Microwave Link Installation Report

And Structural Calculation Report

For Microwave Antenna Fixing
At So Lo Pun

(Re-submission A)

Chan Lit Ming (RSE 18/00)
Registered Structural Engineer

			Prepared	Checked	Approved
Project No.	:	J8009 – S2693-LANDS			
Client	:	HGC Global Communications Limited			
Structural Engineer	:	JEG Engineering Company Limited			
Date	:	April 2024		Tim	

Contents:

The following are the Drawings to be submitted with report.

Drawing No.	**Rev**	**Description**
S2693-LANDS-1	A	Details of Transmission Microwave Antenna Fixing
S2693-LANDS-2	A	Details of Transmission Microwave Antenna Fixing

Introduction

This report is to present the omni antenna installation work to be located at So Lo Pun for HGC Global Communications Limited (HGC).

The objective of the structural design calculation is to prove design check for the structural adequacy of antenna posts and equipment.

Microwave Link Installation Works

Installation of Equipment

- 1 group of BTS equipment (which include 3 nos. of S.S. Cabinet) will be installed.

The proposed equipment location and details of mounting are shown in the structural drawing and in the attached marked photos.

Installation of Antennae

- 6 nos. of microwave antenna (A1 to A6) mounted on 2 nos. of antenna posts (P1 to P2) will be installed.

The proposed antennae location and details of mounting are shown in the structural drawing and in the attached marked photos.

Installation of Power Cable

Total 200A three phase electrical power source will be required for the proposed equipment. Application will be submitted to China Light & Power Company Ltd. (CLP) to install additional power meter. In this case, a diameter of 50mm armored power cable from the proposed power meter to the proposed BTS equipment will be installed without blocking any access.

Installation of Fiber Cable

A diameter of 50mm armored fiber cable from the proposed BTS equipment to the proposed antenna will be installed without blocking any access.

Conclusion

Based on our calculation and site inspection, the proposed works will not induce adverse effect to the existing structure and the existing structure is adequate to sustain the proposed load.

Design Code and Reference

I. Code of Practice for the Structural Use of Steel 2011;

II. Code of Practice on Wind Effects Hong Kong 2019;

III. Code of Practice for Dead and Imposed Loads 2011;

IV. Hong Kong Building (Construction) Regulation;

V. Hilti Fastening Technology Manual;

Material Strength

I. All structural steel shall be class 1 of Grade S275 minimum to BS EN 10025 part 1 to 6: 2004 standards or equivalent, and complying with the relevant reference material standards in Annex A1.1 of the Code of Practice for the Structural Use of Steel 2011;

II. All welds shall comply with BS EN 1011 Part 1: 2009 & Part 2: 2001 with weld strength of 220 N/mm^2;

III. All structural steelworks shall be hot dip galvanized in compliance with BS EN ISO 1461: 2009, with minimum thickness not less than 85μm unless otherwise stated;

IV. All steel bolt/stud to be grade 8.8 comply with BS EN ISO 3560 part 1&2: 2009 (P_{tb} = 560N/mm^2, P_{sb} = 375N/mm^2)

Design Calculation

JEG	Job	Job No. J8009 S2693	Page 51
CALCULATION	Calculations by	Checked by A. Chan	Date Apr 2024

Design Wind Pressure Calculation under CoP on Wind Effects 2019

Max. Actual Height , Z, above ground level = 2.5 m

Wind reference pressure, Qo,z = 3.7 (2.5/ 500) ^0.16 ==> 1.59 kPa

Directionality factor on pressure, Sθ = 0.85 (assume cricital value)

Max. Slope Height = 0 m; Max. Slope Length = 0 m;

Upwind slope of topographic feature = 0 / 0 ==> #DIV/0! <0.03

The topography factor, St = 1.00 Outside the topography significant zone

Net pressure on surface, Qz = Qo,z St Sθ ==> 1.35 kPa

Building Size = 1.50 (W) x 3.40 (D) x 2.30 (H)

Force coefficient (W), Cf_1 = 1.11

$$C_f = 1.1 + \frac{0.055\, H_e/D}{\exp\{|\log_e[(0.6B/D)(1-0.011\, H_e/D)]|^{[1.7-0.0013(H_e/D)^2]}\}}$$

Equation 4-1

Force coefficient (D), Cf_2 = 1.18

Where

- H_e effective building height, based on H, taking account of surroundings.
- B breadth of building
- D depth of building

Equation 4-1 can be used for $H_e/D \le 12$.

The size factor, Ss = 1.00

The finial design wind pressure (W) = Qz x Cf x Ss

= 1.35 x 1.11 x 1

= $\boxed{1.50}$ kPa

The finial design wind pressure (D) = Qz x Cf x Ss

= 1.35 x 1.18 x 1

= $\boxed{1.60}$ kPa

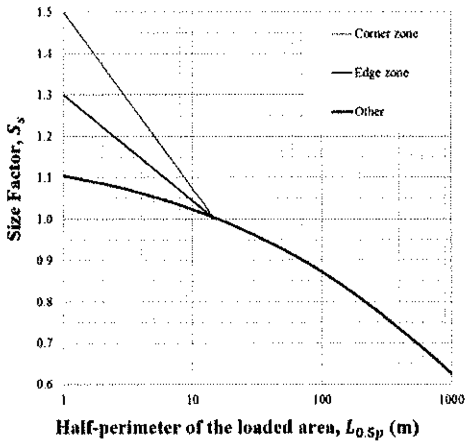


Figure 5-2 Size factor, S_s

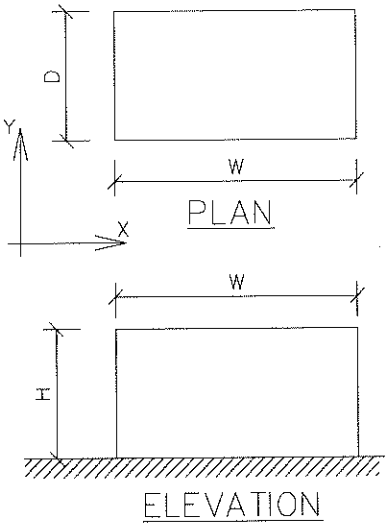
JEG	Job	Job No. J8009 S2693	Page S2
CALCULATION	Calculations by	Checked by A. Chan	Date Apr 2024

Design Loading For Equipment Unit

Max. Overall Size of Cabinet or Antenna = 1.00 m (W) x 1.00 m (D) x 2.30 m (H)

Max. Frontal Area of Cabinet in x dir.
= 3.40 x 2.30 + 0.00 x 0.00 = 7.82 m^2 (Ax)

Max. Frontal Area of Cabinet in y dir
= 1.50 x 2.30 + 0.65 x 0.60 = 3.84 m^2 (Ay)



Wind Load:
W.L. = 1.35 kPa (the building height under 3 m)

Force Coefficient, Cf = 1.2

Live Load:

Equipment self weight = Equipment (200 kg) x 2 Nos. = 400 kg

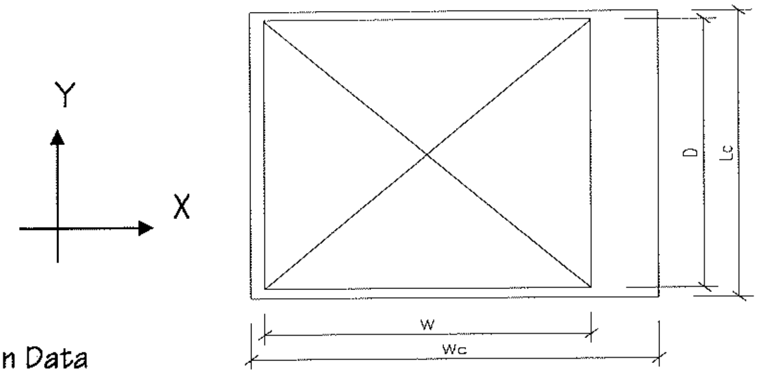
s/w of conc. Plinth = 2450 x W x L x H = 5832 kg

Total Weight = 6233 kg

Unit Weight $= \dfrac{\text{Max Weight}}{\text{Loaded area}} = \dfrac{62.33}{3.45 \times 3.45} = 5.24 < 50.00$ kPa

JEG	Job	Job No. J8009 S2693	Page S3
CALCULATION	Calculations by	Checked by A. Chan	Date Apr 2024

Checking for Equipment Cabinet



PLAN

Design Data

Design Wind Pressure, q	=	1.35	kPa					
Force Coefficient, Cf	=	1.20						
Max. Overall Size of Cabinet or Antenna	=	1.00	m (W) x	1.00	m (D) x	2.30	m (H)	
Proposed Plinth Size	=	3.45	m (Wc) x	3.45	m (Lc) x	0.20	m (Hc)	

Check Stability of Equipment Cabinet

Check Overturning (wind x dir)

Overturning Moment, Mo = q x Cf x Ax x (H/2)
= 1.35 x 1.2 x 7.82 x (2.3 / 2) = 14.6 kNm

Resisting Moment, Mr = total weight of cabinet x (Wc / 2)
= 6233 / 100 x 3.45 / 2 = 107.5 kNm

Factor of Safety = Mr / Mo = (107.5) / 14.6 = 7.4 > = 1.5 OK!

Check Overturning (wind y dir)

Overturning Moment, Mo = q x Cf x Ay x (H/2)
= 1.35 x 1.2 x 3.84 x (2.3 / 2) = 7.2 kNm

Resisting Moment, Mr = total weight of cabinet x (Lc / 2)
= 6233 / 100 x 3.45 / 2 = 107.5 kNm

Factor of Safety = Mr / Mo = (107.5) / 7.2 = 15.03 > = 1.5 OK!

Check Sliding Case (wind x dir) - enclosed by 3.2m height existing R.C. wall

Sliding Force, Fs = q x Cf x Ax
= 1.35 x 1.2 x 7.82 = 12.7 kN

Resisting Force, Fr = total weight of cabinet x μ
= 6233 / 100 x 0.4 = 24.9 kN

Factor of Safety = Fr / Fs = (24.9) / 12.7 = 1.97 > = 1.5 OK!

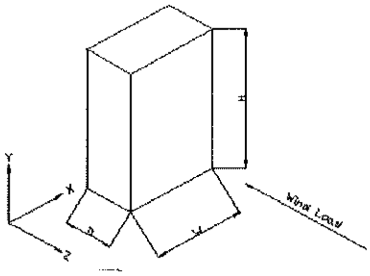
Check Sliding Case (wind y dir) - enclosed by 3.2m height existing R.C. wall

Sliding Force, Fs = q x Cf x Ay
= 1.35 x 1.2 x 3.84 = 6.2 kN

Resisting Force, Fr = total weight of cabinet x μ
= 6233 / 100 x 0.4 = 24.9 kN

Factor of Safety = Fr / Fs = (24.9) / 6.2 = 4.01 > = 1.5 OK!

Design for S.S. Cabinet



Max. Equipment size: 1500 (W) x 1700 (D) x 2300 (H)

Max Weight of Equipment, s/w = 200 kg

Wind pressure, qz = 1.35 kPa (Building under 2.5 m(max))

Force coefficient, Cf = 2.0

Shear due to Wind load,Vx	= qz x Cf x D x H	= 1.35 x 2 x 1.7 x 2.3	= 10.56 kN
Shear due to Wind Load,Vy	= qz x Cf x W x H	= 1.35 x 2 x 1.5 x 2.3	= 9.32 kN
Moment due to Wind Load, Mx	= Vy x H / 2	= 9.315 x 2.3 / 2	= 10.71 kNm
Moment due to Wind Load, My	= Vx x H / 2	= 10.557 x 2.3 / 2	= 12.14 kNm

Adopt 8 nos. HST3-R-M10 Hilti Bolts

www.hilti.com.hk

Company:		Page:	0
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	09-2693-S.S. Cabinet	Date:	17/4/2024
Fastening point:			

Specifier's comments:

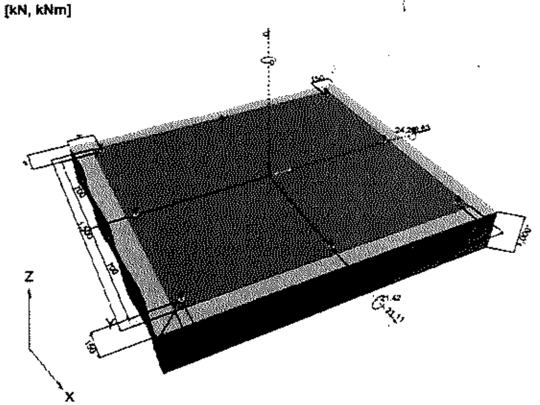
1 Input data

Anchor type and diameter:	**HST3-R M10 hef2**
Return period (service life in years):	50
Item number:	2105864 HST3-R M10x90 30/10
Filling set or any suitable annular gap filling solution	
Effective embedment depth:	$h_{ef,act}$ = 60.0 mm ($h_{ef,limit}$ = - mm), h_{nom} = 68.0 mm
Material:	A4
Evaluation Service Report:	ETA 98/0001
Issued I Valid:	20/7/2023 | -
Proof:	SOFA based on EN 1992-4, Mechanical
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 3.0 mm
Anchor plate[R]:	l_x x l_y x t = 1,500.0 mm x 1,700.0 mm x 3.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, C25/30, $f_{c,cyl}$ = 25.00 N/mm^2; h =1,000.0 mm, 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)
	with longitudinal edge reinforcement d >= 12.0 [mm] + close mesh (stirrups, hangers) s <= 100.0 [mm]

Application also possible with HST4-R M10 under the selected boundary conditions.
More information in section Alternative fastening data of this report.

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [mm] & Loading [kN, kNm]



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Address:		Specifier:	
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Design:	09-2693-S.S. Cabinet	Date:	17/4/2024
Fastening point:			

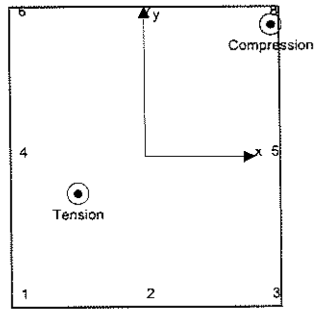
1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 0.000; V_x = 21.110; V_y = 18.630; M_x = -21.420; M_y = 24.280; M_z = 0.000;	no	no	79

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	5.843	3.519	2.639	2.329
2	3.784	3.519	2.639	2.329
3	1.724	3.519	2.639	2.329
4	4.827	3.519	2.639	2.329
5	0.708	3.519	2.639	2.329
6	3.811	3.519	2.639	2.329
7	1.751	3.519	2.639	2.329
8	0.000	3.519	2.639	2.329



max. concrete compressive strain: 0.06 [‰]
max. concrete compressive stress: 1.87 [N/mm^2]
resulting tension force in (x/y)=(-375.7/-206.3): 22.448 [kN]
resulting compression force in (x/y)=(705.9/747.9): 22.448 [kN]

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

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Phone I Fax:	|	E-Mail:	
Design:	09-2693-S.S. Cabinet	Date:	17/4/2024
Fastening point:			

3 Tension load (EN 1992-4, Section 7.2.1)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	5.843	20.500	29	OK
Pullout Strength*	5.843	11.180	53	OK
Concrete Breakout Failure**	5.843	11.929	49	OK
Splitting failure**	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

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

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Ed} [kN]
28.700	1.400	20.500	5.843

3.2 Pullout Strength

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

$N_{Rk,p}$ [kN]	ψ_c	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Ed} [kN]
15.000	1.118	1.500	11.180	5.843

Company:		Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	09-2693-S.S. Cabinet	Date:	17/4/2024
Fastening point:			

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)

$A_{c,N}$ [mm^2]	$A^0_{c,N}$ [mm^2]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	$f_{c,cyl}$ [N/mm^2]
32,400	32,400	90.0	180.0	25.00

$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
0.0	1.000	0.0	1.000	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]
1,442.4	1.000	7.700	17.893	1.500	11.929	5.843

Group anchor ID
1

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4 Shear load (EN 1992-4, Section 7.2.2)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	3.519	20.240	18	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	3.519	31.850	12	OK
Concrete edge failure in direction x+**	22.236	40.496	55	OK

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

4.1 Steel Strength (without lever arm)

$V_{Ed} \le V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{M,s}}$ 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]
25.300	1.000	25.300	1.250	20.240	3.519

4.2 Pryout Strength

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

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

$N_{Rk,c} = N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec1,N} \cdot \psi_{ec2,N} \cdot \psi_{M,N}$ 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)

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

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

$\psi_{ec2,N} = \frac{1}{1 + \left(\frac{2 \cdot e_{V,2}}{s_{cr,N}}\right)} \le 1.00$ 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]	k_8	$f_{c,cyl}$ [N/mm²]
32,400	32,400	90.0	180.0	2.670	25.00

$e_{c1,V}$ [mm]	$\psi_{ec1,N}$	$e_{c2,V}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$	$\psi_{M,N}$
0.0	1.000	0.0	1.000	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	17.893	1.500	31.850	3.519

Group anchor ID
8

4.3 Concrete edge failure in direction x+

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

$V_{Rk,c} = k_T \cdot V^0_{Rk,c} \cdot \frac{A_{c,V}}{A^0_{c,V}} \cdot \psi_{s,V} \cdot \psi_{h,V} \cdot \psi_{\alpha,V} \cdot \psi_{ec,V} \cdot \psi_{re,V}$ EN 1992-4, Eq. (7.40)

$V^0_{Rk,c} = k_9 \cdot d_{nom}^{\alpha} \cdot l_f^{\beta} \cdot \sqrt{f_{ck}} \cdot c_1^{1.5}$ EN 1992-4, Eq. (7.41)

$\alpha = 0.1 \cdot \left(\frac{l_f}{c_1}\right)^{0.5}$ EN 1992-4, Eq. (7.42)

$\beta = 0.1 \cdot \left(\frac{d_{nom}}{c_1}\right)^{0.2}$ EN 1992-4, Eq. (7.43)

$A^0_{c,V} = 4.5 \cdot c_1^2$ EN 1992-4, Eq. (7.44)

$\psi_{s,V} = 0.7 + 0.3 \cdot \frac{c_2}{1.5 \cdot c_1} \le 1.00$ EN 1992-4, Eq. (7.45)

$\psi_{h,V} = \left(\frac{1.5 \cdot c_1}{h}\right)^{0.5} \ge 1.00$ EN 1992-4, Eq. (7.46)

$\psi_{ec,V} = \frac{1}{1 + \left(\frac{2 \cdot e_V}{3 \cdot c_1}\right)} \le 1.00$ EN 1992-4, Eq. (7.47)

$\psi_{\alpha,V} = \sqrt{\frac{1}{(\cos \alpha_V)^2 + (0.5 \cdot \sin \alpha_V)^2}} \ge 1.00$ EN 1992-4, Eq. (7.48)

l_f [mm]	d_{nom} [mm]	k_9	α	β	$f_{c,cyl}$ [N/mm²]
60.0	10.00	1.700	0.063	0.058	25.00

c_1 [mm]	$A_{c,V}$ [mm²]	$A^0_{c,V}$ [mm²]
150.0	286,875	101,250

$\psi_{s,V}$	$\psi_{h,V}$	α_V [°]	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$
0.900	1.000	18.31	1.039	0.0	1.000	1.000

$V^0_{Rk,c}$ [kN]	k_T	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Ed} [kN]
22.922	1.0	1.500	40.496	22.236

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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
0.285	0.174	2.000	12	OK

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

Concrete failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.523	0.549	1.500	79	OK

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

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 4.328 [kN] δ_N = 0.4556 [mm]
V_{Sk} = 2.607 [kN] δ_V = 0.4135 [mm]
δ_{NV} = 0.6153 [mm]

Long term loading:

N_{Sk} = 4.328 [kN] δ_N = 0.9871 [mm]
V_{Sk} = 2.607 [kN] δ_V = 0.6113 [mm]
δ_{NV} = 1.1611 [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 anchor plate! 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 anchor plates 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 anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate 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!
- Design is only valid if hole is filled to remove clearance, clearance as per EN 1992-4 Table 6.1
- 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.
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening meets the design criteria!

S8

www.hilti.com.hk
Company:
Address:
Phone I Fax: |
Design: 09-2693-S.S. Cabinet
Fastening point:

8 Installation data

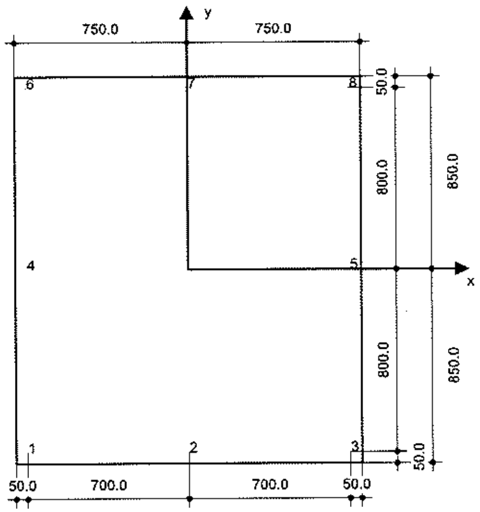
Anchor plate, steel: EN S235; E = 205,000.00 N/mm^2; f_{yk} = 235.00 N/mm^2
Profile: no profile
Hole diameter in the fixture: d_f = - mm
Plate thickness (input): 3.0 mm
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: HST3-R M10 hef2
Item number: 2105864 HST3-R M10x90 30/10
Maximum installation torque: 45 Nm
Hole diameter in the base material: 10.0 mm
Hole depth in the base material: 85.0 mm
Minimum thickness of the base material: 100.0 mm

Hilti HST3 stud anchor with 60 mm embedment, M10 hef2, Stainless steel, installation per ETA 98/0001, 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	• No accessory required	• Torque controlled cordless impact tool • Torque wrench • Hammer



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-700.0	-800.0	-	1,550.0	-	1,750.0
2	0.0	-800.0	-	850.0	-	1,750.0
3	700.0	-800.0	-	150.0	-	1,750.0
4	-700.0	0.0	-	1,550.0	-	950.0
5	700.0	0.0	-	150.0	-	950.0
6	-700.0	800.0	-	1,550.0	-	150.0
7	0.0	800.0	-	850.0	-	150.0
8	700.0	800.0	-	150.0	-	150.0

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Address:
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Design: 09-2693-S.S. Cabinet
Fastening point:

9 Drilling and installation

HST3 (-R) subject to:

Anchor size	M8	M10	M12	M16	M20	M24
Hammer drilling*	TE2(-A) – TE30(-A)				TE40 – TE70	
Diamond core drilling*	DD-30W, DD-EC1					
Setting tool*	Setting tool HS-SC				-	
Hollow drill bit drilling*	-		TE-CD, TE-YD			
Seismic Set/ Filling Set**	Seismic/Filling Set M8-M20 (Carbon and Stainless Steel A4)					-
Impact Wrench and Adaptive Torque Module	Impact Wrench SIW 6AT-A22 and adaptive torque module SI-AT-A22				-	

*Installation methods provided in ETA 98/0001
**Seismic set needed to fill the annular gap between anchor and fixture
(no annular gap, double design resistance (αgap=1))

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Company:		Page:	10
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	09-2693-S.S. Cabinet	Date:	17/4/2024
Fastening point:			

10 Alternative fastening

10.1 Alternative fastening data

Anchor type and diameter:	**HST4-R M10**
Return period (service life in years):	50
Item number:	2329101 HST4-R M10x90 5-40
Filling set or any suitable annular gap filling solution	
Effective embedment depth:	$h_{ef,act}$ = 60.0 mm ($h_{ef,limit}$ = - mm), h_{nom} = 68.0 mm
Material:	A4
Evaluation Service Report:	ETA-21/0878
Issued I Valid:	28/2/2024 | -
Proof:	SOFA based on EN 1992-4, Mechanical
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 3.0 mm
Anchor plate[R] :	l_x x l_y x t = 1,500.0 mm x 1,700.0 mm x 3.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, C25/30, $f_{c,cyl}$ = 25.00 N/mm^2; h =1,000.0 mm, 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) with longitudinal edge reinforcement d >= 12.0 [mm] + close mesh (stirrups, hangers) s <= 100.0 [mm]

Max. Utilization with HST4-R M10: 69 %
Fastening meets the design criteria!

10.2 Installation data

Anchor plate, steel: EN S235; E = 205,000.00 N/mm^2; f_{yk} = 235.00 N/mm^2	Anchor type and diameter: HST4-R M10
Profile: no profile	Item number: 2329101 HST4-R M10x90 5-40
Hole diameter in the fixture: d_f = - mm	Maximum installation torque: 40 Nm
Plate thickness (input): 3.0 mm	Hole diameter in the base material: 10.0 mm
Recommended plate thickness: not calculated	Hole depth in the base material: 88.0 mm
Drilling method: Hammer drilled	Minimum thickness of the base material: 115.0 mm
Cleaning: No cleaning of the drilled hole is required	

Hilti HST4-R stud anchor with 60 mm embedment, M10, Stainless steel, installation per ETA-21/0878, with annular gaps filled with Hilti Filling set or any suitable gap solutions

10.2.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• No accessory required	• Torque controlled cordless impact tool • Torque wrench • Hammer

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Company:		Page:	11
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	09-2693-S.S. Cabinet	Date:	17/4/2024
Fastening point:			

11 Remarks; Your Cooperation Duties

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JEG CALCULATION	Job: BTS site	Job No. J8009 S2693	Page S11
	Calculations by	Checked by A. Chan	Date Apr,2024

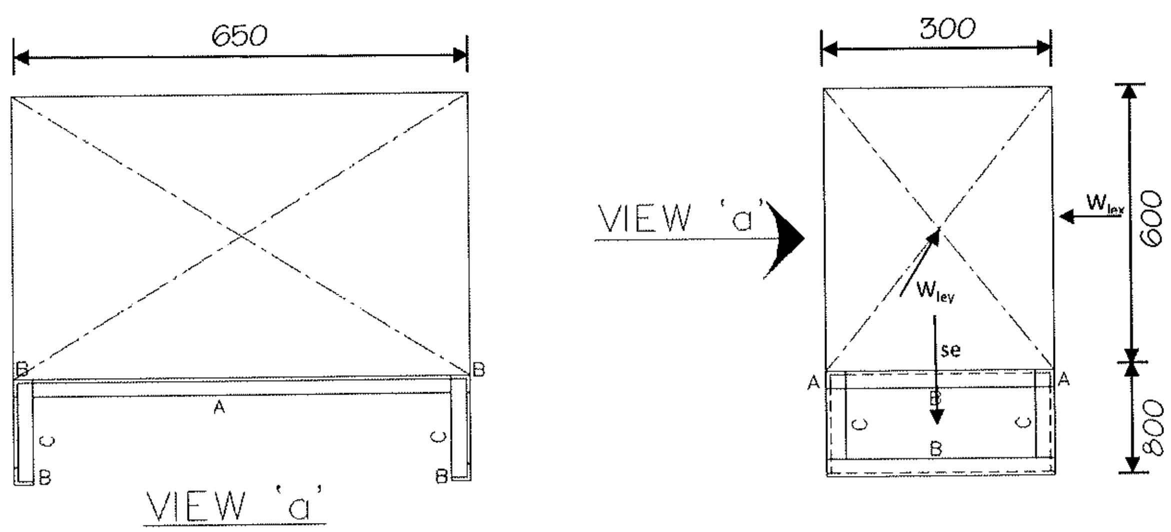
Design Loading For S.S.Cabinet

q_z = 1.35 kPa (the building height under 2.5 m)
Cp = 2.00

Size of S.S.Cabinet = 0.650 m (W) x 0.300 m (D) x 0.600 m (H) (50 kg)

Wind Load
W_{Lex} = qz x Cp x 0.65 x 0.6 x 1.4
= 1.48 kN
W_{Ley} = qz x Cp x 0.3 x 0.6 x 1.4
= 0.69 kN
s/w, se = 50 / 100 x 1.4
= 0.70 kN

Member A : C1
Member B : C2
Member C : C3



JEG	Job BTS site	Job No. J8009 S2693	Page S12
CALCULATION	Calculations by O Checked by A. Chan		Date Apr,2024

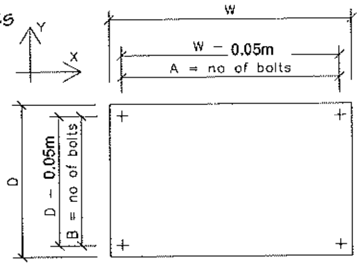
Check Bolt Connection for S.S.Cabinet & Steel Platform

Size of S.S.Cabinet = 0.65 (W) x 0.30 (D) x 0.60 (H)

q_z = 1.35 kPa

C_f = 2.00

Try 2 (row) x 2 (cloumn) nos. M8 Grade A1 - 50 Stainless Steel Bolts



Shear Capacity,P_s = $A_t \times P_{sb}$

= $36.6 \times 200 / 10^3$

= 7.32 kN

Tension Capacity,P_t = $A_t \times P_{st}$

= $36.6 \times 210 / 10^3$

= 7.69 kN

Total nos. of bolts	=	4	nos.
Bolt area,A_t	=	36.6	mm^2
Shear strength of bolt, p_{sb}	=	200	N/mm^2
Tension strength of bolt, p_{tb}	=	210	N/mm^2

For wind in x direction

Shear per bolt, F_s = $q_z \times C_f \times D \times H \times 1.4$ / 4 nos.

= $1.35 \times 2 \times 0.3 \times 0.6 \times 1.4$ / 4nos.

= 0.17 kN < P_s OK!

Tension per bolt,F_t = $q_z \times C_f \times D \times H^2 / 2 / (W - 0.05) \times 1.4$ / 2nos.

= $1.35 \times 2 \times 0.3 \times 0.6^2 / 2 / (0.65 - 0.05) \times 1.4$ / 2 nos.

= 0.17 kN < P_t OK!

Check Combine Effect

$F_s/P_s + F_t/P_{nom}$ = 0.17 / 7.32 + 0.17 / 7.69 = 0.05 < 1.4 OK!

For wind in y direction

Shear per bolt, F_s = $q_z \times C_f \times W \times H \times 1.4$ / 4 nos.

= $1.35 \times 2 \times 0.65 \times 0.6 \times 1.4$ / 4nos.

= 0.37 kN < P_s OK!

Tension per bolt,F_t = $q_z \times C_f \times W \times H^2 / 2 / (D - 0.05) \times 1.4$ / 2nos.

= $1.35 \times 2 \times 0.65 \times 0.6^2 / 2 / (0.3 - 0.05) \times 1.4$ / 2 nos.

= 0.88 kN < P_t OK!

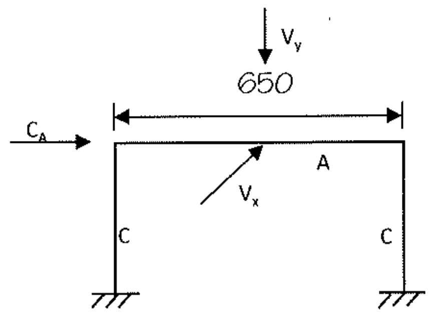
Check Combine Effect

$F_s/P_s + F_t/P_{nom}$ = 0.37 / 7.32 + 0.88 / 7.69 = 0.17 < 1.4 OK!

Adopt 4nos. M8 Stainless Steel Bolts

JEG	Job BTS site	Job No. J8009 S2693	Page S13
CALCULATION	Calculations by 0	Checked by A. Chan	Date Apr,2024

Check Member C1 (L = 650 mm)



Try EA 50x50x5+

Compression on C1, = WLey / 2 nos
= 0.69 / 2 nos
= 0.35 kN

Max Shear on C1, = $[(WLex /2)^2 + (se /2)^2]^{0.5}$
= $[(1.48 /2)^2 + (0.7 /2)^2]^{0.5}$
= 0.82 kN

Moment, M_x = se / 2 x L / 4
= 0.7 /2 x 0.65 /4
= 0.06 kNm

Moment, M_y = WLex / 2 x L / 4
= 1.48 / 2 x 0.65 / 4
= 0.13 kNm

For member checking, please refer to next page.

Adpot EA 50x50x5+

JEG	Job Title		Job No.	Sheet No.	Rev.
				S14	
CALCULATION	Design by	Checked by M.K. Wong	Date:		

Member C1 **EA 50x50x5+** **HKSC:2011 APPROACH**

Member Forces

F_c	Axial Compression	=	**0.35**	kN
F_t	Axial Tension	=	**0.00**	kN
V	Shear Force = $\sqrt{V_x^2 + V_y^2}$	=	**0.82**	kN
M_x	Major Bending	=	**0.06**	kNm
M_y	Minor Bending	=	**0.13**	kNm

Load Case 1

1. Shear Capacity	0.021	O.K.
2. Bending Capacity	0.160	O.K.
3. LTB	-	O.K.
4.Compression Capacity	0.004	O.K.
5.Tensile Capacity	0.000	O.K.
6. Combined Axial & Bending	0.203	O.K.

Section Properties

[illegible]
[illegible]

Dimensions	mm			**Length**		mm	
Depth, D	50			L	=	1000	max
Width, B	50			L_{ex}	= 1.0 L	1000	
Flange Thk, T	5.0			L_{ey}	= 1.0 L	1000	
Web Thk, t	5.0						
depth, d	50.0	d/t =	10				
width, b	50.0	b/T =	10				

Steel Grade S275

p_y =	275	N/mm²	**Radius of Gyration**		; Cl. 3.1.2 Table 3.2
p_{yw} =	275	N/mm²	r_x =	14.8 mm	
$\epsilon = (275/p_y)^{1/2}$	1.00	ϵ web = 1.00	r_y =	14.8 mm	
E =	205000	N/mm²			
Area A_g =	491	mm²			

Second Moment of Area

I_x = 1.070E+05 mm⁴

I_y = 1.070E+05 mm⁴

Section Modulus

Elastic:	Z_x =	2.950E+03 mm³	Plastic:	S_x =	5.580E+03	mm³
	Z_y =	2.950E+03 mm³		S_y =	5.580E+03	mm³

Limiting Width-to-Thickness Ratios ; Cl. Table 7.1 and 7.2

Compression Element (Design Type: Compression due to Bending)		Limiting Value			Ratio	Classification
		Class 1 Plastic	Class 2 Compact	Class 3 Semi-Compact		
Flange	Compression due to Bending	8e 8.00	9e 9.00	13e 13.00	b/T 10.00	**Semi-Compact**
Web	Neutral Axis at Mid-Depth	80e 80.00	100e 100.00	120e 120.00	d/t 10.00	**Plastic**
Web	Generally (>= 40ϵ = 40)	80e/ (1+r1) 79.59	100e / (1+1.5r1) 79.39	120e/ (1+2r2) 119.38	d/t 10.00	**Plastic**

Stress Ratios for Classification

r_1 = Fc / d t pyw ; -1 < r1 <= 1 $r_2 = F_c / A_g p_{yw}$; Cl. 7.3 (a) & (c)

= 0.01 = 0.00

∴ = 0.01

Shear Capacity

$V_c = P_y A_v / \sqrt{3}$ 1 ; Cl. 8.2.1

Av = tD

= 250 mm²

∴ V_c = **39.69** **kN** Low Shear Condition > V, OK

Moment Capacity

; Cl. 7.5.2

$$S_{x,eff} = Z_x + (S_x - Z_x)\left[\frac{\left(\frac{\beta_{3w}}{d/t}\right)-1}{\left(\frac{\beta_{3w}}{\beta_{2w}}\right)-1}\right] \le Z_x + (S_x - Z_x)\left[\frac{\left(\frac{\beta_{3f}}{b/T}\right)-1}{\left(\frac{\beta_{3f}}{\beta_{2f}}\right)-1}\right]$$

= 26623 mm³ ≤ 34510 mm³

= 26623 mm³

$$S_{y,eff} = Z_y + (S_y - Z_y)\left[\frac{\left(\frac{\beta_{3f}}{B/T}\right)-1}{\left(\frac{\beta_{3f}}{\beta_{2f}}\right)-1}\right]$$

= 34510 mm³

Sv = 2083 mm³ $\rho = \left(\frac{2V}{V_c} - 1\right)^2$ = 0.0017

Member C1 **EA 50x50x5+** **HKSC:2011 APPROACH**

$M_c = p_y \times Z$ (Seff) $\leq$ 1.2.py(Zx -p.Sv /1.5) / 1000 = 1 kNm ; Cl. 8.2.2
$\leq$ 1.2.py(Zy -p.Sv /1.5) / 1000 = .97 kNm

$M_{cx} = p_y \times \min(Zx, Sx,eff)$ = 0.81 kNm ∴ M_{cx} = **.81 kNm** > Mx, OK

$M_{cy} = p_y \times \min(Zy, Sy,eff)$ = 0.81 kNm ∴ M_{cy} = **.81 kNm** > My, OK

1

Moment Capacity to Lateral Torsional Buckling

$M_b \geq m_{LT} M_x$; Cl. 8.3.5.2

m_{LT} = 1.0 ; Table 8.4a

M_b = pb Zx or pb Seff ;(8.20 - 8.24)

$\lambda_{LT} = uv\lambda\sqrt{\beta_w}$; Cl. 8.3.5.3

u = 0.9 Hot-rolled Section

$\lambda = L_E / r_y = L_{ey} / r_y$ = 67.57

x = D / T = 10.00

$v = \dfrac{1}{\left(1+0.05(\lambda/x)^2\right)^{0.25}}$ = 0.74

2.00

$\sqrt{\beta_w}$ = 0.5 Semi-Compact Sections

∴ λ_{LT} = 32.85

∴ p_b = 275.00 N/mm² Rolled Section ; 8.3.5.2 App. 8.1

$P_{cy} \geq A_g p_c$

∴ M_b = **1.53** **kNm** **> mLT Mx, OK**

Compression Resistance

L_{ex} = L =	1000	mm	r_x =	14.8	mm	$\lambda_x = L_{ex}/r_x$ =	67.6	Rolled H-Section
L_{ey} = L =	1000	mm	r_y =	14.8	mm	$\lambda_y = L_{ey}/r_y$ =	67.6	

p_{cx} = 206.67 N/mm² $P_{cx} = p_{cx} . A$ = 101.47 kN ; Cl. 8.7.5

p_{cy} = 186.07 N/mm² $P_{cy} = p_{cy} . A$ = 91.36 kN ; Table 8.7, App. 8.4

∴ P_c = **91.36** **kN** **> Fc, OK**

Compression Members under Combined Axial Force and Moments

Cross-section Capacity

$F_c / Ag\, P_y$ + M_x / M_{cx} + M_y / M_{cy} ≤ 1 ; Cl. 8.9.1

= 0.00 + 0.074 + 0.160

= **0.24**

< 1.00 **< 1, OK**

Member Buckling Resistance

m_y = 1.0 ; Table 8.9

$M_{cy} = p_y Z_y$; Cl. 8.9.2

= 0.81 kNm

F_c / P_{cy} + $m_{LT} M_x / M_b$ + $m_y \overline{M_y} / M_{cy}$ ≤ 1 ; Cl. 8.9.2

= 0.00 + 0.04 + 0.16

= 0.20

< 1.00 **< 1, OK**

Tension Resistance

Ke = 1.0

Ae = $K_e a_n$ $\leq$ a_g Hole Area = 0 mm²

= 491 mm²

∴ P_t = py . Ae a1 = 250 mm²

= **135.03** **kN** a2 = 241 mm² **> Ft, OK**

Tension Members under Combined Axial Force and Moments

Ft / Pt + M_x / M_{cx} + M_y / M_{cy} ≤ 1 ; Cl. 8.8

= 0.00 + 0.074 + 0.160

= **0.23**

< 1.00 **< 1, OK**

JEG	Job: BTS site	Job No. J8009 S2693	Page S16
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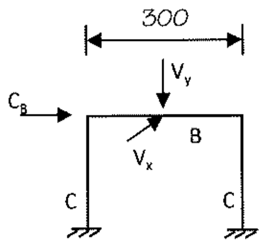
Check Member C2 (L = 300 mm)



Try EA 50x50x5+

Compression on C2, = WLex / 2 nos
= 1.48 / 2 nos
= 0.74 kN

Max Shear on C2, $= [(se / 2)^2 + (WLey /2)^2]^{0.5}$
$= [(0.7 /2)^2 + (0.69 /2)^2]^{0.5}$
= 0.5 kN

Moment, M_x = se / 2 x L / 4
= 0.7 / 2 x 0.3 / 4
= 0.03 kNm

Moment, M_y = WLey / 2 x L / 4
= 0.69 /2 x 0.3 /4
= 0.03 kNm

For member checking, please refer to next page.

