Auckland UniServices Limited

Our Ref: 10677.00

SCREW AND ATTACHMENT FIXING TO POWERSCAPE™ ROCKLINING WALLS

AUCKLAND UNISERVICES LIMITED

a wholly owned company of

THE UNIVERSITY OF AUCKLAND

Prepared for:

Powerscape Ltd
PO Box 12256
Penrose
AUCKLAND

June 2004

Prepared by:

Mark Byrami and Noel Perinpanayagam
Department of Civil & Environmental Engineering
University of Auckland

UniServices

Auckland UniServices Limited

Reports from Auckland UniServices Limited should only be used for the purposes for which they were commissioned. If it is proposed to use a report prepared by Auckland UniServices for a different purpose or in a different context from that intended at the time of commissioning the work, then UniServices should be consulted to verify whether the report is being correctly interpreted. In particular it is requested that, where quoted, conclusions given in UniServices Reports should be stated in full.

Screw and Attachment Fixing to Powerscape™ Rocklining Walls

Introduction

In many traditionally lined walls, the capability of attaching fixtures and fitting to walls is limited because of the low strength in the wallboard. Powerscape™ Rocklining lined walls have the potential of being able to support a wide range of fixtures and fitting. To investigate the potential capacity of attaching different fixtures attached to Powerscape™ Rocklinings, a number of tests were undertaken on screws and other proprietary fastening driven into 13 mm Powerscape™ Rocklinings.

Screw Tests

Tests were undertaken on five different sizes and types of screws. The size and type of the screw tested is detailed in Table 1.

Table 1
Details of Screws Tested

Screw Type	Gauge	Thread Type
12 g Self Taping	12	Fine Steel Self Taping
10 g Self Taping	10	Fine Steel Self Taping
8 g High Thread	8	Coarse Wood High Thread
6 g Self Taping	6	Fine Steel Self Taping
6 g High Thread	6	Coarse Wood High Thread

In all the testing, 13 mm thick Powerscape Confidence™ was used for attaching the screws. The tests were undertaken in the Instron TT-B test machine located in the Civil Materials Laboratory, University of Auckland. Three types of tests were carried out:-

(i) Screws loaded in shear (parallel to the face of the lining, details shown in Figure 1a).
(ii) Screws loaded in withdrawal (at 90 degrees to the face of the lining). Details of this test arrangement are shown in Figure 1b.
(iii) Screws loaded at 45 degrees to the face of the lining. Details are shown in Figure 1c.

All screws were loaded at a constant displacement rate of 0.1 mm /sec. The output from the test machine's load cell and cross-head linear variable differential transformer were monitored by a HP 3852a data acquisition unit. The readings from the data acquisition unit were transferred to Windows 98® computer for storage and display of the real time load displacement behaviour.

Ten replications of each test were undertaken in order that estimates of the lower five percentile values could be determined from the results.

