Názov stavby:	**Kyslíkový aparát č.9** **Oxygen plant ASU No.9**
Construction name:	**Tank Farm, Steel Construction of the new Control Stage by exist. 1000 MT LIN-Storage Tank And Oxygen Station**
Investor:	**U.S. Steel, s.r.o. Vstupný areál U.S. Steel, Košice**
Stupeň: Level:	**Statické posúdenie** **Structural expert's option**
Účel: Scope:	**Posúdenie projektovej dokumentácie fy KMW podl'a STN** **Check of original project by KMW co. according to STN**
Archívne číslo: Archival No.:	**RP - 199/2005**

REFLEX-PRO spol. s r.o.

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Košice, 12 /2005

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Content

Subject, Purpose and Scope of Opinion

The subject of opinion is support steel structure for pumping devices for ASU No: 9 equipment located in US Steel Košice. The list of support steel structures and concrete structures is stated in Structural Analysis prepared by KMW.

Purpose of opinion is to compare, to verify and to check the original project prepared according to DIN standards with valid STN (Slovak Technical Standard) as well as with local geotechnical conditions.

Documents to be verified

- Static Calculation 7574 Part 5, KMW – Tnk farm, Steel Construction of the new Control Stage by existing 1000 MT LIN-Storage Tank, December 2004
  pages 1-62
- Static Calculation 7574 Part 6, KMW - ,Oxygen station, March 2004 – Concrete structure
  pages 1-79

Used codes, Literature

- Detailed Engineering Geological Survey – Final Report, Montana s.r.o., May 2004
- DIN 1055 – Lastannahmen für Bauten / Actions on structures
- DIN 1054 – Baugrund, Zulässige Belastung des Baugrunds / Subsoil, Permissible loading of subsoil
- DIN 1045 (07.88) – Beton und Stahlbeton, Bemessung und Ausführung / Reinforced concrete structures, Design and construction
- DIN 18800 – Návrh oceľových konštrukcií
- STN 73 0035 – Zaťaženie stavebných konštrukcií / Actions on structures
- STN 73 1001 – Základová pôda pod plošnými základmi / Subsoil under shallow foundations
- STN 73 1201 – Navrhovanie betónových konštrukcií / Design of concrete structures/
- STN 73 1401 – Navrhovanie oceľových konštrukcií /Design of steel structures/
- STN EN 206-1 – Betón, Špecifikácia, vlastnosti, výroba a zhoda / Concrete, Specification, performances, production and conformity

Document check

1) Structural Analysis

For the calculation was FEM 3D model used with elastic-bedded foundation slabs. Loading was considered according to data by equipment supplier.

Conversion material table

DIN 1045	STN 73 1201
steel S235	steel S235
concrete B25 – table.1, page 19 cube strength betaWN = 25 MPa characteristic strength betaR = 17,5 MPa modulus of elasticity E = 30 GPa	concrete B25 – table.1, page 19 cube strength 25 MPa characteristic strength Rbn = 18,5 MPa design strength Rbd = 14,5 MPa modulus of elasticity E = 30 GPa
reinforcement steel BSt 420 – table.6, page 24 tensile strength betaZ = 500 MPa yield strength betaS = 420 MPa	reinforcement steel 10425 (V)–table.29, app.1,page 2 tensile strength 420 MPa characteristic yield strength Rsn = 410 MPa design yield strength Rsd = 375 MPa
reinforcement steel BSt 500 – table.6, page 24 tensile strength betaZ = 550 MPa yield strength betaS = 500 MPa	reinforcement steel 10505 (R)–table.29, app.1, page 2 tensile strength 500 MPa characteristic yield strength Rsn = 490 MPa design yield strength Rsd = 450 MPa

2) Support steel structure:

Support steel structure is designed like horizontal platform supported by four columns. Stability of structure is provided by frame effect between columns and girders in buckling direction, in transverse direction, structure is stabilized by 2 vertical reinforcers.

Calculation of actual load is made by common form. Values of actual loading are shown on pages No 20-21. In These loading are used in next part of structural analysis as continual loadings on binders.

Control structural analysis according to STN 731401 was made within of this report.

Results of these two calculations are basicly identical.

3) Concrete structure:

There is a FC aboveground shaft divided into two separate parts. There are two separate entrance openings in one of the horizontal walls. The purpose of the shaft is to resist sudden overpressure from the piping (28 bar) acting upon the dividing wall and ceiling. The shaft structure itself has been designed as a monolithic structure with firm bonds between the bottom, walls and ceiling. It was considered for maximum bending moments from extreme jet load effects and perforation of the mentioned loading (piping 28 bar - the ceiling and dividing wall).

Conclusion

By construction of support steel structures and foundation structures according to original project considering comments mentioned above will foundations safe and be able to carry loads from equipment as well as they will fulfill requirements of valid technical standards for design of structures.

Košice, 12/2005

Prepared: Ing. Marek Sobota
structural engineer

Názov stavby:	**Kyslíkový aparát č.9** **Oxygen plant ASU No.9**
Construction name:	**Tank Farm, Steel Construction of the new Control Stage by exist. 1000 MT LIN-Storage Tank And Oxygen Station**
Investor:	**U.S. Steel, s.r.o. Vstupný areál U.S. Steel, Košice**
Stupeň: Level:	**Statické posúdenie** **Structural expert's option**
Účel: Scope:	**Posúdenie projektovej dokumentácie fy KMW podl'a STN** **Check of original project by KMW co. according to STN**
Archívne číslo: Archival No.:	**RP - 199/2005**

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Košice, 12 /2005

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Obsah

Predmet, účel a rozsah posúdenia

Predmetom posúdenia sú podporné oceľové konštrukcie pre umiestnenie čerpadiel pre stavbu kyslíkového aparátu č.9. v areáli US Steel Košice. Zoznam nosných oceľových konštrukcií a betónových konštrukcií je uvedený v Statickom výpočte firmy KMW .
Účelom posúdenia je porovnať, overiť a posúdiť projektovú dokumentáciu vypracovanú podľa DIN s platnými STN normami a miestnymi geotechnickými podmienkami.

Overovaná dokumentácia

- Statický výpočet – Static Calculation 7574 Part 5, KMW -, December 2004
  strany 1-62.
- Static Calculation 7574 Part 6, KMW - ,Oxygen station, March 2004 – Betónové konštrukcie
  strany 1-79.

Podklady, Použitá literatúra

- Podrobný inžiniersko-geologický prieskum - Záverečná správa, Montana s.r.o., máj 2004
- DIN 1055 – Lastannahmen für Bauten / Zaťaženie stavebných konštrukcií
- DIN 1054 – Baugrund, Zulässige Belastung des Baugrunds / Navrhovanie základových konštrukcií
- DIN 1045 (07.88) – Beton und Stahlbeton, Bemessung und Ausführung / Navrhovanie betónových konštrukcií
- DIN 18800 – Structural steelwork· design and construction
- STN 73 0035 – Zaťaženie stavebných konštrukcií
- STN 73 1001 – Základová pôda pod plošnými základmi
- STN 73 1201 – Navrhovanie betónových konštrukcii
- STN 73 1401 – Navrhovanie oceľových konštrukcii /Design of steel structures/
- STN EN 206-1 – Betón, Špecifikácia, vlastnosti, výroba a zhoda

Posúdenie

1) Statický výpočet

Pre výpočet metódou konečných prvkov bol použitý výpočtový program IDA NEXIS. Oceľová konštrukcia bola namodelovaná ako 3D model.
Zaťaženie bolo uvažované podľa podkladov dodávateľa technológie.

Prevodná tabuľka použitých materiálov

DIN 1045	STN 73 1201
oceľ S235	oceľ S235
betón B25 – tab.1, strana 19 kocková pevnosť betónu = 25 MPa normová pevnosť betónu = 17,5 MPa modul pružnosti E = 30 GPa	betón B25 – tab.1, strana 19 kocková pevnosť 25 MPa normová pevnosť Rbn = 18,5 MPa výpočtová pevnosť Rbd = 14,5 MPa modul pružnosti E = 30 GPa
oceľ BSt 420 – tab.6, strana 24 pevnosť v ťahu betaZ = 420 MPa medza klzu betaS = 420 MPa	oceľ 10425 (V) – tab.29, príloha 1, str.2 pevnosť v ťahu 420 MPa normová pevnosť v ťahu Rsn = 410 MPa výpočtová pevnosť v ťahu Rsd = 375 MPa
oceľ BSt 500 – tab.6, strana 24 pevnosť v ťahu betaZ = 500 MPa medza klzu betaS = 500 MPa	oceľ 10505 (R) – tab.29, príloha 1, str.2 pevnosť v ťahu 500 MPa normová pevnosť v ťahu Rsn = 490 MPa výpočtová pevnosť v ťahu Rsd = 450 MPa

2) Oceľová konštrukcia:

Nosnú konštrukciu tvorí priestorový nosníkový rošt uložený na štyroch stĺpoch. Stabilitu konštrukcie zabezpečuje v pozdĺžnom smere rámový účinok medzi stĺpami a prievlakmi plošiny, v priečnom smere je plošina stužená zvislými stužidlami. Vplyv užitočného zaťaženia na konštrukciu je urobený štandardný spôsobom. Jednotlivé zaťaženia sú zrejmé z obrázkov 20-21. Následne sú zavedené do výpočtového modelu ako rovnomerné zaťaženia na priečniky.
V rámci posudku bol urobený kontrolný prepočet nosnej časti podľa kritérií STN 731401.
Výsledky výpočtov sú s ním takmer totožné.

3) Betónové konštrukcie:

Jedná sa o ŽB nadzemnú jímku, ktorá je vo vnútri rozdelená na dve samostatné časti. Pre vstup do jímky sú na jednej dlhšej steny zariadenie dve samostatné otvory. Jímka má odolávať náhlemu pretlaku od potrubia (28 bar), ktorý voľne pôsobí na deliacu stenu a strop. Betónová konštrukcia jímky je navrhnutá ako monolitická konštrukcia pričom samotné prvky (dno , steny a strop) majú medzi sebou tuhé vazby. Jímka bola posúdená na maximálne ohybové momenty od účinkov externého nahodilého zaťaženia a na prepichnutie od spomínaného zaťaženia (potrubie 28 bar - strop a deliaca stena).

Záver

Realizovaním no h oceľových konštrukcií podľa pôvodn ktovej dokumentácie budú tieto konštrukcie bezpečné a scho renášať zaťaženie na nich pôsobiace sne budú spĺňať ustanovenia platných technických norie e navrhovanie stavebných konštrukcií.

V Košiciach, 12/2 5

Vypracoval: Ing. Marek Sobota
autorizovaný stavebný inžinier

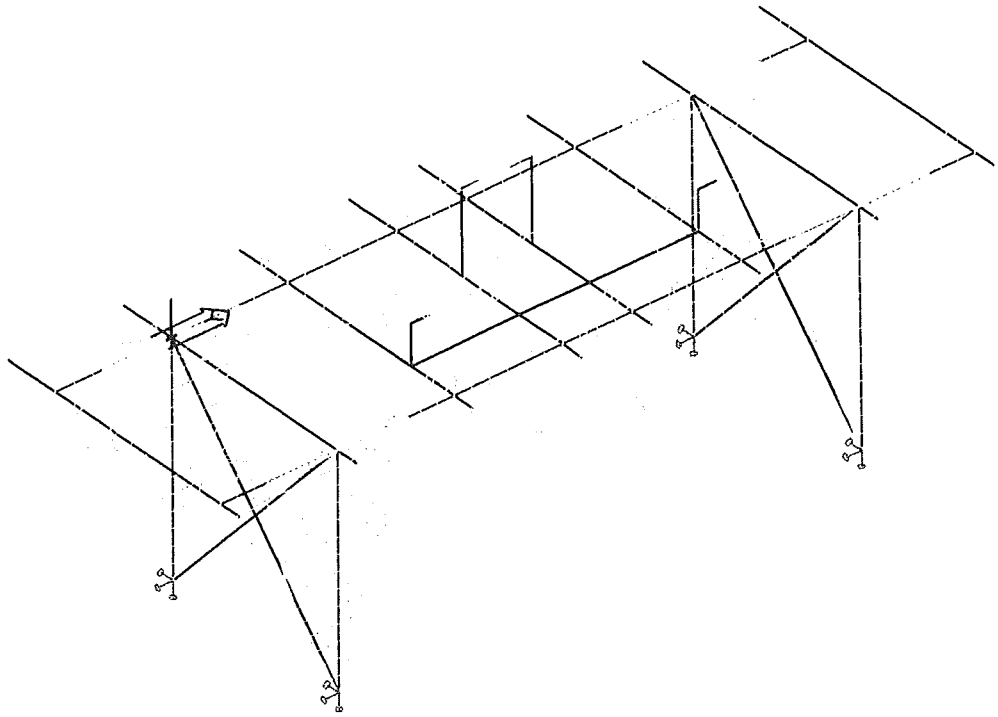
STATIC CALCULATION
1.Supplement to Part 5

Air Liquide AGS GmbH

K70101, ASU No. 9 Kosice
Steel Construction of the new Control Stage by the existing 1000 MT LIN-Storage Tank

Saarbrücken, 07.10.2005

M. Orth
KMW-Ingenieurgesellschaft mbH

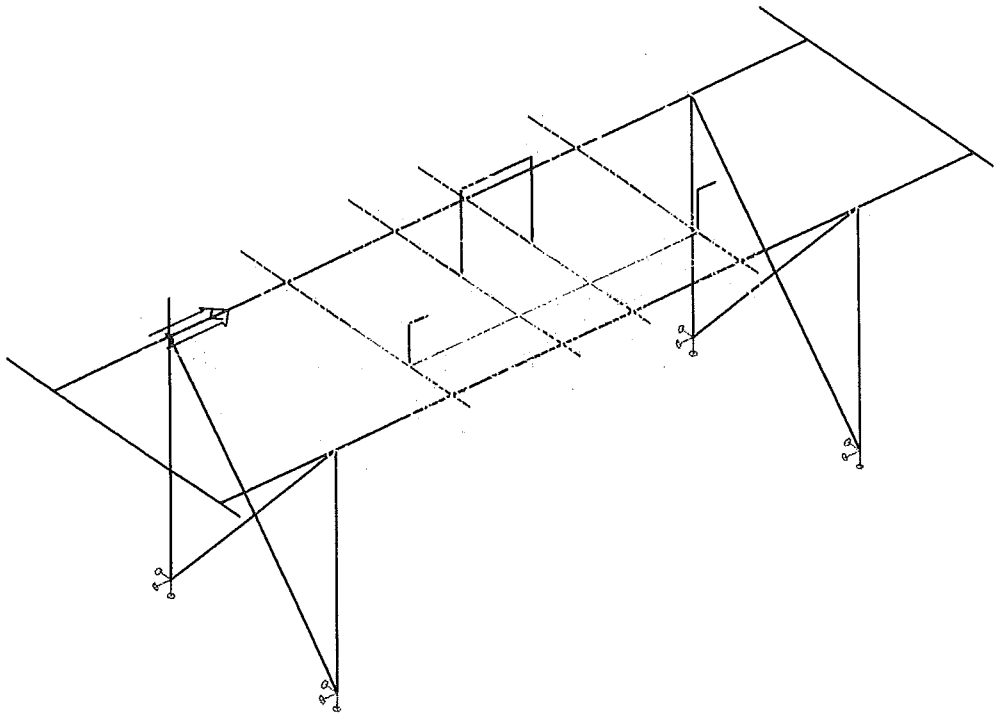


Deformation - uz on member(s). Ser. combi : 1/566

Deformations on member(s). Global extreme

Linear static - extreme or all combinations
Group of member(s) :1/70
Group of serviceability combi :1/566
Cross-section : 1 - HEA160

memb	combi	dx [m]	ux [mm]	uy [mm]	uz [mm]	fix [rad]	fiy [rad]	fiz [rad]
33	478	0.000	**4.68**	-0.28	2.09	-0.00	0.00	0.00
40	528	1.000	**-4.72**	-0.28	2.10	-0.00	-0.00	-0.00
27	517	0.300	-2.36	**1.36**	-4.07	-0.00	0.00	0.00
	136		2.16	**-1.34**	-0.04	0.00	-0.00	-0.00
44	528	1.950	-0.02	0.09	**4.72**	-0.00	-0.00	0.00
27	540	0.300	-2.40	1.34	**-4.88**	-0.00	0.00	0.00
26	338	0.941	-1.13	-1.31	-0.77	**0.00**	0.00	-0.00
38	427		2.12	0.99	-1.29	**-0.00**	-0.00	-0.00
44	460	0.000	-0.00	-0.00	-0.00	0.00	**0.00**	-0.00
42	550		-0.00	-0.00	0.00	-0.00	**-0.00**	-0.00
39	454	0.571	4.24	-0.57	-0.55	-0.00	-0.00	**0.00**
	563		-4.51	0.59	-1.01	-0.00	-0.00	**-0.00**

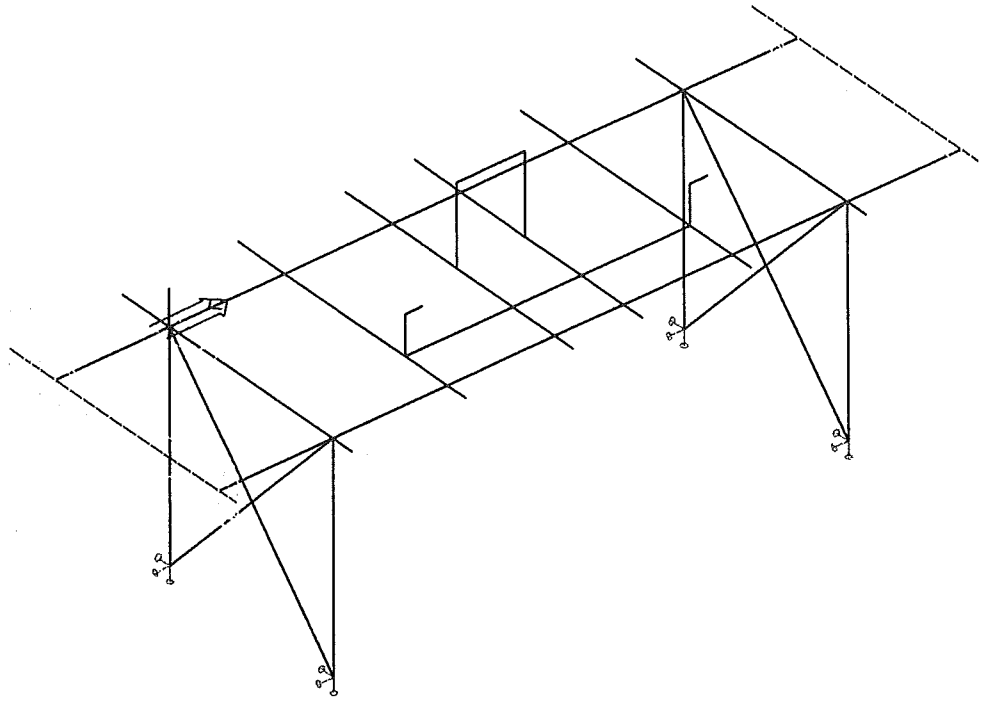


Deformation - uz on member(s). Ser. combi : 1/566

Deformations on member(s). Global extreme

Linear static - extreme or all combinations
Group of member(s) :1/70
Group of serviceability combi :1/566
Cross-section : 2 - HEA120

memb	combi	dx [m]	ux [mm]	uy [mm]	uz [mm]	fix [rad]	fiy [rad]	fiz [rad]
45	329	0.000	**4.69**	-0.73	-2.55	-0.00	0.00	0.00
	300		**-4.74**	0.75	0.04	-0.00	0.00	-0.00
6	498	0.200	-0.22	**4.80**	0.01	-0.00	-0.00	0.00
	259		0.20	**-4.84**	-0.01	0.00	-0.00	-0.00
66	194	0.000	1.31	3.79	**1.48**	0.00	0.00	0.00
	543		-1.33	-3.83	**-5.37**	0.00	-0.00	-0.00
62	518	0.700	-1.33	-0.23	-4.38	**0.00**	-0.00	0.00
67	532		-1.33	0.18	-4.29	**-0.00**	-0.00	-0.00
45	492	0.000	-2.39	-0.98	-2.69	-0.00	**0.00**	-0.00
48	351	0.941	2.51	-1.00	-2.23	-0.00	**-0.00**	-0.00
18	446	1.750	0.21	3.73	-0.04	0.00	-0.00	**0.00**
19	542	0.000	-0.23	-3.79	-0.02	0.00	-0.00	**-0.00**

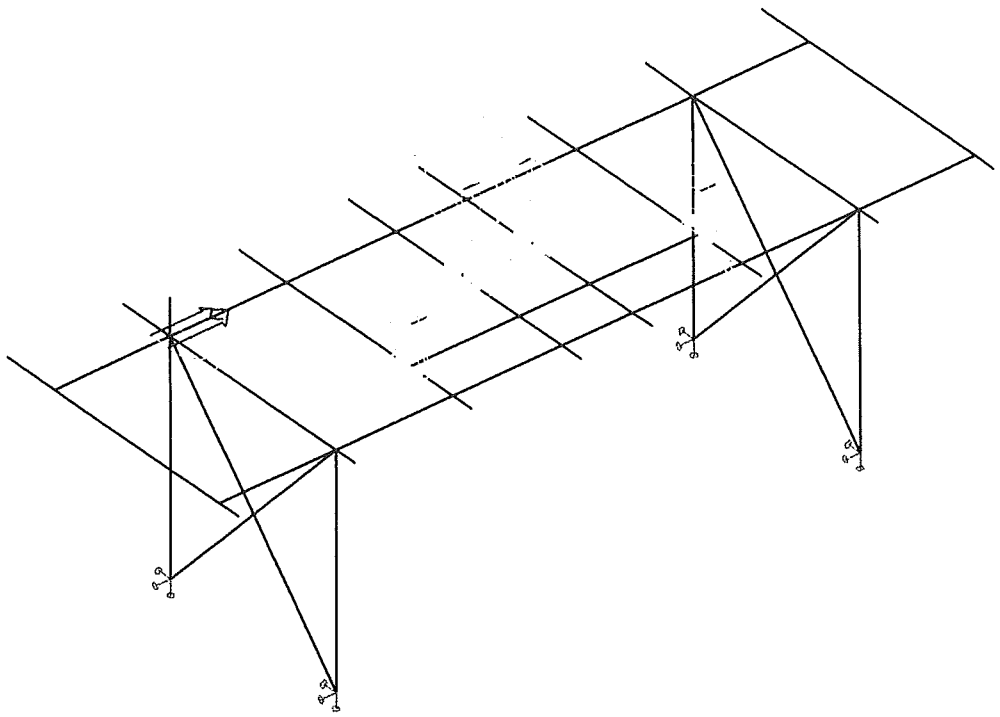


Deformation - uz on member(s). Ser. combi : 1/566

Deformations on member(s). Global extreme

Linear static - extreme or all combinations
Group of member(s) :1/70
Group of serviceability combi :1/566
Cross-section : 3 - U120

memb	combi	dx [m]	ux [mm]	uy [mm]	uz [mm]	fix [rad]	fiy [rad]	fiz [rad]
2	275	1.750	**0.42**	-0.88	-0.50	0.00	-0.00	0.00
	481		**-0.44**	0.85	1.33	-0.00	-0.00	-0.00
3	498	0.200	0.41	**4.78**	2.04	-0.00	-0.00	0.00
	259		-0.42	**-4.81**	-0.98	0.00	-0.00	-0.00
22	550		-0.30	-4.43	**2.68**	0.00	-0.00	0.00
1	259	0.000	-0.42	-4.21	**-2.49**	0.00	-0.00	-0.00
21	550	1.750	-0.30	-4.52	2.56	**0.00**	-0.00	0.00
2	545		-0.32	4.40	2.51	**-0.00**	-0.00	-0.00
21	390	0.146	0.29	4.25	-0.71	-0.00	**0.00**	-0.00
	484	1.750	-0.30	-4.07	1.35	0.00	**-0.00**	0.00
2	483	0.000	0.41	3.53	1.48	-0.00	0.00	**0.00**
	503		-0.43	-3.55	-0.25	0.00	-0.00	**-0.00**



