P & P CONSULTING ENGINEERS LTD

Civil and Structural Engineering

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Ref: 11/243/ds38
18 February 2025

FMI Building Innovation Ltd / Vetro Raccordi

ASSESSMENT OF FRAMELESS GLASS BALUSTRADE

USING CLEARVISTA SURFACE MOUNT SYSTEM & 12mm thick TOUGHENED GLASS (with Top Capping Rail)

(Glass Finished Height from FFL = 1100mm max)

INDEX **PAGE**

Notes:

1. Any parts of the structure which are not covered by the specific design included with these calculations must comply either with the New Zealand Building Code or specific design as detailed by others. Any exceptions to this should be referred back to this Design Office.

2. The above calculations include structural work for which a Building Consent must be obtained prior to building. It is the Owner's responsibility to obtain all necessary consents.

3. It is assumed that the strength and stiffness of the substrate is sufficient to adequately resist the balustrade loads – this must be confirmed for each installation situation.

4. This design assumes that all the specified members are suitably protected from excess moisture in accordance with Section E1, E2 and E3 of the Building Code. All timber, steelwork, bolts and fasteners to be corrosion protected in accordance with the requirements of NZS 3604:2011 Chapter 4, Durability.

5. This design is for glass panels which comply with AS/NZS 2208 and accessories supplied by FMI Building Innovation Ltd / Vetro Raccordi.

engineering new zealand

New Zealand Institute of Architects Incorporated

ACENZ

Building Code Clause(s) B1,F2,F4

PRODUCER STATEMENT – PS1 – DESIGN

(Guidance on use of Producer Statements (formerly page 2) is available at www.engineeringnz.org)

ISSUED BY: P & P CONSULTING ENGINEERS LTD
(Design Firm)

TO: FMI Building Innovation Ltd / Vetro Raccordi
(Owner/Developer)

TO BE SUPPLIED TO: VARIOUS
(Building Consent Authority)

IN RESPECT OF: GLASS BALUSTRADE WITH SURFACE MOUNT & 12 mmTOUGHENED GLASS & TOP CAPPING RAIL
(Description of Building Work)

AT: VARIOUS SITES (Occupancy Type A,B,E, C3 and Up to max "Very High" Wind)
(Address)

Town/City:……………… **LOT**……………… **DP**……………… **SO**………………
(Address)

We have been engaged by the owner/developer referred to above to provide:

GLASS TESTING REVIEW AND DESIGN FOR BASE FIXING

(Extent of Engagement)

services in respect of the requirements of Clause(s) B1, F2, F4 of the Building Code for:

☐ All or ☒ Part only (as specified in the attachment to this statement), of the proposed building work.

The design carried out by us has been prepared in accordance with:

☒ Compliance Documents issued by the Ministry of Business, Innovation & Employment B1/VM1 or
(verification method/acceptable solution)

☐ Alternative solution as per the attached schedule……………

The proposed building work covered by this producer statement is described on the drawings titled:

FMI LTD /VETRO RACCORDI - SURFACE MOUNT and numbered REF:11/243/DS38, DRAWING ENG01
together with the specification, and other documents set out in the schedule attached to this statement.

On behalf of the Design Firm, and subject to:
(i) Site verification of the following design assumptions REFER NOTES AT THE END OF DESIGN SUMMARY
(ii) All proprietary products meeting their performance specification requirements;

I believe on reasonable grounds that a) the building, if constructed in accordance with the drawings, specifications, and other documents provided or listed in the attached schedule, will comply with the relevant provisions of the Building Code and that b), the persons who have undertaken the design have the necessary competency to do so. I also recommend the following level of construction monitoring/observation:

☐ CM1 ☐ CM2 ☐ CM3 ☐ CM4 ☐ CM5 (Engineering Categories) or ☒ as per agreement with owner/developer (Architectural)

I, Parmil Prakash am: ☒ CPEng 251801 # ☐ Reg Arch …………… #
(Name of Design Professional)

I am a member of: ☒ Engineering New Zealand ☐ NZIA and hold the following qualifications: BE(Civil), CPEng
The Design Firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than $200,000*.
The Design Firm is a member of ACENZ: ☐

SIGNED BY Parmil Prakash (Signature)
(Name of Design Professional)

ON BEHALF OF P & P CONSULTING ENGINEERS LTD Date 18 Feb 2025
(Design Firm)

Note: This statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), is limited to the sum of $200,000.*

This form is to accompany **Form 2 of the Building (Forms) Regulations 2004** for the application of a Building Consent.

2. DESIGN GENERAL

The glass balustrade was tested to comply with the following:

STATUTORY

NZS 4223.3:2016	Glazing In Buildings
AS/NZS 1170:2002	Loadings Code
NZS 3404:1997	Structural Steel
NZS 3101:1995	Concrete
NZS 3603:1993	Timber
AS/NZS 1664.1:1997	Aluminium Structures - Part 1 Limit State Design

LOADS (Lateral Loads Only Considered)

Live Loads (Refer to Table 3.3 of AS/NZS 1170:)

Occupancy	Specific Uses	Top Edge		Infill
A	Internal Domestic Situation Only	0.35 kN/m	0.6 kN	0.5 kPa
B, E & C3	External Domestic Balconies, Offices and Work Areas. (NOT subject to Over Crowding)	0.75 kN/m	0.6 kN	1 kPa or 0.5 KN

Wind Loads (VERY HIGH)

Design for Very High Winds in terms of the Wind Speed categories in NZS 3604:2011 (up to 50 m/s).

