



1—Study the drawings and the installation plan ahead of time. Consider laying the components out in the approximate order in which they will be installed. This will help workers become familiar with the components and their order of installation. Try to have an experienced installer at the site.

2—Ensure that you have the correct components and that they are oriented correctly.

3—Follow the manufacturer's instructions and the installation sequences.

4—Measure and stake the bridge abutment work sites (figure 14).

5—Clear and level the abutment work sites (figure 15).

6—Verify the bridge's measurements and layout before constructing the bridge abutments (figure 16). Improper abutment construction has contributed to many bridge failures. Abutments need to be designed by engineers and constructed as designed to prevent failure.

7—In tight working conditions, be especially careful to carry the correct end of long members in first.

8—Assemble bridge trusses at an assembly site or near the bridge abutments (figure 17).

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Figure 14—Staking out a bridge site with a cloth tape.



Figure 15—
Clearing an
abutment with a
small trackhoe.



Figure 16—
Constructing an
abutment for an
FRP bridge.



When assembling trusses, use a tapered bar and a straight bar to line up the bolt holes (figure 18). Tap bolts lightly. Start a bolt at each side and use the mounting bolt to force the alignment bolt or straight bar out. Build as much of the top and bottom chords as can be handled before setting the trusses into place. The added stiffness will make construction easier. Bolt heads should always be on the inside of the top chord and on the outside of the bottom chord. If you have to use force to drive the bolts, something is out of alignment. No bolts should have to be driven except for the deck bolts that pass through the wooden decking and into the top flange. Bolts should not be more than finger tight.

9—Set trusses upright (figure 19) and haul them into place. Based on our experience, trusses carried upright will not flex as much as if they were carried flat and are less likely to be damaged. (Manufacturers say that trusses won't be damaged by flexing and can be carried more easily and safely when they are carried flat. Several people should carry each truss so it's not just supported at the ends.)

10—Install the bridge clips on the abutments and position the completed trusses on the abutments. Square up the trusses and make sure they are parallel to each other (figure 20). Take measurements and verify them. Make sure that all members are in alignment and that all outriggers are installed at the proper

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Figure 17—Assembling a truss on level ground near the bridge site.

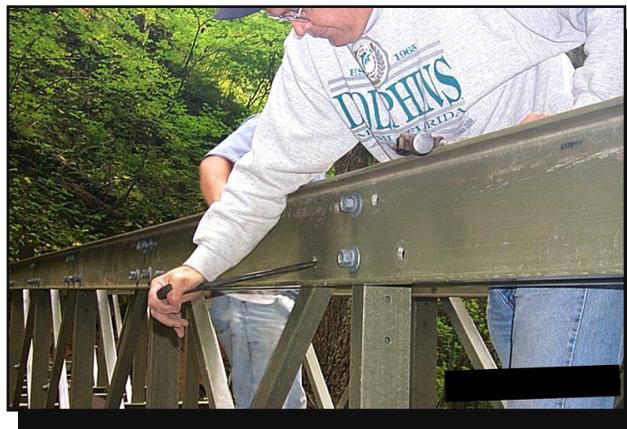


Figure 18— A tapered bar can be used to align bolt holes.

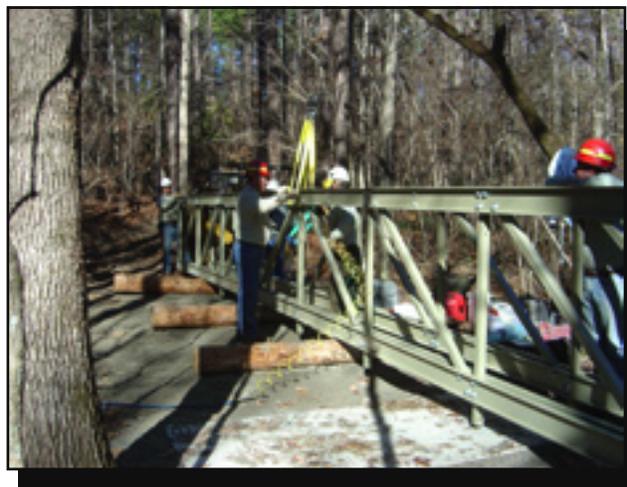


Figure 19—Trusses are set upright before being moved into place.



locations. Install the bridge clips to keep the trusses upright and finger tighten the bolts.

11—Put the three deck boards that have carriage bolts in place: one near each end of the bridge and one in the middle. Leave the bolts loose enough to allow the decking to be adjusted. Install the cross and diagonal bracing between the bottom chords and finger tighten the bolts (figure 21).

12—Place planks on the bridge (figure 22) except for the two end pieces, which should be left off until the bridge clips have been tightened.

13—Set the bridge’s camber using a cross member and a hydraulic jack. Make sure not to lift the truss off the abutment (bolts are only finger tight at this point). Tighten the bolts until the lock washers are compressed (flattened) or until fiberglass begins to deflect. **Do NOT overtighten** because fiberglass **will crack** (figure 23).

14—Tighten truss bolts from the center out and from the top to the bottom. Tighten the center bolts first, bolts at the first panel point on the right, bolts at the first panel point on the left, bolts at the second panel point on right, bolts at the second panel point on the left, and so forth. Tightening bolts in this order is essential for load transfer and proper functioning of an FRP trail bridge. Follow all

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Figure 20—Squaring up bridge trusses.



