



# Surface Materials for Multiple-Use Pathways

National Park Service, Rocky Mountain Region

April, 1992

---

## Introduction

---

Surface materials used in multiple-use pathway projects are critical to the overall success of the project. Managers of multiple purpose pathways who understand the intended uses of the pathway, who have knowledge of the engineering properties of surface materials and their criteria for selection, and who have an eye for aesthetic fitness will advance the development of a well planned, efficiently used and easily maintained pathway.

---

## Pathway Design Team

---

The civil engineer and the landscape architect each have skills that contribute to a well designed pathway project. In the past, the civil engineer and the landscape architect have teamed up to develop the best horizontal and vertical alignments on corridor projects. Other professionals such as structural engineers (bridges and drainage structures), architects (restrooms and visitor structures), interpreters (wayside exhibits) and wildlife biologists should be included as needed.

---

## Uses, Settings and Design Volume

---

The predominant use, the local setting of the proposed pathway, and the volume of use have an impact on surface material selection and design. Major categories of use may range from alternative transportation, to fitness, recreation, and solitude. Pathway settings can be identified as urban, suburban, campus, rural and backcountry. For example, the more urban the area, the more intensive the use and the higher volume of use will require more improvement in the surface. Additionally, the highest volume use areas may require even wider pathway standards than the recommended minimums.

---

## Pathway Access Points

---

Access points to multiple-use pathways usually need to be surfaced. Site analysis and observation should take place to identify all connections to neighborhoods and other access points to the pathway. Links to the local neighborhood are important because they are, in fact, part of the pathway system. Surfacing all connections to the pathway insures overall design appropriateness of the corridor.

---

## Ground Surface and Circulation Patterns

---

Successful development of the ground surface is important to overall project success. Nearly all pathway projects are narrow, and attention is focused on the ground surface not only because of the closely defined vertical elements, but also because of the methods of use: on foot or by small vehicle. Well defined circulation patterns employing appropriate surface materials will insure a properly used pathway. Poorly defined circulation patterns, especially at nodes, can lead to conflict and dangerous situations. *This will raise the level of exposure to liability for agencies and individuals involved.*

---

## Multiple-Use Determinations

---

Multiple-use pathways require carefully selected surface materials. Based on the types of use anticipated, appropriate signs, education programs and enforcement are required to minimize conflicts and prevent improper use or damage to the pathway. *Not all proposed uses of a pathway are compatible. Conflicting activities commonly include horses, handicapped access and skate boards with walking, jogging and bicycling.* Chart 1 shows a comparison of individual use standards.

## Subgrade Materials and Drainage

The engineering properties (structure and function) of the subgrade materials in a pathway project may have a significant impact not only on corridor selection and route selection within the corridor, but also on the design of surface materials in selected routes. Licensed engineers need to be part of the planning and design processes to troubleshoot opportunities and requirements for surfacing.

Proper selection of corridors and routes, combined with proper subgrade preparation for the pathway will economize on required surface materials and lead to long lasting results. Potential problems in pathway subgrades include soils susceptible to frost heaving or expansion, organic matter, and soils with uneven bearing capacity.

Pathway projects often involve ditches, canals, and wetlands, as well as storm and surface runoff. Engineers involved in the corridor and route selection process need to also communicate needs for drainage near and across the improved pathway surfaces. Potential problem areas in surface drainage include areas of intermittent standing water, areas subject to flooding, soils subject to erosion and wet site vegetation.

## Engineering Properties of Surface Materials

Surface materials have differing engineering properties that affect the suitability of the material for a particular use. Thorough investigation of each materials' engineering properties will assist the design team in determining the appropriate materials for use on each part of the project. For example, concrete requires a firm subgrade, but derives little strength from it. Asphalt requires a firm subgrade, as well as a gravel base course and it *does* derive significant strength from its subgrade and base course.

*Note: Manufacturer's specifications and suggestions, as well as industry standards, must be followed throughout the duration of the project.*

### Design Requirements of Surface Materials

Surface materials chosen for use in multi-use pathway projects:

- must support the intended uses;
- should reflect the character of intended pathway uses;
- should reflect the local environment;
- should harmonize with the landscape (best described in terms of form, line, color, and texture);
- should reflect historical influences; and
- should reflect local tradition.

**Chart 1: Pathway Design Standards Comparison Matrix**

		Existing Cross Slopes	Tread Width	Clearing		Surface Materials *				Max. Surface Cross Slope	Maximum Profile Grade
				horiz.	vert.	natural	gravel	asphalt	concrete		
Hiking	Walking	0-10%	4' min	8'	10'	No	No	Pref	Pref	4%	5% avg
	Standard	10-70%	24-36'	6-7'	10'	Pref	Pref	No	No	4%	12%
	Backcountry	10-90%	24'	5'	8'	Pref	OK	No	No	4%	12%
Equestrian	Mtn. Single Track	10-70%	24"	8'	10'	Pref	Pref	No	No	4%	12%
	Rural Double Track	0-30%	48-96"	10-14'	10'	Pref	Pref	No	No	4%	12%
Nordic Ski	Single Track	0-70%	12"	5'	+6'	Pref	Pref	OK	OK	NA	10% desired
	Double Track	0-70%	12"/12"	10'	+6'	Pref	Pref	OK	OK	NA	10% desired
	Skate Lane	0-70%	8'	10'	+6'	Pref	Pref	OK	OK	NA	10% desired
Road Bicycle	One Way	0-10%	5'	9'	10'	No	No	Pref	Pref	>2%	5% desired
	Two Way	0-10%	8'	12'	10'	No	No	Pref	Pref	>2%	5% desired
Mtn. Bike	Mtn. Single Track	10-70%	24"	6'	10'	Pref	Pref	No	No	4%	12%
	Rural Double Track	0-30%	48-96"	8-12'	10'	Pref	Pref	No	No	4%	12%
Multi-Use	Urban/Suburban	0-10%	10'	14'	10'	No	No	Pref	Pref	>2%	5% avg
	Rural	0-30%	24-36'	8-9'	10'	Pref	Pref	OK	No	4%	12%
	Mountain	10-90%	24-36'	8-9'	10'	Pref	Pref	No	No	4%	12%
Handicapped Access	Fully Accessible	0-10%	7'	11'	10'	No	No	Pref	Pref	<2%	5% avg, 8.33% max

\* Pref = Preferred, OK = Acceptable, No = Not Appropriate, NA = Not Applicable.