$V_{sit,\beta}$(Ultimate) = 50.0 m/s
$V_{sit,\beta}$(Serviceability) = 37.3 m/s

q = 1.50 kPa (ULS)
and = 0.83 kPa (SLS)

For external barriers use Cp = 1.30
For internal barriers use Cp = 0.30

Wind Load = q x Cp = 1.95 kPa (ULS)
= 1.08 kPa (SLS)

LOAD FACTORS and DEFLECTIONS

Importance Level = 2
ULS factor = 1.5Q (Refer Section 4.2.2 of AS/NZS 1170)
Maximum Deflection = Height / 30

3. LOAD TESTS

Location of Tests: 49 Woodside Avenue, Auckland
Date of Tests: Feb 2019
Test Description: Load testing of Glass Balustrade
Panel Tested = 1200mm wide x 1080mm high glass panel,
1100mm finished height from FFL

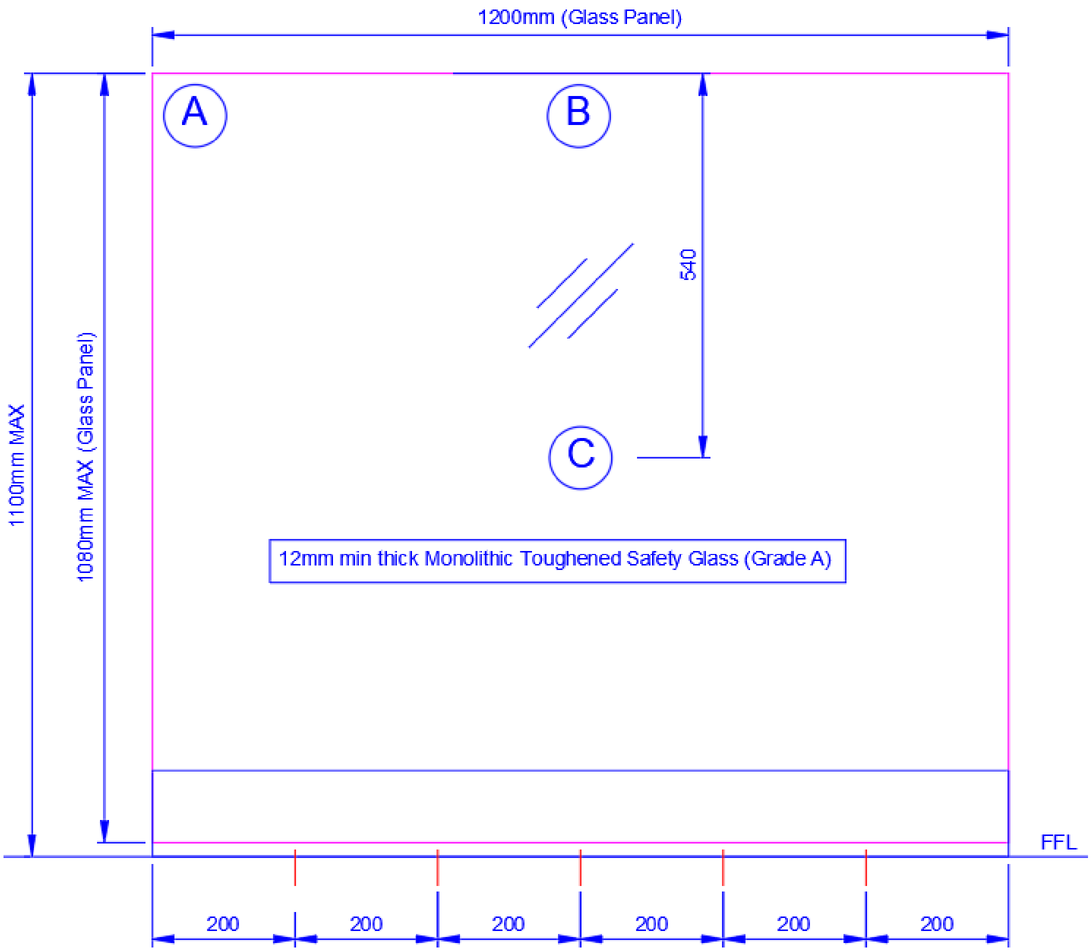
System Description: The glass balustrade which was supplied by FMI Building Innovation Ltd / Vetro Raccordi Ltd. comprised of 12mm thick Toughened (Grade A) Safety Glass supported by ClearVista Surface Mount System and with top capping rail fixed to side posts.

Setup / Procedure:
The balustrade was setup with different load tests as noted on page 4. The glass panel was supported at the base with ClearVista Surface Mount System. This system was bolted to the steel frame assembly with M10 fixings as shown below. Top capping rail was also installed on the glass panel which was fixed to the side posts acting as the supporting neighboring glass panels.

The hydraulic body frame/ram and load cell or weighing indicator were used to attain the required test loads.

4. TESTS ARRANGEMENT & RESULTS

4.1 BALUSTRADE



TESTS	LOAD LOCATION
A	Point Load @ Top Corner with steel round disc
B	Horizontal UDL Load @ Top with Solid Steel Beam
C	Infill & Wind Load @ Middle Centre with Framing

NOTE:
1. Assuming a coefficient of variation (Vr) of 10% for the glass, the variability factor kt is taken as 1.33 for 3 test samples.
2. The structure to which the balustrade system is attached was not tested or analysed. The strength and stiffness of the substrate structure must be specifically confirmed for each situation.

TEST RESULTS (Fracture Check - ULS)

Tests	Target Load (Kg)	Duration (mins)	Observation for Samples 1,2,3
A	122	16	No Fracture
B	183	16	No Fracture
C	344	16	No Fracture

TEST RESULTS (Deflection Check - SLS)

Tests	Target Load @ SLS (Kg)	Deflection @ Top (mm)			Remarks
		Sample 1	Sample 2	Sample 3	
A	61	13	14	13	Passed
B	91.7	12	13	12	Passed
C	145	12	13	12	Passed

Allowable Deflection = H/30 = 36.7 mm

Based on the testing, the glass balustrade which comprised of 12mm thick Toughened (Grade A) Safety Glass supported by ClearVista Surface Mount System and with top capping rail was sufficient for the following:

- Occupancy types A, B, E, C3
- Up to max “Very High” Wind

5.0 Base Fixings

Refer to Summary Drawing ENG 01 for reference.

