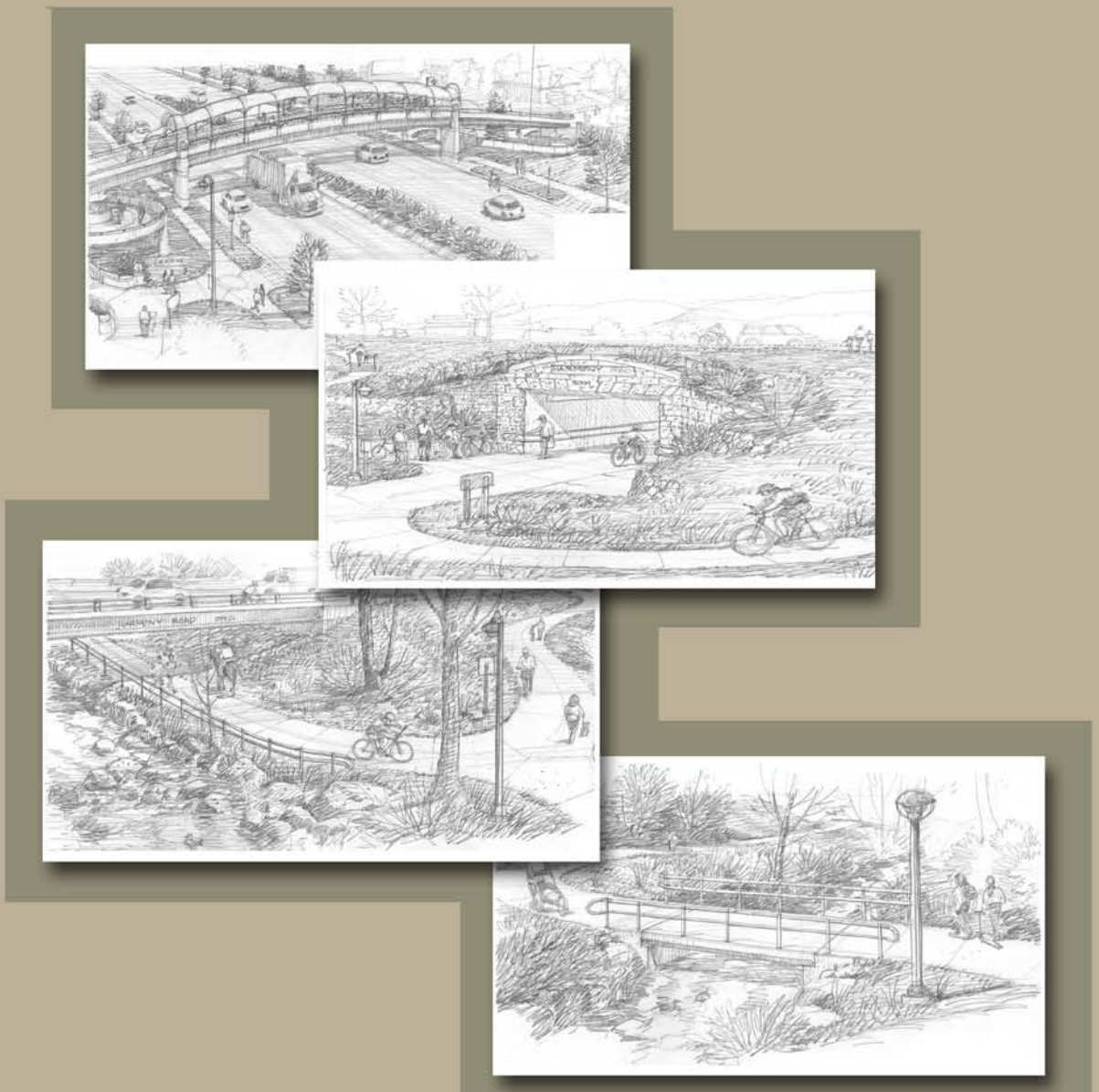
City of Fort Collins

Design Guidelines for Grade-Separated Pedestrian, Cyclist and Equestrian Structures



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I. INTRODUCTION

The City of Fort Collins is committed to designing and building our community transportation facilities to accommodate all modes of travel as well as to encourage the use of alternative modes such as walking and bicycling.

The objective of this *Design Guidelines for Grade-Separated Pedestrian, Cyclist and Equestrian Structures* manual is to establish design principles for grade-separated crossings in order to foster a more complete transportation network throughout the Fort Collins community.

Grade-separated crossings can help - if designed properly - to reduce conflicts among vehicles, cyclists and pedestrians along our City's roadways which often serve the community's highest concentrations of commercial, retail, and employment corridors. The high speed and/or volume of motor vehicle traffic creates safety hazards for cyclists and pedestrians who are trying to cross these roadways in order to travel to their employment destinations, residential areas, schools, adjacent transit stops, or near-by retail centers. Particularly as Fort Collins grows in population and travel demand, these types of grade-separated crossings will become more and more critical to balancing the needs of maximizing roadway operations with the need to provide convenient pedestrian/bicycle connectivity throughout a multimodal transportation system.

In addition to including design guidelines for grade-separated facilities either over or under roadways, this manual also addresses crossings of waterways, railroads, and other potential barriers and includes design considerations for equestrians as well as for cyclists and pedestrians.

This manual is not intended to prescribe where and when grade separated crossings must be provided. Instead, it provides a user-friendly format for evaluating design considerations and solutions when a grade-separated crossing is determined to be appropriate in terms of overall system design. It does offer suggestions in terms of conditions that may lead to the decision to incorporate a grade-separated crossing as part of the transportation system. Other resources such as the *Larimer County Urban Area Street Standards* and other national publications should also be consulted in determining the final design of a specific project.

I.1. When should a grade-separated structure be considered?

The construction of a grade-separated facility is not an endeavor to be taken lightly. When designed and constructed properly a grade-separated structure can become an attractive safety feature that can be used by all of a community's residents. Considering the effort and cost to design and construct such a structure, proper planning is essential to its success.

The City of Fort Collins does not consider the number of users as a factor in determining whether or not to build a grade-separated structure. Its philosophy, rather, is to provide an attractive and continuous transportation and recreational system for all levels of daily use.

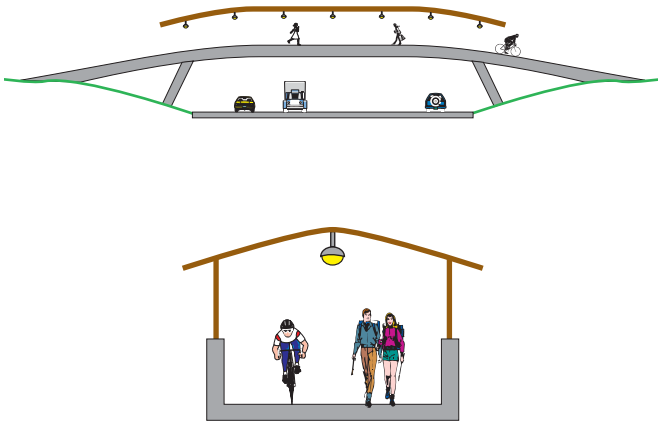
The following four situations are a sample of when a grade-separated structure should be considered:

1. Where pedestrian-oriented uses such as shopping centers, schools, recreational facilities or other activity centers are separated from pedestrian generators such as neighborhoods or employment centers by high-volume and/or high-speed streets.
2. Along designated bike/pedestrian trails or corridors that cross high-volume and/or high- speed streets where a grade-separated structure provides the best opportunity for system continuity and safety for all levels of pedestrian volume.
3. Along designated trails or corridors where a physical obstacle such as a railway or a river, stream or other drainage-way exists.
4. Where a structure would compliment a mass transit facility or is necessary to access a mass transit system.
5. Where a structure would improve cross-street traffic flow by eliminating at-grade pedestrian/cyclist crossings.

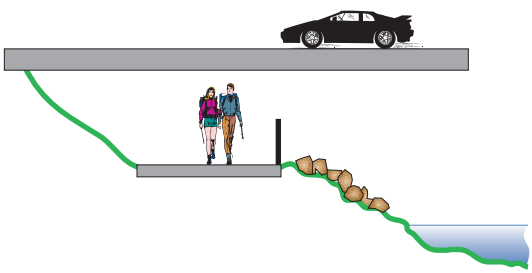
I.2. Structure Types

These guidelines concentrate on four fundamental types of grade-separated structures shown graphically on this page. They include:

1. An overpass over a roadway or railway; includes both elevated (when the roadway or railroad is at-grade) and at-grade structures (when the roadway or railroad is depressed below the natural ground surface).
2. A bridge over water routes such as rivers, streams, drainage-ways, typically with little or no elevation difference between the structure and natural ground.
3. A bridge underpass, typically adjacent a river, stream or other drainage-way.
4. An underpass under a roadway or railway by means of a box culvert.



