美 特 鋁 質 有 限 公 司
MIDI ALUMINIUM FABRICATOR LTD.

工程指示 / 要求簡箋(E.I.)

工程指示編號：EI / 6001 / 23　　修改版次：

工程編號　：J - 858　　工程名稱　：將軍澳日出康城 11

工程項目　：幕牆 地盆用配件 M12 拉爆 (30 粒) Monorail (U 碼固定方案)

收件人　：林哥　　發件人　：Ant Yeung　　日 期 ：13/04/2023

☐要求提供 / ☐確認 事項

( ) 初步鋁料 B.M.　( ) 加工拆圖，然後生產　( ) 尺寸表

( ) 正式鋁料 B.M.　( ) 技術上資料 / 指示　( ) 報價

( ) 配件 B.M.　( ) 樣辦或貨品說明書　( ) 分判合約

內容 ：

請提供 Hilti HST3-R 拉爆 M12 x115 mm 長 (30 粒) 送地盆
供 Monorail (U 碼固定方案) 使用
已計數

請在 **2023.04.25** 前完成上列要求。謝謝!

附：

☐ 原合約工程包　☐ 原合約工程加 / 減賬　☐ 新工程報價

分發東莞各部門 ：

( )生產技術總監☐連附件 ( )技術部 ☐連附件 ( )生產部 ☐連附件 ( )機械設計部☐連附件

( )採購部 ☐連附件 ( )生產統籌部☐連附件 ( ) 小羅&清 ☐連附件

( )質檢部 ☐連附件 ( )會計部 ☐連附件 ( )報關組 ☐連附( )其他 水洪 楊榮輝☐連附件

分發香港各部門

( )行政部☐連附件 ( )會計部☐連附件 (✓)統籌部☑連附件 ( )工程部地盤科文 鍾 ☑連附件、

( )採購部☐連附件 ( )QS 部 ☐連附件 ( )維修部☐連附件 ( )其他 _____☐連附件

傳遞編號：　　發件人簽署：

HK / 23　　項目經理簽署：

DWG-SHT-ISSUE CK-1284-X1

TITLE
MONORAIL DETAIL AT LP11

JOB/CLIENT

DESIGNED	KEITH	SCALES	NFS
DRAWN	KL	JOB N°	CK-1284
CHECKED		DRAWN	2023/04/11
DWG FILE	CK-1284-X1	ISSUED	–

CHINA KING ENGINEERING LIMITED
華光工程有限公司

ISSUE	DATE	BY	CHECK	AMENDMENT DETAILS

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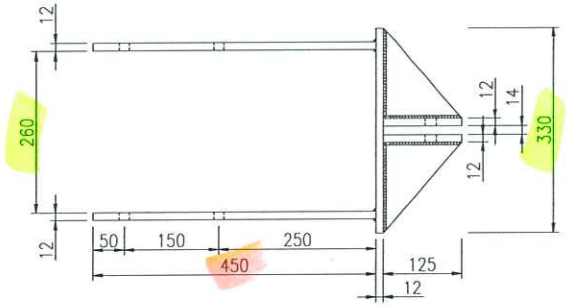
QTY: 1



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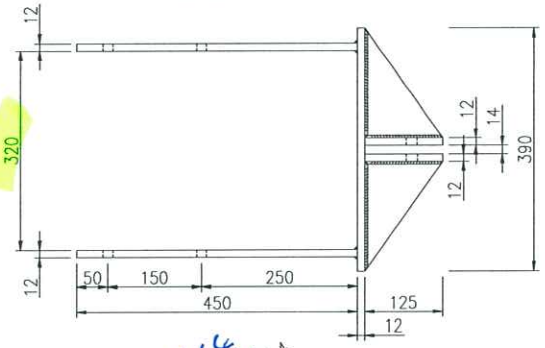
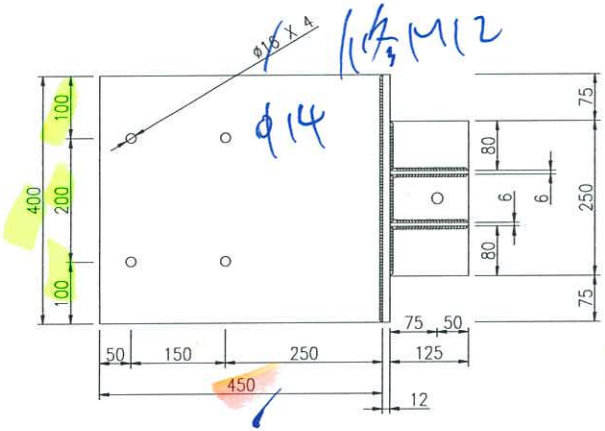
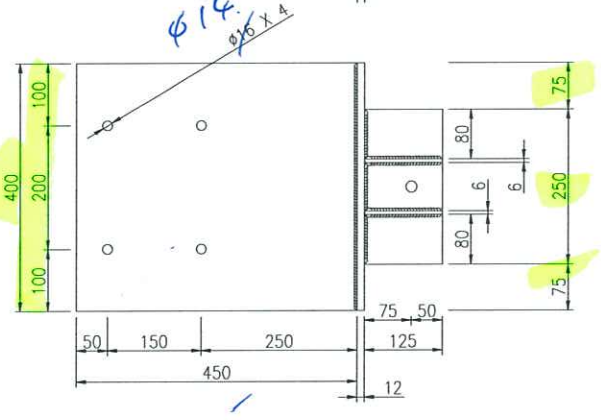
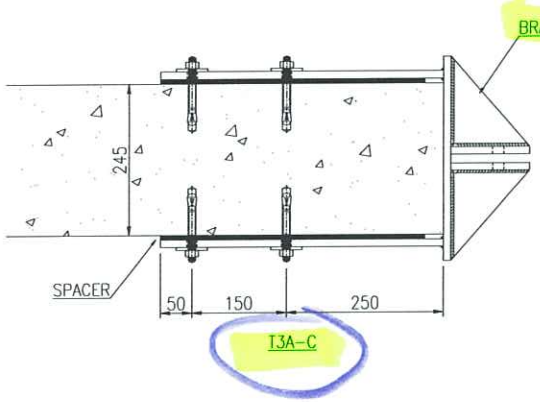
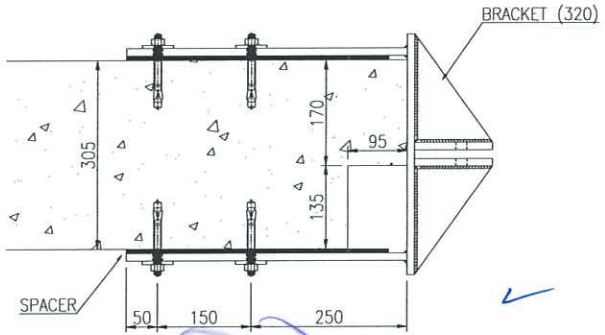




