Chapter 13:

Trail Construction Techniques

A continuation of the previous chapter on trails this chapter focuses on trail construction with an emphasis on backcountry trails. When designing the experience, trail construction techniques become important in designing the desired experience. Topics include trail gradient strategies, roadway construction, and trail signs.

Trail Gradient Strategies

An important consideration in trail design is the gradient of the trail (see Figure 12.3). This section presents several strategies for maintaining an appropriate trail gradient. Gradient strategies include contouring, spiraling, and switchbacks.

<b>**Contouring** – Contouring is used extensively in railroad construction where they seek less than a 2% mainline grade. Normally, a three percent grade is considered the maximum grade for mainline tracks and in most cases, railroads sought to keep their mainline grades at less than two percent. Although a two percent grade may not seem like a large grade, if a person stands at one end of a football field, a six foot person standing in the other end zone would be six feet higher and a two percent slope. A two percent grade is not insignificant. Contouring is one of the techniques used where the railroad or trail follows the contour lines on a topographic map (lines of equal elevation). Since most rail-to-trails originated from abandoned railroads, they tend to practice contouring and have grades less than two percent. This is reflected in the three percent maximum preference for bicyclists in Figure 12.3.

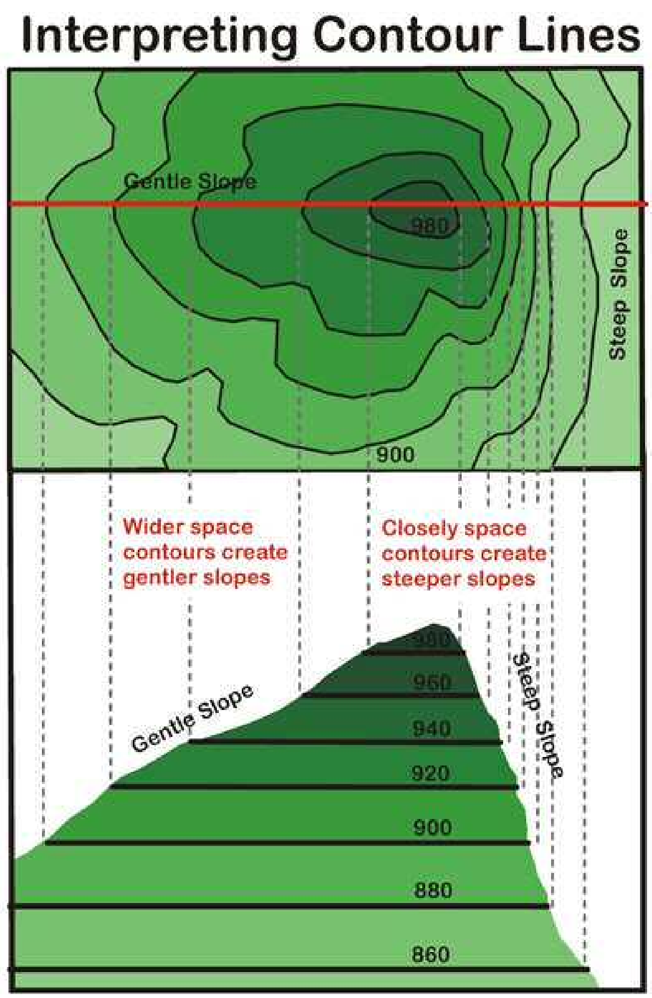

Figure 13.1: Contouring – Used extensively in railroading to maintain an even of slight grade, contouring is a technique where the road or trail follows the contour lines (lines of equal elevation) on a contour map. Source: Author – [file:\fig1213-Contour01.jpg]

Figure 13.1 illustrates the principle of contours. On topographic maps, contour lines are used to convert three-dimensionality into two dimensions. A contour line defined as a line that represents all the equal elevations above sea level on a topographic map. Since they are levels of equal elevation, contour lines by definition do not intersect. In a sidebar, the contour lines of an overhanging cliff will look if they are intersecting. However, they really aren't. Normally, contour lines are in 20 foot intervals but intervals can be larger or smaller as needed. For example in steep mountainous terrain, 50 foot contour intervals may be used. Site renderings will use anywhere between one foot to five intervals, depending on what is being rendered. When interpreting contour lines, the rule is that the further apart the contour lines, the more gentle the grade. The closer the contour lines, the steeper the grade. This is illustrated graphically between the top view (topographic map) and the profile view in Figure 13.2.

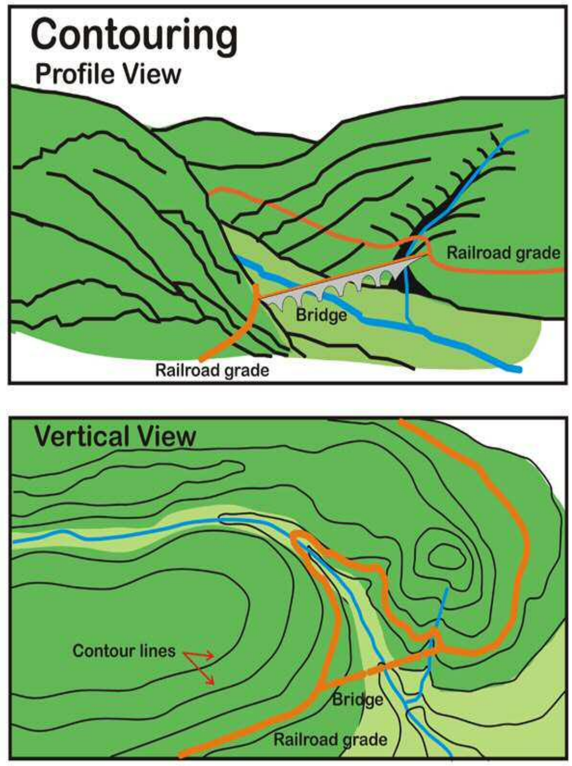

Figure 13.2: Contouring – This scene provides comparison between the top view utilized on a topographic map with a profile view below it of the same area. Source: Author – [file:\fig1214-Contour02.jpg]

Increasing the length of the roadway while maintaining the same vertical height in elevation results in a decrease in the slope of the trail (Figure 13.3). Changing the length of the roadway, can be used to gently increase or decrease the slope of the trail. This can easily be applied to contouring where the elevation of the trail can be gently increased or decreased. Also, the principle has applicability with switchbacks and spiral walkways which utilize this principle to provide a gradual incline or decline in the roadway.

From an experience perspective, a benefit of contouring is that it tends to facilitate *mystery*, anticipation and what is around the corner (see Chapter 7, Figure 7.3, and Figure 8.5). Of course, this assumes hilly terrain. In relatively flat terrain, former railroad grades converted to trails can be quite linear.

<b>***Switchbacks and Spiraling*** – Switchbacks and spiraling are closely related. Both methods decrease the gradient of the roadway by increasing the length of the roadway. The difference is that spiraling turns in on itself. A switchback turns away from itself when making the second turn. If there is only one turn or switchback in the trail, there is no difference between spiraling and switchbacks. It is only on the second turn whether it becomes a switchback or spiral.

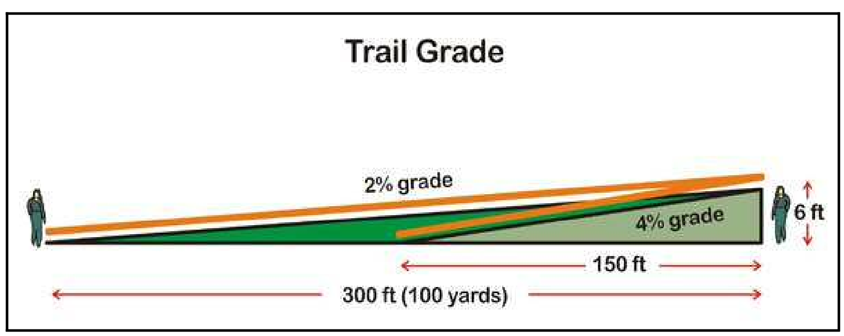

Figure 13.3: Lengthening the Roadway – Double the horizontal length from 150 feet to 300 feet and the slope drops by half, from a 4% to a 2% gradient. Also, the amount of real estate needed for the trail is doubled. Source: Author – [file:\Contour03.jpg]

<c>**Spiraling** – Spiraling is more common in buildings and man-made structures. It is more common than most people might think, particularly in buildings. Most football and baseball stadiums use either a series of spirals on the outside of the building to move people to the upper sections of the stadium. A spiraling walkway is useful creating an overpass (see Figure 11.35). In buildings, most stairwells are an example of spiraling steps. In addition, the modern parking garage typically utilizes a spiral trail as drivers get dizzy spiraling through the structure. In outdoor settings spiraling is less common.

Although it was never built, the Sugarloaf Planetarium commissioned by Gordon Strong from Frank Lloyd Wright in 1924 exemplifies a spiral roadway around the outside of the building (Reinberger, 1984, p.38) (Figure 13.4). In Wright's design, automobiles would spiral upward on an external roadway to the summit of the building. Most often a partial spiral is used in buildings and exhibits. Also, a major benefit of spiraling is that it eliminates steps, facilitates handicapped accessibility, and allows wheeled maintenance vehicles continuous access. He later turned the concept inward with the design of the Guggenheim Museum located in New York City.

