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Ref: 11/243/ds49
8 July 2019

Glass Fittings / Vetro Raccordi Ltd

ASSESSMENT OF FRAMELESS GLASS BALUSTRADE

USING TILT-LOCK BASE CHANNEL SYSTEM (SIDE FIX) & 17.52mm thick EVA TOUGHENED LAMINATED GLASS (with Top Capping Rail)

(Glass Finished Height from FFL = 1100mm max)

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The glass balustrade had been tested to comply with AS/NZS 1170.1: 2002 Table 3.3 Minimum Imposed Actions for Barriers under Occupancy Type C1/C2, D.

The glass balustrade had also been tested for max "Very High" wind load.

Based on the testing, the glass balustrade which comprised of 17.52mm thick EVA Toughened Laminated Grade A Safety Glass (8mm Toughened Glass + 1.52 EVA interlayer + 8mm Toughened Glass) supported by Tilt-lock Base Channel System (side fix) with top capping rail was sufficient for the following:

- Occupancy types C1/C2, D
- Up to max "Very High" Wind

Refer to Summary Drawing ENG 01 for reference.

- For Occupancy types C1/C2, D
- For Up to max "Very High" Wind

- For Occupancy types C1/C2, D
- For Up to max "Very High" Wind

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 Glass Fittings / Vetro Raccordi Ltd.

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: GLASS FITTINGS / VETRO RACCORDI LIMITED
(Owner/Developer)

TO BE SUPPLIED TO: VARIOUS
(Building Consent Authority)

IN RESPECT OF: GLASS BALUSTRADE WITH TILT-LOCK BASE CHANNEL,17.52EVA TOUGHND & TOP CAPPING RAIL
(Description of Building Work)

AT: VARIOUS SITES (Occupancy Type C1, C2, D 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:

GLASS FITTINGS /VETRO RACCORDI LTD-TILT-LOCK CHANNE and numbered REF:11/243/DS49, 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) [signature]
(Name of Design Professional)

ON BEHALF OF P & P CONSULTING ENGINEERS LTD Date 8 JULY 2019
(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:)

Type of occupancy for part of the building or structure	Specific uses	Top edge			Infill	
		Horizontal kN/m	Vertical kN/m	Inwards, outwards or downwards kN	Horizontal kPa	Any direction kN
C1/C2 Areas with tables or fixed seating	Areas with fixed seating adjacent to a balustrade, restaurants, bars, etc.	1.5	0.75	0.6	1.5	1.5
D **Retail areas**	All retail areas including public areas of banks/building societies, (see C5 for areas where overcrowding may occur)	1.5	0.75	0.6	1.5	1.5

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

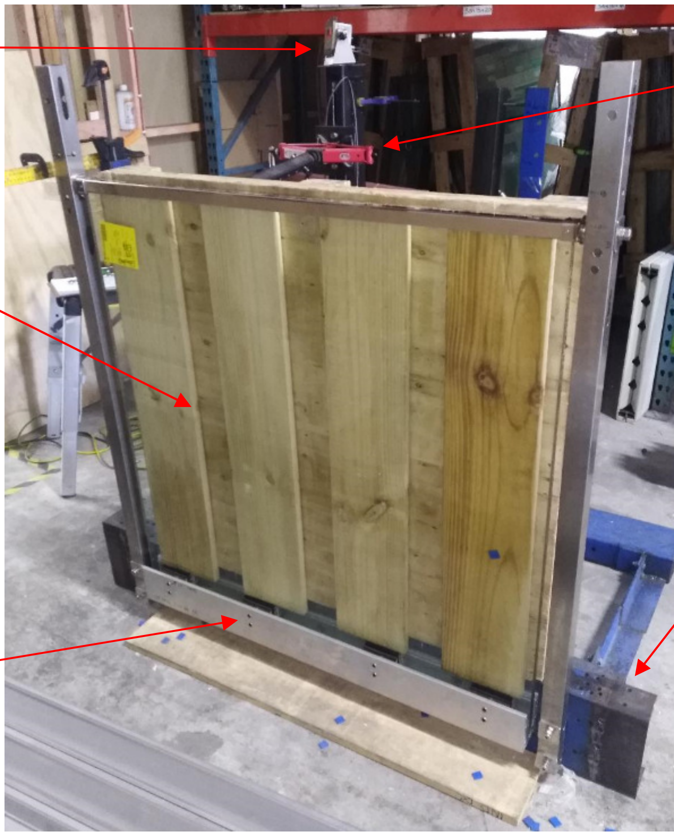
3. LOAD TESTS

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

System Description: The glass balustrade which was supplied by Glass Fittings / Vetro Raccordi Ltd, comprised of 17.52mm thick EVA Toughened Laminated (Grade A) Safety Glass (8mm Toughened Glass + 1.52mm EVA Interlayer + 8mm Toughened Glass) supported by Tilt-lock Base Channel System (side fix) with top capping rail.

