Protection of Wooden Bridge Decks on Aggregate-Surfaced Roads

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There are 36 bridges with wooden decks on aggregate-surfaced roads in the Chequamegon National Forest. These decks wear out rapidly, primarily because of the gouging effect of stray pieces of aggregate that are thrown onto the decks by moving traffic. In an attempt to reduce this rapid wear, forest personnel have experimented since 1981 with different applications of asphalt surfacing to protect the decks. Geotextile underlays have also been experimented with in an attempt to reduce the cracking of the asphalt surfacing on the wooden decks. The different applications of these asphalt surfacings and the results to date are discussed.

There are 39 treated timber bridges with wooden decks in the Chequamegon National Forest in northern Wisconsin. All but three of these bridges are on roads that are surfaced with crushed aggregate. The traffic volume on these roads is usually less than 100 vehicles per day (vpd) and consists of light vehicles and logging trucks with a gross vehicle weight (GVW) of up to 40 tons.

The decks of these bridges consist of running plank tracks, full-width running planks, nail-laminated deck planks, or glulam panels. These wooden decks wear out rapidly and are also subject to rot. Some wear results from the friction of tires on the surface, but most wear is caused by stray pieces of crushed rock from the roadway gouging the wood.

Potholes also develop in the road just behind the abutment walls, which creates a maintenance problem and an impact load to the bridges. When an attempt is made to fill these potholes, the graders damage the top abutment planks and crushed surfacing is carried onto the bridges. This material causes the bridge deck to remain damp, which increases the incidence of rot. Moving traffic also throws angular pieces of aggregate onto the bridge, which causes excessive wear.

In an attempt to reduce this rapid wear, Chequamegon National Forest personnel began experimenting with paved approaches in 1981. That year the approaches of two bridges were paved for a distance of 50 ft with cold-mix asphalt. The decks of both bridges had running planks. The situation improved on both bridges, but it was determined that 50 ft was an insufficient pavement length. The graders dragged the crushed aggregate over part of the paving, and pieces of aggregate were still being thrown onto the bridge by vehicles.

In 1982 it was decided to pave three bridge decks that were showing wear. The decks of two of the three bridges were constructed with glulam panels; the other bridge had a nail-laminated deck. Each bridge was designed to have a wearing course, but it had never been applied. Two of the bridges were almost 10 years old and were beginning to show considerable wear.

It was known from experience in other forests that asphalt coatings on glulam decks developed cracks at the panel joints, which created a continuing maintenance problem. A decision was made to experiment with a geotextile underlay to try to mitigate this problem.

A contract was made to pave the three bridges with a hot asphalt mix in 1982. The approaches were also paved for a distance of at least 75 ft. A standard geotextile underlay, Reepav®, manufactured by duPont, was used on one of the panel decks and the nail-laminated deck. A new product called Petrotac® and manufactured by Phillips Fiber Corporation was used on the other panel deck. Petrotac has a preapplied asphalt backing. It is considerably more expensive than standard underlays, but it was hoped that it would provide better results.

An MC30 tack coat was applied at a rate of 0.3 gal/yd^2 on the approaches, and approximately half that rate on the bridge decks, to bond the Reepav to the deck surface. No tack coat was applied on the deck on which the Petrotac was used because the fabric had an asphalt backing. Petrotac was a new product in 1982 and at that time no tack coat was specified. Since then, it has been recommended to apply a tack coat on top of the Petrotac.

The Reepav geotextile was placed on the bridge and extended about 5 ft onto the approaches to ensure continuity between the bridge and the approaches. The geotextile was not used on the remainder of the road.

Petrotac is sold in 1-ft or 3-ft widths in 50-ft rolls. The 3-ft-wide rolls were purchased and placed transversely across the deck over each seam of the deck panels. One strip was also centered on the abutment/fill seam. Because the glulam panels were 43 in wide and the Petrotac strips were 36 in wide, a 7-in space was left between each transverse strip. This space was purposely left bare.

The bridges were 84, 77, and 71 ft long. The bridge with the nail-laminated deck was 77 ft long and the bridge on which the Petrotac was applied was 71 ft long (see Table 1). The two rolls of Reepav cost \$493 and the Petrotac cost \$583. This amounted to a cost of about \$1.75/yd^2 or approximately one-third the cost of the bituminous surface of \$4.90/yd^2.

