

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/ds9
18 December 2020

GLASS FITTINGS LTD

ASSESSMENT OF FRAMELESS GLASS BALUSTRADES AND POOL FENCE

USING CLEARVISTA SURFACE MOUNTED FRAMELESS GLASS CHANNEL



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	The balustrade and pool fence have been tested to comply with AS/NZS 1170.1:2002 Table 3.3 Minimum Imposed Actions for Barriers under Occupancy Type A, B and C3.	
	The balustrade and pool fence have also been tested for “High Wind”.	
3.	<u>Load Tests</u>	3
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4.1	<u>External Balustrade</u>	4
	Based on the testing, the external balustrade with 12 mm thick toughened Grade A Safety Glass and ClearVista Surface Mounted Frameless Glass Channel is sufficient for the following:	
	- Occupancy types A, B, C3 - Up to Max High Wind	
4.2	<u>Pool Fence</u>	5
	Based on the testing, the pool fence with 12 mm thick toughened Grade A Safety Glass and ClearVista Surface Mounted Frameless Glass Channel is sufficient for the following:	
	- Up to Max High Wind	
5.	<u>Base Fixings</u>	5
	Refer to Summary Drawings ENG 01 - 02.	
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	The maximum bending moment for 1.2m high Internal Balustrade is less than the bending moment from load test used in 1.0m high External Balustrade.	
	Therefore 1.2m max high Internal Balustrade is satisfactory.	

NOTE:

Install Top Rail or Handrail when using 12mm thick Toughened Monolithic Glass.
(Top Rail or Handrail to be designed by others.)

Alternatively use minimum 16mm thick (8mm+8mm) Toughened Laminated Glass without top rail or handrail.

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.

For fixings at external location - must be Stainless Steel

For fixings at internal location – must be Hot-dipped Galvanized Steel

5. This design is for panels supplied by Glass Fittings Limited which complies with AS/NZ2208 and accessories supplied by Glass Fittings Limited.

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 LOCAL AUTHORITY**
(Building Consent Authority)
IN RESPECT OF: **Glass Balustrade & Pool Fence using Clearvista Surface Mounted Frameless Glass Channel**
(Description of Building Work)
AT: **VARIOUS SITES**
(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

(Note: Supporting substrate to be checked/designed by others)

(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 CLEARVISTA FRAMELESS CHANNEL and numbered **REF:11/243/DS9, DRAWING ENG01-02**
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 END OF DESIGN CALCULATIONS**
(ii) All proprietary products meeting their performance specification requirements;

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

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

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

I am a member of: ☒ Engineering New Zealand ☐ NZIA and hold the following qualifications: **BE(Civil), CPEng**

The Design Firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than \$200,000*.

The Design Firm is a member of ACENZ: ☐

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

ON BEHALF OF **P & P CONSULTING ENGINEERS LTD** Date: **18 Dec 2020**
(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.
THIS FORM AND ITS CONDITIONS ARE COPYRIGHT TO ACENZ, ENGINEERING NEW ZEALAND AND NZIA

2. GENERAL

The glass balustrade and pool fence were tested to comply with the following:

STATUTORY

NZS 4223:2008 (Part 1)	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:)

<u>Occupancy</u>	<u>Specific Uses</u>	<u>Top Edge</u>	<u>Infill</u>
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

Design for High Winds in terms of the Wind Speed categories in NZS 3604:2011 (up to 44 m/s).

$V_{sit,\beta}$ (Ultimate)	=	44.0	m/s
$V_{sit,\beta}$ (Serviceability)	=	37.3	m/s
q	=	1.16	kPa (ULS)
and	=	0.83	kPa (SLS)
For external barriers use C_p	=	1.30	
For internal barriers use C_p	=	0.30	
Wind Load = $q \times C_p$	=	1.51	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

GLASS PROPERTIES

Use Grade A, Toughened Safety Glass, Minimum Residual Surface Compression = 69 MPa.
For High Strength Glass, Minimum Residual Surface Compression = 90 MPa

For Design Maximum Stress - Refer to Section 3.3.2 of AS 1288:

$\emptyset$	=	0.67
c_1	=	2.5
c_2	=	1
c_3	=	1
f'	=	57.07 - 7.88 x ln (t) (at edges of glass panels) 71.34 - 9.85 x ln (t) (away from edge of glass panels)