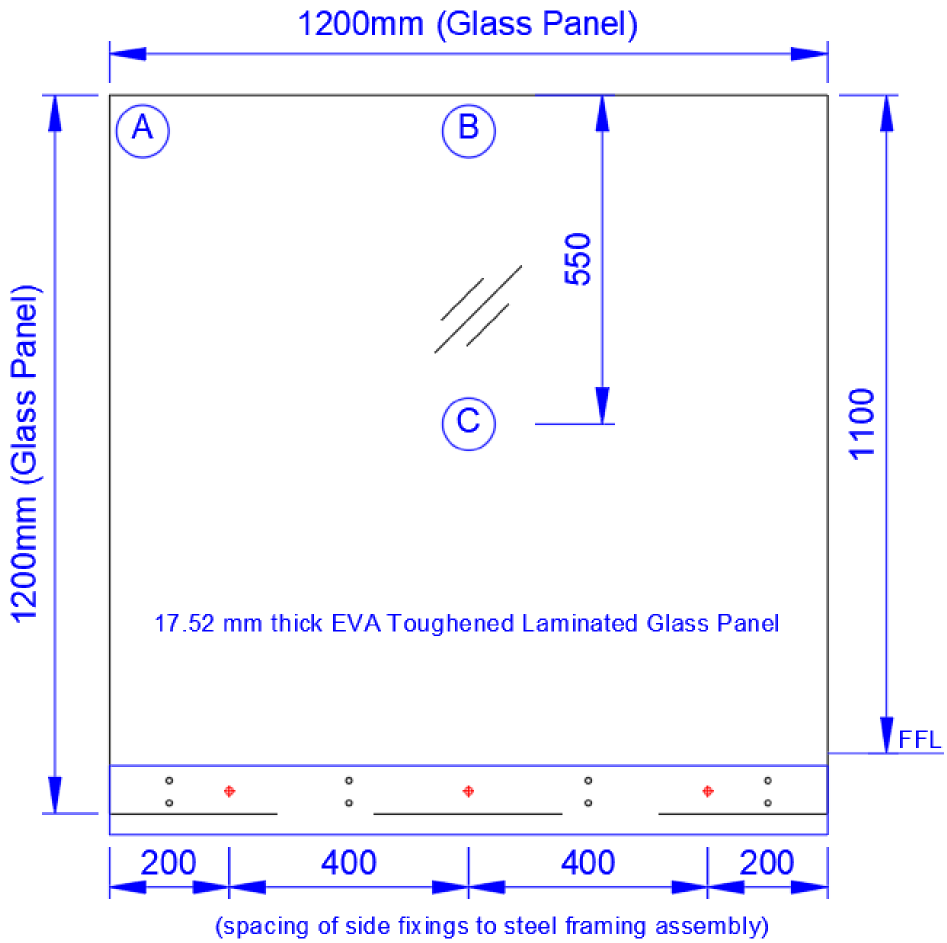
Setup / Procedure:
The balustrade was setup with different load tests as noted on page 4. The glass panel was supported at the base with Tilt-lock Base Channel System (side fix). This channel system was bolted to the steel frame assembly with M12 fixings as shown below. Top capping rail was also installed on the glass panel which was fixed to the side posts acting as the supporting neighboring glass panels.

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)

Tests	Target Load (Kg)	Duration (mins)	Observation for Samples 1,2,3
A	122	16	No Fracture
B	366	16	No Fracture
C	402.7	16	No Fracture

TEST RESULTS (Deflection Check)

Tests	Target Load @ SLS (Kg)	Deflection @ Top (mm)			Remarks
		Sample 1	Sample 2	Sample 3	
A	61.2	13	12	14	Passed
B	184	27	27	26	Passed
C	210	16	15	16	Passed

Allowable Deflection = H/30 = 36.7 mm

Based on the testing, the glass balustrade which comprised of 17.52mm thick EVA Toughened Laminated Grade A Safety Glass (8mm Toughened Glass + 1.52 EVA interlayer + 8mm Toughened Glass) supported by Tilt-lock Base Channel System (side fix) with top capping rail was sufficient for the following:

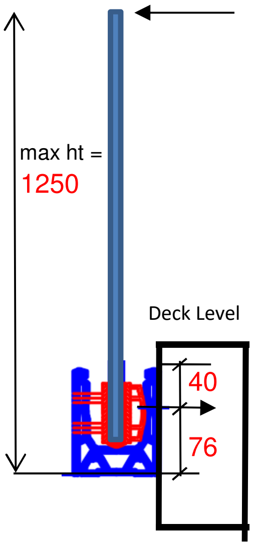
- Occupancy types C1/C2, D
- Up to max "Very High" Wind

5.0 Base Fixings

Refer to Summary Drawing ENG 01 for reference.

5.1 Base Fixings for Internal Balustrade

- For Occupancy types C1 /C2 , D
- For Up to max "Very High" Wind



Maximum Tributary Spacing of Fixings = 400 mm
Number of base fixings per panel = 3

C1/C2, D Loading	1.5Q1:	1.5 x 0.6 kN / (no of base fixings) =	**0.3**	kN
	1.5Q2:	1.5 x 1.5kN/m x trib spacing =	**0.9**	kN
	1.5Q3:	1.5 x 1.5 kPa =	**2.25**	kPa
Wind (VH)-external	Wuls:	0.6 x 50 x 50 /1000 x 1.3 =	**1.95**	kPa

Tension Force for Upper Fixing @ 400 mm max spacing (Central Bolts):

1.5Q1:	N*/anchor =	8.51	kN
1.5Q2:	N*/anchor =	25.52	kN
1.5Q3:	N*/anchor =	14.32	kN
Wuls:	N*/anchor =	12.41	kN

