DESIGN CRITERIA MANUAL

CHAPTER 4 TRAILS

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT & ENGINEERING DEPARTMENT

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DESIGN CRITERIA MANUAL
REVISION LOG

Chapter 4 - Trails

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1.	July 2006	Technical & editorial updates; minor corrections throughout chapter. Chapter 4 re-issued.		
2.	June 25, 2007	Chapter 4 implemented.	All	

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Acronyms and Abbreviations

AASHTO.....American Association of State Highway and Transportation Officials
ADA……..……Americans with Disabilities Act
ADAAG.....Americans with Disabilities Act Accessibility Guidelines
ADOT&PF.....Alaska Department of Transportation and Public Facilities
ADT.....average daily traffic
AMC.....Anchorage Municipal Code
ATP.....Anchorage Trails Plan
DCM.....Design Criteria Manual
FHWA.....Federal Highway Administration
ft.....feet
M.A.S.S.....Municipality of Anchorage Standard Specifications
MOA.....Municipality of Anchorage
MUTCD.....Manual on Uniform Traffic Control Devices
OS&HP.....Official Streets and Highways Plan
PGDHS.....Policy on the Geometric Design of Highways and Streets
PM&E.....Project Management and Engineering
ROW.....rights-of-way

SECTION 4.1 INTRODUCTION

This chapter provides discussion and design criteria for development of trails within the Municipality of Anchorage. While the main focus is placed on multi-use paved trails (also called multi-use pathways AASHTO, 1999 design considerations for safe bicycle travel on shared roadways, signed shared roadways and bike lanes are provided at the end of this chapter. This chapter provides design guidance based on the Areawide Trails Plan (ATP). Designers should consult that document with respect to planning level decisions that affect the planning and design process.

4.1 A Sources Referenced

In developing design criteria for pathways, trails, or bicycle routes, it is important to understand the difference between each. Chapter 4 is largely an adoption of the design TRAILS standards as described within the Areawide Trails Plan, which was adopted by the Municipality of Anchorage in April 1997. Additional information for this chapter has been compiled from references listed at the end of this chapter.

4.1 B Definitions

Trails:
The term "trails" as used in this document and the Areawide Trails Plan refers to the universe of trails, not to any specific type of trail. Following are definitions provided in the ATP:

Multi-Use Paved Trail:
Multi-Use Paved Trails are for pedestrian type uses to include bicycling, jogging, skating, cross-country skiing and skijoring. These trails are not typically used by motorized vehicles, or sled dogs, except when reserved for special events following appropriate public notice. Designers should note that AASHTO uses the term "shared-use" to define such trails.

Typically multi-use trails are two-way directional. One-way multi-use trails can be used, but designers are cautioned that unless measures are provided to control direction, one-way directional trails will most likely be used as two-way trails.

Multi-use trails should be considered as a complementary system to on-road circulation for bicycles. Multi-use paths should not be used to preclude on-road bicycle facilities but rather to supplement them.

Multi-Use Unpaved Trails:
Multi-Use Unpaved Trails are used for pedestrian type activities to include bicycling, jogging, cross-country skiing, skijoring, and also equestrian, natural and interpretive types of uses.

Bicycle Routes:
Bicycle Routes are facilities that provide for bicycles to share roadways. These routes are striped and/or signed and are intended to serve commuters and cyclists. Designers should note that the MUTCD denotes all trails within the right-of-way as "routes" and signage so designates these trails as "routes".

AASHTO, 1999 distinguishes between shared roadways and signed-shared roadways for use as bike routes, as discussed below.

Shared roadways are those roadways where particular roadway features have been modified or designed to be more compatible to bicycle travel. These include bicycle-safe drainage grates and bridge expansion joints, improved railroad crossings, smooth pavements, adequate sight distances, and signal timing and detector systems that respond to bicycles. More costly shoulder improvements including paving over the gutter pan to make space for bicycles or the addition of wide curb lanes can also be considered. Shared roadways are discussed further in Section 4.4 B Commuter Bicycle Routes.

Signed-shared roadways are those roadways that have been identified as a preferred bike routes. Signing suggests to the cyclist that the responsible agency has taken the necessary action to ensure that the route is suitable for bicycle travel. Signed-shared roadways are further discussed in Section 4.4 B Commuter Bicycle Routes.

Sidewalks:
Sidewalks are concrete surfaces or otherwise improved areas for pedestrian use. They are located within public street rights-of-way that also contain roadways for use by vehicular traffic."

AASHTO, 1999 Guide for the Development of bicycle Facilities states that the use of sidewalks for bicycle travel is undesirable and unsatisfactory. Typically designed for pedestrians, sidewalks are not designed for the faster speeds associated with bicycle paths or other multi-use trails accommodating rollerblades, scooters, or other non-motorized wheeled vehicles. Sidewalks, particularly in urban locations or at transit stops, are often designed with pedestrian amenities such as benches, planters, trees, parking meters which all become obstacles around which cyclists must maneuver. The Anchorage Municipal Code (AMC 9.38) contains regulations affecting bicycle travel and precludes the riding of bicycles on sidewalks in a business district such as in the Anchorage Central Business District.

Walkways:
Walkways are rights-of-way or easements, dedicated to public use, which cross within a block to facilitate pedestrian access to adjacent streets and properties.

4.1 C Objective

The objective of this chapter is to provide municipal guidelines for the design of trails. All trails shall be designed, located and signed to discourage incompatible use and to provide safe, enjoyable, and year-round use. In doing so, these design standards will provide for the public safety and welfare while helping to protect the Municipality against liabilities.

The criteria for trail development and design include paving, alignment, stopping sight distance, intersections, grades, cross slopes, clearances, road separation, width of trails, striping and signage, lighting, drainage, surfacing, and trail structure. Each of these is discussed in detail below. Additionally, specific attention should be placed on the landscaping of trails including trees, shrubs, topsoil, and seeding (Refer to Design Criteria Manual, Chapter 3).

4.1 D Authority

AMC 21.05.030 identifies the Anchorage Trails Plan as an element of the Comprehensive Plan. It is a guide for the construction of a trail and walkway network within the Municipality of Anchorage.

AMC 21.080.030 gives the Platting Authority direction to require walkway dedication as part of subdivisions. This may be done when walkways or trails are necessary for adequate pedestrian circulation or safety.

AMC 21.080.060 directs the Platting Authority to require trail dedication when the trail is designated on an adopted municipal plan and cannot be located in an existing dedicated easement or right-of-way.

AMC 21.85.090 establishes sidewalk needs for land development based on the Average Daily Traffic (ADT).

AMC 21.85.100 requires walkways and trails that are not part of required trail dedications to be improved in accordance with AMC 21.85 Table E.

AMC 21.85.Table E establishes minimum, widths and surfaces for trails and sidewalks.

4.1 E Applicability of ADAAG

The Americans with Disabilities Act Accessibility Guidelines must be adhered to for all projects. It must be understood that there is a wide range of standards that deal with trails. Each project must be evaluated and the appropriate standard applied. There are a number of documents that apply to trails:

The ADAAG Manual: A Guide to the Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (July, 2004) applies to many situations, governing "accessible routes", parking and passenger loading zones, curb ramps, stairs, and signage. In particular, it should be consulted for the access along the fronts of buildings, within parking areas, and for sidewalks interior to a site development project.

