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Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Duniface- Pier Base Plate	Date:	15/08/2023
Fastening Point:			

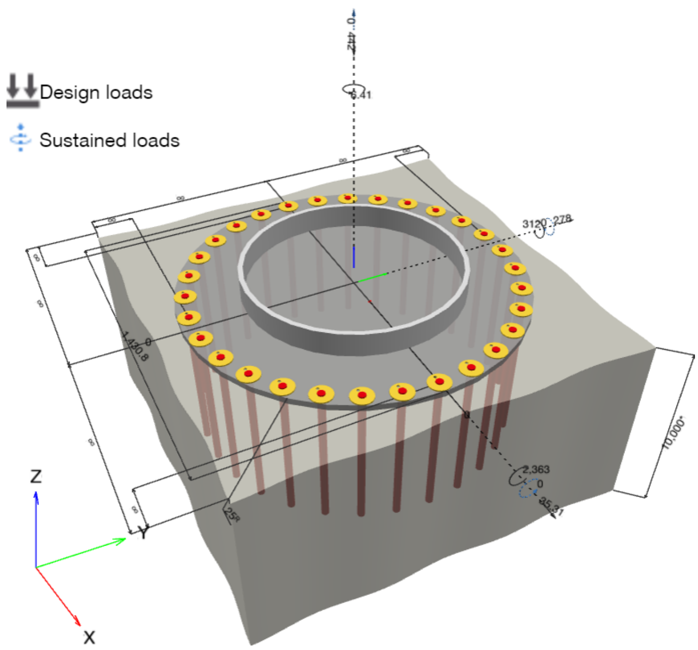
Specifier's comments:

1 Input data

Anchor type and size:	**HIT-HY 200-A + HAS-U 8.8 M30**
Return period (service life in years):	50
Item number:	not available (insert) / 2022696 HIT-HY 200-A (mortar)
Hilti Filling Set or any suitable annular gap filling solution	
Effective embedment depth:	$h_{ef,opti}$ = 600.0 mm ($h_{ef,limit}$ = 600.0 mm)
Material:	8.8
Approval No.:	ETA 11/0493
Issued I Valid:	10/12/2021 | -
Proof:	SOFA based on EN 1992-4, Chemical
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 25.0 mm
Baseplate^R :	l_x x l_y x t = 1,430.8 mm x 1,430.8 mm x 25.0 mm; (Recommended plate thickness: not calculated)
Profile:	Pipe, 914 x 20; (L x W x T) = 914.0 mm x 914.0 mm x 20.0 mm
Base material:	cracked concrete, C50/60, $f_{c,cyl}$ = 50.00 N/mm^2; h = 10,000.0 mm, Temp. short/long: 0/0 °C, User-defined partial material safety factor γ_c = 1.500
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	No reinforcement or Reinforcement spacing >= 150 mm (any Ø) or >= 100 mm (Ø <= 10 mm)
	no longitudinal edge reinforcement

^{R} - The anchor calculation is based on a rigid baseplate assumption.

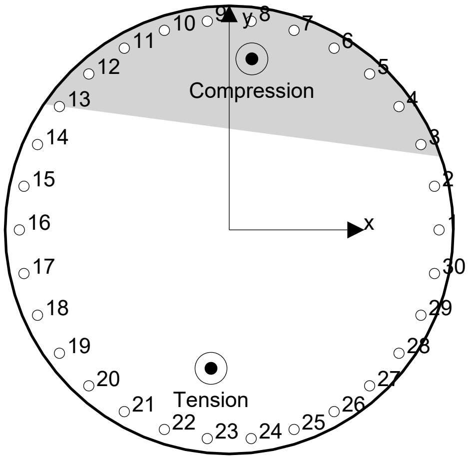
Geometry [mm] & Loading [kN, kNm]



1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	$N = -442.000$; $V_x = 35.310$; $V_y = 278.000$; $M_x = -2,363.000$; $M_y = 312.000$; $M_z = 6.410$; $N_{sus} = 0.000$; $M_{x,sus} = 0.000$; $M_{y,sus} = 0.000$;	no	no	185