Deformation - uz on member(s). Ser. combi : 1/566

Deformations on member(s). Global extreme

Linear static - extreme or all combinations
Group of member(s) :1/70
Group of serviceability combi :1/566
Cross-section : 5 - HEB100

memb	combi	dx [m]	ux [mm]	uy [mm]	uz [mm]	fix [rad]	fiy [rad]	fiz [rad]
55	222	0.300	**6.46**	-2.29	-0.68	0.00	0.00	0.00
	528		**-6.52**	2.32	-3.87	-0.00	-0.00	-0.00
53	478	0.700	-3.70	**6.45**	2.16	0.00	-0.00	0.00
54	528		-3.61	**-6.52**	2.20	-0.00	-0.00	-0.00
	306		-3.41	-4.51	**2.93**	-0.00	-0.00	-0.00
55	540	0.000	-4.58	2.58	**-4.73**	-0.00	-0.00	0.00
58	147	0.340	-0.80	-0.45	-0.52	**0.01**	0.00	0.00
	491		-1.83	0.25	0.80	**-0.01**	-0.00	-0.00
59	492	0.150	-1.36	-3.05	-3.23	-0.00	**0.00**	-0.01
60	351		1.59	-3.13	-1.81	-0.00	**-0.00**	-0.01
	147		-0.45	1.67	-0.83	0.00	0.00	**0.01**
	491		0.25	-1.39	-1.79	-0.00	-0.00	**-0.01**

Static Calculation 7574

Part 5

Air Liquide AGS GmbH
Fütingsweg 34
47805 Krefeld

K70101, ASU No. 9 Kosice
Tank Farm, Steel Construction of the new
Control Stage by the existing 1000 MT
LIN-Storage Tank

Saarbrücken, im Dezember 2004

(statische Berechnung Seiten 1-57)

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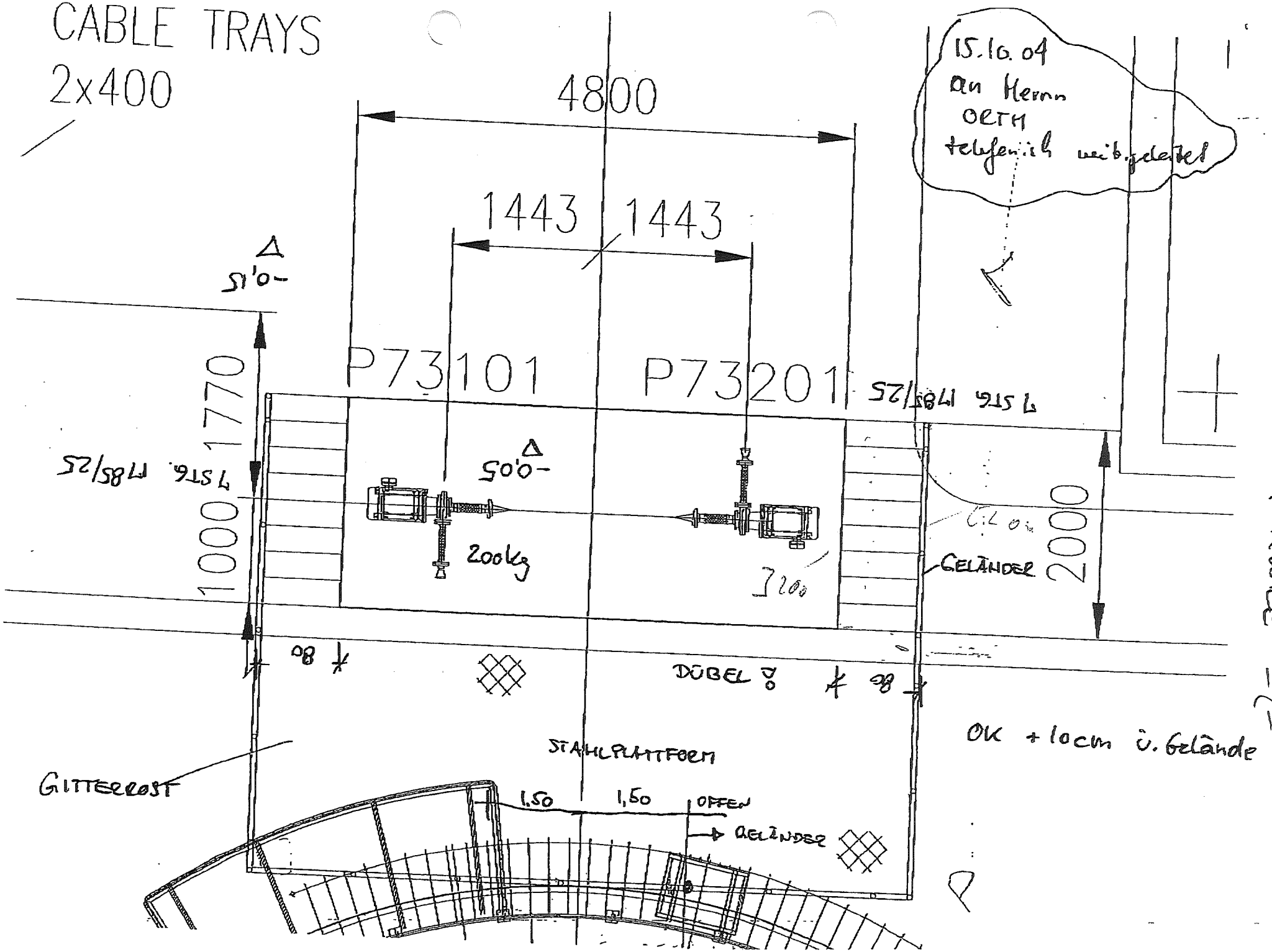
Tragwerkplaner

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


CABLE TRAYS
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an Herrn
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2000
200kg
GELÄNDER
DÜBEL
STAHLPLATTFORM
GITTERROST
1,50
1,50
OFFEN
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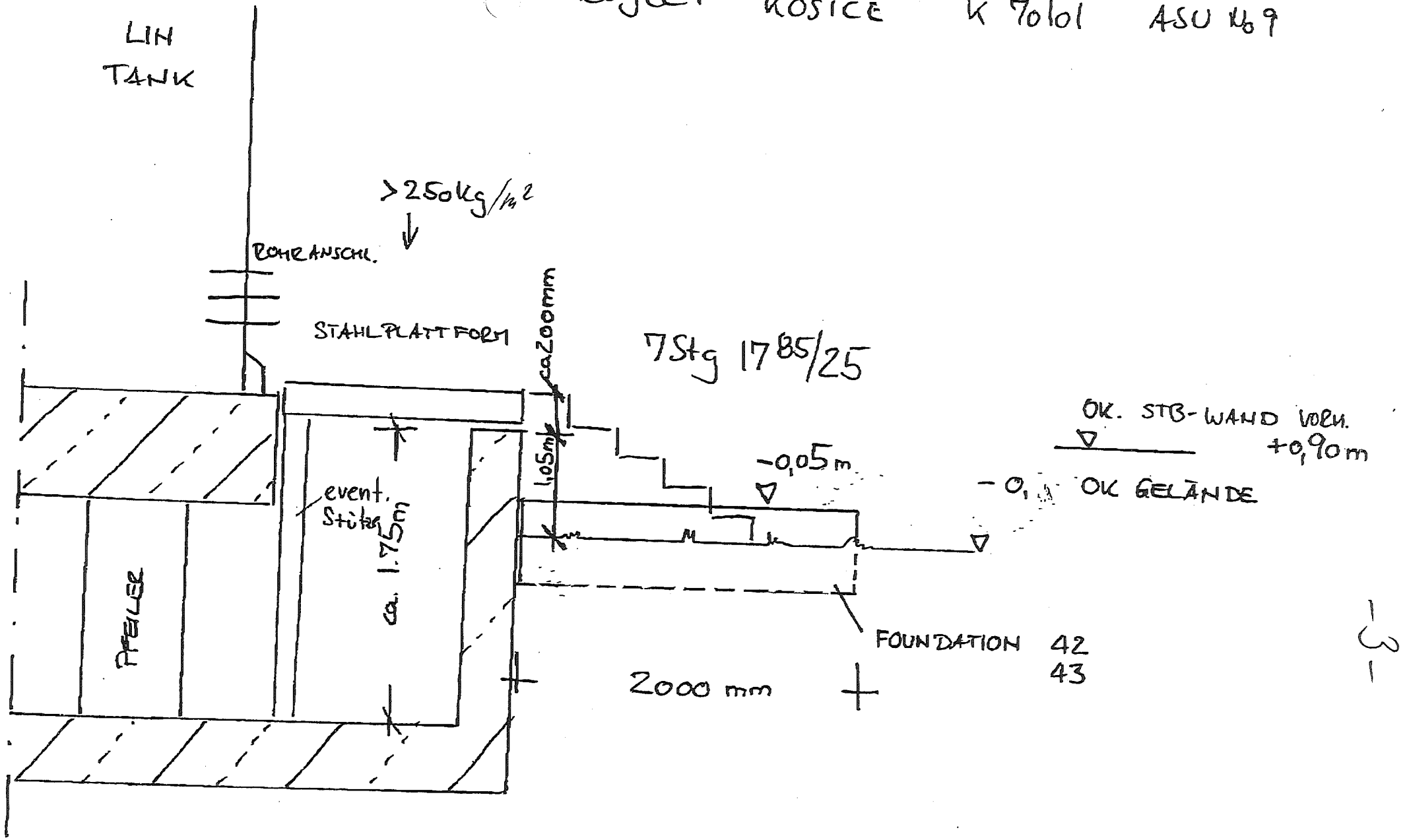
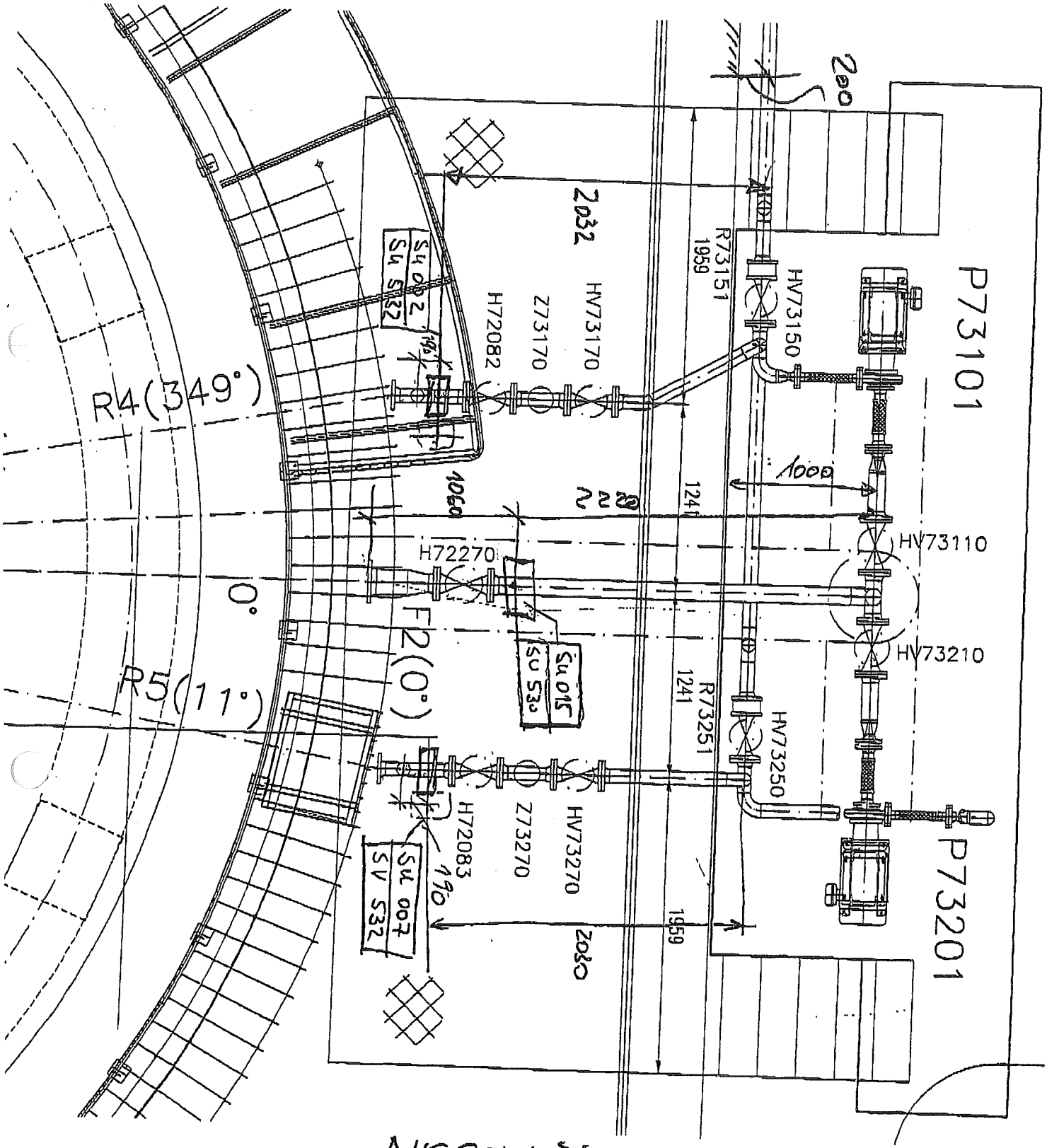
OK +10cm ü. Gelände
PROJEKT: K 7010 ABU NOG KOSICE

PROJECT KOSICE K 7o1o1 ASU Ho 9





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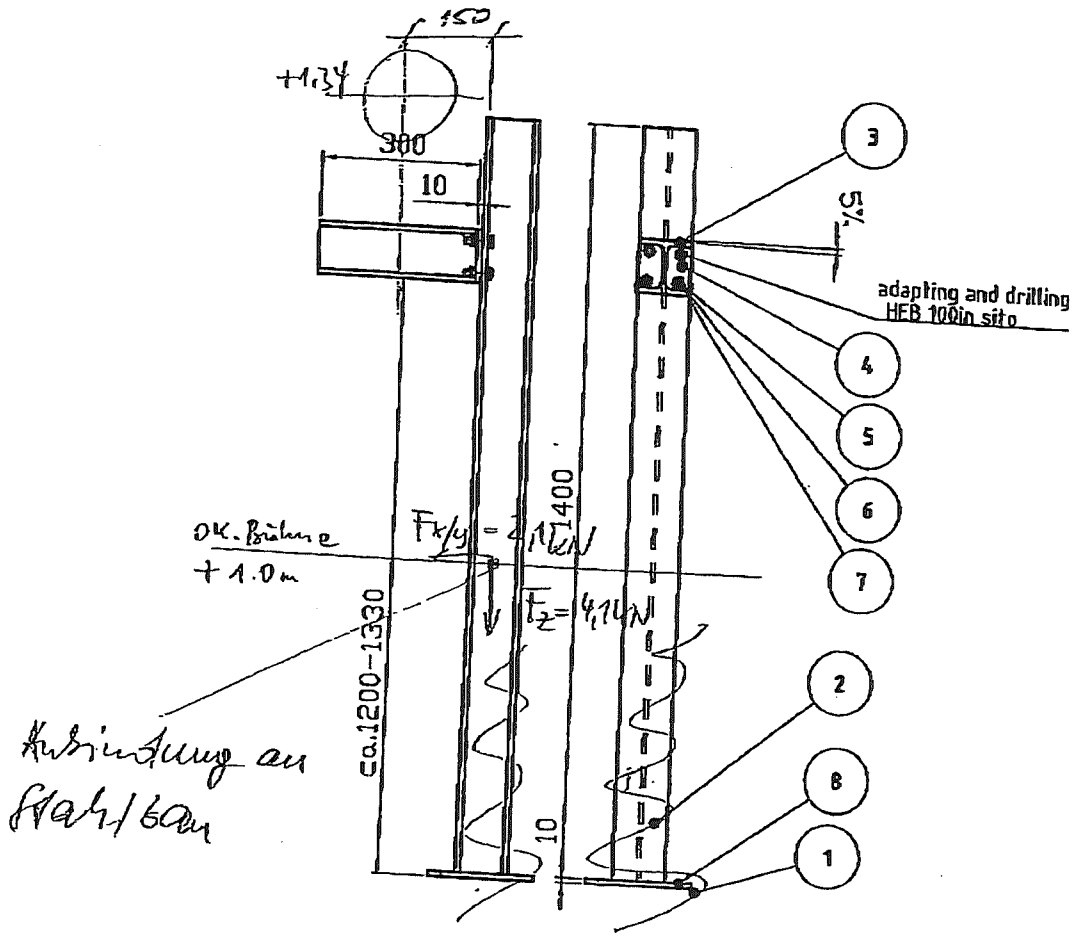
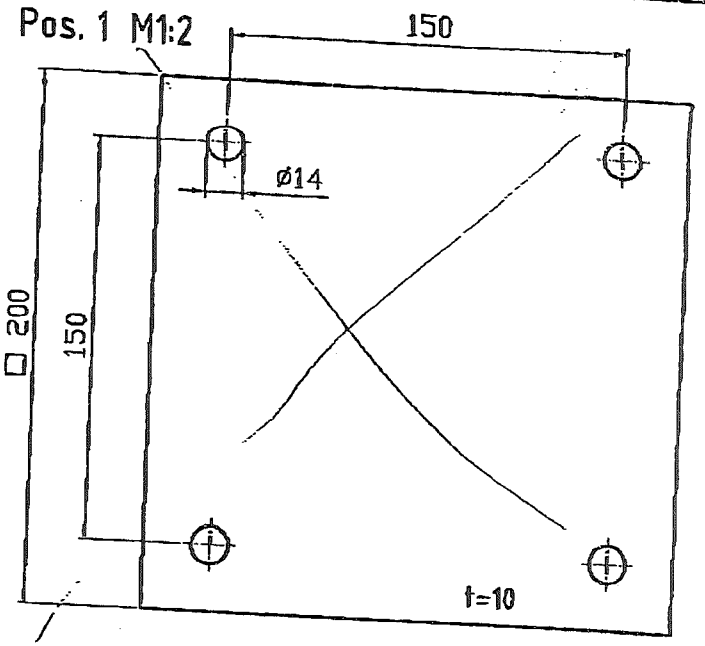
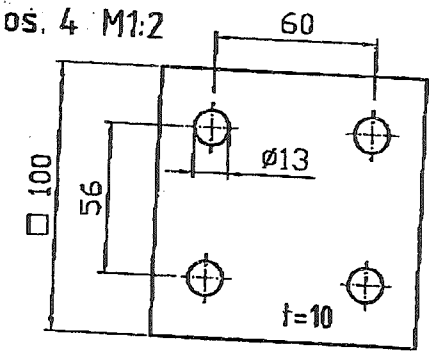
792.86823/001 VOM 30.11.04





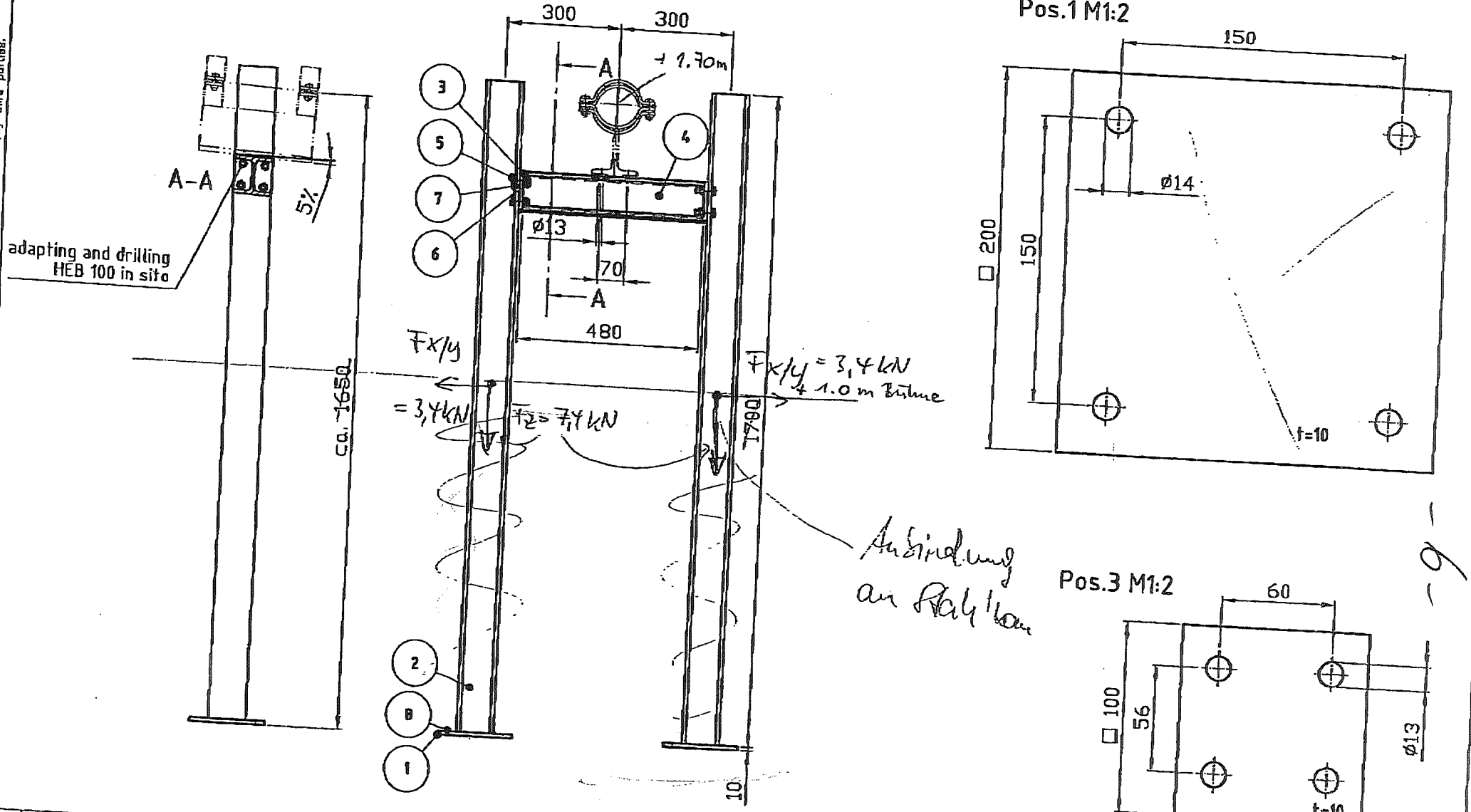


2x

Support	Type	Pos.	Object	DIN EN / Manufacturer		Material	Pcs.	L mm	B mm	H mm	H1 mm	H2 mm	Single Weight kg	Total Weight kg	Surface m2
SU-532	Support	1	Steel plate	DIN EN 10025	K	St37-2	1	200	200	10			3,140	3,140	0,08
SU-532	Support	2	HEB100 profile	DIN 1025	K	St37-2	1	1400					26,560	26,560	0,9604
SU-532	Support	3	HEB100 profile	DIN 1025	K	St37-2	1	300					6,120	6,120	0,2058
SU-532	Support	4	Steel plate	DIN EN 10025	K	St37-2	1	100	100	10			0,785	0,785	0,02
SU-532	Support	5	Hexagonal Screw M12x40mm	DIN EN ISO 4014	S	8.8	4	40					0,082	0,328	
SU-532	Support	6	Hexagonal Nut M12	DIN EN ISO 4032	S	8	4						0,031	0,124	
SU-532	Support	7	Washer M12	DIN EN ISO 7090	S	8	8						0,006	0,050	
SU-532	Support	8	Anchor bolt HST-R M12x145/50	Hilti	A	A4-70	4							0,000	

all not calculated welds: Corner weld a3

Date : 24.11.04	Name : WIP/Rad.	Checked: –	History file: 792.87247
Job code: K70101		Scale 1:10	Original format DIN A3
Reference: ASU Kosice		Sheet: 001	of – Sheets
Replaces: 79_	Title:	Drawing No.:	Rev.
Replaced by: 79_	SU-532		