The trail or pathway can spiral on the inside of the attraction. As noted, the Guggenheim Museum is an example of the spiraling walkway on the inside of the building. The Atlantic Reef at the National Aquarium uses this design also (Figure 13.5). Actually, it uses a modified spiral where there are levels and the walkway spirals downward between several levels. The Aquarium is like a doughnut where the visitors spiral downward on a walkway that hugs the inside of the hole in the doughnut. For the visitors, it gives the feeling that they are descending into the depths of the ocean.

<c>**Switchbacks** – Another method of reducing the trail gradient by elongating the length of the roadway is the use of switchbacks (Figure 13.6). In a switchback, the trail switches back on itself. In an outdoor setting, a switchback is the normal method of working up a hillside. Creating a spiral is impractical. Like a shoe lace going from one side of the shoe to the other, the trail switches back and forth as it works its way up the hill. Figure 13.6 and Figure 13.7 illustrates a typical switchback from two different views.

Figure 13.6 and Figure 13.7 show considerable elevation change made by the switchback. The alternative to the switchback is a series of steps. The switchback avoids installing steps. However, it consumes considerable real estate.

Next, there is fence located on the inside of the switchback. This fence is more than just aesthetic, it is functional. It is a physical barrier on the inside of the switchback to prevent people from shortcutting from the lower portion of the trail to the upper portion. This is often an overlooked component in the discussions of switchbacks. Examination of three of the Forest Service CAD drawings of switchbacks reveals that all three switchbacks have barriers drawn on the inside of the switchback (USFS, 1996). In the White Mountains, the AMC will often place brush in the crux of the switchback to create a physical barrier (see Figure 13.41).

Last, water runoff needs to be managed. Since the trail in Figure 13.6 has an asphalt roadway, waterbars were not installed to disperse the water runoff off the trail. Regardless, the water still needs to be dispersed. Using the fence to prevent shortcuts is also important for water runoff management. Usually, the water will follow the shortcut and quickly erode the trail and the area in between the switchback even further.

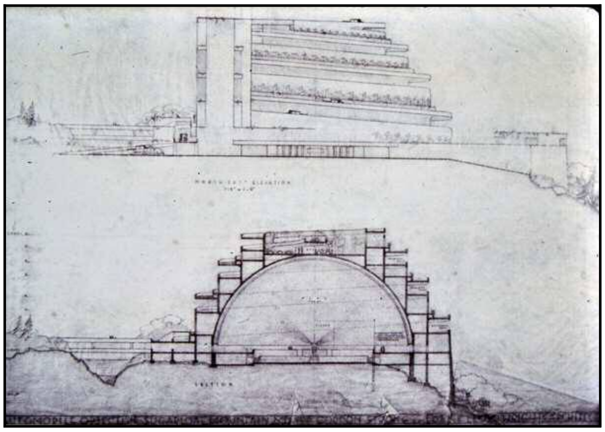

Figure 13.4: Sugarloaf Planetarium – Wright's design for the Planetarium sitting atop of Sugarloaf Mountain, consisted of a spiraling pathway that spiraled to the summit of the building. By lengthening the roadway, he reduced the gradient of the roadway. He later turned the concept inward with the design of the Guggenheim Museum located in New York City. Dickerson, Maryland. Source: Reinberger (1984, p.46) – [file:\SugarLoaf017.jpg]

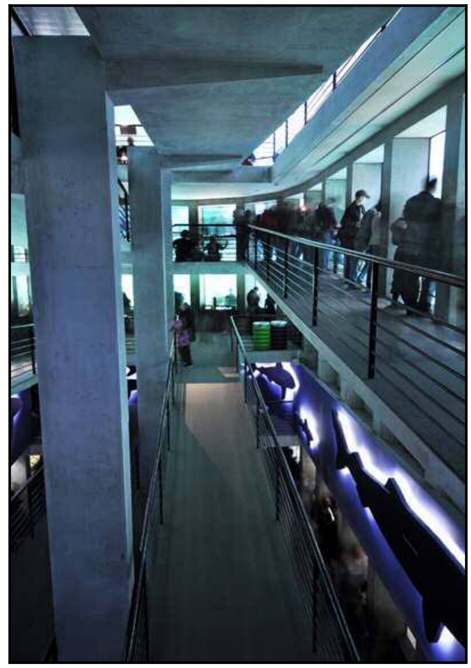

Figure 13.5: Spiraling – Spiraling is not as uncommon as might be expected. The Atlantic Reef at the National Aquarium is designed like a doughnut where visitors spiral downward on a walkway that hugs the inside of the hole. For the visitor, the effect is to feel surrounded by the reef and water. National Aquarium, Baltimore, Maryland. Source: Author – [file:\Aquarium029.jpg]

Figure 13.6: Switchback at Fallingwaters (View #1) – The switchback creates a gentler slope for the trail. This scene shows the trail switching back on itself to gain vertical elevation without having to use steps. Fallingwaters, Ohiopyle, Pennsylvania. Source: Author – [file:\fw097switchback.jpg]

Figure 13.7: Switchback at Fallingwaters (View #2) – The switchback creates a gentler slope for the trail. Imagine connecting the upper section of the path and the lower section about 20 yards up the trail. The incline would most likely require steps. Fallingwaters, Ohiopyle, Pennsylvania. Source: Author – [file:\fw096switchback.jpg]

Although traditionally switchbacks are associated with outdoor trails, they can be used in buildings also. The Atlantic Reef at the National Aquarium is designed like a doughnut where visitors move about in the hole of the donut with the reef surrounding them (Figure 13.8). The top and bottom levels are level. To get to the spiral walkway on the next lower level, there is a switchback (pictured) in the center of the doughnut hole which takes visitors down to the next lower level. In the low light, the walkway makes for relative safe travel.

<b>***Steps*** – Steps are a traditional and efficient method in increasing elevation, and compared with other methods such as spiraling or switchback walkways, they require less space. A disadvantage of steps is that they aren't handicapped accessible and in most cases, ramps, elevators and other methods are used to supplement steps. Also, there needs to be sufficient lighting to prevent tripping. The stairs at Calloway Gardens is an example of a series of steps that quickly and efficiently moves people to the next elevation (see Figure 7.5). In park and backcountry situations, there are a wide variety of steps available. Topics include in this section include construction considerations, stone steps, plank steps, log or treated timber raiser, pinned steps, and chiseled steps.

<c>**Construction Considerations** – In the backcountry, steps are normally used in steep terrain. Design considerations include construction, the psychology of movement, containment, and water dispersal` (Figure 13.9, and Figure 13.10). Regarding construction, consideration is given to the tread and its environment. The treads need to be of sufficient size and mass so that they do not easily become dislodged. Also, the Forest Service recommends that the tread slope slightly backwards (USFS, 1996). Also, the treads should be anchored on the back of the previous tread or on other rocks underneath the tread to anchor the step. In Figure 13.9, the treads are anchored in the soil rather than on the top of other rocks. Actually, the rocks are anchored in the front on top of other rocks. The dirt fill is part of the naturalizing process.

The psychology of how people will use the steps is important to consider when installing the steps. In Figure 13.9, consider where you would step on these steps. Remember that a person carrying a 40 pound pack and just having climbed over a 1,000 feet calculate the "step of least resistance." Mentally, this person wants to minimize the effort as place with every step. If the rise is too high, they will find an intermediate place to place their foot. On the steps pictured in Figure 13.9, where would you step? Would you expect other people to be any different in their use of these steps?

Containment and the environment of the steps are also important. Examine Figure 13.9 more closely. The large rocks on the left side contain the movement of the hiker. At the top of these step is a small pile of logs. These too contain the movement of people and keeps them on the trail. In addition, it helps reduce shortcutting,

In contrast, the scene in Figure 13.10 is more problematic in terms of containment. Without the stacked brush on the right, the obvious shortcut is to bypass the steps. Close inspection reveals that this is the location of the old trail and the brush is a physical barrier to force people to use the steps. As a sidebar, within two years, the area will become naturalized and the brush will look unobtrusive.

The last component is the dispersal of water. A waterbar is installed below the newly installed steps in Figure 13.10 to divert water off the trail. In the steps shown in Figure 13.9, water could be a problem. However, just around the corner there is a dip in the trail that disperses the water before it gains volume and momentum.

