P & P CONSULTING ENGINEERS LTD

Civil and Structural Engineering

Mr P. Prakash (Director)
B.E. (Civil), CPEng, MIPENZ
Mr J. Dela Cruz
B.E. (Civil), GIPENZ
Mr H. Yin
B.E. (Civil), GIPENZ
Dr. H.D.W. FENDALL (Consultant)
B.E. (Civil) Hons., Ph.D., CPEng, MIPENZ

6A Montel Avenue,
Henderson,
AUCKLAND, 0612
Ph. & Fax 09-836-1853
parmil@pnpltd.co.nz
joel@pnpltd.co.nz
hansen@pnpltd.co.nz

Ref: 11/243/ds58
22 October 2021

Vetro Raccordi / FMI Ltd

ASSESSMENT OF FRAMELESS GLASS BALUSTRADE

USING TILT-LOCK BASE CHANNEL SYSTEM (SIDE MOUNTED) & 13.52mm thick SGP TOUGHENED LAMINATED SAFETY GLASS (with Top Capping / Interlinking Rail)

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 and must be checked by others.

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 Vetro Raccordi / FMI Ltd.

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: VETRO RACCORDI / FMI LIMITED
(Owner/Developer)

TO BE SUPPLIED TO: VARIOUS LOCAL AUTHORITY
(Building Consent Authority)

IN RESPECT OF: Glass Balustrade with Tilt-lock Base Channel (side mounted) & 13.52mm SGP Toughened Laminated Glass
(Description of Building Work)

AT: VARIOUS SITES (Refer to design summary and structural drawing)
(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:

VETRO RACCORDI/FMI LTD -TILT-LOCK BASE CHANNEL SYST and numbered REF:11/243/DS58 , 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 (Name of Design Professional) am: ■ CPEng 251801 # ☐ Reg Arch ..... #

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 (Name of Design Professional) (Signature)

ON BEHALF OF P & P CONSULTING ENGINEERS LTD (Design Firm) Date 22 October 2021

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 & 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: 3 Timaru Place, Mt Wellington
Date of Tests: October 2021
Test Description: Load testing of Glass Balustrade
(Panel Tested = 1400mm wide x 1200mm high glass panel)

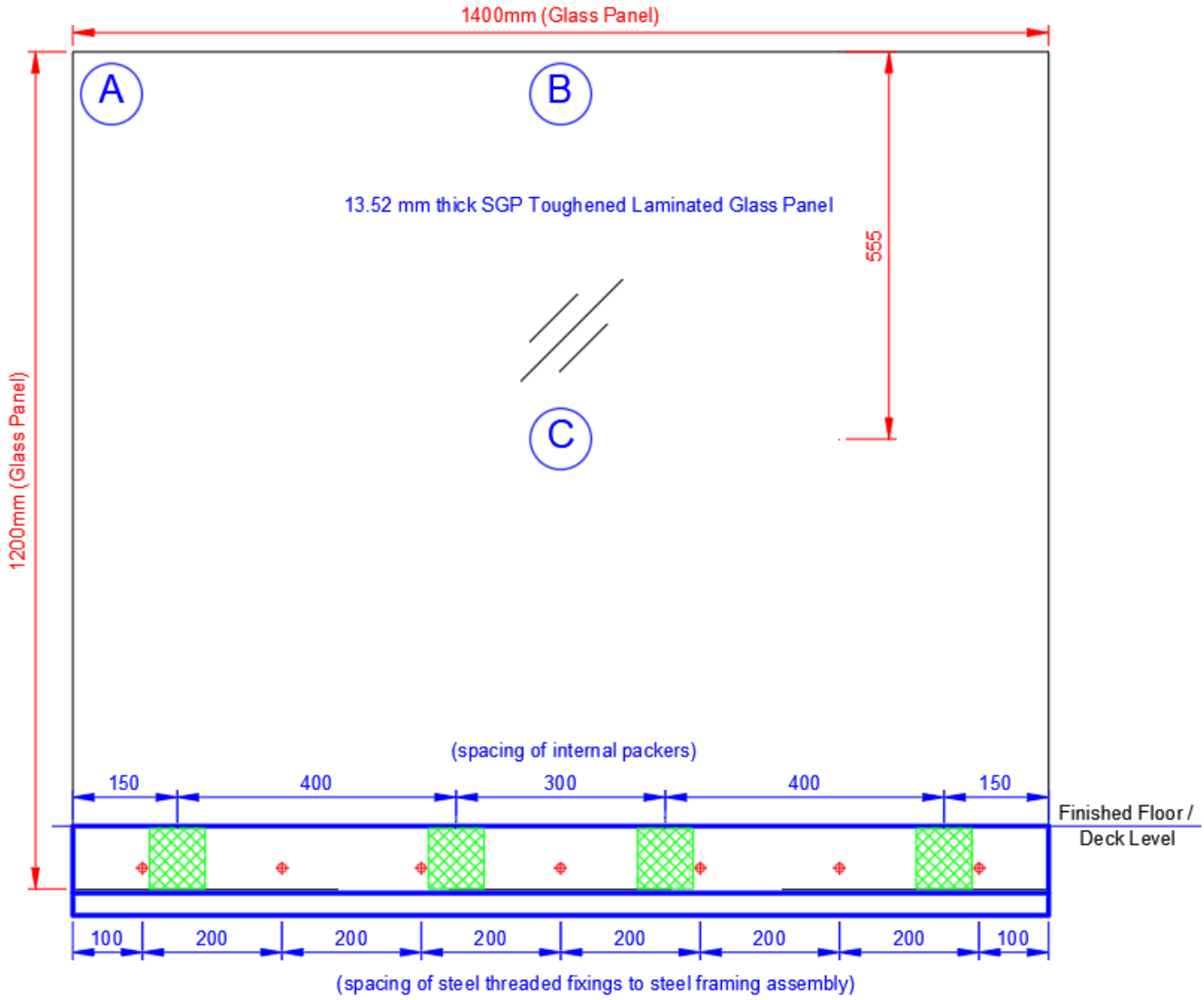
System Description: The glass balustrade which was supplied by Vetro Raccordi / FMI Ltd comprised of 13.52mm thick SGP Toughened Laminated (Grade A) Safety Glass (6mm Toughened Glass + 1.52mm SGP Interlayer + 6mm Toughened Glass) supported by tilt-lock base channel system (side mounted) with top capping / interlinking rail.