Adpot EA 50x50x5+

JEG	Job Title		Job No.	Sheet No. S17	Rev.
CALCULATION	Design by	Checked by M.K. Wong	Date:		

Member C2 **EA 50x50x5+** **HKSC:2011 APPROACH**

Member Forces

F_c Axial Compression		=	**0.74**	**kN**
F_t Axial Tension		=	**0.00**	**kN**
V Shear Force =	$\sqrt{V_x^2 + V_y^2}$	=	**0.50**	**kN**
M_x Major Bending		=	**0.03**	**kNm**
M_y Minor Bending		=	**0.03**	**kNm**

Load Case 1

1. Shear Capacity	0.013	O.K.
2. Bending Capacity	0.037	O.K.
3. LTB	-	O.K.
4.Compression Capacity	0.008	O.K.
5.Tensile Capacity	0.000	O.K.
6. Combined Axial & Bending	0.065	O.K.

Section Properties

Dimensions	mm			Length		mm	
Depth, D	50			L	=	1000	max
Width, B	50			L_{ex}	= 1.0 L	1000	
Flange Thk, T	5.0			L_{ey}	= 1.0 L	1000	
Web Thk, t	5.0						
depth, d	50.0	d/t =	10				
width, b	50.0	b/T =	10				

Steel Grade S275 — **Radius of Gyration** ; Cl. 3.1.2 Table 3.2

p_y =	275	N/mm^2	r_x =	14.8	mm
p_{yw} =	275	N/mm^2	r_y =	14.8	mm
$\epsilon = (275/p_y)^{1/2}$	1.00	ϵ web = 1.00			
E =	205000	N/mm^2			
Area A_g =	491	mm^2			

Second Moment of Area

I_x = 1.070E+05 mm^4

I_y = 1.070E+05 mm^4

Section Modulus

Elastic:			Plastic:		
Z_x =	2.950E+03	mm^3	S_x =	5.580E+03	mm^3
Z_y =	2.950E+03	mm^3	S_y =	5.580E+03	mm^3

Limiting Width-to-Thickness Ratios ; Cl. Table 7.1 and 7.2

Compression Element (Design Type: Compression due to Bending)		Limiting Value Class 1 Plastic	Class 2 Compact	Class 3 Semi-Compact	Ratio	Classification
Flange	Compression due to Bending	8e 8.00	9e 9.00	13e 13.00	b/T 10.00	**Semi-Compact**
Web	Neutral Axis at Mid-Depth	80e 80.00	100e 100.00	120e 120.00	d/t 10.00	**Plastic**
Web	Generally (>= 40ε = 40)	80e/ (1+r1) 79.15	100e / (1+1.5r1) 78.73	120e/ (1+2r2) 118.70	d/t 10.00	**Plastic**

Stress Ratios for Classification ; Cl. 7.3 (a) & (c)

$r_1 = Fc / d\, t\, pyw$; $-1 < r1 <= 1$ $r_2 = F_c / A_g p_{yw}$

= 0.01 = <u>0.01</u>

∴ = 0.01

Shear Capacity ; Cl. 8.2.1

$V_c = P_y A_v / \sqrt{3}$ 1

Av = tD

= <u>250</u> mm^2

∴ V_c = **39.69** **kN** Low Shear Condition > V, OK

Moment Capacity ; Cl. 7.5.2

$$S_{x,eff} = Z_x + (S_x - Z_x)\left[\frac{\left(\frac{\beta_{3w}}{d/t}\right)-1}{\left(\frac{\beta_{3w}}{\beta_{2w}}\right)-1}\right] \le Z_x + (S_x - Z_x)\left[\frac{\left(\frac{\beta_{3f}}{b/T}\right)-1}{\left(\frac{\beta_{3f}}{\beta_{2f}}\right)-1}\right]$$

$$S_{y,eff} = Z_y + (S_y - Z_y)\left[\frac{\left(\frac{\beta_{3f}}{B/T}\right)-1}{\left(\frac{\beta_{3f}}{\beta_{2f}}\right)-1}\right]$$

= 26411 mm^3 ≤ 34510 mm^3 = 34510 mm^3

= 26411 mm^3

Sv = 2083 mm^3 $\rho = \left(\frac{2V}{V_c} - 1\right)^2$ = 0.0006

JEG CALCULATION	Job Title		Job No.	Sheet No. S18	Rev.
	Design by	Checked by M.K. Wong	Date:		

Member C2 **EA 90x90x12** **HKSC:2011 APPROACH**

$M_c = p_y \times Z$ (Seff) $\leq$ 1.2.py(Zx -p.Sv /1.5) / 1000 = 1 kNm ; Cl. 8.2.2

$\leq$ 1.2.py(Zy -p.Sv /1.5) / 1000 = .97 kNm

$M_{cx} = p_y \times$ min(Zx, Sx,eff) = 0.81 kNm $\therefore$ M_{cx} = **.81 kNm** > Mx, OK

$M_{cy} = p_y \times$ min(Zy, Sy,eff) = 0.81 kNm $\therefore$ M_{cy} = **.81 kNm** > My, OK

1

Moment Capacity to Lateral Torsional Buckling

$M_b \geq m_{LT} M_x$; Cl. 8.3.5.2

$m_{LT} = 1.0$; Table 8.4a

M_b = pb Zx or pb Seff ;(8.20 - 8.24)

$\lambda_{LT} = uv\lambda\sqrt{\beta_w}$; Cl. 8.3.5.3

u = 0.9 Hot-rolled Section

$\lambda = L_E / r_y = L_{ey} / r_y =$ 67.57

x = D / T = 10.00

$v = \dfrac{1}{\left(1+0.05(\lambda/x)^2\right)^{0.25}}$ = 0.74

2.00

$\sqrt{\beta_w}$ = 0.5 Semi-Compact Sections

$\therefore$ λ_{LT} = 32.85

$\therefore$ p_b = 275.00 N/mm² Rolled Section ; 8.3.5.2 App. 8.1

$P_{cy} \geq A_g p_c$

$\therefore$ M_b = **1.53** **kNm** > mLT Mx, OK

Compression Resistance

$L_{ex} = L$ = 1000 mm r_x = 14.8 mm $\lambda_x = L_{ex}/r_x$ = 67.6 Rolled H-Section

$L_{ey} = L$ = 1000 mm r_y = 14.8 mm $\lambda_y = L_{ey}/r_y$ = 67.6

p_{cx} = 206.67 N/mm² $P_{cx} = p_{cx} . A$ = 101.47 kN ; Cl. 8.7.5

p_{cy} = 186.07 N/mm² $P_{cy} = p_{cy} . A$ = 91.36 kN ; Table 8.7, App. 8.4

$\therefore$ P_c = **91.36** **kN** > Fc, OK

Compression Members under Combined Axial Force and Moments

Cross-section Capacity

$F_c / Ag P_y + M_x / M_{cx} + M_y / M_{cy} \leq 1$; Cl. 8.9.1

= 0.01 + 0.037 + 0.037

= **0.08**

< 1.00 < 1, OK

Member Buckling Resistance

m_y = 1.0 ; Table 8.9

$M_{cy} = p_y Z_y$; Cl. 8.9.2

= 0.81 kNm

$F_c / P_{cy} + m_{LT} M_x / M_b + m_y \overline{M_y} / M_{cy} \leq 1$; Cl. 8.9.2

= 0.01 + 0.02 + 0.04

= 0.06

< 1.00 < 1, OK

Tension Resistance

Ke = 1.0

Ae = $K_e a_n \leq a_g$ Hole Area = 0 mm²

= 491 mm²

$\therefore$ P_t = py . Ae a1 = 250 mm²

= **135.03** **kN** a2 = 241 mm² > Ft, OK

Tension Members under Combined Axial Force and Moments

$Ft / Pt + M_x / M_{cx} + M_y / M_{cy} \leq 1$; Cl. 8.8

= 0.00 + 0.037 + 0.037

= **0.07**

< 1.00 < 1, OK

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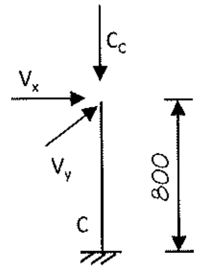
Check Member C3 (L = 800 mm)



Try EA 50x50x5+

Compression on C3, = se / 4 nos
= 0.18 kN

Max Shear on C3, = $[(\ WLex / 4\ )^2 + (\ WLey / 4\ )^2]^{0.5}$
= $[(\ 1.48 / 4\ )^2 + (\ 0.69 / 4\ )^2]^{0.5}$
= 0.41 kN

Moment, M_x = WLex / 4 x (H / 2 + L)
= 1.48 / 4 x (0.6 / 2 + 0.8)
= 0.41 kNm

Moment, M_y = WLey / 4 x (H / 2 + L)
= 0.69 / 4 x (0.6 / 2 + 0.8)
= 0.19 kNm

For member checking, please refer to next page.

Adpot EA 50x50x5+

JEG CALCULATION	Job Title		Job No.	Sheet No. S20	Rev.
	Design by	Checked by M.K. Wong	Date:		

Member C3 **EA 50x50x5+** **HKSC:2011 APPROACH**

Member Forces

F_c Axial Compression		=	**0.18**	kN
F_t Axial Tension		=	**0.00**	kN
V Shear Force =	$\sqrt{F_x^2+F_y^2}$	=	**0.41**	kN
M_x Major Bending		=	**0.41**	kNm
M_y Minor Bending		=	**0.19**	kNm

Load Case 1

1. Shear Capacity	0.010	O.K.
2. Bending Capacity	0.505	O.K.
3. LTB	-	O.K.
4.Compression Capacity	0.002	O.K.
5.Tensile Capacity	0.000	O.K.
6. Combined Axial & Bending	0.503	O.K.

Section Properties

Dimensions	mm		
Depth, D	50		
Width, B	50		
Flange Thk, T	5.0		
Web Thk, t	5.0		
depth, d	50.0	d/t =	10
width, b	50.0	b/T =	10

Length		mm	
L	=	1000	max
L_{ex}	= 1.0 L	1000	
L_{ey}	= 1.0 L	1000	

Steel

Grade S275

p_y =	275	N/mm²
p_{yw} =	275	N/mm²
$\epsilon = (275/p_y)^{1/2}$	1.00	ϵ web = 1.00
E =	205000	N/mm²
Area A_g =	491	mm²

Radius of Gyration ; Cl. 3.1.2 Table 3.2

r_x = 14.8 mm

r_y = 14.8 mm

Second Moment of Area

I_x = 1.070E+05 mm⁴

I_y = 1.070E+05 mm⁴

Section Modulus

Elastic: Z_x = 2.950E+03 mm³ Plastic: S_x = 5.580E+03 mm³

Z_y = 2.950E+03 mm³ S_y = 5.580E+03 mm³

Limiting Width-to-Thickness Ratios ; Cl. Table 7.1 and 7.2

Compression Element		Limiting Value			Ratio	Classification
Design Type	Compression due to Bending	Class 1 Plastic	Class 2 Compact	Class 3 Semi-Compact		
Flange	Compression due to Bending	8e 8.00	9e 9.00	13e 13.00	b/T 10.00	Semi-Compact
Web	Neutral Axis at Mid-Depth	80e 80.00	100e 100.00	120e 120.00	d/t 10.00	Plastic
Web	Generally (>= 40ϵ = 40)	80e/ (1+r1) 79.79	100e / (1+1.5r1) 79.69	120e/ (1+2r2) 119.68	d/t 10.00	Plastic

Stress Ratios for Classification ; Cl. 7.3 (a) & (c)

r_1 = Fc / d t pyw ; -1 < r1 <= 1 $r_2 = F_c / A_g p_{yw}$

= 0.00 = 0.00

∴ = 0.00

Shear Capacity ; Cl. 8.2.1

$V_c = P_y A_v / \sqrt{3}$ 1

Av = tD

= 250 mm²

∴ V_c = **39.69** **kN** Low Shear Condition > V, OK

Moment Capacity ; Cl. 7.5.2

$$S_{x,eff} = Z_x + (S_x - Z_x)\left[\frac{\left(\frac{\beta_{3w}}{d/t}\right)-1}{\left(\frac{\beta_{3w}}{\beta_{2w}}\right)-1}\right] \le Z_x + (S_x - Z_x)\left[\frac{\left(\frac{\beta_{3f}}{b/T}\right)-1}{\left(\frac{\beta_{3f}}{\beta_{2f}}\right)-1}\right]$$

$$S_{y,eff} = Z_y + (S_y - Z_y)\left[\frac{\left(\frac{\beta_{3f}}{B/T}\right)-1}{\left(\frac{\beta_{3f}}{\beta_{2f}}\right)-1}\right]$$

= 26717 mm³ ≤ 34510 mm³ = 34510 mm³

= 26717 mm³

Sv = 2083 mm³ $\rho = \left(\frac{2V}{V_c}-1\right)^2$ = 0.0004

Member C3 **EA 50x50x5+** **HKSC:2011 APPROACH**

$M_c = p_y \times Z$ (Seff) $\leq$ 1.2.py(Zx -p.Sv /1.5) / 1000 = 1 kNm ; Cl. 8.2.2

$\leq$ 1.2.py(Zy -p.Sv /1.5) / 1000 = .97 kNm

$M_{cx} = p_y \times$ min(Zx, Sx,eff) = 0.81 kNm ∴ M_{cx} = **.81 kNm** > Mx, OK

$M_{cy} = p_y \times$ min(Zy, Sy,eff) = 0.81 kNm ∴ M_{cy} = **.81 kNm** > My, OK

1

Moment Capacity to Lateral Torsional Buckling

$M_b \geq m_{LT} M_x$; Cl. 8.3.5.2

m_{LT} = 1.0 ; Table 8.4a

M_b = pb Zx or pb Seff ;(8.20 - 8.24)

$\lambda_{LT} = uv\lambda\sqrt{\beta_w}$; Cl. 8.3.5.3

u = 0.9 Hot-rolled Section

$\lambda = L_E / r_y = L_{ey} / r_y$ = 67.57

x = D / T = 10.00

$$v = \frac{1}{\left(1 + 0.05(\lambda / x)^2\right)^{0.25}} = 0.74$$

2.00

$\sqrt{\beta_w}$ = 0.5 Semi-Compact Sections

∴ λ_{LT} = 32.85

∴ p_b = 275.00 N/mm² Rolled Section ; 8.3.5.2 App. 8.1

$P_{cy} \geq A_g p_c$

∴ M_b = **1.53** **kNm** > mLT Mx, OK

Compression Resistance

$L_{ex} = L$ =	1000	mm	r_x =	14.8	mm	$\lambda_x = L_{ex}/r_x$ =	67.6	Rolled H-Section
$L_{ey} = L$ =	1000	mm	r_y =	14.8	mm	$\lambda_y = L_{ey}/r_y$ =	67.6	

p_{cx} = 206.67 N/mm² $P_{cx} = p_{cx} . A$ = 101.47 kN ; Cl. 8.7.5

p_{cy} = 186.07 N/mm² $P_{cy} = p_{cy} . A$ = 91.36 kN ; Table 8.7, App. 8.4

∴ P_c = **91.36** **kN** > Fc, OK

Compression Members under Combined Axial Force and Moments

Cross-section Capacity ; Cl. 8.9.1

	F_c / Ag P_y	+	M_x / M_{cx}	+	M_y / M_{cy}	≤ 1
=	0.00	+	0.505	+	0.234	
=	**0.74**					
<	1.00					< 1, OK

Member Buckling Resistance

m_y = 1.0 ; Table 8.9

$M_{cy} = p_y Z_y$; Cl. 8.9.2

= 0.81 kNm

	F_c / P_{cy}	+	$m_{LT} M_x / M_b$	+	$m_y \overline{M_y} / M_{cy}$	≤ 1 ; Cl. 8.9.2
=	0.00	+	0.27	+	0.23	
=	0.50					
<	1.00					< 1, OK

Tension Resistance

Ke = 1.0

Ae = $K_e a_n$ $\leq$ a_g Hole Area = 0 mm²

= 491 mm²

∴ P_t = py . Ae a1 = 250 mm²

= **135.03** **kN** a2 = 241 mm² > Ft, OK

Tension Members under Combined Axial Force and Moments

	Ft / Pt	+	M_x / M_{cx}	+	M_y / M_{cy}	≤ 1 ; Cl. 8.8
=	0.00	+	0.505	+	0.234	
=	**0.74**					
<	1.00					< 1, OK

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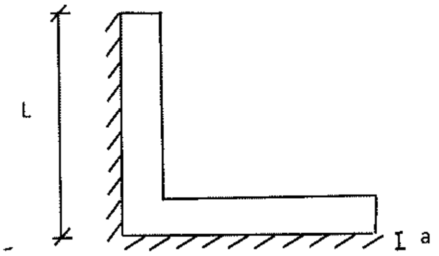
Design for Weld Connection

Try 5 mm fillet weld all round , p_w = 220 N/mm^2



a = 5 sin 45°
= 3.54 mm

L = 50 - 2 x 5
= 40 mm

Weld Area, $A_{(weld)}$ = 2aL
= 2 x 3.54 x 40
= 284 mm^2

C1 : V_A = 0.82 kN
C_A = 0.35 kN
R_A = 0.9 kN

C2 : V_B = 0.5 kN
C_B = 0.74 kN
R_B = 0.9 kN

C3 : V_C = 0.41 kN
C_C = Max. Compression of C3 + Compression due to Wind Moment of C3
= 0.18 + WLex / 2 x (H / 2 + 0.8) / D + WLey / 2 x (H / 2 + 0.8) / W
= 0.18 + 1.48 / 2 x (0.6 / 2 + 0.8) / 0.3 + 0.69 x (0.6 / 2 + 0.8) / 0.65
= 3.4772 kN
R_C = 3.51 kN

Shear on weld = 3.47717948717949 x 1000 / 284
= 12.25 N/mm^2 < p_w OK!

<u>Adopt 5 mm Fillet Weld All Round</u>

<u>Design for Anchor Bolts</u>

Shear, Vx = WLex / 2 / 1.4 = 1.48 / 2 / 1.4 = 0.53 kN
Shear, Vy = WLey / 2 / 1.4 = 0.69 / 2 / 1.4 = 0.25 kN

Moment, My = WLex / 1.4 x (H / 2 + 0.8) = 1.48 / 1.4 x (0.6 / 2 + 0.8) = 1.16 kNm

Max Tension, T = se / 2 / 1.4 + WLey / 1.4 x (H / 2 + 0.8) / W
= 0.7 / 2 + 0.69 / 1.4 x (0.6 / 2 + 0.8) / 0.65
= 1.18 kN

Try 6 nos. HST3 - R - M8
Please refer to hilti output

<u>Adopt 6nos HST3-R- M8 bolts</u>

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Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	09-2693-S.S. Cabinet (1)	Date:	17/4/2024
Fastening point:			

Specifier's comments:

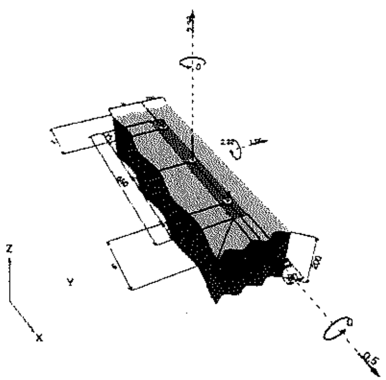
1 Input data

Anchor type and diameter:	**HST3-R M8 hef2**
Return period (service life in years):	50
Item number:	2105896 HST3-R M8x75 -/10
Filling set or any suitable annular gap filling solution	
Effective embedment depth:	$h_{ef,act}$ = 47.0 mm ($h_{ef,limit}$ = - mm), h_{nom} = 54.0 mm
Material:	A4
Evaluation Service Report:	ETA 98/0001
Issued I Valid:	20/7/2023 | -
Proof:	SOFA based on EN 1992-4 and fib bulletin 58, Mechanical
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 3.0 mm
Anchor plate[R] :	l_x x l_y x t = 650.0 mm x 50.0 mm x 3.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, C25/30, $f_{c,cyl}$ = 25.00 N/mm^2; h =200.0 mm, 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)
	with longitudinal edge reinforcement d >= 12.0 [mm] + close mesh (stirrups, hangers) s <= 100.0 [mm]

Application also possible with HST4-R M8 under the selected boundary conditions.
More information in section Alternative fastening data of this report.

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [mm] & Loading [kN, kNm]



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Fastening point:			

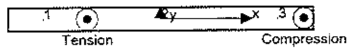
1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 2.360; V_x = 0.500; V_y = 1.060; M_x = 0.000; M_y = 2.320; M_z = 0.000;	no	no	68

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	4.252	0.391	0.167	0.353
2	2.195	0.391	0.167	0.353
3	0.139	0.391	0.167	0.353



max. concrete compressive strain:	0.10 [‰]
max. concrete compressive stress:	2.91 [N/mm^2]
resulting tension force in (x/y)=(-156.1/0.0):	6.586 [kN]
resulting compression force in (x/y)=(305.6/0.0):	4.226 [kN]

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

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3 Tension load (EN 1992-4, Section 7.2.1)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	4.252	12.643	34	OK
Pullout Strength*	4.252	6.336	68	OK
Concrete Breakout Failure**	4.252	8.270	52	OK
Splitting failure**	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

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

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Ed} [kN]
17.700	1.400	12.643	4.252

3.2 Pullout Strength

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

$N_{Rk,p}$ [kN]	ψ_c	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Ed} [kN]
8.500	1.118	1.500	6.336	4.252

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]
19,881	19,881	70.5	141.0	25.00

$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
0.0	1.000	0.0	1.000	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]
461.8	1.000	7.700	12.405	1.500	8.270	4.252

Group anchor ID
1

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4 Shear load (EN 1992-4, Section 7.2.2)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	0.391	12.560	4	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	0.391	21.668	2	OK
Concrete edge failure in direction y+**	1.172	33.440	4	OK

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

4.1 Steel Strength (without lever arm)

$V_{Ed} \le V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{M,s}}$ 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_{Eq} [kN]
15.700	1.000	15.700	1.250	12.560	0.391

4.2 Pryout Strength

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

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

$N_{Rk,c} = N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec1,N} \cdot \psi_{ec2,N} \cdot \psi_{M,N}$ 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)

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

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

$\psi_{ec2,N} = \frac{1}{1 + \left(\frac{2 \cdot e_{V,2}}{s_{cr,N}}\right)} \le 1.00$ 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]	k_8	$f_{c,cyl}$ [N/mm²]
19,881	19,881	70.5	141.0	2.620	25.00

$e_{c1,V}$ [mm]	$\psi_{ec1,N}$	$e_{c2,V}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$	$\psi_{M,N}$
0.0	1.000	0.0	1.000	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	12.405	1.500	21.668	0.391

Group anchor ID
3

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4.3 Concrete edge failure in direction y+

$V_{Ed} \le V_{Rd,c} = \frac{V_{Rk,c}}{\gamma_{M,c}}$ fib Bulletin 58, Table (10.2-1)

$V_{Rk,c} = V^0_{Rk,c} \cdot \psi_{A,V} \cdot \psi_{h,V} \cdot \psi_{s,V} \cdot \psi_{ec,V} \cdot \psi_{\alpha,V} \cdot \psi_{re,V}$ fib Bulletin 58, Eq. (10.2-5)

$V^0_{Rk,c} = k_V \cdot d_{nom}^{\alpha} \cdot l_f^{\beta} \cdot \sqrt{f_{ck}} \cdot c_1^{1.5}$ fib Bulletin 58, Eq. (10.2-5a)

$\alpha = 0.1 \cdot \left(\frac{l_f}{c_1}\right)^{0.5}$ fib Bulletin 58, Eq. (10.2-5a₁)

$\beta = 0.1 \cdot \left(\frac{d_{nom}}{c_1}\right)^{0.2}$ fib Bulletin 58, Eq. (10.2-5a₂)

$A^0_{c,V} = 4.5 \cdot c_1^2$ fib Bulletin 58, Eq. (10.2-5b)

$\psi_{A,V} = \frac{A_{c,V}}{A^0_{c,V}}$ fib bulletin 58 (07/2011) Section 10.2.5.1.1 b)

$A_{c,V}$ fib bulletin 58 (07/2011) Figure 10.2-4

$\psi_{s,V} = 0.7 + 0.3 \cdot \frac{c_2}{1.5 \cdot c_1} \le 1.00$ fib Bulletin 58, Eq. (10.2-5d)

$\psi_{h,V} = \left(\frac{1.5 \cdot c_1}{h}\right)^{0.5} \ge 1.00$ fib Bulletin 58, Eq. (10.2-5c)

$\psi_{ec,V} = \frac{1}{1 + \left(\frac{2 \cdot e_V}{3 \cdot c_1}\right)} \le 1.00$ fib Bulletin 58, Eq. (10.2-5e)

$\psi_{\alpha,V} = \sqrt{\frac{1}{(\cos \alpha_V)^2 + \left(\frac{\sin \alpha_V}{\psi_{90°,V}}\right)^2}} \ge 1.00$ fib Bulletin 58, Eq. (10.2-5f))

l_f [mm]	d_{nom} [mm]	k_V	α	β	$f_{c,cyl}$ [N/mm²]
47.0	8.00	1.700	0.069	0.060	25.00

c_1 [mm]	$A_{c,V}$ [mm²]	$A^0_{c,V}$ [mm²]	$\psi_{A,V}$
100.0	120,000	45,000	2.667

$\psi_{s,V}$	$\psi_{h,V}$	α_V [°]	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$
1.000	1.000	25.25	1.086	0.0	1.000	1.400

$\psi_{90°,V}$	$V^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Ed} [kN]
2.500	12.366	1.500	33.440	1.172

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Company:		Page:	6
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	09-2693-S.S. Cabinet (1)	Date:	17/4/2024
Fastening point:			

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
0.336	0.031	2.000	12	OK

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

Concrete failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.671	0.035	1.500	56	OK

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

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 3.150 [kN] δ_N = 0.5250 [mm]

V_{Sk} = 0.289 [kN] δ_V = 0.2309 [mm]

δ_{NV} = 0.5735 [mm]

Long term loading:

N_{Sk} = 3.150 [kN] δ_N = 0.9624 [mm]

V_{Sk} = 0.289 [kN] δ_V = 0.3479 [mm]

δ_{NV} = 1.0234 [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 anchor plate! 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 anchor plates 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 anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate 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!
- Design is only valid if hole is filled to remove clearance, clearance as per EN 1992-4 Table 6.1
- 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.
- The characteristic bond resistances depend on the return period (service life in years): 50

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Design:	09-2693-S.S. Cabinet (1)	Date:	17/4/2024
Fastening point:			

Fastening meets the design criteria!

Hilti PROFIS Engineering 3.0.93

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Phone I Fax:	|	E-Mail:	
Design:	09-2693-S.S. Cabinet (1)	Date:	17/4/2024
Fastening point:			

8 Installation data

Anchor plate, steel: EN S235; E = 205,000.00 N/mm^2; f_{yk} = 235.00 N/mm^2

Profile: no profile

Hole diameter in the fixture: d_f = - mm

Plate thickness (input): 3.0 mm

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: HST3-R M8 hef2

Item number: 2105896 HST3-R M8x75 -/10

Maximum installation torque: 20 Nm

Hole diameter in the base material: 8.0 mm

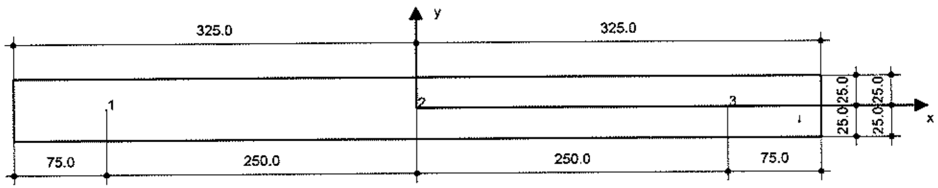
Hole depth in the base material: 71.0 mm

Minimum thickness of the base material: 80.0 mm

Hilti HST3 stud anchor with 47 mm embedment, M8 hef2, Stainless steel, installation per ETA 98/0001, 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	• No accessory required	• Torque controlled cordless impact tool • Torque wrench • Hammer



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-250.0	0.0	-	-	-	100.0
2	0.0	0.0	-	-	-	100.0
3	250.0	0.0	-	-	-	100.0

Hilti PROFIS Engineering 3.0.93

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Company:		Page:	9
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	09-2693-S.S. Cabinet (1)	Date:	17/4/2024
Fastening point:			

9 Drilling and installation

HST3 (-R) subject to:

Anchor size	M8	M10	M12	M16	M20	M24
Hammer drilling*	TE2(-A) – TE30(-A)				TE40 – TE70	
Diamond core drilling*	DD-30W, DD-EC1					
Setting tool*	Setting tool HS-SC					
Hollow drill bit drilling*	-		TE-CD, TE-YD			
Seismic Set/ Filling Set**	Seismic/Filling Set M8-M20 (Carbon and Stainless Steel A4)					-
Impact Wrench and Adaptive Torque Module	Impact Wrench SIW 6AT-A22 and adaptive torque module SI-AT-A22				-	

*Installation methods provided in ETA-98/0001

**Seismic set needed to fill the annular gap between anchor and fixture

No annular gap, double [illegible]

(27)

10 Alternative fastening

10.1 Alternative fastening data

Anchor type and diameter:	**HST4-R M8**
Return period (service life in years):	50
Item number:	2329094 HST4-R M8x65 5-20
Filling set or any suitable annular gap filling solution	
Effective embedment depth:	$h_{ef,act}$ = 47.0 mm ($h_{ef,limit}$ = - mm), h_{nom} = 53.0 mm
Material:	A4
Evaluation Service Report:	ETA-21/0878
Issued I Valid:	28/2/2024 | -
Proof:	SOFA based on EN 1992-4 and fib bulletin 58, Mechanical
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 3.0 mm
Anchor plate[R] :	l_x x l_y x t = 650.0 mm x 50.0 mm x 3.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, C25/30, $f_{c,cyl}$ = 25.00 N/mm^2; h =200.0 mm, 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) with longitudinal edge reinforcement d >= 12.0 [mm] + close mesh (stirrups, hangers) s <= 100.0 [mm]

Max. Utilization with HST4-R M8: 58 %
Fastening meets the design criteria!

10.2 Installation data

Anchor plate, steel: EN S235; E = 205,000.00 N/mm^2; f_{yk} = 235.00 N/mm^2
Profile: no profile
Hole diameter in the fixture: d_f = - mm
Plate thickness (input): 3.0 mm
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: HST4-R M8
Item number: 2329094 HST4-R M8x65 5-20
Maximum installation torque: 20 Nm
Hole diameter in the base material: 8.0 mm
Hole depth in the base material: 73.0 mm
Minimum thickness of the base material: 94.0 mm

Hilti HST4-R stud anchor with 47 mm embedment, M8, Stainless steel, installation per ETA-21/0878, with annular gaps filled with Hilti Filling set or any suitable gap solutions

10.2.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• No accessory required	• Torque controlled cordless impact tool • Torque wrench • Hammer

11 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
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S28

JEG	Job	Job No. J8009 S3679	Page A1
CALCULATION	Calculations by	Checked by M.K. Wong	Date Apr 2024

Design Wind Pressure Calculation under CoP on Wind Effects 2019

Max. Actual Height , Z, above ground level = 16 m

Wind reference pressure, Qo,z = 3.7 (16/ 500) ^0.16 ==> 2.13 kPa

Directionality factor on pressure, Sθ = 0.85 (assume cricital value)

Max. Slope Height = 0 m; Max. Slope Length = 0 m;

Upwind slope of topographic feature = 0 / 0 ==> #DIV/0! <0.03

The topography factor, St = 1.00 Outside the topography significant zone

Net pressure on surface, Qz = Qo,z St Sθ ==> 1.82 kPa

Net pressure coefficient, Cp = 1.8 (at edge zones of building, reference from Table B2-1)

The size factor, Ss = 1.000

The finial design wind pressure = Qz x Cp x Ss

= 1.82 x 1.8 x 1

= $\boxed{3.28}$ kPa (Adopt 3.42 kPa as critical case in some calculation)

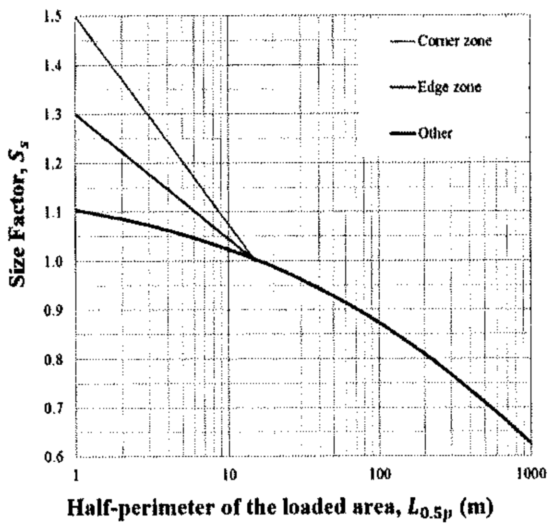

Figure 5-2 Size factor, S_s

A2

SPACE GASS 14 (HK3334) (64-bit) - JEG ENGINEERING CO LTD
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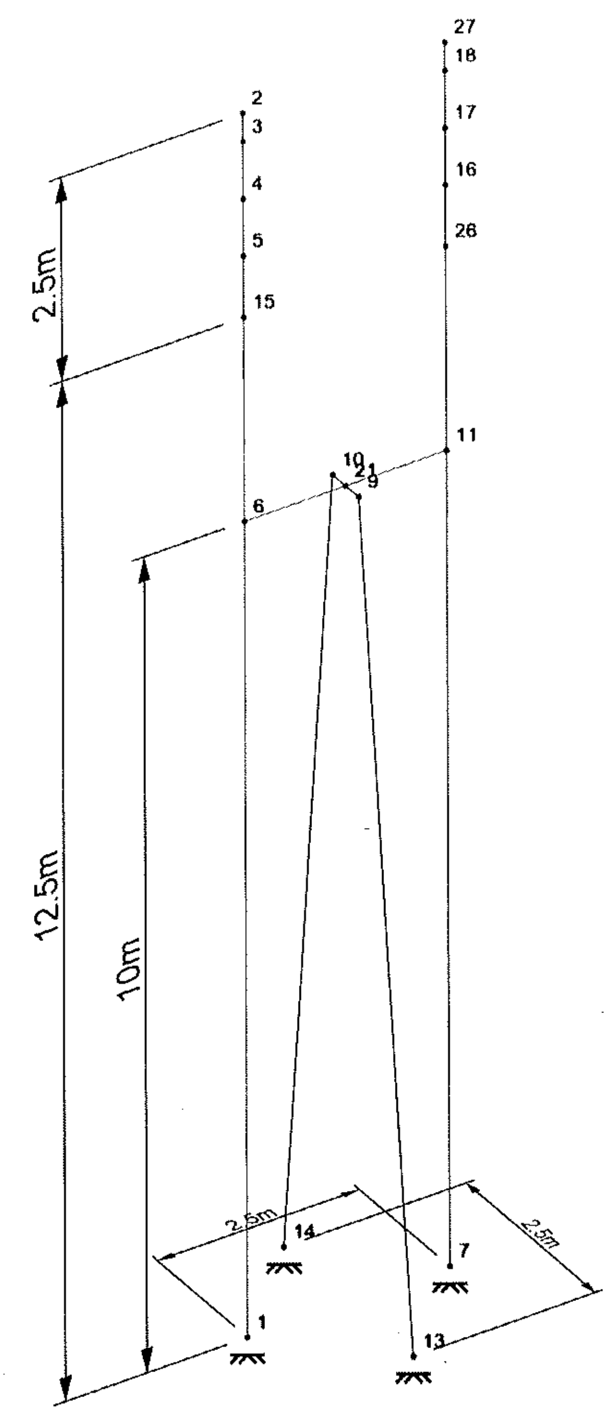
Designer: Date: Wednesday, April 24, 2024 12:11 PM, Page: 1



Scale (1:75), Viewpoint (148,33)

Materials:

1 STEEL

Sections:

