# 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/ds39
27 September 2024

## Vetro Raccordi / FMI Ltd

## ASSESSMENT OF FRAMELESS GLASS BALUSTRADE / POOL FENCE

## USING CUBOID FACE FIX SYSTEM & 12mm thick TOUGHENED GLASS (with Top Capping 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.

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,F9

# 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/Pool Fence with Cuboid Face Fix Systm,12mm ToughenedSafety Glass & top capping rail
(Description of Building Work)

**AT:** VARIOUS SITES ( Occupancy Type A,B,C3 and Up to max "EXTRA 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, F9 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 -CUBOID FACE FIX and numbered Ref: 11/243/ds39; ENG01, 01A & 02 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 27 Sep 2024

*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 (EXTRA HIGH)

Design for EXTRA HIGH Winds in terms of the Wind Speed categories in NZS 3604:2011 (up to 55 m/s).

| | | | |
|---|---|---|---|
| $V_{sit,\beta}(Ultimate)$ | = | 55.0 | m/s |
| $V_{sit,\beta}(Serviceability)$ | = | 37.3 | m/s |
| q | = | 1.82 | 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 =** | | **2.36** | **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: January 2019
Test Description: Load testing of Glass Balustrade
Panel Tested = 1200mm wide x 1100mm high glass panel,
1000mm finished height from FFL

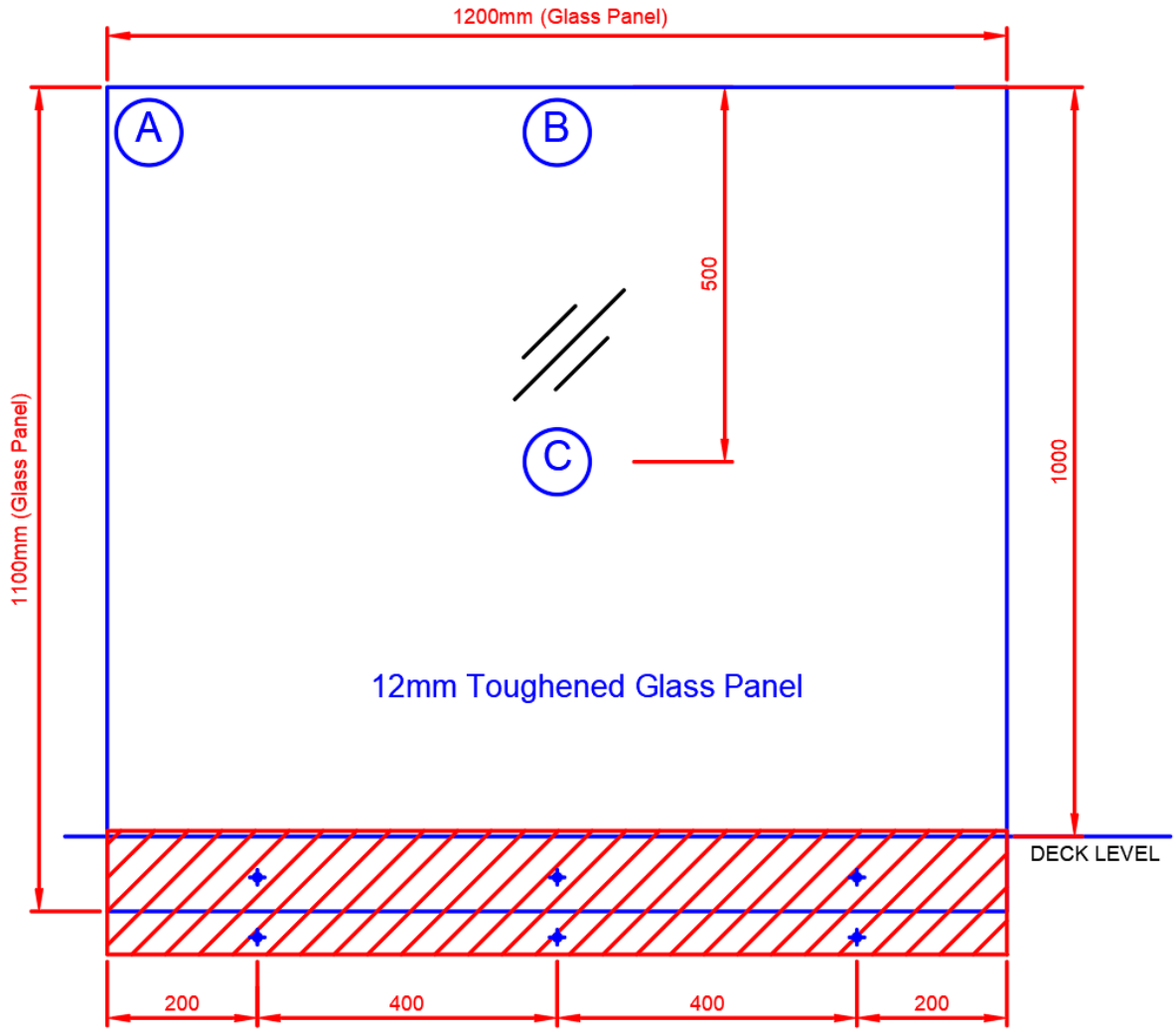
System Description: The glass balustrade which was supplied by Vetro Raccordi / FMI Ltd. comprised of 12mm thick Toughened (Grade A) Safety Glass supported by Cuboid Face Fix System and with top capping rail fixed to side posts.

Setup / Procedure:
The balustrade was setup with different load tests as noted on page 4. The glass panel was supported at the base with Cuboid Face Fix System. This channel 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)**

| Tests | Target Load (Kg) | Duration (mins) | Observation for Samples 1,2,3 |
|---|---|---|---|
| A | 122.0 | 16 | No Fracture |
| B | 183.0 | 16 | No Fracture |
| C | 423 | 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 | 11 | 12 | 12 | Passed |
| B | 91.7 | 10 | 11 | 11 | Passed |
| C | 145.9 | 7 | 7 | 7 | Passed |

**Allowable Deflection = H/30 = 33.3 mm**

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

- Occupancy types A, B, C3
- Up to max “EXTRA HIGH” Wind

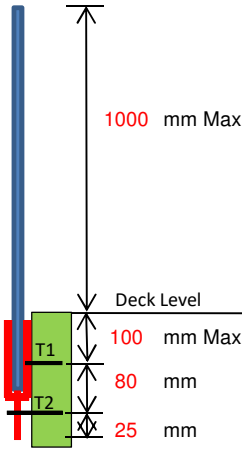
## 5.0 Base Fixings

Refer to Summary Drawing ENG 01 - ENG 02 for reference.

## 5.1 BASE FIXINGS FOR INTERNAL BALUSTRADE

- For Occupancy types A, B, C3
- For Up to max "EXTRA HIGH" Wind

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




| | | | | |
|---|---|---|---|---|
| C3 loading | 1.5Q1: | 1.5 x 0.6 kN / (no of base fixings) = | 0.3 | kN |
| | 1.5Q2: | 1.5 x 0.75kN/m x trib spacing = | 0.45 | kN |
| | 1.5Q3: | 1.5 x 1.0kPa = | 1.5 | kPa |
| (E.H.) Wind - external | Wuls: | 0.6 x 55 x 55 /1000 x 1.3 = | 2.36 | kPa |

**Tension Forces (central bolts)**

| | | T1 | T2 | |
|---|---|---|---|---|
| 1.5Q1: | N*/anchor = | 4.43 | 4.13 | kN |
| 1.5Q2: | N*/anchor = | 6.64 | 6.19 | kN |
| 1.5Q3: | N*/anchor = | 5.22 | 4.50 | kN |
| Wuls: | N*/anchor = | 8.21 | 7.07 | kN |

Max N*/anchor = **8.21** kN

**Shear Force per Fixing (1.2G)**

1.2 x Weight of Glass Panel = 1.2 x (28 kN/m3 x thickness x Area) = 0.292 kN
1.2 x Weight of Al Channel= 1.2 x (0.5 kN/m x spacing) = 0.24 kN

**1.2G:** V*/anchor = **0.53** kN

### A. Fixing to Concrete

Refer to page 7 for design calculations.
Anchor Spacing= 80mm
Concrete Edge Dist= 50mm min
Concrete Strength, f'c = 20MPa min
Considered as NON-Cracked Concrete

Using M10 Chemset Anchors with Epcon C8 Series Epoxy.