1. Roadway/Railway Overpass



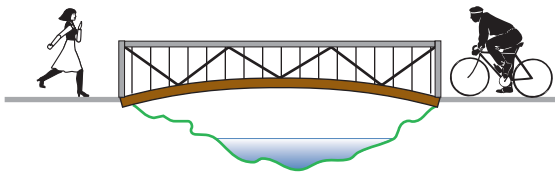
3. Bridge Underpass

The type of structure to be used at any given location shall be discussed with City of Fort Collins staff before the design of such a structure begins.

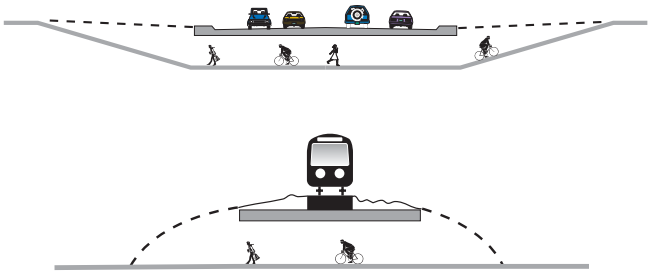
I.3. Where should a grade-separated structure be placed?

The physical location of a grade-separated structure is also important. An improperly placed structure may not achieve its full usage. The location of grade-separated structures should consider the following factors when determining the exact placement of a structure:

1. Provide system continuity along the normal path of pedestrian, cyclist and equestrian movements.
2. Located to minimize out-of-direction travel.
3. Where any extra effort or time required to use the facility would not hinder its use.
4. Logical geographical sites such as fill or cut areas along roadways, railways or waterways.
5. Where it would minimize the impact to cross-street traffic.



2. Bridge Over Water Routes



4. Roadway/Railway Underpass

II. DESIGN CRITERIA

The design characteristics of a grade-separated structure must take into account numerous factors such as the type of obstacle that is being crossed, the surrounding land topography, the location of nearby drainage features, the length of the structure, visual impact, and maintenance and constructability to name a few. The following information serves as a guide to providing not only a safe and attractive facility, but also to strive for a level of structure consistency throughout the City.

II.1. Structure Height

It is critical to assure that the height of a grade-separated structure adequately meets specified dimensions for clearance so that pedestrians, cyclists, equestrians, and maintenance or emergency vehicles can safely use the facility. Dimensions are measured from the walking surface to the overhead obstruction.

Overpass or underpass used by pedestrians and cyclists—10 feet desirable, 8 feet minimum.

Overpass or underpass also used by equestrians—12 feet desirable, 10 feet minimum.

Overpass or underpass also used by emergency vehicles—13'-6". This dimension is required for structures where vehicle access cannot be provided to both sides of the structure from a cross street, trail or other access facility due to physical or topographical constraints. Project-specific design must be coordinated with the Poudre Fire Authority.

II.2. Structure Clearance

For overpasses that cross over a roadway or railway, the following clearance distances shall be provided along the entire length of the structure between the bottom of the structure and the roadway or railway surface:

Clearance between bottom or low chord of pedestrian structure and roadway—17'-6" minimum on state highways. On other city roadways, consult the *Larimer County Urban Area Street Standards.*

Clearance between bottom or low chord of pedestrian structure and railway tracks—23'-6" minimum.

For bridges over water routes, adequate clearance should be provided between the bottom of the structure and the normal water level to minimize the impact of minor flood occurrences. Bridges must be constructed out of the 100-year floodplain, or breakaway bridges and railings must be constructed in accordance with the City's Stormwater Utility regulations.

For a box culvert-type underpass, the minimum cover from the roadway pavement surface to the top of the box culvert shall be structurally verified to assure that vehicle loadings on the top of the underpass do not diminish the structural integrity of the underpass.

II.3. Structure Width

The width of a structure is as important as the structure height. A structure that is too narrow can be perceived as unsafe or simply not an inviting or pleasing facility that residents would want to use. The minimum dimensions identified below must be provided between any obstructions such as handrails, lighting, barriers, drainage facilities or artwork.

1. Entering path/trail/sidewalk width (minimum of 10 feet) plus 2 feet clear obstruction and drainage distance on each side; total of 14 feet.
2. For underpasses greater than 80 feet in length, refer to Table 1 for the minimum structure width.
3. For structures that include drainage facilities, (other than drainage pans as shown in Section II.14), the width of the drainage facility shall be in addition to the width dimensions noted in Table 1.
4. For structures that will accommodate equestrian usage, the width of the equestrian path, typically 6 feet, shall be in addition to the width dimensions noted in Table 1.
5. For structures over roadways or railways, the desirable structure width shall be 12 feet with a minimum width of 10 feet.
6. For structures that will accommodate emergency vehicles, the minimum width will typically be 20 feet. The Poudre Fire Authority shall be consulted on a project by project basis to determine structure width and surface material requirements when emergency access is necessary.
7. For structures that will accommodate wildlife movements, the width for wildlife movements shall be in addition to the width dimensions noted in Table 1. A biologist shall be consulted to identify expected wildlife types and determine additional structure width.

Table 1
Minimum Underpass Structure Width

Structure Length	Minimum Structure Width	Comments
<80 feet	14 feet	Includes 2 feet on each side of the structure for drainage pans and/or amenity (such as handrails, rubrails) clearance. For structures of 80 feet or greater in length, skylights shall be provided in the roadway median if a median is available.
80 feet to <110 feet	16 feet	
110 feet to <150 feet	18 feet	
150 feet to <200 feet	20 feet	For structures >150 feet in length, and where there is a median of sufficient width, two separate structures should be used to provide an opening of natural light. If two separate structures cannot be provided, skylights placed in a median, if available, shall be required.
>200 feet	22 feet	

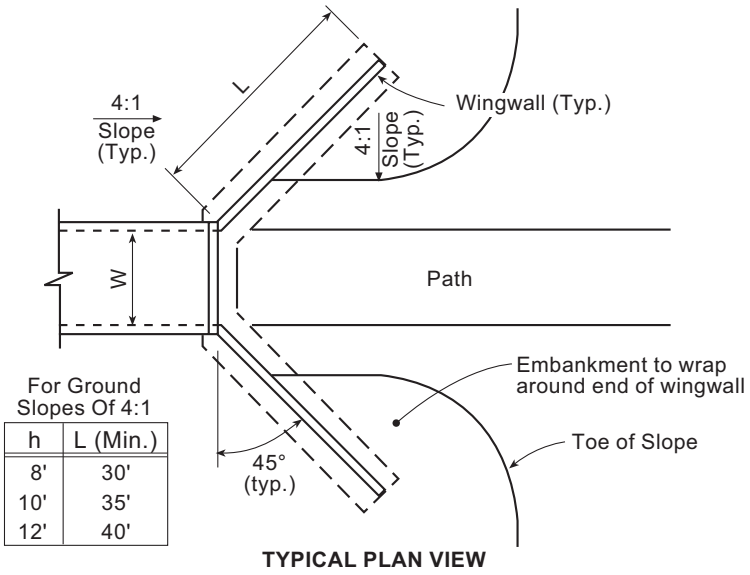
II.4. Box Culvert-Type Underpass Entrance Design

The design of the entrance to a box culvert-type underpass is critical to the user comfort level of the facility. How the wing-walls are constructed to visually minimize the "tunnel" effect can be the difference between a well-used and avoided facility. Following are a few guidelines for entrance treatments.

Wing-Walls

The intent of wing-walls is to retain the adjacent fill or natural ground. The typical design approach may not be the only acceptable design, however. The designer should consult with City staff regarding the proposed design at the initial stage of design preparation.

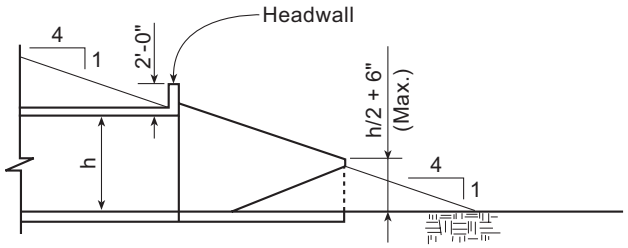
1. Wing-walls shall typically be constructed at a 45 degree angle measured from the face of the structure.
2. Wing-walls shall extend six inches above the adjacent ground slope.
3. The length of the wing-wall is dependent upon the height of the structure and the adjacent ground slope.
4. The roadway fill slope behind the wing-wall typically shall be 4:1.
5. Construct wing-wall faces to be inviting to users.