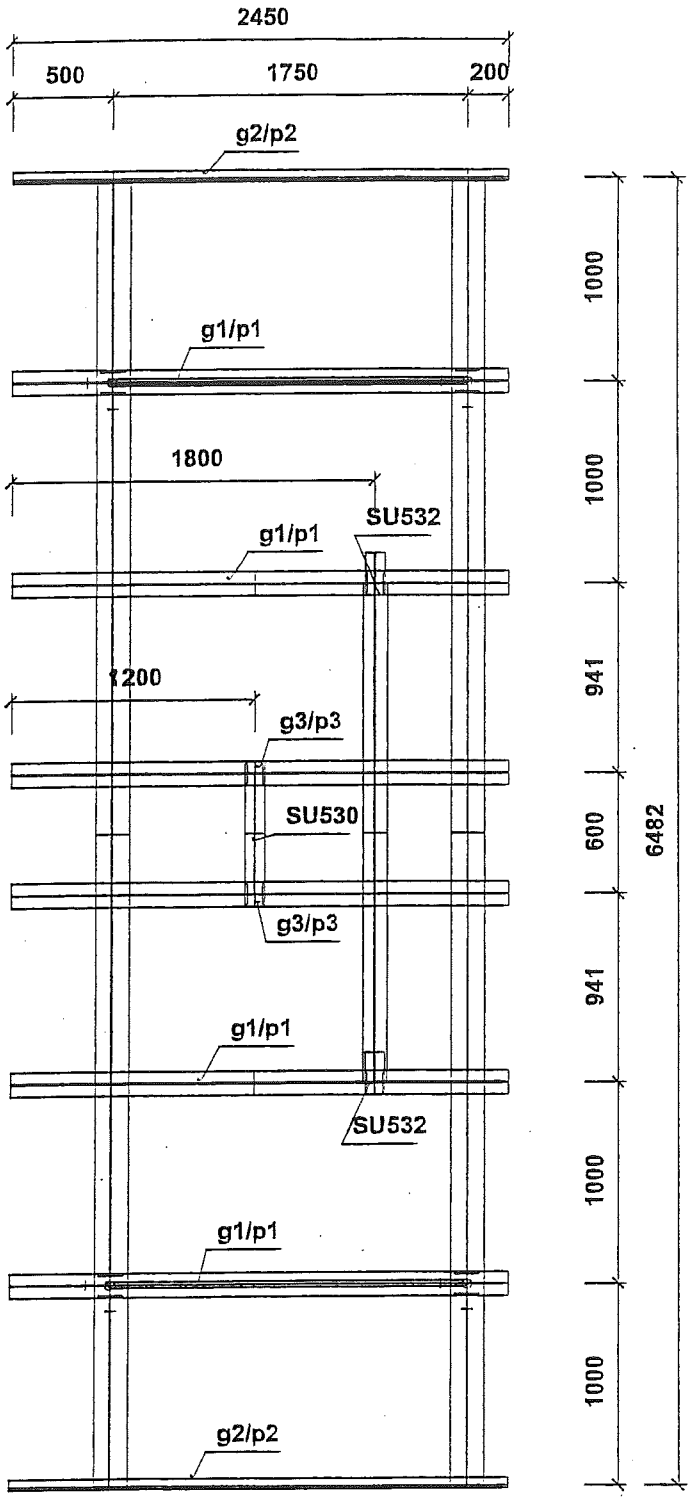
Pos.1 M1:2

Pos.3 M1:2

Support	Type	Pos.	Object	DIN EN / Manufacturer		Material	Pcs.	L mm	B mm	H mm	H1 mm	H2 mm	Single Weight kg	Total Weight kg	Surface m2
SU-530	Support	1	Steel plate	DIN EN 10025	K	St37-2	2	280	200	10			3,140	6,280	0,16
SU-530	Support	2	HEB100 profile	DIN 1025	K	St37-2	2	1700					34,680	69,360	2,3324
SU-530	Support	3	Steel plate	DIN EN 10025	K	St37-2	2	100	100	10			0,785	1,570	0,04
SU-530	Support	4	HEB100 profile	DIN 1025	K	St37-2	1	480					8,782	8,782	0,3283
SU-530	Support	5	Hexagonal Screw M12x40mm	DIN EN ISO 4014	S	8.8	8	40					0,082	0,656	
SU-530	Support	6	Hexagonal Nut M12	DIN EN ISO 4032	S	8	8						0,031	0,248	
SU-530	Support	7	Washer M12	DIN EN ISO 7090	S	8	16						0,006	0,100	
SU-530	Support	8	Anchor bolt HST-R M12x145/50	HILTI	A	A4-70	8							0,000	

all not calculated welds: Corner weld a3

Date : 24.11.04	Name : WIP/Rad.	Checked: –	History file: 792.87247
Job code: K70101		Scale 1:10	Original format DIN A3
Reference: ASU Kosice		Sheet: 001	of – Sheets
Replaces: 79___	Title:	Drawing No.:	Rev.
Replaced by: 79_____	SU-530		



Design Load

a) Dead Loads

Weight of the stage lining

$g' = 0{,}60\ kN/m^2$

$g_1 = 0{,}60 \cdot 1{,}0 = 0{,}60\ kN/m$

$g_2 = 0{,}60 \cdot \frac{1{,}0}{2} + 0{,}05 = 0{,}35\ kN/m$

$g_3 = 0{,}60 \cdot \frac{(1{,}0+0{,}6)}{2} = 0{,}50\ kN/m$

b) Live Loads

$p' = 2{,}50\ kN/m^2$

$p_1 = 2{,}50 \cdot 1{,}0 = 2{,}50\ kN/m$

$p_2 = 2{,}5 \cdot \frac{1{,}0}{2} = 1{,}25\ kN/m$

$p_3 = 2{,}5 \cdot \frac{(1{,}0+0{,}6)}{2} = 2{,}0\ kN/m$

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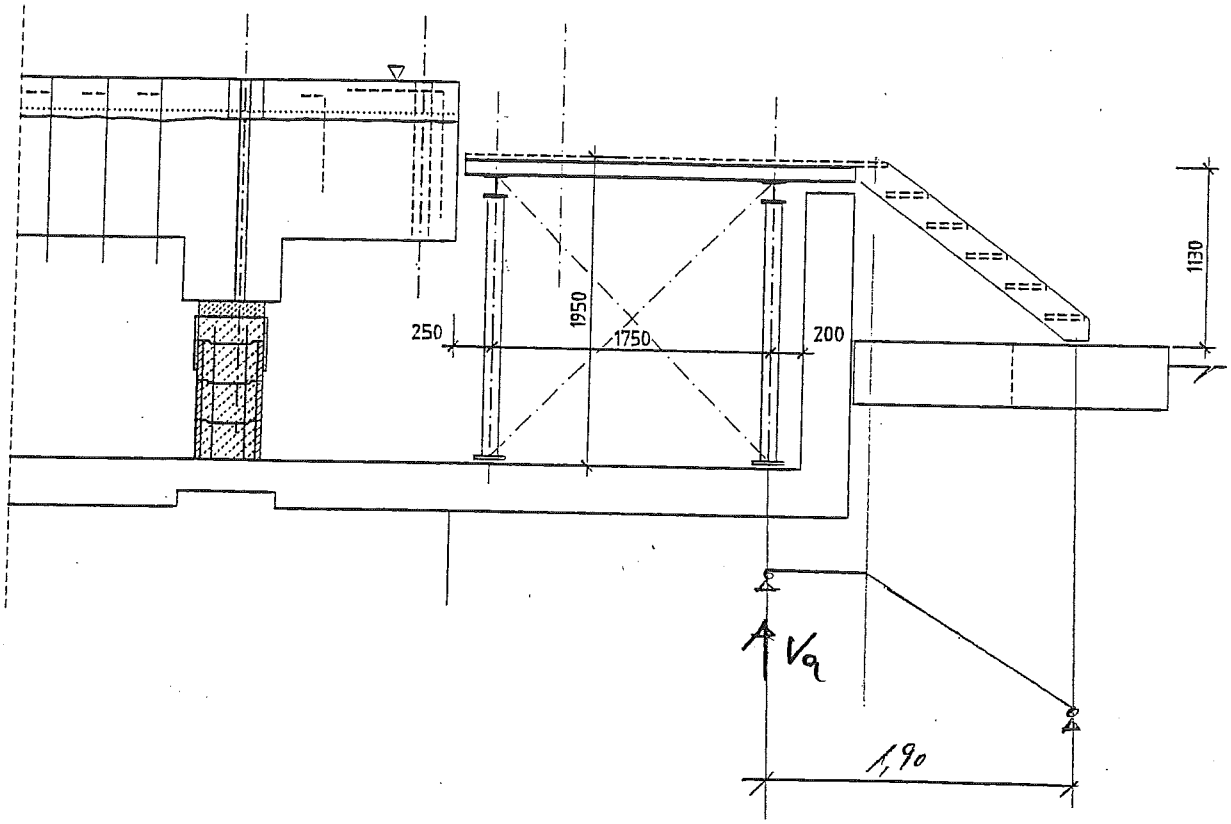

Dead Load

$g' = 1,0\ kN/m^2$

$g = \frac{1,0 \cdot 0,90}{2} + 0,5 = 0,90\ kN/m$

$V_{ag} = \frac{0,90 \cdot 1,90}{2} = \underline{0,86\ kN}$

Live Load

$p' = 2,50\ kN/m^2$

$p = \frac{2,5 \cdot 0,8}{2} = 1,0\ kN/m$

$V_{ap} = \frac{1,0 \cdot 1,90}{2} = \underline{0,95\ kN}$

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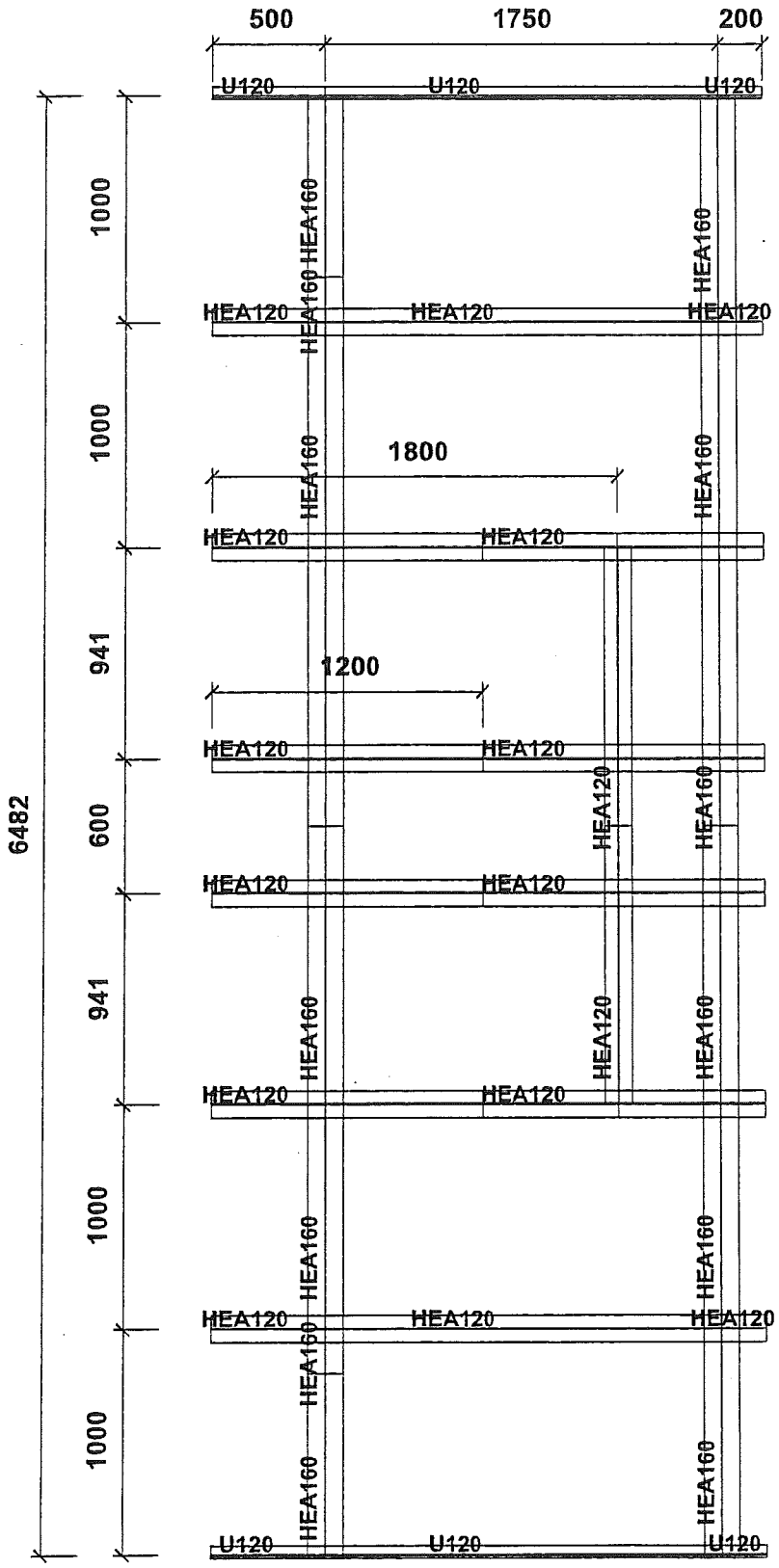
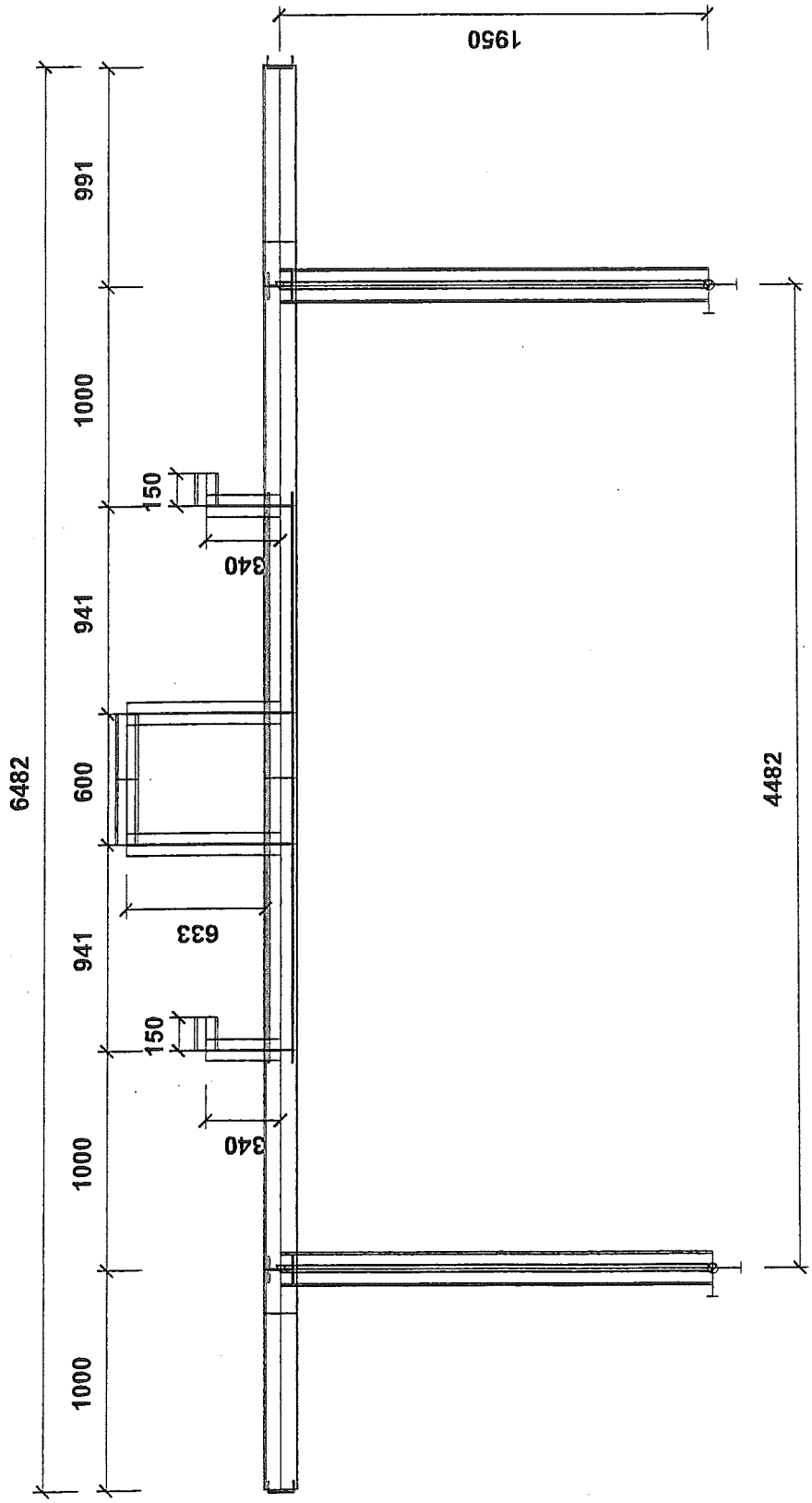
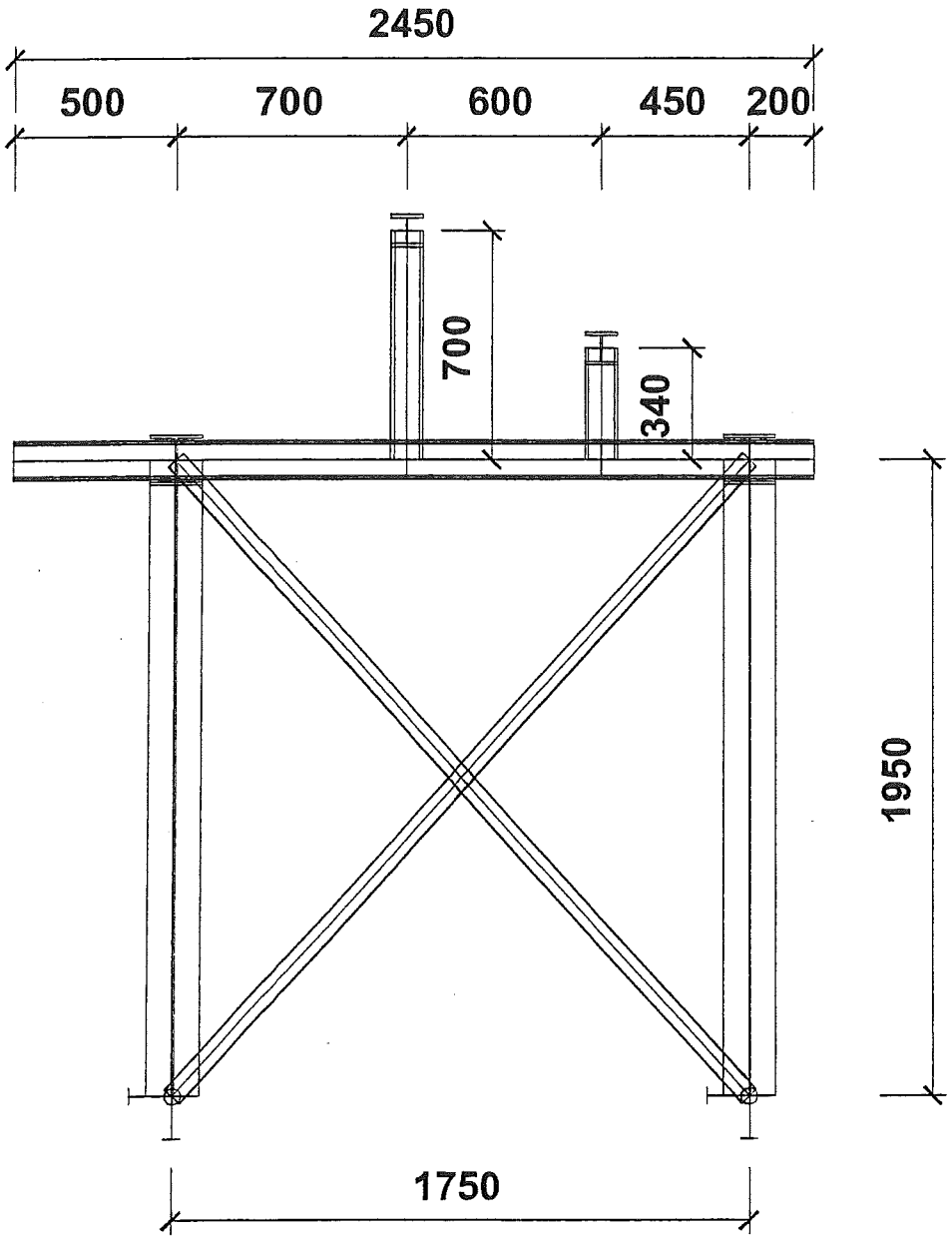

500
1750
200
U120
U120
U120
HEA160
HEA160
HEA160
HEA120
HEA120
HEA120
1000
1000
1800
941
1200
6482
600
941
1000
1000
U120
U120
U120


1950
991
1000
150
340
941
6482
600
4482
633
941
150
340
1000
1000


2450
500
700
600
450
200
700
340
1950
1750

Basic data
Type of structure : General XYZ

Number of nodes:	56
Number of members:	70
Number of 1D macros:	27
Number of bound. lines:	0
Number of 2D macros:	0
Number of profiles :	5
Number of cases:	20
Number of materials:	1

Material

Name:		
S 235		
	Ultimate strength	36.0000 kN/cm^2
	Yield design	24.0000 kN/cm^2
	E modulus	210000.00 MPa
	Poisson coeff.	0.30
	Density	7850.000 kg/m^3
	Extensibility	0.012 mm/m.K

List of material
Group of members : 1/70

no.	Name:	quality	unit weight kg/m	length m	weight kg
1	HEA160	S 235	30.46	20.76	632.43
2	HEA120	S 235	19.86	17.18	341.24
3	U120	S 235	13.35	4.90	65.39
4	L45X4	S 235	2.74	10.48	28.71
5	HEB100	S 235	20.44	2.98	60.92

The total weight of the structure: 1128.69 kg
Surface for painting: 37.17 m^2

Nodes

node	X m	Y m	Z m	node	X m	Y m	Z m
1	1.600	0.000	0.000	8	4.050	1.000	0.000
2	2.100	0.000	0.000	9	1.600	2.000	0.000
3	3.850	0.000	0.000	10	2.100	2.000	0.000
4	4.050	0.000	0.000	11	3.850	2.000	0.000
5	1.600	1.000	0.000	12	4.050	2.000	0.000
6	2.100	1.000	0.000	13	2.100	3.241	0.000
7	3.850	1.000	0.000	14	3.850	3.241	0.000

node	X m	Y m	Z m
15	1.600	4.482	0.000
16	2.100	4.482	0.000
17	3.850	4.482	0.000
18	4.050	4.482	0.000
19	1.600	5.482	0.000
20	2.100	5.482	0.000
21	3.850	5.482	0.000
22	4.050	5.482	0.000
23	1.600	6.482	0.000
24	2.100	6.482	0.000
25	3.850	6.482	0.000
26	4.050	6.482	0.000
27	2.100	1.000	-1.950
28	3.850	1.000	-1.950
29	2.100	5.482	-1.950
30	3.850	5.482	-1.950
31	2.800	2.000	0.000
32	2.800	4.482	0.000
33	3.400	2.000	0.000
34	3.400	3.241	0.000
35	3.400	4.482	0.000

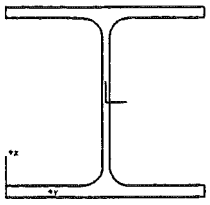
node	X m	Y m	Z m
36	2.800	2.941	0.000
37	2.800	2.941	0.700
38	2.800	3.541	0.000
39	2.800	3.541	0.700
40	2.800	3.241	0.700
41	3.400	2.000	0.340
42	3.400	4.482	0.340
43	3.400	2.150	0.340
44	3.400	4.632	0.340
45	1.600	2.941	0.000
46	2.100	2.941	0.000
47	3.400	2.941	0.000
48	3.850	2.941	0.000
49	4.050	2.941	0.000
50	1.600	3.541	0.000
51	2.100	3.541	0.000
52	3.400	3.541	0.000
53	3.850	3.541	0.000
54	4.050	3.541	0.000
55	2.100	0.800	0.000
56	2.100	5.682	0.000