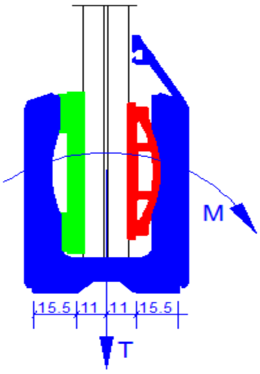
5.1 Base Fixings for Internal Balustrade

- For Occupancy types A, B, E, C3
- For Up to max “Very High” Wind

Maximum Spacing of Base Fixings = 200 mm
Number of base fixings = 4

Max Height of Balustrade from Deck Level = 1.100 m

Design Load					Moment at base, kNm	Shear at base, kN	Tension per fixing, kN
A,B,E,C3 Loading	1.5Q1:	1.5 x 0.75 kN/m x spacing =	0.225	kN	0.25	0.23	9.92
	1.5Q2:	1.5 x 0.6 kN / (no of base fixings) =	0.225	kN	0.25	0.23	9.92
	1.5Q3:	1.5 x 1.0 kPa =	1.5	kPa	0.18	0.33	7.27
Wind (VH)-external	Wuls:	0.6 x 50 x 50 /1000 x 1.3 =	1.95	kPa	0.24	0.43	9.46



Tension per fixing, T = M / (lever arm)
lever arm = 11 + 0.9 (15.5) = 24.95 mm

Max Tension per Fixing, T =	**9.92**	**kN**
Max Shear per Fixing, V =	**0.43**	**kN**

A. Fixing to Concrete

Refer to page 8 for HILTI design calculations.
Concrete Strength, f'c = 20MPa min
Considered as Cracked Concrete
Anchor Spacing = 200 mm
Concrete Edge Distance, e = 75mm min (100mm other side or corner)
Dry Concrete

Use HILTI HIT HY 200-R V3 Adhesive + M12 HAS-U (Grade 5.8) Anchors.
Minimum embedment (h) into cracked concrete to be 120 mm.
(spacing = 200mm max centres)

B. Fixing to Steel

Using M10 Grade 4.6/S

ØN =	**18.56**	kN	**OK**	CDR=	0.58	**OK**
ØV =	**9.62**	kN	**OK**			

Use M10 Grade 4.6/S Steel Bolts with metric round washer per fixing.
(spacing = 200mm max centres)

C. Fixing to Timber Using Bolt

Capacity is controlled by bearing on washers. (ØQ = Ø k1 x k3 x Fp x Aw)

where: Fp = 5.3MPa (wet) or 8.9 Mpa (dry) , Ø=0.8, k1=1.0 (brief), k3=1

Using 50x50x5 Square Washers

ØQ = **16.99** kN (dry) OK

Use M10 Grade 4.6/S Steel Bolts with 50x50x5 Square Steel Washers.

(spacing = 200mm max centres)

D. Fixing to Timber Using Coach Screws

As per NZS3603, Timber Group J5, Screws in Withdrawal.(ØQ = Ø n k1 K p Qk)

where: Ø=0.7, k1=1.0 (brief), K=0.7 (wet) or 1 (dry)

Qk = 107N/mm (M10 Coach Screws) or 118N/mm (M12 Coach Screws)

Using M10 Coach Screws

ØQ = 74.9 N/mm (dry) Min Penetration p = **133** mm (dry)

Using M12 Coach Screws

ØQ = 82.6 N/mm (dry) Min Penetration p = **121** mm (dry)

(spacing = 200mm max centres)

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Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Aug 17, 2022	Date:	18/08/2022
Fastening point:			

Specifier's comments:

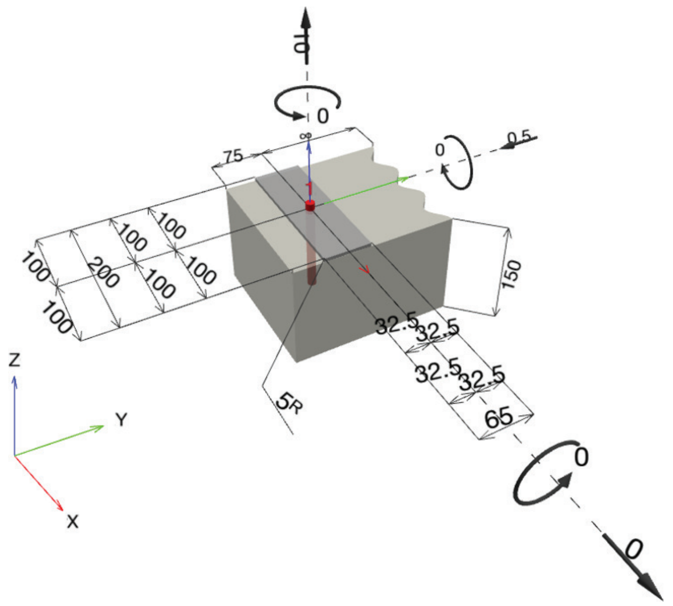
1 Input data

Anchor type and diameter:	**HIT-HY 200-R V3 + HAS-U 5.8 M12**
Return period (service life in years):	50
Item number:	2223823 HAS-U 5.8 M12x160 (element) / 2262134 HIT-HY 200-R V3 (adhesive)
Effective embedment depth:	$h_{ef,act}$ = 120.0 mm ($h_{ef,limit}$ = - mm)
Material:	5.8
Evaluation Service Report:	ETA 19/0601
Issued I Valid:	2/12/2021 | -
Proof:	Design Method New Zealand NZS 3101, chapter 17.5.5 – ETAG Design; EOTA TR 029
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 5.0 mm
Anchor plate^R :	l_x x l_y x t = 200.0 mm x 65.0 mm x 5.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, C20/25, $f_{c,cube}$ = 25.00 N/mm^2; h = 150.0 mm, Temp. short/long: 40/24 °C
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 Reinforcement to control splitting according to EOTA TR 029, 5.2.2.6 present.

Application also possible with HVU2 + HAS-U 5.8 M12_hef1 under the selected boundary conditions.
More information in section Alternative fastening data of this report.

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

Geometry [mm] & Loading [kN, kNm]



1.1 Load combination

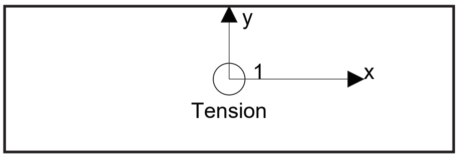
Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	$N = 10.000; V_x = 0.000; V_y = -0.500;$ $M_x = 0.000; M_y = 0.000; M_z = 0.000;$	no	no	95

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	10.000	0.500	0.000	-0.500



max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [N/mm^2]
resulting tension force in (x/y)=(0.0/0.0): 10.000 [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 (EOTA TR 029, Section 5.2.2)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	10.000	28.133	36	OK
Combined pullout-concrete cone failure**	10.000	11.527	87	OK
Concrete Breakout Failure**	10.000	10.574	95	OK
Splitting failure**	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{Sd} \leq N_{Rd,s} = \frac{N_{Rk,s}}{\gamma_{M,s}}$ EOTA TR 029, Table 5.2.2.1