Accessible Public Rights-of-Way: Revised draft guidelines were issued by the U.S. Access Board (11/23/05) which provides specific guidance for compliance with ADAAG in the public rights of way. It deals much more with transportation projects than does the ADAAG Manual (above) and offers guidance on streets, sidewalk, and multi-use trails. It also addresses the degree to which alterations must comply with ADAAG. The design guide was developed to provide uniform guidance to State and local governments on how to design and construct accessible public pedestrian facilities until such time as the Access Board, DOJ, and DOT issue final requirements.

Recommendations for Accessibility Guidelines: Recreational Facilities and Outdoor Developed Areas (ATBCB, 2002) "Final Rulemaking" provides the basis of what will become design requirements. These guidelines were not incorporated into the Department of Justice accessibility standards as of December 2005, and thus are not enforceable. However, they represent the current thinking with respect to recreational facilities and should be consulted for design of trails for recreational purposes. The documents provide a discussion of the issue of "challenge levels" and "spectrum of opportunity" that should be applied when designing trails in a recreational setting.
Project Managers and designers are cautioned that ADAAG presents an evolving set of design criteria. The realm of trails in particular is changing. Design Study Reports should address the current standard to which trails will be designed. Typically, the most current guidelines that are issued, whether as part of a final rule or not, represent the best judgment of a committee of authorities within a field and should be given full consideration as to their applicability to a project. Design Study Reports should indicate where strict application of the criteria would be inappropriate for a project and specific exception to that criteria should be sought from the Municipal Engineer through the design variance process.

The Federal government recognizes that not all trails may be designed to meet ADAAG. Many times, making a trail fully "accessible" would destroy the surroundings and cause inappropriate environmental damage, thus some criteria may be compromised in some instances. However, designers should recognize that this does not remove the necessity to comply with other components of ADAAG that assist those with disabilities, such as the provision of flat, paved rest areas, benches, leaner rails and other accommodations.

Project Managers and designers should also recognize that other organizations offer considerable information on the subject of pedestrian environments. AASHTO expects to issue a new *AASHTO Pedestrian Guide* in 2006 which should be referenced for changes in policies. That document will provide additional information on the subject of design for accessible pedestrian areas.

4.1 F Design Variances

Designers, whether Municipal or private, shall adhere to the criteria established in this Design Criteria Manual and other referenced documents, unless compliance with such will compromise their judgment as professional engineers with regard to safety, welfare, cost effectiveness, and/practicality. In such cases, a written variance request of the standard of criteria may be requested from the Municipal Engineer. Written variance requests shall be submitted through the municipal project manager or private development coordinator for a determination by the Municipal Engineer. Variance requests should contain supporting information, justification and suggested solutions.

In addition to the criteria presented in this manual, the Municipal Engineer may at his/her sole discretion impose greater standards and criteria when deemed appropriate to protect the safety and welfare of the public.

END OF SECTION 4.1

SECTION 4.2 DESIGN STANDARDS

Following is a discussion of design standards for multi-use trails. These criteria will apply for virtually all trails that are separated from the roadway, excepting trails in recreational settings.

4.2 A Paving

Trails in road rights-of-way shall be paved, except those that are:

- identified as multi-use unpaved trails in the Areawide Trails Plan or in an approved Park Master Plan
- located in Girdwood that the Girdwood Board of Supervisors elects to waive
- in the Anchorage Bowl and Chugiak-Eagle River areas that the Planning and Zoning Commission elects to waive.

4.2 B Alignment

The significance of proper alignment, or design radii, varies with the use of the facility. For example, sidewalks and walkways are predominantly used for slow moving pedestrian traffic, while, bike and equestrian trails should be designed to accommodate greater speeds, greater volumes of users, and even greater user types. Trail alignment should include both vertical and horizontal alignment and is related to design speed and sight stopping distance.

1. Design Speed:

Design multi-use paved trails for an appropriate speed for cyclists. A minimum design speed of 20 mph should be used (AASHTO, 1999). Bicycles traveling faster than this on a mixed-use trail would be inappropriate. While design and traffic controls can be used to deter excessive speeds, lower design speeds should not be used to artificially lower user speeds. When a downgrade exceeds 4 percent, or where strong tailwinds prevail, a design speed of 30 mph or more is advisable.

Unpaved trails should have a design speed of 15 mph and a higher design speed of 25 mph where grades or tailwinds dictate.

2. Horizontal Alignment

The ATP (1997) recommends a minimum design radius of 95 feet when designing trails for bicycles, rollerblading, cross-country skiing, and dog mushing, while trails for snowmobiles should use a minimum radius of 565 feet (assuming a design speed of 40 mph).

Horizontal alignment of trails for bicycles must be considered due to the necessity of the cyclist to lean into the turn. Generally, a maximum lean angle for casual cyclists is between 15º and 25º depending on the experience of the cyclist. For most cyclists, the minimum curvature of the pathway can be calculated for a given lean angle by the following equation:

$$R = \frac{0.067V^2}{\tan \theta}$$

Where:

R = Minimum radius of curvature, ft
V = Design Speed, mph
θ = Lean angle from the vertical, degrees

Where the lean angle exceeds 20º, AASHTO (1999) recommends that the pathway should be widened with a centerline placed down the middle of the path. ADAAG requires that cross slopes not exceed 2 to 3 percent to avoid severe slopes that preclude use by people in wheelchairs. The maximum super-elevation for most multi-use trails is 3 percent and requires a minimum transition distance of 25 feet be provided between the end and beginning of consecutive and reversing horizontal curves.

The tables below (AASHTO, 1999) present the minimum design radii for paved multi-use trails for 15º lean angle, and 2-percent super-elevation and 20º lean angle, respectively:

Table 4-1 Desirable Minimum Radii for Paved Multi-Use Paths	
Based on 15º Lean Angle (AASHTO,1999)	
Design Speed (V) (mph)	Minimum Radius (R) (ft)
12	36
20	100
25	156
30	225

Table 4-2 Minimum Radii for Paved Multi-Use Trails		
Based on 2% Super-elevation and 20 Degree Lean Angle (AASHTO 1999)		
Design Speed (V) (mph)	Friction Factor (Paved)	Minimum Radius (R) (ft)
12	0.31	30
20	0.28	90
25	0.25	155
30	0.21	260

4.2 C Stopping Sight Distance

The ability to react in a timely manner to unexpected obstacles on the pathway is a critical element in the design of both bicycle trails and multi-use trails. Of issue is the minimum stopping sight distance needed to stop to prevent an accident or a wildlife encounter. The design of the trail or pathway, in order to provide a safe environment for all users, should consider the slope of the pathway, the length of the vertical curve necessary to provide minimum stopping sight distance, and the minimum clearance needed for line of sight obstructions for horizontal curves.

The ATP (1997) states that the standard required stopping sight distance on flat surfaces shall be 125 feet for pedestrian or bicycle trails. This standard is the same as the adopted Oregon standard that is based on the speed of the fastest bicycle (ATP, 1997). Increase this sight distance as necessary, to accommodate the factor of slope. Trails for equestrians may include shorter stopping sight distances, and dog mushers may require up to twice the distance, as much as 250 feet. Snowmobile trails are designed with a stopping distance of 225 feet (ATP, 1997).

AASHTO's Guide for the Development of Bicycle Facilities (1999) presents detailed information for the minimum stopping sight distance vs. grades for various design speeds, as well as tabular information for minimum length (L) of crest vertical curve based on stopping sight distance and minimum lateral clearance (M) for horizontal curves. General formulas for stopping distances are presented below.