For Ground Slopes Of 4:1

h	L (Min.)
8'	30'
10'	35'
12'	40'

TYPICAL PLAN VIEW

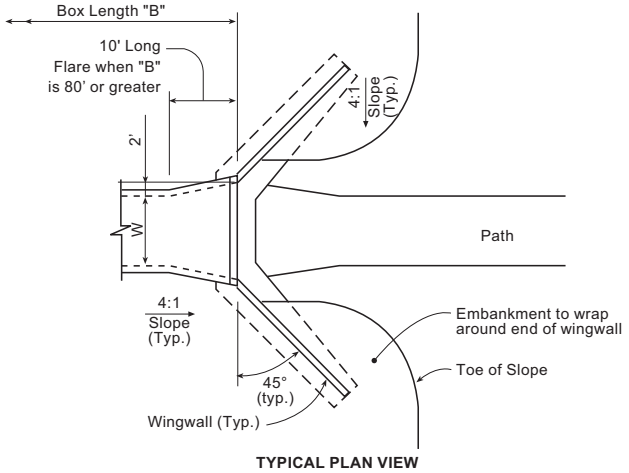


TYPICAL LONGITUDINAL SECTION

Typical Wing-Wall Design

Entrance Flare

For structures of 80 feet or greater in length, the first ten feet at both ends of the structure shall be flared an additional 2 feet on each side of the structure to reduce the effect of "tunneling" by inducing deeper daylight penetration.



TYPICAL PLAN VIEW

Entrance Flare Treatment

II.5 Roadway/Railway Overpass Covering

Overpasses that cross roadways, railways, or major drainage-ways should be covered to limit snow, ice, or water buildup on the walking surface. The covering shall be of a solid material and be integral to the structural components of the overpass design. In addition to protection from weather elements, a covering can also provide a location for the attachment of lighting facilities to create a more attractive environment and enhance safety.

II.6. Grade

The longitudinal grade of any structure, or any ramp or path accessing a structure, shall be 5% (20:1 ratio) or less. If physical constraints restrict achieving a 5% grade, a maximum of 8.33% (12:1 ratio) is permitted; however, grades greater than 5% require landings in the structure as follows:

- >5.00% (20:1 ratio) to 6.25% (16:1 ratio) = landing every 40 feet
- >6.25% (16:1 ratio) to 8.33% (12:1 ratio) = landing every 30 feet

The size of a landing shall be 5 feet long for the entire width of the ramp/path. If there is a change of direction in the ramp/path at a landing location, the minimum landing dimension shall be 5 feet by 5 feet[1].

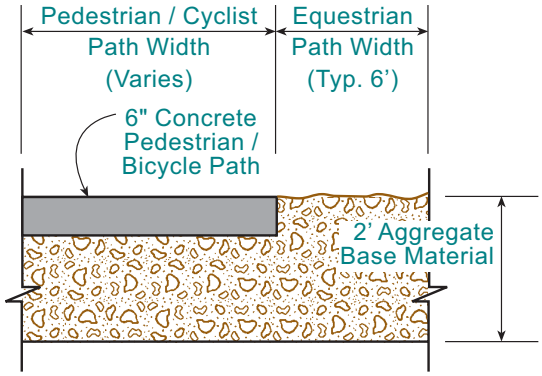
II.7. Cross-Slope

The design of cross-slopes for any structure shall be the responsibility of the structure engineer with the objective being to reduce flat areas where water or debris could accumulate. The typical cross-slope for entrance/exit paths shall be 2%. The minimum cross-slope in a box culvert-type underpass shall be 1%.

II.8. Surface Treatment

These guidelines do not strictly specify the type of material to be used for the construction of grade-separated crossings; however, since a design life of 50 years for overpasses and bridges, and 100 years for underpasses[2] must be provided, it is likely that a concrete surface will be the most common choice. A wooden walking surface is discouraged given its relatively shorter life span and greater ease of destruction and/or vandalism. It is imperative that the pavement surface be smooth and devoid of irregularities that could affect the comfort and safety of pedestrians and cyclists. In underpasses where there is a likelihood of flooding, the surface shall be concrete and provided with a texture to resist slipping.

For facilities that accommodate pedestrians, cyclists and equestrians, a separate riding/walking surface for equestrians is necessary. For these structures, aggregate base material shall be used for the equestrian surface. The structure shall be designed so that this material remains within the structure boundaries and does not wash away or extend along the walking and riding surface for pedestrians and cyclists. If possible, a rider dismount area should be provided near structure entrances.



Surface Treatment for Equestrian Usage

II.9. Entrance/Exit Radii

At structure locations where the entrance/exit to a facility will require a curved path or ramp, the radius information of Table 2 shall apply.

When curve radii smaller than those shown in Table 2 must be used due to limited right-of-way, topographical features or other considerations, standard curve warning signs and supplemental pavement markings shall be installed in accordance with the *Manual On Uniform Traffic Control Devices* (MUTCD).[3] Other accommodations shall be made to facilitate safe movements. One method would be to widen the trail at sharp curves.

II.10 Approach Alignment

Approaches to each structure type shall have a minimum of 20 feet of straight trail alignment before accessing the structure.

II.11. Sight Distance Requirements

Stopping Sight Distance

The minimum stopping sight distance necessary to provide adequate reaction time to avoid unforeseen circumstances shall be per AASHTO[4] requirements. These data provide the minimum stopping sight distance for a cyclist to come to a full controlled stop for varying design speeds and grades.

Landscape/Obstruction Restrictions

Landscaping and/or other obstructions that could restrict user visibility will not be permitted. Low-type ground covers are encouraged within user sight lines.

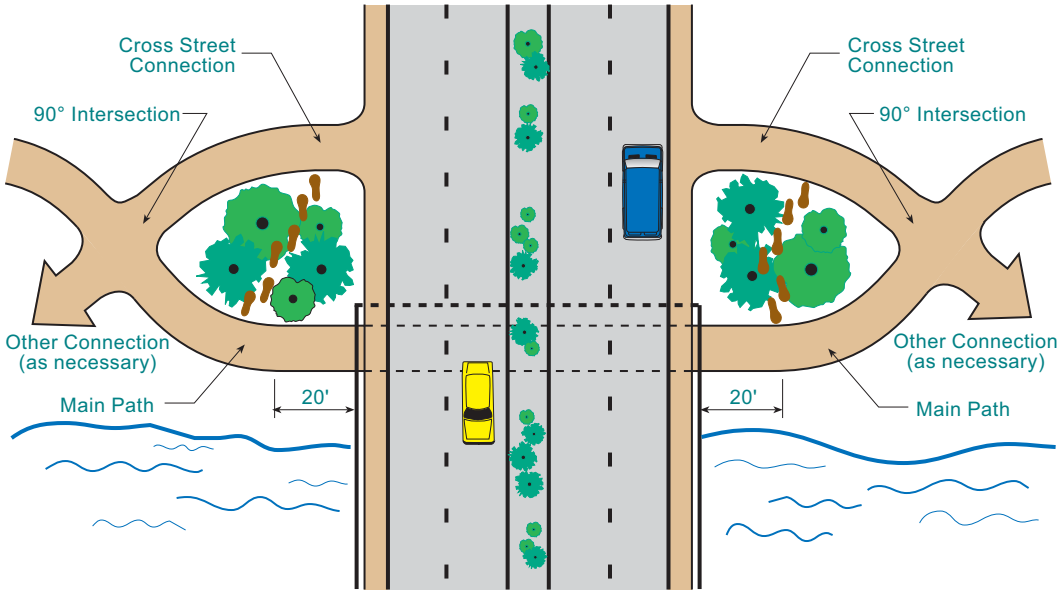
Table 2
Minimum Centerline Entrance/Exit Radii

15° Cyclist Lean Angle		2% Superelevation Rate and 20° Cyclist Lean Angle		
Design Speed (mph)	Minimum Radius (feet)	Design Speed (mph)	Friction Factor	Minimum Radius (feet)
12	36	12	0.31	30
20	100	20	0.28	90
25	150	20	0.25	155
30	225	30	0.21	260

Source: *guide for the development of bicycle facilities,* AASHTO, 1999.

II.12. Cross Street Accessibility

At all structure locations, a path must be provided on each side of the intersection of the roadway and the structure for accessibility between the roadway and the structure. These paths must meet the grade criteria established in Section II.6. The intent of these connections is to provide direct and convenient access to/from the cross street. Informal walking paths/steps should be provided to serve cut-through pedestrian traffic in landscape or grass areas.



