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 /5168 / 22　　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　修補方案用配件 (M16, M24)

收件人　：林哥　　發件人　：Ant Yeung　　日　期　：03/10/2022

☐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 ：

請按 BM 訂購修補方案用配件 (M16, M24)供地盆使用

附 MC41501

請在　2022.10.10　前完成上列要求。

附：　頁

☐ 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　☐連附件　( )其他 _____☐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☐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　/ 22　　項目經理簽署：

美特鋁質有限公司 MIDI Aluminium Fabricator Ltd.	工程號:	J-858	計算: WCM	日期: 2022/10/03	送呈: Jason哥
	地盤名稱:	康城11期	核對:	日期: 2022/10/03	副本:
地盤用配件B.M.表	項目類別:	**修補方案用 單元幕墻**	批准:	日期:	
BM編號: 修補方案用	A/C Code: EI				**此BM依 MC 41501**

序號	修改標示	配件圖號	物料編號	配件名稱	顏色	實用	後備	**總數**	單位	備注
1			**Hilti HST3-R**	M16x145mm 拉爆	A4-70	100	0	**100**	套	修補方案 ：起腳(4粒) ，標準層中企(4粒)
2			**Hilti HST3-R**	M24x200mm 拉爆	A4-70	20	0	**20**	套	修補方案 ：標準層邊位(2粒)

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

Our ref. MC/41501/858 30th September, 2022

Gammon Construction Company Limited
22/F Tower 1, The Quayside,
77 Hoi Bun Road,
Kwun Tong, Kowloon.

By Email & Hand

Attn.: Mr. Matthew Wong

Dear Sir,

Re: Design, Supply and Installation of Curtain Wall, Glass Wall, Aluminium Window, Aluminium Cladding, Aluminium Louvres and Glass Balustrade Nominated Sub-Contract at T.K.O.T.L. 70 RP, Phase 11, LOHAS Park, Tseung Kwan O, N.T.
Submission of Remedial Proposal for Curtain Wall (TS031)

Regarding the captioned project, we would like to submit Remedial Proposal for Curtain Wall for your review and comment.

Remarks:
1. Attachment 1 (RM3) TYP : Use M16 x4
2. Attachment 2 (RM4) TYP at edge : Use M24 x2
3. Attachment 3 (RM5) Starter : Use M16 x4

If you have any query, please feel free to contact us.

Thank you for your kind attention.

Yours faithfully,
MIDI ALUMINIUM FABRICATOR LTD.

Marco Tam
Director

Encl -40page(s)

cc.	Gammon	- Mr. Jun Tsui / Mr. Brian Ng	(w/e)
	Sino	- Mr. Terry Wan / Mr. Andy Chan	(w/e) (Email Only)
	RLP	- Ms. Marina Tong / Ms. Ginny Chau	(w/e) (Email Only)
	Aecom	- Mr. Ryan Ko / Mr. Cole Li	(w/e) (Email Only)
		- Ms. Daisy Lau / Ms. Crystal Wong	

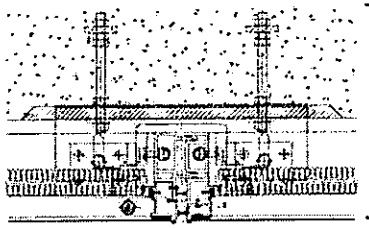
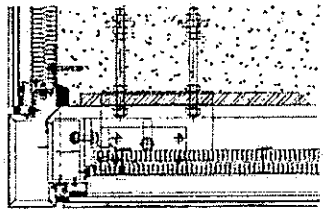
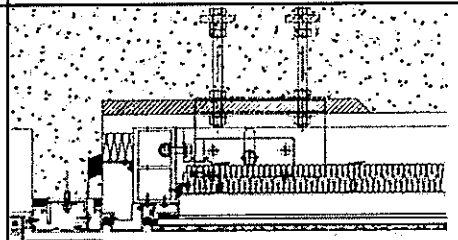
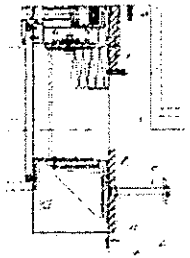
FM/MT/DW/JL/BL/AY/yl

九龍荼果嶺道610號生利工業中心1樓6-8號
Units 6-8, 1st Floor, Sunray Industrial Centre, 610 Cha Kwo Ling Road, Kln.
TEL. (電話) : 2348 9211 FAX. (傳真) : 2772 7666 E-mail Address (電郵) : midi@midiltd.com.hk.

ISO 9001 : 2015
Certificate No.: CC 1795

Summary of Remedial

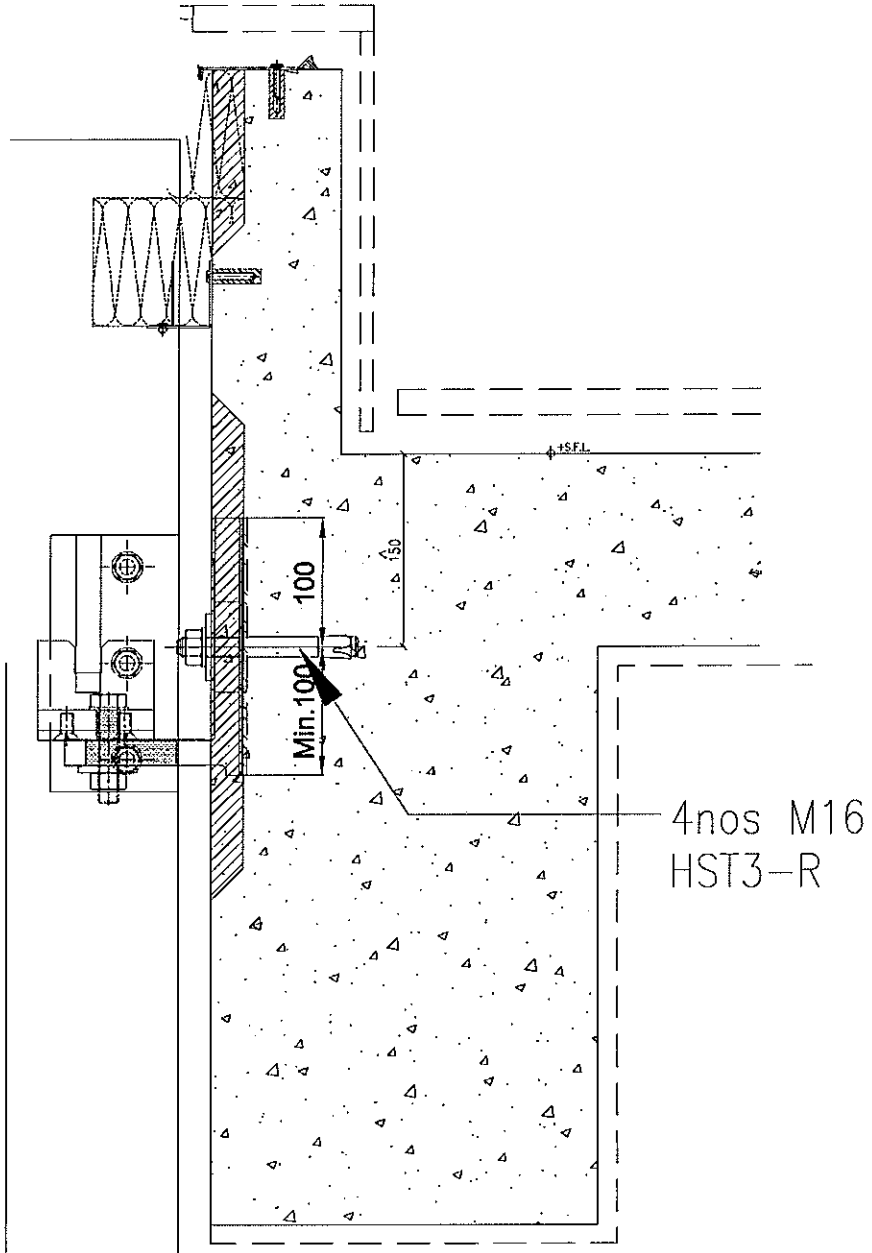
Missing or Out of 25 mm toloerance (XYZ)

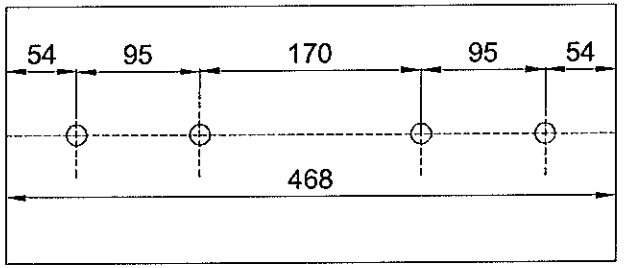
			拉爆	Bracket	Remark	Oringal Detail
Attachment 1	TYP	直位絲桿	M16 x4	原鋁碼寬度	(54 +95+170+95+54 M16 c/c)	
Attachment 2	TYP	邊企絲桿	M24x2	鋁碼加寬	沒有石矢牆在旁	
			M24x2	原鋁碼	有石矢牆在旁	
Attachment 3	9/F	起腳Embed	M16 x4	鐵掌向下加深		

