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Field Performance of Timber Bridges

3. Birchlog Run and Tumbling Rock Run Stress-Laminated Deck Bridge

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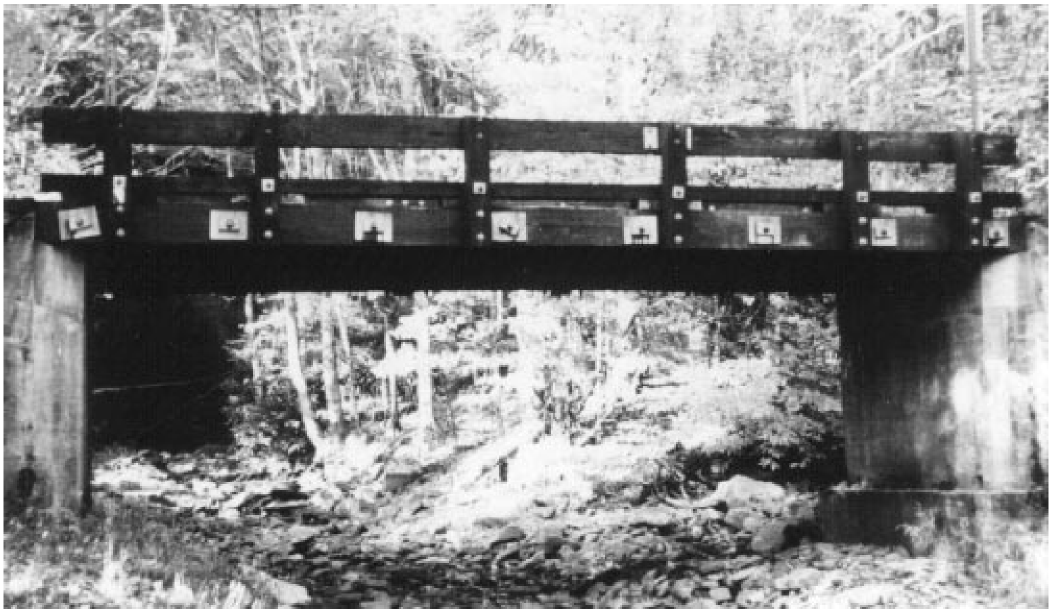

Abstract

The Birchlog Run and Tumbling Rock Run bridges were constructed in the summer of 1990 on the Monongahela National Forest in West Virginia. The bridges are simple span, single-lane, stress-laminated deck superstructures, and each bridge is approximately 30 ft long and 13 ft wide. The bridges are located approximately 1/2 mile apart and are nearly identical in design. However, the Birchlog Run bridge is constructed of Southern Pine (softwood) lumber, and the Tumbling Rock Run bridge is constructed of Northern Red Oak (hardwood) lumber. The close proximity of the bridges provided an opportunity to compare the performance of stress-laminated decks constructed of softwood and hardwood species under similar environmental conditions. Performance of the bridges was monitored for 3 years, beginning at the time of installation. This monitoring involved gathering and analyzing data relative to the wood moisture content, force level of the stressing bars, vertical bridge creep, and behavior of the bridges under static-load conditions. In addition, comprehensive visual inspections were conducted to assess the overall condition of the bridges. Based on 3 years of field monitoring, the bridges are performing well with no structural or serviceability deficiencies.

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Field Performance of Timber Bridges

3. Birchlog Run and Tumbling Rock Run Stress-Laminated Deck Bridges

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Introduction

In 1988, Congress passed the Timber Bridge Initiative (TBI) to further develop and extend the use of timber as a bridge material. Responsibility for administration of the TBI was delegated to the USDA Forest Service and included a demonstration timber bridge program managed by the Timber Bridge Information Resource Center (TBIRC) in Morgantown, West Virginia, and a research program at the USDA Forest Service, Forest Products Laboratory (FPL), in Madison, Wisconsin (USDA 1994). Additionally, the Forest Service National Forest System, which administers the national forests of the country, made a commitment to demonstrate new technology in timber bridge design and construction. A large percentage of National Forest lands are located in rural communities where the economy depends on natural resource management and utilization. Traditionally, the National Forest System maintains jurisdiction over thousands of bridges, a significant percentage of which are timber bridges.

This report describes the development, design, construction, and field performance of the Birchlog Run and Tumbling Rock Run bridges on the Monongahela National Forest in West Virginia. The bridges were constructed in June 1990 as part of a commitment by the Forest Service National Forest System to demonstrate new and emerging timber bridge technology. Both bridges are single-lane, single-span, stress-laminated decks that are approximately 30 ft long and 13 ft wide. (See Table 1 for metric conversion factors.) This monitoring project is unique in that the two stress-laminated deck bridges are located only 1/2 mile apart and are nearly identical in design, but utilize different wood species. The Birchlog Run bridge is constructed of Southern Pine (softwood) lumber, and the Tumbling Rock Run bridge is constructed of Northern Red Oak (hardwood) lumber. Information sheets on both bridges are located in Appendices A and B.

Table 1—SI conversion factors

English unit	Conversion factor	SI unit
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
square foot (ft^2)	0.09	square meter (m^2)
pound (lb)	0.14	Newton (N)
lb/in^2 (stress)	6,894	Pascal (Pa)
lb/ft^2 (weight)	4.88	kilogram/meter^2 (kg/m^2)
ton (short, 2,000 lb)	907	kilogram (kg)

Background

The Birchlog Run and Tumbling Rock Run bridges are located within the Monongahela National Forest approximately 45 miles North of Lewisburg, West Virginia (Fig. 1). They are on Forest Road 76, a single-lane, gravel roadway that accesses the Cranberry Back Country botanical area of the Monongahela National Forest. The road provides access for fire fighting, logging, and maintenance vehicles, but is gated to restrict vehicle traffic.