Tensile Stress = $\emptyset \times c_1 \times c_2 \times c_3 \times f'$

	<u>Edge</u>	<u>Away From Edge</u>	
=	62.8	78.5	MPa for 12 mm glass thickness

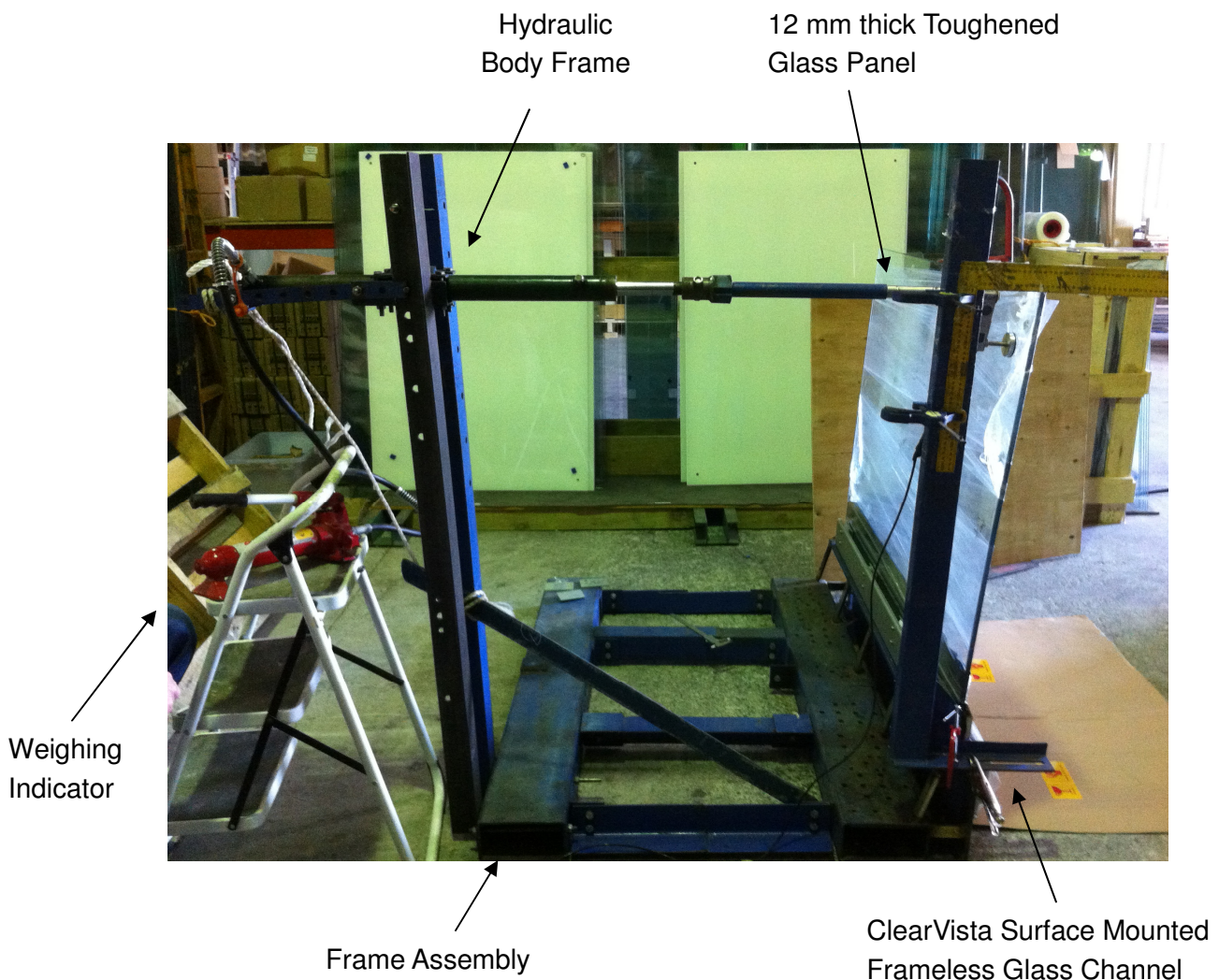
Youngs Modulus = 70 GPa

3. LOAD TESTS

<u>Location of Tests:</u>	49 Woodside Avenue, Auckland
<u>Date of Tests:</u>	October 2013
<u>Test Description:</u>	External Balustrade and Pool Fence
<u>System Description:</u>	12 mm thick Toughened (Grade A) Safety Glass Balustrade with ClearVista Surface Mounted Frameless Glass Channel supplied by Glass Fittings

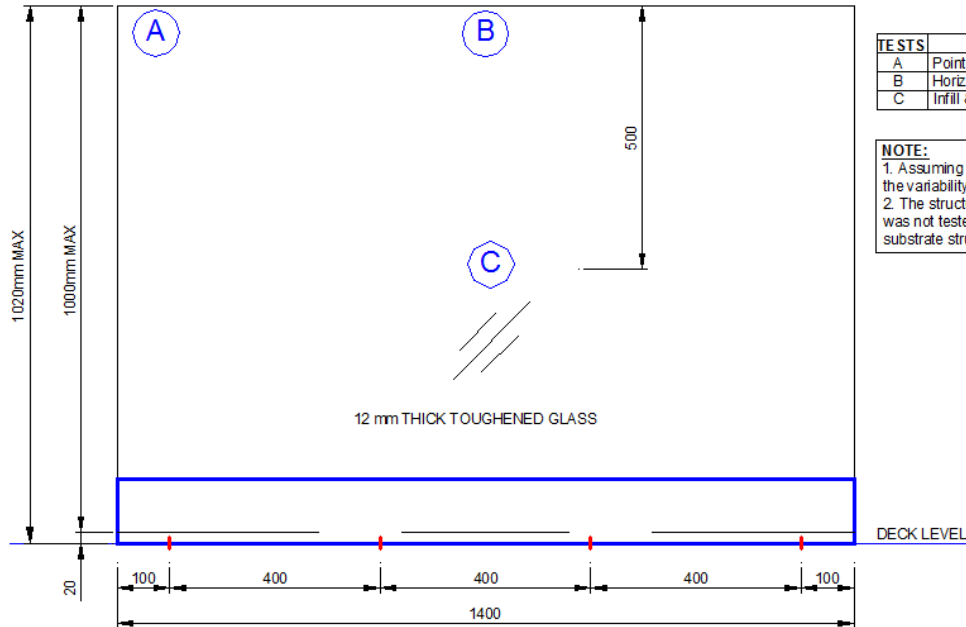
Setup / Procedure:

The Balustrade and Pool Fence were setup with different load tests, refer to pages 4-5. The glass panel was supported at the base with ClearVista Surface Mounted Frameless Glass Channel and fixed to the steel frame assembly with M10 bolts as shown below. Hydraulic Body Frame/Ram and load cell or weighing indicator were used to attain the required test loads.



4. TESTS ARRANGEMENT & RESULTS

4.1 EXTERNAL BALUSTRADE



TESTS	LOAD LOCATION
A	Point Load @ Top Corner with 50 Diameter 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 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	213.5	16	No Fracture
C	292.4	16	No Fracture

TEST RESULTS (Deflection Check)

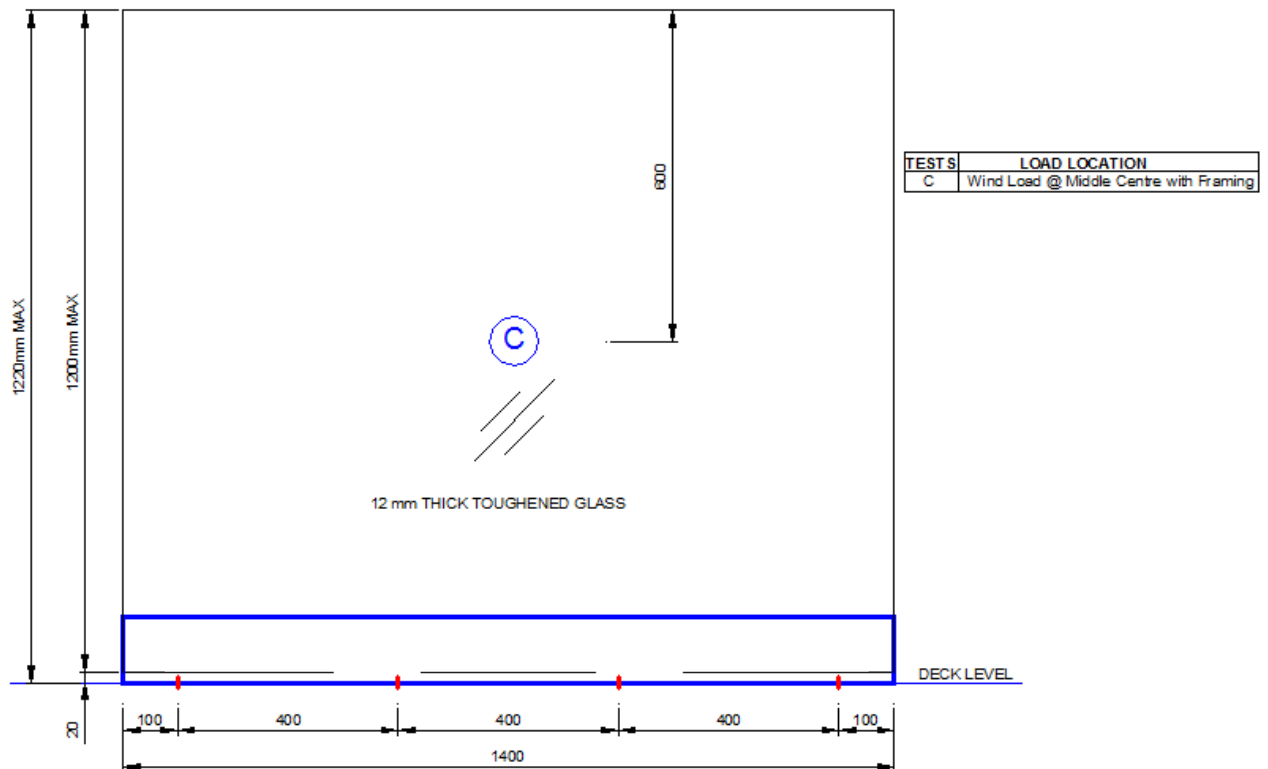
Tests	Target Load @ SLS (Kg)	Deflection @ Top			Remarks
		Sample 1	Sample 2	Sample 3	
A	61.2	24	23	24	Passed
B	107.0	31	32	29	Passed
C	158.0	18	17	18	Passed

Allowable Deflection = $H/30 = 34 \text{ mm}$

Based on the testing, the external balustrade with 12 mm thick toughened Grade A Safety Glass and ClearVista Surface Mounted Frameless Glass Channel is sufficient for the following:

- Occupancy types A, B, C3
- Up to Max High Wind

4.2 POOL FENCE



TEST RESULTS (Fracture Check)

Tests	Target Load (Kg)	Duration (mins)	Observation for Samples 1,2,3
C	349.7	16	No Fracture

TEST RESULTS (Deflection Check)

Tests	Target Load @ SLS (Kg)	Deflection @ Top			Remarks
		Sample 1	Sample 2	Sample 3	
C	188.9	26	27	26	Passed

Allowable Deflection = $H/30 = 40.7$ mm

Based on the testing, the pool fence with 12 mm thick toughened Grade A Safety Glass and ClearVista Surface Mounted Frameless Glass Channel is sufficient for the following:

- Up to Max High Wind

5. BASE FIXINGS

Refer to Summary Drawings ENG 01 - 02.

6.0 ASSESSMENT OF 1.2 m HIGH INTERNAL BALUSTRADE

From load tests used in 1.0 m high External Balustrade (Refer to page 4)

Maximum Test Load Applied @ Top Edge = 213.5 kg (2.14 kN)

Width of Glass Panel = 1.4 m

Variability Factor, $k_t = 1.33$

Equivalent UDL @ Top Edge = $2.14\text{kN} / 1.4\text{m} = 1.53\text{ kN/m}$

Max Bending Moment at the Base = $\frac{1.53\text{ kN/m} \times 1.02\text{ m}}{1.33} = 1.17\text{ kN-m / m}$

For 1.2 m high Internal Balustrade

UDL @ Top Edge = 0.35 kN/m

Max Bending Moment at the Base = $1.5 \times 0.35\text{ kN/m} \times 1.2\text{ m} = 0.63\text{ kN-m / m} < 1.17\text{ kN-m / m}$
OK

The maximum bending moment for 1.2m high Internal Balustrade is less than the bending moment from load test used in 1.0m high External Balustrade.

Therefore 1.2m max high Internal Balustrade is satisfactory.

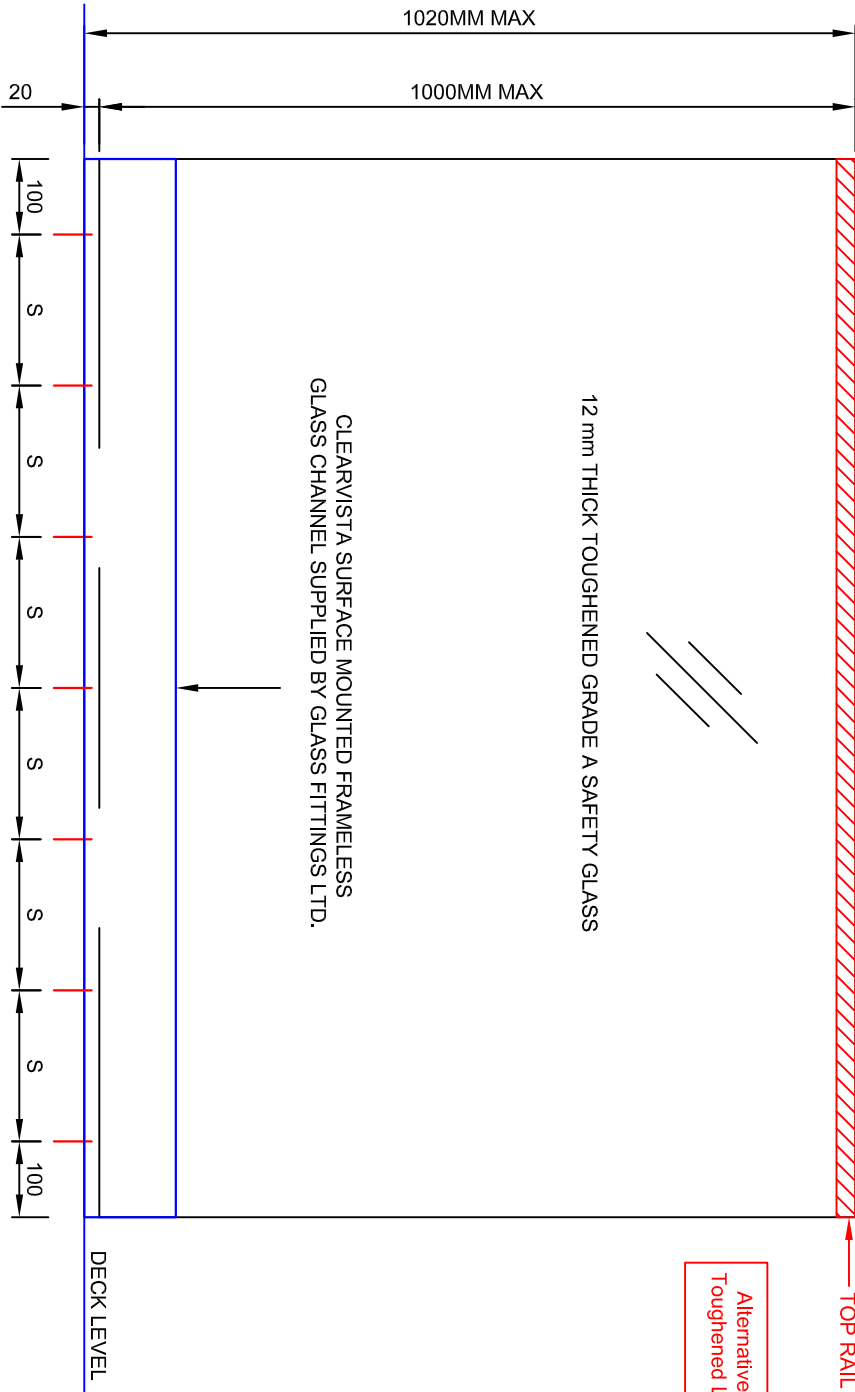
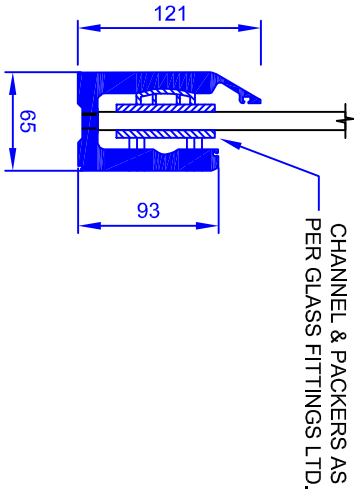
1400 MM MAX PER PANEL