RM3–Typical Missing

ATTACHEMENT 1

TYP



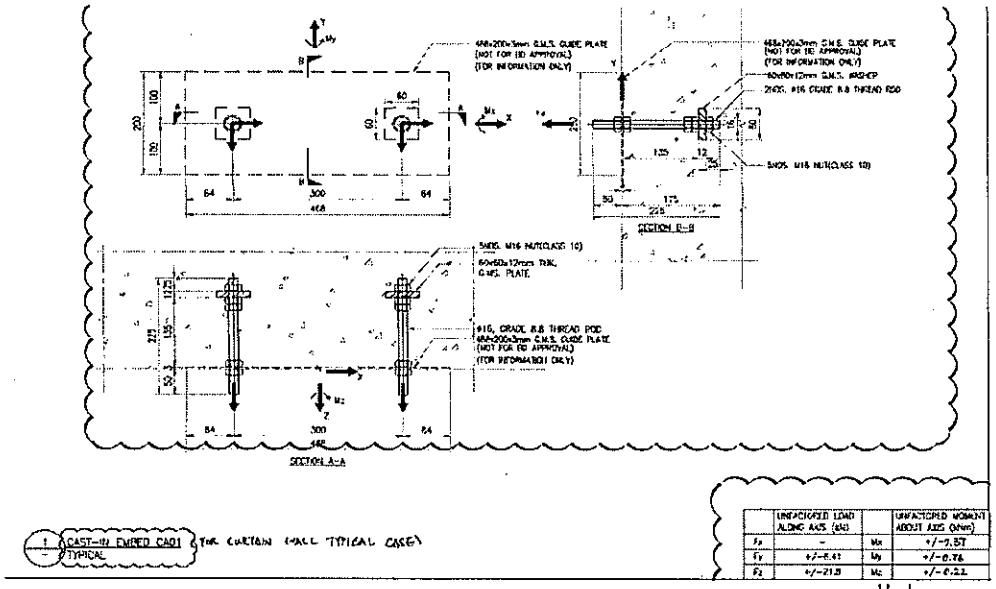


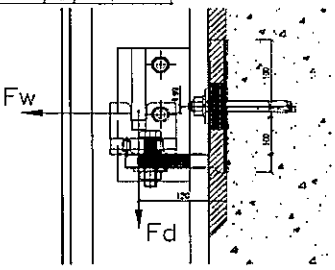
Elevation

20220930

RM3- Anchor remedial of missing cast in rods at typical location

BD Approved load





Design wind load	Fw	=	21.8	KN
Design dead load	Fd	=	6.41	KN
Ecc.	e1	=	10	mm
	e1	=	120	mm
RC.Tolerance	et	=	25	mm

Check 4nos HST3-R M16 Anchor bolts

Case 1 Negative Wind	Me	=	Fd*(e2+et)-Fw*e1	
		=	0.71	KNm
Compression edge	d	=	100	mm
Factored tension force of anchor	Ft	=	2*Fw	
		=	43.6	KN
Factored shear force of anchor	Fs	=	2*Fd	
		=	12.82	KN
Ecc. Moment	M	=	2*Me	
		=	1.4229	KNm

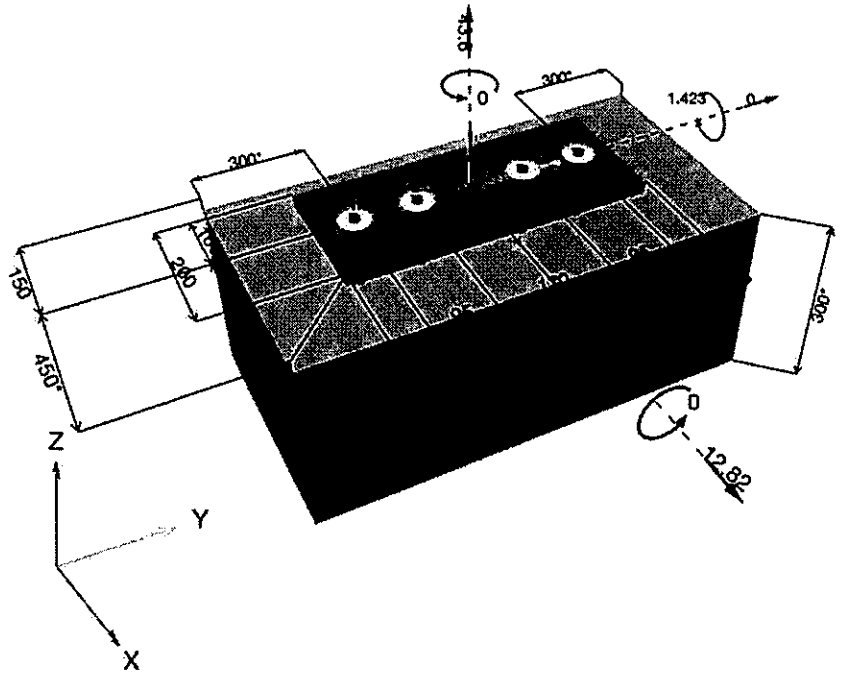
Anchor checking please refer to Hilti Report

1 Input data

Anchor type and diameter:	**HST3 M16 hef2**
Return period (service life in years):	50
Item number:	2105859 HST3 M16x145 45/25
Filling set or any suitable annular gap filling solution	
Effective embedment depth:	$h_{ef,act}$ = 85.0 mm ($h_{ef,limit}$ = - mm), h_{nom} = 98.0 mm
Material:	
Evaluation Service Report:	ETA 98/0001
Issued I Valid:	4/5/2021 | -
Proof:	Engineering judgement SOFA - based on ETAG testing
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 19.0 mm
Anchor plate[R]:	l_x x l_y x t = 200.0 mm x 468.0 mm x 19.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, C35/45, $f_{c,cube}$ = 45.00 N/mm²; h = 300.0 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.

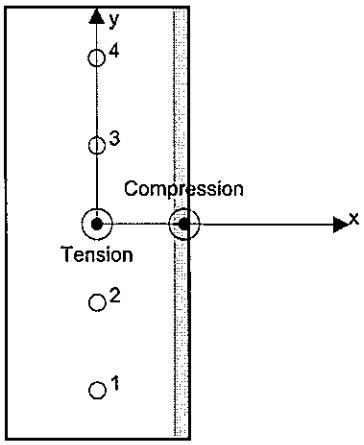
Geometry [mm] & Loading [kN, kNm]



1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 43.600; V_x = 12.820; V_y = 0.000; M_x = 0.000; M_y = 1.423; M_z = 0.000;	no	no	95

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	14.657	3.205	3.205	0.000
2	14.657	3.205	3.205	0.000
3	14.657	3.205	3.205	0.000
4	14.657	3.205	3.205	0.000

max. concrete compressive strain: 0.13 [‰]
max. concrete compressive stress: 4.02 [N/mm²]
resulting tension force in (x/y)=(0.0/0.0): 58.630 [kN]
resulting compression force in (x/y)=(94.7/0.0): 15.030 [kN]

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

Company:		Page:	4
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Sep 25, 2022 (1)	Date:	29/9/2022
Fastening point:			

3 Tension load (ETAG, Annex C, Section 5.2.2)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	14.657	54.286	28	OK
Pullout Strength*	14.657	24.150	61	OK
Concrete Breakout Failure**	58.630	65.083	91	OK
Splitting failure**	58.630	93.094	63	OK

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

3.1 Steel Strength

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
76.000	1.400	54.286	14.657

3.2 Pullout Strength

$N_{Rk,p}$ [kN]	Ψ_c	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Sd} [kN]
27.000	1.342	1.500	24.150	14.657

3.3 Concrete Breakout Failure

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]
156,825	65,025	127.5	255.0

$e_{c1,N}$ [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

k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$N_{Rd,c}$ [kN]	N_{Sd} [kN]
7.700	40.479	1.500	65.083	58.630

Group anchor ID
1-4

3.4 Splitting failure

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,sp}$ [mm]	$s_{cr,sp}$ [mm]	$\Psi_{h,sp}$
156,825	65,025	127.5	255.0	1.500

$e_{c1,N}$ [mm]	$\Psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\Psi_{ec2,N}$	$\Psi_{s,N}$	$\Psi_{re,N}$	k_1
0.0	1.000	0.0	1.000	1.000	1.000	7.700

$N^0_{Rk,c}$ [kN]	$\gamma_{M,sp}$	$N_{Rd,sp}$ [kN]	N_{Sd} [kN]
38.600	1.500	93.094	58.630

Group anchor ID
1-4

4 Shear load (ETAG, Annex C, Section 5.2.3)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	3.205	44.240	8	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	12.820	221.934	6	OK
Concrete edge failure in direction x+**	12.820	53.895	24	OK

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

4.1 Steel Strength (without lever arm)

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
55.300	1.250	44.240	3.205

4.2 Pryout Strength

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k-factor
156,825	65,025	127.5	255.0	3.410

$e_{c1,V}$ [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]
40.479	1.500	221.934	12.820

Group anchor ID
1-4

4.3 Concrete edge failure in direction x+

l_f [mm]	d_{nom} [mm]	k_1	α	β
85.0	16.00	1.700	0.065	0.060

c_1 [mm]	$c_1^{'}$ [mm]	$A_{c,V}$ [mm²]	$A^0_{c,V}$ [mm²]
450.0	200.0	288,000	180,000

$\Psi_{s,V}$	$\Psi_{h,V}$	$\Psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\Psi_{ec,V}$	$\Psi_{re,V}$
1.000	1.000	1.000	0.0	1.000	1.000

$V^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]
50.527	1.500	53.895	12.820

5 Combined tension and shear loads (ETAG, Annex C, Section 5.2.4)

Steel failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.901	0.238	1.000	95	OK

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

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 10.857 [kN] $\quad \delta_N$ = 1.4585 [mm]

V_{Sk} = 2.374 [kN] $\quad \delta_V$ = 0.3231 [mm]

δ_{NV} = 1.4938 [mm]

Long term loading:

N_{Sk} = 10.857 [kN] $\quad \delta_N$ = 1.3774 [mm]

V_{Sk} = 2.374 [kN] $\quad \delta_V$ = 0.4808 [mm]

δ_{NV} = 1.4589 [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!
- 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 design method SOFA assumes that no hole clearance between the anchors and the fixture is present. This can be achieved by filling the gap with mortar of sufficient compressive strength (e.g. by using the Hilti Filling set) or by other suitable means
- The compliance with current standards (e.g. EN 1993, AS 4100:1998, etc.) is the responsibility of the user
- An SLS-check is not performed for SOFA and has to be provided by the user!
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening meets the design criteria!