Setup / Procedure:
The balustrade was setup with different load tests as noted on page 4. The glass panel was supported at the base with tilt-lock base channel system (side mounted). This channel system was bolted to the steel frame assembly with steel threaded fixings as shown below. Top capping / interlinking rail was also installed on top of the glass panel which was fixed to the side posts acting as the supporting neighboring glass panels.

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	213	16	No Fracture
C	407	16	No Fracture

TEST RESULTS (Deflection Check - SLS)

Tests	Target Load @ SLS (Kg)	Deflection @ Top (mm)			Remarks
		Sample 1	Sample 2	Sample 3	
A	61.2	13.04	13.95	13.77	Passed
B	107	15.40	16.34	16.28	Passed
C	170	12.05	12.13	11.85	Passed

Allowable Deflection = H/30 = 36.7 mm
= 30 mm

Based on the testing, the glass balustrade which comprised of 13.52mm thick SGP Toughened Laminated Grade A Safety Glass (6mm Toughened Glass + 1.52mm SGP interlayer + 6mm Toughened Glass) supported by tilt-lock base channel system (side mounted) with top capping / interlinking rail was sufficient for the following:

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

5.0 Base Fixings

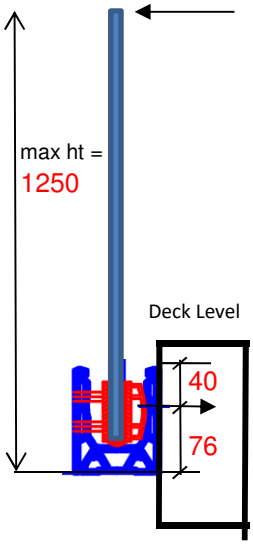
Refer to Summary Drawing ENG 01 for reference.

5.1 BASE FIXINGS FOR INTERNAL BALUSTRADE

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

Maximum Tributary Spacing of Fixings = 200 mm
Number of base fixings per panel = 5

A,B,E,C3 loading	1.5Q1:	1.5 x 0.6 kN / (no of base fixings) =	0.18	kN
	1.5Q2:	1.5 x 0.75kN/m x trib spacing =	0.225	kN
	1.5Q3:	1.5 x 1.0kPa =	1.5	kPa
Very High Wind	Wuls:	0.6 x 50 x 50 /1000 x 1.3 =	1.95	kPa



Tension Force for Upper Fixing @ 200 mm max spacing (Central Bolts):

1.5Q1:	N*/anchor =	5.10	kN
1.5Q2:	N*/anchor =	6.38	kN
1.5Q3:	N*/anchor =	4.77	kN
Wuls:	N*/anchor =	6.20	kN
	Max N*/anchor =	**6.38**	kN

Shear Force per Fixing (1.2G)

1.2 x Weight of Glass Panel =	1.2 x (28 kN/m3 x thickness x Area) =	0.151	kN
1.2 x Weight of Al Channel=	1.2 x (0.5 kN/m x spacing) =	0.12	kN
1.2G:	V*/anchor =	**0.27**	kN

A. Fixing to Concrete

Refer to page 7 for design calculations.

