Project:	**Box girder diaphragm according to EN**
Project no:	**Project-08/16/2021**
Author:	**Jason Smith**

Project data

Project name	Box girder diaphragm according to EN
Project number	Project-08/16/2021
Author	Jason Smith
Description	Box girder diaphragm solved by CSFM (Compatible stress field method)
Date	8/16/2021
Design code	EN

Materials

Concrete

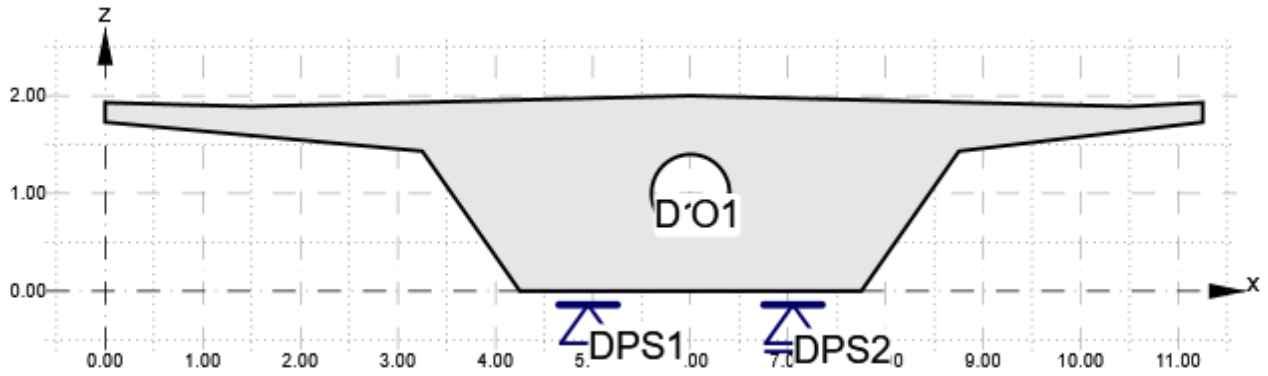
Name	f_{ck} [MPa]	$f_{ctk,0.05}$ [MPa]	f_{ctm} [MPa]	E_{cm} [MPa]
C30/37	30.0	2.0	2.9	32836.6
	ε_{c2} = 20.0 1e-4, ε_{cu2} = 500.0 1e-4, Diagram type: Parabolic Creep coefficient: 2.50			

Reinforcement

Name	f_{yk} [MPa]	k [-]	E_s [MPa]	Unit mass [kg/m^3]	ε_{uk} [1e-4]	Surface
B 500B	500.0	1.08	200000.0	7850	500.0	Ribbed
	ε_{st} = 500.0 1e-4, ε_{sc} = 500.0 1e-4,					

DRM1

Geometry



Overview table

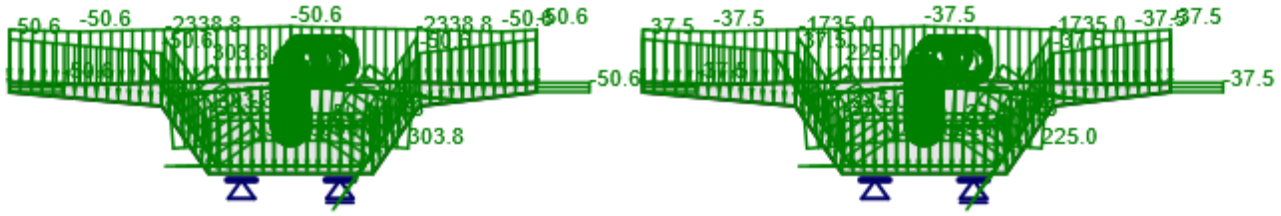
Name	Type	Properties	Position
D1	Diaphragm	Two-way bridge; B: 11.25 m; H: 2.00 m; bu1: 1.50 m; bu2: 4.50 m; bu3: 4.50 m; bf: 3.25 m; bl: 3.50 m; bw: 0.00 m; bw1: 1.00 m; bw2: 0.00 m; h1: 0.00 m; hf1: 0.07 m; hf2: 0.11 m; hf3: 0.11 m; hf4: 0.07 m; tf1: 0.20 m; tf2: 0.50 m; T: 1.50 m; Material: C30/37	
O1	Opening	Circular; D: 0.80 m	M: D1; IP: 0; MP: 1; X: 6.00 m; Z: 1.00 m
DPS1	Distributed point support	X; Z; W: 0.60 m; Partially loaded area: Yes; Thickness: 0.70 m; Inclination: 63.4 m	M: D1; Edge: 1; From beginning; X: 0.70 m
DPS2	Distributed point support	Z; W: 0.60 m; Partially loaded area: Yes; Thickness: 0.70 m; Inclination: 63.4 m	M: D1; Edge: 1; From end; X: 0.70 m

Nonconformities

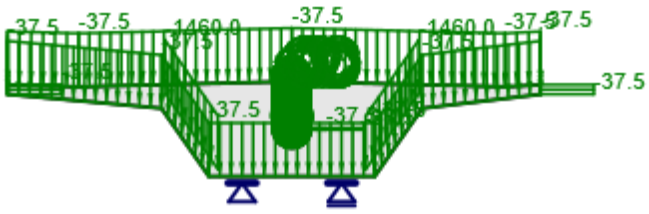
⚠	DPS1 The resistance of the partially loaded area is increased according to the ratio of the design distributed area and the loaded area stated in EN 1992-1-1 (6.7) This functionality allows to transfer all loads from the model to the supports. It cannot precisely describe the stress state over a partially loaded area. It is necessary to provide hand-calculation for assessment of the partially loaded area.
⚠	DPS2 The resistance of the partially loaded area is increased according to the ratio of the design distributed area and the loaded area stated in EN 1992-1-1 (6.7) This functionality allows to transfer all loads from the model to the supports. It cannot precisely describe the stress state over a partially loaded area. It is necessary to provide hand-calculation for assessment of the partially loaded area.

Loads

C1, C2



C3

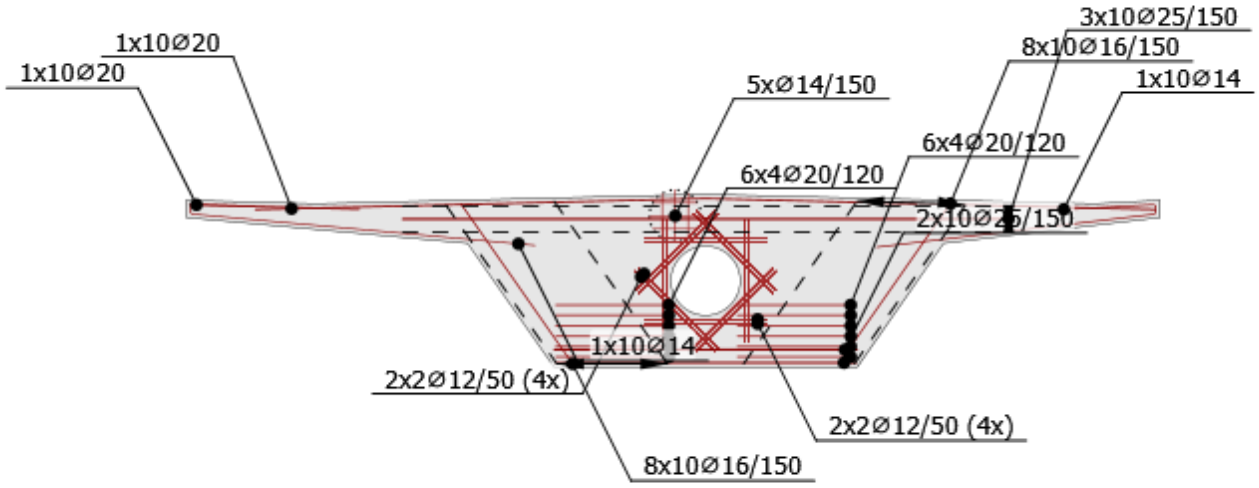


Combination

Name	Type	Content
C1	ULS	1.35*LC1 + LC2 + 1.35*LC3
C2	SLS - Characteristic	LC1 + LC2 + LC3
C3	SLS - Quasi-permanent	LC1 + LC2

Reinforcement

Scheme of reinforcement



Concrete: C30/37; Steel: B 500B

Results

Summary

Overview table

Check item	Combination	Increment	Item	
ULS	C1	P100.0%, V100.0%	Strength of reinforcement	✓