2 Load case/Resulting anchor forces



Anchor reactions [kN]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	42.254	9.658	1.177	9.586
2	17.945	9.643	1.111	9.579
3	0.000	9.615	1.047	9.558
4	0.000	9.576	0.990	9.525
5	0.000	9.527	0.940	9.480
6	0.000	9.469	0.901	9.426
7	0.000	9.406	0.874	9.365
8	0.000	9.340	0.860	9.300
9	0.000	9.273	0.860	9.233
10	0.000	9.210	0.874	9.168
11	0.000	9.152	0.901	9.107
12	0.000	9.102	0.940	9.053
13	0.958	9.063	0.990	9.009
14	24.068	9.036	1.047	8.975
15	48.657	9.023	1.111	8.955
16	73.653	9.025	1.177	8.948
17	97.962	9.041	1.243	8.955
18	120.523	9.070	1.307	8.975
19	140.350	9.111	1.364	9.009
20	156.576	9.163	1.414	9.053
21	168.491	9.222	1.453	9.107
22	175.574	9.287	1.480	9.168
23	177.518	9.353	1.494	9.233
24	174.236	9.419	1.494	9.300
25	165.872	9.481	1.480	9.365
26	152.791	9.537	1.453	9.426
27	135.566	9.585	1.414	9.480
28	114.948	9.622	1.364	9.525
29	91.838	9.647	1.307	9.558
30	67.250	9.659	1.243	9.579

max. concrete compressive strain:	0.59 [‰]
max. concrete compressive stress:	17.74 [N/mm^2]
resulting tension force in (x/y)=(-58.1/-442.0):	2,147.029 [kN]
resulting compression force in (x/y)=(72.3/546.1):	2,589.029 [kN]

Anchor forces are calculated based on the assumption of a rigid baseplate.

3 Tension load EN 1992-4, Section 7.2.1

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel failure*	177.518	299.200	60	OK
Combined pullout-concrete cone failure**	2,147.029	2,360.020	91	OK
Concrete Breakout failure**	2,147.029	1,162.969	185	not recommended
Splitting failure**	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (anchors in tension)

3.1 Steel failure

$$N_{Ed} \leq N_{Rd,s} = \frac{N_{Rk,s}}{\gamma_{M,s}}$$ EN 1992-4, Table 7.1

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Ed} [kN]
448.800	1.500	299.200	177.518

3.2 Combined pullout-concrete cone failure

$N_{Ed} \leq N_{Rd,p} = \frac{N_{Rk,p}}{\gamma_{M,p}}$ EN 1992-4, Table 7.1

$N_{Rk,p} = N^0_{Rk,p} \cdot \frac{A_{p,N}}{A^0_{p,N}} \cdot \psi_{g,Np} \cdot \psi_{s,Np} \cdot \psi_{re,N} \cdot \psi_{ec1,Np} \cdot \psi_{ec2,Np}$ EN 1992-4, Eq. (7.13)

$N^0_{Rk,p} = \psi_{sus} \cdot \tau_{Rk} \cdot \pi \cdot d \cdot h_{ef}$ EN 1992-4, Eq. (7.14)

$\psi_{sus} = 1$ EN 1992-4, Eq. (7.14a)

$s_{cr,Np} = 7.3 \cdot d \cdot \sqrt{\psi_{sus} \cdot \tau_{Rk}} \leq 3 \cdot h_{ef}$ EN 1992-4, Eq. (7.15)

$\psi_{g,Np} = \psi^0_{g,Np} - \left(\frac{s}{s_{cr,Np}}\right)^{0,5} \cdot \left(\psi^0_{g,Np} - 1\right) \geq 1.00$ EN 1992-4, Eq. (7.17)

$\psi^0_{g,Np} = \sqrt{n} - (\sqrt{n} - 1) \cdot \left(\frac{\tau_{Rk}}{\tau_{Rk,c}}\right)^{1,5} \geq 1.00$ EN 1992-4, Eq. (7.18)

$\tau_{Rk,c} = \frac{k_3}{\pi \cdot d} \cdot \sqrt{h_{ef} \cdot f_{ck}}$ EN 1992-4, Eq. (7.19)

$\psi_{s,Np} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,Np}} \leq 1.00$ EN 1992-4, Eq. (7.20)

$\psi_{ec1,Np} = \frac{1}{1 + \left(\frac{2 \cdot e_{c1,N}}{s_{cr,Np}}\right)} \leq 1.00$ EN 1992-4, Eq. (7.21)

$\psi_{ec2,Np} = \frac{1}{1 + \left(\frac{2 \cdot e_{c2,N}}{s_{cr,Np}}\right)} \leq 1.00$ EN 1992-4, Eq. (7.21)

