Obsah

Kapitola 1

Predpoklady statického výpočtu

Popis konštrukcie:

- Typ:Portal Frame: Opti Cadre 9.5m x 5.4m
- Svetlá výška: 5.4 m
- Svetlý rozpon: 9.5 m
- Hrúbka horného dielca: 450 mm
- Hrúbka stenového dielca: 400 mm
- Dĺžka monolitickej pätky: 650 mm

Materiály:

- Betón prefabrikát: C45/55
- Betón monolit: C16/20

Hodnota nominálneho krytia výstuže pre stupeň vplyvu prostredia XF4 je 50mm, pre stupeň vplyvu prostredia xc4 35mm.

Statická Analýza:

Konštrukcia bola analyzovaná pomocou programu ROBOT MILLENNIUM. Statický model konštrukcie zodpovedá tvaru strednicovej roviny prenesenej do rámu o šírke jeden meter. V bodoch spojov medzi horným a stenovým dielcom konštrukcie (tzv. Ball Socket Joint) sú namodelované kĺby.

Základy:

Základy sú modelované pomocou Winklerových pružin, vložených do bodov základových pätiek (dosiek). Výpočet tuhostí pružín je založený na Menardovej teórii.

Použitím tejto teórie bola stanovená hodnota súčiniteľa poddajnosti Kz =40Mpa/m.

Bočný zásyp:

Dôležitým statickým prvkom konštrukcie je priliehajúci zásyp. Pasívnu tuhosť bočného zásypu vo výpočte reprezentujú jednosmerné vodorovné Winklerové pružiny, ktoré sú aplikované do bodov stenových prvkov konštrukcie. Predpísaná hodnota Edef2 pre zásypovú zeminu po zhutnění je 70MPa. Táto hodnota musí byť kontrolovaná po dobu výstavby napríklad statickou zaťažovacou skúškou. Súčiniteľ vodorovnej poddajnosti zásypového materiálu a teda tuhosť vodorovných Winklerových pružín bola stanovená pomocou Menardovej teorie na Kx=20MPa/m.

Zásyp, jeho hutnenie a výber materiálu musí byť v súlade s technologickým predpisom zasýpania schválený statikom.

Zaťaženie:

Súčiniteľe zemného tlaku:

Vodorovné účinky zemného tlaku sú uvažované v súlade s

EN 1997-1. Hodnota uhlu vnútrného trenia zásypového materiálu nesmie klesnúť pod 30°.

- K_0 max = 0.60
- K_0 min = 0.15
- K a = 0.33

Stále a dlhodobé náhodilé zaťaženia:

- Vlastná tiaž konštrukcie
- Objemová hmotnosť betónu = 25kN/m^3
- Zvislé zaťaženie zásypovou zeminou
- Objemová hmotnosť zeminy = 20 kN/m3
- Výška nadnásypu:
  DOCmin=0.7 m, DOCmax=2 m, DOCcons=1 m
- Zaťaženie vozovkou
- Objemová hmotnosť vozovky = 20 kN/m3

Nahodilé krátkodobé zaťaženie:

Zaťaženie cestnou dopravou

Zvislé zaťaženia:

- Model zaťaženia LM1
- Model zaťaženia LM2
- Model zaťaženia LM3

Vodorovné zaťaženia:

- Rozjazdové a brzdné sily
- Zvýšenie zemného tlaku vyvolané pohyblivým zaťažením

Použité normy:

- EN 1990: Zásady navrhovania konštrukcií
- EN 1991–1: Zaťaženie konštrukcií – Všeobecné zaťaženia
- EN 1991–2: Zaťaženie konštrukcií – Zaťaženie mostov
- EN 1992–1-1: Navrhovanie betónových konštrukcií – Všeobecné pravidlá
- EN 1992–2: Navrhovanie betónových konštrukcií – Betónové mosty
- EN 1997–1: Navrhovánie geotechnických konštrukcií
- STN EN 206–1: Betón – Špecifikácia, vlastnosti, výroba a zhoda

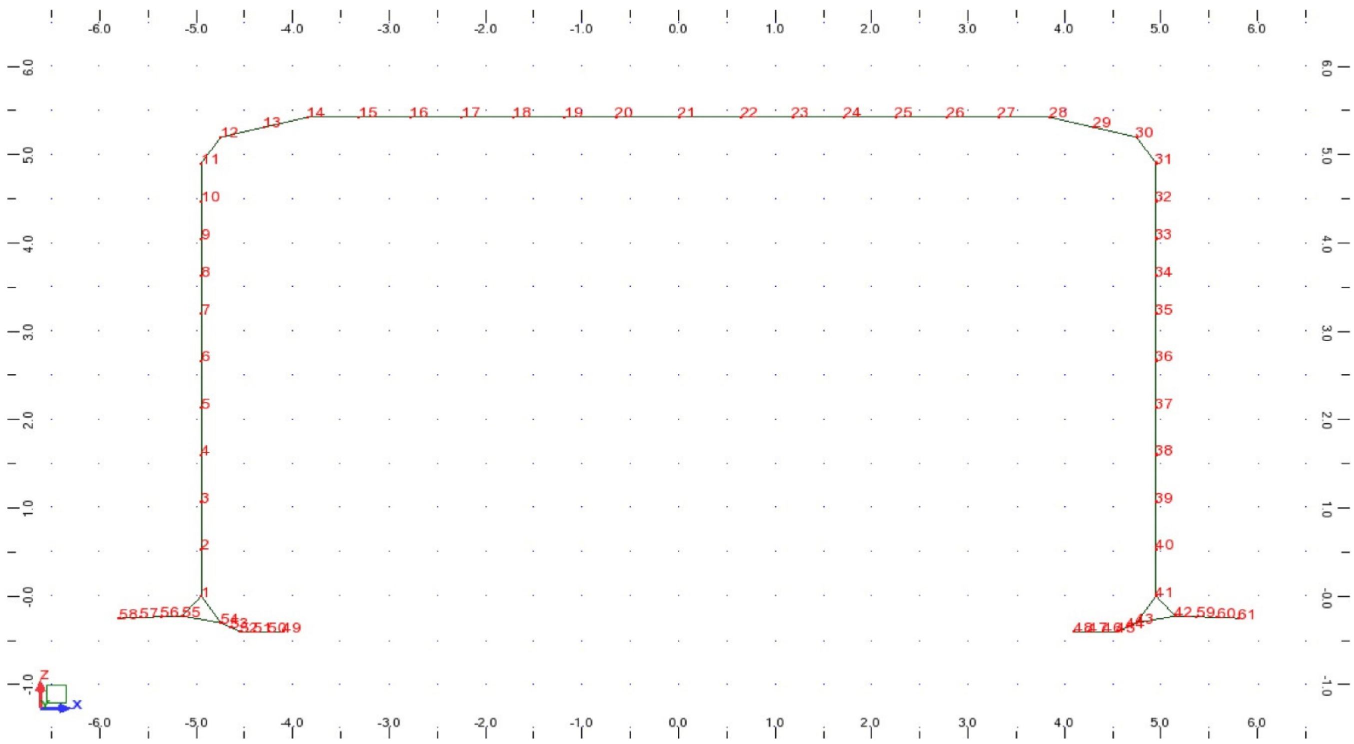
Navrhol:

- Meno: Ing. Rastislav Schreiber
- Dátum: 15/4/2015

Kapitola 2

Statický model, číslovanie prútov a bodov, podpory, vlastnosti prierezov

Diagram of nodes

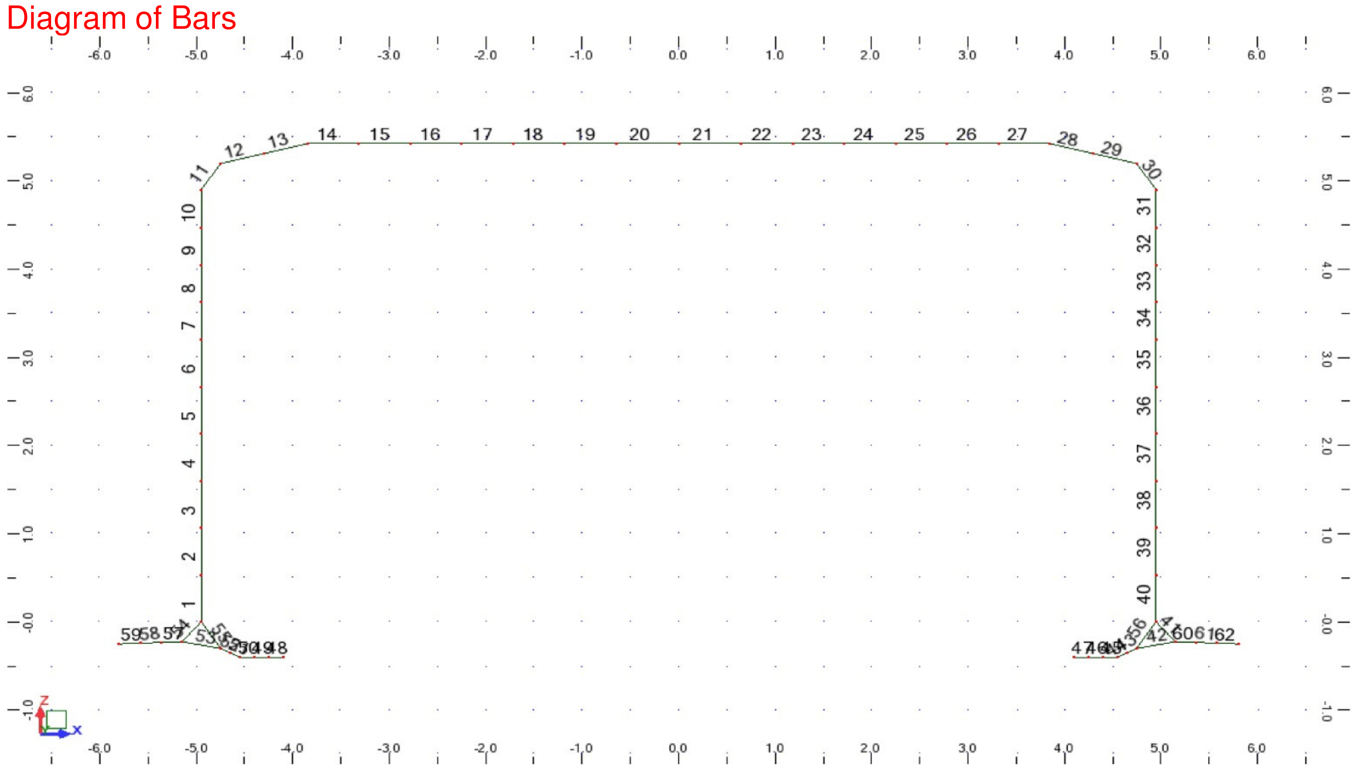


Nodes properties

Node	X (m)	Z (m)	Support
1	-4.95	0.0	ADD_Spring_1+
2	-4.95	0.53	ADD_Spring_2+
3	-4.95	1.07	ADD_Spring_3+
4	-4.95	1.60	ADD_Spring_4+
5	-4.95	2.13	ADD_Spring_5+
6	-4.95	2.67	ADD_Spring_6+
7	-4.95	3.20	ADD_Spring_7+
8	-4.95	3.63	ADD_Spring_8+
9	-4.95	4.05	ADD_Spring_9+
10	-4.95	4.48	ADD_Spring_10+
11	-4.95	4.90	ADD_Spring_11+
12	-4.75	5.20	
13	-4.30	5.31	
14	-3.85	5.43	
15	-3.32	5.43	
16	-2.78	5.43	
17	-2.25	5.43	
18	-1.72	5.43	
19	-1.19	5.43	
20	-0.65	5.43	
21	0.0	5.43	
22	0.65	5.43	
23	1.19	5.43	
24	1.72	5.43	
25	2.25	5.43	
26	2.78	5.43	
27	3.32	5.43	
28	3.85	5.43	
29	4.30	5.31	
30	4.75	5.20	
31	4.95	4.90	ADD_Spring_31-
32	4.95	4.48	ADD_Spring_32-
33	4.95	4.05	ADD_Spring_33-
34	4.95	3.63	ADD_Spring_34-

35	4.95	3.20	ADD_Spring_35-
36	4.95	2.67	ADD_Spring_36-
37	4.95	2.13	ADD_Spring_37-
38	4.95	1.60	ADD_Spring_38-
39	4.95	1.07	ADD_Spring_39-
40	4.95	0.53	ADD_Spring_40-
41	4.95	0.0	ADD_Spring_41-
42	5.15	-0.23	ADD_Spring_55
43	4.75	-0.30	ADD_Spring_43
44	4.65	-0.35	ADD_Spring_44
45	4.55	-0.40	ADD_Spring_45
46	4.40	-0.40	ADD_Spring_46
47	4.25	-0.40	ADD_Spring_47
48	4.10	-0.40	ADD_Spring_48
49	-4.10	-0.40	ADD_Spring_48
50	-4.25	-0.40	ADD_Spring_47
51	-4.40	-0.40	ADD_Spring_46
52	-4.55	-0.40	ADD_Spring_45
53	-4.65	-0.35	ADD_Spring_44
54	-4.75	-0.30	ADD_Spring_43
55	-5.15	-0.23	ADD_Spring_55
56	-5.37	-0.23	ADD_Spring_56
57	-5.58	-0.24	ADD_Spring_57
58	-5.80	-0.25	ADD_Spring_58
59	5.37	-0.23	ADD_Spring_56
60	5.58	-0.24	ADD_Spring_57
61	5.80	-0.25	ADD_Spring_58

Diagram of Bars



Bars properties

Bar/Node	Node 1	Node 2	Section	Material	Length (m)	RECT_BF (mm)	RECT_HT (mm)	RECT_TH (mm)
1/ 1	1	2	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
1/ 2	1	2	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
2/ 2	2	3	ADD	*C45/55*	0.53	1000	400	0.0

			0.4x0.4					
2/ 3	2	3	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
3/ 3	3	4	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
3/ 4	3	4	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
4/ 4	4	5	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
4/ 5	4	5	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
5/ 5	5	6	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
5/ 6	5	6	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
6/ 6	6	7	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
6/ 7	6	7	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
7/ 7	7	8	ADD 0.4x0.4	*C45/55*	0.43	1000	400	0.0
7/ 8	7	8	ADD 0.4x0.4	*C45/55*	0.43	1000	400	0.0
8/ 8	8	9	ADD 0.4x0.4	*C45/55*	0.42	1000	400	0.0
8/ 9	8	9	ADD 0.4x0.4	*C45/55*	0.42	1000	400	0.0
9/ 9	9	10	ADD 0.4x0.4	*C45/55*	0.43	1000	400	0.0
9/ 10	9	10	ADD 0.4x0.4	*C45/55*	0.43	1000	400	0.0
10/ 10	10	11	ADD 0.4x0.4	*C45/55*	0.42	1000	400	0.0
10/ 11	10	11	ADD 0.4x0.4	*C45/55*	0.42	1000	400	0.0
11/ 11	11	12	ADD 0.4x0.525	*C45/55*	0.36	1000	400	0.0
11/ 12	11	12	ADD 0.4x0.525	*C45/55*	0.36	1000	525	0.0
12/ 12	12	13	ADD 0.525x0.488	*C45/55*	0.46	1000	525	0.0
12/ 13	12	13	ADD 0.525x0.488	*C45/55*	0.46	1000	488	0.0
13/ 13	13	14	ADD 0.488x0.45	*C45/55*	0.46	1000	488	0.0
13/ 14	13	14	ADD 0.488x0.45	*C45/55*	0.46	1000	450	0.0
14/ 14	14	15	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
14/ 15	14	15	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
15/ 15	15	16	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
15/ 16	15	16	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
16/ 16	16	17	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
16/ 17	16	17	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
17/ 17	17	18	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
17/ 18	17	18	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
18/ 18	18	19	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
18/ 19	18	19	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
19/ 19	19	20	ADD	*C45/55*	0.53	1000	450	0.0

				0.45x0.45					
19/	**20**	19	20	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
20/	**20**	20	21	ADD 0.45x0.45	*C45/55*	0.65	1000	450	0.0
20/	**21**	20	21	ADD 0.45x0.45	*C45/55*	0.65	1000	450	0.0
21/	**21**	21	22	ADD 0.45x0.45	*C45/55*	0.65	1000	450	0.0
21/	**22**	21	22	ADD 0.45x0.45	*C45/55*	0.65	1000	450	0.0
22/	**22**	22	23	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
22/	**23**	22	23	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
23/	**23**	23	24	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
23/	**24**	23	24	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
24/	**24**	24	25	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
24/	**25**	24	25	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
25/	**25**	25	26	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
25/	**26**	25	26	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
26/	**26**	26	27	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
26/	**27**	26	27	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
27/	**27**	27	28	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
27/	**28**	27	28	ADD 0.45x0.45	*C45/55*	0.53	1000	450	0.0
28/	**28**	28	29	ADD 0.45x0.488	*C45/55*	0.46	1000	450	0.0
28/	**29**	28	29	ADD 0.45x0.488	*C45/55*	0.46	1000	488	0.0
29/	**29**	29	30	ADD 0.488x0.525	*C45/55*	0.46	1000	488	0.0
29/	**30**	29	30	ADD 0.488x0.525	*C45/55*	0.46	1000	525	0.0
30/	**30**	30	31	ADD 0.525x0.4	*C45/55*	0.36	1000	525	0.0
30/	**31**	30	31	ADD 0.525x0.4	*C45/55*	0.36	1000	400	0.0
31/	**31**	31	32	ADD 0.4x0.4	*C45/55*	0.42	1000	400	0.0
31/	**32**	31	32	ADD 0.4x0.4	*C45/55*	0.42	1000	400	0.0
32/	**32**	32	33	ADD 0.4x0.4	*C45/55*	0.43	1000	400	0.0
32/	**33**	32	33	ADD 0.4x0.4	*C45/55*	0.43	1000	400	0.0
33/	**33**	33	34	ADD 0.4x0.4	*C45/55*	0.42	1000	400	0.0
33/	**34**	33	34	ADD 0.4x0.4	*C45/55*	0.42	1000	400	0.0
34/	**34**	34	35	ADD 0.4x0.4	*C45/55*	0.43	1000	400	0.0
34/	**35**	34	35	ADD 0.4x0.4	*C45/55*	0.43	1000	400	0.0
35/	**35**	35	36	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
35/	**36**	35	36	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
36/	**36**	36	37	ADD	*C45/55*	0.53	1000	400	0.0

				0.4x0.4					
36/	**37**	36	37	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
37/	**37**	37	38	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
37/	**38**	37	38	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
38/	**38**	38	39	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
38/	**39**	38	39	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
39/	**39**	39	40	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
39/	**40**	39	40	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
40/	**40**	40	41	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
40/	**41**	40	41	ADD 0.4x0.4	*C45/55*	0.53	1000	400	0.0
41/	**41**	41	42	ADD 0.4x0.6	*C45/55*	0.30	1000	400	0.0
41/	**42**	41	42	ADD 0.4x0.6	*C45/55*	0.30	1000	600	0.0
42/	**42**	42	43	ADD 0.6x0.6	*C45/55*	0.41	1000	600	0.0
42/	**43**	42	43	ADD 0.6x0.6	*C45/55*	0.41	1000	600	0.0
43/	**43**	43	44	ADD 0.6x0.521	*C45/55*	0.11	1000	600	0.0
43/	**44**	43	44	ADD 0.6x0.521	*C45/55*	0.11	1000	521	0.0
44/	**44**	44	45	ADD 0.521x0.4	*C45/55*	0.11	1000	521	0.0
44/	**45**	44	45	ADD 0.521x0.4	*C45/55*	0.11	1000	400	0.0
45/	**45**	45	46	ADD 0.4x0.4	*C45/55*	0.15	1000	400	0.0
45/	**46**	45	46	ADD 0.4x0.4	*C45/55*	0.15	1000	400	0.0
46/	**46**	46	47	ADD 0.4x0.4	*C45/55*	0.15	1000	400	0.0
46/	**47**	46	47	ADD 0.4x0.4	*C45/55*	0.15	1000	400	0.0
47/	**47**	47	48	ADD 0.4x0.4	*C45/55*	0.15	1000	400	0.0
47/	**48**	47	48	ADD 0.4x0.4	*C45/55*	0.15	1000	400	0.0
48/	**49**	49	50	ADD 0.4x0.4	*C45/55*	0.15	1000	400	0.0
48/	**50**	49	50	ADD 0.4x0.4	*C45/55*	0.15	1000	400	0.0
49/	**50**	50	51	ADD 0.4x0.4	*C45/55*	0.15	1000	400	0.0
49/	**51**	50	51	ADD 0.4x0.4	*C45/55*	0.15	1000	400	0.0
50/	**51**	51	52	ADD 0.4x0.4	*C45/55*	0.15	1000	400	0.0
50/	**52**	51	52	ADD 0.4x0.4	*C45/55*	0.15	1000	400	0.0
51/	**52**	52	53	ADD 0.4x0.521	*C45/55*	0.11	1000	400	0.0
51/	**53**	52	53	ADD 0.4x0.521	*C45/55*	0.11	1000	521	0.0
52/	**53**	53	54	ADD 0.521x0.6	*C45/55*	0.11	1000	521	0.0
52/	**54**	53	54	ADD 0.521x0.6	*C45/55*	0.11	1000	600	0.0
53/	**54**	54	55	ADD	*C45/55*	0.41	1000	600	0.0

