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LOXO WALL CLADDING ASSESSMENT

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SUBMITTED: MATTHEW BLYTH

1. INTRODUCTION

TM Consultants Limited have been engaged to assess the Loxo Cladding wall system and its associated connections to timber framing to confirm compliance of the system to clause B1 of the New Zealand Building Code.

The Loxo cladding system consists of lightweight reinforced autoclaved aerated concrete (AAC) panels screwed to the timber framed walls through cavity battens.

The AAC panels have standard dimensions of 2200 x 600 x 50 mm and 2200 x 600 x 75 mm. The panels are plastered with 6 mm thick Granosite render system.

The polystyrene cavity battens provide ventilation between the wall framing and panels. They come in two sizes:

- Classic Battens: 22mm x 40mm x 1200mm
- Deluxe Battens: 50mm x 40mm x 1200mm

The battens are connected to the wall framing with galvanised flathead nails or adhesive fixings.

To connect the panels to the wall framing, 14g self-cutting Bugle screws are used. The location of these screws for various panel configurations is shown in appendix A of this report.

For the 50mm thick Loxo panel:

- A 100mm long Bugle screw is used in combination with a ‘Classic’ 22mm thick EPS batten with the screw head being inserted 5mm beneath the panel surface.
- A 125mm long Bugle screw is used in combination with a ‘Deluxe’ 50mm thick EPS batten with the screw head being inserted 5mm beneath the panel surface.

For the 75mm thick Loxo panel:

- A 125mm long Bugle screw is used in combination with a ‘Classic’ 22mm thick EPS batten with the screw head being inserted 5mm beneath the panel surface.
- A 150mm long Bugle screw is used in combination with a ‘Deluxe’ 50mm thick EPS batten with the screw head being inserted 5mm beneath the panel surface.

2. METHODOLOGY AND ASSUMPTIONS

To assess the compliance of the Loxo cladding system, we have completed the structural calculations for imposed loadings as determined by AS/NZS1170.

Design of the panel and bugle screw fixings have been completed for various combinations of gravity, wind and seismic action as required by the New Zealand Loadings standard.

The following assumptions have been made for the structural calculations:

Parameter	**Specification**	**Source of information**
Density of ACC panels with 25% moisture content	ρ_{ACC} = 650 kg/m^3	Letter by Nanjing Asahi New Building Materials, dated 16 November 2018
Compressive strength of ACC, minimum required	f'_c = 3.2 MPa	Internal Inspection Report by Nanjing Asahi New Building Materials, dated 7 December 2018
Panel reinforcing steel: yield strength	f_y = 500 MPa	Test Report by Sharp and Howells Pty Ltd, dated 26 August 2019, ref.19-0247
Diameter of reinforcing for 50 mm panel	d = 3.2 mm	
Diameter of reinforcing for 75 mm panel	d = 5.0 mm	
Bugle screw steel grade	AISI 1022	Certificate of Conformity by Macsim Fastening Pty Ltd, dated February 2018
Bugle screw steel properties Yield strength Tensile strength	 f_y = 330 MPa f_u = 550 MPa	Specification by Interlloy, retrieved from http://www.interlloy.com.au/our-products/carbon-steels/1022-carbon-steel-bar/

The layout of panel reinforcing including concrete covers and bar spacings is used as per drawings by Nanjing Asahi New Building Materials, dated 02 August 2018.

Timber framing of the building supporting the Loxo Panel system is required to comply with NZS3604:2011.

3. ASSESSMENT

In applying the load to the cladding system, we have adopted the following conditions:

Gravity loads

Typical panel weight:

650 kg/m^3 x 9.81 km/s^2 = 6.37 kN/m^3

Weight of plaster:

From Appendix A to AS/NZS 1170.1:2002: 0.23 kN/m^2 per 10 mm of thickness

From Loxo specification: six coats of texture each 1 mm thick

0.23 kN/m^2 x 6 mm / 10 mm = 0.14 kPa

Distributed gravity load:

75 mm panel: 6.37 kN/m^3 x 0.075 m x 0.6 m + 0.14 kPa x 0.6 m = 0.29 kN/m + 0.08 kN/m = 0.37 kN/m

50 mm panel: 6.37 kN/m^3 x 0.050 m x 0.6 m + 0.14 kPa x 0.6 m = 0.19 kN/m + 0.08 kN/m = 0.27 kN/m

For wind loads

Importance level:	2
Wind zone:	very high as per NZS 3604:2011
Maximum height of the structure:	7.5 m
Maximum site elevation above sea level:	500 m
Terrain category:	2 as per AS/NZS 1170.2:2011
Wind speed:	non-directional as per AS/NZS 1170.2:2011
Site location:	outside the lee zones as per AS/NZS 1170.2:2011

The ultimate wind pressure of -2.37 kPa has been calculated using aerodynamic shape factor C_{fig} = -1.30 for side wall.

For seismic loads

Seismic coefficient for parts has been used for in-plane and out-of-plane actions as per Section 8 of AS/NZS 1170.5:2004.

Importance level:	2
Soil class:	Shallow soil, C
Ductility of part:	limited, μ = 2.0
Hazard factor:	Z = 0.42
Height of attachment of the part:	h_i = 7.5 m
Height to the uppermost seismic mass:	h_n = 7.5 m
Part risk factor:	R_p = 1.0

Period of part: $T_p = 0.4$ s

Near Fault value of 1.0 has been used.

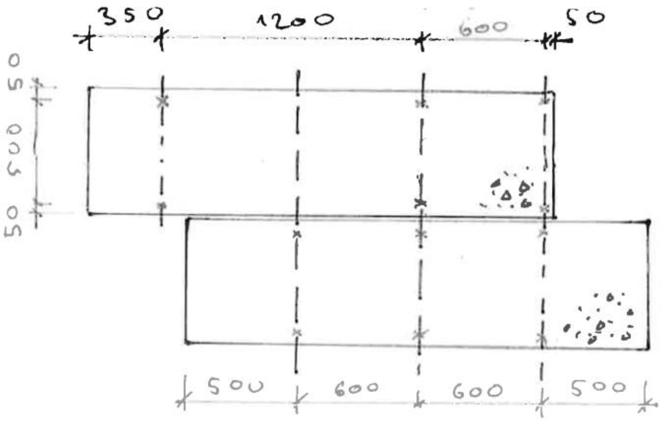
The ultimate horizontal seismic actions for parts have been calculated as $F_{ph} = 1.38 W_p$.

Note: Sites locations outside the above conditions will require specific engineering design for the cladding, associated connections and supporting structure.

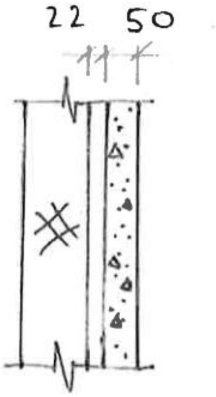
Two cases of panel to wall studs' connections were considered:

Case 1 – Minimum distance from the centre of the screw to the edge of concrete – 50 mm

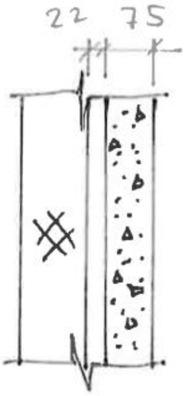
Case2 – Maximum panel cantilever – 500mm



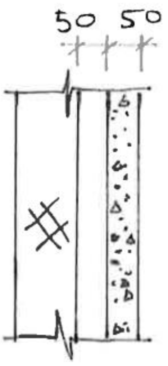
Four combinations of panel batten have been considered:



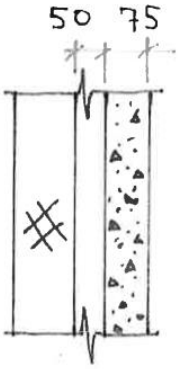
'Classic' batten and 50mm panel



'Classic" batten and 75mm panel



'Deluxe' batten and 50mm panel



'Deluxe' batten and 75mm panel

4. RESULTS

A typical AAC panel is connected to three wall studs with 14g Bugle screws. We have completed structural calculations to check panels for out of plane bending and screws in timber studs for pull-out, shear and bending.

Gravity Check

The panels are subject to bending under the self-weight. The summary of the panel check for bending is presented in the table below.