Anchor Spacing= 200 mm
Concrete Edge Dist= 60mm min
Concrete Strength, f'c = 20MPa min
Considered as Cracked concrete

Using M10 Chemset Anchors with Epcon C8 Series Epoxy.

ØN = **11.50** kN **OK** CDR= 0.61 **< 1.2 OK**
ØV = **4.70** kN **OK**

Use M10 Chemset Anchors (Grade 5.8 Steel) with Epcon C8 Series Epoxy.
Drilled hole depth to be 120 mm min into concrete.
(spacing = 200mm max centres)

B. Fixing to Steel

Using M10 Grade 4.6/S

ØN = **18.56** kN **OK** CDR= 0.37 **OK**
ØV = **9.62** kN **OK**

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

Cracked Concrete - ChemSet Anchor Stud Design Calculator

European Technical Approval: ETA-10/0309

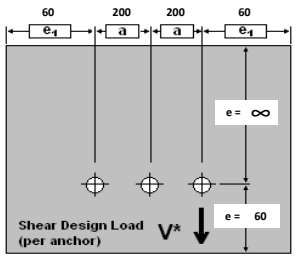
Ramset™

CRACKED Concrete - EPCON™ C8

Anchor Type: Anchor Stud - Gr 5.8 Anchor Size d_b = M 10

Input Description (Strength Limit State Design)	Input Data (per anchor)		
1. Number of anchors (n)	n =	5	-
2. Anchor Spacing (a)	a =	200	mm
3. Concrete Edge Distance (e)	e =	60	mm
4. Concrete Cylinder Strength (f'c)	f'c =	20	MPa
5. Cracked Conc. (C) or Non-Cracked (N)	C or N	C	-
6. Effective Depth (h>6xdh)	h =	120	mm
7. Anchor Stud size (d_b) - M8 → M30	d_b =	10	mm
8. Concrete Edge Distance Corner (e1)	e_1 =	60	mm
9. Internal to a row (I) or end of row (E)	I or E	E	row
10. Dry Hole (D) or Wet hole (W)	D or W	D	-
11. Min Concrete Sub'te Thickness (b_m)	b_m =	150	mm
12. Anchor Stud Grade (5.8, 8.8, 316 SS)	Grade =	5.8	Gr
13. Fixture Thickness (t)	t =	5	mm
14. Effective Length (L_e)	L_e =	125	mm
15. Design Tensile Load-per anchor (N*)	N* =	0	kN
16. Design Shear Load-per anchor (V*)	V* =	0	kN
17. Direction of Shear design load (α)	α =	0	°
18. Service Temperature (˚C)	-40˚C to	+40˚C	-

Plan View - Generic (Dimensions in (mm))



Project Details

Project Name:-

Project Site Address:-

Company Name:-

Design Identification:-

Date:-

ChemSet™ Anchor Stud "Specification"

Special Length - Use Typ Thr'd Rod Gr 8.8 or Diff.Size

EPCON™ C8 "Specification"

Part No. C8-450

Hole Diameters (mm)

Drill d_h = 12

Fixture d_f = 12

Capacity Reduction Factors

Conc Tension $1/\gamma_{Msp} = \phi_c$ = 0.56

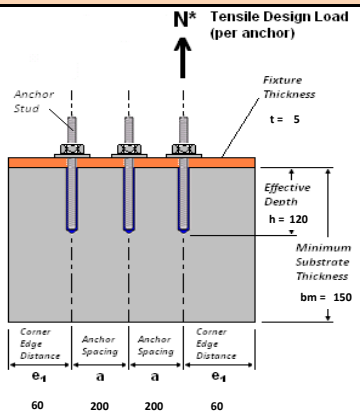
Conc Shear $1/\gamma_{Mc} = \phi_c$ = 0.67

Direction of Shear Design Load - α

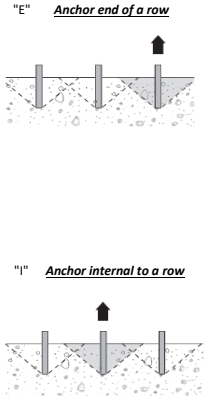
α = 0˚- towards edge
α = 180˚ - away from edge

Output Description (Strength Limit State Design)	Output Data (per anchor)		
DESIGN O.K.	MIN. CRITERIA for a,e & h - O.K.		
Des.Pullout & CONC.Tensile Resistance	$N_{Rd,p}$ =	11.5	kN
Cracked Conc. STEEL Tensile Resistance	$N_{Rd,s}$ =	19.3	kN
Design CONC. Edge Shear Resistance	$V_{Rd,c}$ =	4.7	kN
Cracked Conc. STEEL Shear Resistance	$V_{Rd,s}$ =	12.0	kN
Des. Cracked Conc. Pryout Failure	$V_{Rd,cp}$ =	20.8	kN
Drill hole diameter	d_h =	12	mm
TENSION O.K.			
Design Tensile Resistance	N_{Rd} =	11.5	kN
Tension Design Check	N^*/N_{Rd} =	0.00	< 1
SHEAR O.K.			
Design Shear Resistance	V_{Rd} =	4.7	kN
Shear Design Check	V^*/V_{Rd} =	0.00	< 1
COMBINED TENSION SHEAR O.K.			
Combined Check - $N^*/N_{Rd} + V^*/V_{Rd}$ =		0.00	< 1.2

