Preparation by	DOV	Verification by	KER	Approval by	RIW
Date	16-08-2021	Date	16-08-2021	Date	16-08-2021

"For Approval"

Expansion Storage Capacity TP3

WEIGHT CALCULATION

CULVERT

Client	NESTE	Client number	2307
Project	Expansion Storage Capacity TP3	KH number	68685
Plant	Vlaardingen		
Unit	Tankpit 3	Revision	0
Document Code	2307-E40-CN-1735-0001	Date	16-08-2021

Revision	Description	Date
0	For Approval	August 16, 2021

Index

Appendices	Title	Document title
Enclosure 1	Whole culvert under loading	ENCL1 Culvert dd 4 aug 2021.rww
Enclosure 2	Additional calculations + pictures	Enclosure 2 dd 4 aug 2021.xlsx

1 INTRODUCTION

Neste Terminal in Rotterdam has the intention to expand the storage capacity of their tank terminal in Vlaardingen.

The expansion of the terminal consists of 15 tanks divided over two tank pits. Both tank pits are connected underground in order to guarantee the buffer capacity of the tank pits. The bundwall shall consist of either a retaining wall or sheet piling wall.

There is a maintenance road between the two tank pits. A new truck loading area with 5 bays is located At the north-east side.

The new tankpits are connected to the existing tankpit and new loading area by means of pipe racks.
On the north side of the new tankpits a recently built tankpit (built in 2017-2018), so-called phase 1, is present. The foundation of these existing tanks in this tank area is on a crushed stone ring on a deep soil improvement.

Another existing tankpit area is present west of the current new site, built approx. 40 y. ago (1960).

The RC culvert on 6 piles, being the subject of this report, is present in the connection between the 2 new tankpit areas. It forms part of the road between both tankpits. The outer dimensions are as depicted in paragraph 2.1: b*L*h = 6,5*6,8*3,5 m³. See also pictures in **Enclosure 2**.

The piping lines pass the 2 spaces beneath the bridging RC slabs (thick: h = 0,4 m). The self-weight of the piping is assumed being 3 kN/m² (upper limit).

Traffic passes over these bridging slabs. A max. of 2 standardized lorries VK30 can pass at one time. For traffic class VK30, consult paragraph 2.3.2.

The pile load estimate for the culvert (Dutch: gewichtsberekening, acronym: GB), also called a Weight Calculation, is determined in this report.

See paragraph 3.3 for the results.

2 INPUTDATA

2.1 Dimensions of the culvert

Envelope dimensions:
- enveloping dimensions: b*L*h = 6,5*6,8*3,5 m³;
- 2 cover supports, each: b*L*h = 0,2*5,8*0,35 m³;
- 10 cover plates, each: b*L*h = 2*0,995*0,25 m³.

Deduction volumes:
- 2 holes for piping, each: b*L*h = 3,1*6,5*1,55 m³;
- 1 recess above: b*L*h = 5,8*6,5*0,25 m³;
- 1 recess below: b*L*h = 5,45*6,5*0,95 m³.

Extra fill volume per 5 cover plates:
- b*L*h = 5*2*0,25 m³;
- max. ½ of this compacted fill self-weight is an additional load on the culvert.

2.2 Consequence class and geotechnical class

Safety class in accordance with basic Eurocode NEN-EN 1990+NB:
- Consequence Class 2 (CC2).

Geotechnical class in accordance with geotechnical Eurocode NEN 9997-1:
- Geotechnical class 2.

2.3 Loads in general

2.3.1 Self-weight of volumes

Self-weight of volumes:
- compacted fill: 18 kN/m³;
- plain concrete: 24 kN/m³;
- reinforced concrete: 25 kN/m³;
- steel structures; 78½ kN/m³;

piping loads:
- area load (upper level): 3 kN/m².

2.3.2 Traffic loads

Traffic loads:
- lorry class: VK30;
- meaning: 3 axle loads of 100 kN each, c.t.c.-distance 1 and 4 m;
- additional area load: 2 kN/m². Due to the short span, this value has been omitted!

Construction traffic:
- commonly used value: 10 up to 20 kN/m²;
- used in **Enclosure 1**: 10 kN/m².

Impact factor s for slow traffic (v ≤ 30 km/h):
- assumption: s = 1,1.

Brake loads for VK30:
- for 3 axles on the culvert: H_{rem} = 100 kN per vehicle.

2.3.3 Load input for Enclosure 1 (Technosoft 2D)

Load cases:
- Load case 1: self-weight RC;
- Load case 2: self-weight compacted fil on cover plates, thick 0,25 m;
- Load case 3: self-weight piping 3 kN/m²;
- Load case 4: vehicle load is 10 kN/m² on 2 traffic lanes;
- Load case 5: 2 vehicles VK30, 2 axle loads c.t.c. 1 m on cover plates left;
- Load case 6: 2 vehicles VK30, 2 axle loads c.t.c. 1 m on left culvert wall;
- Load case 7: 2 vehicles VK30, 2 axle loads c.t.c. 1 m on center culvert wall;
- Load case 8: 2 vehicles VK30, 2 axle loads c.t.c. 1 m on right culvert wall;
- Load case 9: 2 vehicles VK30, 2 axle loads c.t.c. 1 m on cover plates right.

Load case 1:
self-weight of 2 thickened edges (in Dutch: vorstrand). Per thickened edge:
- height: h = 1,35-0,4 m = 0,95 m;
- length: L = 6,8 m;
- width: b = 0,25+½*0,543 m = 0,5215 m;
- volume: V = b*L*h = 3,369 m³;
- e.g. per stuk: ½V_{rep} = V*r*g = 3,369*25 kN = 84,22 kN;
- q-load in **Enclosure 1**, load case self-w. RC: V_{rep}/L = 2*84,22 kN/6,8 m = **28,1 kN/m¹**.

Load case 2:
- self-weight fill: q = b*h*ρ*g = 5*0,25 m³/m¹*18 kN/m³ = **22½ kN/m¹**.

Load case 3:
- self-weight piping: q = b*p = 6½ m*3 kN/m² = **19½ kN/m¹**.

Load case 4: traffic load for 10 kN/m²:
- 2 traffic lanes are present;
- traffic lane width is 3 m;
- 2 traffic lanes imply the following: q = 2*3 m*10 kN/m² = 60 kN/m¹;
- cover plates width is only 5 m: q = 5 m*10 kN/m² = 50 kN/m¹.

Load case 5 up to 9: traffic load for 2 axle loads:
- each 100 kN c.t.c. 1 m: the 3rd axle load is 4 m apart, thus neglected;
- 2 traffic lanes present, so 2 loads of 200 kN c.t.c. 1 m.

Wind and snow load are irrelevant and neglected.

Remark:
In **Enclosure 1** members 13 and 14 are modeled as weightless to impede double calculation of culvert self-weight. They connect the cover plates with the culvert enclosure. They are in fact dummy members.

2.3.4 Input for Enclosure 2 (Excel)

The self-weight of the culvert is calculated by help of the available dimensions in paragraph. It is more precise than the 2-dimsnional model in **Enclosure 1** for obvious reasons.

The additional lateral and vertical load on the pile tops by braking vehicles VK30 on the culvert is calculated in **Enclosure 1**:

- per vehicle VK30: H_{rem} = 100 kN, when all 3 axles are present on the culvert;
- for ease of calculation: 2 vehicles braking in the same direction are assumed on the culvert.

In **Enclosure 1**, the ½ passive resistance of the soil present is estimated with $½K_p = 1½$, and $K_n = ½$ (neutral counter pressure). See also paragraph 3.2.2.

For ease of calculation, the additional friction resistance of the culvert is neglected.

2.4 Load factors

Consequence Class 2 implies the following load factors in the ULS:

- for permanent loads: 0,9, 1,2 or 1,35;
- for variable loads: 1,5.

In the SLS:

- all load factors: 1,0.

2.5 Load combinations

See for the load combinations the listing in **Enclosure 1**.

2.6 Available drawing

New drawing:

- dwg.no. 2307-E40-DW-1742-0002 Rev.1: Form drawing concrete culvert.

3 CALCULATION RESULTS

3.1 Pile load estimates in Enclosure 2

What follows are pile load estimates, yielding a lower limit of the actual pile loads.
It is for comparison purposes only. Calculation results from **Enclosure 1** are governing.

The self-weight of the structure and loads in the SLS is in accordance with **Enclosure 2**:

- self-weight RC: 1312 kN
- self-weight compacted fill: 90 kN
- piping load: 121 kN
- vehicles on 2 lanes (2*300 kN): 601 kN +
- sum of loads in SLS, excl. impact: **2124 kN**.

Pile loads will increase due to:

- impact of vehicle loads (s = 1,1);
- brake forces (100 kN per vehicle VK30, when all 3 axles are present).

With impact factor, the sum of loads in the SLS is:

- sum of loads in SLS, incl. impact: **2184 kN** (= 2124+60 kN)

Brake forces induce a vertical load into the perimeter piles due to a mechanical couple:

- take symmetrical brake load for ease of analysis, so 2 brake forces are used, 1 per lane;
- 2x brake force: $2*H_{rem}$ = 2*100 kN = 200 kN;
- height above pile top: h = 3½-1,35+0,4-0,25 m = 2,3 m;
- distance between pile tops: L = 3+3 m = 6 m
- sum of vertical forces: $V_{rep} = 2*H_{rem}*h/L$ = 2*100 kN*2,3 m/6 m = $76^2/_3$ kN;
- each pile gets 50% of force: $½V_{rep}$ = ½*$76^2/_3$ kN = **$38^1/_3$ kN**;

Divided evenly over 6 piles, except the brake force:

- per pile in SLS, excl. impact: 2124 kN/6 = **354 kN**;
- per pile in SLS, incl. impact: 2184 kN/6 = **364 kN**;
- ditto, incl. impact + brake: 364+$38^1/_3$ kN = **403 kN**.

This is a pile estimate based on an evenly distribution of loads over the pile rows, which is too optimistic.

Pile loads will increase in SLS due to:

- uneven distribution of loads over the pile rows,

and in ULS, additional increase due to:

- load factors.

3.2 Pile loads in Enclosure 1

3.2.1 Vertical pile loads

Pile loads in SLS based on **Enclosure 1**:

Item	Pile row 1: axial load kN	Pile row 2: axial load kN	Pile row 3: axial load kN
For 2 piles	880½	757	880½
Per pile	**440¼**	**378½**	**440¼**

For ULS, see next page.

Pile loads in ULS based on **Enclosure 1**:

Item	Pile row 1: axial load kN	Pile row 2: axial load kN	Pile row 3: axial load kN
For 2 piles	1200	986	1200
Per pile	**600**	**493**	**600**

Due to brake forces the pile forces of 2 piles increase with:
- In SLS: 38$^1/_3$ kN;
- In ULS: 57½ kN (= 1,5*38$^1/_3$ kN).

The pile forces thus become, per pile:

Item	**Pile row 1: axial load kN**	**Pile row 2: axial load kN**	**Pile row 3: axial load kN**
in SLS	**479**	**378½**	**479**
in ULS	**657½**	**493**	**657½**

3.2.2 Lateral pile loads

Lateral pile loads will be low because of the potential passive resistance of the surrounding soil, which is relatively large. In accordance with **Enclosure 2**, the potential passive resistance in the SLS is as follows, excl. reduction due to the GWL (Ground Water Level):
- ½ passive resistance – neutral pressure = 1½ - ½ = 1,0;
- vertical soil pressure: $p_v = h*\rho*g$ = 2,3 m*18 kN/m³ = 41,4 kN/m²;
- lateral peak pressure: $p_h = ½(K_p-K_n)*p_v$ = 41,4 kN/m²;
- lateral area: A = b*h = 2,3*6½ m² = 14,95 m²;
- max. lateral resistance: $H_{u\ rep} = ½*p_h*A$ = 309½ kN, excl. reduction due to the GWL.

Lateral drift in SLS for ½ passive resistance is considerable:
- consult NEN 9997-1: u_{rep} = h/200 = 2,3 m/200 = 0,0115 m = **11½ mm**.

The lateral pile load without the passive resistance of the soil is as follows:
- in SLS: $H_{rep} = 2*H_{rem}/n$ = 2*100 kN/6 = **33$^1/_3$ kN**;
- in ULS: H_{Ed} = 1,5 *H_{rep} = 1,5*33$^1/_3$ kN = **50 kN**.

However, due to the potential passive resistance of the surrounding soil, the lateral pile load in ULS is reduced as follows:
- assumed passive resistance in ULS: $H_{Rd\ soil} \geq$ 60 kN;
- reduced lateral load per pile in ULS: $H_{Ed} \leq$ 50-60 kN/6 = **40 kN**.

These lateral pile top loads are of course safe upper limits.

