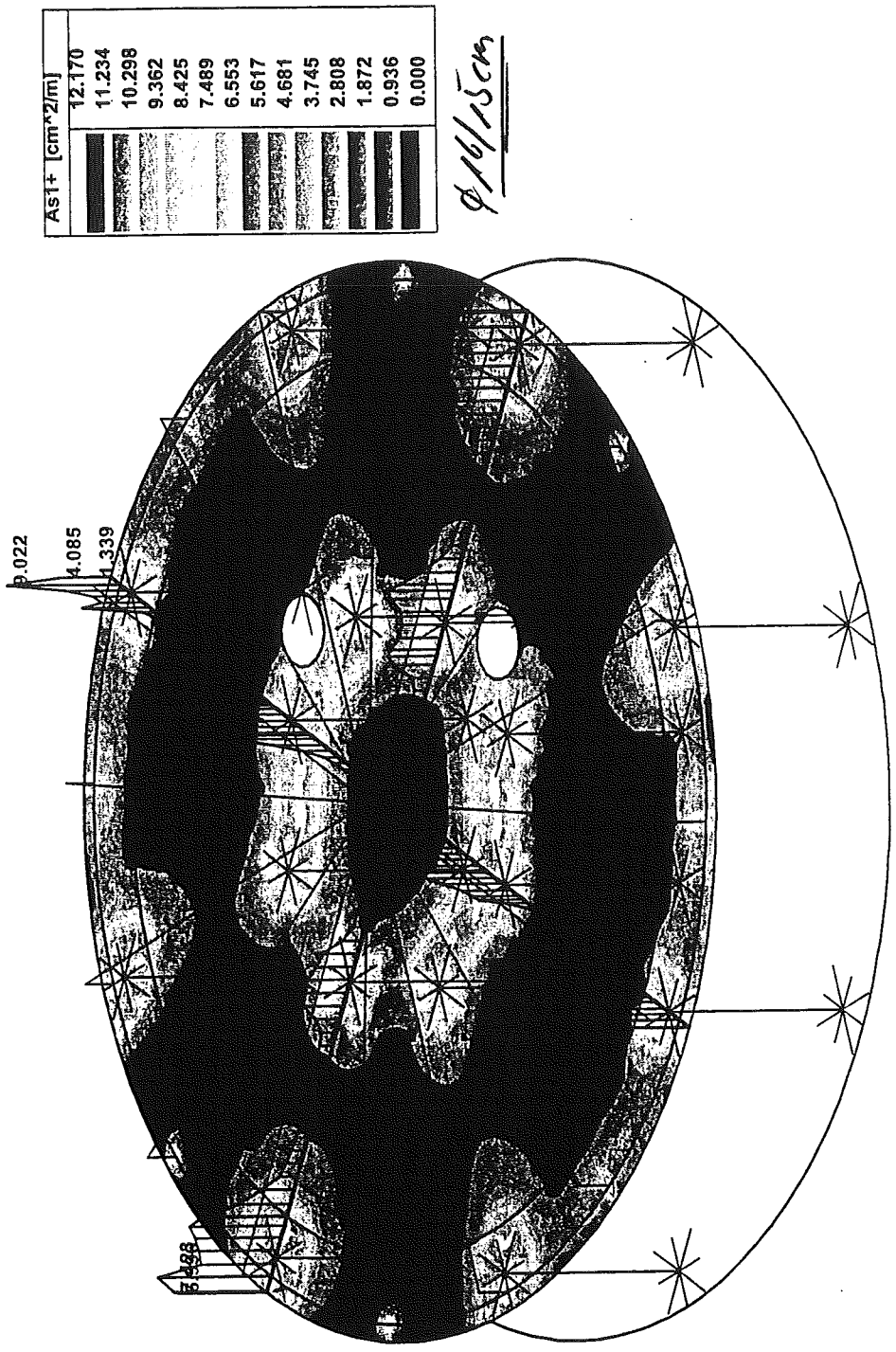
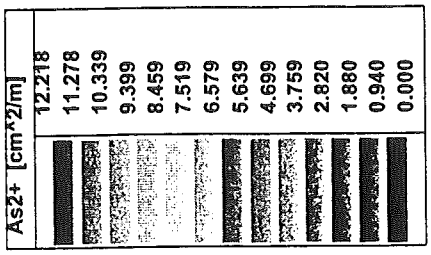
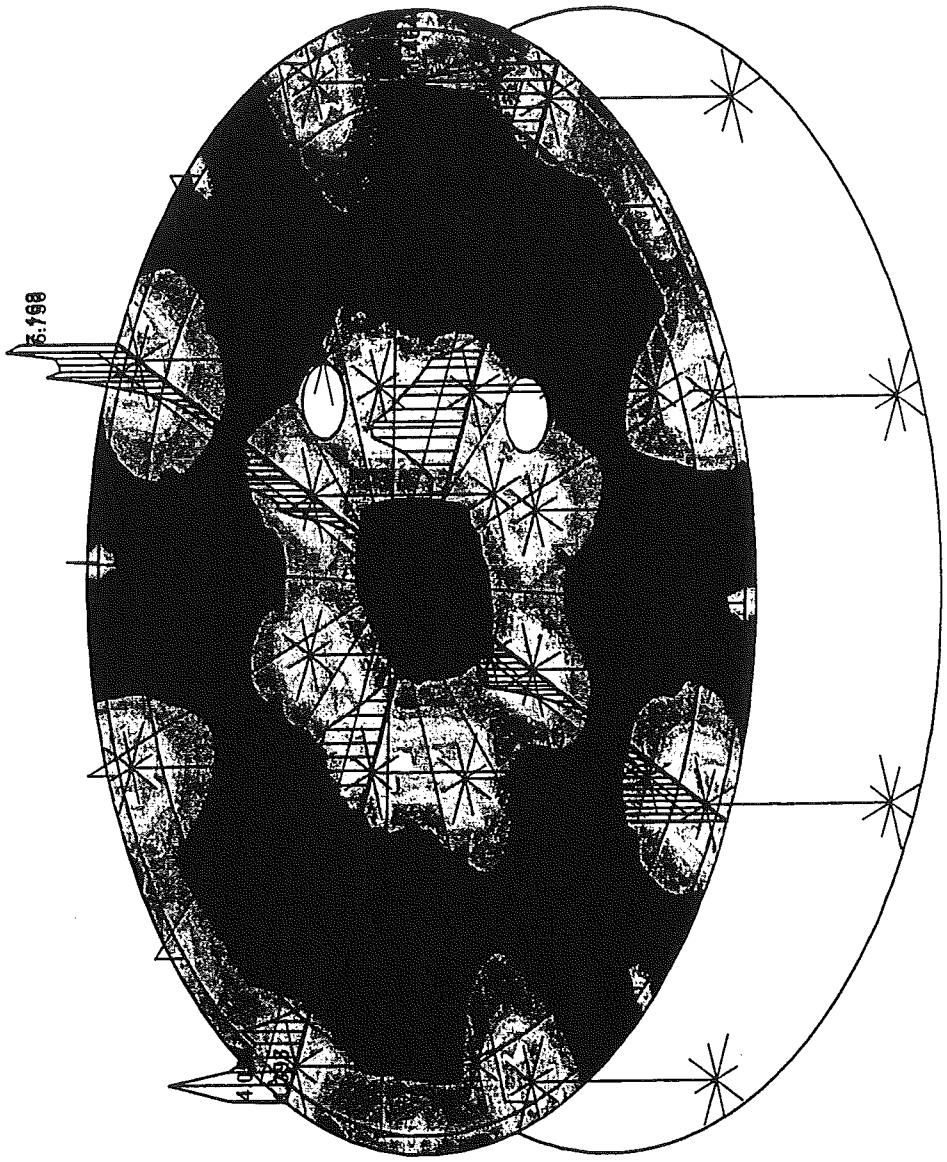
node	As1+ [cm^2/m]	As2+ [cm^2/m]	As3+ [cm^2/m]	As3- [cm^2/m]	As2- [cm^2/m]	As1- [cm^2/m]	Ass [cm^2/m^2]	tau [MPa]	tau0 [MPa]
5536	5.154	4.940	~	~	0.000	0.007	0.000	0.00	0.06
17	7.958c	9.200	~	~	10.324s	15.360	0.000+	0.00	0.08
5588	5.050	4.995s	~	~	0.007	0.000s	0.000+	0.00	0.06
128	7.488	4.523	~	~	1.497v	0.299c	18.979	0.46	0.83
4722	0.036	0.183	~	~	6.791	9.210c	0.000	0.00	0.01
128	7.488	4.523	~	~	1.497v	0.299c	18.979	0.46	0.83
4722	0.036	0.183	~	~	6.791	9.210c	0.000	0.00	0.01
128	7.488	4.523	~	~	1.497v	0.299c	18.979	0.46	0.83
5135	0.869	0.847	~	~	11.665	11.540c	0.000	0.00	0.00

