T. Levchenko & Assoc.
Consulting Structural, Civil & Drainage Engineers
PO Box 2752, Rowville, 3178
tlevchenko@hotmail.com Tel. 0412 888 658
(Registered Building Practitioner: EC 27322)

JOB NO: 23937

SHEETS: 1 OF 8

DATE: 9/08/2017

STRUCTURAL COMPUTATIONS

PROJECT: FIXING OF STONE CLAD (DOMESTIC)

FOR: STONECLAD PTY LTD

SUMMARY:

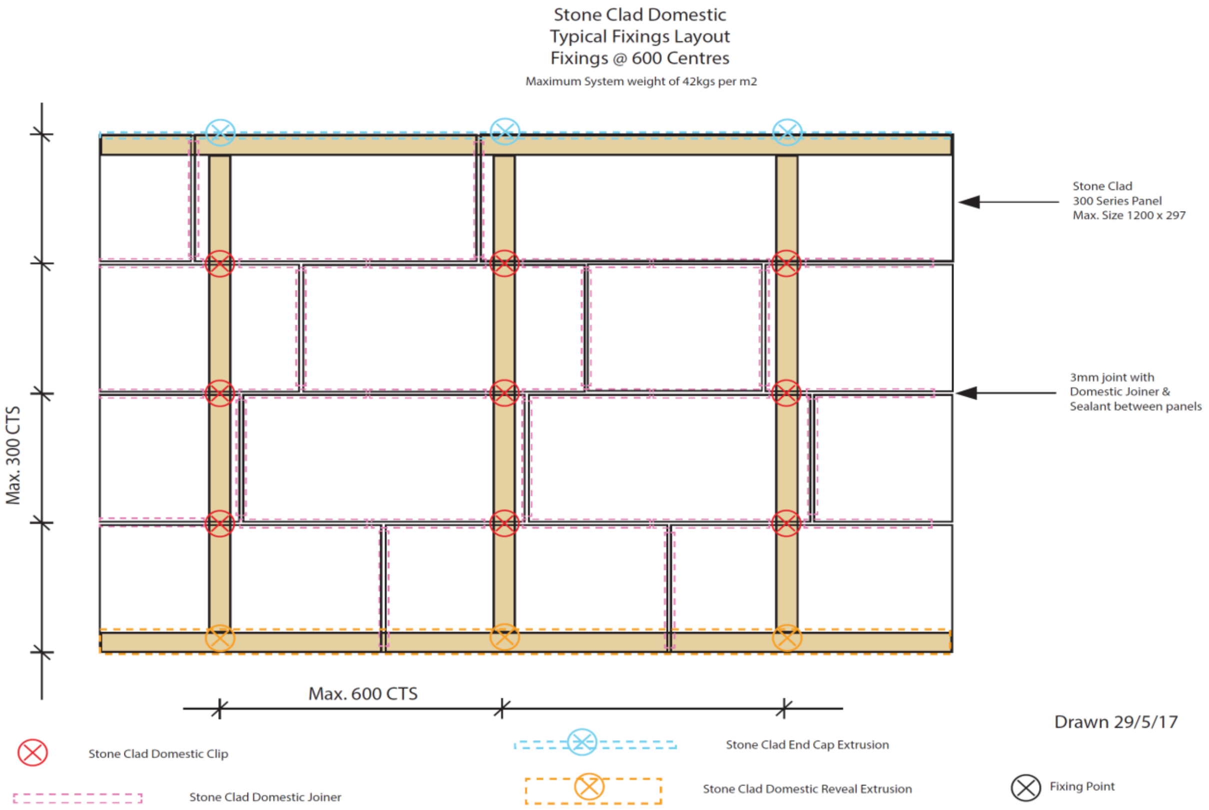
- This analysis covers the support system for the Domestic version of the Stone Clad system.
NOTE: The strength and suitability of the panels for the intended purpose are NOT addressed in this report

- Cladding support system has been analysed for AS 1170.0-2002 loadings, particularly combinations of dead load and wind load to AS 1170.2-2011.