3.3 Pile forces, rounded

The pile forces are rounded up as follows:

Item	Axial load, compression kN	Axial load, tension kN	Lateral load kN
in SLS	**500**	**-**	**+/-30**
in ULS	**700**	**-**	**+/-40**

4 APPENDICES

Enclosures:

Technosoft Raamwerken release 6.60d 4 aug 2021

Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading
Constructeur.: V.Domingo Carballeira
Opdrachtgever: NESTE
Dimensies....: kN;m;rad (tenzij anders aangegeven)
Datum.....: August 4, 2021
Bestand.....: K:\BU3\Proj-Open\Neste\68685-001\141-CSA\1414-Calc\
F_Culvert\GB\ENCL1 Culvert dd 4 aug 2021.rww

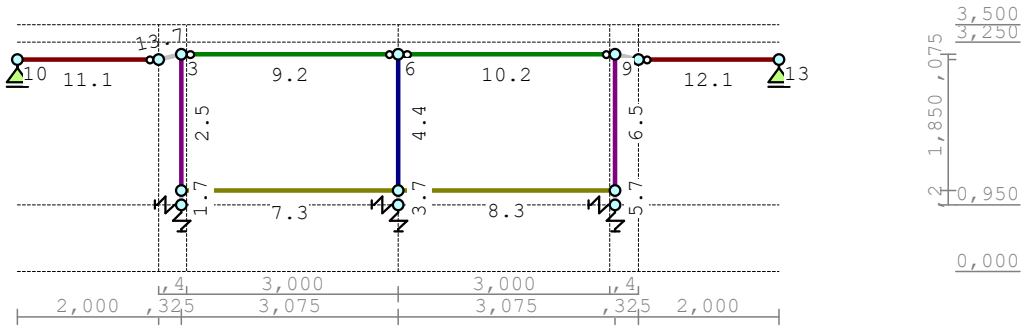
Theorie voor de bepaling van de krachtsverdeling: Geometrisch lineair.

Gunstige werking van de permanente belasting wordt automatisch verwerkt.

Toegepaste normen volgens Eurocode met Nederlandse NB

Belastingen	NEN-EN 1990:2002	C2:2010	NB:2011(nl)
	NEN-EN 1991-1-1:2002	C1:2009	NB:2011(nl)

GEOMETRIE



STRAMIENLIJNEN

Nr.	Naam	X	Z-min	Z-max
1		-3.400	0.000	3.500
2		-3.000	0.000	3.500
3		0.000	0.000	3.500
4		3.000	0.000	3.500
5		3.400	0.000	3.500

NIVEAUS

Nr.	Z	X-min	X-max
1	0.000	-5.400	5.400
2	0.950	-5.400	5.400
3	3.250	-5.400	5.400
4	3.500	-5.400	5.400

MATERIALEN

Mt	Omschrijving	E-modulus[N/mm2]	S.G.	Pois.	Uitz. coëff
1	C35/45	21000	25.0	0.20	1.0000e-05
2	C25/30	8352	0.0	0.20	1.0000e-05

MATERIALEN vervolg

Mt	Omschrijving	Cement	Kruipfac.	Toeslag	Rho[kg/m3]
1	C35/45	N	2.18	Normaal	2400
2	C25/30	N	2.77	Normaal	2400

PROFIELEN [mm]

Prof.	Omschrijving	Materiaal	Oppervlak	Traagheid	Vormf.
1	B*H 5000*250	1:C35/45	1.2500e+06	6.5104e+09	0.00
2	B*H 6500*350	1:C35/45	2.2750e+06	2.3224e+10	0.00
3	B*H 6500*400	1:C35/45	2.6000e+06	3.4667e+10	0.00
4	B*H 6500*500	1:C35/45	3.2500e+06	6.7708e+10	0.00
5	B*H 6500*650	1:C35/45	4.2250e+06	1.4876e+11	0.00

Technosoft Raamwerken release 6.60d 4 aug 2021

Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

PROFIELEN [mm]

Prof.	Omschrijving	Materiaal	Oppervlak	Traagheid	Vormf.
6	B*H 5000*100	2:C25/30	5.0000e+05	4.1667e+08	0.00
7	B*H 5000*300	2:C25/30	1.5000e+06	1.1250e+10	0.00

PROFIELEN vervolg [mm]

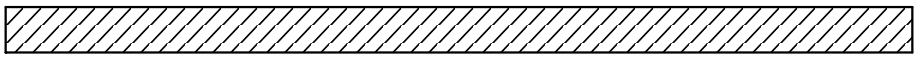
Prof.	Staaftype	Breedte	Hoogte	e	Type	b1	h1	b2	h2
1	0:Normaal	5000	250	125.0	0:RH				
2	0:Normaal	6500	350	175.0	0:RH				
3	0:Normaal	6500	400	200.0	0:RH				
4	0:Normaal	6500	500	250.0	0:RH				
5	0:Normaal	6500	650	325.0	0:RH				
6	0:Normaal	5000	100	50.0	0:RH				
7	0:Normaal	5000	300	150.0	0:RH				

VERLOPENDE PROFIELEN

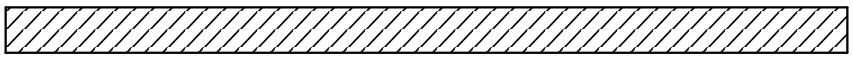
Nr.	Hi	Bi	Hj	Bj	tf	tw	r	Vormf-i	Vormf-j	Materiaal
1	250	6500	650	6500						1:C35/45

PROFIELVORMEN [mm]

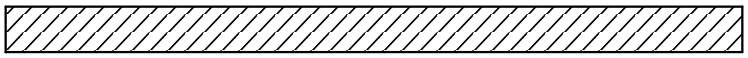
1 B*H 5000*250



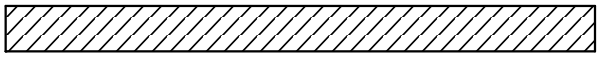
2 B*H 6500*350



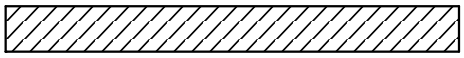
3 B*H 6500*400



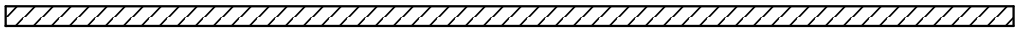
4 B*H 6500*500



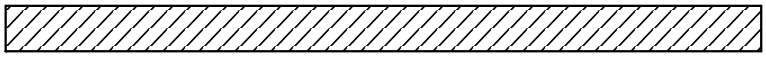
5 B*H 6500*650



6 B*H 5000*100



7 B*H 5000*300



KNOPEN

Knoop	X	Z	Knoop	X	Z
1	-3.075	0.950	6	0.000	3.075
2	-3.075	1.150	7	3.075	0.950
3	-3.075	3.075	8	3.075	1.150
4	0.000	0.950	9	3.075	3.075
5	0.000	1.150	10	-5.400	3.000
11	-3.400	3.000			
12	3.400	3.000			
13	5.400	3.000			

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Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

STAVEN

St.	ki	kj	Profiel	Aansl.i	Aansl.j	Lengte	Opm.
1	1	2	7:B*H 5000*300	NDM	NDM	0.200	
2	2	3	5:B*H 6500*650	NDM	NDM	1.925	
3	4	5	7:B*H 5000*300	NDM	NDM	0.200	
4	5	6	4:B*H 6500*500	NDM	NDM	1.925	
5	7	8	7:B*H 5000*300	NDM	NDM	0.200	
6	8	9	5:B*H 6500*650	NDM	NDM	1.925	
7	2	5	3:B*H 6500*400	NDM	NDM	3.075	
8	5	8	3:B*H 6500*400	NDM	NDM	3.075	
9	3	6	2:B*H 6500*350	ND-	ND-	3.075	
10	6	9	2:B*H 6500*350	ND-	ND-	3.075	
11	10	11	1:B*H 5000*250	NDM	ND-	2.000	
12	12	13	1:B*H 5000*250	ND-	NDM	2.000	
13	3	11	7:B*H 5000*300	NDM	NDM	0.334	
14	9	12	7:B*H 5000*300	NDM	NDM	0.334	

VASTE STEUNPUNTEN

Nr.	knoop	Kode XZR 1=vast 0=vrij	Hoek
1	10	010	0.00
2	13	010	0.00

VEREN

Veer	Knoop	Richting	Hoek	Veerwaarde	Type	Ondergrens	Bovengrens
1	1	1:X-transl.	0.00	8.000e+03	Normaal	-1.000e+10	1.000e+10
2	1	2:Z-transl.	0.00	1.200e+05	Normaal	-1.000e+10	1.000e+10
3	4	1:X-transl.	0.00	8.000e+03	Normaal	-1.000e+10	1.000e+10
4	4	2:Z-transl.	0.00	1.200e+05	Normaal	-1.000e+10	1.000e+10
5	7	1:X-transl.	0.00	8.000e+03	Normaal	-1.000e+10	1.000e+10
6	7	2:Z-transl.	0.00	1.200e+05	Normaal	-1.000e+10	1.000e+10

BELASTINGGEVALLEN

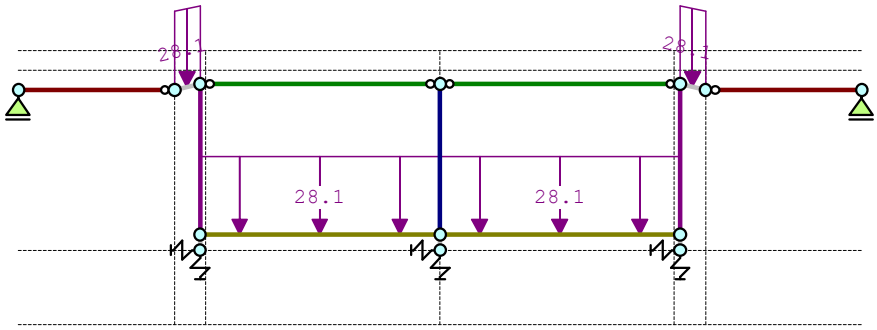
B.G.	Omschrijving	Type
1	Self-weight RC incl. edge EGZ=-1.00	1 Permanente belasting
2	Compacted fill EGZ=0.00	1 Permanente belasting
3	Piping load: 3 kPa	5 Ver. belasting door machines
4	Vehicle load: 10 kPa	6 Ver. belasting door voertuigen
5	Vehicle Pos.1: 2*2 axis loads	6 Ver. belasting door voertuigen
6	Vehicle Pos.2: 2*2 axis loads	6 Ver. belasting door voertuigen
7	Vehicle Pos.3: 2*2 axis loads	6 Ver. belasting door voertuigen
8	Vehicle Pos.4: 2*2 axis loads	6 Ver. belasting door voertuigen
9	Vehicle Pos.5: 2*2 axis loads	6 Ver. belasting door voertuigen

Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

BELASTINGEN

B.G:1 Self-weight RC incl. edge

Eigen gewicht van alle staven is meegenomen in berekening. Richting:↓



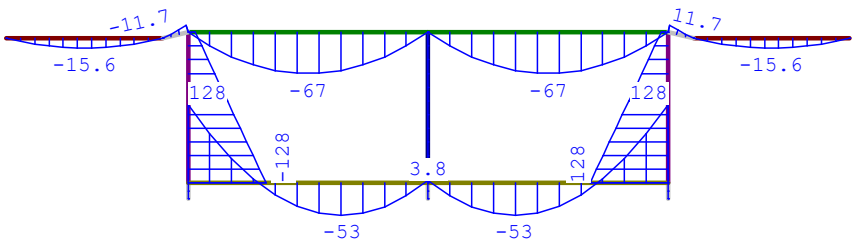
STAAFBELASTINGEN

B.G:1 Self-weight RC incl. edge

Staaf	Type	q1/p/m	q2	A	B	ψ_0	ψ_1	ψ_2
13	5:QZGlobaal	-28.10	-28.10	0.000	0.000			
14	5:QZGlobaal	-28.10	-28.10	0.000	0.000			
7	1:QZLokaal	-28.10	-28.10	0.000	0.000			
8	1:QZLokaal	-28.10	-28.10	0.000	0.000			

MOMENTEN

B.G:1 Self-weight RC incl. edge



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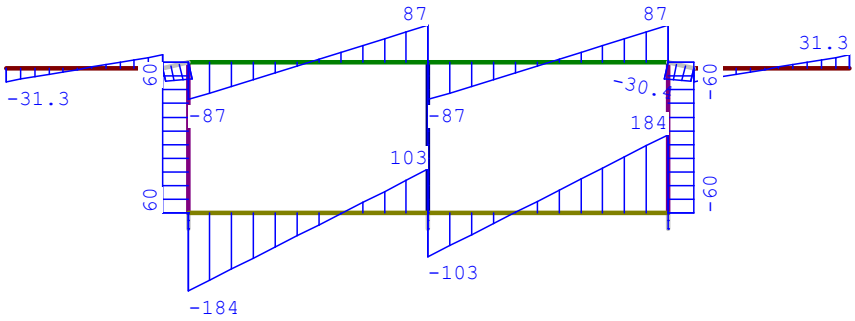
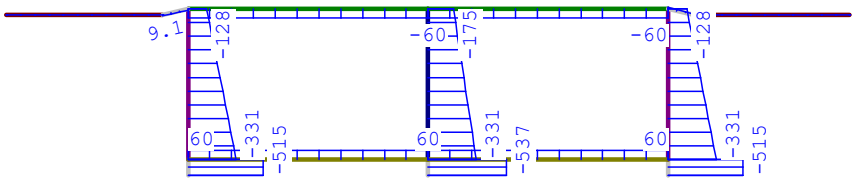
Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