Elevation View - Generic (Dimensions in (mm))



Anchor Loaded



Anchor Size	d_b	Metric	8	10	12	16	20	24	30	36
Drill hole diameter	d_h	(mm)	10	12	14	18	24	26	N/A	N/A
Stressed Area	A_b	(mm^2)	33	53	79	154	232	337	N/A	N/A
Anchor Stud Yield Strength	f_y	(MPa)	430	430	430	420	420	420	N/A	N/A
Cracked Conc. Steel Tensile Resistance	$N_{Rd,s}$	(kN)	12.0	19.3	28.0	52.7	82.0	118.0	N/A	N/A
Cracked Conc. Steel Shear Resistance	$V_{Rd,s}$	(kN)	7.2	12.0	16.8	31.2	48.8	70.4	N/A	N/A
Edge distance for no conc.cone reduction	e_c	**(mm)**	**1xh**	**1xh**	**1xh**	**1xh**	**1xh**	**1xh**	**N/A**	**N/A**
Anchor spacing for no conc.cone reduction	a_c	**(mm)**	**2xh**	**2xh**	**2xh**	**2xh**	**2xh**	**2xh**	**N/A**	**N/A**
Absolute Minimum edge dist. & anc'r spac.	e_m & a_m	**(mm)**	**40**	**50**	**60**	**80**	**100**	**120**	**N/A**	**N/A**

Effective Depth - h		Design tensile resistance N_{Rd} (kN per anchor) Based on edge distance (e_c) and anchor spacing (a_c) for no conc.cone reduction							
65	(mm)	8.6							
70	(mm)	9.3	11.6						
80	(mm)	10.6	13.3						
90	(mm)	11.9	14.9	17.0					
100	(mm)	12.0	16.6	18.8					
110	(mm)	12.0	18.2	20.7	23.5				
120	(mm)	12.0	19.3	22.6	26.8				
125	(mm)	12.0	19.3	23.6	28.5				
150	(mm)	12.0	19.3	28.0	35.6	37.5			
160	(mm)	12.0	19.3	28.0	38.0	41.3	41.3		
170	(mm)	12.0	19.3	28.0	40.4	45.2	45.2		
190	(mm)	12.0	19.3	28.0	45.1	53.4	53.4		
210	(mm)	12.0	19.3	28.0	49.8	62.1	62.1		
240	(mm)	12.0	19.3	28.0	52.7	71.2	75.8	N/A	
280	(mm)	12.0	19.3	28.0	52.7	82.0	95.6	N/A	
350	(mm)	12.0	19.3	28.0	52.7	82.0	118.0	N/A	
450	(mm)	12.0	19.3	28.0	52.7	82.0	118.0	N/A	N/A
550	(mm)	12.0	19.3	28.0	52.7	82.0	118.0	N/A	N/A

The design engineer should ensure the structural element is capable of supporting these loads. Refer to Ramset™ Specifiers Anchorng Resource Book ANZ for more information or explanation of Tech. Data.

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=0.7, k1=0.8, k3=1

Using 50x50x5 Square Washers

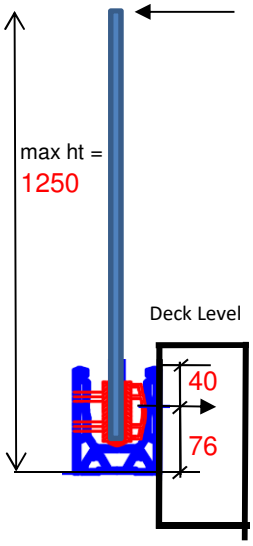
ØQ = **11.90** kN (dry) **OK**

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

(spacing = 200mm max centres)

5.2 BASE FIXINGS FOR EXTERNAL BALUSTRADE

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



Maximum Tributary Spacing of Fixings = 200 mm
Number of base fixings per panel = 5

B,E,C3 loading	1.5Q1:	1.5 x 0.6 kN / (no of base fixings) =	0.18	kN
	1.5Q2:	1.5 x 0.75kN/m x trib spacing =	0.225	kN
	1.5Q3:	1.5 x 1.0kPa =	1.5	kPa
Very High Wind	Wuls:	0.6 x 50 x 50 /1000 x 1.3 =	1.95	kPa

Tension Force for Upper Fixing @ 200 mm max spacing (Central Bolts):

1.5Q1:	N*/anchor =	5.10	kN
1.5Q2:	N*/anchor =	6.38	kN
1.5Q3:	N*/anchor =	4.77	kN
Wuls:	N*/anchor =	6.20	kN
	Max N*/anchor =	**6.38**	kN

Shear Force per Fixing (1.2G)

1.2 x Weight of Glass Panel =	1.2 x (28 kN/m3 x thickness x Area) =	0.151	kN
1.2 x Weight of Al Channel=	1.2 x (0.5 kN/m x spacing) =	0.12	kN
1.2G:	V*/anchor =	**0.27**	kN

A. Fixing to Concrete

Refer to page 10 for design calculations.