$A_{p,N}$ [mm²]	$A^0_{p,N}$ [mm²]	$\tau_{Rk,ucr,20}$ [N/mm²]	$s_{cr,Np}$ [mm]	$c_{cr,Np}$ [mm]	c_{min} [mm]	$f_{c,cyl}$ [N/mm²]
3,784,714	863,298	18.00	929.1	464.6	∞	50.00

ψ_c	$\tau_{Rk,cr}$ [N/mm²]	k_3	$\tau_{Rk,c}$ [N/mm²]	$\psi^0_{g,Np}$	$\psi_{g,Np}$
1.096	9.86	7.700	14.15	2.452	1.981

$e_{c1,N}$ [mm]	$\psi_{ec1,Np}$	$e_{c2,N}$ [mm]	$\psi_{ec2,Np}$	$\psi_{s,Np}$	$\psi_{re,Np}$
0.4	0.999	170.5	0.731	1.000	1.000

ψ^0_{sus}	α_{sus}	ψ_{sus}
0.740	0.000	1.000

$N^0_{Rk,p}$ [kN]	$N_{Rk,p}$ [kN]	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Ed} [kN]
557.775	3,540.029	1.500	2,360.020	2,147.029

Group anchor ID
1, 2, 13-30

3.3 Concrete Breakout failure

$N_{Ed} \leq N_{Rd,c} = \frac{N_{Rk,c}}{\gamma_{M,c}}$ EN 1992-4, Table 7.1

$N_{Rk,c} = N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec1,N} \cdot \psi_{ec2,N} \cdot \psi_{M,N}$ EN 1992-4, Eq. (7.1)

$N^0_{Rk,c} = k_1 \cdot \sqrt{f_{ck}} \cdot h_{ef}^{1,5}$ EN 1992-4, Eq. (7.2)

$A^0_{c,N} = s_{cr,N} \cdot s_{cr,N}$ EN 1992-4, Eq. (7.3)

$\psi_{s,N} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}} \leq 1.00$ EN 1992-4, Eq. (7.4)

$\psi_{ec1,N} = \frac{1}{1 + \left(\frac{2 \cdot e_{N,1}}{s_{cr,N}}\right)} \leq 1.00$ EN 1992-4, Eq. (7.6)

$\psi_{ec2,N} = \frac{1}{1 + \left(\frac{2 \cdot e_{N,2}}{s_{cr,N}}\right)} \leq 1.00$ EN 1992-4, Eq. (7.6)

$\psi_{M,N} = 1$ EN 1992-4, Eq. (7.7)

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	$f_{c,cyl}$ [N/mm²]
8,405,508	3,240,000	900.0	1,800.0	50.00

$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
0.4	1.000	170.5	0.841	1.000	1.000

z [mm]	$\psi_{M,N}$	k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$N_{Rd,c}$ [kN]	N_{Ed} [kN]
996.7	1.000	7.700	800.207	1.500	1,162.969	2,147.029

Group anchor ID
1, 2, 13-30

4 Shear load EN 1992-4, Section 7.2.2

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel failure (without lever arm)*	9.659	179.520	6	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout failure**	280.233	2,996.061	10	OK
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (relevant anchors)

4.1 Steel failure (without lever arm)

$V_{Ed} \leq V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{M,s}}$ EN 1992-4, Table 7.2

$V_{Rk,s} = k_7 \cdot V^0_{Rk,s}$ EN 1992-4, Eq. (7.35)

$V^0_{Rk,s}$ [kN]	k_7	$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Ed} [kN]
224.400	1.000	224.400	1.250	179.520	9.659

4.2 Pryout failure (concrete cone relevant)

$V_{Ed} \leq V_{Rd,cp} = \frac{V_{Rk,cp}}{\gamma_{M,c,p}}$ EN 1992-4, Table 7.2

$V_{Rk,cp} = k_8 \cdot \min\{N_{Rk,c}; N_{Rk,p}\}$ EN 1992-4, Eq. (7.39c)

$N_{Rk,c} = N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec1,N} \cdot \psi_{ec2,N} \cdot \psi_{M,N}$ EN 1992-4, Eq. (7.1)

$N^0_{Rk,c} = k_1 \cdot \sqrt{f_{ck}} \cdot h_{ef}^{1,5}$ EN 1992-4, Eq. (7.2)

$A^0_{c,N} = s_{cr,N} \cdot s_{cr,N}$ EN 1992-4, Eq. (7.3)