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
42.200	1.500	28.133	10.000

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Fastening point:			

4 Shear load (EOTA TR 029, Section 5.2.3)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	0.500	20.256	3	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	0.500	21.147	3	OK
Concrete edge failure in direction y-**	0.500	6.035	9	OK

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

4.1 Steel Strength (without lever arm)

$$V_{Sd} \leq V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{M,s}}$$ EOTA TR 029, Table 5.2.3.1

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
25.320	1.250	20.256	0.500

5 Combined tension and shear loads (EOTA TR 029, Section 5.2.4)

Steel failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.946	0.083	1.000	86	OK

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

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 7.407 [kN] δ_N = 0.1146 [mm]

V_{Sk} = 0.370 [kN] δ_V = 0.0185 [mm]

δ_{NV} = 0.1161 [mm]

Long term loading:

N_{Sk} = 7.407 [kN] δ_N = 0.2620 [mm]

V_{Sk} = 0.370 [kN] δ_V = 0.0296 [mm]

δ_{NV} = 0.2637 [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 EOTA TR 029, Section 7!
- The design is only valid if the clearance hole in the fixture is not larger than the value given in Table 4.1 of EOTA TR029! For larger diameters of the clearance hole see Chapter 1.1. of EOTA TR029!
- 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.
- Bore hole cleaning must be performed according to instructions for use (blow twice with oil-free compressed air (min. 6 bar), brush twice, blow twice with oil-free compressed air (min. 6 bar)).
- Characteristic bond resistances depend on short- and long-term temperatures.
- Edge reinforcement is not required to avoid splitting failure
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening meets the design criteria!

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Fastening point:			

8 Installation data

Anchor plate, steel: S 235; E = 210,000.00 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): 5.0 mm

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

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

Anchor type and diameter: HIT-HY 200-R V3 + HAS-U 5.8 M12

Item number: 2223823 HAS-U 5.8 M12x160 (element) / 2262134 HIT-HY 200-R V3 (adhesive)

Maximum installation torque: 40 Nm

Hole diameter in the base material: 14.0 mm

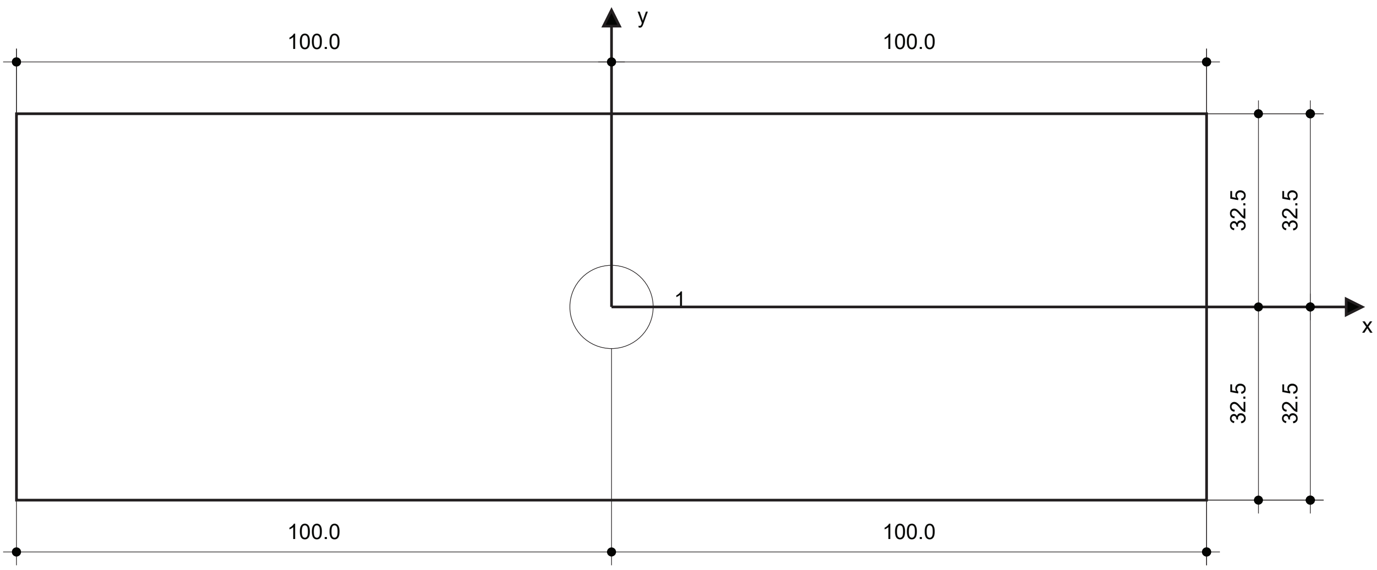
Hole depth in the base material: 120.0 mm

Minimum thickness of the base material: 150.0 mm

Hilti HAS-U threaded rod with HIT-HY 200-R V3 injection mortar with 120 mm embedment h_ef, M12, Steel galvanized, Hammer drilled installation per ETA 19/0601

8.1 Recommended accessories

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



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.0	0.0	100.0	100.0	75.0	-

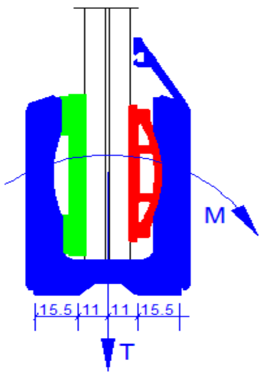
5.2 BASE FIXINGS FOR EXTERNAL BALUSTRADE

- For Occupancy types B, E, C3
- For Up to max “Very High” Wind

Maximum Spacing of Base Fixings 200 mm
Number of base fixings = 4

Max Height of Balustrade from Deck Level = 1.100 m

Design Load					Moment at base, kNm	Shear at base, kN	Tension per fixing, kN
B,E,C3 Loading	1.5Q1:	1.5 x 0.75 kN/m x spacing =	0.225	kN	0.25	0.23	9.92
	1.5Q2:	1.5 x 0.6 kN / (no of base fixings) =	0.225	kN	0.25	0.23	9.92
	1.5Q3:	1.5 x 1.0 kPa =	1.5	kPa	0.18	0.33	7.27
Wind (VH)-external	Wuls:	0.6 x 50 x 50 /1000 x 1.3 =	1.95	kPa	0.24	0.43	9.46



Tension per fixing, T = M / (lever arm)
lever arm = 11 + 0.9 (15.5) = 24.95 mm

Max Tension per Fixing, T =	**9.92**	**kN**
Max Shear per Fixing, V =	**0.43**	**kN**

A. Fixing to Concrete

Refer to page 11 for HILTI design calculations.
Concrete Strength, f'c = 20MPa min
Considered as Cracked Concrete
Anchor Spacing = 200 mm
Concrete Edge Distance, e = 75mm min (100mm other side or corner)
No water standing in the hole

Use HILTI HIT HY 200-R V3 Adhesive + M12 A4 HAS-U (Stainless Steel) Anchors.
Minimum embedment (h) into cracked concrete to be 120 mm.

