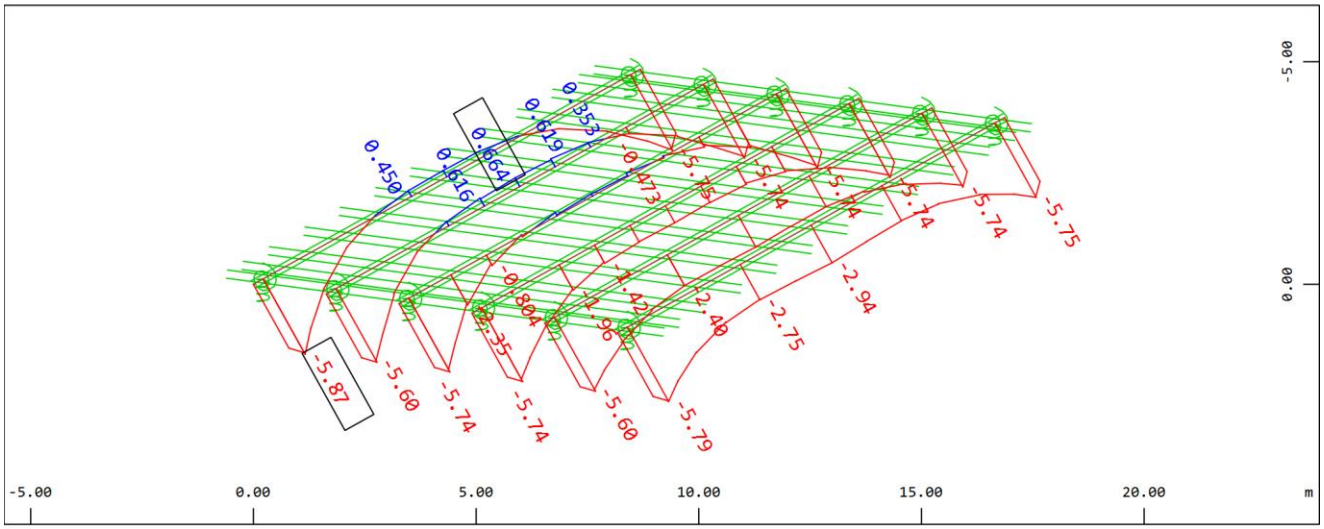
Beam Elements , Maximum stress in tendon, Design Case 9305 Stress time t1
freq_Pk_inf_maxMY, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements
, Maximum Stress (Unit=1000. MPa) (Max=1113.)

M 1 : 156
X * 0.502
Y * 0.906
Z * 0.962



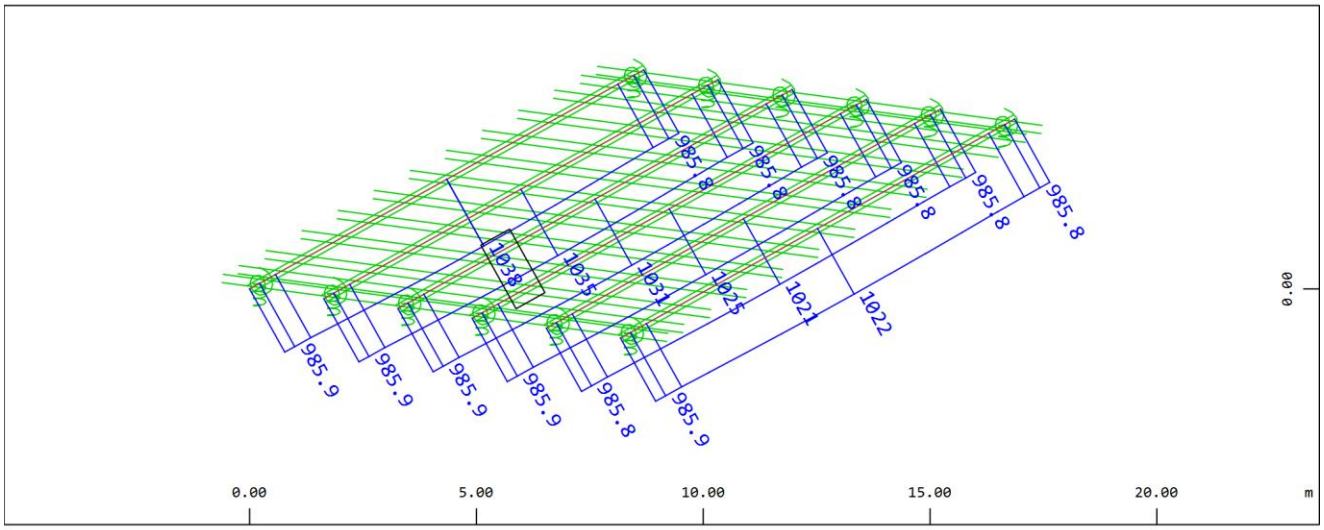
Beam Elements , Uniaxial top stress, Design Case 9315 Stress freq_Pk_inf_maxMY, Material 1
C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-6.06) (Max=-3.63)

M 1 : 162
X * 0.502
Y * 0.906
Z * 0.962



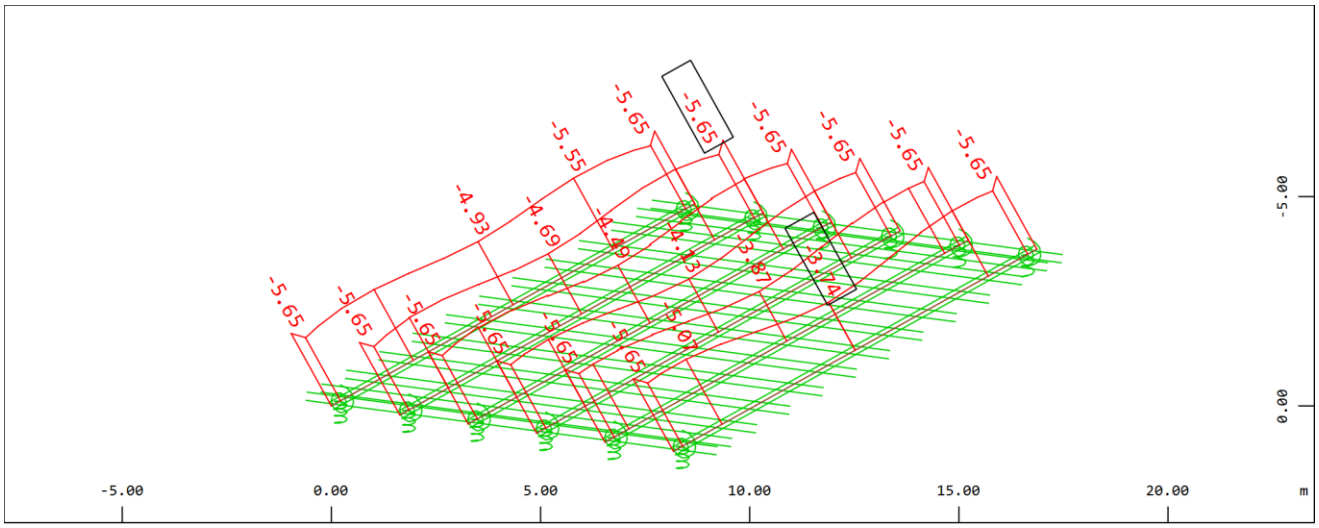
Beam Elements , Uniaxial bottom stress, Design Case 9315 Stress freq_Pk_inf_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-5.87) (Max=0.664)

M 1 : 165
X * 0.502
Y * 0.906
Z * 0.962



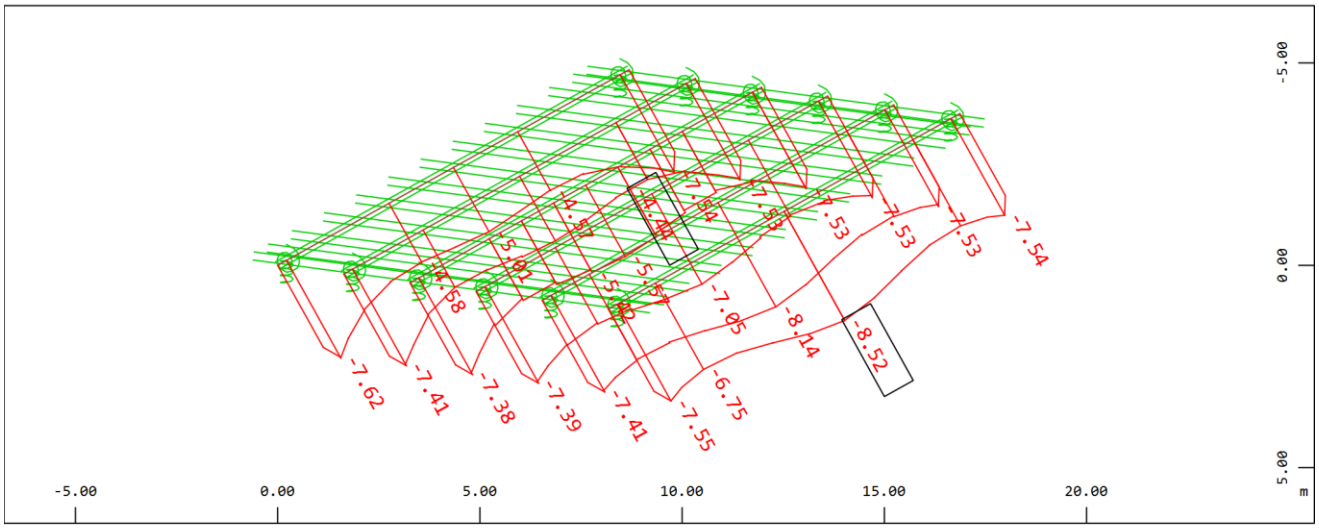
Beam Elements , Maximum stress in tendon, Design Case 9315 Stress freq_Pk_inf_maxMY,
Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress
(Unit=1000. MPa) (Max=1038.)

M 1 : 162
X * 0.502
Y * 0.906
Z * 0.962



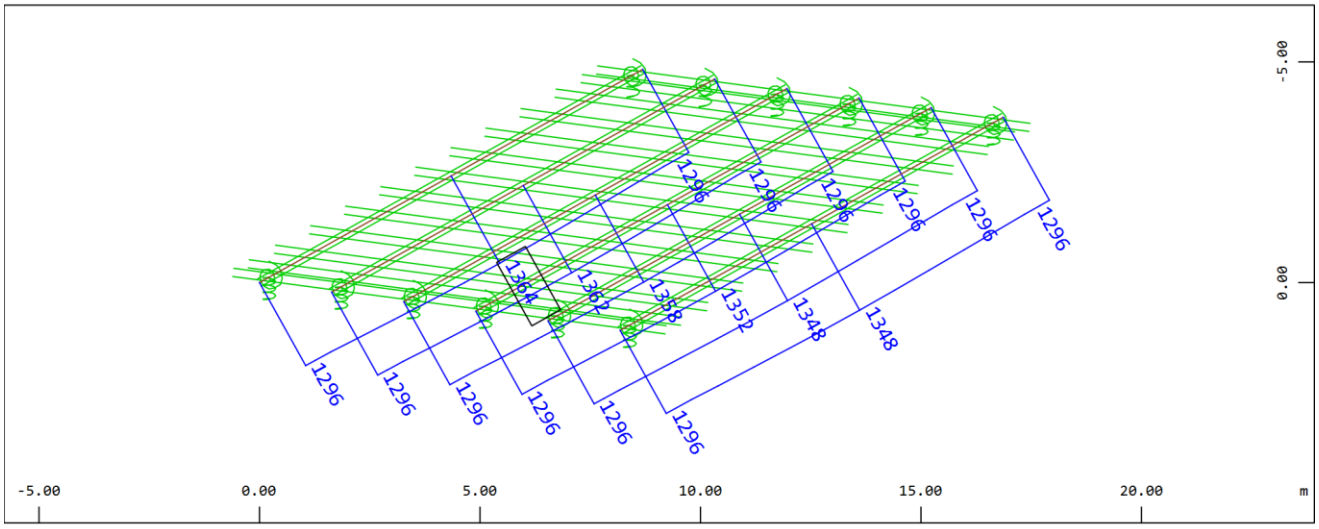
Beam Elements , Uniaxial top stress, Design Case 9311 Stress time t1 freq_Pk_sup_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-5.65) (Max=-3.74)

M 1 : 175
X * 0.502
Y * 0.906
Z * 0.962



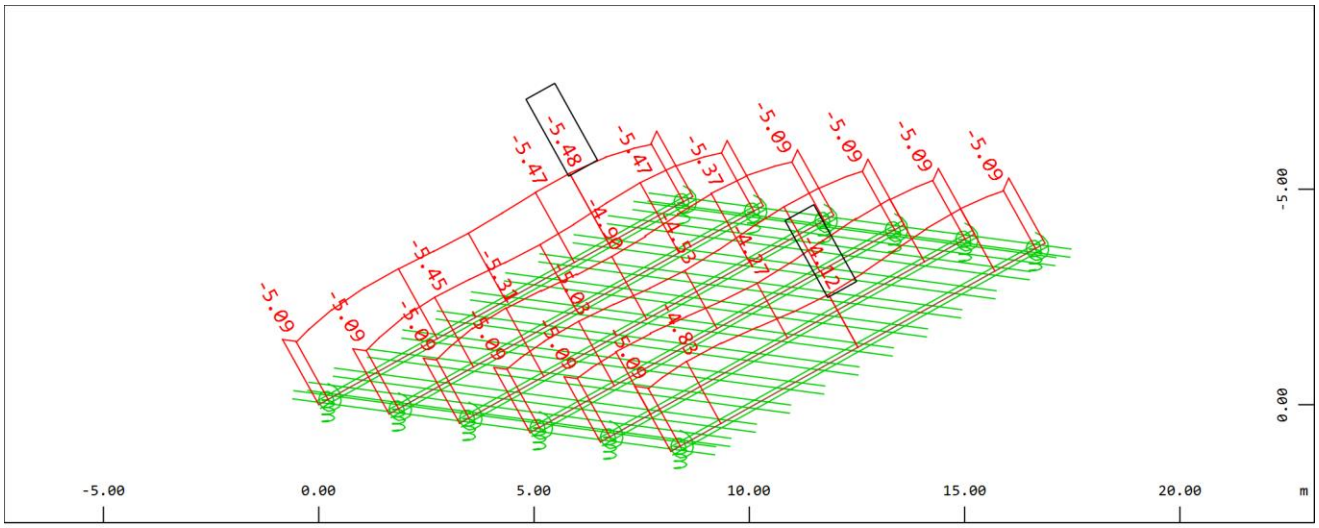
Beam Elements , Uniaxial bottom stress, Design Case 9311 Stress time t1 freq_Pk_sup_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-8.52) (Max=-4.44)

M 1 : 181
X * 0.502
Y * 0.906
Z * 0.962



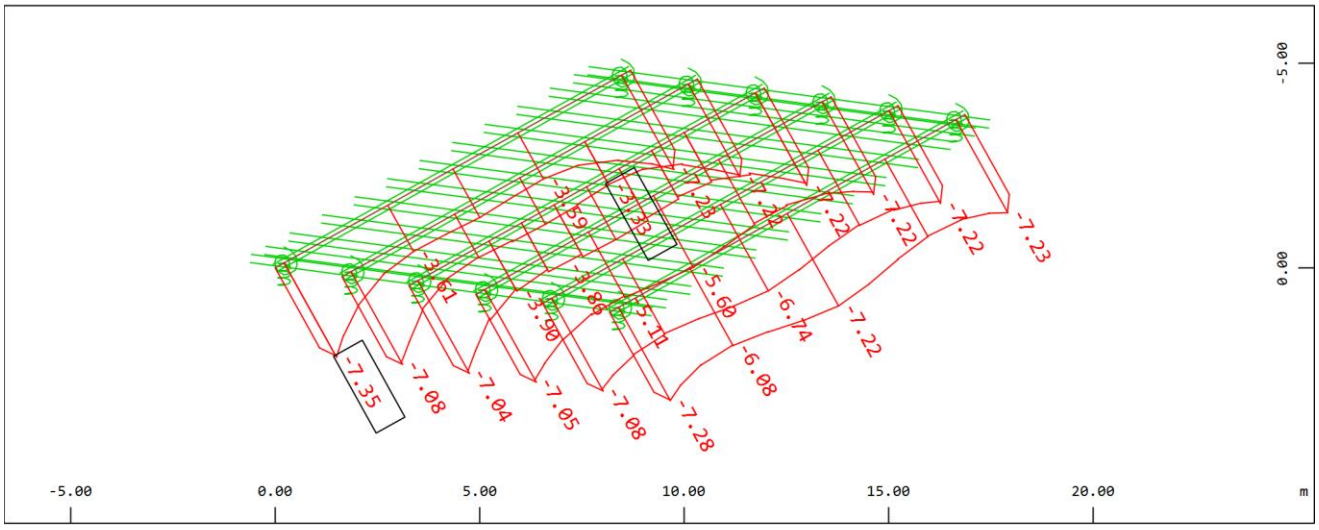
Beam Elements , Maximum stress in tendon, Design Case 9311 Stress time t1
freq_Pk_sup_maxMY, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements
, Maximum Stress (Unit=1000. MPa) (Max=1364.)

M 1 : 166
X * 0.502
Y * 0.906
Z * 0.962



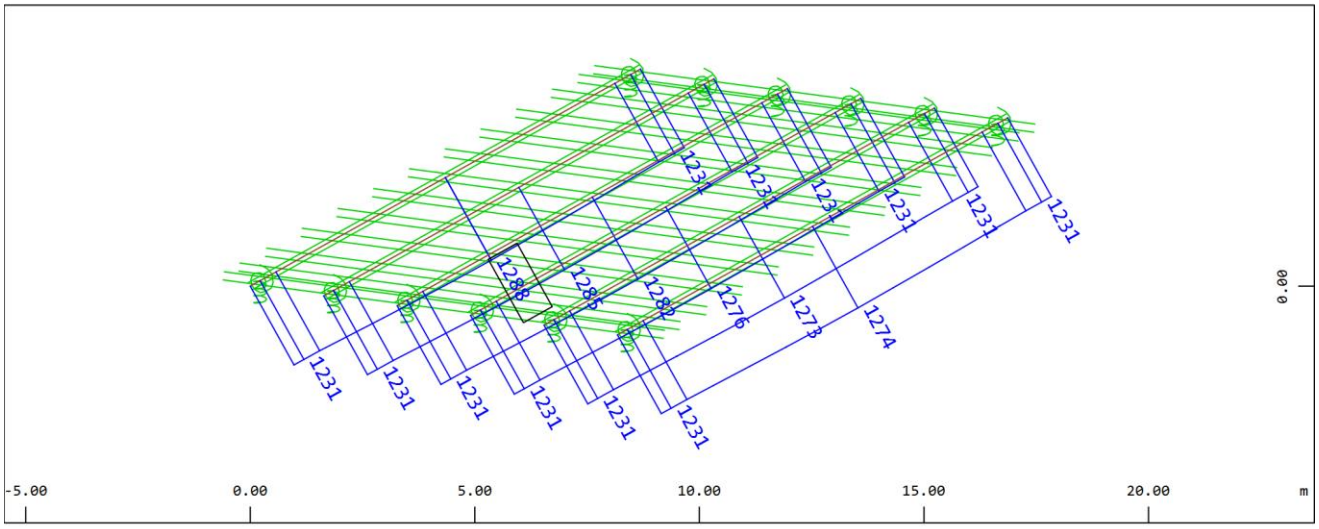
Beam Elements , Uniaxial top stress, Design Case 9321 Stress freq_Pk_sup_maxMY, Material 1
C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-5.48) (Max=-4.12)

M 1 : 170
X * 0.502
Y * 0.906
Z * 0.962



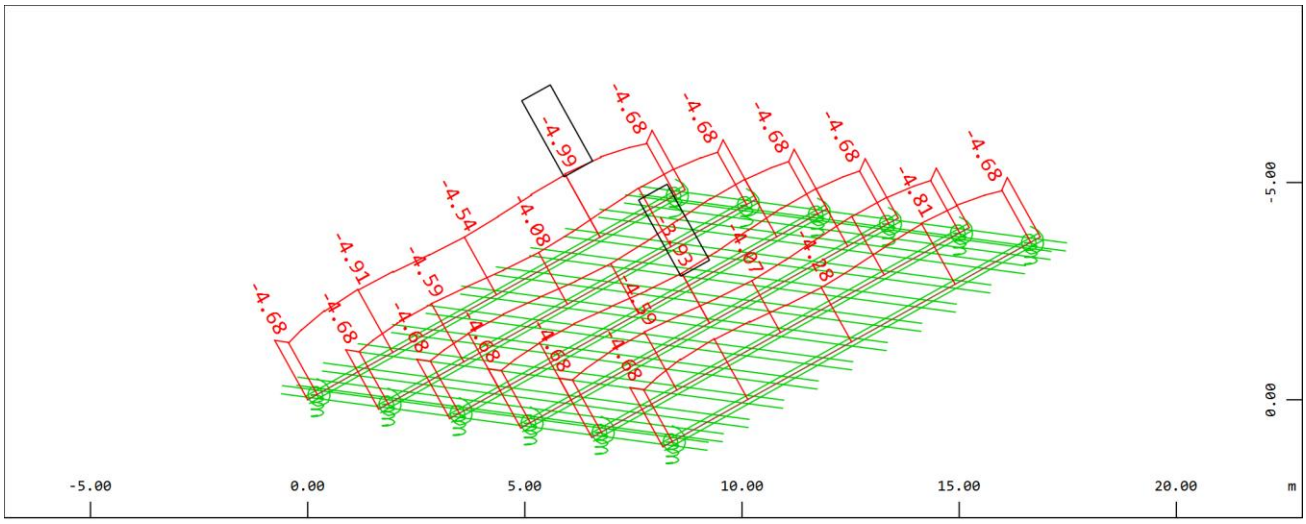
Beam Elements , Uniaxial bottom stress, Design Case 9321 Stress freq_Pk_sup_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-7.35) (Max=-3.33)

M 1 : 179
X * 0.502
Y * 0.906
Z * 0.962



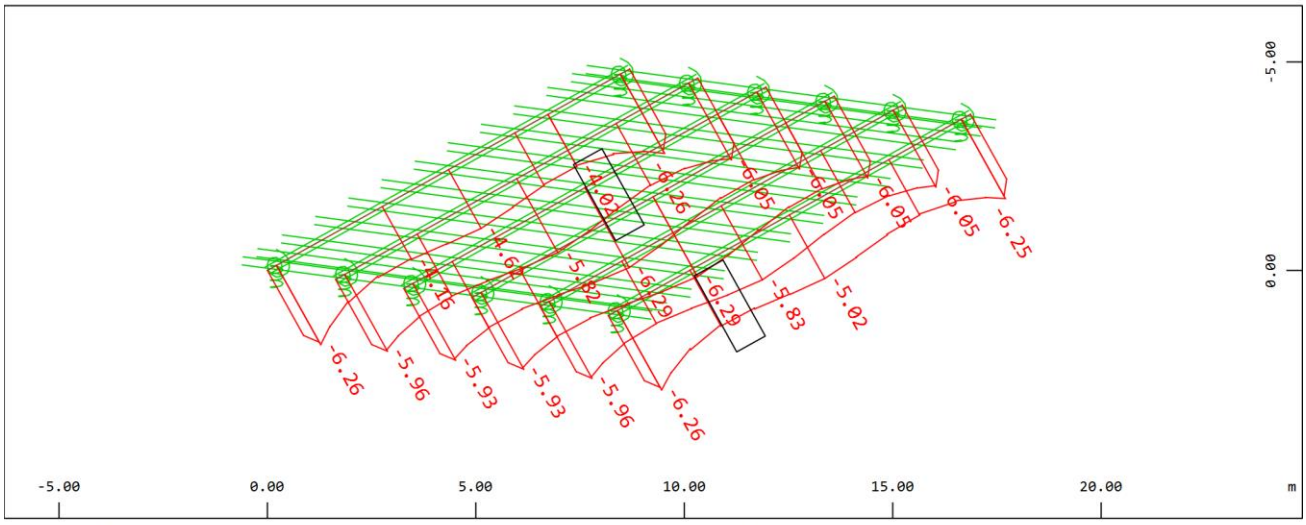
Beam Elements , Maximum stress in tendon, Design Case 9321 Stress freq_Pk_sup_maxMY,
Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress
(Unit=1000. MPa) (Max=1288.)

M 1 : 163
X * 0.502
Y * 0.906
Z * 0.962



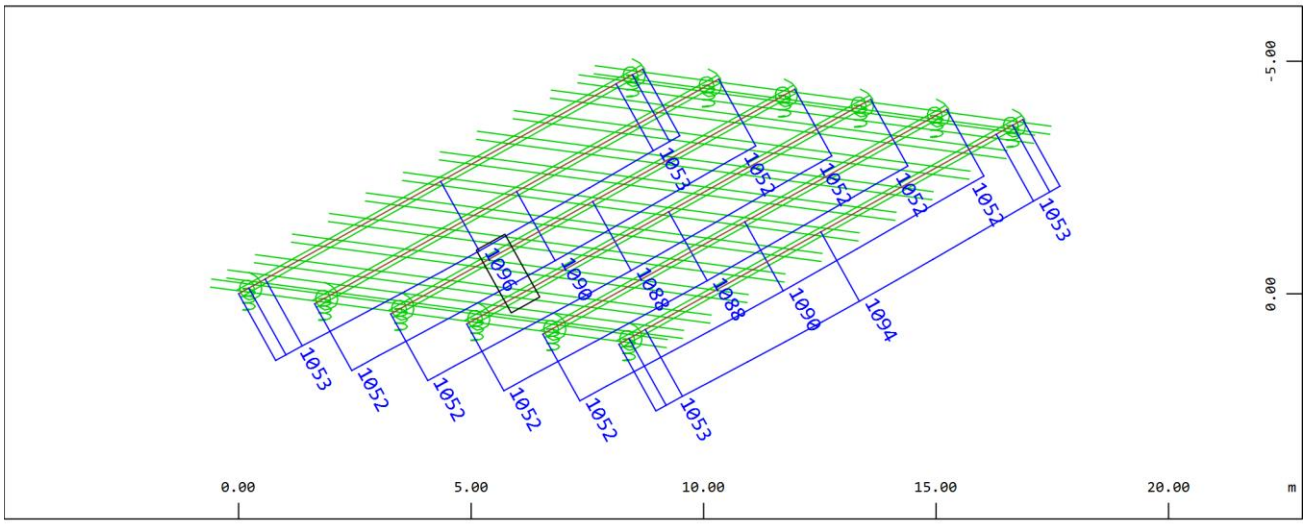
Beam Elements , Uniaxial top stress, Design Case 9405 perm_traffic_opening_inf+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-4.99) (Max=-3.93)

M 1 : 167
X * 0.502
Y * 0.906
Z * 0.962



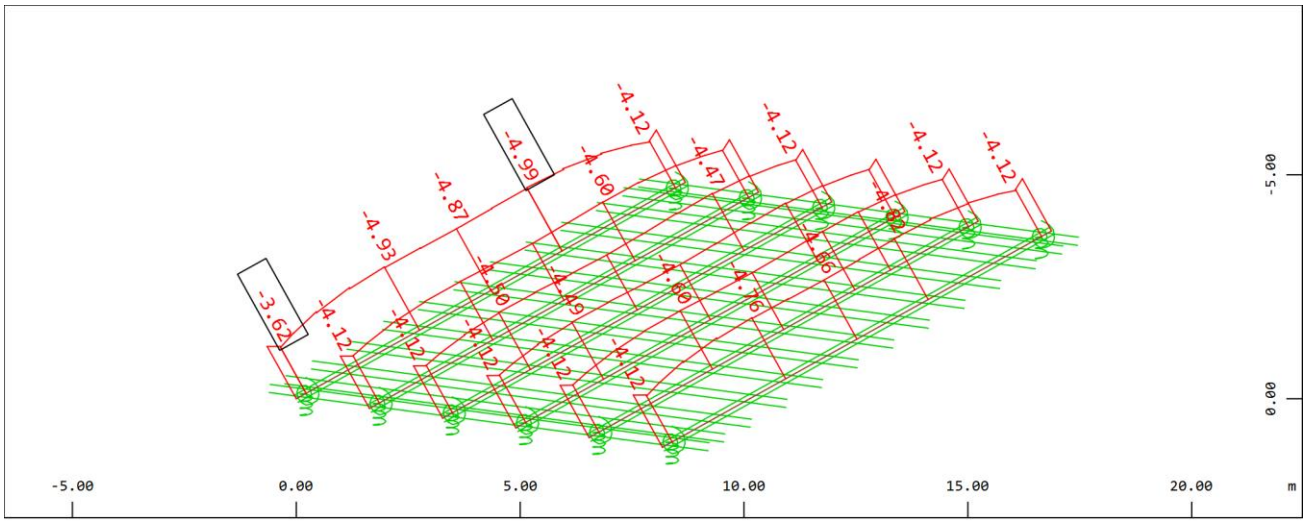
Beam Elements , Uniaxial bottom stress, Design Case 9405 perm_traffic_opening_inf+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-6.29) (Max=-4.02)

M 1 : 174
X * 0.502
Y * 0.906
Z * 0.962



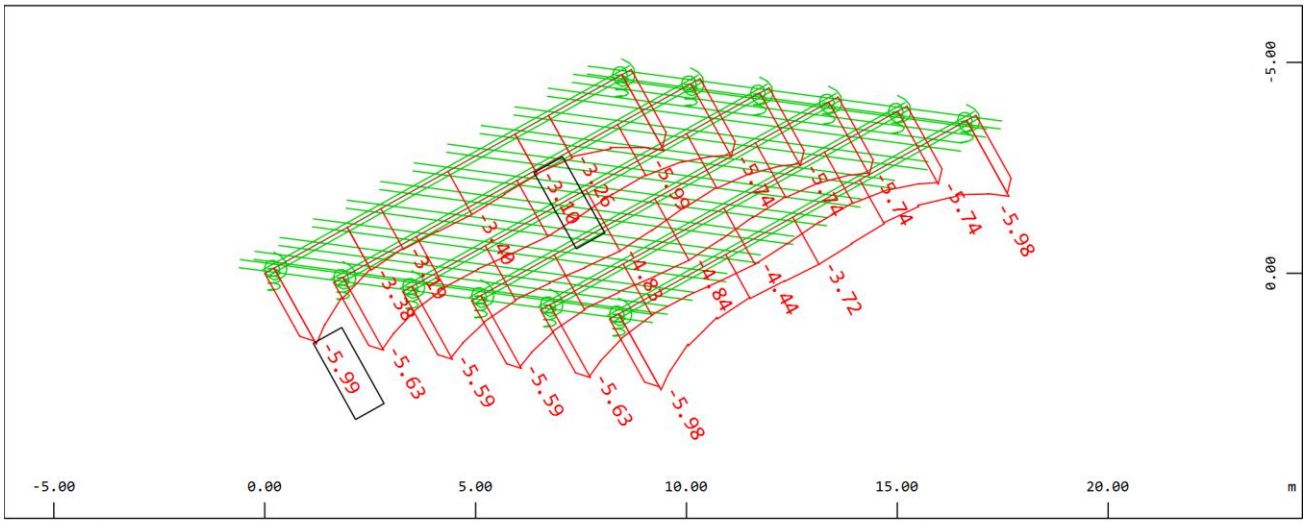
Beam Elements , Maximum stress in tendon, Design Case 9405 perm_traffic_opening_inf+, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress (Unit=1000. MPa) (Max=1096.)

M 1 : 156
X * 0.502
Y * 0.906
Z * 0.962



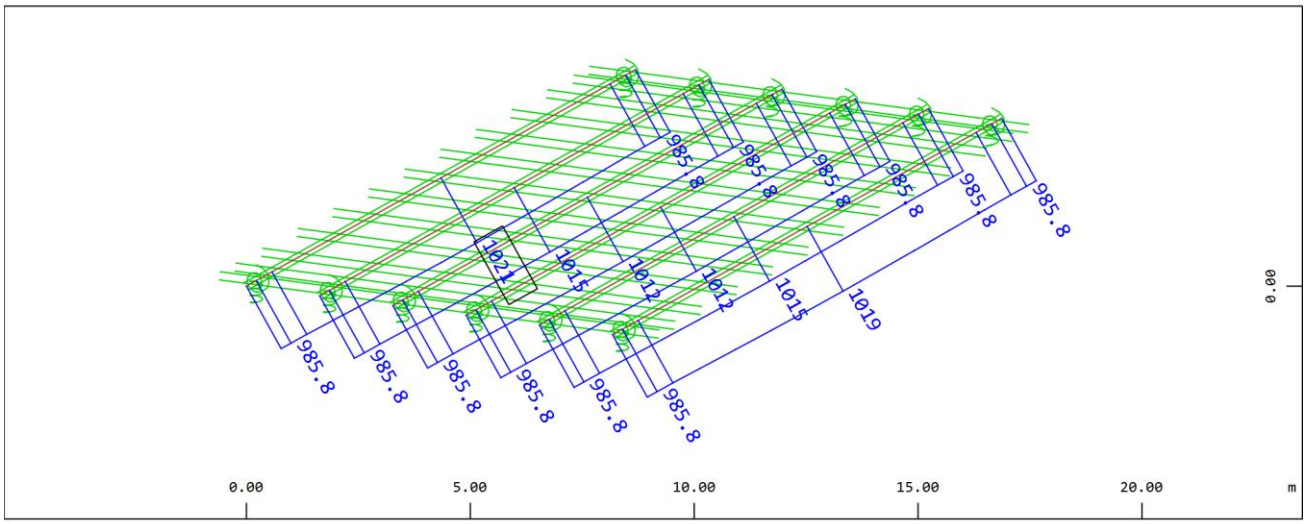
Beam Elements , Uniaxial top stress, Design Case 9415 perm_inf+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-4.99) (Max=-3.62)

M 1 : 162
X * 0.502
Y * 0.906
Z * 0.962



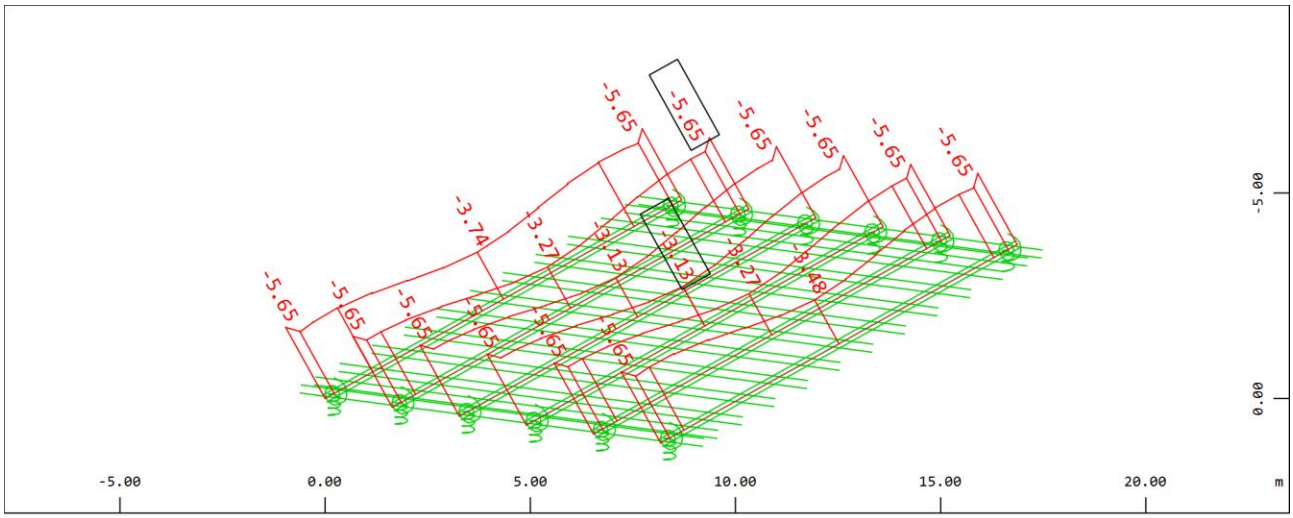
Beam Elements , Uniaxial bottom stress, Design Case 9415 perm_inf+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-5.99) (Max=-3.10)

M 1 : 172
X * 0.502
Y * 0.906
Z * 0.962



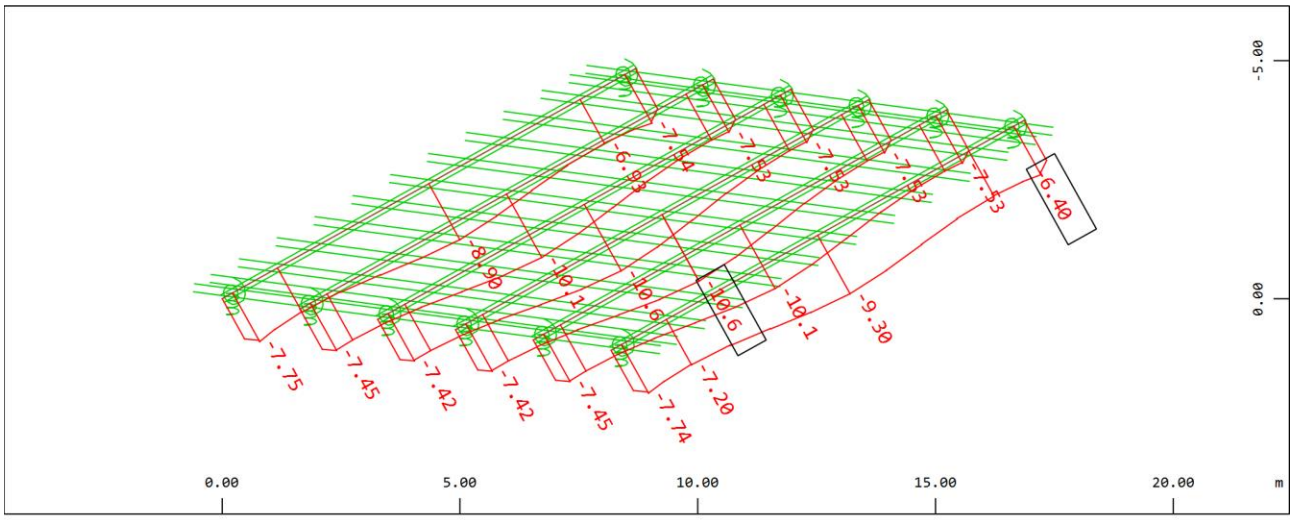
Beam Elements , Maximum stress in tendon, Design Case 9415 perm_inf+, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress (Unit=1000. MPa) (Max=1021.)

M 1 : 162
X * 0.502
Y * 0.906
Z * 0.962



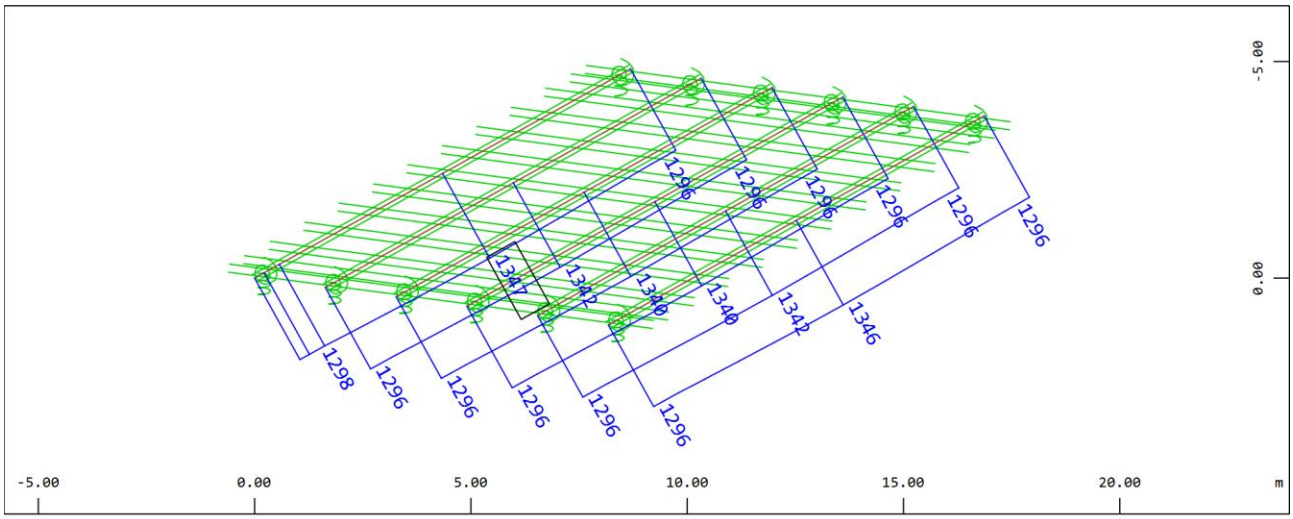
Beam Elements , Uniaxial top stress, Design Case 9411 perm_traffic_opening_sup+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-5.65) (Max=-3.13)

M 1 : 175
X * 0.502
Y * 0.906
Z * 0.962



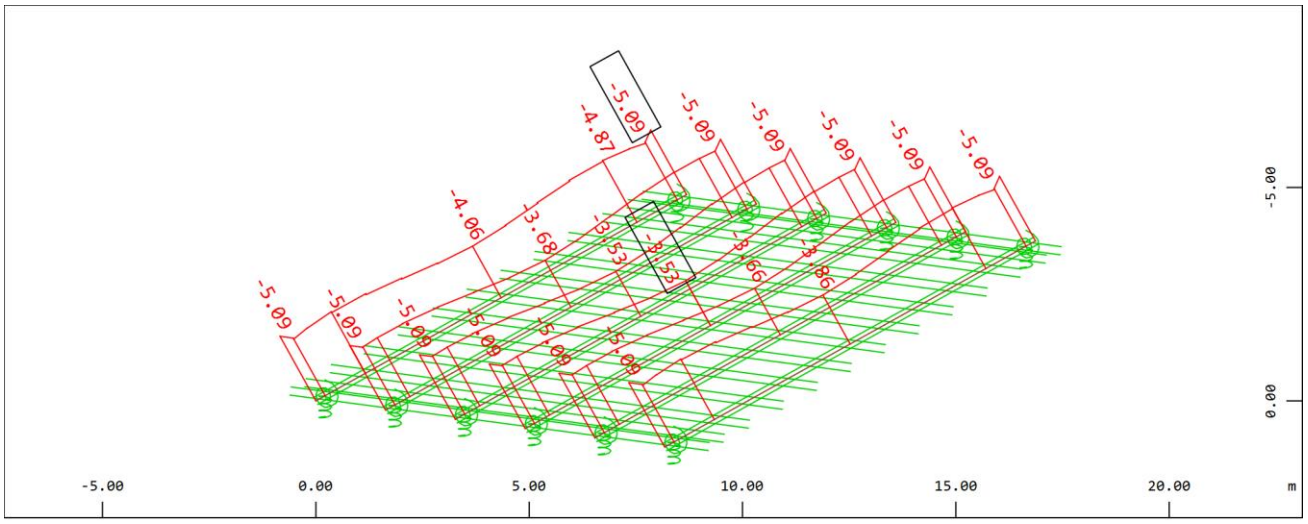
Beam Elements , Uniaxial bottom stress, Design Case 9411 perm_traffic_opening_sup+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 10.0 MPa (Min=-10.6) (Max=-6.40)

M 1 : 151
X * 0.502
Y * 0.906
Z * 0.962



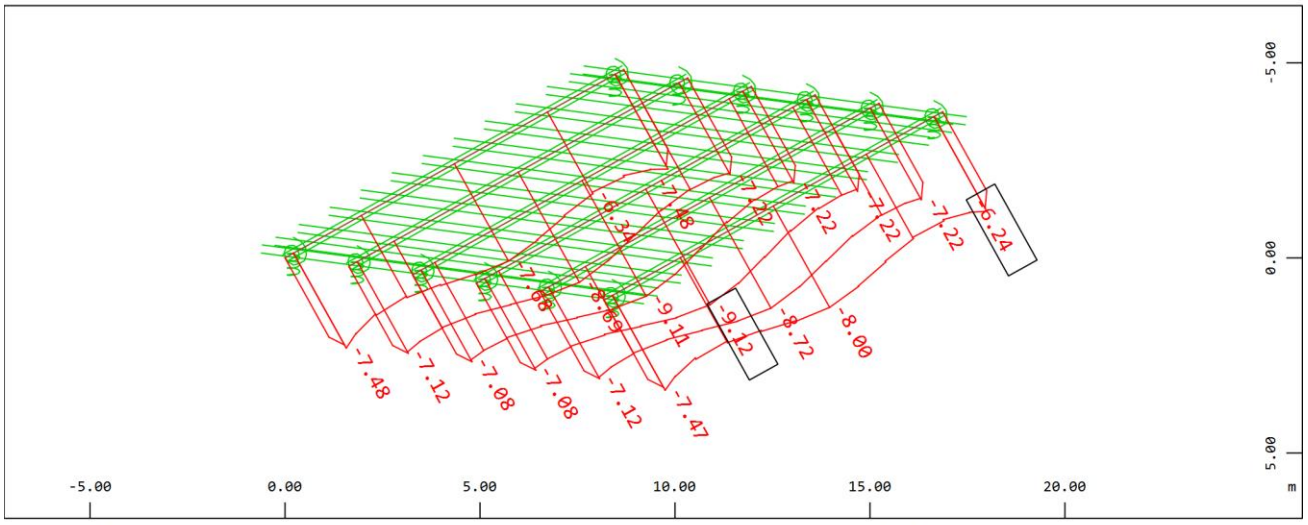
Beam Elements , Maximum stress in tendon, Design Case 9411 perm_traffic_opening_sup+, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress (Unit=1000. MPa) (Max=1347.)

M 1 : 166
X * 0.502
Y * 0.906
Z * 0.962



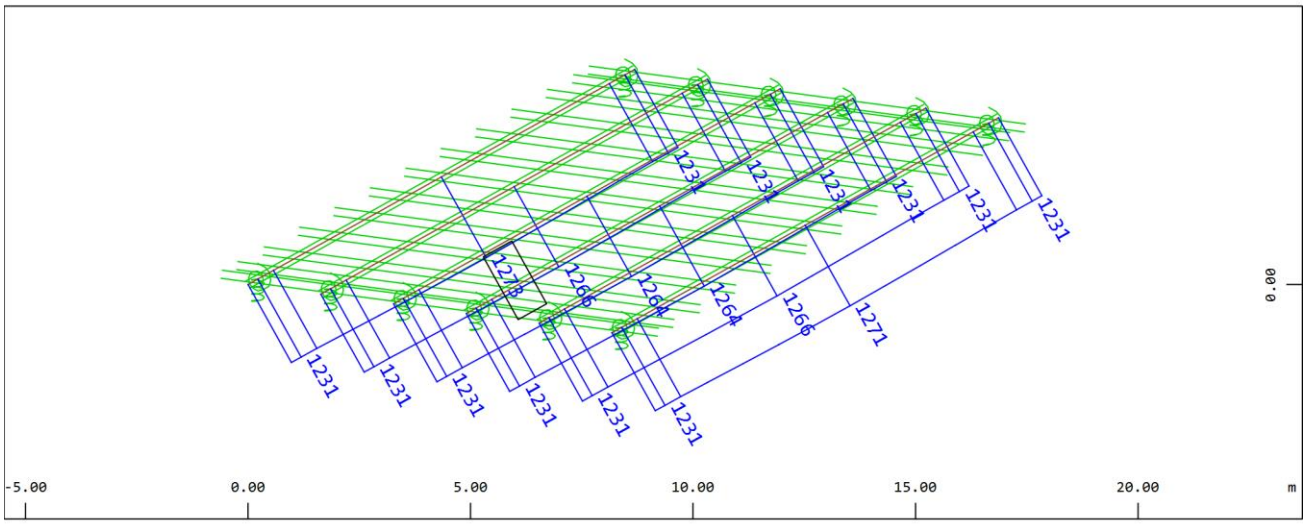
Beam Elements , Uniaxial top stress, Design Case 9421 perm_sup+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-5.09) (Max=-3.53)

M 1 : 170
X * 0.502
Y * 0.906
Z * 0.962



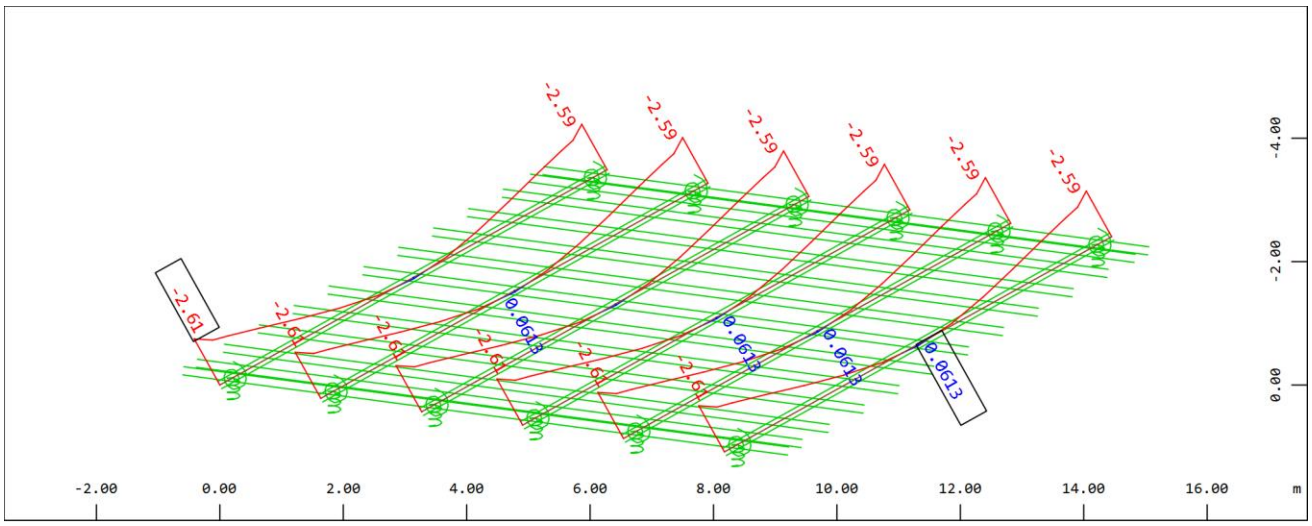
Beam Elements , Uniaxial bottom stress, Design Case 9421 perm_sup+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-9.12) (Max=-6.24)

M 1 : 186
X * 0.502
Y * 0.906
Z * 0.962



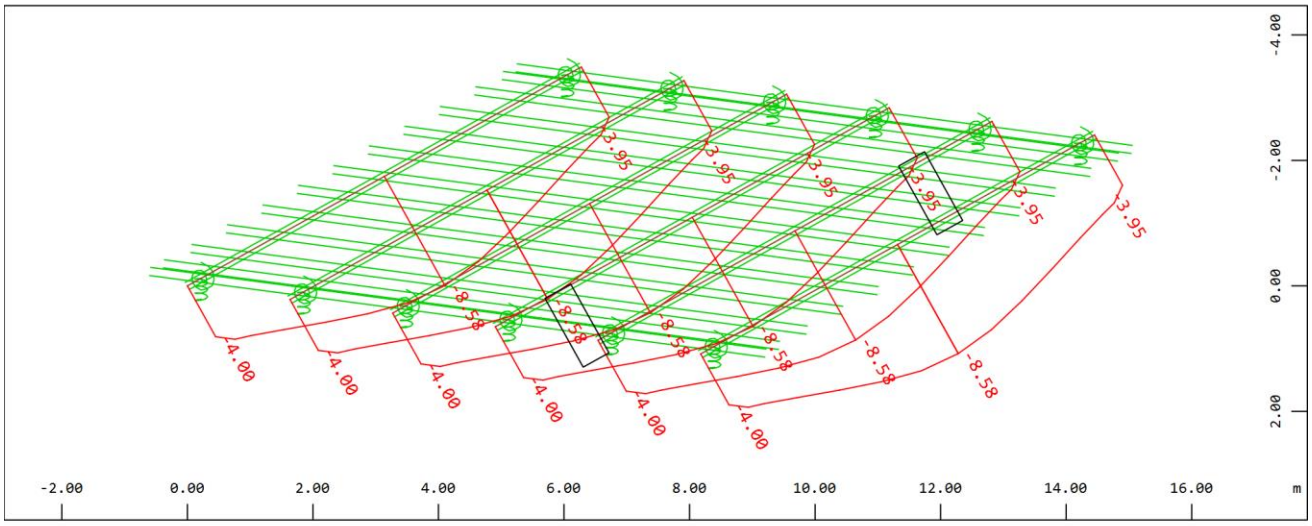
Beam Elements , Maximum stress in tendon, Design Case 9421 perm_sup+, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress (Unit=1000. MPa) (Max=1273.)

M 1 : 163
X * 0.502
Y * 0.906
Z * 0.962



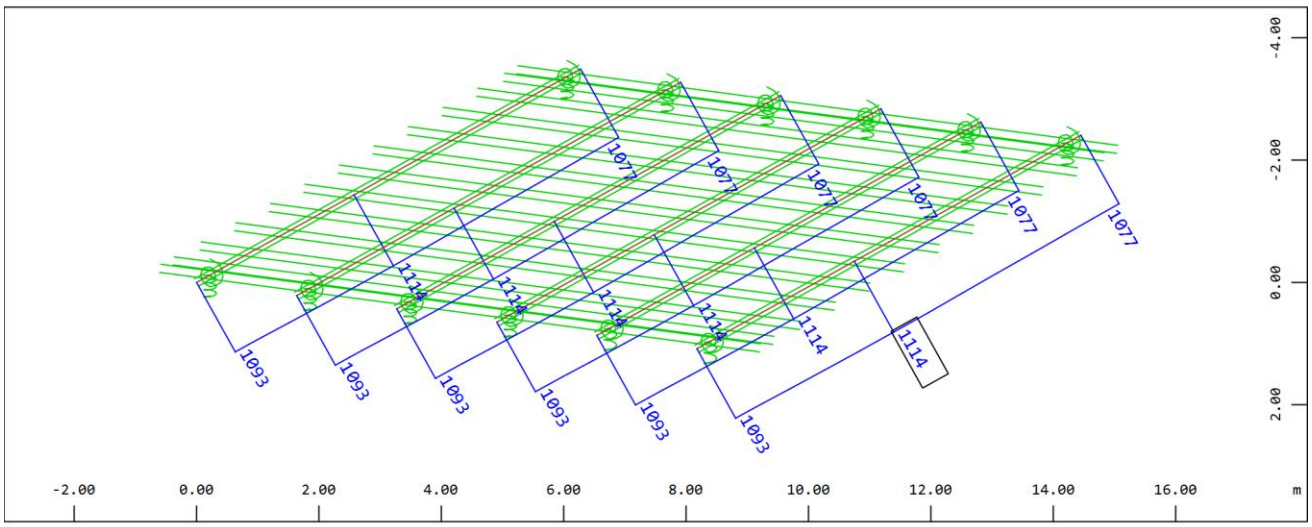
Beam Elements , Uniaxial top stress, Design Case 7010 Sum_10 Prestress, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-2.61) (Max=0.0613)

M 1 : 118
X * 0.502
Y * 0.906
Z * 0.962



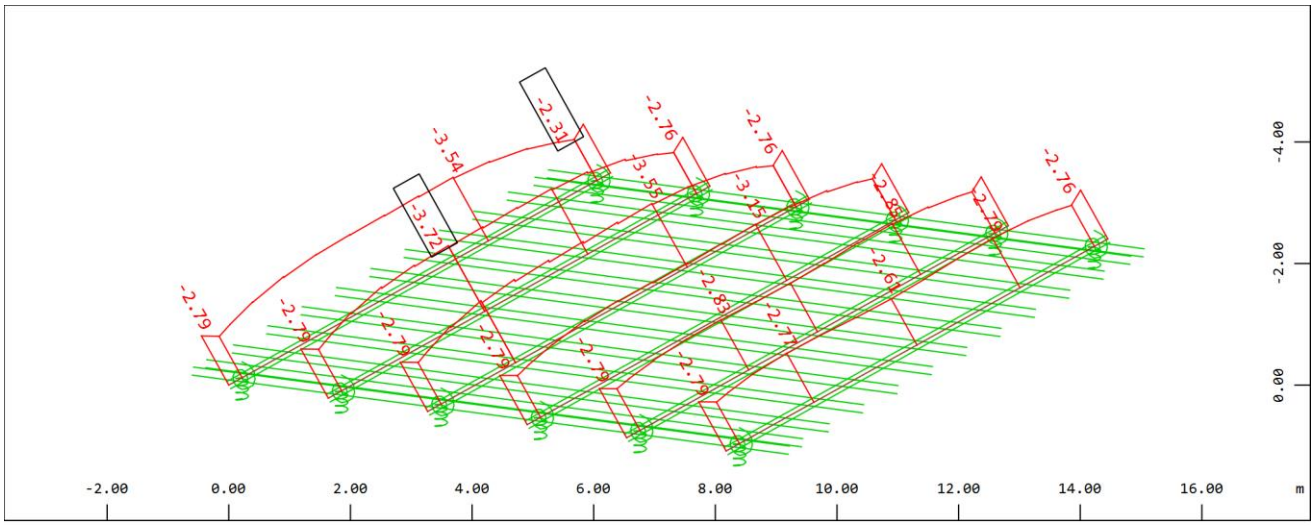
Beam Elements , Uniaxial bottom stress, Design Case 7010 Sum_10 Prestress, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-8.58) (Max=-3.95)

M 1 : 116
X * 0.502
Y * 0.906
Z * 0.962



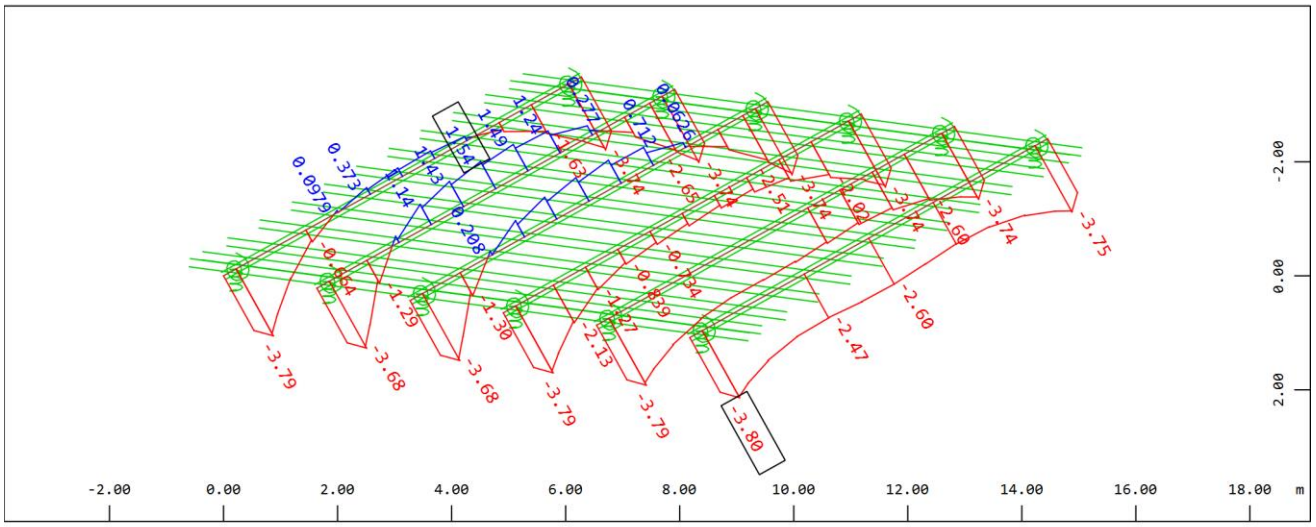
Beam Elements , Maximum stress in tendon, Design Case 7010 Sum_10 Prestress, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress (Unit=1000. MPa) (Max=1114.)

M 1 : 119
X * 0.502
Y * 0.906
Z * 0.962



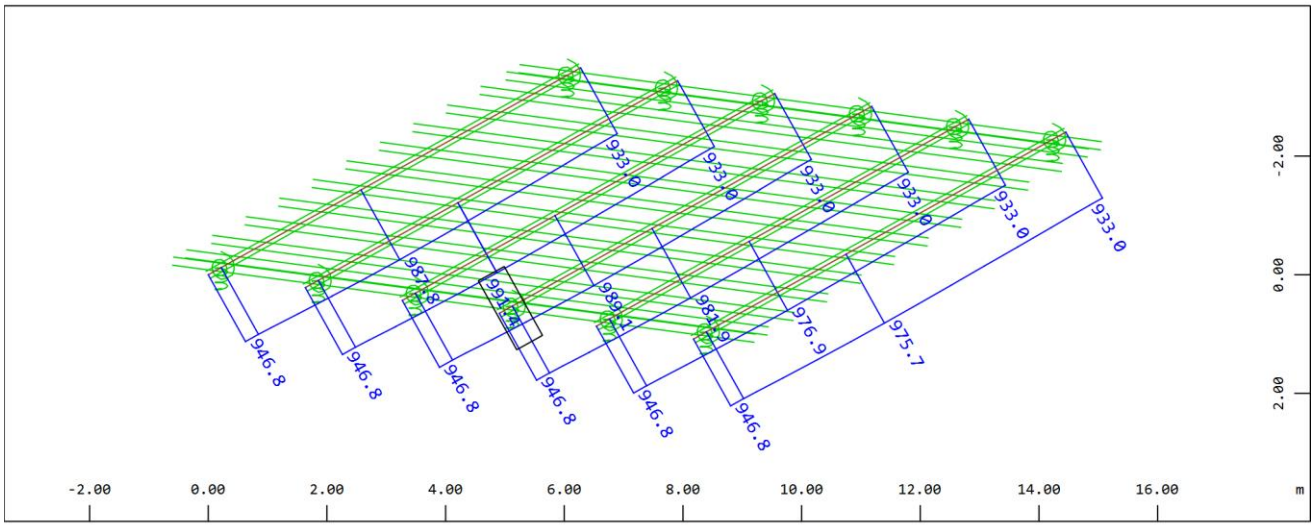
Beam Elements , Uniaxial top stress, Design Case 9105 Stress time t1 rare_Pk_inf_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-3.72) (Max=-2.31)

M 1 : 120
X * 0.502
Y * 0.906
Z * 0.962



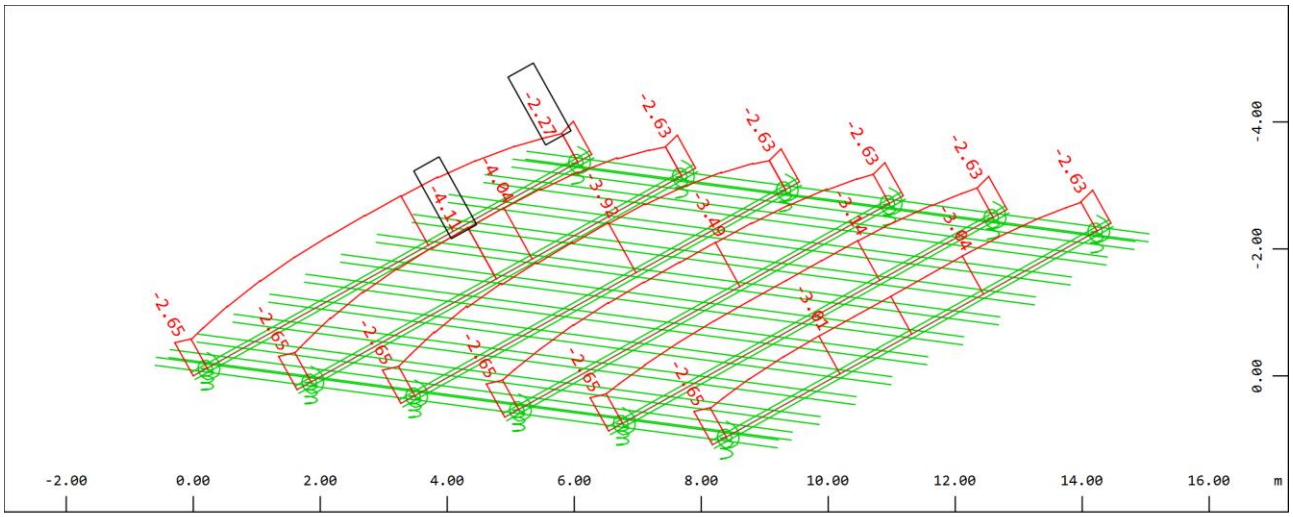
Beam Elements , Uniaxial bottom stress, Design Case 9105 Stress time t1 rare_Pk_inf_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-3.80) (Max=1.54)

M 1 : 128
X * 0.502
Y * 0.906
Z * 0.962



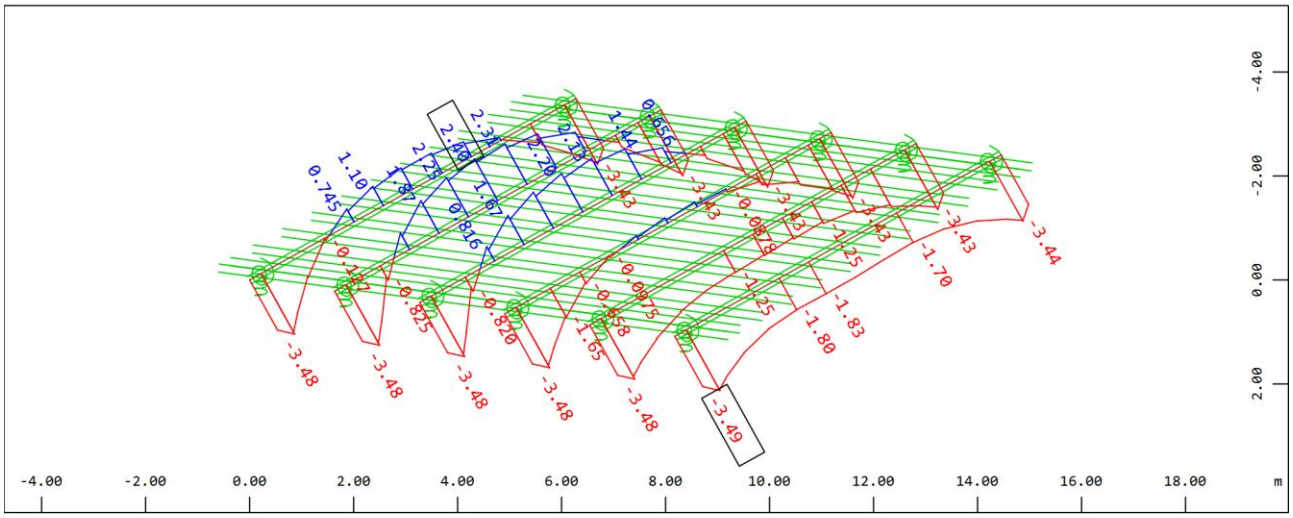
Beam Elements , Maximum stress in tendon, Design Case 9105 Stress time t1
rare_Pk_inf_maxMY, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements
, Maximum Stress (Unit=902.3 MPa) (Max=991.4)

M 1 : 123
X * 0.502
Y * 0.906
Z * 0.962



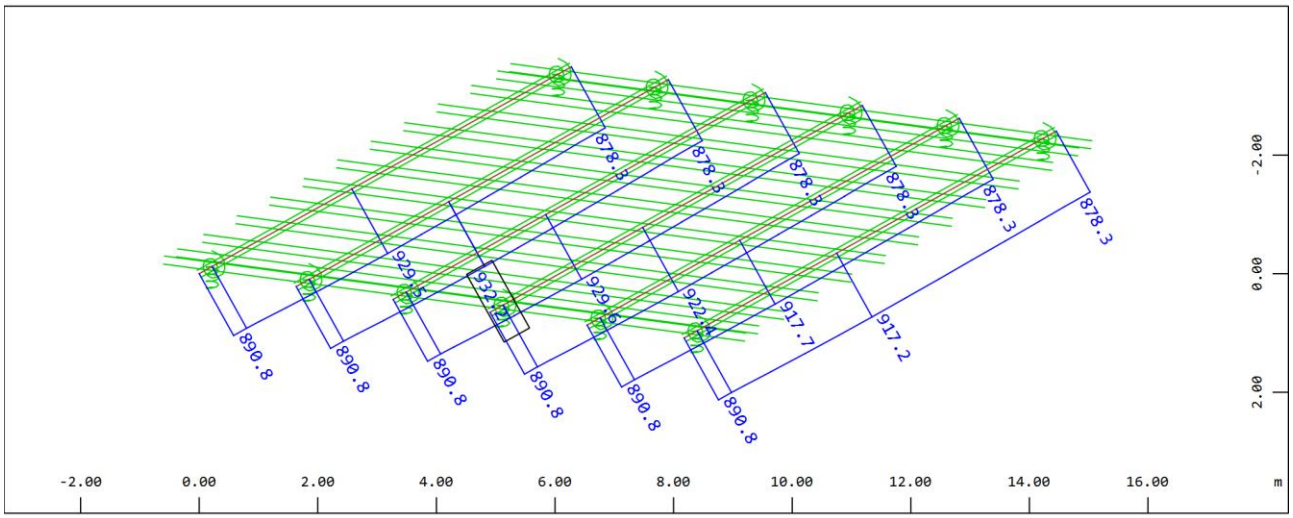
Beam Elements , Uniaxial top stress, Design Case 9115 Stress rare_Pk_inf_maxMY, Material 1
C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-4.11) (Max=-2.27)

M 1 : 113
X * 0.502
Y * 0.906
Z * 0.962



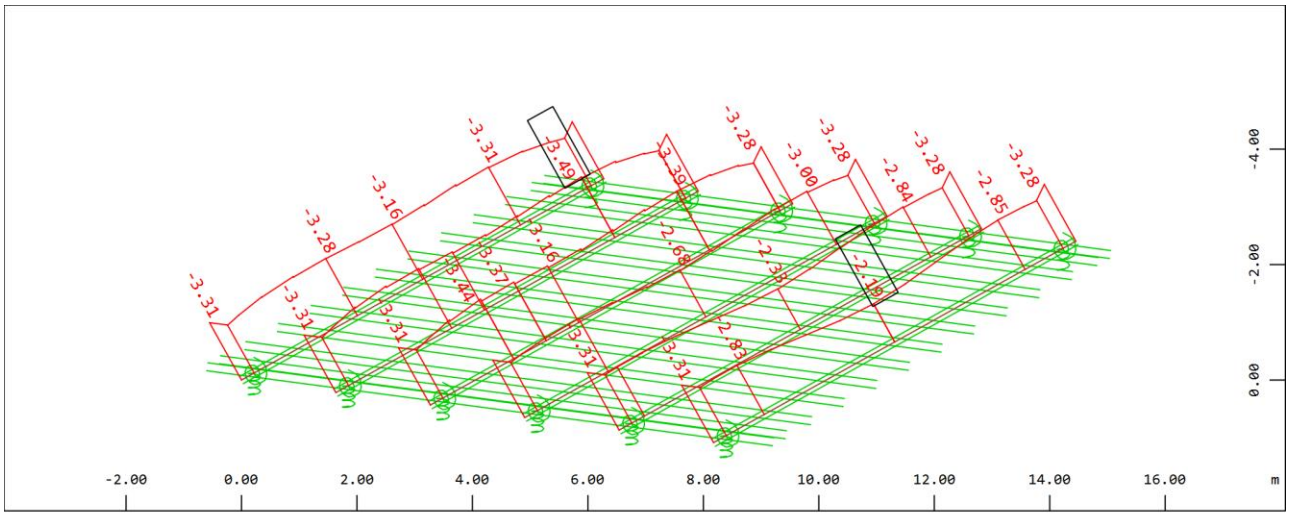
Beam Elements , Uniaxial bottom stress, Design Case 9115 Stress rare_Pk_inf_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-3.49) (Max=2.40)

M 1 : 138
X * 0.502
Y * 0.906
Z * 0.962



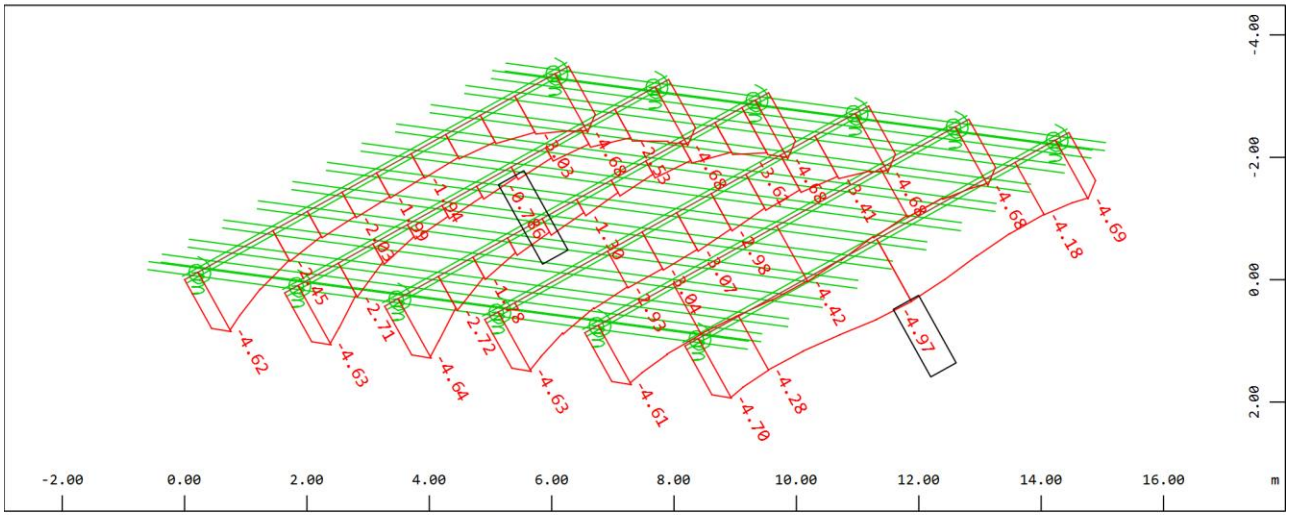
Beam Elements , Maximum stress in tendon, Design Case 9115 Stress rare_Pk_inf_maxMY,
Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress
(Unit=902.3 MPa) (Max=932.2)

M 1 : 121
X * 0.502
Y * 0.906
Z * 0.962



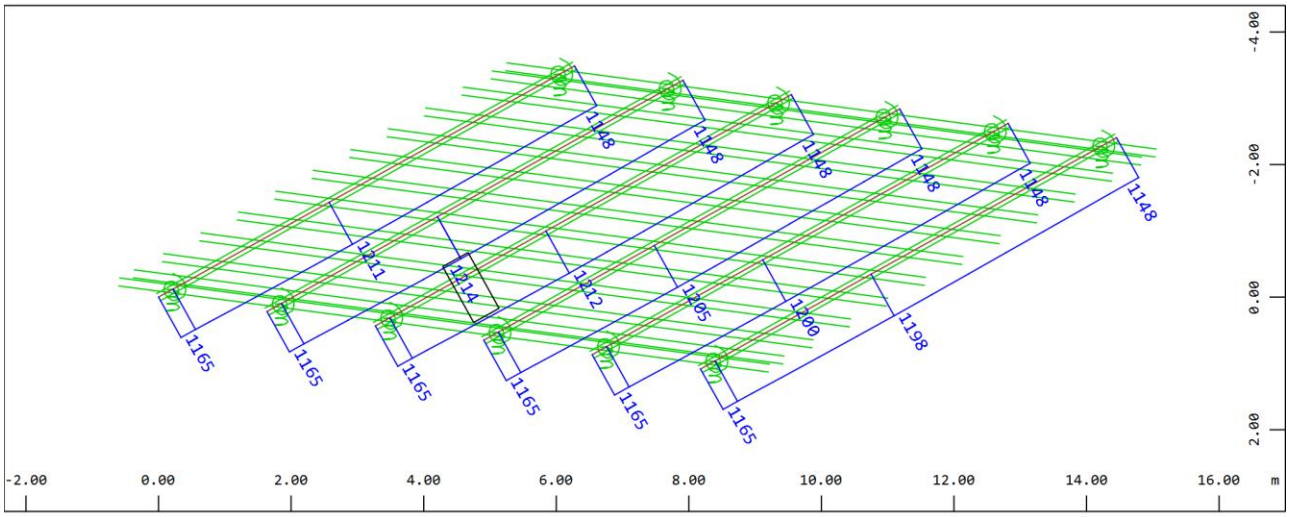
Beam Elements , Uniaxial top stress, Design Case 9111 Stress time t1 rare_Pk_sup_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-3.49) (Max=-2.19)

M 1 : 124
X * 0.502
Y * 0.906
Z * 0.962



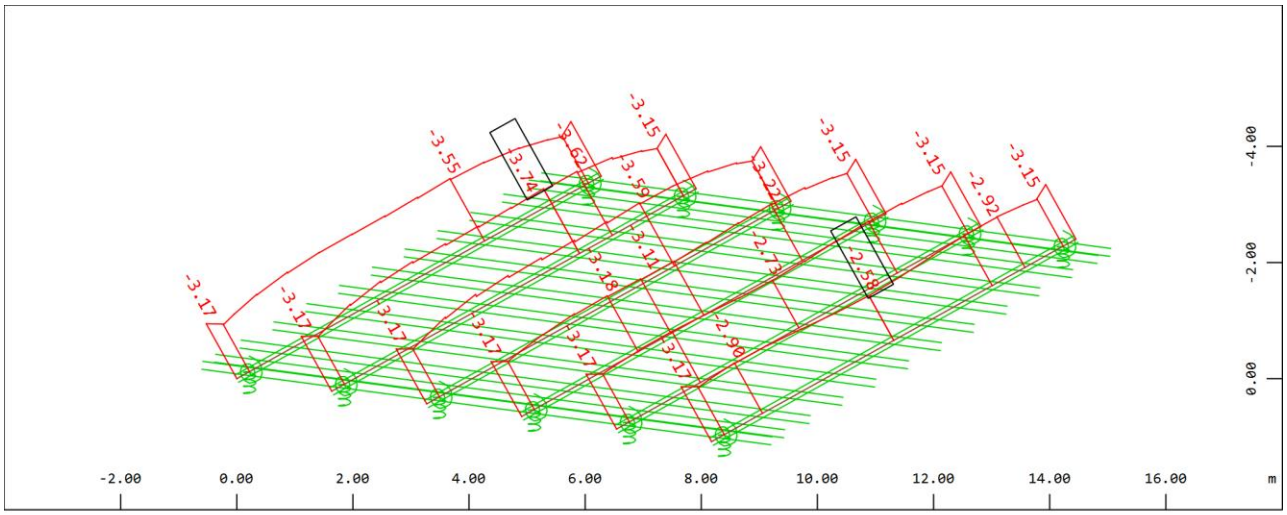
Beam Elements , Uniaxial bottom stress, Design Case 9111 Stress time t1 rare_Pk_sup_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-4.97) (Max=-0.786)

M 1 : 117
X * 0.502
Y * 0.906
Z * 0.962



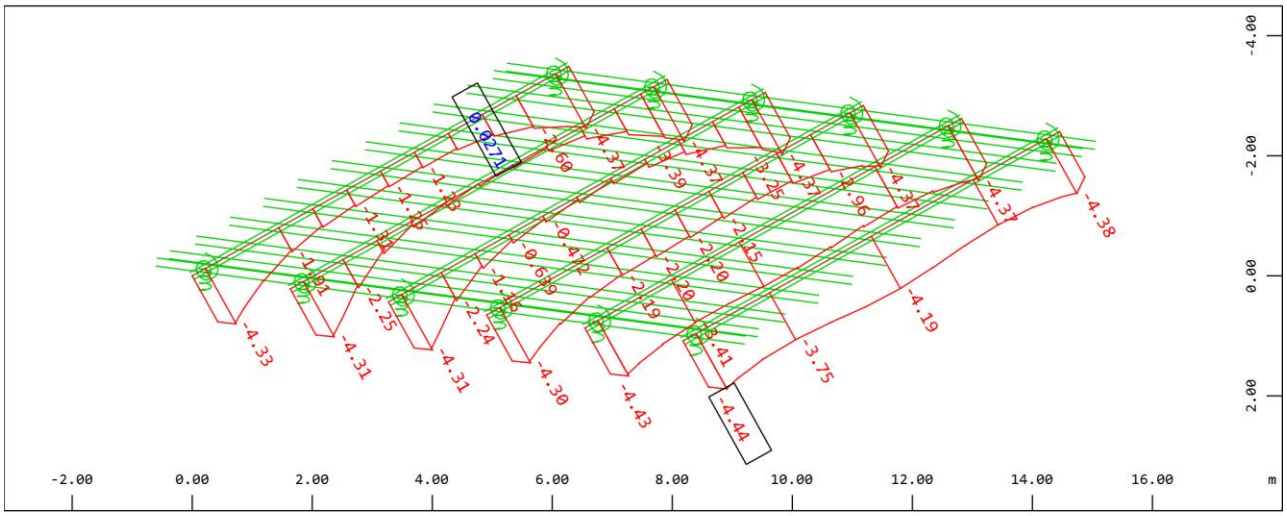
Beam Elements , Maximum stress in tendon, Design Case 9111 Stress time t1
rare_Pk_sup_maxMY, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements
, Maximum Stress (Unit=1805. MPa) (Max=1214.)

M 1 : 108
X * 0.502
Y * 0.906
Z * 0.962



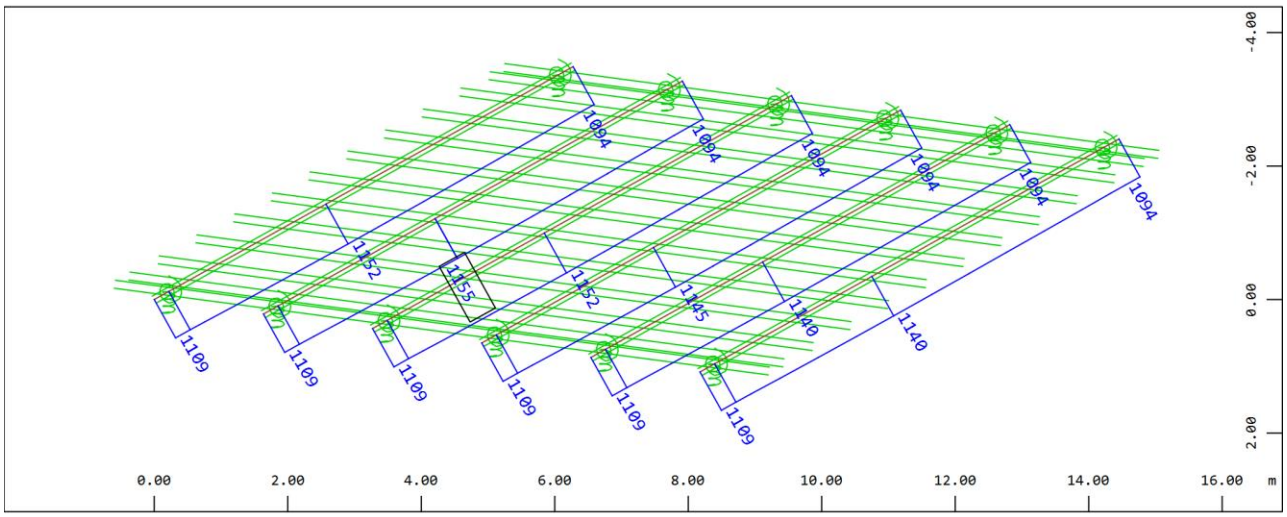
Beam Elements , Uniaxial top stress, Design Case 9121 Stress rare_Pk_sup_maxMY, Material 1
C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-3.74) (Max=-2.58)

M 1 : 123
X * 0.502
Y * 0.906
Z * 0.962



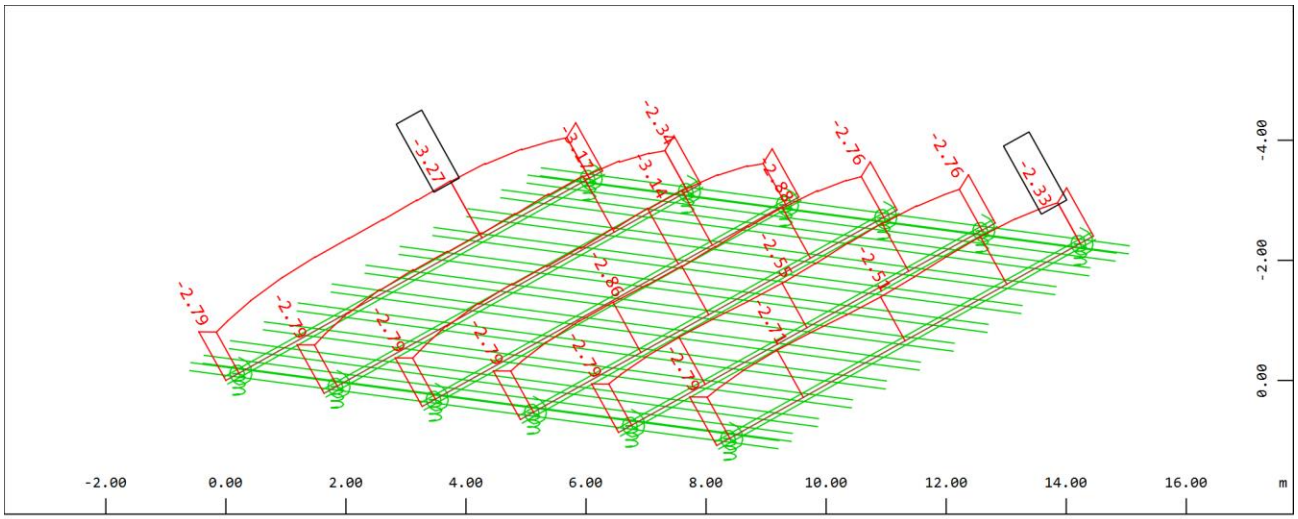
Beam Elements , Uniaxial bottom stress, Design Case 9121 Stress rare_Pk_sup_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-4.44) (Max=0.0271)

M 1 : 119
X * 0.502
Y * 0.906
Z * 0.962



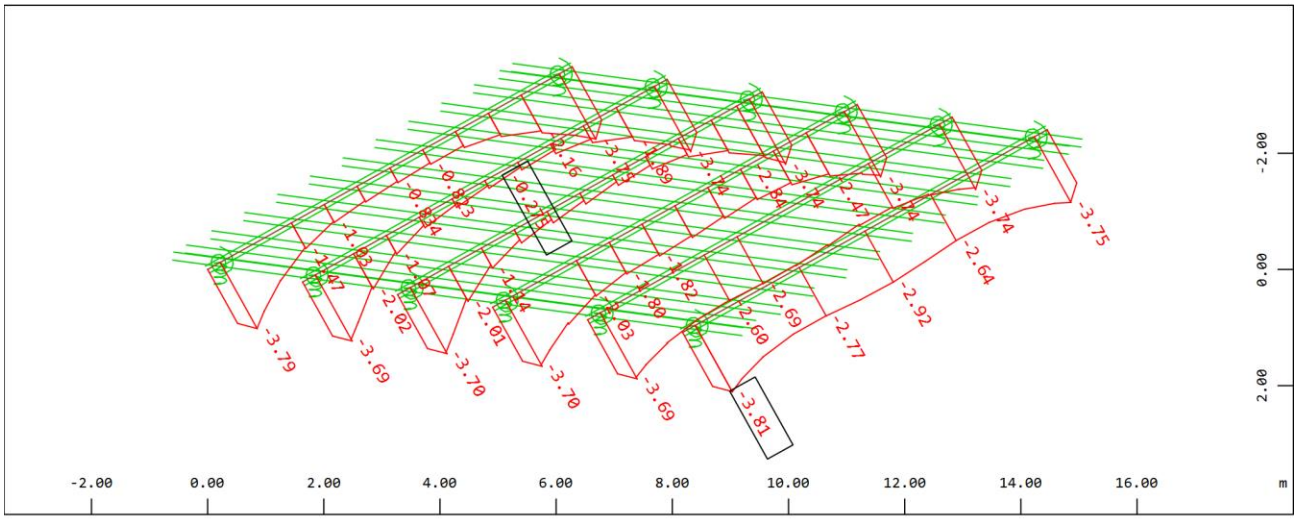
Beam Elements , Maximum stress in tendon, Design Case 9121 Stress rare_Pk_sup_maxMY,
Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress
(Unit=1805. MPa) (Max=1155.)

M 1 : 107
X * 0.502
Y * 0.906
Z * 0.962



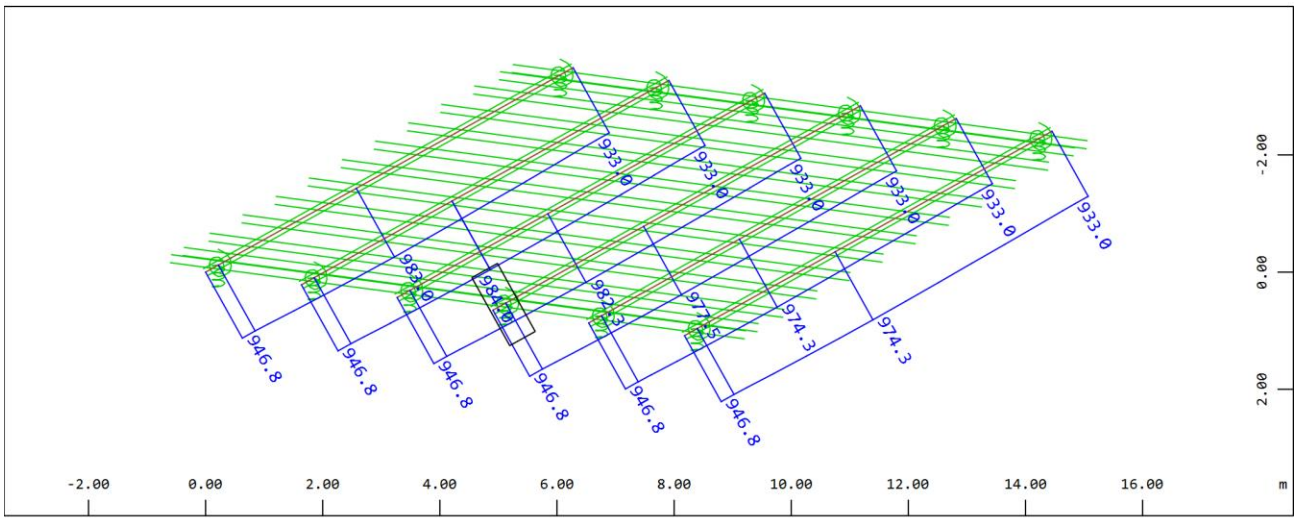
Beam Elements , Uniaxial top stress, Design Case 9305 Stress time t1 freq_Pk_inf_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-3.27) (Max=-2.33)

M 1 : 120
X * 0.502
Y * 0.906
Z * 0.962



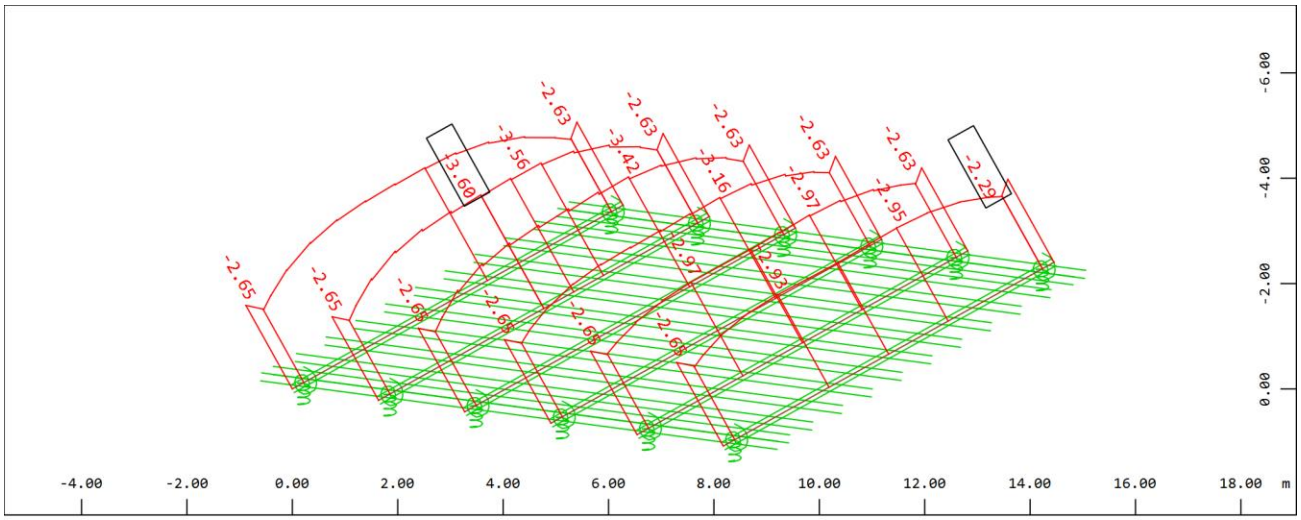
Beam Elements , Uniaxial bottom stress, Design Case 9305 Stress time t1 freq_Pk_inf_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-3.81) (Max=-0.275)

M 1 : 124
X * 0.502
Y * 0.906
Z * 0.962



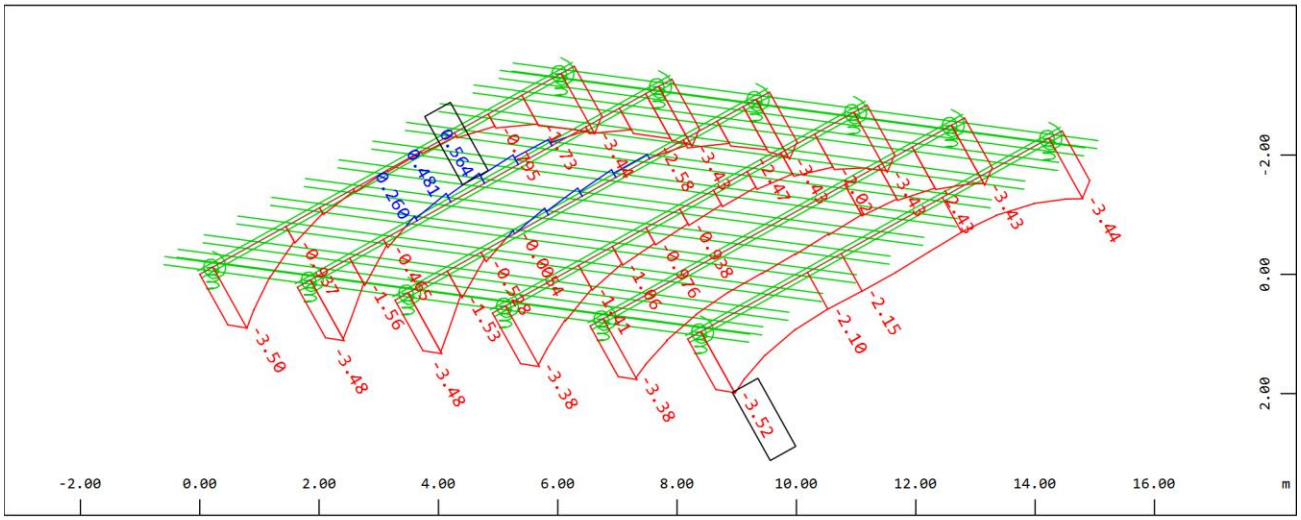
Beam Elements , Maximum stress in tendon, Design Case 9305 Stress time t1
freq_Pk_inf_maxMY, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements
, Maximum Stress (Unit=902.3 MPa) (Max=984.0)

M 1 : 123
X * 0.502
Y * 0.906
Z * 0.962



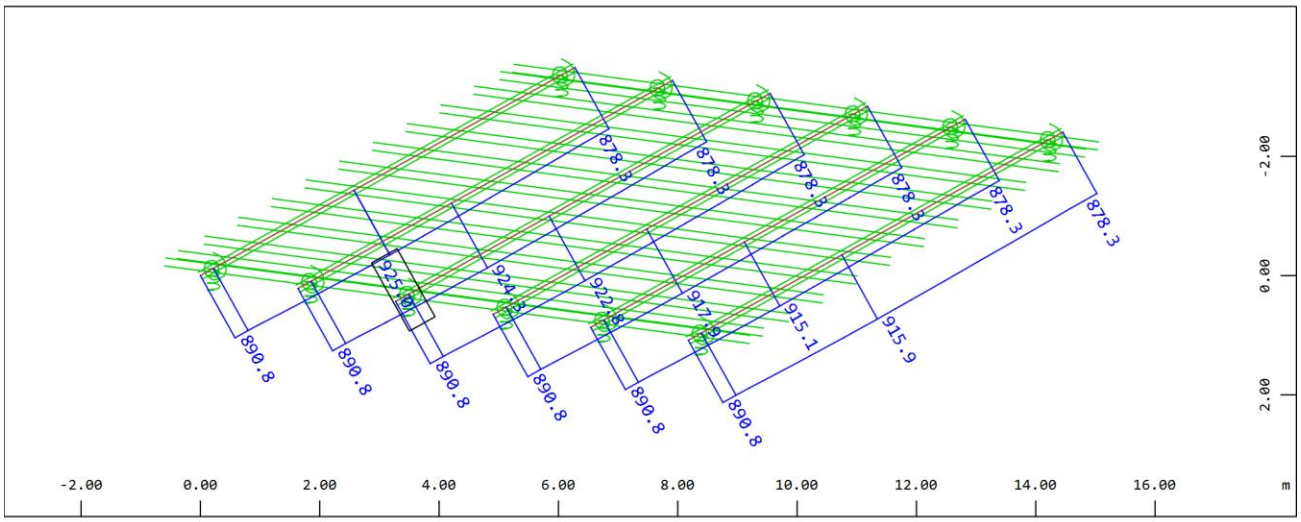
Beam Elements , Uniaxial top stress, Design Case 9315 Stress freq_Pk_inf_maxMY, Material 1
C 50/60 (EN 1992) , 1 cm 3D = 2.00 MPa (Min=-3.60) (Max=-2.29)

M 1 : 137
X * 0.502
Y * 0.906
Z * 0.962



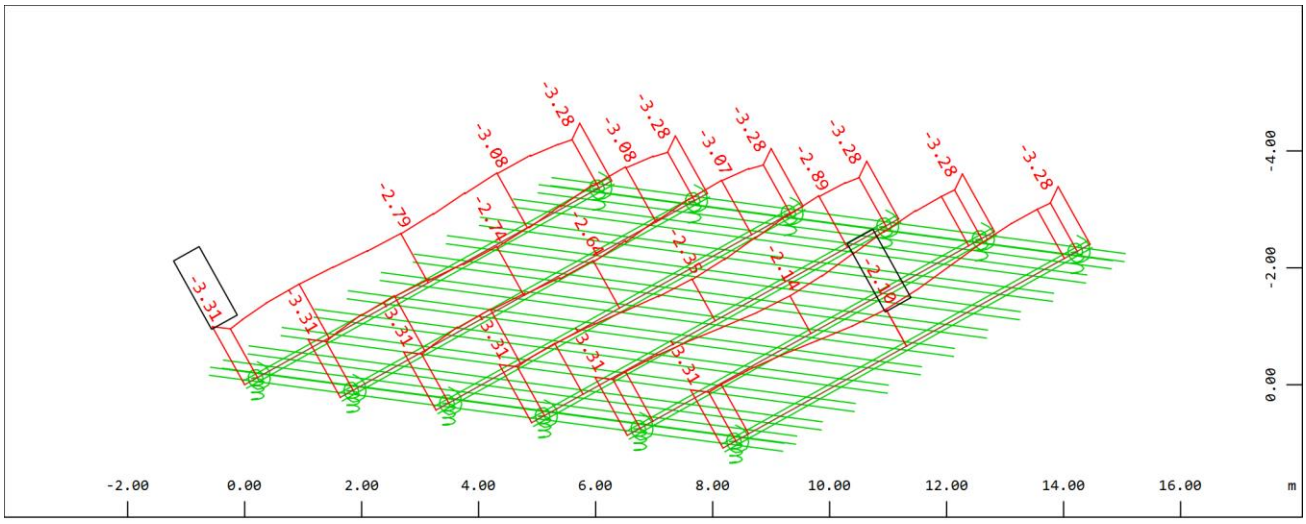
Beam Elements , Uniaxial bottom stress, Design Case 9315 Stress freq_Pk_inf_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-3.52) (Max=0.564)

M 1 : 121
X * 0.502
Y * 0.906
Z * 0.962



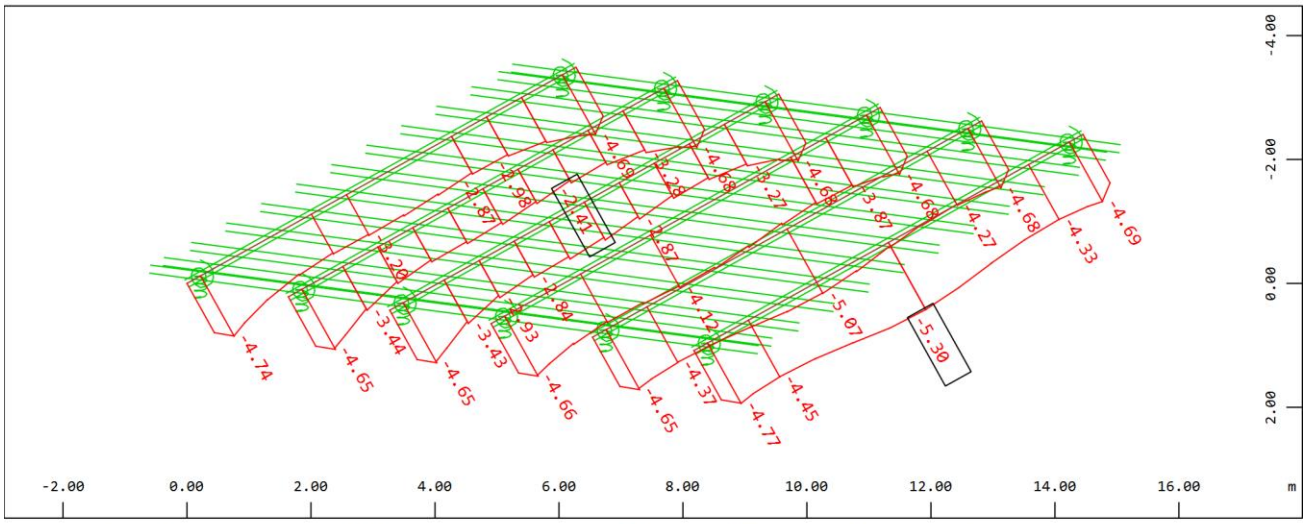
Beam Elements , Maximum stress in tendon, Design Case 9315 Stress freq_Pk_inf_maxMY,
Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress
(Unit=902.3 MPa) (Max=925.0)

M 1 : 121
X * 0.502
Y * 0.906
Z * 0.962



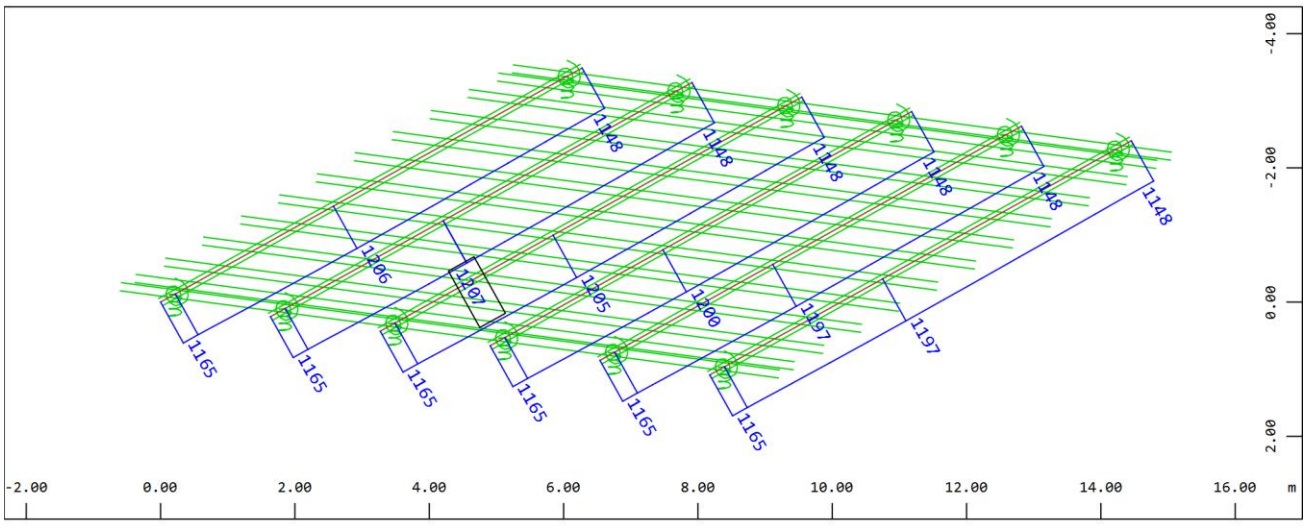
Beam Elements , Uniaxial top stress, Design Case 9311 Stress time t1 freq_Pk_sup_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-3.31) (Max=-2.10)

M 1 : 124
X * 0.502
Y * 0.906
Z * 0.962



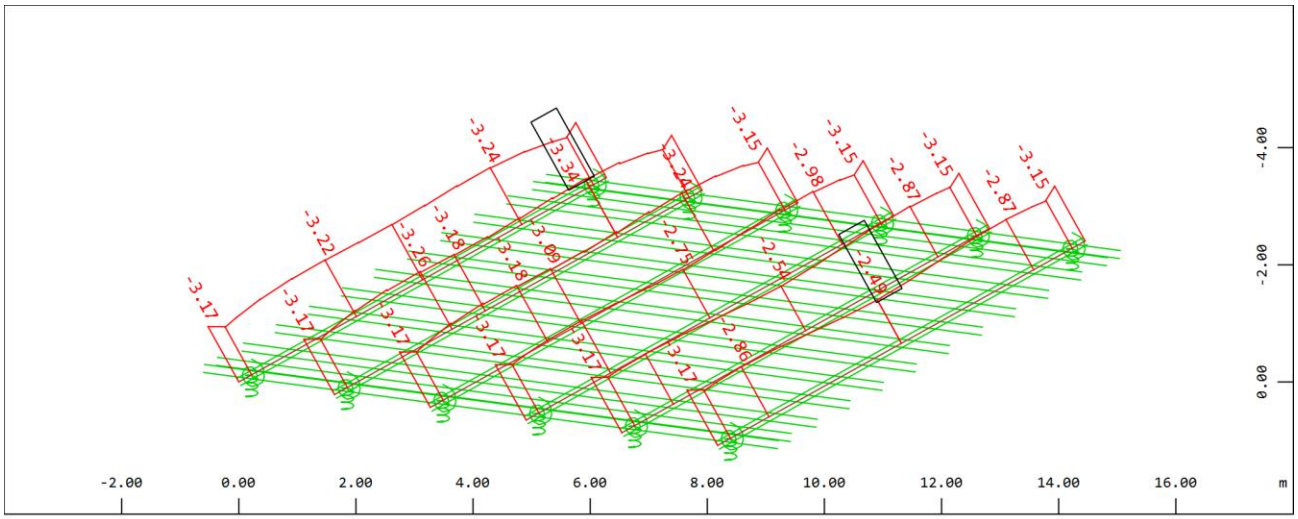
Beam Elements , Uniaxial bottom stress, Design Case 9311 Stress time t1 freq_Pk_sup_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-5.30) (Max=-2.41)

M 1 : 117
X * 0.502
Y * 0.906
Z * 0.962



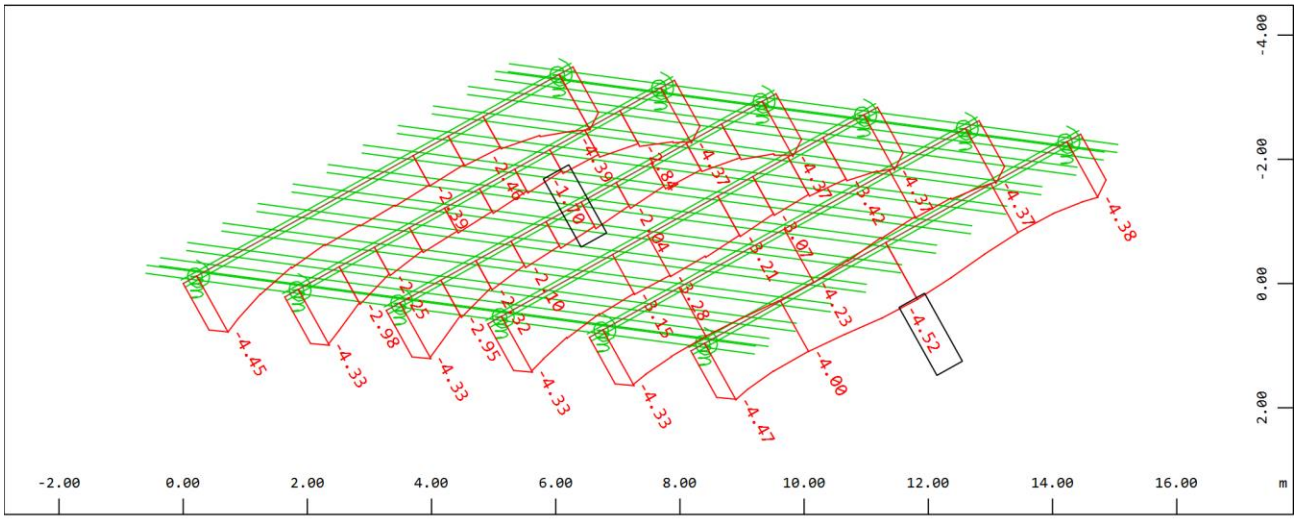
Beam Elements , Maximum stress in tendon, Design Case 9311 Stress time t1
freq_Pk_sup_maxMY, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements
, Maximum Stress (Unit=1805. MPa) (Max=1207.)

M 1 : 108
X * 0.502
Y * 0.906
Z * 0.962



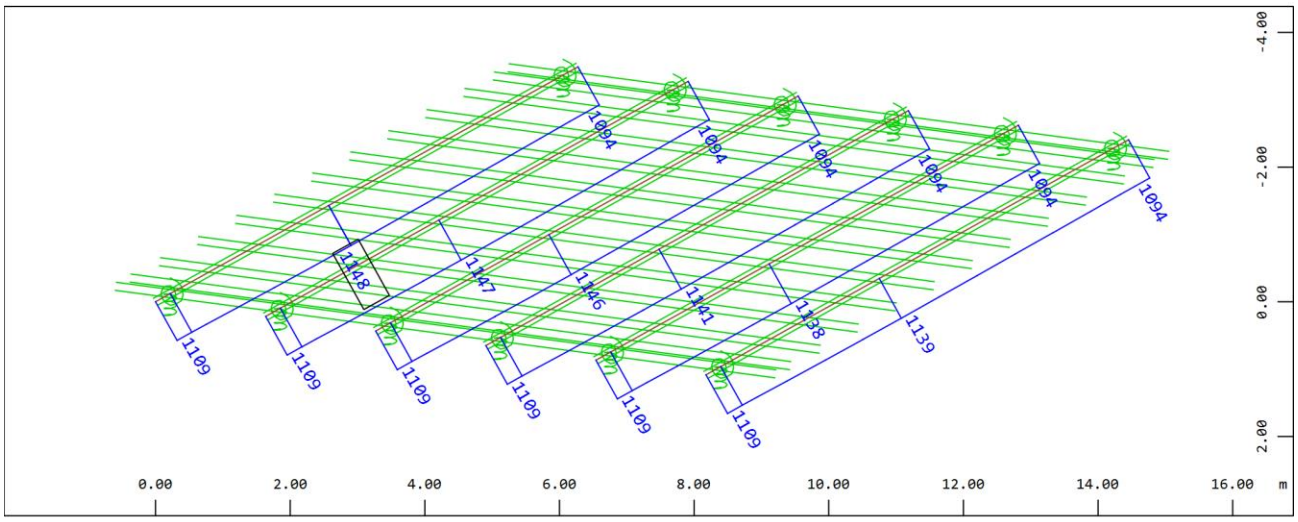
Beam Elements , Uniaxial top stress, Design Case 9321 Stress freq_Pk_sup_maxMY, Material 1
C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-3.34) (Max=-2.49)

M 1 : 123
X * 0.502
Y * 0.906
Z * 0.962



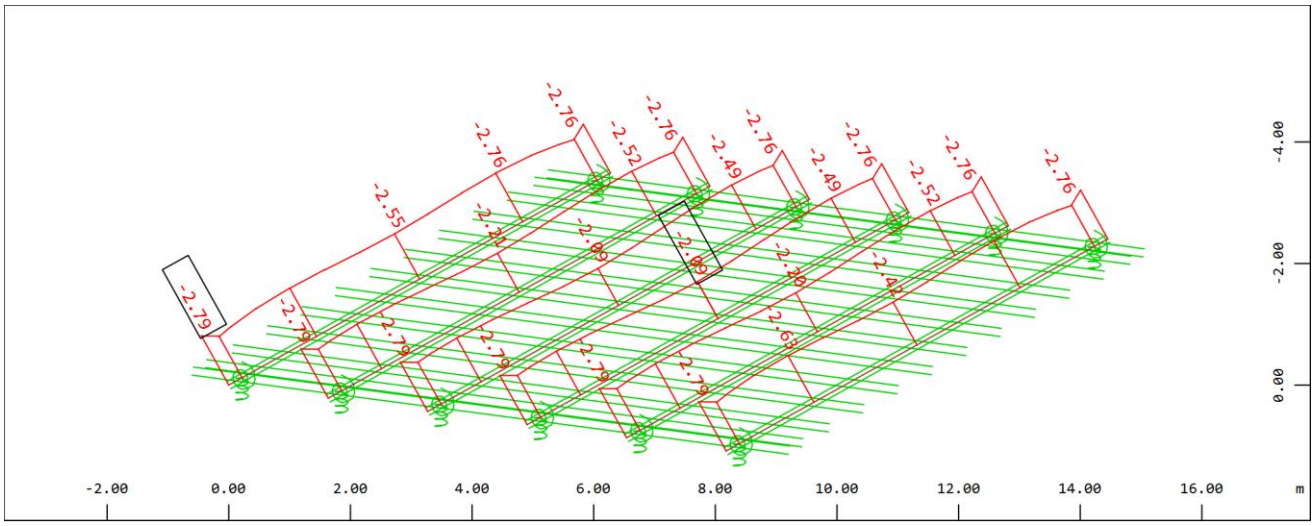
Beam Elements , Uniaxial bottom stress, Design Case 9321 Stress freq_Pk_sup_maxMY,
Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-4.52) (Max=-1.70)

M 1 : 116
X * 0.502
Y * 0.906
Z * 0.962

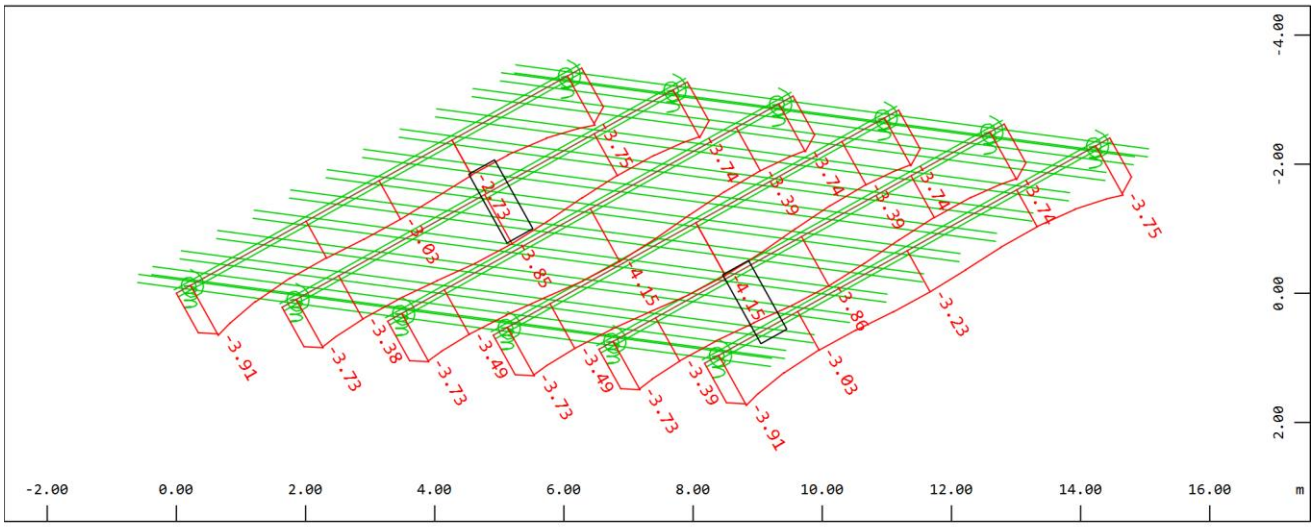


Beam Elements , Maximum stress in tendon, Design Case 9321 Stress freq_Pk_sup_maxMY,
Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress
(Unit=1805. MPa) (Max=1148.)

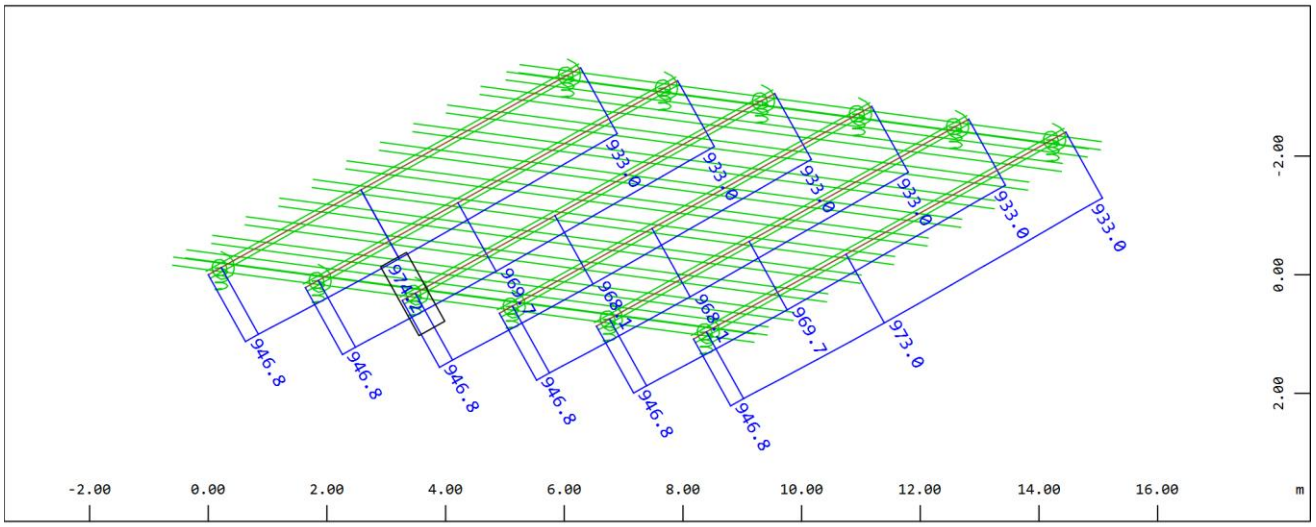
M 1 : 107
X * 0.502
Y * 0.906
Z * 0.962



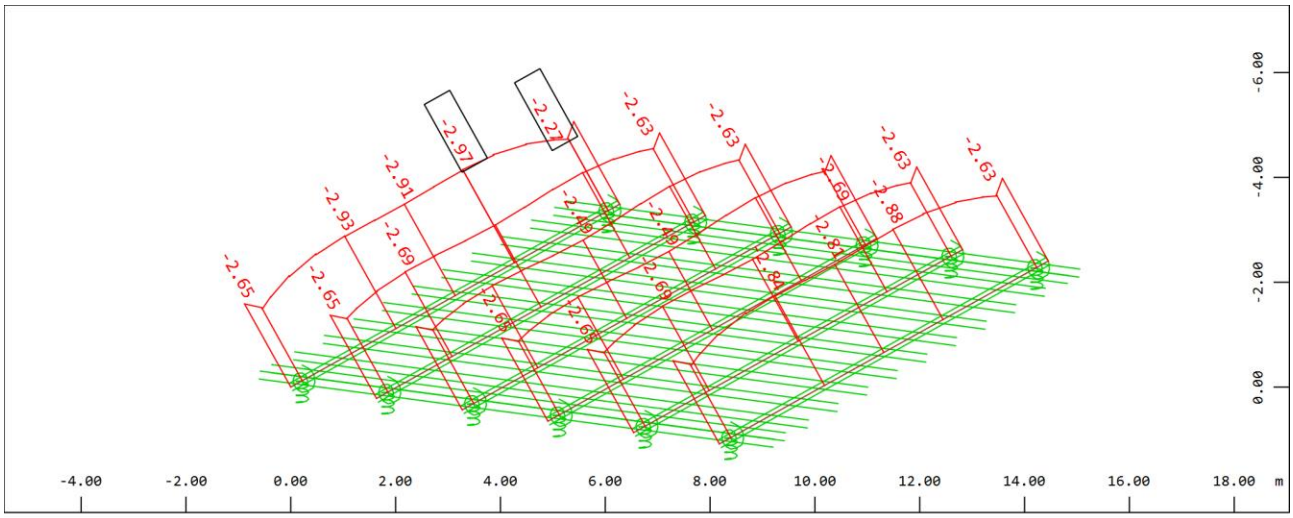
Beam Elements , Uniaxial top stress, Design Case 9405 perm_traffic_opening_inf+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-2.79) (Max=-2.09)



Beam Elements , Uniaxial bottom stress, Design Case 9405 perm_traffic_opening_inf+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-4.15) (Max=-2.73)

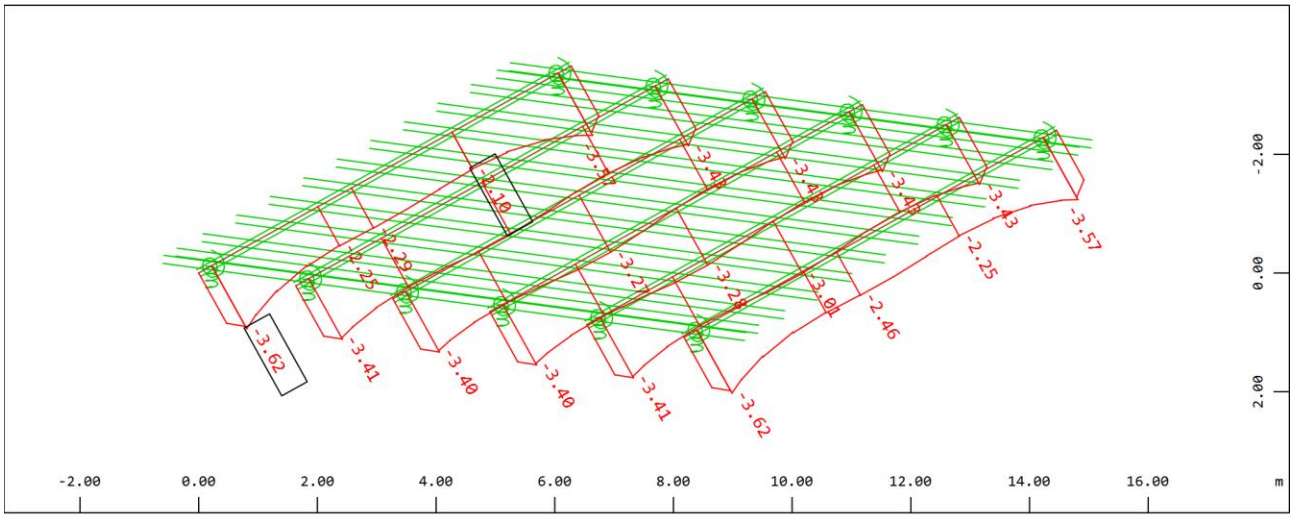


Beam Elements , Maximum stress in tendon, Design Case 9406 perm_traffic_opening_inf-, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress (Unit=902.3 MPa) (Max=974.2)



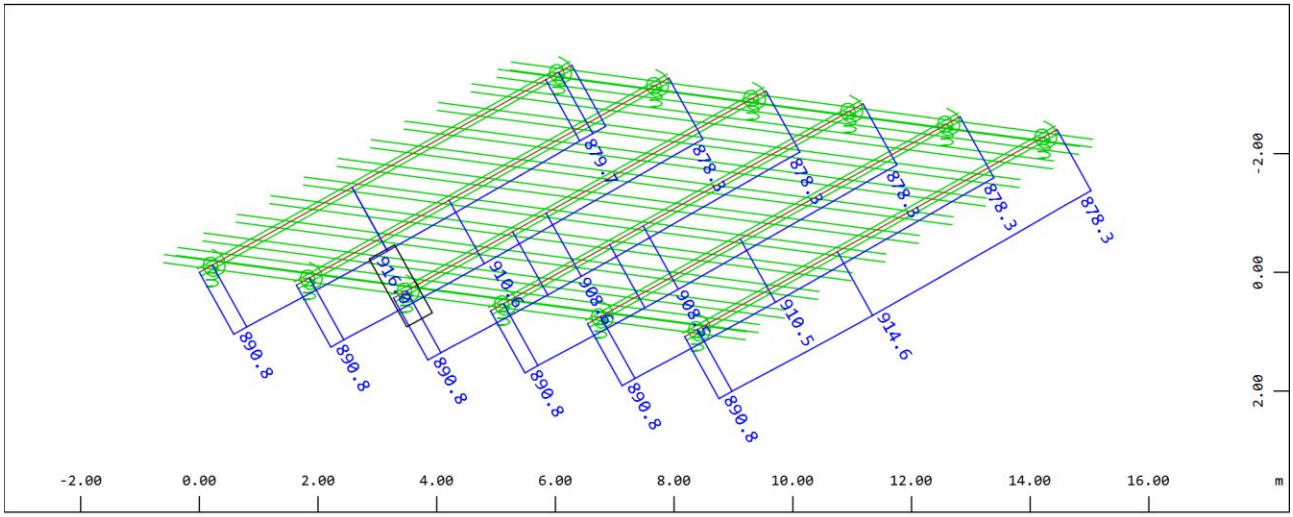
Beam Elements , Uniaxial top stress, Design Case 9415 perm_inf+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 2.00 MPa (Min=-2.97) (Max=-2.27)

M 1 : 137
X * 0.502
Y * 0.906
Z * 0.962



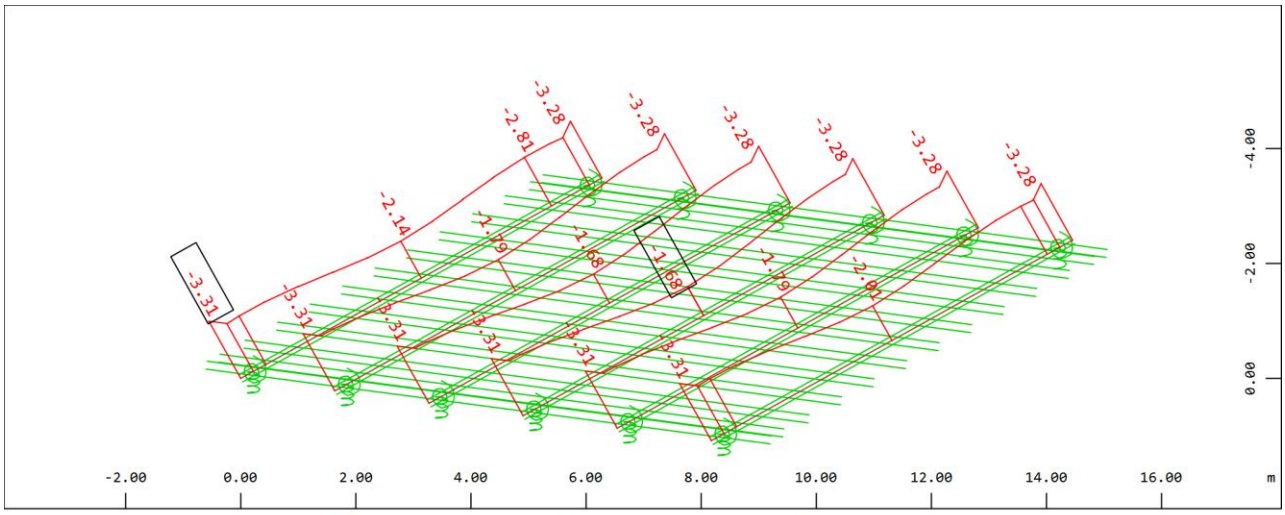
Beam Elements , Uniaxial bottom stress, Design Case 9415 perm_inf+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-3.62) (Max=-2.10)

M 1 : 121
X * 0.502
Y * 0.906
Z * 0.962



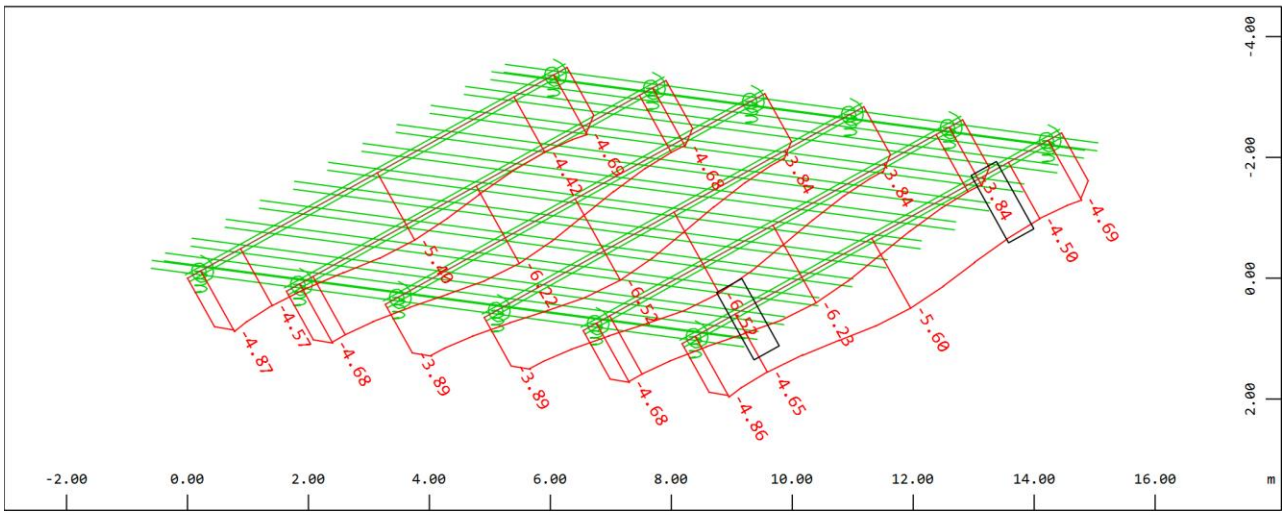
Beam Elements , Maximum stress in tendon, Design Case 9415 perm_inf+, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress (Unit=902.3 MPa) (Max=916.0)

M 1 : 121
X * 0.502
Y * 0.906
Z * 0.962



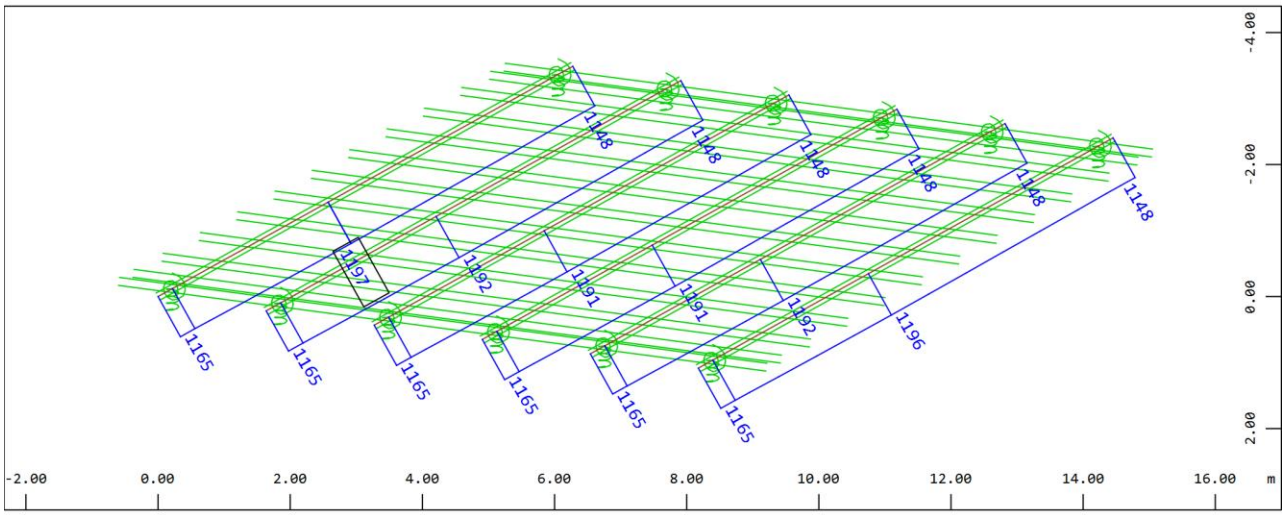
Beam Elements , Uniaxial top stress, Design Case 9411 perm_traffic_opening_sup+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-3.31) (Max=-1.68)

M 1 : 124
X * 0.502
Y * 0.906
Z * 0.962



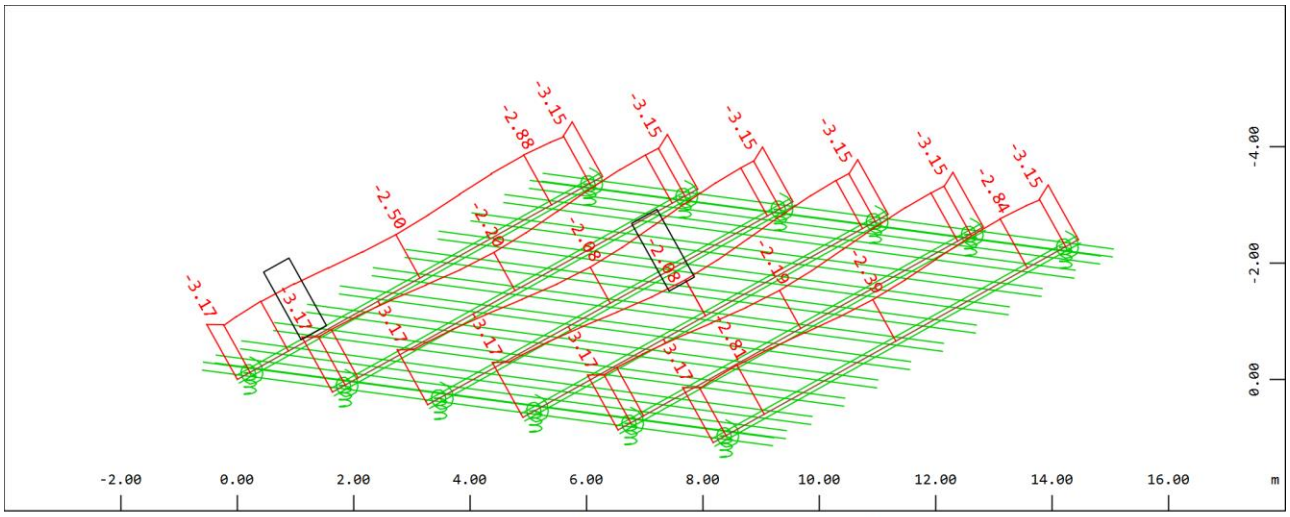
Beam Elements , Uniaxial bottom stress, Design Case 9411 perm_traffic_opening_sup+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-6.52) (Max=-3.84)

M 1 : 118
X * 0.502
Y * 0.906
Z * 0.962



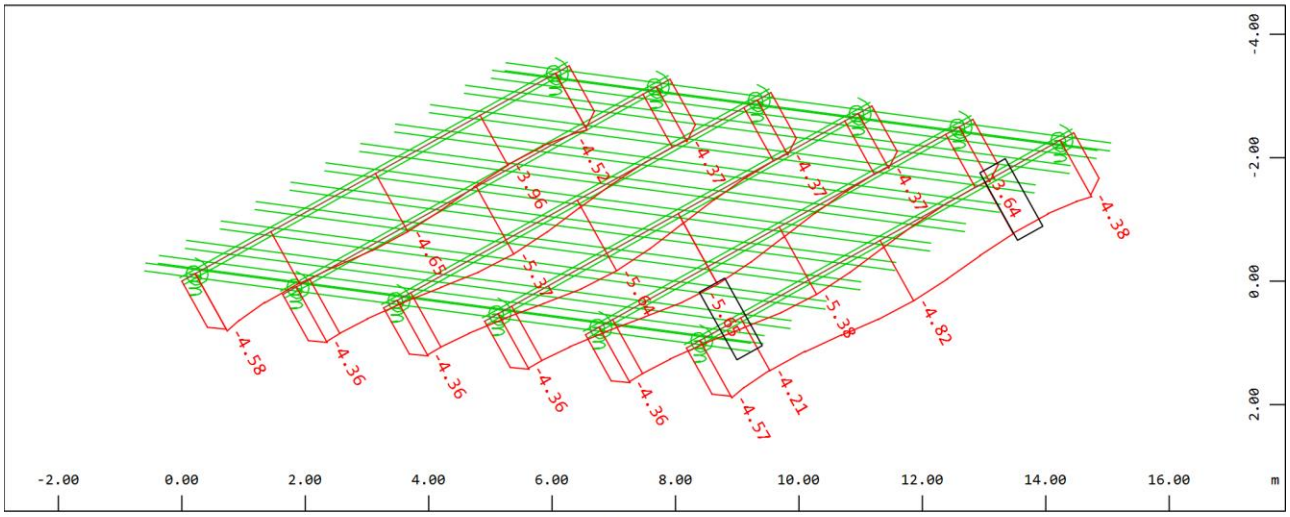
Beam Elements , Maximum stress in tendon, Design Case 9411 perm_traffic_opening_sup+, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress (Unit=1805. MPa) (Max=1197.)

M 1 : 108
X * 0.502
Y * 0.906
Z * 0.962



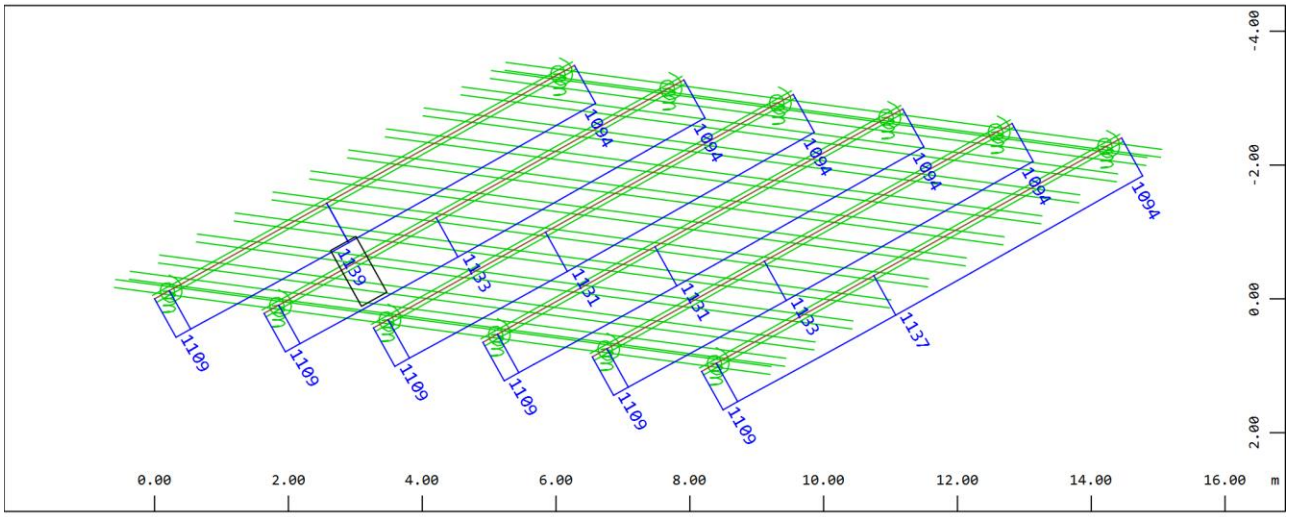
Beam Elements , Uniaxial top stress, Design Case 9421 perm_sup+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 3.61 MPa (Min=-3.17) (Max=-2.08)

M 1 : 123
X * 0.502
Y * 0.906
Z * 0.962



Beam Elements , Uniaxial bottom stress, Design Case 9421 perm_sup+, Material 1 C 50/60 (EN 1992) , 1 cm 3D = 5.00 MPa (Min=-5.65) (Max=-3.64)

M 1 : 116
X * 0.502
Y * 0.906
Z * 0.962



Beam Elements , Maximum stress in tendon, Design Case 9421 perm_sup+, Material 12 Y 1860 (EN 1992) (mod) , (1 cm 3D = unit) Beam Elements , Maximum Stress (Unit=1805. MPa) (Max=1139.)

