# Wetland Trail Design and Construction



## Structures Requiring Foundations - (continued)

### Gadbury

Gadbury (figure 49), a structure similar to puncheon, was developed in the Pacific Northwest. Gadbury uses two half logs, as described for puncheon, and longer notched sleepers. The notch cut for gadbury must be about twice as wide as the notch cut for puncheon. The two half logs are placed on each side of the center of the notch with the flat surface up. Two full logs are placed in the notch on the outside of each of the half logs.

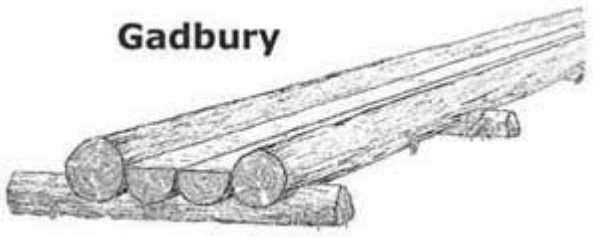


Figure 49-Gadbury is another rustic structure similar to puncheon.
Use peeled logs for gadbury.

An experienced crew can construct gadbury without using spikes or steel drift pins. Such construction requires considerable skill and experience with woodworking tools. Lacking this experience, the pieces can be spiked or pinned together. Earth may be placed on the half logs and held in place by the full, outside logs.

Gadbury uses more wood than puncheon. From a standpoint of sustainable design, gadbury is less suitable than other techniques.

### Bog Bridge



A bog bridge is a form of puncheon. Normally, bog bridges have a single or double-plank tread surface resting directly on mud sills (sleepers) (figure 50), cribbing, or piles. A puncheon, by contrast, will usually have stringers resting on the mud sills or sleepers, with tread decking nailed perpendicular to the stringers.

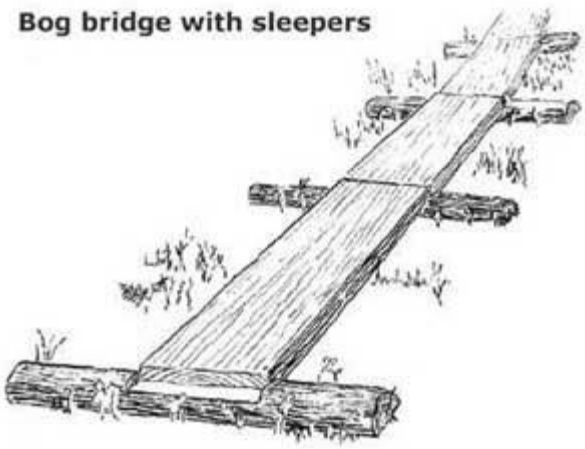


Figure 50-A simple bog bridge with sleepers. This common structure is also called a single-plank boardwalk in coastal Alaska.

To add to the confusion over terminology, in coastal Alaska, bog bridges are called boardwalks, or step-and-run boardwalks if spacers are used to create steps (figure 51). In other places, the term bog bridge is synonymous with puncheon. In parts of the Rocky Mountains and Sierras, bog bridge equates to turnpike, a structure we described as a raised walkway of stone and fill material. We define bog bridges as a series of connected, short-span bridges close to the ground.

