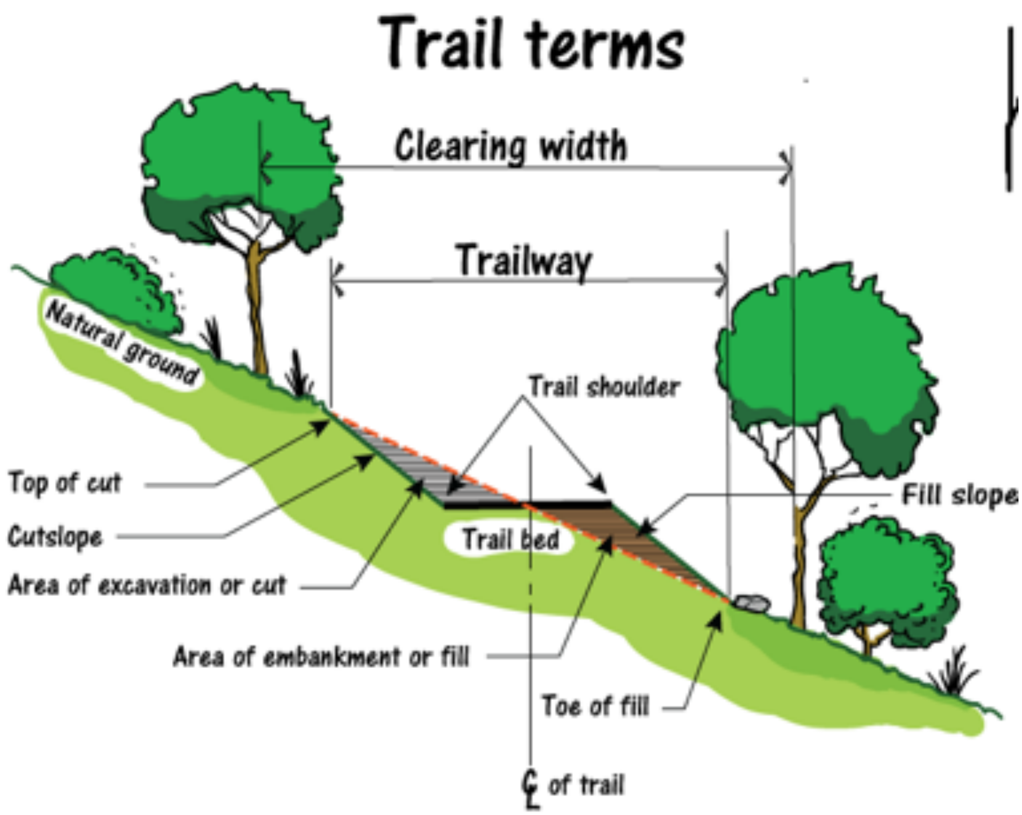
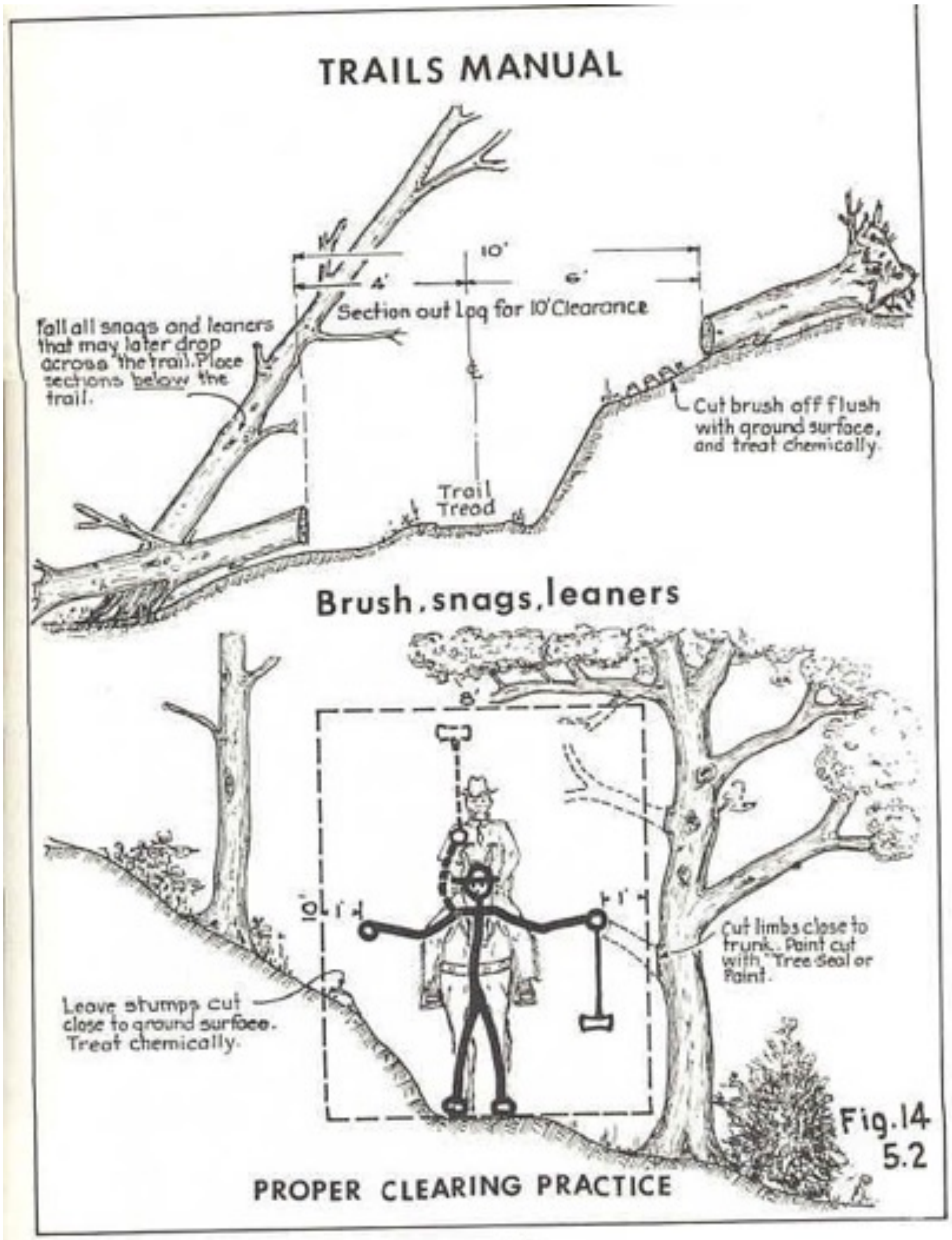
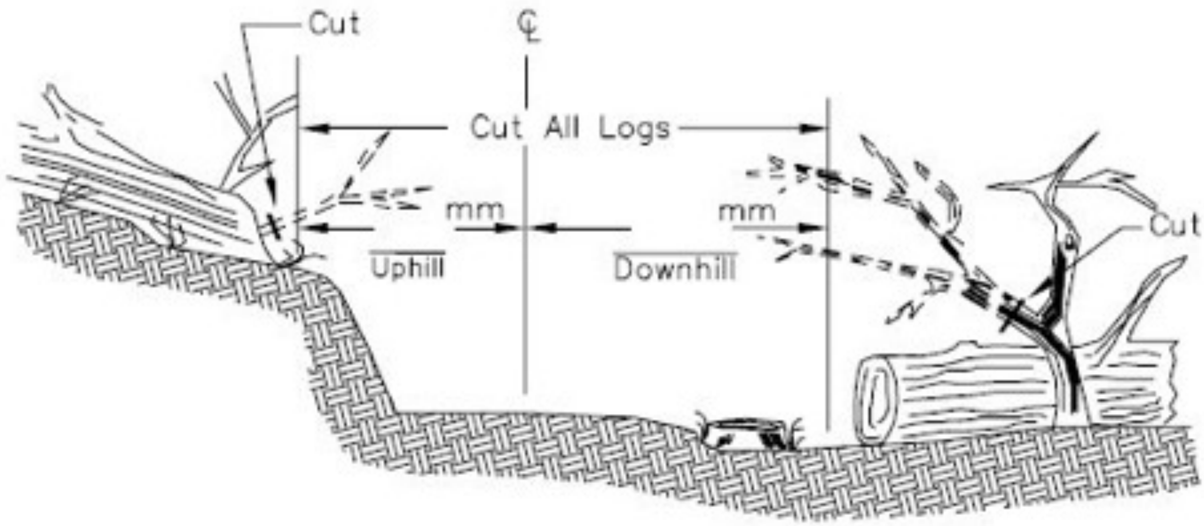
Trail Clearing specifications