For minimum stopping sight distance on slopes of varying design speeds:

$$S = \frac{V^2}{30(f \pm G)} + 3.67V$$

Where:
S = Stopping sight distance, ft
V = Velocity, mph
F = Coefficient of friction, use 0.25
G = Grade, ft/ft (rise/run)

For minimum lateral clearance on horizontal curves:

M = R(1-COS(28.65S/R))

S = (R/28.65)(COS-1((R-M)/R))

Where:
S = Stopping sight distance, ft
R = Radius for centerline of lane, ft
M = Distance from centerline of Lane to obstruction, ft

4.2 D Intersections

Intersections of trails shall be perpendicular. Due to design constraints, it may not always be possible to have a 90-degree intersection. AASHTO allows a 45-degree latitude for intersecting trails when crossing roadways, but where right-of-way is not an issue, crossings should be as close to perpendicular as possible.

The intersections of dog sled trails with other user groups shall intersect at 90-degrees. Sufficient clearing should be provided to ensure sight distances are adequate. All trail intersections shall be signed to alert users as to the type of crossing and the expected type of traffic, if the trails typically have different users. Depending on the amount of use of the mushing trail, fencing may be used to control use during race events.

Intersections between multi-use trails and roadways are discussed in Section 4.2 Q Trail-Roadway Intersections.

4.2 E Grades

The AASHTO standards for grades for paved bicycle trails are as follows: "Grades on shared use paths should be kept to a minimum, especially on long inclines. Grades greater than 5 percent are undesirable because the ascents are difficult for many bicyclists to climb and the descents cause some bicyclists to exceed the speeds at which they are competent or comfortable. On some shared use paths, where terrain dictates, design may need to exceed the 5 percent grade recommended for bicycles for some short sections." Also, grades exceeding 5-percent conflict with ADAAG language.

The ADAAG "Public Rights-of-Way Design Guide (1999) in Section 3.2.2 states, "On a new site, a knowledgeable designer can often manipulate cut and fill, entrance location, and approach direction and length to limit walkway running slope to 1:20 (5%), adding, where necessary, ramped segments with handrails and landings at or below the 1:12 (8.33%) slope specified in accessibility standards for ramps. These slopes will not be consistently possible to achieve along public sidewalks and multi-use paths, where running slope is tied to roadway gradient and underlying terrain. Nevertheless, running slope should be kept to the minimum feasible consistent with these factors. Artificial slopes should not be added as landscaping features, nor should meandering walkways that add significantly to the travel distance be permitted on a primary circulation route."

Further, multi-use trails or paths may also serve a pedestrian circulation/transportation function, particularly in suburban and rural rights-of-way. "Where such a route is located in a public right-of-way and provides a direct pedestrian connection between neighborhoods, residential areas, schools, employment centers, and other origins and destinations, it must be accessible."

Recognizing that there may be a need to exceed the five percent grade, AASHTO, 1999 recommends the following for bicycles for short sections, as a general guide:

5-6% for up to 800 ft
7% for up to 400 ft
8% for up to 300 ft
9% for up to 200ft
10% for up to 100 ft
11% + for up to 50ft

AASHTO provides the following recommendations to mitigate excessive grades:

- when using a longer grade, an additional 4-6 feet of width to permit slower speed bicyclists to dismount and walk may be considered.
- provide signing that alerts bicyclists to the maximum percent of grade.
- provide recommended descent speed signing.
- exceed minimum stopping sight distances.
- exceed minimum horizontal clearances, recovery area and/or protective bike rails.
- when possible (and practical), use a wider path, 4-6 feet addition recommended, and
- a series of short switchbacks to contain the speed of descending bicyclists.

Where long stretches of excessive grade are required, provide level rest areas with benches. Changing surfacing to gravel in order to slow traffic is not an option due to handling and drainage concerns. If the grade is steep, the gravel tends to migrate freely, creating soft shoulders, and uneven surface.

These conditions pose serious handling issues, particular for those users on bicycles with narrower tires that are often used by commuters. This is also unsafe for children who may not be able to estimate their ability to slow down before reaching the gravel. Further, the migration of gravel may create drainage problems through short-circuiting of the designed drainage facilities as well as the possible introduction of fines into drainages.

Unpaved shared-use trails are generally used for multiple purposes in recreational settings. Designers and project managers should confer when planning these trails to determine the appropriate grade criteria relative to the users, the setting, and trail purposes.

4.2 F Cross Slopes

Though ADAAG allows cross-slopes up to 2%, designers should seek to achieve trail cross slopes of approximately 1 percent in accordance with criteria from the ATP. Where driveways cross paved trails, the 2-percent maximum cross slope applies. Ensuring cross-slopes do not exceed 2% increases safety for all users, especially roller bladders and children.

4.2 G Clearances

Horizontal and vertical clearances are important safety considerations. The greater the speed traveled on the trail, the greater the tendency for users to "shy" or steer away from nearby obstructions such as trees, fences, light poles, and retaining walls. This creates a safety hazard by moving the user toward the center of the facility and/or distracting attention from other users. Minimum clear widths are measured the edge of the paved surface.

The minimum clear width for a bridge, underpass, overpass or other structure, should be the same as the approach of a paved multi-use path plus an additional minimum 2-foot wide clear areas on either side (AASHTO, 1999). The clear areas provide a minimum horizontal shy distance from railings, walls or barriers. The clear areas also provide additional room for maneuvering space to prevent conflicts between cyclists and other path users. ATP (1997) states that the minimum clear dimensions for tunnels and bridges should be 12-foot wide x12-foot high.

Vertical clearances are dictated by the size of emergency and maintenance vehicles. Where practical, a vertical clearance of 10 feet is desirable for most trail users, but bridge and tunnel clearances should be increased to 12 feet where equestrian activity is permitted. Railings, fences, or other barriers should be a minimum of 42 inches high.

Provide trails with minimum 2-foot wide graded shoulders on each side of the trail, measured from the edge of the paved surface, with a preferred slope of 3-5%. Wider shoulders of three feet are appropriate for trails that have a high percentage of use by runners and joggers since they often prefer a soft surface. A clear zone of 3 feet from the edge of the traveled surface or pavement should be maintained from trees, poles, walls, signs, or other potential obstructions. Where slopes are adjacent to canals, streams, or similar open water, or are steeper than 3H:1V, a wider shoulder, not less than 5 feet, should be provided (AASHTO, 1999). A physical barrier may also be warranted in certain situations. Side slopes of embankments should slope at 3H:1V or flatter, and never steeper than 2H:1V.

It is advisable to incorporate a 100-foot selective thinning zone along each side of all trails, except for trails designated for cross-country skiing, equestrian, dog mushing, or for interpretive use, and any trails where preservation of the existing flora is important (ATP, 1997). Selective thinning of trees and brush shall only include limbing of trees to a height of 10 feet, removal of trees with calipers smaller than two inches, and removal of shrubs higher than 3 feet if they significantly restrict vision. However, there shall be no selective thinning within 25 feet of streams.

Cottonwood (Populus balsamifera) trees in particular are problematic for trails. Trails are often located in damp soils and the gravel subgrade that is provided for trails provides an ideal rooting environment for cottonwoods.

This leads to significant problems associated with horizontal and longitudinal cracking. This problem is not generally associated with other tree species.