Typical Cross Street Accessibility Design

II.13. Lighting

Lighting provides a welcome dusk and nighttime atmosphere where structure entrances/exits, destination points and features are highlighted. Traveled pathways can also be lighted to provide guidance. The basic objectives of lighting include:

- Safety and security
- Aesthetic image
- Nighttime visibility and function
- Environmental sensitivity

Safety and Security

Safety involves providing light on hazards so that they can be detected with sufficient reaction time. The lighting system, along with other site design elements, must provide visual information to assist users in avoiding collisions or a loss of bearings.

Security is often referred to as the perception of safety. Providing for security involves lighting potentially hazardous locations and situations. Lighting can also act as a crime deterrent by increasing the visibility in an area of concern.

Nighttime Visibility and Function (Lighting Quality not Quantity)

Too often, lighting quantity or lighting levels are used for design instead of lighting quality. Lighting quality involves contrast, brightness adaptation, glare and light source color. Increasing contrast will increase visibility. An example of poor contrast would be a person in dark clothing against a dark wall. If the wall is lighted, objects are easier to see.

Eyes adjust to the brightest object in the field of view. This adjustment is referred to as brightness adaptation. If an object is very bright, like uncontrolled light from a floodlight, everything else in the immediate surrounding area appears relatively dark, making it harder to detect object details.

Glare is usually caused by uncontrolled light emitted from unshielded luminaires. An example of this is unshielded wall pack fixtures or floodlights located on a wall. These situations can be easily avoided with proper equipment selection, location, aiming and shielding. Light sources and luminaries on overpasses shall not be so bright that the brightness causes a hazard to motorists driving below.

Light Sources

Light source color is another key to low light level visibility. Night vision is very sensitive to short wavelength light (blue and green light), resulting in crisp and clear vision, especially in peripheral vision. Reaction time and color recognition under low light levels is far superior with white light sources like metal halide, fluorescent, and induction lamps.

Environmental Sensitivity

Environmental sensitivity includes minimizing light trespass and lighting pollution, and using minimal energy through lighting equipment selection and operation. Recommended practice "Lighting for Exterior Environments"[5] shall be used as criteria to limit light pollution and light trespass.

Light trespass is sometimes referred to as the "light shining in my window" syndrome. Usual culprits are unshielded floodlights, high wattage pedestrian lights, wall packs and other unshielded luminaires that are improperly located and poorly aimed. Light trespass can be minimized with careful equipment selection, proper location, and proper aiming and shielding. Light trespass shall be minimized to the extent possible.

Light pollution is uncontrolled light that travels into the atmosphere. This light is wasted energy and creates a "sky glow". Unshielded luminaires and excessively high lighting levels cause light pollution. High wattage luminaires with poor visual shielding will not be permitted. Excessive light levels with high amounts of reflected light will not be permitted. Use low wattage, shielded luminaires that are properly located and aimed.

Luminaire Selections

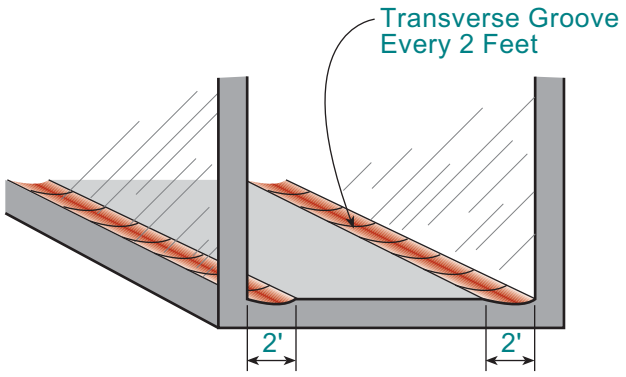
Underpass and overpass lighting should enhance the design theme of the structures. Luminaire selections should not only be based on photometric performance, but also on the aesthetic character appropriate for the design. All luminaires shall be vandal resistant, UL listed for wet locations, and meet Americans with Disabilities Act (ADA)[1] requirements. The type, style, color and location of luminaires shall be consulted with the City of Fort Collins for approval.

II.14. Drainage

Drainage facilities should be placed along the edges of the trail/path and out of the way of the main pedestrian/cyclist usable surface. Any drainage facility that must be in or along the usable surface must have a smooth, flat surface (in the case of a manhole) or inlet grates that are transverse to the trail/path direction. Careful consideration should be given to intercept groundwater at underpass entrances to prevent trail surface water from entering the structure and freezing during cold weather.

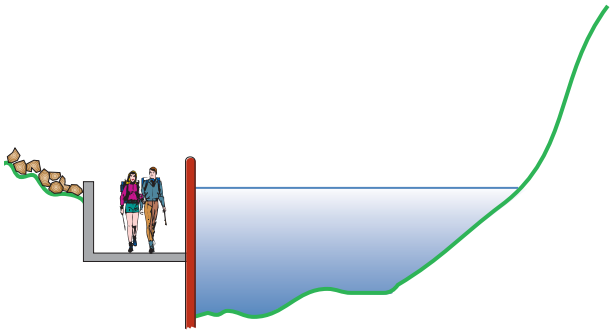
Each box culvert-type underpass shall be provided with drainage pans longitudinally along the entire length of the structure. The drainage pans shall be constructed of colored concrete to differentiate between the

drainage facility and the main travel path. The drainage pans shall also be provided with a transverse groove every 2 feet along the structure length to provide warning to errant cyclists similar to the design of a rumble-strip along a highway.



Drainage Pan Design

In some cases, the trail system may need to be lower than an adjacent creek, river or drainageway. The design of such facilities must be able to restrict normal water flow from encroaching onto the trail system.



Path Below Water Elevation

II.15. Structure Design Loadings

Typically, overpass structures shall be designed to accommodate a live load of 85 pounds per square foot. The design for each structure should be checked, however, to assure that an 85 pound per square foot live load is adequate for emergency or maintenance vehicle loadings.

For other design loadings for overpass and underpass structures, the engineer should refer to the following:

- "Guide Specifications for Design of Pedestrian Bridges"[6]
- "Larimer County Urban Area Street Standards"[2]
- "AASHTO Specifications for Highway Bridges"[7]
- "Colorado Department of Transportation Bridge Design Manual"[8]

II.16. Protective Barriers

Location

Railing, walls or other types of barriers shall be placed at locations where pedestrians, cyclists or equestrians require protection from obstacles; locations such as:

- Along the wing-walls and top of a box culvert type underpass,
- On underpasses between the walking surface and adjacent drainage facilities or other water features, and/or
- On overpasses to reduce the potential for objects falling from the overpass onto vehicles, trains or other users on the roadway, sidewalk or railway surface below the structure.

These barriers must be designed with care to ensure aesthetic compatibility with the surrounding area and to minimize visual impact.

Barrier Height

A 54 inch barrier height shall be provided along the entire length of the obstacle with a bicycle rub rail attached at a height of 42 inches.

II.17. Handrails

Handrails to assist in public access along structures shall be provided when the structure, entering trail facility or cross-street accessibility path, has a longitudinal grade greater than 5 percent. Handrails are required only along one side of the structure, entering trail facility or cross-street accessibility path.

Height
The height of handrails shall be 34-38 inches above the structure, trail or path walking surface.

Design
The design of handrails and their installation shall meet ADA requirements as documented in Figure 39, *Size and Spacing of Handrails and Grab Bars, Section 4.26 of the Code of Federal Regulations, 28 CFR Part 36, Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities* by the Department of Justice.

II.18. Stairs
Stairs for structure accessibility are discouraged. It is recognized, however, that certain locations with physical or topographical constraints may limit the construction of accessible routes to a grade-separated structure with appropriate grades as documented in Section II.6. Stairs may be provided only if an adequate and reasonable access per ADA requirements to both sides of the overpass or underpass structure can be provided.

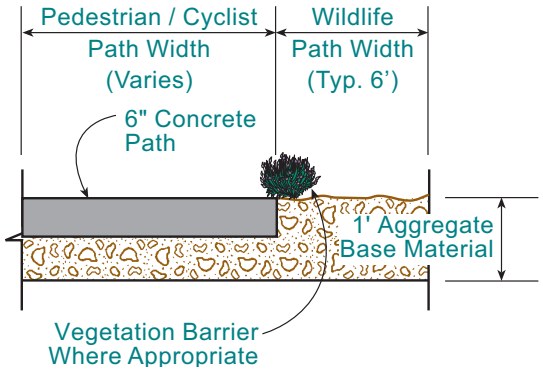
II.19. Elevators
The need for an elevator at a grade-separated structure shall be decided on a project-by-project basis. Typically, elevators should not be designed for a facility if adequate grades can be provided for ramp construction. If the physical constraints of a structure location necessitates that the grade criteria of Section II.6 cannot be met, an elevator shall be provided.