M 1 : 107
X * 0.502
Y * 0.906
Z * 0.962

Granično stanje dekompresije

Granično stanje dekompresije razmatra se za prividnostalnu (quasi-permanent) kombinaciju opterećenja za razred C.

$$\Sigma Gi + r_{inf/sup} \cdot P + C + \Sigma \psi_{2,i} Q_{k,i}$$

Za prividnostalnu (quasi-permanent) kombinaciju opterećenja treba biti ispunjen uvjet da nema vlaka:

$$\sigma_c \leq 0$$

To je kombinacija opterećenja je LC 9405 - 9422.

Uvjet je zadovoljen. Nosači su u tlaku za prividnostalnu kombinaciju.

Naprezanja odmah po prednapinjanju

Naprezanja u betonu

Odmah po prednapinjanju (LC 7021) tlačno naprezanje mora biti manje od:

$\sigma_c \leq 0{,}6 \cdot f_{ck(t=t0)} = 0{,}6 \cdot 40 = 24{,}0\ N/mm^2$

To je kombinacija opterećenja LC 7021. Sva najveća tlačna naprezanja su manja od 24,0 Mpa.

$\sigma_c \leq f_{ctm(t=t0)} = 3{,}5\ N/mm^2$ uvjet da možemo smatrati da presjek nije raspucao.

To je kombinacija opterećenja LC 7021. Sva najveća vlačna naprezanja su manja od 3,5 Mpa.

Naprezanja u čeliku za prednapinjanje

U točki 2.1.4 kod određivanja sile prednapinjanja je vidljivo da granične vrijednosti nisu premašene. U LC 7021 (odmah nakon prednapinjanja) vrijednost naprezanja u kabelu je:

$\sigma_{pm0} \leq 0{,}75\ f_{pk} = 0{,}75 \cdot 1860 = 1395{,}0\ N/mm^2$

Naprezanja u eksploataciji

Naprezanja u betonu

LC 9105 – 9122 (rijetka kombinacija)

rijetka kombinacija (rare) $\Sigma G_i + r_{inf/sup} \cdot P + C + Q_{k,1} + \Sigma \psi_{o,i} Q_{k,i}$

$\sigma_c \leq 0{,}6 \cdot f_{ck} = 24{,}0\ N/mm^2$
Sva najveća tlačna naprezanja su manja od 24,0 Mpa.

$\sigma_c \leq f_{ctm(t=t0)} = 3{,}5\ N/mm^2$ uvjet da možemo smatrati da presjek nije raspucao.

Sva najveća vlačna naprezanja su manja od 3,5 Mpa.

Naprezanja u čeliku za prednapinjanje
$\sigma_p \leq 0{,}75 \cdot f_{pk} = 1395{,}0\ N/mm^2$ Uvjeti su ispunjeni.

LC 9405 – 9422 (prividnostalna kombinacija)

prividnostalna kombinacija (quasipermanent) $\Sigma G_i + r_{inf/sup} \cdot P + C + \Sigma \psi_{2,i} Q_{k,i}$

$\sigma_c \leq 0{,}45 \cdot f_{ck} = 18{,}5\ N/mm^2$ Sva najveća tlačna naprezanja su manja od 18,5 Mpa.

3.6.2 Granično stanje pukotina

Treba biti ispunjen zahtjev:

$$w_k \leq w_g$$

w_k = karakteristična širina pukotina
w_g = 0,2 mm - granična širina pukotine za predn. konstr., učestala kombinacija (razred C)

Širina pukotina se provjerava za učestalu kombinaciju opterećenja:

učestala kombinacija $\Sigma Gi + r_{inf/sup} \cdot P + C + \psi_{1,1} Q_{k,1} + \Sigma \psi_{2,i} Q_{k,i}$

Ako su za rijetku kombinaciju opterećenja vlačna naprezanja manja od f_{ctm} (3,5 N/mm^2), onda neće doći do raspucavanja presjeka (LC 9105 - 9122).

$$\sigma_{ct} \leq f_{ctm}$$

Uvjet je ispunjen.

3.6.3 Granično stanje progiba

Razmatra se granično stanje progiba za ove kombinacije opterećenja:

Kombinacije opterećenja za kontrolu progiba		
Slučaj opterećenja	Opis opterećenja	Kombinacije opterećenja
LC 4010	Odmah po prednapinjanju	G_1+P
LC 4027	Prije dodatnog stalnog opterećenja	G_1+P+C_i
LC 4030	Nakon djelovanja dodatnog stalnog opterećenja	$G_1+G_2+P+C_i$
LC 4037	Neposredno prije puštanja u promet	ΣG_i+P+C_i
LC 4042	Nakon 100 g	ΣG_i+P+C_{100g}
LC 18900	Učestala kombinacija opterećenja	$\Sigma G_i+P+C_{100g}+\max(0,75 Q +0,5ZT)$

gdje je:

G_1	vlastita težina nosača
G_2	težina kolničke ploče (svježeg betona)
ΣG_i	ukupno stalno opterećenje
P	prednapinjanje
C_i	puzanje i skupljanje nakon i dana ili godina
Q	prometno opterećenje
ZT	temperaturno djelovanje

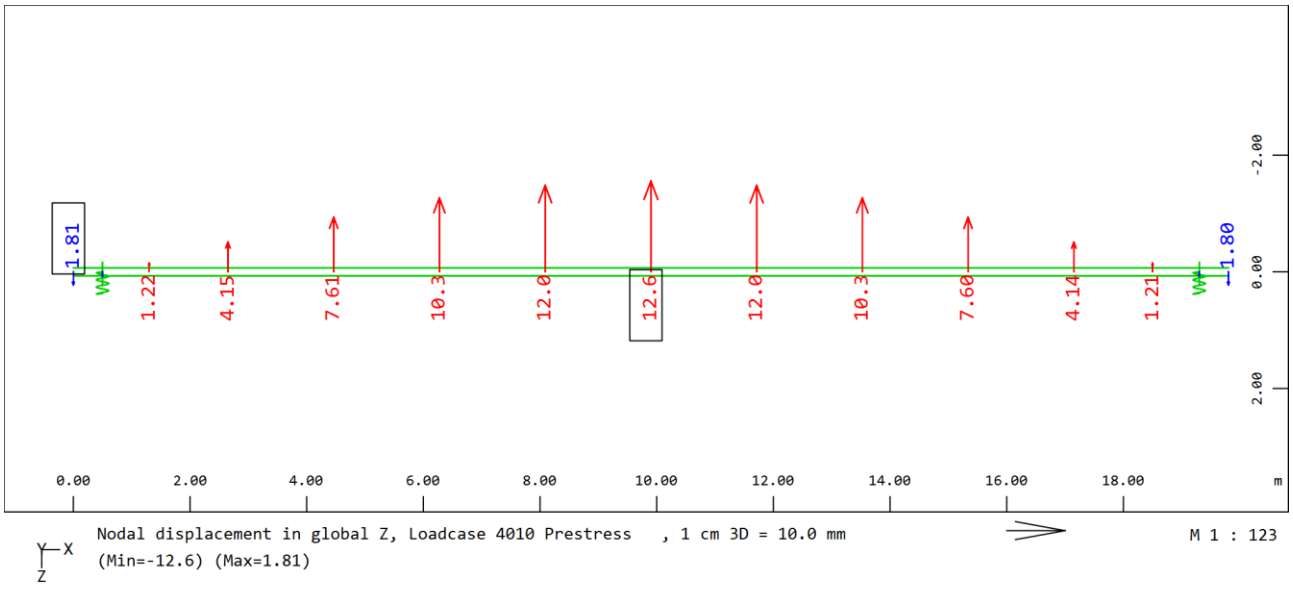
Treba biti ispunjen uvjet $\nu_{tot} \leq w_g = L_{eff}/250$

$$\nu_{tot} = -12,6 \text{ mm} < w_g = L_{eff}/250 = 18,8 \cdot 10^3/250 = 75,2 \text{ mm}$$

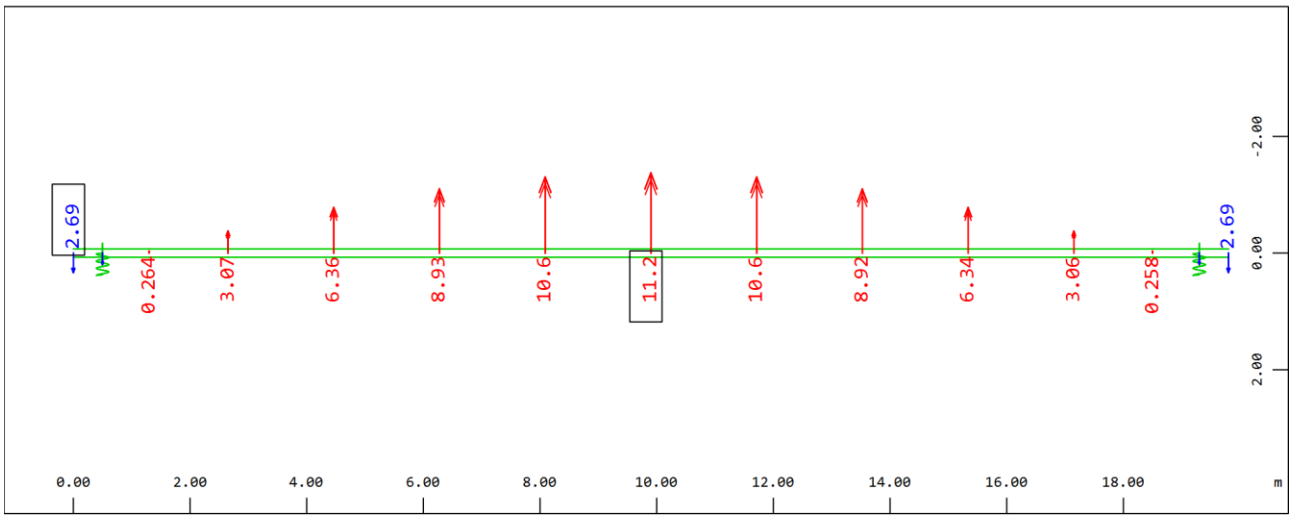
$$\nu_{tot} = -3,66 \text{ mm} < w_g = L_{eff}/250 = 13,3 \cdot 10^3/250 = 53,2 \text{ mm}$$

Na slijedećoj stranici prikazani su progibi za mjerodavne kombinacije opterećenja.

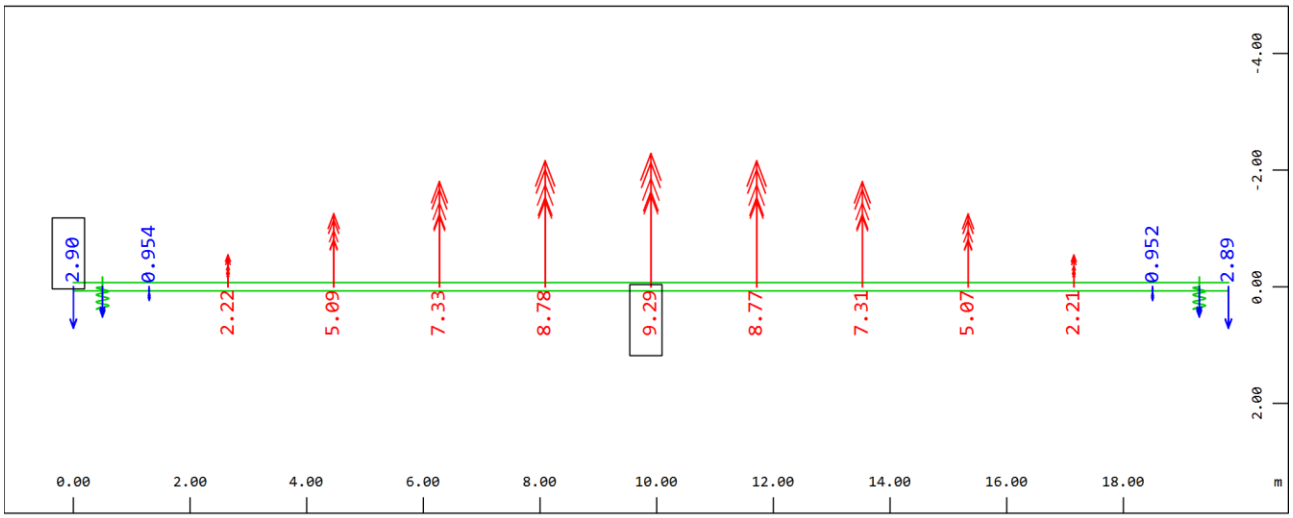
Prikaz progiba za navedene kombinacije opterećenja



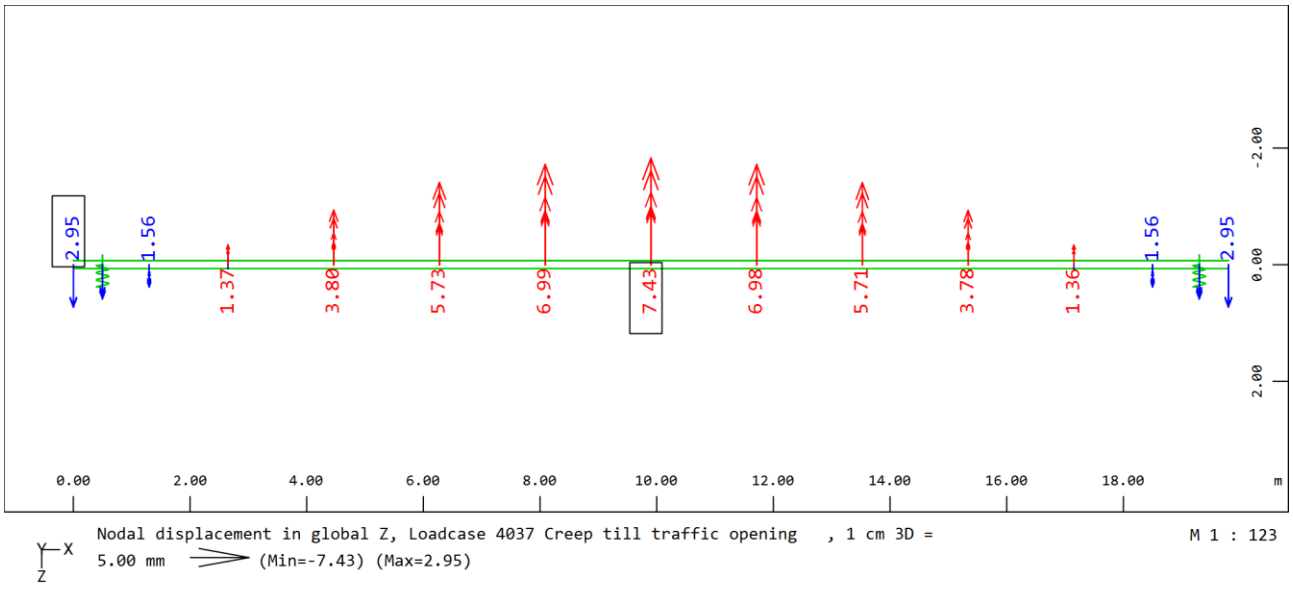
Nodal displacement in global Z, Loadcase 4010 Prestress , 1 cm 3D = 10.0 mm
(Min=-12.6) (Max=1.81)
M 1 : 123



Nodal displacement in global Z, Loadcase 4027 Creep till superimpose G_2 , 1 cm 3D =
10.0 mm (Min=-11.2) (Max=2.69)
M 1 : 123

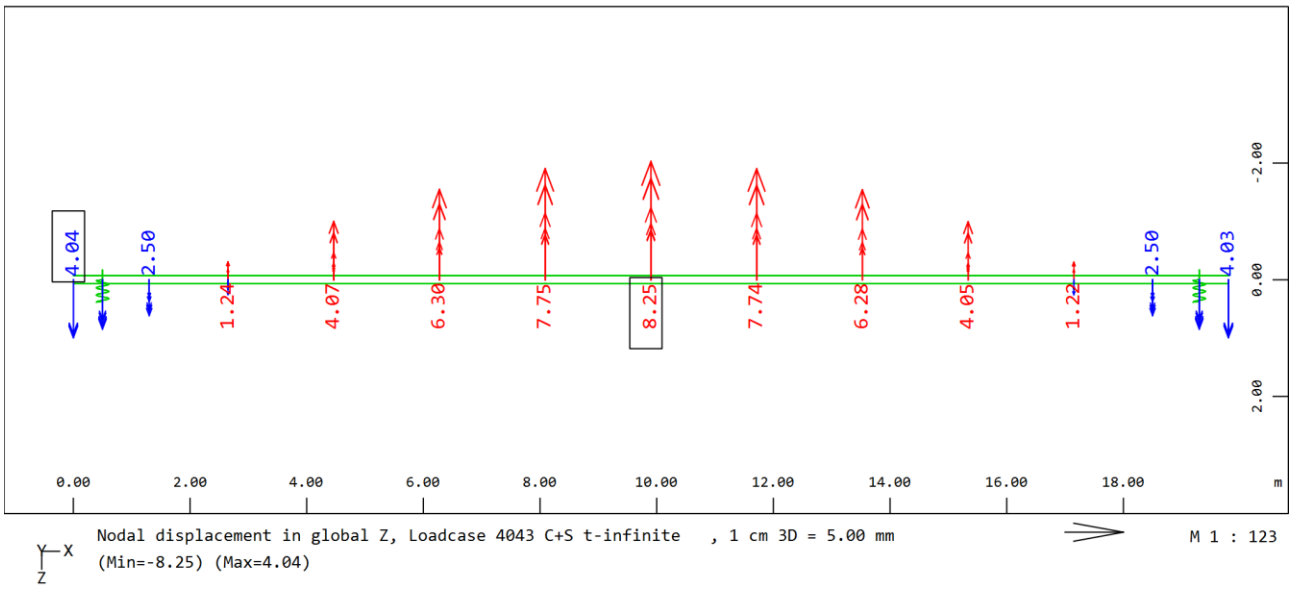


Nodal displacement in global Z, Loadcase 4030 G_2, Asphalt, capping , 1 cm 3D = 5.00 mm
(Min=-9.29) (Max=2.90)
M 1 : 123



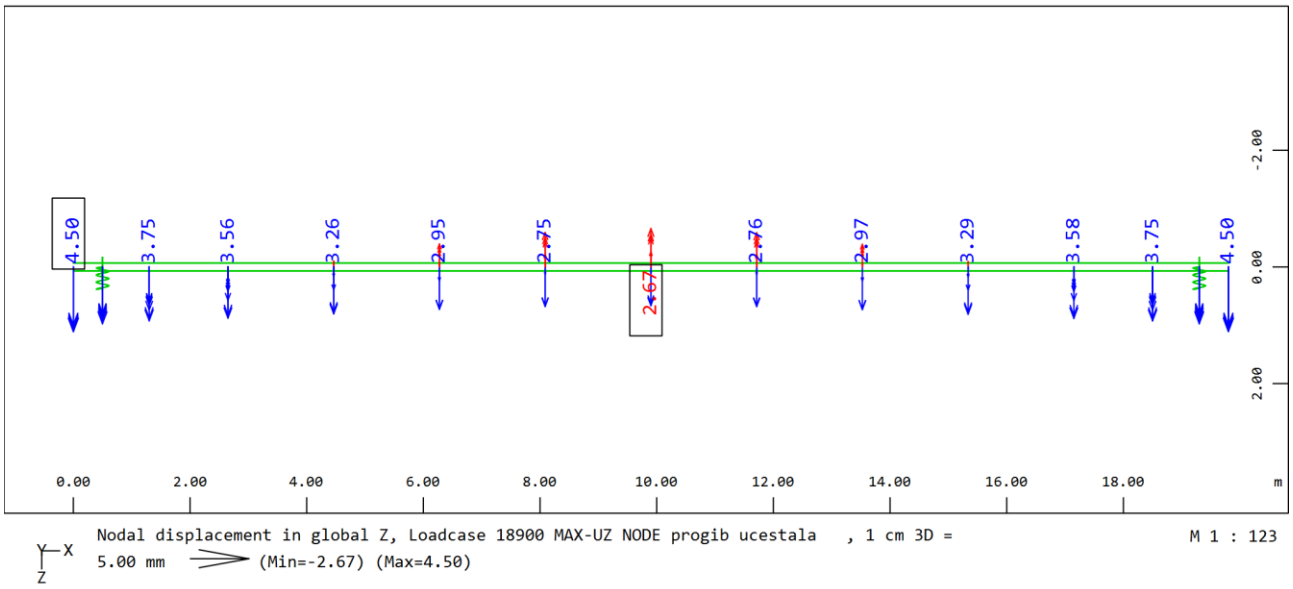
Nodal displacement in global Z, Loadcase 4037 Creep till traffic opening , 1 cm 3D = 5.00 mm (Min=-7.43) (Max=2.95)

M 1 : 123



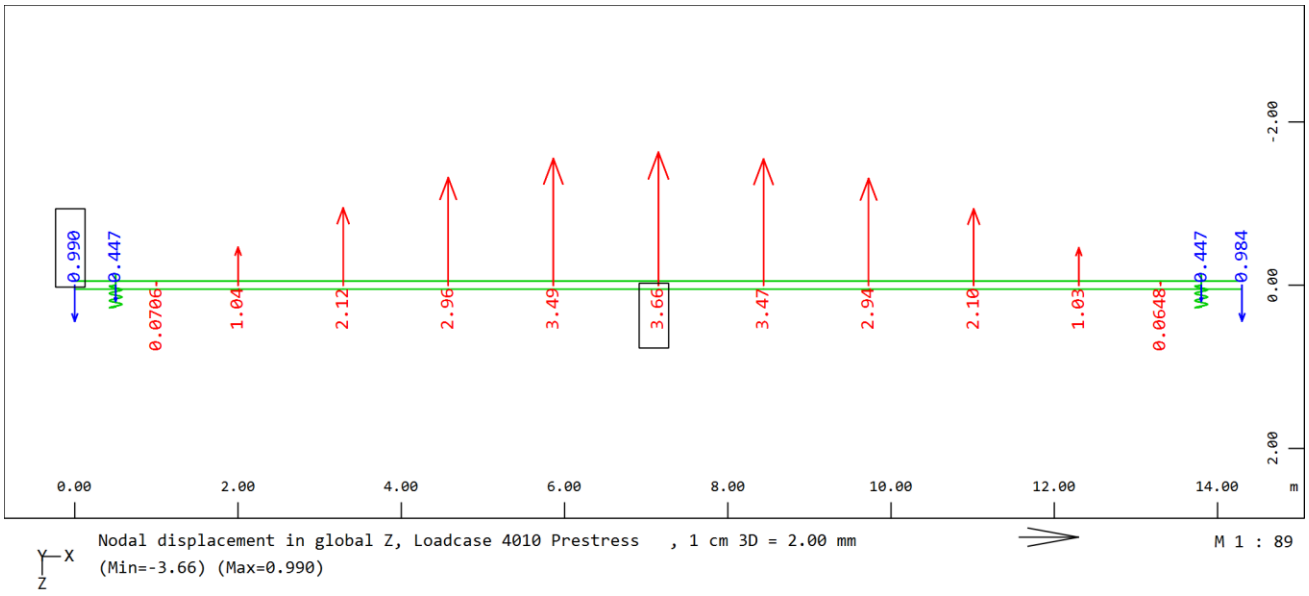
Nodal displacement in global Z, Loadcase 4043 C+S t-infinite , 1 cm 3D = 5.00 mm (Min=-8.25) (Max=4.04)

M 1 : 123

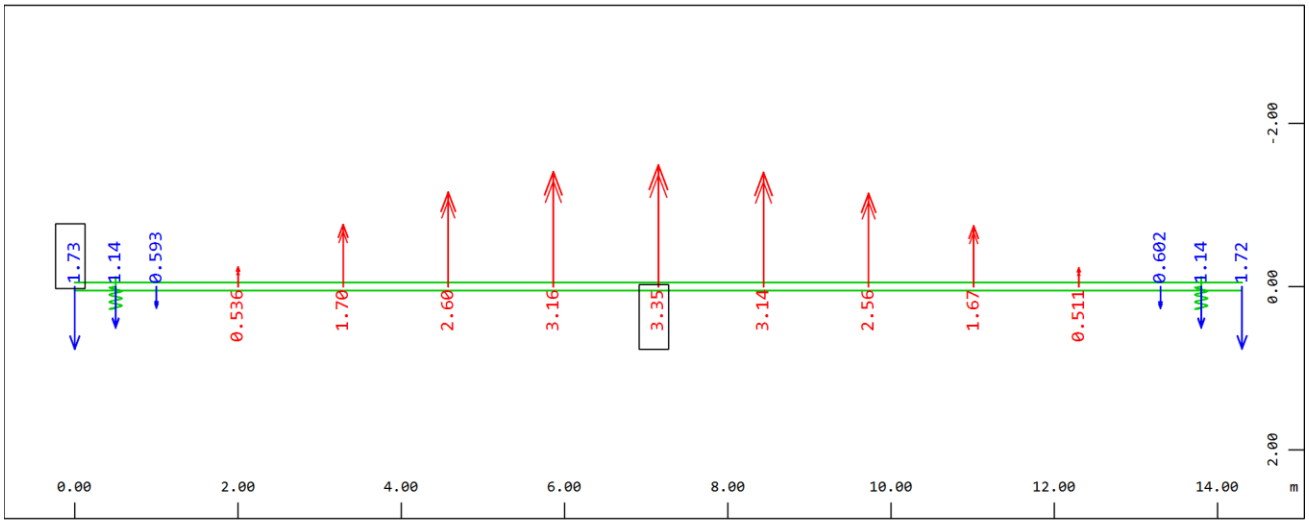


Nodal displacement in global Z, Loadcase 18900 MAX-UZ NODE progib ucestala , 1 cm 3D = 5.00 mm (Min=-2.67) (Max=4.50)

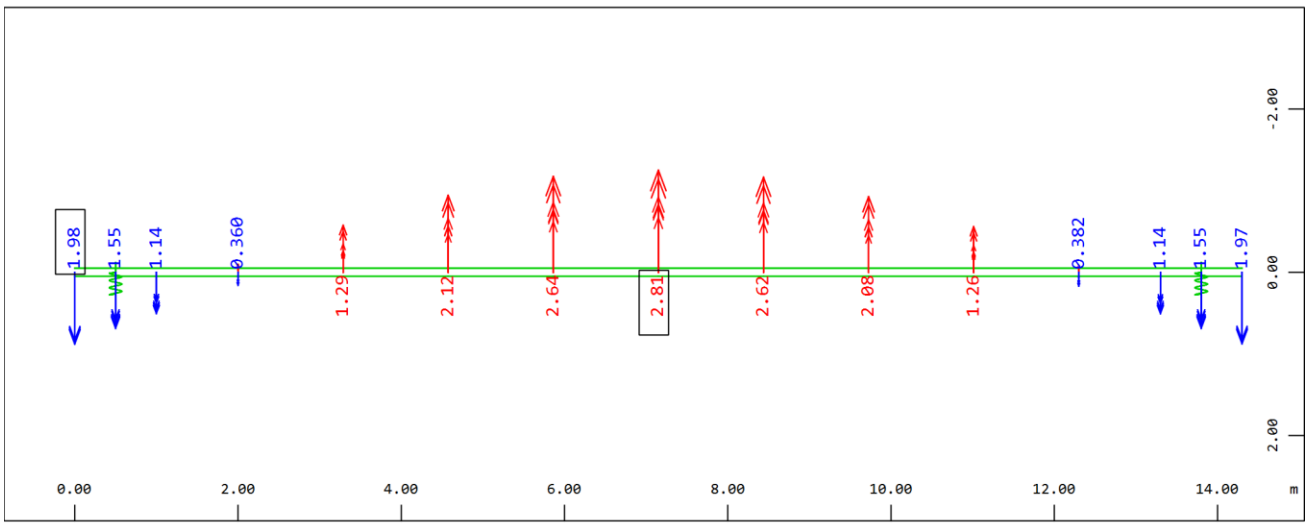
M 1 : 123



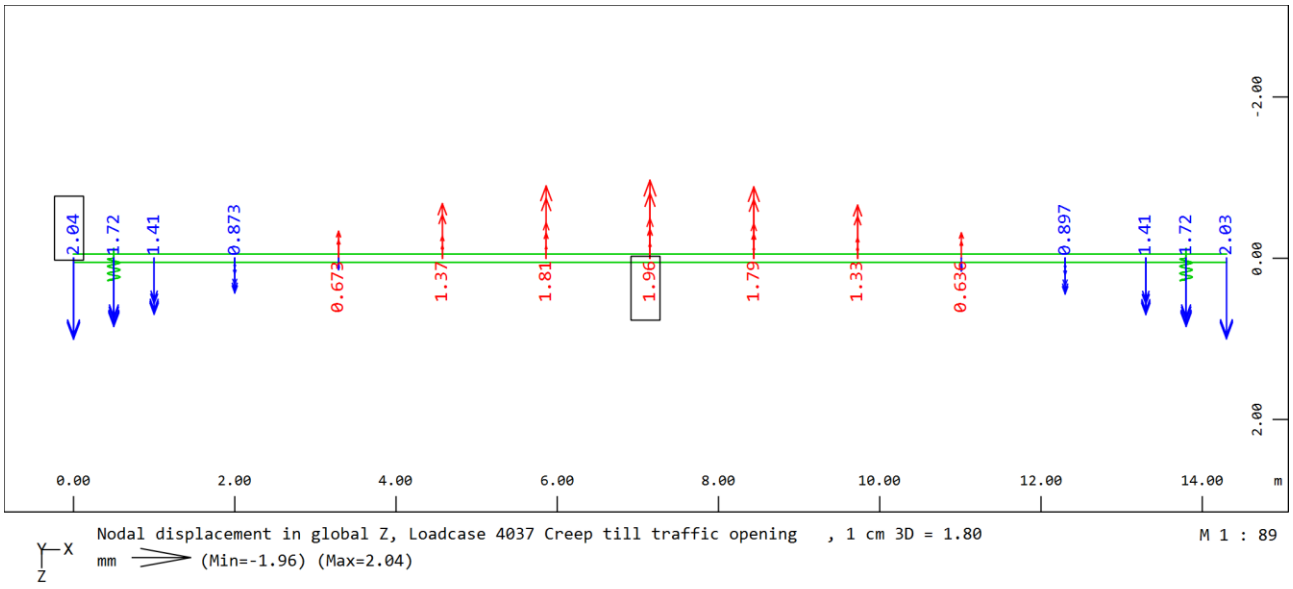
Nodal displacement in global Z, Loadcase 4010 Prestress , 1 cm 3D = 2.00 mm
(Min=-3.66) (Max=0.990)
M 1 : 89



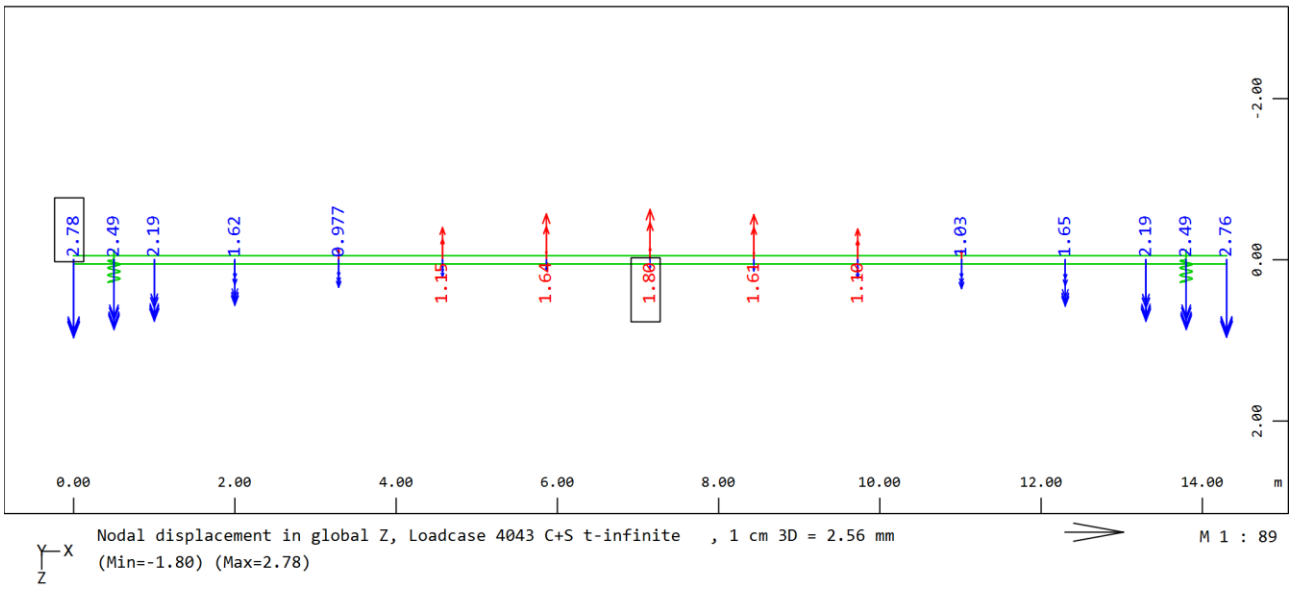
Nodal displacement in global Z, Loadcase 4027 Creep till superimpose G_2 , 1 cm 3D = 2.00
mm (Min=-3.35) (Max=1.73)
M 1 : 89



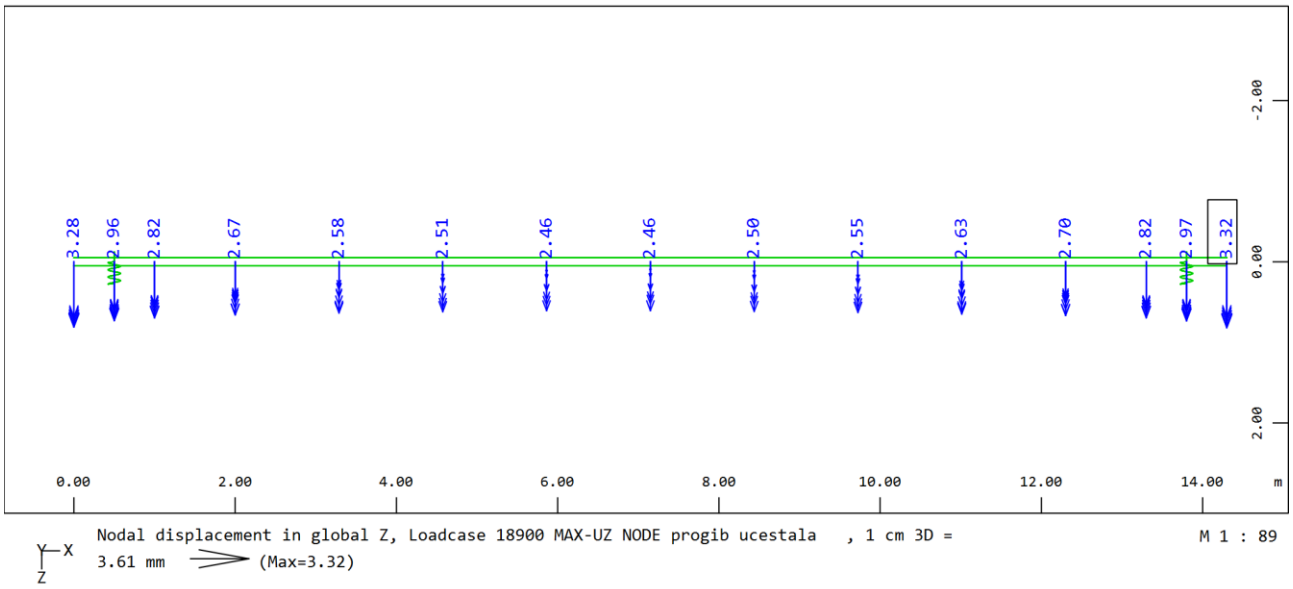
Nodal displacement in global Z, Loadcase 4030 G_2, Asphalt, capping , 1 cm 3D = 2.00 mm
(Min=-2.81) (Max=1.98)
M 1 : 89



Nodal displacement in global Z, Loadcase 4037 Creep till traffic opening , 1 cm 3D = 1.80 M 1 : 89
mm (Min=-1.96) (Max=2.04)



Nodal displacement in global Z, Loadcase 4043 C+S t-infinite , 1 cm 3D = 2.56 mm M 1 : 89
(Min=-1.80) (Max=2.78)



Nodal displacement in global Z, Loadcase 18900 MAX-UZ NODE progib ucestala , 1 cm 3D = M 1 : 89
3.61 mm (Max=3.32)

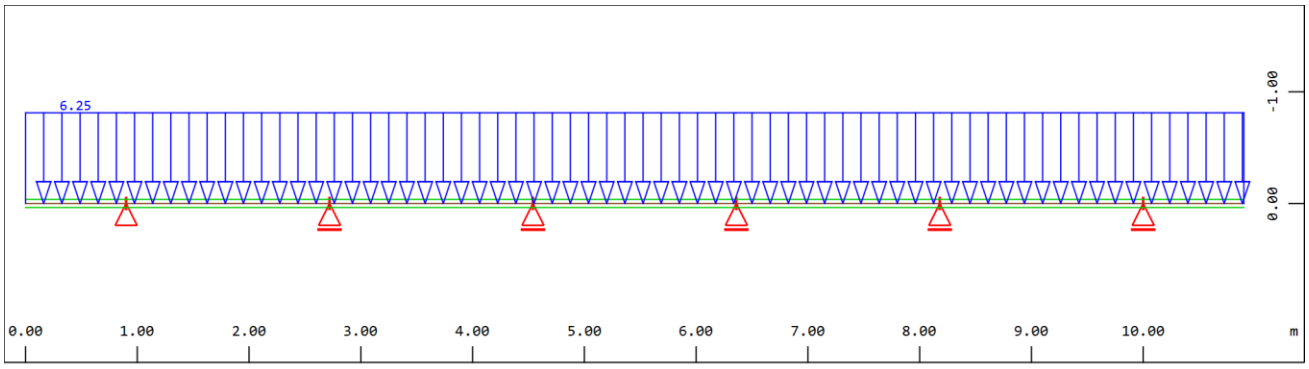
3.7 Proračun ploče u poprečnom smjeru

Za proračun ploče u poprečnom smjeru – proračun konzole koriste se sljedeća opterećenja:

1. vlastita težina — LC 1
2. dodatno stalno opterećenje — LC 2
3. opterećenje prometom (LM1, LM2) — LC 3-4,10-12
4. izvanredna opterećenja — LC 5-6
   - udar na odbojnu ogradu
     (vertikalna sila 0,75xQ_{1k}; horizontalna sila 200kN)
   - udar na rubnjak
     (vertikalna sila 0,75xQ_{1k}; horizontalna sila 100kN)

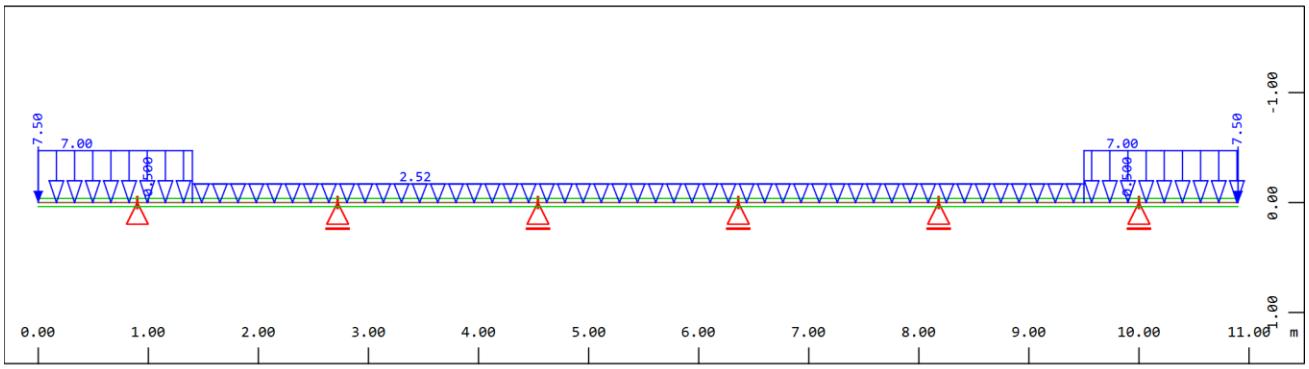
Kombinacije djelovanja:

OZNAKA KOMBINACIJE LC	KOMBINACIJE	Icr
1000-1099	Stalna kombinacija $S_d = S_d \cdot \left[\sum_j (\gamma_{G,j} \cdot G_{k,j}) + \gamma_Q \cdot Q_{k,1} + \sum_{i>1} (\gamma_Q \cdot \psi_{0,i} \cdot Q_{k,i}) \right]$	1
1500-1599	Izvanredna kombinacija $S_d = S_d \cdot \left[\sum_j (\gamma_{G,j} \cdot G_{k,j}) + \psi_{1,1} \cdot Q_{k,1} + \sum_{i>1} (\psi_{2,i} \cdot Q_{k,i}) + A_d \right]$	3
3000-3099	Kvazistalna kombinacija $S_d = S_d \cdot \left[\sum_{j \geq 1} G_{k,j} "+" P "+" \sum_{i \geq 1} \psi_{2,i} Q_{k,i} \right]$	2



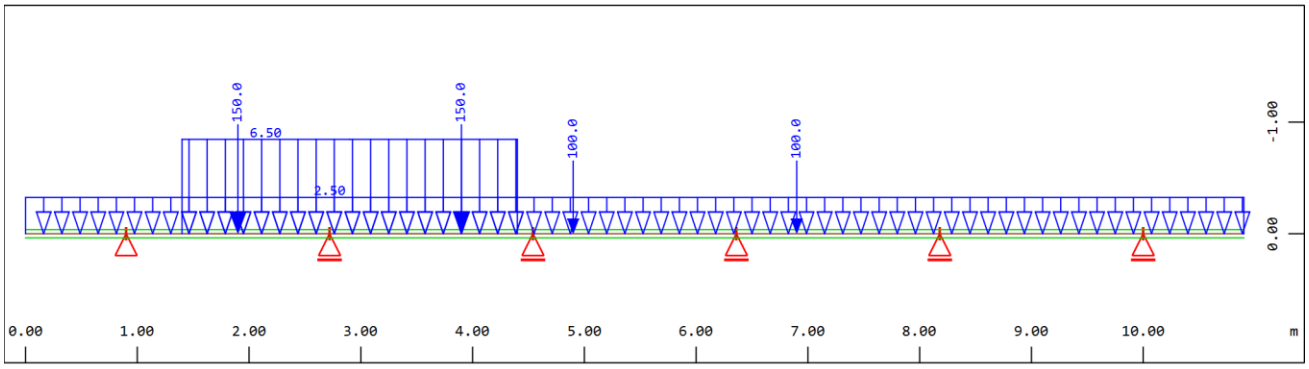
All loads, Loadcase 1 V.T. , (1 cm 3D = unit) Beam dead load in global Z (Unit=5.00 kN/m) (Max=6.25)

M 1 : 65



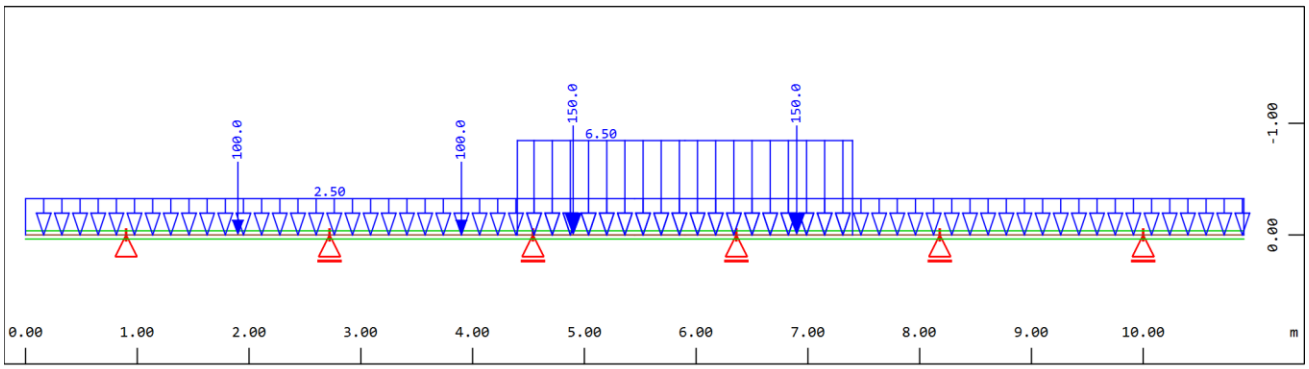
All loads, Loadcase 2 DOD.STALNO , (1 cm 3D = unit) Nodal load (force) vector (Unit=9.80 kN,Max=7.50), Free single load (force) in global Z (Unit=9.80 kN,Max=0.500), Free line load (force) in global Z (Unit=9.80 kN/m,Max=7.00)

M 1 : 66



All loads, Loadcase 3 PROMETNO , (1 cm 3D = unit) Free single load (force) in global Z (Unit=100.0 kN,Max=150.0), Free line load (force) in global Z (Unit=5.00 kN/m,Max=6.50)

M 1 : 65



All loads, Loadcase 4 PROMETNO , (1 cm 3D = unit) Free single load (force) in global Z (Unit=100.0 kN,Max=150.0), Free line load (force) in global Z (Unit=5.00 kN/m,Max=6.50)

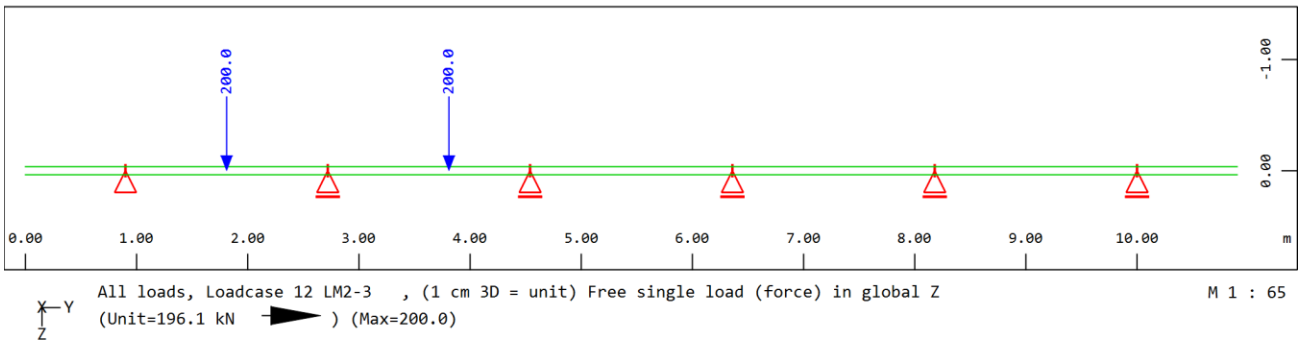
M 1 : 65



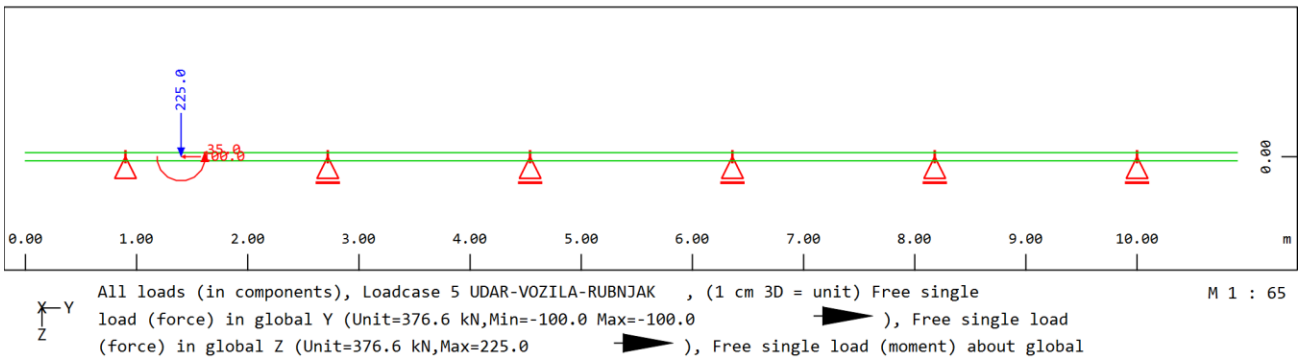
All loads, Loadcase 10 LM2 , (1 cm 3D = unit) Free single load (force) in global Z
(Unit=275.0 kN) (Max=200.0)
M 1 : 65



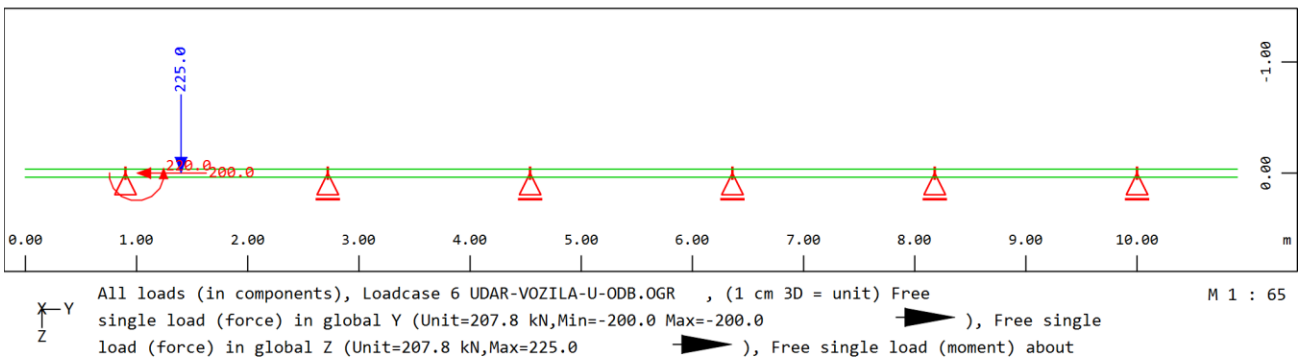
All loads, Loadcase 11 LM2-2 , (1 cm 3D = unit) Free single load (force) in global Z
(Unit=204.7 kN) (Max=200.0)
M 1 : 65



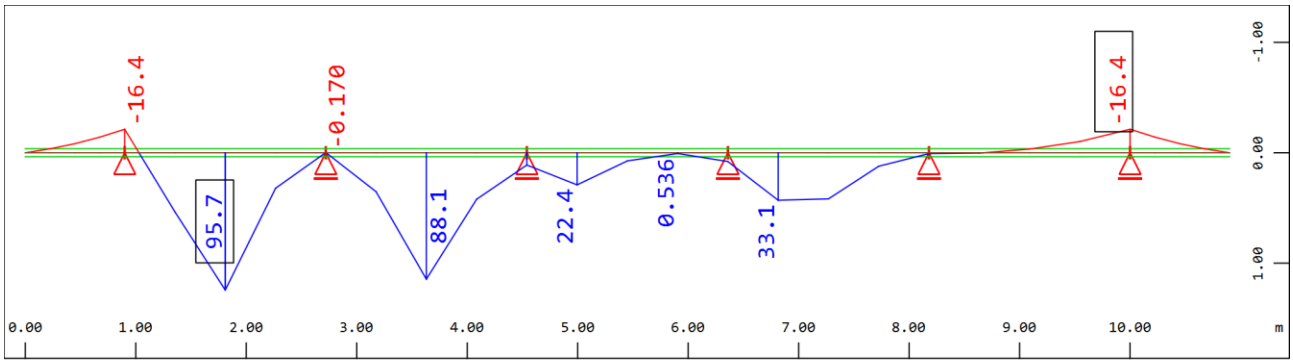
All loads, Loadcase 12 LM2-3 , (1 cm 3D = unit) Free single load (force) in global Z
(Unit=196.1 kN) (Max=200.0)
M 1 : 65



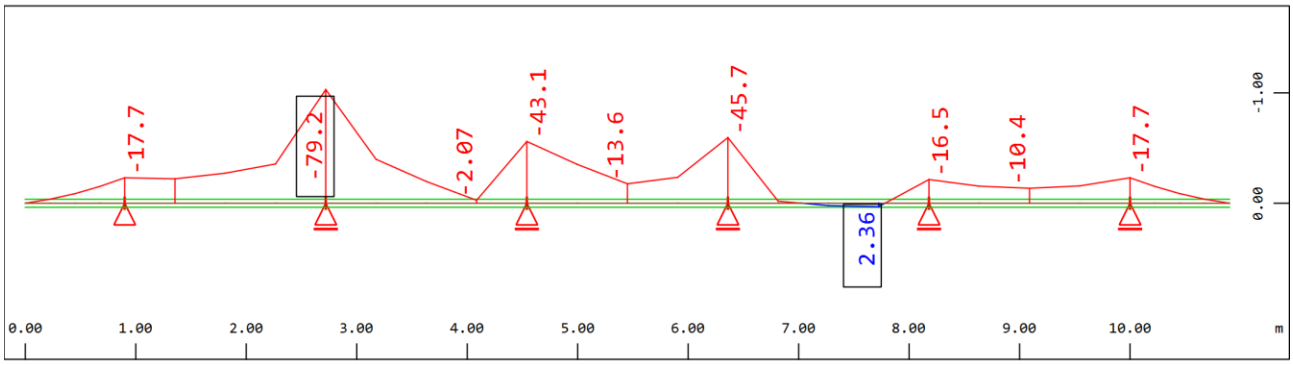
All loads (in components), Loadcase 5 UDAR-VOZILA-RUBNJAK , (1 cm 3D = unit) Free single load (force) in global Y (Unit=376.6 kN,Min=-100.0 Max=-100.0), Free single load (force) in global Z (Unit=376.6 kN,Max=225.0), Free single load (moment) about global
M 1 : 65



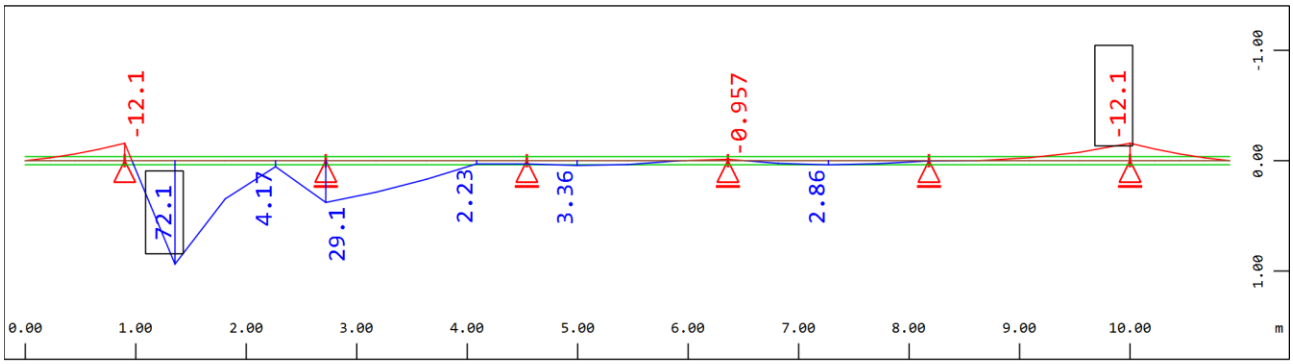
All loads (in components), Loadcase 6 UDAR-VOZILA-U-ODB.OGR , (1 cm 3D = unit) Free single load (force) in global Y (Unit=207.8 kN,Min=-200.0 Max=-200.0), Free single load (force) in global Z (Unit=207.8 kN,Max=225.0), Free single load (moment) about
M 1 : 65



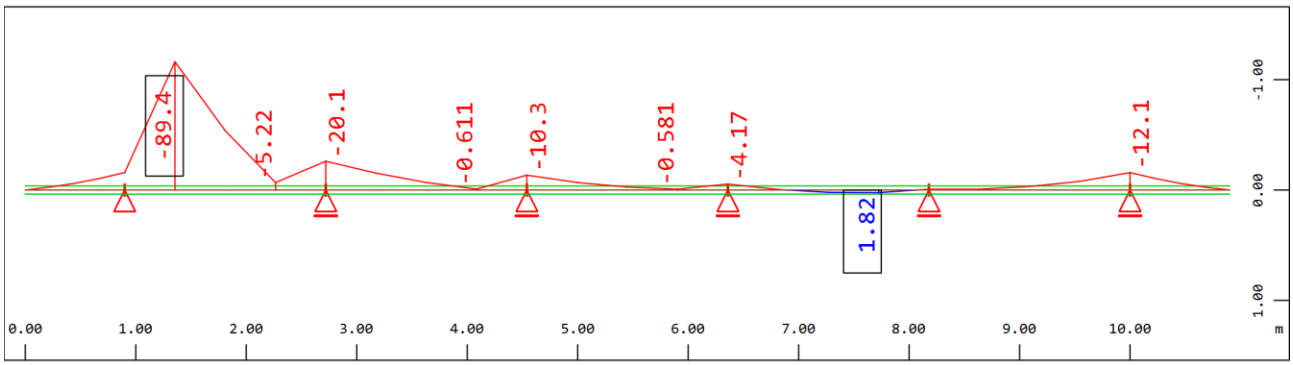
Beam Elements , Bending moment My, Loadcase 1025 MAX-MY BEAM , 1 cm 3D = 50.0 kNm M 1 : 65
(Min=-16.4) (Max=95.7)



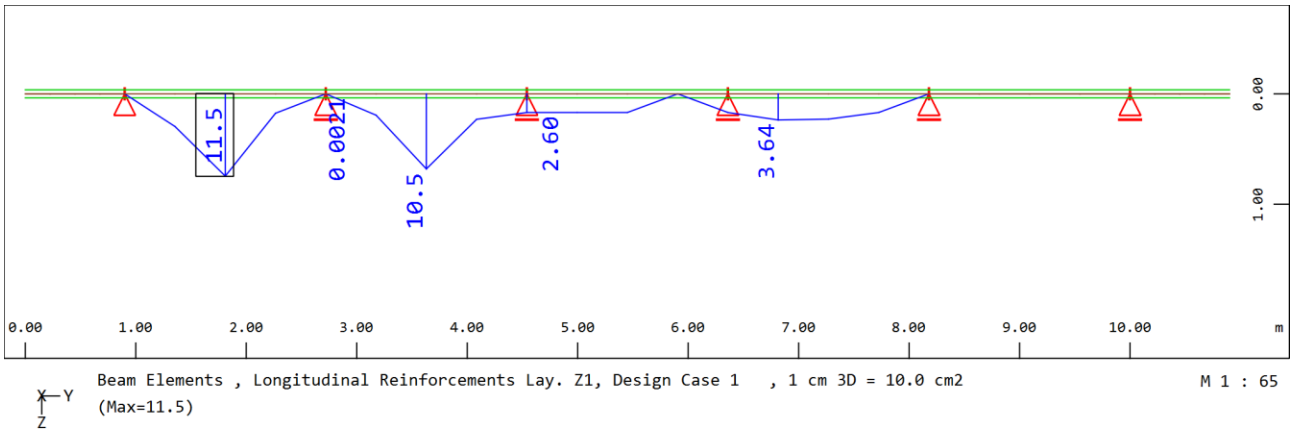
Beam Elements , Bending moment My, Loadcase 1026 MIN-MY BEAM , 1 cm 3D = 50.0 kNm M 1 : 65
(Min=-79.2) (Max=2.36)



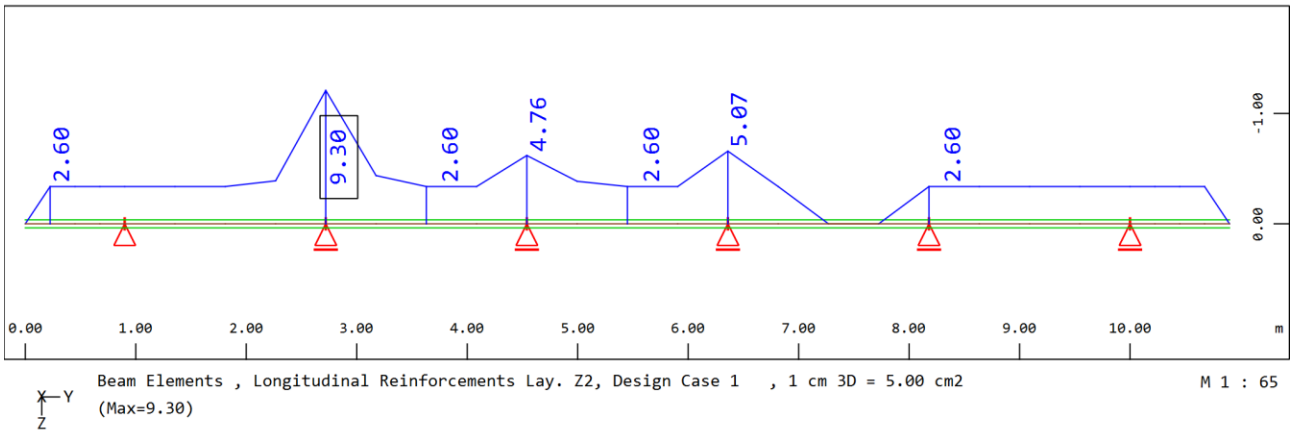
Beam Elements , Bending moment My, Loadcase 1525 MAX-MY BEAM , 1 cm 3D = 50.0 kNm M 1 : 65
(Min=-12.1) (Max=72.1)



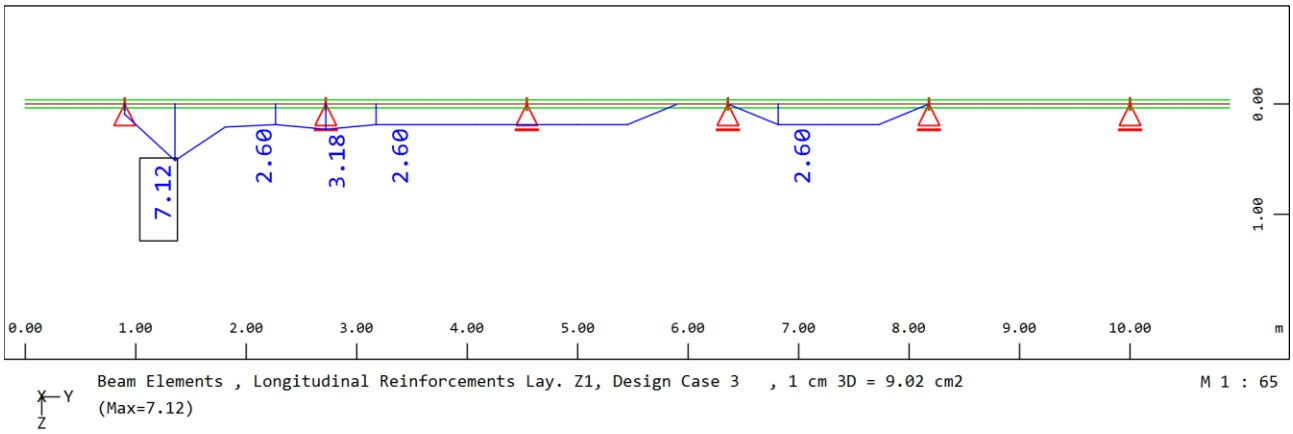
Beam Elements , Bending moment My, Loadcase 1526 MIN-MY BEAM , 1 cm 3D = 50.0 kNm M 1 : 65
(Min=-89.4) (Max=1.82)



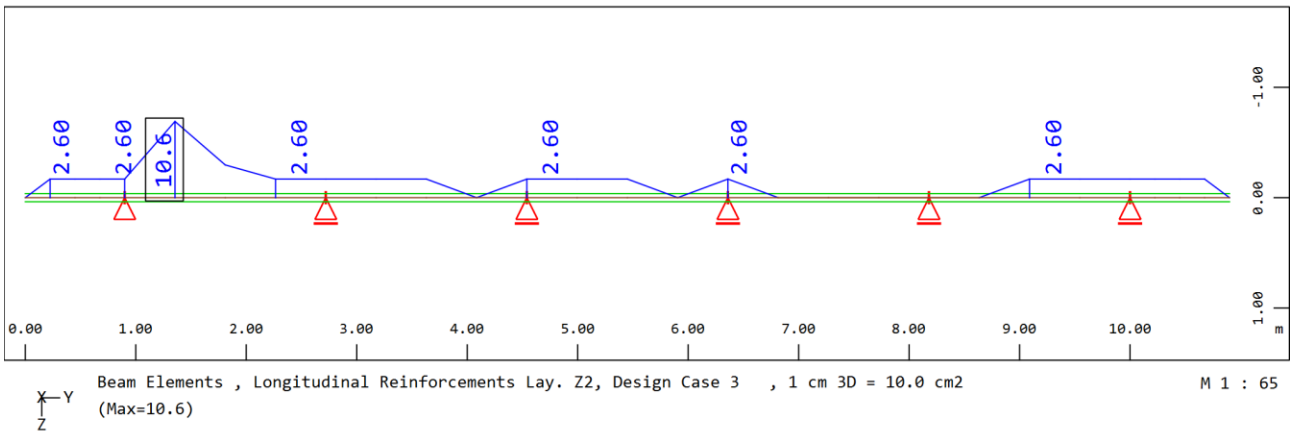
Beam Elements , Longitudinal Reinforcements Lay. Z1, Design Case 1 , 1 cm 3D = 10.0 cm2 M 1 : 65
(Max=11.5)



Beam Elements , Longitudinal Reinforcements Lay. Z2, Design Case 1 , 1 cm 3D = 5.00 cm2 M 1 : 65
(Max=9.30)



Beam Elements , Longitudinal Reinforcements Lay. Z1, Design Case 3 , 1 cm 3D = 9.02 cm2 M 1 : 65
(Max=7.12)



Beam Elements , Longitudinal Reinforcements Lay. Z2, Design Case 3 , 1 cm 3D = 10.0 cm2 M 1 : 65
(Max=10.6)

Minimalna površina armature u presjeku h=25cm:

$A_{s,min} = 0{,}0013 \cdot b \cdot d =$ 0,0013·100·19,7 = 2,56 cm^2/m'

$A_{s,min} = 0{,}26 \cdot (f_{ctm} / f_{yk}) \cdot b \cdot d = 0{,}26 \cdot (2{,}9/500) \cdot 100 \cdot 19{,}7$ = 2,97 cm^2/m'

Maksimalna površina armature u presjeku h=25cm:

$A_{s,max} = 0{,}04\ A_c = 0{,}04 \cdot 100 \cdot 25 = 100{,}0$ cm^2/m'

ODABRANO Φ14/15,00 cm ($A_{s1,od}$ = 10,4 cm^2)

ODABRANO Φ14/15,00 cm ($A_{s1,od}$ = 10,40 cm^2)

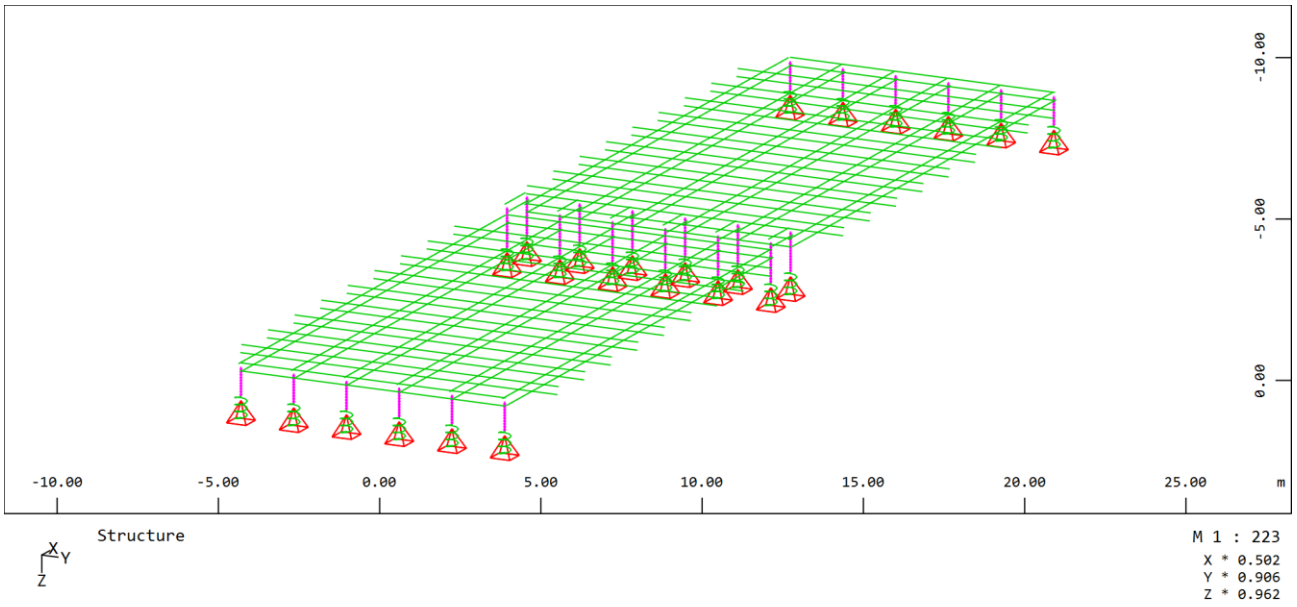
3.8 Proračun kontinuitetne ploče

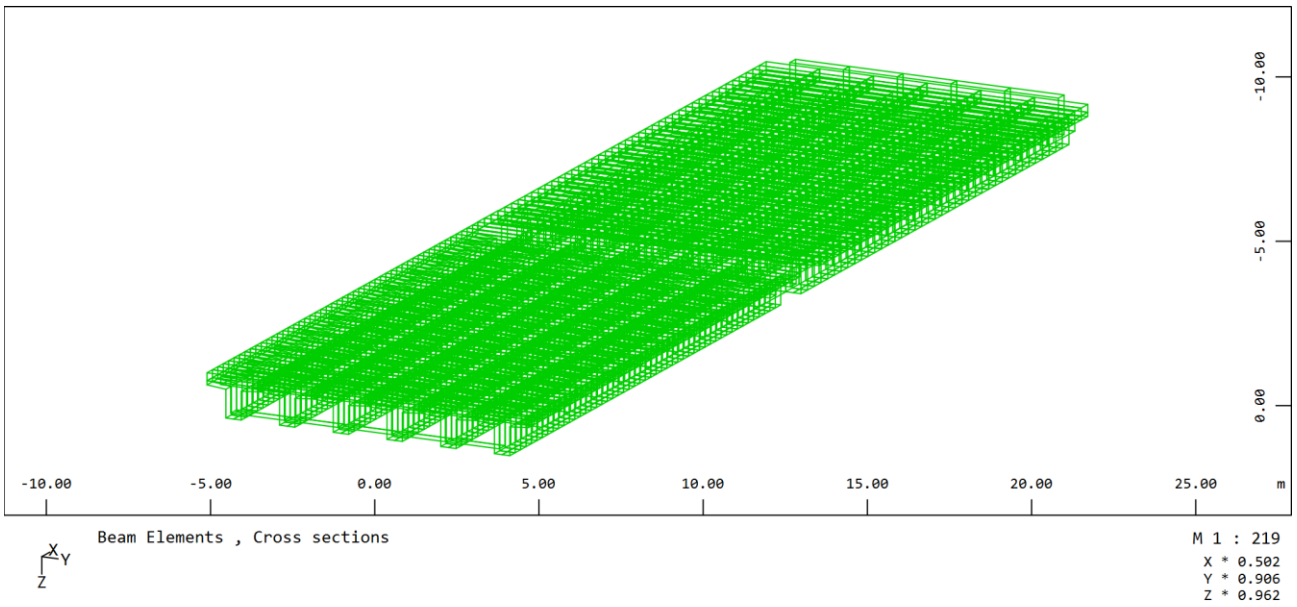
Za proračun kontinuitetne ploče koriste se sljedeća opterećenja:

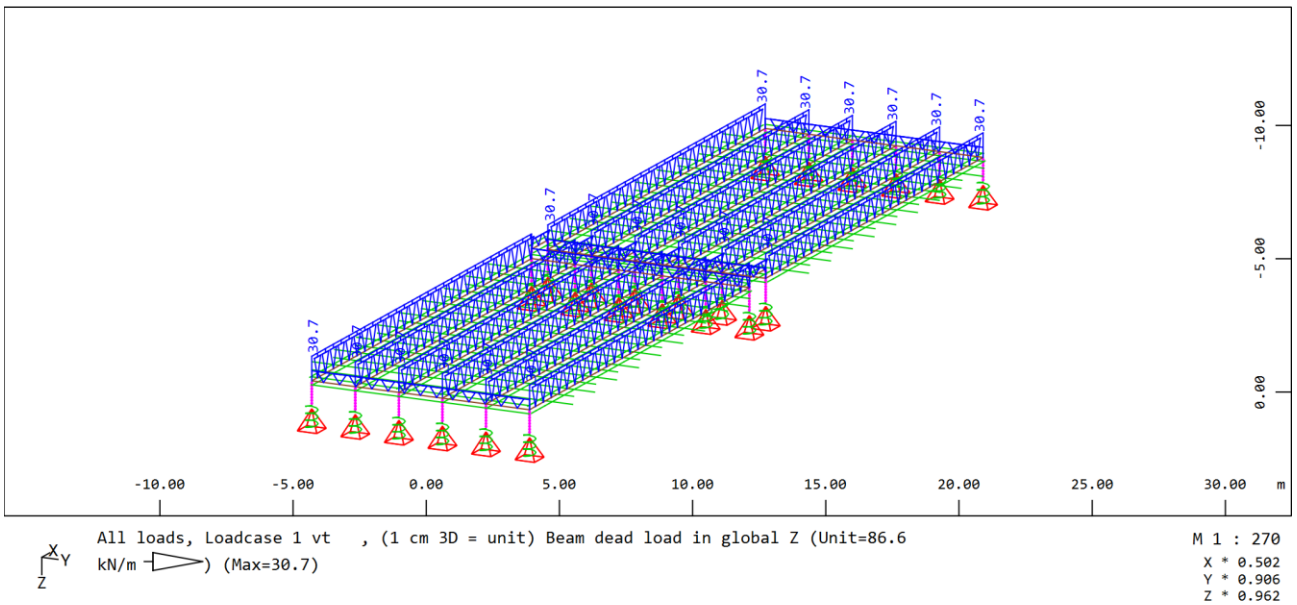
1. vlastita težina — LC 1
2. dodatno stalno opterećenje — LC 2
3. opterećenje prometom (LM1) — LC 21, 22-23,101-103
4. temperatura — LC 6-13
5. puzanje i skupljanje — LC 50

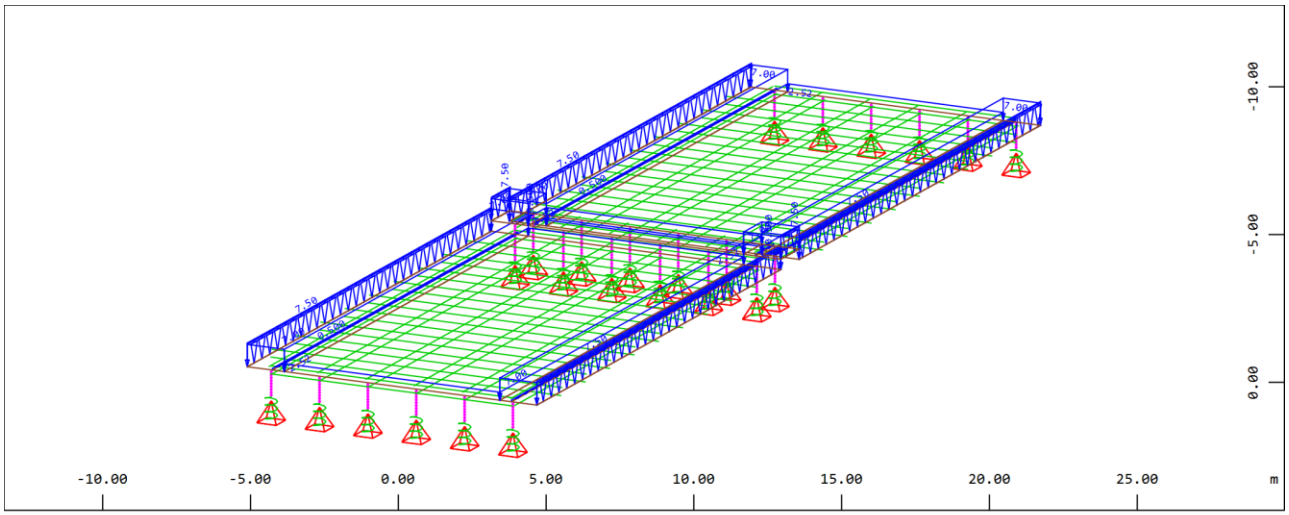
Kombinacije djelovanja:

OZNAKA KOMBINACIJE LC	KOMBINACIJE	Icr
9900-9999	Stalna kombinacija $S_d = S_d \cdot \left[\sum_j (\gamma_{G,j} \cdot G_{k,j}) + \gamma_Q \cdot Q_{k,1} + \sum_{i>1} (\gamma_Q \cdot \psi_{0,i} \cdot Q_{k,i}) \right]$	1
3200-3299	Kvazistalna kombinacija $S_d = S_d \cdot \left[\sum_{j \geq 1} G_{k,j} "+" P "+" \sum_{i \geq 1} \psi_{2,i} Q_{k,i} \right]$	2


-10.00
-5.00
0.00
-10.00
-5.00
0.00
5.00
10.00
15.00
20.00
25.00
m
Structure
M 1 : 223
X * 0.502
Y * 0.906
Z * 0.962

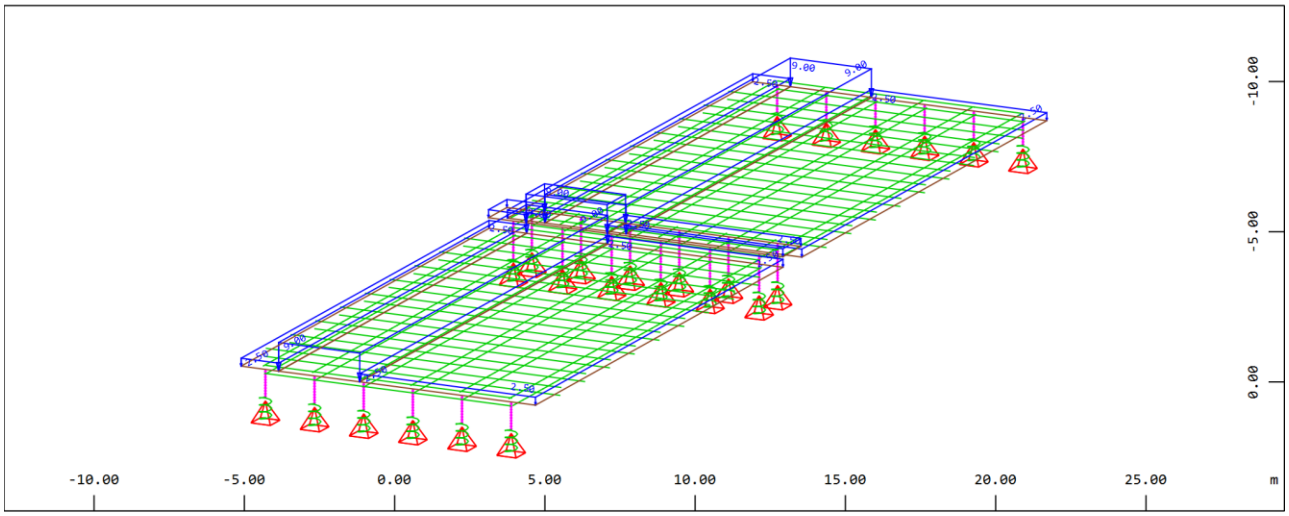

-10.00
-5.00
0.00
-10.00
-5.00
0.00
5.00
10.00
15.00
20.00
25.00
m
Beam Elements , Cross sections
M 1 : 219
X * 0.502
Y * 0.906
Z * 0.962


30.7
-10.00
-5.00
0.00
-10.00
-5.00
0.00
5.00
10.00
15.00
20.00
25.00
30.00
m
All loads, Loadcase 1 vt , (1 cm 3D = unit) Beam dead load in global Z (Unit=86.6
kN/m) (Max=30.7)
M 1 : 270
X * 0.502
Y * 0.906
Z * 0.962



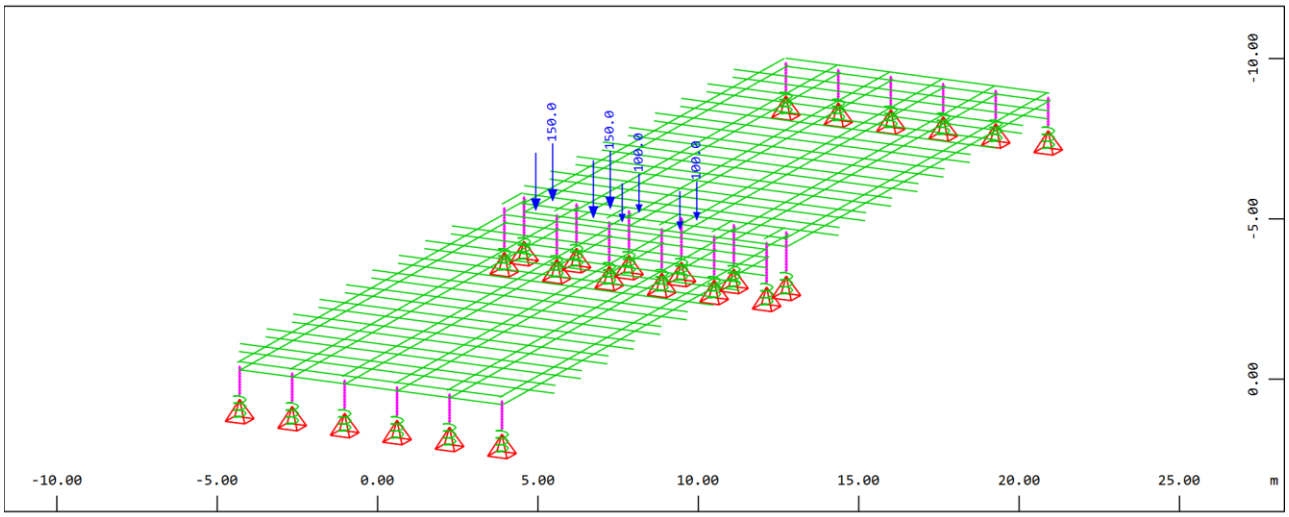
All loads, Loadcase 2 dg , (1 cm 3D = unit) Free line load (force) in global Z (Unit=21.6 kN/m,Max=7.50), Free area load (force) in global Z (Unit=21.6 kN/m2,Max=7.00)

M 1 : 242
X * 0.502
Y * 0.906
Z * 0.962



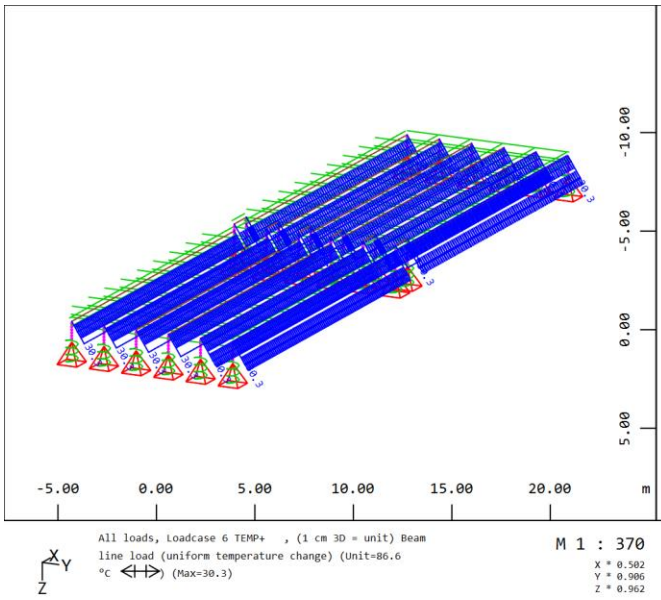
All loads, Loadcase 21 kont1 , (1 cm 3D = unit) Free area load (force) in global Z (Unit=21.6 kN/m2) (Max=9.00)

M 1 : 238
X * 0.502
Y * 0.906
Z * 0.962



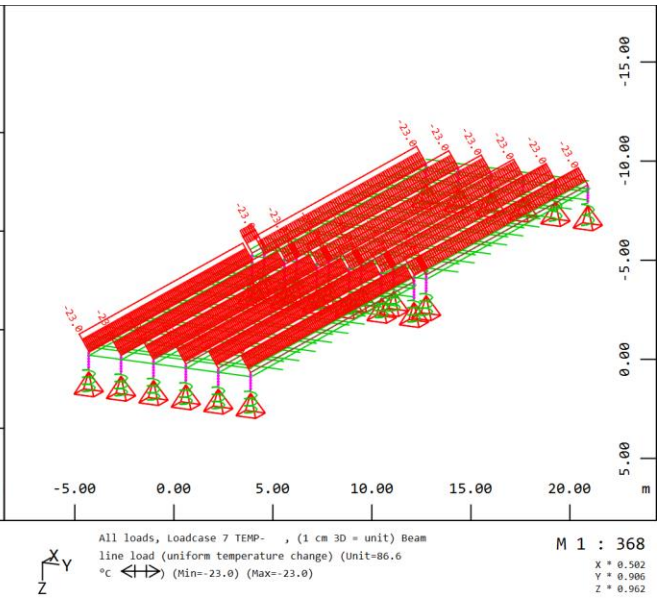
All loads, Loadcase 23 konc2 , (1 cm 3D = unit) Free single load (force) in global Z (Unit=180.5 kN) (Max=150.0)

M 1 : 223
X * 0.502
Y * 0.906
Z * 0.962



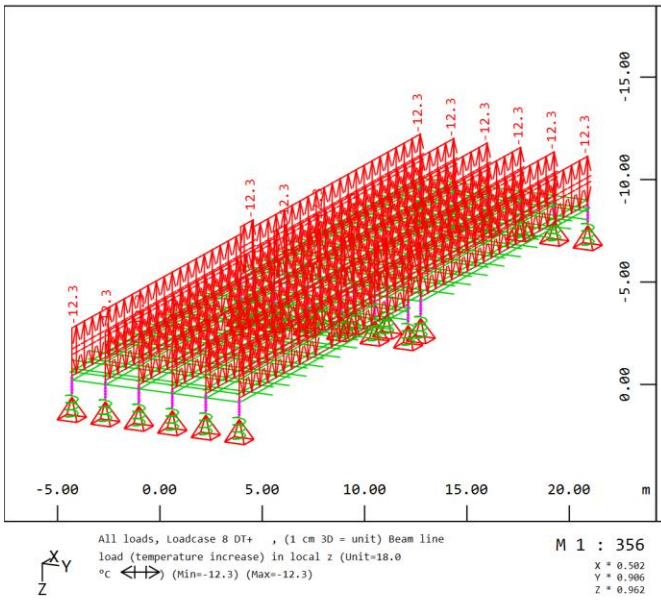
All loads, Loadcase 6 TEMP+ , (1 cm 3D = unit) Beam line load (uniform temperature change) (Unit=86.6 °C ⟷) (Max=30.3)

M 1 : 370
X * 0.502
Y * 0.906
Z * 0.962



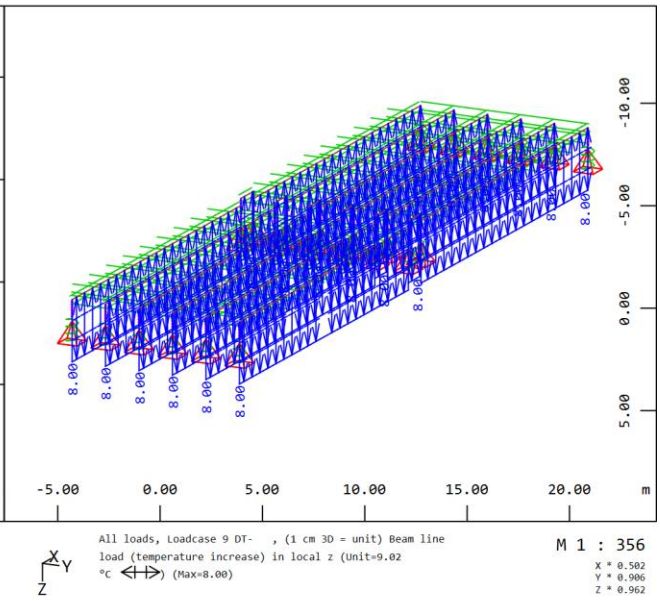
All loads, Loadcase 7 TEMP- , (1 cm 3D = unit) Beam line load (uniform temperature change) (Unit=86.6 °C ⟷) (Min=-23.0) (Max=-23.0)

M 1 : 368
X * 0.502
Y * 0.906
Z * 0.962



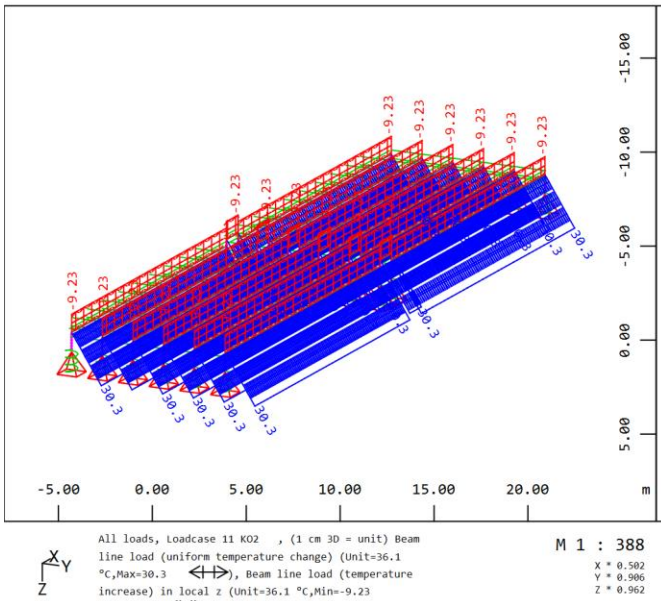
All loads, Loadcase 8 DT+ , (1 cm 3D = unit) Beam line load (temperature increase) in local z (Unit=18.0 °C ⟷) (Min=-12.3) (Max=-12.3)

M 1 : 356
X * 0.502
Y * 0.906
Z * 0.962



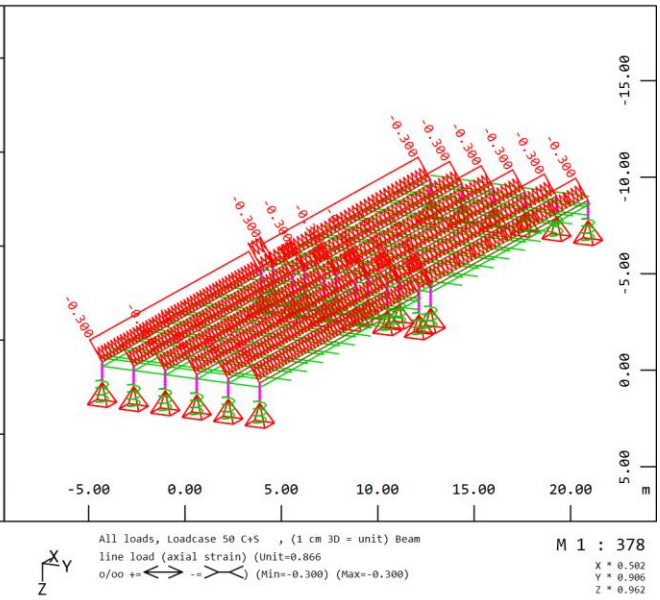
All loads, Loadcase 9 DT- , (1 cm 3D = unit) Beam line load (temperature increase) in local z (Unit=9.02 °C ⟷) (Max=8.00)

M 1 : 356
X * 0.502
Y * 0.906
Z * 0.962



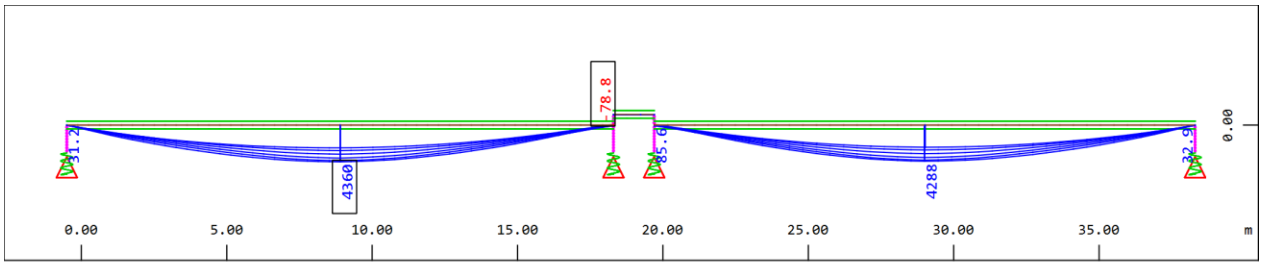
All loads, Loadcase 11 KO2 , (1 cm 3D = unit) Beam line load (uniform temperature change) (Unit=36.1 °C,Max=30.3 ⟷), Beam line load (temperature increase) in local z (Unit=36.1 °C,Min=-9.23 Max=-9.23 ⟷)

M 1 : 388
X * 0.502
Y * 0.906
Z * 0.962

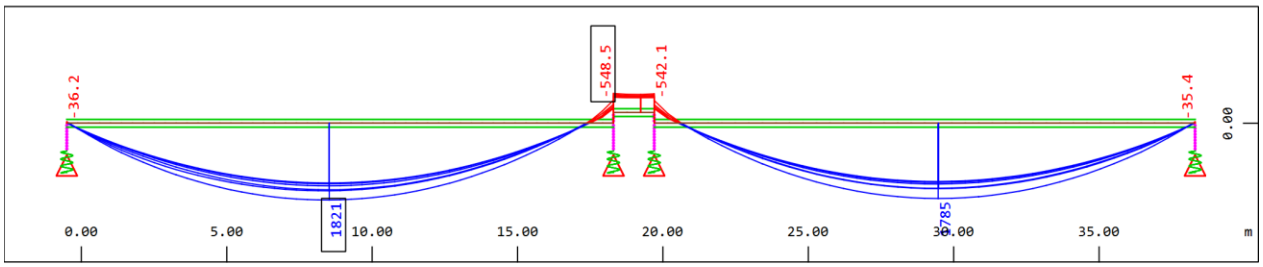


All loads, Loadcase 50 C+S , (1 cm 3D = unit) Beam line load (axial strain) (Unit=0.866 o/oo +⟷ -⟷) (Min=-0.300) (Max=-0.300)

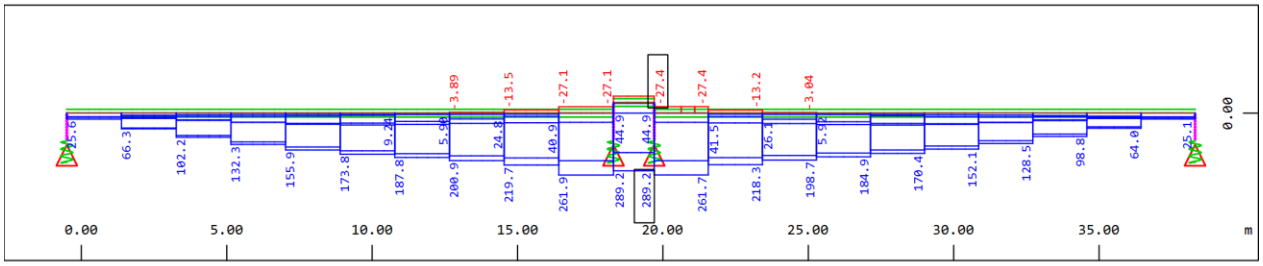
M 1 : 378
X * 0.502
Y * 0.906
Z * 0.962



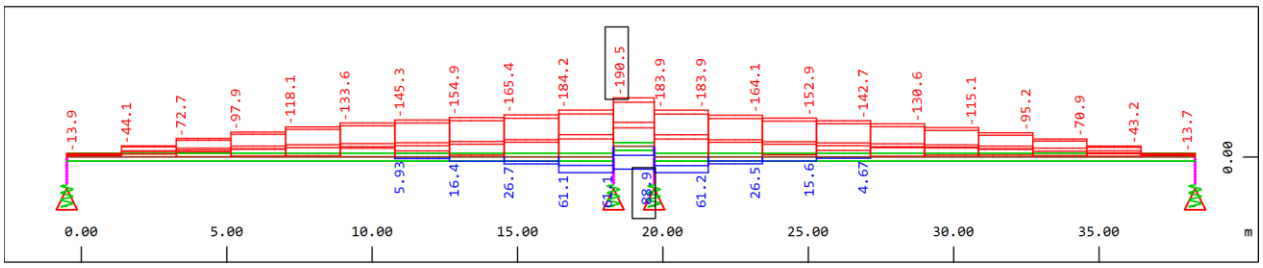
Sector of system Group 1 4 22 M 1 : 241
Beam Elements , Bending moment My, Loadcase 9900 MAX-MY BEAM ULS-traffic,temp,win , 1 cm
3D = 8320. kNm (Min=-78.8) (Max=4360.)



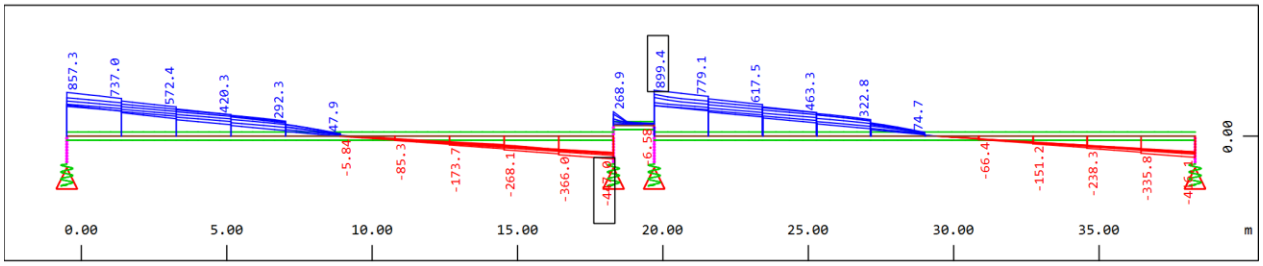
Sector of system Group 1 4 22 M 1 : 241
Beam Elements , Bending moment My, Loadcase 9901 MIN-MY BEAM ULS-traffic,temp,win , 1 cm
3D = 1664. kNm (Min=-548.5) (Max=1821.)



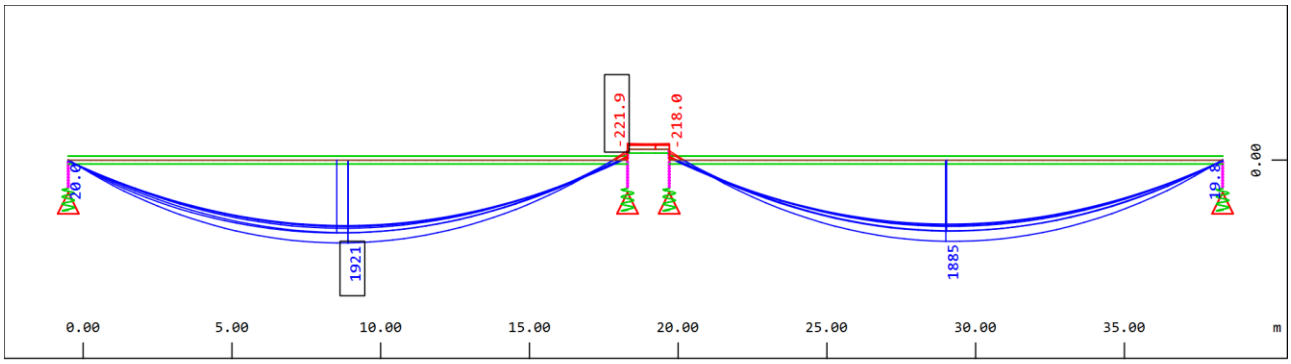
Sector of system Group 1 4 22 M 1 : 241
Beam Elements , Normal force Nx, Loadcase 9908 MAX-N BEAM ULS-traffic,temp,wind , 1 cm
3D = 296.9 kN (Min=-27.4) (Max=289.2)



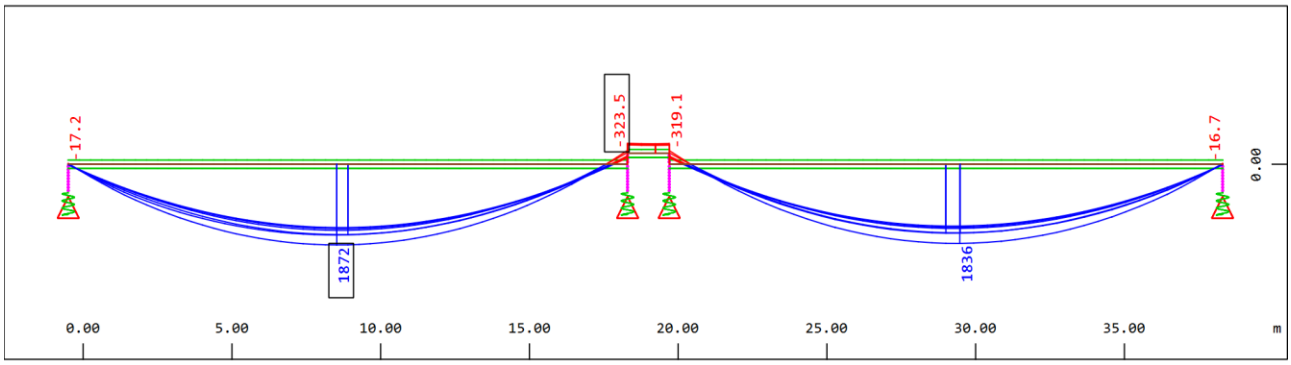
Sector of system Group 1 4 22 M 1 : 241
Beam Elements , Normal force Nx, Loadcase 9909 MIN-N BEAM ULS-traffic,temp,wind , 1 cm
3D = 275.0 kN (Min=-190.5) (Max=88.9)



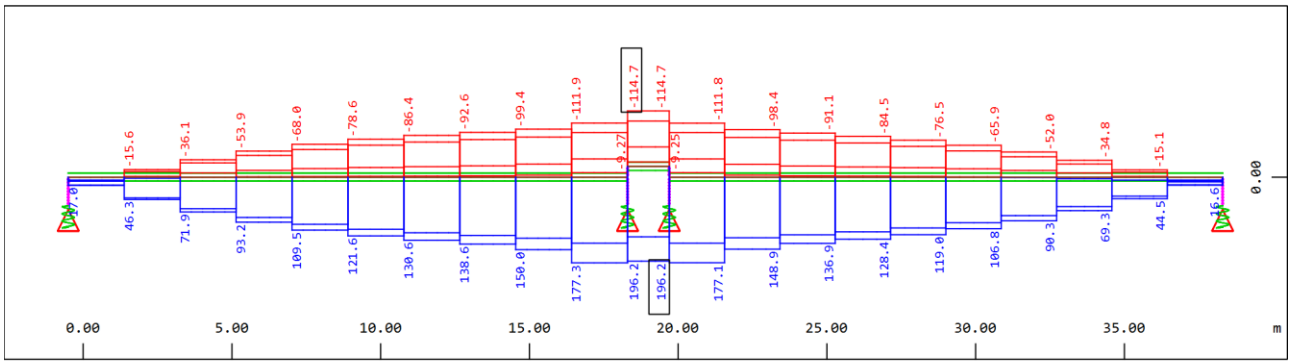
Sector of system Group 1 4 22 M 1 : 241
Beam Elements , Shear force Vz, Loadcase 9902 MAX-VZ BEAM ULS-traffic,temp,win , 1 cm 3D
= 1375. kN (Min=-447.0) (Max=899.4)



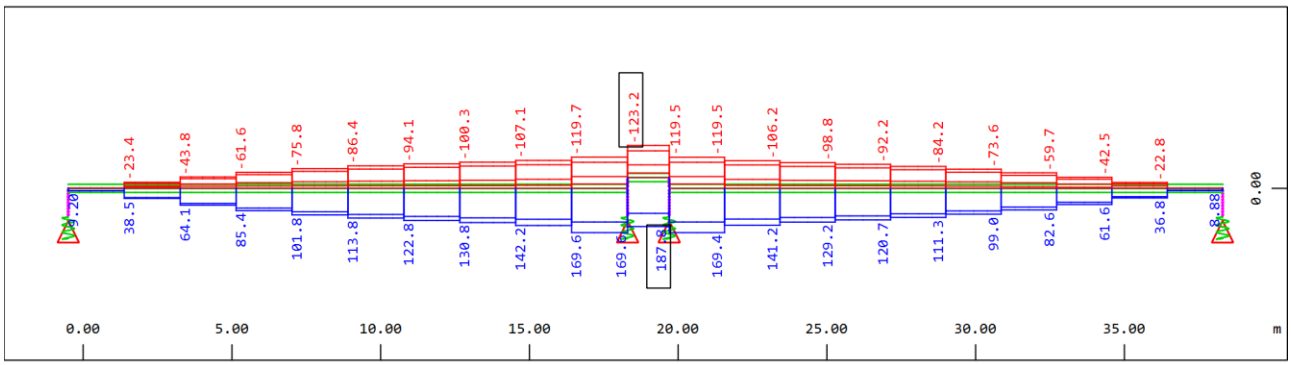
Sector of system Group 1 4 22 M 1 : 241
Beam Elements , Bending moment My, Loadcase 3200 MAXP-MY BEAM SLS-PERMANENT , 1 cm 3D =
1664. kNm (Min=-221.9) (Max=1921.)



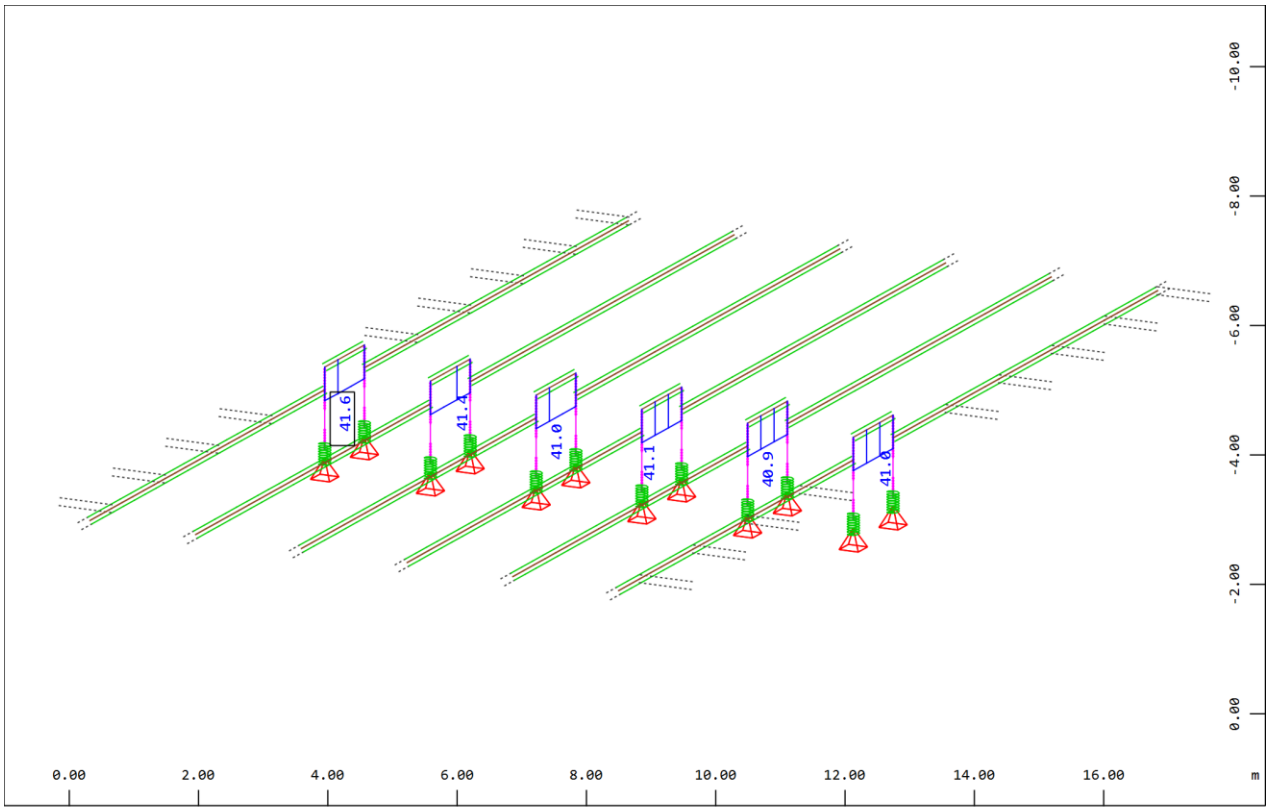
Sector of system Group 1 4 22 M 1 : 241
Beam Elements , Bending moment My, Loadcase 3201 MINP-MY BEAM SLS-PERMANENT , 1 cm 3D =
1664. kNm (Min=-323.5) (Max=1872.)



Sector of system Group 1 4 22 M 1 : 241
Beam Elements , Normal force Nx, Loadcase 3208 MAXP-N BEAM SLS-PERMANENT , 1 cm 3D =
148.4 kN (Min=-114.7) (Max=196.2)

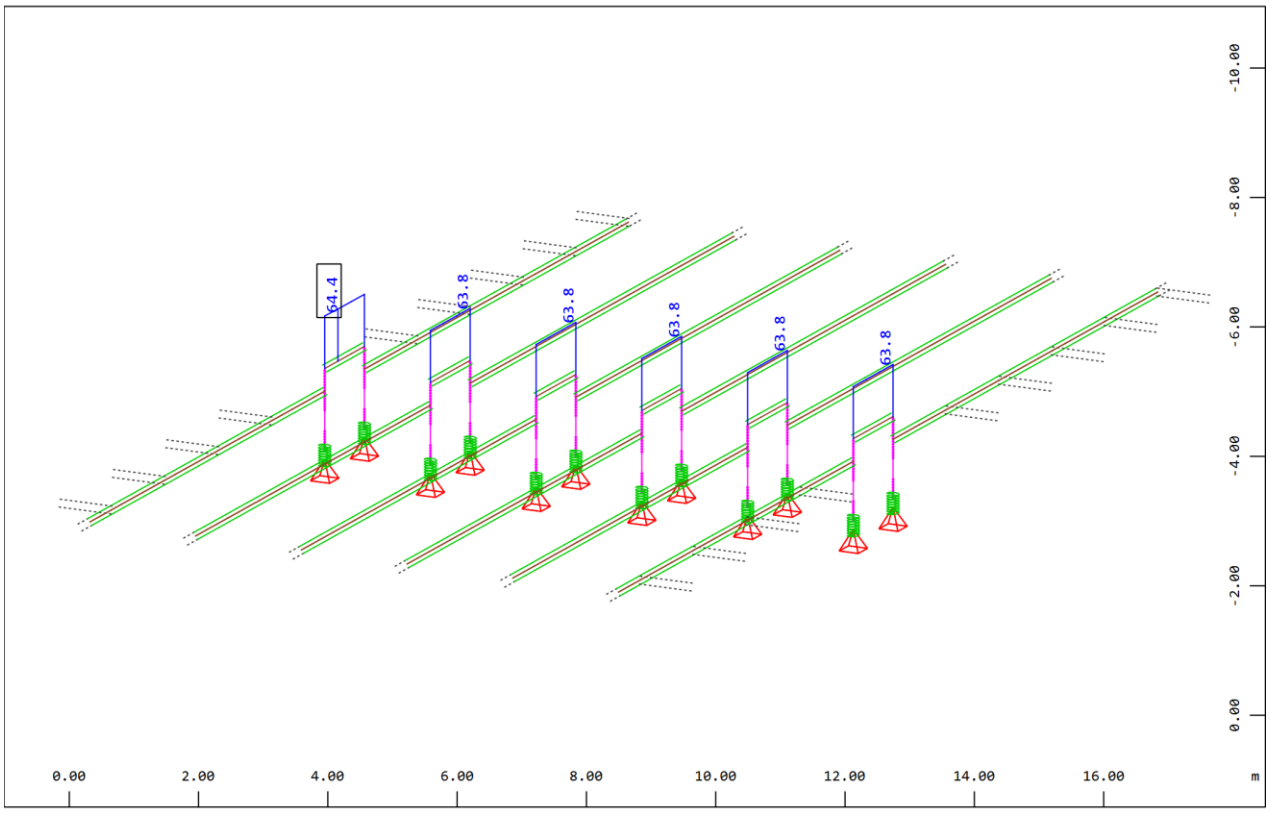


Sector of system Group 1 4 22 M 1 : 241
Beam Elements , Normal force Nx, Loadcase 3209 MINP-N BEAM SLS-PERMANENT , 1 cm 3D =
275.0 kN (Min=-123.2) (Max=187.8)



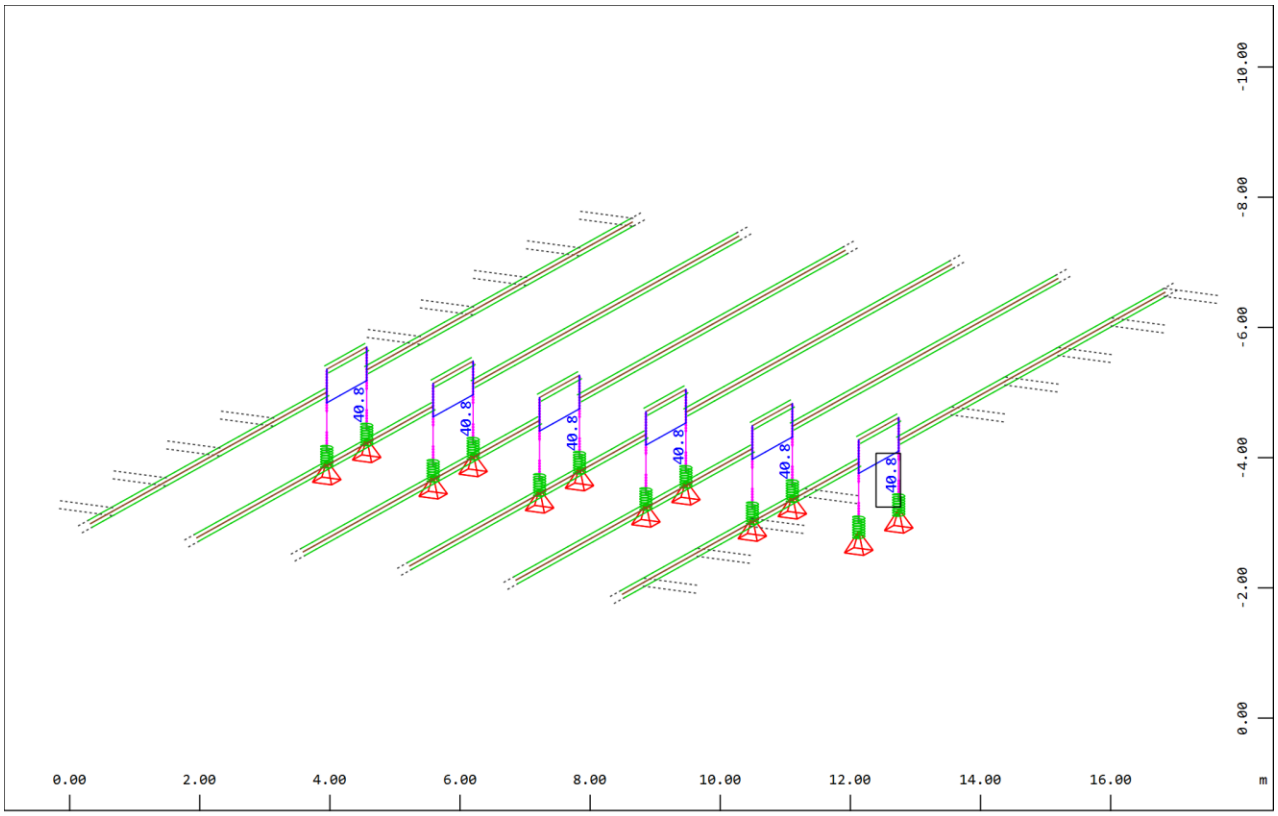
Sector of system Group 1 4 22
Beam Elements , Longitudinal Reinforcements Lay. 1, Design Case 1 , 1 cm 3D = 83.2 cm2
(Max=41.6)

M 1 : 109
X * 0.502
Y * 0.906
Z * 0.962



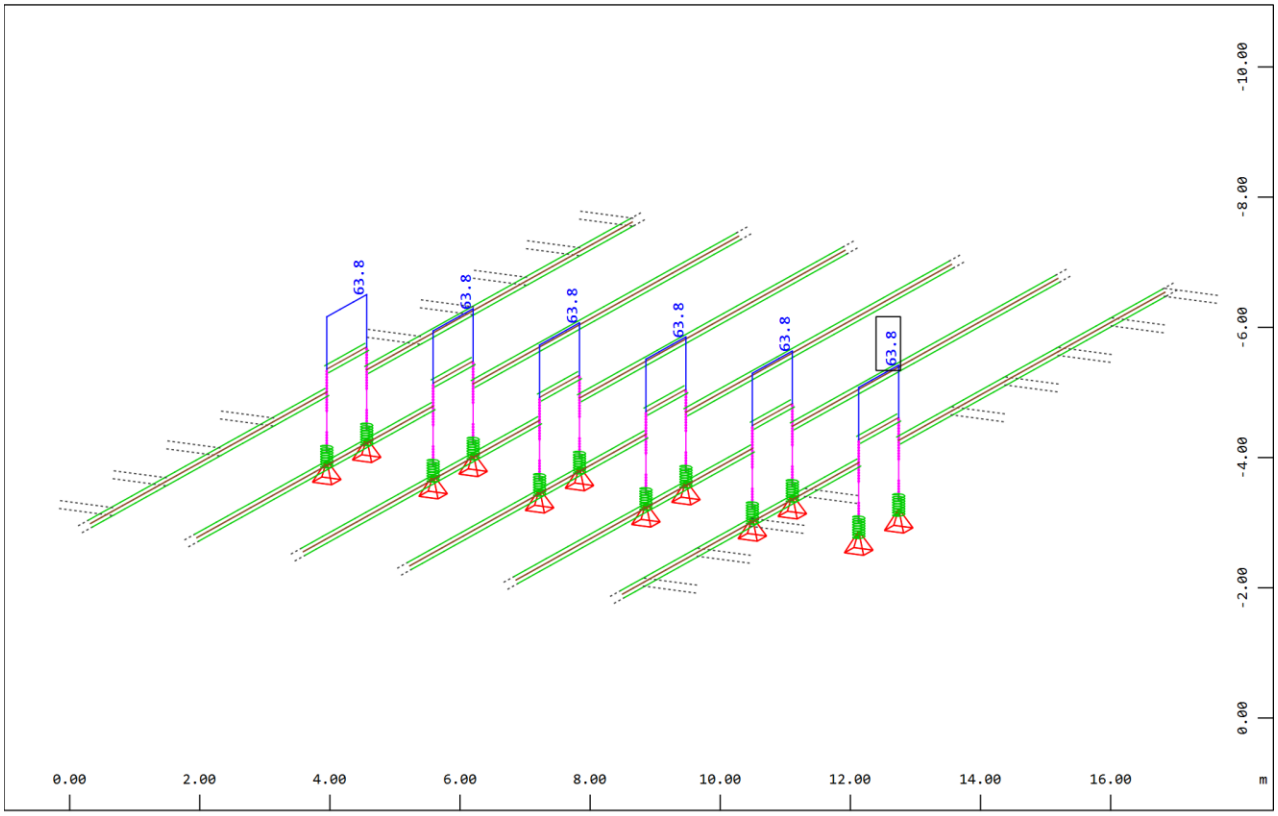
Sector of system Group 1 4 22
Beam Elements , Longitudinal Reinforcements Lay. 2, Design Case 1 , 1 cm 3D = 83.2 cm2
(Max=64.4)

M 1 : 109
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 1 4 22
Beam Elements , Longitudinal Reinforcements Lay. 1, Design Case 2 , 1 cm 3D = 83.2 cm2
(Max=40.8)

M 1 : 109
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 1 4 22
Beam Elements , Longitudinal Reinforcements Lay. 2, Design Case 2 , 1 cm 3D = 83.2 cm2
(Max=63.8)

M 1 : 109
X * 0.502
Y * 0.906
Z * 0.962

Minimalna površina armature u presjeku h=25cm:

$A_{s,min} = 0{,}0013 \cdot b \cdot d =$ 0,0013·100·19,7 = 2,56 cm^2/m'

$A_{s,min} = 0{,}26 \cdot (f_{ctm} / f_{yk}) \cdot b \cdot d = 0{,}26 \cdot (2{,}9/500) \cdot 100 \cdot 19{,}7$ = 2,97 cm^2/m'

Maksimalna površina armature u presjeku h=25cm:

$A_{s,max}$ = 0,04 A_c = 0,04·100·25 = 100,0 cm^2/m'

Max. dobivena armatura gornje zone je 64,4 cm^2, 64,4/1,82=35,38 cm^2/m'. Odabire se:

ODABRANO Φ28/15 cm ($A_{s1,od}$ = 41,2 cm^2/m')

Poprečna armatura Φ14/15 cm

Max. dobivena armatura donje zone je 41,6 cm^2, 41,6/1,82=22,86 cm^2/m'. Odabire se:

ODABRANO Φ22/15 cm ($A_{s1,od}$ = 25,3 cm^2/m')

Poprečna armatura Φ14/15 cm

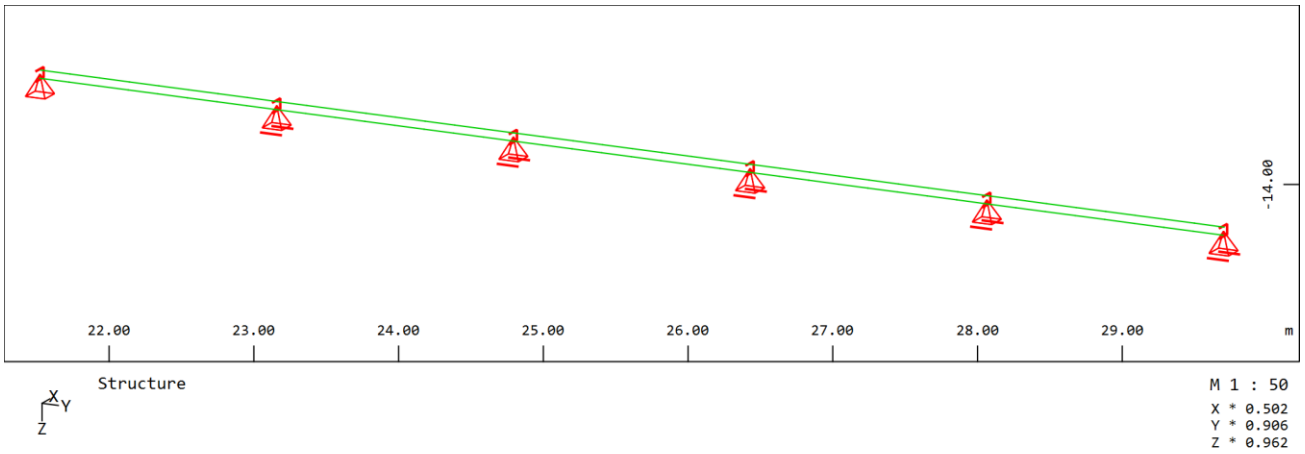
3.9 Proračun poprečnog nosača

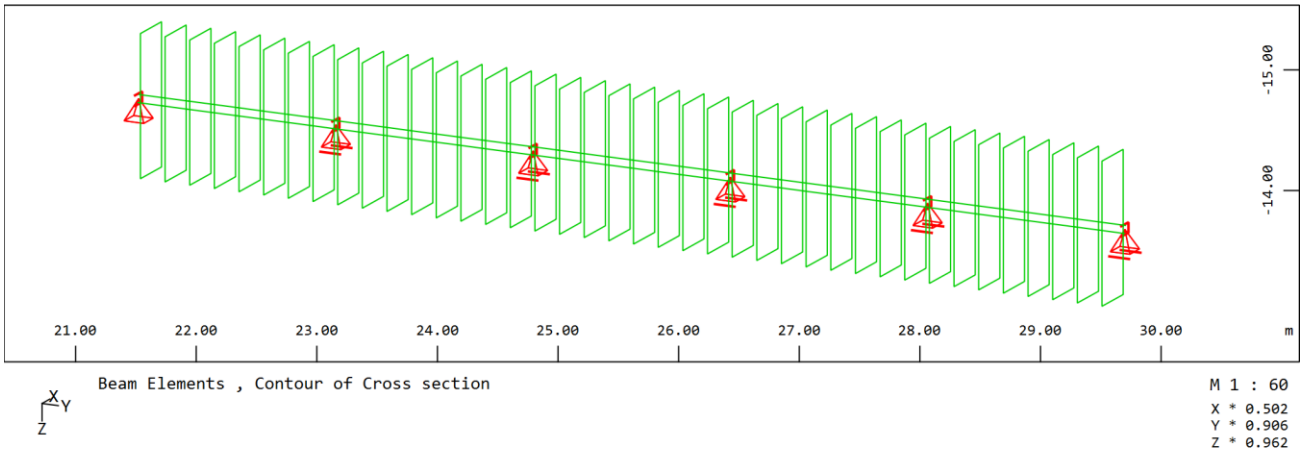
Za proračun poprečnog nosača koriste se sljedeća opterećenja:

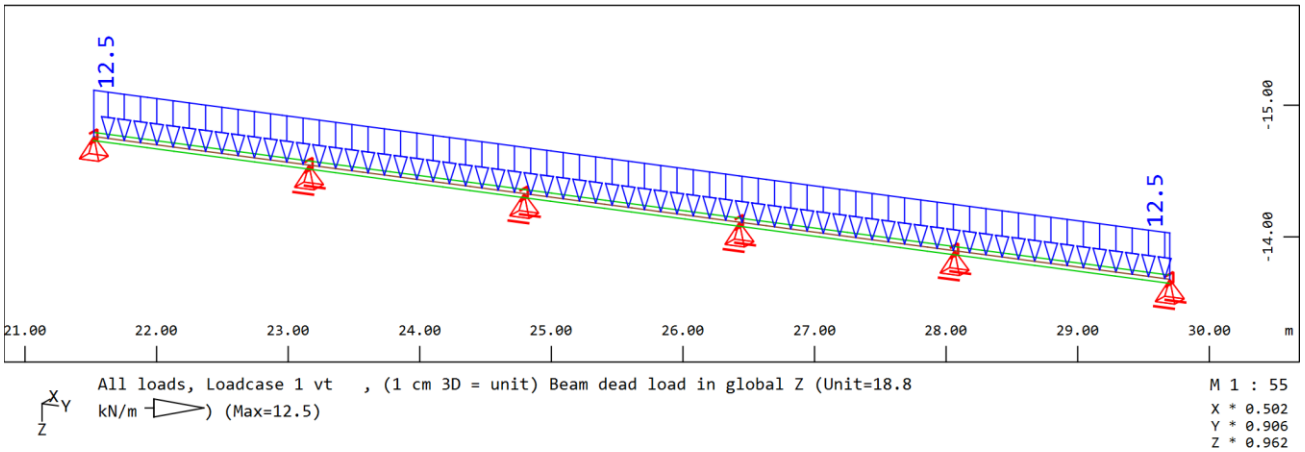
1. vlastita težina — LC 1
2. dodatno stalno opterećenje — LC 2
3. opterećenje prometom (LM1, LM2) — LC 25-26,10-13
4. kočna sila — LC 8-9
5. izvanredna opterećenja — LC 5-6
   - udar na odbojnu ogradu
     (vertikalna sila 0,75xQ_{1k}; horizontalna sila 200kN)
   - udar na rubnjak
     (vertikalna sila 0,75xQ_{1k}; horizontalna sila 100kN)

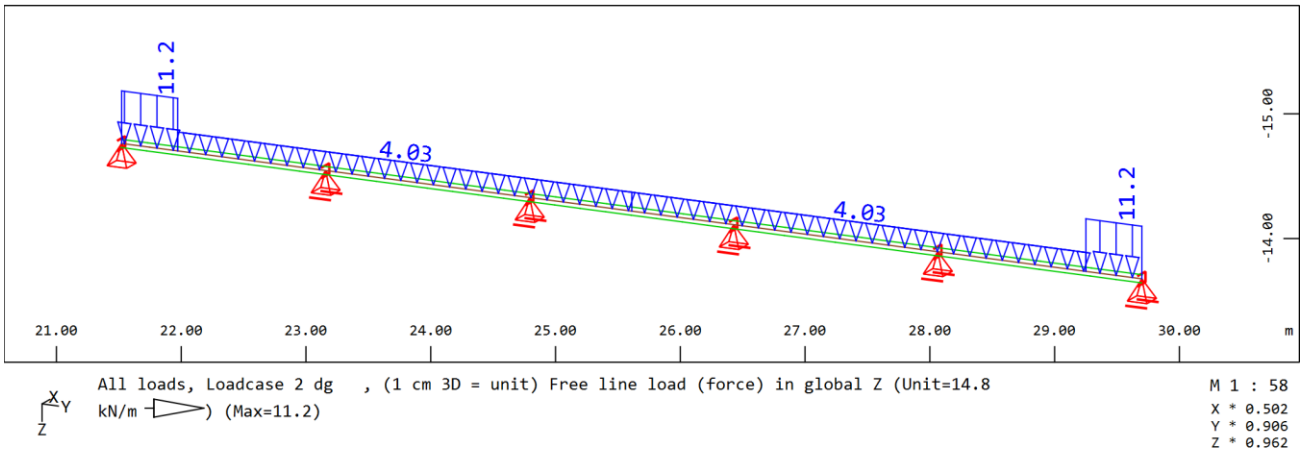
Kombinacije djelovanja:

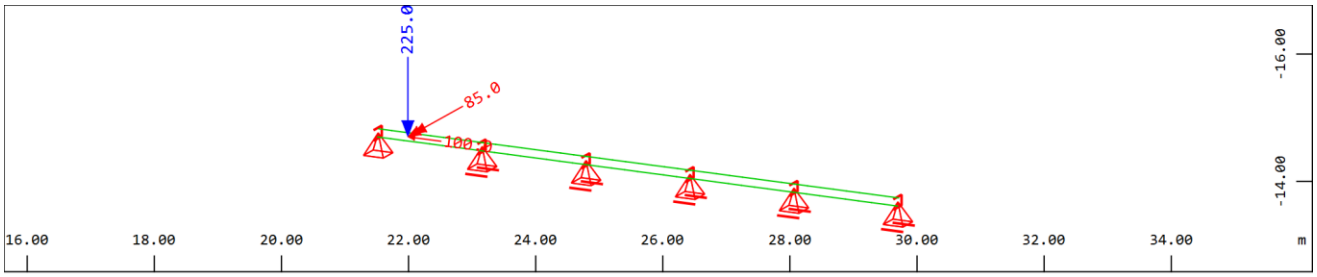
OZNAKA KOMBINACIJE LC	KOMBINACIJE	Icr
1000-1099, 1100-1199	Stalna kombinacija $S_d = S_d \cdot \left[\sum_j (\gamma_{G,j} \cdot G_{k,j}) + \gamma_Q \cdot Q_{k,1} + \sum_{i>1} (\gamma_Q \cdot \psi_{0,i} \cdot Q_{k,i}) \right]$	1
1500-1599	Izvanredna kombinacija $S_d = S_d \cdot \left[\sum_j (\gamma_{G,j} \cdot G_{k,j}) + \psi_{1,1} \cdot Q_{k,1} + \sum_{i>1} (\psi_{2,i} \cdot Q_{k,i}) + A_d \right]$	3
3000-3099	Kvazistalna kombinacija $S_d = S_d \cdot \left[\sum_{j \geq 1} G_{k,j} "+" P "+" \sum_{i \geq 1} \psi_{2,i} Q_{k,i} \right]$	2


-14.00
22.00
23.00
24.00
25.00
26.00
27.00
28.00
29.00
m
Structure
M 1 : 50
X * 0.502
Y * 0.906
Z * 0.962


-15.00
-14.00
21.00
22.00
23.00
24.00
25.00
26.00
27.00
28.00
29.00
30.00
m
Beam Elements , Contour of Cross section
M 1 : 60
X * 0.502
Y * 0.906
Z * 0.962

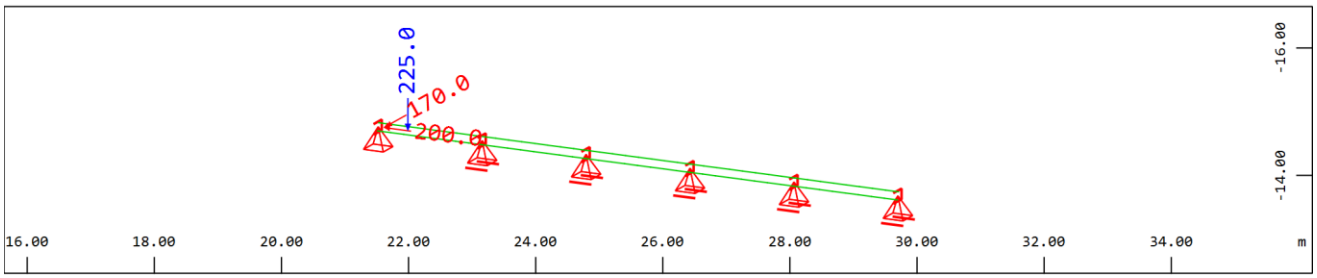

12.5
12.5
-15.00
-14.00
21.00
22.00
23.00
24.00
25.00
26.00
27.00
28.00
29.00
30.00
m
All loads, Loadcase 1 vt , (1 cm 3D = unit) Beam dead load in global Z (Unit=18.8
kN/m) (Max=12.5)
M 1 : 55
X * 0.502
Y * 0.906
Z * 0.962


11.2
4.03
4.03
11.2
-15.00
-14.00
21.00
22.00
23.00
24.00
25.00
26.00
27.00
28.00
29.00
30.00
m
All loads, Loadcase 2 dg , (1 cm 3D = unit) Free line load (force) in global Z (Unit=14.8
kN/m) (Max=11.2)
M 1 : 58
X * 0.502
Y * 0.906
Z * 0.962



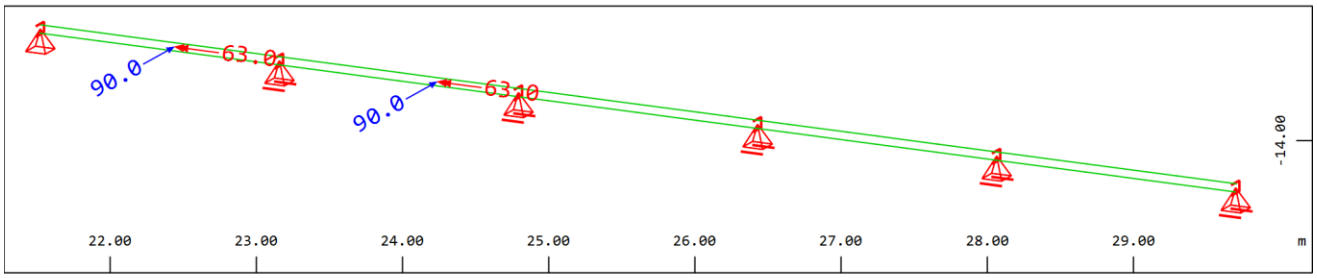
All loads, Loadcase 5 Udar u rub , (1 cm 3D = unit) Free single load (force) in global Y
(Unit=200.0 kN,Min=-100.0 Max=-100.0), Free single load (force) in global Z
(Unit=200.0 kN,Max=225.0), Free single load (moment) about global X (Unit=50.0

M 1 : 115
X * 0.502
Y * 0.906
Z * 0.962



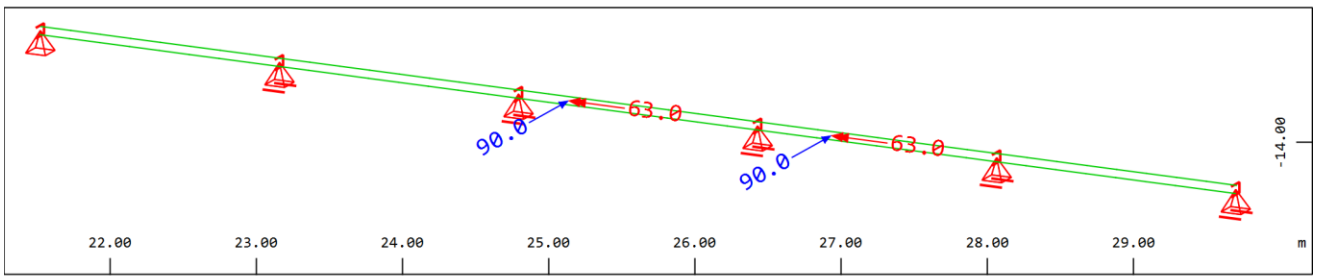
All loads, Loadcase 6 Udar u odb , (1 cm 3D = unit) Free single load (force) in global Y
(Unit=495.3 kN,Min=-200.0 Max=-200.0), Free single load (force) in global Z
(Unit=495.3 kN,Max=225.0), Free single load (moment) about global X (Unit=247.7

M 1 : 115
X * 0.502
Y * 0.906
Z * 0.962



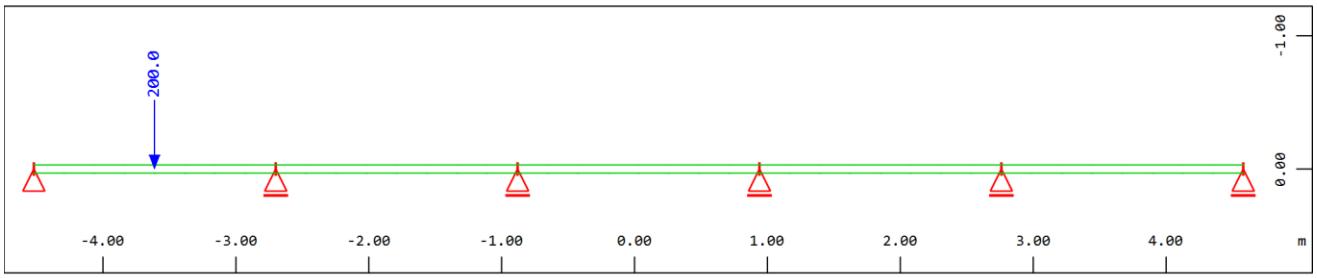
All loads, Loadcase 8 KS1 , (1 cm 3D = unit) Free single load (force) in global X
(Unit=94.1 kN,Max=90.0), Free single load (moment) about global Y (Unit=94.1
kNm,Min=-63.0 Max=-63.0)