				0.6x0.6					
53/	**55**	54	55	ADD 0.6x0.6	*C45/55*	0.41	1000	600	0.0
54/	**55**	55	1	ADD 0.6x0.4	*C45/55*	0.30	1000	600	0.0
54/	**1**	55	1	ADD 0.6x0.4	*C45/55*	0.30	1000	400	0.0
55/	**54**	54	1	ADD 0.6x0.4	*C45/55*	0.36	1000	600	0.0
55/	**1**	54	1	ADD 0.6x0.4	*C45/55*	0.36	1000	400	0.0
56/	**41**	41	43	ADD 0.4x0.6	*C45/55*	0.36	1000	400	0.0
56/	**43**	41	43	ADD 0.4x0.6	*C45/55*	0.36	1000	600	0.0
57/	**55**	55	56	ADD 0.45x0.433	*C16/20*	0.22	1000	450	0.0
57/	**56**	55	56	ADD 0.45x0.433	*C16/20*	0.22	1000	433	0.0
58/	**56**	56	57	ADD 0.433x0.417	*C16/20*	0.22	1000	433	0.0
58/	**57**	56	57	ADD 0.433x0.417	*C16/20*	0.22	1000	417	0.0
59/	**57**	57	58	ADD 0.417x0.4	*C16/20*	0.22	1000	417	0.0
59/	**58**	57	58	ADD 0.417x0.4	*C16/20*	0.22	1000	400	0.0
60/	**42**	42	59	ADD 0.45x0.433	*C16/20*	0.22	1000	450	0.0
60/	**59**	42	59	ADD 0.45x0.433	*C16/20*	0.22	1000	433	0.0
61/	**59**	59	60	ADD 0.433x0.417	*C16/20*	0.22	1000	433	0.0
61/	**60**	59	60	ADD 0.433x0.417	*C16/20*	0.22	1000	417	0.0
62/	**60**	60	61	ADD 0.417x0.4	*C16/20*	0.22	1000	417	0.0
62/	**61**	60	61	ADD 0.417x0.4	*C16/20*	0.22	1000	400	0.0

Diagram of Sections

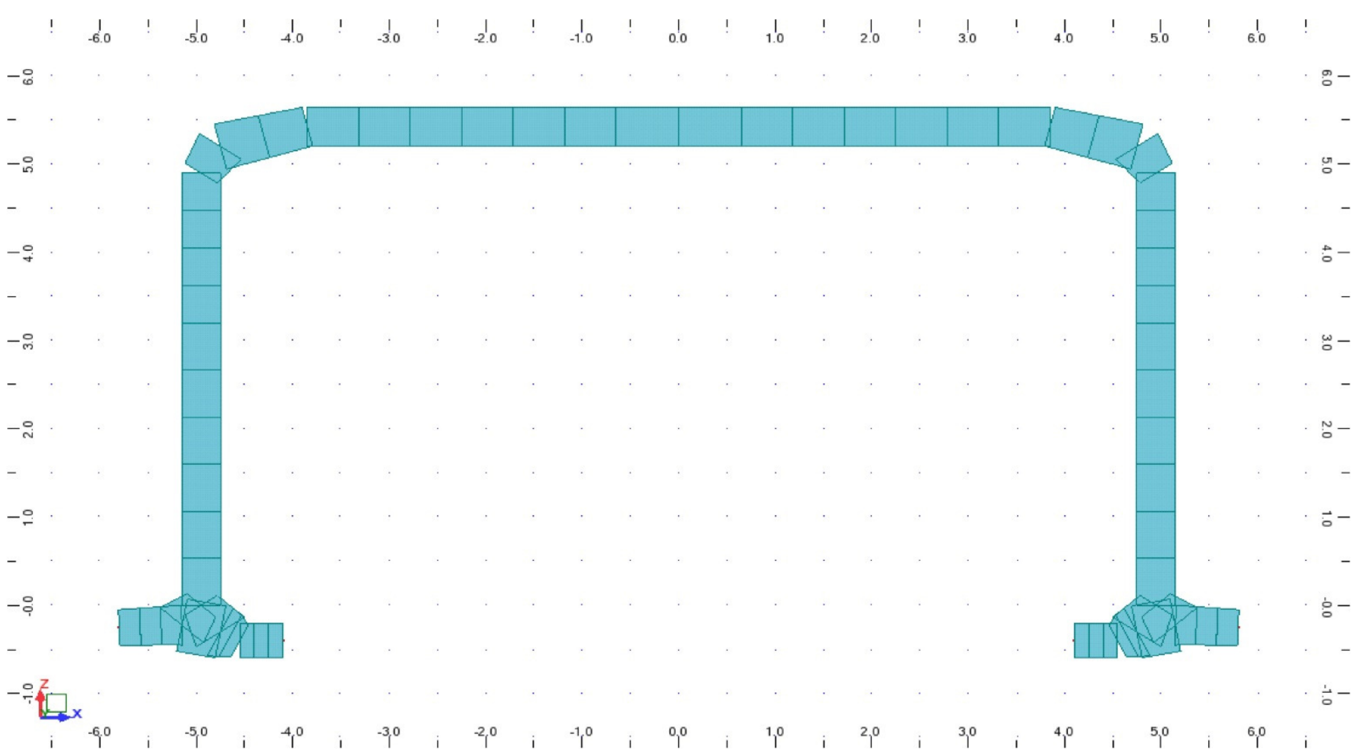
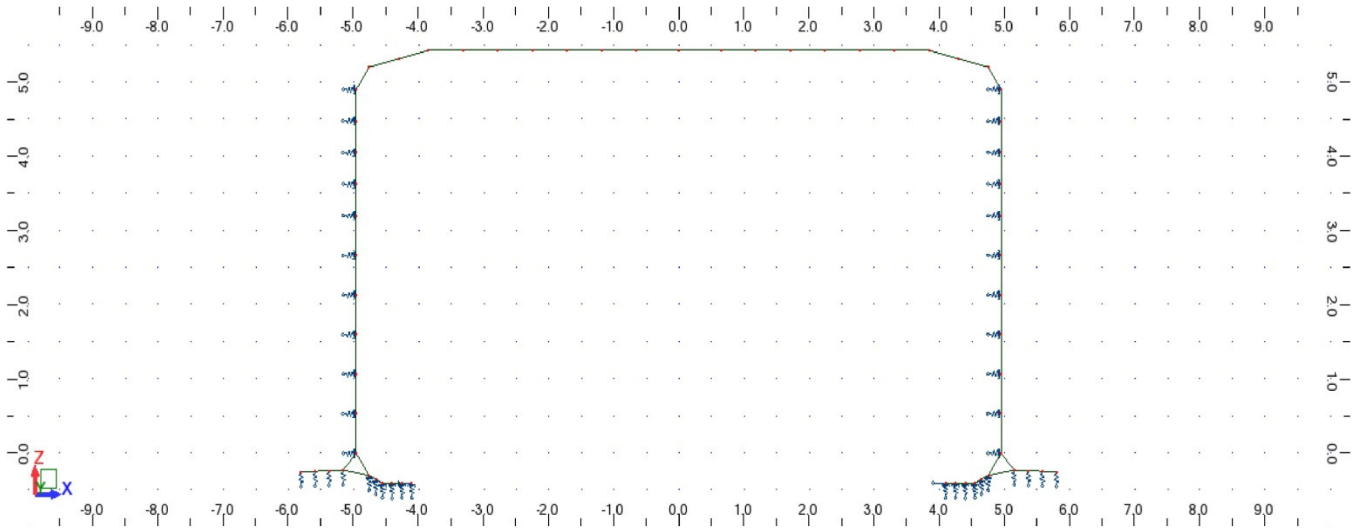


Diagram of Supports



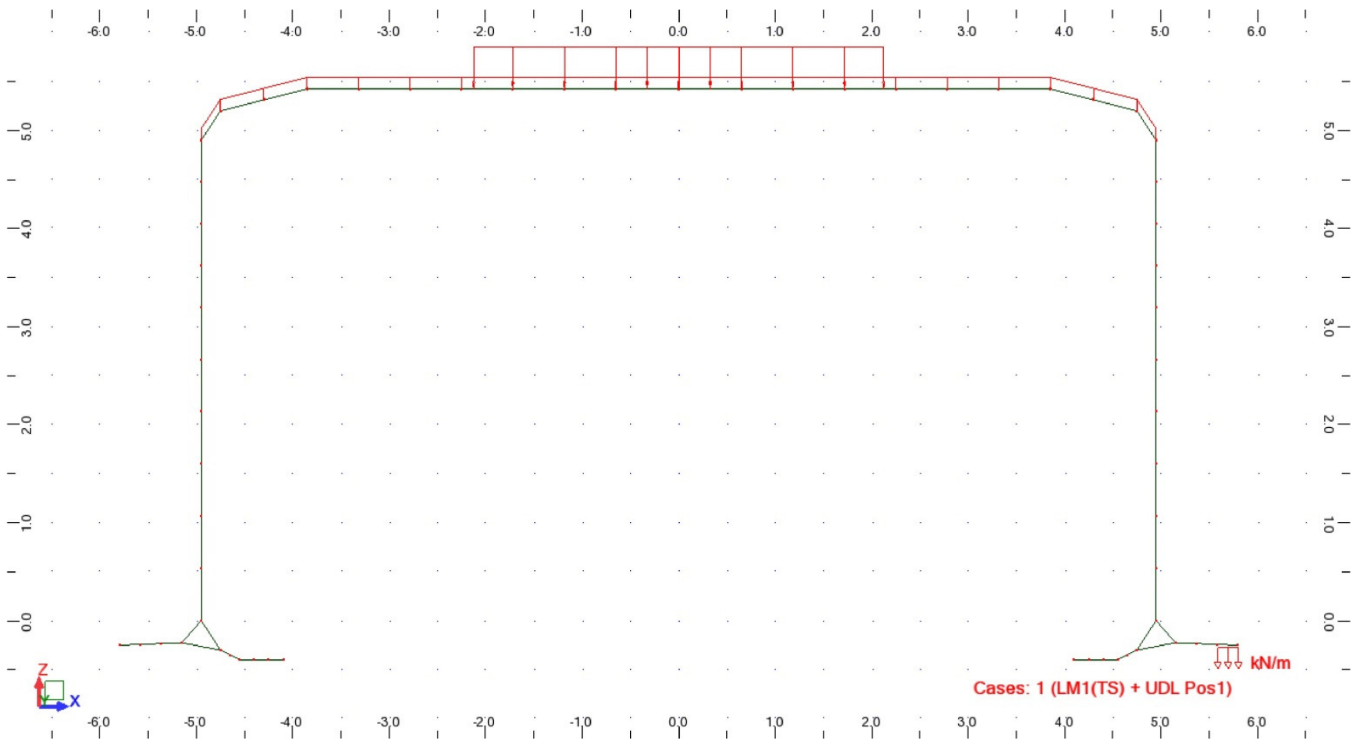
Supports properties

Support name	List of nodes	Support conditions
ADD_Spring_55	42 55	KZ=18723.54 (kN/m)
ADD_Spring_56	56 59	KZ=13000.05 (kN/m)
ADD_Spring_57	57 60	KZ=13000.05 (kN/m)
ADD_Spring_58	58 61	KZ=6514.42 (kN/m)
ADD_Spring_43	43 54	KZ=15563.22 (kN/m) +
ADD_Spring_44	44 53	KZ=6708.20 (kN/m) +
ADD_Spring_45	45 52	KZ=9000.00 (kN/m) +
ADD_Spring_46	46 51	KZ=9000.00 (kN/m) +
ADD_Spring_47	47 50	KZ=9000.00 (kN/m) +
ADD_Spring_48	48 49	UX KZ=4500.00 (kN/m) +
ADD_Spring_1+	1	KX=8340.40 (kN/m) +
ADD_Spring_41-	41	KX=8340.40 (kN/m) -
ADD_Spring_2+	2	KX=10670.00 (kN/m) +
ADD_Spring_40-	40	KX=10670.00 (kN/m) -
ADD_Spring_3+	3	KX=10670.00 (kN/m) +
ADD_Spring_39-	39	KX=10670.00 (kN/m) -
ADD_Spring_4+	4	KX=10660.00 (kN/m) +
ADD_Spring_38-	38	KX=10660.00 (kN/m) -
ADD_Spring_5+	5	KX=10670.00 (kN/m) +
ADD_Spring_37-	37	KX=10670.00 (kN/m) -
ADD_Spring_6+	6	KX=10670.00 (kN/m) +
ADD_Spring_36-	36	KX=10670.00 (kN/m) -
ADD_Spring_7+	7	KX=9580.00 (kN/m) +
ADD_Spring_35-	35	KX=9580.00 (kN/m) -
ADD_Spring_8+	8	KX=8500.00 (kN/m) +
ADD_Spring_34-	34	KX=8500.00 (kN/m) -
ADD_Spring_9+	9	KX=8500.00 (kN/m) +
ADD_Spring_33-	33	KX=8500.00 (kN/m) -
ADD_Spring_10+	10	KX=8500.00 (kN/m) +
ADD_Spring_32-	32	KX=8500.00 (kN/m) -
ADD_Spring_11+	11	KX=7855.55 (kN/m) +
ADD_Spring_31-	31	KX=7855.55 (kN/m) -

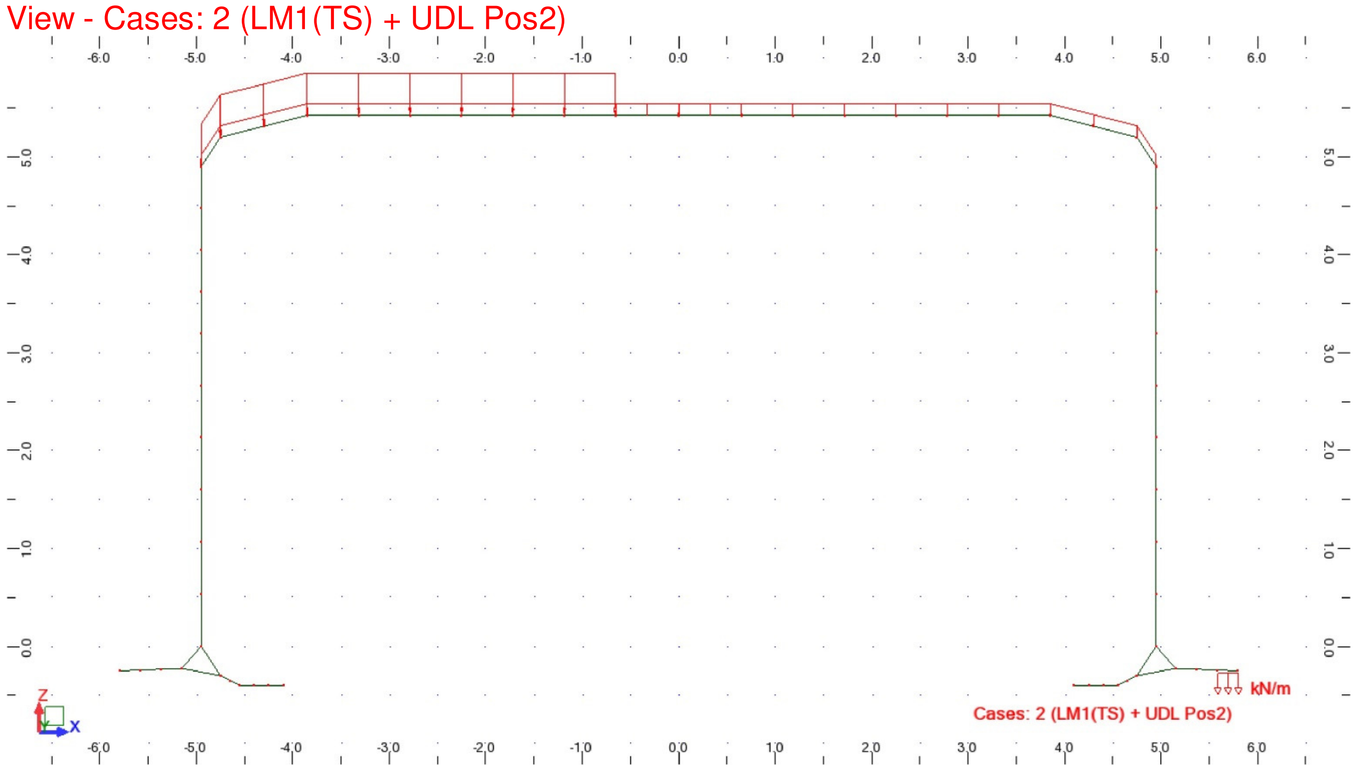
Kapitola 3

Zaťažovacie stavy - Schémy

View - Cases: 1 (LM1(TS) + UDL Pos1)



View - Cases: 2 (LM1(TS) + UDL Pos2)



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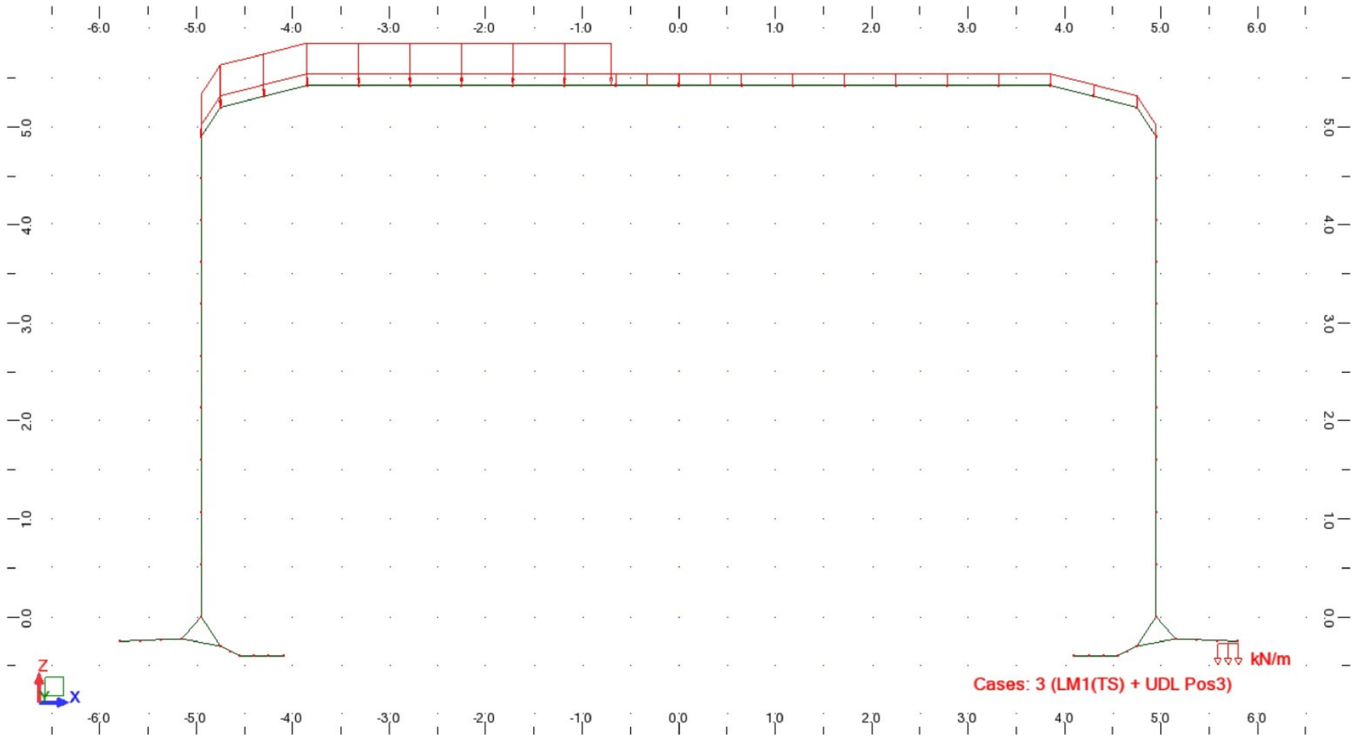
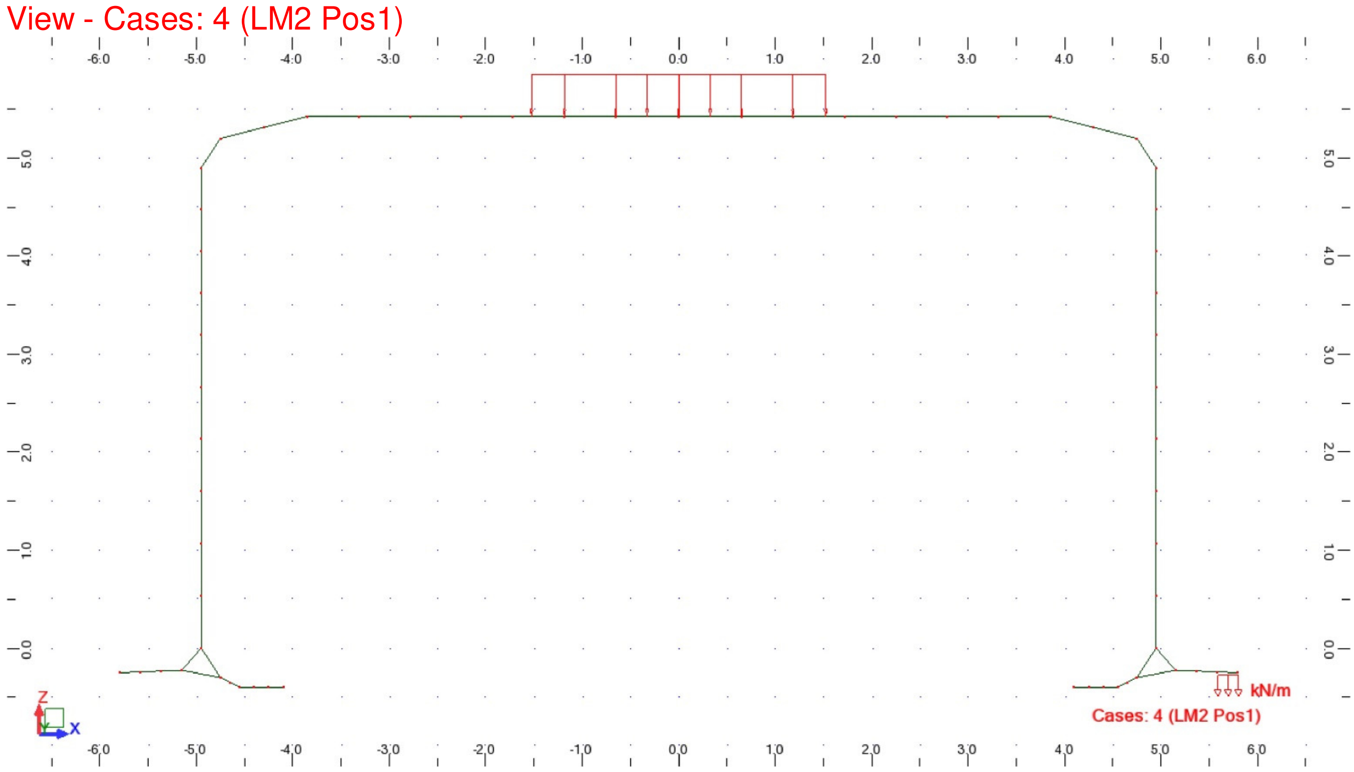
Author: **RS**
Address:

File: **ServiceMax_ULS.rtd**
Project: 15403-OC3-9.5m x 5.4m

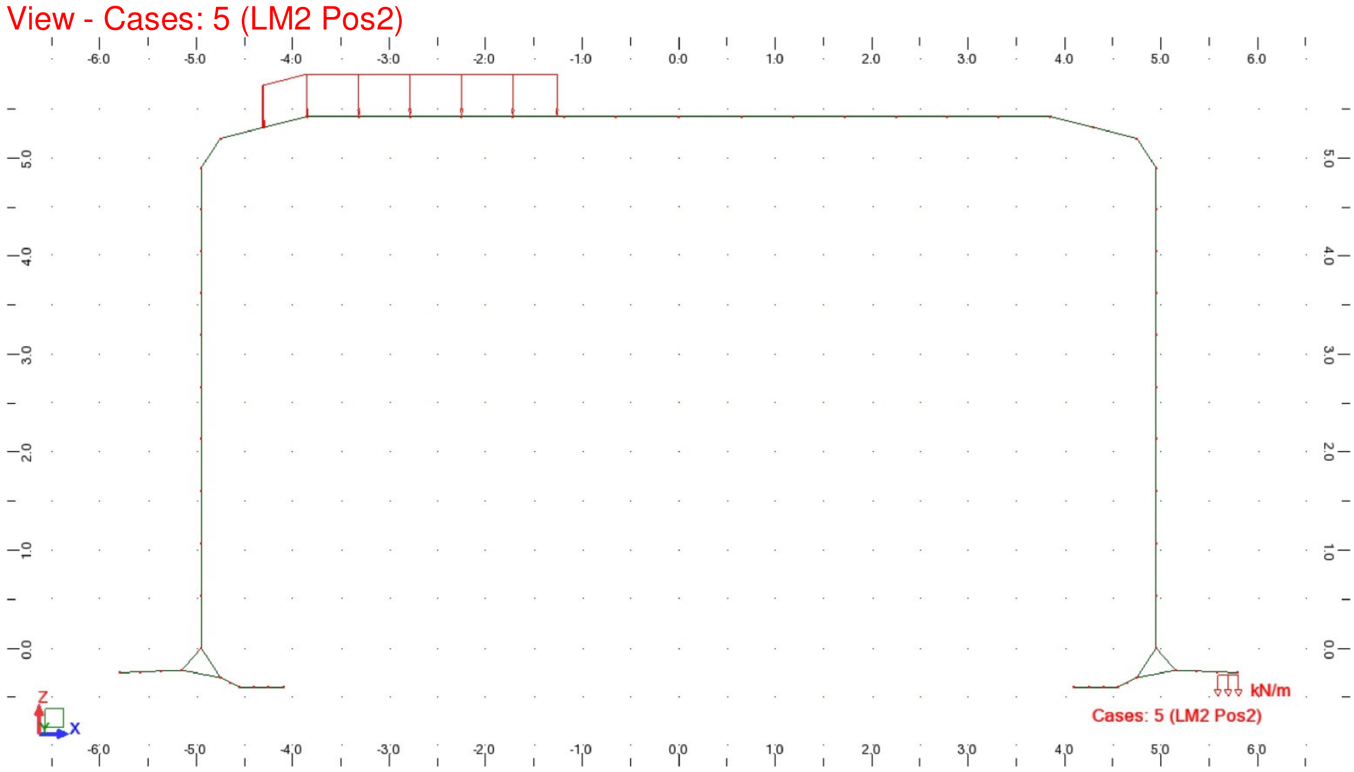
View - Cases: 3 (LM1(TS) + UDL Pos3)



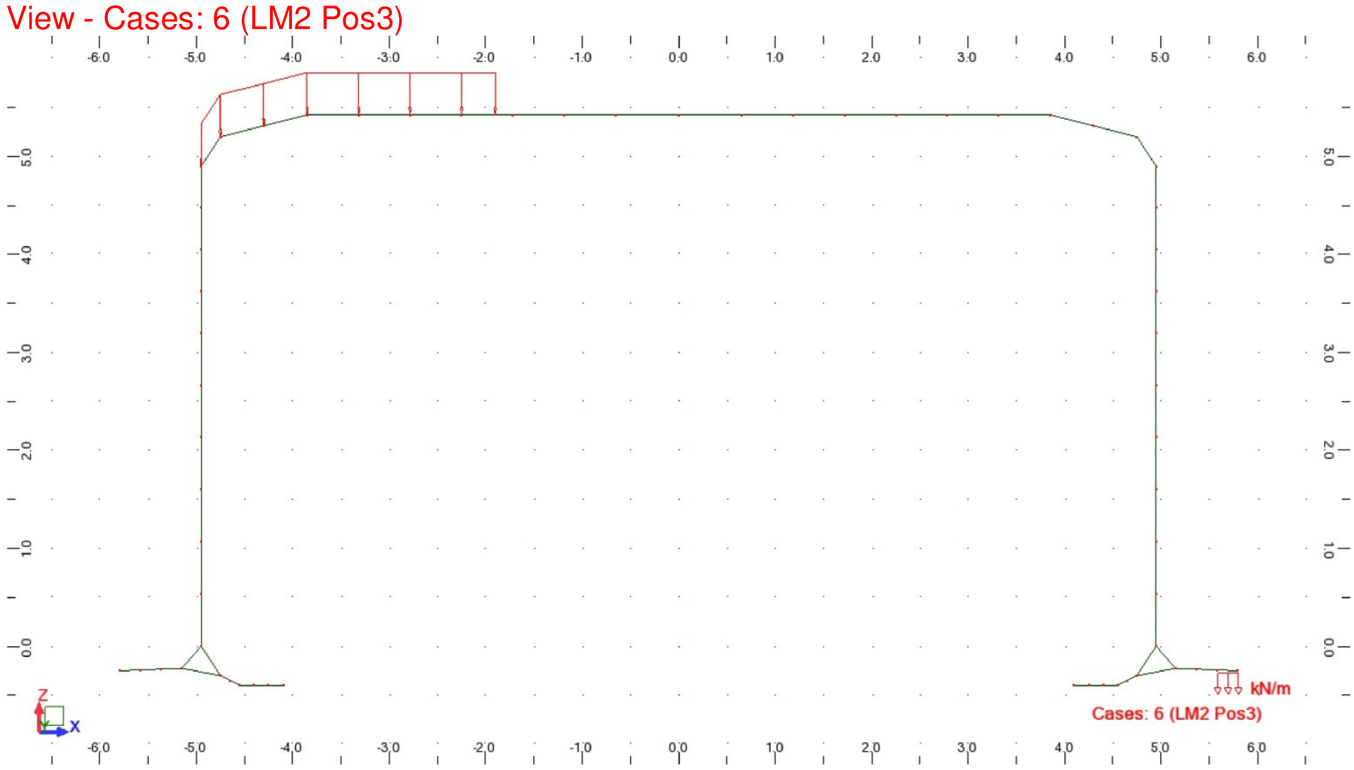
View - Cases: 4 (LM2 Pos1)



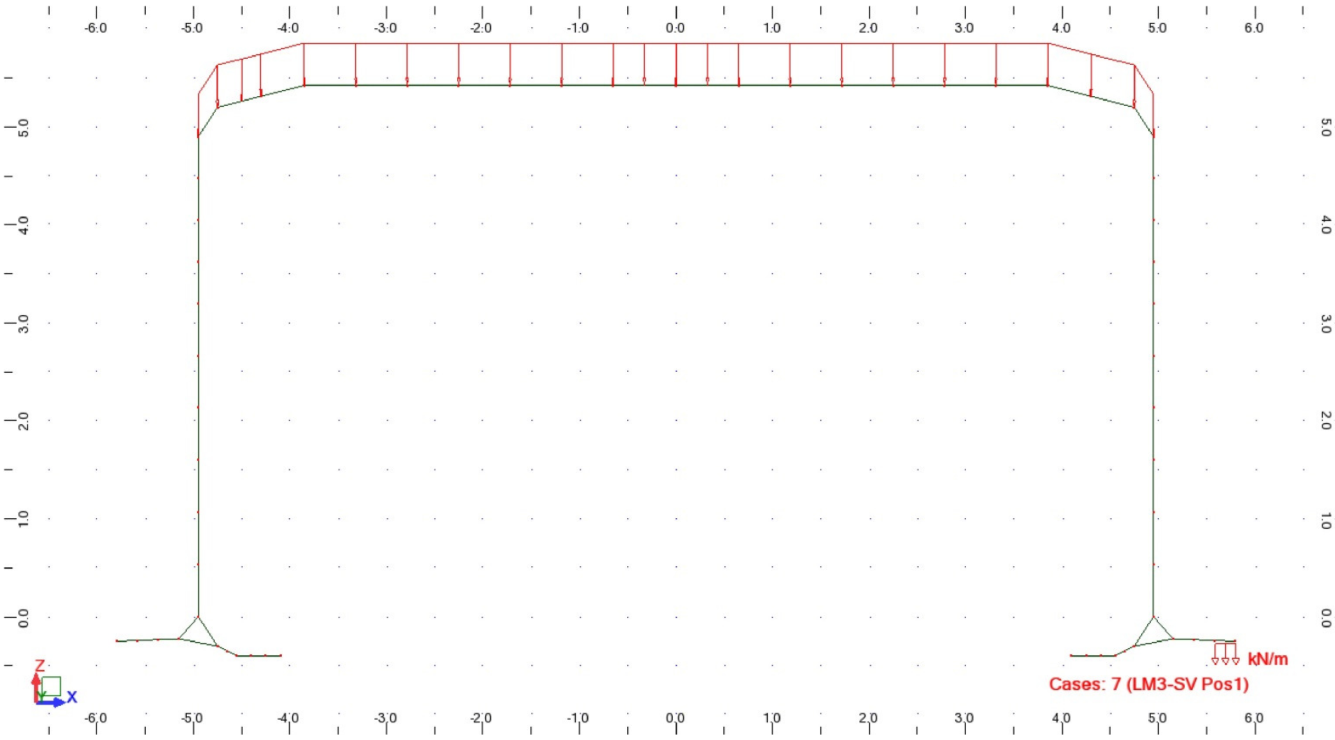
View - Cases: 5 (LM2 Pos2)



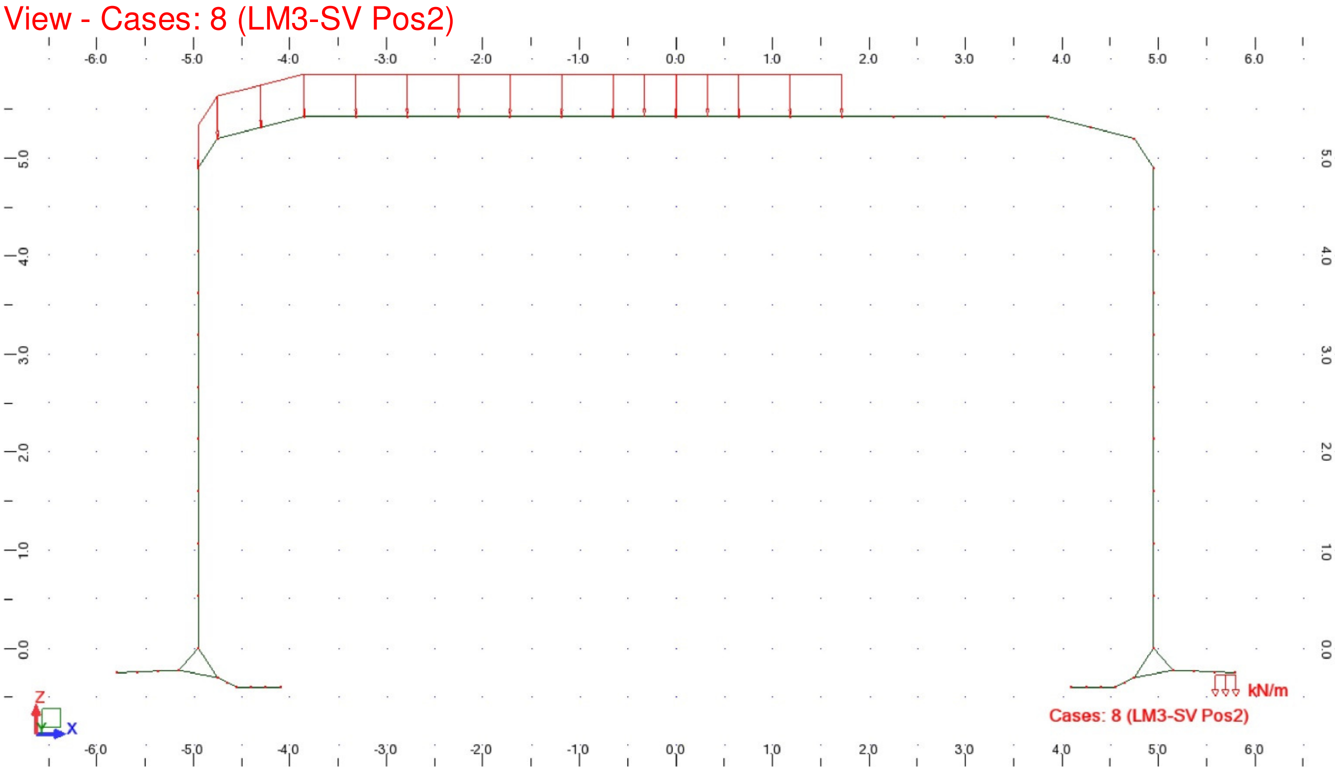
View - Cases: 6 (LM2 Pos3)



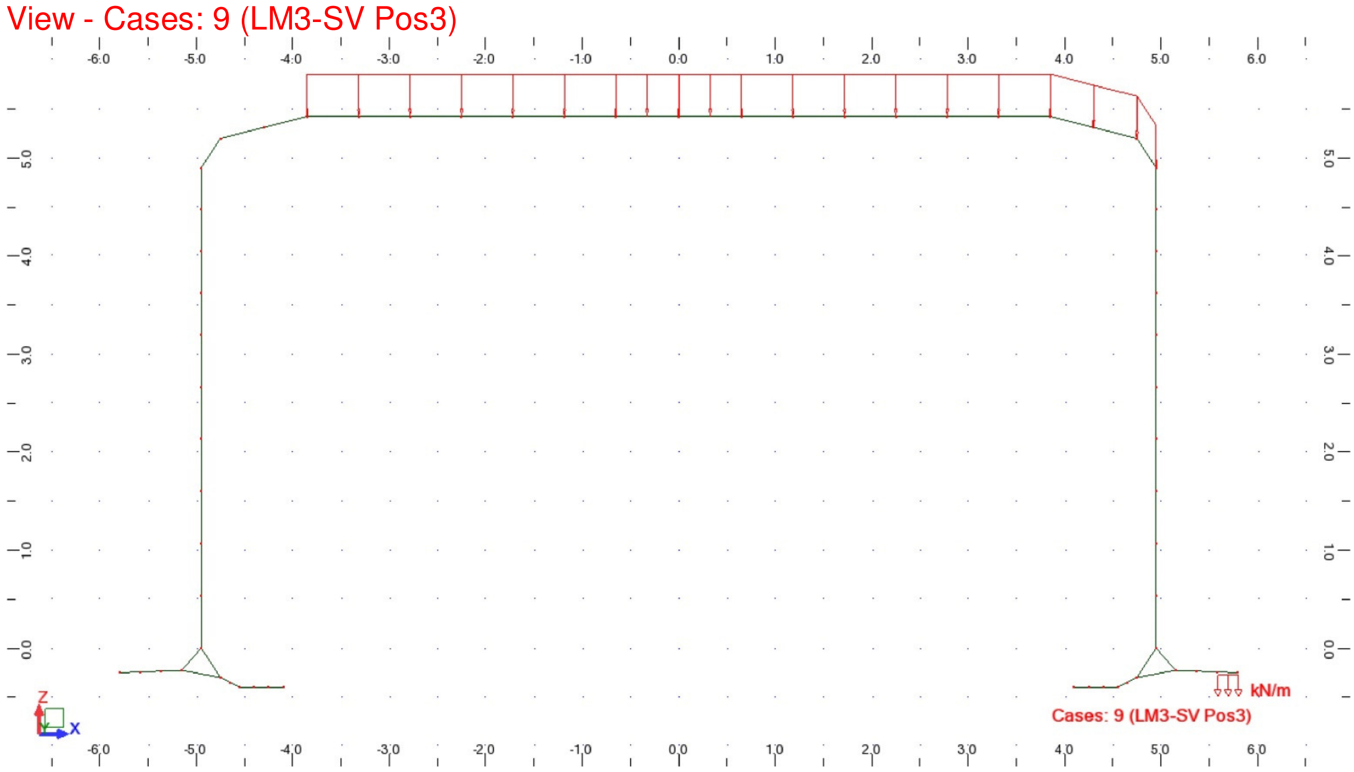
View - Cases: 7 (LM3-SV Pos1)



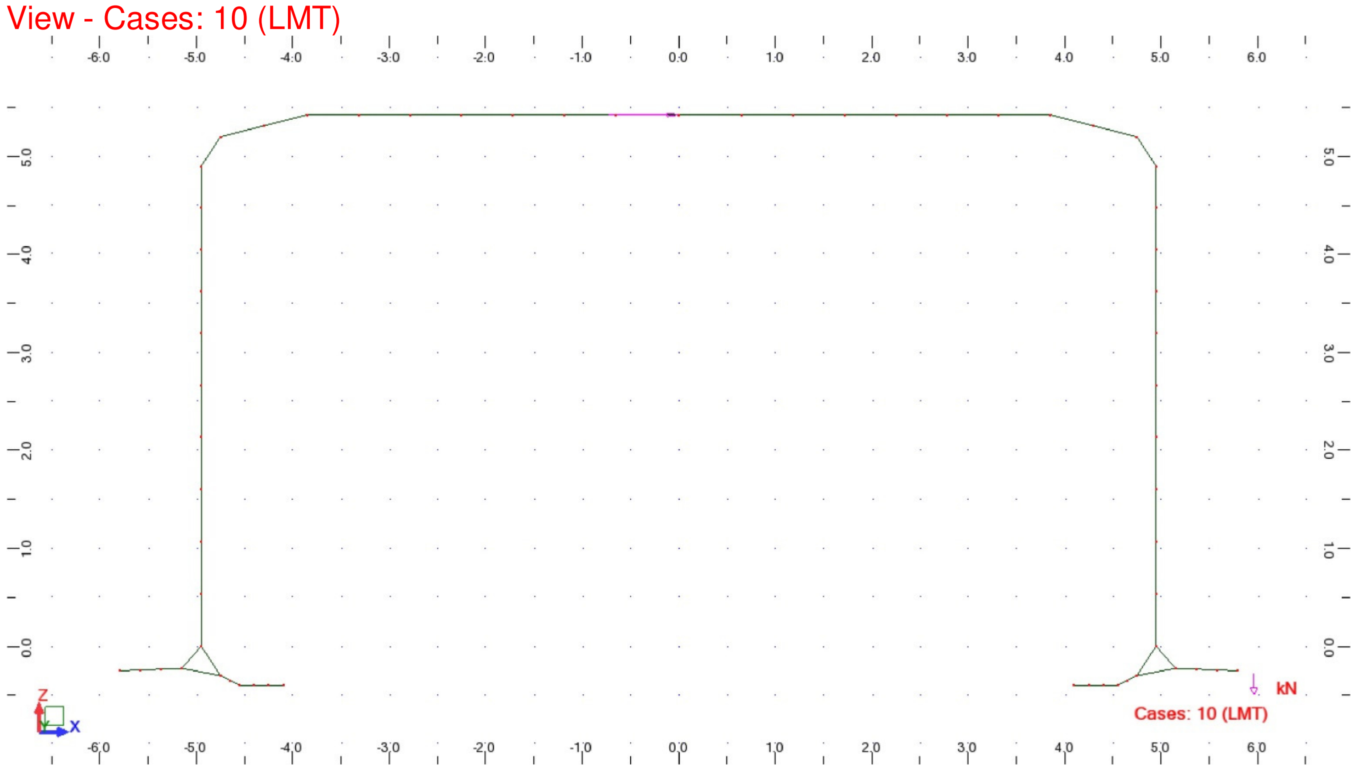
View - Cases: 8 (LM3-SV Pos2)