II.20. Signing/Striping
Signing Guidelines
The installation of any warning, regulatory or other types of signs at structure locations or on structure approaches shall be per the MUTCD.

Striping Guidelines
Each approach to each structure shall have a painted yellow centerline for approximately 100 feet in advance of the structure entrance. All curves with restricted sight distances are required to be painted with a yellow centerline to separate traffic. The centerline shall be 4 inches in width.

Way-Finding Signing
At junctions of main trails and cross-street access routes, signing shall be placed to direct users to the appropriate side of the cross-street for the direction in which they wish to proceed.

II.21. Wildlife Movement
If an underpass is constructed where there is a likelihood that the underpass could also serve as a wildlife movement corridor, the designer should consult with a biologist to understand what species may use the underpass, in addition to humans, that could influence the structure design. Such factors as the openness of the structure, the presence of a natural or dirt floor, vegetation within the structure, wall color, and the absence of artificial lighting must be evaluated as part of the structure design. An artificial vegetation barrier could be used where natural light is not sufficient to grow living vegetation.



Surface Treatment for Typical Wildlife Movement

II.22. Bird Nesting Treatments
Structures shall be designed so that birds do not nest in these facilities. A typical treatment for an underpass would be to have angled top corners at 45 degrees.

III. AESTHETIC APPEARANCE

The aesthetic qualities of a grade-separated structure are as important as the specific design criteria. For example, a structure may be constructed to the exact criteria set forth in Section II; however, if the structure is not attractive, its use will be diminished. Therefore, the provision for landscaping, wall treatments, artwork and other features will be given equal consideration during the design process as would structure width and height, grade or sight distance.

Much of the success of these types of trail connections has to do with the perceptions of the trail users. Some of these perceptions, as in the case of narrow underpasses, can be safety related. These guidelines are intended to create a more positive response from all trail users. Perhaps less critical, but none-the-less important, is if these structures are perceived as foreboding features or, in a more positive light, a sort of gateway to new neighborhoods. If attention is paid to a number of aesthetic details, these perceptions can be positive and contribute to the overall success and connectivity of the surrounding communities.

All of the overpass and underpass features can be described as being nodes of activity for the surrounding communities. They are cross roads where connections to other trail networks and neighborhoods/ activity centers are made. These structures are public in nature and are worthy of some of the planning and refinement that are provided for the community's parks and streetscapes. Some aesthetic considerations may include:

- Structures like bridge girders, abutments, wingwalls, and retaining walls must have texture and color treatments. There may be a corridor theme of materials that is appropriate. Coarse wall textures may also help deter graffiti potential. The use of native materials like stone may also be appropriate for retaining walls and stream channel improvements.

- Look for "park" opportunities near these areas. While most commuter trail users have more practical considerations, recreation trail users welcome the opportunity to stop for a break and take in a view of a stream or landscape. Intersections near bridges and underpasses are often good locations for this type of activity. Additional width of trail, a pull-off area, benches, or shade from a tree, are some features worth considering.

- Tree and shrub planting, and associated landscape elements, particularly if in an urban park area, are important aesthetic considerations.

III.1. Landscaping

While some trails are utilitarian in nature and confined to available right-of-way space, many pass through community open-space corridors. Whether they are protected open-space natural areas or city parks, both deserve a collaborative effort of civil engineering and landscape architecture disciplines for the best results. Park planning begins with carefully planned and designed "hard" features like structures, drainageways and paved trails which are designed to best compliment the park or open space resources.

The next step becomes to give the trail side "soft" area, or landscape area, the appropriate refinement. This may include careful grading of cut and fill slopes so that they are both attractive and easy to maintain, and the planting of trees, shrubs and appropriate grasses. In an urban area this may include irrigation systems and extensive vegetation or reestablishment of stream channel habitat. In the dryer Colorado climate, new tree and shrub plantings require supplemental irrigation water which is often not available in remote natural areas. For these reasons, tree and shrub plantings in these areas is more difficult unless it is a wetland in nature and depends on natural pre-existing soil moisture conditions. The choice of landscape materials shall utilize Xeriscaping techniques and native plantings that have low water demands.

All new tree and shrub plantings should be located with ample clearance from the paved trail surface. Tree clearance over trail surfaces or within sight lines

is a safety issue much like street trees in an urban sidewalk situation. Likewise, materials associated with a landscape such as boulders and cobble or wood fences should not be placed in such a way to present any visual or physical obstruction to trail traffic or sight lines. Landscape irrigation, if utilized, should avoid spraying onto the trail surface.

Landscaping shall be provided along structure approaches. The designer shall take creative license to develop plans that are both functional and beautiful. Low, groundcover-type vegetation that helps prevent slope erosion as well as shrubs to discourage "short-cutting" is encouraged. The only restrictions are:

1. Landscaping materials shall not interfere with the minimum sight distance requirements of the structure.
2. Landscaping design and/or materials shall include precautions to prohibit small rocks, bark or other materials from progressing onto the traveled pathway or into the structure.
3. Landscaping shall not encroach upon the trail that may constrain circulation such as tree branch height or vegetation overhang.

The designer of a structure shall employ the services of a registered landscape architect to develop landscape plans for the project.

III.2. Wall Treatments

Interior

Interior concrete walls of underpasses shall be provided with a light colored matte finish to promote a light reflectivity of 60% or greater. The finish can be a combination of paint coating, concrete stain or texture coating. The preferred finish is a paint coating or concrete stain since these finishes can also be applied with a graffiti-resistant coating.

Exterior

1. Exterior walls along underpass entrances or along overpass abutments shall be lined with an aesthetically pleasing treatment such as rock or trailing vegetation.
2. Exterior steel surfaces on overpasses shall be finished with a combination primer/urethane or primer/acrylic coating. A graffiti-resistant coating shall be applied to all exterior concrete and steel surfaces.

Color

All painted or stained concrete or steel surfaces shall be finished in light, natural neutral tones. Some of the accepted federal color standards are shown in Table 3. The designer shall consult with the City's Project Manager to finalize color selection(s) and additional options for accent colors.

Table 3
Acceptable Finish Colors

Federal Table No.	Federal Color No.
II	31643
II	31667
III	32630
III	32648
IV	33613
IV	33690
VII	36628
VIII	37722
VIII	37769
VIII	37778
VIII	37855
VIII	37875
VIII	37886
VIII	37925

III.3. Rest Benches

Each entry/exit area of an overpass or underpass shall be equipped with a rest bench or seating area. The bench shall be incorporated into the landscaping/streetscape amenities to the extent possible. The rest benches shall be located away from the structure entrances and exits and be located in such a manner that they do not encourage stopping in the

middle of the structure approach and at, or near, path intersections.

III.4. Artwork

Artwork shall be an integral part of any structure and reflect the character of the surrounding area. Refer to Photo Examples of Guideline Intent section of this report found on pages 22-26.

III.5. Street Name, Construction Date and Clearance References

All overpasses and underpasses shall have the cross-street name, construction date and smallest structure clearance height inscribed into the overhead portion of the structure. This information must be a physical part of the structure, not by a painting or embossing method. The shortest structure clearance shall be placed at the point of shortest clearance. The minimum letter height shall be 6". Lettering font and materials can be determined on a project by project basis.

Typical Structure Reference Information

III.6. Vandalism Deterrents

Each overpass and underpass structure shall be designed to reduce the potential for vandalism to the extent possible. Such strategies may include:

- Limiting the number of structure materials that could be removed
- Install vandal-resistant luminaries
- Hanging/clinging vegetation

In each case, all exposed concrete and steel surfaces shall be provided with an anti-graffiti coating.

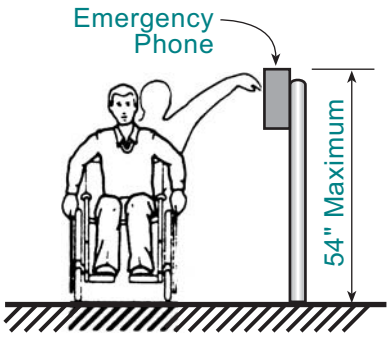
IV. SECURITY

IV.1. Lighting

Interior and exterior lighting shall be designed per the guidelines of Section II.13. Lighting shall be designed to create a pleasant environment while also providing sufficient security so that the facility continues to be used at night.

IV.2. Emergency Phone

An emergency phone shall be placed at one end of each structure (excluding trail bridges over water routes). The phone shall have a direct connection to the local 911 operator for reporting of emergencies. The top mounting height of the highest mechanical part of the phone shall be mounting a maximum of 54 inches from the ground surface[1].