M 1 : 50
X * 0.502
Y * 0.906
Z * 0.962



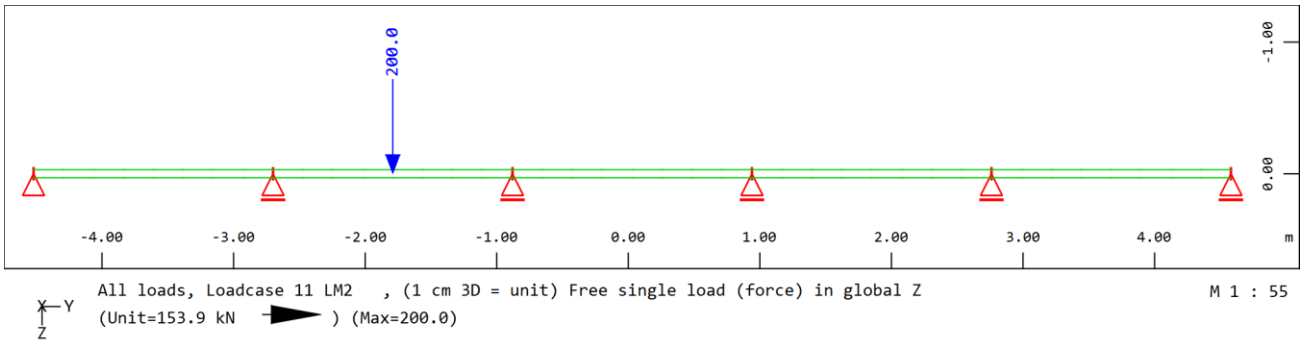
All loads, Loadcase 9 KS2 , (1 cm 3D = unit) Free single load (force) in global X
(Unit=74.2 kN,Max=90.0), Free single load (moment) about global Y (Unit=74.2
kNm,Min=-63.0 Max=-63.0)

M 1 : 50
X * 0.502
Y * 0.906
Z * 0.962



All loads, Loadcase 10 LM2 , (1 cm 3D = unit) Free single load (force) in global Z
(Unit=214.1 kN) (Max=200.0)

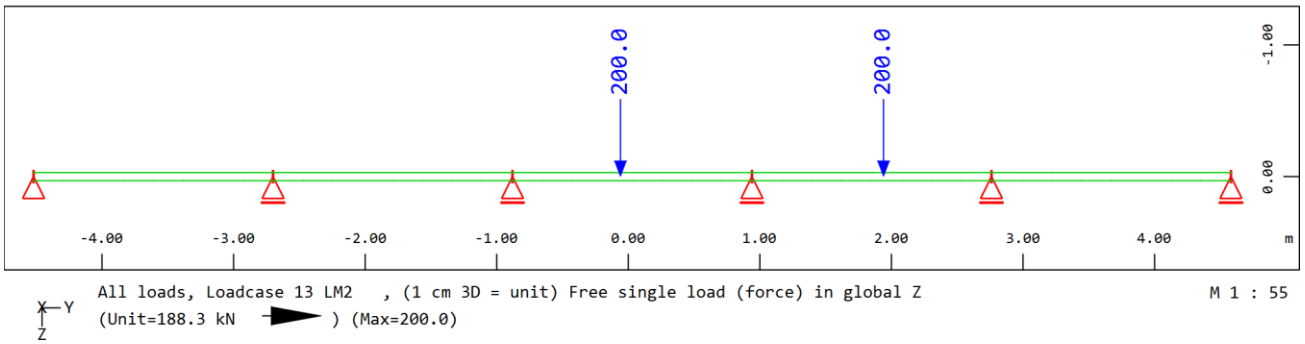
M 1 : 55



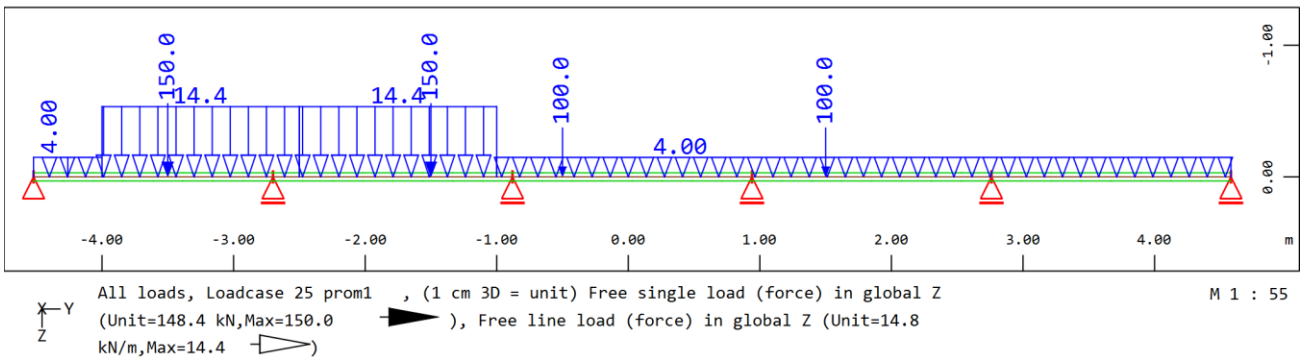
All loads, Loadcase 11 LM2 , (1 cm 3D = unit) Free single load (force) in global Z
(Unit=153.9 kN) (Max=200.0)
M 1 : 55



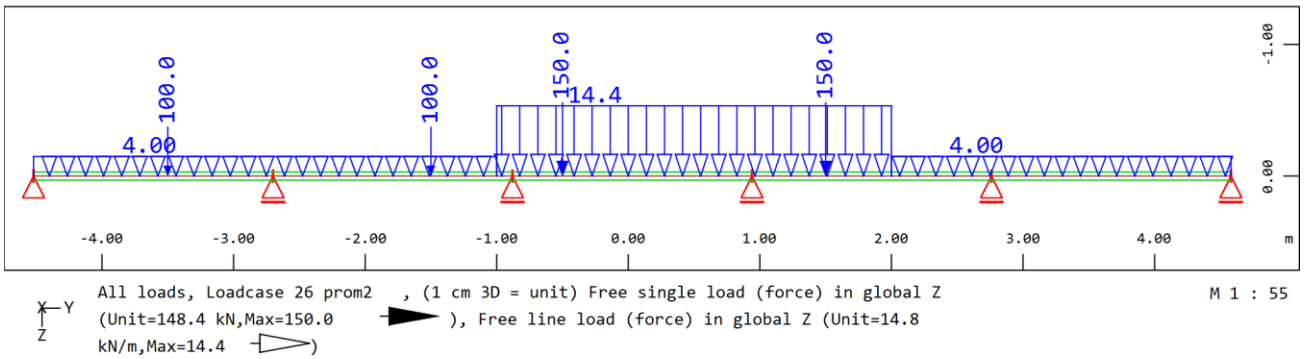
All loads, Loadcase 12 LM2 , (1 cm 3D = unit) Free single load (force) in global Z
(Unit=247.7 kN) (Max=200.0)
M 1 : 55



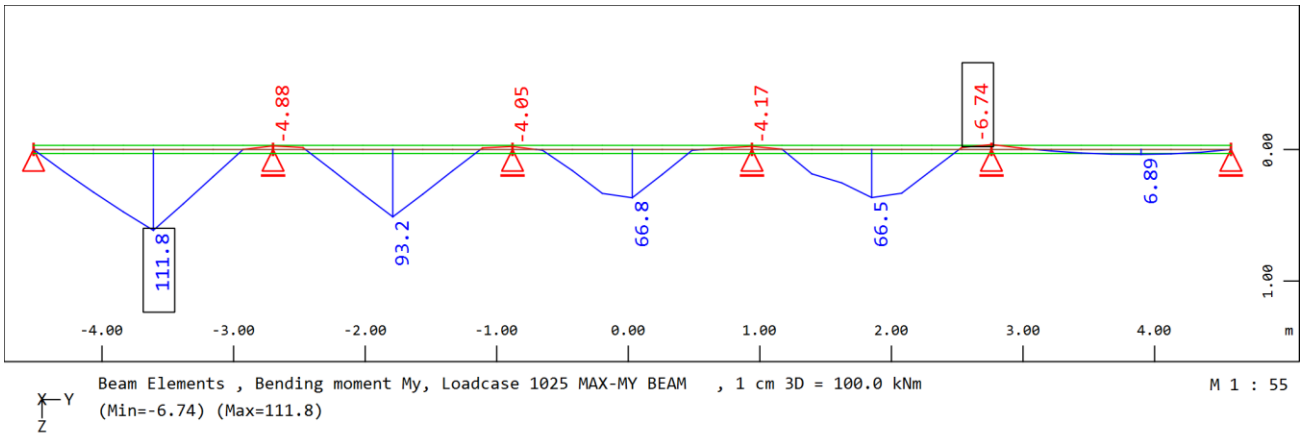
All loads, Loadcase 13 LM2 , (1 cm 3D = unit) Free single load (force) in global Z
(Unit=188.3 kN) (Max=200.0)
M 1 : 55



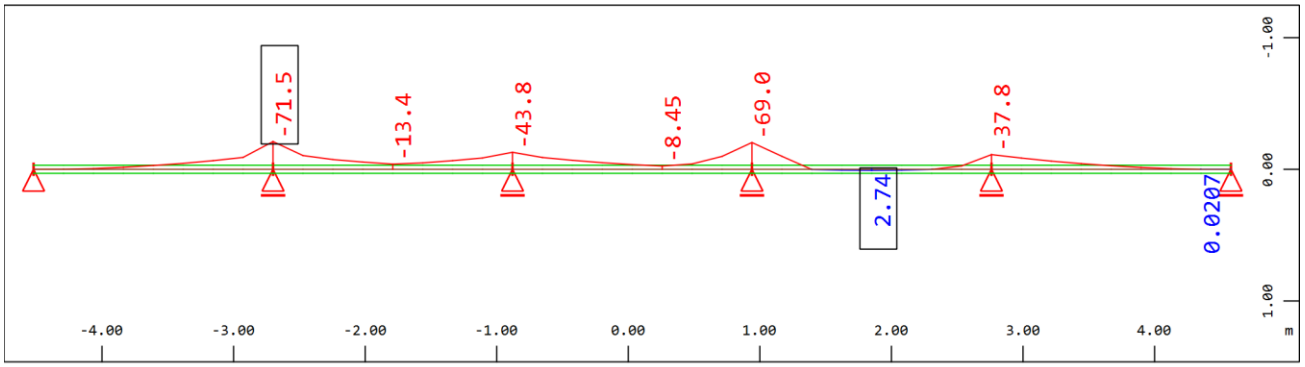
All loads, Loadcase 25 prom1 , (1 cm 3D = unit) Free single load (force) in global Z
(Unit=148.4 kN,Max=150.0), Free line load (force) in global Z (Unit=14.8
kN/m,Max=14.4)
M 1 : 55



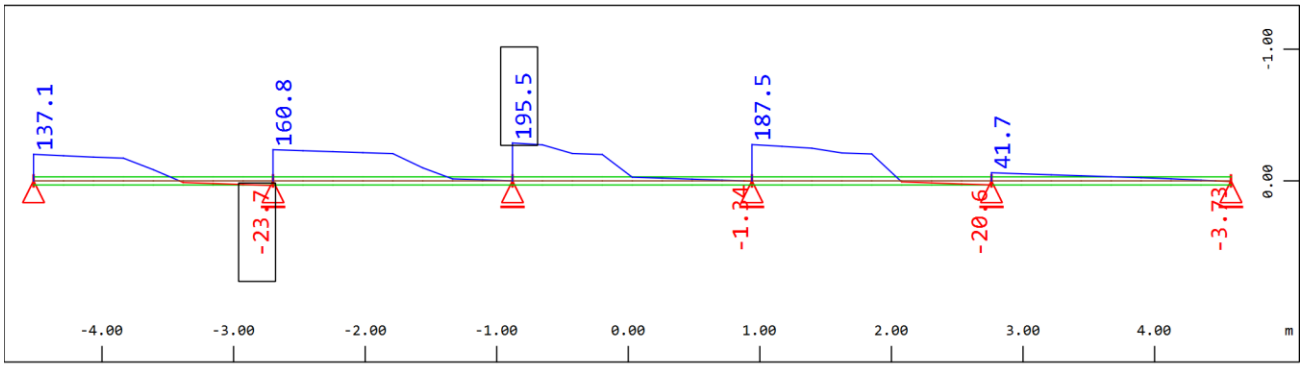
All loads, Loadcase 26 prom2 , (1 cm 3D = unit) Free single load (force) in global Z
(Unit=148.4 kN,Max=150.0), Free line load (force) in global Z (Unit=14.8
kN/m,Max=14.4)
M 1 : 55



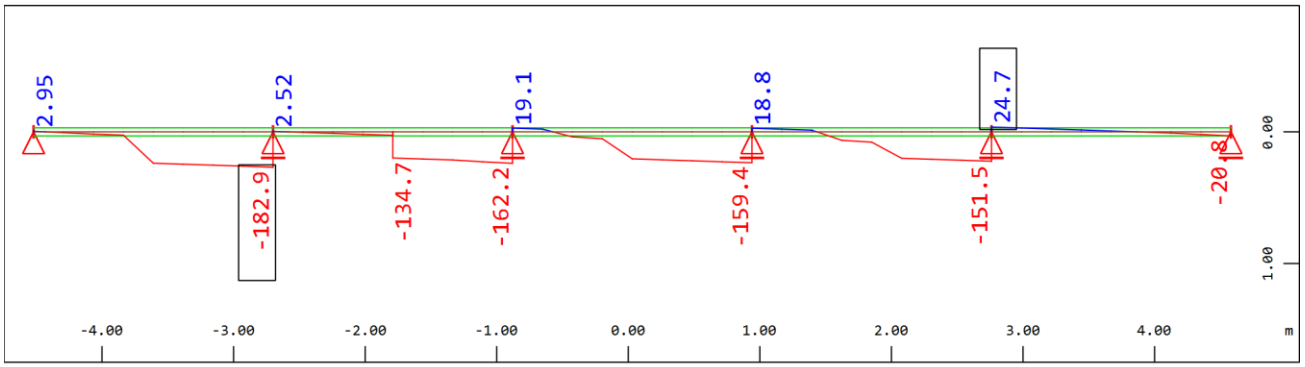
Beam Elements , Bending moment My, Loadcase 1025 MAX-MY BEAM , 1 cm 3D = 100.0 kNm M 1 : 55
(Min=-6.74) (Max=111.8)



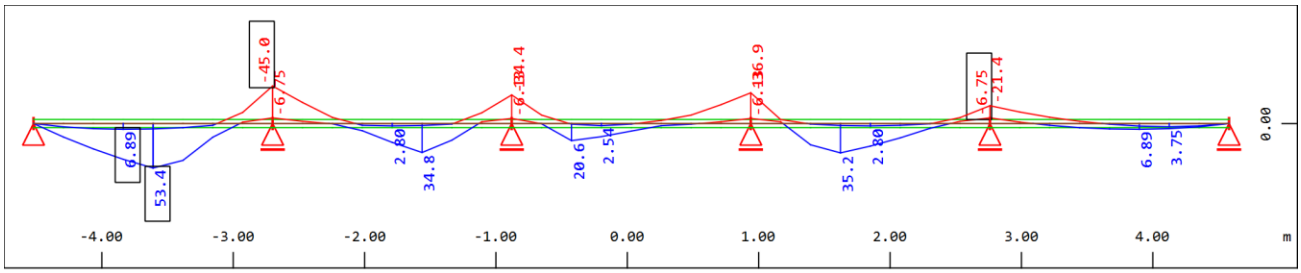
Beam Elements , Bending moment My, Loadcase 1026 MIN-MY BEAM , 1 cm 3D = 186.7 kNm M 1 : 55
(Min=-71.5) (Max=2.74)



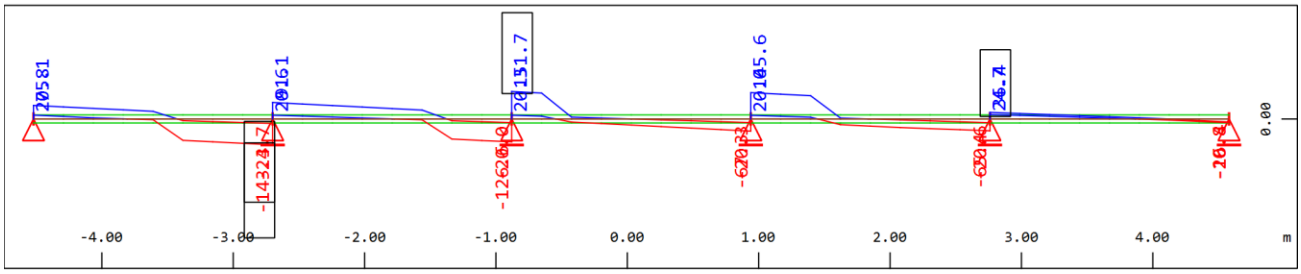
Beam Elements , Shear force Vz, Loadcase 1032 MAX-VZ BEAM , 1 cm 3D = 373.4 kN M 1 : 55
(Min=-23.7) (Max=195.5)



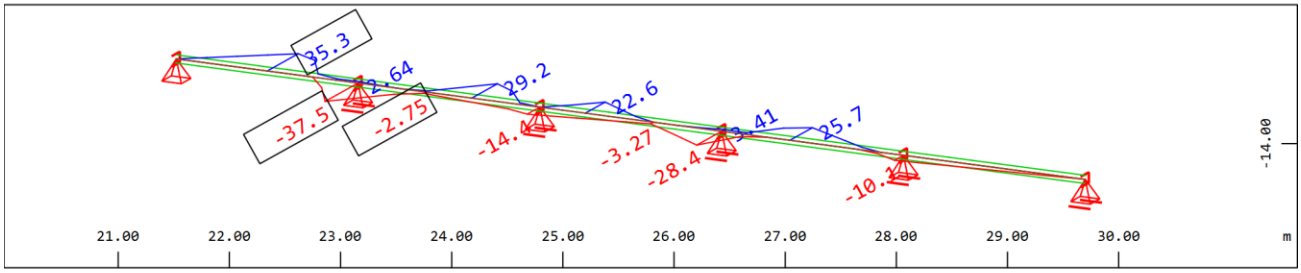
Beam Elements , Shear force Vz, Loadcase 1033 MIN-VZ BEAM , 1 cm 3D = 373.4 kN M 1 : 55
(Min=-182.9) (Max=24.7)



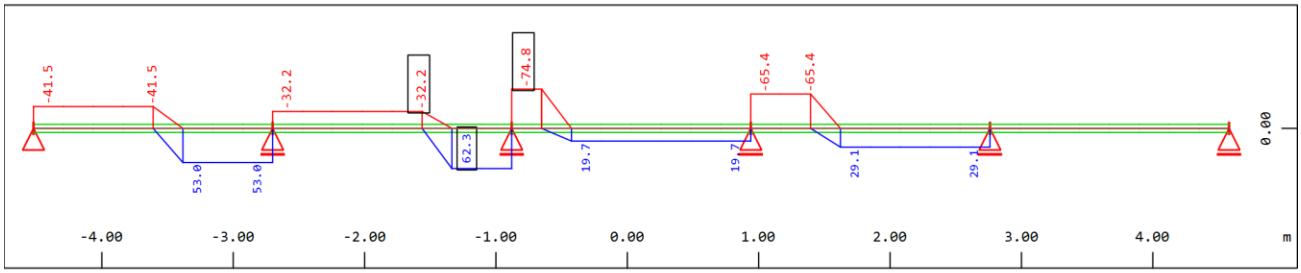
Beam Elements , Bending moment My, Loadcase 1125 MAX-MY BEAM , 1 cm 3D = 86.7 kNm M 1 : 55
(Min=-6.75) (Max=53.4)
Beam Elements , Bending moment My, Loadcase 1126 MIN-MY BEAM , 1 cm 3D = 86.7 kNm



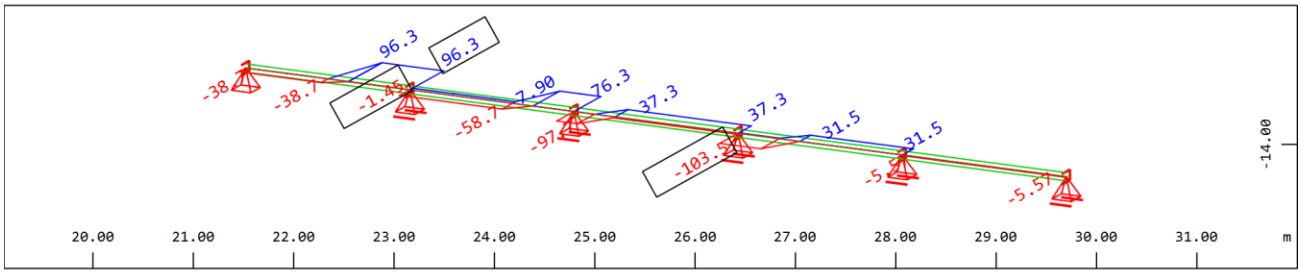
Beam Elements , Shear force Vz, Loadcase 1132 MAX-VZ BEAM , 1 cm 3D = 400.0 kN M 1 : 55
(Min=-24.7) (Max=151.7)
Beam Elements , Shear force Vz, Loadcase 1133 MIN-VZ BEAM , 1 cm 3D = 400.0 kN



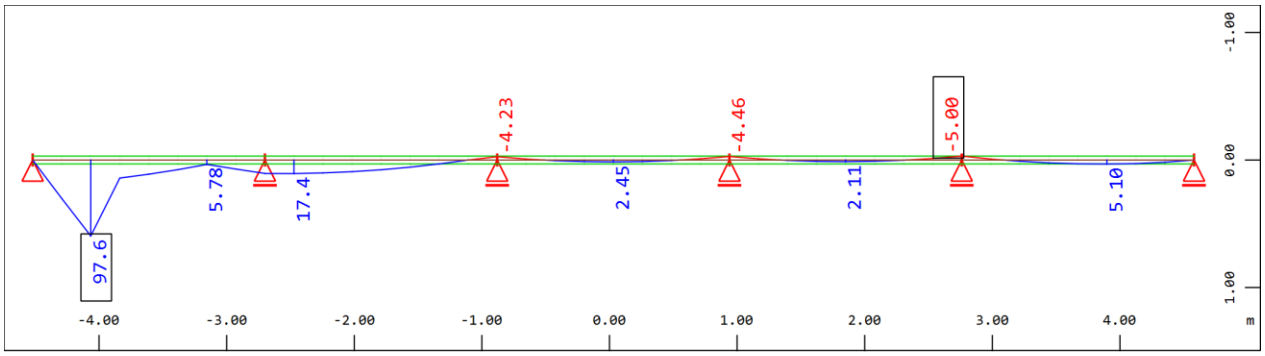
Beam Elements , Bending moment Mz, Loadcase 1127 MAX-MZ BEAM , 1 cm 3D = 36.1 kNm M 1 : 65
(Max=35.3)
Beam Elements , Bending moment Mz, Loadcase 1128 MIN-MZ BEAM , 1 cm 3D = 36.1 kNm
X * 0.502
Y * 0.906
Z * 0.962



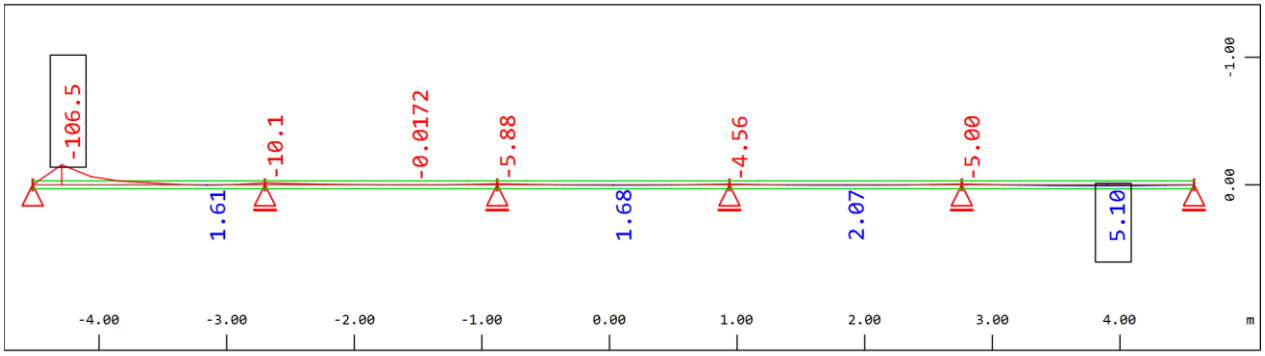
Beam Elements , Torsional moment Mt, Loadcase 1123 MAX-MT BEAM , 1 cm 3D = 112.1 kNm M 1 : 55
(Max=62.3)
Beam Elements , Torsional moment Mt, Loadcase 1124 MIN-MT BEAM , 1 cm 3D = 137.5 kNm



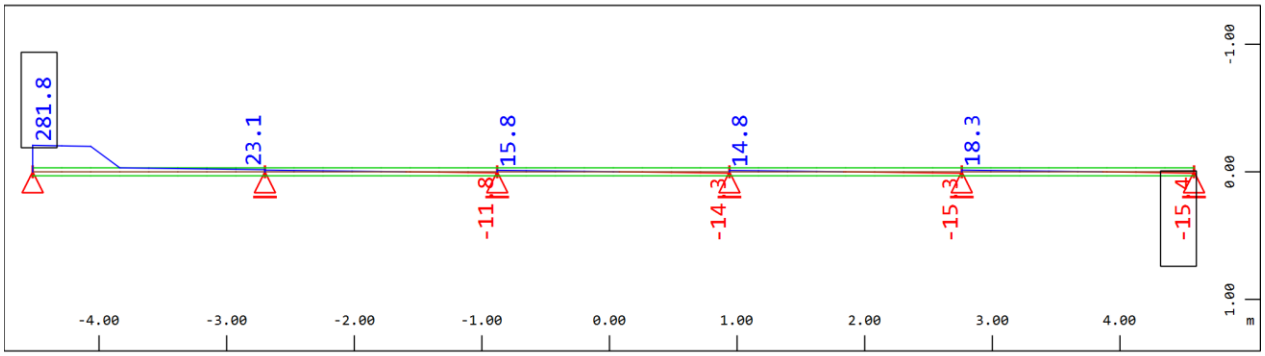
Beam Elements , Shear force Vy, Loadcase 1130 MAX-VY BEAM , 1 cm 3D = 90.2 kN (Max=96.3) M 1 : 72
Beam Elements , Shear force Vy, Loadcase 1131 MIN-VY BEAM , 1 cm 3D = 180.5 kN
(Min=-103.5) (Max=0)
X * 0.502
Y * 0.906
Z * 0.962



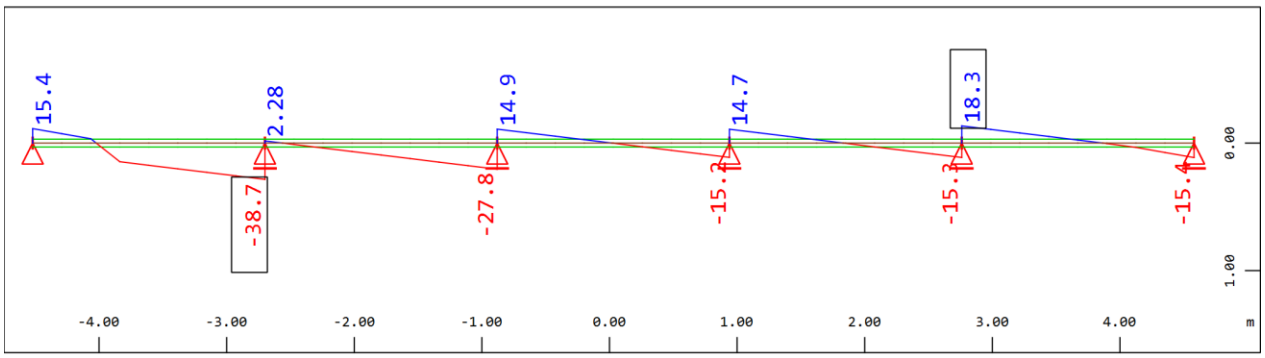
Beam Elements , Bending moment My, Loadcase 1525 MAX-MY BEAM , 1 cm 3D = 90.2 kNm M 1 : 55
(Min=-5.00) (Max=97.6)



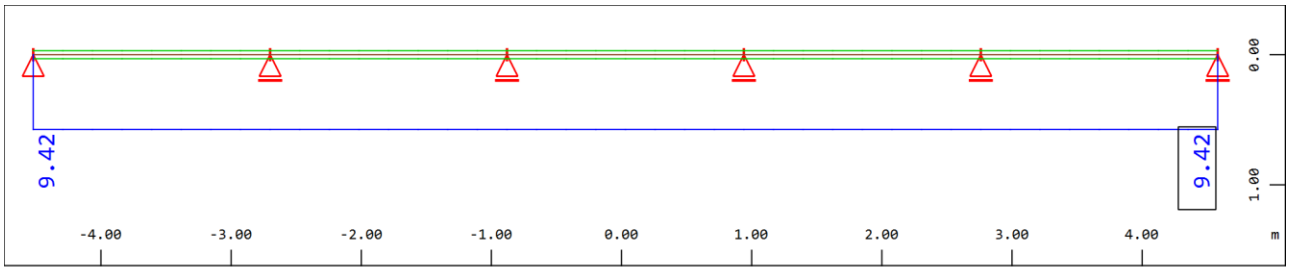
Beam Elements , Bending moment My, Loadcase 1526 MIN-MY BEAM , 1 cm 3D = 373.4 kNm M 1 : 55
(Min=-106.5) (Max=5.10)



Beam Elements , Shear force Vz, Loadcase 1532 MAX-VZ BEAM , 1 cm 3D = 746.9 kN M 1 : 55
(Min=-15.4) (Max=281.8)

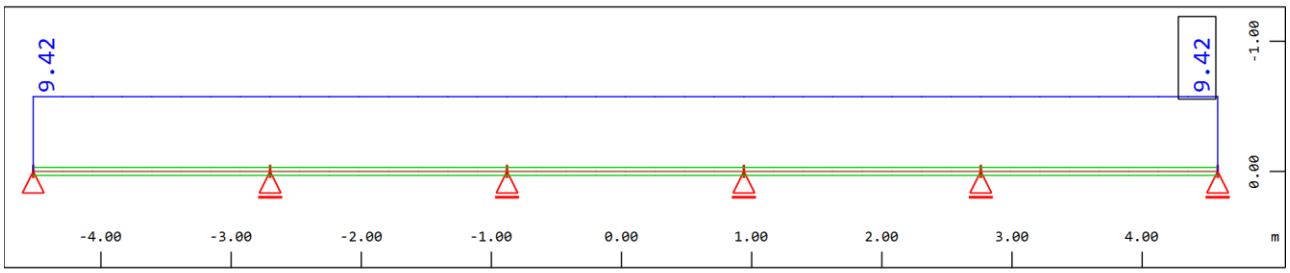


Beam Elements , Shear force Vz, Loadcase 1533 MIN-VZ BEAM , 1 cm 3D = 74.7 kN (Min=-38.7) M 1 : 55
(Max=18.3)



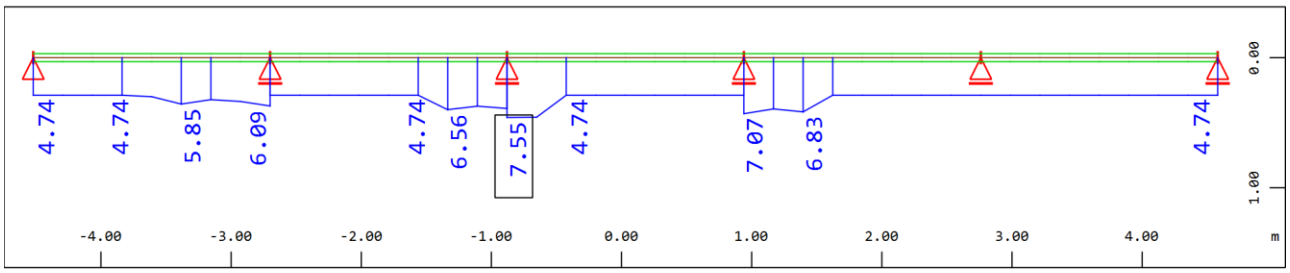
Beam Elements , Longitudinal Reinforcements Lay. M1, Design Case 1 , 1 cm 3D = 9.02 cm2 (Max=9.42)

M 1 : 55



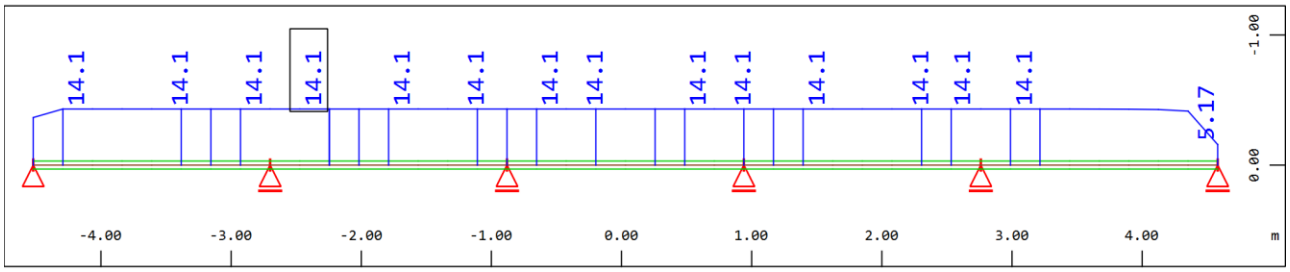
Beam Elements , Longitudinal Reinforcements Lay. M2, Design Case 1 , 1 cm 3D = 9.02 cm2 (Max=9.42)

M 1 : 55



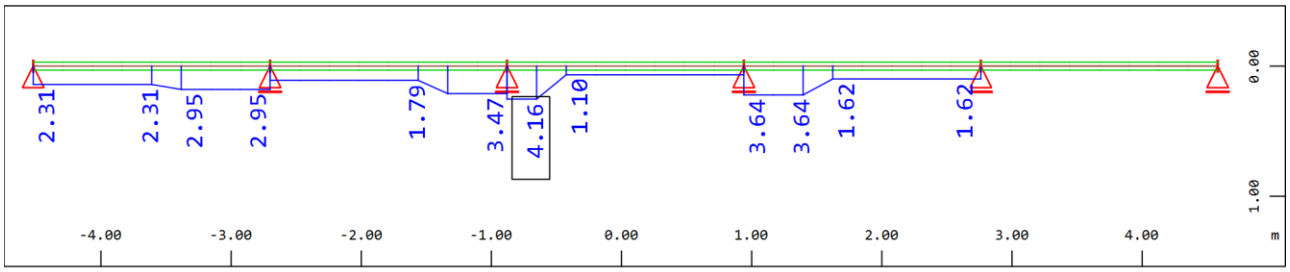
Beam Elements , Longitudinal Reinforcements Lay. M3, Design Case 1 , 1 cm 3D = 9.02 cm2 (Max=7.55)

M 1 : 55



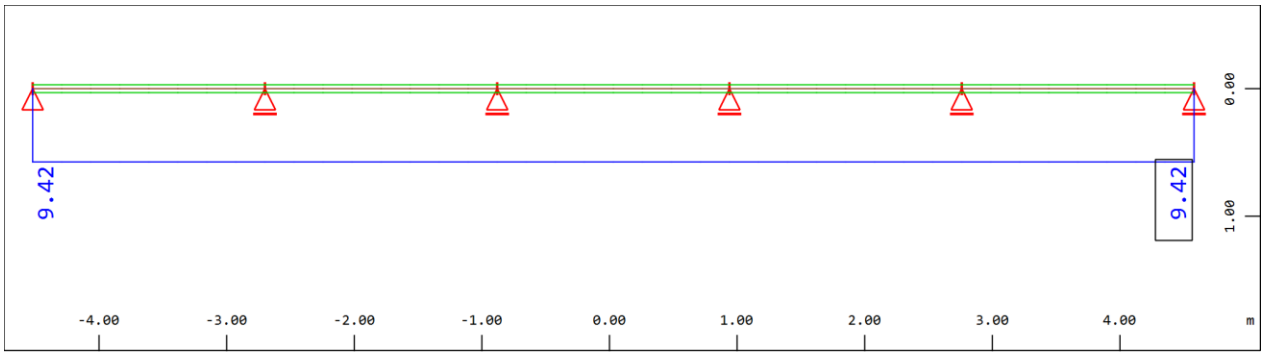
Shear reinforcements (maximum), Design Case 1 , (1 cm 3D = unit) Beam Elements (Unit=18.0 cm2/m) (Max=14.1)

M 1 : 55



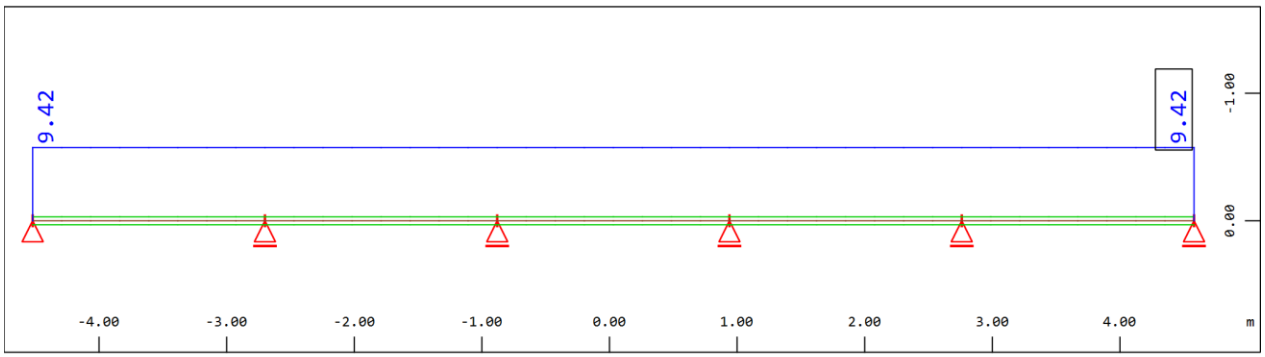
Beam Elements , Torsional contribution Lay. 1, Design Case 1 , 1 cm 3D = 9.02 cm2/m (Max=4.16)

M 1 : 55



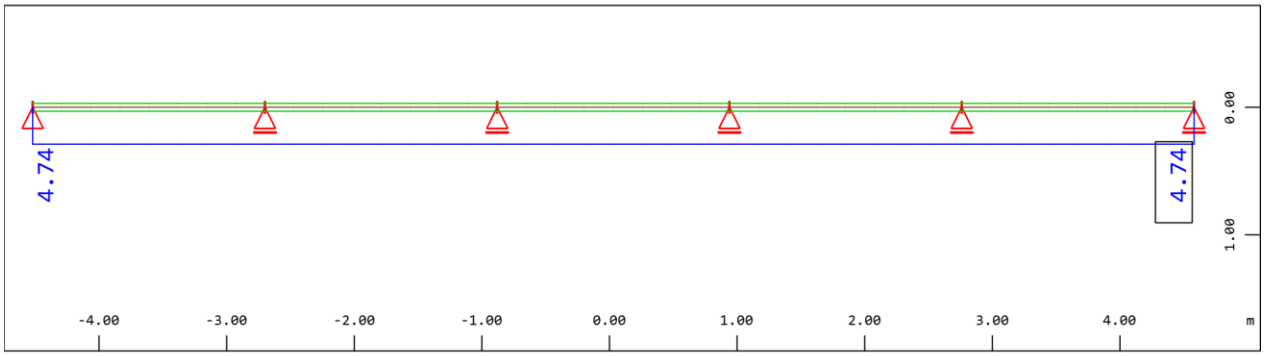
Beam Elements , Longitudinal Reinforcements Lay. M1, Design Case 3 , 1 cm 3D = 9.02 cm2 (Max=9.42)

M 1 : 55



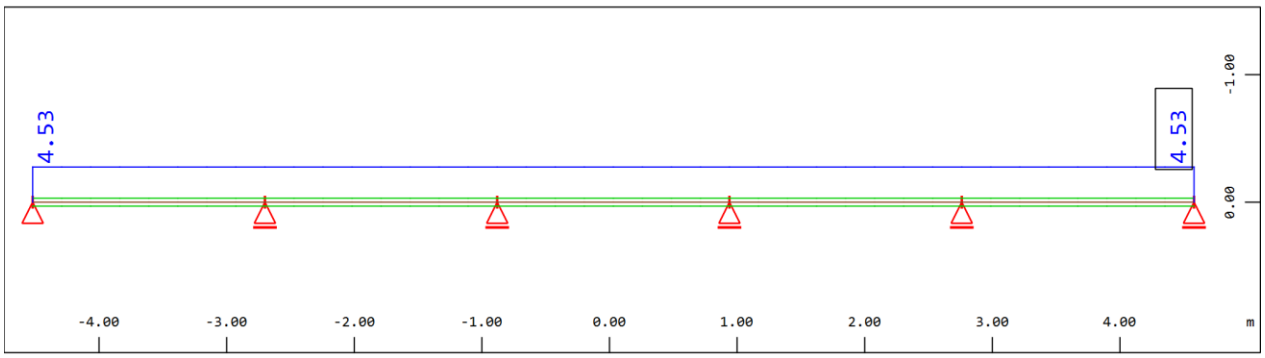
Beam Elements , Longitudinal Reinforcements Lay. M2, Design Case 3 , 1 cm 3D = 9.02 cm2 (Max=9.42)

M 1 : 55



Beam Elements , Longitudinal Reinforcements Lay. M3, Design Case 3 , 1 cm 3D = 9.02 cm2 (Max=4.74)

M 1 : 55



Shear reinforcements (maximum), Design Case 3 , (1 cm 3D = unit) Beam Elements (Unit=9.02 cm2/m) (Max=4.53)

M 1 : 55

3.10 Armatura poprečnog nosača

b x h=40x125 cm, materijali: C30/37, B500B

Statička visina:
$d_1 = c + \Phi_v + ½*\Phi_s = 5 + 1,2 + ½*2,5 = 7,5$ cm
$d_s=h-d_1=125,0-7,5=117,5$ cm

Minimalna površina armature u presjeku b x h=40x125cm:

$$A_{s,min} = 0,0013 \cdot b \cdot d = 0,0013 \cdot 40 \cdot 117,5 = 6,11 \text{ cm}^2$$

$$A_{s,min} = 0,26 \cdot (f_{ctm} / f_{yk}) \cdot b \cdot d = 0,26 \cdot (2,9/500) \cdot 40 \cdot 117,5 = 7,09 \text{ cm}^2$$

Maksimalna površina armature u presjeku b x h=40x125cm:

$A_{s,max} = 0,04\ A_c = 0,04 \cdot 40 \cdot 125 = 200,0$ cm^2

Potrebna armatura:

- gornja zona
  POTREBNO: 9,42 cm^2
  ODABRANO: 2x3Φ14 (9,23 cm^2)
- donja zona
  POTREBNO: 9,25 cm^2
  ODABRANO: 2x3Φ14 (9,23 cm^2)

- na bočnim stranama
  POTREBNO: 7,55 cm^2/2=3,77cm^2 (sa jedne i druge strane)
  ODABRANO: Φ10/15 (5,24 cm^2)

- poprečna armatura
  POTREBNO: 14,1 cm^2/m'
  ODABRANO: Φ12/15, m=2 (15,07 cm^2/m')

Minimalna količina poprečne armature prema EC2 za elemente naprezane poprečnim silama:

$A_{smin} = \rho_{min} \cdot b_w = 0,0011 \cdot 250,0 = 0,25$ cm^2/cm

- $\rho_{min} = 0,0011$ za C30/37 i B500B

Minimalni razmak vilica prema EC2 za elemente naprezane poprečnim silama:
$s_{w,max} = \max \{ 0,6 \cdot d, 20 \text{ cm} \}$
$s_{w,max} = 20,0$ cm

4 LEŽAJEVI I PRIJELAZNE NAPRAVE

4.1 Ležajevi – elastomerni (deformabilni u svim smjerovima)

4.1.1 Kombinacije opterećenja za ležajeve

Sile i pomaci ležajeva određuju se kao najveće iz ovih kombinacija opterećenja:

SILE U LEŽAJEVIMA		
REDOVNE KOMBINACIJE		
Maksimalna vertikalna sila	1,35(1,0)·G+1,0·C+1,35·Q+1,5·K+1,5·ZW	15232-15233
	1,35(1,0)·G+1,0·C+1,5·ZT+1,35·0,75·Q+1,5·0,75·K	15332-15333
SEIZMIČKE KOMBINACIJE		
Minimalna vertikalna sila	$1,0 \cdot G+1,0 \cdot C+0,5 \cdot ZT+1,0 \cdot A_y+0,3 \cdot A_x+0,3 \cdot A_z$	15432-15433
	$1,0 \cdot G+1,0 \cdot C+0,5 \cdot ZT+0,3 \cdot A_y+1,0 \cdot A_x+0,3 \cdot A_z$	15533-15533
POMACI LEŽAJEVA		
REDOVNE KOMBINACIJE		
Pomak smjer x (uzdužni)	1,0·G+1,0·C+1,0·ZT+1,0·K+1·ZW	16760-16761
Pomak smjer y (poprečni)	1,0·G+1,0·C+1,0·ZT+1,0·K+1·ZW	16762-16763
POTRES		
Potres x (uzdužni)	A_x	570
Potres y (poprečni)	A_y	670
Vlastita težina	G	1
Dodatno stalno	G	2
C+S	C	50
Temperatura	ZT	19

G_{kj} - karakteristična vrijednost stalnog djelovanja, a to su:

- vlastita težina
- dodatno stalno opterećenje
- puzanje i skupljanje C

Q_{k1} - karakteristična vrijednost pretežnog (dominantnog) promjenjivog djelovanja, moguća djelovanja su:

- prometno opterećenje Q
- opterećenje vjetrom ZW
- kočna sila K
- temperatura ZT

E_{ed} - seizmičko djelovanje za ležajeve, odnosno najnepovoljnija od sljedećih kombinacija seizmičkih komponenti E_x, E_y, E_z :

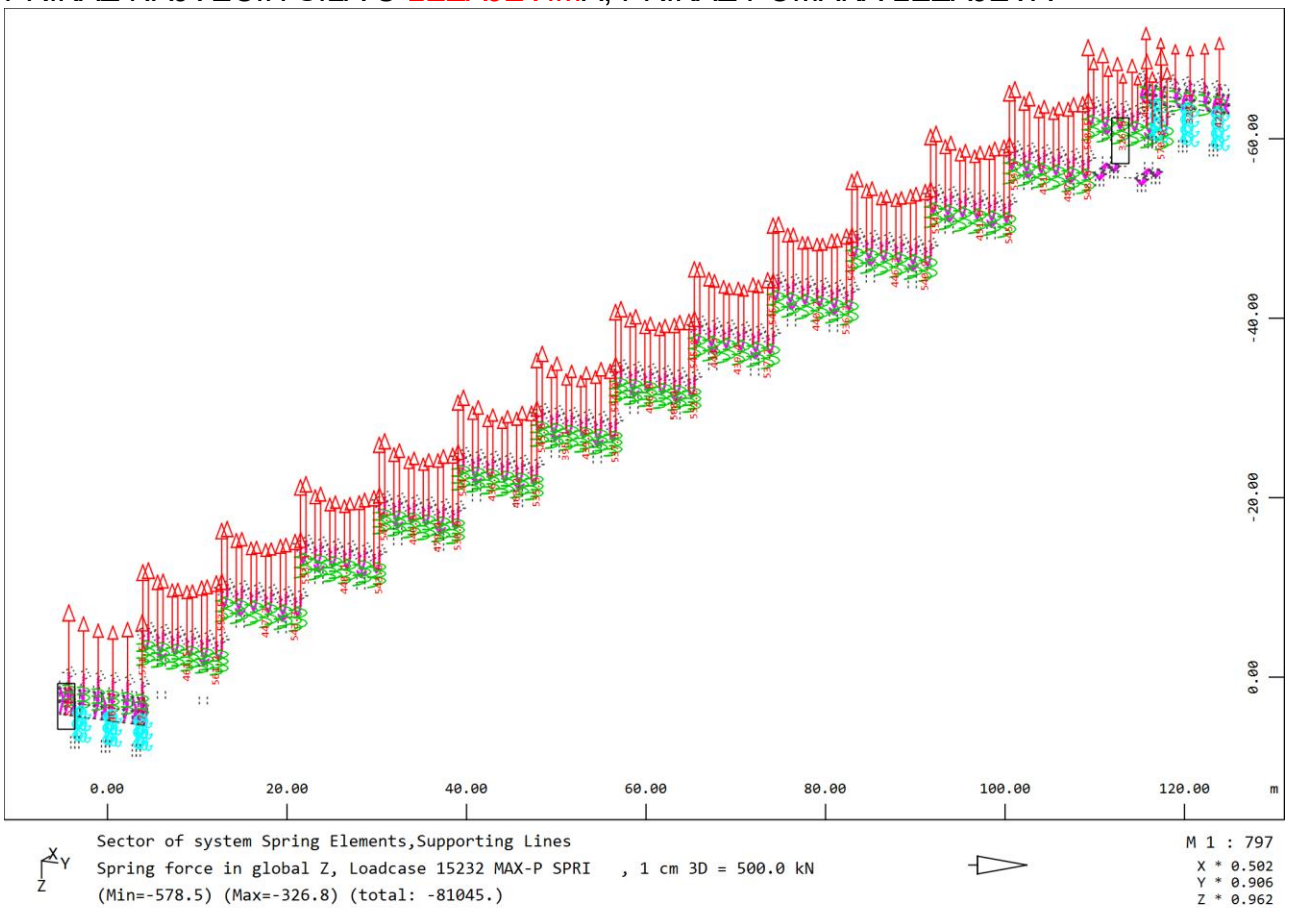
$q \cdot E_x + 0,3 \cdot q \cdot E_y + 0,3 \cdot E_z$

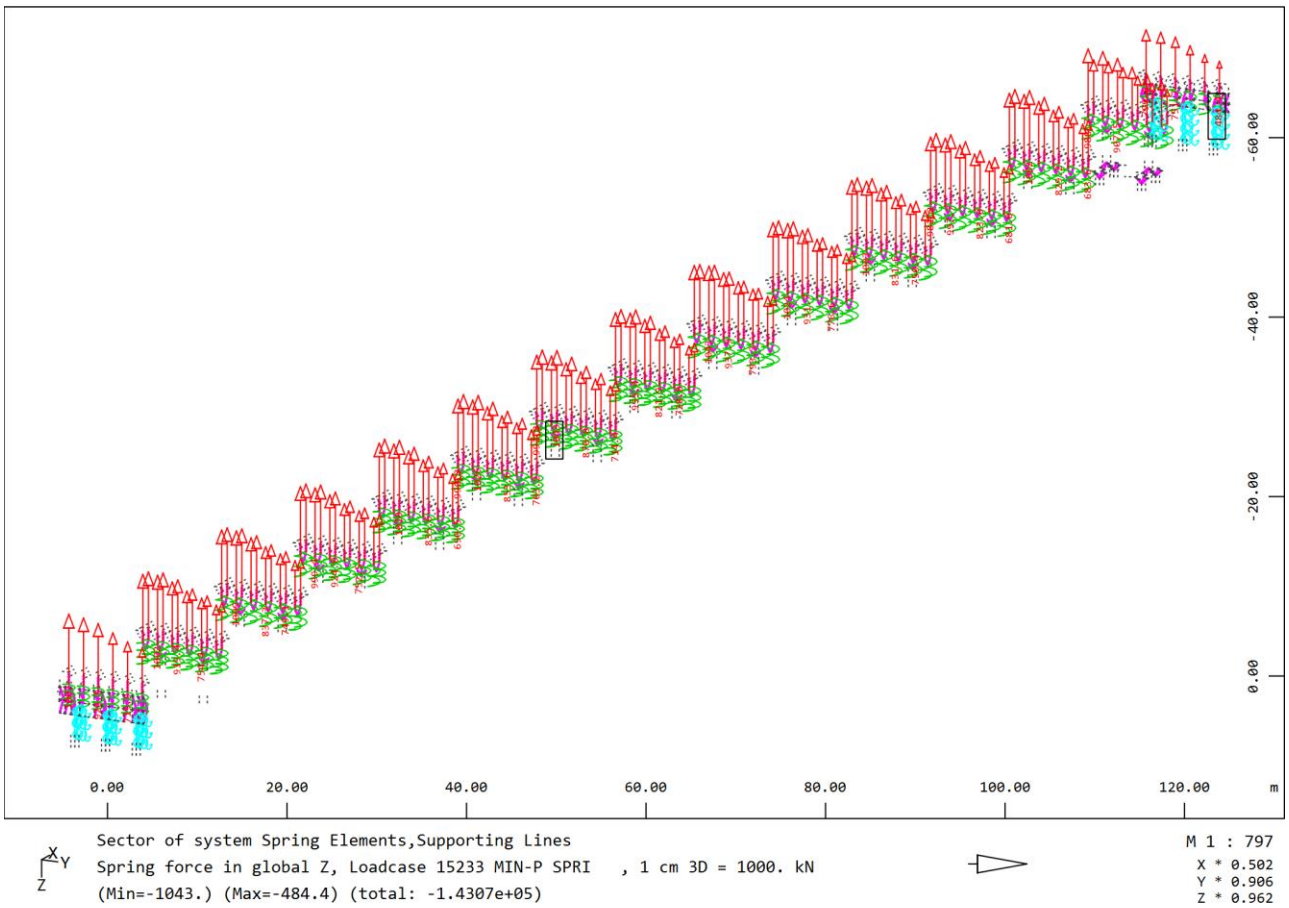
$0,3 \cdot q \cdot E_x + q \cdot E_y + 0,3 \cdot E_z$

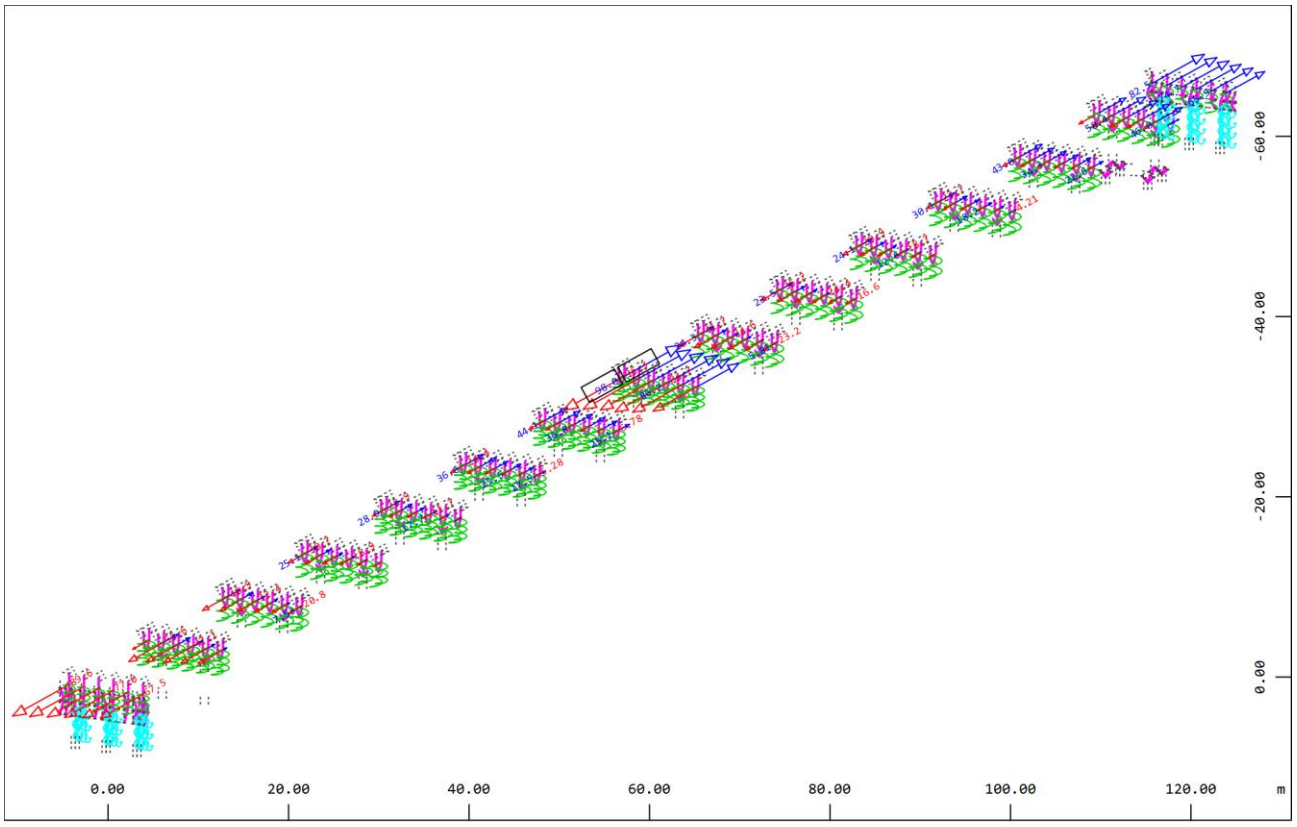
γ_I – faktor važnosti koji ovisio položaju i značaju objekta u cestovnoj mreži koji se, uzima se $\gamma_I = 1,0$

Provjera pomaka u potresu za pojedina stupna mjesta i upornjake nalazi se na slijedećim stranicama.

PRIKAZ NAJVEĆIH SILA U LEŽAJEVIMA, PRIKAZ POMAKA LEŽAJEVA






0.00
20.00
40.00
60.00
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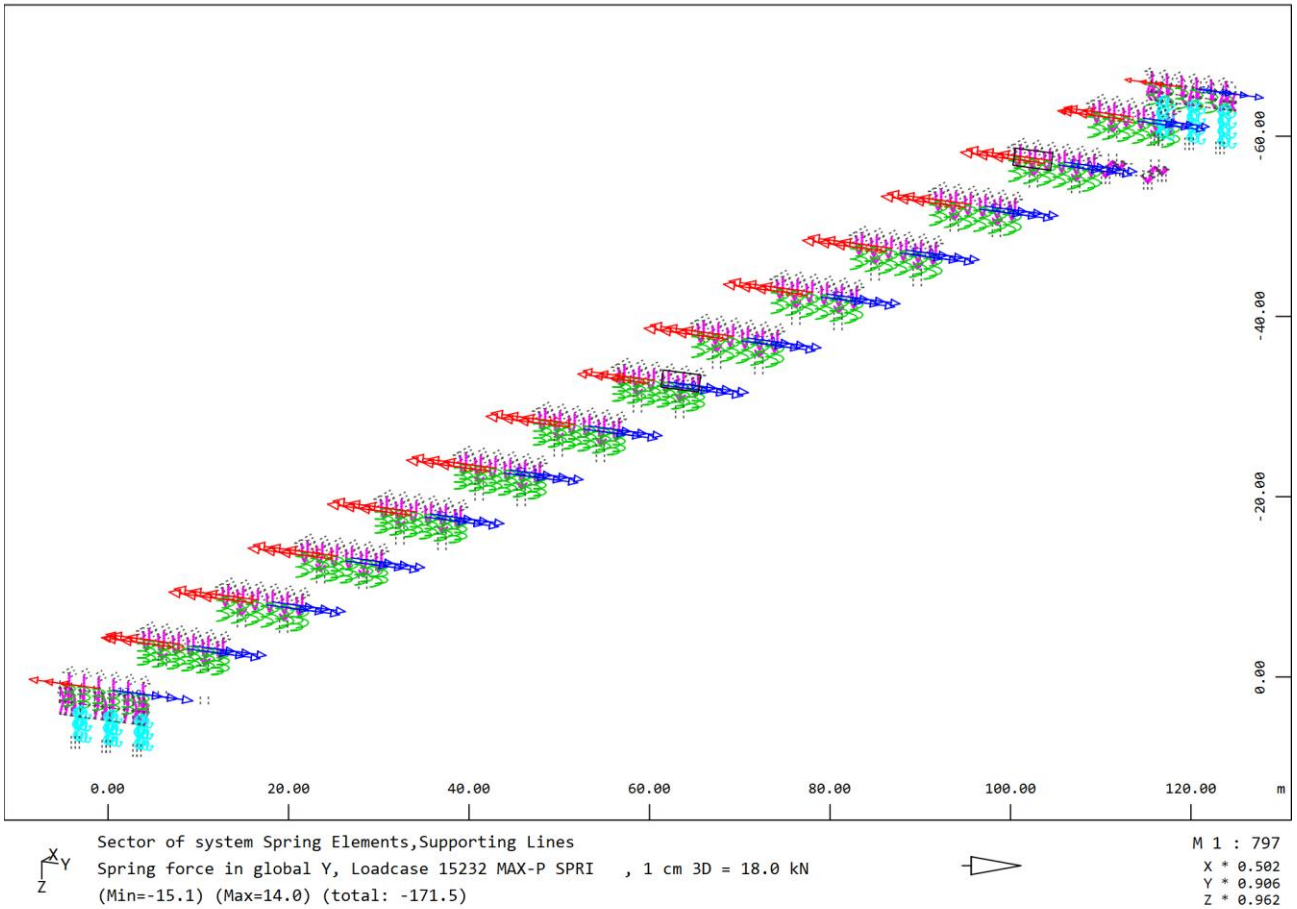
100.00
120.00
m
-60.00
-40.00
-20.00
0.00
Sector of system Spring Elements,Supporting Lines
Spring force in global X, Loadcase 15232 MAX-P SPRI , 1 cm 3D = 50.0 kN
(Min=-96.3) (Max=98.0) (total: -28.2)
M 1 : 797
X * 0.502
Y * 0.906
Z * 0.962


0.00
20.00
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60.00
80.00
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m
-60.00
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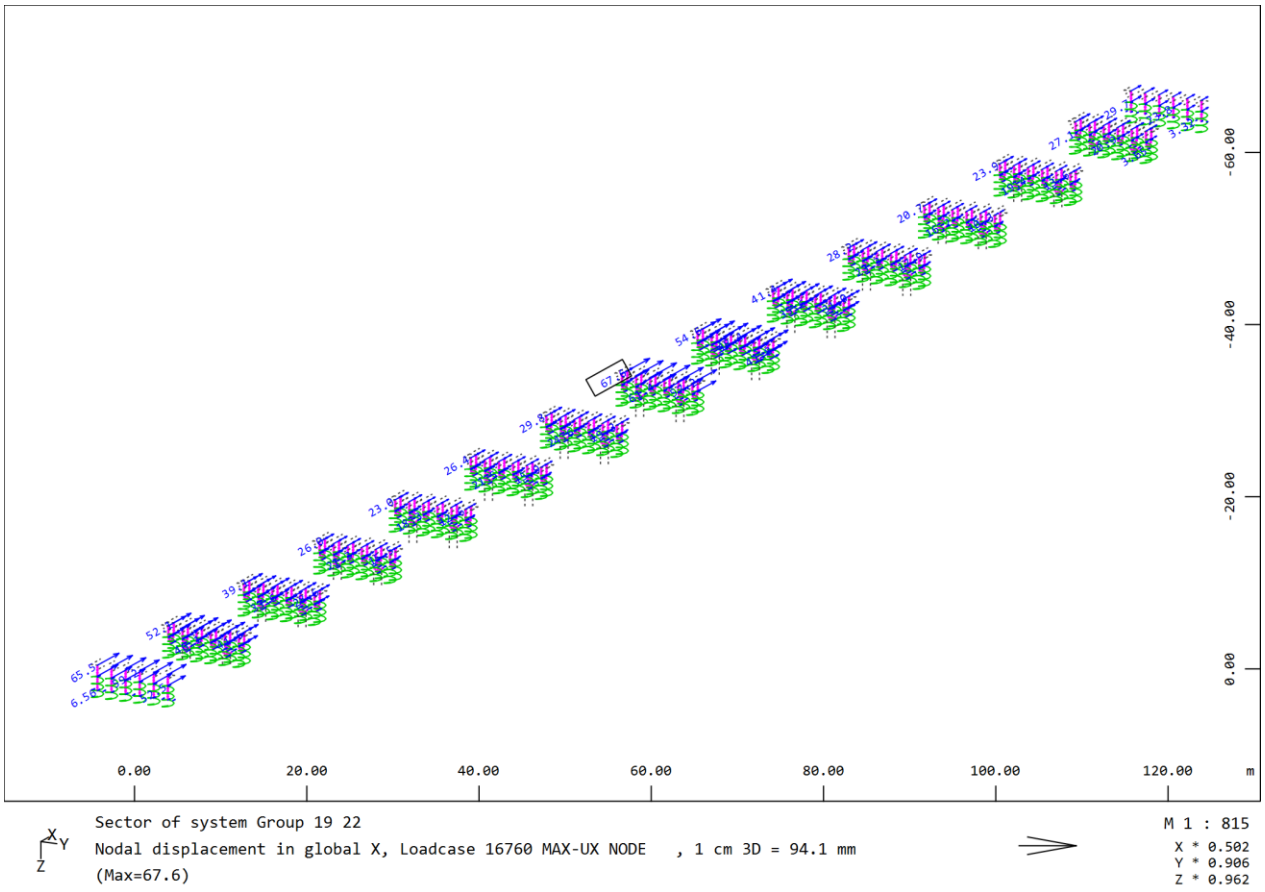
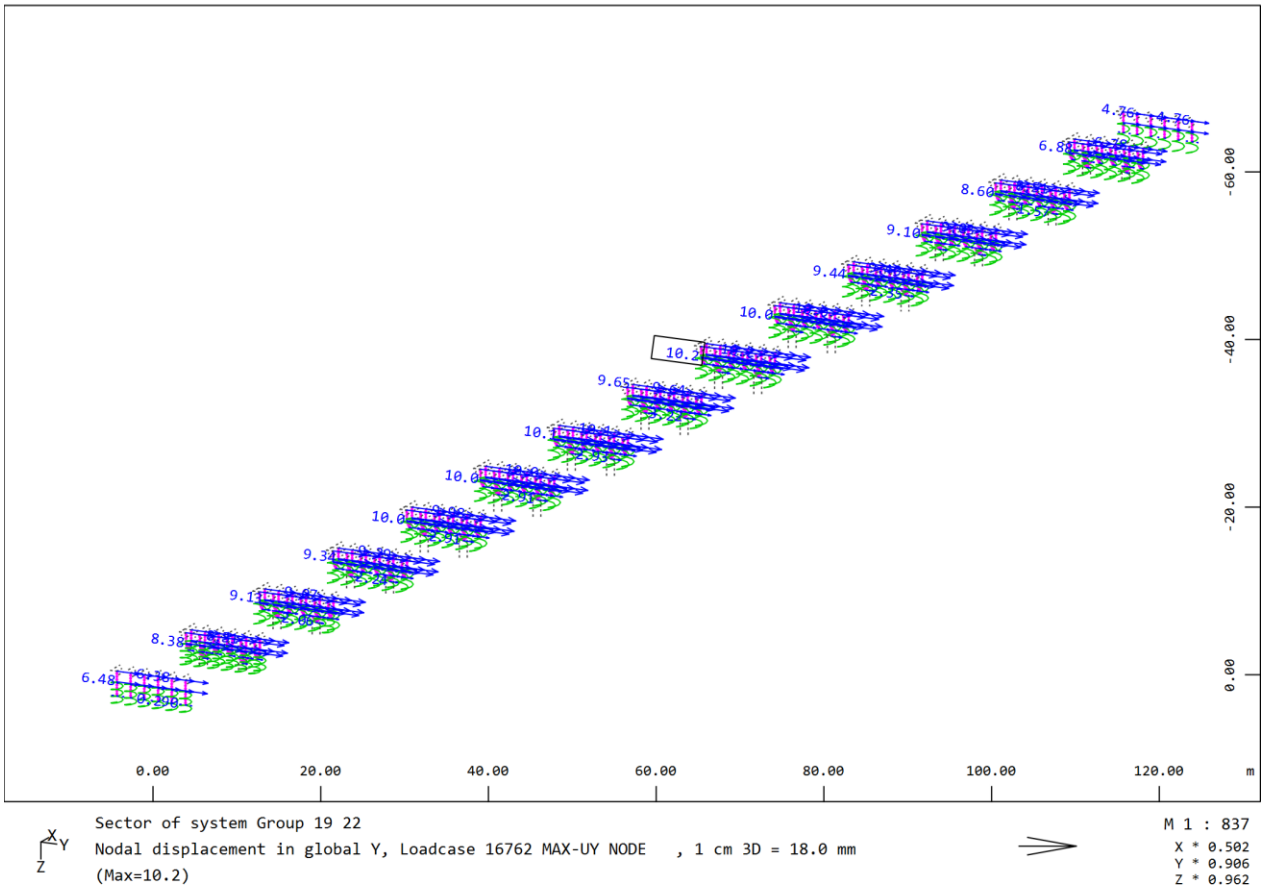
-20.00
0.00
Sector of system Spring Elements,Supporting Lines
Spring force in global Y, Loadcase 15232 MAX-P SPRI , 1 cm 3D = 18.0 kN
(Min=-15.1) (Max=14.0) (total: -171.5)
M 1 : 797
X * 0.502
Y * 0.906
Z * 0.962


-60.00
-40.00
-20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
m
Sector of system Group 19 22
Nodal displacement in global X, Loadcase 16760 MAX-UX NODE , 1 cm 3D = 94.1 mm
(Max=67.6)
M 1 : 815
X * 0.502
Y * 0.906
Z * 0.962


-60.00
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20.00
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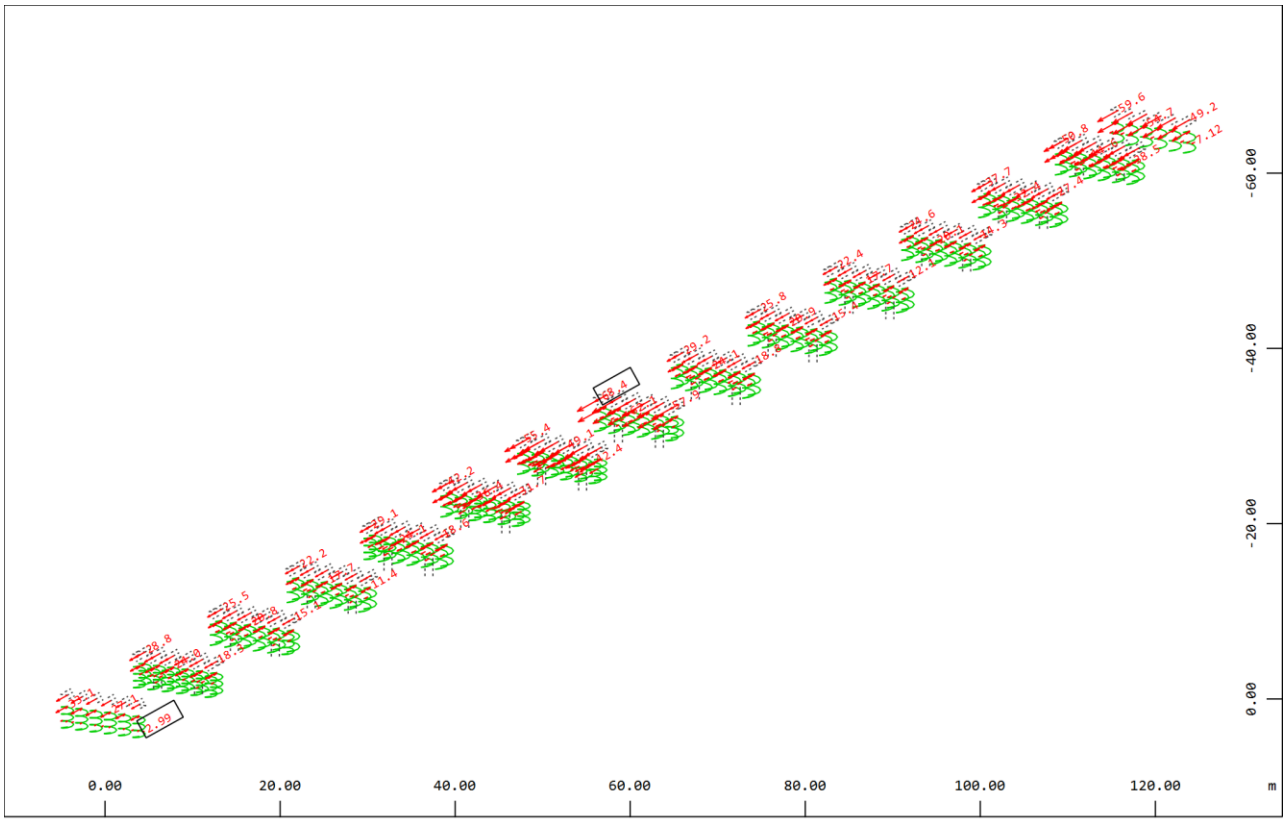
80.00
100.00
120.00
m
Sector of system Group 19 22
Nodal displacement in global Y, Loadcase 16762 MAX-UY NODE , 1 cm 3D = 18.0 mm
(Max=10.2)
M 1 : 837
X * 0.502
Y * 0.906
Z * 0.962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m
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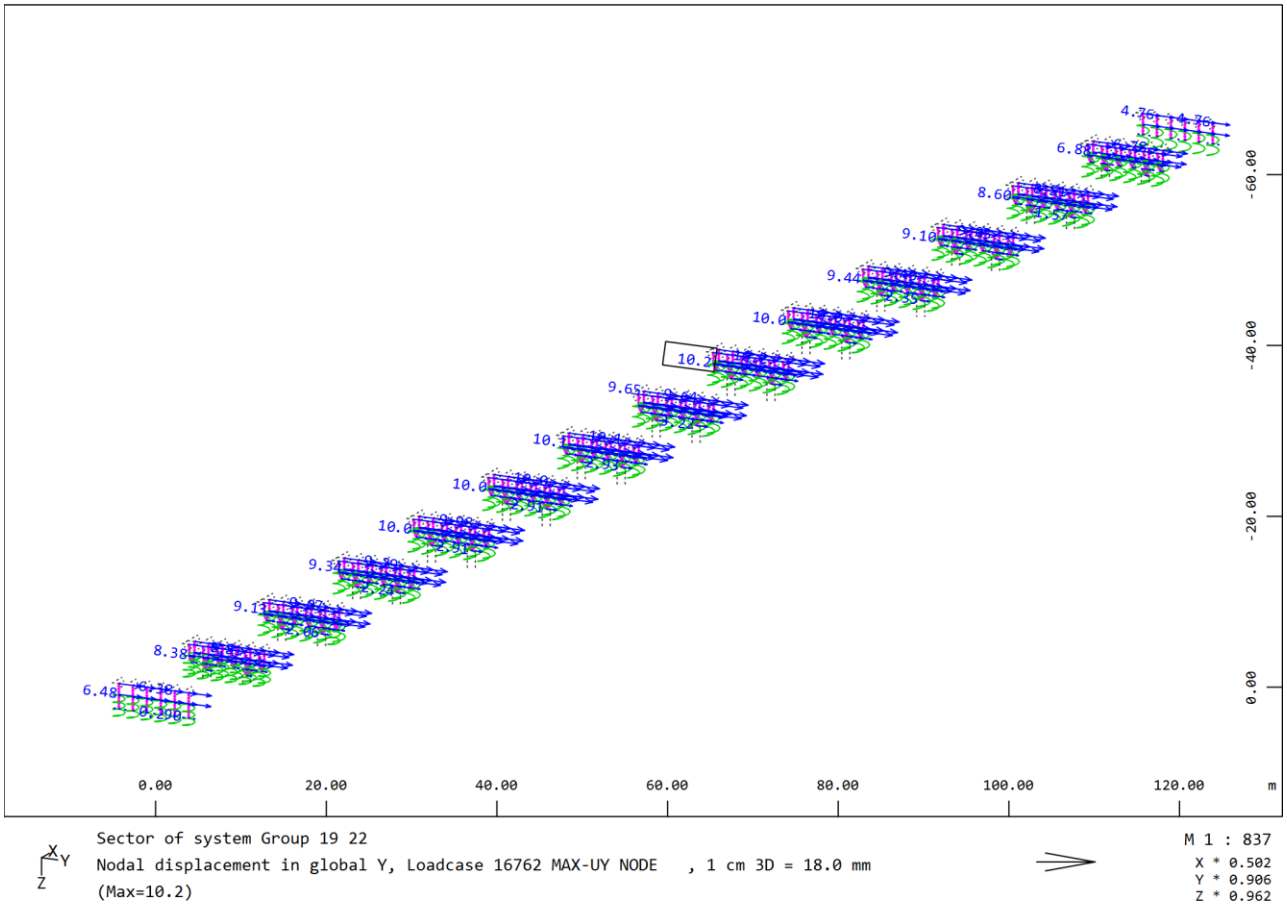
-40.00
-20.00
0.00
Sector of system Group 19 22
Nodal displacement in global X, Loadcase 16761 MIN-UX NODE , 1 cm 3D = 94.1 mm
(Min=-68.4) (Max=-2.99)
M 1 : 816
X * 0.502
Y * 0.906
Z * 0.962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m
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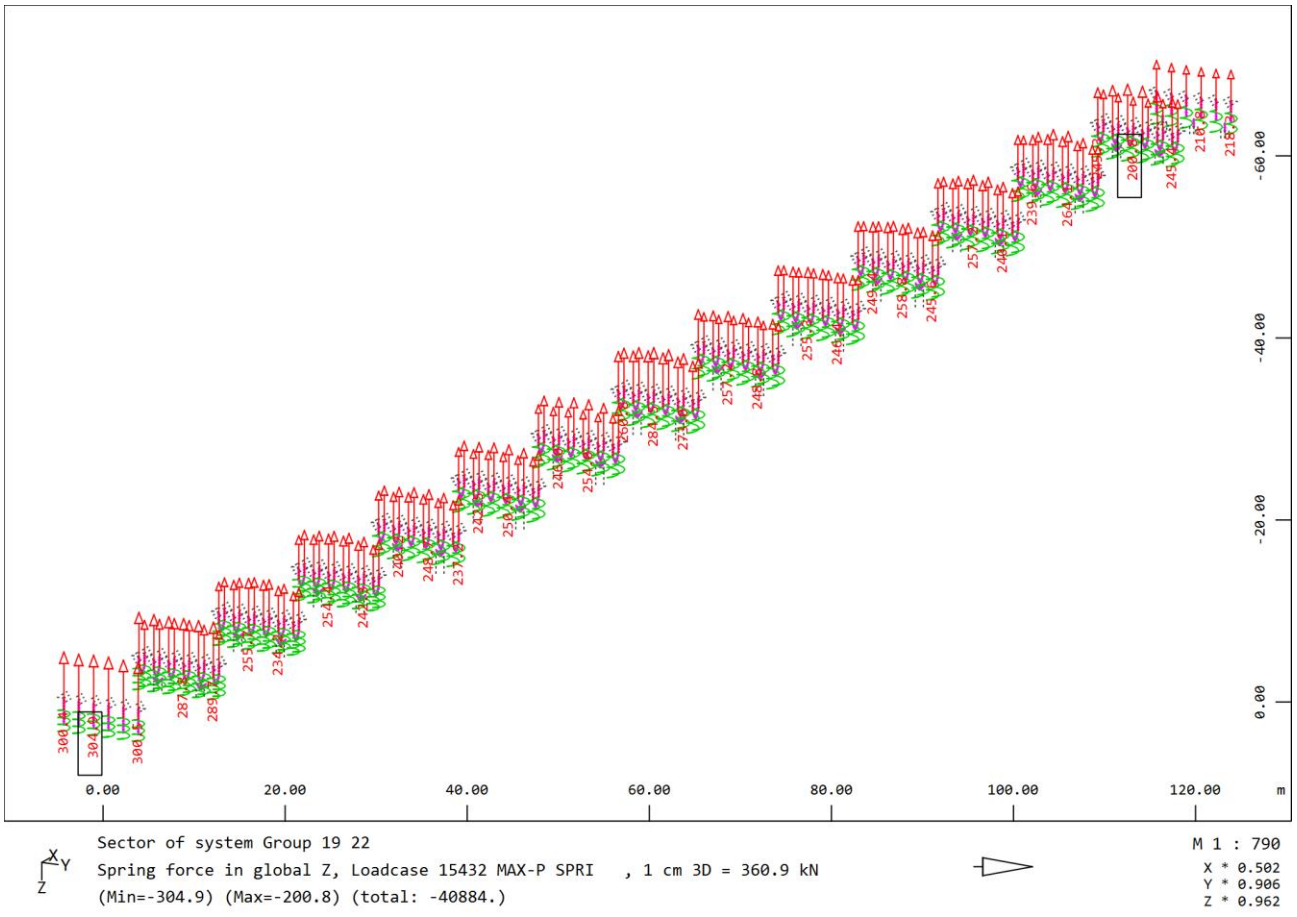
0.00
Sector of system Group 19 22
Nodal displacement in global Y, Loadcase 16762 MAX-UY NODE , 1 cm 3D = 18.0 mm
(Max=10.2)
M 1 : 837
X * 0.502
Y * 0.906
Z * 0.962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20.00
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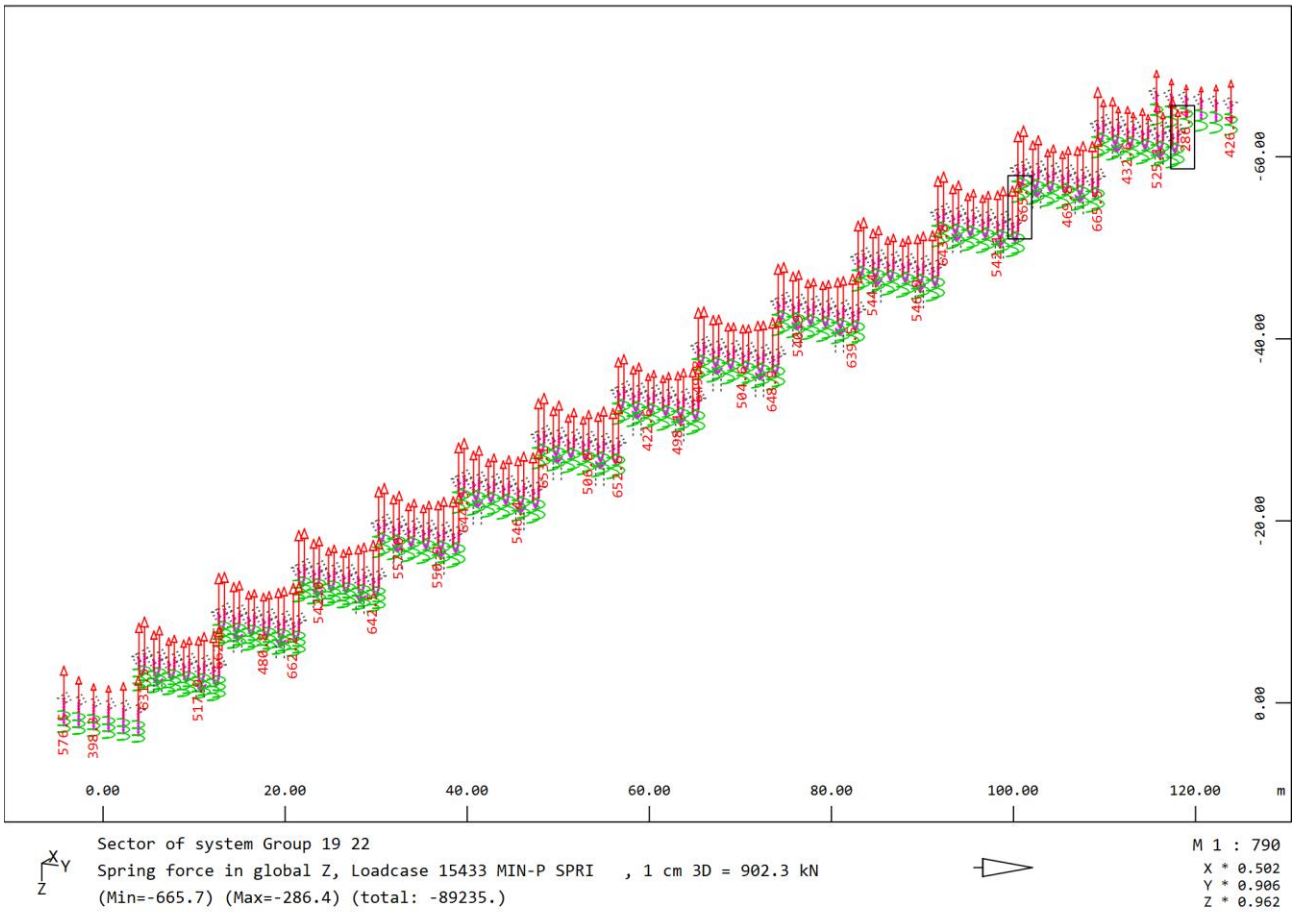
100.00
120.00
m
-60.00
-40.00
-20.00
0.00
Sector of system Group 19 22
Spring force in global Z, Loadcase 15432 MAX-P SPRI , 1 cm 3D = 360.9 kN
(Min=-304.9) (Max=-200.8) (total: -40884.)
M 1 : 790
X * 0.502
Y * 0.906
Z * 0.962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100.00
120.00
m
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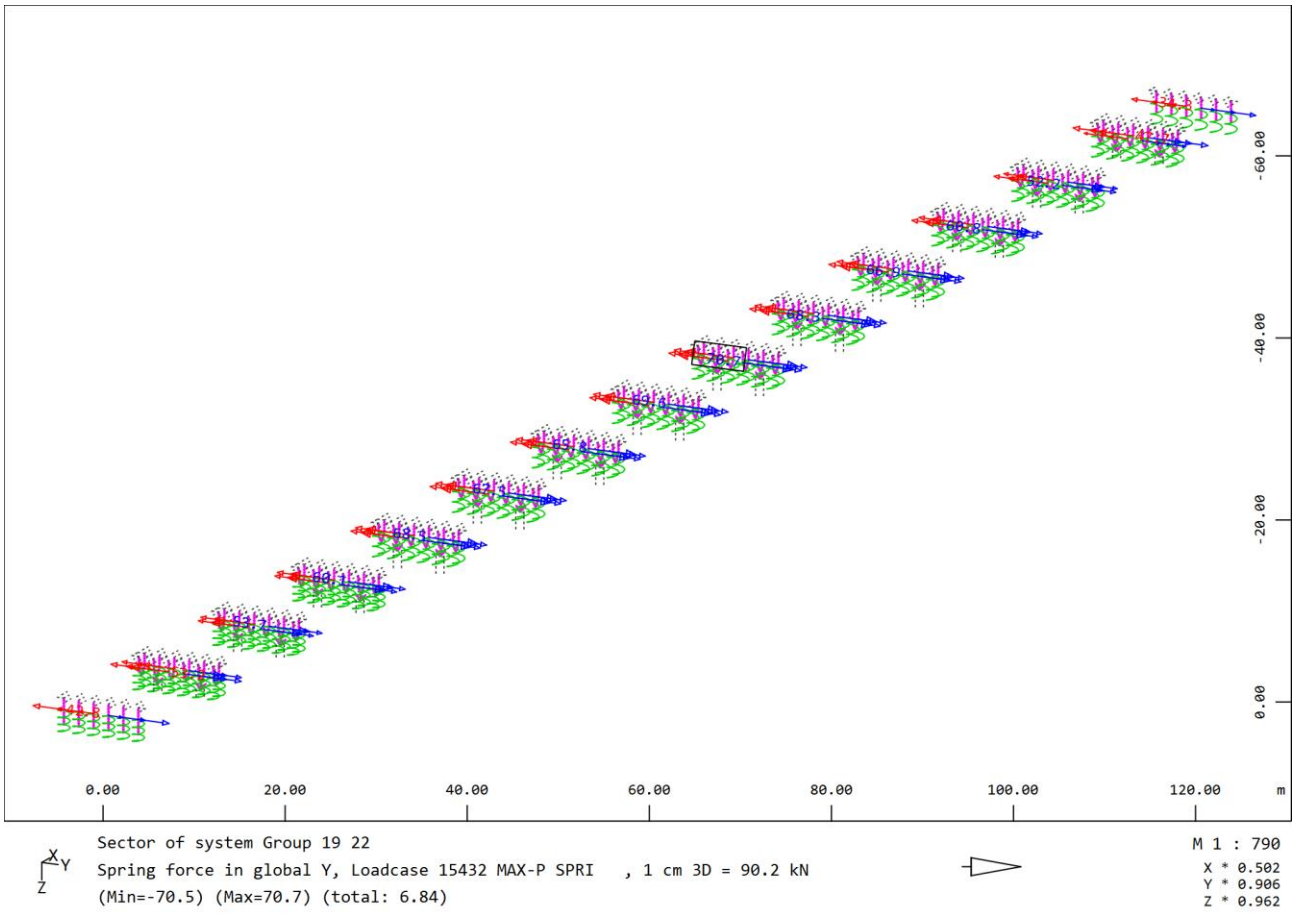
-40.00
-20.00
0.00
Sector of system Group 19 22
Spring force in global Z, Loadcase 15433 MIN-P SPRI , 1 cm 3D = 902.3 kN
(Min=-665.7) (Max=-286.4) (total: -89235.)
M 1 : 790
X * 0.502
Y * 0.906
Z * 0.962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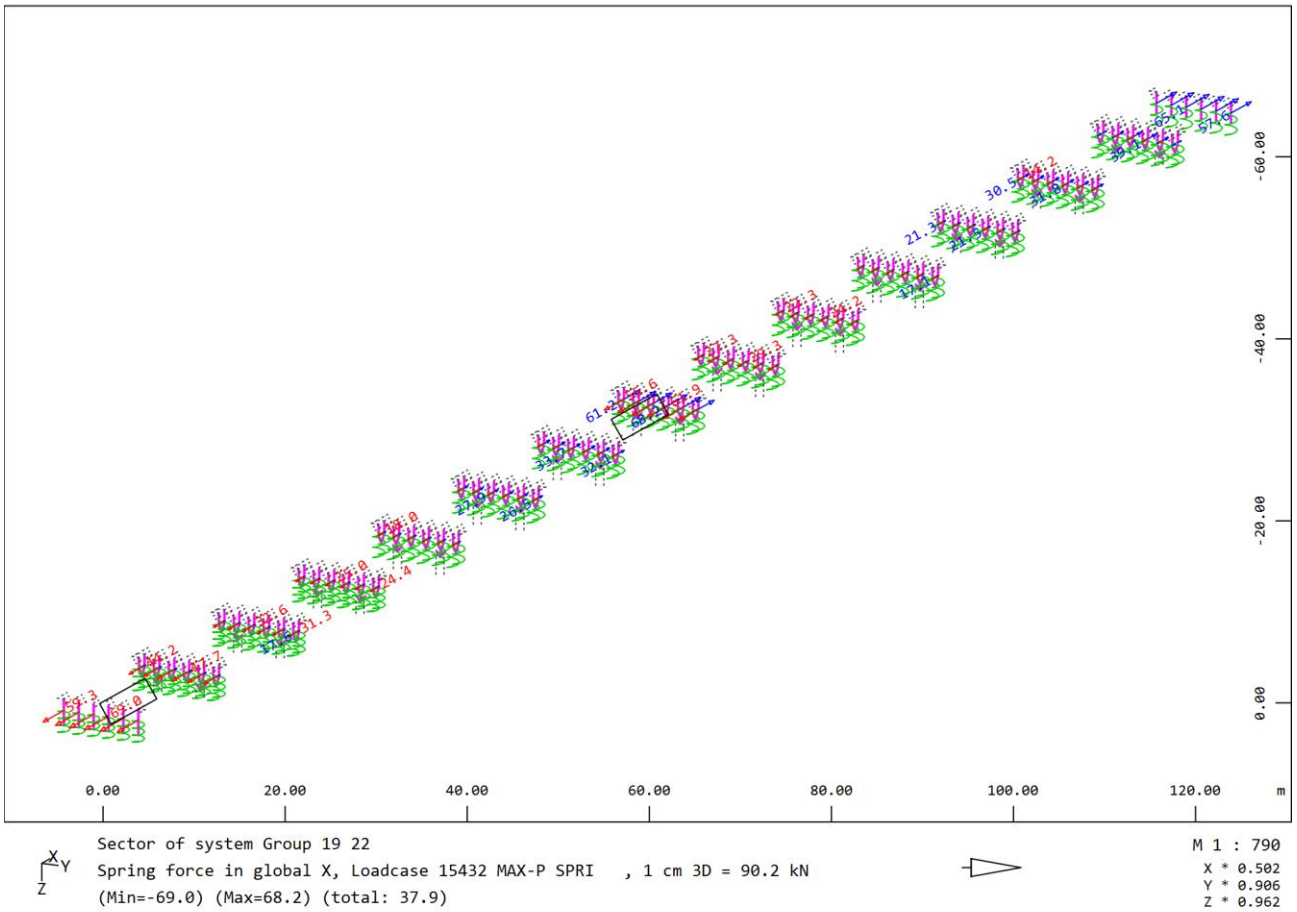
80.00
100.00
120.00
m
-60.00
-40.00
-20.00
0.00
Sector of system Group 19 22
Spring force in global Y, Loadcase 15432 MAX-P SPRI , 1 cm 3D = 90.2 kN
(Min=-70.5) (Max=70.7) (total: 6.84)
M 1 : 790
X * 0.502
Y * 0.906
Z * 0.962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m
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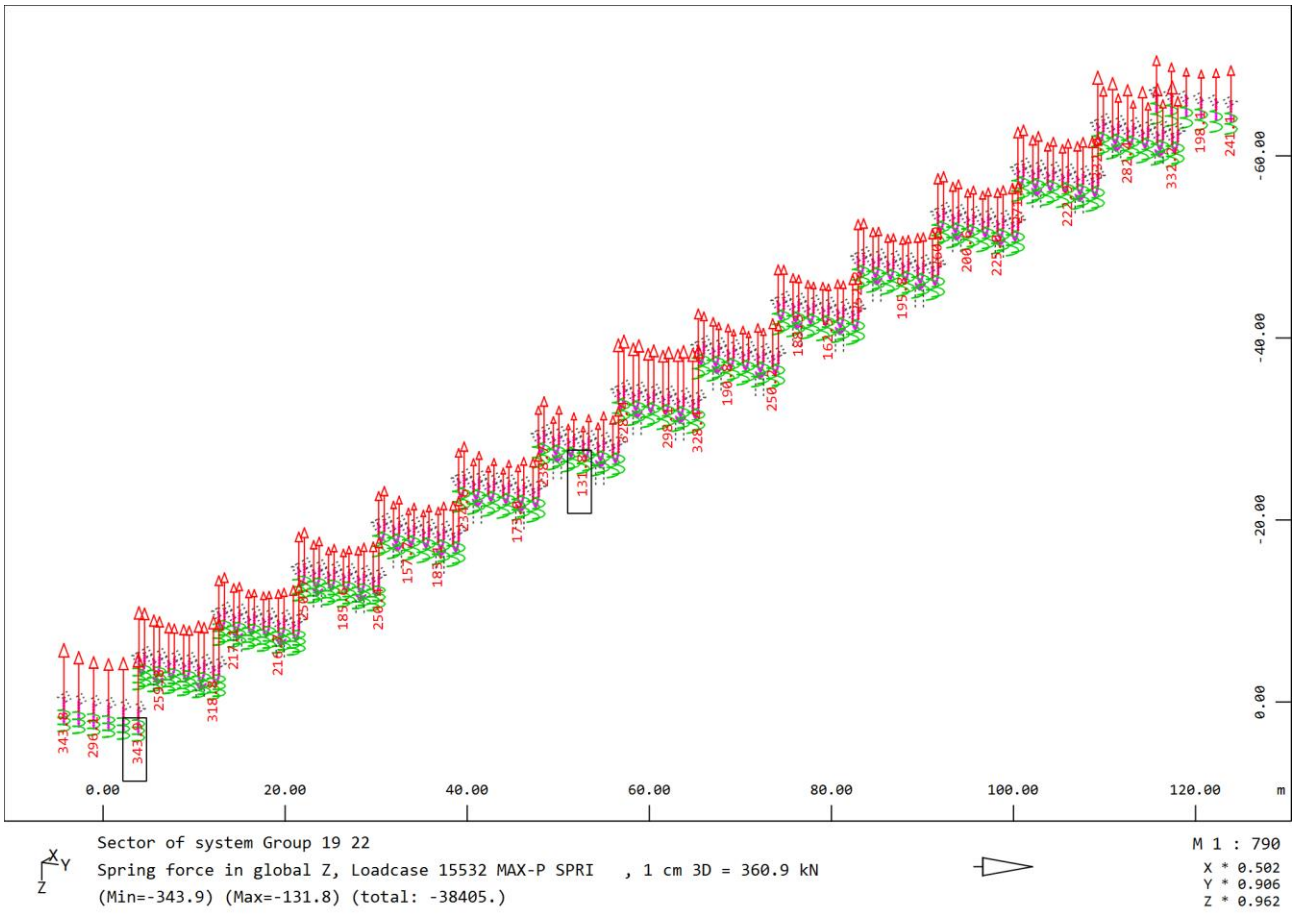
Sector of system Group 19 22
Spring force in global X, Loadcase 15432 MAX-P SPRI , 1 cm 3D = 90.2 kN
(Min=-69.0) (Max=68.2) (total: 37.9)
M 1 : 790
X * 0.502
Y * 0.906
Z * 0.962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60.00
80.00
100.00
120.00
m
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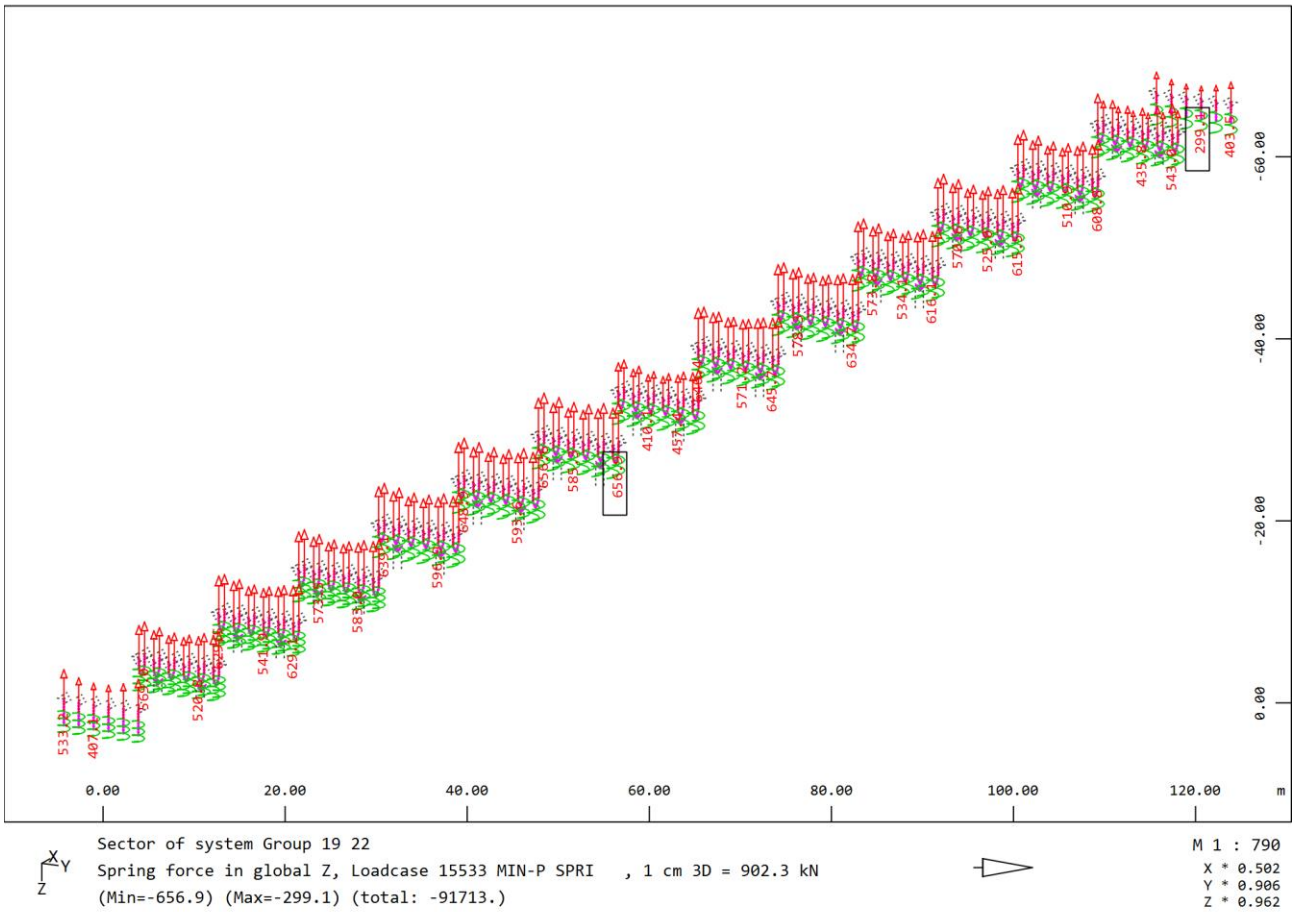
-40.00
-20.00
0.00
Sector of system Group 19 22
Spring force in global Z, Loadcase 15532 MAX-P SPRI , 1 cm 3D = 360.9 kN
(Min=-343.9) (Max=-131.8) (total: -38405.)
M 1 : 790
X * 0.502
Y * 0.906
Z * 0.962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100.00
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m
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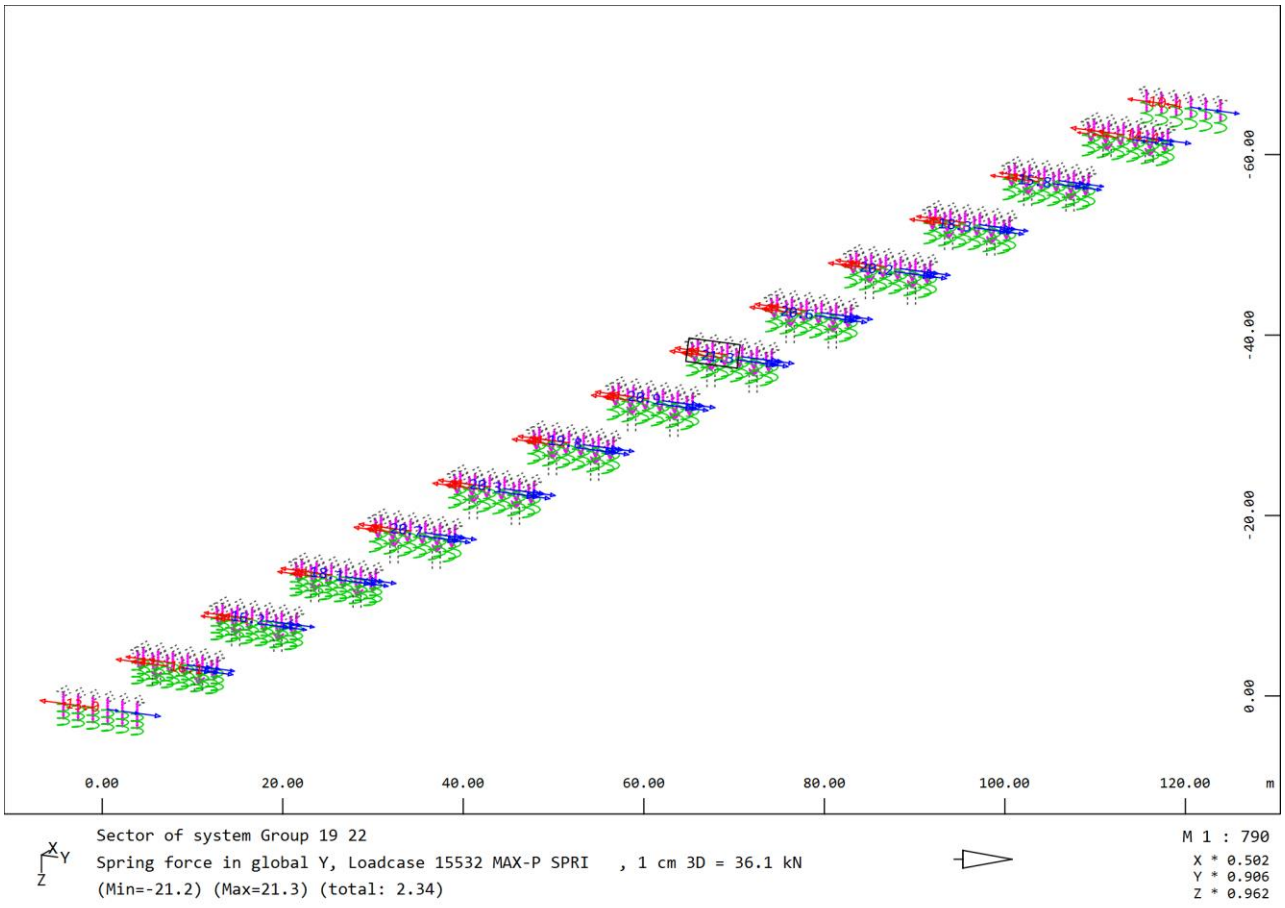
-40.00
-20.00
0.00
Sector of system Group 19 22
Spring force in global Z, Loadcase 15533 MIN-P SPRI , 1 cm 3D = 902.3 kN
(Min=-656.9) (Max=-299.1) (total: -91713.)
M 1 : 790
X * 0.502
Y * 0.906
Z * 0.962


0.00
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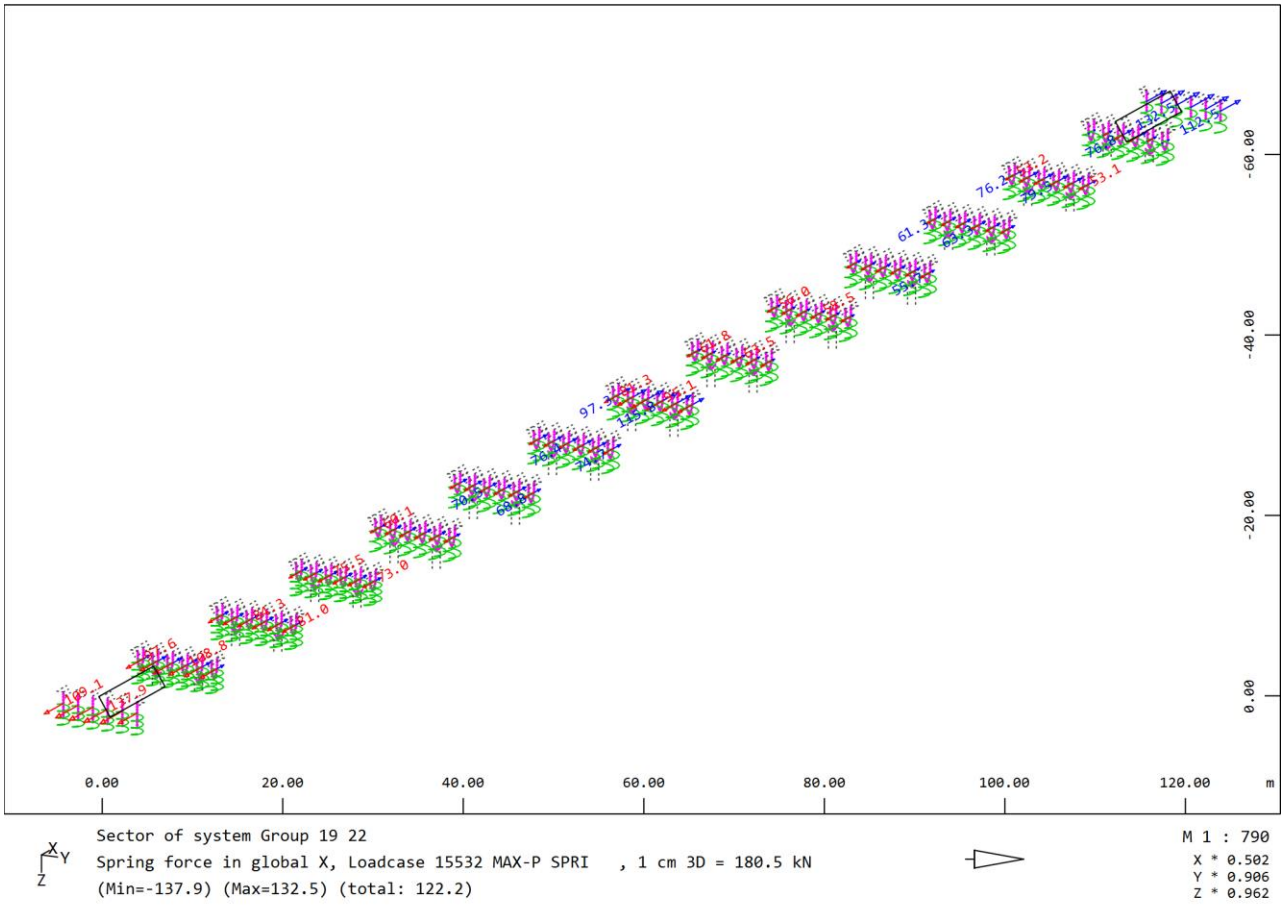
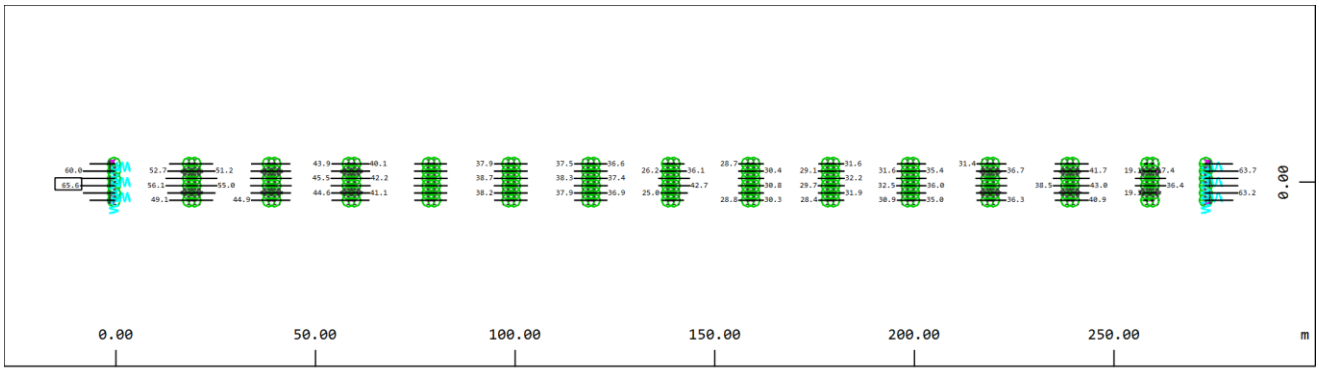
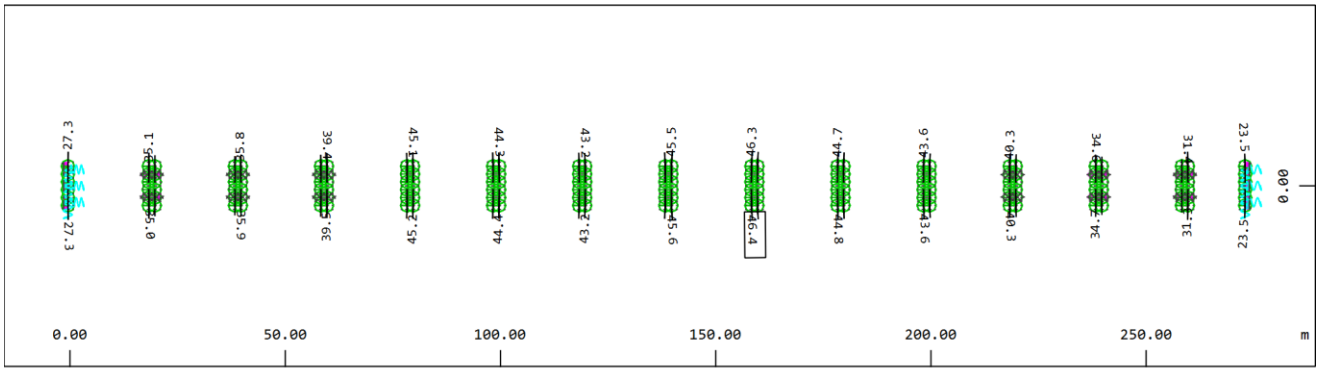
60.00
80.00
100.00
120.00
m
-60.00
-40.00
-20.00
0.00
Sector of system Group 19 22
Spring force in global Y, Loadcase 15532 MAX-P SPRI , 1 cm 3D = 36.1 kN
(Min=-21.2) (Max=21.3) (total: 2.34)
M 1 : 790
X * 0.502
Y * 0.906
Z * 0.962

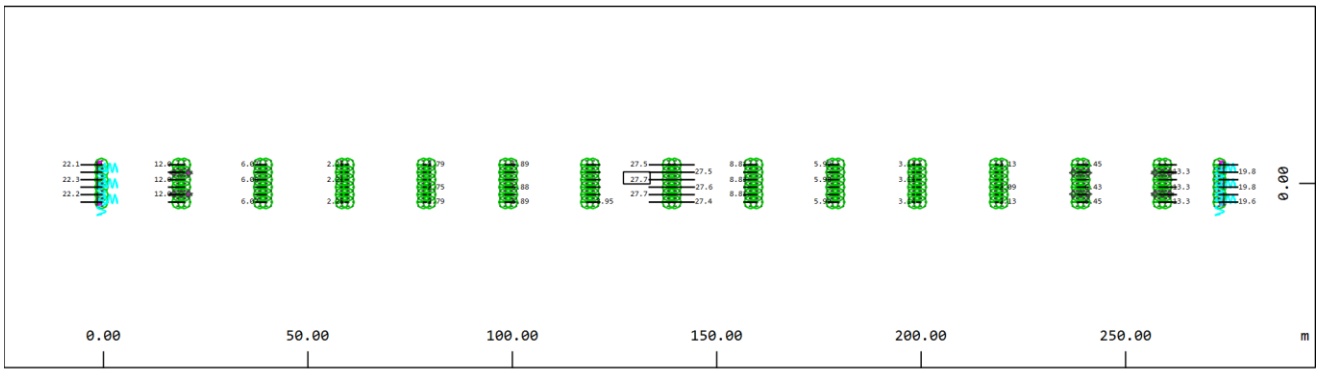

0.00
20.00
40.00
60.00
80.00
100.00
120.00
m
-60.00
-40.00
-20.00
0.00
Sector of system Group 19 22
Spring force in global X, Loadcase 15532 MAX-P SPRI , 1 cm 3D = 180.5 kN
(Min=-137.9) (Max=132.5) (total: 122.2)
M 1 : 790
X * 0.502
Y * 0.906
Z * 0.962



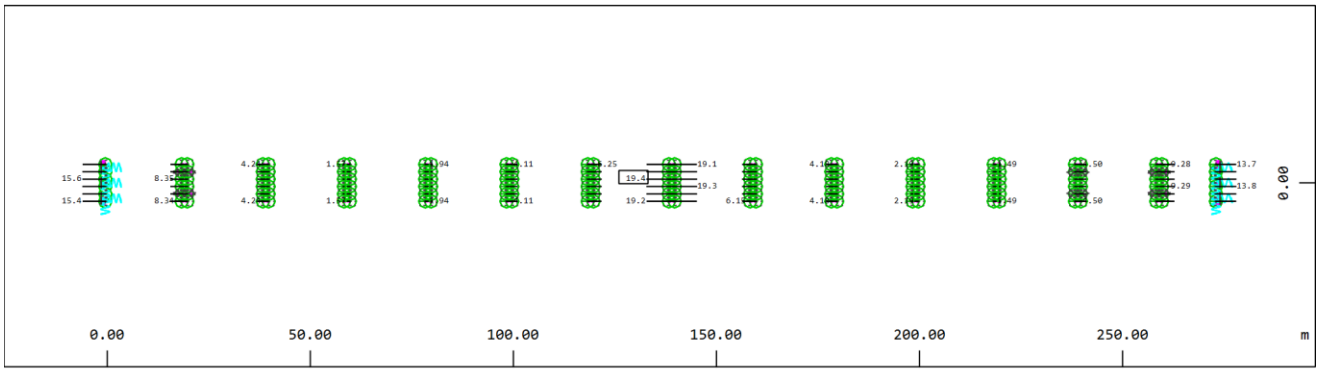
Sector of system Group 19 22
Spring transverse displacement, Loadcase 570 MAX P (CQC) , 1 cm 3D = 145.3 mm
(Max=65.6)
M 1 : 1835



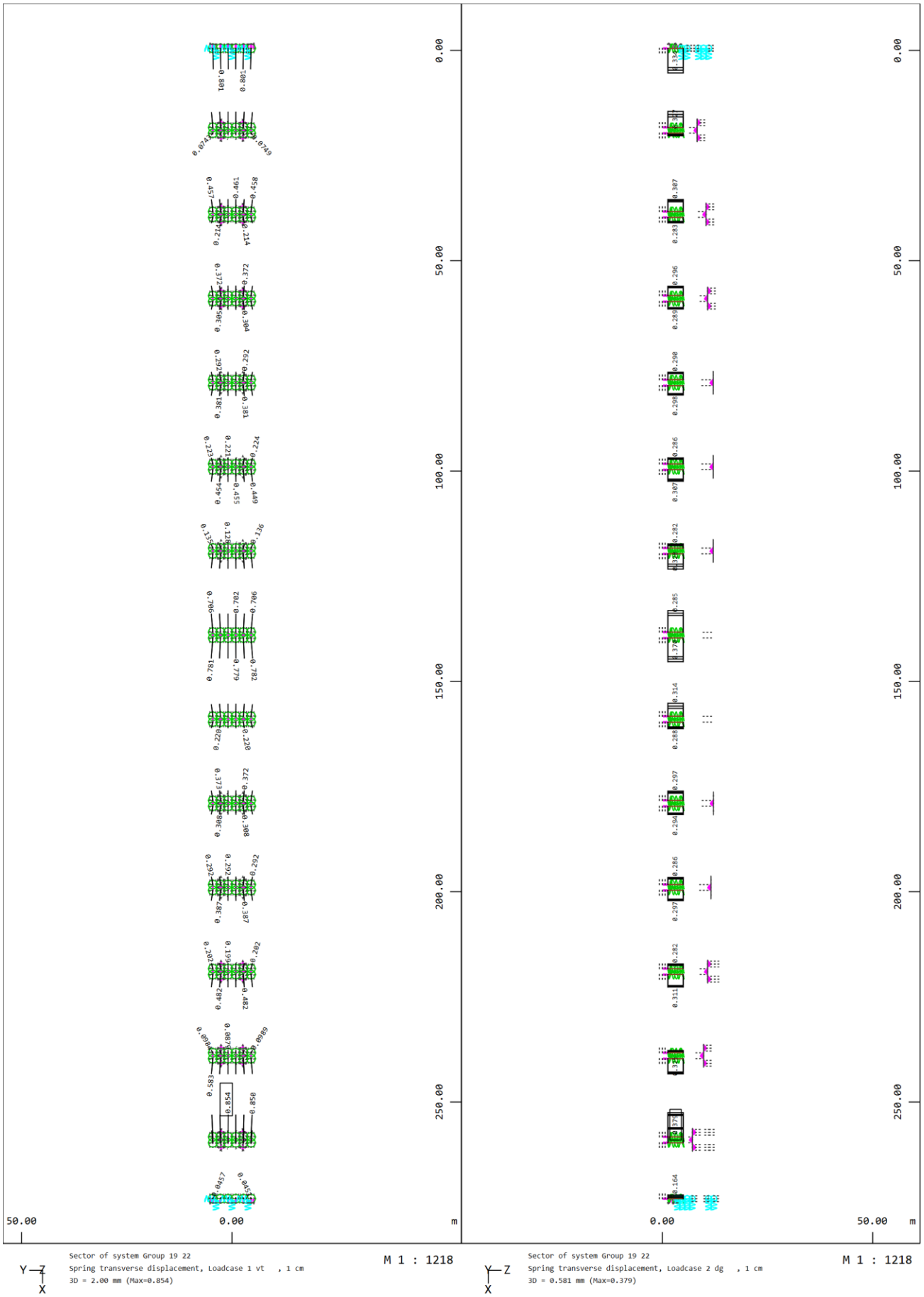
Sector of system Group 19 22
Spring transverse displacement, Loadcase 670 MAX P (CQC) , 1 cm 3D = 145.3 mm
(Max=46.4)
M 1 : 1702



Sector of system Group 19 22
Spring transverse displacement, Loadcase 19 TEMPL- , 1 cm 3D = 80.0 mm (Max=27.7)
M 1 : 1792



Sector of system Group 19 22
Spring transverse displacement, Loadcase 50 C+S , 1 cm 3D = 51.5 mm (Max=19.4)
M 1 : 1804


0.00
50.00
100.00
150.00
200.00
250.00
50.00
0.00
m
Sector of system Group 19 22
Spring transverse displacement, Loadcase 1 vt , 1 cm
3D = 2.00 mm (Max=0.854)
M 1 : 1218
Y
Z
X
Sector of system Group 19 22
Spring transverse displacement, Loadcase 2 dg , 1 cm
3D = 0.581 mm (Max=0.379)
M 1 : 1218

4.1.2 Provjera ležajeva za uls i potres

		$N_{Sd,max}$ (kN)*	$N_{Sd,min}$ (kN)*	Horizontalna sila uzduž V_{Sdx} (kN)	Horizontalna sila poprečno V_{Sdy} (kN)	Pomak paralelno s osi mosta /pomak okomito na os mosta(mm)*
U0	REDOVNA	1007,0	467,7	89,6	13,9	+52,9/+6,18
	POTRESNA	576,5 533,2	300,4 296,1	69,0 137,9	42,8 13,0	+57,4/+40,95 +126,28/+12,29
S1	REDOVNA	1002,0	461,5	55,6	15,2	+45,5/+7,06
	POTRESNA	631,5 569,6	287,8 259,8	47,7 108,8	53,2 16,1	+39,93/+52,65 +98,85/+15,8
S2	REDOVNA	1009,0	443,3	27,7	15,1	+25,2/+7,07
	POTRESNA	662,6 629,5	234,2 216,7	32,6 84,3	53,7 16,2	+32,76/+51,3 +90,51/+15,39
S3	REDOVNA	999,4	448,1	30,7	15,1	+17,1/+7,1
	POTRESNA	642,5 583,0	242,3 185,6	25,0 75,5	60,1 18,1	+23,84/+59,1 +71,61/+17,73
S4	REDOVNA	1010,1	442,7	28,7	15,0	+15,2/+7,1
	POTRESNA	557,0 639,1	240,2 157,7	18,0 60,1	68,5 20,7	+20,4/+67,8 +58,76/+20,34
S5	REDOVNA	1026,0	442,7	36,6	15,0	+28,7/+7,1
	POTRESNA	642,0 648,5	242,0 173,0	27,9 70,5	67,5 20,3	+25,2/+66,6 +65,87/+19,98
S6	REDOVNA	1043,0	439,6	44,1	15,1	+34,3/+7,2
	POTRESNA	653,1 656,9	246,6 131,8	33,7 76,4	65,8 19,8	+28,9/+64,8 +69,08/+19,44
S7 – dil.	REDOVNA	999,4	466,0	98,0	14,0	+62,6/+6,35
	POTRESNA	496,1 457,4	260,0 298,1	68,2 115,8	69,6 20,9	+53,6/+68,4 +98,45/+20,52
S8	REDOVNA	1043,0	439,4	41,7	15,0	+30,2/+7,1
	POTRESNA	649,8 646,4	248,8 190,8	29,3 63,5	70,7 21,3	+25,2/+69,6 +57,55/+20,88
S9	REDOVNA	1043,0	440,2	35,2	15,0	+23,0/+7,1
	POTRESNA	639,5 634,7	246,4 162,5	24,2 55,7	68,3 20,6	+22,4/+67,2 +56,3/+20,16
S10	REDOVNA	1024,0	446,0	29,9	15,0	+61,1/+5,2
	POTRESNA	639,5 616,1	258,8 195,8	17,1 58,5	66,9 20,2	+20,6/+65,4 +58,44/+19,62
S11	REDOVNA	1003,0	451,6	29,9	15,0	+61,1/+5,2
	POTRESNA	582,0 615,5	257,2 200,6	21,5 55,7	60,8 18,3	+20,3/+60,45 +59,75/+18,14
S12	REDOVNA	997,0	451,6	30,1	15,0	+61,1/+5,2
	POTRESNA	643,8 608,8	239,6 222,9	31,8 63,3	52,2 15,8	+28,0/+47,7 +73,14/+14,31
S13	REDOVNA	1002,0	326,6	43,0	15,0	+61,1/+5,2
	POTRESNA	665,0 543,0	200,8 282,4	39,1 79,5	47,7 14,4	+33,55/+47,1 +71,77/+14,13
U14	REDOVNA	988,7	328,1	58,1	15,0	+61,1/+5,2
	POTRESNA	426,4 403,5	210,8 198,1	65,1 132,5	34,3 10,4	+52,6/+35,25 +119,46/+10,58

Tablica Provjera ležajeva za ULS i potres

Odabran je elastomerni ležaj 300x400x138mm tip C (V).
U tablici Provjera ležajeva za ULS i potres vidljive su male razlike u dobivenim silama na upornjacima i stupištima. Zbog toga je odabran najnepovoljniji slučaj djelovanja na konstrukciju i s tim je napravljen proračun za odabir ležajeva.
Zbog razmaka između nosača na S7 dilataciji od 120 mm, usred najvećih potresnih opterećenja, može doći do oštećenja rubnih ležajeva. Nakon svakog potresa potrebno je provjeriti ležajeve i zamijeniti ih po potrebi.

Selected Bearings on abutment 300/400/138(88) Mageba type V (C)

Gg - shear modul of testing bearing 0,7; 0,9; 1,15;

a	300 mm		diametar
b	400 mm		diametar
tb	138 mm		total thickness of bearing
n	11		number of layers
a'	290 mm		effective diametar
b'	390 mm		effective diametar
Tq =	88 mm		total thickness of elastomer
ti =	8 mm	layers	te - individual thickness
Gd =	0,9 MPa		design shear modul of elastomer
			G-shear modul of bearing

Total design shear deformation

a) Deformation from compression

dominant direction x

$F_{zd,max}$	1050 kN	ULS	max vert. force
$F_{zd,min}$	440 kN	ULS	min vert. force
$F_{zd,g}$ =	580 kN	ULS	dead loads
$v_{x,d}$	75,525 mm	ULS	movements x
$v_{y,d}$	20 mm	ULS	movements y
$v_{xy,d} = \sqrt{(v_{x,d}^2 + v_{y,d}^2)}$	78,1 mm	ULS	vector
A1 = a'xb'	113100,0 mm2		effective area
Ar = A1 (1 - $v_{x,d}$/a' - vy,d/b')	89445,3 mm2		reduction plan area
lp= 2(a' + b')	1360,0 mm		free perimetar
σe = $F_{z,d}$/Ar	11,74 N/mm2		
S = A1/(lpxti)	10,4 mm		shape factor

a) Deformation from compressive loads

Design strain compresive loads

$\varepsilon_{c,d}$ = (1,5 x Fz,d) /(Ar x S x G) 1,9

b) Deformation from shear movement

Design strain from translatory movements

$\varepsilon_{q,d} = v_{xy,d} / T_q$ 0,89 < 1 $\varepsilon_{q,d} \le 1,0$

c) Deformation from angular rotation

Design strain from angular rotation

$$\varepsilon_{\alpha,d} = \frac{\left(a'^2 \cdot \alpha_{a,d} + b'^2 \cdot \alpha_{b,d}\right) t_i}{2\sum\left(t_i^3\right)}$$

αa,d= 0,012 rad

αb,d= 0,0025 rad radijani = α x (2xΠ/360)

εα,d = 0,9 Can be 0 for seismic combination

a',b' = D'

Total design deformation

Maximum design strain

$d_{b\acute{z},a} = \gamma_{IS} \times d_{b\acute{z},d}$ potresni pomak

$d_{m,\acute{z}} \ge d_{G,\acute{z}} + d_{b\acute{z},a}$ dG,i - stalno+puz+50%temp

$\varepsilon_{t,d} = K_L(\varepsilon_{c,d} + \varepsilon_{q,d} + \varepsilon_{\alpha,d}) < \varepsilon_{u,d}$ **3,67 < 7** ULS $\varepsilon_{u,d} = \varepsilon_{uk} / \gamma_m = 7/1 = 7$

KL=1 for all loads

KL=1,5 for live loads

Sliding check

for min. loads

$\sigma_{cd,min} = F_{z,d\,min} / A_r$ ≥ 3,0 MPa

$\sigma_{cd,min}$= 3,89 MPa ≥ 3,0 MPa no anchoring

For load combination

$F_{xy,d} \le \mu_e \cdot F_{z,dmin}$

μ_e = 0,1 + 1,5 ·K_f/σ_m = 0,16 koef of friction (Kf-friction factor 0,2 or 0,6)

$\sigma_m = F_{z,dmin} / A_r$ = 4,91 MPa average min.stress

$\mu_e \cdot F_{z,dmin}$ = 70,88 kN

$F_{xy,d}$ = 125 kN need anchoring

Buckling stability

$F_{z,d}$ / Ar = 11,7

(2xa'xGxS1) / (3xT_e)= 20,6

$F_{z,d}$ / Ar ≤ (2xa'xGxS1) / (3xT_e) **11,7 < 20,6 satisfy**

POTRESNA DJELOVANJA

Selected Bearings on abutment 300/400/138(88) Type C (V)

			Gg - shear modul of testing bearing 0,7; 0,9; 1,15
a	300 mm		diametar
b	400 mm		diametar
tb	138 mm		total thickness of bearing
n	11		number of layers
a'	290 mm		effective diametar
b'	390 mm		effective diametar
Tq =	88 mm		total thickness of elastomer
ti =	8 mm	layers	te - individual thickness
Gd =	0,9 MPa		design shear modul of elastomer
			G-shear modul of bearing

Total design shear deformation

a) Deformation from compression

dominant direction x

$F_{zd,max}$	665 kN		ULS	max vert. force
$F_{zd,min}$	132 kN		ULS	min vert. force
$F_{zd,g}$ =	580 kN		ULS	dead loads
$v_{x,d}$	110 mm		ULS	movements x
$v_{y,d}$	20 mm		ULS	movements y
$v_{xy,d} = \sqrt{(v_{x,d}^2 + v_{y,d}^2)}$	111,8 mm		ULS	vector
A1 = a'xb'	113100,0	mm2		effective area
Ar = A1 (1 – $v_{x,d}$/a' – vy,d/b')	76000,0	mm2		reduction plan area
lp= 2(a' + b')	1360,0	mm		free perimetar
σe = $F_{z,d}$/Ar	8,75	N/mm2		
S = A1/(lpxti)	10,4	mm		shape factor

a) Deformation from compressive loads

Design strain compresive loads

ε c,d = (1,5 x Fz,d) / (Ar x S x G) 1,4

b) Deformation from shear movement

Design strain from translatory movements

ε q,d = $v_{xy,d}$ / T_q 1,27 < 2

$\varepsilon_{q,d} \le 2,0$

$d_{bi,a} = \gamma_{IS} \times d_{bi}$ potresni pomak

$\gamma_{IS} = 1,5$

$d_{mi} \ge d_{Gi} + d_{bi,a}$ dG,i - stalno+puz+5

posmična deform proračunana u skladu s izrazom

c) Deformation from angular rotation

Design strain from angular rotation

$$\varepsilon_{\alpha,d} = \frac{\left(a'^2 \cdot \alpha_{a,d} + b'^2 \cdot \alpha_{b,d}\right) t_i}{2\sum\left(t_i^3\right)}$$

αa,d= 0,0145 rad

αb,d= 0,005 rad

εα,d = 1,3

radijani = α x (2xΠ/360)

Can be 0 for seismic combination

a',b' = D'

Total design deformation

Maximum design strain

$d_{bi,a} = \gamma_{IS} \times d_{bi,d}$ potresni pomak

$d_{mi} \ge d_{Gi} + d_{bi,a}$ dG,i - stalno+puz+50%temp

$\varepsilon_{t,d} = K_L(\varepsilon_{c,d} + \varepsilon_{q,d} + \varepsilon_{\alpha,d}) < \varepsilon_{u,d}$ **3,96 < 7**

ULS $\varepsilon_{u,d} = \varepsilon_{uk} / \gamma_m = 7/1 = 7$

KL=1 for all loads

KL=1,5 for live loads

Sliding check

for min. loads

$\sigma_{cd,min} = F_{z,d\,min} / A_r \ge 3,0$ MPa

$\sigma_{cd,min}$= 1,73 MPa ≥ 3,0 MPa need anchoring

For load combination

$F_{xy,d} \le \mu_e \cdot F_{z,dmin}$

$\mu_e = 0,1 + 1,5 \cdot K_f/\sigma_m$ = 0,27 koef of friction (Kf-friction factor 0,2 or 0,6)

$\sigma_m = F_{z,dmin} / A_r$ = 1,73 MPa average min.stress

$\mu_e \cdot F_{z,dmin}$ = 36,09 kN

$F_{xy,d}$ = 271 kN need anchoring

Buckling stability

$F_{z,d}$ / Ar = 8,8

(2xa'xGxS1) / (3xT_e)= 20,6

$F_{z,d}$ / Ar ≤ (2xa'xGxS1) / (3xT_e) **8,8 < 20,6 satisfy**

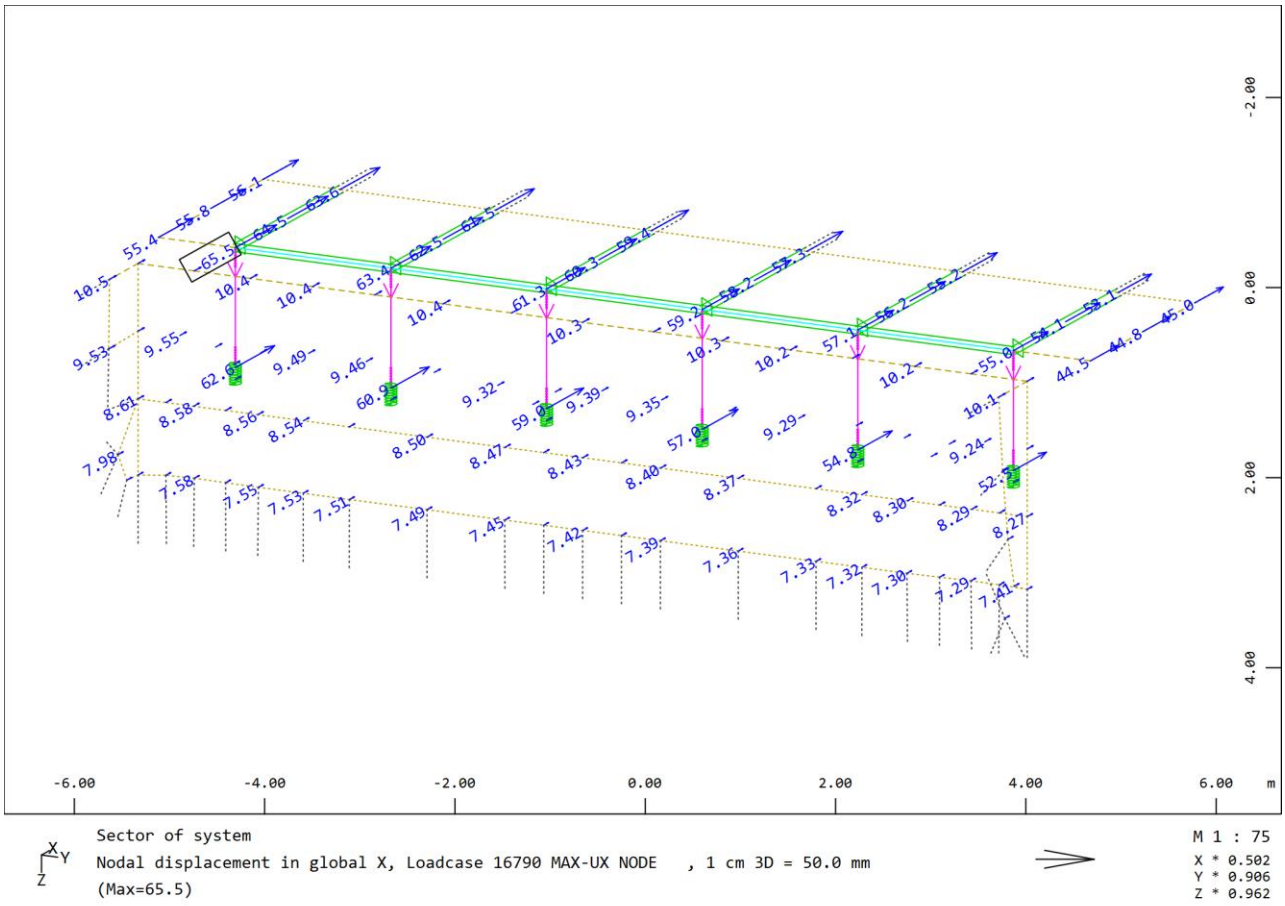
Prijelazne naprave

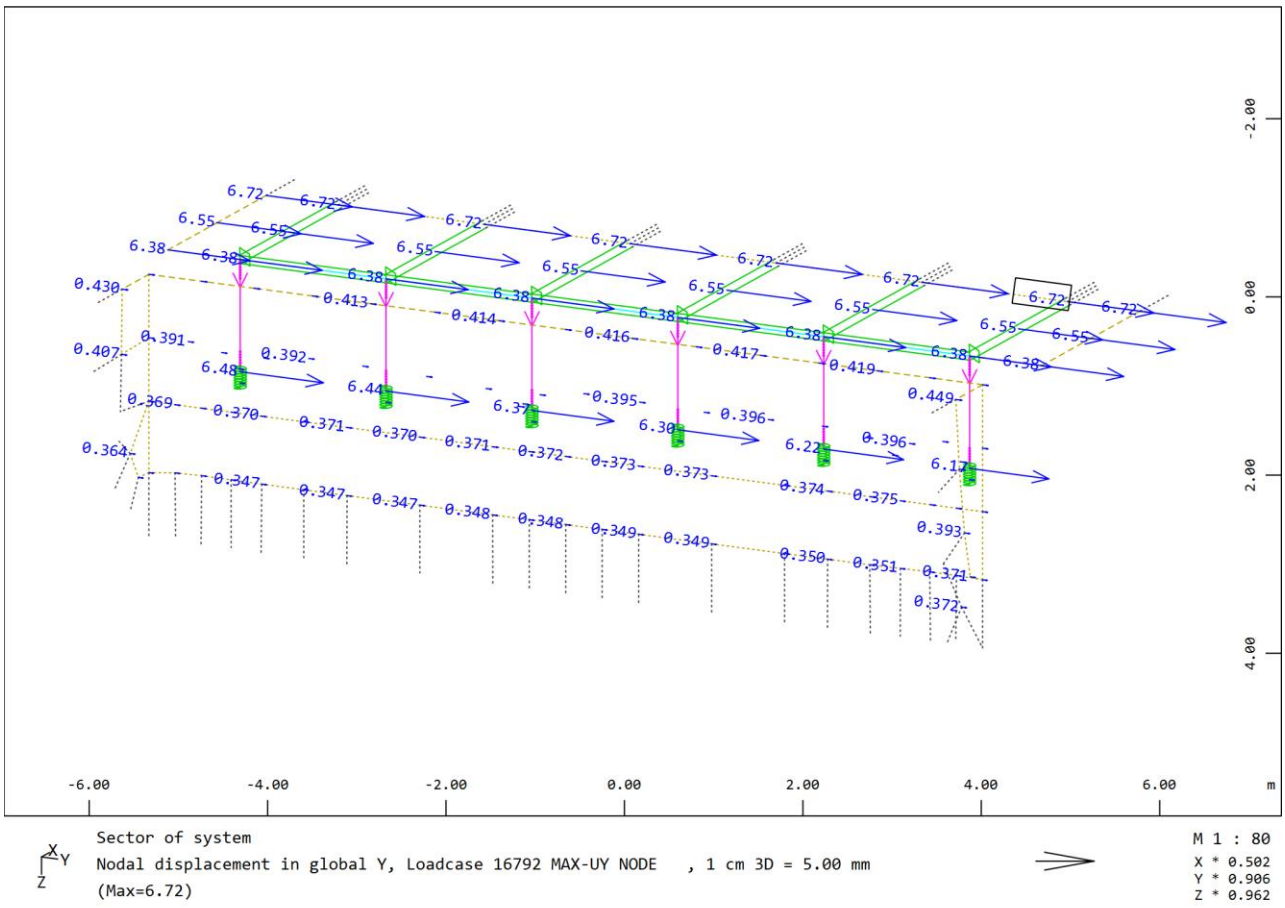
Potrebni pomaci dilatacijske naprave pronalaze se prema kombinacijama u tablici.