8 Installation data

Anchor plate, steel: GB Q390; E = 205,000.00 N/mm^2; f_{yk} = 335.00 N/mm^2

Profile: no profile

Hole diameter in the fixture: d_f = 18.0 mm

Plate thickness (input): 19.0 mm

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: HST3 M16 hef2

Item number: 2105859 HST3 M16x145 45/25

Maximum installation torque: 110 Nm

Hole diameter in the base material: 16.0 mm

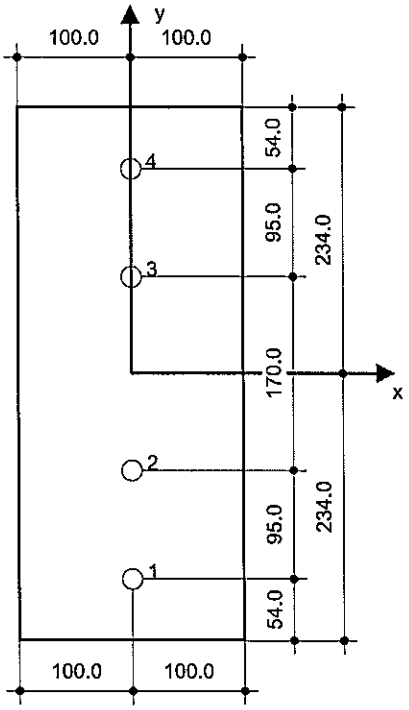
Hole depth in the base material: 118.0 mm

Minimum thickness of the base material: 140.0 mm

Hilti HST3 stud anchor with 85 mm embedment, M16 hef2, Steel galvanized, 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	• Hilti SIW 6AT-A22 + SI AT-A22 • Filling set • Torque wrench • Hammer



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.0	-180.0	150.0	450.0	300.0	660.0
2	0.0	-85.0	150.0	450.0	395.0	565.0
3	0.0	85.0	150.0	450.0	565.0	395.0
4	0.0	180.0	150.0	450.0	660.0	300.0

9 Drilling and installation

HST3 (-R) subject to:

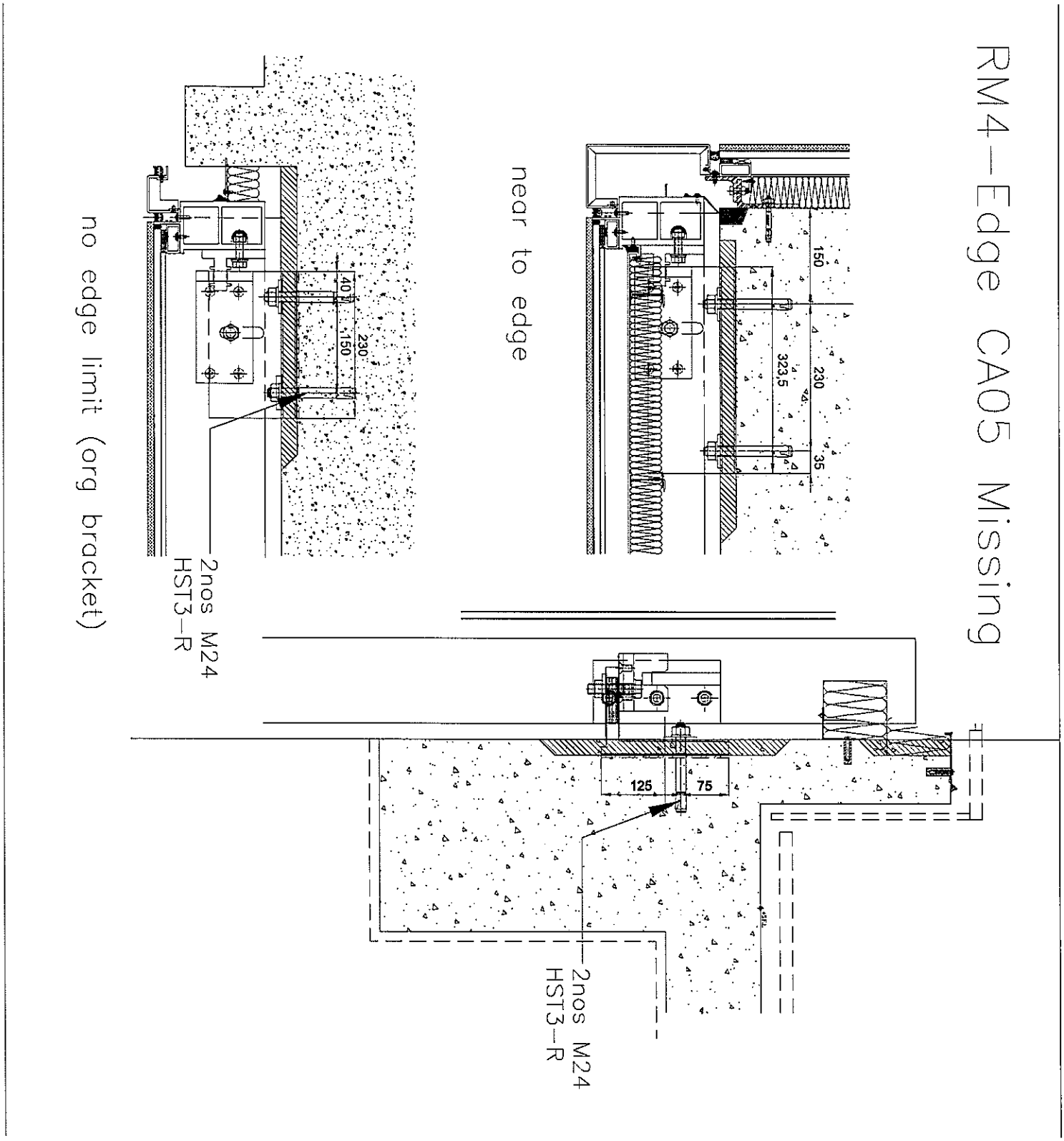
Anchor size	M8	M10	M12	M16	M20	M24
Hammer drilling*	TE2(-A) – TE30(-A)				TE40 – TE70	
Diamond core drilling* 	DD-30W, DD-EC1					
Setting tool*	Setting tool HS-SC				-	
Hollow drill bit drilling* 	-	TE-CD, TE-YD				
Seismic Set/ Filling Set** 	Seismic/Filling Set M8-M20 (Carbon and Stainless Steel A4)					-
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)

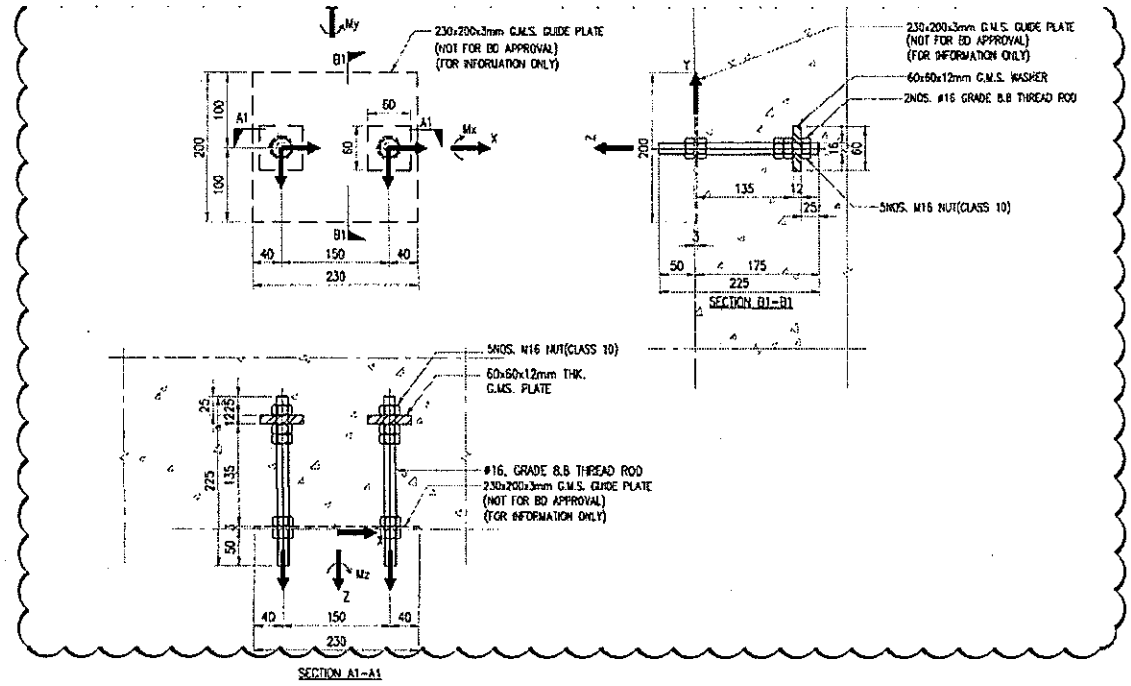
10 Remarks; Your Cooperation Duties

- 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.

ATTACHMENT 2 EDGE



RM4 Check Renedial case of edge (missing CA05)

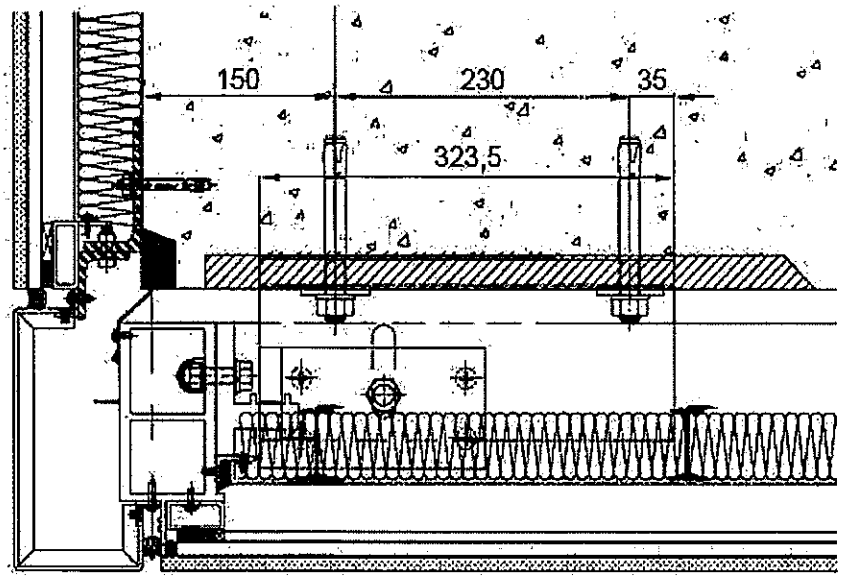


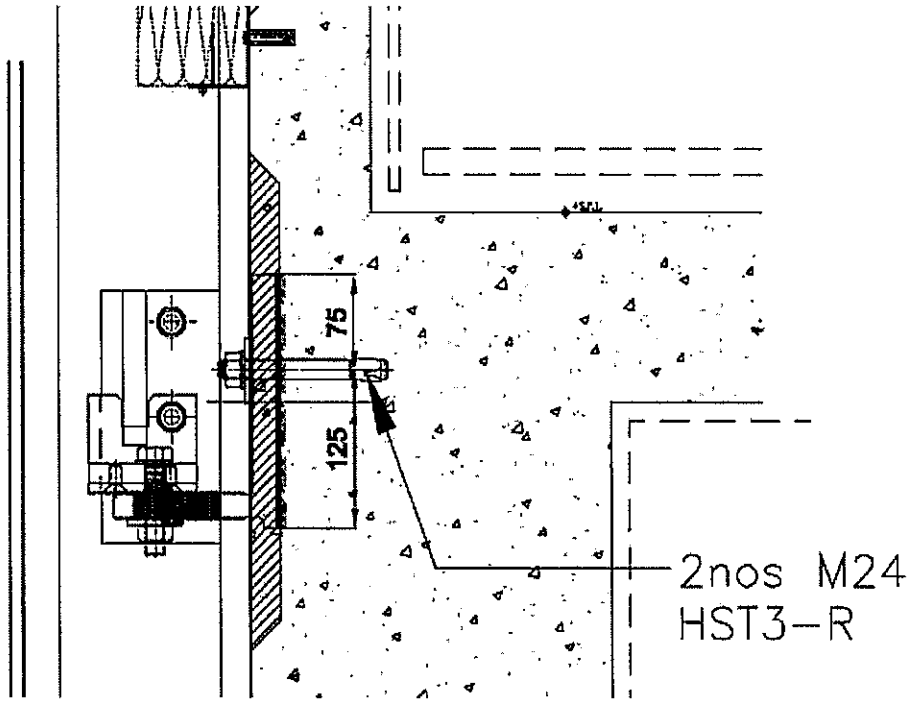
CAST-IN EMBED CA05 (FOR CURTAIN WALL END PST CASE)
TYPICAL