The original Birchlog Run and Tumbling Rock Run bridges were built in 1935 and consisted of steel girders supporting transverse, nail-laminated lumber decks. In the late 1980s, the bridges were rated structurally deficient by the Monongahela National Forest engineering staff because of a 15-ton load limit on each bridge. Administrative vehicles that used the roadway were in excess of 30 tons and could not safely cross the bridges. Because of this deficiency, the engineering staff recommended replacement of the existing bridges with timber bridges constructed from locally available wood species.

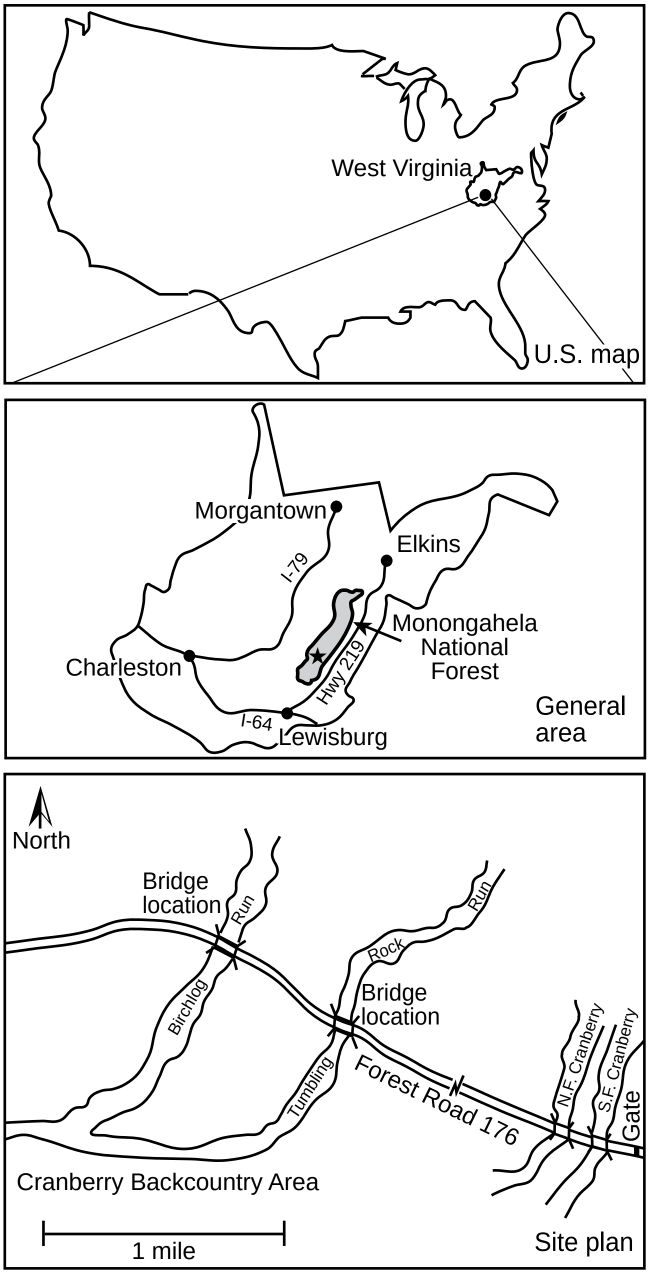


Figure 1—Location maps of the Birchlog Run and Tumbling Rock Run bridges.

For assistance in the selection and design of replacement timber bridges for the Birchlog Run and Tumbling Rock Run sites, the Monongahela National Forest engineering staff consulted the Forest Service Eastern Regional Office. The Regional Office staff suggested the use of the relatively new stress-laminated wood deck system. Through consultation with the FPL and the Civil Engineering Department of the University of Wisconsin–Madison, the decision was made to build stress-laminated deck bridges constructed of Southern Pine and Northern Red Oak for the Birchlog Run and Tumbling Rock Run bridges, respectively.

It was further determined that the field performance of the bridges should be monitored after bridge installation to provide assurance that the performance of the newly developed timber bridge system was satisfactory. Subsequently, FPL and the Monongahela National Forest entered into a memorandum of understanding to complete structural monitoring of the bridges as part of an ongoing national timber bridge monitoring program at FPL.

Objective and Scope

The main objective of this project was to determine the field performance characteristics of the Birchlog Run and Tumbling Rock Run stress-laminated deck bridges for a minimum of 3 years, beginning at bridge installation. An additional objective was to compare the performance of the softwood and hardwood lamination species to determine if wood species significantly affected the relative performance of the two bridges. The project scope included data collection and analysis related to the wood moisture content, stressing bar force, vertical bridge creep, behavior under static truck loading, and general structure condition. The results of this project will be considered with similar monitoring projects in an effort to improve design and construction methods for future stress-laminated timber bridges.

Design, Construction, and Cost

The design of the Birchlog Run and Tumbling Rock Run bridges was completed by the bridge design office of the Forest Service Eastern Regional Office with assistance from the FPL and the Civil Engineering Department of the University of Wisconsin–Madison. Construction of the bridges was contractually administered by the engineering staff of the Monongahela National Forest. The following presents an overview of the design, construction, and cost of the bridge superstructures.

Design

The Birchlog Run and Tumbling Rock Run bridges were designed before a nationally recognized design procedure for stress-laminated timber bridges was available in the United States. However, numerous stress-laminated bridges have been constructed in Canada, and a design procedure for stress-laminating was available in the *Ontario Highway Bridge Design Code* (OHBDC) (MTC 1983). Based on work previously completed in Ontario, research was in progress at the University of Wisconsin and FPL to develop a U.S. procedure for stress-laminated bridge design. To the extent possible, the Birchlog Run and Tumbling Rock Run bridges were designed in accordance with *Standard Specifications for Highway Bridges*, published by the American Association of State Highway and Transportation Officials (AASHTO)

(AASHTO 1983). The design criteria for those aspects related directly to stress laminating were based on OHBDC, with minor modifications to reflect completed U.S. research.