TOP RAIL OR HANDRAIL (DESIGNED BY OTHERS)

Alternatively use minimum 16mm thick (8mm+8mm) Toughened Laminated Glass without top rail or handrail.

12 mm THICK TOUGHENED GRADE A SAFETY GLASS

CLEARVISTA SURFACE MOUNTED FRAMELESS GLASS CHANNEL SUPPLIED BY GLASS FITTINGS LTD.



TYPICAL ELEVATION

NOTE:
S = MAXIMUM SPACING OF THE BASE FIXINGS

CHANNEL DETAILS

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	INCLUDING 1.2M HIGH INTERNAL BALUSTRADE EXTERNAL DOMESTIC BALCONIES, OFFICES AND WORK AREAS. (NOT SUBJECT TO OVER CROWDING)

WIND LOAD:

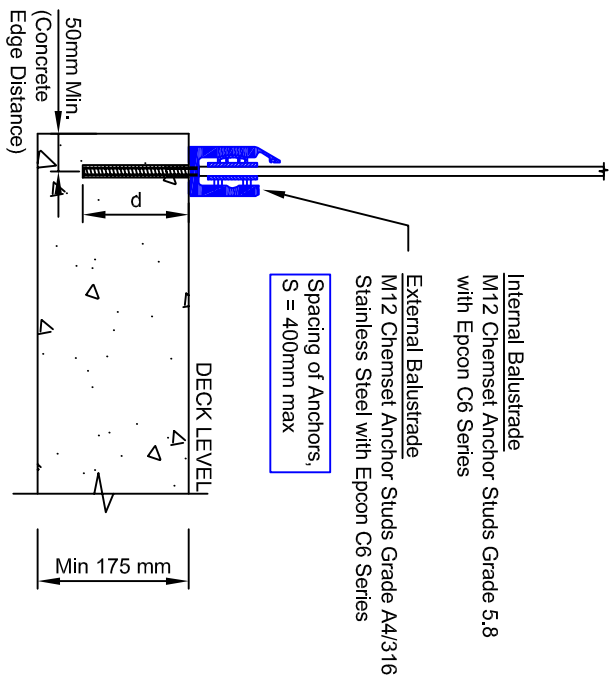
UP TO "HIGH" WIND ZONE WITH MAXIMUM BASIC WIND SPEED OF 44 m/s.
(DESIGN WIND PRESSURE = 1.5 kPa @ ULS)

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.