Members

macro	memb	node 1	node 2	length m	Rx deg	profile	quality
1	1	1	2	0.500	0.00	3 - U120	S 235
	2	2	3	1.750	0.00	3 - U120	S 235
	3	3	4	0.200	0.00	3 - U120	S 235
2	4	5	6	0.500	0.00	2 - HEA120	S 235
	5	6	7	1.750	0.00	2 - HEA120	S 235
	6	7	8	0.200	0.00	2 - HEA120	S 235
3	7	9	10	0.500	0.00	2 - HEA120	S 235
	8	10	31	0.700	0.00	2 - HEA120	S 235
	9	31	33	0.600	0.00	2 - HEA120	S 235
	10	33	11	0.450	0.00	2 - HEA120	S 235
	11	11	12	0.200	0.00	2 - HEA120	S 235
4	12	15	16	0.500	0.00	2 - HEA120	S 235
	13	16	32	0.700	0.00	2 - HEA120	S 235
	14	32	35	0.600	0.00	2 - HEA120	S 235
	15	35	17	0.450	0.00	2 - HEA120	S 235
	16	17	18	0.200	0.00	2 - HEA120	S 235
5	17	19	20	0.500	0.00	2 - HEA120	S 235
	18	20	21	1.750	0.00	2 - HEA120	S 235
	19	21	22	0.200	0.00	2 - HEA120	S 235
6	20	23	24	0.500	0.00	3 - U120	S 235
	21	24	25	1.750	0.00	3 - U120	S 235
	22	25	26	0.200	0.00	3 - U120	S 235
7	23	2	55	0.800	0.00	1 - HEA160	S 235

macro	memb	node 1	node 2	length m	Rx deg	profile	quality
	24	55	6	0.200	0.00	1 - HEA160	S 235
	25	6	10	1.000	0.00	1 - HEA160	S 235
	26	10	46	0.941	0.00	1 - HEA160	S 235
	27	46	13	0.300	0.00	1 - HEA160	S 235
	28	13	51	0.300	0.00	1 - HEA160	S 235
	29	51	16	0.941	0.00	1 - HEA160	S 235
	30	16	20	1.000	0.00	1 - HEA160	S 235
	31	20	56	0.200	0.00	1 - HEA160	S 235
	32	56	24	0.800	0.00	1 - HEA160	S 235
8	33	3	7	1.000	0.00	1 - HEA160	S 235
	34	7	11	1.000	0.00	1 - HEA160	S 235
	35	11	48	0.941	0.00	1 - HEA160	S 235
	36	48	14	0.300	0.00	1 - HEA160	S 235
	37	14	53	0.300	0.00	1 - HEA160	S 235
	38	53	17	0.941	0.00	1 - HEA160	S 235
	39	17	21	1.000	0.00	1 - HEA160	S 235
	40	21	25	1.000	0.00	1 - HEA160	S 235
9	41	27	6	1.950	90.00	1 - HEA160	S 235
10	42	28	7	1.950	90.00	1 - HEA160	S 235
11	43	29	20	1.950	90.00	1 - HEA160	S 235
12	44	30	21	1.950	90.00	1 - HEA160	S 235
13	45	33	47	0.941	0.00	2 - HEA120	S 235
	46	47	34	0.300	0.00	2 - HEA120	S 235
14	47	34	52	0.300	0.00	2 - HEA120	S 235
	48	52	35	0.941	0.00	2 - HEA120	S 235
15	49	27	7	2.620	0.00	4 - L45X4	S 235
16	50	6	28	2.620	0.00	4 - L45X4	S 235
17	51	29	21	2.620	0.00	4 - L45X4	S 235
18	52	20	30	2.620	0.00	4 - L45X4	S 235
19	53	36	37	0.700	0.00	5 - HEB100	S 235
20	54	38	39	0.700	0.00	5 - HEB100	S 235
21	55	37	40	0.300	0.00	5 - HEB100	S 235
	56	40	39	0.300	0.00	5 - HEB100	S 235
22	57	33	41	0.340	0.00	5 - HEB100	S 235
23	58	35	42	0.340	0.00	5 - HEB100	S 235
24	59	41	43	0.150	0.00	5 - HEB100	S 235
25	60	42	44	0.150	0.00	5 - HEB100	S 235
26	61	45	46	0.500	0.00	2 - HEA120	S 235
	62	46	36	0.700	0.00	2 - HEA120	S 235
	63	36	47	0.600	0.00	2 - HEA120	S 235
	64	47	48	0.450	0.00	2 - HEA120	S 235
	65	48	49	0.200	0.00	2 - HEA120	S 235
27	66	50	51	0.500	0.00	2 - HEA120	S 235
	67	51	38	0.700	0.00	2 - HEA120	S 235
	68	38	52	0.600	0.00	2 - HEA120	S 235
	69	52	53	0.450	0.00	2 - HEA120	S 235
	70	53	54	0.200	0.00	2 - HEA120	S 235

Profiles



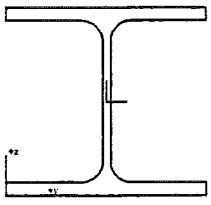
HEA160

Profile no. 1 - HEA160
Material : 12 - S 235

A:	3.880000e+001 cm^2		
Ay/A:	0.646	Az/A:	0.208
Iy:	1.670000e+003 cm^4	Iz:	6.160000e+002 cm^4
Iyz:	0.000000e+000 cm^4	It:	1.220000e+001 cm^4
Iw:	3.150259e+004 cm^6		
Wely:	2.200000e+002 cm^3	Welz:	7.700000e+001 cm^3
Wply:	2.460000e+002 cm^3	Wplz:	1.180000e+002 cm^3
cy:	8.00 cm	cz:	7.60 cm
iy:	6.56 cm	iz:	3.98 cm
dy:	0.00 cm	dz:	-0.00 cm
Outline :		93.20 cm	

Type for check: I section

Height	15.20 cm	Width	16.00 cm
Thickness of flange	0.90 cm	Thickness of web	0.60 cm
Radius	1.50 cm		



HEA120

Profile no. 2 - HEA120
Material : 12 - S 235

A:	2.530000e+001 cm^2		
Ay/A:	0.657	Az/A:	0.197
Iy:	6.060000e+002 cm^4	Iz:	2.310000e+002 cm^4
Iyz:	2.142655e-009 cm^4	It:	5.990000e+000 cm^4
Iw:	6.491084e+003 cm^6		
Wely:	1.060000e+002 cm^3	Welz:	3.850000e+001 cm^3
Wply:	1.200000e+002 cm^3	Wplz:	5.900000e+001 cm^3
cy:	6.00 cm	cz:	5.70 cm
iy:	4.89 cm	iz:	3.02 cm
dy:	0.00 cm	dz:	0.00 cm
Outline :		69.80 cm	

Type for check: I section

Height	11.40 cm	Width	12.00 cm
Thickness of flange	0.80 cm	Thickness of web	0.50 cm
Radius	1.20 cm		

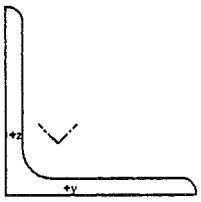
U120

Profile no. 3 - U120
Material : 12 - S 235

A:	1.700000e+001 cm^2		
Ay/A:	0.312	Az/A:	0.395
Iy:	3.640000e+002 cm^4	Iz:	4.320000e+001 cm^4
Iyz:	4.150461e-012 cm^4	It:	4.150000e+000 cm^4
Iw:	9.000000e+002 cm^6		
Wely:	6.070000e+001 cm^3	Welz:	1.110000e+001 cm^3
Wply:	7.260000e+001 cm^3	Wplz:	2.320000e+001 cm^3
cy:	1.63 cm	cz:	6.00 cm
iy:	4.63 cm	iz:	1.59 cm
dy:	-3.41 cm	dz:	0.00 cm
Outline :			44.60 cm

Type for check: Channel section

Height	12.00 cm	Width	5.50 cm
Thickness of flange	0.90 cm	Thickness of web	0.70 cm
Radius	0.90 cm		



L45X4

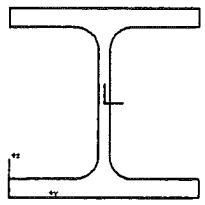
Profile no. 4 - L45X4
Material : 12 - S 235

A:	3.490000e+000 cm^2		
Ay/A:	0.419	Az/A:	0.417
Iy:	1.020000e+001 cm^4	Iz:	2.680000e+000 cm^4
Iy0:	6.430000e+000 cm^4	Iz0:	6.430000e+000 cm^4
alpha:	45.000 deg		

A:	3.490000e+000 cm^2		
Iyz:	-3.751882e+000 cm^4	It:	1.920000e-001 cm^4
Iw:	0.000000e+000 cm^6		
Wely:	3.205551e+000 cm^3	Welz:	1.535204e+000 cm^3
Wply:	5.090208e+000 cm^3	Wplz:	2.651562e+000 cm^3
cy:	1.23 cm	cz:	1.23 cm
iy:	1.71 cm	iz:	0.88 cm
dy:	-1.52 cm	dz:	-0.00 cm
Outline :		18.00 cm	

Type for check: Angle section

Height	4.50 cm	Width	4.50 cm
Thickness of flange	0.40 cm	Radius	0.35 cm



HEB100

Profile no. 5 - HEB100
Material : 12 - S 235

A:	2.604000e+001 cm^2		
Ay/A:	0.660	Az/A:	0.194
Iy:	4.495000e+002 cm^4	Iz:	1.673000e+002 cm^4
Iyz:	1.629903e-009 cm^4	It:	9.250000e+000 cm^4
Iw:	3.384985e+003 cm^6		
Wely:	8.991000e+001 cm^3	Welz:	3.345000e+001 cm^3
Wply:	1.040000e+002 cm^3	Wplz:	5.100000e+001 cm^3
cy:	5.00 cm	cz:	5.00 cm
iy:	4.15 cm	iz:	2.53 cm
dy:	0.00 cm	dz:	-0.00 cm
Outline :		58.80 cm	

Type for check: I section

Height	10.00 cm	Width	10.00 cm
Thickness of flange	1.00 cm	Thickness of web	0.60 cm
Radius	1.20 cm		

Nontypical elements

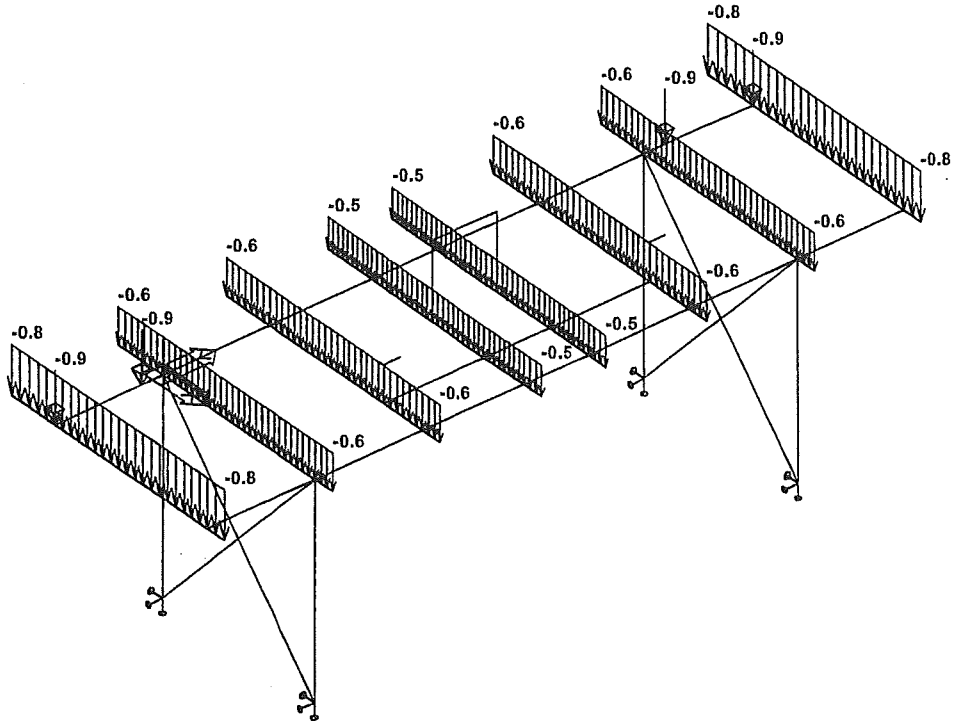
memb	type	memb	type	memb	type
49	X	50	X	51	X
52	X				

Supports

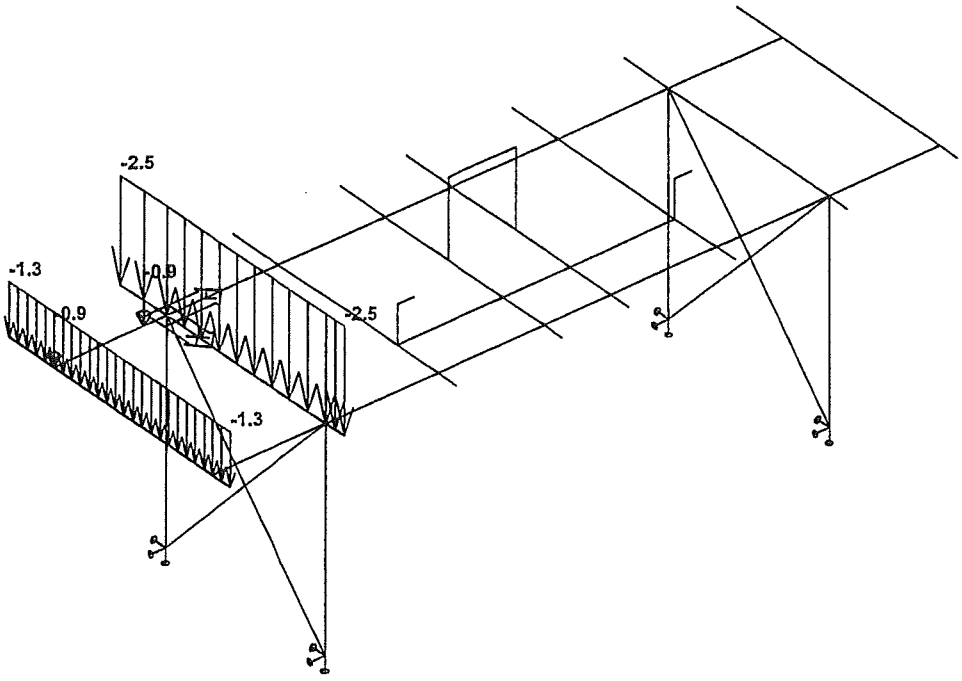
support	node	type	Size m
1	27	XYZ	0.20
2	28	XYZ	0.20
3	29	XYZ	0.20
4	30	XYZ	0.20

Loadcases

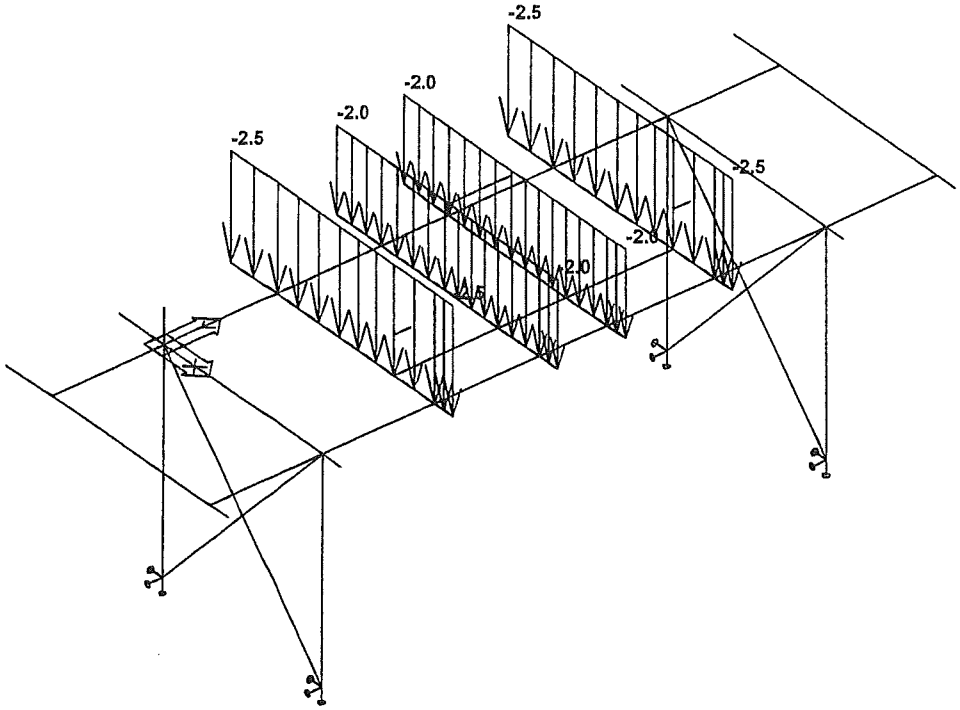
Case	Name:	Description
1	Dead Load	Self weight. Direction -Z
2	weight of the stage lining	Permanent - Loads
3	p1	Variable - p
4	p2	Variable - p
5	p3	Variable - p
6	SU 532 Z	Variable - p
7	SU 532 Z	Variable - p
8	SU 530 Z	Variable - p
9	SU 532 +X	Variable - p
10	SU 532 +X	Variable - p
11	SU 530 +X	Variable - p
12	SU 532 -X	Variable - p
13	SU 532 -X	Variable - p
14	SU 530 -X	Variable - p
15	SU 532 +Y	Variable - p
16	SU 532 +Y	Variable - p
17	SU 530 +Y	Variable - p
18	SU 532 -Y	Variable - p
19	SU 532 -Y	Variable - p
20	SU 530 -Y	Variable - p