Max N*/anchor = <u>**25.52**</u> kN

Shear Force per Fixing (1.2G)

1.2 x Weight of Glass Panel = 1.2 x (28 kN/m3 x thickness x Area) = 0.302 kN
1.2 x Weight of Al Channel= 1.2 x (0.5 kN/m x spacing) = 0.24 kN

1.2G: V*/anchor = <u>**0.54**</u> kN

A. Fixing to Concrete

<u>Refer to page 8 for design calculations.</u>

Anchor Spacing= 400 mm — Concrete Strength, f'c = 20MPa min
Concrete Edge Dist= 50mm min — Considered as NON-Cracked Concrete

<u>Using M12 Chemset Anchors with Epcon C6 Series Epoxy.</u>

øN = **33.10** kN **OK** — CDR= 0.92 **< 1.2 OK**
øV = **3.70** kN **OK**

Use M12 Chemset Anchors (Grade 5.8 Steel) with Epcon C6 Series Epoxy.
Drilled hole depth to be 120 mm min into concrete.
(spacing = 400mm max centres)

B. Fixing to Steel

<u>Using M12 Grade 4.6/S</u>

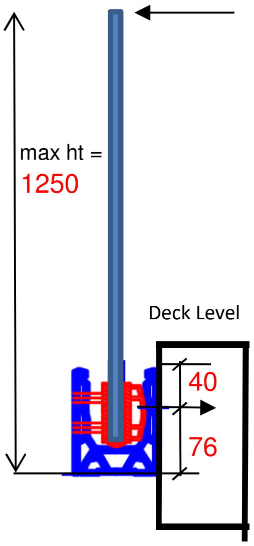
øN = **27.00** kN OK — CDR= 0.98 OK
øV = **15.10** kN OK

Use M12 Grade 4.6/S Steel Bolts with metric round washer per fixing.
(spacing = 400mm max centres)

Using Spacing = 200mm max centres

Maximum Tributary Spacing of Fixings = 200 mm
Number of base fixings per panel = 3

C1/C2, D Loading	1.5Q1:	1.5 x 0.6 kN / (no of base fixings) =	0.3	kN
	1.5Q2:	1.5 x 1.5kN/m x trib spacing =	0.45	kN
	1.5Q3:	1.5 x 1.5 kPa =	2.25	kPa
Wind (VH)-external	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 =	8.51	kN
1.5Q2:	N*/anchor =	12.76	kN
1.5Q3:	N*/anchor =	7.16	kN
Wuls:	N*/anchor =	6.20	kN

Max N*/anchor = 12.76 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

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 = 16.37 kN (dry) **OK**

Use M12 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)

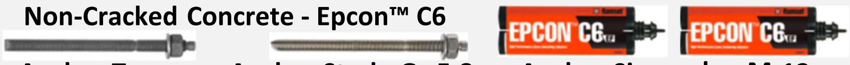
Using M10 Coach Screws
ØQ = 74.9 N/mm (dry) Min Penetration = 171 mm (dry)

Using M12 Coach Screws
ØQ = 82.6 N/mm (dry) Min Penetration = 155 mm (dry)

(spacing = 200mm max centres)

Chemical Anchoring - ChemSet Anchor Stud Design Calculator

Ramset™

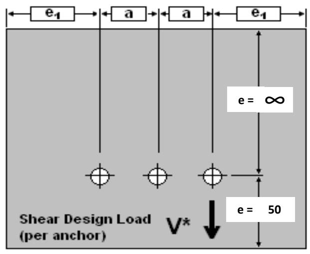


Non-Cracked Concrete - Epcon™ C6

Anchor Type: Anchor Stud - Gr 5.8 | Anchor Size d_b = M 12

Input Description (Strength Limit State Design)	Input Data (per anchor)		
1. Number of anchors (n)	n =	1	-
2. Anchor Spacing (a)	a =	400	mm
3. Concrete Edge Distance (e)	e =	50	mm
4. Concrete Cylinder Strength (f'c)	f'c =	20	MPa
5. Seismic Crack (S_{cr}) or Non-Cracked (N)	S_{cr} or N	N	-
6. Effective Depth (h>6xdh)	h =	120	mm
7. Anchor Stud size (d_b) - M8 → M24	d_b =	12	mm
8. Concrete Edge Distance Corner (e1)	e_1 =	50	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* =	26	kN
16. Design Shear Load-per anchor (V*)	V* =	1	kN
17. Direction of Shear design load (α)	α =	0	°
18. Service Temperature (˚C)	-40˚C to	+45˚C	-

Plan View - Generic
Dimensions in (mm)



Project Details

Project Name:-

Project Site Address:-

Company Name:-

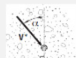
Design Identification:-

Date:-

ChemSet™ Anchor Stud "Specification"	Epcon™ C6 Series "Specification"
Part No. CS12160 or CS12160GH	C6-18

Hole Diameters (mm)	Capacity Reduction Factors
Drill d_h = 14	Conc. Tension/Shear ϕ = 0.6
Fixture d_f = 15	Steel Tension/Shear ϕ = 0.8