	Design Load, kN/m	Design bending moment, kNm	Moment capacity of panel, kNm	Safety factor against failure
75mm panel	0.50	0.06	4.19	69.8
50mm panel	0.36	0.04	1.8	45

Table 1: Summary of gravity checks of panels

The screws are subject to shear force from the weight of panel and plaster. Additionally, the shear force applied through cavity batten creates bending moment in screw with the lever arm equal to the batten thickness. Therefore, the screws have been checked for shear and bending from gravity loads. The number of screws required at each stud is shown in the table below.

	Design shear force at stud, kN	Shear capacity of one screw in timber, kN	Design moment per screw, kNm		Bending capacity of one screw, kNm	Number of screws required at stud	
			22mm Batten	50mm Batten		22mm Batten	50mm Batten
75mm panel	0.57	1.12	0.0125	0.0285	0.0073	2	4
50mm panel	0.41	1.12	0.0090	0.0210		2	3

Table 2: Summary of gravity checks of screws

Wind check

The panels are subject to out of plane bending under wind and earthquake loads. Screws are subject to tension, pull-out and shear forces. The load combination of gravity and wind governs for out of plane bending of AAC panel. The panels have also been checked for out of plane bending.

	Design out of plane force at stud, kN	Pull-out capacity of one screw in timber, kN	Design out of plane bending moment, kNm	Bending capacity of panel, kNm	Safety factor against failure
75mm panel	1.61	2.79	0.18	0.77	4.3
50 mm panel	1.61	2.79	0.18	0.25	1.33

Table 3: Summary of panel check for out-of-plane bending under wind actions

Seismic check

The combination of gravity and earthquake governs for in-plane screw shear and bending check. Screws have been checked for combined vertical shear from gravity and horizontal shear from earthquake.

	Design shear force per screw, kN		Shear capacity of one screw in timber, kN	Design moment per screw, kNm		Bending capacity of one screw, kNm	Safety factor against failure, governed by moment capacity	
	22 mm	50 mm		22 mm	50 mm		22 mm	50 mm
75 mm panel	0.28	0.14	2.66	0.0062	0.0072	0.0073	1.18	1.01
50 mm panel	0.19	0.12	2.66	0.0040	0.0062		1.83	1.18

Table 4: Summary of screw check for shear and bending under seismic in-plane loads

5. CONCLUSION

The AAC panels 75 mm and 50 mm thick comply to clause B1 of the New Zealand Building Code.

The standard layout of panel to timber stud connections with two 14g Bugle screw to three studs per panel complies to clause B1 of the New Zealand Building Code under the following conditions:

- The panels are directly supported on the foundation or steel sitting angle
- When the panels are not directly supported on the foundation, the standard connection arrangement may be used with 'Classic' 22 mm cavity battens.
- The 'Deluxe' 50 mm cavity battens may be used provided that the panels are fixed to the timber studs with four screws per stud for 75 mm panel and three screws per stud for 50 mm panels.

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Please direct any queries to the author below.

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6. APPENDICES

APPENDIX 1

Panel to wall stud connection sketch

APPENDIX 2

Structural calculations

APPENDIX 3

Supporting documentation

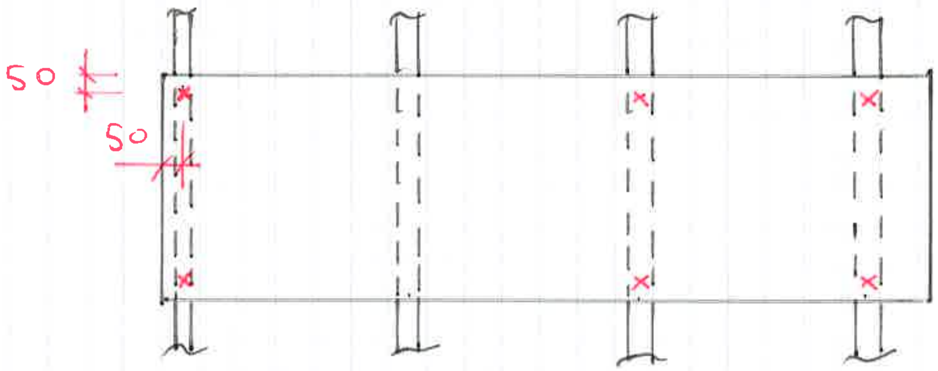
FILE NAME: Loxo cladding

DATE: 3/03/2020 FILE No: 150619

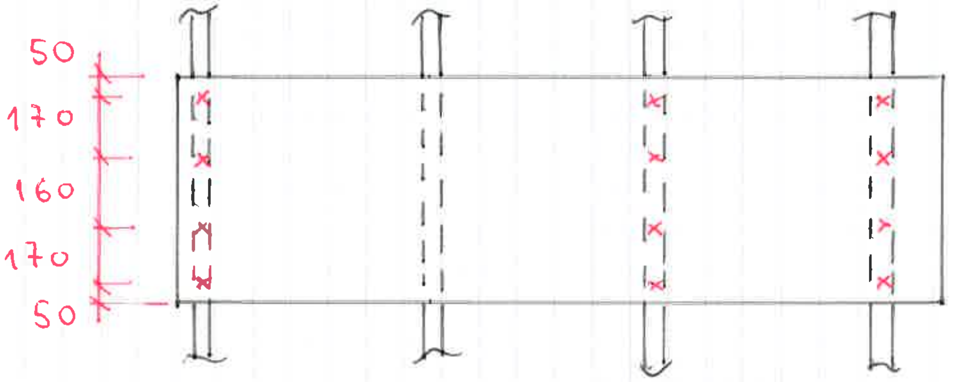
DESIGNER: AZ SHEET No:

Standard solution :

22 mm batten:



50 mm batten:



General notes :

Min wall studs – 90x45 SG8 @ 600 CRS

x – 14g bugle screws C1022 steel f_y = 330 MPa min

L = 150 mm for 75 mm panels

L = 125 mm for 50 mm panels

min penetration into timber 50 mm

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DATE: 13/03/2020 FILE No: 150619

DESIGNER: AZ SHEET No: 1

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Check LOXO AAC panels

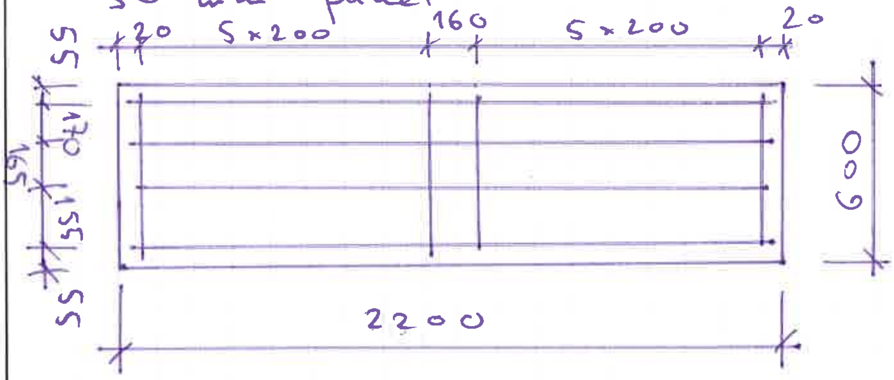
Panels: 50 mm & 75 mm thick

Panel density: 650 kg/m^3 @ 25% moisture

AAC compressive strength: $f'_c = \underbrace{3.2 \div 4.0 \text{ MPa}}_{\text{From test report}} \rightarrow 2.9$ ↓ From website

Reinforcing: (placed centrally)

- 50 mm panel



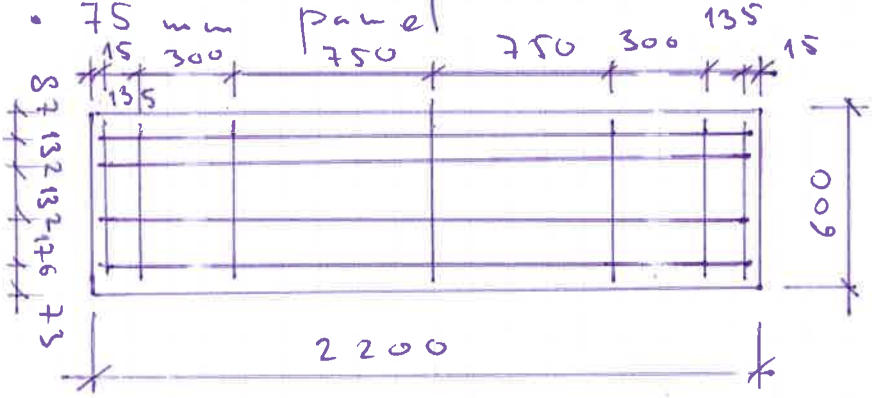
ϕ 3.2 mm

f_y = ~~350 MPa~~

500 MPa

as per Sharp & Howells Test report dated 26 Aug 19

- 75 mm panel



ϕ 5.0 mm

f_y = 500 MPa

Weight of panel: $650 \times 9.8 / _{1000} = 6.37$ kN/m^3

ref. to Nanjing Asahi New Building Materials report dated 16th November 2018.