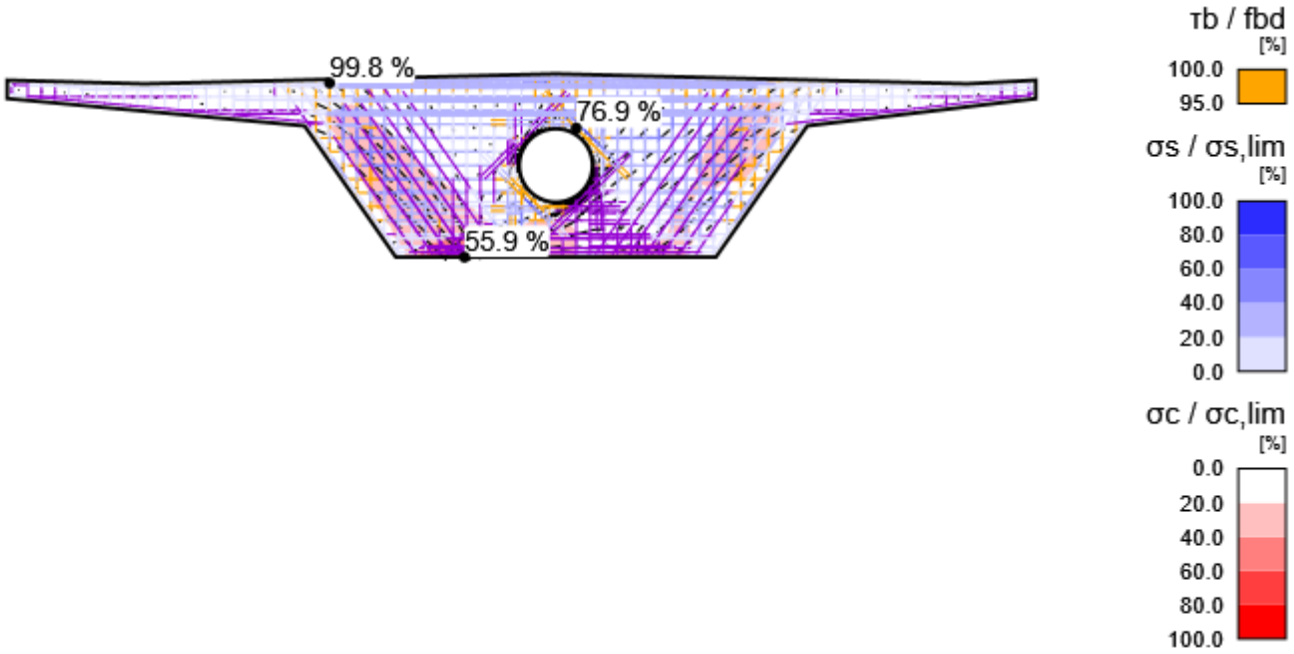
Check item	Item	Utilization	
Strength of concrete	D1	σc/σc,lim: 55.9%	✓
Strength of reinforcement	RO1	εs/εs,lim: 10.8%, σs/σs,lim: 76.9%	✓
Anchorage length	WF1	τb/fbd: 99.8%	✓

SLS	C3 (LT)	P100.0%, V100.0%	Crack width	✓

Check item	Combination	Increment	Critical check	Item	Utilization	
Stress limitation	C2 (ST)	P100.0%, V100.0%	7.2(5)	RO1	74.2%	✓
Crack width	C3 (LT)	P100.0%, V100.0%	w/wlim	WF1	69.1%	✓

ULS - Summary

Stress flow



Above yield	Compression	Explanation
		Thickness proportional to force

Summary of reactions and applied loads: C1, Load increment: P100.0%, V100.0%

Type	F_x [kN]	F_z [kNm]	M_y [kNm]
Summary of reactions	0.0	6107.1	36594.2
Summary of applied load	0.0	-6107.0	-36593.5
Check of equilibrium	0.0	0.1	0.7

ULS - Strength

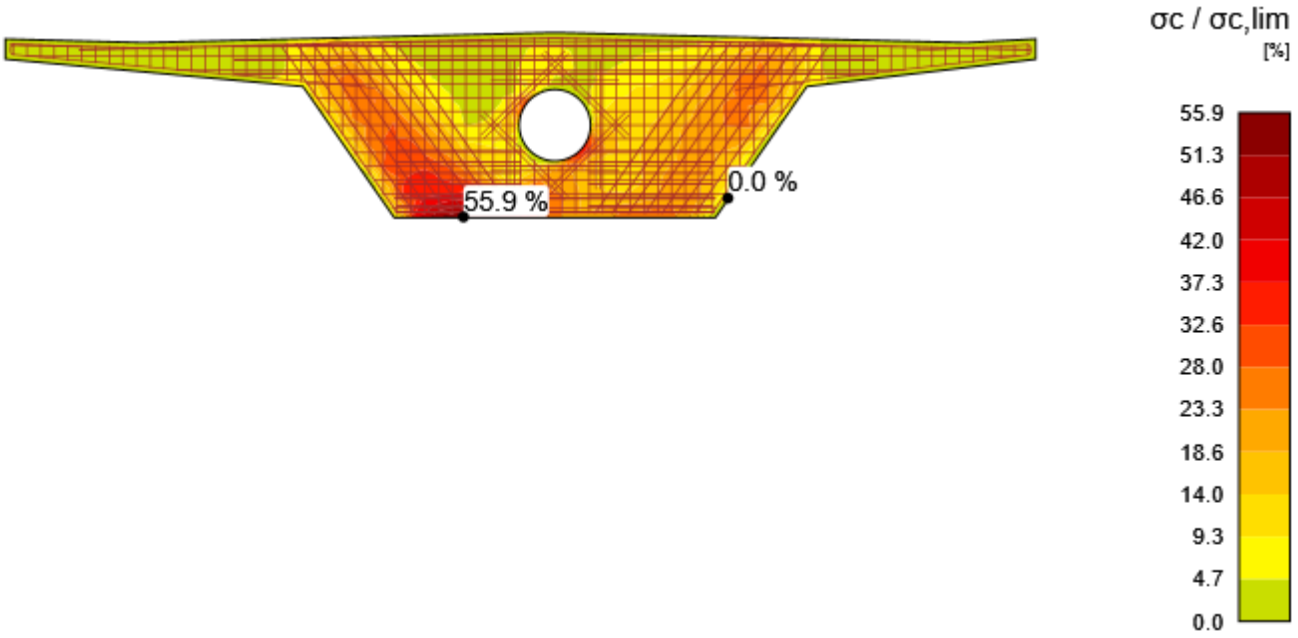
Detailed concrete strength results: C1, Load increment: P100.0%, V100.0%

Member	X [m]	Z [m]	σ_c [MPa]	ε_c [1e-4]	k_{c2} [-]	$\sigma_c/\sigma_{c,lim}$ [%]	
D1	5.00	0.00	-11.2	-6.7	1.00	55.9	OK
D1	5.76	0.68	0.0	0.0	0.63	0.0	OK

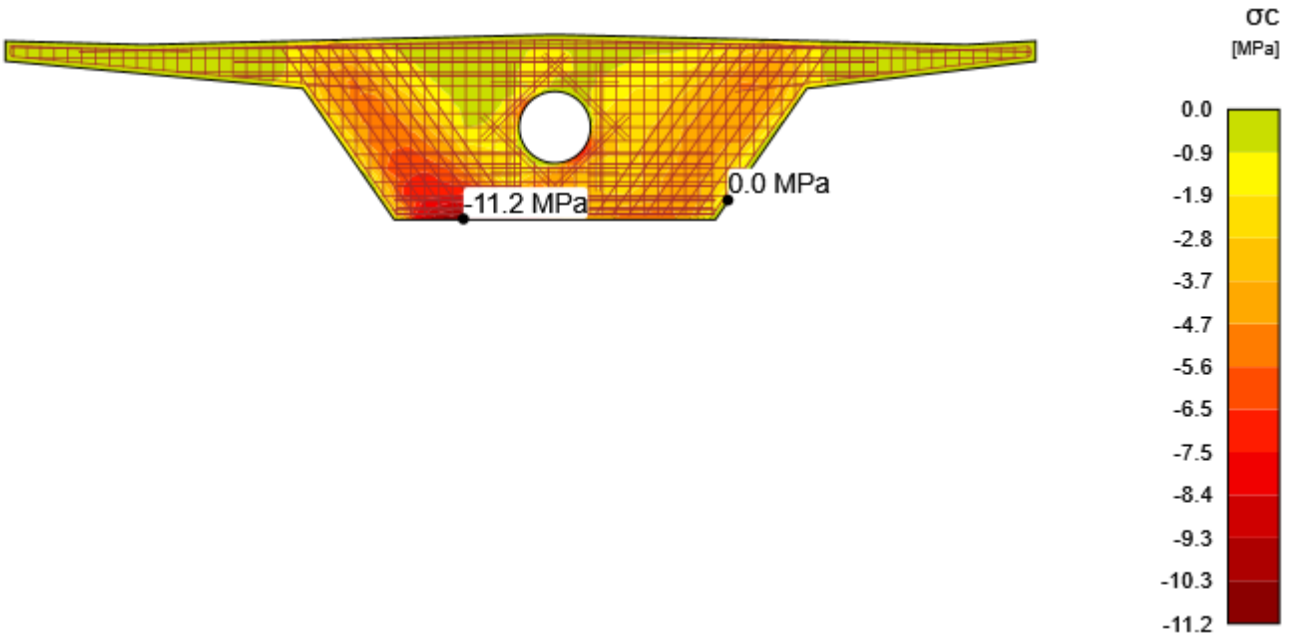
Detailed reinforcement strength results: C1, Load increment: P100.0%, V100.0%

