NZBC Clause B1 Structure - Design

Aluminium Canopies and Window Frames

Project number:	23040127-01A		
Company name:	Aurae Ltd		
Date:	14/04/2023	Expiry:	14/04/2025
Location:	All regions within NZ considered a high wind zone or below, and all sub-alpine snow regions with NZ as per this report's parameters		

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Auckland 1010, New Zealand.

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Building Code Clause(s) B1

PRODUCER STATEMENT – PS1 – DESIGN

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

ISSUED BY: Brevity Ltd
(Design Firm)

TO: Aurae Ltd
(Owner/Developer)

TO BE SUPPLIED TO: Building Consent Authority
(Building Consent Authority)

IN RESPECT OF: Brevity report # 23040127-01A Design of Non-Structural Building Elements
(Description of Building Work)

AT: Various locations in New Zealand, excluding lee zones and high snow regions - Refer attached report
(Address)

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

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

Design Consultancy for seismic restraint of non-structural building elements

(Extent of Engagement)

services in respect of the requirements of Clause(s) B1 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:

Canopy and Window Hood Standard Fixing Detail and numbered IN-STDDC-1.1, IN-STDDC- 1.2, IN-STDDC-1.3 & STDWH- 1.1, STDWH- 1.2, STDWH- 1.3 ;
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 see attached report - #16121908
(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, Matt Bishop am: ■ CPEng 243276 # ☐ Reg Arch ..... #
(Name of Design Professional)

I am a member of: ■ Engineering New Zealand ☐ NZIA and hold the following qualifications: BE (Hons)
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 Matt Bishop (Signature)
(Name of Design Professional)

ON BEHALF OF Brevity Ltd Date 10/04/2024
(Design Firm)
Expiry Date: 14/04/2025

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.

1. Overview

This report is a detailed document defining the structure's design criteria and recording key decisions or outcomes. It outlines design loading, structural modelling assumptions, material properties, foundation requirements and design standards. This report also defines the calculation procedure and checking principles to be followed, providing a clear explanation of the full design.

2. Means of Compliance

The design of the structures are in compliance with the New Zealand Building Code (NZBC), section B1. The following standards have been used:

- AS/NZS 1170: 2001
- AS 1664.1: 1997
- NZS 3603: 1993
- NZS 3604: 2011

3. The Structure General

Three structure types have been assessed under the loading requirements of AS/NZS 1170:2001:

1) Aluminium sheet metal canopies fixed back to the structure with M8 Stainless Steel Rod.
2) Aluminium 200x50x3 RHS or Solaris 200 Louvre window frames
3) Aluminium Balustrade, consisting of 100x50x3RHS frame and 50 SHS balusters

The design life of the structures is 50 years.

4. Location

The structures can be located in all regions within NZ considered a high wind zone or below, and all sub-alpine snow regions with NZ as per section 5.4 of this report.

5. Design Actions

5.1 Load Cases

LC1:	1.2G + Wu	(ULS Wind downforce)
LC2:	0.9G +Wu	(ULS Wind uplift)
LC3:	1.2G +1.5Q	(ULS Balustrade loading)
LC4:	1.2G + Su	(ULS Snow loading)

5.2 Wind Actions

Wind Zone: High

V_{Des}: 37.35 ms^{-1}

C_{fig_canopy}: 0.5

C_{fig_frames}: 1.99

C_{dyn}: 1.0

P_{ULS_Canopy}: 419 Pa
P_{ULS_Frames}: 1667 Pa

5.3 Balustrade Loading

Q_{Point}: 600 N (in any direction)

Q_{UDL}: 0.75 kN/m (on balustrade top rail)

Q_{press}: 1 kPa (on all balustrade members)

5.4 Snow Loading (Sub-alpine regions only)

h_0,max: 100 m

k_P: 1.25 (APoE 1/150)

Pitch: 0 degrees

mu_i: 0.84

S_g: 0.9 kPa

S_ULS: 0.756 kPa

6. Specifications

All standards stated are the latest versions available at the time of design:

- All workmanship to comply with with NZS 3404.1, AS/NZS 1665, AS/NZS 1554
- All cold formed steel sections to AS/NZS 1163 - G350
- All hot rolled steel plate to AS/NZS 3678 - G250
- All aluminium alloy sections to AS/NZS 1866

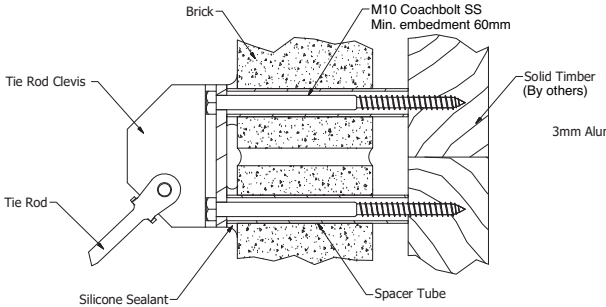
7. Proprietary Items

The following proprietary items have been specified as part of this project:

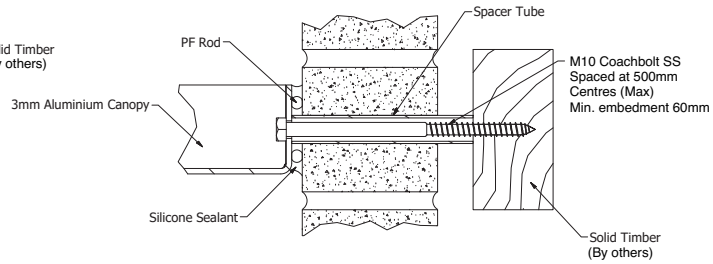
- 10G Stainless Tek Screws
- 14G Stainless Tek Screws
- M8 Coach bolt
- M6 CSK Screws
- 3.2mm S/S Rivets
- RHS/Louvre clasp bracket
- 50m Square Balusters
- Corner staking angle extrusions

Appendix A - Supporting Calculations

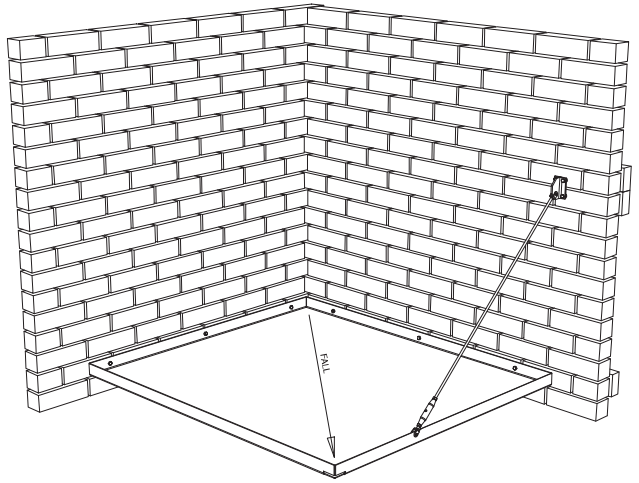
CHECKED AND APPROVED BY
BREVITY CONSULTING LTD
DATE: 22/02/2017
BREVITY REF: 16121908
REVISION: A
Brevity



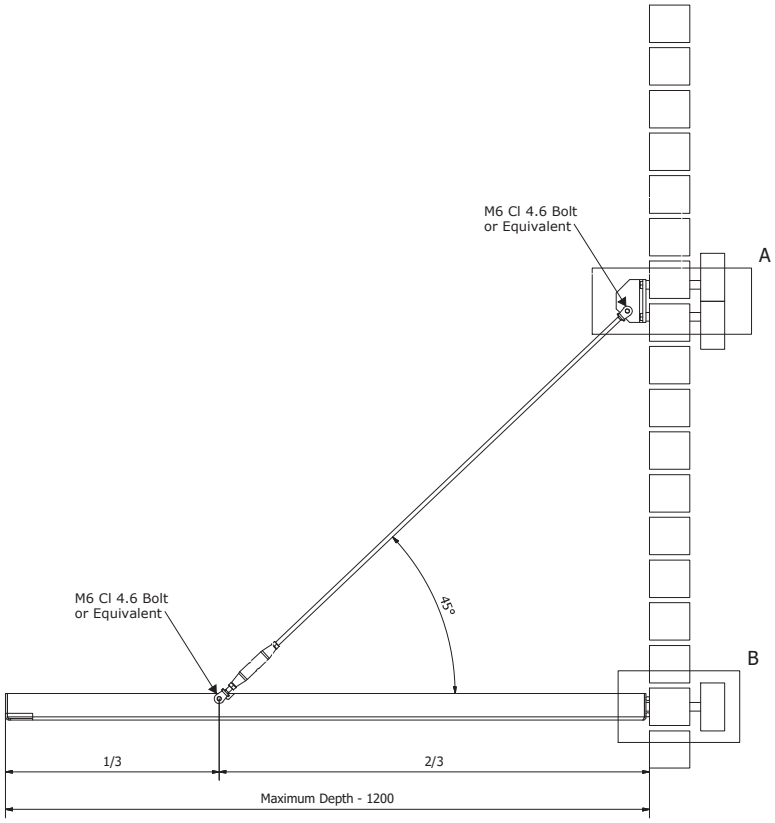
Detail A 1:1.5
Tie Rod Clevis to Brick Fixing Detail



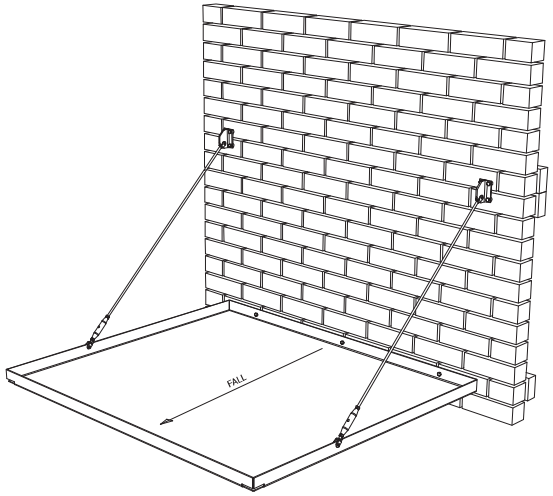
Detail B 1:1.5
Canopy to Brick Fixing Detail



Rear and Side Fix N.T.S



Side Elevation 1:5
Tie Rod Clevis to Brick Fixing Detail
Maximum Canopy Width 1500mm



Rear Fix N.T.S

Revision Table			
Rev	Description	By	Date

Tolerance:
Dimension Decimal Places:
0 = +/- 1mm
0.0 = +/- 0.1mm
Angle = +/- 1°
*Unless otherwise stated. Do not scale. If in doubt ask.

Third Angle

All dimensions are in **mm** unless otherwise stated

File:
C:\Users\INSOL\Dropbox (Insol Ltd)\Insol\Product Information\Standard Details\Inventor Models\Fletcher Living Door Canopy Fixing.iam

Material:
Weight: **N/A**
Finish:
Qty Req as Shown:
Qty Req Opp Hand:

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Fax 03 216 5928
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Title:
Canopy Standard Fixing Detail

Desc:
Brick Rear Fixed and Rear / Side Fixed

Drawing No: **IN-I -STDDC-1.1**
Rev: **A**
Org Date: **21/02/2017**
Dwg By: **DM** App By: **DM**
Scale: **1:10**
Project No: **STDDC**
A1

Perspective

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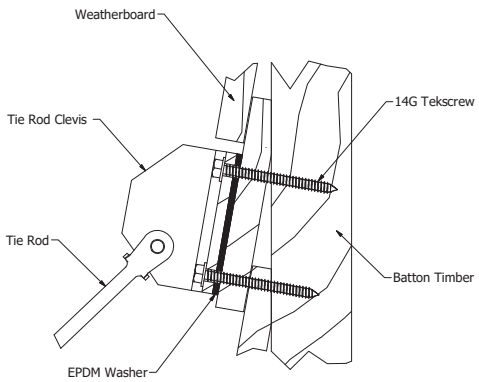
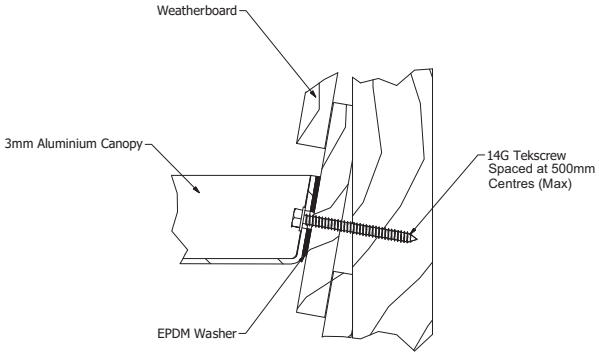
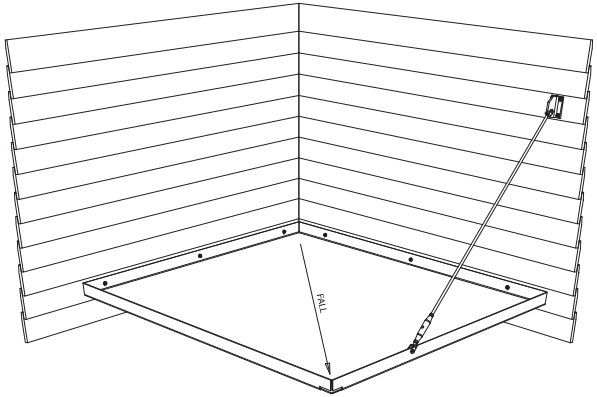