This is @ moisture content of ~ 25%.

FILE NAME: LOXO Cladding

DATE: 13/03/2020 FILE No: 150619

DESIGNER: AZ AZ SHEET No: 2

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Gravity loads

- Weight of panel:

$6.37 \times 0.075 = 0.48$ kPa – 75 mm

$0.48 \times 0.6 = 0.29$ kN/m

$6.37 \times 0.05 = 0.32$ kPa – 50 mm

$0.32 \times 0.6 = 0.19$ kN/m

- Weight of plaster:

0.23 kPa / 10 mm for cement plaster, NZS 1170.1, App. A

From LOXO spec: 6 coats of texture 1 mm thick →

→ 6 mm

$$0.23 \times \frac{6}{10} = 0.14 \text{ kPa}$$

- Total weight

75 mm

$W = 0.48 + 0.14 = 0.62$ kPa

Distributed load: $0.62 \times 0.6 = 0.37$ kN/m

50 mm

$W = 0.32 + 0.14 = 0.46$ kPa

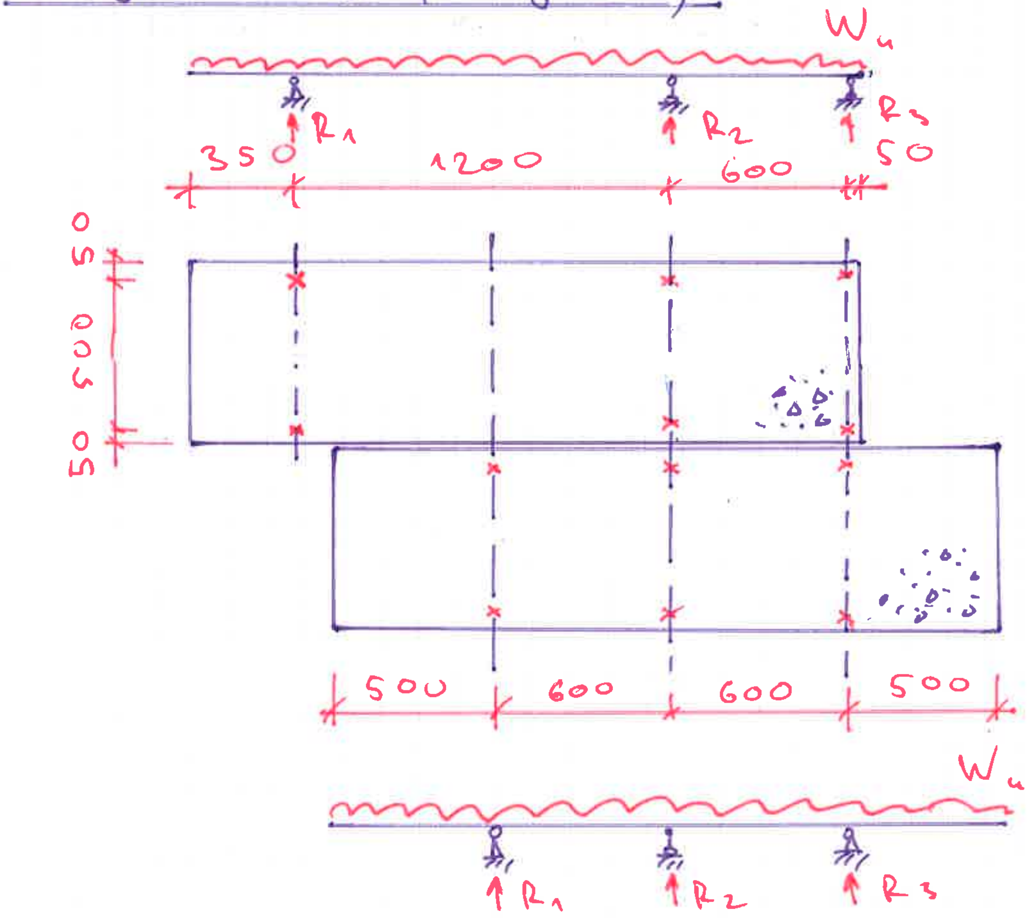
Distributed load: $0.46 \times 0.6 = 0.27$ kN/m

FILE NAME: Loxo Cladding

DATE: 13/03/2020 FILE No: 150619

DESIGNER: AZ AZ SHEET No: 3

Design screws for gravity



Case 1: min end distance 50 mm

Case 2: max cantilever 500 mm

1,35 G : $W_u = 1,35 \times 0.37 = 0.50$ kN/m

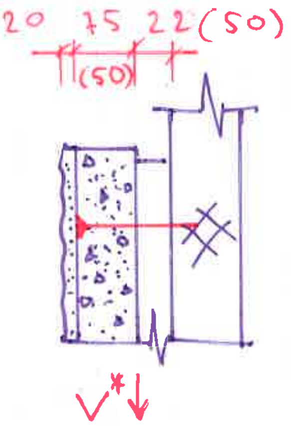
(for 75 mm panel)

Case 1: $R_1 = 0.45$ kN
$R_2 = 0.57$ kN — governs
$R_3 = 0.08$ kN

Case 2: $R_1 = 0.52$ kN
$R_2 = 0.06$ kN
$R_3 = 0.52$ kN

Try 2/14g screws each stud. $d_a = 6.3$ mm

Embedment: min $4 \times 6.3 = 25$ mm (less than $7 d_a$ → → reduce capacity)



Check shear:

$V^* = 0.57/2 = 0.29$ kN

$Q_k = 2.663$ kN

$k_1 = 0.6$; $\phi = 0.7$

$\phi Q_n = 0.6 \times 0.7 \times \frac{4 \times 6.3}{7 \times 6.3} \times 2.663 = 0.64$ kN

Shear OK. (upd. below)

Check bending: Max lever arm 0.05 m

$M^*_{50} = 0.29 \times 0.05 = 0.0145$ kNm – 50mm batten

$M^*_{22} = 0.29 \times 0.022 = 0.0064$ kNm – 22 mm batten

Calculate capacity per screw

- 14 g screws

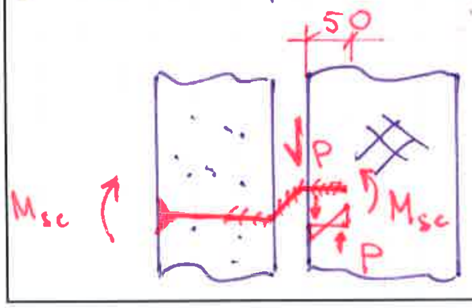
ϕ 6.3 mm : $Z = 3.14 \times \frac{d^3}{32} = 0.0245 \times 10^3$ mm^3

From FORTRESS FASTENERS spec for Bugle Head Batten Screw: Steel C 1022

$f_y = 330$ MPa

$\phi M_{sc} = 0.9 \times 0.0245 \times 330 = 0.0073$ kNm

- Screw to timber: lever arm $= 50$ mm $\times \frac{2}{3} = 33$ mm



(Increase embedment to 50mm)

$k = 1.0$; $\phi Q_n = 0.6 \times 0.7 \times 2.663 = 1.12$ kN

Area of screw under pressure:

$A_{sc} = \frac{50mm}{2} \times 6.3mm = 157.5 \ mm^2$

Compressive strength of timber, parallel to grain : $f_p = 18$ MPa (dry)

$\phi = 0.7$

$k_1 = 0.6$

$\phi f_p = 0.7 \times 0.6 \times 18 = 7.56$ MPa

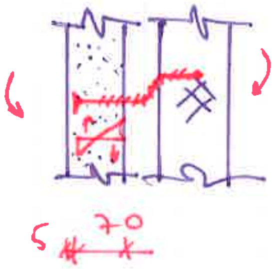
Capacity of screw in timber: $(7.56 \times 157.5) \times 0.033 = 0.0393$ kN

Moment capacity of screw governs.

