Landscape and Aesthetics Design Manual

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Manual: *Landscape and Aesthetics Design Manual*

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Purpose

The *Landscape and Aesthetics Design Manual* is being revised:

- To comply with an administrative rule change.

Contents

The Construction Landscape Program has been replaced with the Transportation Alternatives Program in Section 3 of Chapter 1. References to Title 6, Texas Transportation Code in Section 7 have been updated, along with Texas Administrative Codes.

The Plant Selection Criteria described in Chapter 2 has been edited as well, in accordance with changes to the Texas Transportation Code.

Supersedes

The revised manual supersedes prior versions of the manual.

Contact

You may contact the Design Division's Landscape Group at DES-LAND@TxDOT.gov if you have any questions.

Archives

Past manual notices are available in a PDF archive link.

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Chapter 1 — Introduction to Landscape and Aesthetics Design

Contents:

Section 1 — Overview

The transportation system is a network of highways, trails, railroads, airports, transmission lines, pipelines, canals, and waterways set in the landscape. The goal of the transportation designer is to fit the highway or other facility into the adjacent landscape in a way that is complementary to, and enhances, the existing landscape. Achieving this goal requires consideration of natural, ecological, aesthetic, economic, and social influences related to that landscape.

Sections in this chapter cover:

- Landscape and Aesthetics Design of the Transportation Infrastructure
- Responsibilities of Landscape Architects
- Highway and Transportation Corridors
- Aesthetics of Transportation System Elements
- Context Sensitive Transportation Design
- Policy and Authorities Impacting Landscape and Aesthetics Design

Subsequent chapters in this manual deal with:

- Assessment, Planning, and Design
- Project Development Process
- Common Structural Elements: Recommendations and Guidelines
- Common Transportation System Features: Recommendations and Guidelines

Non-discrimination

TxDOT policy is to ensure that no person in the United States of America shall on the grounds of race, color, national origin, sex, age or disability be excluded from the participation in, be denied the benefits of or otherwise be subjected to discrimination under any of our programs or activities.

Section 2 — Landscape and Aesthetics Design of the Transportation Infrastructure

Overview

Subsections in this section deal with:

- Policy and Authorities
- Project Development Process
- Role of Landscape and Aesthetics in Transportation Design
- Aesthetics and Aesthetic Quality

Policy and Authorities

There is a body of regulation and policy that provides the foundation for landscape and aesthetics design activities. These include:

- federal regulations
- state law and regulations
- departmental policy and programs

Section 7 of this chapter discusses policy and authorities further and gives references or links to specific regulations, laws, and programs.

Project Development Process

The development of a contemporary transportation project is a complex interdisciplinary process. TxDOT divides the project development process into six broad groups of activities:

- planning and programming
- preliminary design
- environmental
- right-of-way and utilities
- PS&E development
- letting

The involvement of landscape architects and other design professionals may occur at any point in the process. However, they are usually most heavily involved in preliminary design, environmental design, and plan specification and estimate (PS&E) development. Specific activities and tasks in these areas are outlined in Chapter 3 of this manual.

Role of Landscape and Aesthetics in Transportation Design

The Environmental Protection Agency (http://www.epa.gov/) (EPA) and the Federal Highway Administration, (http://www.fhwa.dot.gov/) (FHWA) have recognized the visual, scenic, and aesthetic qualities of a landscape as an environmental component that must be taken into account. Several sections of the Code of Federal Regulations (40 CFR) and the U.S. Code (Title 23, Sections 109) specifically state that the aesthetic or scenic qualities of a place may be taken into account and preserved or enhanced.

In addition to the regulatory requirement to consider the aesthetic quality, the general public is increasingly demanding aesthetic enhancements to existing and proposed transportation facilities. The greatest pressure for aesthetic enhancements tends to be in the major urban centers of the state and in rural areas having high scenic quality (such as the Davis Mountains).

Aesthetics and Aesthetic Quality

Aesthetics is most often associated with a sense of beauty. By definition it is a "particular theory or conception of beauty or art; a pleasing appearance or effect." With respect to the practice of transportation design, aesthetics may be defined as dealing with the visual integration of highways and other transportation modes into the fabric of a landscape in a way that blends with or complements that setting. This is important since the view to and from highways and other transportation facilities contributes to the perception of communities and the quality of a place.

However, the aesthetic properties of a transportation facility have purpose beyond simply creating a pleasant view. Aesthetics is intertwined with the function of the facility. An aesthetically pleasing highway or other transport mode is one that provides its users with a clear picture of what is going on around them and what is expected of them. This is accomplished by using techniques and materials to provide better definition of the elements of the facility, to visually highlight important information, and to reduce the stress on users that results from operating a vehicle in a complex environment.

The first consideration of landscape and aesthetics master planning and design is to improve the safety and function of the transportation network. This means that aesthetics planning is a process that occurs at every stage of design, construction, and maintenance. In a majority of cases meeting basic safety, operational, and design goals will be sufficient to meet most landscape and aesthetics goals. However, in special cases meeting aesthetics goals may require going beyond these basic needs, `without compromising the safety of the facility`.

Section 3 — Responsibilities of Landscape Architects

Overview

TxDOT uses a team approach to project development. Landscape architects and consulting design professionals participate in the design process as defined in this manual and in Chapter 5, Section 4, 5280: Design landscape/aesthetic plans of the *Project Development Process Manual*.

Landscape architects routinely work in a multi-disciplinary context, exemplified by the TxDOT project development process. They are trained in the earth sciences, construction materials, and technology as well as aesthetics design. The landscape architect's primary role is to assist in integrating environmental and aesthetic concerns with engineering and safety requirements. In this role landscape architects contribute to a broad range of highway planning and design activities.

Landscape architects in transportation practice have five primary responsibilities:

- safety of the traveling public
- stewardship of land, air, water, scenic, cultural, and historic resources
- mitigation of adverse environmental and cultural resource impacts
- integration of the transportation network into the adjacent landscape
- enhancement of the aesthetic quality of the transportation network

Each of these responsibilities is explained in a subsection of this section. Other topics include:

- visual perception of highway and transportation corridors.
- design considerations for scale
- laws of perspective related to highway and transportation design
- design implications of visual perspective

Safety of the Traveling Public

The most important consideration is to ensure the safety of the traveling public and those that maintain transportation facilities. Ensuring safety is a demanding task that requires a broad understanding of vehicle performance, driver capabilities, and design geometry as well as landscape design.

Stewardship of Land, Air, Water, Scenic, Cultural, and Historic Resources

The conservation of land and water resources is essential to the long-term sustainability of the state's transportation system. Statutory mandates that reinforce TxDOT's stewardship responsibilities include:

- 42 USC 4321 et seq. –The National Environmental Policy Act of 1969
- 33 USC 1251 et seq. –The Clean Water Act of 1977 and 1987
- 42 USC 7501 et seq. – The Clean Air Act as amended 1990
- 23 CFR Part 771 – Highways.

The landscape architect and other design professionals have a primary responsibility in helping the department meet its stewardship obligations as defined by these acts.

Mitigation of Adverse Environmental and Cultural Resource Impacts

The landscape architect provides assistance at all levels of the project development process related to environmental and resource stewardship and impact mitigation. `Their` unique planning and design skills are particularly useful in the mandated process of documenting project need, demonstrating impact avoidance, and preparing strategies for mitigation. In the planning phase of the project, landscape architects assist in identifying and hiring subject matter experts, prepare preliminary reports, and plan for all types of environmental and cultural resource impact mitigation. In the final design process the landscape architects prepare or oversee the preparation of PS&E documents related to environmental agreements as well as any landscape and aesthetics improvements.

Integration of the Transportation Network into the Adjacent Landscape

Transportation corridors `interact with` the environment through every conceivable landscape type. Projects that involve opening a new corridor, or improving and expanding an existing corridor, require careful consideration of how the proposed improvements will fit into the existing landscape whether it is urban, suburban, or rural. Fitting a complex modern highway into the adjacent landscape requires close attention to detail, knowledge of environmental constraints and an appreciation for the safety and engineering requirements of the highway structure.

Enhancement of the Aesthetic Quality of the Transportation Network

Transportation agencies are often asked to enhance the aesthetic quality of the transportation corridor. Enhancement in this context means careful coordination of the architectural details of structures along with the skillful manipulation of the landform and careful planning of clearing, revegetation, reforestation, and erosion control operations in order to blend the highway with its surroundings.

Visual Perception of Highway and Transportation Corridors

An individual aesthetic experience of a highway or other transportation corridor is a function of what one sees over time and space. This is very different than other types of landscape design, which focus on the design of spaces that are experienced as individual places, for example, a back yard, a civic plaza, or a park. Even a development as large as Disney World is designed and perceived as a unified place.

By contrast, highways and other transportation corridors are large-scale landscapes, revealed as a sequence of visual experiences over time. In this context the aesthetic quality of a corridor is the sum of the visual experience over time and not the quality of any single view. In other words, a highway may have some visually unpleasant elements, yet still have a very favorable overall visual impression.

Design Considerations for Scale

The scale of the highway landscape is probably the most critical aesthetic design consideration. For example, a typical freeway interchange will occupy a site of 30 acres to as many as 100 acres. A mile of typical urban freeway, which represents approximately 1 minute of travel time, is approximately 36 acres of right-of-way. However, depending on the topography, a single mile of highway may represent a view shed of several square miles.