Given the problems associated with cottonwoods, removal of all cottonwoods within the right-of-way adjacent to the trail is warranted. It is recognized that this may sometimes meet public resistance which will require that cottonwoods be retained. Projects should seek to remove them completely, including the root wad and fibrous roots to the maximum degree possible. Also, the fill prism should receive design considerations as addressed in that section of this chapter.

However, in recognition of the degree of disturbance caused by root removal, an acceptable alternative is to remove all cottonwood trees and saplings by cutting flush to the ground. This approach allows existing more desirable birch and spruce trees to receive greater amounts of light, water and nutrients. Further, this approach allows the birch and spruce to grow more quickly and better compete against the cottonwood's attempt at re-growth, while causing less overall disruption to the existing natural forest floor.

4.2 H Road Separation

When trails are located adjacent to a road of collector or higher OS & HP classification, the designer should consider the need for horizontal and vertical separation between vehicles on the road and trail users. Two-way directional, separated multi-use trails can create confusion and or problems between motorists and bicyclists, if the pathway is too close to the roadway. Separating these two uses increases safety and provides time for each to react to potential conflicts before they occur. Trail separation from roadways also allows areas for snow storage and drainage channels, separating trail users from roadway tire splash.

Trails shall have a 7-foot separation from the roadway. See the standard road sections in Chapter 1 of the DCM for the applicable standard for each road classification. The federally approved ADOT&PF Pre-construction Manual guides the development of trails within State rights-of-way.

AASHTO (1999) standards state that when the distance between the edge of the roadway and the bicycle trail is less than 5 feet, a suitable physical divider should be considered. Such dividers serve both to prevent bicyclists from making unwanted movements between the trail and the highway and to reinforce the concept that the bicycle path is an independent facility. Where used, the dividers should be a minimum 3.5 feet high in order to prevent bicyclists from toppling over them. Physical dividers should not become an un-necessary obstacle themselves in the roadside's clear zone. Consult AASHTO Roadside Design Guide (2002) for barrier design.

4.2 I Width of Trails

The desired width of a trail is directly related to the volume of users and type of use it receives. Paved multi-use trails are typically 8 to 10 feet wide and unpaved trails should have a minimum width of 5 feet.

Because of increased speeds and joint use by bicyclists, walkers and joggers on paved trails, the minimum paved width is 8 feet. Minimum 2-foot wide shoulders are required on each side of the trail. Shoulders should be increased to 3 feet if high use by joggers or runners is expected. Shoulders should slope away from the trail at 3 to 5 percent in order to maintain positive drainage. The embankment from the road shoulder should slope 3H:1V or flatter and never steeper than 2H:1V. The designer should consider whether high use, steep grades, and sharp turns may pose safety issues that would suggest a need for a wider trail. (Refer to Section 4.2 G Clearances for more information).

Where traffic volumes are expected to exceed 1,000 users per day, the paved trail width should be 10 feet with 3-foot unpaved shoulders on each side of the trail. This will accommodate multiple use characteristics and users that travel at greatly differing speeds.

AASHTO (1999) recommends that for separated rights-of-way, the paved surface for a two-way directional, multi-use pathway should be 10 feet. A width of 8 feet can be used only when:

- bicycle traffic is expected to be low,
- pedestrian traffic is expected only to be occasional,
- a good horizontal and vertical alignment is present allowing for safe and frequent passing opportunities,
- the pathway will not be continuously exposed to maintenance vehicle traffic causing damage to the pavement edges.

AASHTO standards state that, under certain conditions, it may be necessary or desirable to increase the width of a bicycle trail to 12 feet. This is particularly true for trails that receive substantial bicycle volume or have steep grades.

4.2 J Striping and Signage

Signing and marking of multi-use trails is essential in reducing conflicts between different path users and between path users and motorists at highway intersections. Signing and marking is also helpful in providing direction, destinations, distances, and crossing names.

The majority of trails are designed and constructed to minimize safety hazards. Therefore, signage and pavement markings are not significant concerns. However, the designer should closely evaluate the proposed grades, sight distances, and types of intersections for potential safety hazards. Trails that experience as much as 1000 users per day or have restricted sight distance shall have a 4-inch yellow centerline. This is also appropriate where separation of two-way directional traffic on the pathway is necessary, such as on busy sections, curves, intersections between different trails, unlit portions of the path, underpasses where passing is very limited, or where sight distance is reduced due to unavoidable obstructions. A broken yellow line could also be considered in other areas where passing sight distance is greater.

Trails that do not fully meet ADAAG requirements should be signed to denote level of accessibility and challenge. Trails that do meet ADAAG requirements must also meet ADAAG sign requirements.

Trails shall be signed at the time of construction to indicate uses appropriate to the trail. Significant misunderstanding exists in the community over the compatibility of various uses on the many Anchorage trails. Signage is an important component in the resolution of many conflict issues, but is also a maintenance expense.

All trail signage placed in the right-of-way must conform to the MUTCD and be approved by the Municipal Traffic Engineer. In ADOT & PF rights-of-way, approved of State Traffic Engineer must also be obtained. The MUTCD provides minimum traffic control measures that should be applied to trails as well as roadways.

Pavement markings at crossings should direct users to cross at a clearly defined location, and provide a clear message to motorists that this section of road must be shared with other users. For path users, stop signs, stop bar pavement markings, yield signs, caution signs or other devices should be used where appropriate. For the motorist, traditional treatments should be considered according to the MUTCD. In addition, new sign and marking applications have been developed, that, although suitable in some urban areas, may not be suitable in more rural areas. AASHTO (1999) suggests several techniques, listed below, but that each case should be considered separately by the designer.

- "Zebra-style" and or colored pavement crosswalks, which are more noticeable than traditional designs.
- Raised platform crossings, which can define roadway space for non-motorized users and stress the need for motorists to proceed with caution.

- Pedestrian friendly intersection crossings, which include appropriate signal heads, infrared motion detectors, pressure mats and other technologies.
- Mid-block neck-down or intersection curb-bulbs, which shorten the crossing distance for path users.

4.2 K Lighting

Most trails located adjacent to existing roads will have adequate illumination from existing streetlights but trail illumination must be considered as part of the overall facility design. Illumination on trails and in tunnels not located on the right-of-way shall be in accordance with direction from the Facility Management and the Parks Department.

4.2 L Drainage

Trail designs shall give careful considerations to potential drainage impacts. Trails should be built above nearby roadways unless existing conditions prevent such placement. Particular attention shall be given to ponding along property lines and the possibility of trail fill blocking drainage. Trails should be designed so that no adverse drainage impacts result from construction. Trails should not be constructed by filling existing roadway ditches, which may result in water ponding on roadway and trail and in deterioration of the road and trail. The cross-slope on a trail should be in one direction, rather than by crowning the pathway, and drainage from the trail surface should be routed to the inside of a curve, providing a 2% super-elevation to the curve.

Culverts should be provided at appropriate intervals and should be sized to convey appropriate drainage flows. Frost heaving of culverts is often a problem on trails as a result of the "freeze/thaw bulb" created by cold air in the culvert, thus consideration should be given to insulating under the culvert to reduce the likelihood of a temperature differential between the rest of the trail and that area under the culvert.

4.2 M Surfacing

Several conditions must be considered when evaluating the appropriate surface to accommodate a particular trail use. While Table 4-3 is a guide, consideration must be given to environmental conditions, environmental impacts, accessibility needs, and the desirable challenge levels of each trail. While off-road vehicles and equestrians may both use trails built of native material, the environmental impact of each varies greatly. Gravel and native earth trails pose significant restrictions to the disabled.