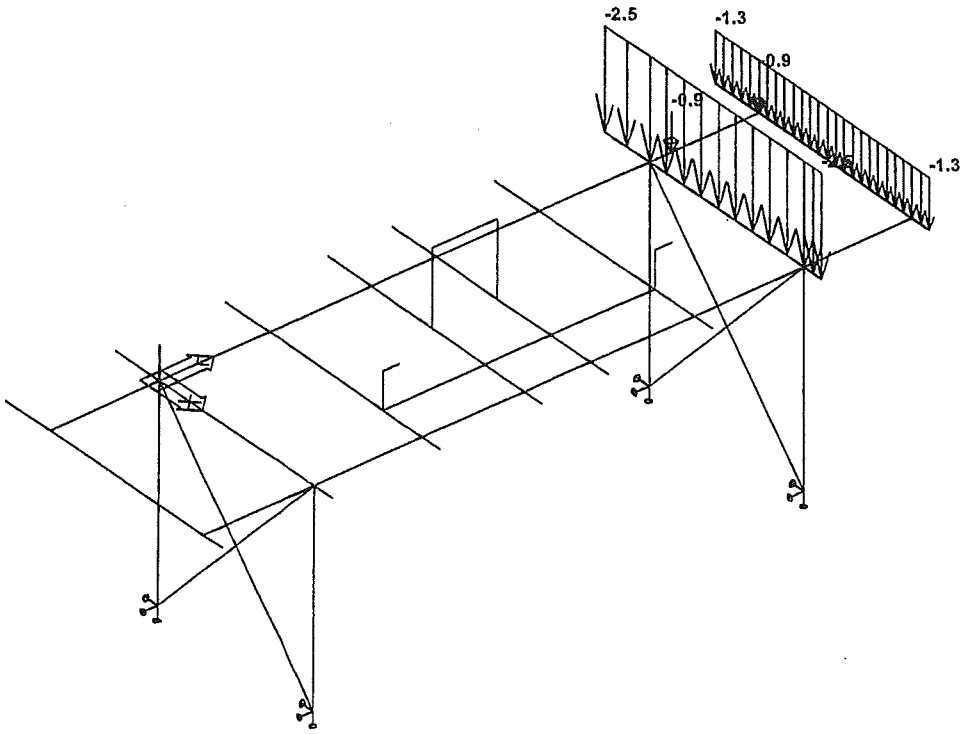
2. weight of the stage lining



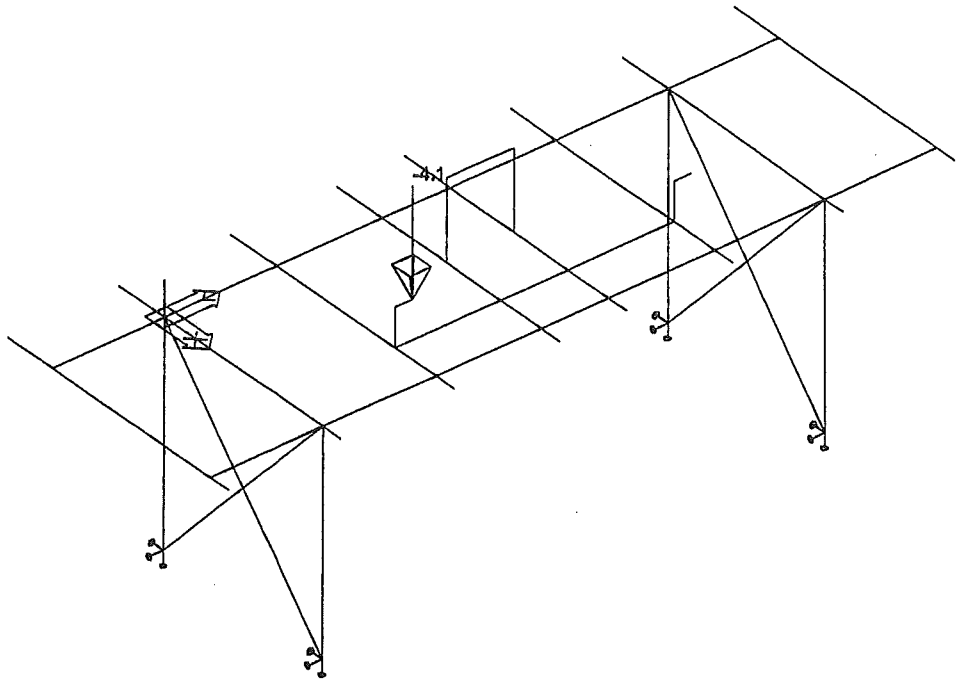
3. p1



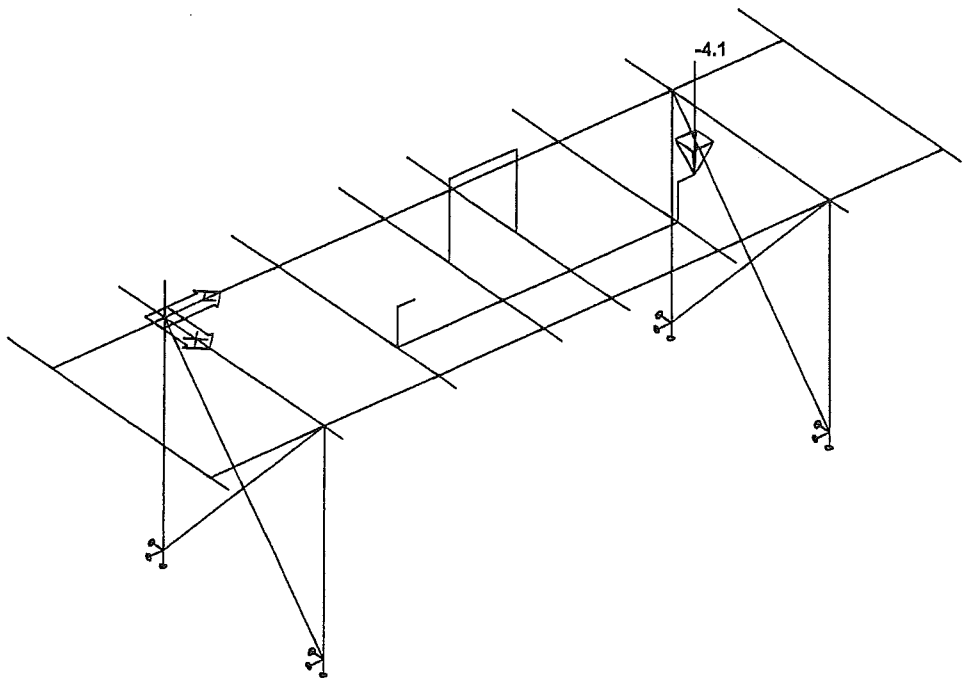
4. p2



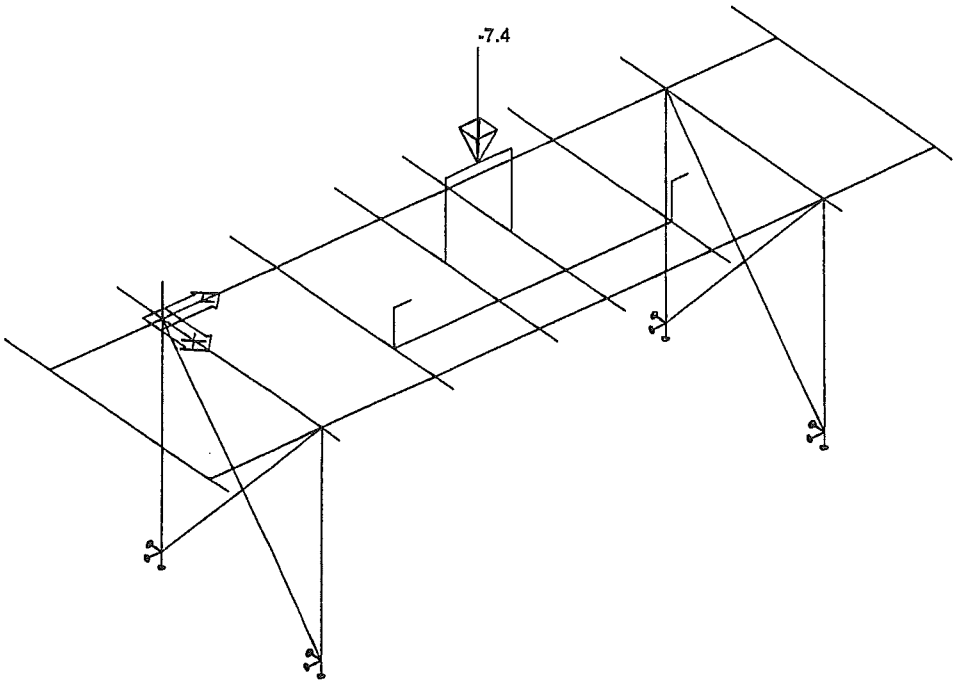
5. p3



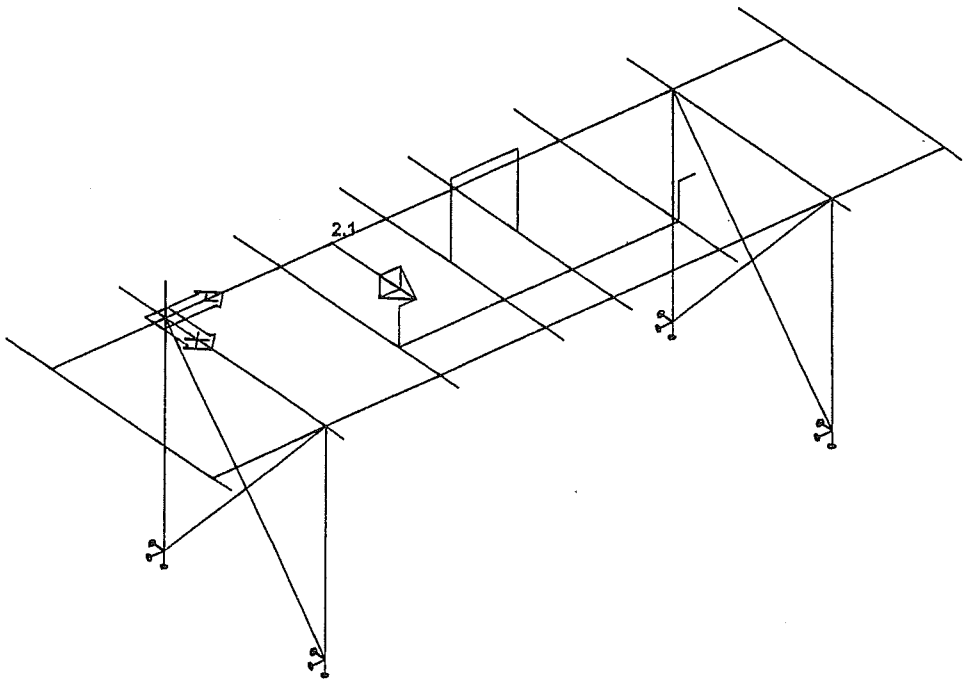
6. SU 532 Z



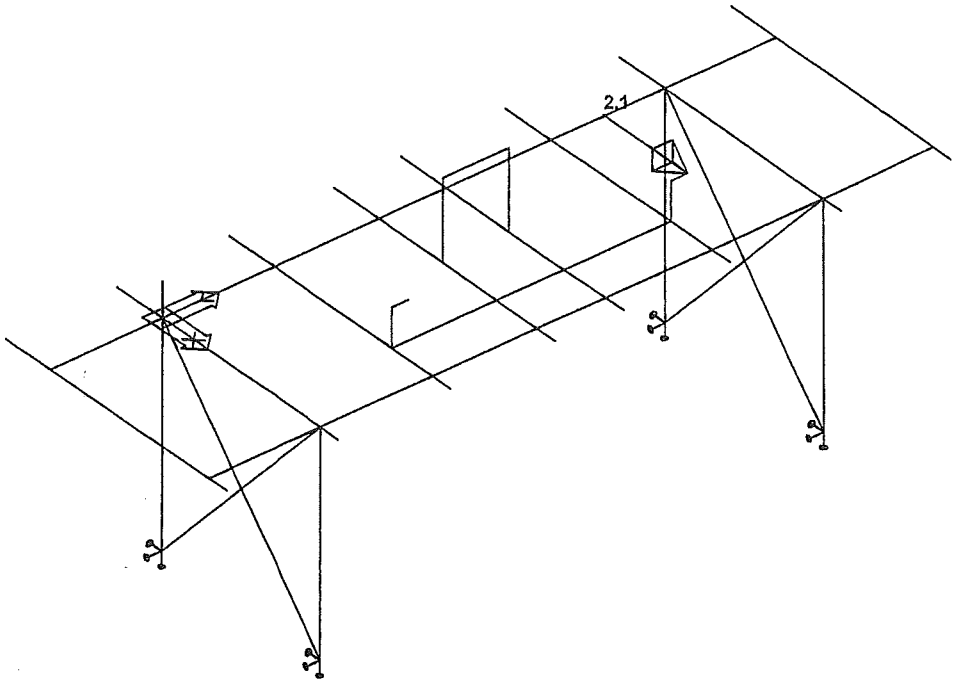
7. SU 532 Z



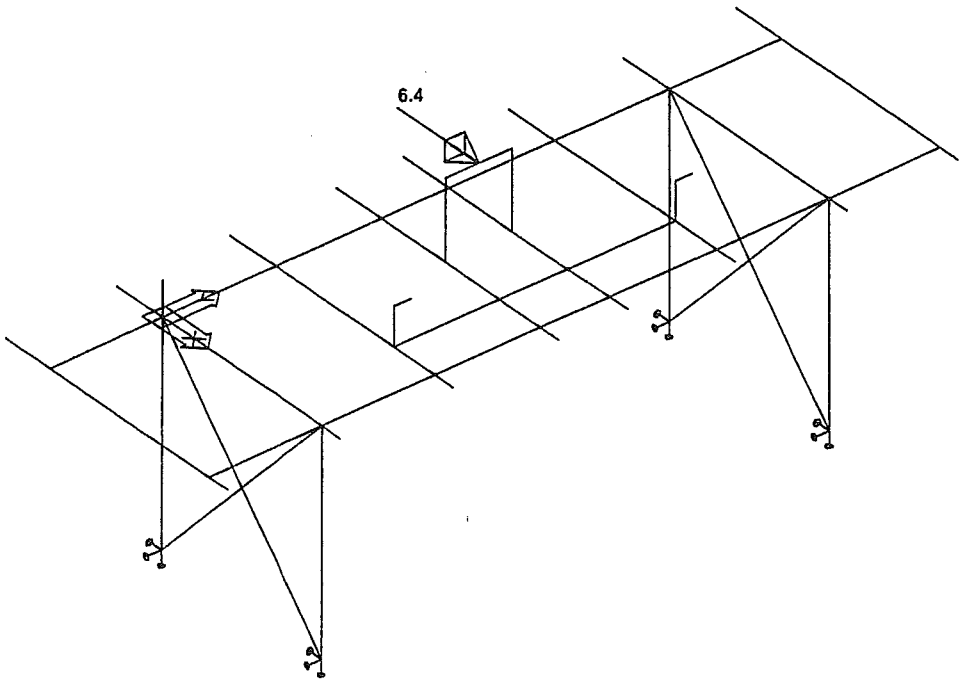
8. SU 530 Z



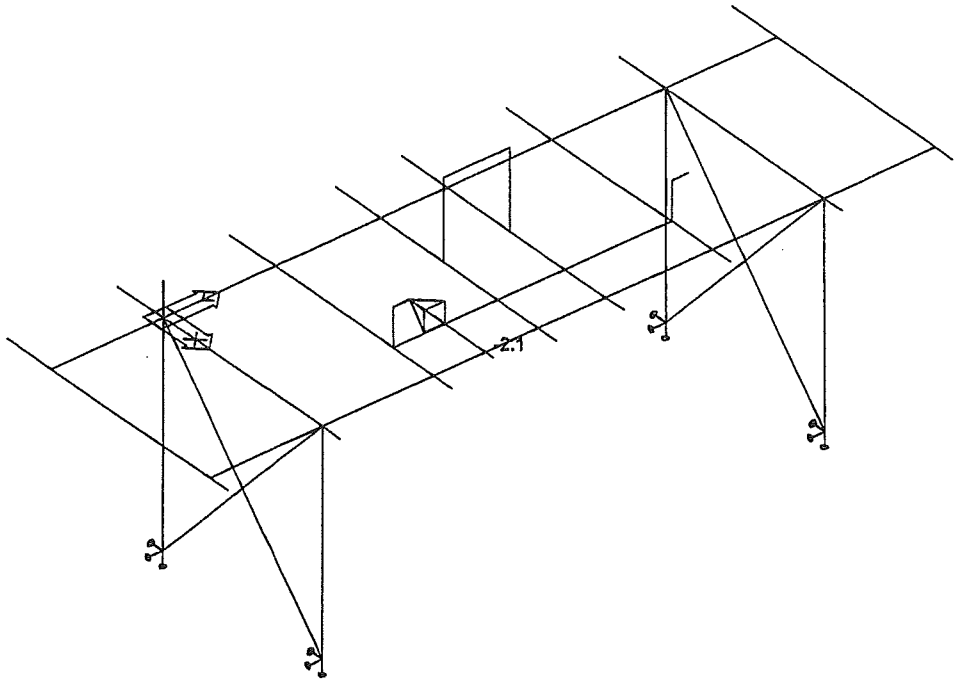
9. SU 532 +X



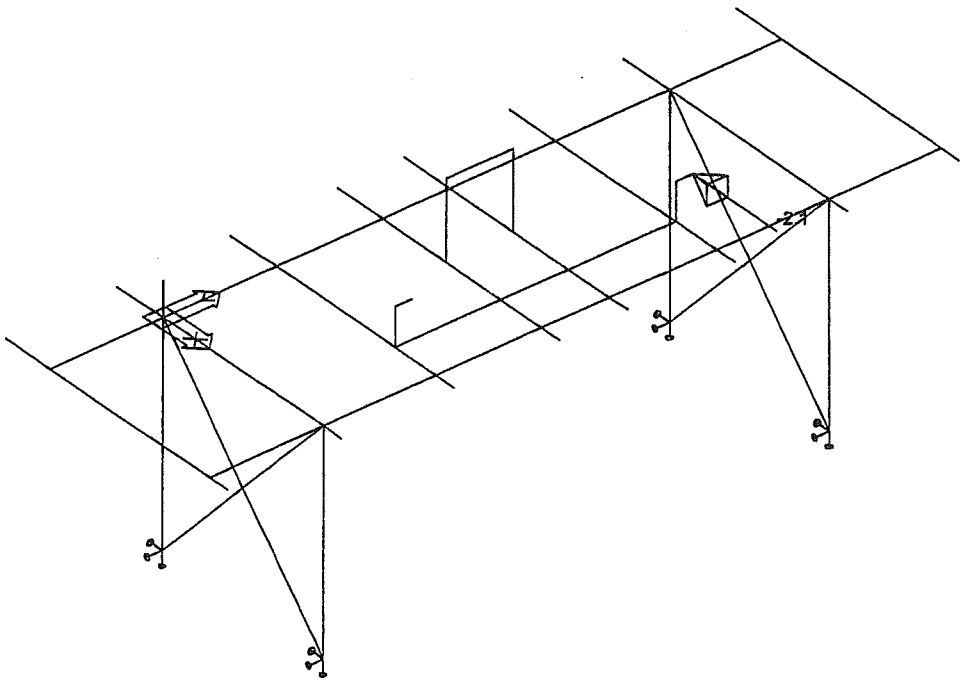
10. SU 532 +X



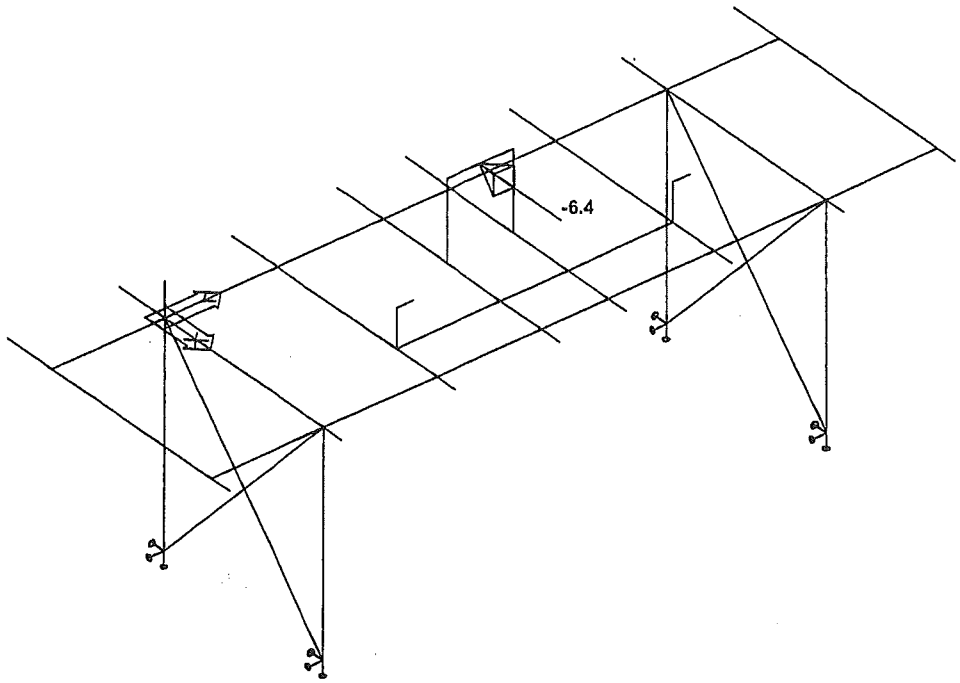
11. SU 530 +X



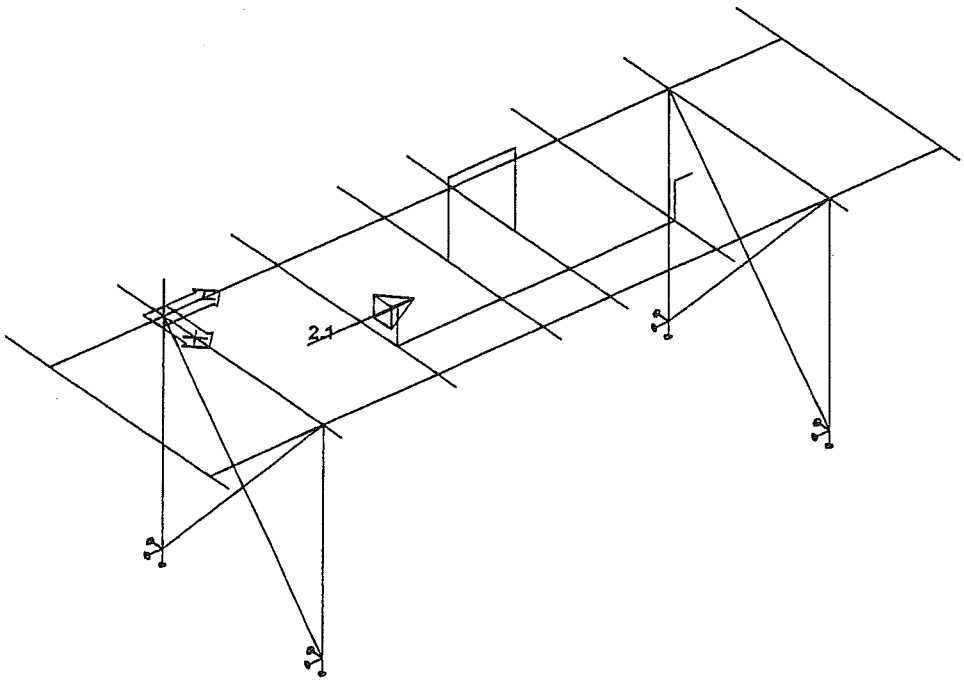
12. SU 532 -X



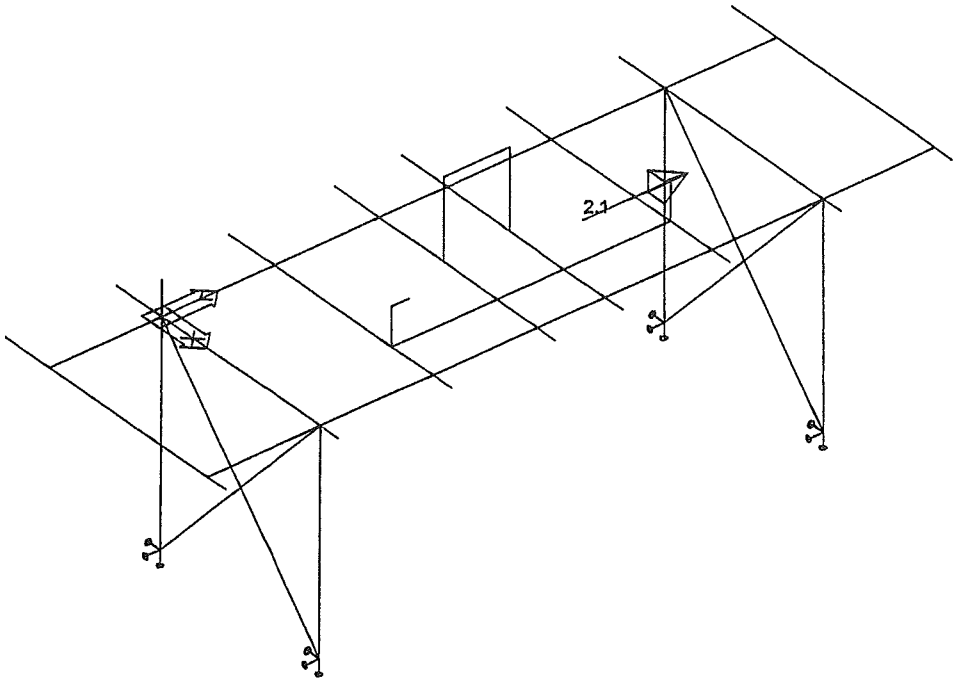
13. SU 532 -X



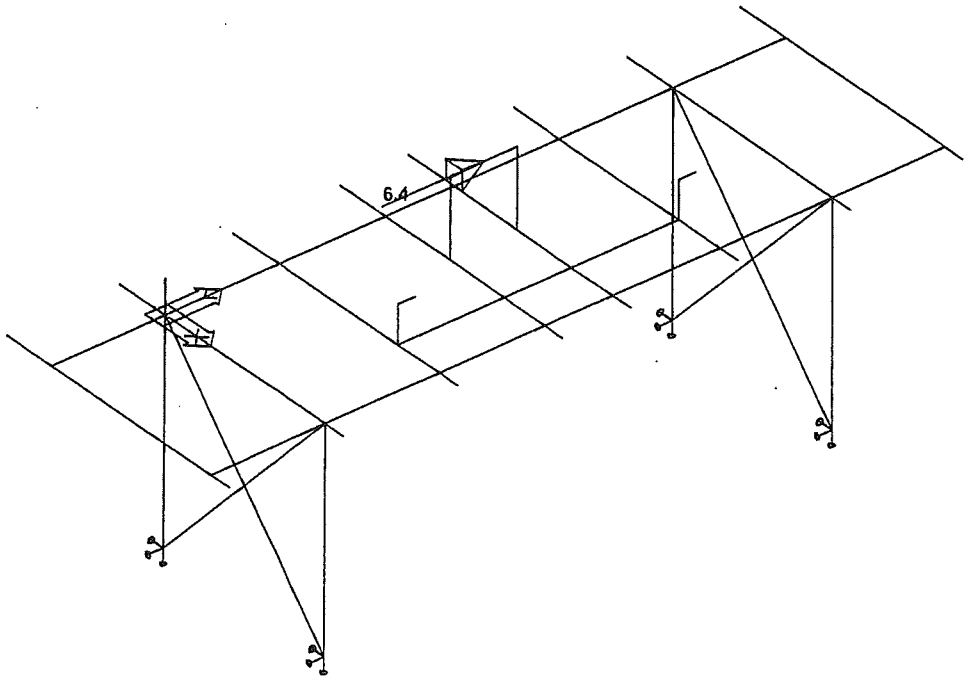
14. SU 530 -X



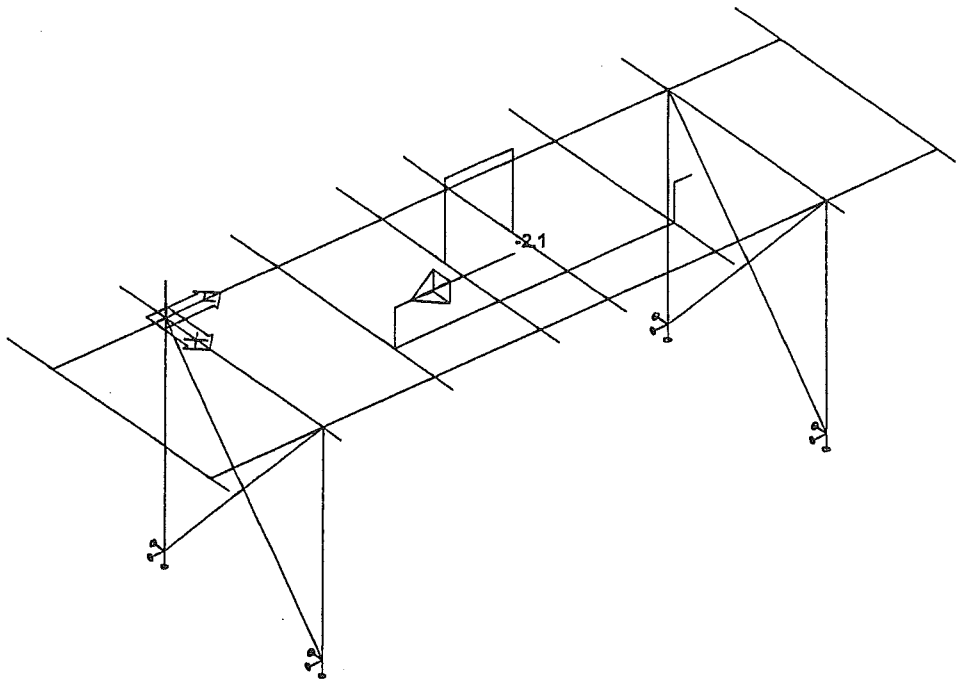
15. SU 532 +Y



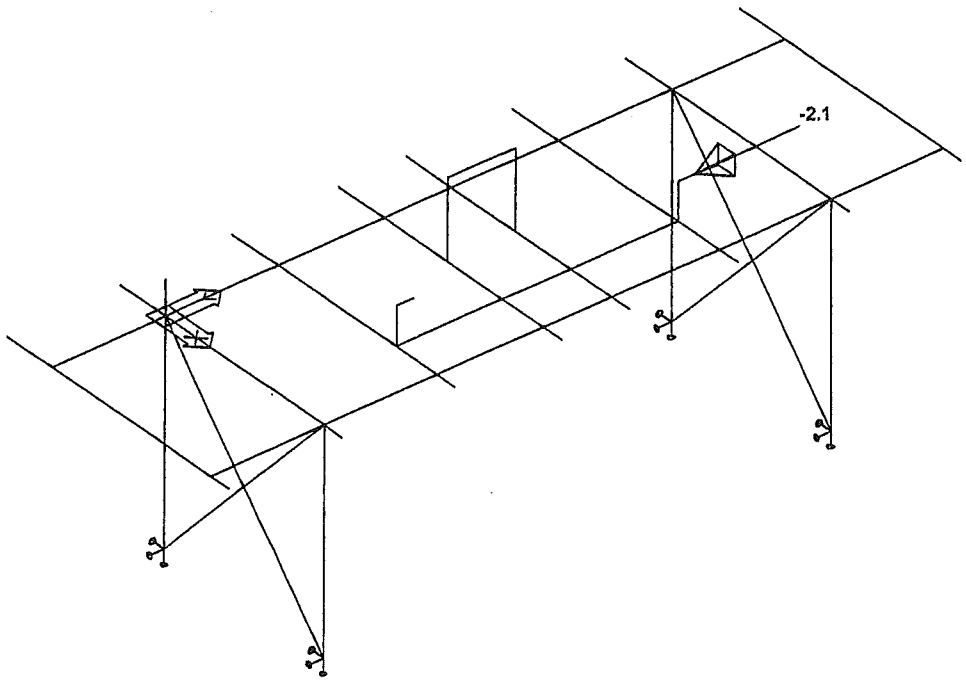
16. SU 532 +Y



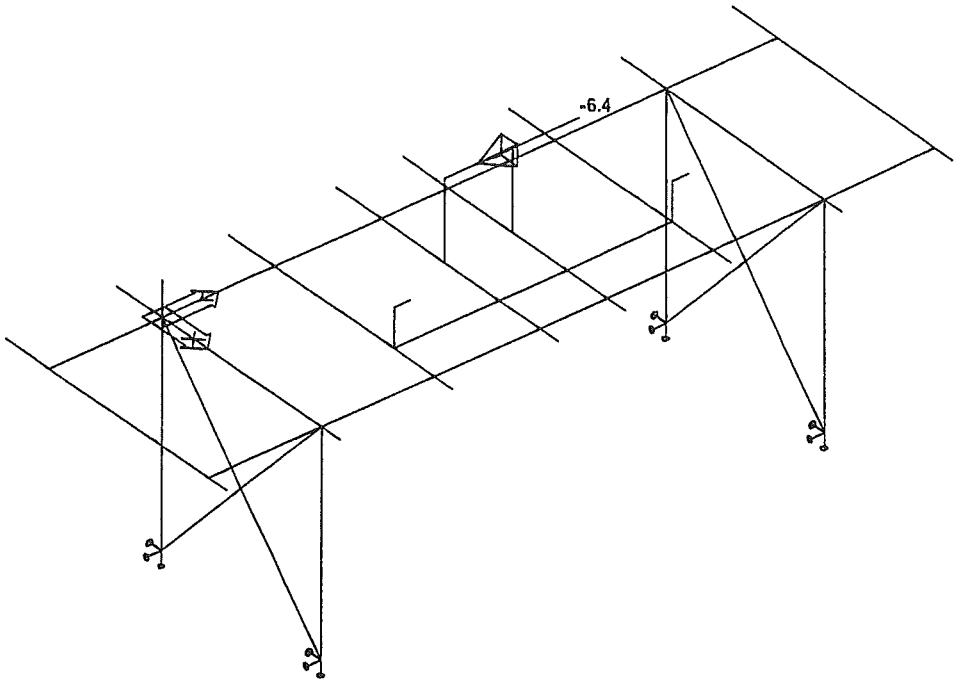
17. SU 530 +Y



18. SU 532 -Y



19. SU 532 -Y



20. SU 530 -Y

Variable loads group

Name:

p

Loadcase no. 2 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
2	0.00	0.00	-0.86	0.00	0.00	0.00
24	0.00	0.00	-0.86	0.00	0.00	0.00
55	0.00	0.00	-0.86	0.00	0.00	0.00
56	0.00	0.00	-0.86	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	-0.95	0.00	0.00	0.00
55	0.00	0.00	-0.95	0.00	0.00	0.00

Loadcase no. 5 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
24	0.00	0.00	-0.95	0.00	0.00	0.00
56	0.00	0.00	-0.95	0.00	0.00	0.00

Loadcase no. 6 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
43	0.00	0.00	-4.10	0.00	0.00	0.00

Loadcase no. 7 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
44	0.00	0.00	-4.10	0.00	0.00	0.00

Loadcase no. 8 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
40	0.00	0.00	-7.40	0.00	0.00	0.00

Loadcase no. 9 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
43	2.10	0.00	0.00	0.00	0.00	0.00

Loadcase no. 10 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
44	2.10	0.00	0.00	0.00	0.00	0.00

Loadcase no. 11 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
40	6.40	0.00	0.00	0.00	0.00	0.00

Loadcase no. 12 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
43	-2.10	0.00	0.00	0.00	0.00	0.00

Loadcase no. 13 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
44	-2.10	0.00	0.00	0.00	0.00	0.00

Loadcase no. 14 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
40	-6.40	0.00	0.00	0.00	0.00	0.00

Loadcase no. 15 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
43	0.00	2.10	0.00	0.00	0.00	0.00

Loadcase no. 16 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
44	0.00	2.10	0.00	0.00	0.00	0.00

Loadcase no. 17 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
40	0.00	6.40	0.00	0.00	0.00	0.00

Loadcase no. 18 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
43	0.00	-2.10	0.00	0.00	0.00	0.00

Loadcase no. 19 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
44	0.00	-2.10	0.00	0.00	0.00	0.00

Loadcase no. 20 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
40	0.00	-6.40	0.00	0.00	0.00	0.00

Loadcase no. 2 - 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	0.00	-0.80
	kN/m	1.00			len	0.00	0.00	-0.80
2	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-0.60
	kN/m	1.00			len	0.00	0.00	-0.60
3	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-0.60
	kN/m	1.00			len	0.00	0.00	-0.60
4	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-0.60
	kN/m	1.00			len	0.00	0.00	-0.60
5	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-0.60
	kN/m	1.00			len	0.00	0.00	-0.60
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
26	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-0.50