Moment capacity per screw: $\underline{0.0073 \ kNm}$ < 0.0145 > 0.0066

OK for 22 mm, no good for 50 mm batten

Check screw in panel



Lever arm: $70 \times \frac{2}{3} = 46.7$ mm

Area: $\frac{70}{2} \times 6.3 = 220.5$ mm^2

$f_c = 3.2$ MPa $\phi = 0.75$

$\phi P_u = 3.2 \times 220.5 \times 0.75 =$

$= 0.53$ kN

$\phi M_{sc} = 0.53 \times 0.0467 =$

$= 0.0247$ kNm

does not govern

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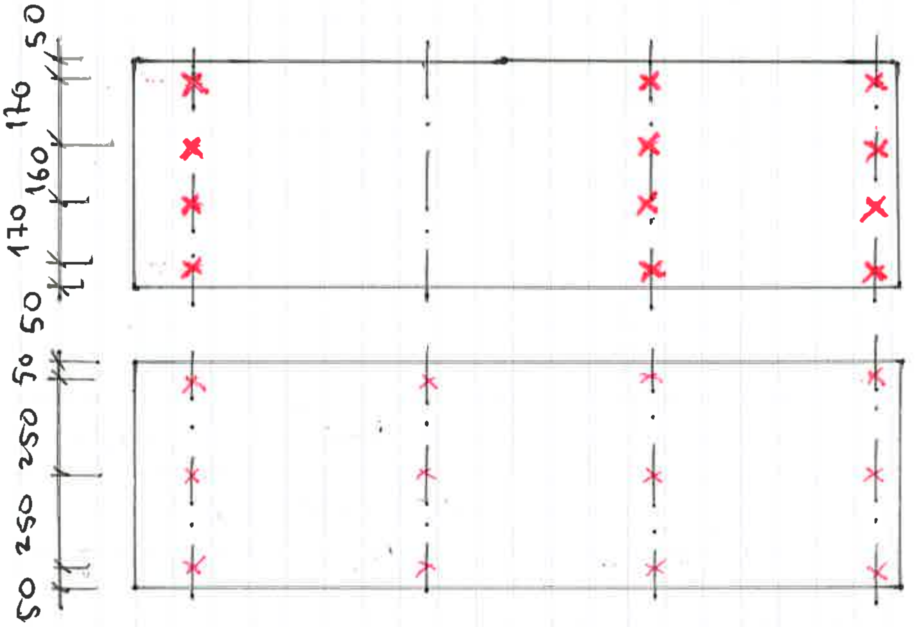
Try more screws for 50mm batten:

M^*_{50} = 0.0145 kNm × 2 = 0.029 kNm

ϕM_{sc} = 0.0073 kNm

n = 0.029 / 0.0073 = 3.97 → 4 off.



Alternatively:
try fixings to
4 studs

V^* = 0.36 kN, M^*_{50} = 0.36 × 0.05 = 0.018 kNm

n = 0.018 / 0.0073 = 2.47 → 3 off.

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Check screw for deflection

G : P_s = 0.29 kN / 1.35 = 0.21 kN - 75 mm panel

L = 0.022 m - 22 mm batten

ϕ 6.3 mm : $I = \frac{3.14 \times 6.3^4}{64} = 0.00007729 \times 10^6$ mm^4

E = 200 GPa

$\Delta = \frac{0.21 \times 0.022^3}{3 \times 200 \times 0.00007729} = \underline{0.048}$ mm

P_s = 0.21kN/1.35 = 0.16 kN - 50 mm panel

L = 0.05 m - 50 mm panel

$\Delta = \frac{0.16 \times 0.05^3}{3 \times 200 \times 0.00007729} = \underline{0.43 \text{ mm}}$

Deflection OK

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Check 50 mm panel:

1.35 G

$W_u = 1.35 \times 0.27 = 0.36 \text{ kN/m}$

Max reaction: $0.57 \text{ kN} \times \frac{0.36}{0.50} = 0.41 \text{ kN}$

↓ max reaction from 75 mm panel @ $W_u = 0.5$ kN/m

Check screw bending: $V^* = 0.41/2 = 0.21 \text{ kN}$

$M^*_{50} = 0.21 \times 0.05 = 0.0103 \text{ kNm}$ – no good

$M^*_{22} = 0.21 \times 0.022 = 0.0046 \text{ kNm}$ – ok

Results of gravity check of fixings

For 22 mm battens use
6/14g bugle screws per panel
L = 150 mm – for 75 mm panel
L = 125 mm – for 50 mm panel

Try more screws for 50 mm batten:

$M^*_{50} = 0.0103 \times 2 = 0.0206 \text{ kNm}$

$n = 0.0206 / 0.0073 = 2.82 \rightarrow 3 \text{ off.}$

For 50 mm battens use
9/14g bugle screws per panel
Penetration as above

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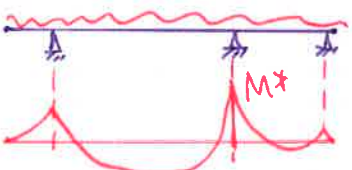
Check panel in-plane for gravity load

- For 75 mm panel

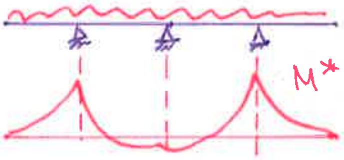
1.35 G $W_u = 1.35 \times 0.37 = 0.50$ kN/m

Case 1:



$M^* = 0.06$ kNm

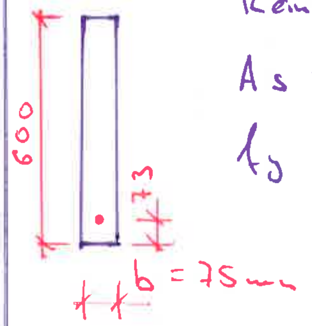
Case 2:



$M^* = 0.06$ kNm

$M^* = 0.06$ kNm

Reinforcing: ϕ5 500 grade



$A_s = 19.6$ mm^2

$f_y = 500$ MPa

$f_c' = 3.2$ MPa

$d = 600 - 73 = 527$ mm

$$a = \frac{19.6 \times 500}{0.85 \times 3.2 \times 75} = 48 \text{ mm}$$

$$\phi M_n = 0.85 \times 19.6 \times 500 \times \left(527 - \frac{48}{2}\right)$$

$= 4.19$ kNm − OK

- For 50 mm panel:

$W_u = 1.35 \times 0.27 = 0.36$ kN/m

$$M^* = 0.06 \times \frac{0.36}{0.50} = 0.04 \text{ kNm}$$

$b = 50$ mm

Reinforcing: ϕ3.2 mm $A_s = 8.0$ mm^2 $f_y = 500$MPa

$$a = \frac{8 \times 500}{0.85 \times 3.2 \times 50} = 30 \text{ mm}$$ $d = 600 - 55 = 545$ mm

$$\phi M_n = 0.85 \times 8.0 \times 500 \times \left(545 - \frac{30}{2}\right) = 1.80 \text{ kNm}$$ − OK

$\boxed{\text{Panels OK for in-plane bending}}$

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Wind loads

$$\left.\begin{array}{l} H = 500 \text{ m} \\ Z = 7.5 \text{ m} \end{array}\right\} \text{max}$$

Wind speed: $V_{des,\theta} = 55$ m/s for Extra High Wind Zone

Terrain Category 2

$M_d = 1,0$ - all directions

$$M_{z,cat} = (\underset{z=10m}{1.0} + \underset{z=5m}{0.95})/2 = 0.97$$ - Regions C & D

$M_s = 1,0$

M_h, $M_{lee} = 1$ - Hill/escarpment or lee zone effects are not considered

(or $M_{lee} = 1.35$?)

