New York - New Jersey Trail Conference

Bridge Best Practices and Samples

Approved by the Policy Council on June 10, 2020

1. Intent and Overview

Many trails built and maintained by the Trail Conference have existing bridges or locations where a bridge might be desired. This document includes some best practices about when a bridge is appropriate, the types and designs of bridges, and the maintenance of bridges. While decisions about bridges ultimately rest with the land manager, this document provides guidance for discussing bridges with land managers and making recommendations.

2. Applicable Policies and Practices

- Trail Management Policy (section 3.10)
- Trail Use Policy
- Trail Design Standards
- Trail Approval Process
  - Appalachian Trail bridges have similar but different processes and bridge requirements. See their policy dated May 2011: http://www.appalachiantrail.org/docs/trail-management-policies/stream-crossings-and-bridges-2011.pdf
- Accessibility Guidebook for Outdoor Recreation and Trails
- USFS bridge inspection manual
- Locating Your Trail Bridge for Longevity

3. Definitions

A **bridge** is a permanent, artificial structure not in continuous contact with the ground, regardless of length, width, or height above the surface, with a load-bearing free span between abutments or sills, typically for passage over streams or wetlands. The bridge abutments are part of the bridge. Helical piers and wooden piles higher than a foot above the ground are typically a series of small bridges linked together. Bog bridges or puncheon used for trail hardening are excluded from this best practice. For the purposes of this best practice, bridges are classified into three categories.

- **Standard Bridges**: Bridges for which the Trail Conference has standard plans and which can be built by someone with reasonable carpentry skills. Generally these are smaller bridges, including most bridges built with framing lumber.
- **Custom Bridges**: Bridges which must be designed to fit a site or built with non standard or natural materials. Generally these are medium length bridges, for example bridges built with logs or telephone poles.
- **Engineered Bridges**: More complicated bridges, for example fiberglass truss or cable suspension bridges. Generally these are longer than 20 feet.

Bridge abutments: Bridges sit on abutments on both ends and possibly on a pier in the middle. Typical abutments include wood sills, rocks, cast concrete, cribs, or gabions. If an abutment fails, the bridge fails.

4. Description of Best Practices

4.1 Should There Be a Bridge?

The decision about whether or not to build or replace a bridge is influenced by the development classification of the trail as defined in the Trail Design Standards, though individual assessment will be required in many cases. The possibility that a crossing might be difficult or dangerous at occasional times of high water does not necessarily require building a bridge.

Trails with a development class of 4-5: Trails with this level of development would normally have bridges over a stream which poses any significant impediment to trail use. Issues with the sustainability, feasibility, or affordability of a bridge may be raised as part of consultation with land managers.

Trails with a development class of 2-3: The default should be to build a bridge if sustainable, feasible, and affordable and no other good alternatives such as rock steps or fords are practical. It should be recognized that closing the crossing seasonally or for short periods is an option to avoid building a bridge.

Primitive trails with a development class of 1: Rock steps or fords should be used whenever possible. A bridge should be constructed or replaced only if:

1. It is essential for hiker safety during the snow-free hiking season, recognizing that a stream may be unfordable when seasonal or occasional flooding occurs; or
2. It is necessary to protect sensitive resources, such as soils along a river's bank, which may be highly susceptible to erosion.

4.2 Bridge Siting and Design

4.2.1 Location

Site selection is key to building a sustainable, feasible, and cost-effective bridge. The location should be such that the bridge is not destroyed by flooding. This means either building the bridge high enough above flood levels or at places where the bridge spans only the normal channel and high waters can occupy floodplains at the ends of the bridge without washing it out.

4.2.2 Feasibility

Trail Conference bridge designs are limited to those not requiring the use of heavy motorized construction equipment. Additional considerations include the ability to transport materials to the construction site and/or the availability of grants or landowner funding used to cover the project cost.