Detail A 1:2.5
Tie Rod Clevis to Weatherboard Fixing Detail



Detail B 1:2.5
Canopy to Weatherboard Fixing Detail



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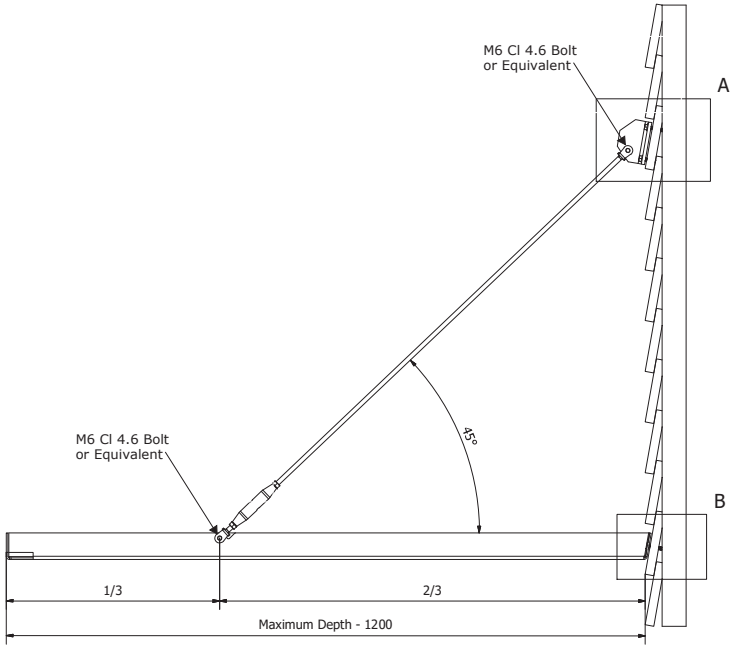
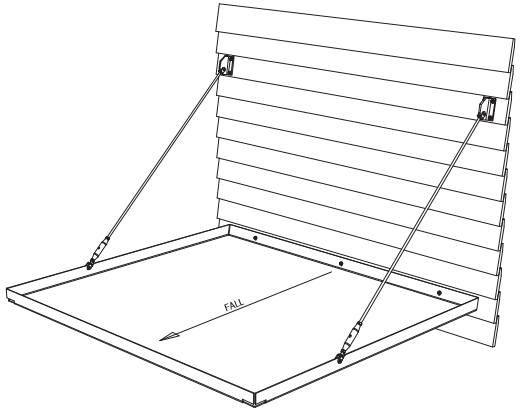


Side Elevation 1:5
Tie Rod Clevis to Weatherboard Fixing Detail
Maximum Canopy Width 1500mm



Rear Fix N.T.S

Revision Table			
Rev	Description	By	Date

Tolerance:
Dimension Decimal Places:
0 = +/- 1mm
0.0 = +/- 0.1mm
Angle = +/- 1°
*Unless otherwise stated. Do not scale. If in doubt ask.

Third Angle

All dimensions are in **mm** unless otherwise stated

File:
C:\Users\INSOL\Dropbox (Insol Ltd)\Insol\Product Information\Standard Details\Inventor Models\Fletcher Living Door Canopy Fixing Weatherboard.iam

Material:
Weight: **N/A**
Finish:
Qty Req as Shown:
Qty Req Opp Hand:

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Title:
Canopy Standard Fixing Detail

Desc:
Weatherboard Rear Fixed and Rear / Side Fixed

Drawing No: **IN-I -STDDC-1.2** | Rev: **A**
Org Date: **21/02/2017**
Dwg By: **DM** App By: **DM**
Scale: **0.11 : 1**
Project No: **STDDC** | **A1**

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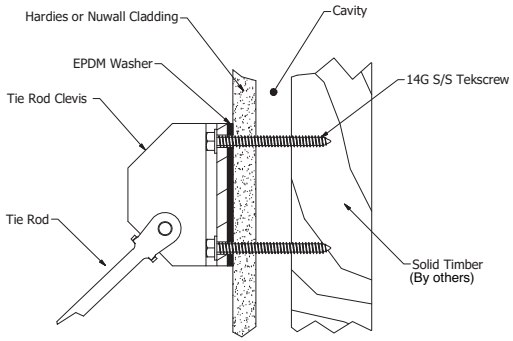
DATE: 22/02/2017
BREVITY REF: 16121908
REVISION: A
Brevity



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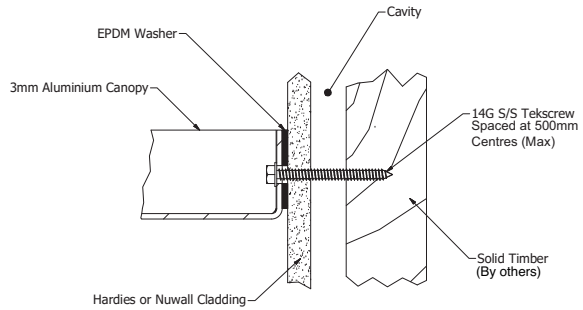
Tie Rod Clevis Fixing Detail



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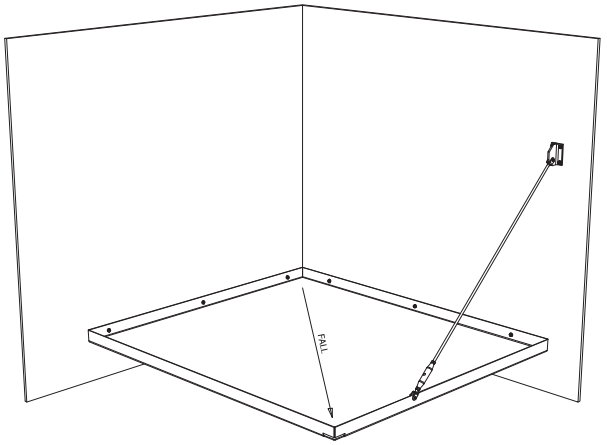
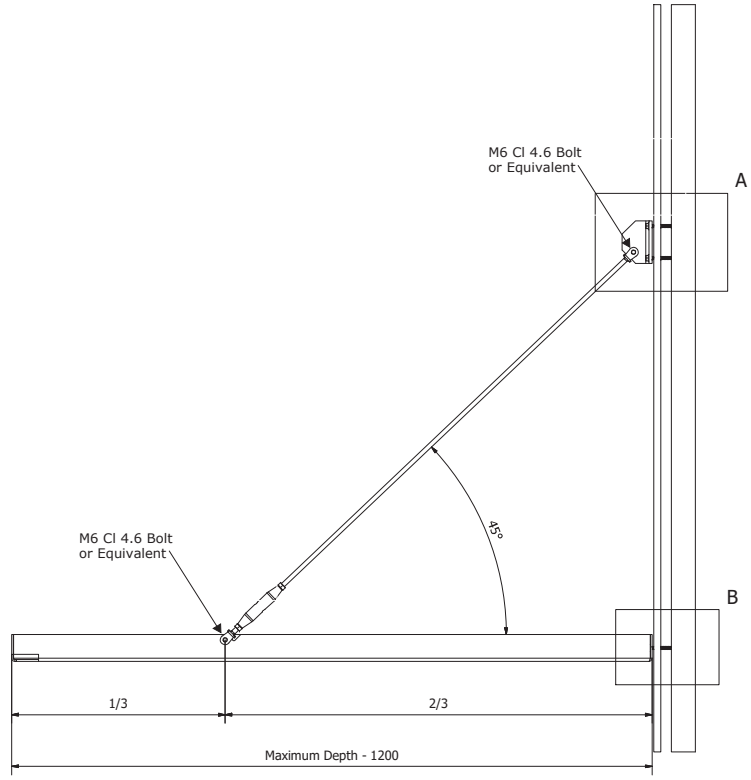
Canopy Fixing Detail



Rear and Side Fix N.T.S



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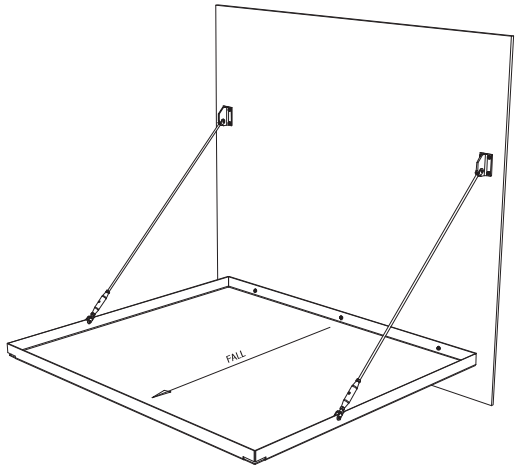

Rear Fix N.T.S

Revision Table			
Rev	Description	By	Date

Tolerance:
Dimension Decimal Places:
0 = +/- 1mm
0.0 = +/- 0.1mm
Angle = +/- 1°
*Unless otherwise stated. Do not scale. If in doubt ask.

Third Angle

All dimensions are in **mm** unless otherwise stated

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Material:
Weight: **N/A**
Finish:
Qty Req as Shown:
Qty Req Opp Hand:

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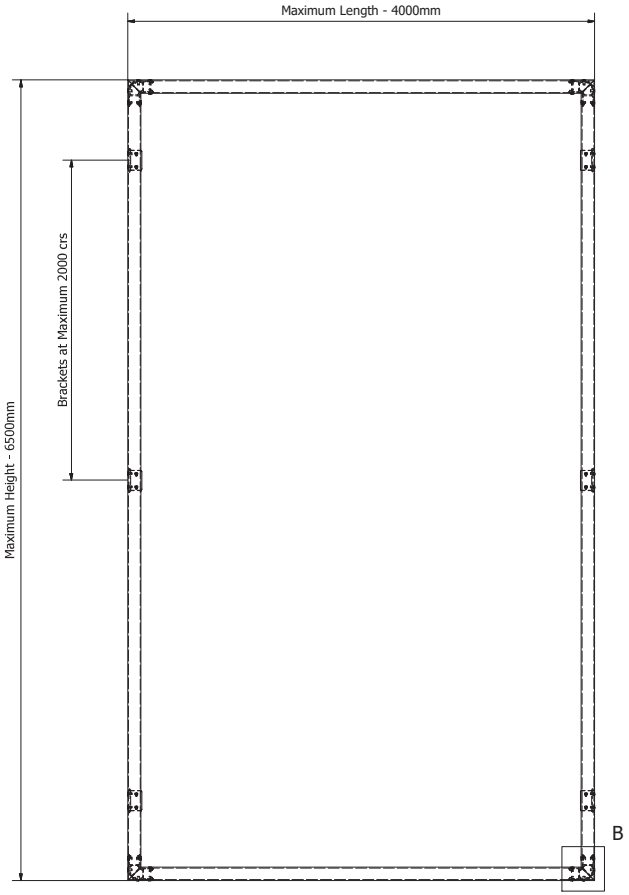
Title:
Canopy Standard Fixing Detail

Desc:
Hardies / Nuwall Rear Fixed and Rear / Side Fixed

Drawing No: **IN-I -STDDC-1.3**
Rev: **A**
Org Date: **21/02/2017**
Dwg By: **DM**
App By: **DM**
Scale: **1:5**
Project No: **STDDC**
A1