Selection was done for macros: 1/2

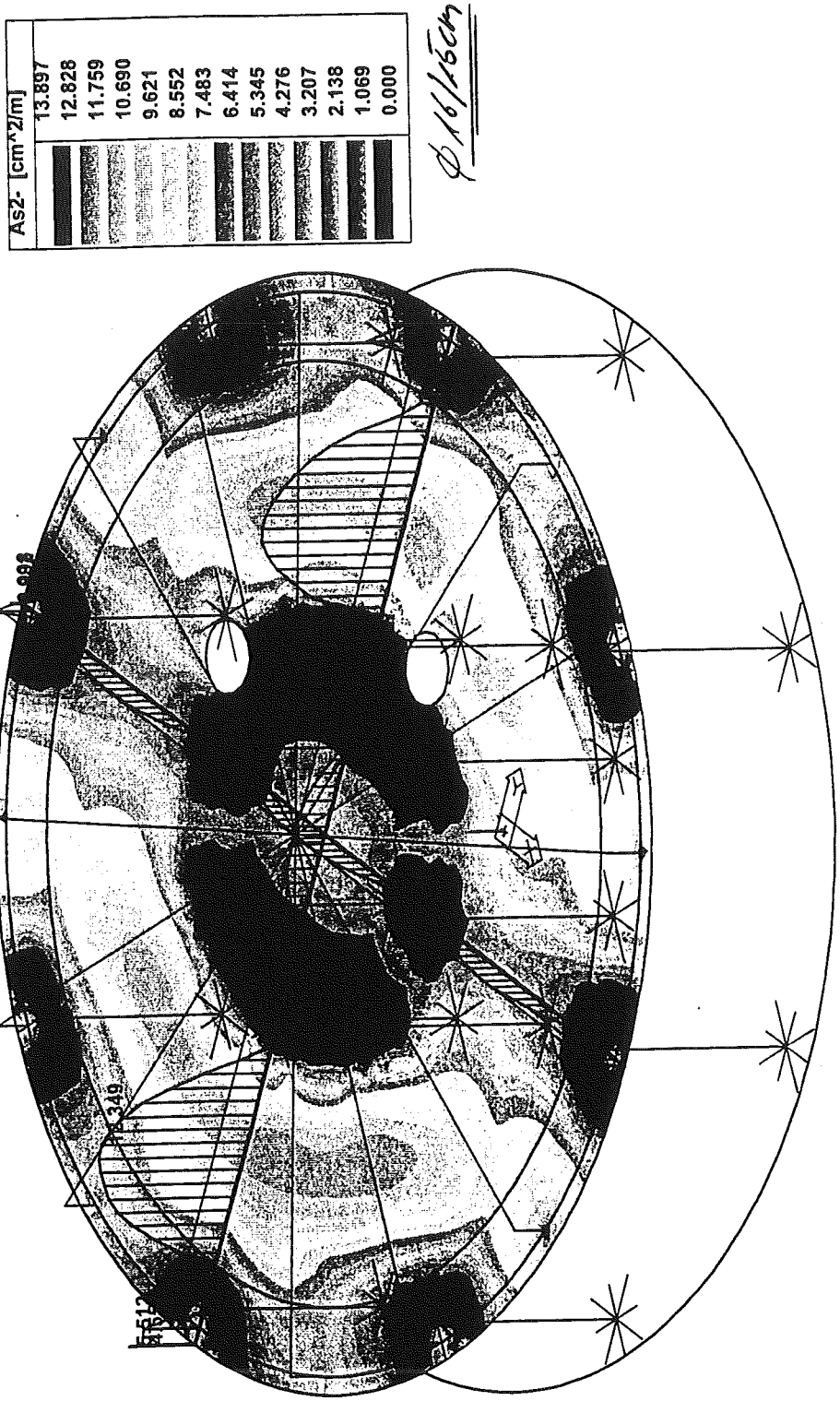


2D reinforcement - As1+

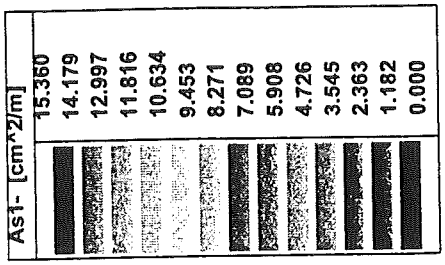




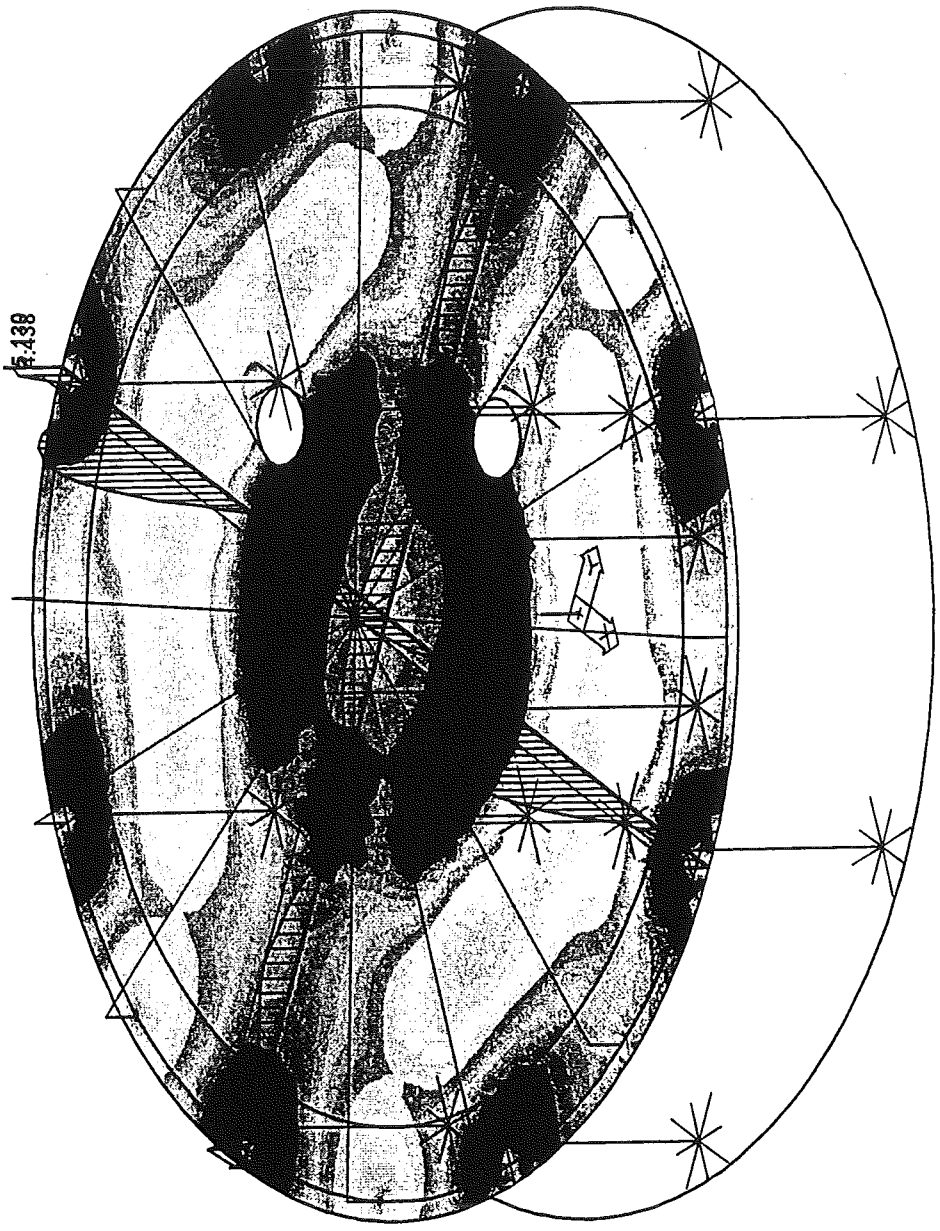
2D reinforcement - As2+



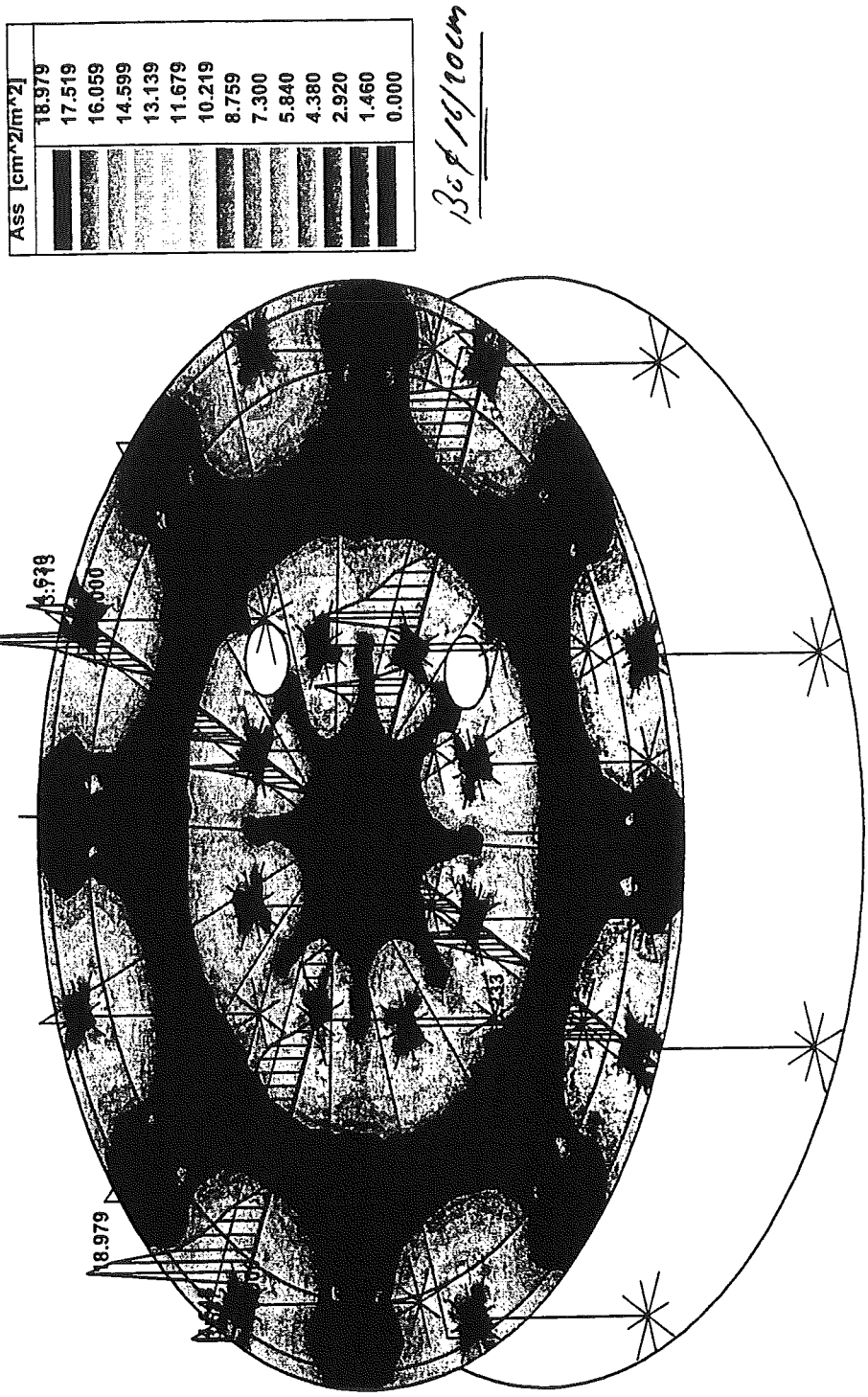
2D reinforcement - As2-



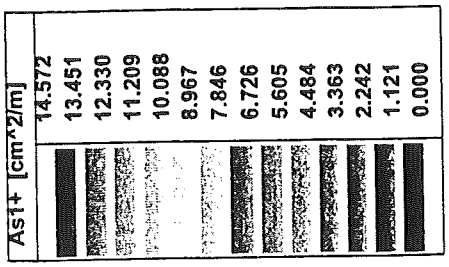
Ø 16/15 cm



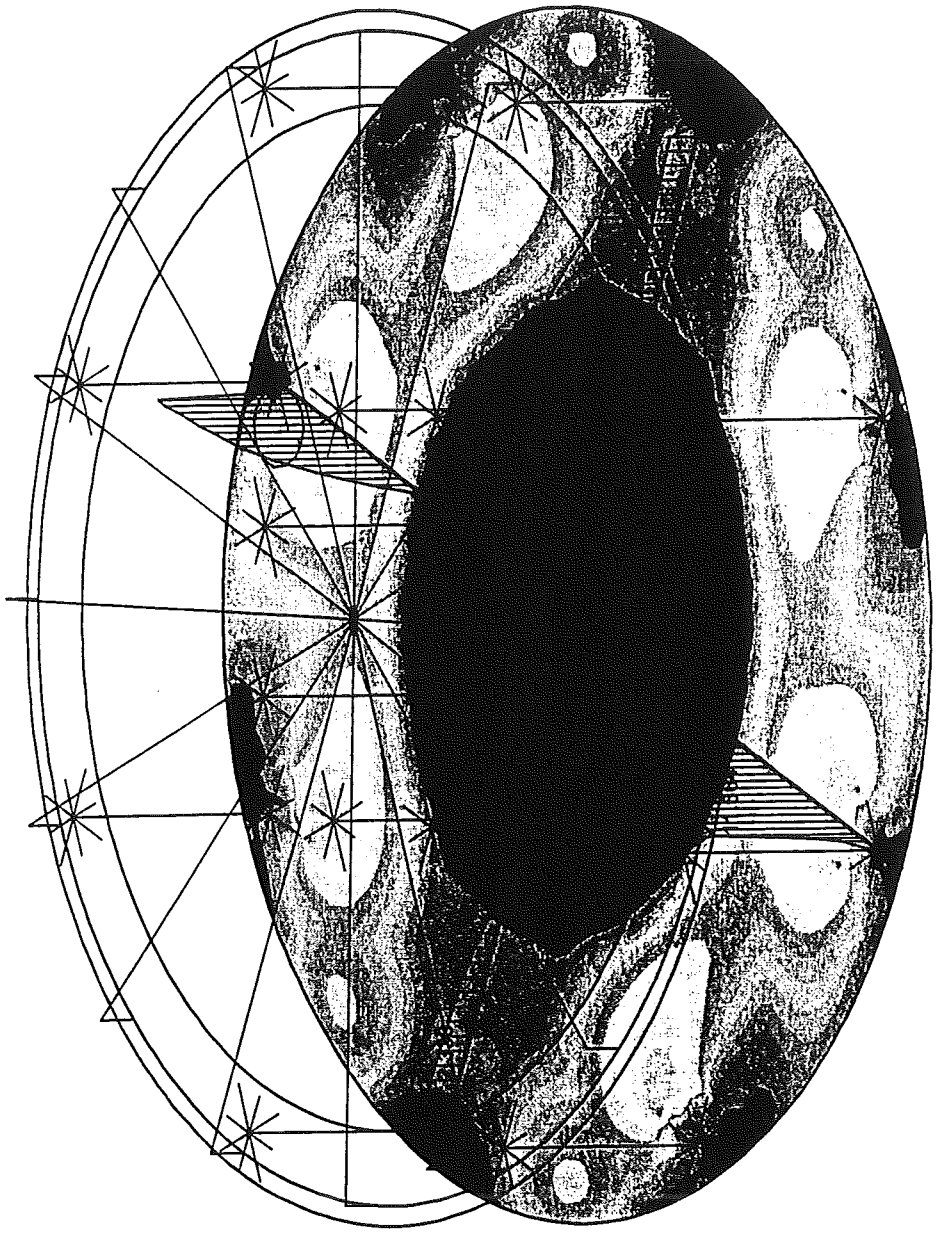
2D reinforcement - As1-



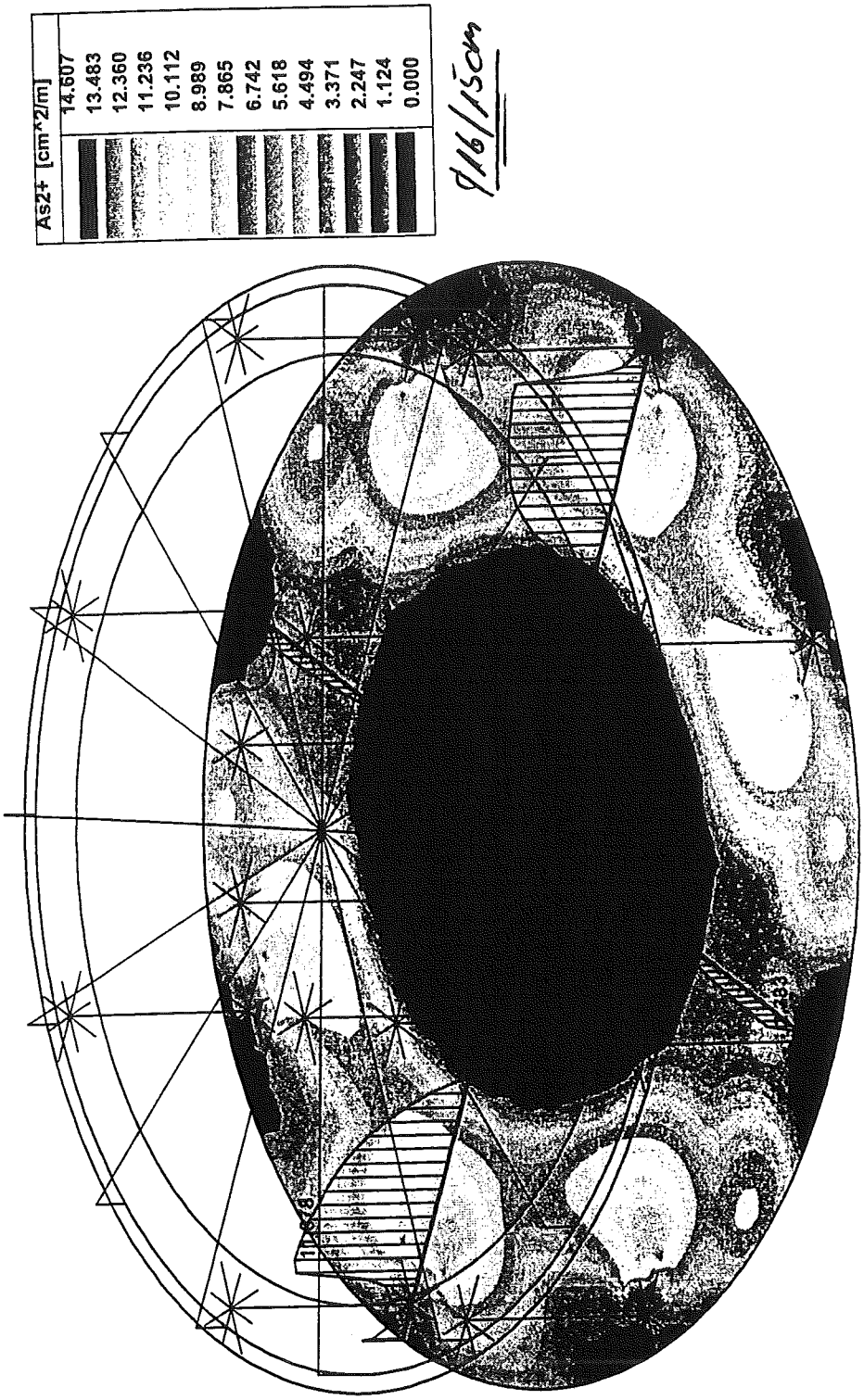
2D reinforcement - Ass



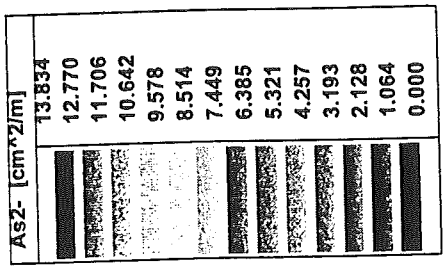
Ø16/13cm



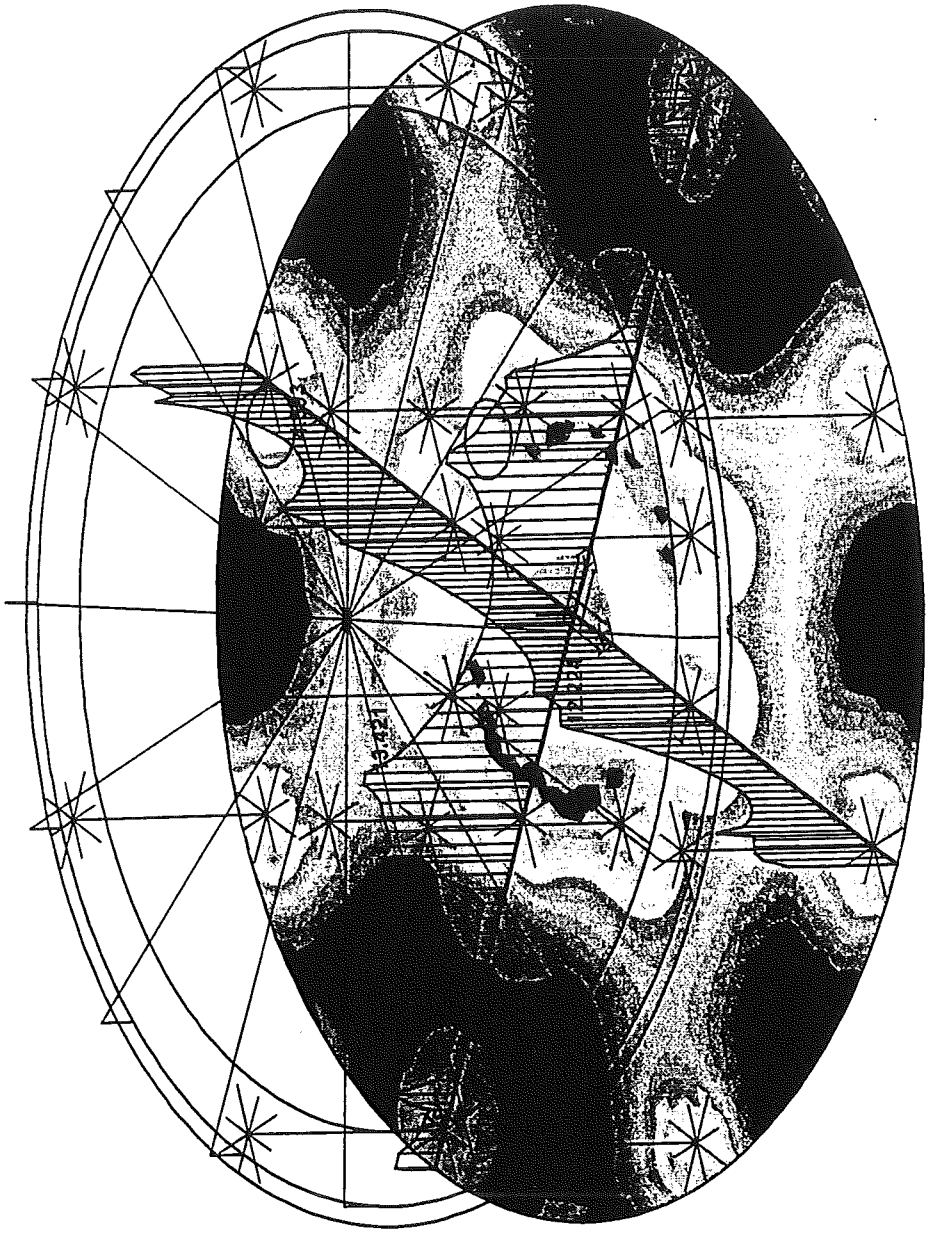
2D reinforcement - As1+



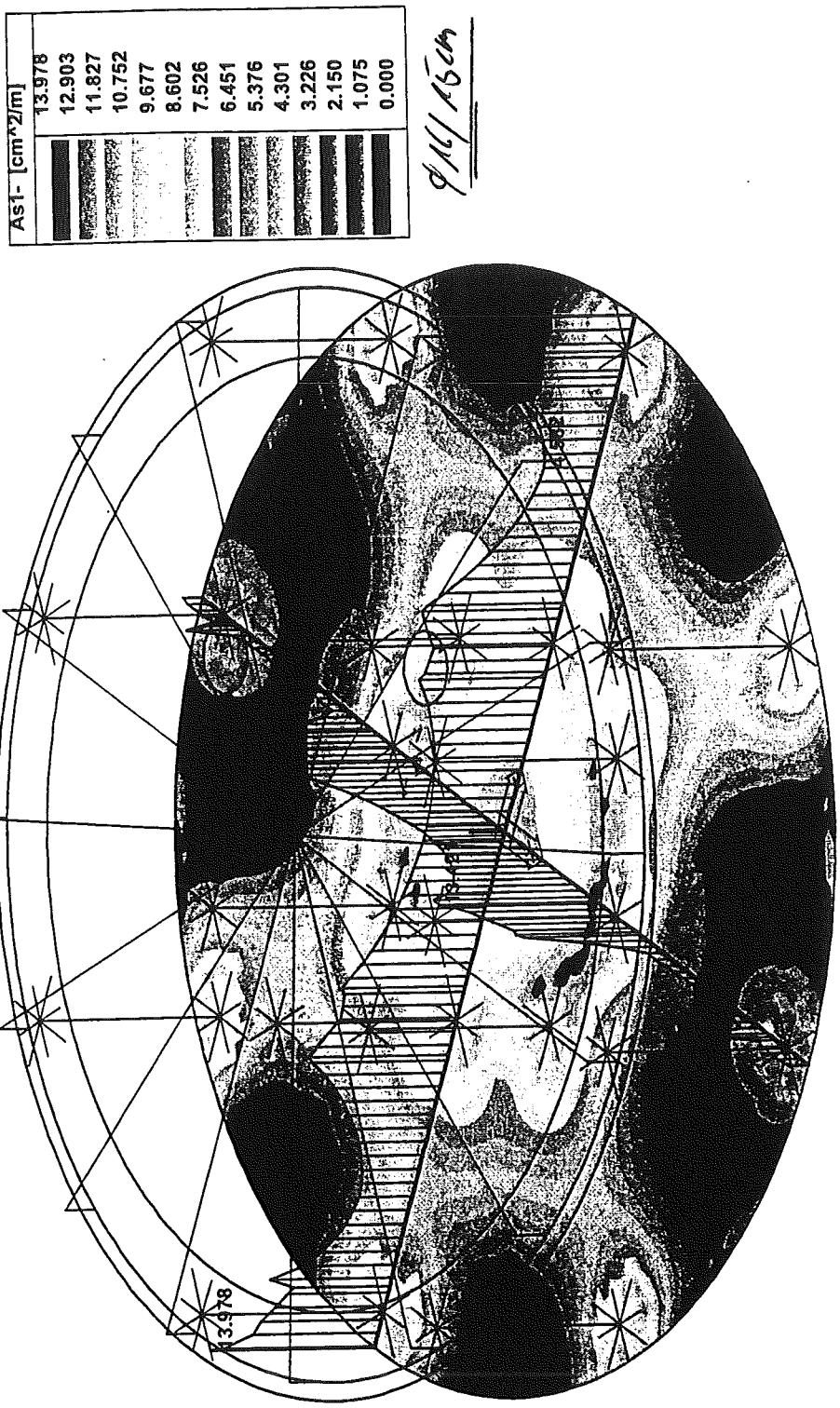
2D reinforcement - As2+



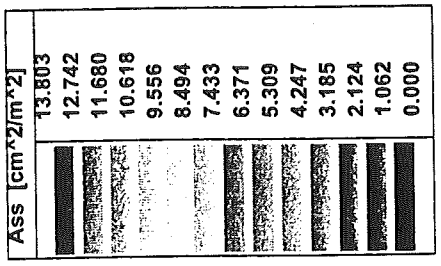
Ø 16/15 cm



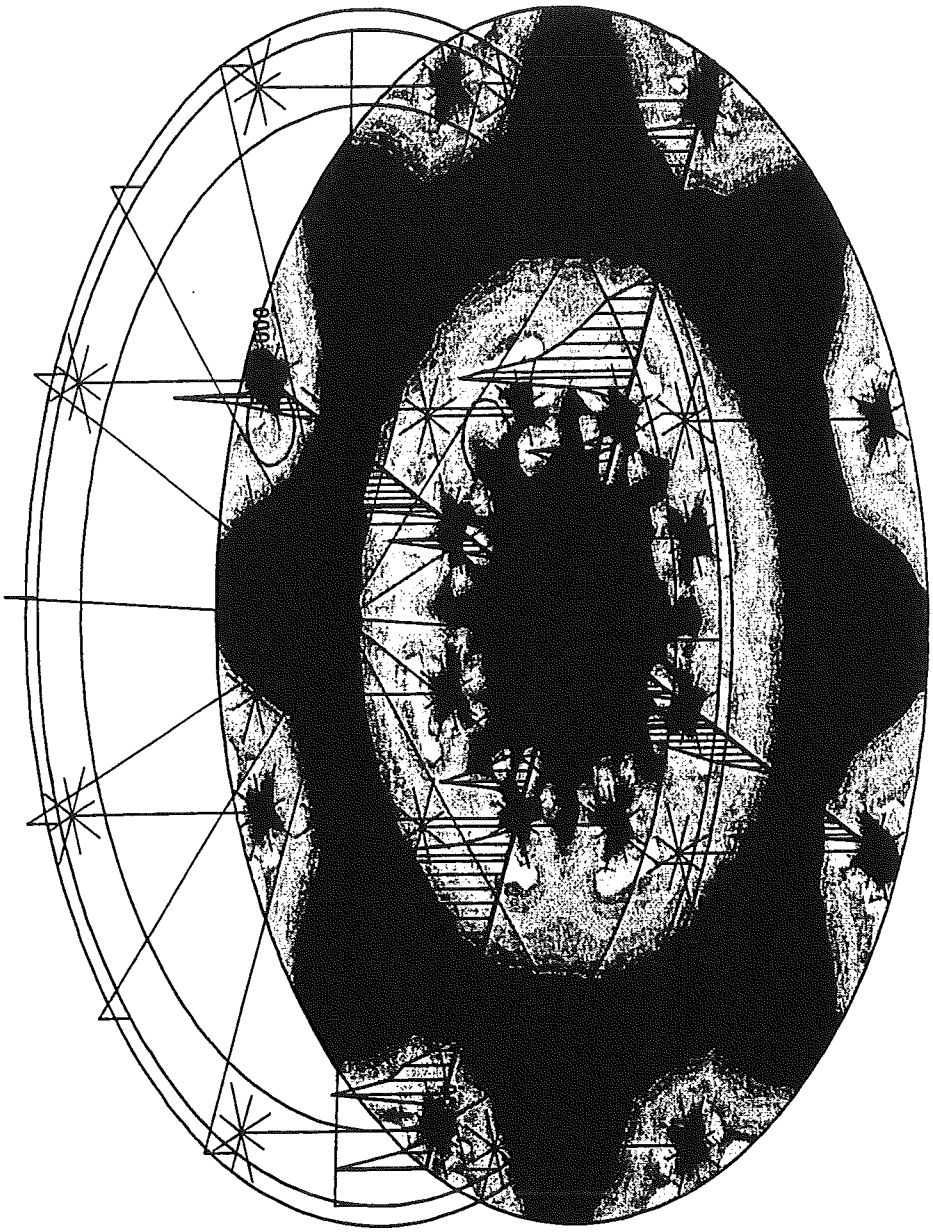
2D reinforcement - As2-



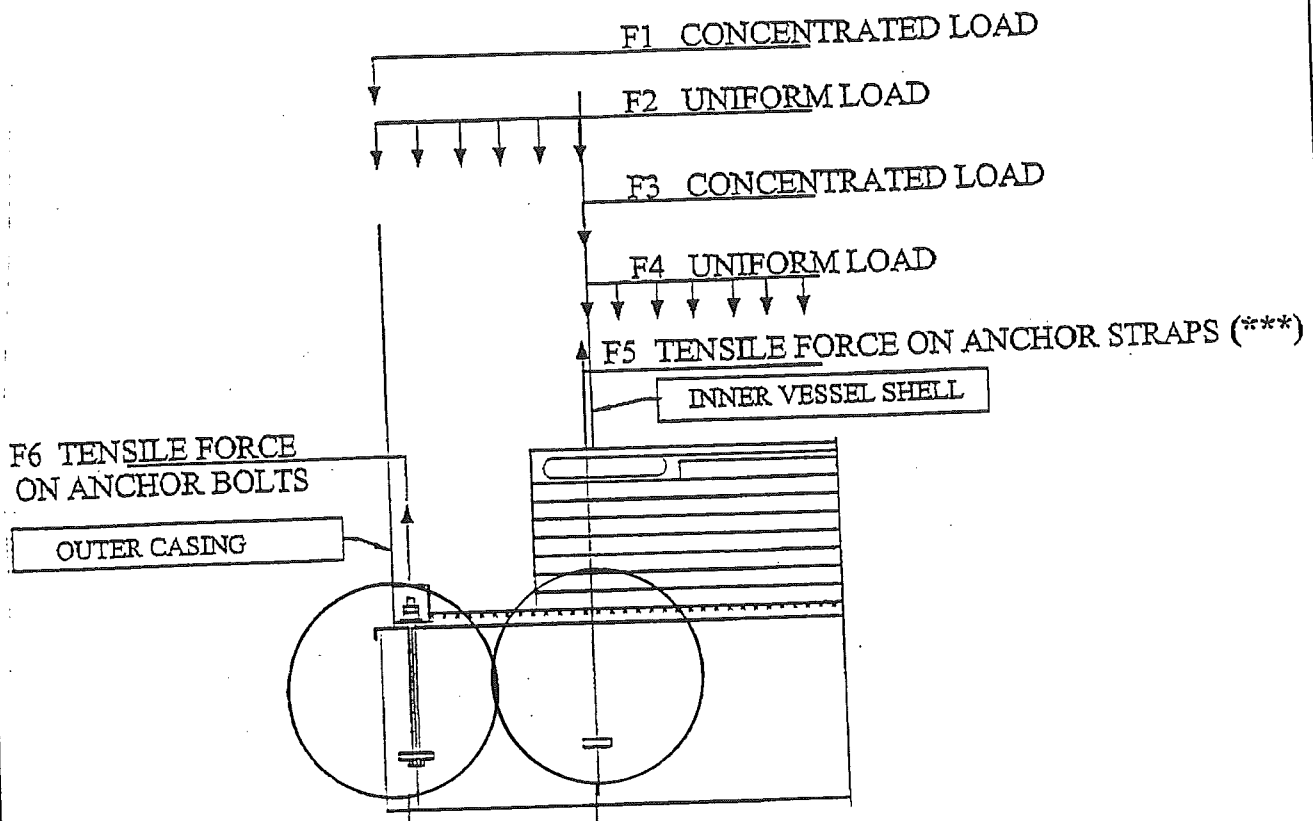
2D reinforcement - As1-



13a-9/16/20
rs-9



2D reinforcement - Ass



$\max F_{z_5} = 69\,kN$ ↑

BSt III (420)

$a_s / A_{s2} = \frac{69}{24,0} = 2,88\,cm^2$

2 × ⌀ 14 / Anchor

(6,16 > 2,88 cm²)

$\max F_{z_6} = 42\,kN$ ↑

2 ⌀ 14 / Anchor

KMW
Ingenieurgesellschaft mbH
Saarbrücker Straße 9
66130 Saarbrücken-Brebach
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E-Mail info@kmw-ing.de

Chapter B

Foundation LIN/LOX Wather bath vaporizer

W64001 and W73001

KMW
Ingenieurgesellschaft mbH
Saarbrücker Straße 9
66130 Saarbrücken-Brebach
Telefon (0681) 8 83 13-0
Telefax (0681) 8 83 13-88
E-Mail info@kmw-ing.de

Messer AGS GmbH

Füttingsweg 34
47805 Krefeld

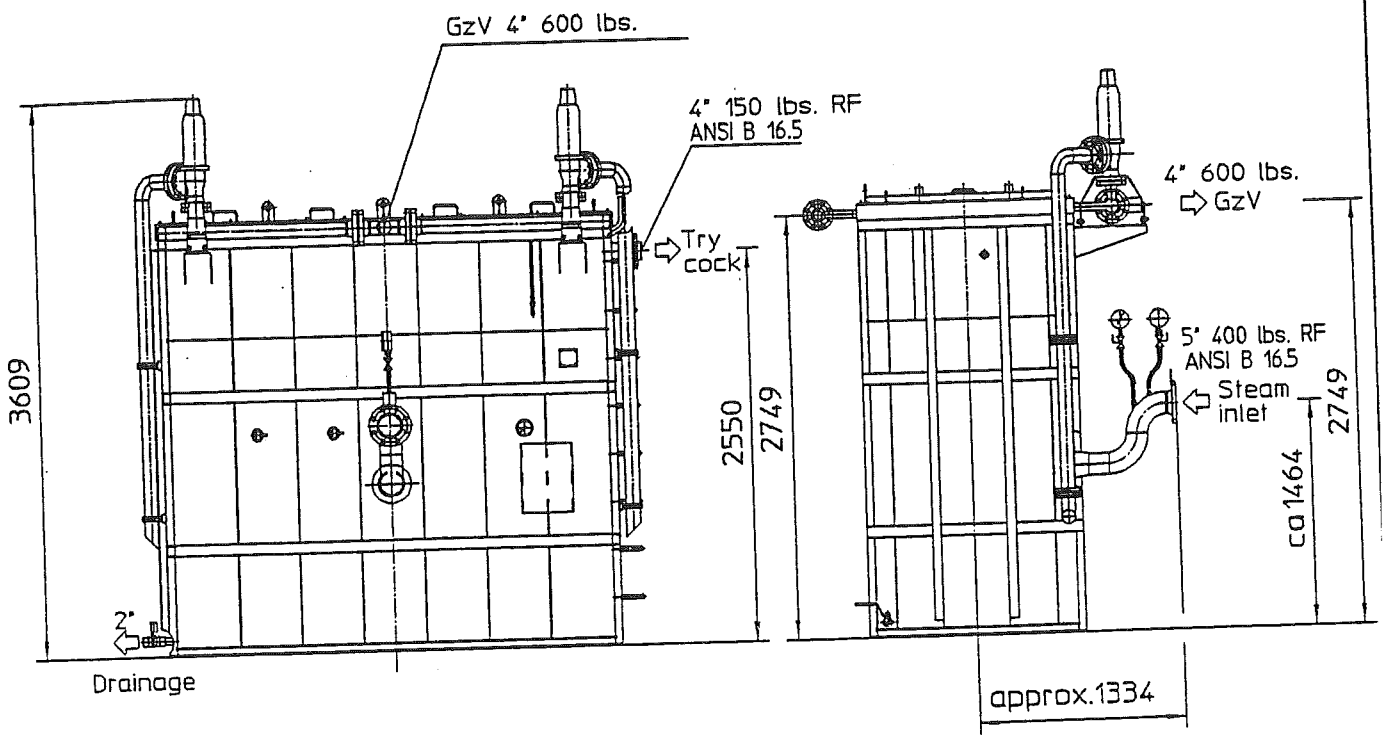
Tel. (02151) 379-0

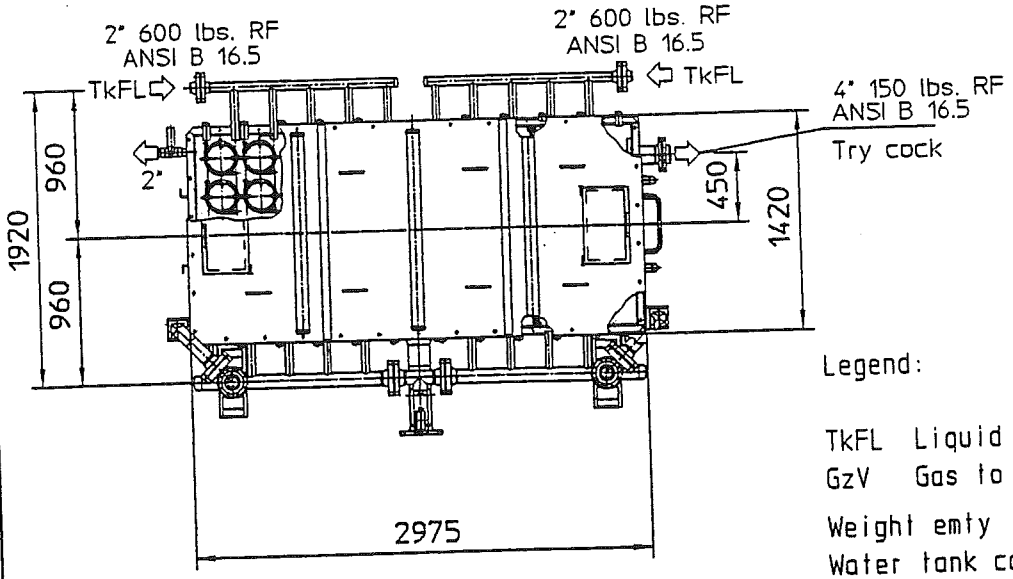
MESSER

W 6400 1 / W 7300 1

Vaporizer

Water bath vaporiser /steam heated
DV 200 / main dimension





Legend:

TkFL Liquid to vaporizer
GzV Gas to customer

Weight emty	: approx.	6000 kg
Water tank capacity	: approx.	9000 l
Weight filled with water	: approx	15000 kg
Material:		
-Water tank	:	SS
-Pipes	:	SS
-Nozzles/flanges	:	SS
-Heating system	:	SS

 01.2004

Loadcases

Weight:

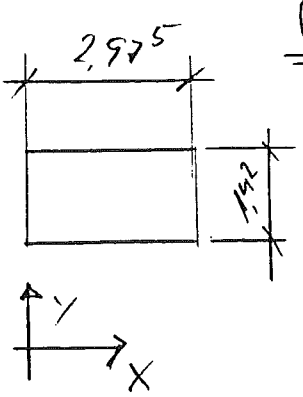
$G = 60\ kN$

Wind:

$P = 90\ kN$

$Q = 150\ kN$

Wind ± X



$H < 8{,}0\ m \rightsquigarrow q_{w_0} = 0{,}50\ kN/m^2$

$C = 0{,}8 + 0{,}5 = 1{,}3$

$q_{H_X} = 1{,}3 \cdot 0{,}5 \cdot \frac{1{,}42}{2} = \pm 0{,}46\ kN/m$

Wind ± Y

$q_{H_Y} = 1{,}3 \cdot 0{,}5 \cdot \frac{2{,}975}{2} = \pm 0{,}98\ kN/m$

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Telefax (0681) 8 83 13-88
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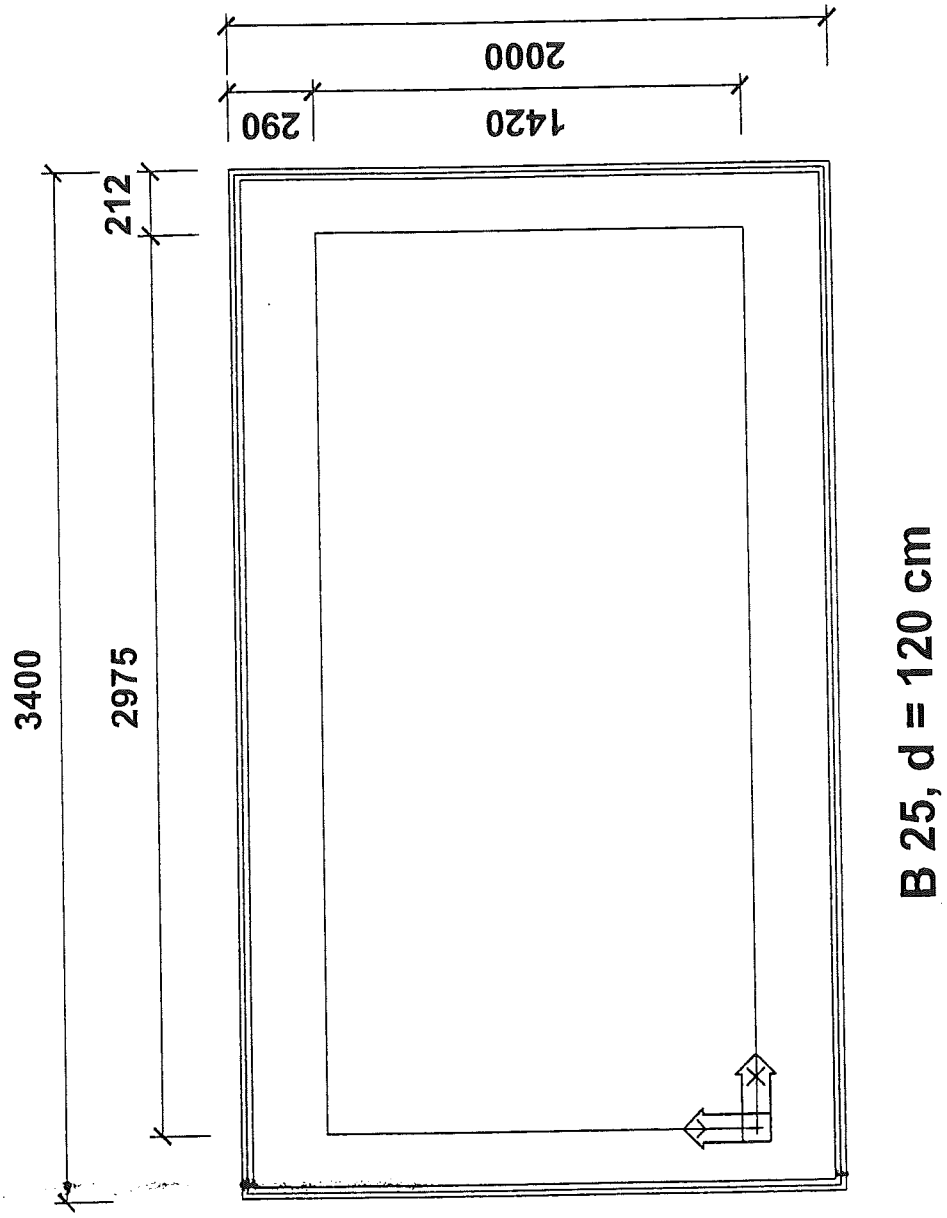
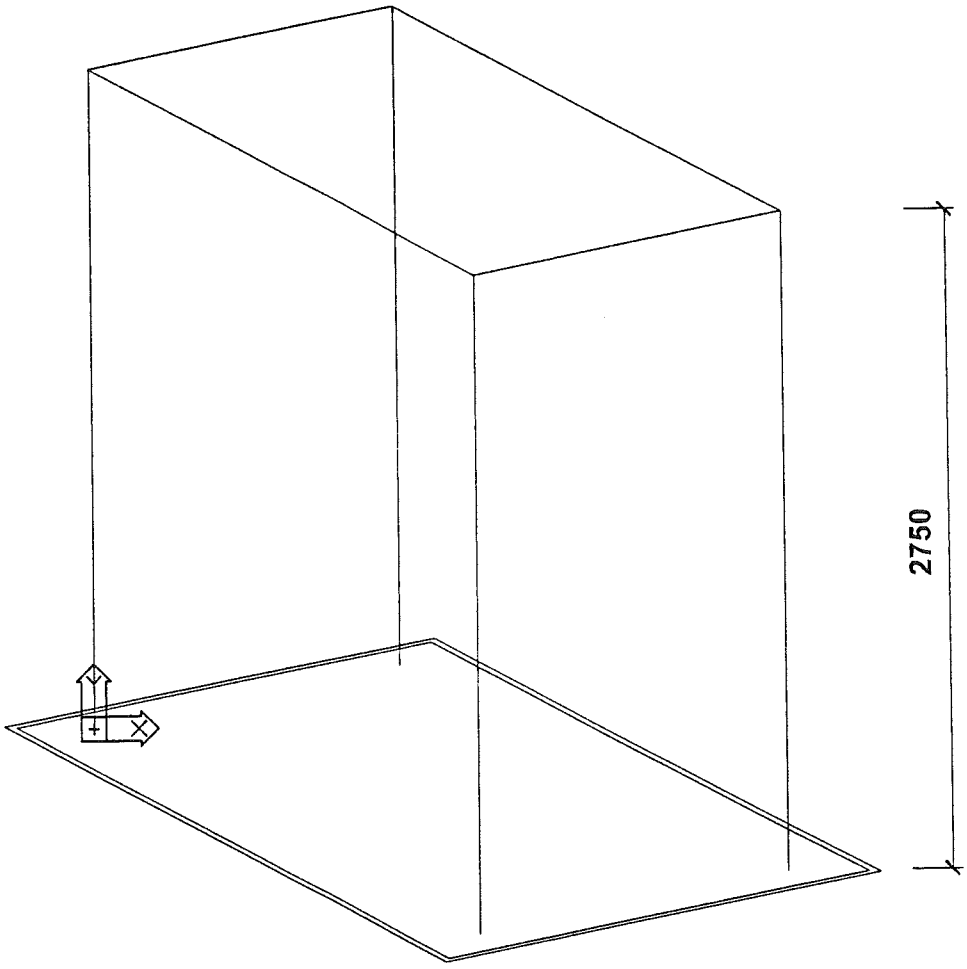
Inhalt



plan view



System

Basic data
Type of structure : General XYZ

Number of nodes:	12
Number of members:	8
Number of 1D macros:	5
Number of bound. lines:	4
Number of 2D macros:	1
Number of profiles :	1
Number of cases:	7
Number of materials:	2

Material

Name:

B 25

E modulus	30000.00 MPa
Poisson coeff.	0.20
Density	2500.000 kg/m^3
Extensibility	0.01 mm/m.K

B 25 gewichtslos

E modulus	30000.00 MPa
Poisson coeff.	0.20
Density	0.000 kg/m^3
Extensibility	0.01 mm/m.K

List of material
Group of members :
1/8

no.	Name:	quality	unit weight kg/m	length m	weight kg

List of material - Macro2D
Group of members :
1/1

no.	Name:	quality	unit volume weight kgm^3	volume m^3	weight kg
4	B 25	B 25	2500.00	8.16	20400.00

The total weight of the structure: 20400.00 kg

Nodes

node	X m	Y m	Z m
1	0.000	0.000	0.000
2	0.000	0.000	2.750

node	X m	Y m	Z m
3	2.975	0.000	0.000
4	2.975	0.000	2.750
5	2.975	1.420	0.000
6	2.975	1.420	2.750
7	0.000	1.420	0.000
8	0.000	1.420	2.750
9	-0.212	-0.290	0.000
10	3.188	-0.290	0.000
11	3.188	1.710	0.000
12	-0.212	1.710	0.000

Members

macro	memb	node 1	node 2	length m	Rx deg	profile	quality
1	1	1	2	2.750	0.00	1 - Numerical	B 25 gewichtslos
2	2	3	4	2.750	0.00	1 - Numerical	B 25 gewichtslos
3	3	5	6	2.750	0.00	1 - Numerical	B 25 gewichtslos
4	4	7	8	2.750	0.00	1 - Numerical	B 25 gewichtslos
5	5	2	4	2.975	0.00	1 - Numerical	B 25 gewichtslos
	6	4	6	1.420	0.00	1 - Numerical	B 25 gewichtslos
	7	6	8	2.975	0.00	1 - Numerical	B 25 gewichtslos
	8	8	2	1.420	0.00	1 - Numerical	B 25 gewichtslos

Boundaries

bound. line	type	node
1	Line	9,10
2	Line	10,11
3	Line	11,12
4	Line	12,9

2D Macros

num	type		
1			
	B 25	Thickness	1.20 m
	Boundary:	1,2,3,4	
	Nodes :	1,3,5,7	

Profiles

Profile no. 1 - Numerical
Material : 8 - B 25 gewichtslos

A:	1.000000e+002 cm^2		
Ay/A:	1.000	Az/A:	1.000
Iy:	1.000000e+005 cm^4	Iz:	1.000000e+005 cm^4
Iyz:	0.000000e+000 cm^4	It:	1.000000e+005 cm^4
Iw:	1.000000e+006 cm^6		
Wely:	1.000000e+003 cm^3	Welz:	1.000000e+003 cm^3
Wply:	1.000000e+003 cm^3	Wplz:	1.000000e+003 cm^3
cy:	0.00 cm	cz:	0.00 cm
iy:	31.62 cm	iz:	31.62 cm
dy:	0.00 cm	dz:	0.00 cm
Outline:		0.00 cm	

Type for check: Untypical section

Hinges
The stiffeness values of line hinges are stated in 1 m´ of length

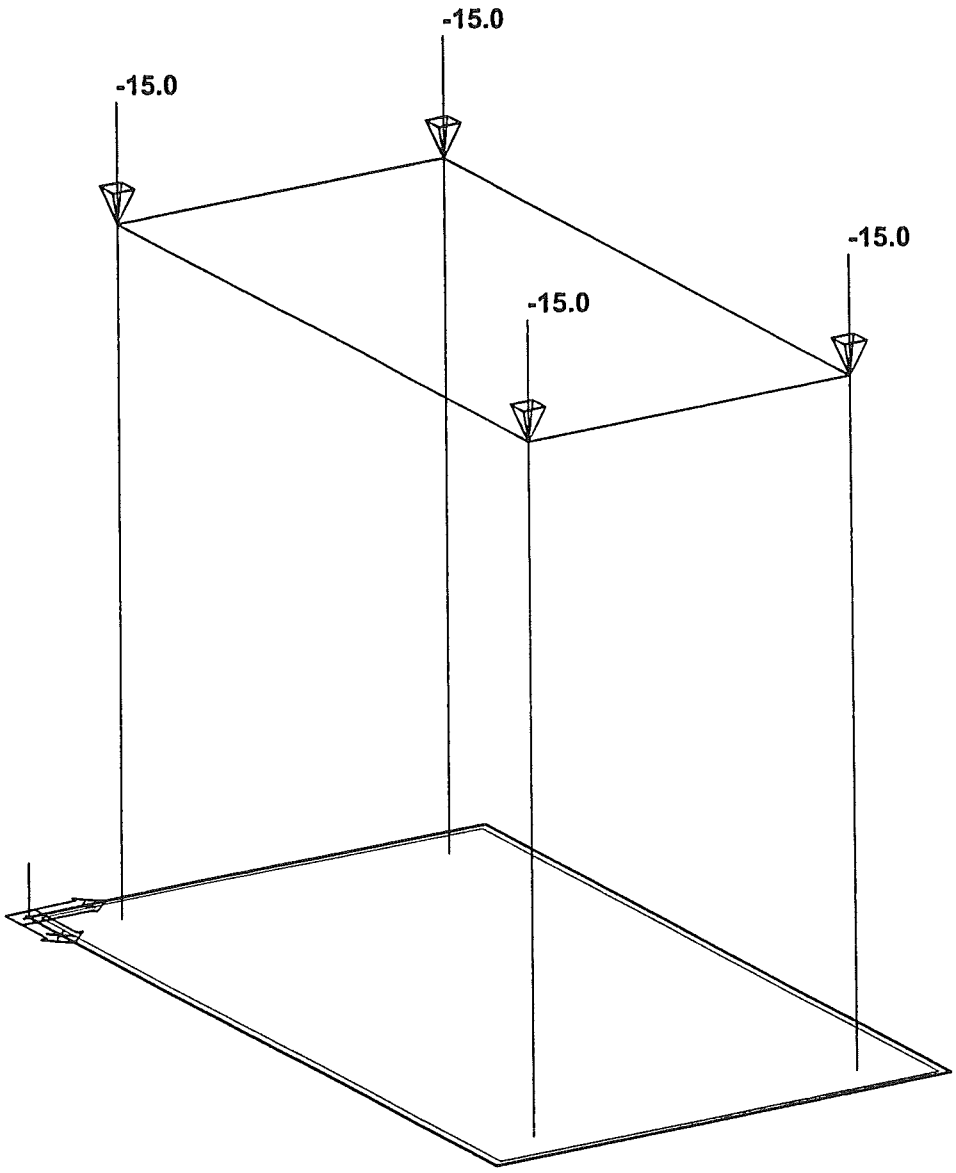
macro	type	pos
1	fiyfiz	beg
2	fiyfiz	beg
3	fiyfiz	beg
4	fiyfiz	beg