Emergency Phone Mounting

IV.3. Vehicle Restriction

Overpasses and underpasses shall be designed so that maintenance or emergency vehicle can reach either entrance of the structure. Barriers, bollards or other types of restrictive devices that could cause a hazard for pedestrians, cyclists or equestrians, or be a barrier to emergency access shall not be placed at or near structure entrances.

V. CONSTRUCTABILITY ISSUES

The construction of an overpass or underpass must always be conducted in a safe manner and with a minimal disruption of existing vehicle, train, bike and pedestrian traffic. Traffic control plans must be submitted to the City of Fort Collins before permitting to assure the City that accessibility of all users is not disrupted to any great extent during the construction of these facilities.

The designer and contractor must identify and address issues that could impact the constructability of these structures such as:

- The location of overhead and underground utilities
- Traffic control, including the necessary road closures or detours
- Train schedules
- Water (surface and groundwater) control

VI. MAINTENANCE AND OPERATION

Maintenance and operation responsibility for new overpass and underpass structures will be determined during the site/subdivision plan approval process and in all cases, prior to construction. Public access easements shall be conveyed to the City of Fort Collins. The routine maintenance of these structures is necessary to provide a good walking/riding surface for users. Overpass and underpass structures should always be kept clean of debris such as rocks, glass, sand, litter, or landscape materials. Some strategies to reduce maintenance costs include:

- Structures shall be designed to have a natural draining surface to reduce the buildup of water and/or ice.
- Incorporate areas into the design for the storage and removal of snow and sediment.
- Use concrete trails and other washable architecture techniques on underpasses to reduce the potential damage from flooding.
- Use an anti-graffiti protective coating on all concrete and steel surfaces.
- Use vandal-resistant lighting.
- Use high-quality paint to reduce re-painting intervals.
- Use graffiti-resistant coating on all painted surfaces.
- Keep the growth of trees, shrubs and other vegetation controlled to reduce pavement damage and to provide adequate clearances and sight distance.
- Trash receptacles should be placed and maintained at convenient locations.
- Seeded and sodded areas in the vicinity of these structures should be mowed regularly.
- Inspect signs and pavement markings regularly and replace when necessary.

REFERENCES

1. *Americans with Disabilities Act*, 42 U.S.C. 12181, United States Department of Justice, Washington, DC, 1990.

2. *Larimer County Urban Area Street Standards*, Chapter 11, March 2001.

3. *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD), Federal Highway Administration, National Advisory Committee on Uniform Traffic Control Devices, Washington, DC, 1988.

4. *guide for the development of bicycle facilities*, American Association of State Highway and Transportation Officials, Washington, DC, 1999.

5. RP-33-99 *Lighting for Exterior Environments,* Illuminating Engineering Society of North America, New York, NY, 1999.

6. *Guide Specifications for Design of Pedestrian Bridges*, American Association of State Highway and Transportation Officials, Washington, DC, 1997.

7. *Standard Specifications for Highways Bridges*, Sixteenth Edition as amended, American Association of State Highway and Transportation Officials, Washington, DC, 1996.

8. *Colorado Department of Transportation Bridge Design Manual*, Colorado Department of Transportation, Denver, CO.

REPRESENTATIONAL SKETCHES OF GUIDELINE INTENT

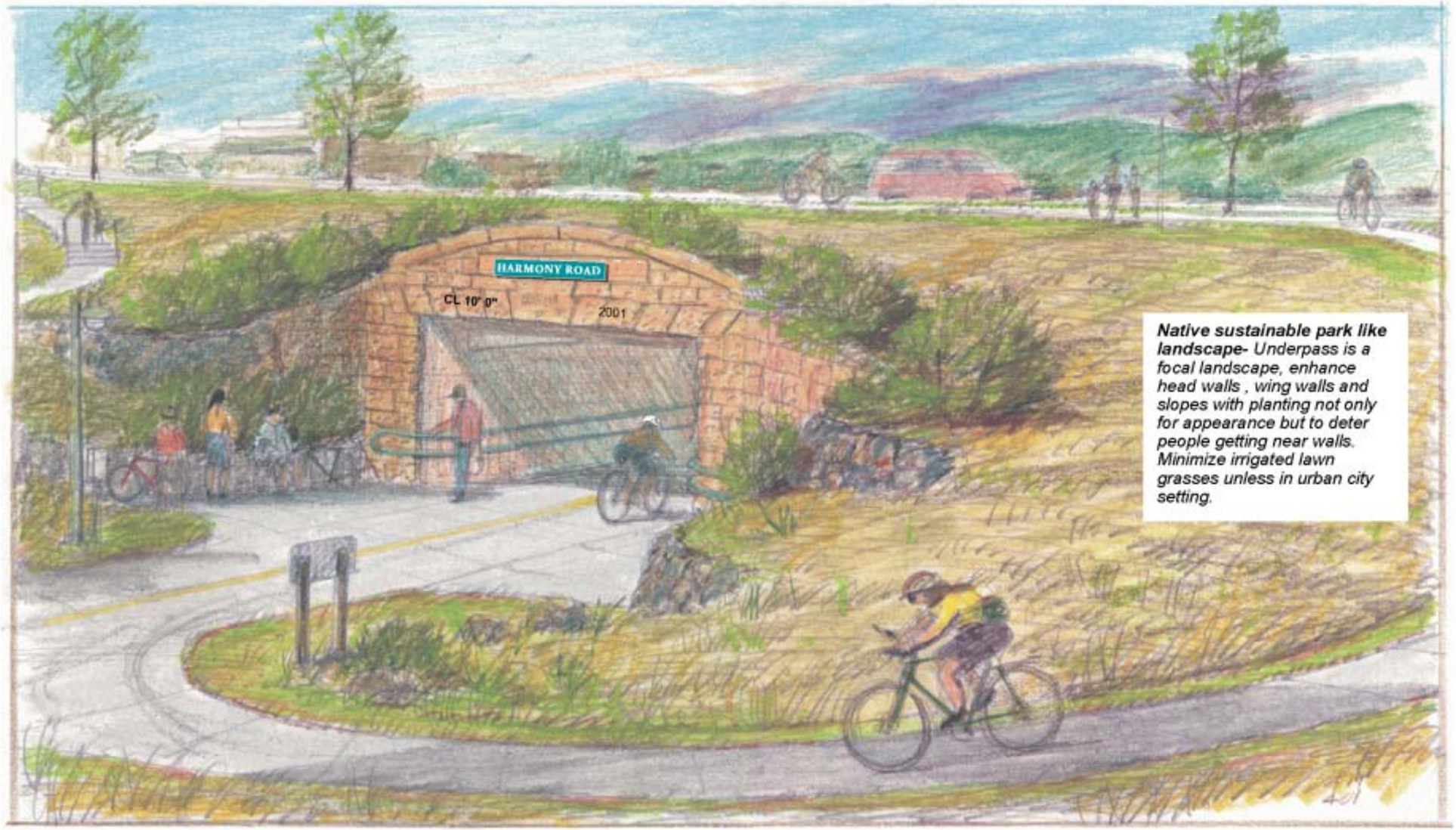
Possible auxiliary pedestrian access- *to local neighborhood walkways.*

Rock retaining walls *to hold slopes and enhance landscape character, also for informal seating.*

Information signing *on head wall helps orient trail users.*

Wing walls- *vary with different site conditions; for architectural finishes consider coarse surface texture to minimize reflected light and deter graffiti. This is also a possible artwork opportunity location.*

Connections to sidewalk *and / or bike lanes on roadway above.*



Native sustainable park like landscape- *Underpass is a focal landscape, enhance head walls , wing walls and slopes with planting not only for appearance but to deter people getting near walls. Minimize irrigated lawn grasses unless in urban city setting.*

Illustration by: Frank Miltenberger Landscape Architect

Corridor trail *has clear straight approach to allow clear view of underpass and oncomming traffic.*

Area light *low wattage, indirect or downcast lighting for approach area.*

Inside structure- *smooth textured surface to reflect light, and 'rub rails'/ hand rails for added assistance to trail users.*

Sight lines- *trail users should have a clear line of sight to underpass approach.*

Trail connection to roadway above- *Note that there may be need for connections on both sides of underpass. Not applicable to railway underpasses.*

Underpass Structures

Bikeway and pedestrian structures under roadways or railways

At one time these features were foreboding impediments to pedestrian and bicycle accessibility, little more than glorified box culverts. Past experience has given way to a number of strategies for enhancing the trail users experience with some of the ideas outlined here.
The solutions to making underpasses a welcome and functional transition between neighborhoods consist of careful attention to a number of trail and structural details.

Structure size -A primary design factor is the dimensions of the structure opening, bigger *is* better. Not just for pure function but for user perceptions. More light, more space to maneuver, and less intimidating (see report guidelines for specific recommendations).