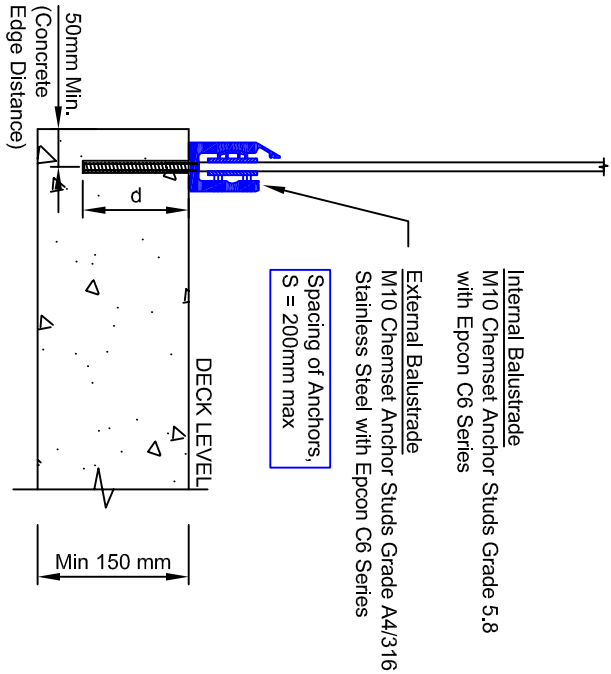
DURABILITY

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



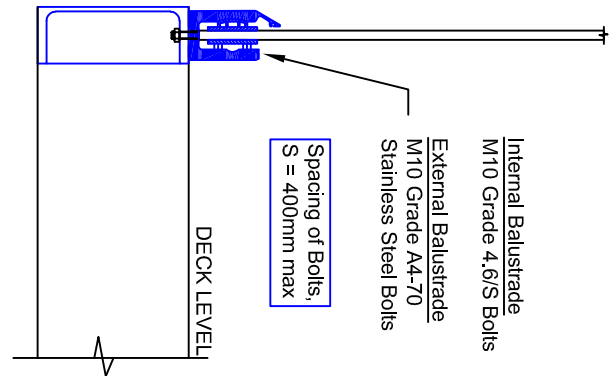
d = 140 mm Min Embedment into Concrete
(Min Concrete Strength to be 20 MPa)

FIXING TO CONCRETE

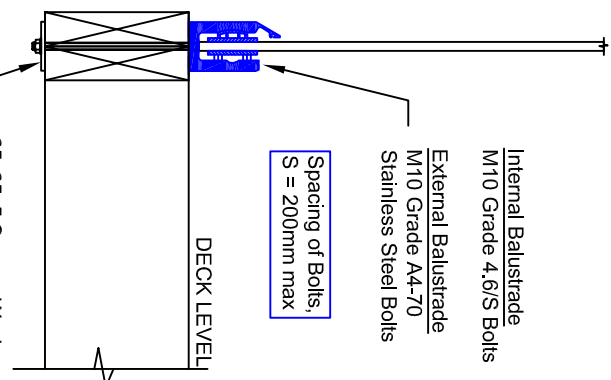


d = 125 mm Min Embedment into Concrete
(Min Concrete Strength to be 20 MPa)