Typical windward wall:

$$q = 0.5 \rho_{air} V_{des,\theta}^2 = 0.5 \times 1.2 \times 55^2 = \underline{1.82 \text{ kPa}}$$

Lee zone: $1.82 \times 1.35 = 2.46$ kPa

Aerodynamic shape factor

$$C_{fig,e} = C_{p,e} K_a K_{c,e} K_e K_p$$

Use external pressure for windward wall

$h < 25\,m \rightarrow C_{p,e} = 0.8$

For leeward wall: $C_{p,e} = -0.75 \ (\frac{d}{b} \leq 0.1)$

-0.5

Side wall: $C_{p,e} =$ -0.65 ($\leq h$ from windward edge)

-0.5 ($1h \div 2h$)

$K_a = 1.0 \ (A_{trib.} \leq 10\,m^2)$

$K_{c,e} = 1.0$

K_e

For windward walls: $K_e = 1.25$

$A \leq 0.25\,a^2$

Take $a = h = 7.5\,m$; $A \leq 14\,m^2$

For side walls (negative press.): $K_e = 1.5$, $A \leq 7.5^2 = 56\,m^2$

$K_e = 2.0$, $A \leq 0.25 \times 7.5^2 = 14\,m^2$

$K_p = 1.0$

Wind ward walls

$C_{fig} = 0.8 \times 1.25 = 1.0$

Design wind pressure:

$P_{u,w} = 1.82$ kPa

Leeward walls

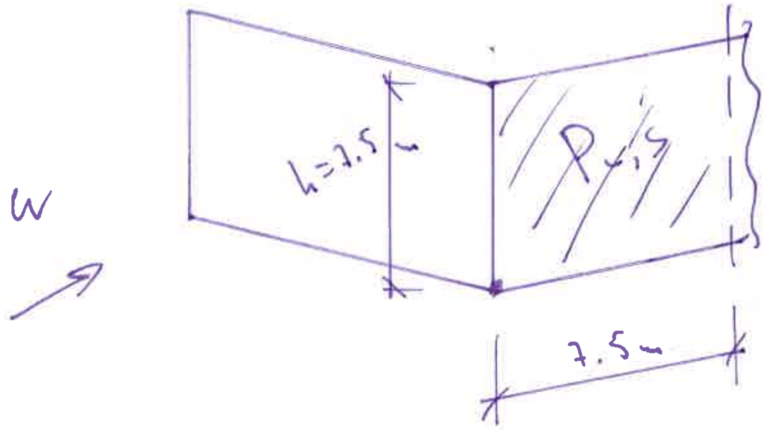
$C_{fig} = -0.75$

$P_{u,L} = -1.82 \times 0.75 = -1.37$ kPa

Side walls

$C_{fig} = -0.65 \times 2.0 = -1.30$

$P_{u,s} = -1.82 \times 1.30 = -2.37$ kPa



FILE NAME: LOXO Cladding

DATE: 13/03/2020 FILE No: 150619

DESIGNER: AZ SHEET No: 14

Seismic loads

Use seismic coefficient for parts

$\mu = 1.25$ $T_1 \leq 0.4$ s

$h_n = 7.5$ m (max building height)

$h_i = 7.5$ m

Christchurch

$Z = 0.3$ Soil class D $F_{ph} = 1.29 W_p$ ULS

$0.32 W_p$ SLS

Soil class C $F_{ph} = 1.53 W_p$ ULS

$0.38 W_p$ SLS

Kaikoura

$Z = 0.42$ Soil class D $F_{ph} = 1.80 W_p$ ULS

$0.45 W_p$ SLS

Soil class C $F_{ph} = 2.14 W_p$ ULS

$0.53 W_p$ SLS

Wellington

$Z = 0.4$ Soil class D $F_{ph} = 1.71 W_p$ ULS

$0.43 W_p$ SLS

Soil class C $F_{ph} = 2.03 W_p$ ULS

$0.51 W_p$ SLS

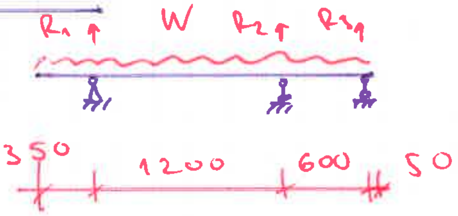
For Kaikoura, soil C, using $\mu = 2.0$:

$F_{ph} = 1.38 W_p$ ULS

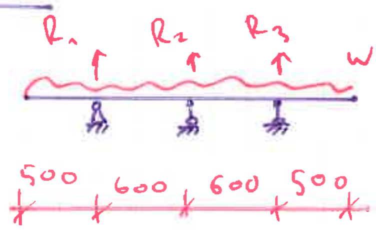
$0.35 W_p$ SLS

Check out of plane

Case 1



Case 2



EQ loads:

$W_p = 0.37$ kN/m – for 75 mm panel

$F_{ph} = 1.38 \times 0.37 = 0.51$ kN/m

Wind loads : $W_u = 2.37$ kPa $\times$ 0.6 m = 1.42 kN/m
(governs)

Case 1: $M_1^* = 0.16$ kNm

$R_1 = 1.29$ kN

$R_2 - 1.61$ kN – governs

$R_3 = 0.23$ kN

Case 2: $M_2^* = 0.18$ kNm – governs

$R_1 = R_3 = 1.47$ kN

$R_2 = 0.18$ kN

Check 75 mm panel

$4 \times \phi 5.0: \quad A_s = 78.5 \ mm^2$

$f_y = 500 \ MPa \qquad f'_c = 3.2 \ MPa$

$$a = \frac{78.5 \times 500}{0.85 \times 3.2 \times 600} = 24 \ mm$$

$$d = 75/2 - 5.0/2 = 35 \ mm$$

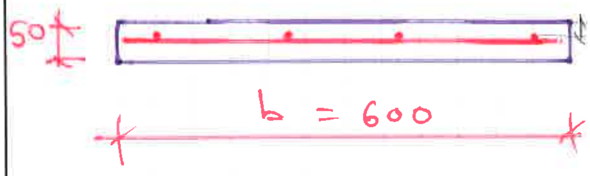
$$\phi M_u = 0.85 \times 78.5 \times 500 \times (35 - 24/2) = 0.77 \ kNm$$

$> 0.18 \ kNm$

ok.

$\boxed{\text{Use } \phi 5.0 \text{ bars } f_y = 500 \text{ MPa} \quad \text{Max cantilever } 0.5m}$

Check 50 mm panel



$4 \times \phi 3.2 : A_s = 32 \text{ mm}^2$

$f_y = 500 \text{ MPa}$

$f'_c = 3.2 \text{ MPa}$

$d = (50/2) - 3.2/2 = 23.4 \text{ mm}$

$$a = \frac{32 \times 500}{0.85 \times 3.2 \times 600} = 9.8 \text{ mm}$$

~~0.184~~ ~~0.16~~

$$\phi M_n = 0.85 \times 32 \times 500 \times \left(23.4 - \frac{9.8}{2}\right) = 0.25 \text{ kNm}$$

$> 0.18 \text{ kNm}$

OK

Use $\phi 3.2$ bars $f_y = 500$ MPa. Max cantilever 0.5 m

Check connections for pull-out:

$N^* = 1.61 \text{ kN}$

14 g screw, 50 mm into timber

$Q_k = 0.0795 \text{ kN/mm}$

$\phi = 0.7$ $n = 2$ $p = 50 \text{ mm}$ $k = 1.0$

$\phi Q_n = 0.7 \times 2 \times 0.0795 \times 50 = 5.57 \text{ kN}$ - ok.