	kN/m	1.00			len	0.00	0.00	-0.50
27	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-0.50
	kN/m	1.00			len	0.00	0.00	-0.50

Loadcase no. 3 - 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	0.00	-1.25
	kN/m	1.00			len	0.00	0.00	-1.25
2	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-2.50
	kN/m	1.00			len	0.00	0.00	-2.50

Loadcase no. 4 - 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	0.00	-2.50
	kN/m	1.00			len	0.00	0.00	-2.50
4	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-2.50
	kN/m	1.00			len	0.00	0.00	-2.50
26	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-2.00
	kN/m	1.00			len	0.00	0.00	-2.00
27	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-2.00
	kN/m	1.00			len	0.00	0.00	-2.00

Loadcase no. 5 - distributed loads

macro	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	-2.50
	kN/m	1.00			len	0.00	0.00	-2.50
6	force	0.00 rel	0.00	0.00	glo	0.00	0.00	-1.25
	kN/m	1.00			len	0.00	0.00	-1.25

Rechenprotokoll

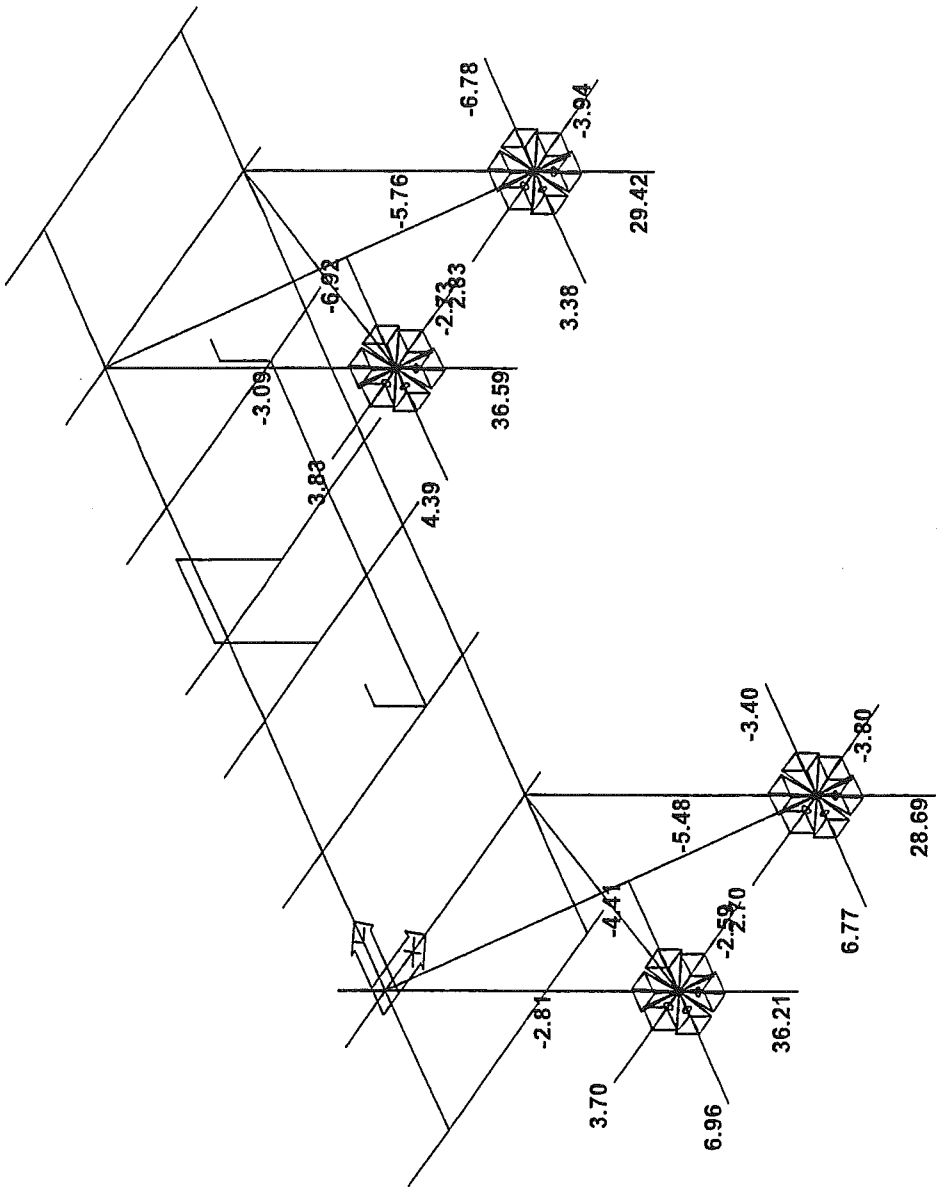
Lineare Berechnung

Anzahl 2D-Elemente	0
Anzahl 1D-Elemente	70
Anzahl Netzknoten	56
Anzahl Gleichungen	336
Lastfälle	LF 1 Dead Load
	LF 2 weight of the stage lining
	LF 3 p1
	LF 4 p2
	LF 5 p3
	LF 6 SU 532 Z
	LF 7 SU 532 Z
	LF 8 SU 530 Z
	LF 9 SU 532 +X
	LF 10 SU 532 +X
	LF 11 SU 530 +X
	LF 12 SU 532 -X
	LF 13 SU 532 -X
	LF 14 SU 530 -X
	LF 15 SU 532 +Y
	LF 16 SU 532 +Y
	LF 17 SU 530 +Y
	LF 18 SU 532 -Y
	LF 19 SU 532 -Y
	LF 20 SU 530 -Y
Biegetheorie	Mindlin
Start der Berechnung	08.12.2004 09:49
Berechnung beendet	08.12.2004 09:49

Summe der Lasten und Reaktionen

			X	Y	Z
Lastfall	1	Lasten	0.0	0.0	-11.3
		Auflagerkräfte	0.0	0.0	11.3
		Kontakt	0.0	0.0	0.0
Lastfall	2	Lasten	0.0	0.0	-15.7
		Auflagerkräfte	0.0	0.0	15.7
		Kontakt	0.0	0.0	0.0
Lastfall	3	Lasten	0.0	0.0	-11.1
		Auflagerkräfte	0.0	-0.0	11.1
		Kontakt	0.0	0.0	0.0
Lastfall	4	Lasten	0.0	0.0	-22.1
		Auflagerkräfte	0.0	-0.0	22.1
		Kontakt	0.0	0.0	0.0
Lastfall	5	Lasten	0.0	0.0	-11.1
		Auflagerkräfte	0.0	0.0	11.1
		Kontakt	0.0	0.0	0.0
Lastfall	6	Lasten	0.0	0.0	-4.1
		Auflagerkräfte	-0.0	0.0	4.1

			X	Y	Z
		Kontakt	0.0	0.0	0.0
Lastfall	7	Lasten	0.0	0.0	-4.1
		Auflagerkräfte	-0.0	0.0	4.1
		Kontakt	0.0	0.0	0.0
Lastfall	8	Lasten	0.0	0.0	-7.4
		Auflagerkräfte	0.0	-0.0	7.4
		Kontakt	0.0	0.0	0.0
Lastfall	9	Lasten	2.1	0.0	0.0
		Auflagerkräfte	-2.1	0.0	0.0
		Kontakt	0.0	0.0	0.0
Lastfall	10	Lasten	2.1	0.0	0.0
		Auflagerkräfte	-2.1	-0.0	0.0
		Kontakt	0.0	0.0	0.0
Lastfall	11	Lasten	6.4	0.0	0.0
		Auflagerkräfte	-6.4	-0.0	0.0
		Kontakt	0.0	0.0	0.0
Lastfall	12	Lasten	-2.1	0.0	0.0
		Auflagerkräfte	2.1	-0.0	-0.0
		Kontakt	0.0	0.0	0.0
Lastfall	13	Lasten	-2.1	0.0	0.0
		Auflagerkräfte	2.1	0.0	-0.0
		Kontakt	0.0	0.0	0.0
Lastfall	14	Lasten	-6.4	0.0	0.0
		Auflagerkräfte	6.4	-0.0	-0.0
		Kontakt	0.0	0.0	0.0
Lastfall	15	Lasten	0.0	2.1	0.0
		Auflagerkräfte	-0.0	-2.1	0.0
		Kontakt	0.0	0.0	0.0
Lastfall	16	Lasten	0.0	2.1	0.0
		Auflagerkräfte	-0.0	-2.1	0.0
		Kontakt	0.0	0.0	0.0
Lastfall	17	Lasten	0.0	6.4	0.0
		Auflagerkräfte	-0.0	-6.4	0.0
		Kontakt	0.0	0.0	0.0
Lastfall	18	Lasten	0.0	-2.1	0.0
		Auflagerkräfte	0.0	2.1	-0.0
		Kontakt	0.0	0.0	0.0
Lastfall	19	Lasten	0.0	-2.1	0.0
		Auflagerkräfte	0.0	2.1	-0.0
		Kontakt	0.0	0.0	0.0
Lastfall	20	Lasten	0.0	-6.4	0.0
		Auflagerkräfte	0.0	6.4	-0.0
		Kontakt	0.0	0.0	0.0

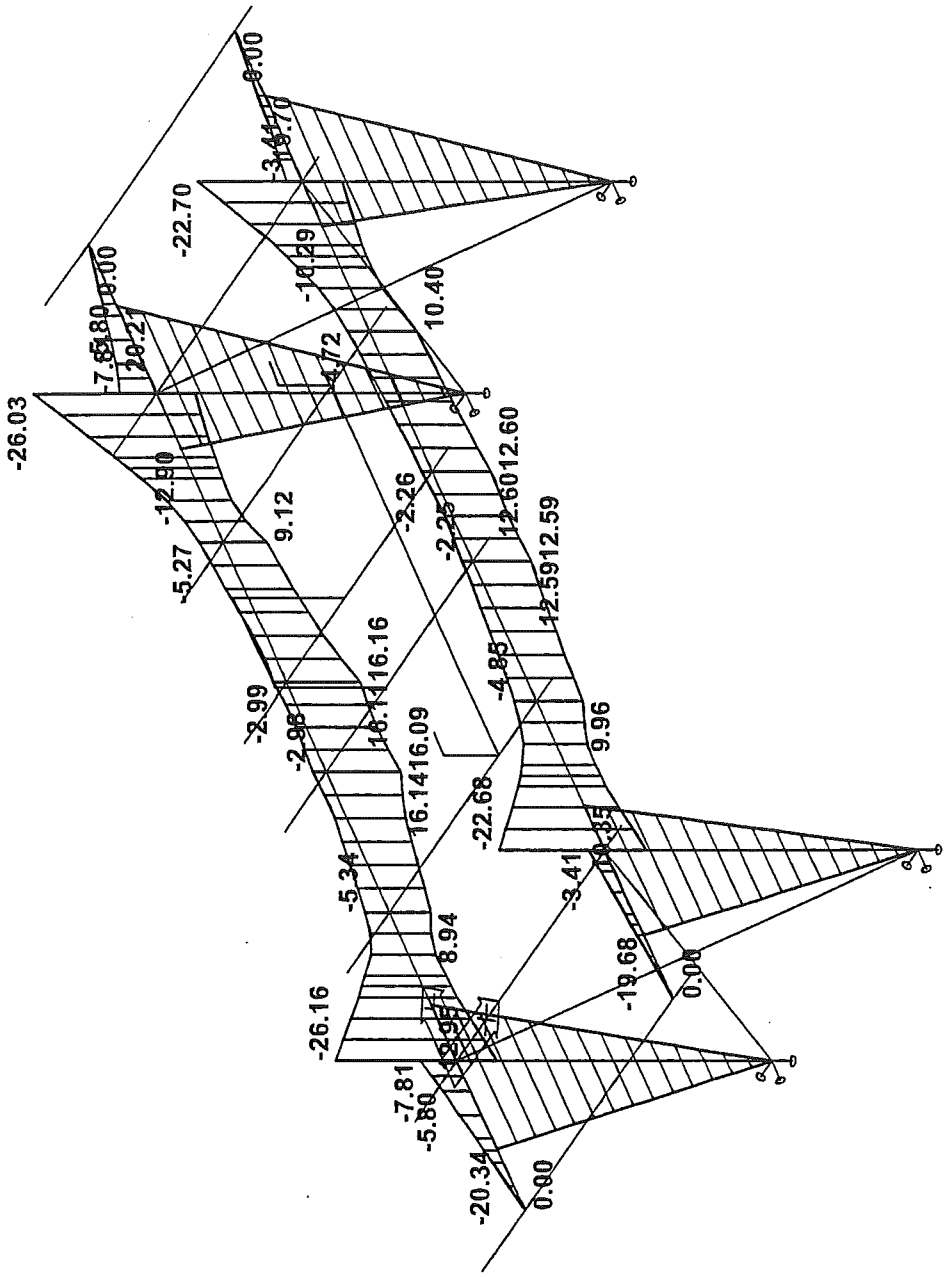


Reactions. Ser. combi : 1/566

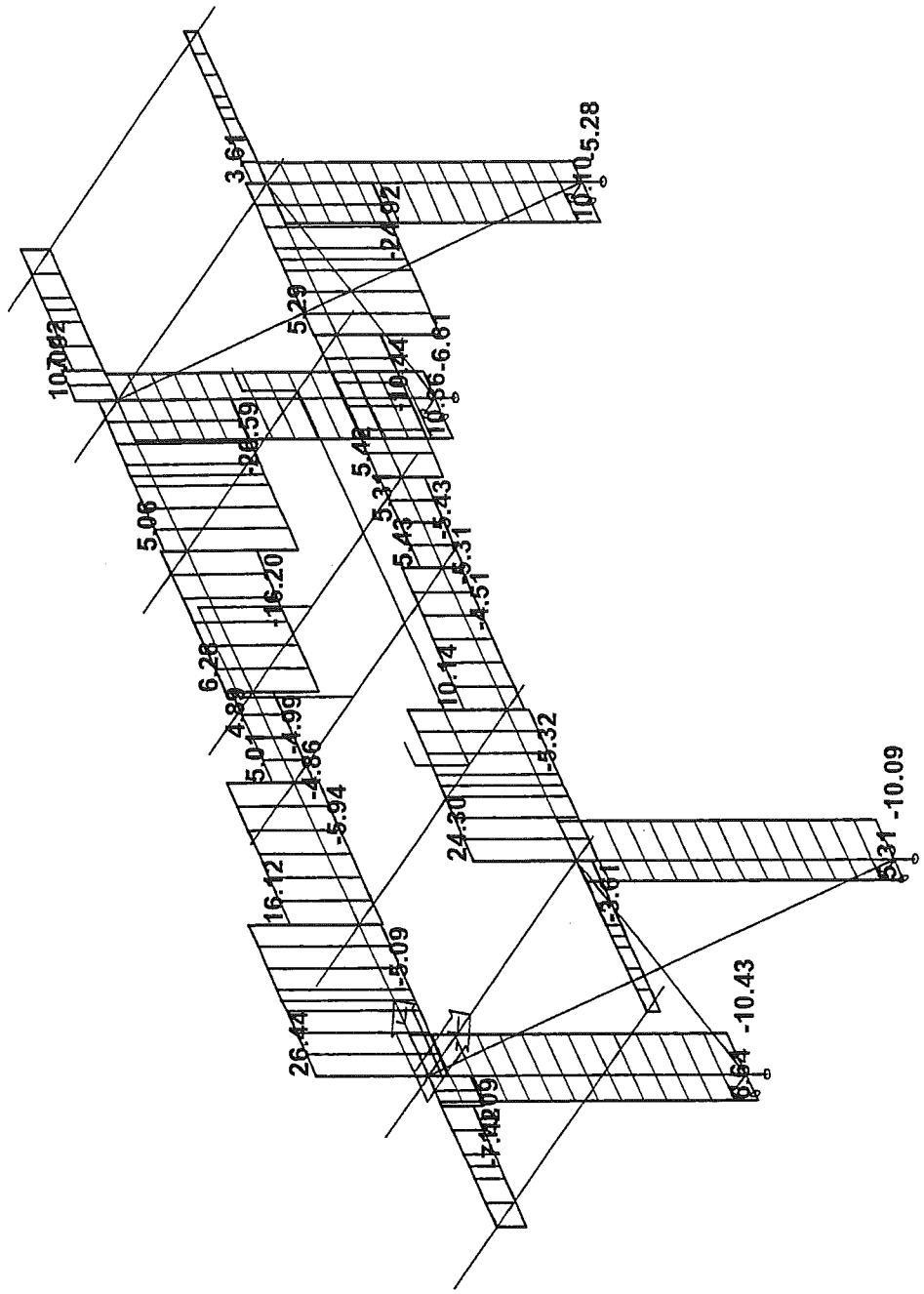
Reactions in support(s) - nodal values. Global extreme

Linear static - extreme or all combinations
Group of node(s) :1/56
Group of serviceability combi :1/566