øN = **22.70** kN **OK** CDR= 0.55 **< 1.2 OK**
øV = **2.80** 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 = 400mm max centres)

### B. Fixing to Steel

Using M10 Grade 4.6/S

øN = **18.56** kN **OK** CDR= 0.50 **OK**
øV = **9.62** kN **OK**

Use M10 Grade 4.6/S Steel Bolts with metric round washer per fixing.
(spacing = 400mm 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=0.7, 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 = 400mm max centres)

# Chemical Anchoring - ChemSet Anchor Stud Design Calculator

European Technical Approval ETA-10/0309

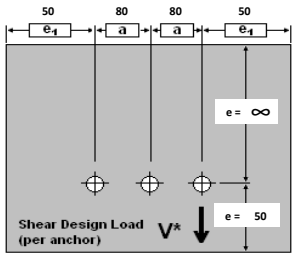
Ramset™

Non-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 = | 2 | - |
| 2. Anchor Spacing (a) | a = | 80 | mm |
| 3. Concrete Edge Distance (e) | e = | 50 | mm |
| 4. Concrete Cylinder Strength (f'c) | f'c = | 20 | MPa |
| 5. Cracked Conc. (C) or Non-Cracked (N) | C or N | N | - |
| 6. Effective Depth (h>6xdh) | h = | 120 | mm |
| 7. Anchor Stud size ($d_b$) - M8 → M36 | $d_b$ = | 10 | 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* = | 9 | 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 | +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"**

C8-450

**Hole Diameters (mm)**

Drill $d_h$ = 12

Fixture $d_f$ = 12

**Capacity Reduction Factors**

Concrete Tension ϕ = 0.56

Concrete Shear ϕ = 0.6

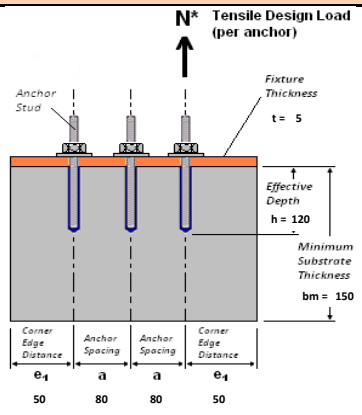
Steel Tension/Shear ϕ = 0.8

**Direction of Shear Design Load - α**


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

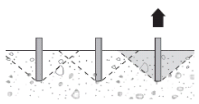
| Output Description (Strength Limit State Design) | Output Data (per anchor) | | |
|---|---|---|---|
| **DESIGN O.K.** | MIN. CRITERIA for a,e & h - O.K. | | |
| Des. Red. Ult. CONC. Tensile Capacity | $\phi N_{urc}$ = | 33.5 | kN |
| Red. Char. Ult. STEEL Tensile Capacity | $\phi N_{us}$ = | 22.7 | kN |
| Des. Red. Ult. CONC. Shear Capacity | $\phi V_{urc}$ = | 2.8 | kN |
| Red. Char. Ult. STEEL Shear Capacity | $\phi V_{us}$ = | 14.1 | kN |
| Drill hole diameter | $d_h$ = | 12 | mm |
| **TENSION O.K.** | | | |
| Design Red. Ult. Tensile Capacity | $\phi N_{ur}$ = | 22.7 | kN |
| Tension Design Check | $N^*/\phi N_{ur}$ = | 0.40 | < 1 |
| **SHEAR O.K.** | | | |
| Design Red. Ult. Shear Capacity | $\phi V_{ur}$ = | 2.8 | kN |
| Shear Design Check | $V^*/\phi V_{ur}$ = | 0.35 | < 1 |
| **COMBINED TENSION SHEAR O.K.** | | | |
| Combined Check - $N^*/\phi N_{ur} + V^*/\phi V_{ur}$ = | | 0.75 | < 1.2 |

**Elevation View - Generic** (Dimensions in (mm))

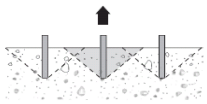



**Anchor Loaded**

"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) | 430 | 430 | 430 | 420 | 420 | 420 | N/A | N/A |
| Red.Char. Ult. Steel Tensile Capacity | $\phi N_{us}$ | (kN) | 14.3 | 22.7 | 33.8 | 64.7 | 97.6 | 141.3 | N/A | N/A |
| Red.Char. Ult. Steel Shear capacity | $\phi V_{us}$ | (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** |

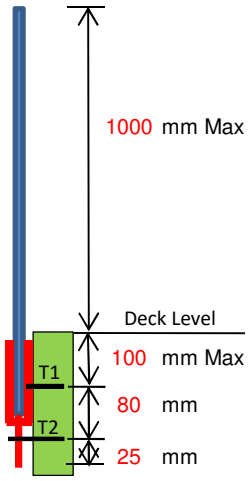
| Effective Depth - h | | Design Reduced Ultimate tensile capacity $\phi N_{ur}$ (kN per anchor) Based on edge distance ($e_c$) and anchor spacing ($a_c$) for no conc.cone reduction | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 60 | (mm) | 10.5 | | | | | | | |
| 65 | (mm) | 11.9 | | | | | | | |
| 70 | (mm) | 13.2 | 13.2 | | | | | | |
| 80 | (mm) | 14.3 | 16.2 | | | | | | |
| 90 | (mm) | 14.3 | 19.3 | 19.3 | | | | | |
| 100 | (mm) | 14.3 | 22.6 | 22.6 | | | | | |
| 110 | (mm) | 14.3 | 22.7 | 26.1 | 26.1 | | | | |
| 125 | (mm) | 14.3 | 22.7 | 31.6 | 31.6 | | | | |
| 140 | (mm) | 14.3 | 22.7 | 33.8 | 37.5 | | | | |
| 150 | (mm) | 14.3 | 22.7 | 33.8 | 41.6 | 41.6 | | | |
| 160 | (mm) | 14.3 | 22.7 | 33.8 | 45.8 | 45.8 | 45.8 | | |
| 170 | (mm) | 14.3 | 22.7 | 33.8 | 50.1 | 50.1 | 50.1 | | |
| 180 | (mm) | 14.3 | 22.7 | 33.8 | 54.6 | 54.6 | 54.6 | | |
| 190 | (mm) | 14.3 | 22.7 | 33.8 | 59.2 | 59.2 | 59.2 | N/A | |
| 220 | (mm) | 14.3 | 22.7 | 33.8 | 64.7 | 73.8 | 73.8 | N/A | |
| 240 | (mm) | 14.3 | 22.7 | 33.8 | 64.7 | 84.1 | 84.1 | N/A | N/A |
| 270 | (mm) | 14.3 | 22.7 | 33.8 | 64.7 | 97.6 | 100.4 | N/A | N/A |
| 330 | (mm) | 14.3 | 22.7 | 33.8 | 64.7 | 97.6 | 135.6 | 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 B, C3
- For Up to max "EXTRA HIGH" Wind

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




| | | | | | |
|---|---|---|---|---|---|
| | C3 loading | 1.5Q1: | 1.5 x 0.6 kN / (no of base fixings) = | 0.3 | kN |
| | | 1.5Q2: | 1.5 x 0.75kN/m x trib spacing = | 0.45 | kN |
| | | 1.5Q3: | 1.5 x 1.0kPa = | 1.5 | kPa |
| (E.H.) | Wind - external | Wuls: | 0.6 x 55 x 55 /1000 x 1.3 = | 2.36 | kPa |

**Tension Forces (central bolts)**

| | | T1 | T2 | |
|---|---|---|---|---|
| 1.5Q1: | N*/anchor = | 4.43 | 4.13 | kN |
| 1.5Q2: | N*/anchor = | 6.64 | 6.19 | kN |
| 1.5Q3: | N*/anchor = | 5.22 | 4.50 | kN |
| Wuls: | N*/anchor = | 8.21 | 7.07 | kN |

Max N*/anchor = **8.21** kN

**Shear Force per Fixing (1.2G)**

1.2 x Weight of Glass Panel = 1.2 x (28 kN/m3 x thickness x Area) = 0.292 kN
1.2 x Weight of Al Channel= 1.2 x (0.5 kN/m x spacing) = 0.24 kN