Anchor Spacing= 200 mm
Concrete Edge Dist= 60mm min
Concrete Strength, f'c = 20MPa min
Considered as Cracked concrete

Using M10 Chemset Anchors with Epcon C8 Series Epoxy.

ØN = **8.10** kN **OK** CDR= 0.85 **< 1.2 OK**
ØV = **4.70** kN **OK**

Use M10 Chemset Anchors (Grade 316 Stainless Steel) with Epcon C8 Series Epoxy.
Drilled hole depth to be 120 mm min into concrete.
(spacing = 200mm max centres)

B. Fixing to Steel

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

ØN = **27.20** kN **OK** CDR= 0.18 **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)

Cracked Concrete - ChemSet Anchor Stud Design Calculator

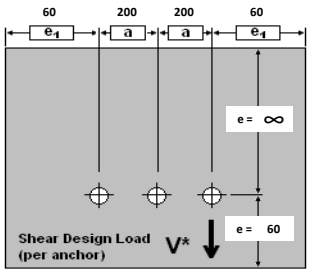
European Technical Approval: ETA-10/0309

CRACKED Concrete - EPCON™ C8

Anchor Type: Anchor Stud - Gr 316 Anchor Size d_b = M 10

Input Description (Strength Limit State Design)	Input Data (per anchor)		
1. Number of anchors (n)	n =	5	-
2. Anchor Spacing (a)	a =	200	mm
3. Concrete Edge Distance (e)	e =	60	mm
4. Concrete Cylinder Strength (f'c)	f'c =	20	MPa
5. Cracked Conc. (C) or Non-Cracked (N)	C or N	C	-
6. Effective Depth (h>6xdh)	h =	120	mm
7. Anchor Stud size (d_b) - M8 → M30	d_b =	10	mm
8. Concrete Edge Distance Corner (e1)	e_1 =	60	mm
9. Internal to a row (I) or end of row (E)	I or E	E	row
10. Dry Hole (D) or Wet hole (W)	D or W	W	-
11. Min Concrete Sub'te Thickness (b_m)	b_m =	150	mm
12. Anchor Stud Grade (5.8, 8.8, 316 SS)	Grade =	316	SS
13. Fixture Thickness (t)	t =	5	mm
14. Effective Length (L_e)	L_e =	125	mm
15. Design Tensile Load-per anchor (N*)	N* =	0	kN
16. Design Shear Load-per anchor (V*)	V* =	0	kN
17. Direction of Shear design load (α)	α =	0	°
18. Service Temperature (˚C)	-40˚C to	+40˚C	-

Plan View - Generic (Dimensions in (mm))



Project Details

Project Name:-

Project Site Address:-

Company Name:-

Design Identification:-

Date:-

ChemSet™ Anchor Stud "Specification"

Special Length - Use Typ Thr'd Rod or Diff.Size

EPCON™ C8 "Specification"

Part No. C8-450

Hole Diameters (mm)

Drill d_h = 12

Fixture d_f = 12

Capacity Reduction Factors

Conc Tension $1/\gamma_{Msp} = \phi_c$ = 0.56

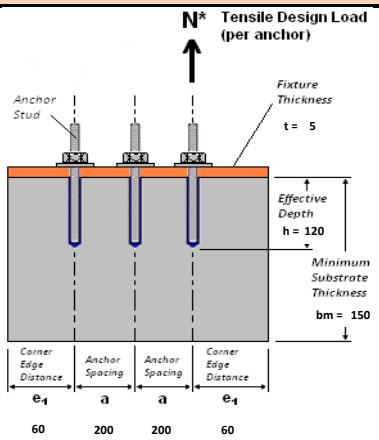
Conc Shear $1/\gamma_{Mc} = \phi_c$ = 0.67