TRAILS MANUAL
10'
4'
6'
Section out Log for 10' Clearance
Fall all snags and leaners that may later drop across the trail. Place sections below the trail.
Cut brush off flush with ground surface, and treat chemically.
Trail Tread
Brush, snags, leaners
8'
10'
1'
1'
Cut limbs close to trunk. Paint cut with "Tree Seal or Paint.
Leave stumps cut close to ground surface. Treat chemically.
Fig. 14
5.2
PROPER CLEARING PRACTICE



Crossing a Hillside
A hillside trail must quickly drain surface water off the tread while maintaining its shape and a grade that is comfortable for trail users. Options for crossing a hillside include full-bench and cut-and-fill trails, retaining walls, diverting water across the tread, and diverting water flowing down the tread.

Full-Bench and Cut-and-Fill Trail

A flat trail bed cut from a hillside provides a safe and comfortable crossing for users. In a full-bench trail, the full width of the tread is cut from the hillside. A full-bench trail usually has a well-compacted base because the underlying material has been in place for thousands of years.

If part of the tread is built upon fill material that was cut from the hillside, it is a cut-and-fill trail. Fill material may be difficult to compact, especially with hand tools. If fill material is not well compacted, horses and vehicles may destroy the tread. If fill material must be used for part of the trail bed, use large rocks to form the trail bed and serve as edging, and cover them with tightly compacted soil.

Backslope is the area above a trail where material has been cut from a hillside in the process of leveling the tread. The backslope grade necessary to prevent soil erosion depends on the material. A backslope of 1.5:1 (horizontal run: vertical rise) is adequate for stable materials whereas a backslope of 4:1 may be needed on erodible materials.

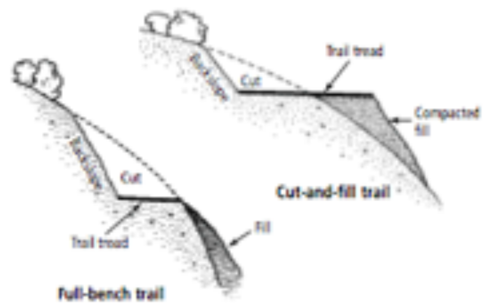


Figure 13-7. Full-bench and cut-and-fill trails provide safe travel across steep slopes.

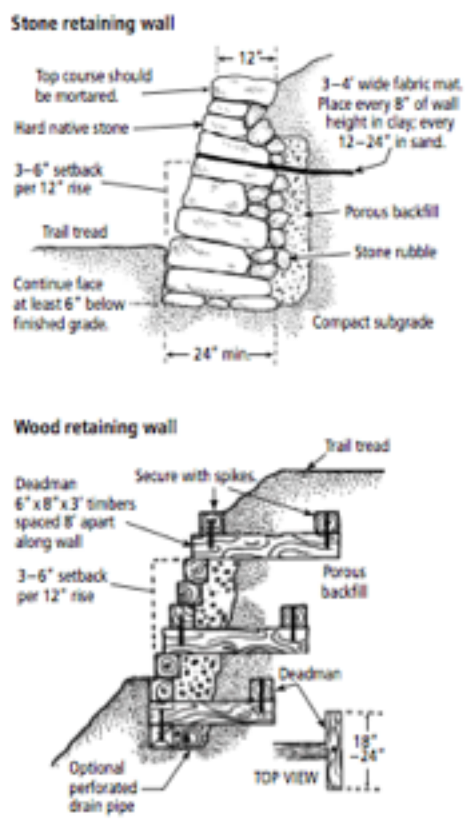


Figure 13-8. On steep slopes use walls to support the backslope or the tread.

Retaining Wall

Where a trail cuts across a slope and vegetation does not stabilize exposed soil above or below the tread, a retaining wall will prevent soil erosion. A retaining wall below the tread may be more durable than one along the backslope (perhaps because trail crews are more careful in building walls that support the tread). Building a retaining wall to support the tread may negate the need for cutting into the backslope, thus preserving natural vegetation that holds the soil. Tie walls into the embankment with a deadman (such as geotextile fabric, logs, or large rocks). Build walls without mortar, or install drain pipes, to allow water to seep through a wall.

Outslopes and Inslopes

Where a trail crosses a hillside with medium- to coarse-textured soil, outslope the tread to quickly drain off surface water. A 2 to 5 percent outslope is quite common and suitable for most trail users. In heavy rainfall areas, outslope up to 10 percent, provided trail users can safely negotiate this slope without slipping or rolling off the trail.

Some trail designers recommend no outslope on horse trails. Horses tend to walk on the outside edge of a tread and will crumble the edge over time. A sloped tread also increases the likelihood that horses will slip when the surface is wet. If you build a flat-cross-section trail, divert water from the tread using rolling grade and water bars (described below.) On flat-cross-section trails that traverse steep slopes, you may wish to create an edge berm (raised shoulder), except at grade dips, to protect the outside edge of the tread from erosion and to create a safer trail for users. Strengthen an edge berm with vegetation or rocks.