The Birchlog Run and Tumbling Rock Run bridges were designed for a span length of 27.9 ft center-to-center of bearings, a width of 12.6 ft, and a nominal deck thickness of 14 in. Tabulated values for the deck design were obtained from the *National Design Specification for Wood Construction* (AFPA 1986, 1988) based on nominal 4- by 14-in. lumber laminations. Visually graded No. 1 Southern Pine lumber was selected for the Birchlog Run bridge, and visually graded No. 1 Northern Red Oak lumber was selected for the Tumbling Rock Run bridge. In both cases, design was controlled by a AASHTO HS 20-44 live-load deflection limit of 1/360 of the bridge span measured center-to-center of bearings. The design live-load deflection for Birchlog Run was 0.85 in., or 1/394 of the bridge span, based on a tabulated modulus of elasticity (MOE) of 1.5×10^6 lb/in.^{2} For Tumbling Rock Run, the design deflection of 0.91 in., or 1/368 of the bridge span, was based on a tabulated MOE of 1.4×10^6 lb/in.^{2} To offset dead-load deflection and creep, a design camber of 1.5 in. was specified for both bridges.

Aside from the difference in lumber species, most design features for the Birchlog Run and Tumbling Rock Run bridges were identical. Both decks were designed with 1-in. diameter high strength threaded steel bars, conforming to the requirements of ASTM A722 (ASTM 1988). Bars were spaced 4 ft on-center, and a discrete plate bar anchorage was used (Ritter 1990). Butt joints in the deck laminations were placed in every fourth lamination transversely, with a minimum 4-ft spacing longitudinally between butt joints in adjacent laminations. Lumber was specified to be pressure treated with creosote prior to fabrication, and all steel stressing bars and hardware were required to be galvanized. Because of the low traffic volume, the bridge deck was intended to function as the wearing surface, and additional surfacing was not specified.

Construction

Construction of the Birchlog Run and Tumbling Rock Run bridges was contractually administered by the Monongahela National Forest engineering staff in the late spring of 1990. Construction began with the removal of the existing structures. Modifications to the existing substructures were then completed to account for the change in the replacement superstructure depth. The stress-laminated decks were not as deep as the existing bridges; therefore, the concrete abutment caps were elevated 12 in. so that the replacement bridges would match the existing approach roadway grades. The approach roadways were in good condition and did not need improvements.

Both the Birchlog Run and Tumbling Rock Run bridges were completely preassembled and stress laminated at a fabrication facility located approximately 75 miles from the construction sites (Fig. 2). The bridges were then transported to the construction sites on tractor trailers (Fig. 3) and lifted into place by a small crane using eye-hooks attached through the deck at several butt joint locations (Fig. 4). The stressing bars for both bridges were initially tensioned to a level of 72,000 lb at the fabrication facility. In addition, 4 and 8 weeks after installation, the bars were tensioned to the same bar force using a single hydraulic jack (Fig. 5). The installation of the two bridges was completed in less than 1 day under favorable weather conditions.

The as-built configurations for the Birchlog Run and Tumbling Rock Run bridges varied slightly from the design configurations and are shown in Figure 6. The Birchlog Run bridge measured 30.7 ft long and 12.8 ft wide, with an actual deck thickness of 13.5 in. The Tumbling Rock Run bridge was 30.3 ft long and 12.8 ft wide, with an actual deck thickness of 14 in. The span length measured center-to-center of bearings was 29.7 ft and 29.1 ft for Birchlog Run and Tumbling Rock Run, respectively. Overall dimensions of the two bridges indicated that length differed by 0.6 ft and deck thickness differed by 0.5 in. The completed bridges are shown in Figure 7.

Cost

Final contract costs for materials, fabrication, and construction of the Birchlog Run and Tumbling Rock Run bridge superstructures, including bridge railing, are given in Table 2. Design costs are not included, because the design process was a collaborative effort and actual costs were not recorded.

Evaluation Methodology

To evaluate the structural performance of the Birchlog Run and Tumbling Rock Run bridges, a 3-year monitoring plan was developed by the FPL and implemented through a memorandum of understanding with the Monongahela National Forest. The plan called for periodic field evaluations of moisture content, stressing bar force, vertical bridge creep, static live-load test behavior, and general structure condition. At the initiation of field monitoring, FPL personnel visited the bridge site to install instrumentation and train Monongahela National Forest personnel in data collection procedures for moisture content, bar force, and vertical creep. Static-load tests and general structure condition assessments were conducted by FPL personnel during site visits. The evaluation methodology used procedures and equipment developed by Wacker and Ritter (1992) and Ritter and others (1991) and is discussed in the following sections.

Figure 2—Prefabricated stress-laminated bridge deck at the fabrication facility.

Figure 3—Delivering bridge deck to the construction site on a tractor trailer.

Figure 4—Lifting the prefabricated bridge deck into place with a small crane. Lifting attachments were placed through the deck at several butt joint locations.

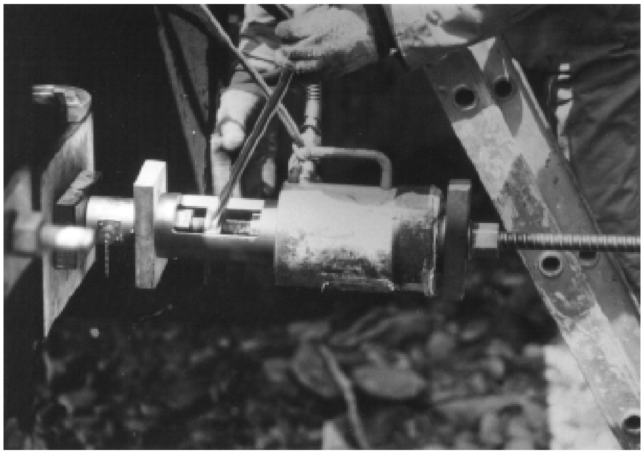


Figure 5—Bar tensioning with a single hydraulic jack.

