SPREAD AND RETENTION OF A PRESERVATIVE ON DIFFICULT TO ACCESS LINTEL MEMBERS USING A REMEDIAL TREATMENT METHOD

Ian Simpson, Dave Page and Tripti Singh

www.scionresearch.com

SPREAD AND RETENTION OF A PRESERVATIVE ON DIFFICULT TO ACCESS LINTEL MEMBERS USING A REMEDIAL TREATMENT METHOD

Ian Simpson, Dave Page and Tripti Singh
Scion
Rotorua

Report prepared for:

Department of Building and Housing
PO Box 10729
Wellington

Correspondence to:

Project Leader
Bioactives and Wood Preservation
Private Bag 3020
ROTORUA

Phone: (07) 343-5777
Fax: (07) 343-5507

Approved for Release

Project Leader

Date: April 2012

The opinions provided in the Report have been provided in good faith and on the basis that every endeavour has been made to be accurate and not misleading and to exercise reasonable care, skill and judgement in providing such opinions. Neither Scion nor any of its employees, contractors, agents or other persons acting on its behalf or under its control accept any responsibility or liability in respect of any opinion provided in this Report By Scion

REMEDIAL TREATMENT OF LINTELS

Ian Simpson, Dave Page and Tripti Singh
Scion, Rotorua

SUMMARY

Double lintels of various widths were assembled and treated with boron glycol by applying a double coat on exposed surfaces and injected on concealed faces using injection holes in one lintel member. Lintels were disassembled after nine days and photographs were taken to observe preservative coverage on to the concealed surfaces. Cross-section samples were also taken to determine overall preservative penetration and retentions.

Results showed variation in preservative spread depending on size of lintels and spacing of holes and position of rows where preservative was injected. However, generally the preservative retention was higher than required H1.2 treatment specification (0.40% BAE m/m); out of 72 samples tested, only eight had a retention of less than 0.40% BAE m/m in cross sections.

INTRODUCTION

A previous study conducted at Scion (commissioned by DBH) showed that a combination of brushing and injection treatment with boron glycol using 'double coat brush-on plus injection treatment between studs' application gave preservative spread onto concealed surfaces resulting the cross section boron retention analyses in all components similar to the 0.40% BAE m/m, required by the H1.2 treatment specification (Page and Singh, September 2011). The objective of this study was to evaluate if the 'brush on plus injection method' previously tested on complex vertical components could be applicable on horizontal components such as lintels.

Two scoping studies including method development for lintel treatment and a comparison of fixing lintels with nails or screws (Simpson, Page and Singh, November 2011; February 2012) was conducted before this full-scale study.

MATERIALS AND METHODS

Lintel construction

Eighteen double lintels were assembled from three widths of SG8 untreated *Pinus radiata* according to the following table.

Table 1: Number of lintels produced

Group number	200x50mm	250x50mm	300x50mm
Group 1 (single row of injection holes)	3	3	3
Group 2 (double rows of injection holes)	3	3	3

Six mm diameter injection holes were drilled to a depth of 45 mm and at an angle of 30 degrees from the horizontal through one lintel member. Two patterns of injection holes were drilled (Figures 1 and 2):

- Group 1 – One row of holes were drilled 10 mm from the top of the outer lintel. Holes were drilled 75 mm each end of the lintel. The spacing of the other holes was in groups of 100, 150 and 200mm. The order of the holes was rotated between the three lintels in the group, so that each hole spacing was represented at each location on the lintel.
- Group 2 – Two rows of holes were drilled. The first row of holes was drilled 10mm from the top of the lintel. The second row of holes was drilled at half the depth of the lintel (i.e. 100 mm, 125 mm and 150 mm) and midpoint between the holes in the top row. Holes were drilled 75 mm each end of the lintel. The spacing of the other holes was in groups of 100, 150 and 200mm. The order of the holes was rotated between the three lintels in the group, so that each hole spacing was represented at each location on the lintel.