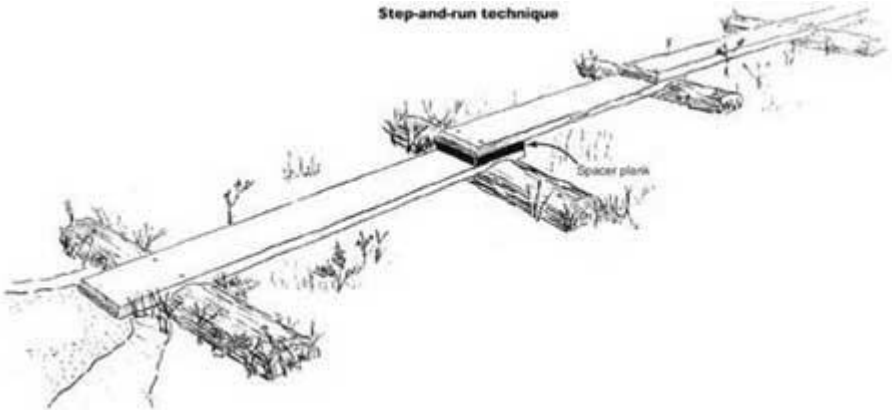


Figure 51-The step-and-run technique is a way of keeping planks level as elevation changes. Level planks help reduce slipping in wet climates.

The tread of a bog bridge is usually treated, rough-sawn 3- by 12-inch plank that is 6 to 9 feet long. The plank parallels the centerline of the trail and rests on closely spaced, lightweight foundations. This means that the tread of the bog bridge can be closer to the ground, perhaps only 6 to 12 inches above it, providing 3 to 9 inches of clear space below the tread. There is little to block the flow of water (in either direction) below the plank, and little to resist the force of floodwater going over it. In the backcountry, bog bridges are normally one 12-inch plank wide. A plank this narrow does little to interfere with plant growth underneath. The span of each of these small bridges will vary with the type of wood used for the plank, the thickness of the plank, and the anticipated weight on the plank. In areas of heavy, wet snow, the snow may be the heaviest weight on the bridge. Snow load may be as much as 300 pounds per square foot in such areas.

## Bog Bridge on Sleepers or Sills

In its simplest form, the plank of the bog bridge rests on sleepers or sills. A sleeper is placed in a shallow trench at right angles to the trail centerline. A second sleeper is prepared and placed in

another trench 6 to 9 feet away. This distance is the span, which is determined from older installations or with the help of someone with carpentry or structural engineering experience. Place the plank flat in the notches of the sleepers, with one cut end centered in line with the centerline of the log. Mark the plank where it meets the centerline of the next sleeper and saw it to the proper length. The plank is nailed to the sleepers at each end with two 50- or 60-penny (Appendix D), ring-shank nails driven through previously drilled pilot holes. This process continues across the wetland.

## Bog Bridge on Cribbing

Occasionally, log or timber cribbing can be used to support the plank of a bog bridge. Plank can either be nailed to each of the top logs or timbers, or one large-diameter log can be notched and pinned to the top logs (similar to the sleepers described earlier). If the bog bridge is more than 2 feet high, the plank should be two planks wide for safety.

## Bog Bridge on Piles

Another technique for building bog bridges is to rest the plank on pile foundations. The three types of suitable piles are end-bearing piles, friction piles, and helical piles.

After installing a pair of bents or piers, pressure-treated 3- by 12-inch planks are nailed to the ledger or ledgers as described for the bog bridge on sleepers. The ledgers do not have to be notched. When piles are used, the plank may be more than 2 feet above the ground or water. In such cases, the tread should be two planks wide.

## Bog Bridge Summary

Whether a bog bridge is built on sleepers, cribbing, or wood piles, it lends itself to backcountry construction. The bog bridge requires no large machinery. The materials are wood, steel washers, bolts, nuts, and nails. The pieces of wood are relatively small and can be carried by hand. No concrete is needed.

## Boardwalk

- Stringers
- Boardwalk Summary

For the purpose of this book, a boardwalk is a structure that uses widely spaced bents or piers as a foundation. Stringers, parallel with the centerline of the boardwalk, rest on the ledgers of the bents or piers. The stringers support the deck, which is usually 2 by 6 or 2 by 8 lumber laid perpendicular to the center-line and nailed or screwed to the stringers, or to nailers bolted to the stringers. Boardwalks usually have a curb or handrail along their edges (figure 52).

Figure 52-A typical boardwalk. Boardwalks are expensive and some-what complicated, so seek the help of engineers and landscape designers during planning.

