First inspection of remedial treatments on the Howe Truss Railway Bridge, Waikino

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Abstract

Sections of the Howe truss railway bridge at Waikino that had been treated with preservatives were inspected after approximately 12 months. There were minor colour changes, particularly where CD50 and Busan 30L had been applied to the surface. CD50 was the only surface treatment which was still water-repellent. Of the preservatives which had been inserted into holes bored in the stringers, the Busan Pole Gel had largely disappeared but the CN emulsion and the Impel rods had only gone where there were shakes or major voids in the wood. The inserted preservative reservoir holes were replenished and resealed.

1. Introduction

Early in July 1999 the lower section of trusses and the upper surfaces of transoms on the Goldfields Railway bridge near Waikino were coated with a variety of brush-on preservatives (see Appendices I & II). Preservatives were also injected or inserted into holes bored in the main bridge stringers in the following September (Page & Durbin 2000). The bridge was inspected in June 2000 to determine whether there were visible differences between the treated and untreated surfaces and how much of the injected/inserted preservatives had been absorbed into the wood.

2. Surface treatments

The treated sections of all the struts in the trusses were visible and there was no redevelopment of lichen and algae on them. All surfaces were covered with a thin layer of degraded wood, similar to that present before the preservatives were applied. Occasional vegetation and moss plants had re-established on the treated sections of transoms 29, 22 and 21, but this appeared to be related to the fact that some debris had not been removed from deep fissures by water-blasting. The debris in the fissures is providing a suitable medium for vegetation to become established. The components treated with Busan 30L were very pale silver grey on the upper surface, almost white. This "whitening" of the surface has previously been recorded on radiata pine treated with TCMTB-based products and exposed to weathering. In radiata pine it has been accompanied by the surface fibres becoming soft and loose, often described as "furriness". No "furriness" was visible on the treated struts. Those treated with Borocol and Busan Pole Gel were pale silver grey on the upper surfaces and not noticeably different in colour to the untreated sections. Both copper naphthenate in diesel and CN emulsion changed the surface colour very slightly, giving it a grey-green tinge. The king strut (2) was quite notice-

ably darker than other components treated with copper naphthenate in diesel, although there was no obvious reason why. The sections coated with CD50 were much darker than the untreated sections and components treated with other products. Both the oil carrier and the copper-based active ingredient in CD50 would have contributed to this darkening.

Water-repellency can influence surface deterioration and preservative leaching. The copper naphthenate products and CD50 were inherently water-repellent while the Boracol formulation had 10% water-repellent added to it. The Busan products do not have any water-repellent properties. Water was sprinkled on the surface of several struts to determine whether the products retained any water-repellency. It beaded and quickly ran off the CD50-coated wood and there was slight slowing of water absorption on the surface of the sections treated with copper naphthenate in diesel and CN emulsion. Water quickly soaked into the surface of sections treated with the Boracol and Busan products. The lack of water-repellency of the Boracol treatment could result in preservative loss because boron-based preservatives are easily leached from wood. If this product is used in future, more than 10% water-repellency may be required to prevent leaching.

3. Inserted/injected preservatives

The plastic plugs sealing the preservative reservoir holes were easily removed with a screwdriver and the level of preservative remaining in the holes was checked with a wire probe. Because the holes were horizontal and the preservatives had tended to liquefy, it was difficult to determine exactly how much preservative remained. Where it appeared that some preservative had been absorbed into the wood, the reservoir was refilled with preservative. Approximate amounts of preservative remaining in the reservoir holes and the amounts used in replenishment are given in Table 1.

The Impel rods at point "A" were still all in place and did not appear to have dissolved. When the reservoir holes were bored at this point the wood was all sound and the wood moisture content 27-30%. At point "D" there were originally shakes at the top hole and rot in the centre hole, but the bottom hole was in sound wood with a moisture content of 36%. Here the rod in the top hole had partly dissolved, there was only liquid in the centre hole, and the rods in the bottom hole had not dissolved. This indicates that there is little or no absorption of the boron rods into the wood until the moisture content is above 30% or there is some moisture ingress through shakes and decay pockets.

The Busan pole gel appears to have been absorbed into the wood, even where it was relatively sound and at a moisture content of about 30%. The reservoir holes only have a volume of about 30 ml, so much of the preservative used in

replenishment of reservoirs in unsound wood has gone into voids or shakes in the wood.

The CN Emulsion absorption appears to have been minimal except in reservoir holes where there were significant shakes or decay. The amount of preservative used in replenishment did not exceed the volume of the reservoir holes.

4. Conclusions

There was no evidence of algae or lichen regrowth on the surface-treated sections of the bridge components after twelve months. Occasional vegetation is growing in debris in deep fissures on the top of transoms.

Minor colour changes have resulted from the surface treatments, particularly whitening from Busan 30L treatment and darkening from CD50 treatment.

CD 50 was the only surface treatment retaining a reasonable degree of water-repellency.

For the preservative inserted in holes bored in the stringers, the Impel boron rods and CN Emulsion only diffused into the wood where there were major defects, whereas the Busan Pole Gel had gone from most of the reservoir holes.

5. Reference

Page, D.; Durbin, G. 2000. In-service wood preservative test on the Howe truss railway bridge, Waikino. *Conservation Advisory Science Notes 299*. 27 p.