Soil - 2D macro

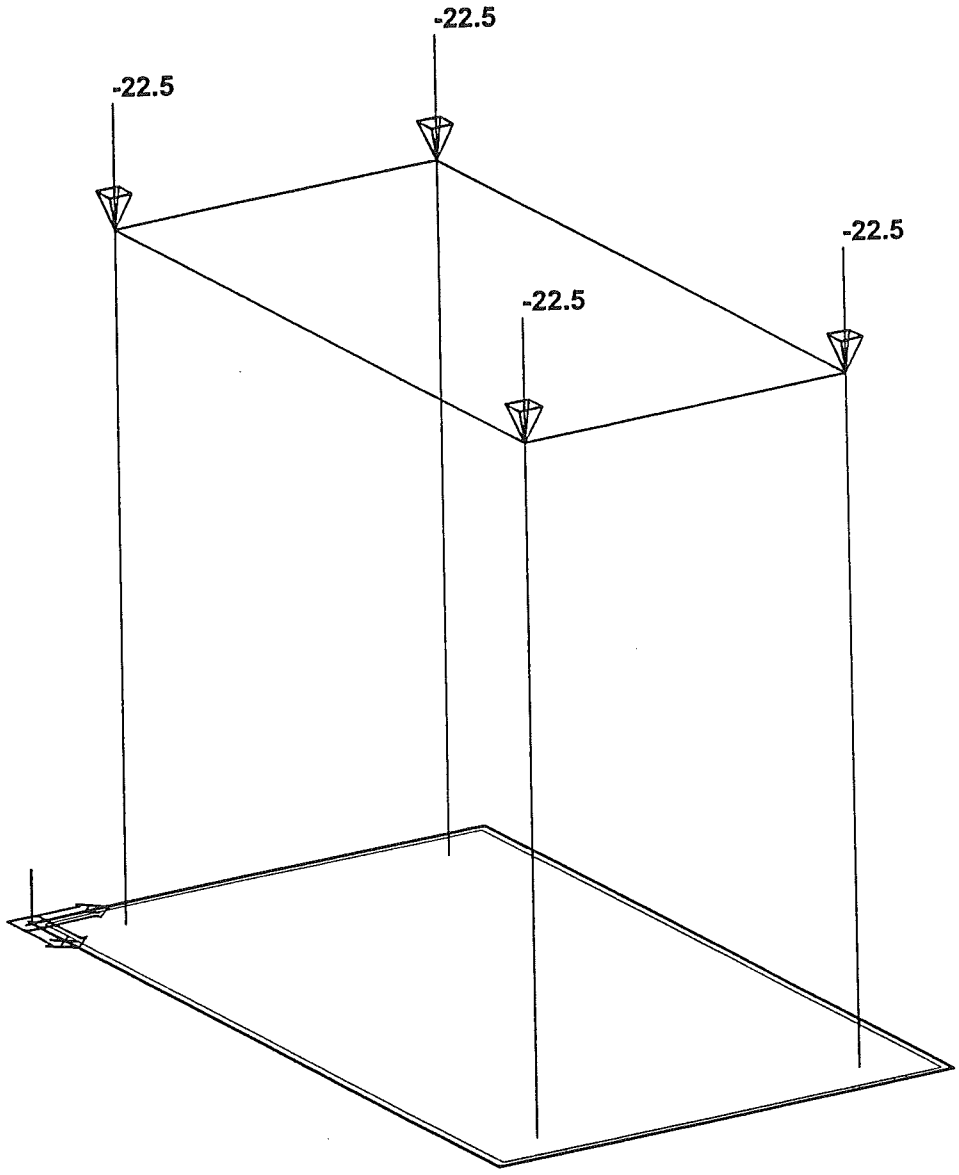
Index	2D macro	Name of subsoil
1	1	Sand/Clean/Moderate

Loadcases

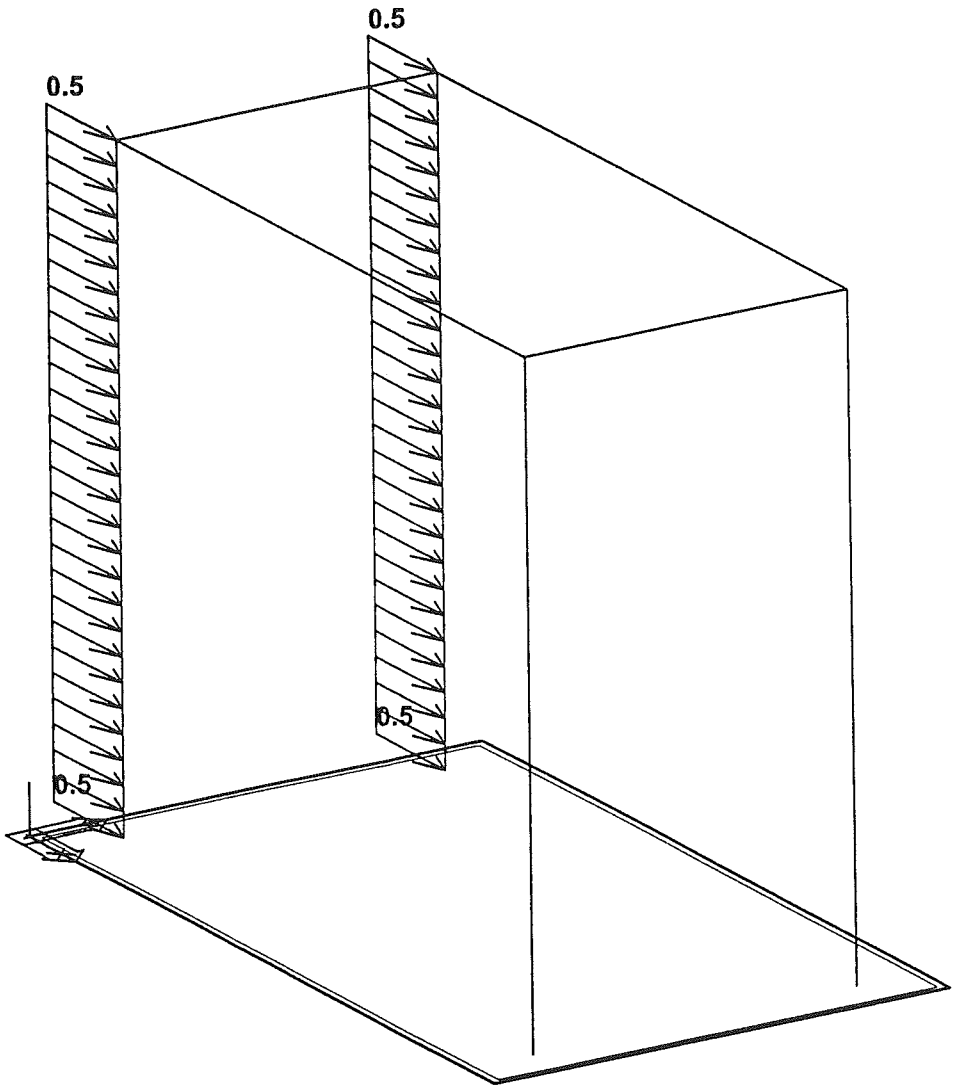
Case	Name:	Description
1	Weight concret	Self weight. Direction -Z
2	Weight	Permanent - Loads
3	Water	Variable - P
4	Wind +X	Variable - Wind Excl.
5	Wind -X	Variable - Wind Excl.
6	Wind +Y	Variable - Wind Excl.
7	Wind -Y	Variable - Wind Excl.



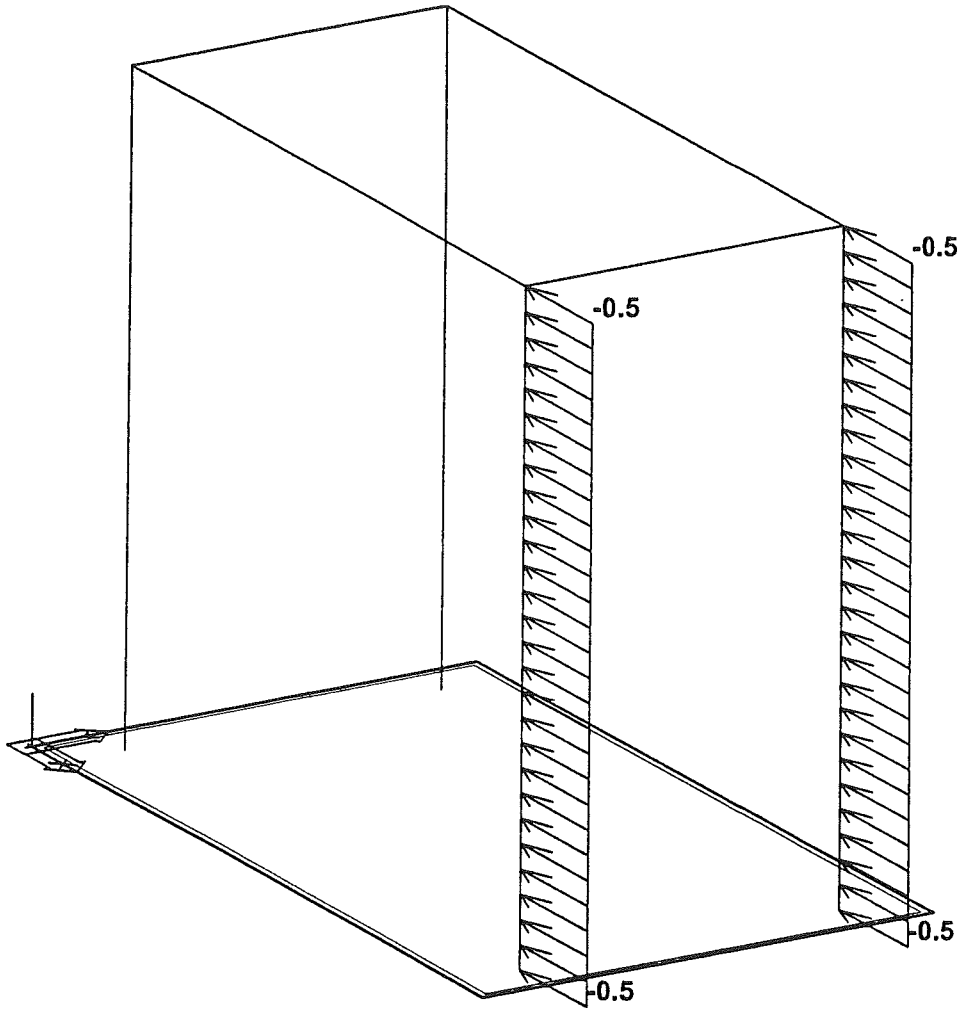
2. Weight



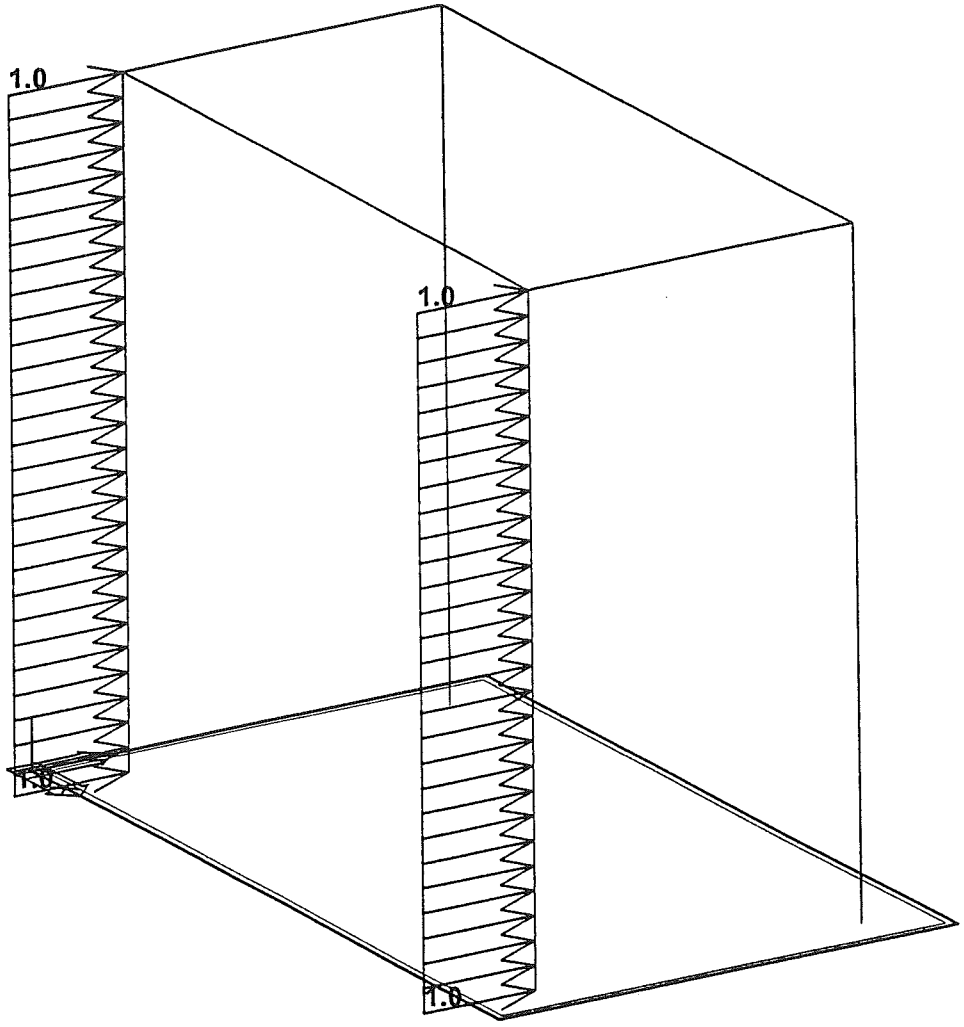
3. Water



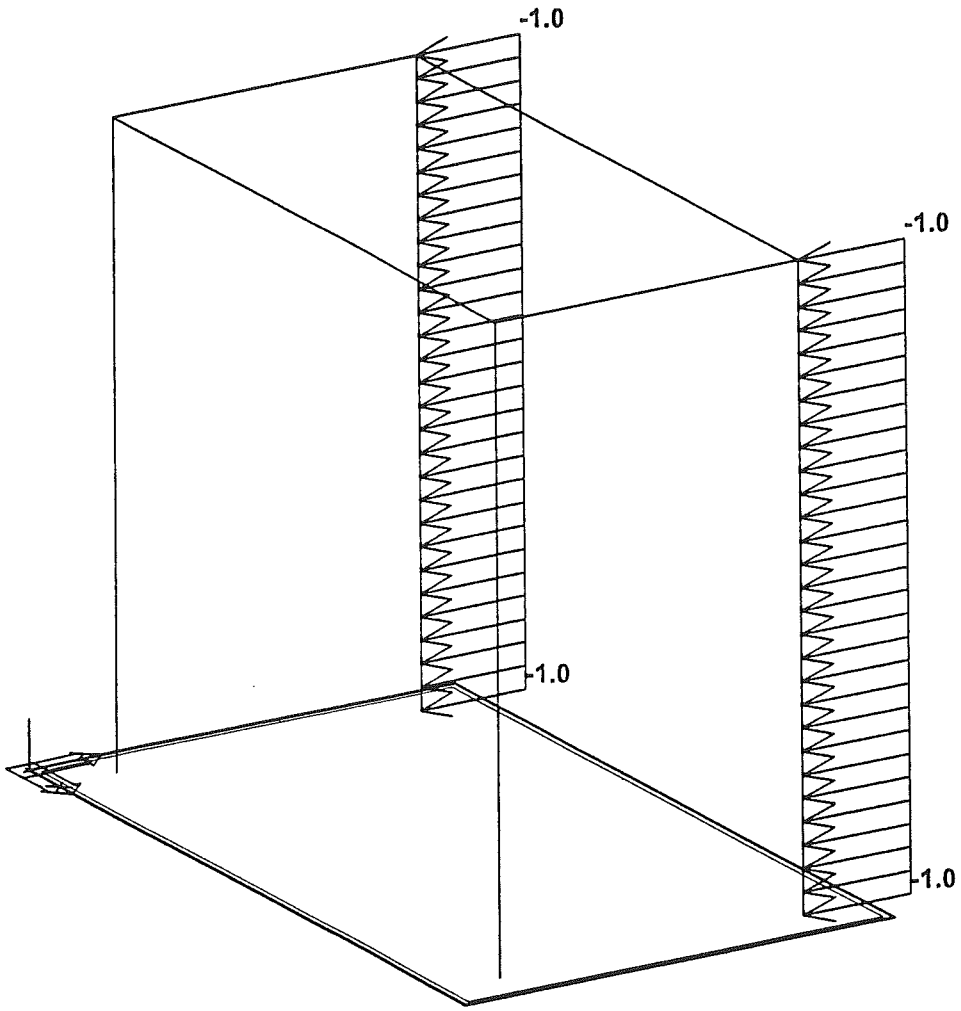
4. Wind +X



5. Wind -X



6. Wind +Y



7. Wind -Y

Variable loads group

Name:
P
Wind Excl.

Loadcase no. 2 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
2	0.00	0.00	-15.00	0.00	0.00	0.00
4	0.00	0.00	-15.00	0.00	0.00	0.00
6	0.00	0.00	-15.00	0.00	0.00	0.00
8	0.00	0.00	-15.00	0.00	0.00	0.00

Loadcase no. 3 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
2	0.00	0.00	-22.50	0.00	0.00	0.00
4	0.00	0.00	-22.50	0.00	0.00	0.00
6	0.00	0.00	-22.50	0.00	0.00	0.00
8	0.00	0.00	-22.50	0.00	0.00	0.00

Loadcase no. 4 - distributed loads

macro	type	dx m	exY m	exZ m		X beg end	Y beg end	Z beg end
1	force	0.00 rel	0.00	0.00	glo	0.46	0.00	0.00
	kN/m	1.00			len	0.46	0.00	0.00
4	force	0.00 rel	0.00	0.00	glo	0.46	0.00	0.00
	kN/m	1.00			len	0.46	0.00	0.00

Loadcase no. 5 - distributed loads

macro	type	dx m	exY m	exZ m		X beg end	Y beg end	Z beg end
2	force	0.00 rel	0.00	0.00	glo	-0.46	0.00	0.00
	kN/m	1.00			len	-0.46	0.00	0.00
3	force	0.00 rel	0.00	0.00	glo	-0.46	0.00	0.00
	kN/m	1.00			len	-0.46	0.00	0.00

Loadcase no. 6 - distributed loads

macro	type	dx m	exY m	exZ m		X beg end	Y beg end	Z beg end
1	force	0.00 rel	0.00	0.00	glo	0.00	0.98	0.00
	kN/m	1.00			len	0.00	0.98	0.00
2	force	0.00 rel	0.00	0.00	glo	0.00	0.98	0.00
	kN/m	1.00			len	0.00	0.98	0.00

Loadcase no. 7 - distributed loads

macro	type	dx m	exY m	exZ m		X beg end	Y beg end	Z beg end
3	force	0.00 rel	0.00	0.00	glo	0.00	-0.98	0.00
	kN/m	1.00			len	0.00	-0.98	0.00
4	force	0.00 rel	0.00	0.00	glo	0.00	-0.98	0.00
	kN/m	1.00			len	0.00	-0.98	0.00

Combinations

Combi	Norm	Case	coeff
1.	User-ultimate	1 Weight concret	1.00
		2 Weight	1.00
		3 Water	1.00
		4 Wind +X	1.00
		5 Wind -X	1.00
		6 Wind +Y	1.00
		7 Wind -Y	1.00

Basic rules for generation of ultimate load combinations:
1 : 1.00*LC1 / 1.00*LC2 / 1.00*LC3 / 1.00*LC4 / 1.00*LC5 / 1.00*LC6 / 1.00*LC7

List of extreme ultimate load combinations
1/ 1 : +1.00*LC1+1.00*LC2+1.00*LC4
2/ 1 : +1.00*LC1+1.00*LC2+1.00*LC5
3/ 1 : +1.00*LC1+1.00*LC2+1.00*LC6
4/ 1 : +1.00*LC1+1.00*LC2+1.00*LC7
5/ 1 : +1.00*LC1+1.00*LC2+1.00*LC3+1.00*LC4
6/ 1 : +1.00*LC1+1.00*LC2+1.00*LC3+1.00*LC5
7/ 1 : +1.00*LC1+1.00*LC2+1.00*LC3+1.00*LC6
8/ 1 : +1.00*LC1+1.00*LC2+1.00*LC3+1.00*LC7

Subsoils

Name:	Type of position	C1x kN/m^3	C1y kN/m^3	C1z kN/m^3	C2x kN/m	C2y kN/m	SigZpl kN/m^2
Sand/Clean/Moderate	Under plate, block	1000.000	1000.000	15000.000	0.000	0.000	0.000

Calculation protocol.

Linear calculation

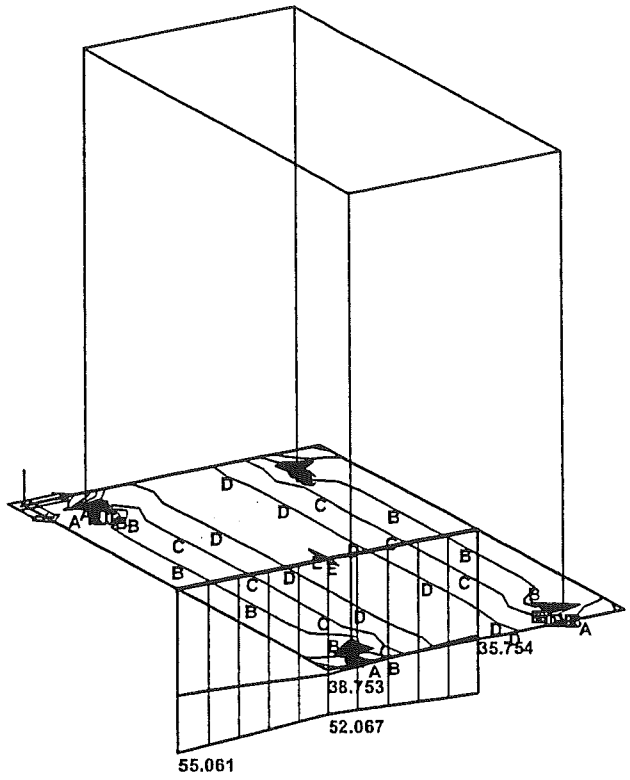
Number of 2D elements	178
Number of 1D elements	8
Number of mesh nodes	206
Number of equations	1236
Loadcases	LC 1 Weight concret
	LC 2 Weight
	LC 3 Water
	LC 4 Wind +X
	LC 5 Wind -X

Number of 2D elements	178
Number of 1D elements	8
Number of mesh nodes	206
Number of equations	1236
	LC 6 Wind +Y
	LC 7 Wind -Y
Bending theory	Mindlin
Start of calculation	23.08.2004 10:31
End of calculation	23.08.2004 10:31

Sum of loads and reactions.

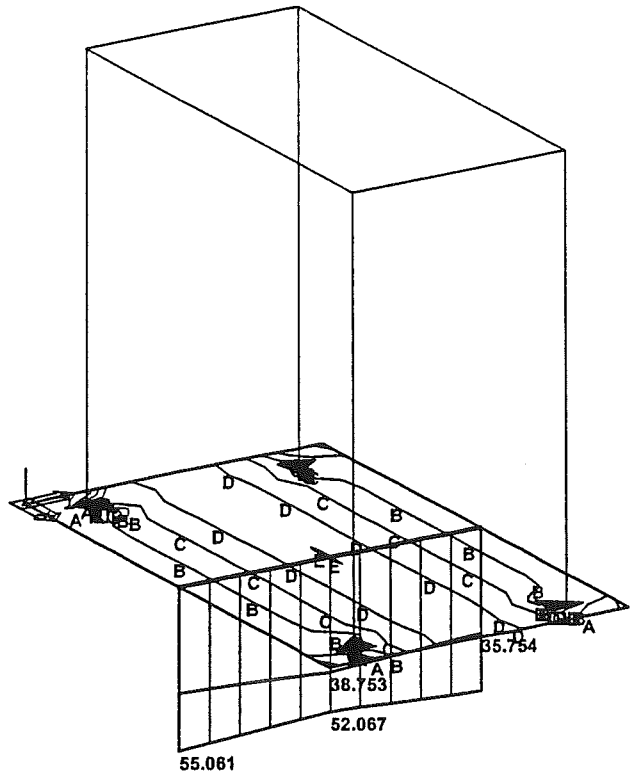
			X	Y	Z
loadcase	1	loads	0.0	0.0	-204.0 ✓
		reactions	0.0	0.0	0.0
		contact	-0.0	0.0	204.0
loadcase	2	loads	0.0	0.0	-60.0 ✓
		reactions	0.0	0.0	0.0
		contact	-0.0	0.0	60.0
loadcase	3	loads	0.0	0.0	-90.0 ✓
		reactions	0.0	0.0	0.0
		contact	-0.0	0.0	90.0
loadcase	4	loads	2.5	0.0	0.0
		reactions	0.0	0.0	0.0
		contact	-2.5	0.0	0.0
loadcase	5	loads	-2.5	0.0	0.0
		reactions	0.0	0.0	0.0
		contact	2.5	0.0	-0.0
loadcase	6	loads	0.0	5.4	0.0
		reactions	0.0	0.0	0.0
		contact	-0.0	-5.4	-0.0
loadcase	7	loads	0.0	-5.4	0.0
		reactions	0.0	0.0	0.0
		contact	0.0	5.4	0.0

$G = 3,40 \cdot 2,0 \cdot 1,20 \cdot 25,0 = 204\,kN$



Min sigmz	[kPa]
Max	45.240
N	44.424
M	43.608
L	42.793
K	41.977
J	41.161
H	40.345
G	39.529
E	38.714
D	37.898
C	37.082
B	36.266
A	35.450
Min	34.634

Contact stress - min sigmz - FEM Combi : 1



Min sigmz	[kPa]
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D	37.898
C	37.082
B	36.266
A	35.450
Min	34.634

Contact stress - min sigmz - FEM Combi : 1

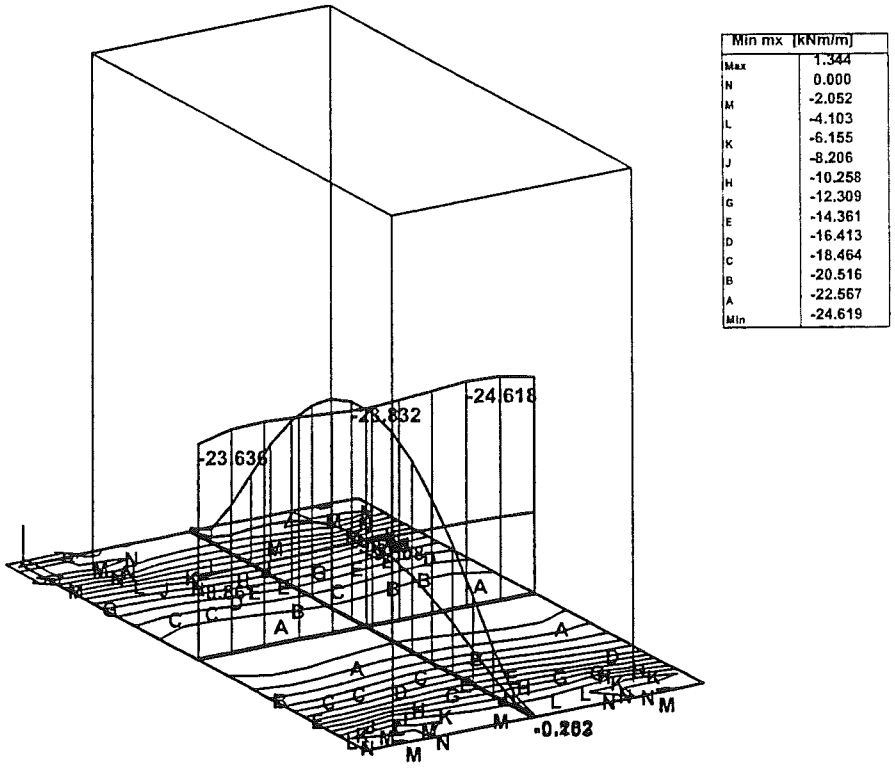
RESULTS : CONTACT STRESSES

FEM Combi:
C1 User-ultimate

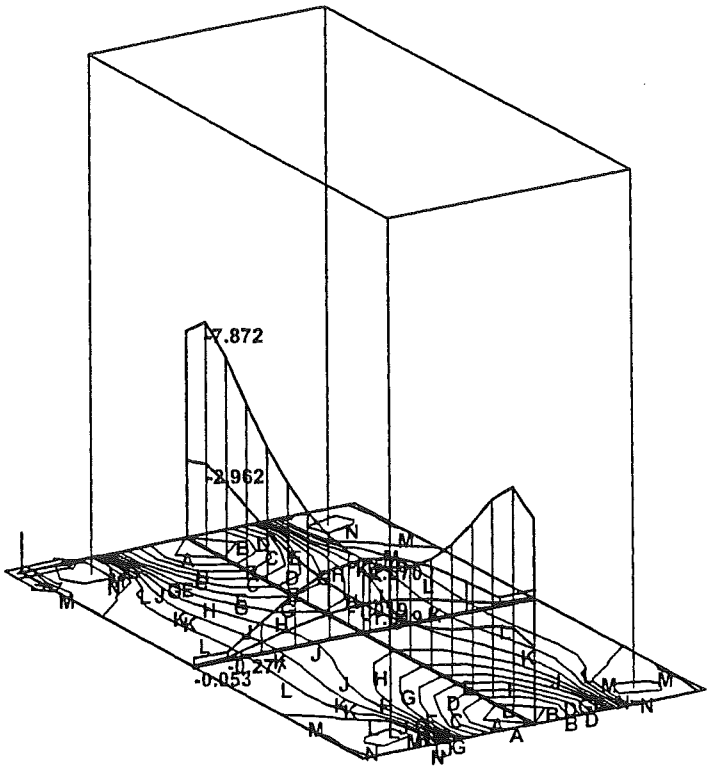
Global extremes

node	tauzx [kPa]	tauzy [kPa]	sigmz [kPa]
167	**0.372**	0.793	52.232
191	**-0.372**	-0.793	34.634
11	0.372	**0.793**	55.260
9	-0.372	**-0.793**	35.867
1	0.372	0.793	**67.136**
167	-0.372	-0.793	**34.634**