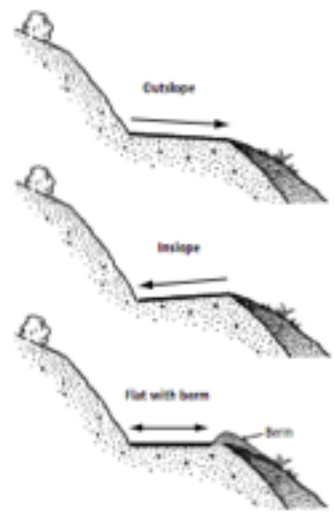


Figure 13-9. Outslope, inslope, and berm.

Where a trail crosses a hillside that has fine-textured, erodible soil, inslope the tread to a ditch, then divert water in the ditch across the trail and downhill through grade dips or culverts.

Divert Water Flowing Down the Tread

Where the tread has a relatively flat or concave cross-section, some water will run down the length of the trail. To prevent soil erosion, divert water off the tread with rolling grade or waterbars.

Rolling Grade

A rolling grade divides the trail into narrow watersheds with undulating crests and dips like a gentle roller coaster. Water drains off at the dips. Ideally, no part of the tread is completely level. Outslope the bottom of each dip and make the outlet wide enough to drain off water without clogging. Place tread dips at natural drainage ways and at other locations as needed. Rolling grade is most appropriate when traversing hill slopes (fall lines) of 20 to 70 percent. On hill slopes less than 20 percent, water does not drain well at the dips.

Drainage dips can deposit sediment into waterways. To reduce sedimentation, consider these alternatives: maintain a low tread grade on the approach to the drainage; design a small tread watershed with a short slope toward the waterway; harden the tread; or maintain a nearly level tread and install a boardwalk, bridge or culvert over the waterway.

Also use rolling grade to ascend/descend hillsides. In those situations, rolling grade is most effective when the tread grade is less than 1/4 to 1/3 of the hill slope. For example, if the hill slope is 45 percent, the tread grade should not exceed 15 percent, and 10 percent is preferred. As the trail climbs, periodically reverse the grade downhill for a few steps to create a dip that allows water to drain off.

Even when a trail is outsloped, insloped, or center-crowned, a rolling grade is desirable. These cross-sectional shapes are difficult to sustain over long periods without substantial maintenance.

Adjust the size of each tread watershed based on these factors:

- When the watershed above the tread is large, increasing the potential for runoff, make tread watersheds small.
- If the water infiltration rate of the upslope soil is slow, resulting in more potential runoff, make tread watersheds small.
- If the potential for erosion is high, make tread watersheds small. Hardening the tread, placing the trail beneath a tree canopy that will intercept precipitation and reduce splash erosion, or reducing tread width to minimize exposed soil will also reduce risk of erosion.
- Where trail grade is steep, make tread watersheds small or reduce the trail grade by lengthening the trail or adding switchbacks or turns. Tread erosion risk is relatively low when tread grade is less than 5 percent, moderate when tread grade is 5 to 10 percent, and higher when tread grade is greater than 10 percent.
- When hill grade is steep, make tread watersheds small. Tread dips drain best when there is a substantial difference between the tread grade and hill grade.

Figure 13-10. A rolling grade uses undulating crests and dips to divert water off the tread.

Waterbars

A waterbar is an obstruction placed across a trail tread to divert surface water off the tread. Waterbars may be needed on a sloping trail with a flat cross-section (no outslope) or where rolling grade is not adequate to divert water at tread dips. Because most waterbars create a significant bump in the trail, they are not desirable on trails used for bicycling, skiing, or snowmobiling. A rubber waterbar (Figure 13-11) can be used for bicycle trails. When waterbars are placed on horse trails, horses tend to compact the soil immediately above and below the water bar leading to depressions that collect water and mud. Horses also can damage waterbars because of their weight and strength. When used on horse trails, anchor waterbars well.

Place waterbars at a 30 to 45 degree angle across a trail. Where heavy runoff is expected, place stones at the outflow to disperse water without causing soil erosion.

If a waterbar diverts water into a ditch, make sure the bar does not protrude into the ditch where it might catch debris and block the ditch.

Use judgment and experimentation in spacing waterbars. Closer spacing is needed where the trail grade is steep, the soil is erodible, or you want a high quality tread without the expense of hardening materials.

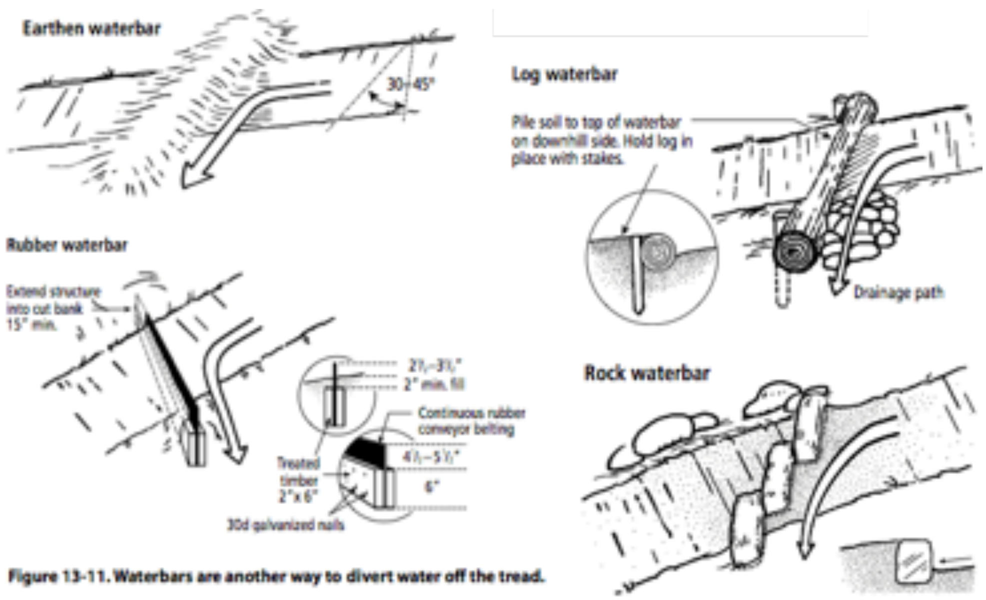


Figure 13-11. Waterbars are another way to divert water off the tread.

Climbing and Descending Steep Slopes and Cliffs
Switchbacks

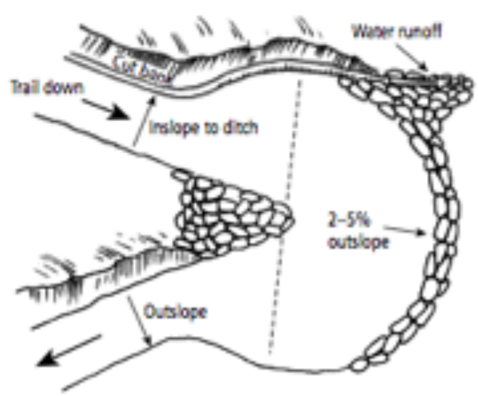


Figure 13-12. Switchbacks help the user climb a steep slope at a comfortable grade.