Member	X [m]	Z [m]	σ_s [MPa]	ε_s [1e-4]	$\sigma_s/\sigma_{s,lim}$ [%]	$\varepsilon_s/\varepsilon_{s,lim}$ [%]	
RO1	6.22	1.41	361.0	14.9	76.9	10.8	OK
WF1	8.18	1.36	275.2	10.2	58.6	8.1	OK
WF1	8.18	1.50	277.1	10.6	59.0	7.9	OK
DPS1	4.27	0.72	191.3	6.7	40.7	4.4	OK
GB8	6.36	1.56	177.3	6.5	37.8	3.6	OK
DPS2	7.59	0.72	149.4	4.6	31.8	3.0	OK
GB1	5.58	1.94	176.4	7.1	37.6	3.0	OK
GB8	5.64	1.86	170.1	6.9	36.2	2.7	OK
GB1	5.86	1.95	175.1	7.3	37.3	2.7	OK
GB6	8.04	0.50	130.1	3.0	27.7	2.3	OK
GB3	3.75	1.43	118.5	3.1	25.2	2.0	OK
GB4	8.11	1.40	104.6	2.3	22.3	1.5	OK
GB7	5.10	0.05	-126.3	-6.3	26.9	1.4	OK
GB5	5.32	0.39	101.0	1.9	21.5	1.4	OK
GB7	7.33	0.20	38.8	0.3	8.3	0.1	OK
GB2	1.72	1.83	11.2	0.1	2.4	0.0	OK