Selection was done for macros: 1

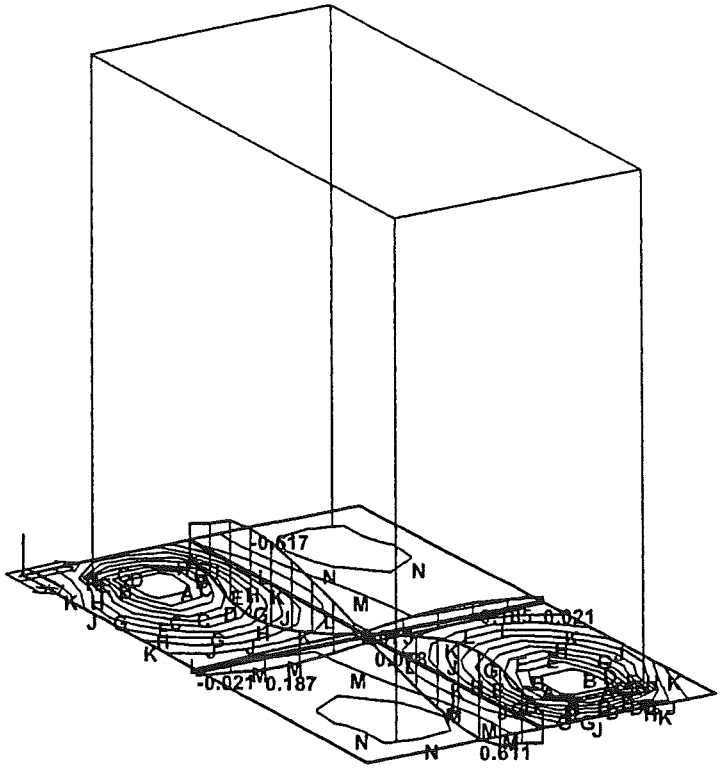


Internal force - min mx - FEM Combi : 1



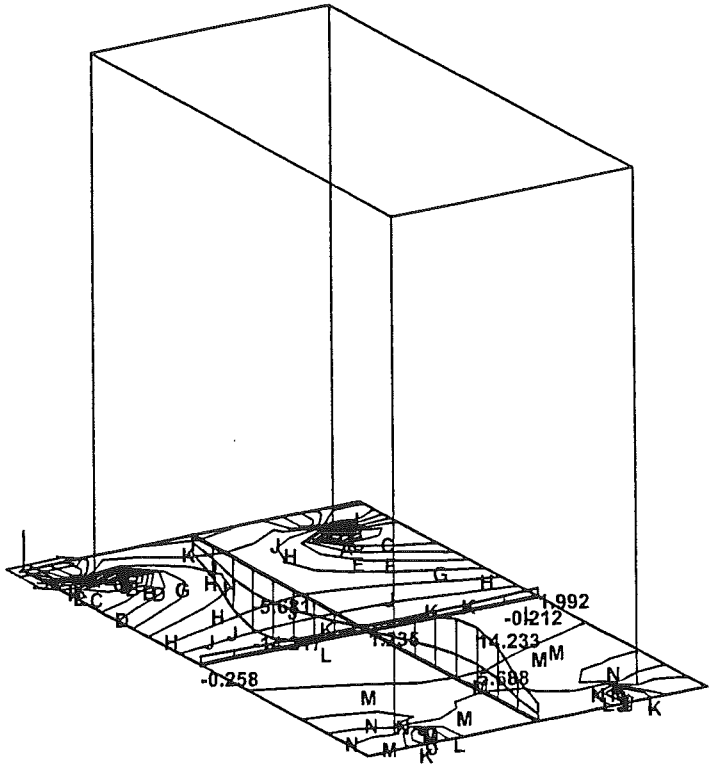
Min my [kNm/m]	
Max	1.631
N	0.815
M	0.000
L	-0.716
K	-1.431
J	-2.147
H	-2.863
G	-3.578
E	-4.294
D	-5.010
C	-5.725
B	-6.441
A	-7.156
Min	-7.872

Internal force - min my - FEM Combi : 1



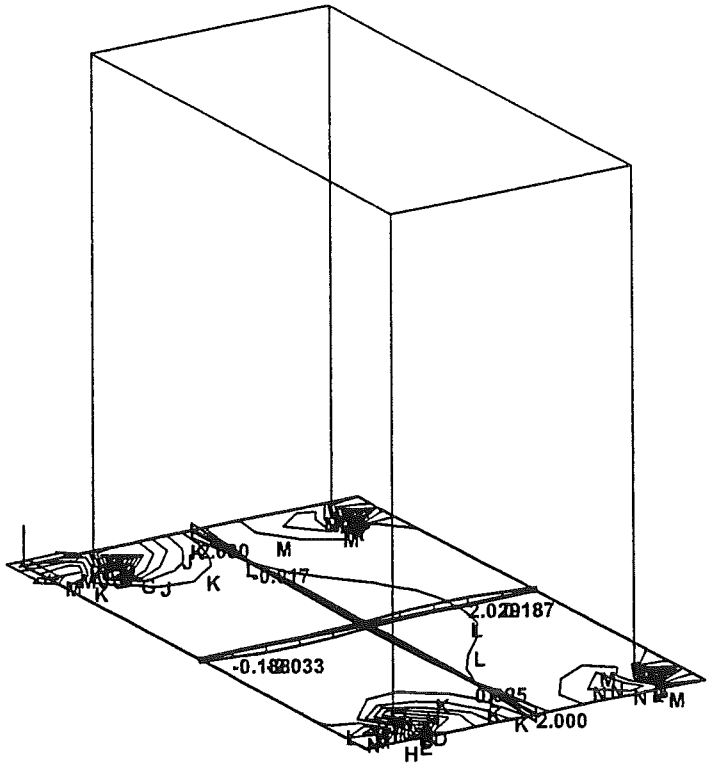
Min mxy [kNm/m]	
Max	0.730
N	0.365
M	0.000
L	-0.290
K	-0.580
J	-0.870
H	-1.161
G	-1.451
E	-1.741
D	-2.031
C	-2.321
B	-2.611
A	-2.901
Min	-3.192

Internal force - min mxy - FEM Combi : 1



Min qx [kN/m]	
Max	16.382
N	10.922
M	5.461
L	0.000
K	-5.245
J	-10.489
H	-15.734
G	-20.979
E	-26.224
D	-31.468
C	-36.713
B	-41.958
A	-47.202
Min	-52.447

Internal force - min qx - FEM Combi : 1



Min qy [kN/m]	
Max	15.411
N	10.274
M	5.137
L	0.000
K	-6.095
J	-12.190
H	-18.284
G	-24.379
E	-30.474
D	-36.569
C	-42.664
B	-48.759
A	-54.853
Min	-60.948

Internal force - min qy - FEM Combi : 1

RESULTS : INTERNAL FORCES

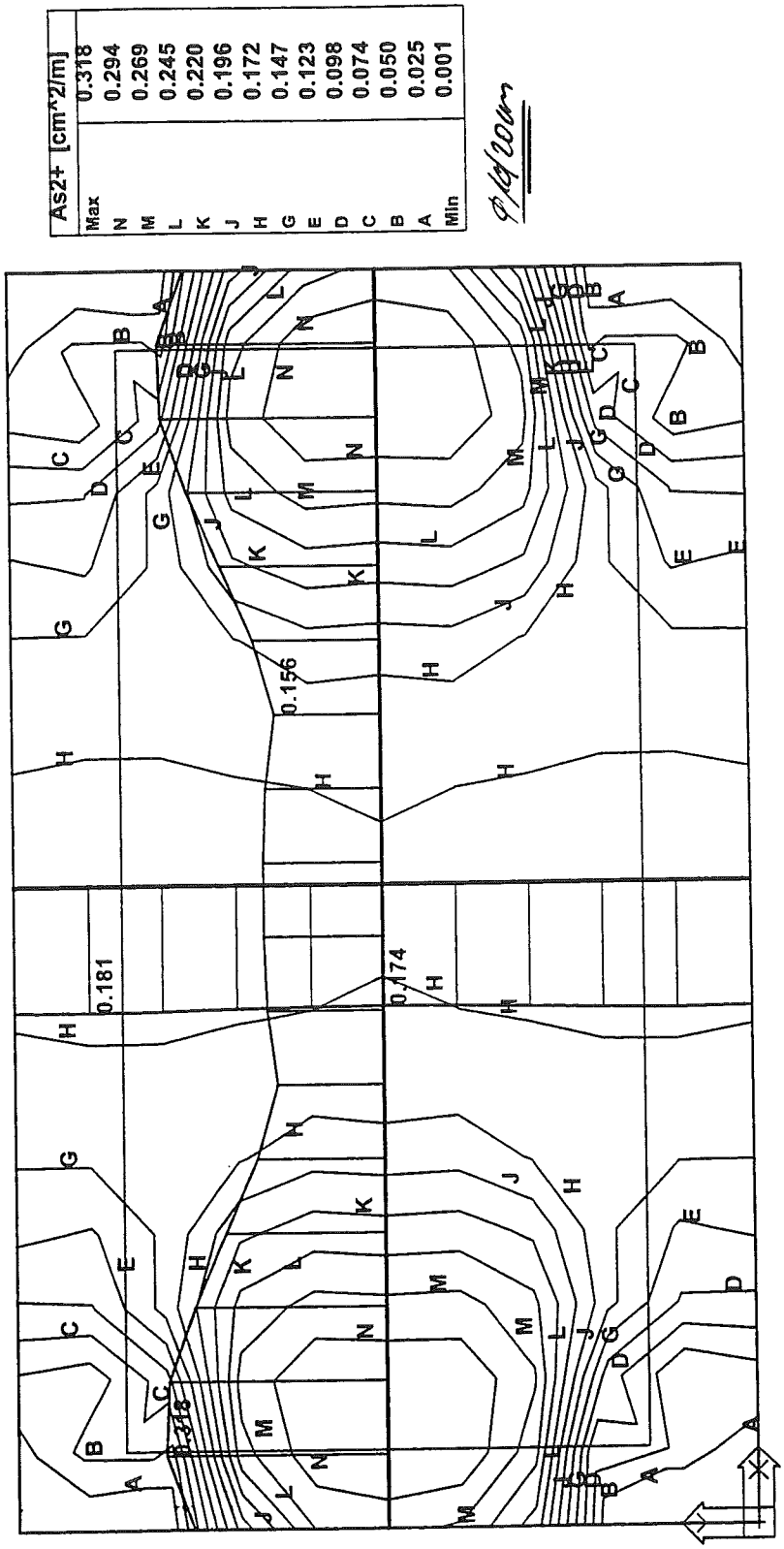
FEM Combi:
C1 Eigen-Tragfähigk.

Global extremes

Rotation of the local system: No
Basic magnitudes - bending, membrane

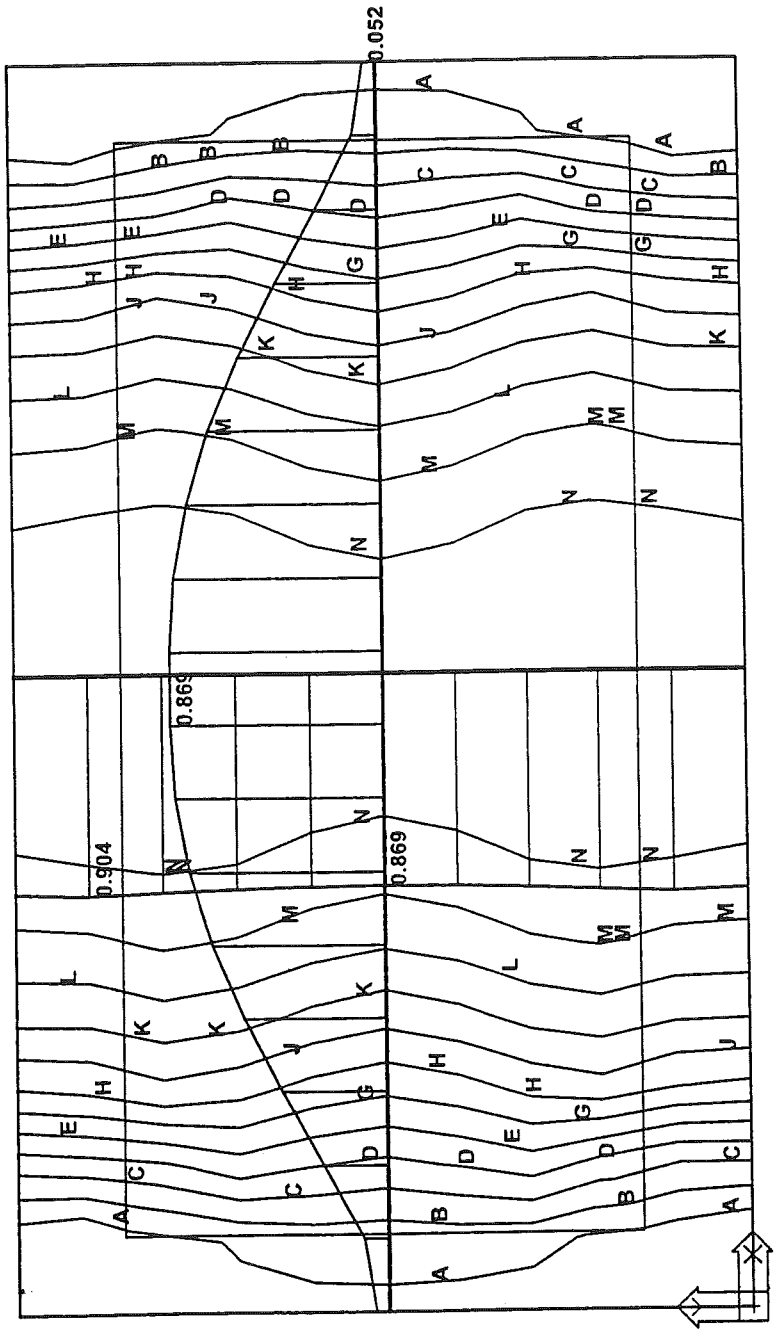
node	mx [kNm/m]	my [kNm/m]	mxy [kNm/m]	qx [kN/m]	qy [kN/m]	nx [kN/m]	ny [kN/m]	qxy [kN/m]
5	**-4.856**	5.432	-0.550	17.475	2.245	0.331	0.137	0.557
113	**-24.619**	-1.066	0.033	-2.364	0.093	-1.357	-0.115	-0.086
1	4.579	**5.765**	-0.492	-4.174	-2.514	1.450	0.181	0.509
60	-1.337	**-7.872**	-0.383	-7.286	-1.215	-0.052	-1.053	-0.766
39	-1.524	1.699	**3.194**	51.096	-10.125	0.526	0.911	2.124
120	-4.021	0.294	**-3.192**	16.327	10.186	-1.656	-3.151	-2.116
39	-1.524	1.699	3.194	**51.096**	-10.125	0.526	0.911	2.124
25	-3.927	0.208	-3.094	**-52.447**	-30.215	-1.662	-3.468	-2.274
193	2.196	2.973	1.670	12.317	**50.021**	0.218	2.506	1.374
201	0.418	-0.341	-2.103	-13.996	**-60.948**	-1.114	-8.236	-1.892
180	-8.864	-0.054	0.106	-1.043	0.872	**3.078**	0.019	0.005
	-23.643	-0.317	0.015	-3.288	0.167	**-2.700**	-0.005	-0.005
154	3.749	3.514	0.846	13.608	44.557	0.623	**6.509**	0.753
201	0.418	-0.341	-2.103	-13.996	-60.948	-1.114	**-8.236**	-1.892
39	-1.524	1.699	3.194	51.096	-10.125	0.526	0.911	**2.124**
25	-3.927	0.208	-3.094	-52.447	-30.215	-1.662	-3.468	**-2.274**

Selection was done for macros: 1

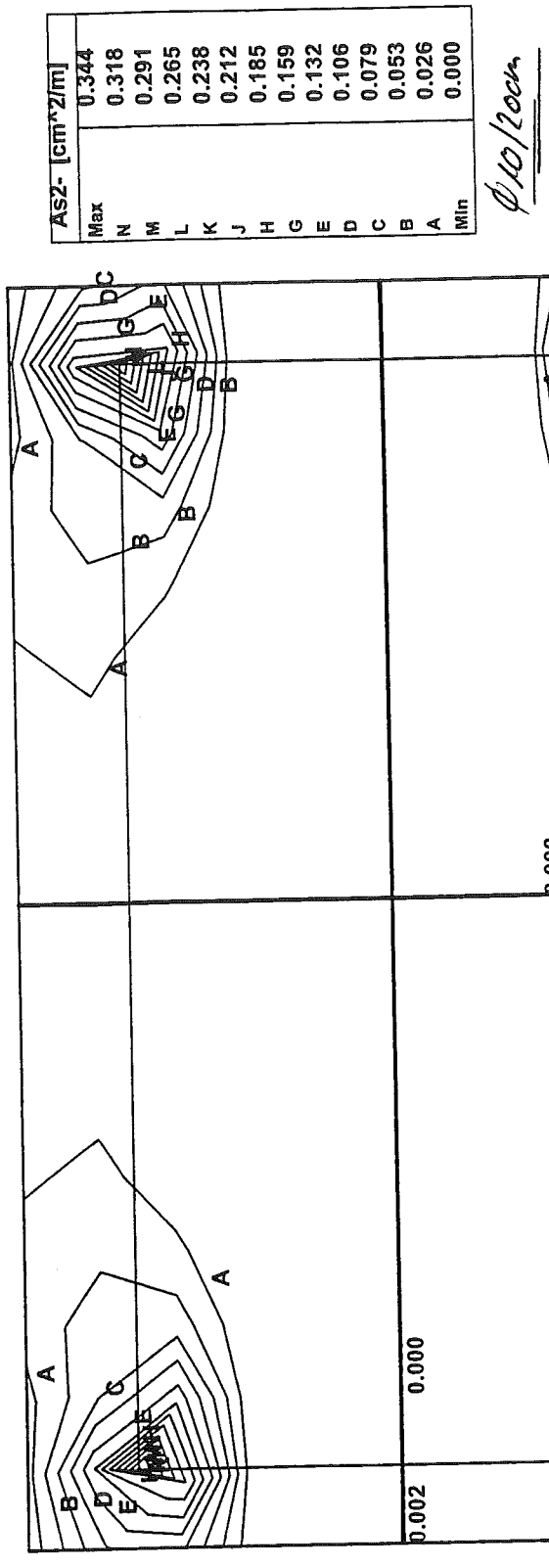


2D reinforcement - As2+

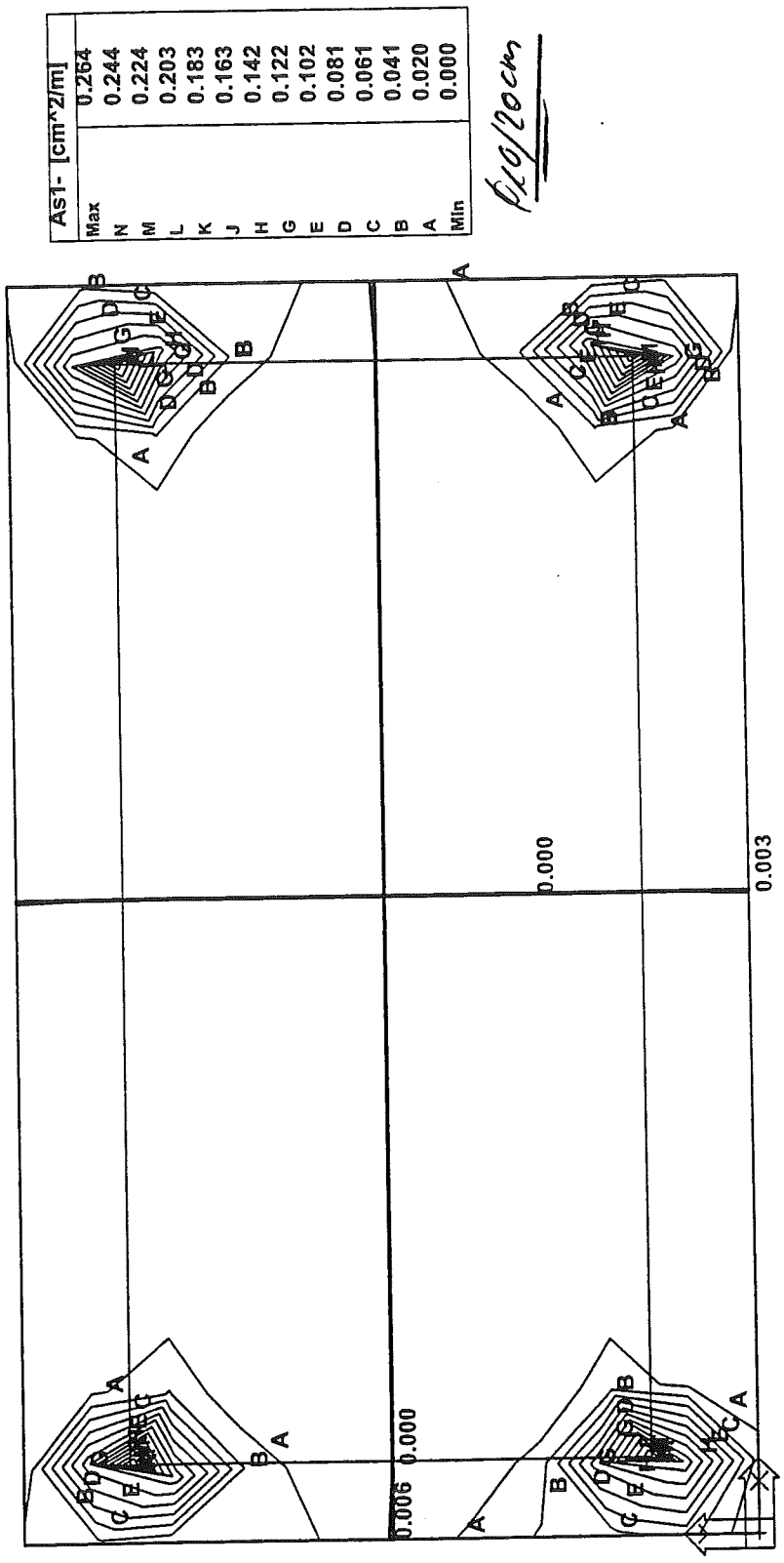
As1+ [cm^2/m]	
	0.904
	0.835
	0.765
	0.696
	0.626
	0.557
	0.487
	0.417
	0.348
	0.278
	0.209
	0.139
	0.070
	0.000
Max	
N	
M	
L	
K	
J	
H	
G	
E	
D	
C	
B	
A	
Min	



2D reinforcement - As1+



2D reinforcement - As2-



2D reinforcement - As1-

Code for calculation: DIN 1045 7/88

Explanation of concrete symbols

Abbreviation	Explanation
betaWN	Concrete cube compression strength.
betaR	Design concrete compression strength.
Tau01	1st shear stress limit according Table 13.
Tau02	2nd shear stress limit according Table 13.
Tau03	3rd shear stress limit according Table 13.

Concrete characteristics

	B 25
betaWN	25000.000 kPa
betaR	17500.000 kPa
Tau011_1 plates	350.000 kPa
Tau011_2 plates	500.000 kPa
Tau02 plates	1800.000 kPa
Tau012 beams	750.000 kPa
Tau02 beams	1800.000 kPa
Tau03 beams	3000.000 kPa

Explanation of reinforcement steel symbols

Abbreviation	Explanation
betaS	Characteristic yield strength of reinforcement

Steel characteristics

	BSt 420
betaS	420000.000 kPa
E modulus	200000000.000 kPa

Input parameters

Description	Percentage
Maximum % of reinforcement	9.00
Minimum % of net reinforcement	0.00
Minimum % of pressure reinforcement	0.50
Minimum % of tension reinforcement	0.00
Minimum % of transverse reinforcement	20.00

Shear mode
Tension reinforcement is partially anchored in the field.

Description	Value
height < 7 cm represents increase of internal forces (§ 17.2.1 (6))	ON
Structural reinforcement of deep beam	OFF

Global extremes

Necessary areas

node	As1+ [cm^2/m]	As2+ [cm^2/m]	As3+ [cm^2/m]	As3- [cm^2/m]	As2- [cm^2/m]	As1- [cm^2/m]	Ass [cm^2/m^2]	tau [MPa]	tau0 [MPa]
					0.003	0.000	0.000	0.00	0.00
126	0.904	0.181	-	-	0.004	0.023	0.000	0.00	0.00
9	0.000	0.002	-	-	0.000	0.000	0.000	0.00	0.01
60	0.100	0.318	-	-	0.075	0.035	0.000	0.00	0.02
167	0.047	0.001	-	-	0.344	0.261	0.000	0.00	0.04
5	0.053	0.065	-	-	0.000	0.000	0.000	0.00	0.02
26	0.505	0.252	-	-	0.322	0.264	0.000	0.00	0.04
7	0.053	0.065	-	-	0.000	0.000	0.000	0.00	0.02
26	0.505	0.252	-	-	0.344	0.264	0.000	0.00	0.04
1	0.067	0.070	-	-	0.344	0.264	0.000	0.00	0.04
	0.067	0.070	-	-	0.344	0.264	0.000	0.00	0.04
	0.067	0.070	-	-	0.344	0.264	0.000	0.00	0.04
	0.067	0.070	-	-	0.147	0.042	0.000	0.00	0.06
39	0.259	0.085	-	-	0.004	0.023	0.000	0.00	0.00
9	0.000	0.002	-	-					

Selection was done for macros: 1

Chapter C

Foundation HP-LIN Vaporizer

W74101, W74201, W74301, W74401

KMW
Ingenieurgesellschaft mbH
Saarbrücker Straße 9
66130 Saarbrücken-Brebach
Telefon (0681) 8 83 13-0
Telefax (0681) 8 83 13-88
E-Mail info@kmw-ing.de

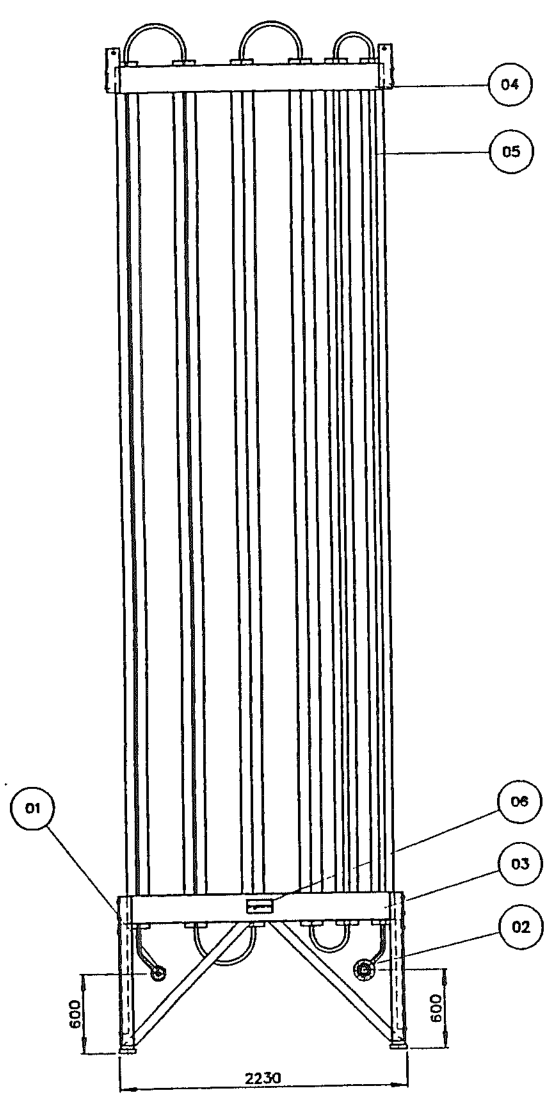
GENERAL NOTES

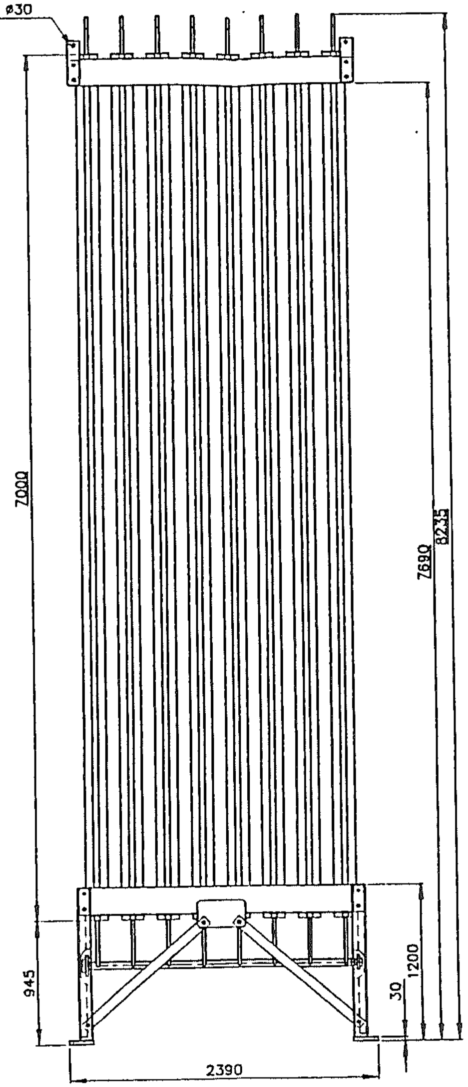
NOM. CAPACITY	: 1750 Nm³/hr.
MEDIA	: O_2–N_2–Ar–CO_2.
WEIGHT	: ±1800 KGS.
MAX. WORKING PRESSURE	: 40 BAR.
TEST PRESSURE	: 44 BAR

TOLERANCE ON DIMENSIONS ±3MM.
CLEANED FOR OXYGEN USE.
FLANGE OUTSIDE DIAMETER AND BOLTCIRCLE ACC. TO DIN 2635 PN40.