Moisture Content

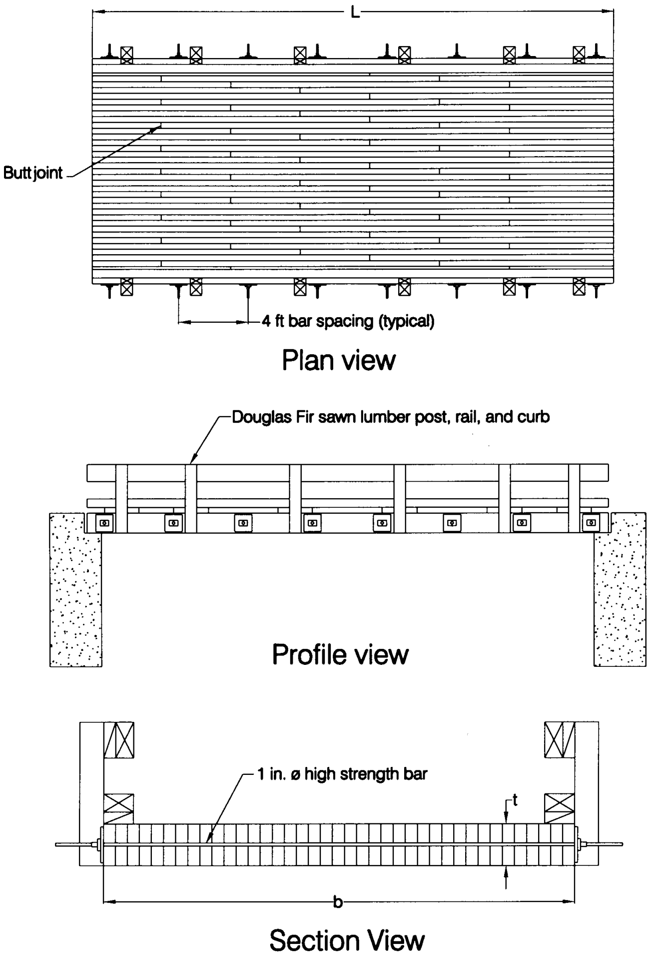
Global changes in the moisture content of the deck laminations can cause deck shrinking and swelling that can significantly affect stressing bar force (Ritter and Oliva 1990). To characterize and evaluate moisture content trends in the deck laminations, periodic moisture content measurements were taken on the underside of the bridge with an electrical-resistance moisture meter. Moisture content measurements were obtained in accordance with ASTM D 4444-84 requirements at probe penetrations of 1 to 2 in. (ASTM 1990).

Bar Force

To effectively resist vehicle loads, stress-laminated decks must maintain a minimum level of compression between the lumber laminations. To evaluate the interlaminar compression of the Birchlog Run and Tumbling Rock Run bridges, bar force was monitored with calibrated load cells (Ritter and others 1991). The load cells were installed on two of the eight stressing bars on each bridge, just prior to the final bar tensioning. Load cell strain readings were taken by Monongahela National Forest personnel using a portable strain indicator. Prior to installation, the load cells were calibrated to provide the basis for converting measured load cell strain into equivalent units of bar force. At the conclusion of the monitoring period, load cell recalibrations were performed to validate the accuracy of the data. In addition, hydraulic stressing equipment was used to measure bar forces and verify load cell data during the monitoring period (Ritter and others 1991).

Creep

When wood is subjected to sustained loads, it will deform or creep over time. In extreme situations, creep as a result of structure dead load can cause bridges to sag at midspan. To measure creep of the Birchlog Run and Tumbling Rock Run



	L (ft)	b (ft)	t (in.)
Birchlog Run	30.7	12.8	13.5
Tumbling Rock Run	30.3	12.8	14.0

Figure 6—As-built configurations for the Birchlog Run and Tumbling Rock Run bridges.

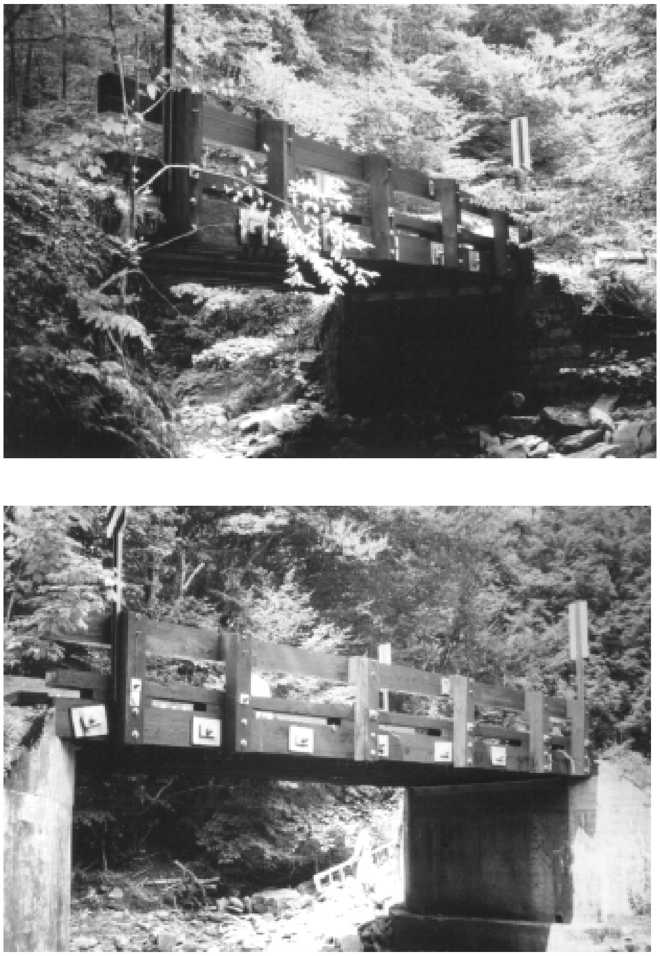


Figure 7—Completed bridges: Birchlog Run bridge, (top) Tumbling Rock Run bridge (bottom).