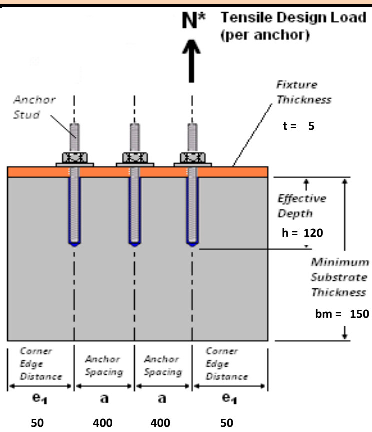
Direction of Shear Design Load - α



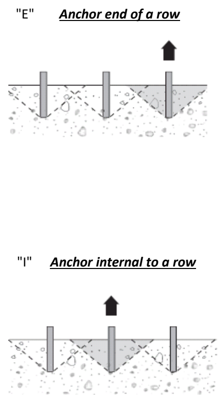
α = 0˚- towards edge
α = 180˚ - away from edge

Output Description (Strength Limit State Design)	Output Data (per anchor)		
DESIGN O.K.	MIN. CRITERIA for a,e & h - O.K.		
Des. Red. Ult. CONC. Tensile Capacity	ϕN_{urc} =	33.1	kN
Red. Char. Ult. STEEL Tensile Capacity	ϕN_{us} =	33.8	kN
Des. Red. Ult. CONC. Shear Capacity	ϕV_{urc} =	3.7	kN
Red. Char. Ult. STEEL Shear Capacity	ϕV_{us} =	21.0	kN
Drill hole diameter	d_h =	14	mm
TENSION O.K.			
Design Red. Ult. Tensile Capacity	ϕN_{ur} =	33.1	kN
Tension Design Check	$N^*/\phi N_{ur}$ =	0.79	< 1
SHEAR O.K.			
Design Red. Ult. Shear Capacity	ϕV_{ur} =	3.7	kN
Shear Design Check	$V^*/\phi V_{ur}$ =	0.27	< 1
COMBINED TENSION SHEAR O.K.			
Combined Check - $N^*/\phi N_{ur} + V^*/\phi V_{ur}$ =		1.05	< 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	(mm²)	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
Red.Char. Ult. Steel Tensile Capacity	ϕN_{us}	(kN)	14.3	22.7	33.8	64.7	97.6	141.3	N/A	N/A
Red.Char. Ult. Steel Shear capacity	ϕV_{us}	(kN)	8.9	14.1	21.0	39.7	59.9	86.8	N/A	N/A
Edge distance for no conc.cone reduction	**e_c**	**(mm)**	**35**	**40**	**50**	**65**	**80**	**100**	**N/A**	**N/A**
Anchor spacing for no conc.cone reduction	**a_c**	**(mm)**	**50**	**60**	**75**	**100**	**120**	**145**	**N/A**	**N/A**
Absolute Minimum edge dist. & anc'r spac.	**e_m & a_m**	**(mm)**	**25**	**30**	**35**	**50**	**60**	**75**	**N/A**	**N/A**

Effective Depth - h		Design Reduced Ultimate tensile capacity ϕN_{ur} (kN per anchor) Based on edge distance (e_c) and anchor spacing (a_c) for no conc.cone reduction							
60	(mm)	9.9							
65	(mm)	11.2							
70	(mm)	12.5	13.7						
80	(mm)	14.3	16.7						
90	(mm)	14.3	20.0	21.5					
100	(mm)	14.3	22.7	25.2					
110	(mm)	14.3	22.7	29.0	32.6				
125	(mm)	14.3	22.7	33.8	39.5				
140	(mm)	14.3	22.7	33.8	46.8				
150	(mm)	14.3	22.7	33.8	51.9	56.7			
160	(mm)	14.3	22.7	33.8	57.2	62.5	67.2		
170	(mm)	14.3	22.7	33.8	62.6	68.4	73.6		
180	(mm)	14.3	22.7	33.8	64.7	74.6	80.2		
190	(mm)	14.3	22.7	33.8	64.7	80.9	87.0	N/A	
220	(mm)	14.3	22.7	33.8	64.7	97.6	108.4	N/A	
240	(mm)	14.3	22.7	33.8	64.7	97.6	123.5	N/A	N/A
270	(mm)	14.3	22.7	33.8	64.7	97.6	141.3	N/A	N/A
330	(mm)	14.3	22.7	33.8	64.7	97.6	141.3	N/A	N/A
350	(mm)	14.3	22.7	33.8	64.7	97.6	141.3	N/A	N/A

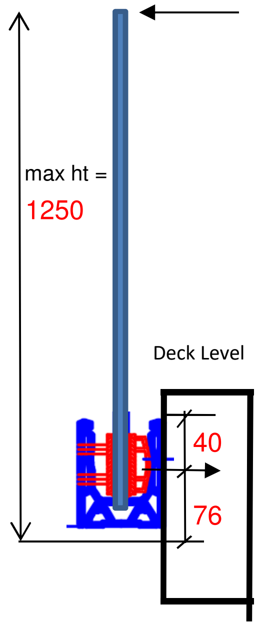
The design engineer should ensure the structural element is capable of supporting these loads. Refer to Ramset™ Specifiers Anchoring Resource Book ANZ for more information or explanation of Tech. Data.