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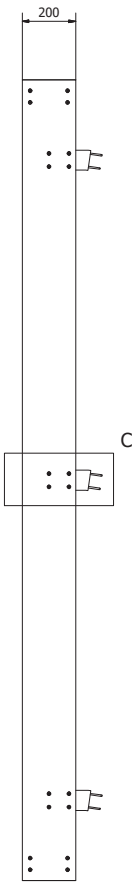
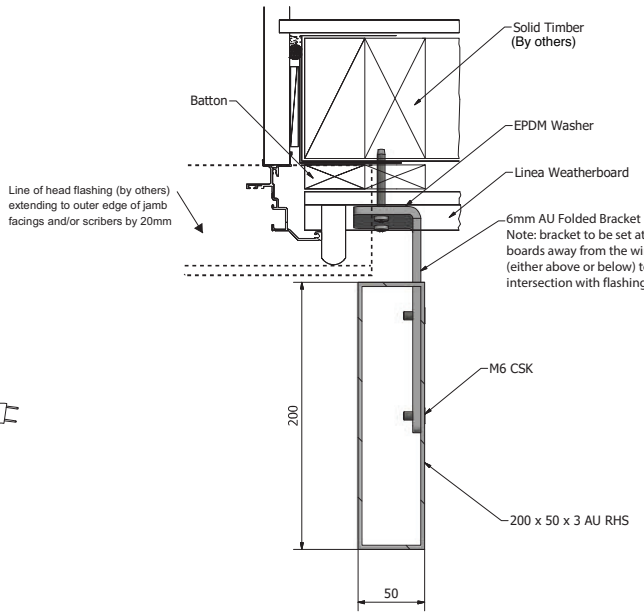
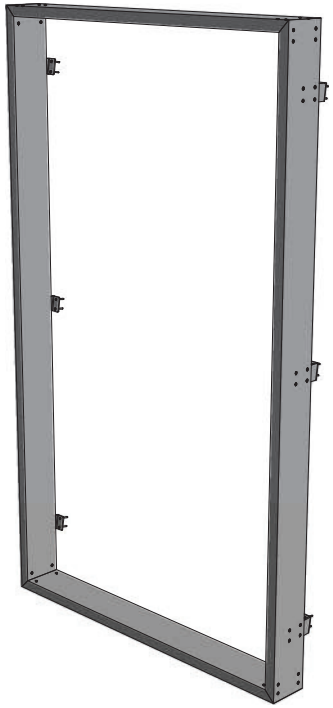
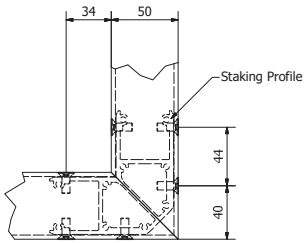


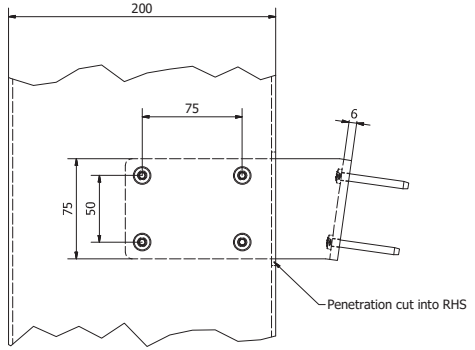


Detail A 1:2
Jamb Fixing Detail





Detail B 1:2
Frame Corner Staking Detail



Detail C 1:2
Folded Bracket Detail

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BREVITY CONSULTING LTD
DATE: 22/02/2017
BREVITY REF: 16121908
REVISION: A
Brevity

Revision Table			
Rev	Description	By	Date

Tolerance:
Dimension Decimal Places:
0 = +/- 1mm
0.0 = +/- 0.1mm
Angle = +/- 1°
*Unless otherwise stated. Do not scale. If in doubt ask.

Third Angle

All dimensions are in **mm** unless otherwise stated

File:
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Material:
Weight: **N/A**
Finish:
Qty Req as Shown:
Qty Req Opp Hand:

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Title:
Window Hood Standard Fixing Detail

Desc:
Weatherboard Bracket

Drawing No: **IN-I -STDWH-1.1** Rev: **A**
Org Date: **1/12/2016**
Dwg By: **DM** App By: **DM**
Scale: **1:10**
Project No: **STDWH** **A1**

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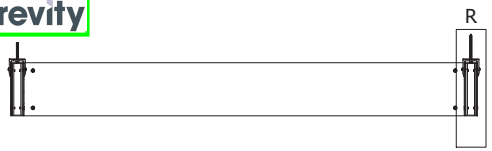
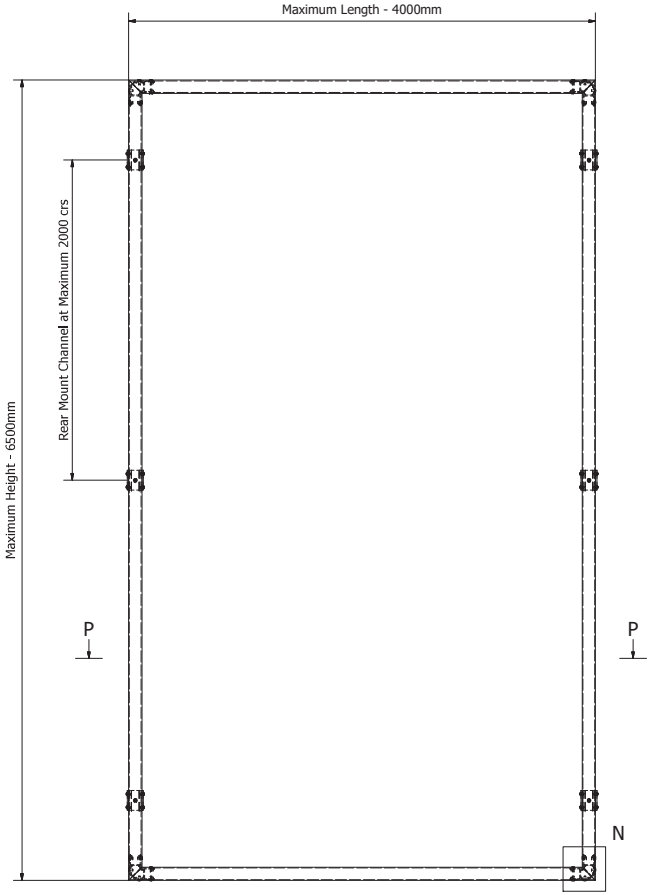
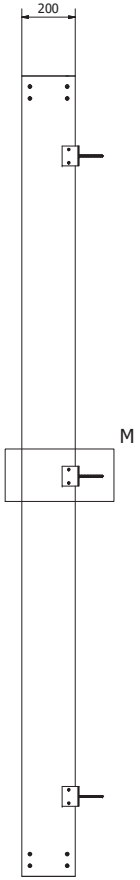
BREVITY CONSULTING LTD
DATE: 22/02/2017
BREVITY REF: 16121908
REVISION: A

Brevity







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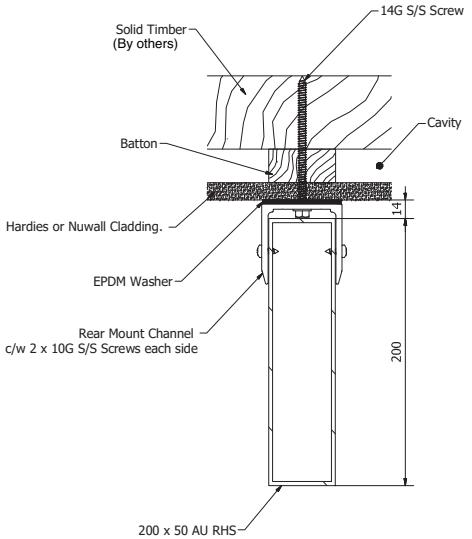
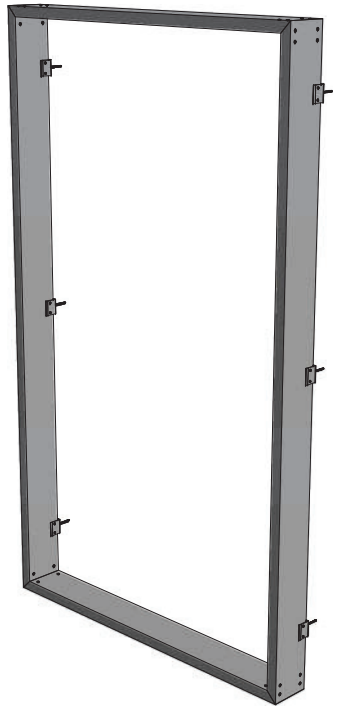
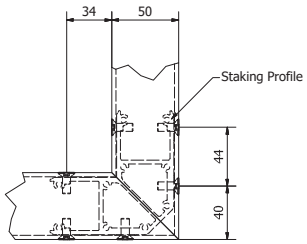
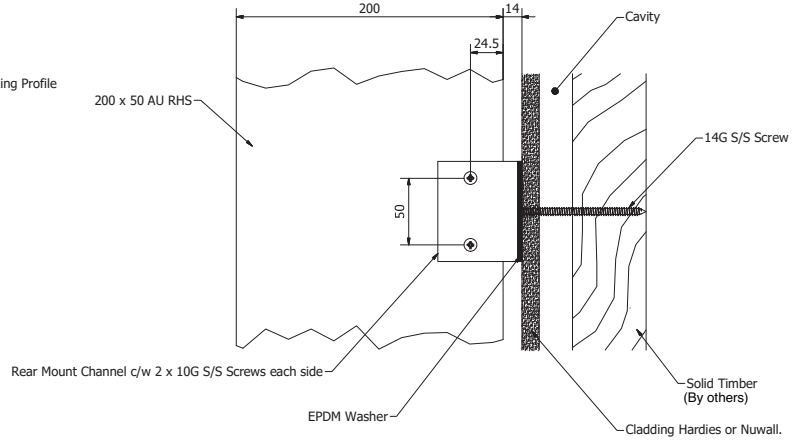


Detail C 1:2
Horizontal Fixing Detail





Detail B 1:2
Frame Corner Staking Detail



Detail D 1:2
Vertical Fixing Detail

Revision Table			
Rev	Description	By	Date

Tolerance:
Dimension Decimal Places:
0 = +/- 1mm
0.0 = +/- 0.1mm
Angle = +/- 1°
*Unless otherwise stated. Do not scale. If in doubt ask.

Third Angle

All dimensions are in **mm** unless otherwise stated

File:
C:\Users\INSOL\Dropbox (Insol Ltd)\Insol\Product Information\Standard Details\Inventor Models\Window Hood RHS Frame Rear Mount.iam

Material:
Weight: **N/A**
Finish:
Qty Req as Shown:
Qty Req Opp Hand:

INSOL Architectural Aluminium Louvres

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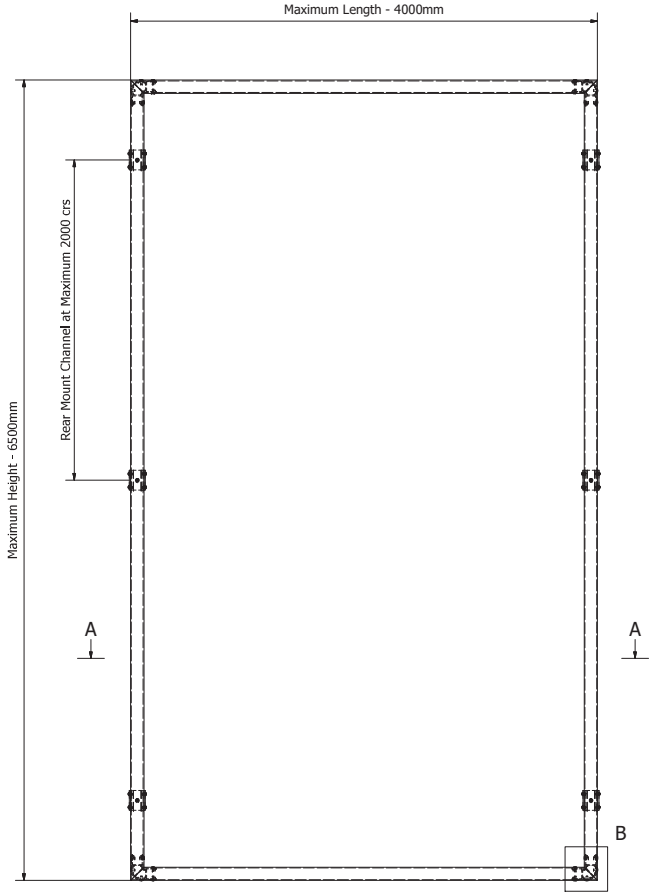
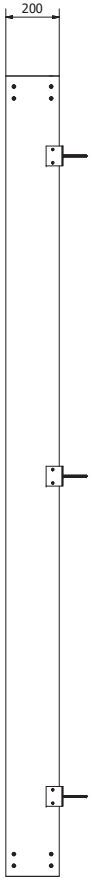
Ph 216 3287
Fax 03 216 5928
www.insolnz.co.nz