	UNFACTORED LOAD ALONG AXIS (kN)		UNFACTORED MOMENT ABOUT AXIS (kNm)
Fx	-	Mx	+/-0.97
Fy	+/-4.96	My	+/-0.96
Fz	+/-16.85	Mz	+/-0.29

Check 2nos M24 HST3-R Anchor

Factored tension load on anchor	Ft	=	2*Fz	
		=	33.7	KN
Factored shear load on anchor	Fs	=	2*Fy	
		=	9.92	KN
Factored Moment	M1	=	2*Mx	
		=	1.94	KNm
	M2	=	2*My	
		=	1.92	KNm
Factored torsion	M2	=	2*Mz	
		=	0.58	KNm


150
230
35
323,5


75
125
2nos M24
HST3-R

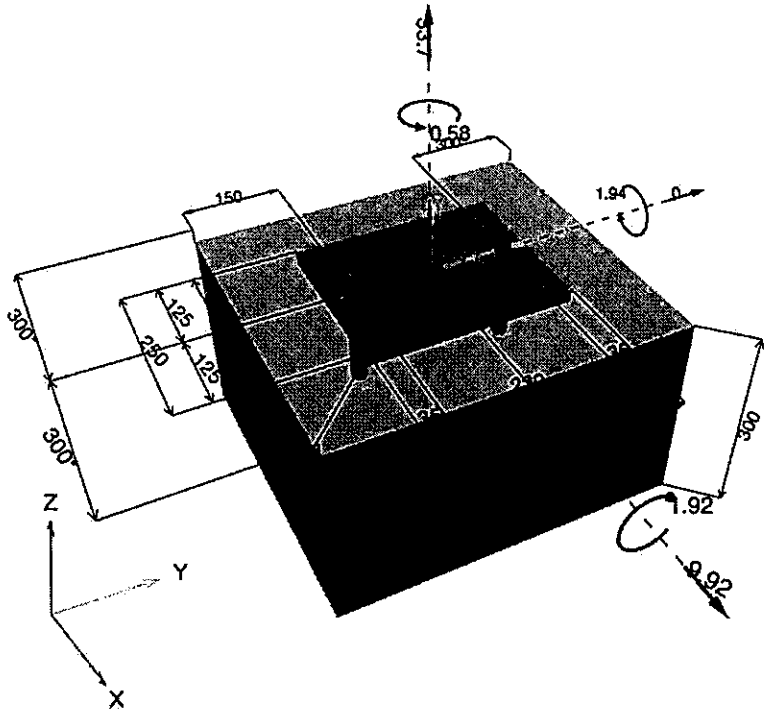
Specifier's comments:

1 Input data

Anchor type and diameter:	**HST3-R M24 hef2**
Return period (service life in years):	50
Item number:	2105901 HST3-R M24x200 -/30
Effective embedment depth:	h_{ef} = 125.0 mm, h_{nom} = 143.0 mm
Material:	A4
Evaluation Service Report:	ETA-98/0001
Issued I Valid:	13/7/2020 | -
Proof:	Design Method ETAG (No. 001 Annex C/2010)
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 19.0 mm
Anchor plate[R]:	l_x x l_y x t = 250.0 mm x 300.0 mm x 19.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, C35/45, $f_{c,cube}$ = 45.00 N/mm²; h = 300.0 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.

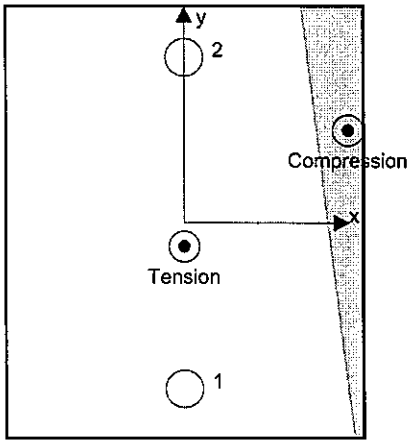
Geometry [mm] & Loading [kN, kNm]



1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 33.700; V_x = 9.920; V_y = 0.000; M_x = -1.920; M_y = 1.940; M_z = 0.580;	no	no	99

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	28.948	7.482	7.482	0.000
2	21.735	2.438	2.438	0.000

max. concrete compressive strain: 0.23 [‰]
max. concrete compressive stress: 6.88 [N/mm²]
resulting tension force in (x/y)=(0.0/-16.4): 50.684 [kN]
resulting compression force in (x/y)=(114.2/64.2): 16.984 [kN]

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

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Design:	Concrete - Sep 28, 2022	Date:	28/9/2022
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3 Tension load (ETAG, Annex C, Section 5.2.2)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	28.948	100.000	29	OK
Pullout Strength*	28.948	35.777	81	OK
Concrete Breakout Failure**	50.684	58.875	87	OK
Splitting failure**	50.684	66.484	77	OK

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

3.1 Steel Strength

$N_{Sd} \leq N_{Rd,s} = \frac{N_{Rk,s}}{\gamma_{M,s}}$ ETAG 001 Annex C, Table 5.2.2.1

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
156.000	1.560	100.000	28.948

3.2 Pullout Strength

$N_{Sd} \leq N_{Rd,p} = \frac{\Psi_c \cdot N_{Rk,p}}{\gamma_{M,p}}$ ETAG 001 Annex C, Table 5.2.2.1

$N_{Rk,p}$ [kN]	Ψ_c	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Sd} [kN]
40.000	1.342	1.500	35.777	28.948

3.3 Concrete Breakout Failure

$N_{Sd} \le N_{Rd,c} = \frac{N_{Rk,c}}{\gamma_{M,c}}$ ETAG 001 Annex C, Table 5.2.2.1

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

$\Psi_{s,N} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}} \le 1.00$ ETAG 001 Annex C, Eq. (5.2c)

$\Psi_{re,N} = 0.5 + \frac{h_{ef}}{200} \le 1.00$ ETAG 001 Annex C, Eq. (5.2d)

$\Psi_{ec1,N} = \frac{1}{1 + \frac{2 \cdot e_{c1,N}}{s_{cr,N}}} \le 1.00$ ETAG 001 Annex C, Eq. (5.2e)

$\Psi_{ec2,N} = \frac{1}{1 + \frac{2 \cdot e_{c2,N}}{s_{cr,N}}} \le 1.00$ ETAG 001 Annex C, Eq. (5.2e)

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]
212,812	140,625	187.5	375.0

$e_{c1,N}$ [mm]	$\Psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\Psi_{ec2,N}$	$\Psi_{s,N}$	$\Psi_{re,N}$
0.0	1.000	16.4	0.920	0.940	1.000

k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$N_{Rd,c}$ [kN]	N_{Sd} [kN]
7.200	67.500	1.500	58.875	50.684

Group anchor ID
1, 2

3.4 Splitting failure

$N_{Sd} \le N_{Rd,sp} = \frac{N_{Rk,sp}}{\gamma_{M,sp}}$ ETAG 001 Annex C, Table 5.2.2.1

$N_{Rk,sp} = N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \Psi_{s,N} \cdot \Psi_{re,N} \cdot \Psi_{ec1,N} \cdot \Psi_{ec2,N} \cdot \Psi_{h,sp}$ ETAG 001 Annex C, Eq. (5.3)

$N^0_{Rk,c} = k_1 \cdot \sqrt{f_{ck,cube}} \cdot h_{ef}^{1,5}$ ETAG 001 Annex C, Eq. (5.2a)

$A^0_{c,N} = s_{cr,sp} \cdot s_{cr,sp}$ ETAG 001 Annex C, Eq. (5.2b)

$\Psi_{s,N} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,sp}} \le 1.00$ ETAG 001 Annex C, Eq. (5.2c)

$\Psi_{ec1,N} = \frac{1}{1 + \left(\frac{2 \cdot e_{c1,N}}{s_{cr,sp}}\right)} \le 1.00$ ETAG 001 Annex C, Eq. (5.2e)

$\Psi_{ec2,N} = \frac{1}{1 + \left(\frac{2 \cdot e_{c2,N}}{s_{cr,sp}}\right)} \le 1.00$ ETAG 001 Annex C, Eq. (5.2e)

$\Psi_{h,sp} = \left(\frac{h}{h_{min}}\right)^{2/3} \le 1.5$ ETAG 001 Annex C, Eq. (5.3a)

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,sp}$ [mm]	$s_{cr,sp}$ [mm]	$\Psi_{h,sp}$
212,812	140,625	187.5	375.0	1.129

$e_{c1,N}$ [mm]	$\Psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\Psi_{ec2,N}$	$\Psi_{s,N}$	$\Psi_{re,N}$	k_1
0.0	1.000	16.4	0.920	0.940	1.000	7.200

$N^0_{Rk,c}$ [kN]	$\gamma_{M,sp}$	$N_{Rd,sp}$ [kN]	N_{Sd} [kN]
67.500	1.500	66.484	50.684