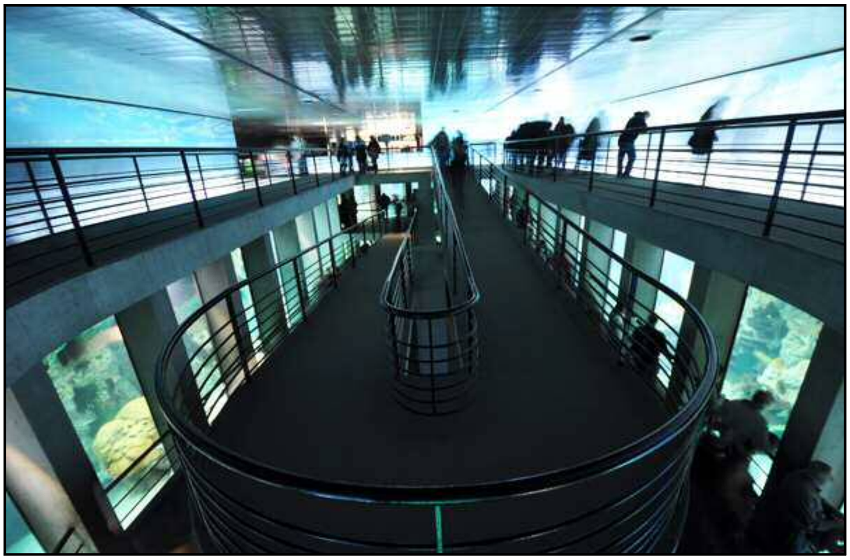

Figure 13.8: Atlantic Reef Switchback – Switchbacks can be used internally in buildings. The Atlantic Reef at the National Aquarium is designed like a doughnut where visitors move about in the hole of the donut with the reef surrounding them. The top and bottom levels are level. To get to the spiral walkway on the next lower level, there is a switchback (pictured) in the center of the hole which takes visitors down to the next lower level. In the low light, the walkway makes for safe traversing. National Aquarium, Baltimore, Maryland. Source: Author – [file:\Aquarium030b.jpg]

Figure 13.9: Closeup of Step Construction – Consider these rock steps from the perspective of a backpacker. Where would a backpacker step with a 40 lb pack on his or her back. Think minimal energy and minimal lifting of the feet. Also, look at the containment of the backpacker on the sides with the logs and rocks. Lonesome Lake Pond, White Mountains, New Hampshire. Source: Author – [file:\DSC_0164.JPG]

Figure 13.10: AMC Steps, Waterbars, and Brush – The AMC (Appalachian Mountain Club) recently completed this trail section. The brush piled on the right encourages the use of the steps and discourages use of the old trail (i.e. where the brush is piled). The waterbar below the steps diverts water off the trail. In two years, this site will look completely natural. Boot Spur, White Mountains. Source: Author – [file:\T905-RockSteps.JPG]

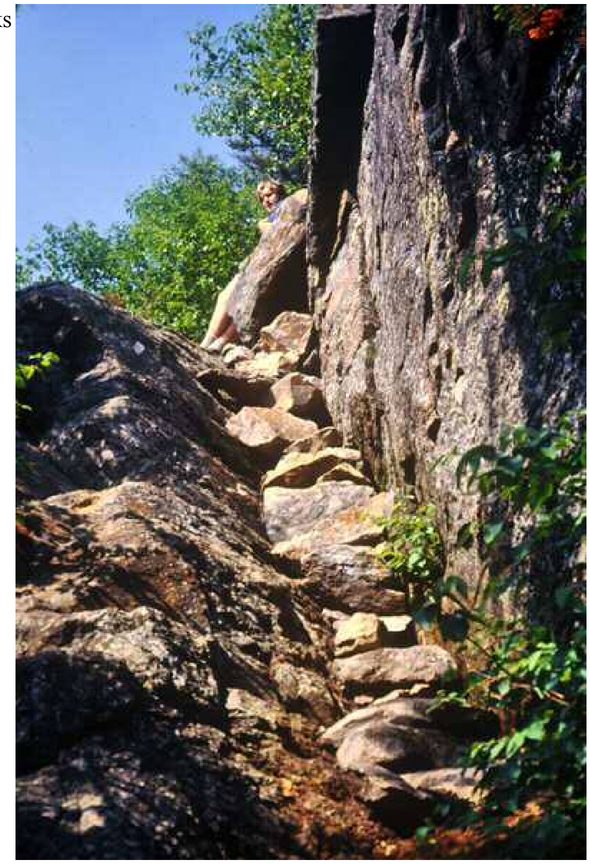

Figure 13.11: Stacked rock steps – Steps take all forms. These rocks were stacked in the crack to create steps. Close examination of the rocks reveals sharp edges and coloration suggesting that they were freshly cut and not weathered or aged field stone. In time, the rocks will weather and naturalize. Near Pinkham Notch, White Mountains, New Hampshire. Source: Author – [file:\DSC_0157.JPG]

<c>**Stone Steps** – The stone steps in Figure 13.9 and Figure 13.10 depict typical stone steps. Stone steps are durable and commonplace. The stacked stone steps pictured are over twelve feet tall and the rocks are wedged in the rock crack (Figure 13.11). The rock faces on either side of the steps provide user containment. Water dispersal is not an issue with these steps.

<c>**Planked Tread** – Planked tread steps are traditionally constructed steps. The carriage or runner is cut out and the plank tread is nailed to the carriage to form the step (Figure 13.12).

<c>**Log or Timber Raiser** – Typically, a log or timber step uses a log or timber as the tread of the step (Figure 13.13). Usually, the timber is a 6"x6" or 6"x8" pressure treated beam or railroad tie. Two holes are drilled in the beams and reinforcing rods are used to tie the beam into hillside. When logs are used in a backcountry situation, external wooden spikes are often used instead of the metal reinforcing rods. The area behind the beam is backfilled to the next step.

The log or timber raiser pictured in Figure 13.13 illustrates several principles. First, the steps form a nice gentle and visually pleasing C-curve. Unfortunately, the railing does not follow the curvature of the stairs. It is like installing a square peg into a curved hole. It looks out-of-place. Next, look carefully at the fill behind the beams used as treads. The backfill slopes uphill effectively making the step higher than it actually is. Often this is done to reduce the number of steps required. On the steps pictured, the backfill is not too bad. Regardless, it is something to consider because it makes the raiser larger than it should be. Third, there is nothing to retain the backfill on the left side of each of the treads. Close examination reveals that the backfill on the sides of the lower steps has eroded away. At the time of the photography, it was not a problem, but could become a problem at later date.

Figure 13.12: Planked Tread – The typical plank tread steps are illustrated at the Flume in Franconia Notch. Flume, Franconia Notch, New Hampshire. Source: Author – file:\fig1255-T317.JPG]

<c>**Pinned Steps** – Pinned steps wedge a diagonally cut beam onto two reinforcing rods that have been inserted into two holes drilled into the rock (Figure 13.14 and Figure 13.15). The more weight placed on the steps wedges the steps tighter against the rock. In the opinion of this author, these steps are aesthetically ugly and look inconsistent with a naturalistic image. Anyone who thinks otherwise is free to use them.

<c>**Chiseled Footsteps** – Chiseled footsteps literally chisel or carve the steps out of the rock (Figure 13.16). The star drill holes can easily be seen on the backside of the step. Also the coloration of the rock reveals that this was a fresh cut. In several years the weather process will most likely naturalize the color of the rock. In addition, this method requires a sturdy and stable rock. Compared with the pinned step (see Figure 13.15), the chiseled footstep is a less obtrusive alternative for creating steps.

<b>***Ladders*** – Ladders are useful when elevation changes are so steep that other alternatives are impractical (Figure 13.17). An advantage of using ladders is that it has minimal impact on the environment. They are not handicapped accessible and even non-handicapped people may be hesitant using ladders. Also, there may be safety considerations. Entrance to the Balcony Cliff Dwelling at Mesa Verde requires climbing several ladders. One of these is shown in Figure 13.17. One woman who was wearing a skirt was momentarily caught off guard. She was thankful that she was wearing underwear the day she visited the Balcony Cliff Dwelling. Such are the issues of interpreters.

Figure 13.13: Log or Timber Raiser – A typical timber raiser steps where railroad ties are used to create the step. The area behind the step is backfilled up to the next step. – Dingman's Ferry, Pennsylvania. Source: Author – [file:\T312-RRsteps.JPG]

A second use of ladders is for historical accuracy (Figure 13.18). Entrance into the reconstructed Kiva at Mesa Verde National Park is by ladder. It is historically accurate. It is part of the experience. It would be difficult to create an entrance into the Kiva other than using a ladder which was the original method to enter it. It should be noted that there are numerous exhibits elsewhere that show life in a typical Kiva for those who didn't want to descend the ladder.

From a risk management perspective, look at the wear on the rungs of the ladder. There is noticeable wear. The ladder rungs need to be monitored and replaced before they become breakable under the weight of a visitor on the ladder.

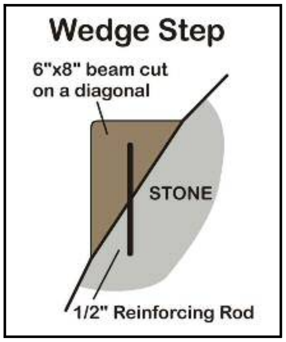

Figure 13.14: Pinned Steps (diagram) – This graphic illustrates how pinned steps work. Source: Author – [file:\StepsWedge01.JPG]

Figure 13.15: Pinned Steps – The pinned steps climb over this rock quickly and efficiently. In the opinion of the author, they are ugly and inconsistent with a backcountry experience. White Mountains, New Hampshire. Source: Author – [file:\T916-PinSteps.JPG]

Figure 13.16: Chiseled Footsteps – The footsteps are literally carved or chiseled out of the rock. With time, the color differentiation with the weathered rock will naturalize the coloration of the freshly chiseled footstep. White Mountains, New Hampshire. Source: Author – [file:\T920-CutStep.jpg]

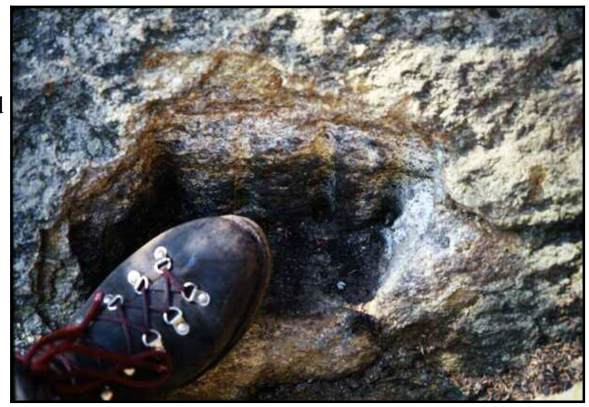

Figure 13.17: Ladders – Caption: In Mesa Verde National Park, entrance into the Balcony Cliff Dwelling requires climbing ladders. Mesa Verde National Park, Colorado. Source: Author – [file:\MV129.jpg]

Figure 13.18: Ladders – In Mesa Verde National Park, entrance into the reconstructed kiva requires the use of a ladder. The ladder is historical authentic and consistent with the kiva construction. Mesa Verde National Park, Colorado. Source: Author – [file:\MV178[vg].jpg]

Roadway Construction

In designing the experience, trail construction involves the type of activity using the trail and structural considerations. When a trail is constructed with a crown, the center of the trail is higher than the sides (Figure 13.19). The crown helps to disperse water off the trail. Normally, creating a crown requires fill to raise the elevation of the trail. This requires additional construction time, money and materials. Usually, most trails become a subsoil trail (Figure 13.20).