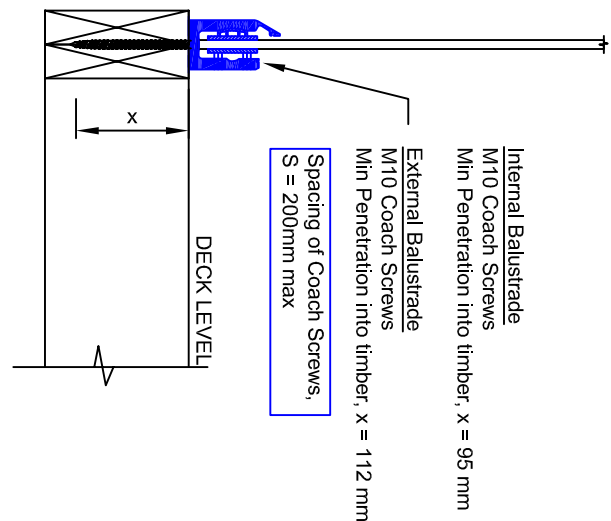
FIXING TO CONCRETE



FIXING TO STEEL



FIXING TO TIMBER USING BOLTS



FIXING TO TIMBER USING COACH SCREWS

P & P CONSULTING ENGINEERS LTD

Civil and Structural Engineering
6A Montel Avenue, Henderson ph: 836-1853

GLASS FITTINGS LTD - CLEARVISTA SURFACE MOUNTED FRAMELESS GLASS CHANNEL

INTERNAL & EXTERNAL BALUSTRADES

Scales

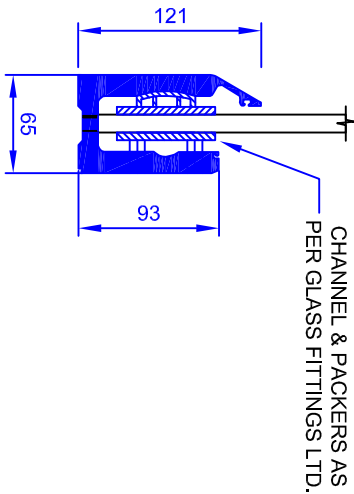
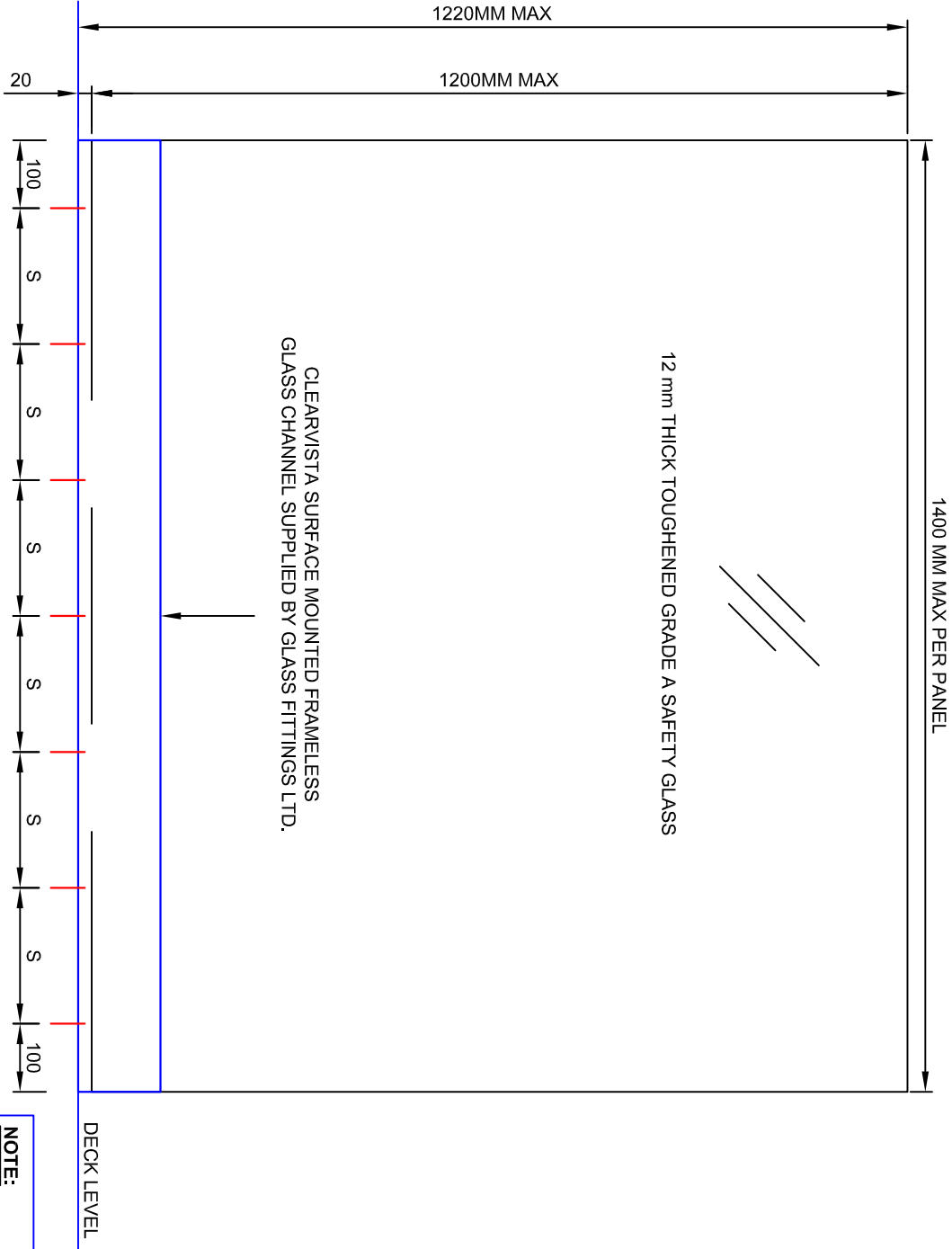
NOT TO SCALE

Project 11/243

Drawn JD

Date 18-12-20

Sheet ENG 01



THIS POOL FENCE IS SUITABLE FOR THE FOLLOWING:

WIND LOAD: UP TO "HIGH" WIND ZONE WITH MAXIMUM BASIC WIND SPEED OF 44 m/s.

(DESIGN WIND PRESSURE = 1.5 kPa @ ULS)

FIXINGS:

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

2. BOLTING ARRANGEMENT MUST COMPLY WITH RELEVANT MATERIAL CODES.

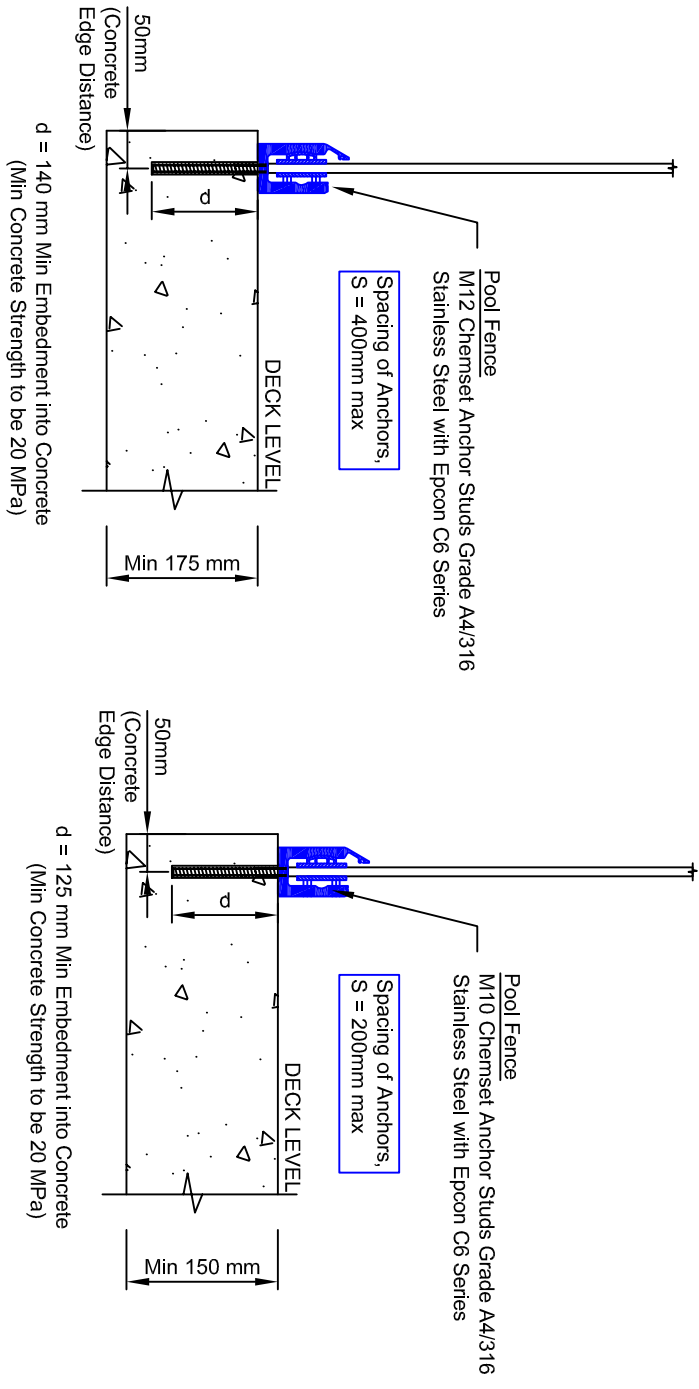
3. STRENGTH & STIFFNESS OF THE SUBSTRATE STRUCTURE MUST BE SUFFICIENT FOR THE BALUSTRADE LOADS - THIS MUST BE SPECIFICALLY CHECKED BY OTHERS FOR EACH SITUATION.