Designers must be conscious of the basic design implications related to the scale of the transportation system:

- Surface and landscape treatments generally have to be limited to areas where they achieve the greatest visual impact.
- Supplementing the existing landscape is usually more successful and cost effective than creating a new or different landscape.

Laws of Perspective Related to Highway and Transportation Design

The viewer's perception of a roadway corridor follows the laws of visual perspective. The critical relationships of perspective in highway and transportation design practice are the station point, horizon line, vanishing point(s), and the cone of vision. The station point is the location of the viewer in relation to what is being observed. The horizon line is a plane through the viewer's eye level. The vanishing point(s) is a reference on the horizon line that appears to be the origin of horizontal lines or planes. The cone of vision is the viewing area where all objects will be in focus.

Station Point. The station point of a vehicle operator is constantly moving usually along a path parallel to the centerline of the right-of-way. This means that the perspective view is constantly changing. Traveling at normal speeds, an observer processes the equivalent of about 50 snap shots

every second. Therefore a viewers impression of a transportation corridor is the sum of many individual observations.

Horizon Line. The eye level horizon line determines the apparent height of an object. Driver eye level is generally between 44 in and 48 in from the ground. This is about 12 in to 16 in below eye level in a standing position (which is about 60 in). As eye level decreases, the first point on the ground that can be observed moves further from the viewer and the apparent area of the ground plane decreases rapidly. For this reason the ability to perceive patterns on the ground is decreased dramatically. In general, objects that lie between the horizon and the ground are difficult to distinguish. This is because they foreshorten rapidly as the distance from the viewer increases and, depending on the color, they may blend with other objects in or on the ground plane. Therefore, low objects or plant materials that do not break the horizon are not prominent as visual design elements.

Vanishing Point. A corridor is a long narrow space that appears to have a single vanishing point on the horizon line located perpendicular to the horizon line. A corridor type space is one of the few types of space that is perceived as a “one point” perspective.

Cone of Vision. The primary cone of vision, objects that compose the primary field of view, is 60 degrees for a stationary observer. Objects outside this vision cone, 60 degrees to ±180 degrees, are perceived with peripheral vision; they are visible but not in sharp focus. Research has also demonstrated that as an observer begins to move the cone of vision begins to narrow depending on the activity and task load. For most drivers the vision cone is estimated to be 30 degrees. With a 30-degree cone of vision, objects 20 ft from the edge of the pavement will be at least 120 ft from the viewer to be within the 30-degree cone of vision.

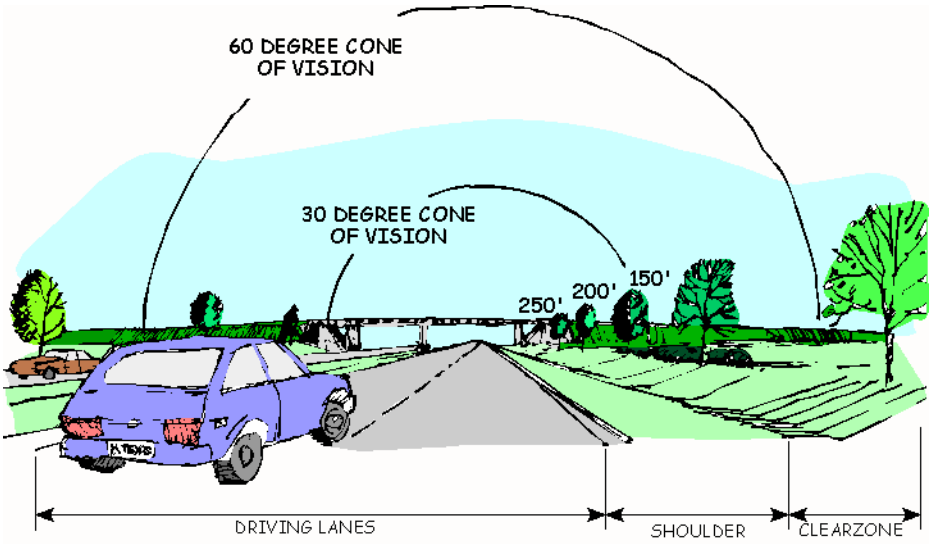

Figure 1-1. Due to the scale of the roadway, only objects that are large or near the viewer are readily seen.

Design Implications of Visual Perspective

The laws of visual perspective are mathematical relationships that will be constant regardless of the type of transportation facility. They govern how users perceive space and time relationships. While there are no hard rules where aesthetic design is concerned, the laws of perspective govern the viewer's perception of space and detail. Designers must take this into account and design accordingly.

- The elements perceived by a vehicle operator are at considerable distance, usually a minimum of 120 ft to 150 ft.
- Details, particularly patterns on the ground, are difficult to see at highway speeds and have little impact on the driver's sense of space and design.
- Objects that have the greatest impact on the driver's perception are those that break the driver's horizon line. This means that vertical elements, such as embankments, cut slopes, walls, and trees will have the most significant impact on the driver's field of view.

Section 4 — Highway and Transportation Corridors

Overview

The physical and visual relationship of the roadway to its surroundings is a key factor in the aesthetics of the roadway. A corridor is defined as a long, narrow passageway. While we tend to think of corridors in association with building, the corridor concept applies to highways as well. The concept is useful because it prompts the designer to consider the linear nature of the roadway as a movement in space and time. Figure 1-2 shows the concept of a rural corridor, and Figure 1-3 shows the concept of an urban corridor.

Figure 1-2. The visual definition of rural corridors is determined by landform changes, vegetation, and distant views.

Figure 1-3. Urban corridors tend to be linear and are visually defined by the surrounding architecture and alignment of the roadway.

As individuals move along corridors, their perceptions change as the character of roadway and the surrounding landscape change. Sections of roadway usually maintain a particular character for a distance, which can also be described as a unit of time. Areas that are in view for a longer period tend to take on greater significance in the viewer's perception of a place.

Changes in the character of the landscape usually occur at important landmarks that people use to orient themselves (see Figure 5-8). Landmarks may be very subtle, such as a distinctive building, bridge, or an intersection. More dramatic changes are usually associated with changes in topography, panoramic vistas, river crossings or views of large water bodies.

Figure 1-4. Landmarks can be important orientation elements that may also carry cultural significance for a community.

The contextual landscape can be grouped into two categories, urban and rural. While there is variation within each category the basic aesthetic considerations are similar within each category. Sections in this chapter cover the following aesthetic considerations for roadway corridor design:

- corridor segments as a unit of design
- defining a corridor segment
- urban corridors
- urban design principles and application
- rural corridors
- rural design principles and application

Corridor Segments as a Unit of Design

TxDOT develops highways in project units. Project limits are based on concerns of budget, construction sequencing, buildability, environmental fit, and other issues of priority and need. However, user understanding and experience of traveling on highway are strongly related to travel patterns and cultural sense of the city or region.

Researchers have found that highways tend to be perceived as edges or boundaries that segregate parts of the city or landscape. Interchanges and intersections are perceived as nodes or gateways to precincts that are usually identified in terms of their land use. Structure, such as major bridges, are seen as landmarks used for orientation.

These facts argue strongly for design approach that recognizes perceived cultural boundaries and deals with the landscape and aesthetics design of highway system as corridor segments rather than on a project basis.

Defining a Corridor Segment

The limits of a corridor are essentially defined by the perception of the resident population of a city or region. The sense of corridor limits tends to grow up with the city. For example, in Houston there is no formal land use designation of "Museum District" but Houstonians will generally agree that it lies south of US 59 between South Main Street and Montrose. This is one example, but every community has some sense of corridors, and where the beginning and ending point are. Designers working on the development of landscape and aesthetics plans should work with local residents to identify meaningful corridor units.

Urban Corridors

This visual character of an urban corridor tends to change more rapidly when compared to changes in a rural setting. This is due to the visually distinct characteristics of various abutting land uses and the limited area likely to be occupied by a given land use. Some design characteristics that affect aesthetic design decisions in urban areas include the following:

- social and cultural influences
- impact of adjacent land use
- visual complexity
- views
- bicycle and pedestrian access
- environmental mitigation

Social and Cultural Influences. Social and cultural patterns have a marked impact on what will constitute an acceptable design solution. Increasing the population close to the highway increases the potential for conflicts between special interests and those with the responsibility for the design of the transportation infrastructure. More intense land use means that there is a closer contact with the highway and associated structures. Land uses in close proximity to the highway are more affected by noise and vibration, stray light and other impacts associated with highway operations.

Impact of Adjacent Land Use. Adjacent land use establishes the character of the landscape. During the design process a conscious decision must be made as to whether the highway should be blended with the surrounding landscape or allowed to contrast. The basis for this decision involves consideration of the engineering properties of the highway, cross section, structures, and operational needs in relation to the character of the landscape. It is usually desirable to keep the highway

visually neutral in residential and commercial area while in larger scale landscapes such as industrial zones it may be desirable to design for visual contrast.

Visual Complexity. The urban setting is dominated by structure connected by a network of transportation links and utilities. The aggregation of building, streets, drives, signs, power distribution lines, light standards, etc., combine to create a very complex visual environment. Drivers, pedestrians, and bicyclists are required to extract from the visual scene information appropriate to the individual situation. As the visual scene becomes more complex the task of interpretation becomes more demanding. Recent research has demonstrated that older adults and inexperienced drivers often have trouble interpreting and reacting to visual information.

Views. Views to and from the highway are very important. In residential areas it is usually desirable to restrict views to and from the highway corridor. However, in commercial, institutional, and industrial zones maintaining views to and from properties becomes very important. Businesses in particular depend on being seen from the highway. Likewise, open views of business and public properties tend to reduce vandalism and other criminal activities.

