ΣΤΑΤΙΚΟΙ ΥΠΟΛΟΓΙΣΜΟΙ

ΠΕΡΙΕΧΟΜΕΝΑ

1. ΜΕΘΟΔΟΣ ΑΝΑΛΥΣΗΣ - ΠΕΡΙΓΡΑΦΗ ΠΡΟΣΟΜΟΙΩΜΑΤΟΣ

Ο υπολογισμός των εντατικών μεγεθών καθώς και ο έλεγχος της επάρκειας των διατομών του φορέα του ορθογωνικού αγωγού, γίνεται με χρήση Η/Υ και του προγράμματος SOFISTIK της SOFISTIK Gmbh που χρησιμοποιεί τη μέθοδο των πεπερασμένων στοιχείων (γραμμικά στοιχεία-ράβδοι).

Ο φορέας (λωρίδα αγωγού πλάτους 1.00m) θεωρείται κλειστό πλαίσιο που εδράζεται σε ελαστικό έδαφος. Το έδαφος αντικαθίσταται από πεπερασμένο αριθμό ελατηρίων, που το μέγεθος της σταθεράς τους εξαρτάται από τον δείκτη εδάφους.

Στη στατική επίλυση του φορέα εξετάζονται όλοι οι πιθανοί κατά περίπτωση συνδυασμοί μονίμων (ίδια βάρη, ωθήσεις γαιών) και κινητών (τύπος αεροπλάνου boeing 737-800) φορτίων.

Η διαστασιολόγηση των διατομών βασίζεται στη **περιβάλλουσα** δύο επιλύσεων : μιας με δείκτη εδάφους θεμελίωσης **ks=1000 KN/m3** και μιας με συντελεστή **ks=50000 KN/m3** (που αντιστοιχεί σε πρακτικά ανυποχώρητο έδαφος). Το φάσμα των τιμών που επιλέχθηκε, καλύπτει τις προτεινόμενες, στη Γεωτεχνική Μελέτη, τιμές του δείκτη εδάφους.

Τα μέλη του φορέα θεωρούνται πλήρως ελαστικά (ακαμψία σταδίου Ι).

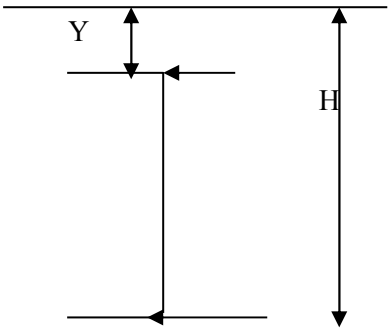
Οι στηρίξεις του φορέα στο έδαφος είναι ελαστικές με τα ακόλουθα χαρακτηριστικά :

- Στοιχεία θεμελίωσης ks=1000 KN/m3 και ks=50000 KN/m3
- Αντιδράσεις επίχωσης στα βάθρα : ksh =2.4*Es*y/(H^2) [εγκ. 39/99 παρ.3.2.2(2)]

  Οπου : Es=50000 KN/m2 (υλικό επίχωσης)

  H=συνολικό υψος επίχωσης

  y=βάθος εφαρμογής ελατηριωτών στηρίξεων



Η γεωμετρία του προσομοιώματος, οι στατικοί υπολογισμοί και η διαστασιολόγηση των χρησιμοποιούμενων διατομών παρουσιάζονται αναλυτικά στα τεύχη υπολογισμών:

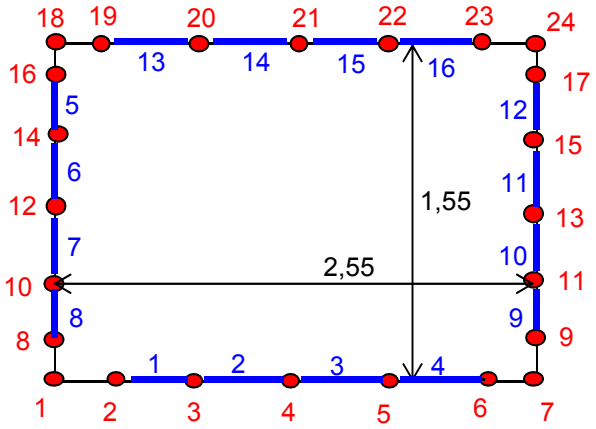
Για την διαστασιολόγηση των διατομών του φορέα έγιναν όλοι οι απαιτούμενοι συνδυασμοί φορτίσεων σύμφωνα με τον Ευροκώδικα.

Στα σχέδια όπλισης των διατομών ελήφθησαν υπόψη τα απαιτούμενα μήκη παράθεσης και αγκύρωσης των οπλισμών ώστε να είναι σύμφωνα με τις απαιτήσεις των κανονισμών.

Τα απαιτούμενα μήκη παράθεσης και αγκύρωσης των οπλισμών, όπως επίσης οι διάμετροι των τυμπάνων καμπύλωσης παρουσιάζονται σε σχετικό υπόμνημα στα σχέδια οπλισμών της μελέτης.

2. ΠΡΟΣΟΜΟΙΩΜΑ ΟΧΕΤΟΥ 2.20Χ1.20 (Ηεπ=4.50m)

Εσωτερικό πλάτος	2,20 m
Εσωτερικό ύψος (με στρώση φθοράς)	1,20 m
Πάχος τοιχωμάτων	0,35 m
Πάχος πάνω πλάκας	0,35 m
Πάχος κάτω πλάκας	0,35 m
Ύψος επίχωσης	4,50 m
Δείκτης εδάφους	1000,00 kN/m3
Es	50000,00 kN/m2
H	6,40 m



ΚΟΜΒΟΙ	Συντεταγμένες κόμβων		Ελατήρια πυθμένα	Πλευρικά ελατήρια			ΜΕΛΗ	Κόμβοι αρχής-τέλους	Μήκη
	X (m)	Y (m)	kN/m	y	Ksh	cp (kN/m)			L (m)
1	0	0	625				**1**	2-3	0,55
2	0,175	0					**2**	3-4	0,55
3	0,725	0	550				**3**	4-5	0,55
4	1,275	0	550				**4**	5-6	0,55
5	1,825	0	550				**5**	16-14	0,3
6	2,375	0					**6**	14-12	0,3
7	2,55	0	625	6,23	18237,30	9118,65	**7**	12-10	0,3
8	0	0,175					**8**	10-8	0,3
9	2,55	0,175		6,05	17724,61		**9**	9-11	0,3
10	0	0,475					**10**	11-13	0,3
11	2,55	0,475		5,75	16845,70	5053,71	**11**	13-15	0,3
12	0	0,775					**12**	15-17	0,3
13	2,55	0,775		5,45	15966,80	4790,04	**13**	19-20	0,55
14	0	1,075					**14**	20-21	0,55
15	2,55	1,075		5,15	15087,89	4526,37	**15**	21-22	0,55
16	0	1,375					**16**	22-23	0,55
17	2,55	1,375		4,85	14208,98		**ΑΚΑΜΠΤΑ ΜΕΛΗ**	1-2	**ΚΟΜΒΟΙ ΑΡΧΗΣ-ΤΕΛΟΥΣ**
18	0	1,55						6-7	
19	0,175	1,55						1-8	
20	0,725	1,55						7-9	
21	1,275	1,55						16-18	
22	1,825	1,55						17-24	
23	2,375	1,55						18-19	
24	2,55	1,55		4,68	13696,29	6848,14		23-24	

3. ΠΑΡΑΔΟΧΕΣ ΦΟΡΤΙΣΕΩΝ ΟΧΕΤΟΥ 2.20 Χ 1.20

Ηεπ = 4,50m

ΣΤΑΤΙΚΟΙ ΥΠΟΛΟΓΙΣΜΟΙ

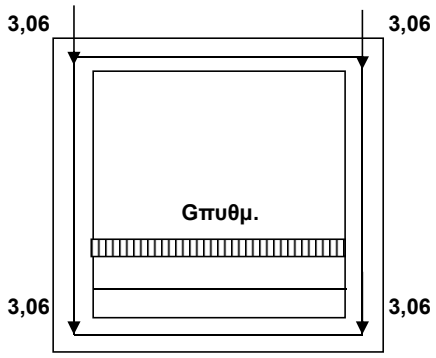
ΓΕΝΙΚΑ ΧΑΡΑΚΤΗΡΙΣΤΙΚΑ

e: h επίχωσης= 4,50
f: πάχος στρ.φθοράς= 0,00
H: συνολ. εσωτ.υψος= 1,20
h: πάχος τοιχωμάτων= 0,35
d_1=πάχος άνω πλάκας= 0,35
d_2=πάχος κάτω πλάκας= 0,35
L:εσωτ. πλάτος τεχνικού= 2,20
g_1: ι.β. σκυροδέματος= 25,00
g_2: ι.β. επίχωσης= 20,00

S=σεισμικός συντελεστής εδάφος= 1,00
α_0=σεισμικός συντελεστής= 0,24
β_0=συντ.φασματικής ενισχ.= 2,50
q=συντ. συμπεριφοράς= 1,50
φ=γωνία τριβής γαιών= 30,00

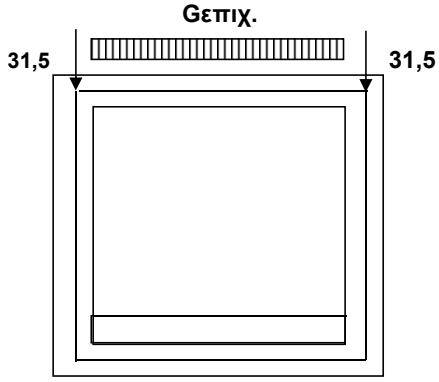
Σημειώσεις:
Ο πραγματικός φορέας έχει μεγαλύτερες διαστάσεις από τον φορέα της ανάλυσης. Τα κατανεμημένα φορτία ασκούνται στις εσωτερικές διαστάσεις του οχετού (δηλαδή χωρίς τα τοιχώματα) και στη συνέχεια ασκούνται κατάλληλα επικόμβια φορτία - είναι η επιρροή των κατανεμημένων στο πάχος του τοιχώματος ή της πλάκας - έτσι ώστε να ληφθούν οι σωστές φορτίσεις.

ΦΟΡΤΙΣΗ 1: Ιδιο βάρος



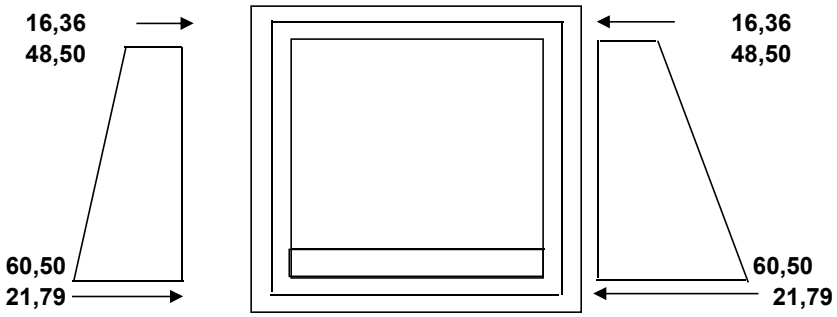
Ιδιο βάρος στρώσης φθοράς: Gπυθμ.=f*g1= 0,00 KN/m2
Ιδιο βάρος φορεα: Gιβ.=g1= 25,00 KN/m3

ΦΟΡΤΙΣΗ 2: Βάρος επίχωσης



Ίδιο βάρος επίχωσης: Gεπιχ.=g_2*e= 90,00 KN/m2

ΦΟΡΤΙΣΗ 3: Ωθήσεις Γαιών.



λο: συντ. ουδ. ώθησης

(1-sinφ)= 0,500

P_{oben} = λο*g2*(e+d1)= 48,50 KN/m2

P_{unter} =λο*g2*(e+d1+H)= 60,50 KN/m2

ΦΟΡΤΙΣΗ 4: Συστολή Ξήρανσης.

Λαμβάνεται ομοιόμορφη θερμοκρασιακή μεταβολή ΔΤ= -15°C στην πλάκα ανωδομής και ΔΤ= -10°C στον υπόλοιπο φορέα

ΦΟΡΤΙΣΗ 5: Ομοιόμορφη θερμοκρασιακή μεταβολή ΔΤ=+20°C

Λαμβάνεται στο σύνολο του φορέα ομοιόμορφη θερμοκρασιακή μεταβολή ΔΤ=+20°C.

ΦΟΡΤΙΣΗ 6: Ομοιόμορφη θερμοκρασιακή μεταβολή ΔΤ=-20°C

Λαμβάνεται στο σύνολο του φορέα ομοιόμορφη θερμοκρασιακή μεταβολή ΔΤ=-20°C.

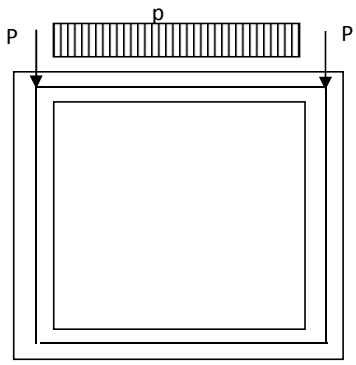
ΦΟΡΤΙΣΗ 7: Γραμμική θερμοκρασιακή διαφορά πελμάτων ΔΤ=+7°C

Λαμβάνεται γραμμική θερμοκρασιακή διαφορά ΔΤ=+7°C στην πλάκα ανωδομής

ΦΟΡΤΙΣΗ 8: Γραμμική θερμοκρασιακή διαφορά πελμάτων ΔΤ=-3.5°C

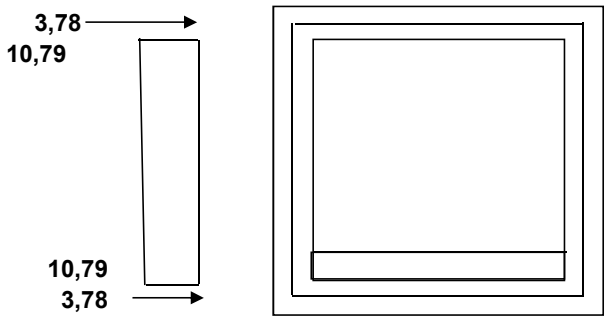
Λαμβάνεται γραμμική θερμοκρασιακή διαφορά ΔΤ=-3.5°C στην πλάκα ανωδομής

ΦΟΡΤΙΣΗ 90: Κινητά Φορτία (αεροπλανα)



Ρολ=	260,4 x 4=	1041,6	kN
Επιφάνεια εφαρμογης:	B=1,30+0,40	1,7	m
	L=1,40+0,40	1,8	m
	p= Ρολ/[(b+2xextan30)x(l+2xextan30)]=	21,5891	kN/m^2

ΦΟΡΤΙΣΗ 10: Ωθήσεις Γαιών από Κινητά Αριστερά.



	p=	21,59	kN/m^2
q=	λο*p=	10,79	KN/m2

ΕΠΕΙΔΗ Ηεπ>1/2 ΤΟΥ ΥΨΟΥΣ ΤΟΥ ΟΧΕΤΟΥ ΔΕΝ ΛΑΜΒΑΝΕΤΑΙ ΥΠΟΨΗ ΣΕΙΣΜΟΣ

ΚΙΒΩΤΟΕΙΔΗΣ ΟΧΕΤΟΣ 2.20x1.20 [Ηεπ=4.50m]

(ks=1000 KN/m^3)

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)

Default design code is EuroNorm EN 1992 Concrete with country code 30 (Hellas/Greece)
Class(Tab.7.1N): N (Reinforced members and prestressed members with unbonded tendons)
Snow load zone : 1

No. 1 C 25/30 (EN 1992)

Youngs-modulus	E	31476 [MPa]	Safetyfactor		1.50 [-]	
Poisson-Ratio	mu	0.20 [-]	Strength	fc	21.25 [MPa]	
Shear-modulus	G	13115 [MPa]	Nomin. strength	fcn	25.00 [MPa]	
Compression modulus		17487 [MPa]	Tens. strength	fctm	2.56 [MPa]	
Weight		25.0 [kN/m3]	5 % t.strength	fctk	1.80 [MPa]	
Weight buoyancy		25.0 [kN/m3]	95 % t.strength	fctk	3.33 [MPa]	
Temp.elongat.coeff.		1.00E-05 [1/°K]	Bond strength	fbd	2.69 [MPa]	
			Service strength		33.00 [MPa]	
			Fatigue strength		12.75 [MPa]	

Stress-Strain for serviceability	eps[o/oo]	sig-m[MPa]	E-t[MPa]
Is only valid within the defined	0.000	0.00	33050
stress range	-1.035	-25.04	15658
	-2.069	-33.00	0
	-3.500	-18.95	-19203
	Safetyfactor		1.35
Stress-Strain for ultimate load	eps[o/oo]	sig-u[MPa]	E-t[MPa]
Is only valid within the defined	0.000	0.00	21250
stress range	-2.000	-21.25	0
	-3.500	-21.25	0
	Safetyfactor		1.50
Stress-Strain of calc. mean values	eps[o/oo]	sig-r[MPa]	E-t[MPa]
Is only valid within the defined	0.000	0.00	27541
stress range	-1.035	-12.41	4259
	-2.069	-14.17	0
	-3.500	-12.64	-1802
	Safetyfactor		(1.50)

No. 3 S 500 (EN 1992)

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

Stress-Strain for serviceability	eps[o/oo]	sig-m[MPa]	E-t[MPa]
Is also extended beyond the	1000.000	550.00	0
defined stress range	50.000	550.00	0
	2.500	500.00	1053
	0.000	0.00	200000
	-2.500	-500.00	200000
	-50.000	-550.00	1053
	-1000.000	-550.00	0
	Safetyfactor		1.15
Stress-Strain for ultimate load	eps[o/oo]	sig-u[MPa]	E-t[MPa]
Is also extended beyond the	1000.000	478.26	0
defined stress range	50.000	478.26	0
	2.174	434.78	909
	0.000	0.00	200000
	-2.174	-434.78	200000
	-50.000	-478.26	909
	-1000.000	-478.26	0
	Safetyfactor		(1.15)

Cross-sections static properties

No.	Mat / NoR	A[m2] / It[m4]	Ay/Az/Ayz [m2]	Iy/Iz/Iyz [m4]	ys/zs [m]	y/z-sc [m]	modules [MPa]	gam [kN/m]
1	=	UPPER SLAB						
	1	3.5000E-01		3.573E-03	0.000	0.000	31476	8.75
	3	1.115E-02		2.917E-02	0.175	0.175	13115	
2	=	BOTTOM SLAB						
	1	3.5000E-01		3.573E-03	0.000	0.000	31476	8.75
	3	1.115E-02		2.917E-02	0.175	0.175	13115	
3	=	WALLS						
	1	3.5000E-01		3.573E-03	0.000	0.000	31476	8.75
	3	1.115E-02		2.917E-02	0.175	0.175	13115	

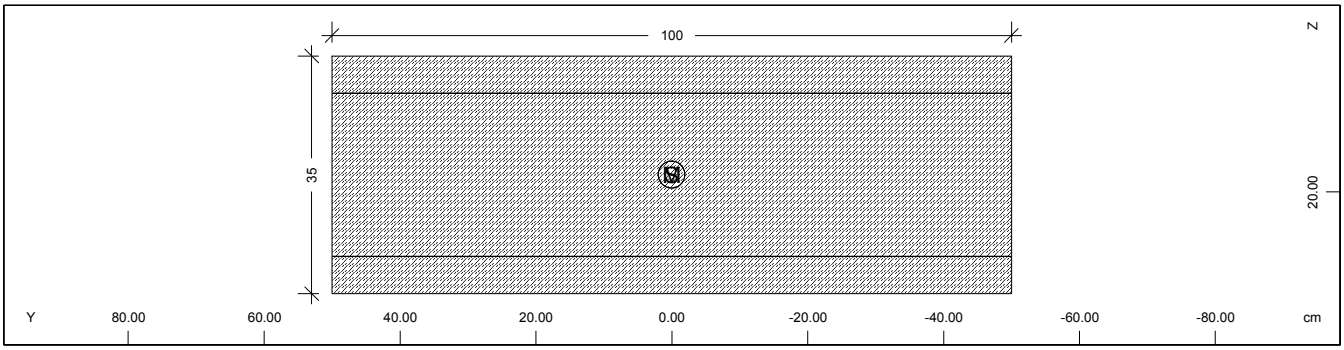
Summary of all beam elements

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)

Cross sections

No.	TotLength [m]	Max.Length [m]	TotWeight [t]	Surface [m2]	Title
1	2.200	0.550	1.925	5.940	UPPER SLAB
2	2.200	0.550	1.925	5.940	BOTTOM SLAB
3	2.400	0.300	2.100	6.480	WALLS
Sum	6.800		5.950	18.360	

Cross section No. 1 - UPPER SLAB



Static properties of cross section

Mat NoR	A[m2] It[m4]	Ay/Az/Ayz [m2]	Iy/Iz/Iyz [m4]	ys/zs [cm]	y/z-sc [cm]	modules [MPa]	gam [kN/m]
1	3.5000E-01		3.573E-03	0.00	0.00	31476	8.75
3	1.115E-02		2.917E-02	17.50	17.50	13115	

Additional static properties of cross section

Alfa-T [1/°K]	ymin ymax [cm]	zmin zmax [cm]	hymin hzmin [cm]	AK AB [m2]	MB	Tau-T Tau-B [1/m3]	Tau-Vy Tau-Vz [1/m2]
1.0E-05	-50.00	-17.50	1.918E-01		3	2.013E+01	
	50.00	17.50	3.500E-01			4.286E+00	

Section values for warping

Wmin[m2]	Wmax[m2]	CM[m6]	CMS[m4]	ASwyy[m6]	ASwzz[m6]	ry[cm]	rz[cm]
-0.0584	0.0584	0.000	0.000	0.000	0.000	0.00	0.00

Design values of cross section

Mat NoR	A[m2] It[m4]	Ay/Az/Ayz [m2]	Iy/Iz/Iyz [m4]	ys/zs [cm]	modules [MPa]	gam [kN/m]
1	3.5000E-01		3.573E-03	0.00	23315	8.75
	1.115E-02		2.917E-02	17.50	9715	

Additional Design Data

M	periphery-O/-I [m2/m]	[m2/m]	deff [cm]	t-min [cm]	t-max [cm]	SMP [o/o]	thet-p [tm2/m]	thet-y [tm2/m]	thet-z [tm2/m]	thet-yz [tm2/m]
	2.700		25.93			0.0	0.082	0.009	0.073	

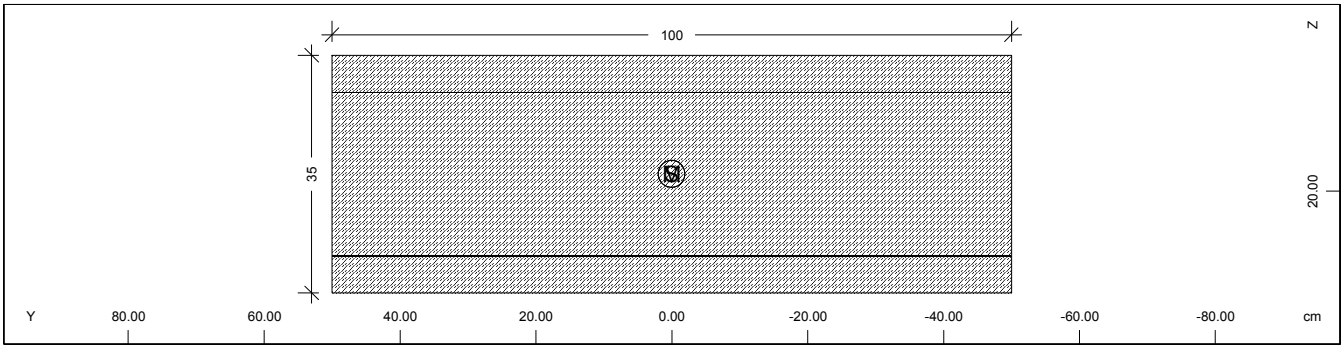
Reinforcement global values

Layer	mS	mR	area [cm2]	lower-A [cm2]	upper-A [cm2]	yL [cm]	zL [cm]	L-tors [cm]	N-pr [kN]	M-pr [kNm]
M1	1	3	1.00	1.00		0.00	29.50			
M2	1	3	1.00	1.00		0.00	5.50			

Distributed reinforcement

Id.	MNo	ya[cm]	za[cm]	ye[cm]	ze[cm]	As/As-max[cm2/m]	Lay	D	Ar[m2/m]
1	3	49.90	29.50	-49.90	29.50	1.00	1	14	
2	3	49.90	5.50	-49.90	5.50	1.00	2	14	

Cross section No. 2 - BOTTOM SLAB



BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)

Static properties of cross section

Mat NoR	A[m2] It[m4]	Ay/Az/Ayz [m2]	Iy/Iz/Iyz [m4]	ys/zs [cm]	y/z-sc [cm]	modules [MPa]	gam [kN/m]
1	3.5000E-01		3.573E-03	0.00	0.00	31476	8.75
3	1.115E-02		2.917E-02	17.50	17.50	13115	

Additional static properties of cross section

Alfa-T [1/°K]	ymin ymax [cm]	zmin zmax [cm]	hymin hzmin [cm]	AK AB [m2]	MB	Tau-T Tau-B [1/m3]	Tau-Vy Tau-Vz [1/m2]
1.0E-05	-50.00	-17.50		1.918E-01	3	2.013E+01	
	50.00	17.50		3.500E-01			4.286E+00

Section values for warping

Wmin[m2]	Wmax[m2]	CM[m6]	CMS[m4]	ASwyy[m6]	ASwzz[m6]	ry[cm]	rz[cm]
-0.0584	0.0584	0.000	0.000	0.000	0.000	0.00	0.00

Design values of cross section

Mat NoR	A[m2] It[m4]	Ay/Az/Ayz [m2]	Iy/Iz/Iyz [m4]	ys/zs [cm]	modules [MPa]	gam [kN/m]
1	3.5000E-01		3.573E-03	0.00	23315	8.75
	1.115E-02		2.917E-02	17.50	9715	

Additional Design Data

M	periphery-O/-I [m2/m]	[m2/m]	deff [cm]	t-min [cm]	t-max [cm]	SMP [o/o]	thet-p [tm2/m]	thet-y [tm2/m]	thet-z [tm2/m]	thet-yz [tm2/m]
	2.700		25.93			0.0	0.082	0.009	0.073	