**Chart 2: Surface Materials And Individual Use Types**

	Concrete	Brick or Masonry	Asphalt	Boardwalk	Road Base Gravel	Soil Hardener	Limestone Fines	Sandstone Fines	Wood Chips	Natural Surface	Sand	Over Snow
Walking	**	*	***	**	**	***	**	*	*	***	*	
Hiking								*		***		*
Jogging					*	*	**	**	**	***	*	
Fitness	*	*	*	*	*	**	*	*	**	***	*	
H. Accessible	***	*	**	*								
Bicycle	**	*	***	*	**	*	**	*				
Mountain Bike	*		*	*	**	**	**	**		***	*	
Equestrian									*	***	*	
Ski												***
<b>KEY: *** Most Desirable, ** Medium Desirability, * Acceptable</b>												

Design Guidelines for Surface Materials

Just as design guidelines are required for the overall corridor project, they should be developed for the pathway surfacing. Design guidelines are most beneficial when initiated early in the process, not added on towards the end. By gaining an early understanding of surface material needs, the design team will ensure the harmony of the overall project with the environment and other facilities related to the pathway.

Most corridors display a hierarchy of uses. So too, should there be a hierarchy of surfacing materials in the pathways (bicycles require asphalt or concrete; a parallel jogging surface may be gravel). *Understandably, not all pathway surfaces need to be hard-surface paved, and several materials may be used in the same corridor.*

Compatible materials, exhibiting similar colors and textures, can be used to differentiate uses within the overall corridor. Design guidelines for surface materials include a description of the intended subgrade preparation, the particular material chosen and its color, and anticipated maintenance activities.

Design Standards and Surfacing Materials

Design standards for a particular recreation use will sometimes dictate the surfacing material and the corresponding standard to attain during construction, maintenance, repair and rehabilitation of the project. Road bicycle (by AASHTO guideline) and handicapped access (by federal standard) pathways are good examples of this use requirement for a hard surface. Chart 2 compares individual uses and surfaces.

Provision of Adequate Space

Consideration must be given to the full cross section of the selected surface material (shoulders, setbacks, buffers, cut or fill slopes, maintenance strips) and the required design section (depth and subgrade preparation) of the surface material. In some regions, solar access to portions of the pathway may be required to ensure snow and ice do not accumulate in cold pockets (near bridge abutments, retaining walls, dense vegetation, and north facing areas). Also, adequate space must be provided off of the pathway for support facilities (bike racks, benches, restrooms, fountains, pathway intersections and interpretive panels).

---

### Criteria for Material Selection

---

Many different criteria will come into play when deciding what type of surface material to choose for each pathway project. Selection of surface materials for multiple use pathways should be based on a rational and defensible process. The following is a comprehensive list of questions to begin the discussion process for the design team. *It is suggested that your team discuss the following questions (and others you may come up with) for each material and record your decision in a tabular or matrix form.*

- Who is qualified to design your pathway?
  - A/E firm
  - in house
  - professional volunteer
- What environmental factors may affect use of a particular material?
  - frost/heaving
  - flooding
  - exposure or glare
  - snow/ice
  - wind
  - sun/shade
  - vegetation

*Note: These environmental factors could have an influence on selection of a surfacing material. For example: a predominantly asphalt or gravel pathway may be periodically flooded at low points. Concrete would be the best material in an area that is periodically flooded.*

- Who is qualified to build your project?
  - day labor
  - contract
  - volunteer
- How available are the materials?
  - seasonally
  - local/distant
- How economical are the materials?
  - start up
  - life cycle
- What scale and types of *planning* drawings are required?
  - plan and profile (1" = 200' through 1" = 1000' suggested)
  - sketch cross sections

---

### Criteria Continued

---

- What scale and types of *design* drawings are required?
  - plan and profile (1" = 100' suggested)
  - detailed cross sections
  - are shop drawings required?
- What specifications are required?
  - manufacturer
  - outline
  - detailed for bid
- What are alternative sources of the materials?
  - commercial
  - local agency
  - donation
- What standards must be attained?
  - width/height
  - cross slope
  - subgrade preparation
  - design section
  - do codes apply to the material or use?
- Will the users be satisfied?
  - comfort
  - zoning and volume of use
  - adequate horizontal space provided
- What is the local unit of measurement?
  - ton/cubic yard
  - square yard/linear foot
- What quality control is required?
  - in design
  - in construction
  - during maintenance
- What special qualities are available?
  - color

---

### Summary

---

Multi-use pathway managers who understand the factors related to surface material selection and design will be able to promote a safe and aesthetically pleasing pathway project. It is suggested that your design team refine the process presented here, custom tailoring a surface materials selection process to each local project or portion of a project.

---

*Prepared by Hugh Duffy of the National Park Service's, Rivers, Trails, and Conservation Assistance Program, 12795 W. Alameda Pkwy., Lakewood, CO 80225-0287. Phone: (303) 969-2781.*