The viewsheds in an urban landscape tend to be limited. Panoramic views in urban settings are most likely associated with high bridge structures or roads that ascend major topographic features. Buildings and other structures usually obscure the natural horizon. Therefore there is less sky and a more shadow. Shade will wash out contrast in color and texture and can make it difficult for viewers to distinguish colors and materials. The lack of natural references increases the reliance on landmarks and other information devices in way finding.

Bicycle and Pedestrian Access. Bicycle and pedestrian access has been mandated under **Intermodal Surface Transportation Efficiency Act of 1991(ISTEA)** and Transportation Equity Act for the 21st century (TEA-21) legislation. TxDOT seeks to provide safe accommodation of pedestrians and cyclists on all state maintained right-of-way. The AASHTO *Guide for the Development of Bicycle Facilities* is the basis for detailed design of bicycle facilities. The authority for pedestrian facilities is the AASHTO publication *A Policy on the Geometric Design of Highways and Streets*.

Environmental Mitigation. Environmental mitigation embraces a broad scope of activities dealing with issues of air quality, water quality, noise and vibration, and environmental justice. Environmental mitigation requires a variety of structural features that can be incorporated as landscape and aesthetic assets at no additional cost.

Urban Design Principles and Application

This section provides basic design principles that can be employed to address urban landscape characteristics. Each of these principles is broad, and intended to give designers a point of beginning when making design decisions about materials, colors, forms, and levels of design complexity in an urban setting.

- Use the public participation process to understand the social and cultural influences acting in a project area and avoid conflicts with special interests.
- Consider adjacent land use as a paramount consideration in making design decisions.
  - The colors, textures, material, and scale of adjacent structures should influence selections for the highway.
  - When noise and vibration mitigation are necessary, design should be integrated into the highway as well as influenced by adjacent properties.
  - The form of land and other structures should complement the adjacent land uses to the extent possible.
  - Views to important community landmarks should be identified and maintained.
  - Views to commercial properties should be maintained or enhanced.
- Reduce visual complexity where possible. Techniques that can be employed are:
  - Use vertical screens to reveal landscape and highway elements in understandable sequences. For example vegetation can be placed to divide a complex scene into a series of understandable spaces.
  - Where possible, maintain or enhance the views to commercial properties.
  - To the extent possible reduce the number of free standing signs.
  - Compose signs in a way that reduces visual complexity.
- Utilize environmental mitigation requirements as an integral part of the aesthetic design decision process.
  - Utilize noise mitigation as visual screens and structural landscape elements.
  - Utilize water quality and flood control basins as features to complement the landscape of interchanges and other highway design elements.
  - Integrate historic, cultural, and scenic themes into structural details of the highway.
- Use design elements to manage desirable and undesirable view to and from the highway.
  - Early in the design process alignment and landform can be used to good advantage to manage views to and from the highway.
  - Traffic barriers, vegetation, signs, fences and walls of all types are effective tools for managing views to and from highway.
  - Use contrast in material color, texture, and scale to draw attention to important points along the highway corridor.
  - In shaded areas use shape color contrasts to help observers distinguish between driving lanes, shoulders, vertical, and horizontal surfaces of the highway.
  - Use more intense colors on surfaces that receive some shading because the intensity will be diminished by the shade.
  - Use very bold, rough textures on surfaces to make them more visible.

- Plants with coarse texture will be more effective than small leafed plants.
- Trees should be planted so they break the horizon line of sight. If trees are planted on a slope so that they do not break the horizon they will appear to be little more than a different shade of green.

◆ To the extent possible, bicycle and pedestrian traffic must be accommodated with the right-of-way.

Rural Corridors

Rural corridors have aesthetic design characteristics quite different from urban settings. The key properties of a rural corridor are:

◆ The natural or agricultural landscape dominates the visual field.

◆ Viewers perceive more of the adjacent land.

◆ There is less visual change in the landscape.

◆ The landscape is visually simple.

◆ Views extend far beyond the right-of-way.

◆ The scale of the highway is perceived as smaller in relation to the rural landscape.

Dominance of the Natural Landscape. In the rural landscape the natural landform and vegetation dominate the visual field. Structures such as farmsteads, barns, or small subdivisions of single family homes are viewed as individual objects within the landscape as opposed to objects that compose the landscape. This makes the highway read as a ribbon of pavement through the landscape and the boundaries of the right-of-way become blurred. There is also less variation in color. Generally greens, warm grays, and muted blues dominate the color palette. This means that the introduction of bright colors, particularly reds and yellows, will quickly draw attention.

Perception of a Larger Landscape. Traffic volumes tend to be lower and traffic less concentrated in the rural setting. While this is not always true on the interstate highway system, it has the effect of widening the cone of vision. As the cone of vision increases the view extends further into the landscape and there is less focus on the immediate right-of-way. Observers tend to perceive more of the landscape than they will in a confined urban condition.

Perception of Change in the Landscape. The rural landscape is much more uniform in its visual properties and does not change character rapidly. If the landscape is forested it will usually remain forested for a considerable distance and if it is agricultural cropland it will also remain so for some time. This simplifies the driver's workload because there is much less visual information to be interpreted.

Perception of Scale. In the rural landscape the perceived scale of the highway is much smaller than in a confined urban setting. Drivers perceive that the natural landscape is larger than the highway and it's associated structures.

Rural Design Principles and Application

This brief discussion of rural landscape characteristics suggests some aesthetic design principles that should guide development of landscape and aesthetic plans. Each principle is general and only a guide to making aesthetic design decisions about materials, colors, forms, and visual complexity in a rural setting.

Importance of the Natural Landscape. The natural landscape of a rural highway tends to be visually dominant. Therefore landscape improvements should be designed to supplement or enhance the existing conditions. This may include activities such as:

- marking community entrances
- enhancing existing vegetation
- screening or focusing views

Scale of the Rural Landscape. The scale of the rural landscape requires dramatic contrast if an introduced design feature is to be effective.

- Colors that contrast with the basic background colors will be the most effective in the rural landscape. Other colors will simply fade into the background.
- Limit ornamental planting to very large shrubs and trees that will break the horizon line or line of sight.
- Use the features of the existing landscape where possible. Add structural features and plant materials so that they complement existing landscape features.

Change in Visual Character. The landscape character changes infrequently in a rural setting and the views are less complex.

- The pattern of the landscape changes slowly in the rural landscape. This means the areas of greatest importance are the transition points. For example, moving from open pastureland into a forested area marks a distinct change.
- There is much less information to process in a rural landscape, and drivers tend to relax. This has been linked to the loss of driver concentration and possible mistakes that could lead to accidents. For this reason designers should be alert to opportunities to add interest to the rural setting.

Viewsheds. Viewsheds tend to extend well beyond the boundaries of the right-of-way.

- Views tend to be less focused on objects.

- Because the landscape area is much larger, small disturbances or unattractive occurrences tend to have much less visual impact.
- Edges and boundaries are the most sensitive to change because they form the background or end of a viewshed.

Perceived Scale. The perceived scale of the roadway is smaller in the rural landscape.

- The pavement tends to be the only visual reference to the roadway in an open landscape, which minimizes the perceived scale of the roadway.
- In forested land the mass and height of the trees tends to dominate the scale of the road.
- Because of the perceived scale it is difficult to achieve sharp contrasts with the landscape and architectural forms.
- Contrast in a rural landscape is best generated with the use of color.

Section 5 — Aesthetics of Transportation System Elements

Overview

An aesthetically pleasing setting is one in which each element of the design is in harmony with all others. This simple principle is the foundation of aesthetic design for transportation facilities. A transportation corridor is a complex composition of functional elements, each designed to meet a specific task. To meet the goal of visual harmony the design characteristics of individual elements must be coordinated to provide a clear sense of order, clarity, and continuity.

Visual Design Elements

The following visual design elements collectively establish the architectural and visual framework of transportation facilities and most directly affect perceptions of the facility and the surrounding environment:

- material
- color
- texture
- pattern
- form

TxDOT districts are encouraged to develop corridor-specific plans to coordinate the aesthetic properties of materials, colors, textures, patterns, and form, particularly within key urban corridors of the district. The vehicles for accomplishing this are the Landscape and Aesthetics Assessment and the Landscape and Aesthetics Master Plan.

Material. With the possible exception of landform, the materials used to build a transportation facility exercise the greatest impact on the aesthetic and visual quality. The materials palette of transportation is broad and includes common structural materials such as concrete, steel, asphalt, rock, and soil. However, the palette also includes plant materials, which are used for erosion control, slope stabilization, and reforestation as well as contributing to the aesthetic quality of the facility.

Materials generally possess native design traits that cover all of the other design elements of color, texture, pattern, and form. Therefore the selection of a material often sets the character of the other design elements. For this reason material selection should always be done with some consideration of the aesthetic properties and how they will fit into the adjacent landscape.

Color. Color is generally associated with a material. Concrete for example has a native color of mottled warm gray to off white. This color is not particularly objectionable but when the dominant

material of a transportation facility is concrete such as a typical urban freeway, it becomes visually dull and monotonous. Color can be added using surface finishes.

Texture. Texture is the apparent roughness or smoothness of a surface. Texture can be an important element in creating visual variety within a transportation corridor. Some materials such as glass or steel have a smooth texture that is difficult to change. However, materials such as concrete can be easily textured by manipulating how it is placed and finished. The use of texture is often a good alternative when the use of color is not desirable or cost effective.