Table 2—Bridge superstructure final costs

	Cost (US$)				
	Treated timber	Steel hardware	Mobilization[a]	Total	Per ft² [b]
Birchlog Run	18,398	2,572	1,772	22,742	58
Tumbling Rock Run	26,929	2,572	2,194	31,695	81

[a] This is the portion of the total project mobilization estimated to be accountable to the superstructure.

[b] Based on an average bridge deck area of 390 ft^2.

bridges, periodic deflection measurements were taken by suspending calibrated rules at the deck edges and reading midspan elevations relative to a stringline attached at the bearings.

Behavior Under Static Load

Static-load testing of the Birchlog Run and Tumbling Rock Run bridges was conducted to determine the responses of the bridges to full truck loading. An analytical assessment was also completed on each bridge to determine the predicted bridge response.

Static-Load Testing

To determine the load test behavior of the Birchlog Run and Tumbling Rock Run bridges, a static-load test was conducted on each bridge at the end of the monitoring period in May 1993. The test consisted of positioning a fully loaded truck on the bridge deck and measuring the resulting deflections at a series of locations along the bridge midspan cross-section. Measurements of bridge deflections were obtained by suspending calibrated rules from the deck underside and reading values to the nearest 0.04 in. with a surveyor's level. Bridge deflections were recorded prior to testing (unloaded), after placement of the test vehicle (loaded), and at the conclusion of testing (unloaded).

Both load tests were completed using a loaded three-axle dump truck with a gross vehicle weight of 53,400 lb (Fig. 8). Longitudinally, the vehicle was positioned on the bridge so that the bridge centerspan bisected the rear truck axles and the front axle was off the bridge span. Transversely, the vehicle was centered on the centerline of the roadway (Fig. 9).

Analytical Assessment

Previous research showed that stress-laminated decks can be accurately modeled as orthotropic plates (Oliva and others 1990). To analyze the behavior of the Birchlog Run and the Tumbling Rock Run bridges, an orthotropic plate computer model, currently being developed and verified at the FPL, was used to model bridge behavior under load test conditions and predict bridge deflection under AASHTO HS20-44 loading.

Condition Assessment

The general condition of the bridges was assessed on three occasions during the monitoring period. The first assessment occurred shortly after installation, when monitoring instrumentation was installed. The second assessment occurred during a site visit, approximately midway into the monitoring period. The third assessment occurred at the time of load testing, near the end of the monitoring period. Each assessment involved visual inspections, measurements, and photographic documentation of the bridge condition. Items of specific interest included the condition of the wood components, the wearing surface, and the stressing bar and anchorage system.

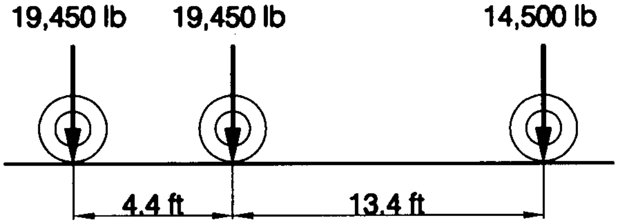


Figure 8—Load test vehicle configuration and axle weights. The same vehicle was used to test the Birchlog Run and Tumbling Rock Run bridges.

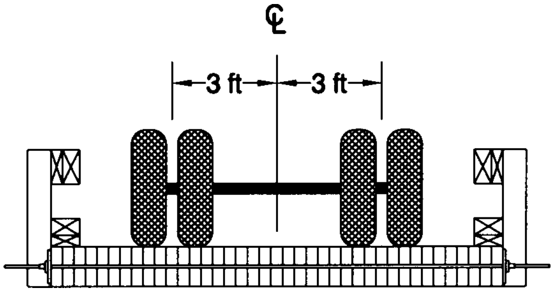


Figure 9—Transverse vehicle position used for static-load testing.

Results and Discussion

The performance monitoring of the Birchlog Run and Tumbling Rock Run bridges covered 3 years beginning June 1990 and ending May 1993.

Moisture Content

The Birchlog Run and Tumbling Rock Run bridges were both installed at an initial moisture content of 12 to 15 percent. At the conclusion of the monitoring period, the average moisture content of both bridges had increased 2 to 4 percent.

It is likely that the heavy creosote treatment provided a barrier to moisture migration and contributed significantly to minimizing moisture content changes. However, both bridges experienced minor cyclic changes in moisture content during the 3 years, primarily because of seasonal changes and environmental conditions. Moisture content generally increased during months of warm, humid weather when the bridges were relatively sheltered from direct sunlight by foliage on surrounding trees. Moisture content decreased slightly during periods of cold, dry weather when the bridges were subject to direct sunlight.

Bar Force

The stressing bars for both the Birchlog Run and Tumbling Rock Run bridges were tensioned to the design level of 72,000 lb at the final bar tensioning. Given the difference in deck thickness, this resulted in a level of interlaminar compression of approximately 111 lb/in^2 for the Birchlog Run bridge and 107 lb/in^2 for the Tumbling Rock Run bridge. After the final bar tensioning, the average trend in bar force for both bridges was similar. During the first 5 months after final tensioning, bar force for both bridges decreased to an average of 59,000 lb, or approximately 90 lb/in^2 interlaminar compression. Bar force losses were gradual during the remainder of the monitoring period. At the completion of monitoring, the average bar force for both bridges stabilized at 56,000 lb, or approximately 85 lb/in^2 interlaminar stress.