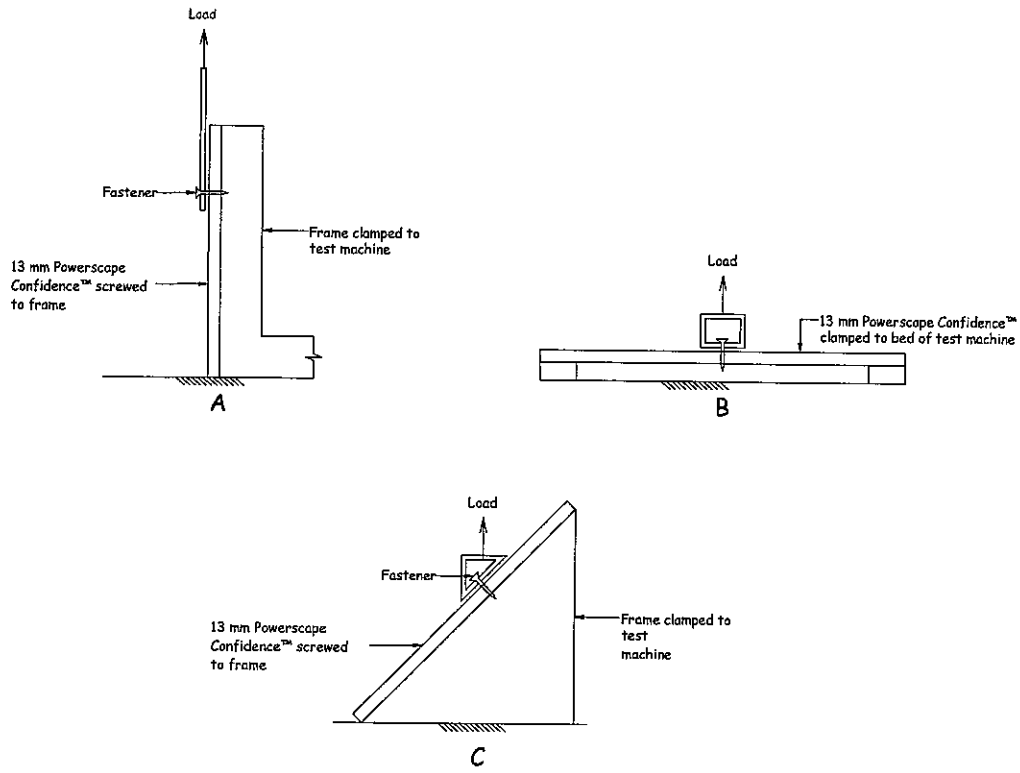

Figure 1
Screw Test Arrangement

Proprietary Fastener Testing

Two types of proprietary fastener were tested:-

(i) Holdfast single picture hook, No. 03432. This picture hook is attached to the lining in with one 1.5 mm diameter nail.
(ii) Holdfast double picture hook, No. 03433. This picture hook is attached to the lining with two 1.5 mm diameter nails.

The picture hooks were only tested in shear, with the load being applied parallel to the face of the lining. Details of the test arrangement are shown in Figure 2.

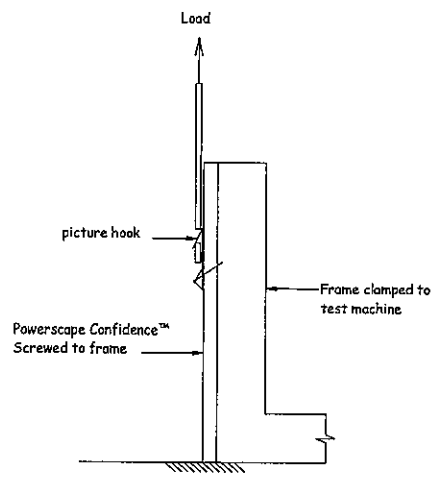

Figure 2.
Picture Hook Test Arrangement

Test Results

Screw Testing

The results of the screw testing are shown in Table 2.

Table 2
Results of Screw Testing

Screw Type	Test Number	Maximum Load (N)		
		Loaded at 0 degrees to Face of Lining	Loaded at 45 degrees to Face of Lining	Loaded at 90 degrees to Face of Lining
12 gauge x 1-1/2 Self Tapping	1	785	637	598
	2	819	662	588
	3	688	749	583
	4	767	727	678
	5	852	741	595
	6	822	604	586
	7	969	662	617
	8	771	664	578
	9	767	653	600
	10		688	553
10 gauge x 1-1/2 Self Tapping	1	802	693	571
	2	784	750	541
	3	610	682	533
	4	715	586	553
	5	719	606	635
	6	677	687	577
	7	901	692	617
	8	877	603	575
	9	915	753	618
	10	747	682	575
8 gauge x 1 3/4 High Thread	1	917	711	601
	2	1117	646	551
	3	1131	535	514
	4	1132	543	595
	5	1099	538	558
	6	1180	743	508
	7	1148	560	572
	8	1167	710	565
	9	1165	646	598
	10	1096	615	593
6 gauge x 41 Self Tapping	1	860	585	538
	2	788	552	535
	3	750	473	547
	4	625	511	548
	5	821	544	552
	6	728	473	540
	7	823	546	553
	8	742	532	521
	9	807	442	530
	10	699	523	532
6 gauge x 41 High Thread	1	695	594	550
	2	673	502	548
	3	688	580	517
	4	634	630	504
	5	677	604	593
	6	691	647	582
	7	681	567	545
	8	707	572	564
	9	785	492	502
	10		562	601

Fixture Testing

The results of the fixture testing are shown in Table 3.