Pattern. Pattern is usually the result of a finishing technique or the placement of modular units. Some common elements of the transportation design palette that generally have a strong visual pattern that will impact the visual quality are retaining walls, bridge and guard rails, modular pavements, and some illumination hardware. When materials have strong pattern characteristics they should be coordinated with other elements of the corridor to achieve visual harmony.

Form. Most structural elements of a transportation corridor have distinct form characteristics. In general transportation facilities that move vehicles have very sinuous geometries as opposed to the more rigid geometric forms of the built environment. These flowing forms tend to be visually compatible with the natural landscape. In urban settings the curvilinear geometry of bridges and transportation rights-of-way do not fit easily into the rigid grid-like form of the city. The mismatch in geometry often results in unanticipated or undesirable edge conditions where the two geometric types meet.

In the ground plane the sinuous curves of horizontal alignments needed for safety and mobility result in a ragged patchwork of small, usually triangular parcels. These are often too small to use effectively and can be very difficult to maintain. Designers should be conscious of these conditions and avoid the creation of maintenance problems. Selling or trading the land to adjacent properties when there is no need for the right-of-way is one of the most practical solutions.

In vertical plane embankments, walls and bridge supports often create shaded areas that tend to collect trash and become unsightly. Careful consideration of what happens under structures and their proximity to adjacent properties is critical. Since the areas under bridges do not receive direct sun, vegetation is seldom an appropriate ground surface treatment.

Section 6 — Context Sensitive Transportation Design

Overview

The process of developing a modern transportation project goes beyond the traditional engineering design process. It requires consideration of influences and impacts that extend far beyond the right-of-way lines.

Context sensitive design at the national level has grown out of what has been learned in the post World War II period during the construction of the interstate highway system and expansion of connected urban freeway systems. During this period the design focus has been guided almost entirely by considerations of cost effectiveness, safety, and mobility. This view of the process has resulted in conflicts with a wide range of community, environmental, and other special interests. The move toward context sensitive design seeks to avoid such conflicts and form partnerships with the communities to meet transportation needs and user expectations.

Where landscape and aesthetics design is concerned, context refers to the physical and cultural landscape of a project site. The physical landscape includes the visual elements of the transportation corridor and its surroundings. The cultural landscape is composed of those influences imposed on the site by tradition or special interests. Context sensitive design seeks to ensure that the character of the transportation facility is appropriate to this surrounding landscape. This will accomplish a sense of visual unity and public acceptance that is the basis of an attractive transportation facility.

Context may be considered in two ways. The first is the relation of the design elements to each other within the right-of-way and the second is the context of the transportation facility in the larger landscape. Each is important and intertwined.

The following subsections cover context sensitive design in relation to contextual parameters, structural design elements of transportation facilities, and aesthetic design of common transportation features.

Contextual Parameters

Where multiple structural elements come together, relationships may be unattractive, even though each individual element is visually pleasant. To achieve aesthetic harmony structural elements must be designed so that the form, finish, and color of the elements are complementary to one another. Likewise the landforms generated by the alignment may result in objectionable scars in the landscape. Where possible, dramatic revision of the landform should be evaluated for its visual impact.

What aesthetic qualities will be acceptable in a given contextual situation is not always easy to predict. Many of the contextual considerations of a place may be cultural or ephemeral. That is, the landscape may appear average and without areas of obvious visual sensitivity. However, upon fur-

ther investigation links may be discovered related to traditional beliefs, local cultural importance, or ephemeral qualities such as stands of vegetation that are prized for their seasonal color displays.

The primary vehicle for determining the contextual parameters that will influence the aesthetic design of transportation facilities is the public participation process. Individuals charged with oversight or development of a Landscape and Aesthetics Assessment or Landscape and Aesthetics Master Plan should participate in or review all public participation documents related to a project or target corridor.

Structural Design Elements of Transportation Facilities

A transportation corridor can be broken down into a palette of fourteen structural design elements. Each of these has aesthetic design properties that can be manipulated to change its visual character and to help it blend with other structures within a corridor.

Common Structural Elements of Transportation Facilities. The twelve most common structural elements of a transportation corridor are listed below. This design manual provides detailed recommendations and design guidelines for each of these elements:

- bridges
- retaining walls and noise walls
- topography and grading
- character of adjacent properties
- surface finishes
- landscape design
- traffic barriers and guard fences
- signals and signs
- illumination
- bicycle and pedestrian access
- public art
- medians and traffic islands

Aesthetic Design of Common Transportation Features

Interchanges, intersections, adjacent properties, and right-of-way configurations all impact the visual character of a facility. These features are complex landscapes composed of multiple structural design elements. Depending on the type of facility, the basic structural elements tend to be repeated in similar ways.

For this reason it is useful to provide more detailed discussion of landscape and aesthetic design considerations associated with each of them. They include:

- intersections
- elevated driving lanes
- interchanges
- highway and transportation corridors
- depressed driving lanes
- entrance and exit ramps

Section 7 — Policy and Authorities Impacting Landscape and Aesthetics Design

Overview

Subsections in this section introduce the topics of:

- Regulations
- Landscape and Aesthetics Assessment
- Landscape and Aesthetics Master Plans

Regulations

This section identifies the body of regulation and policy that establishes departmental responsibilities in the area of landscape and aesthetics design. It also provides basic information on the programmatic tools available to affect landscape and aesthetics responsibilities. For more information on the individual regulations listed here, see Chapter 5, Section 4, 5280: Design landscape/aesthetic plans of the *Project Development Process Manual*.

There are a variety of federal, state, and departmental acts and directives that mandate TxDOT design and maintenance activities related to landscape and aesthetics design. While there are numerous citations, the combined impact of these requirements can be summarized as follows:

- The landscape and visual aesthetic qualities of a transportation corridor are an environmental characteristic that, by law, must be considered in the design process and, where possible, enhanced.
- The landscape disturbed by the construction of a highway must be reestablished for environmental and aesthetic reasons. The revegetation process is to be accomplished with appropriate native and adapted species.
- To the extent possible, plants used for revegetation of rights-of-way should be low water use (xeric) plant materials.
- Where a transportation project must disturb an environmentally sensitive landscape, wetland, historic site, established residential neighborhood, or scenic landscape, appropriate actions must be taken to mitigate visual and adverse environmental impacts.
- TxDOT recognizes the need for developing highways with acceptable visual quality and has developed several proactive programs that encourage and assist the development of such transportation corridors. These include the Transportation Enhancements Program, `Transportation Alternatives Program`, Cost Share Program, the Governors Community Achievement Awards, Green Ribbon Landscape Improvement Program, and Landscape Partnership Program.

Federal Regulations

Federal Highway Administration. Code of Federal Regulations Title 23-- Highways, Part 752 Landscape Development. Establishes landscape development policy and guidelines on federally funded or federally participating construction projects.

National Environmental Policy Act (NEPA) of 1969. This act establishes a national policy that requires all federally funded or federally participating projects to give proper consideration to the relationship between humans and the environment, and to assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings. (Sec. 101.b.2 [42 USC Sec. 4331])

Architectural Barriers Act of 1968, and the Americans with Disabilities Act of 1990. These acts establish guidelines for accessibility of facilities. Under their provisions, TxDOT is required to follow guidelines established by the Architectural and Transportation Barriers Compliance Board. The Board publishes Americans with Disabilities Act Accessibility Guidelines (www.access-board.gov/bfdg/adaag.htm) that are the framework for administration of the provisions of the acts: The Architectural Barriers Act (42 U.S.C). The Americans with Disabilities Act of 1990 (42 U.S.C. Section 504).

Executive Memorandum: Memorandum on Environmentally Beneficial Landscaping, April 26, 1994. This memorandum establishes policy regarding landscape design and management on federally funded or assisted projects. It stresses use of regionally native plants, minimal impact to habitat, reduced used of fertilizers and pesticides, and efficient water use and runoff reduction practices.

Executive Memorandum: Memorandum on Invasive Species, February 3, 1999. This memorandum establishes federal policy with respect to the enforcement and administration of several acts that are intended to prevent or control the introduction and spread of invasive plant species. The focus of efforts is on the encouragement to reestablish native species. The related acts are 42 U.S.C. 4321, 16 U.S.C. 4701, 18 U.S.C. 42, 7 U.S.C. 2801, 7 U.S.C. 150aa, and 16 U.S.C. 1531.

Intermodal Surface Transportation Efficiency Act, 1991 (ISTEA)

Transportation Equity Act for the 21st Century, 1998 (TEA-21)

Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, 2005 (SAFETEA-LU)

Moving Ahead for Progress in the 21st Century Act, 2012 (MAP-21)

State Law and Regulations

State of Texas, State Purchasing and General Services Act, Section 2166.404 of the Government Code. This act requires that TxDOT use and require the use of xeriscape practices in the practice and maintenance of landscapes associated with state-owned property or facilities.

Title 43, Texas Administrative Code Section 2.4, Comprehensive Policy on the Environment. This policy establishes guidelines for consideration of environmental issues within the context of highway planning, design, construction, and maintenance within the Texas Department of Transportation.

Title 43, Texas Administrative Code Part I, Subchapter D, Section 2.63, Adopt-a-Highway Program. This section sets forth policies and procedures to be used in establishing and maintaining Adopt-a-Highway public participation programs on Texas roadways.