(spacing = 200mm max centres)

B. Fixing to Steel

Using M10 Grade A4/316 SS (A4-70)

ØN = **27.20** kN **OK** CDR= 0.28 **OK**
ØV = **17.86** kN **OK**

Use M10 Grade 316 Stainless Steel (A4-70) Bolts with metric round washer per fixing

(spacing = 200mm max centres)

C. Fixing to Timber Using Bolt

Capacity is controlled by bearing on washers. (ØQ = Ø k1 x k3 x Fp x Aw)

where: Fp = 5.3MPa (wet) or 8.9 Mpa (dry) , Ø=0.8, k1=1.0 (brief), k3=1

Using 65x65x5 Square Washers

ØQ = **17.43** kN (wet) OK

Use M10 Grade 316 Stainless Steel (A4-70) Bolts with 65x65x5 square steel washers.

(spacing = 200mm max centres)

D. Fixing to Timber Using Coach Screws

As per NZS3603, Timber Group J5, Screws in Withdrawal.(ØQ = Ø n k1 K p Qk)

where: Ø=0.7, k1=1.0 (brief), K=0.7 (wet) or 1 (dry)

Qk = 107N/mm (M10 Coach Screws) or 118N/mm (M12 Coach Screws)

Using M10 Coach Screws

ØQ = 52.43 N/mm (wet) Min Penetration p = **190** mm (wet)

Using M12 Coach Screws

ØQ = 57.82 N/mm (wet) Min Penetration p = **172** mm (wet)

(spacing = 200mm max centres)

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Phone I Fax:	|	E-Mail:	
Design:	Concrete - Aug 17, 2022	Date:	18/08/2022
Fastening point:			

Specifier's comments:

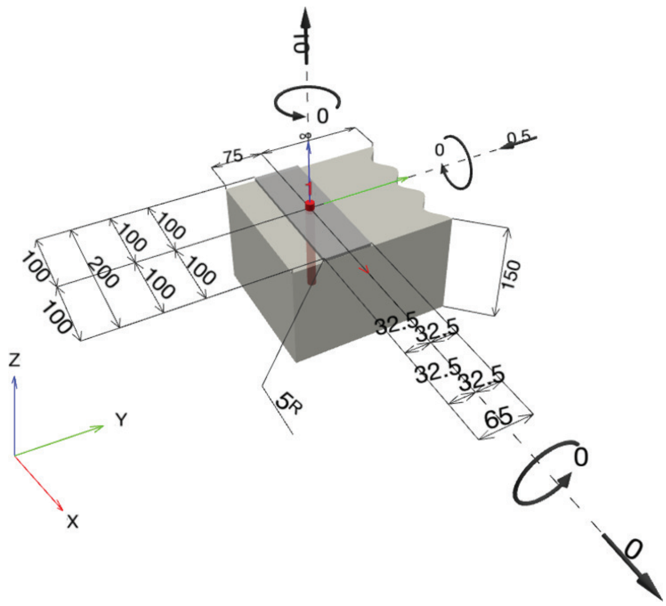
1 Input data

Anchor type and diameter:	**HIT-HY 200-R V3 + HAS-U A4 M12**
Return period (service life in years):	50
Item number:	2223844 HAS-U A4 M12x160 (element) / 2262134 HIT-HY 200-R V3 (adhesive)
Effective embedment depth:	$h_{ef,act}$ = 120.0 mm ($h_{ef,limit}$ = - mm)
Material:	A4
Evaluation Service Report:	ETA 19/0601
Issued I Valid:	2/12/2021 | -
Proof:	Design Method New Zealand NZS 3101, chapter 17.5.5 – ETAG Design; EOTA TR 029
Stand-off installation:	e_b = 0.0 mm (no stand-off); t = 5.0 mm
Anchor plate^R :	l_x x l_y x t = 200.0 mm x 65.0 mm x 5.0 mm; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, C20/25, $f_{c,cube}$ = 25.00 N/mm^2; h = 150.0 mm, Temp. short/long: 40/24 °C
Installation:	**hammer drilled hole, Installation condition: Water saturated**
Reinforcement:	no reinforcement or reinforcement spacing >= 150 mm (any Ø) or >= 100 mm (Ø <= 10 mm) no longitudinal edge reinforcement Reinforcement to control splitting according to EOTA TR 029, 5.2.2.6 present.

Application also possible with HVU2 + HAS-U A4 M12_hef1 under the selected boundary conditions.
More information in section Alternative fastening data of this report.

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

Geometry [mm] & Loading [kN, kNm]



Input data and results must be checked for conformity with the existing conditions and for plausibility!

1.1 Load combination

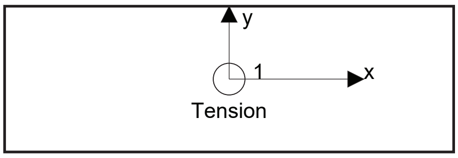
Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. Anchor [%]
1	Combination 1	N = 10.000; V_x = 0.000; V_y = -0.500; M_x = 0.000; M_y = 0.000; M_z = 0.000;	no	no	95

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	10.000	0.500	0.000	-0.500



max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [N/mm^2]
resulting tension force in (x/y)=(0.0/0.0): 10.000 [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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3 Tension load (EOTA TR 029, Section 5.2.2)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	10.000	31.551	32	OK
Combined pullout-concrete cone failure**	10.000	11.527	87	OK
Concrete Breakout Failure**	10.000	10.574	95	OK
Splitting failure**	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{Sd} \leq N_{Rd,s} = \frac{N_{Rk,s}}{\gamma_{M,s}}$ EOTA TR 029, Table 5.2.2.1