Group anchor ID
1, 2

4 Shear load (ETAG, Annex C, Section 5.2.3)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	7.482	88.462	9	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	9.920	121.994	9	OK
Concrete edge failure in direction x+**	9.920	30.570	33	OK

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

4.1 Steel Strength (without lever arm)

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

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
115.000	1.300	88.462	7.482

4.2 Pryout Strength

$V_{Sd} \le V_{Rd,cp} = \frac{V_{Rk,cp}}{\gamma_{M,c,p}}$ 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)

$\Psi_{s,N} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}} \le 1.00$ ETAG 001 Annex C, Eq. (5.2c)

$\Psi_{re,N} = 0.5 + \frac{h_{ef}}{200} \le 1.00$ ETAG 001 Annex C, Eq. (5.2d)

$\Psi_{ec1,N} = \frac{1}{1 + \frac{2 \cdot e_{c1,V}}{s_{cr,N}}} \le 1.00$ ETAG 001 Annex C, Eq. (5.2e)

$\Psi_{ec2,N} = \frac{1}{1 + \frac{2 \cdot e_{c2,V}}{s_{cr,N}}} \le 1.00$ 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
212,812	140,625	187.5	375.0	2.500

$e_{c1,V}$ [mm]	$\Psi_{ec1,N}$	$e_{c2,V}$ [mm]	$\Psi_{ec2,N}$	$\Psi_{s,N}$	$\Psi_{re,N}$
0.0	1.000	58.5	0.762	0.940	1.000

$N^0_{Rk,c}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Sd} [kN]
67.500	1.500	121.994	9.920

Group anchor ID
1, 2

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)

$c_1' = \max\left(\frac{c_{2,max}}{1.5}, \frac{h}{1.5}, \frac{s_{2,max}}{3}\right)$

l_f [mm]	d_{nom} [mm]	k_1	α	β
125.0	24.00	1.700	0.079	0.065

c_1 [mm]	c_1' [mm]	$A_{c,V}$ [mm²]	$A^0_{c,V}$ [mm²]
300.0	200.0	204,000	180,000

$\Psi_{s,V}$	$\Psi_{h,V}$	$\Psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\Psi_{ec,V}$	$\Psi_{re,V}$
0.850	1.000	1.000	58.5	0.837	1.000

$V^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]
56.877	1.500	30.570	9.920

5 Combined tension and shear loads (ETAG, Annex C, Section 5.2.4)

Steel failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.861	0.325	1.500	99	OK

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

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 21.443 [kN] $\quad \delta_N$ = 0.9029 [mm]

V_{Sk} = 5.542 [kN] $\quad \delta_V$ = 0.2431 [mm]

δ_{NV} = 0.9350 [mm]

Long term loading:

N_{Sk} = 21.443 [kN] $\quad \delta_N$ = 1.9186 [mm]

V_{Sk} = 5.542 [kN] $\quad \delta_V$ = 0.3597 [mm]

δ_{NV} = 1.9520 [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!
- 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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8 Installation data

Anchor plate, steel: GB Q390; E = 205,000.00 N/mm^2; f_{yk} = 335.00 N/mm^2

Profile: no profile

Hole diameter in the fixture: d_f = 26.0 mm

Plate thickness (input): 19.0 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-R M24 hef2

Item number: 2105901 HST3-R M24x200 -/30

Maximum installation torque: 300 Nm

Hole diameter in the base material: 24.0 mm

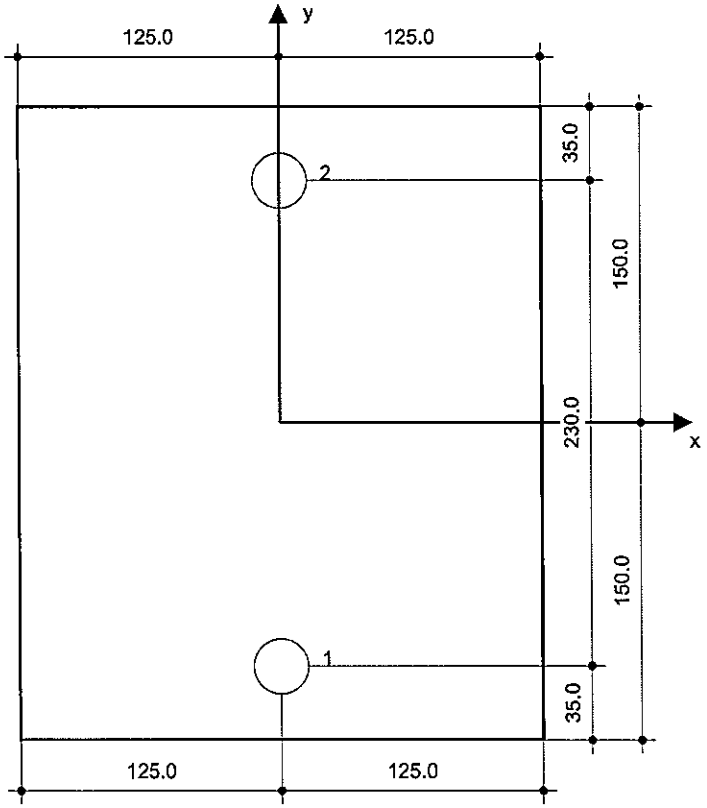
Hole depth in the base material: 151.0 mm

Minimum thickness of the base material: 250.0 mm

Hilti HST3 stud anchor with 143 mm embedment, M24 hef2, Stainless steel, installation per ETA-98/0001

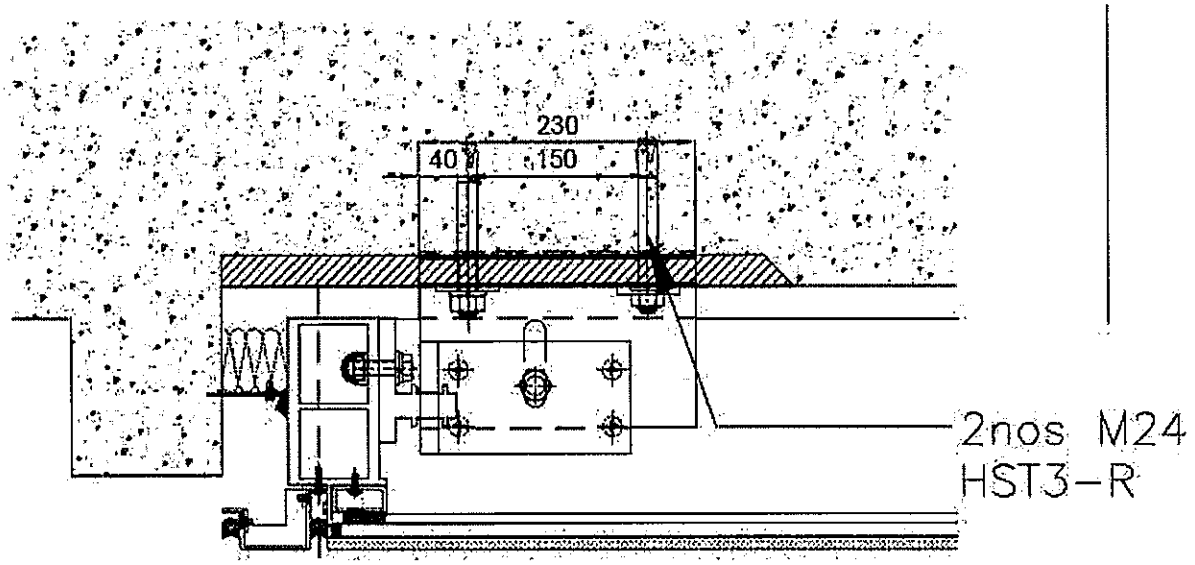
8.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Torque wrench • Hammer



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.0	-115.0	300.0	300.0	150.0	530.0
2	0.0	115.0	300.0	300.0	380.0	300.0



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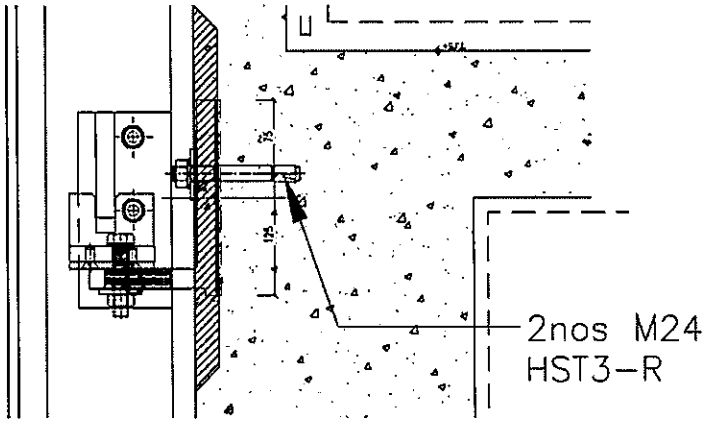

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Design:	Copy - Concrete - Sep 28, 2022	Date:	28/9/2022
Fastening point:			

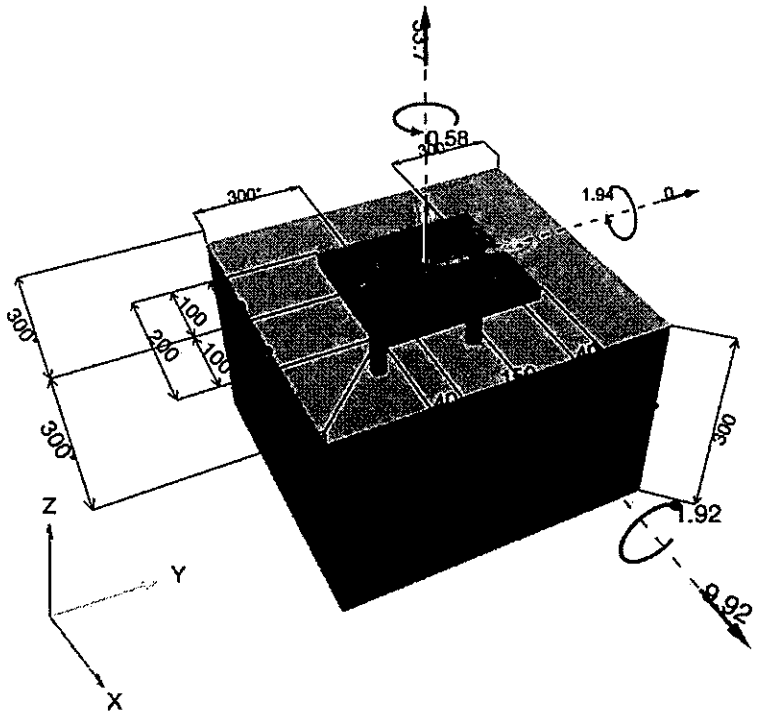
Specifier's comments:

1 Input data

Anchor type and diameter:	**HST3-R M24 hef2**
Return period (service life in years):	50
Item number:	2105901 HST3-R M24x200 -/30
Effective embedment depth:	h_{ef} = 125.0 mm, h_{nom} = 143.0 mm
Material:	A4
Evaluation Service Report:	ETA-98/0001
Issued I Valid:	13/7/2020 | -
Proof:	Design Method ETAG (No. 001 Annex C/2010)
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 19.0 mm
Anchor plate[R]:	l_x x l_y x t = 200.0 mm x 230.0 mm x 19.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, C35/45, $f_{c,cube}$ = 45.00 N/mm²; h = 300.0 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.