5.2 Base Fixings for External Balustrade

- For Occupancy types C1 /C2 , D
- For Up to max "Very High" Wind

Maximum Tributary Spacing of Fixings = 400 mm
Number of base fixings per panel = 3

C1/C2, D Loading	1.5Q1:	1.5 x 0.6 kN / (no of base fixings) =	**0.3**	kN
	1.5Q2:	1.5 x 1.5kN/m x trib spacing =	**0.9**	kN
	1.5Q3:	1.5 x 1.5 kPa =	**2.25**	kPa
Wind (VH)-external	Wuls:	0.6 x 50 x 50 /1000 x 1.3 =	**1.95**	kPa



Tension Force for Upper Fixing @ 400 mm max spacing (Central Bolts):

1.5Q1:	N*/anchor =	8.51	kN
1.5Q2:	N*/anchor =	25.52	kN
1.5Q3:	N*/anchor =	14.32	kN
Wuls:	N*/anchor =	12.41	kN

Max N*/anchor = <u>**25.52**</u> kN

Shear Force per Fixing (1.2G)

1.2 x Weight of Glass Panel = 1.2 x (28 kN/m3 x thickness x Area) = 0.302 kN
1.2 x Weight of Al Channel= 1.2 x (0.5 kN/m x spacing) = 0.24 kN

1.2G: V*/anchor = <u>**0.54**</u> kN

A. Fixing to Concrete

<u>Refer to page 11 for design calculations.</u>
Anchor Spacing= 400 mm — Concrete Strength, f'c = 20MPa min
Concrete Edge Dist= 50mm min — Considered as NON-Cracked Concrete

<u>Using M12 Chemset Anchors with Epcon C6 Series Epoxy.</u>

ØN = **32.40** kN **OK** — CDR= 0.93 **< 1.2 OK**
ØV = **3.70** kN **OK**

Use M12 Chemset Anchors (Grade 316 Stainless Steel) with Epcon C6 Series Epoxy.
Drilled hole depth to be 150 mm min into concrete.

(spacing = 400mm max centres)

B. Fixing to Steel

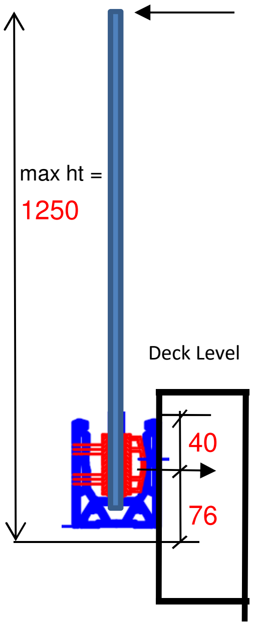
<u>Using M12 Grade A4/316 SS (A4-70)</u>

ØN = **39.54** kN OK — CDR= 0.48 OK
ØV = **25.96** kN OK

Use M12 Grade 316 Stainless Steel (A4-70) Bolts with metric round washer per fixing

(spacing = 400mm max centres)

Using Spacing = 200mm max centres



Maximum Tributary Spacing of Fixings = 200 mm
Number of base fixings per panel = 3

C1/C2, D Loading	1.5Q1:	1.5 x 0.6 kN / (no of base fixings) =	**0.3**	kN
	1.5Q2:	1.5 x 1.5kN/m x trib spacing =	**0.45**	kN
	1.5Q3:	1.5 x 1.5 kPa =	**2.25**	kPa
Wind (VH)-external	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 =	8.51	kN
1.5Q2:	N*/anchor =	12.76	kN
1.5Q3:	N*/anchor =	7.16	kN
Wuls:	N*/anchor =	6.20	kN

Max N*/anchor = **12.76** 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

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 = **17.06** kN (wet) **OK**

Use M12 Grade 316 Stainless Steel (A4-70) Bolts with 65x65x5 square SS 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 (dry) Min Penetration = **244** mm (wet)

Using M12 Coach Screws

ØQ = 57.82 N/mm (dry) Min Penetration = **221** mm (wet)

(spacing = 200mm max centres)

Chemical Anchoring - ChemSet Anchor Stud Design Calculator

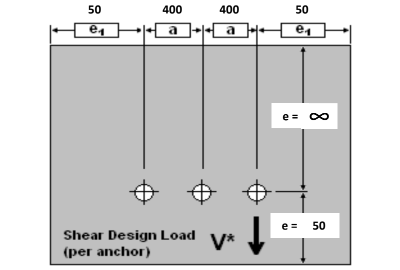
Ramset™

Non-Cracked Concrete - Epcon™ C6

Anchor Type: Anchor Stud - Gr 316 Anchor Size d_b = M 12

Input Description (Strength Limit State Design)	Input Data (per anchor)		
1. Number of anchors (n)	n =	1	-
2. Anchor Spacing (a)	a =	400	mm
3. Concrete Edge Distance (e)	e =	50	mm
4. Concrete Cylinder Strength (f'c)	f'c =	20	MPa
5. Seismic Crack (S_{cr}) or Non-Cracked (N)	S_{cr} or N	N	-
6. Effective Depth (h>6xdh)	h =	150	mm
7. Anchor Stud size (d_b) - M8 → M24	d_b =	12	mm
8. Concrete Edge Distance Corner (e1)	e_1 =	50	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 =	188	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 =	155	mm
15. Design Tensile Load-per anchor (N*)	N* =	26	kN
16. Design Shear Load-per anchor (V*)	V* =	1	kN
17. Direction of Shear design load (α)	α =	0	°
18. Service Temperature (˚C)	-40˚C to	+45˚C	-