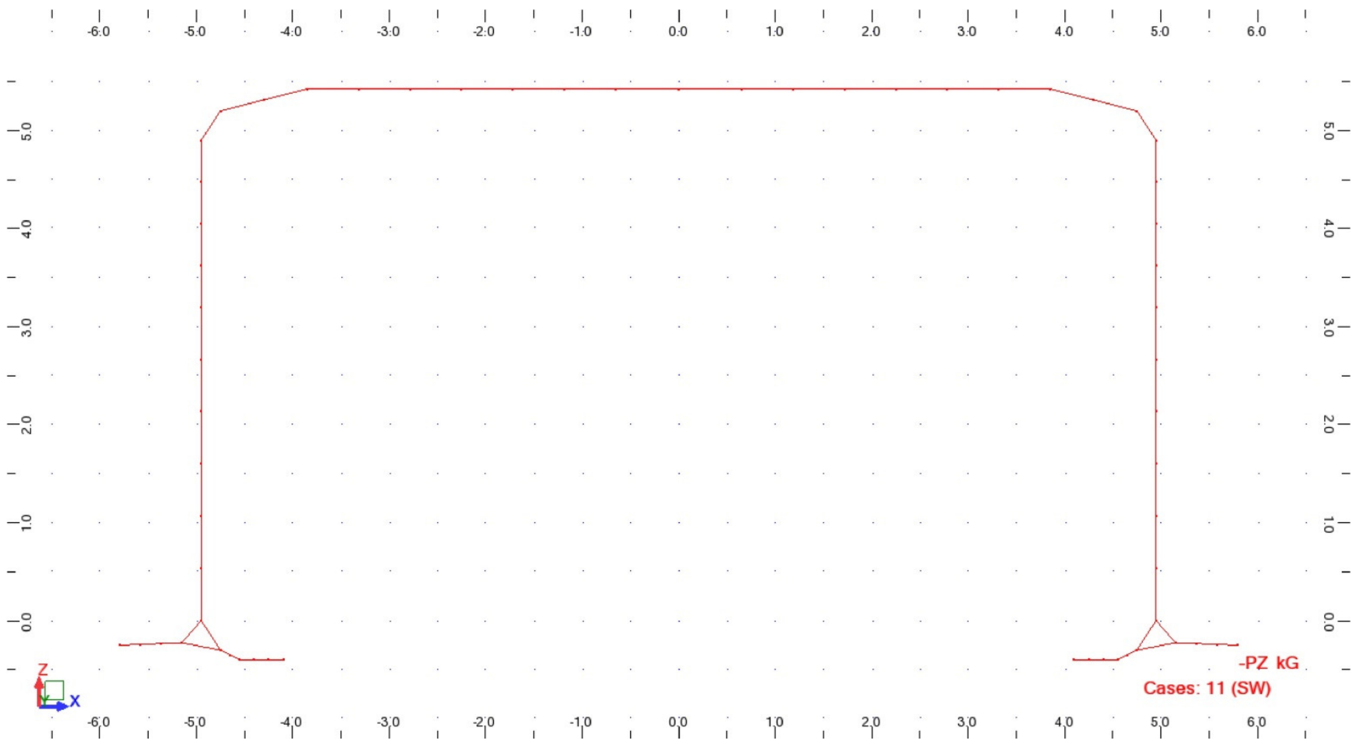
View - Cases: 9 (LM3-SV Pos3)



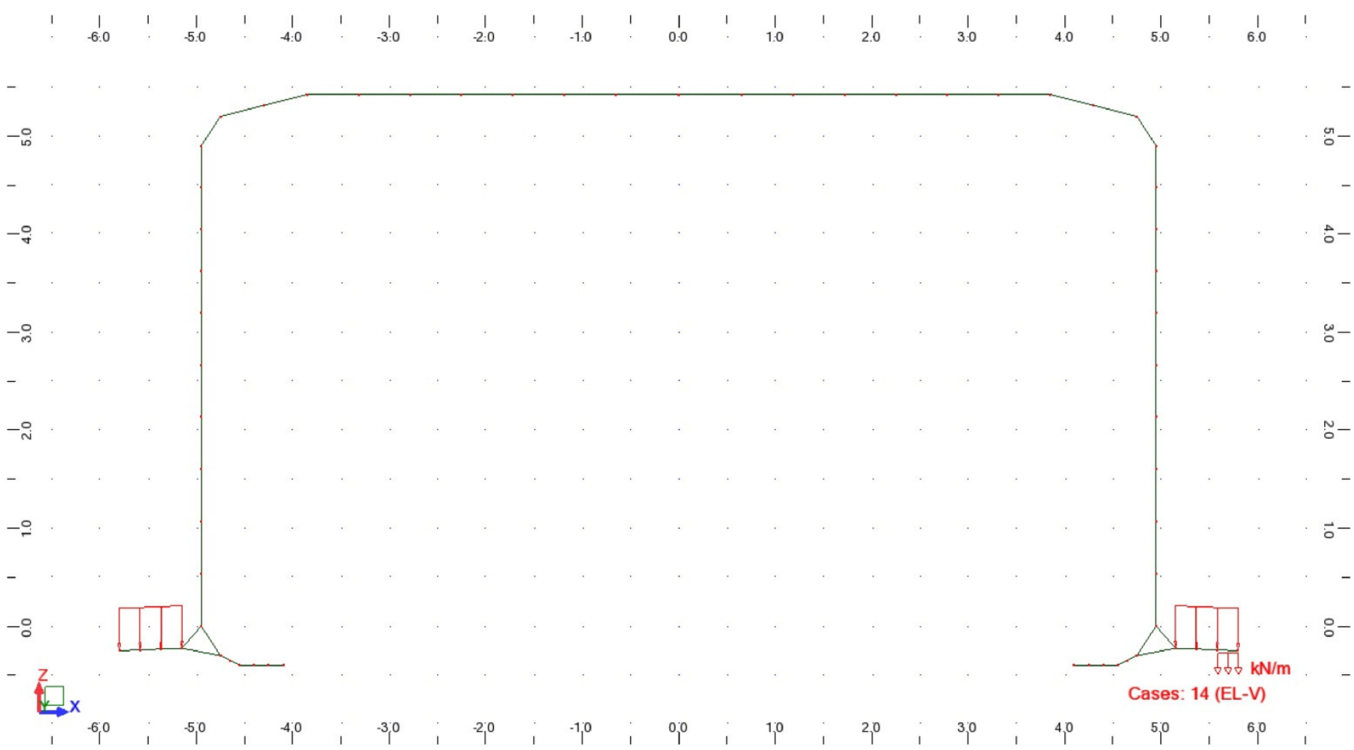
View - Cases: 10 (LMT)



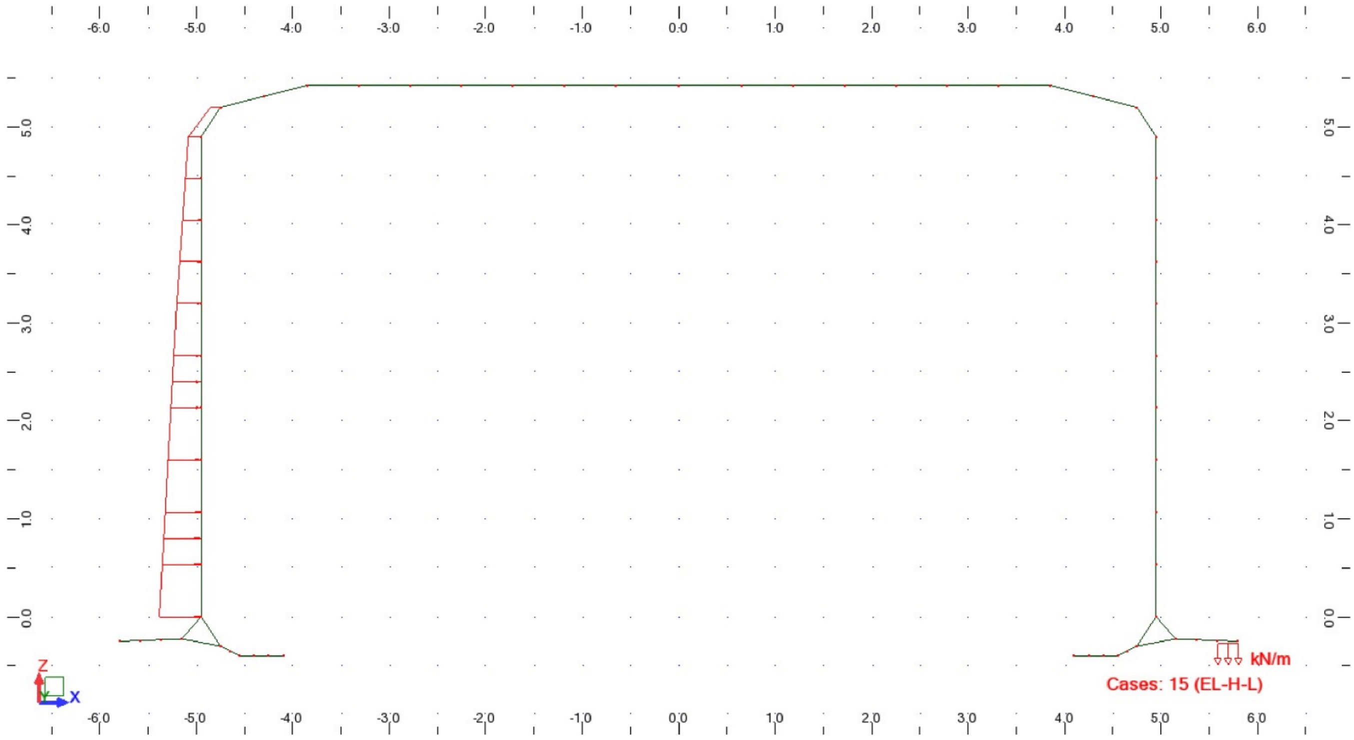
View - Cases: 11 (SW)



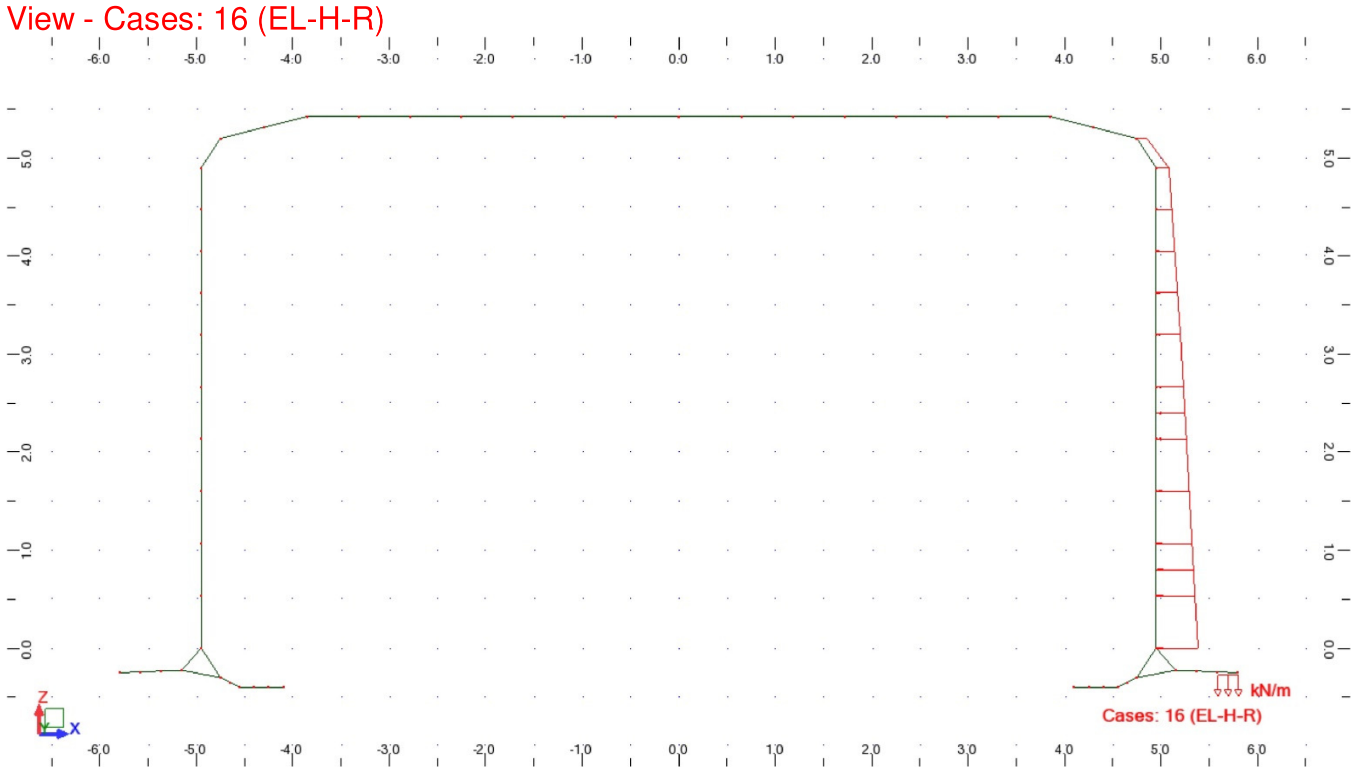
View - Cases: 14 (EL-V)



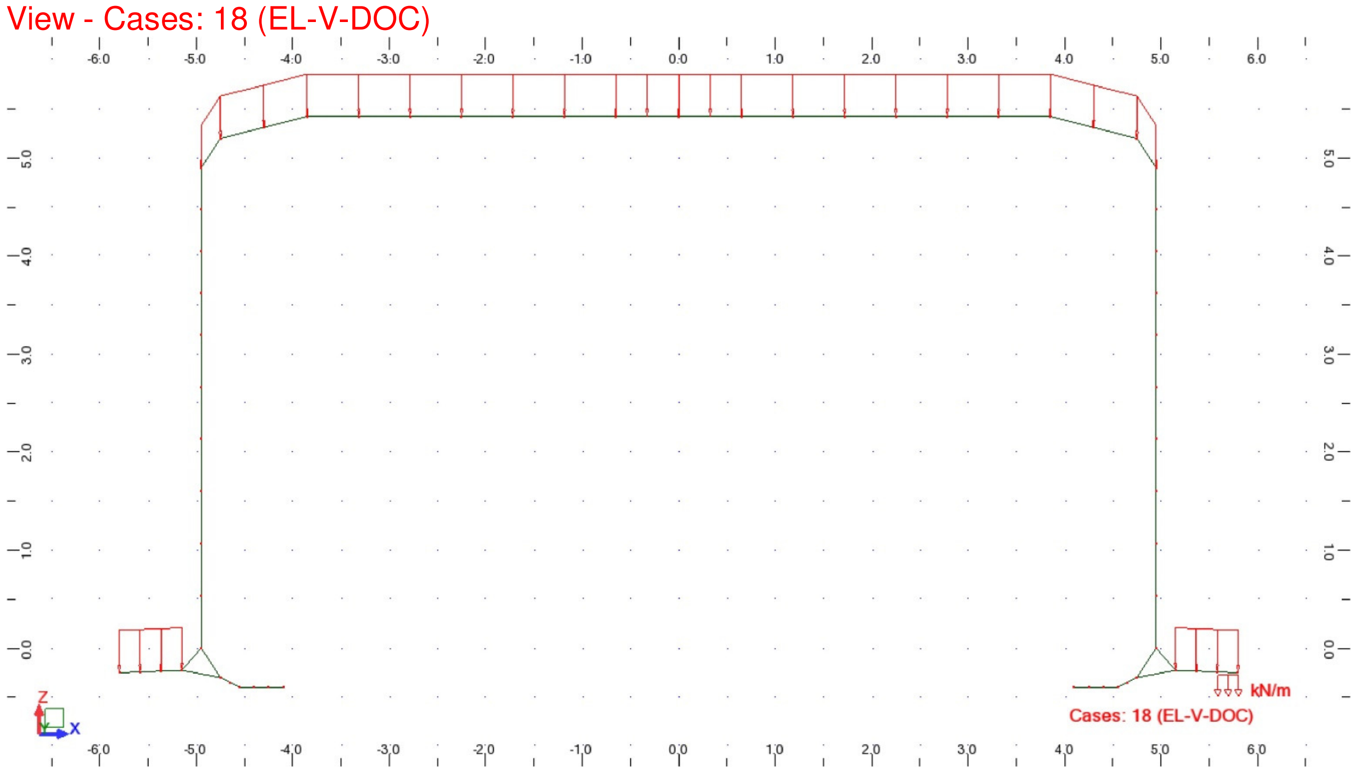
View - Cases: 15 (EL-H-L)



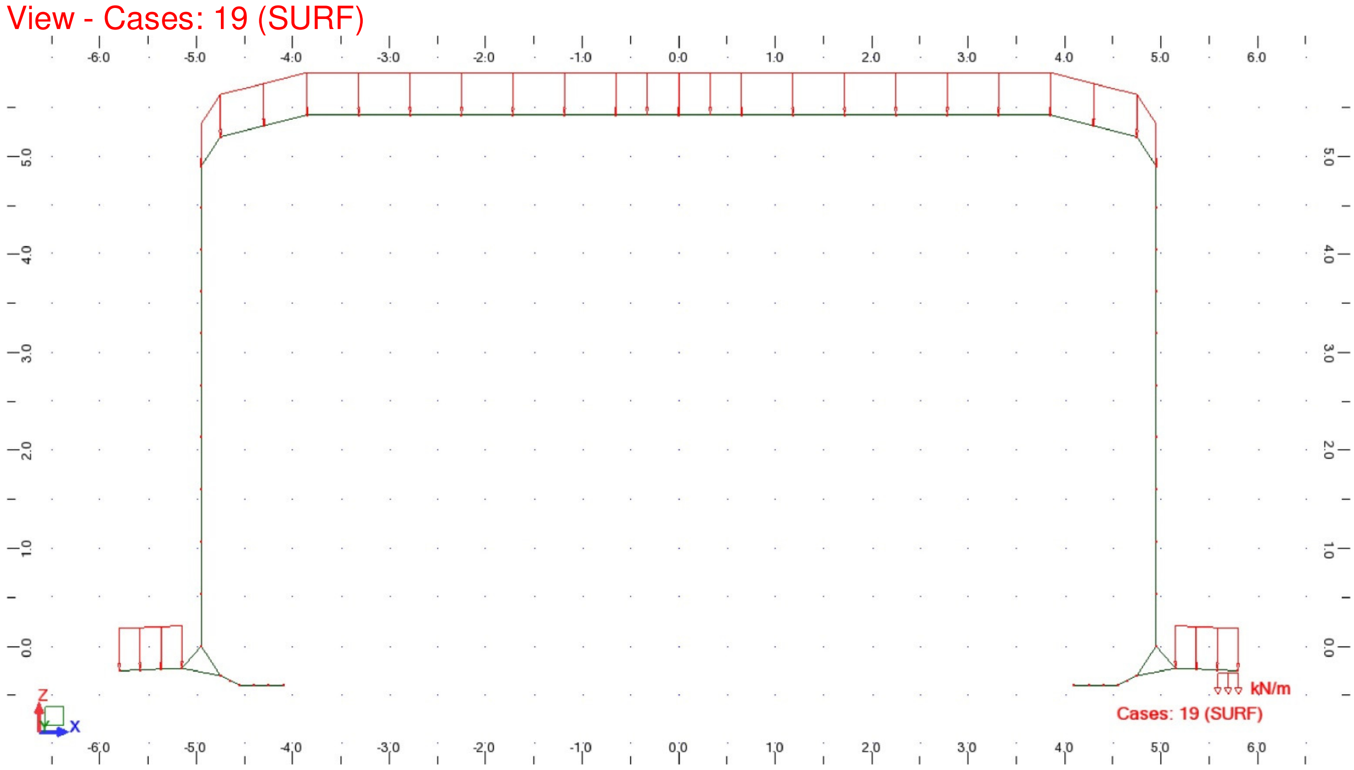
View - Cases: 16 (EL-H-R)