The bar force loss for the Birchlog Run and Tumbling Rock Run bridges was less than observed on other stress-laminated bridges where laminations were installed at a relatively high moisture content (Ritter and Oliva 1990). Because the moisture content of the laminations for these bridges was relatively low at installation, bar force loss was minimal. The bar force loss that did occur was primarily the result of stress relaxation in the lumber laminations. It is probable that the increase in lamination moisture content caused a slight increase in bar force and partially offset the expected losses as a result of stress relaxation.

Creep

Camber measurements and creep losses for the Birchlog Run and Tumbling Rock Run bridges are shown in Table 3. At final bar tensioning, camber measurements of both bridges indicated a positive camber of approximately 1.9 in. During the monitoring period, the relative camber loss of 0.6 in. for the Birchlog Run bridge and 0.5 in. for the Tumbling Rock Run bridge was similar and did not appear to be significantly affected by the difference in lumber species. These losses in camber are relatively minor and had no adverse effect on the performance or serviceability of the bridges. It is anticipated that additional camber loss because of creep will occur over the life of the bridges, but will remain within acceptable limits.

Table 3—Camber measurements and creep losses

	Camber measurement (in.)		
Bridge	Final bar tensioning September 1990	End of monitoring May 1993	Creep loss during monitoring
Birchlog Run	1.9	1.3	0.6
Tumbling Rock Run	1.9	1.4	0.5

Behavior Under Static Load

Results of the load tests and the predicted response of the bridge decks under AASHTO HS20-44 loading are presented. For each bridge, transverse deflection measurements are given at the bridge centerspan as viewed from the west end of the bridge (looking east). No permanent, residual deformation was measured at the conclusion of testing, and no vertical movement was detected at the abutments at either bridge.

Static-Load Testing

Results of static-load testing of the Birchlog Run and Tumbling Rock Run bridges are shown in Figure 10. Maximum deflection was 0.63 in. for the Birchlog Run bridge and 0.57 in. for the Tumbling Rock Run bridge. For both bridges, the maximum deflection occurred at the edge of the wheel load, 12 in. from the center of the wheel line. The deflected shape for both bridges was similar and typical of the orthotropic plate behavior previously observed for other stress-laminated timber bridges (Ritter and Oliva 1990). Although the MOE of the Birchlog Run Southern Pine laminations was greater than the MOE of the Northern Red Oak laminations of the Tumbling Rock Run bridge, the greater deflection at Birchlog Run was expected because of the longer span and thinner deck.

Analytical Assessment

A comparison of the measured deflection and that generated by orthotropic plate modeling is shown in Figure 11. Using the same analysis parameters and criteria, the predicted behavior of both bridges when subjected to AASHTO HS 20-44 loading is shown in Figure 12. For the Birchlog Run bridge, the maximum HS 20-44 deflection was 0.77 in., or 1/463 of the as-built bridge span measured center-to-center of bearings. The maximum HS 20-44 deflection for the Tumbling Rock Run bridge was 0.69 in., or 1/506 of the as-built bridge span. Although the span of both bridges exceeded that assumed in the initial design, the predicted live-load static deflections are well within the 1/360 limit.

Condition Assessment

Condition assessments of the Birchlog Run and Tumbling Rock Run bridges indicated that structural and serviceability performance were good. Inspection results for specific items follow.

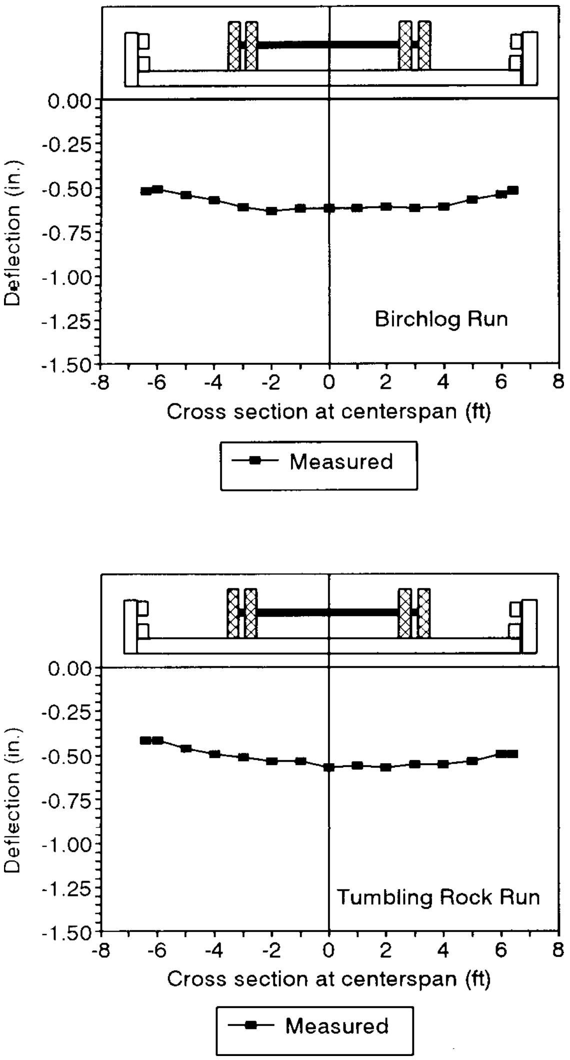


Figure 10—Measured load deflections for the Birchlog Run and Tumbling Rock Run bridges (plots are viewed looking east). Bridge cross-sections and vehicle positions are shown to aid interpretation and are not to scale.