**1.2G:** V*/anchor = **0.53** kN

## A. Fixing to Concrete

Refer to page 9 for design calculations.
Anchor Spacing= 80mm
Concrete Edge Dist= 50mm min
Concrete Strength, f'c = 20MPa min
Considered as NON-Cracked Concrete

Using M10 Chemset Anchors with Epcon C8 Series Epoxy.
øN = **16.80** kN **OK** CDR= 0.68 **< 1.2 OK**
øV = **2.80** 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 = 400mm max centres)

## B. Fixing to Steel

Using M10 Grade A4/316 SS (A4-70)
øN = **27.20** kN OK CDR= 0.24 OK
øV = **17.86** kN OK

Use M10 Grade 316 Stainless Steel (A4-70) Bolts with metric round washer per fixing.
(spacing = 400mm 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=0.7, k1=0.8, k3=1

Using 65x65x5 Square S/S washer
øQ = **12.20** kN (wet) **OK**

Use M10 Grade 316 Stainless Steel (A4-70) Bolts with 65x65x5 Square S/S washers.
(spacing = 400mm max centres)

# Chemical Anchoring - ChemSet Anchor Stud Design Calculator

European Technical Approval ETA-10/0309

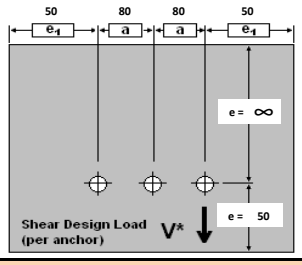
Ramset™

Non-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 = | 2 | - |
| 2. Anchor Spacing (a) | a = | 80 | mm |
| 3. Concrete Edge Distance (e) | e = | 50 | mm |
| 4. Concrete Cylinder Strength (f'c) | f'c = | 20 | MPa |
| 5. Cracked Conc. (C) or Non-Cracked (N) | C or N | N | - |
| 6. Effective Depth (h>6xdh) | h = | 120 | mm |
| 7. Anchor Stud size ($d_b$) - M8 → M36 | $d_b$ = | 10 | 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 ($b_m$) | $b_m$ = | 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* = | 9 | 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 | +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"**

C8-450

**Hole Diameters (mm)**

Drill $d_h$ = 12

Fixture $d_f$ = 12

**Capacity Reduction Factors**

Concrete Tension ϕ = 0.56

Concrete Shear ϕ = 0.6

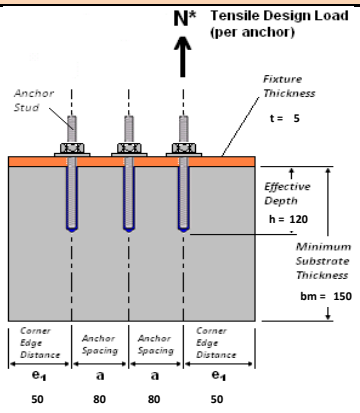
Steel Tension/Shear ϕ = 0.8

**Direction of Shear Design Load - α**


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

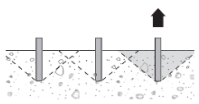
| Output Description (Strength Limit State Design) | Output Data (per anchor) | | |
|---|---|---|---|
| **DESIGN O.K.** | MIN. CRITERIA for a,e & h - O.K. | | |
| Des. Red. Ult. CONC. Tensile Capacity | $\phi N_{urc}$ = | 16.8 | kN |
| Red. Char. Ult. STEEL Tensile Capacity | $\phi N_{us}$ = | 23.8 | kN |
| Des. Red. Ult. CONC. Shear Capacity | $\phi V_{urc}$ = | 2.8 | kN |
| Red. Char. Ult. STEEL Shear Capacity | $\phi V_{us}$ = | 17.0 | kN |
| Drill hole diameter | $d_h$ = | 12 | mm |
| **TENSION O.K.** | | | |
| Design Red. Ult. Tensile Capacity | $\phi N_{ur}$ = | 16.8 | kN |
| Tension Design Check | $N^*/\phi N_{ur}$ = | 0.54 | < 1 |
| **SHEAR O.K.** | | | |
| Design Red. Ult. Shear Capacity | $\phi V_{ur}$ = | 2.8 | kN |
| Shear Design Check | $V^*/\phi V_{ur}$ = | 0.35 | < 1 |
| **COMBINED TENSION SHEAR O.K.** | | | |
| Combined Check - $N^*/\phi N_{ur} + V^*/\phi V_{ur}$ = | | 0.89 | < 1.2 |

**Elevation View - Generic** (Dimensions in (mm))

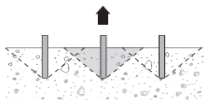



**Anchor Loaded**

"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 | $A_b$ | ($mm^2$) | 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 | $\phi N_{us}$ | (kN) | 14.9 | 23.8 | 35.3 | 69.3 | 104.6 | 151.4 | N/A | N/A |
| Red.Char. Ult. Steel Shear capacity | $\phi V_{us}$ | (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** |

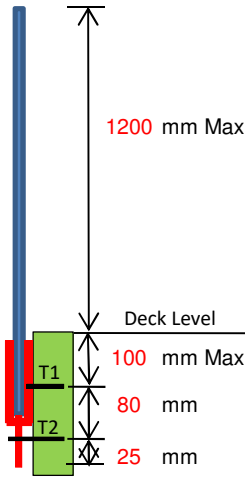
| Effective Depth - h | | Design Reduced Ultimate tensile capacity $\phi N_{ur}$ (kN per anchor) Based on edge distance ($e_c$) and anchor spacing ($a_c$) for no conc.cone reduction | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 60 | (mm) | 5.3 | | | | | | | |
| 65 | (mm) | 5.9 | | | | | | | |
| 70 | (mm) | 6.6 | 6.6 | | | | | | |
| 80 | (mm) | 8.1 | 8.1 | | | | | | |
| 90 | (mm) | 9.7 | 9.7 | 9.7 | | | | | |
| 100 | (mm) | 11.2 | 11.3 | 11.3 | | | | | |
| 110 | (mm) | 12.3 | 13.0 | 13.0 | 13.0 | | | | |
| 125 | (mm) | 14.0 | 15.8 | 15.8 | 15.8 | | | | |
| 140 | (mm) | 14.9 | 18.7 | 18.7 | 18.7 | | | | |
| 150 | (mm) | 14.9 | 20.8 | 20.8 | 20.8 | 20.8 | | | |
| 160 | (mm) | 14.9 | 22.3 | 22.9 | 22.9 | 22.9 | 22.9 | | |
| 170 | (mm) | 14.9 | 23.7 | 25.1 | 25.1 | 25.1 | 25.1 | | |
| 180 | (mm) | 14.9 | 23.8 | 27.3 | 27.3 | 27.3 | 27.3 | | |
| 190 | (mm) | 14.9 | 23.8 | 29.6 | 29.6 | 29.6 | 29.6 | N/A | |
| 220 | (mm) | 14.9 | 23.8 | 35.3 | 36.9 | 36.9 | 36.9 | N/A | |
| 240 | (mm) | 14.9 | 23.8 | 35.3 | 42.0 | 42.0 | 42.0 | N/A | N/A |
| 270 | (mm) | 14.9 | 23.8 | 35.3 | 50.2 | 50.2 | 50.2 | N/A | N/A |
| 330 | (mm) | 14.9 | 23.8 | 35.3 | 67.8 | 67.8 | 67.8 | N/A | N/A |
| 350 | (mm) | 14.9 | 23.8 | 35.3 | 69.3 | 74.1 | 74.1 | 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.