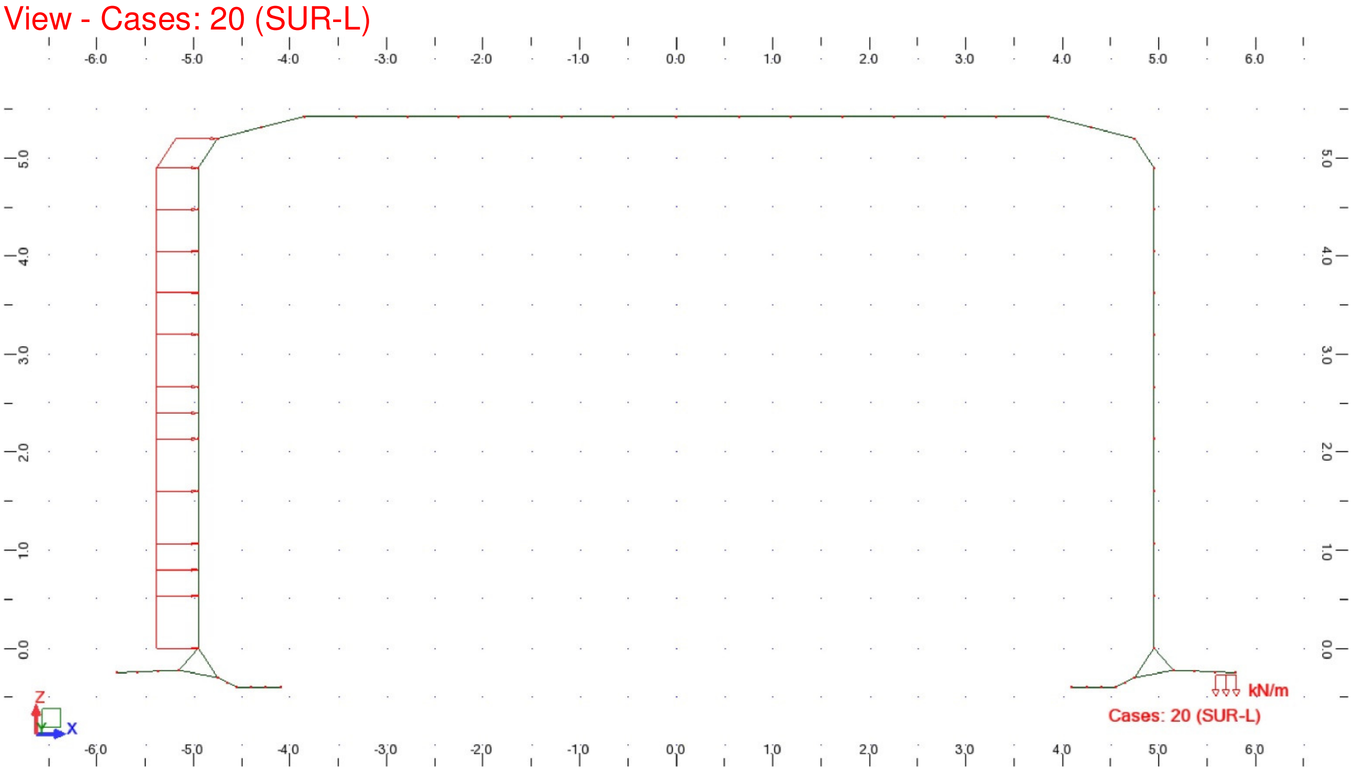
View - Cases: 18 (EL-V-DOC)



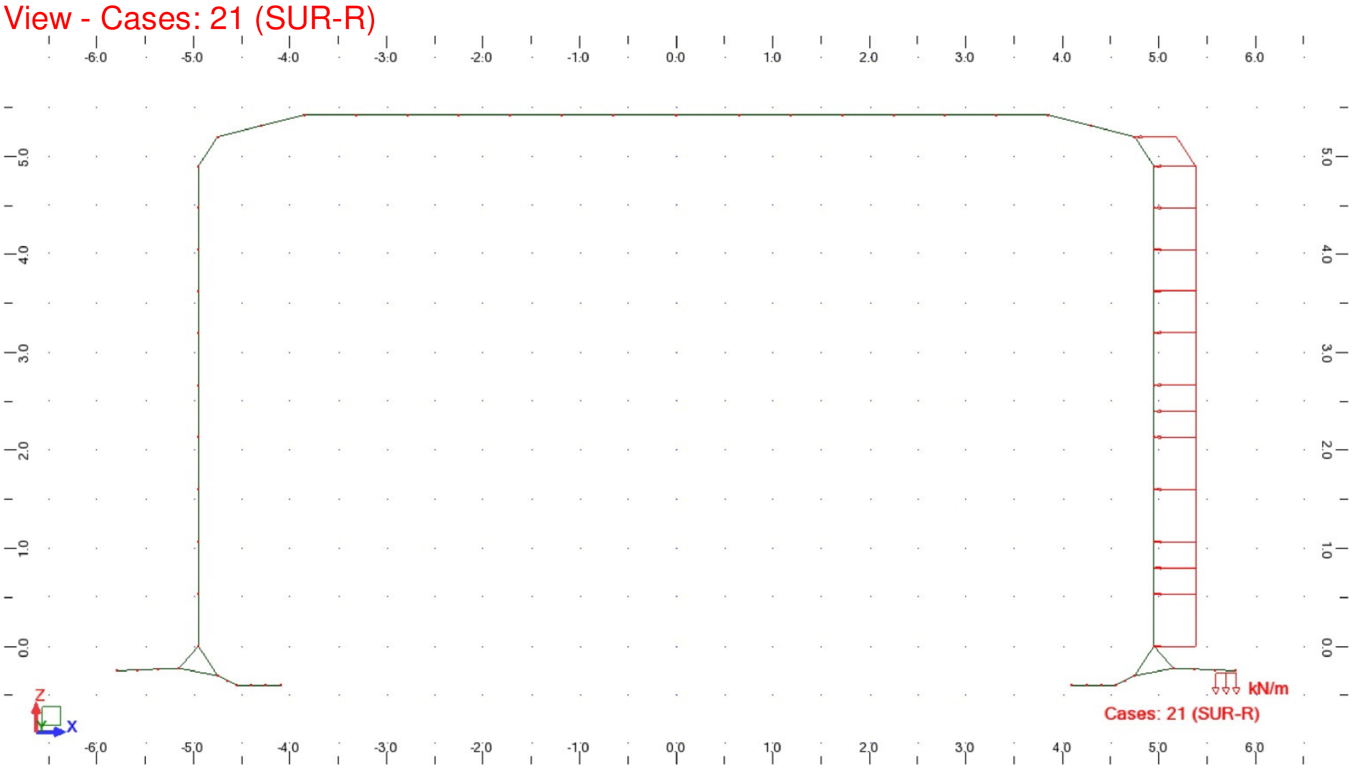
View - Cases: 19 (SURF)



View - Cases: 20 (SUR-L)



View - Cases: 21 (SUR-R)



Service Max - SLS - Load Case Values

- Cases: 1to11 14to16 18to24

	Case	Case name	Nature	Load type	List	Load values
	1	LM1(TS) + UDL Pos1	live	uniform load	11to30	PZ=-8.10(kN/m) projected
	1	LM1(TS) + UDL Pos1	live	uniform load	21to23	PZ=-29.83(kN/m) projected
	1	LM1(TS) + UDL Pos1	live	trapezoidal load (2p)	24	PZ2=-29.83(kN/m) PZ1=-29.83(kN/m) X2=0.41(m) X1=0.0(m) global projected absolute
	1	LM1(TS) + UDL Pos1	live	uniform load	18to20	PZ=-29.83(kN/m) projected
	1	LM1(TS) + UDL Pos1	live	trapezoidal load (2p)	17	PZ2=-29.83(kN/m) PZ1=-29.83(kN/m) X2=0.53(m) X1=0.13(m) global projected absolute
	2	LM1(TS) + UDL Pos2	live	uniform load	16to18	PZ=-29.83(kN/m) projected
	2	LM1(TS) + UDL Pos2	live	trapezoidal load (2p)	19	PZ2=-29.83(kN/m) PZ1=-29.83(kN/m) X2=0.53(m) X1=0.0(m) global projected absolute
	2	LM1(TS) + UDL Pos2	live	uniform load	11to15	PZ=-29.83(kN/m) projected
	2	LM1(TS) + UDL Pos2	live	uniform load	11to30	PZ=-8.10(kN/m) projected
	3	LM1(TS) + UDL Pos3	live	uniform load	11to30	PZ=-8.10(kN/m) projected
	3	LM1(TS) + UDL Pos3	live	uniform load	11to18	PZ=-29.83(kN/m) projected
	3	LM1(TS) + UDL Pos3	live	trapezoidal load (2p)	19	PZ2=-29.83(kN/m) PZ1=-29.83(kN/m) X2=0.48(m) X1=0.0(m) global projected absolute
	4	LM2 Pos1	live	uniform load	21 22	PZ=-22.86(kN/m) projected
	4	LM2 Pos1	live	trapezoidal load (2p)	23	PZ2=-22.86(kN/m) PZ1=-22.86(kN/m) X2=0.34(m) X1=0.0(m) global projected absolute
	4	LM2 Pos1	live	uniform load	19 20	PZ=-22.86(kN/m) projected
	4	LM2 Pos1	live	trapezoidal load (2p)	18	PZ2=-22.86(kN/m) PZ1=-22.86(kN/m) X2=0.53(m) X1=0.19(m) global projected absolute
	5	LM2 Pos2	live	uniform load	16 17	PZ=-22.86(kN/m) projected
	5	LM2 Pos2	live	trapezoidal load (2p)	18	PZ2=-22.86(kN/m) PZ1=-22.86(kN/m) X2=0.46(m) X1=0.0(m) global projected absolute
	5	LM2 Pos2	live	uniform load	13to15	PZ=-22.86(kN/m) projected
	5	LM2 Pos2	live	trapezoidal load (2p)	12	PZ2=-22.86(kN/m) PZ1=-22.86(kN/m) X2=0.46(m) X1=0.45(m) global projected absolute
	6	LM2 Pos3	live	uniform load	11to16	PZ=-22.86(kN/m) projected
	6	LM2 Pos3	live	trapezoidal load (2p)	17	PZ2=-22.86(kN/m) PZ1=-22.86(kN/m) X2=0.35(m) X1=0.0(m) global projected absolute
	7	LM3-SV Pos1	live	uniform load	13to20	PZ=-19.47(kN/m) projected
	7	LM3-SV Pos1	live	trapezoidal load (2p)	12	PZ2=-19.47(kN/m) PZ1=-19.47(kN/m) X2=0.46(m) X1=0.26(m) global projected absolute
	7	LM3-SV Pos1	live	uniform load	11 12	PZ=-19.47(kN/m) projected
	7	LM3-SV Pos1	live	uniform load	21to30	PZ=-19.47(kN/m) projected
	8	LM3-SV Pos2	live	uniform load	16to22	PZ=-19.47(kN/m) projected
	8	LM3-SV Pos2	live	trapezoidal load (2p)	23	PZ2=-19.47(kN/m) PZ1=-19.47(kN/m) X2=0.53(m) X1=0.0(m) global projected absolute
	8	LM3-SV Pos2	live	uniform load	11to15	PZ=-19.47(kN/m) projected
	9	LM3-SV Pos3	live	uniform load	14to30	PZ=-19.47(kN/m) projected
	10	LMT	live	nodal force	21	FX=116.02(kN)
	11	SW	dead	self-weight	1to62	PZ Negative Factor=1.00

	14	EL-V	dead	uniform load	57to62	PZ=-117.00(kN/m) projected
	15	EL-H-L	dead	trapezoidal load (2p)	1	PX2=142.36(kN/m) PX1=153.00(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	2	PX2=131.73(kN/m) PX1=142.36(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	3	PX2=121.09(kN/m) PX1=131.73(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	4	PX2=110.45(kN/m) PX1=121.09(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	5	PX2=99.82(kN/m) PX1=110.45(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	6	PX2=89.18(kN/m) PX1=99.82(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	7	PX2=78.55(kN/m) PX1=89.18(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	8	PX2=67.91(kN/m) PX1=78.55(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	9	PX2=57.27(kN/m) PX1=67.91(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	10	PX2=46.64(kN/m) PX1=57.27(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	11	PX2=36.00(kN/m) PX1=46.64(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	40	PX2=-153.00(kN/m) PX1=-142.36(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	39	PX2=-142.36(kN/m) PX1=-131.73(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	38	PX2=-131.73(kN/m) PX1=-121.09(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	37	PX2=-121.09(kN/m) PX1=-110.45(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	36	PX2=-110.45(kN/m) PX1=-99.82(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	35	PX2=-99.82(kN/m) PX1=-89.18(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	33	PX2=-78.55(kN/m) PX1=-67.91(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	32	PX2=-67.91(kN/m) PX1=-57.27(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	31	PX2=-57.27(kN/m) PX1=-46.64(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	30	PX2=-46.64(kN/m) PX1=-36.00(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	34	PX2=-89.18(kN/m) PX1=-78.55(kN/m) X2=1.00 X1=0.0 global projected relative
	18	EL-V-DOC	dead	uniform load	11to30 57to62	PZ=-36.00(kN/m) projected
	19	SURF	dead	uniform load	11to30 57to62	PZ=-4.40(kN/m) projected
	20	SUR-L	live	uniform load	1to11	PX=20.00(kN/m) projected
	21	SUR-R	live	uniform load	30to40	PX=-20.00(kN/m) projected

Service Min - SLS - Load Case Values

- Cases: 1to11 14to16 18to24

	Case	Case name	Nature	Load type	List	Load values
	1	LM1(TS) + UDL Pos1	live	uniform load	11to30	PZ=-8.10(kN/m) projected
	1	LM1(TS) + UDL Pos1	live	uniform load	21 22	PZ=-67.80(kN/m) projected
	1	LM1(TS) + UDL Pos1	live	trapezoidal load (2p)	23	PZ2=-67.80(kN/m) PZ1=-67.80(kN/m) X2=0.29(m) X1=0.0(m) global projected absolute
	1	LM1(TS) + UDL Pos1	live	uniform load	19 20	PZ=-67.80(kN/m) projected
	1	LM1(TS) +	live	trapezoidal load (2p)	18	PZ2=-67.80(kN/m) PZ1=-67.80(kN/m)

		UDL Pos1				X2=0.53(m) X1=0.24(m) global projected absolute
	2	LM1(TS) + UDL Pos2	live	uniform load	16 17	PZ=-67.80(kN/m) projected
	2	LM1(TS) + UDL Pos2	live	trapezoidal load (2p)	18	PZ2=-67.80(kN/m) PZ1=-67.80(kN/m) X2=0.41(m) X1=0.0(m) global projected absolute
	2	LM1(TS) + UDL Pos2	live	uniform load	14 15	PZ=-67.80(kN/m) projected
	2	LM1(TS) + UDL Pos2	live	trapezoidal load (2p)	13	PZ2=-67.80(kN/m) PZ1=-67.80(kN/m) X2=0.46(m) X1=0.04(m) global projected absolute
	2	LM1(TS) + UDL Pos2	live	uniform load	11to30	PZ=-8.10(kN/m) projected
	3	LM1(TS) + UDL Pos3	live	trapezoidal load (2p)	17	PZ2=-67.80(kN/m) PZ1=-67.80(kN/m) X2=0.25(m) X1=0.0(m) global projected absolute
	3	LM1(TS) + UDL Pos3	live	uniform load	11to16	PZ=-67.80(kN/m) projected
	3	LM1(TS) + UDL Pos3	live	uniform load	11to30	PZ=-8.10(kN/m) projected
	4	LM2 Pos1	live	uniform load	21	PZ=-54.30(kN/m) projected
	4	LM2 Pos1	live	trapezoidal load (2p)	22	PZ2=-54.30(kN/m) PZ1=-54.30(kN/m) X2=0.22(m) X1=0.0(m) global projected absolute
	4	LM2 Pos1	live	uniform load	20	PZ=-54.30(kN/m) projected
	4	LM2 Pos1	live	trapezoidal load (2p)	19	PZ2=-54.30(kN/m) PZ1=-54.30(kN/m) X2=0.53(m) X1=0.31(m) global projected absolute
	5	LM2 Pos2	live	uniform load	16	PZ=-54.30(kN/m) projected
	5	LM2 Pos2	live	trapezoidal load (2p)	17	PZ2=-54.30(kN/m) PZ1=-54.30(kN/m) X2=0.34(m) X1=0.0(m) global projected absolute
	5	LM2 Pos2	live	uniform load	15	PZ=-54.30(kN/m) projected
	5	LM2 Pos2	live	trapezoidal load (2p)	14	PZ2=-54.30(kN/m) PZ1=-54.30(kN/m) X2=0.53(m) X1=0.19(m) global projected absolute
	6	LM2 Pos3	live	uniform load	11to14	PZ=-54.30(kN/m) projected
	6	LM2 Pos3	live	trapezoidal load (2p)	15	PZ2=-54.30(kN/m) PZ1=-54.30(kN/m) X2=0.12(m) X1=0.0(m) global projected absolute
	7	LM3-SV Pos1	live	uniform load	15to20	PZ=-29.56(kN/m) projected
	7	LM3-SV Pos1	live	trapezoidal load (2p)	14	PZ2=-29.56(kN/m) PZ1=-29.56(kN/m) X2=0.53(m) X1=0.0(m) global projected absolute
	7	LM3-SV Pos1	live	uniform load	12 13 28 29	PZ=-29.56(kN/m) projected
	7	LM3-SV Pos1	live	uniform load	21to26	PZ=-29.56(kN/m) projected
	7	LM3-SV Pos1	live	trapezoidal load (2p)	27	PZ2=-29.56(kN/m) PZ1=-29.56(kN/m) X2=0.53(m) X1=0.0(m) global projected absolute
	8	LM3-SV Pos2	live	uniform load	16to21	PZ=-29.56(kN/m) projected
	8	LM3-SV Pos2	live	trapezoidal load (2p)	22	PZ2=-29.56(kN/m) PZ1=-29.56(kN/m) X2=0.41(m) X1=0.0(m) global projected absolute
	8	LM3-SV Pos2	live	uniform load	11to15	PZ=-29.56(kN/m) projected
	9	LM3-SV Pos3	live	uniform load	14to26	PZ=-29.56(kN/m) projected
	9	LM3-SV Pos3	live	trapezoidal load (2p)	27	PZ2=-29.56(kN/m) PZ1=-29.56(kN/m) X2=0.53(m) X1=0.0(m) global projected absolute
	10	LMT	live	nodal force	21	FX=116.02(kN)
	11	SW	dead	self-weight	1to62	PZ Negative Factor=1.00
	14	EL-V	dead	uniform load	57to62	PZ=-117.00(kN/m) projected
	15	EL-H-L	dead	trapezoidal load (2p)	1	PX2=116.36(kN/m) PX1=127.00(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	2	PX2=105.73(kN/m) PX1=116.36(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	3	PX2=95.09(kN/m) PX1=105.73(kN/m) X2=1.00 X1=0.0 global projected relative

	15	EL-H-L	dead	trapezoidal load (2p)	4	PX2=84.45(kN/m) PX1=95.09(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	5	PX2=73.82(kN/m) PX1=84.45(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	6	PX2=63.18(kN/m) PX1=73.82(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	7	PX2=52.55(kN/m) PX1=63.18(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	8	PX2=41.91(kN/m) PX1=52.55(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	9	PX2=31.27(kN/m) PX1=41.91(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	10	PX2=20.64(kN/m) PX1=31.27(kN/m) X2=1.00 X1=0.0 global projected relative
	15	EL-H-L	dead	trapezoidal load (2p)	11	PX2=10.00(kN/m) PX1=20.64(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	40	PX2=-127.00(kN/m) PX1=-116.36(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	39	PX2=-116.36(kN/m) PX1=-105.73(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	38	PX2=-105.73(kN/m) PX1=-95.09(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	37	PX2=-95.09(kN/m) PX1=-84.45(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	36	PX2=-84.45(kN/m) PX1=-73.82(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	35	PX2=-73.82(kN/m) PX1=-63.18(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	33	PX2=-52.55(kN/m) PX1=-41.91(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	32	PX2=-41.91(kN/m) PX1=-31.27(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	31	PX2=-31.27(kN/m) PX1=-20.64(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	30	PX2=-20.64(kN/m) PX1=-10.00(kN/m) X2=1.00 X1=0.0 global projected relative
	16	EL-H-R	dead	trapezoidal load (2p)	34	PX2=-63.18(kN/m) PX1=-52.55(kN/m) X2=1.00 X1=0.0 global projected relative
	18	EL-V-DOC	dead	uniform load	11to30 57to62	PZ=-10.00(kN/m) projected
	19	SURF	dead	uniform load	11to30 57to62	PZ=-4.40(kN/m) projected
	20	SUR-L	live	uniform load	1to11	PX=20.00(kN/m) projected
	21	SUR-R	live	uniform load	30to40	PX=-20.00(kN/m) projected