(min embedment for pull-out:

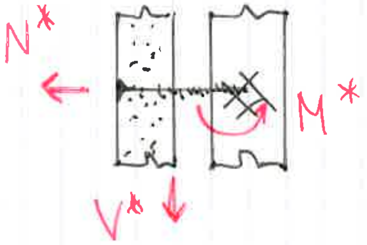
$P_{min} = 1.61 / (0.7 \times 2 \times 0.0795) = 15 \text{ mm}$)

FILE NAME: Loxo Cladding

DATE: 2/03/2020 FILE No: 150619

DESIGNER: AZ SHEET No: 18

Check screw for combined bending and tension



$1.2G + W_u$

Load downwards:

$W_u = 1.2 \times 0.37 = 0.44$ kN/m

Max Reaction:

$1.61 \text{ kN} \times \frac{0.44}{0.51} = 1.39 \text{ kN}$

↑ R_2 from Wind load

$M^* = \frac{1}{2} \times 0.44 \times 0.022 = 0.0048$ kNm

Axial load:

$N_t^* = 1.61$ kN $f_u = 550$ MPa

$N_t = (6\text{mm}^2 \times 3.14 / 4) \times 550\text{MPa} =$

28mm^2 $= 15.54$ kN

$$M_o = M_b\left(1 + \frac{N^*}{\phi N_t}\right) = 0.0073 \cdot \left(1 + \frac{1.61}{15.54 \times 0.9}\right) =$$

$$= 0.0081 \text{ kNm} > M^*$$

OK.

FILE NAME: LOXO Cladding

DATE: 2/03/26 FILE No: 150619

DESIGNER: AZ SHEET No: 19

Check screws in-plane for EQ

$W_p = 0.62 \text{ kPa} \times 0.6 \text{ m} \times 2.2 \text{ m} = 0.82 \text{ kN}$

For 75 mm panel

G + Eu

• For 22 mm batten:

Gravity demand:

$0.57 \text{ kN} / 1.35 = 0.42 \text{ kN}$

↑ max reaction from 1.35G

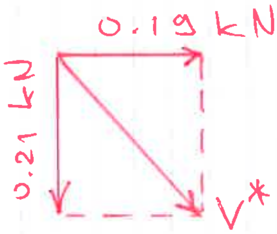
Consider two screws: $V_G^* = 0.21 \text{ kN}$

EQ demand:

$F_{ph} = 1.38 W_p = 1.38 \times 0.82 = 1.13 \text{ kN}$

Consider six screws: $V_{EQ}^* = 0.19 \text{ kN}$

Total shear demand:



$V^* = \sqrt{0.21^2 + 0.19^2} = 0.28 \text{ kN}$

$M_{22}^* = 0.28 \times 0.022 = 0.0062 \text{ kNm}$

$< 0.0073 \text{ kNm}$ – OK for 22 mm batten

$Q_k = 2.663 \text{ kN}$ $k_1 = 1.0$ $\phi = 1.0$ (C2.5 of NZS 3603)

Embedment 50 mm > 7 × 6.3 mm = 44.1 mm → k = 1.0

$\phi Q_n = 2.663 \text{ kN}$ – OK

FILE NAME: LOXO Cladding

DATE: 2/03/20 FILE No: 150619

DESIGNER: AZ SHEET No: 20

TM
CONSULTANTS
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- For 50 mm batten:

Gravity demand, four screws

$V_G^* = 0.42 / 4 = 0.11$ kN

EQ demand, 12 screws:

$V_{EQ}^* = 1.13 / 12 = 0.094$ kN

Total shear demand:

$V^* = \sqrt{0.11^2 + 0.094^2} = 0.14$ kN < 2.663 kN

OK

$M_{50}^* = 0.14 \times 0.050 = 0.0072$ kNm

< 0.0073 kNm

OK for 50 mm batten

Check timber for compression

$f_p = 8.9$ MPa - perpendicular to grain

$\left.\begin{array}{l} \phi = 1.0 \\ k_1 = 1.0 \end{array}\right\}$ - seismic case

$(8.9 \times \underset{A\ \text{screw}}{157.5}) \times \underset{\frac{2}{3}\ \text{embedment}}{0.033} = 0.0463$ kNm

Screw governs, OK.

FILE NAME: LOXO Cladding

DATE: 9/03/2020 FILE No: 150619

DESIGNER: AZ SHEET No: 21

TM CONSULTANTS
KNOWLEDGE YOU CAN BUILD ON

For 50 mm panel

Gravity demand:

$0.42\ kN \times \frac{50\,mm}{75\,mm} = 0.28\ kN$

EQ demand:

$1.13 \times \frac{50}{75} = 0.75\ kN$

For 22 mm batten:

2 screws per stud, 6 screws per panel

$V_G^* = 0.28 / 2 = 0.14\ kN$

$V_{EQ}^* = 0.75 / 6 = 0.13\ kN$

$V^* = \sqrt{0.14^2 + 0.13^2} = 0.19\ kN$ shear OK

$M_{22}^* = 0.19 \times 0.022 = 0.0040\ kNm$

$< 0.0073\ kNm$ bending OK

For 50 mm batten:

3 screws per stud, 9 screws per panel

$V_G^* = 0.28 / 3 = 0.093\ kN$

$V_{EQ}^* = 0.75 / 9 = 0.083\ kN$

$V^* = \sqrt{0.095^2 + 0.083^2} = 0.12\ kN$ Shear OK

$M_{50}^* = 0.12 \times 0.050 = 0.0062\ kNm$

$< 0.0073\ kNm$

Bending OK.

NANJING ASAHI NEW BUILDING MATERIALS CO., LTD.
南京旭建新型建材股份有限公司

Date: 16th November 2018

RE: DENSITY OF AAC PANEL

To whom it may concern,

Regarding the AAC panels manufactured by our company, the Absolute Dry Density of Grade B05 AAC material is 480~520kg/m^3. This is the density of AAC material with moisture content close to 0%, without any reinforcement.

With moisture content of around 20~25%, and average reinforcement weight about 20~25kg/m^3, the ambient density of our AAC panel including reinforcement will be around 650kg/m^3. Different moisture content and different reinforcement can influence the density of AAC panel, but the 650kg/m^3 is specified in Japanese design standard for structure design of ALC(AAC) panel.

Should you have any questions for the above, please do not hesitate to contact me.

Yours sincerely,

Helen Luo
Import & Export Dept. Manager
Nanjing Asahi New Building Materials Co., Ltd.
Tel: +86-25-6819 7509
Fax: +86-25-6819 0009
Email: h.luo@najalc.com

中国・南京建邺区楠溪江东街 68 号 68 Nanxijiang Dongjie, Jianye District, Nanjing, P.R.China 邮编 (P.C): 210019
电话(Tel): +86-25-8342-2221 传真(Fax): +86-25-6819-0009 http://www.najalc.cn

NANJING ASAHI

New Building Materials Co., Ltd.

INTERNAL INSPECTION REPORT

SAMPLE Name: NASAHI 75mm Panel **SPECIFICATION:** 2200*600*75
Production Date: 3rd Dec, 2018 **Batch No.:** 1812031371

INSPECT No.:181203 INSPECT DATE: 7th Dec, 2018

No.	Inspection Item		Technical Requirement	Unit	Test Result	Judgement
1	Appearance		No visual cracks at a distance of 0.6m.	piece	Comply with the requirement	Qualified
			Without defect for use (no warp, hollow, irregularity of bubble, chip)		Comply with the requirement	Qualified
2	Allowance of Size		Length (±3)	mm	2	Qualified
			Width (0～-3)	mm	0	Qualified
			Thickness (1～-2)	mm	-1	Qualified
3	Flexural performance	Flexural Strength	Cracking Load ≥1000	N	4696.2	Qualified
4	Other Performance	Density (B05)	≤525	Kg/m^3	494	Qualified
5		Compressive Strength	Average Value ≥4.0	MPa	4.3	Qualified
			Min. Value ≥3.2		4.2	Qualified
6		Dry Shrinkage (Rapid Method)	≤0.8	mm/m	0.69	Qualified
7		Anti-rust Performance of Reinforcement Coating	<5	%	0	Qualified

Remarks: 1. Moisture content of Compressive Strength testing sample is 10%.
2. For Anti-rust Performance testing of reinforcement coating, the ratio of rust area to surface area is applied.