Figure 1a: Spacing of holes for Group 1

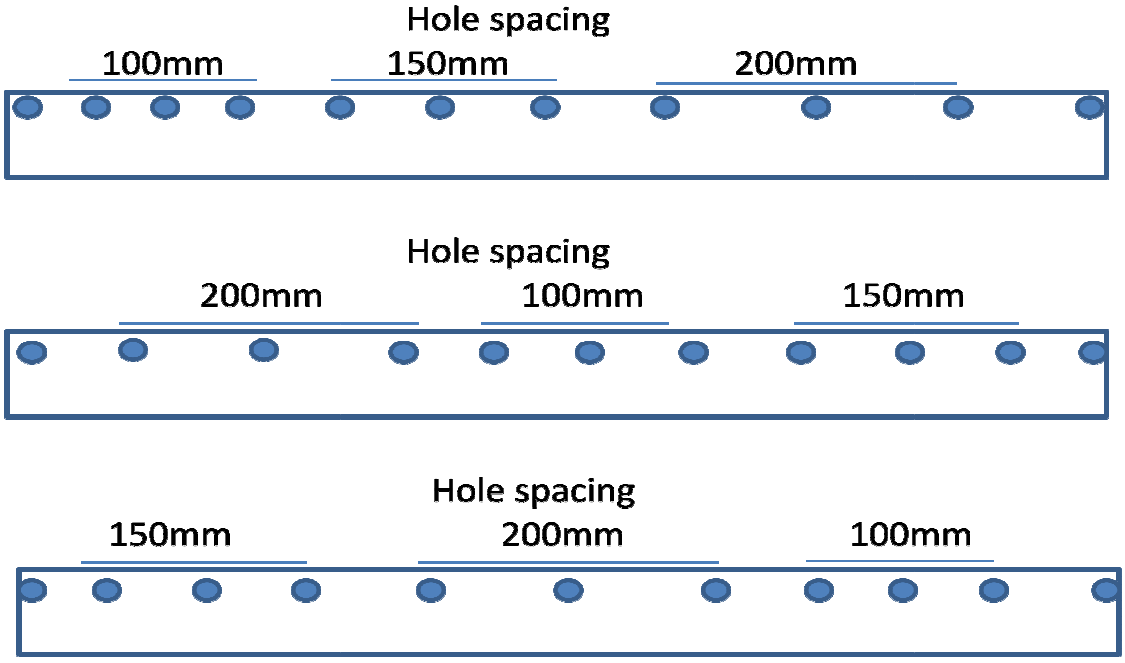


Figure 1b: Spacing of holes for Group 2

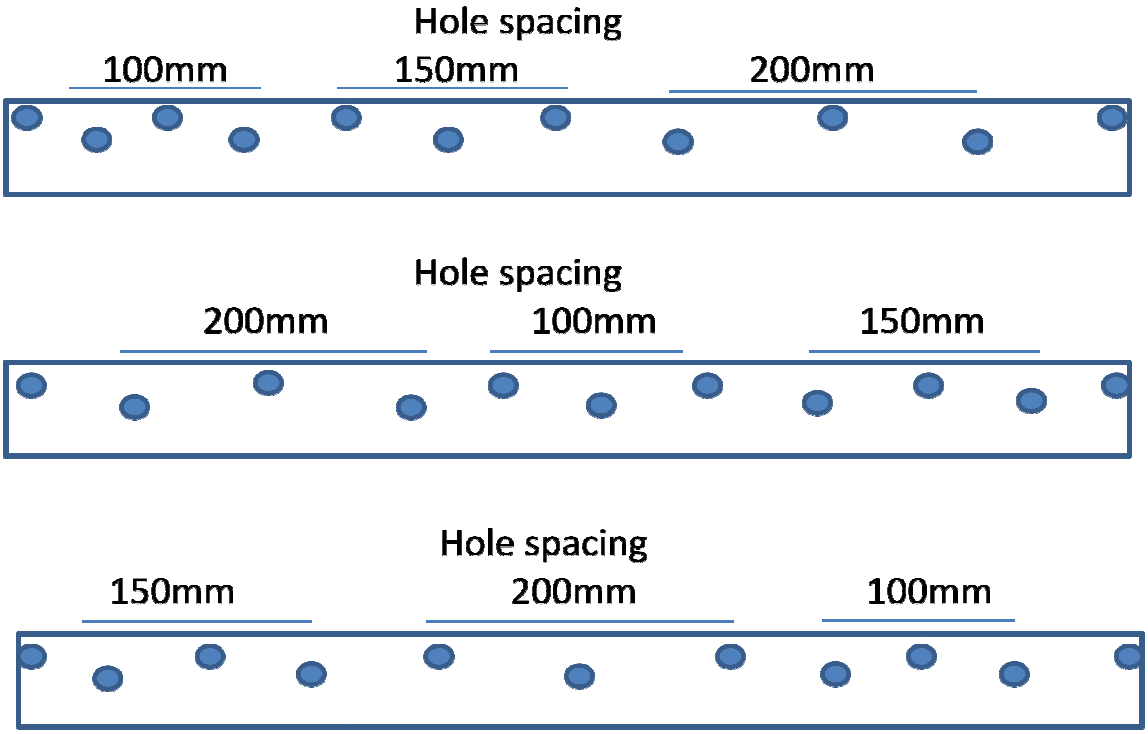


Figure 2: Drilling injection holes, single row of holes (photo on left) and double row of holes (photo on right shows hole at mid depth being drilled).

The lintels were fixed together with two rows of 90mm long nails at 270mm spacing along the lintel as described in the nailing schedule contained in NZS 3604:2011. Each alternate pair of nails was inserted from alternate sides of the lintel. Eight pairs of nails were inserted at 270 mm spacing, with a 120mm gap from each end. Clamps were not used to hold the lintels together during fixing. Cloth tape (Sellotape cloth tape 48mm wide) was attached to the bottom edge of each lintel (Figure 3).

Figure 3: Cloth tape applied to under edge of lintel.

The lintels were placed horizontally on saw stools to replicate an installation in a timber house frame (Figure 4).

Figure 4: Assembled lintels prior to injection.

Preservative treatment

A boron glycol solution was made according to a generic recipe. Approximately 15 ml of boron glycol solution was injected into each hole in the lintel using a syringe with a nozzle that fitted tightly into the hole. The boron glycol solution was dyed pink. After 30 minutes, a further 15 ml of boron glycol solution was injected into the holes. Each lintel was given two coats of treatment solution using a brush. The treatment solution was applied to the top, bottom and sides of the lintel. Treatment solution was not applied to the end of the lintel. The amount of treatment solution applied was measured for one lintel of each size.

