11 March 2010

COPY

To Loxo Cladding (NZ) Systems Ltd
PO Box 10-176
Christchurch

Attention: Marcus Stufkens

JOB NO: 10013

Dear Marcus,

LOXO WALL CLADDING ASSESSMENT

1.0 Introduction

The purpose of this report is to show compliance of the Loxo Cladding wall system including its associated connections to clause B1 of the Building Code: 2004. Compliance with the building code requires that the cladding system meets the performance requirements of B1.3.1 to B1.3.3, set out under the first schedule of clause B1-STRUCTURE.

The Loxo cladding system is a lightweight autoclaved aerated concrete (AAC) panel system fixed to either a timber or steel stud framing system with 14g Bugle head, self cutting screws. The cavity system which provides ventilation between the stud framing and the back face of the panels consists of high density expanded polystyrene (class VH).

The EPS battens are provided in two sizes:

1. EPS 22mm thick x 50mm wide x 300mm long battens for the Loxo 'Classic' wall system and,
2. EPS 50mm thick x 50mm wide x 300mm long battens for the Loxo 'Deluxe' wall system.

The EPS battens are fixed to either a steel or timber stud and in turn the Loxo panel is fixed through the EPS batten to the stud framing.

2.0 Screw Fixings for 50mm and 75mm thick Loxo Panels

The 14g Bugle head self cutting screws used to secure the panels to the stud framing vary in length depending on the EPS batten thickness and also the Panel thickness.

2.1 For the 50mm thick Loxo panel

- A 100mm long Bugle screw is used in combination with the 'Classic' 22mm thick EPS batten and the screw penetrates 33mm into the timber stud framing. Based on the screw head being inserted 5mm beneath the panel surface.

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- A 125mm long Bugle screw is used in combination with the 'Delux' 50mm thick EPS batten and the screw penetrates 30mm into the timber stud framing. Based on the screw head being inserted 5mm beneath the panel surface.

2.2 For the 75mm thick Loxo panel

- A 125mm long Bugle screw is used in combination with the 'Classic' 22mm thick EPS batten and the screw penetrates 33mm into the timber stud framing. Based on the screw head being inserted 5mm beneath the panel surface.
  The 75mm thick panel is only used in combination with the 'Classic' 22mm thick EPS batten.

3.0 Compliance with clause B.1.3.3 of Building Code

In assessing the performance requirements for the Bugle screw fixings, the table below shows the applied loadings due to 'in-plane' seismic loads and wind loads. The term 'in-plane' means that the seismic load is acting along the length of the panel and the load is caused by the combined weight of the panel and a plaster finish coating 20mm thick.

The applied Ultimate wind load in table 3.1 is based on "Very high wind speed" in accordance with NZS 3604:1999. This wind speed has been determined in accordance with the loadings code NZS1170:2002 and is based on the following assumptions:

- Maximum height of structure shall be 7.5m
- Terrain category is " Category 2"
- 'Non directional' wind speed has been adopted for site wind speed.
- Maximum site elevation has been limited to 500m
- All site locations occur outside the lee zones.

The applied seismic loads in table 3.1 are based on all structures responding in a limited ductile manner in accordance with NZS 1170:2004:"Loadings Code" and NZS 3604:1999: "Light weight timber structures". The following assumptions have been made in deriving the 'in-plane' loads for the Loxo panel screw fixings:

- Soil classification 'C' has been used
- Screw fixings designed for limited ductile response equivalent to μ=2.0. This ensures the fixings can withstand a higher loading than would typically be applied to the screw due to the response of the structure.
- Hazard factor of 0.42 has been used for assessing design spectra coefficient :Cd(T).
- Near Fault value of 1.0 has been used.
- Risk factor of 1.0 used in accordance with a seismic return period of 475 years (for design working life of 50 years)

Load Regime	Typical Panel size (2.2m*0.6 m)	Applied suction Load (kN)	Number of screws per panel	Applied Tension Load per screw (kN)	Ultimate Pullout capacity per screw fixing (kN) (see note 1)	Safety Factor
Wind (2.16kPa)	1.32m2	2.85	6	0.475	2.80	5.90

Table 3.1 Ultimate wind load applied to each screw fixing

The Ultimate wind pressure of 2.16kPa in table 3.1 has been calculated based on an external pressure coefficient of C_{fig} =1.5 which takes into account a localised wind suction factor of Kp =1.5; to be used for design of screw fixings for connection of both the EPS battens and the Loxo Panels to the stud framing.