$\psi_{s,N} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}} \leq 1.00$ EN 1992-4, Eq. (7.4)

$\psi_{ec1,N} = \frac{1}{1 + \left(\frac{2 \cdot e_{V,1}}{s_{cr,N}}\right)} \leq 1.00$ EN 1992-4, Eq. (7.6)

$\psi_{ec2,N} = \frac{1}{1 + \left(\frac{2 \cdot e_{V,2}}{s_{cr,N}}\right)} \leq 1.00$ EN 1992-4, Eq. (7.6)

$\psi_{M,N} = 1$ EN 1992-4, Eq. (7.7)

$A_{c,N}$ [mm^2]	$A^0_{c,N}$ [mm^2]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k_8	$f_{c,cyl}$ [N/mm^2]
9,357,437	3,240,000	900.0	1,800.0	2.000	50.00

$e_{c1,V}$ [mm]	$\psi_{ec1,N}$	$e_{c2,V}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$	$\psi_{M,N}$
22.7	0.975	2.9	0.997	1.000	1.000	1.000

k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Ed} [kN]
7.700	800.207	1.500	2,996.061	280.233

Group anchor ID
1-30

5 Combined tension and shear loads (EN 1992-4, Section 7.2.3)

Steel failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.593	0.052	2.000	36	OK

$\beta_N^{\alpha} + \beta_V^{\alpha} \leq 1.0$

Concrete failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
1.846	0.094	1.000	162	not recommended

$(\beta_N + \beta_V) / 1.2 \leq 1.0$

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 131.494 [kN] δ_N = 0.1628 [mm]

V_{Sk} = 6.928 [kN] δ_V = 0.2079 [mm]

δ_{NV} = 0.2640 [mm]

Long term loading:

N_{Sk} = 131.494 [kN] δ_N = 0.3721 [mm]

V_{Sk} = 6.928 [kN] δ_V = 0.3464 [mm]

δ_{NV} = 0.5084 [mm]

Comments: Tension displacements are valid with half of the required installation torque moment for uncracked concrete! Shear displacements are valid without friction between the concrete and the baseplate! The gap due to the drilled hole and clearance hole tolerances are not included in this calculation!

The acceptable anchor displacements depend on the fastened construction and must be defined by the designer!

7 Warnings

- The anchor design methods in PROFIS Engineering require rigid baseplates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the baseplate are not considered - the baseplate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required baseplate thickness with CBFEM to limit the stress of the baseplate based on the assumptions explained above. The proof if the rigid baseplate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Checking the transfer of loads into the base material is required in accordance with EN 1992-4, Annex A!
- The design is only valid if the clearance hole in the fixture is not larger than the value given in Table 6.1 of EN 1992-4! For larger diameters of the clearance hole see section 6.2.2 of EN 1992-4!
- The accessory list in this report is for the information of the user only. In any case, the instructions for use provided with the product have to be followed to ensure a proper installation.
- For the determination of the $\psi_{re,v}$ (concrete edge failure) the minimum concrete cover defined in the design settings is used as the concrete cover of the edge reinforcement.
- Drilled hole cleaning must be performed according to instructions for use (blow twice with oil-free compressed air (min. 6 bar), brush twice, blow twice with oil-free compressed air (min. 6 bar)).
- Characteristic bond resistances depend on short- and long-term temperatures.
- Edge reinforcement is not required to avoid splitting failure
- Design is only valid if hole is filled to remove clearance, clearance as per EN 1992-4 Table 6.1
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening does not meet the design criteria!

8 Installation data

Baseplate, steel: S 355; E = 210,000.00 N/mm^2; f_{yk} = 355.00 N/mm^2

Profile: Pipe, 914 x 20; (L x W x T) = 914.0 mm x 914.0 mm x 20.0 mm

Hole diameter in the fixture: d_f = 33.0 mm

Plate thickness (input): 25.0 mm

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and size: HIT-HY 200-A + HAS-U 8.8 M30

Item number: not available (insert) / 2022696 HIT-HY 200-A (mortar)