# 5.3 BASE FIXINGS FOR POOL FENCE

- For Up to max "EXTRA HIGH" Wind

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




| | | | | | |
|---|---|---|---|---|---|
| | C3 loading | 1.5Q1: | 1.5 x 0.6 kN / (no of base fixings) = | 0.3 | kN |
| | | 1.5Q2: | 1.5 x 0.75kN/m x trib spacing = | 0.45 | kN |
| | | 1.5Q3: | 1.5 x 1.0kPa = | 1.5 | kPa |
| (E.H.) | Wind - external | Wuls: | 0.6 x 55 x 55 /1000 x 1.3 = | 2.36 | kPa |

**Tension Forces (central bolts)**

| | | T1 | T2 | |
|---|---|---|---|---|
| 1.5Q1: | N*/anchor = | 5.18 | 4.88 | kN |
| 1.5Q2: | N*/anchor = | 7.76 | 7.31 | kN |
| 1.5Q3: | N*/anchor = | 7.14 | 6.30 | kN |
| Wuls: | N*/anchor = | 11.23 | 9.90 | kN |

Max N*/anchor = **11.23** kN

**Shear Force per Fixing (1.2G)**

1.2 x Weight of Glass Panel = 1.2 x (28 kN/m3 x thickness x Area) = 0.34 kN
1.2 x Weight of Al Channel= 1.2 x (0.5 kN/m x spacing) = 0.24 kN

**1.2G:** V*/anchor = **0.58** kN

## A. Fixing to Concrete

Refer to page 11 for design calculations.
Anchor Spacing= 80mm Concrete Strength, f'c = 20MPa min
Concrete Edge Dist= 50mm min Considered as NON-Cracked Concrete

Using M10 Chemset Anchors with Epcon C8 Series Epoxy.
øN = **16.80** kN **OK** CDR= 0.88 **< 1.2 OK**
øV = **2.80** 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 = 400mm max centres)

## B. Fixing to Steel

Using M10 Grade A4/316 SS (A4-70)
øN = **27.20** kN OK CDR= 0.33 OK
øV = **17.86** kN OK

Use M10 Grade 316 Stainless Steel (A4-70) Bolts with metric round washer per fixing.
(spacing = 400mm 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=0.7, k1=0.8, k3=1

Using 65x65x5 Square S/S washer
øQ = **12.20** kN (wet) **OK**

Use M10 Grade 316 Stainless Steel (A4-70) Bolts with 65x65x5 Square S/S washers.
(spacing = 400mm max centres)

# Chemical Anchoring - ChemSet Anchor Stud Design Calculator

European Technical Approval ETA-10/0309

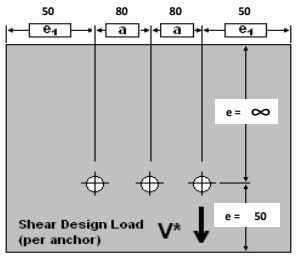
Ramset™

**Non-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 = | 2 | - |
| 2. Anchor Spacing (a) | a = | 80 | mm |
| 3. Concrete Edge Distance (e) | e = | 50 | mm |
| 4. Concrete Cylinder Strength (f'c) | f'c = | 20 | MPa |
| 5. Cracked Conc. (C) or Non-Cracked (N) | C or N | N | - |
| 6. Effective Depth (h>6xdh) | h = | 120 | mm |
| 7. Anchor Stud size ($d_b$) - M8 → M36 | $d_b$ = | 10 | 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 ($b_m$) | $b_m$ = | 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* = | 12 | 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 | +40˚C | - |

**Plan View - Generic** (Dimensions in (mm))




**Project Details**

Project Name:-

Project Site Address:-

Company Name:-

Design Identification:-

Date:-

**ChemSet™ Anchor Stud "Specification"**

**EPCON™ C8 "Specification"**

Special Length - Use Typ Thr'd Rod or Diff.Size — C8-450

**Hole Diameters (mm)**

Drill $d_h$ = 12

Fixture $d_f$ = 12

**Capacity Reduction Factors**

Concrete Tension ϕ = 0.56

Concrete Shear ϕ = 0.6

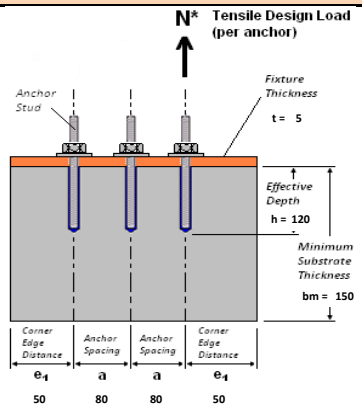
Steel Tension/Shear ϕ = 0.8

**Direction of Shear Design Load - α**

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

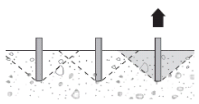
| Output Description (Strength Limit State Design) | Output Data (per anchor) | | |
|---|---|---|---|
| **DESIGN O.K.** | MIN. CRITERIA for a,e & h - O.K. | | |
| Des. Red. Ult. CONC. Tensile Capacity | $\phi N_{urc}$ = | 16.8 | kN |
| Red. Char. Ult. STEEL Tensile Capacity | $\phi N_{us}$ = | 23.8 | kN |
| Des. Red. Ult. CONC. Shear Capacity | $\phi V_{urc}$ = | 2.8 | kN |
| Red. Char. Ult. STEEL Shear Capacity | $\phi V_{us}$ = | 17.0 | kN |
| Drill hole diameter | $d_h$ = | 12 | mm |
| **TENSION O.K.** | | | |
| **Design Red. Ult. Tensile Capacity** | $\phi N_{ur}$ = | **16.8** | **kN** |
| **Tension Design Check** | $N^*/\phi N_{ur}$ = | **0.72** | **< 1** |
| **SHEAR O.K.** | | | |
| **Design Red. Ult. Shear Capacity** | $\phi V_{ur}$ = | **2.8** | **kN** |
| **Shear Design Check** | $V^*/\phi V_{ur}$ = | **0.35** | **< 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))

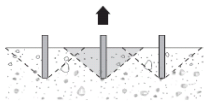



**Anchor Loaded**

"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 | $\phi N_{us}$ | (kN) | 14.9 | 23.8 | 35.3 | 69.3 | 104.6 | 151.4 | N/A | N/A |
| Red.Char. Ult. Steel Shear capacity | $\phi V_{us}$ | (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 $\phi N_{ur}$ (kN per anchor) Based on edge distance ($e_c$) and anchor spacing ($a_c$) for no conc.cone reduction | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 60 | (mm) | 5.3 | | | | | | | |
| 65 | (mm) | 5.9 | | | | | | | |
| 70 | (mm) | 6.6 | 6.6 | | | | | | |
| 80 | (mm) | 8.1 | 8.1 | | | | | | |
| 90 | (mm) | 9.7 | 9.7 | 9.7 | | | | | |
| 100 | (mm) | 11.2 | 11.3 | 11.3 | | | | | |
| 110 | (mm) | 12.3 | 13.0 | 13.0 | 13.0 | | | | |
| 125 | (mm) | 14.0 | 15.8 | 15.8 | 15.8 | | | | |
| 140 | (mm) | 14.9 | 18.7 | 18.7 | 18.7 | | | | |
| 150 | (mm) | 14.9 | 20.8 | 20.8 | 20.8 | 20.8 | | | |
| 160 | (mm) | 14.9 | 22.3 | 22.9 | 22.9 | 22.9 | 22.9 | | |
| 170 | (mm) | 14.9 | 23.7 | 25.1 | 25.1 | 25.1 | 25.1 | | |
| 180 | (mm) | 14.9 | 23.8 | 27.3 | 27.3 | 27.3 | 27.3 | | |
| 190 | (mm) | 14.9 | 23.8 | 29.6 | 29.6 | 29.6 | 29.6 | N/A | |
| 220 | (mm) | 14.9 | 23.8 | 35.3 | 36.9 | 36.9 | 36.9 | N/A | |
| 240 | (mm) | 14.9 | 23.8 | 35.3 | 42.0 | 42.0 | 42.0 | N/A | N/A |
| 270 | (mm) | 14.9 | 23.8 | 35.3 | 50.2 | 50.2 | 50.2 | N/A | N/A |
| 330 | (mm) | 14.9 | 23.8 | 35.3 | 67.8 | 67.8 | 67.8 | N/A | N/A |
| 350 | (mm) | 14.9 | 23.8 | 35.3 | 69.3 | 74.1 | 74.1 | 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.