Figure 5: Lintels after injection and coating.

Sampling and Analyses

After nine days stabilisation (drying) period the lintels were disassembled. The boron spread was assessed by measuring the occurrence of boron at three points along one member of each lintel as shown in Table 2. The position of measurement for the 300mm deep lintels was the same as used in the earlier study, and the positions for the 200 and 250 mm deep lintels was at the same proportion as for the 300 mm deep lintels (Appendix 5).

Table 2: Position for boron spread measurements

Depth of lintel (mm)		
200	250	300
Distance from top of Lintel (mm)		
70	80	100
130	170	200
170	200	250

Cross-sectional samples were cut from the lintels for penetration testing and chemical analysis 17 days after treatment. Cross sections were cut in the area of the lintel with 100, 150 and 200mm spacing between injection holes. Table 3 shows which lintels were sampled. Chemical analysis used the following methods:

- Boron - Wilson, W.J. Anal. Chim. Acta. 1958, 19, 516.
- Vogel, A. I. Quantitative Inorganic Analysis, 3rd Ed., Section III-17, 252.

Table 3: Lintels that were sampled for penetration testing and chemical analysis

	Lintel depth(mm)					
	200		250		300	
	Sample number of lintels that were sampled					
Single row of holes	1	2	7	8	13	14
Double row of holes	4	5	10	11	16	17

RESULTS AND DISCUSSION

Observation on spread of boron glycol solution

There was a difference between preservative spread at single and double injection holes. Double rows of injection holes gave higher spread of boron for all sizes of lintel (Table 4). As shown in Table 4, double rows of injection holes gave significantly better spread for the 200 mm deep lintels, with a smaller benefit from double rows of injection holes for the 300 mm deep lintels.

Table 4: Effect of single and double rows of injection holes on boron spread (%)

Lintel size (mm)	Spread of boron (%)	
	Single row of holes	Double row of holes
200 x 50	78	93
250 x 50	75	88
300 x 50	92	94

Table 5: Effect of hole spacing on boron spread (%)

Lintel size (mm)	Spread of boron (%) Hole spacing (mm)		
	100	150	200
200 x 50	86	71	82
250 x 50	82	85	74
300 x 50	93	91	74

The highest spread of boron for the 200 and 300 mm deep lintels was achieved with the 100 mm injection hole spacing (Table 5). For the 250 mm deep lintels the 150 mm injection hole spacing gave slightly higher spread of boron than the 100 mm hole spacing. The lowest boron spread for the 250 and 300 mm deep lintels was achieved with the 200 mm hole spacing, and for the 200 mm deep lintels with the 150 mm hole spacing.

Photos of boron spread for each lintel are in Appendix 1. Appendix 2 contains an assessment of the spread of boron on the inner face of each lintel, separately for each injection hole spacing. Boron spread is expressed as a percentage of the length of the lintel with each hole spacing. Maximum spread would be indicated by an assessment of 100%. Values of spread of 60% or less are shown in bold.

Boron spread was variable for some lintels and was probably caused by uneven gap between lintel members. For example, Lintel 3 (200x50, single injection hole) had poor boron spread for each of the hole spacings. The highest coverage was 60% for the 200 mm injection hole spacing and only 44% coverage with the 150 mm injection hole spacing. Boron coverage along the length of Lintel 3 was excellent near the top of the lintel (70 mm from the top edge) but poor at 130 and 170 mm from the top of the lintel. It was noted during assembly of the lintels, that the 200x50mm boards had moderate twist which may have caused uneven gaps between the lintel members and poor spread of the preservative treatment.

Attaching tape to the lower edge of the lintel prior to injection of boron formulation appears to have improved spread of boron and reduced drippage significantly. In all but one case the tape remained attached to the lower edge of the lintel during and after treatment. Treatment fluid pooled along the bottom edge of the between the lintels.

Preservative penetration and retention

The average preservative penetration for the 'double coat brush-on' treated lintels was 30%. There was a trend for higher penetration for the 200x50 mm lintels (Table 6 and Figure 7).

The preservative retention for all lintels was generally acceptable. Out of 72 samples, only 8 samples had a retention of less than 0.40 % m/m BAE in cross section. Individual retention data are contained in Appendix 3. The 300 mm deep lintels had the highest number with a retention of less than 0.40 % m/m BAE in cross section. The double row of injection holes gave a lower average retention for all sizes of lintels.

Table 6: Effect of single and double injection holes on retention and penetration

Lintel size (mm)	Single row of holes		Double row of holes	
	Avg. retention (%m/m)	Avg. Penetration (%)	Avg. retention (%m/m)	Avg. Penetration (%)
200x50	0.73	35	0.62	38
250x50	0.79	28	0.54	34
300x50	0.82	23	0.58	30

Figure 6: Penetration of boron for the 200x50 mm lintels. Sample A contained the injection holes.

The spacing of the injection holes had little effect on the average preservative retention. Injection holes with a spacing of 200 mm gave higher numbers of samples with a retention of less than 0.40 % m/m BAE in cross section.