Title:
Window Hood Standard Fixing Detail

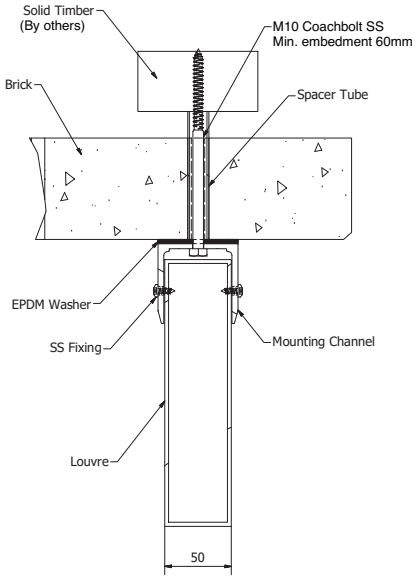
Desc:
Hardies & Nu-Wall Rear Mount Channel

Drawing No: IN-I -STDWH-1.2
Rev: A
Org Date: **1/12/2016**
Dwg By: **DM** App By: **DM**
Scale: **1:10**
Project No: **STDWH**
A1

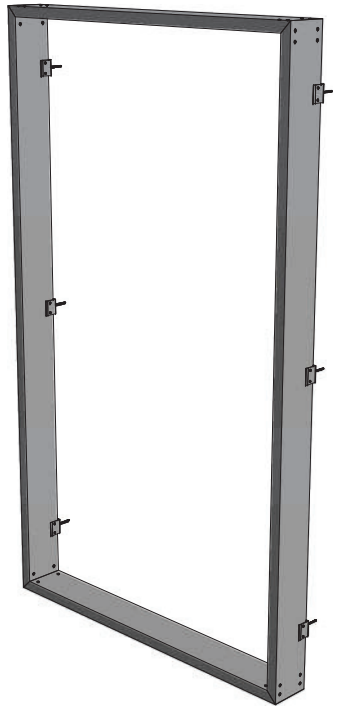


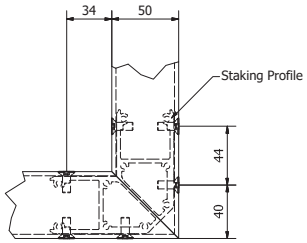


Frame Elevation 1:10

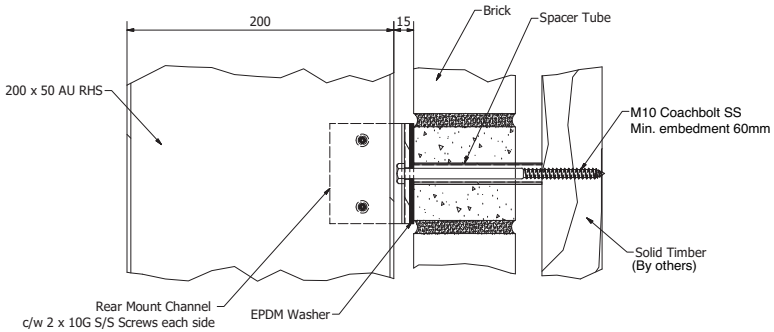


Detail C 1:2
Horizontal Fixing Detail





Detail B 1:2
Frame Corner Staking Detail



Detail D 1:2
Vertical Fixing Detail

Revision Table			
Rev	Description	By	Date

Tolerance:
Dimension Decimal Places:
0 = +/- 1mm
0.0 = +/- 0.1mm
Angle = +/- 1°
*Unless otherwise stated. Do not scale. If in doubt ask.

Third Angle

All dimensions are in **mm** unless otherwise stated

File:
C:\Users\INSOL\Dropbox (Insol Ltd)\Insol\Product Information\Standard Details\Inventor Models\Fletcher Living Window Hood Fixing.iam

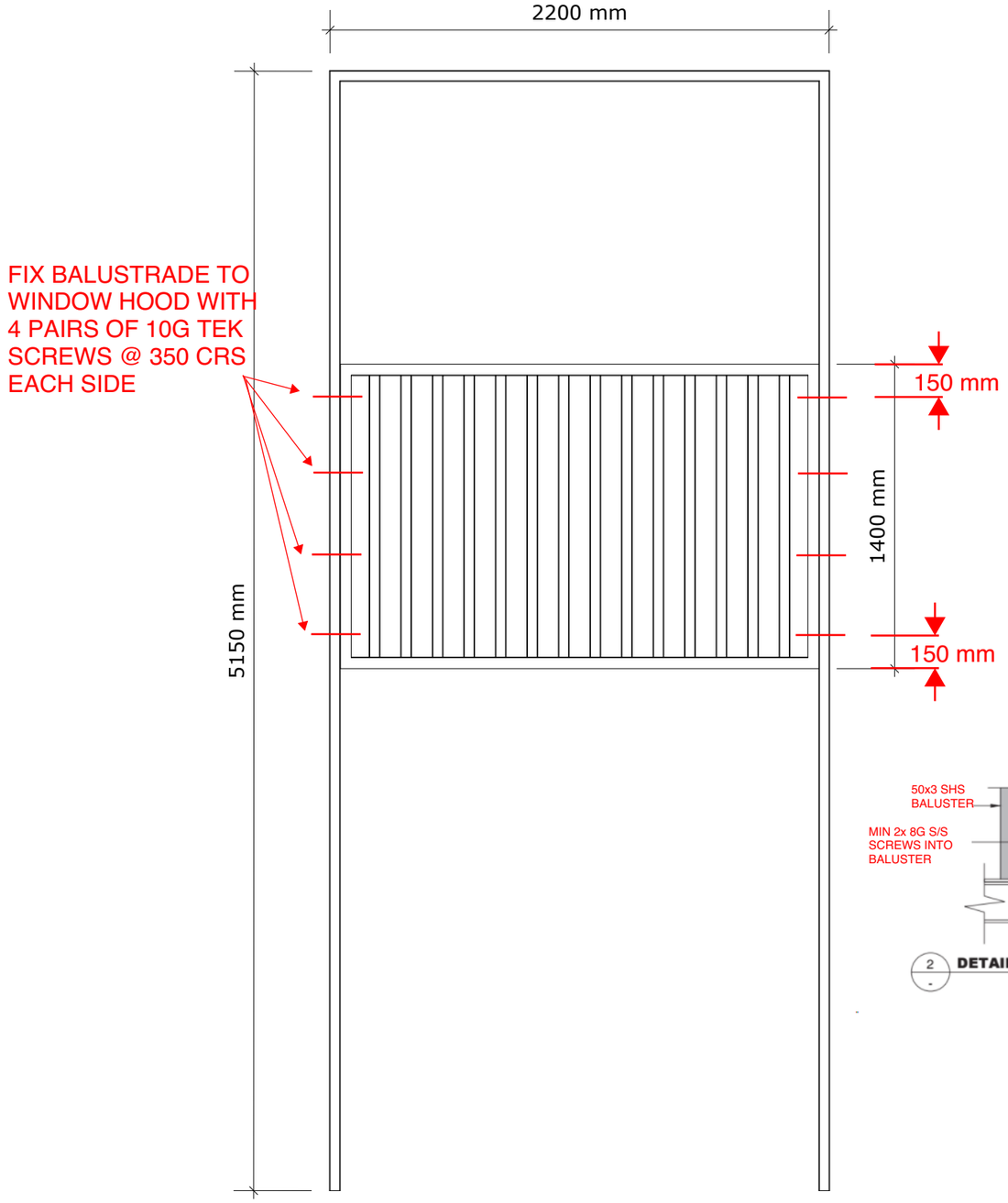
Material:
Weight: **213.753 kg**
Finish:
Qty Req as Shown:
Qty Req Opp Hand:

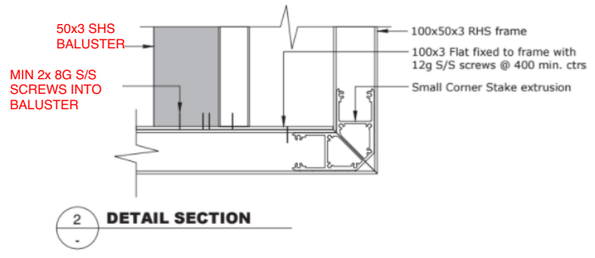
INSOL Architectural Aluminium Louvres
P O Box 231, Invercargill
Free 0800 34 6000
Ph 216 3287
Fax 03 216 5928
www.insolnz.co.nz

Title:
Window Hood Standard Fixing Detail

Desc:
Brick Rear Mount Channel

Drawing No:	IN-I -STDWH-1.3
Rev:	A
Org Date:	1/12/2016
Dwg By:	DM
App By:	DM
Scale:	0.03 : 1
Project No:	STDWH
	A1





CHECKED AND APPROVED BY
BREVITY CONSULTING LTD
DATE: 22/02/2017
BREVITY REF: 16121908
REVISION: A
Brevity

INSOL Architectural Aluminium Louvres

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Catalina Precinct
Fletcher Living

Juliet Balustrade Concept

Date: 01/08/2017
Revision: A
Job No:
Original Size: A3

Drawing No: 1
SCALE (N.T.S.)

ENGINEER Craig BVT JOB NUMBER 16121908

CLIENT Insol DATE 07/12/16 SHEET 1 OF 1

Hobsonville Canopies & Window Frames – Summary

- 2 structure types:
  1) Sheet metal (Al) Canopy supported by M8 Rods
  2) 200x50x3 RHS frames surrounding windows.

- Load Cases:
  1) $1.2G + W_u$ (down force)
  2) $0.9G + W_u$ (uplift)

Structure 1) – Checked under LC1 & LC2

⇒ sheet metal tray checked in ANSYS, stress & δ minimal

⇒ Support Rod stresses low & Even an M6 rod wont buckle under LC2 therefore O.k (see SPL)

⇒ Connections checked in Pensolve Calcs, all O.k

Structure 2)

⇒ Max bending in RHS; $f_b^* = 3.32$ MPa ⇒ Negligible

⇒ Bracket connections checked; 2x10G teks to structure sufficient

⇒ Corner connections checked, 3.2mm rivets in shear sufficient.

SIGNED: DATE: / /

16121908- INSOL - Hobsonville Canopy and Window Frames Design - Pensolve Calcs

Job number: 16121908.0

Calculations prepared by Craig MacDonald on December 5, 2016

From spreadsheet: 16121908- INSOL - Hobsonville Canopy and Window Frames Design - Pensolve Calcs.xlsx

Calculations reviewed by Alex Merino on 22/02/17

Amended by A. Yung to include snow loads on 04/02/2019

Contents

1 Canopy

1.1 Calculations Updated 04.09.2019

Inclusion of snow loads. Canopy design OK for snow regions N4, N5 at maximum height above mean sea level installation of 100 m or S_g = 0.9 kPa.

1.2 Wind Actions

Wind Actions to 1170.2 - canopy.

1.2.1 Finding C_fig as per Appendix D4.1

Single inputs	Value	Units	Comments	Cell Ref.	
b	1.0	m	Width of canopy.	C8	
l	1.0	m	Length of Canopy.	C9	
K_a	1.0	-		C10	
K_l	1.0	-		C11	
$C_{p,n,d}$	0.5	-		C14	*1170.2 Table D8 (downforce worstcase)*
$C_{p,n,u}$	0.2	-		C15	*1170.2 Table D8 (uplift worstcase)*

h_c/h $= 0.4$

[C13] $= 0.4$ $= \underline{0.4}$

$C_{fig,d}$ $= C_{p,n,d} \cdot K_l \cdot K_a$ *1170.2 D4.1*

[C16] $= 0.5 \cdot 1.0 \cdot 1.0$ $= 0.5$

$C_{fig,u}$ $= C_{p,n,u} \cdot K_l \cdot K_a$ *1170.2 D4.1*

[C17] $= 0.2 \cdot 1.0 \cdot 1.0$ $= 0.2$

1.2.2 Design wind speed

Single inputs	Value	Units	Comments	Cell Ref.	
C_{dyn}	1.0	-		C21	
ρ_{air}	1.2	-		C22	
V_R	45.0	m/s	V500.	C24	*table 3.1*
M_d	1.0	-	Directional multiplier - any direction.	C25	
M_z	0.83	-	Terrain Height Multiplier - 5m.	C26	*1170.2 Table 4.1*
M_s	1.0	-	Not applicable.	C27	*1170.2 4.3.1*
M_t	1.0	-	M_lee.	C28	*1170.2 4.4.1b*

Design Wind Speed.