## 6. Wind Load Assessment for Pool Fence

From the testing
Panel size used = 1200mm wide x 1100mm high glass (1000mm height from FFL)
Maximum Target Load (Test C) = 422.3kg at 500mm from FFL

Bending Moment along the base (tested) = 2.49 kNm

Pool Fence
Panel size = 1200mm wide x 1300mm high glass (1200mm height from FFL)

For EXTRA High Wind (EH):
- Vuls = 55m/s
- Qu = 1.815 kPa
- External Pressure Coefficient, say = 1.3
- Design Wind Load, Wu = 2.3595 kPa

Bending Moment along the base (from wind) = 2.38 kNm (less than 2.49 kNm tested)
Hence OK

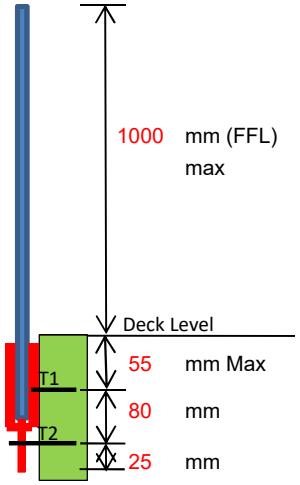
Based from the assessment, the pool fence with size of 1200mm wide x 1300mm high glass (1200mm height from FFL) is satisfactory for up to maximum Extra High Wind.

# 7. Alternative Base Fixing into Timber (at 300mm max centres)

- Balustrade - C3 load type - Extra High Wind

Maximum Tributary Spacing of Fixings = 300 mm
Number of row of base fixings per panel = 3

| | | | | |
|---|---|---|---|---|
| C3 loading | 1.5Q1: | 1.5 x 0.6 kN / (no of base fixings) = | 0.3 | kN |
| | 1.5Q2: | 1.5 x 0.75kN/m x trib spacing = | 0.338 | kN |
| | 1.5Q3: | 1.5 x 1.0kPa = | 1.5 | kPa |
| Wind - Extra High | Wuls: | 0.6 x 55 x 55 /1000 x 1.3 = | 2.36 | kPa |




**Tension Forces (central bolts)**

| | | T1 | T2 | |
|---|---|---|---|---|
| 1.5Q1: | N*/anchor = | 4.26 | 3.96 | kN |
| 1.5Q2: | N*/anchor = | 4.79 | 4.45 | kN |
| 1.5Q3: | N*/anchor = | 3.62 | 3.10 | kN |
| Wuls: | N*/anchor = | 5.70 | 4.88 | kN |

Max N*/anchor = **5.70** kN

| | |
|---|---|
| ht (Glass finished height from top fixings) | =1055mm |

**Shear Force per Fixing (1.2G)**

1.2 x Weight of Glass Panel = 1.2 x (28 kN/m3 x thickness x Area) = 0.21 kN
1.2 x Weight of Al Channel= 1.2 x (0.5 kN/m x spacing) = 0.18 kN

**1.2G:** V*/anchor = **0.39** kN

**Combined Load (1.2G + 1.5Q or Wuls)**

Additional N* due to 1.2G = **0.24** kN
e = **50** mm

Max N*/anchor = **5.94** kN

## Fixing into Timber using Coach Screws / Lagscrews

As per NZS3603, Timber Group J5, Screws in Withdrawal.( $\phi Q = \phi\, n\, k1\, K\, p\, Qk$)

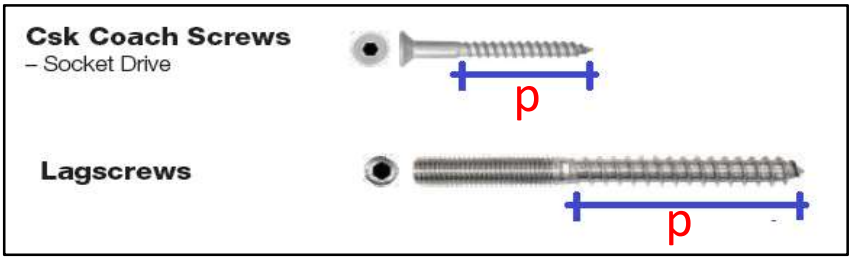
where: Ø=0.7, k1=1 (brief), K=0.7 (wet) or 1 (dry)
Qk = 107N/mm (M10 Coach Screws) or 118N/mm (M12 Coach Screws)

Using M10 Coach Screws (spacing = 300mm max centres)

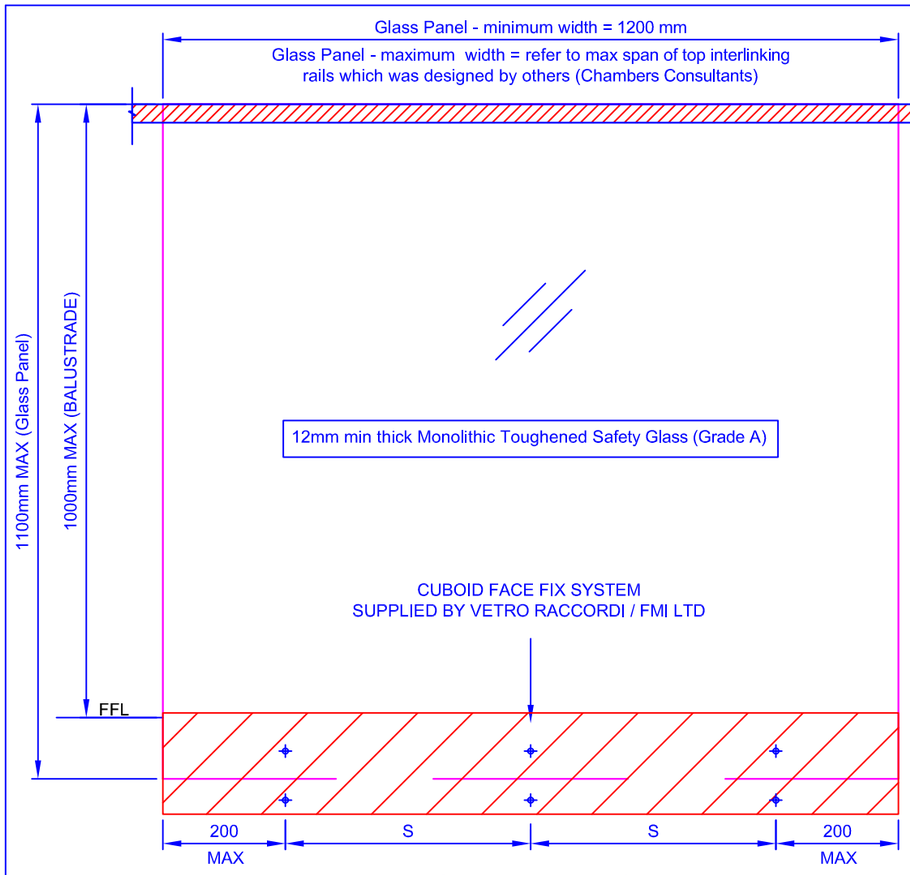
ØQ = 52.43 N/mm (wet) Min Screw Penetration, p= **114** mm (wet)
ØQ = 74.9 N/mm (dry) Min Screw Penetration, p= **80** mm (dry)

Using M12 Coach Screws (spacing = 300mm max centres)

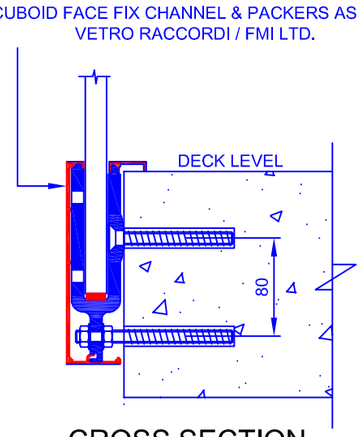
ØQ = 57.82 N/mm (wet) Min Screw Penetration, p= **103** mm (wet)
ØQ = 82.6 N/mm (dry) Min Screw Penetration, p= **72** mm (dry)




| MINIMUM REQUIREMENTS FOR COACHSCREWS / LAGSCREWS | | | |
|---|---|---|---|
| Option 1: Using M10 Stainless Steel 316 | Minimum Screw Penetration (p) into timber (mm) = | **114** | external |
| | | **80** | internal |
| Option 2: Using M12 Stainless Steel 316 | Minimum Screw Penetration (p) into timber (mm) = | **103** | external |
| | | **72** | internal |




## TYPICAL ELEVATION




## CROSS SECTION

## CUBOID FACE FIX CHANNEL

**NOTE:**
S = MAXIMUM SPACING OF THE SIDE FIXINGS

NOTE:
THE CUBOID FACE FIX CHANNEL MUST 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 & C3 | EXTERNAL DOMESTIC BALCONIES, OFFICES AND WORK AREAS. ( NOT SUBJECT TO OVER CROWDING) |

WIND LOAD: UP TO "EXTRA HIGH" (EH) WIND ZONE WITH MAXIMUM BASIC WIND SPEED OF 55 m/s.
(DESIGN WIND PRESSURE = 2.36 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 FRAMING:

* 1. FOR FIXING OF BOUNDARY/END JOISTS TO DECK FRAMING (STRAPS, BOLTS,ETC), REFER TO NZS3604:2011 FIGURE 7.10.