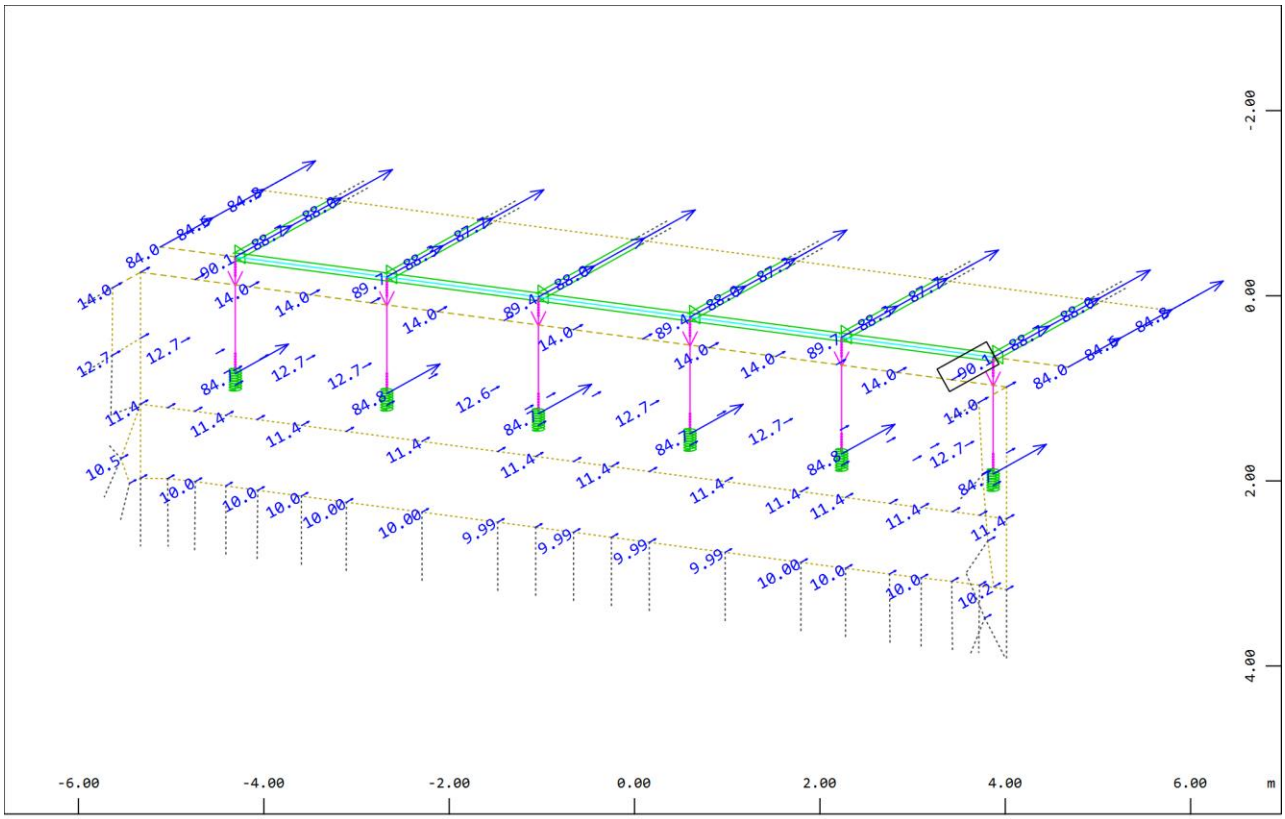
POMACI DILATACIJSKIH NAPRAVA		
Redovna kombinacija	$1,0 \cdot G+1,0 \cdot C+1,0 \cdot ZT+1,0 \cdot K+1 \cdot ZW$	16790-16791 16792-16793
Seizmička kombinacija	$1,0 \cdot G+1,0 \cdot C+0,5 \cdot ZT+0,15 \cdot q \cdot A_y+0,5 \cdot q \cdot A_x+0,15 \cdot A_z$ $1,0 \cdot G+1,0 \cdot C+0,5 \cdot ZT+0,5 \cdot q \cdot A_y+0,15 \cdot q \cdot A_x+0,15 \cdot A_z$	16960-16961 16962-16963 16970-16971 16972-16973

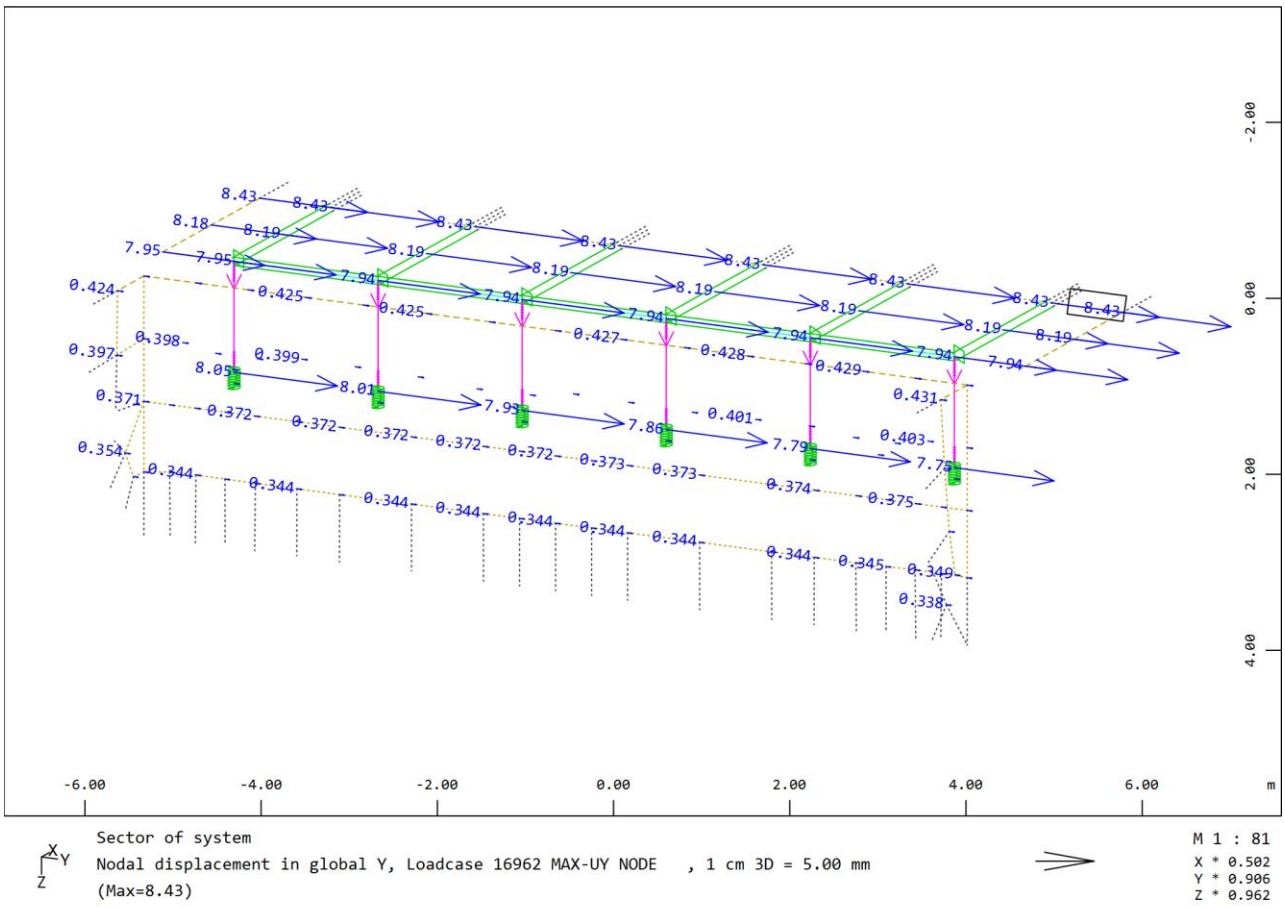
Najveći pomaci dilatacijske naprave ostvaruju se u potresnoj kombinaciji opterećenja. Potrebna dilatacijska naprava na oba upornjaka i na dilatacijskom stupu je: dopuštenog pomaka za redovne kombinacije ±68,4mm, a u poprečnom smjeru ±9,97mm, odnosno za potresne dominantan uzdužni smjer uzdužno ±92,9mm, a u poprečnom smjeru ±16,1mm , odnosno za potresne dominantan poprečni smjer uzdužno ±52,5mm, a u poprečnom smjeru ±53,5mm.

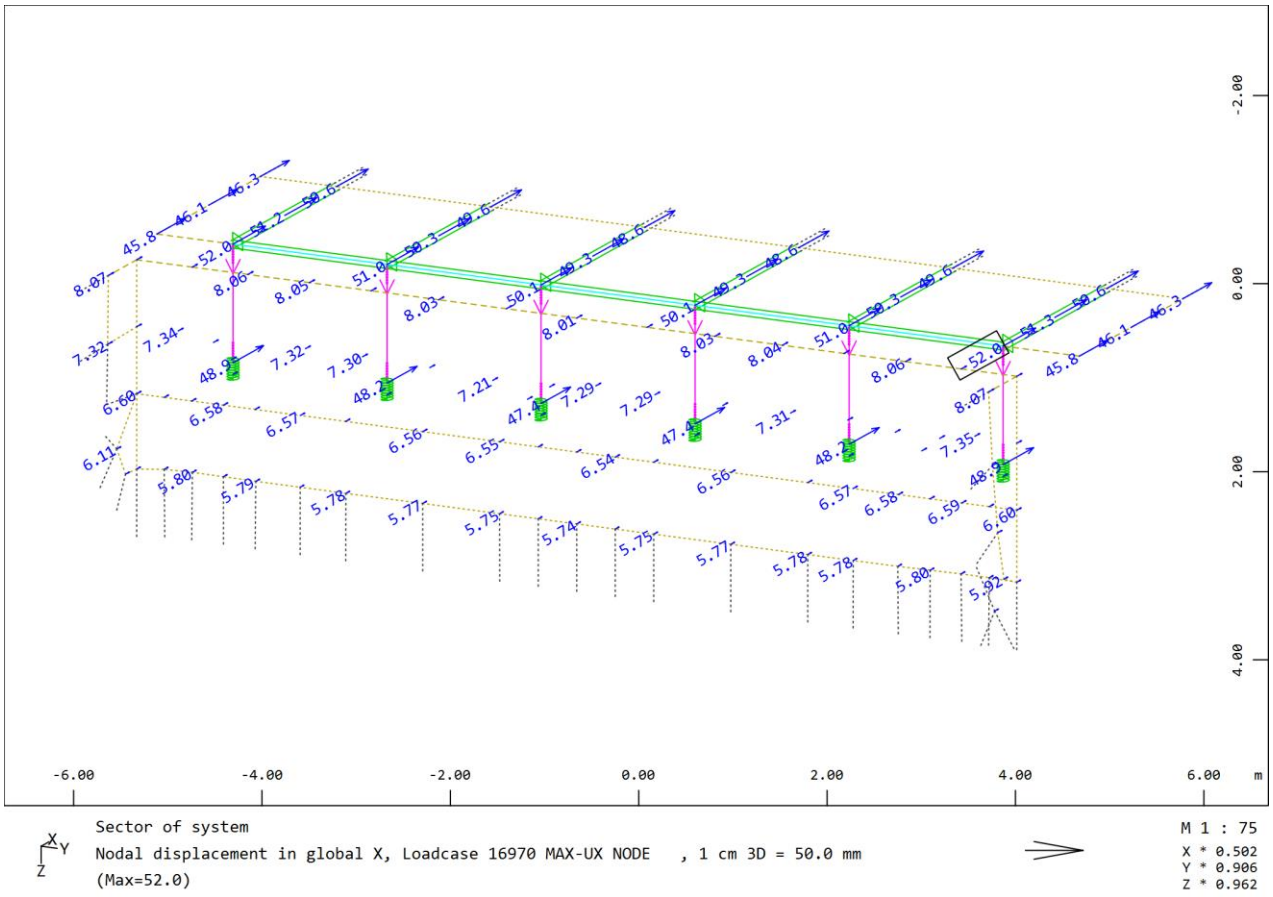
Odabrane su prijelazne naprave na upornjacima sa pomacima D160 ±80mm i na stupištu S7 D240 ±120mm. Pretpostavljena temperatura ugradnje je 10ºC. Prijelazne naprave moraju izdržati bočne pomake od ±10mm.


-2.00
0.00
2.00
4.00
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
m
Sector of system
Nodal displacement in global X, Loadcase 16790 MAX-UX NODE , 1 cm 3D = 50.0 mm
(Max=65.5)
M 1 : 75
X * 0.502
Y * 0.906
Z * 0.962


-2.00
0.00
2.00
4.00
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
m
Sector of system
Nodal displacement in global Y, Loadcase 16792 MAX-UY NODE , 1 cm 3D = 5.00 mm
(Max=6.72)
M 1 : 80
X * 0.502
Y * 0.906
Z * 0.962

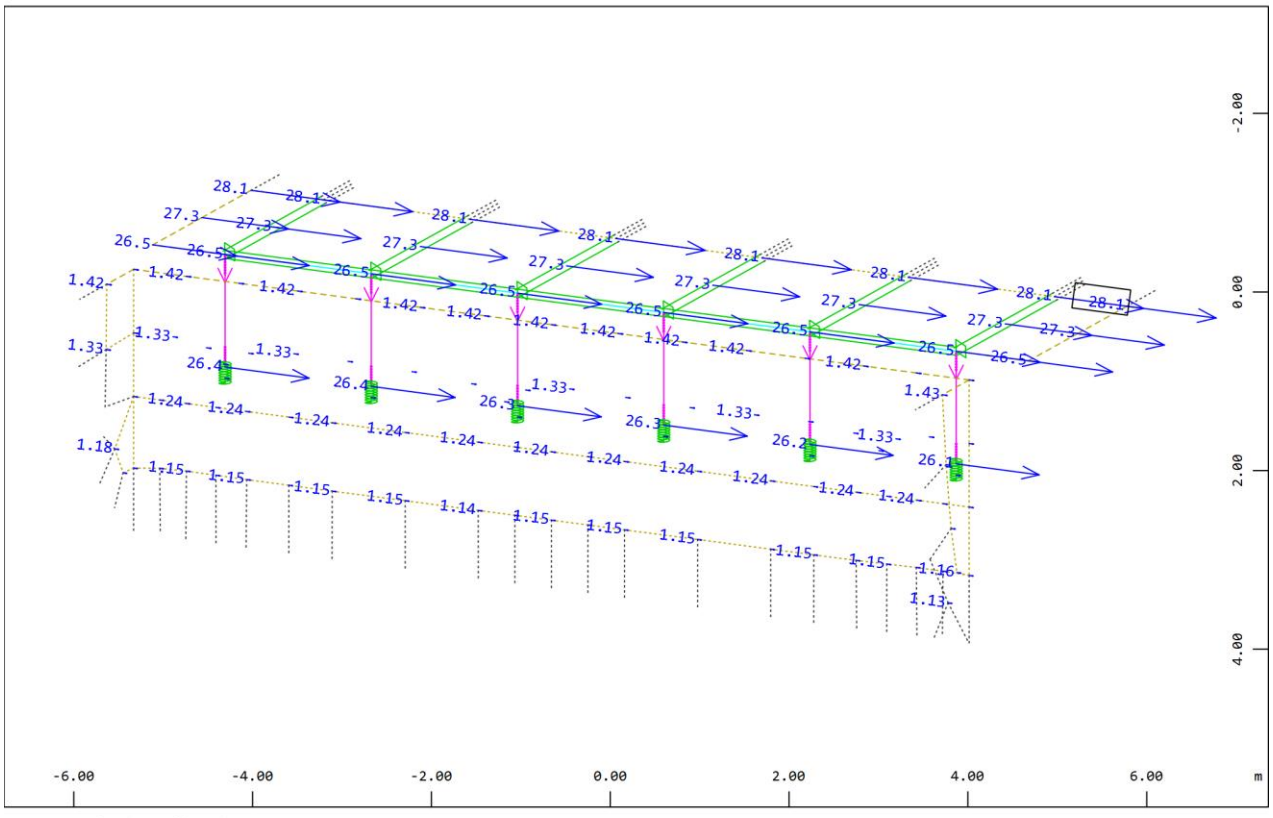

-2.00
0.00
2.00
4.00
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
m
Sector of system
Nodal displacement in global X, Loadcase 16960 MAX-UX NODE , 1 cm 3D = 50.0 mm
(Max=90.1)
M 1 : 77
X * 0.502
Y * 0.906
Z * 0.962


-2.00
0.00
2.00
4.00
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
m
Sector of system
Nodal displacement in global Y, Loadcase 16962 MAX-UY NODE , 1 cm 3D = 5.00 mm
(Max=8.43)
M 1 : 81
X * 0.502
Y * 0.906
Z * 0.962



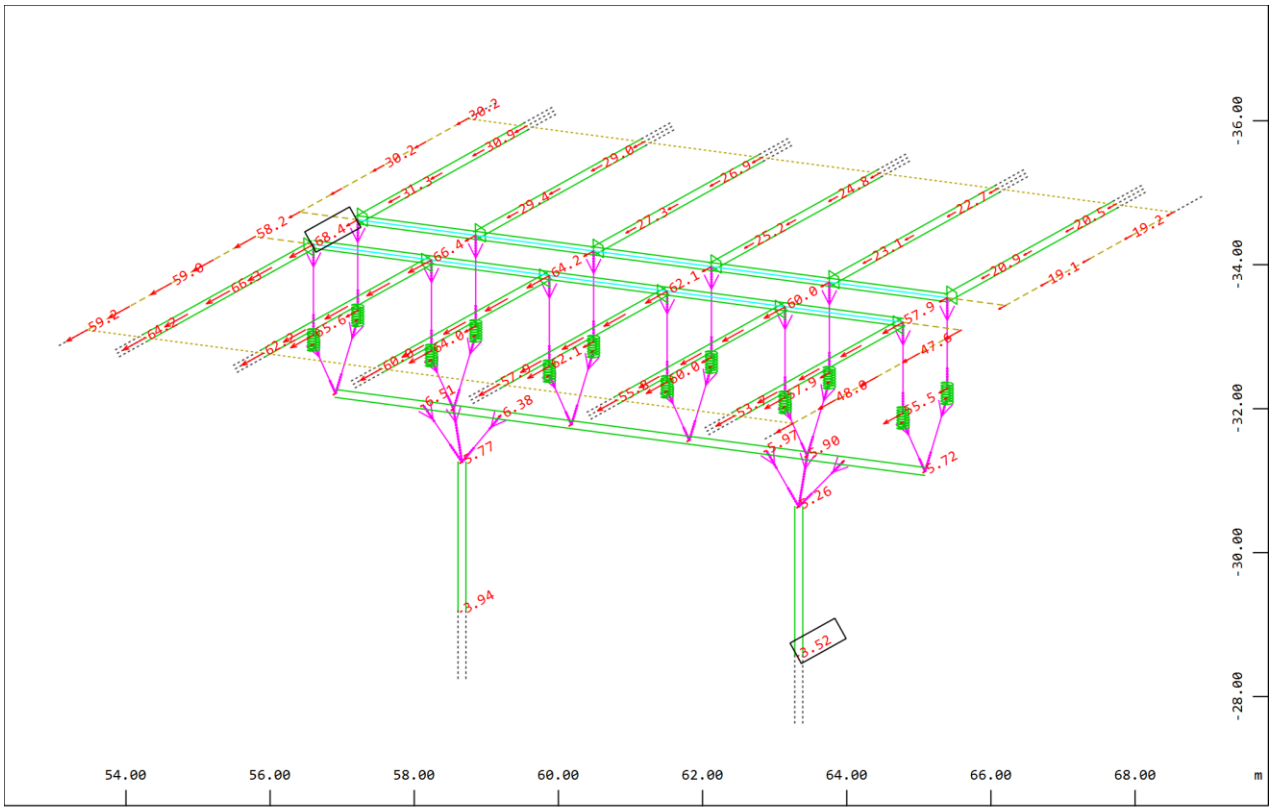
Sector of system
Nodal displacement in global X, Loadcase 16970 MAX-UX NODE , 1 cm 3D = 50.0 mm
(Max=52.0)

M 1 : 75
X * 0.502
Y * 0.906
Z * 0.962



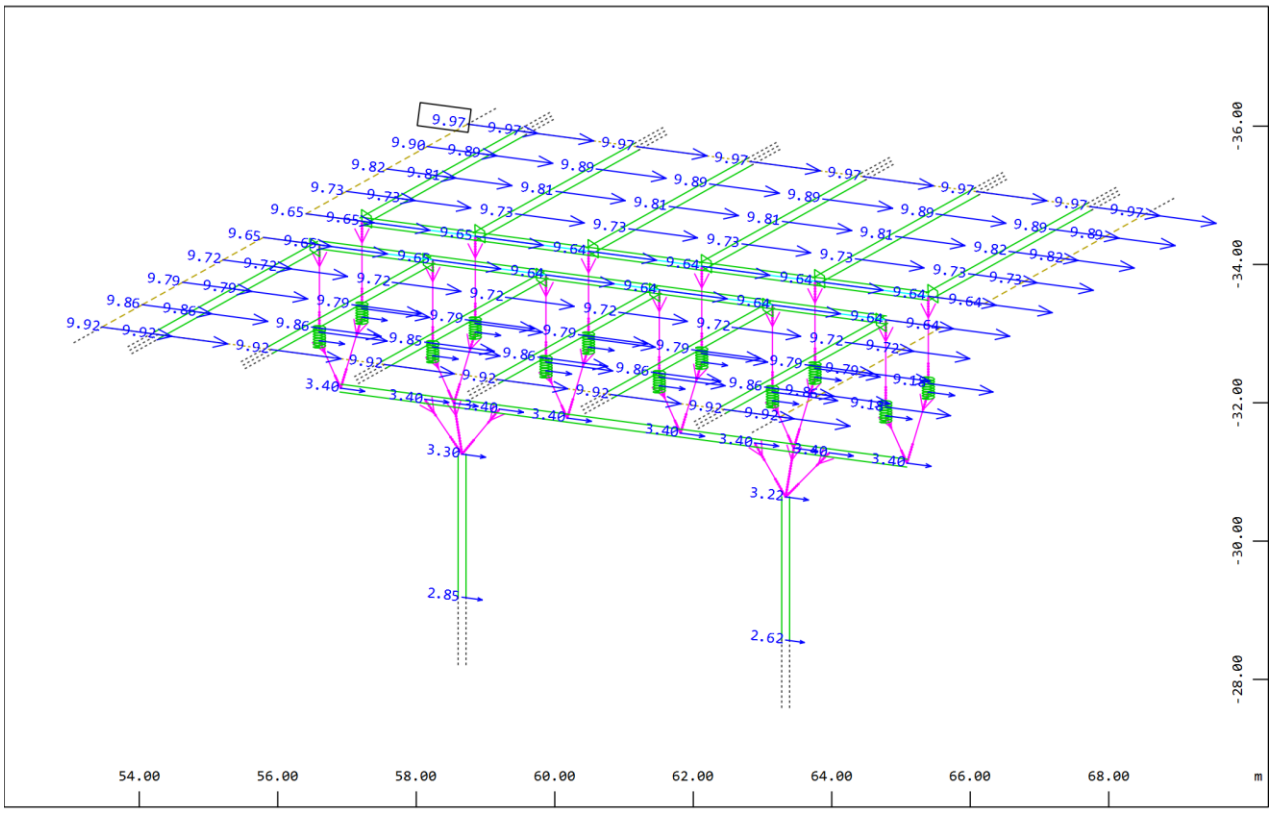
Sector of system
Nodal displacement in global Y, Loadcase 16972 MAX-UY NODE , 1 cm 3D = 20.0 mm
(Max=28.1)

M 1 : 79
X * 0.502
Y * 0.906
Z * 0.962



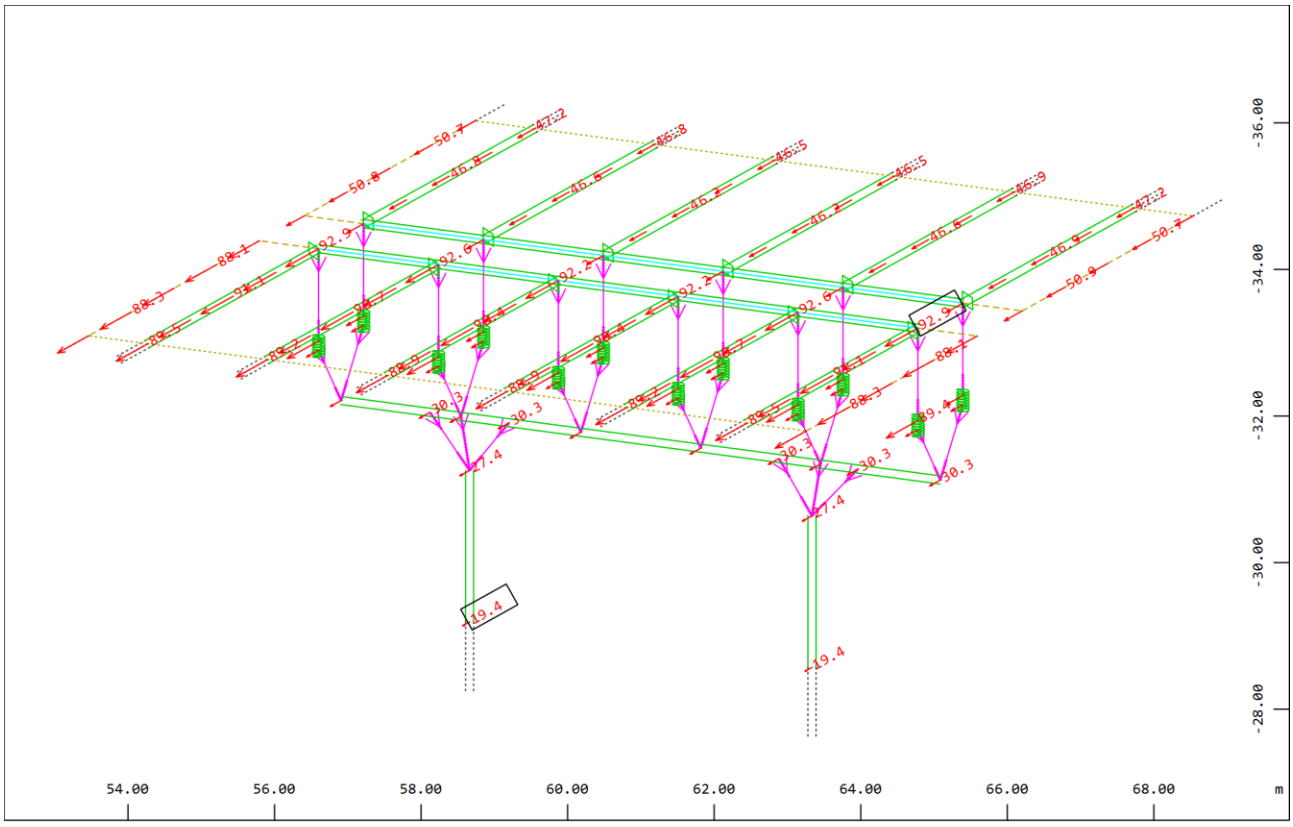
Sector of system
Nodal displacement in global X, Loadcase 16791 MIN-UX NODE , 1 cm 3D = 90.2 mm
(Min=-68.4) (Max=-3.52)

M 1 : 98
X * 0.502
Y * 0.906
Z * 0.962



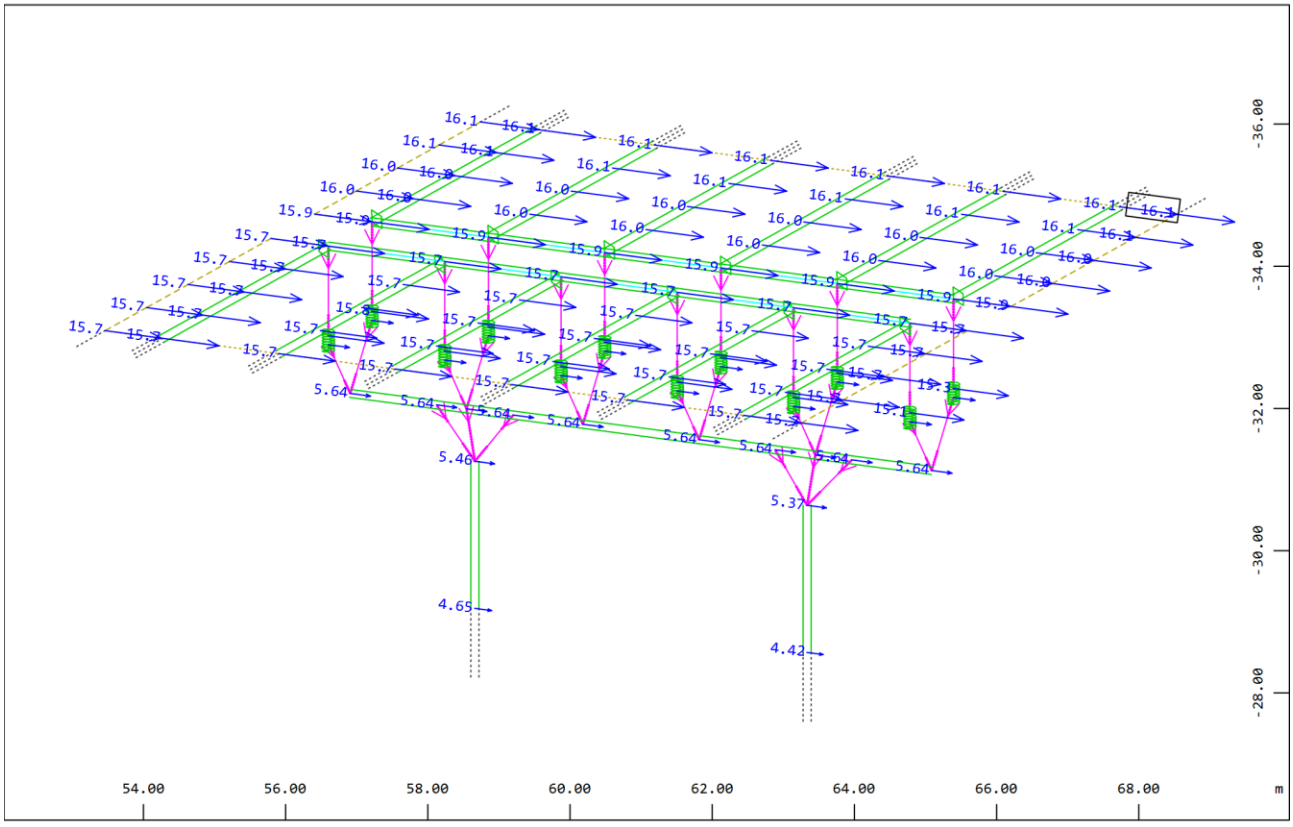
Sector of system
Nodal displacement in global Y, Loadcase 16792 MAX-UY NODE , 1 cm 3D = 9.02 mm
(Max=9.97)

M 1 : 102
X * 0.502
Y * 0.906
Z * 0.962



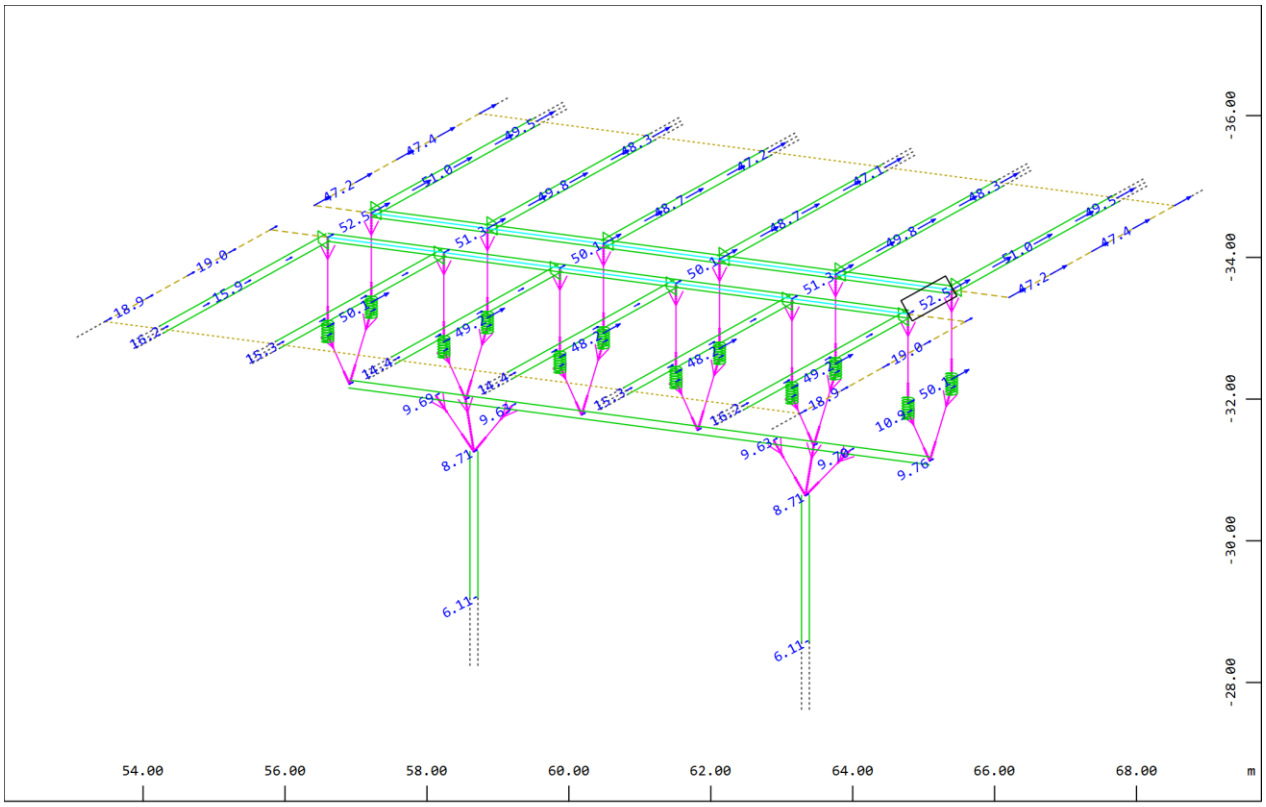
Sector of system
Nodal displacement in global X, Loadcase 16961 MIN-UX NODE , 1 cm 3D = 90.2 mm
(Min=-92.9) (Max=-19.4)

M 1 : 98
X * 0.502
Y * 0.906
Z * 0.962



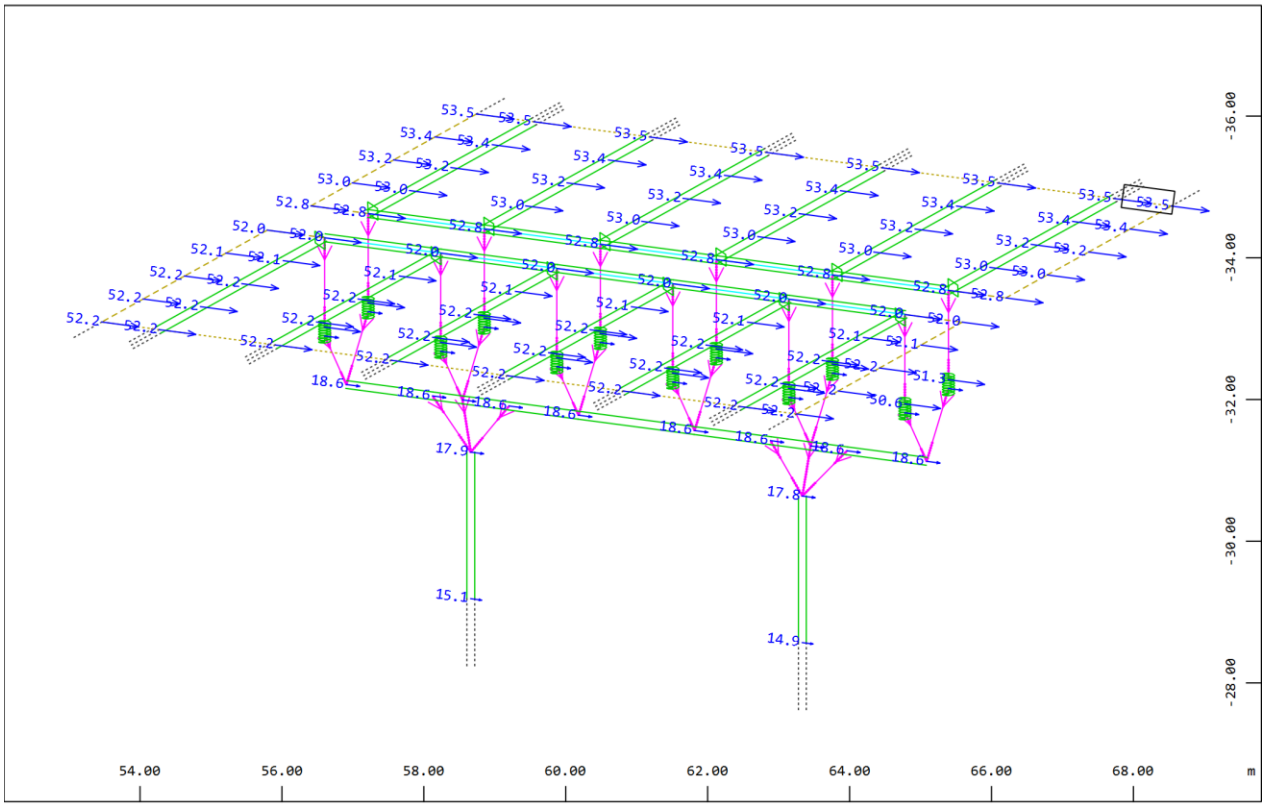
Sector of system
Nodal displacement in global Y, Loadcase 16962 MAX-UY NODE , 1 cm 3D = 18.0 mm
(Max=16.1)

M 1 : 101
X * 0.502
Y * 0.906
Z * 0.962



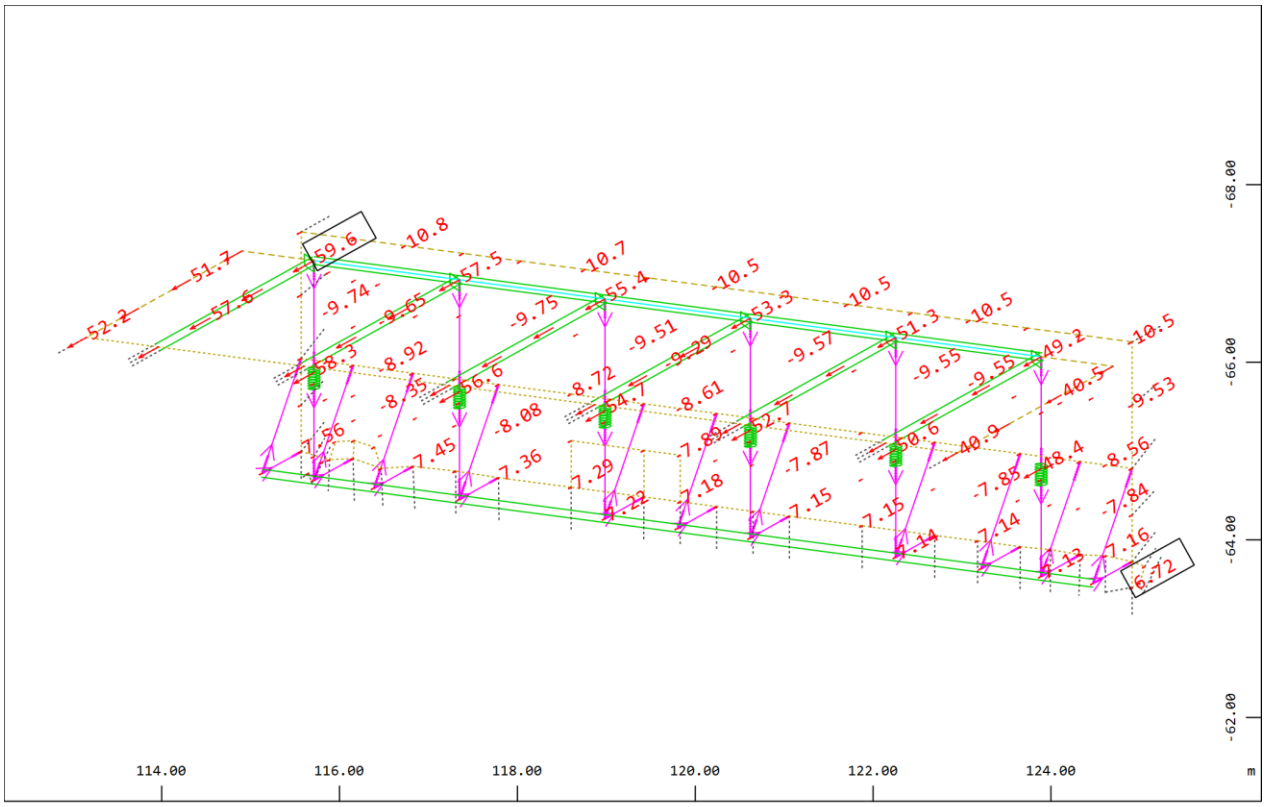
Sector of system
Nodal displacement in global X, Loadcase 16970 MAX-UX NODE , 1 cm 3D = 90.2 mm
(Max=52.5)

M 1 : 99
X * 0.502
Y * 0.906
Z * 0.962



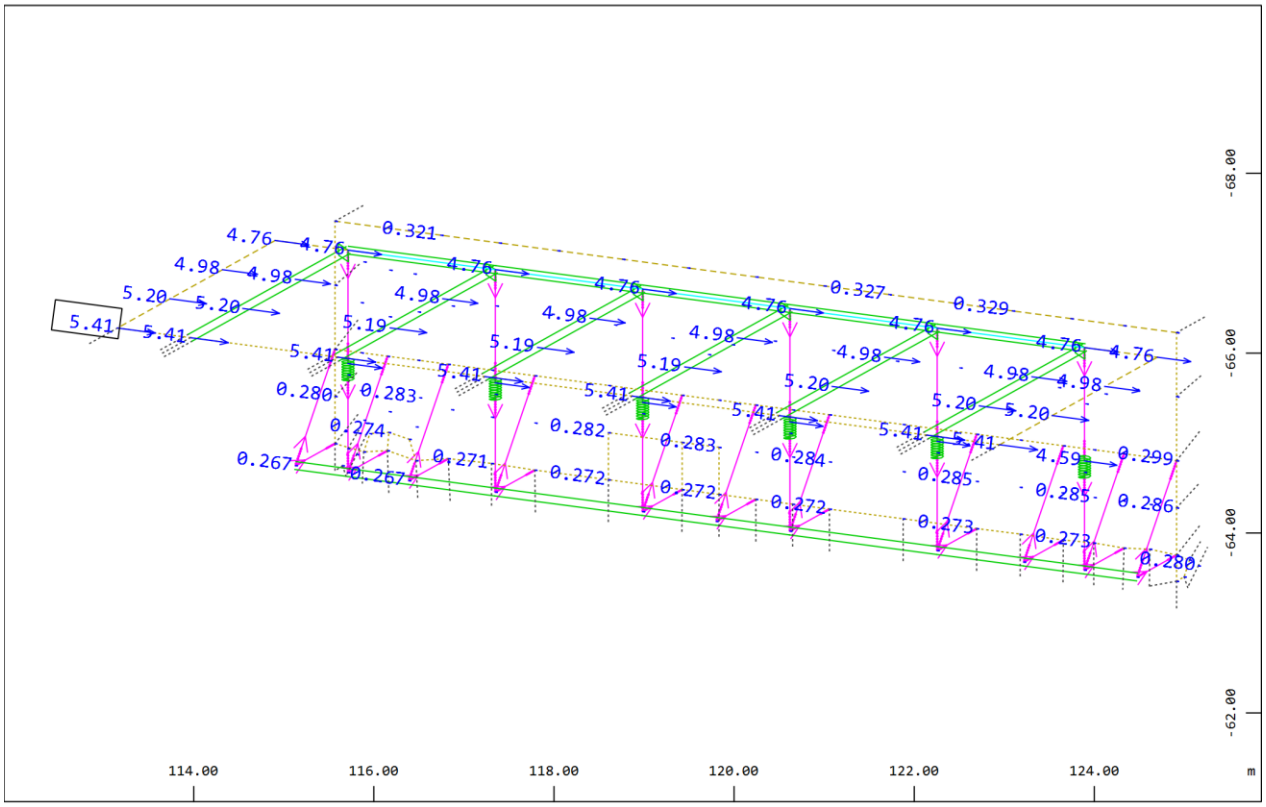
Sector of system
Nodal displacement in global Y, Loadcase 16972 MAX-UY NODE , 1 cm 3D = 90.2 mm
(Max=53.5)

M 1 : 99
X * 0.502
Y * 0.906
Z * 0.962



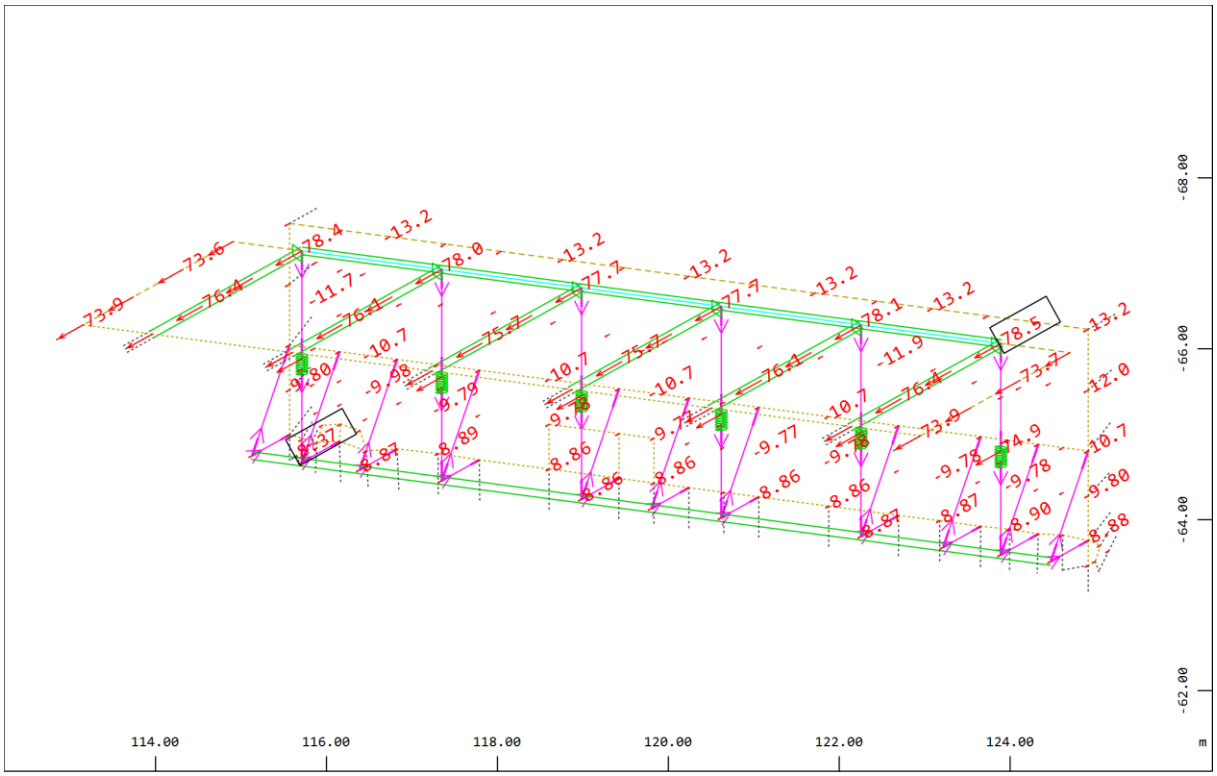
Sector of system
Nodal displacement in global X, Loadcase 16791 MIN-UX NODE , 1 cm 3D = 90.2 mm
(Min=-59.6) (Max=-6.72)

M 1 : 79
X * 0.502
Y * 0.906
Z * 0.962



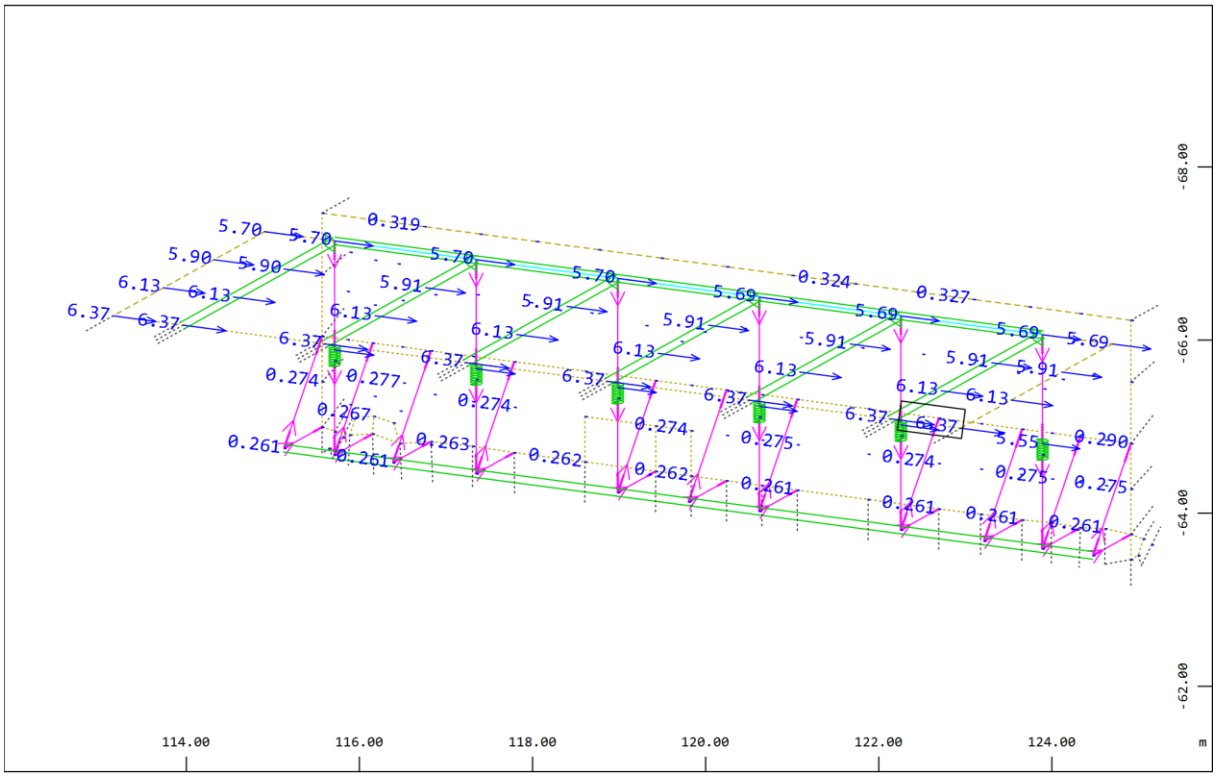
Sector of system
Nodal displacement in global Y, Loadcase 16792 MAX-UY NODE , 1 cm 3D = 9.02 mm
(Max=5.41)

M 1 : 78
X * 0.502
Y * 0.906
Z * 0.962



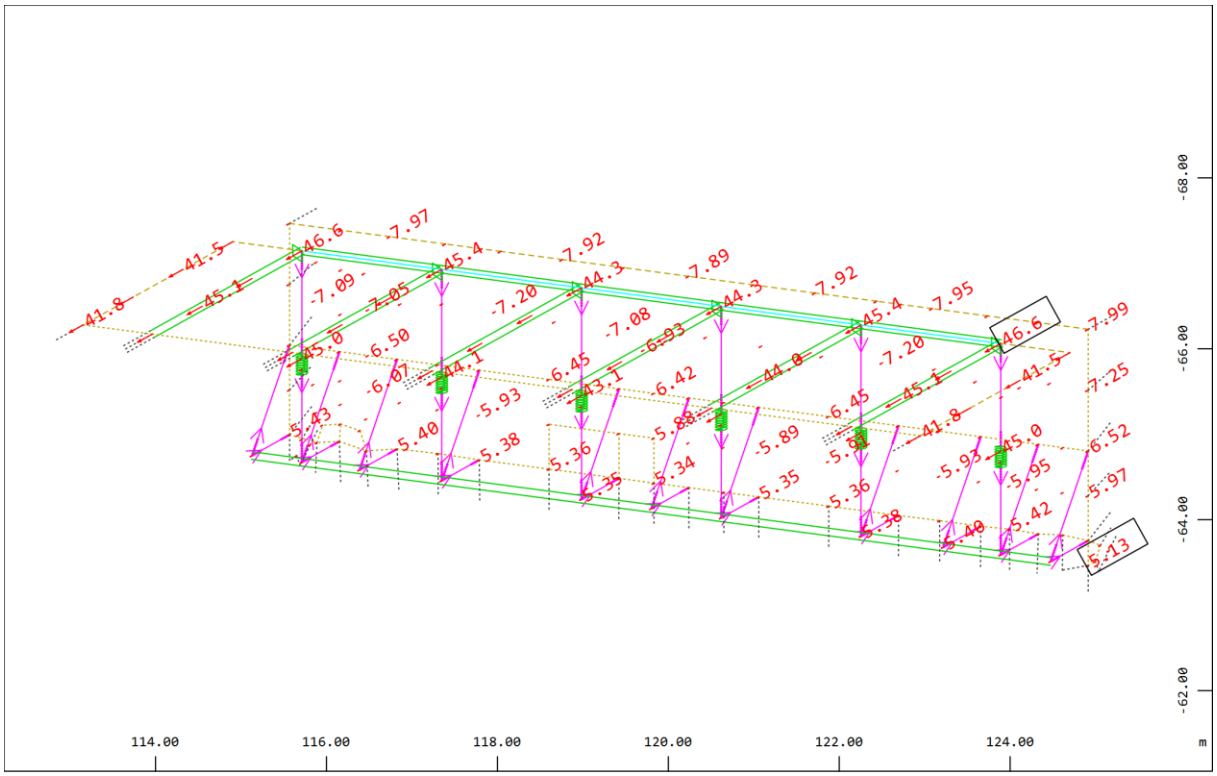
Sector of system
Nodal displacement in global X, Loadcase 16961 MIN-UX NODE , 1 cm 3D = 90.2 mm
(Min=-78.5) (Max=-8.37)

M 1 : 79
X * 0.502
Y * 0.906
Z * 0.962



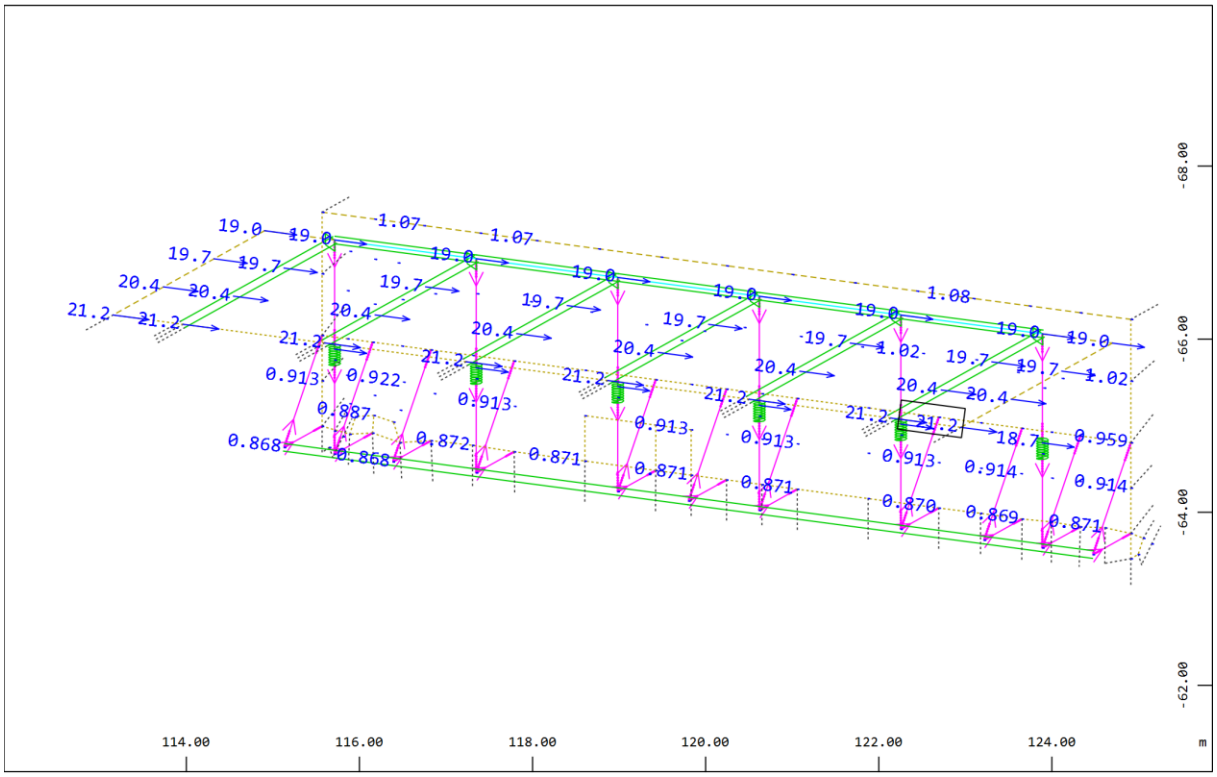
Sector of system
Nodal displacement in global Y, Loadcase 16962 MAX-UY NODE , 1 cm 3D = 9.02 mm
(Max=6.37)

M 1 : 78
X * 0.502
Y * 0.906
Z * 0.962



Sector of system
Nodal displacement in global X, Loadcase 16971 MIN-UX NODE , 1 cm 3D = 90.2 mm
(Min=-46.6) (Max=-5.13)

M 1 : 79
X * 0.502
Y * 0.906
Z * 0.962

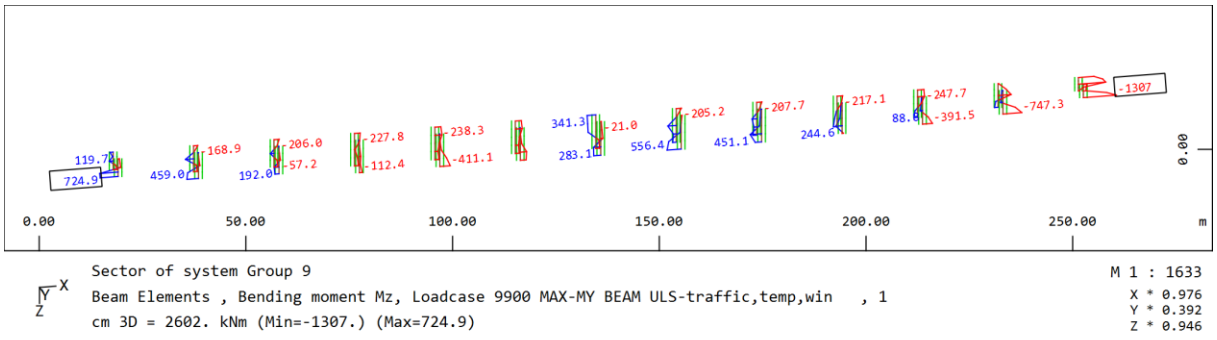


Sector of system
Nodal displacement in global Y, Loadcase 16972 MAX-UY NODE , 1 cm 3D = 36.1 mm
(Max=21.2)

M 1 : 78
X * 0.502
Y * 0.906
Z * 0.962

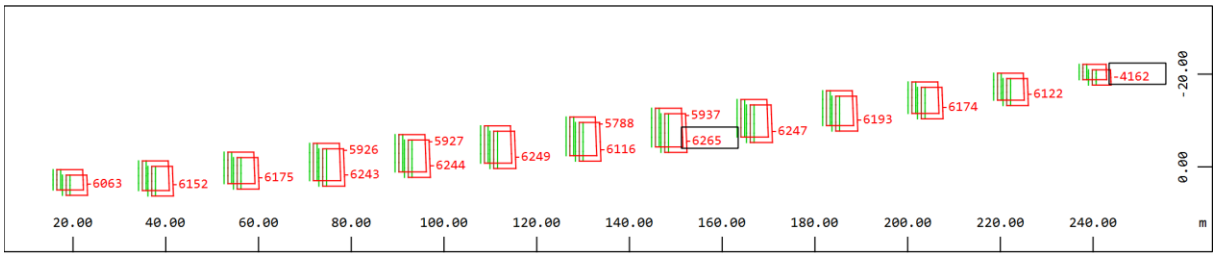
5. STUPOVI

5.1 Prikaz reznih sila od mjerodavnih kombinacija za stupove



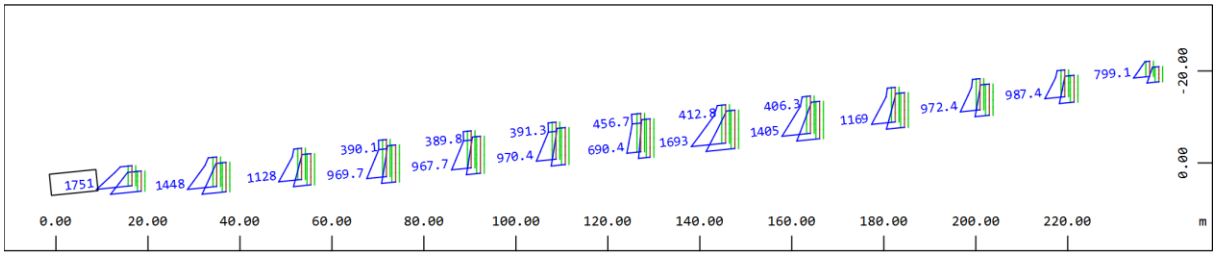
Sector of system Group 9
Beam Elements , Bending moment Mz, Loadcase 9900 MAX-MY BEAM ULS-traffic,temp,win , 1
cm 3D = 2602. kNm (Min=-1307.) (Max=724.9)

M 1 : 1633
X * 0.976
Y * 0.392
Z * 0.946



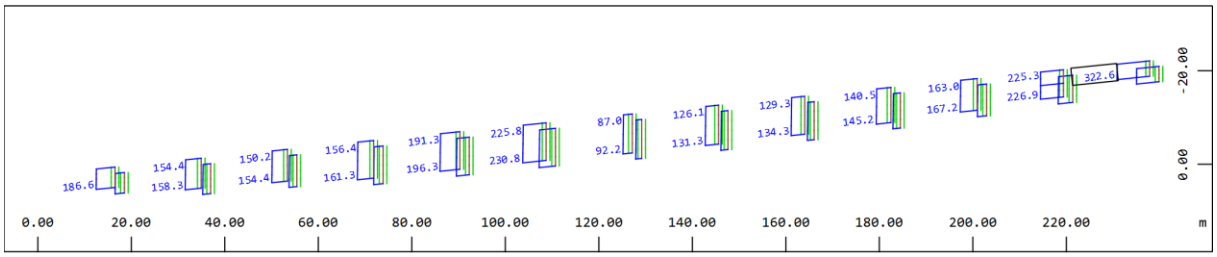
Sector of system Group 9
Beam Elements , Normal force Nx, Loadcase 9909 MIN-N BEAM ULS-traffic,temp,wind , 1 cm
3D = 15391. kN (Min=-6265.) (Max=-4162.)

M 1 : 1456
X * 0.927
Y * 0.448
Z * 0.970



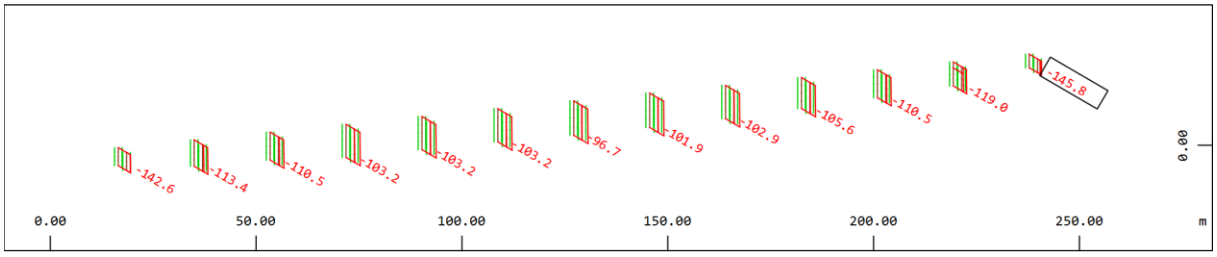
Sector of system Group 9
Beam Elements , Bending moment Mz, Loadcase 9904 MAX-MZ BEAM ULS-traffic,temp,win , 1
cm 3D = 3078. kNm (Max=1751.)

M 1 : 1468
X * 0.927
Y * 0.448
Z * 0.970



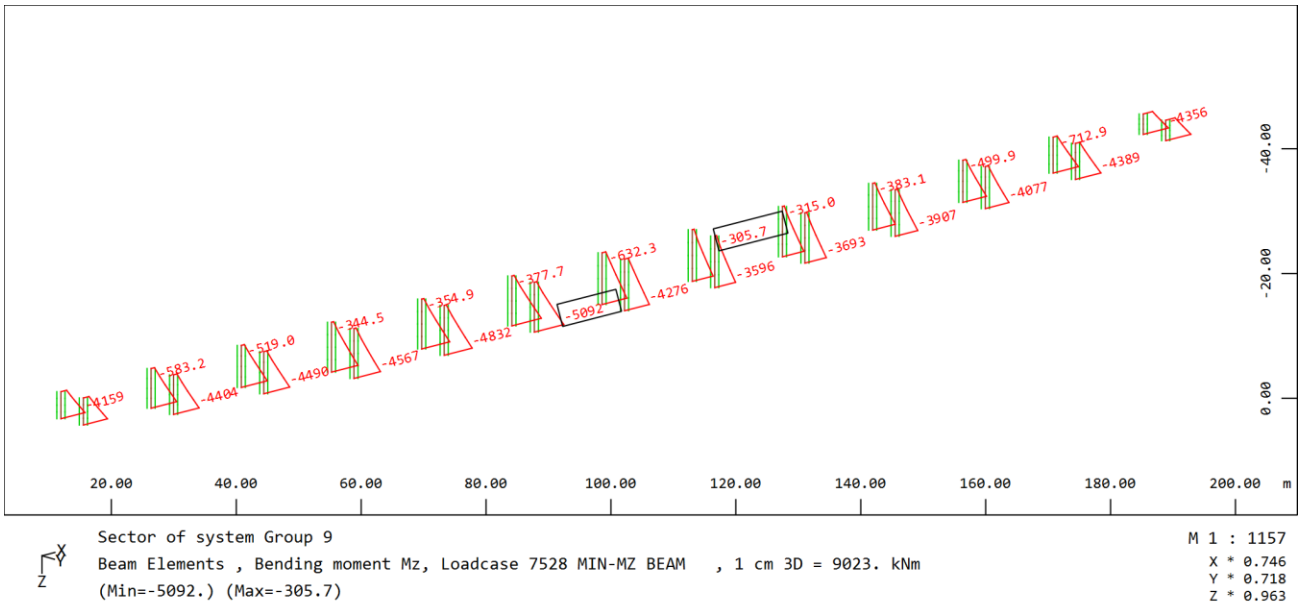
Sector of system Group 9
Beam Elements , Shear force Vy, Loadcase 9906 MAX-VY BEAM ULS-traffic,temp,win , 1 cm
3D = 615.6 kN (Max=322.6)

M 1 : 1444
X * 0.927
Y * 0.448
Z * 0.970



Sector of system Group 9
Beam Elements , Shear force Vz, Loadcase 9903 MIN-VZ BEAM ULS-traffic,temp,win , 1 cm
3D = 307.8 kN (Min=-145.8) (Max=-29.8)

M 1 : 1640
X * 0.927
Y * 0.448
Z * 0.970


-4159
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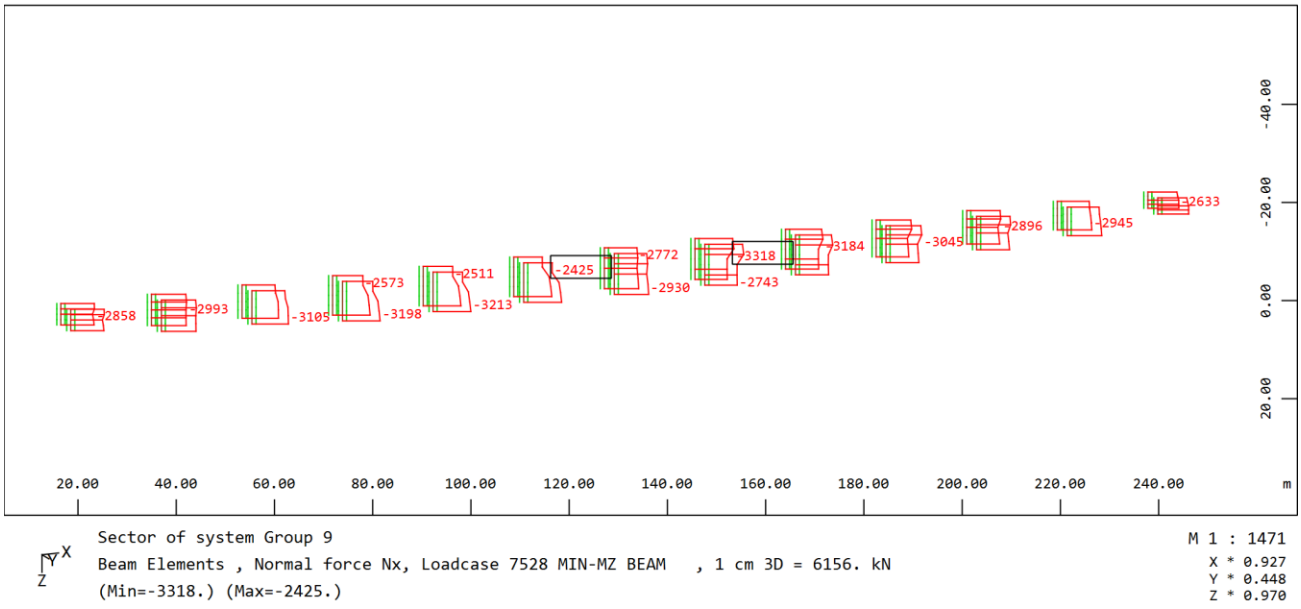
-4567
-4832
-5092
-4276
-3596
-3693
-3907
-4077
-4389
-4356
-583.2
-519.0
-344.5
-354.9
-377.7
-632.3
-305.7
-315.0
-383.1
-499.9
-712.9
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
m
-40.00
-20.00
0.00
Sector of system Group 9
Beam Elements , Bending moment Mz, Loadcase 7528 MIN-MZ BEAM , 1 cm 3D = 9023. kNm
(Min=-5092.) (Max=-305.7)
M 1 : 1157
X * 0.746
Y * 0.718
Z * 0.963


-2858
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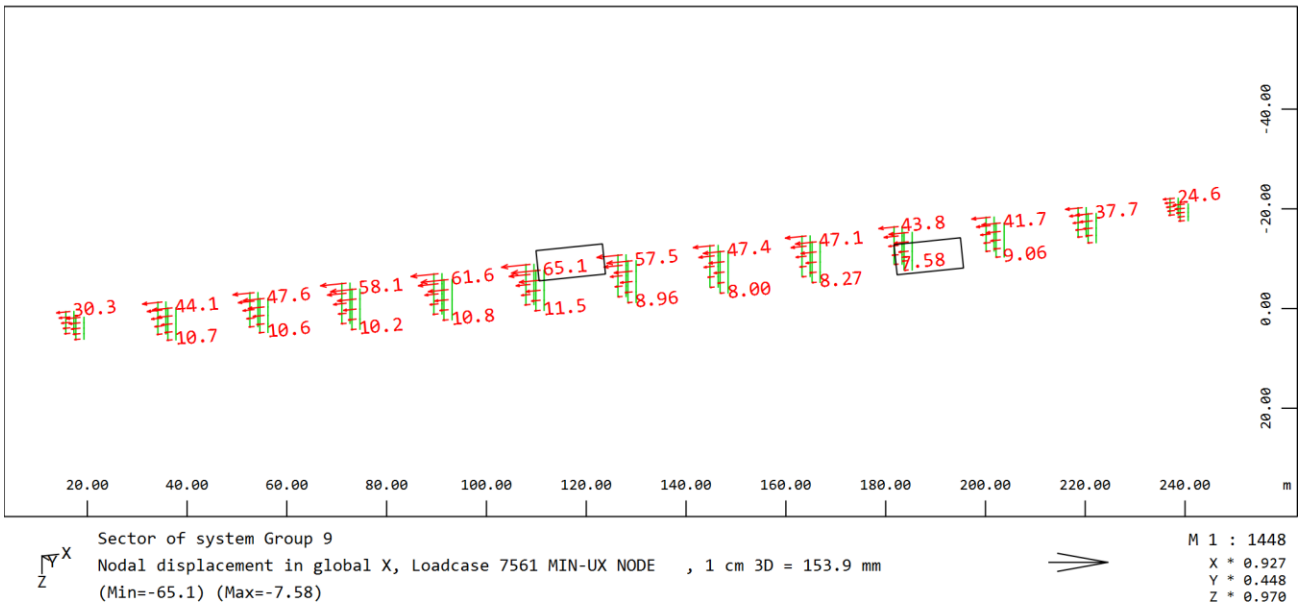
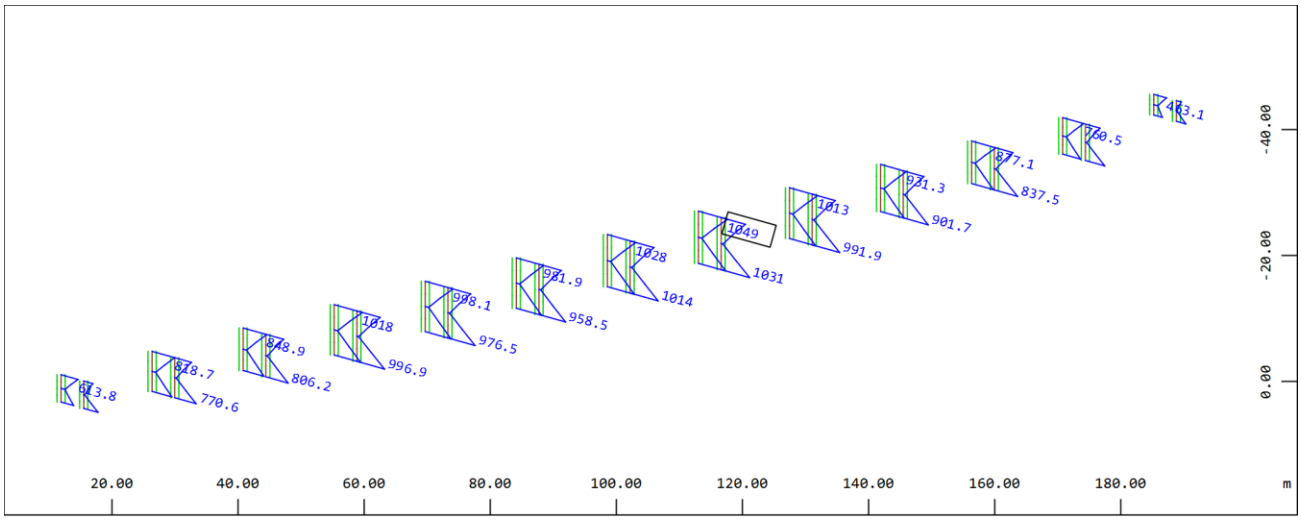
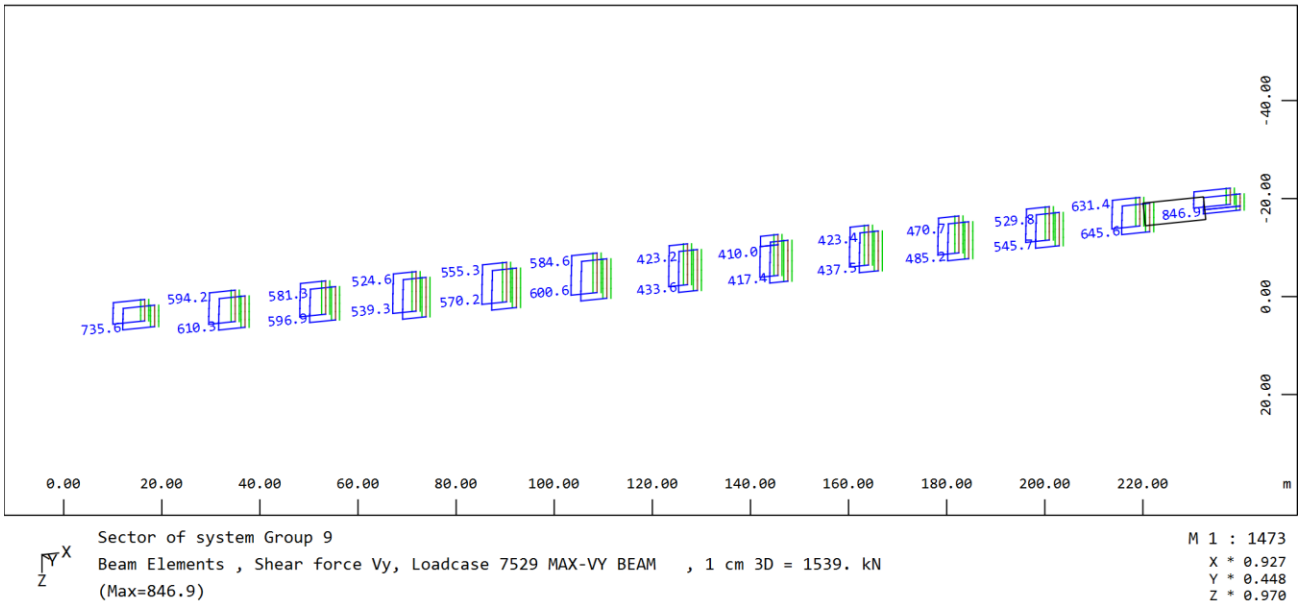
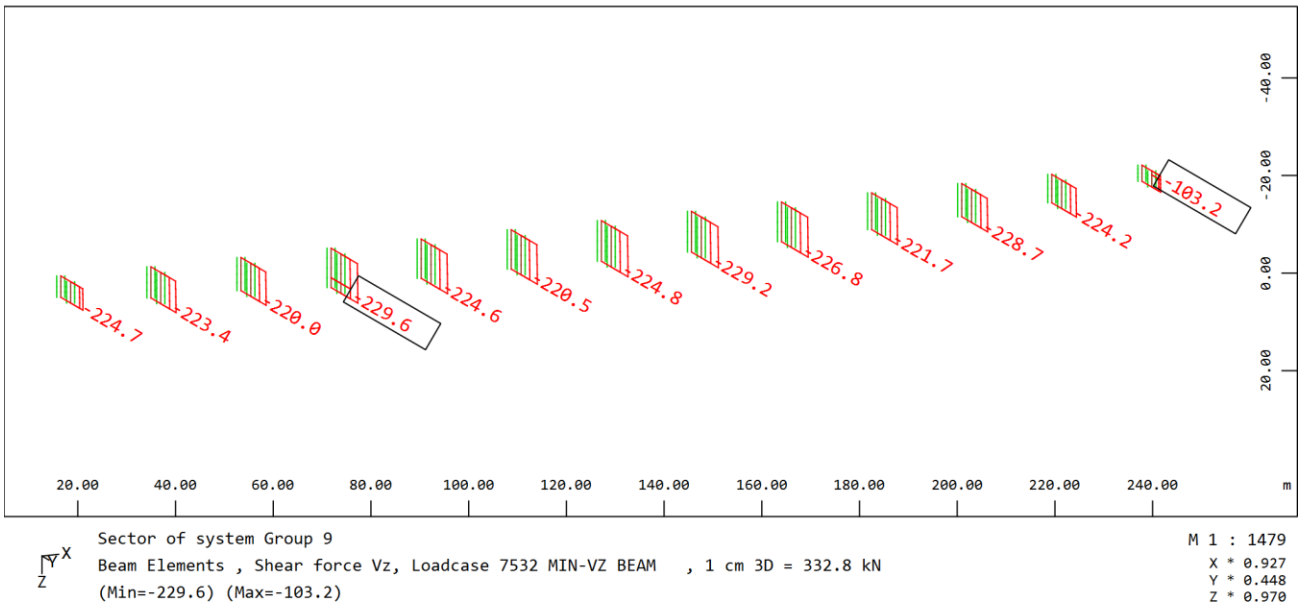
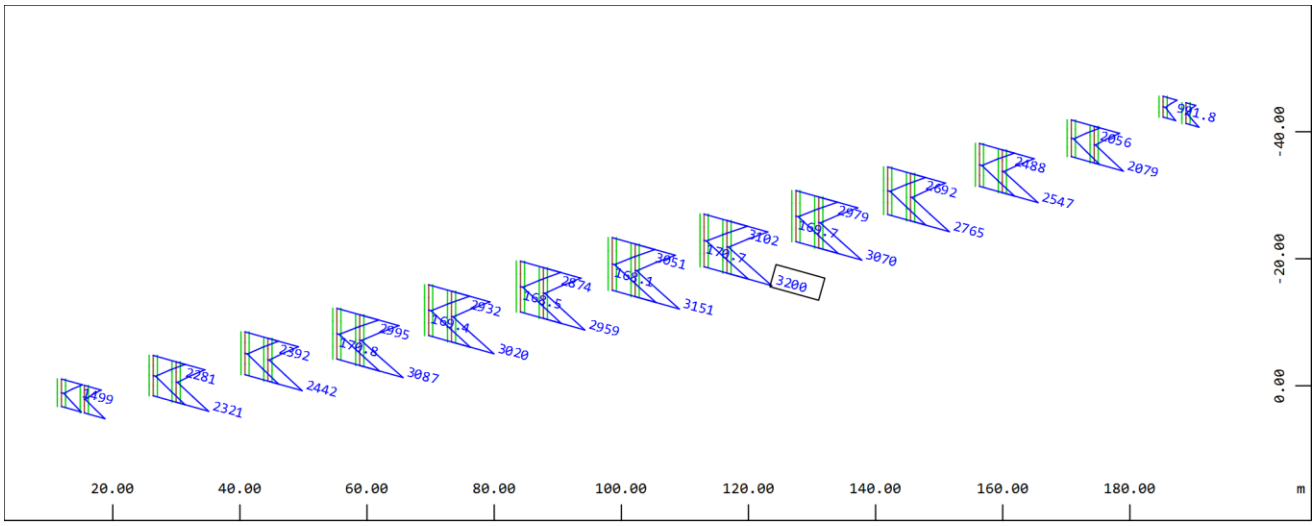
-3105
-3198
-3213
-2425
-2930
-2743
-3184
-3045
-2896
-2945
-2633
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
240.00
m
-40.00
-20.00
0.00
20.00
Sector of system Group 9
Beam Elements , Normal force Nx, Loadcase 7528 MIN-MZ BEAM , 1 cm 3D = 6156. kN
(Min=-3318.) (Max=-2425.)
M 1 : 1471
X * 0.927
Y * 0.448
Z * 0.970


30.3
44.1
10.7
47.6
10.6
58.1
10.2
61.6
10.8
65.1
11.5
57.5
8.96
47.4
8.00
47.1
8.27
43.8
7.58
41.7
9.06
37.7
24.6
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
240.00
m
-40.00
-20.00
0.00
20.00
Sector of system Group 9
Nodal displacement in global X, Loadcase 7561 MIN-UX NODE , 1 cm 3D = 153.9 mm
(Min=-65.1) (Max=-7.58)
M 1 : 1448
X * 0.927
Y * 0.448
Z * 0.970


-40.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
m
Sector of system Group 9
Beam Elements , Bending moment My, Loadcase 7525 MAX-MY BEAM , 1 cm 3D = 1805. kNm
(Max=1049.)
M 1 : 1146
X * 0.746
Y * 0.718
Z * 0.963

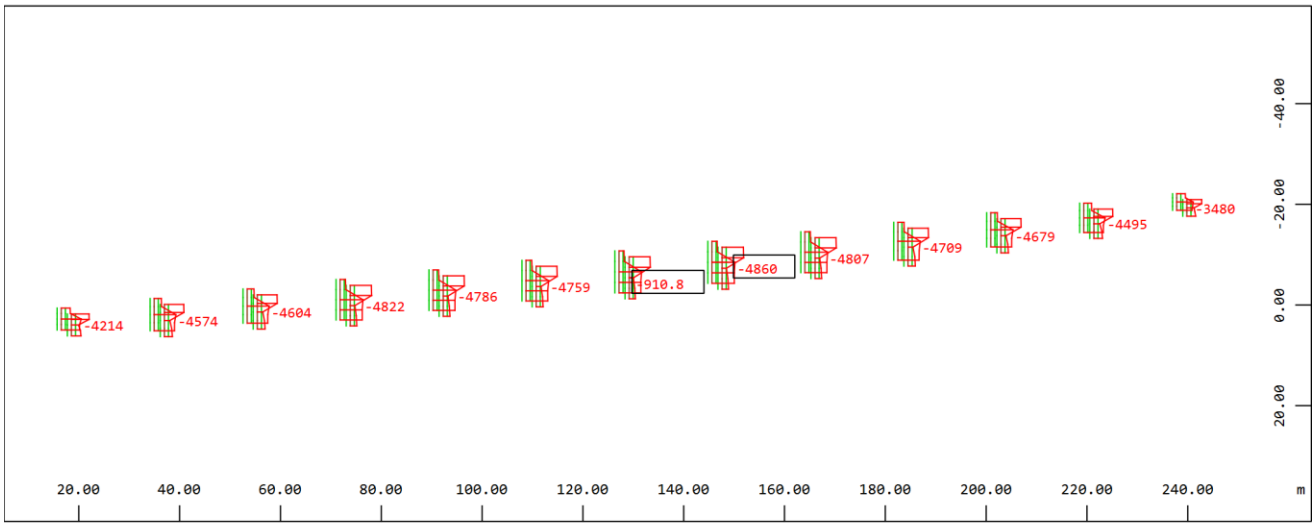

-40.00
-20.00
0.00
20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
m
Sector of system Group 9
Beam Elements , Shear force Vy, Loadcase 7529 MAX-VY BEAM , 1 cm 3D = 1539. kN
(Max=846.9)
M 1 : 1473
X * 0.927
Y * 0.448
Z * 0.970


-40.00
-20.00
0.00
20.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
240.00
m
Sector of system Group 9
Beam Elements , Shear force Vz, Loadcase 7532 MIN-VZ BEAM , 1 cm 3D = 332.8 kN
(Min=-229.6) (Max=-103.2)
M 1 : 1479
X * 0.927
Y * 0.448
Z * 0.970



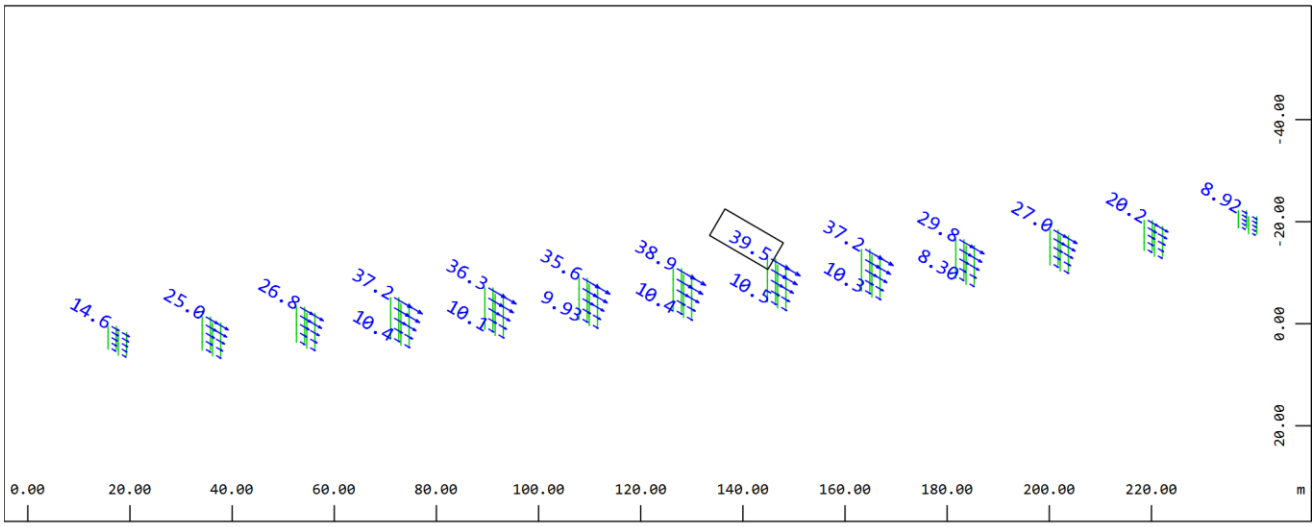
Sector of system Group 9
Beam Elements , Bending moment My, Loadcase 8525 MAX-MY BEAM , 1 cm 3D = 3609. kNm
(Max=3200.)

M 1 : 1149
X * 0.746
Y * 0.718
Z * 0.963



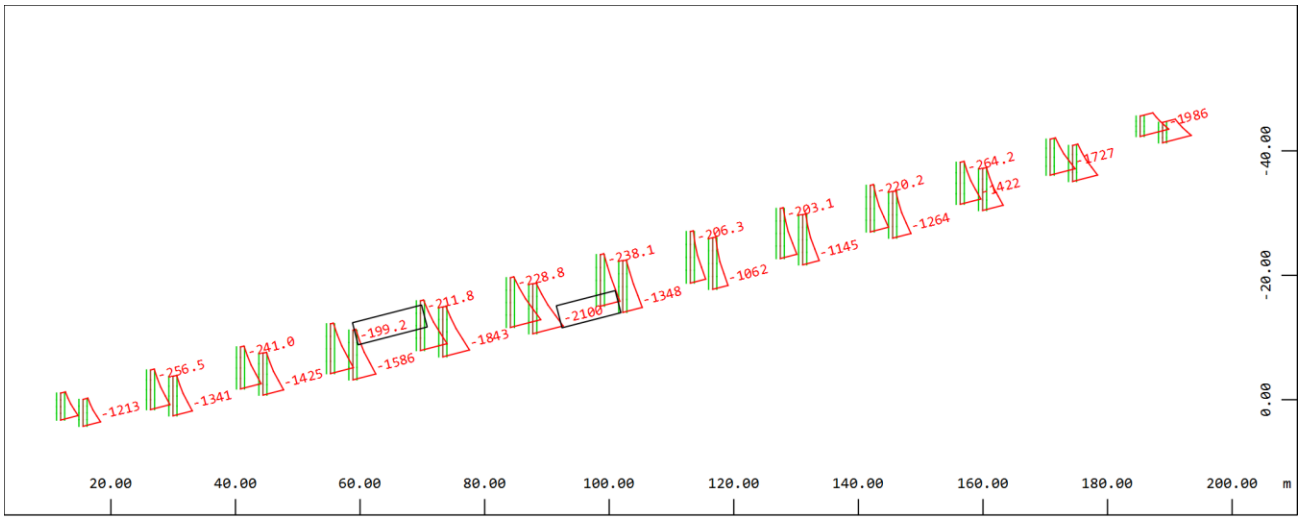
Sector of system Group 9
Beam Elements , Normal force Nx, Loadcase 8525 MAX-MY BEAM , 1 cm 3D = 15391. kN
(Min=-4860.) (Max=-910.8)

M 1 : 1449
X * 0.927
Y * 0.448
Z * 0.970



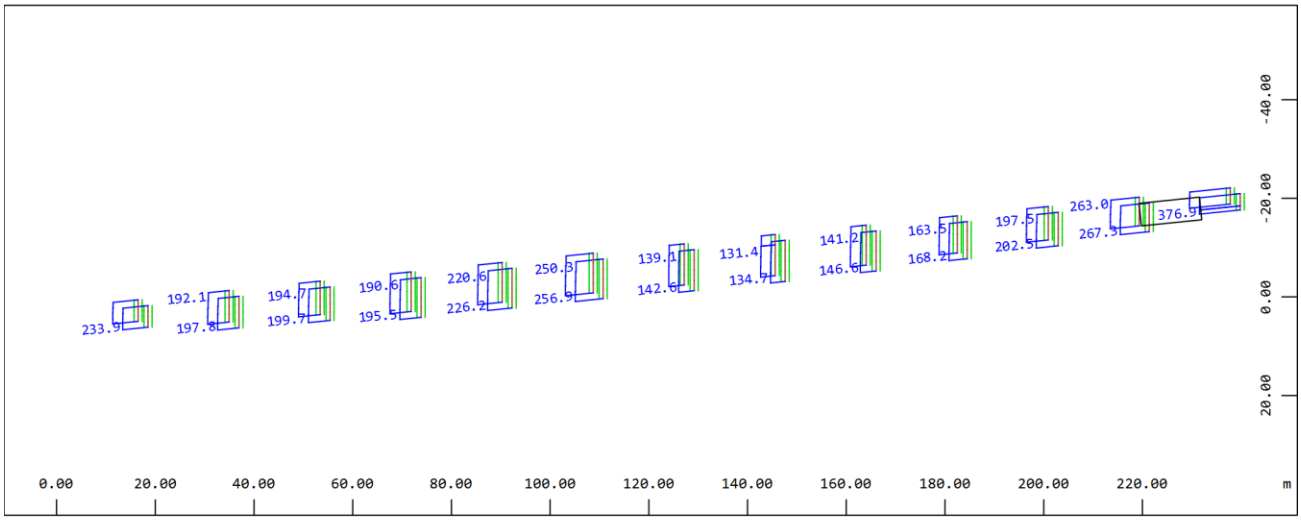
Sector of system Group 9
Nodal displacement in global Y, Loadcase 8562 MAX-UY NODE , 1 cm 3D = 61.6 mm
(Max=39.5)

M 1 : 1430
X * 0.927
Y * 0.448
Z * 0.970



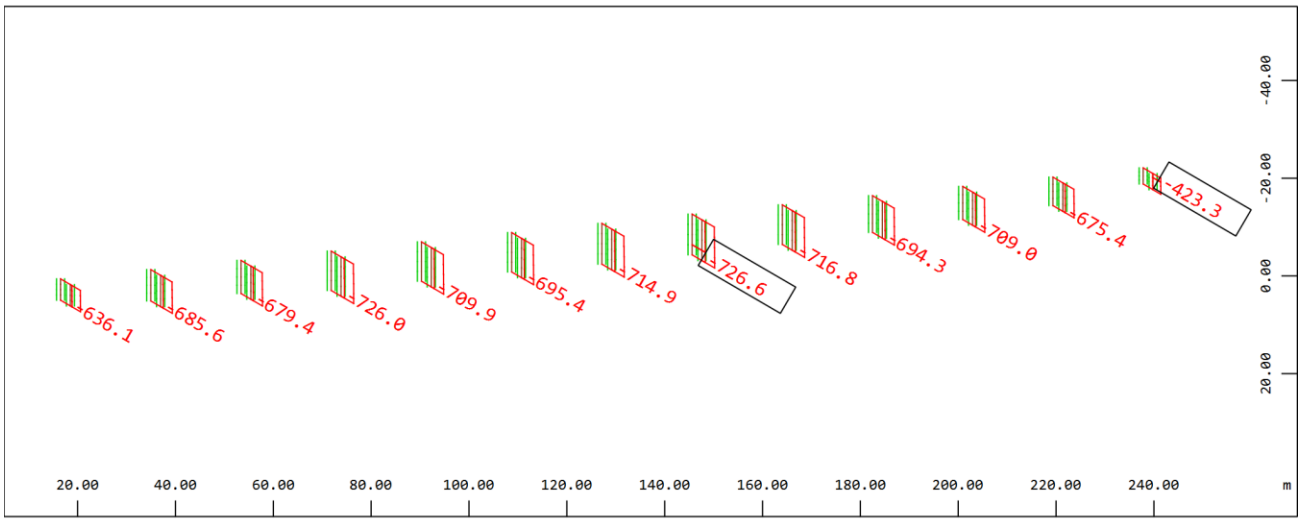
Sector of system Group 9
Beam Elements , Bending moment Mz, Loadcase 8528 MIN-MZ BEAM , 1 cm 3D = 3609. kNm
(Min=-2100.) (Max=-199.2)

M 1 : 1160
X * 0.746
Y * 0.718
Z * 0.963



Sector of system Group 9
Beam Elements , Shear force Vy, Loadcase 8529 MAX-VY BEAM , 1 cm 3D = 615.6 kN
(Max=376.9)

M 1 : 1464
X * 0.927
Y * 0.448
Z * 0.970



Sector of system Group 9
Beam Elements , Shear force Vz, Loadcase 8532 MIN-VZ BEAM , 1 cm 3D = 1539. kN
(Min=-726.6) (Max=-423.3)

M 1 : 1477
X * 0.927
Y * 0.448
Z * 0.970

Kombinacije opterećenja stupova prikazane su u tablici.

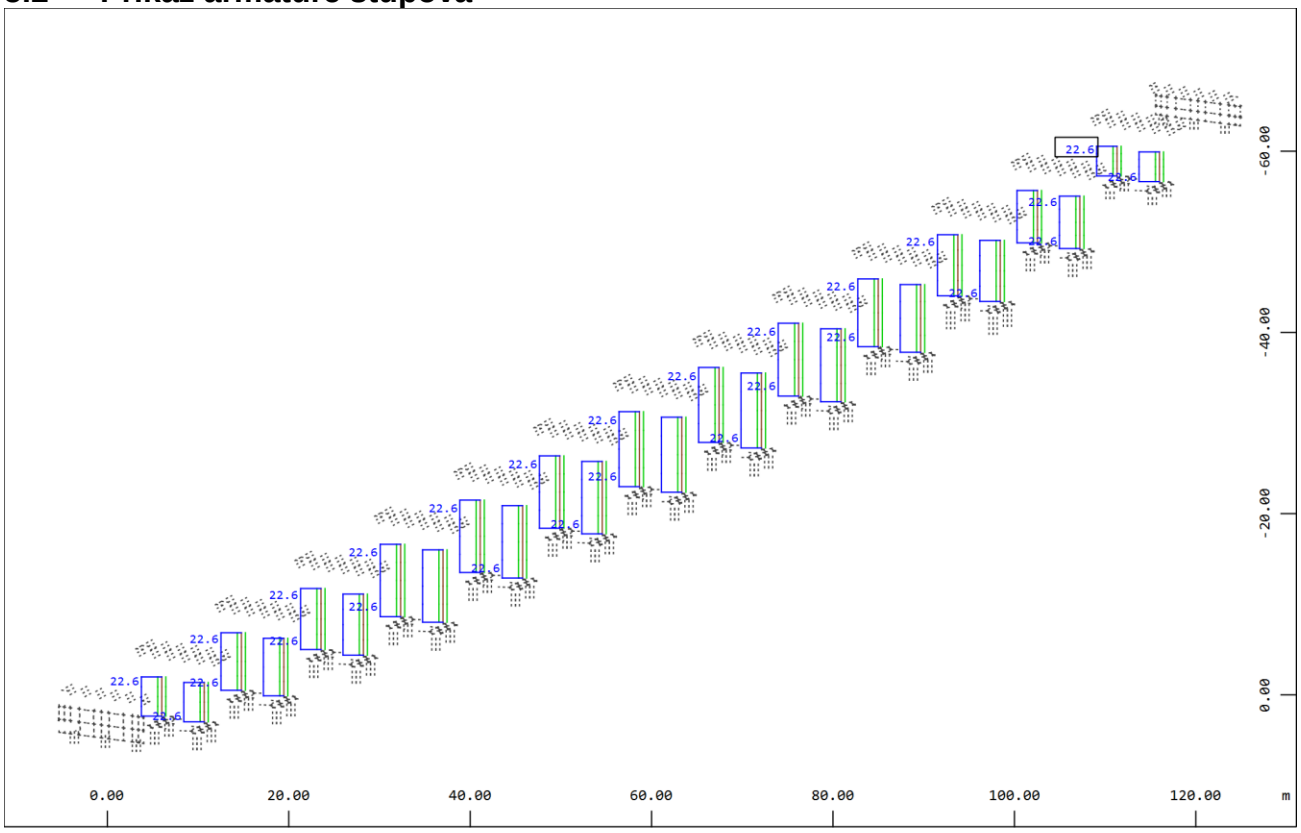
OZNAKA KOMBINACIJE LC	**Raspisane kombinacije korištene za dimenzioniranje rasponskog sklopa, stupova, naglavnica pilota i pilota**	**NAZIV KOMBINACIJE**	**Oznaka armature**
9900 – 9999	1,35 (1,0)·G+1,35(1,0)·R+1,35·(Q_{oso}+Q_{jed}) +1,0·C + 1,5·ZW_{opt} +0,75·ZT + 1,0·ZF	PROMET+VJETAR	Lcr 1
	1,35 (1,0)·G+1,35(1,0)·R +1,5·ZT+ 1,35·(0,75·Q_{oso}+0,4·Q_{jed}) +1,0·C + 1,0·ZF	TEMPERATURA	
	1,35(1,0)·G+1,35(1,0)·R+1,5·K+0,75·ZT 1,35·(0,75·Q_{oso}+0,4·Q_{jed})+1,0·C +1,0·ZF+1,5·ZW_{opt}	KOČENJE	
9800 – 9899	1,0·G+1,0·R+A+0,75·Q_{oso}+0,4·Q_{jed} +1,0·C + 1,0·ZF + 1,0·$ZW_{opterećen}$ + 0,5·ZT	UDAR	Lcr 4
	1,0·G+1,0·R+A + 0,2·Q_{oso}+0,2·Q_{jed} +1,0·C + 1,0·ZF + 1,0·$ZW_{opterećen}$ + 0,6·ZT		
7500 – 7599*	1,0·G+1,0·C+1,0·R +E_X+0,3·E_Y+0,3·Ez	POTRES	Lcr 7
8500 – 8599*	1,0·G+1,0·C+1,0·R+0,3·E_X+E_Y+0,3·Ez		Lcr 8

*****U proračunu je uzeto u obzir povećanje momenta po teoriji II. reda, prema EN 1998-2 točka 5.4 Učinci drugog reda, preko formule:

$$\Delta M = \frac{(1+q)}{2} d_{Ed} N_{Ed} \qquad (5.3)$$

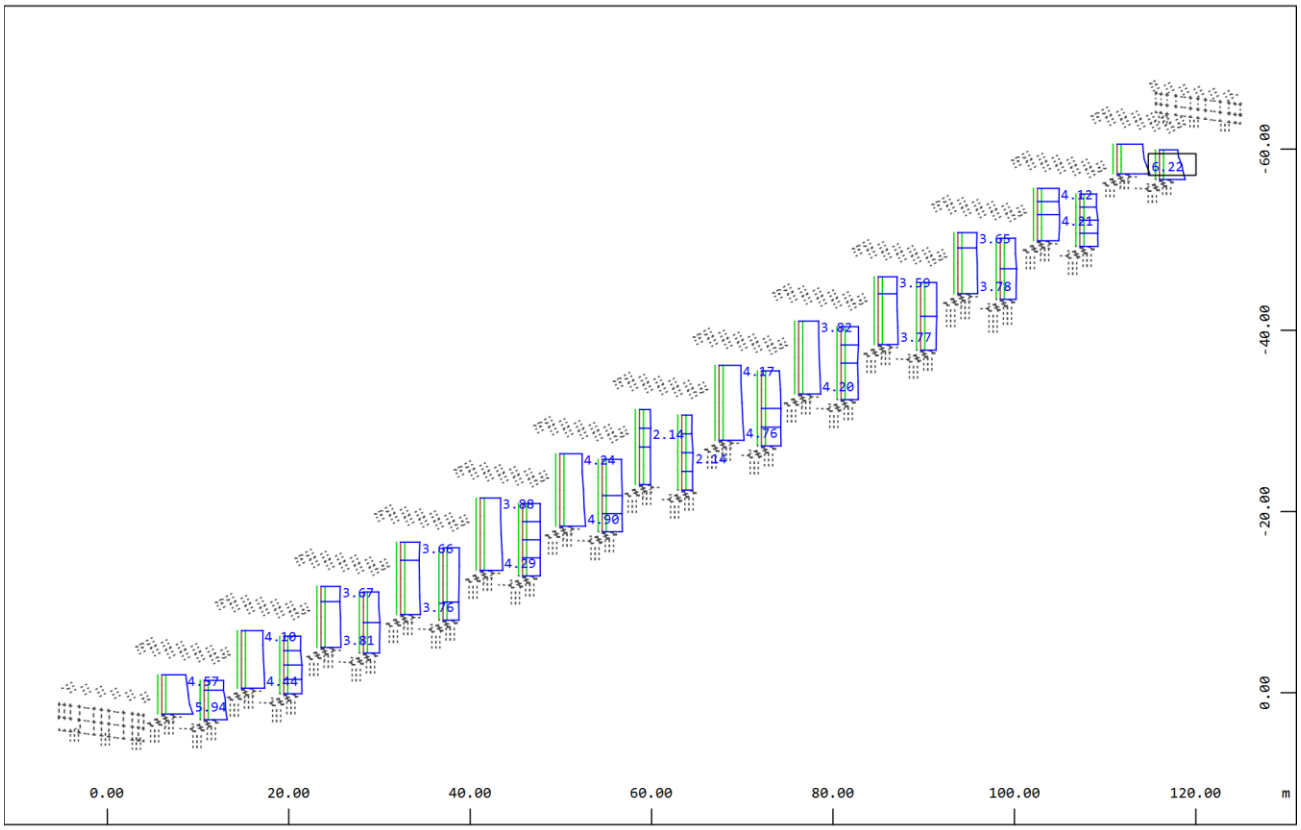
gdje je N_{Ed} uzdužna sila, a d_{Ed} relativni poprečni pomak krajeva promatranog duktilnog elementa u proračunskoj potresnoj situaciji.

5.2 Prikaz armature stupova



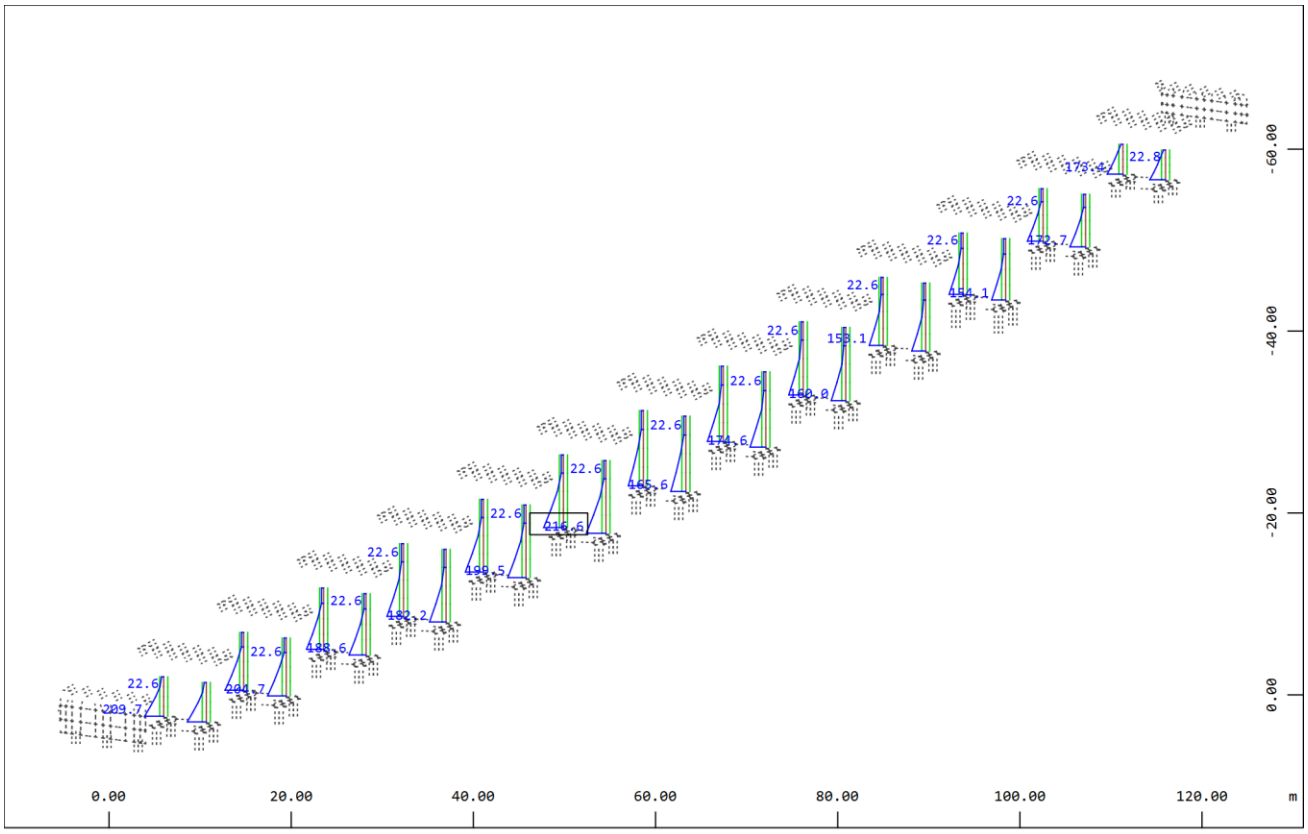
Sector of system Group 9
Beam Elements , Longitudinal reinforcements (total), Design Case 1 , 1 cm 3D = 80.0 cm2
(Max=22.6)

M 1 : 796
X * 0.502
Y * 0.906
Z * 0.962



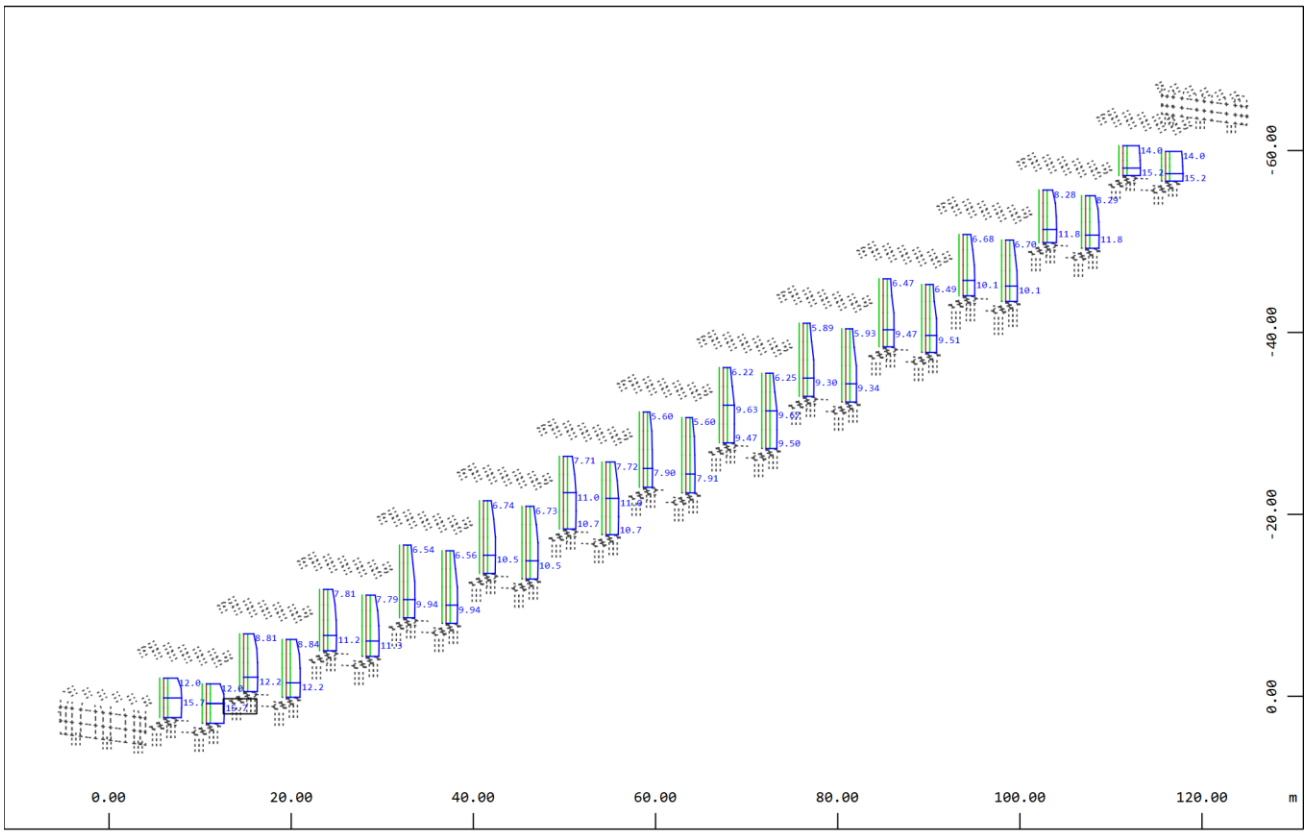
Sector of system Group 9
Shear reinforcements (maximum), Design Case 1 , (1 cm 3D = unit) Beam Elements
(Unit=13.8 cm2/m) (Max=6.22)

M 1 : 796
X * 0.502
Y * 0.906
Z * 0.962



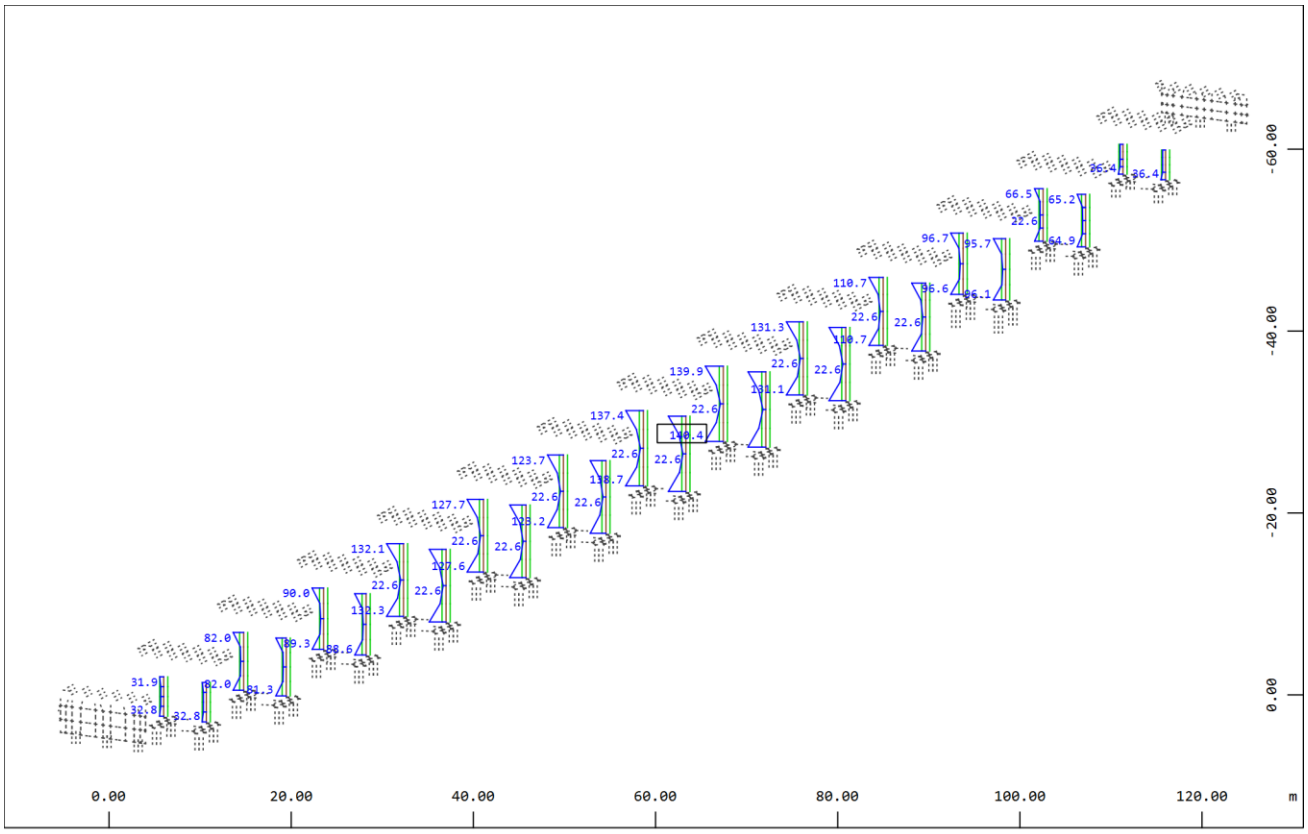
Sector of system Group 9
Beam Elements , Longitudinal reinforcements (total), Design Case 7 , 1 cm 3D = 800.0 cm2
(Max=216.6)

M 1 : 797
X * 0.502
Y * 0.906
Z * 0.962



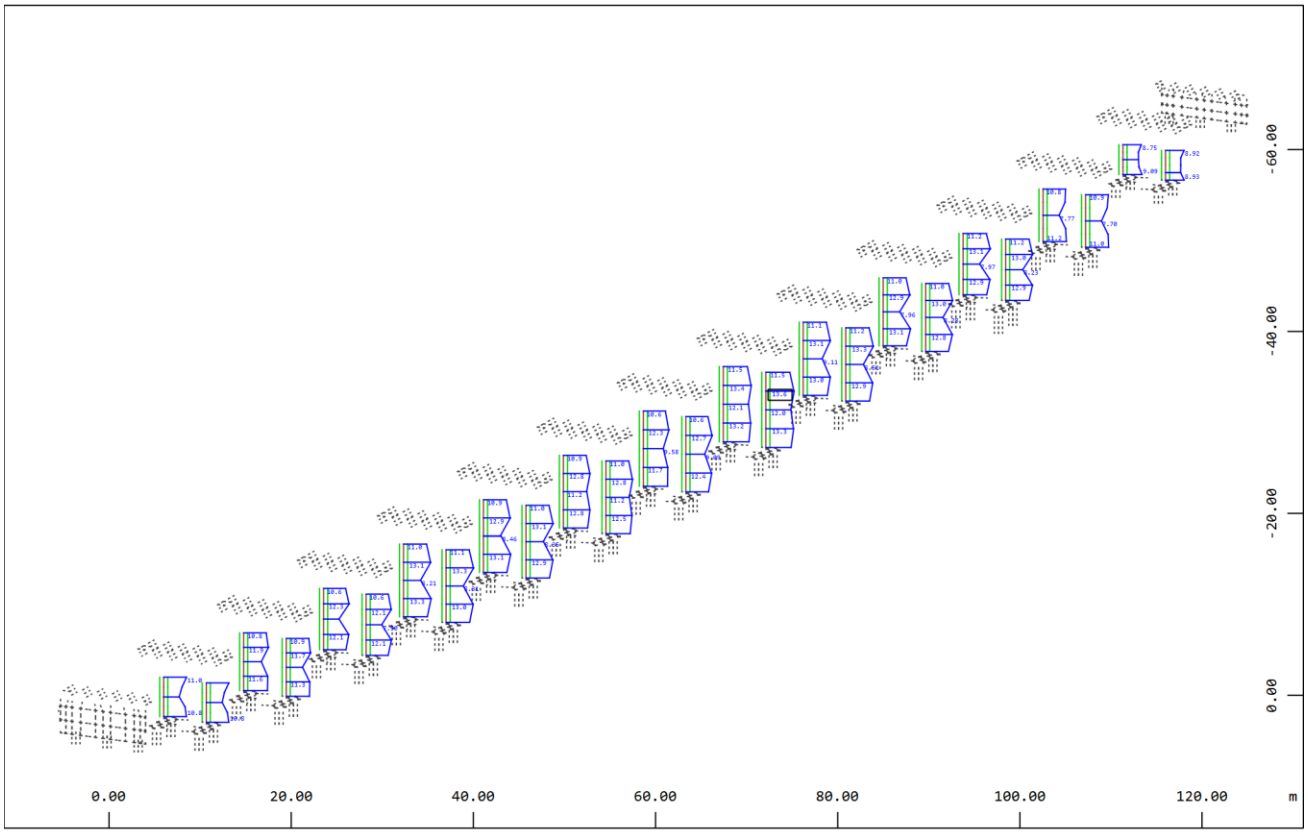
Sector of system Group 9
Shear reinforcements (maximum), Design Case 7 , (1 cm 3D = unit) Beam Elements
(Unit=63.1 cm2/m) (Max=15.7)

M 1 : 797
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 9
Beam Elements , Longitudinal reinforcements (total), Design Case 8 , 1 cm 3D = 567.2 cm2
(Max=140.4)

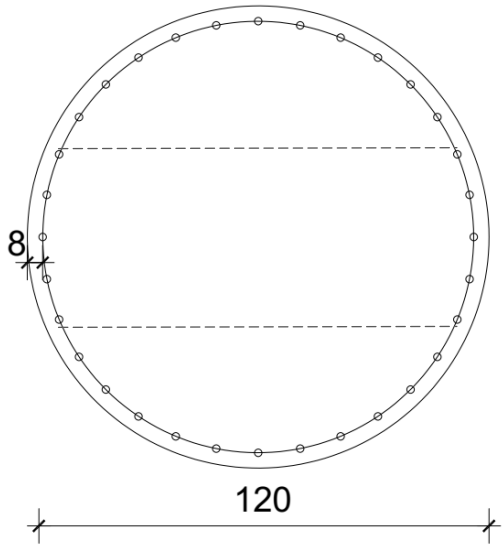
M 1 : 797
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 9
Shear reinforcements (maximum), Design Case 8 , (1 cm 3D = unit) Beam Elements
(Unit=34.8 cm2/m) (Max=13.6)

M 1 : 797
X * 0.502
Y * 0.906
Z * 0.962

5.3 Veličine za kontrolu armature



STUPOVI

- $d_1 = c + \Phi_v + ½*\Phi_s = 5 + 1,4 + ½*2,8 = 7,8$ cm (zaštitni sloj c = 5 cm, pretpostavljene vilice Φ_v 14, pretpostavljena uzdužna armatura Φ_s28)

$d_s = h – d_{1s} = 120,0 – 7,8 = 112,2$ cm

Računske čvrstoće gradiva

- *Računska čvrstoća betona C30/37*

$f_{cd} = 0,85 \cdot f_{ck}/\gamma_c = 0,85 \cdot 30/1,5 = 17,0$ N/mm^2 = 1,7 kN/cm^2

- *Računska granica popuštanja betonskog čelika B500C*

$f_{yd} = f_{yk}/\gamma_s = 500/1,15 = 434,78$ N/mm^2 = 43,478 kN/cm^2

5.4 Uzdužna armatura

Najveća armatura je dobivena u potresnoj kombinaciji opterećenja.

Kratki stupovi (S1,S13)

ODABRANO: 28Φ32 ($A_{s,odabrano} = 224,0$ cm^2)

Stupovi srednje visine (S2,S3, S11,S12)

ODABRANO: 28Φ32 ($A_{s,odabrano} = 224,0$ cm^2)

Vitki stupi (S4-S10)

ODABRANO: 30Φ32 ($A_{s,odabrano} = 241,2$ cm^2)

Minimalna armatura prema EC2 za elemente naprezane uzdužnom silom:

$A_{s,min} = 0,15 \cdot N_{Sd}/f_{yd} \geq 0,003A_c$
$A_{s,min} = 0,15 \cdot 6265/43,478 = 21,61$ cm^2 < $0,003 \cdot 1,13 \cdot 100 \cdot 100 = 33,9$ cm^2
N_{Sd} = maksimalna uzdužna sila u stupu, dobivena iz redovne kombinacije.

5.5 Posmična armatura

Kratki stupovi (S1,S13)

Poprečna armatura po cijeloj visini stupa:

19,7 cm^2/m (**odabrano** spiralna armatura Φ12/10 cm ili 22,6 cm^2/m)

Gornjih i donjih 2m, dodane u poprečnom smjeru vilice(ukosnice) Φ10/10 cm

Stupovi srednje visine (S2,S3, S11,S12)

Poprečna armatura pri vrhu/dnu stupa (2m):

17,1 cm^2/m (**odabrano** spiralna armatura Φ12/10 cm ili 22,6 cm^2/m)
Gornjih i donjih 2m, dodane u poprečnom smjeru vilice(ukosnice) Φ10/10 cm

Poprečna armatura u sredini stupa:

14,8 cm^2/m (**odabrano** spiralna armatura Φ12/10 cm ili 22,6 cm^2/m)

Vitki stupi (S4-S10)

Poprečna armatura pri vrhu/dnu stupa:

13,6 cm^2/m (**odabrano** spiralna armatura Φ12/10 cm ili 22,6 cm^2/m)
Gornjih i donjih 2m, dodane u poprečnom smjeru vilice(ukosnice) Φ10/10 cm

Poprečna armatura u sredini stupa:

12,0 cm^2/m (**odabrano** spiralna armatura Φ12/10 cm ili 22,6 cm^2/m)

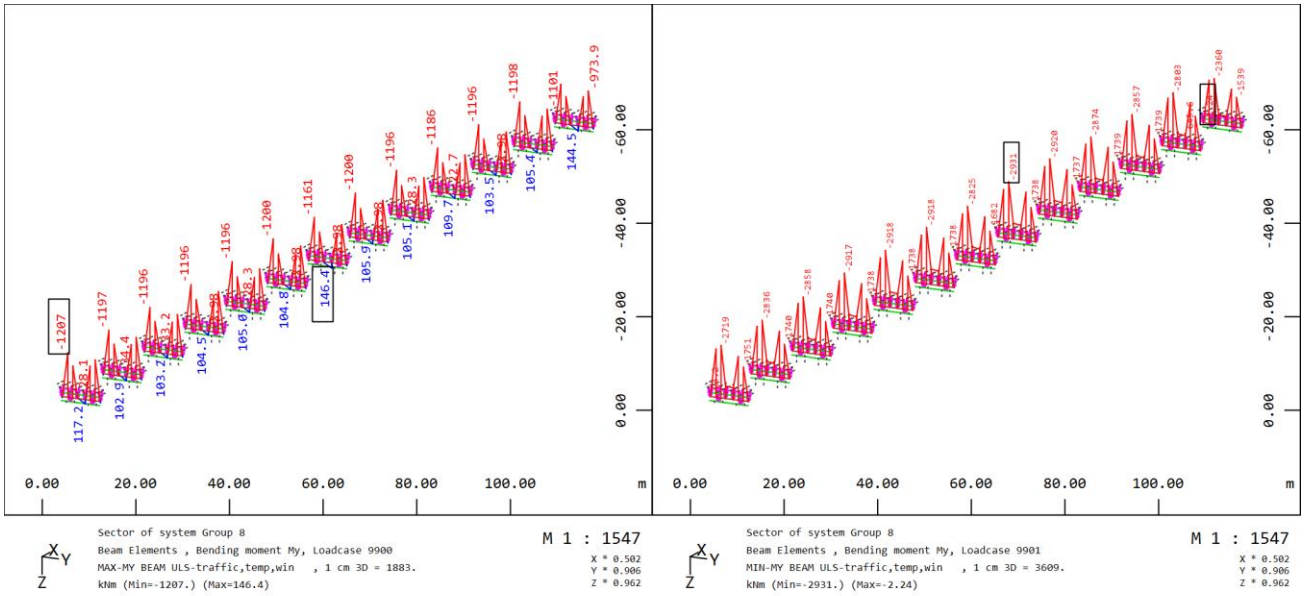
6 NAGLAVNICA STUPOVA

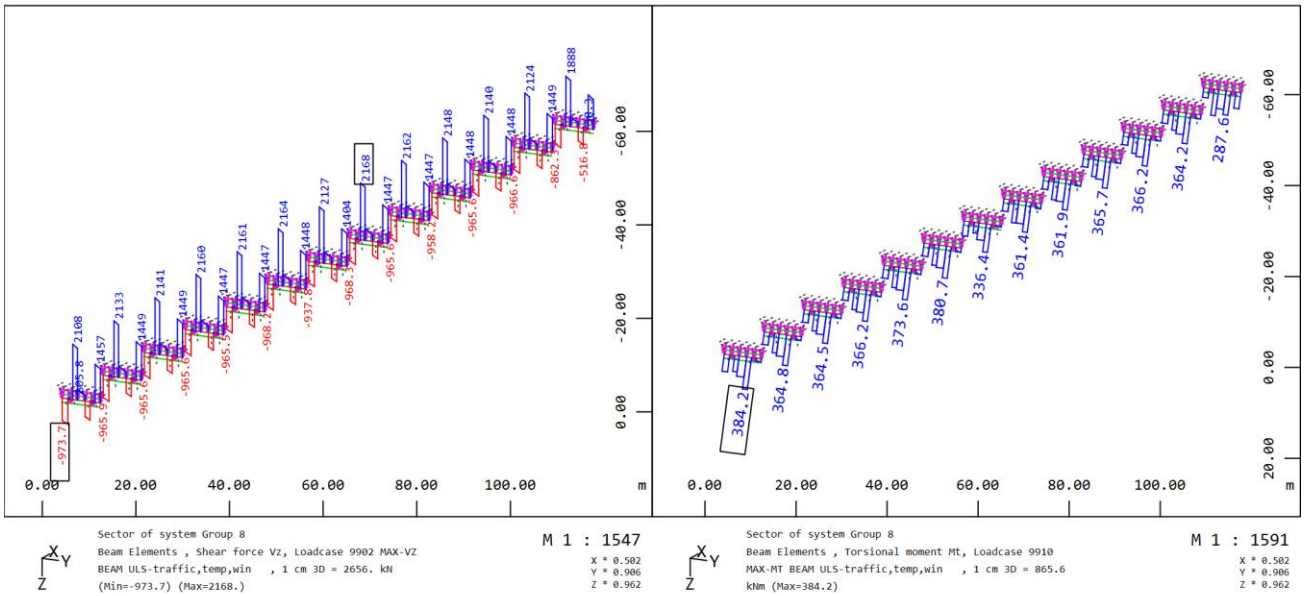
6.1 Rezne sile u naglavnicama od kombinacije opterećenja

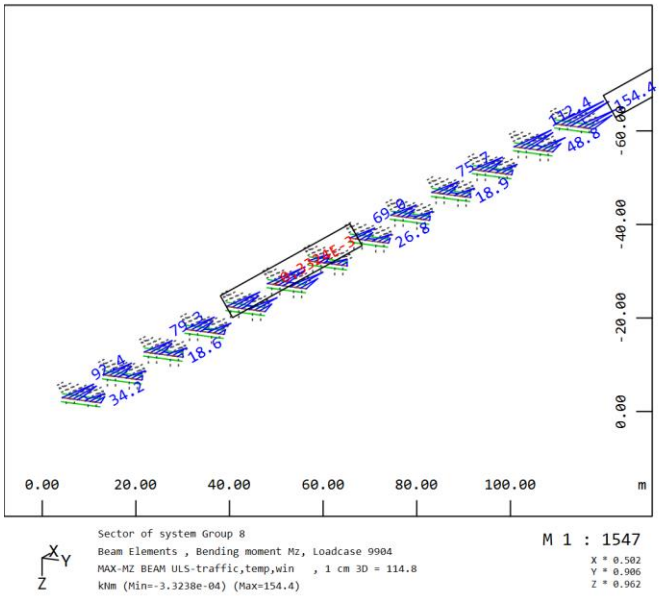
Kombinacije opterećenja naglavnice pilota iste su kao i za pilote.

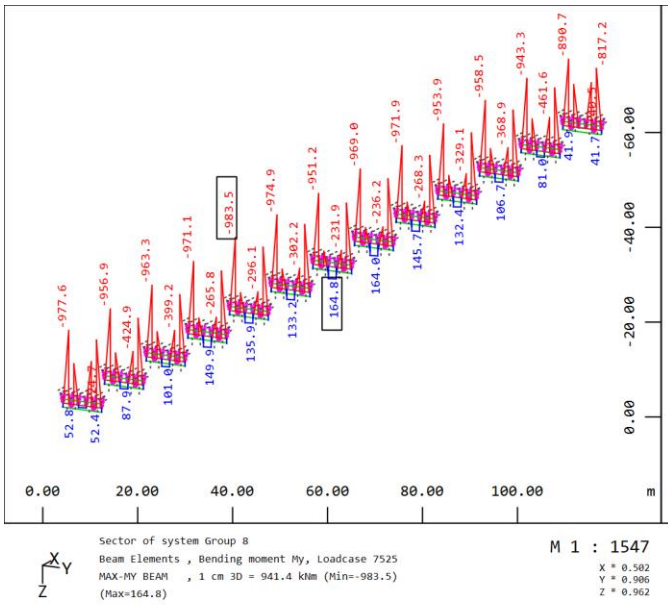
OZNAKA KOMBINACIJE LC	Raspisane kombinacije korištene za dimenzioniranje rasponskog sklopa, stupova, naglavnica pilota i pilota	NAZIV KOMBINACIJE	Oznaka armature
9900 – 9999	1,35 (1,0)·G+1,35(1,0)·R+1,35·(Q_{oso}+Q_{jed}) +1,0·C + 1,5·ZW_{opt} +0,75·ZT + 1,0·ZF	PROMET+VJETAR	Lcr 1
	1,35 (1,0)·G+1,35(1,0)·R +1,5·ZT+ 1,35·(0,75·Q_{oso}+0,4·Q_{jed}) +1,0·C + 1,0·ZF	TEMPERATURA	
	1,35(1,0)·G+1,35(1,0)·R+1,5·K+0,75·ZT 1,35·(0,75·Q_{oso}+0,4·Q_{jed})+1,0·C +1,0·ZF+1,5·ZW_{opt}	KOČENJE	
9800 – 9899	1,0·G+1,0·R+A+0,75·Q_{oso}+0,4·Q_{jed} +1,0·C + 1,0·ZF + 1,0·$ZW_{opterećen}$ + 0,5·ZT	UDAR	Lcr 4
	1,0·G+1,0·R+A + 0,2·Q_{oso}+0,2·Q_{jed} +1,0·C + 1,0·ZF + 1,0·$ZW_{opterećen}$ + 0,6·ZT		
7500 – 7599	1,0·G+1,0·C+1,0·R +E_X+0,3·E_Y+0,3·Ez	POTRES	Lcr 7
8500 – 8599	1,0·G+1,0·C+1,0·R+0,3·E_X+E_Y+0,3·Ez		Lcr 8

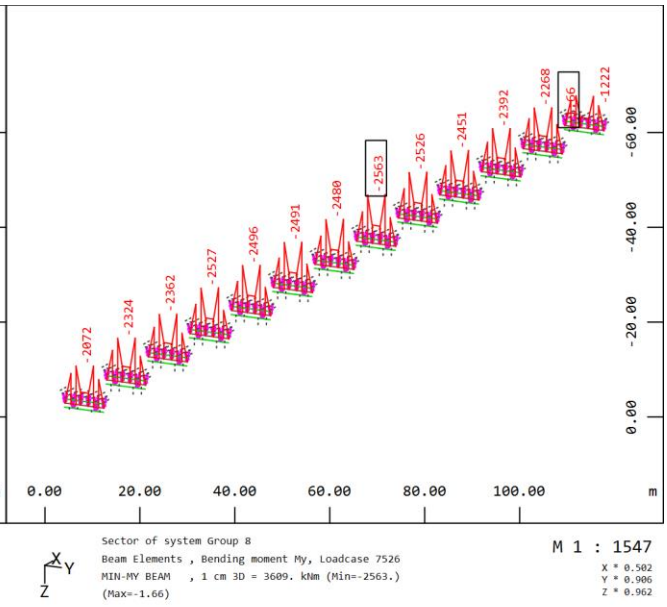
REZNE SILE U NAGLAVNICAMA OD KOMBINACIJA OPTEREĆENJA

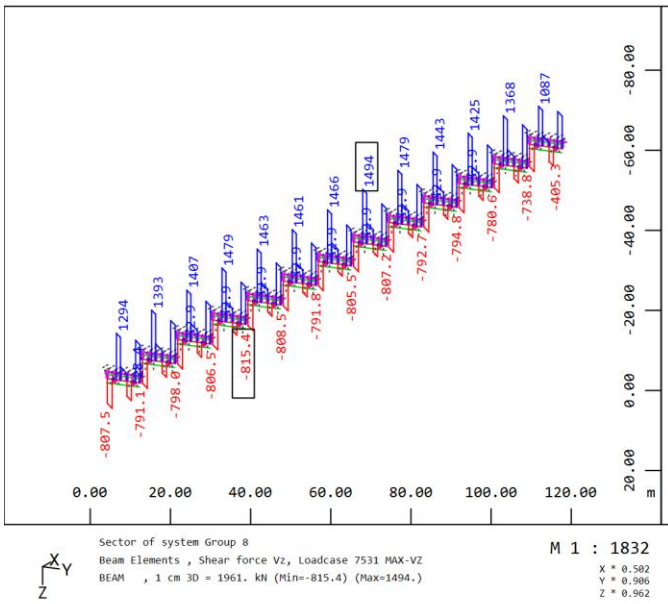


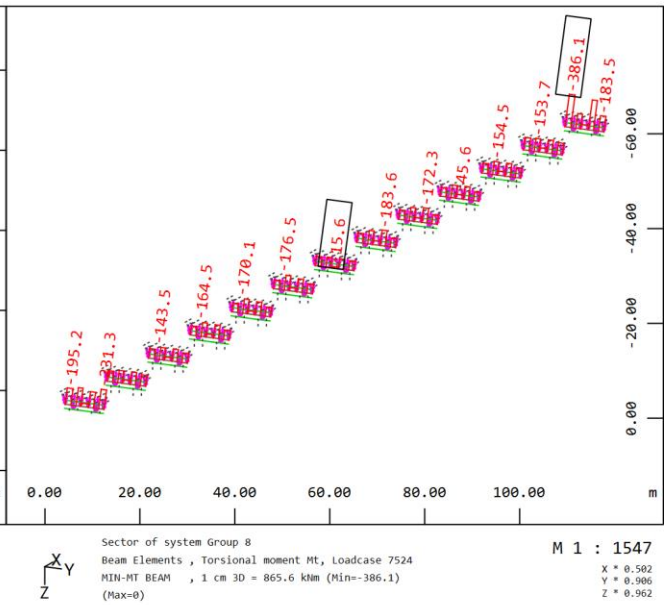


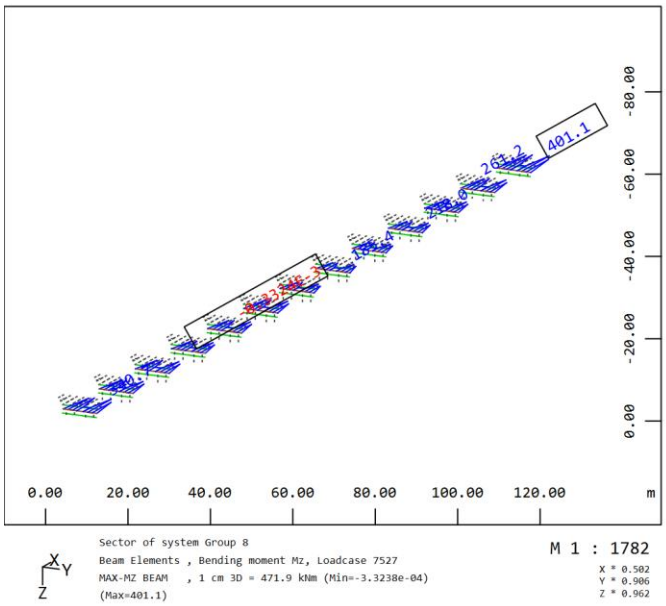


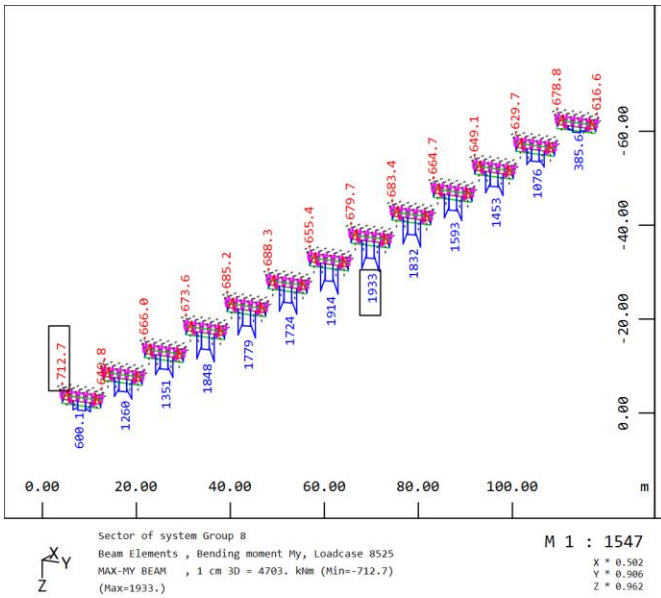

Sector of system Group 8
Beam Elements , Bending moment My, Loadcase 7525
MAX-MY BEAM , 1 cm 3D = 941.4 kNm (Min=-983.5)
(Max=164.8)
M 1 : 1547
X * 0.502
Y * 0.906
Z * 0.962


Sector of system Group 8
Beam Elements , Bending moment My, Loadcase 7526
MIN-MY BEAM , 1 cm 3D = 3609. kNm (Min=-2563.)
(Max=-1.66)
M 1 : 1547
X * 0.502
Y * 0.906
Z * 0.962


Sector of system Group 8
Beam Elements , Shear force Vz, Loadcase 7531 MAX-VZ
BEAM , 1 cm 3D = 1961. kN (Min=-815.4) (Max=1494.)
M 1 : 1832
X * 0.502
Y * 0.906
Z * 0.962


Sector of system Group 8
Beam Elements , Torsional moment Mt, Loadcase 7524
MIN-MT BEAM , 1 cm 3D = 865.6 kNm (Min=-386.1)
(Max=0)
M 1 : 1547
X * 0.502
Y * 0.906
Z * 0.962

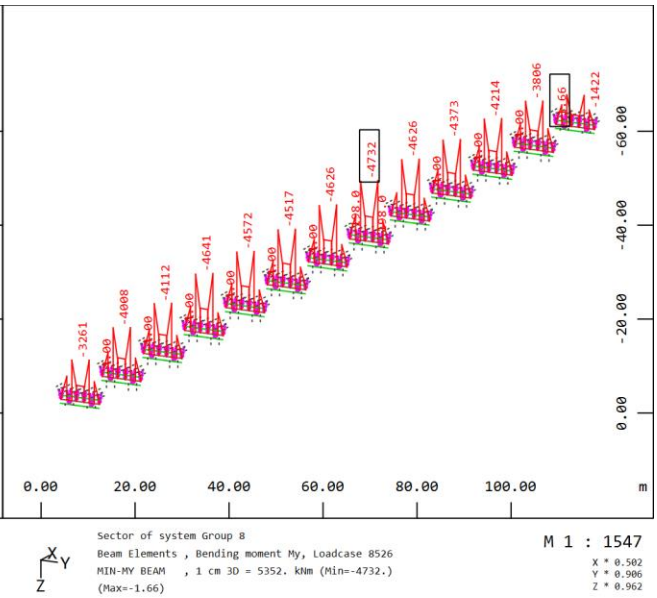

Sector of system Group 8
Beam Elements , Bending moment Mz, Loadcase 7527
MAX-MZ BEAM , 1 cm 3D = 471.9 kNm (Min=-3.3238e-04)
(Max=401.1)
M 1 : 1782
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 8
Beam Elements , Bending moment My, Loadcase 8525
MAX-MY BEAM , 1 cm 3D = 4703. kNm (Min=-712.7)
(Max=1933.)