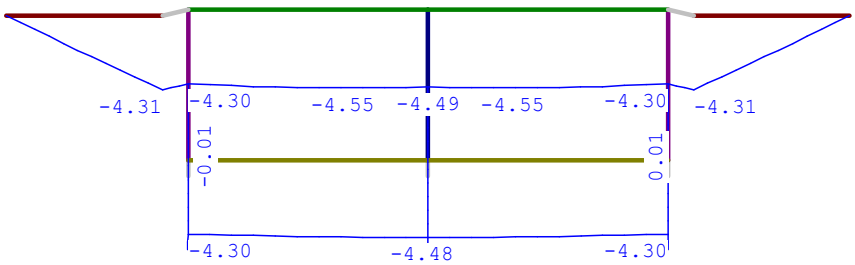
DWARSKRACHTEN B.G:1 Self-weight RC incl. edge



NORMAALKRACHTEN B.G:1 Self-weight RC incl. edge



VERPLAATSINGEN [mm] B.G:1 Self-weight RC incl. edge



Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

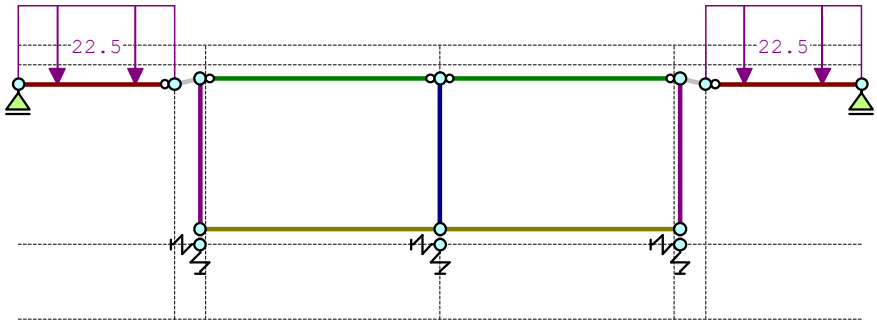
VERPLAATSINGEN [mm;rad]

B.G:1 Self-weight RC incl. edge

Kn.	X-verpl.	Z-verpl.	Rotatie	Kn.	X-verpl.	Z-verpl.	Rotatie
1	-0.01	-4.29	0.00003	6	-0.00	-4.49	-0.00000
2	-0.00	-4.30	0.00003	7	0.01	-4.29	-0.00003
3	0.00	-4.30	-0.00001	8	0.00	-4.30	-0.00003
4	-0.00	-4.47	-0.00000	9	-0.00	-4.30	0.00001
5	-0.00	-4.48	-0.00000	10	0.01	0.00	0.00223
11	0.01	-4.31	-0.00003				
12	-0.01	-4.31	0.00003				
13	-0.01	0.00	-0.00223				

BELASTINGEN

B.G:2 Compacted fill



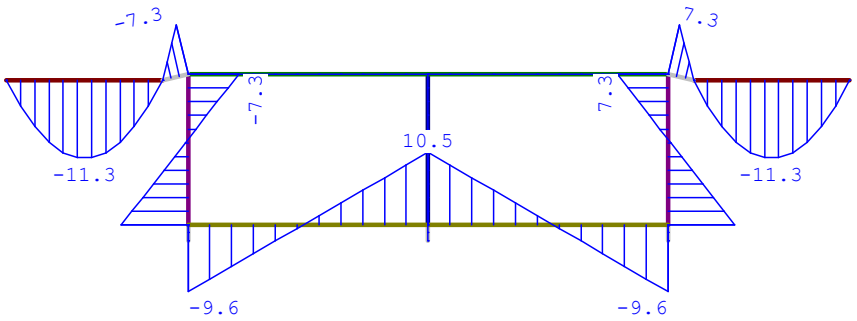
STAAFBELASTINGEN

B.G:2 Compacted fill

Staaf	Type	q1/p/m	q2	A	B	ψ_0	ψ_1	ψ_2
11	1:QZLokaal	-22.50	-22.50	0.000	0.000			
12	1:QZLokaal	-22.50	-22.50	0.000	0.000			

MOMENTEN

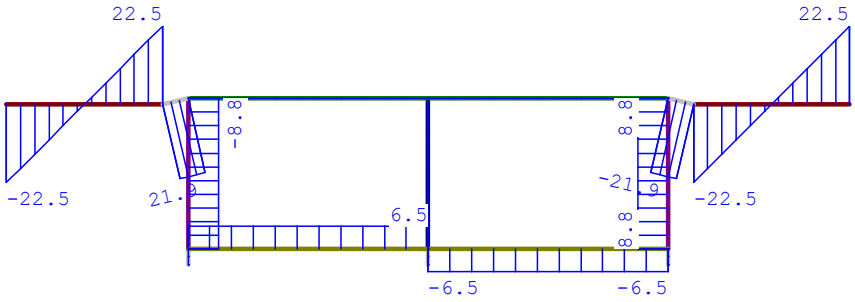
B.G:2 Compacted fill



Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

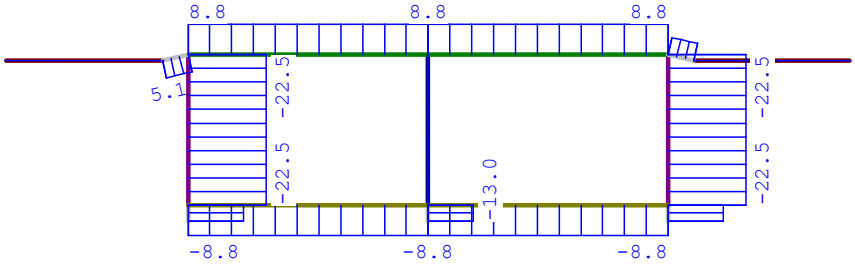
DWARSKRACHTEN

B.G:2 Compacted fill



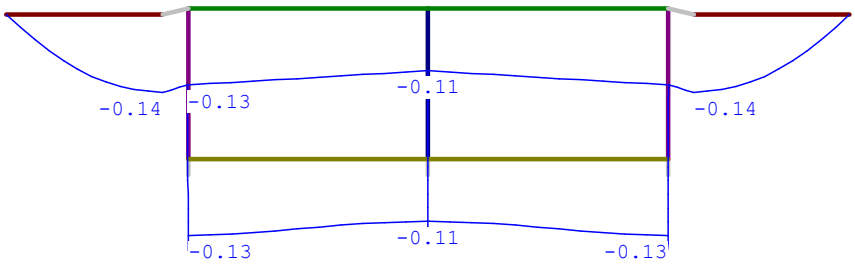
NORMAALKRACHTEN

B.G:2 Compacted fill



VERPLAATSINGEN [mm]

B.G:2 Compacted fill



Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

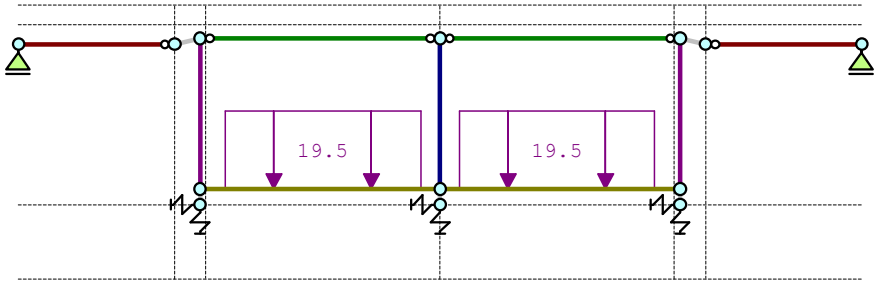
VERPLAATSINGEN [mm;rad]

B.G:2 Compacted fill

Kn.	X-verpl.	Z-verpl.	Rotatie	Kn.	X-verpl.	Z-verpl.	Rotatie
1	0.00	-0.13	-0.00000	6	-0.00	-0.11	-0.00000
2	0.00	-0.13	-0.00000	7	-0.00	-0.13	0.00000
3	-0.00	-0.13	-0.00000	8	-0.00	-0.13	0.00000
4	-0.00	-0.11	-0.00000	9	0.00	-0.13	0.00000
5	-0.00	-0.11	-0.00000	10	0.00	0.00	0.00012
11	0.00	-0.14	-0.00001				
12	-0.00	-0.14	0.00001				
13	-0.00	0.00	-0.00012				

BELASTINGEN

B.G:3 Piping load: 3 kPa



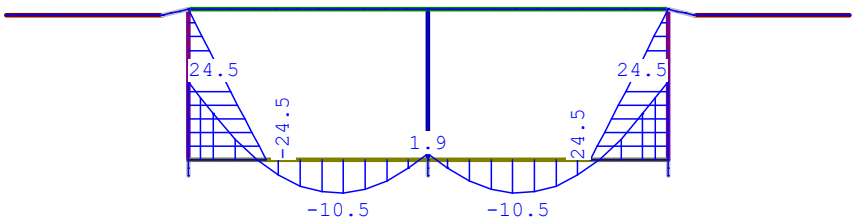
STAAFBELASTINGEN

B.G:3 Piping load: 3 kPa

Staaf	Type	q1/p/m	q2	A	B	ψ_0	ψ_1	ψ_2
7	1:QZLokaal	-19.50	-19.50	0.325	0.250	0.0	0.0	0.0
8	1:QZLokaal	-19.50	-19.50	0.250	0.325	0.0	0.0	0.0

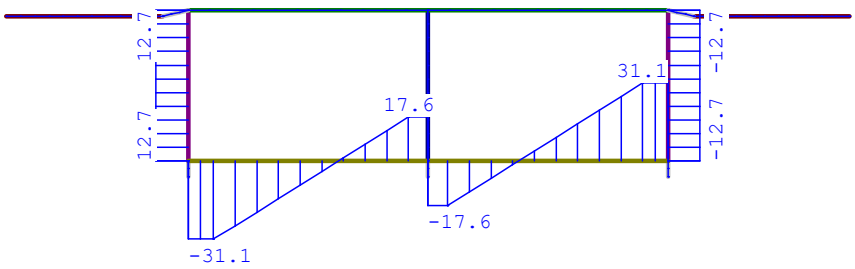
MOMENTEN

B.G:3 Piping load: 3 kPa

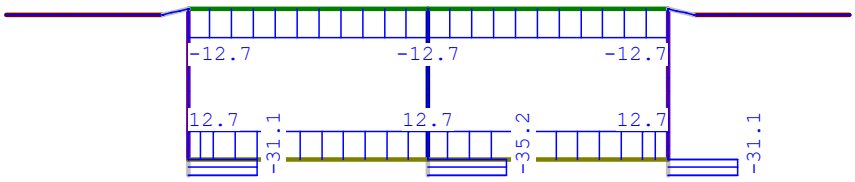


Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

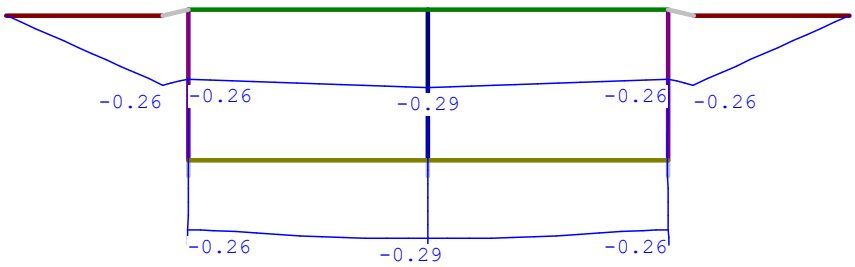
DWARSKRACHTEN B.G:3 Piping load: 3 kPa



NORMAALKRACHTEN B.G:3 Piping load: 3 kPa



VERPLAATSINGEN [mm] B.G:3 Piping load: 3 kPa



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Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