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
59.000	1.870	31.551	10.000

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Fastening point:			

4 Shear load (EOTA TR 029, Section 5.2.3)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	0.500	18.910	3	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	0.500	21.147	3	OK
Concrete edge failure in direction y-**	0.500	6.035	9	OK

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

4.1 Steel Strength (without lever arm)

$$V_{Sd} \le V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{M,s}}$$ EOTA TR 029, Table 5.2.3.1

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
29.500	1.560	18.910	0.500

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5 Combined tension and shear loads (EOTA TR 029, Section 5.2.4)

Steel failure

β_N	β_V	α	Utilization $\beta_{N,V}$ [%]	Status
0.946	0.083	1.000	86	OK

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

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 7.407 [kN] δ_N = 0.1146 [mm]

V_{Sk} = 0.370 [kN] δ_V = 0.0185 [mm]

δ_{NV} = 0.1161 [mm]

Long term loading:

N_{Sk} = 7.407 [kN] δ_N = 0.2620 [mm]

V_{Sk} = 0.370 [kN] δ_V = 0.0296 [mm]

δ_{NV} = 0.2637 [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 EOTA TR 029, Section 7!
- The design is only valid if the clearance hole in the fixture is not larger than the value given in Table 4.1 of EOTA TR029! For larger diameters of the clearance hole see Chapter 1.1. of EOTA TR029!
- 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.
- Bore hole cleaning must be performed according to instructions for use (blow twice with oil-free compressed air (min. 6 bar), brush twice, blow twice with oil-free compressed air (min. 6 bar)).
- Characteristic bond resistances depend on short- and long-term temperatures.
- Edge reinforcement is not required to avoid splitting failure
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening meets the design criteria!

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Fastening point:			

8 Installation data

Anchor plate, steel: S 235; E = 210,000.00 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): 5.0 mm

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

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

Anchor type and diameter: HIT-HY 200-R V3 + HAS-U A4 M12

Item number: 2223844 HAS-U A4 M12x160 (element) / 2262134 HIT-HY 200-R V3 (adhesive)

Maximum installation torque: 40 Nm

Hole diameter in the base material: 14.0 mm

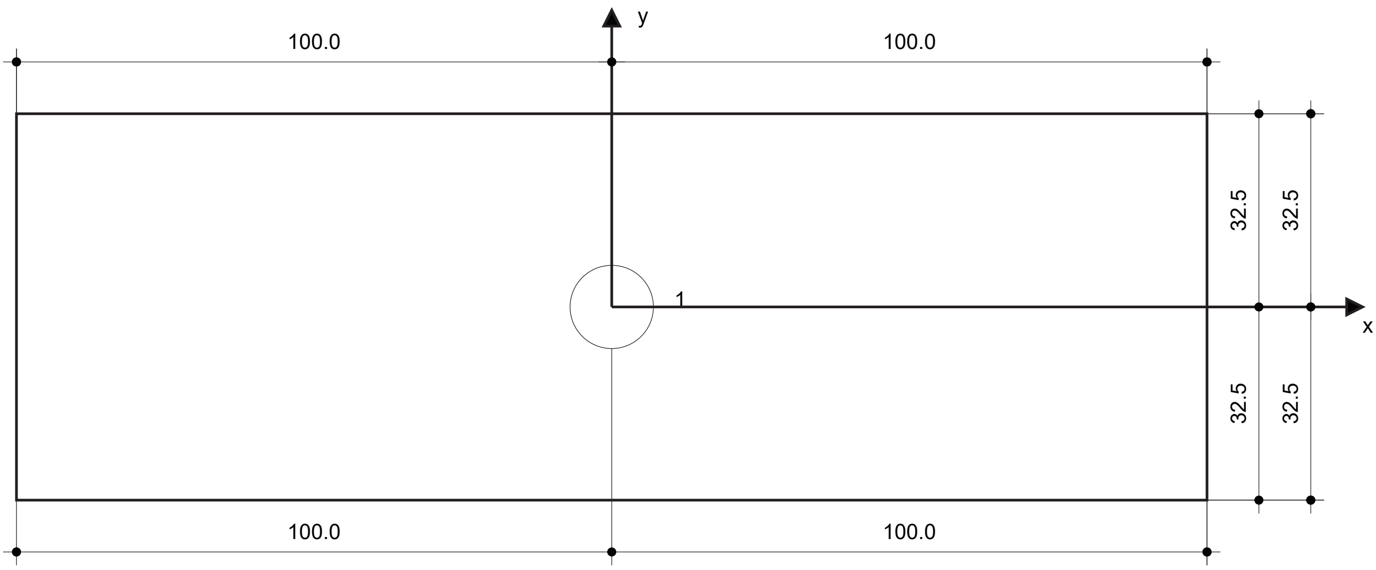
Hole depth in the base material: 120.0 mm

Minimum thickness of the base material: 150.0 mm

Hilti HAS-U threaded rod with HIT-HY 200-R V3 injection mortar with 120 mm embedment h_ef, M12, Stainless steel, Hammer drilled installation per ETA 19/0601