M 1 : 1547

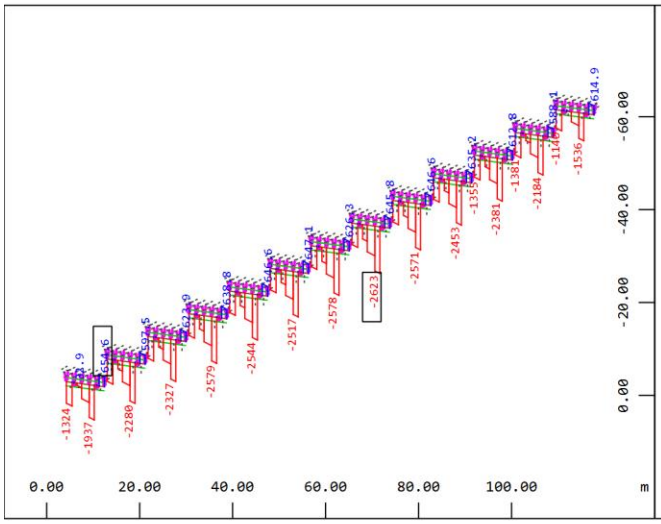
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 8
Beam Elements , Bending moment My, Loadcase 8526
MIN-MY BEAM , 1 cm 3D = 5352. kNm (Min=-4732.)
(Max=-1.66)

M 1 : 1547

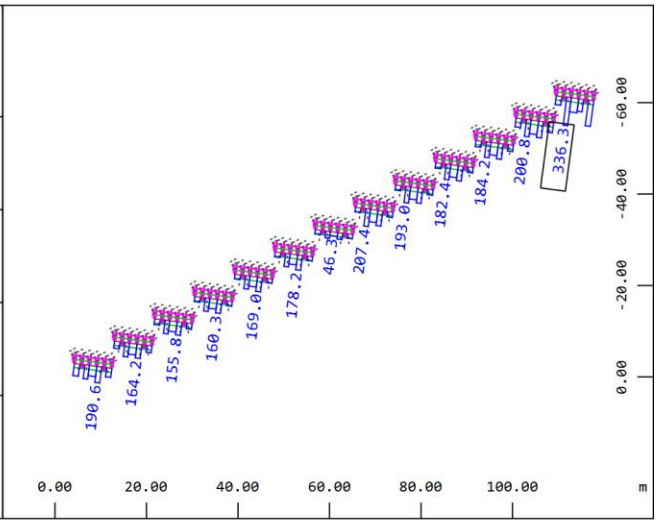
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 8
Beam Elements , Shear force Vz, Loadcase 8532 MIN-VZ
BEAM , 1 cm 3D = 3922. kN (Min=-2623.) (Max=654.6)

M 1 : 1564

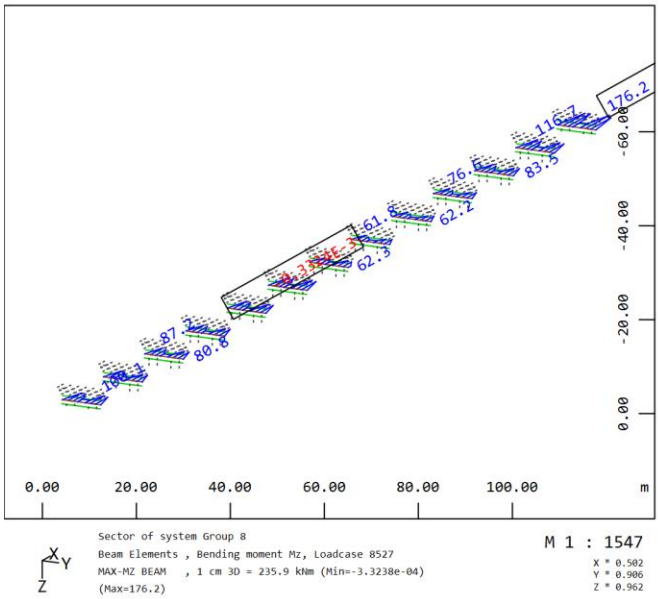
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 8
Beam Elements , Torsional moment Mt, Loadcase 8523
MAX-MT BEAM , 1 cm 3D = 865.6 kNm (Max=336.3)

M 1 : 1589

X * 0.502
Y * 0.906
Z * 0.962

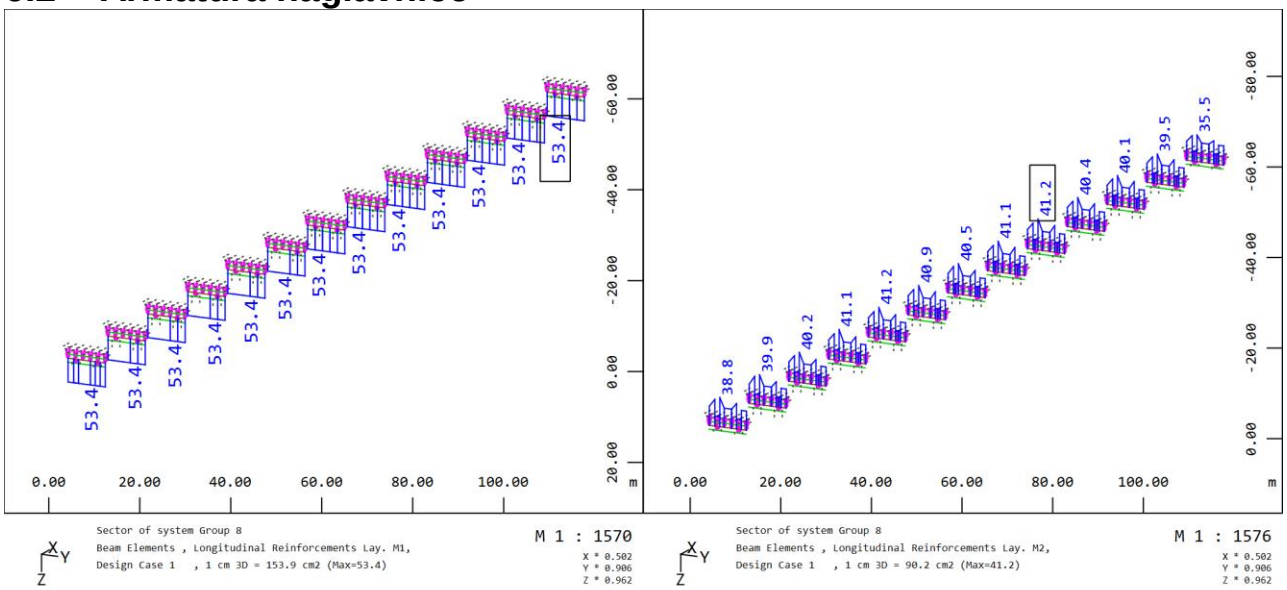


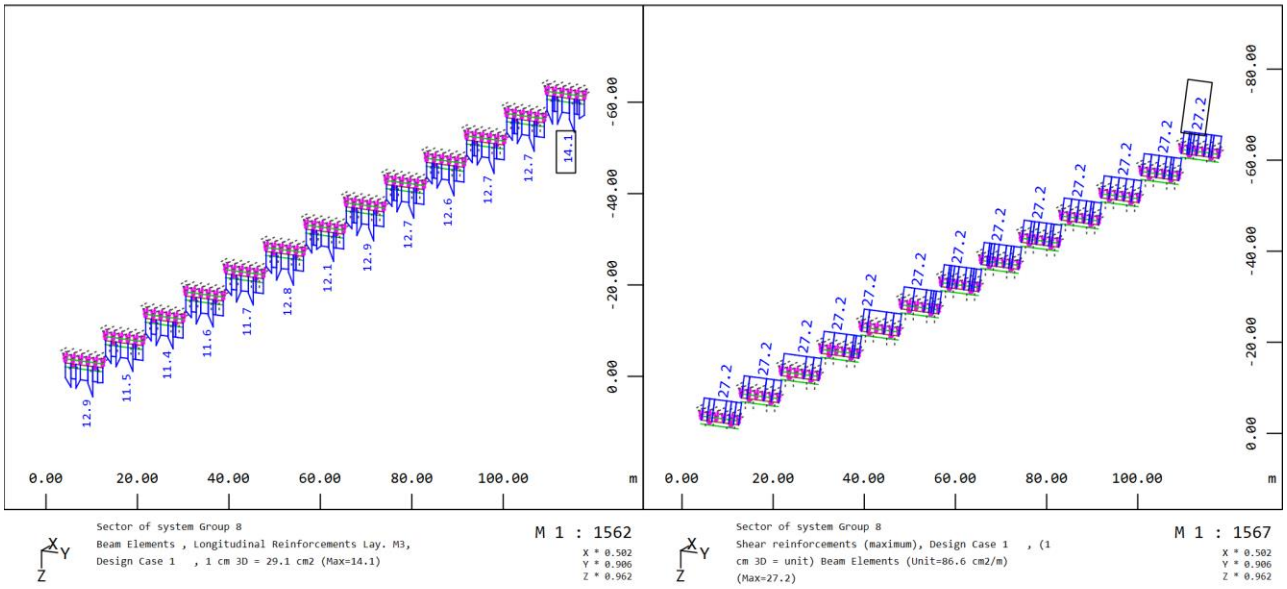
Sector of system Group 8
Beam Elements , Bending moment Mz, Loadcase 8527
MAX-MZ BEAM , 1 cm 3D = 235.9 kNm (Min=-3.3238e-04)
(Max=176.2)

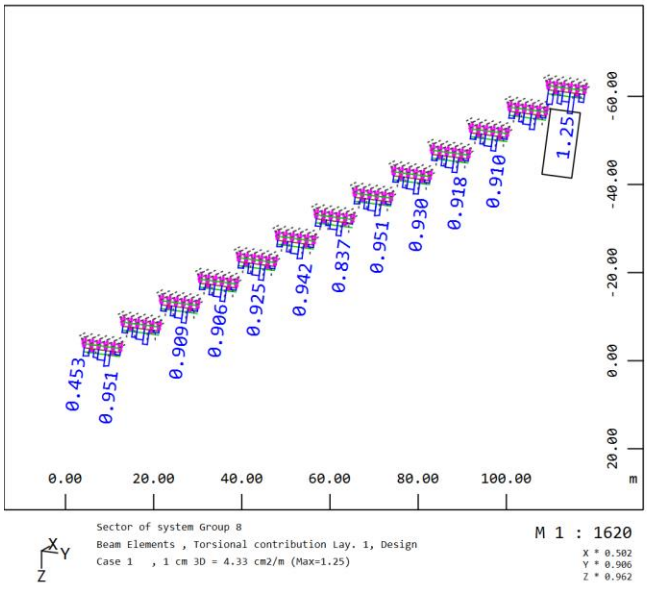
M 1 : 1547

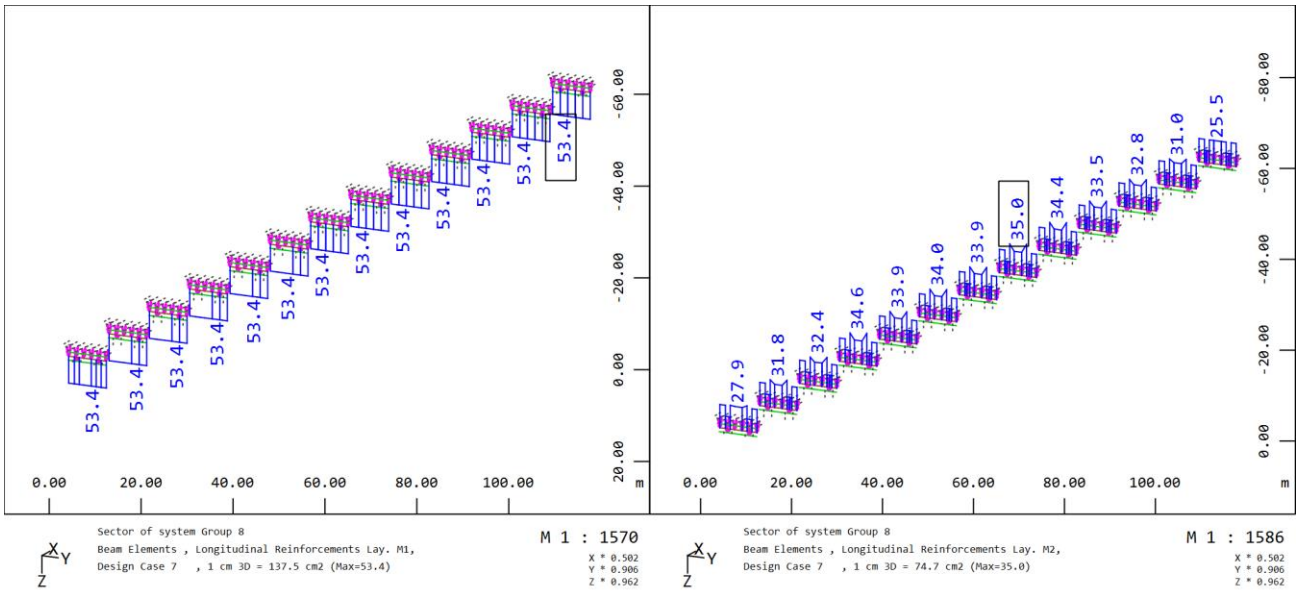
X * 0.502
Y * 0.906
Z * 0.962

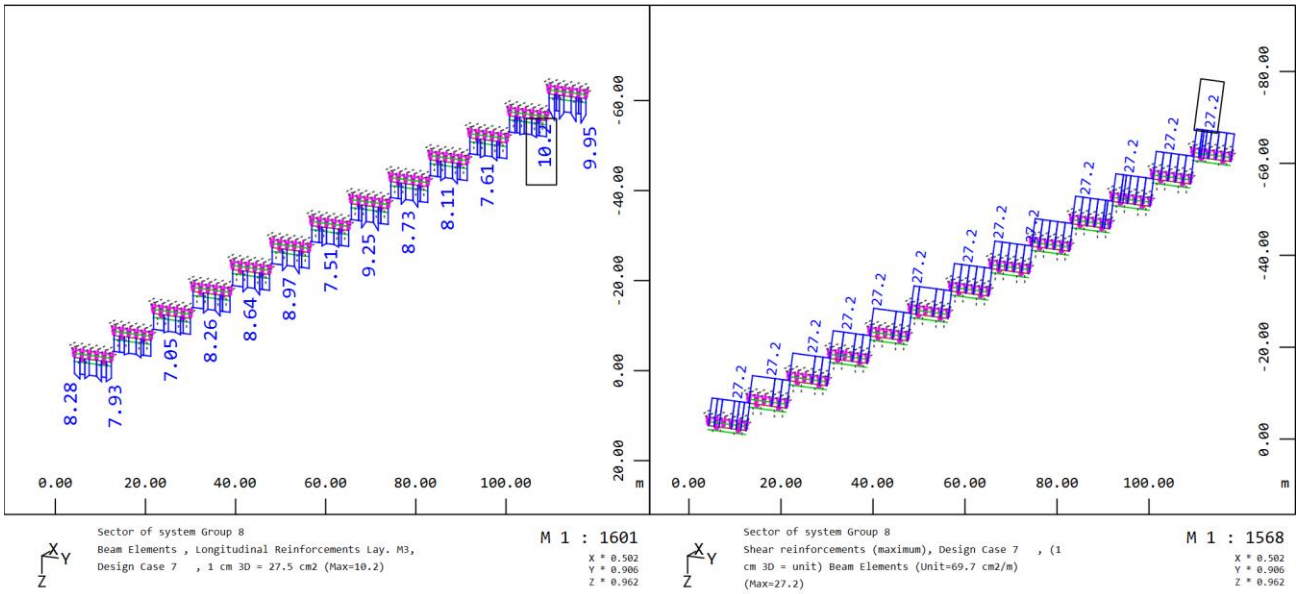
6.2 Armatura naglavnice

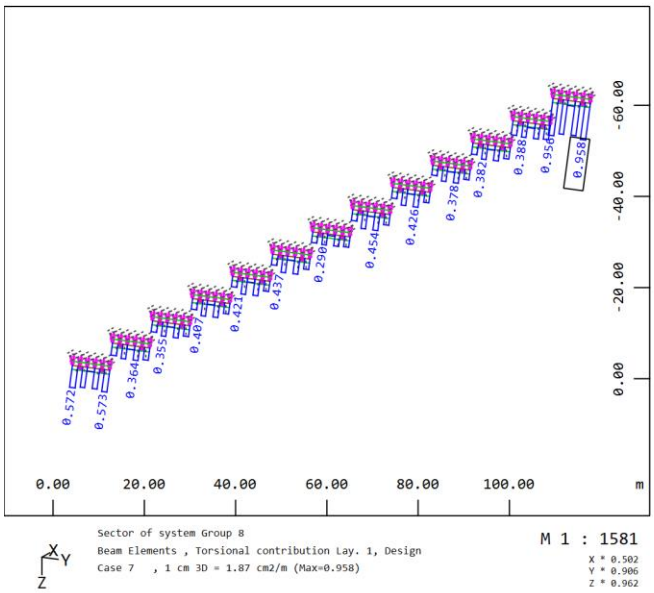


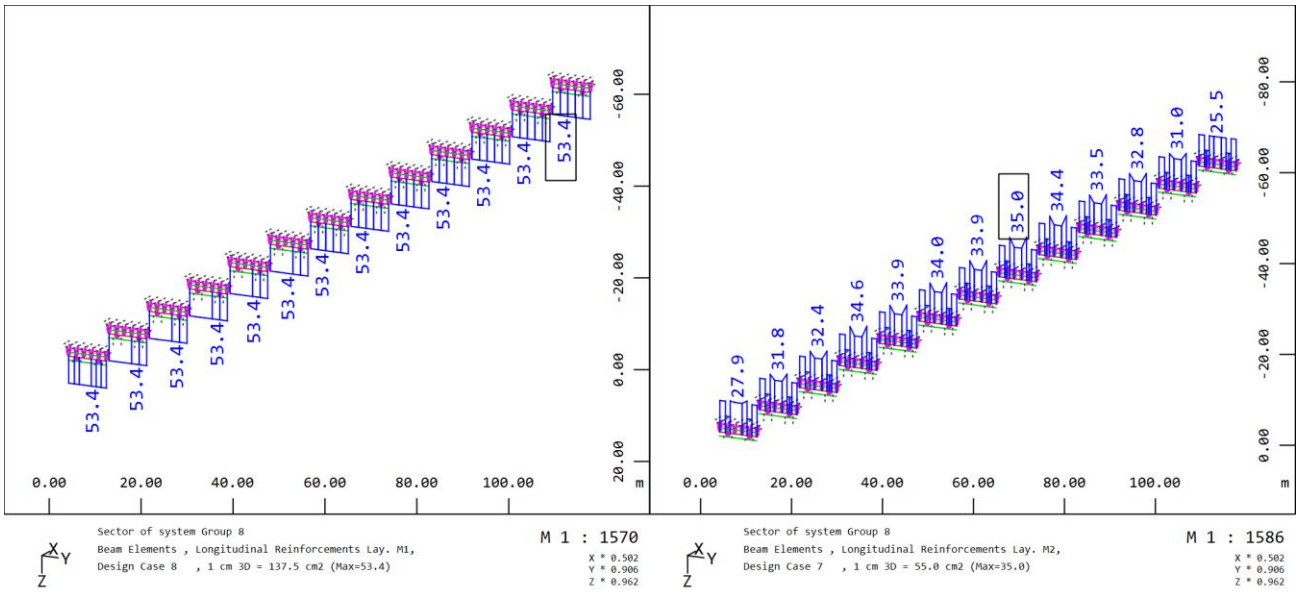


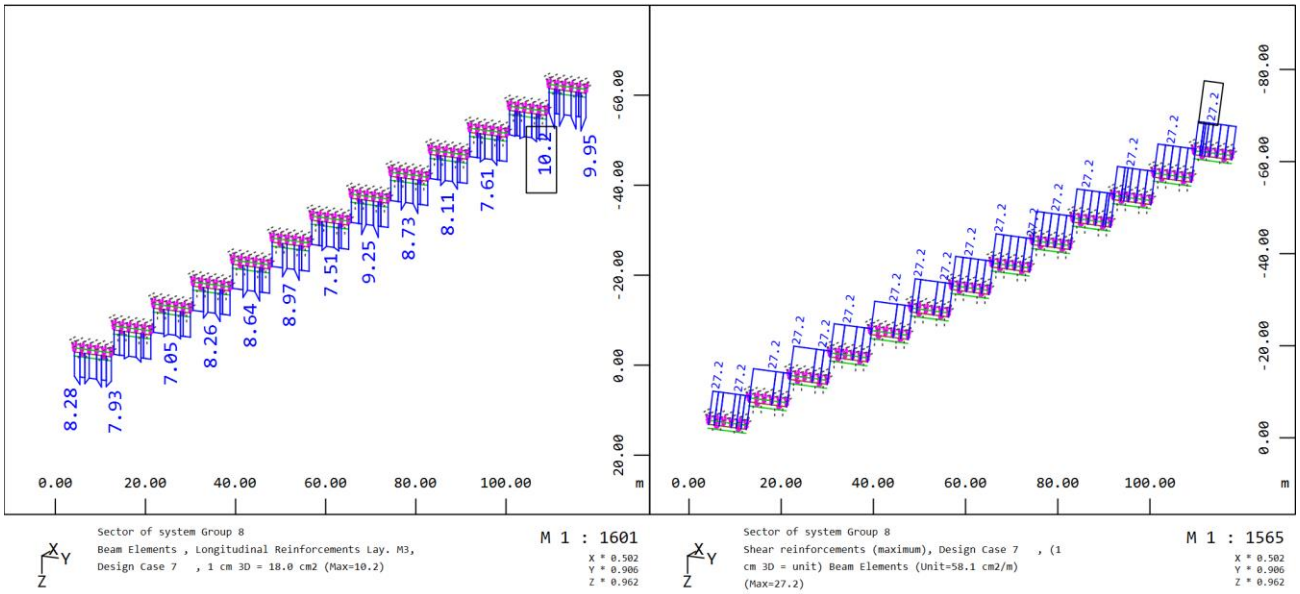


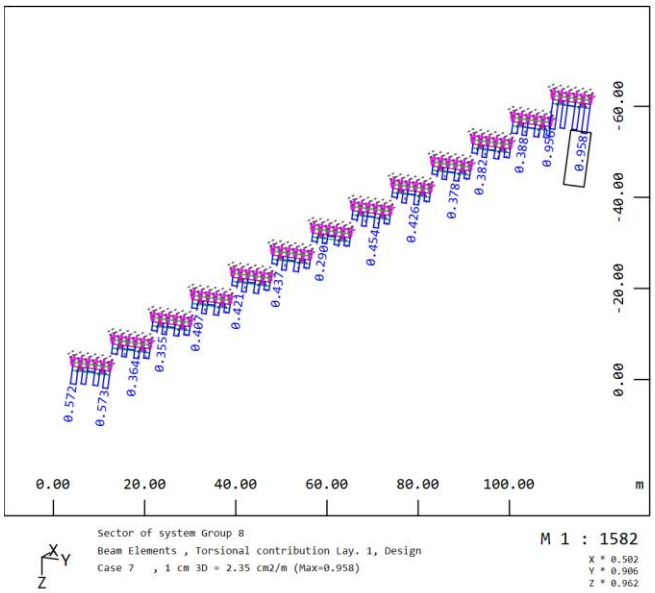

53.4
53.4
53.4
53.4
53.4
53.4
53.4
53.4
53.4
53.4
0.00
20.00
40.00
60.00
80.00
100.00
m
-60.00
-40.00
-20.00
0.00
20.00
Sector of system Group 8
Beam Elements , Longitudinal Reinforcements Lay. M1,
Design Case 7 , 1 cm 3D = 137.5 cm2 (Max=53.4)
M 1 : 1570
X * 0.502
Y * 0.906
Z * 0.962
27.9
31.8
32.4
34.6
33.9
34.0
33.9
35.0
34.4
33.5
32.8
31.0
25.5
-80.00
Sector of system Group 8
Beam Elements , Longitudinal Reinforcements Lay. M2,
Design Case 7 , 1 cm 3D = 74.7 cm2 (Max=35.0)
M 1 : 1586


8.28
7.93
7.05
8.26
8.64
8.97
7.51
9.25
8.73
8.11
7.61
10.2
9.95
0.00
20.00
40.00
60.00
80.00
100.00
m
-60.00
-40.00
-20.00
0.00
20.00
Sector of system Group 8
Beam Elements , Longitudinal Reinforcements Lay. M3,
Design Case 7 , 1 cm 3D = 27.5 cm2 (Max=10.2)
M 1 : 1601
X * 0.502
Y * 0.906
Z * 0.962
27.2
-80.00
Sector of system Group 8
Shear reinforcements (maximum), Design Case 7 , (1
cm 3D = unit) Beam Elements (Unit=69.7 cm2/m)
(Max=27.2)
M 1 : 1568


0.572
0.573
0.364
0.355
0.407
0.421
0.437
0.290
0.454
0.426
0.378
0.382
0.388
0.956
0.958
0.00
20.00
40.00
60.00
80.00
100.00
m
-60.00
-40.00
-20.00
0.00
Sector of system Group 8
Beam Elements , Torsional contribution Lay. 1, Design
Case 7 , 1 cm 3D = 1.87 cm2/m (Max=0.958)
M 1 : 1581
X * 0.502
Y * 0.906
Z * 0.962


Sector of system Group 8
Beam Elements , Longitudinal Reinforcements Lay. M1,
Design Case 8 , 1 cm 3D = 137.5 cm2 (Max=53.4)
M 1 : 1570
Sector of system Group 8
Beam Elements , Longitudinal Reinforcements Lay. M2,
Design Case 7 , 1 cm 3D = 55.0 cm2 (Max=35.0)
M 1 : 1586


Sector of system Group 8
Beam Elements , Longitudinal Reinforcements Lay. M3,
Design Case 7 , 1 cm 3D = 18.0 cm2 (Max=10.2)
M 1 : 1601
Sector of system Group 8
Shear reinforcements (maximum), Design Case 7 , (1
cm 3D = unit) Beam Elements (Unit=58.1 cm2/m)
(Max=27.2)
M 1 : 1565


Sector of system Group 8
Beam Elements , Torsional contribution Lay. 1, Design
Case 7 , 1 cm 3D = 2.35 cm2/m (Max=0.958)
M 1 : 1582

6.3 Rekapitulacija armature naglavnice stupišta

bxh=240x150 cm, materijali: C30/37, B500B

Statička visina:

$d_1 = 5 + \Phi_v + ½*\Phi_s = 5 + 1,6 + ½*2,8 = 8$ cm
$d_s=h-d_1=150,0-8=142$ cm

Minimalna površina armature u presjeku:

$A_{s,min} = 0,0013 \cdot b \cdot d =$ 0,0013·240·142 = 44,3 cm^2

$A_{s,min} = 0,26 \cdot (f_{ctm} / f_{yk}) \cdot b \cdot d =$ 0,26·(2,9/500)·240·142 = 51,39 cm^2

Maksimalna površina armature u presjeku:

$A_{s,max} = 0,04\ A_c =$ 0,04·240·150 = 1440 cm^2

Potrebna armatura:

- gornja zona (layer 2)
  POTREBNO: 41,2 cm^2
  ODABRANO: 16Φ28/15 (78,4 cm^2)

- donja zona (layer 1)
  POTREBNO: 53,4 cm^2
  ODABRANO: 16Φ28/15 (78,4 cm^2)

- sa strane ukupno (layer 3)
  POTREBNO: 14,1 cm^2
  ODABRANO: 2x8Φ16/15 (32,2 cm^2)

- posmična armatura
  POTREBNO: 27,2 cm^2/m^2
  ODABRANO: Φ18/15 , m=4 (60,2 cm^2/m') – s prorijeđenjima iznad stupova do 20cm

Minimalna količina poprečne armature prema EC2 za elemente naprezane poprečnim silama:
$A_{smin} = \rho_{min} \cdot b_w =$ 0,0011 · 240,0 = 0,264 cm^2/cm
- $\rho_{min} = 0,0011$ za C30/37 i B500B

6.4. Bočne maske na stupištima– protupotresne istake

Vertikalna armatura u obje zone
ODABRANO: Φ22/15 (As,odabrano = 25,3 cm2/m)

Horizontalan armatura vilice :
ODABRANO: m=8 Φ12/15 (As,odabrano = 60,3 cm2/m)

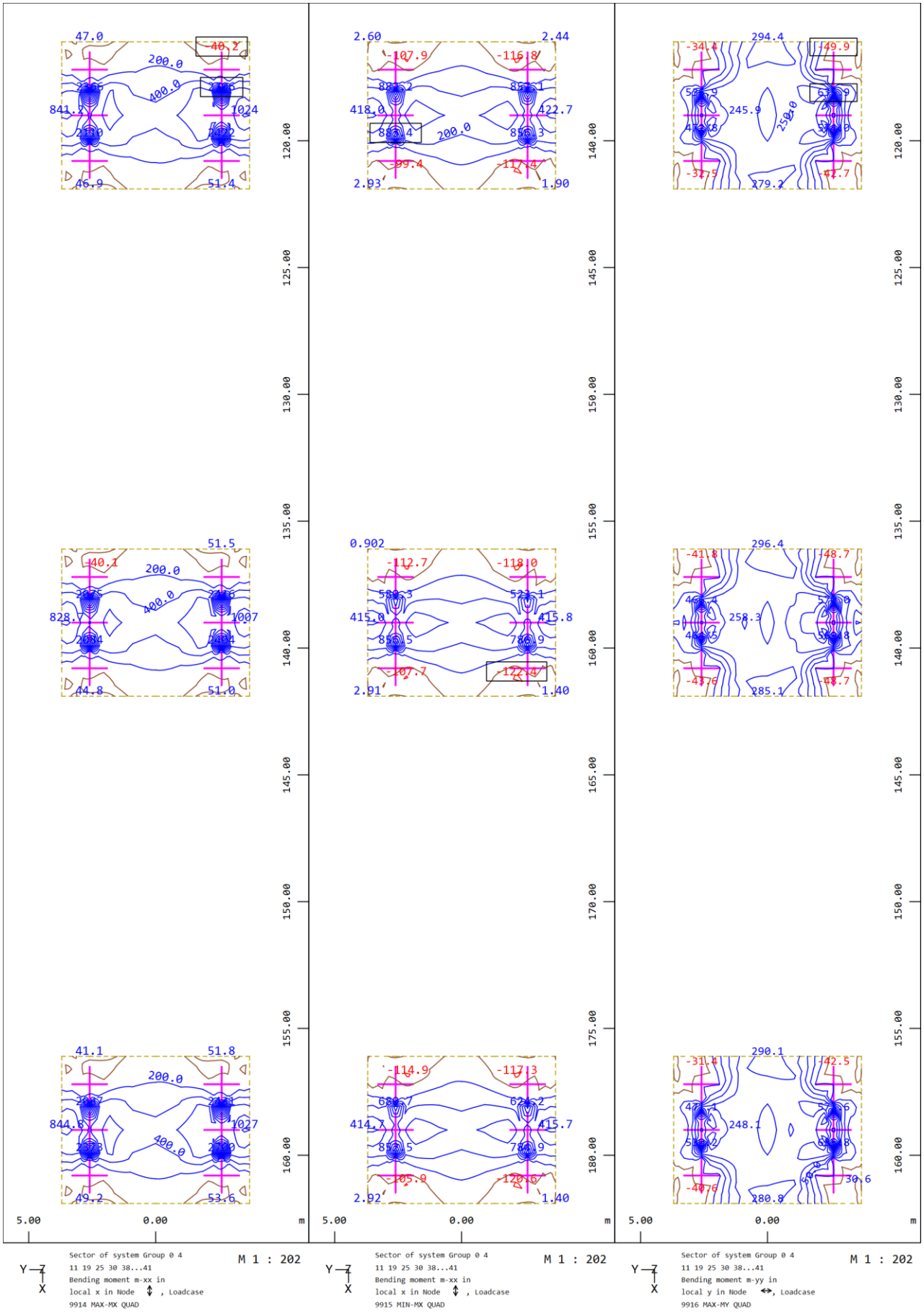
7 NAGLAVNICE PILOTA STUPOVA

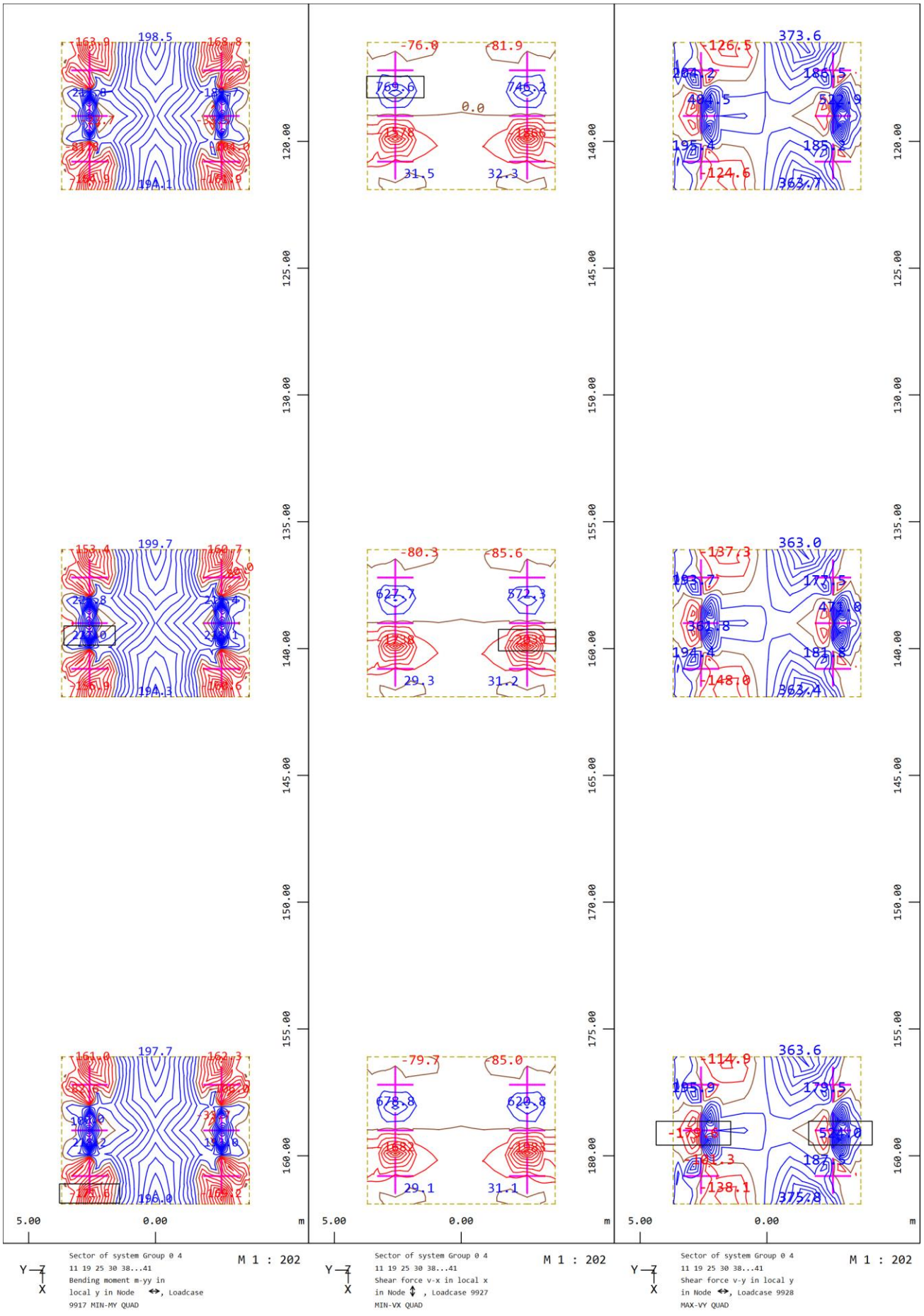
7.1 Rezne sile u naglavnicama od kombinacije opterećenja

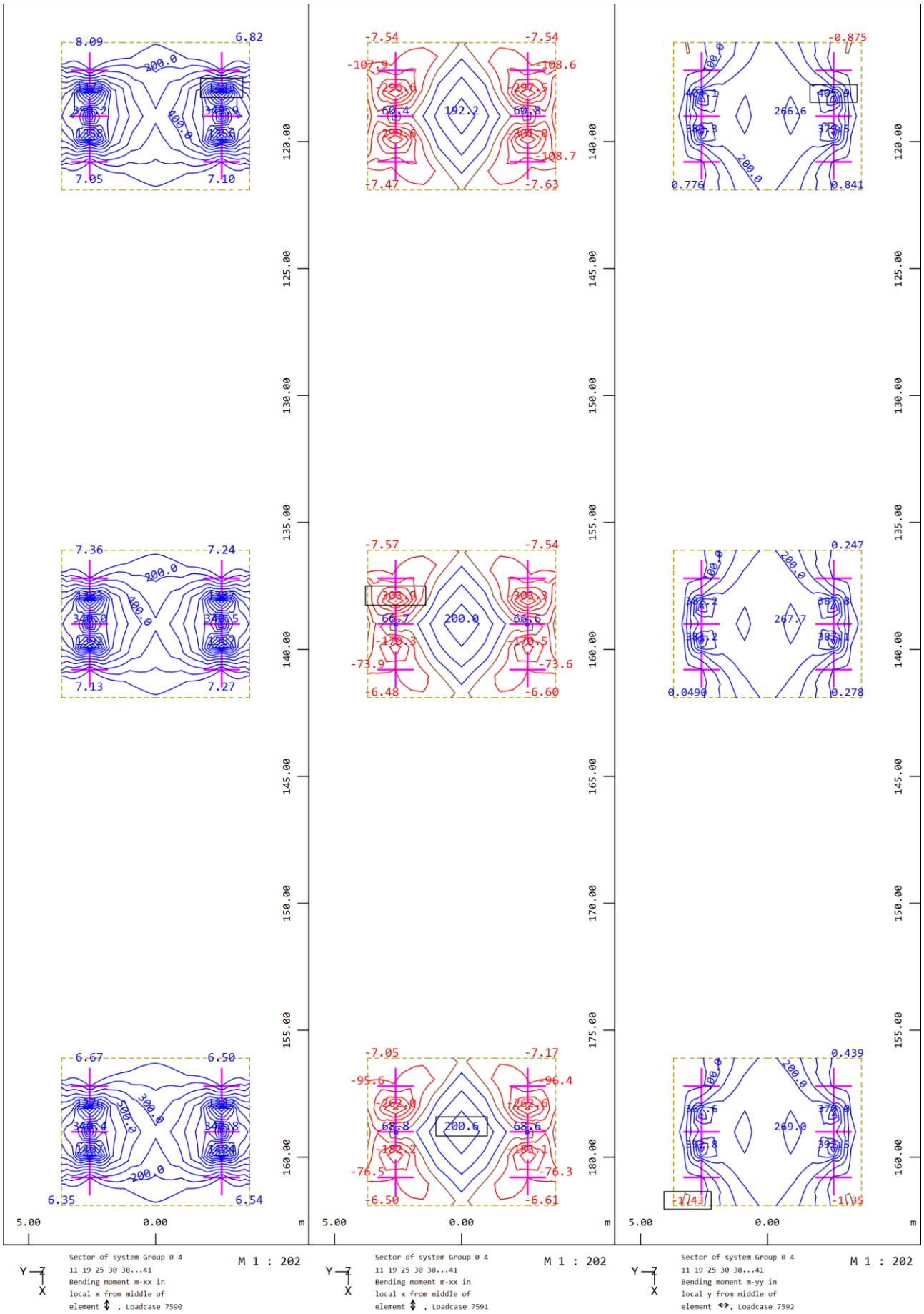
Kombinacije opterećenja naglavnice pilota iste su kao i za pilote.

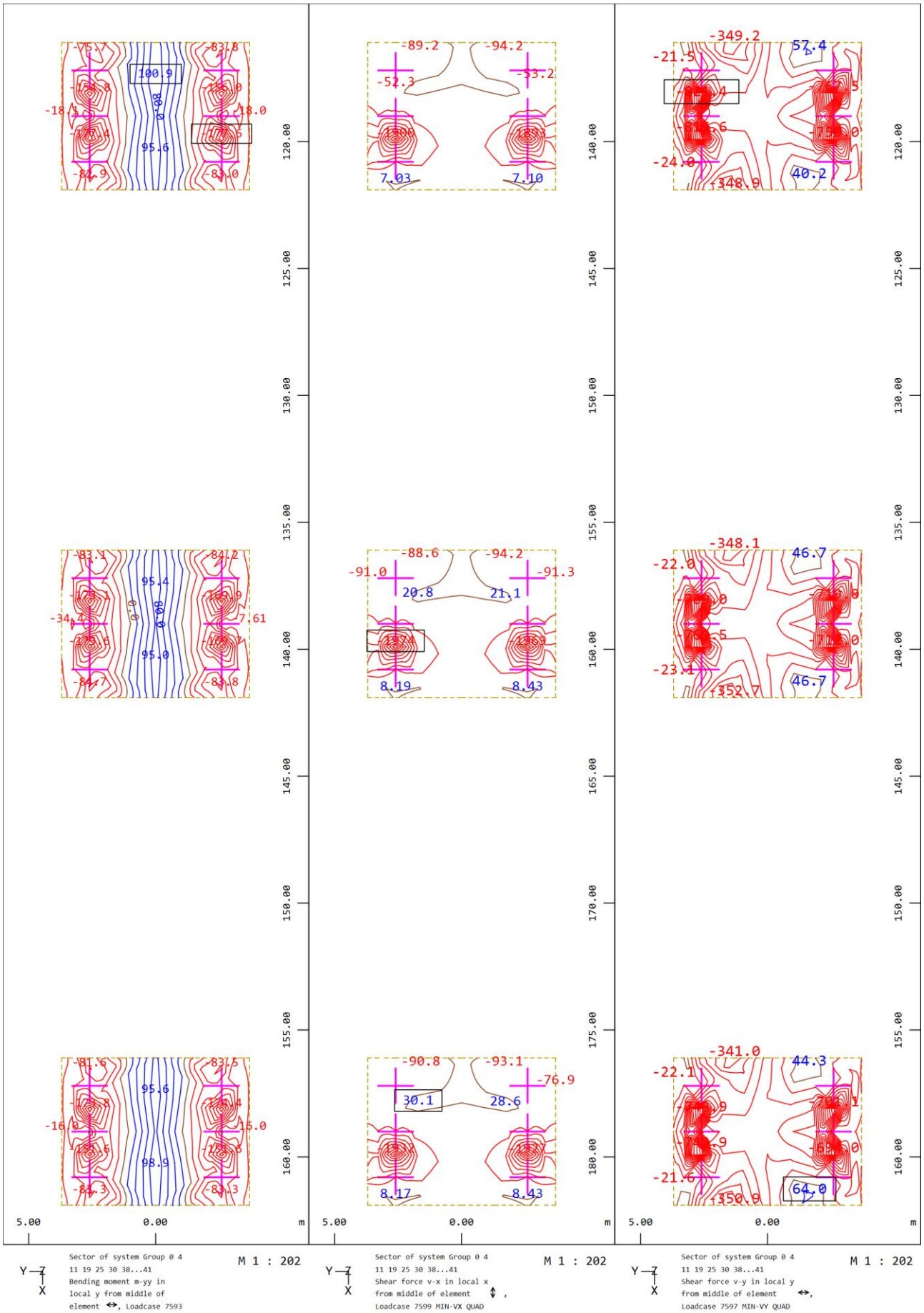
OZNAKA KOMBINACIJE LC	Raspisane kombinacije korištene za dimenzioniranje rasponskog sklopa, stupova, naglavnica pilota i pilota	NAZIV KOMBINACIJE	Oznaka armature
9900 – 9999	1,35 (1,0)·G+1,35(1,0)·R+1,35·(Q_{oso}+Q_{jed}) +1,0·C + 1,5·ZW_{opt} +0,75·ZT + 1,0·ZF	PROMET+VJETAR	Lcr 1
	1,35 (1,0)·G+1,35(1,0)·R +1,5·ZT+ 1,35·(0,75·Q_{oso}+0,4·Q_{jed}) +1,0·C + 1,0·ZF	TEMPERATURA	
	1,35(1,0)·G+1,35(1,0)·R+1,5·K+0,75·ZT 1,35·(0,75·Q_{oso}+0,4·Q_{jed})+1,0·C +1,0·ZF+1,5·ZW_{opt}	KOČENJE	
9800 – 9899	1,0·G+1,0·R+A+0,75·Q_{oso}+0,4·Q_{jed} +1,0·C + 1,0·ZF + 1,0·$ZW_{opterećen}$ + 0,5·ZT	UDAR	Lcr 4
	1,0·G+1,0·R+A + 0,2·Q_{oso}+0,2·Q_{jed} +1,0·C + 1,0·ZF + 1,0·$ZW_{opterećen}$ + 0,6·ZT		
7500 – 7599	1,0·G+1,0·C+1,0·R +E_X+0,3·E_Y+0,3·Ez	POTRES	Lcr 7
8500 – 8599	1,0·G+1,0·C+1,0·R+0,3·E_X+E_Y+0,3·Ez		Lcr 8

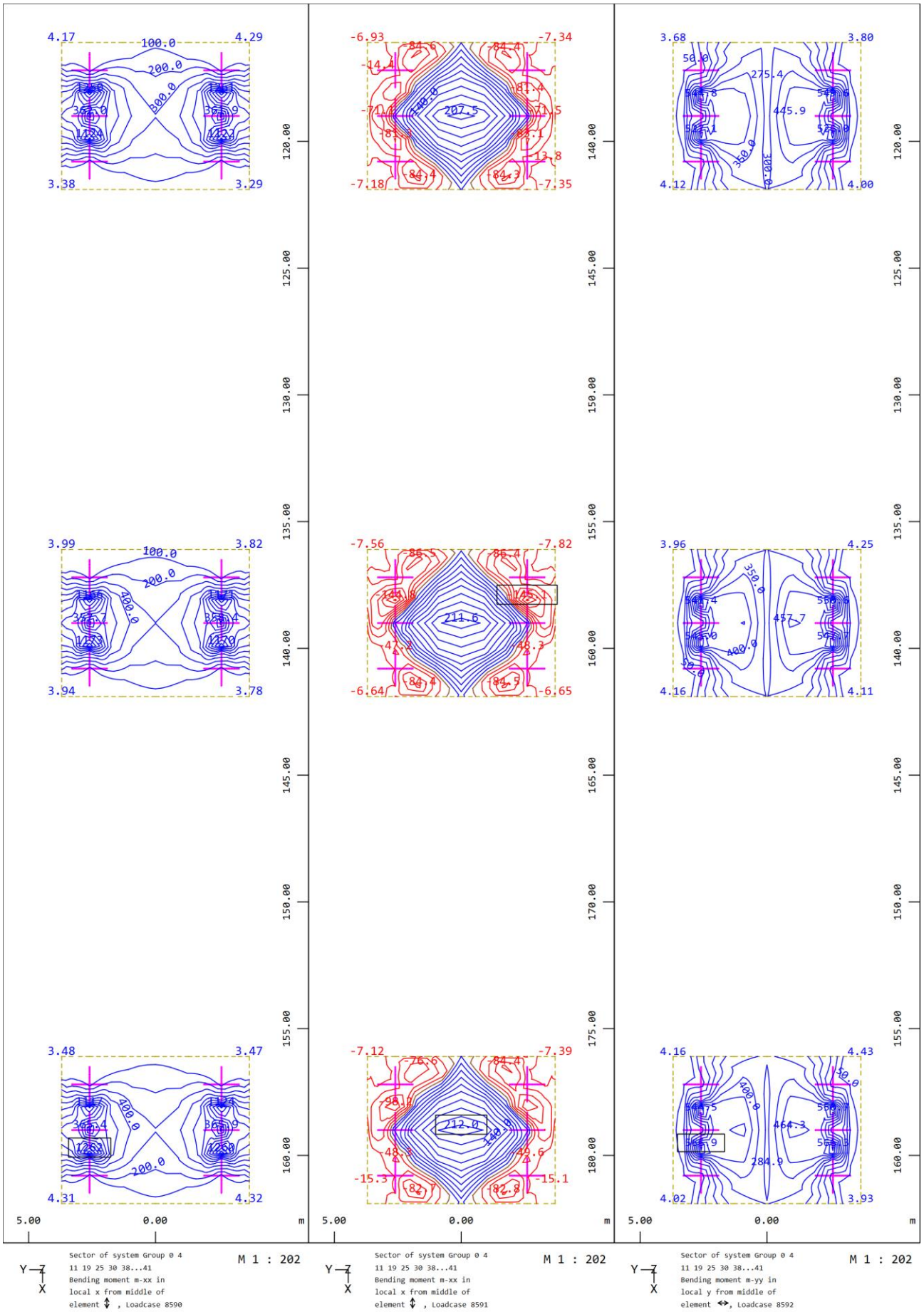
REZNE SILE U NAGLAVNICAMA OD KOMBINACIJA OPTEREĆENJA

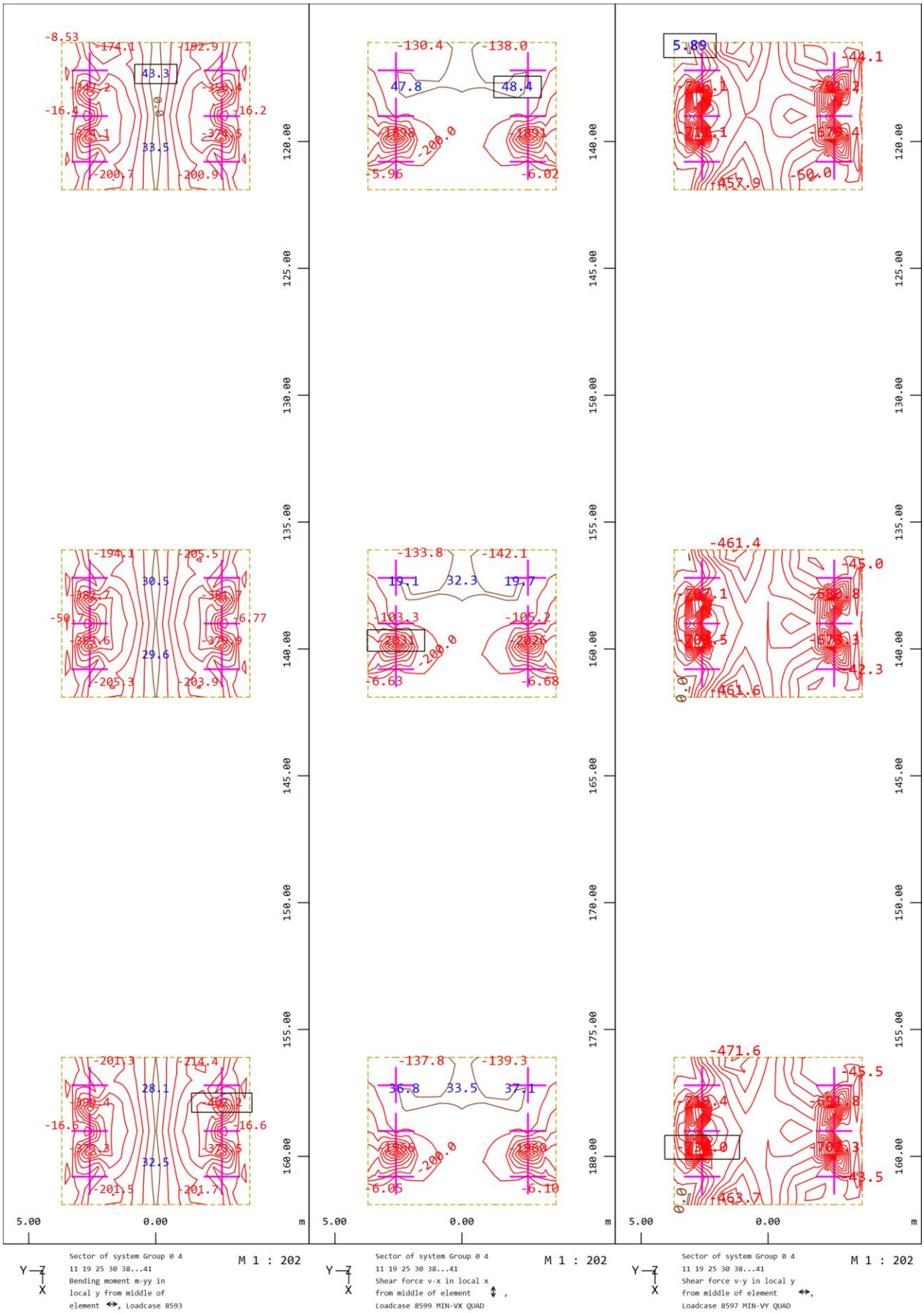



198.5
199.7
197.7
-76.0
-81.9
769.6
745.1
0.0
31.5
32.3
-80.3
-85.6
627.7
572.3
29.3
31.2
-79.7
-85.0
678.8
620.8
29.1
31.1
373.6
-126.5
363.0
-137.3
363.6
-114.9
5.00
0.00
m
120.00
125.00
130.00
135.00
140.00
145.00
150.00
155.00
160.00
165.00
170.00
175.00
180.00
Sector of system Group 0 4
11 19 25 30 38...41
Bending moment m-yy in
local y in Node ↔, Loadcase
9917 MIN-MY QUAD
M 1 : 202
Sector of system Group 0 4
11 19 25 30 38...41
Shear force v-x in local x
in Node ↕ , Loadcase 9927
MIN-VX QUAD
M 1 : 202
Sector of system Group 0 4
11 19 25 30 38...41
Shear force v-y in local y
in Node ↔, Loadcase 9928
MAX-VY QUAD
M 1 : 202

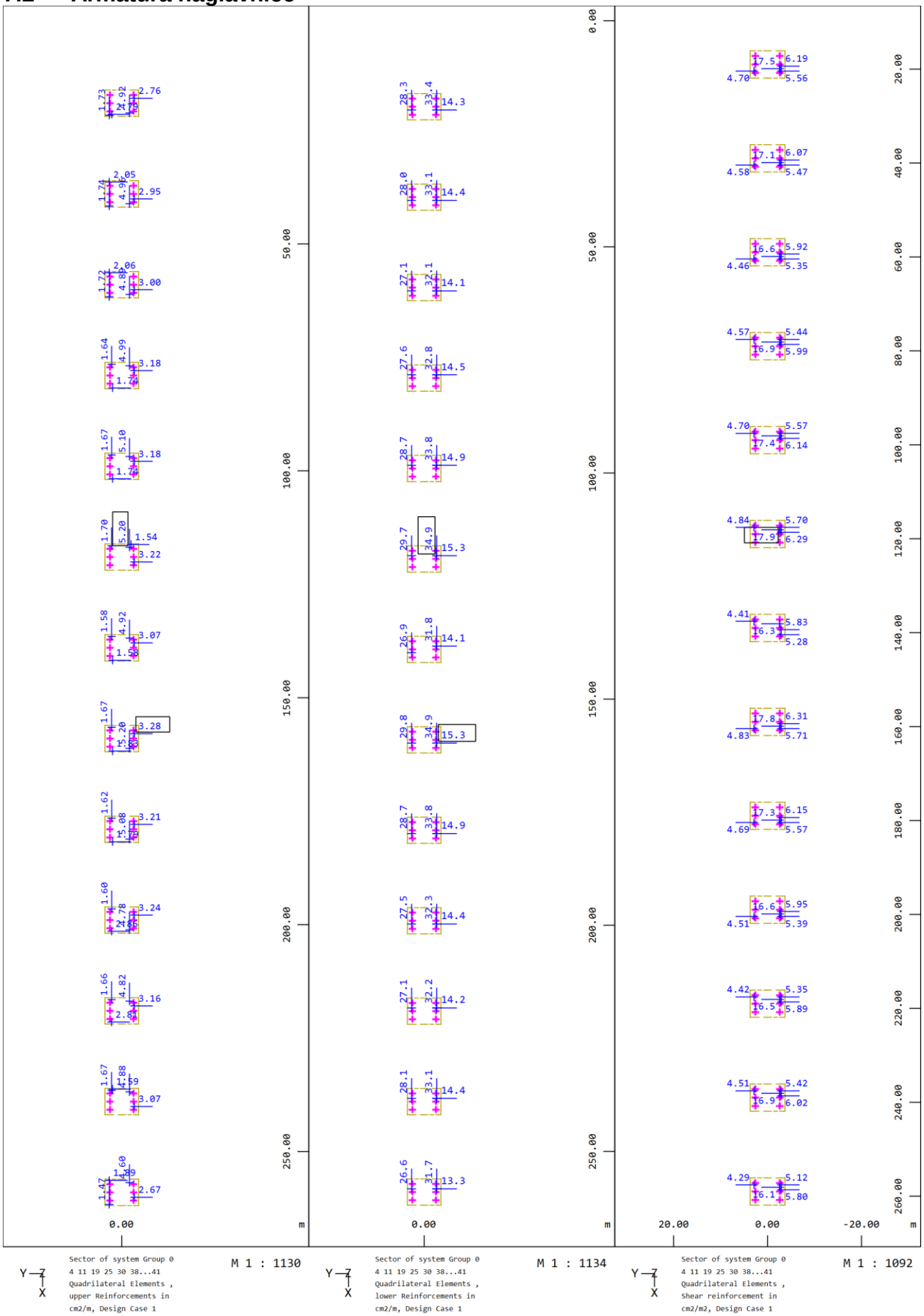

8.09
6.82
200.0
400.0
7.05
7.10
-7.54
-7.54
-107.9
-108.6
60.4
192.2
60.8
-108.7
-7.47
-7.63
-0.875
0.776
266.6
200.0
0.841
7.36
7.24
200.0
400.0
7.13
7.27
-7.57
-7.54
66.7
200.0
66.6
-73.9
-73.6
-6.48
-6.60
0.247
267.7
0.0490
0.278
6.67
6.50
300.0
200.0
200.0
6.35
6.54
-7.05
-7.17
-95.6
-96.4
68.8
200.6
68.6
-76.5
-76.3
-6.50
-6.61
0.439
269.0
-1.143
-1.135
5.00
0.00
m
M 1 : 202
Sector of system Group 0 4
11 19 25 30 38...41
Bending moment m-xx in
local x from middle of
element , Loadcase 7590
Sector of system Group 0 4
11 19 25 30 38...41
Bending moment m-xx in
local x from middle of
element , Loadcase 7591
Sector of system Group 0 4
11 19 25 30 38...41
Bending moment m-yy in
local y from middle of
element , Loadcase 7592

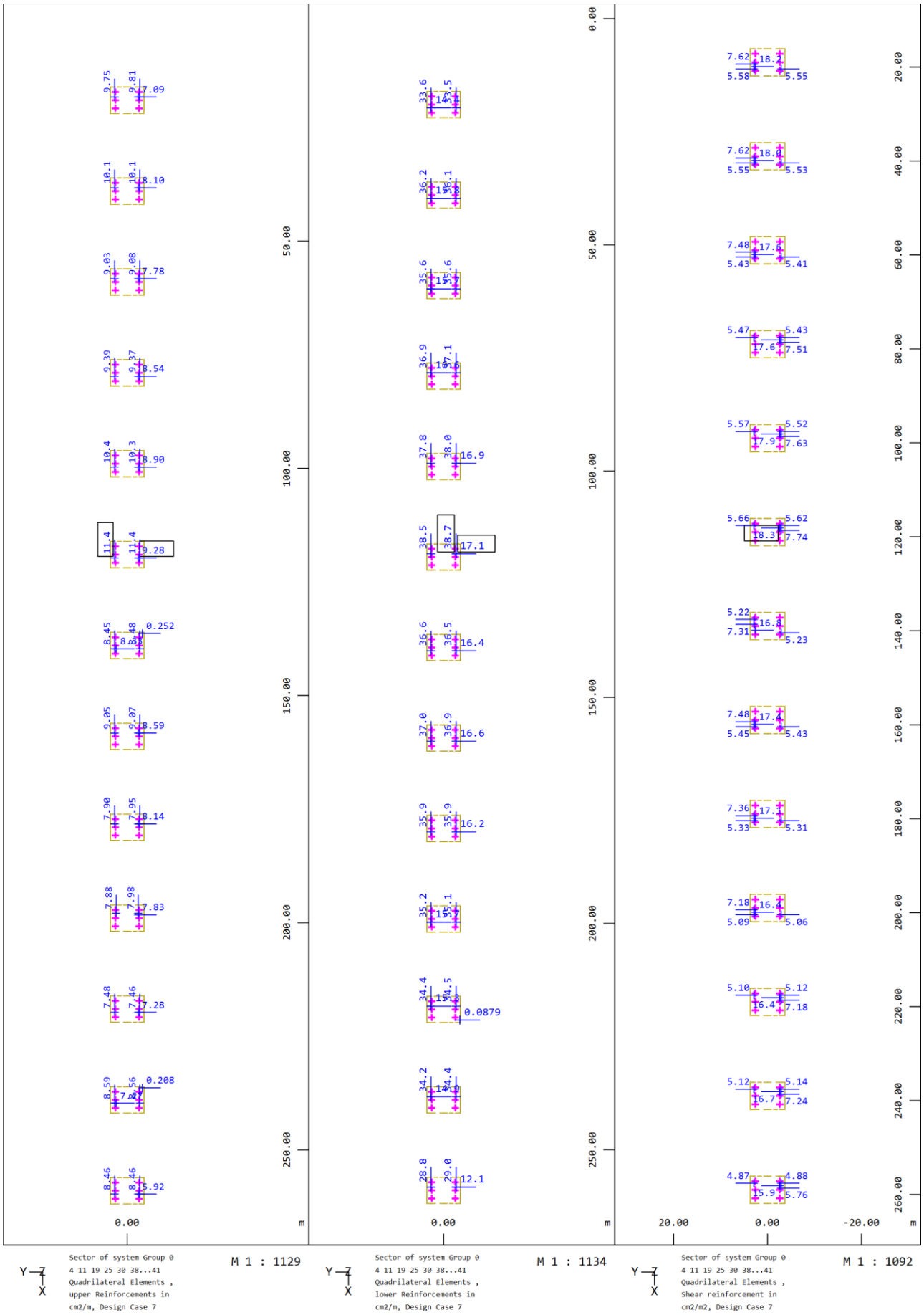

Sector of system Group 0 4
11 19 25 30 38...41
Bending moment m-yy in
local y from middle of
element ↔, Loadcase 7593
M 1 : 202
Sector of system Group 0 4
11 19 25 30 38...41
Shear force v-x in local x
from middle of element ↕ ,
Loadcase 7599 MIN-VX QUAD
M 1 : 202
Sector of system Group 0 4
11 19 25 30 38...41
Shear force v-y in local y
from middle of element ↔,
Loadcase 7597 MIN-VY QUAD
M 1 : 202

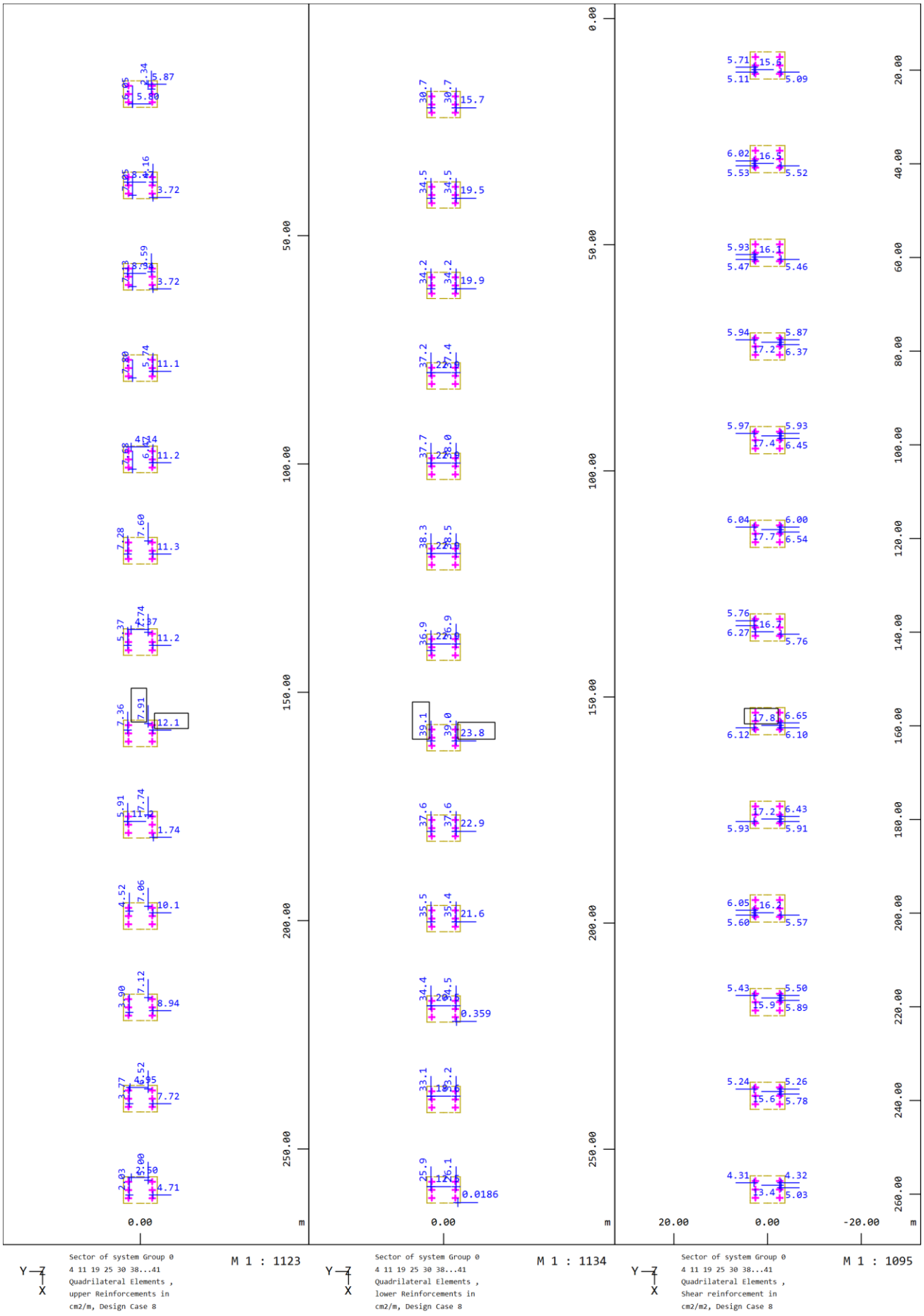

Sector of system Group 0 4
11 19 25 30 38...41
Bending moment m-xx in
local x from middle of
element , Loadcase 8590
M 1 : 202
Sector of system Group 0 4
11 19 25 30 38...41
Bending moment m-xx in
local x from middle of
element , Loadcase 8591
M 1 : 202
Sector of system Group 0 4
11 19 25 30 38...41
Bending moment m-yy in
local y from middle of
element , Loadcase 8592
M 1 : 202


Sector of system Group 0 4
11 19 25 30 38...41
Bending moment m-yy in
local y from middle of
element, Loadcase 8593
M 1 : 202
Sector of system Group 0 4
11 19 25 30 38...41
Shear force v-x in local x
from middle of element
Loadcase 8599 MIN-VX QUAD
M 1 : 202
Sector of system Group 0 4
11 19 25 30 38...41
Shear force v-y in local y
from middle of element
Loadcase 8597 MIN-VY QUAD
M 1 : 202

7.2 Armatura naglavnice




Sector of system Group 0
4 11 19 25 30 38...41
Quadrilateral Elements ,
upper Reinforcements in
cm2/m, Design Case 7
M 1 : 1129
Sector of system Group 0
4 11 19 25 30 38...41
Quadrilateral Elements ,
lower Reinforcements in
cm2/m, Design Case 7
M 1 : 1134
Sector of system Group 0
4 11 19 25 30 38...41
Quadrilateral Elements ,
Shear reinforcement in
cm2/m2, Design Case 7
M 1 : 1092


Sector of system Group 0
4 11 19 25 30 38...41
Quadrilateral Elements ,
upper Reinforcements in
cm2/m, Design Case 8
M 1 : 1123
Sector of system Group 0
4 11 19 25 30 38...41
Quadrilateral Elements ,
lower Reinforcements in
cm2/m, Design Case 8
M 1 : 1134
Sector of system Group 0
4 11 19 25 30 38...41
Quadrilateral Elements ,
Shear reinforcement in
cm2/m2, Design Case 8
M 1 : 1095

7.3 Rekapitulacija armature naglavnice

h=140 cm, materijali: C30/37, B500B

Statička visina:

$d_1 = 6 + \Phi_v + ½*\Phi_s = 6 + 2,8 + ½*2,8 = 10,2$ cm
$d_s=h-d_1=140,0-10,2=129,8$ cm

Minimalna površina armature u presjeku h=140cm:

$A_{s,min} = 0,0013 \cdot b \cdot d =$ 0,0013·100·129,8 = 16,87 cm^2/m'

$A_{s,min} = 0,26 \cdot (f_{ctm} / f_{yk}) \cdot b \cdot d = 0,26 \cdot (2,9/500) \cdot 100 \cdot 129,8$ = 19,57 cm^2/m'

Maksimalna površina armature u presjeku h=140cm:

$A_{s,max} = 0,04\ A_c = 0,04 \cdot 100 \cdot 140 = 560,0$ cm^2/m'

Potrebna armatura:

- gornja zona oba smjera
  POTREBNO: 12,1 cm^2/m'
  ODABRANO: Φ25/15 (32,93 cm^2/m')

- donja zona oba smjera S1-S5 i S10-S13
  POTREBNO: 39,1 cm^2/m'
  ODABRANO: Φ28/15 (41,07 cm^2/m')

- donja zona oba smjera S6-S9
  POTREBNO: 39,1 cm^2/m'
  ODABRANO: Φ32/15 (53,07 cm^2/m')

- poprečna armatura
  POTREBNO: 18,3 cm^2/m^2
  ODABRANO: m=4 Φ16/30/30 (22,33 cm^2/m^2)

*peek value

Minimalna količina poprečne armature prema EC2 za elemente naprezane poprečnim silama:
$A_{smin} = \rho_{min} \cdot b_w =$ 0,0011 · 100,0 = 0,11 cm^2/cm

- $\rho_{min} = 0,0011$ za C30/37 i B500B

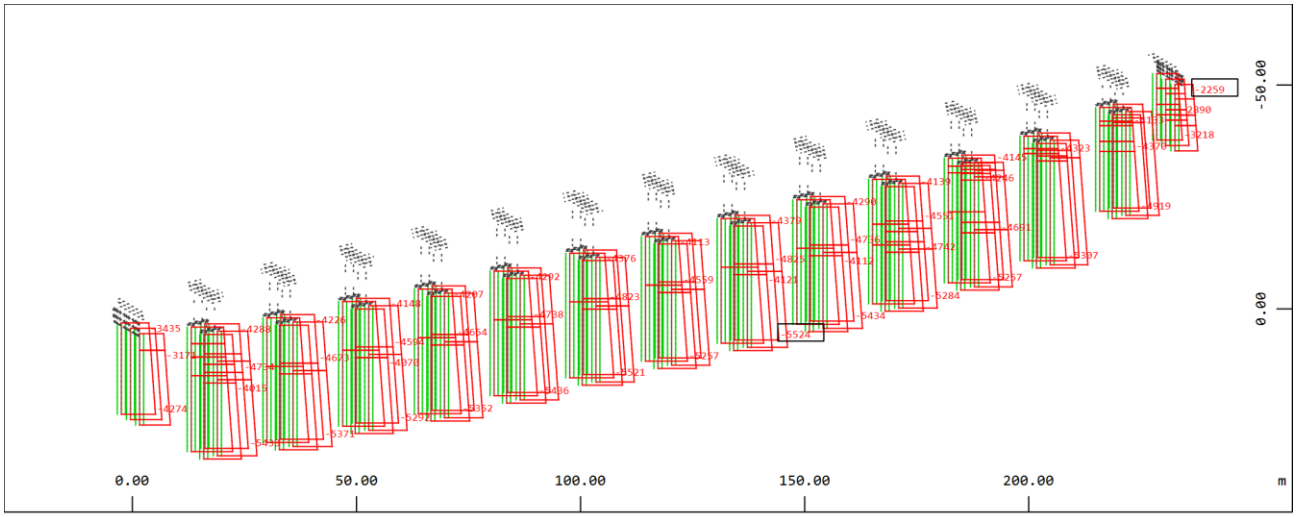
8 PILOTI

8.1 Rezne sile u pilotima za kombinacije opterećenja

Kombinacije opterećenja pilota iste su kao i za naglavnicu pilota.

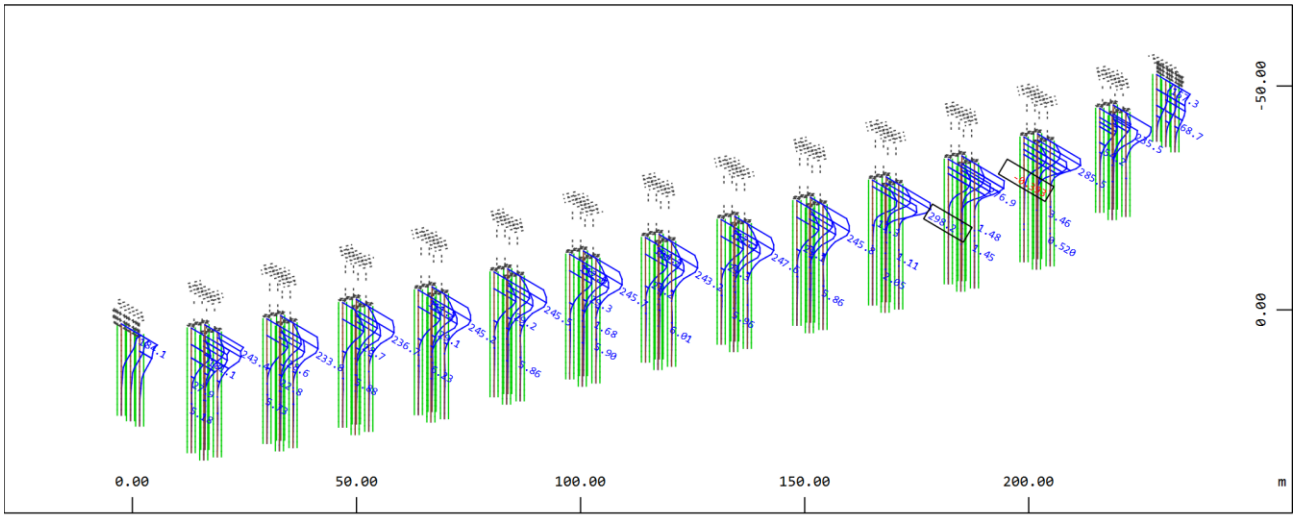
OZNAKA KOMBINACIJE LC	Raspisane kombinacije korištene za dimenzioniranje rasponskog sklopa, stupova, naglavnica pilota i pilota	NAZIV KOMBINACIJE	Oznaka armature
9900 – 9999	1,35 (1,0)·G+1,35(1,0)·R+1,35·(Q_{oso}+Q_{jed}) +1,0·C + 1,5·ZW_{opt} +0,75·ZT + 1,0·ZF	PROMET+VJETAR	Lcr 1
	1,35 (1,0)·G+1,35(1,0)·R +1,5·ZT+ 1,35·(0,75·Q_{oso}+0,4·Q_{ied}) +1,0·C + 1,0·ZF	TEMPERATURA	
	1,35(1,0)·G+1,35(1,0)·R+1,5·K+0,75·ZT 1,35·(0,75·Q_{oso}+0,4·Q_{jed})+1,0·C +1,0·ZF+1,5·ZW_{opt}	KOČENJE	
9800 – 9899	1,0·G+1,0·R+A+0,75·Q_{oso}+0,4·Q_{jed} +1,0·C + 1,0·ZF + 1,0·$ZW_{opterećen}$ + 0,5·ZT	UDAR	Lcr 4
	1,0·G+1,0·R+A + 0,2·Q_{oso}+0,2·Q_{jed} +1,0·C + 1,0·ZF + 1,0·$ZW_{opterećen}$ + 0,6·ZT		
7500 – 7599	1,0·G+1,0·C+1,0·R +E_X+0,3·E_Y+0,3·Ez	POTRES	Lcr 7
8500 – 8599	1,0·G+1,0·C+1,0·R+0,3·E_X+E_Y+0,3·Ez		Lcr 8

REZNE SILE U PILOTIMA OD KOMBINACIJA OPTEREĆENJA



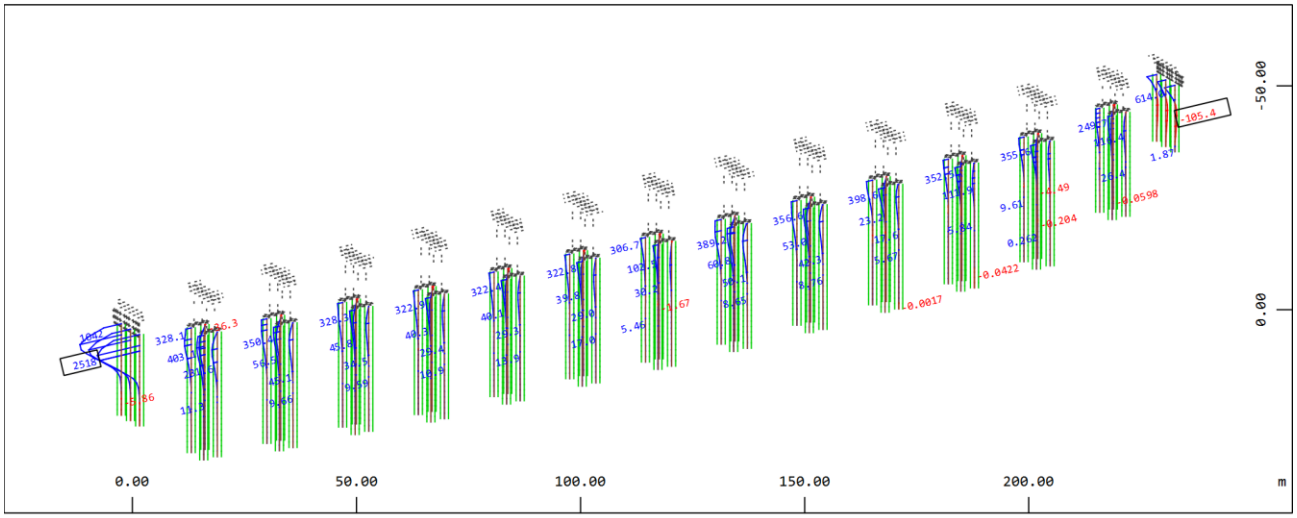
Sector of system Group 0 11
Beam Elements , Normal force Nx, Loadcase 9909 MIN-N BEAM ULS-traffic,temp,wind , 1 cm
3D = 9023. kN (Min=-5524.) (Max=-2259.)

M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927



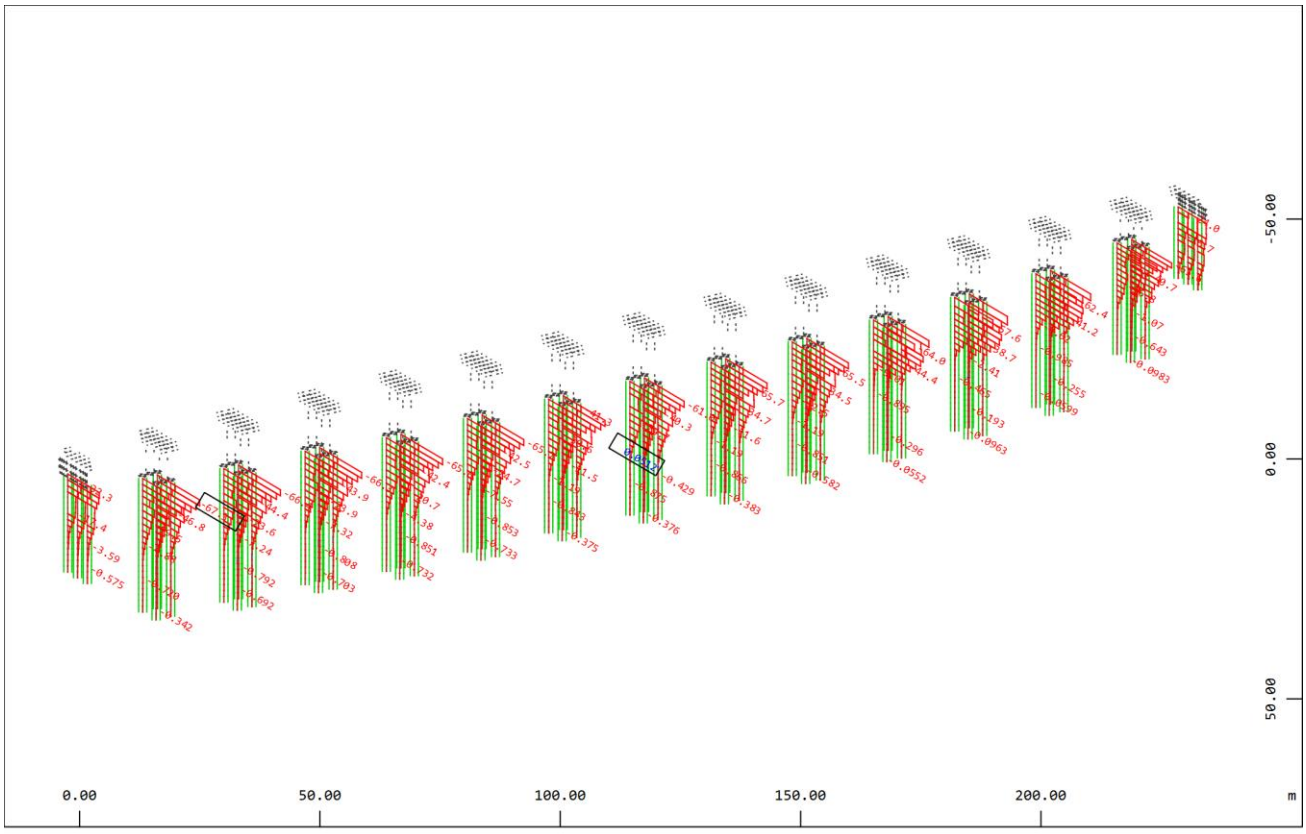
Sector of system Group 0 11
Beam Elements , Bending moment My, Loadcase 9900 MAX-MY BEAM ULS-traffic,temp,win , 1
cm 3D = 360.9 kNm (Min=-0.393) (Max=298.2)

M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927



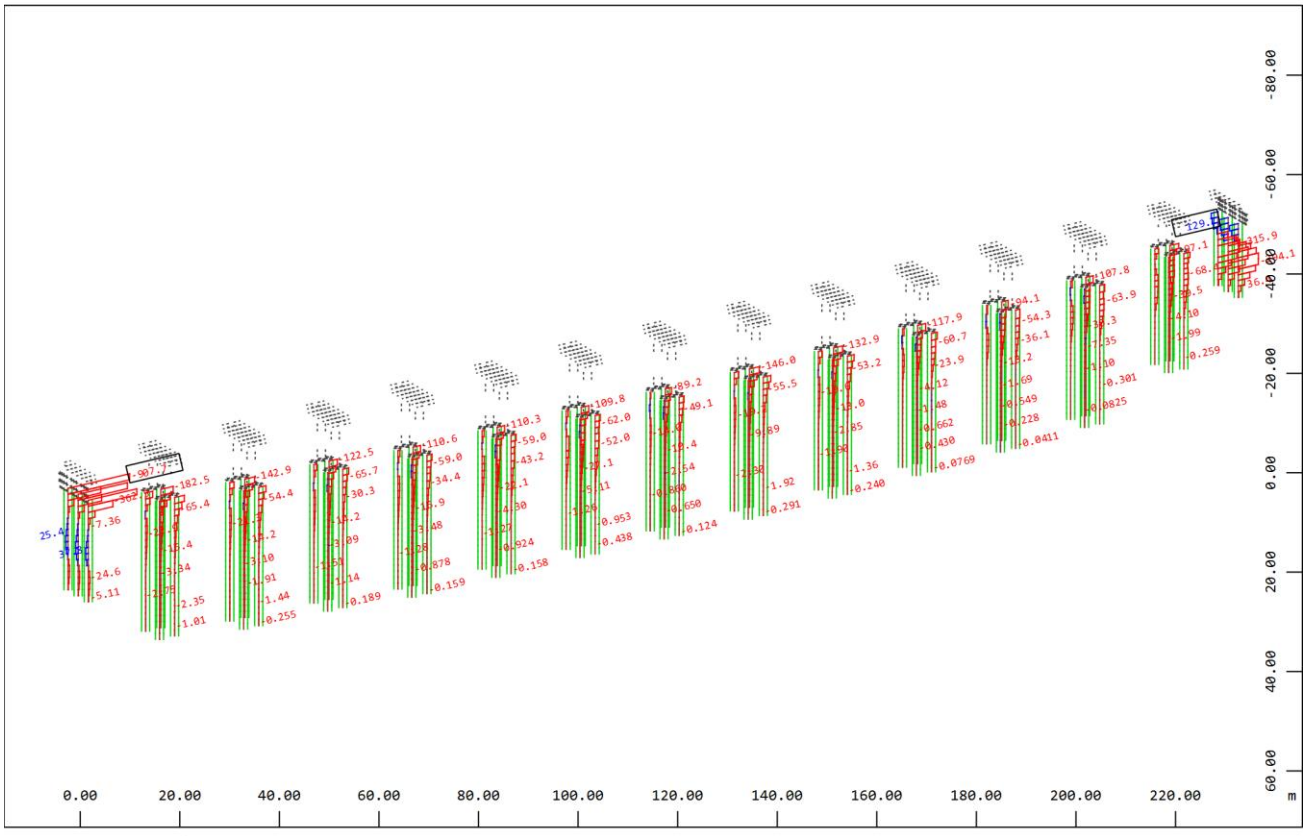
Sector of system Group 0 11
Beam Elements , Bending moment Mz, Loadcase 9904 MAX-MZ BEAM ULS-traffic,temp,win , 1
cm 3D = 3609. kNm (Min=-105.4) (Max=2518.)

M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927



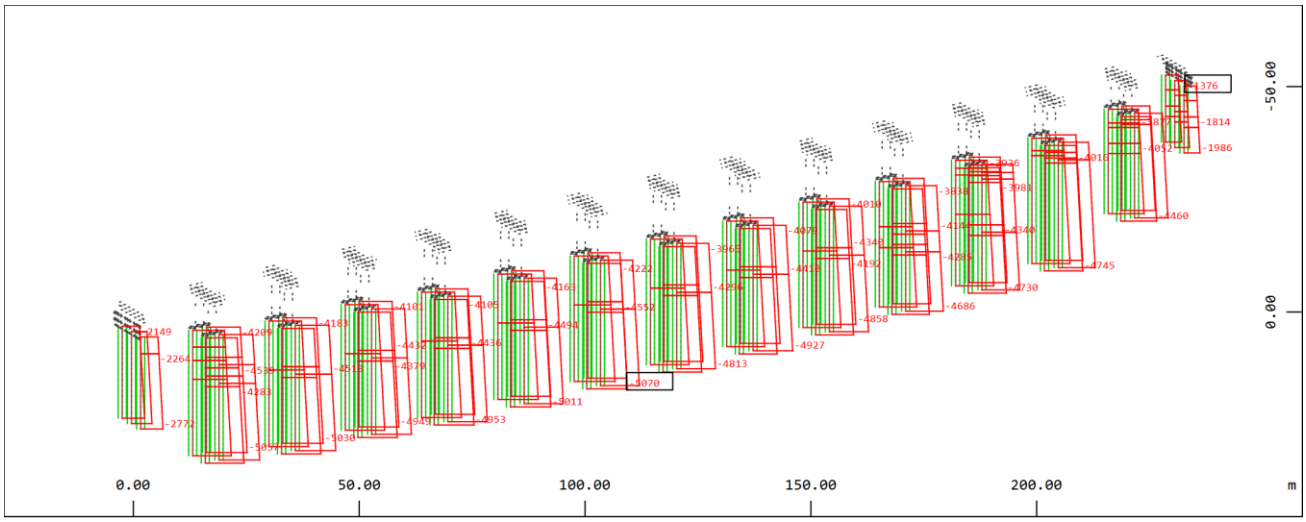
Sector of system Group 0 11
Beam Elements , Shear force Vz, Loadcase 9903 MIN-VZ BEAM ULS-traffic,temp,win , 1 cm
3D = 90.2 kN (Min=-67.3) (Max=0.0512)

M 1 : 1509
X * 0.868
Y * 0.622
Z * 0.927



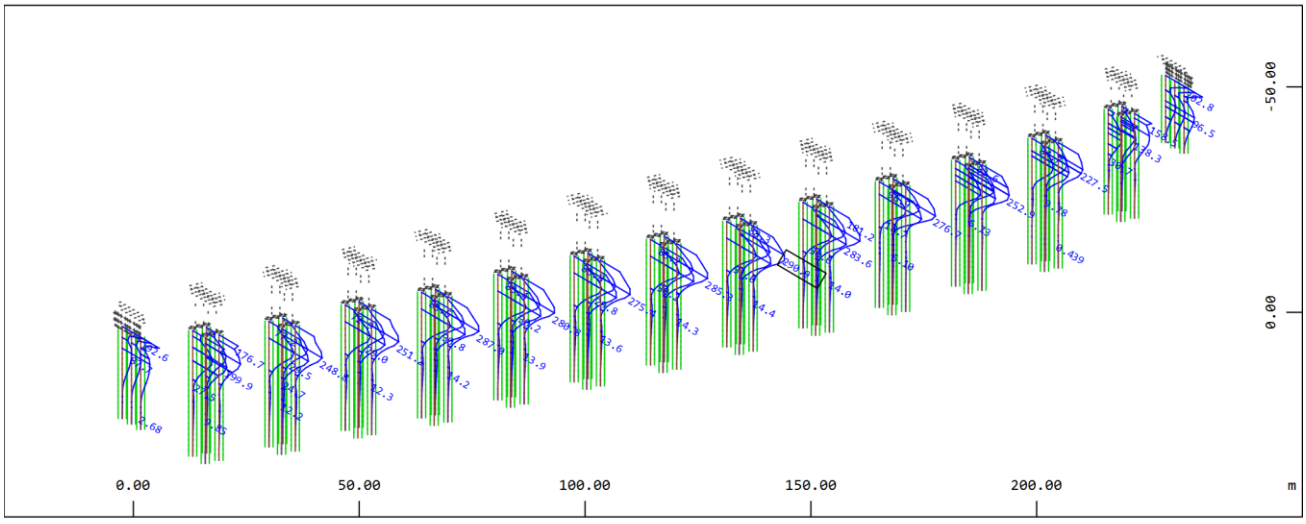
Sector of system Group 0 11
Beam Elements , Shear force Vy, Loadcase 9907 MIN-VY BEAM ULS-traffic,temp,win , 1 cm
3D = 902.3 kN (Min=-907.7) (Max=129.7)

M 1 : 1457
X * 0.868
Y * 0.622
Z * 0.927



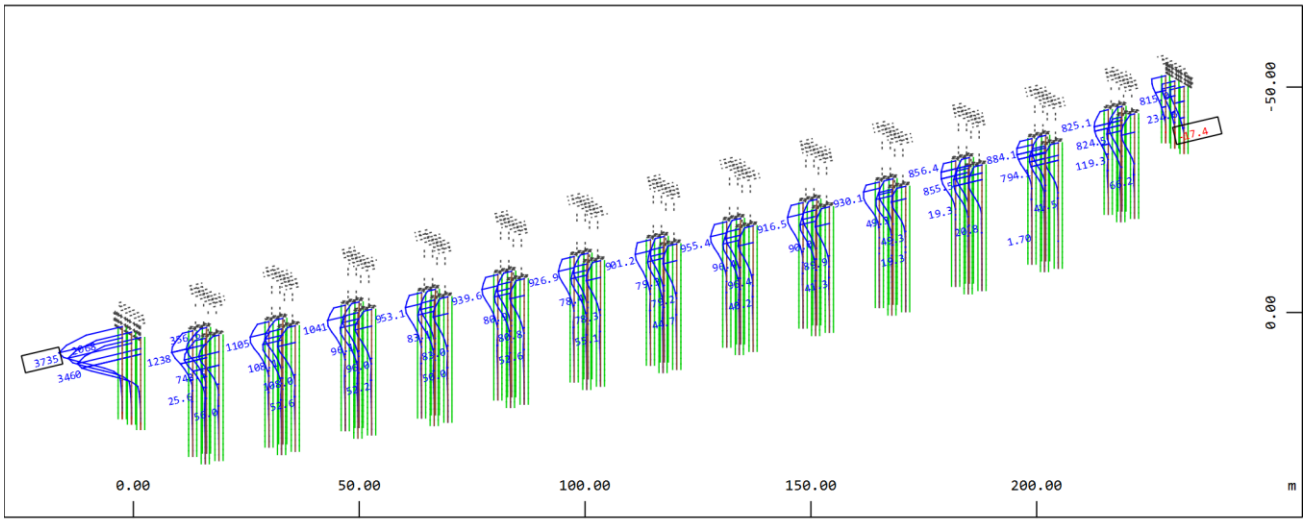
Sector of system Group 0 11
Beam Elements , Normal force Nx, Loadcase 7522 MIN-N BEAM , 1 cm 3D = 9023. kN
(Min=-5070.) (Max=-1376.)

M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927



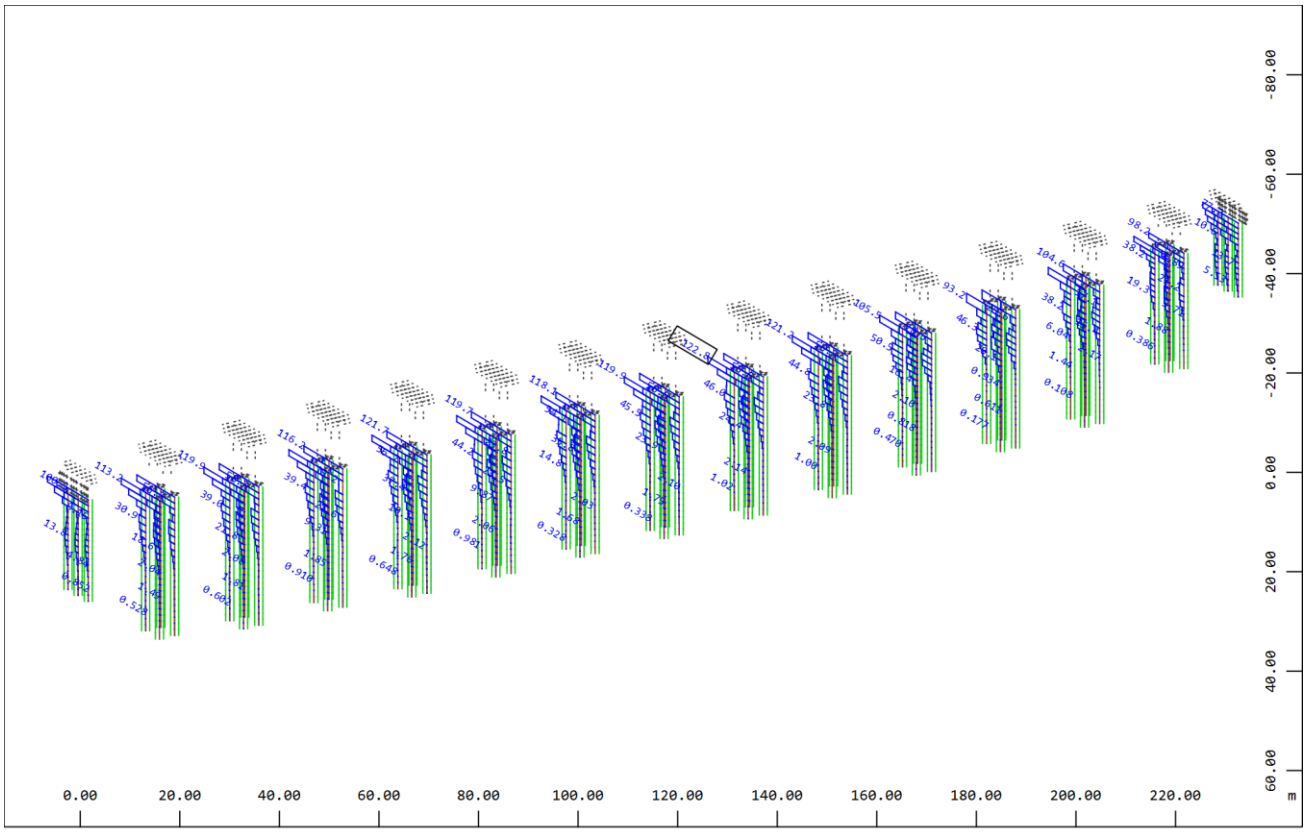
Sector of system Group 0 11
Beam Elements , Bending moment My, Loadcase 7525 MAX-MY BEAM , 1 cm 3D = 360.9 kNm
(Min=-1.9920e-13) (Max=290.9)

M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927



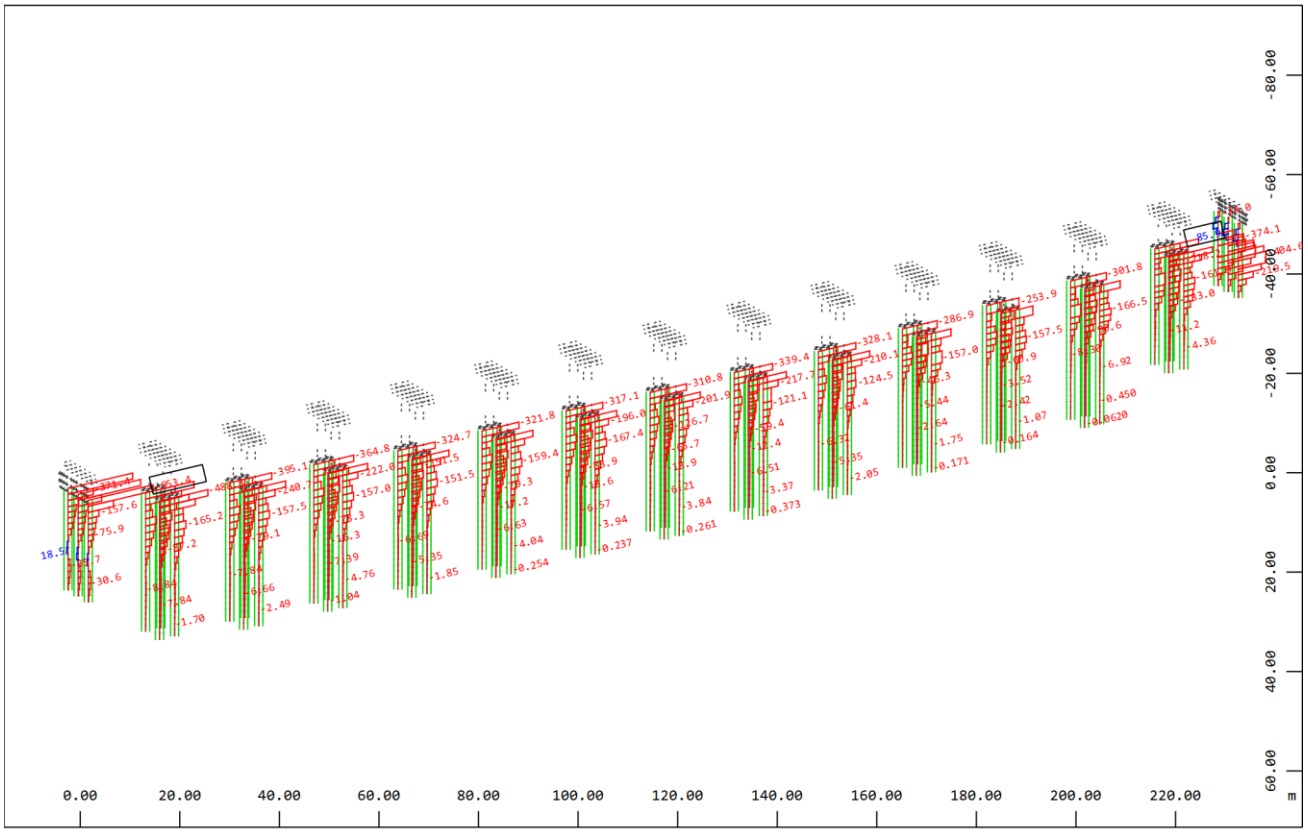
Sector of system Group 0 11
Beam Elements , Bending moment Mz, Loadcase 7527 MAX-MZ BEAM , 1 cm 3D = 3609. kNm
(Min=-17.4) (Max=3735.)

M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927



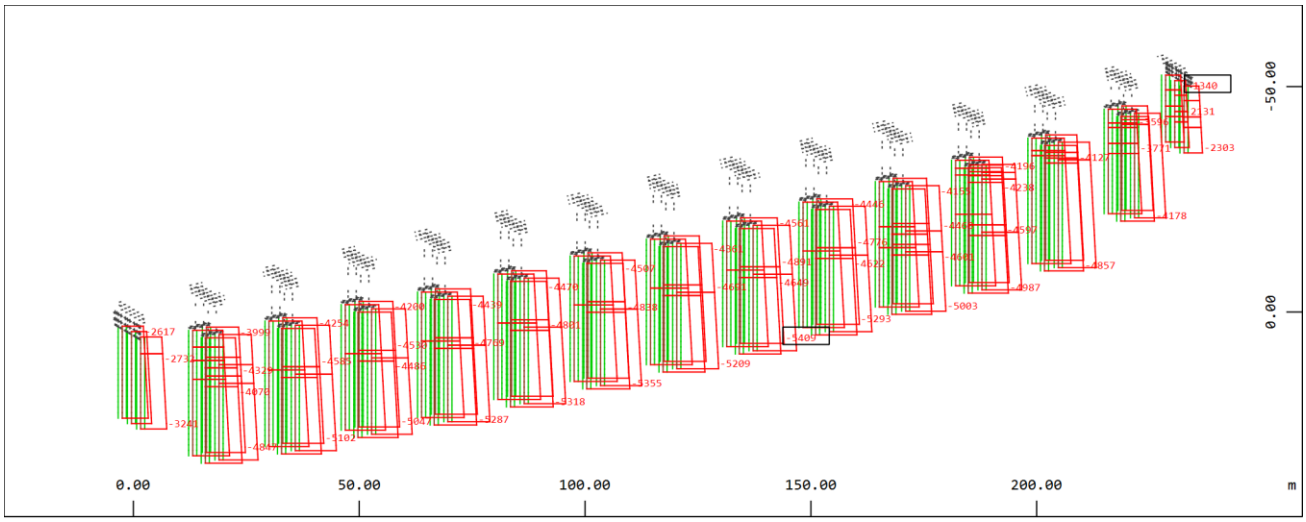
Sector of system Group 0 11
Beam Elements , Shear force Vz, Loadcase 7531 MAX-VZ BEAM , 1 cm 3D = 180.5 kN
(Max=122.8)

M 1 : 1457
X * 0.868
Y * 0.622
Z * 0.927



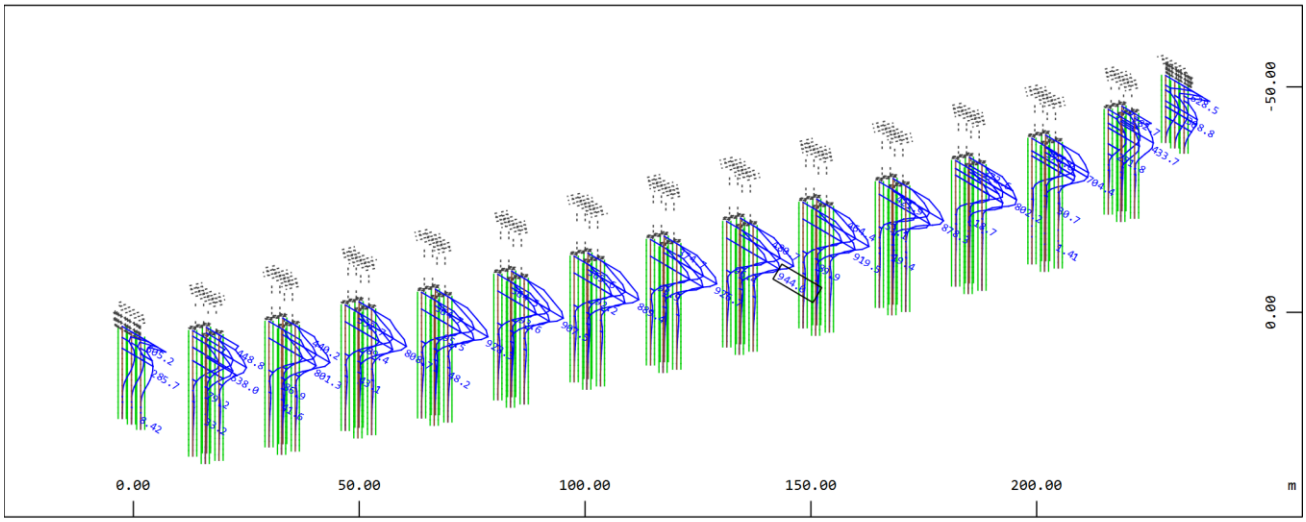
Sector of system Group 0 11
Beam Elements , Shear force Vy, Loadcase 7530 MIN-VY BEAM , 1 cm 3D = 902.3 kN
(Min=-953.4) (Max=85.9)

M 1 : 1457
X * 0.868
Y * 0.622
Z * 0.927



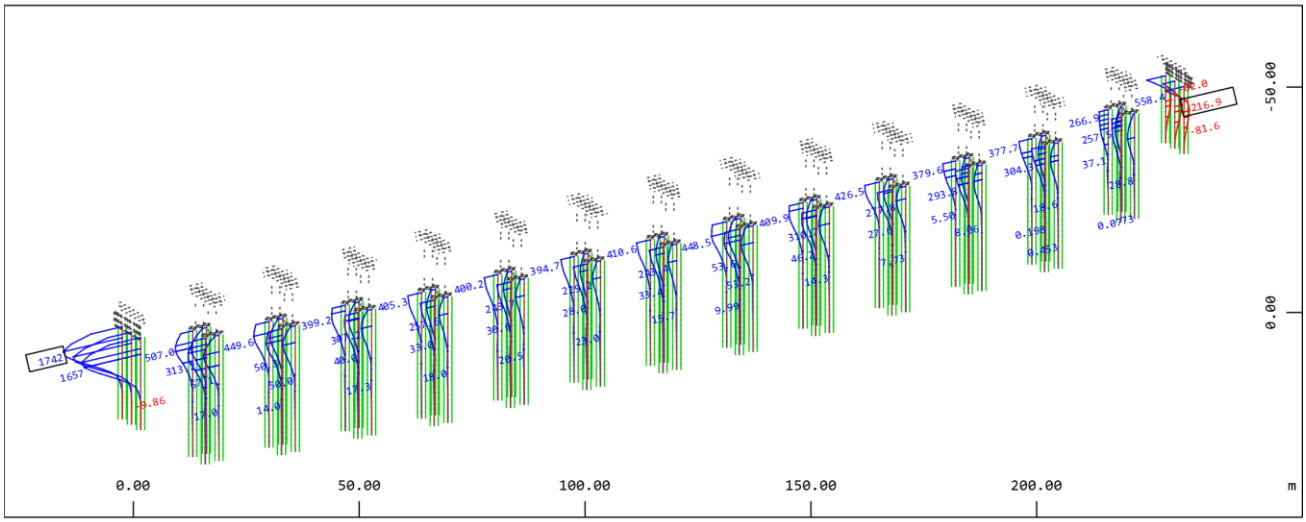
Sector of system Group 0 11
Beam Elements , Normal force Nx, Loadcase 8522 MIN-N BEAM , 1 cm 3D = 9023. kN
(Min=-5409.) (Max=-1340.)

M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927



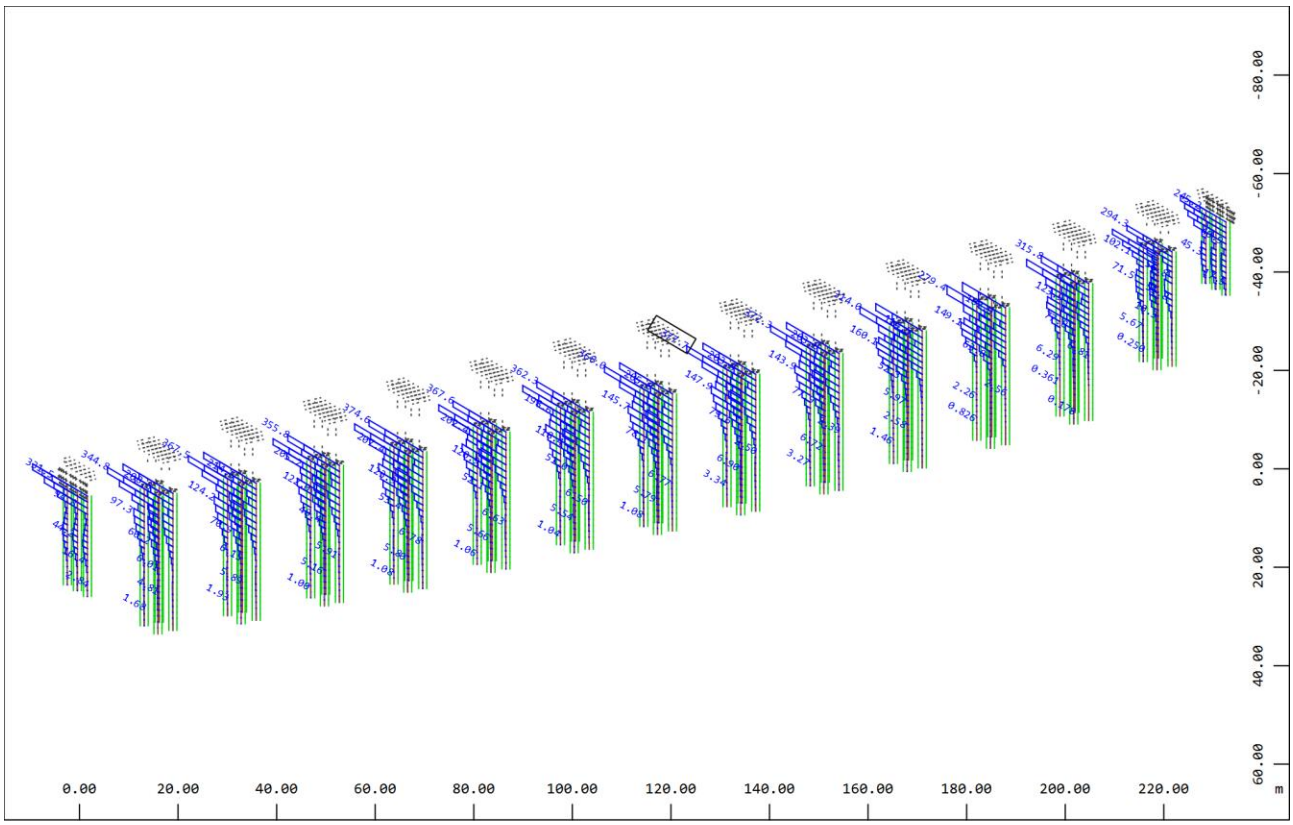
Sector of system Group 0 11
Beam Elements , Bending moment My, Loadcase 8525 MAX-MY BEAM , 1 cm 3D = 902.3 kNm
(Max=944.0)

M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927



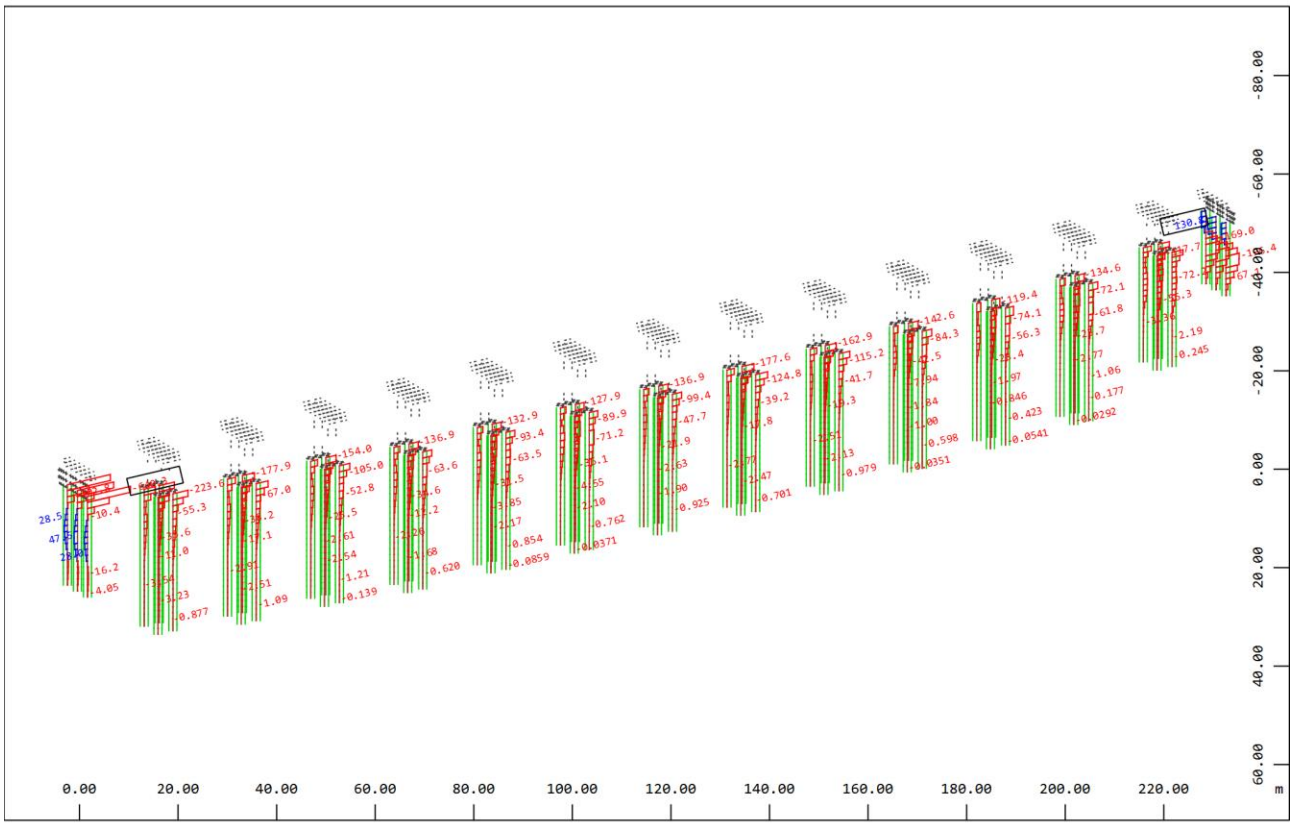
Sector of system Group 0 11
Beam Elements , Bending moment Mz, Loadcase 8527 MAX-MZ BEAM , 1 cm 3D = 1805. kNm
(Min=-216.9) (Max=1742.)

M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927



Sector of system Group 0 11
Beam Elements , Shear force Vz, Loadcase 8531 MAX-VZ BEAM , 1 cm 3D = 360.9 kN
(Max=377.7)

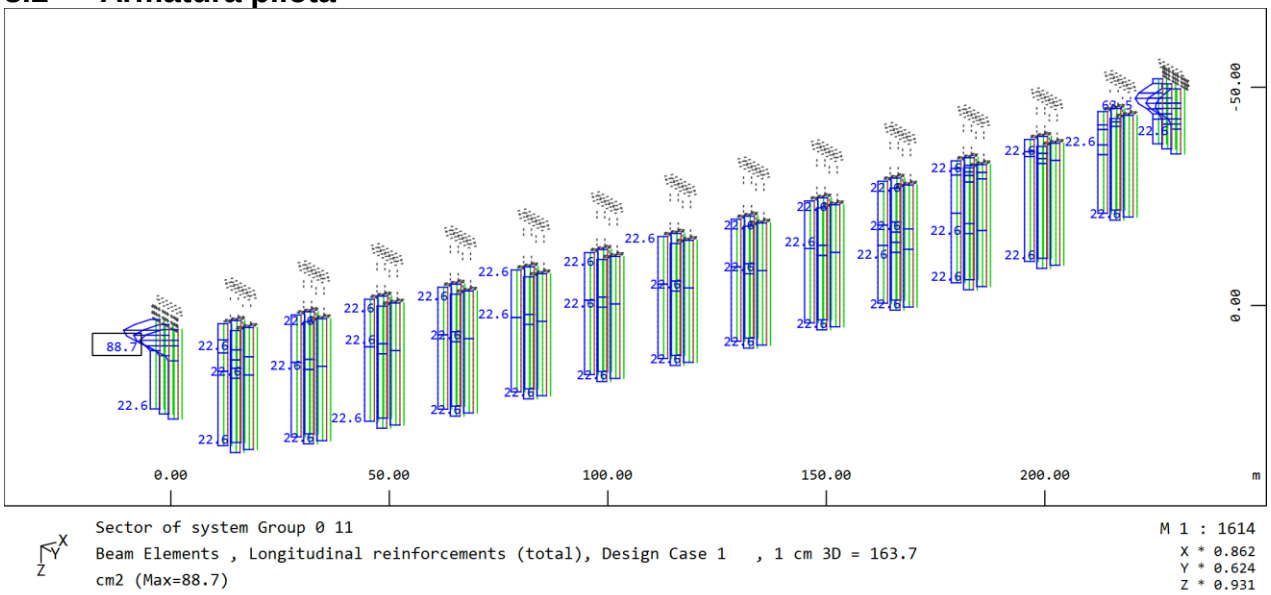
M 1 : 1457
X * 0.868
Y * 0.622
Z * 0.927



Sector of system Group 0 11
Beam Elements , Shear force Vy, Loadcase 8530 MIN-VY BEAM , 1 cm 3D = 902.3 kN
(Min=-640.3) (Max=130.8)

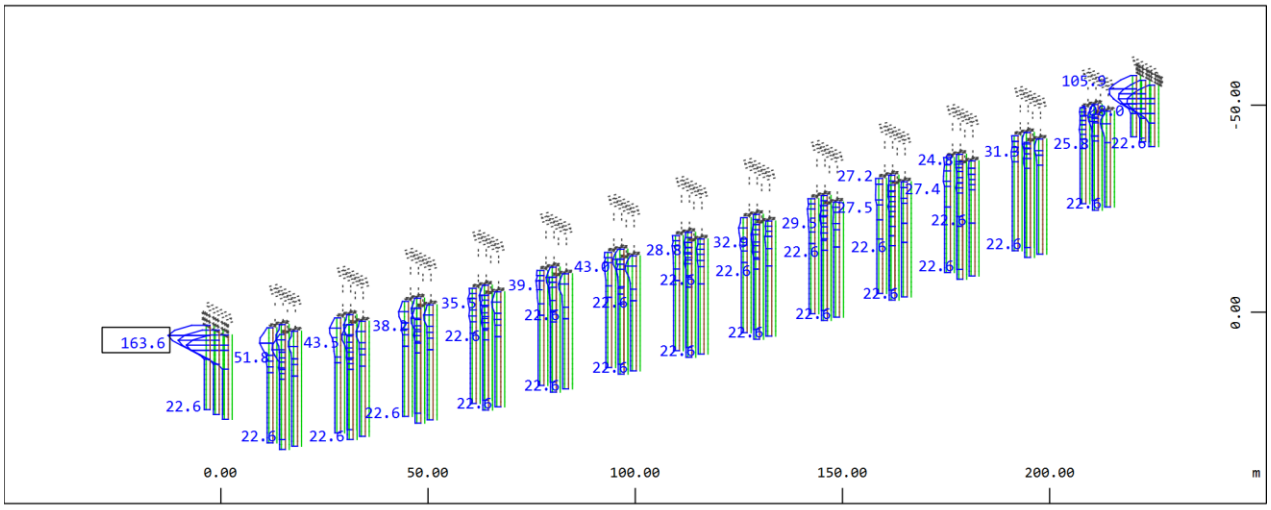
M 1 : 1457
X * 0.868
Y * 0.622
Z * 0.927

8.2 Armatura pilota



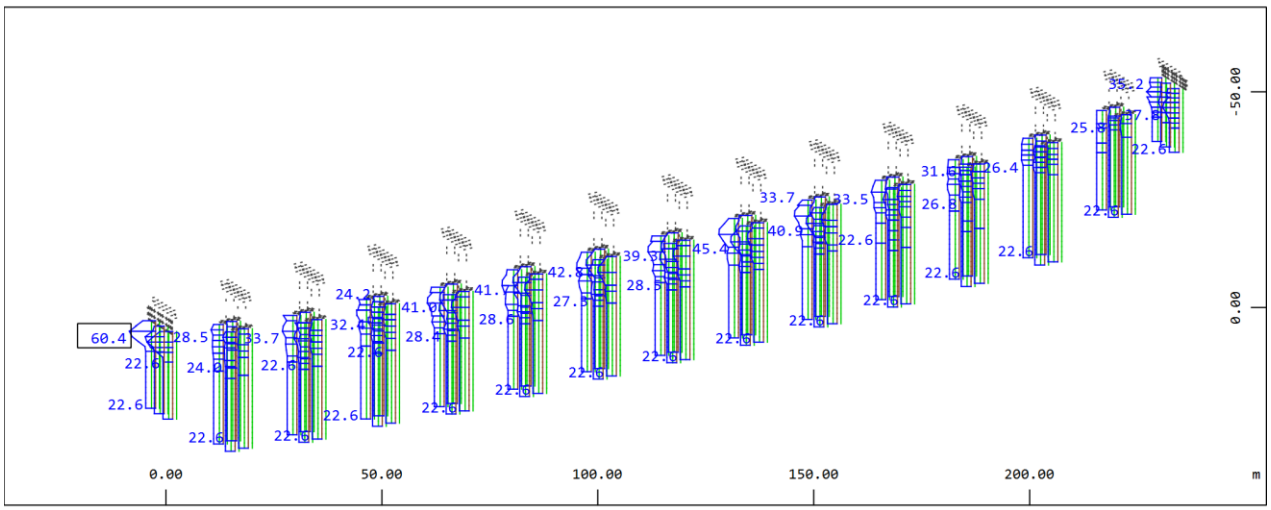
Sector of system Group 0 11
Beam Elements , Longitudinal reinforcements (total), Design Case 1 , 1 cm 3D = 163.7
cm2 (Max=88.7)

M 1 : 1614
X * 0.862
Y * 0.624
Z * 0.931



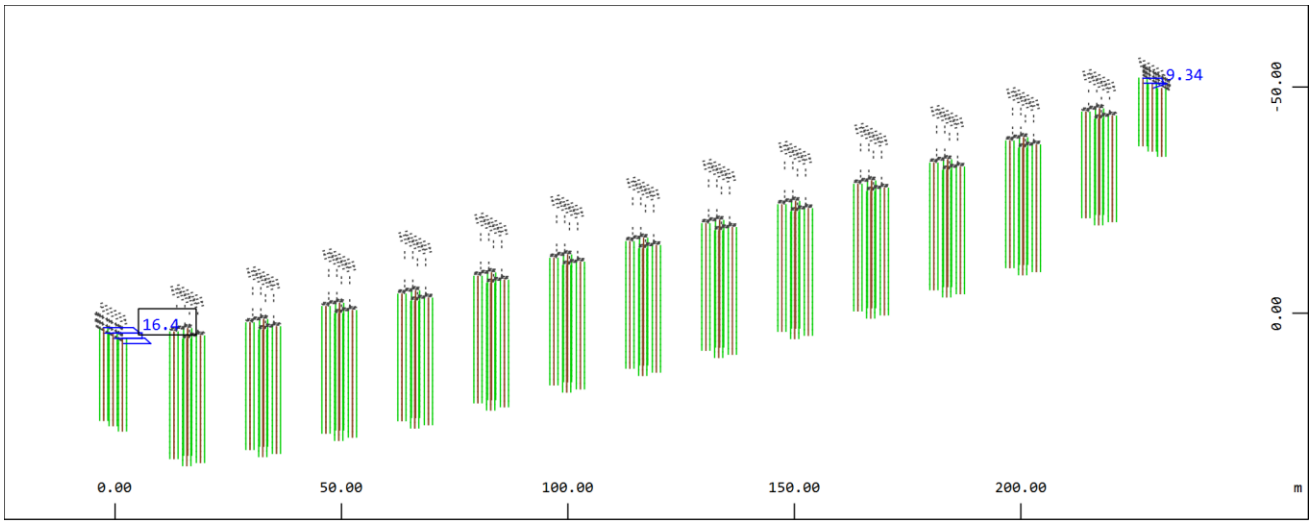
Sector of system Group 0 11
Beam Elements , Longitudinal reinforcements (total), Design Case 7 , 1 cm 3D = 275.0
cm2 (Max=163.6)

M 1 : 1702
X * 0.846
Y * 0.653
Z * 0.926



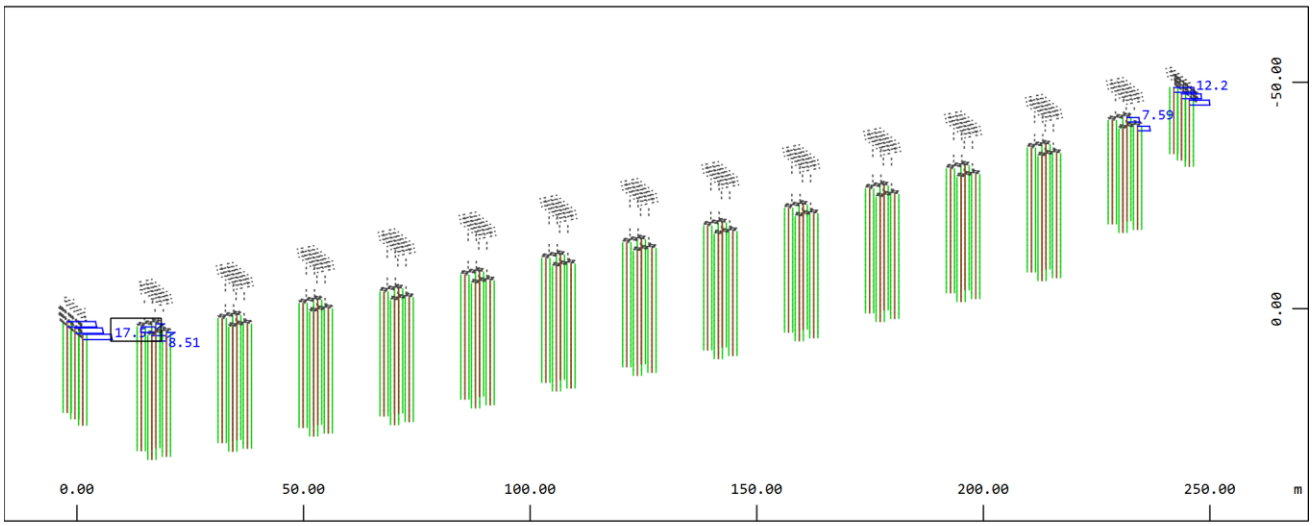
Sector of system Group 0 11
Beam Elements , Longitudinal reinforcements (total), Design Case 8 , 1 cm 3D = 163.7
cm2 (Max=60.4)

M 1 : 1633
X * 0.876
Y * 0.619
Z * 0.922



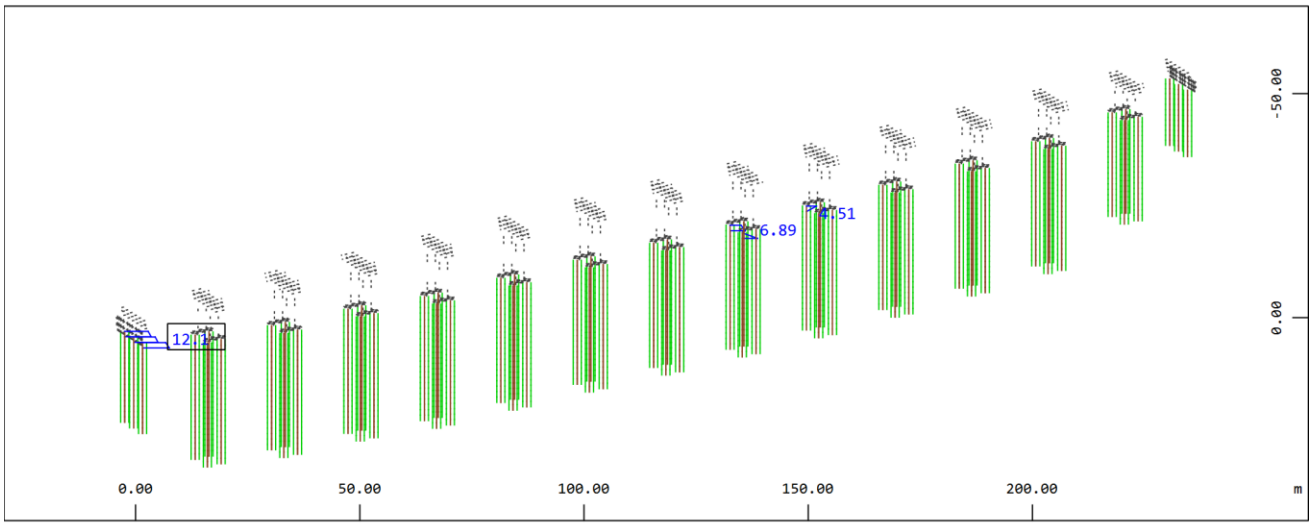
Sector of system Group 0 11
Shear reinforcements (maximum), Design Case 1 , (1 cm 3D = unit) Beam Elements
(Unit=32.7 cm2/m) (Max=16.4)

M 1 : 1609
X * 0.862
Y * 0.624
Z * 0.931



Sector of system Group 0 11
Shear reinforcements (maximum), Design Case 7 , (1 cm 3D = unit) Beam Elements
(Unit=43.3 cm2/m) (Max=17.5)

M 1 : 1608
X * 0.912
Y * 0.582
Z * 0.911



Sector of system Group 0 11
Shear reinforcements (maximum), Design Case 8 , (1 cm 3D = unit) Beam Elements
(Unit=32.7 cm2/m) (Max=12.1)

M 1 : 1625
X * 0.876
Y * 0.619
Z * 0.922

PILOTI

Dimenzije: ∅=150cm smanjeni za ($d_{nom} > 1\,000$ mm) $d = d_{nom} - 50$ mm = $\varnothing_{rač}$**=145cm**

- d_1 = c + Φ_v + ½*Φ_s = 8,5 + 1,4 + ½*3,2 = 11,5 cm (zaštitni sloj c = 8,5 cm, pretpostavljene vilice Φ_v 12, pretpostavljena uzdužna armatura Φ_s28)

d_s = h – d_{1s} = 150,0 – 11,5 = **138,5 cm**

Računske čvrstoće gradiva

- *Računska čvrstoća betona C30/37*

$f_{cd} = f_{ck}/\gamma_c$ = 0,85 · 30 / (1,5 · 1,1) = 15,45 N/mm^2 = 1,545 kN/cm^2

- *Računska granica popuštanja betonskog čelika B500B*

$f_{yd} = f_{yk}/\gamma_s$ = 500/1,15 = 434,78 N/mm^2 = 43,478 kN/cm^2

<u>Uzdužna armatura</u>

Piloti stupišta

maksimalna proračunska armatura u pilotima stupišta: A_s = 52,9 cm^2
odabrano: 16Φ28/25,0 cm ($A_{s,odabrano}$ = 98,5 cm^2)

Piloti upornjaka

maksimalna proračunska armatura u pilotima upornjaka: A_s = 163,6 cm^2
odabrano: 22Φ32/18 cm ($A_{s,odabrano}$ = 176,88 cm^2)

Minimalna armatura prema EC2 za elemente naprezane uzdužnom silom:

$A_{s,min} = 0,15 \cdot N_{Sd}/f_{yd} \geq 0,003A_c$
$A_{s,min} = 0,15 \cdot 4842/43,478 = 16,7$ cm^2 < $0,003 \cdot 1,13 \cdot 100^2 = 33,9$ cm^2
N_{Sd} = maksimalna uzdužna sila u stupu
As ≥ 0,0025 · Ac = 44,2 cm2

Maksimalna armatura:

$A_{s,max} = 0,04A_c = 0,04 \cdot 1,13 \cdot 100^2 = 452,0$ cm^2
$A_{s,min} \leq A_{s,od} \leq A_{s,max}$

<u>Poprečna armatura</u>

Piloti stupišta
Na gornjih 3xD pri vrhu (**odabrano** spirala Φ12/10,0 cm ili 22,6 cm^2/m)
(prema HRN EN 1998-2, t.6.4.2(3) min. na 3xpromjer pilota)
Ostalo (**odabrano** spirala Φ12/15,0 cm ili 15,1 cm^2/m)

Piloti upornjaka pri vrhu (6m) (**odabrano** spirala Φ14/10 cm ili 30,8 cm^2/m)
Ostalo (**odabrano** spirala Φ12/15,0 cm ili 15,1 cm^2/m)

Minimalna armatura je:

- $A_{sw,min} = \rho_{w,min} \cdot b_w = 0,0011 \cdot 120,0 = 0,132$ cm^2/cm = 13,2 cm^2/m, gdje je $\rho_{w,min}$ = 0,0011 za klasu betona C30/37 i B500B
- $s_{w,max}$ = max { 0,6·d, 15 cm }
- $s_{w,max}$ = 15,0 cm

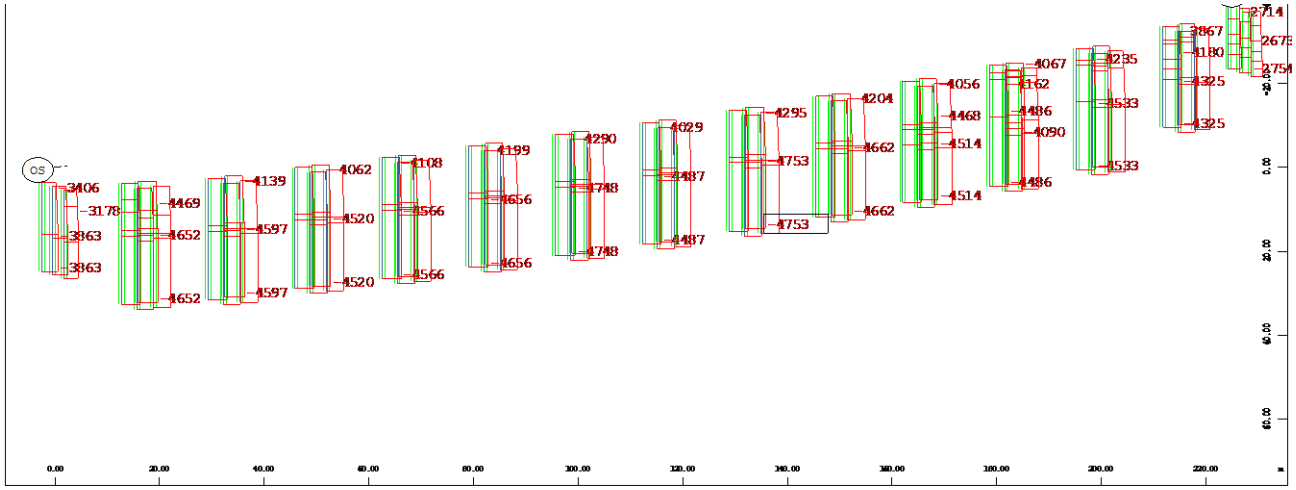
8.3 Nosivost pilota

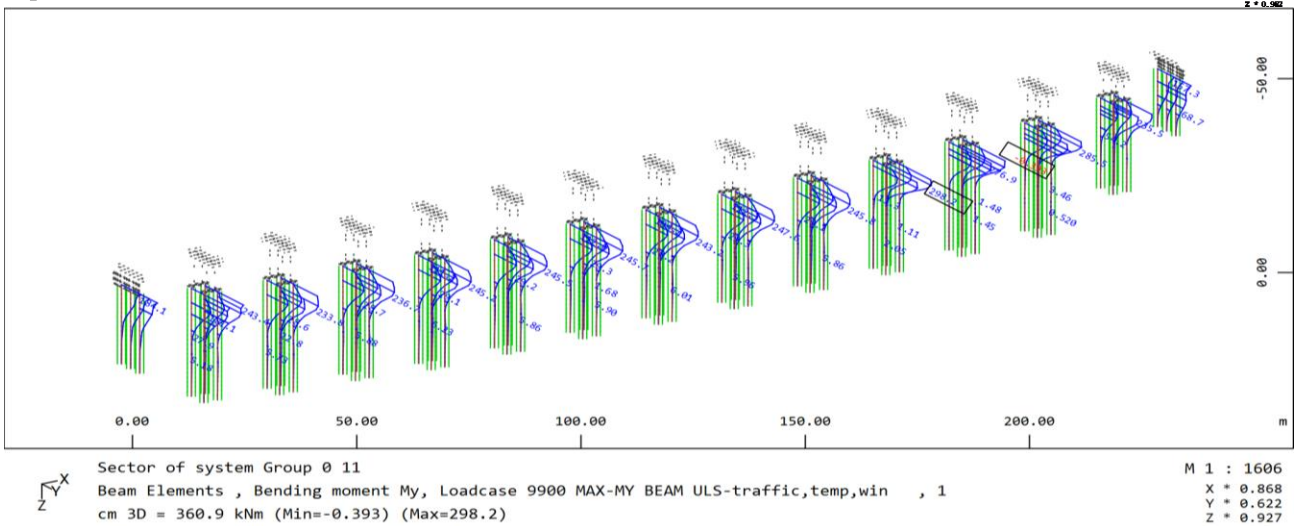
Za kontrolu nosivosti pilota se koriste ova opterećenja i potresne kombinacije opterećenja:

LC 9900-9909	ULS kombinacija
LC 7500-7599	potres-x kombinacija
LC 8500-8599	potres-y kombinacija

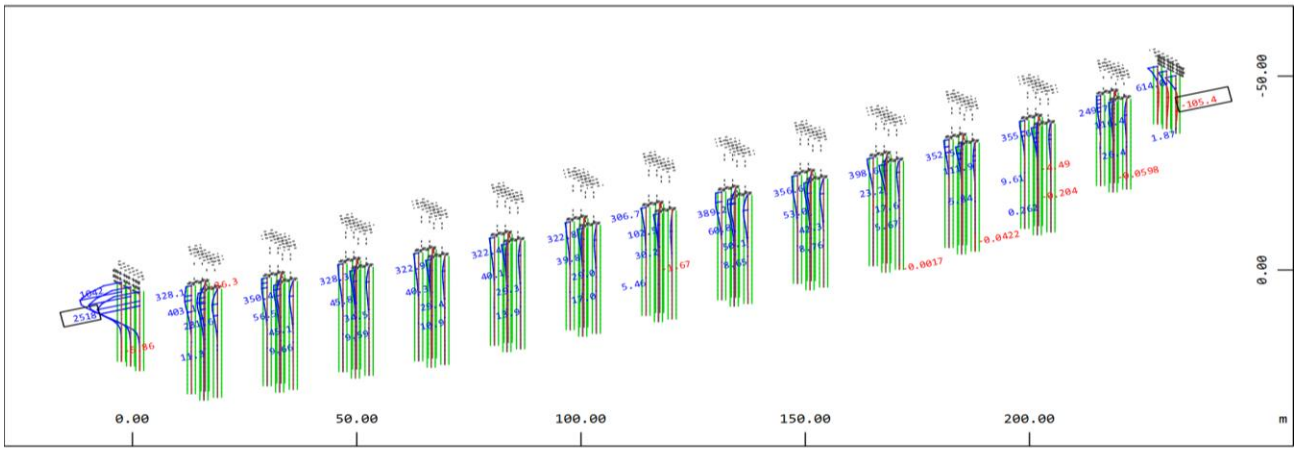
Uzdužne sile u pilotima nisu veće od dopuštenih danih u geotehničkom projektu.