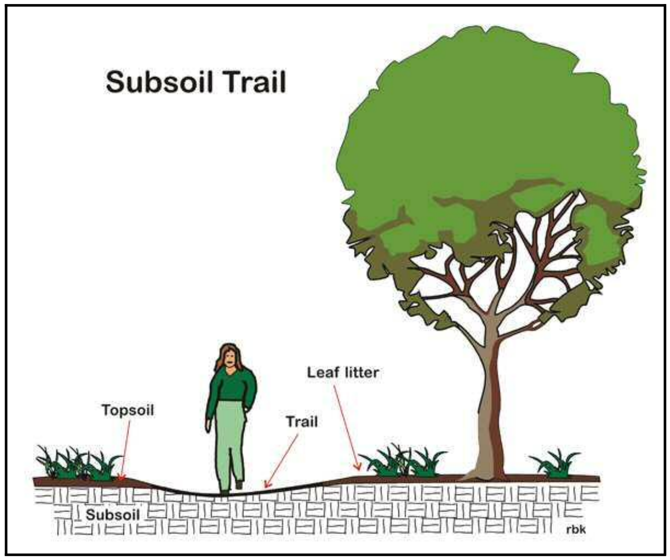

Figure 13.19: Parts of a Trail – A typical trail includes a surfacing material contained by stringers. Source: author – [file:\Trail01.pdf]

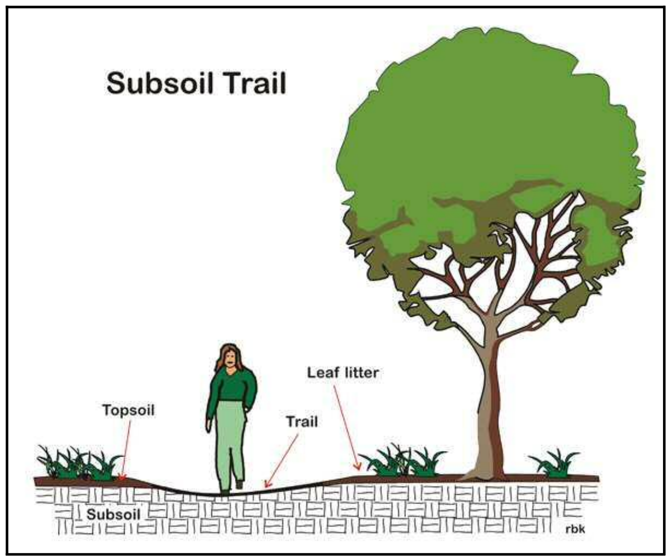

Figure 13.20: Subsoil Trail – Most trails eventually become subsoil trails where the surface material is worn or eroded away. Source: author – [file:\Trail02.pdf]

<b>***Surfacing*** – Figure 13.2 lists the acceptable and preferred surfacing for each of the activities. There can be considerable overlap in acceptable surfaces listed. A synopsis of surfacing materials is listed in Figure 13.21. To some degree, surface selection can be used to deter use by other user groups. For example, a trail surfacing of loose coarse stone will deter most bike users (excluding mountain bikers) who prefer a smooth asphalt or a surface of packed crusher run stone. However the downside of using a loose coarse stone surface is that it can be noticeably noisier underneath foot traffic (see Figure 13.25).

In Figure 13.22, the wood chip covered interpretive trail makes for a quiet walking surface. The roadway is well defined by the color differential between the wood chips and the green of the surrounding vegetation. Although the trail does not have stringers, the vegetation provides considerable containment of visitors as they travel the trail.

Figure 13.21: Trail Synopsis Specifications – Different recreational activities favor and disfavor different types of surfacing. Source: Ryan, K., (1993, p.97) – [file:\hdt-TrailSurfaceSynopsis.pdf]

Water surfaces can vary greatly. For rivers and whitewater use the International Scale of River Difficulty (AW, 2005). For coastal waters use the ACA Safety Code for Coastal Waters which includes a difficulty scale (ACA, 2007). For the travelers pictured in Figure 13.23, this roadway or stretch of whitewater was portaged by the group. The portage trail is off-scene on the left. The warning sign on the Lehigh river indicates the changing difficulty encountered with different water levels (Figure 13.24).

Figure 13.21

Table 2. Trail Surface Synopsis

SURFACE MATERIAL	ADVANTAGES	DISADVANTAGES
Soil Cement	Uses natural materials, more durable than native soils, smoother surface, low cost	Surface wears unevenly, not a stable all-weather surface, erodes, difficult to achieve correct mix.
Granular stone	Soft but firm surface, natural material, moderate cost, smooth surface, accommodates multiple use.	Surface can rut or erode with heavy rainfall, regular maintenance to keep consistent surface, replenishing stones may be a long term expense, not for steep slopes.
Asphalt	Hard surface, supports most types of use, all weather, does not erode, accommodates most users simultaneously, low maintenance.	High installation cost, costly to repair, not a natural surface, freeze/thaw can crack surface, heavy construction vehicles need access.
Concrete	Hardest surface, easy to form to site conditions, supports multiple use lowest maintenance, resists freeze/thaw, best cold weather surface.	High installation cost, costly to repair, not a natural looking surface, construction vehicles will need access to the trail corridor.
Native soil	Natural material, lowest cost, low maintenance, can be altered for future improvements, easiest for volunteers to build and maintain.	Dusty, ruts when wet, not an all-weather surface, can be uneven and bumpy, limited use, not accessible.
Wood chips	Soft, spongy surface - good for walking, moderate cost, natural material	Decomposes under high temperature and moisture, requires constant replenishment, not typically accessible, limited availability, not usable for all activity types.

Source: Karen-Lee Ryan (ed) Trails for the Twenty First Century. Washington, DC: Island Press, 1993, p.97.

<b>***Stringers*** – Stringers are the borders of the trail. They provide several functions. They help to provide a clear course of travel for the visitor by defining the trail. Next they are both a physical and psychological barrier. Physically, they note the limits of the tail. Psychologically, they define the boundaries of the trail. Last, if fill is used to build up the roadway, the stringers help to contain the fill.

The trail in Figure 13.25 utilizes stone stringers to help define the trail. In addition, the roadway is a moderately coarse limestone which give the trail its blue color. The blue colored roadway makes the course of travel obvious. However, even though this limestone is blue in color, some people will find the color unnatural. Also, walking on this trail is noisier with the stone crunching noise underneath the footsteps. In comparison, the wood chip trail pictured in Figure 13.22 look as if they are quieter. Also, the wood chips create a soft or cushioned walkway. Last, the coarse stone will resist erosion even though this is a level stretch.

Figure 13.22: Olympic Trail – The wood chip trail surfacing provides a clear and obvious trail to follow, and it provides a quiet walkway consistent with the experience. Olympic National Park. Source: Author – [file:\OlympicTrail-S113.jpg] [alt file:\DSC_0139.JPG]

The trail in Figure 13.26 replaced the old subsoil trail to Cunningham Falls that is still visible in the picture. The stringers are recycled railroad ties and they help to contain the moderately coarse limestone roadway. The trail is well defined and the course of travel is obvious. Given the width of this trail most people will walk single file on the trail.

The old trail is still visible and this poses a potential management problem. The new trail turns left in the picture while the old trail goes straight. The old trail is the shortcut. Unless there is a barrier or unless the historical knowledge of the shortcut can be extinguished, many people will continue to use the shortcut. Close examination reveals that the old trail is a subsoil trail (i.e. the topsoil is missing).

One solution to eliminating the shortcut would be to install a split rail fence on the corner. A physical barrier, people would either need to climb over the fence or walk around it. A second solution would be to naturalize the area. This would provide a psychological barrier since all the cues of the old trail would be erased. Some topsoil would be added to fill in the stretch of subsoil trail. Then some indigenous plants would be added along with leaf litter. Visually, the old trail would look exactly like the surrounding forest. It should be noted that both strategies could be used in conjunction with each other.