DURABILITY

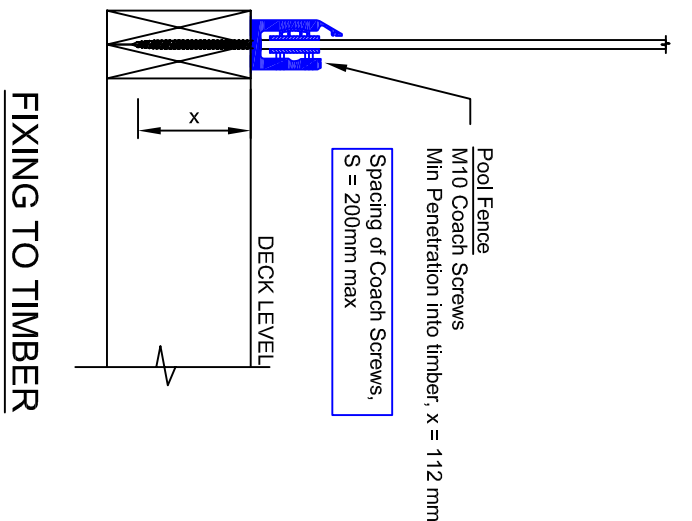
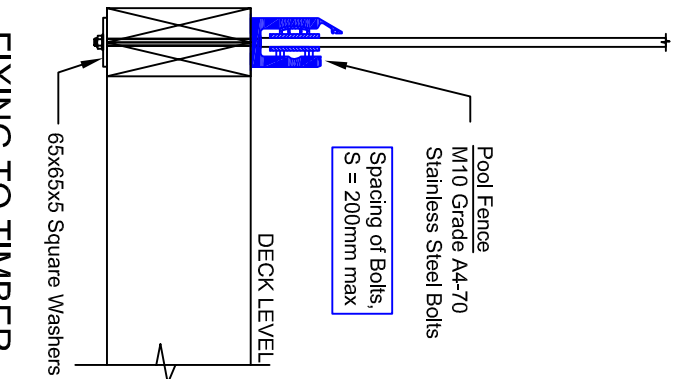
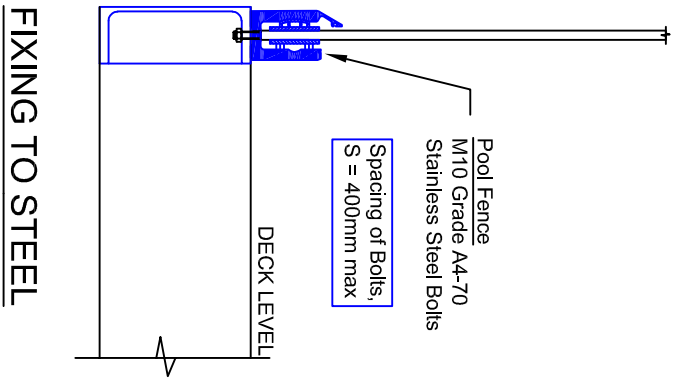
1. ALL FIXINGS & STRUCTURAL STEEL MUST COMPLY WITH SECTION 4 "DURABILITY" OF NZS 3604:2011.

TYPICAL ELEVATION

NOTE:
S = MAXIMUM SPACING OF THE BASE FIXINGS



FIXING TO CONCRETE



FIXING TO CONCRETE

FIXING TO STEEL

**FIXING TO TIMBER
USING BOLTS**

**FIXING TO TIMBER
USING COACH SCREWS**