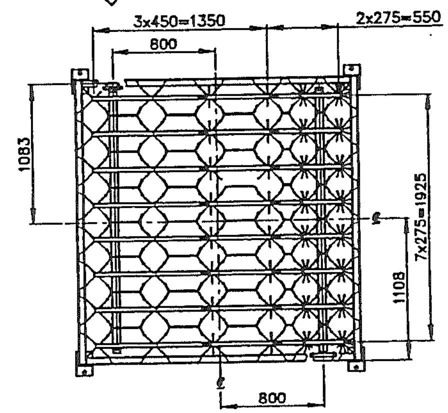
Gr: 180 kW

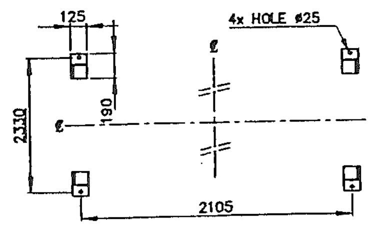
-C2-





TOP VIEW





FOUNDATION

W 74401 - 74404
74401

NR.	QUANT.	NAME/DESCRIPTION	DRWG.	MATERIAL	REMARKS
06	1	NAMEPLATE	CN4193-4	ALUMINIUM	–
05	1	VAPORISER BLOCK	CN4309-2	ALUMINIUM	–
04	1	UPPER FRAME	CN4099-1	ALUMINIUM	–
03	1	BASE FRAME	CN4099-1	ALUMINIUM	–
02	1	OUTLET FLANGE WITH MATING FLANGE DN80	1583-A3 ITEM F	ALU./AISI BRASS	–
01	1	INLET FLANGE WITH MATING FLANGE DN40	1583-A3 ITEM B	ALU./AISI BRASS	–

Fu Rev. 1 25/05/04

REV.	DESCRIPTION	DRWN.	CHK.	DATE
A	CHECKED	JB		25-07-00

CNLP 8x6x7000
AMBIENT AIR VAPORISER

DRWN.: A.BROUWER SCALE: 1:25
CHECKED: JB DATE: 10-07-00
CAD NR. I:\...\E05_205\2WV

CN4307-2

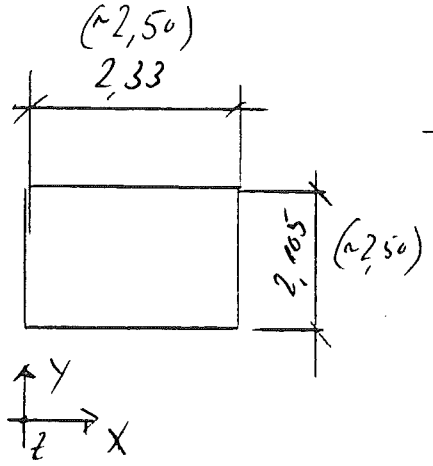
cryonorm bv

REPLACES:

Loadcase

Weight

G = 100 kN



Wind ± X + ± Y

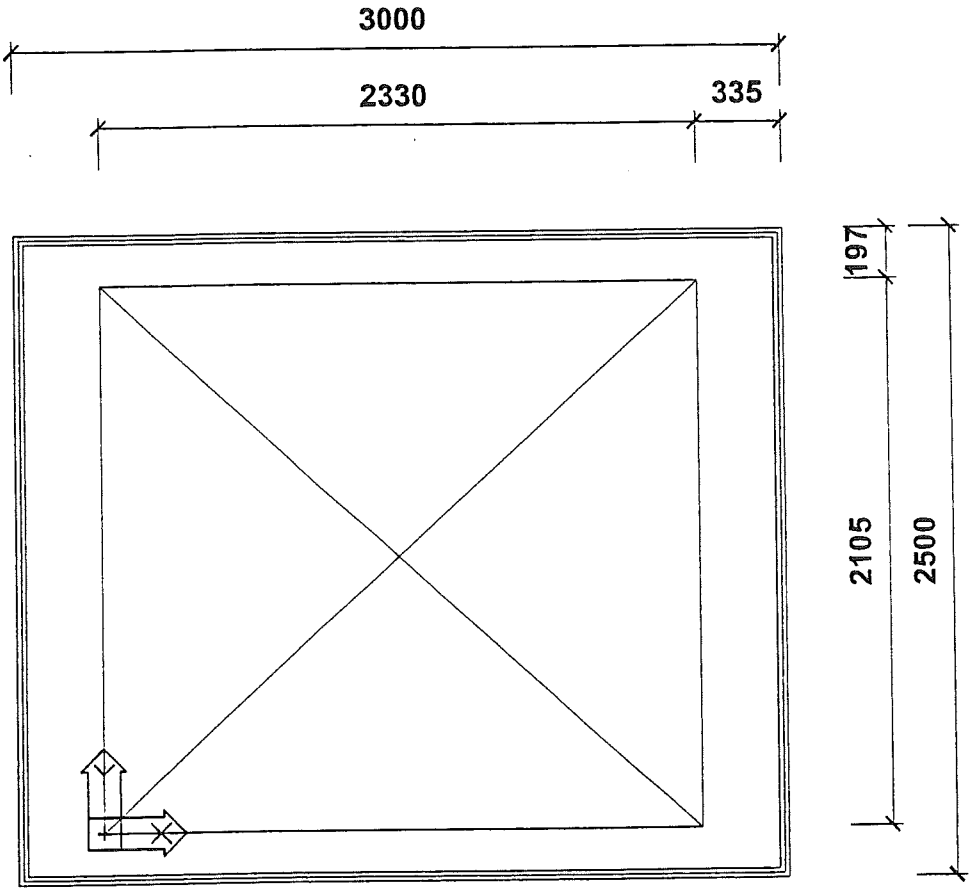
$v_{max} \simeq 80\,m \rightsquigarrow 900 \cdot 0{,}50\ kN/m^2$

$C = 1{,}3$

$q_{wx} \leq 1{,}3 \cdot 0{,}5 \cdot 2{,}50 = \pm 1{,}625\ kN/m$

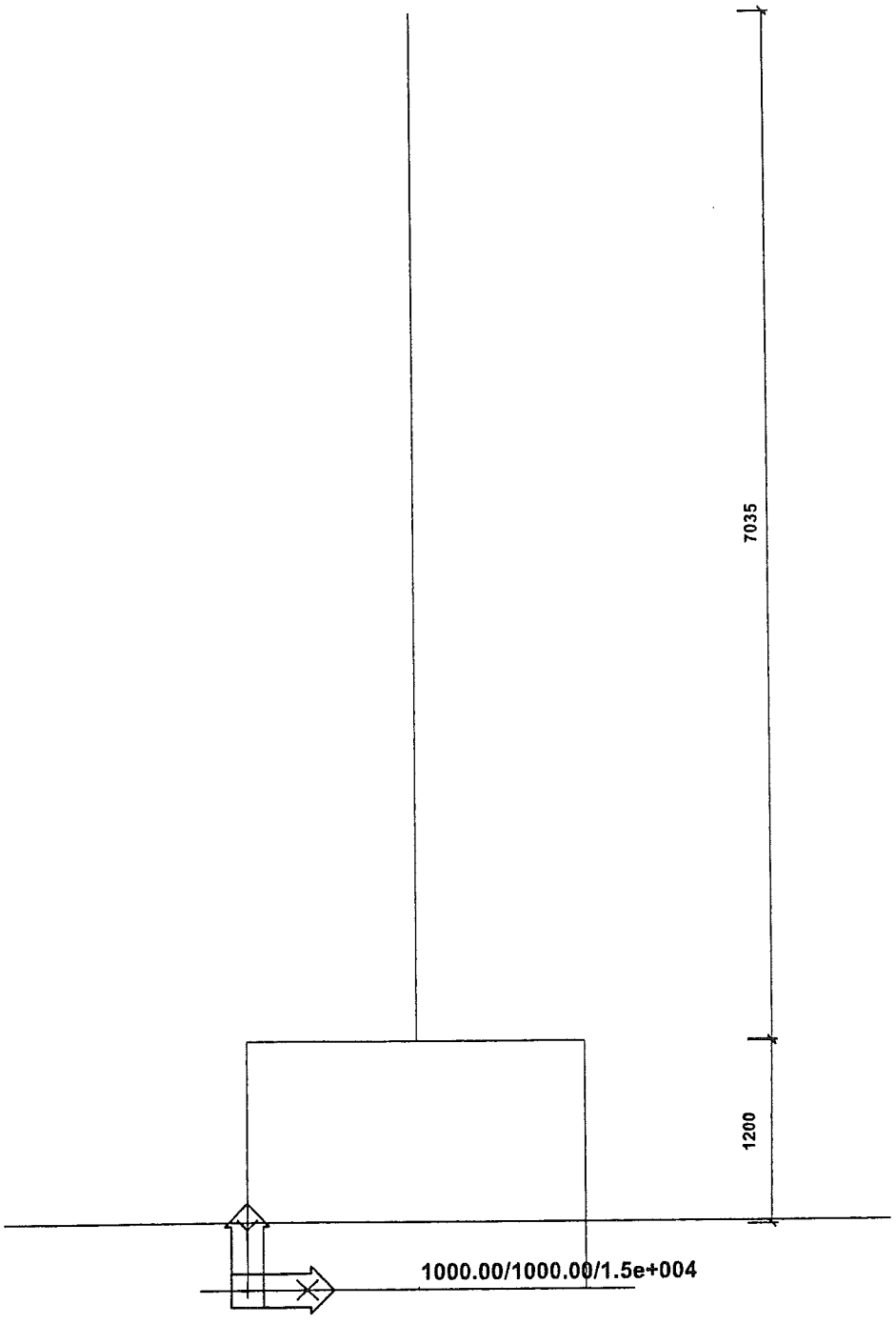
KMW
Ingenieurgesellschaft mbH
Saarbrücker Straße 9
66130 Saarbrücken-Brebach
Telefon (0681) 8 83 13-0
Telefax (0681) 8 83 13-88
E-Mail info@kmw-ing.de

Inhalt



B25 / d = 1.20 m

plan view



System

Basic data
Type of structure : General XYZ

Number of nodes:	14
Number of members:	13
Number of 1D macros:	7
Number of bound. lines:	4
Number of 2D macros:	1
Number of profiles :	1
Number of cases:	6
Number of materials:	2

Material

Name:		
B 25		
	E modulus	30000.00 MPa
	Poisson coeff.	0.20
	Density	2500.000 kg/m^3
	Extensibility	0.01 mm/m.K
B 25 gewichtslos		
	E modulus	30000.00 MPa
	Poisson coeff.	0.20
	Density	0.000 kg/m^3
	Extensibility	0.01 mm/m.K

List of material
Group of members : 1/13

no.	Name:	quality	unit weight kg/m	length m	weight kg

List of material - Macro2D
Group of members : 1/1

no.	Name:	quality	unit volume weight kgm^3	volume m^3	weight kg
4	B 25	B 25	2500.00	9.00	22500.00

The total weight of the structure: 22500.00 kg

Nodes

node	X m	Y m	Z m
1	0.000	0.000	0.000
2	0.000	0.000	1.700

node	X m	Y m	Z m
3	2.330	0.000	0.000
4	2.330	0.000	1.700
5	0.000	2.105	0.000
6	0.000	2.105	1.700
7	2.330	2.105	0.000
8	2.330	2.105	1.700
9	1.165	1.053	1.700
10	1.165	1.053	8.735
11	-0.335	-0.198	0.000
12	2.665	-0.198	0.000
13	2.665	2.303	0.000
14	-0.335	2.303	0.000

Members

macro	memb	node 1	node 2	length m	Rx deg	profile	quality
1	1	1	2	1.700	0.00	1 - Lasteinleitung (Numerica...	B 25 gewichtslos
2	2	3	4	1.700	0.00	1 - Lasteinleitung (Numerica...	B 25 gewichtslos
3	3	5	6	1.700	0.00	1 - Lasteinleitung (Numerica...	B 25 gewichtslos
4	4	7	8	1.700	0.00	1 - Lasteinleitung (Numerica...	B 25 gewichtslos
5	5	2	9	1.570	0.00	1 - Lasteinleitung (Numerica...	B 25 gewichtslos
	6	9	8	1.570	0.00	1 - Lasteinleitung (Numerica...	B 25 gewichtslos
6	7	6	9	1.570	0.00	1 - Lasteinleitung (Numerica...	B 25 gewichtslos
	8	9	4	1.570	0.00	1 - Lasteinleitung (Numerica...	B 25 gewichtslos
	9	4	8	2.105	0.00	1 - Lasteinleitung (Numerica...	B 25 gewichtslos
	10	8	6	2.330	0.00	1 - Lasteinleitung (Numerica...	B 25 gewichtslos
	11	6	2	2.105	0.00	1 - Lasteinleitung (Numerica...	B 25 gewichtslos
	12	2	4	2.330	0.00	1 - Lasteinleitung (Numerica...	B 25 gewichtslos
7	13	9	10	7.035	0.00	1 - Lasteinleitung (Numerica...	B 25 gewichtslos

Boundaries

bound. line	type	node
1	Line	11,12
2	Line	12,13
3	Line	13,14
4	Line	14,11

2D Macros

num	type	
1		
	B 25	Thickness 1.20 m
	Boundary:	1,2,3,4

num type
Nodes : 1,3,5,7

Profiles

Profile no. 1 - Lasteinleitung (Numerical)
Material : 8 - B 25 gewichtslos

A:	1.000000e+002 cm^2		
Ay/A:	1.000	Az/A:	1.000
Iy:	1.000000e+005 cm^4	Iz:	1.000000e+005 cm^4
Iyz:	0.000000e+000 cm^4	It:	1.000000e+005 cm^4
Iw:	1.000000e+005 cm^6		
Wely:	1.000000e+003 cm^3	Welz:	1.000000e+003 cm^3
Wply:	1.000000e+003 cm^3	Wplz:	1.000000e+003 cm^3
cy:	0.00 cm	cz:	0.00 cm
iy:	31.62 cm	iz:	31.62 cm
dy:	0.00 cm	dz:	0.00 cm
Outline :		0.00 cm	

Type for check: Untypical section

Hinges
The stiffeness values of line hinges are stated in 1 m´ of length

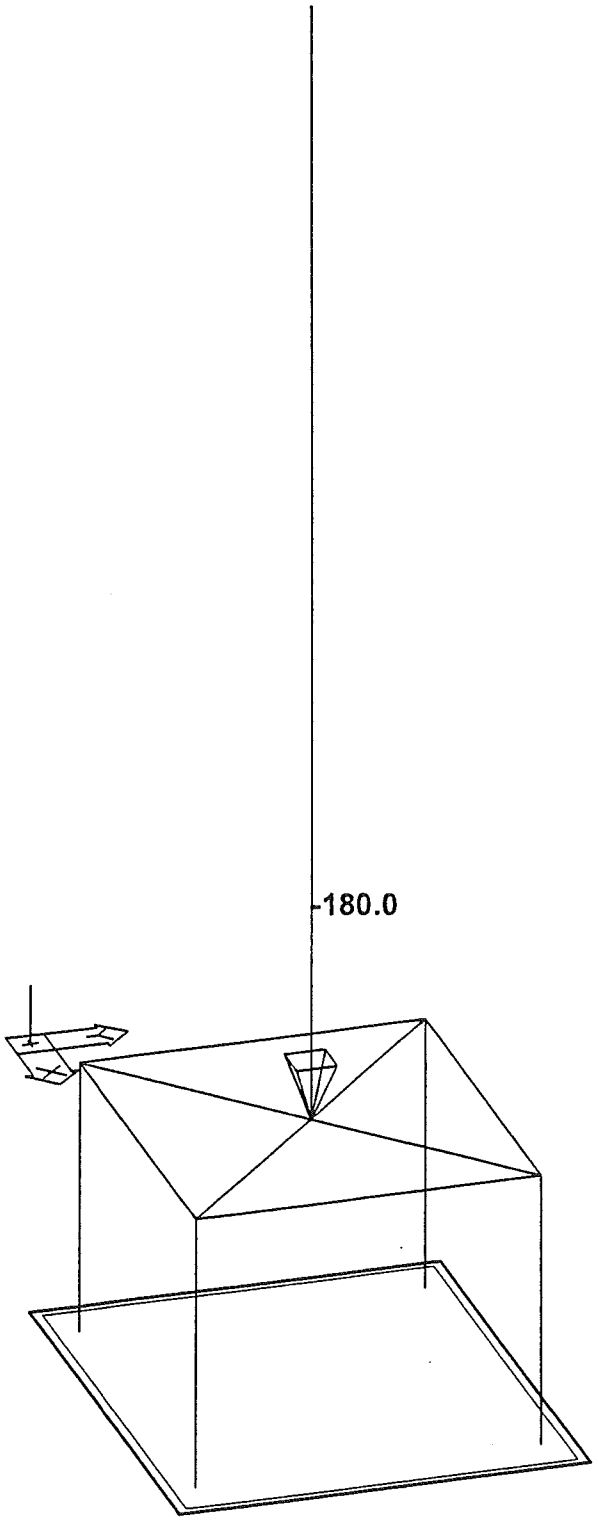
memb	type	pos
1	fiyfiz	beg
2	fiyfiz	beg
3	fiyfiz	beg
4	fiyfiz	beg

Soil - 2D macro

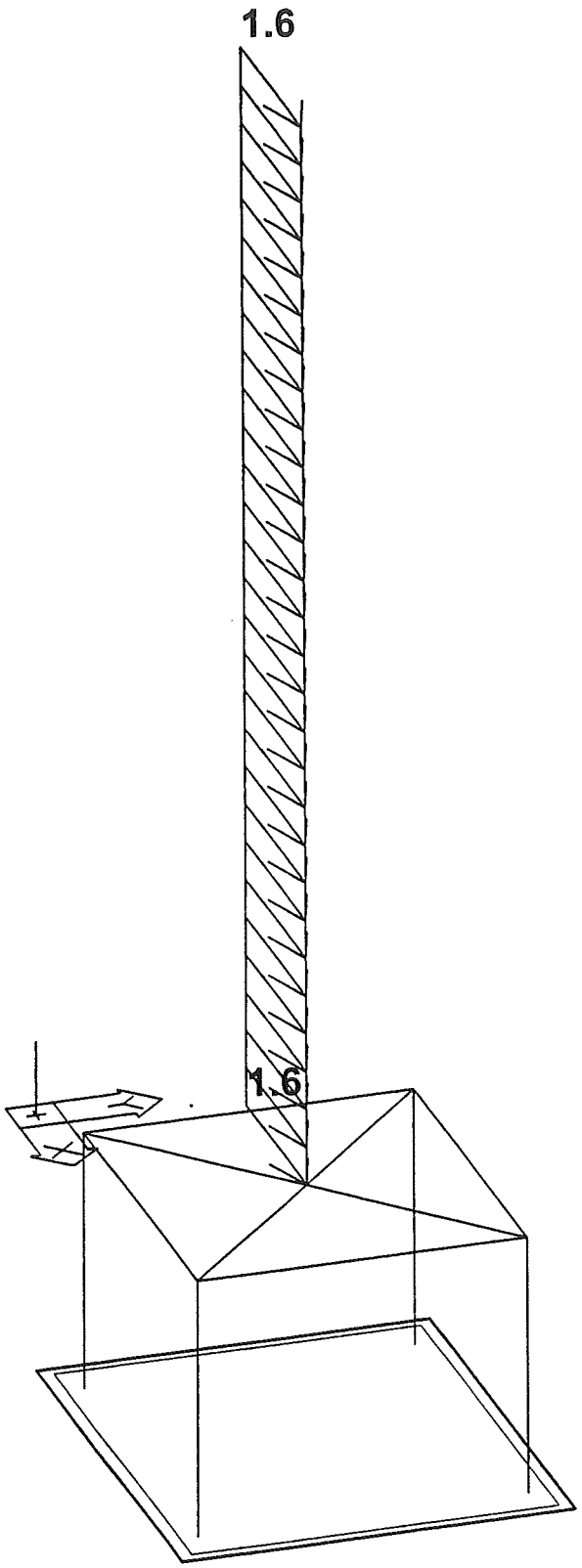
Index	2D macro	Name of subsoil
1	1	Sand/Clean/Moderate

Loadcases

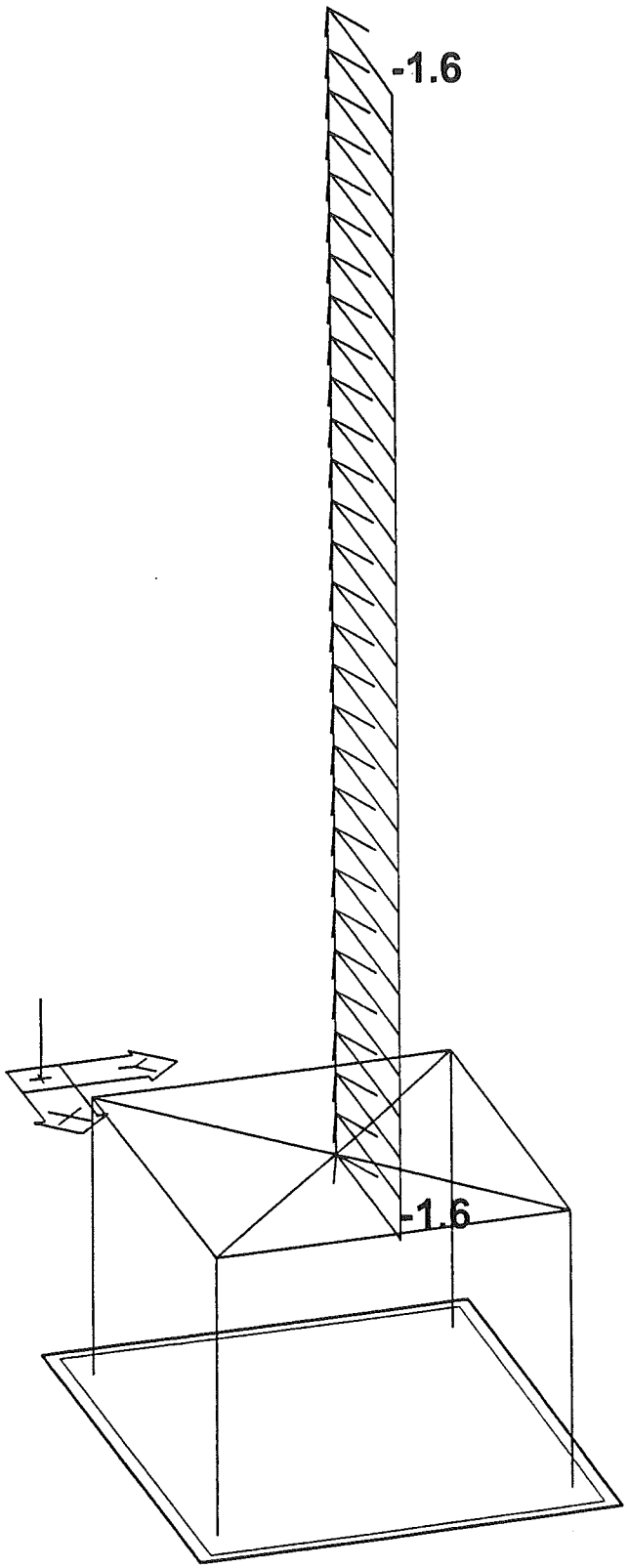
Case	Name:	Description
1	Weight concret	Self weight. Direction -Z
2	Weight	Permanent - Loads
3	Wind +X	Variable - Wind Excl.
4	Wind -X	Variable - Wind Excl.
5	Wind +Y	Variable - Wind Excl.
6	Wind -Y	Variable - Wind Excl.



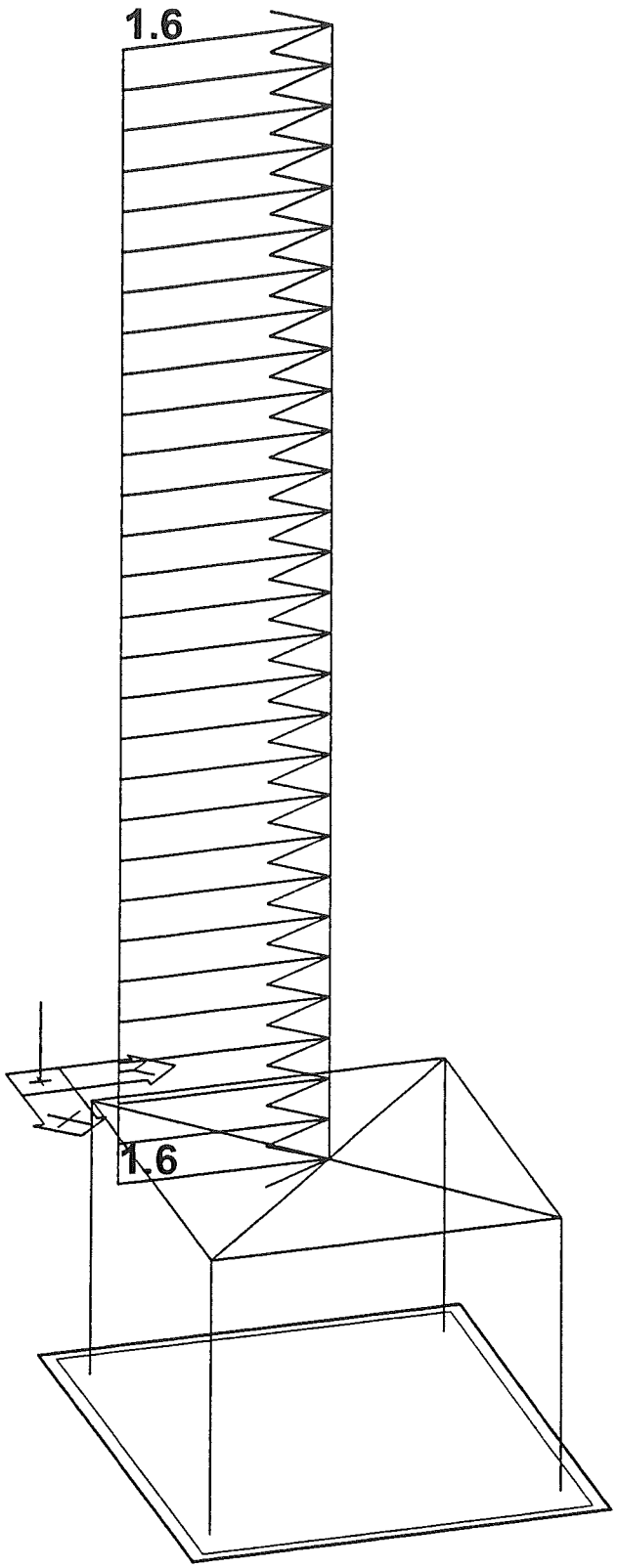
2. Weight



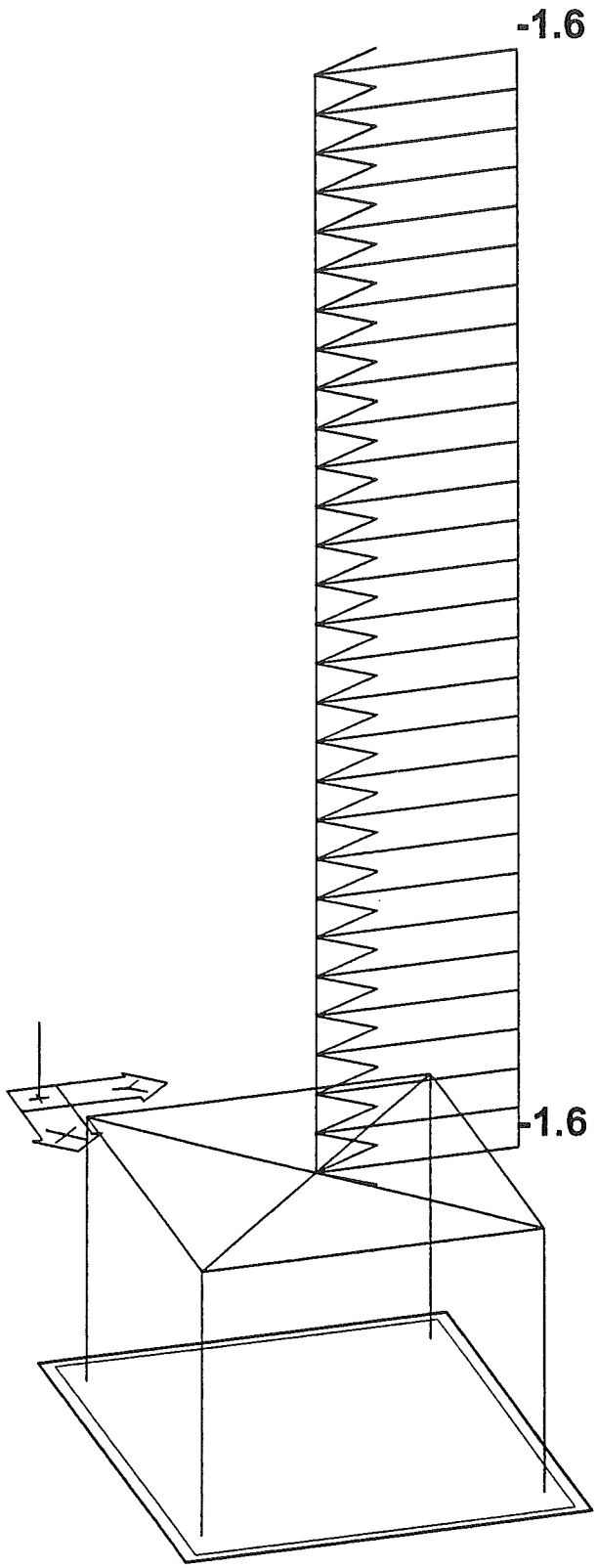
3. Wind +X



4. Wind -X



5. Wind +Y



6. Wind -Y

Loadcase no. 3 - distributed loads

macro	type	dx m	exY m	exZ m		X beg end	Y beg end	Z beg end
7	force	0.00 rel	0.00	0.00	glo	1.63	0.00	0.00
	kN/m	1.00			len	1.63	0.00	0.00

Loadcase no. 4 - distributed loads

macro	type	dx m	exY m	exZ m		X beg end	Y beg end	Z beg end
7	force	0.00 rel	0.00	0.00	glo	-1.63	0.00	0.00
	kN/m	1.00			len	-1.63	0.00	0.00

Loadcase no. 5 - distributed loads

macro	type	dx m	exY m	exZ m		X beg end	Y beg end	Z beg end
7	force	0.00 rel	0.00	0.00	glo	0.00	1.63	0.00
	kN/m	1.00			len	0.00	1.63	0.00

Loadcase no. 6 - distributed loads

macro	type	dx m	exY m	exZ m		X beg end	Y beg end	Z beg end
7	force	0.00 rel	0.00	0.00	glo	0.00	-1.63	0.00
	kN/m	1.00			len	0.00	-1.63	0.00

Combinations

Combi	Norm	Case	coeff
1.	User-ultimate	1 Weight concret	1.00
		2 Weight	1.00
		3 Wind +X	1.00
		4 Wind -X	1.00
		5 Wind +Y	1.00
		6 Wind -Y	1.00

Basic rules for generation of ultimate load combinations:
1 : 1.00*LC1 / 1.00*LC2 / 1.00*LC3 / 1.00*LC4 / 1.00*LC5 / 1.00*LC6

List of extreme ultimate load combinations
1/ 1 : +1.00*LC1+1.00*LC2+1.00*LC3
2/ 1 : +1.00*LC1+1.00*LC2+1.00*LC4
3/ 1 : +1.00*LC1+1.00*LC2+1.00*LC5
4/ 1 : +1.00*LC1+1.00*LC2+1.00*LC6

Subsoils

Name:	Type of position	C1x kN/m^3	C1y kN/m^3	C1z kN/m^3	C2x kN/m	C2y kN/m	SigZpl kN/m^2
Sand/Clean/Moderate	Under plate, block	1000.000	1000.000	15000.000	0.000	0.000	0.000

Calculation protocol.

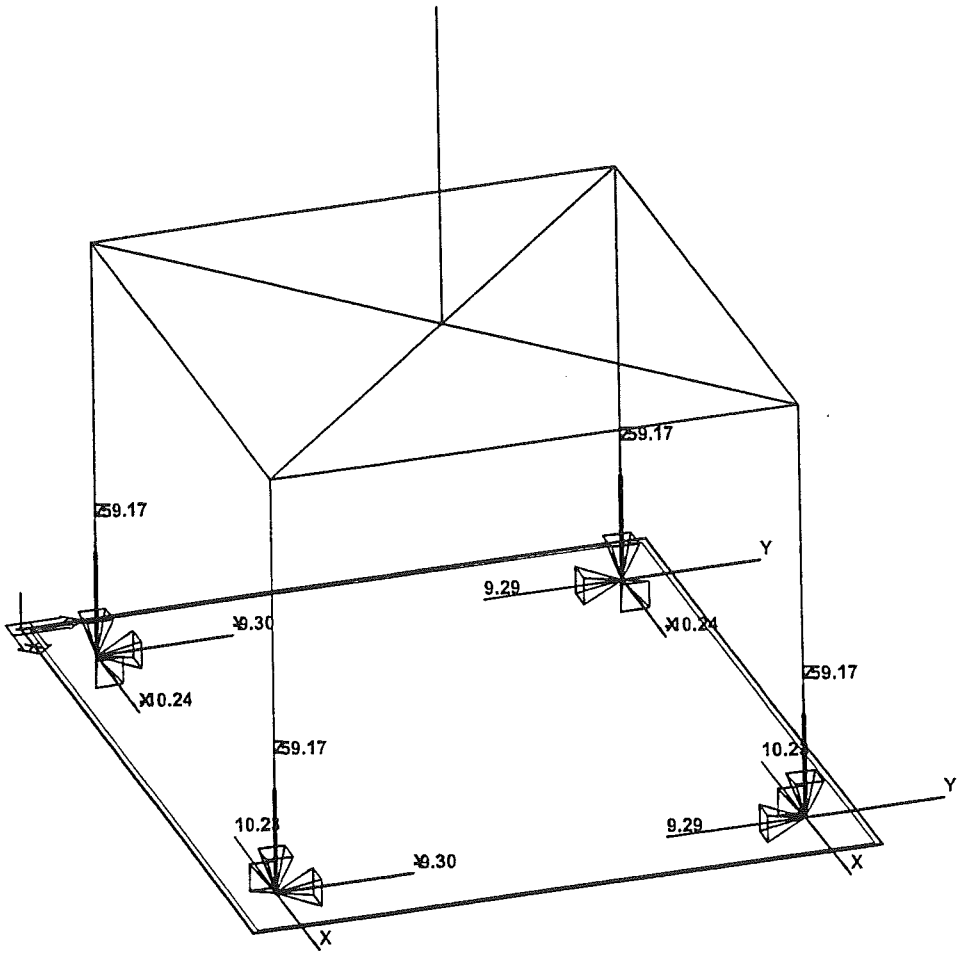
Linear calculation

Number of 2D elements	208
Number of 1D elements	13
Number of mesh nodes	242
Number of equations	1452
Loadcases	LC 1 Weight concret
	LC 2 Weight
	LC 3 Wind +X
	LC 4 Wind -X
	LC 5 Wind +Y
	LC 6 Wind -Y
Bending theory	Mindlin
Start of calculation	23.08.2004 09:25
End of calculation	23.08.2004 09:25

Sum of loads and reactions.