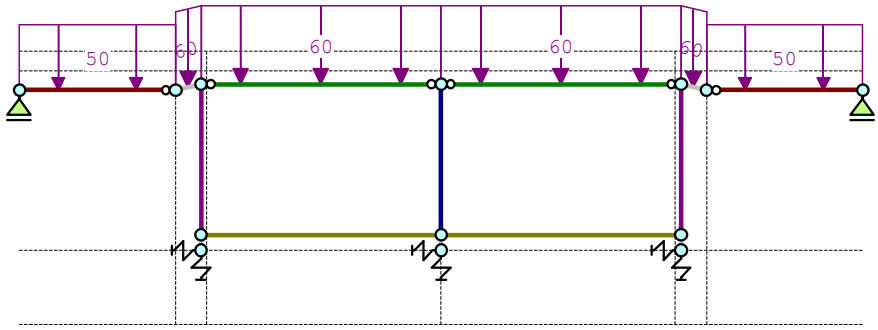
VERPLAATSINGEN [mm;rad]

B.G:3 Piping load: 3 kPa

Kn.	X-verpl.	Z-verpl.	Rotatie	Kn.	X-verpl.	Z-verpl.	Rotatie
1	-0.00	-0.26	0.00001	6	-0.00	-0.29	-0.00000
2	-0.00	-0.26	0.00001	7	0.00	-0.26	-0.00001
3	0.00	-0.26	-0.00000	8	0.00	-0.26	-0.00001
4	-0.00	-0.29	-0.00000	9	-0.00	-0.26	0.00000
5	-0.00	-0.29	-0.00000	10	0.00	0.00	0.00013
11	0.00	-0.26	-0.00000				
12	-0.00	-0.26	0.00000				
13	-0.00	0.00	-0.00013				

BELASTINGEN

B.G:4 Vehicle load: 10 kPa



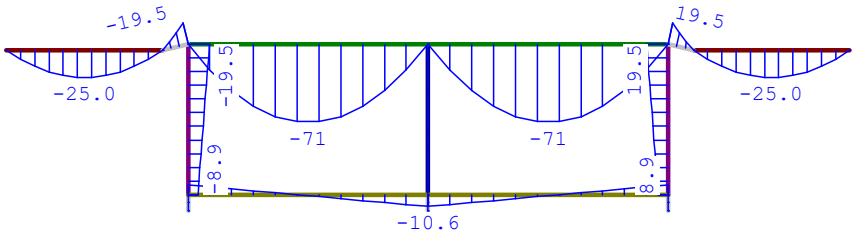
STAAFBELASTINGEN

B.G:4 Vehicle load: 10 kPa

Staaf	Type	q1/p/m	q2	A	B	ψ_0	ψ_1	ψ_2
9	1:QZLokaal	-60.00	-60.00	0.000	0.000	1.0	0.9	0.8
10	1:QZLokaal	-60.00	-60.00	0.000	0.000	1.0	0.9	0.8
11	1:QZLokaal	-50.00	-50.00	0.000	0.000	1.0	0.9	0.8
12	1:QZLokaal	-50.00	-50.00	0.000	0.000	1.0	0.9	0.8
13	5:QZGlobaal	-60.00	-60.00	0.000	0.000	1.0	0.9	0.8
14	5:QZGlobaal	-60.00	-60.00	0.000	0.000	1.0	0.9	0.8

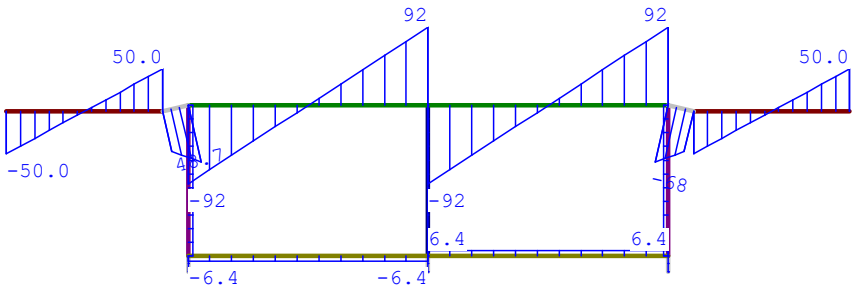
MOMENTEN

B.G:4 Vehicle load: 10 kPa

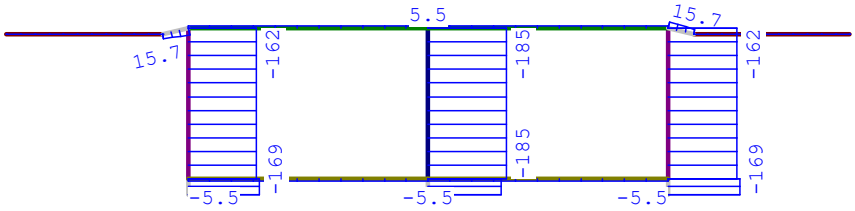


Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

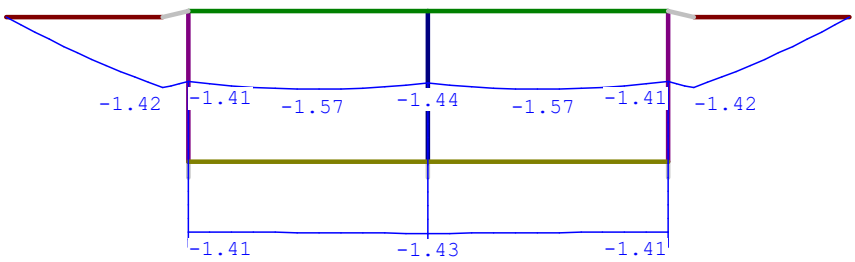
DWARSKRACHTEN B.G:4 Vehicle load: 10 kPa



NORMAALKRACHTEN B.G:4 Vehicle load: 10 kPa



VERPLAATSINGEN [mm] B.G:4 Vehicle load: 10 kPa



Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

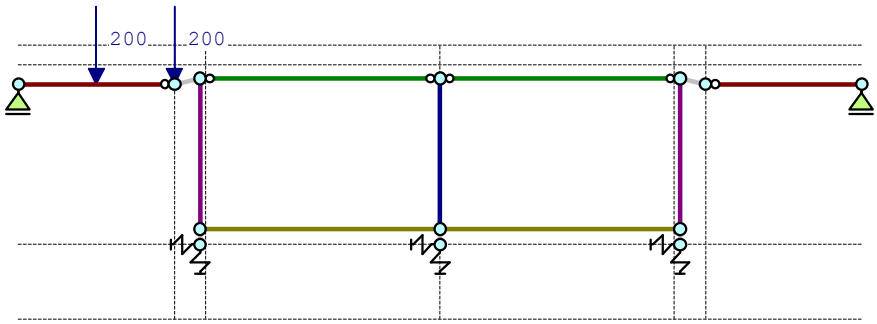
VERPLAATSINGEN [mm;rad]

B.G:4 Vehicle load: 10 kPa

Kn.	X-verpl.	Z-verpl.	Rotatie	Kn.	X-verpl.	Z-verpl.	Rotatie
1	-0.00	-1.41	0.00000	6	-0.00	-1.44	-0.00000
2	0.00	-1.41	0.00000	7	0.00	-1.41	-0.00000
3	-0.00	-1.41	-0.00001	8	-0.00	-1.41	-0.00000
4	-0.00	-1.43	-0.00000	9	0.00	-1.41	0.00001
5	-0.00	-1.43	-0.00000	10	0.00	0.00	0.00083
11	0.00	-1.42	-0.00004				
12	-0.00	-1.42	0.00004				
13	-0.00	0.00	-0.00083				

BELASTINGEN

B.G:5 Vehicle Pos.1: 2*2 axis loads



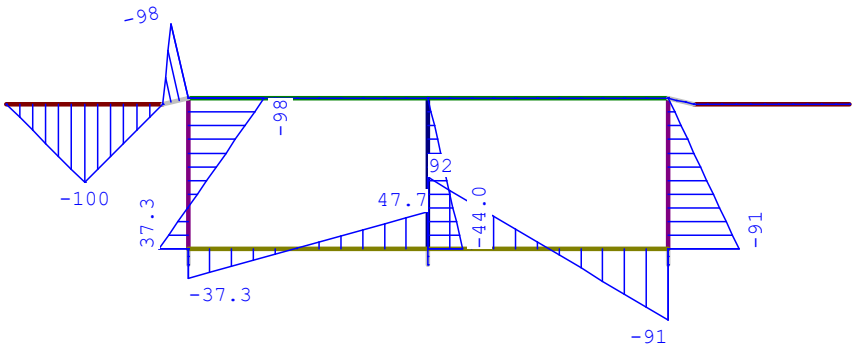
STAAFBELASTINGEN

B.G:5 Vehicle Pos.1: 2*2 axis loads

Staaf	Type	q1/p/m	q2	A	B	ψ_0	ψ_1	ψ_2
11	8:PZLokaal	-200.00		1.000		1.0	0.9	0.8
11	8:PZLokaal	-200.00		2.000		1.0	0.9	0.8

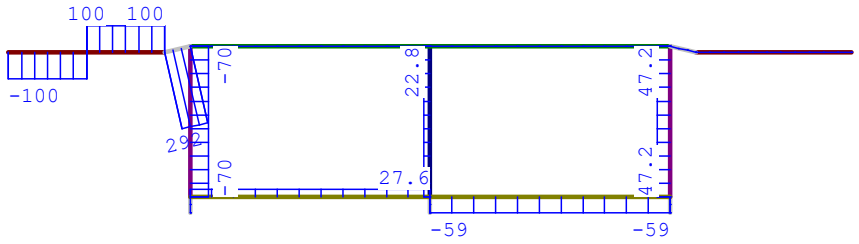
MOMENTEN

B.G:5 Vehicle Pos.1: 2*2 axis loads

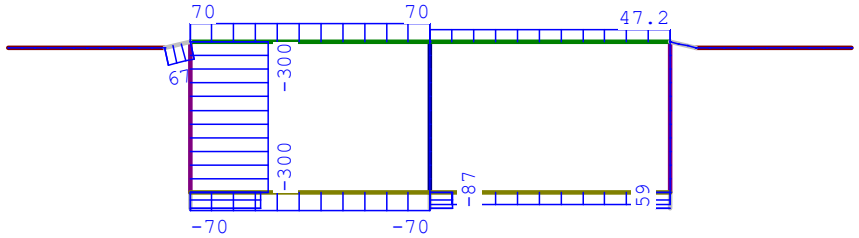


Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

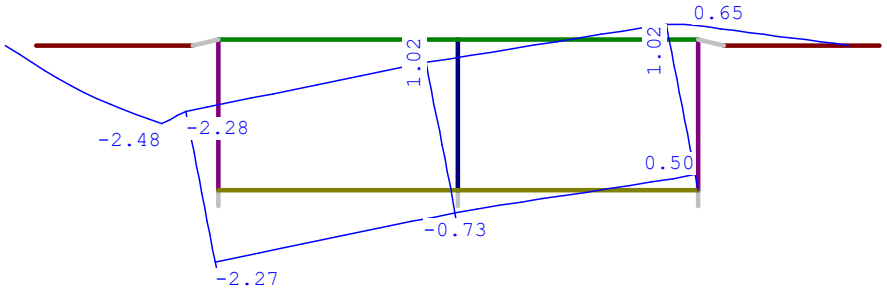
DWARSKRACHTEN B.G:5 Vehicle Pos.1: 2*2 axis loads



NORMAALKRACHTEN B.G:5 Vehicle Pos.1: 2*2 axis loads



VERPLAATSINGEN [mm] B.G:5 Vehicle Pos.1: 2*2 axis loads



Technosoft Raamwerken release 6.60d 4 aug 2021

Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

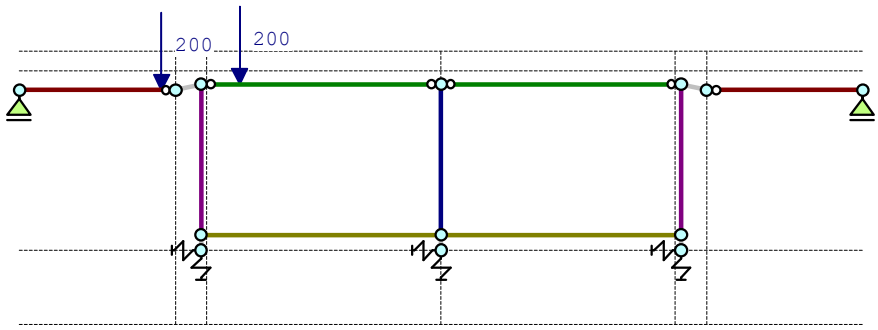
VERPLAATSINGEN [mm;rad]

B.G:5 Vehicle Pos.1: 2*2 axis loads

Kn.	X-verpl.	Z-verpl.	Rotatie	Kn.	X-verpl.	Z-verpl.	Rotatie
1	0.01	-2.27	-0.00048	6	-1.02	-0.73	-0.00049
2	-0.09	-2.27	-0.00048	7	-0.00	0.49	-0.00046
3	-1.03	-2.28	-0.00050	8	-0.10	0.50	-0.00046
4	-0.00	-0.72	-0.00046	9	-1.02	0.50	-0.00049
5	-0.09	-0.73	-0.00046	10	-0.98	0.00	0.00161
11	-0.98	-2.48	-0.00068				
12	-0.98	0.65	-0.00049				
13	-0.98	0.00	0.00033				