V_{des} $= V_R \cdot M_d \cdot M_z \cdot M_s \cdot M_t$

[C30] $= 45.0 \cdot 1.0 \cdot 0.83 \cdot 1.0 \cdot 1.0$ $= 37.4$ m/s

1.2.3 Design Wind Pressure

Design Wind Pressure from uplift.

W_u $= 0.5 \cdot \rho_{air} \cdot {V_{des}}^2 \cdot C_{fig,u} \cdot C_{dyn}$ *1170.2 eq 2.4(1)*

[C32] $= 0.5 \cdot 1.2 \cdot 37.4^2 \cdot 0.2 \cdot 1.0$ $= 167.0$ Pa

Design Wind Pressure from downforce.

W_d $= 0.5 \cdot \rho_{air} \cdot {V_{des}}^2 \cdot C_{fig,d} \cdot C_{dyn}$

[C33] $= 0.5 \cdot 1.2 \cdot 37.4^2 \cdot 0.5 \cdot 1.0$ $= 419.0$ Pa

1.2.4 Gravity Loads

Single inputs	Value	Units	Comments	Cell Ref.
$\rho_{Aluminium}$	2700.0	kg/m^3		C36

G $= \rho_{Aluminium} \cdot 0.003$
[C37] $= 2700.0 \cdot 0.003$ = 8.1 Pa

1.2.5 Snow Loading to ASNZS 1170.3 (included 04.02.2019)

Single inputs	Value	Units	Comments	Cell Ref.	
h_0	100.0	m	Height above NZ mean sea level, less than 400 m.	C40	
k_P	1.25	-	1/150.	C41	*Table 5.1*
$alpha$	0.0	degrees	Pitch.	C42	
$s_{g,min}$	0.9	kPa	MBIE guidance document, amendment for N4, N5 regions.	C43	
C_e	1.0	-	Exposure reduction coefficient, sub-alpine.	C45	*4.2.2*

Characteristic snow load.

s_g $= k_P \cdot 1.2 \cdot (\frac{3 \cdot h_0}{1000} + 0.3)$ *5.4.3*
[C44] $= 1.25 \cdot 1.2 \cdot (\frac{3 \cdot 100.0}{1000} + 0.3)$ = 0.9 kPa

Shape coefficient.

mu_i $= \frac{0.7 \cdot (60 - alpha)}{50}$ *Section 6 or 7*
[C46] $= \frac{0.7 \cdot (60 - 0.0)}{50}$ = 0.84

S $= 1000 \cdot \text{MAX}(s_{g,min},\quad s_g) \cdot C_e \cdot mu_i$
[C47] $= 1000 \cdot \text{MAX}(0.9,\quad 0.9) \cdot 1.0 \cdot 0.84$ = 756 Pa

1.2.6 Load Cases

$1.2G + W_d(down)$ $= (1.2 \cdot G + W_d) \cdot b \cdot l$
[C50] $= (1.2 \cdot 8.1 + 419.0) \cdot 1.0 \cdot 1.0$ = 428.0 N

$0.9G + W_u(Up)$ $= (-0.9 \cdot G + W_u) \cdot b \cdot l$
[C51] $= (-0.9 \cdot 8.1 + 167.0) \cdot 1.0 \cdot 1.0$ = 160.0 N

$1.2G + S_u$ $= (1.2 \cdot G + S) \cdot b \cdot l$ *added 04.02.2019*
[C52] $= (1.2 \cdot 8.1 + 756) \cdot 1.0 \cdot 1.0$ = 766.0 N

1.3 Connection Checks

1.3.1 Connection A - brace to Canopy

Single inputs	Value	Units	Comments	Cell Ref.
BoltDiameter	6.0	mm		C59
Althickness	3.0	mm		C60

Note: M6 Bolt in shear due to T=349N.

Note: connection consists of an M6 SS Bolt through 3mm Al.

V* under 1.2G+s_g.

$V^*_{[C61]}$ $= N_{t^*,[C87]}$ = 349 N

$V^*, 1.2G + Su$ $= \frac{V^* \cdot 1.2G + S_u}{1.2G + W_d(down)}$ *Snow loading case, linear interpolation (added 04.02.2019)*
[C62] $= \frac{349 \cdot 766.0}{428.0}$ = 624.0 N

ΦV $= 9000$

[C63] $= 9000$ $= \underline{9000}$ N

$f_{bearing}$ $= \frac{V^*}{BoltDiameter \cdot Althickness}$

[C65] $= \frac{349}{6.0 \cdot 3.0}$ $= \underline{19.4}$ MPa

$f_{bearing,1.2G+S..}$ $= \frac{V^{*},1.2G+Su}{BoltDiameter \cdot Althickness}$ *Snow loading case, linear interpolation (added 04.02.2019)*

[C66] $= \frac{624.0}{6.0 \cdot 3.0}$ $= \underline{34.7}$ MPa

$\Phi F_{bearing}$ $= 170$ *1664.1 CL 3.4.6*

[C67] $= 170$ $= \underline{170}$ MPa

Note: Demand far less than capacity therefore connection OK.

1.3.2 Connection B - Canopy to wall

Note:10G Tek Screw into solid blocking.

ΦV. 6800.0. N. Ref: Buildex Tek Screw Catalogue. ΦT. 5700.0. N. Ref: Buildex Tek Screw Catalogue.

Note: Demand seen in SPL far less than capacity therefore connection OK.

1.3.3 Connection C- Brace to wall

Note:10G Tek Screw into solid blocking.

ΦV. 6800.0. N. Ref: Buildex Tek Screw Catalogue. ΦT. 5700.0. N. Ref: Buildex Tek Screw Catalogue.

Note: Demand seen in SPL far less than capacity therefore connection OK.

1.4 Design Tension in tie brace

Single inputs	Value	Units	Comments	Cell Ref.
$N_{t^*,[C87]}$	349.0	N		C87

From ANSYS 1.2G + Wu case

$A_{brace,[C88]}$ $= \frac{\pi \cdot 8^2}{4}$

[C88] $= \frac{\pi \cdot 8^2}{4}$ $= 50.3$ mm^2

$f_{t^*,[C89]}$ $= \frac{N_{t^*,[C87]}}{A_{brace,[C88]}}$

[C89] $= \frac{349.0}{50.3}$ $= \underline{6.94}$ MPa

$N_{t^*,[C91]}$ $= \frac{N_{t^*,[C87]} \cdot 1.2G+Su}{1.2G+W_d(down)}$ *Snow loading case, linear interpolation (added 04.02.2019)*

[C91] $= \frac{349.0 \cdot 766.0}{428.0}$ $= 624.0$ N

$A_{brace,[C92]}$ $= \frac{\pi \cdot 8^2}{4}$

[C92] $= \frac{\pi \cdot 8^2}{4}$ $= 50.3$ mm^2

$f_{t^*,[C93]}$ $= \frac{N_{t^*,[C91]}}{A_{brace,[C92]}}$

[C93] $= \frac{624.0}{50.3}$ $= \underline{12.4}$ MPa

1.4.1 Allowable Stress in Tension brace for Canopy

Single inputs	Value	Units	Comments	Cell Ref.
Φ_y	0.95	-		C97
F_{ty}	110.0	MPa		C99

$\Phi F_L = F_{ty} \cdot \Phi_y$ *1664.1 CL 3.4.2*

[C101] $= 110.0 \cdot 0.95$ $= \underline{105.0}$ MPa

Note: Demand far less than capacity therefore brace OK.

1.5 Design Compression in tie brace

Single inputs	Value	Units	Comments	Cell Ref.
N_{c^*}	49.0	N		C106

$A_{brace,[C107]} = \frac{\pi \cdot 8^2}{4}$

[C107] $= \frac{\pi \cdot 8^2}{4}$ $= 50.3$ mm^2

$f_{t^*,[C108]} = \frac{N_{c^*}}{A_{brace,[C107]}}$

[C108] $= \frac{49.0}{50.3}$ $= \underline{0.975}$ MPa

Note: See SPL - Even in a 6mm diameter rod no buckling will occur and stress minimal.

2 Louvre Screens

2.1 Wind Actions

Wind Actions to 1170.2 E - Exposed structural members.

2.1.1 Finding C_fig as per Appendix E

Single inputs	Value	Units	Comments	Cell Ref.
b	200.0	mm	Width of member.	C8
d	50.0	mm	depth of member.	C9

Max Length of member.

L $= 4250$

[C10] $= 4250$ $= 4250$ m

d/b $= \frac{d}{b}$

[C11] $= \frac{50.0}{200.0}$ $= \underline{0.25}$

C_{fx} $= 2.4$ *1170.2 table E2A*

[C12] $= 2.4$ $= 2.4$

C_{fy} $= 0.5$ *1170.2 table E2B*

[C13] $= 0.5$ $= \underline{0.5}$

L/b $= \frac{L}{b}$

[C14] $= \frac{4250}{200.0}$ $= \underline{21.3}$

K_{ar} $= 0.83$ *1170.2 table E1*

[C15] $= 0.83$ $= 0.83$

C_{fig} $= C_{fx} \cdot K_{ar} \cdot 1$ *1170.2 Eq E2(2)*

[C16] $= 2.4 \cdot 0.83 \cdot 1$ $= 1.99$

2.1.2 Design wind speed as per Section 2.3

Single inputs	Value	Units	Comments	Cell Ref.	
C_{dyn}	1.0	-		C18	
ρ_{air}	1.2	-		C19	
V_R	45.0	m/s	V500.	C21	*table 3.1*
M_d	1.0	-	Directional multiplier - any direction.	C22	
M_z	0.83	-	Terrain Height Multiplier - 5m.	C23	*1170.2 Table 4.1*
M_s	1.0	-	Not applicable.	C24	*1170.2 4.3.1*
M_t	1.0	-	M_lee.	C25	*1170.2 4.4.1b*

Design Wind Speed.

V_{des} $= V_R \cdot M_d \cdot M_z \cdot M_s \cdot M_t$

[C27] $= 45.0 \cdot 1.0 \cdot 0.83 \cdot 1.0 \cdot 1.0$ $= 37.4$ m/s

2.1.3 Design Wind Pressure as per Section 2.4

Design Wind Pressure.

p $= 0.5 \cdot \rho_{air} \cdot {V_{des}}^2 \cdot C_{fig} \cdot C_{dyn}$ *1170.2 eq 2.4(1)*

[C29] $= 0.5 \cdot 1.2 \cdot 37.4^2 \cdot 1.99 \cdot 1.0$ $= 1670.0$ Pa

2.2 Member Checks

2.2.1 200x50x3 RHS in weak axis bending

Single inputs	Value	Units	Comments	Cell Ref.
I	706000.0	mm^4		C34

M^* $= \frac{\frac{p \cdot b}{1000} \cdot 1.5^2}{8}$

[C33] $= \frac{\frac{1670.0 \cdot 200.0}{1000} \cdot 1.5^2}{8}$ = 93.8 Nm

fb^* $= \frac{M^* \cdot 1000 \cdot 25}{I}$

[C35] $= \frac{93.8 \cdot 1000 \cdot 25}{706000.0}$ = 3.32

Note: Bending Stress due to wind is minimal.

2.3 Connection Checks

2.3.1 Connection A- frame to wall

Note: connection consists of 2x10G tek screws 3 connections per side of frame.

Shear in Tek screw fixing frames to wall.

$V^*_{[C44]}$ $= \frac{\frac{p \cdot b \cdot L}{1000}}{6}$

[C44] $= \frac{\frac{1670.0 \cdot 200.0 \cdot 4250}{1000}}{6}$ = 236.0 N

From Buildex Catalogue.

ΦV $= 6800$

[C45] $= 6800$ = 6800 N

Note: Demand well below capacity therefore OK.

2.3.2 Connection A2 - shear in bracket

$V^*_{[C49]}$ $= V^*_{[C44]} \cdot 2$

[C49] $= 236.0 \cdot 2$ = 472.0 N

$t_{bracket}$ $= 6$

[C50] $= 6$ = 6 mm

$d_{bracket}$ $= 75$

[C51] $= 75$ = 75 mm

f_{shear} $= \frac{V^*_{[C49]}}{t_{bracket} \cdot d_{bracket}}$

[C52] $= \frac{472.0}{6 \cdot 75}$ = 1.05 MPa

2.3.3 Connection B - Corner Connection

Single inputs	Value	Units	Comments	Cell Ref.
d_{rivet}	3.2	mm		C56

Note: connection consists of 3 rivets per member into staking angle.