2 168.3x6.3 CHS

3 193.7x10.0 CHS

4 114.3x5.0 CHS

A3

SPACE GASS 14 (HK3334) (64-bit) - JEG ENGINEERING CO LTD
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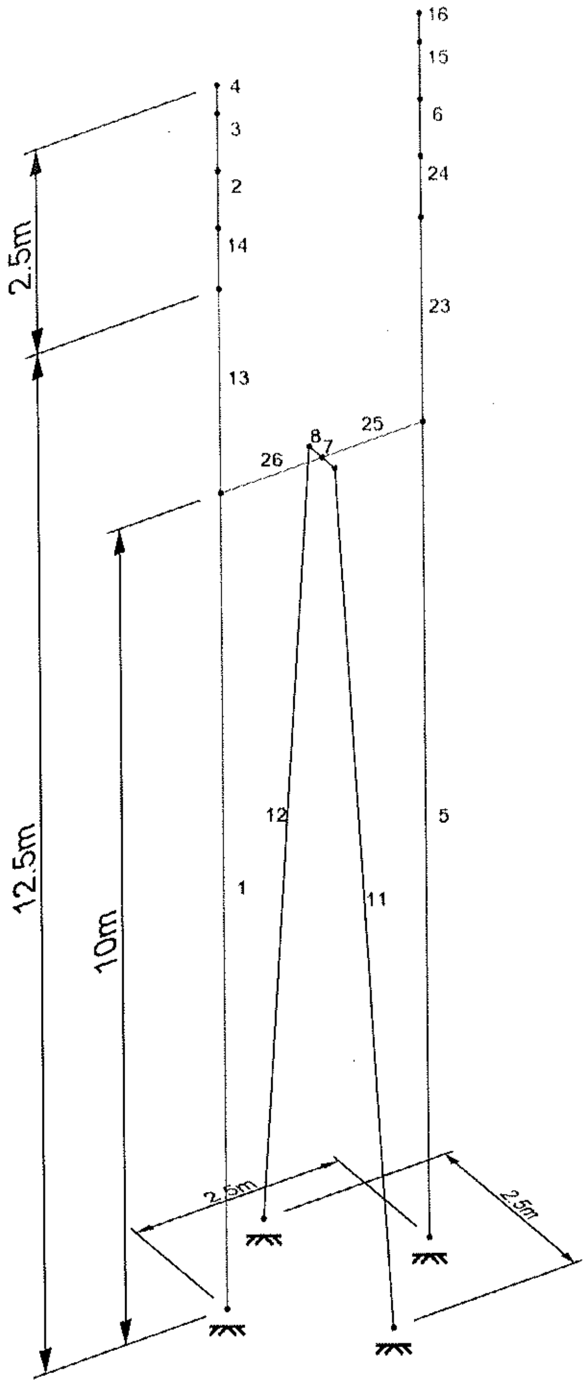

Scale (1:75), Viewpoint (148,33)

Materials:

1 STEEL

Sections:

2 168.3x6.3 CHS

3 193.7x10.0 CHS

4 114.3x5.0 CHS

A4

SPACE GASS 14 (HK3334) (64-bit) - JEG ENGINEERING CO LTD
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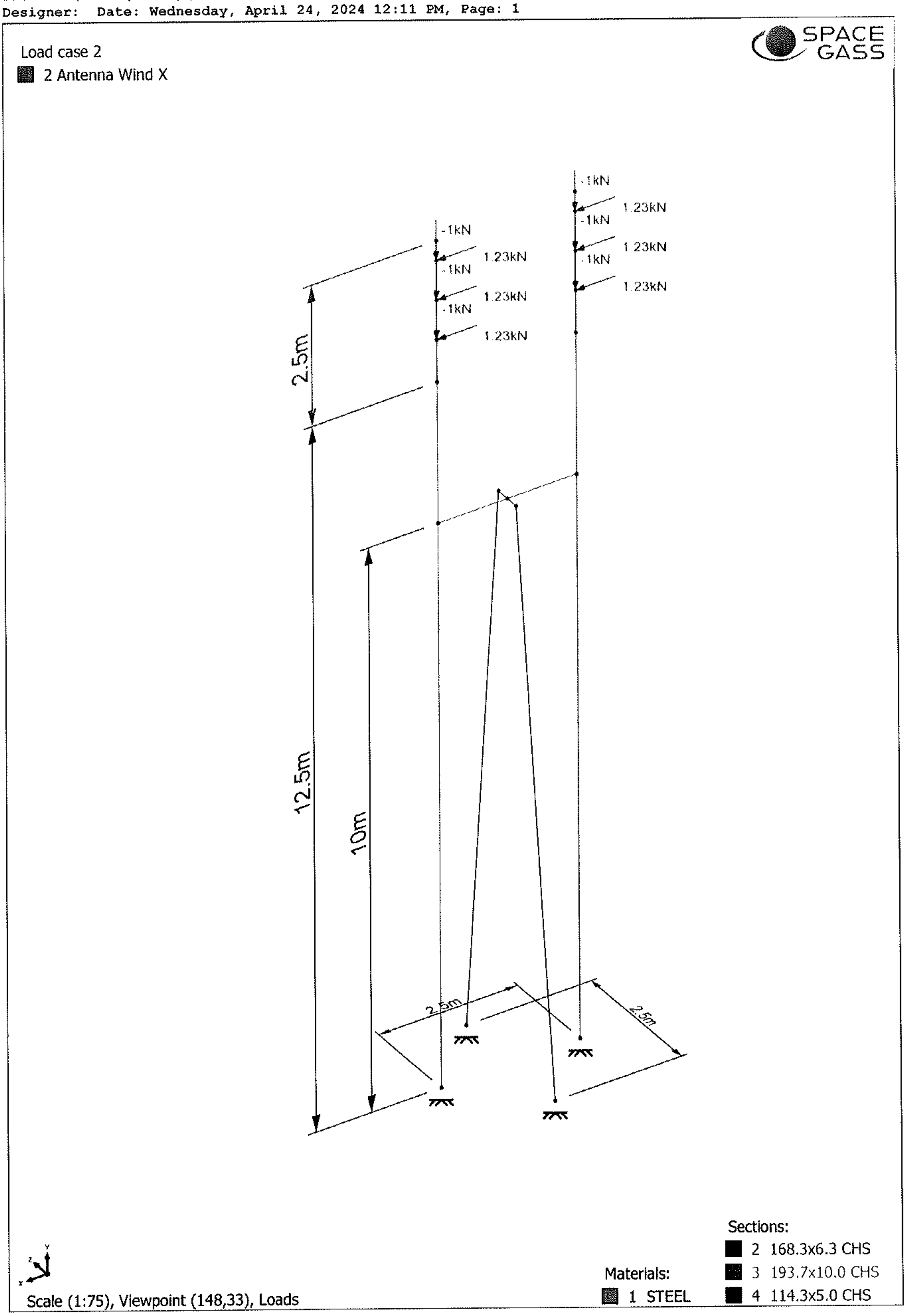
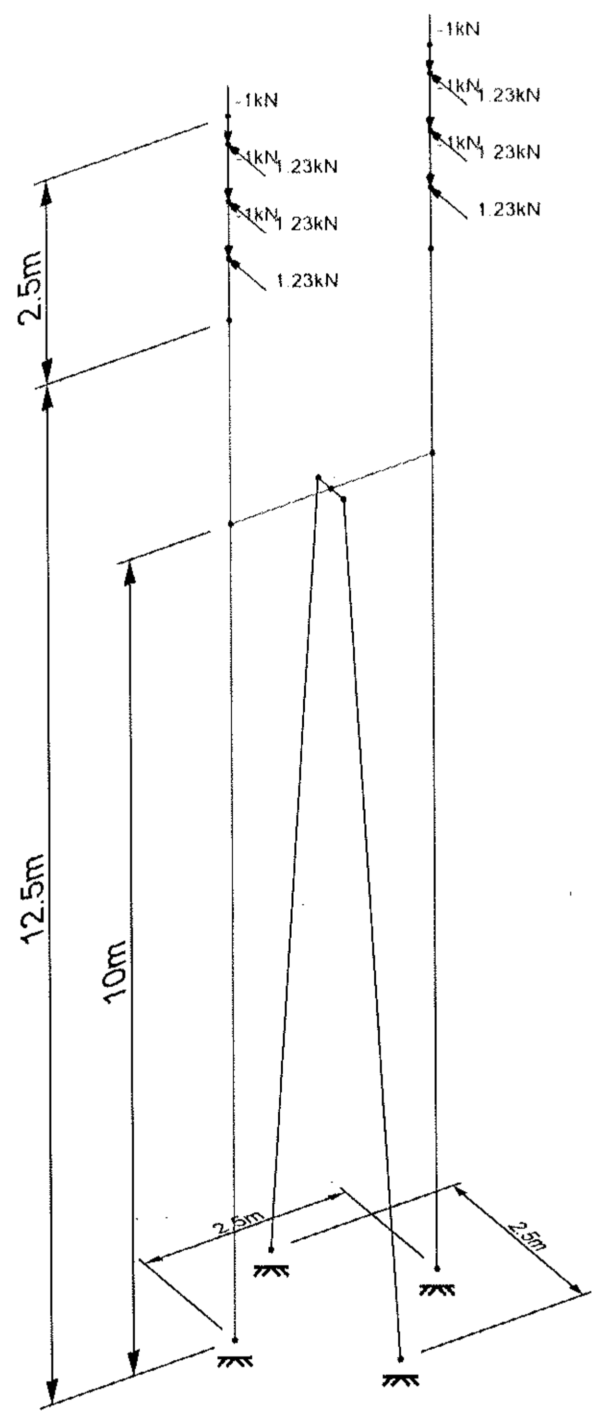


A5

Load case 3

3 Antenna Wind Z



Scale (1:75), Viewpoint (148,33), Loads

Materials:
1 STEEL

Sections:
2 168.3x6.3 CHS
3 193.7x10.0 CHS
4 114.3x5.0 CHS

Ab

SPACE GASS 14 (HK3334) (64-bit) - JEG ENGINEERING CO LTD
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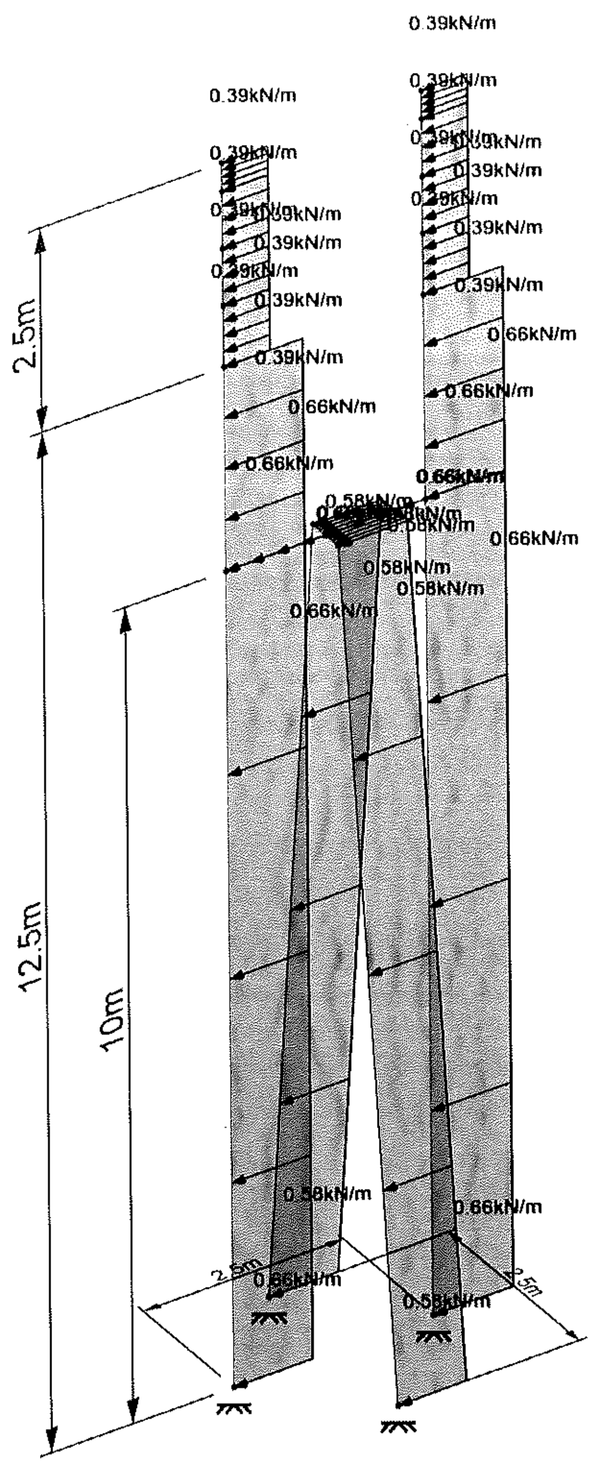
Load case 4

4 Pole Wind X



Scale (1:75), Viewpoint (148,33), Loads

Materials:

1 STEEL

Sections:

2 168.3x6.3 CHS

3 193.7x10.0 CHS

4 114.3x5.0 CHS

A7

SPACE GASS 14 (HK3334) (64-bit) - JEG ENGINEERING CO LTD
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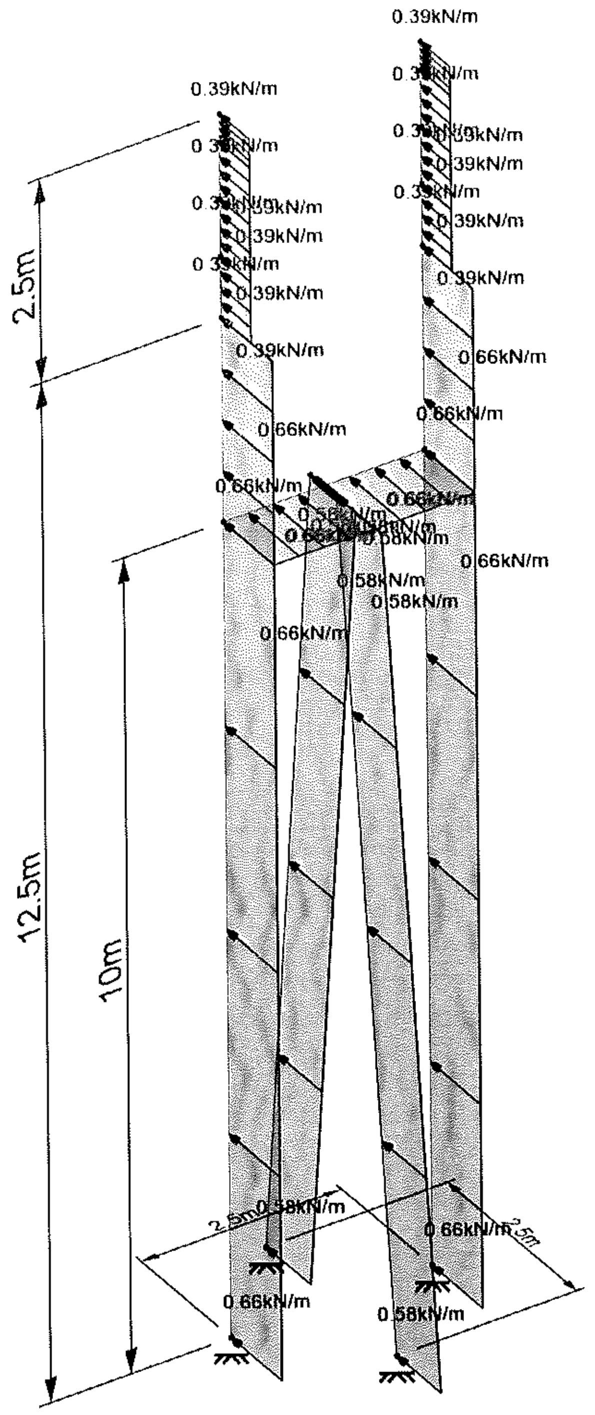
Designer: Date: Wednesday, April 24, 2024 12:13 PM, Page: 1

Load case 5
5 Pole Wind Z



Scale (1:75), Viewpoint (148,33), Loads

Materials:
1 STEEL

Sections:
2 168.3x6.3 CHS
3 193.7x10.0 CHS
4 114.3x5.0 CHS

A8

SPACE GASS 14 (HK3334) (64-bit) - JEG ENGINEERING CO LTD
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Combination Case	1 SW	2 Antenna Wind X	3 Antenna Wind Z	4 Pole Wind X	5 Pole Wind Z	11 Wind X	12 Wind Z
11	1.4	1.4		1.4			
12	1.4		1.4		1.4		
21						0.7143	
22							0.7143

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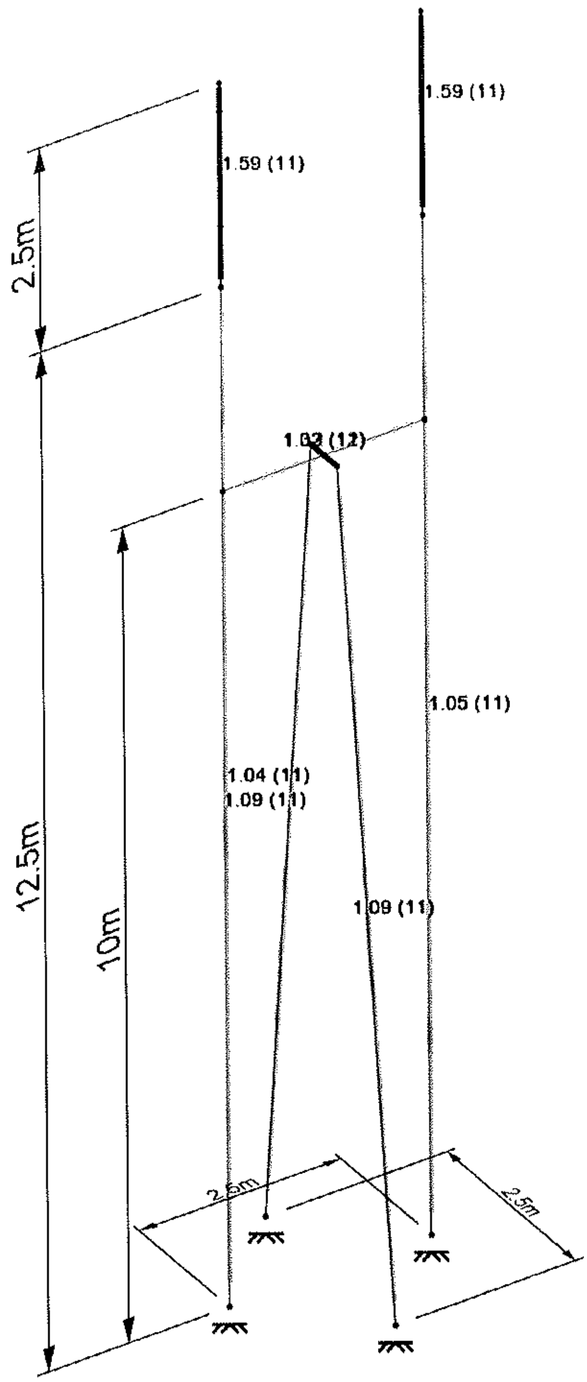
HK CP2011 Load Factors:
- >= 2.00 (Pass)
- >= 1.10 (Pass)
- >= 1.00 (Pass)
- < 1.00 (Fail)
- < 0.90 (Fail)
- < 0.50 (Fail)
- Seismic failure
- L/r failure
- Design error
- Not Designed



Scale (1:75), Viewpoint (148,33)

Materials:
1 STEEL

Sections:
2 168.3x6.3 CHS
3 193.7x10.0 CHS
4 114.3x5.0 CHS

A10

SPACE GASS 14 (HK3334) (64-bit) - JEG ENGINEERING CO LTD
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Filter: No filter

[illegible]

Static analysis	Y	
Buckling analysis	Y	
Dynamic frequency analysis	N	
Spectral response analysis	N	
Harmonic response analysis	N	
Transient response analysis	N	
Ill-conditioned	N	
Non-linear convergence	Y	
Frontwidth	16	
Total degrees of freedom	90	
Static load cases	5	(10000)
Mass load cases	1	(10000)
Step load cases	[illegible]	(10000)

STEEL DESIGN STATUS REPORT

Members with design data	3	([illegible])
Member design or check	C	[illegible]
Connections with design data	[illegible]	(50000)
Connection design	N	

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NODE COORDINATES (m)

[illegible]

MEMBER DATA (m,deg)

[illegible]

NODE RESTRAINTS (kN/m,kNm/rad,kN,kNm)
(F=Fixed, R=Released, S=Spring, V=Variable, P=Plastic, H=Friction, *=Gen)
(Active Dirn: P=Positive-only, N=Negative-only, B=Bi-directional)

Node	Rest. Code	Active Dirn	X Trans Spng Stiff /Plas Lmt	Y Trans Spng Stiff /Plas Lmt	Z Trans Spng Stiff /Plas Lmt	X Rotn Spng Stiff /Plas Lmt	Y Rotn Spng Stiff /Plas Lmt	Z Rotn Spng Stiff /Plas Lmt
1	FFFFFF	BBBBBB						
7	FFFFFF	BBBBBB						
13	FFFFFF	BBBBBB						
14	FFFFFF	BBBBBB						

SECTION PROPERTIES (mm,mm 2,mm 4,deg)
(*=Factored properties)

Sect	Name	Mark	Shape	Source
1	139.7x6.3 CHS	S1	Circular tube	British
2	168.3x6.3 CHS	S2	Circular tube	British
3	193.7x10.0 CHS	S3	Circular tube	British
4	114.3x5.0 CHS	S4	Circular tube	British

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Sect	Area of Section	Torsion Constant	Y-Axis Mom of In	Z-Axis Mom of In	Y-Axis Shr Area	Z-Axis Shr Area	Princ Angle
1	2.6400E+03	1.1300E+07	5.6900E+06	5.0900E+06	Infinite	Infinite	0.00
2	3.2100E+03	2.1100E+07	1.0500E+07	1.0500E+07	Infinite	Infinite	0.00
3	5.7700E+03	4.8800E+07	2.4400E+07	2.4400E+07	Infinite	Infinite	0.00
4	1.7200E+03	5.1400E+06	2.5700E+06	2.5700E+06	Infinite	Infinite	0.00

Sect	Shape	Trans	Mir	Rotate	D	Bt/Bb	Btw/Bbw	Tt/Tb	Tw/Br
1	Circular tube	No	No	0.00	139.70	0.00 0.00	0.00 0.00	0.00 0.00	6.30 0.00
2	Circular tube	No	No	0.00	168.30	0.00 0.00	0.00 0.00	0.00 0.00	6.30 0.00
3	Circular tube	No	No	0.00	193.70	0.00 0.00	0.00 0.00	0.00 0.00	10.00 0.00
4	Circular tube	No	No	0.00	114.30	0.00 0.00	0.00 0.00	0.00 0.00	5.00 0.00

MATERIAL PROPERTIES (MPa,t/m 3,strain/deg C)

Matl	Material Name	Young's Modulus	Poisson's Ratio	Mass Density	Coeff of Expansion	Concrete Strength
1	STEEL	2.0000E+05	0.25	7.8500E+00	1.17E-05	

NODE LOADS (kN,kNm)

Load Case	Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment	Load Cat
2	3	1.223	-1.000	0.000	0.000	0.000	0.000	0
	4	1.223	-1.000	0.000	0.000	0.000	0.000	0
	5	1.223	-1.000	0.000	0.000	0.000	0.000	0
	16	1.228	-1.000	0.000	0.000	0.000	0.000	0
	17	1.228	-1.000	0.000	0.000	0.000	0.000	0
	18	1.228	-1.000	0.000	0.000	0.000	0.000	0
3	3	0.000	-1.000	1.223	0.000	0.000	0.000	0
	4	0.000	-1.000	1.223	0.000	0.000	0.000	0
	5	0.000	-1.000	1.223	0.000	0.000	0.000	0
	16	0.000	-1.000	1.223	0.000	0.000	0.000	0
	17	0.000	-1.000	1.223	0.000	0.000	0.000	0
	18	0.000	-1.000	1.228	0.000	0.000	0.000	0

MEMBER DISTRIBUTED FORCES (m,kN/m)

Load Case	Memb	Sub Load	Axes Sys	Start Position	Finish Position	X Start/ Finish	Y Start/ Finish	Z Start/ Finish	Load Cat
4	1	1	GI	0.000%	100.000%	0.662 0.662	0.000 0.000	0.000 0.000	0
	2	1	GI	0.000%	100.000%	0.390 0.390	0.000 0.000	0.000 0.000	0
	3	1	GI	0.000%	100.000%	0.390 0.390	0.000 0.000	0.000 0.000	0
	4	1	GI	0.000%	100.000%	0.390 0.390	0.000 0.000	0.000 0.000	0
	5	1	GI	0.000%	100.000%	0.662 0.662	0.000 0.000	0.000 0.000	0
	6	1	GI	0.000%	100.000%	0.390 0.390	0.000 0.000	0.000 0.000	0
	7	1	GI	0.000%	100.000%	0.576 0.576	0.000 0.000	0.000 0.000	0

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Load Case	Memb	Sub Load	Axes Sys	Start Position	Finish Position	X Start/ Finish	Y Start/ Finish	Z Start/ Finish	Load Cat
	[illegible]	1	GI	0.000%	100.000%	0.576 0.576	0.000 0.000	0.000 0.000	0
	11	1	GI	0.000%	100.000%	0.576 0.576	0.000 0.000	0.000 0.000	0
	12	1	GI	0.000%	100.000%	0.576 0.576	0.000 0.000	0.000 0.000	0
	13	1	GI	0.000%	100.000%	0.662 0.662	0.000 0.000	0.000 0.000	0
	14	1	GI	0.000%	100.000%	0.390 0.390	0.000 0.000	0.000 0.000	0
	15	1	GI	0.000%	100.000%	0.390 0.390	0.000 0.000	0.000 0.000	0
	16	1	GI	0.000%	100.000%	0.390 0.390	0.000 0.000	0.000 0.000	0
	23	1	GI	0.000%	100.000%	0.662 0.662	0.000 0.000	0.000 0.000	0
	24	1	GI	0.000%	100.000%	0.390 0.390	0.000 0.000	0.000 0.000	0
	25	1	GI	0.000%	100.000%	0.662 0.662	0.000 0.000	0.000 0.000	0
	26	1	GI	0.000%	100.000%	0.662 0.662	0.000 0.000	0.000 0.000	0
5	1	1	GI	0.000%	100.000%	0.000 0.000	0.000 0.000	0.662 0.662	0
	2	1	GI	0.000%	100.000%	0.000 0.000	0.000 0.000	0.390 0.390	0
	3	1	GI	0.000%	100.000%	0.000 0.000	0.000 0.000	0.390 0.390	0
	4	1	GI	0.000%	100.000%	0.000 0.000	0.000 0.000	0.390 0.390	0
	5	1	GI	0.000%	100.000%	0.000 0.000	0.000 0.000	0.662 0.662	0
	6	1	GI	0.000%	100.000%	0.000 0.000	0.000 0.000	0.390 0.390	0
	7	1	GI	0.000%	100.000%	0.000 0.000	0.000 0.000	0.576 0.576	0
	8	1	GI	0.000%	100.000%	0.000 0.000	0.000 0.000	0.576 0.576	0
	11	1	GI	0.000%	100.000%	0.000 0.000	0.000 0.000	0.576 0.576	0
	12	1	GI	0.000%	100.000%	0.000 0.000	0.000 0.000	0.576 0.576	0
	13	1	GI	0.000%	100.000%	0.000 0.000	0.000 0.000	0.662 0.662	0
	14	1	GI	0.000%	100.000%	0.000 0.000	0.000 0.000	0.390 0.390	0
	15	1	GI	0.000%	100.000%	0.000 0.000	0.000 0.000	0.390 0.390	0

A11

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Sect No.								
13	1	GI	[illegible]	100.000	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1	GI	[illegible]	100.000	[illegible]	[illegible]	[illegible]	[illegible]
21	1	GI	[illegible]	100.000	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1	GI	[illegible]	100.000	[illegible]	[illegible]	[illegible]	[illegible]
26	1	GI	[illegible]	100.000	[illegible]	[illegible]	[illegible]	[illegible]

SELF WEIGHT (g's)

Load Case	X-Axis Accel'n	Y-Axis Accel'n	Z-Axis Accel'n	Load Cat
1	0.000	-1.000	0.000	0

COMBINATION LOAD CASES

Load case 11: Wind X

1.400 * Load case 1: SW
1.400 * Load case 2: Antenna Wind X
1.400 * Load case 4: Pole Wind X

Load case 12: Wind Z

1.400 * Load case 1: SW
1.400 * Load case 3: Antenna Wind Z
1.400 * Load case 5: Pole Wind Z

Load case 21: Wind X Footing

0.714 * Load case 11: Wind X

Load case 22: Wind Z Footing

0.714 * Load case 12: Wind Z

LOAD CASE TITLES

Load Case	Title
1	SW
2	Antenna Wind X
3	Antenna Wind Z
4	Pole Wind X
5	Pole Wind Z
11	Wind X
12	Wind Z
21	Wind X Footing
22	Wind Z Footing

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NODE DISPLACEMENTS (mm, rad)

Load case 1 (Linear): SW
Paradise solver

Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n	X-Axis Rotation	Y-Axis Rotation	Z-Axis Rotation
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	0.000	[illegible]	[illegible]	[illegible]
14	0.000	[illegible]	0.000	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27	[illegible]	-0.036	[illegible]	[illegible]	[illegible]	[illegible]

Load case 2 (Linear): Antenna Wind X
Paradise solver

Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n	X-Axis Rotation	Y-Axis Rotation	Z-Axis Rotation
1	0.000	0.000	0.000	0.000	0.000	0.000
2	[illegible]	-0.264	-0.000	-0.000	0.000	-0.016
3	[illegible]	-0.264	-0.000	-0.000	0.000	-0.016
4	[illegible]	-0.262	-0.000	-0.000	0.000	-0.015
5	[illegible]	[illegible]	-0.000	-0.000	0.000	-0.012
6	[illegible]	-0.218	-0.000	-0.000	0.000	-0.002
7	0.000	0.000	0.000	0.000	0.000	0.000
9	[illegible]	[illegible]	0.000	0.000	0.000	-0.000
10	52.353	-0.063	-0.000	-0.000	-0.000	-0.001
11	[illegible]	0.192	0.000	0.000	0.000	-0.002
13	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000
15	65.004	-0.251	-0.000	-0.000	0.000	-0.007
16	72.760	[illegible]	0.000	0.000	0.000	-0.012
17	[illegible]	[illegible]	0.000	0.000	0.000	-0.015
18	[illegible]	[illegible]	0.000	0.000	0.000	-0.016
21	52.365	-0.004	0.000	-0.000	0.000	0.000
26	61.354	[illegible]	0.000	0.000	0.000	-0.007
27	91.353	0.177	0.000	0.000	0.000	-0.016

Load case 3 (Linear): Antenna Wind Z
Paradise solver

Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n	X-Axis Rotation	Y-Axis Rotation	Z-Axis Rotation
1	0.000	0.000	0.000	0.000	0.000	0.000
2	0.159	-0.043	61.142	0.017	-0.001	-0.000
3	0.102	-0.043	55.066	0.017	-0.001	-0.000
4	0.066	-0.041	43.050	0.017	-0.001	-0.000
5	0.071	-0.037	31.990	0.014	-0.001	-0.000
6	0.000	-0.024	6.827	0.004	-0.001	-0.000
7	0.000	0.000	0.000	0.000	0.000	0.000
9	-0.000	0.027	6.226	-0.004	0.000	0.000
10	0.000	-0.033	6.283	-0.003	0.000	-0.000
11	-0.000	-0.024	6.827	0.004	0.001	0.000
13	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000
15	0.055	-0.031	23.079	0.009	-0.001	-0.000
16	-0.071	-0.037	31.990	0.014	0.001	-0.000

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Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n	X-Axis Rotation	Y-Axis Rotation	Z-Axis Rotation
17	-0.066	-0.041	43.050	0.017	0.001	0.000
18	-0.102	-0.043	55.066	0.017	0.001	0.000
21	-0.000	-0.004	6.290	0.000	0.000	0.000
26	-0.055	-0.031	23.079	0.009	0.001	0.000
27	-0.109	-0.043	61.142	0.017	0.001	0.000

Load case 4 (Linear): Pole Wind X
Paradise solver

Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n	X-Axis Rotation	Y-Axis Rotation	Z-Axis Rotation
1	0.000	0.000	0.000	0.000	0.000	0.000
2	151.759	-0.297	-0.000	-0.000	0.000	-0.006
3	149.596	-0.297	-0.000	-0.000	0.000	-0.006
4	145.308	-0.297	-0.000	-0.000	0.000	-0.006
5	141.239	-0.297	-0.000	-0.000	0.000	-0.006
6	128.550	-0.297	-0.000	-0.000	0.000	-0.003
7	0.000	0.000	0.000	0.000	0.000	0.000
9	128.535	-0.000	0.000	0.000	0.000	-0.001
10	128.535	-0.000	-0.000	-0.000	-0.000	-0.001
11	128.550	0.297	0.000	0.000	0.000	-0.003
13	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000
15	137.541	-0.297	-0.000	-0.000	0.000	-0.004
16	141.239	0.297	0.000	0.000	0.000	-0.006
17	145.308	0.297	0.000	0.000	0.000	-0.006
18	149.596	0.297	0.000	0.000	0.000	-0.006
21	128.550	-0.000	0.000	-0.000	0.000	0.000
26	137.541	0.297	0.000	0.000	0.000	-0.004
27	151.759	0.297	0.000	0.000	0.000	-0.006

Load case 5 (Linear): Pole Wind Z
Paradise solver

Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n	X-Axis Rotation	Y-Axis Rotation	Z-Axis Rotation
1	0.000	0.000	0.000	0.000	0.000	0.000
2	-0.000	-0.000	25.921	0.002	-0.001	0.000
3	-0.000	-0.000	25.395	0.002	-0.001	0.000
4	-0.000	-0.000	24.379	0.001	-0.001	0.000
5	-0.000	-0.000	23.583	0.001	-0.001	0.000
6	-0.000	-0.000	26.089	-0.002	-0.001	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000
9	-0.000	-1.570	25.575	-0.006	0.000	0.000
10	0.000	1.570	25.575	-0.006	0.000	-0.000
11	0.000	-0.000	26.089	-0.002	0.001	-0.000
13	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000
15	-0.000	-0.000	23.392	-0.000	-0.001	0.000
16	0.000	-0.000	23.583	0.001	0.001	-0.000
17	0.000	-0.000	24.379	0.001	0.001	-0.000
18	0.000	-0.000	25.395	0.002	0.001	-0.000
21	0.000	-0.000	25.577	-0.006	0.000	-0.000
26	0.000	-0.000	23.392	-0.000	0.001	-0.000
27	0.000	-0.000	25.921	0.002	0.001	-0.000

Load case 11 (Linear): Wind X
Paradise solver

Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n	X-Axis Rotation	Y-Axis Rotation	Z-Axis Rotation
1	0.000	0.000	0.000	0.000	0.000	0.000
2	351.336	-0.836	-0.000	-0.000	0.000	-0.031
3	341.056	-0.836	-0.000	-0.000	0.000	-0.031
4	319.618	-0.833	-0.000	-0.000	0.000	-0.030
5	299.327	-0.827	-0.000	-0.000	0.000	-0.026
6	253.283	-0.805	-0.000	-0.000	0.000	-0.007
7	0.000	0.000	0.000	0.000	0.000	0.000
9	253.243	-0.043	0.000	-0.000	0.000	-0.002

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Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n	X-Axis Rotation	Y-Axis Rotation	Z-Axis Rotation
10	253.243	-0.043	-0.000	0.000	-0.000	-0.002
11	253.283	0.645	0.000	0.000	0.000	-0.007
13	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000
15	283.564	-0.817	-0.000	-0.000	0.000	-0.016
16	299.585	0.623	0.000	0.000	0.000	-0.026
17	319.524	0.617	0.000	0.000	0.000	-0.030
18	340.709	0.614	0.000	0.000	0.000	-0.031
21	253.252	-0.041	0.000	-0.000	0.000	0.001
26	283.477	0.633	0.000	0.000	0.000	-0.016
27	351.524	0.614	0.000	0.000	0.000	-0.031

Load case 12 (Linear): Wind Z
Paradise solver

Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n	X-Axis Rotation	Y-Axis Rotation	Z-Axis Rotation
1	0.000	0.000	0.000	0.000	0.000	0.000
2	0.186	-0.111	121.699	0.026	-0.002	-0.000
3	0.173	-0.111	112.645	0.026	-0.002	-0.000
4	0.147	-0.108	94.400	0.025	-0.002	-0.000
5	0.121	-0.102	77.302	0.021	-0.002	-0.000
6	0.000	-0.090	46.083	0.002	-0.002	-0.000
7	0.000	0.000	0.000	0.000	0.000	0.000
9	-0.000	-2.139	44.609	-0.009	0.000	0.000
10	0.000	2.113	44.609	-0.009	0.000	-0.000
11	-0.000	-0.090	46.083	0.002	0.002	0.000
13	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000
15	0.093	-0.092	65.060	0.011	-0.002	-0.000
16	-0.121	-0.102	77.302	0.021	0.002	0.000
17	-0.147	-0.108	94.400	0.025	0.002	0.000
18	-0.173	-0.111	112.645	0.026	0.002	0.000
21	-0.000	-0.011	44.614	-0.009	0.000	0.000
26	-0.093	-0.092	65.060	0.011	0.002	0.000
27	-0.186	-0.111	121.699	0.026	0.002	0.000