Load Regime	Loxo Panel thickness(mm)	Applied Load (kN)	Number of screws per panel	Applied Shear Load per screw fixing (kN)
Earthquake	50	0.106	6	0.00176
	75	0.142	6	0.00236

Table 3.2 Seismic load applied to each screw fixing

Note 1: The screw's Ultimate pullout capacity value specified in table 3.1 has been established by BEAL Ltd in accordance with accepted testing procedures, based on a 14g screw penetrating 30mm into Radiata Pine timber at 12% moisture content and perpendicular to the timber grain. A capacity reduction factor of 0.7 has been applied to BEAL's pullout test value to determine the dependable pullout capacity for use in table 3.1

The 14g Bugle screws will be subjected to bending stresses caused by load transfer from the panel to the stud framing through 'reverse curvature' of the screw thread. The bending stresses will therefore vary depending on the thickness of the EPS batten used, (i.e. 'Classic' or 'Delux '), used in combination with the Loxo panel thickness (refer section 2 above for EPS batten/panel combinations).

Table 3.3 below shows the applied bending moment for a 14g Bugle screw and also the bending moment capacity of the screw; which has been calculated based on the material and section properties of the screw:

- Elastic Section Modulus (Zx) is taken as 10.86mm^3 based on the net screw diameter of 4.8mm.
- Net cross sectional area is taken as 18.10mm^2 based on a net screw diameter of 4.8mm.
- Yield strength of screw (Fy) is taken as 830Mpa (i.e. N/mm^2); (see note 2 below).
- Ultimate strength reduction factor (ϕ) taken as 0.9 for bending moment capacity.

Load Regime	Loxo Panel thickness (mm)	Bending moment in screw (kNm)	Bending moment capacity in screw (kNm)	Safety factor against failure
Earthquake	50	0.000443	0.0081	18.00
	75	0.000260	0.0081	31.00

Table 3.3 Seismic-induced bending loads in each 14g Bugle screw fixing

Note 2: The yield strength (Fy) has been determined by back analysis based on a minimum required tensile capacity of 15kN (confirmed by testing from the screw manufacturer) and using the net sectional area of the screw.

4.0 Conclusions

The Loxo screw connections have been assessed for performance requirements in accordance with clause B1.3.3 set out under the first schedule of clause B1-STRUCTURE.

The factor of safety against failure of the 14g Bugle screw connections has been assessed as follows:

- For Ultimate wind pressure corresponding to very high wind speed to NZS 3604:1999:

  Factor of safety against failure is 5.90

- For Ultimate seismic Loads to NZS 1170:2004:"Loadings Code"

  Factor of safety against failure is 18.0

The factor of safety against failure of the 14g Bugle screw connections is governed by Ultimate wind pressures and is much greater than 1.0 (the Ultimate limit state factor against failure).
If the Loxo panels and associated connections are to be used for wind speeds exceeding NZS 3604:1999, then specific design of the connections would be required. It is recommended that the Ultimate wind pressure for specific design be limited to 2.5kPa, which results in a reduced safety factor of 5.09.

Clause B1.3.1 and B1.3.2 in the first schedule of B1-Structure require that buildings and building elements (including cladding) shall have a low probability of:

- Rupture or becoming unstable,
- losing equilibrium or causing loss of *amenity* through undue deformation,
- Degradation or other physical characteristics throughout the intended working life of the building.

The Loxo cladding system is a lightweight autoclaved aerated concrete (AAC) panel which is inherently stable and not susceptible to rupture, becoming unstable or degrading during the intended working life (i.e. 50 years) of the cladding system. Therefore the Loxo Cladding system is deemed to satisfy clauses B1.3.1 to B1.3.3 in accordance with B1-Structure of the Building Code: 2004.

5.0 Disclaimer

This report has been prepared solely for the benefit of Loxo Cladding (NZ) Systems Ltd, and BEAL Ltd. No liability is accepted by this company or any employee of this company with respect to its intended use by any other person or persons. This disclaimer shall apply notwithstanding that the report may be made available to other persons for an application for permission or approval to fulfill a legal requirement.

Yours faithfully,

S. ROBERTS
Director