Figure 13.23: End of the Portage Trail – Rivers are roadways too. It is the water. Unlike land trails, they can change in difficulty with changes in water levels. Author – [file:\PICT0087.jpg]

Figure 13.24: Lehigh River Sign – This warning sign on the Lehigh River reminds river users on the changing conditions associated with different water levels. The lower sign indicates the size of rafts required for different water levels on the river. Author – [file:\DSC_0942.JPG]

Figure 13.25: Stone Stringers – The stone stringers on this trail provide a clear and obvious trail to follow as does the unnatural looking crushed limestone roadway. However, the limestone roadway is noisy under foot. Also, close examination reveals this trail was once a wider dirt road. Although mountain bikers would not be deterred by the thick gravel surface, normal bikes could find this trail surface uncomfortable. Gambrill State Park, Maryland. Source: Author – [file:\DSC_0137.JPG]

Figure 13.26: The Old Trail – The trail is well defined with the limestone surfacing and the railroad tie stringers. The old trail to Cunningham Falls is clearly visible. A fence or naturalization with plants would help deter use of the old trail and short cut. Thurmont, Maryland. Source: Author – [file:\DSC_0136.JPG]

<b>***Waterbars*** – Water dispersal and management is an important consideration in trail design and construction. Generally, this is not an issue for water trails unless the river is flooding. As water gains volume, it gains speed, and its ability to carry sediment increases exponentially. For this reason, the primary strategy of protecting trail surfaces is to disperse water quickly. One strategy is to put a crown in the trail. Filling in the roadway and putting a crown on the trail diverts the water off of the trail. Also, it reduces the likelihood that the trail becomes a streambed (see Figure 13.27). A crown in the road is where the center of the road is purposely made higher than the sides so that water drains off the road. Another strategy is to create dips in the roadway to prevent long continuous stretches of trail and to disperse the water more quickly.

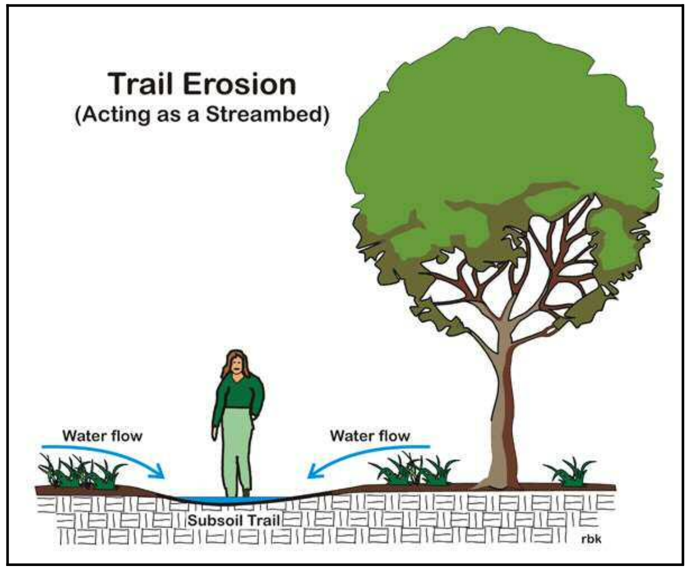

Figure 13.27: Trail Erosion (Streambed) – When it rains, trails will often collect the water and become stream-like. The purpose of a waterbar is to collect this water before it can erode the trail and divert it off the trail. Source: Author – [file:\DSC_0145.JPG]

As noted, most backcountry trails tend to become subsoil trails (see Figure 13.20). An unfortunate characteristic of a subsoil trail is that the trail becomes the low point and the trail acts like a streambed (Figure 13.27). The power of moving water to erode a trail is shown in the photo in Figure 13.28. The gully next to the newly relocated trail is three to four feet deep where the old trail was eroded down to bedrock. The AMC (Appalachian Mountain Club) relocated the trail to the right and partially filled in the gully. The brush serves two purposes. It acts as a physical barrier to hikers, and equally important, it slows the movement of the water and over time it helps the gully to fill in with sediment.

Figure 13.28: Trail erosion (gully) – When it rains, trails will often collect the water and become stream-like. The trail has been relocated and the three to four-foot deep gully filled with brush. – White Mountains, New Hampshire. Source: Author – [file:\DSC_0145.JPG]

Another strategy is to install waterbars. Constructed of wood, stone or other substantial material, waterbars divert water from the trail before the water accumulates sufficient volume and speed to erode the trail (Figure 13.29 and Figure 13.30). The figure notes a 30-40 degree angle. Note that the Forest Service drawing recommends a 45-60 degree angle. Regardless, the critical factor is that the waterbar should have sufficient angle to it to divert the water off the trail (USFS, 1996). Figure 13.31 shows a typical stone waterbar and Figure 13.32 shows a series of log waterbars placed periodically along a trail. Also, the section of trail is a typical subsoil surface trail (see Figure 13.20)

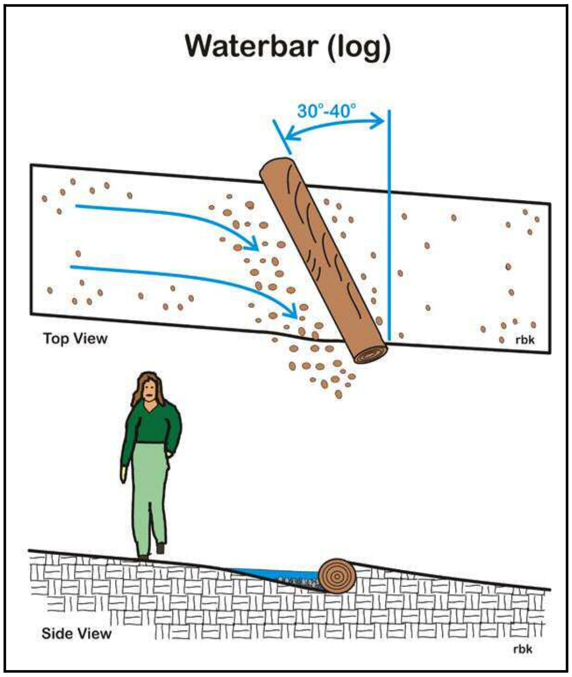

Figure 13.29: Waterbar (log) – When it rains, trails will often collect the water and become stream-like. The purpose of a waterbar is to collect this water before it can erode the trail and divert it off the trail. Source: Author – [file:\DSC_0145.JPG]

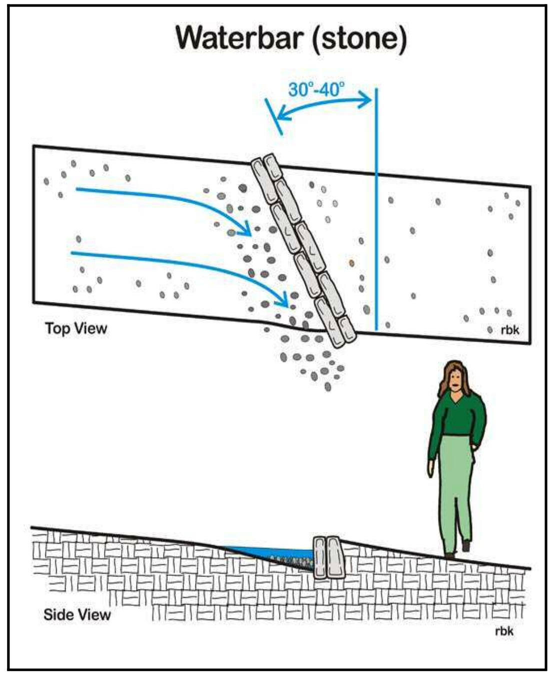

Figure 13.30: Waterbar (stone) – Note that the stones are place in an interlocking fashion to more effectively divert the water to the side of the trail. Source: Author – [file:\DSC_0145.JPG]

Figure 13.31: Waterbar (stone) – An example of a stone waterbar. Note that it utilizes only one row of rocks and an attempt was made to interlock the rocks. The view is looking uphill and the water is diverted to the right in the picture. Gambrill State Park, Maryland. Source: Author – [file:\DSC_0149.jpg]

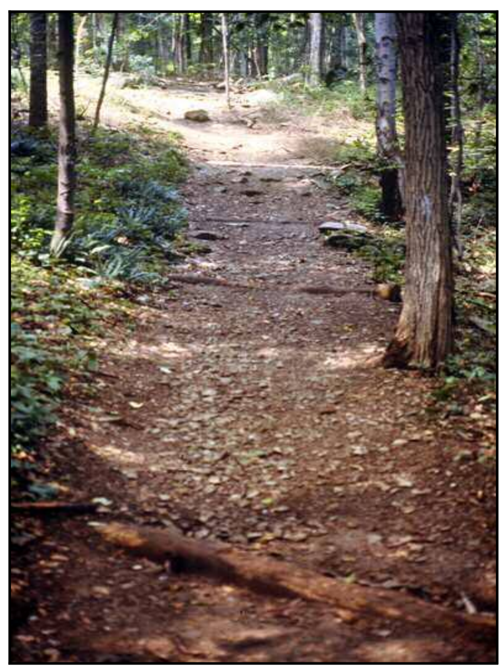

Figure 13.32: Multiple waterbars – A series of waterbars placed on the trail to divert water off the trail before it can gain sufficient power to erode the trail. Gambrill State Park, Maryland. – Source: Author – [file:\waterbars.-multi.jpg]

<b>***Environmental considerations*** – In addition to erosive impacts, there are other environmental considerations to consider with trails. Both items involve dieback. The first is to the trees surrounding the trail and the second is to the low vegetation bordering the trail.