Load case 21 (Linear): Wind X Footing
Paradise solver

Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n	X-Axis Rotation	Y-Axis Rotation	Z-Axis Rotation
1	0.000	0.000	0.000	0.000	0.000	0.000
2	251.360	-0.597	-0.000	-0.000	0.000	-0.022
3	243.616	-0.597	-0.000	-0.000	0.000	-0.022
4	228.303	-0.595	-0.000	-0.000	0.000	-0.021
5	214.166	-0.591	-0.000	-0.000	0.000	-0.019
6	180.920	-0.575	-0.000	-0.000	0.000	-0.005
7	0.000	0.000	0.000	0.000	0.000	0.000
9	180.892	-0.030	0.000	-0.000	0.000	-0.002
10	180.892	-0.030	-0.000	0.000	-0.000	-0.002
11	180.920	0.461	0.000	0.000	0.000	-0.005
13	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000
15	202.621	-0.584	-0.000	-0.000	0.000	-0.011
16	213.993	0.445	0.000	0.000	0.000	-0.018
17	228.093	0.441	0.000	0.000	0.000	-0.021
18	243.363	0.439	0.000	0.000	0.000	-0.022
21	180.910	-0.029	0.000	-0.000	0.000	0.001
26	202.483	0.452	0.000	0.000	0.000	-0.011
27	251.093	0.439	0.000	0.000	0.000	-0.022

Load case 22 (Linear): Wind Z Footing
Paradise solver

Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n	X-Axis Rotation	Y-Axis Rotation	Z-Axis Rotation
1	0.000	0.000	0.000	0.000	0.000	0.000
2	0.133	-0.079	87.065	0.019	-0.001	-0.000

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Node	X-Axis Translation	Y-Axis Translation	Z-Axis Translation	X-Axis Rotation	Y-Axis Rotation	Z-Axis Rotation
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	-0.036	33.172	[illegible]	[illegible]	[illegible]
16	[illegible]	-0.073	35.774	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26	[illegible]	-0.036	[illegible]	[illegible]	[illegible]	[illegible]
27	[illegible]	-0.073	[illegible]	[illegible]	[illegible]	[illegible]

MEMBER FORCES AND MOMENTS (SUMMARY)

Load case 1 (Linear): DL
Paradise solver

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	[illegible]	-0.001	-0.000	-0.000	[illegible]	[illegible]
	6	[illegible]	-0.001	-0.000	-0.000	-0.000	-0.002
2	5	0.232	0.000	[illegible]	-0.000	[illegible]	-0.000
	4	0.139	0.000	[illegible]	-0.000	[illegible]	-0.000
3	4	0.139	0.000	[illegible]	-0.000	[illegible]	-0.000
	3	0.048	0.000	[illegible]	-0.000	[illegible]	-0.000
4	3	0.048	0.000	[illegible]	[illegible]	[illegible]	-0.000
	2	-0.000	0.000	[illegible]	[illegible]	[illegible]	-0.000
5	7	[illegible]	0.001	-0.000	[illegible]	-0.000	-0.005
	11	[illegible]	-0.001	-0.000	[illegible]	-0.000	-0.002
6	16	0.232	[illegible]	-0.000	-0.000	-0.000	0.000
	17	0.139	[illegible]	-0.000	-0.000	-0.000	0.000
7	21	0.170	-0.416	-0.000	-0.000	-0.000	-0.032
	9	0.170	-0.476	-0.000	-0.000	-0.000	-0.193
8	21	0.170	-0.416	-0.000	-0.000	-0.000	-0.032
	10	0.170	-0.476	-0.000	-0.000	-0.000	-0.193
11	9	0.451	0.121	-0.000	-0.000	0.000	-0.193
	13	2.362	-0.121	-0.000	-0.000	-0.000	-0.214
12	10	0.451	0.121	0.000	0.000	-0.000	-0.193
	14	2.362	-0.121	0.000	0.000	-0.000	-0.214
13	6	1.441	0.000	0.000	-0.000	-0.000	-0.000
	15	0.331	0.000	0.000	-0.000	-0.000	-0.000
14	15	0.331	0.000	0.000	-0.000	-0.000	-0.000
	5	0.232	0.000	0.000	-0.000	-0.000	-0.000
15	17	0.139	-0.000	0.000	0.000	-0.000	0.000
	18	0.048	-0.000	0.000	0.000	-0.000	0.000
16	18	0.048	0.000	0.000	0.000	-0.000	0.000
	27	-0.000	0.000	0.000	0.000	0.000	-0.000
23	11	1.441	-0.000	0.000	0.000	-0.000	0.000
	26	0.331	-0.000	0.000	0.000	-0.000	0.000

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Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
24	26	0.331	-0.000	[illegible]	[illegible]	[illegible]	[illegible]
	16	0.232	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	21	-0.001	0.417	-0.000	[illegible]	[illegible]	-0.032
	11	-0.001	-0.141	-0.000	[illegible]	[illegible]	[illegible]
26	6	[illegible]	0.141	[illegible]	[illegible]	[illegible]	[illegible]
	21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-0.167

Load case 2 (Linear): Antenna Wind X
Paradise solver

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	25.763	1.441	-0.000	-0.000	-0.000	-15.246
	6	25.763	1.441	-0.000	-0.000	0.000	11.150
2	5	2.000	2.456	0.000	-0.000	-0.000	-2.579
	4	2.000	2.456	0.000	-0.000	-0.000	-0.860
3	4	1.000	1.228	0.000	0.000	-0.000	-0.860
	3	1.000	1.228	0.000	0.000	-0.000	-0.000
4	3	0.000	0.000	-0.000	0.000	-0.000	-0.000
	2	0.000	0.000	-0.000	0.000	0.000	-0.000
5	7	-25.573	2.456	-0.000	-0.000	0.000	-15.2[illegible]
	11	-25.573	2.456	-0.000	-0.000	-0.000	11.24[illegible]
6	16	2.000	2.456	-0.000	-0.000	0.000	-2.579
	17	2.000	2.456	-0.000	-0.000	-0.000	-0.860
7	21	0.021	-0.205	1.237	-0.031	-0.311	0.049
	9	0.021	-0.205	1.237	-0.031	-0.001	-0.002
8	21	0.021	-0.205	-1.237	0.031	0.311	0.049
	10	0.021	-0.205	-1.237	0.031	0.001	-0.002
11	9	-0.266	0.000	1.237	-0.007	-5.110	-0.002
	13	-0.266	0.000	1.237	-0.007	5.321	0.001
12	10	0.266	0.000	-1.237	0.007	5.110	-0.002
	14	0.266	0.000	-1.237	0.007	-5.321	0.001
13	6	3.000	3.684	0.000	-0.000	-0.000	-14.552
	15	3.000	3.684	0.000	-0.000	-0.000	-5.342
14	15	3.000	3.684	0.000	-0.000	-0.000	-5.342
	5	3.000	3.684	0.000	-0.000	-0.000	-2.579
15	17	1.000	1.228	-0.000	-0.000	0.000	-0.860
	16	1.000	1.228	-0.000	-0.000	0.000	-0.000
16	18	0.000	-0.000	-0.000	0.000	0.000	-0.000
	27	0.000	-0.000	-0.000	0.000	-0.000	-0.000
23	11	3.000	3.684	-0.000	0.000	0.000	-14.552
	26	3.000	3.684	-0.000	0.000	0.000	-5.342
24	26	3.000	3.684	-0.000	-0.000	0.000	-5.342
	16	3.000	3.684	-0.000	-0.000	0.000	-2.579
25	21	1.231	25.673	-0.000	0.000	0.000	-5.294
	11	1.231	25.673	-0.000	0.000	0.000	25.797
26	6	-1.213	25.263	-0.000	0.000	-0.000	-25.712
	21	-1.213	25.263	-0.000	0.000	-0.000	5.367

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Load case 3 (Linear): Antenna Wind Z
Paradise solver

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	2.795	-0.006	0.642	0.246	-1.475	0.021
	6	2.795	-0.006	0.642	0.246	4.350	-0.043
2	5	2.000	0.000	-2.456	0.000	2.579	-0.000
	4	2.000	0.000	-2.456	0.000	0.860	-0.000
3	4	1.000	0.000	-1.228	0.000	0.860	-0.000
	3	1.000	0.000	-1.228	0.000	0.000	-0.000
4	3	0.000	0.000	-0.000	0.000	-0.000	-0.000
	2	0.000	0.000	-0.000	0.000	-0.000	-0.000
5	7	2.795	0.006	0.642	-0.246	-1.475	-0.021
	11	2.795	0.006	0.642	-0.246	4.350	0.043
6	16	2.000	-0.000	-2.456	-0.000	2.579	0.000
	17	2.000	-0.000	-2.456	-0.000	0.860	0.000
7	21	-4.306	41.452	-0.000	0.000	0.000	-9.553
	9	-4.306	41.452	-0.000	0.000	0.000	0.810
8	21	4.347	-41.862	-0.000	0.000	0.000	9.651
	10	4.347	-41.862	-0.000	0.000	0.000	-0.814
11	9	-41.675	-0.160	-0.000	-0.000	0.000	0.810
	13	-41.675	-0.160	-0.000	-0.000	-0.000	-0.795
12	10	42.037	0.160	-0.000	-0.000	0.000	-0.814
	14	42.037	0.160	-0.000	-0.000	-0.000	0.797
13	6	3.000	0.000	-3.684	0.000	14.552	-0.000
	15	3.000	0.000	-3.684	0.000	5.342	-0.000
14	15	3.000	0.000	-3.684	0.000	5.342	-0.000
	5	3.000	0.000	-3.684	0.000	2.579	-0.000
15	17	1.000	-0.000	-1.228	-0.000	0.860	0.000
	18	1.000	-0.000	-1.228	-0.000	0.000	0.000
16	18	0.000	0.000	0.000	0.000	-0.000	0.000
	27	0.000	0.000	0.000	0.000	0.000	-0.000
23	11	3.000	-0.000	-3.684	0.000	14.552	0.000
	26	3.000	-0.000	-3.684	0.000	5.342	0.000
24	26	3.000	-0.000	-3.684	-0.000	5.342	0.000
	16	3.000	-0.000	-3.684	-0.000	2.579	0.000
25	21	-0.006	0.265	4.326	9.602	-5.162	-0.213
	11	-0.006	0.265	4.326	9.602	0.246	0.043
26	6	-0.006	-0.265	-4.326	-9.602	0.246	0.043
	21	-0.006	-0.265	-4.326	-9.602	-5.162	-0.213

Load case 4 (Linear): Pole Wind X
Paradise solver

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	34.314	10.076	0.000	-0.000	-0.000	-40.615
	6	34.314	3.436	0.000	-0.000	0.000	27.041
2	5	0.000	0.683	0.000	-0.000	-0.000	-0.597
	4	0.000	0.409	0.000	-0.000	-0.000	-0.215
3	4	0.000	0.409	0.000	-0.000	-0.000	-0.215
	3	0.000	0.137	0.000	-0.000	-0.000	-0.024

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Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
4	3	0.000	0.137	0.000	0.000	-0.000	-0.024
	2	0.000	0.000	0.000	0.000	-0.000	0.000
5	7	-34.314	10.076	-0.000	-0.000	0.000	-40.615
	11	-34.314	3.456	-0.000	-0.000	-0.000	27.041
6	16	-0.000	0.683	-0.000	-0.000	0.000	-0.597
	17	-0.000	0.409	-0.000	-0.000	0.000	-0.215
7	21	0.000	-0.000	0.002	-10.126	-1.031	0.000
	3	0.000	-0.000	0.146	-10.126	-1.012	-0.000
8	21	0.000	-0.000	-0.002	10.126	1.031	0.000
	10	0.000	-0.000	-0.146	10.126	1.012	-0.000
11	9	0.000	0.000	0.146	-0.000	-10.176	-0.000
	13	0.000	0.000	5.335	-0.000	20.378	0.000
12	10	0.000	0.000	-0.146	0.000	10.176	-0.000
	14	0.000	0.000	-5.335	0.000	-20.378	0.000
13	6	-0.000	2.630	0.000	-0.000	-0.000	-5.725
	15	-0.000	0.975	0.000	-0.000	-0.000	-1.219
14	15	-0.000	0.975	0.000	-0.000	-0.000	-1.219
	5	-0.000	0.683	0.000	-0.000	-0.000	-0.597
15	17	-0.000	0.409	-0.000	-0.000	0.000	-0.215
	18	-0.000	0.137	-0.000	-0.000	0.000	-0.024
16	18	0.000	0.137	-0.000	0.000	0.000	-0.024
	27	0.000	0.000	-0.000	0.000	-0.000	0.000
23	11	-0.000	2.630	-0.000	0.000	0.000	-5.725
	26	-0.000	0.975	-0.000	0.000	0.000	-1.219
24	26	0.000	0.975	-0.000	-0.000	0.000	-1.219
	16	0.000	0.683	-0.000	-0.000	0.000	-0.597
25	21	0.002	34.314	-0.000	0.000	0.000	-10.126
	11	-0.826	34.314	-0.000	0.000	0.000	32.766
26	6	0.826	34.314	-0.000	0.000	-0.000	-32.766
	21	-0.002	34.314	-0.000	0.000	-0.000	10.126

Load case 5 (Linear): Pole Wind Z
Paradise solver

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	0.000	0.000	-5.445	0.232	15.178	-0.000
	6	0.000	0.000	1.175	0.232	-6.167	0.000
2	5	0.000	-0.000	-0.683	0.000	0.597	0.000
	4	0.000	-0.000	-0.409	0.000	0.215	0.000
3	4	0.000	0.000	-0.409	0.000	0.215	0.000
	3	0.000	0.000	-0.137	0.000	0.024	0.000
4	3	0.000	-0.000	-0.137	0.000	0.024	0.000
	2	0.000	-0.000	-0.000	0.000	-0.000	-0.000
5	7	0.000	-0.000	-5.445	-0.232	15.173	0.000
	11	0.000	-0.000	1.175	-0.232	-6.167	-0.000
6	16	0.000	0.000	-0.683	-0.000	0.597	-0.000
	17	0.000	0.000	-0.409	-0.000	0.215	-0.000
7	21	-4.633	62.341	-0.000	0.000	0.000	-11.892
	9	-4.777	62.341	-0.000	0.000	0.000	3.693

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Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	9	[illegible]	1.150	[illegible]	[illegible]	[illegible]	[illegible]
	13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	15	[illegible]	[illegible]	[illegible]	[illegible]	1.119	[illegible]
	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	21	[illegible]	-0.000	1.033	11.8[illegible]	[illegible]	0.000
	11	[illegible]	-0.000	1.365	11.8[illegible]	[illegible]	-0.000
26	6	0.000	0.000	-1.365	-11.8[illegible]	[illegible]	-0.000
	21	0.000	0.000	-1.033	-11.8[illegible]	[illegible]	0.000

Load case 11 (Linear): Wind 4
Paradise solver

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	93.041	17.521	0.000	-0.000	-0.000	-75.460
	6	89.[illegible]	8.155	0.000	-0.000	0.000	53.469
2	5	3.124	1.394	0.000	-0.000	-0.000	-4.116
	4	2.995	1.012	0.000	-0.000	-0.000	-1.504
3	4	1.535	2.295	0.000	-0.000	-0.000	-1.504
	3	1.465	1.940	0.000	-0.000	-0.000	-0.033
4	3	0.065	0.131	0.000	0.000	-0.000	-0.033
	2	0.000	-0.000	0.000	0.000	0.000	-0.000
5	7	-71.511	17.543	-0.000	-0.000	0.000	-75.473
	11	-77.546	8.175	-0.000	-0.000	-0.000	53.614
6	16	3.124	1.394	-0.000	-0.000	0.000	-4.416
	17	2.995	1.012	-0.000	-0.000	-0.000	-1.504
7	21	0.267	-0.867	1.734	-22.689	-2.711	-0.033
	9	0.267	-0.954	1.936	-22.689	-2.252	-0.273
8	21	0.267	-0.867	-1.734	22.689	2.710	-0.036
	10	0.267	-0.954	-1.936	22.689	2.252	-0.273
11	9	0.976	0.171	1.936	-0.010	-22.801	-0.273
	13	4.435	-0.175	10.840	-0.010	37.378	-0.203
12	10	0.976	0.171	-1.936	0.010	22.801	-0.273
	14	4.435	-0.175	-10.840	0.010	-37.378	-0.203
13	6	6.213	8.340	0.000	-0.000	-0.000	-24.348
	15	4.663	6.523	0.000	-0.000	-0.000	-9.185

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Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
14	15	4.663	6.523	0.000	-0.000	-0.000	-9.185
	5	4.524	6.113	0.000	-0.000	-0.000	-1.446
15	17	1.5[illegible]	2.[illegible]	-0.000	-0.000	[illegible]	-1.504
	18	1.465	1.940	-0.000	-0.000	[illegible]	-0.033
16	18	0.065	0.131	0.000	0.000	-0.000	-0.033
	27	0.000	-0.000	0.000	0.000	-0.000	-0.000
23	11	6.21[illegible]	8.3[illegible]	-0.000	0.000	[illegible]	-24.3[illegible]
	26	4.663	6.523	-0.000	0.000	[illegible]	-9.185
24	26	4.663	6.523	-0.000	-0.000	0.000	-9.185
	16	4.524	6.113	-0.000	-0.000	0.000	-4.446
25	21	1.723	51.[illegible]	-0.000	0.009	[illegible]	-23.155
	11	-0.565	53.[illegible]	-0.000	0.000	[illegible]	[illegible]
26	6	-0.517	53.[illegible]	-0.000	0.000	-0.000	-51.[illegible]
	21	-1.745	52.[illegible]	-0.000	0.000	-0.000	22.173

Load case 1[illegible] (Linear): Wind [illegible]
Paradise solver

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	11.347	-0.011	-0.713	0.669	13.18[illegible]	0.027
	6	6.12[illegible]	-0.011	2.545	0.669	-1.707	-0.073
2	5	3.121	0.000	-4.534	0.000	1.446	-0.000
	4	2.99[illegible]	0.000	-4.012	0.000	1.504	-0.000
3	4	1.5[illegible]	0.000	-2.2[illegible]	0.000	1.504	-0.065
	3	1.435	0.000	-1.915	0.000	0.033	-0.000
4	3	0.065	-0.000	-0.191	0.000	0.033	-0.000
	2	0.000	-0.000	-0.000	0.000	-0.000	-0.000
5	7	12.437	0.011	-6.723	-0.669	13.1[illegible]	-0.036
	11	6.12[illegible]	0.011	2.545	-0.669	-1.707	0.073
6	16	3.124	-0.000	-4.534	-0.000	4.446	0.000
	17	2.995	-0.000	-4.012	-0.000	1.504	0.000
7	21	-12.[illegible]	144.[illegible]	-0.000	0.000	0.000	-30.175
	9	-12.17[illegible]	141.96[illegible]	-0.000	0.000	0.000	6.[illegible]33
8	21	12.410	-146.4[illegible]4	-0.000	0.000	0.000	30.447
	10	13.01[illegible]	-146.551	-0.000	0.000	0.000	-6.550
11	9	-145.167	1.976	-0.000	-0.000	0.000	6.033
	13	-142.513	-6.434	-0.000	-0.000	-0.000	-16.404
12	10	147.118	-1.635	-0.000	-0.000	0.000	-6.550
	14	151.344	6.083	-0.000	-0.000	-0.000	15.765
13	6	6.218	0.000	-8.340	0.000	24.388	-0.000
	15	4.663	0.000	-6.523	0.000	9.185	-0.000
14	15	4.663	0.000	-6.523	0.000	9.185	-0.000
	5	4.524	0.000	-6.113	0.000	4.446	-0.000
15	17	1.535	-0.000	-2.299	-0.000	1.504	0.000
	18	1.465	-0.000	-1.910	-0.000	0.033	0.000
16	18	0.065	0.000	-0.191	0.000	0.033	0.000
	27	0.000	0.000	-0.000	0.000	0.000	0.000
23	11	6.216	-0.000	-8.340	0.000	24.388	0.000
	26	4.663	-0.000	-6.523	0.000	9.185	0.000

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Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
24	26	4.663	-0.000	-6.523	-0.000	9.185	0.000
	16	4.524	-0.000	-6.113	-0.000	4.446	0.000
25	21	-0.011	0.867	12.543	30.092	-14.236	-0.526
	11	-0.011	0.690	11.395	30.092	0.669	0.073
26	6	-0.011	-0.690	-11.335	-30.092	0.669	0.073
	21	-0.011	-0.867	-12.543	-30.092	-14.290	-0.526

Load case 21 (Linear): Wind X Footing
Paradise solver

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	63.602	12.516	0.000	-0.000	-0.000	-53.858
	6	64.160	5.895	0.000	-0.000	0.000	33.195
2	5	2.232	3.139	0.000	-0.000	-0.000	-3.176
	4	2.139	2.866	0.000	-0.000	-0.000	-1.075
3	4	1.139	1.633	0.000	-0.000	-0.000	-1.075
	3	1.046	1.365	0.000	-0.000	-0.000	-0.024
4	3	0.046	0.137	0.000	0.000	0.000	-0.024
	2	0.000	-0.000	0.000	0.000	-0.000	-0.000
5	7	-50.964	12.531	-0.000	-0.000	0.000	-53.910
	11	-55.406	5.911	-0.000	-0.000	-0.000	33.297
6	16	2.232	3.139	-0.000	-0.000	0.000	-3.176
	17	2.139	2.866	-0.000	-0.000	0.000	-1.075
7	21	0.191	-0.620	1.239	-16.207	-1.941	-0.033
	9	0.191	-0.681	1.383	-16.207	-1.614	-0.135
8	21	0.191	-0.620	-1.239	16.207	1.941	-0.033
	10	0.191	-0.681	-1.383	16.207	1.614	-0.135
11	9	0.637	0.122	1.383	-0.007	-16.227	-0.135
	13	3.163	-0.125	7.172	-0.007	26.633	-0.213
12	10	0.637	0.122	-1.383	0.007	16.267	-0.135
	14	3.165	-0.125	-7.172	0.007	-26.699	-0.213
13	6	4.412	6.314	0.000	-0.000	-0.000	-20.277
	15	3.331	4.659	0.000	-0.000	-0.000	-6.561
14	15	3.331	4.659	0.000	-0.000	-0.000	-6.561
	5	3.232	4.367	0.000	-0.000	-0.000	-3.176
15	17	1.139	1.633	-0.000	-0.000	0.000	-1.075
	18	1.046	1.365	-0.000	-0.000	0.000	-0.024
16	18	0.046	0.137	0.000	0.000	-0.000	-0.024
	27	-0.000	0.000	0.000	0.000	0.000	0.000
23	11	4.412	6.314	-0.000	0.000	0.000	-20.277
	26	3.331	4.659	-0.000	0.000	0.000	-6.561
24	26	3.331	4.659	-0.000	-0.000	0.000	-6.561
	16	3.232	4.367	-0.000	-0.000	0.000	-3.176
25	21	1.231	60.402	-0.000	0.000	0.000	-16.552
	11	0.404	59.347	-0.000	0.000	0.000	58.374
26	6	-0.113	59.713	-0.000	0.000	-0.000	-59.170
	21	-1.247	59.165	-0.000	0.000	-0.000	15.331

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Load case 22 (Linear): Wind Z Footing
Paradise solver

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	3.813	-0.003	-4.502	0.478	13.743	0.026
	6	4.377	-0.003	1.318	0.478	-1.210	-0.052
2	5	2.232	0.000	-3.133	0.000	3.176	-0.000
	4	2.139	0.000	-2.866	0.000	1.075	-0.000
3	4	1.139	-0.000	-1.638	0.000	1.075	-0.000
	3	1.046	-0.000	-1.365	0.000	0.024	-0.000
4	3	0.046	0.000	-0.137	0.000	0.024	-0.000
	2	0.000	0.000	-0.000	0.000	0.000	0.000
5	7	3.319	0.003	-4.802	-0.178	13.703	-0.026
	11	4.377	0.003	1.318	-0.178	-1.213	0.052
6	16	2.232	-0.000	-3.139	-0.000	3.176	0.000
	17	2.139	-0.000	-2.866	-0.000	1.075	0.000
7	21	-8.769	103.390	-0.000	0.000	0.000	-21.528
	9	-8.713	103.318	-0.000	0.000	0.000	4.310
8	21	9.150	-104.619	-0.000	0.000	0.000	21.462
	10	9.294	-104.691	-0.000	0.000	0.000	-4.700
11	9	-103.602	1.412	-0.000	-0.000	0.000	4.310
	13	-101.797	-4.596	-0.000	-0.000	-0.000	-11.699
12	10	105.066	-1.168	-0.000	-0.000	0.000	-4.700
	14	108.134	4.345	-0.000	-0.000	-0.000	11.263
13	6	4.442	0.000	-6.314	0.000	20.277	-0.000
	15	3.331	0.000	-4.659	0.000	6.561	-0.000
14	15	3.331	0.000	-4.659	0.000	6.561	-0.000
	5	3.232	0.000	-4.367	0.000	3.176	-0.000
15	17	1.139	-0.000	-1.638	-0.000	1.075	0.000
	18	1.046	-0.000	-1.365	-0.000	0.024	0.000
16	18	0.046	-0.000	-0.137	0.000	0.024	0.000
	27	-0.000	-0.000	0.000	0.000	0.000	0.000
23	11	4.442	-0.000	-6.314	0.000	20.277	0.000
	26	3.331	-0.000	-4.659	0.000	6.561	0.000
24	26	3.331	-0.000	-4.659	-0.000	6.561	0.000
	16	3.232	-0.000	-4.367	-0.000	3.176	0.000
25	21	-0.008	0.620	3.960	21.495	-10.205	-0.375
	11	-0.008	0.064	3.132	21.495	0.478	0.352
26	6	-0.068	-0.064	-3.132	-21.495	0.478	0.352
	21	-0.068	-0.620	-3.960	-21.495	-10.205	-0.375

NODE REACTIONS (kN,kNm)

Load case 1 (Linear): GW
Paradise solver

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
1	0.001	6.024	-0.000	-0.000	-0.000	-0.005
7	-0.001	6.024	-0.000	-0.000	0.000	0.005
13	0.000	2.960	0.170	-0.214	0.000	-0.000
14	0.000	2.960	-0.170	0.214	-0.000	-0.000
Sum	0.000	17.968	0.000	0.000	0.000	-0.000

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Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
Load	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Reac	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Equil	[illegible]	[illegible]	[illegible]			
Resid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
YCntr	[illegible]	[illegible]	[illegible]			

Load case 2 (Linear): Antenna Wind X
Paradise solver

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	0.001	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	-0.001	[illegible]	[illegible]
Sum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Load	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Reac	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Equil	[illegible]	[illegible]	[illegible]			
Resid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
YCntr	[illegible]	[illegible]	[illegible]			
ZCntr	[illegible]	[illegible]	[illegible]			

Load case 3 (Linear): Antenna Wind Z
Paradise solver

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Load	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Reac	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Equil	[illegible]	[illegible]	[illegible]			
Resid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
YCntr	[illegible]	[illegible]	[illegible]			
ZCntr	[illegible]	[illegible]	[illegible]			

Load case 4 (Linear): Pole Wind X
Paradise solver

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	0.000	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	-0.000	[illegible]	[illegible]	[illegible]
Sum	[illegible]	[illegible]	0.000	[illegible]	[illegible]	[illegible]
Load	[illegible]	[illegible]	0.000	[illegible]	[illegible]	[illegible]
Reac	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Equil	[illegible]	[illegible]	[illegible]			
Resid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
XCntr	[illegible]	0.000	[illegible]			

Load case [illegible] (Linear): Pole Wind Z
Paradise solver

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Load	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Reac	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Equil	[illegible]	[illegible]	[illegible]			
Resid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ZCntr	-1.250	[illegible]	[illegible]			

Load case 11 (Linear): Wind X
Paradise solver

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Load	50.144	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Reac	-50.144	33.555	[illegible]	[illegible]	[illegible]	[illegible]
Equil	[illegible]	[illegible]	[illegible]			
Resid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
YCntr	[illegible]	[illegible]	[illegible]			
ZCntr	[illegible]	[illegible]	[illegible]			

Load case 12 (Linear): Wind Z
Paradise solver

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
1	[illegible]	11.317	[illegible]	-19.131	[illegible]	[illegible]
7	[illegible]	11.317	[illegible]	-19.131	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sum	[illegible]	33.555	-55.144	[illegible]	[illegible]	[illegible]
Load	0.000	-33.555	55.144	0.000	0.000	0.000
Reac	0.000	33.555	-55.144	[illegible]	-0.000	-0.000
Equil	1.431E-16	0.000E+00	0.000E+00			
Resid	2.387E-15	1.044E-13	1.111E-11	5.340E-15	6.217E-14	5.413E-16
YCntr	-1.250	0.000	[illegible]			
ZCntr	-1.250	0.000	[illegible]			

Load case 21 (Linear): Wind X Footing
Paradise solver

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
1	-12.615	[illegible]	0.000	0.000	-0.000	[illegible]
7	[illegible]	[illegible]	-0.000	-0.000	-0.000	[illegible]
13	[illegible]	3.165	0.191	-0.213	-2.684	26.566
14	[illegible]	3.165	-0.191	0.213	2.684	26.586
Sum	-39.339	23.368	0.000	0.000	0.000	[illegible]

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
Load	39.389	-23.368	0.000	0.000	0.000	0.000
Reac	-39.389	23.368	-0.000	-0.000	-0.000	160.900
Equil	0.000E+00	0.000E+00	-2.776E-17			
Resid	5.368E-11	1.245E-13	1.406E-17	8.639E-16	9.619E-12	1.529E-12
XCntr	-1.250	0.000	0.000			
YCntr	4.986	0.000	0.000			

Load case 22 (Linear): Wind Z Footing
Paradise solver

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
1	0.003	8.819	-4.802	-13.703	0.476	-0.026
7	-0.003	8.819	-4.802	-13.703	-0.476	0.026
13	0.000	-100.835	-14.762	-11.689	-0.000	-0.000
14	-0.000	107.165	-15.083	-11.263	-0.000	0.000
Sum	0.000	23.368	-39.389	-50.358	-0.000	-0.000
Load	0.000	-23.369	39.399	0.000	0.000	0.000
Reac	0.000	23.369	-39.389	-50.358	-0.000	-0.000
Equil	3.220E-16	0.000E+00	0.000E+00			
Resid	4.163E-15	4.263E-13	3.475E-11	7.499E-15	1.599E-13	1.580E-16
YCntr	-1.250	0.000	10.049			
ZCntr	-1.250	0.900	5.012			

BUCKLING LOAD FACTORS

Load Case	Mode	Load Factor	Tolerance	Iterations	Node at Max Trans	Node at Max Rotn
1	1	71.262	0.007812	21	2 (X)	2 (Z)
2	1	49.948	0.007812	13	2 (Z)	3 (X)
3	1	87.910	0.007812	21	27 (Z)	27 (X)
4	1	>1000.0				
5	1	>1000.0				
11	1	14.659	0.007812	15	2 (Z)	2 (X)
12	1	47.051	0.007812	19	27 (Z)	27 (X)
21	1	65.520	0.007812	21	2 (Z)	2 (X)
22	1	65.263	0.007812	21	27 (Z)	27 (X)

BUCKLING EFFECTIVE LENGTHS (kN,m)

Load case 1 (Linear): SW
Wavefront solver, Signcount ES, Linear AFD

Mode	Memb	Pcr	Length	Ly	Lz
1	1	429.279	10.000	10.592	10.592
	2	16.513	0.700	17.528	17.528
	3	9.903	0.700	22.628	22.628
	4	3.303	0.350	39.193	39.193
	5	429.279	10.000	10.592	10.592
	6	16.513	0.700	17.528	17.528
	7	12.024	0.250	41.397	41.397
	8	12.024	0.250	41.397	41.397
	11	211.081	10.050	9.909	9.909
	12	211.081	10.050	9.909	9.909
	13	102.723	2.500	21.653	21.653
	14	23.559	0.750	14.665	14.665
	15	9.903	0.700	22.628	22.628
	16	3.303	0.350	39.193	39.193
	23	102.723	2.500	21.653	21.653
	24	23.503	0.750	14.665	14.665
	25	-4.093	1.250	Not in compression	
	26	-4.093	1.250	Not in compression	

Load case 2 (Linear): Antenna Wind X
Wavefront solver, Signcount ES, Linear AFD

Mode	Memb	Pcr	Length	Ly	Lz
1	1	1298.454	10.000	6.090	6.090
	2	91.863	0.700	7.430	7.430
	3	45.941	0.700	10.506	10.504
	4	0.000	0.350	Not in compression	
	5	-1041.635	10.000	Not in compression	
	6	91.883	0.700	7.430	7.430
	7	0.357	0.250	147.157	147.157
	8	0.357	0.250	147.157	147.157
	11	3.463	10.050	46.799	46.799
	12	3.463	10.050	46.799	46.799
	13	137.324	2.500	18.694	18.694
	14	137.324	0.750	6.067	6.067
	15	45.941	0.700	10.505	10.508
	16	-0.000	0.350	Not in compression	
	23	137.024	2.500	18.694	18.694
	24	137.624	0.750	6.067	6.067
	25	58.534	1.250	29.103	29.103
	26	-57.122	1.250	Not in compression	

Load case 3 (Linear): Antenna Wind Z
Wavefront solver, Signcount ES, Linear AFD

Mode	Memb	Pcr	Length	Ly	Lz
1	1	245.715	10.000	14.001	14.001
	2	175.820	0.700	5.372	5.372
	3	87.910	0.700	7.596	7.596
	4	0.000	0.350	Not in compression	
	5	245.715	10.000	14.001	14.001
	6	175.820	0.700	5.372	5.372
	7	-374.510	0.250	Not in compression	
	8	382.173	0.250	7.364	7.364
	11	-3663.610	10.050	Not in compression	
	12	3639.834	10.050	5.025	5.025
	13	263.730	2.500	13.514	13.514
	14	263.730	0.750	4.386	4.386
	15	87.310	0.700	7.596	7.596
	16	0.000	0.350	Not in compression	
	23	263.730	2.500	13.514	13.514
	24	263.730	0.750	4.386	4.386
	25	-0.563	1.250	Not in compression	
	26	-0.563	1.250	Not in compression	

Load case 11 (Linear): Wind X
Wavefront solver, Signcount ES, Linear AFD

Mode	Memb	Pcr	Length	Ly	Lz
1	1	1350.202	10.000	5.973	5.973
	2	43.925	0.700	10.747	10.747
	3	22.419	0.700	15.043	15.043
	4	0.912	0.350	74.577	74.577
	5	-1063.043	10.000	Not in compression	
	6	43.925	0.700	10.747	10.747
	7	3.750	0.250	74.340	74.340
	8	3.750	0.250	74.340	74.340
	11	62.354	10.050	19.232	19.232
	12	62.354	10.050	19.232	19.232
	13	87.413	2.500	23.473	23.473
	14	65.561	0.750	8.796	8.796
	15	22.410	0.700	15.043	15.043
	16	0.912	0.350	74.577	74.577
	23	87.410	2.500	23.473	23.473
	24	65.561	0.750	8.796	8.796
	25	21.229	1.250	44.505	44.505
	26	-8.249	1.250	Not in compression	

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[illegible]
[illegible]

Mode	Memb	Pcr	Length	Ky	Kz
1	1	[illegible]	10.000	[illegible]	[illegible]
	2	[illegible]	0.700	[illegible]	[illegible]
	3	[illegible]	0.700	[illegible]	[illegible]
	4	[illegible]	0.350	[illegible]	[illegible]
	5	[illegible]	10.000	[illegible]	[illegible]
	6	[illegible]	0.700	[illegible]	[illegible]
	7	-77.216	0.250	Not in compression	
	8	[illegible]	0.250	[illegible]	[illegible]
	11	[illegible]	10.000	Not in compression	
	12	[illegible]	10.000	[illegible]	[illegible]
	13	[illegible]	2.500	[illegible]	[illegible]
	14	[illegible]	0.750	[illegible]	[illegible]
	15	[illegible]	0.700	[illegible]	[illegible]
	16	[illegible]	0.350	[illegible]	[illegible]
	23	[illegible]	2.500	[illegible]	[illegible]
	24	[illegible]	0.750	[illegible]	[illegible]
	25	[illegible]	1.250	Not in compression	
	26	[illegible]	1.250	Not in compression	

Load case 21 (Linear): Wind X F[illegible]
Wavefront solver, Signcount ES, Linear AFI

Mode	Memb	Pcr	Length	Ky	Kz
1	1	[illegible]	10.000	[illegible]	[illegible]
	2	146.224	[illegible]	[illegible]	[illegible]
	3	[illegible]	0.700	[illegible]	[illegible]
	4	[illegible]	0.350	[illegible]	[illegible]
	5	[illegible]	10.000	Not in compression	
	6	146.224	0.700	[illegible]	[illegible]
	7	[illegible]	0.250	40.745	[illegible]
	8	[illegible]	0.250	40.745	[illegible]
	11	237.573	10.000	[illegible]	[illegible]
	12	237.573	10.000	[illegible]	[illegible]
	13	241.810	2.500	[illegible]	[illegible]
	14	[illegible]	0.750	[illegible]	[illegible]
	15	71.630	0.700	[illegible]	[illegible]
	16	[illegible]	0.350	[illegible]	[illegible]
	23	241.810	2.500	[illegible]	[illegible]
	24	[illegible]	0.750	[illegible]	[illegible]
	25	[illegible]	1.250	[illegible]	[illegible]
	26	[illegible]	1.250	Not in compression	

Load case 22 (Linear): Wind Z F[illegible]
Wavefront solver, Signcount ES, Linear AFI

Mode	Memb	Pcr	Length	Ky	Kz
1	1	[illegible]	10.000	9.106	9.106
	2	146.991	0.700	5.375	5.375
	3	78.022	0.700	4.223	4.223
	4	3.052	0.350	40.767	40.767
	5	530.663	10.000	9.106	9.106
	6	146.991	0.700	5.375	5.375
	7	-532.553	0.250	Not in compression	
	8	612.144	0.250	5.319	5.319
	11	-6794.704	10.000	Not in compression	
	12	7142.428	10.000	5.025	5.025
	13	292.537	2.500	12.331	12.331
	14	219.397	0.750	4.309	4.309
	15	78.022	0.700	4.223	4.223
	16	3.052	0.350	40.767	40.767
	23	292.537	2.500	12.331	12.331
	24	219.397	0.750	4.309	4.309
	25	-0.513	1.250	Not in compression	
	26	-0.513	1.250	Not in compression	

[illegible]

Load case 1 (Linear): [illegible]
[illegible]