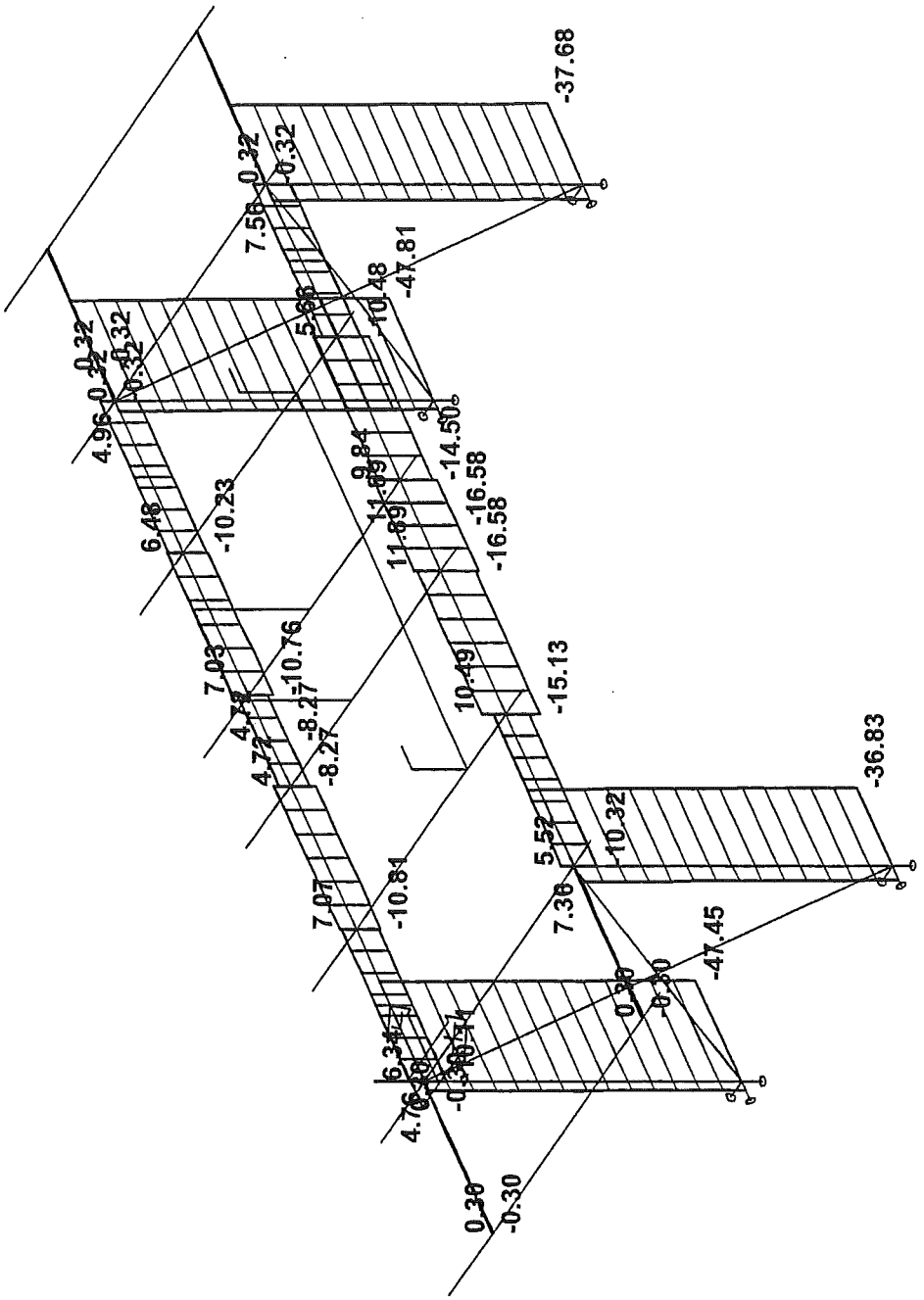
support	node	combi	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
3	29	565	-3.83	-2.48	32.53	0.00	0.00	0.00
4	30	481	-3.94	-3.94	27.05	0.00	0.00	0.00
1	27	543	3.29	-6.96	28.46	0.00	0.00	0.00
3	29	510	3.42	-6.92	28.84	0.00	0.00	0.00
		555	3.71	-6.24	36.59	0.00	0.00	0.00
4	30	173	2.55	3.24	-5.76	0.00	0.00	0.00



Internal forces - My on member(s). Ult. combi : 1/476



Internal forces - Vz on member(s). Ult. combi : 1/476

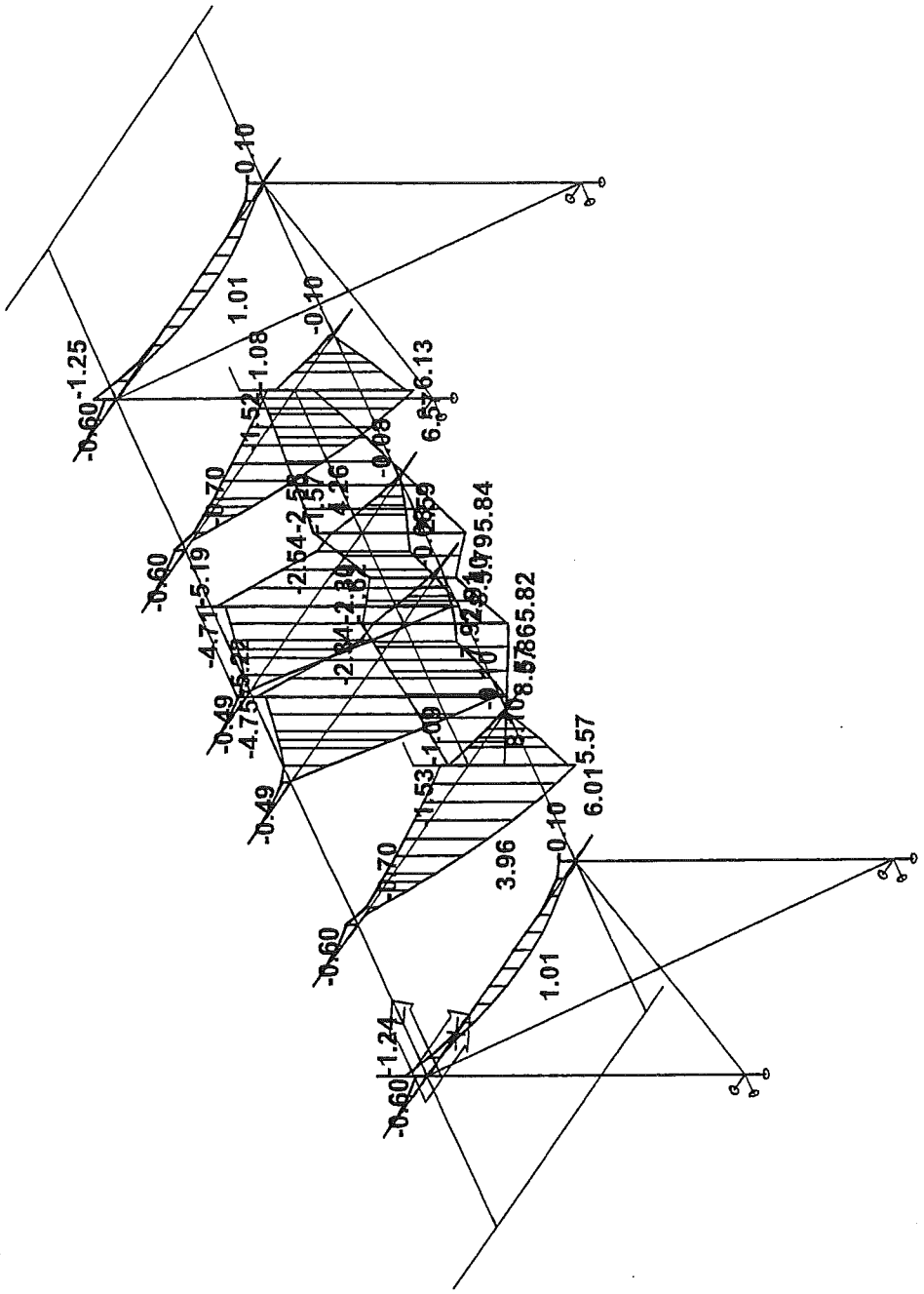


Internal forces - N on member(s). Ult. combi : 1/476

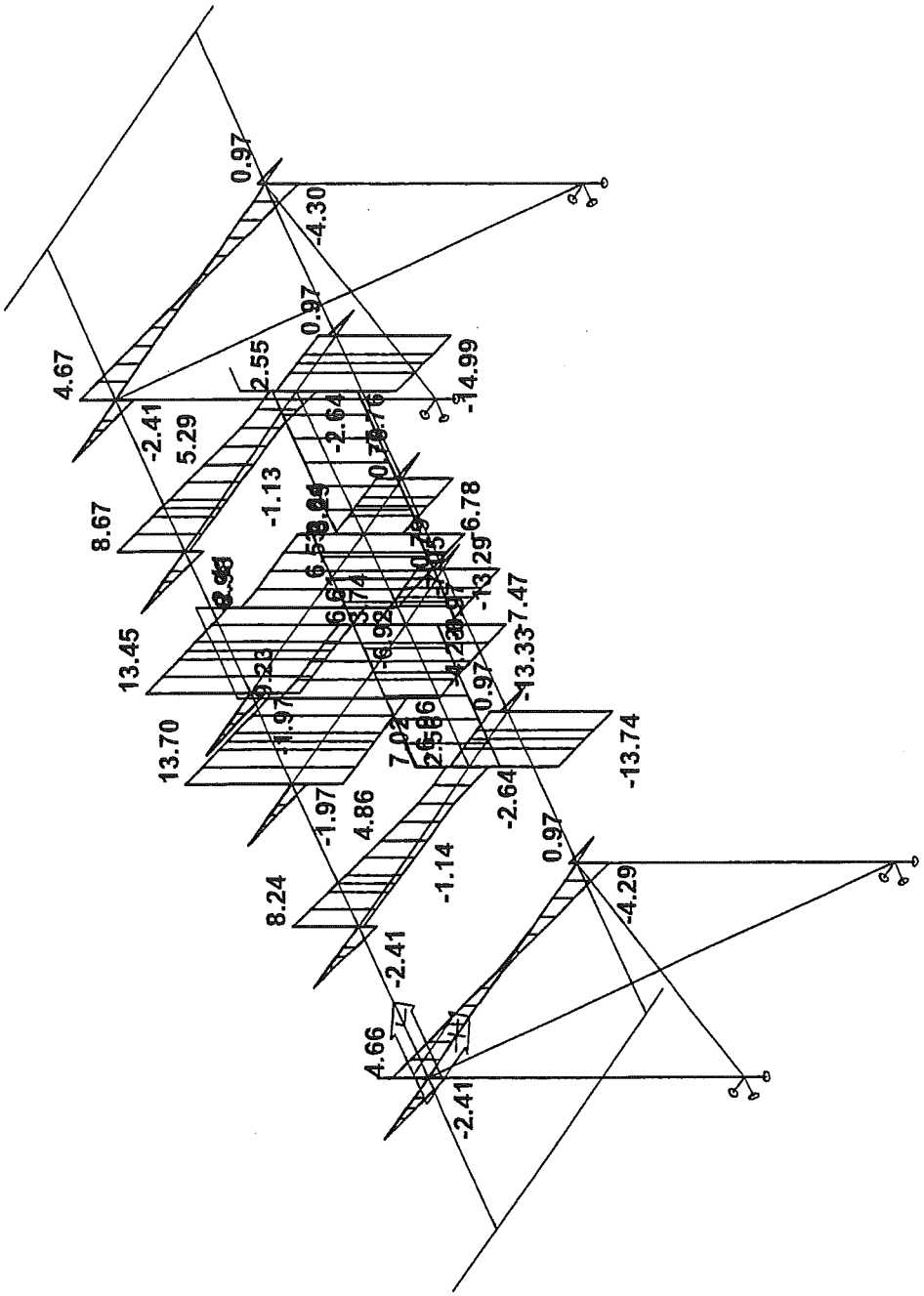
Internal forces on member(s). Global extreme

Linear static - extreme or all combinations
Group of member(s) :1/70
Group of ultimate combi :1/476
Cross-section : 1 - HEA160

memb	combi	dx [m]	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
36	63	0.000	11.89	-0.16	0.10	-0.00	2.39	0.74
43	467		-47.81	-0.32	9.34	0.00	-0.00	0.00
39	232		-1.51	4.87	-0.25	-0.01	0.70	-2.70
	260		-2.47	-4.87	-16.75	-0.01	4.39	2.71
25	471		-7.30	-3.80	26.44	-0.01	-26.16	1.82
30	467	1.000	-7.13	3.96	-26.59	0.01	-26.03	1.91
28	59	0.000	1.08	-0.82	-3.09	0.03	2.03	-0.05
39	364		-7.81	4.14	-15.99	-0.03	3.45	-2.31
43	438	1.950	-35.68	-0.16	10.36	0.00	20.21	-0.31
39	374	0.000	-7.12	-4.64	-22.62	-0.02	2.05	2.81
	244		2.29	4.63	3.40	-0.00	3.63	-2.80



Internal forces - My on member(s). Ult. combi : 1/476

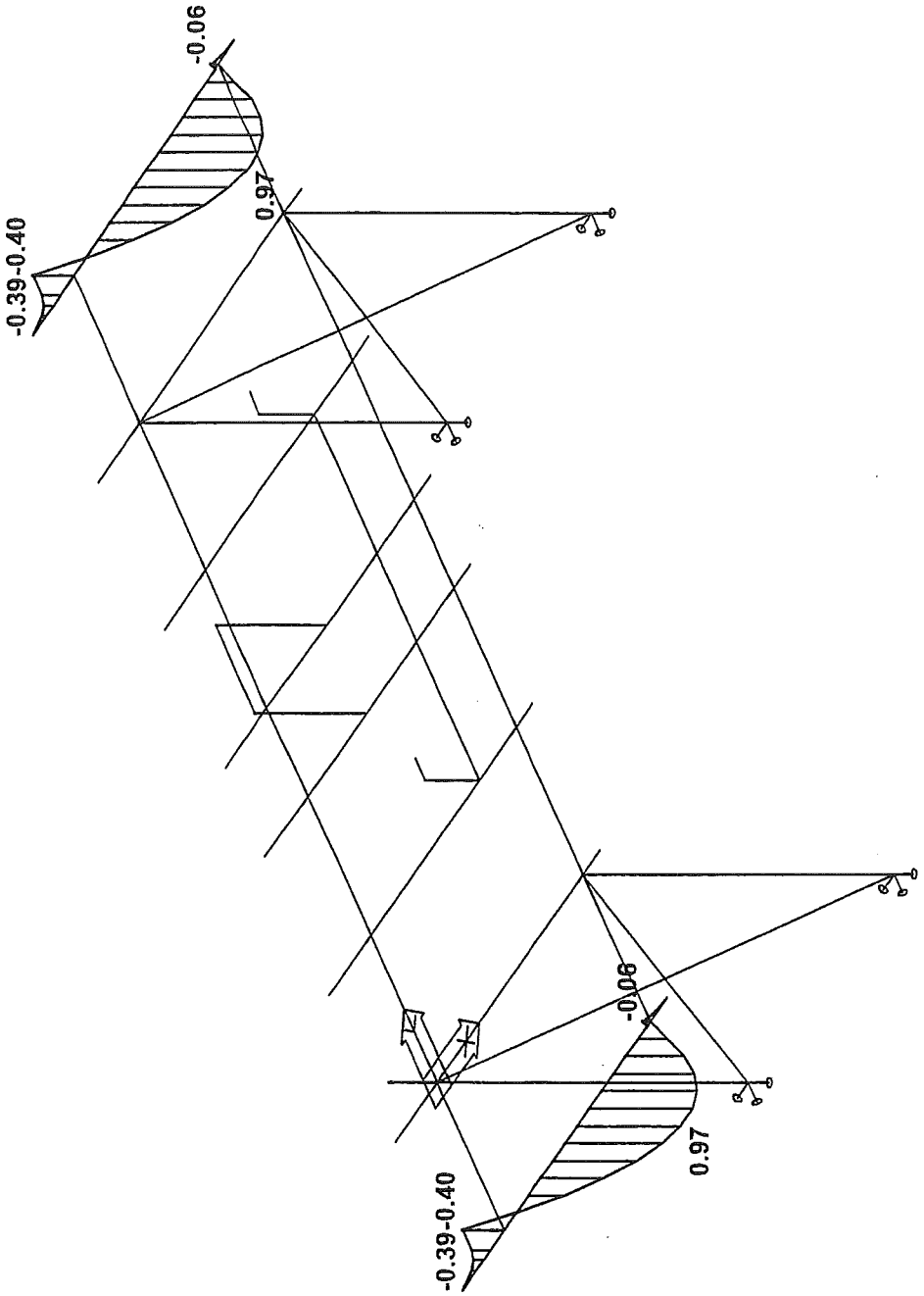


Internal forces - Vz on member(s). Ult. combi : 1/476

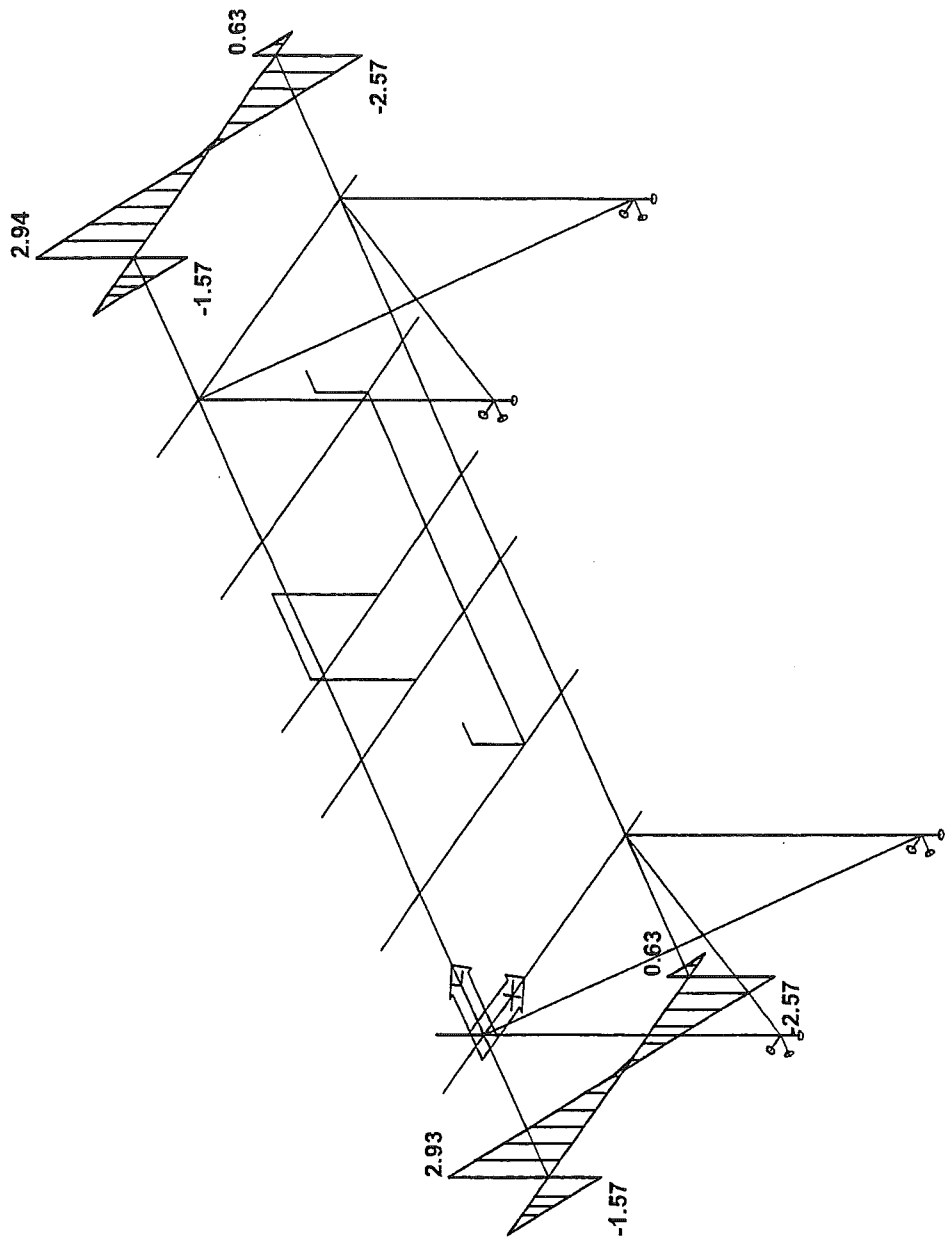
Internal forces on member(s). Global extreme

Linear static - extreme or all combinations
Group of member(s) :1/70
Group of ultimate combi :1/476
Cross-section : 2 - HEA120

memb	combi	dx [m]	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
46	137	0.000	**11.40**	-0.00	0.06	0.00	0.63	-0.25
	211		**-11.34**	-0.00	-0.36	-0.00	2.90	0.23
10	180		2.43	**10.00**	2.40	0.00	-1.02	-1.60
	415		-2.40	**-10.15**	-11.41	0.00	5.51	1.64
62	432		0.57	2.63	**13.70**	-0.05	-0.52	-0.92
15	408	0.450	-2.91	8.48	**-14.99**	-0.01	-0.13	2.81
63	107	0.000	-2.80	-3.60	-10.50	**0.05**	8.17	0.89
68	106		-2.84	3.62	-10.40	**-0.05**	8.25	-0.89
63	419		-2.42	-3.51	-9.92	0.05	**8.57**	0.91
	184		2.36	3.31	7.87	-0.04	**-5.22**	-0.84
15	395	0.450	-2.67	9.37	-14.81	-0.01	-0.12	**2.97**
	203		2.69	-9.21	2.02	-0.00	-0.02	**-2.94**



Internal forces - My on member(s). Ult. combi : 1/476

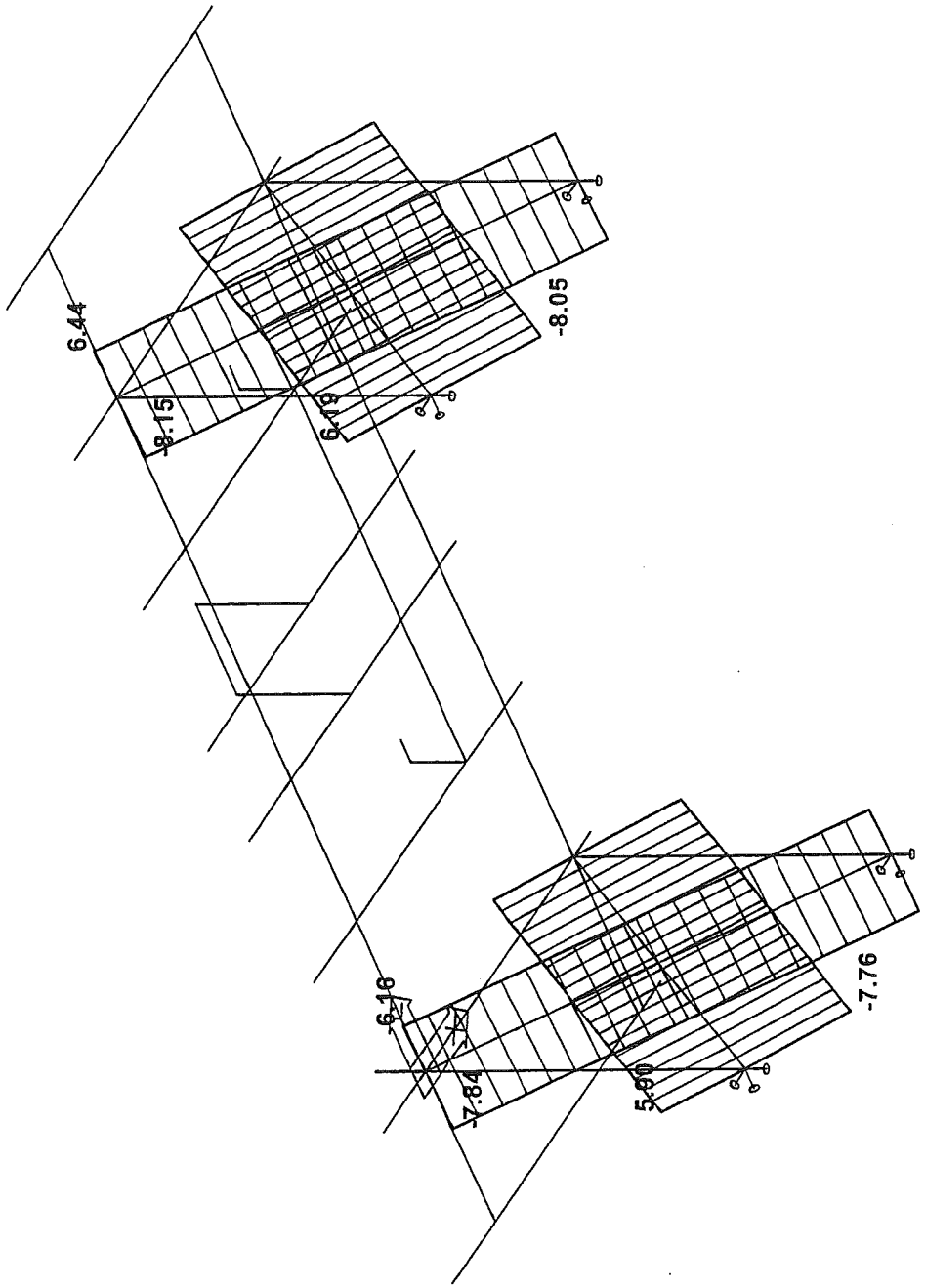


Internal forces - Vz on member(s). Ult. combi : 1/476

Internal forces on member(s). Global extreme

Linear static - extreme or all combinations
Group of member(s) :1/70
Group of ultimate combi :1/476
Cross-section : 3 - U120

memb	combi	dx [m]	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
21	457	0.000	-0.11	-0.24	2.93	-0.00	-0.40	0.22
	133		-0.10	0.24	0.87	-0.00	-0.11	-0.21
	163		-0.05	0.32	2.61	-0.00	-0.34	-0.28
	427		0.06	-0.32	1.18	0.00	-0.16	0.28
	347		0.03	-0.29	2.94	0.00	-0.40	0.26
	417	1.750	-0.02	0.30	-2.57	-0.00	-0.08	0.26
2	391	0.000	-0.02	-0.28	2.92	0.00	-0.38	0.25
21	417		-0.02	0.30	2.92	-0.00	-0.38	-0.26
	476	0.875	0.00	0.00	0.18	-0.00	0.97	0.00



Internal forces - N on member(s). Ult. combi : 1/476

Internal forces on member(s). Global extreme

Linear static - extreme or all combinations
Group of member(s) :1/70
Group of ultimate combi :1/476
Cross-section : 4 - L45X4

memb	combi	dx [m]	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
52	181	0.000	6.44	0.00	0.00	0.00	0.00	0.00
	416		-8.15	0.00	0.00	0.00	0.00	0.00

DIN. Profile - 1 all. UC all.