A switchback reduces trail grade by lengthening the trail in a zigzag pattern. Design each trail segment to conform to the desired grade as much as possible. Place a switchback where the trail reaches an impassable obstacle or begins to run too far in the wrong direction. Avoid closely spaced switchbacks to discourage trail users from taking shortcuts, leading to erosion. To further reduce shortcuts, locate switchbacks at interesting focal points (such as conspicuous tree, boulder, or rock outcrop) and place barriers (such as boulders, logs, thorny bushes) in the cutoff zone. Build the switchback platform with a 2 to 5 percent grade. On a very steep slope install a treadwall to support the platform, or install steps. If the main trail has a substantially higher grade than the platform, create a transition grade as the trail approaches the switchback platform. Divert surface water off the trail above the switchback by means of inslope to a ditch. The switchback turning radius must work for the intended users. Switchbacks may not be practical for skiers and snowmobilers because of the long turning radius they require.

Fixed Ropes

On a lightly used foot trail with a steep slope and soil that becomes slippery when wet, tie a rope (1/2” or larger diameter) to a firm object at the top of the slope and lay the rope along the tread or tie it to trees along the trail as a handrail.

Climbing Causeways (Turnpike)

When a slope has an uneven surface or is composed of erodible materials, a climbing causeway can build up the tread in short sections. A climbing causeway is useful on hiking and horse trails, but hazardous for skiers, snowmobilers, bicyclists, motorcyclists, and ATVs. Place 6- to 10-inch diameter logs or sawn timbers along each side of the tread to hold fill material in place. Using the same material, place crossbars at four-foot or longer intervals to prevent fill material from migrating downhill. Fill the spaces between logs with soil or gravel, varying the fill depth to create long steps that provide the desired grade. A climbing causeway is most useful on grades of 10 to 20 percent. For steeper grades, see the section on Steps, below.

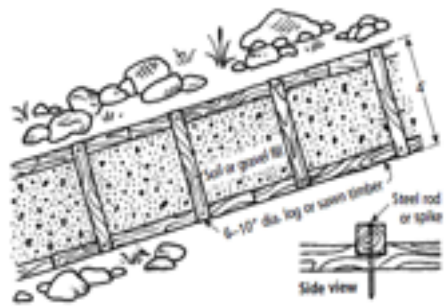


Figure 13-13. A climbing causeway allows you to hold fill material on a steep grade.

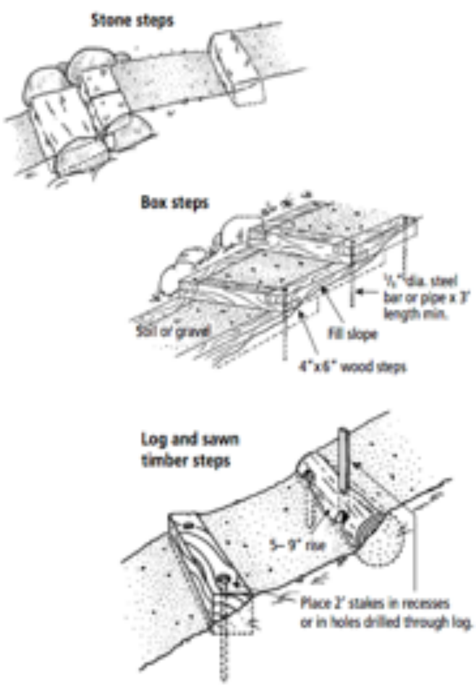


Figure 13-14. Steps help prevent erosion and make it easier to navigate a slope.

Steps

Where trail grade exceeds 20 percent, steps help prevent erosion while aiding hikers and horses. Make step height (rise) 5 to 9 inches (7.5 inches is ideal) and step depth (run) at least 10 inches. You can vary step depth up to several feet to fit the hill slope. Make simple steps by anchoring logs, sawn timbers, or large stones across the tread and back-filling with soil. Make more durable steps from 6- to 8-inch diameter logs or sawn timbers positioned into a three-sided box fastened with steel rods and backfilled with soil or gravel.

Ladders

A wooden ladder can be a good solution for helping hikers climb a steep slope or cliff. If you need a ladder longer than 16 feet, butt two long pieces of lumber together and nail an over-lapping reinforcement of 2” x 6” lumber across the joint. For longer ladders, build a platform at intervals of about 32 feet that allows users to get off the ladder and rest before ascending/descending another ladder. A platform at the top of a ladder permits users to safely get on and off.

On a primitive trail a flexible cable ladder that conforms to changing land contours can be used to climb a steep, actively eroding slope.

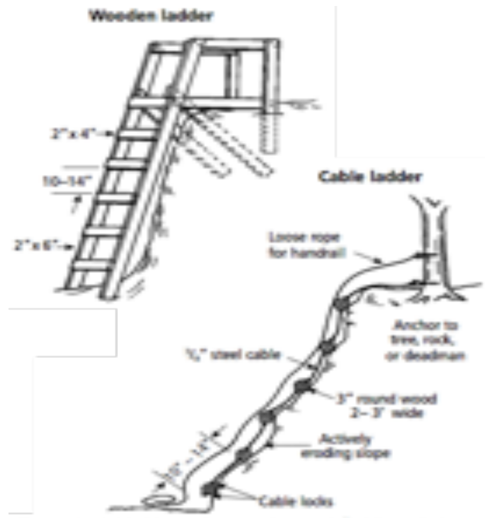


Figure 13-15. A ladder can be a good way to help hikers climb a steep slope.

Crossing Wet Soil

Poorly drained soil on flat land may develop mud or water puddles after snowmelt or rainfall or where groundwater seeps from a hillside and flows across the trail. The solution is to raise the tread.

Corduroy Logs and Tree Cookies

On a primitive trail, corduroy logs, 6- to 10-inch in diameter, placed side by side across the trail will raise the tread and allow surface water to flow naturally between the logs. For added buoyancy in waterlogged soil, place log stringers along trail edges beneath the ends of corduroy logs. A corduroy tread is uneven and somewhat slippery but may be used for short distances by hikers, ATVs, skiers, and snowmobilers.

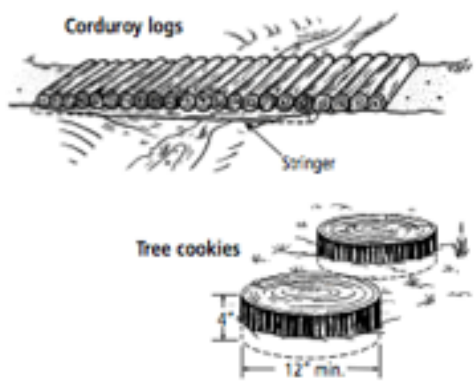


Figure 13-16. Corduroy logs and tree cookies are inexpensive ways to raise a tread in wet soil but they are slippery to cross.