BELASTINGEN

B.G:6 Vehicle Pos.2: 2*2 axis loads



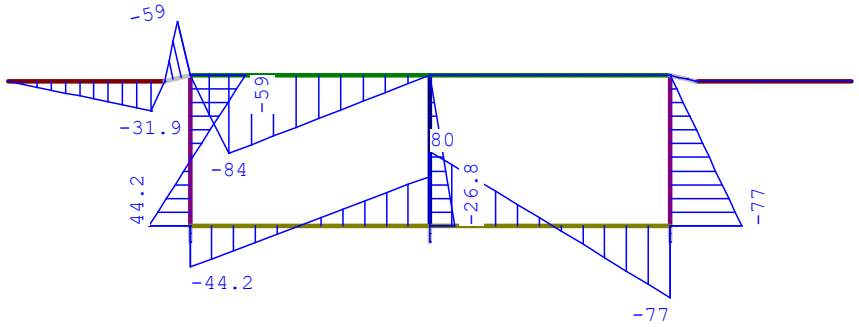
STAAFBELASTINGEN

B.G:6 Vehicle Pos.2: 2*2 axis loads

Staaf	Type	q1/p/m	q2	A	B	ψ_0	ψ_1	ψ_2
11	8:PZLokaal	-200.00		1.825		1.0	0.9	0.8
9	8:PZLokaal	-200.00		0.500		1.0	0.9	0.8

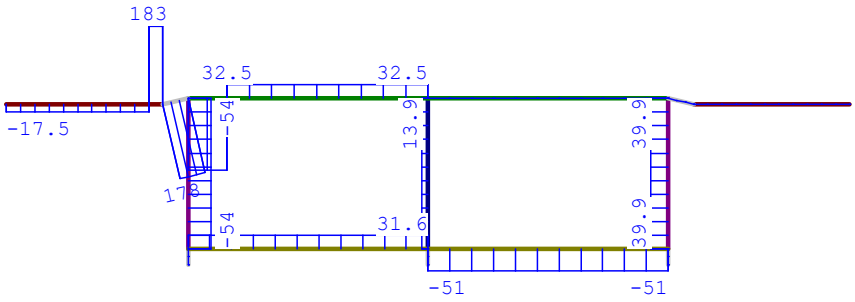
MOMENTEN

B.G:6 Vehicle Pos.2: 2*2 axis loads

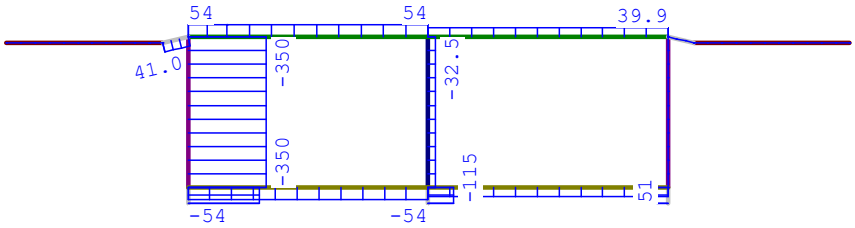


Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

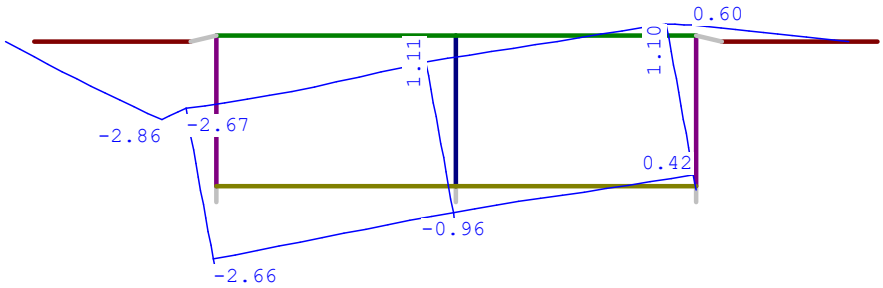
DWARSKRACHTEN B.G:6 Vehicle Pos.2: 2*2 axis loads



NORMAALKRACHTEN B.G:6 Vehicle Pos.2: 2*2 axis loads



VERPLAATSINGEN [mm] B.G:6 Vehicle Pos.2: 2*2 axis loads



Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

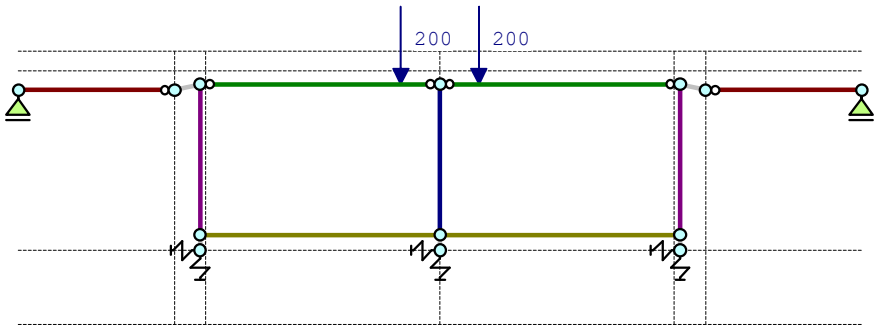
VERPLAATSINGEN [mm;rad]

B.G:6 Vehicle Pos.2: 2*2 axis loads

Kn.	X-verpl.	Z-verpl.	Rotatie	Kn.	X-verpl.	Z-verpl.	Rotatie
1	0.01	-2.65	-0.00053	6	-1.11	-0.96	-0.00053
2	-0.10	-2.66	-0.00053	7	-0.00	0.42	-0.00050
3	-1.11	-2.67	-0.00053	8	-0.11	0.42	-0.00050
4	-0.00	-0.96	-0.00051	9	-1.10	0.42	-0.00053
5	-0.10	-0.96	-0.00051	10	-1.06	0.00	0.00152
11	-1.06	-2.86	-0.00064				
12	-1.06	0.60	-0.00053				
13	-1.06	0.00	0.00030				

BELASTINGEN

B.G:7 Vehicle Pos.3: 2*2 axis loads



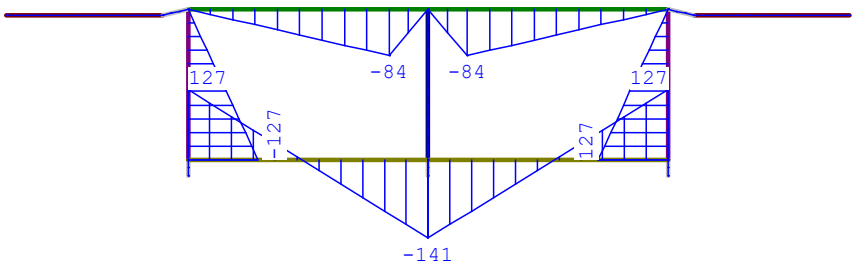
STAAFBELASTINGEN

B.G:7 Vehicle Pos.3: 2*2 axis loads

Staaf	Type	q1/p/m	q2	A	B	ψ_0	ψ_1	ψ_2
9	8:PZLokaal	-200.00		2.575		0.4	0.5	0.3
10	8:PZLokaal	-200.00		0.500		0.4	0.5	0.3

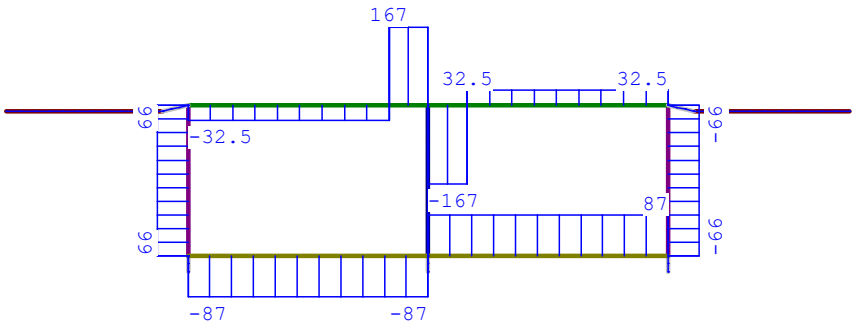
MOMENTEN

B.G:7 Vehicle Pos.3: 2*2 axis loads

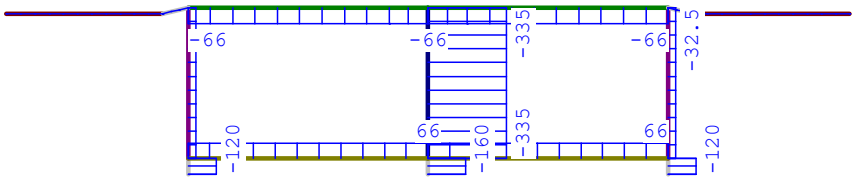


Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

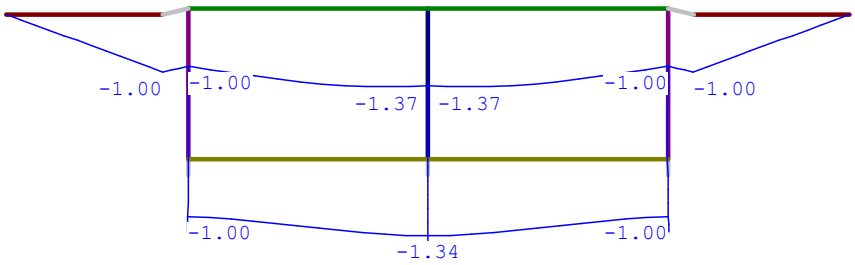
DWARSKRACHTEN B.G:7 Vehicle Pos.3: 2*2 axis loads



NORMAALKRACHTEN B.G:7 Vehicle Pos.3: 2*2 axis loads



VERPLAATSINGEN [mm] B.G:7 Vehicle Pos.3: 2*2 axis loads



Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

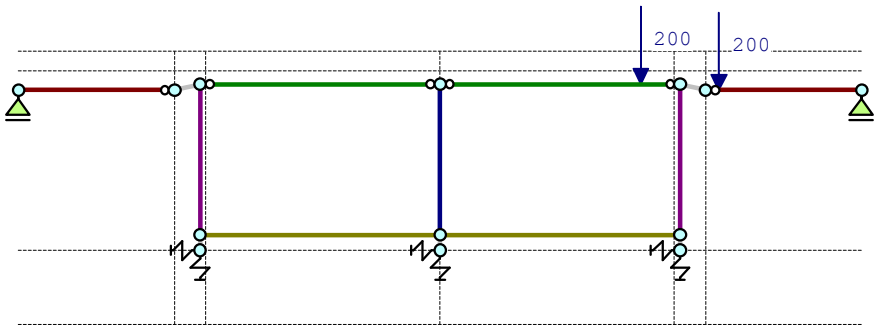
VERPLAATSINGEN [mm;rad]

B.G:7 Vehicle Pos.3: 2*2 axis loads

Kn.	X-verpl.	Z-verpl.	Rotatie	Kn.	X-verpl.	Z-verpl.	Rotatie
1	-0.01	-1.00	0.00003	6	0.00	-1.35	0.00000
2	-0.00	-1.00	0.00003	7	0.01	-1.00	-0.00003
3	0.00	-1.00	-0.00001	8	0.00	-1.00	-0.00003
4	-0.00	-1.34	0.00000	9	-0.00	-1.00	0.00001
5	0.00	-1.34	0.00000	10	0.00	0.00	0.00050
11	0.00	-1.00	-0.00001				
12	-0.00	-1.00	0.00001				
13	-0.00	0.00	-0.00050				

BELASTINGEN

B.G:8 Vehicle Pos.4: 2*2 axis loads



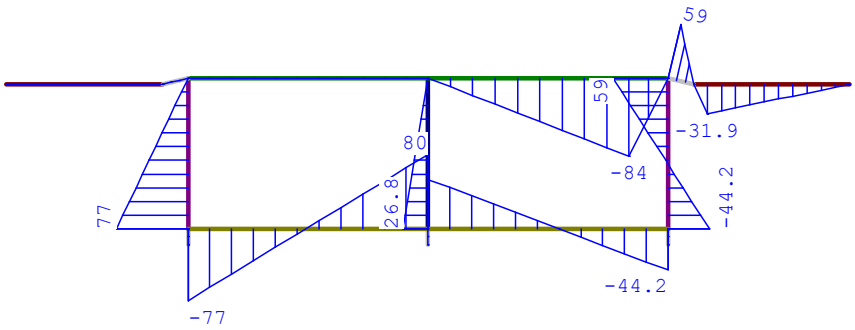
STAAFBELASTINGEN

B.G:8 Vehicle Pos.4: 2*2 axis loads

Staaf	Type	q1/p/m	q2	A	B	ψ_0	ψ_1	ψ_2
10	8:PZLokaal	-200.00		2.575		1.0	0.9	0.8
12	8:PZLokaal	-200.00		0.175		1.0	0.9	0.8