Basically, a boardwalk is a series of connected bridges, each with a span as long as is practical, perhaps 8 to 40 feet. At most wetland sites, longer stringers are not practical because they are difficult to transport. Also, building adequate foundations for the long spans often requires large pieces of specialized equipment that cannot negotiate unstable soil.

## Stringers

At least two stringers or beams rest on the ledgers and span the space between consecutive bents or piers. As the space between bents or piers increases, a third stringer, or heftier stringers, must be used.

Long, thick stringers are more expensive than smaller ones. However, they permit the bents or piers to be farther apart. Studies of soil conditions and problems of construction access to the site will indicate the costs for stringers compared to bents or piers. Bring in some engineering help to figure out the most economical spacing of bents or piers. Large stringers should be bolted to steel angles that have been bolted to the ledgers. Nailers should be used to attach the deck, as described for type 3 puncheon (figure 53).

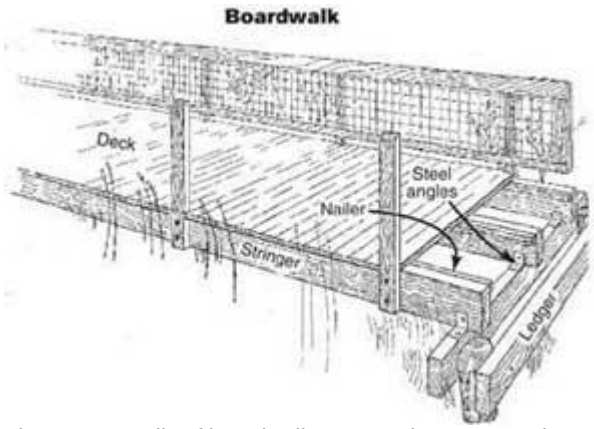


Figure 53-Details of boardwalk construction. Large stringers and ledgers connected with steel angles and nailers help increase the life of the stringers.

Ideally, the bottom of the stringers of a boardwalk should be above high-water levels, but this is often impractical. To reduce maintenance, the design of the boardwalk should avoid interference with the flow of floodwater and floating debris. To check for evidence of flooding, look for clusters of dead, broken branches stuck in shrubbery or the crowns of trees. Bark on the upstream side of trees

may be scraped or stripped off. The height of anticipated floodwater may seriously affect the design of a proposed handrail. Joists can be toenailed to the ledgers, or steel joist or truss hangers may be nailed to the ledgers to support the joists (figure 54). Joist and truss hangers reduce the distance between the deck and the ground below, perhaps eliminating the need for a pedestrian railing.

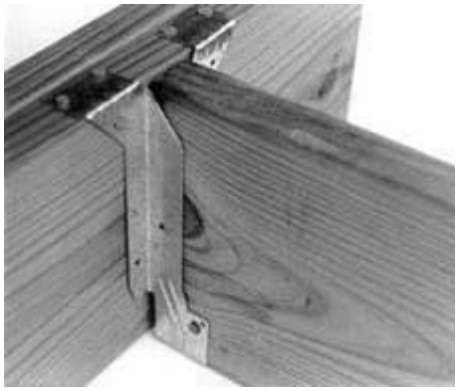

Figure 54-Supporting joists with truss hangers helps keep a boardwalk closer to the ground.

## Boardwalk Summary

Often boardwalks, as described here, are found around visitor centers, heavily used interpretive trails, or at other high-use sites. The sophisticated construction and materials needed for a boardwalk are less appropriate in the backcountry where the trail user expects simpler, more rustic construction and more challenging facilities.

During floods, the posts and rails can catch debris and form a dam. In most situations it is better to build as little as possible that will have to resist the force of high-velocity floodwaters. A decision on how much or how little to build should be based on the type and age of the visitors who will use the finished facility-schoolchildren, senior citizens, day hikers, or backpackers. Professional geotechnical and structural engineers and landscape architects are needed for effective design of these big-budget structures.