Winter activities are generally compatible on any trail surface type, though other problems with compatibility may exist. Consideration must be given to snow pack in determining when particular activities are allowable. Popular trails, such as Chester Creek Greenbelt Trail, can serve multiple winter uses when width allows. Trails groomed specifically for cross-country skiing are generally not compatible with other activities.

Where trail is to be paved with asphalt, a minimum thickness of two inches of asphalt shall be placed.

Table 4-3 Compatibility of Surface Type to Summer Trail Use

Trail Use	Paved	RAP	Gravel	Natural
Biking (Mountain)	X	X	X	X
Biking (Non-Mt.)	X	X		
Dog Walking	X	X	X	X
Equestrian		+	X	X
Hiking		X	X	X
Interpretive	X	X	X	X
Jogging/Running	X	X	X	X
Motorized Vehicles			X	X
Natural				X
Roller Skiing	X			
Rollerblading	X			
Walking	X	X	X	X

Key: RAP = recycled asphalt pavement
X = compatible
+ = may be compatible if not oiled or compacted

(ATP, 1997)

4.2 N Trail Structure

Required trail structure is related to surface material. All trails with paved surface shall be designed in accordance with Municipal and State criteria for roadway structural fill (ATP, 1997). Surfaces must withstand snow removal practices and wear from maintenance equipment. The designer should consider the impacts of each use when determining trail structure. For example, while equestrians prefer a native surface material, locating an equestrian trail in wetland conditions may require an engineered gravel structural section. Proper planning and design should attempt to locate trails such that expensive engineering solutions are not needed for their construction.

For most applications, a minimum structural section will typically consist of the two inch asphalt surface placed over two inches of base course or leveling course. This will be placed over classified fill which overlies a geotextile fabric placed at the bottom of the excavation. The underlying subgrade should be evaluated for competency as part of the design process.

Trail design, like that of highway design, requires an understanding of the soil conditions. A soils investigation should address the carrying capacities and frost classifications of the native soils and any special provisions necessary to construct the trail. While loads on trails will be considerably less than those for highways, paths should be designed to sustain wheel loads of emergency, maintenance, or other occasional vehicles traveling the path as well as the freeze/thaw characteristics of the soils. For most purposes, there is little difference in the subgrade design section of roadway and that of a trail.

Adequate edge support of the path's paved surface should be considered where vehicular traffic is anticipated as, typically, vehicle wheels will be at the edge of the pavement. A paved surface width of 10 feet reduces the stress on the pavement edge where vehicular traffic will travel the path. The extra width is also considered an advantage, allowing greater maneuvering room for faster trail users.

Where paved paths cross over unpaved driveways or roads, the unpaved driveway or road surface should be paved a minimum of 10 feet on each side of the trail crossing to reduce the amount of gravel being scattered on the path. These wide aprons should be designed with a structural base to prevent degradation of the asphalt surface.

As discussed earlier in Section 4.2 G Clearances, cottonwoods are problematic for trails. Because of the affinity of cottonwoods for damp, gravelly soils, efforts should be made to reduce the likelihood of cottonwood root intrusion into the trail fill prism. Where cottonwoods are prevalent, a trench immediately beside the fill material should be dug and a plastic, or metal membrane should be placed vertically from the ground surface to a depth of 18 inches to retard root growth. Where groundwater movement may be an issue, weed barrier fabric may be used instead.

4.2 O Bridges

Bridges should be designed to match the design vehicle weight and width requirements, recognizing maintenance requirements as well as user needs. Many trail locations are remote from the vehicular circulation grid, thus trail bridges must be used as access for maintenance, safety and service needs. Recognizing this, bridges should typically be designed for 12,000 lbs. design vehicle. An exception may be made where reasonable access from the street grid is available to both ends of a bridge. Bridges shall be signed as to the design load capacity.

AASHTO specifies that minimum pedestrian bridge railing height is 42 inches. However, bridges designed for bicycle traffic and or bridges where specific protection of bicyclists is deemed necessary, should be equipped with bicycle railings. The height of bicycle railings shall be not less than 54 inches, measured from top of riding surface.

If deemed necessary, rub-rails attached to the rail to prevent snagging should be deep enough to protect a wide range of bicycle handlebar heights.

4.2 P Amenities

Trails serve many purposes—transportation, recreation, education, and fitness maintenance. Also, trail corridors have clear identities in the minds of users and the trail should be designed to capture the character and to introduce character where appropriate. Recognizing the many aspects of trail use, it is appropriate to provide amenities that reflect the use that a trail will accommodate. Appropriate amenities include benches, waste receptacles, signage, interpretive materials, wooden signage pylons, bollards and "hardscape" such as specialized paving, walls, and structural elements.

1. Benches

Benches are an integral part of trail infrastructure and provide seating for rest and for lingering at scenic waysides and interpretive locations. They are particularly important to small children, older adults, and the disabled. They should be provided within individual trail increments or, where a trail is continuous for over one mile, at ½ mile increments at a minimum and more often when terrain is hilly. Crests of hills or midpoints at longer hills are appropriate locations for benches in order to mitigate prolonged slopes. Also, benches would be appropriate along trails where in the proximity of playgrounds, elementary schools, or elderly housing.

When provided, benches should meet the requirements of the Americans with Disabilities Act Accessibility Guidelines for Outdoor Developed Areas. Where one fixed bench is provided, the bench must comply with requirements for height, back support, and must have one armrest. Where multiple benches are located at a site, at least 50% of the benches must meet those provisions, and 50% of those shall provide an armrest. It is appropriate to provide users a choice of bench configurations to accommodate different needs.

Benches should be located to capture views and not impede pedestrian travel. This requires a dedicated space off of the trail with room for the bench and a sitting person's legs. The area should be level. For maintenance purposes, it is advisable to mount benches on a concrete pad or provide paving around and under the bench to include a paved surface in front of the bench.

2. Waste Receptacles

Waste receptacles should be provided at intervals where numbers of individuals are expected to congregate. Waste receptacles should not be provided without coordinating first with the appropriate property manager in order to ensure routine maintenance and upkeep will be performed. Where provided, waste receptacles should have a cover to prevent the accumulation of rain and snow in the trash compartment. Before specifying a type of waste receptacle, determine whether the owner or managing agency has a standard design that is preferred.

In some instances bear-proof trash receptacles are necessary. Designers should coordinate with the Parks Department and the Alaska Department of Fish and Game to determine whether bear-proof receptacles are necessary or recommended.

3. Educational Information

Interpretive information is appropriate at view locations, stream crossings, or other locations with remarkable attributes. Also, interpretive signage and visitor information is appropriate at trailheads.

Install interpretive structures such that the structure and the viewing public are separated from pathway traffic with a level viewing surface. Exhibits should be located a maximum height of 36 inches above the ground. Comfortable viewing area is 48 inches to 67 inches above the ground. A mounting height of 24 to 30 inches with a 30 to 45 degree inclination toward the viewer is a good design for most users.

For projects that include interpretive panels, a duplicate panel should be manufactured in addition to the original, and the copy provided to Parks Maintenance Division as a replacement should the original become damaged.