The paving contract was made in September of 1982; a record rainfall was experienced in the fall of that year. After the weather cleared and paving was to proceed, it was found that the aggregate road surface was too moist for adequate penetration of a tack coat. Instead of postponing the project until spring, the contractor was allowed to use a cement block sealing compound cut with gasoline as a tack coat to bond the Reepav. This worked well, but probably not as well as a light MC30 tack coat.

The two bridges on which the Reepav fabric was used were paved on the same day. The temperature on that day was

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TABLE 1 BRIDGES AND TREATMENTS

Year	Bridge Name	Length (ft)	Deck Composition	Treatment
1981	Hungry Run (FR 164)	26	Full-width running planks	50-ft approaches
1981	East Fork, Chippewa River (FR 164)	175	Two-track running planks	50-ft approaches
1982	South Fork, Flambeau River (FR 149)	77	Nail-laminated	Reepav, deck, and approaches
1982	South Fork, Flambeau River (FR 152)	84	Glulam panels	Reepav, deck, and approaches
1982	Brunsweiler River (FR 196)	71	Glulam panels	Petrotac, deck, and approaches
1984	Elk River (FR 131)	51	Glulam panels	Reepav, deck, and approaches
1984	Yellow River (FR 121)	93	Nail-laminated	Reepav, deck, and approaches
1984	North Fork, Yellow River (FR 108)	51	Full-width running planks	100-ft approaches
1984	North Fork, Yellow River (FR 112)	58	Full-width running planks	100-ft approaches

between 42° and 50°F (6 and 10°C), which was not an ideal temperature for paving. Shortly after the second lane on the second bridge was started, it began to rain hard for about 15 min. When the rain stopped, the water was swept off the bridge and paving was completed.

It snowed the day after these two bridges were paved; the third bridge could not be paved for 2 weeks. Some ice was on the shoulders of this bridge on the day paving was resumed. The ice was melting when the Petrotac was being applied, which dampened the deck and prevented the Petrotac from bonding before the asphalt was applied. The material tended to gather under the paver and form pleats under the asphalt, particularly at the center of the bridge. The temperature of the hot mix was between 260° and 295°F (127 and 146°C). The heat was expected to evaporate the moisture on the deck and enable the Petrotac to bond. This apparently succeeded because no pleating problems have been observed to date.

In 1983, Nicolet National Forest personnel paved two glulam panel decks with Petrotac by laying it longitudinally across the full width of the deck. The decks and at least 75 ft of the approaches were paved with 2 in of hot asphalt mix. The cost of Petrotac rose dramatically between 1982 and 1983. The bid price for Petrotac was $6.75/yd^2, whereas the cost of the 2-in hot mix was $6.50/yd^2.

In 1984 four more bridges and approaches were paved. One of the bridges had a nail-laminated deck that had been in place for over 12 years. The deck on this bridge was worn as much as an inch in places. It was decided to place a standard geotextile mat on this bridge and pave it with 2 in of hot asphalt. This same treatment was applied to another bridge that had a deck of glulam panels.

Two other bridges had full-width running planks. The approaches of these bridges were paved with the same hot-mix asphalt for a distance of 100 ft.

The bridges and approaches have been monitored each year since they were applied. As was previously mentioned, it was found that the 50-ft approaches were too short, so they were extended. The longer approach length appears to be keeping most of the aggregate particles off the bridges.

The geotextile underlays are not performing as well as anticipated. After 2 or 3 years service cracks began to develop at the panel points on the glulam decks and randomly on the nail-laminated decks. It was hoped that there would be less cracking. These cracks appeared to be narrower than those observed on decks with no underlay; the use of geotextiles therefore cannot yet be considered a total failure. The cracks must be sealed, however, and that represents a maintenance cost.

One of the bridges in the forest is on a paved road and has a deck that consists of full-width running planks. This bridge was constructed in 1973, and the running planks do not show any appreciable wear yet. It appears from this example that another possible solution is to pave the approaches for a considerable distance, possibly 200 ft, to ensure that the aggregate is kept off the deck. The deck can then be replaced when it is worn out.