Table 7: Effect of hole spacing on retention

Lintel size (mm)	Hole spacing (mm)		
	100	150	200
	Avg. retention (% m/m)	Avg. retention (% m/m)	Avg. retention (% m/m)
200x50	0.71	0.66	0.65
250x50	0.65	0.63	0.73
300x50	0.71	0.78	0.61

CONCLUSIONS

Remedial treatment of lintels using 'double coat brush-on plus injection method' gave good but variable spread of preservative on concealed faces of the lintels. In most cases the retention of boron formulation achieved the 0.40 % m/m BAE in cross section required for H1.2 framing. However, full sapwood penetration was not achieved.

Double rows of injection holes gave greater boron spread for all sizes of lintels, and although the average retention was slightly lower than for single holes, most of the retentions were acceptable. Best results were observed with spacing of injection holes at 100 or 150 mm.

The following factors could have contributed to the variability of the results;

- Variable gap between lintel members.
- Rate and duration of injection.
- Leakage in the tape fixed at underside of the lintels.

Before recommendations can be made, a further confirmation is required using double rows of holes, and 100 mm hole spacing for three lintel depths, in the laboratory and at building sites.

REFERENCES

Page D and Singh T (2011). Remedial treatment of difficult to access framing timber - comparison of two treatment methods.

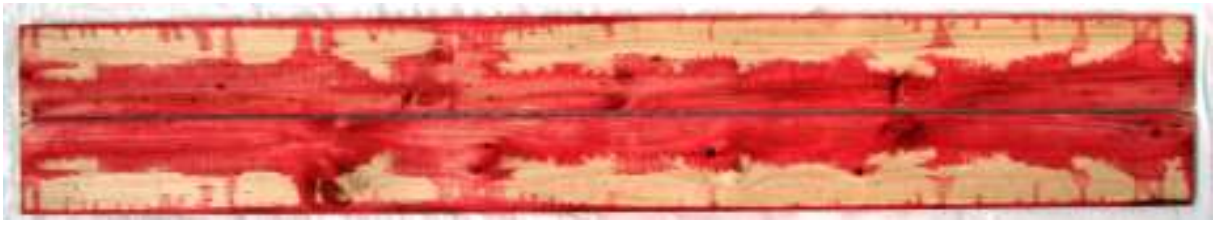
Simpson I, Page D and Singh T (2011). A scoping study on methodology to assess remedial treatment for lintels.

Simpson I, Page D and Singh T (2012). Comparison of fixing lintels with screws or nails for remedial treatment.