4. Other Considerations

Bollards should be provided at trailhead parking lots and street crossings. For multi-purpose trails, bollards should be located 5 feet on center. For most applications, bollards at the centerline and trail edge should suffice. In locations where only pedestrians are expected, bollards may be placed such that a 36-inch clear area is available.

Removable bollards should be provided at trailheads and crossings whenever bollards are required. This facilitates access by maintenance and emergency vehicles. Locks should be provided, keyed to Parks Department requirements.

Bicycle racks should be installed wherever bicyclists might be expected to dismount and continue by foot to another activity. This would include playgrounds, fishing docks, parks, trailheads, or where interpretive material is located.

Many trails have established "thematic elements" that should be replicated along the trail in order to provide a consistency in message and a unity to the trail. Designers should consult with the Parks Department in order to determine whether specific colors, details, or other design elements have been used consistently for completed portions of trails being designed. Designers should also review completed portions of trails being designed in order to determine whether a theme can be recognized from the existing improvements.

Color can be an important component in highlighting waysides. Designers should consider the use of pigmented concrete or specific highlighting of details to interject color where appropriate.

4.2 Q Trail-Roadway Intersections

AASHTO (1999) describes three basic pathway-roadway intersections where trail users must interact with motorists: mid-block, adjacent path, and complex.

1. Types of Crossings

a) Mid-block crossings: In general, mid-block crossings should be avoided. Drivers do not expect to see pedestrian or trail traffic crossing between intersections. However, where trail alignment, topographic features or other conditions require a mid-block crossing, they should be set far enough away from existing intersections to be clearly separate from the activity that occurs as motorists approach the intersection. Design considerations should include how motorists merge, accelerate and decelerate and prepare for entering turning lanes. Also consideration should be given to right-of-way assignment, traffic control devices, and sight distances for bicycles, as well as motorists, refuge islands, access control and pavement markings.

Mid-block crossings should be perpendicular to the roadway in order to assure good wayfinding and reduce crossing distance for pedestrians. In those instances where the crossing is skewed and right-of-way is not available to obtain a perpendicular crossing, less than a perpendicular crossing may be acceptable with concurrence of the Municipal Engineer. In no circumstance will an intersection of less than 45 degrees be acceptable.

Additional signage and pavement markings should be considered for mid-block crossings, e.g.:

- crosswalk markings
- crossing signs
- flashing beacon

or others as approved by the Municipal Traffic Engineer.

b) Adjacent Path Crossings: Adjacent path crossings occur when the bike path crosses a roadway at an existing

c) Intersection between two roads. This is the case with "T" intersections, full four-legged intersections, and also driveways. The pathway should cross close to the intersection so both motorist and path users have the opportunity to recognize each other and their respective intentions. Clear sight lines across corners at the intersection, as well as right-of-way assignment, traffic control devices and separation distances between the roadway and the pathway are all design issues when considering the adjacent path crossing.

d) Complex Intersection Crossings: Those path crossings that do not fall within the definition of either the mid-block crossing or the adjacent path crossing are considered complex crossings. Improvements to complex crossings must be made on a case- by-case basis. AASHTO (2004) suggests in each case the following options be considered:

- move the crossing,
- install a signal,
- change signalization timing, or
- provide a refuge island and make a two-step crossing for path users.

In all intersection cases where the trail crosses the road, assigning who has the right-of-way should not be based entirely on highway classification, volume and speed alone. Consideration should be given to the comfort and convenience level of the trail user, as well as the behavioral characteristics of both the motorist and the path user. Design should recognize the behavioral characteristics of the path user. Path users may have:

- a very low delay tolerance
- a strong desire to maintain momentum
- little traffic knowledge (particularly with children)
- an attitude of "regulations don't apply to me".

At complex intersections, a bike box /advanced stop bar should be provided to allow bicyclists to ride past motor vehicles and sit at the head of the queue, to the side of vehicular traffic. Where there are frequent right-hand turning motor vehicles, the bike box allows the cyclist to clear and not be cut off by overtaking and right-hand turning vehicles. The bike box should be a minimum of four feet wide, with a preferred width of five feet.

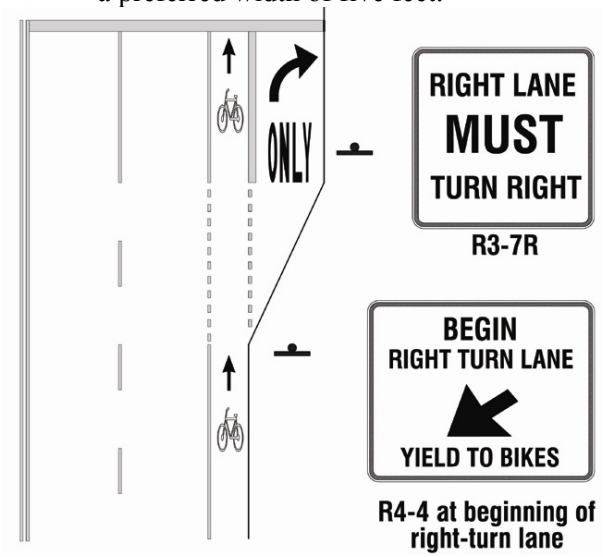

FIGURE 4-1 BIKE BOX AT INTERSECTION (AASHTO, 1999)

2. Traffic Signs/Stop Signs

AASHTO (1999) recommends that a regulatory traffic control device be installed on the pathway at all pathway-roadway intersections.

Path stop signs and stopping bars should be placed as close to the intersection as possible. The size, type, and location of stop sign should conform to the MUTCD. Care should be taken when placing both pathway stop signs and yield signs, as well as roadway signs so as not to confuse the motorist or the path user.

Transitions zones should be clearly labeled for both path users and motorists where trails terminate at an existing roadway. All intersections along the pathway should be considered by the designer as a potential entry/ exit point for the path user.

Technology exists for "bicycle-actuated" traffic controls. These may be warranted at locations other than intersection where bicycle volumes are high or the trail is a commuter route. Designers should refer to warrants within the MUTCD to consider the possibility of applying bicycle-actuated crossing devices.

3. Sight Distance

There are three main sight distance issues with pathway design:

- stopping sight distance,
- intersection sight distance, and
- decision sight distance.

There are two ways that the motorists' ability to notice path users can be improved. AASHTO (1999) suggests that increasing the standard sight perception-reaction time value of 2.5 seconds for motorists' stopping distance could potentially improve the sight distance for motorists approaching an intersection, where a path crossing exists. Selecting the most appropriate decision sight distance value from Table III-3 in AASHTO's Policy on Geometric Design of Highways and Streets (Green Book) could also improve the motorists' ability to notice path users, although the Green Book does not really address path crossings.

Decision sight distance for cyclists involves providing clear sight lines based on the distances that approaching motor vehicles will travel in the time it takes the cyclist to clear the intersection from a "stop-go" decision point. This concept acknowledges the cyclists' desire to maintain momentum.

4. Approach Treatments

Intersections and approaches of multi-use trails should be on flat grades. Stopping sight distances at intersections should be appropriately signed providing the cyclist adequate stopping time before reaching the intersection. AASHTO (1999) states that paved aprons extending a minimum of 10 feet from the edge of the paved road should be provided for unpaved multi-use trails.

5. Ramp Widths

Ramp Widths: Ramps for curbs at intersections should be at least the same width as the shared pathway. A smooth transition should be provided between the pathway and the roadway. AASHTO (1999) states that a 5 foot radius or flare should be provided to allow bicycles to make right-hand turns.