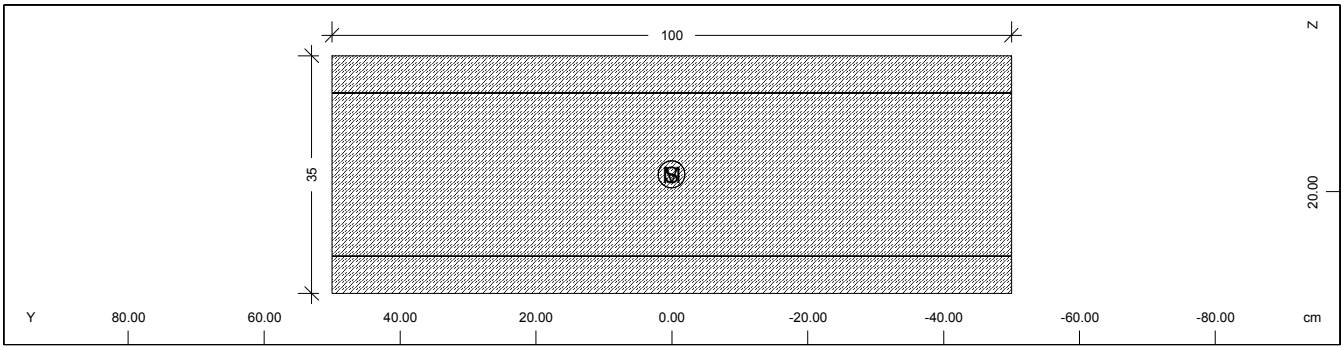
Reinforcement global values

Layer	mS	mR	area [cm2]	lower-A [cm2]	upper-A [cm2]	yL [cm]	zL [cm]	L-tors [cm]	N-pr [kN]	M-pr [kNm]
M1	1	3	1.00	1.00		0.00	29.50			
M2	1	3	1.00	1.00		0.00	5.50			

Distributed reinforcement

Id.	MNo	ya[cm]	za[cm]	ye[cm]	ze[cm]	As/As-max[cm2/m]	Lay	D	Ar[m2/m]
1	3	49.90	29.50	-49.90	29.50	1.00	1	14	
2	3	49.90	5.50	-49.90	5.50	1.00	2	14	

Cross section No. 3 - WALLS



Static properties of cross section

Mat NoR	A[m2] It[m4]	Ay/Az/Ayz [m2]	Iy/Iz/Iyz [m4]	ys/zs [cm]	y/z-sc [cm]	modules [MPa]	gam [kN/m]
1	3.5000E-01		3.573E-03	0.00	0.00	31476	8.75
3	1.115E-02		2.917E-02	17.50	17.50	13115	

Additional static properties of cross section

Alfa-T [1/°K]	ymin ymax [cm]	zmin zmax [cm]	hymin hzmin [cm]	AK AB [m2]	MB	Tau-T Tau-B [1/m3]	Tau-Vy Tau-Vz [1/m2]
1.0E-05	-50.00	-17.50		1.918E-01	3	2.013E+01	
	50.00	17.50		3.500E-01			4.286E+00

Section values for warping

Wmin[m2]	Wmax[m2]	CM[m6]	CMS[m4]	ASwyy[m6]	ASwzz[m6]	ry[cm]	rz[cm]
-0.0584	0.0584	0.000	0.000	0.000	0.000	0.00	0.00

Design values of cross section

Mat NoR	A[m2] It[m4]	Ay/Az/Ayz [m2]	Iy/Iz/Iyz [m4]	ys/zs [cm]	modules [MPa]	gam [kN/m]
1	3.5000E-01		3.573E-03	0.00	23315	8.75
	1.115E-02		2.917E-02	17.50	9715	

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)

Additional Design Data

M	periphery-O/-I [m2/m]	[m2/m]	deff [cm]	t-min [cm]	t-max [cm]	SMP [o/o]	thet-p [tm2/m]	thet-y [tm2/m]	thet-z [tm2/m]	thet-yz [tm2/m]
	2.700		25.93			0.0	0.082	0.009	0.073	

Reinforcement global values

Layer	mS	mR	area [cm2]	lower-A [cm2]	upper-A [cm2]	yL [cm]	zL [cm]	L-tors [cm]	N-pr [kN]	M-pr [kNm]
M1	1	3	1.00	1.00		0.00	29.50			
M2	1	3	1.00	1.00		0.00	5.50			

Distributed reinforcement

Id.	MNo	ya[cm]	za[cm]	ye[cm]	ze[cm]	As/As-max[cm2/m]	Lay	D	Ar[m2/m]
1	3	49.90	29.50	-49.90	29.50	1.00	1	12	
2	3	49.90	5.50	-49.90	5.50	1.00	2	12	

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)

Nodal Coordinates and Supports

Number	X[m]	Y[m]	Z[m]	Support Conditions		
1	0.000	0.000	0.000			
2	0.175	0.000	0.000	*	*	*
3	0.725	0.000	0.000			
4	1.275	0.000	0.000			
5	1.825	0.000	0.000			
6	2.375	0.000	0.000	*	*	*
7	2.550	0.000	0.000			
8	0.000	-0.175	0.000	*	*	*
9	2.550	-0.175	0.000	*	*	*
10	0.000	-0.475	0.000			
11	2.550	-0.475	0.000			
12	0.000	-0.775	0.000			
13	2.550	-0.775	0.000			
14	0.000	-1.075	0.000			
15	2.550	-1.075	0.000			
16	0.000	-1.375	0.000	*	*	*
17	2.550	-1.375	0.000	*	*	*
18	0.000	-1.550	0.000			
19	0.175	-1.550	0.000	*	*	*
20	0.725	-1.550	0.000			
21	1.275	-1.550	0.000			
22	1.825	-1.550	0.000			
23	2.375	-1.550	0.000	*	*	*
24	2.550	-1.550	0.000			
MIN	0.000	-1.550	0.000			
MAX	2.550	0.000	0.000			

Kinematic Constraints

Grp	LV	Node	type	reference	dx	dy	dz	df
1		2	KF	1	0.175	0.000	0.000	
1		6	KF	7	-0.175	0.000	0.000	
1		8	KF	1	0.000	-0.175	0.000	
1		9	KF	7	0.000	-0.175	0.000	
1		16	KF	18	0.000	0.175	0.000	
1		19	KF	18	0.175	0.000	0.000	
1		17	KF	24	0.000	0.175	0.000	
1		23	KF	24	-0.175	0.000	0.000	

Beam Elements

Grp	Number	Node	x[m]	NoS	NoP	reference	Hinges	direction	local y-axis
0	1	2	0.000	2				0.000	0.000 -1.000
		3	0.550	2					
0	2	3	0.000	2				0.000	0.000 -1.000
		4	0.550	2					
0	3	4	0.000	2				0.000	0.000 -1.000
		5	0.550	2					
0	4	5	0.000	2				0.000	0.000 -1.000
		6	0.550	2					
0	5	16	0.000	3				0.000	0.000 -1.000
		14	0.300	3					
0	6	14	0.000	3				0.000	0.000 -1.000
		12	0.300	3					
0	7	12	0.000	3				0.000	0.000 -1.000
		10	0.300	3					
0	8	10	0.000	3				0.000	0.000 -1.000
		8	0.300	3					
0	9	9	0.000	3				0.000	0.000 -1.000
		11	0.300	3					
0	10	11	0.000	3				0.000	0.000 -1.000
		13	0.300	3					
0	11	13	0.000	3				0.000	0.000 -1.000
		15	0.300	3					
0	12	15	0.000	3				0.000	0.000 -1.000
		17	0.300	3					
0	13	19	0.000	1				0.000	0.000 -1.000
		20	0.550	1					
0	14	20	0.000	1				0.000	0.000 -1.000
		21	0.550	1					
0	15	21	0.000	1				0.000	0.000 -1.000
		22	0.550	1					
0	16	22	0.000	1				0.000	0.000 -1.000
		23	0.550	1					

Spring Elements

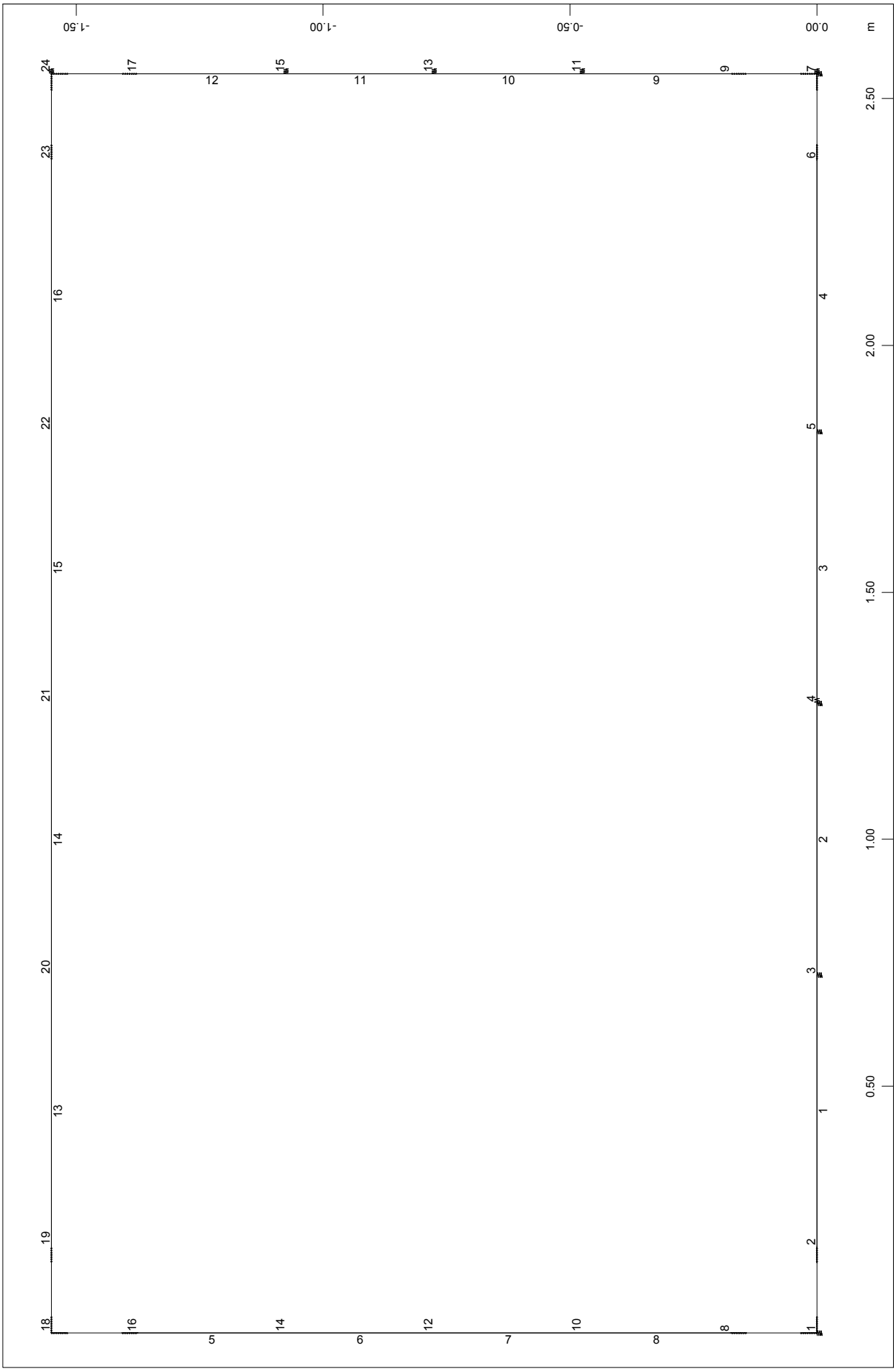
Grp	Number	Node	Node	dX[-] e-P[-]	dY[-] e-T[-]	dZ[-] e-M[-]	CP[kN/m] DP[kNsec/m]	CT[kN/m] DT[kNsec/m]	CM[kNm] DM[kNmsec]
1	1001	1		0.000	1.000	0.000	6.250E+02		
1	1003	3		0.000	1.000	0.000	5.500E+02		
1	1004	4		0.000	1.000	0.000	5.500E+02		

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)

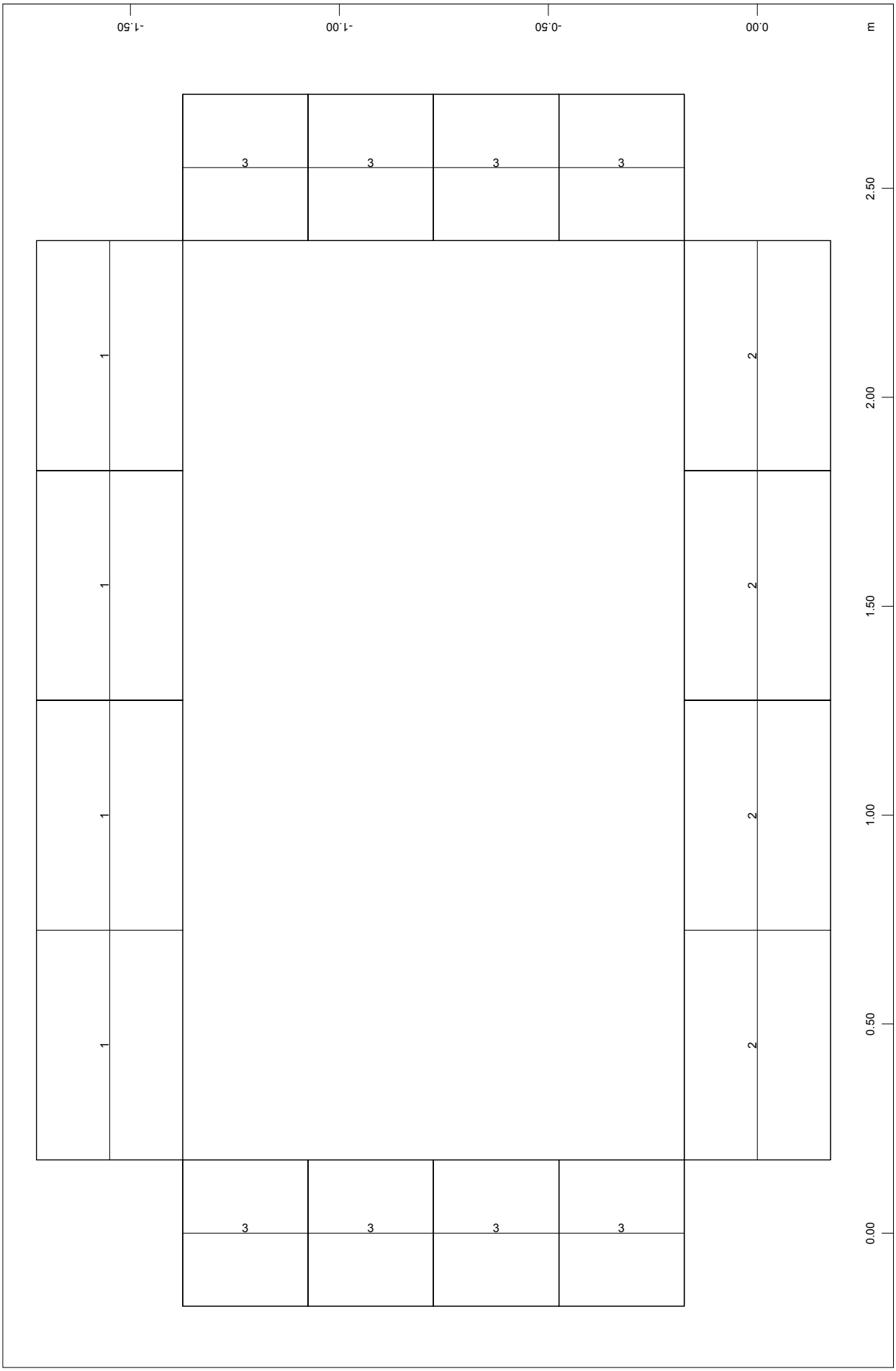
Spring Elements

Grp	Number	Node	Node	dX[-]	dY[-]	dZ[-]	CP[kN/m]	CT[kN/m]	CM[kNm]
				e-P[-]	e-T[-]	e-M[-]	DP[kNsec/m]	DT[kNsec/m]	DM[kNmsec]
1	1005	5		0.000	1.000	0.000	5.500E+02		
1	1007	7		0.000	1.000	0.000	6.250E+02		
2	2001	7		1.000	0.000	0.000	9.119E+03		
2	2003	11		1.000	0.000	0.000	5.054E+03		
2	2004	13		1.000	0.000	0.000	4.790E+03		
2	2005	15		1.000	0.000	0.000	4.526E+03		
2	2007	24		1.000	0.000	0.000	6.848E+03		
3	3002	4		1.000	0.000	0.000	1.000E+06		

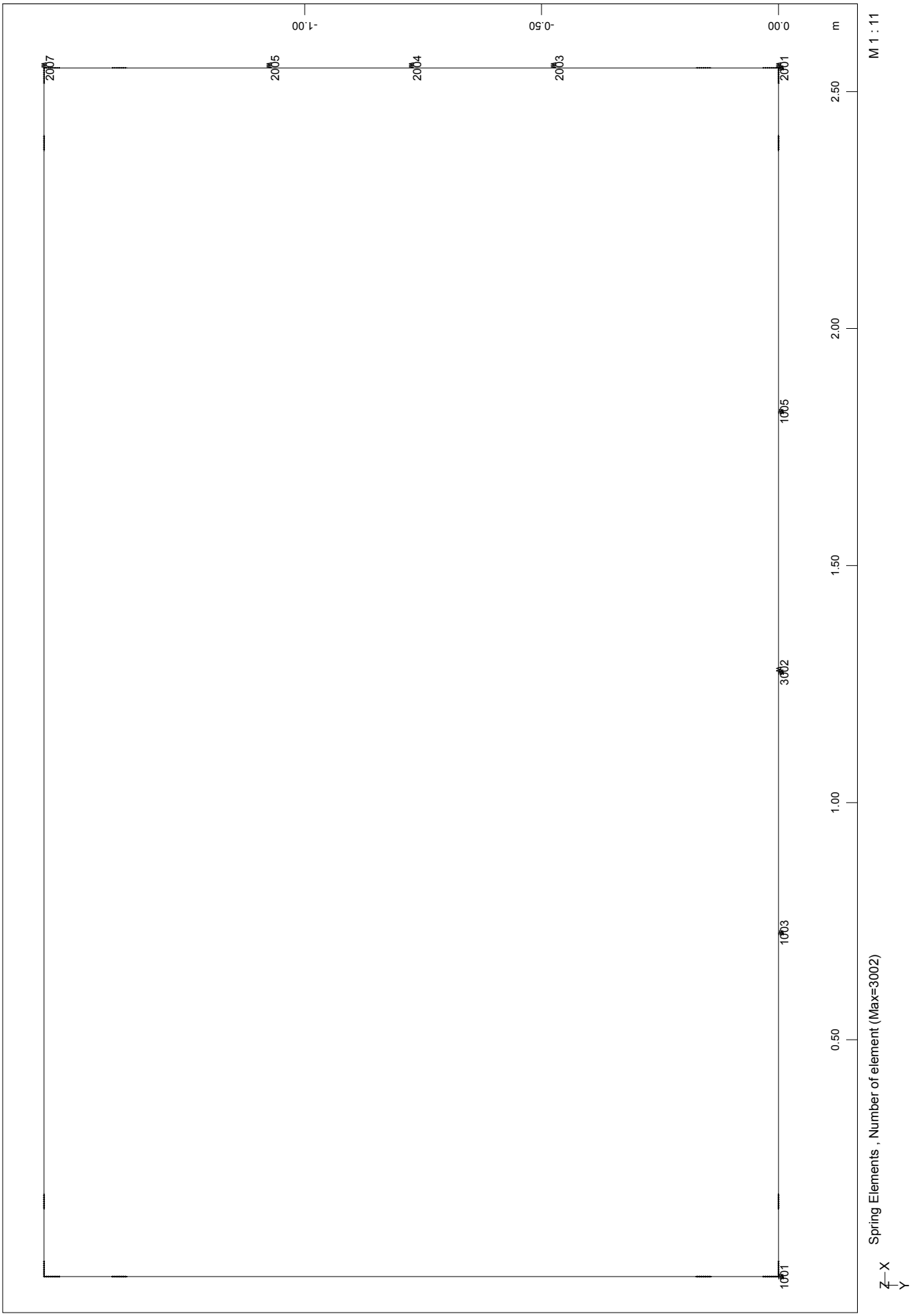
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)



BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)



BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)



BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)

Default design code is EuroNorm EN 1992 Concrete with country code 30 (Hellas/Greece)
Class(Tab.7.1N): N (Reinforced members and prestressed members with unbonded tendons)
Snow load zone : 1

Elementgroups

No	fac-S	fac-L	fac-D	fac-P	fac-B	PLC
0	1.000	1.000	0.000	1.000	1.000	0
1	1.000	1.000	0.000	1.000	1.000	0
3	1.000	1.000	0.000	1.000	1.000	0

Nodes

Number	X [m]	Y [m]	Z [m]	supports/number of unknown					
						PZ	MX	MY	
1	0.000	0.000	0.000	1	2	0	0	0	3
2	0.175	0.000	0.000	*	*	PZ	MX	MY	*
				-1	-2	0	0	0	-3
3	0.725	0.000	0.000			PZ	MX	MY	
				4	5	0	0	0	6
4	1.275	0.000	0.000			PZ	MX	MY	
				10	11	0	0	0	12
5	1.825	0.000	0.000			PZ	MX	MY	
				16	17	0	0	0	18
6	2.375	0.000	0.000	*	*	PZ	MX	MY	*
				-4	-5	0	0	0	-6
7	2.550	0.000	0.000			PZ	MX	MY	
				22	23	0	0	0	24
8	0.000	-0.175	0.000	*	*	PZ	MX	MY	*
				-7	-8	0	0	0	-9
9	2.550	-0.175	0.000	*	*	PZ	MX	MY	*
				-10	-11	0	0	0	-12
10	0.000	-0.475	0.000			PZ	MX	MY	
				7	8	0	0	0	9
11	2.550	-0.475	0.000			PZ	MX	MY	
				28	29	0	0	0	30
12	0.000	-0.775	0.000			PZ	MX	MY	
				13	14	0	0	0	15
13	2.550	-0.775	0.000			PZ	MX	MY	
				34	35	0	0	0	36
14	0.000	-1.075	0.000			PZ	MX	MY	
				19	20	0	0	0	21
15	2.550	-1.075	0.000			PZ	MX	MY	
				40	41	0	0	0	42
16	0.000	-1.375	0.000	*	*	PZ	MX	MY	*
				-13	-14	0	0	0	-15
17	2.550	-1.375	0.000	*	*	PZ	MX	MY	*
				-19	-20	0	0	0	-21
18	0.000	-1.550	0.000			PZ	MX	MY	
				25	26	0	0	0	27
19	0.175	-1.550	0.000	*	*	PZ	MX	MY	*
				-16	-17	0	0	0	-18
20	0.725	-1.550	0.000			PZ	MX	MY	
				31	32	0	0	0	33
21	1.275	-1.550	0.000			PZ	MX	MY	
				37	38	0	0	0	39
22	1.825	-1.550	0.000			PZ	MX	MY	
				43	44	0	0	0	45
23	2.375	-1.550	0.000	*	*	PZ	MX	MY	*
				-22	-23	0	0	0	-24
24	2.550	-1.550	0.000			PZ	MX	MY	
				46	47	0	0	0	48

Definition of load type in this output:
PZZ - load in global direction Z in reference to the element length
PZP - load in global direction Z in reference to the projection
Pz - load in local direction z
PG - load in dead load direction in reference to the element length

Load Case 1 IDIO BAROS
Factor forces and moments 1.000
Factor dead weight DL-XX 0.000
Factor dead weight DL-YY 1.000

Loads acting on Nodes

Node	PX[kN]	PY[kN]	PZ[kN]	MX[kNm]	MY[kNm]	MZ[kNm]	MB[kNm2]
1		3.1					
7		3.1					
18		3.1					
24		3.1					
sum		12.2					

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)

Loads acting on Beam-elements

Number	Type	a[m]	l[m]	Loadval	Loadval	Dimens.	ya[m]	za[m]	ye[m]	ze[m]
1	PG	0.000	0.550	0.00		[kN/m]				
2	PG	0.000	0.550	0.00		[kN/m]				
3	PG	0.000	0.550	0.00		[kN/m]				
4	PG	0.000	0.550	0.00		[kN/m]				

Load Case 2 SOIL FILL WEIGHT

Factor forces and moments 1.000
Factor dead weight DL-XX 0.000
Factor dead weight DL-YY 0.000

Loads acting on Nodes

Node	PX[kN]	PY[kN]	PZ[kN]	MX[kNm]	MY[kNm]	MZ[kNm]	MB[kNm2]
18		31.5					
24		31.5					
sum		63.0					

Loads acting on Beam-elements

Number	Type	a[m]	l[m]	Loadval	Loadval	Dimens.	ya[m]	za[m]	ye[m]	ze[m]
13	PG	0.000	0.550	90.00		[kN/m]				
14	PG	0.000	0.550	90.00		[kN/m]				
15	PG	0.000	0.550	90.00		[kN/m]				
16	PG	0.000	0.550	90.00		[kN/m]				

Load Case 3 EARTH PRESSURE

Factor forces and moments 1.000
Factor dead weight DL-XX 0.000
Factor dead weight DL-YY 0.000

Loads acting on Nodes

Node	PX[kN]	PY[kN]	PZ[kN]	MX[kNm]	MY[kNm]	MZ[kNm]	MB[kNm2]
1	21.8						
7	-21.8						
18	16.4						
24	-16.4						
sum							

Loads acting on Beam-elements

Number	Type	a[m]	l[m]	Loadval	Loadval	Dimens.	ya[m]	za[m]	ye[m]	ze[m]
5	PXX	0.000	0.300	48.50	51.50	[kN/m]				
6	PXX	0.000	0.300	51.50	54.50	[kN/m]				
7	PXX	0.000	0.300	54.50	57.50	[kN/m]				
8	PXX	0.000	0.300	57.50	60.50	[kN/m]				
9	PXX	0.000	0.300	-60.50	-57.50	[kN/m]				
10	PXX	0.000	0.300	-57.50	-54.50	[kN/m]				
11	PXX	0.000	0.300	-54.50	-51.50	[kN/m]				
12	PXX	0.000	0.300	-51.50	-48.50	[kN/m]				

Load Case 4 SHRINKAGE OF CONCRETE

Factor forces and moments 1.000
Factor dead weight DL-XX 0.000
Factor dead weight DL-YY 0.000

Loads acting on Beam-elements

Number	Type	a[m]	l[m]	Loadval	Loadval	Dimens.	ya[m]	za[m]	ye[m]	ze[m]
1	TEMP	0.000	0.550	-10.000		[°C]				
2	TEMP	0.000	0.550	-10.000		[°C]				
3	TEMP	0.000	0.550	-10.000		[°C]				
4	TEMP	0.000	0.550	-10.000		[°C]				
5	TEMP	0.000	0.300	-10.000		[°C]				
6	TEMP	0.000	0.300	-10.000		[°C]				
7	TEMP	0.000	0.300	-10.000		[°C]				
8	TEMP	0.000	0.300	-10.000		[°C]				
9	TEMP	0.000	0.300	-10.000		[°C]				
10	TEMP	0.000	0.300	-10.000		[°C]				
11	TEMP	0.000	0.300	-10.000		[°C]				
12	TEMP	0.000	0.300	-10.000		[°C]				
13	TEMP	0.000	0.550	-15.000		[°C]				
14	TEMP	0.000	0.550	-15.000		[°C]				
15	TEMP	0.000	0.550	-15.000		[°C]				
16	TEMP	0.000	0.550	-15.000		[°C]				