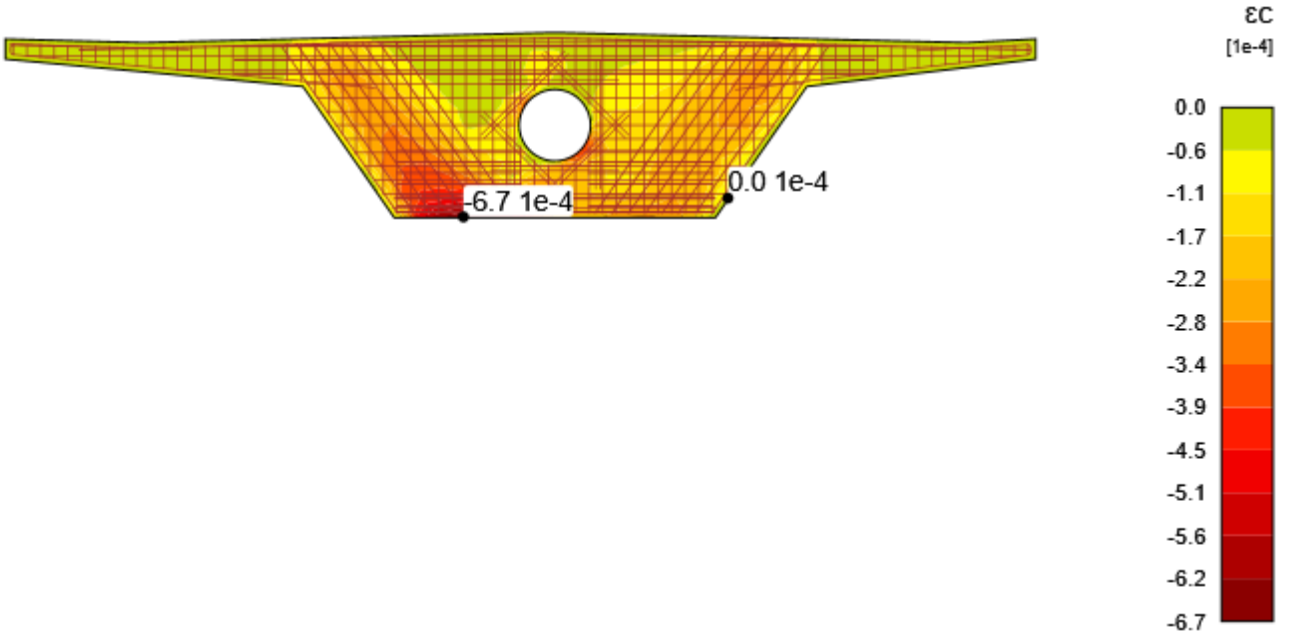
Concrete stress/strength ratio



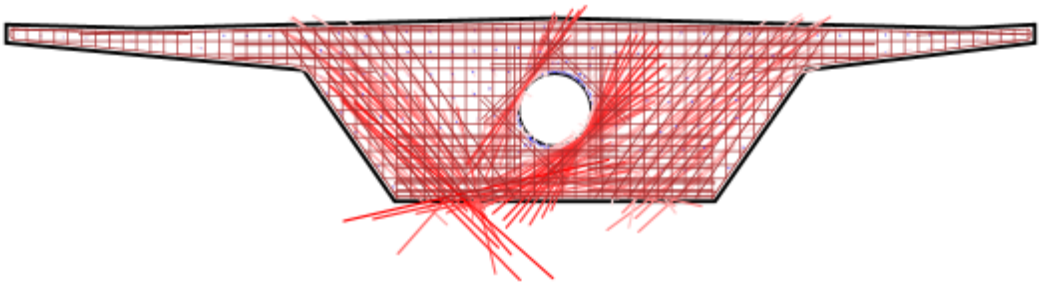
Concrete principal stress σ_c



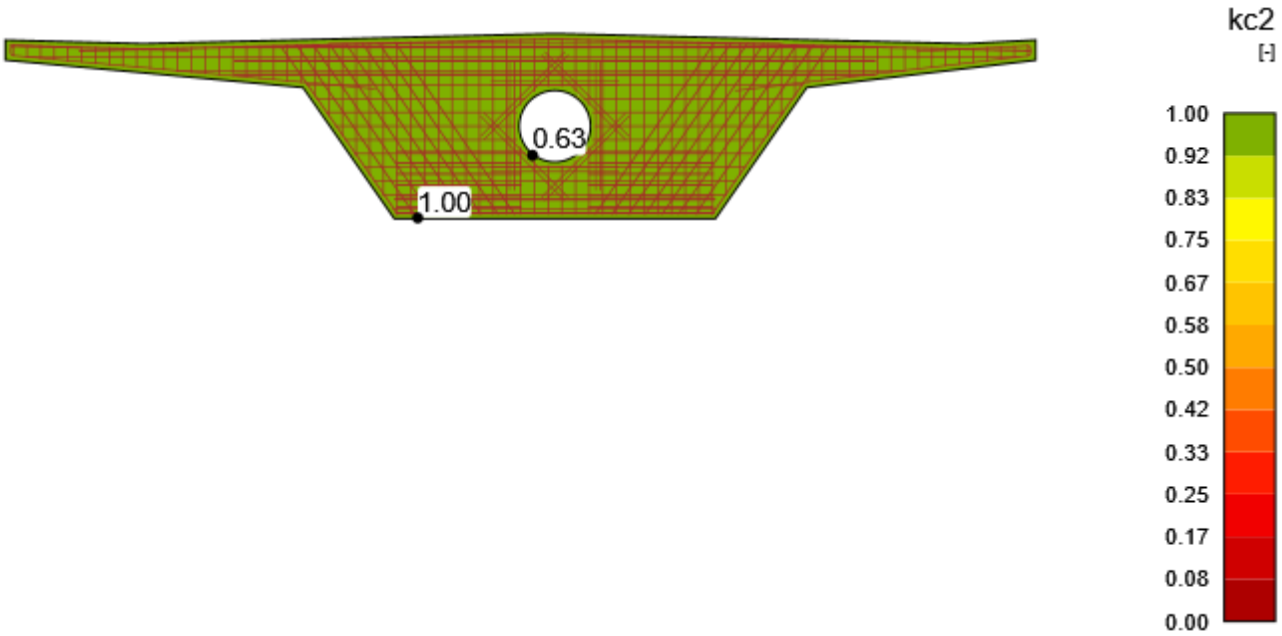
Concrete principal strain ε_c



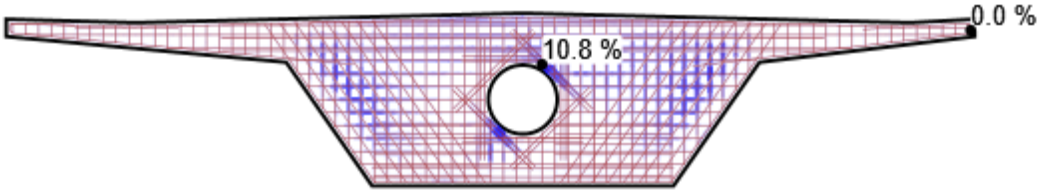
Directions of principal stresses



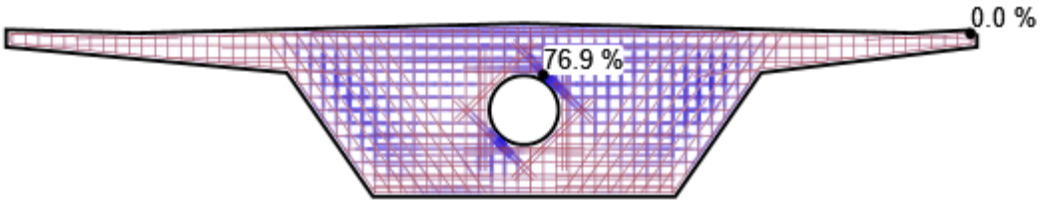
Compressive strength reduction factor kc2



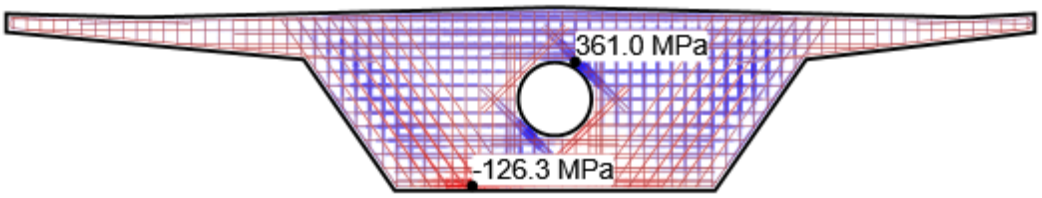
Reinforcement strain/limit strain ratio - $\varepsilon_s/\varepsilon_{s,lim}$ [%]



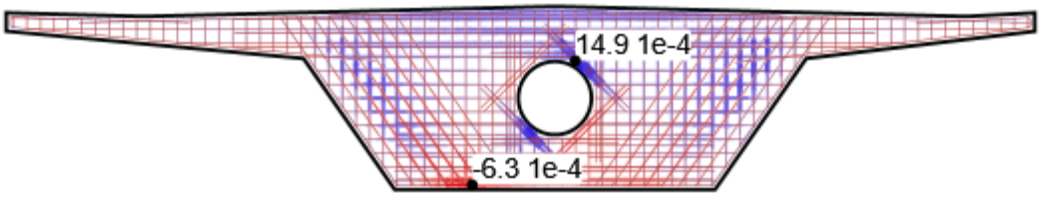
Reinforcement stress/strength ratio - $\sigma_s/\sigma_{s,lim}$ [%]



Reinforcement stress - σ_s [MPa]



Reinforcement strain - ε_s [1e-4]



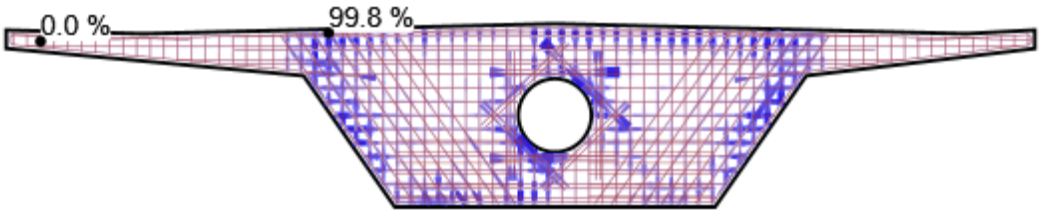
ULS - Anchorage

Detailed anchorage results: C1, Load increment: P100.0%, V100.0%

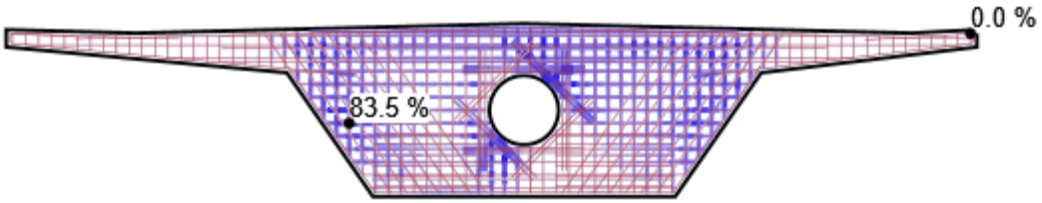
Member	X [m]	Z [m]	τ_b [MPa]	F_a [kN]	F_{tot} [kN]	F_{tot}/F_{lim} [%]	τ_b/f_{bd} [%]	
WF1	3.53	1.90	3.0	0.3	44.3	50.4	99.8	OK
WF1	8.48	1.11	-3.0	0.3	44.3	50.4	99.8	OK
WF1	8.18	1.50	0.1	0.3	213.3	59.0	4.5	OK
WF1	5.08	0.10	-0.2	0.3	-78.7	21.8	6.8	OK
WF1	3.97	0.85	2.1	0.3	156.9	83.5	99.5	OK
RO1	5.89	1.81	3.0	0.1	15.0	50.3	99.8	OK
RO1	5.55	0.30	-3.0	0.1	16.1	50.3	99.8	OK
RO1	6.22	1.41	3.0	0.1	81.7	76.9	99.8	OK
RO1	6.41	0.78	-0.6	0.1	-12.1	11.4	18.7	OK
GB3	4.03	1.41	-3.0	0.7	95.2	50.4	99.8	OK
GB3	3.47	1.46	2.4	0.7	-6.0	0.8	80.5	OK
GB3	3.75	1.43	0.5	0.7	182.4	48.2	15.9	OK
GB3	3.04	1.50	-0.2	0.7	-19.9	2.8	5.5	OK
GB3	3.89	1.42	-0.9	0.7	95.2	50.4	30.8	OK
GB4	7.98	1.39	3.0	0.7	94.1	50.4	99.8	OK
GB4	8.53	1.45	-2.4	0.7	92.2	12.8	77.7	OK
GB4	8.11	1.40	0.4	0.7	161.0	43.1	13.6	OK
GB4	8.81	1.49	-0.2	0.7	-19.8	2.7	6.2	OK
GB5	5.01	0.04	3.0	71.4	-108.3	11.5	99.8	OK
GB5	3.59	1.55	-2.1	71.4	93.3	10.0	70.2	OK
GB5	5.32	0.39	1.1	71.4	203.2	21.5	36.6	OK
GB5	4.67	0.27	-0.5	71.4	-154.4	16.4	17.9	OK
GB5	3.17	1.89	2.6	71.4	129.7	26.0	85.5	OK
GB8	3.50	1.56	2.6	0.1	239.2	10.4	84.6	OK
GB8	8.50	1.56	-2.0	0.1	436.0	18.9	65.8	OK
GB8	6.36	1.56	-0.1	0.1	870.4	37.8	2.5	OK
GB8	2.93	1.56	-0.1	0.1	-30.1	1.3	3.4	OK
GB6	8.42	1.31	-2.5	67.8	191.0	20.2	81.5	OK
GB6	8.18	0.97	2.2	67.8	127.8	13.5	72.8	OK
GB6	8.04	0.50	1.5	67.8	261.5	27.7	49.1	OK
GB6	7.33	0.27	-0.2	67.8	-81.9	8.7	7.2	OK
GB7	4.82	0.05	-1.9	72.9	-382.7	16.6	61.4	OK
GB7	7.32	0.05	1.1	72.9	-155.0	6.7	36.8	OK
GB7	7.33	0.20	0.8	72.9	190.6	11.3	26.1	OK
GB7	5.10	0.05	-0.1	72.9	-620.0	26.9	2.0	OK
GB1	8.81	1.88	1.6	0.0	26.3	1.8	52.3	OK
GB1	3.19	1.88	-1.2	0.0	143.5	9.7	39.8	OK
GB1	5.58	1.94	0.2	0.0	554.2	37.6	6.2	OK
GB1	11.20	1.82	0.0	0.0	0.4	0.2	0.2	OK
GB2	2.00	1.83	0.4	0.1	16.0	6.0	14.8	OK
GB2	0.74	1.86	-0.1	0.1	21.8	1.5	2.9	OK
GB2	1.72	1.83	0.0	0.1	35.2	4.4	0.5	OK