6. Refuge Islands

Refuge Islands: Refuge islands should be considered in design where one or more of the following apply:

- high volumes of traffic or excessive speeds make crossing conditions unacceptable for path users,
- roadway width is excessive given the available crossing time for path users,
- it is anticipated that the path users will be slower in crossing the intersection.

AASHTO (1999) suggests that the refuge area be designed large enough to accommodate groups of people, including wheelchairs, bicycles, strollers, and equestrians (where permitted). Adequate space should be provided so those within the refuge area do not feel threatened by passing vehicles while waiting to complete the crossing.

4.2 R Trail-Trail Intersections

Trail to trail intersections generally do not pose the same hazards as for trail-roadway intersections, but the possibility of conflict and injury still exists.

Treatment of trail to trail intersections should be much the same as trail to roadway intersections. Areas adjacent to the intersection trails should be cleared to provide adequate sight distance for the intersecting trails. The approaches should be on relatively flat grades. Warning signs should be provided. Also, a minimum five-foot radius

should be provided at the corners of the intersection to facilitate right turns.

Trail "roundabouts" should be considered for trail to trail intersections, particularly for trails that receive heavy use (greater than 1000 users per day). Roundabouts should include a minimum planted area with a 10-foot inside radius with a rolled curb. A five-foot radius should be provided between the pavement edge of the intersecting trail with that of the circle. The circle should be mounded, planted with a barrier plant that can thwart "cut-through" traffic. Wood bollards should be placed at the intersecting centerline of each intersecting trail. The trail around the roundabout should be a minimum of 10 feet wide, wider where higher levels of traffic are expected. The roundabout nodes are suitable locations for seating and rest areas, but such amenities should be placed such that users of the rest areas do not become impediments or hazards to bicycle traffic.

END OF SECTION 4.2

SECTION 4.3 DESIGN FOR MAINTENANCE

Trails and walkways parallel to roadways should be physically separated by a combination of distance, barrier, or elevation in order to reduce maintenance problems. Where the recommended horizontal distance cannot be achieved, a physical barrier (Refer to Section 4.2H Road Separation) should be placed between the trail and roadway so as to protect the trail from road splash, and reduce the amount of dirt and debris that comes onto the trail. Trail shoulders should be constructed of a porous material that will not wash out or be scattered onto hard surfaced trails. The shoulders should be maintained for walking or running and should not be allowed to settle below the elevation of the trail surface, which could cause bicycle tires to drop off the edge or a pedestrian to be injured.

All utilities, traffic control pedestals, hydrants, signs, and utility poles should be placed between the back of the curb and the trail. In no instance should they be placed within two feet of the edge of the paved edge of trail. (Refer to Section 4.2 G Clearances for further discussion).

Consideration should be given to the use of an impermeable surface such as textured concrete, where separation of trails from the back of curb is less than four feet. When unpaved, these areas, particularly along high capacity roadways such as Tudor Road, do not support vegetative cover and pose on-going maintenance problems for the trail and roadway. A textured surface can help warn users (especially young users) of the proximity of the roadway. Care should be exercised to ensure that the texture that is used does not direct trail users into the roadway, nor cause them to lose control of bicycles or roller blades.

Consideration should be given to the type of maintenance and emergency vehicles that will be maintaining trails. Bridges should be designed for a 12,000 lb. design vehicle, if access is not readily available to both sides of a bridge. This will provide access by maintenance vehicles and standard ambulances. Designers should recognize the setting of individual trails and consult with PM&E and Parks Department personnel on a case by case basis in order to determine whether bridges should be designed to accommodate vehicles exceeding a 12,000 pound design load.

Trails groomed for skiing should be designed to accommodate ski grooming equipment. For ski trails groomed for multiple uses or for skate skiing, a cleared, level tread (including trail, shoulders, and clear zone) needs be clear of all obstructions and be level enough to provide for grooming by a 17-foot wide grooming machine.

END OF SECTION 4.3

SECTION 4.4 SPECIFIC TRAILS

4.4 A Equestrian Trails

Like other trails, the design of an equestrian trail should be based upon a careful evaluation of the location of the planned trail. Equestrian trails should include provisions for protection of the adjoining resources, as well as the safety and enjoyment of the users, and consideration should be given to the volume and type of traffic, and economies of construction. The design should incorporate features that mitigate adverse impacts upon the environment and result in a trail of high quality that is permanent and inexpensive to maintain. Consideration should be given to surface treatment and overhead clearance.

4.4 B Commuter Bicycle Routes (On-Street Facilities)

Routes that serve only as major transportation routes, such as "C" Street north of 36th Avenue, should be considered as serving "commuter" bicycle traffic. Routes that are anticipated to include use by a number of novices, children, or people not comfortable riding in traffic situations should be considered as serving "local" users. The designer should design to the most restrictive criteria dependent on the anticipated user.

In most cases, the streets that require separated bike routes already use all the available right-of-way for the street section itself. Therefore, the costs of additional acquisition and impact on adjacent properties to create bike routes can be substantial. The design of these routes should carefully balance funding limitations with safety needs. When trail construction is associated with construction of a collector or higher classification street, assistance in determining appropriate design should be provided in the review process. The street and highway designs are reviewed and approved by the Planning and Zoning Commission because these streets are classified as "public facilities" (AMC 21.15.015). The designer should be prepared to present the pros and cons of various design options to the Commission.

The design of on-street bike routes is determined by the speed and volume of cars, as well as the type of user, whether it is a local user (typically a less adept cyclist) or a commuter who is comfortable traveling alongside moving vehicular traffic. Routes that serve only as major transportation routes, such as "C" Street north of 36th Avenue, should be considered as serving "commuter" traffic. Routes that are anticipated to include use by a number of novices, children, or people not comfortable riding in traffic situations should be considered as serving "local" users. The designer should design to the most restrictive criteria dependent on the anticipated user.

Design features that can make roadways more compatible to bicycle travel include bicycle-safe drainage grates and bridge expansion joints, improved railroad crossing, smooth pavements, adequate sight distances, and signal timing and detector systems that respond to bicycles. More costly shoulder improvements including paving over the gutter pan to make space for bicycles, or the addition of wide curb lanes can also be considered (AASHTO, 1999).

1. Types of Commuter Bicycle Facilities

Width of the area available for bicyclists is the most critical factor that influences the ability of a roadway to accommodate bicycle traffic. This can be accommodated by either wide outside lanes or paved shoulders. In general, AASHTO's recommendations for shoulder width recommended in *A Policy on Geometric Design of Highways and Streets* is the best guide for shoulder widths, since wider shoulders are recommended on heavily traveled and high speed roads and those carrying large numbers of trucks. Shoulders for use by bicyclists must be paved.

a) Paved Shoulders

For bicycle use on shared roadways, the shoulder of the road must be paved. The minimum shoulder width for bicycle use is 4 feet, though the provision of any shoulder in addition to the travel lane is an improvement over no shoulder at all.