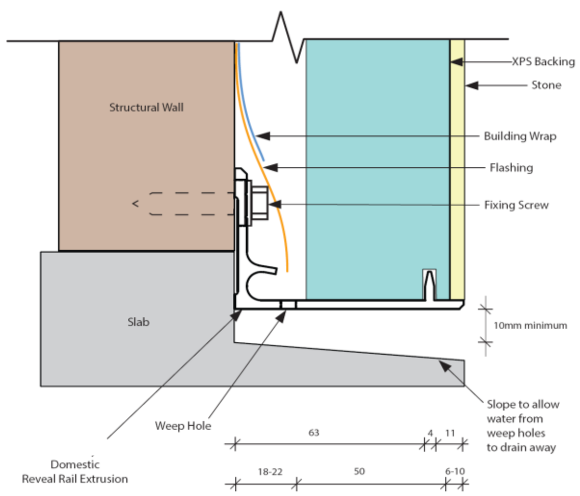
- Analysis considers the worse-case design loads with the maximum installed panel size, with examination of:
  - the various proposed fixing types (reveal, horizontal joint and end cap);
  - 14g fasteners assumed attaching the fixings to the support structure.

- Calculations show that panel layout as shown meets the structural strength requirements under the applied loadings when supported on proposed fixings with up to 600 centres for wind load classifications up to N4 / C2 (i.e. 61 m/s).

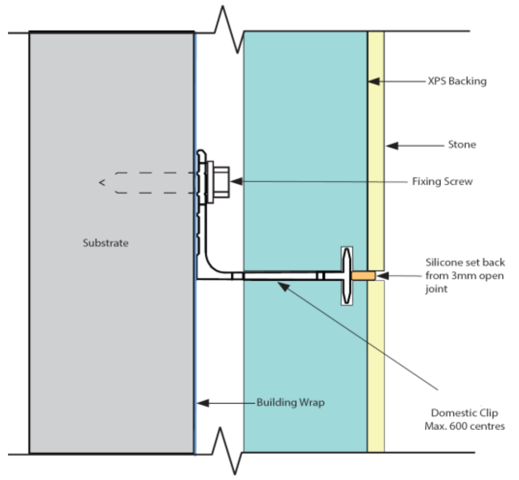
GEOMETRY - PROPOSED FIXING SYSTEM



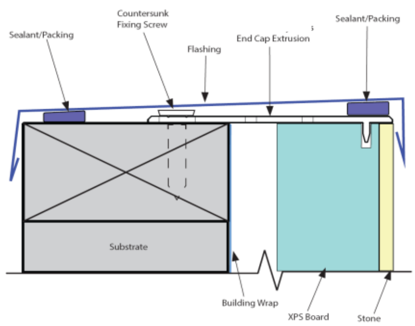
Domestic Reveal Extrusion per Drawing DR Rev B:



Domestic Clip Bracket per Drawing DB Rev C:



End Cap Extrusion per Drawing EC Rev B:



Extrusion Material

Material	=	6063-T6	
Fty	=	172	MPa

DESIGN LOADS

Dead Load, G

Bluestone cladding mass (maximum) = 42 kg.m^2

Live Loads, Wu (Live loads on wall or soffit cladding due to wind loading only.)

Calculate Wind Loading in accordance with AS 1170.2:2011)

Calculate Vsit,beta = Vr . Md . (Mzcat . Ms . Mt)

Design Working Life		=	50	years	
Importance Level		=	3		(Major structures (affecting crowds))
Annual Prob of Exceedance, Wind		=	0.002		
Region		=	B		
					(AS1170.2)
Vr	=V500	=	57.0	m/s	(Table 3.1)
Md		=	1		(Table 3.2)
Mzcat					
	Category		2		(Section 4.2.1, open terrain, few obstructions)
	z	=	18	m	
	Mz,cat	=	1.07		(Table 4.1(A), TC2 with height to 10m)
	Ms	=	1.00		(Table 4.3, no shielding)
	Mt	=	1.00		(Table 4.4.2, flat terrain)
Therefore, Vsit,beta		**=**	**61.0**	**m/s**	**(equivalent to class N4 / C2 per AS 4055-2006)**