Mode	Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n
1	1	[illegible]	[illegible]	[illegible]
	2	[illegible]	[illegible]	[illegible]
	3	[illegible]	[illegible]	[illegible]
	4	[illegible]	[illegible]	[illegible]
	5	[illegible]	[illegible]	[illegible]
	6	[illegible]	[illegible]	[illegible]
	7	[illegible]	[illegible]	[illegible]
	9	[illegible]	[illegible]	[illegible]
	10	[illegible]	[illegible]	[illegible]
	11	[illegible]	[illegible]	[illegible]
	13	[illegible]	[illegible]	[illegible]
	14	[illegible]	[illegible]	[illegible]
	15	[illegible]	[illegible]	[illegible]
	16	[illegible]	[illegible]	[illegible]
	17	[illegible]	[illegible]	[illegible]
	18	[illegible]	[illegible]	[illegible]
	21	[illegible]	[illegible]	[illegible]
	26	[illegible]	[illegible]	[illegible]
	27	[illegible]	[illegible]	[illegible]

Load case 2 (Linear): Antenna Wind X
Wavefront solver, Signcount ES, Linear AFI

Mode	Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n
1	1	[illegible]	0.000	[illegible]
	2	[illegible]	[illegible]	1.000
	3	[illegible]	[illegible]	[illegible]
	4	[illegible]	[illegible]	[illegible]
	5	0.000	[illegible]	[illegible]
	6	0.000	[illegible]	[illegible]
	7	0.000	[illegible]	[illegible]
	9	[illegible]	0.013	[illegible]
	10	[illegible]	-0.013	[illegible]
	11	[illegible]	[illegible]	[illegible]
	13	[illegible]	0.000	[illegible]
	14	[illegible]	[illegible]	[illegible]
	15	[illegible]	[illegible]	[illegible]
	16	[illegible]	[illegible]	[illegible]
	17	[illegible]	[illegible]	[illegible]
	18	[illegible]	[illegible]	[illegible]
	21	[illegible]	[illegible]	[illegible]
	26	[illegible]	[illegible]	[illegible]
	27	[illegible]	[illegible]	0.127

Load case 3 (Linear): Antenna Wind Z
Wavefront solver, Signcount ES, Linear AFI

Mode	Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n
1	1	0.000	0.000	0.000
	2	[illegible]	-0.001	1.000
	3	[illegible]	-0.001	[illegible]
	4	-0.147	-0.001	[illegible]
	5	-0.101	-0.001	[illegible]
	6	[illegible]	-0.001	[illegible]
	7	0.000	0.000	0.000
	9	0.006	-0.004	0.066
	10	0.006	-0.027	[illegible]
	11	0.000	-0.001	[illegible]
	13	0.000	0.000	0.000
	14	0.000	0.000	0.006
	15	[illegible]	-0.001	0.339
	16	0.101	-0.001	[illegible]

Mode	Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n
	17	0.147	-0.001	[illegible]
	18	[illegible]	-0.001	0.332
	21	0.000	-0.015	0.066
	26	0.065	-0.001	0.339
	27	0.224	-0.001	1.000

Load case 11 (Linear): Wind X
Wavefront solver, Signcount ES, Linear AFI

Mode	Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n
1	1	0.000	0.000	0.000
	2	0.000	-0.000	1.000
	3	0.000	-0.000	[illegible]
	4	0.000	-0.000	0.726
	5	0.000	-0.000	[illegible]
	6	0.000	-0.000	-0.150
	7	0.000	0.000	0.000
	9	-0.006	0.017	-0.124
	10	0.006	-0.017	-0.124
	11	0.000	0.000	[illegible]
	13	0.000	0.000	0.000
	14	0.000	0.000	0.000
	15	0.000	-0.000	0.373
	16	0.000	0.000	[illegible]
	17	0.000	0.000	0.056
	18	0.000	0.000	[illegible]
	21	0.000	-0.000	-0.123
	26	0.000	0.000	-0.003
	27	0.000	0.000	[illegible]

Load case 12 (Linear): Wind Z
Wavefront solver, Signcount ES, Linear AFI

Mode	Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n
1	1	0.000	0.000	0.000
	2	[illegible]	-0.001	1.000
	3	[illegible]	-0.001	0.899
	4	[illegible]	-0.001	0.693
	5	[illegible]	-0.001	0.516
	6	0.000	-0.001	0.057
	7	0.000	0.000	0.000
	9	0.000	-0.003	0.054
	10	0.000	-0.030	0.054
	11	0.000	-0.001	0.057
	13	0.000	0.000	0.000
	14	0.000	0.000	0.000
	15	-0.063	-0.001	0.366
	16	0.034	-0.001	0.516
	17	0.131	-0.001	0.699
	18	0.172	-0.001	0.899
	21	0.000	-0.015	0.054
	26	0.063	-0.001	0.366
	27	0.193	-0.001	1.000

Load case 21 (Linear): Wind X Footing
Wavefront solver, Signcount ES, Linear AFI

Mode	Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n
1	1	0.000	0.000	0.000
	2	0.000	-0.000	1.000
	3	0.000	-0.000	[illegible]
	4	0.000	-0.000	[illegible]
	5	0.000	-0.000	[illegible]
	6	0.000	-0.000	-0.127
	7	0.000	0.000	0.000
	9	-0.010	0.010	[illegible]

Mode	Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n
	10	[illegible]	-0.010	[illegible]
	11	0.000	0.000	-0.025
	13	0.000	0.000	0.000
	14	0.000	0.000	0.000
	15	0.000	-0.000	[illegible]
	16	0.000	0.000	[illegible]
	17	0.000	0.000	[illegible]
	18	0.000	0.000	[illegible]
	21	0.000	-0.000	[illegible]
	26	0.000	0.000	0.047
	27	0.000	0.000	[illegible]

Load case 22 (Linear): Wind Z Footing
Wavefront solver, Signcount ES, Linear AFI

Mode	Node	X-Axis Transl'n	Y-Axis Transl'n	Z-Axis Transl'n
1	1	0.000	0.000	0.000
	2	-0.193	-0.001	1.000
	3	-0.172	-0.001	0.899
	4	-0.131	-0.001	0.699
	5	-0.094	-0.001	0.516
	6	0.000	-0.001	0.057
	7	0.000	0.000	0.000
	9	0.000	-0.003	0.054
	10	0.000	-0.030	0.054
	11	0.000	-0.001	0.057
	13	0.000	0.000	0.000
	14	0.000	0.000	0.000
	15	-0.063	-0.001	0.366
	16	0.034	-0.001	0.516
	17	0.131	-0.001	0.699
	18	0.172	-0.001	0.899
	21	0.000	-0.015	0.054
	26	0.063	-0.001	0.366
	27	0.193	-0.001	1.000

BILL OF MATERIALS (m,m^2,t)

Memb Item	Sect	Qty	Section Name	Unit Length	Total Length	Unit Mass	Total Mass
1	3	2	193.7x10.0 CHS	10.000	20.000	0.453	0.906
2	4	4	114.3x5.0 CHS	0.700	2.800	0.009	0.038
3	4	2	114.3x5.0 CHS	0.350	0.700	0.005	0.009
4	2	2	168.3x6.3 CHS	0.250	0.500	0.006	0.013
5	2	2	168.3x6.3 CHS	10.050	20.100	0.253	0.506
6	3	2	193.7x10.0 CHS	2.500	5.000	0.113	0.226
7	4	2	114.3x5.0 CHS	0.750	1.500	0.010	0.020
8	3	2	193.7x10.0 CHS	1.250	2.500	0.057	0.113
					53.100		1.832
	2		168.3x6.3 CHS		20.600		0.519
	3		193.7x10.0 CHS		27.500		1.246
	4		114.3x5.0 CHS		5.000		0.066
					53.100		1.832

Total mass = 1.832
Center of gravity = -1.250,6.438,0.000

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[illegible]

Mass Case	X Mass	Y Mass	Z Mass	Centre of Mass X	Y	Z
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STEEL MEMBER DESIGN DATA (m)

Restraint codes used:
F = Fixed restraint
P = Partial restraint
R = Fixed and rotational restraint
S = Partial and rotational restraint
L = Lateral restraint
U = Unrestrained
C = Continuous lateral restraint
I = Ignore segment

Group: 1
Member list: 1,2
Comp'n eff lengths: Major axis => Calculate, Minor axis => Calculate
(Unbraced) (Unbraced)
Bending eff lengths: +ve bending => Calculate, -ve bending => Calculate
Top flange restr posn's:
Bot flange restr posn's:
Top flange restr types: FF
Bot flange restr types: FF

Group: 5
Member list: 5,[illegible]
Comp'n eff lengths: Major axis => Calculate, Minor axis => Calculate
(Unbraced) (Unbraced)
Bending eff lengths: +ve bending => Calculate, -ve bending => Calculate
Top flange restr posn's:
Bot flange restr posn's:
Top flange restr types: FF
Bot flange restr types: FF

Group: 8
Member list: 6,7
Comp'n eff lengths: Major axis => Calculate, Minor axis => Calculate
(Unbraced) (Unbraced)
Bending eff lengths: +ve bending => Calculate, -ve bending => Calculate
Top flange restr posn's:
Bot flange restr posn's:
Top flange restr types: FF
Bot flange restr types: FF

Group: 11
Member list: 11
Comp'n eff lengths: Major axis => Calculate, Minor axis => Calculate
(Unbraced) (Unbraced)
Bending eff lengths: +ve bending => Calculate, -ve bending => Calculate
Top flange restr posn's:
Bot flange restr posn's:
Top flange restr types: FF
Bot flange restr types: FF

Group: 12
Member list: 12
Comp'n eff lengths: Major axis => Calculate, Minor axis => Calculate
(Unbraced) (Unbraced)
Bending eff lengths: +ve bending => Calculate, -ve bending => Calculate
Top flange restr posn's:
Bot flange restr posn's:
Top flange restr types: FF
Bot flange restr types: FF

Group: 14
Member list: 14,[illegible]
Comp'n eff lengths: Major axis => Calculate, Minor axis => Calculate
(Unbraced) (Unbraced)
Bending eff lengths: +ve bending => Calculate, -ve bending => Calculate
Top flange restr posn's:
Bot flange restr posn's:
Top flange restr types: FF
Bot flange restr types: FF

Group: 24
Member list: [illegible],15,[illegible]
Comp'n eff lengths: Major axis => Calculate, Minor axis => Calculate
(Unbraced) (Unbraced)
Bending eff lengths: +ve bending => Calculate, -ve bending => Calculate
Top flange restr posn's:
Bot flange restr posn's:
Top flange restr types: FF
Bot flange restr types: FF

Group: 26
Member list: 26,25
Comp'n eff lengths: Major axis => Calculate, Minor axis => Calculate
(Unbraced) (Unbraced)
Bending eff lengths: +ve bending => Calculate, -ve bending => Calculate
Top flange restr posn's:
Bot flange restr posn's:
Top flange restr types: FF
Bot flange restr types: FF

Group	Str Grade	Units	Load Height Posn	Stan Code	Angle Type	End Conn	Stp Eff	Design Crit	Holes in Cross Section	IS or NS Seismic Spec
1	Norm	Ratio	Centre	AS	Single	Con	Yes	Weight	None	N/A
5	Norm	Ratio	Centre	AS	Single	Con	Yes	Weight	None	N/A
8	Norm	Ratio	Centre	AS	Single	Con	Yes	Weight	None	N/A
11	Norm	Ratio	Centre	AS	Single	Con	Yes	Weight	None	N/A
12	Norm	Ratio	Centre	AS	Single	Con	Yes	Weight	None	N/A
14	Norm	Ratio	Centre	AS	Single	Con	Yes	Weight	None	N/A
24	Norm	Ratio	Centre	AS	Single	Con	Yes	Weight	None	N/A
26	Norm	Ratio	Centre	AS	Single	Con	Yes	Weight	None	N/A

HK CP2011 STEEL MEMBER DESIGN NOTES
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1. The sign convention used in this design report for cross section axes is shown below. Note that it is not the same as the sign convention used in the analysis.

   x = major geometric axis (or angle section short leg)
   y = minor geometric axis (or angle section long leg)
   u = major principal axis
   v = minor principal axis

2. Double angle sections are treated as solid Tee shapes.

3. Torsion moments are not considered.

4. Items that affect the end connection of members such as block shear, bearing, tearing, bolts, welds, stiffeners and the like are considered to be part of the connection design rather than the member design and, as such, are not considered here.

5. Cantilevers cannot be automatically detected. ALWAYS check that the bending effective lengths calculated by the program for cantilevered members are correct.

6. Initial frame imperfections are not automatically allowed for. When applicable, you should apply notional horizontal forces or initial deformations to the analysis model in accordance with the requirements of the design code.

7. A component that provides full, partial or lateral restraint to a member is not automatically checked to see if it is capable of resisting the force required to provide such restraint. To check this, the restraint forces should be added to the applied loads.

HK CP2011 STEEL MEMBER DESIGN SUMMARY (MPa,m) (*=Failure)
(#=Warning)

Group	Section Name	Yield Str	Total Length	Seg Length	Failure Mode	Crit Case	Load Factor
1#	193.7x10.0 CHS	275	12.500	12.500	Section	11	1.04#
5#	193.7x10.0 CHS	275	12.500	12.500	Section	11	1.05#
8#	168.3x6.3 CHS	275	0.500	0.500	Section	12	1.33#
11#	168.3x6.3 CHS	275	10.050	10.050	Section	11	1.00#
12#	168.3x6.3 CHS	275	10.050	10.050	Section	11	1.03#
14#	114.3x5.0 CHS	275	2.500	2.500	Section	11	1.59#
24#	114.3x5.0 CHS	275	2.500	2.500	Section	11	1.59#
26#	193.7x10.0 CHS	275	2.500	2.500	Section	11	1.62#

WEIGHTED AVERAGE LOAD FACTORS

Case	Mass	WALF
1	1.832	64.845
2	1.832	5.645
3	1.832	7.974
4	1.832	2.606
5	1.832	5.643
11	1.832	1.151
12	1.832	2.630
21	1.832	1.610
22	1.832	3.751

HK CP2011 CALCULATIONS FOR GROUP 1 (*=Failure)

Critical load case is 11, out of 1-22

Section: 193.7x10.0 CHS (Circular tube, Cold formed)
Class: Semi-compact

WARNING: Not all load cases were analysed non-linearly with P-Δ

Failure Mode	Crit Case	Start Pos'n	Finish Pos'n	Axial Force	Major Shear	Minor Shear	Major Moment	Minor Moment	Load Factor
Section	11	0.000		96.04	0.00	17.52	-75.40	0.00	1.04
Member	11	0.000	12.500	96.04			-75.40	0.00	1.46
Shear	11	0.000		96.04	0.00	17.52	-75.40	0.00	31.37 (1.00)

Load Case	Load Factor	Failure Mode
1	56.60	Member - Comp and biaxial bending (8.9.2 eq 8.79)
2	5.65	Section - Compression and bending (8.9.1 eq 8.78)
3	5.65	Section - Compression and bending (8.9.1 eq 8.78)
4	1.96	Section - Compression and bending (8.9.1 eq 8.78)
5	5.48	Section - Bending about minor axis (8.2.2.1)
11	1.04	Section - Compression and bending (8.9.1 eq 8.78)
12	2.30	Section - Compression and bending (8.9.1 eq 8.78)
21	1.45	Section - Compression and bending (8.9.1 eq 8.78)
22	4.06	Section - Compression and bending (8.9.1 eq 8.78)

```
PY      =   275.0 MPa
pyr     =   275.0 MPa              Us      =   430.0 MPa
Ltot    =  12.500 m                Lseg    =  12.500 m  (FF Bot-Bot)
Le      =  12.500 m  (Bending)
Lex     =   5.973 m  (Compression) Ley     =   5.973 m  (Compression)
Lex/rx  =    91.9    (Compression) Le/ry   =   192.2     (Bending)
Anf     =     0.0 mm^2             Anw     =     0.0 mm^2
Ag      =  5770.0 mm^2             Ae      =  5770.0 mm^2 (7.6/8.6)
Avx     =  3462.0 mm^2             Avy     =  3462.0 mm^2 (8.2.1)
Ceffx   =   96.85 mm               Ceffy   =   96.85 mm   (7.8)
Zeffx   =  251.94x10^3 mm^3        Zeffy   =  251.94x10^3 mm^3 (7.6)
Seffx   =  338.00x10^3 mm^3        Seffy   =  338.00x10^3 mm^3 (7.5)

γm1     =    1.00 (3.1.2)          γm2     =    1.20 (3.1.2)
mx      =    0.00 (8.9.2)          my      =    0.00 (8.9.2)
mLT     =    0.00 (8.3.5.2)        λLT     =    0.00 (8.3.5.3/A8.2)
u       =    0.00 (8.3.5.3/A8.2)   v       =    0.00 (8.3.5.3/A8.2)
βw      =    0.00 (8.3.5.3/A8.2)   λ       =    0.00 (8.3.5.3/A8.2)
λx      =    0.00 (8.7.4)          λy      =    0.00 (8.7.4)
qw      =    0.00 MPa (8.4.6)      pb      =    0.00 MPa (8.3.5.2/A8.1)
pcx     =    0.00 MPa (8.7.6/A8.4) pcy     =    0.00 MPa (8.7.6/A8.4)
Kef     =    1.20 (9.3.4.4)        Kew     =    1.20 (9.3.4.4)

F       =   96.04 kN (Semi-compact)
Fvx     =    0.00 kN               Fvy     =   17.52 kN
Mx      =  -75.40 kNm (Plastic)    My      =    0.00 kNm (Plastic)

Pt      =    0.00 kN  (8.6)        Vw      =    0.00 kN  (8.4.6)
Pcx     =    0.00 kN  (8.7.5)      Pcy     =    0.00 kN  (8.7.5)
Pcxbar  =    0.00 kN  (8.7.5)      Pcybar  =    0.00 kN  (8.7.5)
Vcx     =  549.67 kN  (8.2.1)      Vcy     =  549.67 kN  (8.2.1)
Mcx     =   93.14 kNm (8.2.2.1)    Mcy     =   93.14 kNm (8.2.2.1)
Mb      =    0.00 kNm (8.3.5.2)    Mp      =    0.00 kNm (8.4.4.2b)
```

Governing mode = Compression and bending (8.9.1 eq 8.78) (Pass)

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HK CP2011 CALCULATIONS FOR GROUP [illegible] (*=Failure)

Critical load case is 11, out of 1-22

Section: [illegible] CHS (Circular tube, Cold formed)
Class: Plastic

WARNING: Not all load cases were analysed non-linearly with P-Δ

Failure Mode	Crit Case	Start Pos'n	Finish Pos'n	Axial Force	Major Shear	Minor Shear	Major Moment	Minor Moment	Load Factor
Section	11	[illegible]		-71.47	0.00	17.54	-35.47	0.00	[illegible]
Member	11	[illegible]	[illegible]	[illegible]			-35.47	0.00	[illegible]
Shear	11	[illegible]		-71.47	0.00	17.54	-35.47	0.00	[illegible] (1.00)

Load Case	Load Factor	Failure Mode
1	[illegible]	Member - Comp and biaxial bending (8.9.2 eq 8.79)
2	[illegible]	Section - Compression and bending (8.9.1 eq 8.78)
3	[illegible]	Section - Compression and bending (8.9.1 eq 8.78)
4	[illegible]	Section - Tension and bending (8.8 eq 8.77)
5	[illegible]	Section - Bending about minor axis (8.2.2.1)
11	[illegible]	Section - Tension and bending (8.8 eq 8.77)
12	[illegible]	Section - Compression and bending (8.9.1 eq 8.78)
21	[illegible]	Section - Tension and bending (8.8 eq 8.77)
22	[illegible]	Section - Compression and bending (8.9.1 eq 8.78)

py = 275.0 MPa			
pyw = 275.0 MPa		Us = 430.0 MPa	
Ltot = 12.500 m		Lseg = 12.500 m (FF Bot-B t)	
Le = 12.500 m (Bending)			
Lex = 12.500 m (Compression)		Ley = 12.500 m (Compression)	
Lex/rx = [illegible] (Compression)		Le/ry = [illegible] (Bending)	
Arf = 0.0 mm^2		Arw = 0.0 mm^2	
Ag = 5770.0 mm^2		Ae = 5770.0 mm^2 (7.6/8.6)	
Avx = [illegible] mm^2		Avy = [illegible] mm^2 (8.2.1)	
Ceffx = 98.35 mm		Ceffy = 98.35 mm (7.9)	
Zeffx = 251.91x10^3 mm^3		Zeffy = 251.91x10^3 mm^3 (7.6)	
Seffx = 33[illegible]x10^3 mm^3		Seffy = 33[illegible]x10^3 mm^3 (7.5)	

ym1 = 1.00 (3.1.2)	ym2 = 1.20 (3.1.2)
mx = 0.00 (8.9.2)	my = 0.00 (8.9.2)
mLT = 0.00 (8.3.5.2)	ALT = 0.00 (8.3.5.3/A8.2)
u = 0.00 (8.3.5.3/A8.2)	v = 0.00 (8.3.5.3/A8.2)
βw = 0.00 (8.3.5.3/A8.2)	x = 0.00 (8.3.5.3/A8.2)
λx = 0.00 (8.7.4)	λy = 0.00 (8.7.4)
qw = 0.00 MPa (8.4.6)	pb = 0.00 MPa (8.3.5.2/A8.1)
pcx = 0.00 MPa (8.7.6/A8.4)	pcy = 0.00 MPa (8.7.6/A8.4)
Kef = 1.20 (9.3.4.4)	Kew = 1.20 (9.3.4.4)

F = -71.35 kN (Plastic)	
Fvx = 0.00 kN	Fvy = 17.54 kN
Mx = -35.47 kNm (Plastic)	My = 0.00 kNm (Plastic)

Pt = 1586.75 kN (8.6)	Vw = 0.00 kN (8.4.6)
Pcx = 0.00 kN (8.7.5)	Pcy = 0.00 kN (8.7.5)
Pcxbar = 0.00 kN (8.7.5)	Pcybar = 0.00 kN (8.7.5)
Vcx = 549.67 kN (8.2.1)	Vcy = 549.67 kN (8.2.1)
Mcx = 83.14 kNm (8.2.2.1)	Mcy = 83.14 kNm (8.2.2.1)
Mb = 0.00 kNm (8.3.5.2)	Mp = 0.00 kNm (8.4.4.2b)

Governing mode = Tension and bending (8.8 eq 8.77) (Pass)

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HK CP2011 CALCULATIONS FOR GROUP [illegible] (*=Failure)

Critical load case is 12, out of 1-22

Section: [illegible] CHS (Circular tube, Cold formed)
Class: Semi-compact

WARNING: Not all load cases were analysed non-linearly with P-Δ
WARNING: Minor compression effective length was reduced by flange restraints

Failure Mode	Crit Case	Start Pos'n	Finish Pos'n	Axial Force	Major Shear	Minor Shear	Major Moment	Minor Moment	Load Factor
Section	12	[illegible]		[illegible]	0.00	-116.48	[illegible]	0.00	[illegible]
Member	12	[illegible]	[illegible]	[illegible]			[illegible]	0.00	[illegible]
Shear	12	[illegible]		[illegible]	0.00	-116.55	[illegible]	0.00	[illegible] (1.00)

Load Case	Load Factor	Failure Mode
1	[illegible]	Section - Compression and bending (8.9.1 eq 8.78)
2	[illegible]	Member - Comp and biaxial bending (8.9.2 eq 8.79)
3	4.14	Section - Compression and bending (8.9.1 eq 8.78)
4	[illegible]	Member - Comp and biaxial bending (8.9.2 eq 8.79)
5	[illegible]	Section - Compression and bending (8.9.1 eq 8.78)
11	[illegible]	Member - Comp and biaxial bending (8.9.2 eq 8.79)
12	1.35	Section - Compression and bending (8.9.1 eq 8.78)
21	[illegible]	Member - Comp and biaxial bending (8.9.2 eq 8.79)
22	1.85	Section - Tension and bending (8.8 eq 8.77)

py = 275.0 MPa	
pyw = 275.0 MPa	Us = 430.0 MPa
Ltot = [illegible] m	Lseg = [illegible] m (FF Bot-Top)
Le = [illegible] m (Bending)	
Lex = [illegible] m (Compression)	Ley = [illegible] m (Compression)
Lex/rx = 45.7 (Compression)	Le/ry = [illegible] (Bending)
Arf = 0.0 mm^2	Arw = 0.0 mm^2
Ag = 3210.0 mm^2	Ae = 3210.0 mm^2 (7.6/8.6)
Avx = 1926.0 mm^2	Avy = 1926.0 mm^2 (8.2.1)
Ceffx = 34.15 mm	Ceffy = 34.15 mm (7.9)
Zeffx = 124.78x10^3 mm^3	Zeffy = 124.78x10^3 mm^3 (7.6)
Seffx = 165.00x10^3 mm^3	Seffy = 165.00x10^3 mm^3 (7.5)

ym1 = 1.00 (3.1.2)	ym2 = 1.20 (3.1.2)
mx = 0.00 (8.9.2)	my = 0.00 (8.9.2)
mLT = 0.00 (8.3.5.2)	ALT = 0.00 (8.3.5.3/A8.2)
u = 0.00 (8.3.5.3/A8.2)	v = 0.00 (8.3.5.3/A8.2)
βw = 0.00 (8.3.5.3/A8.2)	x = 0.00 (8.3.5.3/A8.2)
λx = 0.00 (8.7.4)	λy = 0.00 (8.7.4)
qw = 0.00 MPa (8.4.6)	pb = 0.00 MPa (8.3.5.2/A8.1)
pcx = 0.00 MPa (8.7.6/A8.4)	pcy = 0.00 MPa (8.7.6/A8.4)
Kef = 1.20 (9.3.4.4)	Kew = 1.20 (9.3.4.4)

F = 13.31 kN (Semi-compact)	
Fvx = 0.00 kN	Fvy = -116.48 kN
Mx = 30.45 kNm (Plastic)	My = 0.00 kNm (Plastic)

Pt = 0.00 kN (8.6)	Vw = 0.00 kN (8.4.6)
Pcx = 0.00 kN (8.7.5)	Pcy = 0.00 kN (8.7.5)
Pcxbar = 0.00 kN (8.7.5)	Pcybar = 0.00 kN (8.7.5)
Vcx = 305.79 kN (8.2.1)	Vcy = 305.79 kN (8.2.1)
Mcx = 41.18 kNm (8.2.2.1)	Mcy = 41.18 kNm (8.2.2.1)
Mb = 0.00 kNm (8.3.5.2)	Mp = 0.00 kNm (8.4.4.2b)

Governing mode = Compression and bending (8.9.1 eq 8.78) (Pass)

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HK CP2011 CALCULATIONS FOR GROUP 11 (*=Failure)

Critical load case is 11, out of 1-22

Section: 168.3x6.3 CHS (Circular tube, Cold formed)
Class: Semi-compact

WARNING: Not all load cases were analysed non-linearly with P-Δ
WARNING: Minor compression effective length was reduced by flange restraints

Failure Mode	Crit Case	Start Pos'n	Finish Pos'n	Axial Force	Major Shear	Minor Shear	Major Moment	Minor Moment	Load Factor
Section	11	10.050		4.44	10.04	-0.18	-0.30	37.39	1.09
Member	11	0.000	10.050	4.44			-0.30	37.38	2.27
Shear	11	10.050		4.44	10.04	-0.18	-0.30	37.38	30.46 (1.00)

Load Case	Load Factor	Failure Mode
1	43.66	Member - Comp and biaxial bending (8.9.2 eq 8.79)
2	6.51	Section - Compression and bending (8.9.1 eq 8.78)
3	11.05	Section - Tension and bending (8.8 eq 8.77)
4	2.02	Section - Bending about minor axis (8.2.2.1)
5	3.02	Section - Tension and bending (8.8 eq 8.77)
11	1.09	Section - Compression and bending (8.9.1 eq 8.78)
12	1.79	Section - Tension and bending (8.8 eq 8.77)
21	1.52	Section - Compression and bending (8.9.1 eq 8.78)
22	2.51	Section - Tension and bending (8.8 eq 8.77)

py = 275.0 MPa	
pyw = 275.0 MPa	Us = 430.0 MPa
Ltot = 10.050 m	Lseg = 10.050 m (FF Bot-Bot)
Le = 10.050 m (Bending)	
Lex = 13.232 m (Compression)	Ley = 10.050 m (Compression)
Lex/rx = 318.3 (Compression)	Le/ry = 175.7 (Bending)
Arf = 0.0 mm^2	Arw = 0.0 mm^2
Ag = 3210.0 mm^2	Ae = 3210.0 mm^2 (7.6/8.6)
Avx = 1926.0 mm^2	Avy = 1926.0 mm^2 (8.2.1)
Ceffx = 34.15 mm	Ceffy = 34.15 mm (7.9)
Zeffx = 124.78x10^3 mm^3	Zeffy = 124.78x10^3 mm^3 (7.6)
Seffx = 165.00x10^3 mm^3	Seffy = 165.00x10^3 mm^3 (7.5)

ym1 = 1.00 (3.1.2)	ym2 = 1.20 (3.1.2)
mx = 0.00 (8.9.2)	my = 0.00 (8.9.2)
mLT = 0.00 (8.3.5.2)	ALT = 0.00 (8.3.5.3/A8.2)
u = 0.00 (8.3.5.3/A8.2)	v = 0.00 (8.3.5.3/A8.2)
βw = 0.00 (8.3.5.3/A8.2)	x = 0.00 (8.3.5.3/A8.2)
λx = 0.00 (8.7.4)	λy = 0.00 (8.7.4)
qw = 0.00 MPa (8.4.6)	pb = 0.00 MPa (8.3.5.2/A8.1)
pcx = 0.00 MPa (8.7.6/A8.4)	pcy = 0.00 MPa (8.7.6/A8.4)
Kef = 1.20 (9.3.4.4)	Kew = 1.20 (9.3.4.4)

F = 4.44 kN (Semi-compact)	
Fvx = 10.04 kN	Fvy = -0.18 kN
Mx = -0.30 kNm (Plastic)	My = 37.38 kNm (Plastic)

Pt = 0.00 kN (8.6)	Vw = 0.00 kN (8.4.6)
Pcx = 0.00 kN (8.7.5)	Pcy = 0.00 kN (8.7.5)
Pcxbar = 0.00 kN (8.7.5)	Pcybar = 0.00 kN (8.7.5)
Vcx = 305.79 kN (8.2.1)	Vcy = 305.79 kN (8.2.1)
Mcx = 41.18 kNm (8.2.2.1)	Mcy = 41.18 kNm (8.2.2.1)
Mb = 0.00 kNm (8.3.5.2)	Mp = 0.00 kNm (8.4.4.2b)

Governing mode = Compression and bending (8.9.1 eq 8.78) (Pass)

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HK CP2011 CALCULATIONS FOR GROUP 12 (*=Failure)

Critical load case is 11, out of 1-22

Section: 168.3x6.3 CHS (Circular tube, Cold formed)
Class: Semi-compact

WARNING: Not all load cases were analysed non-linearly with P-Δ
WARNING: Minor compression effective length was reduced by flange restraints

Failure Mode	Crit Case	Start Pos'n	Finish Pos'n	Axial Force	Major Shear	Minor Shear	Major Moment	Minor Moment	Load Factor
Section	11	10.050		4.44	-10.04	-0.18	-0.30	-37.38	1.09
Member	12	0.000	10.050	151.39			-0.32	0.00	1.93
Shear	11	10.050		4.44	-10.04	-0.18	-0.30	-37.38	30.46 (1.00)

Load Case	Load Factor	Failure Mode
1	48.66	Member - Comp and biaxial bending (8.9.2 eq 8.79)
2	6.51	Section - Compression and bending (8.9.1 eq 8.78)
3	10.03	Member - Comp and biaxial bending (8.9.2 eq 8.79)
4	2.02	Section - Bending about minor axis (8.2.2.1)
5	3.02	Section - Compression and bending (8.9.1 eq 8.78)
11	1.09	Section - Compression and bending (8.9.1 eq 8.78)
12	1.31	Section - Compression and bending (8.9.1 eq 8.78)
21	1.52	Section - Compression and bending (8.9.1 eq 8.78)
22	2.53	Section - Compression and bending (8.9.1 eq 8.78)

py = 275.0 MPa	
pyw = 275.0 MPa	Us = 430.0 MPa
Ltot = 10.050 m	Lseg = 10.050 m (FF Bot-Bot)
Le = 10.050 m (Bending)	
Lex = 13.232 m (Compression)	Ley = 10.050 m (Compression)
Lex/rx = 313.5 (Compression)	Le/ry = 175.7 (Bending)
Arf = 0.0 mm^2	Arw = 0.0 mm^2
Ag = 3210.0 mm^2	Ae = 3210.0 mm^2 (7.6/8.6)
Avx = 1926.0 mm^2	Avy = 1926.0 mm^2 (8.2.1)
Ceffx = 34.15 mm	Ceffy = 34.15 mm (7.9)
Zeffx = 124.78x10^3 mm^3	Zeffy = 124.78x10^3 mm^3 (7.6)
Seffx = 165.00x10^3 mm^3	Seffy = 165.00x10^3 mm^3 (7.5)

ym1 = 1.00 (3.1.2)	ym2 = 1.20 (3.1.2)
mx = 0.00 (8.9.2)	my = 0.00 (8.9.2)
mLT = 0.00 (8.3.5.2)	ALT = 0.00 (8.3.5.3/A8.2)
u = 0.00 (8.3.5.3/A8.2)	v = 0.00 (8.3.5.3/A8.2)
βw = 0.00 (8.3.5.3/A8.2)	x = 0.00 (8.3.5.3/A8.2)
λx = 0.00 (8.7.4)	λy = 0.00 (8.7.4)
qw = 0.00 MPa (8.4.6)	pb = 0.00 MPa (8.3.5.2/A8.1)
pcx = 0.00 MPa (8.7.6/A8.4)	pcy = 0.00 MPa (8.7.6/A8.4)
Kef = 1.20 (9.3.4.4)	Kew = 1.20 (9.3.4.4)

F = 4.44 kN (Semi-compact)	
Fvx = -10.04 kN	Fvy = -0.18 kN
Mx = -0.30 kNm (Plastic)	My = -37.38 kNm (Plastic)

Pt = 0.00 kN (8.6)	Vw = 0.00 kN (8.4.6)
Pcx = 0.00 kN (8.7.5)	Pcy = 0.00 kN (8.7.5)
Pcxbar = 0.00 kN (8.7.5)	Pcybar = 0.00 kN (8.7.5)
Vcx = 305.79 kN (8.2.1)	Vcy = 305.79 kN (8.2.1)
Mcx = 41.18 kNm (8.2.2.1)	Mcy = 41.18 kNm (8.2.2.1)
Mb = 0.00 kNm (8.3.5.2)	Mp = 0.00 kNm (8.4.4.2b)

Governing mode = Compression and bending (8.9.1 eq 8.78) (Pass)

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HK CP2011 CALCULATIONS FOR GROUP [illegible] (*=Failure)

Critical load case is 11, out of 1-22

Section: 114.3x[illegible] CHS (Circular tube, Cold formed)
Class: Semi-compact

WARNING: Not all load cases were analysed non-linearly with P-Δ
WARNING: Minor compression effective length was reduced by flange restraints

Failure Mode	Crit Case	Start Pos'n	Finish Pos'n	Axial Force	Major Shear	Minor Shear	Major Moment	Minor Moment	Load Factor
Section	11	[illegible]		1.60	[illegible]	[illegible]	-4.1[illegible]	[illegible]	[illegible]
Member	11	[illegible]	2.500	1.60			-4.1[illegible]	[illegible]	[illegible]
Shear	11	[illegible]		1.60	[illegible]	[illegible]	-4.1[illegible]	[illegible]	[illegible] ([illegible])

```
 Load   Load  Failure
 Case Factor     Mode

    1  [illegible]  Member - Comp about major axis buckling ([illegible])
    2  [illegible]  Section - Compression and bending ([illegible] eq [illegible])
    3  [illegible]  Section - Compression and bending ([illegible] eq [illegible])
    4  [illegible]  Section - Bending about major axis ([illegible])
    5  [illegible]  Section - Bending about minor axis ([illegible])
   11  [illegible]  Section - Compression and bending ([illegible] eq [illegible])
   12  [illegible]  Section - Compression and bending ([illegible] eq [illegible])
   21  [illegible]  Section - Compression and bending ([illegible] eq [illegible])
   22  [illegible]  Section - Compression and bending ([illegible] eq [illegible])

py     =  275.0 MPa
pyw    =  275.0 MPa              Us     =  430.0 MPa
Ltot   =  2.500 m                Lseg   =  2.500 m  (FF Bot-Top)
Le     =  2.500 m  (Bending)
Lex    =  8.7[illegible] m (Compression)  Ley    =  2.500 m  (Compression)
Lex/rx =  227.6  (Compression)   Le/ry  =  64.3    (Bending)
Act    =  0.0 mm^2               Acw    =  0.0 mm^2
Ag     =  1720.0 mm^2            Ae     =  1720.0 mm^2 (7.6/8.6)
Avx    =  1032.0 mm^2            Avy    =  1032.0 mm^2 (8.2.1)
Ceffx  =  57.15 mm               Ceffy  =  57.15 mm   (7.8)
Zeffx  =  44.97x10^3 mm^3        Zeffy  =  44.97x10^3 mm^3 (7.6)
Seffx  =  59.30x10^3 mm^3        Seffy  =  59.30x10^3 mm^3 (7.5)

γm1    =  1.00 (3.1.2)           γm2    =  1.20 (3.1.2)
mx     =  0.00 (8.9.2)           my     =  0.00 (8.9.2)
mLT    =  0.00 (8.3.5.2)         λLT    =  0.00 (8.3.5.3/A8.2)
u      =  0.00 (8.3.5.3/A8.2)    v      =  0.00 (8.3.5.3/A8.2)
βw     =  0.00 (8.3.5.3/A8.2)    x      =  0.00 (8.3.5.3/A8.2)
λx     =  0.00 (8.7.4)           λy     =  0.00 (8.7.4)
qw     =  0.00 MPa (8.4.6)       pb     =  0.00 MPa (8.3.5.2/A8.1)
pcx    =  0.00 MPa (8.7.6/A8.4)  pcy    =  0.00 MPa (8.7.6/A8.4)
Kef    =  1.20 (9.3.4.4)         Kew    =  1.20 (9.3.4.4)

F      =  1.60 kN (Semi-compact)
Fvx    =  0.00 kN                Fvy    =  6.52 kN
Mx     =  -4.1[illegible] kNm (Plastic)    My     =  0.00 kNm (Plastic)

Pt     =  0.00 kN  (8.6)         Vw     =  0.00 kN  (8.4.6)
Pcx    =  0.00 kN  (8.7.5)       Pcy    =  0.00 kN  (8.7.5)
Pcxbar =  0.00 kN  (8.7.5)       Pcybar =  0.00 kN  (8.7.5)
Vcx    =  163.85 kN  (8.2.1)     Vcy    =  163.85 kN  (8.2.1)
Mcx    =  14.84 kNm (8.2.2.1)    Mcy    =  14.84 kNm (8.2.2.1)
Mb     =  0.00 kNm (8.3.5.2)     Mp     =  0.00 kNm (8.4.4.2b)
```