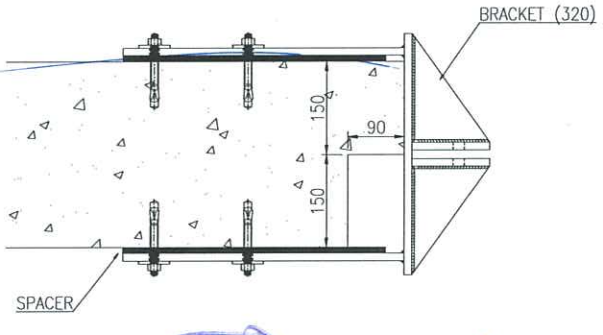




T3A-C

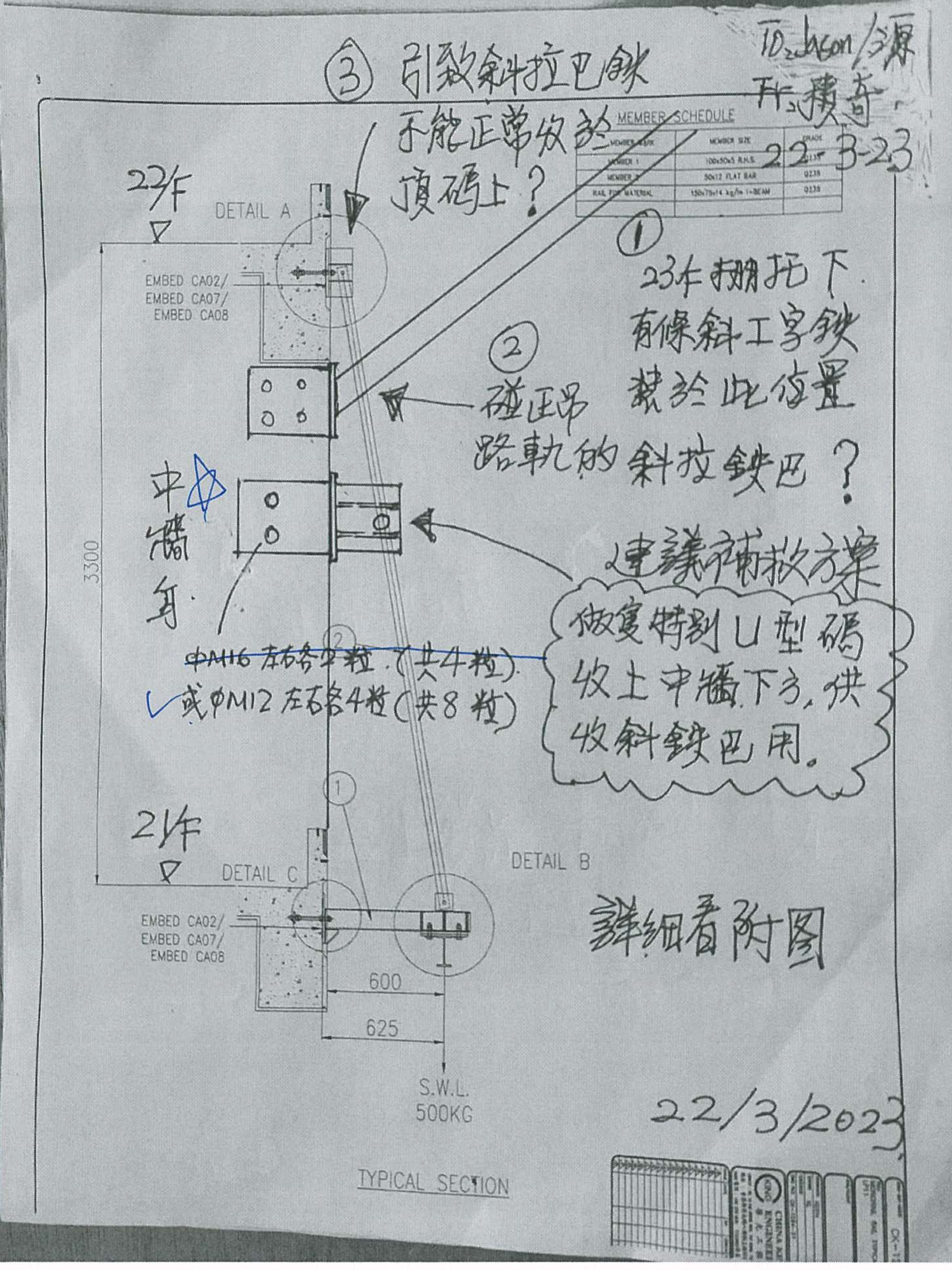


T3B-A



T2B-A

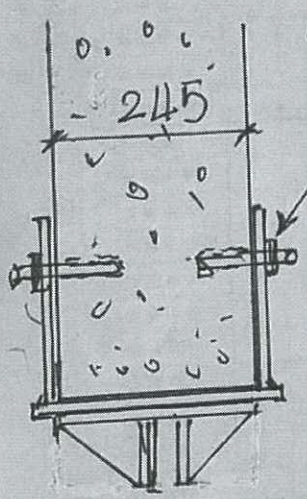
T2 地3 吊工字路軌鉄巴受阻.



T2/T3 中墙特别U型砖安装示意图

P3/5

T3A-C



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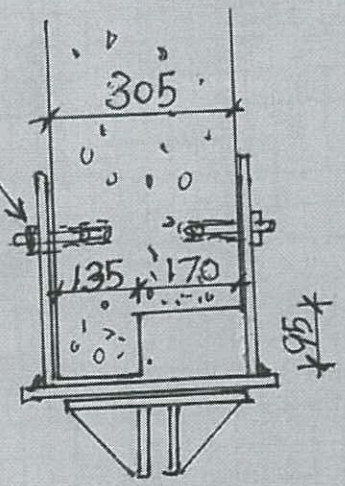
T3B-A



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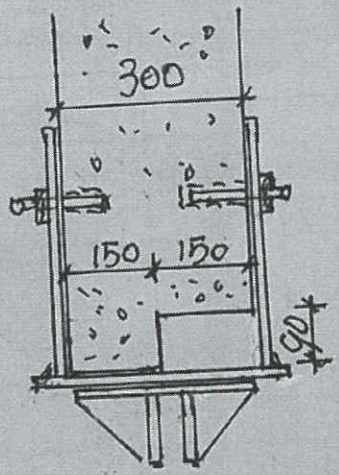
T2B-A

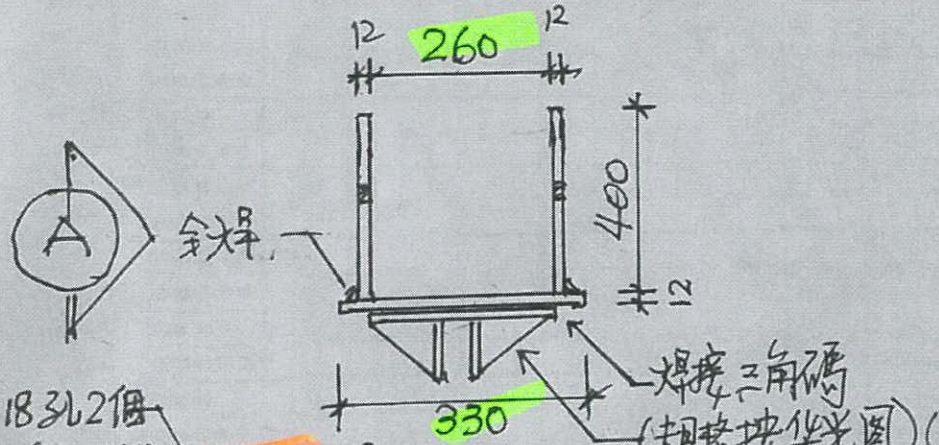


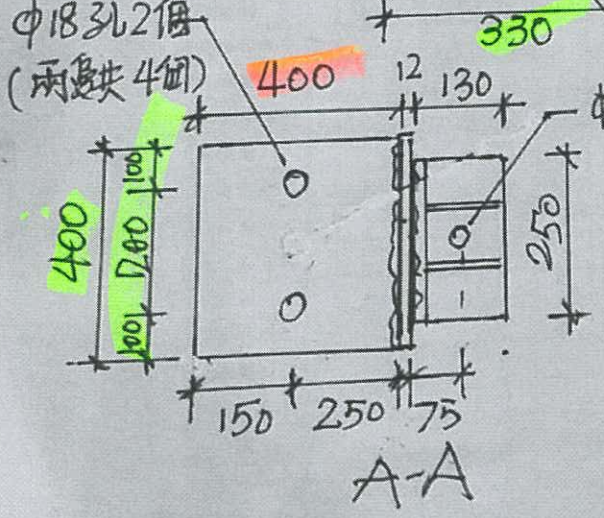
#2

註：是否可用左右各4粒中M12拉爆

22/3/2023

特别铁鸡加工图。

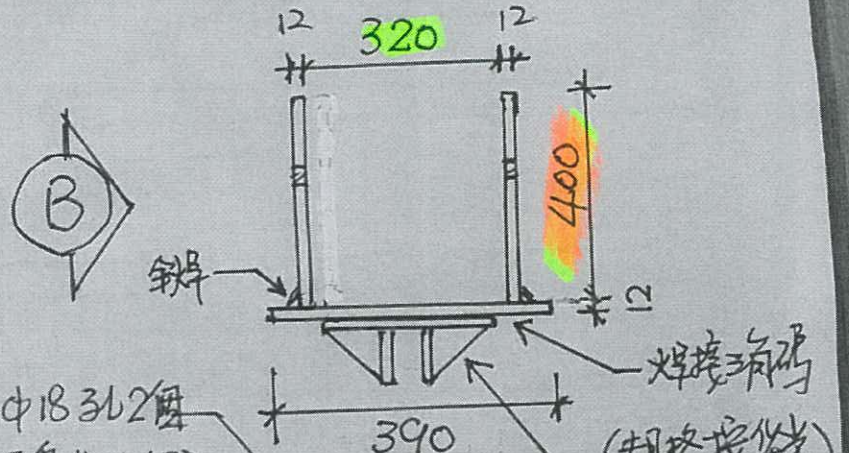


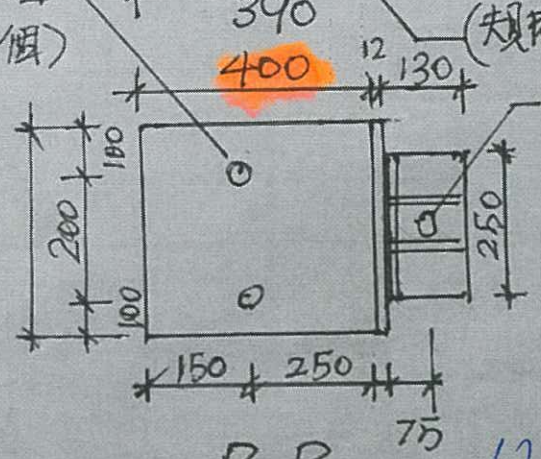


A-A

#1

数量：1隻(T3A-C用)