Pressure load, P **=** 0.5 . Rho . Vdes^2 . Cfig . Cdyn (Section 2.4.1)
where Cfig,e = Cpe . Kl (Section 5.2)

(SWAY)	Cpe (windward)	=	0.7	(Table 5.2(A), +ve inward)
(SWAY)	Cpe (leeward)	=	-0.5	(Table 5.2(B), +ve inward)
(END)	Cpe (sideward)	=	-0.65	(Table 5.2(C), +ve inward)
	Local Pressure Factors, Kl			
	Windward Wall, WA1	=	1.5	(Table 5.6)
	Side Wall near edge, SA2	=	2.0	(Table 5.6)

Resultant Applied Pressures

P1, kPa (Windward Wall)	=	**2.34**	(inward)
P2, kPa (Leeward Wall)	=	-1.12	(outward)
P1 = P4, kPa (Side Wall)	=	**-2.90**	(outward)

(Area reduction factor, Ka, has conservatively not been considered)

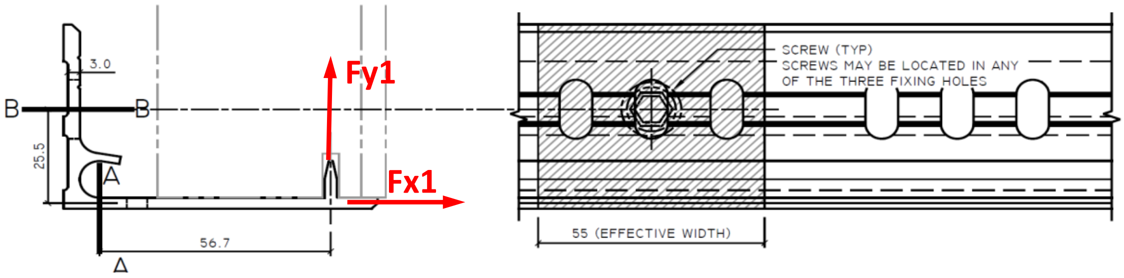
Load Combinations for Analysis (from AS 1170.0:2002 for Ultimate Limit State Strength)

* 1.35G
* 1.2G + Wu(in)
* 1.2G + Wu(out)
* 0.9G + Wu(in)
* 0.9G + Wu(out)

ANALYSIS - REVEAL EXTRUSION

Reveal extrusion is continuous across bottom of wall, but assumed only effective for 55mm widths at supports, based on the results of the FEM analysis (see page 8).

Panel height	=	300	mm
Support spacing	=	600	mm centres



Load Case	Fx1 (N)	Fy1 (N)
* 1.35G	0	-100.1
* 1.2G + Wu(in)	-210.9	-89.0
* 1.2G + Wu(out)	261.1	-89.0
* 0.9G + Wu(in)	-210.9	-66.7
* 0.9G + Wu(out)	261.1	-66.7

From support interface loads, worst-case applied load due to 1.35G dead load case at Section A, and due to 0.9G + Wu(out) at Section B.

Calculate Bending Moment and Stress at Point 'A'

Load	=	100.1	N	
Distance, d	=	56.7	mm	(assumed load application point)
Design Bend. Moment, M*	=	5677	N.mm	

At Point A:

Section width	=	55	mm	(effective bracket width from FEM analysis)
Section thickness	=	3	mm	
Section area	=	165	mm^2	
Section modulus, Z	=	83	mm^3	
Fy	=	172	MPa	(6063-T6 yield stress)
Design Moment Capacity	=	13481	N.mm	(=ø . Z . Fy)
Safety factor	**=**	**2.37**		

Calculate Bending Moment and Stress at Point 'B'

		due Fx1	due Fy1		
Load	=	261.1	-66.7	N	
Distance, d	=	25.5	56.7	mm	(assumed load application point)
Design Bend. Moment, M*		6659	-3785	N.mm	(components)
Design Bend. Moment, M*	**=**	**2874**		**N.mm**	(total)

At Point A:

Section width	=	55.0	mm	(effective bracket width from FEM analysis)
Section thickness	=	3	mm	
Section area	=	165	mm^2	
Section modulus, Z	=	83	mm^3	
Fy	=	172	MPa	(6063-T6 yield stress)
Design Moment Capacity	=	13481	N.mm	(=ø . Z . Fy)
Safety factor	**=**	**4.69**		

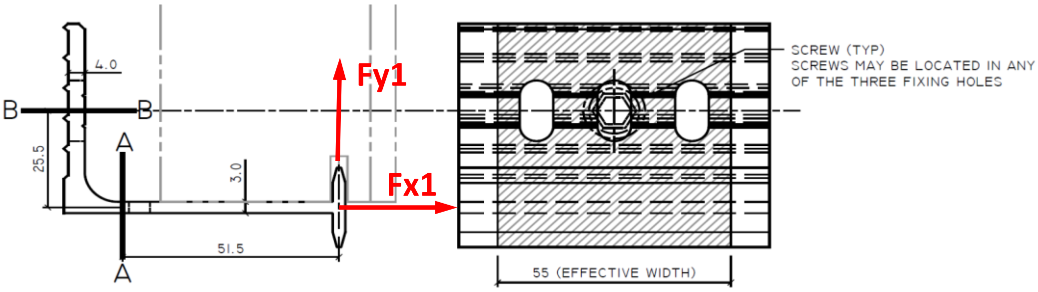
Attachment to Support Structure

Attachment is via one 14g (6.3mm dia) screw in any of the three hole locations. 14g allowables are very large compared to applied shear/tension loads in this application, therefore: **Safety Factor >> 10**

ANALYSIS - HORIZONTAL JOINT SECTION

Horizontal joint section is 74 mm wide, but assumed only effective for 55mm widths at supports, based on the results of the FEM analysis (see page 8).

Panel height	=	300	mm
Support spacing	=	600	mm centres



Load Case	Fx1 (N)	Fy1 (N)
* 1.35G	0	-100.1
* 1.2G + Wu(in)	-421.8	-89.0
* 1.2G + Wu(out)	522.3	-89.0
* 0.9G + Wu(in)	-421.8	-66.7
* 0.9G + Wu(out)	522.3	-66.7

From support interface loads, worst-case applied load due to 1.35G dead load case at Section A, and due to 0.9G + Wu(out) at Section B.

Calculate Bending Moment and Stress at Point 'A'

Load	=	100.1	N	
Distance, d	=	51.5	mm	(assumed load application point)
Design Bend. Moment, M*	=	5156	N.mm	
At Point A:				
Section width	=	55	mm	(effective bracket width from FEM analysis)
Section thickness	=	3	mm	
Section area	=	165	mm^2	
Section modulus, Z	=	83	mm^3	
fy	=	172	MPa	(6063-T6 yield stress)
Design Moment Capacity	=	13481	N.mm	(=ø . Z . Fy)
Safety factor	**=**	**2.61**		

Calculate Bending Moment and Stress at Point 'B'

		due Fx1	due Fy1		
Load	=	522.3	-66.7	N	
Distance, d	=	25.5	51.5	mm	(assumed load application point)
Design Bend. Moment, M*		13318	-3437	N.mm	(components)
Design Bend. Moment, M*	**=**	**9880**		**N.mm**	(total)

At Point A:				
Section width	=	55.0	mm	(effective bracket width from FEM analysis)
Section thickness	=	4	mm	
Section area	=	220	mm^2	
Section modulus, Z	=	147	mm^3	
Fy	=	172	MPa	(6063-T6 yield stress)
Design Moment Capacity	=	23965	N.mm	(=ø . Z . Fy)
Safety factor	**=**	**2.43**		