APPENDIX 1
PHOTOS SHOWING BORON SPREAD ON INNER FACES OF EACH LINTEL

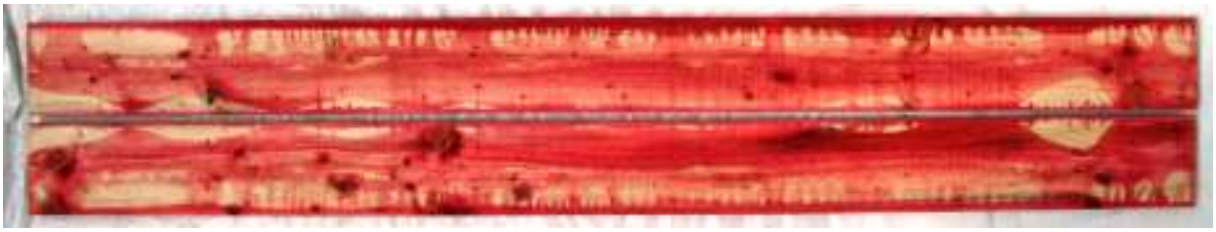
Lintel 1

Lintel 2



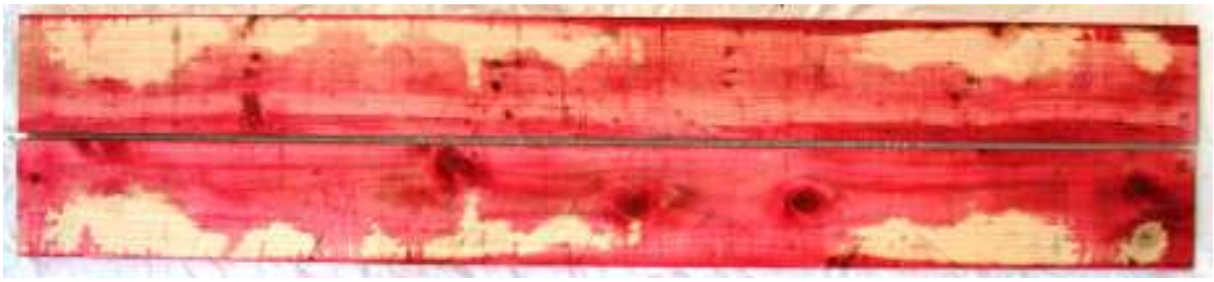
Lintel 3

Lintel 4



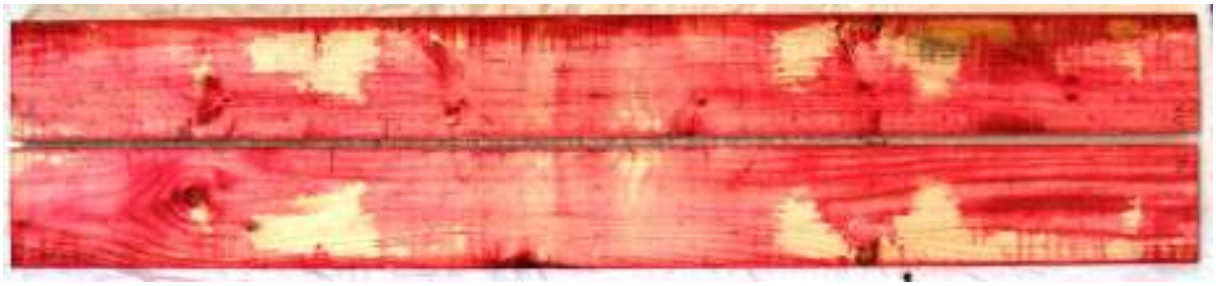
Lintel 5

Lintel 6

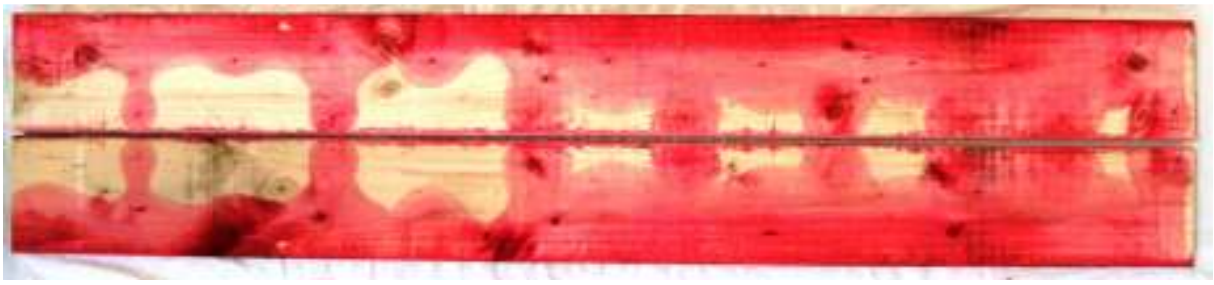


Lintel 7

Lintel 8

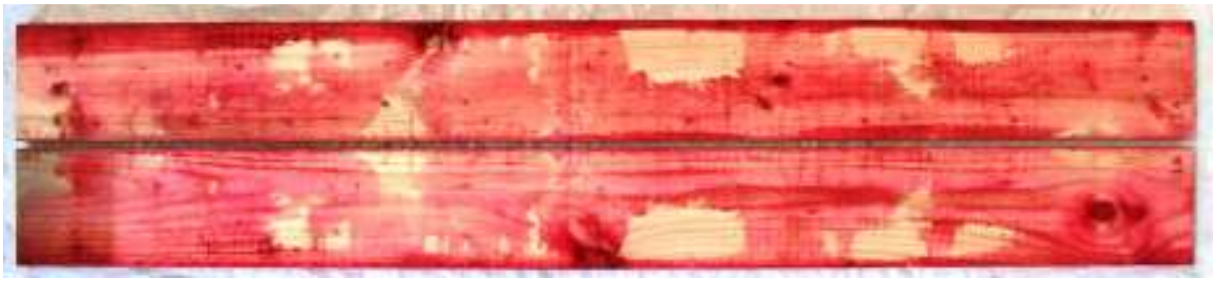


Lintel 9



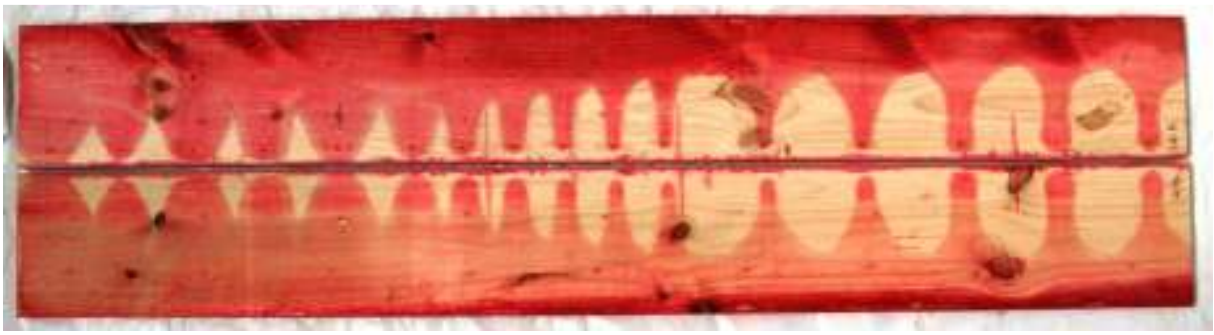
Lintel 10

Lintel 11

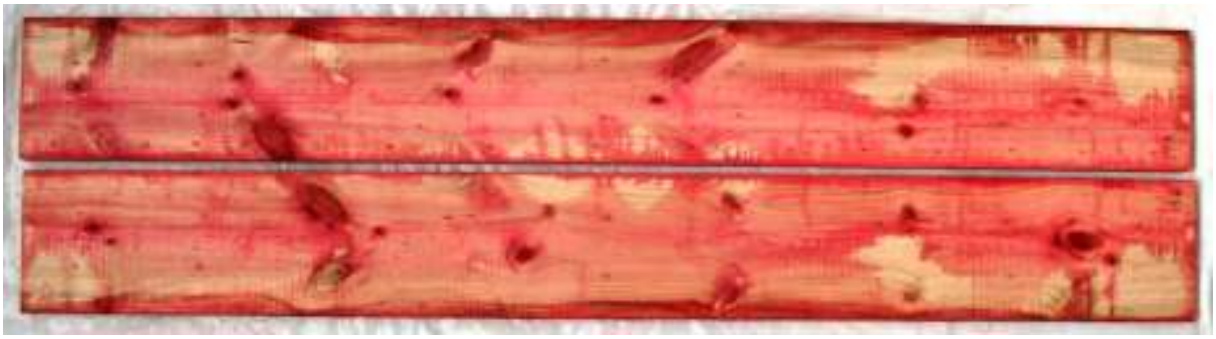


Lintel 12

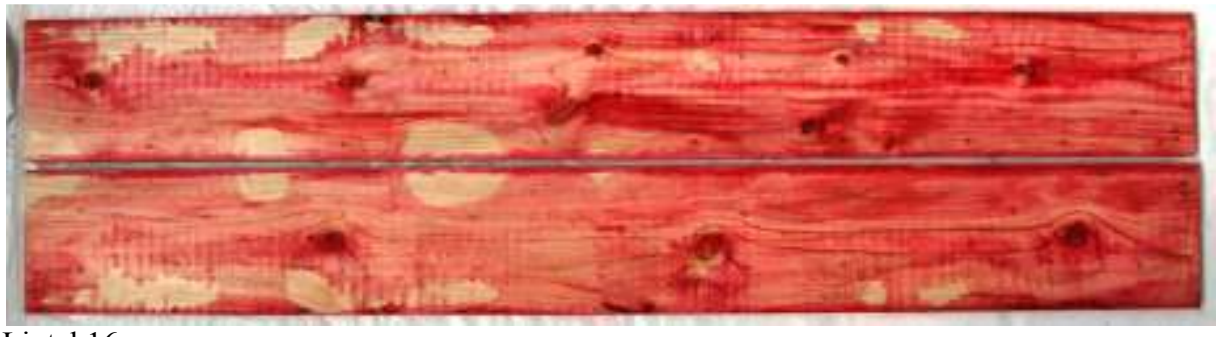
Lintel 13



Lintel 14

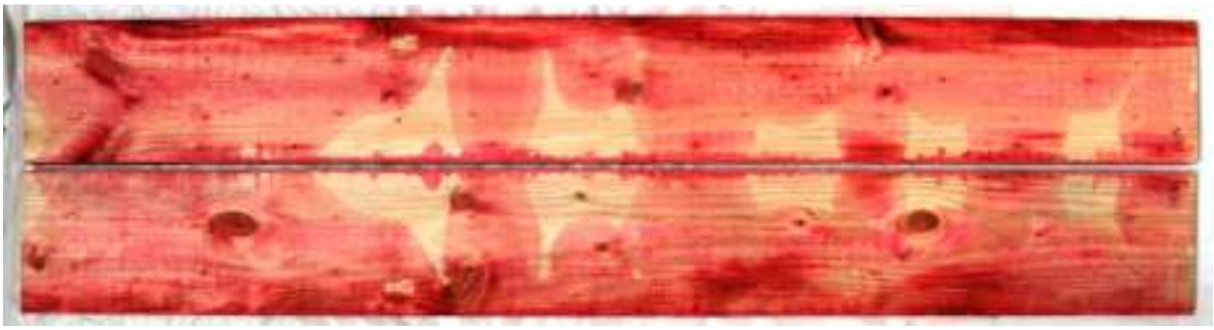


Lintel 15



Lintel 16

Lintel 17



Lintel 18

The top edge of the lintels are to the centre of each photo.

APPENDIX 2

SPREAD OF BORON ON INNER FACES OF LINTEL

Table 8a: Boron spread (%) along the lintels for different injection hole spacings – 200mm deep lintels

Lintel No.	Size (mm)	Rows	Hole spacing (mm)	Spread of boron (%) Hole spacing (mm)			
				100	150	200	TOTAL
1	200x50	Single	100,150,200	91	74	79	81
2	200x50	Single	200,100,150	92	81	75	80
3	200x50	Single	150,200,100	**48**	**44**	**60**	**51**
4	200x50	Double	100,150,200	90	71	95	86
5	200x50	Double	200,100,150	99	83	94	92
6	200x50	Double	150,200,100	90	76	87	84

Table 8b: Boron spread (%) along the lintels for different injection hole spacings – 250mm deep lintels

Lintel No.	Size (mm)	Rows	Hole spacing (mm)	Spread of boron (%) Hole spacing (mm)			
				100	150	200	TOTAL
7	250x50	Single	100,150,200	**51**	83	67	67
8	250x50	Single	200,100,150	83	95	77	84
9	250x50	Single	150,200,100	98	68	83	80
10	250x50	Double	100,150,200	98	98	72	87
11	250x50	Double	200,100,150	68	88	71	76
12	250x50	Double	150,200,100	97	81	74	82