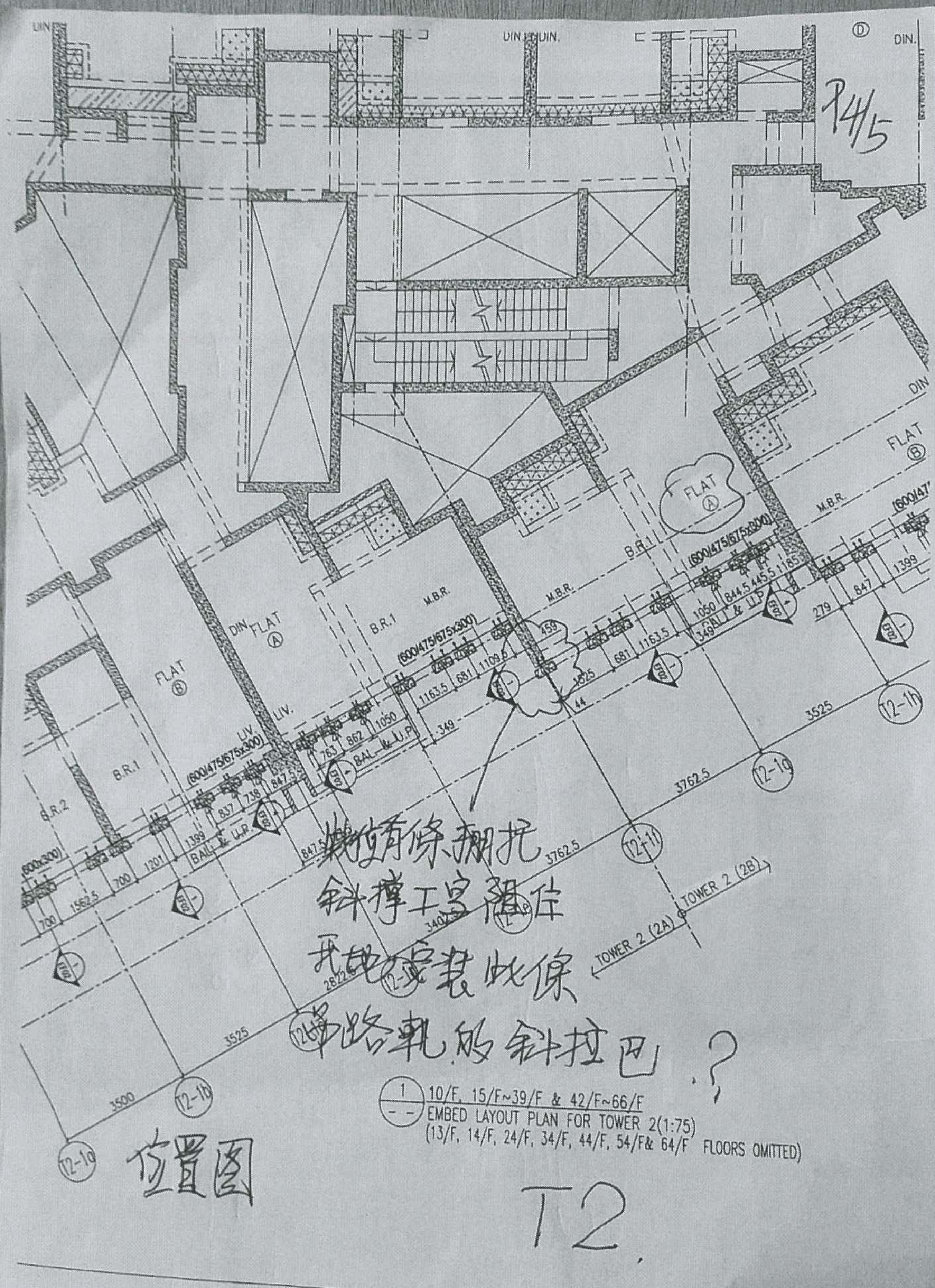


B-B

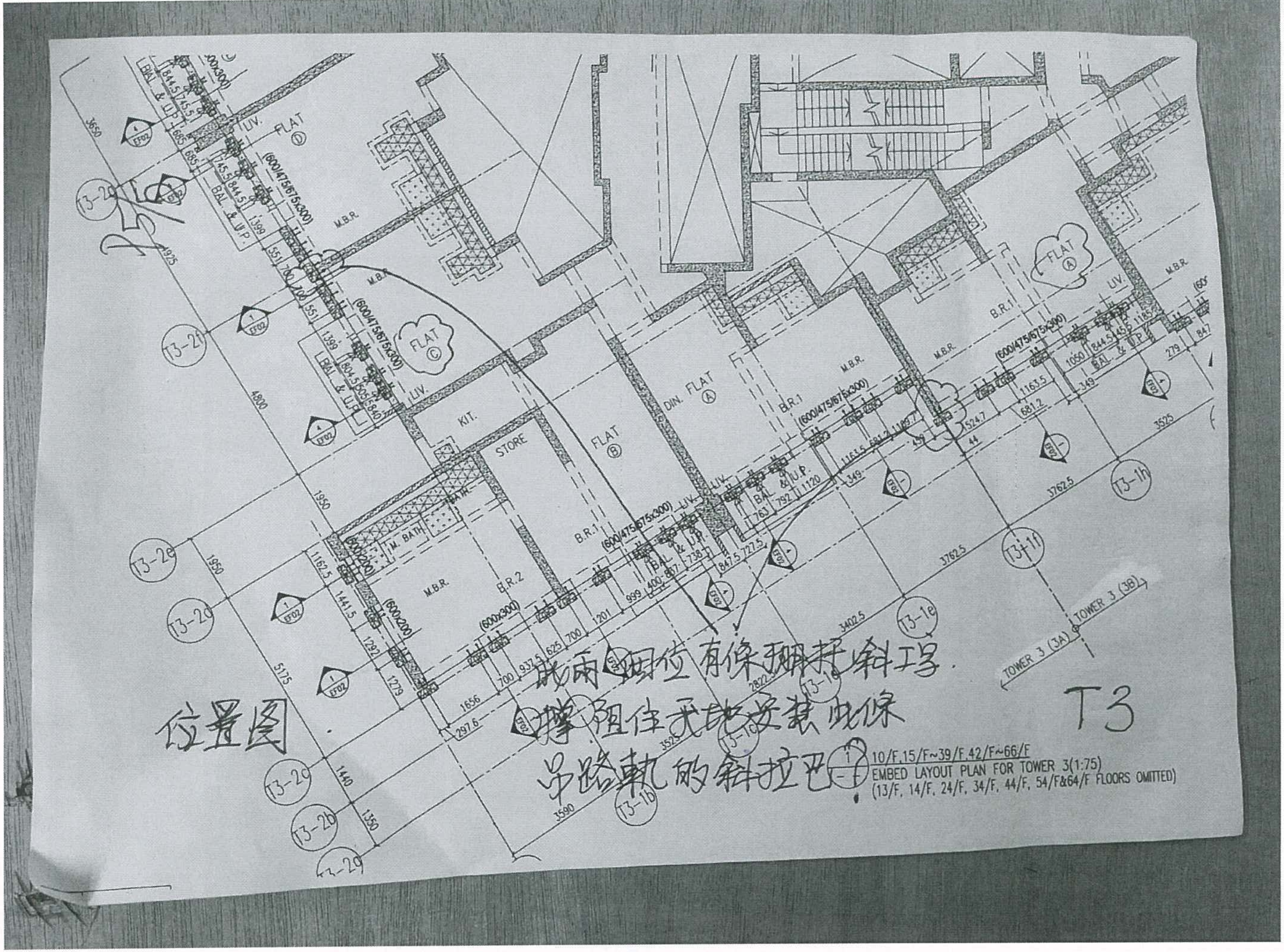
#2

数量：2隻(T3B-A用)
(T2B-A用)

22-3-2023



1 10/F, 15/F~39/F & 42/F~66/F
EMBED LAYOUT PLAN FOR TOWER 2(1:75)
(13/F, 14/F, 24/F, 34/F, 44/F, 54/F& 64/F FLOORS OMITTED)


位置圖
T3
TOWER 3 (3A)
TOWER 3 (3B)
FLAT A
FLAT B
FLAT C
FLAT D
M.B.R.
B.R.1
B.R.2
LIV.
DIN.
KIT.
STORE
M. BATH
BAL. & U.P.
10/F,15/F~39/F,42/F~66/F
EMBED LAYOUT PLAN FOR TOWER 3(1:75)
(13/F, 14/F, 24/F, 34/F, 44/F, 54/F&64/F FLOORS OMITTED)

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Date : 12th April, 2023	**Design Calculation for Monorail System**	Ref. CKT-1284-02
Revision No.: -		

PROJECT: LP11

****

Design Calculation

OF

Special bracket FOR Monorail System

(Typical floor)

****

Prepared By : Kelvin Lai Date : 2023-04-12	Approved By : Date :