Inspector: 周涛 Zhou Tao Inspect conclusion: Qualified

Approved by: Deng Suping Issue date: 10th Jan, 2019

Sharp and Howells Pty Ltd
CHEMICAL LABORATORIES
ABN 26 004 782 996
NATA Lab No. 61
Est. 1922

41 Greenaway St
Bulleen Vic 3105
P: (03) 9850 9722
E: lab@sharpandhowells.com.au
www.sharpandhowells.com.au

TEST REPORT NO.: 19 – 0247

Report Date:	26th August 2019
Client:	**Nasahi Building Materials Australia Pty Ltd,**
Address:	1331 Stud Road, **ROWVILLE**, VIC, 3178
Attention:	Michael Garruba
By Email:	michael@nasahi.net.au
Sample(s):	3 x Steel Reinforcing
Sampled By:	Client
Date Received:	1st August 2019
Lab Number:	19/A/1311 – 1313
Project:	*Yield Stress & Tensile Strength (AS 1391)* *Uniform Elongation (AS 1391)* *Geometric Properties (AS/NZS 4671 – Appendix C3.1 & 3.2)* *Mass per Unit Length (AS/NZS 4671 – Appendix C3.3)* *Weld Strength Testing (ISO 15630-2)*

Notes:

This laboratory was not involved with, consulted, or requested to undertake sampling of the specimens provided, and testing of those test specimens has been conducted as received in the laboratory.

Accordingly, no responsibility is taken for the integrity, authenticity, appropriateness, or representativeness, of any of the test specimens provided and this must be taken into account when reviewing, comparing or checking the test results published in this report. Unless otherwise notified, all samples will be disposed of in three months from reporting date.

Yours faithfully,
Sharp and Howells Pty. Ltd.

JKEllingsen.
Julia Ellingsen
BSc (Hons), MRACI, C. Chem
Senior Chemist

Maria Zaksek
BSc, MRACI, C. Chem
Senior Chemist

INTRODUCTION:

We were provided with three sets of steel reinforcing mesh and asked to conduct the following tests for compliance with AS 4671:

1. Yield Stress, Tensile Strength & Uniform Elongation
2. Weld Strength
3. Mass per Unit Length & Geometric Properties

Results of analysis are shown below.

RESULTS OF TESTING:

1. Yield Stress, Tensile Strength & Uniform Elongation: (AS 1391)

Lab Number:	**19/A/1311**		**19/A/1312**		**19/A/1313**	
Sample Marked:	**Ex. 50mm Panel**		**Ex. 62/75mm Panel Old**		**Ex. 62/75mm Panel New**	
	Longitudinal	Transverse	Longitudinal	Transverse	Longitudinal	Transverse
Dimensions, mm:	Φ 3.20	Φ 3.20	Φ 5.00	Φ 5.00	Φ 5.00	Φ 5.00
C.S. Area, mm^2:	8.04	8.04	19.63	19.63	19.63	19.63
Max Force, kN:	6.3	6.4	12.25	12.20	12.30	12.10
Ultimate Tensile Strength, MPa:	784	796	624	621	627	616
0.2 % Proof Stress, MPa:	734	697	581	565	581	571
Elongation, %:	4.4	4.4	4.0	4.8	4.0	4.0
Rm/Re:	1.07	1.14	1.07	1.10	1.08	1.08
AS 4671 Grade 500L Compliance*¹:	Pass		Pass		Pass	

Note: *The specimens all fractured in the central third of the gauge length.*

AS 4671 Grade 500L Requirements:

Test:	Requirement:
0.2 % Proof Stress	≥ 500 MPa
Elongation	≥ 1.5 %
R_m/R_e	≥ 1.03

f_y = 500 MPa

RESULTS OF TESTING:

2. Weld Strength: (ISO 15630-2)

Lab Number:	**19/A/1311**			**19/A/1312**			**19/A/1313**		
Sample Marked:	**Ex. 50mm Panel**			**Ex. 62/75mm Panel Old**			**Ex. 62/75mm Panel New**		
Dimensions, mm:	Φ3.2 x 3.2			Φ 5.0 x 5.0			Φ 5.0 x 5.0		
C.S. Area, mm^2:	8.04			21.24			21.24		
Max Force, kN:	3.68	3.11	2.87	5.67	6.33	5.59	5.65	5.89	5.80
Fracture Point:	Weld	Weld	Weld	Weld	Weld	Parent Material	Weld	Weld	Weld
AS 4671 Clause 7.2.5 Compliance*[2]:	Pass			Pass			Pass		

*[2] **AS 4671 Clause 7.2.5 Requirements:**

Test:	Requirement:
Max Force @ 8.04mm^2 C.S. Area	≥ 2.11 kN
Max Force @ 21.24mm^2 C.S. Area	≥ 5.57 kN

RESULTS OF TESTING:

3. Mass per Unit Length & Geometric Properties: (AS/NZS 4671 – Appendix C3.1, 3.2 & 3.3)

Lab Number:	**19/A/1311**					
Sample Marked:	**Ex. 50mm Panel**					
	Longitudinal Bar 1	Longitudinal Bar 2	Longitudinal Bar 3	Transverse Bar 1	Transverse Bar 2	Transverse Bar 3
Rib Geometry, mm:	None			None		
Length, mm:	196.0			161.5		
Mass, g:	12.24	12.22	12.25	10.49	10.47	10.47
Mass per Unit Length, g/mm:	0.062	0.062	0.063	0.065	0.065	0.065
Average Mass per Unit Length, kg/m:	0.062			0.065		
AS 4671 Table 5A Compliance*3:	Fail			Pass		

*3 **AS 4671 Clause 7.2.5 Requirements:**

Test:	Requirement:
Mass per Unit Length	≥ 0.063 kg/m

?

RESULTS OF TESTING:

3. Mass per Unit Length & Geometric Properties: (AS/NZS 4671 – Appendix C3.1, 3.2 & 3.3)

Lab Number:	**19/A/1312**				
Sample Marked:	**Ex. 62/75mm Panel – Old**				
	Longitudinal Bar 1	Longitudinal Bar 2	Transverse Bar 1	Transverse Bar 2	Transverse Bar 3
Rib Geometry, mm:	None		None		
Length, mm:	302.0		163.0		
Mass, g:	48.18	48.09	25.82	25.88	25.85
Mass per Unit Length, g/mm:	0.160	0.159	0.158	0.159	0.159
Average Mass per Unit Length, kg/m:	0.159		0.159		
AS 4671 Table 5A Compliance*3:	Pass		Pass		

Lab Number:	**19/A/1313**				
Sample Marked:	**Ex. 62/75mm Pane – New**				
	Longitudinal Bar 1	Longitudinal Bar 2	Transverse Bar 1	Transverse Bar 2	Transverse Bar 3
Rib Geometry, mm:	None		None		
Length, mm:	305.0		164.0		
Mass, g:	48.58	48.69	26.02	26.08	26.03
Mass per Unit Length, g/mm:	0.159	0.160	0.159	0.159	0.159
Average Mass per Unit Length, kg/m:	0.160		0.159		
AS 4671 Table 5A Compliance*3:	Pass		Pass		

***3 AS 4671 Clause 7.2.5 Requirements:**

Test:	Requirement:
Mass per Unit Length	≥ 0.154 kg/m

MACSIM®

CERTIFICATE OF CONFORMITY

MACSIM CLASS 4 BATTEN SCREWS PRODUCT REFERENCE 17GBC RANGE -

We hereby certify Macsim Type17 Batten Screws labelled and supplied as 'Class 4' Galvanised have 40um mechanical galvanised plating and are constructed to conform to Australian Standard AS5566 Class 4.

All Macsim Class 4 coatings exceed the 1000 Hour salt spray test.

Macsim Type 17 Batten Screws are manufactured from min AISI 1022 wire and case hardened. ?

Base design on suggest tensile strength of screws to confirm.

Macsim Fastenings Pty. Ltd
February 2018

MACSIM Fastenings Pty Ltd **ABN 30 000 056 119**
Head Office:10 Wonderland Dr, Eastern Creek, NSW, 2766 (Ph) 02 9881 2400 (Fax) 02 9881 2444
VIC: 268 Wolseley Place, Thomastown, VIC 3074 (Ph) 03 9495 7495 (Fax) 03 9495 7444
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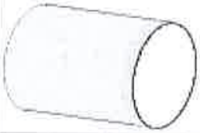
1022 CARBON STEEL BAR

1022 is a general purpose low tensile low hardenability carbon steel generally supplied in the black hot rolled condition, with a typical tensile strength range 360 - 560 Mpa and Brinell hardness range 100 - 170.Characterised by excellent weldability, fairly good machinability with reasonable strength and good ductility.
1022 due to its very low hardenability will through harden only in very small sections to relatively moderate strength levels, and is therefore generally used in the as rolled condition. It can however be carburised achieving case hardnesses over Rc 65 with smaller sections, reducing as section size increases. Core strength will remain as supplied for all sections. Alternatively it can be carbonitrided offering some advantages over standard carburising.
It will not respond satisfactorily to flame or induction hardening due to its low carbon content, nor to nitriding due to a lack of suitable alloying elements.
1022 is used by all industry sectors for applications involving welding or when high strength is not necessary, plus lightly stressed carburised parts.
Typical applications are: General Engineering Parts and Components, Welded Structures etc. or Carburised: Camshafts, Light Duty Gears, Gudgon Pins, Ratchets, Spindles, Worm Gears etc.