Load Case 5 TEMPERATURE FLUCTUATIONS DT 20

Factor forces and moments 1.000
Factor dead weight DL-XX 0.000
Factor dead weight DL-YY 0.000

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)

Loads acting on Beam-elements

Number	Type	a[m]	l[m]	Loadval	Loadval Dimens.	ya[m]	za[m]	ye[m]	ze[m]
1	TEMP	0.000	0.550	20.000	[°C]				
2	TEMP	0.000	0.550	20.000	[°C]				
3	TEMP	0.000	0.550	20.000	[°C]				
4	TEMP	0.000	0.550	20.000	[°C]				
5	TEMP	0.000	0.300	20.000	[°C]				
6	TEMP	0.000	0.300	20.000	[°C]				
7	TEMP	0.000	0.300	20.000	[°C]				
8	TEMP	0.000	0.300	20.000	[°C]				
9	TEMP	0.000	0.300	20.000	[°C]				
10	TEMP	0.000	0.300	20.000	[°C]				
11	TEMP	0.000	0.300	20.000	[°C]				
12	TEMP	0.000	0.300	20.000	[°C]				
13	TEMP	0.000	0.550	20.000	[°C]				
14	TEMP	0.000	0.550	20.000	[°C]				
15	TEMP	0.000	0.550	20.000	[°C]				
16	TEMP	0.000	0.550	20.000	[°C]				

Load Case 6 TEMPERATURE FLUCTUATIONS DT -20

Factor forces and moments		1.000
Factor dead weight	DL-XX	0.000
Factor dead weight	DL-YY	0.000

Loads acting on Beam-elements

Number	Type	a[m]	l[m]	Loadval	Loadval Dimens.	ya[m]	za[m]	ye[m]	ze[m]
1	TEMP	0.000	0.550	-20.000	[°C]				
2	TEMP	0.000	0.550	-20.000	[°C]				
3	TEMP	0.000	0.550	-20.000	[°C]				
4	TEMP	0.000	0.550	-20.000	[°C]				
5	TEMP	0.000	0.300	-20.000	[°C]				
6	TEMP	0.000	0.300	-20.000	[°C]				
7	TEMP	0.000	0.300	-20.000	[°C]				
8	TEMP	0.000	0.300	-20.000	[°C]				
9	TEMP	0.000	0.300	-20.000	[°C]				
10	TEMP	0.000	0.300	-20.000	[°C]				
11	TEMP	0.000	0.300	-20.000	[°C]				
12	TEMP	0.000	0.300	-20.000	[°C]				
13	TEMP	0.000	0.550	-20.000	[°C]				
14	TEMP	0.000	0.550	-20.000	[°C]				
15	TEMP	0.000	0.550	-20.000	[°C]				
16	TEMP	0.000	0.550	-20.000	[°C]				

Load Case 7 LINEAR TEMPERATURE DIFFERENCE dT

Factor forces and moments		1.000
Factor dead weight	DL-XX	0.000
Factor dead weight	DL-YY	0.000

Loads acting on Beam-elements

Number	Type	a[m]	l[m]	Loadval	Loadval Dimens.	ya[m]	za[m]	ye[m]	ze[m]
13	dTz	0.000	0.550	-7.000	[°C]				
14	dTz	0.000	0.550	-7.000	[°C]				
15	dTz	0.000	0.550	-7.000	[°C]				
16	dTz	0.000	0.550	-7.000	[°C]				

Load Case 8 LINEAR TEMPERATURE DIFFERENCE d

Factor forces and moments		1.000
Factor dead weight	DL-XX	0.000
Factor dead weight	DL-YY	0.000

Loads acting on Beam-elements

Number	Type	a[m]	l[m]	Loadval	Loadval Dimens.	ya[m]	za[m]	ye[m]	ze[m]
13	dTz	0.000	0.550	3.500	[°C]				
14	dTz	0.000	0.550	3.500	[°C]				
15	dTz	0.000	0.550	3.500	[°C]				
16	dTz	0.000	0.550	3.500	[°C]				

Load Case 90 LIVE LOADS_UNIFORM

Factor forces and moments		1.000
Factor dead weight	DL-XX	0.000
Factor dead weight	DL-YY	0.000

Loads acting on Nodes

Node	PX[kN]	PY[kN]	PZ[kN]	MX[kNm]	MY[kNm]	MZ[kNm]	MB[kNm2]
18		7.5					
24		7.5					
sum		15.0					

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)

Loads acting on Beam-elements

Number	Type	a[m]	l[m]	Loadval	Loadval Dimens.	ya[m]	za[m]	ye[m]	ze[m]
13	PYY	0.000	0.550	21.59	[kN/m]				
14	PYY	0.000	0.550	21.59	[kN/m]				
15	PYY	0.000	0.550	21.59	[kN/m]				
16	PYY	0.000	0.550	21.59	[kN/m]				

Sum of Loads

LC	Title	PXX[kN]	PYY[kN]	PZZ[kN]
1	IDIO BAROS	0.0	71.8	0.0
2	SOIL FILL WEIGHT	0.0	261.0	0.0
3	EARTH PRESSURE	0.0	0.0	0.0
4	SHRINKAGE OF CONCRETE	0.0	0.0	0.0
5	TEMPERATURE FLUCTUATIONS	0.0	0.0	0.0
6	TEMPERATURE FLUCTUATIONS	0.0	0.0	0.0
7	LINEAR TEMPERATURE DIFFE	0.0	0.0	0.0
8	LINEAR TEMPERATURE DIFFE	0.0	0.0	0.0
90	LIVE LOADS_UNIFORM	0.0	62.5	0.0

Sum of Reactions and Loads

LC	Title	PXX[kN]	PYY[kN]	PZZ[kN]
1	IDIO BAROS	0.0	-71.8	0.0
		0.0	71.8	0.0
2	SOIL FILL WEIGHT	0.0	-261.0	0.0
		0.0	261.0	0.0
3	EARTH PRESSURE	0.0	0.0	0.0
		0.0	0.0	0.0
4	SHRINKAGE OF CONCRETE	0.0	0.0	0.0
		0.0	0.0	0.0
5	TEMPERATURE FLUCTUATIONS	0.0	0.0	0.0
		0.0	0.0	0.0
6	TEMPERATURE FLUCTUATIONS	0.0	0.0	0.0
		0.0	0.0	0.0
7	LINEAR TEMPERATURE DIFFE	0.0	0.0	0.0
		0.0	0.0	0.0
8	LINEAR TEMPERATURE DIFFE	0.0	0.0	0.0
		0.0	0.0	0.0
90	LIVE LOADS_UNIFORM	0.0	-62.5	0.0
		0.0	62.5	0.0

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)

Definition of load type in this output:
PZZ - load in global direction Z in reference to the element length
PZP - load in global direction Z in reference to the projection
Pz - load in local direction z
PG - load in dead load direction in reference to the element length

Load Case 10 LIVE LOAD EARTH PRESSURE
Factor forces and moments 1.000
Factor dead weight DL-XX 0.000
Factor dead weight DL-YY 0.000

Loads acting on Nodes

Node	PX[kN]	PY[kN]	PZ[kN]	MX[kNm]	MY[kNm]	MZ[kNm]	MB[kNm2]
1	3.7						
18	3.7						
sum	7.5						

Loads acting on Beam-elements

Number	Type	a[m]	l[m]	Loadval	Loadval Dimens.	ya[m]	za[m]	ye[m]	ze[m]
5	PXX	0.000	0.300	10.79	[kN/m]				
6	PXX	0.000	0.300	10.79	[kN/m]				
7	PXX	0.000	0.300	10.79	[kN/m]				
8	PXX	0.000	0.300	10.79	[kN/m]				

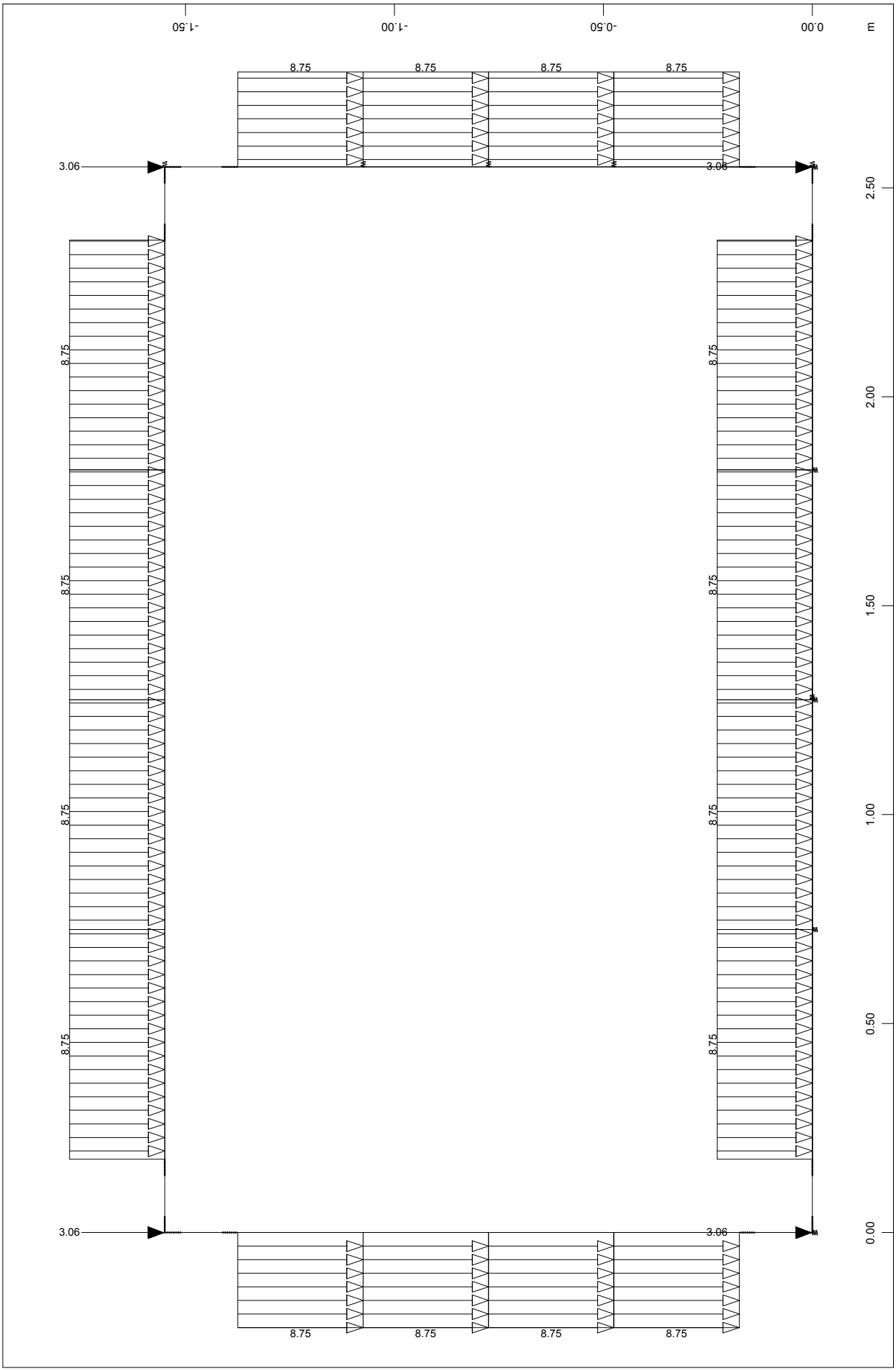
Sum of Loads

LC	Title	PXX[kN]	PYY[kN]	PZZ[kN]
10	LIVE LOAD EARTH PRESSURE	20.4	0.0	0.0

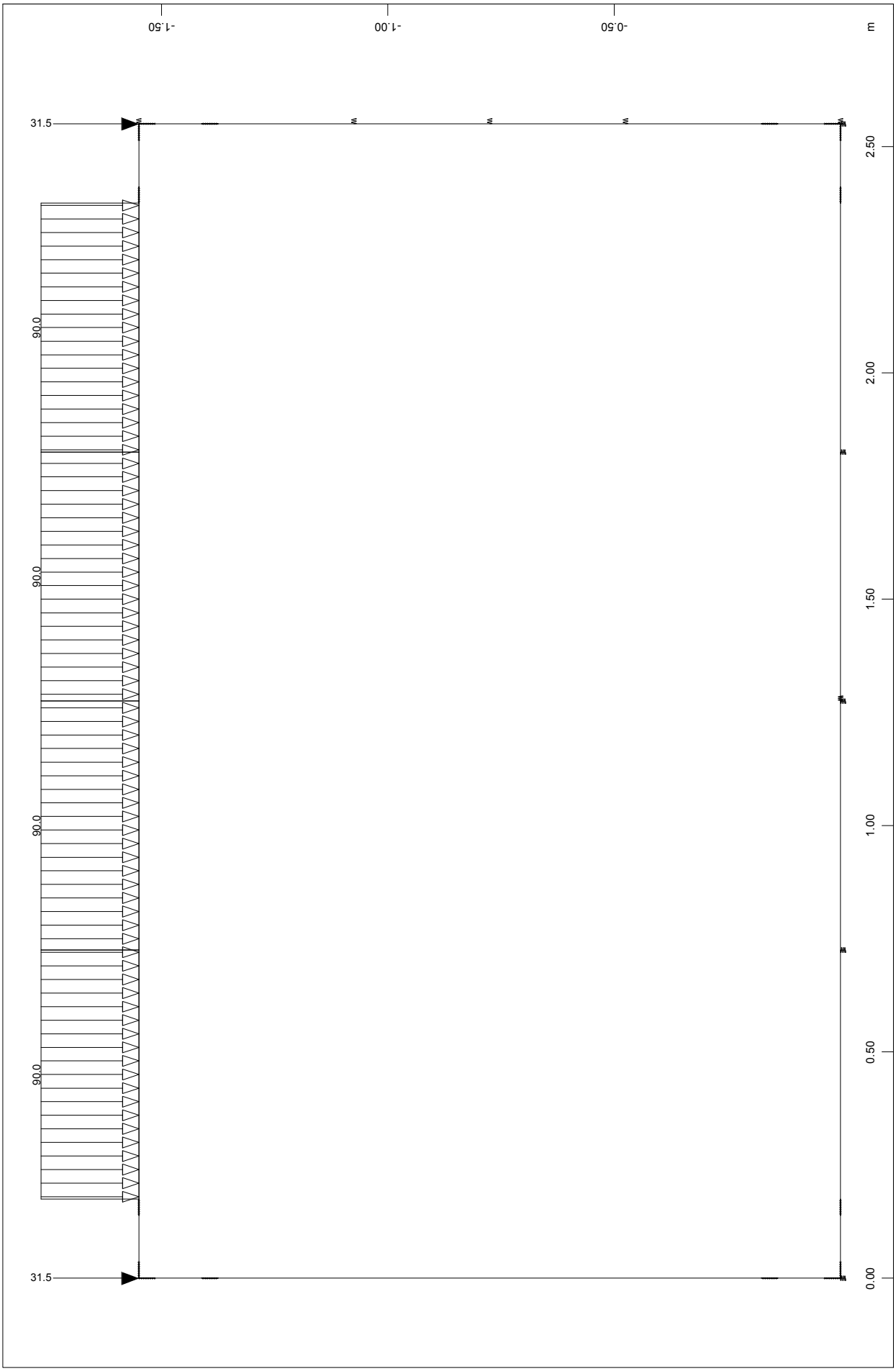
Sum of Reactions and Loads

LC	Title	PXX[kN]	PYY[kN]	PZZ[kN]
10	LIVE LOAD EARTH PRESSURE	-20.4	0.0	0.0
		20.4	0.0	0.0

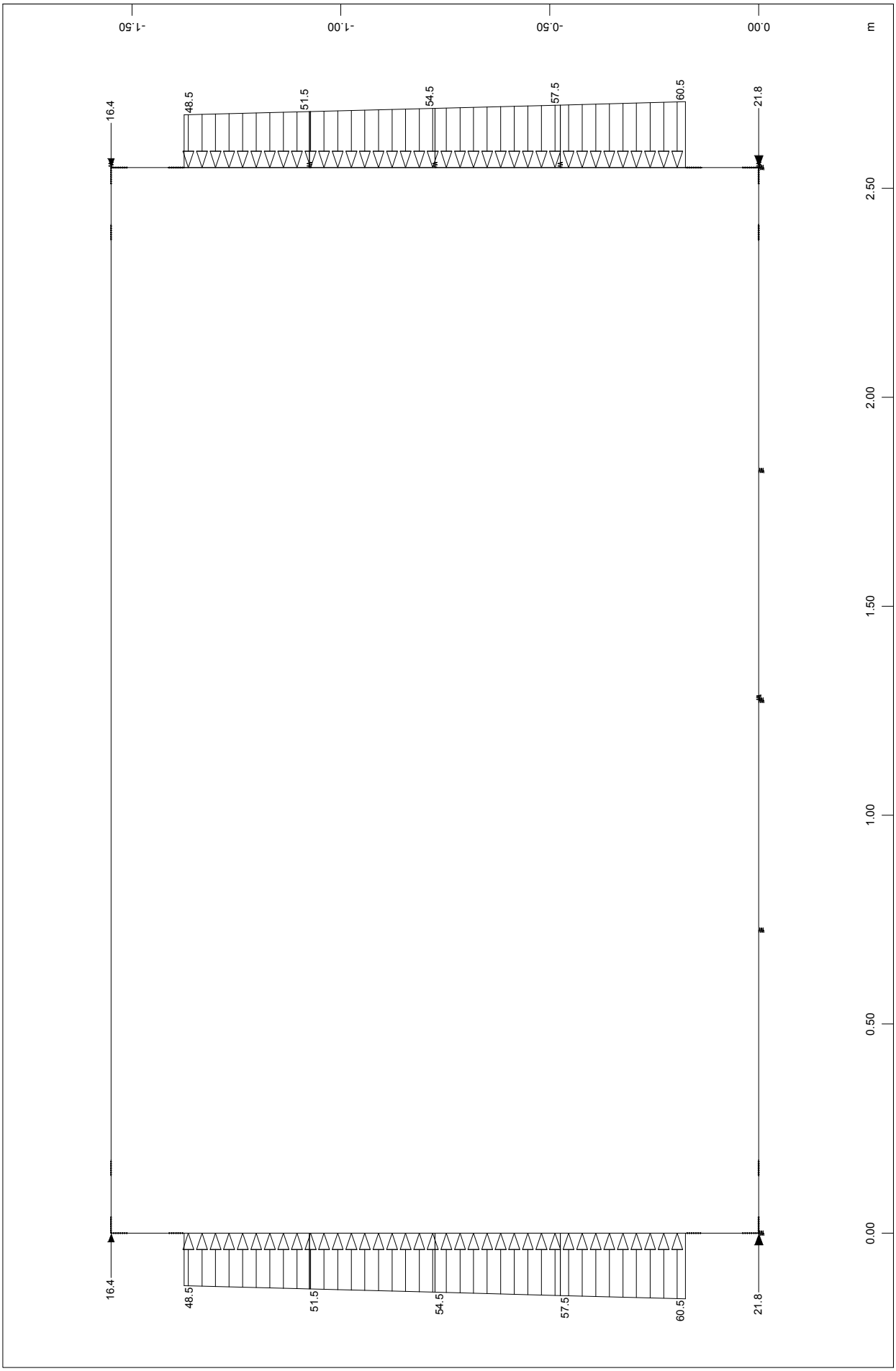
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)



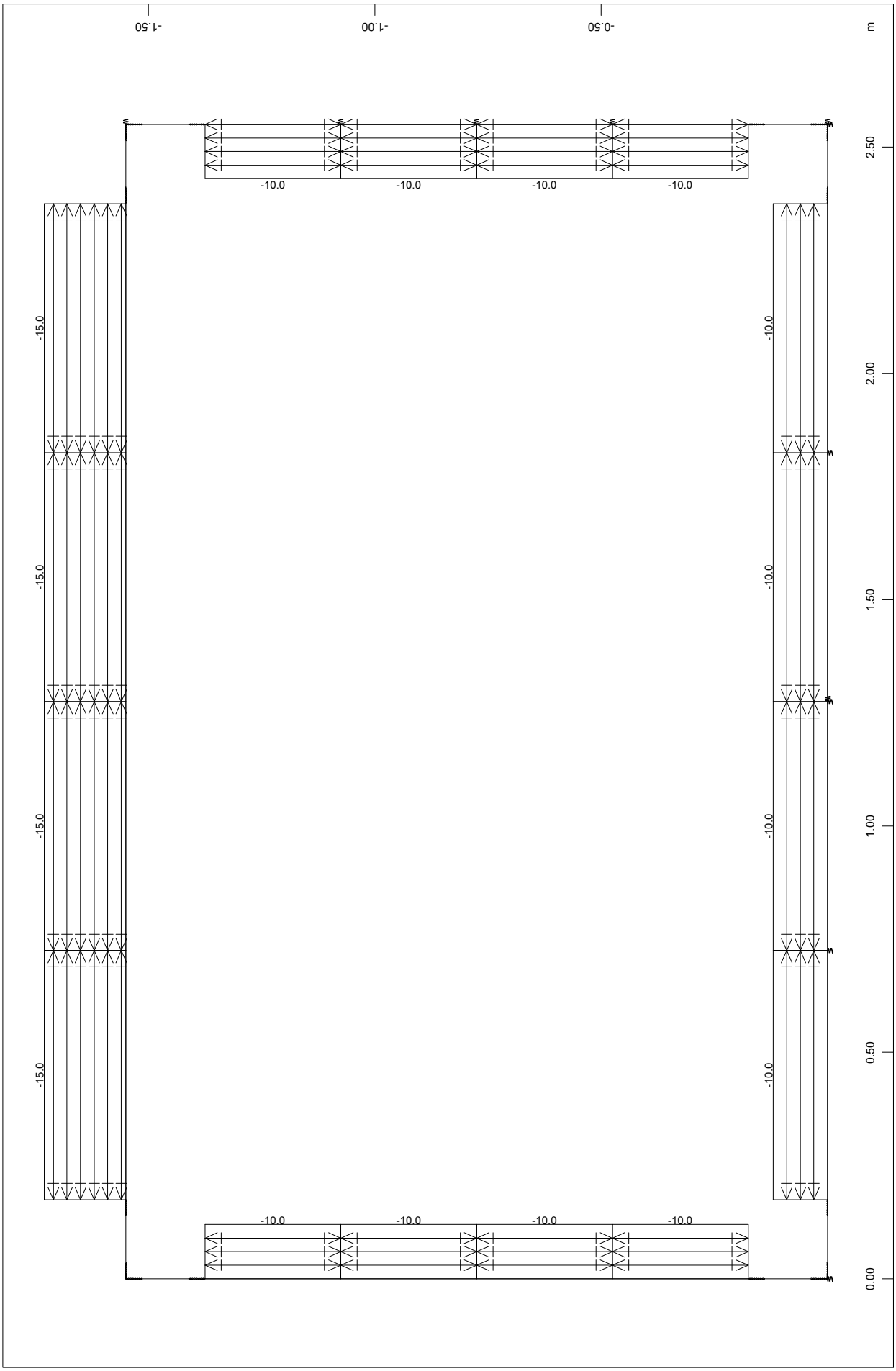
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)



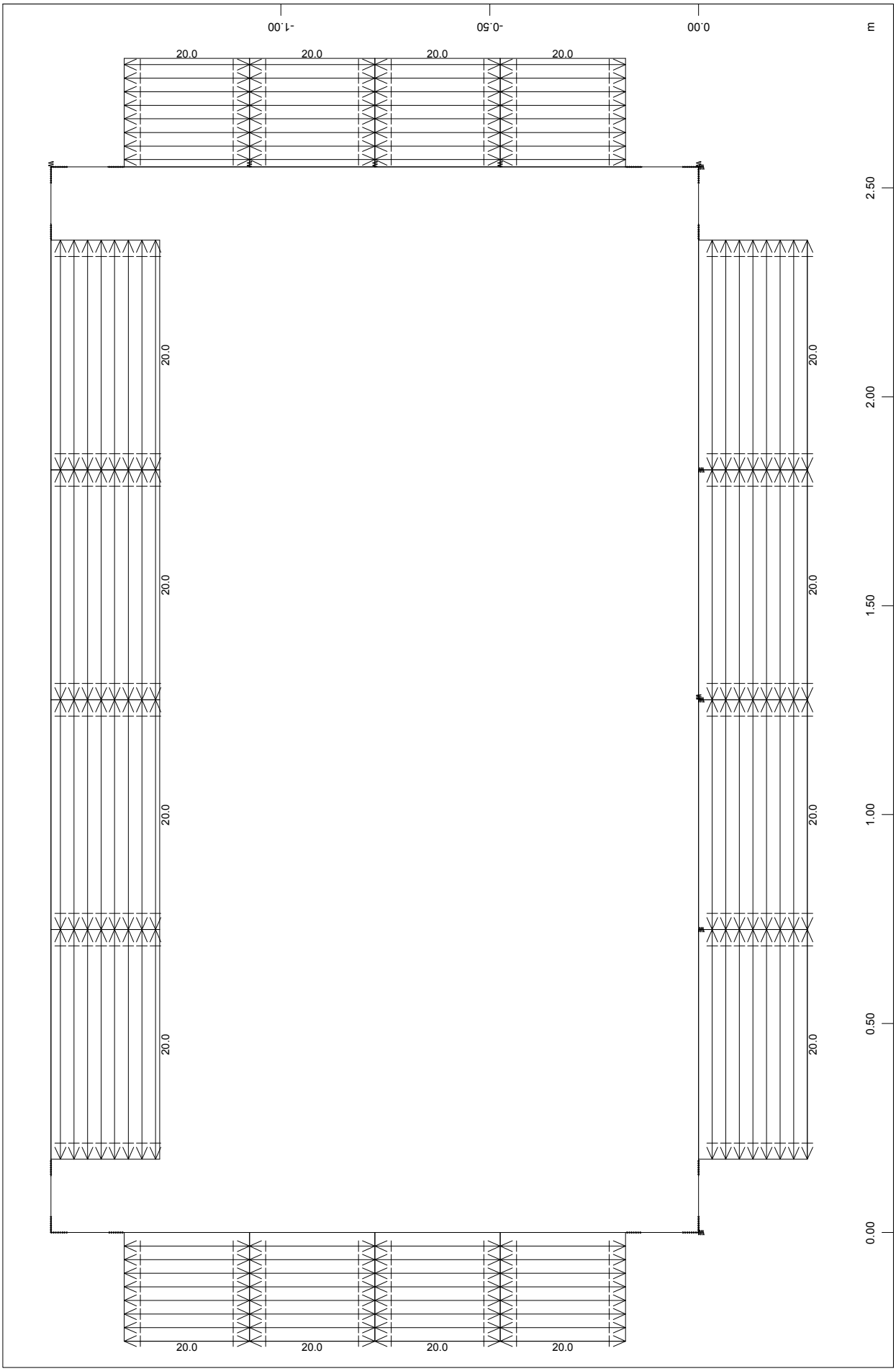
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)