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1.0 Design Standards and References

i. Hong Kong Buildings (Construction) Regulations

ii. Code of Practice for Structural Use of Steel 2011

iii. Code of Practice on Wind Effects in Hong Kong 2004

iv. Code of Practice for Dead and Imposed Loads 2011

v. Code of Practice for Structural Use of Concrete 2013

vi. Code of Practice for Safe Use and Operation of Suspended Working Platform

2.0 Material Properties

i. All Mild Steels:-

- Shall be grade Q235 in compliance with GB 50017.
- Design Strength, p_y = 215 N/mm^2
- Modulus of elasticity, E = 205 kN/mm^2

ii. The I-Beam rail:-

- Shall be grade min. Q235 in compliance with GB 50017.
- Design Strength, p_y = 215 N/mm^2
- Modulus of elasticity, E = 205 kN/mm^2

iii. Grade 8.8 Bolt & Nuts:-

- All bolts shall be grade 8.8 in compliance with BS 3692:2001.
- Tensile Strength of Bolt, p_t = 560 N/mm^2
- Shear Strength of Bolt, p_s = 375 N/mm^2

iv. Design Weld:-

- Shall be complied with GB 50017.
- Design Strength of weld = 160 N/mm^2

v. Con. Grade of R.C. Structures:- C45/20, f_{cu} = 45 N/mm^2

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3.0 Design Loads on rail for hoisting the material

(i) Dead load

The weight of the material winch with chain		=	200 kg
Combined with dynamic effect (25%)	= 200kg x 1.25 x 9.81	=	2.45 kN

(ii) Imposed Load

Safety Working (S.W.L.) (Actual S.W.L. to be used = 625kg x 0.8 = 500kg)		=	625 kg
Combined with dynamic effect (25%)	= 625kg x 1.25 x 9.81	=	7.66 kN

(iii) Wind Load

Refer to the COP for Safe use and operation of suspended working platform section 5.2.3, the suspended working platform in its operating position should be designed to withstand the sustained wind speed up to 14m/s and gust up to 31m/s.

Design gust wind speed under operation position, V_z		=	31 m/s
Pressure = $1 / 2 \times \rho \times V_z^2$	= $(1 / 2) \times 1.2 \times (31m/s)^2$	=	0.58 kPa
Design material projected area	~ 0.6m(W) x 3.0m(L)	=	1.8 m^2
Force coefficient, C_f	= 2		
Wind load	= 0.58 x 1.8 x 2	=	2.1 kN

(iv) Total load (unfactored) (DL+LL+WL) = 2.45 kN + 7.66 kN + 2.1 kN = 12.21 kN

3.1 Load Combination

(a) Load case 1 – 1.2 x dead load + 1.2 live load + 1.2 x wind load

Characteristic load on suspension point

= 1.2 x (2.45kN + 7.66 kN + 2.1 kN) = 14.7 kN

(b) Load case 2 – 1.4 x dead load + 1.6 live load

Characteristic load on suspension point

= 1.4 x 2.45kN + 1.6 x 7.66 kN = **15.7 kN**

(c) Load case 3 – 1.4 x dead load + 1.4 wind load

Characteristic load on suspension point

= (1.4 x 2.45 kN + 1.4 x 2.1 kN) = 6.37 kN

∴ **Load case 2 is adopted**

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3.2 Strength Check of the member 150x75x14kg/m I-beam

- Design load = **15.7 kN** will be used for checking

-	Max. Span of Beam, L	=	2000	mm			
-	Shear Force, V_x	=	15.7	kN			
-	Horizontal Force, V_y (10% of V_x)	=	15.7	kN	x	10%	
		=	1.6	kN			
-	Axial Force, F_T (10% of V_x)	=	15.7	kN	x	10%	
		=	1.6	kN			
-	Bending Moment, M_x	=	V_x	x	L	/	4
		=	15.7	x	2.0	/	4
		=	**7.85 kNm**				
-	Bending Moment, M_y	=	F_h	x	L	/	4
		=	1.6	x	2.0	/	4
		=	**0.8 kNm**				
-	Bending Moment, M_x	=	V_x	x	L		
	(Cantilever at end)	=	15.7	x	0.3		
		=	4.71 kNm				
-	Bending Moment, M_y	=	F_h	x	L		
	(Cantilever at end)	=	1.7	x	0.3		
		=	0.5 kNm				

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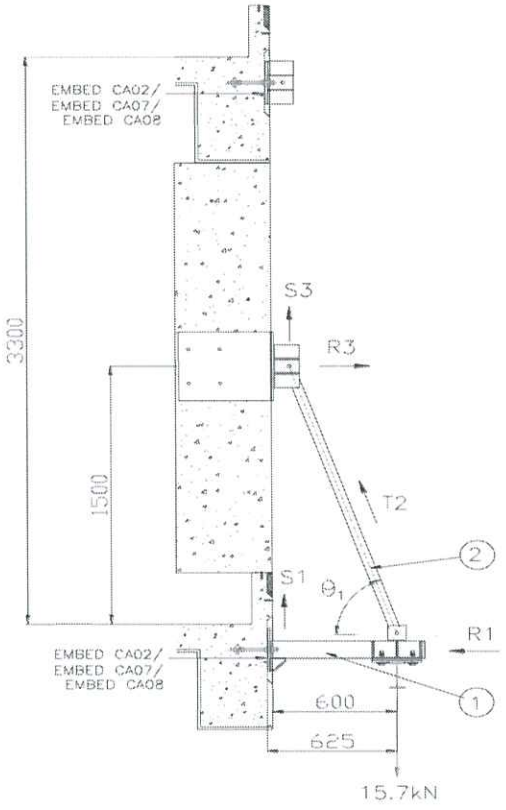
4.0 Special bracket



θ_1 $= \tan^{-1}(1500 / 600)$ $= 68^\circ$

Max. Load (P) = 15.7 kN

Force on each Member

Member 2, T2 = 15.7 kN / $\sin \theta_1^\circ$ = 16.9 kN

Member 1, R1 = 15.7 kN / $\tan \theta_1^\circ$ + 10% x P = 7.9 kN

Reaction Force on upper support

S3 = P = 15.7 kN

R3 = R1 = 7.9 kN (Tension)

Reaction Force on lower support

S1 = P = 15.7 kN

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4.1 Strength Check of the 100x50x5mm thk. R.H.S. (Q235)) - Member 1

A. Section Properties

D =	100	mm	I_{xx} =	167	cm^4	r_x =	34.8	cm
B =	50	mm	I_{yy} =	54.3	cm^4	r_y =	19.9	cm
t =	5	mm	Z_{xx} =	33.3	cm^3			
mass =	10.8	kg/m	Z_{yy} =	21.7	cm^3			
d/t =	17		S_{xx} =	42.6	cm^3			
b/t =	7		S_{yy} =	25.8	cm^3	A =	13.7	cm^2

B. Material Properties

E	=	205000	N/mm^2
p_y	=	215	N/mm^2

C. Section Classification

$\varepsilon = \sqrt{275/p_y}$ = 1.13

b / T =	7	<	28ε	→	Class 1 Plastic
d / t =	17	<	64ε	→	Class 1 Plastic

D. Checking of Shear Capacity

Shear area, A_{vx}	=	2td	=	850	mm^2
Shear area, A_{vy}	=	2BT	=	1050	mm^2
Shear Capacity, P_{vx}	=	$\frac{p_y A_{vx}}{\sqrt{3}}$	=	93.1	kN
Shear Capacity, P_{vy}	=	$\frac{p_y A_{vy}}{\sqrt{3}}$	=	130.3	kN
0.6 P_{vx}			=	55.9	kN
			>	15.7	kN ∴OK
0.6 P_{vy}			=	78.2	kN
			>	1.6	kN ∴OK

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E. Checking of Compression Resistance

Compressive force on member 1	=	R1	=	7.9 kN
L_E	=	625 mm		
$\lambda = L_E / r$	=	625 / 19.9		
	=	31		
From Table 8.8e				
Compressive strength, p_c	=	207 N/mm^2	(From Table 8.8e)	
Area, A	=	1370 mm^2	(100 x 50 x 5 mm thick RHS)	
Compression capacity	=	p_c x A	=	284 kN
			>	7.9 kN ∴OK

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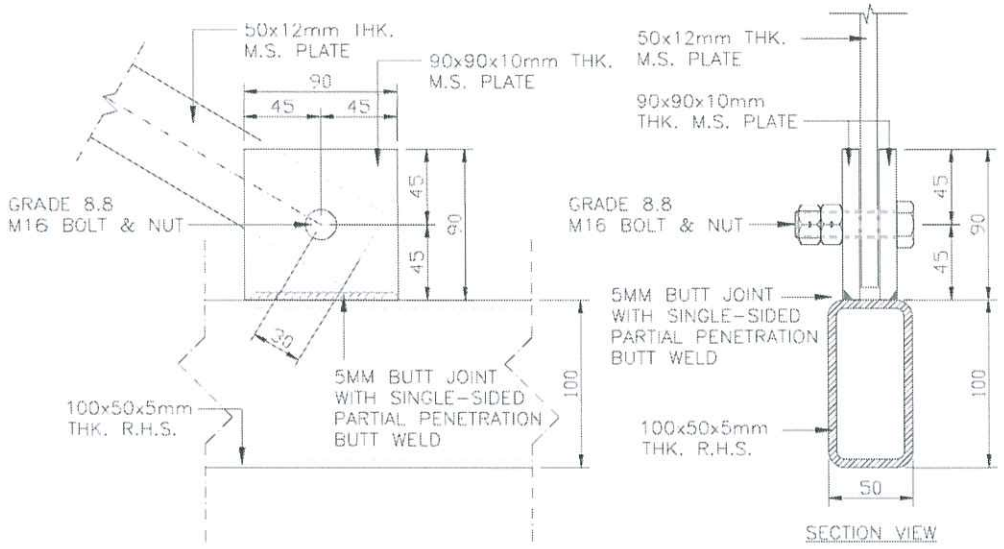
4.2 Strength Check of the 50x12mm thk. Flat Bar (Q235)) - Member 2