REZNE SILE U PILOTIMA OD KOMBINACIJA ZA NOSIVOST PILOTA

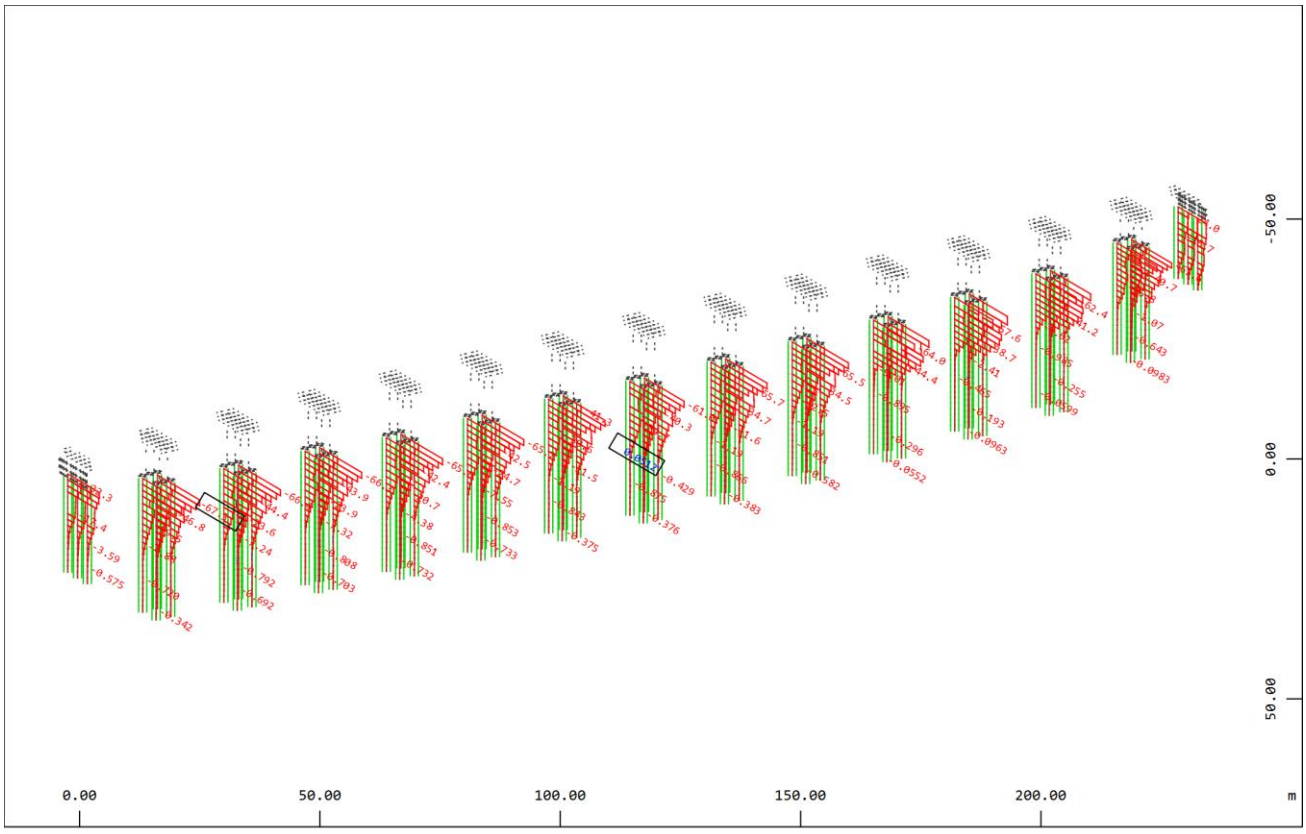




Sector of system Group 0 11
Beam Elements , Bending moment My, Loadcase 9900 MAX-MY BEAM ULS-traffic,temp,win , 1
cm 3D = 360.9 kNm (Min=-0.393) (Max=298.2)
M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927

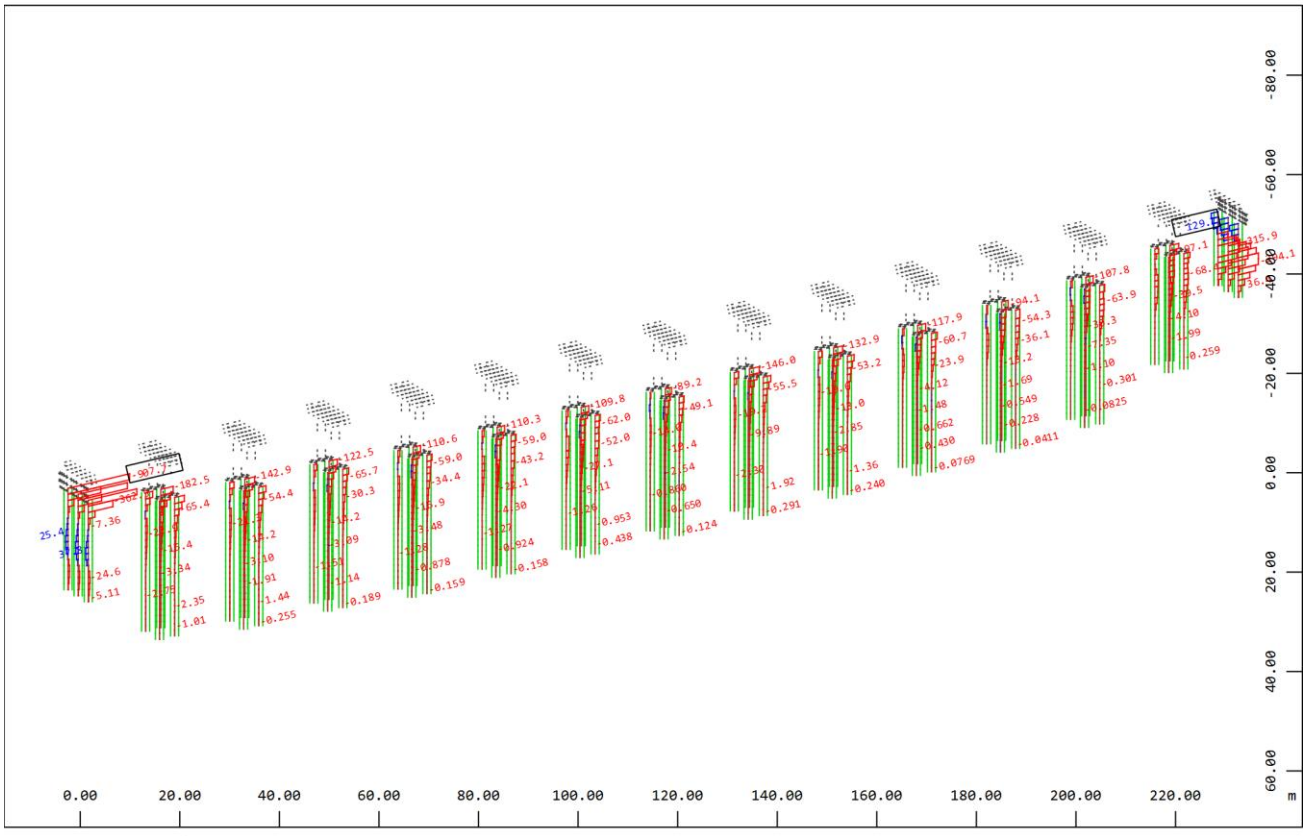


Sector of system Group 0 11
Beam Elements , Bending moment Mz, Loadcase 9904 MAX-MZ BEAM ULS-traffic,temp,win , 1
cm 3D = 3609. kNm (Min=-105.4) (Max=2518.)
M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927



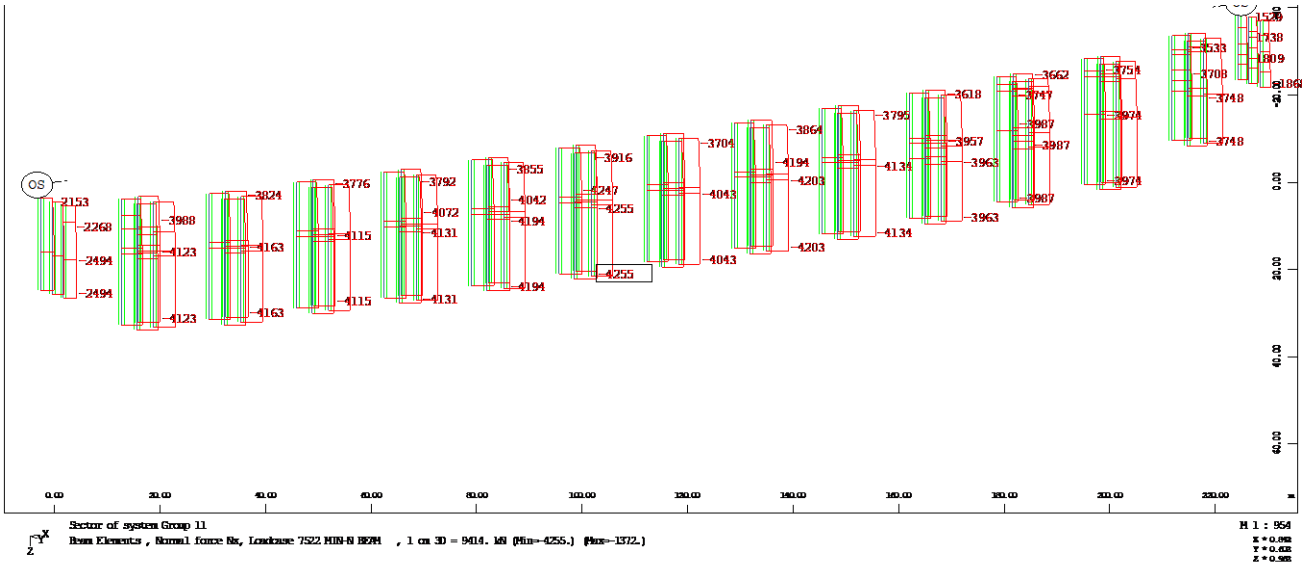
Sector of system Group 0 11
Beam Elements , Shear force Vz, Loadcase 9903 MIN-VZ BEAM ULS-traffic,temp,win , 1 cm
3D = 90.2 kN (Min=-67.3) (Max=0.0512)

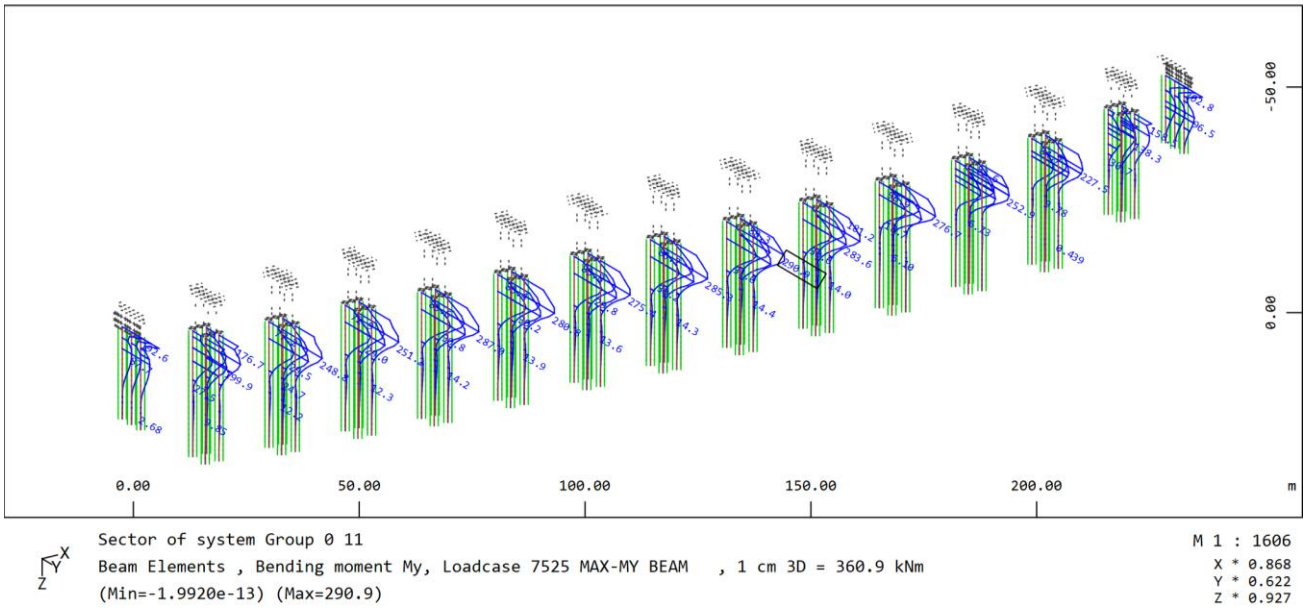
M 1 : 1509
X * 0.868
Y * 0.622
Z * 0.927

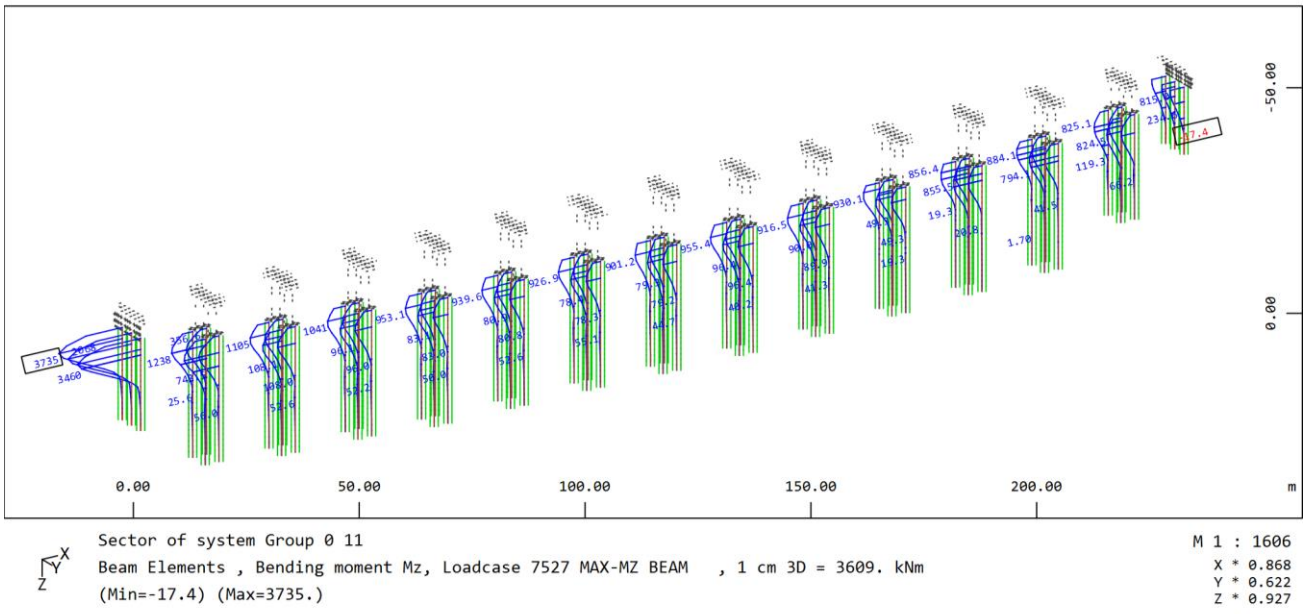


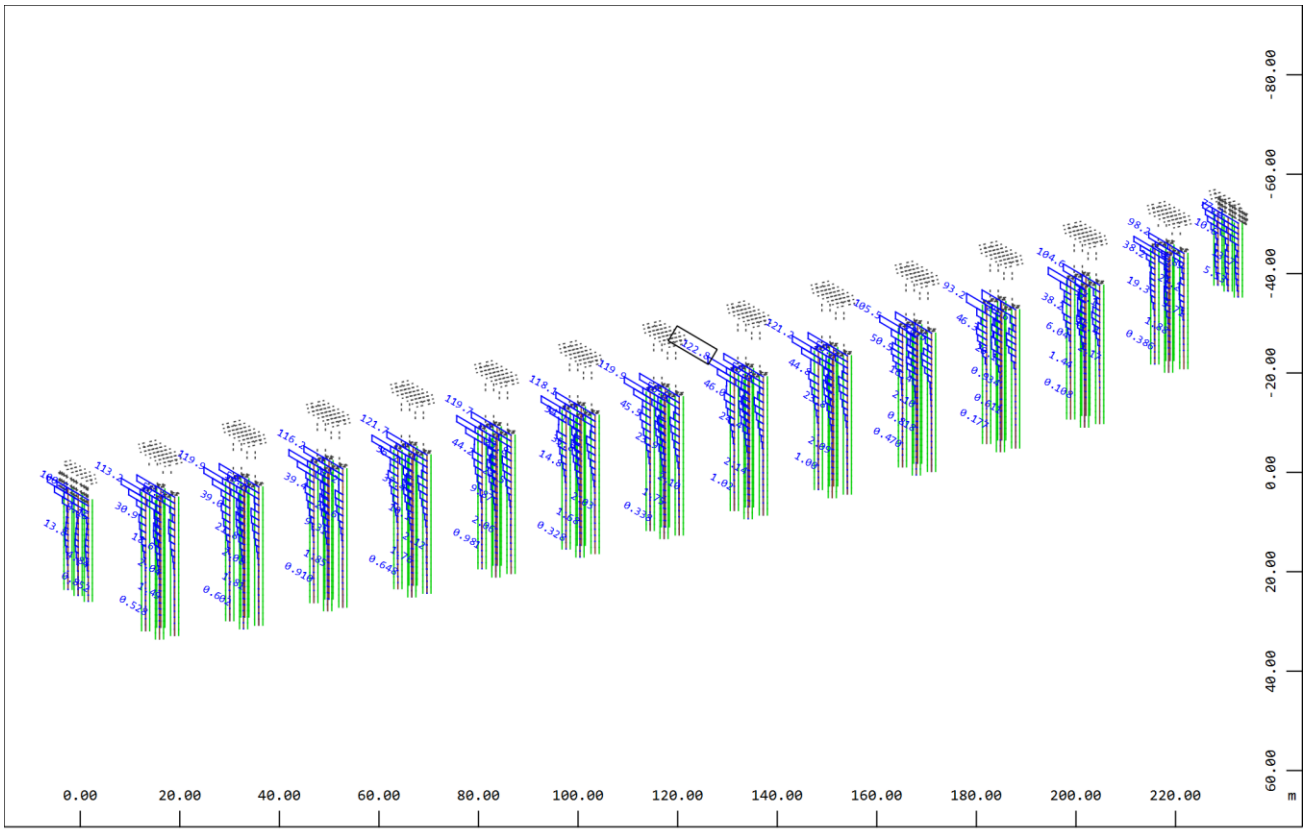
Sector of system Group 0 11
Beam Elements , Shear force Vy, Loadcase 9907 MIN-VY BEAM ULS-traffic,temp,win , 1 cm
3D = 902.3 kN (Min=-907.7) (Max=129.7)

M 1 : 1457
X * 0.868
Y * 0.622
Z * 0.927


Sector of system Group 11
Beam Elements , Normal force Nx, Loadcase 7522 MIN-N BEAM , 1 cm 3D = 9414. kN (Min=-4255.) (Max=-1572.)
M 1 : 954

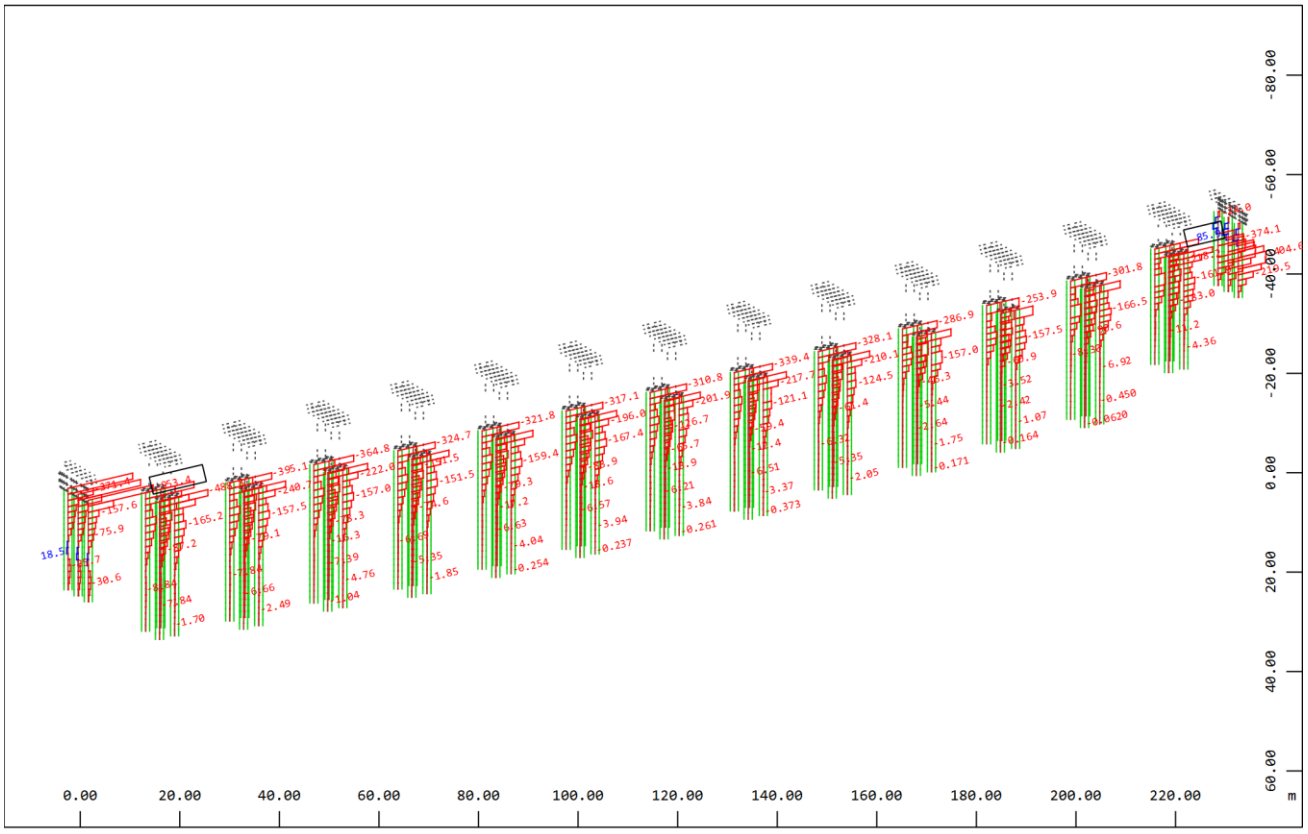

Sector of system Group 0 11
Beam Elements , Bending moment My, Loadcase 7525 MAX-MY BEAM , 1 cm 3D = 360.9 kNm
(Min=-1.9920e-13) (Max=290.9)
M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927


Sector of system Group 0 11
Beam Elements , Bending moment Mz, Loadcase 7527 MAX-MZ BEAM , 1 cm 3D = 3609. kNm
(Min=-17.4) (Max=3735.)
M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927



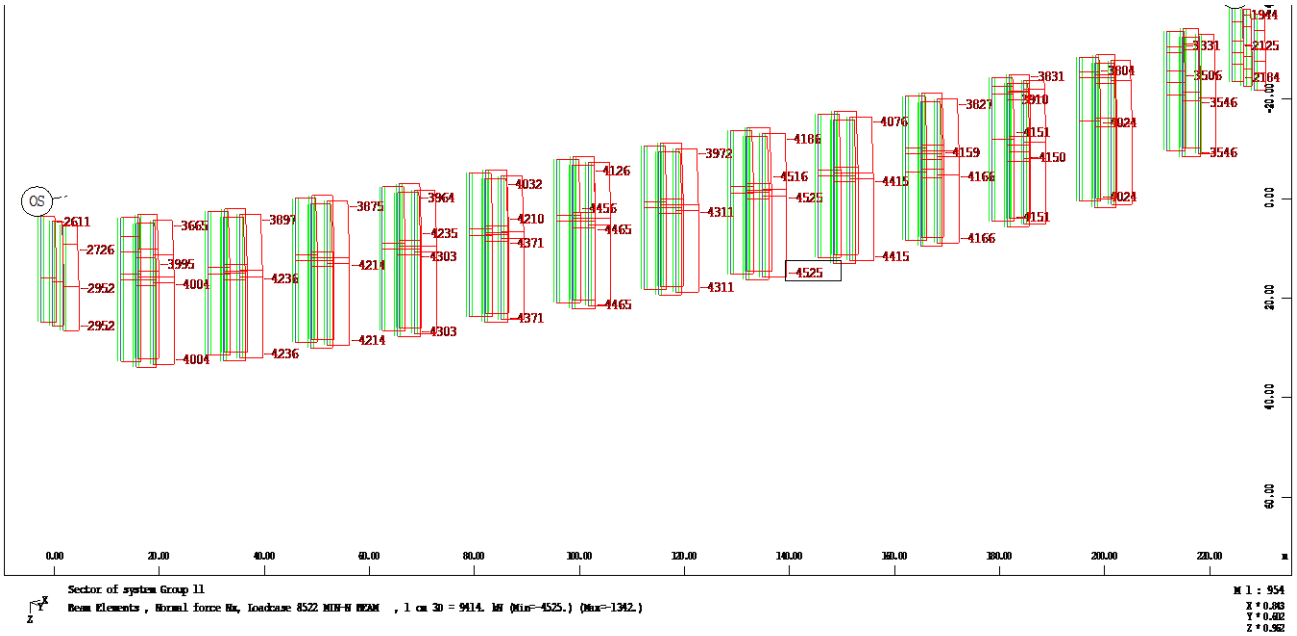
Sector of system Group 0 11
Beam Elements , Shear force Vz, Loadcase 7531 MAX-VZ BEAM , 1 cm 3D = 180.5 kN
(Max=122.8)

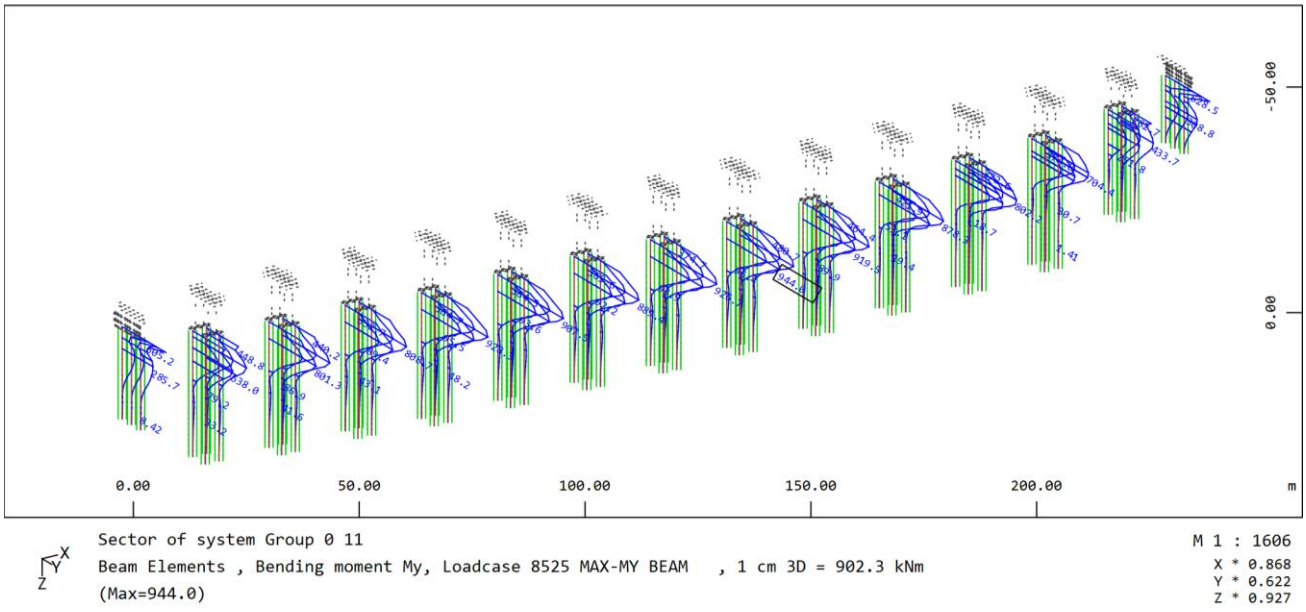
M 1 : 1457
X * 0.868
Y * 0.622
Z * 0.927

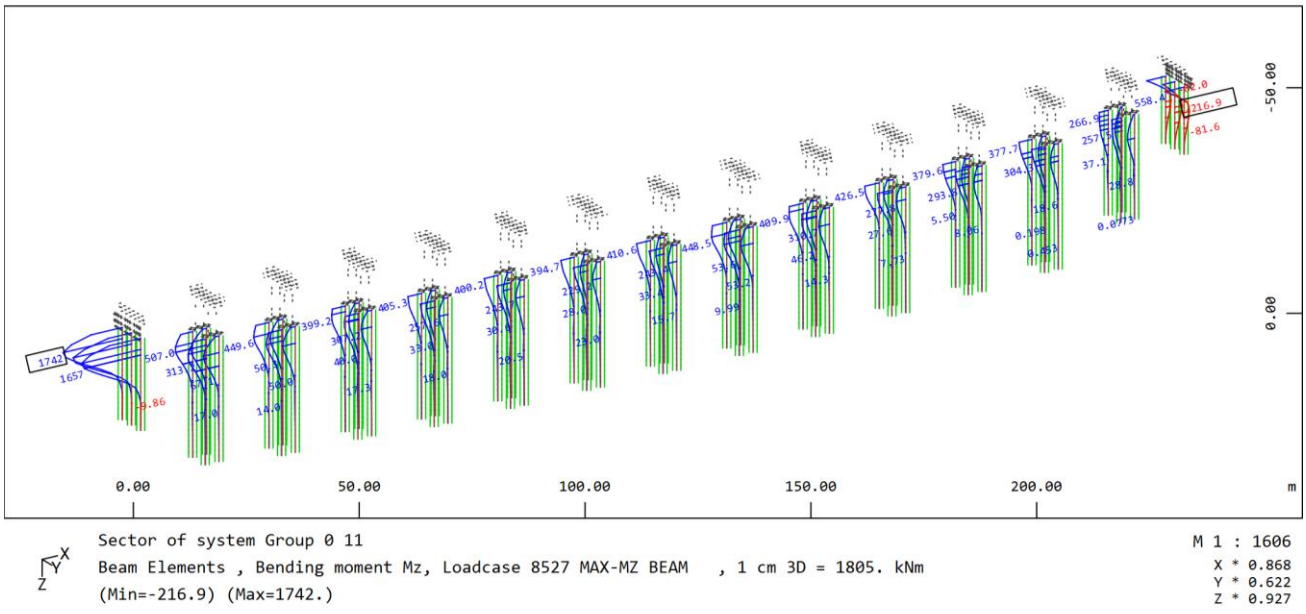


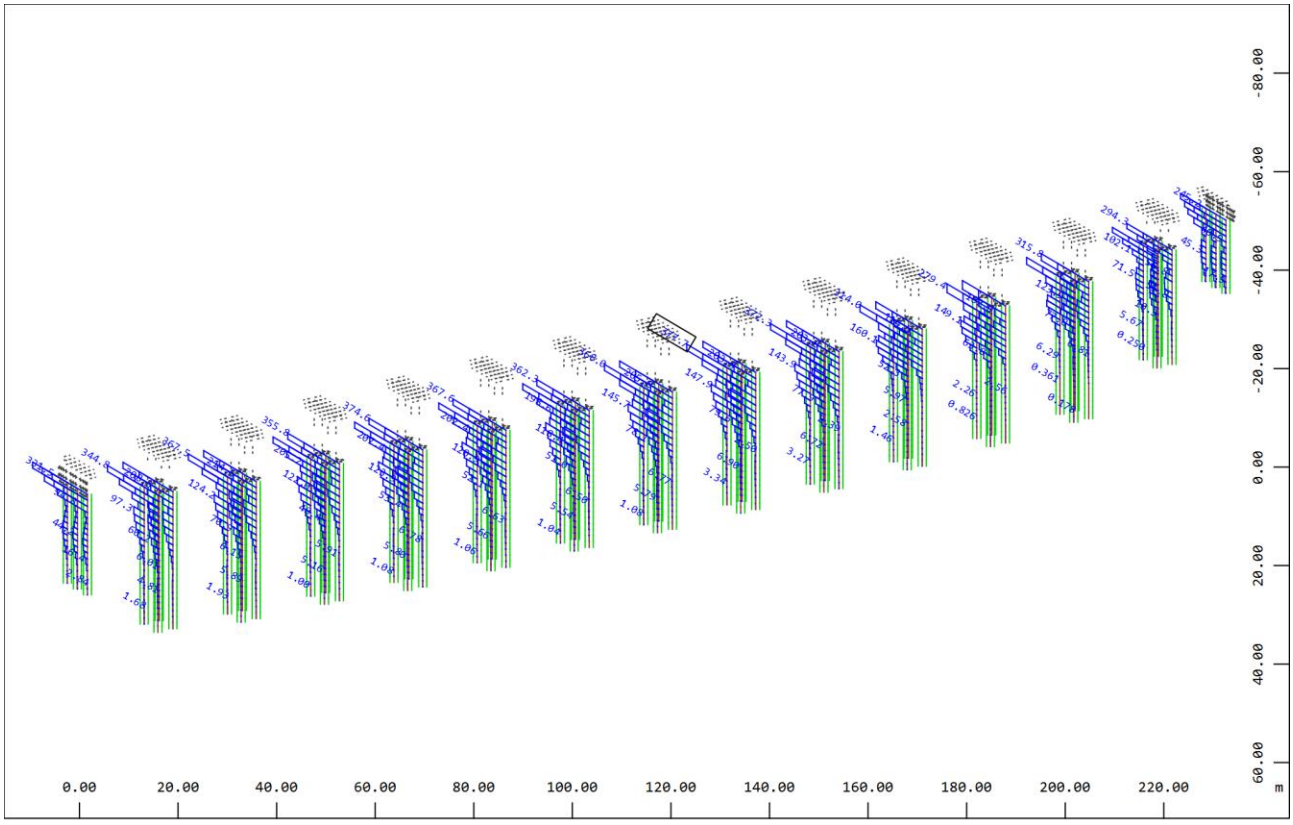
Sector of system Group 0 11
Beam Elements , Shear force Vy, Loadcase 7530 MIN-VY BEAM , 1 cm 3D = 902.3 kN
(Min=-953.4) (Max=85.9)

M 1 : 1457
X * 0.868
Y * 0.622
Z * 0.927


Sector of system Group 11
Beam Elements , Normal force Nx, Loadcase 8522 MIN-N BEAM , 1 cm 3D = 9414. kN (Min=-4525.) (Max=-1342.)
M 1 : 954
X * 0.883
Y * 0.602
Z * 0.962

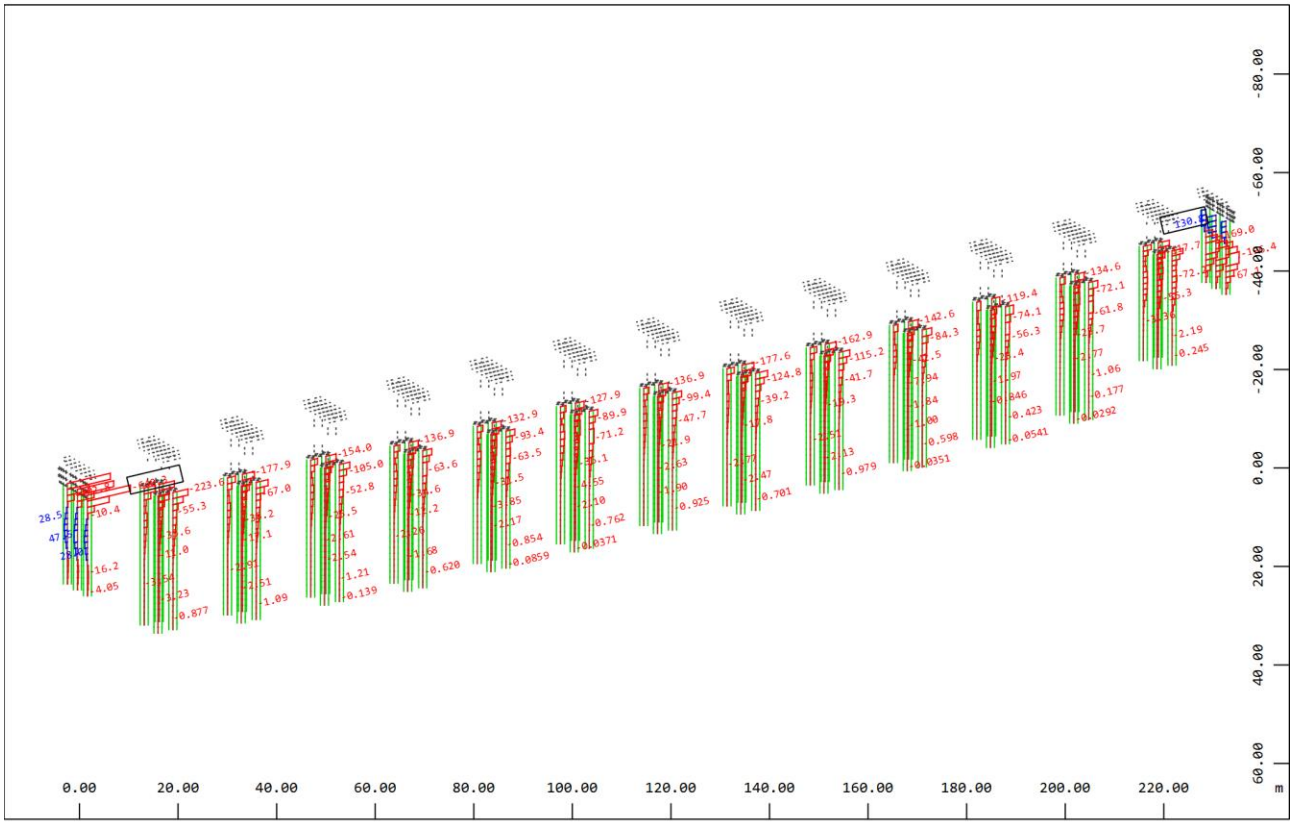

Sector of system Group 0 11
Beam Elements , Bending moment My, Loadcase 8525 MAX-MY BEAM , 1 cm 3D = 902.3 kNm
(Max=944.0)
M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927


Sector of system Group 0 11
Beam Elements , Bending moment Mz, Loadcase 8527 MAX-MZ BEAM , 1 cm 3D = 1805. kNm
(Min=-216.9) (Max=1742.)
M 1 : 1606
X * 0.868
Y * 0.622
Z * 0.927



Sector of system Group 0 11
Beam Elements , Shear force Vz, Loadcase 8531 MAX-VZ BEAM , 1 cm 3D = 360.9 kN
(Max=377.7)

M 1 : 1457
X * 0.868
Y * 0.622
Z * 0.927



Sector of system Group 0 11
Beam Elements , Shear force Vy, Loadcase 8530 MIN-VY BEAM , 1 cm 3D = 902.3 kN
(Min=-640.3) (Max=130.8)

M 1 : 1457
X * 0.868
Y * 0.622
Z * 0.927

9. UPORNJAK

9.1 Kombinacije opterećenja za proračun upornjaka

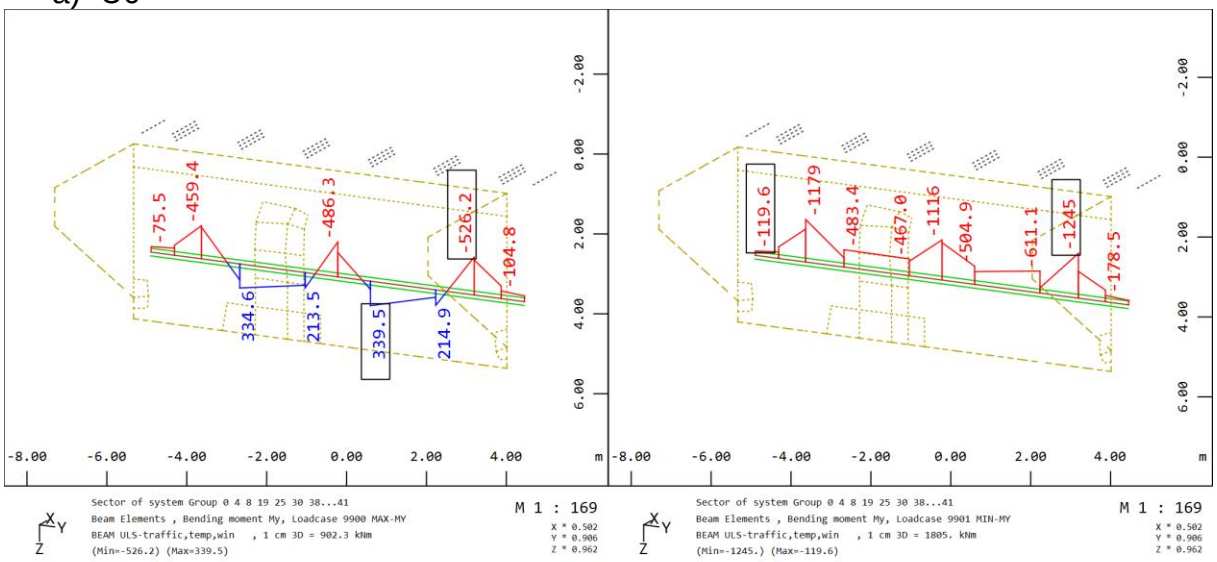
Dimenzioniranje zida i krila upornjaka vrši se prema ovim kombinacijama opterećenja:

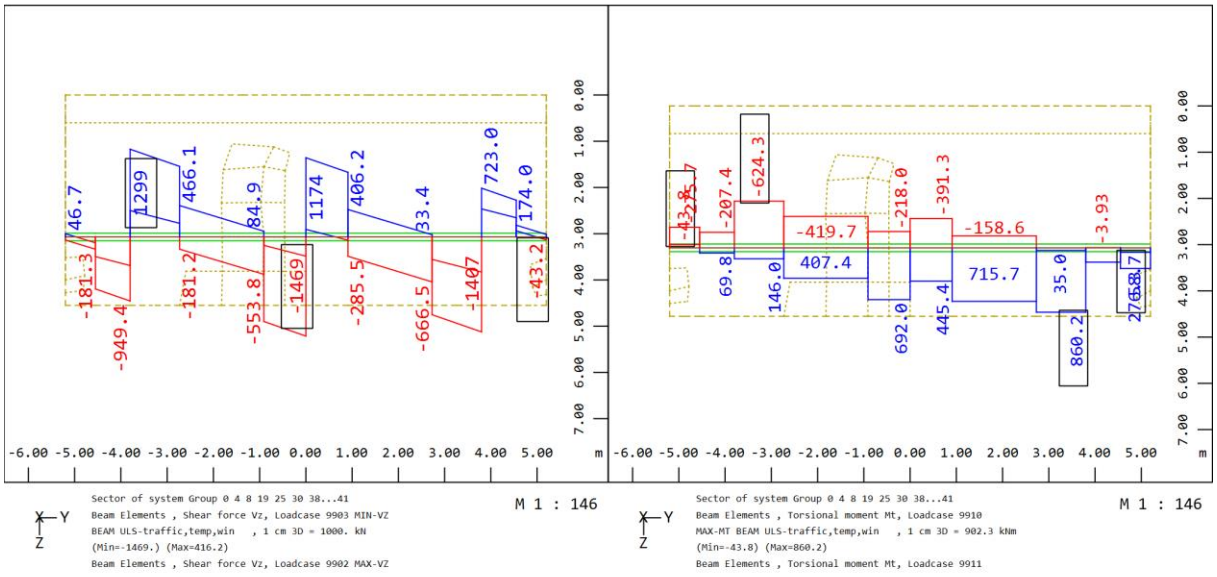
OZNAKA KOMBINACIJE LC	Raspisane kombinacije korištene za dimenzioniranje rasponskog sklopa, stupova, naglavnica pilota i pilota	NAZIV KOMBINACIJE	Oznaka armature
9900 – 9999	1,35 (1,0)·G+1,35(1,0)·R+1,35·(Q_{oso}+Q_{jed}) +1,0·C + 1,5·ZW_{opt} +0,75·ZT + 1,0·ZF	PROMET+VJETAR	Lcr 1
	1,35 (1,0)·G+1,35(1,0)·R +1,5·ZT+ 1,35·(0,75·Q_{oso}+0,4·Q_{jed}) +1,0·C + 1,0·ZF	TEMPERATURA	
	1,35(1,0)·G+1,35(1,0)·R+1,5·K+0,75·ZT 1,35·(0,75·Q_{oso}+0,4·Q_{jed})+1,0·C +1,0·ZF+1,5·ZW_{opt}	KOČENJE	
9800 – 9899	1,0·G+1,0·R+A+0,75·Q_{oso}+0,4·Q_{jed} +1,0·C + 1,0·ZF + 1,0·$ZW_{opterećen}$ + 0,5·ZT	UDAR	Lcr 4
	1,0·G+1,0·R+A + 0,2·Q_{oso}+0,2·Q_{jed} +1,0·C + 1,0·ZF + 1,0·$ZW_{opterećen}$ + 0,6·ZT		
7500 – 7599	1,0·G+1,0·C+1,0·R +E_X+0,3·E_Y+0,3·Ez	POTRES	Lcr 7
8500 – 8599	1,0·G+1,0·C+1,0·R+0,3·E_X+E_Y+0,3·Ez		Lcr 8

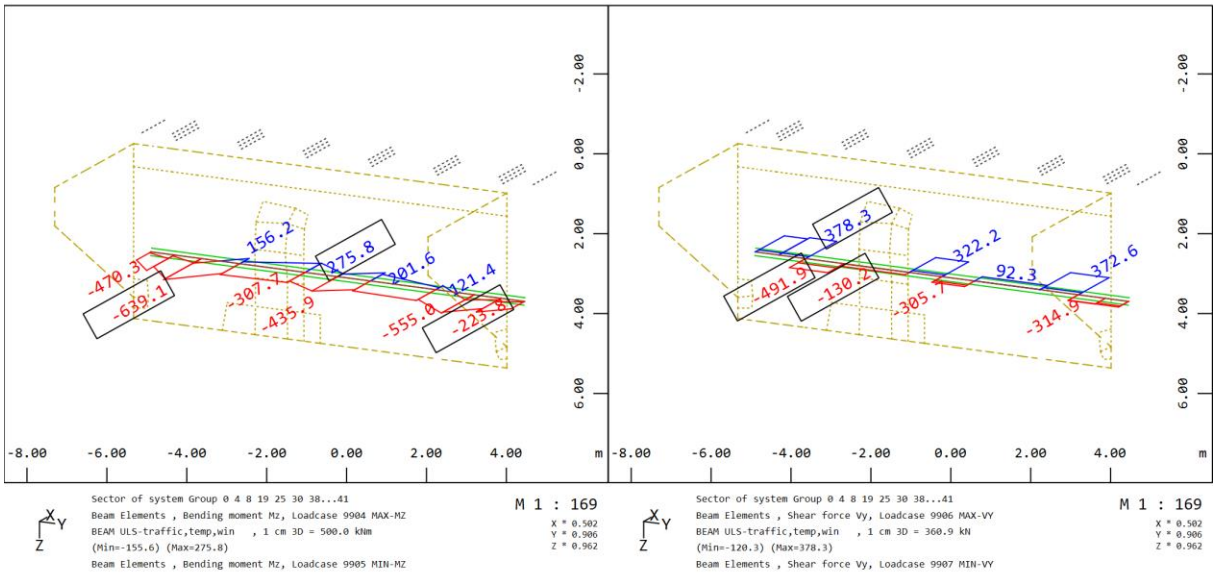
9.2 Rezultati proračuna za upornjak

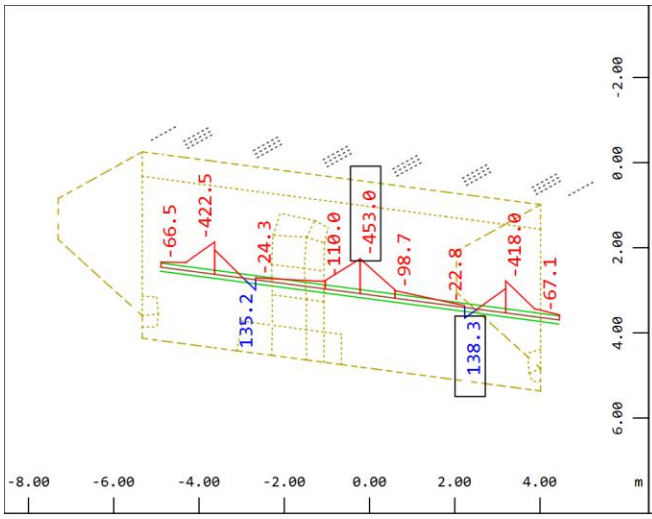
9.2.1 Rezne sile za kombinacije opterećenja

a) U0

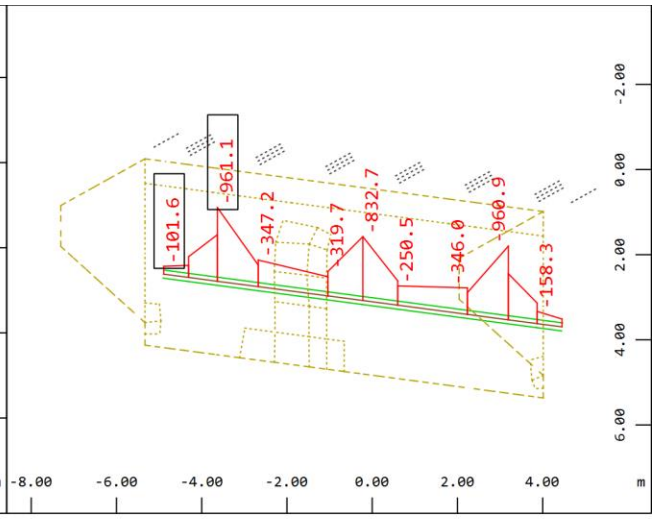




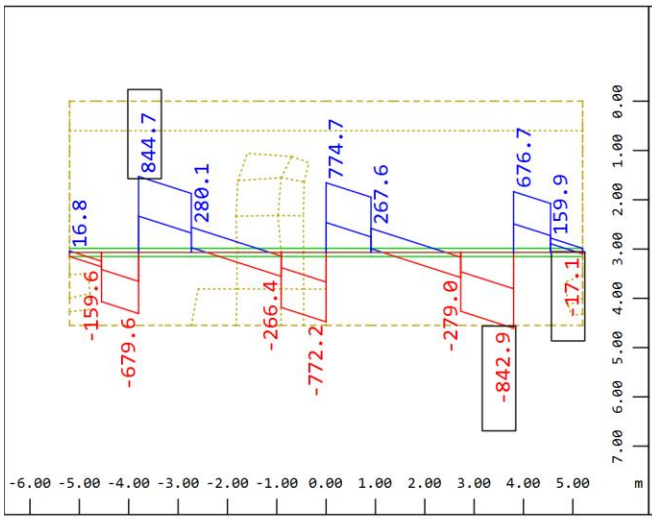




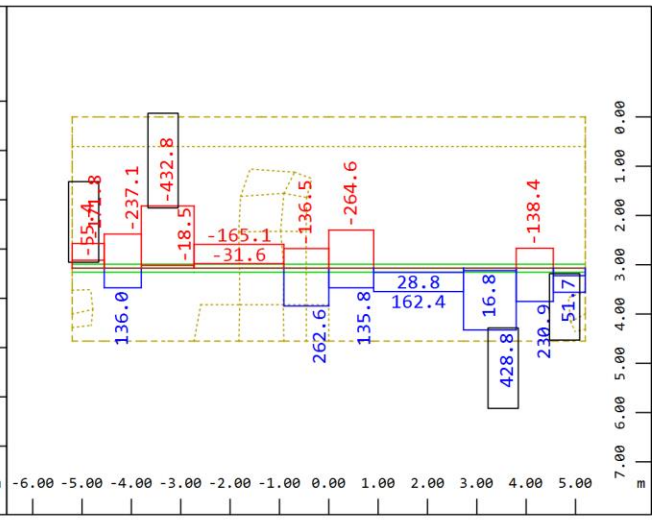
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment My, Loadcase 7525 MAX-MY
BEAM , 1 cm 3D = 902.3 kNm (Min=-453.0) (Max=138.3)
M 1 : 169
X * 0.502
Y * 0.906
Z * 0.962



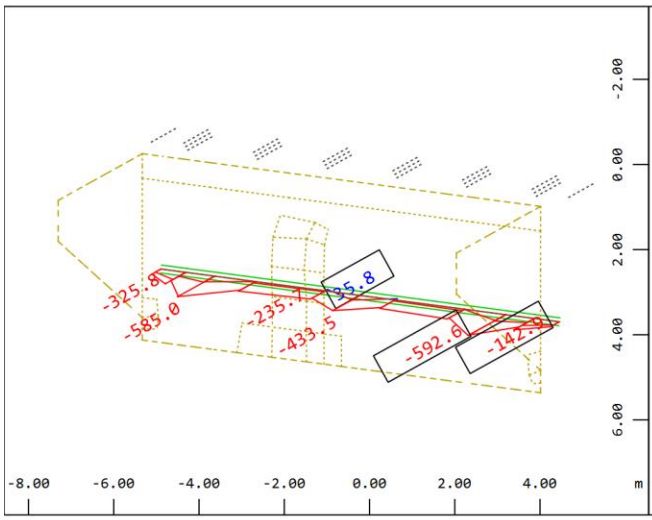
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment My, Loadcase 7526 MIN-MY
BEAM , 1 cm 3D = 902.3 kNm (Min=-961.1) (Max=-101.6)
M 1 : 169
X * 0.502
Y * 0.906
Z * 0.962



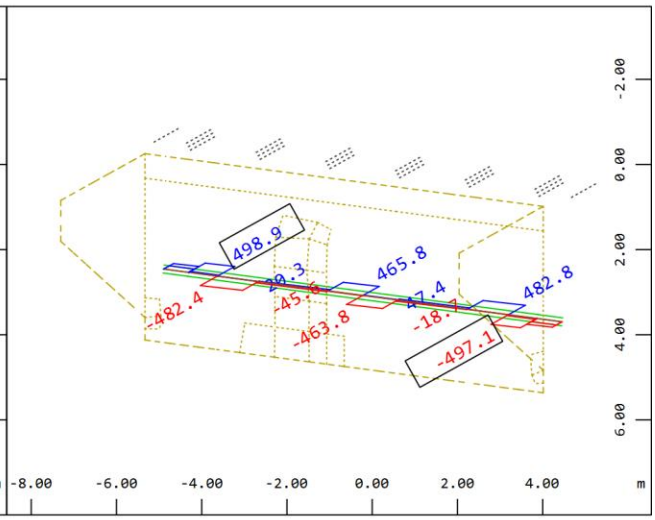
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Shear force Vz, Loadcase 7532 MIN-VZ
BEAM , 1 cm 3D = 800.0 kN (Min=-842.9) (Max=404.3)
Beam Elements , Shear force Vz, Loadcase 7531 MAX-VZ
BEAM , 1 cm 3D = 800.0 kN (Min=-403.3) (Max=844.7)
M 1 : 146



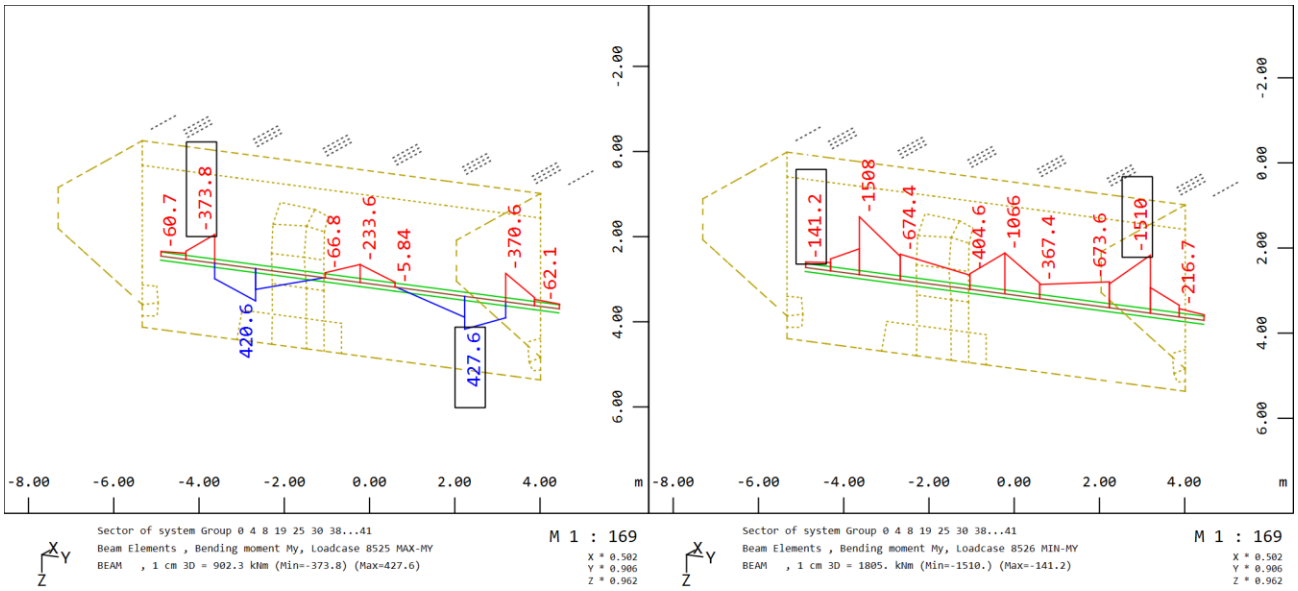
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Torsional moment Mt, Loadcase 7523
MAX-MT BEAM , 1 cm 3D = 500.0 kNm (Min=-55.4)
(Max=428.8)
Beam Elements , Torsional moment Mt, Loadcase 7524
M 1 : 146



Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment Mz, Loadcase 7527 MAX-MZ
BEAM , 1 cm 3D = 500.0 kNm (Min=-204.0) (Max=35.8)
Beam Elements , Bending moment Mz, Loadcase 7528 MIN-MZ
BEAM , 1 cm 3D = 500.0 kNm (Min=-592.6) (Max=-142.9)
M 1 : 169
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Shear force Vy, Loadcase 7529 MAX-VY
BEAM , 1 cm 3D = 902.3 kN (Min=-161.0) (Max=498.9)
Beam Elements , Shear force Vy, Loadcase 7530 MIN-VY
BEAM , 1 cm 3D = 902.3 kN (Min=-497.1) (Max=165.1)
M 1 : 169
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment My, Loadcase 8525 MAX-MY
BEAM , 1 cm 3D = 902.3 kNm (Min=-373.8) (Max=427.6)

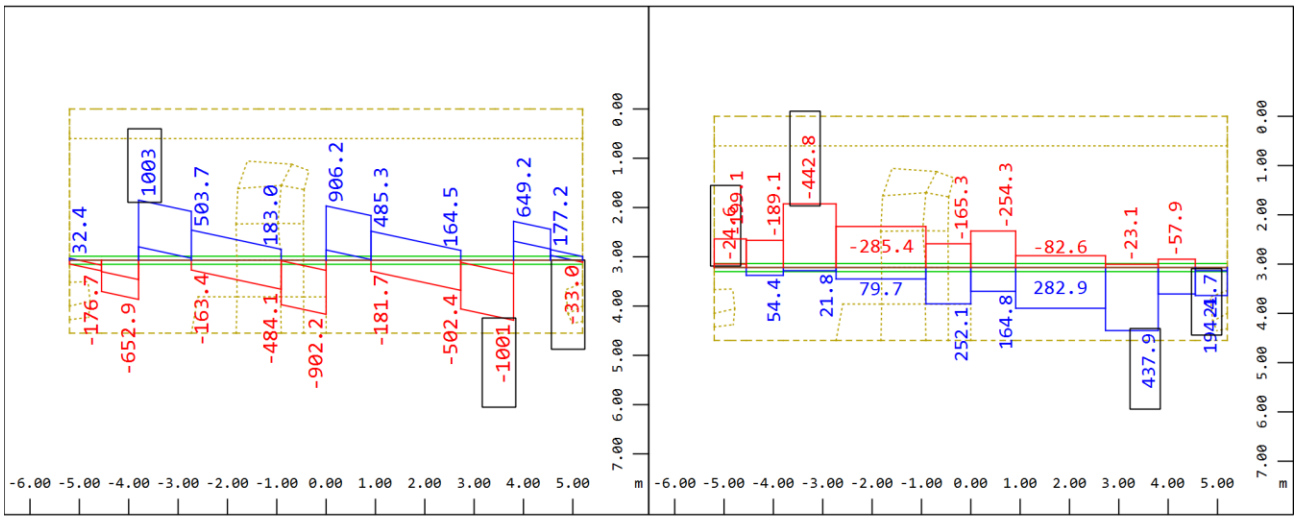
M 1 : 169

X * 0.502
Y * 0.906
Z * 0.962

Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment My, Loadcase 8526 MIN-MY
BEAM , 1 cm 3D = 1805. kNm (Min=-1510.) (Max=-141.2)

M 1 : 169

X * 0.502
Y * 0.906
Z * 0.962

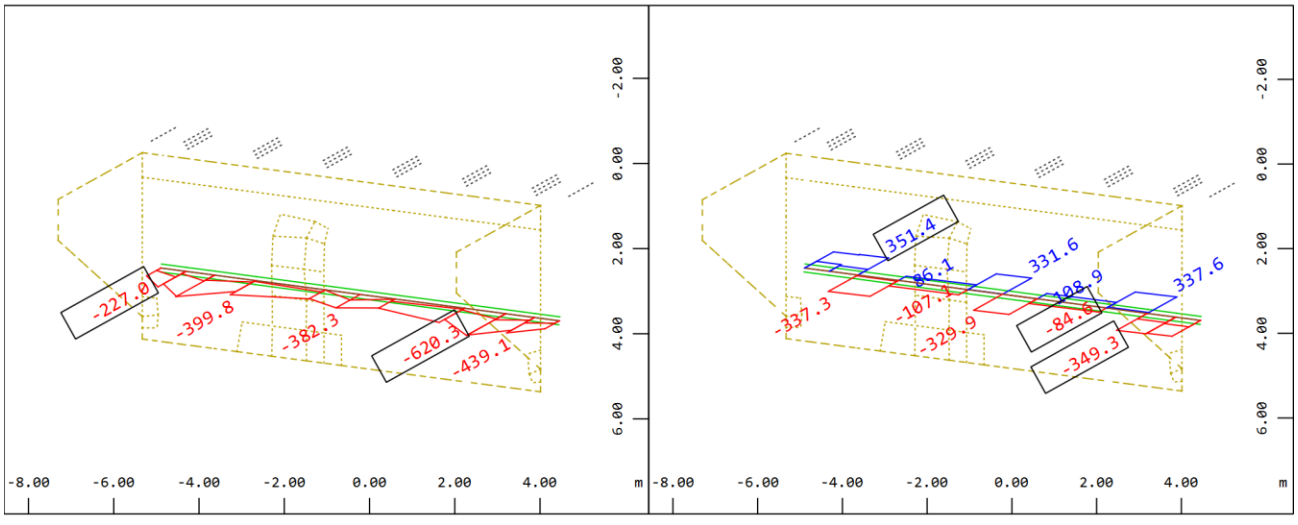


Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Shear force Vz, Loadcase 8532 MIN-VZ
BEAM , 1 cm 3D = 1200. kN (Min=-1001.) (Max=319.1)
Beam Elements , Shear force Vz, Loadcase 8531 MAX-VZ
BEAM , 1 cm 3D = 1200. kN (Min=-321.5) (Max=1003.)

M 1 : 146

Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Torsional moment Mt, Loadcase 8523
MAX-MT BEAM , 1 cm 3D = 500.0 kNm (Min=-24.6)
(Max=437.9)
Beam Elements , Torsional moment Mt, Loadcase 8524

M 1 : 146



Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment Mz, Loadcase 8527 MAX-MZ
BEAM , 1 cm 3D = 500.0 kNm (Min=-173.6) (Max=-5.59)
Beam Elements , Bending moment Mz, Loadcase 8528 MIN-MZ
BEAM , 1 cm 3D = 500.0 kNm (Min=-620.3) (Max=-227.0)

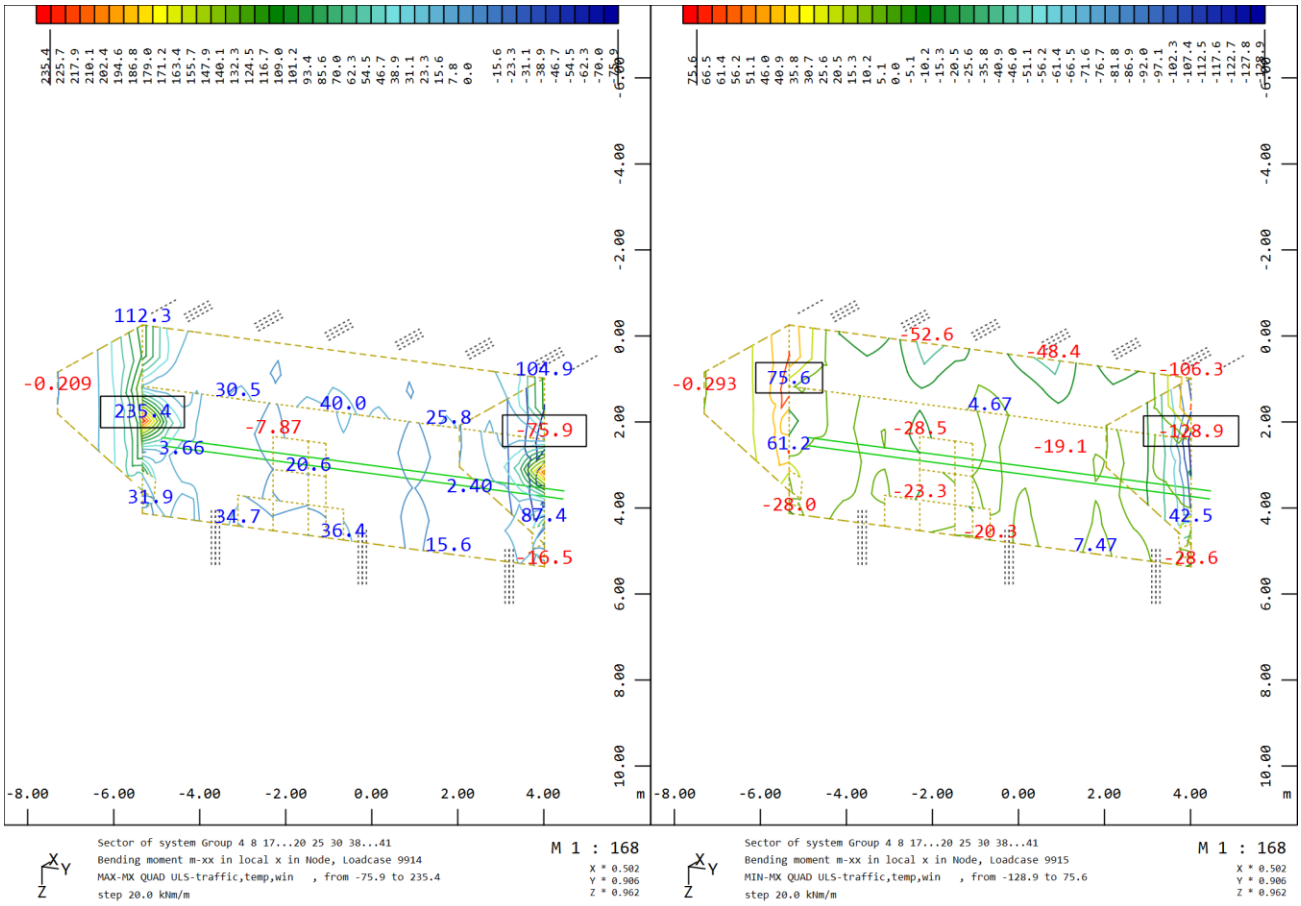
M 1 : 169

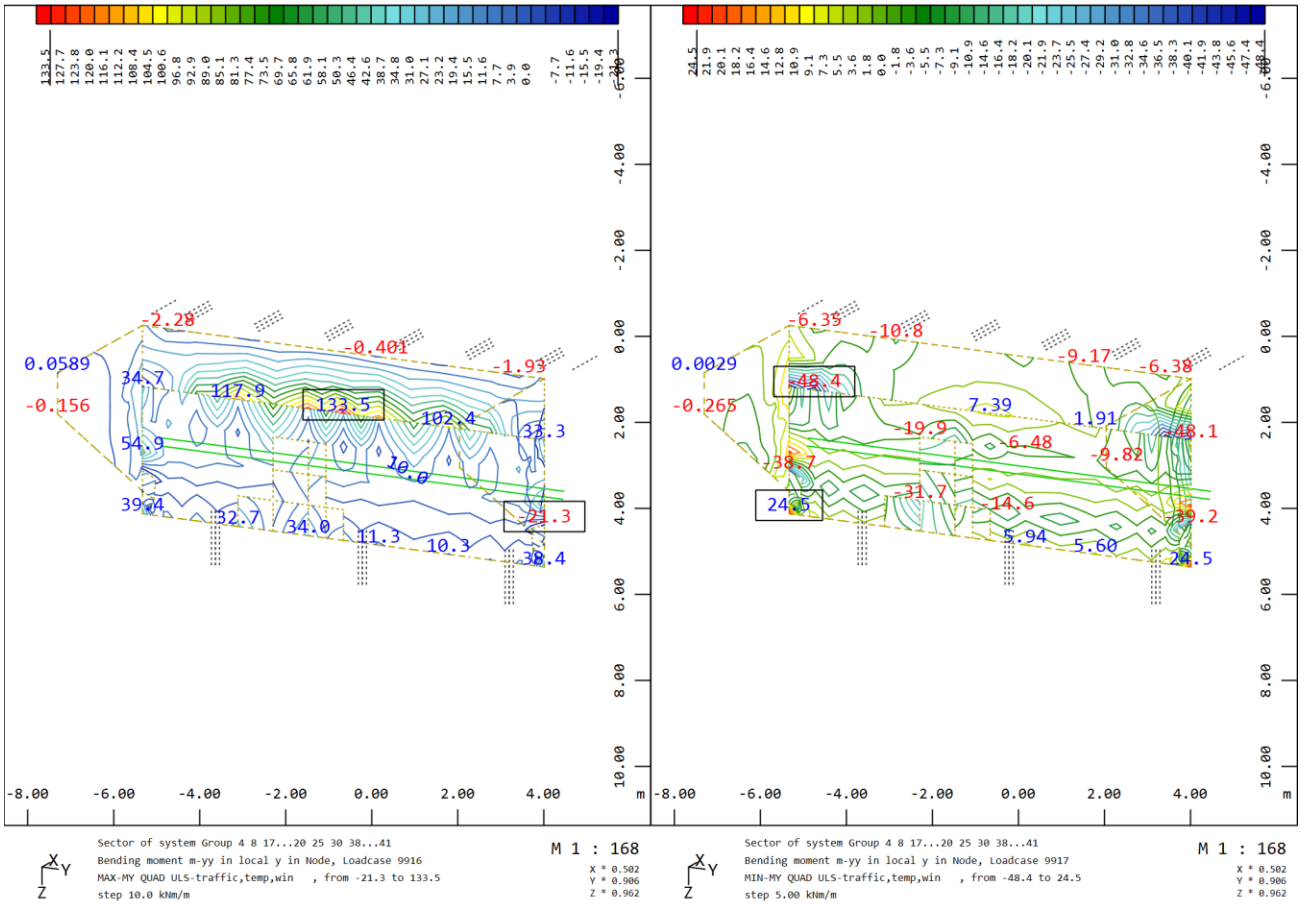
X * 0.502
Y * 0.906
Z * 0.962

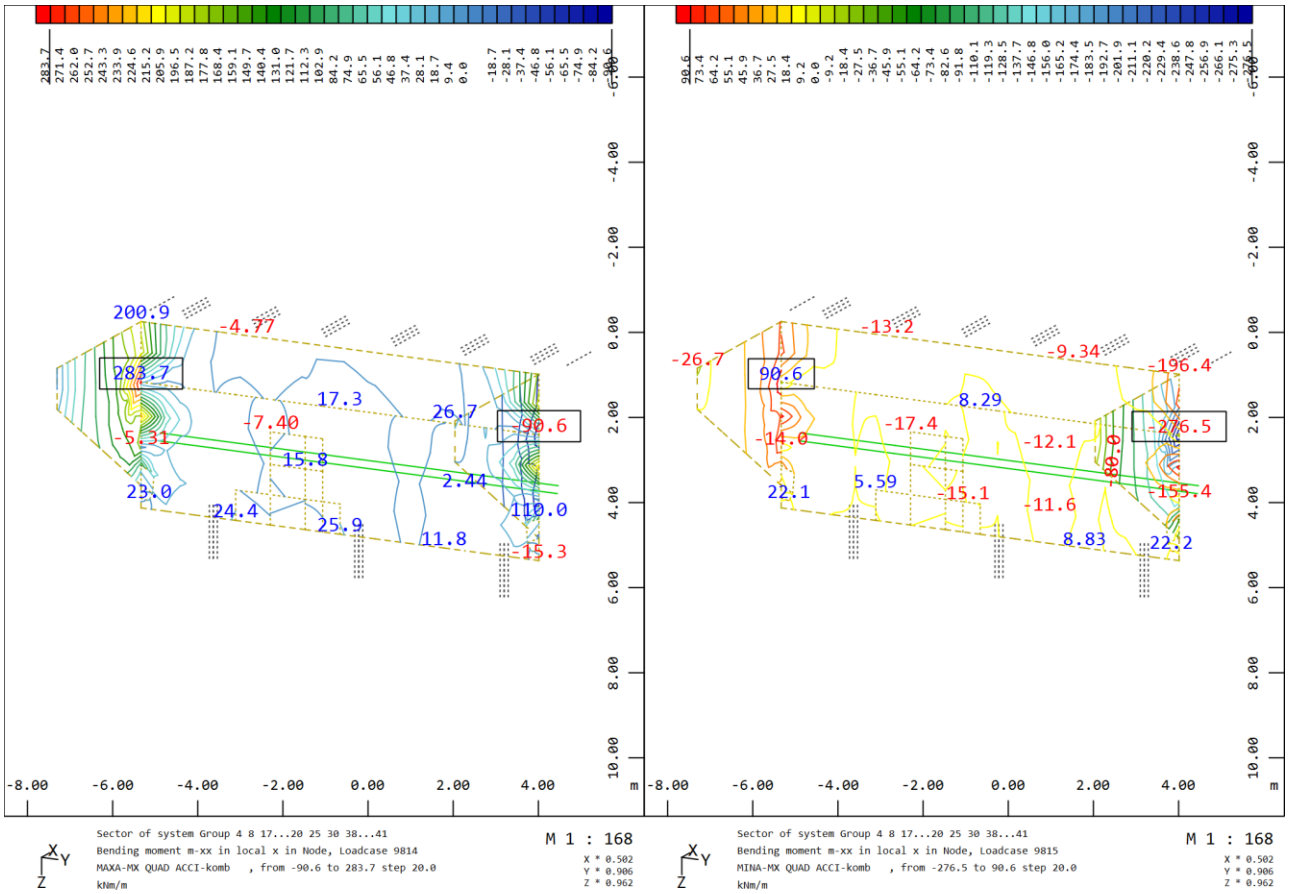
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Shear force Vy, Loadcase 8529 MAX-VY
BEAM , 1 cm 3D = 360.9 kN (Min=-132.7) (Max=351.4)
Beam Elements , Shear force Vy, Loadcase 8530 MIN-VY
BEAM , 1 cm 3D = 360.9 kN (Min=-349.3) (Max=136.9)

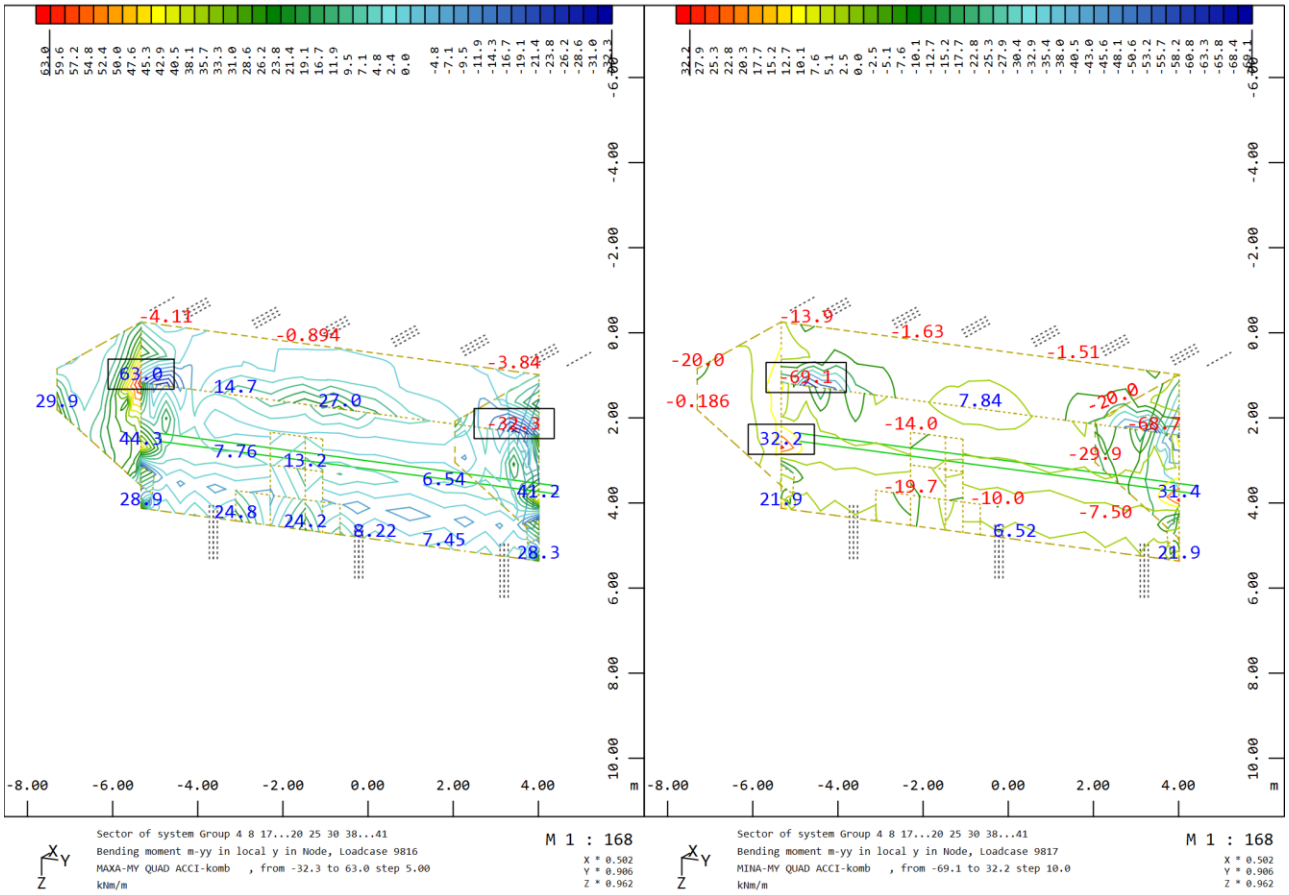
M 1 : 170

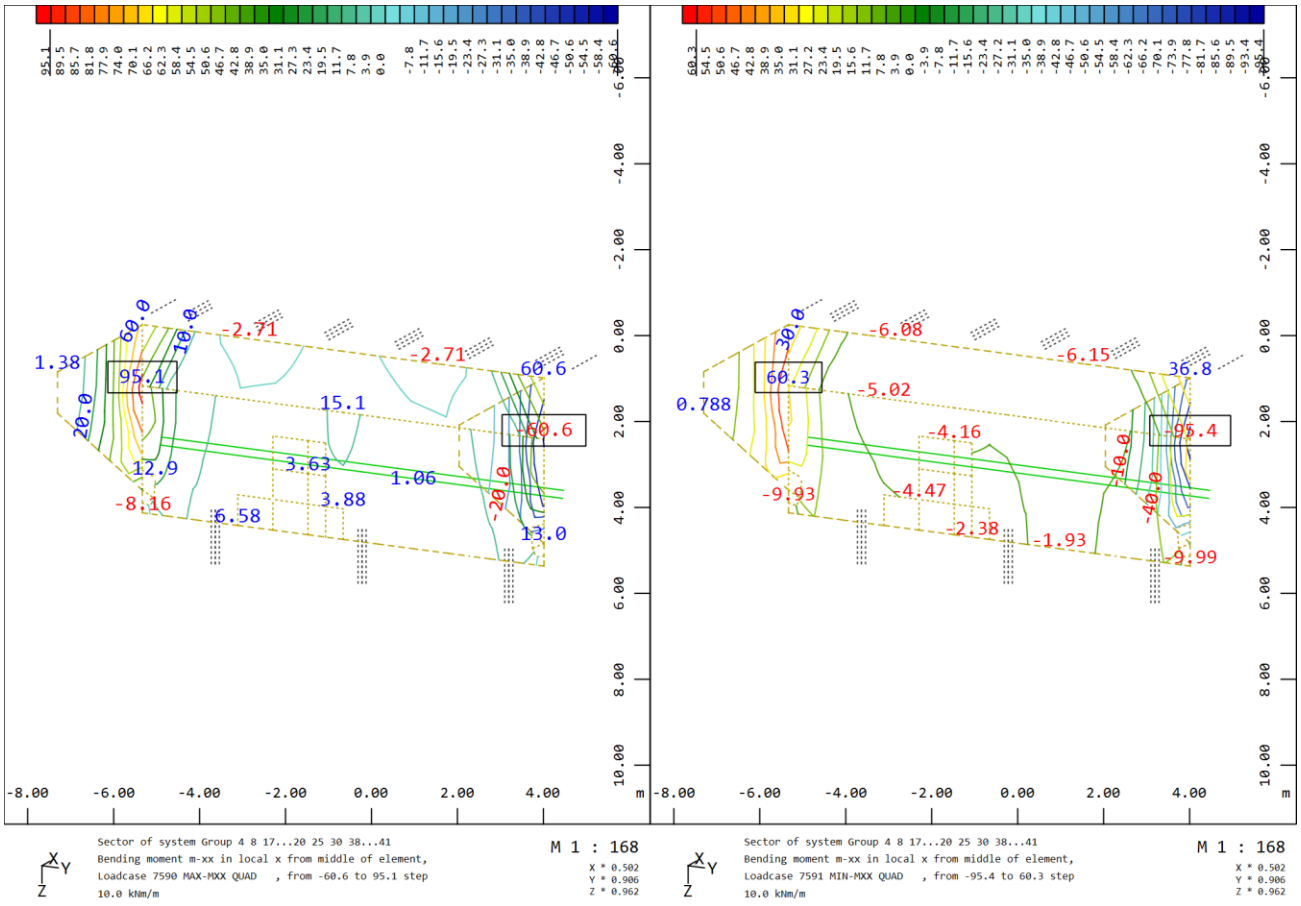
X * 0.502
Y * 0.906
Z * 0.962

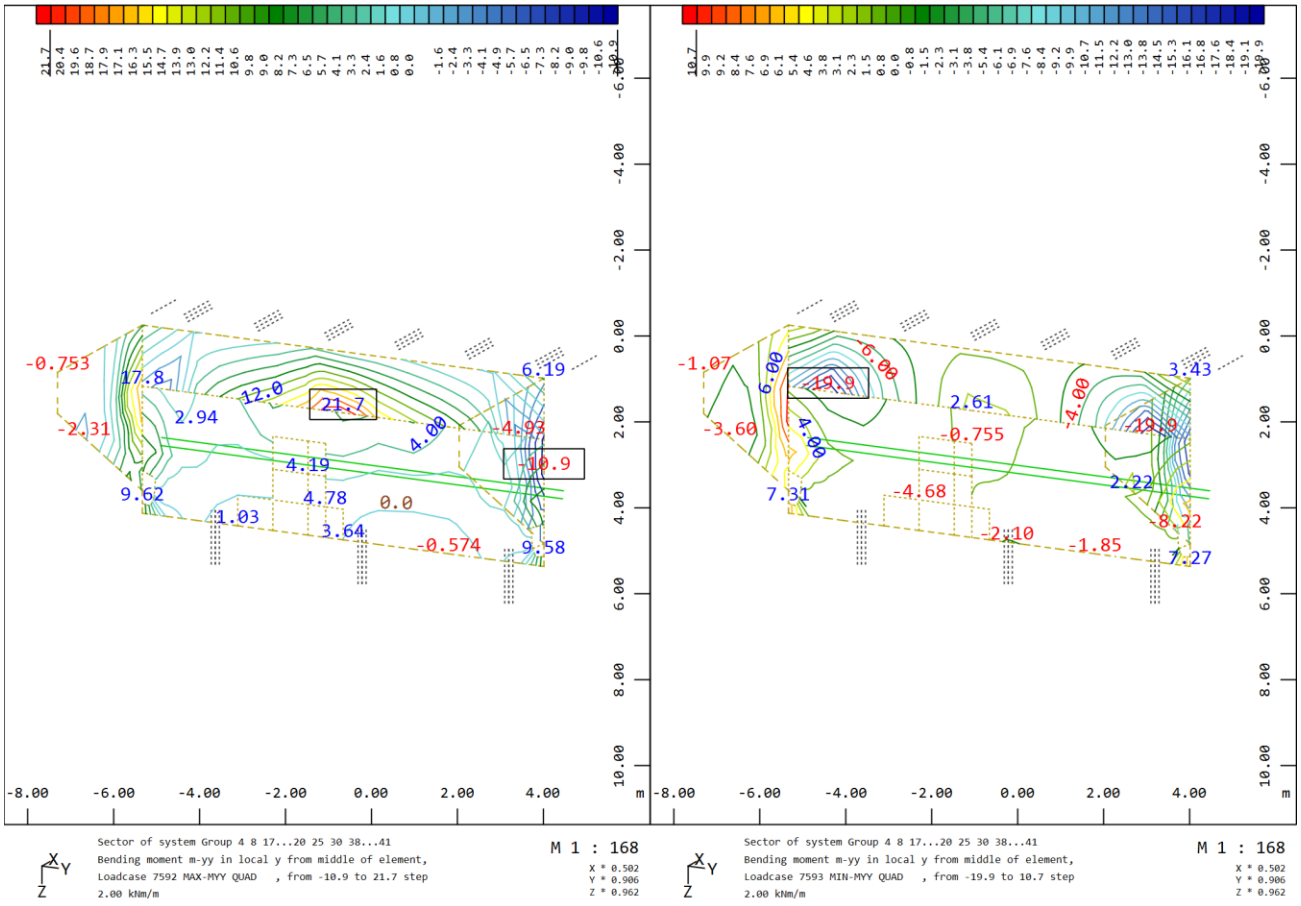

112.3
-0.209
104.9
30.5
40.0
25.8
235.4
-7.87
-75.9
3.66
20.6
2.40
31.9
34.7
36.4
87.4
15.6
-16.5
-52.6
-48.4
-106.3
-0.293
75.6
4.67
61.2
-28.5
-128.9
-19.1
-28.0
-23.3
42.5
-20.3
7.47
-28.6
-8.00 -6.00 -4.00 -2.00 0.00 2.00 4.00 m
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x in Node, Loadcase 9914
MAX-MX QUAD ULS-traffic,temp,win , from -75.9 to 235.4
step 20.0 kNm/m
M 1 : 168
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x in Node, Loadcase 9915
MIN-MX QUAD ULS-traffic,temp,win , from -128.9 to 75.6
step 20.0 kNm/m
M 1 : 168

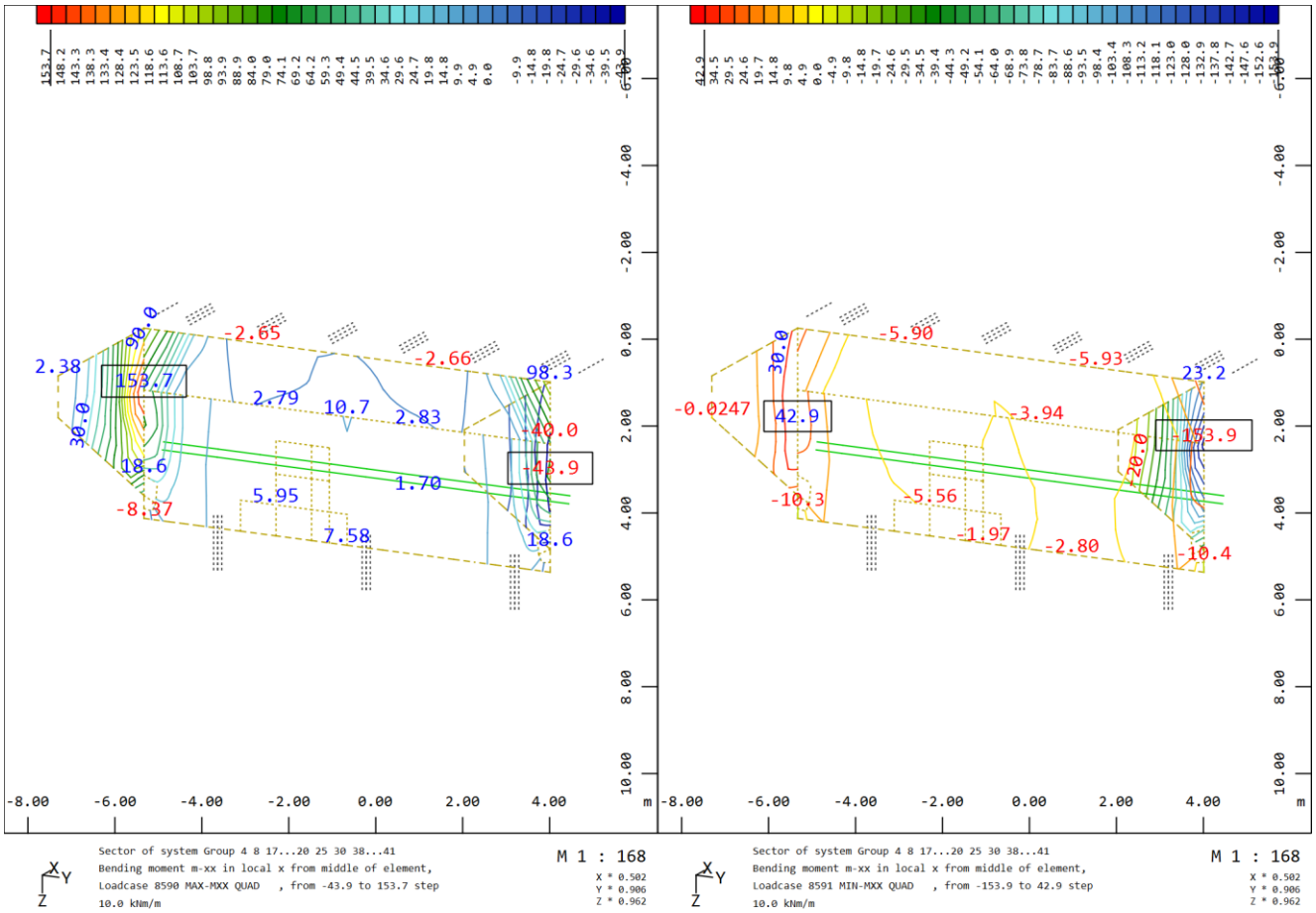

-2.28
-0.401
0.0589
-1.93
34.7
117.9
133.5
-0.156
102.4
33.3
54.9
10.0
39.4
32.7
34.0
11.3
10.3
-21.3
38.4
-6.35
-10.8
-9.17
-6.38
0.0029
-48.4
-0.265
7.39
1.91
-19.9
-6.48
-48.1
-9.82
38.7
24.5
31.7
14.6
-39.2
5.94
5.60
24.5
-8.00 -6.00 -4.00 -2.00 0.00 2.00 4.00 m
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y in Node, Loadcase 9916
MAX-MY QUAD ULS-traffic,temp,win , from -21.3 to 133.5
step 10.0 kNm/m
M 1 : 168
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y in Node, Loadcase 9917
MIN-MY QUAD ULS-traffic,temp,win , from -48.4 to 24.5
step 5.00 kNm/m
M 1 : 168

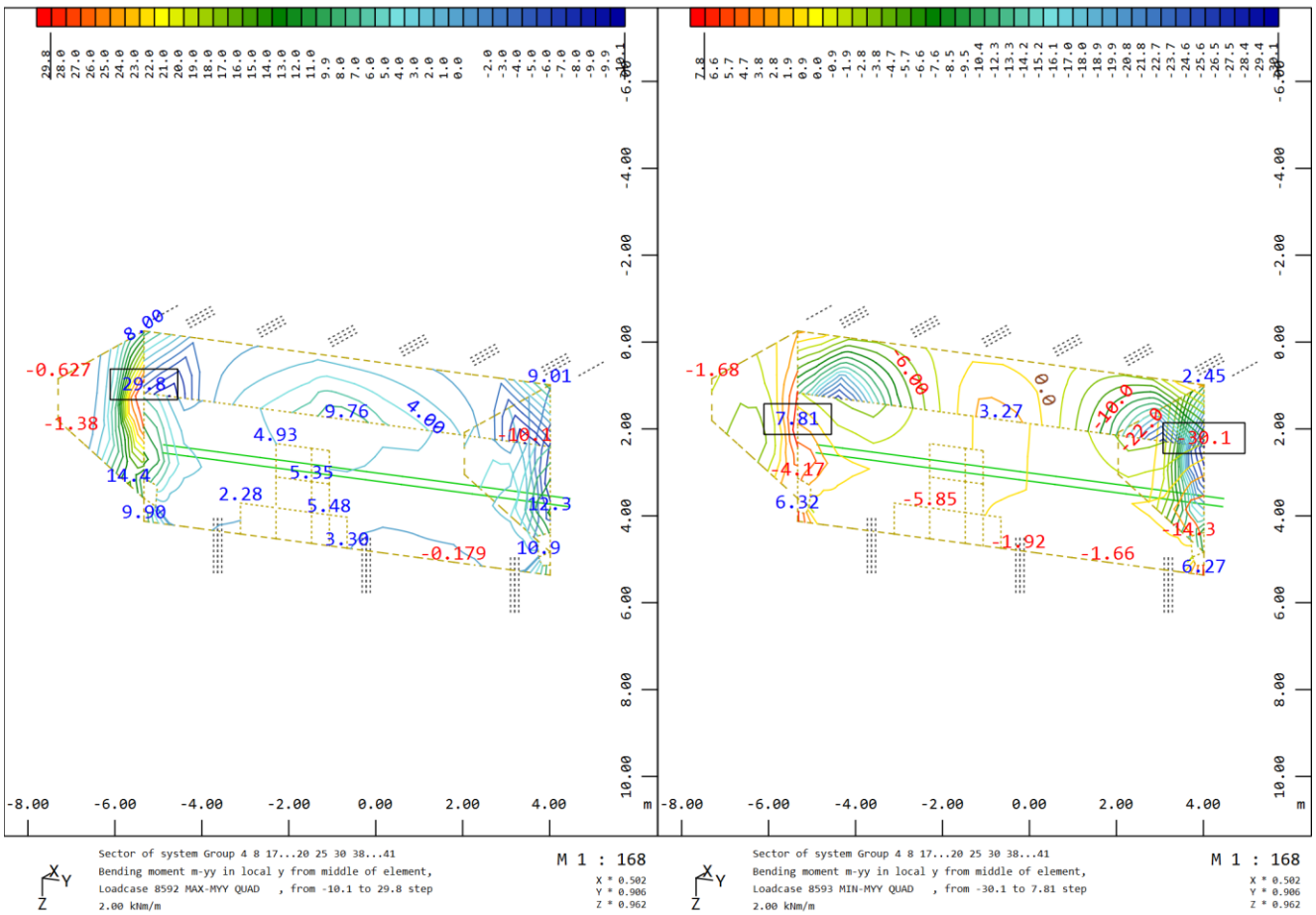

Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x in Node, Loadcase 9814
MAXA-MX QUAD ACCI-komb , from -90.6 to 283.7 step 20.0
kNm/m
M 1 : 168
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x in Node, Loadcase 9815
MINA-MX QUAD ACCI-komb , from -276.5 to 90.6 step 20.0
kNm/m
M 1 : 168


Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y in Node, Loadcase 9816
MAXA-MY QUAD ACCI-komb , from -32.3 to 63.0 step 5.00
kNm/m
M 1 : 168
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y in Node, Loadcase 9817
MINA-MY QUAD ACCI-komb , from -69.1 to 32.2 step 10.0
kNm/m
M 1 : 168

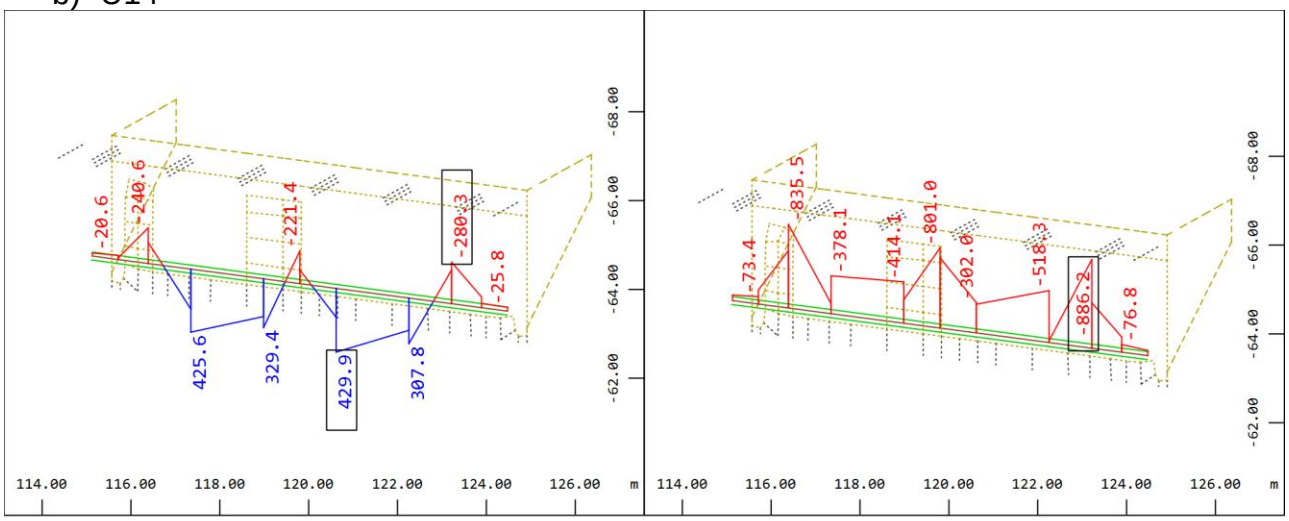

Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x from middle of element,
Loadcase 7590 MAX-MXX QUAD , from -60.6 to 95.1 step
10.0 kNm/m
M 1 : 168
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x from middle of element,
Loadcase 7591 MIN-MXX QUAD , from -95.4 to 60.3 step
10.0 kNm/m
M 1 : 168

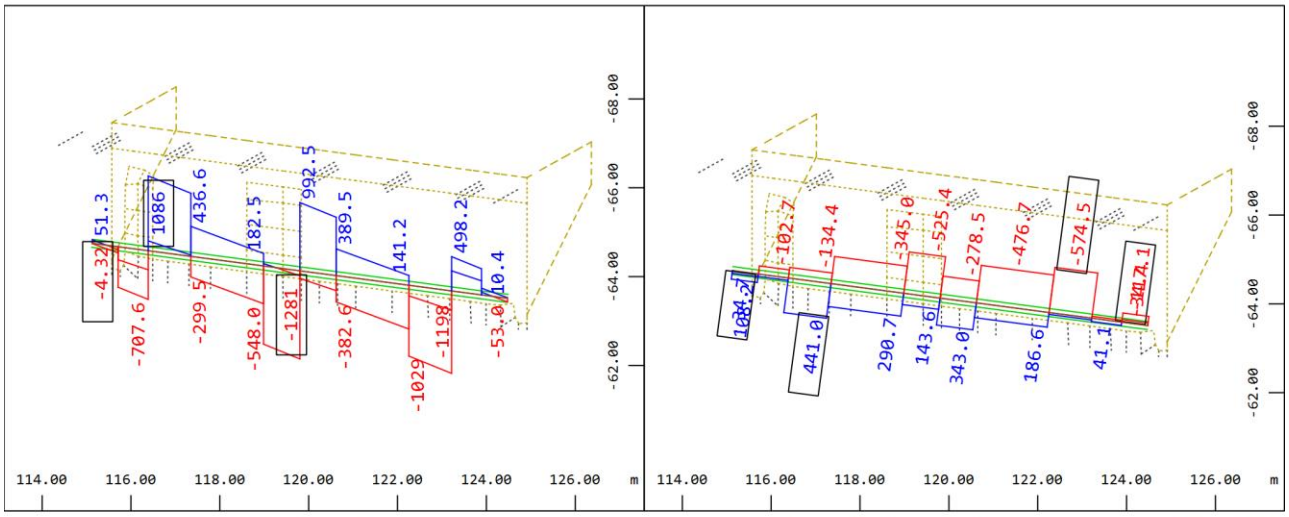

Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y from middle of element,
Loadcase 7592 MAX-MYY QUAD , from -10.9 to 21.7 step
2.00 kNm/m
M 1 : 168
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y from middle of element,
Loadcase 7593 MIN-MYY QUAD , from -19.9 to 10.7 step
2.00 kNm/m
M 1 : 168

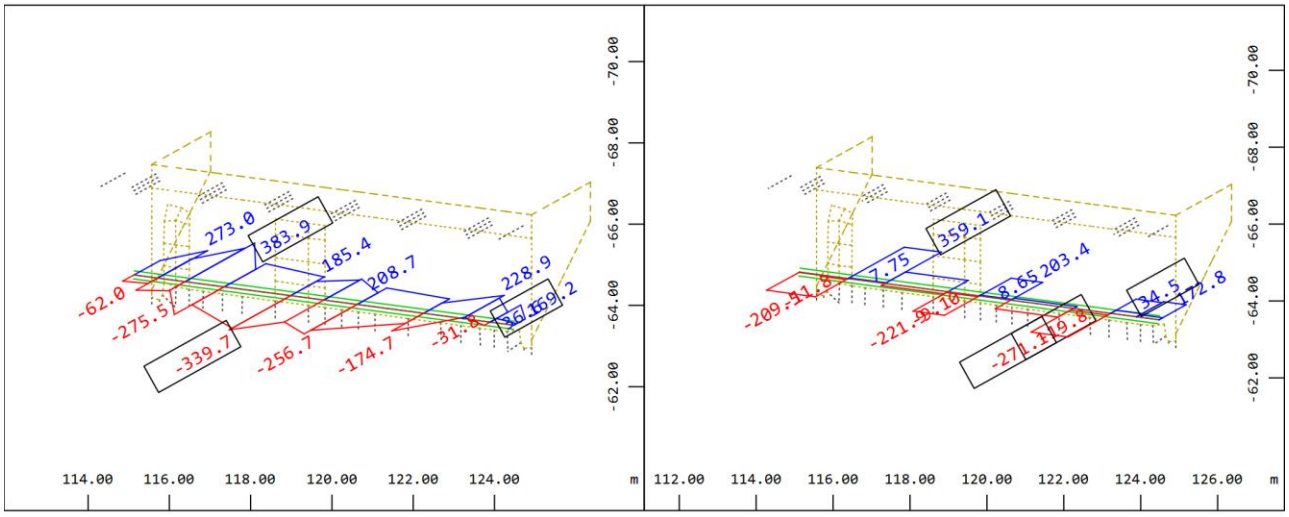

Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x from middle of element,
Loadcase 8590 MAX-MXX QUAD , from -43.9 to 153.7 step
10.0 kNm/m
M 1 : 168
X * 0.502
Y * 0.906
Z * 0.962
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x from middle of element,
Loadcase 8591 MIN-MXX QUAD , from -153.9 to 42.9 step
10.0 kNm/m
M 1 : 168
X * 0.502
Y * 0.906
Z * 0.962

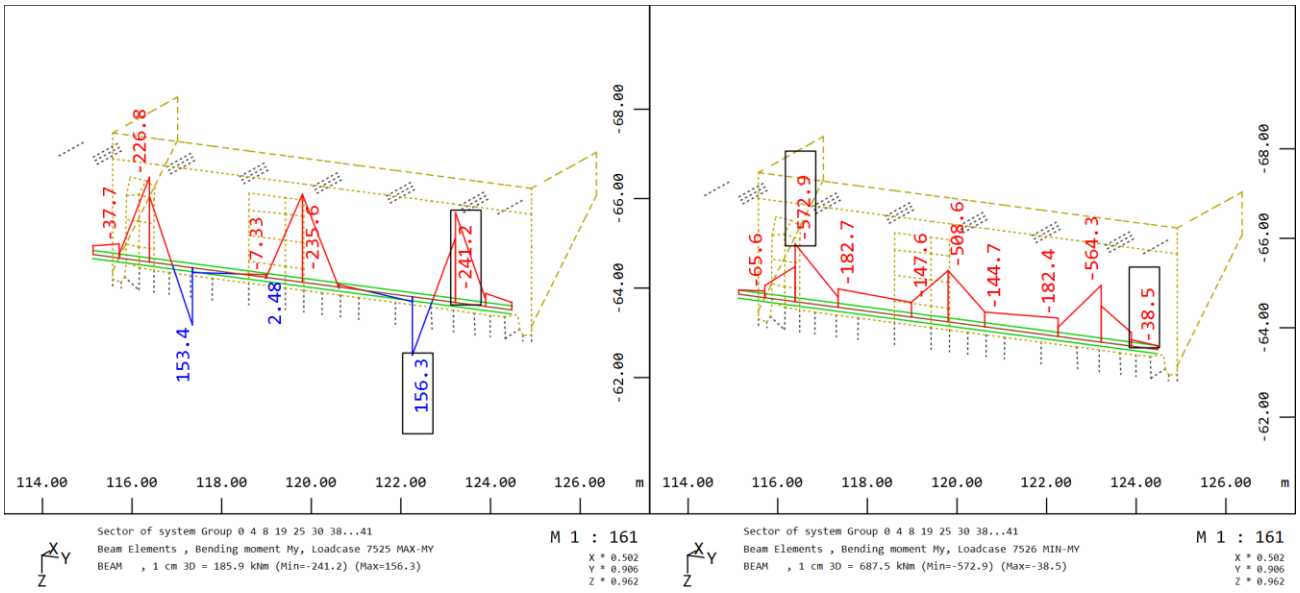

Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y from middle of element,
Loadcase 8592 MAX-MYY QUAD , from -10.1 to 29.8 step
2.00 kNm/m
M 1 : 168
X * 0.502
Y * 0.906
Z * 0.962
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y from middle of element,
Loadcase 8593 MIN-MYY QUAD , from -30.1 to 7.81 step
2.00 kNm/m
M 1 : 168
X * 0.502
Y * 0.906
Z * 0.962

b) U14


Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment My, Loadcase 9900 MAX-MY
BEAM ULS-traffic,temp,win , 1 cm 3D = 464.8 kNm
(Min=-280.3) (Max=429.9)
M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment My, Loadcase 9901 MIN-MY
BEAM ULS-traffic,temp,win , 1 cm 3D = 687.5 kNm
(Min=-886.2) (Max=-17.7)
M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962


Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Shear force Vz, Loadcase 9902 MAX-VZ
BEAM ULS-traffic,temp,win , 1 cm 3D = 1000. kN
(Min=-279.1) (Max=1086.)
Beam Elements , Shear force Vz, Loadcase 9903 MIN-VZ
M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Torsional moment Mt, Loadcase 9910
MAX-MT BEAM ULS-traffic,temp,win , 1 cm 3D = 902.3 kNm
(Min=-34.4) (Max=441.0)
Beam Elements , Torsional moment Mt, Loadcase 9911
M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962


Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment Mz, Loadcase 9904 MAX-MZ
BEAM ULS-traffic,temp,win , 1 cm 3D = 173.4 kNm
(Max=383.9)
Beam Elements , Bending moment Mz, Loadcase 9905 MIN-MZ
M 1 : 176
X * 0.502
Y * 0.906
Z * 0.962
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Shear force Vy, Loadcase 9906 MAX-VY
BEAM ULS-traffic,temp,win , 1 cm 3D = 200.0 kN
(Min=-19.8) (Max=359.1)
Beam Elements , Shear force Vy, Loadcase 9907 MIN-VY
M 1 : 186
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment My, Loadcase 7525 MAX-MY
BEAM , 1 cm 3D = 185.9 kNm (Min=-241.2) (Max=156.3)

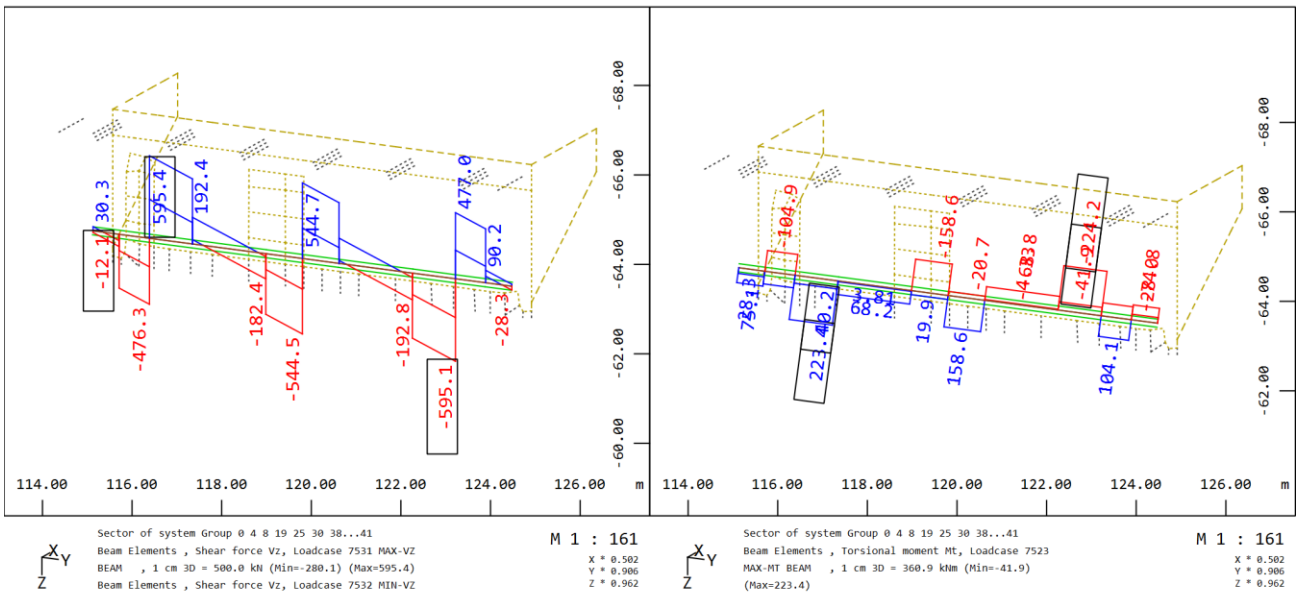
M 1 : 161

X * 0.502
Y * 0.906
Z * 0.962

Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment My, Loadcase 7526 MIN-MY
BEAM , 1 cm 3D = 687.5 kNm (Min=-572.9) (Max=-38.5)

M 1 : 161

X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Shear force Vz, Loadcase 7531 MAX-VZ
BEAM , 1 cm 3D = 500.0 kN (Min=-280.1) (Max=595.4)
Beam Elements , Shear force Vz, Loadcase 7532 MIN-VZ
BEAM , 1 cm 3D = 500.0 kN (Min=-595.1) (Max=280.0)

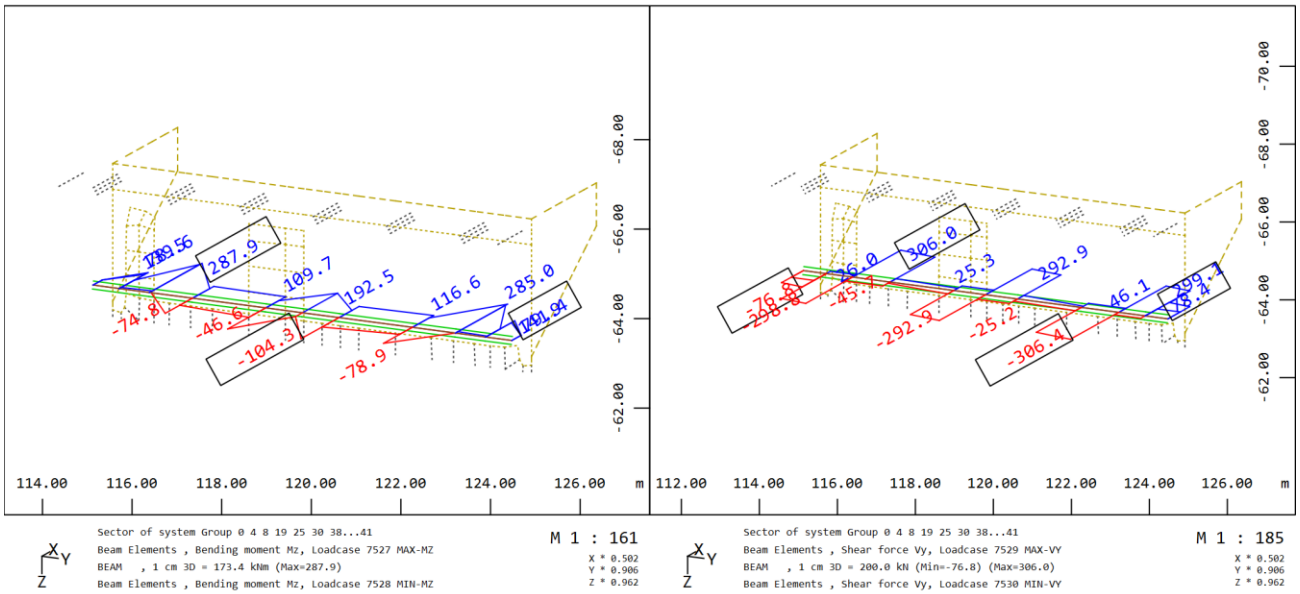
M 1 : 161

X * 0.502
Y * 0.906
Z * 0.962

Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Torsional moment Mt, Loadcase 7523
MAX-MT BEAM , 1 cm 3D = 360.9 kNm (Min=-41.9)
(Max=223.4)
Beam Elements , Torsional moment Mt, Loadcase 7524

M 1 : 161

X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment Mz, Loadcase 7527 MAX-MZ
BEAM , 1 cm 3D = 173.4 kNm (Max=287.9)
Beam Elements , Bending moment Mz, Loadcase 7528 MIN-MZ
BEAM , 1 cm 3D = 86.7 kNm (Min=-104.3) (Max=79.9)

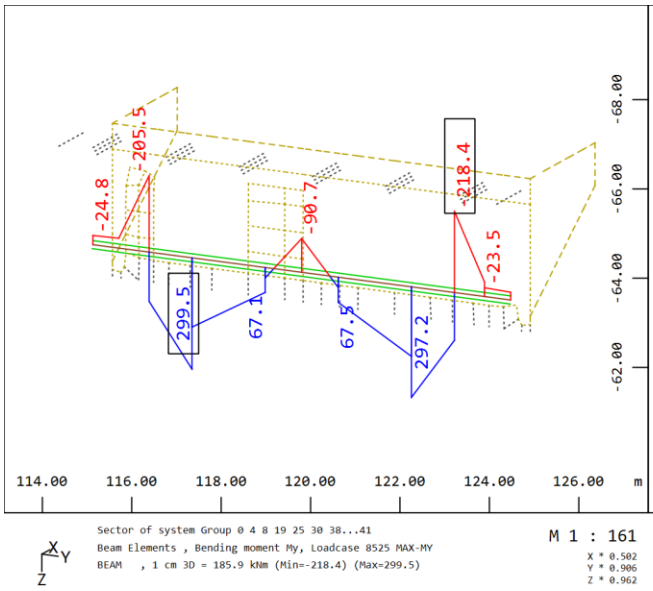
M 1 : 161

X * 0.502
Y * 0.906
Z * 0.962

Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Shear force Vy, Loadcase 7529 MAX-VY
BEAM , 1 cm 3D = 200.0 kN (Min=-76.8) (Max=306.0)
Beam Elements , Shear force Vy, Loadcase 7530 MIN-VY
BEAM , 1 cm 3D = 200.0 kN (Min=-306.4) (Max=78.4)

M 1 : 185

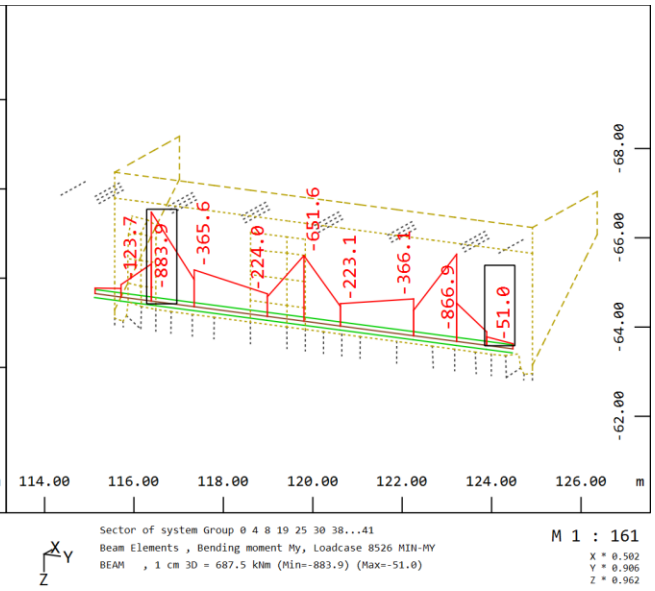
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment My, Loadcase 8525 MAX-MY
BEAM , 1 cm 3D = 185.9 kNm (Min=-218.4) (Max=299.5)

M 1 : 161

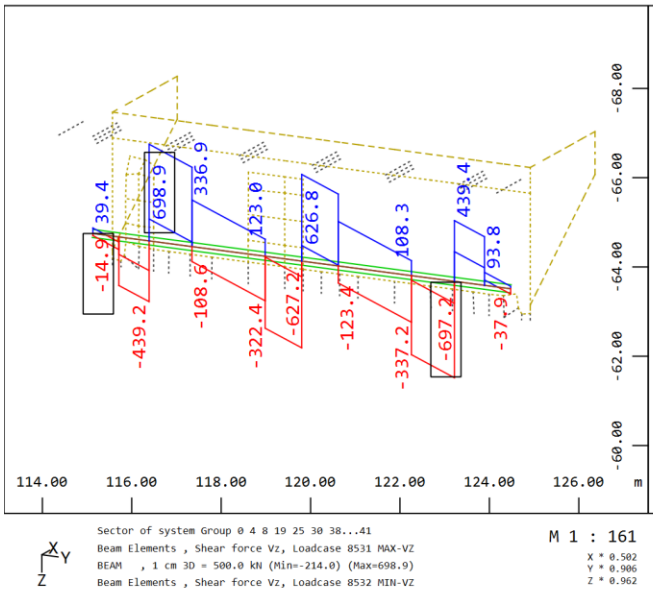
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment My, Loadcase 8526 MIN-MY
BEAM , 1 cm 3D = 687.5 kNm (Min=-883.9) (Max=-51.0)

M 1 : 161

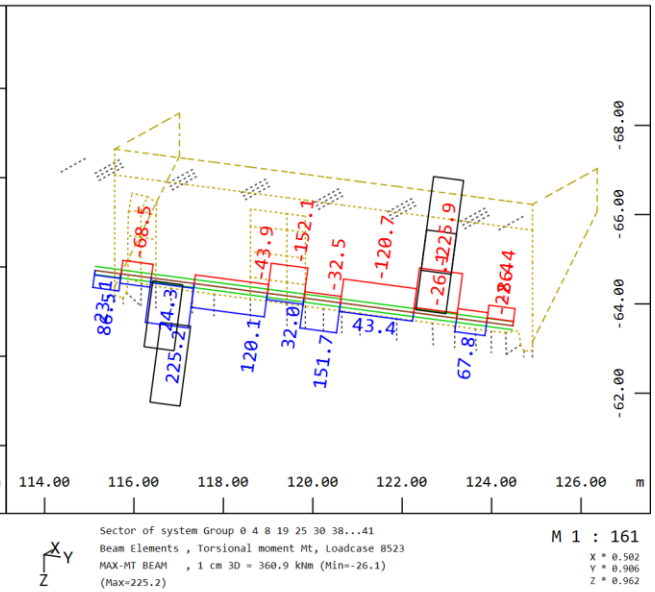
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Shear force Vz, Loadcase 8531 MAX-VZ
BEAM , 1 cm 3D = 500.0 kN (Min=-214.0) (Max=698.9)
Beam Elements , Shear force Vz, Loadcase 8532 MIN-VZ
BEAM , 1 cm 3D = 500.0 kN (Min=-697.2) (Max=214.9)

M 1 : 161

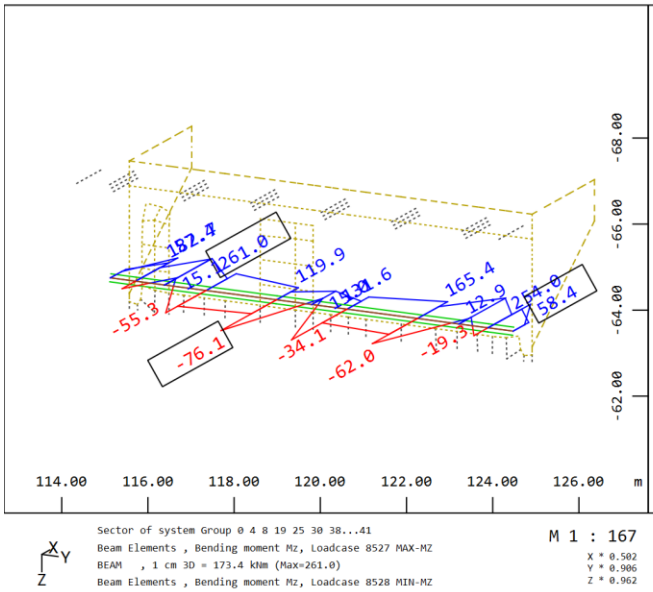
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Torsional moment Mt, Loadcase 8523
MAX-MT BEAM , 1 cm 3D = 360.9 kNm (Min=-26.1)
(Max=225.2)
Beam Elements , Torsional moment Mt, Loadcase 8524

M 1 : 161

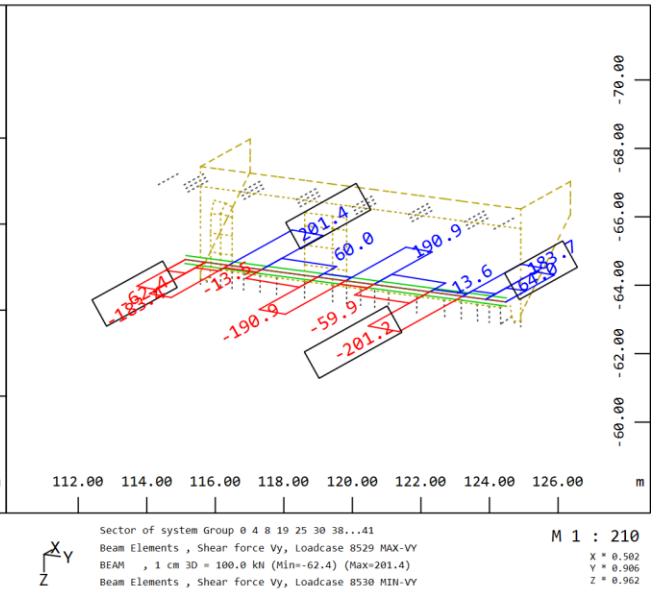
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Bending moment Mz, Loadcase 8527 MAX-MZ
BEAM , 1 cm 3D = 173.4 kNm (Max=261.0)
Beam Elements , Bending moment Mz, Loadcase 8528 MIN-MZ
BEAM , 1 cm 3D = 43.4 kNm (Min=-76.1) (Max=58.4)

M 1 : 167

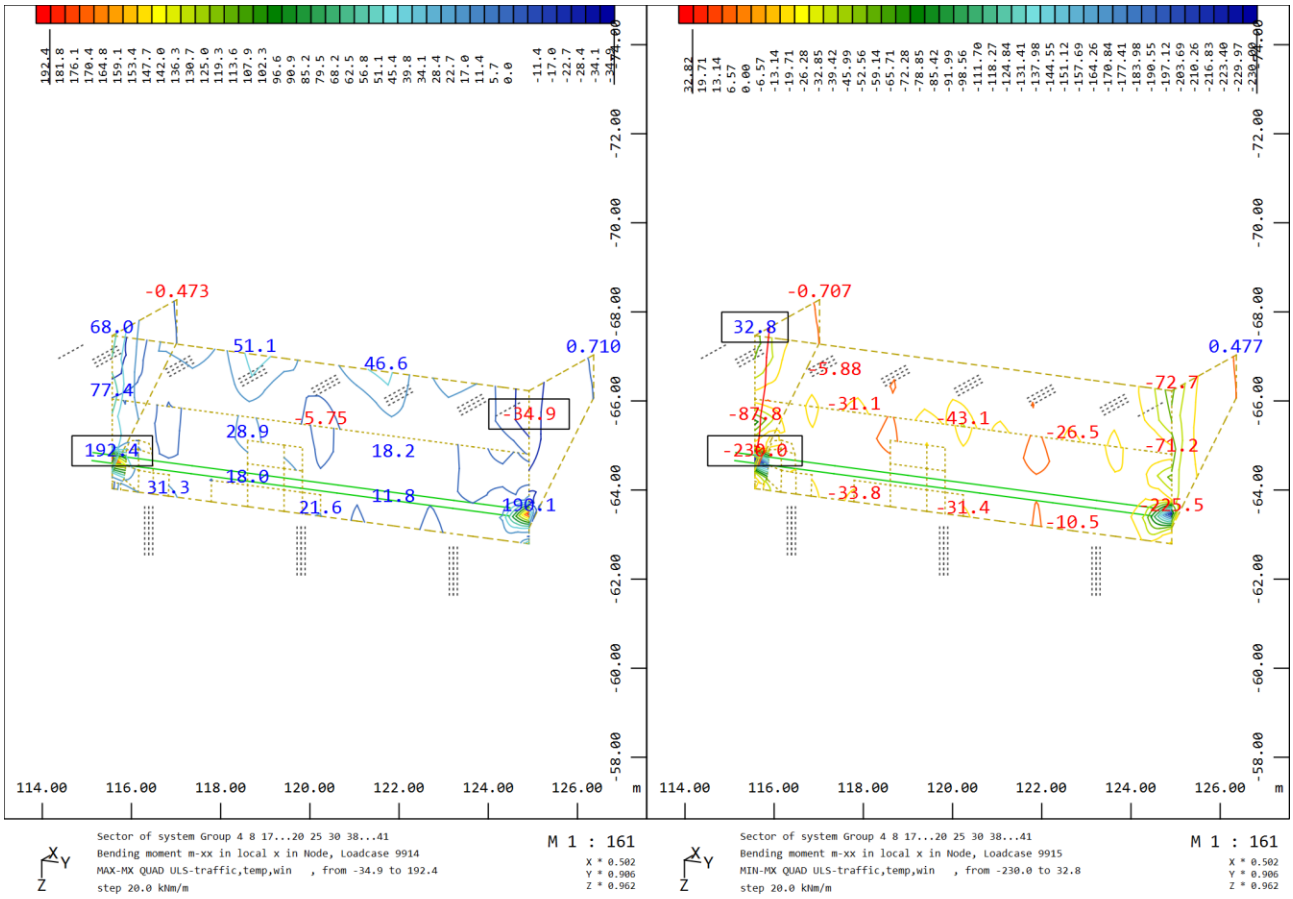
X * 0.502
Y * 0.906
Z * 0.962

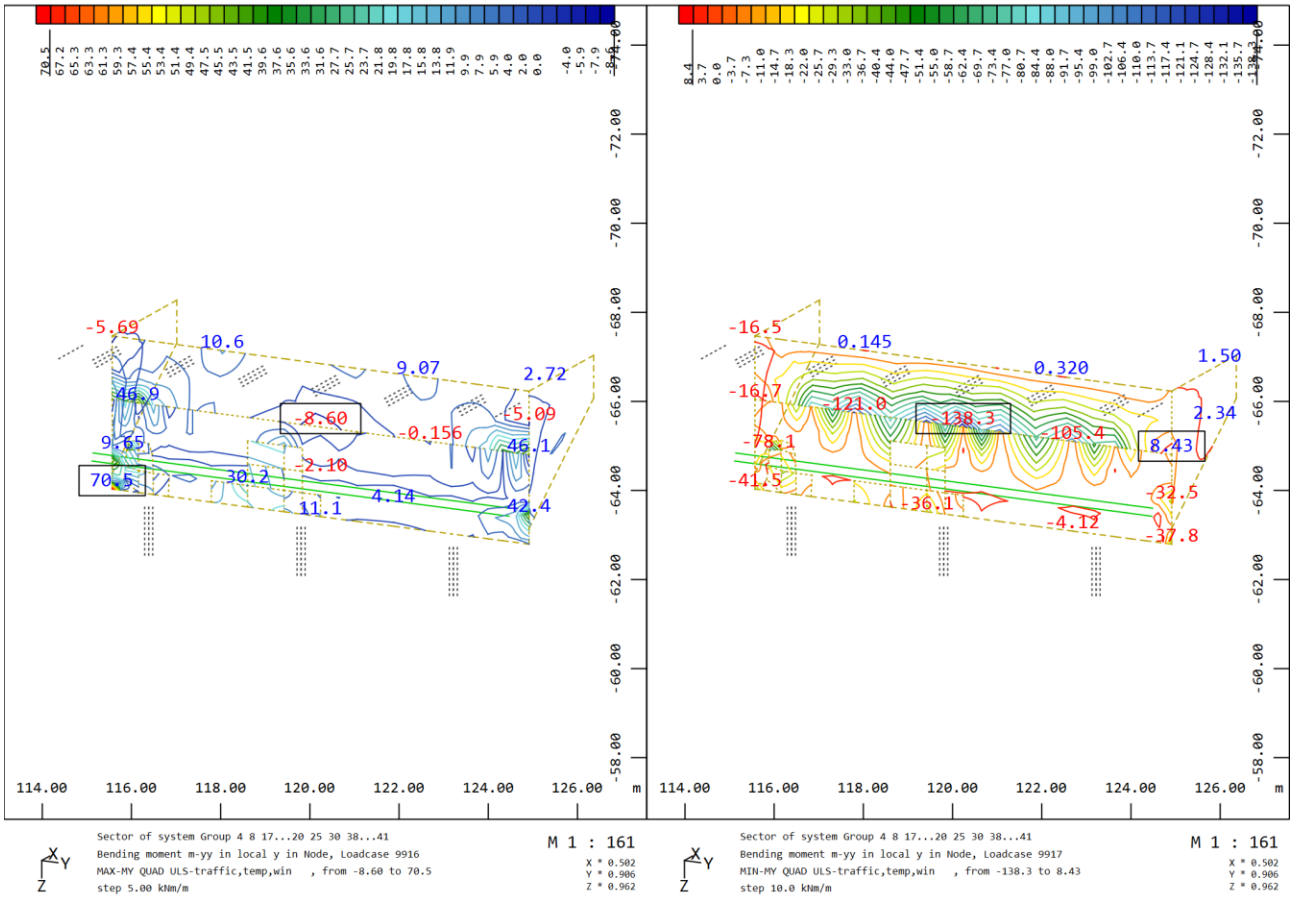


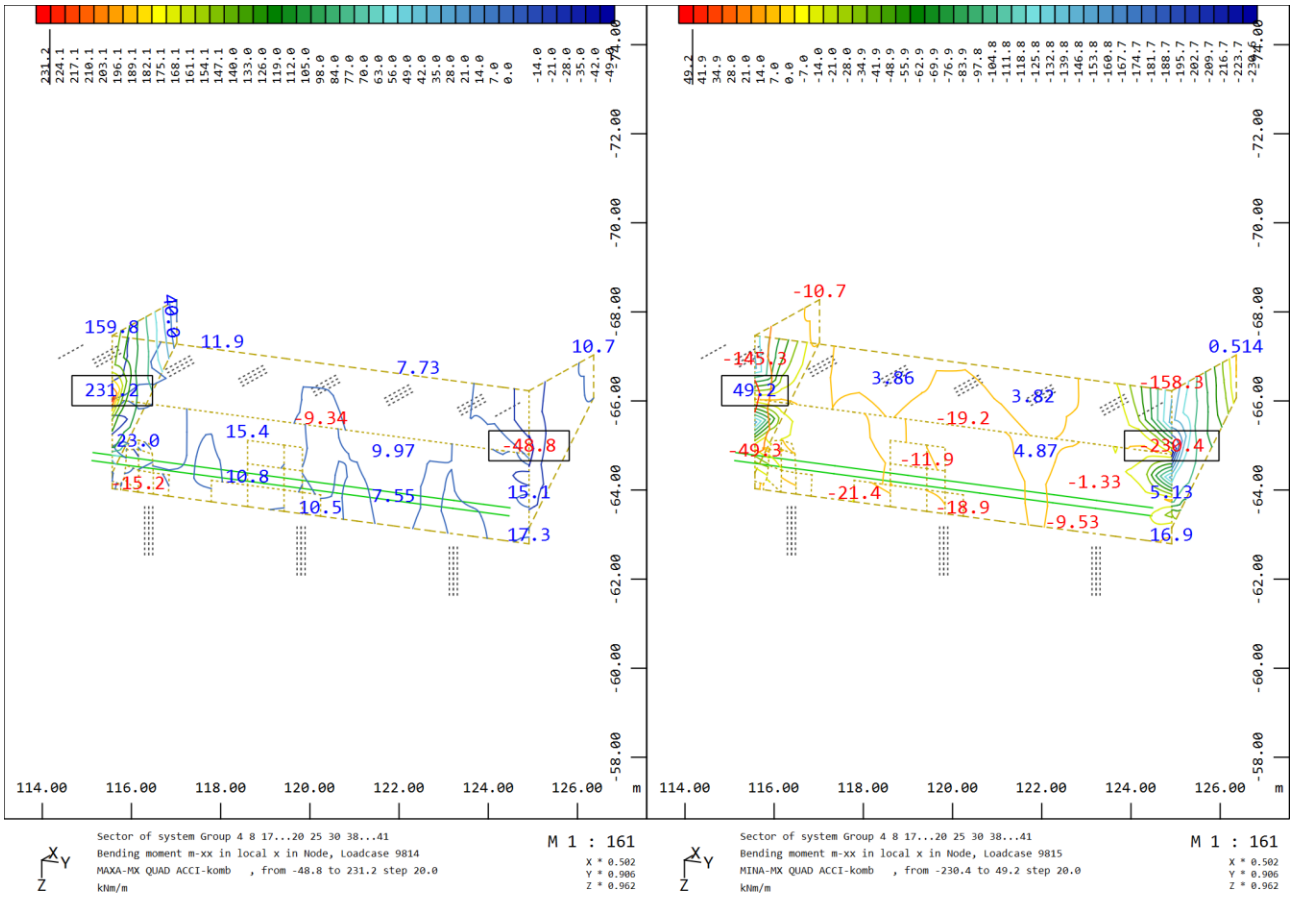
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Shear force Vy, Loadcase 8529 MAX-VY
BEAM , 1 cm 3D = 100.0 kN (Min=-62.4) (Max=201.4)
Beam Elements , Shear force Vy, Loadcase 8530 MIN-VY
BEAM , 1 cm 3D = 100.0 kN (Min=-201.2) (Max=64.0)