Figure 13.33: Trail Erosion (Roots) – Trail users cause compaction and trail erosion leaving exposed roots. White Mountains, New Hampshire. Source: Author – [file:\DSC_0141.JPG]

<c>**Tree Dieback** – Trail use can cause *"dieback"* to trees and other vegetation along the trail. Compaction of the soil by constant foot traffic or other uses, weakens trees and their ability to move nutrients to the top of the tree. The weakened tree will literally begin to die back from the top of the tree toward its base. A visual inspection of the top of the tree can be used to determine this thinning process and dieback.

Dieback is influenced by several factors including soil type, the amount and type of use, the size and health of the tree, and the percentage of the tree beneath the drip zone affected by compaction. Reexamine the large tree in the middle of the interpretive trail in the Olympic National Park (see Figure 13.22). It is a prime candidate for die back. Examination of the tree at the time of the photo revealed that there was no die back present. It could be that this is a mature tree whose root structure extends far beyond the sides of the trail. Or it could be that the interpretive trail is not heavily used and there is not sufficient compaction to harm the tree. If the tree eventually shows signs of dieback, one solution would be to construct a ground level boardwalk around the tree which would prevent soil compaction.

With fragile duff soil types, trail erosion can be extensive (Figure 13.33). The soil is compacted by hikers. The roots no longer hold the soil and it either blows away or washes away leaving the exposed roots. This type of erosion can be consider a form of *erosive vandalism or depreciative behavior* discussed in Chapter 15. Generally, erosive vandalism results from the lack of knowledge or user ignorance. In this case, most people are unaware of how they are contributing to this form of depreciative behavior.

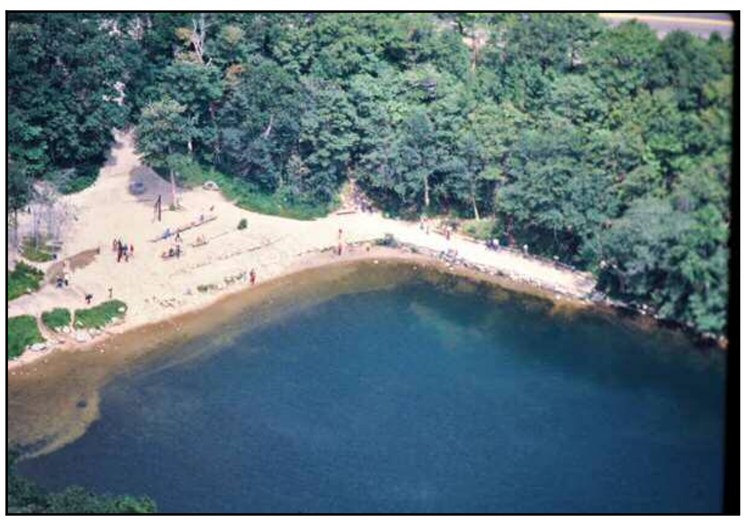

Figure 13.34: Old Man in the Mountain Dieback – This is a view looking down from the Old Man in the Mountain onto its viewing area before it fell into the valley below. It shows considerable dieback and encroachment of vegetative areas. Franconia Notch, New Hampshire. Source: Author – [file:\FM301-OldManMt.JPG]

Figure 13.35: Dieback (stepping stones) – This is the classic scene showing dieback of vegetation along the trail. People want to avoid walking in the mud and walk on the edge. This creates dieback and mud widens and the process repeats itself. The rock stepping stones are a recent management action that "harden" the site and provide hikers with stepping stones. In time the grass will grow back. Source: Author – [file:\T1419-SteppingStones.JPG]

Figure 13.34 is a photo of the viewing area of the Old Man in the Mountain before the rock face fell into the valley and before they hardened the site with a modernized viewing area. It provides a view of overuse, poor management, and dieback. The trees on the left have died. There is one tree toward the back of the viewing area standing by itself. The tree looks a little thin in its upper limbs and it has a lighter green color than most of the other trees. The flooring is a crushed granite which normally has a high carrying capacity because it doesn't readily compact. In the viewing area on the right, the benches lining the area form a barrier and limit additional encroachment into the forest area behind it. In contrast there are few physical barriers on the large viewing area on the left and there has been considerable encroachment of the grassy areas and islands which are progressively getting smaller.

<c>**Trail Dieback** – Dieback affects other vegetation bordering the trail also. In the backcountry, this is a typical dieback situation where the trail becomes muddy (Figure 13.35). Rather than walking through the mud, hikers walk along the sides trying not to avoid the mud while minimizing their impact to the vegetation. The collective impact compacts the soil creating dieback and an ever widening trail. The stepping stones in the picture are a recent management addition. They harden the site. In time, the grass will grow back and fill in around the rocks. The question to ask is this. Would a typical hiker use the stepping stones or avoid them and hike around the border of the mud? Psychologically, most people will probably find the stepping stones reasonably convenient and use them.

Unlike land-based trails, there are few environmental impacts with water trails. Impacts tend to occur at the launching, takeout, and camping sites. On the Everglades trip, the canoes have "gunwaled-up" and students are having a snack while on the trail (Figure 13.36). The canoes on the water are having little environmental impact on the trail.

Figure 13.36: Snack time on the water – "*A canoe across the water leaves no trace. Practice low impact camping*." (rbk) Unlike land based trails, water trails have few environmental impacts. Everglades National Park, Florida – Source: Author – [file:\DSC_0067.JPG]

<c>**Succession Impacts** – Trails affect ecosystems. In discussing managing the vertical and overhead planes in Chapter 8, the different examples affected habitat. The closed overhead and open vertical planes are often characteristic of a mature forest where little light penetrates the overhead canopy. The open top encourages an "edge effect" where there is ample light available for vegetation to grow along the trail (see Figure 8.6). The deer in the picture is close to its food source. Trails and abandoned trails can have long term environmental effects. This is clearly evident on the abandoned logging roads next to Zeland Pond (Figure 13.37). The abandoned roads zigzagging up the hillside were filled in with a more evasive species.

Figure 13.37: Logging Roads Succession – To the trained eye, previous land use and impacts can have long term effects. Close inspection reveals abandoned logging roads etched on the side of mountain by non-climax species. The roads are the slightly diagonal lines that are a lighter shade of color. Zeland Pond, New Hampshire. Source: Author – [file:\FW1110-ZelandPondLogging.JPG]

<b>***Service and Maintenance Needs*** – Trail development needs to consider maintenance and service needs. Service needs include maintenance, security, and emergency needs. In this chapter, most of the exhibits were backcountry trail maintenance which required hand work without the aid of large motorized equipment. Trail crews used picks, shovels, and digging bars to install steps and waterbars. Examples include the relocating the steps and trails next to the four foot deep gully (see Figure 13.28) and the new step construction (see Figure 13.9 and Figure 13.10). In contrast, the rockslide on the Great Allegany Passage trail required heavy equipment to remove (Figure 13.38). The width of the trail and bridges were more than adequate to handle the mechanized equipment used to remove the boulders and repair the right-of-way.

Figure 13.38: Rockslide on GAP – When designing a trail, maintenance needs to be considered. This rockslide on the Great Allegany Passage trail required heavy equipment to remove. The width of the trail and bridges were more than adequate to handle the equipment. Source: Author – [file:\GAP030rockslide001.jpg]

The use of bollards and gates on trails enable access by maintenance and emergency vehicles while reducing unwanted access by other vehicles (Figure 13.39). It is important to use a common key and to make the key available to emergency vehicles for easy access. The bollard in the center of the trail is removable for maintenance and emergency vehicle access. Normally, bollards across trails should be installed in odd numbers (e.g one, three, etc).

Intuitively, users will go to the right of this bollard and avoid conflict between people passing each other at this bollard. Also, it is important to note what this bollard will allow to pass through it, and what it prevents from passing through it. Pedestrians, bicyclists, equestrian, ATVs can easily pass through the gap. Motor vehicles are not permitted passage without removing the bollard.

Figure 13.39: Sandpatch Gate and Bollard – To provide access, this area utilizes both a removable bollard and gate. Removing the bollard allows access of the rails-to-trail by emergency and maintenance vehicles. Sandpatch, Pennsylvania. Source: Author – [file:\GAP028sandpatch001.jpg]

Bridges and Boardwalks

Bridges come in all shapes and sizes. They may be recycled railroad bridges on a rails-to-trail bike trail. They can be ornamental as in a Japanese Garden (see Figure 5.22). Functionally, a bridge connects one side to the other side. They link experiences. The bridge connecting to the island in the Japanese Garden is an obvious symbolic as well as physical link to the island (see Figure 5.22). Bridges can provide points of interest and scenic overlooks. People stop on the bridge and look for the lions at the Big Cat Falls exhibit at the Philadelphia Zoo (see Figure 6.16). A split log bridge may not seem like a bridge, but it is. The bridge can bridge fragile soils and protect the environment beneath the bridge. Boardwalks are modified bridges and provide similar functions and uses. Also, bridges can avoid conflict between different user groups including a trail bridge over a busy highway or railroad. This section, examines bridges and boardwalks in terms of access, avoiding conflicts, protecting the environment, and providing an experience.