			X	Y	Z
loadcase	1	loads	0.0	0.0	-225.0
		reactions	0.0	0.0	0.0
		contact	0.0	-0.0	225.0
loadcase	2	loads	0.0	0.0	-180.0
		reactions	0.0	0.0	0.0
		contact	0.0	0.0	180.0
loadcase	3	loads	11.4	0.0	0.0
		reactions	0.0	0.0	0.0
		contact	-11.4	0.0	0.0
loadcase	4	loads	-11.4	0.0	0.0
		reactions	0.0	0.0	0.0
		contact	11.4	-0.0	-0.0
loadcase	5	loads	0.0	11.4	0.0
		reactions	0.0	0.0	0.0
		contact	0.0	-11.4	-0.0
loadcase	6	loads	0.0	-11.4	0.0
		reactions	0.0	0.0	0.0
		contact	-0.0	11.4	0.0

$G = 3,0 \cdot 2,5 \cdot 1,2 \cdot 25,0 = 225\,kN$



in node(s). Ult. combi : 1/4

Force in connection coordinate system.

Group of ultimate combi :1/4

1 - a

Node - 3. Position of connection coordinate system related to node : : x : 0.00 m,y : 0.00 m,z : 0.00 m

combi	memb	Fx [kN]	Fy [kN]	Fz [kN]
1	2	10.23	-7.40	-57.80
	sum :	10.23	-7.40	-57.80
2	2	4.52	-5.47	-32.20
	sum :	4.52	-5.47	-32.20

combi	memb	Fx [kN]	Fy [kN]	Fz [kN]
3	2	6.26	-3.58	-30.83
	sum :	6.26	-3.58	-30.83
4	2	8.49	-9.30	-59.17
	sum :	8.49	-9.30	-59.17

2 - b
Node - 7. Position of connection coordinate system related to node : : x : 0.00 m,y : 0.00 m,z : 0.00 m

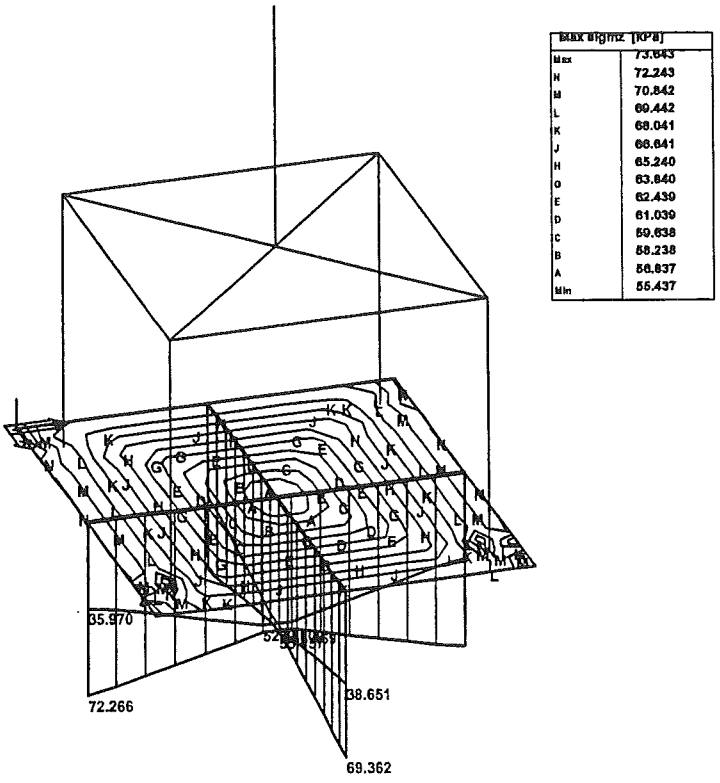
combi	memb	Fx [kN]	Fy [kN]	Fz [kN]
1	4	10.23	7.40	-57.80
	sum :	10.23	7.40	-57.80
2	4	4.52	5.47	-32.20
	sum :	4.52	5.47	-32.20
3	4	8.49	9.29	-59.17
	sum :	8.49	9.29	-59.17
4	4	6.26	3.58	-30.83
	sum :	6.26	3.58	-30.83

3 - c
Node - 5. Position of connection coordinate system related to node : : x : 0.00 m,y : 0.00 m,z : 0.00 m

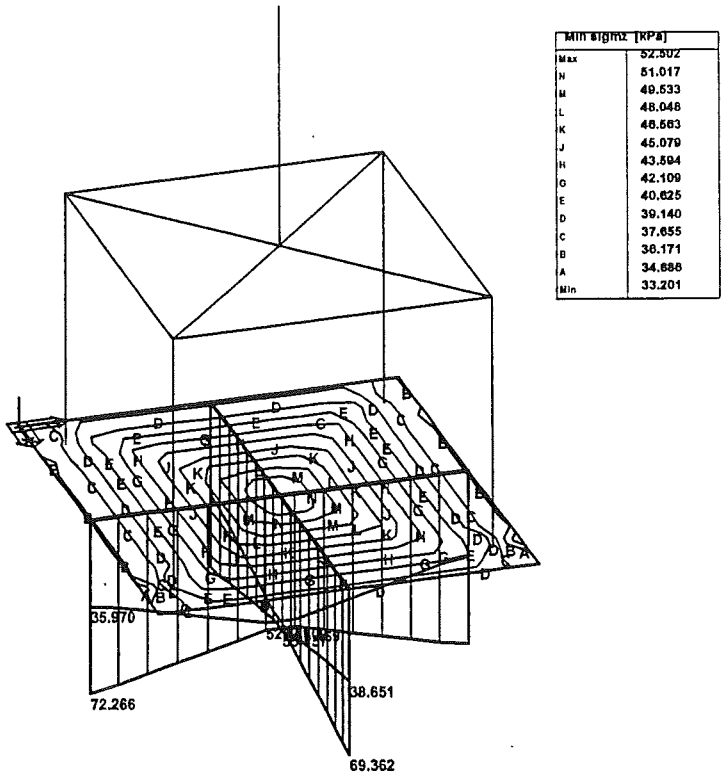
combi	memb	Fx [kN]	Fy [kN]	Fz [kN]
1	3	-4.52	5.47	-32.20
	sum :	-4.52	5.47	-32.20
2	3	-10.24	7.40	-57.80
	sum :	-10.24	7.40	-57.80
3	3	-8.49	9.29	-59.17
	sum :	-8.49	9.29	-59.17
4	3	-6.27	3.58	-30.83
	sum :	-6.27	3.58	-30.83

4 - d
Node - 1. Position of connection coordinate system related to node : : x : 0.00 m,y : 0.00 m,z : 0.00 m

combi	memb	Fx [kN]	Fy [kN]	Fz [kN]
1	1	-4.52	-5.47	-32.20
	sum :	-4.52	-5.47	-32.20
2	1	-10.24	-7.40	-57.80
	sum :	-10.24	-7.40	-57.80
3	1	-6.27	-3.58	-30.83
	sum :	-6.27	-3.58	-30.83
4	1	-8.49	-9.30	-59.17
	sum :	-8.49	-9.30	-59.17



Contact stress - max sigmz - FEM Combi : 1



Contact stress - min sigmz - FEM Combi : 1

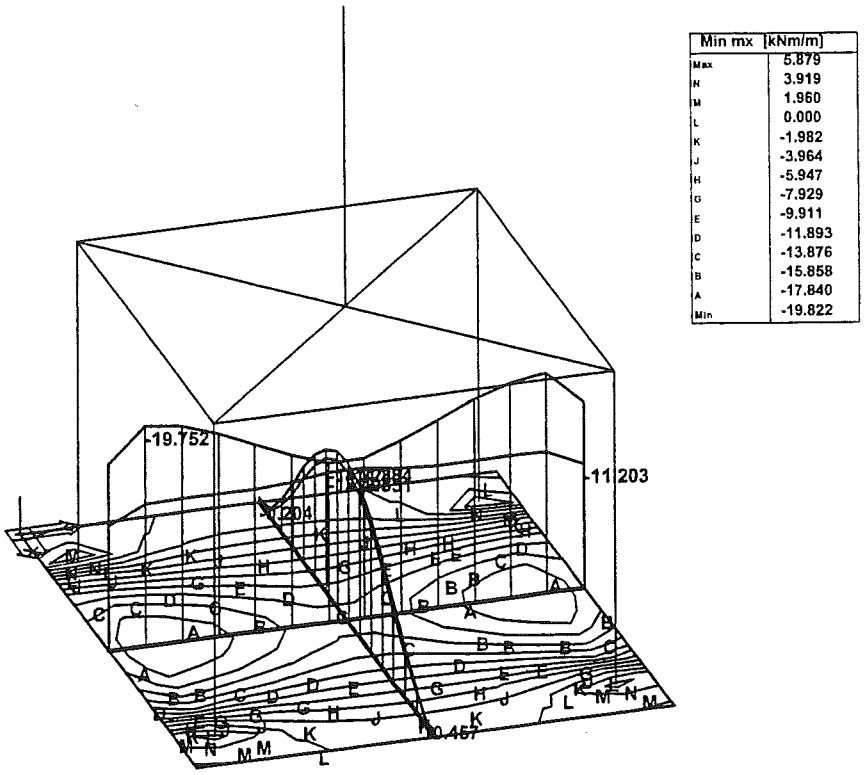
RESULTS : CONTACT STRESSES

FEM Combi:
C1 Eigen-Tragfähigk.

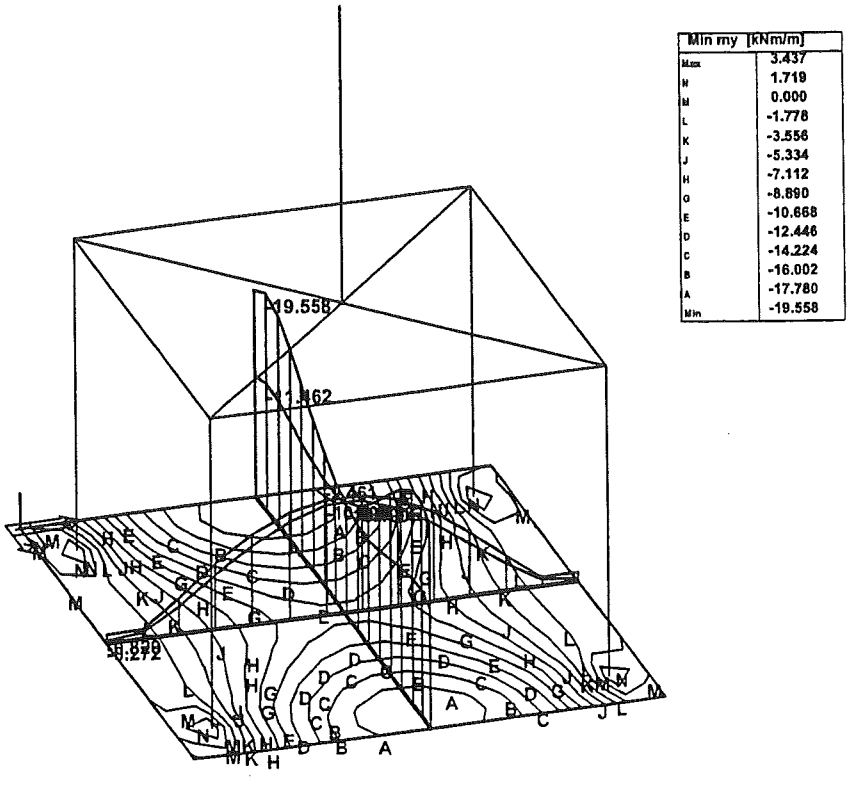
Global extremes

node	tauzx [kPa]	tauzy [kPa]	sigmz [kPa]
11	1.525	1.524	72.417
13	-1.525	-1.524	36.324
163	1.525	1.525	73.643
219	-1.524	1.525	36.708
163	1.525	1.525	73.643
175	-1.525	-1.524	33.201

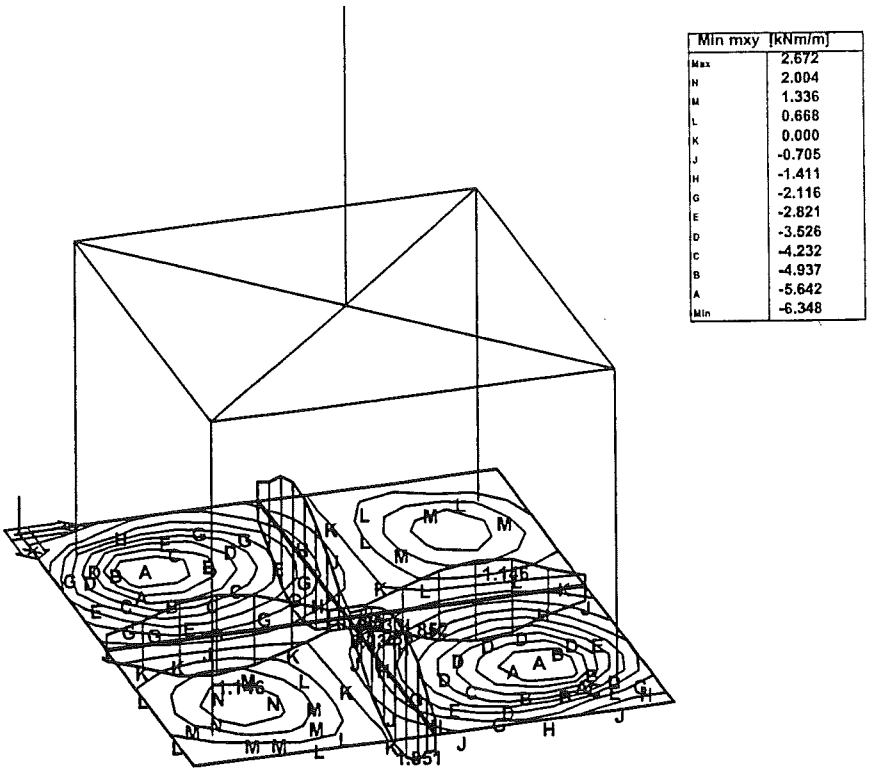
Selection was done for macros: 1



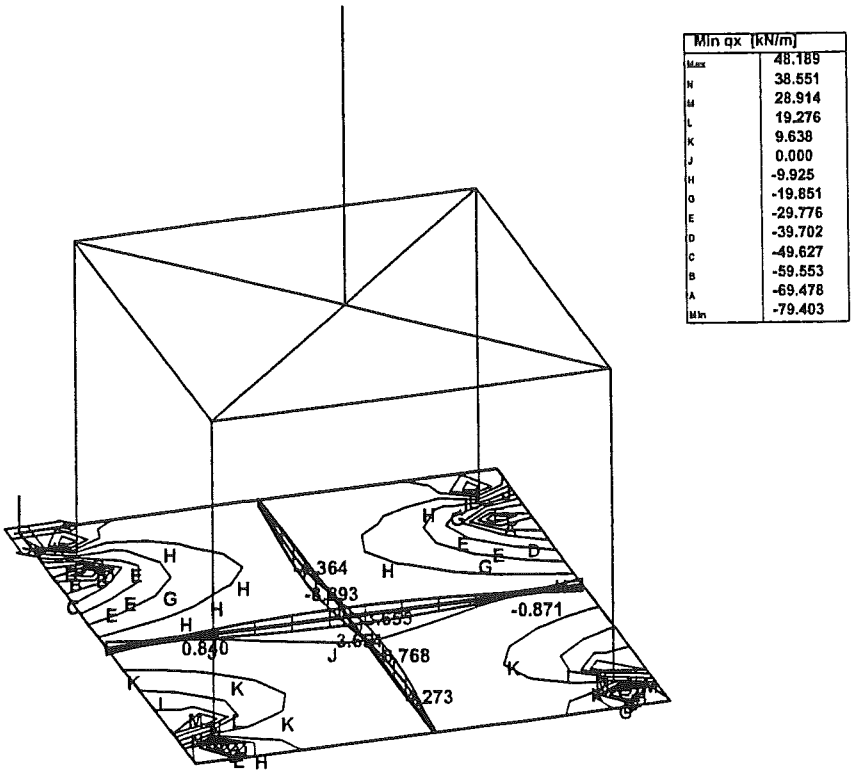
Internal force - min mx - FEM Combi : 1



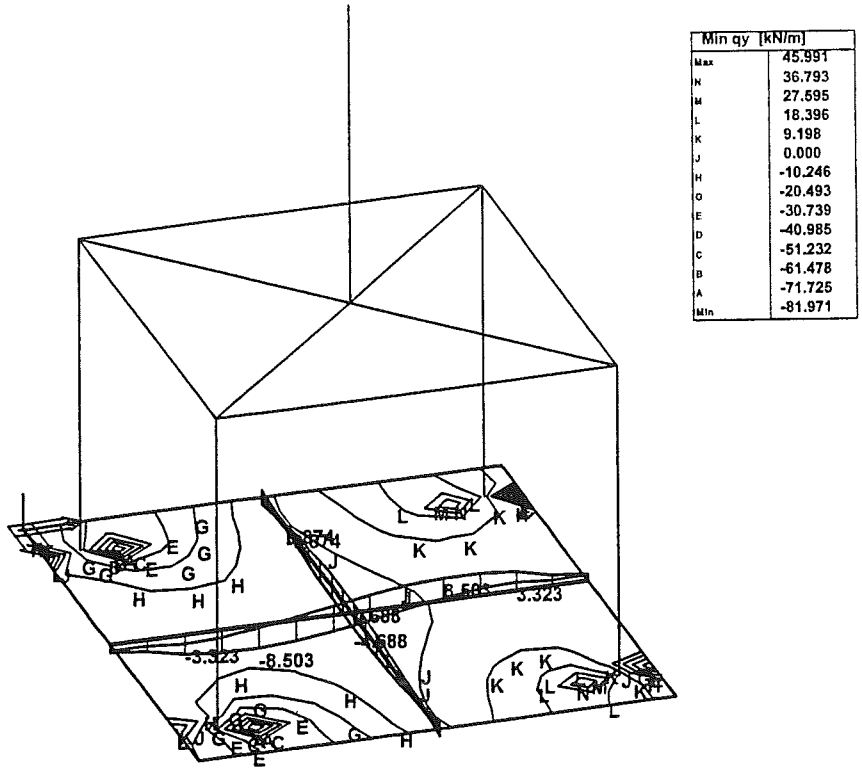
Internal force - min my - FEM Combi : 1



Internal force - min mxy - FEM Combi : 1



Internal force - min qx - FEM Combi : 1



Internal force - min qy - FEM Combi : 1

RESULTS : INTERNAL FORCES

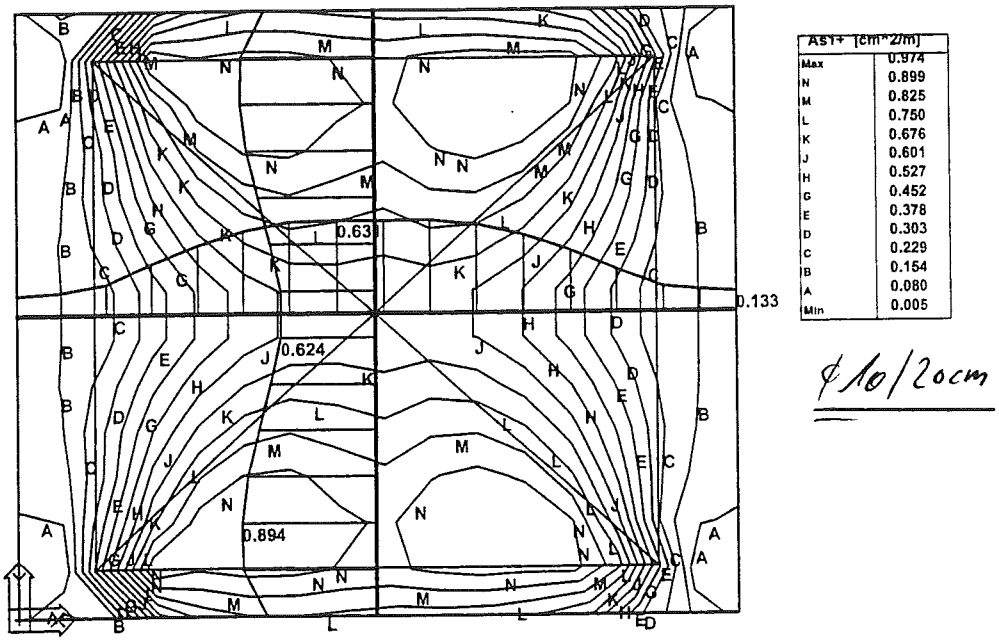
FEM Combi:
C1 Eigen-Tragfähigk.

Global extremes

Rotation of the local system: No
Basic magnitudes - bending, membrane

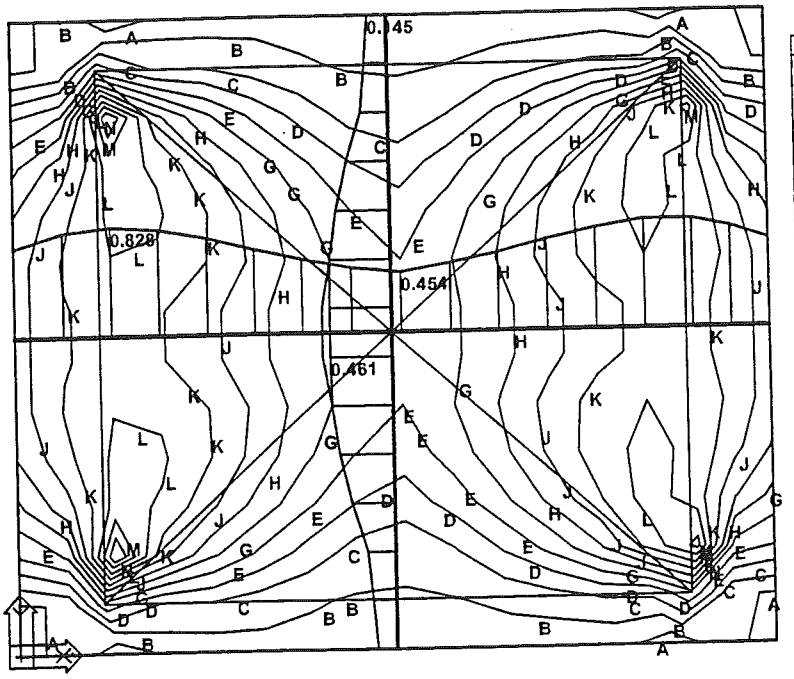
node	mx [kNm/m]	my [kNm/m]	mxy [kNm/m]	qx [kN/m]	qy [kN/m]	nx [kN/m]	ny [kN/m]	qxy [kN/m]
5	**12.048**	7.269	2.745	-6.734	26.328	8.663	7.445	-2.284
159	**-19.822**	-0.836	-0.512	0.686	-4.139	6.830	0.136	-0.588
5	12.048	**7.269**	2.745	-6.734	26.328	8.663	7.445	-2.284
67	-0.793	**-19.558**	-1.379	-3.816	-4.608	-0.121	2.835	-0.269
20	-5.964	-2.907	**6.348**	33.346	-10.677	10.676	3.669	-4.048
146	-8.757	-4.592	**-6.348**	18.506	10.677	6.357	2.287	4.048
176	1.253	2.954	3.758	**90.846**	-6.371	26.769	2.580	-2.930
164	-5.566	1.064	-3.999	**-79.403**	-15.069	11.675	0.520	2.964
148	5.495	-3.597	-1.518	11.115	**81.925**	1.170	23.640	13.189
35	2.474	-6.182	1.517	6.688	**-81.971**	0.252	10.172	-13.181
176	1.253	2.954	3.758	90.846	-6.371	**26.769**	2.580	-2.930
161	2.235	1.555	-1.123	26.937	-23.354	**-14.292**	3.842	-11.609
148	5.495	-3.597	-1.518	11.115	81.925	1.170	**23.640**	13.189
163	3.564	-0.371	-0.990	-44.532	33.444	14.251	**-14.078**	-1.695
21	4.353	-3.522	-1.986	-12.967	-45.040	9.072	22.295	**17.399**
137	1.498	-6.016	1.986	-22.978	45.040	4.094	8.671	**-17.399**

Selection was done for macros: 1



Ø10/20cm

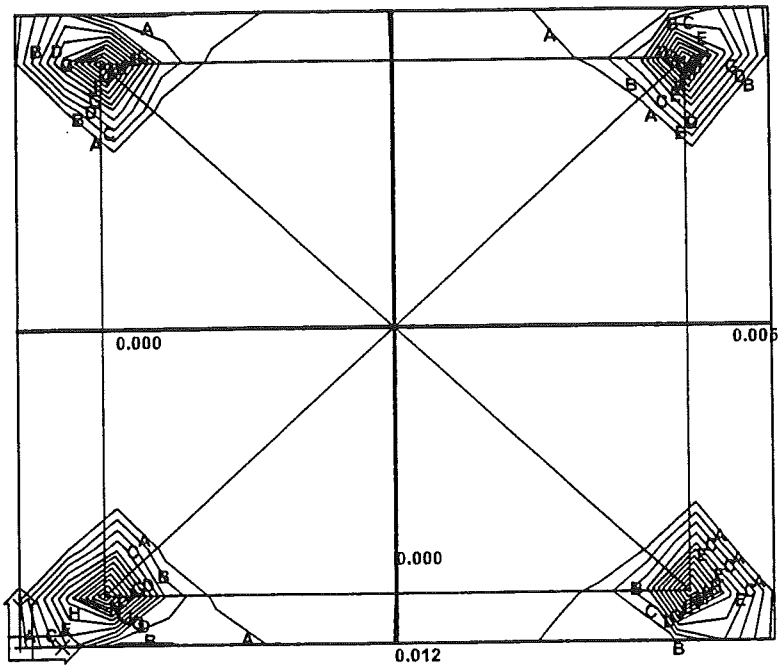
2D reinforcement - As1+



As2+ [cm^2/m]	
Max	1.144
N	1.056
M	0.969
L	0.881
K	0.794
J	0.707
H	0.619
G	0.532
E	0.444
D	0.357
C	0.270
B	0.182
A	0.095
Min	0.007

9/10/20cm

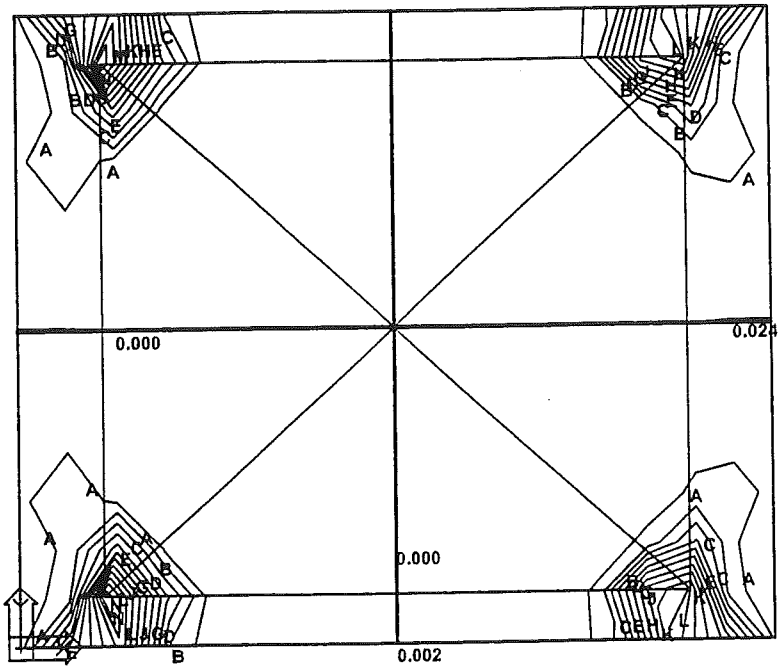
2D reinforcement - As2+



As2- [cm^2/m]	
Max	0.839
N	0.774
M	0.710
L	0.645
K	0.581
J	0.516
H	0.452
G	0.387
E	0.323
D	0.258
C	0.194
B	0.129
A	0.065
Min	0.000

9/10/20 cm

2D reinforcement - As2-



As1- [cm^2/m]	
Max	1.019
N	0.941
M	0.862
L	0.784
K	0.706
J	0.627
H	0.549
G	0.470
E	0.392
D	0.314
C	0.235
B	0.157
A	0.078
Min	0.000

Ø 10/20cm

2D reinforcement - As1-

Code for calculation: DIN 1045 7/88

Explanation of concrete symbols

Abbreviation	Explanation
betaWN	Concrete cube compression strength.
betaR	Design concrete compression strength.
Tau01	1st shear stress limit according Table 13.
Tau02	2nd shear stress limit according Table 13.
Tau03	3rd shear stress limit according Table 13.

Concrete characteristics

	B 25
betaWN	25000.000 kPa
betaR	17500.000 kPa
Tau011_1 plates	350.000 kPa
Tau011_2 plates	500.000 kPa
Tau02 plates	1800.000 kPa
Tau012 beams	750.000 kPa
Tau02 beams	1800.000 kPa
Tau03 beams	3000.000 kPa

Explanation of reinforcement steel symbols

Abbreviation	Explanation
betaS	Characteristic yield strength of reinforcement

Steel characteristics

	BSt 420
betaS	420000.000 kPa
E modulus	200000000.000 kPa

Input parameters

Description	Percentage
Maximum % of reinforcement	9.00
Minimum % of net reinforcement	0.00
Minimum % of pressure reinforcement	0.50
Minimum % of tension reinforcement	0.00
Minimum % of transverse reinforcement	20.00

Shear mode
Tension reinforcement is partially anchored in the field.