Maximum installation torque: 300 Nm

Hole diameter in the base material: 35.0 mm

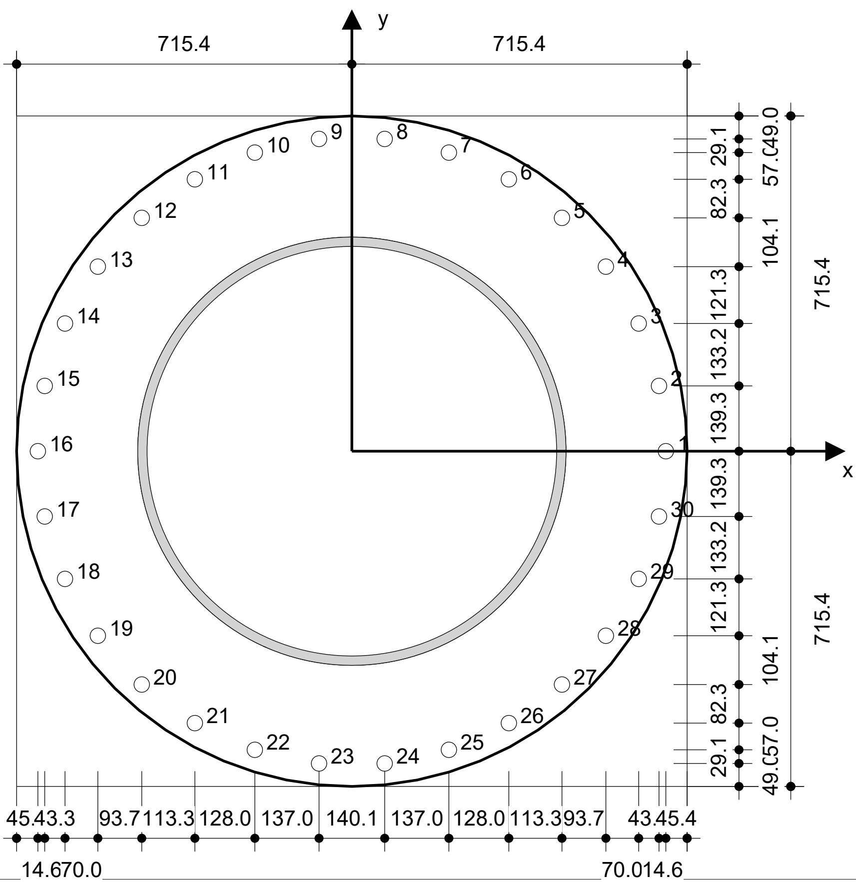
Hole depth in the base material: 600.0 mm

Minimum thickness of the base material: 670.0 mm

Hilti HAS-U threaded rod with HIT-HY 200 injection mortar with 600 mm embedment h_ef, M30, Steel galvanized, Hammer drilling installation per ETA 11/0493, with annular gaps filled with Hilti Filling Set or any suitable gap solutions

8.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Compressed air with required accessories to blow from the bottom of the hole • Proper diameter wire brush	• Dispenser including cassette and mixer • Torque wrench



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Company:
Address:
Phone I Fax: |
Design: Duniface- Pier Base Plate
Fastening Point:

Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}	Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	670.0	-0.0	-	-	-	-	16	-670.0	-0.0	-	-	-	-
2	655.4	139.3	-	-	-	-	17	-655.4	-139.3	-	-	-	-
3	612.1	272.5	-	-	-	-	18	-612.1	-272.5	-	-	-	-
4	542.0	393.8	-	-	-	-	19	-542.0	-393.8	-	-	-	-
5	448.3	497.9	-	-	-	-	20	-448.3	-497.9	-	-	-	-
6	335.0	580.2	-	-	-	-	21	-335.0	-580.2	-	-	-	-
7	207.0	637.2	-	-	-	-	22	-207.0	-637.2	-	-	-	-
8	70.0	666.3	-	-	-	-	23	-70.0	-666.3	-	-	-	-
9	-70.0	666.3	-	-	-	-	24	70.0	-666.3	-	-	-	-
10	-207.0	637.2	-	-	-	-	25	207.0	-637.2	-	-	-	-
11	-335.0	580.2	-	-	-	-	26	335.0	-580.2	-	-	-	-
12	-448.3	497.9	-	-	-	-	27	448.3	-497.9	-	-	-	-
13	-542.0	393.8	-	-	-	-	28	542.0	-393.8	-	-	-	-
14	-612.1	272.5	-	-	-	-	29	612.1	-272.5	-	-	-	-
15	-655.4	139.3	-	-	-	-	30	655.4	-139.3	-	-	-	-

9 Remarks; Your Cooperation Duties

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