Direction of Shear Design Load - α

α = 0˚- towards edge
α = 180˚ - away from edge

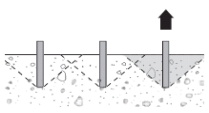
Output Description (Strength Limit State Design)	Output Data (per anchor)		
DESIGN O.K.	MIN. CRITERIA for a,e & h - O.K.		
Des.Pullout & CONC.Tensile Resistance	$N_{Rd,p}$ =	8.1	kN
Cracked Conc. STEEL Tensile Resistance	$N_{Rd,s}$ =	21.9	kN
Design CONC. Edge Shear Resistance	$V_{Rd,c}$ =	4.7	kN
Cracked Conc. STEEL Shear Resistance	$V_{Rd,s}$ =	12.8	kN
Des. Cracked Conc. Pryout Failure	$V_{Rd,cp}$ =	20.8	kN
Drill hole diameter	d_h =	12	mm
TENSION O.K.			
Design Tensile Resistance	N_{Rd} =	8.1	kN
Tension Design Check	N^*/N_{Rd} =	0.00	< 1
SHEAR O.K.			
Design Shear Resistance	V_{Rd} =	4.7	kN
Shear Design Check	V^*/V_{Rd} =	0.00	< 1
COMBINED TENSION SHEAR O.K.			
Combined Check - $N^*/N_{Rd} + V^*/V_{Rd}$ =		0.00	< 1.2

Elevation View - Generic (Dimensions in (mm))

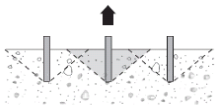


Anchor Loaded

"E" *Anchor end of a row*



"I" *Anchor internal to a row*



Anchor Size	d_b	Metric	8	10	12	16	20	24	30	36
Drill hole diameter	d_h	(mm)	10	12	14	18	24	26	N/A	N/A
Stressed Area	A_b	(mm²)	33	53	79	154	232	337	N/A	N/A
Anchor Stud Yield Strength	f_y	(MPa)	450	450	450	450	450	450	N/A	N/A
Cracked Conc. Steel Tensile Resistance	$N_{Rd,s}$	(kN)	13.9	21.9	31.6	58.8	92.0	132.1	N/A	N/A
Cracked Conc. Steel Shear Resistance	$V_{Rd,s}$	(kN)	8.3	12.8	19.2	35.3	55.1	79.5	N/A	N/A
Edge distance for no conc.cone reduction	e_c	**(mm)**	**1xh**	**1xh**	**1xh**	**1xh**	**1xh**	**1xh**	**N/A**	**N/A**
Anchor spacing for no conc.cone reduction	a_c	**(mm)**	**2xh**	**2xh**	**2xh**	**2xh**	**2xh**	**2xh**	**N/A**	**N/A**
Absolute Minimum edge dist. & anc'r spac.	e_m & a_m	**(mm)**	**40**	**50**	**60**	**80**	**100**	**120**	**N/A**	**N/A**

Effective Depth - h		Design tensile resistance N_{Rd} (kN per anchor) Based on edge distance (e_c) and anchor spacing (a_c) for no conc.cone reduction							
65	(mm)	6.0							
70	(mm)	6.5	8.1						
80	(mm)	7.4	9.3						
90	(mm)	8.4	10.4	11.9					
100	(mm)	9.3	11.6	13.2					
110	(mm)	10.2	12.8	14.5	16.5				
120	(mm)	11.1	13.9	15.8	18.8				
125	(mm)	11.6	14.5	16.5	20.0				
150	(mm)	13.9	17.4	19.8	24.9	26.2			
160	(mm)	13.9	18.6	21.1	26.6	28.9	28.9		
170	(mm)	13.9	19.7	22.4	28.2	31.6	31.6		
190	(mm)	13.9	21.9	25.1	31.6	37.4	37.4		
210	(mm)	13.9	21.9	27.7	34.9	43.4	43.4		
240	(mm)	13.9	21.9	31.6	39.9	49.8	53.1	N/A	
280	(mm)	13.9	21.9	31.6	46.5	58.2	66.9	N/A	
350	(mm)	13.9	21.9	31.6	58.2	72.7	87.2	N/A	
450	(mm)	13.9	21.9	31.6	58.8	92.0	112.2	N/A	N/A
550	(mm)	13.9	21.9	31.6	58.8	92.0	132.1	N/A	N/A

The design engineer should ensure the structural element is capable of supporting these loads. Refer to Ramset™ Specifiers Anchorng Resource Book ANZ for more information or explanation of Tech. Data.