Colour Code	Stocked Sizes
White (Bar End) 	36 mm - 690 mm Dia **Bar Finish** Black Bar

Related Specifications	
Australia	AS 1442 - 1992 1022
Germany	W.Nr 1.0402 C22 W.Nr 1.1151 CK22
Great Britain	BS970 - Part 3 - 1991 070M20 BS970 - Part 1 - 1983 120M19 BS970 - 1955 EN3C
Japan	JIS G 4051 S20C
USA	AISI C1022 and C1522 ASTM A29/A29M - 91 1022 and 1522 SAE 1022 and 1522 UNS G 10220 UNS G 15220

Chemical Composition

	Min. %	**Max. %**
Carbon	0.16	0.24
Silicon	0.10	0.40
Manganese	0.70	1.40
Phosphorous	0	0.05
Sulphur	0	0.05

Typical Mechanical Properties - Hot Rolled Condition

Tensile Strength Mpa	550
Yield Strength Mpa	330
Elongation in 50mm %	27

Hardness Brinell HB	150		
Typical Mechanical Properties - Hardened by Water Quench at 875 °C and Tempered Between 540 °C - 680°C			
Section Size mm		up to 16mm	17 - 40mm
Tensile Strength Mpa	Min	550	500
	Max	700	650
Yield Strength Mpa	Min	350	300
Elongation in 50mm %	Min	20	22
Impact Charpy J	Average	55	55
Hardness HB	Min	165	150
	Max	210	190

Forging

Heat to 1100 °C - 1200 °C maximum, hold until temperature is uniform throughout the section and commence forging.Do not forge below 900 °C
Finished forgings may be air cooled.

Heat Treatment

Annealing

Heat to 870 °C - 910 °C hold until temperature is uniform throughout the section, and cool in furnace.

Carburizing

Pack, salt or gas carburise at 880 °C - 920 °C, holding for sufficient time to develop the required case depth and carbon content, followed by a suitable refining/hardening and tempering cycle to optimise case and core properties.

Core Refine

Slow cool from Carburising temperature and re-heat to 870 °C - 900 °C, hold until temperature is uniform throughout the section and quench as required in oil, water or brine.

Case Hardening

Following core refining, re-heat to 760 °C - 780 °C, hold until temperature is uniform throughout the section and quench in water.Temper immediately while still hand warm.

Tempering - After Carburising, Core Refining and Case Hardening

Re-heat to 150 °C - 200 °C, hold until temperature is uniform throughout the section, soak for 1 hour per 25 mm of section and cool in still air.NB. Tempering will improve the toughness of the case with only slight reduction in case hardness. It will also reduce it susceptibility to grinding cracks.

Normalizing

Heat to 890 °C - 940 °C hold until temperature is uniform throughout the section, soak for 10 - 15 minutes and cool in still air.

Stress Relieving

Heat to 650 °C - 700 °C hold until temperature is uniform throughout the section, soak for 1 hour per 25mm of section, and cool in still air.

Through Hardening

Heat to 860 °C - 890 °C hold until temperature is uniform throughout the section, soak for 10 - 15 minutes per 25mm of section, and quench in water or brine.Temper immediately while still hand warm

Tempering - After Through Hardening

Re heat to 540 °C - 680 °C as required, hold until temperature is uniform throughout the section, soak for 1 hour per 25mm of section, and cool in still air.

Notes on Heat Treatment

Heating temperatures, rate of heating, cooling and soaking times will vary due to factors such as work piece size/shape, also furnace type employed, quenching medium and work piece transfer facilities etc.Please consult your heat treater for best results.

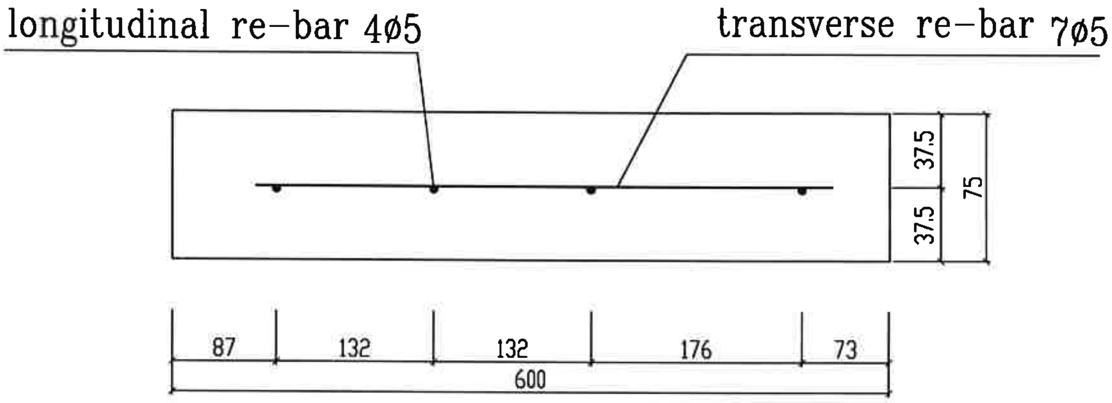
Machining

1022 in the black hot rolled as supplied condition has slightly lower machinability than a similar product such as M1020 bright steel. The hot rolled structure being softer tends to wrap around the cutting tool resulting in a less clean cut. All machining operations should be carried out as per machine manufacturers recommendations for suitable tool type, feeds and speeds.
Welding
1022 has excellent weldability in the hot rolled as supplied condition, and can be readily welded by any of the standard welding processes.NB. Welding in the carburised or heat treated condition is not recommended.
Welding Procedure
A pre-heat or post-heat is not generally required, however a post-weld stress relieve can be beneficial if possible as can pre-heating larger sections.please consult your welding consumables supplier for suitable electrodes etc.

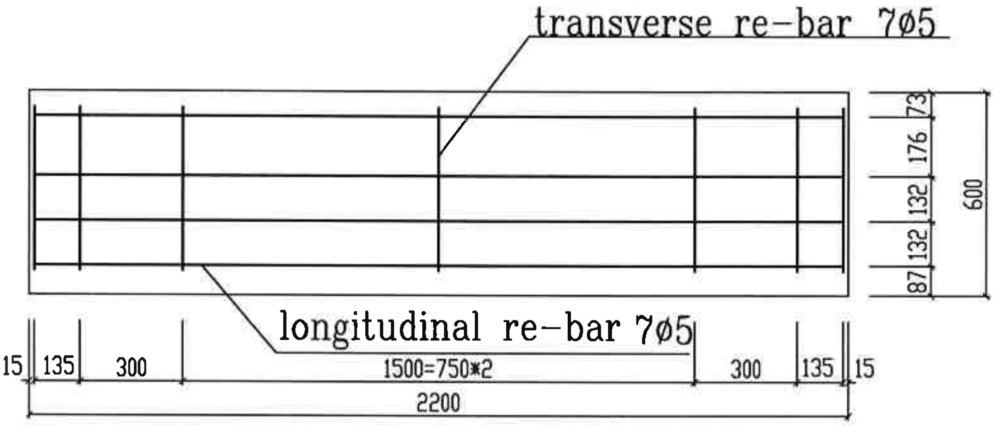
NANJING ASAHI NEW BUILDING MATERIALS CO.,LTD.

Steel Mesh Drawing

Project Name				Load (N/m^2)	
Type	partition panel	Dimension (mm)	75*600*2200		



sectional view



Drafted by	Approved by	Date
		2018.08.02

Nanjing Asahi-Jiantong New Building Materials Co., Ltd.
AAC Panel Mesh Drawing

Product Code	CS50-22	Size (mm)	50*600*2200