Figure 13.40: Pa-hay-okee Overlook – Boardwalks enable people to access areas that they otherwise wouldn't be able to access. In addition, it limits or controls access and protects wildlife. Everglades National Park, Florida. Source: Author – [file:\DSC_0188.JPG]

<b>**Provides Access** – Boardwalks and bridges provide access to areas that would normally be inaccessible. The bridge in the Japanese Garden provides access to the small island (see Figure 5.22). Also, this bridge provides more than a physical connection. It creates a visual, spiritual and metaphorical connection with the island. The Pa-hay-okee Overlook in the Florida Everglades is a boardwalk and overlook that provides access to areas that would be difficult to access without a boat or wading boots (Figure 13.40). The overlook provides a scenic view of the wide expanse of the river of grass that people would not be able to see standing at normal eye level.

<b>***Pedestrian control*** – In terms of managing people's experience, bridges and boardwalks are an excellent method of controlling people's movement. Literally, they keep people on the trail. People travel where the planners want the visitor's to go. This important feature can protect both the visitors as well as the animals. Even with a boat, Corkscrew Swamp is fairly impenetrable (see Figure 7.2). The boardwalk provides access for visitors. However, it also limits people's access to what they can see from the boardwalk.

In the Everglades, the Anhinga Trail Overlook is a modified boardwalk that provides visitors a view of a gator pond (Figure 13.41). The boardwalk and overlook provides access. Also, it protects the people because it separates them from the alligators in the pond below. In addition, it protects the animals because it limits people's access to only the boardwalk and overlook.

<b>***Avoids Conflict*** – Bridges and boardwalks can help avoid interactive conflicts between different user groups. It is axiomatic that it is desirable to create separate trails for different user groups, particularly those who move ast significantly different rates. For example, the auto crossing on the W&OD rails-to-trail is a potentially dangerous crossing for bicyclists (Figure 13.42). A bridge at this location would eliminate the conflict. In contrast, on the Great Allegany Passage, the viaduct crosses an active railroad, a county road, and a stream (Figure 13.43). The bridge helps to avoid conflicts between user groups and other conflicts.

<b>***Protects the Environment*** – Bridges and boardwalks can be use to protect the environment. They provide a hard road surface and depending on their configuration they can keep people on the trail. Both the Pa-hay-okee Overlook, and the Anhinga boardwalk and its overlook protects the environment by limiting access to the resource. It is a management issue. By providing some access, the general public receives an experience that they could not have received otherwise, and the overall resource is

Figure 13.41: Anhinga Trail Overlook – The Anhinga Trail Overlook is a boardwalk that provides access to an alligator pond. It manages the peoples movement and protects both the wildlife and resource. Source: Author – [file:\DSC_0183.jpg]

Figure 13.42: Auto Crossing – A bridge at this location would avoid conflict between bikers and automobiles. W&OD Trail, Ashburn, Virginia. Source: Author – [file:\W&OD008.jpg]

Figure 13.43: Viaduct – On the Great Allegany Passage rails-to-trail, this viaduct crosses a railroad, automobile road, and stream. In doing so, this viaduct avoids three different conflicts. Near Myersdale, Pennsylvania. Source: Author– [file:\GAP029viaduct156.jpg]

Figure 13.44: Split log bridge – This split log bridge protects the fragile duff soil. This area will grow back assuming that hikers use the bridge. Hike this section yourself. Would you use the bridge or the existing compacted trail on the left? Many people would avoid the inconvenience of balancing on the bridge. Perhaps they need to put some brush or rocks to make the trail on the left less convenient. White Mountains, New Hampshire. Source: Author – [file:\T1411-SplitLogBridge[1].jpg]

protected because of the limited access. Also, there is an issue with using pressure treated wood and the leaching of the preservation chemicals in the piling into the surrounding environment.

Although it may not seem like a bridge, the split log bridge in Figure 13.44 provides a bridge across fragile duff soils. When the duff gets wet, it becomes muddy and people walk along the sides to avoid the mud. This compacts the soil, kills the vegetation, and expands the width of the trail. If hikers use the bridge, the vegetation will eventually grow back.

Consider the psychology of using this bridge from the perspective of the user. Intuitively, most people realize that the split log bridge is there for people to avoid compacting the soil on the left of the trail. They may have seen an interpretive sign at the visitor's center on the topic. However, will people use the bridge or will they find it more convenient to hike on the compacted area next to the trail. Hike this section yourself. Would you use the bridge or the existing compacted trail on the left? The path on the left of the bridge suggests that a significant number of people do not use the bridge. Perhaps they need to put some brush or a couple of rocks to make the trail on the left less convenient.

Figure 13.45: Ineffective Stone Walkway – This section of the trail demonstrates the improper use of stepping stones on the trail. Most hikers will simply hike on the compacted trail to the left of the rocks and avoid the even slight unevenness of the stepping stones. White Mountains, New Hampshire. Source: Author – [file:\T1410-ImproperSteppingStones.JPG]

Further illustrating the need to address the psychology of the users using the trail, compare the split log bridge (Figure 13.44) with the stone stepping stones (Figure 13.45). The stepping stones were inserted on the trail to avoid compaction on the trail. As in the previous example, walk this section yourself. Would you find it inconvenient to walk on the stones or to simply avoid them? Most people would probably avoid the stepping stones as an inconvenience. Also, note the exposed roots on the trail and the associated trail erosion.

Figure 13.46: USFS $50,000 Bridge – These are three different crossing across the same stream within 100 yards of each other. Although they address the safety issue, they also address the issue of designing the experience. This is the bridge built by the Forest Service for $50,000. Franconia Notch, New Hampshire. Source: Author – [file:\fig1248-DSC_0174.JPG]

<b>***Experience Provided*** – When selecting the bridge or boardwalk used, the desired experience should be considered. In the White Mountains, two very different types of bridges occur within 100 yards of each other. The laminate bridge was installed by the Forest Service (Figure 13.46). It is consistent with the bridge specifications offered in the Forest Service Trail Manual (USFS, 1996). One hundred yards up the stream, the State Parks built a rustic log bridge for a fraction of the cost (Figure 13.47). However, consider the experience provided by the two bridges. The aesthetic experience of either bridge can be justified. The State Park's bridge is more rustic while the Forest Service bridge is a professionally designed bridge that looks like a bridge designed for the purpose of crossing the stream.

Figure 13.47: State Park Bridge – This is the bridge built by the state parks 100 yards up the same stream for $300. Contrast the experience provide by this bridge with that of the USFS downsteam of it. Franconia Notch, New Hampshire. Source: Author – [file:\fig1249-DSC_0173.JPG]

<b>***Safety*** – Bridges and boardwalks can provide user safety. The boardwalk and overlook on the Anhinga overlook in the Everglades National Park separates people from the alligators (see Figure 13.41). The same is true of boardwalk in the Corkscrew Swamp (see Figure 7.1).

In the previous section, the Forest Service built the laminate bridge because less than fifty yards down stream, is a sixty-foot waterfall. Originally, the trail crossed this section of the stream using the stepping stones pictured in Figure 13.48. At the time of the picture, the stepping stones were still available to cross the stream. The stepping stones provide more than a suitable crossing in low water situations such as the one pictured. Most people would question the need or purpose of the expensive laminate bridge when the stepping stones are more than adequate.

Figure 13.48: Stepping Stones – These stepping stones are just upstream of the Forest Service bridge and comprised the normal crossing before the bridge. During high water situations, the stepping stones can be hazardous. Franconia Notch, New Hampshire. Source: Author – [file:\DSC_0199.JPG]

However, in high water situations, this crossing can become a significant hazard. The normal hazard posed by a high water river crossing is compounded by the sixty-foot waterfall just downstream of the crossing (i.e. where the people are located in the photo). In this context, the bridge addresses a significant safety concern.

Figure 13.49: Yellowstone Boardwalk – This is a low level boardwalk traversing the hot springs at Yellowstone National Park. Notice how the walkway harmonizes with the landscape. However, since there are no railings, some would raise a safety concern. Yellowstone National Park, Wyoming. Source: Author – [file:\T1017-DSC_0189.JPG]

Caution needs to be expressed that the bridge or boardwalk does not itself create a hazard. Consider the boardwalk over the hot springs at Yellowstone Park (Figure 13.49). The hot springs are deep pools of scalding hot water. The boardwalk without railings is aesthetically pleasing and visually less obtrusive. It harmonizes with the landscape. However, the lack of railings poses a potential safety issue.

Trail Signs

Trail signs provide valuable information, rules, and directions to trail users. They serve as a “point of entrance” source of information. In this regard, the value of using interpretive signs at a point of entry has been addressed in Chapter 14 (see Figure 14.33). This section addresses entrance signs and their placement along the trail. The focus is more on providing informational information than interpretive.

<b>***Trail Head*** – Several Figures show a typical ensemble of signs at a public entrance point on a rail-to-trail. Figure 13.50 provides a photo of the overall scene at the trail entrance. Its purpose is to provide orientation. The sign on the left deals with hunters. One sign in the background gives the mileage to the next major trail head, and the other sign indicates that this trail is part of a bike route. In the foreground are two rules signs (Figure 13.51 and Figure 13.52).

