

Little Raven Trail Project - Bog Bridge Construction - Lessons Learned

Having just completed a relatively unusual, for our part of the world, and technical volunteer project focused on building timber structures (bog bridges) in a back country environment, we thought it might be useful to pass on some of our experiences.

We've divided the material into general, specific, and tools related categories. We'll leave our most of the high-level design items in order to focus on project management and construction details.

General

As always, plan ahead:

- Get construction advice (especially if you're not sure about what you are doing)
- Listen to it
- Draft an experienced resource if you can. We were lucky to get the Forest Service's Frank Lilley to help us out.
- Use IMBA, local bike groups, the Internet, etc., to find construction, materials, and tools advice. I've attached several of the design documents we found.
- Make sure the land management agency is comfortable with what you plan to do. In our case we were converting a dearly beloved ski trail to a multi-use trail. The ski community was justifiably concerned. By working with the Forest Service we were able to develop alignments that significantly enhanced the biking ride and kept the skier lines intact.
- Let your crew leaders and volunteers know what you are planning and get them the construction details and procedures. If it is at all possible schedule some crew leader training time. We've attached the project information we sent to our crew leaders. The completed project was somewhat different as we made some design changes on the job.

The above all sounds like typical motherhood, but it's most important on a technical construction, especially if you, the crew leaders, and the volunteers are inexperienced in the work required. It requires extra time, especially on-site time with the land agency folks and crew leader training.

When you are involved in a construction project, unexpected problems can bring things to a screeching halt. If you suddenly need an item that's not on site or that requires an hour's work by the only guy with the right tool or experience, the 20 or 30 folks in your trail crews are going to be standing around doing nothing and wondering why they bothered to show up. You need to plan for project problems. Here are some strategies to limit your exposure:

- Stage heavy materials in advance. We had 10 pieces of 2"x12"x12' and 3"x12"x10' lumber to move 3/4 mile to the site. It took 8 people a total of 21 hours to get the lumber to the work site. We did it in advance.
- Prepare on-site materials in advance. We needed 20 3' log sills which were to be procured from on site resources. We arranged to work with the Forest Service to fell the necessary trees and to cut the sills to length. We planned to debark the sills and cut 2"x12" notches in them during the project. This was almost a disaster, as I'll explain below.
- Test new procedures to make sure they fit the project. We had planned to do on-site preparation of the sills and found that cutting the required notches by hand would require hours of labor. We were fortunate to be able to get the Forest Service to agree to help in the preparation with a chain saw.
- Prepare a detail work plan (who, what, how many, where), assuming all goes well. This will be complicated and is required by the need to distribute project specific tools and materials to specific crews and locations. In our case this included connectors, drivers, cutters, drills, measuring and marking devices, etc.
- Prepare an alternate work plan (what if, what else, where else), assuming you will run into a problem and need to find meaningful work for volunteers to do. With the help of the Forest Service chain saw, we were able to get the sills prepared. but that still took time. We couldn't work in the vicinity of the chain saw due to noise and safety requirements. Fortunately we had planned other "bonus" and site preparation work that could be done while the sills were being prepared, so the volunteers didn't have to stand around doing nothing.
- Keep the crew sizes small for the technical work. We'd recommend three volunteers and one crew leader.

Specific

Sills:

Fell the trees and sills in advance. You need the materials in place and you don't need the insurance liability.

Removing bark from sills is relatively simple. Using a Pulaski or an ax to cut off a line of bark from one end of the sill to the other and then using the tool to peel the bark off the sill was effective for the Engleman spruce we were cleaning. We sent our first project party in, with an experienced leader, to get a jump-start on the debarking.

Marking lines on fresh sills is not easy and is required to cut the notches. Chalk doesn't work, although it is fine on rough cut lumber. Pencils and fine-tip markers are borderline effective. We found wide magic markers worked satisfactorily.

Cutting notches in sills is very time consuming. To do it right requires 6-8 2" deep slots cut in each 12" wide notch before the waste material can be cut out. It's best to cut the slots with a chain saw, before the project if at all possible. The waste material between the slots can then be removed with an ax or hatchet (short-handled axes work best, Pulaskis can be used, but the blade is too wide to be the best option). Removing the waste can be done during the project if the sills are cut and scored in advance.