Tree cookies are cross-sections of tree stems cut at least 4 inches thick and 12 inches wide. On primitive trails, tree cookies may be used as steps for hikers, but they are extremely slippery when wet and often tip downward in soft soil causing the hiker to slip or fall. Corduroy logs or firmly imbedded stepping stones are safer!

Select naturally decay-resistant wood for corduroy logs and tree cookies, although they may still last only a few years. These are primitive, low cost, temporary solutions to crossing muddy areas.

Drainage Lens

If surface water continually seeps slowly across a section of trail creating a perennial mudhole, a drainage lens that enables water to seep beneath the tread may be required. First excavate several inches of water-saturated soil in the trail bed, then backfill with a layer of large rocks. Add layers of progressively smaller rocks on top of the first layer, leaving large pore spaces between rocks at lower levels. Top this rock fill with soil or gravel to form the tread.

If saturated subsoil is extremely deep or unstable, first lay geotextile fabric on the ground, then add rock layers. Place additional geotextile fabric on top

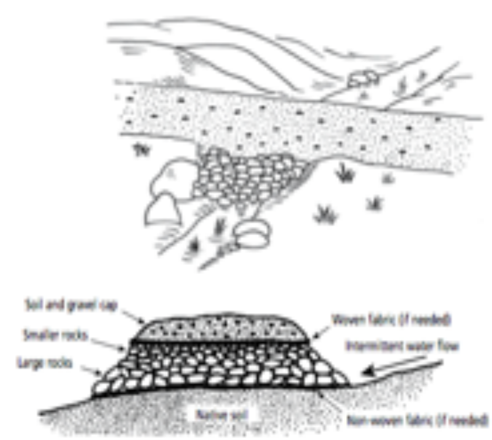


Figure 13-17. A drainage lens allows water to seep beneath the tread.

of the rocks and top with soil or gravel. Geo-textile fabric separates rock fill from the substrate, preventing soil from clogging pores between the rocks yet allowing water to percolate through the fabric and the fill material.

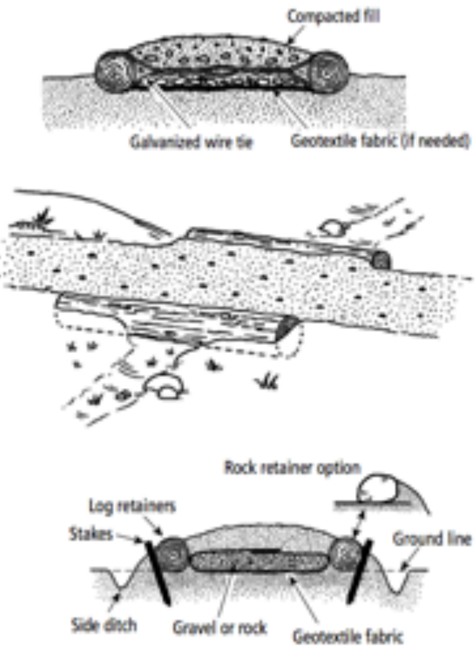


Figure 13-18. A causeway (turnpike) raises the tread above wet soil.

Causeways (Turnpike)
A causeway produces a raised tread that is suitable for all trail users. Place curbs made from logs, cut timbers, or rocks along both sides of the tread and fill the space between curbs with soil or gravel. If fill material is expected to sink into the substrate, first place geotextile fabric on the ground surface, then install curbs and fill material. If surface water actively flows across the site, place a ditch on one or both sides to divert water to culverts through the raised tread.
Center Crown with Ditches
A center crown is constructed like a highway with a raised tread and ditches on one or both sides. Use material from the ditches to raise the center tread if it is the appropriate texture. On very wet soils, place geotextile fabric on the ground surface before adding fill.
Boardwalks
A boardwalk enables trail users to cross over wetlands, fragile vegetation, or unstable soil.
On hiking trails make the boardwalk deck (tread) from 2” x 6” lumber. Use thicker lumber on boardwalks intended for heavier users, such as ATVs or horses. Full-sized boards are stiffer and last longer than typical 2” x 6” lumber that really is 1.5” x 5.5”.

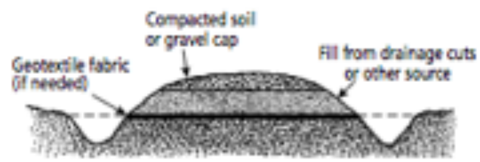


Figure 13-19. Center crown with ditches.

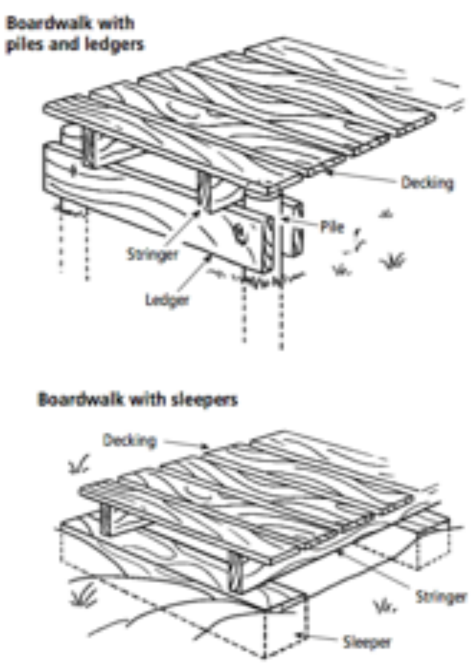


Figure 13-20. Boardwalks allow users to cross over wet or sensitive landscapes.

Boardwalks are slippery when wet. To increase traction, orient deck boards at a 90-degree angle to the direction of travel and consider using rough-surfaced lumber (unplaned or split rather than sawn) or cover boards with a roughening product. Leave gaps between planks to further increase traction and to facilitate air movement that dries wood more quickly, lengthening its useful life. A 3/8” to 1/2” gap works well for most users. Closer spacing helps retain snow for skiing and snowmobiling. Wider spacing may be acceptable on primitive trails and for OHVs. Build the deck as level as possible for safety. Install steps on sloping ground, if compatible with trail uses.

Support the deck with stringers running beneath the deck. Orient stringers with the direction of travel. For weather protection, inset the stringer from the ends of deck boards. Space the stringers according to the stiffness of the materials–the stiffer the material the further the spacing (typically 18 to 30 inches). For example, wood-plastic composite lumber is not as stiff as sawn lumber, thus requiring closer stringer spacing.

Use one of the following to support stringers:

- Sleepers oriented 90° to the direction of travel and resting on the ground.
- Cribbing made from rocks or logs.
- Vertical posts (such as wooden poles or helical screws) sunk into the ground and spanned by ledgers. Sunken posts are the most stable, but there may be situations where you do not want to dig into the ground (such as rocky ground or organic soil).