F_{member} $= \frac{\frac{p \cdot b \cdot 1600}{1000}}{1000}$

[C57] $= \frac{\frac{1670.0 \cdot 200.0 \cdot 1600}{1000}}{1000}$ = 534.0 N

V^*_{rivet} $= \frac{\frac{F_{member}}{2}}{3}$

[C58] $= \frac{\frac{534.0}{2}}{3}$ = 88.9 N

f_v $= \frac{V^*_{rivet}}{\frac{\pi \cdot {d_{rivet}}^2}{4}}$

[C59] $= \frac{88.9}{\frac{\pi \cdot 3.2^2}{4}}$ = 11.1 MPa

Note: Minimal shear stress in all connections therefore OK.

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Hobsonville Canopy

3mm Sheet metal Al canopy

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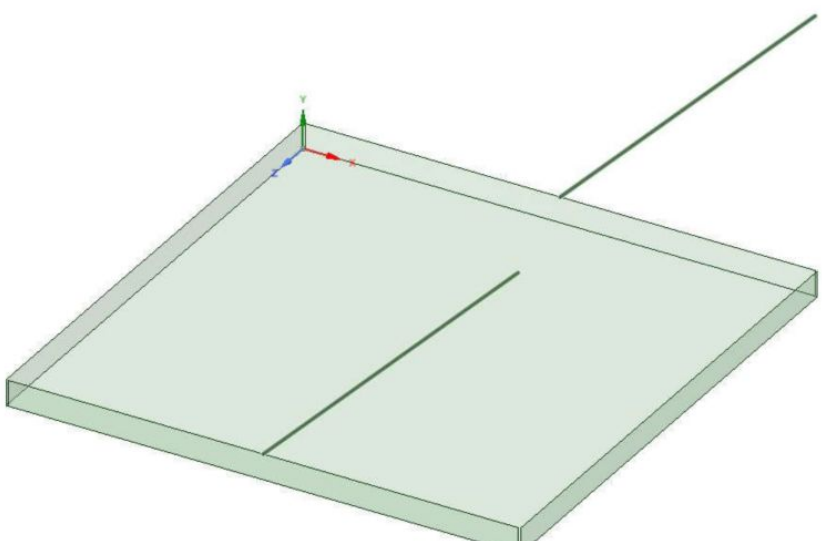
Model

Beam and Surface model set up in SC. thickness = 3mm diameter of rod = 10mm



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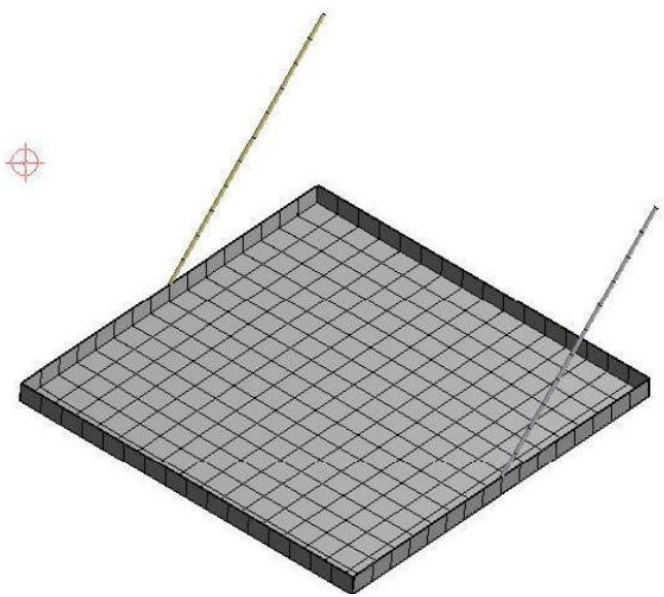
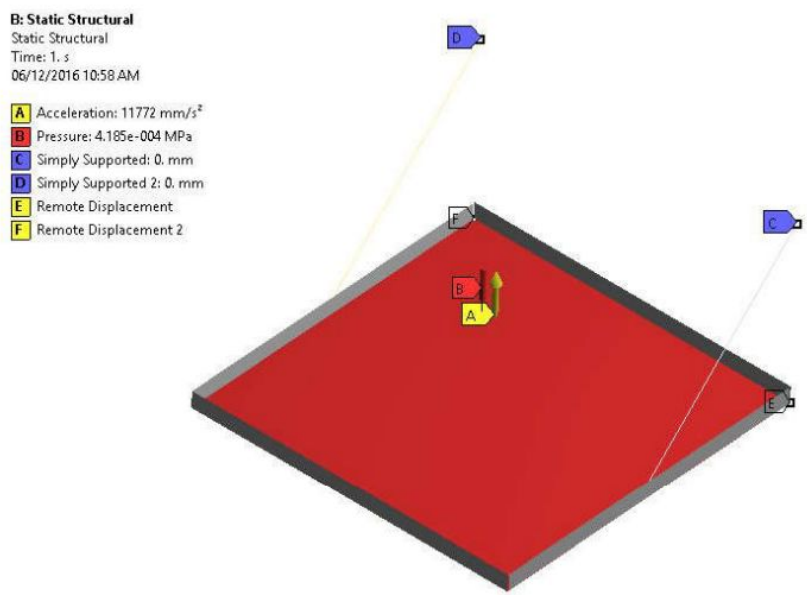
Setup - ANSYS 17

Mesh and 1.2G + Wu setup





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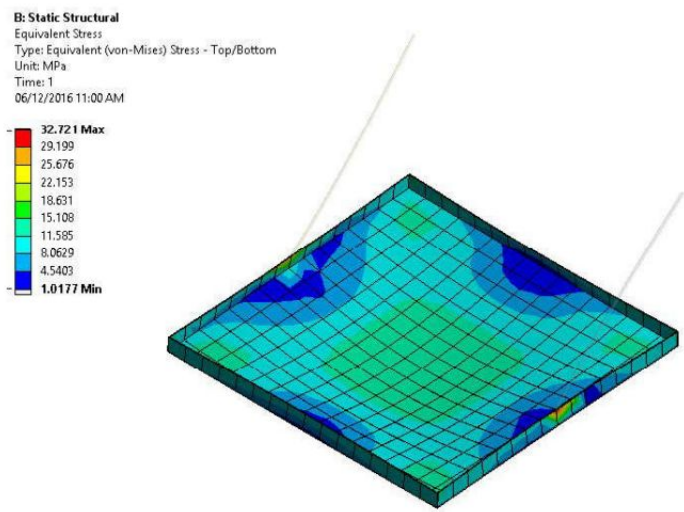
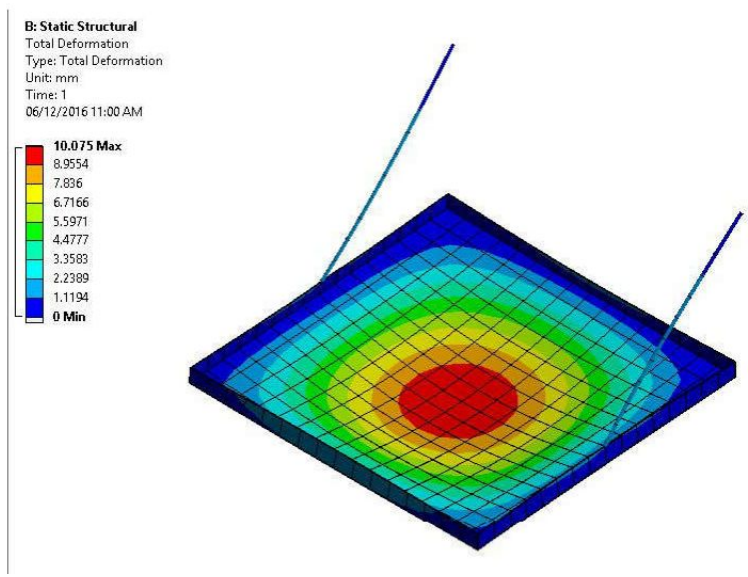
Results - Sheet metal

Deflection and stress allowable





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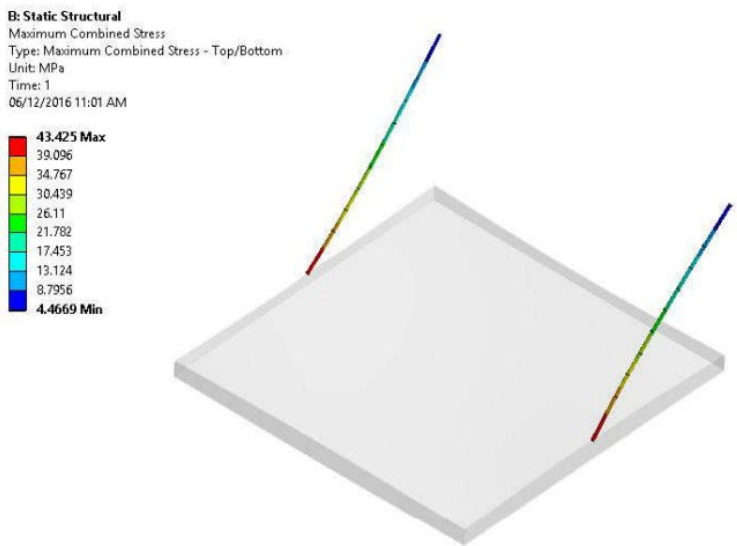
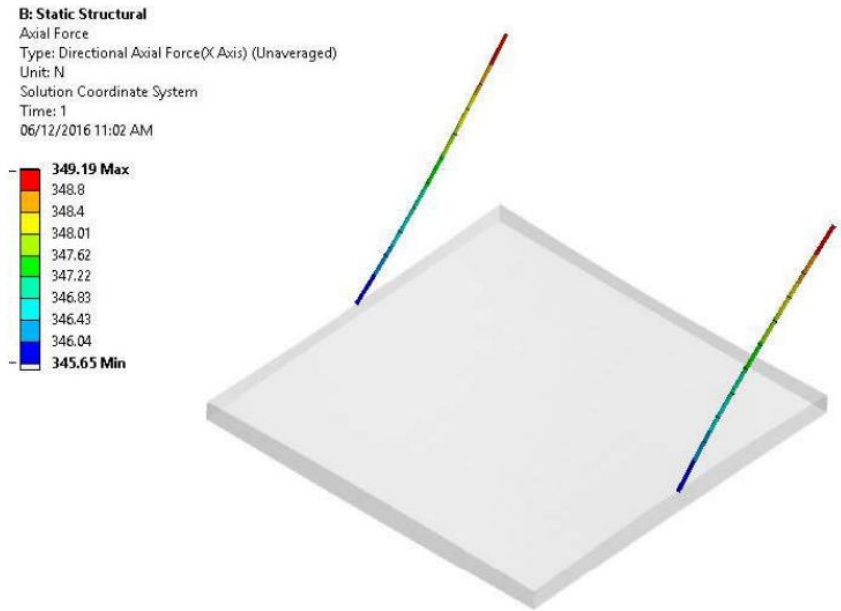
Results - Tie Rods