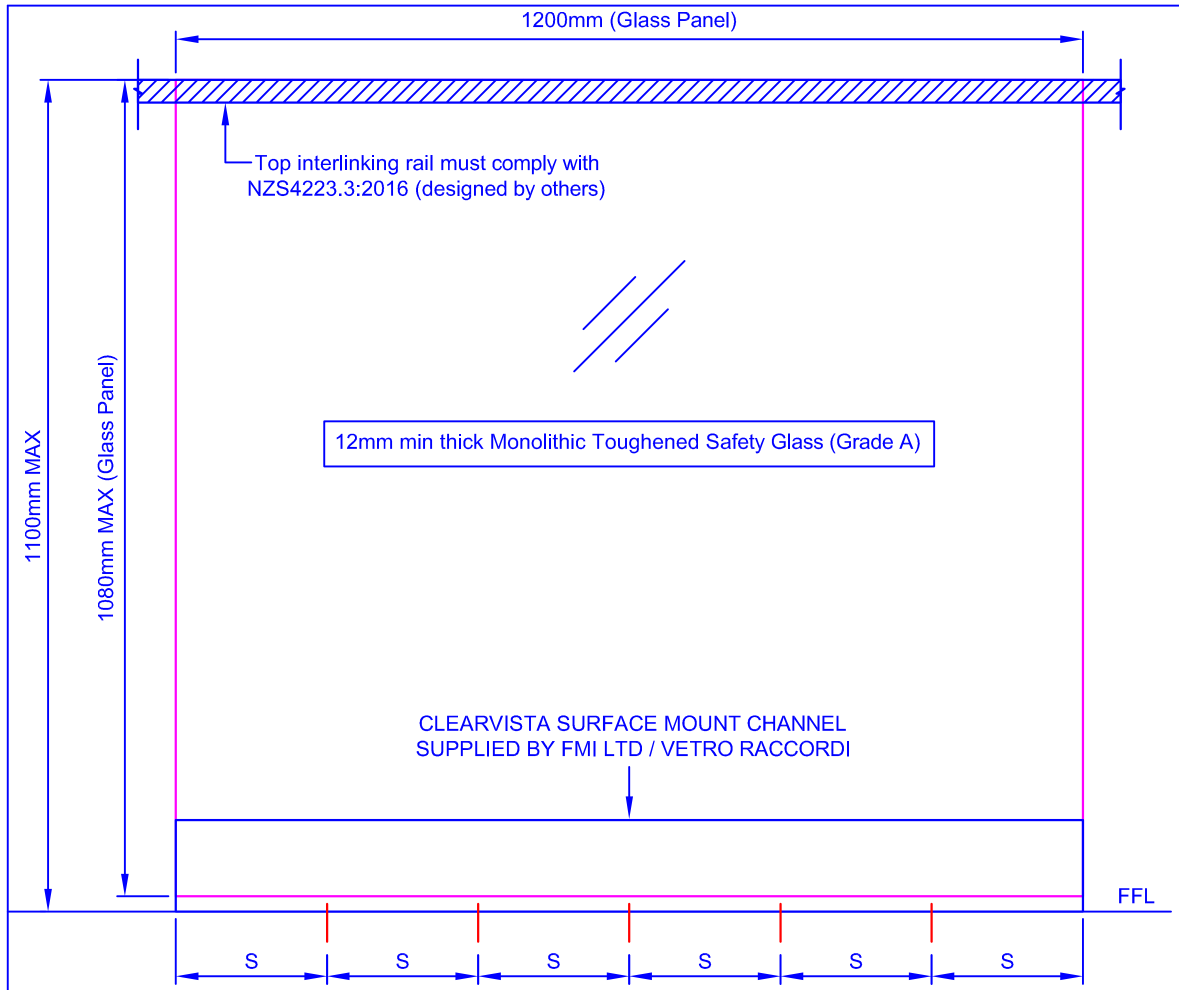
8.1 Recommended accessories

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



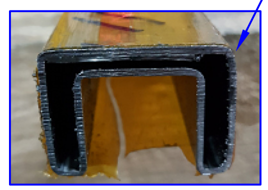
Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.0	0.0	100.0	100.0	75.0	-

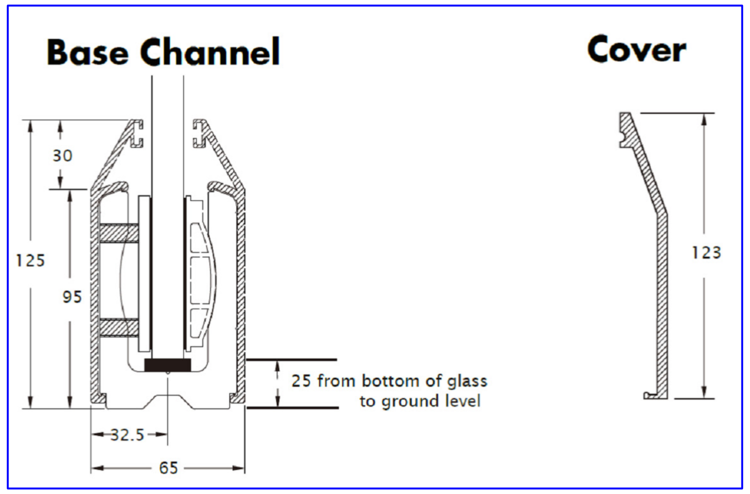


TYPICAL ELEVATION

NOTE:
S = MAXIMUM SPACING OF THE BASE FIXINGS



TOP CAPPING RAIL USED



ClearVista Surface Mount Channel & Cover

THIS GLASS BALUSTRADE IS SUITABLE FOR THE FOLLOWING:

LIVE LOAD:

OCCUPANCY TYPE	REFER TABLE 3.3 OF AS/NZS 1170
A	ALL AREAS WITHIN OR SERVING EXCLUSIVELY ONE DWELLING INCLUDING STAIRS, LANDINGS ETC. BUT EXCLUDING EXTERNAL BALCONIES & EDGES OF ROOFS.
B, E & C3	EXTERNAL DOMESTIC BALCONIES, OFFICES AND WORK AREAS. (NOT SUBJECT TO OVER CROWDING)

WIND LOAD: UP TO "VERY HIGH" (VH) WIND ZONE WITH MAXIMUM BASIC WIND SPEED OF 50 m/s. (DESIGN WIND PRESSURE = 1.95 kPa @ ULS)

FIXINGS:

1. ALL ANCHORS MUST BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS REQUIREMENTS.

2. BOLTING ARRANGEMENT MUST COMPLY WITH RELEVANT MATERIAL CODES.

3. STRENGTH & STIFFNESS OF THE SUBSTRATE STRUCTURE MUST BE SUFFICIENT FOR THE BALUSTRADE LOADS - THIS MUST BE SPECIFICALLY CHECKED BY OTHERS FOR EACH SITUATION.

DURABILITY:

1. ALL FIXINGS & STRUCTURAL STEEL MUST COMPLY WITH SECTION 4 "DURABILITY" OF NZS 3604:2011.

CONNECTION TO SUPPORTING DECK TIMBER FRAMING:

*1. TO RESIST THE ROTATION AT THE BASE, FIX THE SUPPORTING BOUNDARY / END JOISTS TO THE SUPPORTING DECK TIMBER FRAMING AS PER THE DETAILS FROM NZS3604:2011 FIGURE 7.10.