On high-use boardwalks or those built more than two feet above ground, add a raised curb along each edge to help prevent users from stumbling off the boardwalk. Install a railing on one or both sides of a boardwalk that is more than four feet above the ground, crosses open water, or is intended for use by persons with mobility impairments. See more information about curbs and railings in the section on Bridges.

For decay resistance, select preservative-treated lumber, wood-plastic composite lumber, or naturally decay-resistant wood for boardwalk components. Some tropical hardwoods have a durable life of more than 50 years without chemical treatment, but are very expensive.

To cross deep water or connect trail users more closely with water environments, use a floating boardwalk. Make floats from thick styrofoam contained in wood or plastic, or from more durable sealed plastic or steel airtanks. Commercially available floating docks offer easy installation.

Crossing Waterways and Gullies

Stepping stones, fords, culverts or bridges help users cross open water in springs, streams, and rivers.

Stepping Stones and Fordstrail

On a primitive trail, hikers might appreciate stepping stones that are firmly imbedded in the stream bottom. They might also wade across a slow-moving stream (less than two feet deep) through a ford. Horses can ford a slow-moving stream (less than three feet deep). Place a ford where the streambed has firm sand or gravel. On horse trails remove large rocks from the streambed to prevent tripping. If a small dam is installed to stabilize water depth and bottom structure, a

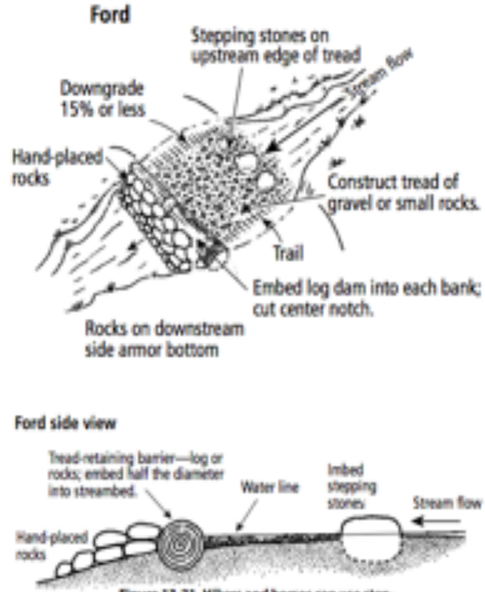


Figure 13-21. Hikers and horses can use stepping stones and fords to cross small bodies of water.

government permit may be required.
Culverts
Install a culvert to channel water across a trail, allowing trail users to cross a narrow stream. An open-top log or rock culvert is easy to clean when it becomes clogged, but creates a hazard for some trail users.

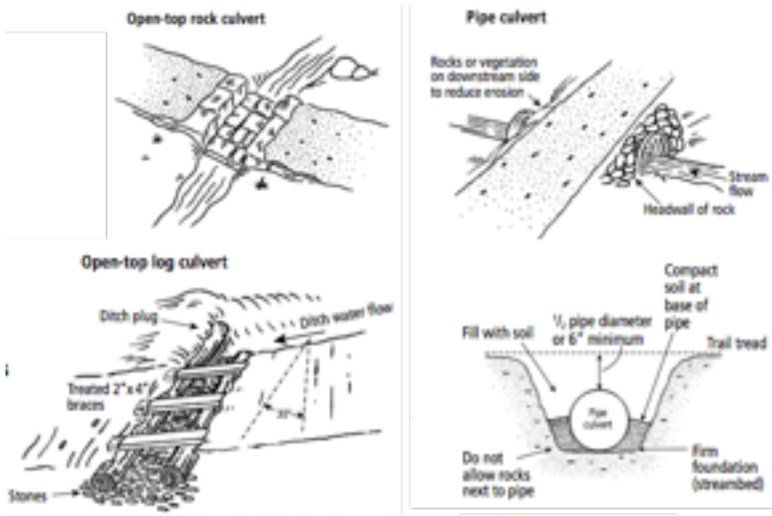


Figure 13-22. A culvert is a good option for crossing a narrow stream.

A pipe culvert covered with soil can be used by all trail user. Pipe culverts may be steel (durable, but heavy) or plastic (less durable, but lightweight for transporting into areas with difficult access). To permit fish movement on streams, a culvert should slope no more than 1 precent and its end must be flush with the stream bottom. Place rocks around the culvert's upstream end to armor the bank against erosion.

Seek professional advice from a soil and water expert to gauge the appropriate diameter culvert to install. If the culvert is too small, high water will wash it out or flood land upstream from the culvert.

Bridges
Bridges are expensive to build and require a high level of expertise. Use them where necessary for safety or to protect natural resources. First consider other alternatives, such as trail re-alignment, culverts, causeways, or boardwalks. This section provides only general guidelines; seek engineering assistance for any bridge that is long or high. Because of cost, make bridges as short as possible by installing them where gaps are narrow. Select a location where the approach is relatively level and straight, and where you can build firm abutments at each end above the normal high water level.
Any construction in waters and wetlands that drain into or are connected to a navigable stream requires a U.S. Army Corp of Engineers 404 Permit. Bridges that span navigable waters must have a 3-foot minimum clearance above the ordinary high water level. Temporary bridges must have a 3-foot minimum clearance between the lowest portion of the bridge and normal summer stream flow.

Abutments

Abutments support the ends of the bridge and provide intermediate support for long bridges. If the terrain is subject to flooding, raise end abutments to elevate the bridge above flood level. On a primitive, lightly used trail, a very small bridge may be anchored with a cable on one end with the expectation that it will break loose during a flood, but can be retrieved and repositioned. Construct abutments from durable materials since they are in contact with ground moisture, and may deteriorate more quickly than stringers, decks, and railings. A sill is a simple abutment made from a single structure, such as log, sawn timber, gabion, or concrete. Sills require little excavation, but should be used only for small bridges that can move with frost heaving. A crib is a box-like structure made from logs or sawn timbers and filled with rocks. A retaining wall is an earth-retaining structure tied into the banks with a deadman. A retaining wall may be made from logs, sawn timbers, gabion, or concrete. Piles are wood or steel posts that are pounded or screwed down to a firm footing and cross-braced to prevent sway. To estimate the depth required to obtain a firm footing, drive a small diameter steel rod into the substrate.