C. Fixing to Timber Using Bolt

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

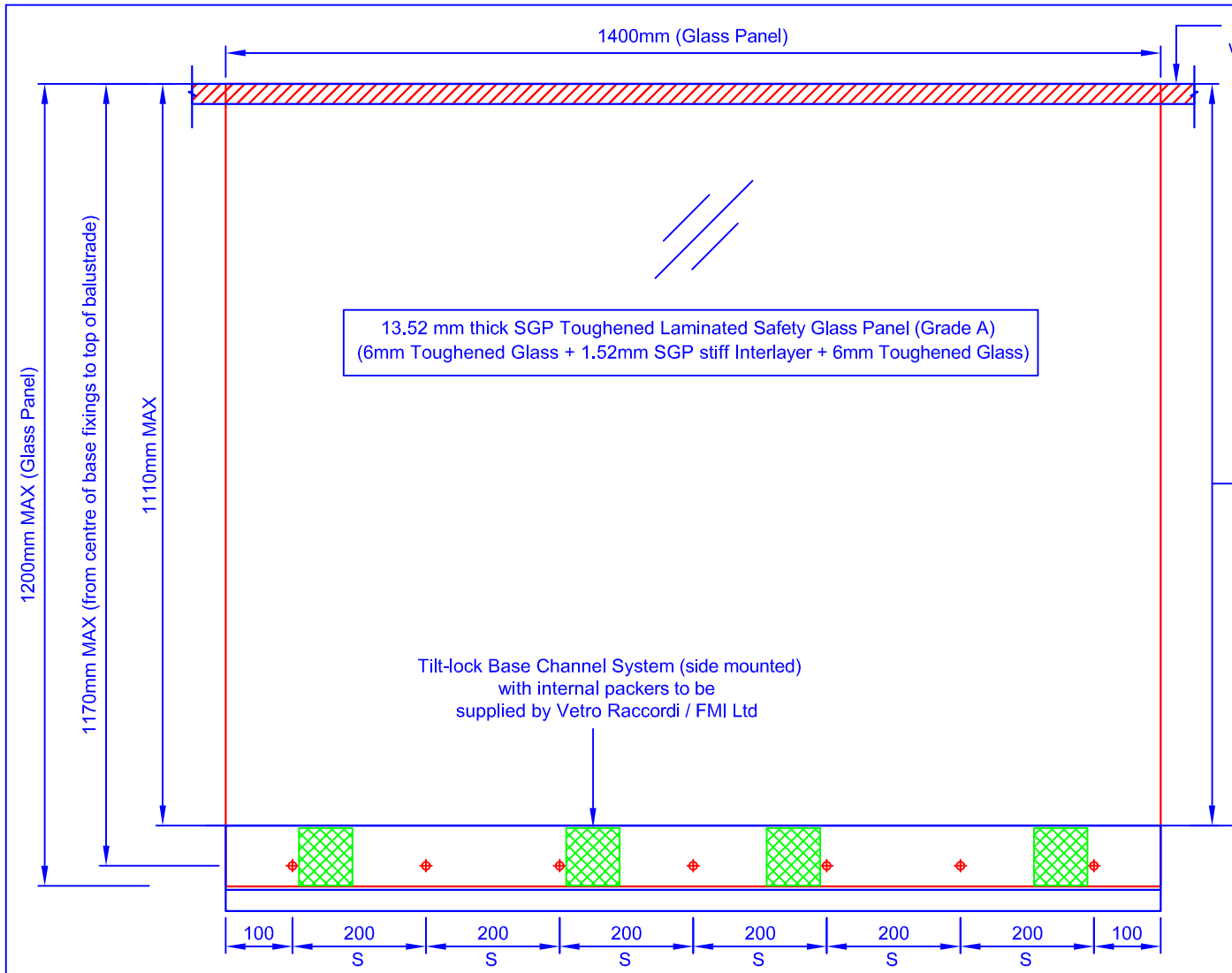
where: Fp = 5.3MPa (wet) or 8.9 Mpa (dry) , Ø=0.7, k1=0.8, k3=1

Using 50x50x5 Washers

ØQ = **7.08** kN (wet) **OK**

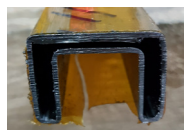
Use M10 Grade 316 Stainless Steel (A4-70) Bolts with 50x50x5 Square S/S Washers.

(spacing = 200mm max centres)

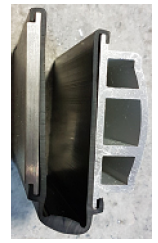


Note:
S = maximum spacing of the side fixings

TYPICAL ELEVATION



TOP CAPPING RAIL



PACKER DETAILS

CHANNEL DETAILS

NOTE:
BASE CHANNEL TO BE PLACED WITH FULL BEARING AGAINST THE SIDE OF THE SUPPORTING STRUCTURE.

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.