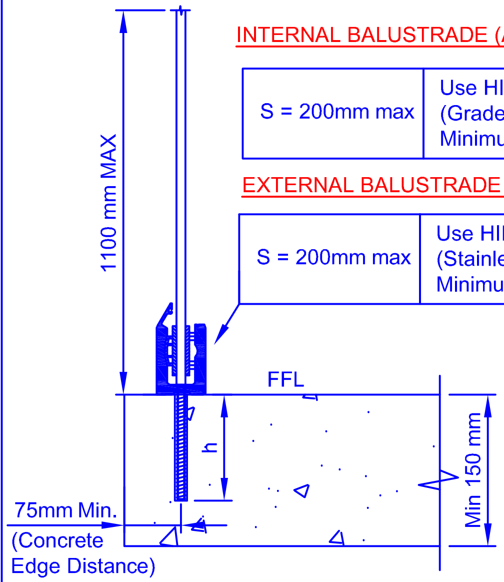
(OTHERWISE THOSE STRAPS, BOLTS,ETC - TO BE SPECIFICALLY DESIGNED BY OTHERS.)

INTERNAL BALUSTRADE (A,B,E,C3,VH)

S = 200mm max	Use HILTI HIT HY 200-R V3 Adhesive + M12 HAS-U (Grade 5.8) Anchors. Minimum embedment (h) into cracked concrete to be 120 mm.

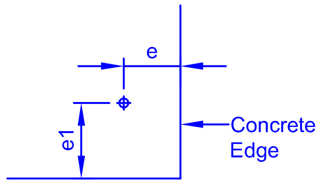
EXTERNAL BALUSTRADE (B,E,C3,VH)

S = 200mm max	Use HILTI HIT HY 200-R V3 Adhesive + M12 A4 HAS-U (Stainless Steel) Anchors. Minimum embedment (h) into cracked concrete to be 120 mm.



FIXING TO CONCRETE
(Spacing, S = 200mm max)

NOTE:
- Min Concrete Strength f'c =20 MPa
- Considered as Cracked Concrete
- No water standing in the drilled hole
- Minimum concrete edge distance for anchors:
  - e = 75 mm minimum (perpendicular to glass panel)
  - e1 = 100 mm minimum (along the glass panel)



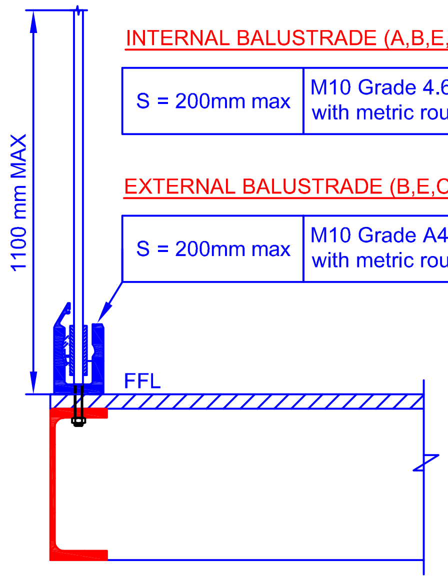
CORNER ANCHOR

INTERNAL BALUSTRADE (A,B,E,C3,VH)

S = 200mm max	M10 Grade 4.6/S Bolts with metric round washers

EXTERNAL BALUSTRADE (B,E,C3,VH)

S = 200mm max	M10 Grade A4-70 SS Bolts with metric round washers



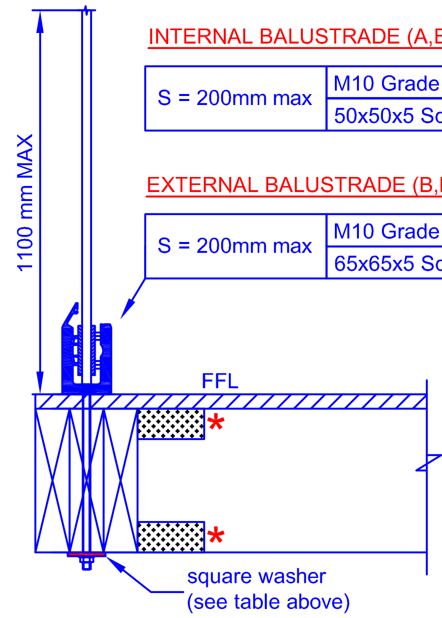
FIXING TO STEEL
(Spacing, S = 200mm max)

INTERNAL BALUSTRADE (A,B,E,C3,VH)

S = 200mm max	M10 Grade 4.6/S Bolts
	50x50x5 Square Steel Washers

EXTERNAL BALUSTRADE (B,E,C3,VH)

S = 200mm max	M10 Grade A4-70 SS Bolts
	65x65x5 Square SS Washers



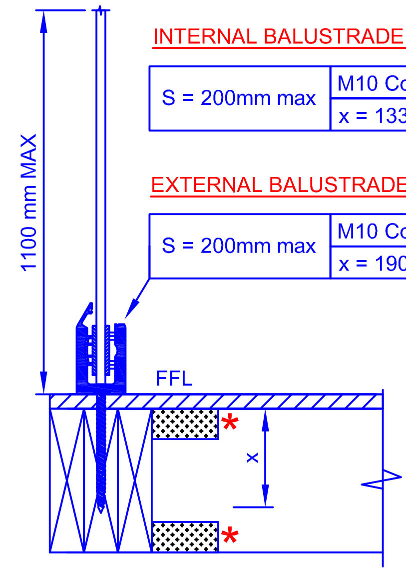
FIXING TO TIMBER USING ENG BOLTS
(Spacing, S = 200mm max)

INTERNAL BALUSTRADE (A,B,E,C3,VH)

S = 200mm max	M10 Coach Screws
	x = 133 mm (dry)

EXTERNAL BALUSTRADE (B,E,C3,VH)

S = 200mm max	M10 Coach Screws (A4-70 SS)
	x = 190 mm (wet)



FIXING TO TIMBER USING COACH SCREWS
(Spacing, S = 200mm max)

P & P CONSULTING ENGINEERS LTD Civil and Structural Engineering 6A Montel Avenue, Henderson ph: 836-1853	FMI LTD / VETRO RACCORDI - CLEARVISTA SURFACE MOUNT SYSTEM	Scales NOT TO SCALE	Project 11/243(DS38)
	INTERNAL & EXTERNAL BALUSTRADE - 12mm thick TOUGHENED GLASS (WITH TOP CAPPING RAIL)	Drawn JD / Date 18/2/2025	Sheet ENG 01