Description	Value
height < 7 cm represents increase of internal forces (§ 17.2.1 (6))	ON
Structural reinforcement of deep beam	OFF

Global extremes

Necessary areas

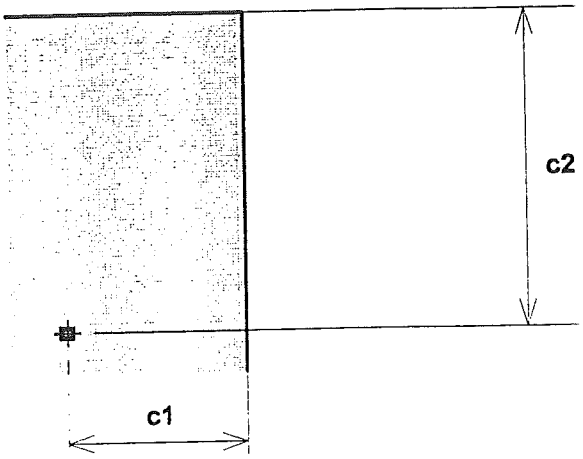
node	As1+ [cm^2/m]	As2+ [cm^2/m]	As3+ [cm^2/m]	As3- [cm^2/m]	As2- [cm^2/m]	As1- [cm^2/m]	Ass [cm^2/m^2]	tau [MPa]	tau0 [MPa]
18	0.974	0.472	-	-	0.009	0.001	0.000	0.00	0.02
224	0.005	0.078	-	-	0.061	0.021	0.000	0.00	0.01
137	0.405	0.145	-	-	0.307	0.430	0.000	0.00	0.03
14	0.053	0.007	-	-	0.037	0.050	0.000	0.00	0.01
1	0.394	0.414	-	-	0.839	1.019	0.000	0.00	0.06
22	0.627	0.871	-	-	0.000	0.008	0.000	0.00	0.03
5	0.394	0.414	-	-	0.839	1.019	0.000	0.00	0.06
24	0.819	0.723	-	-	0.000	0.000	0.000	0.00	0.02
1	0.394	0.414	-	-	0.839	1.019	0.000	0.00	0.06
	0.394	0.414	-	-	0.839	1.019	0.000	0.00	0.06
	0.394	0.414	-	-	0.839	1.019	0.000	0.00	0.06
	0.394	0.414	-	-	0.839	1.019	0.000	0.00	0.06
164	0.967	0.259	-	-	0.181	0.335	0.000	0.00	0.07
101	0.693	0.444	-	-	0.000	0.000	0.000	0.00	0.00

Selection was done for macros: 1

Anchor fastening design for HST-M8

As per ETAG Annex C method

Positioning

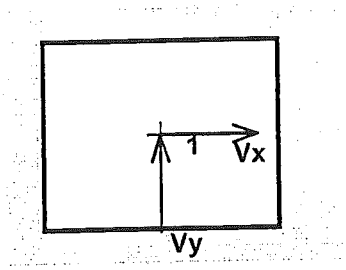


Anchoring plate:

Single anchor
lx=125 mm ly=100 mm
c1: 190.0 cm c2: 335.0 cm

⊕ Anchor

Loads (design values)



Shear Load:

Vx_d=4.3 kN (1.50*2.9 kN)
Vy_d=4.3 kN (1.50*2.9 kN)

Concrete

Compressive class: C20/25
tensile zone / cracked concrete
Thickness of base material: 120.0 cm
no edge reinforcement
close reinforcement (close reinforcement (s <= 15 cm))

Tension Load N

HST-M8

Anchor 1
Design value of tension load $N_{Sd,i}$ 0.0 kN

Design value of anchor group $N^{g}_{Sd} = \sum N_{Sd,i}$ = 0.0 kN

Steel failure

Characteristic value for one anchor $N_{Rk,s}$ = —
Partial safety factor γ_{Ms} = 1.00

Design value of resistance $N_{Rd,s} = \frac{N_{Rk,s}}{\gamma_{Ms}}$ = — Check $\frac{N^{h}_{Sd}}{N_{Rd,s}}$ = 0.00

Pullout failure

Characteristic value for one anchor $N_{Rk,p}$ = —
Partial safety factor γ_{Mp} = 1.00

Design value of resistance $N_{Rd,p} = \frac{N_{Rk,p}}{\gamma_{Mp}}$ = — Check $\frac{N^{h}_{Sd}}{N_{Rd,p}}$ = 0.00

Concrete cone failure

Initial value of the anchor resistance	$N^{0}_{Rk,c}$	= —		
Actual area of concrete cone	$A_{c,N}$	= —		
Reference area of concrete cone	$A^{0}_{c,N}$	= —		
Factor for disturbance of stressed distribution	$\psi_{s,N}$	= 1.00		
Shell spalling factor	$\psi_{re,N}$	= 1.00		
Eccentricity of the resulting tensile load	$e_{N,x}$	= 0 mm	$e_{N,y}$	= 0 mm
Factors for eccentrical loading	$\psi_{ec,N,x}$	= 1.00	$\psi_{ec,N,y}$	= 1.00
Factors for the position of the anchorage	$\psi_{ucr,N}$	= 1.00		

Characteristic value for the anchor group

$$N_{Rk,c} = N^{0}_{Rk,c} \cdot \frac{A_{c,N}}{A^{0}_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec,N,x} \cdot \psi_{ec,N,y} \cdot \psi_{ucr,N} = —$$

Partial safety factor γ_{Mc} = 1.00

Design value of resistance $N_{Rd,c} = \frac{N_{Rk,c}}{\gamma_{Mc}}$ = — Check $\frac{N^{g}_{Sd}}{N_{Rd,c}}$ = 0.00

Shear Load V

HST-M8

Anchor		1
Design value of shear in x	$V_{Sd,x,i}$	4.3 kN
Design value of shear in y	$V_{Sd,y,i}$	4.3 kN

Design value of anchor group: $V^g_{Sd,x} = \sum V_{Sd,x,i}$ = 4.3 kN $V^g_{Sd,y} = \sum V_{Sd,y,i}$ = 4.3 kN

Resulting design value of shear: $V_{Sd,i}$ = 6.2 kN

Steel failure without lever arm

Characteristic value for one anchor: $V_{Rk,s}$ = 13.0 kN

Partial safety factor: $_{Ms}$ = 1.25

Design value of resistance: $V_{Rd,s} = \frac{V_{Rk,s}}{Ms}$ = 10.4 kN Check $\frac{V^h_{Sd}}{V_{Rd,s}}$ = 0.59

Concrete edge failure

Initial value of the anchor resistance	$V^0_{Rk,c}$	= —		
Actual area of concrete cone	$A_{c,V}$	= 0 mm²		
Reference area of concrete cone	$A^0_{c,V}$	= 0 mm²		
Factor for disturbance of stressed distribution	$_{s,V}$	= 1.00		
Factor for member thickness	$_{h,V}$	= 1.00		
Factor for load direction	$_{,V}$	= 1.00		
Eccentricity of the resulting shear load	$e_{V,x}$	= 0 mm	$e_{V,y}$	= 0 mm
Factors for eccentrical loading	$_{ec,V,x}$	= 1.00	$_{ec,V,y}$	= 1.00
Factors for the position of the anchorage	$_{ucr,V}$	= 1.0		

Characteristic value for the anchor group

$V_{Rk,c} = V^0_{Rk,c} \cdot \frac{A_{c,V}}{A^0_{c,V}} \cdot {}_{s,V} \cdot {}_{h,V} \cdot {}_{,V} \cdot {}_{ec,V} \cdot {}_{ucr,V}$ $V_{Rk,c,x}$ = — $_{Mc}$ = 0.00

Design value of resistance: $V_{Rd,c} = \frac{V_{Rk,c}}{Mc}$ = — Check $\frac{V^g_{Sd}}{V_{Rd,c}}$ = 0.00

Concrete pryout failure

HST-M8

Factor for short stiff anchors	$k = 2.0$	
Characteristic value for the anchor group	$N_{Rk,c} = 8.5$ kN	
Characteristic value for the anchor group	$V_{Rk,c} = 17.1$ kN	
Partial safety factor	$_{Mc} = 1.80$	
Design value of resistance	$V_{Rd,c} = \frac{V_{Rk,c}}{Mc} = 9.5$ kN	Check $\frac{V_{Sd}^{g}}{V_{Rd,c}} = 0.65$

Chapter D

Foundation LIN Wather bath vaporizer

W73101

KMW
Ingenieurgesellschaft mbH
Saarbrücker Straße 9
66130 Saarbrücken-Brebach
Telefon (0681) 8 83 13-0
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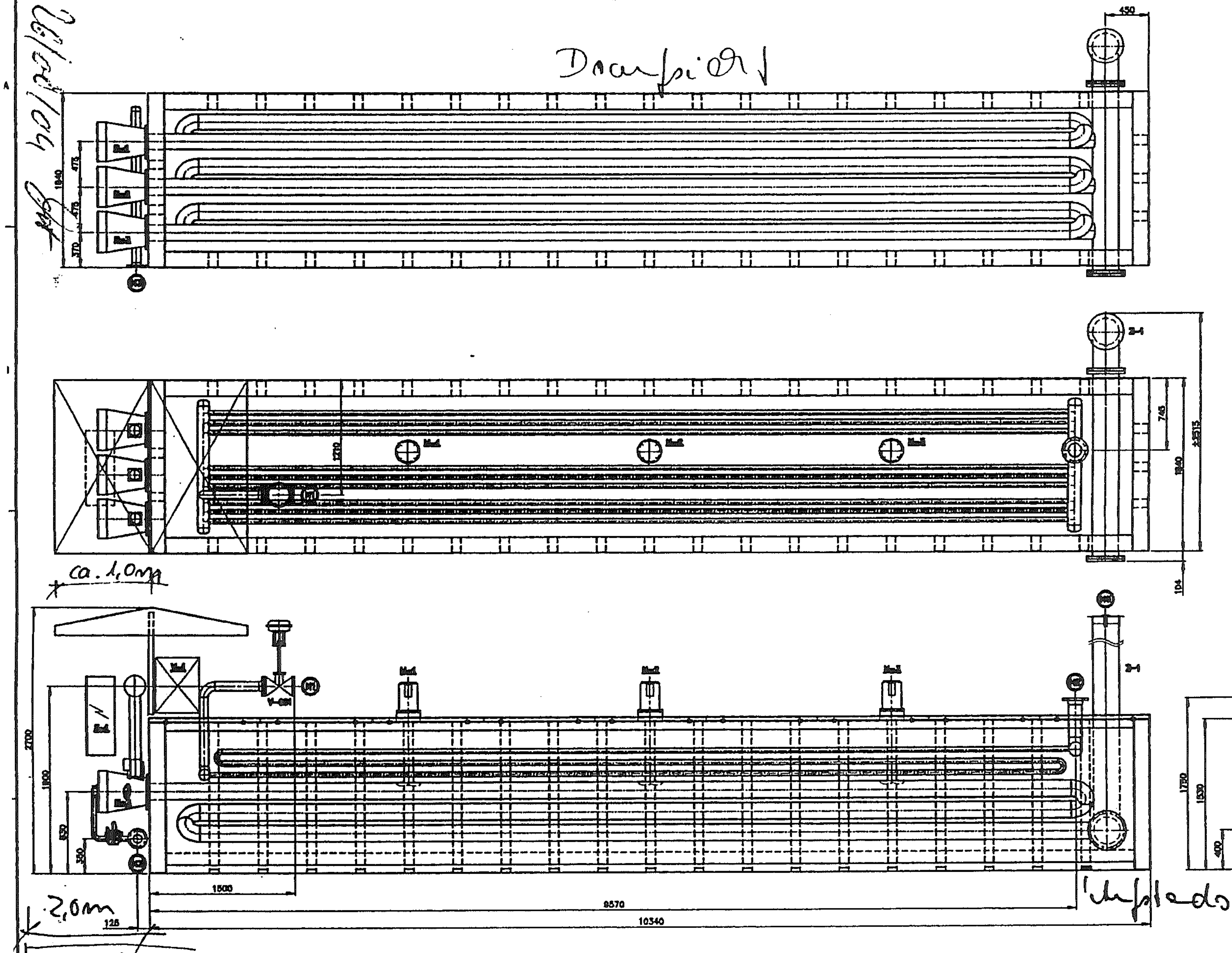
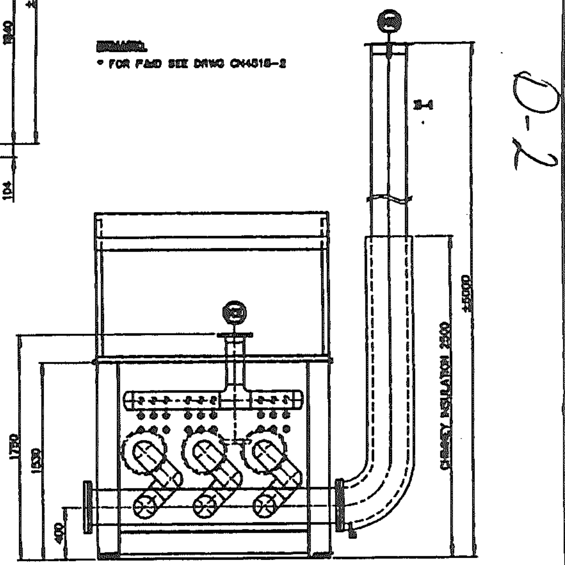
E. Ma. Hr. CN4154

MGSR / Ra 03.08.04

D-2





NOZZLE CONNECTIONS

POS.	DESCRIPTION	DN	REMARKS
N1	LIQUID NITROGEN INLET	DN80	PN16-DIN2633
N2	GASEOUS NITROGEN OUTLET	DN150	PN16-DIN2633
N3	NATURAL GAS INLET	DN80	PN16-DIN2633
N4	WATER INLET	1"	HOSE NIPPLE
N5	WATER OUTLET/ DRAIN	2"	HOSE NIPPLE
N6	BURNER EXHAUST	10"	PN10-DIN2576

GENERAL NOTES

MEDIUM : N_2
CAPACITY : 16.000 $Nm^3/hr.$

COIL:

DESIGN PRESSURE : 16 BAR
MAX. WORKING PRESSURE : 16 BAR
TEST PRESSURE : 23 BAR WITH WATER
MIN./MAX. WORKING TEMP. : -196°/+80°C
DESIGN TEMP. : -196°/+80°C
CONTENTS : ±320 LTR.
CORROSION ALLOWANCE : 0
WELDING DETAILS : ACCORDING TO WPS 01.08.01
MATERIAL COIL : AISI-316(L)
WELDING CONSUMABLE MAT. : ER 308 LSI
MATERIALDOCUMENTATION : ACCORDING TO EN 10204 - 3.1.B
NON DESTRUCTIVE TESTING : 10% X-RAY
DESIGN NORM : ACC. TO ASME SEC VIII, DIV 1, 1998
WELDS PICKLED AND PASSIVATED

VESSEL:

DESIGN PRESSURE : ATM.
TEST PRESSURE : HYDROSTATIC WITH WATER
MIN./MAX. WORKING TEMP. : 0°/+80°C
DESIGN TEMP. : 0°/+80°C
CONTENTS : ±17.000 LTR.
MATERIAL : AISI-304(L)
WELDS PICKLED AND PASSIVATED
VESSEL PROVIDED WITH INSULATION 150 MM ROCKWOOL AND STUCO PLATE

REMARKS:

* FOR P&ID SEE DRWG CN4516-2

→ Weight in service: approx. 28000 kg

ASU No 9 - KOSICE: W73101

26/04/04

INDIRECT FIRED WATER BATH VAP.
GENERAL ARRANGEMENT

cryonorm

CN4165-1

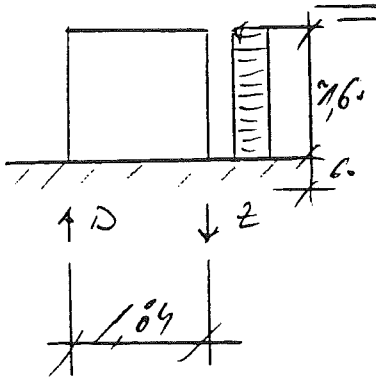
Load case

Weight

$$G = 28000\,kg \hat{=} \underline{280\,kN}$$

$$g' = \frac{280}{2 \cdot 10{,}34} = \underline{13{,}54\,kN/m}$$

Wind ± y



$$q_w = 1{,}3 \cdot 0{,}5 = 0{,}65\,kN/m^2$$

$$q_z = -q_D = \frac{\pm 0{,}65 \cdot 1{,}6 \cdot 1{,}4}{1{,}84} \simeq \pm \underline{0{,}80\,kN/m}$$

Snow: $s_0 = 0{,}75\,kN/m^2$

$$q_s = \frac{0{,}75 \cdot 1{,}84}{2} = \underline{0{,}69\,kN/m}$$

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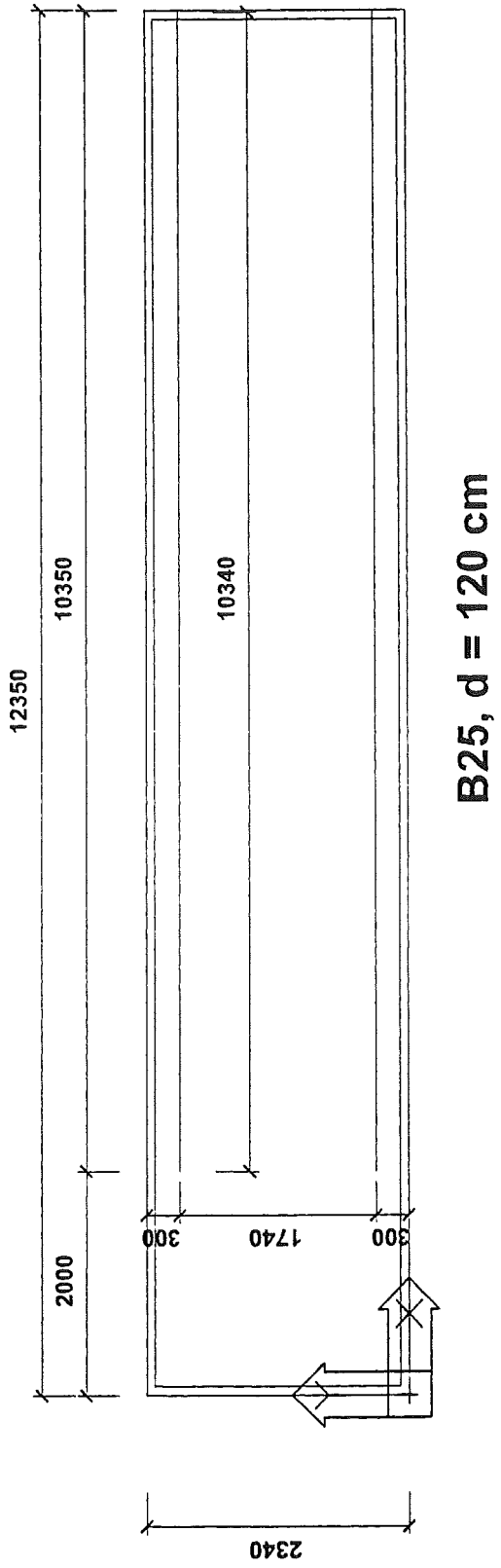
Inhalt



plan view

Basic data
Type of structure : General XYZ

Number of nodes:	8
Number of members:	0
Number of 1D macros:	0
Number of bound. lines:	6
Number of 2D macros:	1
Number of profiles :	0
Number of cases:	5
Number of materials:	1

Material

Name:
B 25

E modulus	30000.00 MPa
Poisson coeff.	0.20
Density	2500.000 kg/m^3
Extensibility	0.01 mm/m.K

List of material - Macro2D
Group of members :
1/3

no.	Name:	quality	unit volume weight kgm^3	volume m^3	weight kg
4	B 25	B 25	2500.00	34.68	86697.00

The total weight of the structure: 86697.00 kg

Nodes

node	X m	Y m	Z m
1	0.000	0.000	0.000
2	12.350	0.000	0.000
3	12.350	2.340	0.000
4	0.000	2.340	0.000
5	2.000	0.300	0.000
6	12.340	0.300	0.000
7	2.000	2.040	0.000
8	12.340	2.040	0.000

Boundaries

bound. line	type	node
1	Line	1,2
2	Line	2,3
3	Line	3,4
4	Line	4,1
5	Line	5,6
6	Line	7,8

2D Macros

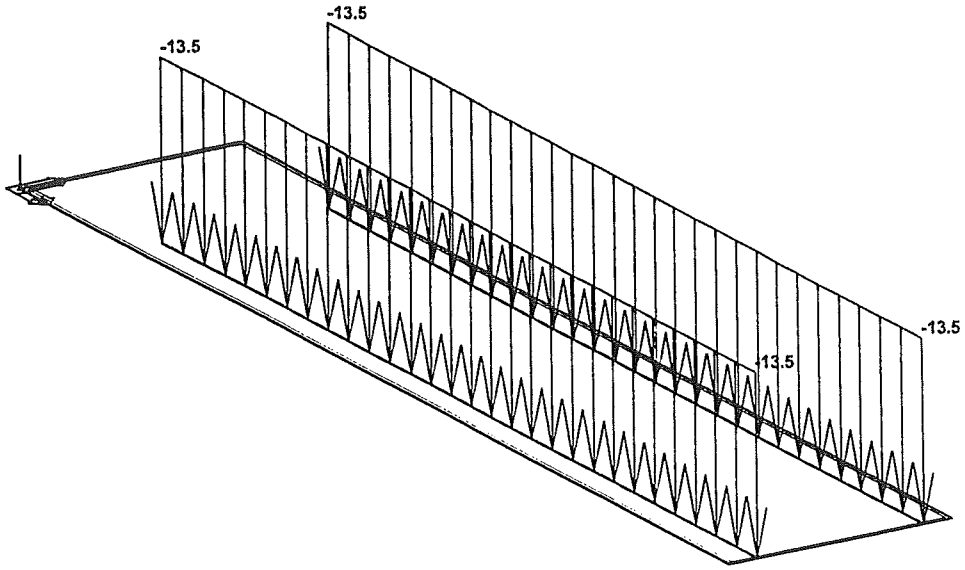
num	type		
1			
	B 25	Thickness	1.20 m
	Boundary:	1,2,3,4	
	1 Inner line:	5	
	2 Inner line:	6	

Soil - 2D macro

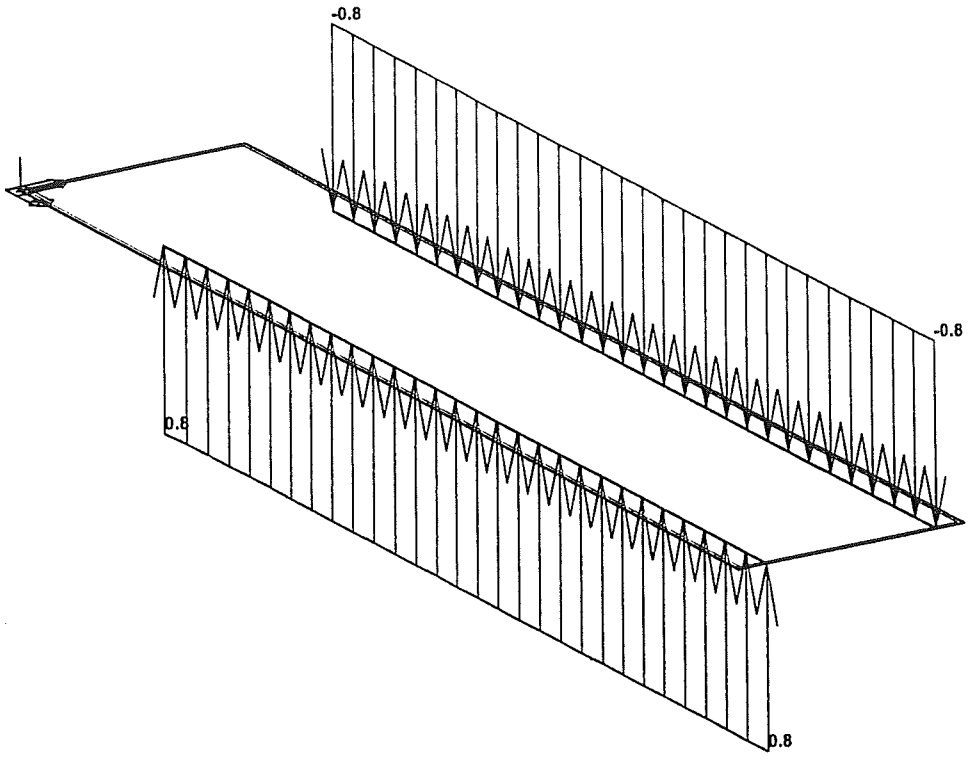
Index	2D macro	Name of subsoil
1	1	Sand/Clean/Moderate

Loadcases

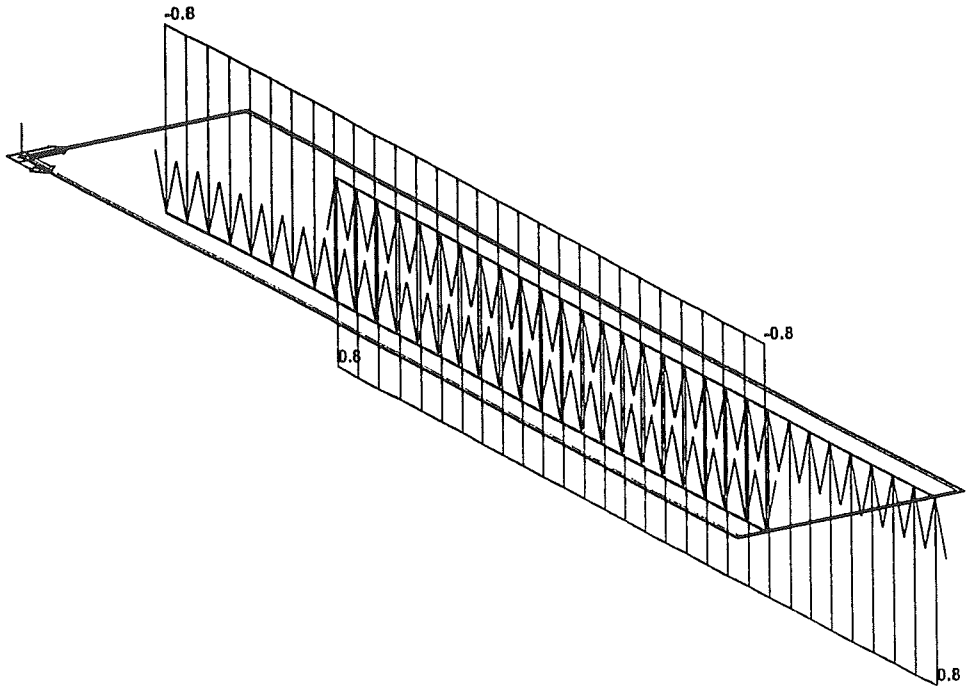
Case	Name:	Description
1	Weight concrete	Self weight. Direction -Z
2	weight	Permanent - Loads
3	Wind +Y	Variable - Wind Excl.
4	Wind -Y	Variable - Wind Excl.
5	Snow	Variable - Snow



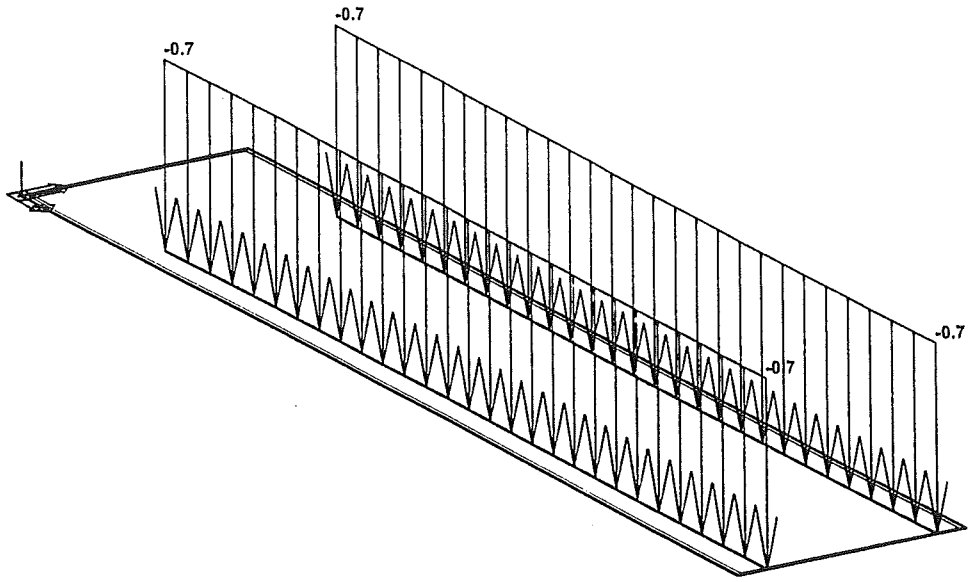
2. weight



3. Wind +Y



4. Wind -Y



5. Snow

Variable loads group

Name:
Wind Excl.
Snow

Loadcase no. 2 - distributed loads

bound	type	dx m	exY m	exZ m		X beg end	Y beg end	Z beg end
5	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-13.54
	kN/m	1.00			len	0.00	0.00	-13.54
6	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-13.54
	kN/m	1.00			len	0.00	0.00	-13.54

Loadcase no. 3 - distributed loads

bound	type	dx m	exY m	exZ m		X beg end	Y beg end	Z beg end
5	force	0.00 rel	0.00	0.00	glo	0.00	0.00	0.80
	kN/m	1.00			len	0.00	0.00	0.80
6	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-0.80
	kN/m	1.00			len	0.00	0.00	-0.80

Loadcase no. 4 - distributed loads

bound	type	dx m	exY m	exZ m		X beg end	Y beg end	Z beg end
5	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-0.80
	kN/m	1.00			len	0.00	0.00	-0.80
6	force	0.00 rel	0.00	0.00	glo	0.00	0.00	0.80
	kN/m	1.00			len	0.00	0.00	0.80

Loadcase no. 5 - distributed loads

bound	type	dx m	exY m	exZ m		X beg end	Y beg end	Z beg end
5	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-0.69
	kN/m	1.00			len	0.00	0.00	-0.69
6	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-0.69
	kN/m	1.00			len	0.00	0.00	-0.69

Combinations

Combi	Norm	Case	coeff
1.	User-ultimate	1 Weight concrete	1.00
		2 weight	1.00
		3 Wind +Y	1.00
		4 Wind -Y	1.00
		5 Snow	1.00
2.	User-serviceability	1 Weight concrete	1.00

Combi	Norm	Case	coeff
		2 weight	1.00
		3 Wind +Y	1.00
		4 Wind -Y	1.00
		5 Snow	1.00

Basic rules for generation of ultimate load combinations:
1 : 1.00*LC1 / 1.00*LC2 / 1.00*LC3 / 1.00*LC4 / 1.00*LC5

Basic rules for generation of serviceability load combinations:
1 : 1.00*LC1 / 1.00*LC2 / 1.00*LC3 / 1.00*LC4 / 1.00*LC5

Subsoils

Name:	Type of position	C1x kN/m^3	C1y kN/m^3	C1z kN/m^3	C2x kN/m	C2y kN/m	SigZpl kN/m^2
Sand/Clean/Moderate	Under plate, block	1000.000	1000.000	15000.000	0.000	0.000	0.000

Calculation protocol.

Linear calculation

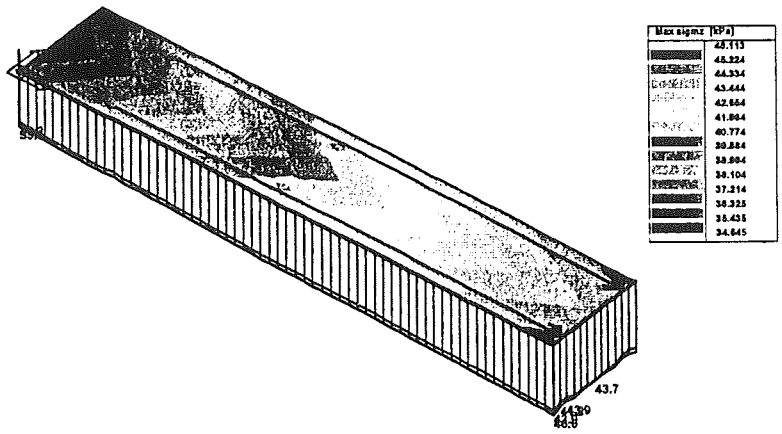
Number of 2D elements	862
Number of 1D elements	0
Number of mesh nodes	932
Number of equations	5592
Loadcases	LC 1 Weight concrete
	LC 2 weight
	LC 3 Wind +Y
	LC 4 Wind -Y
	LC 5 Snow
Bending theory	Mindlin
Start of calculation	27.08.2004 14:54
End of calculation	27.08.2004 14:54

Sum of loads and reactions.

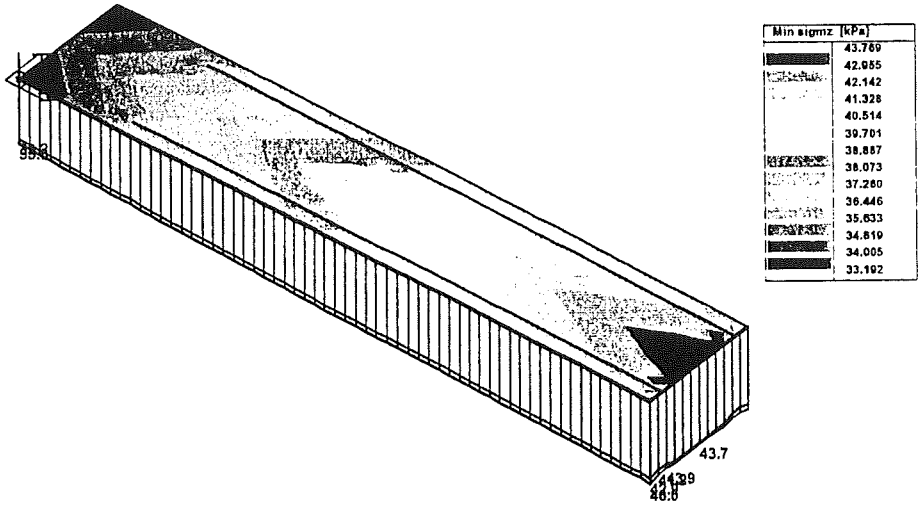
			X	Y	Z
loadcase	1	loads	0.0	0.0	-867.0
		reactions	0.0	0.0	0.0
		contact	0.0	0.0	867.0
loadcase	2	loads	0.0	0.0	-280.0
		reactions	0.0	0.0	0.0
		contact	0.0	0.0	280.0
loadcase	3	loads	0.0	0.0	0.0
		reactions	0.0	0.0	0.0
		contact	0.0	0.0	0.0
loadcase	4	loads	0.0	0.0	0.0
		reactions	0.0	0.0	0.0
		contact	0.0	0.0	-0.0
loadcase	5	loads	0.0	0.0	-14.3
		reactions	0.0	0.0	0.0

$G = 2,34 \cdot 12,35 \cdot 1,20 \cdot 25,0 = 867,40$

	X	Y	Z
contact	0.0	0.0	14.3



Contact stress - max sigmz - FEM Combi : 1



Contact stress - min sigmz - FEM Combi : 1

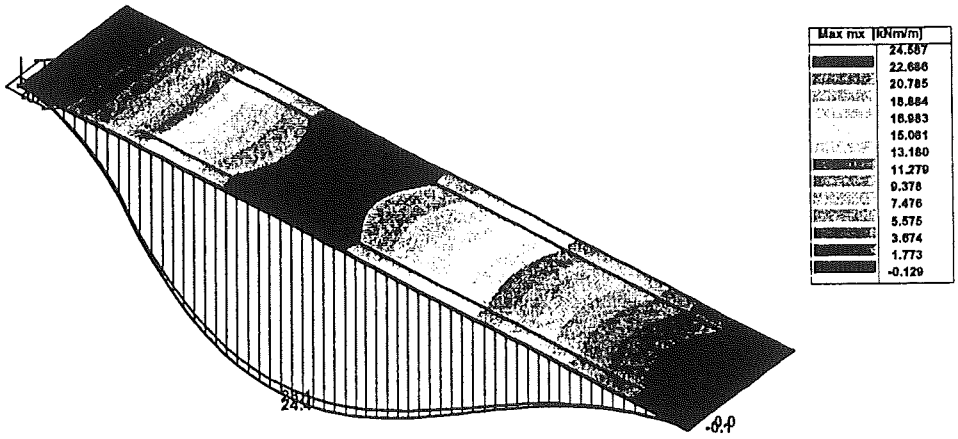
RESULTS : CONTACT STRESSES

FEM Combi:
C1 Eigen-Tragfähigk.