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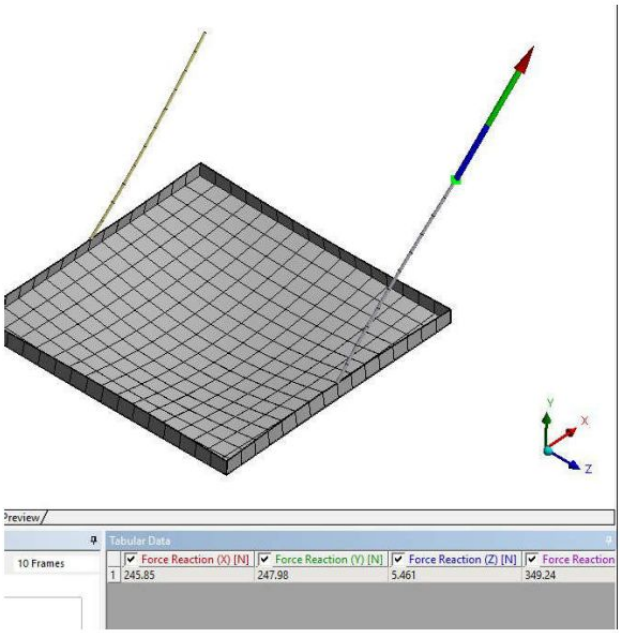
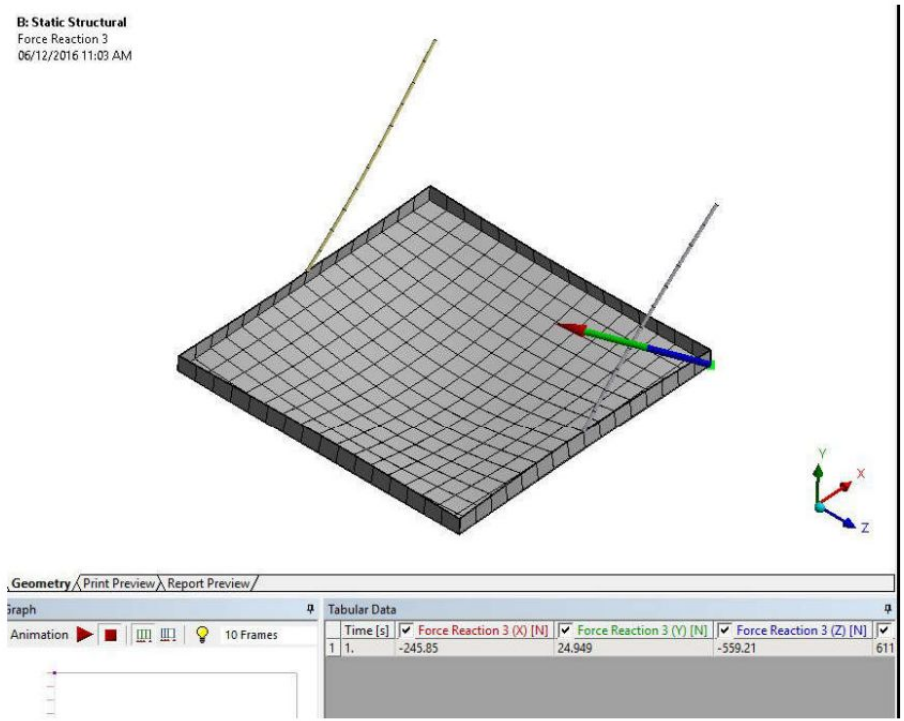
Results - Fixing reactions





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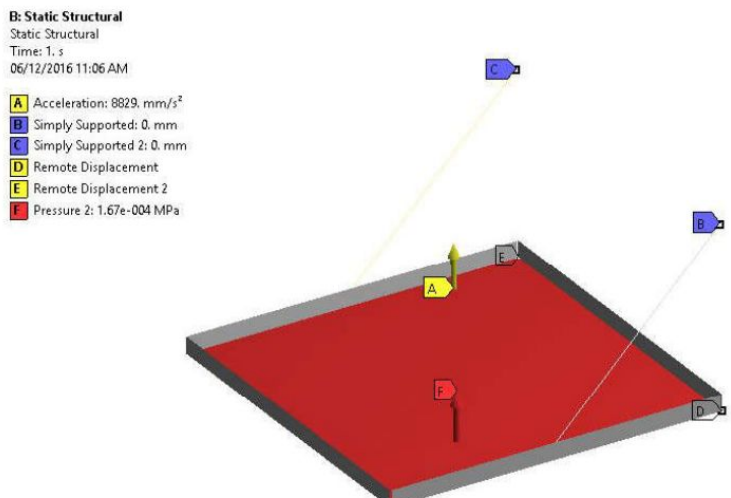
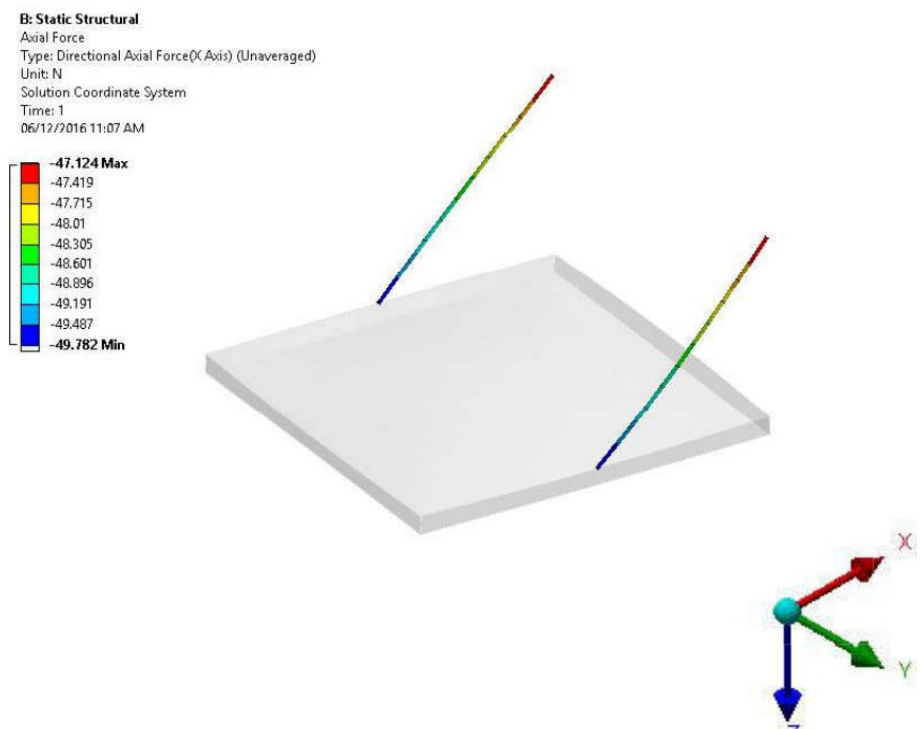
Compression in Rod under 0.9G + uplift





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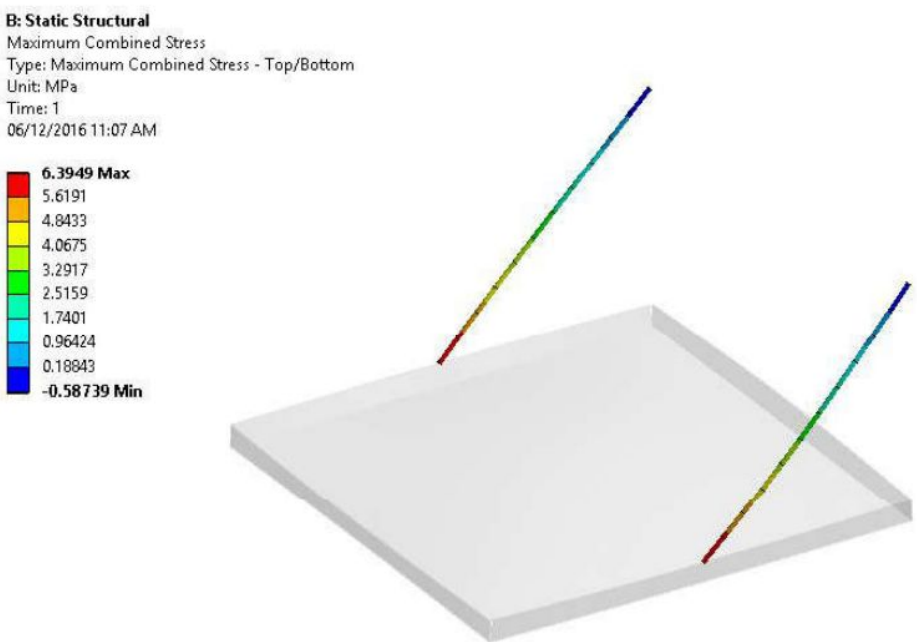
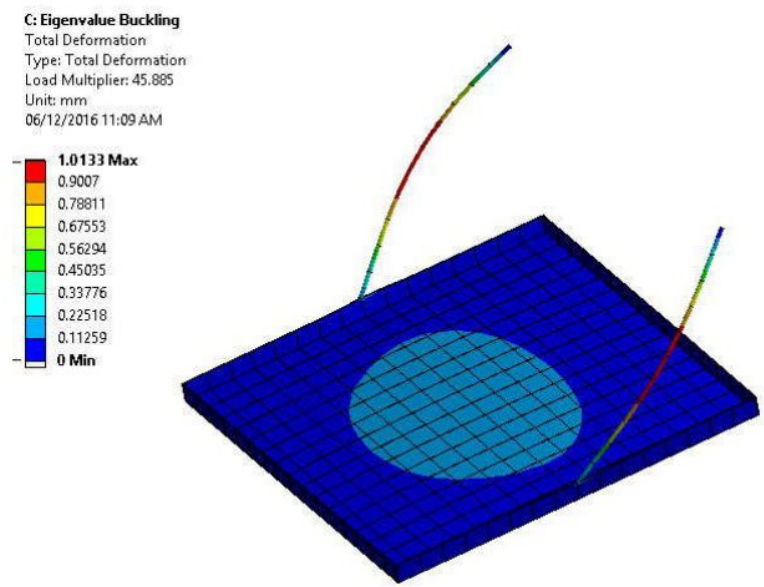
Compression in Rod under 0.9G + uplift





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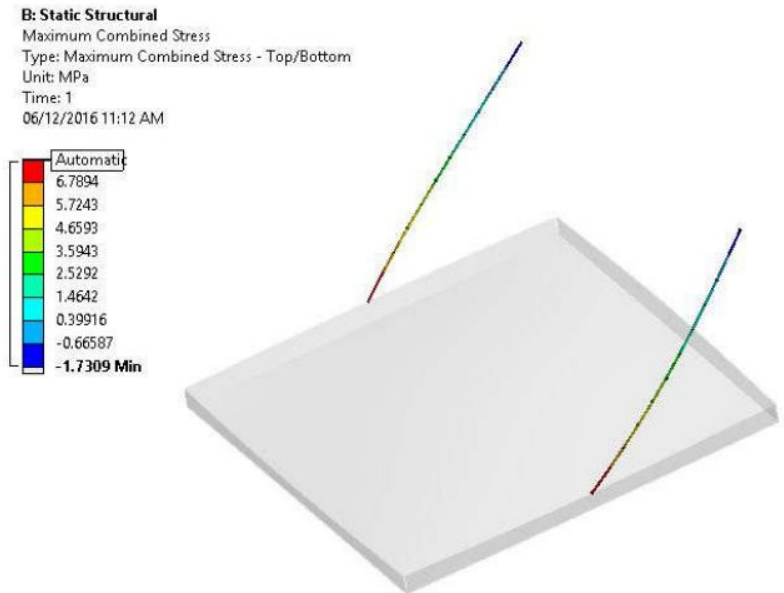
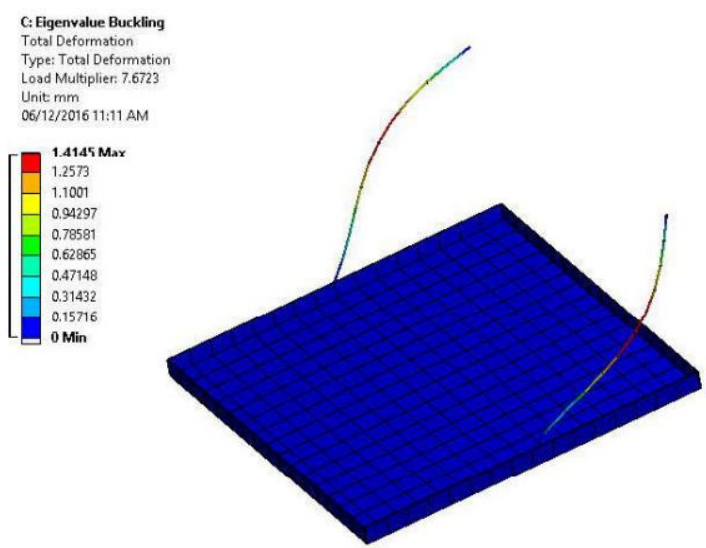
Compression in Rod under 0.9G + uplift 6mm rod

Stress still minimal and will not buckle with 6mm rod





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Date : 09/08/17

Job No. : 16121908-03

Project Title : Hobsonville Canopy and frame - balustrade addition

Prepared for : INSOL

Prepared by : Alex Merino

Approved by : Matt Bishop

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Overview

- Purpose of this project is to add a balustrade design to the existing window hood
- Generic PS1 issue valid for 12 months
- AxisVM beam analysis of balustrade added to existing window hood design
    - Utilising beams/sections/model from previous PS1 calcs for speed.

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Methodology

- AxisVM - Beam models
- 1664.1 Limit state used - Bending stress limit: 98 MPa
- Loads applied:
  - G
  - Qp = 600N
  - Qudl = 0.75kN/m
  - Qpress = 1 kPa
- Load combinations all checked under 1.2G+1.5Q

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Model/Analysis Setup

- Pinned connections at all wall interfaces
- Rigid links at screw locations between balustrade and louvre
- Forces applied are from 1170 for balustrade/handrail loads
- Run in linear and nonlinear just to check, difference is negligible as material is nowhere near yield.