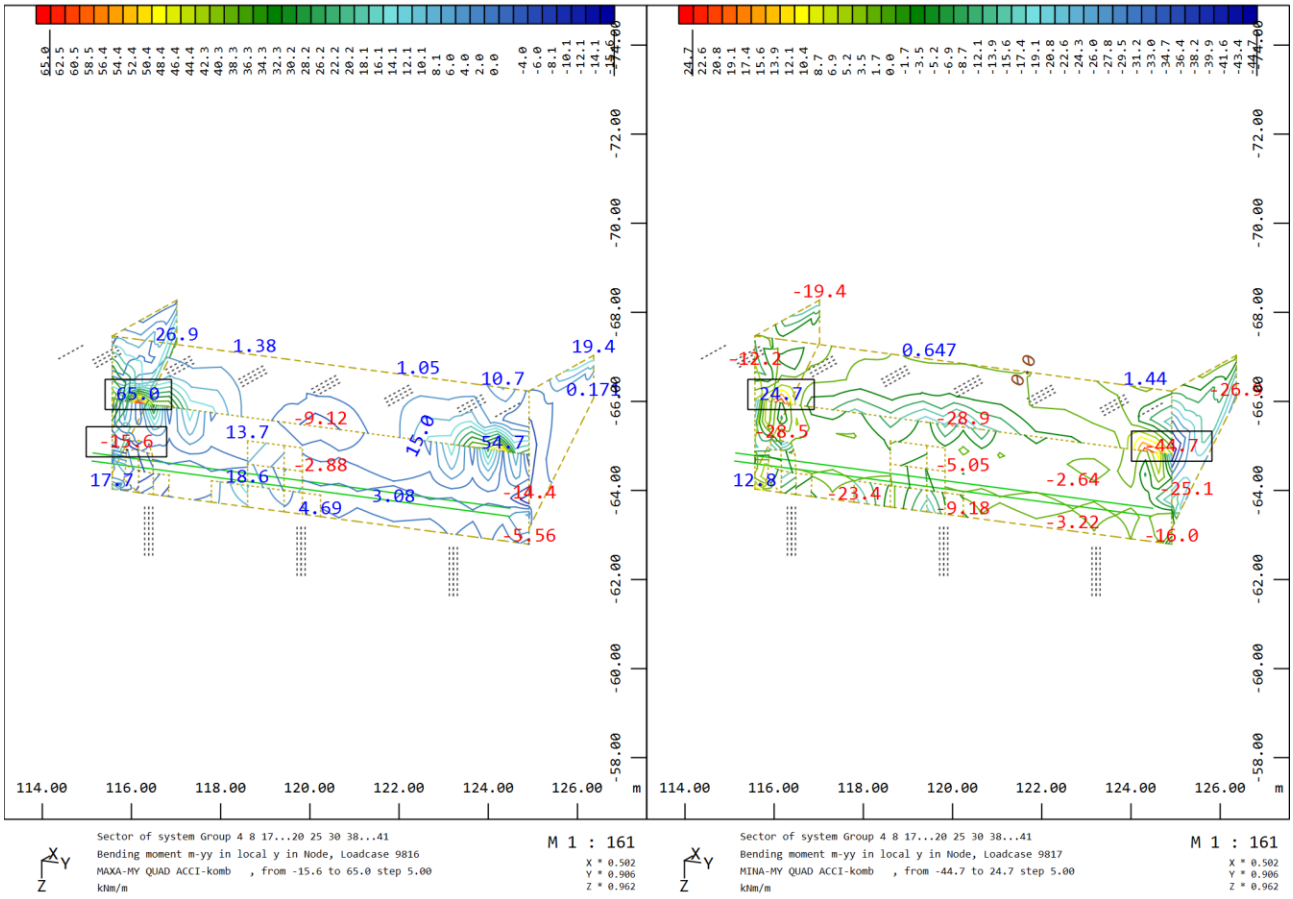
M 1 : 210

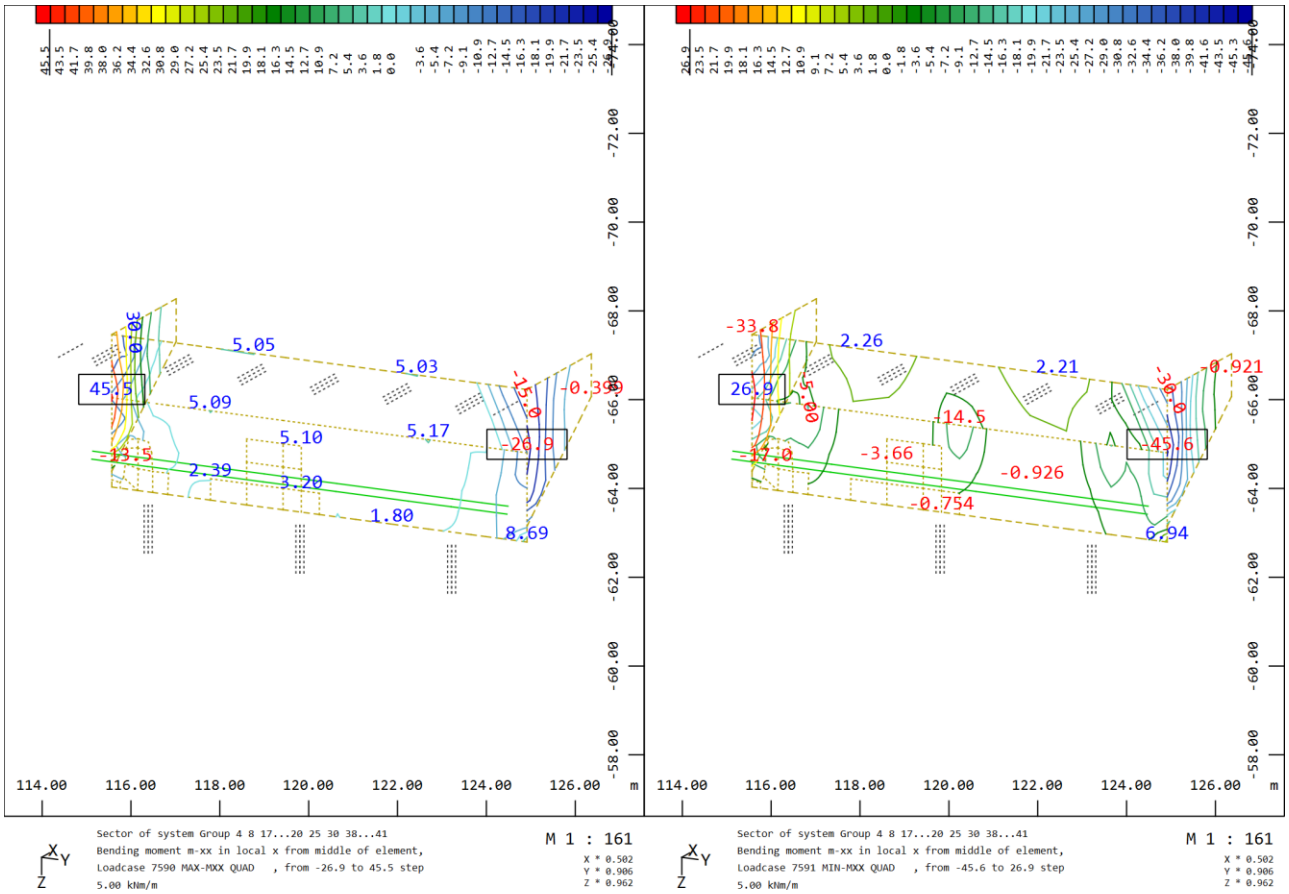
X * 0.502
Y * 0.906
Z * 0.962

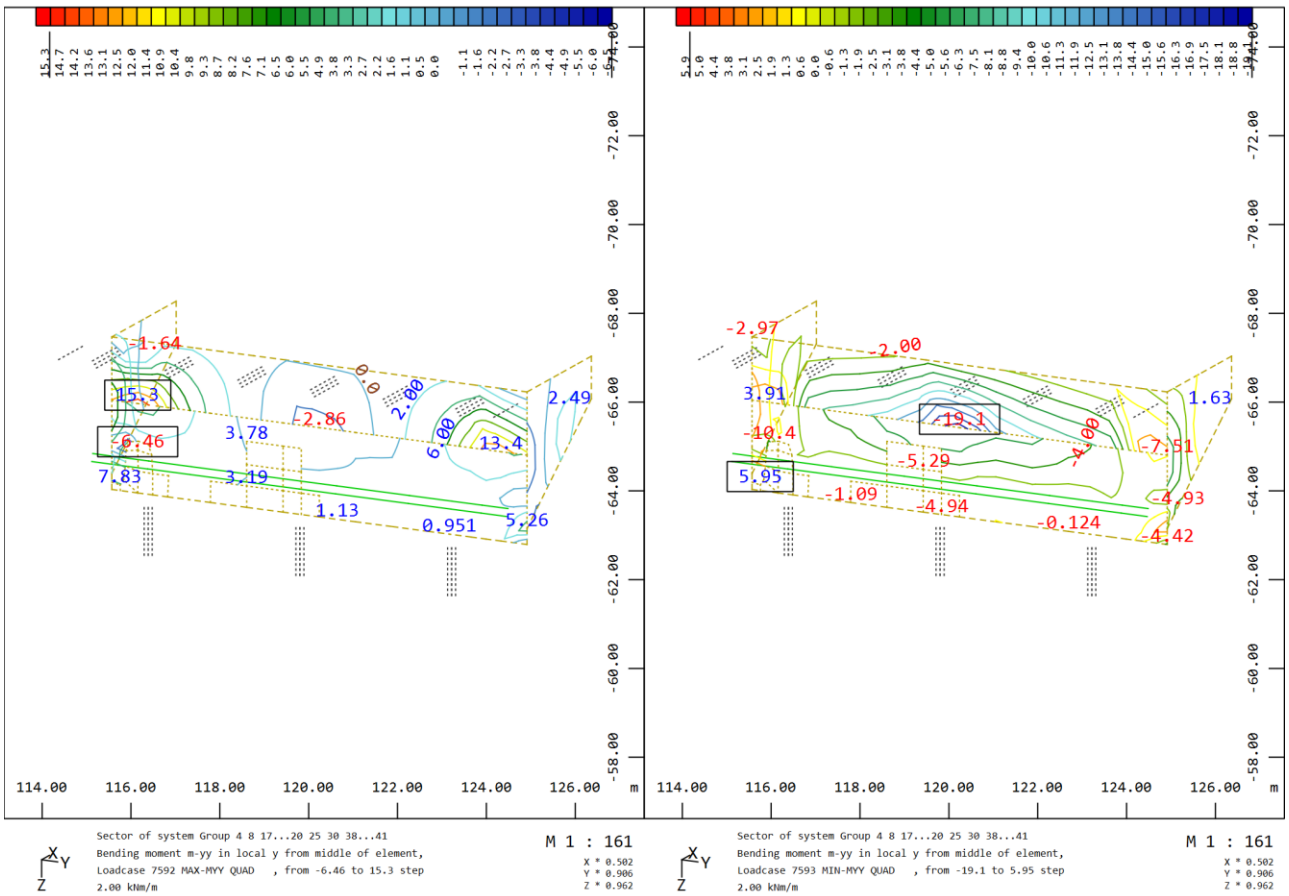

-0.473
68.0
51.1
46.6
0.710
77.4
-5.75
-34.9
28.9
192.4
18.2
18.0
31.3
21.6
11.8
190.1
-0.707
32.8
-5.88
0.477
-72.7
-31.1
-87.8
-43.1
-26.5
-230.0
-71.2
-33.8
-31.4
-10.5
225.5
114.00
116.00
118.00
120.00
122.00
124.00
126.00
m
-72.00
-70.00
-68.00
-66.00
-64.00
-62.00
-60.00
-58.00
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x in Node, Loadcase 9914
MAX-MX QUAD ULS-traffic,temp,win , from -34.9 to 192.4
step 20.0 kNm/m
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x in Node, Loadcase 9915
MIN-MX QUAD ULS-traffic,temp,win , from -230.0 to 32.8
step 20.0 kNm/m
M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962

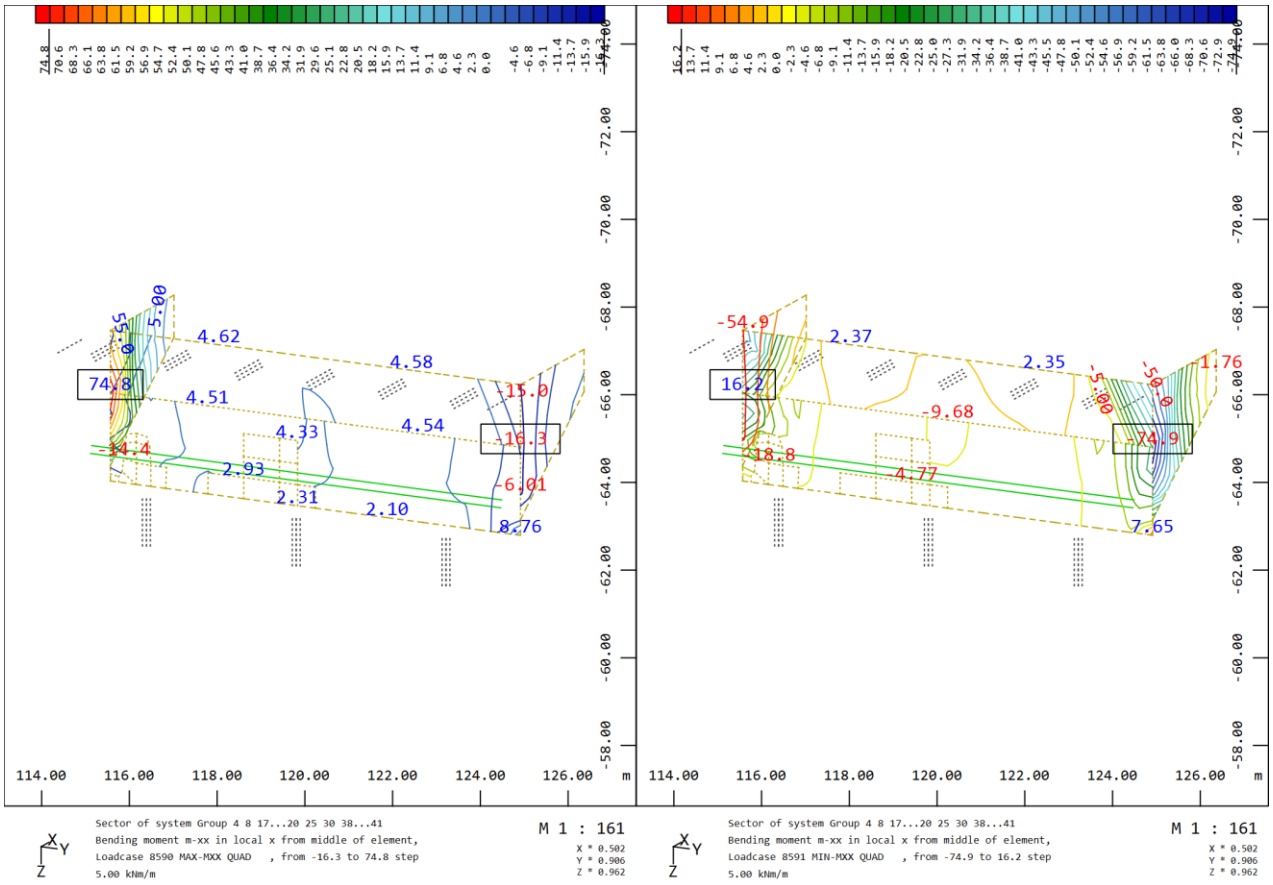

-5.69
10.6
9.07
2.72
46.9
-8.60
-5.09
-0.156
9.65
46.1
-2.10
70.5
30.2
4.14
11.1
42.4
-16.5
0.145
0.320
1.50
-16.7
-121.0
138.3
2.34
-78.1
-105.4
8.43
-41.5
-36.1
-32.5
-4.12
-37.8
114.00
116.00
118.00
120.00
122.00
124.00
126.00
m
-72.00
-70.00
-68.00
-66.00
-64.00
-62.00
-60.00
-58.00
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y in Node, Loadcase 9916
MAX-MY QUAD ULS-traffic,temp,win , from -8.60 to 70.5
step 5.00 kNm/m
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y in Node, Loadcase 9917
MIN-MY QUAD ULS-traffic,temp,win , from -138.3 to 8.43
step 10.0 kNm/m
M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962

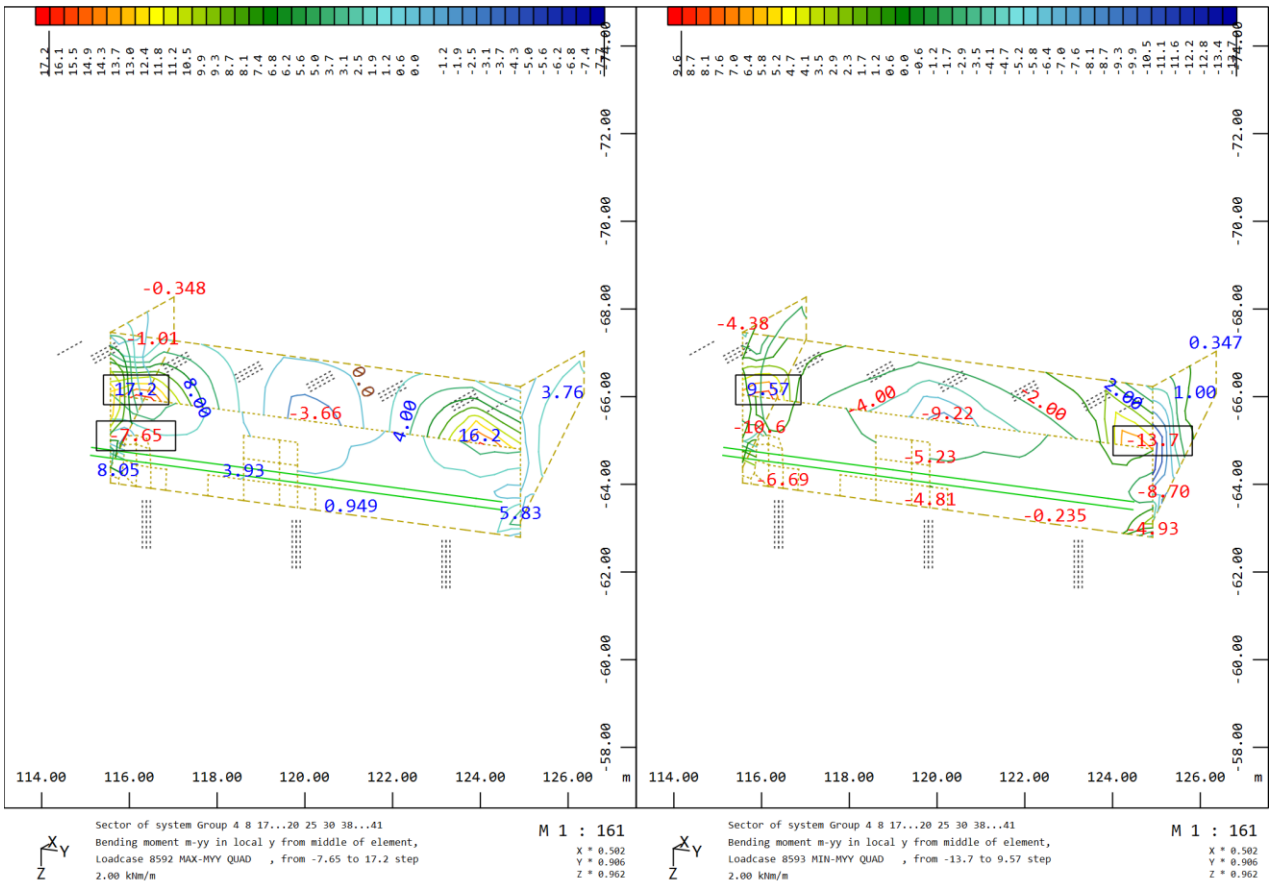

Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x in Node, Loadcase 9814
MAXA-MX QUAD ACCI-komb , from -48.8 to 231.2 step 20.0
kNm/m
M 1 : 161
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x in Node, Loadcase 9815
MINA-MX QUAD ACCI-komb , from -230.4 to 49.2 step 20.0
kNm/m
M 1 : 161


Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y in Node, Loadcase 9816
MAXA-MY QUAD ACCI-komb , from -15.6 to 65.0 step 5.00
kNm/m
M 1 : 161
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y in Node, Loadcase 9817
MINA-MY QUAD ACCI-komb , from -44.7 to 24.7 step 5.00
kNm/m
M 1 : 161


Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x from middle of element,
Loadcase 7590 MAX-MXX QUAD , from -26.9 to 45.5 step
5.00 kNm/m
M 1 : 161
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x from middle of element,
Loadcase 7591 MIN-MXX QUAD , from -45.6 to 26.9 step
5.00 kNm/m
M 1 : 161

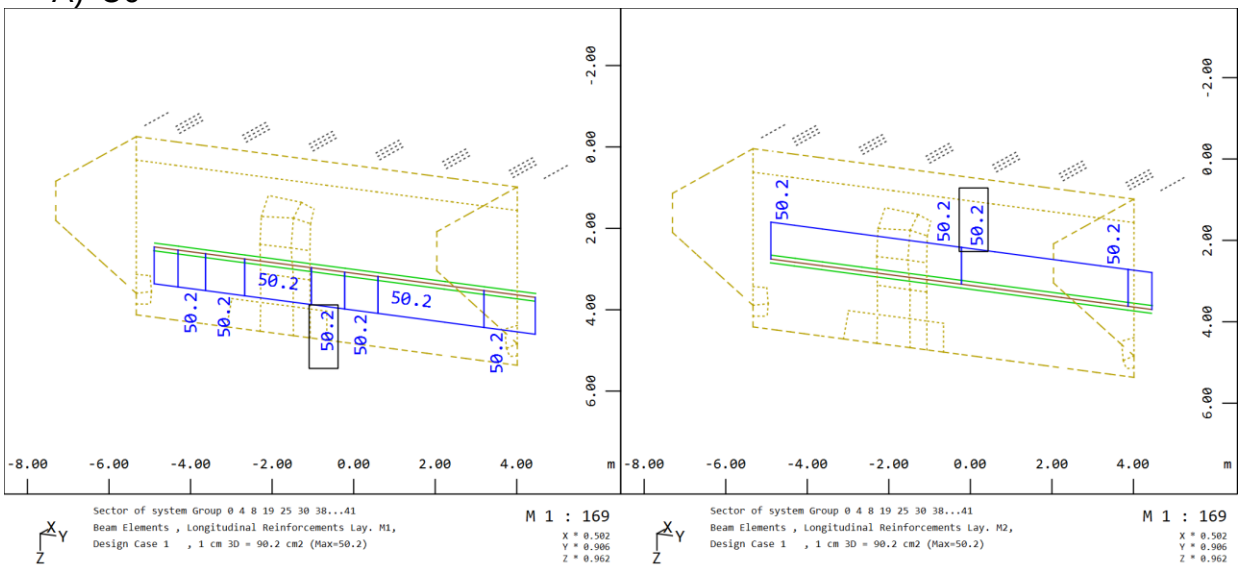

Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y from middle of element,
Loadcase 7592 MAX-MYY QUAD , from -6.46 to 15.3 step
2.00 kNm/m
M 1 : 161
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y from middle of element,
Loadcase 7593 MIN-MYY QUAD , from -19.1 to 5.95 step
2.00 kNm/m
M 1 : 161

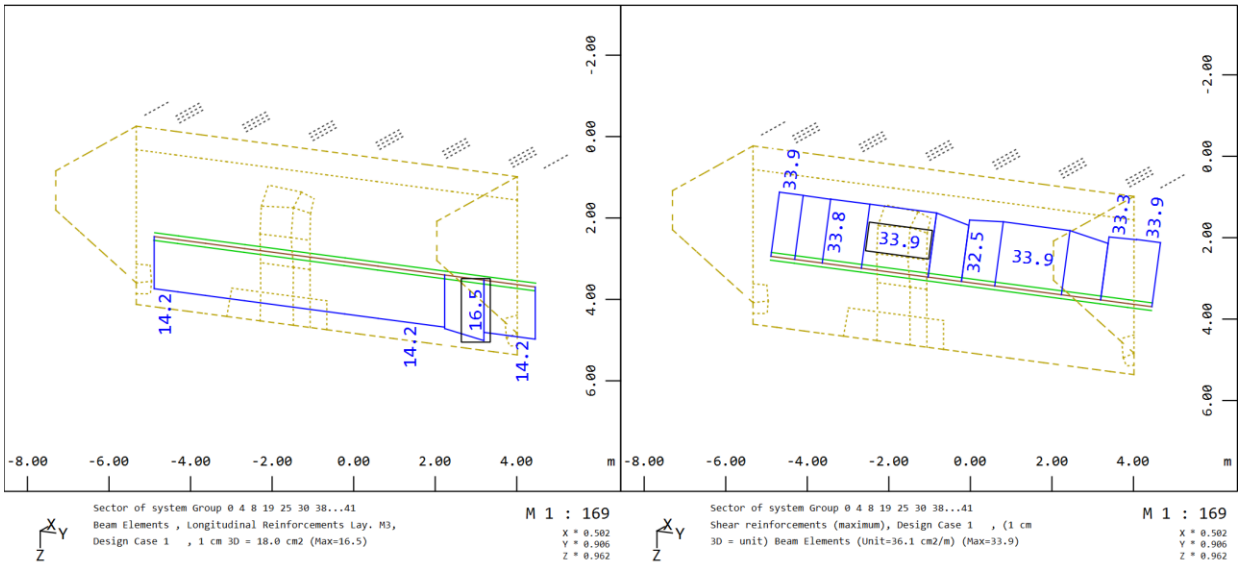

Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x from middle of element,
Loadcase 8590 MAX-MXX QUAD , from -16.3 to 74.8 step
5.00 kNm/m
M 1 : 161
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-xx in local x from middle of element,
Loadcase 8591 MIN-MXX QUAD , from -74.9 to 16.2 step
5.00 kNm/m
M 1 : 161

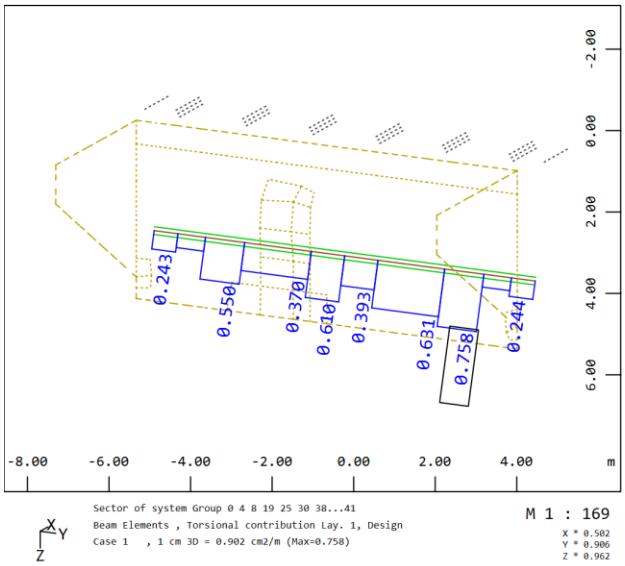

Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y from middle of element,
Loadcase 8592 MAX-MYY QUAD , from -7.65 to 17.2 step
2.00 kNm/m
M 1 : 161
Sector of system Group 4 8 17...20 25 30 38...41
Bending moment m-yy in local y from middle of element,
Loadcase 8593 MIN-MYY QUAD , from -13.7 to 9.57 step
2.00 kNm/m
M 1 : 161

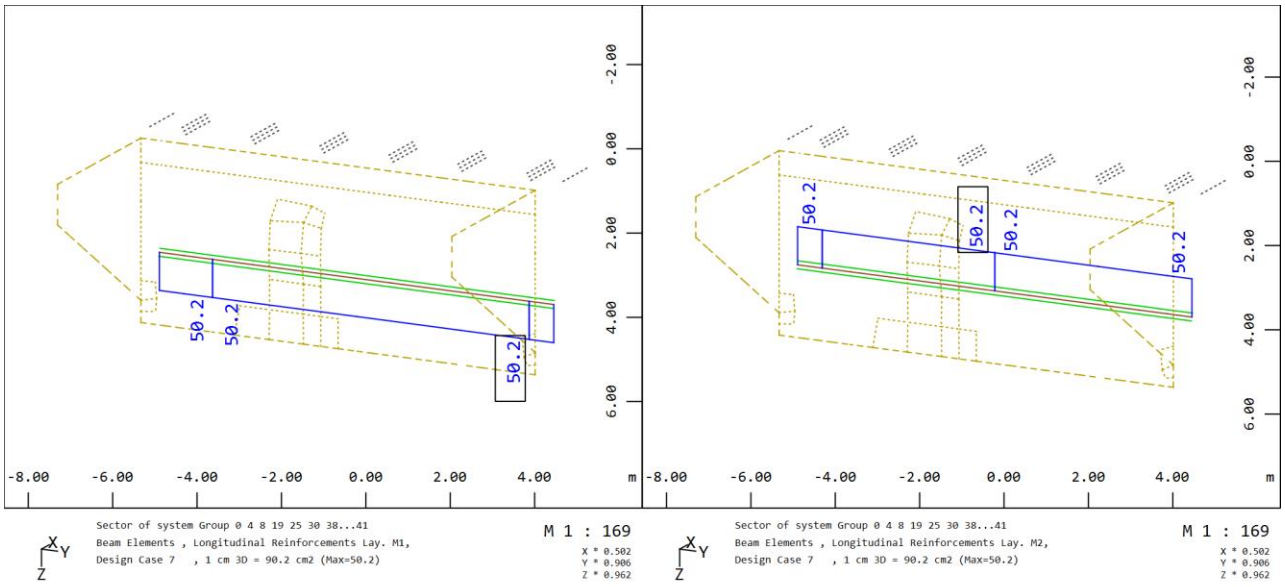
9.2.2 Potrebna armatura u naglavnici pilota

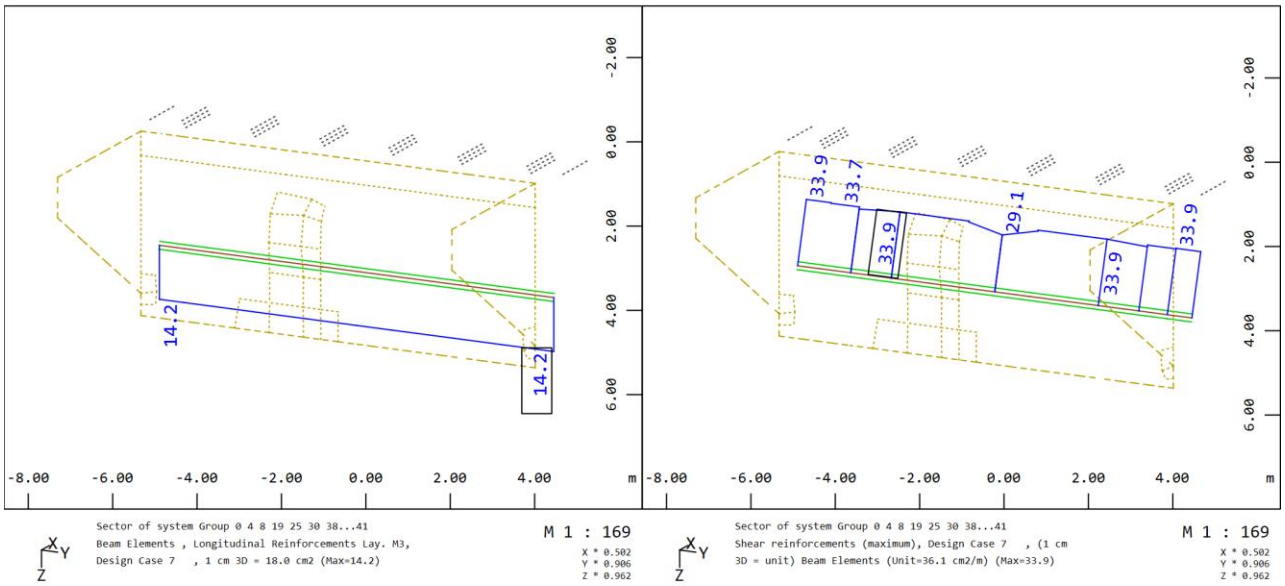
A) U0

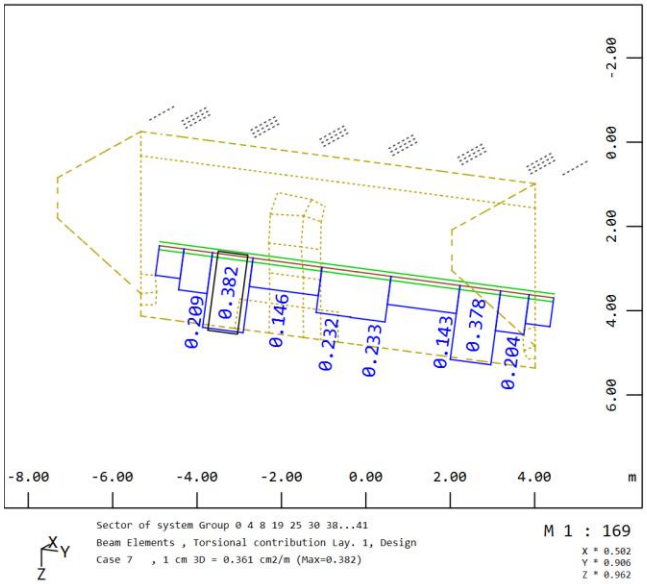


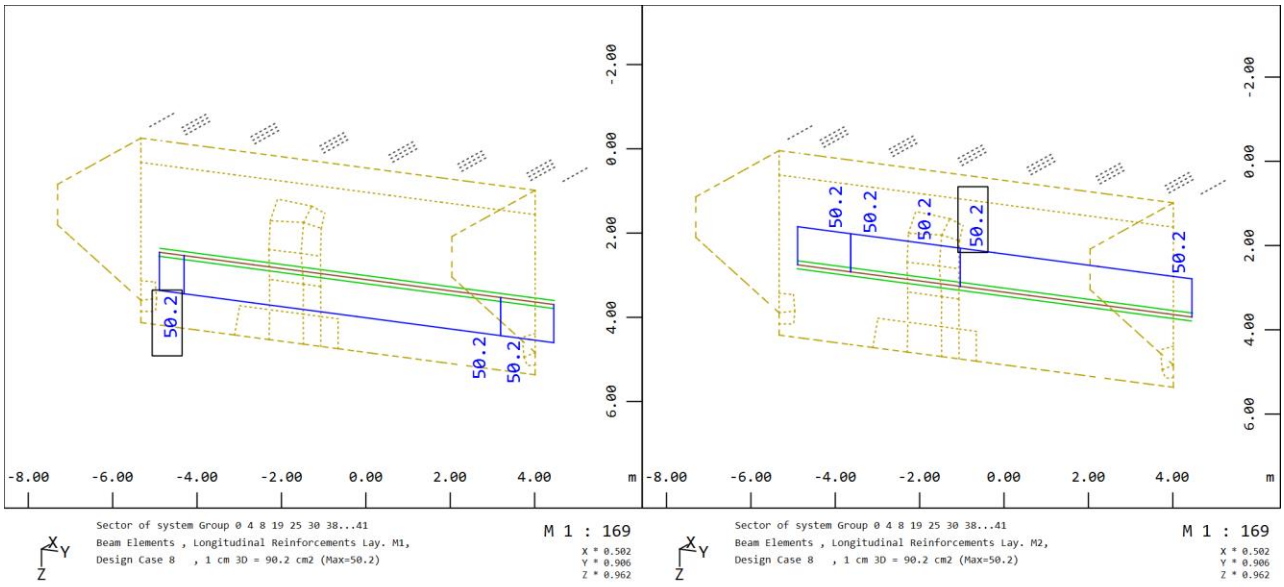


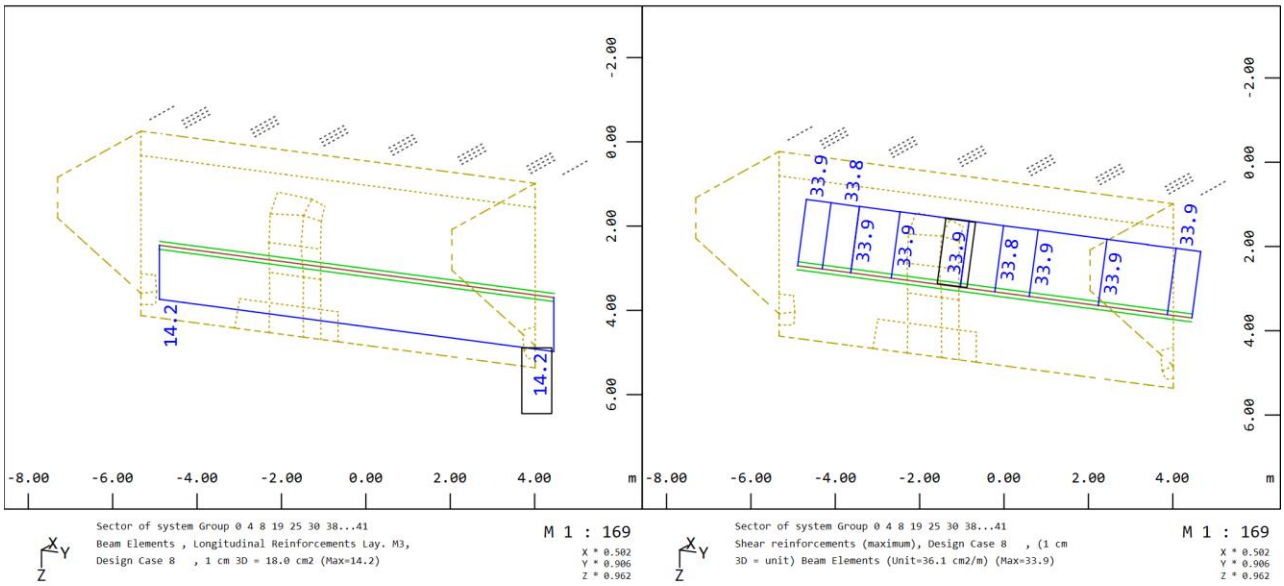


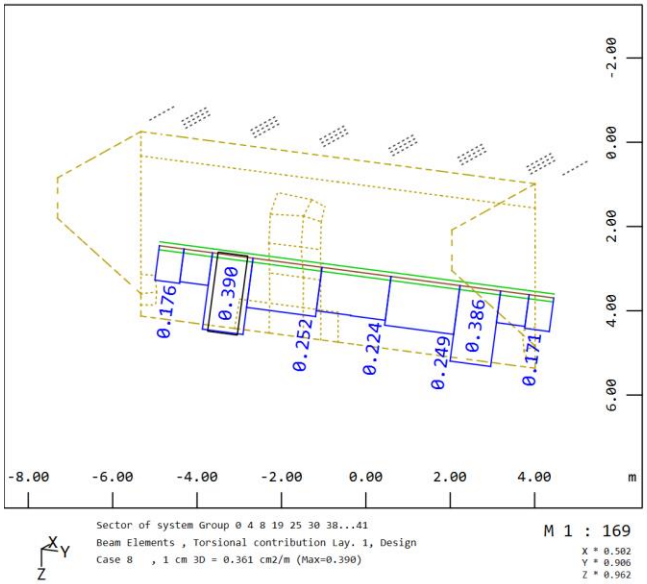

50.2
50.2
50.2
-8.00 -6.00 -4.00 -2.00 0.00 2.00 4.00 m
-2.00 0.00 2.00 4.00 6.00
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M1,
Design Case 7 , 1 cm 3D = 90.2 cm2 (Max=50.2)
M 1 : 169
X * 0.502
Y * 0.906
Z * 0.962
50.2
50.2
50.2
50.2
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M2,
Design Case 7 , 1 cm 3D = 90.2 cm2 (Max=50.2)
M 1 : 169


14.2
14.2
-8.00 -6.00 -4.00 -2.00 0.00 2.00 4.00 m
-2.00 0.00 2.00 4.00 6.00
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M3,
Design Case 7 , 1 cm 3D = 18.0 cm2 (Max=14.2)
M 1 : 169
X * 0.502
Y * 0.906
Z * 0.962
33.9
33.7
33.9
29.1
33.9
33.9
Sector of system Group 0 4 8 19 25 30 38...41
Shear reinforcements (maximum), Design Case 7 , (1 cm
3D = unit) Beam Elements (Unit=36.1 cm2/m) (Max=33.9)
M 1 : 169

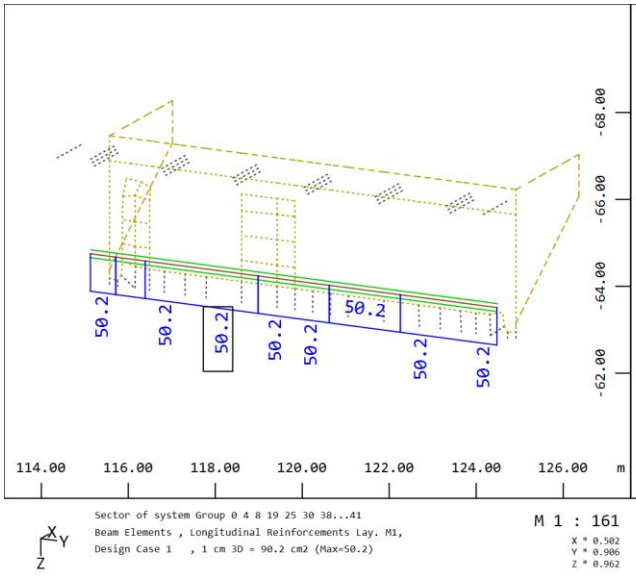

0.209
0.382
0.146
0.232
0.233
0.143
0.378
0.204
-8.00 -6.00 -4.00 -2.00 0.00 2.00 4.00 m
-2.00 0.00 2.00 4.00 6.00
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Torsional contribution Lay. 1, Design
Case 7 , 1 cm 3D = 0.361 cm2/m (Max=0.382)
M 1 : 169
X * 0.502
Y * 0.906
Z * 0.962


50.2
50.2
50.2
-8.00 -6.00 -4.00 -2.00 0.00 2.00 4.00 m
-2.00 0.00 2.00 4.00 6.00
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M1,
Design Case 8 , 1 cm 3D = 90.2 cm2 (Max=50.2)
M 1 : 169
X * 0.502
Y * 0.906
Z * 0.962
50.2
50.2
50.2
50.2
50.2
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M2,
Design Case 8 , 1 cm 3D = 90.2 cm2 (Max=50.2)
M 1 : 169


14.2
14.2
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M3,
Design Case 8 , 1 cm 3D = 18.0 cm2 (Max=14.2)
M 1 : 169
33.9
33.8
33.9
33.9
33.9
33.8
33.9
33.9
33.9
Sector of system Group 0 4 8 19 25 30 38...41
Shear reinforcements (maximum), Design Case 8 , (1 cm
3D = unit) Beam Elements (Unit=36.1 cm2/m) (Max=33.9)
M 1 : 169

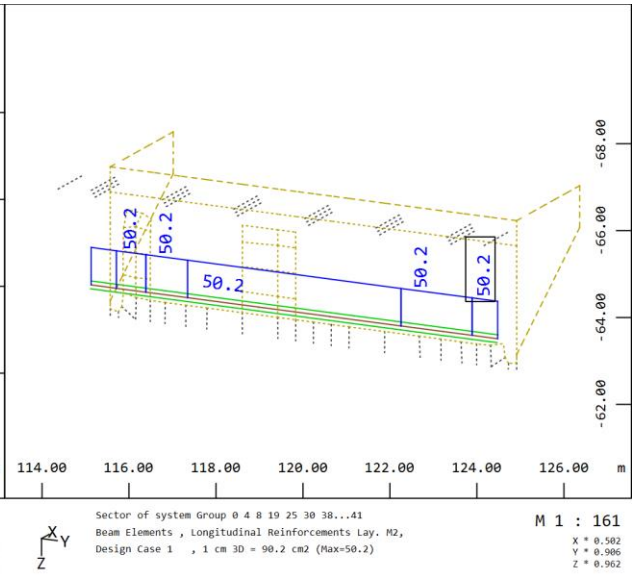

0.176
0.390
0.252
0.224
0.249
0.386
0.171
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Torsional contribution Lay. 1, Design
Case 8 , 1 cm 3D = 0.361 cm2/m (Max=0.390)
M 1 : 169

B) U14



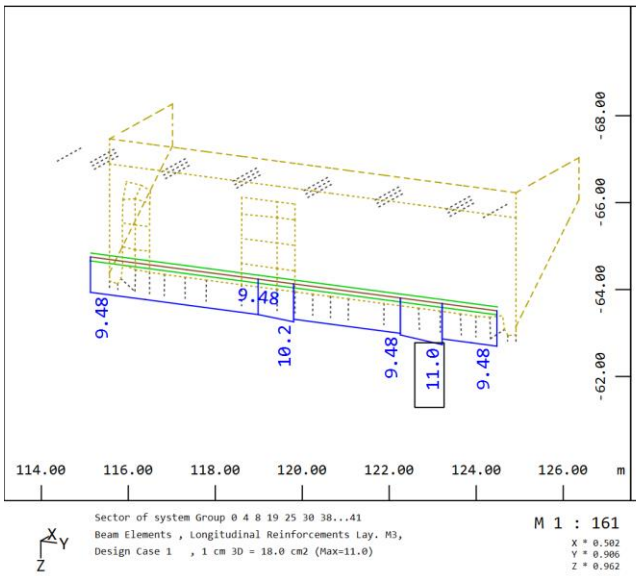
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M1,
Design Case 1 , 1 cm 3D = 90.2 cm2 (Max=50.2)

M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962



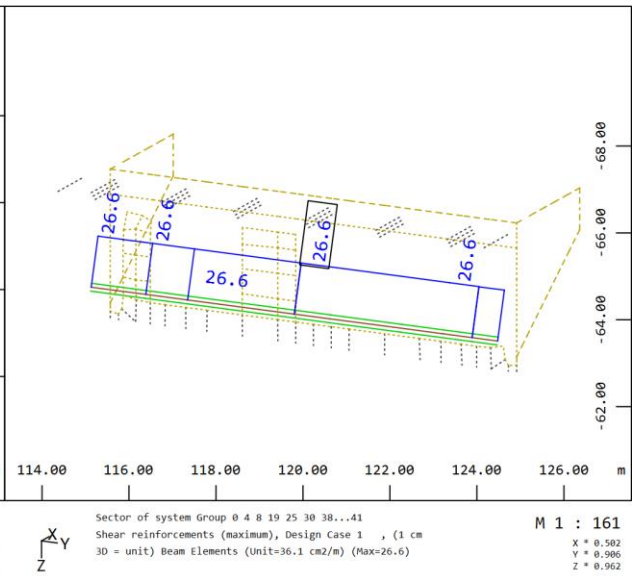
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M2,
Design Case 1 , 1 cm 3D = 90.2 cm2 (Max=50.2)

M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962



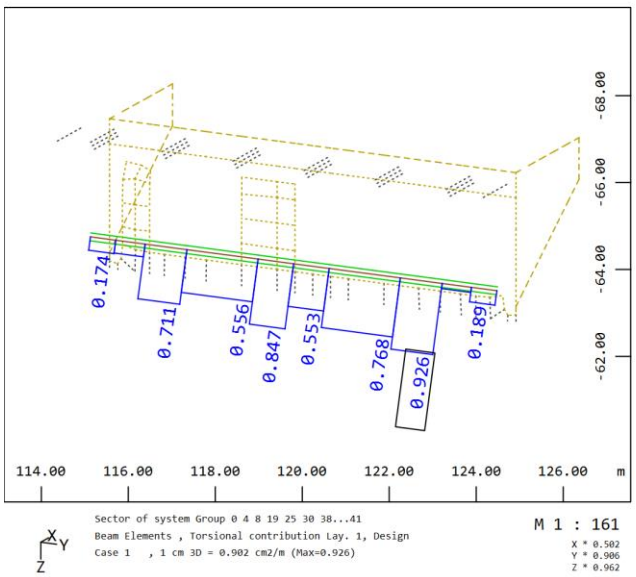
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M3,
Design Case 1 , 1 cm 3D = 18.0 cm2 (Max=11.0)

M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962



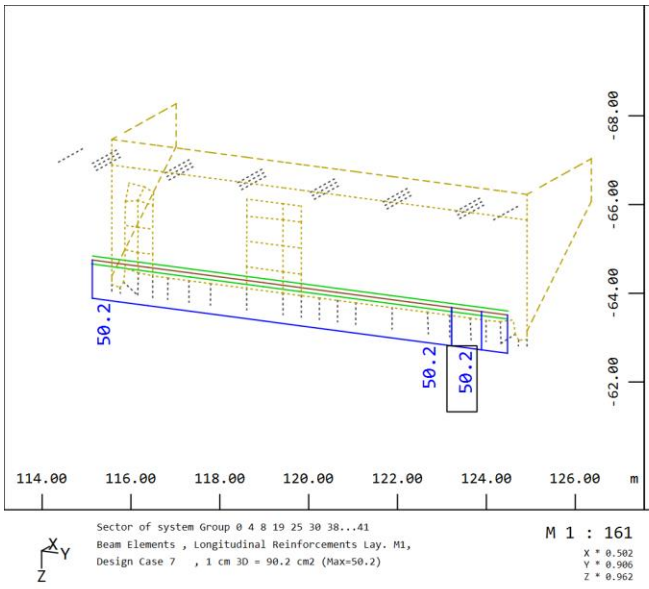
Sector of system Group 0 4 8 19 25 30 38...41
Shear reinforcements (maximum), Design Case 1 , (1 cm
3D = unit) Beam Elements (Unit=36.1 cm2/m) (Max=26.6)

M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962



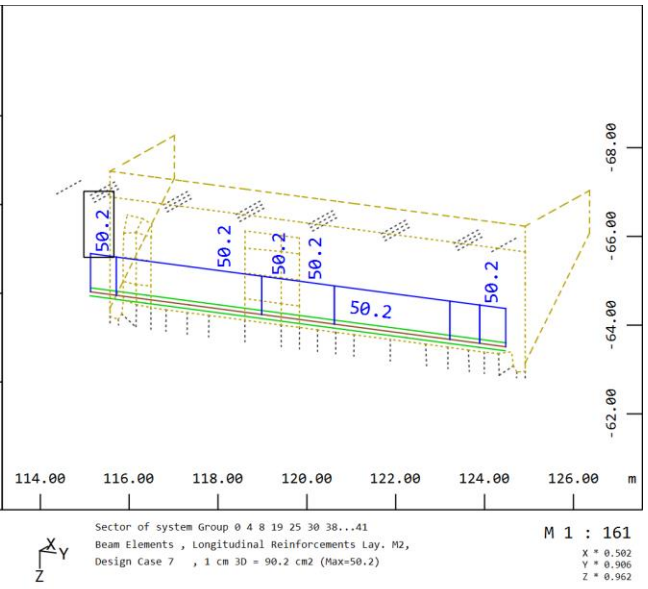
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Torsional contribution Lay. 1, Design
Case 1 , 1 cm 3D = 0.902 cm2/m (Max=0.926)

M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962



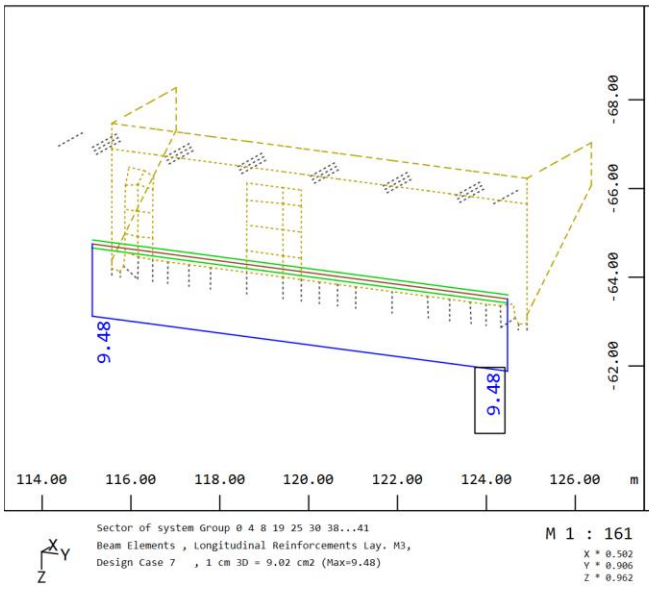
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M1,
Design Case 7 , 1 cm 3D = 90.2 cm2 (Max=50.2)

M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962



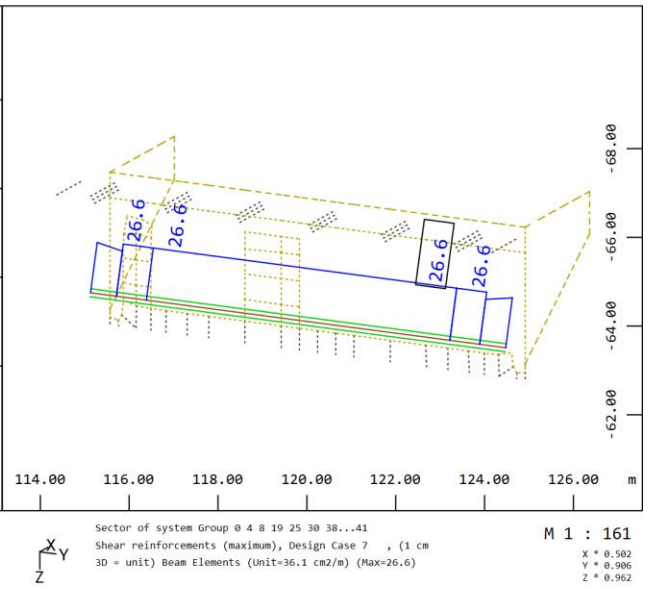
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M2,
Design Case 7 , 1 cm 3D = 90.2 cm2 (Max=50.2)

M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962



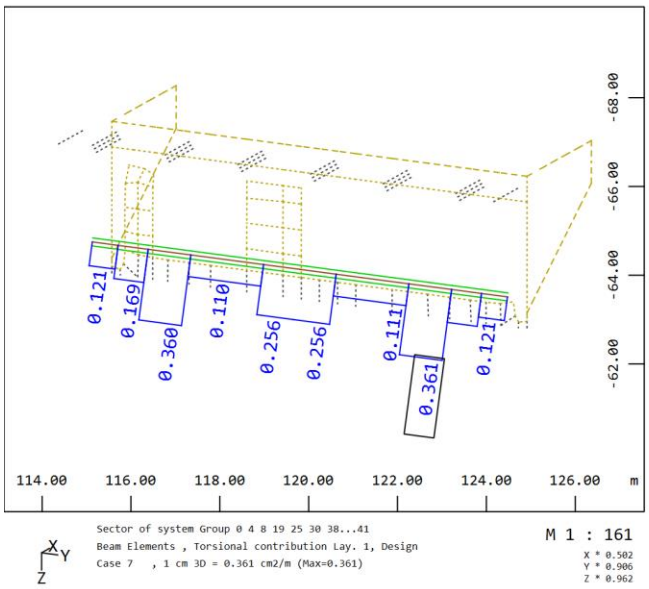
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M3,
Design Case 7 , 1 cm 3D = 9.02 cm2 (Max=9.48)

M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962



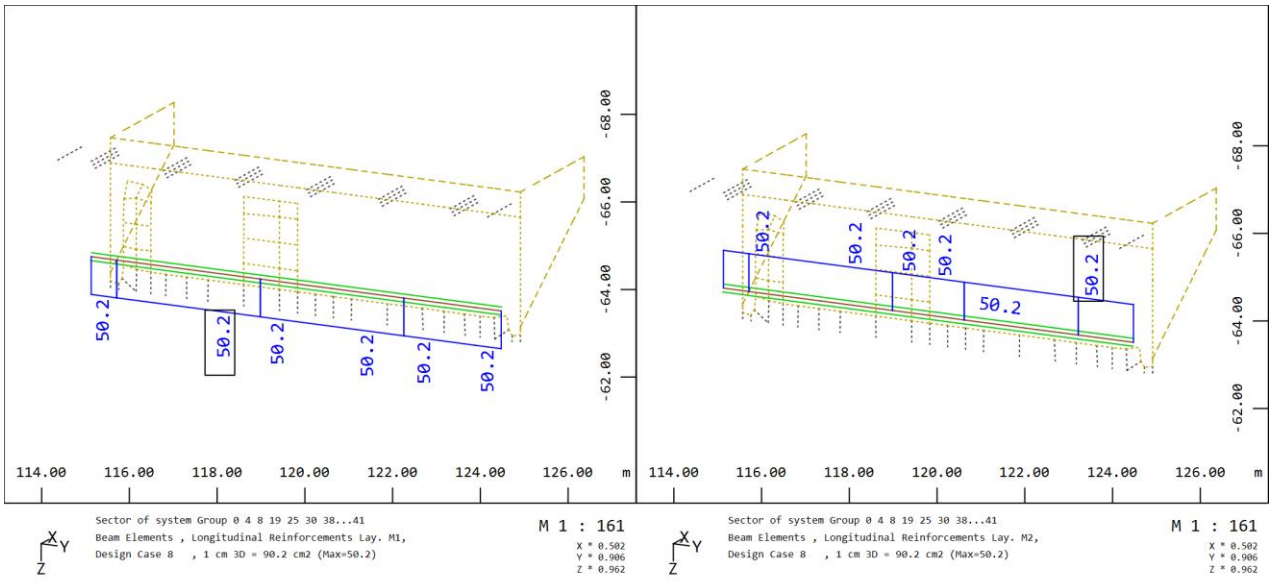
Sector of system Group 0 4 8 19 25 30 38...41
Shear reinforcements (maximum), Design Case 7 , (1 cm
3D = unit) Beam Elements (Unit=36.1 cm2/m) (Max=26.6)

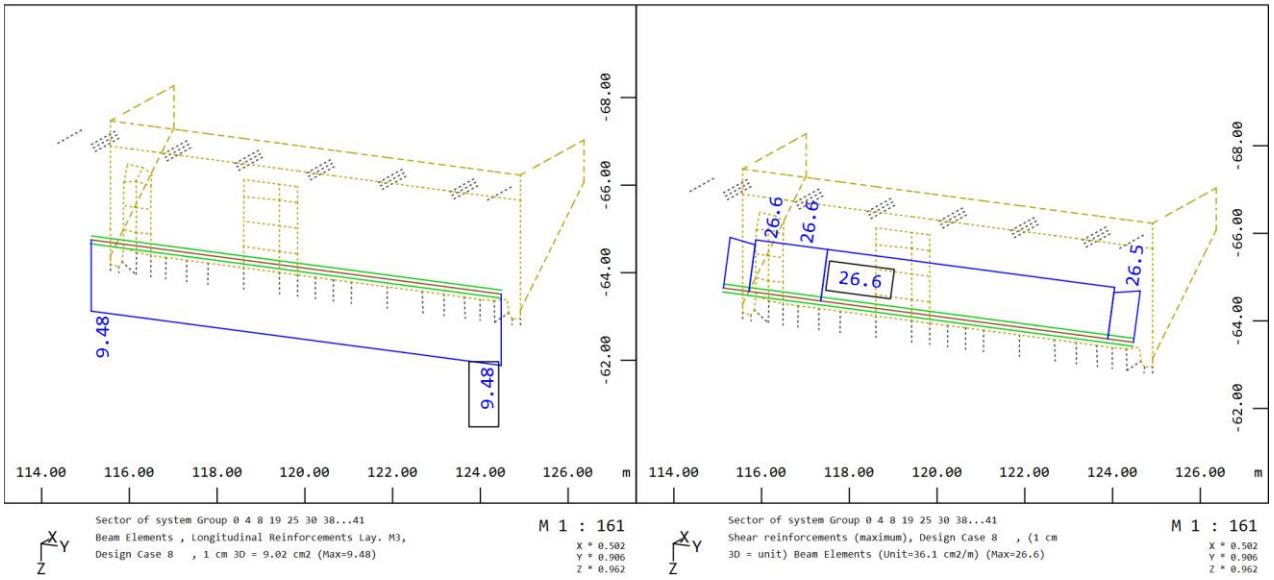
M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962

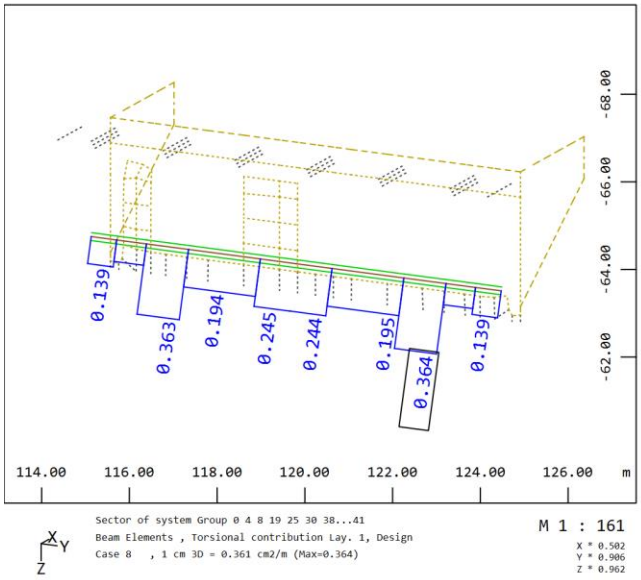


Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Torsional contribution Lay. 1, Design
Case 7 , 1 cm 3D = 0.361 cm2/m (Max=0.361)

M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962

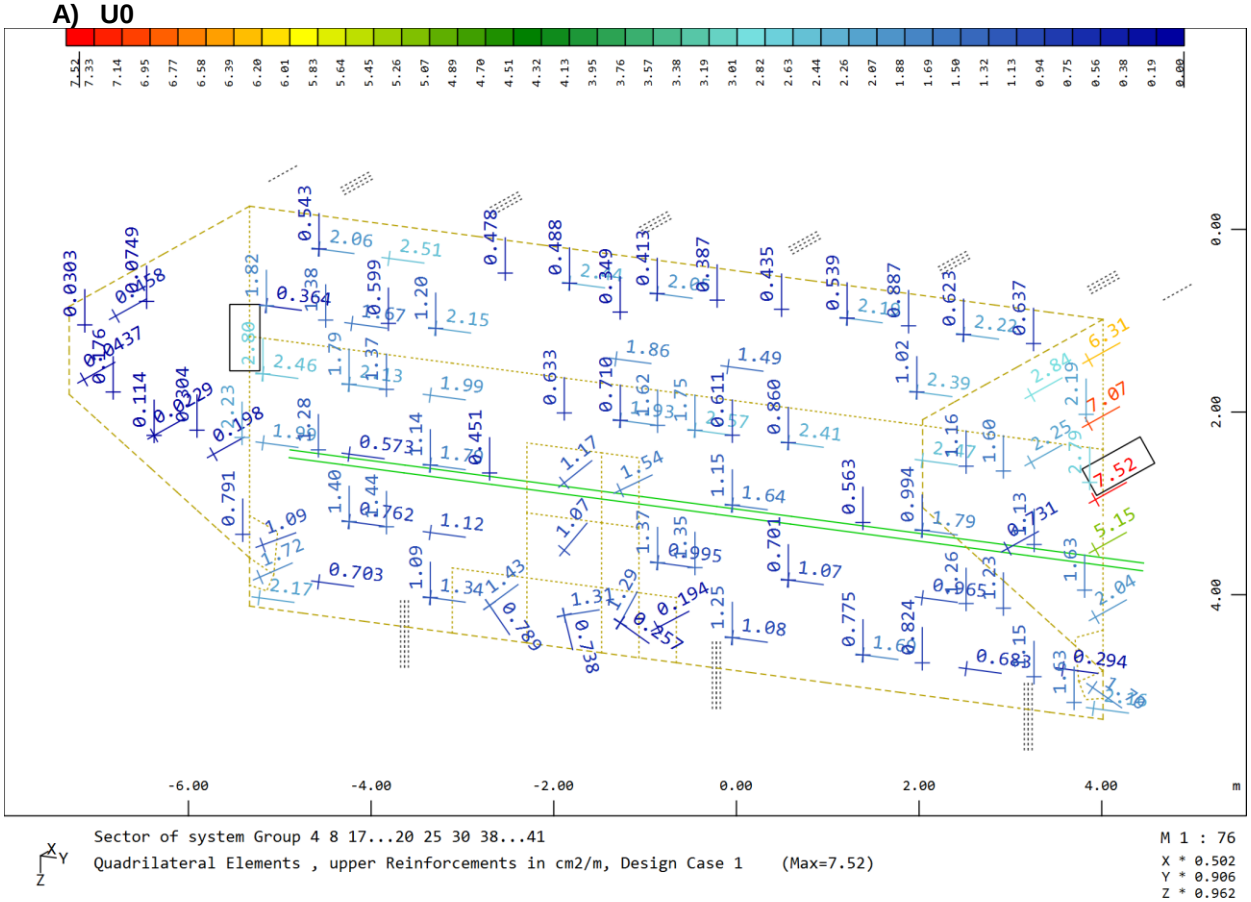

50.2
50.2
50.2
50.2
50.2
50.2
50.2
50.2
50.2
50.2
50.2
-68.00
-66.00
-64.00
-62.00
114.00
116.00
118.00
120.00
122.00
124.00
126.00
m
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M1,
Design Case 8 , 1 cm 3D = 90.2 cm2 (Max=50.2)
M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M2,
Design Case 8 , 1 cm 3D = 90.2 cm2 (Max=50.2)
M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962

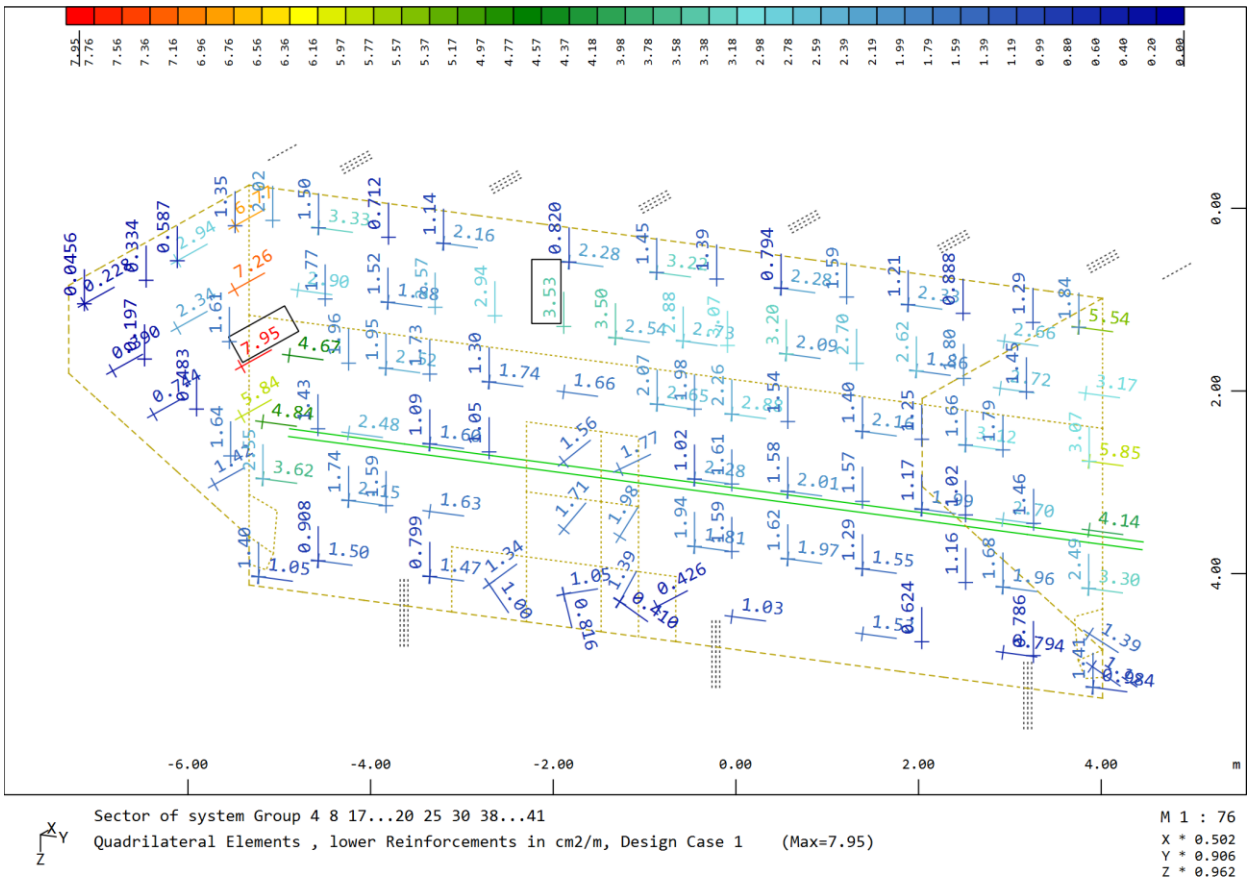

9.48
9.48
26.6
26.6
26.6
26.5
-68.00
-66.00
-64.00
-62.00
114.00
116.00
118.00
120.00
122.00
124.00
126.00
m
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Longitudinal Reinforcements Lay. M3,
Design Case 8 , 1 cm 3D = 9.02 cm2 (Max=9.48)
M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962
Sector of system Group 0 4 8 19 25 30 38...41
Shear reinforcements (maximum), Design Case 8 , (1 cm
3D = unit) Beam Elements (Unit=36.1 cm2/m) (Max=26.6)
M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962

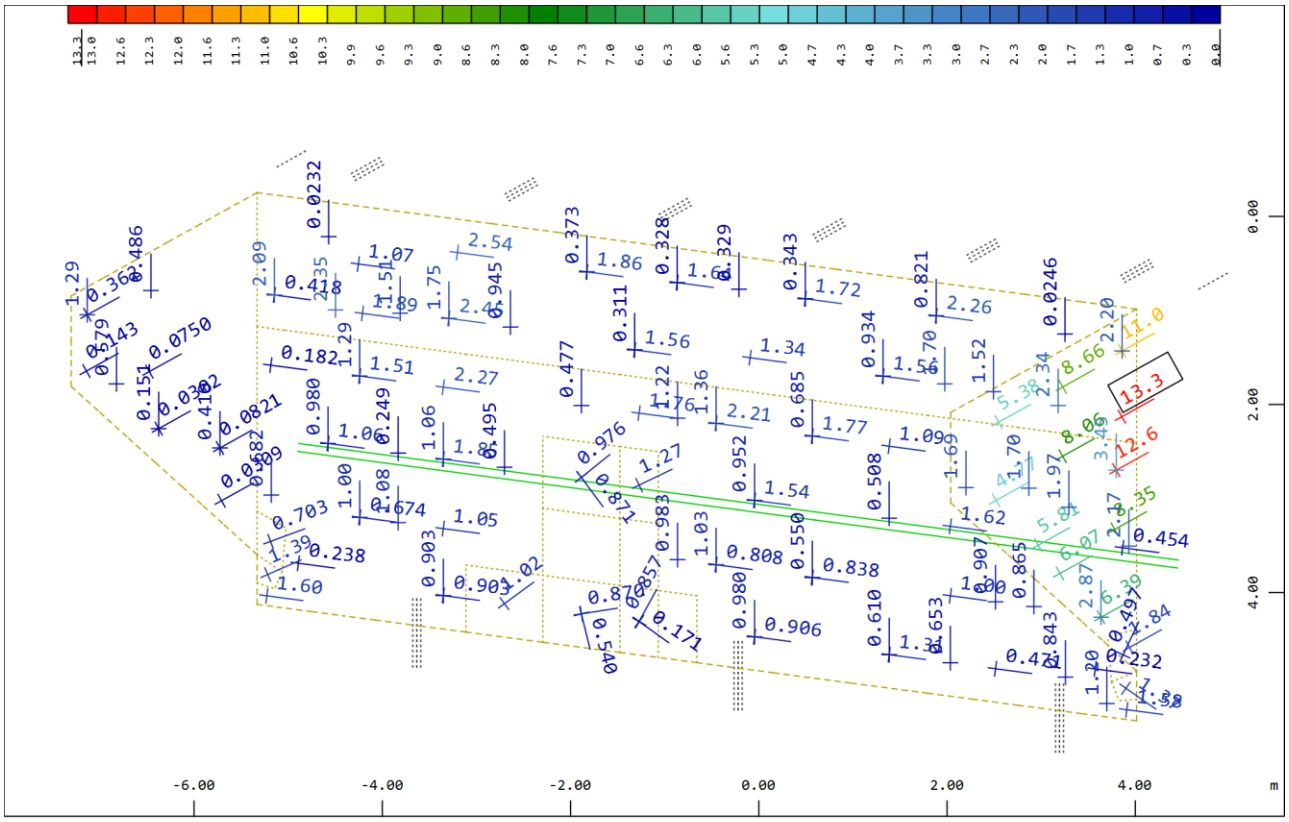

0.139
0.363
0.194
0.245
0.244
0.195
0.364
0.139
-68.00
-66.00
-64.00
-62.00
114.00
116.00
118.00
120.00
122.00
124.00
126.00
m
Sector of system Group 0 4 8 19 25 30 38...41
Beam Elements , Torsional contribution Lay. 1, Design
Case 8 , 1 cm 3D = 0.361 cm2/m (Max=0.364)
M 1 : 161
X * 0.502
Y * 0.906
Z * 0.962

9.2.3 Potrebna armatura u zidiću i krilima upornjaka

A) U0

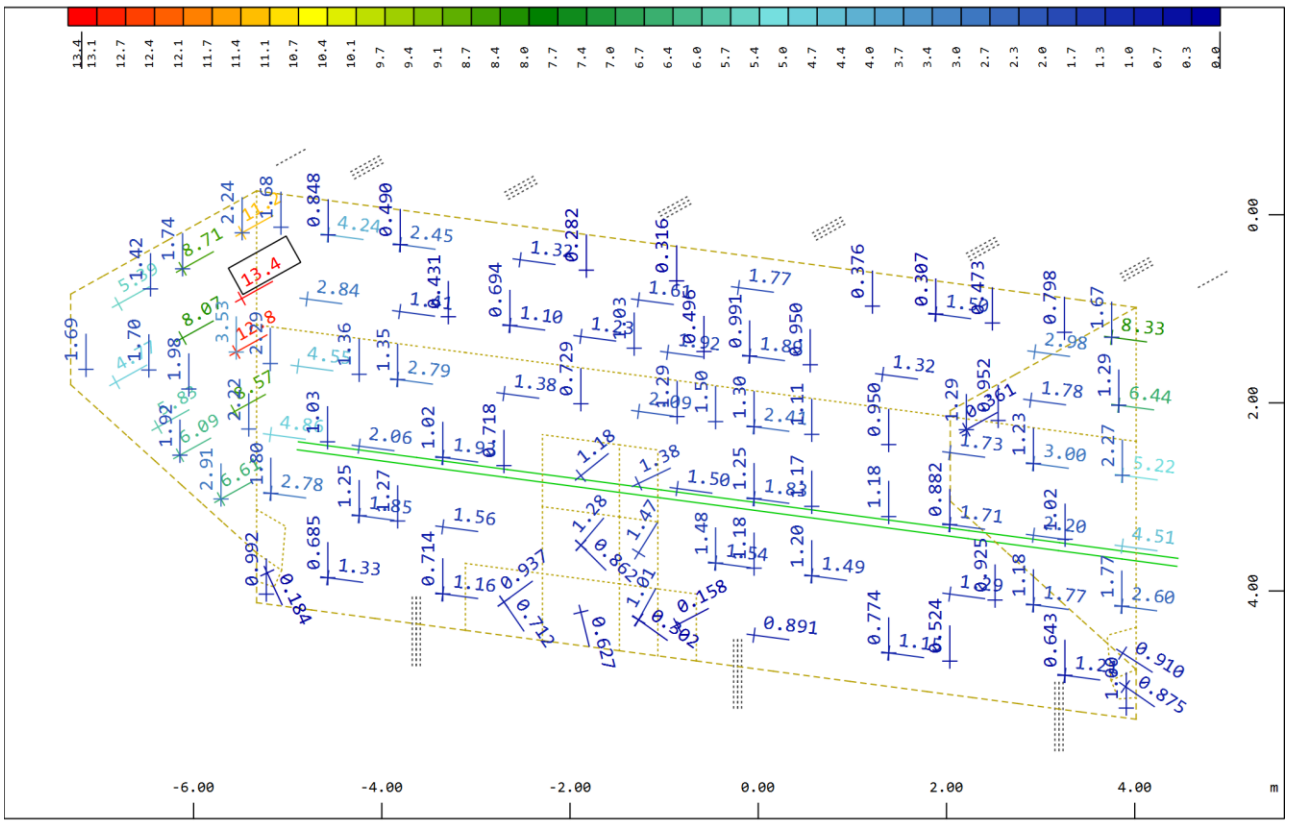






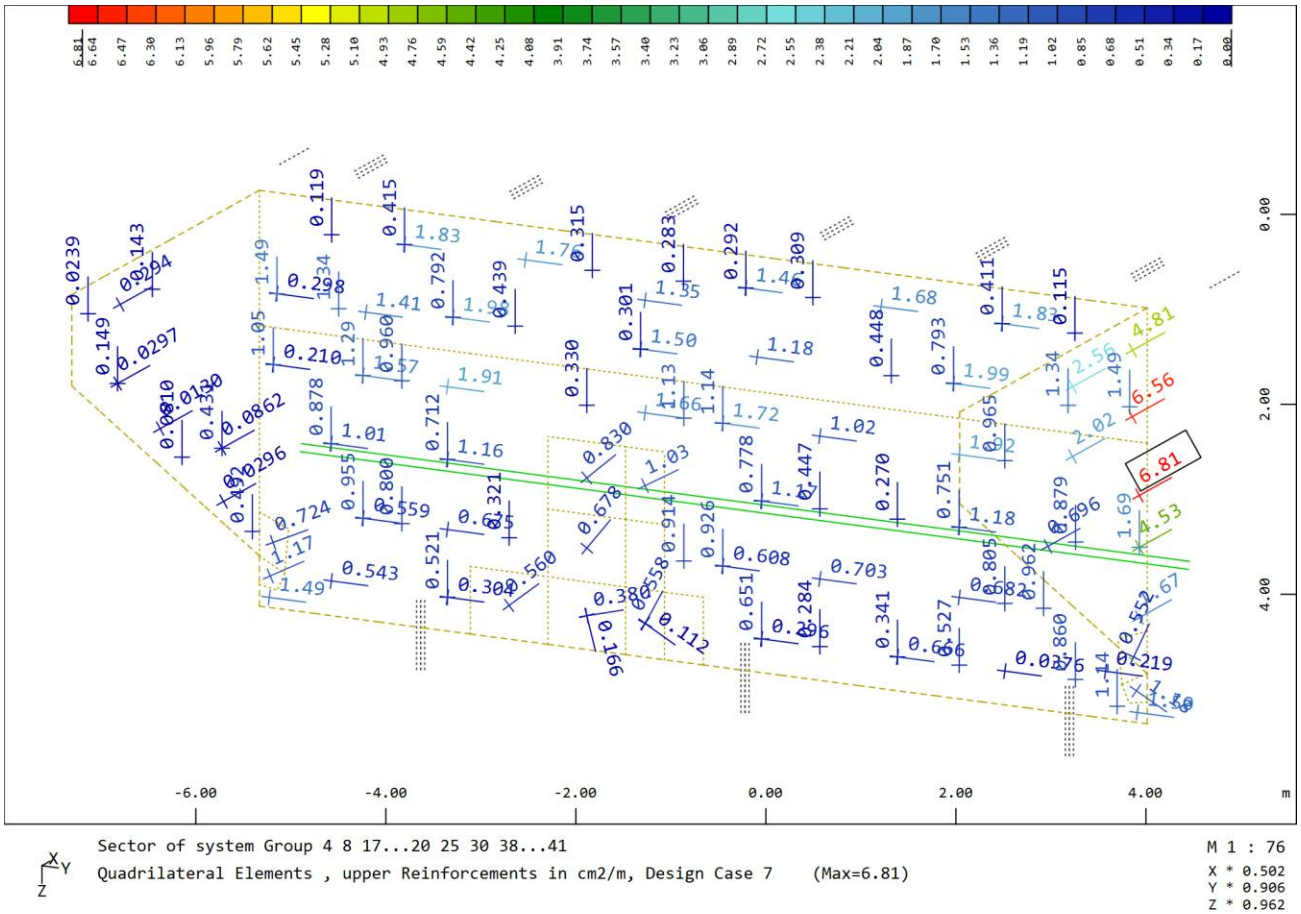
Sector of system Group 4 8 17...20 25 30 38...41
Quadrilateral Elements , upper Reinforcements in cm2/m, Design Case 4 (Max=13.3)

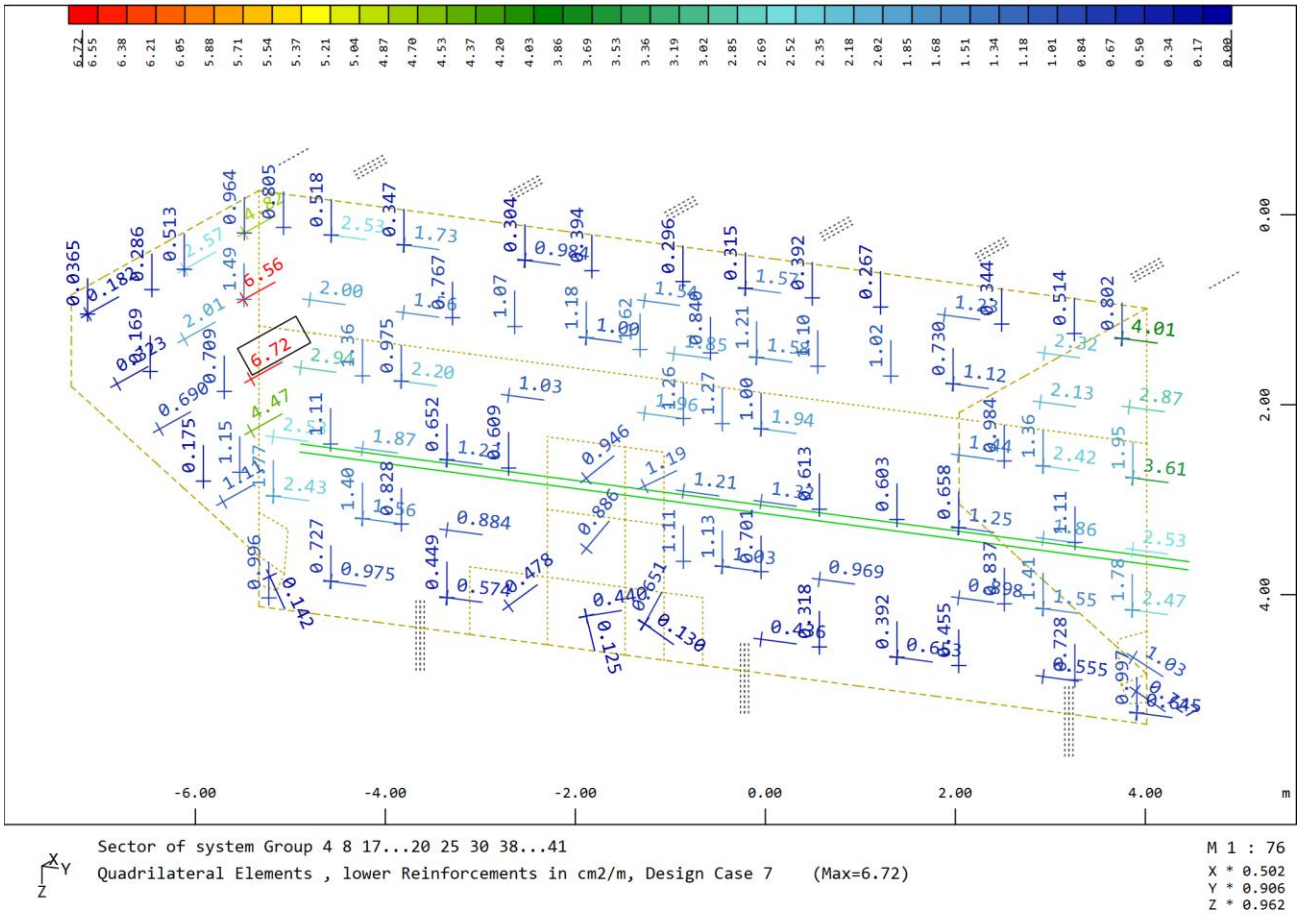
M 1 : 76
X * 0.502
Y * 0.906
Z * 0.962

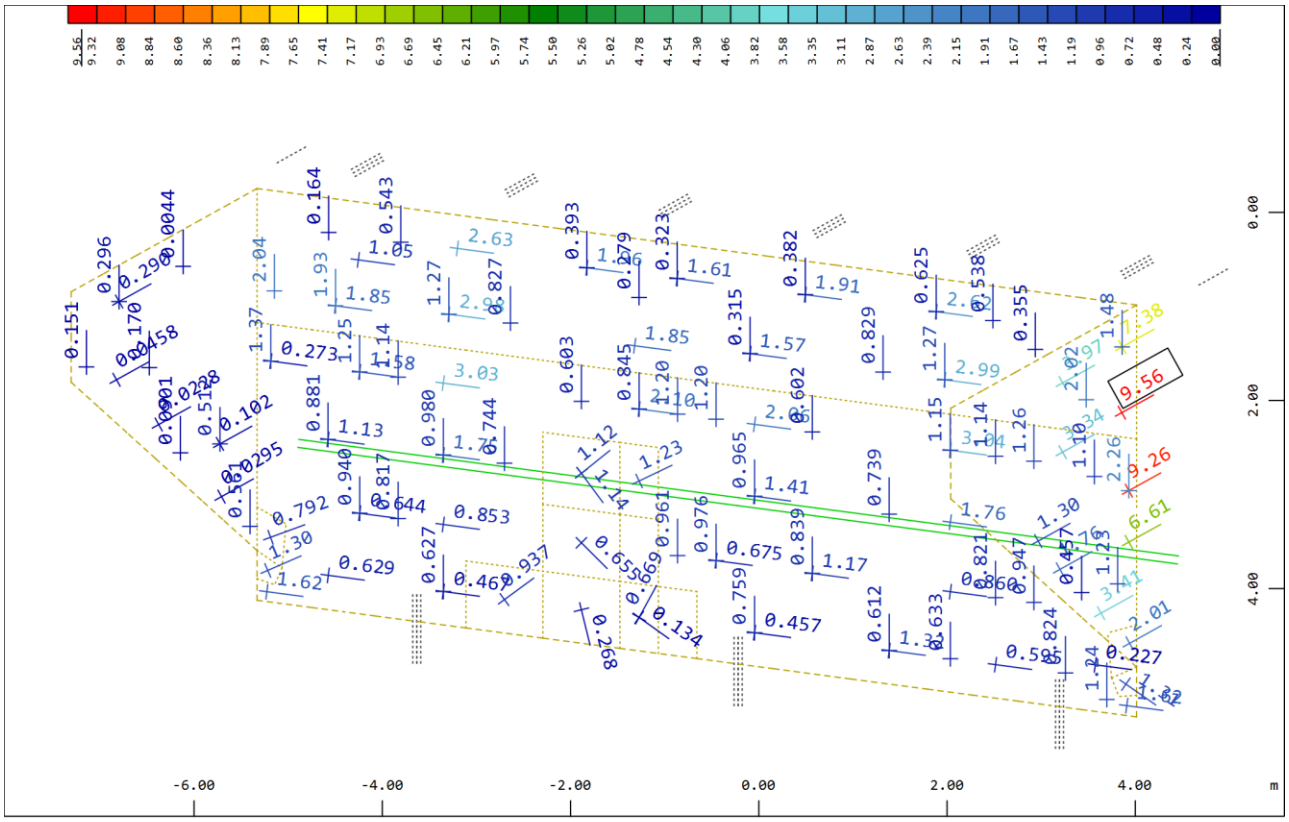


Sector of system Group 4 8 17...20 25 30 38...41
Quadrilateral Elements , lower Reinforcements in cm2/m, Design Case 4 (Max=13.4)

M 1 : 76
X * 0.502
Y * 0.906
Z * 0.962

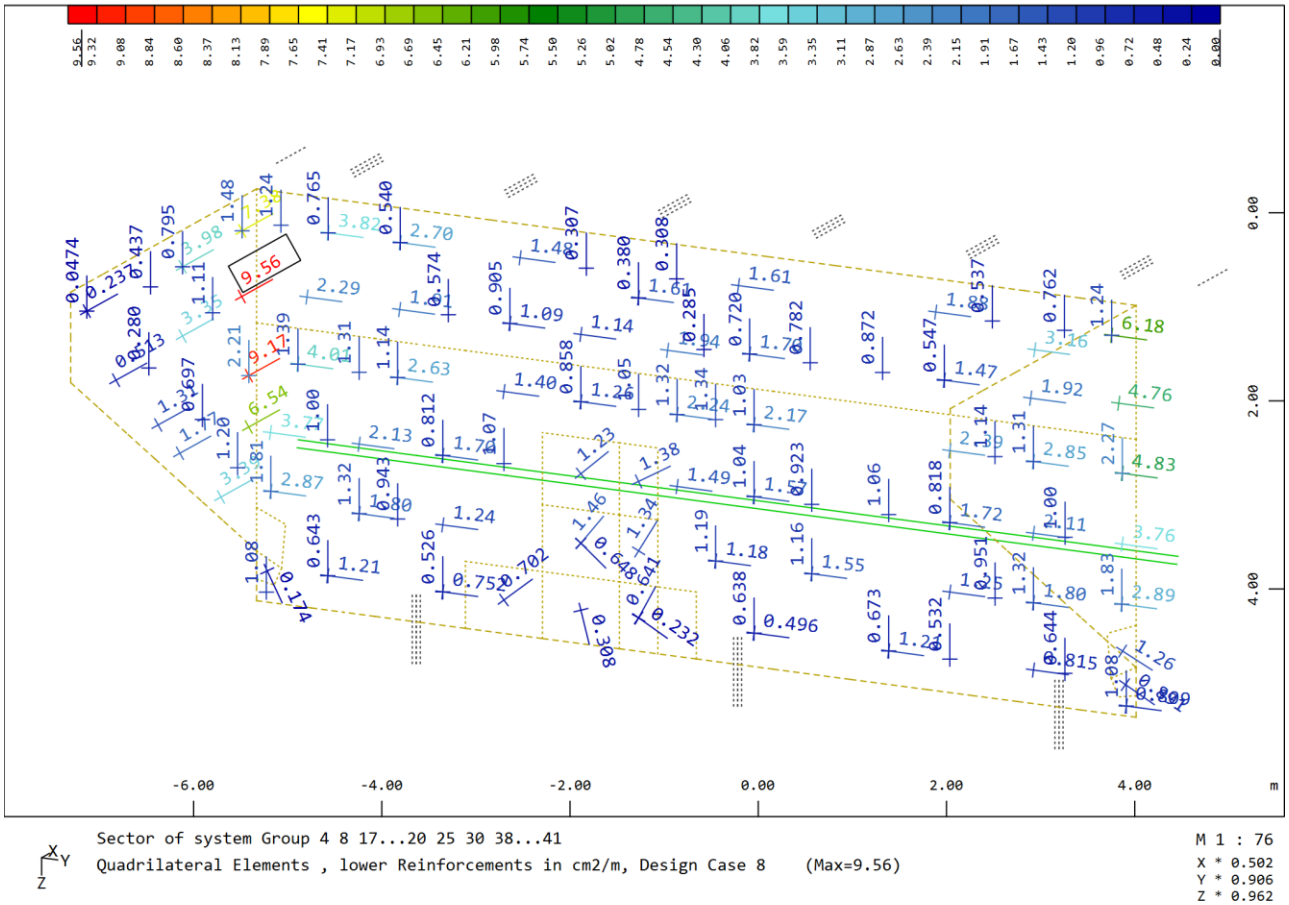

-6.00
-4.00
-2.00
0.00
2.00
4.00
m
Sector of system Group 4 8 17...20 25 30 38...41
Quadrilateral Elements , upper Reinforcements in cm2/m, Design Case 7 (Max=6.81)
M 1 : 76
X * 0.502
Y * 0.906
Z * 0.962


-6.00
-4.00
-2.00
0.00
2.00
4.00
m
Sector of system Group 4 8 17...20 25 30 38...41
Quadrilateral Elements , lower Reinforcements in cm2/m, Design Case 7 (Max=6.72)
M 1 : 76
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 4 8 17...20 25 30 38...41
Quadrilateral Elements , upper Reinforcements in cm2/m, Design Case 8 (Max=9.56)

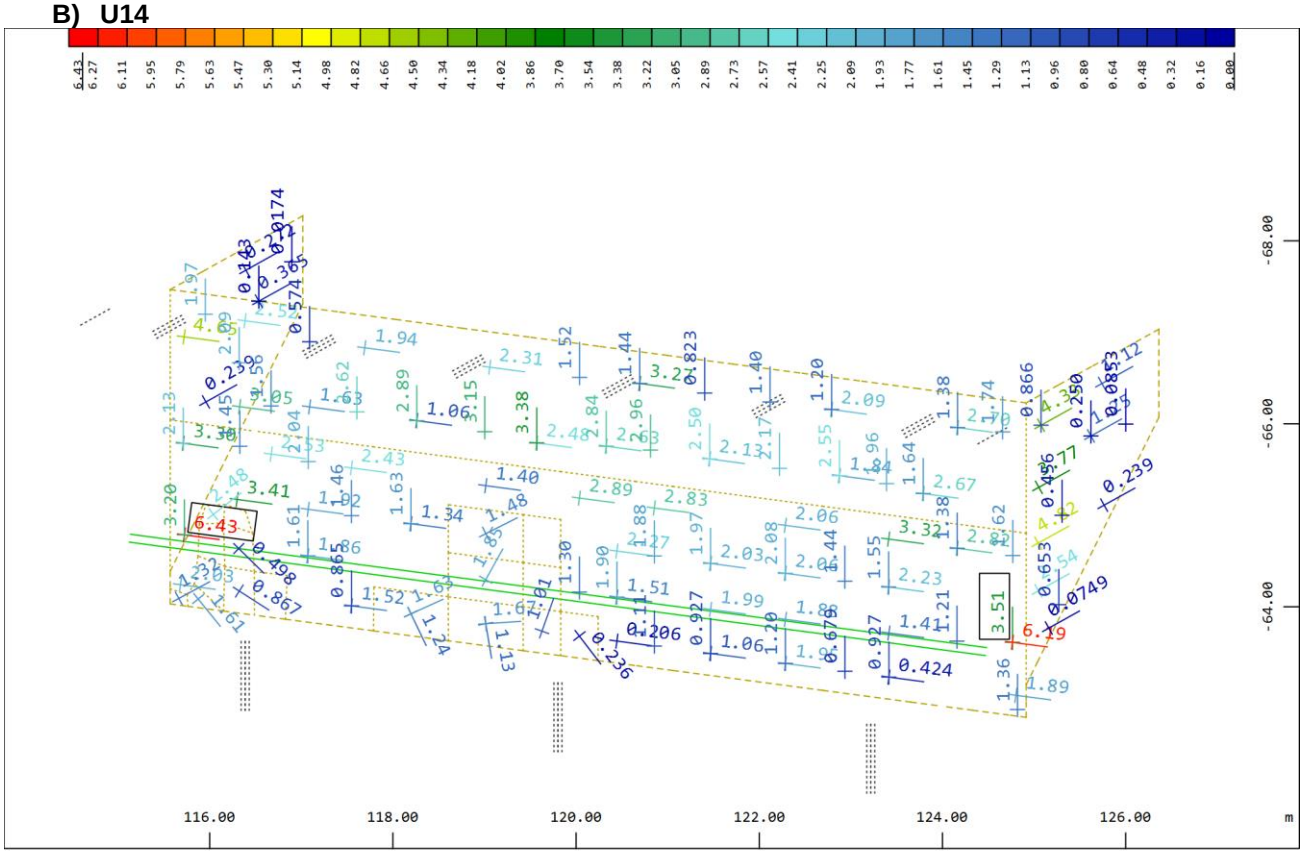
M 1 : 76
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 4 8 17...20 25 30 38...41
Quadrilateral Elements , lower Reinforcements in cm2/m, Design Case 8 (Max=9.56)

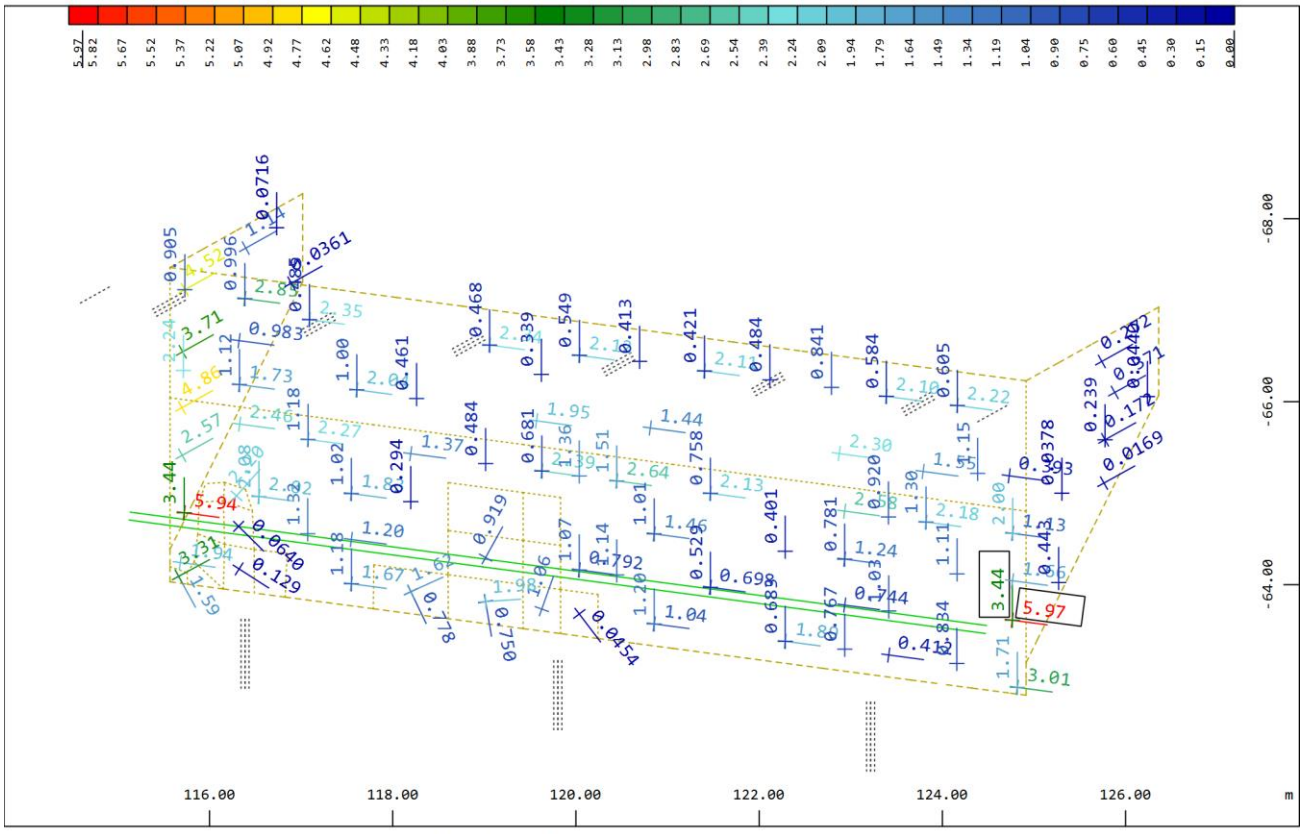
M 1 : 76
X * 0.502
Y * 0.906
Z * 0.962

B) U14



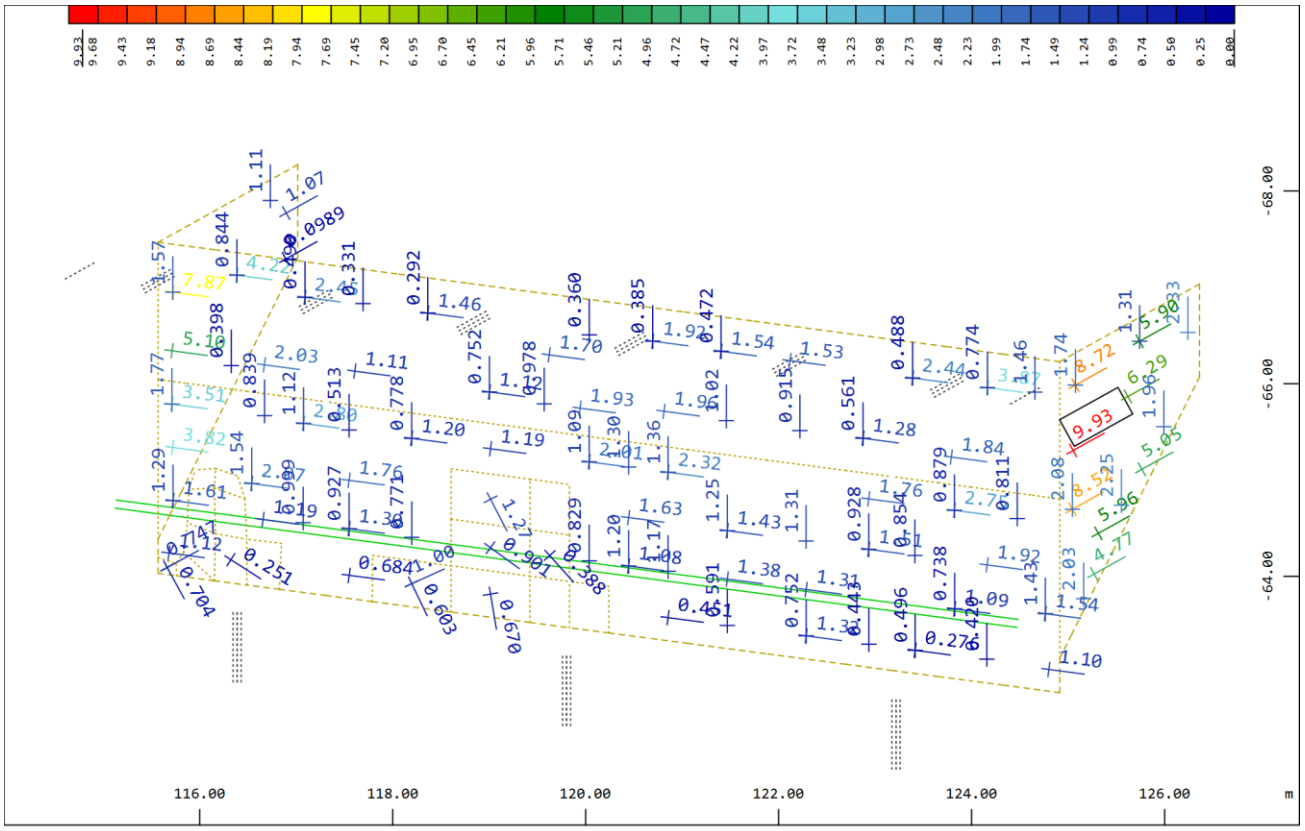
Sector of system Group 4 8 17...20 25 30 38...41
Quadrilateral Elements , upper Reinforcements in cm2/m, Design Case 1 (Max=6.43)

M 1 : 79
X * 0.502
Y * 0.906
Z * 0.962



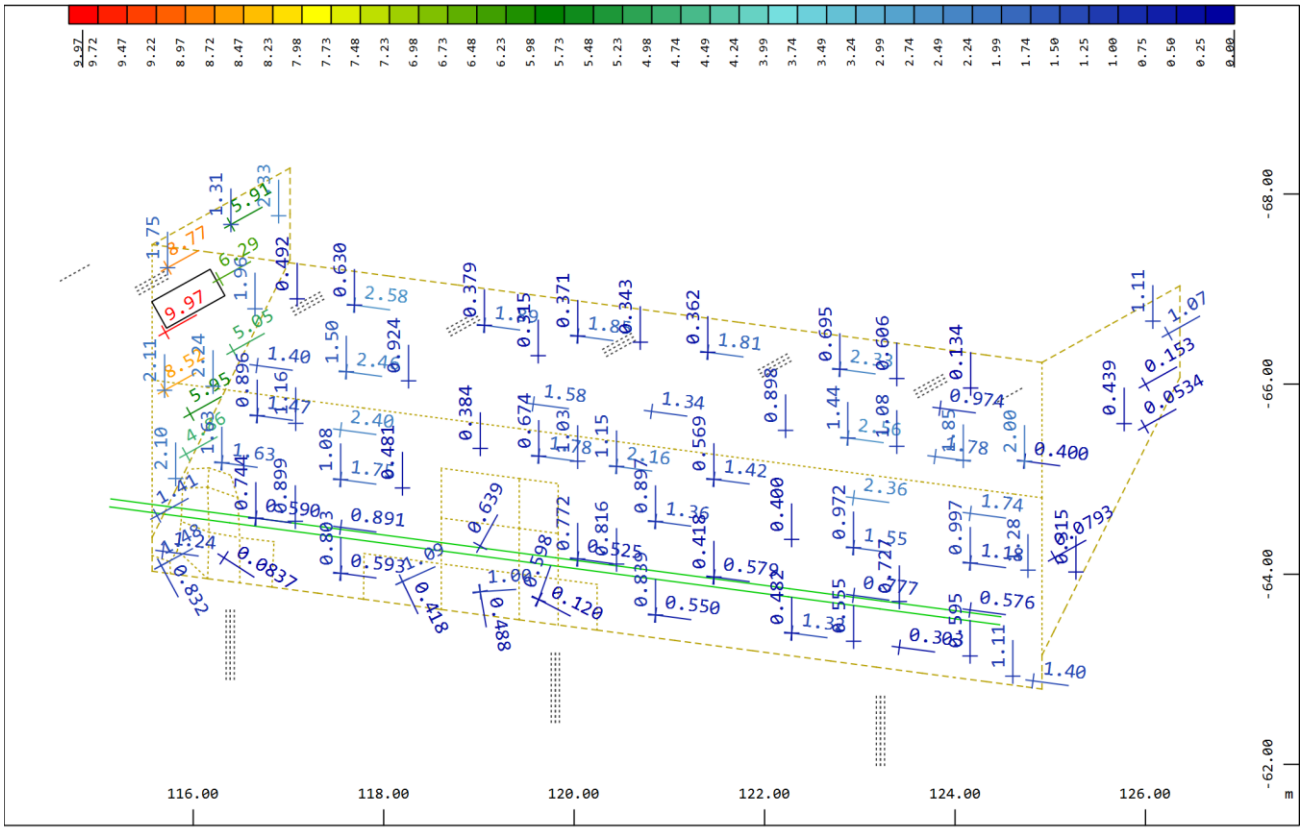
Sector of system Group 4 8 17...20 25 30 38...41
Quadrilateral Elements , lower Reinforcements in cm2/m, Design Case 1 (Max=5.97)

M 1 : 79
X * 0.502
Y * 0.906
Z * 0.962



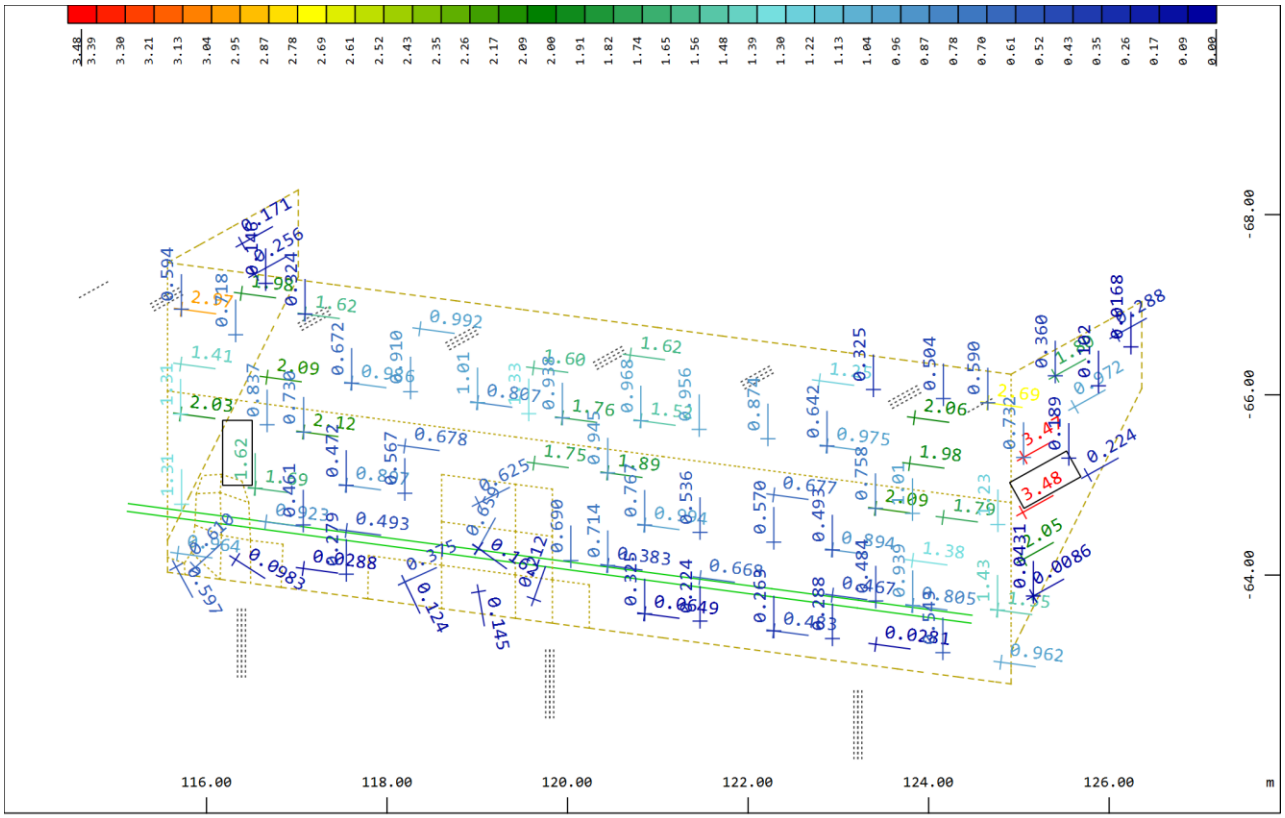
Sector of system Group 4 8 17...20 25 30 38...41
Quadrilateral Elements , upper Reinforcements in cm2/m, Design Case 4 (Max=9.93)

M 1 : 75
X * 0.502
Y * 0.906
Z * 0.962



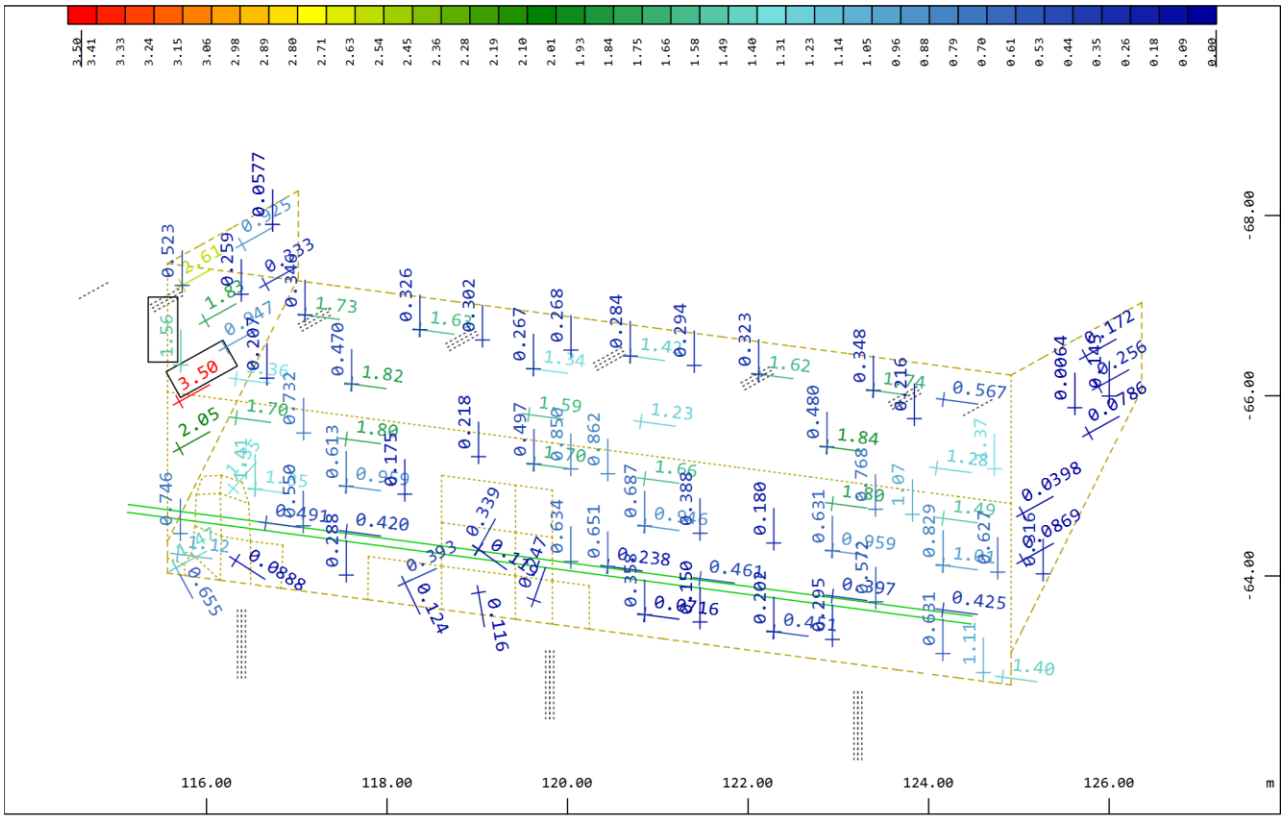
Sector of system Group 4 8 17...20 25 30 38...41
Quadrilateral Elements , lower Reinforcements in cm2/m, Design Case 4 (Max=9.97)

M 1 : 76
X * 0.502
Y * 0.906
Z * 0.962



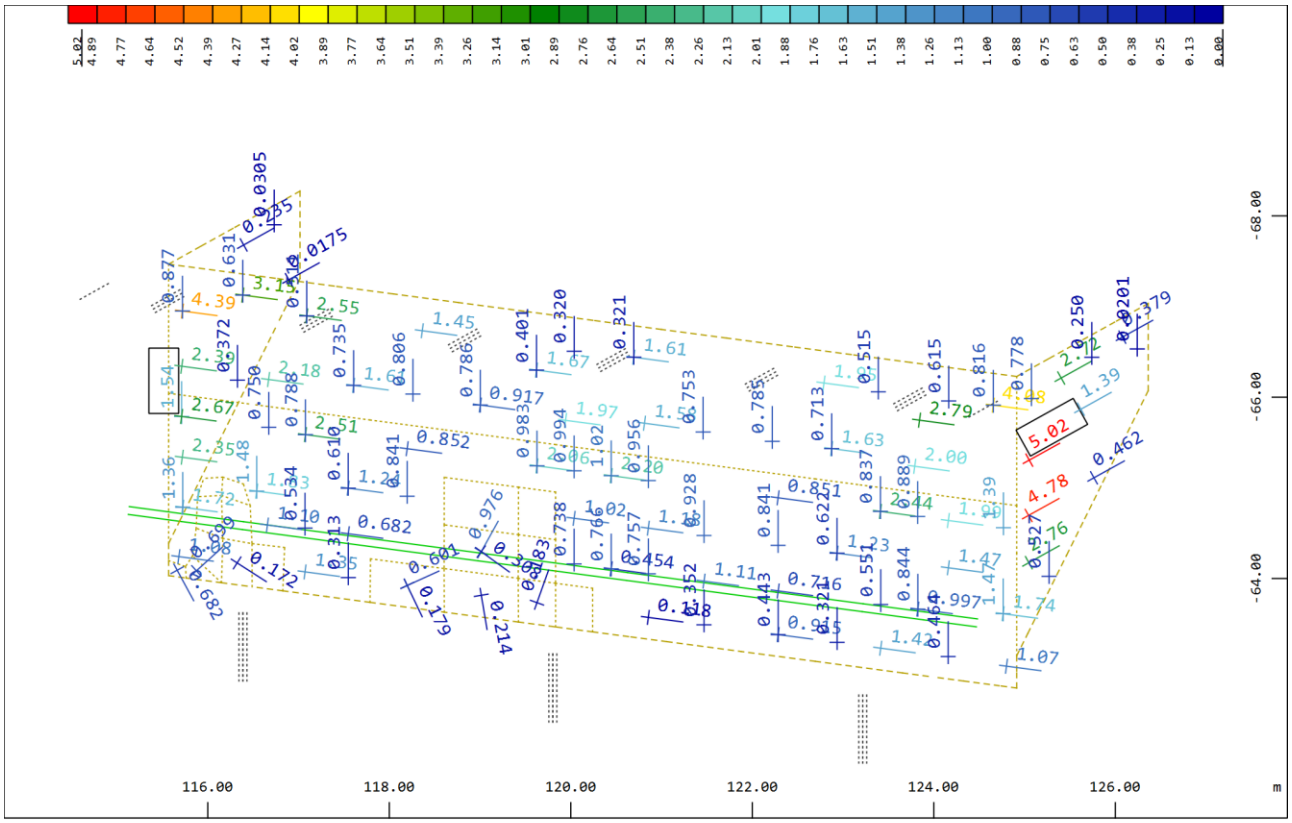
Sector of system Group 4 8 17...20 25 30 38...41
Quadrilateral Elements , upper Reinforcements in cm2/m, Design Case 7 (Max=3.48)

M 1 : 79
X * 0.502
Y * 0.906
Z * 0.962



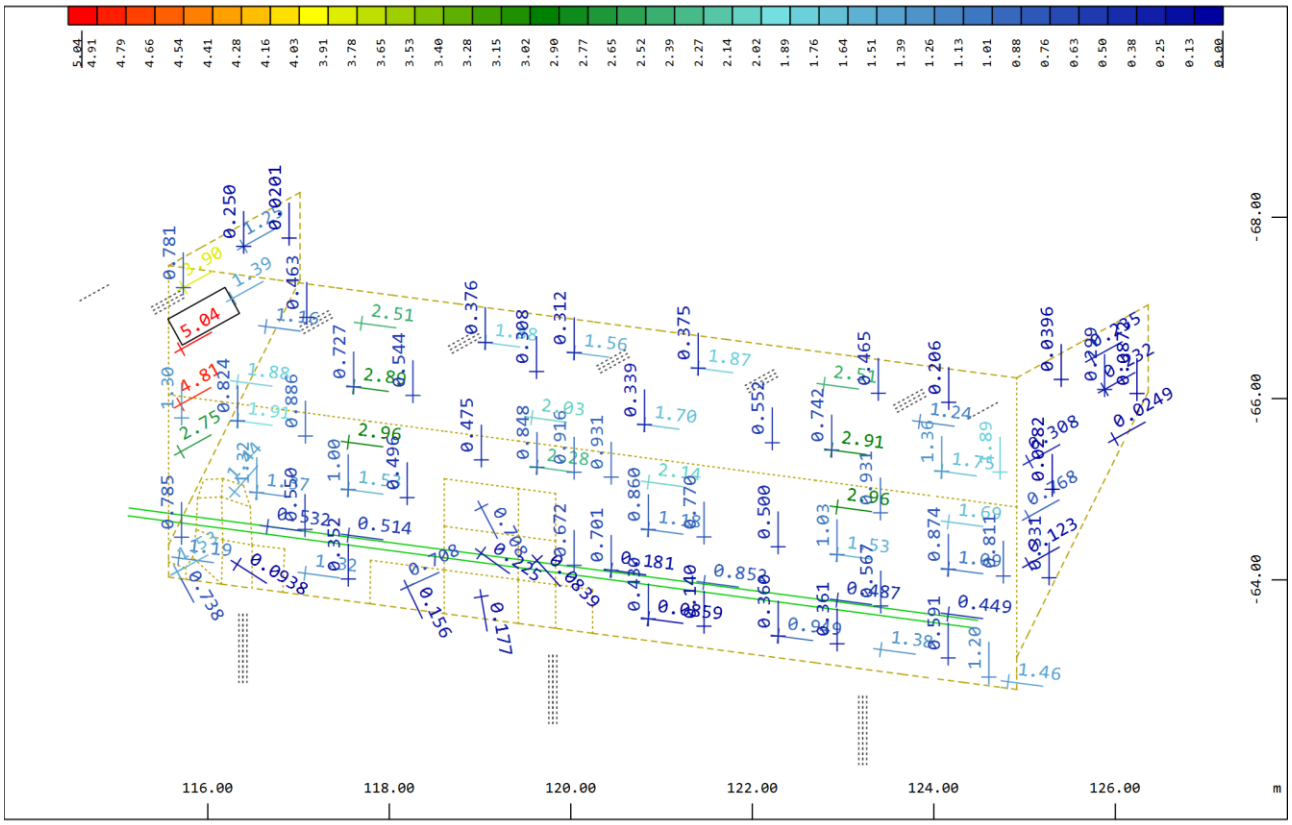
Sector of system Group 4 8 17...20 25 30 38...41
Quadrilateral Elements , lower Reinforcements in cm2/m, Design Case 7 (Max=3.50)

M 1 : 79
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 4 8 17...20 25 30 38...41
Quadrilateral Elements , upper Reinforcements in cm2/m, Design Case 8 (Max=5.02)

M 1 : 79
X * 0.502
Y * 0.906
Z * 0.962



Sector of system Group 4 8 17...20 25 30 38...41
Quadrilateral Elements , lower Reinforcements in cm2/m, Design Case 8 (Max=5.04)

M 1 : 79
X * 0.502
Y * 0.906
Z * 0.962

9.3 Rekapitulacija armature upornjaka

9.3.1 Armatura naglavnice pilota

Upornjak U0

bxh=235x300 cm, materijali: C30/37, B500B

Statička visina:
$d_1 = c + \Phi_v + ½*\Phi_s = 6 + 2,0 + ½*2,8 = 9,4$ cm
$d_s=h-d_1=300,0-9,4=290,6$ cm

Minimalna površina armature u presjeku bxh=235x300cm:

$A_{s,min} = 0,0013 \cdot b \cdot d =$ 0,0013·235·290,6 = 88,78 cm^2

$A_{s,min} = 0,26 \cdot (f_{ctm} / f_{yk}) \cdot b \cdot d = 0,26 \cdot (2,9/500) \cdot 235 \cdot 290,6 = 102,98$ cm^2

Maksimalna površina armature u presjeku bxh=235x300cm:

$A_{s,max} = 0,04\ A_c = 0,04 \cdot 235 \cdot 300 = 2820,0$ cm^2

Potrebna armatura:

- gornja zona
  POTREBNO: 50,2 cm^2
  ODABRANO: 18Φ28 (110,88 cm^2)
- donja zona
  POTREBNO: 50,2 cm^2
  ODABRANO: 18Φ28 (110,88 cm^2)

- sa strane
  POTREBNO: 16,5 cm^2 (ukupno sa jedne i druge strane)
  ODABRANO: 2x15Φ16 (60,3 cm^2)

- posmična armatura
  POTREBNO: 33,9 cm^2/m'
  ODABRANO: Φ20/15, m=2 (41,86 cm^2/m')

Minimalna količina poprečne armature prema EC2 za elemente naprezane poprečnim silama:
$A_{smin} = \rho_{min} \cdot b_w =$ 0,0011 · 235,0 = 0,235 cm^2/cm
- $\rho_{min} = 0,0011$ za C30/37 i B500B

Minimalni razmak vilica prema EC2 za elemente naprezane poprečnim silama:
$s_{w,max} = \max \{ 0,6 \cdot d, 20 \text{ cm} \}$
$s_{w,max} = 20,0$ cm

Upornjak U14

bxh=235x200 cm, materijali: C30/37, B500B

Statička visina:
$d_1 = c + \Phi_v + ½*\Phi_s = 6 + 2,0 + ½*2,8 = 9,4$ cm
$d_s=h-d_1=200,0-9,4=190,6$ cm

Minimalna površina armature u presjeku bxh=235x200cm:

$A_{s,min} = 0,0013 \cdot b \cdot d =$ 0,0013·235·190,6 = 58,22 cm^2

$A_{s,min} = 0,26 \cdot (f_{ctm} / f_{yk}) \cdot b \cdot d = 0,26 \cdot (2,9/500) \cdot 235 \cdot 190,6 = 67,54$ cm^2

Maksimalna površina armature u presjeku bxh=235x200cm:

$A_{s,max} = 0,04\ A_c = 0,04 \cdot 235 \cdot 200 = 1880,0$ cm^2

Potrebna armatura:

- gornja zona
  POTREBNO: 50,2 cm^2
  ODABRANO: 18Φ28 (110,88 cm^2)
- donja zona
  POTREBNO: 50,2 cm^2
  ODABRANO: 18Φ28 (110,88 cm^2)

- sa strane
  POTREBNO: 11,0 cm^2 (ukupno sa jedne i druge strane)
  ODABRANO: 2x10Φ16 (40,2 cm^2)

- posmična armatura
  POTREBNO: 26,6 cm^2/m'
  ODABRANO: Φ20/15, m=2 (41,86 cm^2/m')

Minimalna količina poprečne armature prema EC2 za elemente naprezane poprečnim silama:
$A_{smin} = \rho_{min} \cdot b_w =$ 0,0011 · 235,0 = 0,235 cm^2/cm
- $\rho_{min} = 0,0011$ za C30/37 i B500B

Minimalni razmak vilica prema EC2 za elemente naprezane poprečnim silama:
$s_{w,max}$ = max { 0,6·d, 20 cm }
$s_{w,max}$ = 20,0 cm

9.3.2 Bočne maske na stupištima– protupotresne istake

Vertikalna armatura u obje zone
ODABRANO: Φ20/15 (As,odabrano = 25,3 cm2/m)

Horizontalan armatura - vilice :
ODABRANO: m=5 Φ12/15 (As,odabrano = 37,5 cm2/m)

9.3.3 Armatura prsnog zidića upornjaka

h=50 cm, materijali: C30/37, B500B
Statička visina:

$d_1 = c + \Phi_v + ½*\Phi_s = 6 + 1,6 + ½*1,6 = 8,4$ cm
$d_s = h - d_1 = 50,0 - 8,4 = 41,6$ cm

Minimalna površina armature u presjeku h=50cm:

$A_{s,min} = 0,0013 \cdot b \cdot d =$ 0,0013·100·41,6 = 5,41 cm^{2}m'

$A_{s,min} = 0,26 \cdot (f_{ctm} / f_{yk}) \cdot b \cdot d = 0,26 \cdot (2,9/500) \cdot 100 \cdot 41,6$ = 6,27 cm^2/m'

Maksimalna površina armature u presjeku h=50cm:

$A_{s,max} = 0,04\ A_c = 0,04 \cdot 100 \cdot 50 = 200,0$ cm^{2}m'

Upornjak U0
Potrebna armatura:

- vanjska horizontalna armatura- prema tlu:
  POTREBNO: 3,03 cm^2/m'
  ODABRANO: Φ18/15cm (16,0 cm^2/m')

- vanjska vertikalna armatura- prema tlu:
  POTREBNO: 2,8 cm^2/m'
  ODABRANO: Φ20/15 cm (20,27 cm^2/m')

- unutrašnja horizontalna armatura – prema rasponskoj konstrukciji:
  POTREBNO: 8,33 cm^2/m'
  ODABRANO: Φ18/15cm (16,0 cm^2/m')

- unutrašnja vertikalna armatura – prema rasponskoj konstrukciji::
  POTREBNO: 3,53 cm^2/m'
  ODABRANO: Φ22/15 cm (25,27 cm^2/m')

Upornjak U14
Potrebna armatura:

- vanjska horizontalna armatura- prema tlu:
  POTREBNO: 3,03 cm^2/m'
  ODABRANO: Φ18/15cm (16,0 cm^2/m')

- vanjska vertikalna armatura- prema tlu:
  POTREBNO: 2,8 cm^2/m'
  ODABRANO: Φ20/15 cm (20,27 cm^2/m')

- unutrašnja horizontalna armatura – prema rasponskoj konstrukciji:
  POTREBNO: 8,33 cm^2/m'
  ODABRANO: Φ18/15cm (16,0 cm^2/m')

- unutrašnja vertikalna armatura – prema rasponskoj konstrukciji::
  POTREBNO: 3,53 cm^2/m'
  ODABRANO: Φ22/15 cm (25,27 cm^2/m')

posmična armatura za oba upornjaka
ODABRANO: Φ10mm/30cm/30cm, (7,07 cm2/m2)

Armatura krila upornjaka

h=50 cm, materijali: C30/37, B500B
Statička visina:
$d_1 = c + \Phi_v + ½*\Phi_s = 6 + 1,6 + ½*1,6 = 8,4$ cm
$d_s=h-d_1=50,0-8,4=41,6$ cm

Minimalna površina armature u presjeku h=50cm:
$A_{s,min} = 0,0013 \cdot b \cdot d =$ 0,0013·100·41,6 = 5,41 cm^{2}m'
$A_{s,min} = 0,26 \cdot (f_{ctm} / f_{yk}) \cdot b \cdot d =$ 0,26·(2,9/500)·100·41,6 = 6,27 cm^2/m'
Maksimalna površina armature u presjeku h=50cm:
$A_{s,max} = 0,04\ A_c = 0,04 \cdot 100 \cdot 50 = 200,0$ cm^{2}m'

Upornjak U0
Potrebna armatura:

- vanjska horizontalna armatura:
  POTREBNO: 1 cm^2/m
  ODABRANO: Φ14/15 cm (10,27 cm^2/m')

- vanjska vertikalna armatura:
  POTREBNO: 0,56 cm^2/m
  ODABRANO: Φ14/15 cm (10,27 cm^2/m')

- unutrašnja horizontalna armatura:
  POTREBNO: 13,4 cm^2/m
  ODABRANO: Φ20/15 cm (20,41 cm^2/m')

- unutrašnja vertikalna armatura:
  POTREBNO: 2,87 cm^2/m
  ODABRANO: Φ16/15 cm (13,27 cm^2/m')

Upornjak U14
Potrebna armatura:

- vanjska horizontalna armatura:
  POTREBNO: 0,77 cm^2/m
  ODABRANO: Φ14/15 cm (10,27 cm^2/m')

- vanjska vertikalna armatura:
  POTREBNO: 0,46 cm^2/m
  ODABRANO: Φ14/15 cm (10,27 cm^2/m')

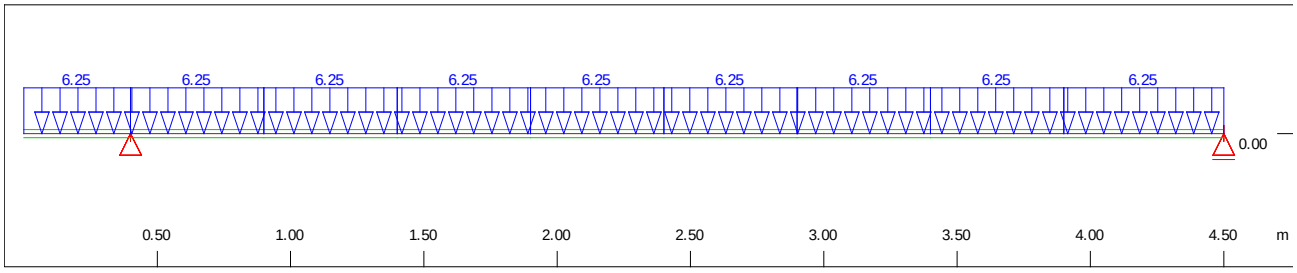
- unutrašnja horizontalna armatura:
  POTREBNO: 9,97 cm^2/m
  ODABRANO: Φ20/15 cm (13,41 cm^2/m')

- unutrašnja vertikalna armatura:
  POTREBNO: 2,08 cm^2/m
  ODABRANO: Φ16/15 cm (10,27 cm^2/m')

*peek value

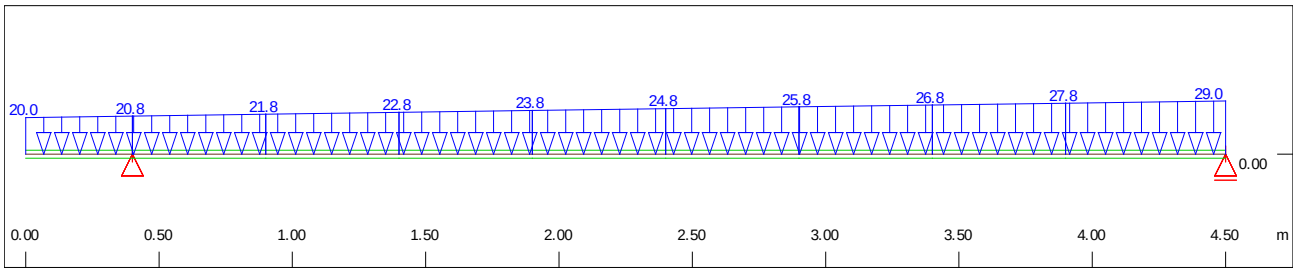
Ovdje su prikazane maksimalne armature pojedinih slojeva. Kod izrade armaturnog nacrta treba konzultirati dijagrame armature, uvažavajući pritom minimalnu armaturu.

10 PRIJELAZNA PLOČA



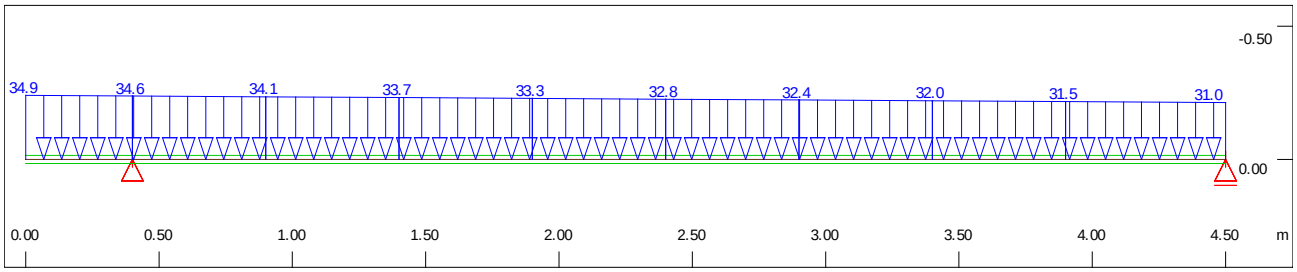
All loads, Loadcase 1 V.T. , (1 cm 3D = unit) Beam dead load in global Z (Unit=9.80 kN/m) (Max=6.25)

M 1 : 27



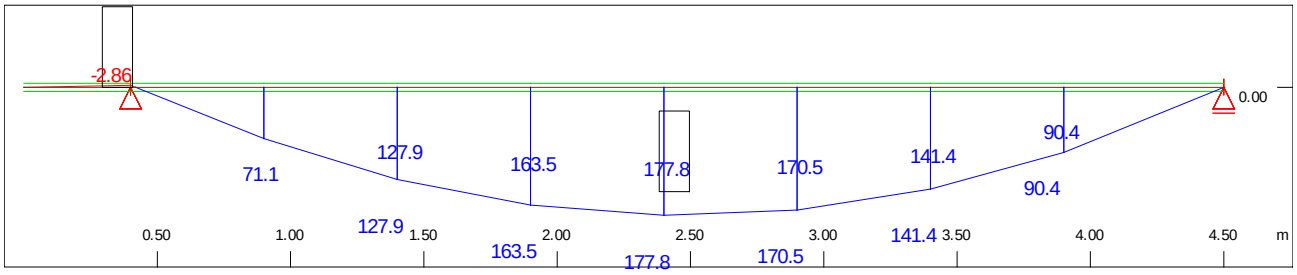
All loads, Loadcase 2 NADSLOJ , (1 cm 3D = unit) Beam line load (force) in global Z (Unit=39.2 kN/m) (Max=29.0)

M 1 : 27



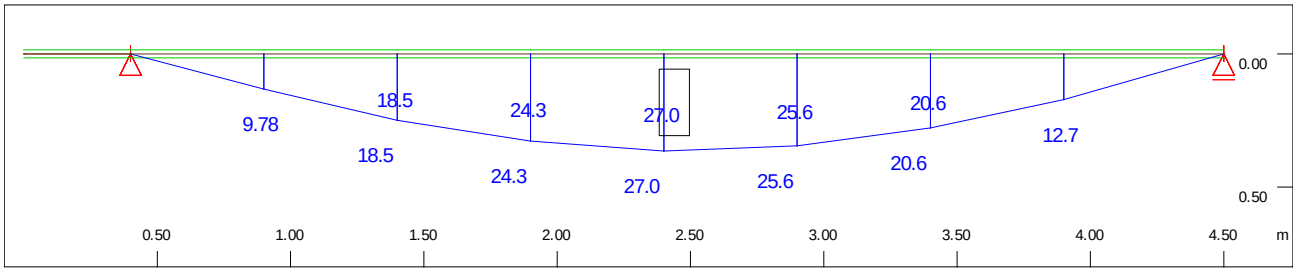
All loads, Loadcase 3 PROMETNO-RASP , (1 cm 3D = unit) Beam line load (force) in global Z (Unit=39.2 kN/m) (Max=34.9)

M 1 : 27



Beam Elements , Bending moment My, Loadcase 1025 MAX-MY BEAM , 1 cm 3D = 100.0 kNm (Min=-2.86) (Max=177.8)

M 1 : 27



Beam Elements , Longitudinal Reinforcements Lay. Z1, Design Case 1 , 1 cm 3D = 20.0 cm2 (Max=27.0)

M 1 : 27

STATIČKA VISINA

- $d_1 = c + \Phi_v + ½*\Phi_s = 5 + 1,2 + ½ \cdot 2,0 = 7,2$ cm (zaštitni sloj c = 5 cm, pretpostavljena uzdužna armatura Φ_s20)
  $d_s = h – d_{1s} = 25 – 7,2 =$ **17,8 cm**

- *Računska čvrstoća betona C25/30*

$f_{cd} = 0,85 \cdot f_{ck}/\gamma_c = 0,85 \cdot 25/1,5 = 14,2$ N/mm^2 = 1,42 kN/cm^2

Minimalna površina armature u presjeku h=25cm:

$A_{s,min} = 0,0013 \cdot b \cdot d =$ 0,0013·100·17,8 = 2,31 cm^{2}m'

$A_{s,min} = 0,26 \cdot (f_{ctm} / f_{yk}) \cdot b \cdot d = 0,26 \cdot (2,6/500) \cdot 100 \cdot 17,8 = 2,41$ cm^2/m'

Maksimalna površina armature u presjeku h=25cm:

$A_{s,max} = 0,04\ A_c = 0,04 \cdot 100 \cdot 25 = 100,0$ cm^{2}m'

Potrebna armatura donja zona glavna : 27,0 cm^2/m **ODABRANO**: Φ22/12,5 cm ($A_{s1,od}$ = 30,4 cm^2/m)

Donja zona, poprečna armatura
Odabrana armatura Φ12/15 cm

Gornja zona, glavna armatura
Odabrana armatura Φ14/15 cm

Gornja zona, poprečna armatura
Odabrana armatura Φ10/15 cm

Posmična armatura ili jahači i distanceri
Odabrana armatura
$\phi 12 / \left(2 kom / m^2\right)$

- armatura konzolnog oslonca na upornjaku za prijelaznu ploču Ø14/15;

U Zagrebu, travanj 2023.

Projektant:

Mate Pezer, dipl.ing.građ.