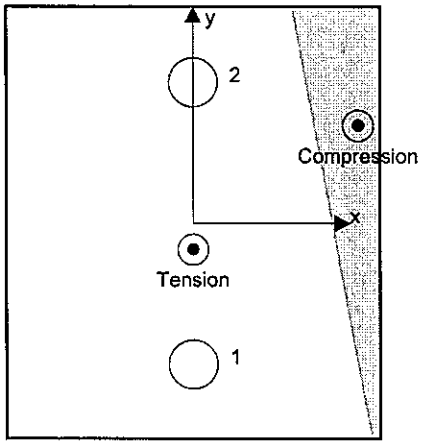
Geometry [mm] & Loading [kN, kNm]



1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 33.700; V_x = 9.920; V_y = 0.000; M_x = -1.920; M_y = 1.940; M_z = 0.580;	no	no	100

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	33.034	8.827	8.827	0.000
2	22.642	1.093	1.093	0.000

max. concrete compressive strain: 0.37 [‰]
max. concrete compressive stress: 11.14 [N/mm²]
resulting tension force in (x/y)=(0.0/-14.0): 55.676 [kN]
resulting compression force in (x/y)=(88.3/51.9): 21.976 [kN]

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

3 Tension load (ETAG, Annex C, Section 5.2.2)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	33.034	100.000	34	OK
Pullout Strength*	33.034	35.777	93	OK
Concrete Breakout Failure**	55.676	58.623	95	OK
Splitting failure**	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{Sd} \le N_{Rd,s} = \frac{N_{Rk,s}}{\gamma_{M,s}}$ ETAG 001 Annex C, Table 5.2.2.1

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
156.000	1.560	100.000	33.034

3.2 Pullout Strength

$N_{Sd} \le N_{Rd,p} = \frac{\Psi_c \cdot N_{Rk,p}}{\gamma_{M,p}}$ ETAG 001 Annex C, Table 5.2.2.1

$N_{Rk,p}$ [kN]	Ψ_c	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Sd} [kN]
40.000	1.342	1.500	35.777	33.034

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Fastening point:			

3.3 Concrete Breakout Failure

$N_{Sd} \le N_{Rd,c} = \frac{N_{Rk,c}}{\gamma_{M,c}}$ ETAG 001 Annex C, Table 5.2.2.1

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

$\Psi_{s,N} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}} \le 1.00$ ETAG 001 Annex C, Eq. (5.2c)

$\Psi_{re,N} = 0.5 + \frac{h_{ef}}{200} \le 1.00$ ETAG 001 Annex C, Eq. (5.2d)

$\Psi_{ec1,N} = \frac{1}{1 + \frac{2 \cdot e_{c1,N}}{s_{cr,N}}} \le 1.00$ ETAG 001 Annex C, Eq. (5.2e)

$\Psi_{ec2,N} = \frac{1}{1 + \frac{2 \cdot e_{c2,N}}{s_{cr,N}}} \le 1.00$ ETAG 001 Annex C, Eq. (5.2e)

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]
196,875	140,625	187.5	375.0

$e_{c1,N}$ [mm]	$\Psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\Psi_{ec2,N}$	$\Psi_{s,N}$	$\Psi_{re,N}$
0.0	1.000	14.0	0.931	1.000	1.000

k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$N_{Rd,c}$ [kN]	N_{Sd} [kN]
7.200	67.500	1.500	58.623	55.676

Group anchor ID
1, 2

Company:		Page:	17
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Copy - Concrete - Sep 28, 2022	Date:	28/9/2022
Fastening point:			

4 Shear load (ETAG, Annex C, Section 5.2.3)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	8.827	88.462	10	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	9.920	120.061	9	OK
Concrete edge failure in direction x+**	9.920	39.667	26	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]
115.000	1.300	88.462	8.827

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
196,875	140,625	187.5	375.0	2.500

$e_{c1,V}$ [mm]	$\psi_{ec1,N}$	$e_{c2,V}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
0.0	1.000	58.5	0.762	1.000	1.000

$N^0_{Rk,c}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Sd} [kN]
67.500	1.500	120.061	9.920

Group anchor ID
1, 2

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)

$c_1 = \max\left(\frac{c_{2,max}}{1.5}, \frac{h}{1.5}, \frac{s_{2,max}}{3}\right)$

l_f [mm]	d_{nom} [mm]	k_1	α	β
125.0	24.00	1.700	0.079	0.065

c_1 [mm]	c_1 [mm]	$A_{c,V}$ [mm²]	$A^0_{c,V}$ [mm²]
300.0	200.0	225,000	180,000

$\Psi_{s,V}$	$\Psi_{h,V}$	$\Psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\Psi_{ec,V}$	$\Psi_{re,V}$
1.000	1.000	1.000	58.5	0.837	1.000

$V^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]
56.877	1.500	39.667	9.920

5 Combined tension and shear loads (ETAG, Annex C, Section 5.2.4)

Steel failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.950	0.250	1.000	100	OK

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

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 24.469 [kN] $\quad \delta_N$ = 1.0303 [mm]

V_{Sk} = 6.538 [kN] $\quad \delta_V$ = 0.2868 [mm]

δ_{NV} = 1.0695 [mm]

Long term loading:

N_{Sk} = 24.469 [kN] $\quad \delta_N$ = 2.1894 [mm]

V_{Sk} = 6.538 [kN] $\quad \delta_V$ = 0.4244 [mm]

δ_{NV} = 2.2301 [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!
- 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!

8 Installation data

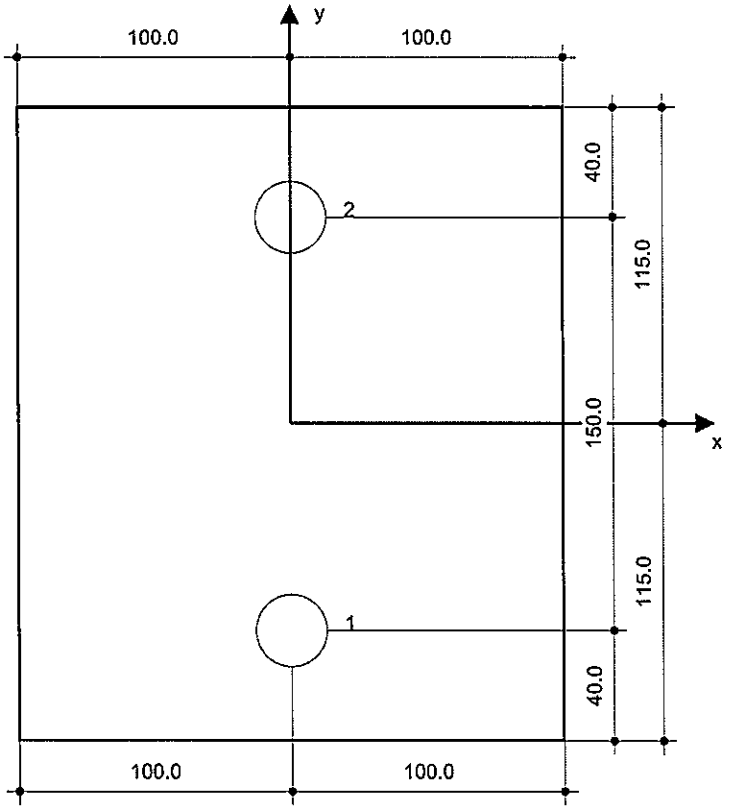
Anchor plate, steel: GB Q390; E = 205,000.00 N/mm^2; f_{yk} = 335.00 N/mm^2
Profile: no profile
Hole diameter in the fixture: d_f = 26.0 mm
Plate thickness (input): 19.0 mm
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: HST3-R M24 hef2
Item number: 2105901 HST3-R M24x200 -/30
Maximum installation torque: 300 Nm
Hole diameter in the base material: 24.0 mm
Hole depth in the base material: 151.0 mm
Minimum thickness of the base material: 250.0 mm

Hilti HST3 stud anchor with 143 mm embedment, M24 hef2, Stainless steel, installation per ETA-98/0001

8.1 Recommended accessories

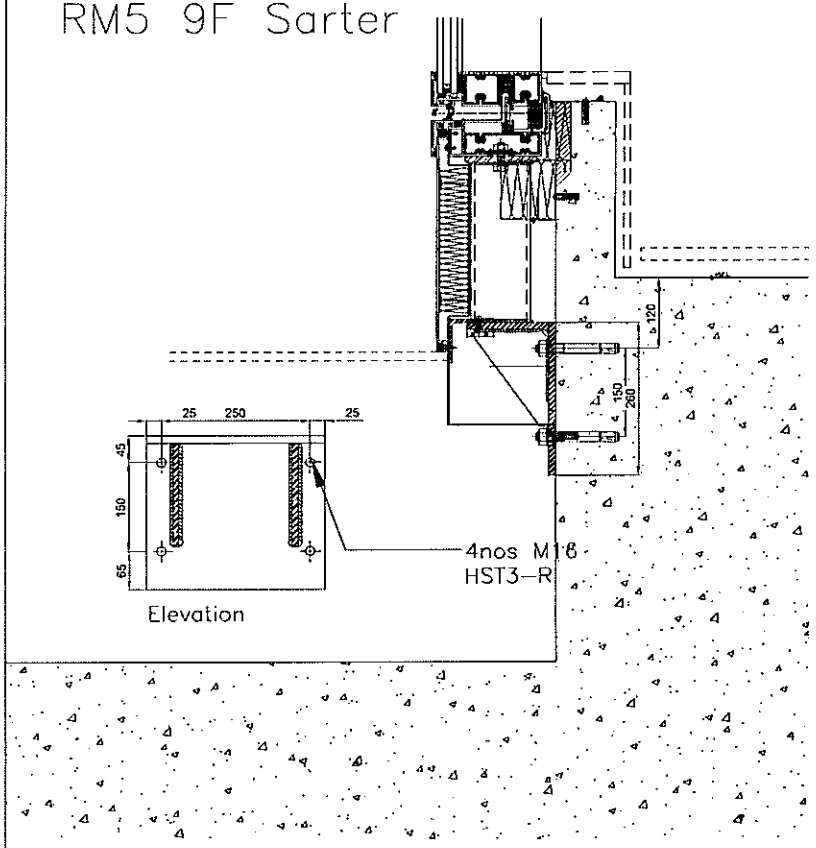
Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Torque wrench • Hammer