Title 43, Texas Administrative Code Part I, Subchapter D, Section 2.64, Adopt-a-Highway for Landscaping Program. This section sets forth policies and procedures to be used in establishing and maintaining Adopt-a-Highway for Landscaping public participation programs on Texas roadways.

Title 43, Texas Administrative Code Part I, Chapter 11, Subchapter E, Statewide Transportation Enhancement Program. This section prescribes the policies and procedures for implementation of the enhancement provisions of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA).

Title 43, Texas Administrative Code Part I, Chapter 11, Subchapter F, Transportation Alternatives Program. This section prescribes the policies and procedures for implementation of the enhancement provisions of the Moving Ahead for Progress in the 21st Century Act (MAP-21).

Title 43, Texas Administrative Code Part I, Chapter 11, Subchapter D. This section sets forth policy and procedures for the department to prepare landscape and aesthetic master plans for cities with a population over 100,000 and to emphasize the planting of vegetation, the use of public art, and respect for local neighborhoods in designing and building highways in urban areas.

Title 43, Texas Administrative Code Part I, Chapter 12.1-12.11, Subchapter A, Public Participation in Landscaping and Litter Removal. This section sets forth policy and procedures for the department to allow local governments, civic organizations or private businesses an opportunity to support the aesthetic improvement of the state highway system by donating 100% of the development, establishment, and maintenance of a landscape project on the right of way.

Title 6, Texas Transportation Code Subtitle H, Chapter 392, Subchapter A. This section establishes guidelines for beautification

projects on state highway right of way that require the use of only regionally appropriate plants.

Departmental Policy and Programs

Administrative Orders

Texas Department of Transportation. Administrative Order No. 7-60, Jan. 20, 1960. Preservation of Native Growth on Highways. Mandates consideration of preservation of native growth along highways during construction and reconstruction.

Texas Department of Transportation: Administrative Order 80-63, June 4, 1963. References Highway Research Board's Committee on Geometric Highway Design Report entitled Requirements of an Obstacle-Clear Roadsides, dated Jan. 7, 1963.

Texas Department of Transportation: Administrative Order 51-63, Oct. 9, 1963. Restates AO 7-60 and references Administrative Circular No. 80-63 for roadside clearances.

Cost Share Program

Texas Administrative Code: Landscape Cost Sharing Program, Title 43, Part I, Chapter 12, Subchapter A, Sec. 12.5. Sets forth policies and procedures to be used in establishing and maintaining Landscape Cost Sharing public participation programs on Texas roadways.

Governors Community Achievement Award

Texas Department of Transportation: Minute Order 84702, July 23, 1986. The Governor's Community Achievement Awards Program was initiated in 1986 by the Texas Transportation Commission as a statewide annual awards program in cooperation with Keep Texas Beautiful. Keep Texas Beautiful sponsors a competition each year among its member cities throughout Texas. The competition recognizes communities for local environmental improvement through litter prevention, solid waste management and recycling, beautification, public education and litter law enforcement. One winning city is chosen in each of nine population categories.

The department participates in the program by designing and installing a landscape development project along the highway right-of-way in each winning city. Projects range from $60,000 for populations of 1,000 or less, to $265,000 for populations greater than 250,001 with an annual funding amount of $1,000,000.

Green Ribbon Program

Texas Administrative Code: Green Ribbon Program, Title 43, Part I, Chapter 11, Subchapter D. The Green Ribbon Program was implemented to expand the Houston District's Green Ribbon Project concept to other areas of the state. The department will accomplish the requirements of

Title 43, Part I Chapter 11, Subchapter D by initiating two specific actions. The first action is to establish public/private partnerships within specific cities and regions to develop Landscape and Aesthetic Master Plans in districts with cities that have populations of 100,000 or more. The second action allocates funds for district with non-attainment counties to plant and establish trees and plants on the state highway system that help mitigate the effects of air pollution.

Landscape Partnership Program

Texas Administrative Code: Landscape Partnership Program, Title 43, Part I, Chapter 12, Subchapter A, Sec. 12.7. The program was created to allow local governments, civic organizations or private businesses an opportunity to support the aesthetic improvement of the state highway system by donating 100% of the development, establishment, and maintenance of a landscape project on the right-of-way.

Landscape and Aesthetics Assessment

As part of the advanced planning process an assessment of landscape and aesthetic issues should be prepared. Because the visual and aesthetic and landscape qualities of a highway corridor are important to a project's success and by law must be taken into account, an effort to identify landscape and aesthetics issues will assist in meeting these requirements and ensuring that appropriate consideration is given during the detailed design process. This statement should address the issues outlined in Landscape and Aesthetics Assessment.

Landscape and Aesthetics Master Plans

Because the visual and aesthetic and landscape qualities of a highway corridor are important to a project's success and by law must be taken into account, it is recommended that a Landscape and Aesthetics Masters Plan be prepared for communities that have a population of 100,000 or more. The plan is a means to:

- demonstrate that the landscape and aesthetic qualities of a corridor have been considered and appropriate actions have been prescribed
- coordinate architectural features and details
- coordinate materials palettes
- coordinate colors and color schemes
- establish regionally appropriate design themes
- control the level and complexity of development
- provide a vehicle for developing cost sharing agreements
- provide a means of estimating development and maintenance costs

Title 43, TAC, Part I, Chapter 11, Subchapter D requires that the planning process include public/private participation that will reach out to constituents and interested persons. Possible participants include Metropolitan Planning Organizations (MPO) officials, elected officials, citizen advocacy groups, district landscape architects, engineers or planners, Design Division landscape staff, city or county officials and other interested stakeholders.

Chapter 2 — Assessment, Planning, and Design

Contents:

Section 1 — Overview

This chapter contains the following sections:

The overall planning process for landscape and aesthetic design employs a variety of tools and techniques to guide the process. This chapter reviews three of these elements essential to the planning process.

- Section 2 of this chapter explains a Landscape and Aesthetics Assessment (LAA), which identifies issues associated with a specific project. The LAA provides planners with a means of estimating development costs and gathering information that will assist in determining choices appropriate to the specific project. The assessment results in a statement useful in both recording and communicating project issues and recommendations.
- Section 3 discusses a Landscape and Aesthetics Master Plan (LAMP), which builds on the LAA to coordinate project decisions, control project complexity, estimate costs, and ensure sustainability. The final LAMP contains palettes which provide guidance on materials, colors, finishes, signage and fixtures, and structural choices.
- Section 4 provides recommendations and guidelines for developing a Landscape Design, which determines and records specific landscape and aesthetic approaches and choices for a project.

Section 2 — Landscape and Aesthetics Assessment

Overview

A Landscape and Aesthetics Assessment (LAA) is a tool for identifying landscape and aesthetic issues associated with a specific highway corridor segment. The procedure involves field observation and participation in or review of public participation venues.

The objectives of the LAA are to:

- identify landscape and aesthetic issues that will impact the character and/or cost of a transportation project
- ensure that the landscape and aesthetic qualities of a corridor have been considered as required by law
- identify issues related to the character of architectural features and details
- identify issues that relate to the selection of materials for a project
- identify issues related to colors and color schemes
- identify appropriate design themes
- inform entities about the opportunities for cost sharing
- gather information that will assist in estimating development costs

Development Process

This subsection describes the process of developing an LAA and establishes the sections of the assessment. Table 2.1 shows the steps in developing an LAA. The steps are explained in detail following the table.

Table 2.1. Developing the LAA

Step Number	Tasks
Step 1	Identify the corridor
Step 2	Inventory the corridor
Step 3	Identify assets, liabilities, and opportunities
Step 4	Assess the sensitivity of the corridor to construction and change
Step 5	Develop a landscape and aesthetics assessment statement

Step 1: Identify the Corridor

A highway or transportation corridor usually does not correspond to the exact limits of a project. To ensure visual and aesthetic continuity it is important to fit project related aesthetic design decisions into a regionally meaningful corridor segment. A corridor is a section of highway with regionally meaningful boundaries. Characteristics that usually impact the perception of boundaries are features such as significant intersections or bridge crossings, historic districts or neighborhoods, commercial or institutional centers, or distinctive scenery or open space.

As an example: I-45 in Houston from the 610 north to the 610 south interchange is a locally recognized corridor. It has two sub parts: 610 north to SH 288 and US 59, and SH 288 and U.S. 59 to 610 South. A less urban example is Loop 287 in Lufkin. The loop is a locally recognized corridor with three sub parts: U.S. 59 South to U.S. 59 north, U.S. 59 north to SH 103 west and SH 103 west to U.S. 59 South.

The key to corridor definition is that it has beginning and ending points that are meaningful to local residents.

Step 2: Inventory the Corridor

The LAA inventory involves collecting data and documenting a variety of physical and contextual conditions.

Visual Geometry of Highway Corridors. Be alert for the potential for significant change in geometry or character that could cause adverse public reaction. In most urban areas projects to expand the number of lanes within an existing right-of-way will require the use of numerous retaining walls which will materially change the character and feel of the existing highway. Figures 2-1 and 2-2 show examples of highway corridors using wall textures.