Table 8c: Boron spread (%) along the lintels for different injection hole spacings – 300mm deep lintels

Lintel No.	Size (mm)	Rows	Hole spacing (mm)	Spread of boron (%) Hole spacing (mm)			
				100	150	200	TOTAL
13	300x50	Single	100,150,200	100	77	**53**	74
14	300x50	Single	200,100,150	89	99	76	86
15	300x50	Single	150,200,100	86	75	98	87
16	300x50	Double	100,150,200	95	97	78	89
17	300x50	Double	200,100,150	90	100	**53**	76
18	300x50	Double	150,200,100	98	98	92	96

Table 9a: Boron spread (%) along the lintels at different distances from the top of the lintel – 200mm deep lintels

Lintel No.	Size (mm)	Rows of holes	Hole spacing (mm)	Spread of boron (%) Distance from top of Lintel (mm)			
				70	130	170	TOTAL
1	200x50	Single	100,150,200	**43**	99	100	81
2	200x50	Single	200,100,150	**41**	100	100	80
3	200x50	Single	150,200,100	100	**20**	**34**	**51**
4	200x50	Double	100,150,200	100	**59**	99	86
5	200x50	Double	200,100,150	100	85	90	92
6	200x50	Double	150,200,100	100	83	68	84

Table 9b: Boron spread (%) along the lintels at different distances from the top of the lintel – 250mm deep lintels

Lintel No.	Size (mm)	Rows	Hole spacing (mm)	Spread of boron (%) Distance from top of Lintel (mm)			
				80	170	200	TOTAL
7	250x50	Single	100,150,200	100	**60**	**42**	67
8	250x50	Single	200,100,150	65	87	99	84
9	250x50	Single	150,200,100	96	74	71	80
10	250x50	Double	100,150,200	63	99	99	87
11	250x50	Double	200,100,150	**48**	83	97	76
12	250x50	Double	150,200,100	96	77	73	82

Table 9c: Boron spread (%) along the lintels at different distances from the top of the lintel – 300mm deep lintels

Lintel No.	Size (mm)	Rows	Hole spacing (mm)	Spread of boron (%) Distance from top of Lintel (mm)			
				100	200	250	TOTAL
13	300x50	Single	100,150,200	96	**60**	64	74
14	300x50	Single	200,100,150	**59**	100	100	86
15	300x50	Single	150,200,100	100	79	81	87
16	300x50	Double	100,150,200	100	96	70	89
17	300x50	Double	200,100,150	73	76	78	76
18	300x50	Double	150,200,100	89	98	100	96

APPENDIX 3

INDIVIDUAL PRESERVATIVE PENETRATION AND RETENTION

Table 10a: Retention and penetration – 200mm deep lintels

ID (Lintel number /hole spacing)	Size (mm)	Rows	Sapwood (%)	Penetration (%)	BAE in cross sections (% m/m)
1A/100	200x50	Single	100	40	0.59
1A/150	200x50	Single	95	40	0.56
1A/200	200x50	Single	98	45	0.88
1B/100	200x50	Single	95	30	0.77
1B/150	200x50	Single	90	35	0.85
1B/200	200x50	Single	95	40	0.55
2A/100	200x50	Single	100	45	0.89
2A/150	200x50	Single	100	35	0.66
2A/200	200x50	Single	100	30	0.77
2B/100	200x50	Single	60	40	0.86
2B/150	200x50	Single	60	20	0.8
2B/200	200x50	Single	75	20	0.58
4A/100	200x50	Double	100	30	0.55
4A/150	200x50	Double	100	30	0.43
4A/200	200x50	Double	100	30	**0.37**
4B/100	200x50	Double	100	40	0.77
4B/150	200x50	Double	100	35	0.72
4B/200	200x50	Double	100	40	0.65
5A/100	200x50	Double	70	50	0.61
5A/150	200x50	Double	75	50	0.72
5A/200	200x50	Double	70	50	0.68
5B/100	200x50	Double	100	50	0.66
5B/150	200x50	Double	70	25	0.55
5B/200	200x50	Double	90	30	0.73

Table 10b: Retention and penetration – 250mm deep lintels

ID (Lintel number /hole spacing)	Size (mm)	Rows	Sapwood (%)	Penetration (%)	BAE in cross sections (% m/m)
7A/100	250x50	Single	50	30	0.93
7A/150	250x50	Single	40	30	0.96
7A/200	250x50	Single	40	30	1.28
7B/100	250x50	Single	100	50	0.55
7B/150	250x50	Single	100	30	0.57
7B/200	250x50	Single	100	35	0.44
8A/100	250x50	Single	20	15	0.71
8A/150	250x50	Single	25	20	0.77
8A/200	250x50	Single	20	20	1.65
8B/100	250x50	Single	100	25	0.68