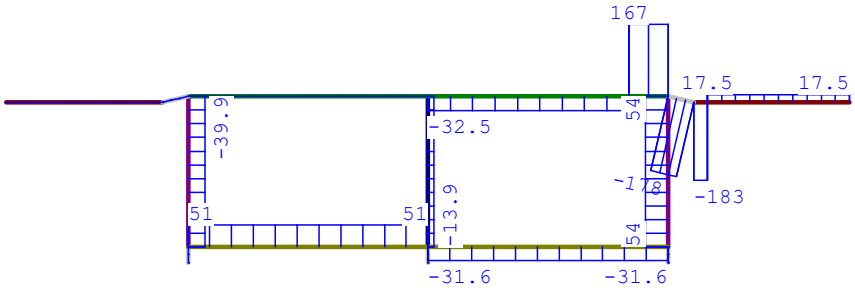
MOMENTEN

B.G:8 Vehicle Pos.4: 2*2 axis loads

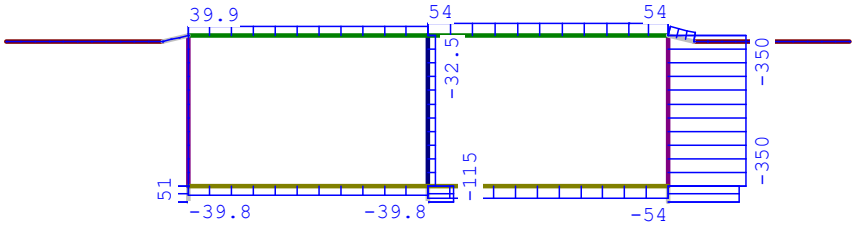


Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

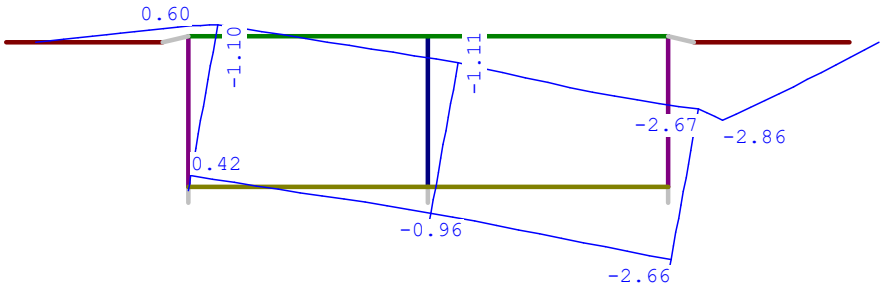
DWARSKRACHTEN B.G:8 Vehicle Pos.4: 2*2 axis loads



NORMAALKRACHTEN B.G:8 Vehicle Pos.4: 2*2 axis loads



VERPLAATSINGEN [mm] B.G:8 Vehicle Pos.4: 2*2 axis loads



Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

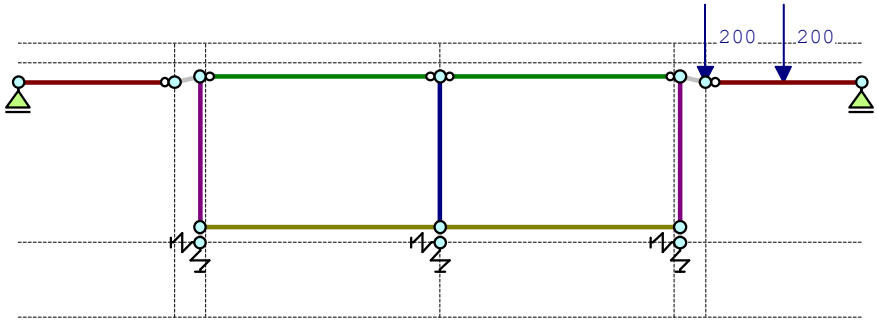
VERPLAATSINGEN [mm;rad]

B.G:8 Vehicle Pos.4: 2*2 axis loads

Kn.	X-verpl.	Z-verpl.	Rotatie	Kn.	X-verpl.	Z-verpl.	Rotatie
1	0.00	0.42	0.00050	6	1.11	-0.96	0.00053
2	0.11	0.42	0.00050	7	-0.01	-2.65	0.00053
3	1.10	0.42	0.00053	8	0.10	-2.66	0.00053
4	0.00	-0.96	0.00051	9	1.11	-2.67	0.00053
5	0.10	-0.96	0.00051	10	1.06	0.00	-0.00030
11	1.06	0.60	0.00053				
12	1.06	-2.86	0.00064				
13	1.06	0.00	-0.00152				

BELASTINGEN

B.G:9 Vehicle Pos.5: 2*2 axis loads



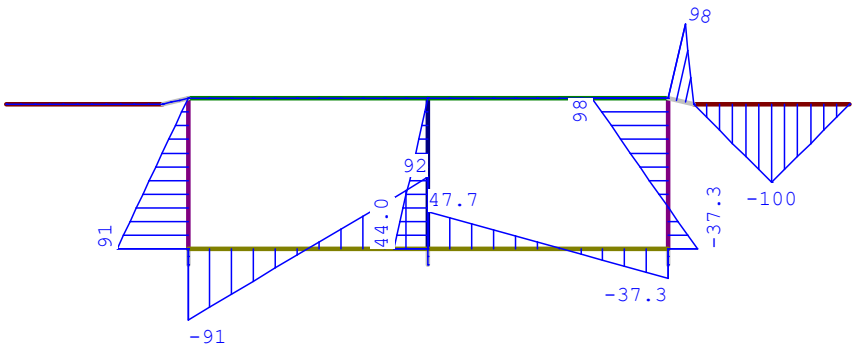
STAAFBELASTINGEN

B.G:9 Vehicle Pos.5: 2*2 axis loads

Staaf	Type	q1/p/m	q2	A	B	ψ_0	ψ_1	ψ_2
12	8:PZLokaal	-200.00		0.000		1.0	0.9	0.8
12	8:PZLokaal	-200.00		1.000		1.0	0.9	0.8

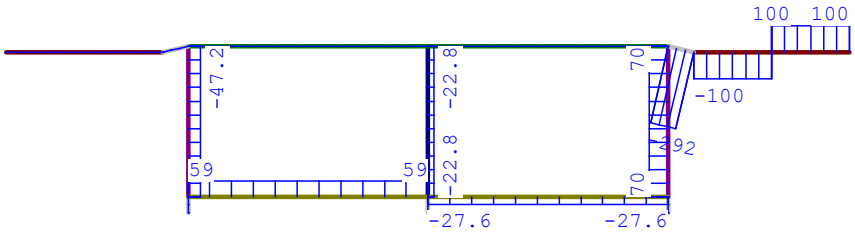
MOMENTEN

B.G:9 Vehicle Pos.5: 2*2 axis loads

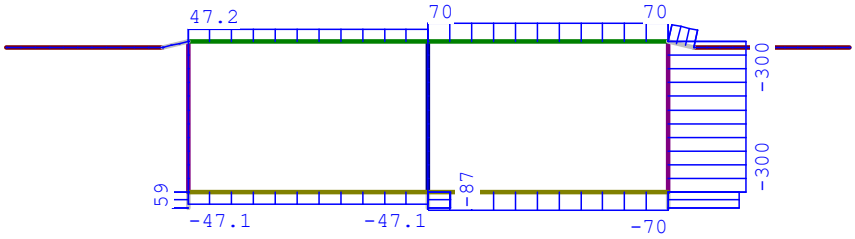


Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

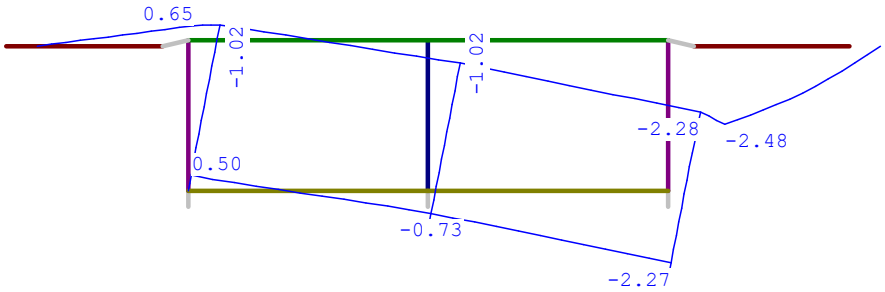
DWARSKRACHTEN B.G:9 Vehicle Pos.5: 2*2 axis loads



NORMAALKRACHTEN B.G:9 Vehicle Pos.5: 2*2 axis loads



VERPLAATSINGEN [mm] B.G:9 Vehicle Pos.5: 2*2 axis loads



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Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

VERPLAATSINGEN [mm;rad] B.G:9 Vehicle Pos.5: 2*2 axis loads

Kn.	X-verpl.	Z-verpl.	Rotatie	Kn.	X-verpl.	Z-verpl.	Rotatie
1	0.00	0.49	0.00046	6	1.02	-0.73	0.00049
2	0.10	0.50	0.00046	7	-0.01	-2.27	0.00048
3	1.02	0.50	0.00049	8	0.09	-2.27	0.00048
4	0.00	-0.72	0.00046	9	1.03	-2.28	0.00050
5	0.09	-0.73	0.00046	10	0.98	0.00	-0.00033
11	0.98	0.65	0.00049				
12	0.98	-2.48	0.00068				
13	0.98	0.00	-0.00161				

REACTIES

Kn.	B.G.	X	Z	M
1	1	0.08	514.93	
1	2	-0.01	15.98	
1	3	0.02	31.15	
1	4	0.00	168.62	
1	5	-0.05	272.36	
1	6	-0.05	318.37	
1	7	0.08	119.87	
1	8	-0.04	-50.90	
1	9	-0.04	-59.35	
4	1	0.00	536.79	
4	2	0.00	13.05	
4	3	0.00	35.20	
4	4	0.00	171.79	
4	5	0.01	86.99	
4	6	0.01	115.02	
4	7	0.00	160.26	
4	8	-0.01	115.02	
4	9	-0.01	86.99	
7	1	-0.08	514.93	
7	2	0.01	15.98	
7	3	-0.02	31.15	
7	4	-0.00	168.62	
7	5	0.04	-59.35	
7	6	0.04	-50.90	
7	7	-0.08	119.87	
7	8	0.05	318.37	
7	9	0.05	272.36	
10	1		31.25	
10	2		22.50	
10	3		0.00	
10	4		50.00	
10	5		100.00	
10	6		17.50	
10	7		0.00	
10	8		0.00	
10	9		0.00	
13	1		31.25	
13	2		22.50	
13	3		0.00	
13	4		50.00	
13	5		0.00	
13	6		0.00	
13	7		0.00	
13	8		17.50	
13	9		100.00	

Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

GUNSTIGE WERKING PERMANENTE BELASTINGEN

BC	Staven met gunstige werking
1	Geen
2	Geen
3	Geen
4	Geen
5	Geen
6	Geen
7	Geen
8	Geen

BELASTINGCOMBINATIE: 1 ULS: self-w. RC

Uiterste grenstoestand; Fundamentele combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.35
2:Compacted fill	Permanent	1.35

BELASTINGCOMBINATIE: 2 ULS: self-w. RC + piping

Uiterste grenstoestand; Fundamentele combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.35
2:Compacted fill	Permanent	1.35
3:Piping load: 3 kPa	Extreem	1.35

BELASTINGCOMBINATIE: 3 ULS: self-w. RC + piping + vehicle

Uiterste grenstoestand; Fundamentele combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.20
2:Compacted fill	Permanent	1.20
3:Piping load: 3 kPa	Extreem	1.20
4:Vehicle load: 10 kPa	Extreem	1.65

BELASTINGCOMBINATIE: 4

Uiterste grenstoestand; Fundamentele combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.20
2:Compacted fill	Permanent	1.20
3:Piping load: 3 kPa	Extreem	1.20
5:Vehicle Pos.1: 2*2 axis loads	Extreem	1.65

BELASTINGCOMBINATIE: 5

Uiterste grenstoestand; Fundamentele combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.20
2:Compacted fill	Permanent	1.20
3:Piping load: 3 kPa	Extreem	1.20
6:Vehicle Pos.2: 2*2 axis loads	Extreem	1.65

BELASTINGCOMBINATIE: 6

Uiterste grenstoestand; Fundamentele combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.20
2:Compacted fill	Permanent	1.20
3:Piping load: 3 kPa	Extreem	1.20
7:Vehicle Pos.3: 2*2 axis loads	Extreem	1.65

Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

BELASTINGCOMBINATIE: 7

Uiterste grenstoestand; Fundamentele combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.20
2:Compacted fill	Permanent	1.20
3:Piping load: 3 kPa	Extreem	1.20
8:Vehicle Pos.4: 2*2 axis loads	Extreem	1.65