Member	X [m]	Z [m]	τ_b [MPa]	F_a [kN]	F_{tot} [kN]	F_{tot}/F_{lim} [%]	τ_b/f_{bd} [%]	
GB2	0.18	1.88	0.0	0.1	0.7	0.3	0.6	OK
GB2	1.86	1.83	0.2	0.1	33.4	6.3	6.2	OK
DPS1	4.27	0.72	0.0	0.0	240.4	40.7	0.0	OK
DPS1	5.09	0.12	0.0	0.0	-116.3	19.7	0.0	OK
DPS2	7.59	0.72	0.0	0.0	187.8	31.8	0.0	OK
DPS2	6.78	0.12	0.0	0.0	-45.3	7.7	0.0	OK

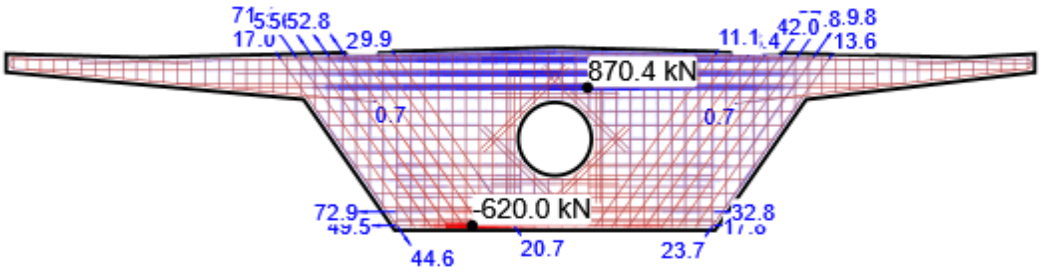
Bond stress check value - τ_b/f_{bd} [%]



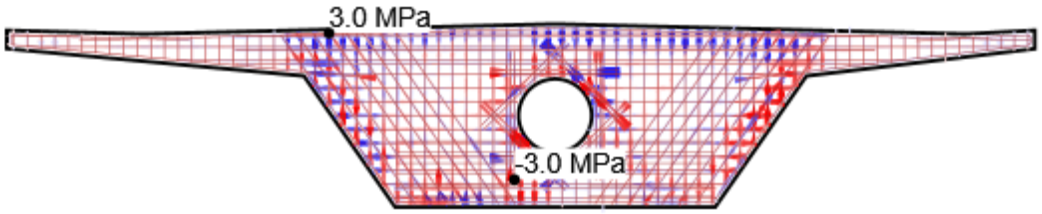
Force check value - F_{tot}/F_{lim} [%]



Total force in the bar - F_{tot} [kN]



Bond stress - τ_b [MPa]



Settings

Creep coefficient

Type of input	Creep coefficient
Input by user	2.5

SLS - Stress

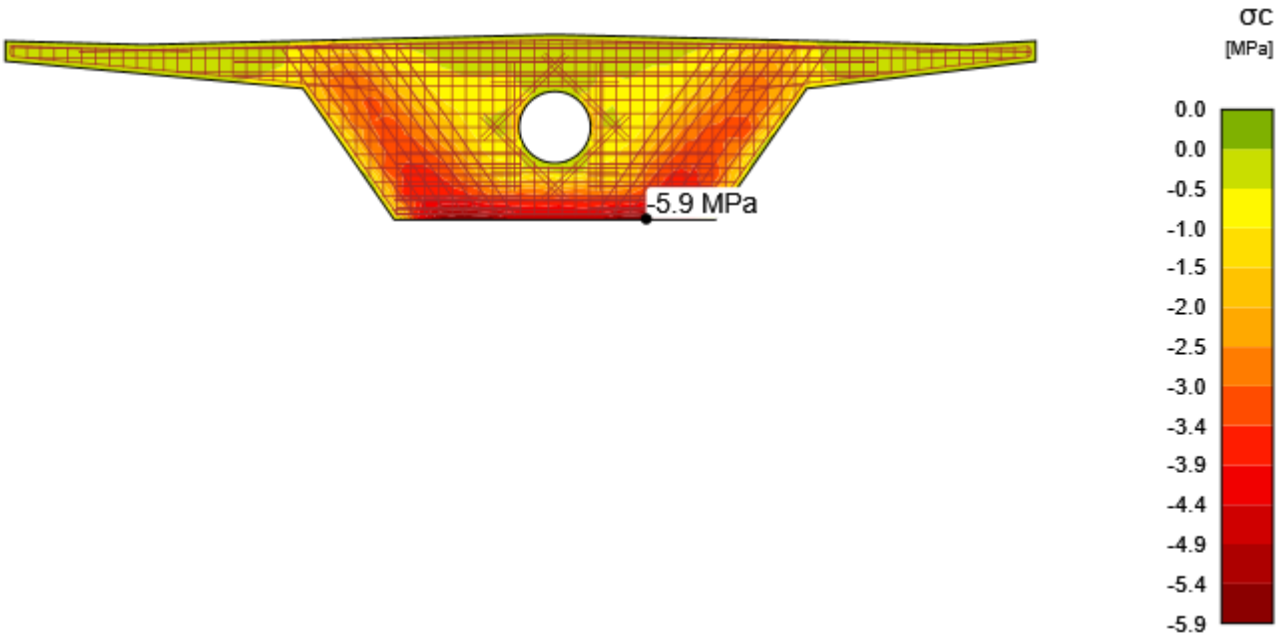
Detailed concrete stress results: C3, Load increment: P100.0%, V100.0%

Member	X [m]	Z [m]	Critical check	σ_c [MPa]	σ_{lim} [MPa]	σ_c/σ_{lim} [%]	
D1	7.00	0.00	7.2(3)	-5.9	13.5	43.8	OK

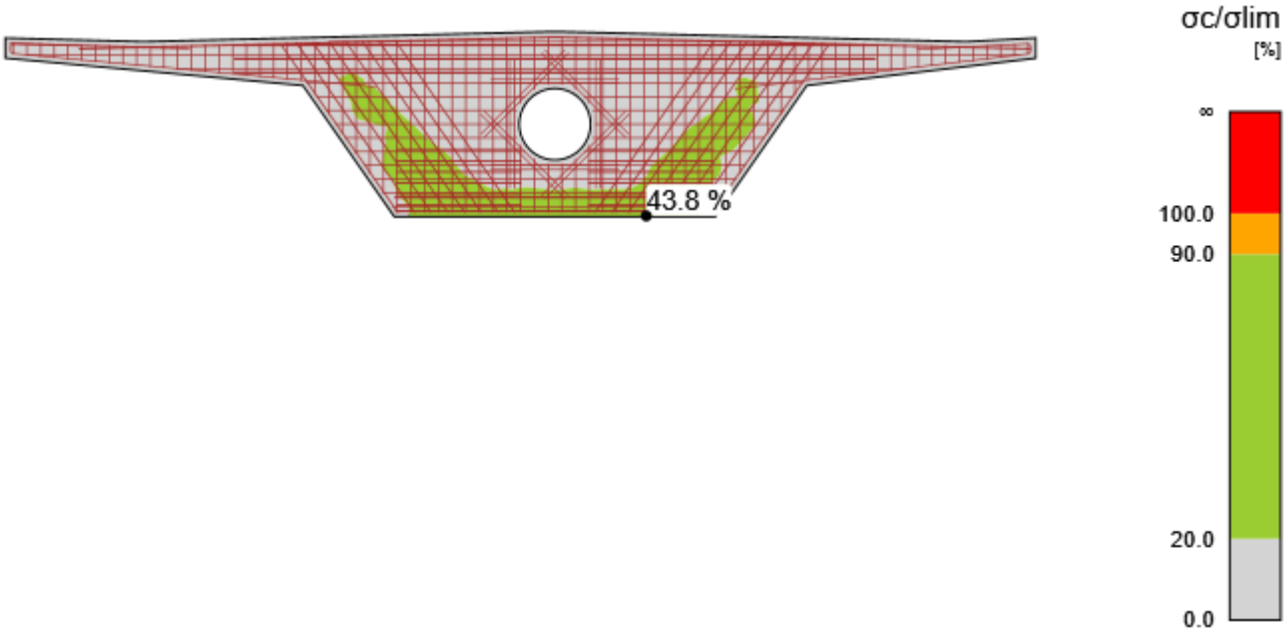
Detailed reinforcement stress results: C2, Load increment: P100.0%, V100.0%