Governing mode - Compression and bending (8.9.1 eq 8.78) (Pass)

SPACE GASS 14 (HK3334) (64-bit) - JRG ENGINEERING CO LTD
Path: Y:\J8009(other)\2693\LANDS\20240415\4
Designer: Date: Wednesday, April 24, 2024 12:45 PM, Page: 34
Filter: No filter

HK CP2011 CALCULATIONS FOR GROUP [illegible] (*=Failure)

Critical load case is 11, out of 1-22

Section: 114.3x[illegible] CHS (Circular tube, Cold formed)
Class: Semi-compact

WARNING: Not all load cases were analysed non-linearly with P-Δ
WARNING: Minor compression effective length was reduced by flange restraints

Failure Mode	Crit Case	Start Pos'n	Finish Pos'n	Axial Force	Major Shear	Minor Shear	Major Moment	Minor Moment	Load Factor
Section	11	[illegible]		1.6[illegible]	[illegible]	[illegible]	-4.1[illegible]	[illegible]	[illegible]
Member	11	[illegible]	2.500	1.60			-4.1[illegible]	[illegible]	[illegible]
Shear	11	[illegible]		1.60	[illegible]	[illegible]	-4.1[illegible]	[illegible]	25.1[illegible] ([illegible])

```
 Load   Load  Failure
 Case Factor     Mode

    1  [illegible]  Member - Comp about major axis buckling ([illegible])
    2  [illegible]  Section - Compression and bending ([illegible] eq [illegible])
    3  [illegible]  Section - Compression and bending ([illegible] eq [illegible])
    4  [illegible]  Section - Bending about major axis ([illegible])
    5  [illegible]  Section - Bending about minor axis ([illegible])
   11  [illegible]  Section - Compression and bending ([illegible] eq [illegible])
   12  [illegible]  Section - Compression and bending ([illegible] eq [illegible])
   21  [illegible]  Section - Compression and bending ([illegible] eq [illegible])
   22  [illegible]  Section - Compression and bending ([illegible] eq [illegible])

py     =  275.0 MPa
pyw    =  275.0 MPa              Us     =  430.0 MPa
Ltot   =  2.500 m                Lseg   =  2.500 m  (FF Bot-Top)
Le     =  2.500 m  (Bending)
Lex    =  8.7[illegible] m (Compression)  Ley    =  2.500 m  (Compression)
Lex/rx =  227.6  (Compression)   Le/ry  =  64.3    (Bending)
Act    =  0.0 mm^2               Acw    =  0.0 mm^2
Ag     =  1720.0 mm^2            Ae     =  1720.0 mm^2 (7.6/8.6)
Avx    =  1032.0 mm^2            Avy    =  1032.0 mm^2 (8.2.1)
Ceffx  =  57.15 mm               Ceffy  =  57.15 mm   (7.8)
Zeffx  =  44.97x10^3 mm^3        Zeffy  =  44.97x10^3 mm^3 (7.6)
Seffx  =  59.30x10^3 mm^3        Seffy  =  59.30x10^3 mm^3 (7.5)

γm1    =  1.00 (3.1.2)           γm2    =  1.20 (3.1.2)
mx     =  0.00 (8.9.2)           my     =  0.00 (8.9.2)
mLT    =  0.00 (8.3.5.2)         λLT    =  0.00 (8.3.5.3/A8.2)
u      =  0.00 (8.3.5.3/A8.2)    v      =  0.00 (8.3.5.3/A8.2)
βw     =  0.00 (8.3.5.3/A8.2)    x      =  0.00 (8.3.5.3/A8.2)
λx     =  0.00 (8.7.4)           λy     =  0.00 (8.7.4)
qw     =  0.00 MPa (8.4.6)       pb     =  0.00 MPa (8.3.5.2/A8.1)
pcx    =  0.00 MPa (8.7.6/A8.4)  pcy    =  0.00 MPa (8.7.6/A8.4)
Kef    =  1.20 (9.3.4.4)         Kew    =  1.20 (9.3.4.4)

F      =  1.66 kN (Semi-compact)
Fvx    =  0.00 kN                Fvy    =  6.52 kN
Mx     =  -4.18 kNm (Plastic)    My     =  0.00 kNm (Plastic)

Pt     =  0.00 kN  (8.6)         Vw     =  0.00 kN  (8.4.6)
Pcx    =  0.00 kN  (8.7.5)       Pcy    =  0.00 kN  (8.7.5)
Pcxbar =  0.00 kN  (8.7.5)       Pcybar =  0.00 kN  (8.7.5)
Vcx    =  163.85 kN  (8.2.1)     Vcy    =  163.85 kN  (8.2.1)
Mcx    =  14.84 kNm (8.2.2.1)    Mcy    =  14.84 kNm (8.2.2.1)
Mb     =  0.00 kNm (8.3.5.2)     Mp     =  0.00 kNm (8.4.4.2b)
```

Governing mode - Compression and bending (8.9.1 eq 8.78) (Pass)

SPACE GASS 14 (HK3334) (64-bit) - JRG ENGINEERING CO LTD
Path: Y:\J8009(other)\2693\LANDS\20240415\4
Designer: Date: Wednesday, April 24, 2024 12:45 PM, Page: 35
Filter: No filter

HK CP2011 CALCULATIONS FOR GROUP 26 (*=Failure)

Critical load case is 11, out of 1-22

Section: 193.7x10.0 CHS (Circular tube, Cold formed)
Class: Semi-compact

WARNING: Not all load cases were analysed non-linearly with P-Δ
WARNING: Minor compression effective length was reduced by flange restraints

Failure Mode	Crit Case	Start Pos'n	Finish Pos'n	Axial Force	Major Shear	Minor Shear	Major Moment	Minor Moment	Load Factor
Section	11	2.500		0.56	0.00	83.78	52.00	0.00	1.02
Member	11	0.000	2.500	1.72			52.00	0.00	2.25
Shear	11	1.250		1.72	0.00	84.56	-23.21	0.00	6.50 (1.00)

```
 Load   Load  Failure
 Case Factor     Mode

    1 513.21  Section - Bending about major axis (8.2.2.1)
    2   3.22  Section - Compression and bending (8.9.1 eq 8.78)
    3  14.41   Member - Comp and biaxial bending (8.9.2 eq 8.79)
    4   2.54  Section - Compression and bending (8.9.1 eq 8.78)
    5  15.44   Member - Comp and biaxial bending (8.9.2 eq 8.79)
   11   1.02  Section - Bending about major axis (8.2.2.1)
   12   5.25   Member - Comp and biaxial bending (8.9.2 eq 8.79)
   21   1.42  Section - Compression and bending (8.9.1 eq 8.78)
   22   7.35   Member - Comp and biaxial bending (8.9.2 eq 8.79)

py     =  275.0 MPa
pyw    =  275.0 MPa              Us     =  430.0 MPa
Ltot   =  2.500 m                Lseg   =  2.500 m  (FF Bot-Top)
Le     =  2.500 m  (Bending)
Lex    = 12.500 m  (Compression) Ley    =  2.500 m  (Compression)
Lex/rx =  192.2    (Compression) Le/ry  =  38.4    (Bending)
Act    =  0.0 mm^2               Acw    =  0.0 mm^2
Ag     =  5770.0 mm^2            Ae     =  5770.0 mm^2 (7.6/8.6)
Avx    =  3462.0 mm^2            Avy    =  3462.0 mm^2 (8.2.1)
Ceffx  =  96.85 mm               Ceffy  =  96.85 mm   (7.8)
Zeffx  =  251.94x10^3 mm^3       Zeffy  =  251.94x10^3 mm^3 (7.6)
Seffx  =  333.00x10^3 mm^3       Seffy  =  338.00x10^3 mm^3 (7.5)

γm1    =  1.00 (3.1.2)           γm2    =  1.20 (3.1.2)
mx     =  0.00 (8.9.2)           my     =  0.00 (8.9.2)
mLT    =  0.00 (8.3.5.2)         λLT    =  0.00 (8.3.5.3/A8.2)
u      =  0.00 (8.3.5.3/A8.2)    v      =  0.00 (8.3.5.3/A8.2)
βw     =  0.00 (8.3.5.3/A8.2)    x      =  0.00 (8.3.5.3/A8.2)
λx     =  0.00 (8.7.4)           λy     =  0.00 (8.7.4)
qw     =  0.00 MPa (8.4.6)       pb     =  0.00 MPa (8.3.5.2/A8.1)
pcx    =  0.00 MPa (8.7.6/A8.4)  pcy    =  0.00 MPa (8.7.6/A8.4)
Kef    =  1.20 (9.3.4.4)         Kew    =  1.20 (9.3.4.4)

F      =  0.56 kN (Semi-compact)
Fvx    =  0.00 kN                Fvy    =  83.78 kN
Mx     =  52.00 kNm (Plastic)    My     =  0.00 kNm (Plastic)

Pt     =  0.00 kN  (8.6)         Vw     =  0.00 kN  (8.4.6)
Pcx    =  0.00 kN  (8.7.5)       Pcy    =  0.00 kN  (8.7.5)
Pcxbar =  0.00 kN  (8.7.5)       Pcybar =  0.00 kN  (8.7.5)
Vcx    = 549.67 kN  (8.2.1)      Vcy    = 549.67 kN  (8.2.1)
Mcx    =  93.14 kNm (8.2.2.1)    Mcy    =  93.14 kNm (8.2.2.1)
Mb     =  0.00 kNm (8.3.5.2)     Mp     =  0.00 kNm (8.4.4.2b)
```

Governing mode - Bending about major axis (8.2.2.1) (Pass)

A19

SPACE GASS 14 (HK3334) (64-bit) - JEG ENGINEERING CO LTD
Path: Y:\J8009(other)\2693\LANDS\20240415\4
Designer: Date: Wednesday, April 24, 2024 12:14 PM, Page: 1

Envelope = Load Cases 11,12
and Nodes 1,7,13,14

DISPLACEMENTS (mm,rad) (*=Maximum, #=Minimum)

Node	Case	Tx	Ty	Tz	Rx	Ry	Rz
1	11	0.00*#	0.00*#	0.00*#	0.00*#	0.00*#	0.00*#

REACTIONS (kN,kNm) (*=Maximum, #=Minimum)

Node	Case	Fx	Fy	Fz	Mx	My	Mz
1	12	0.01*	12.35	-6.72	-19.18#	0.67	-0.04#
7	11	-17.54#	-71.35	0.00	0.00	0.00	75.47*
13	11	-10.04	4.43	0.27*	-0.30	-3.73#	37.19
13	12	0.00	-141.17#	-20.58	-16.36	0.00	0.00
14	11	-10.04	4.43	-0.27	0.30*	3.73*	37.19
14	12	0.00	150.03*	-21.12#	-15.77	0.00	0.00

A20

SPACE GASS 14 (HK3334) (64-bit) - JEG ENGINEERING CO LTD
Path: Y:\J8009(other)\2693\LANDS\20240415\4
Designer: Date: Wednesday, April 24, 2024 12:47 PM, Page: 1

DISPLACEMENTS AT NODE 8 (mm,rad)

Case	Tx	Ty	Tz	Rx	Ry	Rz
21	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00

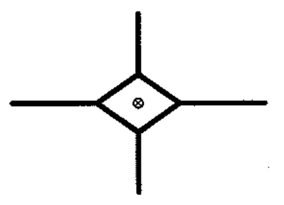
REACTIONS AT NODE 8 (kN,kNm)

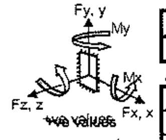
Case	Fx	Fy	Fz	Mx	My	Mz
21	-39.39	24.48	0.00	0.00	0.00	310.36
22	0.00	24.48	-39.39	-310.36	0.00	0.00

A21

Company:	JEG Engineering Company Limited	WeldCalc20100214	© 2001-10 Dr Shaiq Khan, Techno Consultants Ltd
Address:	Blk. E, 1/F, Cheong Fat Factory Bldg., 346 Fuk Wing St., Cheung Sha Wan, Kln	User Registration No: Unregistered Copy	
	Tel: 2117 9500 Fax: 3103 8077 Email: jeg@jeg-ltd.com	Made by / Date / Page No	
Project:			
Client:		Checked / Job No / Revision	
Element:			

Weld Group in X-Y Plane





Sign Convention

Weld Group in Direct Shear, Bending and Torsion

User Reference:
DataStore No: 1010
Weld Description: 193.7 Weld

Applied Loads: / **Load Position from Origin:** / **Load Position from Centroid:** / **Load Eccentricity Moments at Centroid:**

Direction	Mag kN	Xo mm	Yo mm	Zo mm	Xc mm	Yc mm	Zc mm	Mx kNmm	My kNmm	Mz kNmm
Fx kN	17.54									
Fy kN	0									
Fz kN	71.35									

Strength Check:

Design Strength:
0.220 kN/mm2
Induced Max Stress:
0.188 kN/mm2
<Allowable; Hence OK

Applied Moments:

Mx kNmm	My kNmm	Mz kNmm
0	75470	0

Equivalent Stress Calculation Method: SRSS Sqrt [fx^2 + fy^2 + fz^2]

Resultant Moments on the Weld Group:

Mx kNmm	My kNmm	Mz kNmm
	75,470.0	

Centroid of Weld Group from Origin:

Xo mm	Yo mm	Zo mm

Weld Group Properties about its Centroid (x to u-axis angle = 0 deg):

Ixx mm^4	Iyy mm^4	Ixy mm^4	Iuu mm^4	Ivv mm^4	Ipp mm^4
125,243,734	125,243,734		125,243,734	125,243,734	250,487,468

Input for Weld Group Geometry: / **Component Properties for Each Weld Length:** / **Stress Components & Resultant at Each Node:** / **Force Resultants in Each Weld Length:**

Node No	Part No	Xo mm	Yo mm	Throat, a mm	Area, A mm^2	A yo mm^3	A xo mm^3	Ixx mm^4	Iyy mm^4	Ixy mm^4	Stress fx kN/mm^2	Stress fy kN/mm^2	Stress fz kN/mm^2	Stress fe kN/mm^2	Force Fxw kN	Force Fyw kN	Force Fzw kN
1	1	-96.85	0.00	3.54	485	-23,479	23,479	1,515,988	1,515,988	-1,136,991	0.002		0.068	0.068	1.119		18.698
2	1	0.00	96.85	3.54	485	23,479	23,479	1,515,988	1,515,988	1,136,991	0.002		0.009	0.010	1.119		-9.598
3	1	96.85	0.00	3.54	485	23,479	-23,479	1,515,988	1,515,988	-1,136,991	0.002		-0.049	0.049	1.119		-9.598
4	1	0.00	-96.85	3.54	485	-23,479	-23,479	1,515,988	1,515,988	1,136,991	0.002		0.009	0.010	1.119		18.698
5	1	-96.85	0.00	3.54							0.002		0.068	0.068			
6	2	-96.85	0.00	3.54	708	-139,370			29,794,945		0.002		0.068	0.068	1.633		90.626
7	2	-296.85	0.00	3.54	708	-139,370			29,794,945		0.002		0.188	0.188	1.633		90.626
8	2	-96.85	0.00	3.54							0.002		0.068	0.068			
9	3	96.85	0.00	3.54	708	139,370			29,794,945	-0	0.002		-0.049	0.049	1.633		-77.338
10	3	296.85	0.00	3.54	708	139,370			29,794,945	-0	0.002		-0.169	0.170	1.633		-77.338
11	3	96.85	0.00	3.54							0.002		-0.049	0.049			
12	4	0.00	-96.85	3.54	708		-139,370	29,794,945			0.002		0.009	0.010	1.633		6.644
13	4	0.00	-296.85	3.54	708		-139,370	29,794,945			0.002		0.009	0.010	1.633		6.644
14	4	0.00	-96.85	3.54							0.002		0.009	0.010			
15	5	0.00	96.85	3.54	708		139,370	29,794,945		-0	0.002		0.009	0.010	1.633		6.644
16	5	0.00	296.85	3.54	708		139,370	29,794,945		-0	0.002		0.009	0.010	1.633		6.644
17	5	0.00	96.85	3.54							0.002		0.009	0.010			
18																	
19																	
20																	
21																	
22																	
23																	
24																	
25																	
26																	
27																	
28																	
29																	
30																	
					Combined Properties for the Weld Group							Maximum of fz & fe:	0.188	0.188	Force Resultants in the Weld Group		
NB: Shaded areas represent user data input					7,603			125,243,734	125,243,734			Valid Design Maximum Stress:		0.188	17.540		71.350

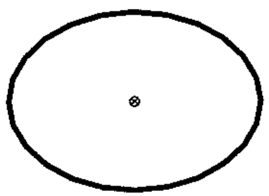
Company: JEG Engineering Company Limited
Address: Blk. E, 1/F, Cheong Fat Factory Bldg., 346 Fuk Wing St., Cheung Sha Wan, Kln
Tel: 2117 9500 Fax: 3103 8077 Email: jeg@jeg-ltd.com

Project:
Client:
Element:

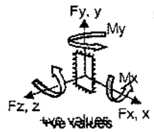
Made by	Date	Page No
Checked	**Job No**	**Revision**

A22

Weld Group in X-Y Plane



o Origin × Centroid —— Welds



Sign Convention

Weld Group in Direct Shear, Bending and Torsion

User Reference:
DataStore No: 1010
Weld Description: 168.3 Weld

Applied Loads: / **Load Position from Origin:** / **Load Position from Centroid:** / **Load Eccentricity Moments at Centroid:**

Direction	Mag kN	Xo mm	Yo mm	Zo mm	Xc mm	Yc mm	Zc mm	Mx kNmm	My kNmm	Mz kNmm
Fx kN	21.12					-0.0				0.0
Fy kN	0				0.0					
Fz kN	150.03				0.0	-0.0		-0.0	-0.0	

Strength Check:

Design Strength:
0.220 kN/mm2
Induced Max Stress:
0.177 kN/mm2
<Allowable; Hence OK

Applied Moments:

Mx kNmm	My kNmm	Mz kNmm
0	15770	0

Equivalent Stress Calculation Method: SRSS Sqrt [fx^2 + fy^2 + fz^2]

Resultant Moments on the Weld Group:

Mx kNmm	My kNmm	Mz kNmm
-0.0	15,770.0	0.0

Centroid of Weld Group from Origin:

Xo mm	Yo mm	Zo mm
-0.0	0.0	

Weld Group Properties about its Centroid (x to u-axis angle = -8.472 deg):

Ixx mm⁴	Iyy mm⁴	Ixy mm⁴	Iuu mm⁴	Ivv mm⁴	Ipp mm⁴
10,445,440	10,445,440	0	10,445,440	10,445,440	20,890,880

Input for Weld Group Geometry: / **Component Properties for Each Weld Length:** / **Stress Components & Resultant at Each Node:** / **Force Results in Each Weld Length:**

Node No	Part No	Xo mm	Yo mm	Throat, a mm	Area, A mm^2	A yo mm^3	A xo mm^3	Ixx mm^4	Iyy mm^4	Ixy mm^4	Stress fx kN/mm^2	Stress fy kN/mm^2	Stress fz kN/mm^2	Stress fe kN/mm^2	Force Fxw kN	Force Fyw kN	Force Fzw kN
1	1	-84.15	0.00	5.66	124	-10,285	1,354	19,660	850,794	-111,998	0.007	-0.000	0.177	0.177	0.880	-0.000	21.778
2	1	-81.28	21.78	5.66	124	-9,584	3,970	131,011	739,443	-305,984	0.007	-0.000	0.173	0.173	0.880	-0.000	20.720
3	1	-72.88	42.08	5.66	124	-8,230	6,315	323,876	546,577	-417,982	0.007	-0.000	0.160	0.160	0.880	-0.000	18.676
4	1	-59.50	59.50	5.66	124	-6,315	8,230	546,577	323,876	-417,982	0.007	-0.000	0.140	0.140	0.880	-0.000	15.785
5	1	-42.08	72.88	5.66	124	-3,970	9,584	739,443	131,011	-305,984	0.007	-0.000	0.114	0.114	0.880	-0.000	12.245
6	1	-21.78	81.28	5.66	124	-1,354	10,285	850,794	19,660	-111,998	0.007	-0.000	0.083	0.083	0.880	-0.000	8.295
7	1	0.00	84.15	5.66	124	1,354	10,285	850,794	19,660	111,998	0.007	0.000	0.050	0.051	0.880	0.000	4.207
8	1	21.78	81.28	5.66	124	3,970	9,584	739,443	131,011	305,984	0.007	0.000	0.017	0.019	0.880	0.000	0.258
9	1	42.08	72.88	5.66	124	6,315	8,230	546,577	323,876	417,982	0.007	0.000	-0.013	0.015	0.880	0.000	-3.283
10	1	59.50	59.50	5.66	124	8,230	6,315	323,876	546,577	417,982	0.007	0.000	-0.040	0.040	0.880	0.000	-6.174
11	1	72.88	42.08	5.66	124	9,584	3,970	131,011	739,443	305,984	0.007	0.000	-0.060	0.060	0.880	0.000	-8.218
12	1	81.28	21.78	5.66	124	10,285	1,354	19,660	850,794	111,998	0.007	0.000	-0.072	0.073	0.880	0.000	-9.276
13	1	84.15	0.00	5.66	124	10,285	-1,354	19,660	850,794	-111,998	0.007	0.000	-0.077	0.077	0.880	0.000	-9.276
14	1	81.28	-21.78	5.66	124	9,584	-3,970	131,011	739,443	-305,984	0.007	0.000	-0.072	0.073	0.880	0.000	-8.218
15	1	72.88	-42.08	5.66	124	8,230	-6,315	323,876	546,577	-417,982	0.007	0.000	-0.060	0.060	0.880	0.000	-6.174
16	1	59.50	-59.50	5.66	124	6,315	-8,230	546,577	323,876	-417,982	0.007	0.000	-0.040	0.040	0.880	0.000	-3.283
17	1	42.08	-72.88	5.66	124	3,970	-9,584	739,443	131,011	-305,984	0.007	0.000	-0.013	0.015	0.880	0.000	0.258
18	1	21.78	-81.28	5.66	124	1,354	-10,285	850,794	19,660	-111,998	0.007	0.000	0.017	0.019	0.880	0.000	4.207
19	1	0.00	-84.15	5.66	124	-1,354	-10,285	850,794	19,660	111,998	0.007	0.000	0.050	0.051	0.880	-0.000	8.295
20	1	-21.78	-81.28	5.66	124	-3,970	-9,584	739,443	131,011	305,984	0.007	-0.000	0.083	0.083	0.880	-0.000	12.245
21	1	-42.08	-72.88	5.66	124	-6,315	-8,230	546,577	323,876	417,982	0.007	-0.000	0.114	0.114	0.880	-0.000	15.785
22	1	-59.50	-59.50	5.66	124	-8,230	-6,315	323,876	546,577	417,982	0.007	-0.000	0.140	0.140	0.880	-0.000	18.676
23	1	-72.88	-42.08	5.66	124	-9,584	-3,970	131,011	739,443	305,984	0.007	-0.000	0.160	0.160	0.880	-0.000	20.720
24	1	-81.28	-21.78	5.66	124	-10,285	-1,354	19,660	850,794	111,998	0.007	-0.000	0.173	0.173	0.880	-0.000	21.778
25	1	-84.15	0.00	5.66							0.007	-0.000	0.177	0.177			
26																	
27																	
28																	
29																	
30																	

Combined Properties for the Weld Group

Area, A	A yo	A xo	Ixx	Iyy	Ixy
2,984	-0	0	10,445,440	10,445,440	0

	Stress fz	Stress fe
Maximum of fz & fe:	0.177	0.177
Valid Design Maximum Stress:		0.177

Force Resultants in the Weld Group

Fxw kN	Fyw kN	Fzw kN
21.120		150.030

NB: Shaded areas represent user data input

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Company:		Page:	0
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	09-2693-139.7 Bracket	Date:	24/4/2024
Fastening point:			

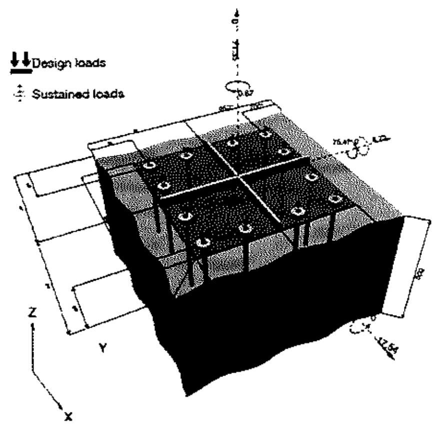
Specifier's comments:

1 Input data

Anchor type and diameter:	**HIT-RE 500 V3 + HAS-U 8.8 M16**
Return period (service life in years):	50
Item number:	2223885 HAS-U 8.8 M16x380 (element) / 2123403 HIT-RE 500 V3 (adhesive)
Filling set or any suitable annular gap filling solution	
Effective embedment depth:	$h_{ef,act}$ = 320.0 mm ($h_{ef,limit}$ = - mm)
Material:	8.8
Evaluation Service Report:	ETA 16/0143
Issued I Valid:	14/5/2019 | -
Proof:	SOFA based on EN 1992-4, Chemical
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 10.0 mm
Anchor plate[R]:	l_x x l_y x t = 600.0 mm x 600.0 mm x 10.0 mm; (Recommended plate thickness: not calculated)
Profile:	Cross beam, ; (L x W x T x FT) = 593.7 mm x 593.7 mm x 10.0 mm x 10.0 mm
Base material:	cracked concrete, C25/30, $f_{c,cyl}$ = 25.00 N/mm^2; h =500.0 mm, Temp. short/long: 40/24 °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) with longitudinal edge reinforcement d >= 12.0 [mm] + close mesh (stirrups, hangers) s <= 100.0 [mm]

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [mm] & Loading [kN, kNm]



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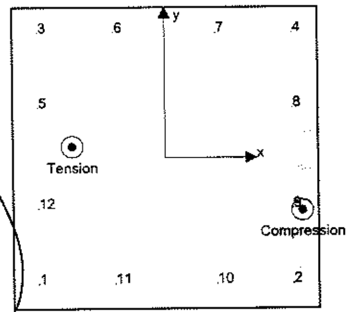
Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	09-2693-139.7 Bracket	Date:	24/4/2024
Fastening point:			

1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 71.350; V_x = 17.540; V_y = 6.720; M_x = 19.180; M_y = 75.470; M_z = 0.670; N_{sus} = 0.000; $M_{x,sus}$ = 0.000; $M_{y,sus}$ = 0.000;	no	no	79

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	32.654	1.667	1.617	0.405
2	0.000	1.768	1.617	0.715
3	38.344	1.368	1.307	0.405
4	0.757	1.489	1.307	0.715
5	36.637	1.457	1.400	0.405
6	27.068	1.398	1.307	0.498
7	12.033	1.447	1.307	0.622
8	0.000	1.572	1.400	0.715
9	0.000	1.683	1.524	0.715
10	6.344	1.732	1.617	0.622
11	21.378	1.692	1.617	0.498
12	34.361	1.577	1.524	0.405

max. concrete compressive strain:	0.28 [‰]
max. concrete compressive stress:	8.43 [N/mm^2]
resulting tension force in (x/y)=(-182.8/22.4):	209.577 [kN]
resulting compression force in (x/y)=(268.8/-104.9):	138.227 [kN]

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

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Company:		Page:	0
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	09-2693-139.7 Bracket (1)	Date:	24/4/2024
Fastening point:			

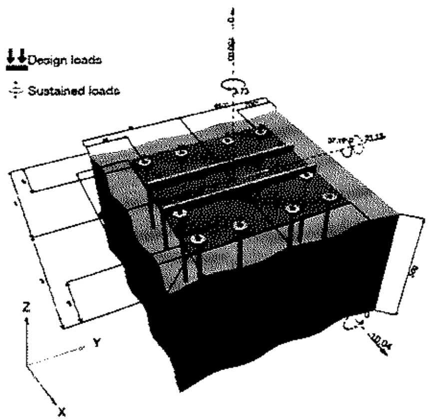
Specifier's comments:

1 Input data

Anchor type and diameter:	**HIT-RE 500 V3 + HAS-U 8.8 M16**
Return period (service life in years):	50
Item number:	2223885 HAS-U 8.8 M16x380 (element) / 2123403 HIT-RE 500 V3 (adhesive)
Filling set or any suitable annular gap filling solution	
Effective embedment depth:	$h_{ef,act}$ = 320.0 mm ($h_{ef,limit}$ = - mm)
Material:	8.8
Evaluation Service Report:	ETA 16/0143
Issued I Valid:	14/5/2019 | -
Proof:	SOFA based on EN 1992-4, Chemical
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 10.0 mm
Anchor plate[R] :	l_x x l_y x t = 600.0 mm x 600.0 mm x 10.0 mm; (Recommended plate thickness: not calculated)
Profile:	Double flat bar, ; (L x W x T) = 600.0 mm x 168.3 mm x 8.0 mm
Base material:	cracked concrete, C25/30, $f_{c,cyl}$ = 25.00 N/mm^2; h =500.0 mm, Temp. short/long: 40/24 °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) with longitudinal edge reinforcement d >= 12.0 [mm] + close mesh (stirrups, hangers) s <= 100.0 [mm]

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [mm] & Loading [kN, kNm]



www.hilti.com.hk

Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	09-2693-139.7 Bracket (1)	Date:	24/4/2024
Fastening point:			

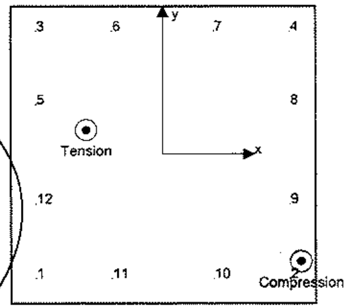
1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 150.030; V_x = 10.040; V_y = 21.120; M_x = 16.360; M_y = 37.190; M_z = 3.730; N_{sus} = 0.000; $M_{x,sus}$ = 0.000; $M_{y,sus}$ = 0.000;	no	no	74

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	23.917	1.922	1.700	0.897
2	0.000	3.126	1.700	2.623
3	32.762	0.897	-0.027	0.897
4	6.409	2.624	-0.027	2.623
5	30.108	1.022	0.491	0.897
6	24.856	1.415	-0.027	1.415
7	14.315	2.106	-0.027	2.105
8	3.756	2.669	0.491	2.623
9	0.218	2.877	1.182	2.623
10	5.470	2.706	1.700	2.105
11	16.011	2.212	1.700	1.415
12	26.570	1.484	1.182	0.897



max. concrete compressive strain:	0.18 [‰]
max. concrete compressive stress:	5.42 [N/mm^2]
resulting tension force in (x/y)=(-151.0/48.5):	184.392 [kN]
resulting compression force in (x/y)=(271.7/-215.8):	34.362 [kN]

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

A24

JEG	Job BTS site	Job No. J8009 S2693	Page A25
CALCULATION	Calculations by	Checked by A. Chan	Date Apr,2024

Design for cast in bolt

N = 38.344 kN

V_x = 3.126 kN

V_y = 3.126 kN

Try M16 Grade 8.8 GMS bolt

Bolt area,A_t = 157 mm^2

Shear strength of bolt, p_{sb} = 375 N/mm^2

Tension strength of bolt, p_{tb} = 560 N/mm^2

Shear Capacity,P_s

= $A_t \times P_{sb}$

= $157 \times 375 / 10^3$

= 58.88 kN

Tension Capacity,P_t

= $A_t \times P_{st}$

= $157 \times 560 / 10^3$

= 87.92 kN

Shear per bolt, F_s

= $\sqrt{(V_x^2 + V_y^2)}$

= $\sqrt{(3.126^2 + 3.126^2)}$

= 4.42 kN $< P_s$ OK!

Tension per bolt,F_t

= N

= 38 kN $< P_t$ OK!

Check Combin Effect

$F_s/P_s + F_t/P_{nom}$ = 4.42 / 58.88 + 38.34 / 87.92 = 0.51 < 1.4 OK!

Adopt M16 Grade 8.8 GMS bolt

Check for anchorage length

Tension per bolt = 38 kN

Concrete cube strength,f_{cu} = 30 N/mm^2

Try anchorage length,l_b = 400 mm

Coefficient dependent on the bar type, β = 0.5 For Type 2 : deformed bars

Design anchorage bond stress,f_b

= $F_s / (\pi \times \varphi \times l_b)$

= $38 \times 10^3 / (\pi \times 16 \times 400)$

= 1.91 N/mm^2

Ultimate anchorage bond stress,f_{bu}

= $\beta \times \sqrt{f_{cu}}$

= $0.5 \times \sqrt{30}$

= 2.74 N/mm^2 $> f_b$

OK!