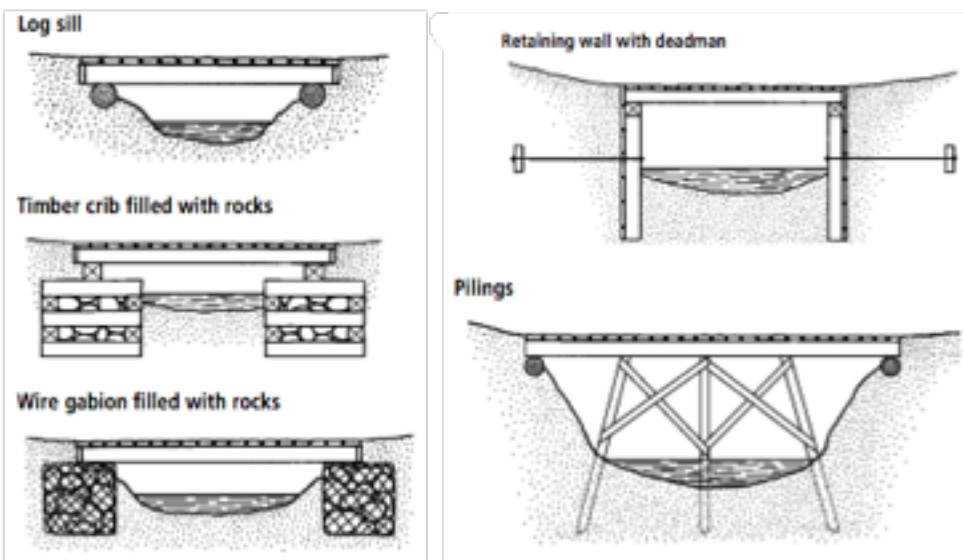


Figure 13-23. The best type of abutments for your bridge depends on the size of the bridge and the surrounding conditions.

Girders and Trusses

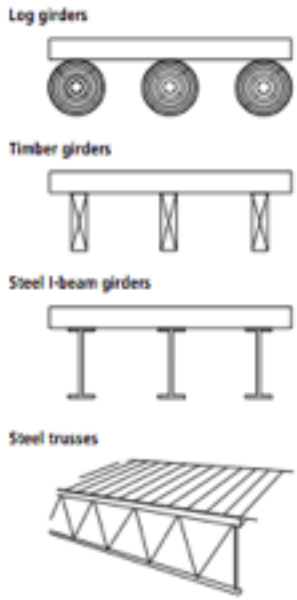


Figure 13-24. Girders and trusses support the bridge deck.

Girders and trusses rest on top of the abutments and support the deck (tread). On a simple deck, they also may serve as the deck.

On a deck girder/truss bridge, the deck is fastened directly to two or more girders or trusses that span the gap. Girders may be logs, timbers, glue-laminated timbers, or steel I-beams. Trusses usually are steel beams with steel cross-braces.

Suspension Cables
A suspension bridge is supported by two steel cables, one on each side of the deck, that span the gap. Suspender cables or steel rods hang down from the two support cables to support the deck below.
A stayed suspension bridge has multiple steel cables spread from the top of a tower down to the deck to support it.


A suspension bridge is an inexpensive solution for a foot trail that crosses a wide stream

Photo © Mel Baughman

A suspension cable car has a cargo box suspended by rollers from a single steel cable that spans the gap. A continuous loop rope, passed through pulleys at both ends of the bridge, can be grasped by the users while sitting in the cable car to pull the car across the gap.

Decks
The tread on a bridge is called a deck. If possible, build the deck to the same width as the tread on other parts of the trail. If railings are used, make the deck two to four feet wider or slant the railing outward at the top to provide more shoulder width. If the bridge deck is a different width from the approaching trail tread, gradually adjust the trail tread width as it approaches the bridge.

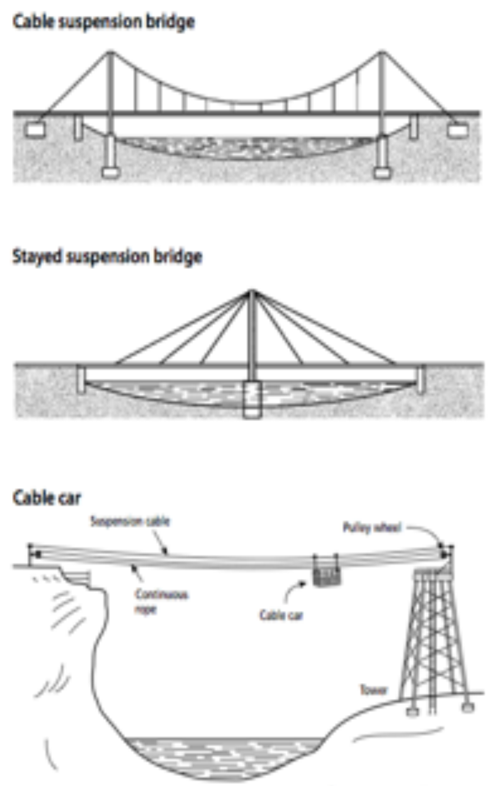


Figure 13-25. Suspension bridges can span wide bodies of water.

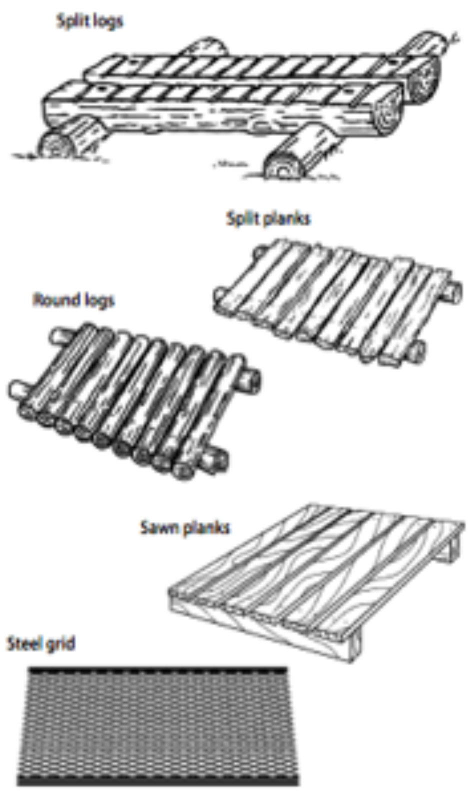


Figure 13-26. Choose deck materials suitable for your trail users.

To prevent water from flowing down the trail and onto the bridge deck, create a drainage dip in the trail approach or elevate the bridge deck. Hikers can step up to a deck, but for other trail users the ends of the bridge deck must be flush in elevation with the approaching trail tread.

When estimating the strength needed for the deck, consider not only the weight of trail users, but snow loading, wind loading, and the weight of equipment that will cross the bridge. Select materials that will not be slippery when wet. Options for decks materials include split logs, sawn planks, wood-plastic composite lumber, steel grids, or fiberglass sheets bonded to shallow fiberglass structural shapes with coarse sand embedded into the gel coating to increase roughness. For more information on deck materials and placement, see Boardwalks.