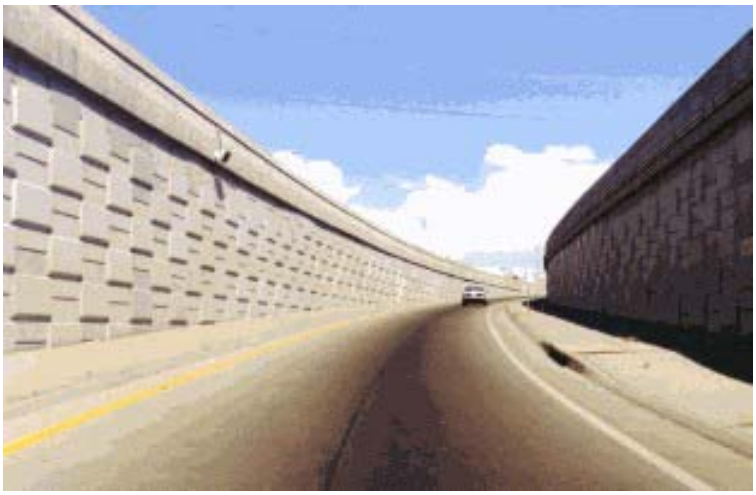

Figure 2-1. Attention to textures and colors in deep cuts can keep areas from being a negative driving experience.

Figure 2-2. Walls of elevated lane sections can be visually dominating. Attention to the aesthetic character of these structures is important in early design stages.

Landform. The landform is most impacted by a highway that runs through topography with high relief or urban areas dominated by tall structures (see Figure 2-3). In a natural landscape with high relief, cuts and fills result in sharp visual contrast with the natural forms of the hills. In urban centers the corridors can become concrete canyons or gashes in the urban skyline. It is important that the potential for change be recognized and that any potential for adverse public reaction to the change be recognized early in the process. (See also discussion on topography and grading in Chapter 4, Section 4.)

Figure 2-3. Urban centers present many possible conflicts with adjacent properties. Aesthetic considerations can help with some of these issues.

Neighborhood Context. Where the public is concerned, the neighborhood context is the most important part of the landscape and aesthetics assessment. Residents, businesses, and institutions that border a transportation corridor generally have a decided interest in the overall design of the

facility. It is vital to the overall success of the project that the neighborhood context be studied and that the concerns of the public be identified. This requires participation in the public participation process and careful attention to comments that relate to landscape and aesthetics design.

Cultural Context. The cultural properties of a corridor relate to the history and regulatory framework that may overlay a project. Ephemeral properties, characteristics of a site that change with time, relate in an LAA to the progression of seasons or play of light and shadow. Designers must be alert to these influences because they are often difficult or impossible to see yet they can have very strong emotional ties within a community. Elements such as a local reverence for a seemingly insignificant church building or the seasonal bloom of regionally prized trees can cause significant delays in a project if they are not identified early in the design process.

Step 3: Identify Assets, Liabilities, and Opportunities

Based on the material gathered in the inventory identify the corridor's visual and aesthetic assets, liabilities, and opportunities. This is similar to the third step in preparing a LAMP. The primary difference is in the breadth and general nature of the information. The objective of Step 3 in the assessment is to be broad. Consider all the possibilities and limit the focus on detail.

Assets. Assets are those characteristics of the corridor that contribute to a scenic or neutral quality. Assets may be related to alignment, landform, adjacent property conditions, or vegetation as well as other structures. Availability of ROW is a very important asset that should not be overlooked. The goal in the LAA is to identify anything that could be considered an asset no matter how it might be used in a final design recommendation.

Liabilities. Liabilities are any potential for conflict with adjacent property owners or communities or physical landscape characteristics that will make project design difficult. Significant physical conflicts are usually very obvious. Much less obvious are the conflicts that arise as a result of public perceptions of a project or conflicts that arise out of the cultural context of place. These are most often related to the history of a place or local customs and traditions.

Opportunities. Opportunities are any physical or contextual influences that would allow enhancement of the visual quality of highway corridor. Communities that have an interest in partnering with TxDOT for landscape and aesthetics improvements by a willingness to assume responsibility for long-term maintenance should be actively recruited.

Step 4: Assess the Sensitivity of the Corridor to Construction and Change

The sensitivity of a corridor to development and change must be judged on the basis of the assets, liabilities, and opportunities identified. It is difficult to suggest any specific guidelines or tools that would be helpful in making this judgement. However, if each area of the inventory is addressed and reviewed in terms of assets, liabilities, and opportunities the relative sensitivity to development will generally be evident. Some specific areas that tend to have high sensitivity to development are:

- established residential neighborhoods
- special districts, medical facilities, historic areas, retail centers
- areas of high scenic quality, mountain, ocean or water views, panoramas, etc.
- developed urban freeway corridors

When any of these types of districts are encountered, special attention should be given to the public participation process. This process is the primary opportunity to identify the critical issues so they can be addressed during the detailed design process. Failure to do so will usually result in add-on costs for landscape and aesthetics development, which may have been avoided.

Step 5: Develop a Landscape and Aesthetics Assessment Statement

The purpose of the Landscape and Aesthetics Assessment statement is to document the aesthetic issues that need to be addressed in the detailed design process. The statement should frame issues in a way that allows a physical design response. For example, if there is a stand of prized trees in a neighborhood, the assessment should identify them and indicate what actions may be necessary to protect and save the trees. Or, if expansion cannot occur without damaging the trees, what measures would be appropriate as mitigation. Similarly where neighborhood concerns such as objectionable views are evident the assessment should state the issue and present design options that could be cost effective in mitigating the problem.

The goal of the assessment statement is to identify the issues and provide suggestions that maximize design flexibility.

Outline of a Landscape and Aesthetics Assessment Statement

1. Project Scope
    a. Physical description of work (e.g. widening of I-35 from 610 south to U.S. 59)
2. Inventory of Corridor
    a. Identification of corridor (indicate whether corridor runs beyond project limit)
    b. Inventory of physical properties
        2. Visual Geometry of Highway Corridors
        3. Landform
        4. Neighborhood Context
        5. Cultural or Ephemeral (short lived) Context
    c. Public Issues from Public Participation Process
3. Design Considerations

a. Discuss specific landscape and aesthetics design considerations that should be addressed in the detailed design process. Focus on the presentation of options rather than any specific solutions. Couch the discussion in terms that relate to the language of the public participation venues.

Section 3 — Landscape and Aesthetics Master Plan

Overview

A Landscape and Aesthetics Master Plan (LAMP) is a tool for managing the aesthetic qualities of a highway segment and for communicating to the public TxDOT's plans for making aesthetic improvements to state maintained rights-of-way.

The objectives of the LAMP are to:

- control the level and complexity of landscape development to ensure sustainability within departmental resources
- demonstrate that the landscape and aesthetic qualities of a corridor have been considered and appropriate actions prescribed as required by law
- coordinate architectural features and details
- coordinate materials palettes
- coordinate colors and color schemes
- establish regionally appropriate design themes
- provide a vehicle for developing cost sharing agreements
- provide a means of estimating development and maintenance costs

Landscape and Aesthetics Master Plan Development Process

This section describes the process of developing an LAMP, establishes the elements of the plan, and provides an example that can be used to develop plans for simple urban and rural corridors. Table 2.2 shows the steps in developing an LAMP. The steps are explained in detail following the table.

Table 2.2. Developing the LAMP

Step Number	Task
Step 1	Use Landscape and Aesthetics Assessment statement developed during LAA
Step 2	Develop a palette of design details to guide development of the corridor
Step 3	Divide the corridor into development zones

Step 1: Utilizing the Landscape and Aesthetics Assessment (LLA)

The LAA provides a comprehensive picture of all relevant uses facing the designer. No matter what stage of the design process or scope of project, an assessment of some type must be performed to ensure that important issues are not overlooked. In this step the designer uses the assessment to set specific goals to address key issues and problems identified in the corridor. This will include (but not be limited to) determinations such as:

- views to be preserved
- areas to be screened
- where noise walls will be employed
- the best locations for landscape plantings
- problem maintenance areas that must be dealt with
- key off-site relationships and interactions
- sites requiring environmental mitigation or protection

Once the designer has determined the best way to meet the needs of specific design goals, the process proceeds to the development of design refinement of Step 2.

Step 2: Develop a Palette of Design Details to Guide Development of the Corridor

The simplest form of LAMP is a collection of design detail palettes. These design palettes are the focus of the LAMP. Their purpose is to provide maximum design flexibility while ensuring a harmony among the basic design elements as described in other sections of this manual.

To guide the design of a transportation facility with respect to its landscape and aesthetics properties there are five palettes recommended as the basis of the LAMP:

- color palette
- finish palette
- signage and fixtures palette
- structural systems and details palette
- plant materials palette

A materials table organizes the selections made from the five palettes listed above.

Color Palette. Materials have a generic color therefore it is very important to coordinate the colors of materials. In so far as possible, all structures placed on the roadside or incorporated into the pavement surface, signage, and other appurtenances should take advantage of natural color and

avoid the use of any finish requiring maintenance or replacement. For example, painted surfaces should be avoided wherever possible.

Finish Palette. Finishes are also related to the native color of the material. In the context of landscape and aesthetics design, finish has to do with the textural quality of the surface or any special surface treatment such as vandal resistant finishes. Finish may also relate to the shape or finish of a modular unit such as a CMU, segmental retaining wall (SRW) unit, reinforced earth retaining wall panel, or tilt wall noise wall panel.

Signage and Fixtures Palette. This category includes all other structural elements that might be incorporated into the corridor. The list would include but not be limited to: fencing, sign supports, guardrail supports, finishes under guardrails, delineators, crash barriers, rail terminators, luminaires, poles, and signals. These are small items but they need to coordinate with the major components to ensure a harmonious end result.