Plan View - Generic
Dimensions in (mm)



Project Details

Project Name:-

Project Site Address:-

Company Name:-

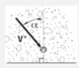
Design Identification:-

Date:-

ChemSet™ Anchor Stud "Specification"	Epcon™ C6 Series "Specification"
Special Length - Use Typ Thr'd Rod	C6-18

Hole Diameters (mm)	Capacity Reduction Factors
Drill d_h = 14	Conc. Tension/Shear ϕ = 0.6
Fixture d_f = 15	Steel Tension/Shear ϕ = 0.8

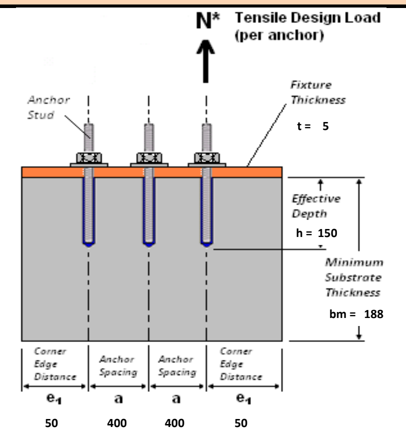
Direction of Shear Design Load - α



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

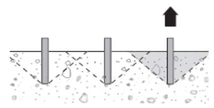
Output Description (Strength Limit State Design)	Output Data (per anchor)		
DESIGN O.K.	MIN. CRITERIA for a,e & h - O.K.		
Des. Red. Ult. CONC. Tensile Capacity	ϕN_{urc} =	32.4	kN
Red. Char. Ult. STEEL Tensile Capacity	ϕN_{us} =	35.3	kN
Des. Red. Ult. CONC. Shear Capacity	ϕV_{urc} =	3.7	kN
Red. Char. Ult. STEEL Shear Capacity	ϕV_{us} =	25.3	kN
Drill hole diameter	d_h =	14	mm
TENSION O.K.			
Design Red. Ult. Tensile Capacity	ϕN_{ur} =	32.4	kN
Tension Design Check	$N^*/\phi N_{ur}$ =	0.80	< 1
SHEAR O.K.			
Design Red. Ult. Shear Capacity	ϕV_{ur} =	3.7	kN
Shear Design Check	$V^*/\phi V_{ur}$ =	0.27	< 1
COMBINED TENSION SHEAR O.K.			
Combined Check - $N^*/\phi N_{ur} + V^*/\phi V_{ur}$ =		1.07	< 1.2

Elevation View - Generic
Dimensions in (mm)