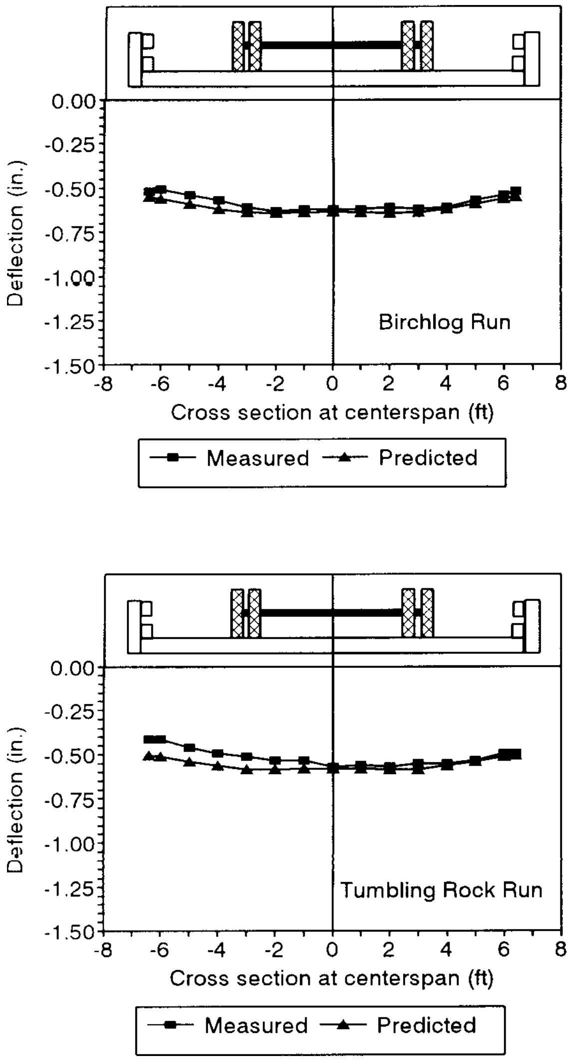


Figure 11—Comparison of the measured load deflections and those obtained by orthotropic plate modeling. Bridge cross-sections and vehicle positions are shown to aid interpretation and are not to scale.

Wood Components

Inspection of the wood components of both bridges showed no signs of deterioration. Exposed end grain of the sawn lumber curb and rail members were provided with spiked metal plates to inhibit checking as a result of moisture content changes, and the plates appeared to be functioning well (Fig. 13). The tops of the rail posts were heavily coated with creosote, which also inhibited checking. Minor checking was evident in the exposed side grain of the curbs and rails.

Inspection of both bridges shortly after installation revealed preservative dripping and large surface residue accumulations. At the final inspection, surface accumulations were heavy on the surfaces exposed to direct sunlight (southern exposure), but preservative dripping had stopped. It is likely that this excessive preservative could have been prevented with proper treating and post-treatment cleaning procedures.

Inspection of the Tumbling Rock Run bridge revealed a wide gap between the bridge end and the substructure backwall (Fig. 14). Although no deterioration was noted, dirt and other debris were accumulating in the gap. If left unattended, the debris will likely hold moisture and could lead to premature deterioration of the superstructure end grain.

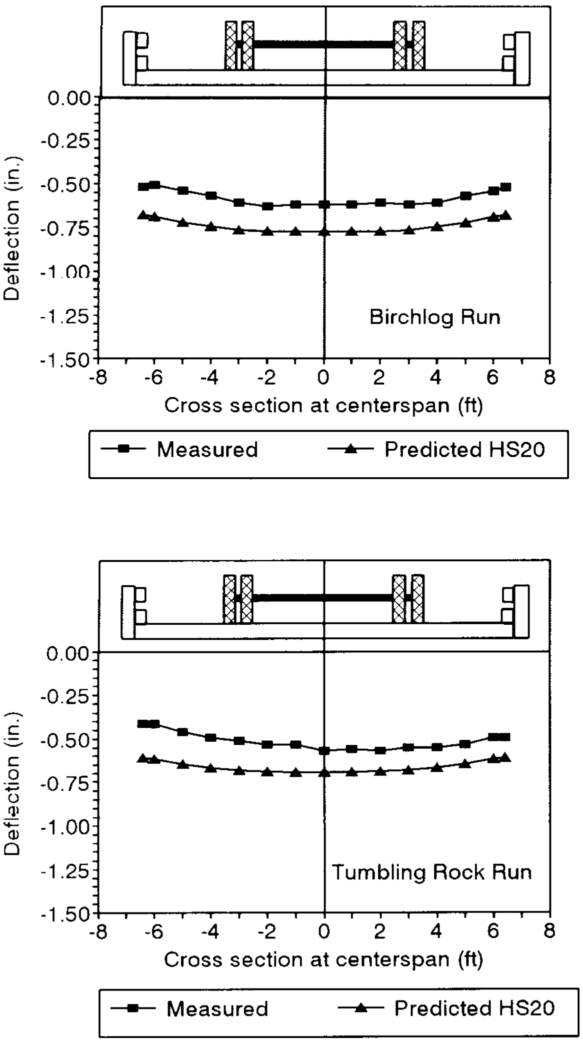


Figure 12—Comparison of the measured load deflection with predicted AASHTO HS 20-44 deflection based on orthotropic plate modeling. Bridge cross-sections and vehicle positions are shown to aid interpretation and are not to scale.

Wearing Surface

The top surface of the unprotected bridge decks showed no signs of deterioration or damage. A small quantity of gravel and other debris was noted on the decks, but did not appear to be a problem because of the low traffic volume. At the initial inspection, large accumulations of preservative were visible on the deck surfaces. At the conclusion of the monitoring period, preservative accumulations were substantially reduced.

Figure 13—Spiked metal plates in the end grain of sawn lumber curb and rail members.