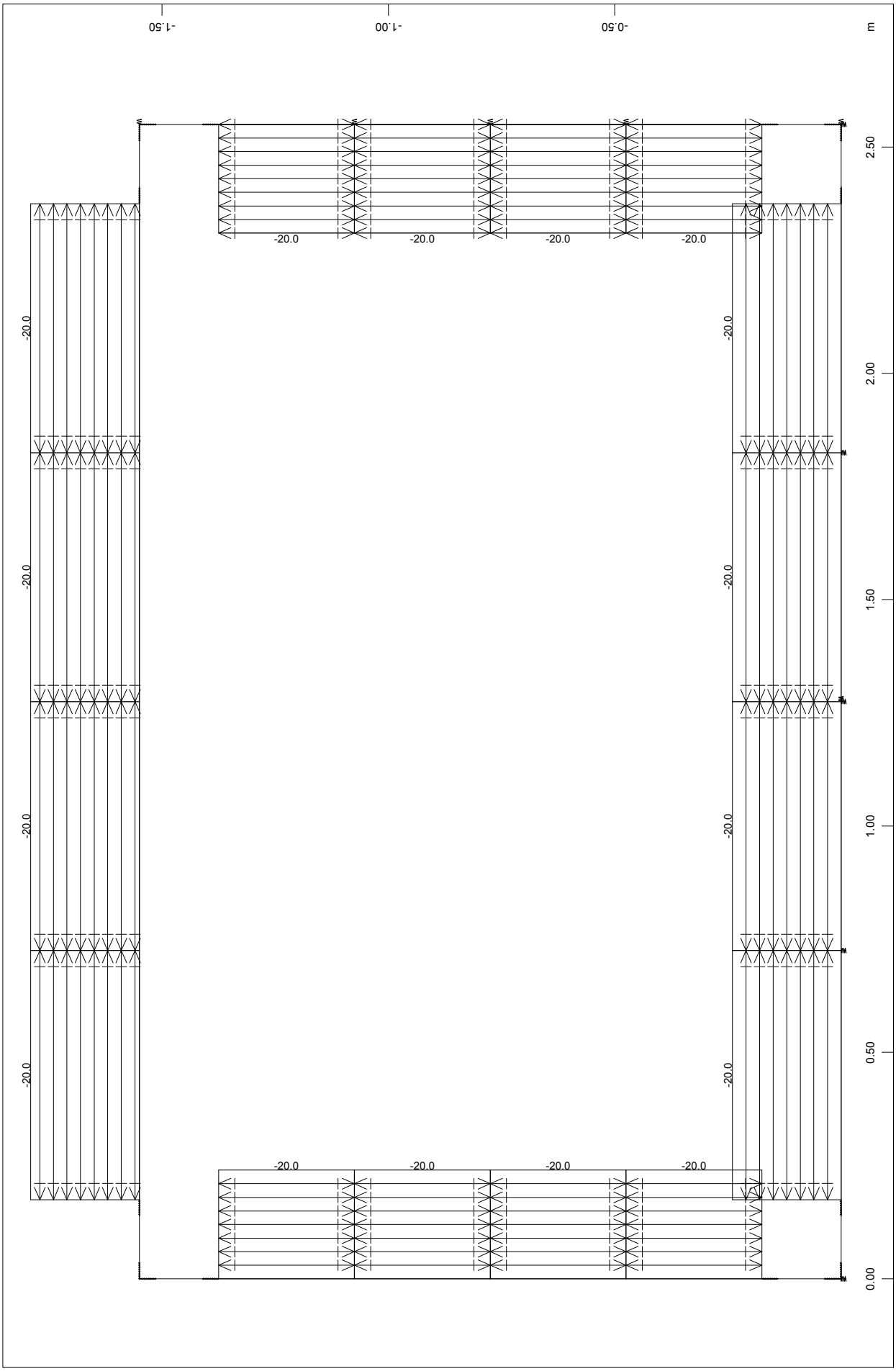
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)



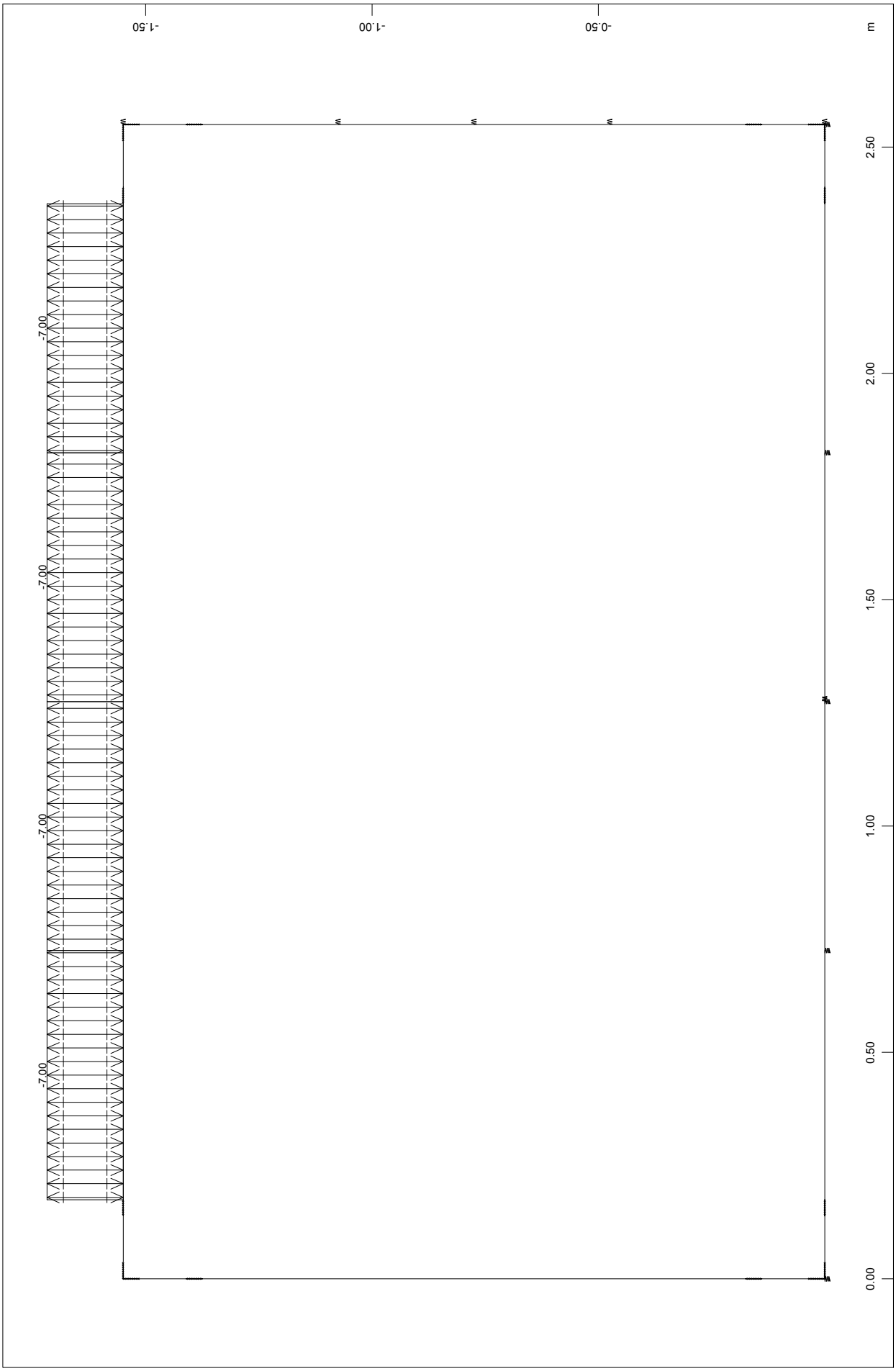
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)



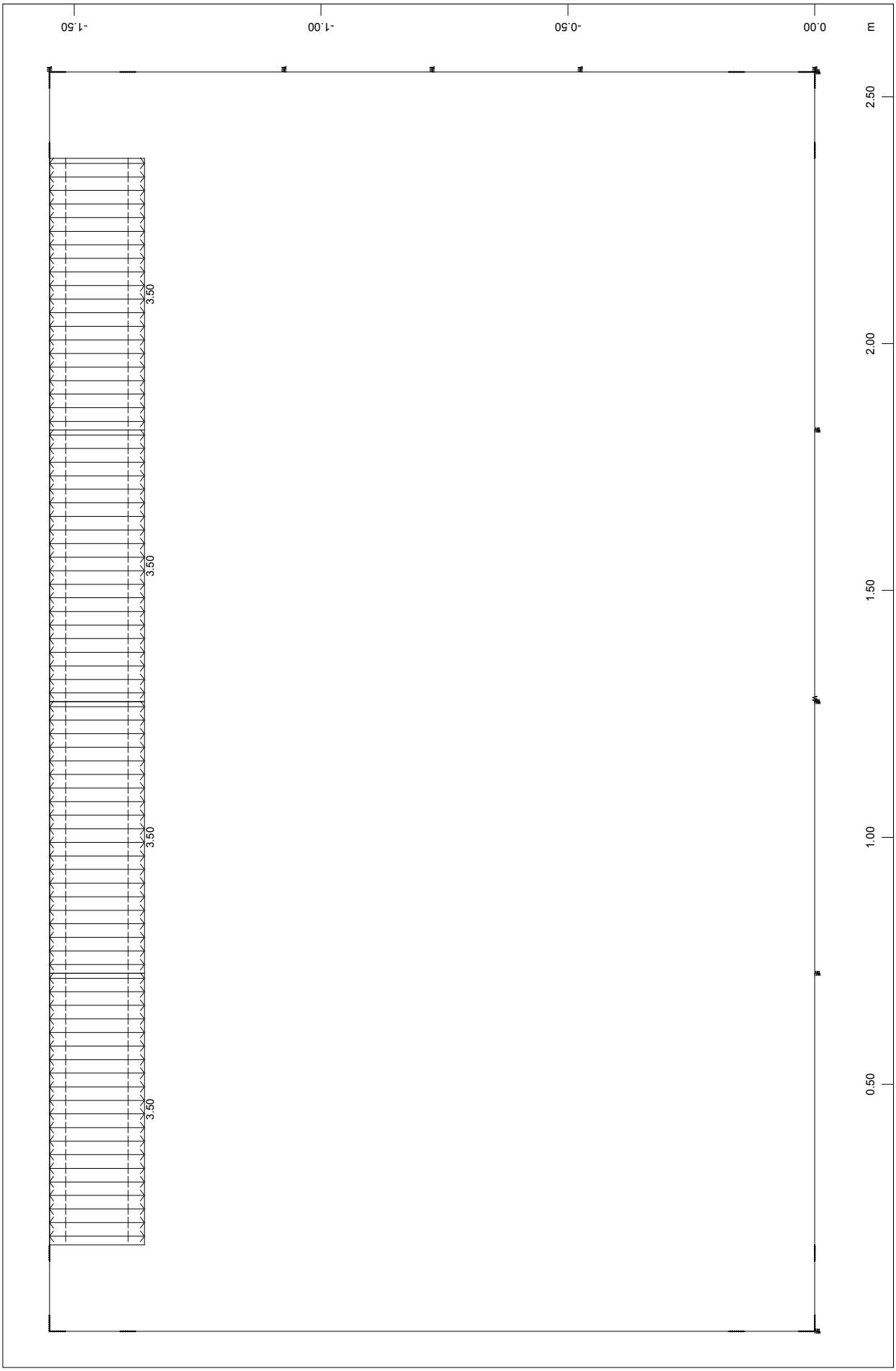
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)



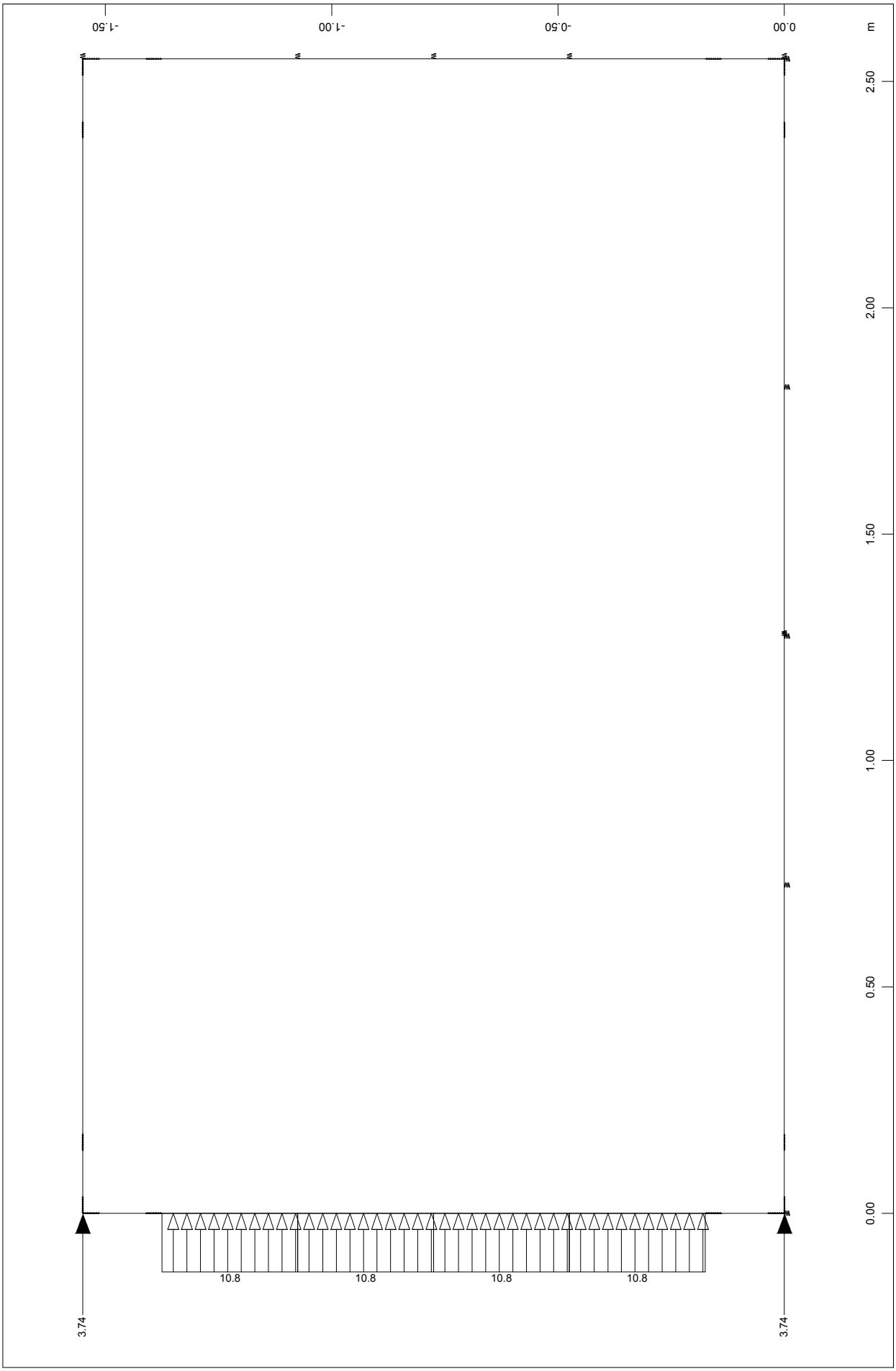
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)



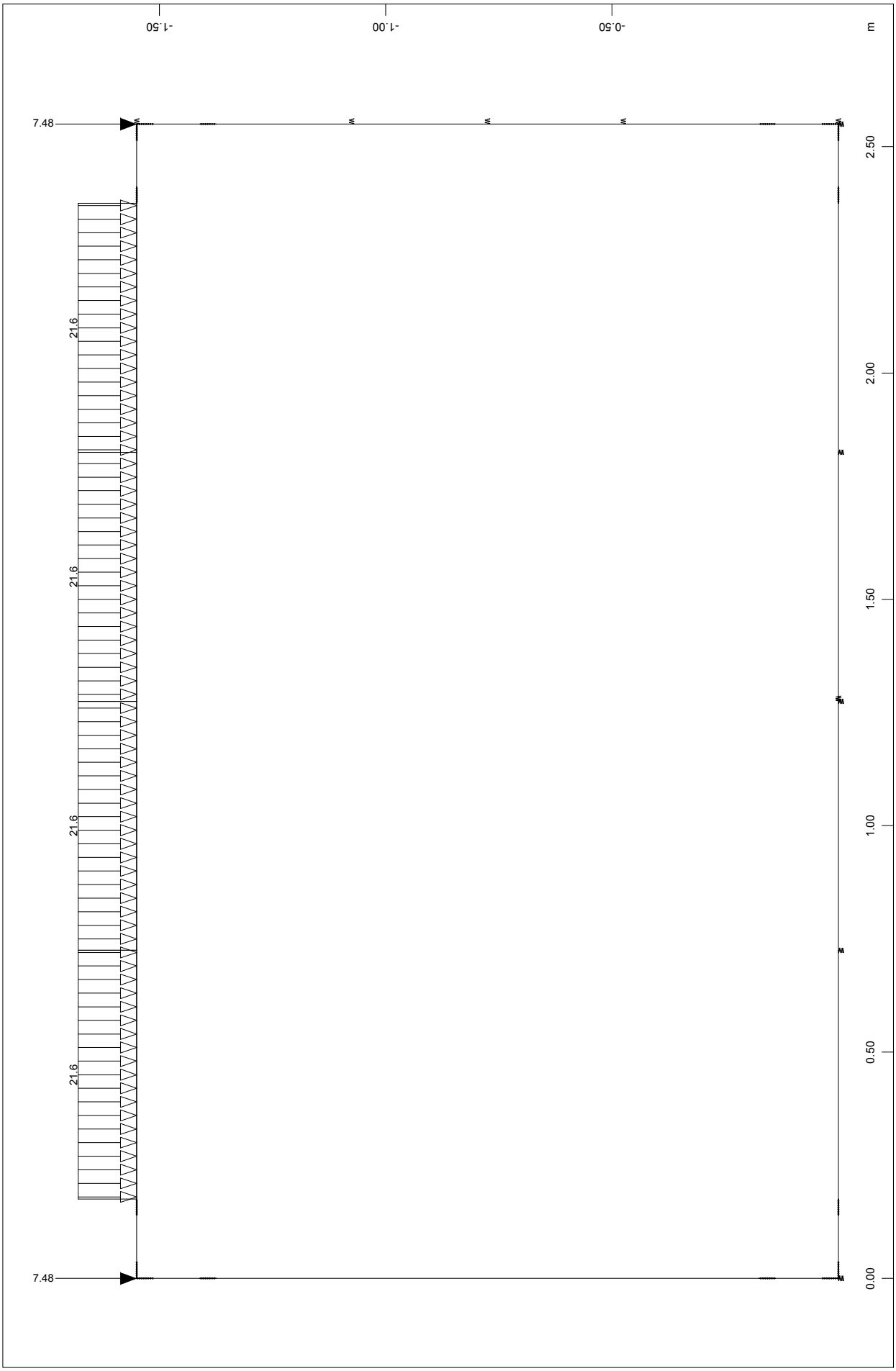
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)



BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)



BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)



BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
comb. no.1 U.L.S

Combination rule Number 1
Design Combination
Resulting loadcases type Design Combination
Loadcase selection

Number	factor	type	Title
1	1.35	permanent load grouped in actions	IDIO BAROS
2	1.35	permanent load grouped in actions	SOIL FILL WEIGHT
3	1.35	Exclusive LC AG	EARTH PRESSURE
3	0.68	Exclusive LC AG	EARTH PRESSURE
4	1.35	permanent load grouped in actions	SHRINKAGE OF CONCRETE
90	1.50	Conditional LC	LIVE LOADS_UNIFORM
10	1.50	Conditional LC	LIVE LOAD EARTH PRESSURE

Generated Loadcases

Number	Comb	Title
501	1	MAX-MY BEAM
502	1	MIN-MY BEAM
503	1	MAX-VZ BEAM
504	1	MIN-VZ BEAM
505	1	MAX-N BEAM
506	1	MIN-N BEAM

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
comb. no.2 U.L.S

Combination rule Number 1
Design Combination
Resulting loadcases type Design Combination
Loadcase selection

Number	factor	type		Title
1	1.35	permanent load grouped in actions		IDIO BAROS
2	1.35	permanent load grouped in actions		SOIL FILL WEIGHT
3	1.35	Exclusive LC	AG EARTH PRESSURE	
3	0.68	Exclusive LC	AG EARTH PRESSURE	
4	1.35	permanent load grouped in actions		SHRINKAGE OF CONCRETE
90	1.05	Conditional LC		LIVE LOADS_UNIFORM
10	1.05	Conditional LC		LIVE LOAD EARTH PRESSURE
5	1.50	Exclusive LC	A 2	TEMPERATURE FLUCTUATIONS
6	1.50	Exclusive LC	A 2	TEMPERATURE FLUCTUATIONS
7	1.50	Exclusive LC	A 3	LINEAR TEMPERATURE DIFFE
8	1.50	Exclusive LC	A 3	LINEAR TEMPERATURE DIFFE

Generated Loadcases

Number	Comb	Title
521	1	MAX-MY BEAM
522	1	MIN-MY BEAM
523	1	MAX-VZ BEAM
524	1	MIN-VZ BEAM
525	1	MAX-N BEAM
526	1	MIN-N BEAM

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
LOAD COMBINATION U.L.S DESIGN
****
ENVELOPES (MY)
****

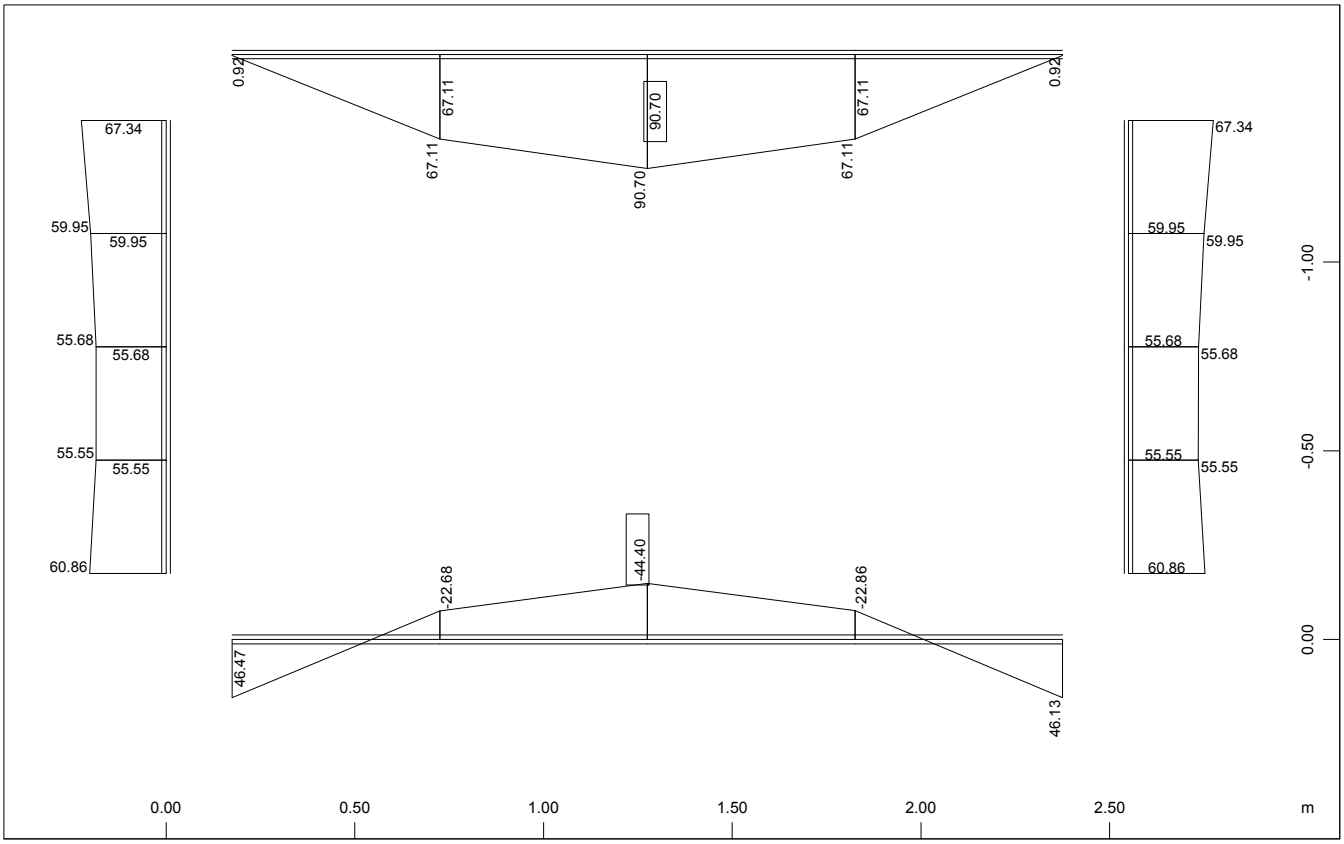
Combination rule Number 1
Design Combination
Resulting loadcases type Design Combination
Loadcase selection

Number	factor	type			Title
501	1.00	Exclusive LC	AG	MAX-MY BEAM	
502	1.00	Exclusive LC	AG	MIN-MY BEAM	
521	1.00	Exclusive LC	AG	MAX-MY BEAM	
522	1.00	Exclusive LC	AG	MIN-MY BEAM	