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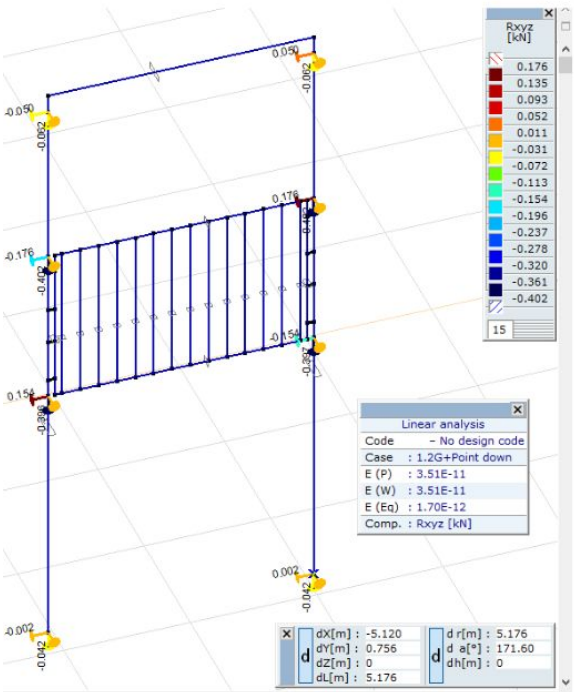
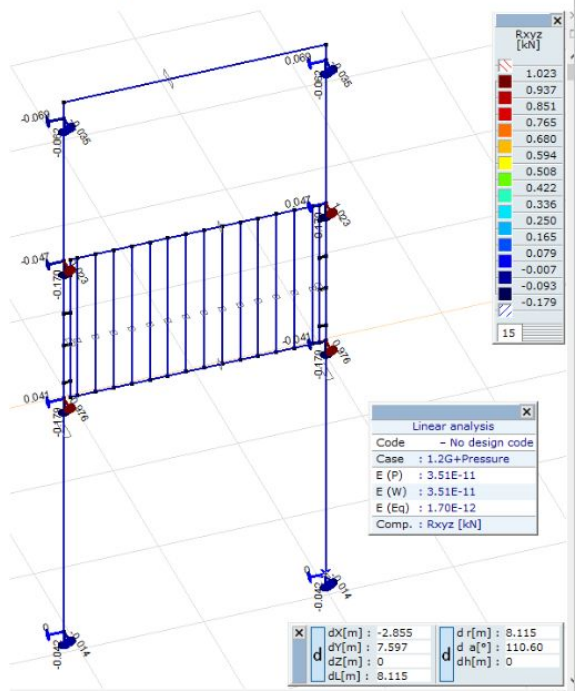
Results - tek screws to structure - 14G in timber

40mm embedment required based on withdrawal load calc

Worst case shear in anchors: 0.4kN



Worst case pull out in anchors: 1.1kN



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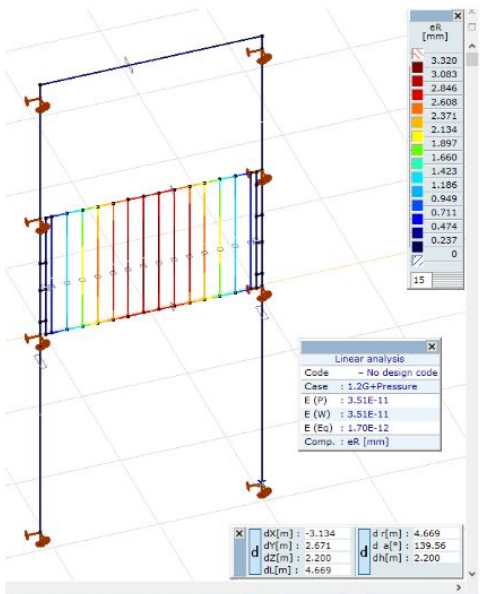
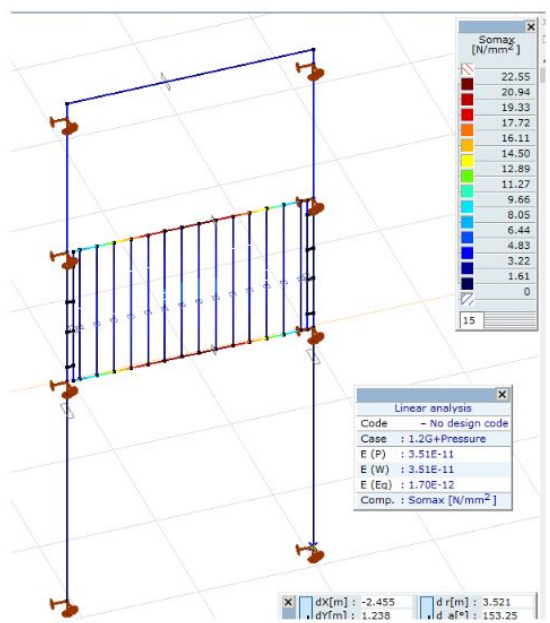
Results

Peak deflection @ULS: 3.3mm OK
L/500 = 4.2mm



Stress max @ ULS: 22.5MPa OK
Allowable: 98 MPa



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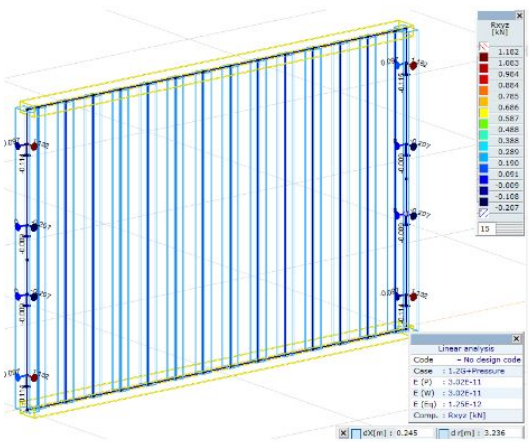
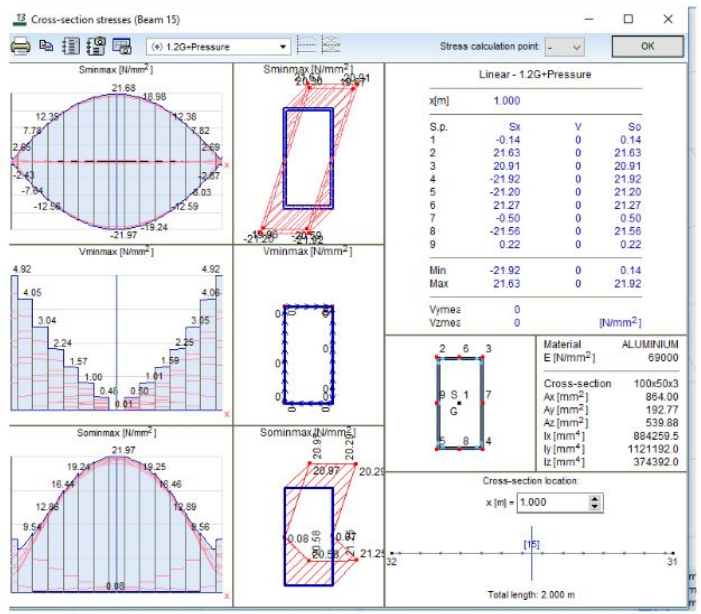
Results

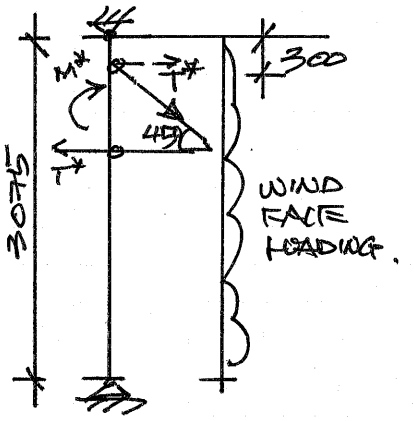
Shear in fixings between balustrade and louvre
More for a sanity check than anything else.
Connections OK with 2x 10G tek screws at each point



Stress plot of balustrade top beam @ ULS



BUILDING SUPPORTING CHECK (ALUMINIUM CANOPY).



ROD TENSION (CRITICAL CASE).

$T^* = 0.35\,kN$ (BVT CALS. PAGE 4/8).

HORIZONTAL PULL OUT FORCE

$T^*_H = T^* \cos 45°$

$= 0.35kN \times 0.707$.

$= 0.25kN$

$M^* = .0.1\,kN.m + \frac{1}{8} \times W^*_F \times 0.4^W \times 3.075^2$ (FACE WIND LOAD

$= 0.38kN.m$

$\phi M_u = 0.8 \times 0.8 \times 1123 \times 1.10 \times 14000 \times 0.09 \times 0.09^2/6$

$= 1123\,kN.m > M^* = 0.38kN.m$ OK.

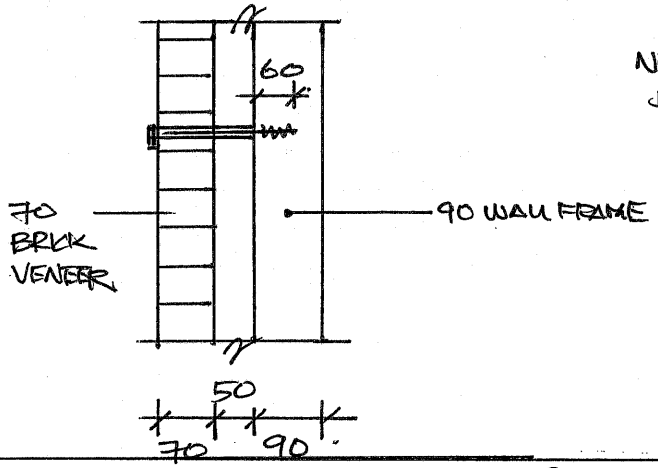
$W^*_F = 0.5 \times 1.12 \times (37.4^2) \times 0.7 = 0.59\,kPa$

SERVICEABILITY:

$W_S = 0.676\,W_u$

$\Delta_S = 0.67 \times 0.005 . = 0.004m = 4mm < \frac{7}{400} = 7.68mm$ OK

USE 2/90X45 SG8 DOUBLE STUDS AS BUILDING SUPPORTING MEMBER TO ROD TIE FIXING, WITH PAIR OF MULTIGRAP CONNECTION TOP & BOTTOM OF THE STUDS.



NEED M10 COACHSCREW X 180LG. MIN. 60mm INTO DOUBLE STUDS.

$\phi Q_u = 0.7 \times 0.8 \times 1.10 \times 1.10 \times 0.107 \times 60$

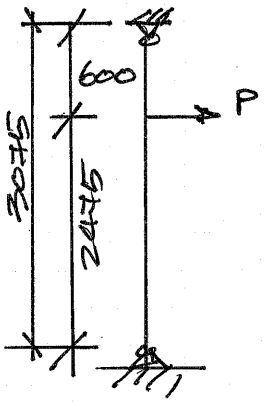
$= 3.6kN > T^*_H = 0.25kN$ OK.

USE M10 COACHSCREW X 180 MM LG FOR THE FIXING OF TIE ROD CLEVIS BACK TO EXTERNAL WALL WITH 70 SERIES BRICK VENEER.

BUILDING SUPPORTING CHECK CANTILEVER LOUVERS WITH BALUSTRADE).

DESIGN LOAD FROM BUT CALCULATION PAGE.

WORST CASE PULLOUT IN ANCHORS: 1.1 kN.



BENDING

$$M^* = 1.1 \times 0.6 \times 2.475 / 3.075 = 0.53\ kN.m$$

$$\phi M_u = 0.8 \times 1.10 \times 1.13 \times 1.10 \times 14000 \times 0.09 \times 0.09^2/6$$

$$= 1.54\ kN.m > M^* \quad OK.$$

USE M10 COACHSCREW X 180 LG MIN. 50 mm INTO DOUBLE STUDS

$$\phi Q_u = 0.7 \times 0.85 \times 1.10 \times 1.10 \times 0.107 \times 50$$

$$= 3.2\ kN > P^* = 1.1\ kN \quad OK.$$

SERVICEABILITY: $E_s = 0.25 E_u$

$$= 0.25 \times 1.1 = 0.275\ kN.$$

$$\Delta E_s = 22\ mm < L/600 = 3075/600 = 5.1\ mm \quad OK.$$

USE M10 COACHSCREW X MIN. 180 mm LG AS HORIZONTAL FIXING BACK TO EXTERNAL WALL WITH BRICK VENEER.