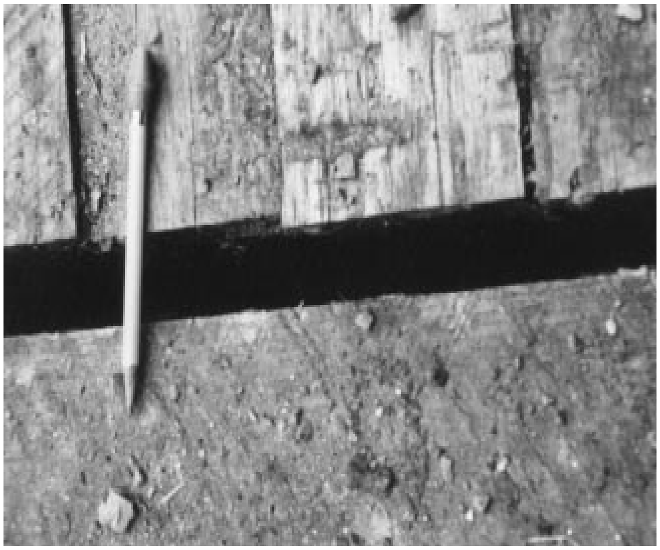


Figure 14—Gap between the bridge end and the substructure backwall at the Tumbling Rock Run bridge.

Stressing Bar and Anchorage System

The stressing bar and discrete-plate anchorage systems for both bridges were generally in good condition with no visible signs of corrosion. At the Birchlog Run bridge, minor plate crushing was observed in the softwood edge laminations near the discrete bearing plates. This minor crushing, which averaged less than 0.10 in., occurred during the initial stressing and did not appear to increase after the second stressing. Thus, plate crushing did not significantly contribute to bar force loss. No crushing was observed in the hardwood edge laminations of the Tumbling Rock Run bridge.

Conclusions

Based on data collected during the 3 years of monitoring, we conclude the following:

- Both the Birchlog Run and the Tumbling Rock Run bridges are performing well with no structural or serviceability deficiencies.
- The performance of the two bridges is very similar. The difference in the lamination species did not appear to significantly affect the performance in the areas monitored.
- The average trend in deck moisture content indicates that moisture content is slowly increasing. Both bridges were installed at a moisture content of 12 to 15 percent and experienced an increase in moisture content of 2 to 4 percent during the monitoring period.
- Stressing bar force decreased approximately 23 percent during the 3 years of monitoring. Most of this loss occurred within the first 5 months after final bar tensioning. Bar force loss during the final 2 years of monitoring was minimal and accounted for less than 20 percent of the total loss.
- Creep resulted in a camber loss of 0.6 in. at the Birchlog Run bridge and 0.5 in. at the Tumbling Rock Run bridge. At the conclusion of the monitoring period, remaining positive camber was 1.3 in. and 1.4 in. for Birchlog Run and Tumbling Rock Run, respectively.
- Load testing indicated that both bridges are acting as orthotropic plates. The maximum deflection as a result of one lane of AASHTO HS 20-44 loading is estimated for the Birchlog Run bridge to be 0.77 in., or 1/463 of the bridge span measured center-to-center of bearings, and for the Tumbling Rock Run bridge 0.69 in., or 1/506 of the bridge span measured center-to-center of bearings.
- The condition of the wood components is good, although excessive preservative accumulations were evident at installation. Minor crushing at the stressing bar bearing plate was evident in the softwood laminations of the Birchlog Run bridge; however, this occurred prior to final bar tensioning and did not significantly contribute to bar force loss. No wood crushing was observed around the bearing plates of the hardwood laminations of the Tumbling Rock Run bridge.

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Appendix A—Birchlog Run Bridge Information Sheet

General

Location: Monongahela National Forest, Pocahontas County, West Virginia
Date of Construction: June 1990
Owner: USDA Forest Service

As-Built Configuration

Structure Type: Stress-laminated deck
Total Length (out-out): 30.7 ft
Skew: None
Number of Spans: 1
Span Length (center-center of bearings): 29.7 ft
Width (out-out): 12.8 ft
Width (curb-curb): 11.2 ft
Number of Traffic Lanes: 1
Design Loading: HS20-44
Butt Joint Frequency: Every 4th lamination transverse
Every 4-ft longitudinal in adjacent laminations
Wearing Surface Type: None

Material and Configuration

Timber:
  Species: Southern Pine
  Size (actual): 4 in. by 13.5 in.
  Grade: No. 1
  Moisture Condition: 12 to 15 percent at installation
  Preservative Treatment: Creosote
Stressing Bars:
  Diameter: 1-in.
  Number: 8
  Design Force: 72,000 lb.
  Spacing (center-center): 4-ft
  Type: High strength steel threadbar with coarse right-hand thread, conforming to ASTM A722
Anchorage Type and Configuration:
  Discrete Steel Plates: 13-1/2 in. by 11-1/2 in. by 1 in. bearing
  6-1/2 in. by 4 in. by 1-1/4 in. anchor

Appendix B—Tumbling Rock Run Bridge Information Sheet

General

Location: Monongahela National Forest, Pocahontas County, West Virginia
Date of Construction: June 1990
Owner: USDA Forest Service

As-Built Configuration

Structure Type: Stress-laminated deck
Total Length (out-out): 30.3 ft
Skew: None
Number of Spans: 1
Span Length (center-center of bearings): 29.1 ft
Width (out-out): 12.8 ft
Width (curb-curb): 11.2 ft
Number of Traffic Lanes: 1
Design Loading: HS20-44
Butt Joint Frequency: Every 4th lamination transverse
Every 4-ft longitudinal in adjacent laminations
Wearing Surface Type: None

Material and Configuration

Timber:
  Species: Northern Red Oak
  Size (actual): 4 in. by 14 in.
  Grade: No. 1
  Moisture Condition: 12 to 15 percent at installation
  Preservative Treatment: Creosote
Stressing Bars:
  Diameter: 1 in.
  Number: 8
  Design Force: 72,000 lb.
  Spacing (center-center): 4 ft
  Type: High strength steel threadbar with coarse right-hand thread, conforming to ASTM A722
Anchorage Type and Configuration:
  Discrete Steel Plates: 12-1/2 in. by 10 in. by 3/4 in. bearing
  6-1/2 in. by 4 in. by 1-1/4 in. anchor