Reinforcement	X [m]	Z [m]	Critical check	σ_s [MPa]	σ_{lim} [MPa]	σ_s/σ_{lim} [%]	
WF1	5.72	0.55	7.2(5)	182.0	400.0	45.5	OK
RO1	6.22	1.41	7.2(5)	296.6	400.0	74.2	OK
GB2	1.86	1.83	7.2(5)	11.1	400.0	2.8	OK
GB5	5.32	0.39	7.2(5)	86.1	400.0	21.5	OK
GB6	8.04	0.50	7.2(5)	102.7	400.0	25.7	OK
GB7	7.33	0.20	7.2(5)	34.6	400.0	8.6	OK
GB8	6.21	1.56	7.2(5)	136.7	400.0	34.2	OK
GB1	5.58	1.94	7.2(5)	125.0	400.0	31.3	OK
GB3	3.89	1.42	7.2(5)	97.6	400.0	24.4	OK
GB4	7.98	1.39	7.2(5)	90.6	400.0	22.7	OK
DPS1	4.27	0.72	7.2(5)	130.0	400.0	32.5	OK
DPS2	7.59	0.72	7.2(5)	108.2	400.0	27.0	OK

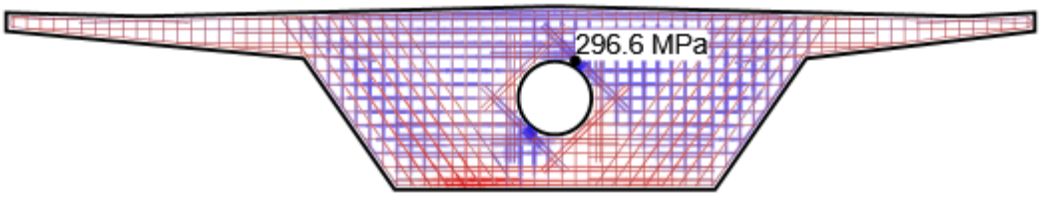
Concrete stress



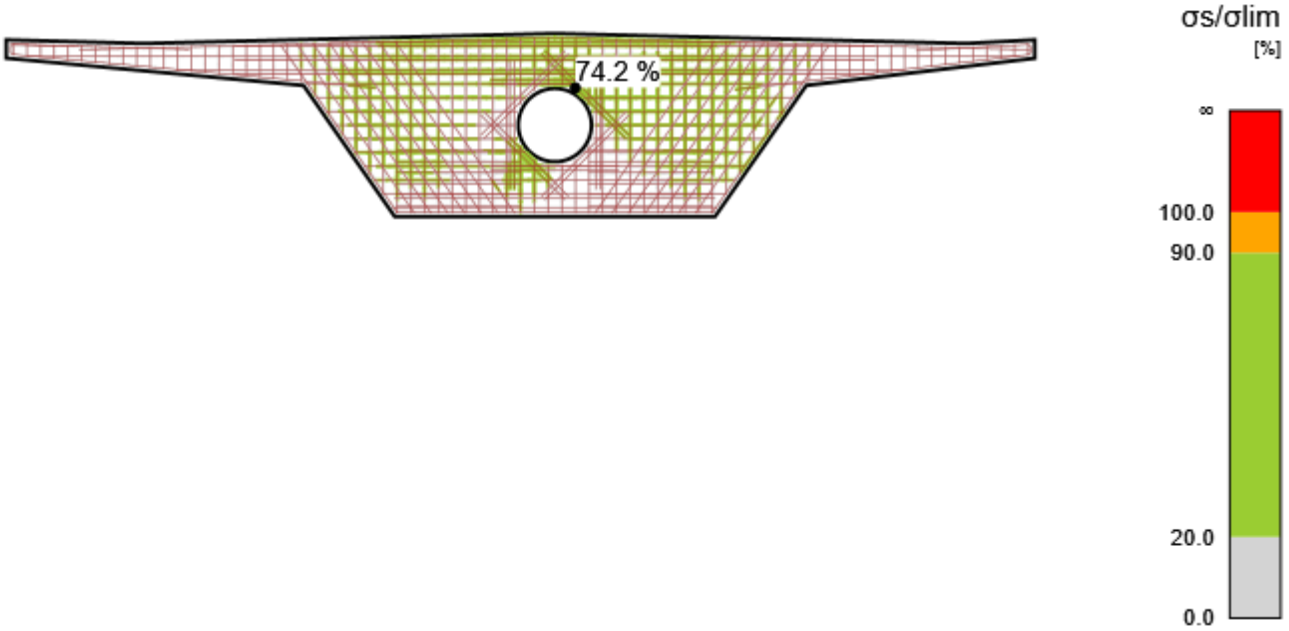
Concrete stress check



Reinforcement stress - σ_s [MPa]



Reinforcement stress check



SLS - Crack

Detailed crack results: C3, Load increment: P100.0%, V100.0%, w_{lim}=0.300 mm

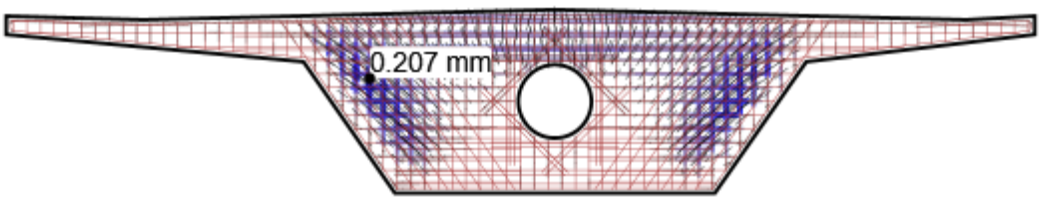
Member	X [m]	Z [m]	w [mm]	w/w_{lim} [%]	
WF1	3.98	1.25	0.207	69.1	OK
DPS1	4.27	0.72	0.134	44.8	OK
DPS2	7.59	0.72	0.112	37.4	OK
GB8	5.93	1.56	0.087	29.1	OK
GB1	6.56	1.94	0.060	20.0	OK
GB6	8.18	0.97	0.048	16.2	OK
RO1	6.14	1.50	0.042	14.1	OK
GB3	3.89	1.42	0.042	13.9	OK
GB4	7.98	1.39	0.036	12.0	OK
GB5	3.43	1.78	0.025	8.2	OK
GB7	4.26	0.05	0.003	0.9	OK
GB2	1.86	1.83	0.001	0.4	OK

Intermediate crack results

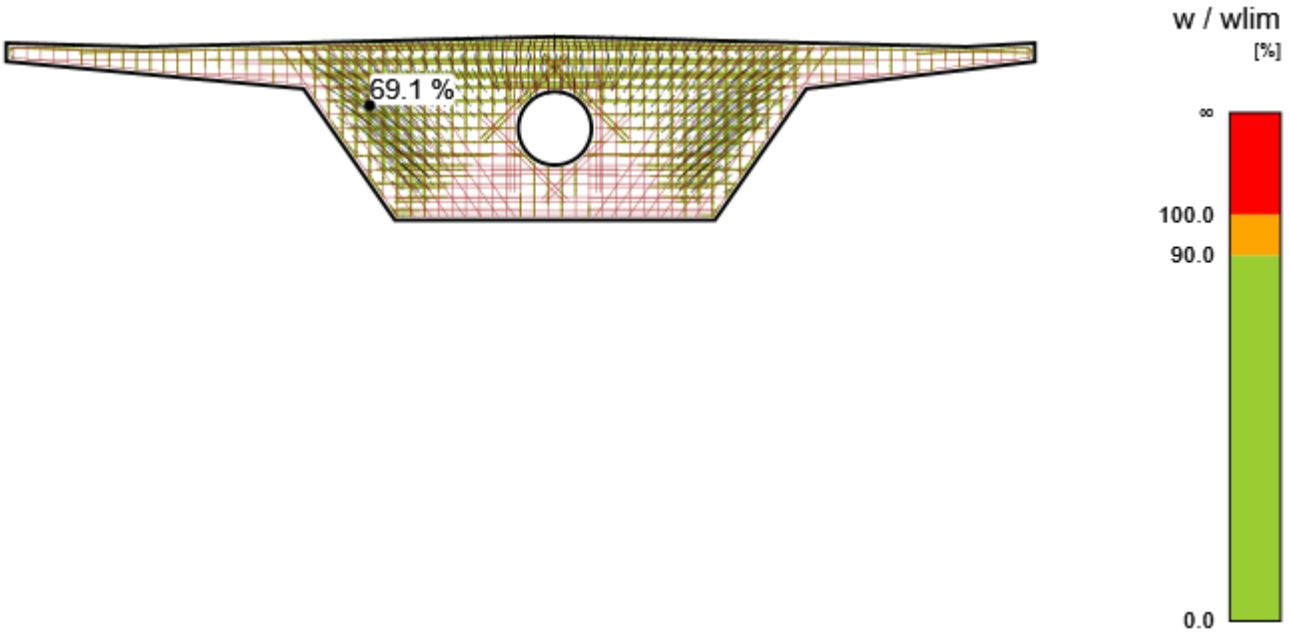
Member	ε_{cm} [1e-4]	ε_m [1e-4]	s_r [mm]	Φ [mm]	ρ_{eff} [%]	w_b [mm]	θ_r [-]	θ_b [-]
WF1	0.0	6.1	265	14	1.30	0.161	2.46	1.57
DPS1	0.0	2.9	315	20	1.56	0.091	2.40	0.00
DPS2	0.0	2.4	315	20	1.56	0.076	0.74	0.00
GB8	0.0	2.7	323	25	1.90	0.087	1.56	0.00
GB1	0.0	3.3	181	20	2.69	0.059	1.73	-0.02
GB6	0.0	0.4	341	16	1.16	0.013	0.69	0.96
RO1	0.0	3.0	140	12	2.09	0.042	1.60	0.00
GB3	0.0	1.1	211	14	1.63	0.022	2.48	-0.09
GB4	0.0	0.8	225	14	1.53	0.018	0.64	0.12
GB5	0.0	0.5	193	16	2.03	0.010	2.61	-0.96
GB7	0.0	0.1	161	25	3.73	0.002	2.53	0.00
GB2	0.0	0.1	186	20	2.62	0.001	2.18	-0.03

Note: There are TCM intermediate values displayed in the table above. Adequate POM values are not available in current version of the program.