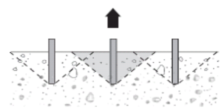


Anchor Loaded

"E" *Anchor end of a row*



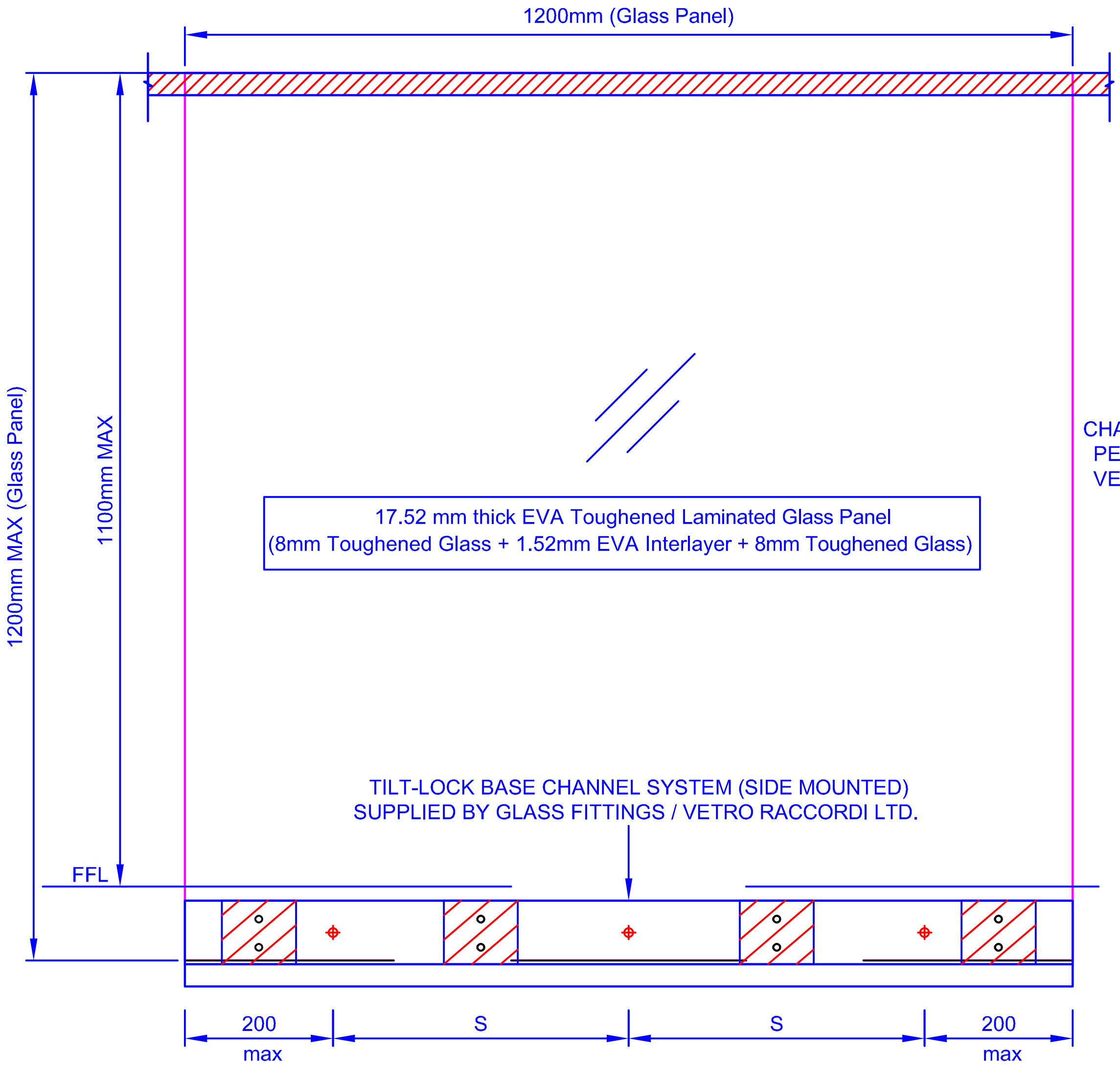
"I" *Anchor internal to a row*



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
Red.Char. Ult. Steel Tensile Capacity	ϕN_{us}	(kN)	14.9	23.8	35.3	69.3	104.6	151.4	N/A	N/A
Red.Char. Ult. Steel Shear capacity	ϕV_{us}	(kN)	10.7	17.0	25.3	49.6	74.9	108.5	N/A	N/A
Edge distance for no conc.cone reduction	e_c	**(mm)**	**35**	**40**	**50**	**65**	**80**	**100**	**N/A**	**N/A**
Anchor spacing for no conc.cone reduction	a_c	**(mm)**	**50**	**60**	**75**	**100**	**120**	**145**	**N/A**	**N/A**
Absolute Minimum edge dist. & anc'r spac.	e_m & a_m	**(mm)**	**25**	**30**	**35**	**50**	**60**	**75**	**N/A**	**N/A**

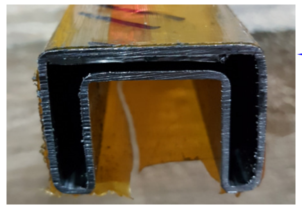
Effective Depth - h		Design Reduced Ultimate tensile capacity ϕN_{ur} (kN per anchor) Based on edge distance (e_c) and anchor spacing (a_c) for no conc.cone reduction							
60	(mm)	7.0							
65	(mm)	7.8							
70	(mm)	8.8	9.6						
80	(mm)	10.7	11.7						
90	(mm)	12.8	14.0	15.0					
100	(mm)	14.9	16.4	17.6					
110	(mm)	14.9	18.9	20.3	22.8				
125	(mm)	14.9	22.9	24.6	27.6				
140	(mm)	14.9	23.8	29.2	32.7				
150	(mm)	14.9	23.8	32.4	36.3	39.7			
160	(mm)	14.9	23.8	35.3	40.0	43.7	47.1		
170	(mm)	14.9	23.8	35.3	43.8	47.9	51.5		
180	(mm)	14.9	23.8	35.3	47.7	52.2	56.2		
190	(mm)	14.9	23.8	35.3	51.8	56.6	60.9	N/A	
220	(mm)	14.9	23.8	35.3	64.5	70.5	75.9	N/A	
240	(mm)	14.9	23.8	35.3	69.3	80.4	86.5	N/A	N/A
270	(mm)	14.9	23.8	35.3	69.3	95.9	103.2	N/A	N/A
330	(mm)	14.9	23.8	35.3	69.3	104.6	139.4	N/A	N/A
350	(mm)	14.9	23.8	35.3	69.3	104.6	151.4	N/A	N/A

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



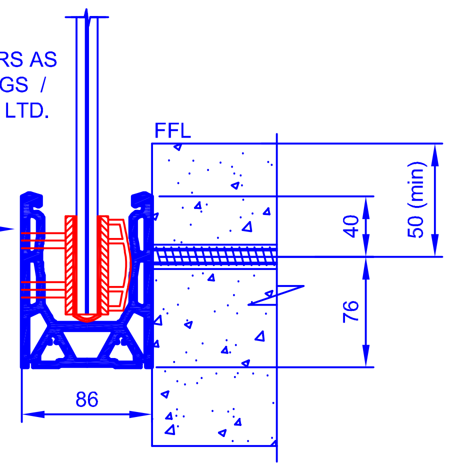
TYPICAL ELEVATION

Top interlinking rail must comply with NZS4223.3:2016 (designed by others)



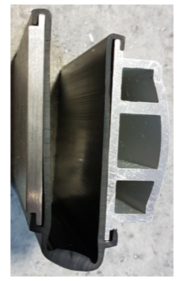
SUPPLIED BY GLASS FITTINGS / VETRO RACCORDI LTD

TOP CAPPING RAIL USED



CROSS SECTION

NOTE:
S = MAXIMUM SPACING OF THE SIDE FIXINGS



PACKER DETAILS

CHANNEL DETAILS

THIS GLASS BALUSTRADE IS SUITABLE FOR THE FOLLOWING:

LIVE LOAD:

OCCUPANCY TYPE	REFER TABLE 3.3 OF AS/NZS 1170
C1/C2	AREAS WITH FIXED SEATING ADJACENT TO A BALUSTRADE, RESTAURANTS, BARS ETC.
D	ALL RETAIL AREAS INCLUDING PUBLIC AREAS OF BANKS/BUILDING SOCIETIES

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.)