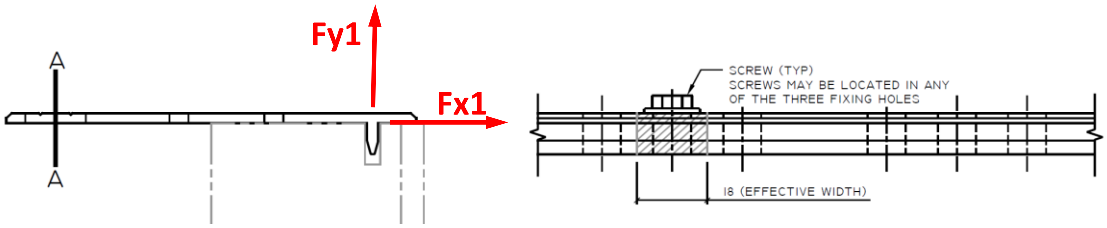
Attachment to Support Structure

Attachment is via one 14g (6.3mm dia) screw in any of the three hole locations. 14g allowables are very large compared to applied shear/tension loads in this application, therefore: **Safety Factor >> 10**

ANALYSIS - END CAP EXTRUSION

End cap extrusion is continuous across top of wall.

Panel height	=	300	mm
Support spacing	=	600	mm centres



Load Case	Fx1 (N)	Fy1 (N)
* 1.35G	0	0.0
* 1.2G + Wu(in)	-421.8	0.0
* 1.2G + Wu(out)	522.3	0.0
* 0.9G + Wu(in)	-421.8	0.0
* 0.9G + Wu(out)	522.3	0.0

From support interface loads, worst-case applied load due to Wu(out) wind load, as shown below:

Calculate Stress at Point 'A'

Load	=	522.3	N	
At Point A:				
Section width	=	18	mm	(effective bracket width = support thickness)
Section thickness	=	3	mm	
Section area	=	54	mm^2	
fy	=	172	MPa	(6063-T6 yield stress)
Design Tensile Stress, N*	=	10	MPa	(= P / A)
Safety factor	=	**17.78**		

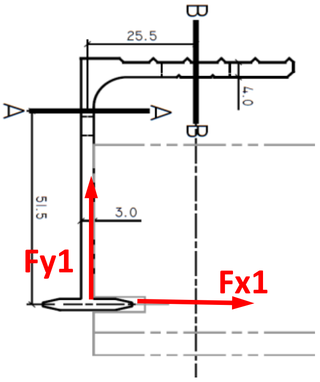
Attachment to Support Structure

Attachment is via one 14g (6.3mm dia) screw in any of the three hole locations. 14g allowables are very large compared to applied shear/tension loads in this application, therefore: **Safety Factor >> 10**

ANALYSIS - HORIZONTAL JOINT SECTION IN SOFFIT APPLICATION

Horizontal joint section is 74 mm wide, but assumed only effective for 55mm widths at supports, based on the results of the FEM analysis (see page 8).

Panel height	=	300	mm
Support spacing	=	600	mm centres



Load Case	Fx1 (N)	Fy1 (N)
* 1.35G	0	-100.1
* 1.2G + Wu(in)	0	332.8
* 1.2G + Wu(out)	0	-611.3
* 0.9G + Wu(in)	0	355.1
* 0.9G + Wu(out)	0	-589.0

From support interface loads, worst-case applied load due to 1.2G + Wu(out) dead load case at Section B.

Calculate Bending Moment and Stress at Point 'B'

		due Fx1	due Fy1		
Load	=	0.0	611.3	N	
Distance, d	=	51.5	25.5	mm	(assumed load application point)
Design Bend. Moment, M*	=	0	15587	N.mm	(components)
Design Bend. Moment, M*	**=**	**15587**	**N.mm**		(total)

At Point A:

Section width	=	55.0	mm	(effective bracket width from FEM analysis)
Section thickness	=	4	mm	
Section area	=	220	mm^2	
Section modulus, Z	=	147	mm^3	
Fy	=	172	MPa	(yield stress)
Design Moment Capacity	=	23965	N.mm	(=ø . Z . Fy)
Safety factor	**=**	**1.54**		

Attachment to Support Structure

Attachment is via one 14g (6.3mm dia) screw in any of the three hole locations. 14g allowables are very large compared to applied shear/tension loads in this application, therefore: **Safety Factor >> 10**

FEM VALIDATION OF HORIZONTAL JOINT WITH 4MM VERTICAL LEG

Load case 1.2G + Wu(out) in SOFFIT application **(Note: red areas exceed Fty = 172 MPa for 6063-T6)**