Lighting - Not surprisingly - lighting is another critical aspect of design. Indirect lighting, which bounces light off walls and ceilings is preferable to direct light which often creates glare and confuses perceptions (see specific report recommendations).

Trail alignment- Clear direct approaches to the structure with a straight, near 90 degree, relatively flat alignment help trail users to anticipate and see oncoming traffic.

Trail connections to roadways above, and walkways and bike lanes above, are a key to a more complete community accessibility.

Architectural Considerations- the area around the portal opening should be as welcoming as possible. Architectural refinements to wing walls and head walls, widened pavement area, informal seating, adequate lighting and site and landscape upgrades can help accomplish this goal.

Canopy or roof *over walkway is desirable for maintaining safe trail surface and protection from weather.*

Slight camber or arch profile of bridge *is desirable for appearance and aids in transitions to approach ramps.*

Clearance *above roadway- See Larimer County urban area street standards. 23ft 6 inches minimum clearance over railway.*

Clear direct connections to neighborhood trail *system with well lighted approaches. Landscape upgrades commensurate with neighborhood.*

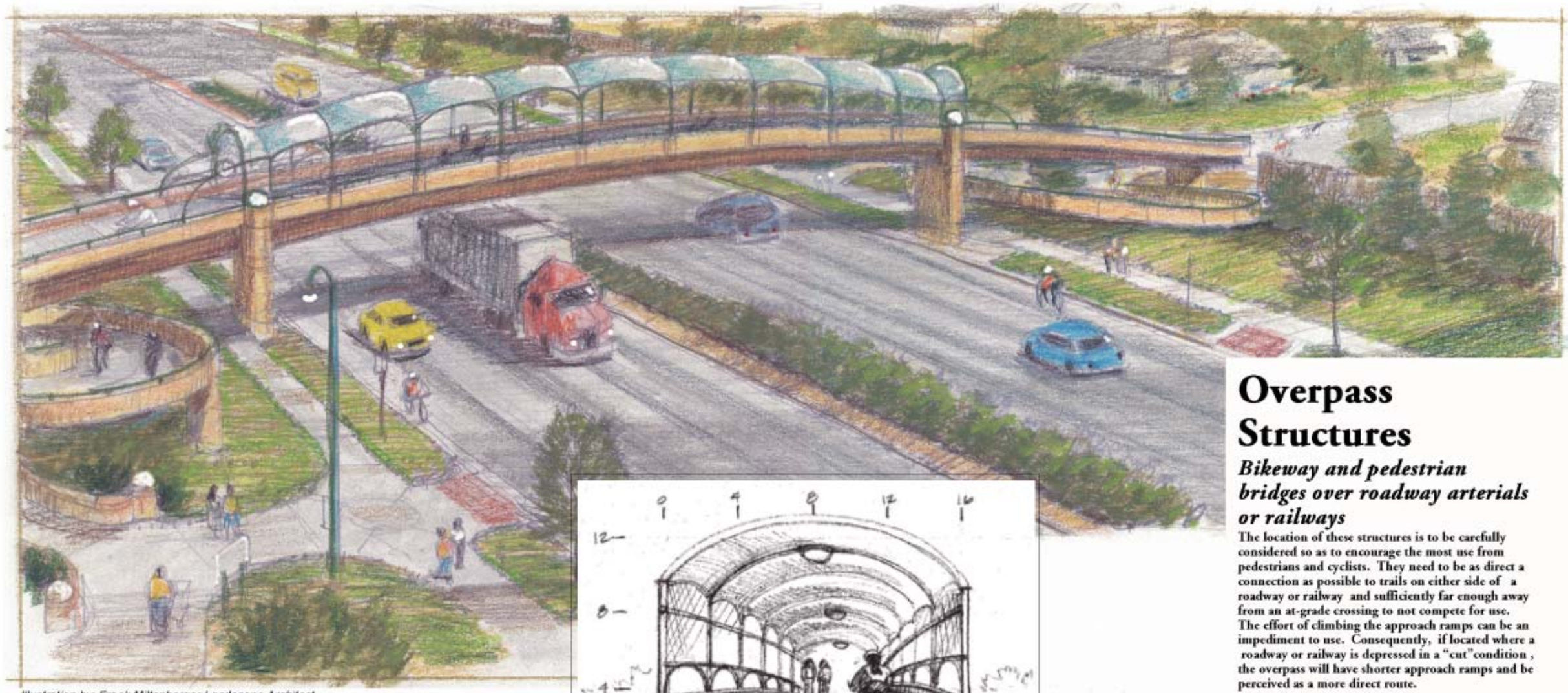


Illustration by: Frank Miltenberger Landscape Architect

Overpass Structures

Bikeway and pedestrian bridges over roadway arterials or railways

The location of these structures is to be carefully considered so as to encourage the most use from pedestrians and cyclists. They need to be as direct a connection as possible to trails on either side of a roadway or railway and sufficiently far enough away from an at-grade crossing to not compete for use. The effort of climbing the approach ramps can be an impediment to use. Consequently, if located where a roadway or railway is depressed in a "cut"condition , the overpass will have shorter approach ramps and be perceived as a more direct route.

Architectural Considerations- **These tend to be conspicuous , sometimes landmark-type, features along roadway corridors . The architectural treatment of piers, bridge rails, railing and vandal screens deserves consideration worthy of other public structures. Colors , textures and site landscape treatments at approaches can do much to make these a more welcome part of adjacent neighborhoods.**

Touch down or bridge approach area
Connections to sidewalks and bike lanes along arterials is important to maximize accessibility. Directional signage can help orient trail users.

Overhead downcast lighting for trail intersections.

Cross section sketch of bridge deck . *Lighting is provided with downcast roof mounted fixtures.*

Information signing- *Street or road name and bridge clearance. Can be attached to bridge girder.*

Adequate width *for horses and wildlife.*

Center line *of trail marked with reflective paint for added visibility.*

Trail connection to roadway *above-and to bike lane or sidewalk. Connection needed on both sides of bridge. Sign identifying trail corridor is helpful.*