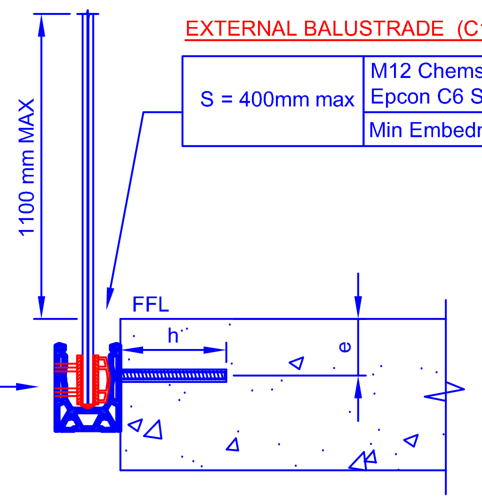
INTERNAL BALUSTRADE (C1/C2, D, VH)

S = 400mm max	M12 Chemset Anchors (Grade 5.8 Steel) with Epcon C6 Series Epoxy
	Min Embedment into Concrete, h= 120mm

EXTERNAL BALUSTRADE (C1/C2, D, VH)

S = 400mm max	M12 Chemset Anchors (Grade 316 SS) with Epcon C6 Series Epoxy
	Min Embedment into Concrete, h= 150mm

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



	Min	Max
e	50mm	70mm

NOTE:
Min Concrete Strength f'c =20 MPa
Considered as NON-Cracked Concrete
(Eg: concrete footings/slab on grade)

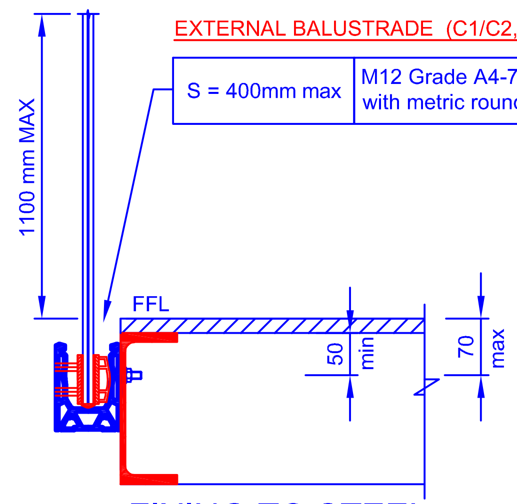
FIXING TO CONCRETE
(Spacing, S = 400mm max)

INTERNAL BALUSTRADE (C1/C2, D, VH)

S = 400mm max	M12 Grade 4.6/S Bolts with metric round washers

EXTERNAL BALUSTRADE (C1/C2, D, VH)

S = 400mm max	M12 Grade A4-70 SS Bolts with metric round washers



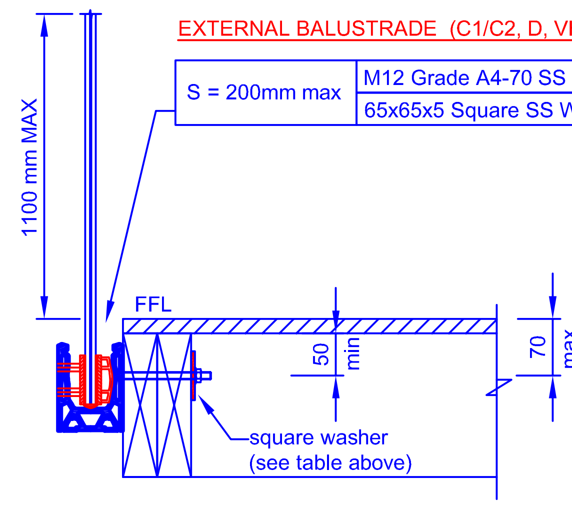
FIXING TO STEEL
(Spacing, S = 400mm max)

INTERNAL BALUSTRADE (C1/C2, D, VH)

S = 200mm max	M12 Grade 4.6/S Bolts
	50x50x5 Square Steel Washers

EXTERNAL BALUSTRADE (C1/C2, D, VH)

S = 200mm max	M12 Grade A4-70 SS Bolts
	65x65x5 Square SS Washers



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

GLASS FITTINGS / VETRO RACCORDI LTD - TILT-LOCK BASE CHANNEL SYSTEM (SIDE MOUNTED)	Scales NOT TO SCALE		Project 11/243 (DS49)
INTERNAL & EXTERNAL BALUSTRADE - 17.52mm thick EVA TOUGHENED LAMINATED GLASS	Drawn JD	Date 8/7/2019	Sheet ENG 01