Generated Loadcases

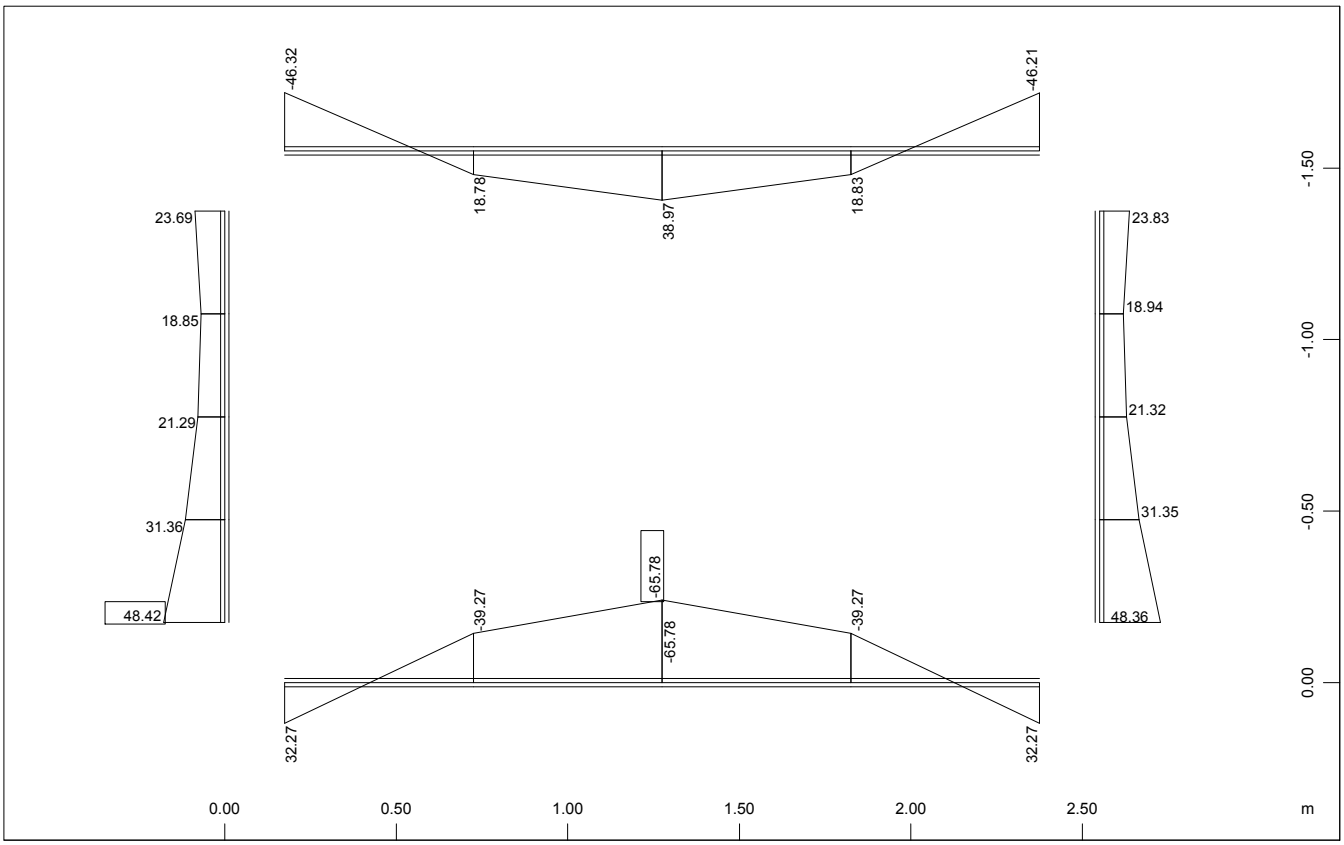
Number	Comb	Title
701	1	MAX-MY BEAM
702	1	MIN-MY BEAM

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
ENVELOPES FOR MY



Sector of system Beam Elements
Beam Elements , Bending moment My, Loadcase 701 MAX-MY BEAM , 1 cm 3D = 60.0 kNm
(Min=-44.4) (Max=90.7)

M 1 : 20



Sector of system Beam Elements
Beam Elements , Bending moment My, Loadcase 702 MIN-MY BEAM , 1 cm 3D = 60.0 kNm
(Min=-65.8) (Max=48.4)

M 1 : 22

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
LOAD COMBINATION U.L.S DESIGN
****
ENVELOPES (VZ)
****

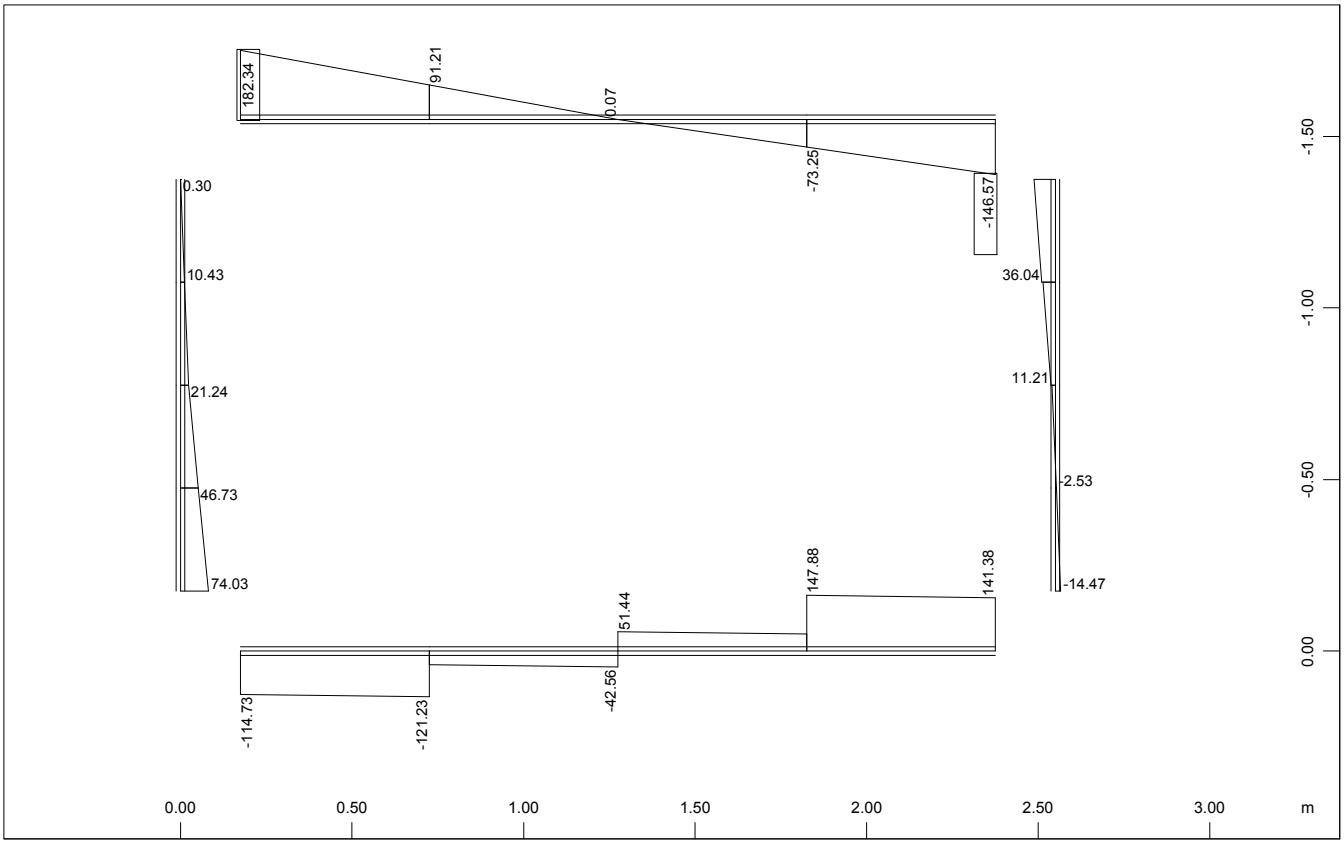
Combination rule Number 1
Design Combination
Resulting loadcases type Design Combination
Loadcase selection

Number	factor	type		Title
503	1.00	Exclusive LC	AG	MAX-VZ BEAM
504	1.00	Exclusive LC	AG	MIN-VZ BEAM
523	1.00	Exclusive LC	AG	MAX-VZ BEAM
524	1.00	Exclusive LC	AG	MIN-VZ BEAM

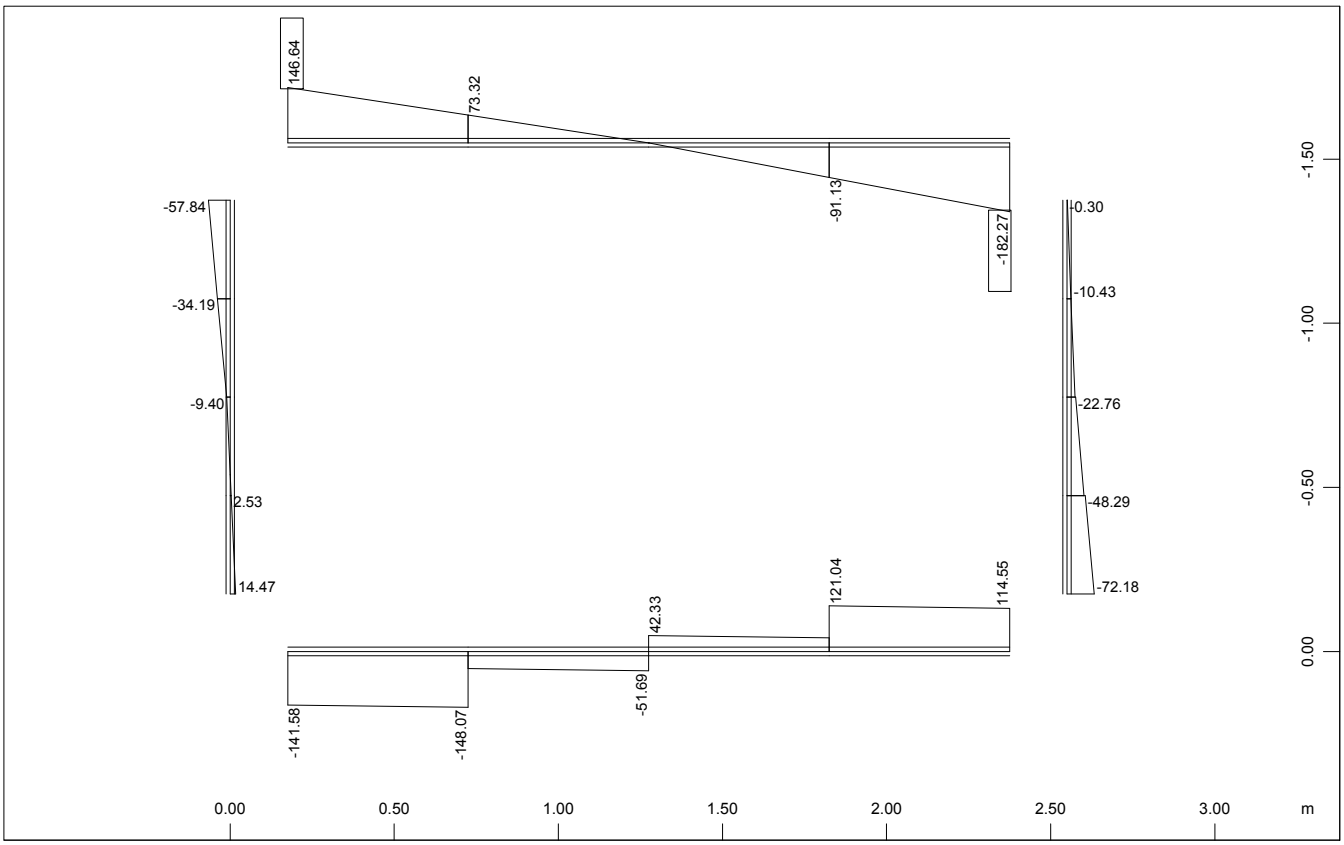
Generated Loadcases

Number	Comb	Title
703	1	MAX-VZ BEAM
704	1	MIN-VZ BEAM

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
ENVELOPES FOR VZ



Sector of system Beam Elements
M 1 : 22
Beam Elements , Shear force Vz, Loadcase 703 MAX-VZ BEAM , 1 cm 3D = 200.0 kN
(Min=-146.6) (Max=182.3)



Sector of system Beam Elements
M 1 : 23
Beam Elements , Shear force Vz, Loadcase 704 MIN-VZ BEAM , 1 cm 3D = 200.0 kN
(Min=-182.3) (Max=146.6)

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
LOAD COMBINATION U.L.S DESIGN
****
ENVELOPES (N)
****

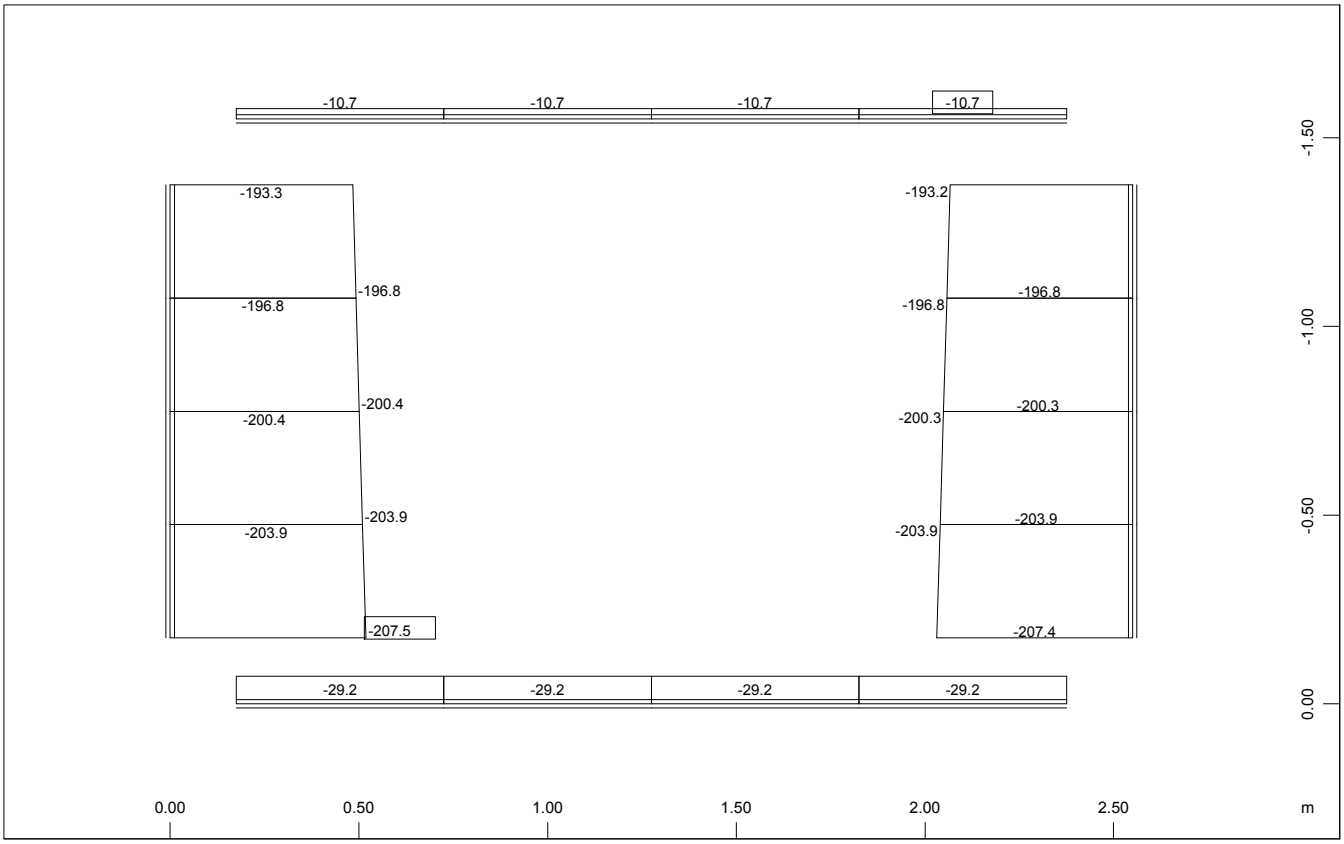
Combination rule Number 1
Design Combination
Resulting loadcases type Design Combination
Loadcase selection

Number	factor	type		Title
505	1.00	Exclusive LC	AG	MAX-N BEAM
506	1.00	Exclusive LC	AG	MIN-N BEAM
525	1.00	Exclusive LC	AG	MAX-N BEAM
526	1.00	Exclusive LC	AG	MIN-N BEAM

Generated Loadcases

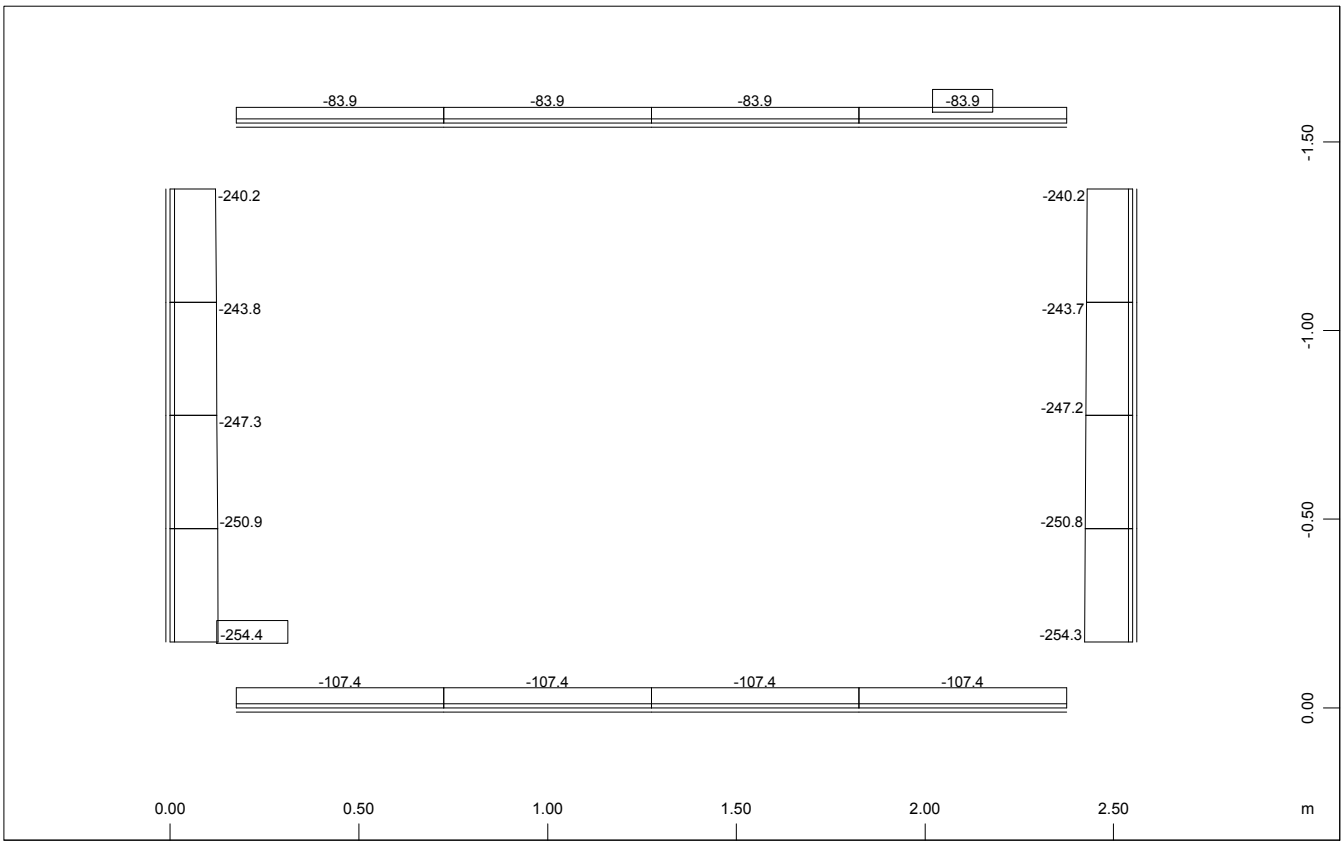
Number	Comb	Title
705	1	MAX-N BEAM
706	1	MIN-N BEAM

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
ENVELOPES FOR N



Sector of system Beam Elements
Beam Elements , Normal force Nx, Loadcase 705 MAX-N BEAM , 1 cm 3D = 80.0 kN
(Min=-207.5) (Max=-10.7)

M 1 : 20



Sector of system Beam Elements
Beam Elements , Normal force Nx, Loadcase 706 MIN-N BEAM , 1 cm 3D = 400.0 kN
(Min=-254.4) (Max=-83.9)

M 1 : 20

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
comb. no.1 S.L.S

Combination rule Number 1
Design Combination
Resulting loadcases type Design Combination
Loadcase selection

Number	factor	type		Title
1	1.00	permanent load grouped in actions		IDIO BAROS
2	1.00	permanent load grouped in actions		SOIL FILL WEIGHT
3	1.00	Exclusive LC	AG EARTH PRESSURE	
3	0.50	Exclusive LC	AG EARTH PRESSURE	
4	1.00	permanent load grouped in actions		SHRINKAGE OF CONCRETE
90	1.00	Conditional LC	LIVE LOADS_UNIFORM	
10	1.00	Conditional LC	LIVE LOAD EARTH PRESSURE	

Generated Loadcases

Number	Comb	Title
601	1	MAX-MY BEAM
602	1	MIN-MY BEAM
603	1	MAX-VZ BEAM
604	1	MIN-VZ BEAM
605	1	MAX-N BEAM
606	1	MIN-N BEAM

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
comb. no.2 S.L.S

Combination rule Number 1
Design Combination
Resulting loadcases type Design Combination
Loadcase selection

Number	factor	type	Title
1	1.00	permanent load grouped in actions	IDIO BAROS
2	1.00	permanent load grouped in actions	SOIL FILL WEIGHT
3	1.00	Exclusive LC AG	EARTH PRESSURE
3	0.50	Exclusive LC AG	EARTH PRESSURE
4	1.00	permanent load grouped in actions	SHRINKAGE OF CONCRETE
90	0.70	Conditional LC	LIVE LOADS_UNIFORM
10	0.70	Conditional LC	LIVE LOAD EARTH PRESSURE
5	1.00	Exclusive LC A 2	TEMPERATURE FLUCTUATIONS
6	1.00	Exclusive LC A 2	TEMPERATURE FLUCTUATIONS
7	1.00	Exclusive LC A 3	LINEAR TEMPERATURE DIFFE
8	1.00	Exclusive LC A 3	LINEAR TEMPERATURE DIFFE

Generated Loadcases

Number	Comb	Title
621	1	MAX-MY BEAM
622	1	MIN-MY BEAM
623	1	MAX-VZ BEAM
624	1	MIN-VZ BEAM
625	1	MAX-N BEAM
626	1	MIN-N BEAM

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
LOAD COMBINATION S.L.S DESIGN
****
ENVELOPES (MY)
****

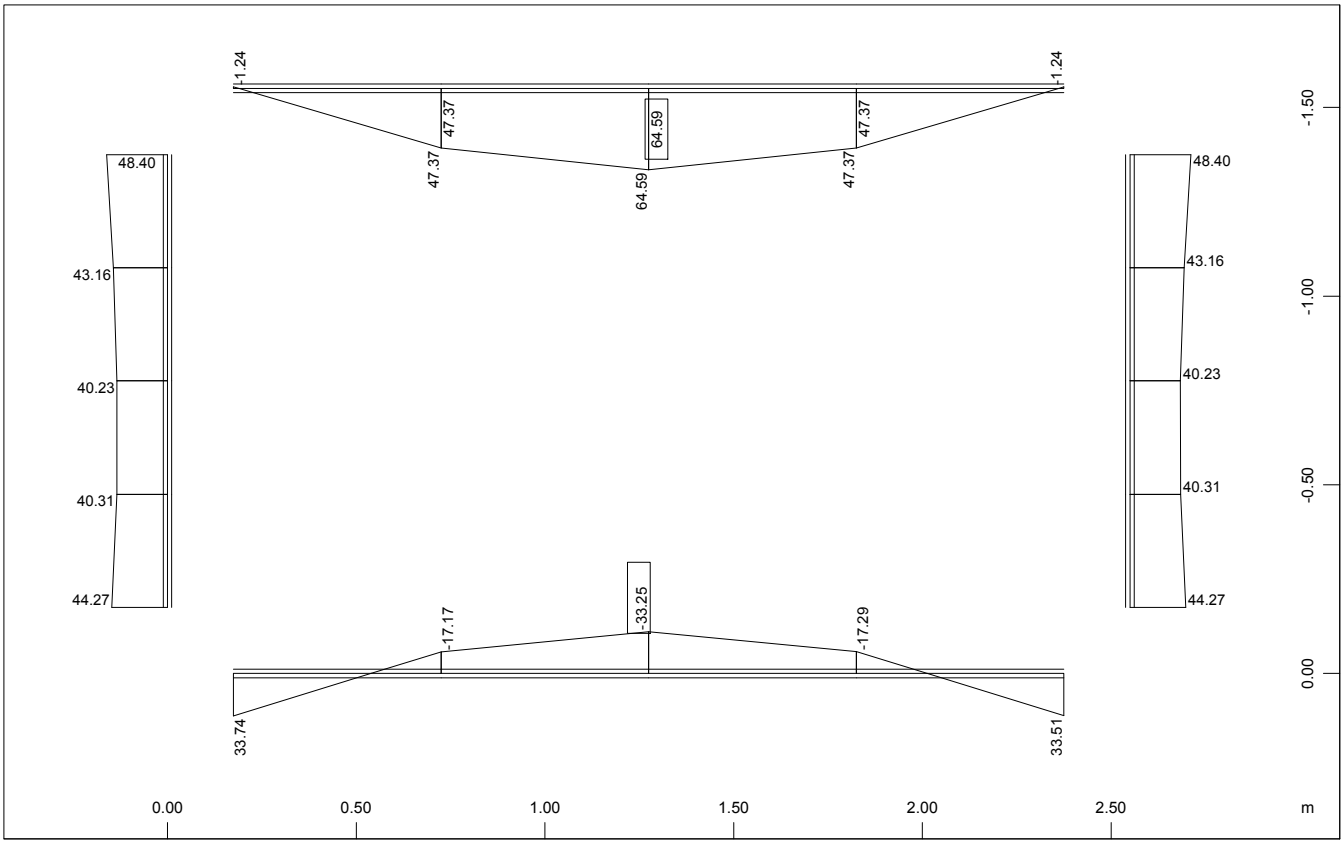
Combination rule Number 1
Design Combination
Resulting loadcases type Design Combination
Loadcase selection

Number	factor	type			Title
601	1.00	Exclusive LC	AG	MAX-MY BEAM	
602	1.00	Exclusive LC	AG	MIN-MY BEAM	
621	1.00	Exclusive LC	AG	MAX-MY BEAM	
622	1.00	Exclusive LC	AG	MIN-MY BEAM	