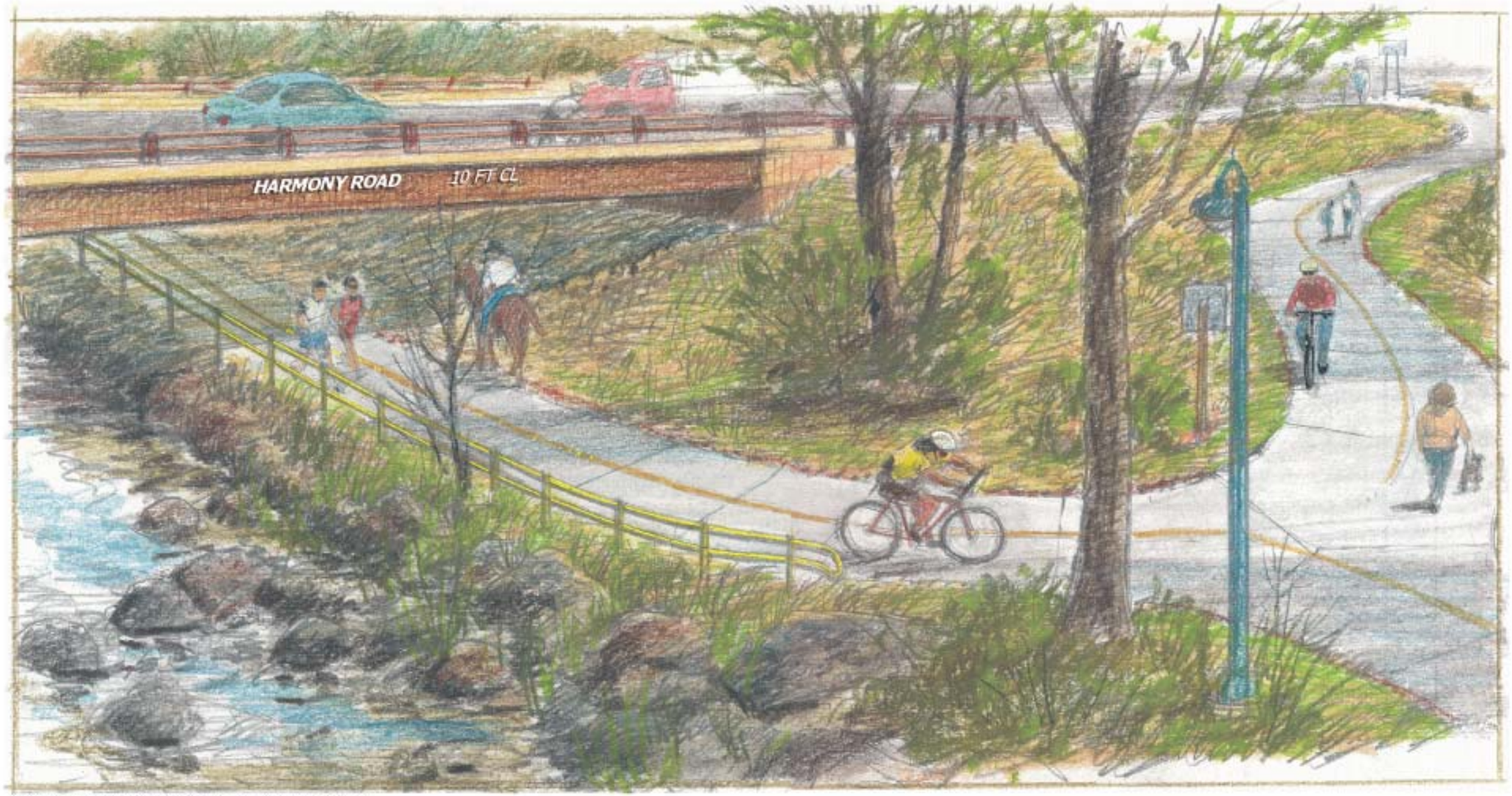


Illustration by: Frank Miltenberger Landscape Architect

Bridge Underpass

Bikeway and Pedestrian trails under bridges, typically adjacent to streams or rivers

This is a common condition where open space corridor trails along major water courses pass under roadway and railway bridges. Fitting newer trail requirements with older bridges has been a challenge with many compromises to good trail design being necessary. Outlined here and in this report are some criteria to add to the hydraulic and structural requirements for new trails and bridges.

Flooding- The trail should be located high enough above the stream normal low flow that it may flood or be covered infrequently perhaps 2 to 3 times per average year .

Vertical Clearance - Should be 10 ft . This will allow for equestrian trail use and game crossing. Some larger maintenance vehicles can also utilize this clearance.

Lighting- while not as critical as underpass tunnels, may be necessary for wider bridges or on commuter trail routes. Indirect reflected light is also better because trail users will often emerge at either end into the darkness of the surroundings.

Trail Alignment- Clear direct approaches to the structure with a 90 degree, relatively flat alignment, help trail users to anticipate trail conditions and see oncoming traffic.

Enhance stream habitat *and aesthetics by using a variety of boulder sizes for channel protection.*

Railings *- where steep or abrupt slopes present hazards.*

Align trail to minimize impacts with adjacent wetland, riparian vegetation. *Provide buffer space between trail and water course where possible. Preserve and protect significant large trees.*

Intersection with connecting trail *should have clear sight lines in all directions and flatter grades if possible. Adequate radii at corners help with trail safety.*

Trail Centerline with reflective paint. Reflective paint or reflectors may also be appropriate for railings.

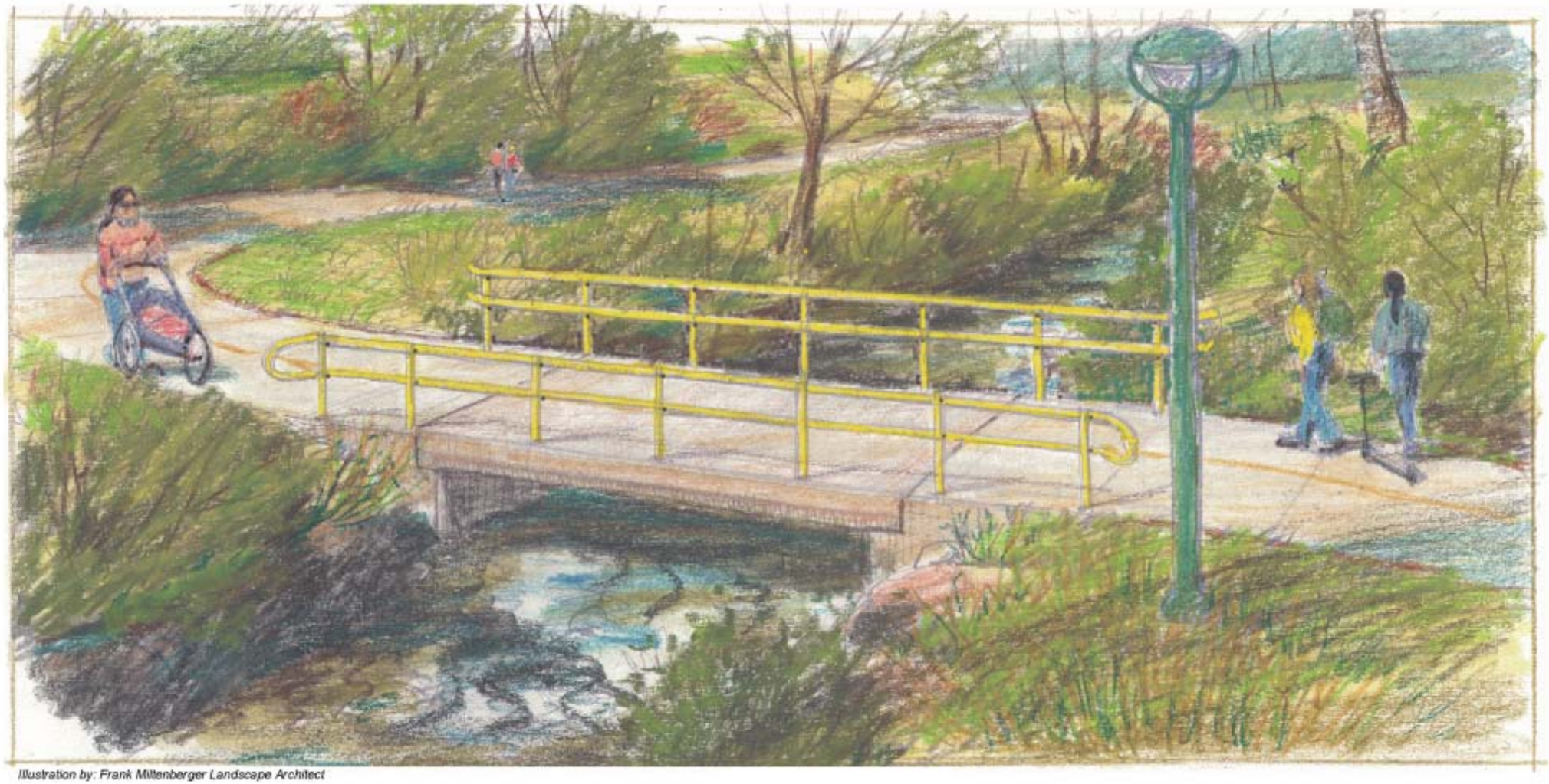


Illustration by: Frank Miltenberger Landscape Architect

Trail Bridge over Drainage Way

Bikeway and pedestrian trail bridges over smaller streams

For larger rivers use overpass guidelines.

Stream hydraulics are the major factor in bridge length and channel width. Bridge and trail height should be set so trail may only flood 2-3 times per year . This is more critical for commuter routes where users depend on regular accessibility. Likewise the trail approaches should be high enough above stream flows to be free of at least yearly flooding.

Trail alignments should approach bridges at right angles with wide radius curves to enable trail users to approach bridge with a clear line of sight.

Trail and bridge should also be located where they would minimize disturbance to native ecosystems and stream habitat. Route trail around large existing trees.

Right angled, wide radii approach to bridge with open sight lines.

***Landscape treatment** - When traversing a native riparian area, stream channel improvements should complement the native landscape setting or stream habitat. More random boulder treatment and channel width variation should be considered.*

***Flair ends of railings** and extend beyond edges of bridge deck toward approaches.*

***Downcast area lighting** for bridge area, 12 ft height poles.*

If in a park setting, amenities like benches, information signs or trash receptacles may be appropriate.

PHOTO EXAMPLES OF GUIDELINE INTENT

Aesthetic Appeal

Location Reference

Ample Structure Width

Median Skylight

Landscape Amenity

PHOTO EXAMPLES OF GUIDELINE INTENT

Decorative Railing

External Artwork

Internal Artwork

Rest Bench

PHOTO EXAMPLES OF GUIDELINE INTENT

Protective Railing

Decorative Wall Treatment

Protective Railing Between Usable Path and Drainage Facility

45° Top Corner

Interior Drainage Plan

PHOTO EXAMPLES OF GUIDELINE INTENT

Cross Street Accessibility

Structure with Drainage Facility

Handrail Example

PHOTO EXAMPLES OF GUIDELINE INTENT

Artwork Amenity

Overpass with Elevator

Overhead Lighting

Protective Side Barrier

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