(OTHERWISE TO BE SPECIFICALLY DESIGNED BY OTHERS.)

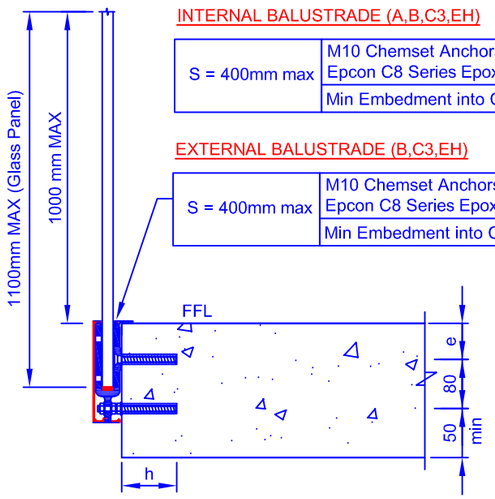
INTERNAL BALUSTRADE (A,B,C3,EH)

| | |
|---|---|
| S = 400mm max | M10 Chemset Anchors (Grade 5.8 Steel) with Epcon C8 Series Epoxy |
| | Min Embedment into Concrete, h= 120 mm |

EXTERNAL BALUSTRADE (B,C3,EH)

| | |
|---|---|
| S = 400mm max | M10 Chemset Anchors (Grade 316 SS) with Epcon C8 Series Epoxy |
| | Min Embedment into Concrete, h= 120 mm |

| | Min | Max |
|---|---|---|
| e | 50mm | 100mm |




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

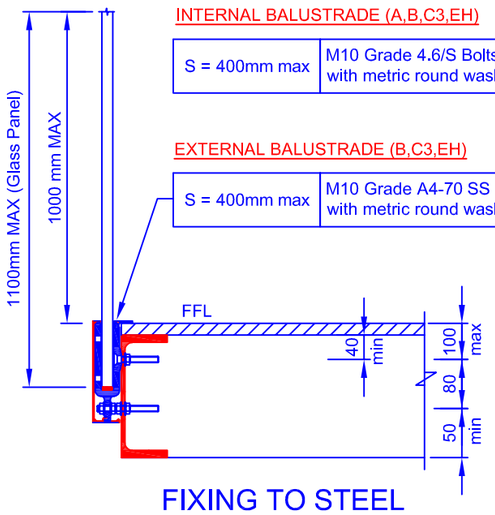
## FIXING TO CONCRETE

INTERNAL BALUSTRADE (A,B,C3,EH)

| | |
|---|---|
| S = 400mm max | M10 Grade 4.6/S Bolts with metric round washers |

EXTERNAL BALUSTRADE (B,C3,EH)

| | |
|---|---|
| S = 400mm max | M10 Grade A4-70 SS Bolts with metric round washers |



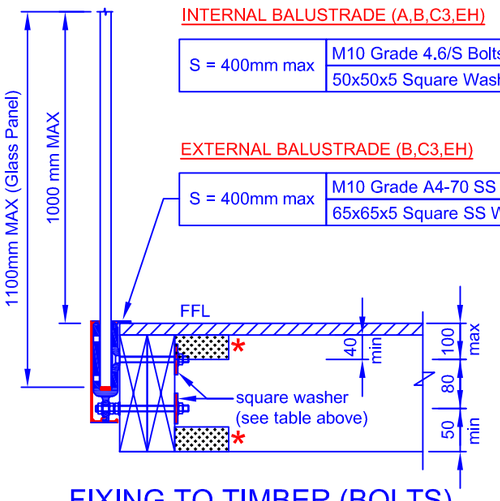

## FIXING TO STEEL

INTERNAL BALUSTRADE (A,B,C3,EH)

| | |
|---|---|
| S = 400mm max | M10 Grade 4.6/S Bolts |
| | 50x50x5 Square Washers |

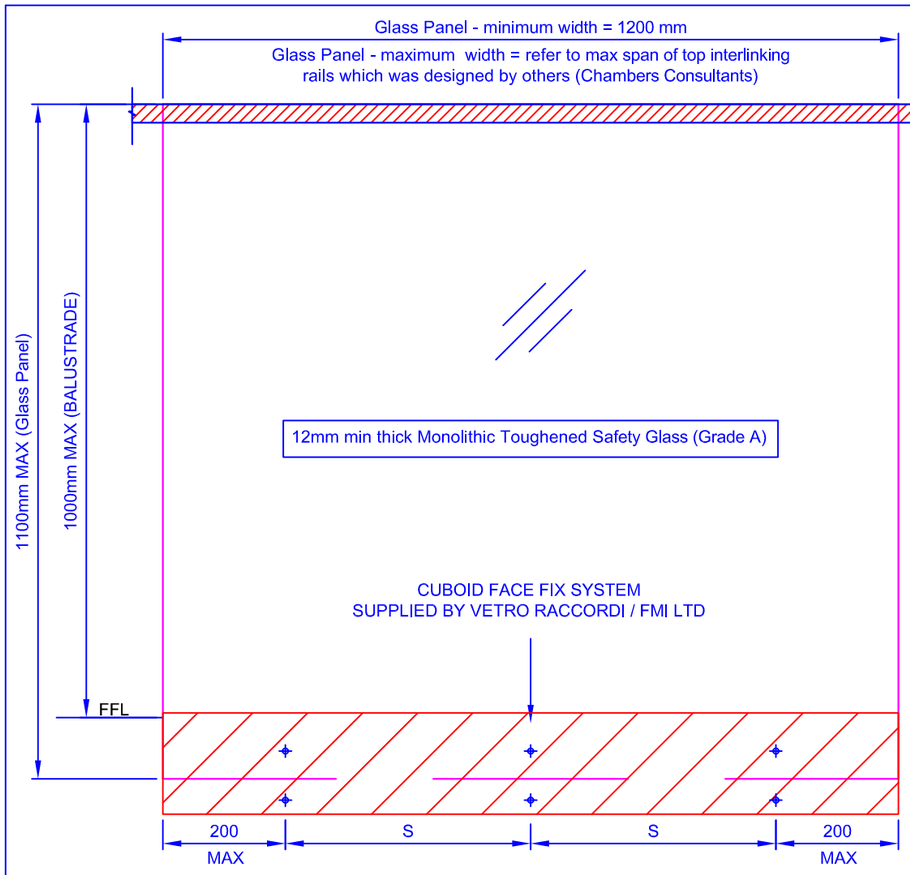
EXTERNAL BALUSTRADE (B,C3,EH)

| | |
|---|---|
| S = 400mm max | M10 Grade A4-70 SS Bolts |
| | 65x65x5 Square SS Washers |

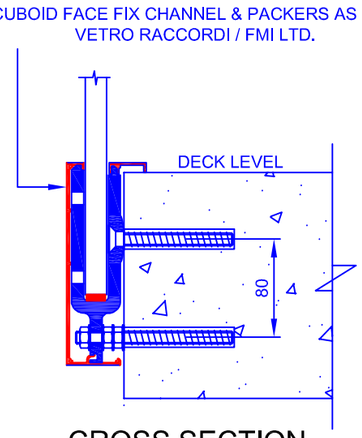



## FIXING TO TIMBER (BOLTS)

| | | | |
|---|---|---|---|
| P & P CONSULTING ENGINEERS LTD<br>Civil and Structural Engineering<br>6A Montel Avenue, Henderson ph: 836-1853 | VETRO RACCORDI / FMI LTD - CUBOID FACE FIX | Scales NOT TO SCALE | Project 11/243 (DS39) |
| | BALUSTRADE - 12mm thick TOUGHENED GLASS (WITH TOP CAPPING RAIL) | Drawn JD / Date 15/7/2024 | Sheet ENG 01 |




TYPICAL ELEVATION




CROSS SECTION

**NOTE:**
S = MAXIMUM SPACING OF THE SIDE FIXINGS

NOTE:
THE CUBOID FACE FIX CHANNEL MUST BE PLACED WITH FULL BEARING AGAINST THE SIDE OF THE SUPPORTING STRUCTURE.