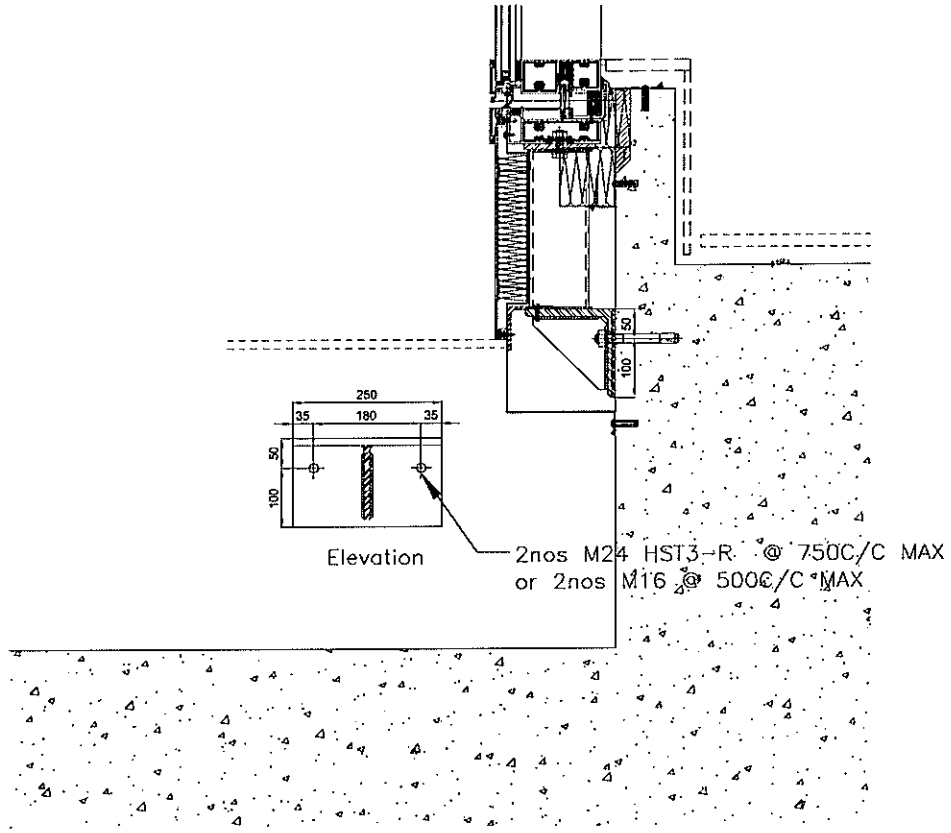
Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.0	-75.0	300.0	300.0	300.0	450.0
2	0.0	75.0	300.0	300.0	450.0	300.0

RM5 9F Sarter



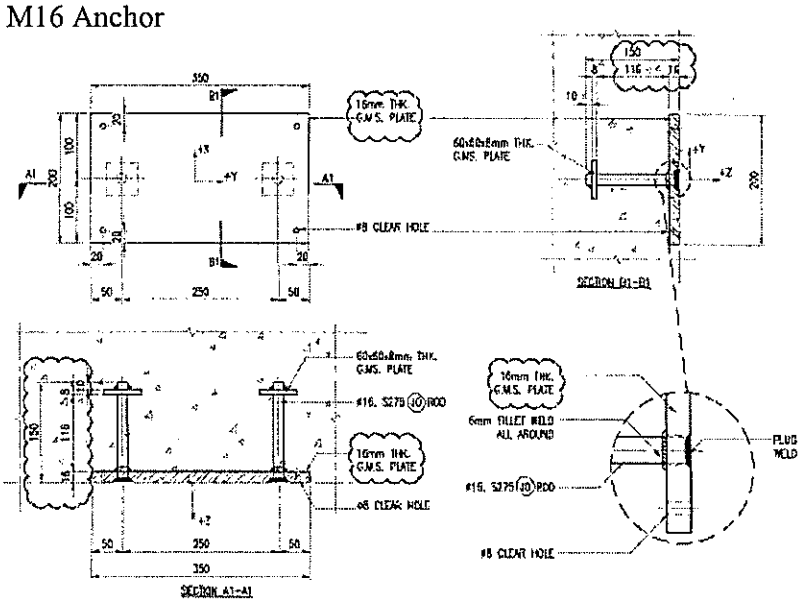
OPTION 1

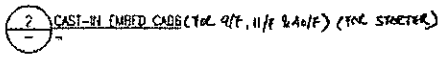


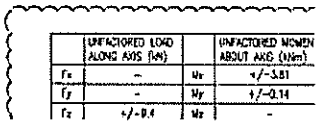
OPTION 2

RM5 Check Remedial case of strater (missing CA06)

4nos HST3-R M16 Anchor







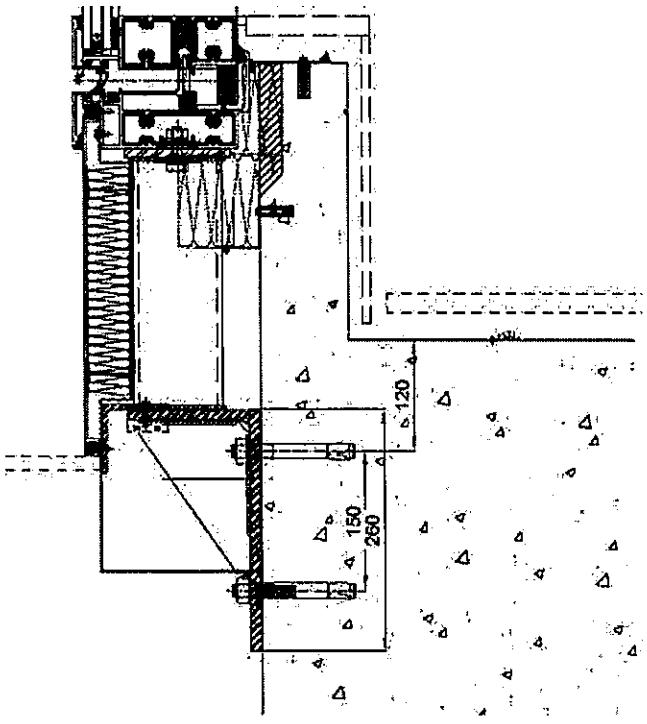
	UNFACTORED LOAD ALONG AXIS (kN)		UNFACTORED MOMENT ABOUT AXIS (kNm)
Fx	-	Mx	+/-3.81
Fy	-	My	+/-0.14
Fz	+/-9.4	Mz	-

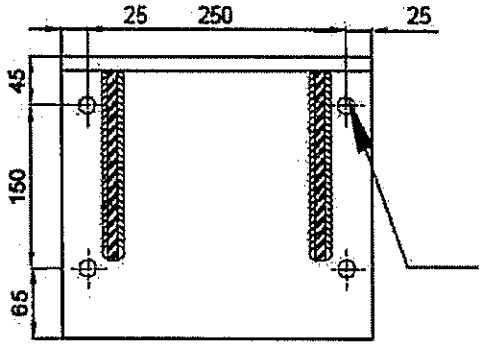
Factored reaction load on anchor Ft = 2*Fz

= 18.8 KN

Factored Moment Me = 2*Mx

= 7.62 KNm





Elevation

Company:		Page:	2
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Sep 27, 2022	Date:	28/9/2022
Fastening point:			

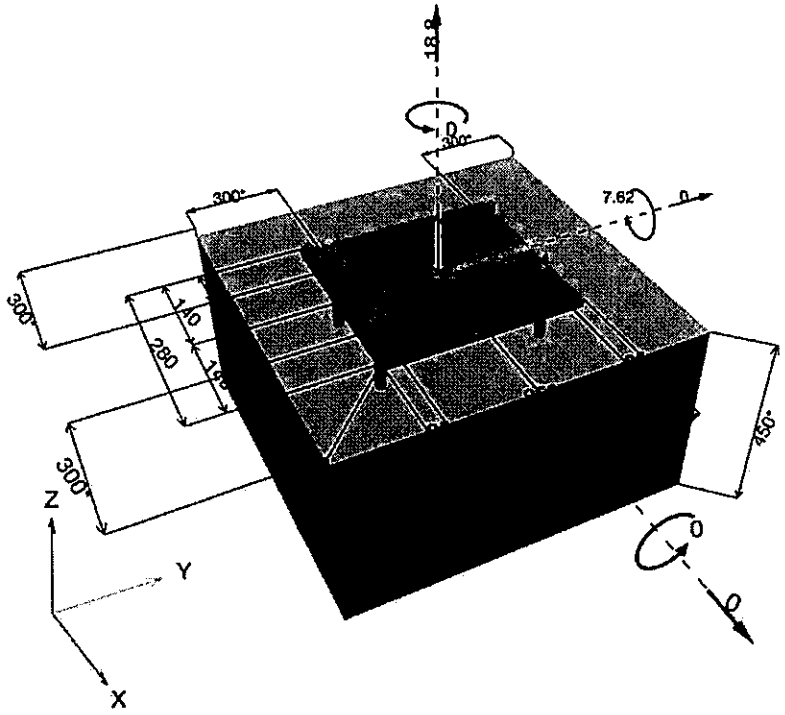
Specifier's comments:

1 Input data

Anchor type and diameter:	**HST3-R M16 hef2**
Return period (service life in years):	50
Item number:	2105876 HST3-R M16x135 35/15
Effective embedment depth:	h_{ef} = 85.0 mm, h_{nom} = 98.0 mm
Material:	A4
Evaluation Service Report:	ETA-98/0001
Issued I Valid:	13/7/2020 | -
Proof:	Design Method ETAG (No. 001 Annex C/2010)
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 12.0 mm
Anchor plate[R]:	l_x x l_y x t = 280.0 mm x 300.0 mm x 12.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, C35/45, $f_{c,cube}$ = 45.00 N/mm²; h = 450.0 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.