Adopt 400mm anchorage length

Shear at Joint

$= 1.71 \times 2 \times 1.4 \times \pi \times \left(\frac{0.675}{2}\right)^2 \times 3 \quad = 5.14 \text{ kN}$

Moment at Joint

$= 5.14 \times \left(2.5 - 0.675 - 0.2 - \frac{0.675}{2}\right) = 6.62 \text{ kNm}$

Company:	JEG Engineering Company Limited	
Address:	Blk. E, 1/F, Cheong Fat Factory Bldg., 346 Fuk Wing St., Cheung Sha Wan, Kln	
	Tel: 2117 9500 Fax: 3103 8077 Email: jeg@jeg-ltd.com	
Project:		
Client:	φ139.7 CHS weld at joint	
Element:		

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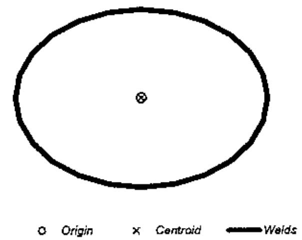
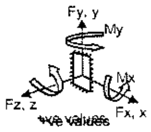
Made by	Date	Page No
Checked	**Job No**	**Revision**

A27

Weld Group in X-Y Plane





Sign Convention

Weld Group in Direct Shear, Bending and Torsion

User Reference:
Weld Description:

DataStore No: 1010

Applied Loads: / **Load Position from Origin:** / **Load Position from Centroid:** / **Load Eccentricity Moments at Centroid:**

Direction	Mag kN	Xo mm	Yo mm	Zo mm	Xc mm	Yc mm	Zc mm	Mx kNmm	My kNmm	Mz kNmm
Fx kN	0					-0.0				
Fy kN	-5.14				0.0					-0.0
Fz kN	0				0.0	-0.0				

Strength Check:

Design Strength:
0.220 kN/mm2
Induced Max Stress:
0.124 kN/mm2
<Allowable; Hence OK

Applied Moments:

Mx kNmm	My kNmm	Mz kNmm
6620	0	0

Equivalent Stress Calculation Method:	
SRSS	Sqrt [fx^2 + fy^2 + fz^2]

Resultant Moments on the Weld Group:

Mx kNmm	My kNmm	Mz kNmm
6,620.0		-0.0

Centroid of Weld Group from Origin:

Xo mm	Yo mm	Zo mm
-0.0	0.0	

Weld Group Properties about its Centroid (x to u-axis angle = -9.485 deg):

Ixx mm^4	Iyy mm^4	Ixy mm^4	Iuu mm^4	Ivv mm^4	Ipp mm^4
3,736,375	3,736,375	0	3,736,375	3,736,375	7,472,750

Input for Weld Group Geometry: / **Component Properties for Each Weld Length:** / **Stress Components & Resultant at Each Node:** / **Force Resultants in Each Weld Length:**

Node No	Part No	Xo mm	Yo mm	Throat, a mm	Area, A mm^2	A yo mm^3	A xo mm^3	Ixx mm^4	Iyy mm^4	Ixy mm^4	Stress fx kN/mm^2	Stress fy kN/mm^2	Stress fz kN/mm^2	Stress fe kN/mm^2	Force Fxw kN	Force Fyw kN	Force Fzw kN
1	1	-69.85	0.00	3.54	65	-4,432	583	7,032	304,332	-40,062	0.000	-0.003	0.000	0.003	0.000	-0.214	1.034
2	1	-67.47	18.08	3.54	65	-4,130	1,711	46,863	264,502	-109,452	0.000	-0.003	0.032	0.032	0.000	-0.214	3.031
3	1	-60.49	34.93	3.54	65	-3,546	2,721	115,852	195,513	-149,514	0.000	-0.003	0.062	0.062	0.000	-0.214	4.822
4	1	-49.39	49.39	3.54	65	-2,721	3,546	195,513	115,852	-149,514	0.000	-0.003	0.088	0.088	0.000	-0.214	6.284
5	1	-34.93	60.49	3.54	65	-1,711	4,130	264,502	46,863	-109,452	0.000	-0.003	0.107	0.107	0.000	-0.214	7.317
6	1	-18.08	67.47	3.54	65	-583	4,432	304,332	7,032	-40,062	0.000	-0.003	0.120	0.120	0.000	-0.214	7.853
7	1	0.00	69.85	3.54	65	583	4,432	304,332	7,032	40,062	0.000	-0.003	0.124	0.124	0.000	-0.214	7.853
8	1	18.08	67.47	3.54	65	1,711	4,130	264,502	46,863	109,452	0.000	-0.003	0.120	0.120	0.000	-0.214	7.317
9	1	34.93	60.49	3.54	65	2,721	3,546	195,513	115,852	149,514	0.000	-0.003	0.107	0.107	0.000	-0.214	6.284
10	1	49.39	49.39	3.54	65	3,546	2,721	115,852	195,513	149,514	0.000	-0.003	0.088	0.088	0.000	-0.214	4.822
11	1	60.49	34.93	3.54	65	4,130	1,711	46,863	264,502	109,452	0.000	-0.003	0.062	0.062	0.000	-0.214	3.031
12	1	67.47	18.08	3.54	65	4,432	583	7,032	304,332	40,062	0.000	-0.003	0.032	0.032	0.000	-0.214	1.034
13	1	69.85	0.00	3.54	65	4,432	-583	7,032	304,332	-40,062	0.000	-0.003	0.000	0.003	-0.000	-0.214	-1.034
14	1	67.47	-18.08	3.54	65	4,130	-1,711	46,863	264,502	-109,452	-0.000	-0.003	-0.032	0.032	-0.000	-0.214	-3.031
15	1	60.49	-34.93	3.54	65	3,546	-2,721	115,852	195,513	-149,514	-0.000	-0.003	-0.062	0.062	-0.000	-0.214	-4.822
16	1	49.39	-49.39	3.54	65	2,721	-3,546	195,513	115,852	-149,514	-0.000	-0.003	-0.088	0.088	-0.000	-0.214	-6.284
17	1	34.93	-60.49	3.54	65	1,711	-4,130	264,502	46,863	-109,452	-0.000	-0.003	-0.107	0.107	-0.000	-0.214	-7.317
18	1	18.08	-67.47	3.54	65	583	-4,432	304,332	7,032	-40,062	-0.000	-0.003	-0.120	0.120	-0.000	-0.214	-7.853
19	1	0.00	-69.85	3.54	65	-583	-4,432	304,332	7,032	40,062	-0.000	-0.003	-0.124	0.124	-0.000	-0.214	-7.853
20	1	-18.08	-67.47	3.54	65	-1,711	-4,130	264,502	46,863	109,452	-0.000	-0.003	-0.120	0.120	-0.000	-0.214	-7.317
21	1	-34.93	-60.49	3.54	65	-2,721	-3,546	195,513	115,852	149,514	-0.000	-0.003	-0.107	0.107	-0.000	-0.214	-6.284
22	1	-49.39	-49.39	3.54	65	-3,546	-2,721	115,852	195,513	149,514	-0.000	-0.003	-0.088	0.088	-0.000	-0.214	-4.822
23	1	-60.49	-34.93	3.54	65	-4,130	-1,711	46,863	264,502	109,452	-0.000	-0.003	-0.062	0.062	-0.000	-0.214	-3.031
24	1	-67.47	-18.08	3.54	65	-4,432	-583	7,032	304,332	40,062	-0.000	-0.003	-0.032	0.032	-0.000	-0.214	-1.034
25	1	-69.85	0.00	3.54							0.000	-0.003	0.000	0.003			
26																	
27																	
28																	
29																	
30																	
					Combined Properties for the Weld Group						Maximum of fz & fe:		0.124	0.124	Force Resultants in the Weld Group		
NB. Shaded areas represent user data input					1,549	-0	0	3,736,375	3,736,375	0	Valid Design Maximum Stress:			0.124	0.000	-5.140	-0.000

Company:	JEG Engineering Company Limited
Address:	Blk. E, 1/F, Cheong Fat Factory Bldg., 346 Fuk Wing St., Cheung Sha Wan, Kln
	Tel: 2117 9500 Fax: 3103 8077 Email: jeg@jeg-ltd.com
Project:	
Client:	ϕ114.3 CHS weld at joint
Element:	

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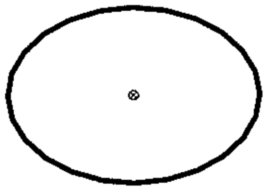
User Registration No: Unregistered Copy

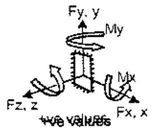
Made by	Date	Page No
Checked	Job No	Revision

A28

Weld Group in X-Y Plane



o Origin × Centroid — Welds



Sign Convention

Weld Group in Direct Shear, Bending and Torsion

User Reference:
Weld Description:
DataStore No: 1010

Applied Loads / Load Position from Origin / Load Position from Centroid / Load Eccentricity Moments at Centroid:

Direction	Mag kN	Xo mm	Yo mm	Zo mm	Xc mm	Yc mm	Zc mm	Mx kNmm	My kNmm	Mz kNmm
Fx kN	0					-0.0				
Fy kN	-5.14				-0.0					0.0
Fz kN	0				-0.0	-0.0				

Strength Check:

Design Strength:
0.220 kN/mm2
Induced Max Stress:
0.185 kN/mm2
<Allowable; Hence OK

Applied Moments:

Mx kNmm	My kNmm	Mz kNmm
6620	0	0

Equivalent Stress Calculation Method: SRSS Sqrt [fx^2 + fy^2 + fz^2]

Resultant Moments on the Weld Group:

Mx kNmm	My kNmm	Mz kNmm
6,620.0		0.0

Centroid of Weld Group from Origin:

Xo mm	Yo mm	Zo mm
0.0	0.0	

Weld Group Properties about its Centroid (x to u-axis angle = 0 deg):

Ixx mm^4	Iyy mm^4	Ixy mm^4	Iuu mm^4	Ivv mm^4	Ipp mm^4
2,046,444	2,046,444	0	2,046,444	2,046,444	4,092,888

Input for Weld Group Geometry / Component Properties for Each Weld Length / Stress Components & Resultant at Each Node / Force Resultants in Each Weld Length:

Node No	Part No	Xo mm	Yo mm	Throat, a mm	Area, A mm^2	A yo mm^3	A xo mm^3	Ixx mm^4	Iyy mm^4	Ixy mm^4	Stress fx kN/mm^2	Stress fy kN/mm^2	Stress fz kN/mm^2	Stress fe kN/mm^2	Force Fxw kN	Force Fyw kN	Force Fzw kN
1	1	-57.15	0.00	3.54	53	-2,967	391	3,852	166,685	-21,942	0.000	-0.004	0.000	0.004	-0.000	-0.214	1.264
2	1	-55.20	14.79	3.54	53	-2,765	1,145	25,667	144,870	-59,948	-0.000	-0.004	0.048	0.048	-0.000	-0.214	3.705
3	1	-49.49	28.58	3.54	53	-2,374	1,822	63,453	107,084	-81,890	-0.000	-0.004	0.092	0.093	-0.000	-0.214	5.893
4	1	-40.41	40.41	3.54	53	-1,822	2,374	107,084	63,453	-81,890	-0.000	-0.004	0.131	0.131	-0.000	-0.214	7.680
5	1	-28.58	49.49	3.54	53	-1,145	2,765	144,870	25,667	-59,948	-0.000	-0.004	0.160	0.160	-0.000	-0.214	8.943
6	1	-14.79	55.20	3.54	53	-391	2,967	166,685	3,852	-21,942	-0.000	-0.004	0.179	0.179	-0.000	-0.214	9.598
7	1	0.00	57.15	3.54	53	391	2,967	166,685	3,852	21,942	-0.000	-0.004	0.185	0.185	-0.000	-0.214	9.598
8	1	14.79	55.20	3.54	53	1,145	2,765	144,870	25,667	59,948	-0.000	-0.004	0.179	0.179	-0.000	-0.214	8.943
9	1	28.58	49.49	3.54	53	1,822	2,374	107,084	63,453	81,890	-0.000	-0.004	0.160	0.160	-0.000	-0.214	7.680
10	1	40.41	40.41	3.54	53	2,374	1,822	63,453	107,084	81,890	-0.000	-0.004	0.131	0.131	-0.000	-0.214	5.893
11	1	49.49	28.58	3.54	53	2,765	1,145	25,667	144,870	59,948	-0.000	-0.004	0.092	0.093	-0.000	-0.214	3.705
12	1	55.20	14.79	3.54	53	2,967	391	3,852	166,685	21,942	-0.000	-0.004	0.048	0.048	-0.000	-0.214	1.264
13	1	57.15	0.00	3.54	53	2,967	-391	3,852	166,685	-21,942	0.000	-0.004	-0.000	0.004	0.000	-0.214	-1.264
14	1	55.20	-14.79	3.54	53	2,765	-1,145	25,667	144,870	-59,948	0.000	-0.004	-0.048	0.048	0.000	-0.214	-3.705
15	1	49.49	-28.58	3.54	53	2,374	-1,822	63,453	107,084	-81,890	0.000	-0.004	-0.092	0.093	0.000	-0.214	-5.893
16	1	40.41	-40.41	3.54	53	1,822	-2,374	107,084	63,453	-81,890	0.000	-0.004	-0.131	0.131	0.000	-0.214	-7.680
17	1	28.58	-49.49	3.54	53	1,145	-2,765	144,870	25,667	-59,948	0.000	-0.004	-0.160	0.160	0.000	-0.214	-8.943
18	1	14.79	-55.20	3.54	53	391	-2,967	166,685	3,852	-21,942	0.000	-0.004	-0.179	0.179	0.000	-0.214	-9.598
19	1	0.00	-57.15	3.54	53	-391	-2,967	166,685	3,852	21,942	0.000	-0.004	-0.185	0.185	0.000	-0.214	-9.598
20	1	-14.79	-55.20	3.54	53	-1,145	-2,765	144,870	25,667	59,948	0.000	-0.004	-0.179	0.179	0.000	-0.214	-8.943
21	1	-28.58	-49.49	3.54	53	-1,822	-2,374	107,084	63,453	81,890	0.000	-0.004	-0.160	0.160	0.000	-0.214	-7.680
22	1	-40.41	-40.41	3.54	53	-2,374	-1,822	63,453	107,084	81,890	0.000	-0.004	-0.131	0.131	0.000	-0.214	-5.893
23	1	-49.49	-28.58	3.54	53	-2,765	-1,145	25,667	144,870	59,948	0.000	-0.004	-0.092	0.093	0.000	-0.214	-3.705
24	1	-55.20	-14.79	3.54	53	-2,967	-391	3,852	166,685	21,942	0.000	-0.004	-0.048	0.048	0.000	-0.214	-1.264
25	1	-57.15	0.00	3.54							0.000	-0.004	0.000	0.004			
26																	
27																	
28																	
29																	
30																	

NB: Shaded areas represent user data input

Combined Properties for the Weld Group

Area, A mm^2	A yo mm^3	A xo mm^3	Ixx mm^4	Iyy mm^4	Ixy mm^4
1,268	0	0	2,046,444	2,046,444	0

Maximum of fz & fe: 0.185 0.185
Valid Design Maximum Stress: 0.185

Force Resultants in the Weld Group

Fxw kN	Fyw kN	Fzw kN
0.000	-5.140	-0.000

JEG CALCULATION	Job: Porposed Antenna Pole Connection Checking		Job No. J8009 S2693	Page A 27
	Calculations by	Checked by A. Chan	Date Apr 2024	

Section Modulus for Bolt Group at Joint of Antenna Group

Try CHS 114.3 x 5.0 for pole above joint — Elastic modulus = 45 cm^3; Plastic modulus = 45 cm^3

Try CHS 193.7 x 10.0 for pole below joint — Elastic modulus = 252 cm^3; Plastic modulus = 252 cm^3

Diameter of blot, d
= 16 mm

Distance between outer most bolts about centroid of blot group
= 350 - 30 x 2 = 290 mm

Elastic modulus

I_{xx} for bolt 1, 4
= $I_c + Ay^2$
= $\pi d^2/64$ + $\pi d^2/4(D/2)^2$
= 3217 + 4227327
= 4230544 mm^4

I_{xx} for bolt 2, 3, 5, 6
= $I_c + Ay^2$
= $\pi d^2/64$ + $\pi d^2/4(D/4)^2$
= 3217 + 1056832
= 1060049 mm^4

Total I_{xx} for bolt group
= 2 x 4230544 + 4 x 1060049
= 1.3E+07 mm^4

Elastic modulus of bolt group
= 1.3E+07 / (D/2)
= 87595 mm^3
= 87.60 cm^3 > 52.5 cm^3 Elastic modulus for CHS 114.3 x 5.0 OK!

Plastic modulus

Plastic modulus for bolt 1, 4
= $A_c y_c$ + $A_T y_T$
(y_c = y_T = D/2)
= $\pi d^2 y/4$ + $\pi d^2 y/4$
= 29154 + 29154
= 58308 mm^3

Plastic modulus for bolt 2, 3, 5, 6
= $A_c y_c$ + $A_T y_T$
(y_c = y_T = D/4)
= $\pi d^2 y/4$ + $\pi d^2 y/4$
= 14577 + 14577
= 29154 mm^3

Total I_{xx} for bolt group
= 1 x 58308 + 2 x 29154
= 116616 mm^3

Plastic modulus of bolt group

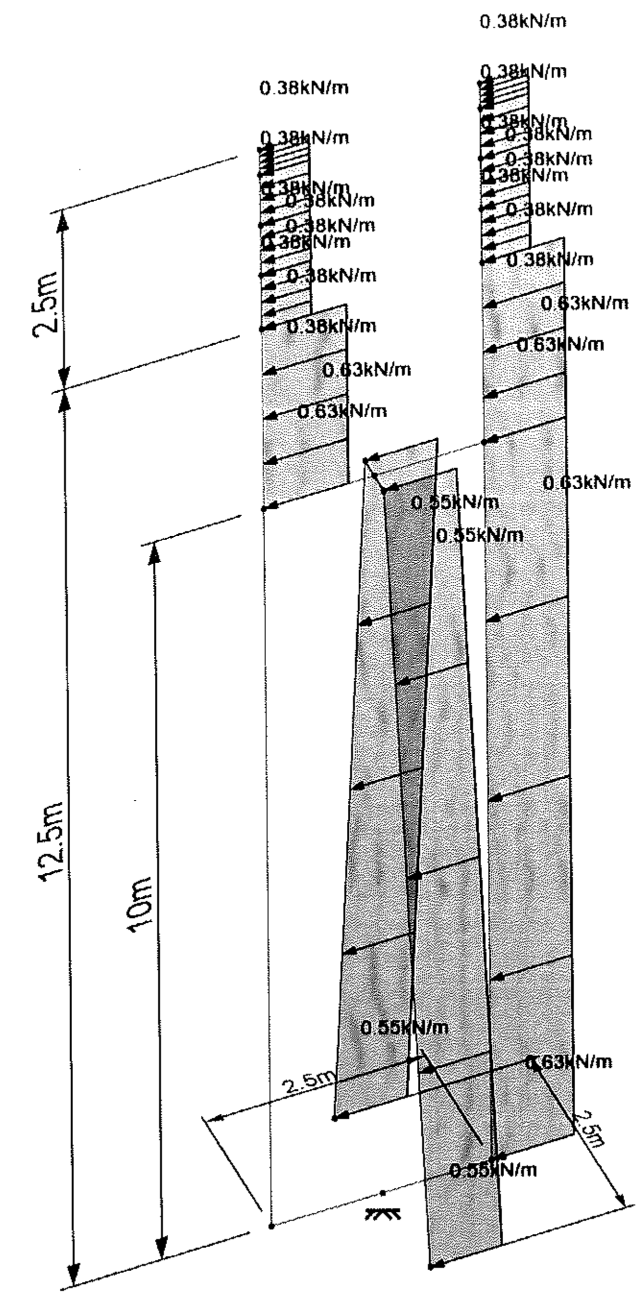
= 116616 mm^3
= 116.6 cm^3 > 45.0 cm^3 Plastic modulus for CHS 114.3 x 5.0 OK!

Therefore, section of bolt group is not a critical section

A30

SPACE GASS 14 (HK3334) (64-bit) - JEG ENGINEERING CO LTD
Path: Y:\J8009(other)\2693\LANDS\20240415\5
Designer: Date: Wednesday, April 24, 2024 4:45 PM, Page: 1

Load case 4
4 Pole Wind X



Scale (1:75), Viewpoint (157,42), Loads

Materials:
1 STEEL

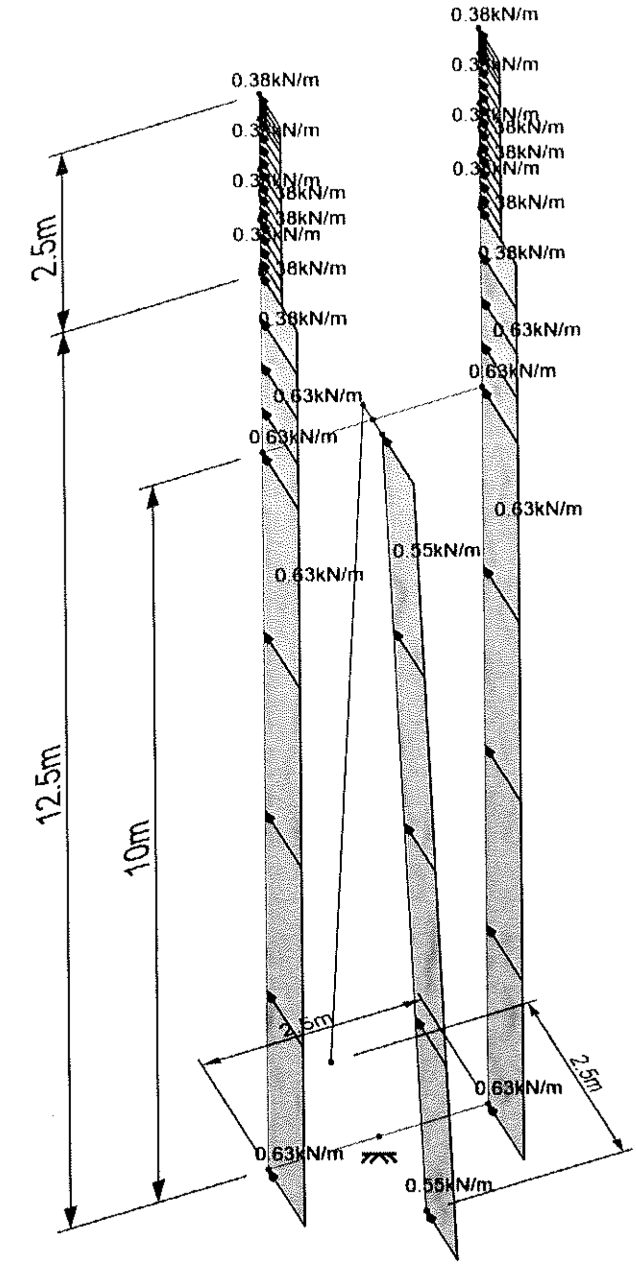
Sections:
2 168.3x6.3 CHS
3 193.7x10.0 CHS
4 114.3x5.0 CHS

A31

SPACE GASS 14 (HK3334) (64-bit) - JEG ENGINEERING CO LTD
Path: Y:\J8009(other)\2693\LANDS\20240415\5
Designer: Date: Wednesday, April 24, 2024 4:46 PM, Page: 1

Load case 5

5 Pole Wind Z



Scale (1:75), Viewpoint (157,42), Loads

Materials:

1 STEEL

Sections:

2 168.3x6.3 CHS

3 193.7x10.0 CHS

4 114.3x5.0 CHS

SPACE GASS 14 (HK3334) (64-bit) - JEG ENGINEERING CO LTD
Path: Y:\J8009(other)\2693\LANDS\20240415\5
Designer: Date: Wednesday, April 24, 2024 4:51 PM, Page: 1

DISPLACEMENTS AT NODE 8 (mm,rad)

Case	Tx	Ty	Tz	Rx	Ry	Rz
21	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00

REACTIONS AT NODE 8 (kN,kNm)

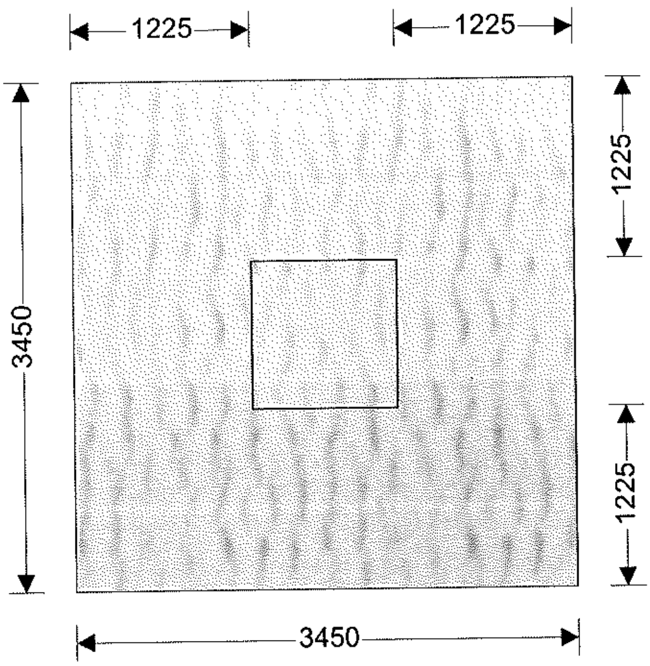
Case	Fx	Fy	Fz	Mx	My	Mz
21	-29.87	25.08	0.00	0.00	0.00	251.54
22	0.00	25.08	-30.67	-255.53	0.00	0.00

Tekla Tedds

Project				Job no. A33	
Calcs for				Start page no./Revision 1	
Calcs by P	Calcs date 4/24/2024	Checked by	Checked date	Approved by	Approved date

PAD FOOTING ANALYSIS AND DESIGN (BS8110-1:1997)

Tedds calculation version 2.0.07



Pad footing details

Length of pad footing: L = **3450** mm

Width of pad footing: B = **3450** mm

Area of pad footing: $A = L \times B$ = **11.903** m^2

Depth of pad footing: h = **800** mm

Depth of soil over pad footing: h_{soil} = **0** mm

Density of concrete: ρ_{conc} = **24.5** kN/m^3

Column details

Column base length: l_A = **1000** mm

Column base width: b_A = **1000** mm

Column eccentricity in x: e_{PxA} = **0** mm

Column eccentricity in y: e_{PyA} = **0** mm

Soil details

Density of soil: ρ_{soil} = **20.0** kN/m^3

Design shear strength: ϕ' = **25.0** deg

Design base friction: δ = **19.3** deg

Allowable bearing pressure: $P_{bearing}$ = **63** kN/m^2

Axial loading on column

Dead axial load on column: P_{GA} = **25.1** kN

Imposed axial load on column: P_{QA} = **0.0** kN

Wind axial load on column: P_{WA} = **0.0** kN

Total axial load on column: P_A = **25.1** kN

Foundation loads

Dead surcharge load: F_{Gsur} = **0.000** kN/m^2

Imposed surcharge load: F_{Qsur} = **0.000** kN/m^2

Pad footing self weight — $F_{swt} = h \times \rho_{conc} = \mathbf{19.600}\ kN/m^2$

Soil self weight — $F_{soil} = h_{soil} \times \rho_{soil} = \mathbf{0.000}\ kN/m^2$

Total foundation load — $F = A \times (F_{Gsur} + F_{Qsur} + F_{swt} + F_{soil}) = \mathbf{233.3}\ kN$

Horizontal loading on column base

Dead horizontal load in x direction — $H_{GxA} = \mathbf{30.7}\ kN$

Imposed horizontal load in x direction — $H_{QxA} = \mathbf{0.0}\ kN$

Wind horizontal load in x direction — $H_{WxA} = \mathbf{0.0}\ kN$

Total horizontal load in x direction — $H_{xA} = \mathbf{30.7}\ kN$

Dead horizontal load in y direction — $H_{GyA} = \mathbf{0.0}\ kN$

Imposed horizontal load in y direction — $H_{QyA} = \mathbf{0.0}\ kN$

Wind horizontal load in y direction — $H_{WyA} = \mathbf{0.0}\ kN$

Total horizontal load in y direction — $H_{yA} = \mathbf{0.0}\ kN$

Moment on column base

Dead moment on column in x direction — $M_{GxA} = \mathbf{-255.530}\ kNm$

Imposed moment on column in x direction — $M_{QxA} = \mathbf{0.000}\ kNm$

Wind moment on column in x direction — $M_{WxA} = \mathbf{0.000}\ kNm$

Total moment on column in x direction — $M_{xA} = \mathbf{-255.530}\ kNm$

Dead moment on column in y direction — $M_{GyA} = \mathbf{0.000}\ kNm$

Imposed moment on column in y direction — $M_{QyA} = \mathbf{0.000}\ kNm$

Wind moment on column in y direction — $M_{WyA} = \mathbf{0.000}\ kNm$

Total moment on column in y direction — $M_{yA} = \mathbf{0.000}\ kNm$

Check stability against sliding

Resistance to sliding due to base friction

$H_{friction} = \max([P_{GA} + (F_{Gsur} + F_{swt} + F_{soil}) \times A], 0\ kN) \times \tan(\delta) = \mathbf{90.5}\ kN$

Passive pressure coefficient — $K_p = (1 + \sin(\phi')) / (1 - \sin(\phi')) = \mathbf{2.464}$

Stability against sliding in x direction

Passive resistance of soil in x direction — $H_{xpas} = 0.5 \times K_p \times (h^2 + 2 \times h \times h_{soil}) \times B \times \rho_{soil} = \mathbf{54.4}\ kN$

Total resistance to sliding in x direction — $H_{xres} = H_{friction} + H_{xpas} = \mathbf{144.9}\ kN$

PASS - Resistance to sliding is greater than horizontal load in x direction

Check stability against overturning in x direction

Total overturning moment — $M_{xOT} = M_{xA} + H_{xA} \times h = \mathbf{-230.994}\ kNm$

Restoring moment in x direction

Foundation loading — $M_{xsur} = A \times (F_{Gsur} + F_{swt} + F_{soil}) \times L / 2 = \mathbf{402.424}\ kNm$

Axial loading on column — $M_{xaxial} = (P_{GA}) \times (L / 2 + e_{PxA}) = \mathbf{43.263}\ kNm$

Total restoring moment — $M_{xres} = M_{xsur} + M_{xaxial} = \mathbf{445.687}\ kNm$

PASS - Overturning safety factor exceeds the minimum of 1.5 in the x direction

Calculate pad base reaction

Total base reaction — $T = F + P_A = \mathbf{258.4}\ kN$

Eccentricity of base reaction in x — $e_{Tx} = (P_A \times e_{PxA} + M_{xA} + H_{xA} \times h) / T = \mathbf{-894}\ mm$

Eccentricity of base reaction in y — $e_{Ty} = (P_A \times e_{PyA} + M_{yA} + H_{yA} \times h) / T = \mathbf{0}\ mm$

Check pad base reaction eccentricity

$abs(e_{Tx}) / L + abs(e_{Ty}) / B = \mathbf{0.259}$

Base reaction acts outside of middle third of base

Calculate pad base pressures

$q_1 = 2 \times T / [3 \times B \times (L / 2 - abs(e_{Tx}))] = \mathbf{60.083}\ kN/m^2$

$q_2 = 2 \times T / [3 \times B \times (L / 2 - abs(e_{Tx}))] = \mathbf{60.083}$ kN/m^2

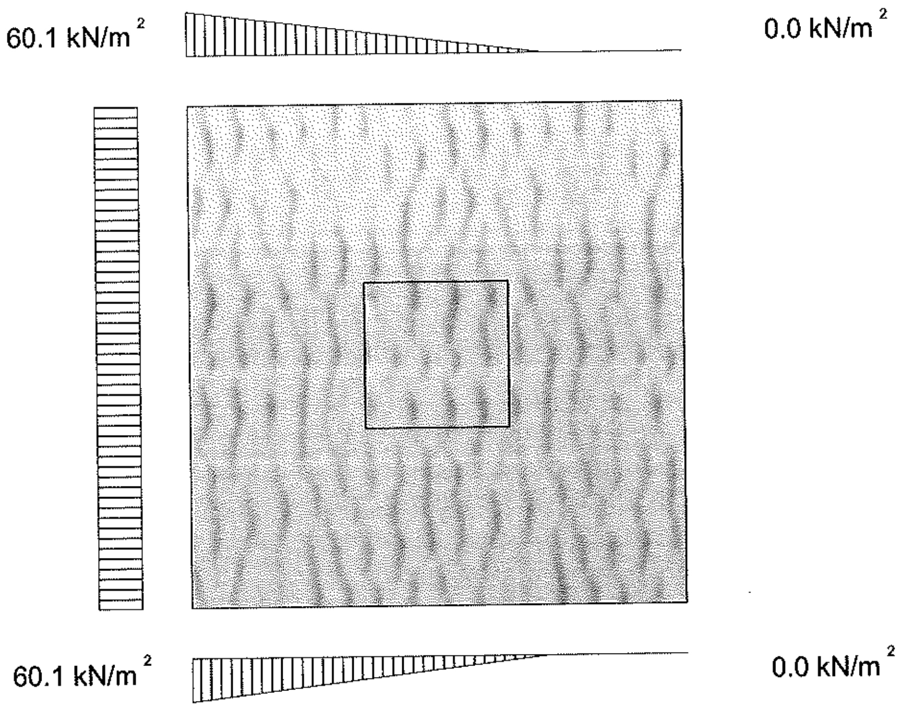
$q_3 = \mathbf{0.000}$ kN/m^2

$q_4 = \mathbf{0.000}$ kN/m^2

Minimum base pressure $q_{min} = min(q_1, q_2, q_3, q_4) = \mathbf{0.000}$ kN/m^2

Maximum base pressure $q_{max} = max(q_1, q_2, q_3, q_4) = \mathbf{60.083}$ kN/m^2

PASS - Maximum base pressure is less than allowable bearing pressure



Partial safety factors for loads

Partial safety factor for dead loads $\gamma_{fG} = \mathbf{1.40}$

Partial safety factor for imposed loads $\gamma_{fQ} = \mathbf{1.60}$

Partial safety factor for wind loads $\gamma_{fW} = \mathbf{0.00}$

Ultimate axial loading on column

Ultimate axial load on column $P_{uA} = P_{GA} \times \gamma_{fG} + P_{QA} \times \gamma_{fQ} + P_{WA} \times \gamma_{fW} = \mathbf{35.1}$ kN

Ultimate foundation loads

Ultimate foundation load $F_u = A \times [(F_{Gsur} + F_{swt} + F_{soil}) \times \gamma_{fG} + F_{Qsur} \times \gamma_{fQ}] = \mathbf{326.6}$ kN

Ultimate horizontal loading on column

Ultimate horizontal load in x direction $H_{xuA} = H_{GxA} \times \gamma_{fG} + H_{QxA} \times \gamma_{fQ} + H_{WxA} \times \gamma_{fW} = \mathbf{42.9}$ kN

Ultimate horizontal load in y direction $H_{yuA} = H_{GyA} \times \gamma_{fG} + H_{QyA} \times \gamma_{fQ} + H_{WyA} \times \gamma_{fW} = \mathbf{0.0}$ kN

Ultimate moment on column

Ultimate moment on column in x direction $M_{xuA} = M_{GxA} \times \gamma_{fG} + M_{QxA} \times \gamma_{fQ} + M_{WxA} \times \gamma_{fW} = \mathbf{-357.742}$ kNm

Ultimate moment on column in y direction $M_{yuA} = M_{GyA} \times \gamma_{fG} + M_{QyA} \times \gamma_{fQ} + M_{WyA} \times \gamma_{fW} = \mathbf{0.000}$ kNm

Calculate ultimate pad base reaction

Ultimate base reaction $T_u = F_u + P_{uA} = \mathbf{361.7}$ kN

Eccentricity of ultimate base reaction in x $e_{Txu} = (P_{uA} \times e_{PxA} + M_{xuA} + H_{xuA} \times h) / T_u = \mathbf{-894}$ mm

Eccentricity of ultimate base reaction in y $e_{Tyu} = (P_{uA} \times e_{PyA} + M_{yuA} + H_{yuA} \times h) / T_u = \mathbf{0}$ mm

Calculate ultimate pad base pressures

$q_{1u} = 2 \times T_u / [3 \times B \times (L / 2 - abs(e_{Txu}))] = \mathbf{84.117}$ kN/m^2

$q_{2u} = 2 \times T_u / [3 \times B \times (L / 2 - abs(e_{Txu}))] = \mathbf{84.117}$ kN/m^2

$q_{3u} = \mathbf{0.000}$ kN/m^2

$q_{4u} = \mathbf{0.000}$ kN/m^2

Minimum ultimate base pressure $q_{minu} = \min(q_{1u}, q_{2u}, q_{3u}, q_{4u}) = \mathbf{0.000}$ kN/m^2

Maximum ultimate base pressure $q_{maxu} = \max(q_{1u}, q_{2u}, q_{3u}, q_{4u}) = \mathbf{84.117}$ kN/m^2

Calculate rate of change of base pressure in x direction

Left hand base reaction $f_{uL} = (q_{1u} + q_{2u}) \times B / 2 = \mathbf{290.202}$ kN/m

Right hand base reaction $f_{uR} = (q_{3u} + q_{4u}) \times B / 2 = \mathbf{0.000}$ kN/m

Length of base reaction $L_x = 3 \times (L / 2 + e_{Txu}) = \mathbf{2493}$ mm

Rate of change of base pressure $C_x = (f_{uR} - f_{uL}) / L_x = \mathbf{-116.413}$ kN/m/m

Calculate pad lengths in x direction

Left hand length $L_L = L / 2 + e_{PxA} = \mathbf{1725}$ mm

Right hand length $L_R = L / 2 - e_{PxA} = \mathbf{1725}$ mm

Calculate ultimate moments in x direction

Ultimate positive moment in x direction $M_x = f_{uL} \times L_L^2 / 2 + C_x \times L_L^3 / 6 - F_u \times L_L^2 / (2 \times L) = \mathbf{191.327}$ kNm

Position of maximum negative moment $L_z = \mathbf{1725}$ mm

Ultimate negative moment in x direction $M_{xneg} = f_{uL} \times L_L^2 / 2 + C_x \times L_L^3 / 6 - F_u \times L_L^2 / (2 \times L) + H_{xuA} \times h + M_{xuA}$

$M_{xneg} = \mathbf{-132.064}$ kNm

Calculate rate of change of base pressure in y direction

Top edge base reaction $f_{uT} = (q_{2u} + q_{4u}) \times L / 2 = \mathbf{145.101}$ kN/m

Bottom edge base reaction $f_{uB} = (q_{1u} + q_{3u}) \times L / 2 = \mathbf{145.101}$ kN/m

Length of base reaction $L_y = B = \mathbf{3450}$ mm

Rate of change of base pressure $C_y = (f_{uB} - f_{uT}) / L_y = \mathbf{0.000}$ kN/m/m

Calculate pad lengths in y direction

Top length $L_T = B / 2 - e_{PyA} = \mathbf{1725}$ mm

Bottom length $L_B = B / 2 + e_{PyA} = \mathbf{1725}$ mm

Calculate ultimate moments in y direction

Ultimate moment in y direction $M_y = f_{uT} \times L_T^2 / 2 + C_y \times L_T^3 / 6 - F_u \times L_T^2 / (2 \times B) = \mathbf{75.035}$ kNm

Material details

Characteristic strength of concrete $f_{cu} = \mathbf{30}$ N/mm^2

Characteristic strength of reinforcement $f_y = \mathbf{500}$ N/mm^2

Characteristic strength of shear reinforcement $f_{yv} = \mathbf{500}$ N/mm^2

Nominal cover to reinforcement $c_{nom} = \mathbf{30}$ mm

Moment design in x direction

Diameter of tension reinforcement $\phi_{xB} = \mathbf{20}$ mm

Depth of tension reinforcement $d_x = h - c_{nom} - \phi_{xB} / 2 = \mathbf{760}$ mm

Design formula for rectangular beams (cl 3.4.4.4)

$K_x = M_x / (B \times d_x^2 \times f_{cu}) = \mathbf{0.003}$

$K_x' = 0.156$

K_x < K_x' compression reinforcement is not required

Lever arm $z_x = d_x \times \min([0.5 + \sqrt{(0.25 - K_x / 0.9)}], 0.95) = \mathbf{722}$ mm

Area of tension reinforcement required $A_{s\_x\_req} = M_x / (0.87 \times f_y \times z_x) = \mathbf{609}$ mm^2

Minimum area of tension reinforcement $A_{s\_x\_min} = 0.0013 \times B \times h =$ **3588** mm²

Tension reinforcement provided **17 No. 20 dia. bars bottom (200 centres)**

Area of tension reinforcement provided $A_{s\_xB\_prov} = N_{xB} \times \pi \times \phi_{xB}^2 / 4 =$ **5341** mm²

PASS - Tension reinforcement provided exceeds tension reinforcement required

Negative moment design in x direction

Diameter of tension reinforcement $\phi_{xT} =$ **20** mm

Depth of tension reinforcement $d_x = h - c_{nom} - \phi_{xT} / 2 =$ **760** mm

Design formula for rectangular beams (cl 3.4.4.4)

$K_x = -M_{xneg} / (B \times d_x^2 \times f_{cu}) =$ **0.002**

$K_x' = 0.156$

$K_x < K_x'$ compression reinforcement is not required

Lever arm $z_x = d_x \times \min([0.5 + \sqrt{(0.25 - K_x / 0.9)}], 0.95) =$ **722** mm

Area of tension reinforcement required $A_{s\_x\_req} = -M_{xneg} / (0.87 \times f_y \times z_x) =$ **420** mm²

Minimum area of tension reinforcement $A_{s\_x\_min} = 0.0013 \times B \times h =$ **3588** mm²

Tension reinforcement provided **17 No. 20 dia. bars top (200 centres)**

Area of tension reinforcement provided $A_{s\_xT\_prov} = N_{xT} \times \pi \times \phi_{xT}^2 / 4 =$ **5341** mm²

PASS - Tension reinforcement provided exceeds tension reinforcement required

Moment design in y direction

Diameter of tension reinforcement $\phi_{yB} =$ **20** mm

Depth of tension reinforcement $d_y = h - c_{nom} - \phi_{xB} - \phi_{yB} / 2 =$ **740** mm

Design formula for rectangular beams (cl 3.4.4.4)

$K_y = M_y / (L \times d_y^2 \times f_{cu}) =$ **0.001**

$K_y' = 0.156$

$K_y < K_y'$ compression reinforcement is not required

Lever arm $z_y = d_y \times \min([0.5 + \sqrt{(0.25 - K_y / 0.9)}], 0.95) =$ **703** mm

Area of tension reinforcement required $A_{s\_y\_req} = M_y / (0.87 \times f_y \times z_y) =$ **245** mm²

Minimum area of tension reinforcement $A_{s\_y\_min} = 0.0013 \times L \times h =$ **3588** mm²