BELASTINGCOMBINATIE: 8

Uiterste grenstoestand; Fundamentele combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.20
2:Compacted fill	Permanent	1.20
3:Piping load: 3 kPa	Extreem	1.20
9:Vehicle Pos.5: 2*2 axis loads	Extreem	1.65

BELASTINGCOMBINATIE: 9 SLS: self-w. RC

Bruikbaarheidsgrenstoestand; Karakteristieke combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.00
2:Compacted fill	Permanent	1.00

BELASTINGCOMBINATIE:10 SLS: self-w. RC + piping

Bruikbaarheidsgrenstoestand; Karakteristieke combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.00
2:Compacted fill	Permanent	1.00
3:Piping load: 3 kPa	Extreem	1.00

BELASTINGCOMBINATIE:11 ULS: self-w. RC + piping + vehicle

Bruikbaarheidsgrenstoestand; Karakteristieke combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.00
2:Compacted fill	Permanent	1.00
3:Piping load: 3 kPa	Extreem	1.00
4:Vehicle load: 10 kPa	Extreem	1.00

BELASTINGCOMBINATIE:12

Bruikbaarheidsgrenstoestand; Karakteristieke combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.00
2:Compacted fill	Permanent	1.00
3:Piping load: 3 kPa	Extreem	1.00
5:Vehicle Pos.1: 2*2 axis loads	Extreem	1.00

BELASTINGCOMBINATIE:13

Bruikbaarheidsgrenstoestand; Karakteristieke combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.00
2:Compacted fill	Permanent	1.00
3:Piping load: 3 kPa	Extreem	1.00
6:Vehicle Pos.2: 2*2 axis loads	Extreem	1.00

Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

BELASTINGCOMBINATIE:14

Bruikbaarheidsgrenstoestand; Karakteristieke combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.00
2:Compacted fill	Permanent	1.00
3:Piping load: 3 kPa	Extreem	1.00
7:Vehicle Pos.3: 2*2 axis loads	Extreem	1.00

BELASTINGCOMBINATIE:15

Bruikbaarheidsgrenstoestand; Karakteristieke combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.00
2:Compacted fill	Permanent	1.00
3:Piping load: 3 kPa	Extreem	1.00
8:Vehicle Pos.4: 2*2 axis loads	Extreem	1.00

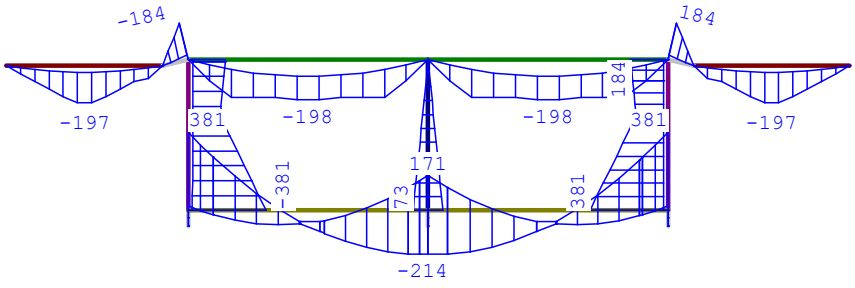
BELASTINGCOMBINATIE:16

Bruikbaarheidsgrenstoestand; Karakteristieke combinatie

Belastinggeval	Gen. type	factor
1:Self-weight RC incl. edge	Permanent	1.00
2:Compacted fill	Permanent	1.00
3:Piping load: 3 kPa	Extreem	1.00
9:Vehicle Pos.5: 2*2 axis loads	Extreem	1.00

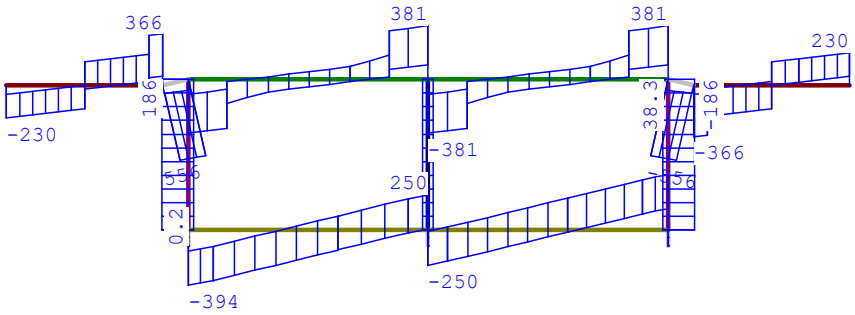
OMHULLENDE VAN DE FUNDAMENTELE COMBINATIES

MOMENTEN Fundamentele combinatie

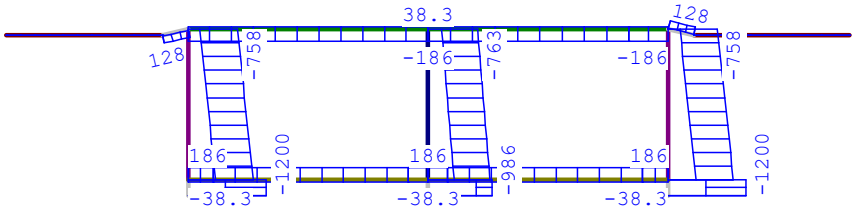


Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

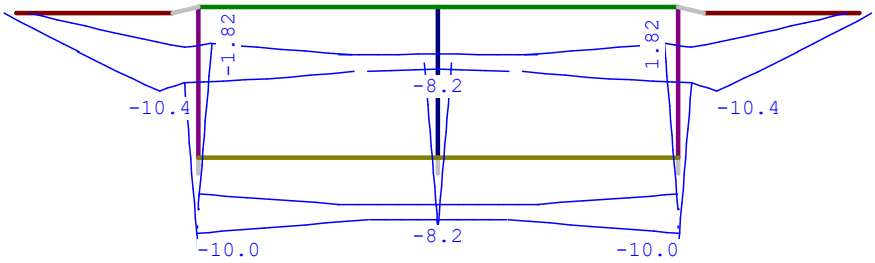
DWARSKRACHTEN Fundamentele combinatie



NORMAALKRACHTEN Fundamentele combinatie



VERPLAATSINGEN [mm] Fundamentele combinatie



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Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

VERPLAATSINGEN [mm;rad]

Fundamentele combinatie

Kn.	X-verpl. Min	X-verpl. Max	Z-verpl. Min	Z-verpl. Max	Rotatie Min	Rotatie Max
1	-0.03	-0.00	-10.00	-4.80	-0.00083	0.00087
2	-0.17	0.17	-10.02	-4.81	-0.00083	0.00087
3	-1.82	1.82	-10.04	-4.82	-0.00089	0.00085
4	-0.00	0.00	-8.21	-6.19	-0.00084	0.00084
5	-0.17	0.17	-8.23	-6.20	-0.00084	0.00084
6	-1.82	1.82	-8.25	-6.21	-0.00087	0.00087
7	0.00	0.03	-10.00	-4.80	-0.00087	0.00083
8	-0.17	0.17	-10.02	-4.81	-0.00087	0.00083
9	-1.82	1.82	-10.04	-4.82	-0.00085	0.00089
10	-1.75	1.76	0.00	0.00	0.00244	0.00563
11	-1.75	1.76	-10.37	-4.57	-0.00117	0.00081
12	-1.76	1.75	-10.37	-4.57	-0.00081	0.00117
13	-1.76	1.75	0.00	0.00	-0.00563	-0.00244

REACTIES

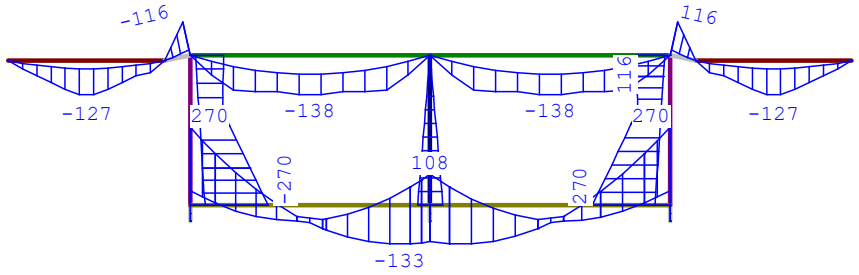
Fundamentele combinatie

Kn.	X-min	X-max	Z-min	Z-max	M-min	M-max
1	0.02	0.23	576.54	1199.78		
4	-0.02	0.02	742.29	985.51		
7	-0.23	-0.02	576.54	1199.78		
10			64.50	229.50		
13			64.50	229.50		

OMHULLENDE VAN DE KARAKTERISTIEKE COMBINATIES

MOMENTEN

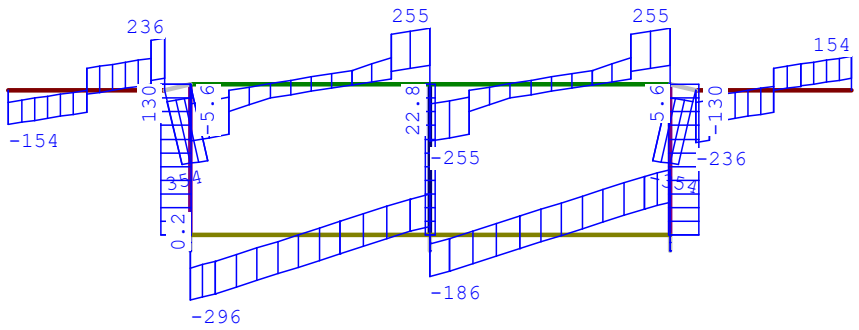
Karakteristieke combinatie



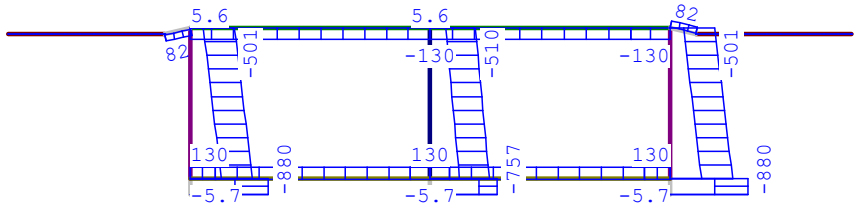
Technosoft Raamwerken release 6.60d 4 aug 2021

Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

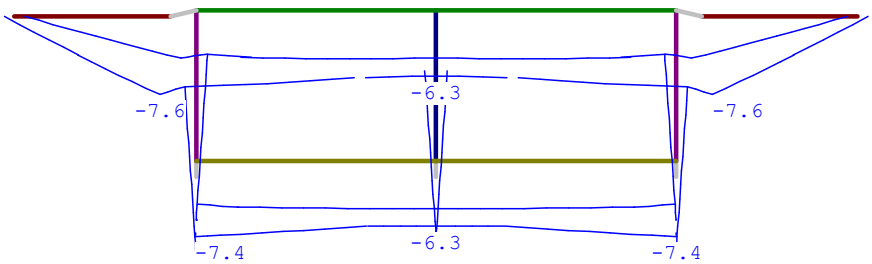
DWARSKRACHTEN Karakteristieke combinatie



NORMAALKRACHTEN Karakteristieke combinatie



VERPLAATSINGEN [mm] Karakteristieke combinatie



Project.....: 68685-001 - NESTE: EPCM Tank project
Onderdeel....: Enclosure 2: whole culvert under loading

VERPLAATSINGEN [mm;rad] Karakteristieke combinatie

	X-verpl.		Z-verpl.		Rotatie	
Kn.	Min	Max	Min	Max	Min	Max
1	-0.02	-0.00	-7.34	-4.19	-0.00049	0.00054
2	-0.10	0.10	-7.35	-4.20	-0.00049	0.00054
3	-1.10	1.11	-7.36	-4.20	-0.00055	0.00051
4	-0.00	0.00	-6.31	-4.58	-0.00051	0.00051
5	-0.10	0.10	-6.32	-4.59	-0.00051	0.00051
6	-1.11	1.11	-6.33	-4.60	-0.00053	0.00053
7	0.00	0.02	-7.34	-4.19	-0.00054	0.00049
8	-0.10	0.10	-7.35	-4.20	-0.00054	0.00049
9	-1.11	1.10	-7.36	-4.20	-0.00051	0.00055
10	-1.06	1.07	0.00	0.00	0.00216	0.00409
11	-1.06	1.07	-7.57	-4.06	-0.00072	0.00048
12	-1.07	1.06	-7.57	-4.06	-0.00048	0.00072
13	-1.07	1.06	0.00	0.00	-0.00409	-0.00216

REACTIES Karakteristieke combinatie

Kn.	X-min	X-max	Z-min	Z-max	M-min	M-max
1	0.03	0.16	502.71	880.43		
4	-0.01	0.01	549.84	756.84		
7	-0.16	-0.03	502.71	880.43		
10			53.75	153.75		
13			53.75	153.75		