Figure 13.50: Trail Entrance – This is one of many public access point on the Great Alleghany Passage Trail. It shows the locations of the signs providing information and rules found on Figure 13.51 through Figure 13.53. Great Alleghany Passage Trail, Near Confluence, Pennsylvania. Source: Author – [file:\rmct-sign10-general.pdf]

The first sign of rules is the standard sign found at most major entrance locations (Figure 13.51). The sign assumes that the primary purpose of the trail is as a bike trail. Although some trail heads have equal amounts of joggers and people strolling as bikers, the trail is designed primarily as a bike trail. The sign presents a series of bullet points delineating for the most part trail etiquette such as “pass on left” and stay

Figure 13.51: Bike Trail Rules – This is closeup photo of the bike trail rules. The rules are brief. They cover riding etiquette and things that are prohibited. Great Alleghany Passage Trail, Near Confluence, Pennsylvania. Source: Author– [file:\rmct-sign11.pdf]

Figure 13.52: More Rules Sign – This figure shows the closeup photo of the other rules sign. Great Alleghany Passage Trail, Near Confluence, Pennsylvania. Source: Author– [file:\rmct-sign12.pdf]

alert for other user groups. As a footnote, “excessive speed or reckless driving” is not defined and has an automobile connotation. The second rule sign focuses on the helmet law as it applies to children (Figure 13.52).

Figure 13.53 – Information Signs – This figure shows a closeup of an information sign. It provides directions and services Great Alleghany Passage Trail, Near Confluence, Pennsylvania – Source: Author– [file:\rmct-sign13.pdf]

An informational sign (Figure 13.53) is out of sight of the trail entrance photo (Figure 13.52). It faces incoming traffic. The sign uses standardized icons as modules that are assembled together on the sign. They provide directions and services available onsite and at the next town.

<b>***Trail Sign Placement*** – Signs or blazes are placed along the trail to assist users with their journey. Mile markers are a common blazing device on trails. Figure 13.54 presents several approaches to their placement on the trail.

<c>**External Source** – Although not truly a trail sign, traditional external sources of trail information includes maps, brochures and guide books. The advantage of using these sources of information is reduced trail maintenance. Disadvantages include litter and the difficulty to change the message between print runs. Increasingly, smart phones, GPS, and other electronic devices will be used to orient trail users.

<c>**Equal Intervals** – Using the equal interval approach, trail signs or blaze marks are provided at equal intervals along the trail (Figure 13.54). On the Great Allegheny Passage bike trail, mile markers represent equal interval markers present along the trail. The primary benefit to users is that they create pacing where users expect to encounter the signs along the trail.

<c>**Critical Junctions** – Using the critical junction approach, tail signs are placed at the critical junctions along the trail (Figure 13.54). Usually, these critical junctions are at places where the trail branches. Trail heads are critical junctions. The signs in Figure 13.50 are located at a trail head.

<c>**Line of Sight** – Using the line of sight approach, trail signs are placed along the trail so that the next sign and the previous sign are in sight (Figure 13.54). This approach provides the maximum user security since a trail sign is always in sight. It is particularly useful on interpretive trails or on trails frequented by people who are unaccustomed to using trails.

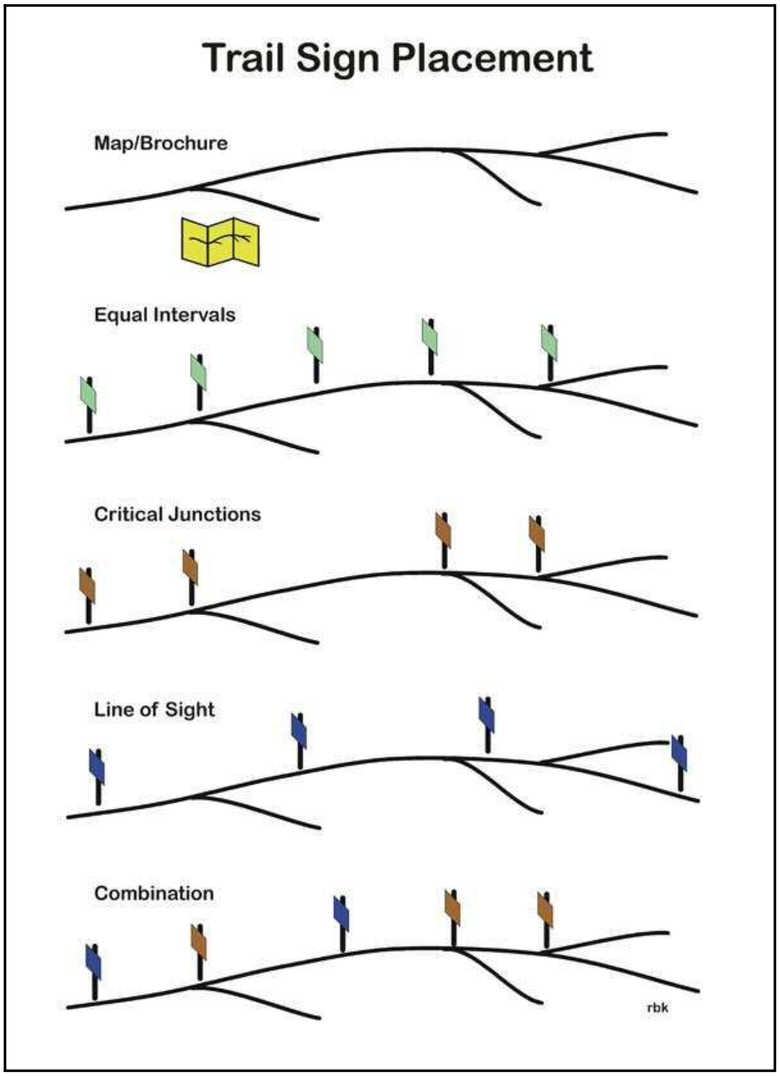

Figure 13.54: Trail Sign Placement – This figure shows the different trail sign placement configurations. – Source: Author– [file:\TrailSignPlacement.pdf]

<c>**Combination of Approaches** –
The approaches can and are easily used in conjunction with each other (Figure 13.54). For example, on the Great Allegheny Passage trail, the trail head signs located at major trail heads are placed at critical junctions along the trail. In addition, mile markers are placed at equal intervals of a mile along the trail. Complementing these information sources are external sources of maps and brochures. They are available along the trail to assist trail users.

Handicapped/Universal Design Considerations

The Americans with Disability Act and Universal Design are discussed in additional depth in Chapter 20 regarding facility construction. The concept of universal design applies to other facilities including trails. Roadway construction, bridges, and switchbacks can easily accommodate handicapped users. Often rails-to-trails and similar facilities lend themselves readily to universal design. Many times it is the parking lot and restrooms that become inaccessible.

Figure 13.55: Motorized Wheelchairs on Rails-to-trail – This rail-to-trails easily accommodates these power wheel chair adventurers without additional modifications. Consider that they run in pairs in case of a breakdown. Also, they are out of cell phone communication if there is a problem. This is a true adventure for them. Near Markleton, Pennsylvania. Source: author – [file:\GAP051trail023.jpg]

An example of universal design is Greater Allegany Passage (GAP) trail. The proper design of the trail for bicycles makes the trail equally accessible to other users, including powered wheel chairs (Figure 20.14). Care needs to be taken with the parking lots and access to the trail to remove barriers. The two adventurers pictured in Figure 13.55 traveled a remote six-mile stretch on the GAP trail. They traveled in pairs for safety reasons. There is no cell phone connectivity. They need to plan for mechanical problems, battery issues, shuttle and blow-downs, and other problems they can encounter along the trail. These problems are a variation of the problems faced by a normal biker.

Figure 13.56: Strollers, Escalators and Switchbacks – Strollers face many of the same issues as handicapped accessibility. At the San Diego Zoo, an escalator helps provide accessibility in a park with significant elevation differences. A stroller is pictured on the lower portion of the escalator. An alternative to the escalator is a walkway consisting of a series of switchbacks. San Diego, California. Source: author – [file:\SDZ051escolator[gd].JPG]

Most people associate universal design and handicapped accessibility with handicapped. This need not be the case. On a typical Saturday and Sunday, the San Diego Zoo is inundated by young parents pushing baby strollers. The strollers face many of the similar problems associated with handicapped accessibility. Presenting an additional challenge, there are significant elevation differences within the park. Helping to address this situation, the park installed an escalator to move people and strollers from the lower levels in the park back to a higher elevation (Figure 13.56). For those not choosing to use the escalator, the park has a typical

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Figure 13.57: Retrofitting for Strollers and Wheelchairs – The sign suggests an alternative route around a steep series of steps. In addition, the sign reinforces the premise of universal design that strollers face many of the same accessibility issues as wheelchairs. San Diego Zoo, California. Source: author – [file:\SDZ019.JPG]

switchback walkway in close proximity to the escalator. There is universal access throughout the park.

Sometimes simple planning can provide universal access without extensive retrofitting (Figure 13.57). To the right of the sign in Figure 13.57 is a steep series of steps that provide a barrier to strollers and wheelchairs. In this case, the path through the aviary provides accessibility or a path to the lower level. In addition, the sign reinforces an underlying premise of universal design that there is not much difference between the accessibility needs of strollers and wheelchairs.

Summary

The previous chapter suggested that trails are the pathways to people's experiences. They are the link to the experience. That discussion was more philosophical and conceptual. In contrast, the focus of this chapter has been more on the practical aspects of trails. In delivering the designed experience, it focuses on the practical aspects of designing and creating trails.

Because they provide access, this chapter suggests that impacts associated with access should be examined thoroughly also. Next the chapter explores the planning process as applied to building trails. Types of trails, their gradient strategies and their design are covered. Last, the placement of trail signs along the trail is addressed. This chapter provides a good primer on trails and their construction.

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