8B/150	250x50	Single	100	25	**0.38**
8B/200	250x50	Single	70	25	0.55
10A/100	250x50	Double	100	25	0.58
10A/150	250x50	Double	100	30	0.6
10A/200	250x50	Double	100	20	0.41
10B/100	250x50	Double	100	30	0.83
10B/150	250x50	Double	100	25	0.56
10B/200	250x50	Double	100	25	0.43
11A/100	250x50	Double	100	20	0.42
11A/150	250x50	Double	100	20	0.56
11A/200	250x50	Double	100	25	0.46
11B/100	250x50	Double	100	100	0.47
11B/150	250x50	Double	100	40	0.6
11B/200	250x50	Double	100	50	0.6

Table 10c: Retention and penetration – 300mm deep lintels

ID (Lintel number /hole spacing)	Size (mm)	Rows	Sapwood (%)	Penetration (%)	BAE in cross sections (% m/m)
13A/100	300x50	Single	40	25	0.83
13A/150	300x50	Single	55	30	1.54
13A/200	300x50	Single	25	20	1.22
13B/100	300x50	Single	90	20	**0.32**
13B/150	300x50	Single	90	15	0.79
13B/200	300x50	Single	85	20	**0.36**
14A/100	300x50	Single	100	20	0.56
14A/150	300x50	Single	100	25	0.44
14A/200	300x50	Single	100	20	0.6
14B/100	300x50	Single	30	30	1.09
14B/150	300x50	Single	30	25	0.8
14B/200	300x50	Single	30	25	1.28
16A/100	300x50	Double	65	30	0.76
16A/150	300x50	Double	65	30	0.72
16A/200	300x50	Double	65	20	0.46
16B/100	300x50	Double	75	30	**0.37**
16B/150	300x50	Double	70	25	0.5
16B/200	300x50	Double	75	25	**0.35**
17A/100	300x50	Double	90	30	1.18
17A/150	300x50	Double	90	30	0.78
17A/200	300x50	Double	100	20	**0.35**
17B/100	300x50	Double	50	20	0.57
17B/150	300x50	Double	45	50	0.7
17B/200	300x50	Double	90	50	**0.27**

APPENDIX 4

APPLICATION RATES AND OBSERVATIONS MADE DURING INJECTION OF TREATMENT FLUID

The amount of preservative that was applied to the lintels is shown in Table 11.

Table 11: Typical preservative application rates on lintels

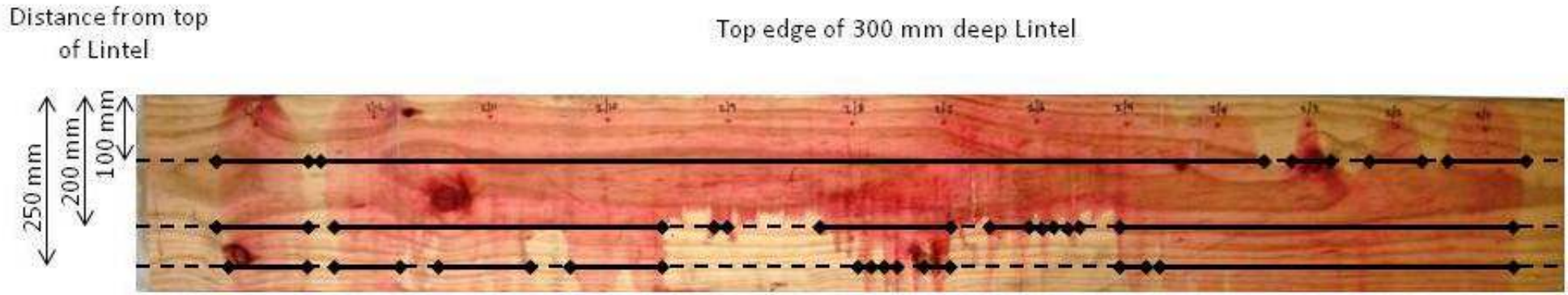
Lintel depth (mm)	First coat (g)	Second coat (g)	Total (g)	Application rate (ml/m^2)
200	181	123	304	253
250	168	132	299	208
300	177	162	339	202

The following observations have been noted during injection of treatment fluid into lintels.

- Fluid may exit from the lintel through knot checks and splits in either lintel member.
- Cloth tape may lose adhesion and fall from the bottom of the lintel.
- Inject fluid slowly to prevent pooling of the fluid on the top edge of the lintel. Injection may take up to 2 minutes per hole. Typical injection times are 30-60 seconds.
- Injection rates may be longer for the second injection.
- It is important to maintain a good seal between the syringe and the face of the lintel to prevent loss of fluid down the outer face of the lintel.
- Excessive pooling of fluid on the top of the lintel may cause fluid to flow out adjacent injection holes.
- Excessive pooling of fluid on the top edge of the lintel may flow out the injection hole if the syringe is removed from the hole while there is still pooling fluid.
- If possible, lintels with a large gap between members should be clamped and renailed prior to injection of boron, to give better boron coverage.

APPENDIX 5

METHOD FOR ASSESSMENT OF BORON SPREAD



For 250mm deep lintels, boron spread was assessed 80, 170 and 200mm from the top edge of the lintel.
For 200mm deep lintels, boron spread was assessed 70, 130 and 170mm from the top edge of the lintel.

Boron spread is the cumulative occurrence of Boron at the specified distance from the top edge of the lintel.