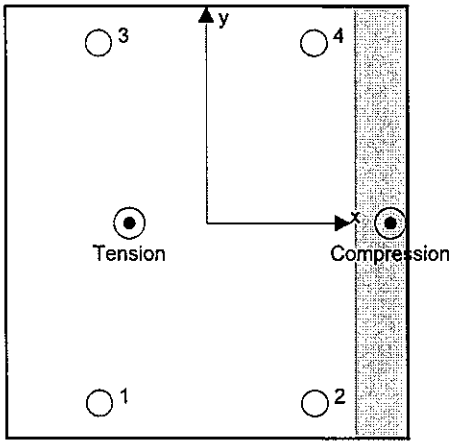
Geometry [mm] & Loading [kN, kNm]



1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 18.800; V_x = 0.000; V_y = 0.000; M_x = 0.000; M_y = 7.620; M_z = 0.000;	no	no	99

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	23.672	0.000	0.000	0.000
2	3.877	0.000	0.000	0.000
3	23.672	0.000	0.000	0.000
4	3.877	0.000	0.000	0.000

max. concrete compressive strain: 0.23 [‰]
max. concrete compressive stress: 6.79 [N/mm^2]
resulting tension force in (x/y)=(-53.9/0.0): 55.098 [kN]
resulting compression force in (x/y)=(128.1/0.0): 36.298 [kN]

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

3 Tension load (ETAG, Annex C, Section 5.2.2)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	23.672	49.571	48	OK
Pullout Strength*	23.672	24.150	99	OK
Concrete Breakout Failure**	55.098	55.788	99	OK
Splitting failure**	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{Sd} \le N_{Rd,s} = \frac{N_{Rk,s}}{\gamma_{M,s}}$ ETAG 001 Annex C, Table 5.2.2.1

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
69.400	1.400	49.571	23.672

3.2 Pullout Strength

$N_{Sd} \le N_{Rd,p} = \frac{\Psi_c \cdot N_{Rk,p}}{\gamma_{M,p}}$ ETAG 001 Annex C, Table 5.2.2.1

$N_{Rk,p}$ [kN]	Ψ_c	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Sd} [kN]
27.000	1.342	1.500	24.150	23.672

3.3 Concrete Breakout Failure

$N_{Sd} \le N_{Rd,c} = \frac{N_{Rk,c}}{\gamma_{M,c}}$ ETAG 001 Annex C, Table 5.2.2.1

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

$\psi_{s,N} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}} \le 1.00$ ETAG 001 Annex C, Eq. (5.2c)

$\psi_{re,N} = 0.5 + \frac{h_{ef}}{200} \le 1.00$ ETAG 001 Annex C, Eq. (5.2d)

$\psi_{ec1,N} = \frac{1}{1 + \frac{2 \cdot e_{c1,N}}{s_{cr,N}}} \le 1.00$ ETAG 001 Annex C, Eq. (5.2e)

$\psi_{ec2,N} = \frac{1}{1 + \frac{2 \cdot e_{c2,N}}{s_{cr,N}}} \le 1.00$ ETAG 001 Annex C, Eq. (5.2e)

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]
204,525	65,025	127.5	255.0

$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
53.9	0.703	0.0	1.000	1.000	1.000

k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$N_{Rd,c}$ [kN]	N_{Sd} [kN]
7.200	37.850	1.500	55.788	55.098

Group anchor ID
1-4

4 Shear load (ETAG, Annex C, Section 5.2.3)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength*	N/A	N/A	N/A	N/A
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

5 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 17.535 [kN] δ_N = 2.3554 [mm]

V_{Sk} = 0.000 [kN] δ_V = 0.0000 [mm]

δ_{NV} = 2.3554 [mm]

Long term loading:

N_{Sk} = 17.535 [kN] δ_N = 2.2246 [mm]

V_{Sk} = 0.000 [kN] δ_V = 0.0000 [mm]

δ_{NV} = 2.2246 [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!

7 Installation data

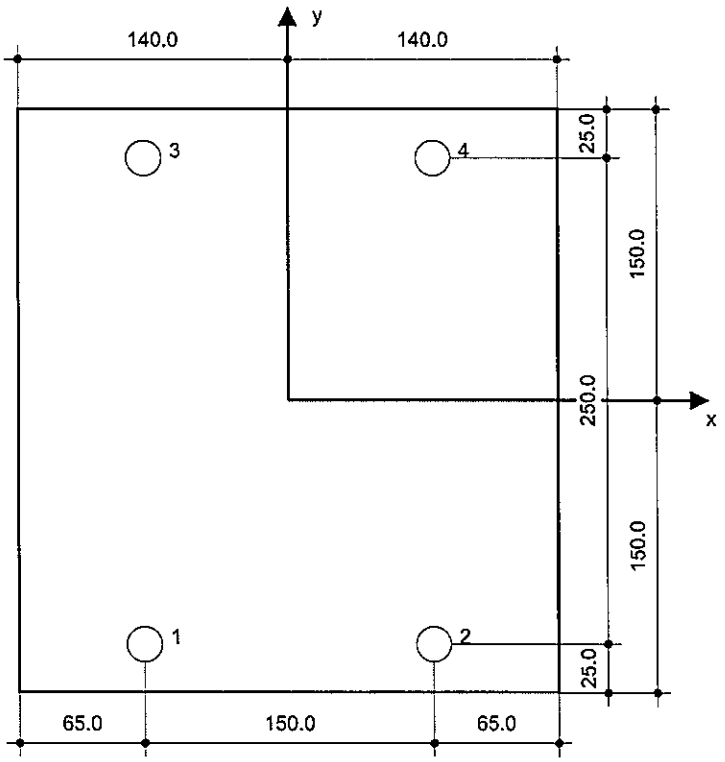
Anchor plate, steel: GB Q390; E = 205,000.00 N/mm^2; f_{yk} = 350.00 N/mm^2
Profile: no profile
Hole diameter in the fixture: d_f = 18.0 mm
Plate thickness (input): 12.0 mm
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: HST3-R M16 hef2
Item number: 2105876 HST3-R M16x135 35/15
Maximum installation torque: 110 Nm
Hole diameter in the base material: 16.0 mm
Hole depth in the base material: 106.0 mm
Minimum thickness of the base material: 160.0 mm

Hilti HST3 stud anchor with 98 mm embedment, M16 hef2, Stainless steel, installation per ETA-98/0001

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Torque wrench • Hammer



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-75.0	-125.0	300.0	450.0	300.0	550.0
2	75.0	-125.0	450.0	300.0	300.0	550.0
3	-75.0	125.0	300.0	450.0	550.0	300.0
4	75.0	125.0	450.0	300.0	550.0	300.0

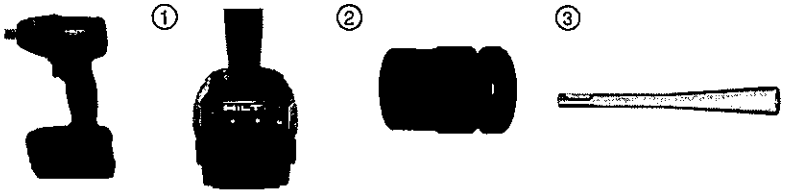
Ordering designation	Anchor size	Anchor length	Drill bit diameter	Drilling Hole Depth at embed. 1	Drilling Hole Depth at embed. 2	Max. fixture thickness at embed. 1	Max. fixture thickness at embed. 2	Base plate clearance hole	Required tightening torque	Sales pack quantity	Item number
HST3-R M12x215 140/120	M12	215 mm	12 mm	68 mm	88 mm	140 mm	120 mm	14 mm	60 Nm	25 pc	2105875
HST3-R M16x115 15/-	M16	115 mm	16 mm	86 mm	-	15 mm	-	18 mm	110 Nm	12 pc	2114057
HST3-R M16x145 45/25	M16	145 mm	16 mm	86 mm	106 mm	45 mm	25 mm	18 mm	110 Nm	12 pc	2105877
HST3-R M16x170 70/50	M16	170 mm	16 mm	86 mm	106 mm	70 mm	50 mm	18 mm	110 Nm	12 pc	2105878
HST3-R M16x220 120/100	M16	220 mm	16 mm	86 mm	106 mm	120 mm	100 mm	18 mm	110 Nm	12 pc	2105879
HST3-R M16x260 160/140	M16	260 mm	16 mm	86 mm	106 mm	160 mm	140 mm	18 mm	110 Nm	12 pc	2105880[1]
HST3-R M16x300 200/180	M16	300 mm	16 mm	86 mm	106 mm	200 mm	180 mm	18 mm	110 Nm	12 pc	2105881[1]
HST3-R M20X170 -/30	M20	170 mm	20 mm	-	124 mm	-	30 mm	22 mm	180 Nm	5 pc	2105899
HST3-R M20X200 -/60	M20	200 mm	20 mm	-	124 mm	-	60 mm	22 mm	180 Nm	5 pc	2105900
HST3-R M24X200 -/30	M24	200 mm	24 mm	-	151 mm	-	30 mm	26 mm	300 Nm	5 pc	2105901
HST3-R M24X230 -/60	M24	230 mm	24 mm	-	151 mm	-	60 mm	26 mm	300 Nm	5 pc	2105902[1]

[1] For detailed stock availability and lead time information please contact your Hilti representative.

Please visit Hilti website for the latest item numbers and related products

Setting tool and adaptive torque system

Fleet Management



Ordering designation	Wrench size	Length	Sales pack quantity	Item number
SI-S 1/2"-13 L ① ②	13 mm	80 mm	1 pc	2070389
SI-S 1/2"-17 L	17 mm	80 mm	1 pc	2070392
SI-S 1/2"-19 L	19 mm	80 mm	1 pc	2070394
HS-SC M8-M16 ③	-	-	1 pc	2051443

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