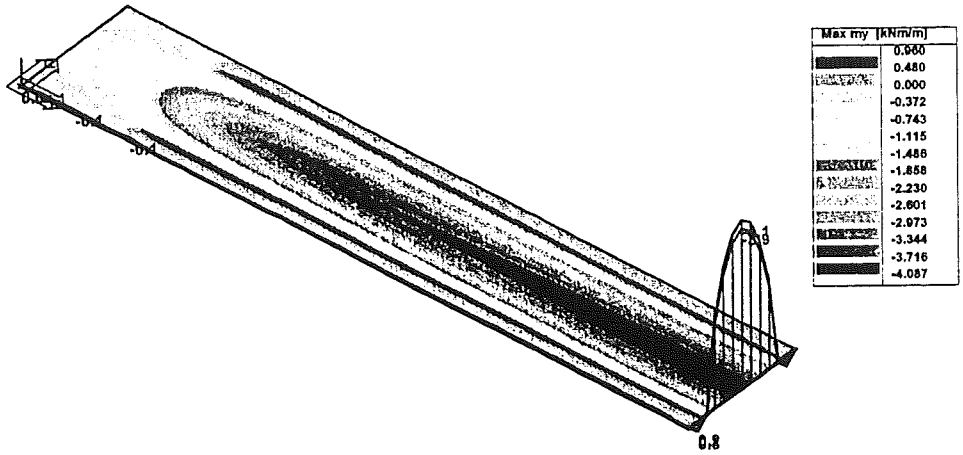
Global extremes

node	sigmz [kPa]
591	46.113
1	33.192

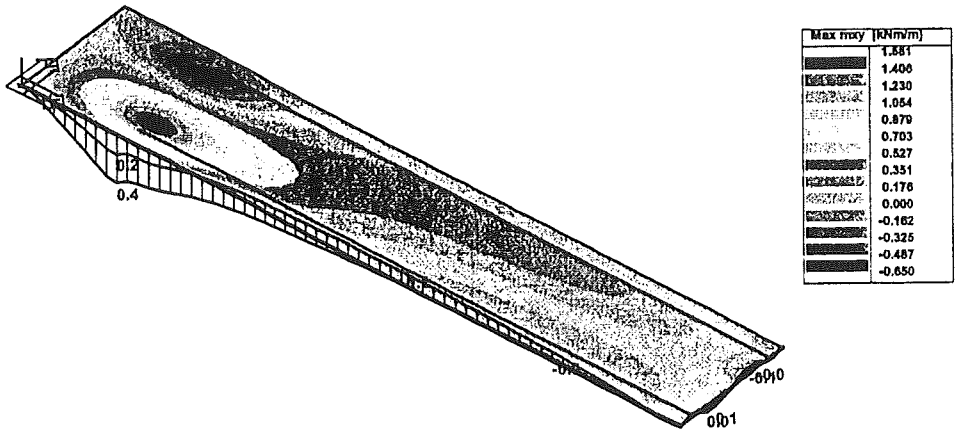
Selection was done for macros: 1



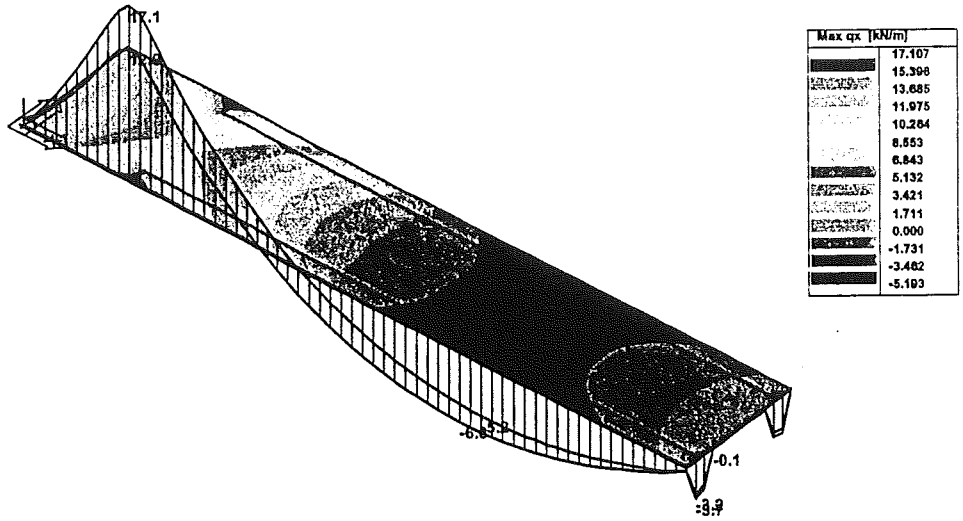
Internal force - max mx - FEM Combi : 1



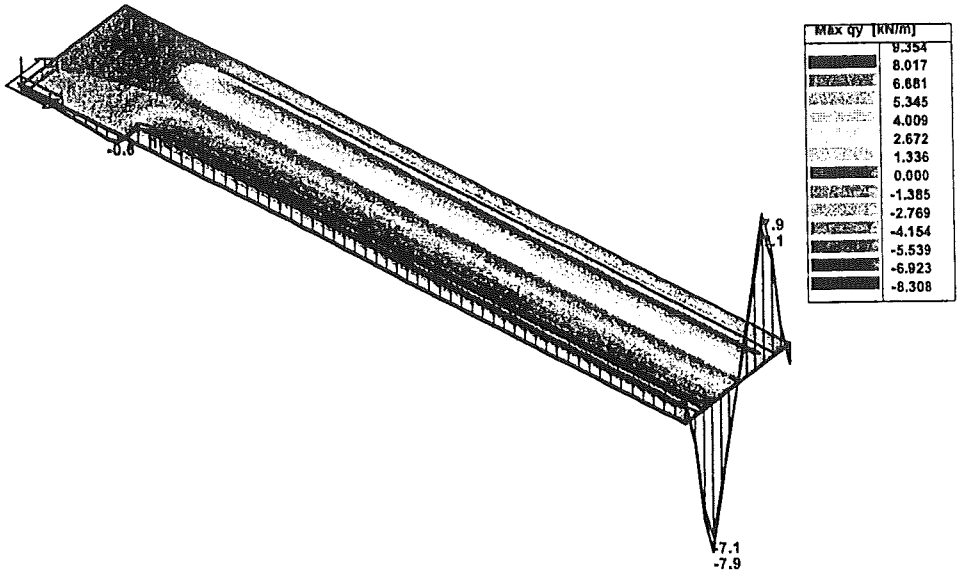
Internal force - max my - FEM Combi : 1



Internal force - max mxy - FEM Combi : 1



Internal force - max qx - FEM Combi : 1



Internal force - max qy - FEM Combi : 1

RESULTS : INTERNAL FORCES

FEM Combi:
C1 Eigen-Tragfähigk.

Global extremes

Rotation of the local system: No
Basic magnitudes - bending

node	mx [kNm/m]	my [kNm/m]	mxy [kNm/m]	qx [kN/m]	qy [kN/m]
757	**24.587**	0.847	0.300	0.580	-3.316
588	**-0.144**	-0.064	-0.024	-3.450	-5.786
837	16.783	**0.960**	-0.357	10.004	2.962
265	0.069	**-4.296**	-0.038	-0.768	-0.011
37	9.953	-0.954	**1.581**	9.998	-2.905
400	9.335	-1.042	**-1.581**	8.608	2.907
707	10.771	-0.064	-0.121	**17.107**	-0.140
544	13.237	-0.047	-0.106	**-6.836**	0.764
600	0.129	-0.842	-0.022	-0.135	**9.354**
591	0.106	-0.930	0.022	-0.185	**-9.354**

Selection was done for macros: 1

Code for calculation: DIN 1045 7/88
Serviceability crack proof

Explanation of concrete symbols

Abbreviation	Explanation
betaWN	Concrete cube compression strength.
betaR	Design concrete compression strength.
Tau01	1st shear stress limit according Table 13.
Tau02	2nd shear stress limit according Table 13.
Tau03	3rd shear stress limit according Table 13.

Concrete characteristics

	B 25
betaWN	25000.000 kPa
betaR	17500.000 kPa
Tau011_1 plates	350.000 kPa
Tau011_2 plates	500.000 kPa
Tau02 plates	1800.000 kPa
Tau012 beams	750.000 kPa
Tau02 beams	1800.000 kPa
Tau03 beams	3000.000 kPa

Explanation of reinforcement steel symbols

Abbreviation	Explanation
betaS	Characteristic yield strength of reinforcement

Steel characteristics

	BSt 420
betaS	420000.000 kPa
E modulus	200000000.000 kPa

Input parameters

Description	Percentage
Maximum % of reinforcement	9.00
Minimum % of net reinforcement	0.00
Minimum % of pressure reinforcement	0.50
Minimum % of tension reinforcement	0.00
Minimum % of transverse reinforcement	20.00

Shear mode
Tension reinforcement goes from one support to the other in full value.

Description	Value
height < 7 cm represents increase of internal forces (§ 17.2.1 (6))	ON
Structural reinforcement of deep beam	OFF

Description	Value
Maximum allowable crack width on face Zp+	0.25
Maximum allowable crack width on face Zp-	0.25
Characteristic bar distances on face Zp+	200.00
Characteristic bar distances on face Zp-	200.00

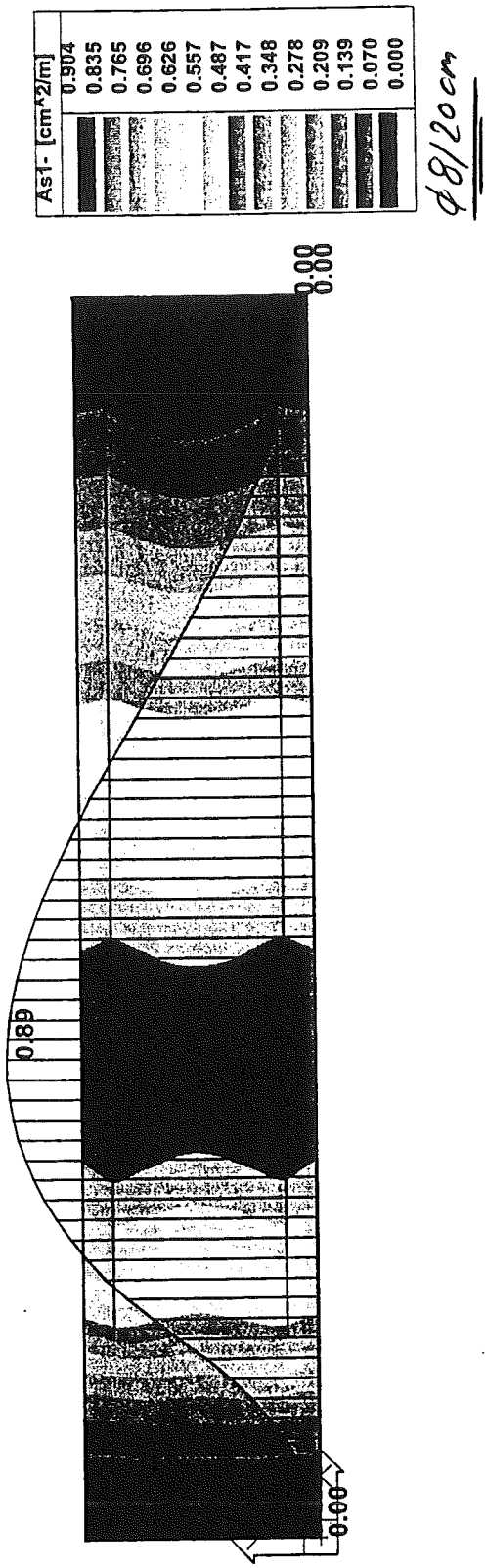
Description	Value
Load case attribute	crack proof LC due to internaly caused imposed deformations
Effect upon the mean strain	1.00
Effect upon the mean crack distance	0.80
Environment class	3. moist - buildings with access outdoor air

Global extremes

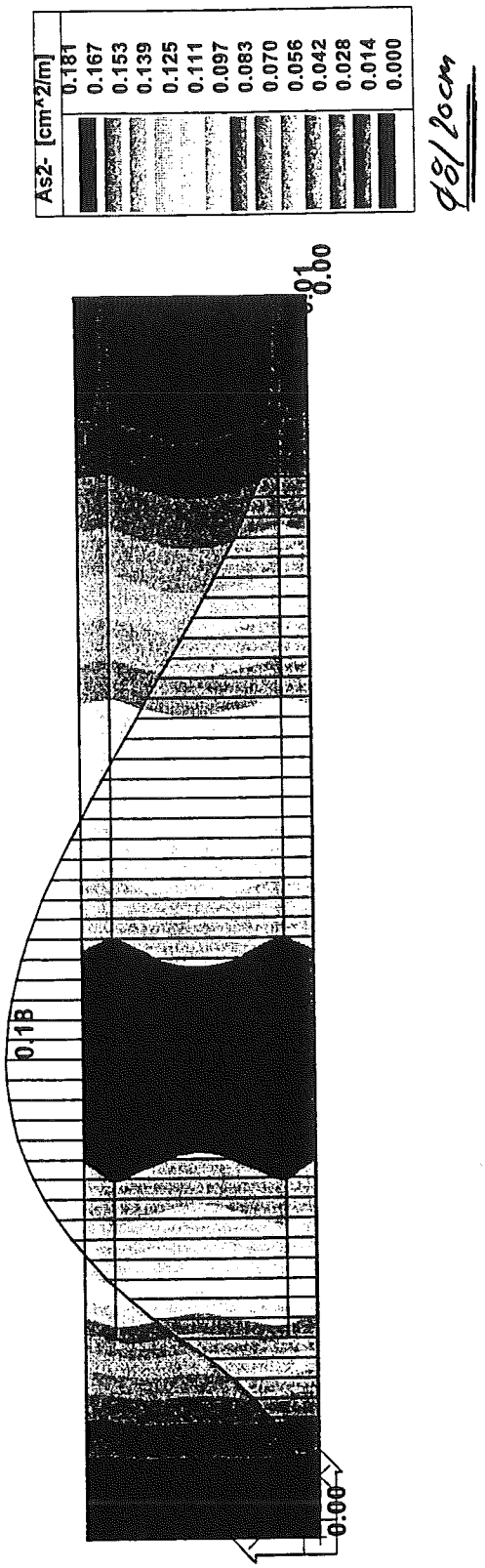
Necessary areas

node	As1+ [cm^2/m]	As2+ [cm^2/m]	As3+ [cm^2/m]	As3- [cm^2/m]	As2- [cm^2/m]	As1- [cm^2/m]	Ass [cm^2/m^2]	tau [MPa]	tau0 [MPa]
245	**0.032**	0.160	~	~	0.104	0.518	0.000	0.00	0.00
579	**0.000**	0.000	~	~	0.007	0.042	0.000	0.00	0.00
245	0.032	**0.160**	~	~	0.104	0.518	0.000	0.00	0.00
1	0.001	**0.000**	~	~	0.000	0.000	0.000	0.00	0.00
857	0.000	0.000	~	~	**0.181**	0.904	0.000	0.00	0.01
1	0.001	0.000	~	~	**0.000**	0.000	0.000	0.00	0.00
857	0.000	0.000	~	~	0.181	**0.904**	0.000	0.00	0.01
1	0.001	0.000	~	~	0.000	**0.000**	0.000	0.00	0.00
	0.001	0.000	~	~	0.000	0.000	**0.000**	0.00	0.00
	0.001	0.000	~	~	0.000	0.000	**0.000**	0.00	0.00
	0.001	0.000	~	~	0.000	0.000	0.000	**0.00**	0.00
	0.001	0.000	~	~	0.000	0.000	0.000	**0.00**	0.00
7	0.006	0.031	~	~	0.087	0.434	0.000	0.00	**0.01**
722	0.005	0.021	~	~	0.000	0.002	0.000	0.00	**0.00**

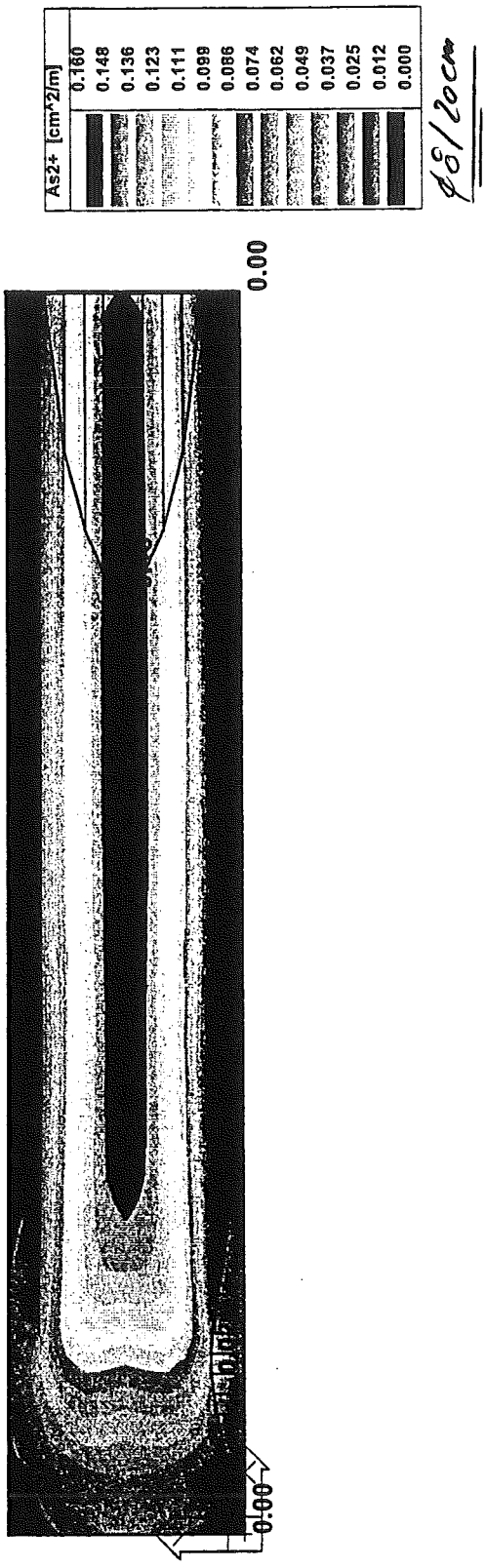
Selection was done for macros: 1



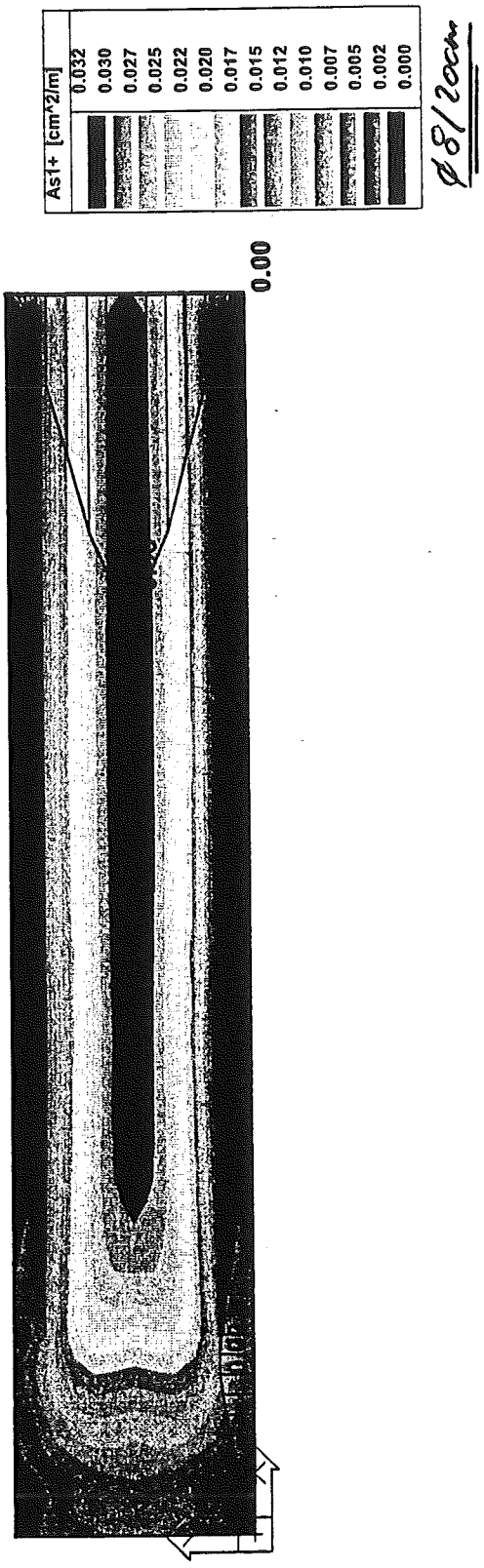
2D reinforcement - As1-



2D reinforcement - As2-



2D reinforcement - As2+



2D reinforcement - As1+

Chapter E

Foundation HP-GAN Reservoir

B73002

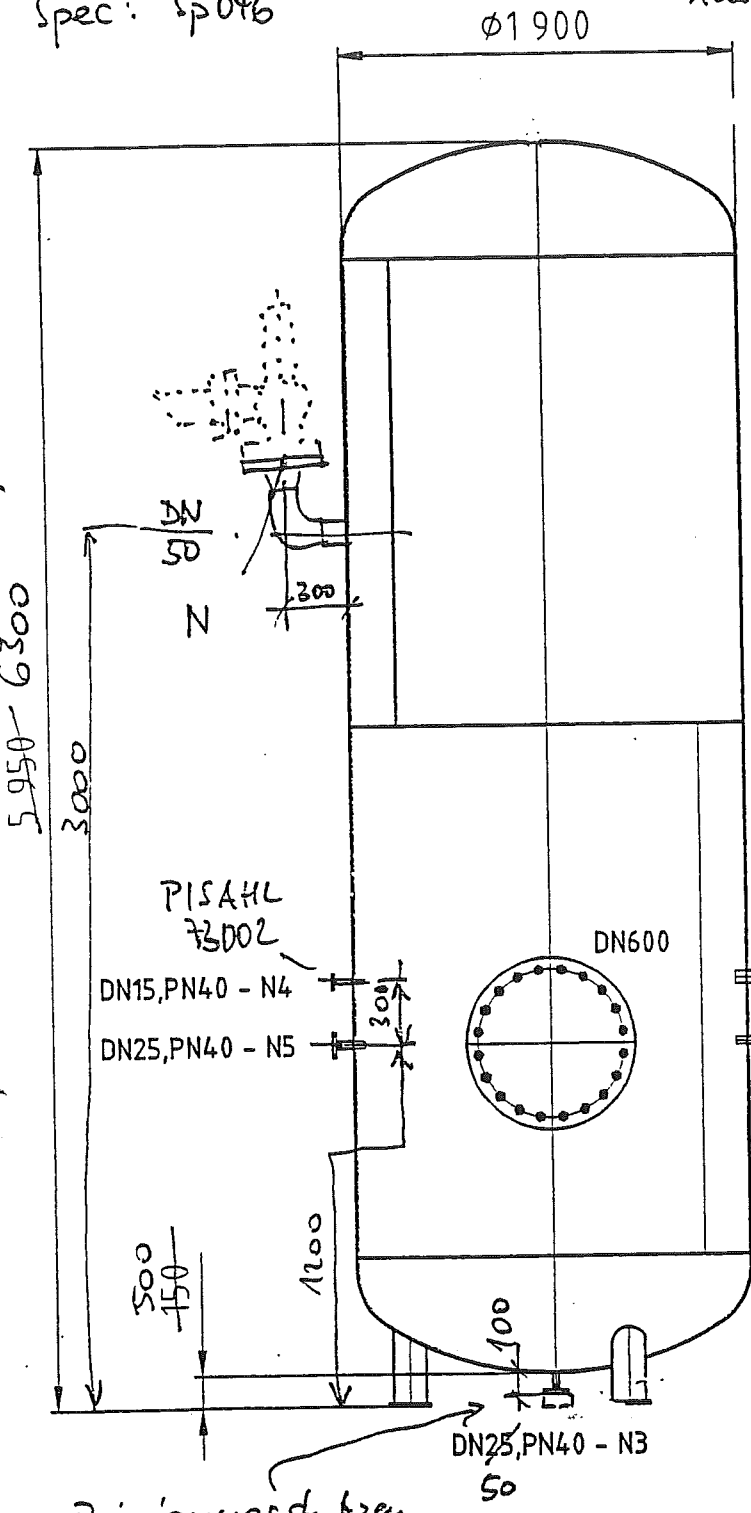
KMA
Ingenieurgesellschaft mbH
Saarbrücker Straße 9
66130 Saarbrücken-Brebach
Telefon (0681) 8 83 13-0
Telefax (0681) 8 83 13-88
E-Mail info@kmw-ing.de

Tag. No.: E2 | B 73002 | HP-GAN Reservoir

Auslegung: PED/AD2000
Spec: Sp046

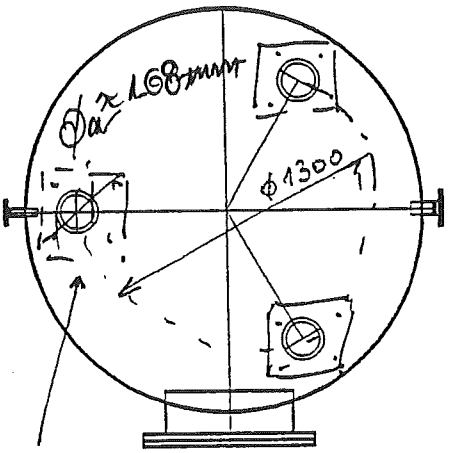
Medium: Gaseous Nitrogen
Betriebsdaten: 9-20 bar / 293°K
Auslegung: 25 bar
Si-Ventil-Ansprechdruck = 25 bar

P



ANSICHT P

Volumen = 15 m³ Nutzvolumen



Vorschlag: □ 400x400
4 Anker M24
ØFlg: 200

N	Stutzentabelle
1	DN50 / PN40 Mediumanschluß
2	DN25 / PN40 Reserve
3	DN50 / PN40 Reinigung/Ausblaser (mit Deckel verschlossen
4	DN15 / PN40 PISAHL 73002
5	DN25 / PN40 Reserve
:	:
6	Si-Ventil-Anschluß

Reinigungsstutzen mit Blindflansch verschlossen

26/08/04

VPS VÝCHODOČESKÉ PLYNÁRENSKÉ STROJÍRNY a.s. ROSICE U CHRASTI	Vypracoval: ODEHNAL P.	29.7.04	Schválil: ing.SEDLAK P.		
	CAD-Název:		Název akce:		
	Název: BEHÄLTER Ø1900 mm 15.000 l		Číslo výkresu	Změna	Formát: 4

Gewicht:
Anstich:
Statik Standsicherheitnachweis.

Gewicht 3800 KG
+ 15.000 KG

3.8.04
Richtige Wasser

Loadcase

Weight:

$\min G \approx 3.000\,kg \hat{=} \underline{30\,kN}$

Water:

$\max P = 15.000\,kg \hat{=} \underline{150\,kN}$

$\max Q = \underline{100\,kN}$

Wind:

(DIN 1055 T4)

$H = 6{,}30\,m < 10{,}0\,m \rightsquigarrow q_{10} = \underline{0{,}50\,kN/m^2}$

$\varnothing$ 1900 mm

$Re = \frac{35{,}0 \cdot 1{,}9}{1{,}5 \cdot 10^{-5}} = 4{,}53 \cdot 10^6$

$c_{f0} = 1{,}2 + \frac{0{,}10 \cdot \log\left(10 \cdot \frac{0{,}001}{1{,}9}\right)}{1 + 0{,}4 \cdot \log 4{,}53} = 0{,}875$

$\lambda = 0{,}7 \cdot \frac{6{,}3}{1{,}9} = 2{,}32 \Rightarrow \psi \approx 0{,}65$

$q_w = 0{,}65 \cdot 0{,}875 \cdot 0{,}50 \cdot 1{,}90 = \underline{0{,}50\,kN/m^2}$

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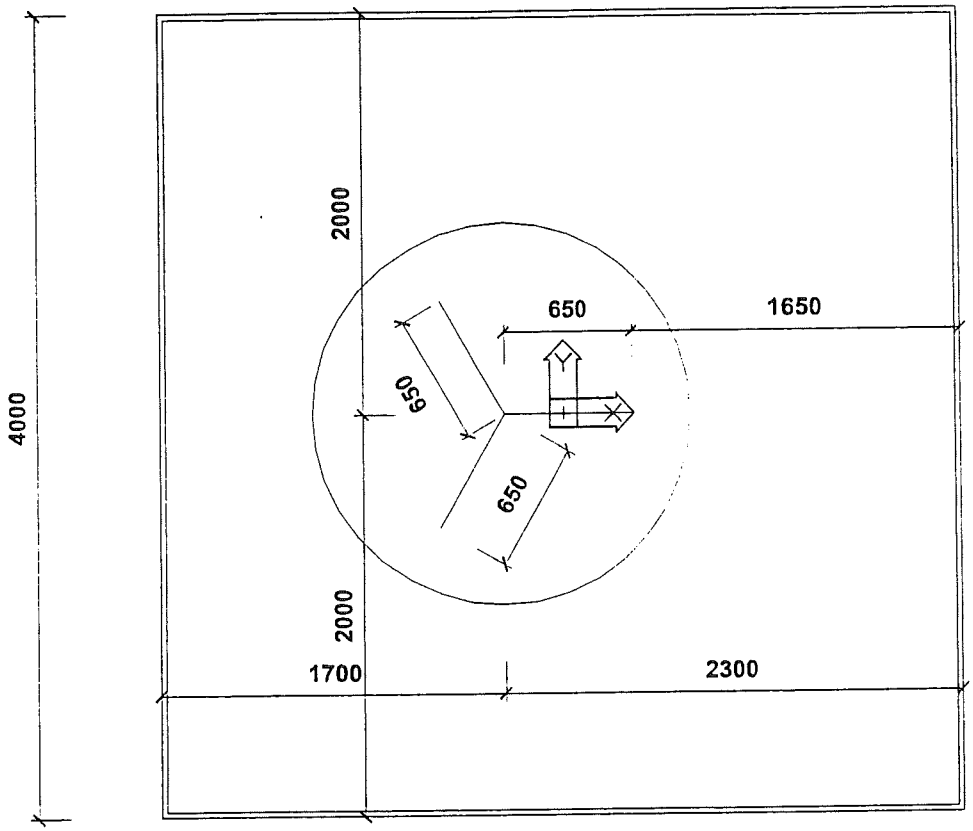
Inhalt



B25, d = 120 cm

plan view