RC CULVERT
SELF-WEIGHT AND ADDITIONAL LOADS

printout:	4-aug-21 16:40:50

self-weight of culvert									
items	dimensions			volume of one c.q. all				**self-w. estimate**	
	width b m	length L m	height h m	volume V = b*L*h m³	number n (-)	**volume n*V m³**	relative n*V/Σ(n*V) %	spec.grav. ρ*g kN/m³	**self-w. V_{rep} kN**
envelope:									
envelope volume	6,5	6,8	3,5	154,7	1	**154,70**	100%		
2 cover pl. supports	0,2	5,8	0,35	0,41	2	**0,81**	1%		
10 ½ cover plates	1	2	0,25	0,50	5	**2,50**	2%		
deduction volumes:									
2 piping holes:	3,1	6,5	1,55	31,2	-2	**-62,47**	-40%		
1 top recess:	5,8	6,5	0,25	9,43	-1	**-9,43**	-6%		
1 bottom recess:	5,45	6,5	0,95	33,7	-1	**-33,65**	-22%		
sum of all volumes:						**52,47**	34%	25	**1312**

additional fill load								
position of fill	dimensions			volume of one c.q. all			**self-w. estimate**	
	width b m	length L m	height h m	volume V = b*L*h m³	number n (-)	**volume n*V m³**	spec.grav. ρ*g kN/m³	**self-w. V_{rep} kN**
on 10 ½ cover plates	1	2	0,25	0,5	5	**2,50**	18	**90**

additional piping load							
piping	dimensions		area of one c.q. all			**piping load**	
	width b m	length L m	area b*L m²	number n (-)	**area n*VA m³**	area load p_{rep} kN/m²	**load V_{rep} kN**
piping load	3,1	6,5	20,15	2	40,3	3,0	**121**

additional vehicle load									
piping	dimensions		area of one c.q. all			**vehicle load**		**low vehicle speed**	
	width b m	length L m	area b*L m²	number n (-)	**area n*VA m³**	area load p_{rep} kN/m²	**load V_{rep} kN**	impact s (-)	**load s*V_{rep} kN**
vehicle load VK30	6,5	8,8	57,2	1	57,2	10,5	601		
additional area load					57,2	0	0		
sum of loads							**601**	1,1	**661**

symmetrical loading						**load estimate per pile**		
contributions	**in SLS** items **(s*)V_{rep} kN**	only perman. (ULS) load factor γ_F (-)	load V_{Ed} kN	**all loads in ULS** load factor γ_F (-)	**load V_{Ed} kN**	**number of piles n (-)**	**pile loads in SLS V_{rep} kN**	**in ULS V_{Ed} kN**
self-weight of culvert	1312	1,35	1771	1,2	1574			
additional fill	90	1,35	122	1,2	108			
piping load	121	0	0	1,5	181			
vehicle load, incl. impact	661	0	0	1,5	991			
sum of all	**2183**		1892		**2854**	**6**	**364**	**476**

vertical pile top load due to brake force											
vehicle	**brake force H_{rem} kN**	**levels of road and pile top** road z_2 m	pile top z_1 m	**height $h = z_1-z_2$ m**	**additional vertical load on pile row in SLS** **c.t.c. L m**	top load $V_o=H_{rem}*h/L$ kN	pile load $V_{ren}=^2/_3*V_o$ kN	**impact s (-)**	**pile load s*V_{rep} kN**	**in ULS** load factor γ_F (-)	**pile load V_{Ed} kN**
VK30	**100**	3,25	0,95	**2,3**	**6**	38,33333	25,6	**1,1**	**28,1**	1,5	**42,2**

lateral force on pile top (upper limit)									
vehicle	**brake force H_{rem} kN**	road lanes m (-)	**impact s (-)**	**in SLS H_{rep} kN**	load factor γ_F (-)	**in ULS H_{Ed} kN**	number of piles n (-)	**lateral pile loads in SLS H_{rep} kN**	**in ULS H_{Ed} kN**
VK30	**100**	2	**1,1**	**220**	1,5	**330**	6	**36,7**	**55**

RC CULVERT
OTHER CALCULATIONS + SOME PICTURES

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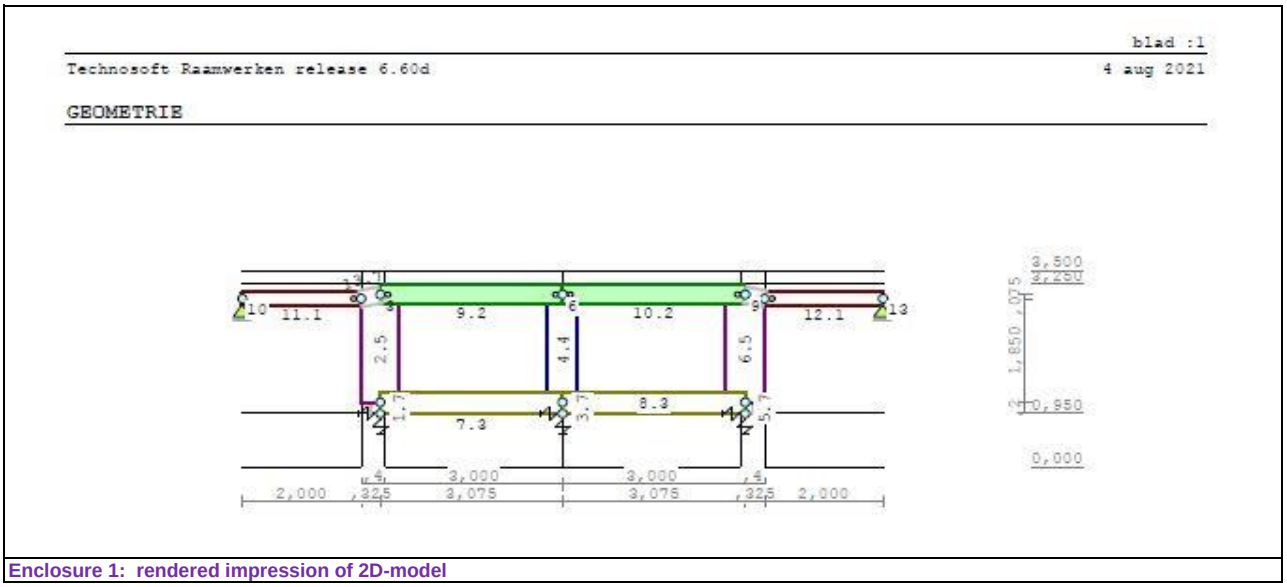
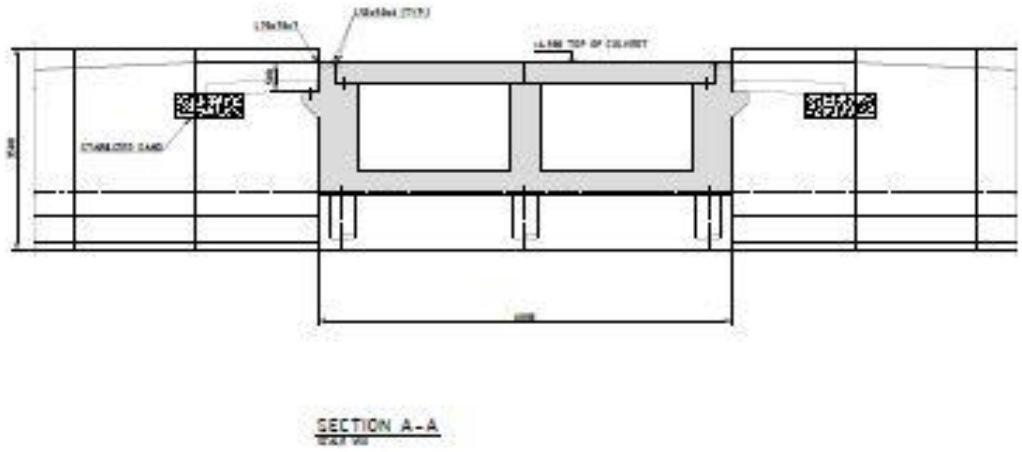
½ passive soil resistance in SLS, without reduction for the GW level									
item	dimensions			max. lateral resistance = ½ passive - neutral pressure					**lateral drift h/200 m**
	height h m	width b m	area A = b*h m²	spec.grav. ρ*g kN/m³	vert. load p_v kN/m²	resist. ½K_p-K_n (-)	lat.peak pr. p_h kN/m²	**lat. capac. ½H_p kN**	
TOC culvert	3,25								
BOC culvert	-0,95								
soil height:	2,3	6,5	14,95	18	41,4	1	41,4	**309**	**0,0115**



Enclosure 1: rendered impression of 2D-model



Section over RC culvert.
See paragraph 2.6 for drawing designation.

RC CULVERT
SOME PICTURES

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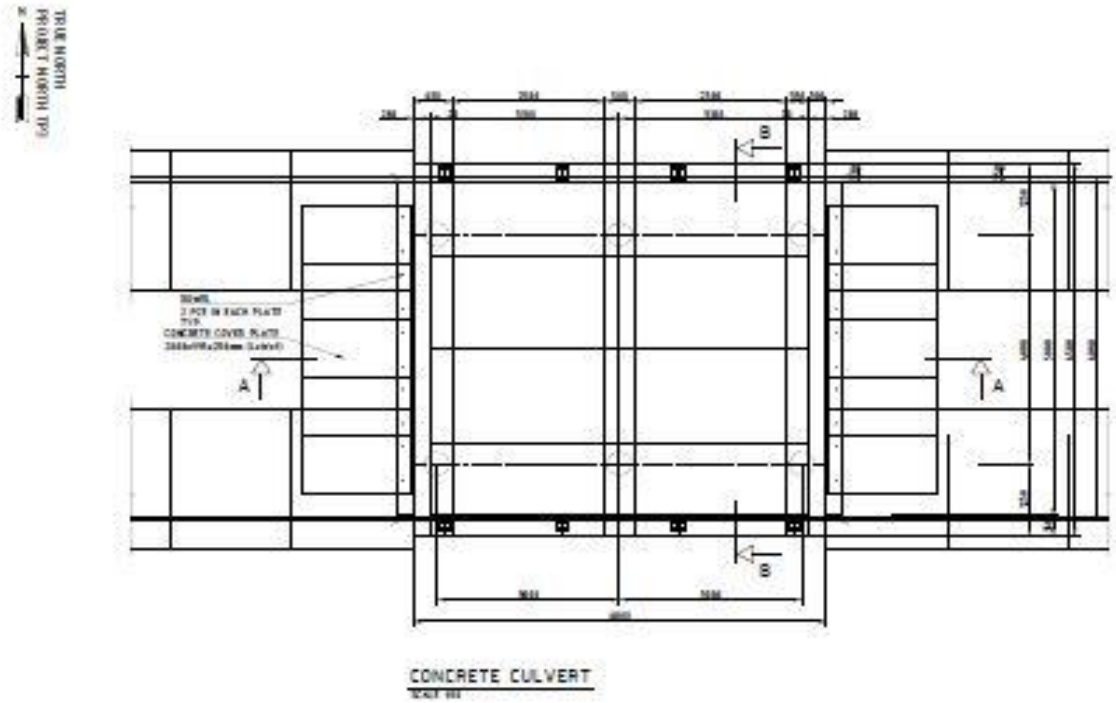
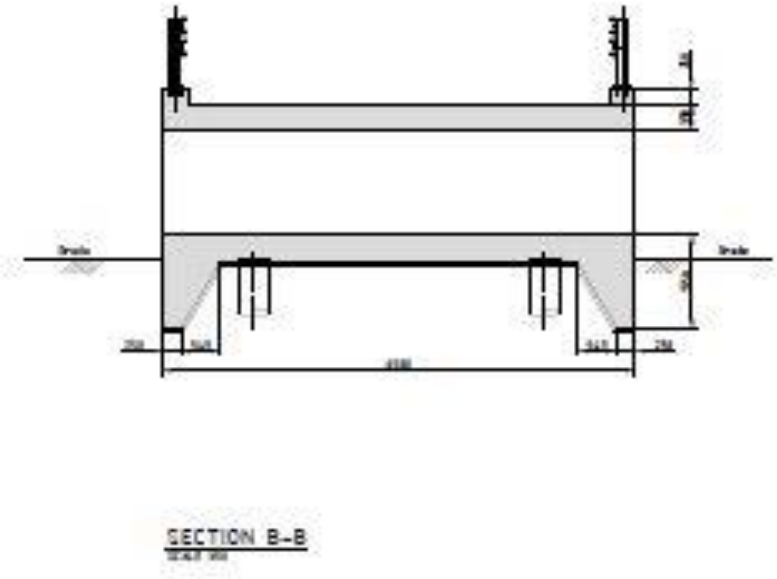


Upper view of RC culvert.
See paragraph 2.6 for drawing designation.



Section over RC culvert.
See paragraph 2.6 for drawing designation.