4.3 Strength Check of the 50x12mm thk. Flat Bar (Q235))

Tensile area, A	=	0.9 x (50-18) x 12	=	345.6 mm^2		
Tension Capacity	=	p_y x A	=	74.3 kN	>	16.9 kN ∴OK

4.4 Strength Check of the Grade 8.8 M16 connection through bolt

Shear Face, n			=	2		
Shear Force per face, V'	=	V / n	=	8.45 kN		
Shear Area of Bolt, A_s			=	201 mm^2		
Shear strength, p_s			=	375 N/mm^2		
Shear capacity, Ps	=	ps As	=	75.4 kN		
			>	8.45 kN		∴OK

4.5 Bearing capacity of bolt check

Diameter of bolt, d			=	16 mm		
Thickness of Plate, t_p			=	12 mm		
Bearing Strength, p_{bb}			=	828 N/mm^2		
Bearing Capacity, P_{bb}	=	d t_p p_{bb}	=	159 kN		
			>	16.9 kN		∴OK

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4.6 Bearing capacity of connected parts (Grade Q235)

Diameter of bolt, d			=	16 mm	
Thickness of Plate, t_p			=	12 mm	
Bearing Strength, p_{bs}			=	215 N/mm^2	
Edge Distance, e			=	45 mm	
Bearing Capacity, p_{bb}	=	d t_p p_{bs}	=	34.4 kN	
			>	16.9 kN	∴OK
Bearing Capacity, p_{bb}	=	0.5 e t_p p_{bs}	=	32.3 kN	
			>	16.9 kN	∴OK

4.7 Checking of 10 mm thk. M.S. connecting plate (Grade Q235)

Horizontal Force, H_T	=	R1	=	7.9 kN	
Number of Plate, n			=	2	
Eccentric, e			=	45 mm	
Eccentric Moment, M_e	=	H_T / n x e	=	0.2 kNm	
Width of Plate, b			=	90 mm	
Thickness of Plate, t			=	10 mm	
Design Strength, py			=	215 N/mm^2	
Section Modulus, Z	=	t b^2 / 6	=	13500 mm^3	
Moment Capacity, M_c	=	p_y Z	=	2.9 kNm	
			>	0.2 kN	∴OK

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4.8 Checking of Weld connection

Provide 5 mm single sides of penetration weld

Number of Plate, n			=	2	
Vertical Force, P	=	16.9 kN / n	=	8.45 kN	
Horizontal Force, F_H	=	R1 / n	=	4 kN	
Eccentric Moment, M_e			=	0.2 kNm	
Area of Weld, A_w	=	(90-2s) x 0.707s	=	283 mm^2	
Moment of Inertial, I_w	=	$(90-2s)^3$ / 12 x 2 x 0.707s	=	301653 mm^4	
Load due to Shear, F_s	=	F_H / A_w	=	14.3 N/mm^2	
Load due to Tension, F_{T1}	=	P / A_w	=	30.2 N/mm^2	
Load due to Moment, F_{T2}	=	M y / I_w	=	29.8 N/mm^2	
Resultant Load, FR	=	$((F_{T1} + F_{T2})^2 + Fs^2)^{1/2}$	=	61.7 N/mm^2	
Weld Strength, p_w			=	160 N/mm2	
Weld Capacity, P_w	=	0.707 x s x p_w	=	566 N/mm^2	
			>	61.7 N/mm^2	∴OK

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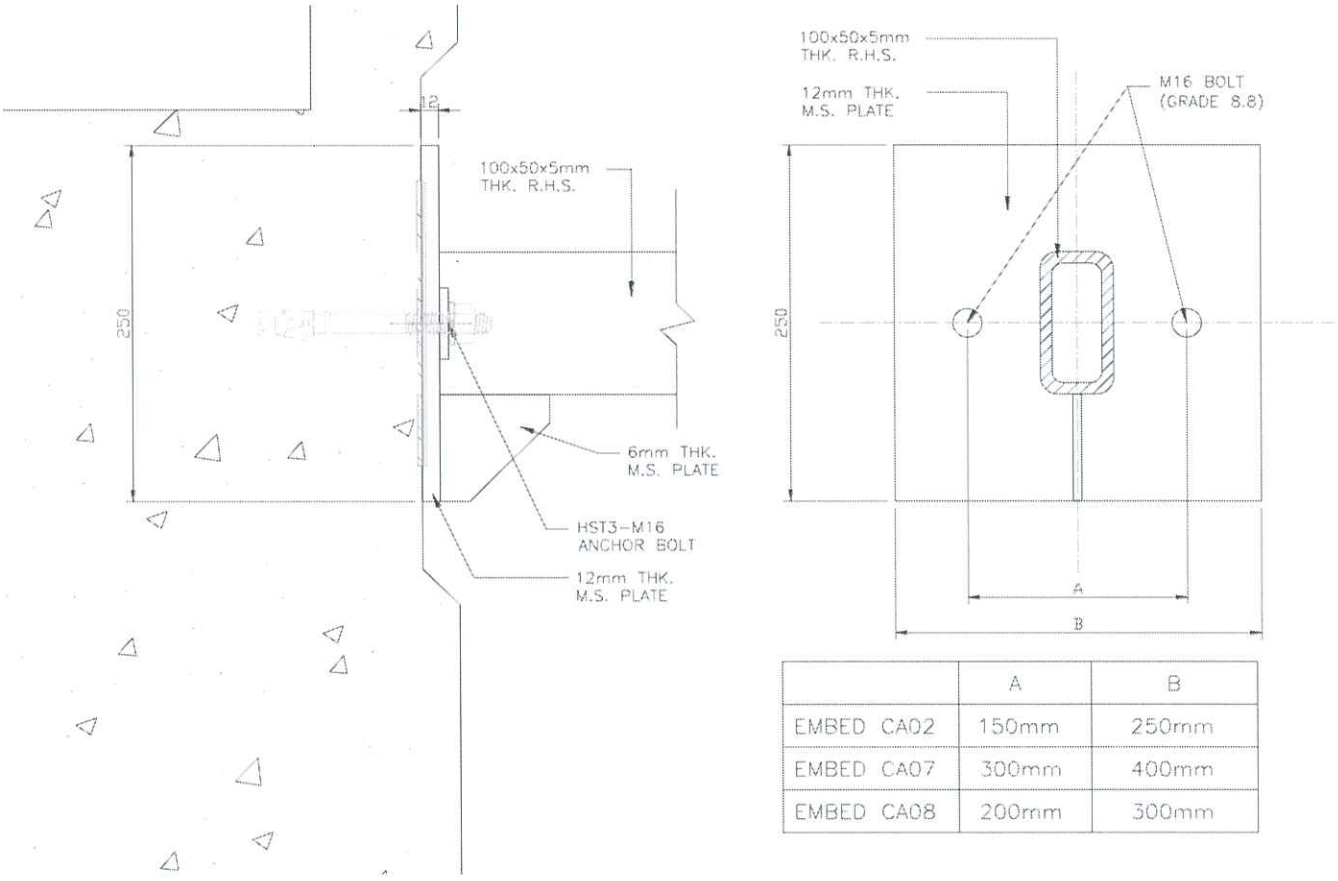
3.0 Strength check on 2 nos. of Grade 8.8 M16 bolt at the lower support



	A	B
EMBED CA02	150mm	250mm
EMBED CA07	300mm	400mm
EMBED CA08	200mm	300mm

3.1. Checking 2 nos. of HST3-M16 Anchor bolt at one side by official online software (F.O.S. =3)

Max. shear force on lower support = 15.7 kN

Detail please refer to the **APPENDIX A** ∴Pass

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3.2 Bearing capacity of connected parts (Grade Q235)

Diameter of bolt, d			=	16 mm	
Thickness of Plate, t_p			=	12 mm	
Bearing Strength, p_{bs}			=	215 N/mm^2	
Edge Distance, e			=	50 mm	
Bearing Capacity, p_{bb}	=	d t_p p_{bs}	=	41.3 kN	
			>	15.7 kN	∴OK
Bearing Capacity, p_{bb}	=	0.5 e t_p p_{bs}	=	64.5 kN	
			>	15.7 kN	∴OK