Kapitola 4

Kombinácie zaťažovacích stavov

Service Min - Load Combination SLS

Combinations	Name	Definition
25	LM1.1-VH-SLS	(11+14+18+1)*1.00+(15+16+20+21)*0.60+19*1.40
26	LM1.2-VH-SLS	(11+14+18+2)*1.00+(15+16+20+21)*0.60+19*1.40
27	LM1.3-VH-SLS	(11+14+18+3)*1.00+(15+16+20+21)*0.60+19*1.40
28	LM2.1-VH-SLS	(11+14+18+4)*1.00+(15+16+20+21)*0.60+19*1.40
29	LM2.2-VH-SLS	(11+14+18+5)*1.00+(15+16+20+21)*0.60+19*1.40
30	LM2.3-VH-SLS	(11+14+18+6)*1.00+(15+16+20+21)*0.60+19*1.40
31	LM3.1-VH-SLS	(11+14+18+7)*1.00+(15+16)*0.60+19*1.40+(20+21)*0.90
32	LM3.2-VH-SLS	(11+14+18+8)*1.00+(15+16)*0.60+19*1.40+(20+21)*0.90
33	LM3.3-VH-SLS	(11+14+18+9)*1.00+(15+16)*0.60+19*1.40+(20+21)*0.90
34	LM3&1.1-VH-SLS	(11+14+18+22)*1.00+(15+16)*0.60+19*1.40+(20+21)*0.90+4*0.30
35	LM3&1.2-VH-SLS	(11+14+18+23)*1.00+(15+16)*0.60+19*1.40+(20+21)*0.90+5*0.30
36	LM3&1.3-VH-SLS	(11+14+18+24)*1.00+(15+16)*0.60+19*1.40+(20+21)*0.90+6*0.30
37	LMT.1-VH-SLS	(11+14+18+10)*1.00+(15+20)*0.33+16*0.60+19*1.40+1*0.75
38	LMT.2-VH-SLS	(11+14+18+10)*1.00+(15+20)*0.33+16*0.60+19*1.40+2*0.75
39	LMT.3-VH-SLS	(11+14+18+10)*1.00+(15+20)*0.33+16*0.60+19*1.40+3*0.75
40	LM1.1-Vh-SLS	(11+14+18+1)*1.00+(15+16)*0.20+19*1.40
41	LM1.2-Vh-SLS	(11+14+18+2)*1.00+(15+16)*0.20+19*1.40
42	LM1.3-Vh-SLS	(11+14+18+3)*1.00+(15+16)*0.20+19*1.40
43	LM3.1-Vh-SLS	(11+14+18+7)*1.00+(15+16)*0.20+19*1.40
44	LM3.2-Vh-SLS	(11+14+18+8)*1.00+(15+16)*0.20+19*1.40
45	LM3.3-Vh-SLS	(11+14+18+9)*1.00+(15+16)*0.20+19*1.40
46	LM2.1-Vh-SLS	(11+14+18+4)*1.00+(15+16)*0.20+19*1.40
47	LM2.2-Vh-SLS	(11+14+18+5)*1.00+(15+16)*0.20+19*1.40
48	LM2.3-Vh-SLS	(11+14+18+6)*1.00+(15+16)*0.20+19*1.40
49	LM3&1.1-Vh-SLS	(11+14+18+22)*1.00+(15+16)*0.20+19*1.40+4*0.30
50	LM3&1.2-Vh-SLS	(11+14+18+23)*1.00+(15+16)*0.20+19*1.40+5*0.30
51	LM3&1.3-Vh-SLS	(11+14+18+24)*1.00+(15+16)*0.20+19*1.40+6*0.30
52	vH-SLS	(11+14+18)*1.00+(15+16+20+21)*0.60+19*0.80
53	LM1.1-T-vH-SLS	(11+14+18+10)*1.00+(15+20)*0.33+16*0.60+19*0.80
54	LM1.2-T-vH-SLS	(11+14+18+10)*1.00+(15+20)*0.33+16*0.60+19*0.80
55	LM1.3-T-vH-SLS	(11+14+18+10)*1.00+(15+20)*0.33+16*0.60+19*0.80

Service Min - Load Combination SLS - QUASI PERMANENT - CRACK WIDTH CHECK

Combinations	Name	Definition
25	VH-SLS-CW	(11+14+18)*1.00+(15+16)*0.60+19*1.40
26	Vh-SLS-CW	(11+14+18)*1.00+(15+16)*0.20+19*1.40
27	vH-SLS-CW	(11+14+18)*1.00+(15+16)*0.60+19*0.80

Service Max - Load Combination SLS

Combinations	Name	Definition
25	LM1.1-VH-SLS	(11+14+18+1)*1.00+(15+16+20+21)*0.60+19*1.40
26	LM1.2-VH-SLS	(11+14+18+2)*1.00+(15+16+20+21)*0.60+19*1.40
27	LM1.3-VH-SLS	(11+14+18+3)*1.00+(15+16+20+21)*0.60+19*1.40
28	LM2.1-VH-SLS	(11+14+18+4)*1.00+(15+16+20+21)*0.60+19*1.40
29	LM2.2-VH-SLS	(11+14+18+5)*1.00+(15+16+20+21)*0.60+19*1.40
30	LM2.3-VH-SLS	(11+14+18+6)*1.00+(15+16+20+21)*0.60+19*1.40
31	LM3.1-VH-SLS	(11+14+18+7)*1.00+(15+16)*0.60+19*1.40+(20+21)*0.90
32	LM3.2-VH-SLS	(11+14+18+8)*1.00+(15+16)*0.60+19*1.40+(20+21)*0.90
33	LM3.3-VH-SLS	(11+14+18+9)*1.00+(15+16)*0.60+19*1.40+(20+21)*0.90
34	LM3&1.1-VH-SLS	(11+14+18+22)*1.00+(15+16)*0.60+19*1.40+(20+21)*0.90+4*0.30
35	LM3&1.2-VH-SLS	(11+14+18+23)*1.00+(15+16)*0.60+19*1.40+(20+21)*0.90+5*0.30
36	LM3&1.3-VH-SLS	(11+14+18+24)*1.00+(15+16)*0.60+19*1.40+(20+21)*0.90+6*0.30
37	LMT.1-VH-SLS	(11+14+18+10)*1.00+(15+20)*0.33+16*0.60+19*1.40+1*0.75
38	LMT.2-VH-SLS	(11+14+18+10)*1.00+(15+20)*0.33+16*0.60+19*1.40+2*0.75
39	LMT.3-VH-SLS	(11+14+18+10)*1.00+(15+20)*0.33+16*0.60+19*1.40+3*0.75
40	LM1.1-Vh-SLS	(11+14+18+1)*1.00+(15+16)*0.20+19*1.40

41	LM1.2-Vh-SLS	(11+14+18+2)*1.00+(15+16)*0.20+19*1.40
42	LM1.3-Vh-SLS	(11+14+18+3)*1.00+(15+16)*0.20+19*1.40
43	LM3.1-Vh-SLS	(11+14+18+7)*1.00+(15+16)*0.20+19*1.40
44	LM3.2-Vh-SLS	(11+14+18+8)*1.00+(15+16)*0.20+19*1.40
45	LM3.3-Vh-SLS	(11+14+18+9)*1.00+(15+16)*0.20+19*1.40
46	LM2.1-Vh-SLS	(11+14+18+4)*1.00+(15+16)*0.20+19*1.40
47	LM2.2-Vh-SLS	(11+14+18+5)*1.00+(15+16)*0.20+19*1.40
48	LM2.3-Vh-SLS	(11+14+18+6)*1.00+(15+16)*0.20+19*1.40
49	LM3&1.1-Vh-SLS	(11+14+18+22)*1.00+(15+16)*0.20+19*1.40+4*0.30
50	LM3&1.2-Vh-SLS	(11+14+18+23)*1.00+(15+16)*0.20+19*1.40+5*0.30
51	LM3&1.3-Vh-SLS	(11+14+18+24)*1.00+(15+16)*0.20+19*1.40+6*0.30
52	vH-SLS	(11+14+18)*1.00+(15+16+20+21)*0.60+19*0.80
53	LM1.1-T-vH-SLS	(11+14+18+10)*1.00+(15+20)*0.33+16*0.60+19*0.80
54	LM1.2-T-vH-SLS	(11+14+18+10)*1.00+(15+20)*0.33+16*0.60+19*0.80
55	LM1.3-T-vH-SLS	(11+14+18+10)*1.00+(15+20)*0.33+16*0.60+19*0.80

Service Max - Load Combination SLS - QUASI PERMANENT - CRACK WIDTH CHECK

Combinations	Name	Definition
25	VH-SLS-CW	(11+14+18)*1.00+(15+16)*0.60+19*1.40
26	Vh-SLS-CW	(11+14+18)*1.00+(15+16)*0.20+19*1.40
27	vH-SLS-CW	(11+14+18)*1.00+(15+16)*0.60+19*0.80

Service Max - Load Combination ULS

- Cases: 25to55

Combinations	**Name**	**Definition**
25	LM1.1-VH-ULS	(11+14+18+1)*1.35+(15+16)*0.97+19*1.68+(20+21)*0.90
26	LM1.2-VH-ULS	(11+14+18+2)*1.35+(15+16)*0.97+19*1.68+(20+21)*0.90
27	LM1.3-VH-ULS	(11+14+18+3)*1.35+(15+16)*0.97+19*1.68+(20+21)*0.90
28	LM2.1-VH-ULS	(11+14+18+4)*1.35+(15+16)*0.97+19*1.68+(20+21)*0.90
29	LM2.2-VH-ULS	(11+14+18+5)*1.35+(15+16)*0.97+19*1.68+(20+21)*0.90
30	LM2.3-VH-ULS	(11+14+18+6)*1.35+(15+16)*0.97+19*1.68+(20+21)*0.90
31	LM3.1-VH-ULS	(11+14+18+20+21+7)*1.35+(15+16)*0.97+19*1.68
32	LM3.2-VH-ULS	(11+14+18+20+21+8)*1.35+(15+16)*0.97+19*1.68
33	LM3.3-VH-ULS	(11+14+18+20+21+9)*1.35+(15+16)*0.97+19*1.68
34	LM3&1.1-VH-ULS	(11+14+18+20+21+22)*1.35+(15+16)*0.97+19*1.68+4*0.41
35	LM3&1.2-VH-ULS	(11+14+18+20+21+23)*1.35+(15+16)*0.97+19*1.68+5*0.41
36	LM3&1.3-VH-ULS	(11+14+18+20+21+24)*1.35+(15+16)*0.97+19*1.68+6*0.41
37	LMT.1-VH-ULS	(11+14+18+10)*1.35+15*0.53+16*0.97+19*1.68+20*0.90+1*1.01
38	LMT.2-VH-ULS	(11+14+18+10)*1.35+15*0.53+16*0.97+19*1.68+20*0.50+2*1.01
39	LMT.3-VH-ULS	(11+14+18+10)*1.35+15*0.53+16*0.97+19*1.68+20*0.50+3*1.01
40	LM1.1-Vh-ULS	(11+14+18+1)*1.35+(15+16)*0.24+19*1.68
41	LM1.2-Vh-ULS	(11+14+18+2)*1.35+(15+16)*0.24+19*1.68
42	LM1.3-Vh-ULS	(11+14+18+3)*1.35+(15+16)*0.24+19*1.68
43	LM3.1-Vh-ULS	(11+14+18+7)*1.35+(15+16)*0.24+19*1.68
44	LM3.2-Vh-ULS	(11+14+18+8)*1.35+(15+16)*0.24+19*1.68
45	LM3.3-Vh-ULS	(11+14+18+9)*1.35+(15+16)*0.24+19*1.68
46	LM2.1-Vh-ULS	(11+14+18+4)*1.35+(15+16)*0.24+19*1.68
47	LM2.2-Vh-ULS	(11+14+18+5)*1.35+(15+16)*0.24+19*1.68
48	LM2.3-Vh-ULS	(11+14+18+6)*1.35+(15+16)*0.24+19*1.68
49	LM3&1.1-Vh-ULS	(11+14+18+22)*1.35+(15+16)*0.24+19*1.68+4*0.41
50	LM3&1.2-Vh-ULS	(11+14+18+23)*1.35+(15+16)*0.24+19*1.68+5*0.41
51	LM3&1.3-Vh-ULS	(11+14+18+24)*1.35+(15+16)*0.24+19*1.68+6*0.41
52	vH-ULS	11*0.95+(14+18)*1.00+(15+16)*0.97+19*0.76+(20+21)*0.90
53	LM1.1-T-vH-ULS	11*0.95+(14+18)*1.00+15*0.53+16*0.97+19*0.76+20*0.50+10*1.35
54	LM1.2-T-vH-ULS	11*0.95+(14+18)*1.00+15*0.53+16*0.97+19*0.76+20*0.50+10*1.35
55	LM1.3-T-vH-ULS	11*0.95+(14+18)*1.00+15*0.53+16*0.97+19*0.76+20*0.50+10*1.35

Kapitola 5

Obálky vnútorných síl

Obálka ohybových momentov (MSU)

Section	MY [kNm]	Load Case-Phase	Face
1	88.79	LM1.1-VH-ULS-Service Min	Internal
1	-73.97	LM1.1-T-vH-ULS-Service Min	External
4	152.17	LM3.1-VH-ULS-Service Min	Internal
4	39.58	LM3&1.3-Vh-ULS-Service Min	Internal
14	150.06	LM1.2-Vh-ULS-Service Min	Internal
14	-351.05	vH-ULS-Service Min	External
15	280.55	LM1.2-Vh-ULS-Service Min	Internal
15	-305.53	vH-ULS-Service Min	External
16	371.77	LM1.2-Vh-ULS-Service Min	Internal
16	-266.79	vH-ULS-Service Min	External
21	598.7	LM1.1-Vh-ULS-Service Min	Internal
21	-179.5	vH-ULS-Service Min	External
31	-120.82	LM3&1.3-Vh-ULS-Service Min	External
31	-455.25	LMT.1-VH-ULS-Service Min	External
32	-72.89	LM3&1.3-Vh-ULS-Service Min	External
32	-314.31	LM1.1-VH-ULS-Service Min	External
50	40.93	LM1.3-VH-ULS-Service Min	Internal
50	9.16	LM3&1.1-Vh-ULS-Service Min	Internal
57	49.06	LM1.3-Vh-ULS-Service Min	Internal
57	-27.12	vH-ULS-Service Min	External

Section	MY [kNm]	Load Case-Phase	Face
1	106.71	LM3.1-VH-ULS-Service Max	Internal
1	-46.12	vH-ULS-Service Max	External
4	184.59	LM3.1-VH-ULS-Service Max	Internal
4	69.58	LM1.1-T-vH-ULS-Service Max	Internal
14	97.35	LM1.2-Vh-ULS-Service Max	Internal
14	-385.2	vH-ULS-Service Max	External
15	262.28	LM1.2-Vh-ULS-Service Max	Internal
15	-290.02	vH-ULS-Service Max	External
16	392.53	LM1.2-Vh-ULS-Service Max	Internal
16	-209	vH-ULS-Service Max	External
21	665.58	LM1.1-Vh-ULS-Service Max	Internal
21	-26.48	vH-ULS-Service Max	External
31	-229.54	LM3&1.3-Vh-ULS-Service Max	External
31	-569.58	LMT.1-VH-ULS-Service Max	External
32	-138.16	LM3&1.3-Vh-ULS-Service Max	External
32	-391.45	LMT.1-VH-ULS-Service Max	External
50	46.44	LM1.2-VH-ULS-Service Max	Internal
50	12.93	LM1.1-T-vH-ULS-Service Max	Internal
57	56.79	LM1.2-Vh-ULS-Service Max	Internal
57	-12.78	vH-ULS-Service Max	External

Obálka ohybových momentov od kvázistálej kombinácie (MSP)

Section	MY [kNm]	Load Case-Phase	Face
1	28.04	VH-SLS-CW-Service Min	Internal
1	-22.12	vH-SLS-CW-Service Min	External
4	63.71	VH-SLS-CW-Service Min	Internal
4	29.54	Vh-SLS-CW-Service Min	Internal
14	4.73	Vh-SLS-CW-Service Min	Internal
14	-111.33	vH-SLS-CW-Service Min	External
15	48.95	Vh-SLS-CW-Service Min	Internal
15	-64.42	vH-SLS-CW-Service Min	External
16	85.45	Vh-SLS-CW-Service Min	Internal
16	-24.49	vH-SLS-CW-Service Min	External
21	154.35	Vh-SLS-CW-Service Min	Internal
21	65.46	vH-SLS-CW-Service Min	Internal
31	-89.03	Vh-SLS-CW-Service Min	External
31	-170.41	VH-SLS-CW-Service Min	External
32	-53.82	Vh-SLS-CW-Service Min	External
32	-121.57	VH-SLS-CW-Service Min	External
50	18.64	VH-SLS-CW-Service Min	Internal
50	6.68	Vh-SLS-CW-Service Min	Internal
57	8.35	Vh-SLS-CW-Service Min	Internal
57	-1.35	vH-SLS-CW-Service Min	External

Section	MY [kNm]	Load Case-Phase	Face
1	46.58	VH-SLS-CW-Service Max	Internal
1	-12.84	Vh-SLS-CW-Service Max	External
4	89.46	VH-SLS-CW-Service Max	Internal
4	55.51	Vh-SLS-CW-Service Max	Internal
14	15.75	Vh-SLS-CW-Service Max	Internal
14	-135.36	VH-SLS-CW-Service Max	External
15	102.24	Vh-SLS-CW-Service Max	Internal
15	-36.17	vH-SLS-CW-Service Max	External
16	173.63	Vh-SLS-CW-Service Max	Internal
16	46.03	vH-SLS-CW-Service Max	Internal
21	308.41	Vh-SLS-CW-Service Max	Internal
21	231.22	vH-SLS-CW-Service Max	Internal
31	-169.27	Vh-SLS-CW-Service Max	External
31	-279.73	VH-SLS-CW-Service Max	External
32	-101.99	Vh-SLS-CW-Service Max	External
32	-194.5	VH-SLS-CW-Service Max	External
50	25.55	VH-SLS-CW-Service Max	Internal
50	9.81	Vh-SLS-CW-Service Max	Internal
57	22.82	Vh-SLS-CW-Service Max	Internal
57	6.45	vH-SLS-CW-Service Max	Internal

Obálka šmykových síl (MSU)

Section	FZ [kNm]	Load Case-Phase	Face
1	225.11	LM3&1.3-VH-ULS-Service Min	Internal
1	52.39	LM3&1.3-Vh-ULS-Service Min	Internal
2	147.67	LM3&1.3-VH-ULS-Service Min	Internal
2	34.04	LM3&1.3-Vh-ULS-Service Min	Internal
4	18.57	LM1.1-T-vH-ULS-Service Min	Internal
4	-68.74	LM3.1-VH-ULS-Service Min	External
21	0	LM3&1.1-VH-ULS-Service Min	Internal
21	-98.58	LMT.1-VH-ULS-Service Min	External
31	339.17	LMT.1-VH-ULS-Service Min	Internal
31	124.57	LM3&1.3-Vh-ULS-Service Min	Internal
32	299.12	LMT.1-VH-ULS-Service Min	Internal
32	110.83	LM3&1.3-Vh-ULS-Service Min	Internal
33	261.19	LM1.1-VH-ULS-Service Min	Internal
33	93.32	LM3&1.3-Vh-ULS-Service Min	Internal
49	92.21	LM1.3-VH-ULS-Service Min	Internal
49	44.99	LM3&1.1-Vh-ULS-Service Min	Internal
50	152.01	LM1.3-VH-ULS-Service Min	Internal
50	76.59	LM3&1.1-Vh-ULS-Service Min	Internal
57	76.75	vH-ULS-Service Min	Internal
57	-144.89	LM1.3-Vh-ULS-Service Min	External
58	60.24	vH-ULS-Service Min	Internal
58	-96.99	LM1.3-Vh-ULS-Service Min	External

Section	FZ [kNm]	Load Case-Phase	Face
1	257.97	LM3&1.3-VH-ULS-Service Max	Internal
1	77.19	LM3&1.3-Vh-ULS-Service Max	Internal
2	167.07	LM3&1.3-VH-ULS-Service Max	Internal
2	49.11	LM1.1-T-vH-ULS-Service Max	Internal
4	7.82	LM1.1-T-vH-ULS-Service Max	Internal
4	-82.25	LM3.1-VH-ULS-Service Max	External
21	1.58	LM3.3-VH-ULS-Service Max	Internal
21	-103.46	LMT.2-VH-ULS-Service Max	External
31	429.5	LMT.1-VH-ULS-Service Max	Internal
31	238.46	LM3&1.3-Vh-ULS-Service Max	Internal
32	378.17	LMT.1-VH-ULS-Service Max	Internal
32	211.73	LM3&1.3-Vh-ULS-Service Max	Internal
33	322.57	LMT.1-VH-ULS-Service Max	Internal
33	178.13	LM3&1.3-Vh-ULS-Service Max	Internal
49	104.41	LM1.2-VH-ULS-Service Max	Internal
49	63.45	LM1.1-T-vH-ULS-Service Max	Internal
50	172.52	LM1.2-VH-ULS-Service Max	Internal
50	103.56	LM1.1-T-vH-ULS-Service Max	Internal
57	43.39	vH-ULS-Service Max	Internal
57	-167.77	LM1.2-Vh-ULS-Service Max	External
58	40.77	vH-ULS-Service Max	Internal
58	-112.97	LM1.2-Vh-ULS-Service Max	External

Projekt:	15403-OC3-9.5m x 5.4m	Job No. 15403
Objekt:	OC3-9.5mx5.4m	
Obsah:	Bending Moment Design EN1992-1-1-04	
Dátum:	15/4/2015	

Bar	h (mm)	b (mm)	c1 (mm)	c2 (mm)	n1 (pcs/m)	fi.1 (mm)	As1 (mm²/m)	n2 (pcs/m)	fi.2 (mm)	As2 (mm²/m)	fi.st (mm)	n
1	400	1000	50	50	10	16	2011	10	16	2011	12	16
1	400	1000	50	50	10	16	2011	10	16	2011	12	
2	400	1000	50	50	10	16	2011	10	16	2011	12	
4	400	1000	50	50	10	16	2011	10	16	2011	12	
14	450	1000	50	50	10	25	4909	5	25	2454	12	
15	450	1000	50	50	10	25	4909	10	25	4909	12	
16	450	1000	50	50	10	16	2011	10	25	4909	12	
21	450	1000	50	50	10	25	4909	10	16	2011	12	
31	400	1000	50	50	10	25	4909	10	12	1131	12	
32	400	1000	50	50	10	25	4909	10	12	1131	12	
33	400	1000	50	50	10	25	4909	10	12	1131	12	
49	400	1000	50	50	10	16	2011	10	16	2011	12	
50	400	1000	50	50	10	16	2011	10	16	2011	12	
57	450	1000	50	50	10	16	2011	10	16	2011	12	
57	450	1000	50	50	10	16	2011	10	16	2011	12	
58	433	1000	50	50	10	16	2011	10	16	2011	12	