Figure 21—Installing and fastening cross bracing.



Figure 22—Workers fasten deck planks.



of the manufacturer's instructions and guidelines.

15—Check the bridge's camber (figure 24) and adjust the bridge as necessary to get the camber as close as possible to specifications. Longer bridges require more precise camber.

16—Fasten planks to the bottom chords and stringers.

17—Tighten the bridge clips to the sills.

18—Place treated timber backwalls at the ends of the bridge and fasten them in place, compacting the soil around the backwall. Use two to four stainless-steel screws to secure the backwall. Backwalls may move over time, particularly if the bridge is used for horses, mountain bikes, and off-highway vehicles.

19—Place the end planks on the bridge and fasten them down.

20—Use touchup paint for damaged areas. In extreme cases, it may be wise to spray sealant over the entire structure, encapsulating the bridge. Damaged members must be repaired or replaced before removing any temporary supports.

21—Fasten the wood rails to the side trusses.

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Figure 23—Overtightening bolts cracked two tubes.

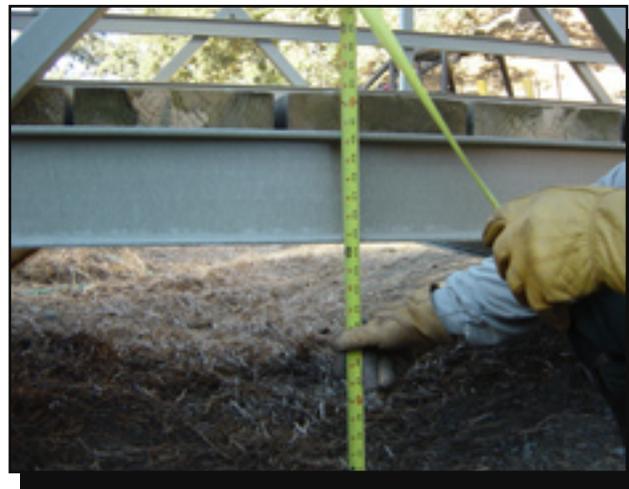


Figure 24—A tape measure can be used to check a bridge's camber and deflection.



22—Bolted connections will loosen over time because of vibration. Repeated bolt tightening helps maintain the bridge's strength. However, overtightening bolts cause various kinds of damage to FRP materials. **Do NOT overtighten.** Tighten until lock washers are compressed, or until the fiberglass begins to deflect. Retighten the bolts every 5 years.

23—Do not remove any members of the completed bridge (figure 25) after the temporary supports have been removed—doing so can lead to deflections and forces for which the bridge was not designed, possibly causing the bridge to fail.

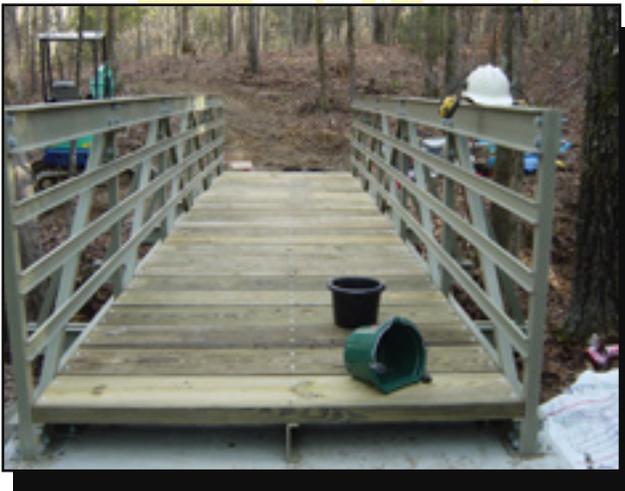


Figure 25—The finished FRP bridge.

Safety and Tools

In the Forest Service, a Job Hazard Analysis (JHA) must be completed for every project. Follow the JHA recommendations for personal safety equipment, as well as direction in the *Health and Safety Code Handbook*, and the manufacturer's assembly instructions (example installation instructions are in appendix I). Wear hard hats, steel-toed boots, gloves, and safety glasses during construction. Tools required for installation and inspections are typically simple carpentry tools, such as hammers, tape measures, levels, socket wrenches, tapered drift pins, and screwdrivers (figure 26). Carbide drill bits and saw blades are best for drilling or cutting FRP materials.

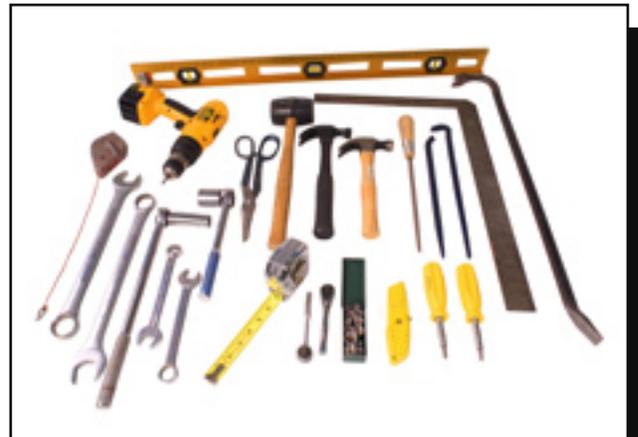


Figure 26—Typical handtools used to construct FRP bridges.

The Forest Service requires that a qualified contracting officer's representative or inspector certified in trail bridges be involved in the construction of all FRP trail bridges.