Structural Systems and Details Palette. This palette sets the types of details that will be used for a variety of structures. It covers the considerations that would not necessarily be covered in the materials, color, and finish palettes. For example, there are a variety of panel shapes that can be used for reinforced earth retaining walls as well as for the wall cap and termination. Likewise the finish on materials such as CMUs, SRW blocks, and walks can vary widely. Other details that should be considered include bent shape and reveals, beam reveals, bent ends and connection types, special bridge rails and CTB, head and end wall railings, pedestrian separation railings, treatment of median voids, under bridge surfaces, and traffic channelization islands.

This section of the corridor plan requires a great deal of coordination between bridge, roadway, signs and signals, and environmental personnel. This section could be a simple table or may involve a more detailed catalog of design options based on the appropriate development zone. The concept of development zone is elaborated in Step 3.

Materials Table

A materials table may be used to view many different elements at one time and allows the designer to consider aesthetics issues as a whole for the corridor rather than on a piece-by-piece basis. The list of elements shown in the sample table (MATTBL) is for example purposes. The final list will vary with the project. The list should include as many elements as possible even if the element will be a generic type. This prompts comparison between these and elements that might be treated specially. In addition to the items already listed, other elements for consideration might include:

- delineators
- crash barrier
- rail terminator
- signals

- signal supports
- sign supports
- bridge type
- abutment protection
- bent ends
- reinforced earth walls
- reinforced earth wall cap
- medians and gores < 12 ft
- medians and gores >12 ft w/curb
- medians w/drainage section
- bridge rails (special)
- guard rails
- sign,
- noise walls
- sign bridge, vertical
- sign bridge, horizontal
- sign mounting hardware
- riprap

Plant Materials Palette

Plant materials should be divided into two sections. The first section would have recommendations for basic erosion control as well as appropriate landscape enhancements for the purpose of minimizing maintenance and ensuring a safe, sustainable roadside. The second section should specify approved plant materials for ornamental purposes in cases where special interests or adjacent communities wish to partner with TxDOT for long term maintenance. Table 2.3 is an example of a plant materials palette.

Table 2.3. Sample Plant Materials Palette – Anywhere, Texas

Roadside Zone	Plant Materials
Shoulder turf (sandy soil)	HOU mix 1 or HOU winter mix temporary
Shoulder turf (clay soil)	HOU mix 2 or HOU winter mix temporary
Borrow ditch zone	HOU hydraulics mix
Steep slope reforestation	Pinus taeda, with HOU mix 4 (understory)

Table 2.3. Sample Plant Materials Palette – Anywhere, Texas

Roadside Zone	Plant Materials
Moderate slope reforestation	See approved woody species in Plant Materials Palette
Ornamental Materials	
Trees	-
Pinus taeda	Loblolly pine
Lagerstroemia indica	Crape myrtle
Liquidambar styracaflua	Sweet gum
Shrubs	-
Pittosporum tobira	Green pittosporum
Nerium oleander	Oleander spp
Cortaderia sellowiana	Pampasgrass
Photinia glabara	Photinia
Pyrancantha coccinea	Pyrancantha
Asalea spp	Azalea

Step 3: Divide the Corridor into Development Zones

The development zone concept is a key to ensuring long term sustainability of a highway corridor. A development zone is a classification of the highway corridor that reflects the anticipated maximum intensity and character of landscape development. This includes pavement all structures and planted right-of-way maintained by TxDOT. The level of development is related directly to the department resources required for long-term maintenance.

There are five zones defined, which represent five different levels of development (see Table 2.4). The first two zones include ornamental landscape enhancements and require that a community partner assume responsibility for long-term maintenance. Zones 3-5 include no ornamental enhancements. All planting and other materials are used to reestablish native or adapted vegetation associations to achieve long-term erosion control and sustainability of the corridor. While the purpose is primarily utilitarian, the proper use of the corridor Landscape and Aesthetics Master Plan will coordinate development so that landscape and aesthetic concerns will be satisfied as well by ensuring harmony among all of the natural and built elements of the highway.

Development Zones. After issues of safety have been addressed, the primary consideration as to the ultimate feasibility of a project will be the level of maintenance it will require to function as it is

intended. The level of maintenance that can be provided is determined by the available funds for maintenance and pool of expertise available through the contracting and inspection process.

Landscape projects installed on TxDOT rights-of-way are to be grouped into five general categories that can be useful for planning. This is an element-based approach that uses the estimated development and maintenance costs of different project elements to classify the project. In landscape development projects certain elements will always call for specific management techniques and the costs for these can be reasonably estimated. The presence of these elements in a plan is therefore an indicator of the relative maintenance or management costs of the project.

This approach does not precisely quantify maintenance costs but does enable the planner to make preliminary resource allocation decisions with regard to maintenance levels and where within the roadside they should occur. The calculation of more accurate maintenance costs for any specific project will be performed as part of the site-design process.

The development zone classification is based on the common elements and maintenance considerations of structures, planting, surface treatment, mowing, and access.

Zone I. A Zone I landscape is one in which there is intensive development requiring frequent or intense maintenance. Almost any type of structures and surface treatments may be in a Zone I development. All Zone I development is limited to projects where a public entity contracts with TxDOT to assume responsibility for all maintenance, except the pavement and associated structures.

Zone I development is generally discouraged on all state rights-of-way due to the extreme maintenance requirements. Before a city is allowed to develop a right-of-way to this level TxDOT should be satisfied that the entity seeking the partnership has the experience and wherewithal to maintain the development at an appropriate level and that the proposed development will in no way threaten the public health or safety.

- **Structures:** Zone I development usually involves an interchange or intersection. For this reason, there are often bridges, channelization islands, signs, lighting standards, and other types of structure that must be considered as part of the project.
- **Planting:** Projects will have a significant budget devoted to the installation of ornamental plant materials and the percentage of the non-paved areas devoted to ornamental planting.
- **Bed plantings:** Zone I projects contain large areas of prepared soil planted with ornamental plants that may include shrubs, ground covers, annuals, and perennials. The projects usually have ornamental planting that requires frequent mechanical weed removal or use of selective herbicides.
- **Bed location:** In Zone I projects, bed areas are usually placed at the same level as the surrounding soil so that beds are subject to weed and grass invasion. Maintenance of the beds requires frequent edging with hand tools.

- **Plant types:** Zone I includes any development that uses annual or perennial plants or plants that require special pest control measures.
- **Irrigation:** Any landscape development that requires irrigation of turf or continuous irrigation of bedded plant materials is a Zone I development.
- **Mowing:** Zone I includes any project requiring frequent mowing cycles to maintain a manicured appearance, or projects with irregular shapes that require the use of small push-type or riding mowing machinery.
- **Access:** Access may be limited and special equipment may be needed to remove refuse or to maintain plants.

Zone II. A Zone II landscape is one in which frequent or intense maintenance activities might occur but are limited to the establishment phase (no more than two growing seasons) of a project. Maintenance thereafter is fairly regular and does not require specialized skills. All tasks can be accomplished with common hand tools or common power equipment.

- **Plant material:** Ornamental planting may be a significant component of Zone II development. However, plantings are less complex than in Zone I and spread over a larger area.
- **Bed plantings:** Bed plantings may occur in Zone II, but will generally be small in size and not a significant portion of the overall project.
- **Bed location:** Beds in Zone II must be raised above the surrounding grade or be located in medians or other structures where they are not in contact with any turf area.
- **Plant species:** Plant species used in Zone II beds shall be evergreen or approved deciduous woody shrubs. No annual or perennial plants may be used in a Zone II development. Maintenance activities such as fertilization, pruning, and insect control may occur but are not required on a regular basis.
- **Turf mowing:** Zone II includes projects that increase the number of mowing cycles and may require the use of small-swath mowing equipment.
- **Plant irrigation:** Irrigation shall be limited to drip or bubbler systems with automatic controllers. Turf irrigation shall be subsurface only.
- **Access:** As noted above, access for maintenance activities must be maintained. Trees planted in open turf shall be limited to areas where slopes are flatter than a 3:1 ratio of run to rise to prevent damage to slopes due to turning actions of mowing equipment.

Zone III. This zone limits the types and placement of plant material and the length of time in which routine maintenance will be required. Maintenance activities for plants in this zone may be intermittent, perhaps only once per year or two years.

- **Bed plantings:** No bed planting which requires the wholesale disturbance of the soil, either in tilling or the adding of soil amendments, shall be included in Zone III. Shrubs used in rows or

as mass plantings shall be planted in individual planting pits. Preparation of planting areas shall be limited to mowing or herbicide application of existing vegetation.

- **Plant selection:** Trees and shrubs used in Zone III shall be those with significantly low maintenance requirements and must be placed in areas where their full mature size can be attained without pruning. Shrubs shall be those species which are fairly rapid growers, evergreen or fast growing perennials such as Pampasgrass that are greater than 4 ft tall and are able to effectively shade out weed seedlings beneath them once established. No plant in Zone III will require pruning to maintain a specific shape or character. Plants requiring routine insect control or fertilization beyond establishment should not be used.
- **Weed control:** Weeding required in Zone III (after the plant establishment period) shall be limited to the use of mechanical or herbicide treatments of structure edges or tree-wells only. No hand weeding shall be required.
- **Plant irrigation:** Irrigation shall be limited to drip or bubbler systems with automatic controllers. Temporary irrigation systems with shrub risers are allowed. No turf irrigation shall be used.

Zone IV. This zone includes landscape elements or treatments that require little or no long-term increase in maintenance.