$i := 1..n$

$$S_i := \frac{b_i}{\begin{cases} n_{1_i} & \text{if } n_{1_i} > 0 \\ 10000000 & \text{otherwise} \end{cases}}$$

$h := h \cdot mm \quad b := b \cdot mm \quad c_1 := c_1 \cdot mm \quad c_2 := c_2 \cdot mm$

$A_{s1} := A_{s1} \cdot mm^2 \quad A_{s2} := A_{s2} \cdot mm^2 \quad A_{c_i} := h_i \cdot b_i \quad bar_i := El_i$

$\phi_1 := \phi_1 \cdot mm \quad \phi_2 := \phi_2 \cdot mm \quad \phi_{st} := \phi_{st} \cdot mm$

$$d_{1_i} := c_{1_i} + \frac{\phi_{1_i}}{2} + \phi_{st_i} \qquad d_{2_i} := c_{2_i} + \frac{\phi_{2_i}}{2} + \phi_{st_i} \qquad d_i := h_i - d_{1_i}$$

$$z_{1_i} := 0.5 \cdot h_i - d_{2_i} \qquad z_{2_i} := -0.5 \cdot h_i + d_i$$

h -Výš ka prierezu
b -Š írka prierezu (1m)
c_1 -Nominálne krytie ť ahaný povrch
c_2 -Nominálne krytie tlač ený povrch
ϕ_1 -Priemer ť ahanej výstuž e
ϕ_2 -Priemer tlač enej výstuž e
ϕ_{st} -Priemer prieč nej výstuž e
n_1 - Poč et prútov ť ahaný povrch (na 1m)
n_2 - Poč et prútov tlač ený povrch (na 1m)
A_1 - Plocha ť ahanej výstuž e (na 1m)
A_2 - Plocha tlač enej výstuž e (na 1m)
e_0 -Excentricita normálovej sily
d -Úč inná výš ka prierezu
z_1 -Rameno ť ahanej výstuž e
z_2 -Rameno tlač enej výstuž e

Bar	MEd (kNm)	NEd (kN)	MEk (kNm)	NEk (kN)	Ved (kN)	Load Case
1	106.7	548	46.58	309.23	257.97	LM 3.1-VH-ULS-Serv
1	73.97	143.2	22.12	172.69	257.97	LM 1.1-T-vH-ULS-Se
2	NS	NS	NS	NS	167.07	NS
4	184.6	533.8	89.46	298.76	82.25	LM 3.1-VH-ULS-Serv
14	385.2	346.4	135.36	219.09	407.06	vH-ULS-Service Ma
15	305.5	251.8	64.42	119.67	356.99	vH-ULS-Service Mi
16	266.8	251.8	24.49	119.67	313.38	vH-ULS-Service Mi
21	665.6	368.8	308.41	190.2	103.46	LM 1.1-Vh-ULS-Serv
31	569.6	484.3	279.73	266.38	429.5	LM T.1-VH-ULS-Serv
32	391.5	489.9	194.5	270.55	378.17	LM T.1-VH-ULS-Serv
33	NS	NS	NS	NS	322.57	NS
49	NS	NS	NS	NS	104.41	NS
50	46.44	234.3	25.55	130.72	172.52	LM 1.2-VH-ULS-Serv
57	56.79	4.36	22.82	1.4303	167.77	LM 1.2-Vh-ULS-Serv
57	27.12	-2.83	1.35	-0.636	167.77	vH-ULS-Service Mi
58	NS	NS	NS	NS	112.97	NS

M_{Ed} -Ohybový moment od zať až enia MSU

N_{Ed} -Normálová sila od zať až enia MSU

M_{Ek} -Ohybový moment od zať až enia MSP

N_{Ek} -Normálová sila od zať až enia MSP

Ved - Š myková sila od zať až enia MSU

Výstuž :

Charakteristická medza klzu $f_{yk} := fyk\ MPa$

Návrhová pevnosť výstuž e $f_{yd} := \frac{f_{yk}}{\gamma_{s\_steel}}$

$\gamma_{s\_steel} \equiv 1.15$

$E_s := 200GPa$

$\varepsilon_{yd} := \frac{f_{yd}}{E_s}$

ε_{cu3} -Pomerné pretvorenie betónu

γ_c -Parciálny faktor spoľ ahlivosti betónu

α_{cc} - Súč initeľ dlhodobej pevnosti betónu v tlaku

η -Súč initeľ tlakovej pevnosti betónu

λ -Súč initeľ definujúci efektívnu výš ku tlač enej zóny betónu

f_{cd} -Návrhová pevnosť betónu v tlaku

Hodnoty zobrané z tabuľ ky 3.1 EN 1992-1-1:2006

Priemerná hodnota pevnosti betónu v tlaku po 28 dň och $f_{cm} := f_{cm} \frac{N}{mm^2}$

Charakteristická valcová pevnosť betónu v tlaku $f_{ck} := f_{ck} \frac{N}{mm^2}$

Súč initeľ veku betónu $\beta_{cc}(t) := e^{.2\left[1-\left(\frac{28}{t}\right)^{\frac{1}{2}}\right]}$ Eq3.1

Priemerná hodnota pevnosti betónu v tlaku v závislosti od veku $f_{cm\_}(t) := \beta_{cc}(t) \cdot f_{cm}$ Eq 3.1

Tieto hodnoty je potrebné zobrať z tabuľky 3.1 EN 1992-1-1page 31

$$f_{ctm}(f_{ck}, f_{cm}) := \left| \begin{array}{l} f_1 \leftarrow \dfrac{f_{ck}}{\dfrac{N}{mm^2}} \\ f_2 \leftarrow \dfrac{f_{cm}}{\dfrac{N}{mm^2}} \\ 0.3 \cdot (f_1)^{\left(\frac{2}{3}\right)} \cdot \dfrac{N}{mm^2} \quad \text{if } f_{ck} \le 50\dfrac{N}{mm^2} \\ 2.12 \cdot \ln\left[1 + \left(\dfrac{f_2}{10}\right)\right] \cdot \dfrac{N}{mm^2} \quad \text{otherwise} \end{array} \right.$$

$$f_{ctm}(f_{ck}, f_{cm}) = 3.795 \cdot \frac{N}{mm^2}$$

$$f_{ck\_}(t, f_{cm}, f_{ck}) := \left| \begin{array}{l} f_{cm\_}(t) - 8\dfrac{N}{mm^2} \quad \text{if } 3 < t < 28 \\ f_{ck} \quad \text{otherwise} \end{array} \right.$$

Charakteristická pevnosť betíonu v tlaku v závislosti od veku $f_{ck\_}(28, f_{cm}, f_{ck}) = 45.000 \cdot \text{MPa}$

Cl 3.1.2.9

$$f_{ctm\_}(f_{ck}, f_{cm}, t) := \left| \begin{array}{l} \alpha \leftarrow 1 \quad \text{if } t < 28 \\ \alpha \leftarrow \dfrac{2}{3} \quad \text{otherwise} \\ \beta_{cc}(t)^{\alpha} \cdot f_{ctm}(f_{ck}, f_{cm}) \end{array} \right.$$

$$f_{ctm\_}(f_{ck}, f_{cm}, 20) = 3.659 \cdot \text{MPa}$$

Modul pruž nosti betónu: $E_{cm}(f_{cm}) := 22 \cdot 1000 \cdot \left(\dfrac{f_{cm} \cdot \dfrac{mm^2}{N}}{10} \right)^{.3} \cdot \dfrac{N}{mm^2}$

$E_{cm}(f_{cm}) = 36688.629\ \text{MPa}$

Modul pruž nosti betónu v závislosti od veku: $Ecm\_(t, f_{cm}) := \left(\dfrac{f_{cm\_}(t)}{f_{cm}} \right)^{.3} \cdot E_{cm}(f_{cm})$ Eq 3.5

$$\varepsilon_{cu1}(f_{ck}, f_{cm}) := \begin{cases} \dfrac{3.5}{1000} & \text{if } f_{ck} < 50\dfrac{N}{mm^2} \\ \dfrac{\left[2.8 + 21 \cdot \left[\dfrac{\left(98 - \dfrac{f_{cm}}{\dfrac{N}{mm^2}}\right)}{100}\right]^4\right]}{1000} & \text{otherwise} \end{cases}$$

$$\varepsilon_{c2}(f_{ck}) := \begin{cases} .002 & \text{if } f_{ck} < 50\dfrac{N}{mm^2} \\ .002 + \dfrac{.085 \cdot \left(\dfrac{f_{ck}}{\dfrac{N}{mm^2}} - 50 \right)^{.53}}{1000} & \text{otherwise} \end{cases}$$

$$\varepsilon_{cu2}(f_{ck}) := \begin{cases} .0035 & \text{if } f_{ck} < 50\dfrac{N}{mm^2} \\ .0026 + \dfrac{35 \cdot \left[\dfrac{\left(90 - \dfrac{f_{ck}}{\dfrac{N}{mm^2}}\right)}{100}\right]^4}{1000} & \text{otherwise} \end{cases}$$

$$\varepsilon_{c3}(f_{ck}) := \begin{cases} .00175 & \text{if } f_{ck} < 50\dfrac{N}{mm^2} \\ .00175 + \dfrac{.55 \cdot \left[\dfrac{\left(\dfrac{f_{ck}}{\dfrac{N}{mm^2}} - 50\right)}{40}\right]^4}{1000} & \text{otherwise} \end{cases}$$

$$\varepsilon_{cu3}(f_{ck}) := \begin{cases} .0035 & \text{if } f_{ck} < 50\dfrac{N}{mm^2} \\ .0026 + \dfrac{35 \cdot \left[\dfrac{\left(90 - \dfrac{f_{ck}}{\dfrac{N}{mm^2}}\right)}{100}\right]^4}{1000} & \text{otherwise} \end{cases}$$

Výpoč tová pevnosť betónu v tlaku $f_{cd} := \alpha_{cc} \cdot \dfrac{f_{ck}}{\gamma c}$ **Eq 3.15**

$\alpha_{cc} \equiv 0.85$ $\gamma c \equiv 1.5$

$f_{ctk\_.05}(f_{ck}, f_{cm}) := .7 \cdot f_{ctm}(f_{ck}, f_{cm})$ **Eq 3.16**

Výpoč tová pevnosť betónu v tlaku $f_{ctd}(f_{ck}, f_{cm}) := \alpha_{ct} \cdot \dfrac{f_{ctk\_.05}(f_{ck}, f_{cm})}{\gamma c}$

$\alpha_{ct} \equiv 1$

Kapitola 6

Posúdenie prierezov namáhaných tlakom za ohybu (MSU)

Reference:C:\Program Files\ABM ADD Automation Menu\Output\15403_OC3-9.5mx5.4m\Rev_0\MathCAD\MathCAD Design - Input.xmcd(R

$h := h$ $b := b$ $c_1 := c_1$ $c_2 := c_2$ $i := 1 .. n$

$A_{s1} := A_{s1}$ $A_{s2} := A_{s2}$ $A_{c_i} := h_i \cdot b_i$

$\phi_1 := \phi_1$ $\phi_2 := \phi_2$ $\phi_{st} := \phi_{st}$

$$d_{1_i} := c_{1_i} + \frac{\phi_{1_i}}{2} + \phi_{st_i} \qquad d_{2_i} := c_{2_i} + \frac{\phi_{2_i}}{2} + \phi_{st_i}$$

$$z_{1_i} := 0.5 \cdot h_i - d_{2_i} \qquad z_{2_i} := -0.5 \cdot h_i + d_i \qquad d_i := h_i - d_{1_i}$$

$$e_{0_i} := \max\left(\frac{h_i}{30}, 20mm\right)$$

$M_{Ed} := M_{Ed} \cdot kN \cdot m$ $N_{Ed} := N_{Ed} \cdot kN$

$$M_{Ed_i} := M_{Ed_i} + \left|N_{Ed_i} \cdot e_{0_i}\right|$$

n -Počet posudzovaných prútov
h -Výška prierezu
b -Šírka prierezu (1bm)
c_1 -Krytie výstuže pri ťahanom vlákne
c_2 -Krytie výstuže pri tlačenom vlákne
M_{Ed} -Návrhová hodnota momentu od zaťaženia
N_{Ed} -Návrhová hodnota normálovej sily od zaťaženia
ϕ_1 -Priemer ťahovej výstuže
ϕ_2 -Priemer tlakovej výstuže
ϕ_{st} -Priemer priečnej výstuže
n_1 - Počet prútov ťahovej výstuže na 1bm
n_2 - Počet prútov tlakovej výstuže na 1bm
A_1 - Plocha ťahovej výstuže na 1bm
A_2 - Plocha tlakovej výstuže na 1bm
e_0 -Minimálna výstrednosť tlakovej sily
d -Účinná výška prierezu
z_1 -Rameno vnútorných síl
z_2 -Rameno vnútorných síl

MATERIÁLOVÉ CHARAKTERISTIKY:

BETÓN:

$f_{ck} = 45 \cdot MPa$

$\varepsilon_{cu3}(f_{ck}) = 0.0035$

$\gamma_c = 1.5$

$\alpha_{cc} = 0.85$

$f_{cd} = 25.5 \cdot MPa$

$$\lambda(f_{ck}) := \begin{cases} .8 & \text{if } f_{ck} \le 50 \frac{N}{mm^2} \\ .8 - \frac{f_{ck} - 50 \cdot \frac{N}{mm^2}}{400 \cdot \frac{N}{mm^2}} & \text{otherwise} \end{cases}$$

$$\eta(f_{ck}) := \begin{cases} 1 & \text{if } f_{ck} \le 50 \frac{N}{mm^2} \\ 1 - \frac{f_{ck} - 50 \cdot \frac{N}{mm^2}}{200 \cdot \frac{N}{mm^2}} & \text{otherwise} \end{cases}$$

f_{ck} -Charakteristická valcová pevnosť betónu v tlaku
ε_{cu3} -Pomerné pretvorenie betónu v tlaku
γ_c -Súčiniteľ spoľahlivosti betónu
α_{cc} -Súčiniteľ dlhodobej spoľahlivosti betónu
η -Súčiniteľ tlakovej pevnosti betónu
λ -Súčiniteľ definujúci efektívnu výšku tlačenej zóny betónu
f_{cd} -Návrhová pevnosť betónu v tlaku

VÝSTUŽ : B500B

$E_s = 2 \times 10^5 \cdot MPa$

$f_{yd} = 434.8 \cdot MPa$

$\varepsilon_{yd} = 0.002174$

$\gamma_s := 1.15$

f_{yk} -Charakteristická pevnosť výstuže v ťahu
E_s -Modul pružnosti výstuže
γ_s -Súčiniteľ spoľahlivosti výstuže
f_{yd} -Návrhová pevnosť výstuže v ťahu
ε_{yd} -Pomerné pretvorenie výstuže v ťahu

VÝPOČ ET VÝSTREDNOSTI NAMÁHANÝCH PRIEREZOV:

$$\xi_{bal1} := \frac{\varepsilon_{cu3}(f_{ck})}{\varepsilon_{cu3}(f_{ck}) + \varepsilon_{yd}} \qquad \xi_{bal2} := \frac{\varepsilon_{cu3}(f_{ck})}{\varepsilon_{cu3}(f_{ck}) - \varepsilon_{yd}}$$

$$\xi_{bal1} = 0.617 \qquad \xi_{bal2} = 2.639$$

$$N_{Rdbal_i} := \lambda(f_{ck}) \cdot \xi_{bal1} \cdot b_i \cdot d_i \cdot \eta(f_{ck}) \cdot f_{cd} + \left(A_{s2_i} - A_{s1_i}\right) \cdot f_{yd}$$

$$Výstrednost_i := if\left(N_{Rdbal_i} < \left|N_{Ed_i}\right|, "ERROR", "Veľká\ výstrednosť"\right)$$

Výstrednost = ("Velká výstrednost", "Velká výstrednost", "Velká výstrednost", "Velká výstrednost", "Velká výstrednost", "Velká výstrednost", "Velká výstrednost", "Velká výstrednost", "Velká výstrednost", "Velká výstrednost", "Velká výstrednost", "Velká výstrednost", "Velká výstrednost", "Velká výstrednost", "Velká výstrednost", "Velká výstrednost")

Ak je "Veľ ká výstrednosť ", σ s1=fyd
Ak je "ERROR" σ s1<fyd a tento výpoč et neplatí

POSÚDENIE:

$$\sigma_{s2_i} := root\left[\frac{\varepsilon_{cu3}(f_{ck}) \cdot \left(\frac{\left|N_{Ed_i}\right| - A_{s2_i} \cdot \sigma_{s2} + A_{s1_i} \cdot f_{yd}}{\lambda(f_{ck}) \cdot b_i \cdot \eta(f_{ck}) \cdot f_{cd}} - d_{2_i}\right)}{\frac{\left|N_{Ed_i}\right| - A_{s2_i} \cdot \sigma_{s2} + A_{s1_i} \cdot f_{yd}}{\lambda(f_{ck}) \cdot b_i \cdot \eta(f_{ck}) \cdot f_{cd}}} \cdot E_s - \sigma_{s2}, \sigma_{s2}\right]$$

$$\sigma_{s2_i} := \begin{cases} 0 & \text{if } \sigma_{s2_i} < 0 \\ f_{yd} & \text{if } \sigma_{s2_i} > f_{yd} \\ \sigma_{s2_i} & \text{otherwise} \end{cases}$$

σ_{s2} -Napätie v tlač enej výstuž i
x -Poloha neutrálnej osi
N_{Rdbal}-Normálová sila na medzi veľ kej a malej výstrednos
M_{Rd}-Moment na medzi únosnosti

$$x_i := \frac{\left|N_{Ed_i}\right| - A_{s2_i} \cdot \sigma_{s2_i} + A_{s1_i} \cdot f_{yd}}{\lambda(f_{ck}) \cdot b_i \cdot \eta(f_{ck}) \cdot f_{cd}}$$

OHYBOVÝ MOMENT NA MEDZI ÚNOSNOSTI:

$$M_{Rd_i} := \lambda(f_{ck}) \cdot b_i \cdot x_i \cdot \eta(f_{ck}) \cdot f_{cd} \cdot 0.5 \cdot \left(h_i - \lambda(f_{ck}) x_i\right) + A_{s2_i} \cdot \sigma_{s2_i} \cdot z_{2_i} + A_{s1_i} \cdot f_{yd} \cdot z_{1_i}$$

Utilization :=

Bar	x (mm)	πs2 (Mpa)	M_{ED}(kN*m)	M_{RD}(kN*m)	Utilization	Result
1	0.070	0.0	117.7	358.4	32.8%	OK
1	0.050	0.0	76.8	296.8	25.9%	OK
2	0.043	0.0	0.0	273.5	0.0%	OK
4	0.069	0.0	195.3	356.4	54.8%	OK
14	0.100	178.9	392.1	764.9	51.3%	OK
15	0.089	115.4	310.6	750.9	41.4%	OK
16	0.055	0.0	271.8	360.1	75.5%	OK
21	0.101	216.543	673.0	777.7	86.5%	OK
31	0.113	278.465	579.3	677.9	85.4%	OK
32	0.113	279.317	401.2	678.5	59.1%	OK
33	0.094	193.141	0.0	620.3	0.0%	OK
49	0.043	0.000	0.0	273.5	0.0%	OK
50	0.054	0.000	51.1	311.3	16.4%	OK
57	0.043	0.000	56.9	318.0	17.9%	OK
57	0.043	0.000	27.2	317.7	8.6%	OK
58	0.043	0.000	0.0	302.3	0.0%	OK

$$\left(bar \quad x \quad \frac{\sigma_{s2}}{1000000} \quad \frac{Mt_{Ed}}{1000} \quad \frac{M_{Rd}}{1000} \quad Result\right)$$

REKAPITULÁCIA NÁVRHU:

	Tension steel / 1m			Compression steel / 1m		
Bar	n1 (pcs/1m)	fi.1 (mm)	As1 (mm^2/m)	n2 (pcs/1m)	fi.2 (mm)	As2 (mm^2/m)
1	10	16	2010.62	10	16	2010.62
1	10	16	2010.62	10	16	2010.62
2	10	16	2010.62	10	16	2010.62
4	10	16	2010.62	10	16	2010.62
14	10	25	4908.74	5	25	2454.37
15	10	25	4908.74	10	25	4908.74
16	10	16	2010.62	10	25	4908.74
21	10	25	4908.74	10	16	2010.62
31	10	25	4908.74	10	12	1130.97
32	10	25	4908.74	10	12	1130.97
33	10	25	4908.74	10	12	1130.97
49	10	16	2010.62	10	16	2010.62
50	10	16	2010.62	10	16	2010.62
57	10	16	2010.62	10	16	2010.62
57	10	16	2010.62	10	16	2010.62
58	10	16	2010.62	10	16	2010.62

$$\left(bar \quad nt_1 \quad \phi t_1 \quad At_{s1} \quad nt_2 \quad \phi t_2 \quad At_{s2}\right)$$

Kapitola 7

Posúdenie prierezov na medzný stav šírky trhlín (MSP)

	Projekt:	15403-OC3-9.5m x 5.4m	Job No. 15403
ABM MOSTY	Objekt:	OC3-9.5mx5.4m	
	Obsah:	Crack Width Check in accordance with En1992-1-1 7.3.4	
	Dátum:	15/4/2015	

Reference:C:\Program Files\ABM ADD Automation Menu\Output\15403_OC3-9.5mx5.4m\Rev_0\MathCAD\MathCAD Design - Input.xmcd(R)