Crack width - w [mm]



Crack width check

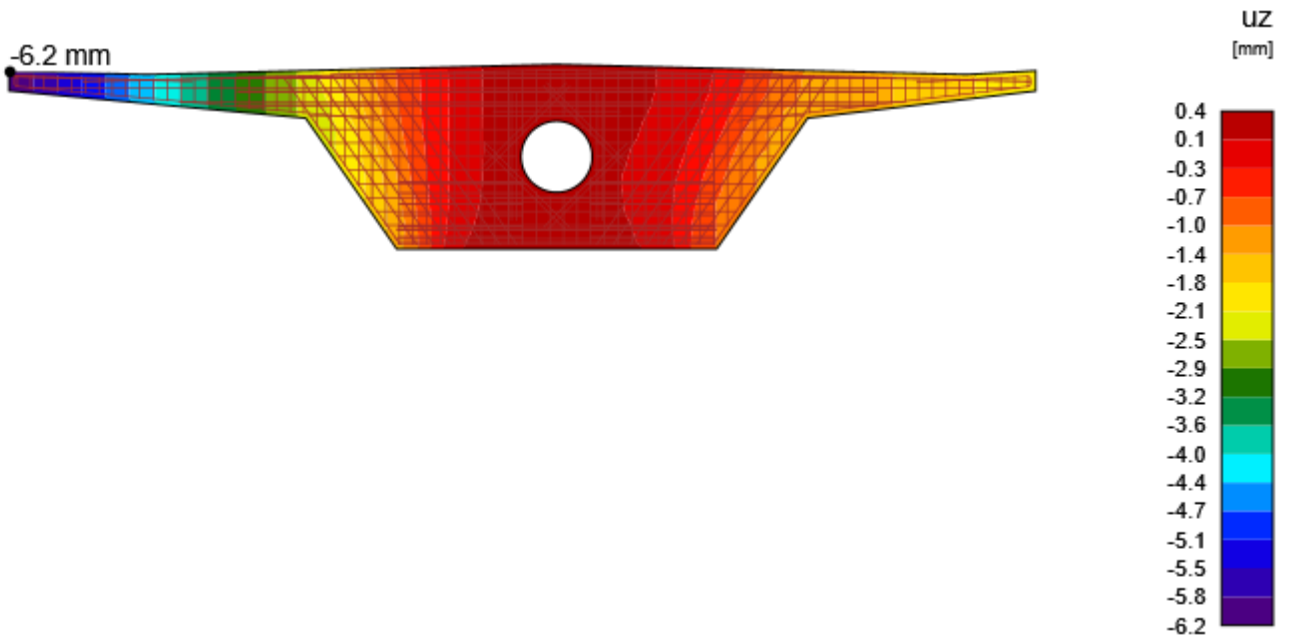


SLS - Deflection

Detailed deflection results: C2, Load increment: P100.0%, V100.0%

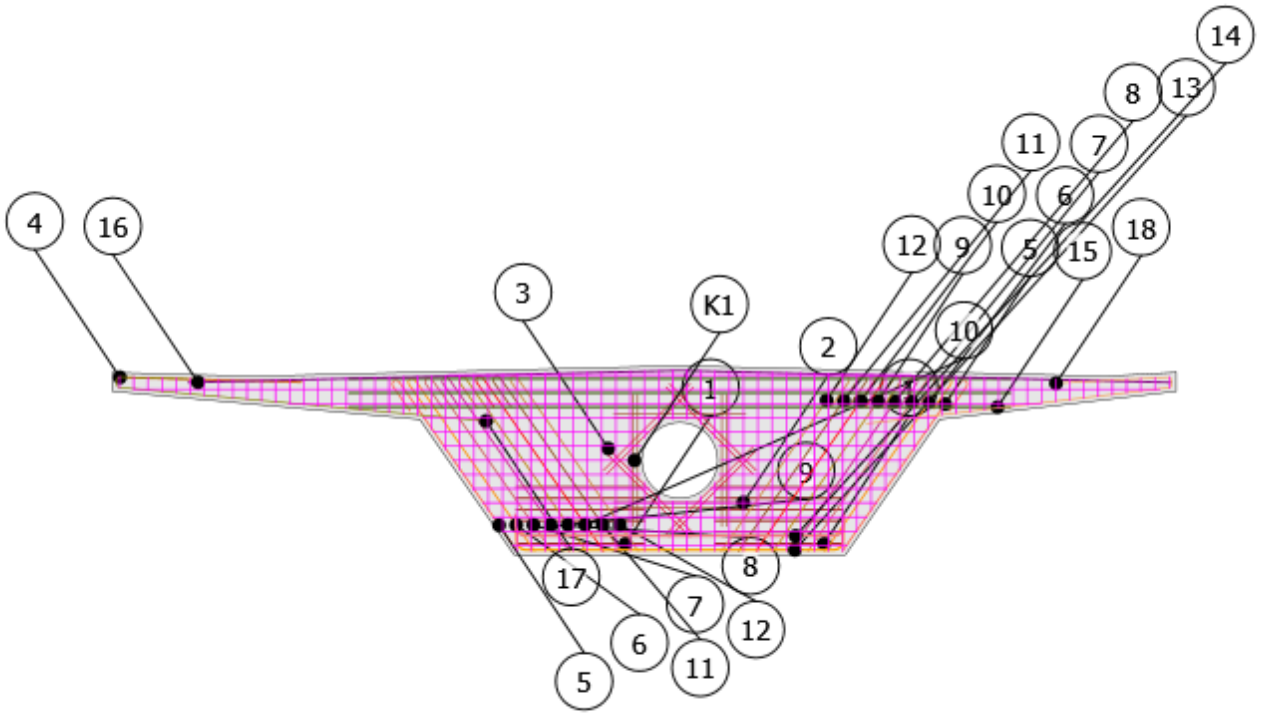
Member	X [m]	Z [m]	$u_{z,st}$ [mm]	$u_{z,lt}$ [mm]	Δu_z [mm]	u_z [mm]	
D1	0.00	1.93	-4.8	-4.0	-2.2	-6.2	OK
D1	0.00	1.73	-4.8	-4.0	-2.2	-6.2	OK

Deflection



Bill of material

Items numbering



Fabric reinforcement tables

Parameter	Value
Index	K1
Φ X/Y [mm]	14 / 14
Material	B 500B
Number of items	5
Total area [m2]	22.50
Bar spacing X/Y [mm]	150 / 150
Weight of one item [kg]	363
Assigned to wall	-all-

Brief reinforcement bar table

Index	Φ [mm]	Material	Items	Length [mm]	Weight [kg]	Total length [m]
1	20	B 500B	48	1361	3	65.33
2	12	B 500B	16	1399	1	22.39
3	12	B 500B	16	1300	1	20.80
4	20	B 500B	10	1959	5	19.59
5	16	B 500B	20	2630	4	52.59
6	16	B 500B	20	2655	4	53.09
7	16	B 500B	20	2660	4	53.20
8	16	B 500B	20	2665	4	53.31
9	16	B 500B	20	2671	4	53.42
10	16	B 500B	20	2676	4	53.52
11	16	B 500B	20	2682	4	53.63
12	16	B 500B	20	2687	4	53.74
13	25	B 500B	10	3815	15	38.15
14	25	B 500B	10	3839	15	38.39
15	25	B 500B	30	7000	27	210.00
16	20	B 500B	10	10400	26	104.00
17	14	B 500B	10	4830	6	48.30
18	14	B 500B	10	4580	6	45.80