TABLE 1
Inserted Preservative Retention and Replenishment

Sample Point	Boring Position	Original Moisture Content	Original Wood Condition	Preservative Used	Amount Remaining	Additional Preservative Inserted
A	Top	27.7	Sound	Impel	100%	Nil
A	Middle	30.4	Sound	Impel	100%	Nil
A	Bottom	27.8	Sound	Impel	100%	Nil
B	Top	31.1	Shakes	BPG	0	90ml
B	Middle	31.9	Centre rot	BPG	0	110ml
B	Bottom	36.3	Shakes	BPG	<25%	25ml
C	Top	29.3	Black	KCNE	>75%	10ml
C	Middle	20.2	Severe rot	KCNE	50%	30ml
C	Bottom	32.3	Shakes	KCNE	>75%	10ml
D	Top	42.4	Shakes	Impel	50%	15g
D	Middle	53.4	Centre rot	Impel	0	35g
D	Bottom	35.6	Sound	Impel	100%	Nil
E	Top	27.9	Sound	KCNE	>75%	10ml
E	Middle	35.7	Rot -old hole	KCNE	>75%	20ml
E	Bottom	24.7	Sound	KCNE	100%	<10ml
F	Top	29.3	Sound	BPG	<25%	25ml
F	Middle	41.1	Centre rot	BPG	0	130ml
F	Bottom	30.5	Sound	BPG	<25%	20ml

APPENDIX I

Preservatives Used

B30L	Busan 30L	A 10% solution in water, active ingredient TCMTB (2-(thiocyanomethylthio) benzo-thiazole)
BPG	Busan Pole Gel	15% TCMTB in a gel which includes "Busperse 47"(wood penetrant).
CNO	Metallex	6% copper naphthenate concentrate mixed 1:3 with light diesel fuel oil.
KCNE	CN Emulsion	Copper naphthenate in a thickened oil-in-water emulsion (1.5% copper)
BORU	Boracol 400RH	40% boron with benzalkonium chloride in an aqueous solution and with 10% "Ultrawood"(water repellent) added
Impel	Impel Rods	Fused boron glass rods containing 100% disodium octaborate
CD50	CD50	Copper-8-quinolinolate (oxine copper) in a proprietary formulation with oil

APPENDIX II - List of Treated Bridge Components

Number	Component Type	Size (mm)	Position (end/side)	Preservative
1	King strut	380x300	Waihi/upstream	CD50
2	King strut	380x300	Waihi/downstream	CNO
3	Queen strut	350x250	Wahi/upstream	KCNE
4	Queen strut	350x250	Waihi/downstream	BPG
5	Queen strut	350x250	Waikino/upstream	BORU
6	Queen strut	350x250	Waikino/downstream	B30L
7	King strut	400x300	Waikino/upstream	B30L
8	King strut	410x310	Waikino/downstream	KCNE
9	Double strut	2/200x140	Waihi/upstream	B30L
10	Double strut	2/200x140	Waihi/downstream	BORU
11	Double strut	2/200x140	Waikino/upstream	CNO
12	Double strut	2/200x140	Waikino/downstream	KCNE
13	Central strut	200xl20	Waihi/upstream	BPG
14	Central strut	200xl30	Waihi/downstream	CD50
15	Central strut	200xl20	Waikino/upstream	BPG
16	Central strut	200x l30	Waikino/downstream	CD50
17	Transom upper surface	2/300x800	Base of 3	KCNE
17a	Transom upper surface	1/300x2100	Base of 3	KCNE
18	Transom upper surface	2/300x800	Base of 4	BPG
18a	Transom upper surface	1/300x1200	Base of 4	CNO
19	Transom upper surface	2/300x800	Base of 9	B30L
19a	Transom upper surface	1/300x2100	Base of 9	B30L
20	Transom upper surface	2/400x300	Base of 10	BORU
20a	Transom upper surface	2/400x300	Base of 10	BORU
21	Transom upper surface	2/300x800	Base of 13 &15	BPG
21a	Transom upper surface	1/300x2100	Base of 13 &15	BPG
22	Transom upper surface	2/300x800	Base of 14 &16	CD50
22a	Transom upper surface	1/300x1200	Base of 14 &16	CD50
23	Transom upper surface	2/300x800	Base of 11	CNO
23a	Transom upper surface	1/300x2100	Base of 11	CNO
24	Transom upper surface	2/300x800	Base of 12	KCNE
24a	Transom upper surface	1/300x1200	Base of 12	KCNE
25	Transom upper surface	2/300x800	Base of 5	BORU
25a	Transom upper surface	1/300x2100	Base of 5	BORU
26	Transom upper surface	2/300x800	Base of 6	B30L
26a	Transom upper surface	1/300xl200	Base of 6	B30L
36	Sway brace	220xl30	End of 26a	B30L
37	Compression block		Base of 3	KCNE
38	Compression block		Base of 4	CNO
39	Compression block		Base of 9	B30L
40	Compression block		Base of 10	BORU
41	Compression block		Base of 13 & 15	BPG
42	Compression block		Base of 14 & 16	CD50
43	Compression block		Base of 11	B30L
44	Compression block		Base of 12	KCNE
45	Compression block		Base of 5	BORU
46	Compression block		Base of 6	B30L
A	Longitudinal stringer	400x300	Waikino/upstream	IMPEL
B	Longitudinal stringer	400x300	Waikino/downstream	BPG
C	Longitudinal stringer	400x300	Above 23	KCNE
D	Longitudinal stringer	400x300	Above 24	IMPEL
E	Longitudinal stringer	400x300	Waihi/downstream	KCNE
F	Longitudinal stringer	400x300	Above20	BPG

Figure 1 (top left). The distinctively whitish colour of components treated with Busan 30L is evident on this king strut at the Waikino end (component 7). The lower part of the queen strut in the background (5), treated with Boracol, was pale in colour but not distinctively different from the untreated section of the strut.

Figure 2 (top right). The lower section of the double strut (12) was treated with CN emulsion and is much the same colour as the untreated section above the intersection with the single strut (14). The dark colour of the lower section of the single strut (14) is from the CD50 treatment.

Figure 3 (bottom right). King strut (1), showing the dark colour of the CD50 treatment.