3.3 Checking of Weld connection, provide 5 mm fillet weld (100x50x5mm R.H.S. and 12mm THK. base plate)

Length of weld, L	=	2 x (100 +50)	=	300 mm	
Area of Weld, A_w	=	L x 0.707s	=	1061 mm^2	
Load due to Shear, F_s	=	16.9 kN / A_w	=	16 N/mm^2	
Weld Strength, p_w			=	160 N/mm2	
Weld Capacity, P_w	=	0.707 x s x p_w	=	566 N/mm^2	
			>	15.7 N/mm^2	∴OK

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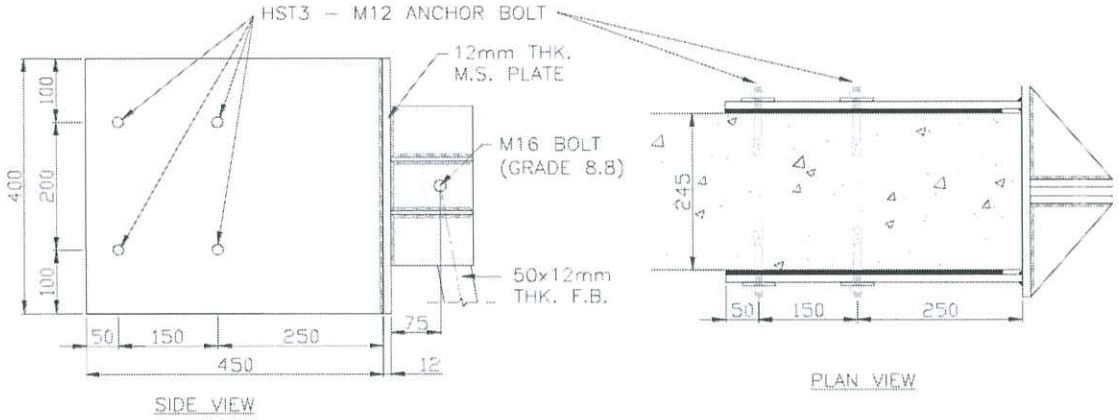
4.0 8 nos. of HST3-M12 anchor bolt will be used at the upper support



Shear force (Outside) = 7.9 kN

Shear force (downward) = 15.7 kN

A. Checking 4 nos. of HST3-M12 Anchor bolt at one side by official online software (F.O.S. =3)

Shear force (Outside) = 7.9 kN / 2 = 3.95 kN

Shear force (download) = 15.7 kN / 2 = 7.9 kN

Detail please refer to the **APPENDIX B** ∴Pass

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4.4 Checking of Weld connection, provide 5 mm single sides of penetration weld

Number of Plate, n			=	2	
Vertical Force, P	=	16.9 kN / n	=	8.45 kN	
Horizontal Force, F_H	=	7.9 kN / n	=	4 kN	
Eccentric Moment, M_e	=	P x 0.075 m	=	0.63 kNm	
Area of Weld, A_w	=	(250-2s) x 0.707s	=	848 mm^2	
Moment of Inertial, I_w	=	$(250-2s)^3$ / 12 x 2 x 0.707s	=	8144640 mm^4	
Load due to Shear, F_s	=	P / A_w	=	10 N/mm^2	
Load due to Tension, F_{T1}	=	F_H / A_w	=	4.7 N/mm^2	
Load due to Moment, F_{T2}	=	$M y / I_w$	=	9.7 N/mm^2	
Resultant Load, FR	=	$((F_{T1} + F_{T2})^2 + Fs^2)^{1/2}$	=	47 N/mm^2	
Weld Strength, p_w			=	160 N/mm2	
Weld Capacity, P_w	=	0.707 x s x p_w	=	566 N/mm^2	
			>	47 N/mm^2	∴OK

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Appendix A

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Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	CK-1284-02A	Date:	12/4/2023
Fastening point:			

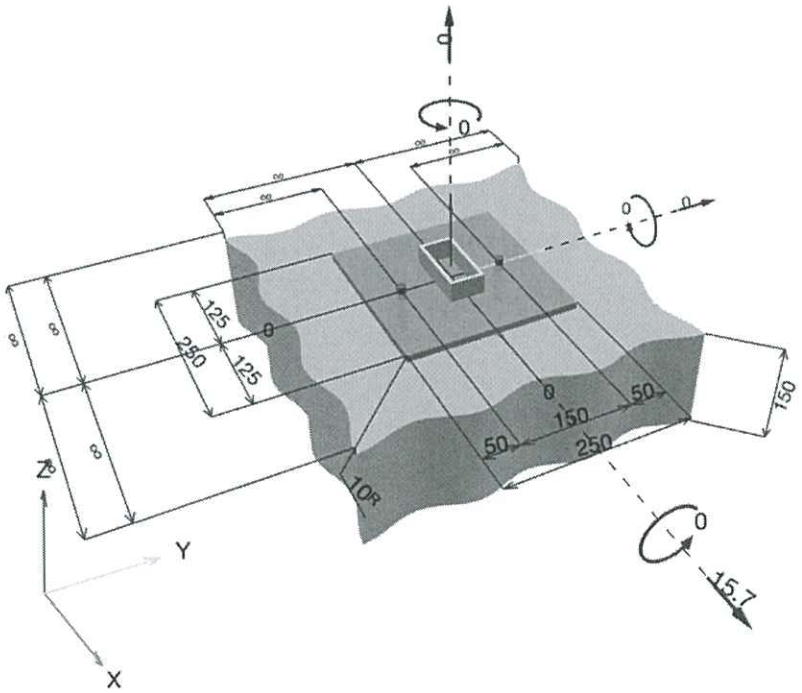
Specifier's comments:

1 Input data

Anchor type and diameter:	**HST3 M12 hef1**
Return period (service life in years):	50
Item number:	2113978 HST3 M12x85 10/-
Effective embedment depth:	h_{ef} = 50.0 mm, h_{nom} = 60.0 mm
Material:	
Evaluation Service Report:	ETA-98/0001
Issued I Valid:	13/7/2020 | -
Proof:	Based on design method ETAG (No. 001 Annex C/2010) with a load factor 2 and global safety factor 3
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 = 250.0 mm x 250.0 mm x 10.0 mm; (Recommended plate thickness: not calculated)
Profile:	Rectangular hollow, 100 x 50 x 5,0; (L x W x T) = 100.0 mm x 50.0 mm x 5.0 mm
Base material:	cracked concrete, C35/45, $f_{c,cube}$ = 45.00 N/mm^2; h = 150.0 mm
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	no reinforcement or reinforcement spacing >= 150 mm (any Ø) or >= 100 mm (Ø <= 10 mm) no longitudinal edge reinforcement

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

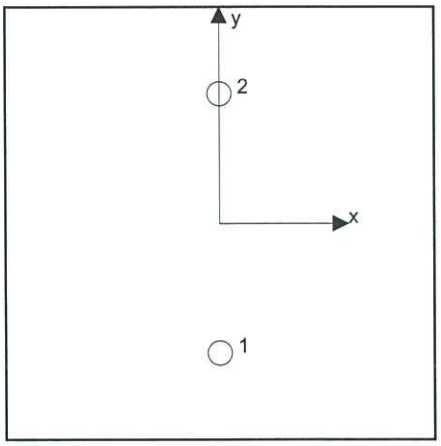
Geometry [mm] & Loading [kN, kNm]



1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 0.000; V_x = 15.700; V_y = 0.000; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	no	70

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	0.000	7.850	7.850	0.000
2	0.000	7.850	7.850	0.000

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [N/mm^2]
resulting tension force in (x/y)=(0.0/0.0): 0.000 [kN]
resulting compression force in (x/y)=(0.0/0.0): 0.000 [kN]

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

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Fastening point:			

3 Tension load (Based on ETAG, Annex C, Section 5.2.2 FOS = 3)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	N/A	N/A	N/A	N/A
Splitting failure**	N/A	N/A	N/A	N/A

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

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Design:	CK-1284-02A	Date:	12/4/2023
Fastening point:			

4 Shear load (Based on ETAG, Annex C, Section 5.2.3 FOS = 3)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	7.850	11.333	70	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	15.700	31.648	50	OK
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

4.1 Steel Strength (without lever arm)

$V_{Sd} \leq V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{M,s}}$ ETAG 001 Annex C, Table 5.2.3.1