Curbs and Railings

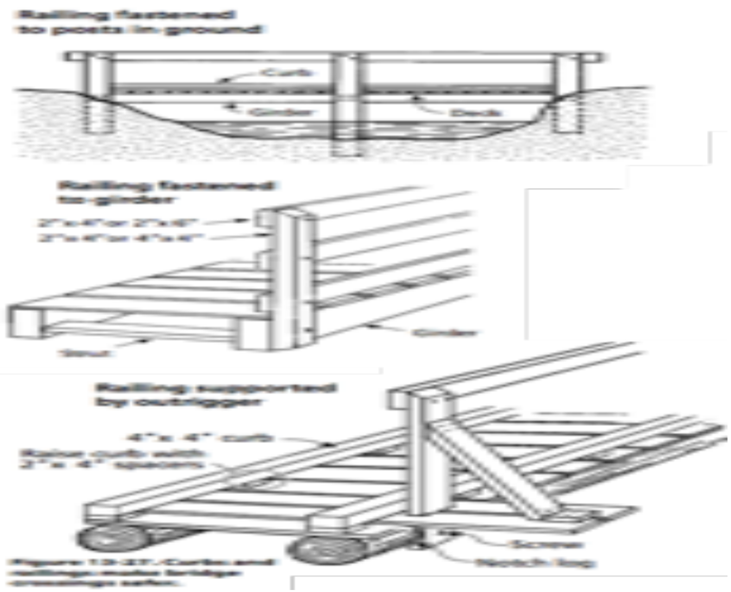
Curbs or railings may be needed on boardwalks and bridges to protect users from hazards (such as steep drop-off, hot spring) and/or to protect trail-side resources (such as archeological sites, fragile vegetation, rare species).

On decks built more than two feet above ground, add a raised curb along each edge to help prevent users from stumbling off the edge. Fasten a 4″x 4″ timber or round log on each side of the deck held 2 inches above the deck by short sections of 2″x 4″ lumber. Gaps beneath the curb allow water and debris to wash off the edge.

In highly accessible areas where a deck is more than four feet above ground, crosses open water, or is used by persons with mobility impairments, install a railing on one or both sides. In more remote areas you might do without rails on decks less than eight feet above ground. If a railing is provided on only one side, place it on the side that exposes trail users to the greatest risk or where users turn to view an interesting scene. If the drop from a bridge or boardwalk is no more hazardous than other unprotected drops along the trail, a railing probably is not needed.

In remote areas design railings to match the level of risk and trail experience that you want to offer. In general make such railings at least 42 inches high for pedestrian traffic and at least 54 inches high for bicycle or horse traffic. Install one or more intermediate rails so the vertical distance between rails does not exceed 15 inches.

Railings attached to buildings, such as visitor centers, and on trail bridges in urban settings that are expected to attract unsupervised children must meet local building codes. The Uniform Building Code (UBC 509) requires a handrail at least 42 inches high that a 4-inch sphere will not pass through.



Railings on trail bridges frequently used by unsupervised children, especially near trailheads, must meet the American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Highway Bridges. This code requires a handrail at least 42 inches high for pedestrian traffic and at least 54 inches high for bicycle or horse traffic. A 6-inch sphere must not pass through the railing in the bottom 27 inches and an 8-inch sphere must not pass through the area higher than 27 inches.

On a wheelchair-accessible trail where the grade is steeper than 5 percent, place a rail 30 to 34 inches above the deck so that a person in a wheelchair can grasp it to pull their wheelchair along or rest without rolling downhill, and place a second rail 42 inches above the deck.

Bridges for OHVs and snowmobiles must have reflective hazard markers visible above the snow level at each end of the bridge.

The strongest railings have vertical support posts that are anchored into the ground and fastened to the girders or stringers before extending up to the top railing. Somewhat less sturdy, but still strong railings can be fastened to the girders or supported by outriggers.

Cut vertical support posts lower than the top railing to encourage use of the railing.

Materials for Bridges
Select bridge construction materials for durability, strength, esthetics, economics, and environmental acceptability.
Select wood that is naturally decay resistant or is treated with environmentally safe chemicals. On portions of trail bridges or boardwalks that trail users touch frequently, such as railings, use wood treated with waterborne chemicals or light solvent oilborne chemicals. Wood without a chemical preservative may last 2 to 12 years depending on its natural decay resistance, though some tropical woods resist decay for over 50 years.

Use steel that is painted or galvanized, unless it is a corrosion-resistant weathering steel. Do not use uncoated weathering steel in coastal areas or in areas with high rainfall, high humidity, or persistent fog. Concrete should have an air entrainment of 4 to 6 percent and a minimum design compressive strength of 3,000 pounds per square inch. Concrete can be texturized, colored, stained, or painted to better match esthetic values.

Fiberglass should have a waterproof, colored surface treatment to protect it from ultraviolet radiation.

Use screws and bolts, not nails. Use non-corrosive fasteners that are hot-dipped galvanized, anodized plated, or stainless steel.

Inspection

Inspect bridges at least twice a year. A qualified bridge inspector should evaluate bridges with long spans or complex designs.

Trails that Cross or Utilize Roads

Crossing Roads

As a trail approaches a road crossing, add a tight turn, ridges and dips in the tread, and/or narrow the clearing width to slow down users. On the final approach, the trail must be at a right (90 degree) angle to the road, nearly level, and have a sight distance adequate for trail users to see the oncoming road in time to stop. Expand the clearing width 1 1/2 to 2 times its normal width or thin forest trees to provide good visibility from the trail toward the road.

Install warning signs if trail users include horseback riders, skiers, snowmobilers, bicyclists, motorcyclists, or other motorized vehicle users that may not be able to stop suddenly. Work with the road authority to determine what signs to use and where to place them. If both the trail and road are lightly used and good sight lines are present, install a Yield or Stop sign on the trail at the road intersection. A Stop sign is not required for non-wheeled and pedestrian-speed users. If traffic along the trail or road is moderately heavy, add a Stop Ahead sign on the trail. If traffic along both the trail and road are heavy, add a Trail Crossing Ahead sign along the road to warn vehicle drivers.

If the trail may be entered from a public road, install a barrier (such as posts, a gate, boulders, mound of dirt) to prohibit unauthorized entry. Install a sign visible from the road that indicates which trail uses are prohibited or permitted.

Ditch Trails

Regulations governing trails in public road ditches vary by state. In some states, for example, low-use trails are permitted between the ditch and the outside edge of state and county road rights-of-way. Off-highway vehicles and snowmobiles may not use the inside slope, shoulder, and road surface of state and county roads. Motorized vehicles in a ditch are expected to travel in the direction of road traffic, so ditch trails are needed on both sides of a highway to permit two-way traffic. However, a bi-directional, non-motorized trail can be provided on one side of a highway only. Along designated ditch trails, utility poles, guy wires, and other trailside obstacles must be marked with a hazard marker. For safety purposes, ditch trails that are within 10 to 20 feet of the road edge should be separated from the road by a different elevation, fence, or guard rail. Separation is more critical where the road curves. All ditch trail design and construction is subject to approval by the local road authority.

Modifying Logging Roads

If a logging skid trail or haul road will be used both for logging and recreational use, it must be designed to accommodate logging equipment. If the skid trail or road will not be used for 10 years for logging purposes, then design it more like a recreational trail. When the time comes to use it for logging, make temporary modifications, such as harden the tread, install temporary stream crossing devices for heavy equipment, expand the clearing width, and install more durable culverts or other drainage devices.