Designing Sustainable Trails

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• Flat Land
• Hills
• Boulder Fields
• Wetlands
• Streams
• Fences
Crossing Flat Land
Cross Drainage/Outslope
Center Crowning w/ Ditches

- Gravel or woodchip cover
- Fill from drainage cuts, minimum 3''
- Minimum cut 3''

Width necessary for drainage
Crossing a Hillside
Full Bench vs. Cut-and-Fill

- Moderate slope with cut-and-fill trail
- Steep slope with full bench trail

Diagram showing cut and fill sections with trail tread and slope indicated.
New trail with steep backslope

Old trail with eroding backslope
Backslope Wall

- Loose Rock
- Fitted, mortared rock
- Wire Gabion
- Concrete Revetment
Rock Wall Design

Top course should be mortared.

Hard native stone

3'-6' set back per 12' rise

Finished grade

Continue face at least 6' below finished grade.

3'-4' wide fabric mat. Place every 8' of wall height in clay; every 12'-24' in sand.

Porous backfill

Stone rubble

Compact subgrade

24 min.

Stone retaining wall
Wood Wall Design

- 6" x 8" x 3' timbers spaced 8' apart along wall
- 3"-6" setback per 12" rise
- Finished grade
- Optional perforated drain pipe
- Deadman
- Secure with spikes
- Porous backfill
- Wood retaining wall
Tread Walls

- Fitted Rock
- Mortared Rock
- Logs
- Plastic
Tread & Backslope Walls

Sandy soil
Divert Water off Slopes
Rolling Grade

- 10% grade

+ 10% reverse grade (6-10 feet)

- 10% grade
Earthen waterbar
Log Waterbar
Log Waterbar

Pile soil to top of waterbar on downhill side. Hold log in place with stakes.
Rock Waterbar
Rubber Waterbar
Rubber Waterbar

Rubber water deflector

Extend structure into cut bank 15" min.

Skew structure 30°-45°

Trail down

Tread cut slope

Continuous rubber conveyor belting

SIDE VIEW (INSTALLED)

2 1/2"

2 1/2"

3 1/2"

Treated timber, 2" x 6"

30d galvanized nails

4 1/2" - 5 1/2"

6"

Trail tread surface

FRONT VIEW
Switchbacks
Switchback Platforms
Climbing Causeway
Box Steps

Treated timbers can protect a switchback landing.
Stairway
Cable Ladder
Fixed Rope
Cross Boulder Field
Cross Boulder Field

Rock Steps

Concrete Fill
Cross Wet Soil

Corduroy Trail

Logs, 6”-8” diameter

Corduroy
Causeway
Center Crowning w/ Ditches

- **Center crowning**
- Gravel or woodchip cover
- Fill from drainage cuts, minimum 3"
- Width necessary for drainage
- Minimum cut 3"
Geotextile Fabric

Elevated tread with geotextile mat

3''-6'' of gravel or other fill material
Log Boardwalk

Split Logs

Steps
Lumber Boardwalk

Cribbing Supports

6 x 6 Sleepers
Low Boardwalk
Elevated Boardwalk
Floating Boardwalk
Helical Screw Piles

http://www.heartlanddesigngroup.com/images/Boardwalk%202.jpg

Stepping Stones
Ford & Stepping Stones
Open-top Culvert
Pipe Culvert

PVC, Plastic, Steel
Culvert Installation

**Metal culvert**

- Fill with soil.
- 1/2 pipe diameter or 1 foot minimum
- Trail tread
- Compact the soil at base of pipe.
- Firm foundation (streambed)

Do not allow rocks in the area next to pipe.

**Use rocks or vegetation on the downstream side to reduce erosion.**

- Headwall of rock should be at least 8" thick.
- Stream flow
Bridge Location
Record high water level

Ordinary high water level

Average water level

Cattails, bulrushes, sedges, and other aquatic vegetation
Bridge Girders
Support the Deck

Log
Solid Wood Beam
Steel I-Beam
Steel Truss
End Abutments
Support Girders

Wood Mud Sill
Concrete
Rock
Wood Timbers
Mid-Span Abutments

Wood Poles

Sawn Wood Timbers

Wood A-Frame
Mid-Span Abutments

Rock-filled wire gabion

Rock-filled wooden cribbing

Mortared stone
Suspension Bridge
Steel Bridge
Bridge and Boardwalk Deck Materials
Deck Board Orientation
Deck Board Spacing
Deck Traction
Deck Traction
Curbs
Hand Rail Supports

- Buried in Ground
- Outrigger
- Attached to Girder
Handrail Posts
Flush with top rail or protruding?
Handrail Materials

- Rope
- Steel Cable w/ Plastic Coating
Wooden Handrails

Sawn Wood

Round Wood
Safety Fencing
Ladder Stiles
Walk-Through Stiles

Maze
Swinging Gate Stile
Fence Gates

Fence Wire

Steel Cable

Steel Tubing

Steel Tube Frame & Wire Mesh
Self-Closing Gate

Ball and Chain

Spring Hinges