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
34.000	3.000	11.333	7.850

4.2 Pryout Strength

$V_{Sd} \leq V_{Rd,cp} = \frac{V_{Rk,cp}}{\gamma_{M,c,p}}$		ETAG 001 Annex C, Table 5.2.3.1
$V_{Rk,cp}$	$= k \cdot N_{Rk,c}$	ETAG 001 Annex C, Eq. (5.6)
$N_{Rk,c}$	$= N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec1,N} \cdot \psi_{ec2,N}$	ETAG 001 Annex C, Eq. (5.2)
$N^0_{Rk,c}$	$= k_1 \cdot \sqrt{f_{ck,cube}} \cdot h_{ef}^{1,5}$	ETAG 001 Annex C, Eq. (5.2a)
$A^0_{c,N}$	$= s_{cr,N} \cdot s_{cr,N}$	ETAG 001 Annex C, Eq. (5.2b)
$\psi_{s,N}$	$= 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}} \leq 1.00$	ETAG 001 Annex C, Eq. (5.2c)
$\psi_{re,N}$	$= 0.5 + \frac{h_{ef}}{200} \leq 1.00$	ETAG 001 Annex C, Eq. (5.2d)
$\psi_{ec1,N}$	$= \frac{1}{1 + \frac{2 \cdot e_{c1,V}}{s_{cr,N}}} \leq 1.00$	ETAG 001 Annex C, Eq. (5.2e)
$\psi_{ec2,N}$	$= \frac{1}{1 + \frac{2 \cdot e_{c2,V}}{s_{cr,N}}} \leq 1.00$	ETAG 001 Annex C, Eq. (5.2e)

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k-factor
45,000	22,500	75.0	150.0	2.780

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

$N^0_{Rk,c}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Sd} [kN]
17.076	3.000	31.648	15.700

Group anchor ID
1, 2

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Fastening point:			

5 Displacements (highest loaded anchor)

Short term loading:

N_{Sk}	=	0.000 [kN]	δ_N	=	0.0000 [mm]
V_{Sk}	=	5.815 [kN]	δ_V	=	0.9292 [mm]
			δ_{NV}	=	0.9292 [mm]

Long term loading:

N_{Sk}	=	0.000 [kN]	δ_N	=	0.0000 [mm]
V_{Sk}	=	5.815 [kN]	δ_V	=	1.4087 [mm]
			δ_{NV}	=	1.4087 [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!

6 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!
- Checking the transfer of loads into the base material is required in accordance with ETAG 001, Annex C(2010)Section 7! The software considers that the grout is installed under the anchor plate without creating air voids and before application of the loads.
- The design is only valid if the clearance hole in the fixture is not larger than the value given in Table 4.1 of ETAG 001, Annex C! For larger diameters of the clearance hole see Chapter 1.1. of ETAG 001, Annex C!
- 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.
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening meets the design criteria!

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Phone I Fax:	|	E-Mail:	
Design:	CK-1284-02A	Date:	12/4/2023
Fastening point:			

7 Installation data

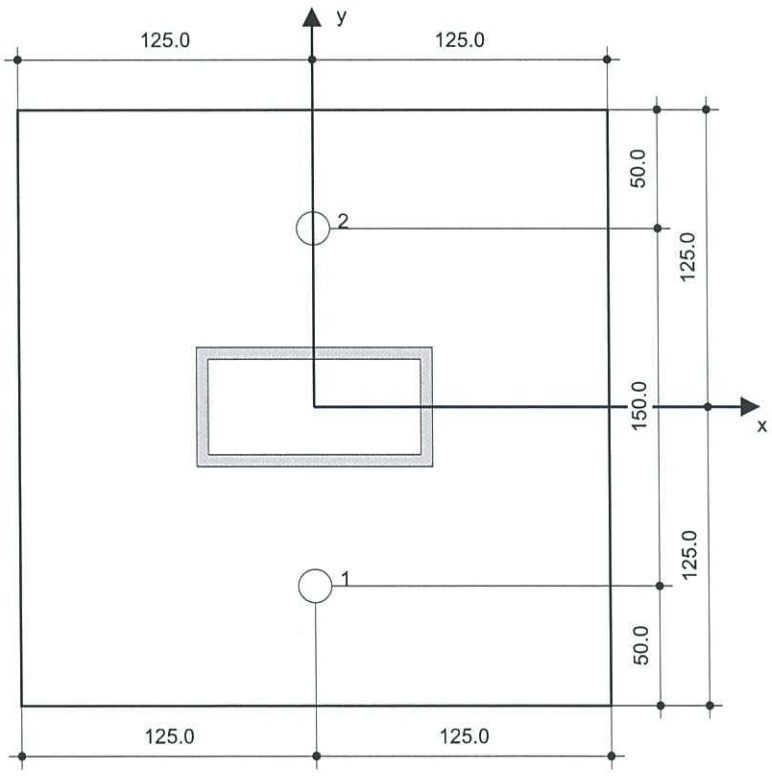
Anchor plate, steel: EN S235; E = 205,000.00 N/mm^2; f_{yk} = 235.00 N/mm^2
Profile: Rectangular hollow, 100 x 50 x 5,0; (L x W x T) = 100.0 mm x 50.0 mm x 5.0 mm
Hole diameter in the fixture: d_f = 14.0 mm
Plate thickness (input): 10.0 mm
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: HST3 M12 hef1
Item number: 2113978 HST3 M12x85 10/-
Maximum installation torque: 60 Nm
Hole diameter in the base material: 12.0 mm
Hole depth in the base material: 68.0 mm
Minimum thickness of the base material: 100.0 mm

Hilti HST3 stud anchor with 60 mm embedment, M12 hef1, Steel galvanized, installation per ETA-98/0001

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Hilti SIW 6AT-A22 + SI AT-A22 • Torque wrench • Hammer

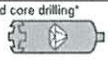


Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.0	-75.0	-	-	-	-
2	0.0	75.0	-	-	-	-

8 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 (agap=1)

9 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.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

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Appendix B

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Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	CK-1284-02B	Date:	12/4/2023
Fastening point:			

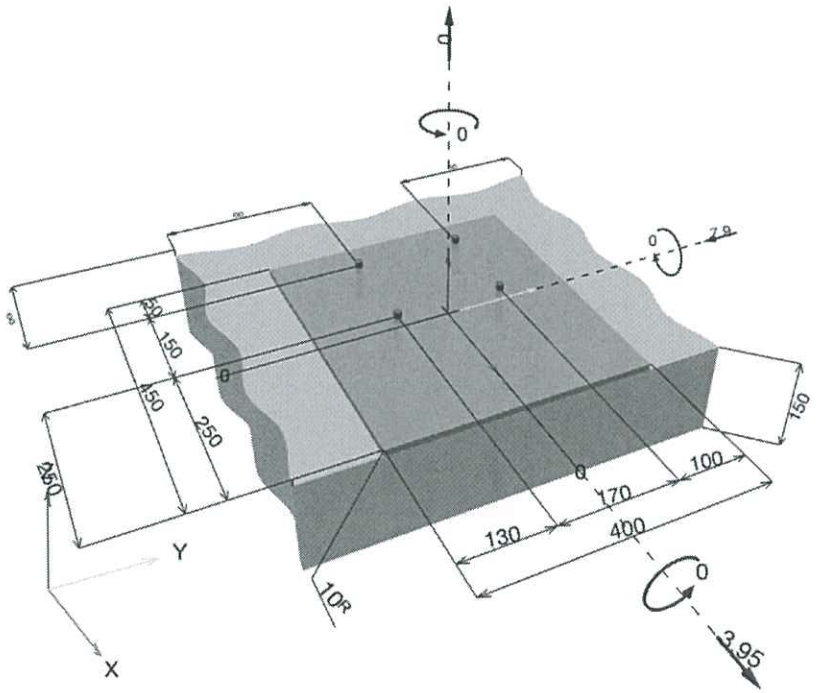
Specifier's comments:

1 Input data

Anchor type and diameter:	**HST3 M12 hef1**
Return period (service life in years):	50
Item number:	2113978 HST3 M12x85 10/-
Effective embedment depth:	h_{ef} = 50.0 mm, h_{nom} = 60.0 mm
Material:	
Evaluation Service Report:	ETA-98/0001
Issued I Valid:	13/7/2020 | -
Proof:	Based on design method ETAG (No. 001 Annex C/2010) with a load factor 2 and global safety factor 3
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 = 450.0 mm x 400.0 mm x 10.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, C35/45, $f_{c,cube}$ = 45.00 N/mm^2; h = 150.0 mm
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	no reinforcement or reinforcement spacing >= 150 mm (any Ø) or >= 100 mm (Ø <= 10 mm) no longitudinal edge reinforcement

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

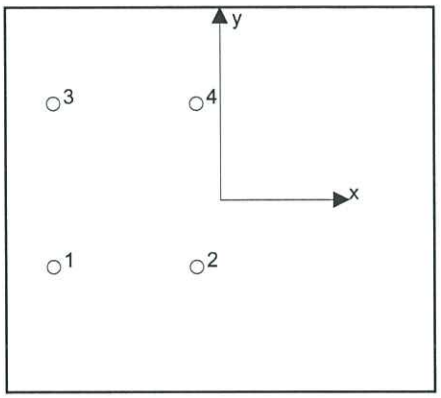
Geometry [mm] & Loading [kN, kNm]



1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 0.000; V_x = 3.950; V_y = -7.900; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	no	36

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	0.000	0.935	-0.221	-0.909
2	0.000	3.049	-0.221	-3.041
3	0.000	2.377	2.196	-0.909
4	0.000	3.751	2.196	-3.041