Sill placement:

"Measure twice, dig once". It's really essential to impress on the crew leaders (and therefore the volunteers) how important it is to get the sills set at the right distance to support the planks, level from side-to-side, in-line with the next sills, and level with all the sills the plank will be resting upon. Tape measures, levels, strings, and string levels can help with this; but the crew leaders and volunteers need to be aware of their importance and of the availability of the required measuring tools. We had the tools on site, but didn't do an adequate job of stressing their use and importance.

Continuity of flow is important. When one bridge leads to another it's important to step back from the specifics on each bridge and make sure the transition between them also works.

Planks:

We experimented with two different configurations; 2"x12"x12' pine planks with three supporting sills and 3"x10"x10' cedar planks with two supporting sills. For the kind of back county use we are expecting, hiker, skier, and biker, with out equestrians, we felt both cases were acceptable. However, the 3"x12"x10' cedar planks did show some vertical deflection with a hiker load and we would suggest limiting unsupported runs to about 8'.

Tool Details

We started the project with the following project specific tool set (in addition to the standard trail building kit of Pulaskis, MacLeods, pick mattocks, shovels, buckets, and a rock bar):

- 2 draw knives
- 2 axes
- hatchet
- webbing/slings for carrying and manipulating timbers
- string lines (200') and spikes to string them on
- 3 carpenters pencils
- chalk
- pull-saw to cut lumber angles
- 3 sets ratchets & drivers - 5/16"
- 2 battery operated drills w/ 3/16" drill bits, 5/16" hex drivers, & extra batteries
- 2 hand drills for when the batteries give out
- 2 hammers & misc. small nails
- 2 tape measures
- 2 1' story sticks
- 3 levels (2 short, one long)

We did not use the following tools:

- 2 draw knives
- 3+ saws to cut timbers
- 2 hand drills
- 2 hammers & misc. small nails

We would have liked to have the following tools or materials:

- Short-handled axes
- Shims (for final adjustments to plank levels)

Without the Forest Service chain saw we would have done a lot more sawing.

2007 Little Raven Trail Project Bog Bridge (Puncheon) Crewleader Information

Northwestern Site

One 10' bridge (1 span) and one 20' bridge (2 spans), each 12" (one plank) wide

Wood:

5-6 sills, native harvest, diameter 12", length 3', to be stripped and shaped (2" deep flat cut on top) by volunteers.

Planks: Three 10-foot 3"x12" cedar timbers

Southeastern Site

One 50' bridge (5 1/2 spans w/center supports) or one 32' bridge (3 spans) and one 24' bridge (2 1/2 spans), each 24" (two planks) wide (span configuration, from south to north: 12', 8', 12' [maybe not be required], 12', 8', 4' [off-ramp])

Wood:

12 sills, native harvest, diameter 12", length 4', to be stripped and shaped (2" deep flat cut on top) by volunteers. (A couple extra sills would be handy in case needed to turn a corner and for flexibility of placement.)

Planks: Eleven 12-foot 2"x12" and two 8-foot 2"x12" fir timbers

(Note: If timber quality is OK and center span is not required, there could be three 12-foot 2"x12"s left over to use at remaining wetland crossing)

Sills: 3' or 4' 12" diameter logs, bark stripped, flat cut on top

(2" deep notch on 12" diameter log yields a 9" wide notch, on 8" diameter log yields a 6 1/2" wide notch)

Fasteners:

TimberLok 6" fasteners. They are threaded on only the first 2 inches so materials get snugged-up. They are self tapping which reduces the need to pre drill and can be driven with a hand-held ratchet (and even started with a hammer tap).

Washers are integrated. Use 2 for each plank at each sill, inset about 3" from ends and edges. It should not be necessary to pre-drill the planks; but, we'll check the initial results and be prepared to pre-drill the planks, but not the sills, if necessary to avoid splitting the ends.

Number required ~44.

Construction notes:

- install planks with growth rings facing down to prevent cupping from trapping water
- allow 3/8" gap between planks on 2-wide sections (1/8" of gap for each 4" of width)
- build approaches out of rock and keep soil from contacting planks.
- set sleepers in rock and minimize contact with soil, completely peel bark off sleepers

Bridge Specific Tools:

- draw knives
- webbing/slings for carrying and manipulating timbers
- log hooks for carrying sills
- adze for shaping sills
- string lines
- carpenters pencils
- saws as required to cut timbers
- ratchets & box wrenches - 5/16"
- battery operated drills & bits
- brace & bit for when the batteries give out
- hammers & chisels
- tape measures