Table 3
Results of Fixture Testing

Fixture Type	Test Number	Maximum Load (N)
Holdfast Single Picture Hook Code No. 03432	1	357
	2	356
	3	408
	4	380
	5	392
	6	405
	7	400
	8	470
	9	368
	10	422
Holdfast Double Picture Hook Code No. 03433	1	794
	2	849
	3	886
	4	876
	5	875
	6	832
	7	824
	8	761

When testing the picture hooks, the hooks tended to straighten at loads substantially less than the capacity of the nails attaching the fixture to the wall. In the case of the double hook, the load causing straightening of the hook was 260 N. The straightening action was prevented during testing by continually pushing the hook back into position.

Summary

The results recorded during testing were used to estimate five percentile lower limit values for each screw and fixture type and for each loading direction. The method detailed in NZS 3603:1990 was used for estimating the five percentile lower limit. Details of the five percentile lower limits are given in Table 4. Five percentile lower limits given in Table 4 are based assuming both normal and log-normal distributions. Also given in Table 4 are mean, standard deviation and coefficients of variation values for each test series.

Table 4
Summary of Results

Screw Type		Loaded at 0 degrees to face	Loaded at 45 degrees to face	Loaded at 90 degrees to face
12 gauge x 1-1/2 Self Tapping	Average Load (N)	804.44	678.70	597.60
	Standard Deviation (N)	77.23	47.14	32.77
	Coefficient of Variation	0.10	0.07	0.05
	Five percentile Lower Limit (Normal) (N)	653.06	588.08	534.59
	Five percentile Lower Limit (Log-Normal) (N)	667.06	592.85	538.92
10 gauge x 1-1/2 Self Tapping	Average Load (N)	774.70	673.40	579.50
	Standard Deviation (N)	100.58	58.12	34.05
	Coefficient of Variation	0.13	0.09	0.06
	Five percentile Lower Limit (Normal) (N)	581.34	561.65	514.04
	Five percentile Lower Limit (Log-Normal) (N)	597.20	567.20	517.17
8 gauge x 1-3/4 High Thread	Average Load (N)	1115.20	624.70	565.50
	Standard Deviation (N)	75.19	78.98	33.68
	Coefficient of Variation	0.07	0.13	0.06
	Five percentile Lower Limit (Normal) (N)	970.63	472.85	500.74
	Five percentile Lower Limit (Log-Normal) (N)	968.10	486.70	502.31
6 gauge x 41 Self Tapping	Average Load (N)	764.30	518.10	539.60
	Standard Deviation (N)	69.83	43.72	10.43
	Coefficient of Variation	0.09	0.08	0.02
	Five percentile Lower Limit (Normal) (N)	630.04	434.05	519.55
	Five percentile Lower Limit (Log-Normal) (N)	634.87	437.69	519.78
6 gauge x 41 High Thread	Average Load (N)	692.33	575.00	550.60
	Standard Deviation (N)	40.26	49.32	35.28
	Coefficient of Variation	0.06	0.09	0.06
	Five percentile Lower Limit (Normal) (N)	613.41	480.17	482.76
	Five percentile Lower Limit (Log-Normal) (N)	618.80	482.56	485.64
Holdfast Single Picture Hook Code No. 03432	Average Load (N)	395.80		
	Standard Deviation (N)	34.27		
	Coefficient of Variation	0.09		
	Five percentile Lower Limit (Normal) (N)	329.91		
	Five percentile Lower Limit (Log-Normal) (N)	335.46		
Holdfast Double Picture Hook Code No. 03433	Average Load (N)	837.13		
	Standard Deviation (N)	43.64		
	Coefficient of Variation	0.05		
	Five percentile Lower Limit (Normal) (N)	749.44		
	Five percentile Lower Limit (Log-Normal) (N)	751.77		

References

Standards New Zealand, 1990, "Timber Structures Standard", New Zealand Standard NZS 3603:1990, Wellington.