4.2.3 Design

In general, bridges should be designed to pass a 25-year flood. In most cases, one can observe the typical high water mark from debris on the banks or similar indicators. Unless you know of a recent extreme storm event that left more extensive debris, these are a good indicator of expected flows that the bridge should pass without damage. However, there are circumstances where, due to the nature of trail use in the area, a bridge that is passable during low-frequency flow events is necessary, resulting in larger and more elaborate structures. In most cases, such structures should be limited to sites where there is an overwhelming public-safety or resource-protection concern or where a cost-benefit analysis clearly demonstrates the benefit of the larger structure.

All bridges, regardless of their span, should be designed to bear a load that meets or exceeds current best management practice. Example bridge designs that meet engineered standards can be found in section 5. Bridges that must support vehicles are excluded from this discussion. Bridges that must support horse traffic are currently deferred from discussion.

Bridges may need to comply with the Outdoor Developed Areas Accessibility Guidelines (ODAAG), which provides an exception mechanism that allow lesser standards for some cases, which must be documented.

In more primitive settings, bridges should be designed to minimize their size and complexity and to utilize natural materials (stone and untreated wood). If the use of modern materials (steel, concrete, treated wood, etc.) is necessary, all reasonable measures should be considered to keep these modern materials hidden from view so the structure presents a rustic appearance.

4.3 Bridge Approvals

Construction or work beyond normal maintenance on bridges requires the same approvals as for other trail projects and the appropriate trail approval process must be followed. The major requirement is that the land manager, the volunteer leader responsible for the work, and the Program Coordinator are in agreement about the work to be done. It should be noted that construction of many bridges requires permits as they are constructed in a wetland. The project manager must ensure that any appropriate permits are in place before construction begins.

Bridge designs must be approved by the land manager, who may require additional approvals. Some jurisdictions may specify particular architectural designs, limit the materials to be used, or require hand railings of particular types. Approval of the design by a licensed professional engineer is sometimes required. Engineered bridges or other complex bridges may require approval of the full bridge and site design. The Trail Conference will comply with all land manager requirements.

The cost of materials for a bridge can be substantial. The land manager often pays for the materials, though sometimes a grant can be sought to cover the cost. If the Trail Conference will pay for some or all of the cost, appropriate financial approvals are required.

The Trail Conference will build bridges only if the landowner will accept legal liability, which should be spelled out in the MOU.

Note that Appalachian Trail bridges have similar but different processes and bridge requirements. See their policy dated May 2011:
http://www.appalachiantrail.org/docs/trail-management-policies/stream-crossings-and-bridges-2011.pdf

4.4 Bridge Construction

Bridge construction typically uses power tools and sometimes a Griphoist for moving beams and building abutments with large rocks. Extra safety precautions apply to all such operations. Read the safety guidelines. You may need waders for working in the water under a bridge. Deep or fast water may introduce additional safety considerations.

4.5 Bridge Maintenance

While Trail Maintainers do not generally have training or expertise in bridge maintenance, they should visually examine bridges during their routine maintenance trips. Any signs of damage, decomposition, excessive slickness, or other potential hazards should be reported to their Supervisor. The Supervisor should consult with the Land Manager or with an experienced trail builder for further assessment as appropriate.

Items of concern when a bridge is examined include:

- Broken or missing parts
- Wobbling when walking on the bridge
- Obvious rot or decay
- Scouring of abutments
- Upstream debris that threatens to crash into the bridge
- Hazard trees that might fall and hit the bridge

These charts from the US Forest Service include additional details: https://www.fs.fed.us/eng/bridges/documents/tbi/inspproc.ppt

5. Sample Bridge Designs

Here are links to a few bridge designs. The Trail Conference has additional bridge designs and photographs for specific situations which your Program Coordinator can share with you. Note that signed designs are site specific but may help to reduce the cost of getting an existing design approved for a new site.

- Standard box bridge (unsigned)
- Mohansic Trailway Bridges (signed)
- USFS Trail Bridge Design
- USFS Trail Bridge Catalog
- Drexel Bridges
- Fiberglass engineered bridges (one example of many manufacturers - Popolopen bridge, for example)