Izradio: **INSTITUT IGH d.d.**

Zavod za projektiranje

10 000 Zagreb, J. Rakuše 1

Građevina: **IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA:**

4. faza izgradnje – nastavak iskopa glinenog materijala u cijelom gabaritu prokopa za izgradnju nasipa sustava obrane od poplava karlovačkog područja, prokop Korana – Kupa, nasipi uz lijevu i desnu obalu prokopa, desnu obalu Kupe, lijevu obalu Korane i uz ispusnu ustavu (N1 – N5), upusna i ispusna ustava, građevine za odvodnju zaobalnih voda, uklanjanje dijela nasipa u sklopu zahvata dionice državne ceste D1 (splitski pravac, brza cesta kroz Karlovac, II. etapa I. faze) i 5. faza izgradnje - most preko prokopa na nerazvrstanoj cesti NC 340720 Gornje Mekušje – Kamensko)

Knjiga: **CESTOVNI MOST PREKO PROKOPA – konstrukcija**

Vrsta projekta (razina i struka): GLAVNI GRAĐEVINSKI PROJEKT

Zajednička oznaka projekta: GP-5986/23

Oznaka projekta: 72120-GP-285-2020

0501 ISKAZ PROCJENJENIH TROŠKOVA GRAĐENJA

Mjesto i datum: Zagreb, travanj 2023.

0301 ISKAZ PROCJENJENIH TROŠKOVA GRAĐENJA

Na temelju članka 24. Pravilnika o obveznom sadržaju i opremanju projekata građevina (NN br. 64/14, 41/15, 105/15, 61/16, 20/17) potrebno je u projektu dati iskaz procijenjenih troškova građenja bez PDV-a.

Procijenjena vrijednost radova prikazanih u glavnom projektu MOST PREKO PROKOPA KUPA KORANA.

Iznosi 4.156.000,00 eura bez PDV-a

Slovima: četiri milijuna i osamstotisuća eura bez PDV-a.
U cijenu nije uključeno duboko temeljenje.

Zagreb,travanj 2023.

Projektant:

Mate Pezer, dipl.ing.građ.

Izradio: **INSTITUT IGH d.d.**

Zavod za projektiranje

10 000 Zagreb, J. Rakuše 1

Građevina: **IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA:**

4. faza izgradnje – nastavak iskopa glinenog materijala u cijelom gabaritu prokopa za izgradnju nasipa sustava obrane od poplava karlovačkog područja, prokop Korana – Kupa, nasipi uz lijevu i desnu obalu prokopa, desnu obalu Kupe, lijevu obalu Korane i uz ispusnu ustavu (N1 – N5), upusna i ispusna ustava, građevine za odvodnju zaobalnih voda, uklanjanje dijela nasipa u sklopu zahvata dionice državne ceste D1 (splitski pravac, brza cesta kroz Karlovac, II. etapa I. faze) i 5. faza izgradnje - most preko prokopa na nerazvrstanoj cesti NC 340720 Gornje Mekušje – Kamensko)

Knjiga: **CESTOVNI MOST PREKO PROKOPA – konstrukcija**

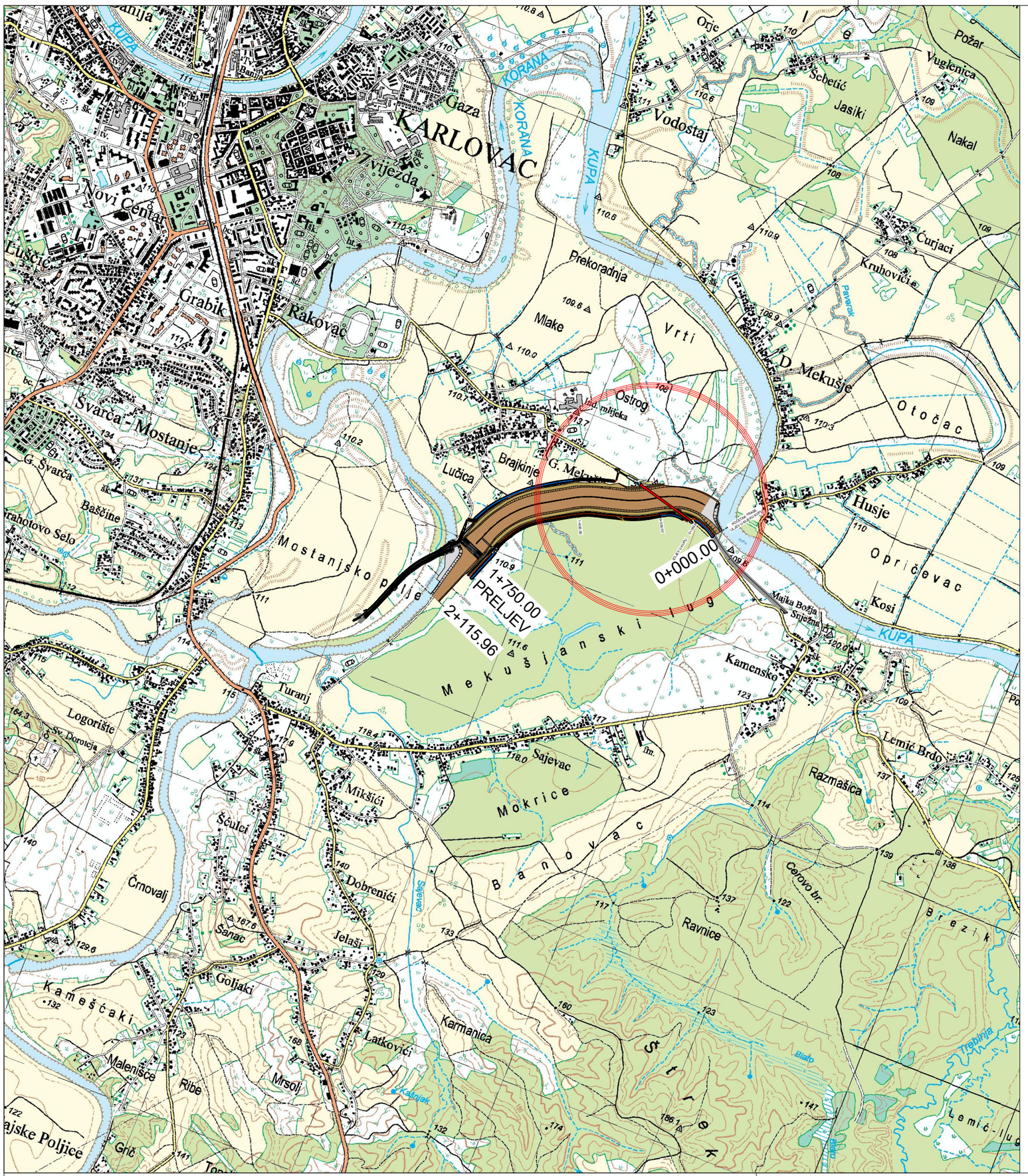
Vrsta projekta (razina i struka): GLAVNI GRAĐEVINSKI PROJEKT

Zajednička oznaka projekta: GP-5986/23

Oznaka projekta: 72120-GP-285-2020

III GRAFIČKI DIO

POPIS NACRTA	Mjerilo	Dokument
1. Pregledna situacija	1:25000	0901
2. Situacija na HOK-u	1:5000	0902
3. Situacija na geod podlozi	1:1000	0903
4. Uzdužni profil	1:1000/100	1001
5. PogledI sa strane i odozgo	1:200	1301
6. Tlocrti	1:200	1201
7. Uzdužni presjek	1:200	1401
8. Karakteristični poprečni presjek	1:50	1501
9. Nosači	1:50,1:25	2301
10. Upornjak U0	1:100	2401
11. Upornjak U14	1:100	2402
12. Stupišta	1:100	2501
13. Hodnik i vijenac	1:20	2701



S

Z I

J

IZMJENA BR.	OPIS	DATUM	POTPIS

INVESTITOR:
HRVATSKE VODE
Ul. Grada Vukovara 220, 10000, Zagreb

INSTITUT IGH, d.d.
10 000 ZAGREB, J. RAKUŠE 1
OIB: 79766124714
ZAVOD ZA PROJEKTIRANJE

RAZINA I STRUKOVNA ODREDNICA:
GLAVNI GRAĐEVINSKI PROJEKT

ZAJEDNIČKA OZNAKA PROJEKTA:
GP-5986/23

GRAĐEVINA: **IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA - 4. i 5. faza izgradnje: PROKOP KORANA - KUPA S PRATEĆIM OBJEKTIMA**

DIO GRAĐEVINE: **CESTOVNI MOST PREKO PROKOPA - KONSTRUKCIJA**

OZNAKA MAPE
72120 - GP - 285 - 2020

SADRŽAJ:
SITUACIJA PREGLEDNA

GLAVNI PROJEKTANT: DARKO JELAŠIĆ, dipl.ing.građ.

MJERILO:
1:25000

PROJEKTANT: MATE PEZER dipl.ing.građ.

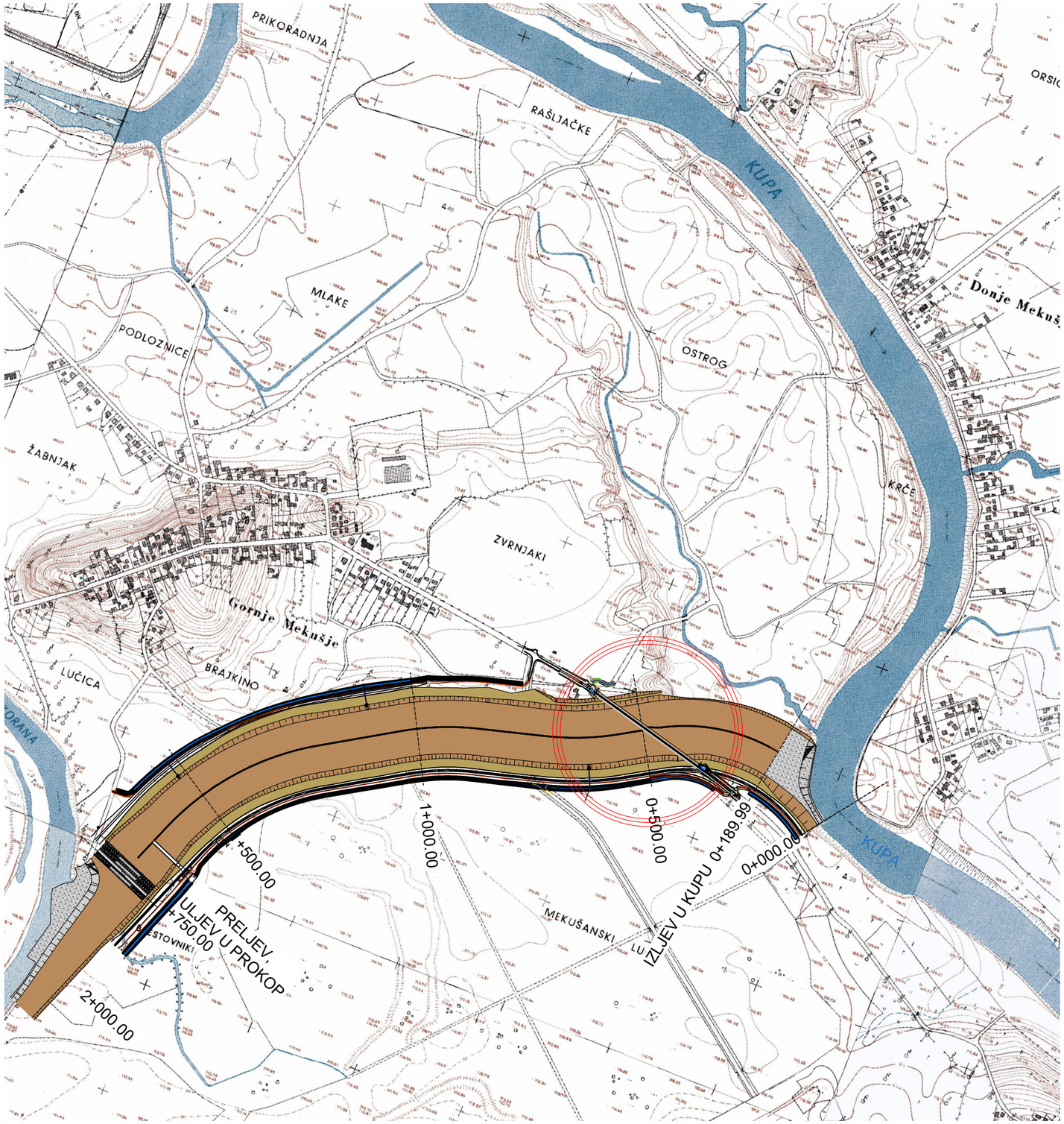
DATUM:
lipanj, 2023.

BROJ PROJEKTA:
72120 - GP - 285 - 2020

SURADNICI: MARINA MARKOTIĆ mag.ing.aedif.

BROJ PRILOGA:
0901

OZNAKA DOKUMENTA:
IGH - PKK - O 0200 - 0901



IZMJENA BR.	OPIS	DATUM	POTPIS

INVESTITOR:
HRVATSKE VODE
Ul. Grada Vukovara 220, 10000, Zagreb

INSTITUT IGH, d.d.
10 000 ZAGREB, J. RAKUŠE 1
OIB: 79766124714
ZAVOD ZA PROJEKTIRANJE

RAZINA I STRUKOVNA ODREDNICA:
GLAVNI GRAĐEVINSKI PROJEKT

ZAJEDNIČKA OZNAKA PROJEKTA: GP-5986/23

GRAĐEVINA: **IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA - 4. i 5. faza izgradnje: PROKOP KORANA - KUPA S PRATEĆIM OBJEKTIMA**

DIO GRAĐEVINE: **CESTOVNI MOST PREKO PROKOPA - KONSTRUKCIJA**

OZNAKA MAPE: **72120 - GP - 285 - 2020**

SADRŽAJ: SITUACIJA na HOK-u

GLAVNI PROJEKTANT: DARKO JELAŠIĆ, dipl.ing.građ.

MJERILO: 1:5000

PROJEKTANT: MATE PEZER dipl.ing.građ.

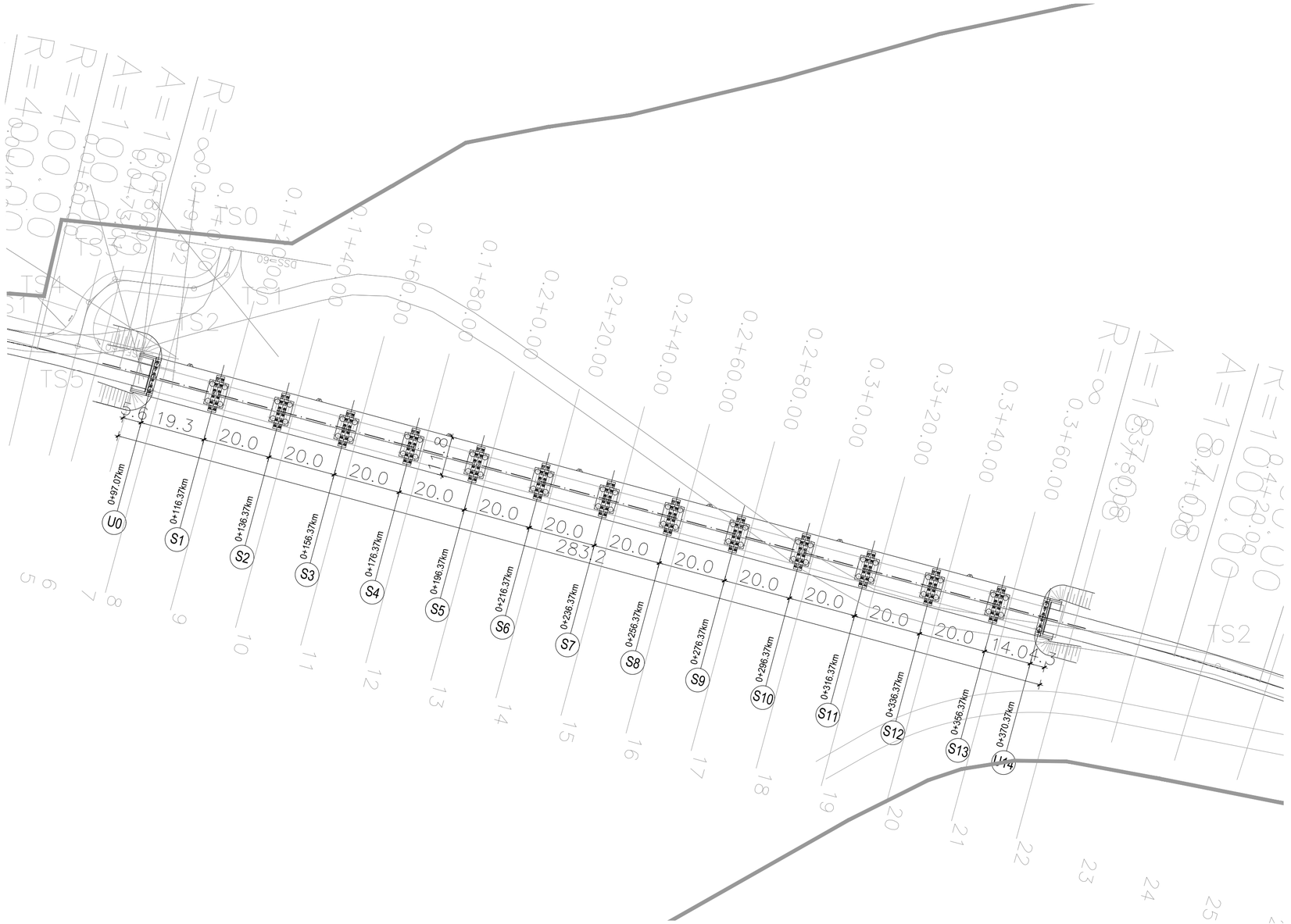
DATUM: lipanj 2023.

BROJ PROJEKTA: **72120 - GP - 285 - 2020**

SURADNICI: MARINA MARKOTIĆ mag.ing.aedif.

BROJ PRILOGA: 0902

OZNAKA DOKUMENTA: IGH - PKK - O 0200 - 0902



IZMJENA BR.	OPIS	DATUM	POTPIS

INVESTITOR:
HRVATSKE VODE
Ul. Grada Vukovara 220, 10000, Zagreb

HRVATSKE VODE

INSTITUT IGH, d.d.
10 000 ZAGREB, J. RAKUŠE 1
OIB: 79766124714
ZAVOD ZA PROJEKTIRANJE

RAZINA I STRUKOVNA ODREDNICA:
GLAVNI GRAĐEVINSKI PROJEKT

ZAJEDNIČKA OZNAKA PROJEKTA:
GP-5986/23

GRAĐEVINA: IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA - 4. i 5. faza izgradnje: PROKOP KORANA - KUPA S PRATEĆIM OBJEKTIMA

DIO GRAĐEVINE: **CESTOVNI MOST PREKO PROKOPA - KONSTRUKCIJA**

OZNAKA MAPE I NAZIV PROJEKTIRANOG DIJELA: **72120 - GP - 285 - 2020**

SADRŽAJ:
SITUACIJA

GLAVNI PROJEKTANT: DARKO JELAŠIĆ, dipl.ing.građ.

MJERILO: 1:1000

PROJEKTANT: MATE PEZER dipl.ing.građ.

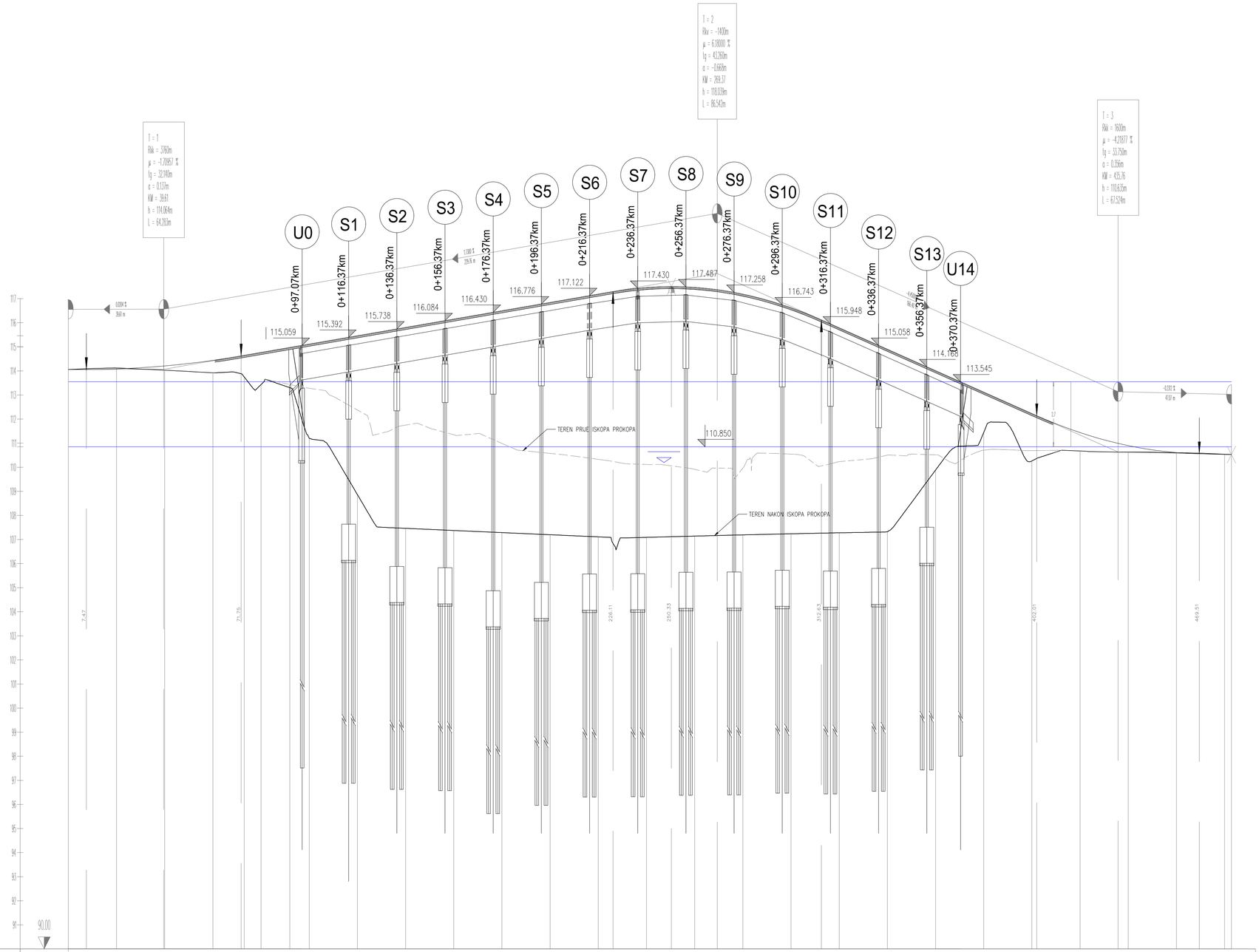
DATUM: lipanj 2023.

BROJ PROJEKTA: **72120 - GP - 285 - 2020**

SURADNICI: MARINA MARKOTIĆ mag.ing.aedif.

BROJ PRILOGA: 0903

OZNAKA DOKUMENTA:
IGH - PKK - O 0200 - 0903

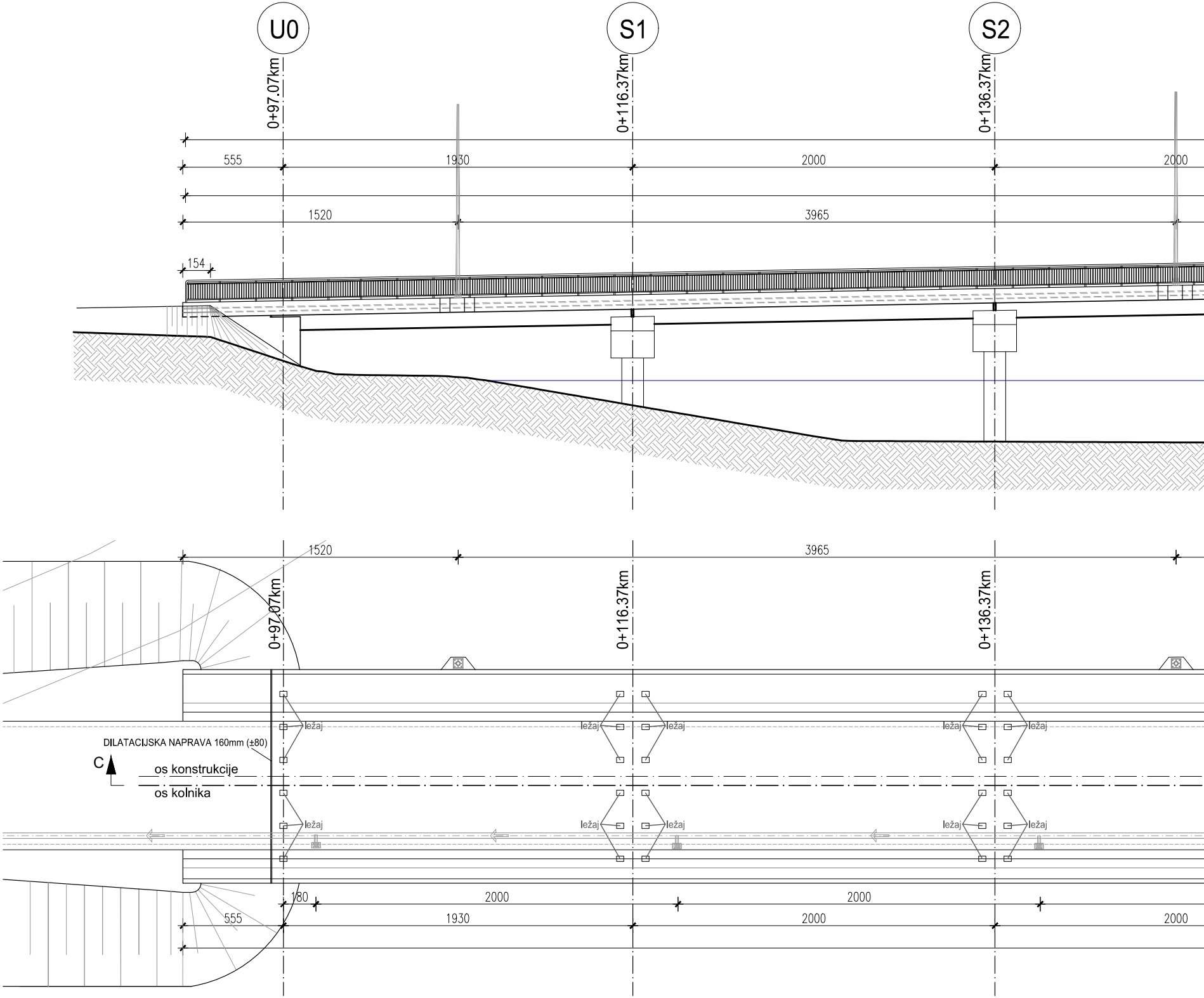


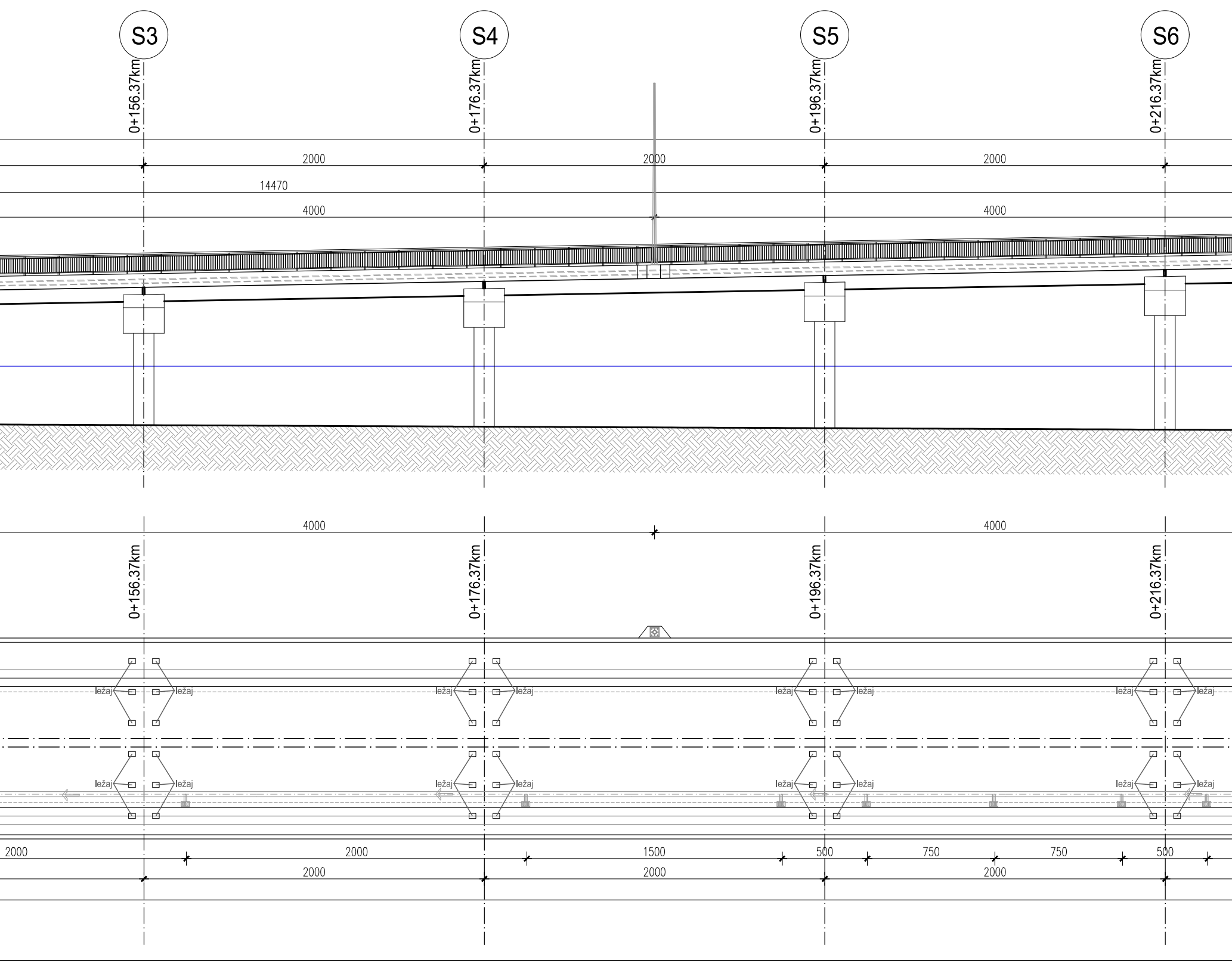
PROFIL-1: OS_0

MJERILO 1:1000/100

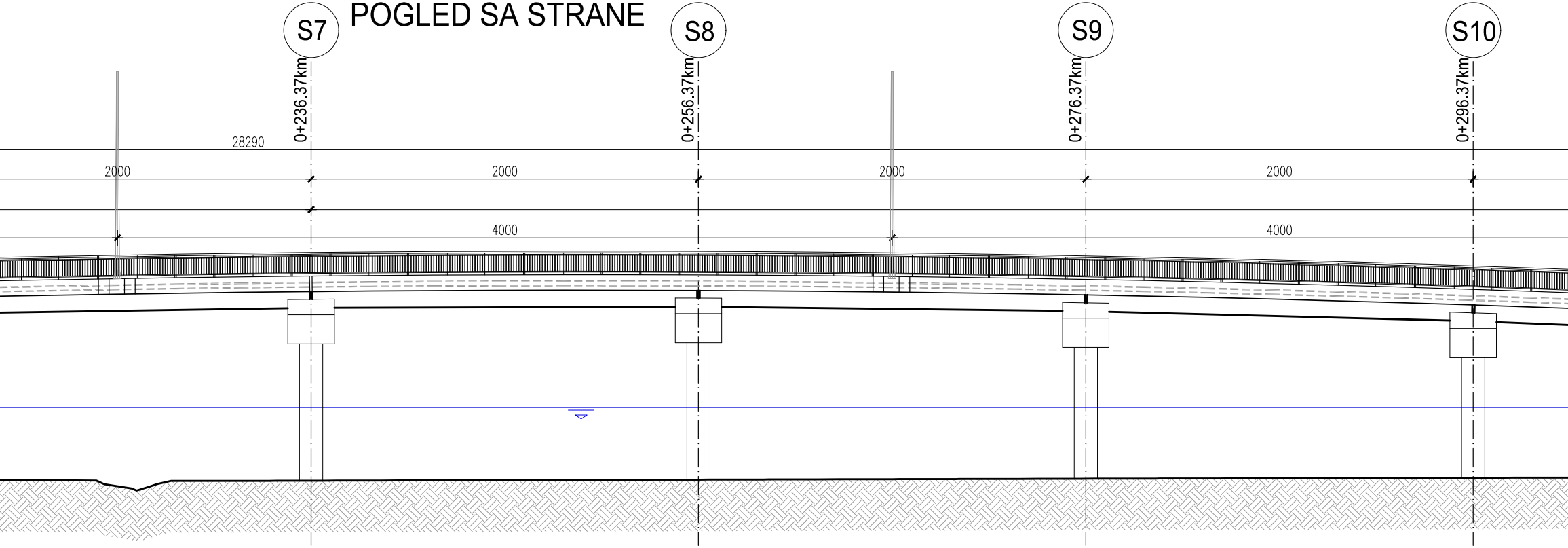
90.00

| | | |

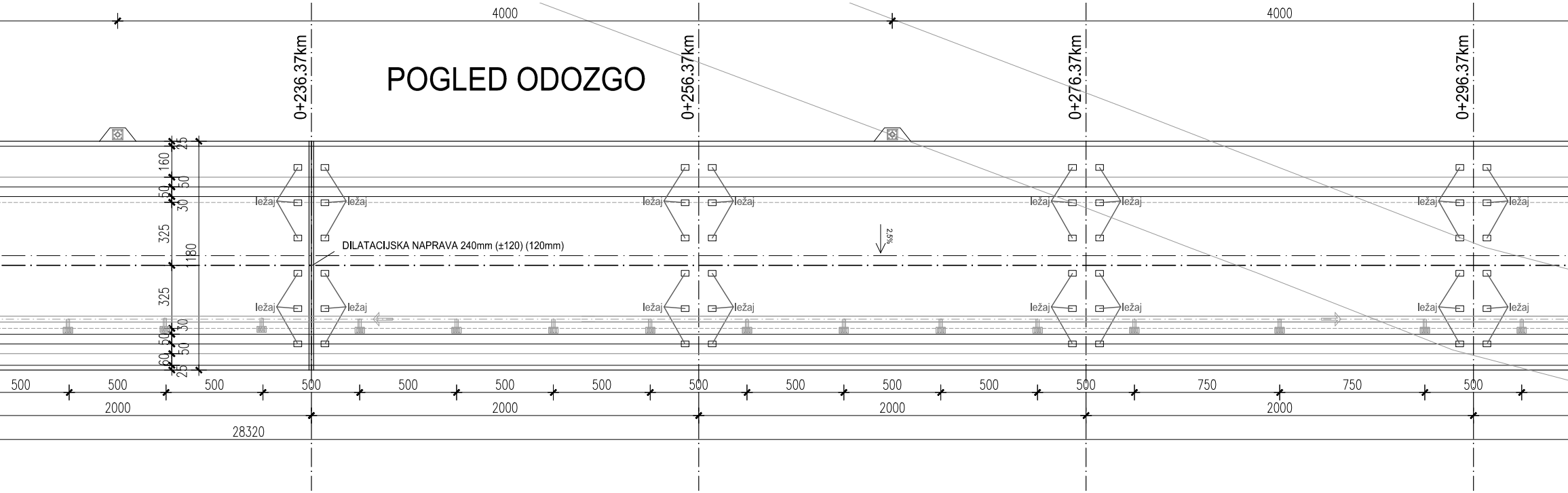

U0
S1
S2
0+97.07km
0+116.37km
0+136.37km
555
1930
2000
2000
1520
3965
154
1520
3965
0+97.07km
0+116.37km
0+136.37km
ležaj
ležaj
ležaj
ležaj
ležaj
DILATACIJSKA NAPRAVA 160mm (±80)
C
os konstrukcije
os kolnika
ležaj
ležaj
ležaj
ležaj
ležaj
180
2000
2000
555
1930
2000
2000

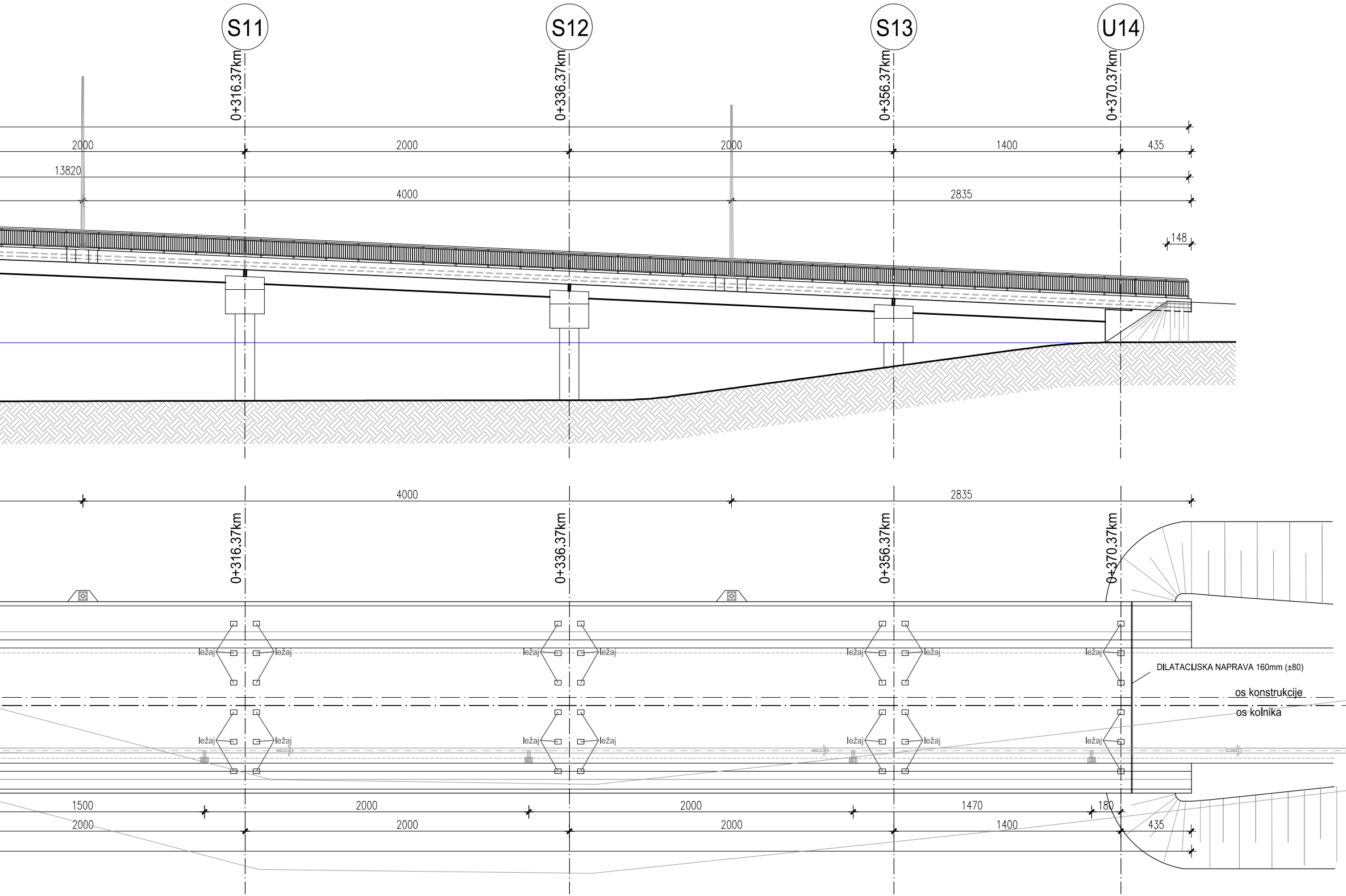

S3
S4
S5
S6
0+156.37km
0+176.37km
0+196.37km
0+216.37km
2000
2000
2000
14470
4000
4000
4000
4000
0+156.37km
0+176.37km
0+196.37km
0+216.37km
ležaj
ležaj
ležaj
ležaj
ležaj
ležaj
ležaj
ležaj
ležaj
ležaj
ležaj
ležaj
ležaj
ležaj
ležaj
ležaj
2000
2000
1500
500
750
750
500
2000
2000
2000

POGLED SA STRANE


S7
S8
S9
S10
0+236.37km
0+256.37km
0+276.37km
0+296.37km
28290
2000
2000
2000
2000
4000
4000

POGLED ODOZGO


4000
4000
0+236.37km
0+256.37km
0+276.37km
0+296.37km
25
160
50
50
30
325
180
325
30
50
50
60
25
ležaj
DILATACIJSKA NAPRAVA 240mm (±120) (120mm)
2.5%
500
500
500
500
500
500
500
500
500
500
500
500
750
750
500
2000
2000
2000
2000
28320


S11
S12
S13
U14
0+316.37km
0+336.37km
0+356.37km
0+370.37km
2000
2000
2000
1400
435
13820
4000
2835
148
4000
2835
0+316.37km
0+336.37km
0+356.37km
0+370.37km
ležaj
DILATACIJSKA NAPRAVA 160mm (±80)
os konstrukcije
os kolnika
1500
2000
2000
1470
180
2000
2000
2000
1400
435

IZMJENA BR.	OPIS	DATUM	POTPIS

INVESTITOR:
HRVATSKE VODE
Ul. Grada Vukovara 220, 10000, Zagreb
HRVATSKE VODE

INSTITUT IGH, d.d.
10 000 ZAGREB, J. RAKUŠE 1
OIB: 79766124714
ZAVOD ZA PROJEKTIRANJE

RAZINA I STRUKOVNA ODREDNICA:
GLAVNI GRAĐEVINSKI PROJEKT

ZAJEDNIČKA OZNAKA PROJEKTA:
GP-5986/23

GRAĐEVINA: **IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA - 4. i 5. faza izgradnje: PROKOP KORANA - KUPA S PRATEĆIM OBJEKTIMA**

DIO GRAĐEVINE: **CESTOVNI MOST PREKO PROKOPA - KONSTRUKCIJA**

OZNAKA MAPE I
NAZIV PROJEKTIRANOG DIJELA: **72120 - GP - 285 - 2020**

SADRŽAJ:
POGLED SA STRANE I ODOZGO

GLAVNI PROJEKTANT: DARKO JELAŠIĆ, dipl.ing.građ.

MJERILO:
1:200

PROJEKTANT: MATE PEZER dipl.ing.građ.

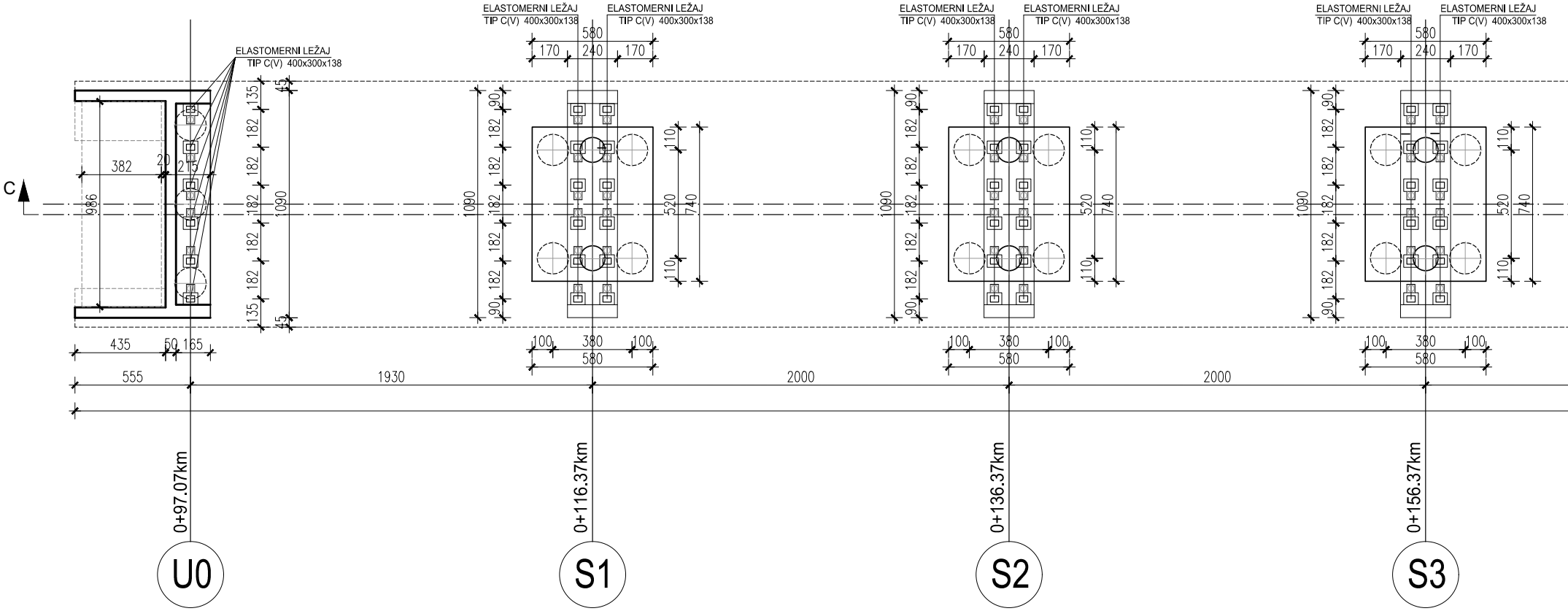
DATUM:
lipanj 2023.

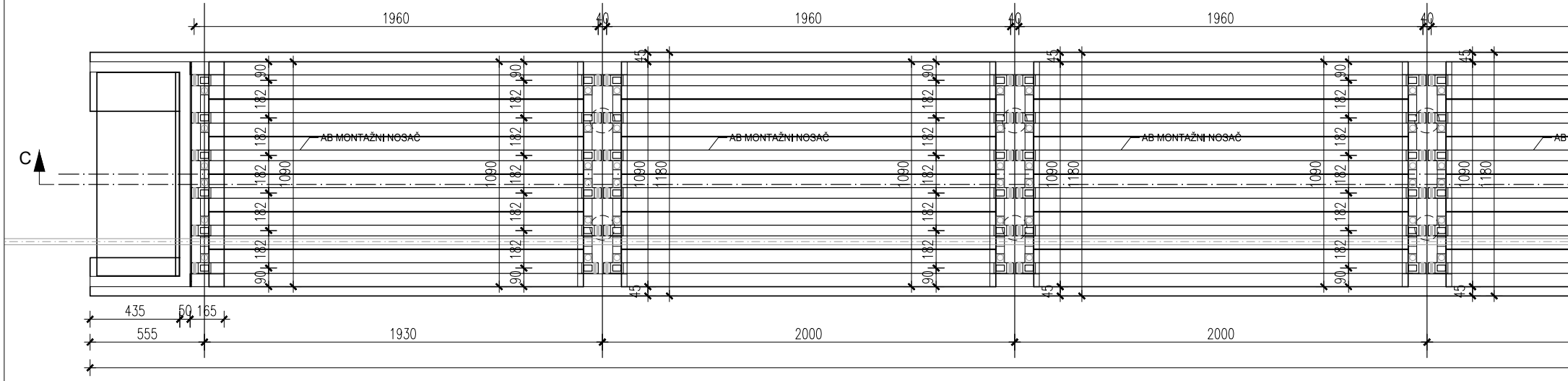
BROJ PROJEKTA:
72120 - GP - 285 - 2020

SURADNICI: MARINA MARKOTIĆ mag.ing.aedif.

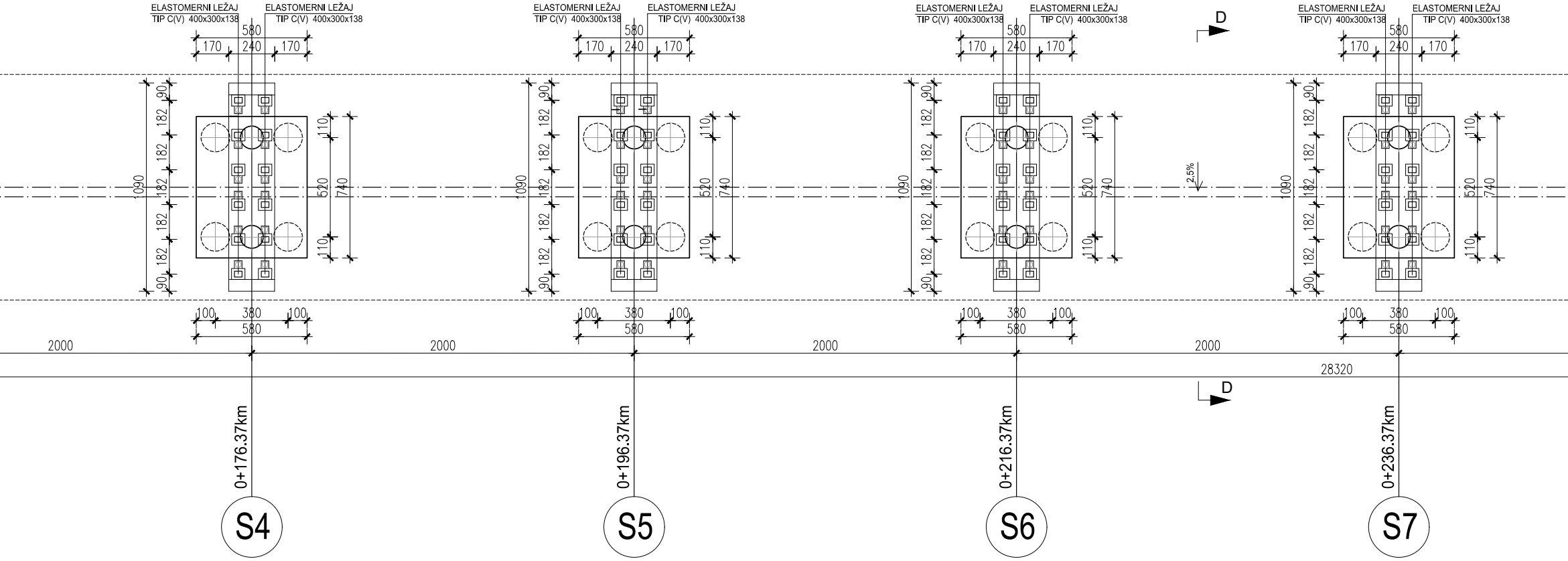
BROJ PRILOGA:
1301

OZNAKA DOKUMENTA:
IGH - PKK - O 0200 - 1302

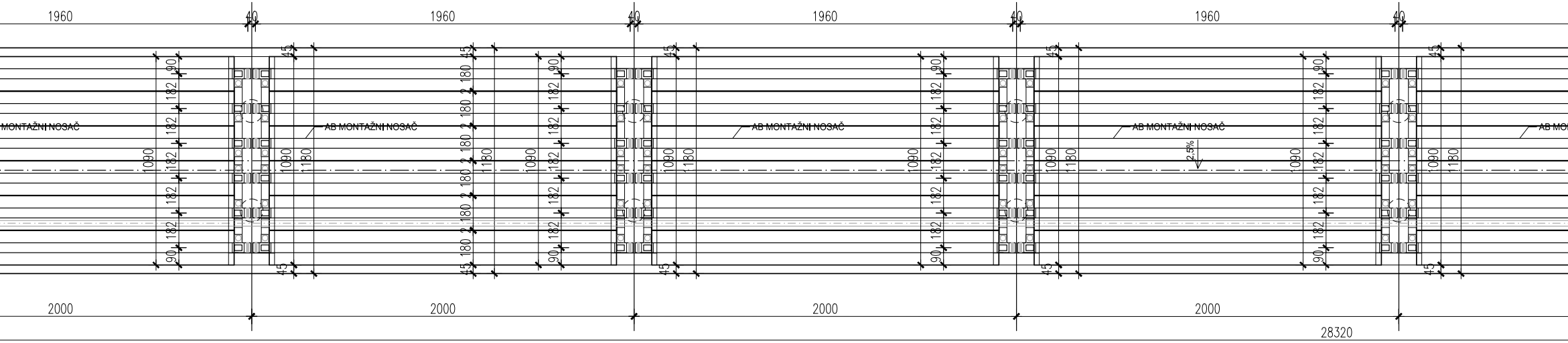

ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
580
170
240
170
C
382
20
215
986
135
182
182
182
182
182
135
45
1090
45
90
182
182
182
182
182
90
1090
110
520
740
110
100
380
100
580
435
50
165
555
1930
2000
2000
0+97.07km
0+116.37km
0+136.37km
0+156.37km
U0
S1
S2
S3

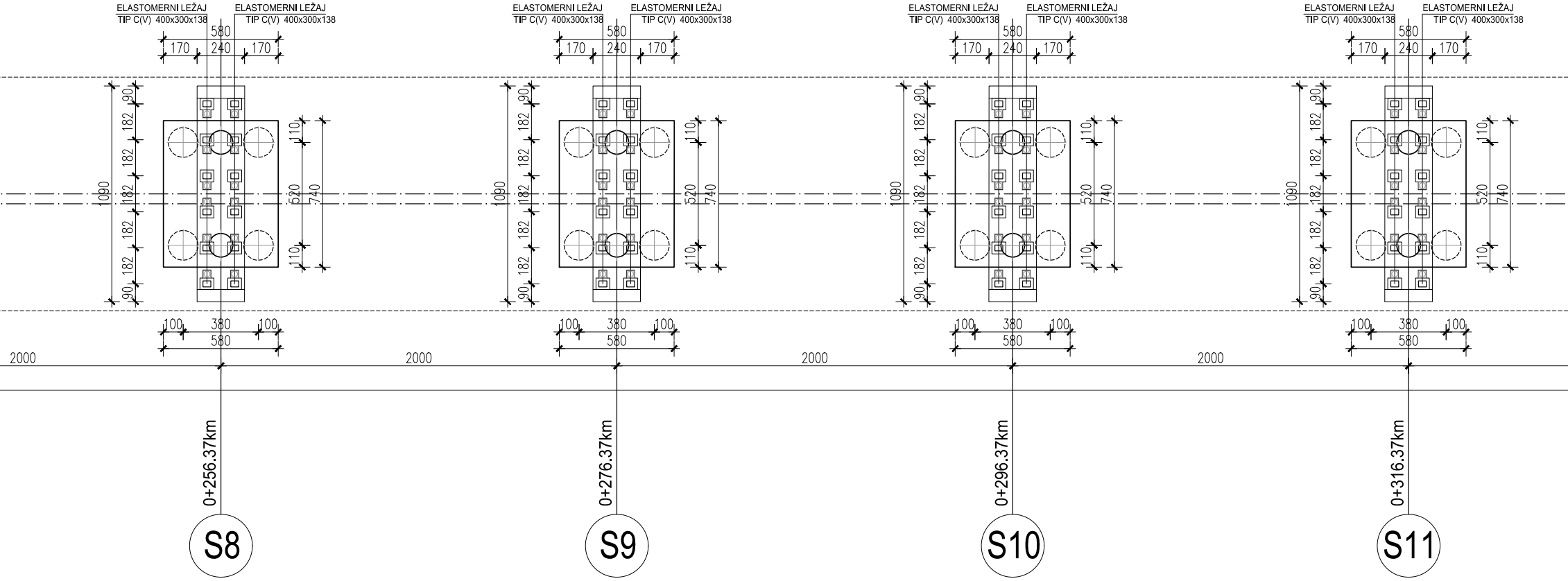

1960
40
1960
40
1960
40
C
AB MONTAŽNI NOSAČ
AB MONTAŽNI NOSAČ
AB MONTAŽNI NOSAČ
AB
90
182
182
182
182
182
90
1090
45
1180
45
435
50
165
555
1930
2000
2000

TLOCRT MOSTA A-A

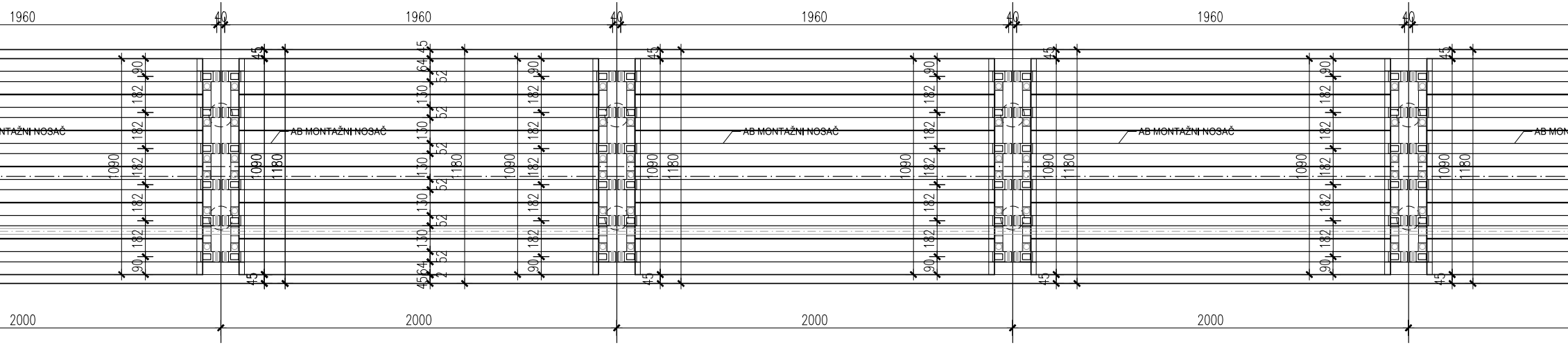

ELASTOMERNI LEŽAJ TIP C(V) 400x300x138
ELASTOMERNI LEŽAJ TIP C(V) 400x300x138
580
170
240
170
90
182
182
182
182
182
90
1090
1080
110
520
740
110
100
380
100
580
2000
2000
2000
2000
28320
2.5%
D
D
0+176.37km
0+196.37km
0+216.37km
0+236.37km
S4
S5
S6
S7

TLOCRT MOSTA B-B

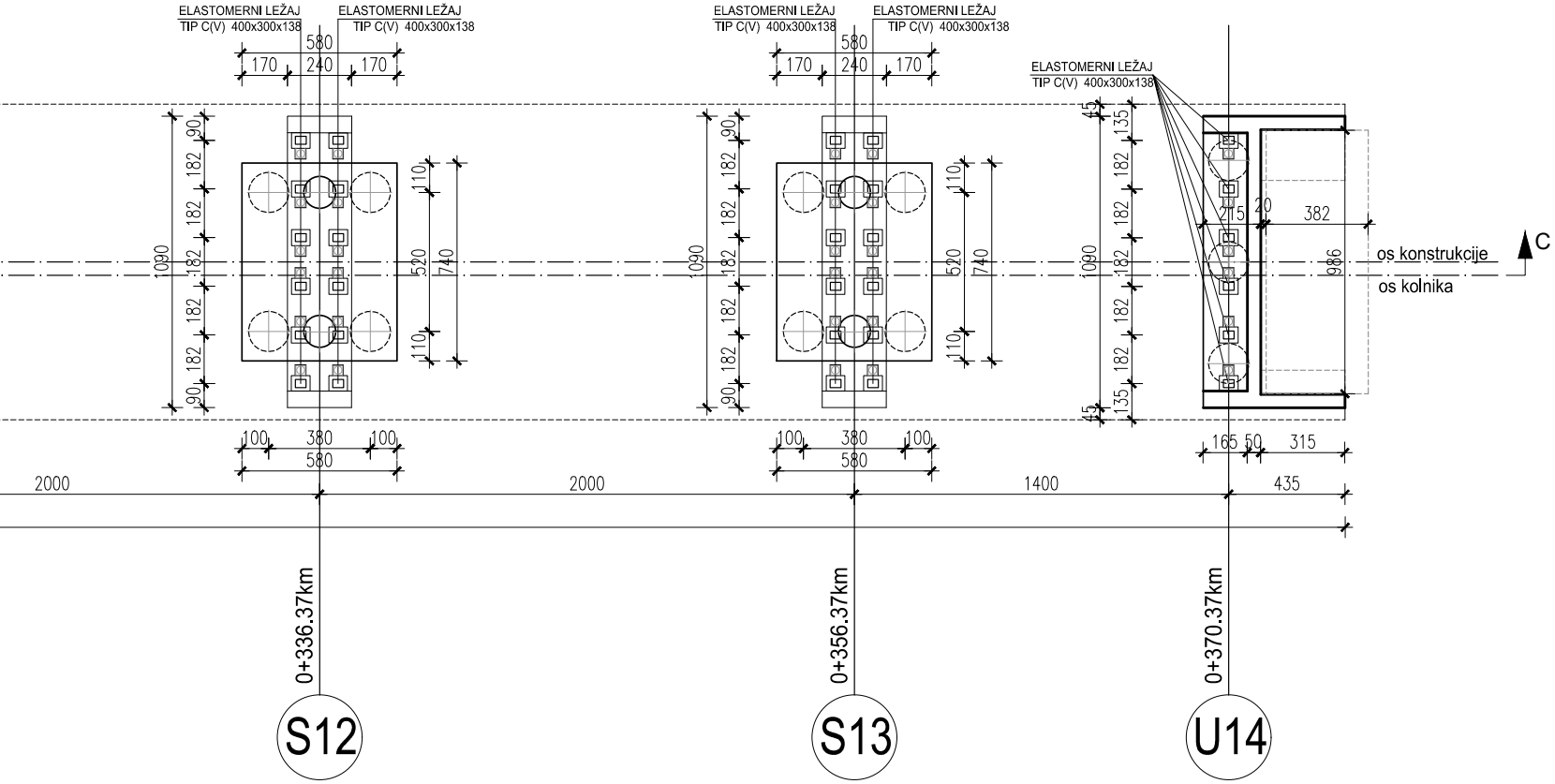

1960
40
1960
40
1960
40
1960
40
45
180
2
90
182
1090
1180
AB MONTAŽNI NOSAČ
AB MONTAŽNI NOSAČ
AB MONTAŽNI NOSAČ
AB MONTAŽNI NOSAČ
2.5%
2000
2000
2000
2000
28320

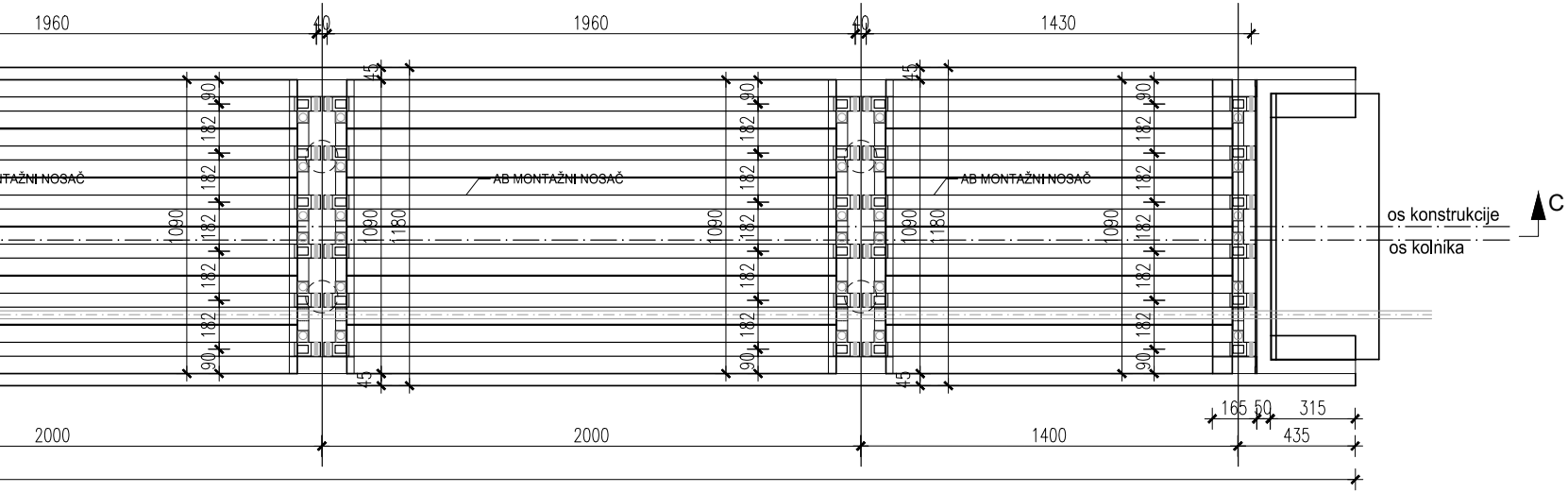


ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
580
170
240
170
90
182
182
182
182
182
90
1090
110
520
740
110
100
380
100
580
2000
0+256.37km
S8
0+276.37km
S9
0+296.37km
S10
0+316.37km
S11



1960
40
45
64
52
130
90
182
1090
1180
NTAŽNI NOSAČ
AB MONTAŽNI NOSAČ
AB MON
2000


ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
580
170
240
170
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
580
170
240
170
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
1090
90
182
182
182
182
182
90
110
520
740
110
1090
90
182
182
182
182
182
90
110
520
740
110
45
135
182
182
182
182
182
135
45
1090
215
20
382
986
os konstrukcije
os kolnika
C
100
380
100
580
100
380
100
580
165
50
315
2000
2000
1400
435
0+336.37km
0+356.37km
0+370.37km
S12
S13
U14


1960
40
1960
40
1430
45
45
90
182
182
182
182
182
90
ONTAŽNI NOSAČ
AB MONTAŽNI NOSAČ
AB MONTAŽNI NOSAČ
1090
1090
1180
1090
1090
1180
1090
90
182
182
182
182
182
90
45
45
os konstrukcije
os kolnika
C
165
50
315
435
2000
2000
1400

PODACI O MATERIJALIMA

BETON

SVOJSTVA U SKLADU S HRN EN 206:2016, HRN EN 13670:2010; HRI CEN/TR 15739

ARMATURA - SVOJSTVA U SKLADU S HRN EN 10080:2012

Konstrukcijski elementi	Granične vrijednosti za sa						
	Min. Razred tlačne čvrstoće C (N/mm^2)	Razred izloženosti (HRN EN 1992-1-1)	Maks. udio klorida (HRN EN 206) %	min. Količina cementa (kg/m3)	Vodone-propusnost (VDP) HRN EN 12390-8 i HRN 1128, prodor vode srednja vrijednost cm	vodo/cementn i faktor (w/c^c)	Dmax agregata mm
Podložni beton	C12/15	X0	-	-	-	-	16
Piloti	C30/37	XC2/XA1	0,2	300	3,0 (VDP2)	0,55	32
Naglavnice pilota	C30/37	XC2/XA1	0,2	300	3,0 (VDP2)	0,55	32
Prijelazna ploča	C30/37	XC2/XA1/XF2	0,2	300	3,0 (VDP2)	0,55	32
Upornjaci	C35/45	XC4/XD3/XF2	0,2	320	3,0 (VDP2)	0,45	32
Stupovi	C30/37	XC4/XD1/XF1	0,2	300	3,0 (VDP2)	0,50	32
Naglavne grede stupova	C30/37	XC4/XD1/XF1	0,2	300	3,0 (VDP2)	0,50	32
Klupice ležajeva i preša	C45/55	XC3/XD1/XF4	0,2	340	3,0 (VDP2)	0,45	16
Montažni nosači	C40/50	XC3/XD1/XF1	0,1	300	3,0 (VDP2)	0,50	16
Poprečni nosači	C30/37	XC3/XD1/XF3	0,2	320	3,0 (VDP2)	0,50	16
Kolnička ploča	C30/37	XC3/XD1/XF3	0,2	320	3,0 (VDP2)	0,50	16
Kontinuitetna ploča	C35/45	XC3/XD1/XF3	0,2	340	3,0 (VDP2)	0,45	16
Hodnici i vijenci	C35/45	XC4/XD3/XF4	0,2	340	3,0 (VDP2)	0,45	16
Beton ugradnje prijelaznih naprava i rubnjaci	C40/50	XC4/XD3/XF4	0,2	340	3,0 (VDP2)	0,45	16

Mogu se koristiti distanceri od vlaknastih betona ili običnog betona. Distanceri se mogu napraviti od vlaknastog betona
otporni na starenje i moraju osigurati min. tlačna čvrstoća do 700 kPa, posebno se projektiraju za nosivi i vidljivi beton
HRN EN 206: 2013 i protupožarnim propisima HRN EN 1991-1-2 i DIN 4201. Također moraju imati koeficijent prošire

ČELIK ZA PREDNAPINJANJE

SVOJSTVA U SKLADU S nkHRN EN 10138-1, nHRN EN 10138-3, HRN EN ISO 15630-3 I ETA PROIZVODIMA

KABLOVI ili UŽADI		Y 1860 S7

KONSTRUKCIJSKI ČELIK

SVOJSTVA U SKLADU S HRN EN 10025, HRN EN 10210 I HRN EN 10219, IZVOĐENJE U SKLADU S HRN EN 1090

KONSTRUKCIJSKI ELEMENT	Vrsta ČELIKA	
ZAVARENE OGRADE ZA PJEŠAKE	S 235 JR	
ZAŠTITNE OGRADE ZA VOZILA	U skladu s tehničkim dopuštenjem u HR	

Zaštita od korozije vrućim pocinčavanjem vrši se na gotovim elementima. Naknadno bušenje, rezanje, brušenje,
elemenata samo s mehaničkim spojevima. Izrada i montaža čeličnih dijelova izvodi se u skladu s HRN EN 1090
EXC2

stav betona

Otpornost na smrzavanje M (HRN 1128; HRN CEN/TS 15177 br. ciklusa smrzavanja i odmrzavanja)	Otpornost na smrzavanje i soli MS (prema HRN 1128 i HRS CEN/TS 12390-9 najveći gubitak mase) kg/m3	Razred konstr. (HRN EN 1992-1-1)	Armatura	Zaštitni sloj (HRN EN 1992-1-1) cm
-	-	-	-	-
-	-	S6	B 500-B	8,0
-	-	S5	B 500-B	5,5
-	1,0 (MS28)	S5	B 500-B	5,5
-	1,0 (MS28)	S6	B 500-B	6,5
M28	-	S6	B 500-B	5,5
M28	-	S6	B 500-B	5,5
M56	-	S5	B 500-B	5,0
M28	-	S5	B 500-B Y1860 S7	5,5 (4,5)
M56	-	S5	B 500-B	5,0
M56	-	S5	B 500-B	5,0
-	0,5 (MS56)	S5	B 500-B	5,0
-	0,5 (MS56)	S6	B 500-B	6,0/2,5
-	0,5 (MS56)	S5	B 500-B	6,0

a ili običnog betona i ne smiju sadržavati azbest. Moraju biti
, mora zadovoljiti zahtjeve za beton i armirani beton u skladu s
nja kao i ostali beton.

	150 mm^2	∅ kabla, < 8,5cm ili 5,5 / 6,5cm

Način zaštite protiv korozije	ostalo
Vruće cinčano min 85 µm	

poliranje, zavarivanje... nije dopušteno! Spajanje pojedinih
0-2, proizvodnom klasom EXC2 EN 1090-2, razred izvedbe

IZMJENA BR.	OPIS	DATUM	POTPIS

INVESTITOR:

HRVATSKE VODE
Ul. Grada Vukovara 220, 10000, Zagreb

HRVATSKE VODE

INSTITUT IGH, d.d.
10 000 ZAGREB, J. RAKUŠE 1
OIB: 79766124714
ZAVOD ZA PROJEKTIRANJE

RAZINA I STRUKOVNA ODREDNICA: **GLAVNI GRAĐEVINSKI PROJEKT**

ZAJEDNIČKA OZNAKA PROJEKTA: **GP-5986/23**

GRAĐEVINA: **IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA - 4. i 5. faza izgradnje: PROKOP KORANA - KUPA S PRATEĆIM OBJEKTIMA**

DIO GRAĐEVINE: **CESTOVNI MOST PREKO PROKOPA - KONSTRUKCIJA**

OZNAKA MAPE I NAZIV PROJEKTIRANOG DIJELA: **72120 - GP - 285 - 2020**

SADRŽAJ: **TLOCRTI**

GLAVNI PROJEKTANT: DARKO JELAŠIĆ, dipl.ing.građ.

MJERILO: 1:200

PROJEKTANT: MATE PEZER dipl.ing.građ.

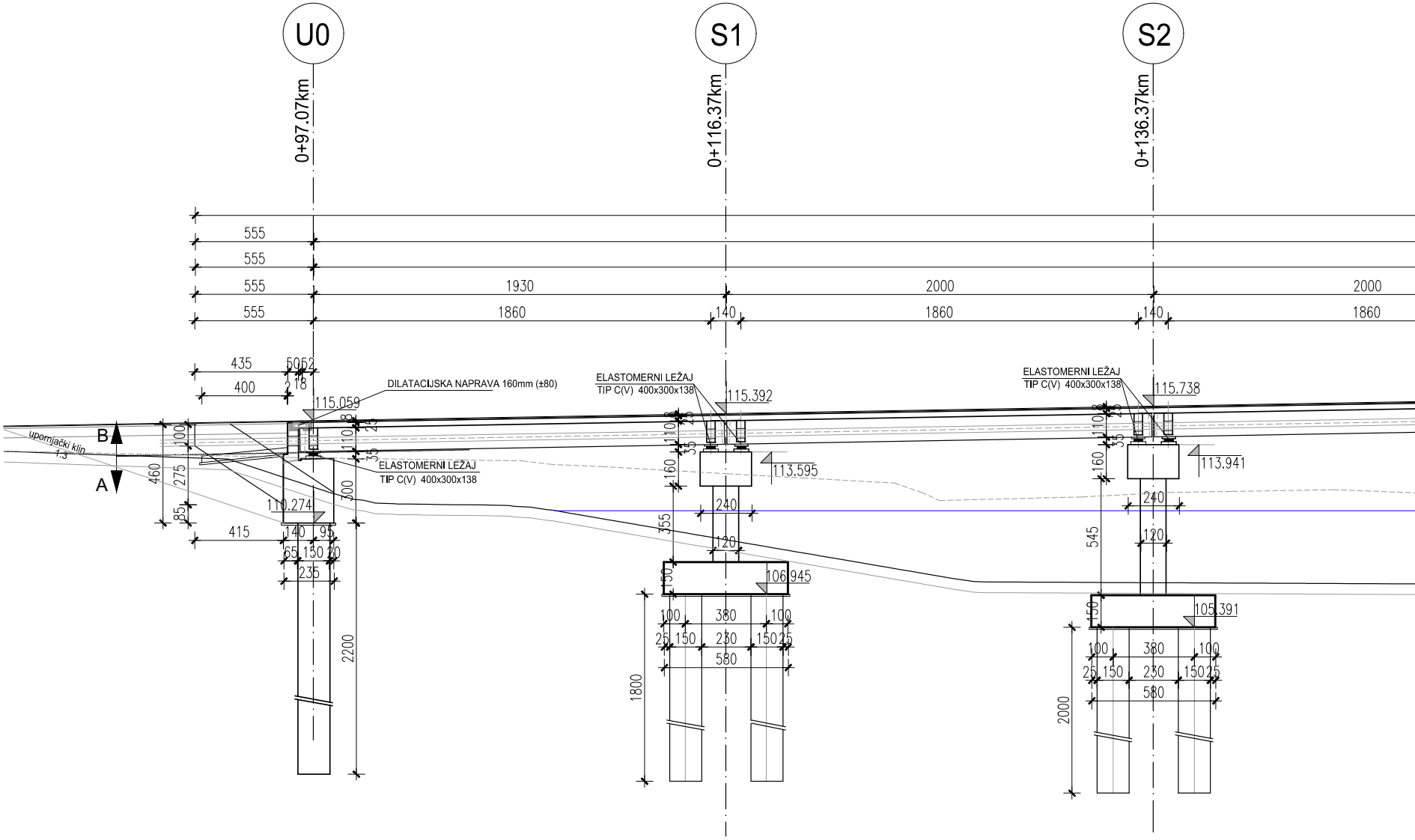
DATUM: lipanj 2023.

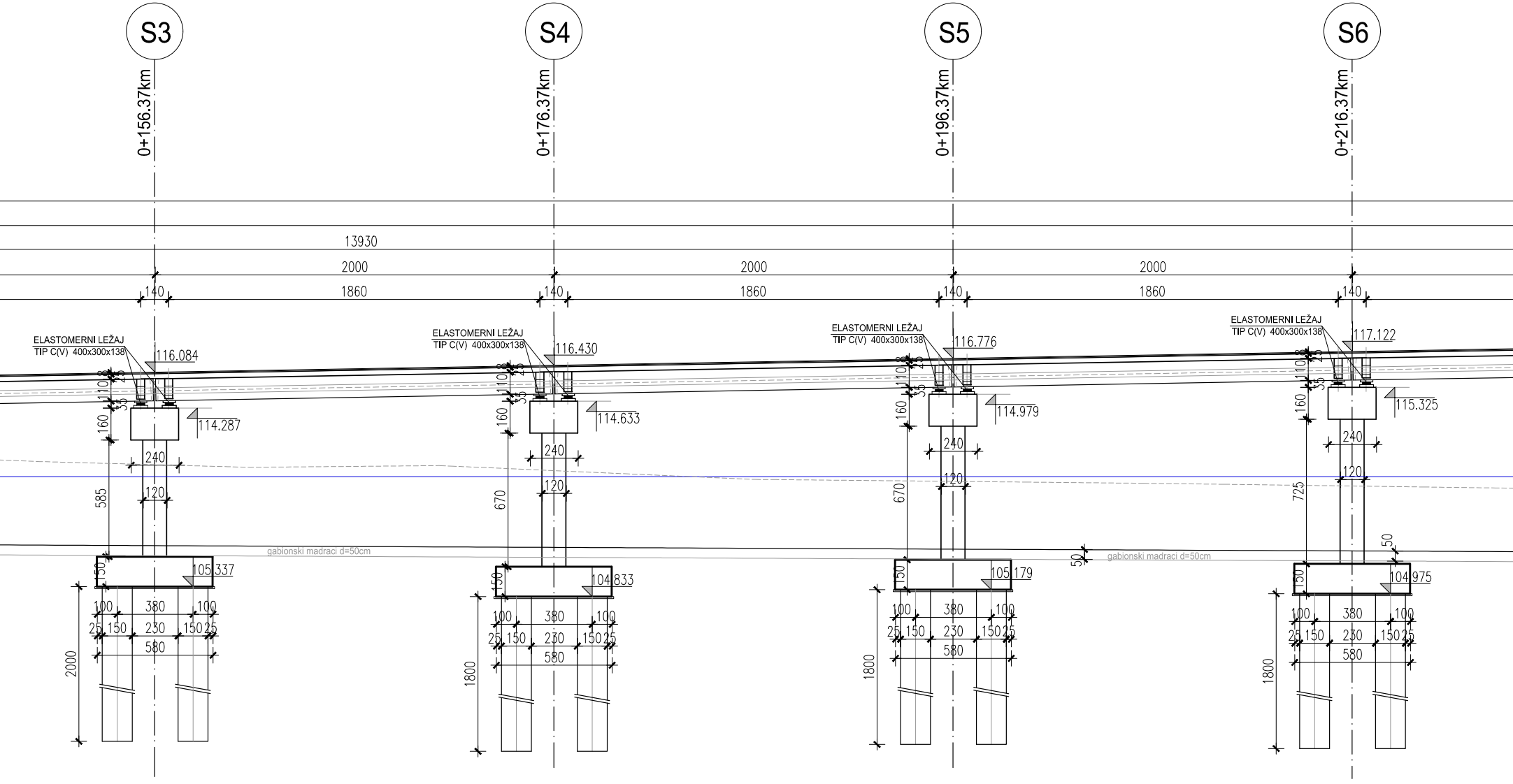
BROJ PROJEKTA: **72120 - GP - 285 - 2020**

SURADNICI: MARINA MARKOTIĆ mag.ing.aedif.

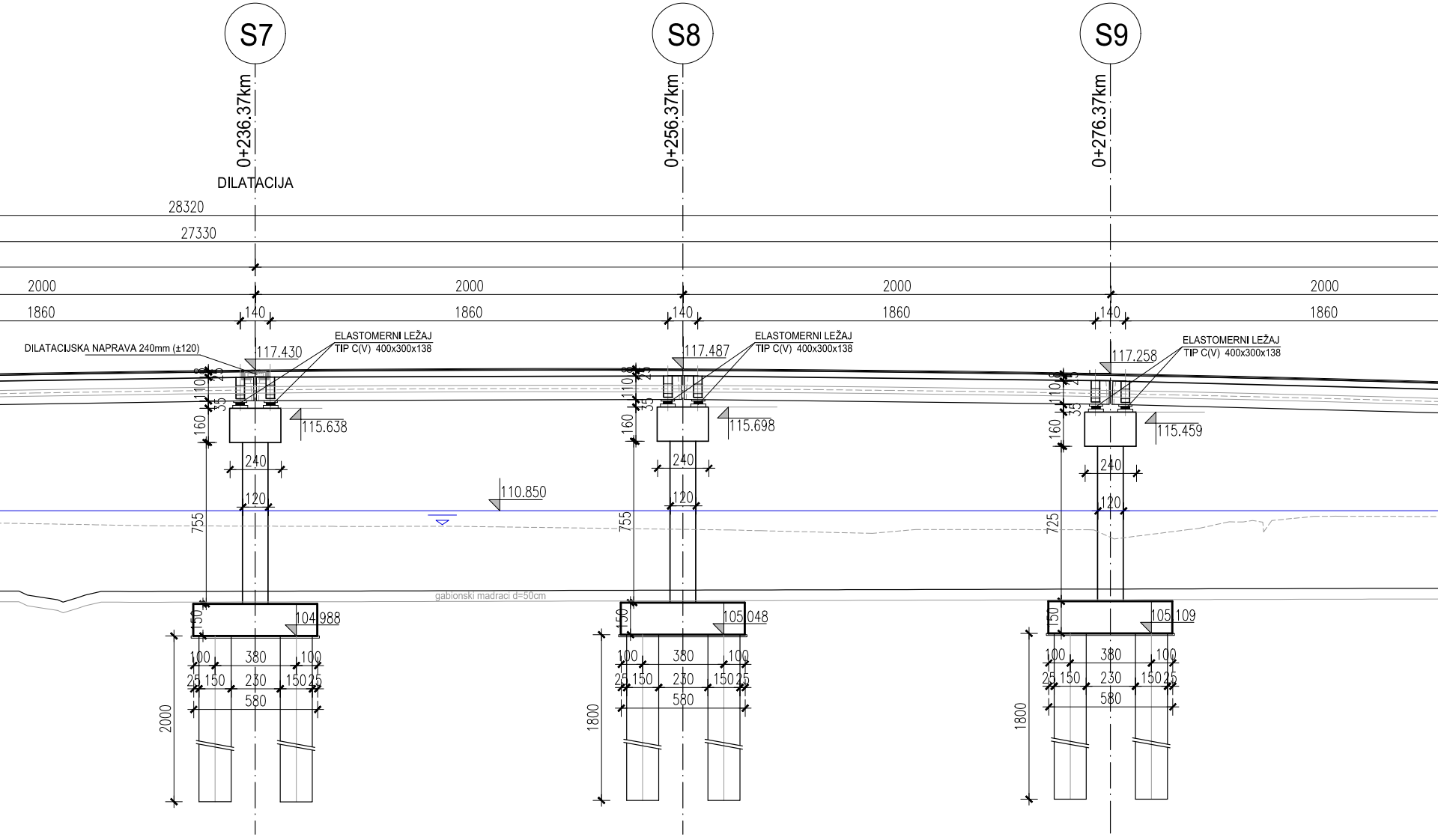
BROJ PRILOGA: 1401

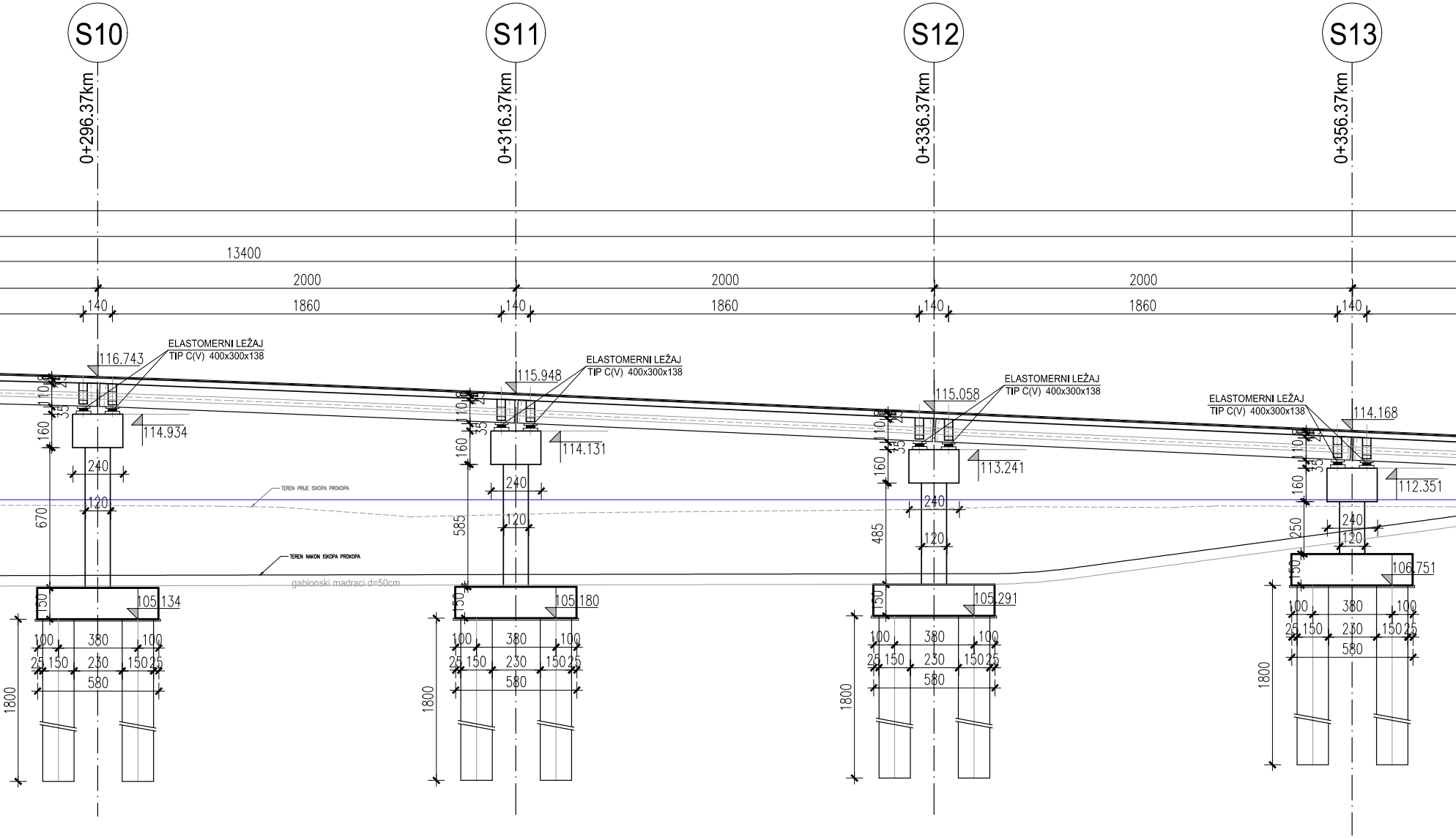
OZNAKA DOKUMENTA: IGH - PKK - O 0200 - 1401

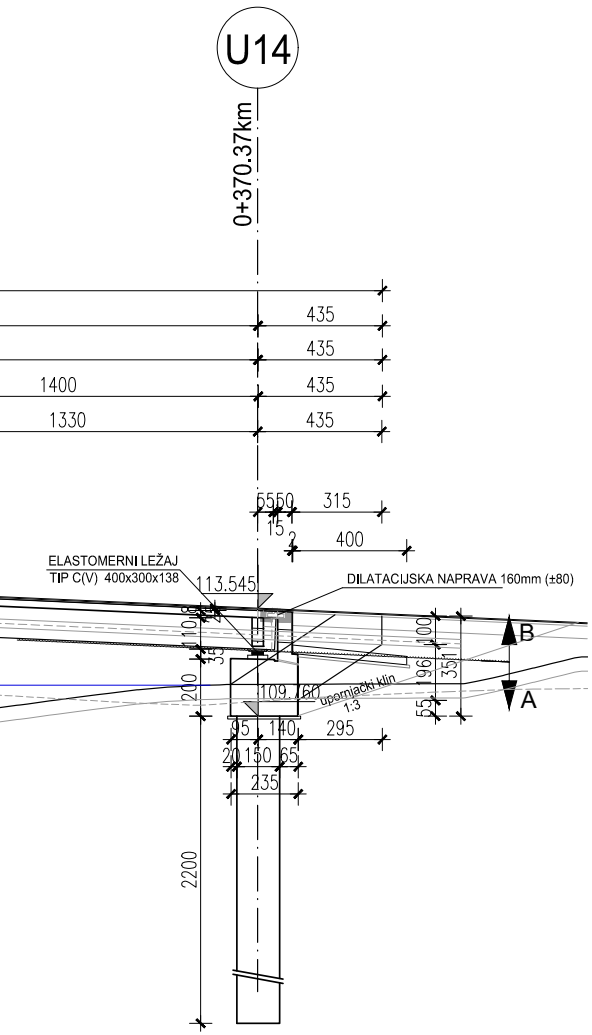

U0
S1
S2
0+97.07km
0+116.37km
0+136.37km
555
555
555
555
1930
2000
2000
1860
1860
1860
140
140
435
5052
400
218
DILATACIJSKA NAPRAVA 160mm (±80)
115.059
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
115.392
113.595
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
115.738
113.941
upornjački klin
1:3
B
A
100
460
275
85
110.274
415
140
95
65
150
20
235
300
2200
110
25
35
160
240
120
355
150
106.945
100
380
100
25
150
230
150
25
580
1800
545
105.391
2000


S3
S4
S5
S6
0+156.37km
0+176.37km
0+196.37km
0+216.37km
13930
2000
2000
2000
140
1860
140
1860
140
1860
140
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
116.084
116.430
116.776
117.122
114.287
114.633
114.979
115.325
110
25
35
160
240
120
585
670
670
725
50
gabionski madraci d=50cm
105.337
104.833
105.179
104.975
150
100
380
100
25
150
230
150
25
580
2000
1800
1800
1800

UZDUŽNI PRESJEK C-C


S7
S8
S9
0+236.37km
0+256.37km
0+276.37km
DILATACIJA
28320
27330
2000
2000
2000
2000
1860
1860
1860
1860
140
140
140
DILATACIJSKA NAPRAVA 240mm (±120)
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
117.430
117.487
117.258
115.638
115.698
115.459
110.850
110
35
160
240
120
755
755
725
gabionski madraci d=50cm
150
104.988
105.048
105.109
100
380
100
25
150
230
150
25
580
2000
1800
1800


S10
S11
S12
S13
0+296.37km
0+316.37km
0+336.37km
0+356.37km
13400
2000
2000
2000
140
1860
140
1860
140
1860
140
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
116.743
114.934
115.948
114.131
115.058
113.241
114.168
112.351
160
670
585
485
250
240
120
TEREN PRIJE ISKOPA PROKOPA
TEREN NAKON ISKOPA PROKOPA
gabionski madraci d=50cm
150
105.134
105.180
105.291
106.751
100
380
25
150
230
580
1800


U14
0+370.37km
435
435
1400
435
1330
435
5550
315
15
2
400
ELASTOMERNI LEŽAJ
TIP C(V) 400x300x138
113.545
DILATACIJSKA NAPRAVA 160mm (±80)
10
8
35
200
109.760
upornjački klin
1:3
100
196
351
55
B
A
95
140
295
20
150
65
235
2200

PODACI O MATERIJALIMA

BETON

SVOJSTVA U SKLADU S HRN EN 206:2016, HRN EN 13670:2010; HRI CEN/TR 15739
ARMATURA - SVOJSTVA U SKLADU S HRN EN 10080:2012

Konstrukcijski elementi	Granične vrijednosti za sastav betona											
	Min. Razred tlačne čvrstoće C (N/mm^2)	Razred izloženosti (HRN EN 1992-1-1)	Maks. udio klorida (HRN EN 206) %	min. Količina cementa (kg/m3)	Vodone-propusnost (VDP) HRN EN 12390-8 i HRN 1128, prodor vode srednja vrijednost cm	vodo/ cementn i faktor (w/c^c)	Dmax agregata mm	Otpornost na smrzavanje M (HRN 1128; HRN CEN/TS 15177 br. ciklusa smrzavanja i odmrzavanja)	Otpornost na smrzavanje i soli MS (prema HRN 1128 i HRS CEN/TS 12390-9 najveći gubitak mase) kg/m3	Razred konstr. (HRN EN 1992-1-1)	Armatura	Zaštitni sloj (HRN EN 1992-1-1) cm
Podložni beton	C12/15	X0	-	-	-	-	16	-	-	-	-	-
Piloti	C30/37	XC2/XA1	0,2	300	3,0 (VDP2)	0,55	32	-	-	S6	B 500-B	8,0
Naglavnice pilota	C30/37	XC2/XA1	0,2	300	3,0 (VDP2)	0,55	32	-	-	S5	B 500-B	5,5
Prijelazna ploča	C30/37	XC2/XA1/XF2	0,2	300	3,0 (VDP2)	0,55	32	-	1,0 (MS28)	S5	B 500-B	5,5
Upornjaci	C35/45	XC4/XD3/XF2	0,2	320	3,0 (VDP2)	0,45	32	-	1,0 (MS28)	S6	B 500-B	6,5
Stupovi	C30/37	XC4/XD1/XF1	0,2	300	3,0 (VDP2)	0,50	32	M28	-	S6	B 500-B	5,5
Naglavne grede stupova	C30/37	XC4/XD1/XF1	0,2	300	3,0 (VDP2)	0,50	32	M28	-	S6	B 500-B	5,5
Klupice ležajeva i preša	C45/55	XC3/XD1/XF4	0,2	340	3,0 (VDP2)	0,45	16	M56	-	S5	B 500-B	5,0
Montažni nosači	C40/50	XC3/XD1/XF1	0,1	300	3,0 (VDP2)	0,50	16	M28	-	S5	B 500-B Y1860 S7	5,5 (4,5)
Poprečni nosači	C30/37	XC3/XD1/XF3	0,2	320	3,0 (VDP2)	0,50	16	M56	-	S5	B 500-B	5,0
Kolnička ploča	C30/37	XC3/XD1/XF3	0,2	320	3,0 (VDP2)	0,50	16	M56	-	S5	B 500-B	5,0
Kontinuitetna ploča	C35/45	XC3/XD1/XF3	0,2	340	3,0 (VDP2)	0,45	16	-	0,5 (MS56)	S5	B 500-B	5,0
Hodnici i vijenci	C35/45	XC4/XD3/XF4	0,2	340	3,0 (VDP2)	0,45	16	-	0,5 (MS56)	S6	B 500-B	6,0/2,5
Beton ugradnje prijelaznih naprava i rubnjaci	C40/50	XC4/XD3/XF4	0,2	340	3,0 (VDP2)	0,45	16	-	0,5 (MS56)	S5	B 500-B	6,0

Mogu se koristiti distanceri od vlaknastih betona ili običnog betona. Distanceri se mogu napraviti od vlaknastog betona ili običnog betona i ne smiju sadržavati azbest. Moraju biti otporni na starenje i moraju osigurati min. tlačna čvrstoća do 700 kPa, posebno se projektiraju za nosivi i vidljivi beton, mora zadovoljiti zahtjeve za beton i armirani beton u skladu s HRN EN 206: 2013 i protupožarnim propisima HRN EN 1991-1-2 i DIN 4201. Također moraju imati koeficijent proširenja kao i ostali beton.

ČELIK ZA PREDNAPINJANJE

SVOJSTVA U SKLADU S nkHRN EN 10138-1, nHRN EN 10138-3, HRN EN ISO 15630-3 I ETA PROIZVODIMA

KABLOVI ili UŽADI		Y 1860 S7		150 mm^2	∅ kabla, < 8,5cm ili 5,5 / 6,5cm

KONSTRUKCIJSKI ČELIK

SVOJSTVA U SKLADU S HRN EN 10025, HRN EN 10210 I HRN EN 10219, IZVOĐENJE U SKLADU S HRN EN 1090

KONSTRUKCIJSKI ELEMENT	Vrsta ČELIKA		Način zaštite protiv korozije	ostalo
ZAVARENE OGRADE ZA PJEŠAKE	S 235 JR		Vruće cinčano min 85 μm	
ZAŠTITNE OGRADE ZA VOZILA	U skladu s tehničkim dopuštenjem u HR			

Zaštita od korozije vrućim pocinčavanjem vrši se na gotovim elementima. Naknadno bušenje, rezanje, brušenje, poliranje, zavarivanje… nije dopušteno! Spajanje pojedinih elemenata samo s mehaničkim spojevima. Izrada i montaža čeličnih dijelova izvodi se u skladu s HRN EN 1090-2, proizvodnom klasom EXC2 EN 1090-2, razred izvedbe EXC2

IZMJENA BR.	OPIS	DATUM	POTPIS

INVESTITOR:
HRVATSKE VODE
Ul. Grada Vukovara 220, 10000, Zagreb
HRVATSKE VODE

INSTITUT IGH, d.d.
10 000 ZAGREB, J. RAKUŠE 1
OIB: 79766124714
ZAVOD ZA PROJEKTIRANJE

RAZINA I STRUKOVNA ODREDNICA:
GLAVNI GRAĐEVINSKI PROJEKT

ZAJEDNIČKA OZNAKA PROJEKTA:
GP-5986/23

GRAĐEVINA: IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA
I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA
- 4. i 5. faza izgradnje: PROKOP KORANA - KUPA S PRATEĆIM OBJEKTIMA

DIO GRAĐEVINE: **CESTOVNI MOST PREKO PROKOPA - KONSTRUKCIJA**

OZNAKA MAPE I
NAZIV PROJEKTIRANOG DIJELA: **72120 - GP - 285 - 2020**

SADRŽAJ:
UZDUŽNI PRESJEK

GLAVNI PROJEKTANT: DARKO JELAŠIĆ, dipl.ing.građ.

MJERILO:
1:200

PROJEKTANT: MATE PEZER dipl.ing.građ.

DATUM:
lipanj 2023.

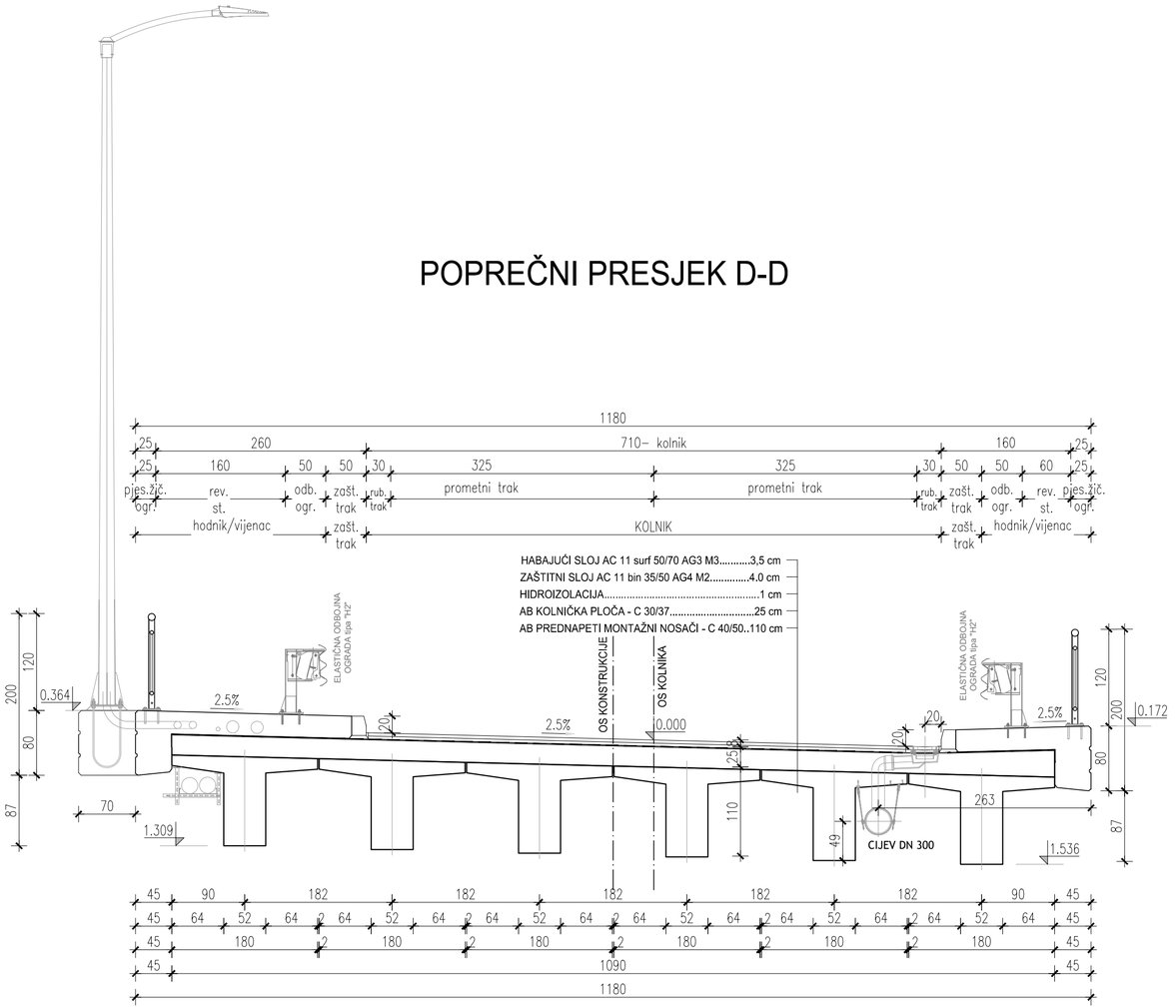
BROJ PROJEKTA:
72120 - GP - 285 - 2020

SURADNICI: MARINA MARKOTIĆ mag.ing.aedif.

BROJ PRILOGA:
1401

OZNAKA DOKUMENTA:
IGH - PKK - O 0200 - 1401

POPREČNI PRESJEK D-D



PODACI O MATERIJALIMA

BETON
SVOJSTVA U SKLADU S HRN EN 206:2016, HRN EN 13670:2010; HRI CEN/TR 15739
ARMATURA - SVOJSTVA U SKLADU S HRN EN 10080:2012

Konstrukcijski elementi	Granične vrijednosti za sastav betona											
	Min. Razred tlačne čvstoće C (N/mm^2)	Razred izloženosti (HRN EN 1992-1-1)	Maks. udio klonida (HRN EN 206) %	min. Količina cementa (kg/m3)	Vodone-propusnost (VDP) HRN EN 12390-8 i HRN 1128, prodor vode srednja vrijednost cm	vodo/ cementn i faktor (w/c^k)	Dmax agregata mm	Otpornost na smrzavanje M (HRN 1128; HRN CEN/TS 15177 br. ciklusa smrzavanja i odmrzavanja)	Otpornost na smrzavanje i soli MS (prema HRN 1128 i HRS CEN/TS 12390-9 najveći gubitak mase) kg/m3	Razred konstr. (HRN EN 1992-1-1)	Armatura	Zaštitni sloj (HRN EN 1992-1-1) cm
Podložni beton	C12/15	X0	-	-	-	-	16	-	-	-	-	-
Piloti	C30/37	XC2/XA1	0,2	300	3,0 (VDP2)	0,55	32	-	-	S6	B 500-B	8,0
Naglavnice pilota	C30/37	XC2/XA1	0,2	300	3,0 (VDP2)	0,55	32	-	-	S5	B 500-B	5,5
Prijelazna ploča	C30/37	XC2/XA1/XF2	0,2	300	3,0 (VDP2)	0,55	32	-	1,0 (MS28)	S5	B 500-B	5,5
Upornjaci	C35/45	XC4/XD3/XF2	0,2	320	3,0 (VDP2)	0,45	32	-	1,0 (MS28)	S6	B 500-B	6,5
Stupovi	C30/37	XC4/XD1/XF1	0,2	300	3,0 (VDP2)	0,50	32	M28	-	S6	B 500-B	5,5
Naglavne grede stupova	C30/37	XC4/XD1/XF1	0,2	300	3,0 (VDP2)	0,50	32	M28	-	S6	B 500-B	5,5
Klupice ležajeva i preša	C45/55	XC3/XD1/XF4	0,2	340	3,0 (VDP2)	0,45	16	M56	-	S5	B 500-B	5,0
Montažni nosači	C40/50	XC3/XD1/XF1	0,1	300	3,0 (VDP2)	0,50	16	M28	-	S5	B 500-B Y1860 S7	5,5 (4,5)
Poprečni nosači	C30/37	XC3/XD1/XF3	0,2	320	3,0 (VDP2)	0,50	16	M56	-	S5	B 500-B	5,0
Kolnička ploča	C30/37	XC3/XD1/XF3	0,2	320	3,0 (VDP2)	0,50	16	M56	-	S5	B 500-B	5,0
Kontinuitetna ploča	C35/45	XC3/XD1/XF3	0,2	340	3,0 (VDP2)	0,45	16	-	0,5 (MS56)	S5	B 500-B	5,0
Hodnici i vijenci	C35/45	XC4/XD3/XF4	0,2	340	3,0 (VDP2)	0,45	16	-	0,5 (MS56)	S6	B 500-B	6,0/2,5
Beton ugradnje prijelaznih naprava i rubnjaci	C40/50	XC4/XD3/XF4	0,2	340	3,0 (VDP2)	0,45	16	-	0,5 (MS56)	S5	B 500-B	6,0

Mogu se koristiti distanceri od vlaknastih betona ili običnog betona. Distanceri se mogu napraviti od vlaknastog betona ili običnog betona i ne smiju sadržavati azbest. Moraju biti otporni na starenje i moraju osigurati min. tlačna čvrstoća do 700 kPa, posebno se projektiraju za nosivi i vidljivi beton, mora zadovoljiti zahtjeve za beton i armirani beton u skladu s HRN EN 206: 2013 i protupožarnim propisima HRN EN 1991-1-2 i DIN 4201. Također moraju imati koeficijent proširenja kao i ostali beton.

ČELIK ZA PREDNAPINJANJE
SVOJSTVA U SKLADU S nkHRN EN 10138-1, nHRN EN 10138-3, HRN EN ISO 15630-3 I ETA PROIZVODIMA

KABLOVI ili UŽADI		Y 1860 S7		150 mm^2	∅ kabla, < 8,5cm ili 5,5 / 6,5cm

KONSTRUKCIJSKI ČELIK
SVOJSTVA U SKLADU S HRN EN 10025, HRN EN 10210 I HRN EN 10219, IZVOĐENJE U SKLADU S HRN EN 1090

KONSTRUKCIJSKI ELEMENT	Vrsta ČELIKA		Način zaštite protiv korozije	ostalo
ZAVARENE OGRADE ZA PJEŠAKE	S 235 JR		Vruće cinčano min 85 µm	
ZAŠTITNE OGRADE ZA VOZILA	U skladu s tehničkim dopuštenjem u HR			

Zaštita od korozije vrućim pocinčavanjem vrši se na gotovim elementima. Naknadno bušenje, rezanje, brušenje, poliranje, zavarivanje... nije dopušteno! Spajanje pojedinih elemenata samo s mehaničkim spojevima. Izrada i montaža čeličnih dijelova izvodi se u skladu s HRN EN 1090-2, proizvodnom klasom EXC2 EN 1090-2, razred izvedbe EXC2

IZMJENA BR.	OPIS	DATUM	POTPIS

INVESTITOR:
HRVATSKE VODE
Ul. Grada Vukovara 220, 10000, Zagreb

HRVATSKE VODE

INSTITUT IGH, d.d.
10 000 ZAGREB, J. RAKUŠE 1
OIB: 79766124714
ZAVOD ZA PROJEKTIRANJE

RAZINA I STRUKOVNA ODREDNICA: GLAVNI GRAĐEVINSKI PROJEKT

ZAJEDNIČKA OZNAKA PROJEKTA: GP-5986/23

GRAĐEVINA: IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA - 4. i 5. faza izgradnje: PROKOP KORANA - KUPA S PRATEĆIM OBJEKTIMA

DIO GRAĐEVINE: **CESTOVNI MOST PREKO PROKOPA - KONSTRUKCIJA**

OZNAKA MAPE I NAZIV PROJEKTIRANOG DIJELA: **72120 - GP - 285 - 2020**

SADRŽAJ: POPREČNI PRESJEK

GLAVNI PROJEKTANT: DARKO JELAŠIĆ, dipl.ing.grad.

MJERILO: 1:50

PROJEKTANT: MATE PEZER dipl.ing.grad.

DATUM: lipanj 2023.

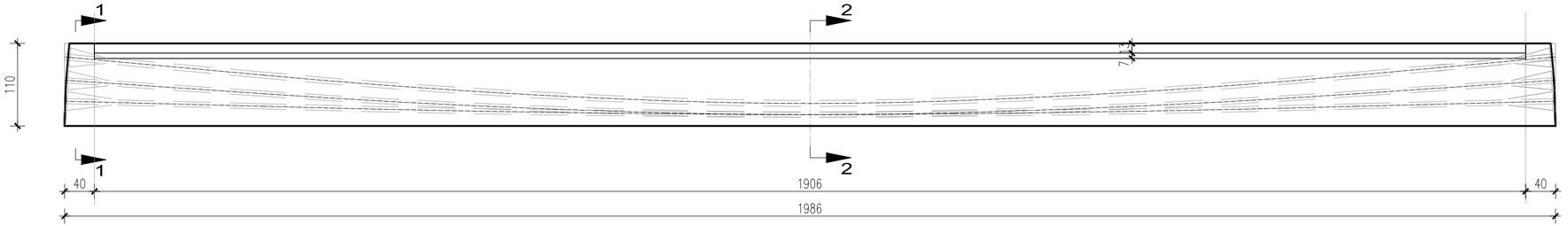
BROJ PROJEKTA: **72120 - GP - 285 - 2020**

SURADNICI: MARINA MARKOTIĆ mag.ing.aedif.

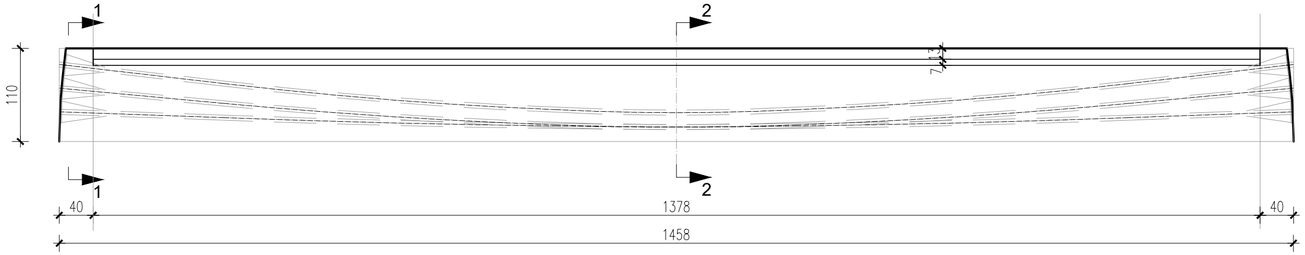
BROJ PRILOGA: 1501

OZNAKA DOKUMENTA: IGH - PKK - O 0200 - 1501

AB PREDNAPETI MONTAŽNI NOSAČ L = 19,86 m - 1-13 POLJE M 1:50

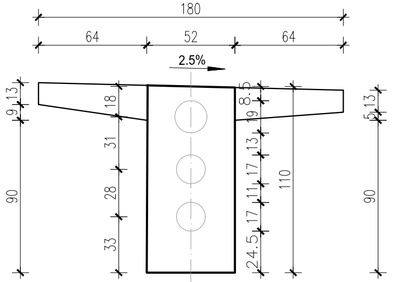


AB PREDNAPETI MONTAŽNI NOSAČ L = 14,58 m - 14. POLJE M 1:50

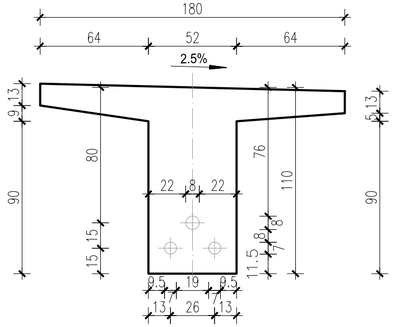


POPREČNI PRESJEK 1-1 M 1:25

L=19,86m

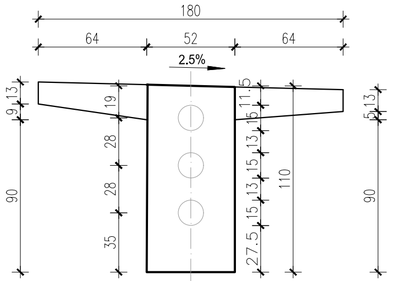


POPREČNI PRESJEK 2-2 M 1:25

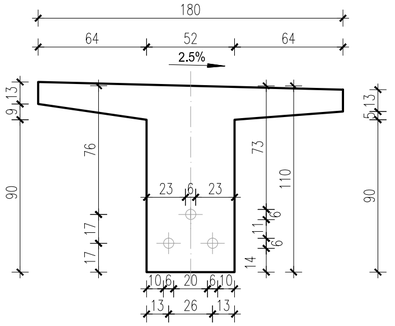


POPREČNI PRESJEK 1-1 M 1:25

L=14,58m



POPREČNI PRESJEK 2-2 M 1:25



IZMJENA BR.	OPIS	DATUM	POTPIS

INVESTITOR:
HRVATSKE VODE
Ul. Grada Vukovara 220, 10000, Zagreb

HRVATSKE VODE

INSTITUT IGH, d.d.
10 000 ZAGREB, J. RAKUŠE 1
OIB: 79766124714
ZAVOD ZA PROJEKTIRANJE

RAZINA I STRUKOVNA ODREDNICA:	ZAJEDNIČKA OZNAKA PROJEKTA:
GLAVNI GRAĐEVINSKI PROJEKT	GP-5986/23

GRAĐEVINA: IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA -4, i 5. faza izgradnje: PROKOP KORANA - KUPA S PRATEĆIM OBJEKTIMA

DIO GRAĐEVINE: **CESTOVNI MOST PREKO PROKOPA - KONSTRUKCIJA**

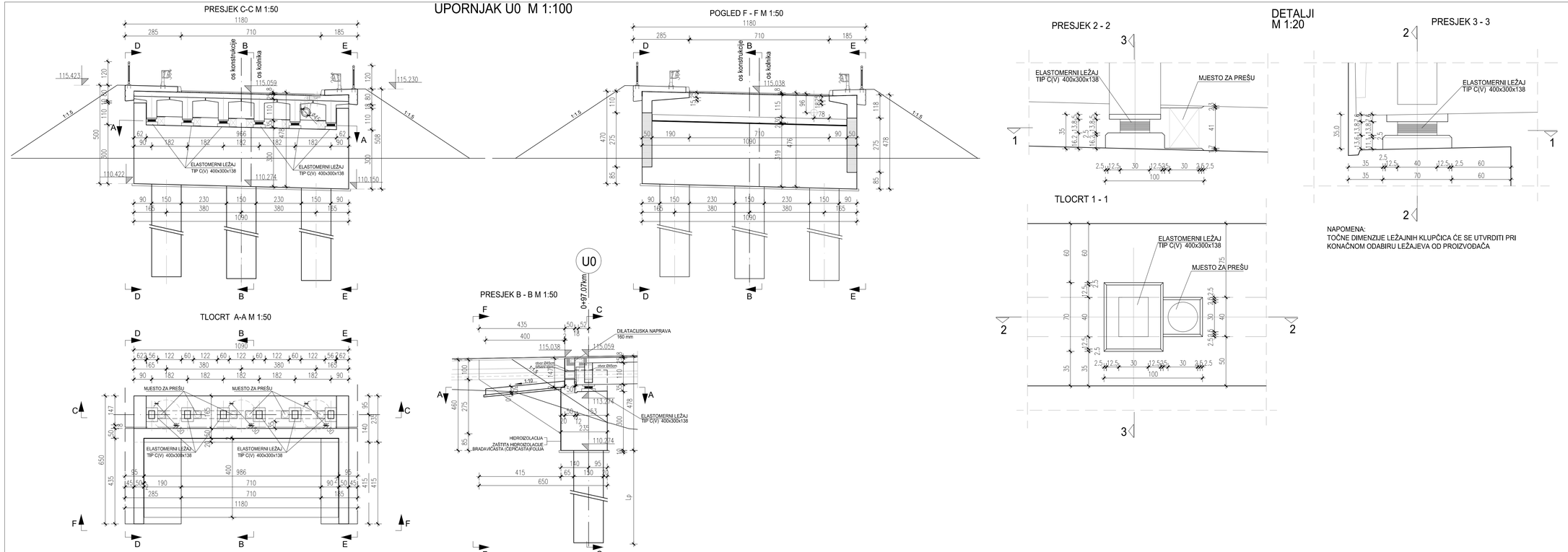
OZNAKA MAPE I NAZIV PROJEKTIRANOG DIJELA: **72120 - GP - 285 - 2020**

SADRŽAJ: MONTAŽNI NOSAČI

GLAVNI PROJEKTANT: DARKO JELAŠIĆ, dipl.ing.grad.	MJERILO: 1:100, 1:25
PROJEKTANT: MATE PEZER dipl.ing.grad.	DATUM: lipanj 2023.
	BROJ PROJEKTA: **72120 - GP - 285 - 2020**
SURADNICI: MARINA MARKOTIĆ mag.ing.aedif.	BROJ PRILOGA: 2301

OZNAKA DOKUMENTA: IGH - PKK - O 0200 - 2301

UPORNJAK U0 M 1:100



NAPOMENA:
TOČNE DIMENZIJE LEŽAJNIH KLUPČICA ĆE SE UTVRDITI PRI KONAČNOM ODABIRU LEŽAJEVA OD PROIZVOĐAČA

IZMJENA BR.	OPIS	DATUM	POTPIS

INVESTITOR:
HRVATSKE VODE
Ul. Grada Vukovara 220, 10000, Zagreb

HRVATSKE VODE

INSTITUT IGH, d.d.
10 000 ZAGREB, J. MARIŠIĆ 1
OIB: 29784124714
ZAVOD ZA PROJEKTIRANJE

RAZINA I STRUKOVNA ODREDNICA: GLAVNI GRAĐEVINSKI PROJEKT

ZAJEDNIČKA OZNAKA PROJEKTA: GP-5986/23

GRAĐEVINA: IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RUŠENJEM DOVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA
- 4. i 5. faza izgradnje: PROKOP KORANA - KUPA S PRATEĆIM OBJEKTIMA

DIO GRAĐEVINE: CESTOVNI MOST PREKO PROKOPA - KONSTRUKCIJA

OZNAKA MAPE I NAZIV PROJEKTIRANOG DIJELA: 72120 - GP - 285 - 2020

SADRŽAJ: UPORNJAK U0

GLAVNI PROJEKTANT: DARKO JELAŠIĆ, dipl.ing.građ.

MJERILO: 1:100, 1:20

PROJEKTANT: MATE PEZER dipl.ing.građ.

DATUM: lipanj 2023.

BROJ PROJEKTA: 72120 - GP - 285 - 2020

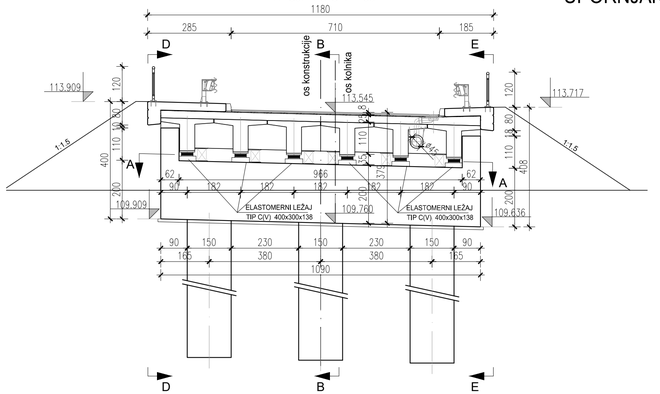
SURADNICI: MARINA MARKOTIĆ mag.ing.aedif.

BROJ PRILOGA: 2401

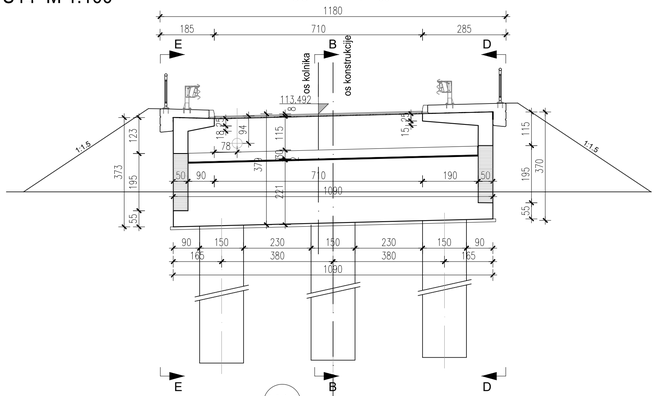
OZNAKA DOKUMENTA: IGH - PKK - O 0200 - 2401

UPORNJAK U14 M 1:100

PRESJEK C-C M 1:50

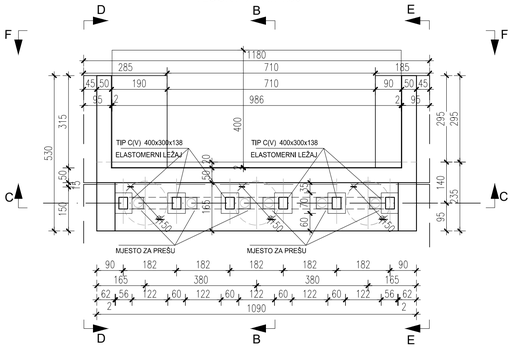


POGLED F-F M 1:50



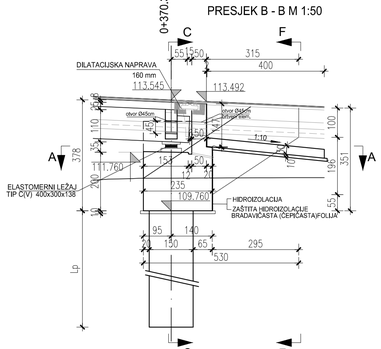
U14

TLOCRT A-A M 1:50



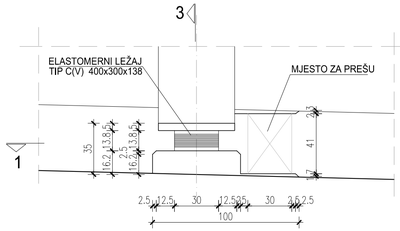
0+370.37km

PRESJEK B - B M 1:50

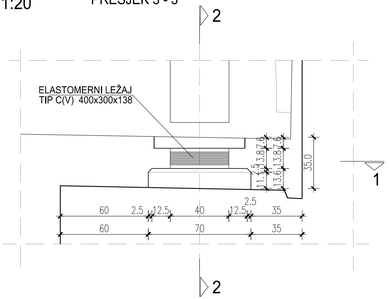


DETALJI
M 1:20

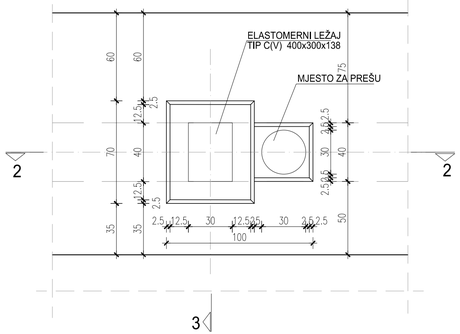
PRESJEK 2 - 2



PRESJEK 3 - 3



TLOCRT 1 - 1



NAPOMENA:
TOČNE DIMENZIJE LEŽAJNIH KLUPČICA ĆE SE UTVRDITI PRI KONAČNOM ODABIRU LEŽAJEVA OD PROIZVOĐAČA

IZMJENA BR.	OPIS	DATUM	POTPIS

INVESTITOR:
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Ul. Grada Vukovara 220, 10000, Zagreb

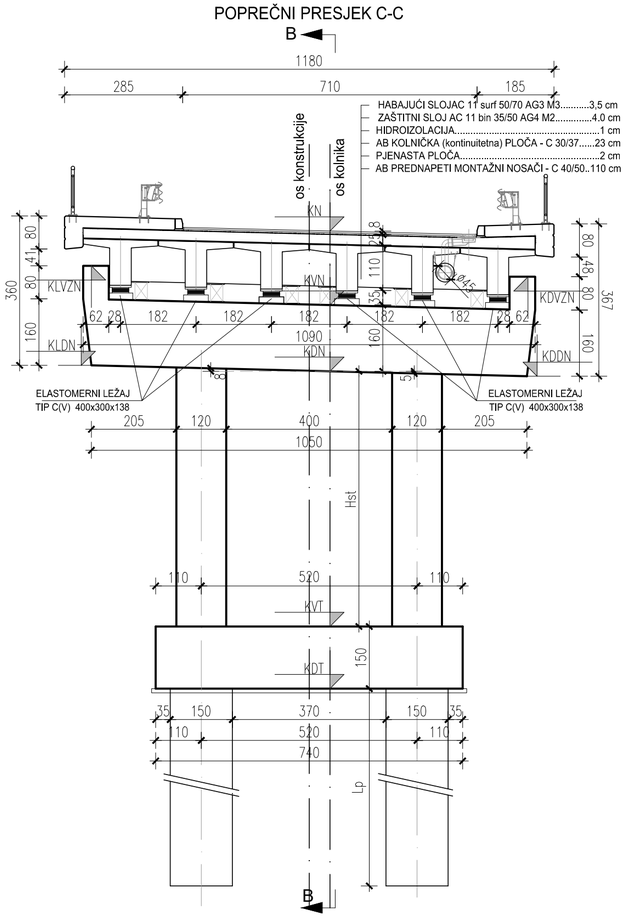
HRVATSKE VODE

INSTITUT IGH, d.d.
10 000 ZAGREB, J. Kavčića 1
OIB: 79746124714
ZAVOD ZA PROJEKTIRANJE

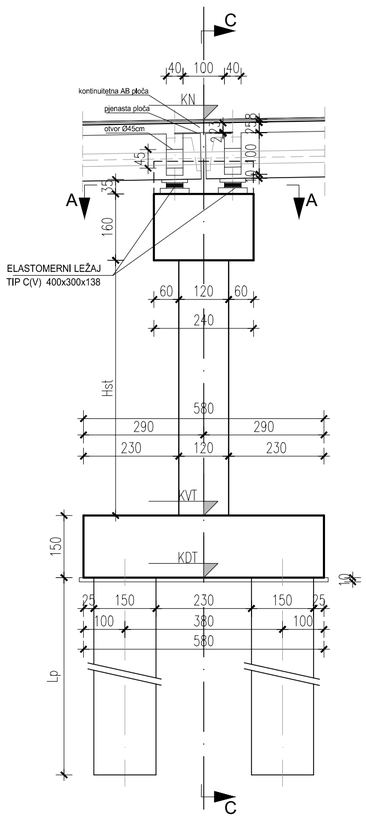
RAZINA I STRUKOVNA ODREDNICA: GLAVNI GRAĐEVINSKI PROJEKT	ZAJEDNIČKA OZNAKA PROJEKTA: GP-5986/23
GRAĐEVINA: IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA • 4. i 5. faza izgradnje: PROKOP KORANA - KUPA S PRATEĆIM OBJEKTIMA	
DIO GRAĐEVINE: CESTOVNI MOST PREKO PROKOPA - KONSTRUKCIJA	
OZNAKA MAPE I NAZIV PROJEKTIRANOG DIJELA: 72120 - GP - 285 - 2020	
SADRŽAJ: UPORNJAK U14	
GLAVNI PROJEKTANT: DARKO JELAŠIĆ, dipl.ing.grad.	MJERILO: 1:100, 1:20
PROJEKTANT: MATE PEZER dipl.ing.grad.	DATUM: lipanj 2023.
	BROJ PROJEKTA: 72120 - GP - 285 - 2020
SURADNICI: MARINA MARKOTIĆ mag.ing.aedif.	BROJ PRILOGA: 2402
OZNAKA DOKUMENTA: IGH - PKK - O 0200 - 2402	

STUPIŠTA S1 - S13 M 1:100

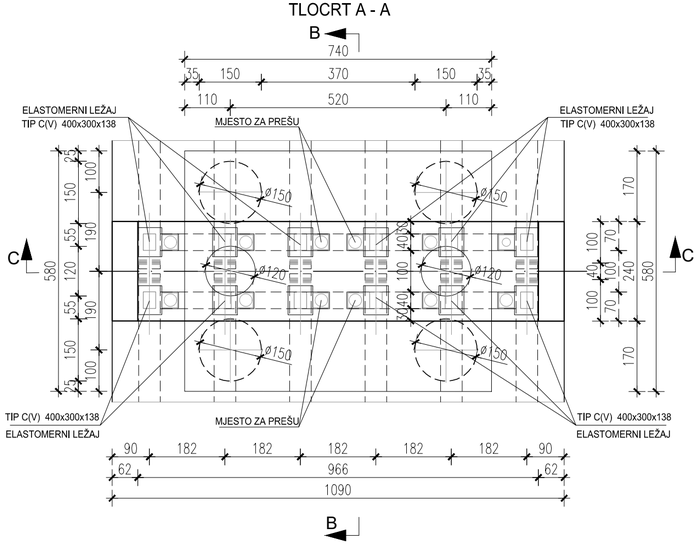
POPREČNI PRESJEK C-C



UZDUŽNI PRESJEK B - B 1:50

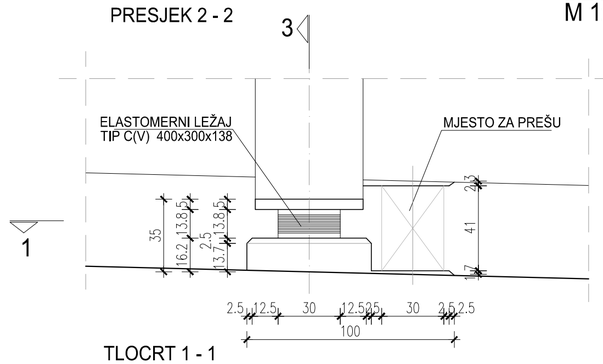


TLOCRT A - A

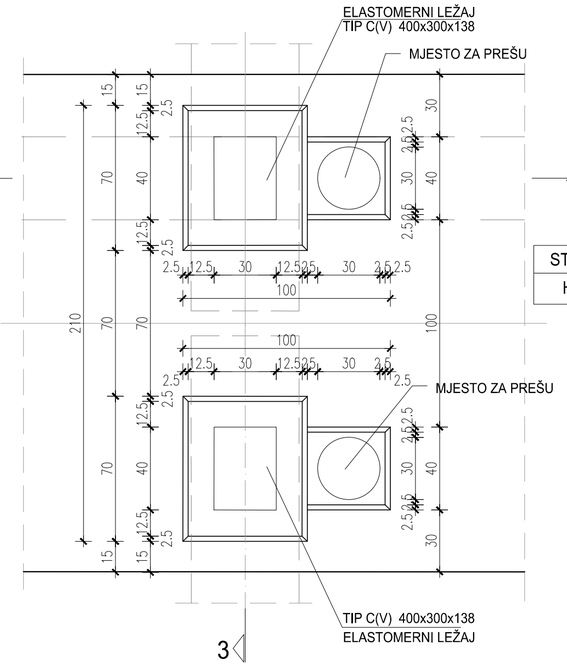


DETALJI
M 1:20

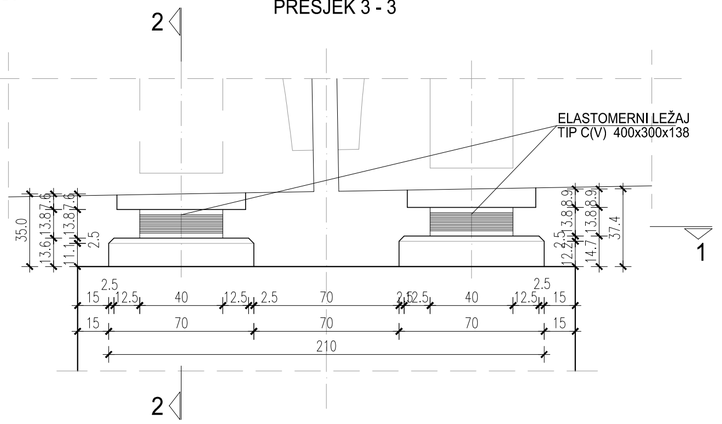
PRESJEK 2 - 2



TLOCRT 1 - 1



PRESJEK 3 - 3



NAPOMENA:
TOČNE DIMENZIJE LEŽAJNIH KLUPČICA ĆE SE UTVRDITI PRI KONAČNOM ODABIRU LEŽAJEVA OD PROIZVOĐAČA

SVA STUPIŠTA SU PO OBLIKU JEDNAKA,

RAZLIKUJU SE PO VISINI STUPA I DULJINI PILOTA.

DOTIČNE DIMENZIJE SE VIDE U UZDUŽMOM PRESJEKU MOSTA

STUPIŠTE	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13
Hst (m)	3,55	5,45	5,85	6,70	6,70	7,25	7,55	7,55	7,25	6,70	5,85	4,85	2,50

IZMJENA BR.	OPIS	DATUM	POTPIS

INVESTITOR:
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Ul. Grada Vukovara 220, 10000, Zagreb

HRVATSKE VODE

INSTITUT IGH, d.d.
10 000 ZAGREB, J. RAKUŠE 1
OIB: 79766124714
ZAVOD ZA PROJEKTIRANJE

RAZINA I STRUKOVNA ODREDNICA:
GLAVNI GRAĐEVINSKI PROJEKT

ZAJEDNIČKA OZNAKA PROJEKTA:
GP-5986/23

GRAĐEVINA: IZGRADNJA DESNOG NASIPA KORANE, DESNOG NASIPA KUPE I PROKOPA KORANA-KUPA S NASIPIMA I RJEŠENJEM ODVODNJE NA PODRUČJU GORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA
- 4. i 5. faza izgradnje: PROKOP KORANA - KUPA S PRATEĆIM OBJEKTIMA

DIO GRAĐEVINE: **CESTOVNI MOST PREKO PROKOPA - KONSTRUKCIJA**

OZNAKA MAPE I NAZIV PROJEKTIRANOG DIJELA: **72120 - GP - 285 - 2020**

SADRŽAJ:
STUPIŠA S1 - S13

GLAVNI PROJEKTANT: DARKO JELAŠIĆ, dipl.ing.grad.

MJERILO: 1:100, 1:20

PROJEKTANT: MATE PEZER dipl.ing.grad.

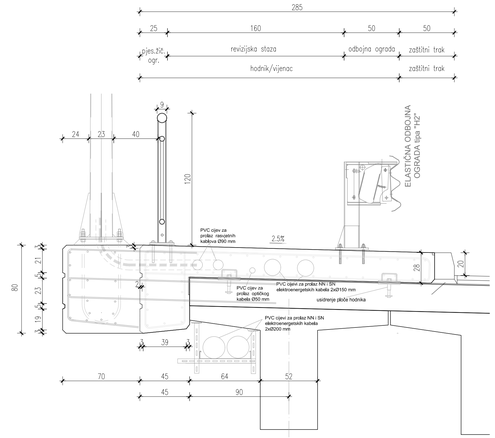
DATUM: lipanj 2023.

BROJ PROJEKTA: **72120 - GP - 285 - 2020**

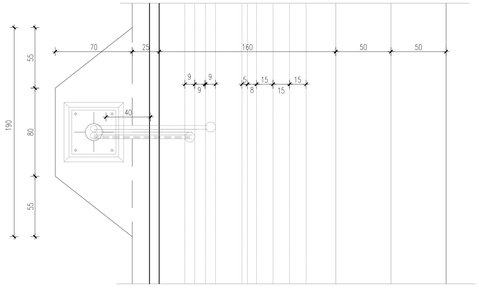
SURADNICI: MARINA MARKOTIĆ mag.ing.aedif.

BROJ PRILOGA: 2501

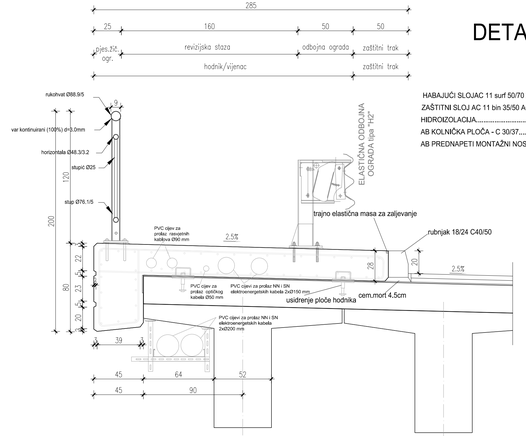
OZNAKA DOKUMENTA:
IGH - PKK - O 0200 - 2501



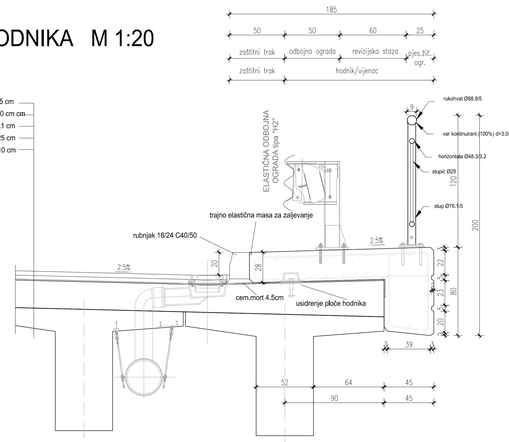
TLOCRT



DETALJ HODNIKA M 1:20



HABAJUĆI SLOJAC 11 surf 50/70 AG3 M3.....3.5 cm
ZAŠTITNI SLOJ AC 11 bin 35/50 AG4 M2.....4.0 cm cm
HIDROIZOLACIJA.....1 cm
AB KOLNIČKA PLOČA - C 30/37.....25 cm
AB PREDNAPETI MONTAŽNI NOSAČI - C 40/50..110 cm



IZMJENA BR.	OPIS	DATUM	POTPIS

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ZAVOD ZA PROJEKTIRANJE

RAZINA I STRUKOVNA ODREDNICA: GLAVNI GRAĐEVINSKI PROJEKT	ZAJEDNIČKA OZNAKA PROJEKTA: GP-5986/23
GRAĐEVINA: IZGRADNJA DESNOG MOSNOG KORIJENA DESNOG MOSNOG KRAKA KUPE I PROKOPA KORIJENA KUPE S RASPRAVOM I KUĆIŠNJIM DOVODNJE NA PODRUČJU DORNJEG MEKUŠJA TE IZGRADNJA CESTOVNOG MOSTA PREKO PROKOPA – K 1.5, faza ispraćaja PROKOP KORIJENA »KUPA 5 PRATEĆIM OBJEKTIMA	
DIO GRAĐEVINE: CESTOVNI MOST PREKO PROKOPA - KONSTRUKCIJA	
OZNAKA MAPE I NAZIV PROJEKTIRANOG DIJELA: 72120 - GP - 285 - 2020	
SADRŽAJ: DETALJ HODNIKA	
GLAVNI PROJEKTANT: DARKO JELAŠIĆ, dipl. ing.grad.	MJERILO: 1:20
PROJEKTANT: MATE PEZER dipl.ing.grad.	DATUM: lipanj 2023.
	BROJ PROJEKTA: 72120 - GP - 285 - 2020
SURADNICI: MARINA MARKOTIĆ mag.ing.aedif.	BROJ PRILOGA: 2701
OZNAKA DOKUMENTA: IGH - PKK - O 0200 - 2701	