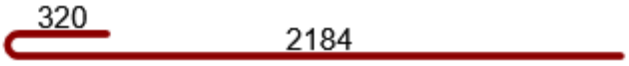
Detailed reinforcement bar tables

Parameter	Value	Shape
Index	1	
Φ [mm]	20	
Material	B 500B	
Number of items	48	
Length [mm]	1361	
Weight [kg]	3	
Total length [m]	65.33	

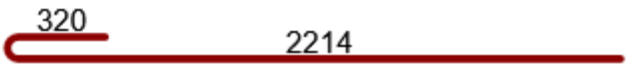
Parameter	Value	Shape
Index	2	
Φ [mm]	12	
Material	B 500B	
Number of items	16	
Length [mm]	1399	
Weight [kg]	1	
Total length [m]	22.39	

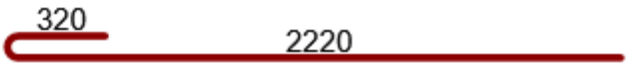
Parameter	Value	Shape
Index	3	
Φ [mm]	12	
Material	B 500B	
Number of items	16	
Length [mm]	1300	
Weight [kg]	1	
Total length [m]	20.80	

Parameter	Value	Shape
Index	4	
Φ [mm]	20	
Material	B 500B	
Number of items	10	
Length [mm]	1959	
Weight [kg]	5	
Total length [m]	19.59	

Parameter	Value	Shape
Index	5	
Φ [mm]	16	
Material	B 500B	
Number of items	20	
Length [mm]	2630	
Weight [kg]	4	
Total length [m]	52.59	

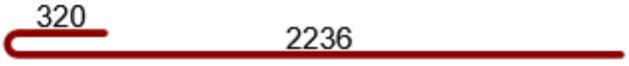
Parameter	Value	Shape
Index	6	
Φ [mm]	16	
Material	B 500B	
Number of items	20	
Length [mm]	2655	
Weight [kg]	4	
Total length [m]	53.09	

Parameter	Value	Shape
Index	7	
Φ [mm]	16	
Material	B 500B	
Number of items	20	
Length [mm]	2660	
Weight [kg]	4	
Total length [m]	53.20	

Parameter	Value	Shape
Index	8	
Φ [mm]	16	
Material	B 500B	
Number of items	20	
Length [mm]	2665	
Weight [kg]	4	
Total length [m]	53.31	

Parameter	Value	Shape
Index	9	
Φ [mm]	16	
Material	B 500B	
Number of items	20	
Length [mm]	2671	
Weight [kg]	4	
Total length [m]	53.42	

Parameter	Value	Shape
Index	10	
Φ [mm]	16	
Material	B 500B	
Number of items	20	
Length [mm]	2676	
Weight [kg]	4	
Total length [m]	53.52	

Parameter	Value	Shape
Index	11	
Φ [mm]	16	
Material	B 500B	
Number of items	20	
Length [mm]	2682	
Weight [kg]	4	
Total length [m]	53.63	

Parameter	Value	Shape
Index	12	
Φ [mm]	16	
Material	B 500B	
Number of items	20	
Length [mm]	2687	
Weight [kg]	4	
Total length [m]	53.74	

Parameter	Value	Shape
Index	13	
Φ [mm]	25	
Material	B 500B	
Number of items	10	
Length [mm]	3815	
Weight [kg]	15	
Total length [m]	38.15	

Parameter	Value	Shape
Index	14	
Φ [mm]	25	
Material	B 500B	
Number of items	10	
Length [mm]	3839	
Weight [kg]	15	
Total length [m]	38.39	

Parameter	Value	Shape
Index	15	
Φ [mm]	25	
Material	B 500B	
Number of items	30	
Length [mm]	7000	
Weight [kg]	27	
Total length [m]	210.00	

Parameter	Value	Shape
Index	16	
Φ [mm]	20	
Material	B 500B	
Number of items	10	
Length [mm]	10400	
Weight [kg]	26	
Total length [m]	104.00	

Parameter	Value	Shape
Index	17	
Φ [mm]	14	
Material	B 500B	
Number of items	10	
Length [mm]	4830	
Weight [kg]	6	
Total length [m]	48.30	

Parameter	Value	Shape
Index	18	
Φ [mm]	14	
Material	B 500B	
Number of items	10	
Length [mm]	4580	
Weight [kg]	6	
Total length [m]	45.80	

Overview table

Φ [mm]	12	14	16	20	25
Total length of Φ [m]	43.19	94.11	426.51	188.92	286.54
Weight per meter of Φ [kg/m]	1	1	2	2	4
Total weight of Φ [kg]	38	114	673	466	1104
Total weight of bars [kg]	2395				
Total weight of fabric reinforcement [kg]	1813				
Total weight [kg]	4208				
Volume of concrete [m3]	16.16				
Reinforcement weight per volume unit of concrete [kg/m3]	260				

Explanation

Symbol	Explanation
f_{ck}	Characteristic compressive cylinder strength of concrete at 28 days
$f_{ctk,0.05}$	Characteristic axial tensile strength of concrete 5% quantile
f_{ctm}	Mean value of axial tensile strength of concrete
E_{cm}	Secant modulus of elasticity of concrete
ε_c	Compressive strain in the concrete at the peak stress fc
ε_{cu}	Ultimate compressive strain in the concrete
f_{yk}	Characteristic yield strength of reinforcement
E_s	Modulus of elasticity of reinforcement steel
ε_{uk}	Characteristic strain of reinforcement or prestressing steel at maximum load
Properties	W - Width; H - Height; T - Thickness; L - Length; r - Radius; α - Inclination
Position	M - Master; MP - Master point; IP - Insert point
σ_c	The extreme value of compressive stress σc of concrete of selected subregion.
k_{c2}	Compressive strength reduction factor kc2
$\sigma_c/\sigma_{c,lim}$	The ratio of concrete stress and concrete strength. It presents the level of material utilization with respect to concrete strength.
σ_s	Maximum stress along the length of reinforcement bar.
ε_s	Maximum strain along the length of reinforcement bar.
$\sigma_s/\sigma_{s,lim}$	The ratio of stress and strength of the reinforcement. It presents the level of material utilization with respect to reinforcement strength.
$\varepsilon_s/\varepsilon_{s,lim}$	The ratio of strain and limit strain of the reinforcement. It presents the level of material utilization with respect to limit strain
τ_b	Bond stress on the surface of reinforcement bar.

Symbol	Explanation
F_a	The anchorage force. It is developed at the ends of the bars due to hooked anchorage.
F_{tot}	Total force developed along the length of the bar. It consists of the anchorage force due to hooked anchorage and bond force, which integrates bond stresses acting on the surface of the bar.
F_{tot}/F_{lim}	The ratio of total force in the bar and limit value of the force. It presents the level of utilization of the rebar. The limit value of the force is calculated as the minimum of two values: (a) the force calculated as the sum of ultimate anchorage force and the force developed from the end of the bar to the point of interest assuming ultimate bond strength, (b) the ultimate strength of the bar.
τ_b/f_{bd}	The ratio of bond stress and ultimate bond strength for selected (group of) bars and applied portion of the load. It shows the level of utilization with respect to ultimate bond strength between the rebar and adjacent concrete.
Creep coefficient	Final value of creep coefficient at time interval (t0 = 28 days, tinf = design working life)
w	Total crack width including effect of creep.
ε_{cm}	the mean strain in the concrete between cracks
ε_m	the mean strain in the reinforcement under relevant combination of loads, including the effect of imposed deformations and taking into account the effects of tension stiffening. Only the additional tensile strain beyond the state of zero strain of the concrete at the same level is considered
s_r	mean value of axial tensile strength of concrete
Φ	diameter of reinforcing bar
ρ_{eff}	effective reinforcement ratio
w_b	calculated crack width
θ_r	inclination of the cracks (the angle between the global coordinate system and the crack direction)
θ_b	bar inclination (the angle between the global coordinate system and the axis of reinforcement bar)
$u_{z,st}$	Immediate deflection caused by total load, calculated with short-term stiffnesses.
$u_{z,lt}$	Long-term effects of long-term load.
Δu_z	Deflection increment caused by variable load.
u_z	Total deflection including effect of creep.

Calculation presumptions

- Minimum amount of reinforcement resisting at least the tensile stresses prior cracking has to be provided in cracked zones.
- It is assumed that a transverse rebar or adequate overlap is provided to enable full anchorage of the stirrups.
- The analysis and code checks are performed for support conditions as specified in the project. No change of supports in construction/service stages is considered.
- The crack width is checked in the vicinity of the reinforcement only. No control of cracking is performed in non-reinforced zones.
- The presentation of crack spacing is schematic only. It does not represent the crack spacing computed for the calculations.