Cross-section : 1 - HEA160

Macro 7 Member 30 HEA160 S 235 Ult. comb 426 0.69

N [kN]	Vy [kN]	Vz [kN]	Mt [kNm]	My [kNm]	Mz [kNm]
-6.96	4.00	-25.39	0.00	-25.75	1.93

The critical check is on position 1.00 m

Buckling parameters	yy	zz
type	sway	sway
Slenderness	98.80	162.68
Reduced slenderness	1.06	1.75
Buckling curve	b	c
Imperfection	0.34	0.49

Buckling parameters	yy	zz	
Reduction factor	0.56	0.25	
Length	6.48	6.48	m
Buckling factor	1.00	1.00	
Buckling length	6.48	6.48	m
Critical Euler load	823.79	303.87	kN

LTB		
LTB length	6.48	m
Betaz	1.00	
Beta0	1.00	
Ksi	1.36	

negative influence of load position

SECTION CHECK	
N	0.01 < 1
Vy	0.01 < 1
Vz	0.23 < 1
M	0.28 < 1

STABILITY CHECK	
Buckling	0.03 < 1
LTB	0.56 < 1
Compression + Moment	0.60 < 1
Compression + LTB	0.69 < 1

DIN. Profile - 2 all. UC all.

Cross-section : 2 - HEA120

Macro 26 Member 63 HEA120 S 235 Ult. comb 419 0.42

N [kN]	Vy [kN]	Vz [kN]	Mt [kNm]	My [kNm]	Mz [kNm]
-2.42	-3.51	-9.92	0.05	8.57	0.91

The critical check is on position 0.00 m

Buckling parameters	yy	zz	
type	sway	non-sway	
Slenderness	52.90	16.39	
Reduced slenderness	0.57	0.18	
Buckling curve	b	c	
Imperfection	0.34	0.49	
Reduction factor	0.85	1.00	
Length	0.60	0.60	m
Buckling factor	4.32	0.83	
Buckling length	2.59	0.50	m
Critical Euler load	1873.68	19510.37	kN

LTB		
LTB length	0.60	m
Betaz	1.00	
Beta0	1.00	
Ksi	1.59	

load in center of gravity

SECTION CHECK	
N	0.00 < 1
Vy	0.01 < 1
Vz	0.15 < 1
M	0.16 < 1

STABILITY CHECK	
Buckling	0.01 < 1
LTB	0.33 < 1
Compression + Moment	0.40 < 1
Compression + LTB	0.42 < 1

DIN. Profile - 3 all. UC all.

Cross-section : 3 - U120

Macro 6 Member 21 U120 S 235 Ult. comb 228 0.14

N [kN]	Vy [kN]	Vz [kN]	Mt [kNm]	My [kNm]	Mz [kNm]
-0.05	0.32	2.92	-0.00	-0.38	-0.28

The critical check is on position 0.00 m

Buckling parameters	yy	zz	
type	sway	non-sway	
Slenderness	37.82	70.42	
Reduced slenderness	0.41	0.76	
Buckling curve	c	c	
Imperfection	0.49	0.49	
Reduction factor	0.89	0.69	
Length	1.75	1.75	m
Buckling factor	1.00	0.64	
Buckling length	1.75	1.12	m
Critical Euler load	2463.45	710.53	kN

LTB

LTB length 1.75 m

SECTION CHECK

Sigma	0.14 < 1
tau	0.04 < 1

STABILITY CHECK

Buckling	0.00 < 1
LTB	0.03 < 1
Compression + Moment	0.08 < 1
Compression + LTB	0.12 < 1

DIN. Profile - 4 all. UC all.

Cross-section : 4 - L45X4

Macro 18 Member 52 L 45X4 S 235 Ult. comb 416 0.41

N [kN]	Vy [kN]	Vz [kN]	Mt [kNm]	My [kNm]	Mz [kNm]
-8.15	0.00	0.00	0.00	0.00	0.00

The critical check is on position 0.00 m

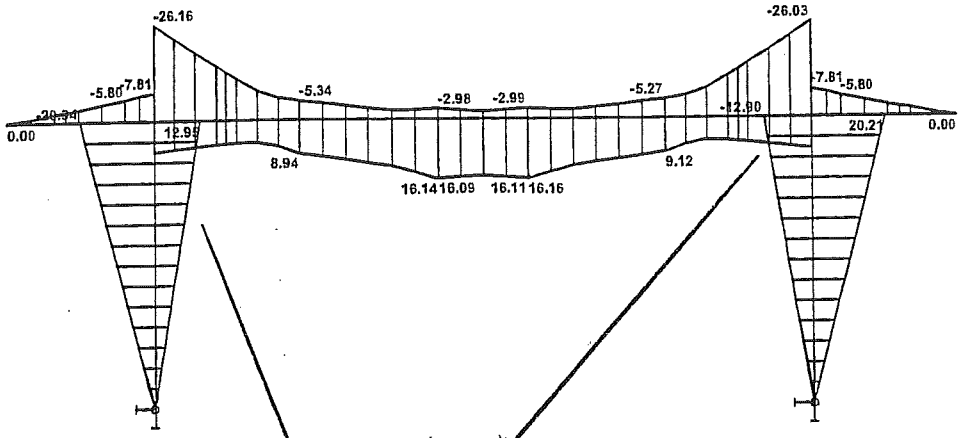
Buckling parameters	yy	zz	
type	sway	non-sway	
Slenderness	157.00	152.43	
Reduced slenderness	1.69	1.64	
Buckling curve	c	c	
Imperfection	0.49	0.49	
Reduction factor	0.26	0.27	
Length	2.62	2.62	m
Buckling factor	1.02	0.51	
Buckling length	2.68	1.34	m
Critical Euler load	29.35	31.13	kN

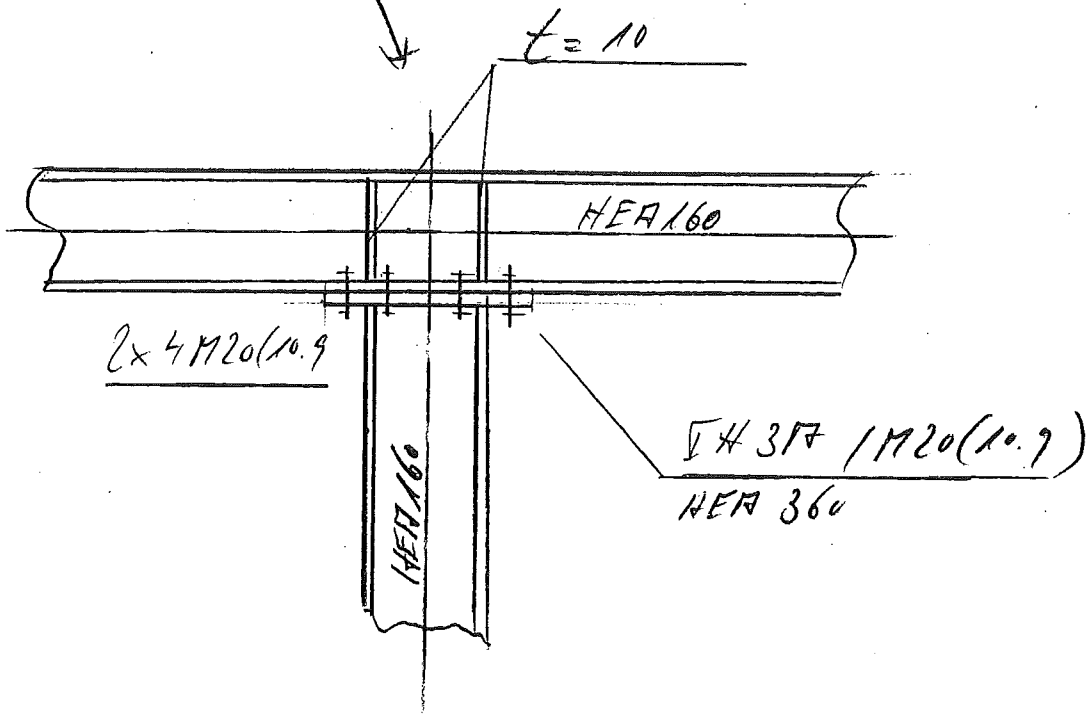
SECTION CHECK

Sigma	0.11 < 1

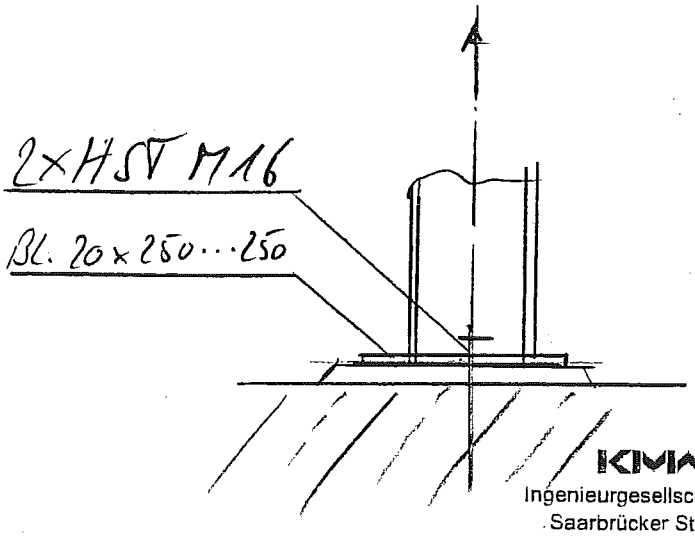
STABILITY CHECK

Buckling	0.41 < 1





$$\text{zul } M_y = 35{,}2 \text{ kNm} > \frac{26{,}16}{1{,}35}$$



$$\max Z = -5{,}76 \text{ kN}$$

$$\max H_y = 6{,}96 \text{ kN}$$

$$\max H_x = 3{,}94 \text{ kN}$$

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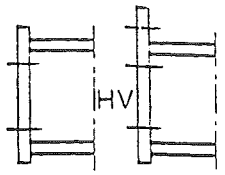
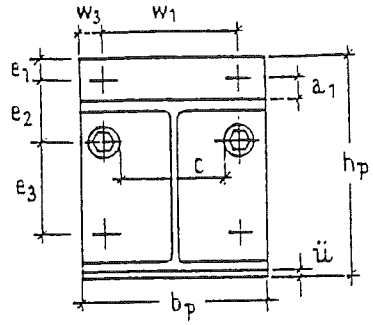
Biegesteife Stirnplatten-Verbindungen mit hochfesten vorgespannten Schrauben

-53-

IH 3 A



Abmessungen



Lochbild

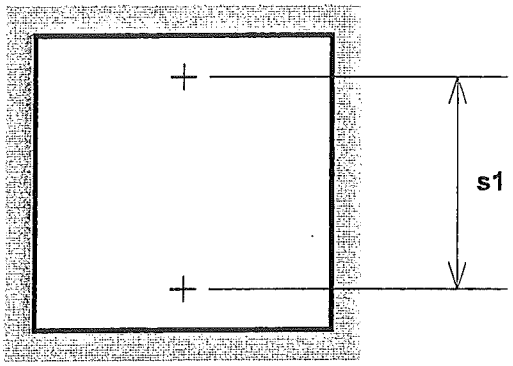
Träger-Nennhöhe	Schraubendurchmesser	Stirnplatten-Abmessungen			Anschluß Träger/ Stirnplatte (Höhenlage)		Lochbild							Träger-schweiß-anßchluß	
		d_p	h_p	b_p	a_1	ü	e_1	e_2	e_3	w_1	w_2	w_3	c	Flansch a_f	Steg a_s
HEA		Alle Abmessungen in (mm)													
120	16	20	180	120	30	11	25	65	40	70		25	40	4	3
140	16	20	200	140	30	12	25	70	50	70		35	40	5	3
160	16	20	220	160	30	13	25	70	70	80		40	50	5	3
180	16	20	235	180	30	9	25	70	90	90		45	60	5	3
200	20	20	270	200	40	10	30	90	90	100		50	63	5	3
	16	20	255		30		25	70	110				70	5	3
220	20	20	300	220	40		30	90	110	110		55	73	6	4
	16	20	285		30		25	70	130				80	5	3
240	24	25	335	240	50		35	115	100	120		60	76	6	4
	20	20	320		40		30	95	120				83	6	4
	16	20	305		30		25	75	140				90	5	3
260	24	25	355	260	50		35	115	120	130		65	86	7	4
	20	20	340		40		30	95	140				93	7	4
	16	20	325		30		25	75	160				100	4	3
280	24	25	375	280	50		35	115	140	140		70	96	7	4
	20	20	360		40		30	95	160				103	6	3
	16	20	345		30	20	25	75	180				110	4	3
300	27	30	410	300	60		40	135	140	150		75	100	7	4
	24	25	395		50		35	115	160				106	7	4
	20	20	380		40		30	95	180				113	6	3
320	27	30	430	300	60		40	135	160	150		75	100	8	5
	24	25	415		50		35	115	180				106	8	4
	20	20	400		40		30	95	200				113	6	3
340	30	30	455	300	60		45	140	170	150		75	94	9	5
	27	30	450		60		40	140	170				100	9	5
	24	25	435		50		35	120	190				106	8	4
	20	20	420		40		30	100	210				113	6	3
360	30	30	475	300	60		45	140	190	150		75	94	9	5
	27	30	470		60		40	140	190				100	9	4
	24	25	455		50		35	120	210				106	8	3
	20	20	440		40		30	100	230				113	6	3
400	30	30	515	300	60		45	140	230	150		75	94	10	5
	27	30	510		60		40	140	230				100	10	4
	24	25	495		50		35	120	250				106	8	3
	20	20	480		40		30	100	270				113	6	3
450	30	30	575	300	60		45	140	280	150		75	94	11	4
	27	30	570		60		40	140	280				100	10	3
	24	25	555		50		35	120	300				106	8	3
	20	20	540		40		30	100	320				113	6	3
500	30	30	625	300	60		45	145	320	150		75	94	12	4
	27	30	620		60		40	145	320				100	10	3
	24	25	605		50		35	125	340				106	8	3
	20	20	590		40	30	30	105	360				113	6	3
550	30	30	675	300	60		45	145	370	150		75	94	12	3
	27	30	670		60		40	145	370				100	10	3
	24	25	655		50		35	125	390				106	8	3
600	30	30	725	300	60		45	145	420	150		75	94	12	3
	27	30	720		60		40	145	420				100	10	3
	24	25	705		50		35	125	440				106	8	3

[1]) Im an den Zugflansch anschließenden Stegbereich ist auf die Länge $b_f/2$ als Nahtdicke $a_s = s/2$ auszuführen;
b_f = Trägerflanschbreite, s = Trägerstegdicke

Dübelbemessung für HST-M16

Nach der ETAG Anhang C Methode

Positionierung

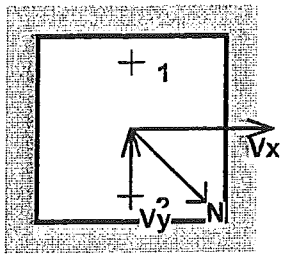


Ankerplatte:

lx=250 mm ly=250 mm
s1=180 mm

+ Dübel
◯ Dübel im Langloch

Lasten (Bemessungswerte)



Zuglast:

N_d=7.7 kN (1.50*5.2 kN)

Querkraft:

Vx_d=10.4 kN (1.50*7.0 kN)
Vy_d=5.9 kN (1.50*3.9 kN)

Beton

Druckfestigkeitsklasse: C20/25
Zugzone / gerissener Beton
Dicke des Betonteils: 30.0 cm
keine Randbewehrung
dichte Bewehrung (dichte Bewehrung (s <= 15 cm))

Zuglast N

HST-M16

Dübel		1	2
Bem.wert der Zuglast	$N_{Sd,i}$	3.9 kN	3.9 kN

Bem.wert der Dübelgruppe $N^{g}_{Sd} = \sum_{i=1}^{n} N_{Sd,i}$ = 7.7 kN

Stahlversagen

Charakt. Wert für einen Dübel $N_{Rk,s}$ = 75.0 kN
Teilsicherheitsbeiwert γ_{Ms} = 1.50

Bemessungswert des Widerstandes $N_{Rd,s} = \frac{N_{Rk,s}}{\gamma_{Ms}}$ = 50.0 kN Check $\frac{N^{h}_{Sd}}{N_{Rd,s}}$ = 0.08

Herausziehen

Charakt. Wert für einen Dübel $N_{Rk,p}$ = 20.0 kN
Teilsicherheitsbeiwert γ_{Mp} = 1.80

Bemessungswert des Widerstandes $N_{Rd,p} = \frac{N_{Rk,p}}{\gamma_{Mp}}$ = 11.1 kN Check $\frac{N^{h}_{Sd}}{N_{Rd,p}}$ = 0.35

Betonausbruch

Initialwert des Dübelwiderstandes	$N^{0}_{Rk,c}$	= 26.7 kN		
Aktuelle Fläche des Betonkegels	$A_{c,N}$	= 104796 mm²		
Referenzfläche des Betonkegels	$A^{0}_{c,N}$	= 60516 mm²		
Faktor für Störung der Spannungsverteilung	$\psi_{s,N}$	= 1.00		
Schalenabplatzfaktor	$\psi_{re,N}$	= 0.91		
Exzentrizität der resultierenden Zugkraft	$e_{N,x}$	= 0 mm	$e_{N,y}$	= 0 mm
Faktoren für exzentrische Last	$\psi_{ec,N,x}$	= 1.00	$\psi_{ec,N,y}$	= 1.00
Faktor für die Lage der Verankerung	$\psi_{ucr,N}$	= 1.00		

Charakteristischer Wert für die Dübelgruppe

$$N_{Rk,c} = N^{0}_{Rk,c} \cdot \frac{A_{c,N}}{A^{0}_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec,N,x} \cdot \psi_{ec,N,y} \cdot \psi_{ucr,N} = 42.1 \text{ kN}$$

Teilsicherheitsbeiwert γ_{Mc} = 1.80

Bemessungswert des Widerstandes $N_{Rd,c} = \frac{N_{Rk,c}}{\gamma_{Mc}}$ = 23.4 kN Check $\frac{N^{g}_{Sd}}{N_{Rd,c}}$ = 0.33

Querkraft V

HST-M16

Dübel		1	2
Bem.wert Querlast in x	$V_{Sd,x,i}$	5.2 kN	5.2 kN
Bem.wert Querlast in y	$V_{Sd,y,i}$	3.0 kN	3.0 kN

Bem.wert der Dübelgruppe $V^{g}_{Sd,x} = \sum V_{Sd,x,i}$ = 10.4 kN $V^{g}_{Sd,y} = \sum V_{Sd,y,i}$ = 5.9 kN

Result. Bemessungswert Querzug $V_{Sd,i}$ 6.0 kN 6.0 kN

Stahlversagen ohne Hebelarm

Charakt. Wert für einen Dübel $V_{Rk,s}$ = 50.0 kN

Teilsicherheitsbeiwert $_{Ms}$ = 1.25

Bemessungswert des Widerstandes $V_{Rd,s} = \frac{V_{Rk,s}}{Ms}$ = 40.0 kN Check $\frac{V^{h}_{Sd}}{V_{Rd,s}}$ = 0.15

Betonkantenbruch

Initialwert des Dübelwiderstandes	$V^{0}_{Rk,c}$	= ---		
Aktuelle Fläche des Betonkegels	$A_{c,V}$	= 0 mm²		
Referenzfläche des Betonkegels	$A^{0}_{c,V}$	= 0 mm²		
Faktor für Störung der Spannungsverteilung	$_{s,V}$	= 1.00		
Faktor für Bauteildicke	$_{h,V}$	= 1.00		
Faktor für Lastrichtung	$_{,V}$	= 1.00		
Exzentrizität der resultierenden Querkraft	$e_{V,x}$	= 0 mm	$e_{V,y}$	= 0 mm
Faktoren für exzentrische Last	$_{ec,V,x}$	= 1.00	$_{ec,V,y}$	= 1.00
Faktor für die Lage der Verankerung	$_{ucr,V}$	= 1.0		

Charakteristischer Wert für die Dübelgruppe

$V_{Rk,c} = V^{0}_{Rk,c} \cdot \frac{A_{c,V}}{A^{0}_{c,V}} \cdot {}_{s,V} \cdot {}_{h,V} \cdot {}_{,V} \cdot {}_{ec,V} \cdot {}_{ucr,V}$ $V_{Rk,c,x}$ = --- $_{Mc}$ = 1.00

Bemessungswert des Widerstandes $V_{Rd,c} = \frac{V_{Rk,c}}{Mc}$ = --- Check $\frac{V^{g}_{Sd}}{V_{Rd,c}}$ = 0.00

Rückwärtiger Betonausbruch

HST-M16

Faktor für kurze, steife Dübel	k= 2.0
Charakteristischer Wert für die Dübelgruppe	$N_{Rk,c}$ = 42.1 kN
Charakteristischer Wert für die Dübelgruppe	$V_{Rk,c}$ = 84.3 kN
Teilsicherheitsbeiwert	$_{Mc}$ = 1.80

Bemessungswert des Widerstandes $V_{Rd,c} = \frac{V_{Rk,c}}{Mc} = 46.8$ kN Check $\frac{V^{g}_{Sd}}{V_{Rd,c}} = 0.26$

Spaltbruch infolge Belastung

$\frac{N^{g}_{Sd}}{N_{Rd,sp}} = 0.20$

Kombinierte Zug- und Querkraft

$_{N} = 0.35 < 1.0$ $_{V} = 0.26 < 1.0$ $(_{N} + _{V})/1.2 = 0.50 < 1.0$ $_{N} + _{V} = 0.34 < 1.0$