MATERIÁLOVÉ CHARAKTERISTIKY:

Vek betónu $t := 28$ days

Charakteristická medza klzu výstuž e $f_{yk} = 500 \cdot MPa$

Súč initeľ dotvarovania $\Phi := 1.5$

$E_s = 200 \cdot GPa$

$$\alpha_e := \frac{E_s}{E_{cm}(f_{cm}) \cdot .9} \cdot (1 + \Phi)$$

Súč initeľ normálovej sily $k_1 := 1.5$

VÝPOČ ET Š ÍRKY TRHLÍN:

Bar	kt	Doba trvania zaťaženia
1	0.4	long
1	0.4	long
2	0.4	long
4	0.4	long
14	0.4	long
15	0.4	long
16	0.4	long
21	0.4	long
31	0.4	long
32	0.4	long
33	0.4	long
49	0.4	long
50	0.4	long
57	0.4	long
57	0.4	long
58	0.4	long

$$\rho_i := \frac{A_{s_i}}{b_i \cdot d_{e_i}} \qquad \rho_{2_i} := \frac{A_{scom_i}}{b_i \cdot d_{e_i}}$$

$$As\_min \cdot \sigma_c = k_c \cdot k \cdot f_{ct\_eff} \cdot A_{ct}$$

$$\sigma_{c_i} := \frac{N_{Ed_i}}{b_i \cdot h_i}$$

$$h_1(h) := if(h < 1000, h, 1000)$$

$$\sigma_s := f_{yk}$$

$$f_{ct\_eff}(t) := f_{ctm\_}(f_{ck}, f_{cm}, t) \qquad h := \frac{h}{m}$$

Charakteristická pevnosť betónu v ťahu v č ase $f_{ct\_eff}(t) = 3.795 \cdot MPa$

$$k(h) := \begin{cases} 1 & \text{if } h \le 300 \\ 1 - h \cdot .0004375 & \text{if } 300 < h \le 800 \\ .65 & \text{otherwise} \end{cases}$$

$$k_c(t,i) := .4 \cdot \left(1 - \frac{\sigma_{c_i}}{\frac{k_1 \cdot h_i}{h_1(h)} \cdot f_{ct\_eff}(t)} \right)$$

Poloha neutrálnej osi prierezu bez trhlín $x_{uncracked}$

$$x_{uncracked\ i} := \frac{b_i \cdot \frac{(h_i m)^2}{2} + b_i \cdot d_{e_i} \cdot (\alpha_e - 1) \cdot \left(\rho_i \cdot d_{e_i} + \rho_{2_i} \cdot d_{2_i}\right)}{b_i \cdot h_i m + b_i \cdot d_{e_i} \cdot (\alpha_e - 1) \cdot \left(\rho_i + \rho_{2_i}\right)}$$

Moment zotrvač nosti prierezu bez trhlín I_{u_i}

$$I_{u_i} := b_i \cdot \frac{(h_i m)^3}{12} + b_i \cdot h_i m \cdot \left(\frac{h_i m}{2} - x_{uncracked_i}\right)^2 + (\alpha_e - 1) \cdot \left[\left[A_{s_i} \cdot \left(d_{e_i} - x_{uncracked_i}\right)^2\right] + A_{scom_i} \cdot \left(x_{uncracked_i} - d_{2_i}\right)^2\right]$$

Ohybový moment na medzi vzniku trhlín M_{cr}

$$M_{cr_i} := f_{ct\_eff}(t) \cdot \frac{I_{u_i}}{\left(h_i \cdot m - x_{uncracked_i}\right)}$$

Poloha neutrálnej osi prierezu s ohybovou trhlinou:

$$K_i := -\alpha_e \cdot \left(\rho_i + \rho_{2_i}\right) + \sqrt{\alpha_e^2 \cdot \left(\rho_i + \rho_{2_i}\right)^2 + 2 \cdot \alpha_e \cdot \left(\rho_i + \rho_{2_i} \cdot \frac{d_{2_i}}{d_{e_i}}\right)}$$

$$x_{c_i} := K_i \cdot d_{e_i}$$

$$I_{c\_transformed_i} := \frac{b_i \cdot \left(x_{c_i}\right)^3}{3} + \alpha_e \cdot \rho_{2_i} \cdot b_i \cdot d_{e_i} \cdot \left(x_{c_i} - d_{2_i}\right)^2 + \alpha_e \cdot \rho_i \cdot b_i \cdot d_{e_i} \cdot \left(d_{e_i} - x_{c_i}\right)^2$$

Napätie v betóne pri ť ahanom vlákne:

$$M_{e_i} := M_{app_i} + N_{Ek_i} \cdot kN \cdot e_1$$

$$\sigma_{concrete_i} := \frac{M_{e_i} \cdot x_{c_i}}{I_{c\_transformed_i}} - \frac{N_{Ek_i}}{b_i \cdot h_i \cdot m} \cdot kN$$

Napätie vo výstuž i pri ť ahanom vlákne:

$$\sigma_{steel_i} := \sigma_{concrete_i} \cdot \alpha_e \cdot \frac{\left(d_{e_i} - x_{c_i}\right)}{x_{c_i}} - \frac{N_{Ek_i}}{b_i \cdot h_i \cdot m} \cdot kN$$

Efektívna ť ahaná plocha betónu:

$$A_{c\_eff_i} := \min\left[\frac{h_i m}{2}, 2.5 \cdot \left(h_i m - d_{e_i}\right), \frac{\left(h_i m - x_{c_i}\right)}{3}\right] \cdot b_i - A_{s_i}$$

$$\rho_{p\_eff_i} := \frac{A_{s_i}}{A_{c\_eff_i}}$$

Súč initeľ súdrž nosti výstuž e $K_1 := .8$ Cl 7.2

Súč initeľ rozdelenia pomerného pretvorenia $K_2 := 0.5$

$K_3 := 3.4$

$K_4 := .425$

Maximálna vzdialenosť trhlín:

$$S_{r\_max_i} := \text{if}\left[S_i\,mm \le 5\cdot\left(C_{nom_i} + \frac{\phi_i}{2}\right), K_3\cdot C_{nom_i} + K_1\cdot K_2\cdot K_4\cdot\frac{\phi_i}{\rho_{p\_eff_i}}, 1.3\left(h_i\,m - x_{c_i}\right)\right]$$

$$\varepsilon_{sm} - \varepsilon_{cm} = \frac{\sigma_s - k_t\cdot\frac{f_{ct\_eff}(t)\cdot\left(1 + \alpha_e\cdot\rho_{p\_eff}\right)}{\rho_{p\_eff}}}{E_s} \ge 0.6\cdot\frac{\sigma_s}{E_s}$$

Priemerná hodnota pomerného pretvorenia výstuž e $\varepsilon_{sm_i} := \frac{\sigma_{steel_i}}{E_s}$

Priemerná hodnota pomerného pretvorenia betónu medzi trhlinami $\varepsilon_{cm_i} := \frac{\left[k_{t_i}\cdot\frac{f_{ct\_eff}(t)\cdot\left(1 + \alpha_e\cdot\rho_{p\_eff_i}\right)}{\rho_{p\_eff_i}}\right]}{E_s}$

Eq 7.9

$$\varepsilon_i := \max\left(\varepsilon_{sm_i} - \varepsilon_{cm_i}, .6\cdot\frac{\sigma_{steel_i}}{E_s}\right)$$

Š írka trhliny $W_{k_i} := \text{if}\left[M_{e_i} \ge M_{cr_i}, S_{r\_max_i}\cdot\left(\varepsilon_i\right), 0\right]$ Eq 7.8

Bar	Mcr (kNm)	M Applied	σ concrete (MPa)	σ steel (MPa)	Crack Width (mm)
1	119	54.3	2.2	68.2	0.00
1	119	26.4	1.0	31.4	0.00
2	119	0.0	0.0	0.0	0.00
4	119	96.9	4.5	142.5	0.00
14	174	140.8	3.9	79.8	0.00
15	181	67.4	1.6	36.9	0.00
16	157	27.5	0.8	30.7	0.00
21	174	313.2	9.6	191.3	0.17
31	135	286.4	11.6	201.5	0.18
32	135	201.3	8.0	137.7	0.11
33	135	0.0	0.0	0.0	0.00
49	119	0.0	0.0	0.0	0.00
50	119	28.8	1.2	38.9	0.00
57	151	22.9	1.0	33.7	0.00
57	151	1.3	0.1	2.0	0.00
58	140	0.0	0.0	0.0	0.00

$$\left(\text{bar}\quad \frac{M_{cr}}{1000}\quad \frac{M_e}{1000}\quad \frac{\sigma_{concrete}}{1000000}\quad \frac{\sigma_{steel}}{1000000}\quad W_k\cdot 1000\right)$$

Kapitola 8

Posúdenie prierezov namáhaných šmykom za ohybu (MSU)

Reference:C:\Program Files\ABM ADD Automation Menu\Output\15403_OC3-9.5mx5.4m\Rev_0\MathCAD\MathCAD Design - Input.xmcd(R)

$f_{ywk} :=$

UŽ ENIA:

$f_{ywd} :=$

$$C_{Rdc} := \frac{0.18}{\gamma c}$$

$$k_i := min\left(1 + \sqrt{\frac{200mm}{d_i}}, 2\right)$$

$$\sigma_{cp_i} := min\left(\frac{N_{Ed_i}}{b_i \cdot h_i}, 0.2f_{cd}\right)$$

$$\rho_{l_i} := \frac{A_{s1_i}}{b_i \cdot d_i}$$

$$v_{min_i} := 0.035 \cdot \left(k_i\right)^{\frac{3}{2}} \cdot \sqrt{\frac{f_{ck}}{MPa}} \cdot MPa$$

$$\upsilon := 0.6 \cdot \left(1 - \frac{f_{ck}}{250MPa}\right)$$

$$V_{Rdcmin_i} := \left(v_{min_i} + 0.15\sigma_{cp_i}\right) \cdot b_i \cdot d_i$$

$$V_{Rdmax_i} := 0.5 \cdot b_i \cdot d_i \cdot \upsilon \cdot f_{cd}$$

$$V_{Rdc_i} := \left[C_{Rdc} \cdot k_i \cdot \left(\frac{100 \cdot \rho_{l_i} \cdot f_{ck}}{MPa}\right)^{0.33} \cdot MPa + 0.15 \cdot \sigma_{cp_i}\right] \cdot b_i \cdot d_i$$

Š MYKOVÁ ODOLNOSŤ PRIEREZU BEZ Š MYKOVEJ VÝSTUŽ E:

$$VRdc_i := \begin{cases} V_{Rdcmin_i} & if\ V_{Rdc_i} < V_{Rdcmin_i} \\ V_{Rdmax_i} & if\ V_{Rdc_i} > V_{Rdmax_i} \\ V_{Rdc_i} & otherwise \end{cases}$$

PRVKY SO Š MYKOVÝM VYSTUŽ ENÍM:

VPLYV NORMÁLOVEJ SILY

$$\alpha_{cw_i} := min\left(1 + \frac{\sigma_{cp_i}}{f_{cd}}, 1.25\right)$$

PODMIENKA PRE Ved < VRd_max_22

$$V_{Rd\_max\_22_i} := \alpha_{cw_i} \cdot 0.3125 \cdot \upsilon \cdot f_{cd} \cdot b_i \cdot d_i$$

PODMIENKA PRE VRd_max_45 >Ved > VRd_max_22

$$V_{Rd\_max\_45_i} := \alpha_{cw_i} \cdot 0.45 \cdot \upsilon \cdot f_{cd} \cdot b_i \cdot d_i$$

VÝPOČ ET SKLONU TLAKOVEJ DIAGONÁLY θ

$$\theta_{x_i} := min\left(\frac{\pi}{4}, \left|0.5 \cdot asin\left(\frac{Ved_i}{V_{Rd\_max\_45_i}}\right)\right|\right)$$

$$\theta_i := \begin{cases} 22\frac{\pi}{180} & if\ \theta_{x_i} \le 22\frac{\pi}{180} \\ \theta_{x_i} & otherwise \end{cases}$$

KONTROLA TLAKOVEJ DIAGONÁLY

$$V_{Rd\_max_i} := \begin{cases} \dfrac{\alpha_{cw_i} \cdot \upsilon \cdot f_{cd} \cdot b_i \cdot 0.9d_i}{\left(tan(\theta_i) + \dfrac{1}{tan(\theta_i)}\right)} & if\ \dfrac{\alpha_{cw_i} \cdot \upsilon \cdot f_{cd} \cdot b_i \cdot 0.9d_i}{\left(tan(\theta_i) + \dfrac{1}{tan(\theta_i)}\right)} \ge Ved_i \\ 0.0001kN & otherwise \end{cases}$$

NÁVRH STRMEŇ OV A SPÔN (na 1000 x 1000mm)

$$s\_links := 1000mm$$

$$A_{sw_i} := \begin{cases} \dfrac{Ved_i \cdot s\_links}{0.9 \cdot d_i \cdot f_{yd} \cdot \dfrac{1}{tan(\theta_i)}} \\ 0 \quad if\ VRdc_i > \left|Ved_i\right| \end{cases}$$

MINIMÁLNY STUPEŇ VYSTUŽ ENIA (na 1000 x 1000mm)

$$A_{sw\_min_i} := \frac{0.08 \cdot \sqrt{\dfrac{f_{ck}}{MPa}} \cdot MPa \cdot b_i \cdot s\_links}{f_{yk}}$$

$$A_{prov_i} := max\left(A_{sw\_min_i}, A_{sw_i}\right)$$

MAXIMÁLNA VZDIALENOSŤ STRMEŇ OV A SPÔN:

Pozdĺ ž ny smer:

$\phi_i := min(\phi_{1_i}, \phi_{2_i})$

$s1max_i := min(15 \cdot \phi_i, 300mm)$

Prieč ny smer:

$s2max_i := 300mm$

PRÍDAVNÁ HLAVNÁ VÝSTUŽ :

$$\Delta F_{sd_i} := 0.5 \cdot Ved_i \cdot \frac{1}{tan(\theta_i)}$$

$$\Delta A_{s1_i} := \begin{cases} \frac{\Delta F_{sd_i}}{f_{yd}} \\ 0 \ \ if \ \ VRdc_i > |Ved_i| \end{cases}$$

Prút	Šmyková odolnosť prvkov bez šmyk. výstuže (kN)	Min plocha šmyk. výstuže (mm2/m2)	Potrebná plocha šmyk. výstuže (mm2/m2)	Navrhnutá plocha šmyk. výstuže (mm2/m2)	Vzdialenosť strmeňov v pozdĺžnom smere (mm)	Vzdialenosť spôn v priečnom smere (mm)	Prídavná hlavná výstuž (mm2)	Kontrola tlakovej diagonály (kN)
1	278	1073	0	1073	240	300.0	0	1364
1	228	1073	807	1073	240	300.0	734	1312
2	210	1073	0	1073	240	300.0	0	1294
4	276	1073	0	1073	240	300.0	0	1362
14	342	1073	1119	1119	300	300.0	1159	1517
15	331	1073	982	1073	300	300.0	1016	1505
16	256	1073	851	1073	240	300.0	892	1523
21	345	1073	0	1073	240	300.0	0	1520
31	339	1073	1362	1362	180	300.0	1223	1337
32	340	1073	1200	1200	180	300.0	1076	1338
33	280	1073	1023	1073	180	300.0	918	1277
49	210	1073	0	1073	240	300.0	0	1294
50	239	1073	0	1073	240	300.0	0	1324
57	225	1073	0	1073	240	300.0	0	1491
57	224	1073	0	1073	240	300.0	0	1490
58	219	1073	0	1073	240	300.0	0	1424
								0
								0
								0
								0

Kapitola 9

Návrh výstuže kĺbového spoja (MSU)

[redacted]

a. Reinforcement to resist spalling

For this scenario the capacity of the concrete is ignored and it is assumed that all the shear forces shall be resisted by the reinforcement. The reinforcement is determined to resist an enhanced shear force including, the shear force and 4% of the axial force. The steel stress should not exceed , nor should the steel strain exceed $.001$ Hence it should be design for Mild steel with $f_y := 200 \frac{N}{mm^2}$ (CIRA Guide 1 Section 3.5).

$$\begin{pmatrix} P \\ V \end{pmatrix} :=$$

P (kN)	Shear stress (kN)
568	268.6205

Axial Force at ULS $P_u := P \cdot kN$ $\quad P_u = 568 \cdot kN$

Shearing stress of the rupture at connection: $V := V \cdot kN$

Enhanced shear force $V_{enhanced} := V + .04 \cdot P_u$

Required links $A := \frac{V_{enhanced}}{f_y}$ $\quad A = 1457 \, mm^2$

b. Bursting Resistance

The reinforcement that should resist the localised shear at the joint is calculated based on the Chapter 7 of Multi- Storey Precast Concrete Frame Structures by K.S Elliot. The book specifies a check calculation to determine the additional reinforcement to resist the lateral effect of bursting due to outward diffusion of force. The are of steel is calculated based on the formula;

$f_y := 500 \frac{N}{mm^2}$, $\quad A_{burs} := \frac{P_u \cdot \xi}{\gamma_m \cdot f_y}$

$\xi \equiv .7$ Recommended coefficient $\qquad \gamma_m \equiv .87$ Partial safety factor for strength

$P_u = 568 \cdot kN$ Axial Force at ULS

required stirrups to resist the bursting $A_{burs} = 914 \, mm^2$

Kapitola 10

Napätie v základovej špáre (MSU)

Projekt	15403-OC3-9.5m x 5.4m		Job No. 15403
Objekt	OC3-9.5mx5.4m		
Predemet			
Navrh	RS	Datum	15/4/2015

Bar	Reaction (kN)	Case	L	n1	n2
49	35.67	LM1.2-VH-ULS-Service Max	1.7	10	20
50	70.72	LM1.2-VH-ULS-Service Max			
51	70.1	LM1.2-VH-ULS-Service Max			
52	69.45	LM1.2-VH-ULS-Service Max			
53	51.43	LM1.2-VH-ULS-Service Max			
54	118.51	LM1.2-VH-ULS-Service Max			
55	138.48	LM1.2-VH-ULS-Service Max			
56	94.5	LM1.2-VH-ULS-Service Max			
57	92.79	LM1.2-VH-ULS-Service Max			
58	45.62	LM1.2-VH-ULS-Service Max			
42	120.4	LM1.2-VH-ULS-Service Max			
43	103.92	LM1.2-VH-ULS-Service Max			
44	45.19	LM1.2-VH-ULS-Service Max			
45	61.15	LM1.2-VH-ULS-Service Max			
46	61.91	LM1.2-VH-ULS-Service Max			
47	62.64	LM1.2-VH-ULS-Service Max			
48	31.69	LM1.2-VH-ULS-Service Max			
59	81.77	LM1.2-VH-ULS-Service Max			
60	79.9	LM1.2-VH-ULS-Service Max			
61	39.09	LM1.2-VH-ULS-Service Max			

Sirka zakladu: $L := L\,m$

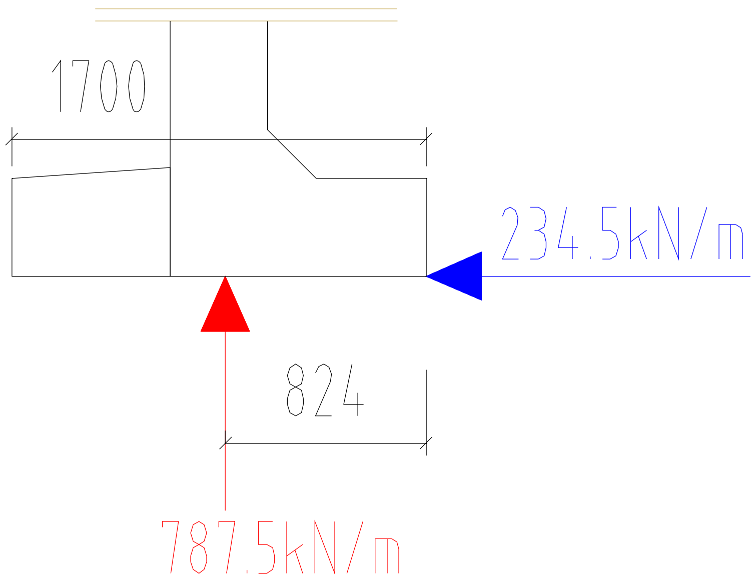
Priemerna dlzka elementu $L_{ave} := \frac{L}{n_1}$

Suma reakcii pod lavou castou $F_{under\_Lfooting} := \sum_{i=1}^{n_1} (F_i\,kN)$ $F_{under\_Lfooting} = 787.270 \cdot kN$

Suma reakcii pod pravou castou $F_{under\_Rfooting} := \sum_{i=n_1+1}^{n_2} (F_i\,kN)$ $F_{under\_Rfooting} = 687.660 \cdot kN$

Priemerne napatie v zakladovej spare $P_{ave\_L} := \frac{F_{under\_Lfooting}}{L \cdot 1m}$ $P_{ave\_L} = 463.100 \cdot \frac{kN}{m^2}$

$P_{ave\_R} := \frac{F_{under\_Rfooting}}{L \cdot 1m}$ $P_{ave\_R} = 404.506 \cdot \frac{kN}{m^2}$



1700
234.5kN/m
824
787.5kN/m

Kapitola 11

Extrém deformácie od náhodilého zaťaženia (MSP)

Displacement

- Case: 1 (LM1(TS) + UDL Pos1)

Node/Case	UZ (mm)	Case name
21/ 1	-6.23	LM1(TS) + UDL Pos1