CUBOID FACE FIX CHANNEL

**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 & C3 | EXTERNAL DOMESTIC BALCONIES, OFFICES AND WORK AREAS. ( NOT SUBJECT TO OVER CROWDING) |

WIND LOAD: UP TO "EXTRA HIGH" (EH) WIND ZONE WITH MAXIMUM BASIC WIND SPEED OF 55 m/s.
(DESIGN WIND PRESSURE = 2.36 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 FRAMING:

* 1. FOR FIXING OF BOUNDARY/END JOISTS TO DECK FRAMING (STRAPS, BOLTS,ETC), REFER TO NZS3604:2011 FIGURE 7.10.

(OTHERWISE TO BE SPECIFICALLY DESIGNED BY OTHERS.)

Alternative Base Fixing Option
(fixings at 300mm max centres)

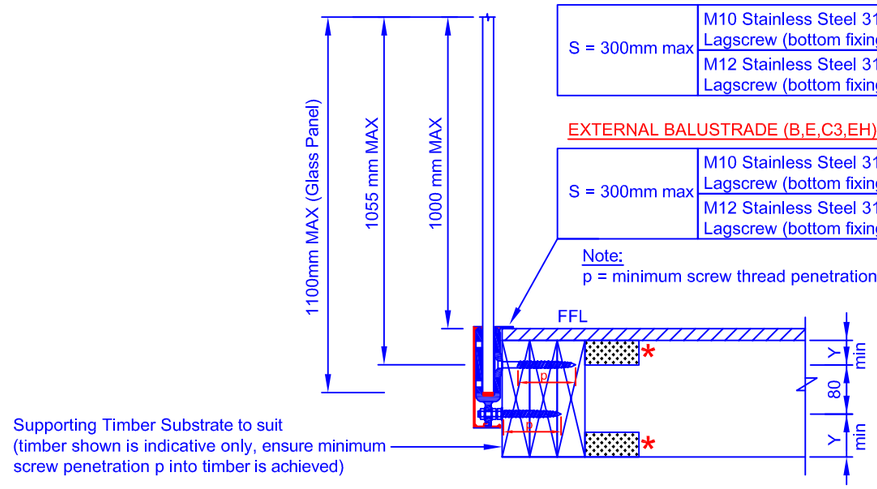
INTERNAL BALUSTRADE (A,B,E,C3,EH)

| | | |
|---|---|---|
| S = 300mm max | M10 Stainless Steel 316 Coach Screw (top fixing) / Lagscrew (bottom fixing) | p = 80 mm |
| | M12 Stainless Steel 316 Coach Screw (top fixing) / Lagscrew (bottom fixing) | p = 72 mm |

EXTERNAL BALUSTRADE (B,E,C3,EH)

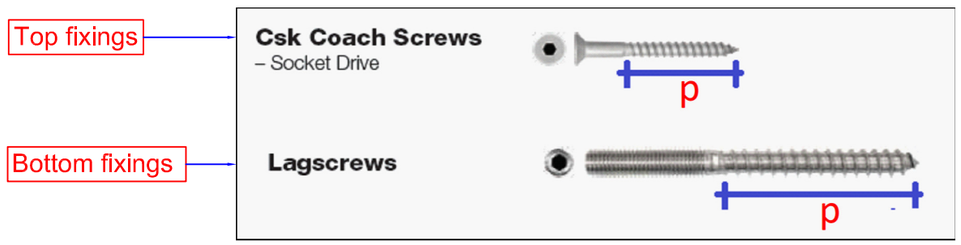
| | | |
|---|---|---|
| S = 300mm max | M10 Stainless Steel 316 Coach Screw (top fixing) / Lagscrew (bottom fixing) | p = 114 mm |
| | M12 Stainless Steel 316 Coach Screw (top fixing) / Lagscrew (bottom fixing) | p = 103 mm |

Note:
p = minimum screw thread penetration into structural timber framing




Note:
Minimum Edge Distance (Y)
Y = 50mm (using M10)
Y = 60mm (using M12)

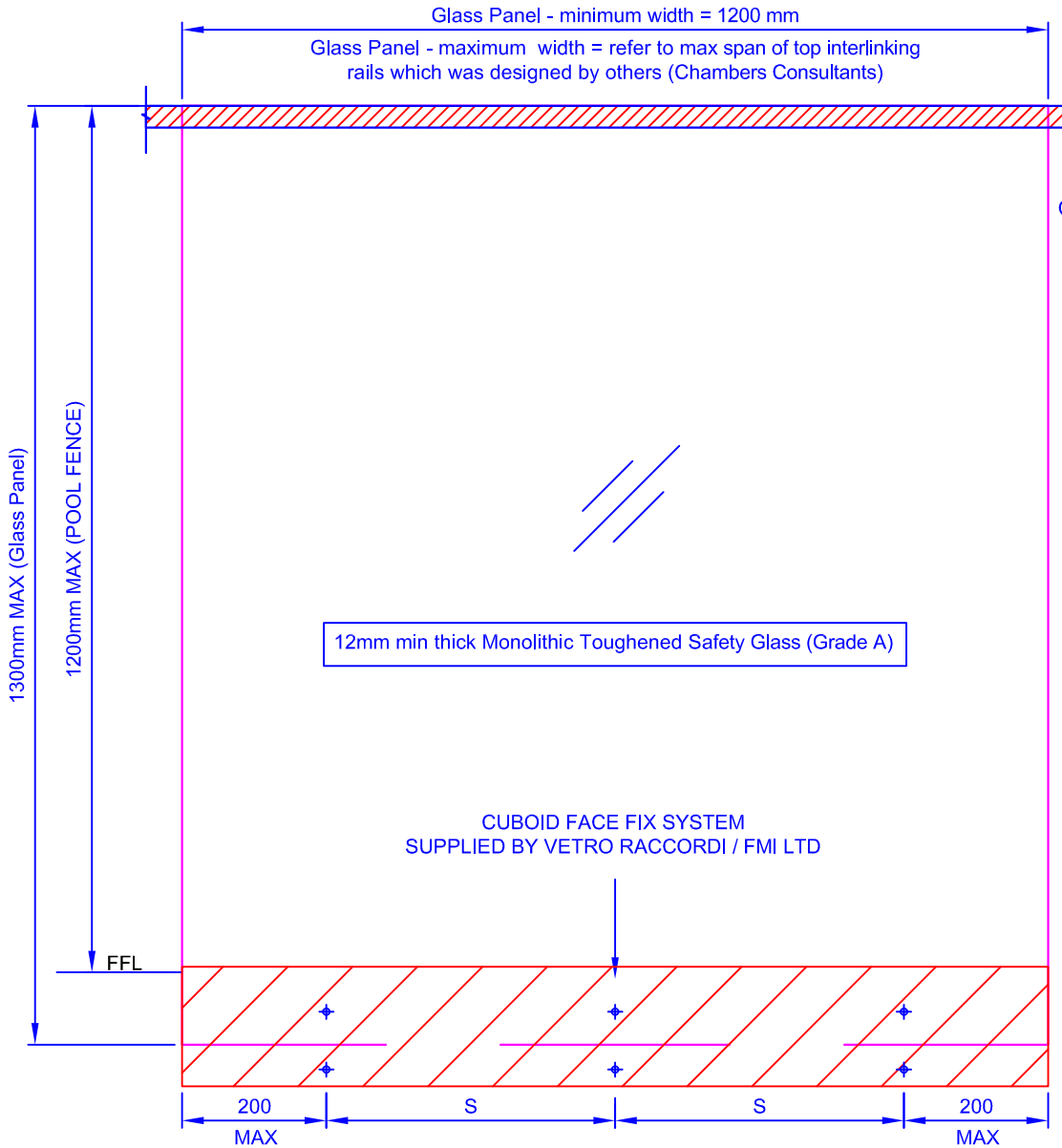
FIXING TO TIMBER (COACHSCREWS/LAGSCREWS)