Generated Loadcases

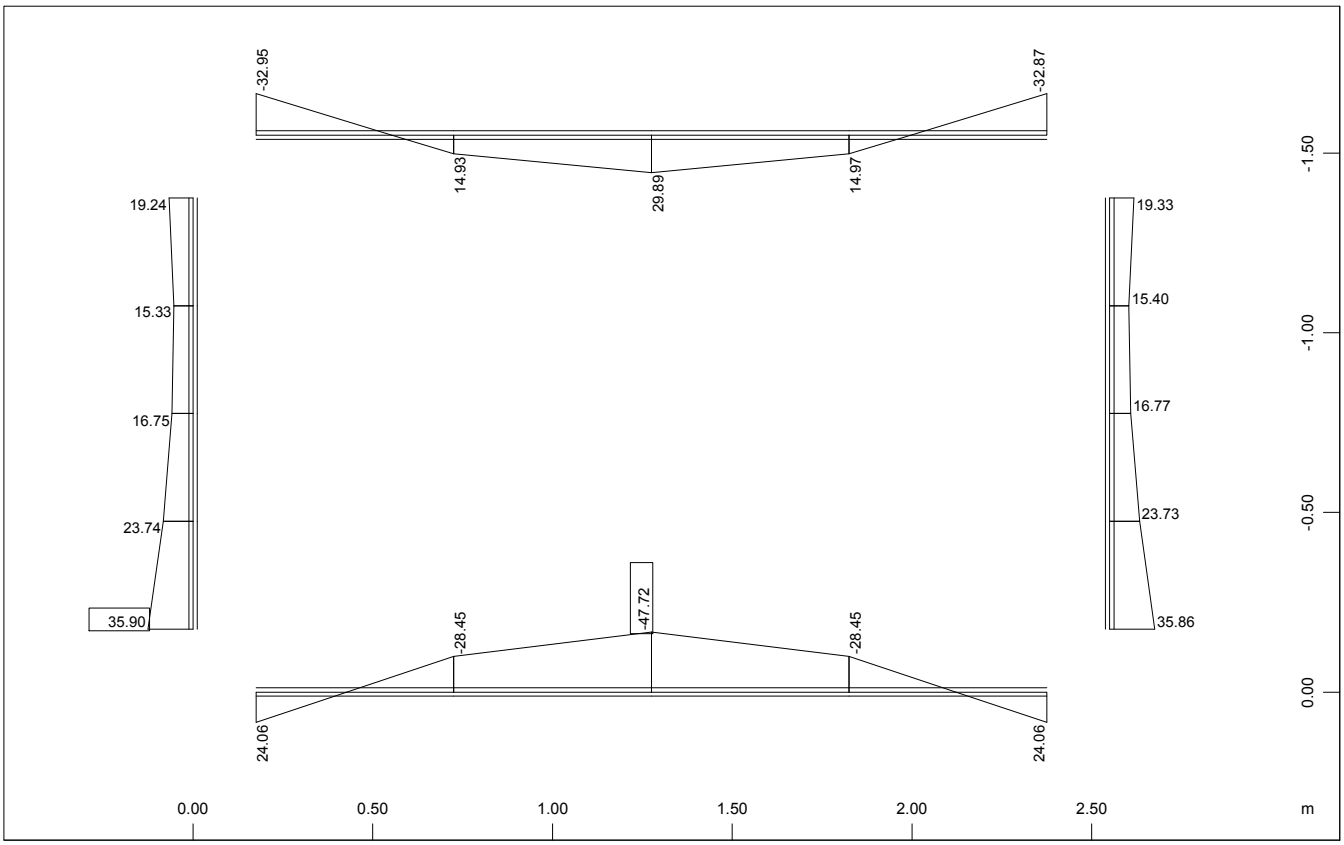
Number	Comb	Title
801	1	MAX-MY BEAM
802	1	MIN-MY BEAM

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
ENVELOPES FOR MY



Sector of system Beam Elements
Beam Elements , Bending moment My, Loadcase 801 MAX-MY BEAM , 1 cm 3D = 60.0 kNm
(Min=-33.3) (Max=64.6)

M 1 : 20



Sector of system Beam Elements
Beam Elements , Bending moment My, Loadcase 802 MIN-MY BEAM , 1 cm 3D = 60.0 kNm
(Min=-47.7) (Max=35.9)

M 1 : 21

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
LOAD COMBINATION S.L.S DESIGN
****
ENVELOPES (VZ)
****

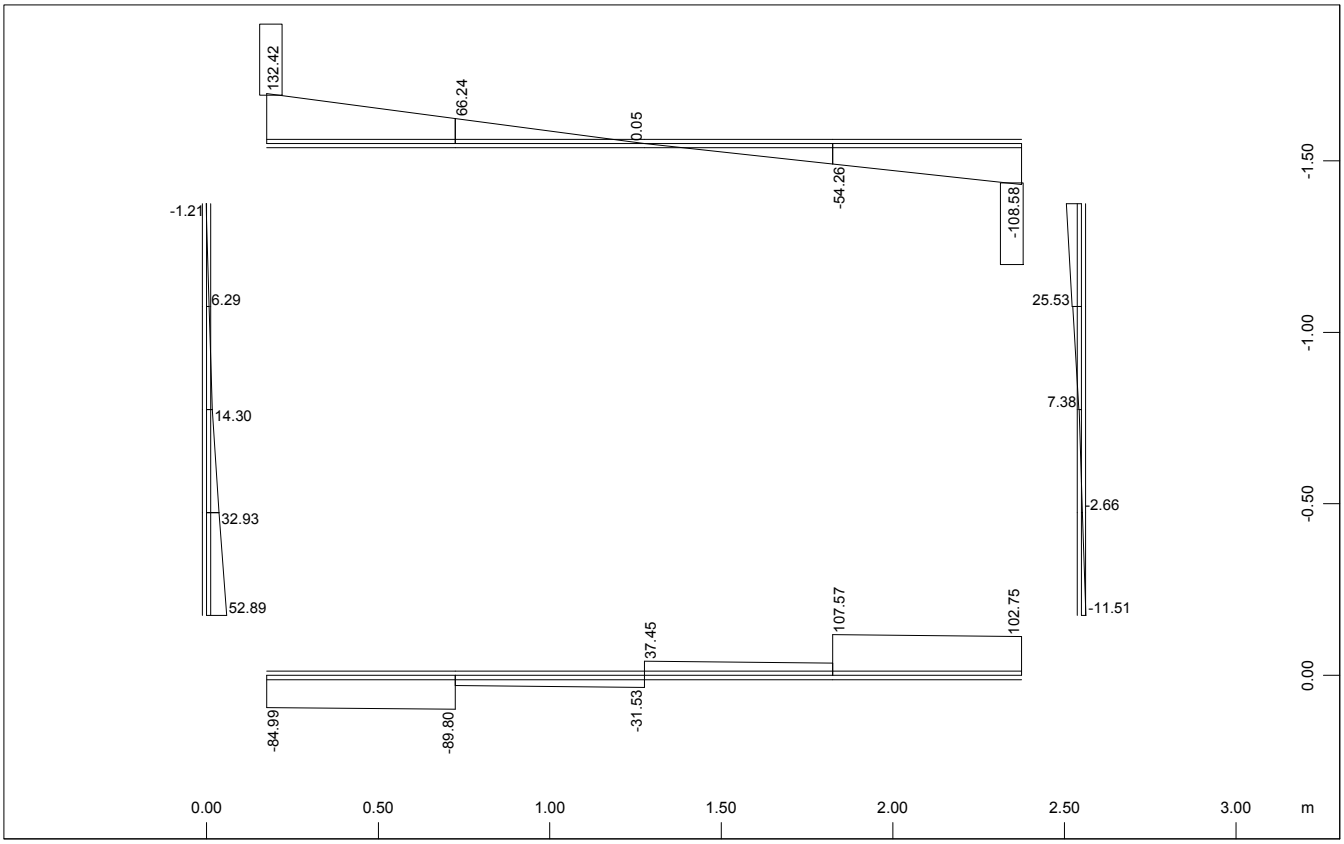
Combination rule Number 1
Design Combination
Resulting loadcases type Design Combination
Loadcase selection

Number	factor	type		Title
603	1.00	Exclusive LC	AG	MAX-VZ BEAM
604	1.00	Exclusive LC	AG	MIN-VZ BEAM
623	1.00	Exclusive LC	AG	MAX-VZ BEAM
624	1.00	Exclusive LC	AG	MIN-VZ BEAM

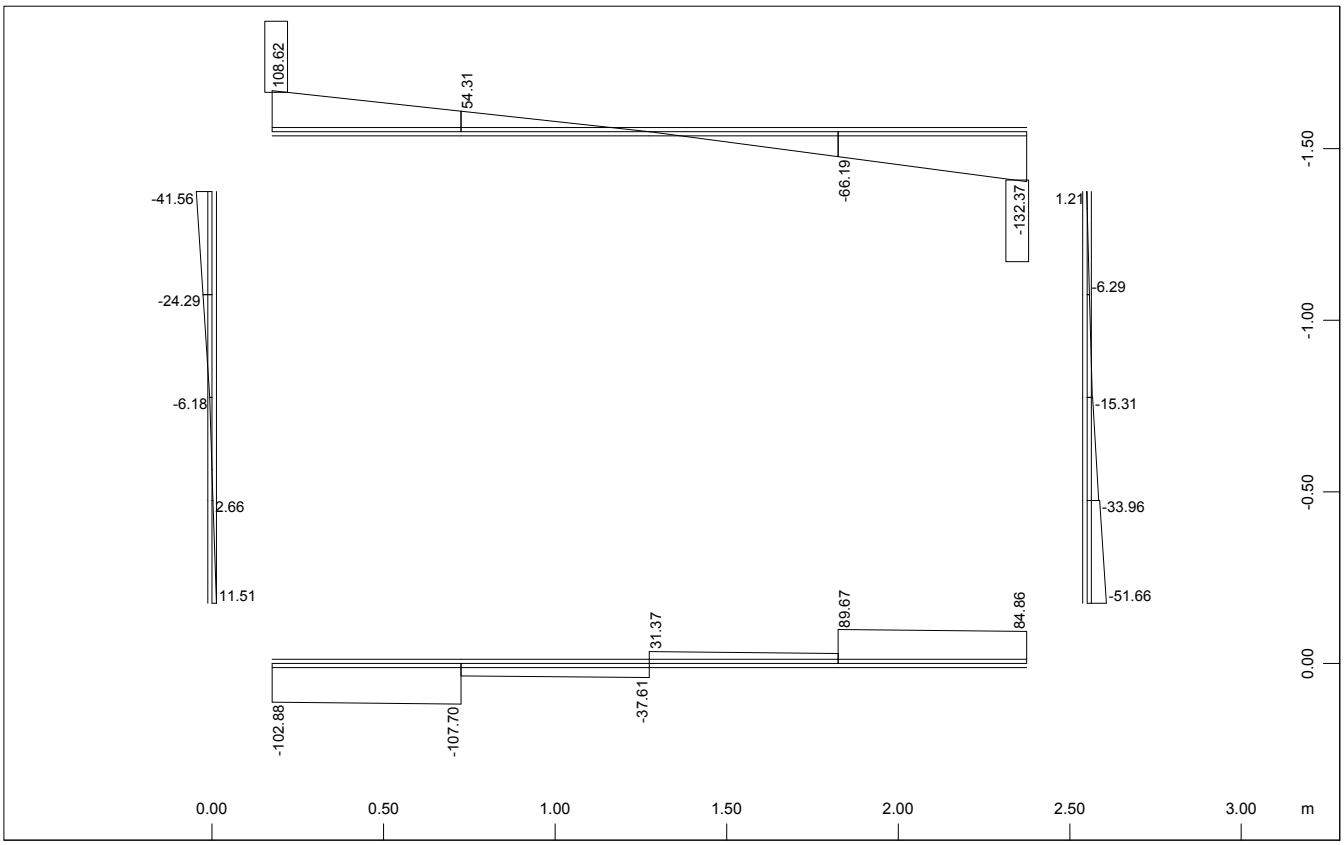
Generated Loadcases

Number	Comb	Title
803	1	MAX-VZ BEAM
804	1	MIN-VZ BEAM

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
ENVELOPES FOR VZ



Sector of system Beam Elements
M 1 : 22
Beam Elements , Shear force Vz, Loadcase 803 MAX-VZ BEAM , 1 cm 3D = 200.0 kN
(Min=-108.6) (Max=132.4)



Sector of system Beam Elements
M 1 : 22
Beam Elements , Shear force Vz, Loadcase 804 MIN-VZ BEAM , 1 cm 3D = 200.0 kN
(Min=-132.4) (Max=108.6)

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
LOAD COMBINATION S.L.S DESIGN
****
ENVELOPES (N)
****

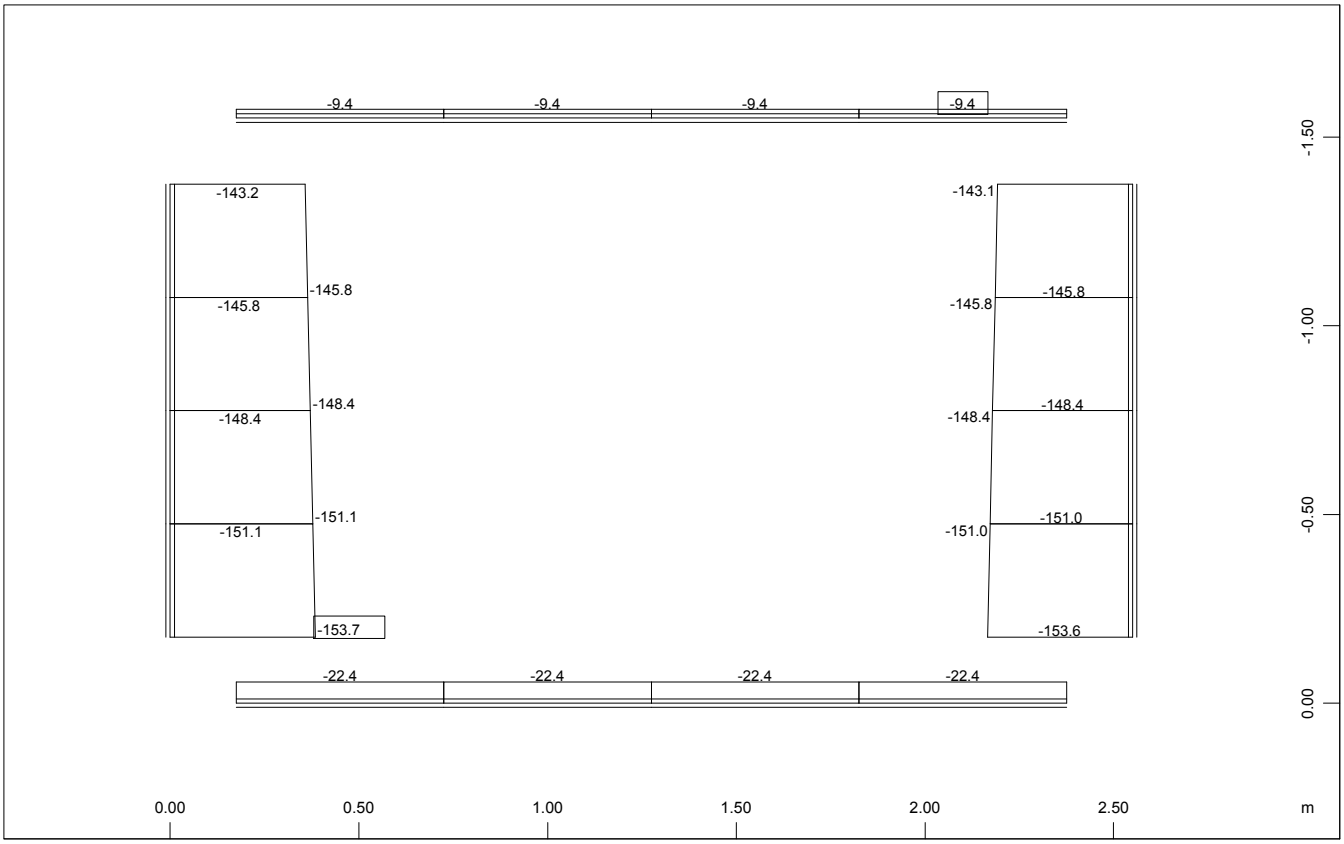
Combination rule Number 1
Design Combination
Resulting loadcases type Design Combination
Loadcase selection

Number	factor	type			Title
605	1.00	Exclusive LC	AG	MAX-N BEAM	
606	1.00	Exclusive LC	AG	MIN-N BEAM	
625	1.00	Exclusive LC	AG	MAX-N BEAM	
626	1.00	Exclusive LC	AG	MIN-N BEAM	

Generated Loadcases

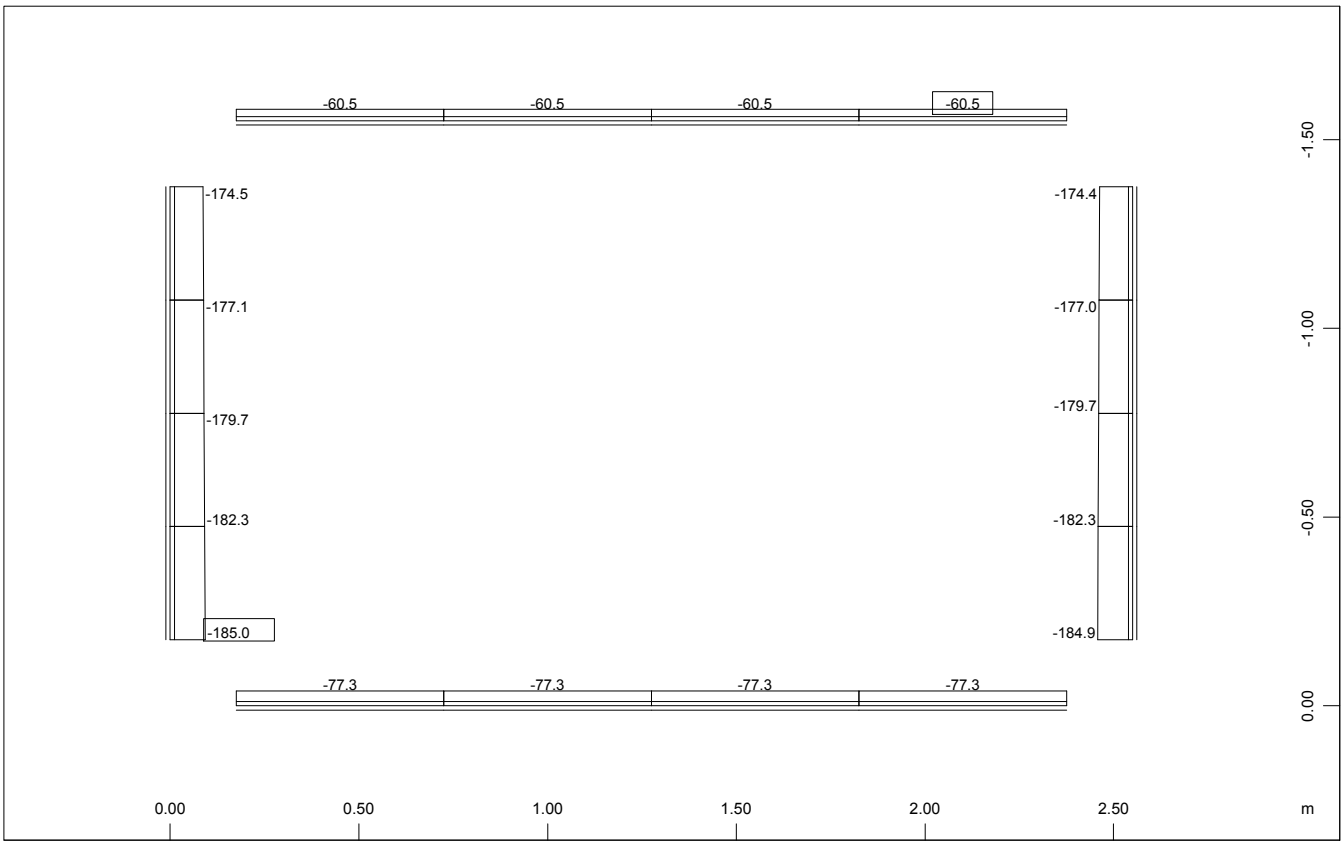
Number	Comb	Title
805	1	MAX-N BEAM
806	1	MIN-N BEAM

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
ENVELOPES FOR N



Sector of system Beam Elements
Beam Elements , Normal force Nx, Loadcase 805 MAX-N BEAM , 1 cm 3D = 80.0 kN
(Min=-153.7) (Max=-9.39)

M 1 : 20



Sector of system Beam Elements
Beam Elements , Normal force Nx, Loadcase 806 MIN-N BEAM , 1 cm 3D = 400.0 kN
(Min=-185.0) (Max=-60.5)

M 1 : 20

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
DESIGN ANALYSIS - STATICAL COMBINATIONS

Selected Beam Elements

FROM	TO	INC	X-VALUE	NC	MEMBER	CS0	CS1	CS2	CS3	CS4	CS5
		all elements									

Default design code is EuroNorm EN 1992 Concrete with country code 30 (Hellas/Greece)
Class(Tab.7.1N): N (Reinforced members and prestressed members with unbonded tendons)
Snow load zone : 1

Materials
No. 1 C 25/30 (EN 1992)
No. 3 S 500 (EN 1992)

All moments will be smoothed out between face and support
Reinforcement will be accounted for sectional values as defined in AQUA
Reinforcements saved as design case LCR 1
Reinforcements become minimum reinforcements

Considered Load Cases

501	502	503	504	505	506
521	522	523	524	525	526

Ultimate Load Design

Design for ultimate loads EuroNorm EN 1992 Concrete
Uniaxial bending

Safety factors	SC-1	SC-2	SC-S	SS-1	SS-2	PIIa
	1.50	1.50	1.50	1.15	1.10	7

Strain limits	C1	C2	S1	S2	Z1	Z2
	-3.50	-2.00	3.00	45.00	-3.50	18.00

parameters for reinforcements

Minimum reinforcements Bending.	Compress.	compression e/d	N/Npl	min. reinforcem. requ. section	maximum- reinforc.
0.00 [o/o]	0.20 [o/o]	3.50	0.0010	0.00	0.10	8.00

normal force xsi*V*cot(Theta) where Theta is estimated before the design and xsi= 0.50

Material of sections uses Ultimate Limit strain-stress law with individual safety factors
Material of reinforcements uses Ultimate Limit strain-stress law with individual safety factors

MNo.	temp lev.	Material- safety [-]	max.compr stress [MPa]	at strain [o/oo]	max.tens stress [MPa]	at strain [o/oo]	tension- stiffening [MPa]
1	0	1.500	-14.17	-2.00	0.00	0.00	
3	0	1.150	-478.26	-50.00	478.26	50.00	

Shear Design

Design for shear Eurocode EC2 (2004) / GR
Minimum shear factor or tan of inclination of compressive struts 0.40 / 2.50

MNo	f-cd [MPa]	tau-rd [MPa]	sigIIQ [MPa]	sigIIT [MPa]	sigIIQ+ [MPa]	fyd [MPa]
1	14.17	0.12	7.65	7.65	7.65	
3						434.78

Tolerance for exceeding maximum shear or principal compression stress 0.0200

Longitudinal Reinforcements LCR 1
Note: Layer includes reinforcements for torsion if followed by T
Note: Layer has only compression reinforcements if followed by a quote

Beam	x[m]	NoS	mue [-]	As-Sum [cm2]	shift by [m]	Lay-0&5 [cm2]	Lay-1&6 [cm2]	Lay-2&7 [cm2]	Lay-3&8 [cm2]	Lay-4&9 [cm2]
1	0.000	2	0.16	5.48			4.48	1.00		
1	0.550	2	0.16	5.51			1.00	4.51		
2	0.000	2	0.11	3.96			1.00	2.96		
2	0.550	2	0.17	6.05			1.00	5.05		
3	0.000	2	0.17	6.05			1.00	5.05		
3	0.550	2	0.11	3.96			1.00	2.96		
4	0.000	2	0.16	5.51			1.00	4.51		
4	0.550	2	0.16	5.48			4.48	1.00		
5	0.000	3	0.27	9.50			6.00	3.50		
5	0.300	3	0.27	9.50			6.00	3.50'		
6	0.000	3	0.27	9.50			6.00	3.50'		
6	0.300	3	0.27	9.50			6.00	3.50'		
7	0.000	3	0.27	9.50			6.00	3.50'		
7	0.300	3	0.20	7.00			6.00	1.00'		
8	0.000	3	0.20	7.00			6.00	1.00'		
8	0.300	3	0.20	7.00			6.00	1.00		
9	0.000	3	0.20	7.00			6.00	1.00		
9	0.300	3	0.20	7.00			6.00	1.00'		
10	0.000	3	0.20	7.00			6.00	1.00'		
10	0.300	3	0.27	9.50			6.00	3.50'		
11	0.000	3	0.27	9.50			6.00	3.50'		
11	0.300	3	0.27	9.50			6.00	3.50'		

BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
DESIGN ANALYSIS - STATICAL COMBINATIONS