Tension reinforcement provided **17 No. 20 dia. bars bottom (200 centres)**

Area of tension reinforcement provided $A_{s\_yB\_prov} = N_{yB} \times \pi \times \phi_{yB}^2 / 4 =$ **5341** mm²

PASS - Tension reinforcement provided exceeds tension reinforcement required

Calculate ultimate shear force at d from left face of column

Ultimate pressure for shear $q_{su} = (q_{2u} + C_x \times (L / 2 + e_{PxA} - l_A / 2 - d_x) / B + q_{1u}) / 2$

$q_{su} =$ **76.271** kN/m²

Area loaded for shear $A_s = B \times \min((L / 2 + e_{PxA} - l_A / 2 - d_x), 3 \times (L / 2 + e_{Tx})) =$ **1.604** m²

Ultimate shear force $V_{su} = A_s \times (q_{su} - F_u / A) =$ **78.338** kN

Shear stresses at d from left face of column (cl 3.5.5.2)

Design shear stress $v_{su} = V_{su} / (B \times d_x) =$ **0.030** N/mm²

From BS 8110:Part 1:1997 - Table 3.8

Design concrete shear stress $v_c = 0.79\ \text{N/mm}^2 \times \min(3, [100 \times A_{s\_xB\_prov} / (B \times d_x)]^{1/3}) \times \max((400\ \text{mm} / d_x)^{1/4}, 0.67) \times (\min(f_{cu} / 1\ \text{N/mm}^2, 40) / 25)^{1/3} / 1.25 =$ **0.337** N/mm²

Allowable design shear stress $v_{max} = \min(0.8\ \text{N/mm}^2 \times \sqrt{(f_{cu} / 1\ \text{N/mm}^2)}, 5\ \text{N/mm}^2) =$ **4.382** N/mm²

PASS - $v_{su} < v_c$ - No shear reinforcement required

Calculate ultimate punching shear force at face of column

Ultimate pressure for punching shear $q_{puA} = q_{1u}+[(L/2+e_{PxA}-l_A/2)+(l_A)/2]\times C_x/B-[(B/2+e_{PyA}-b_A/2)+(b_A)/2]\times C_y/L$ = **25.910** kN/m²

Average effective depth of reinforcement $d = (d_x + d_y) / 2$ = **750** mm

Area loaded for punching shear at column $A_{pA} = (l_A)\times(b_A)$ = **1.000** m²

Length of punching shear perimeter $u_{pA} = 2\times(l_A)+2\times(b_A)$ = **4000** mm

Ultimate shear force at shear perimeter $V_{puA} = P_{uA} + (F_u / A - q_{puA}) \times A_{pA}$ = **36.642** kN

Effective shear force at shear perimeter $V_{puAeff} = V_{puA}\times[1+1.5\times abs(M_{xuA})/(V_{puA}\times(b_A))]$ = **573.255** kN

Punching shear stresses at face of column (cl 3.7.7.2)

Design shear stress $v_{puA} = V_{puAeff} / (u_{pA} \times d)$ = **0.191** N/mm²

Allowable design shear stress $v_{max} = \min(0.8N/mm^2 \times \sqrt{(f_{cu} / 1 N/mm^2)}, 5 N/mm^2)$ = **4.382** N/mm²

PASS - Design shear stress is less than allowable design shear stress

Calculate ultimate punching shear force at perimeter of 1.5 d from face of column

Ultimate pressure for punching shear $q_{puA1.5d} = q_{1u}+[(L/2+e_{PxA}-l_A/2-1.5\times d)+(l_A+2\times 1.5\times d)/2]\times C_x/B-[(B/2+e_{PyA}-b_A/2-1.5\times d)+(b_A+2\times 1.5\times d)/2]\times C_y/L$ = **25.910** kN/m²

Average effective depth of reinforcement $d = (d_x + d_y) / 2$ = **750** mm

Area loaded for punching shear at column $A_{pA1.5d} = (l_A+2\times 1.5\times d)\times(b_A+2\times 1.5\times d)$ = **10.563** m²

Length of punching shear perimeter $u_{pA1.5d} = 2\times(l_A+2\times 1.5\times d)+2\times(b_A+2\times 1.5\times d)$ = **13000** mm

Ultimate shear force at shear perimeter $V_{puA1.5d} = P_{uA} + (F_u / A - q_{puA1.5d}) \times A_{pA1.5d}$ = **51.274** kN

Effective shear force at shear perimeter $V_{puA1.5deff} = V_{puA1.5d}\times[1+1.5\times abs(M_{xuA})/(V_{puA1.5d}\times(b_A+2\times 1.5\times d))]$ = **216.386** kN

Punching shear stresses at perimeter of 1.5 d from face of column (cl 3.7.7.2)

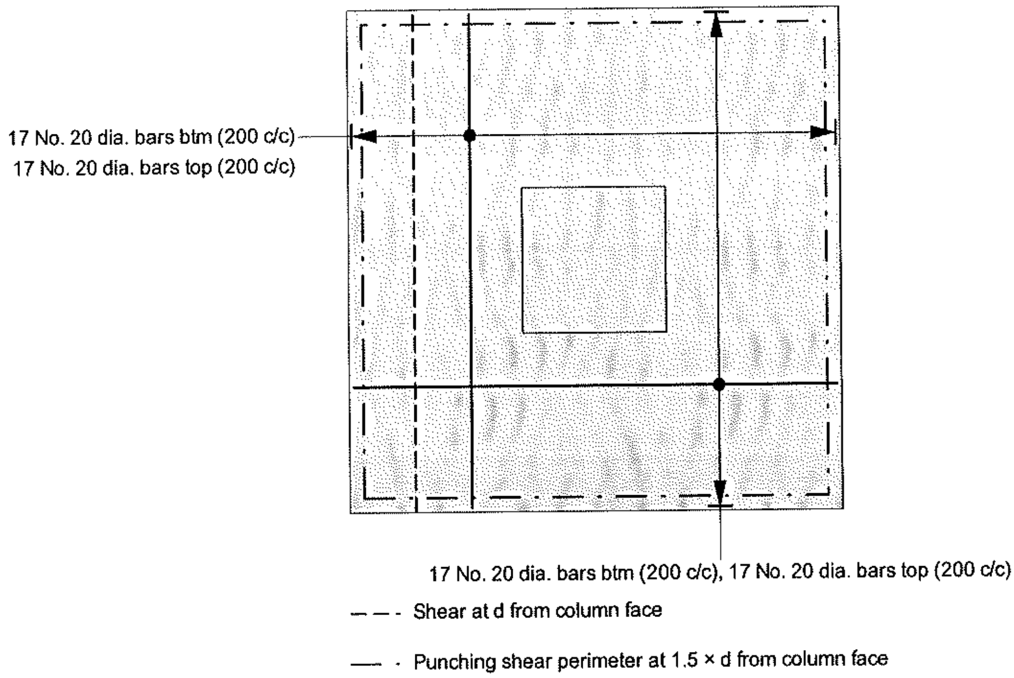
Design shear stress $v_{puA1.5d} = V_{puA1.5deff} / (u_{pA1.5d} \times d)$ = **0.022** N/mm²

From BS 8110:Part 1:1997 - Table 3.8

Design concrete shear stress $v_c = 0.79 N/mm^2 \times \min(3, [100 \times (A_{s\_xB\_prov} / (B \times d_x) + A_{s\_yB\_prov} / (L \times d_y)) / 2]^{1/3}) \times \max((800 mm / (d_x + d_y))^{1/4}, 0.67) \times (\min(f_{cu} / 1 N/mm^2, 40) / 25)^{1/3} / 1.25$ = **0.339** N/mm²

Allowable design shear stress $v_{max} = \min(0.8N/mm^2 \times \sqrt{(f_{cu} / 1 N/mm^2)}, 5 N/mm^2)$ = **4.382** N/mm²

PASS - $v_{puA1.5d}$ < v_c - No shear reinforcement required


17 No. 20 dia. bars btm (200 c/c)
17 No. 20 dia. bars top (200 c/c)
17 No. 20 dia. bars btm (200 c/c), 17 No. 20 dia. bars top (200 c/c)
Shear at d from column face
Punching shear perimeter at 1.5 × d from column face

Site Photos

Photo 1: Showing the proposed antenna & equipment concrete footing location

ANTENNA SCHEDULE

ANTENNA POST NO	P1			P2		
ANTENNA NO.	A1 (UPPER)	A2 (MIDDLE)	A3 (LOWER)	A4 (UPPER)	A5 (MIDDLE)	A6 (LOWER)
ANTENNA TYPE	MICROWAVE ANTENNA	MICROWAVE ANTENNA	MICROWAVE ANTENNA	MICROWAVE ANTENNA	MICROWAVE ANTENNA	MICROWAVE ANTENNA
BEARING (DEG)	-°	-°	-°	-°	-°	-°
DOWNTILT (DEG)	-°	-°	-°	-°	-°	-°
MICROWAVE ANTENNA SIZE=Ø675x558(D)mm WEIGHT=100kg						

ANCHOR SCHEDULE

ANCHOR TYPE	RECOMMENDED LOAD,S TENSION (kN)	TEST LOAD,S x 1.5 TENSION (kN)	EFFECTIVE ANCHORAGE DEPTH (mm)	MIN. BASE MATERIAL THICKNESS (mm)	MIN SPACING (mm)	EDGE DISTANCE (mm)
HST3-R-M8-47	2.8	4.2	47	80	35	40
HST3-R-M10-60	5	7.5	60	120	45	70

MARK SCHEDULE

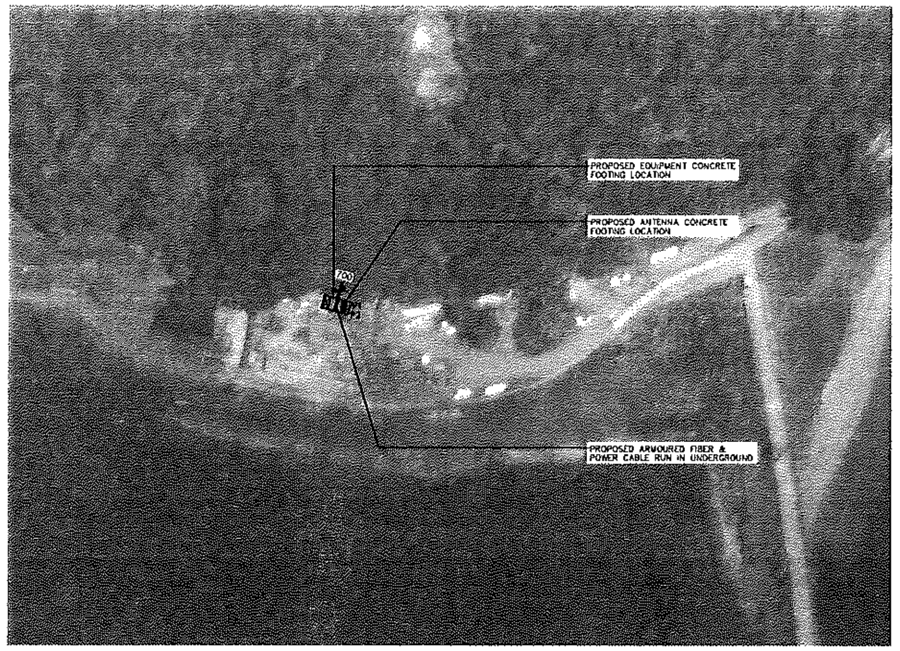
BEAM MARK	DESCRIPTION
C1 - C3	50x50x5mm THK ∠
-	Ø114.3x5mm THK. CHS
-	Ø168.3x8mm THK. CHS
-	Ø193.7x10mm THK. CHS
-	10mm THK. STEEL PLATE

LEGEND

PROPOSED BTS EQUIPMENT LOCATION

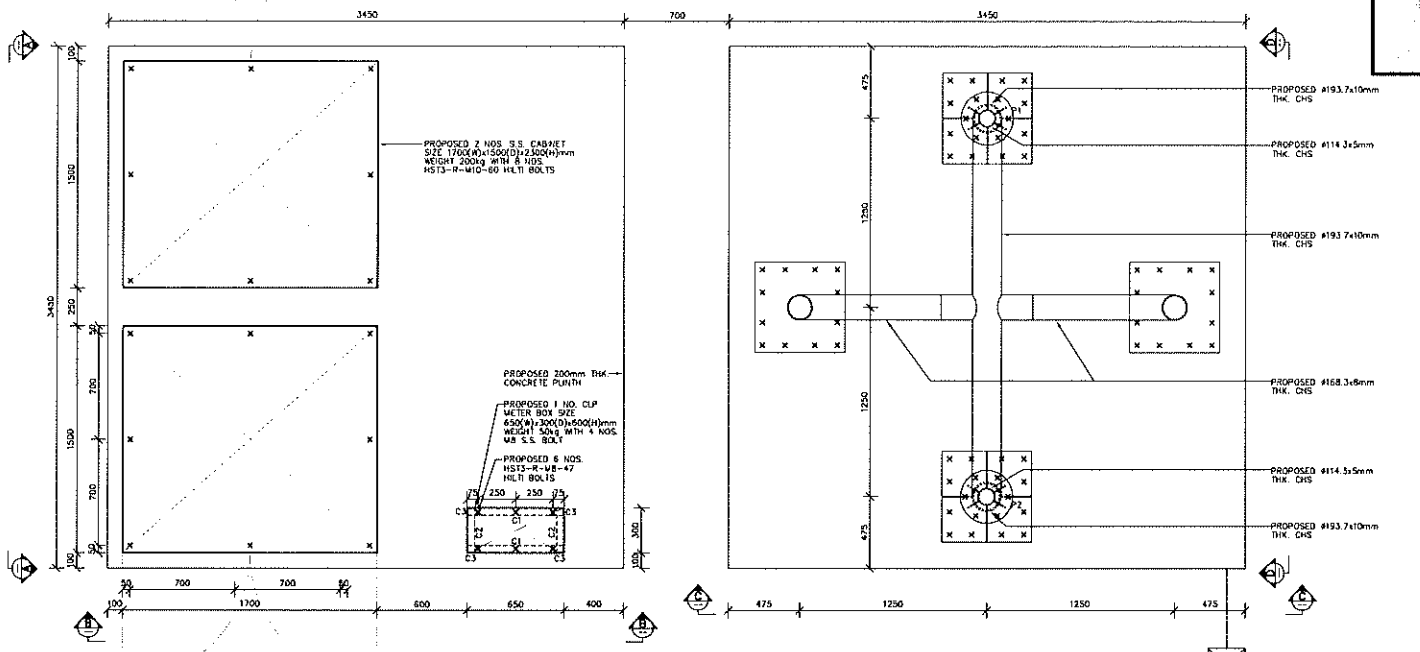
P1 PROPOSED ANTENNA POST P1 LOCATION

1 PHOTO MARK (PHOTO REFER TO REPORT FOR INFORMATION ONLY)



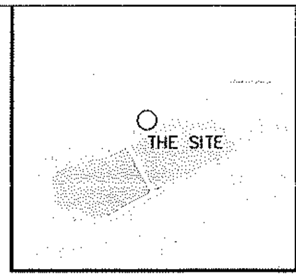
KEY PLAN

N.T.S.

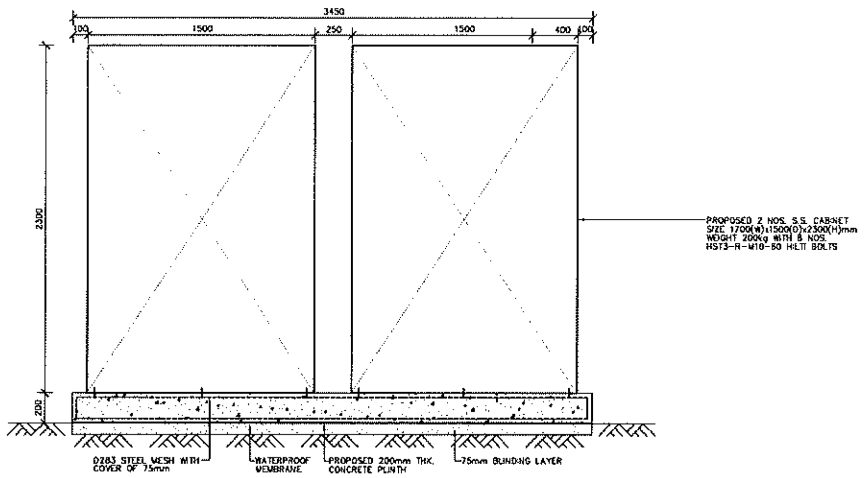


PLAN OF PROPOSED CONCRETE FOOTINGS

1 : 25

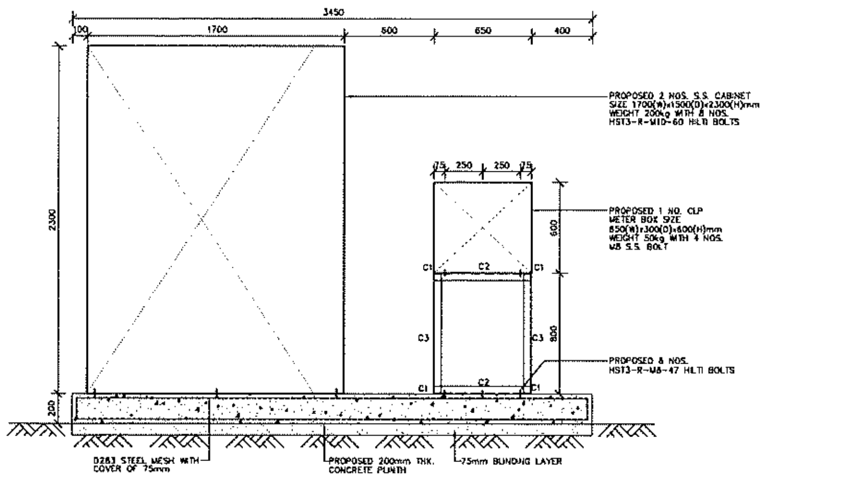


BLOCK PLAN



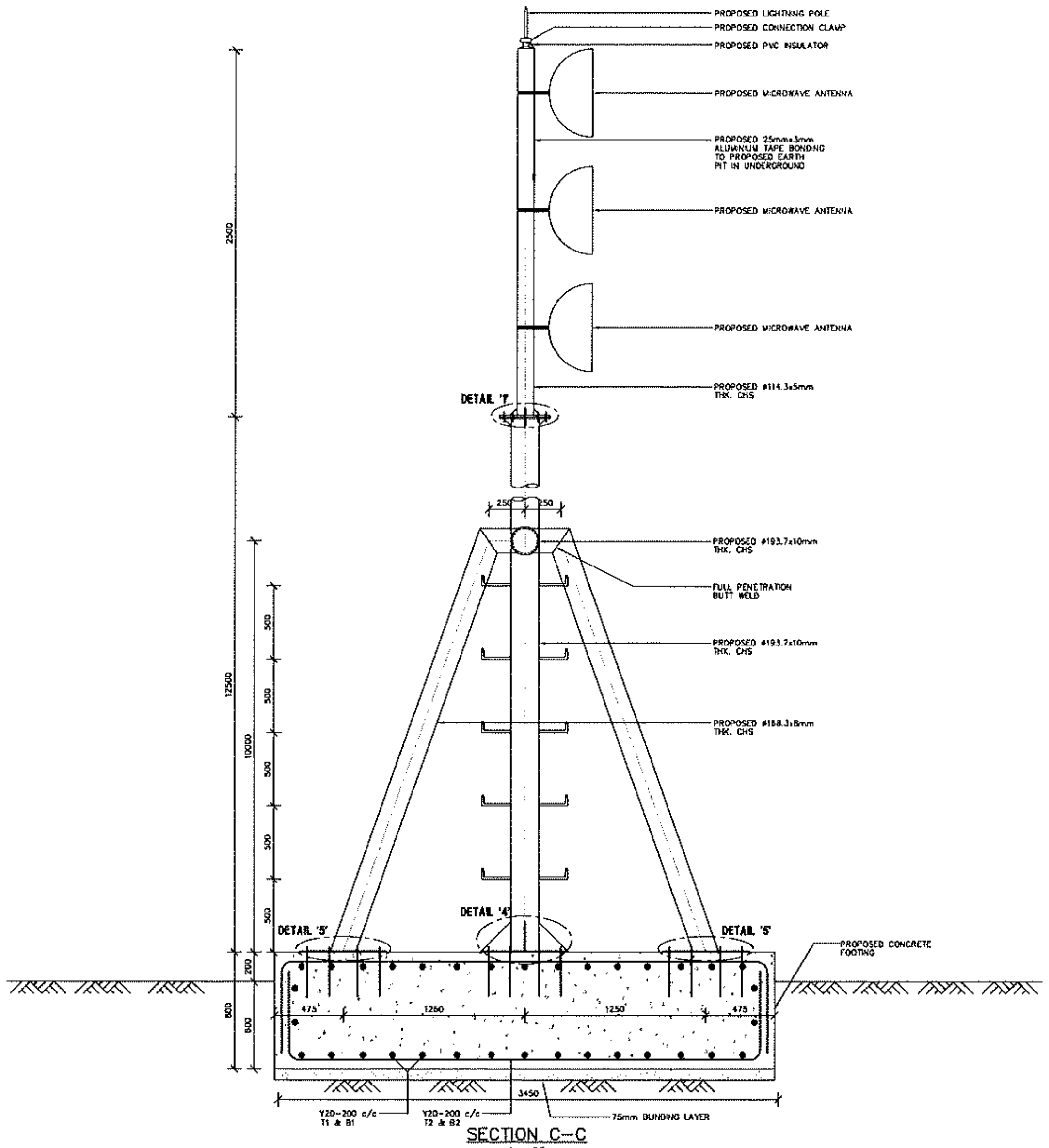
SECTION A-A

1 : 25



SECTION B-B

1 : 25



SECTION C-C

1 : 25

DO NOT SCALE DRAWINGS, VERIFY ALL DIMENSIONS ON SITE.

GENERAL NOTES :

1. ALL DIMENSIONS SHOWN ARE IN mm.
2. EXACT DIMENSIONS TO BE VERIFIED ON SITE.
3. ALL NEW STRUCTURAL STEEL WORK CHECKING COMPLY WITH THE CODE OF PRACTICE FOR THE STRUCTURAL USE OF STEEL 2011.
4. ALL STRUCTURAL STEEL SHALL BE CLASS 1 OF GRADE S275 MINIMUM TO BS EN 10025 PART 1-6 : 2004 STANDARD OR EQUIVALENT COMPLY WITH THE RELEVANT REFERENCE MATERIAL STANDARDS IN ANNEX A1.1 OF THE CODE OF PRACTICE FOR THE STRUCTURAL USE OF STEEL 2011.
5. ALL HOT FINISHED STRUCTURAL HOLLOW SECTIONS SHOULD COMPLY WITH BS EN 10210 PART 1:2006
6. ALL STRUCTURAL STEEL SHALL BE HOT-DIP GALVANIZED TO A COATING OF 85 MICRONS THICK AND TWO COATS OF ZINC RICH PRIMER SHALL BE APPLIED AFTER WELDING CONNECTION TO BS EN ISO 1461:2009.
7. ALL STEEL BOLT/STUD/NUT TO BE GRADE 8.8 COMPLY WITH BS EN ISO 3506 PART 1 & 2: 2009 (P_{sb}=375N/mm², P_{tb}=560N/mm².)
8. ALL WELDING SHALL BE IN ACCORDANCE WITH REQUIREMENT AS PER BS EN 1011 PART 1:2009 & PART 2:2001 (MIN. STRENGTH=220N/mm².)
9. MAX. IMPOSED LOADING :
   i) EQUIPMENT SELF WEIGHT = 450kg (MAX.)
10. WIND PRESSURE IS IN ACCORDANCE WITH CODE OF PRACTICE ON WIND EFFECTS HONG KONG 2019.
    DESIGN WIND PRESSURE=1.35kPa, Cf=1.20 FOR EQUIPMENT.
    DESIGN WIND PRESSURE=1.82kPa, Cf=1.80 FOR ANTENNA
11. THE DESIGN AND CONSTRUCTION OF THE PROPOSED WORK SHALL COMPLY WITH THE BUILDINGS ORDINANCE, BUILDING REGULATIONS AND FIRE SAFETY IN BUILDINGS 2011.
12. ALL HILTI ANCHOR BOLTS SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATION.
13. UNLESS OTHERWISE STATED, ALL ANCHOR BOLTS ARE HILTI TYPE AS SPECIFIED BELOW:
    HST3-R-M12-70
    MIN. EMBEDMENT LENGTH
    12mm DIAMETER ANCHOR
    ANCHOR TYPE
14. ADDITIONAL PLASTIC SHEET WASHER SHOULD BE PROVIDE BETWEEN S.S. BOLT & GMS STEEL.
15. ALL PLASTER TO BE 25mm THICK CEMENT : SAND = 1 : 3.
16. ALL METAL SURFACE SHALL BE CLEANED THOROUGHLY TO REMOVE ALL DIRT, WELD SPLATTER, GREASE AND THE LIKE. CHIP, SCRAPE AND WIRE-BRUSH TO REMOVE LOOSE SCALE UNTIL BACK TO CLEAN METAL. REMOVE SURFACE FILE OF MILL AND BRUSH WITH DETERGENTS.
17. CHIP OFF THE PLASTER FROM THE FACE OF THE R.C. MEMBERS TO BE IN CONTACT WITH THE STEEL MEMBERS BEFORE INSTALLING.
18. ALL WELDING TO BE 5mm FILLET WELD ALL ROUND UNLESS OTHERWISE STATED.
19. ROUTING SHOULD BE ADJUSTED ON SITE TO AVOID CROSSING ON EXISTING SERVICE DUCTS. ALL CONDUIT SHALL BE IN G.I.
20. ADEQUATE EARTHING PROTECTION SHALL BE PROVIDED.
21. ALL ELECTRICAL WORK SHALL COMPLY WITH THE CURRENT COP, IEE AND POWER COMPANY REGULATION.
22. POWER SUPPLY SHOULD BE 200A TPN CLP METER.
23. NAME PLATE SHOULD BE PROVIDED ON ALL PROPOSED EQUIPMENT CABINET, COAXIAL CABLES, CONDUITS AND FACILITIES FOR EASY IDENTIFICATION.
24. ALL NEW CONCRETE USED TO BE DESIGNED MIXED 300/20.
23 CONCRETE COVER TO MAIN REINFORCEMENT TO BE 75mm FOR FOOTING.

REV	DESCRIPTION	DATE	BY	CHK'D	APP

創域工程有限公司

JEG Engineering Co. Ltd.

1/F, Blk E, Cheong Fat Factory Bldg., 346 Fuk Wing St., Cheung Sha Wan, Kln.
TEL : 2117 9500 FAX : 3103 8077 E-MAIL : jeg@jeg-ltd.com

CLIENT :

HGC 環電

GLOBAL COMMUNICATIONS

PROJECT :

SO LO PUN (APPLICATION FOR BLOCK LICENSE)

DRAWING TITLE :

DETAILS OF TRANSMISSION MICROWAVE ANTENNA

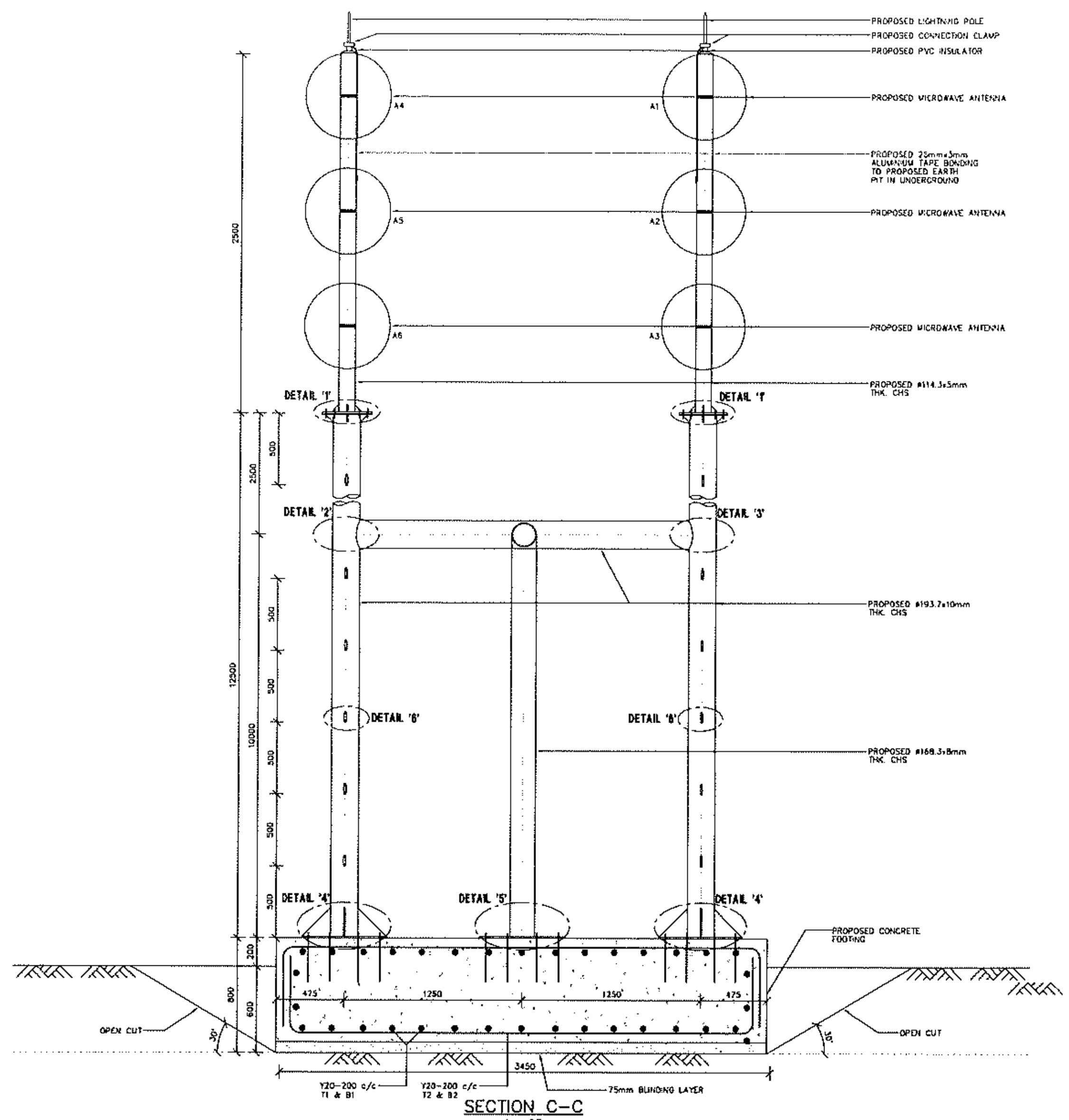
SCALE AT A1	DESIGNED : A. CHAN	DRAWN : S.M.	CHECKED : G.C.
AS SHOWN	APPROVED : A. CHAN	DATE : 29 FEB., 2024	
PROJECT No. J8009	DRAWING No. : S2693-1		REV. -

Chan Lit Ming (RSE 18/00)
Registered Structural Engineer

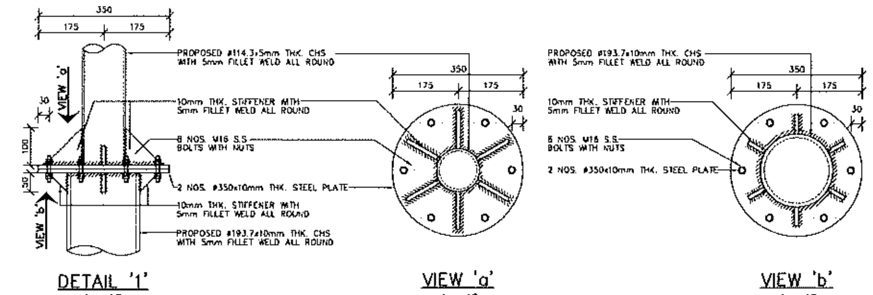
DO NOT SCALE DRAWINGS, VERIFY ALL DIMENSIONS ON SITE.

NOTES :

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH DRAWING S2693-1
1. NOTES REFER TO DRAWING NO. S2693-1



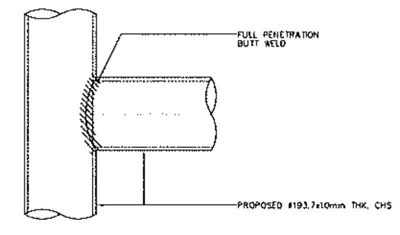
SECTION C–C
1 : 25



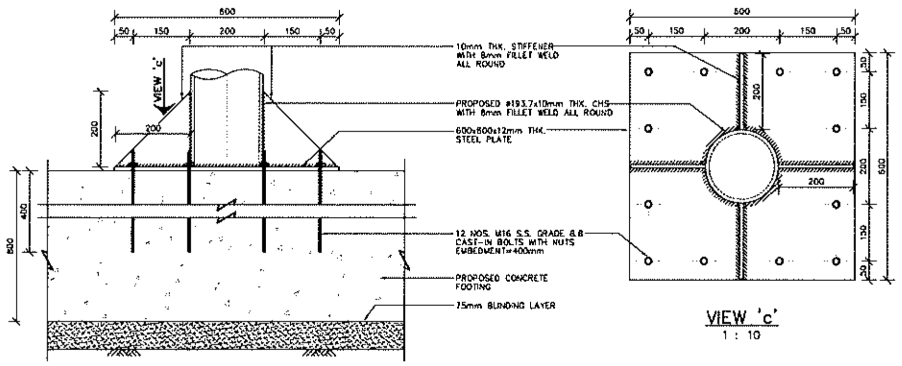
DETAIL '1'
1 : 10

VIEW 'a'
1 : 10

VIEW 'b'
1 : 10

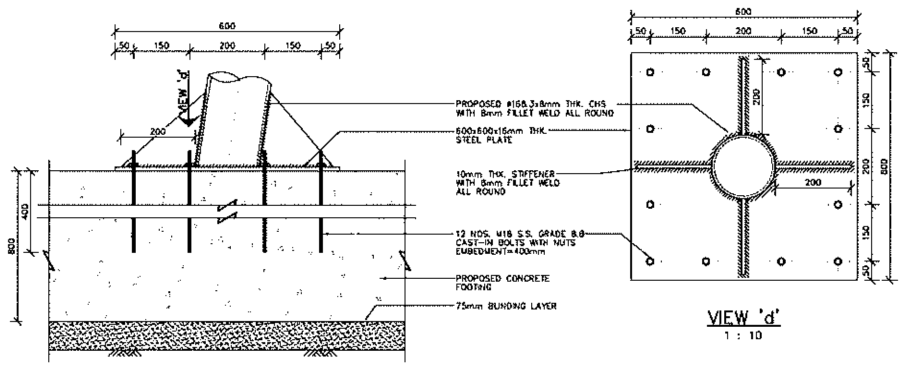


DETAIL '2'
(SIMILAR TO DETAIL '3'
BUT HANDED)
1 : 10



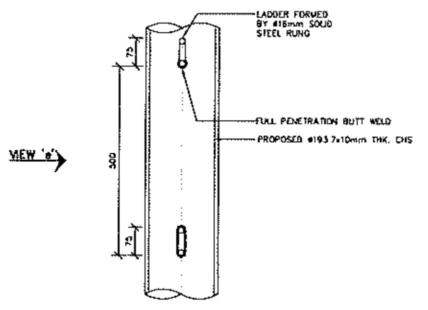
DETAIL '4'
1 : 10

VIEW 'c'
1 : 10

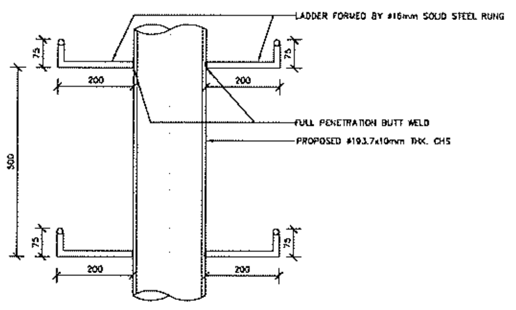


DETAIL '5'
1 : 10

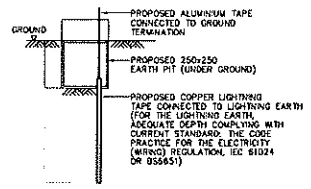
VIEW 'd'
1 : 10



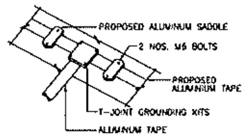
DETAIL '6'
1 : 10



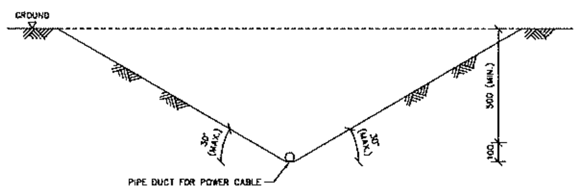
VIEW 'e'
1 : 10



DETAIL FOR PROPOSED LIGHTNING
PIT AT GROUND LEVEL
(FOR INFORMATION ONLY)
1 : 20



PROPOSED EARTH TAP
MOUNTING DETAIL
N.T.S.



TYPICAL OPEN CUT SECTION FOR
UNDERGROUND PIPE DUCT INSTALLATION
1 : 20

REV	DESCRIPTION	DATE	BY	CHK'D	APP

創域工程有限公司
JEG Engineering Co. Ltd.
1/F, Blk E, Cheung Fat Factory Bldg., 346 Fuk Wing St., Cheung Sha Wan, Kln.
TEL : 2117 9500 FAX : 3103 8077 E-MAIL : jeg@jeg-ltd.com

CLIENT :

HGC 環電
GLOBAL COMMUNICATIONS

PROJECT :

SO LO PUN
(APPLICATION
FOR BLOCK LICENSE)

DRAWING TITLE :

DETAILS OF TRANSMISSION
MICROWAVE ANTENNA

SCALE AT A1	DESIGNED :	DRAWN :	CHECKED :
AS SHOWN	A. CHAN	S.M.	G.C.
	APPROVED : A. CHAN	DATE : 29 FEB., 2024	
PROJECT No. J8009	DRAWING No. : S2693-2		REV. –

Chan Lit Ming (RSE 18/00)
Registered Structural Engineer