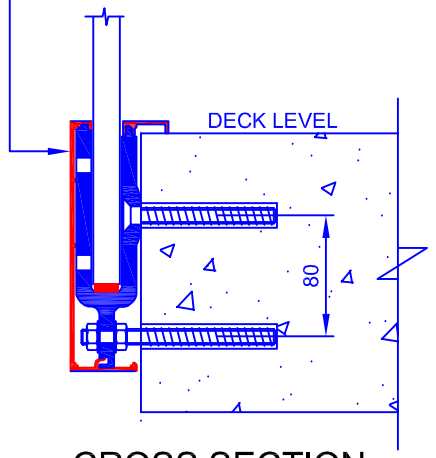

p = minimum screw thread penetration into structural timber framing

DETAILS OF COACH SCREWS / LAGSCREWS

| | | | |
|---|---|---|---|
| P & P CONSULTING ENGINEERS LTD<br>Civil and Structural Engineering<br>6A Montel Avenue, Henderson ph: 836-1853 | VETRO RACCORDI / FMI LTD - CUBOID FACE FIX | Scales NOT TO SCALE | Project 11/243 (DS39) |
| | BALUSTRADE - 12mm thick TOUGHENED GLASS (WITH TOP CAPPING RAIL) | Drawn JD / Date 27/9/2024 | Sheet ENG 01-A |




TYPICAL ELEVATION




CROSS SECTION

**NOTE:**
S = MAXIMUM SPACING OF THE SIDE FIXINGS

NOTE:
THE CUBOID FACE FIX CHANNEL MUST BE PLACED WITH FULL BEARING AGAINST THE SIDE OF THE SUPPORTING STRUCTURE.

CUBOID FACE FIX CHANNEL

**THIS POOL FENCE IS SUITABLE FOR THE FOLLOWING:**

WIND LOAD: UP TO "EXTRA HIGH" (EH) WIND ZONE WITH MAXIMUM BASIC WIND SPEED OF 55 m/s.
(DESIGN WIND PRESSURE = 2.36 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.

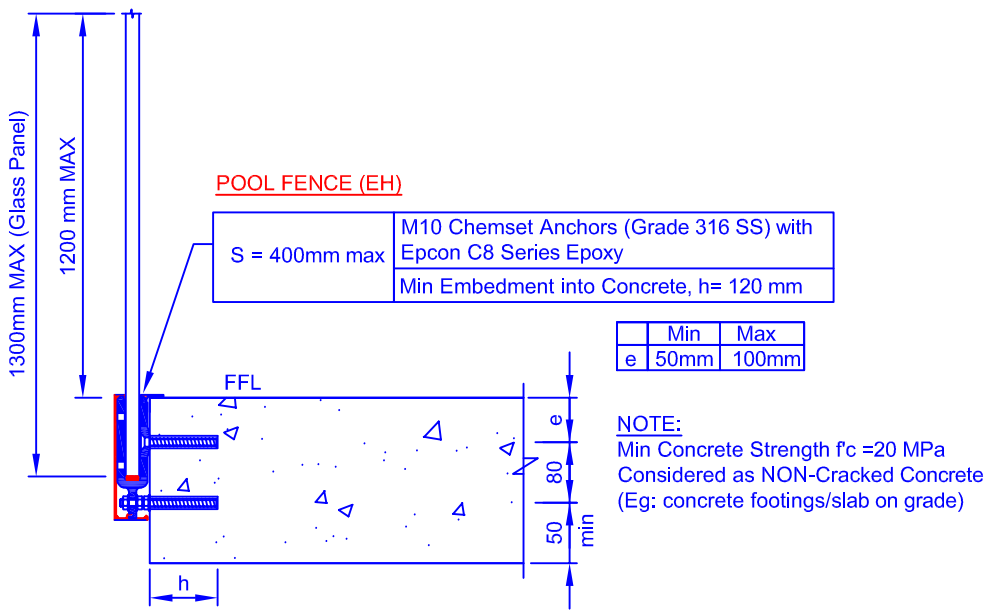
DURABILITY:

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

CONNECTION TO SUPPORTING DECK FRAMING:

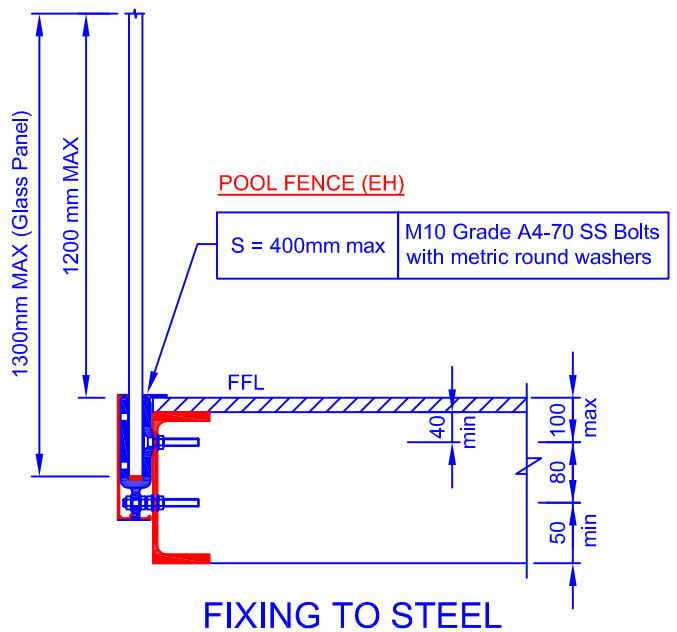
* 1. FOR FIXING OF BOUNDARY/END JOISTS TO DECK FRAMING (STRAPS, BOLTS,ETC), REFER TO NZS3604:2011 FIGURE 7.10.

(OTHERWISE TO BE SPECIFICALLY DESIGNED BY OTHERS.)

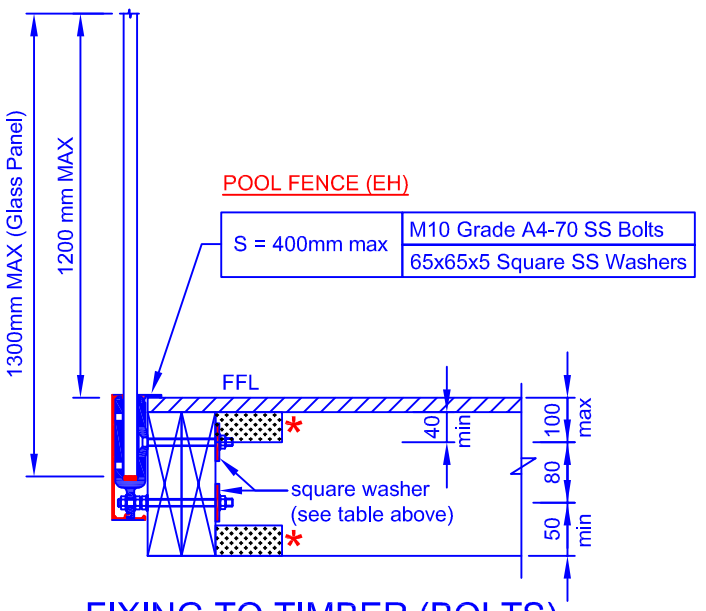



NOTE:
Min Concrete Strength f'c =20 MPa
Considered as NON-Cracked Concrete
(Eg: concrete footings/slab on grade)

FIXING TO CONCRETE




FIXING TO STEEL




FIXING TO TIMBER (BOLTS)

| | | | |
|---|---|---|---|
| P & P CONSULTING ENGINEERS LTD<br>Civil and Structural Engineering<br>6A Montel Avenue, Henderson ph: 836-1853 | VETRO RACCORDI / FMI LTD - CUBOID FACE FIX | Scales NOT TO SCALE | Project 11/243 (DS39) |
| | POOL FENCE - 12mm thick TOUGHENED GLASS (WITH TOP CAPPING RAIL) | Drawn JD / Date 15/7/2024 | Sheet ENG 02 |