The measurement of useable shoulder width should not include the gutter pan, unless the pan is 4 feet or greater. A minimum safe passage width of 5 feet is recommended from the face of guardrail, curb, or other roadside barrier. Rumble strips or raised pavement markers are not recommended where shoulders are to be used by bicycles (AASHTO, 1999).

b) Increased Lane Width

Where shoulders are not provided, extra wide curb lanes, wider than 12 feet can accommodate both bicycles and motor vehicles in the same lane. Generally, 14-foot wide curb lanes are recommended for multi-use travel ways. On grades of 5 percent or more, the curb lane should widen if possible (preferably 15 feet). Where wide curb lanes are provided, motorists will not have to change lanes to pass cyclists. Curb lanes greater than 14 feet may encourage two vehicles in the same lane, and therefore should not be common practice on flat stretches. With 15-foot wide climbing lanes, pavement striping may be advisable (AASHTO, 1999).

c) Bike Lanes

The use of bike lanes on roadways using lane markings provides for more predictable movements by both the cyclist and the motorist. Designated bike lanes can increase a cyclist's confidence in motorists not straying into their path. Likewise where delineated bike lanes exist, motorists are less likely to swerve out of their lane to avoid a cyclist (AASHTO, 1999).

Bike lanes should always carry the bike traffic in the same direction as the adjacent motor traffic. Two-way bike traffic on one side of the road where bicycle travel is traveling against the flow of traffic is not permitted, since it is one of the major causes of bicycle accidents.

At no time should cyclists be traveling in a direction opposite to the travel of the adjacent vehicular lane when the cyclist is on the street side of the curb. It is appropriate to stencil the pavement to provide an indication of the direction of travel, as well as to clearly denote the possible presence of bicycle travel for vehicle drivers.

Multi-use Lane Marking Arrow:
Pavement marking arrows provide an additional option for designers implementing bicycle facilities. Where shared lanes or wide curb lanes are to be used for bicycle facilities, the bicycle arrow should be used in addition to bicycle route signs, or share-the-road signs. Designers should ensure that all street graphics conform to the MUTCD in accordance with Alaska state law.

Bike lanes should be placed on the right-hand side of one-way streets. Two-way bike lanes and bike lanes on the left side of a one-way street should only be considered where a suitable separation between the motor vehicle and the cyclist is provided (AASHTO,1999).

2. Design of Shared Roadways

Follow are specific design guidelines for routes within roadway prisms.

a) On-street Parking

For streets with on-street parking, the most common bicycle riding location is the area between parked cars and moving vehicles. The biggest obstacles in this area include opening car doors, vehicles exiting parking spaces, extended mirrors and obscured views at intersections. While AASHTO (1999) recommends that a minimum 12 feet of combined bicycle travel and parking width for this type of multi-use, ATP (1997) states that under no circumstances shall a bike route be provided on the same side of the street as on-street parking.

b) Pavement Surface Quality

The travel surface for ones tract bike lanes should be smooth, free of debris, and uniform in width. Large cracks, or

joints, parallel to the direction of travel can trap a bicycle wheel and should be repaired promptly (AASHTO, 1999).

c) Drainage Inlets and Grates

Bicycle safe grates should be used on shared roads where bicyclists are encouraged to travel. These would be grates with openings oriented perpendicular to the path of bicycle travel. When road improvements are made, AASHTO (1999) recommends that curb opening inlets should be considered to minimize potential conflicts and obstructions. Grates and utility covers should be flush with the pavement surface. Bar grates with bars parallel with the travel way shall not be used, and should be replaced where possible.

d) Designing Sidewalks as Bikeways

The designation of sidewalks for bicycle travel is not permitted by Anchorage Municipal Code in business zones. Sidewalks should only be considered in limited situations where:

- Bicycle travel along high speed, or heavily traveled roadways is desired, but the roadway provides inadequate space for bicyclists and is uninterrupted by driveways or intersections for long segments.
- On long narrow bridges, in which case ramps should be provided.
- At intersections where provision of ramps for bicyclists and pedestrians should be combined so as not to confuse motorists as to where streams of traffic are crossing.

Curb ramps should always be provided where cyclists are directed from signed shared roadways to sidewalks. Curb ramps are necessary at every intersection, and bikeway yield signs and stop signs are necessary at controlled intersections. Curb ramps should extend the width of the sidewalk to accommodate adult tricycles and two-wheel bike trailers, ensuring that wheels of trailers do not catch the curb transition.

Sidewalks in residential streets are commonly used by children riding bikes. AASHTO (1999) suggests, however, that these areas are not appropriate for high-speed travel by cyclists and should not be signed as such.

e) Signing of Shared Roadways

Signed shared roadways are those roadways that have been identified as the preferred bike route. Signing suggests to the cyclist that the responsible agency has taken the necessary action to ensure the route is suitable for bicycles (AASHTO, 1999).

Bicycle-shared roadways should be signed as such. Destination signs also assist the cyclist with directions. In busy urban areas, signs should be placed approximately ¼ mile apart, at every turn, and at all signalized intersections (AASHTO, 1999).

Painted pavement markings should be used for multi-use or bicycle-shared roadways. This informs drivers that they are sharing the roadway and informs them that it is expected that bicyclists will use the roadway. This is particularly appropriate on those roadways where significant commuter traffic is expected within the curb lane, even though a separated trail may be available for slower traffic. It may also be appropriate in those roadways where no trail is available, thus both commuter and recreational traffic may be using the roadway.

END OF SECTION 4.4

SECTION 4.5 SELECTED REFERENCES

In addition to Title 21, designers of sidewalks, walkways, trails and bicycle routes should be familiar with the following:

AASHTO, *Guide for the Planning, Design, and Operational of Pedestrian Facilities,* Edition 1. 2004.

AASHTO LRPD Bridge Design Specifications, *Third Edition, 2004.*

AASHTO, *Policy on Geometric Design of Highways and Streets,* 2004.

AASHTO, Task Force on Geometric Design. *Guide for the Development of Bicycle Facilities,* 1999.

Alaska Department of Transportation and Public Facilities, *Pre-Construction Manual,* Chapter 12, Non Motorized Transportation, 2002.

Architectural and Transportation Barriers Compliance Board (ATBCB) and FHWA. *Revised Draft Guidelines for Accessible Public Rights-of-Way, November 23, 2005.*

Architectural and Transportation Barriers Compliance Board (ATBCB). *Building a True Community,* 2002.

Architectural and Transportation Barriers Compliance Board (ATBCB). R*ecommendations for Accessibility Guidelines: Recreational Facilities and Outdoor Developed Areas,. Federal Register,* September 3, 2002.

Architectural and Transportation Barriers Compliance Board (ATBCB). *The ADAAG Manual: A Guide to the Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities. Federal Register* July 23, 2004 and amended August 5, 2005.

Bicycle Federation of America. Burgess, B., Denny, C., Nozik, K., and B. Hunter, Authors. *Innovative Bicycle Improvements* (Draft). Publication No. FHWA-00-98-00, 1998.

FHWA, *Manual on Uniform Traffic Control Devices (MUTCD),* 2003, Revision 1, 2004.

Municipality of Anchorage (MOA). *Anchorage Areawide Trails Plan.* 1997.

Municipality of Anchorage (MOA). "Anchorage Areawide Trails Rehabilitation, Phase II Design Study Report." CRW Engineering and Golder Associates, 2003.

Rails-to-Trails Conservancy. *Trails for the Twenty-first Century: Planning, design, and Management Manual for Multi-use Trails.* Ed. Karen-Lee Ryan. Island Press. Washington D.C., 1993.

U.S. Department of Transportation, Federal Highway Administration (FHWA). *Designing Sidewalks and Trails for Access-Best Practices Guide.* Publication No. FHWA-EP_01-027 HEPH/8-01 (10M)E, 2001.

END OF SECTION 4.5