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [N/mm^2]
resulting tension force in (x/y)=(0.0/0.0): 0.000 [kN]
resulting compression force in (x/y)=(0.0/0.0): 0.000 [kN]

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

3 Tension load (Based on ETAG, Annex C, Section 5.2.2 FOS = 3)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	N/A	N/A	N/A	N/A
Splitting failure**	N/A	N/A	N/A	N/A

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

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Design:	CK-1284-02B	Date:	12/4/2023
Fastening point:			

4 Shear load (Based on ETAG, Annex C, Section 5.2.3 FOS = 3)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	3.751	11.333	34	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength*	3.751	15.824	24	OK
Concrete edge failure in direction x+**	7.502	21.269	36	OK

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

4.1 Steel Strength (without lever arm)

$V_{Sd} \leq V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{M,s}}$ ETAG 001 Annex C, Table 5.2.3.1

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
34.000	3.000	11.333	3.751

4.2 Pryout Strength

$V_{Sd} \leq V_{Rd,cp} = \frac{V_{Rk,cp}}{\gamma_{M,c,p}}$		ETAG 001 Annex C, Table 5.2.3.1
$V_{Rk,cp}$	$= k \cdot N_{Rk,c}$	ETAG 001 Annex C, Eq. (5.6)
$N_{Rk,c}$	$= N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec1,N} \cdot \psi_{ec2,N}$	ETAG 001 Annex C, Eq. (5.2)
$N^0_{Rk,c}$	$= k_1 \cdot \sqrt{f_{ck,cube}} \cdot h_{ef}^{1,5}$	ETAG 001 Annex C, Eq. (5.2a)
$A^0_{c,N}$	$= s_{cr,N} \cdot s_{cr,N}$	ETAG 001 Annex C, Eq. (5.2b)
$\psi_{s,N}$	$= 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}} \leq 1.00$	ETAG 001 Annex C, Eq. (5.2c)
$\psi_{re,N}$	$= 0.5 + \frac{h_{ef}}{200} \leq 1.00$	ETAG 001 Annex C, Eq. (5.2d)
$\psi_{ec1,N}$	$= \frac{1}{1 + \frac{2 \cdot e_{c1,V}}{s_{cr,N}}} \leq 1.00$	ETAG 001 Annex C, Eq. (5.2e)
$\psi_{ec2,N}$	$= \frac{1}{1 + \frac{2 \cdot e_{c2,V}}{s_{cr,N}}} \leq 1.00$	ETAG 001 Annex C, Eq. (5.2e)

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k-factor
22,500	22,500	75.0	150.0	2.780

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

$N^0_{Rk,c}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Sd} [kN]
17.076	3.000	15.824	3.751

Group anchor ID
4

4.3 Concrete edge failure in direction x+

$V_{Sd} \le V_{Rd,c} = \frac{V_{Rk,c}}{\gamma_{M,c}}$ — ETAG 001 Annex C, Table 5.2.3.1

$V_{Rk,c} = V^0_{Rk,c} \cdot \frac{A_{c,V}}{A^0_{c,V}} \cdot \psi_{s,V} \cdot \psi_{h,V} \cdot \psi_{\alpha,V} \cdot \psi_{ec,V} \cdot \psi_{re,V}$ — ETAG 001 Annex C, Eq. (5.7)

$V^0_{Rk,c} = k_1 \cdot d_{nom}^{\alpha} \cdot l_f^{\beta} \cdot \sqrt{f_{ck,cube}} \cdot c_1^{1,5}$ — ETAG 001 Annex C, Eq. (5.7a)

$\alpha = 0.1 \cdot \left(\frac{l_f}{c_1}\right)^{0,5}$ — ETAG 001 Annex C, Eq. (5.7b)

$\beta = 0.1 \cdot \left(\frac{d_{nom}}{c_1}\right)^{0,2}$ — ETAG 001 Annex C, Eq. (5.7c)

$A^0_{c,V} = 4.5 \cdot c_1^2$ — ETAG 001 Annex C, Eq. (5.7d)

$\psi_{s,V} = 0.7 + 0.3 \cdot \frac{c_2}{1.5 \cdot c_1} \le 1.00$ — ETAG 001 Annex C, Eq. (5.7e)

$\psi_{h,V} = \left(\frac{1.5 \cdot c_1}{h}\right)^{0,5} \ge 1.00$ — ETAG 001 Annex C, Eq. (5.7f)

$\psi_{\alpha,V} = \sqrt{\frac{1}{(\cos \alpha_V)^2 + \left(\frac{\sin \alpha_V}{2.5}\right)^2}} \ge 1.00$ — ETAG 001 Annex C, Eq. (5.7g)

$\psi_{ec,V} = \frac{1}{1 + \frac{2 \cdot e_{c,V}}{3 \cdot c_1}} \le 1.00$ — ETAG 001 Annex C, Eq. (5.7h)

l_f [mm]	d_{nom} [mm]	k_1	α	β
50.0	12.00	1.700	0.045	0.054

c_1 [mm]	$A_{c,V}$ [mm²]	$A^0_{c,V}$ [mm²]
250.0	138,000	281,250

$\psi_{s,V}$	$\psi_{h,V}$	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$
1.000	1.581	1.494	49.8	0.883	1.000

$V^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]
62.343	3.000	21.269	7.502

5 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 0.000 [kN] — δ_N = 0.0000 [mm]

V_{Sk} = 2.779 [kN] — δ_V = 0.4440 [mm]

δ_{NV} = 0.4440 [mm]

Long term loading:

N_{Sk} = 0.000 [kN] — δ_N = 0.0000 [mm]

V_{Sk} = 2.779 [kN] — δ_V = 0.6732 [mm]

δ_{NV} = 0.6732 [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!

6 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!
- Checking the transfer of loads into the base material is required in accordance with ETAG 001, Annex C(2010)Section 7! The software considers that the grout is installed under the anchor plate without creating air voids and before application of the loads.
- The design is only valid if the clearance hole in the fixture is not larger than the value given in Table 4.1 of ETAG 001, Annex C! For larger diameters of the clearance hole see Chapter 1.1. of ETAG 001, Annex C!
- 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.
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening meets the design criteria!

Company:		Page:	7
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	CK-1284-02B	Date:	12/4/2023
Fastening point:			

7 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 = 14.0 mm

Plate thickness (input): 10.0 mm

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: HST3 M12 hef1

Item number: 2113978 HST3 M12x85 10/-

Maximum installation torque: 60 Nm

Hole diameter in the base material: 12.0 mm

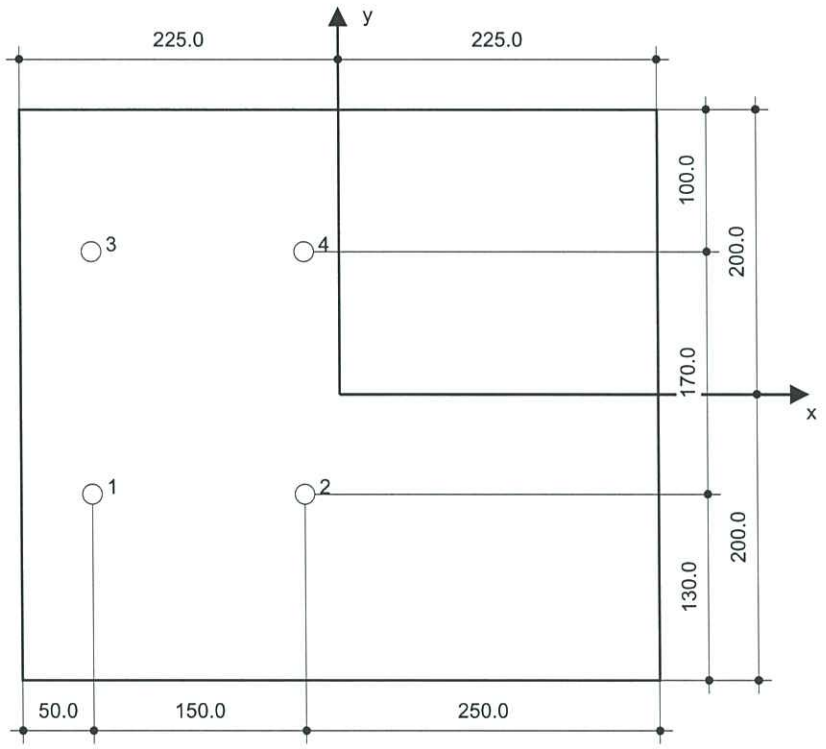
Hole depth in the base material: 68.0 mm

Minimum thickness of the base material: 100.0 mm

Hilti HST3 stud anchor with 60 mm embedment, M12 hef1, Steel galvanized, installation per ETA-98/0001

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Hilti SIW 6AT-A22 + SI AT-A22 • Torque wrench • Hammer

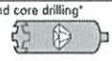


Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-175.0	-70.0	-	400.0	-	-
2	-25.0	-70.0	-	250.0	-	-
3	-175.0	100.0	-	400.0	-	-
4	-25.0	100.0	-	250.0	-	-

8 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 (agap=1)

9 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.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.