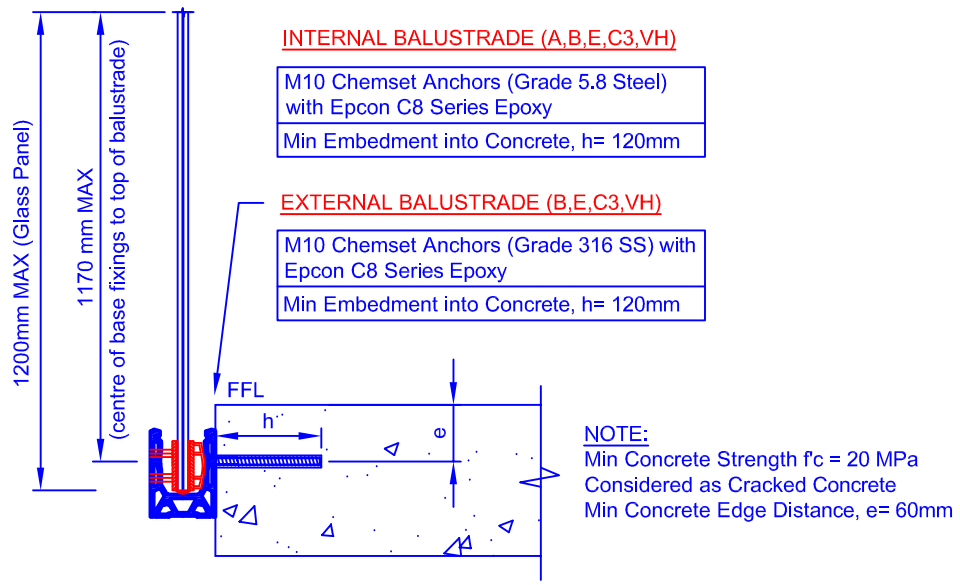
DURABILITY:

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

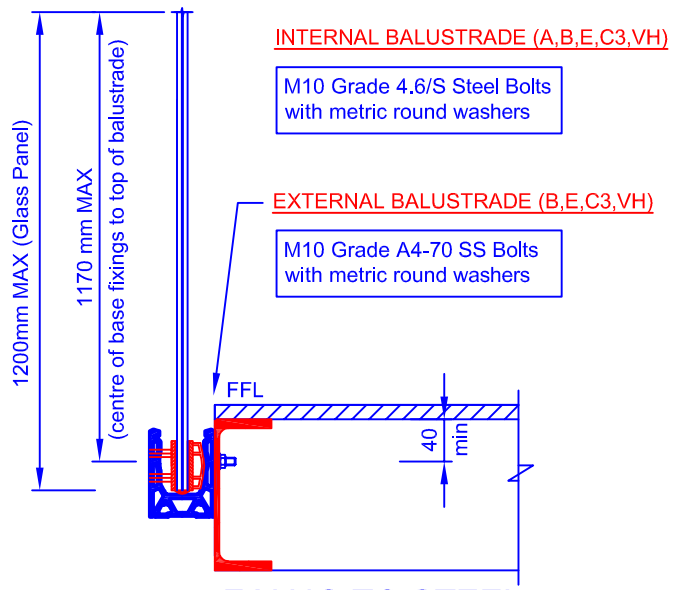
CONNECTION TO SUPPORTING DECK TIMBER FRAMING:

* 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.

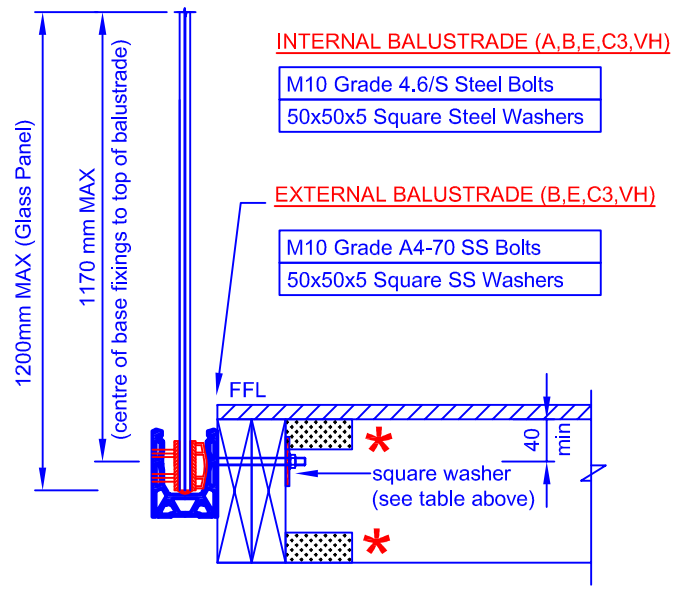
(OTHERWISE THOSE STRAPS, BOLTS,ETC - TO BE SPECIFICALLY DESIGNED BY OTHERS.)



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



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



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

P & P CONSULTING ENGINEERS LTD Civil and Structural Engineering 6A Montel Avenue, Henderson ph: 836-1853	VETRO RACCORDI / FMI LTD - TILT-LOCK BASE CHANNEL SYSTEM (SIDE MOUNTED)	Scales NOT TO SCALE	Project 11/243 (DS58)
	BALUSTRADE - 13.52mm thick SGP TOUGHENED LAMINATED GLASS (WITH TOP CAPPING RAIL)	Drawn JD / Date 22/10/2021	Sheet ENG 01