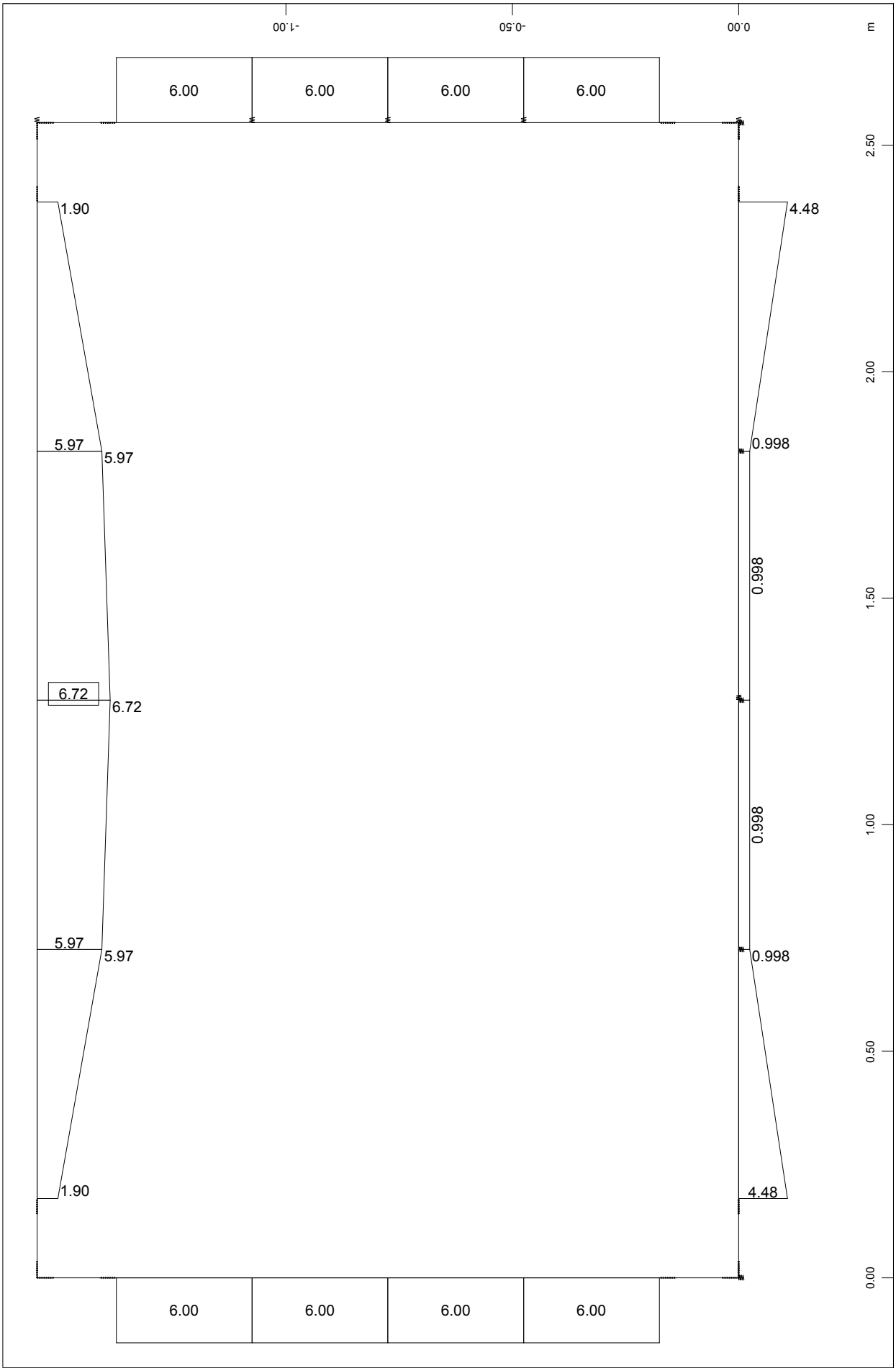
Longitudinal Reinforcements LCR 1
Note: Layer includes reinforcements for torsion if followed by T
Note: Layer has only compression reinforcements if followed by a quote

Beam	x[m]	NoS	mue [-]	As-Sum [cm2]	shift by [m]	Lay-0&5 [cm2]	Lay-1&6 [cm2]	Lay-2&7 [cm2]	Lay-3&8 [cm2]	Lay-4&9 [cm2]
12	0.000	3	0.27	9.50			6.00	3.50'		
12	0.300	3	0.27	9.50			6.00	3.50		
13	0.000	1	0.19	6.74			1.90	4.83		
13	0.550	1	0.20	6.96			5.97	1.00		
14	0.000	1	0.20	6.96			5.97	1.00		
14	0.550	1	0.22	7.72			6.72	1.00		
15	0.000	1	0.22	7.72			6.72	1.00		
15	0.550	1	0.20	6.96			5.97	1.00		
16	0.000	1	0.20	6.96			5.97	1.00		
16	0.550	1	0.19	6.73			1.90	4.82		

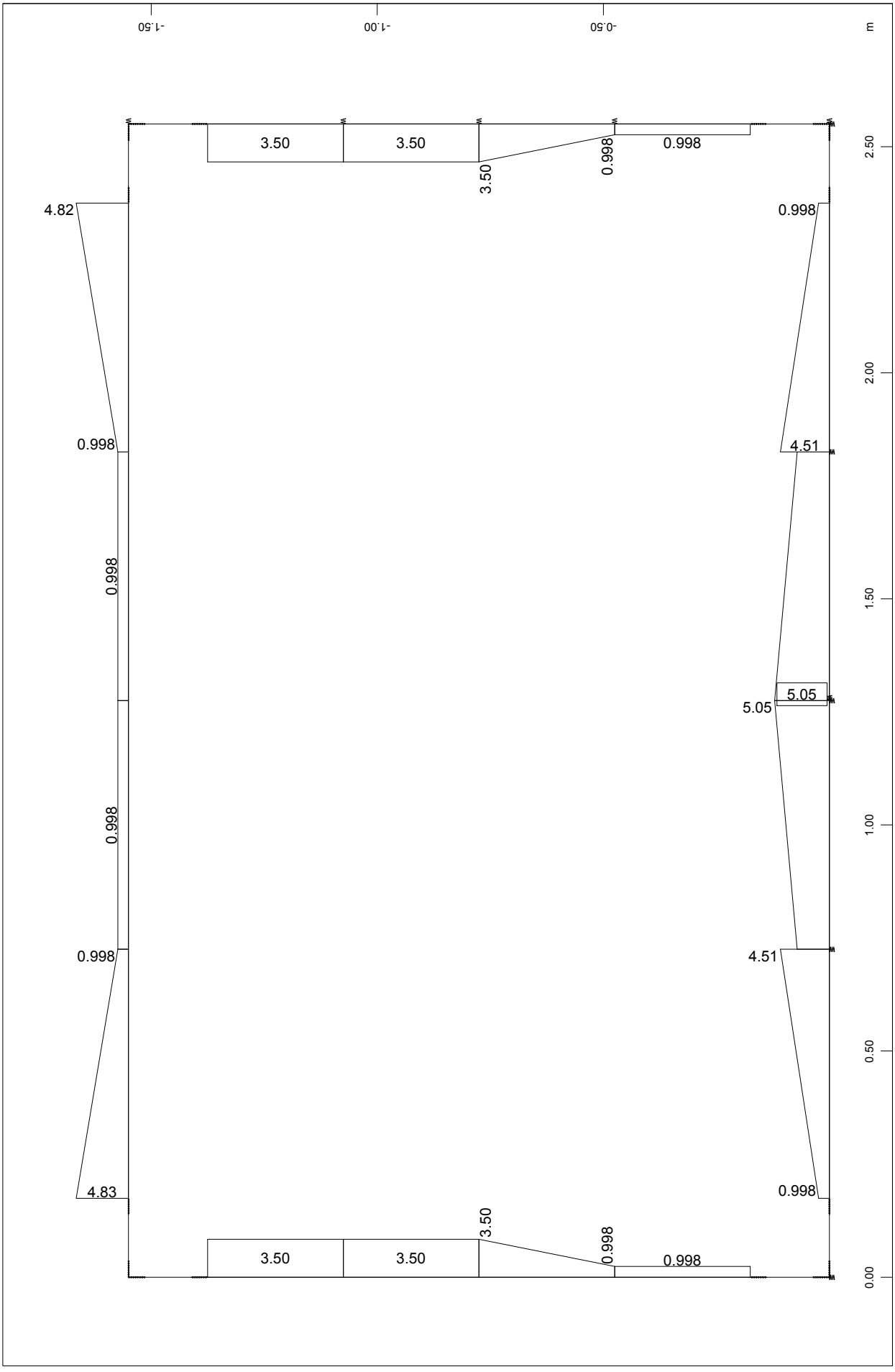
Shear Reinforcements per Cutted Part of Section LCR 1

Beam	x[m]	NoS	Asl-Mt [cm2/m]	SLay-0&5 [cm2/m]	SLay-1&6 [cm2/m]	SLay-2&7 [cm2/m]	SLay-3&8 [cm2/m]	SLay-4&9 [cm2/m]
1	0.000	2	0.00		5.43			
1	0.550	2	0.00		5.68			
4	0.000	2	0.00		5.67			
4	0.550	2	0.00		5.42			
13	0.000	1	0.00		6.99			
16	0.550	1	0.00		6.99			

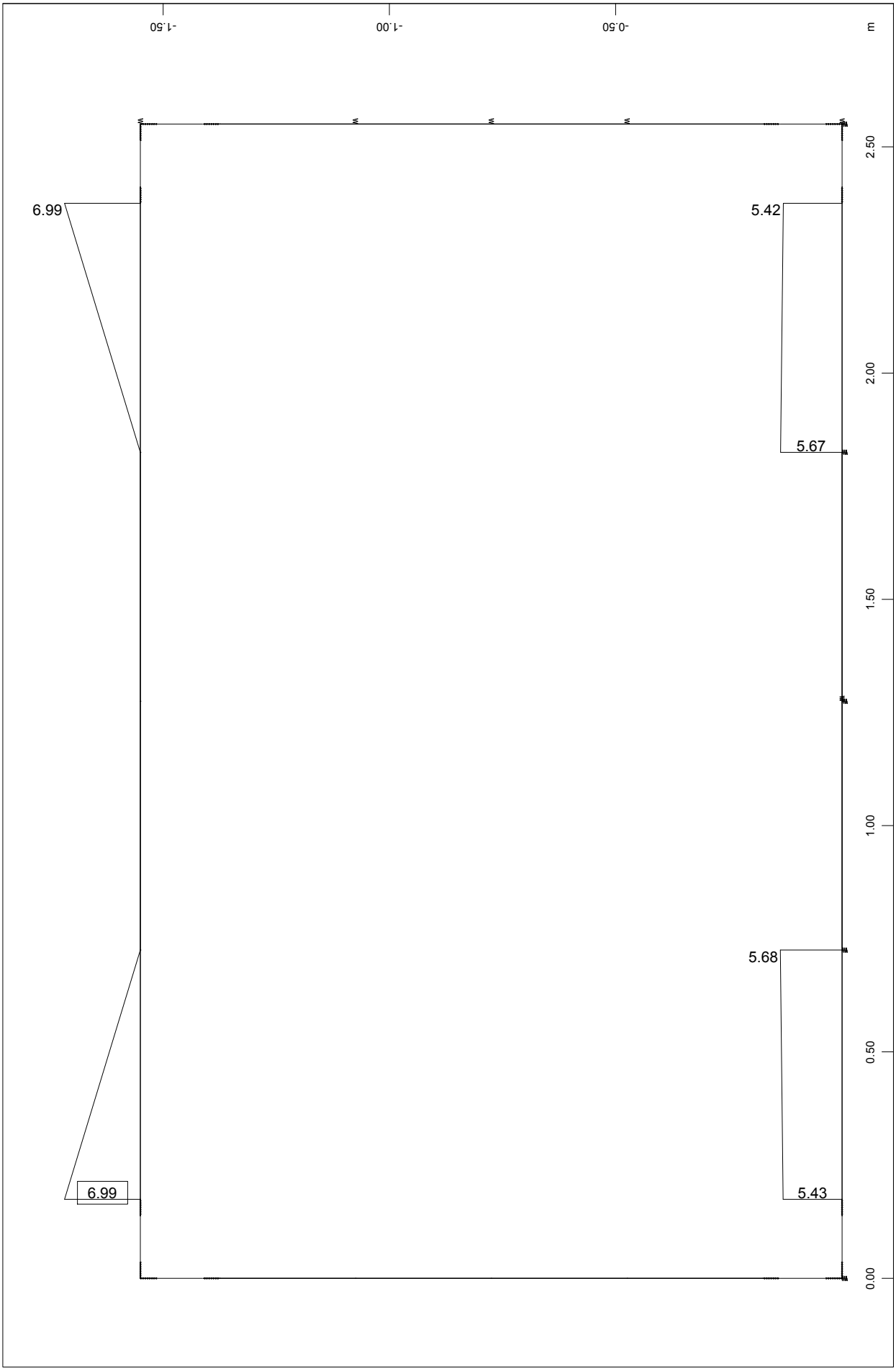
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
DESIGN ANALYSIS - STATICAL COMBINATIONS



BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
DESIGN ANALYSIS - STATICAL COMBINATIONS



BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
DESIGN ANALYSIS - STATICAL COMBINATIONS



BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
CRACK CONTROL

Selected Beam Elements

FROM	TO	INC	X-VALUE	NC	MEMBER	CS0	CS1	CS2	CS3	CS4	CS5
		all elements									

Default design code is EuroNorm EN 1992 Concrete with country code 30 (Hellas/Greece)
Class(Tab.7.1N): N (Reinforced members and prestressed members with unbonded tendons)
Snow load zone : 1

Materials
No. 1 C 25/30 (EN 1992)
No. 3 S 500 (EN 1992)

All moments will be smoothed out between face and support
Reinforcement will be accounted for sectional values as defined in AQUA
Reinforcements saved as design case LCR 1
Reinforcements are superposed with existing minimum reinforcements

Considered Load Cases

601	602	603	604	605	606
621	622	623	624	625	626

Parameters for nonlinear stress / Crackwidth EC2 / 30

MNo	design width		bond	load	h-max
	[mm]	[mm]	[-]	[-]	[m]
3	0.300	0.300	0.80	0.50	0.800

Check for crack width passed with additional reinforcements

Stiffness is not saved in database

Longitudinal Reinforcements LCR 1
Note: Layer includes reinforcements for torsion if followed by T
Note: Layer has only compression reinforcements if followed by a quote

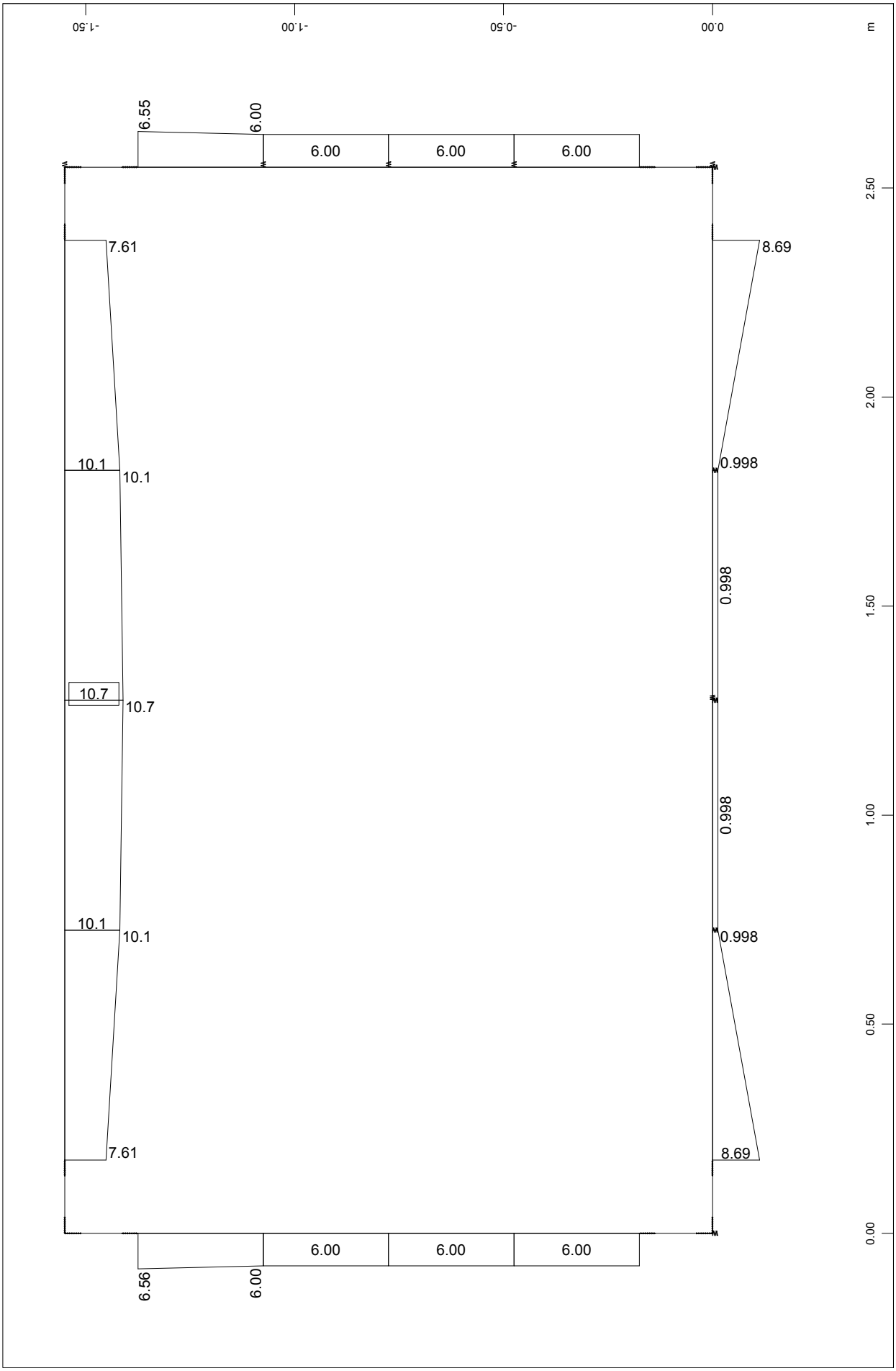
Beam	x[m]	NoS	mue	As-Sum	shift by	Lay-0&5	Lay-1&6	Lay-2&7	Lay-3&8	Lay-4&9
			[-]	[cm2]	[m]	[cm2]	[cm2]	[cm2]	[cm2]	[cm2]
1	0.000	2	0.28	9.69			8.69	1.00		
1	0.550	2	0.28	9.69			1.00	8.70		
2	0.000	2	0.23	7.94			1.00	6.94		
2	0.550	2	0.30	10.35			1.00	9.35		
3	0.000	2	0.30	10.35			1.00	9.35		
3	0.550	2	0.23	7.94			1.00	6.94		
4	0.000	2	0.28	9.69			1.00	8.70		
4	0.550	2	0.28	9.69			8.69	1.00		
5	0.000	3	0.29	10.06			6.56	3.50		
5	0.300	3	0.27	9.50			6.00	3.50'		
6	0.000	3	0.27	9.50			6.00	3.50'		
6	0.300	3	0.27	9.50			6.00	3.50'		
7	0.000	3	0.27	9.50			6.00	3.50'		
7	0.300	3	0.20	7.00			6.00	1.00'		
8	0.000	3	0.20	7.00			6.00	1.00'		
8	0.300	3	0.20	7.00			6.00	1.00		
9	0.000	3	0.20	7.00			6.00	1.00		
9	0.300	3	0.20	7.00			6.00	1.00'		
10	0.000	3	0.20	7.00			6.00	1.00'		
10	0.300	3	0.27	9.50			6.00	3.50'		
11	0.000	3	0.27	9.50			6.00	3.50'		
11	0.300	3	0.27	9.50			6.00	3.50'		
12	0.000	3	0.27	9.50			6.00	3.50'		
12	0.300	3	0.29	10.05			6.55	3.50		
13	0.000	1	0.48	16.63			7.61	9.02		
13	0.550	1	0.32	11.13			10.14	1.00		
14	0.000	1	0.32	11.13			10.14	1.00		
14	0.550	1	0.33	11.72			10.72	1.00		
15	0.000	1	0.33	11.72			10.72	1.00		
15	0.550	1	0.32	11.13			10.14	1.00		
16	0.000	1	0.32	11.13			10.14	1.00		
16	0.550	1	0.47	16.62			7.61	9.01		

Reinforcements saved as design case LCR 1
Reinforcements are superposed with existing minimum reinforcements

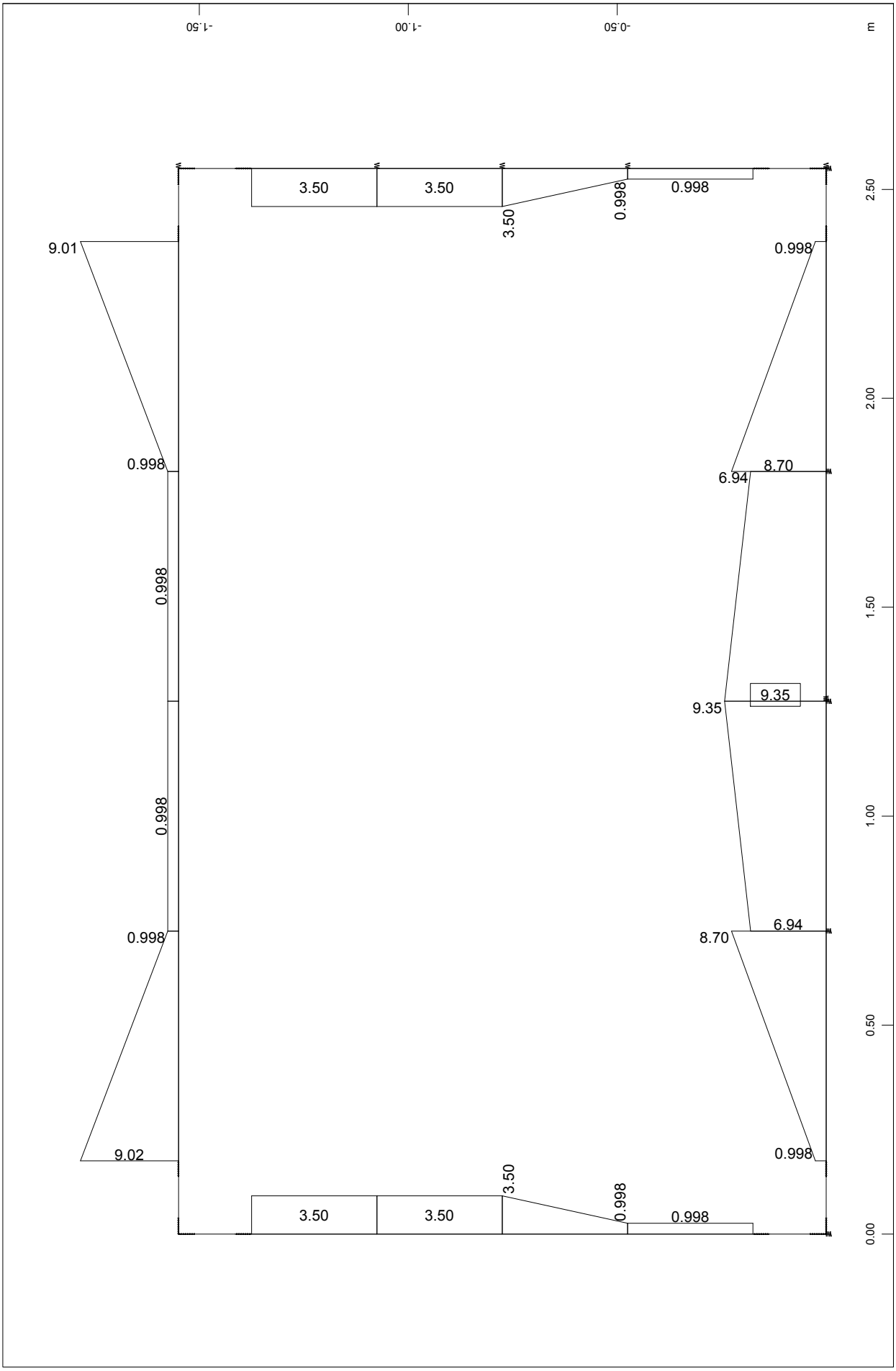
Shear Reinforcements per Cutted Part of Section Accumulated minimum

Beam	x[m]	NoS	Asl-Mt	SLay-0&5	SLay-1&6	SLay-2&7	SLay-3&8	SLay-4&9
			[cm2/m]	[cm2/m]	[cm2/m]	[cm2/m]	[cm2/m]	[cm2/m]
1	0.000	2	0.00		5.43			
1	0.550	2	0.00		5.68			
4	0.000	2	0.00		5.67			
4	0.550	2	0.00		5.42			
13	0.000	1	0.00		6.99			
16	0.550	1	0.00		6.99			

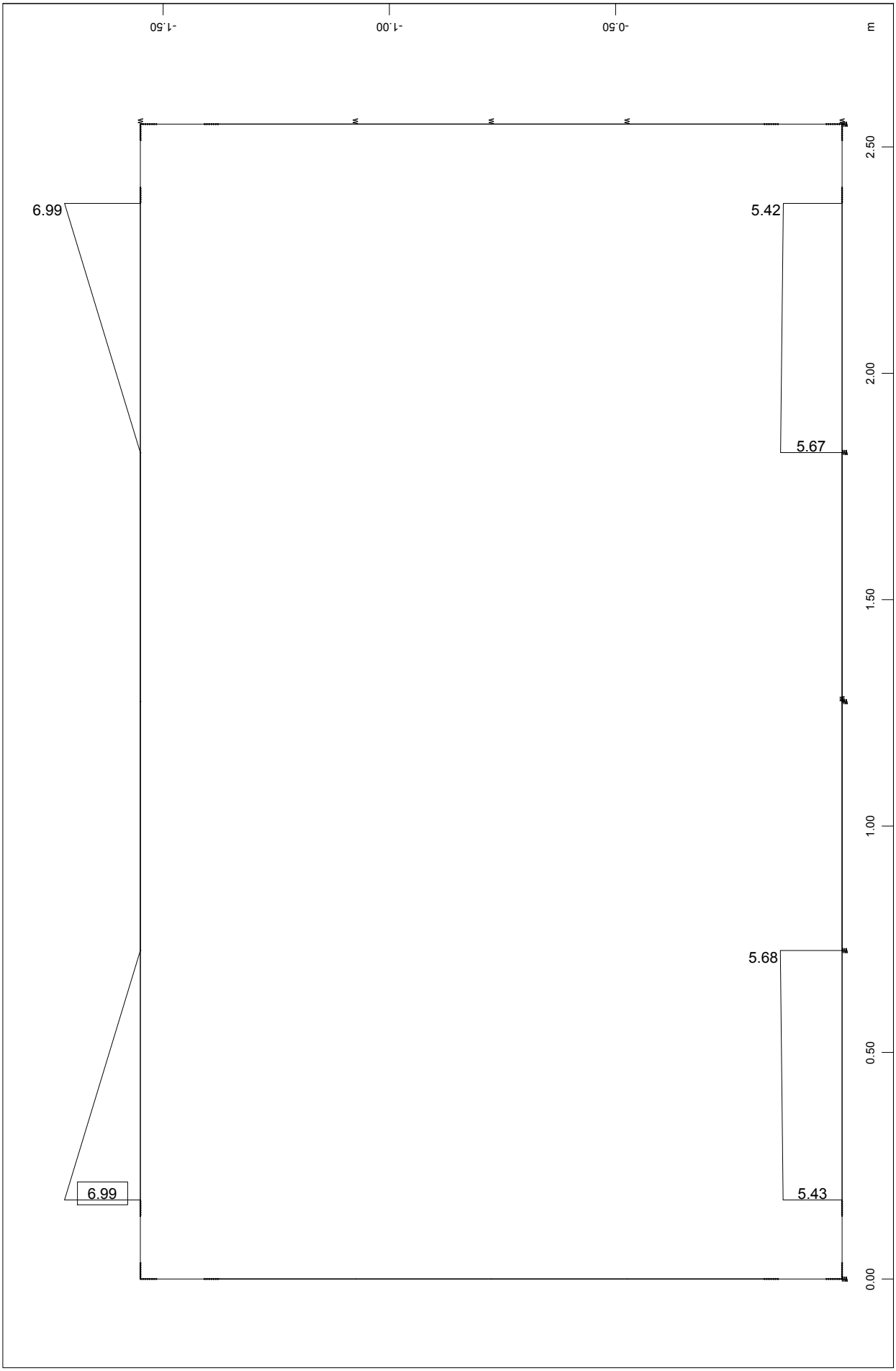
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
CRACK CONTROL



BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
CRACK CONTROL



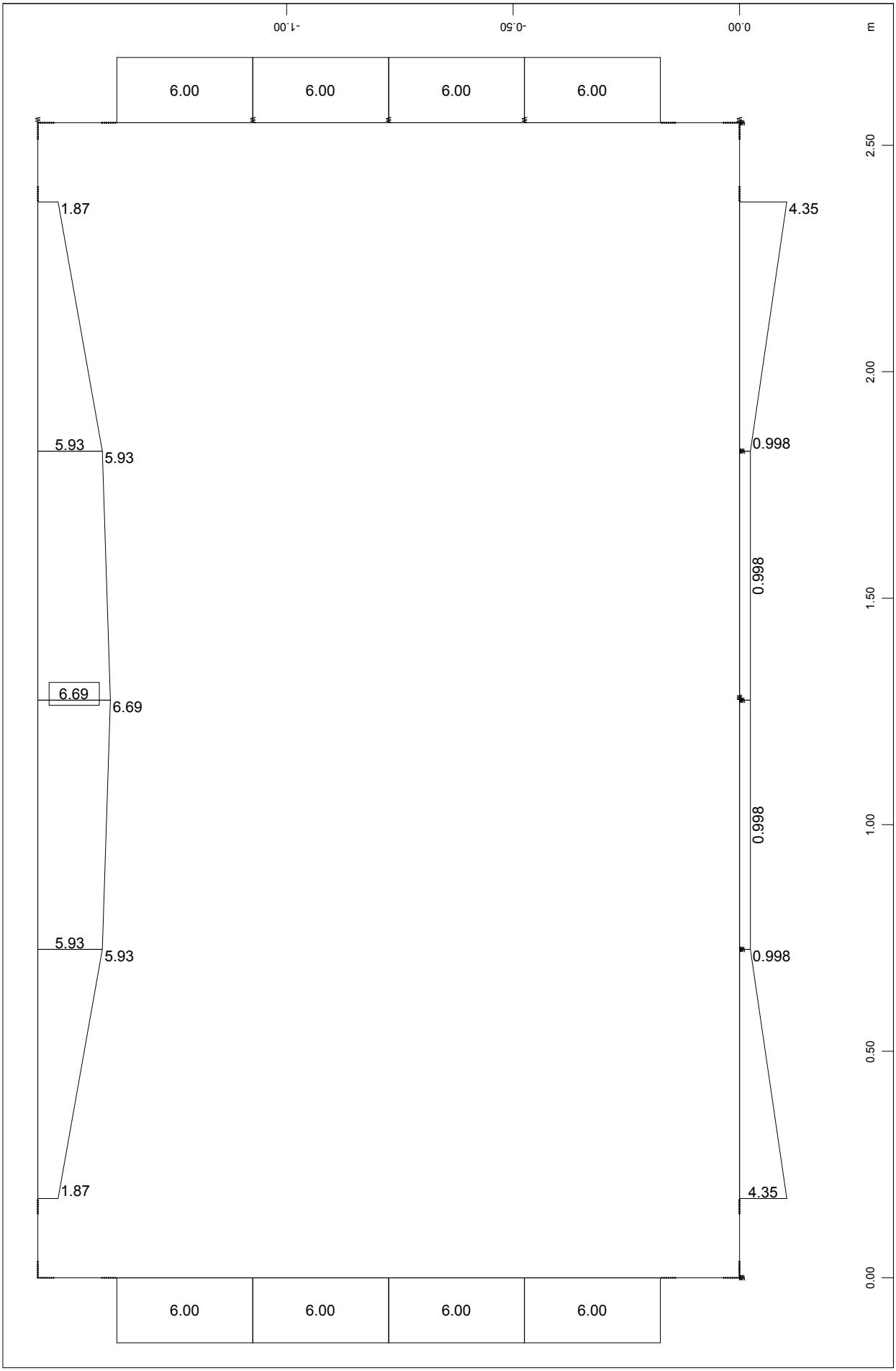
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=1000kN/m3)
CRACK CONTROL



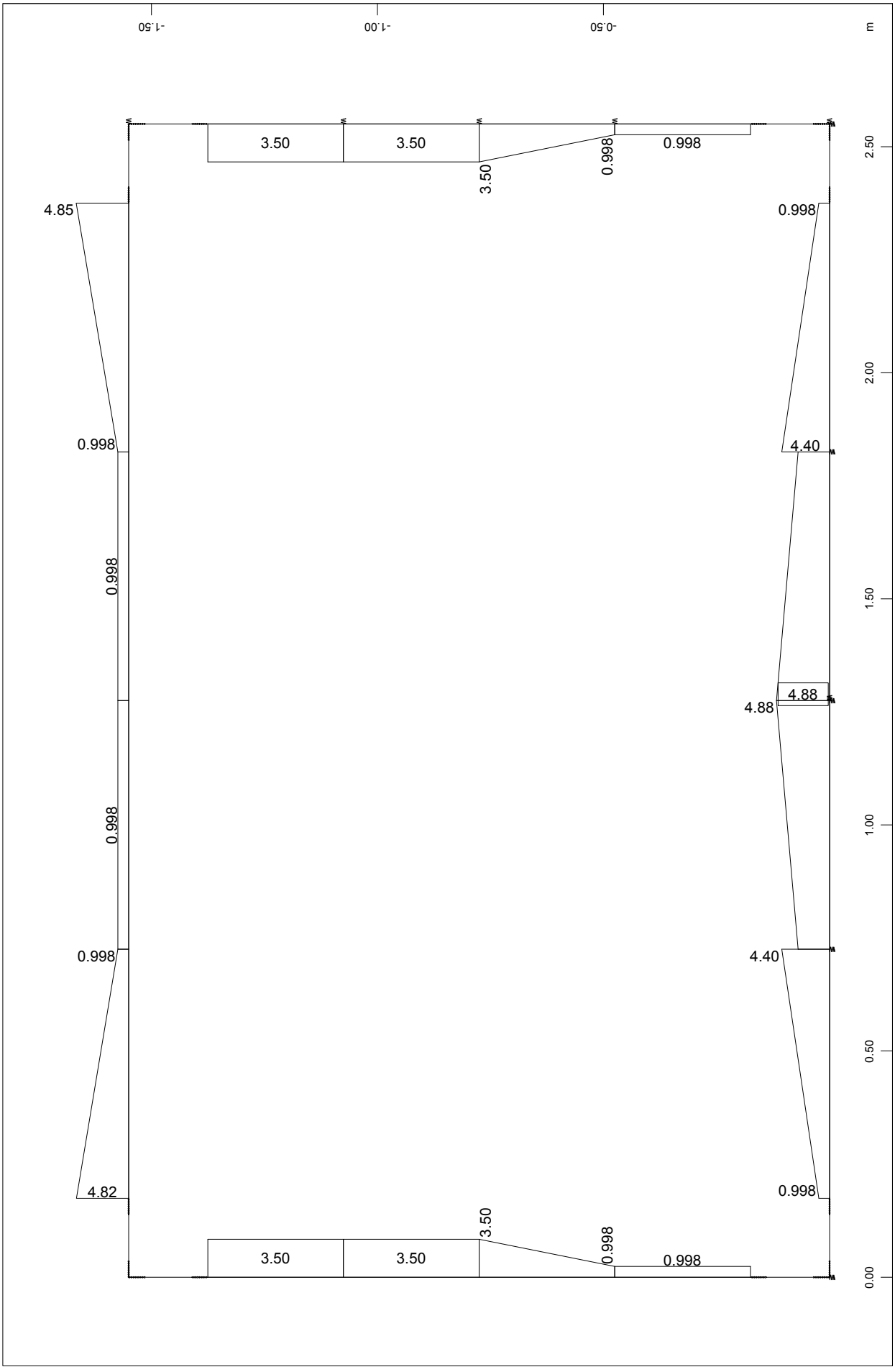
ΓΡΑΦΗΜΑΤΑ ΑΠΟ ΕΠΙΛΥΣΗ ΚΙΒ. ΟΧΕΤΟΥ 2.20x1.20 [Ηεπ=4.50m]

(ks=50000 KN/m^3)

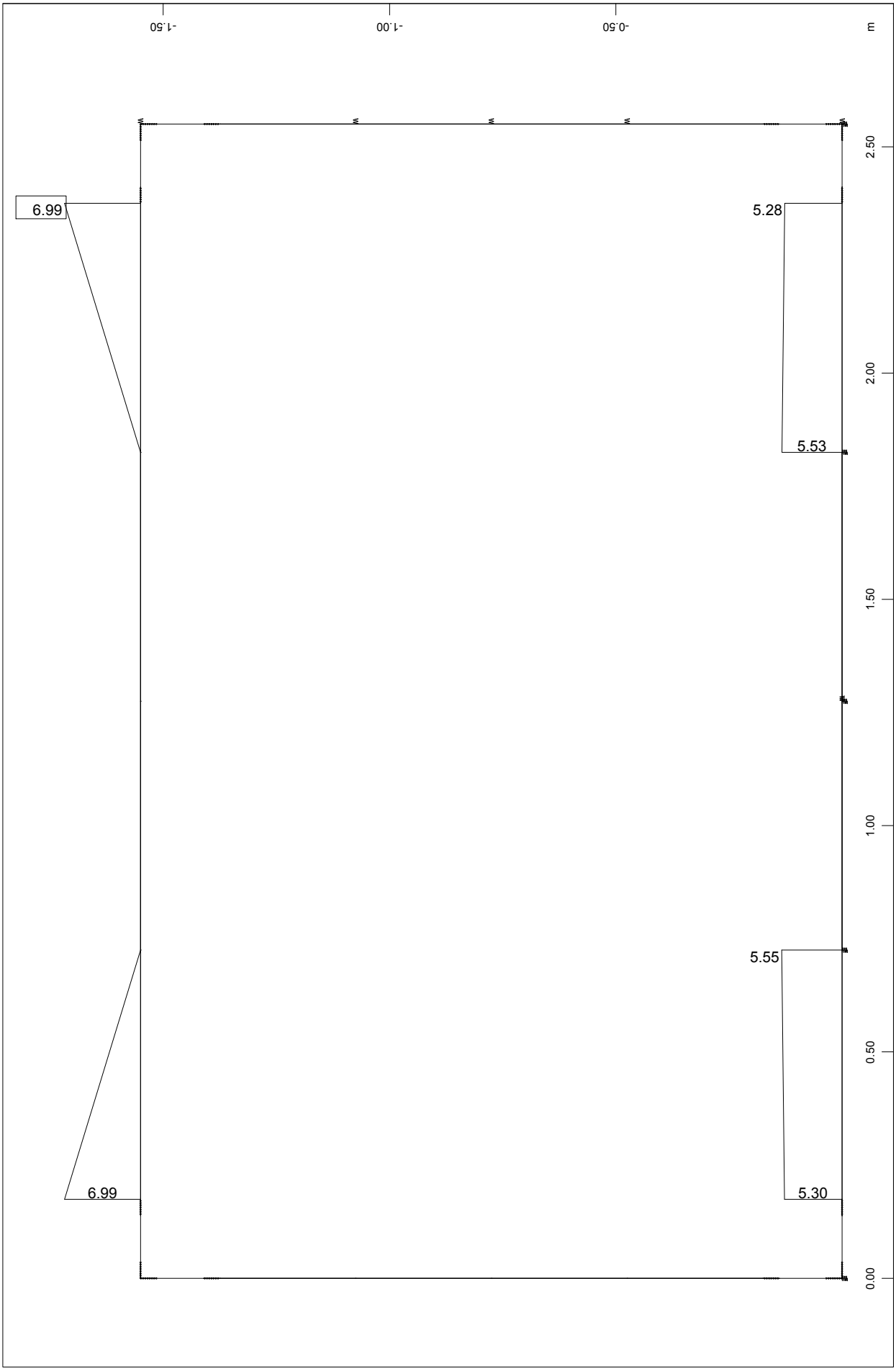
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=50000kN/m3)
DESIGN ANALYSIS - STATICAL COMBINATIONS



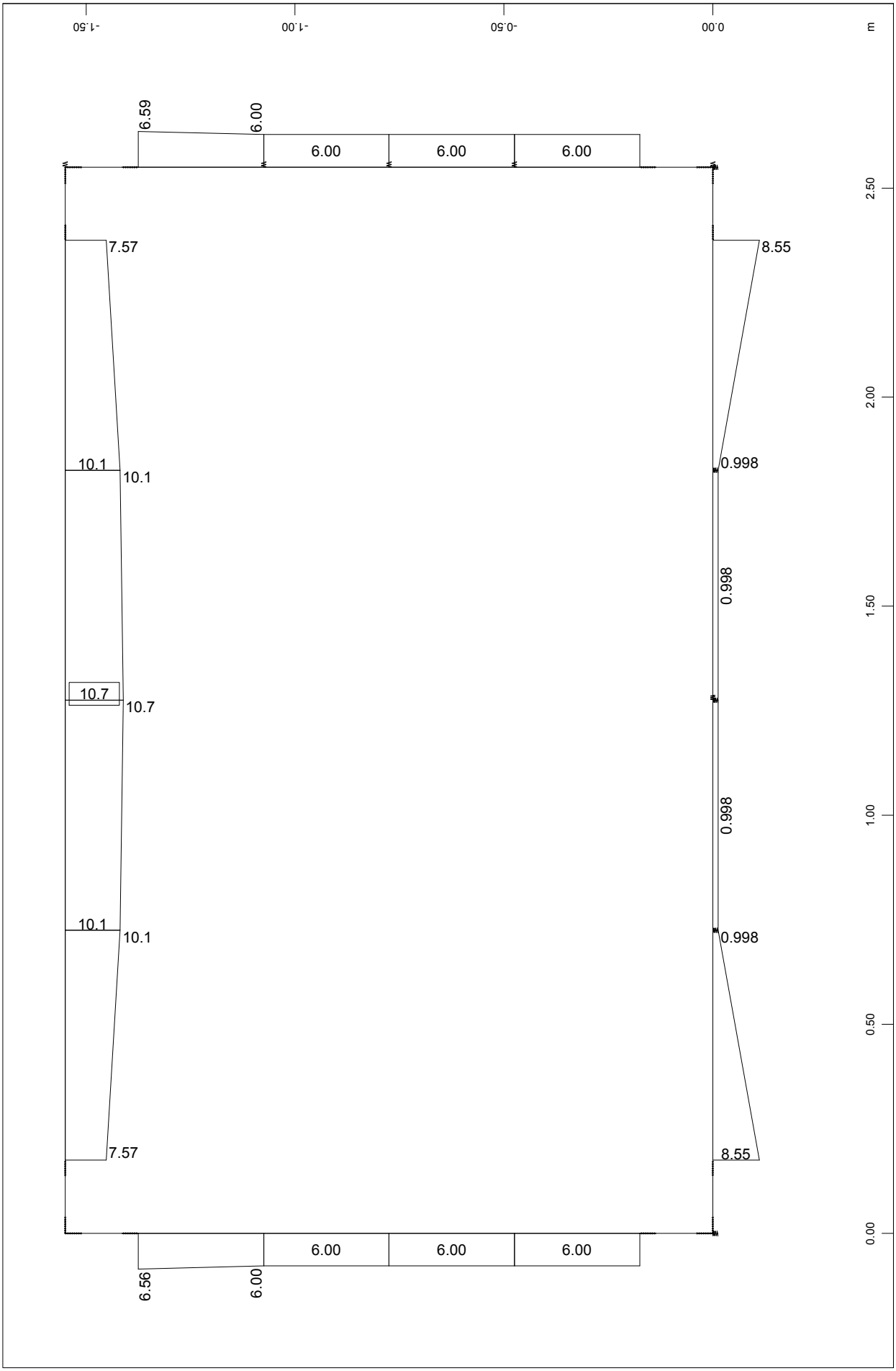
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=50000kN/m3)
DESIGN ANALYSIS - STATICAL COMBINATIONS



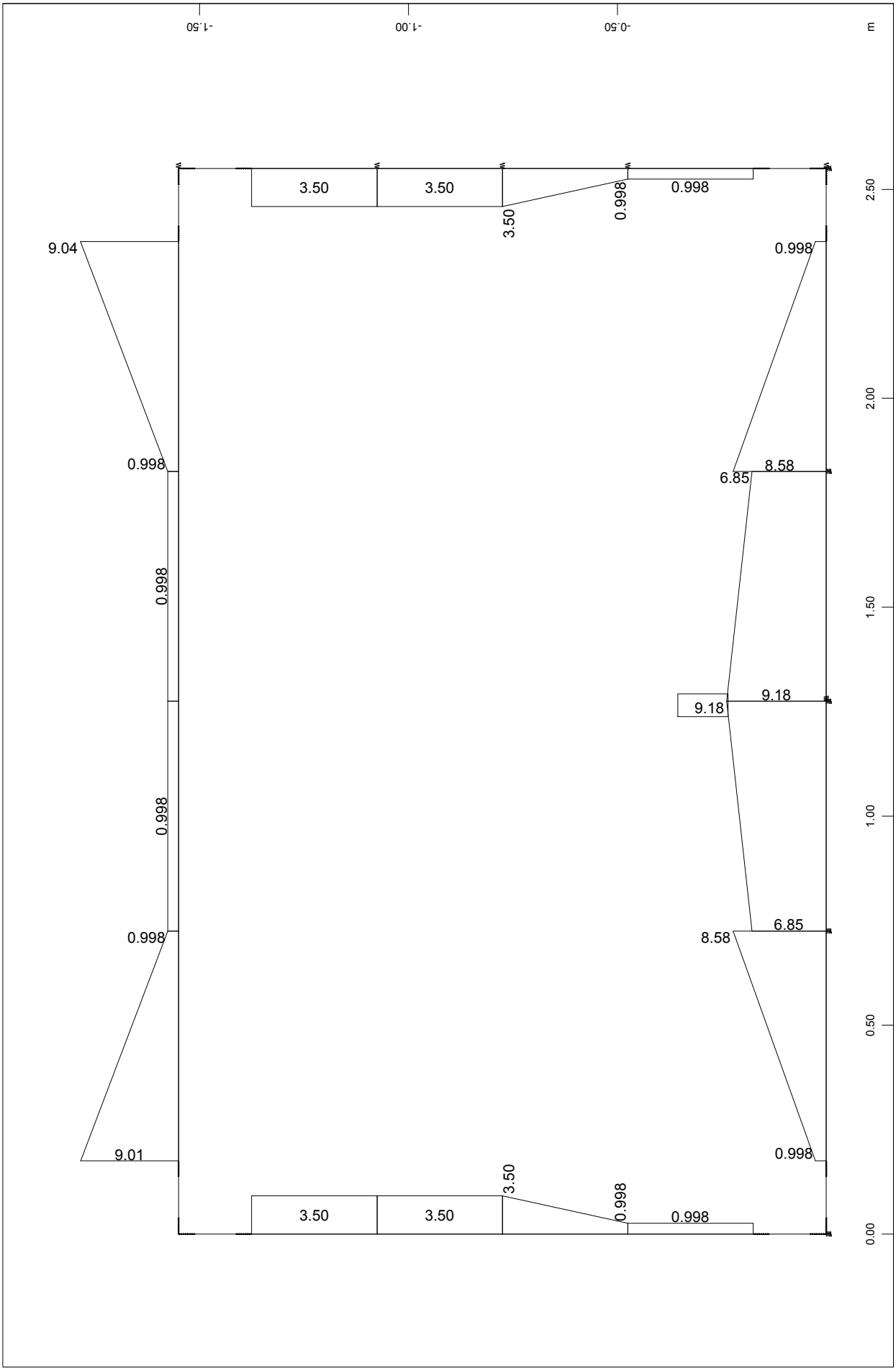
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=50000kN/m3)
DESIGN ANALYSIS - STATICAL COMBINATIONS



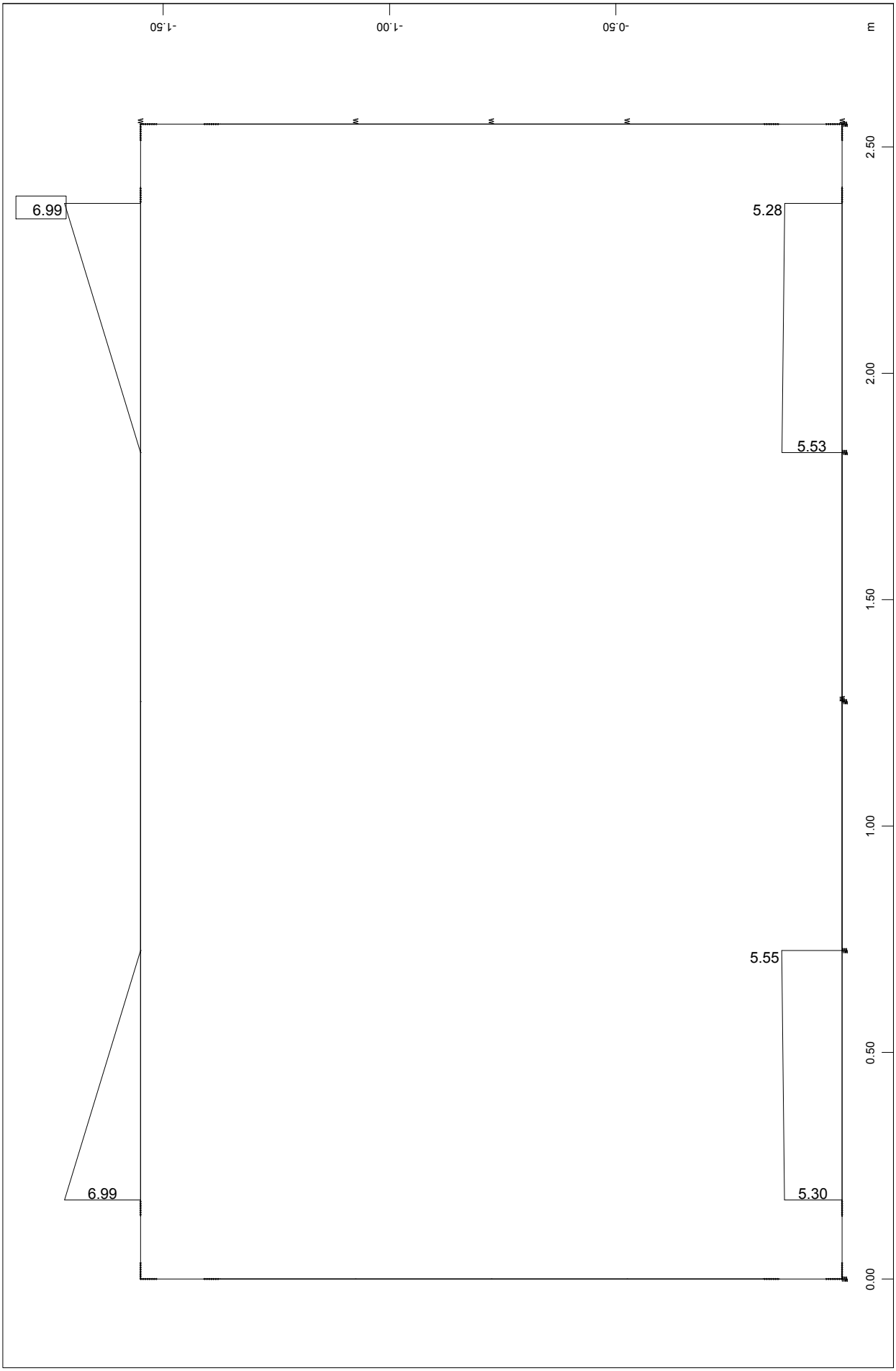
BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=50000kN/m3)
CRACK CONTROL



BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=50000kN/m3)
CRACK CONTROL



BOX CULVERT 2.20X1.20 (Hemb=4.5m, ks=50000kN/m3)
CRACK CONTROL



6. ΕΛΕΓΧΟΙ - ΟΠΛΙΣΜΟΙ

ΟΧΕΤΟΙ 2.20x1.20 - Ηεπ.=4.50m -ks=1000/50000kN/m^3

ΚΑΜΨΗ

Ελάχιστος οπλισμός (κατά DIN 1075, παράγρ. 10.1.1)

Γενικά : 0.06% του Ab

1) Πλάκα πυθμένα d= 0,35 m

Επικάλυψη: 0,055 m h= 0,295 m

Άνω: $fe_{απαιτ.}$= 9,35 cm^2/m (ks=1000KN/m^3)

Τοποθετούνται: Φ14/10 (= 15,40 cm2/m)

Κάτω: $fe_{απαιτ.}$= 8,69 cm^2/m (ks=1000KN/m^3)

Τοποθετούνται: Φ14/13 (= 11,85 cm2/m)

2) Τοιχώματα d= 0,35 m

Επικάλυψη: 0,055 m h= 0,295 m

Εξωτερικά: $fe_{απαιτ.}$= 6,59 cm^2/m (ks=50000KN/m^3)

Τοποθετούνται: Φ14/20 (= 7,70 cm2/m)

Εσωτερικά: $fe_{απαιτ.}$= 3,50 cm^2/m (ks=1000KN/m^3)

Τοποθετούνται: Φ10/20 (= 3,93 cm2/m)

3) Πλάκα επικάλυψης d= 0,35 m

Επικάλυψη: 0,055 m h= 0,295 m

Άνω: $fe_{απαιτ.}$= 9,04 cm^2/m (ks=50000KN/m^3)

Τοποθετούνται: Φ14/13 (= 11,85 cm2/m)

Κάτω: $fe_{απαιτ.}$= 10,70 cm^2/m (ks=1000KN/m^3)

Τοποθετούνται: Φ14/10 (= 15,4 cm2/m)

4) Διαμήκεις οπλισμοί

Τοποθετούνται ανά παρειά: Φ10/20 (= 3,93 cm2/m)

ΔΙΑΤΜΗΣΗ

d= 0,35 m

h= 0,295 m

z=0.85*h= 0,251

k2=0.12/d+0.60= 0,94286 > 0,7

$τ_{011}$= 500 kN/m2

$τ_{02}$= 1800 kN/m2

k_2*$τ_{011}$= 471,429 kN/m2

$Q_{επ}$= 118,21 kN (μέγιστη διατμητική δύναμη χωρίς απαίτηση οπλισμού)

Κάλυψη διαγράμματος με συνδετήρες

Άνω πλάκα:

$fe_{απαιτ.}$= 6,99 cm^2/m^2 (από Sofistik) (ks=1000KN/m^3)

Τοποθετούνται: Φ10/20/80 (= 9,82 cm^2/m^2)

Κάτω πλάκα:

$fe_{απαιτ.}$= 5,68 cm^2/m^2 (από Sofistik) (ks=1000KN/m^3)

Τοποθετούνται: Φ10/20/80 (= 9,82 cm^2/m^2)