- **Plant material:** Plant material in Zone IV shall be limited to the use of tree plantings within areas not included in regular mowing cycles. Shrubs shall be used primarily to reduce or improve maintenance within a site. Only those plant species of demonstrated hardiness for the roadside shall be used. No insect control, supplemental fertilization, or pruning is anticipated for the life of the project.
- **Weed control:** Weeding required in Zone IV shall be limited to the use of herbicide treatments of tree-wells or shrub plantings for a short period only to enhance establishment. No later weed control is anticipated for the life of the planting.
- **Plant irrigation:** Irrigation shall be limited to the use of truck-irrigation only. No continuous, long-term irrigation is anticipated after the establishment period.
- **Access:** Planting included in Zone IV shall not be placed near any structures or obstacles in such a way that normal mowing operations shall be affected.

Zone V. This zone is composed of those areas in which it is not safe or practical to install any landscape element (principally plant material) that will require any maintenance. Development in Zone V areas may be limited to ‘hard-scape’ elements such as paving, walls, or other permanent structures. In most cases, the goal in these sites is to reduce or eliminate the need for regular maintenance.

- **Plant material:** No ornamental plant materials and only limited vegetation for erosion control should be used in Zone V.

- **Weed control:** Weeding required in Zone V shall be limited to the use of spot herbicide treatments to control weed invasion in joints and cracks.

The Development Zone Chart

Table 2.4 provides a graphic description of how the zones are organized. A project's zone classification is determined by which of the highlighted areas are expected to occur in the project. This table is a summary of the development characteristics of the various development zones. It is currently limited in scope and needs to be expanded as the zone definitions mature.

For instance, if a project is expected to require continuous hand-weeding after establishment, it is considered to be a Zone I landscape. Likewise, any project that can be mowed only by push mowers is also rated as a Zone I.

The zones are necessarily vague since many specific design decisions affecting maintenance are yet to be made at the site-design level. TxDOT will make the final determination of the level of management.

Table 2.4. Development Zone Chart

Components	**Zones**				
-	I	II	III	IV	V
Prepared Beds	-	-	-	-	-
Ground level	X	-	-	-	-
Raised bed	-	X	-	-	-
Groundcovers	-	-	-	-	-
Annuals or perennials	X	-	-	-	-
Shrubs	-	-	-	-	-
Deciduous	-	X	-	-	-
Evergreen	-	-	X	-	-
Row or mass plantings	-	-	-	X	-
Trees on Slopes	-	-	-	-	-
Slopes 4:1 or steeper	-	X	-	-	-
Slopes flatter than 4:1	-	-	-	X	-
Mowing	-	-	-	-	-
With non-mowing or reduced mowing	-	-	-	-	-
Push mower or small riding mowers	X	-	-	-	-

Table 2.4. Development Zone Chart

Components	Zones				
Increased number of mowing cycles	-	X	-	-	-
Large equipment use is restricted	-	X	-	-	-
Weed Control	-	-	-	-	-
Hand-weeding	X	-	-	-	-
Herbicide application	-	-	-	-	X
Mechanical (trimmers)	-	-	X	-	-
Irrigation	-	-	-	-	-
Turf - above ground spray	X	-	-	-	-
Turf - below ground drip	-	X	-	-	-
Drip or bubbler systems	-	-	X	-	-
Truck irrigation	-	-	-	X	-
Structures	-	-	-	-	-
Specialty pavings	-	-	-	-	X
Retaining walls	-	-	-	-	X

Partnering Opportunities

TxDOT resources are generally not sufficient to maintain a Zone I and or Zone II project. These types of development require a high degree of maintenance. TxDOT will consider these types of developments when local community or civic groups formally agree to provide the necessary maintenance.

Partnering arrangements should be developed where possible to maximize resources and to instill community pride through involvement in the beautification of TxDOT's highways.

Section 4 — Landscape Design

Overview

Landscape Design coordinates the Landscape and Aesthetics Assessment, Landscape and Aesthetics Master Plan, and other resources with basic landscape concepts to arrive at a working landscape and aesthetics design for a project. Landscape designers bring together ornamental aspects, functional needs, maintenance and sustainability, special environmental goals, relationships to structures, and other factors.

This section contains subsections on ornamental aspects of landscape design which include:

- The Aesthetics of Right-of-Way Vegetation
- Using Ornamental Grasses
- Non-mow Areas
- Restoration, Habitat Creation, and Naturalization
- Ornamental Landscape Planting Design Guidelines
- Plant Selection Criteria
- Plant Container Sizes
- Vandalism
- Using Trees in the Roadway
- Using Shrubs in the Roadway
- Using Groundcovers and Seasonal Color Plants
- Plant Material Relationship to Structures
- Planning and Design for Landscape Maintenance
- Plant Irrigation
- Irrigation System Types
- Designing for Weed Control in Ornamental Landscape Plantings
- Design Guidelines for Weed Control in Tree Plantings
- Design Guidelines for Weed Control in Beds and New Shrub Plantings

The Aesthetics of Right-of-Way Vegetation

The vegetation within the right-of-way, grassy vegetation and wildflowers, is an important part of roadway aesthetics. Grassed rights-of-way in urban areas that are weedy and unkempt give the cor-

ridor a neglected appearance and this image may be transferred to the city. Consequently, mowed vegetation that is edged and free of litter will lend the roadway and the city a look of cleanliness and neatness. In most cases, the first step in improving the aesthetics of the roadway should be to bring the existing vegetation to an acceptable level of appearance.

Roadside vegetation is maintained to accomplish specific goals of sight-distance, clear view of obstructions, erosion control, and aesthetics. Consequently, design alternatives should be reviewed to be sure that minimum standards are met for each of these issues. Most roadways are kept mowed to a height that accomplishes the needs of these issues and meets with the public's expectations for the appearance of the roadside. Public standards should be considered when developing any aesthetic programs that affect roadside vegetation to be sure the proposed enhancements meet with community acceptance.

Using Ornamental Grasses

Ornamental grasses as part of shrub or mass plantings may be unsuitable in most cases due to the extra maintenance required for cutting and removal of annual litter. Plants such as Pampasgrass have been used successfully in some instances where clean-up may be delayed for years at a time.

In the majority of cases grasses for the roadside shall conform as a minimum to the guidelines and specifications given in the *TxDOT Standard Highways Specifications for Construction of Streets and Bridges* and the *Roadside Vegetation Management Manual*.

Non-mow Areas

Non-mow areas are portions of roadside that for reasons of safety, utility, or aesthetics are removed from regular mowing and other management practices such as weeding, pruning, or herbicide control for an indefinite period of time. Sites that are far removed from the travel lanes, are difficult or dangerous to access, are hidden from view, or do not affect drive safety are candidates for non-mow status (see Figure 2-4).

The designer should be aware that the removal of regular mowing might allow weeds previously held in check to proliferate and present an unkempt appearance. The non-mow option is not synonymous with "restoration," "habitat creation," or "naturalization." Likewise, the adjacent land use must be considered. Mowing may be required to control invasive species that could proliferate on the right-of-way and invade the adjacent land. These conditions are most often encountered on rural rights-of-way.

Figure 2-4. Vegetation allowed to attain natural growth may be visually acceptable where it can be set back from travel lanes.

Restoration, Habitat Creation, and Naturalization

The use of the roadside for specialized environmental goals should be carefully considered to be sure that the safety, sustainability, and life-cycle costs of the project meet department goals and resources. These areas of environmental focus may be defined as:

- Restoration - Restoring a site to the topographic shape, hydrologic function, and plant community that existed in historical times before disturbance by man. This practice is expensive and requires detailed knowledge and constant management.
- Habitat Creation – Designing and managing plant communities for use as habitat by birds, mammals, reptiles, or insects. Habitat creation involves providing one or all of cover, food, or water to a targeted species and requires detailed planning and development funding. Where general habitat for wildlife is a goal, the preservation of existing sites is preferable to the development of new habitat.
- Naturalized Areas – The preservation or establishment of native plant communities either as an aesthetic program or as part of habitat creation. Naturalization seeks to promote or re-introduce native plants to minimize maintenance or improve the aesthetics of the roadside. This will usually involve the seeding or planting of desirable plants and periodic management to assist in their survival or it may focus on preserving threatened or endangered species. See Figure 2-4 for an example of a natural growth area.

Some portions of the right-of-way may be suitable as part of a re-naturalization project or to remove large areas from routine maintenance. These are usually large areas beyond the minimum distances from pavement edges that do not require regular maintenance and meet aesthetic and management goals. Most often these areas are found in large interchanges. In these projects, plant

material that would not normally be appropriate for use in other roadside applications may be desirable as a part of urban reforesting programs, wildlife habitat, or storm water quality programs.

The establishment of naturalized areas in the roadway will often entail specialized management techniques and scheduling that may require special specifications and contracting procedures. These needs should be carefully considered in determining the appropriate use and design of these features.

Ornamental Landscape Planting Design Guidelines

Plants can be an important addition to the right-of-way as an aesthetic enhancement that blends highway structures with the surrounding environment. Figures 2-5 through 2-8 show examples of effective planting design.

The proper use of plants can help make roadways a positive element in the visual fabric of our cities. The function and management of transportation corridors place exacting demands on the elements within the roadway. These demands must be thoroughly identified and understood in each design situation. The use of plants in the right-of-way must always be considered in the context of the important role of safe, maintainable transportation corridors.

Figure 2-5. Median plantings can add color and visual separation between driving lanes.

Figure 2-6. Bedded plantings in islands can add interest and variety. Height restrictions on plants in these areas are critical.

Figure 2-7. Pedestrian-ways are often good locations for ornamental plantings.

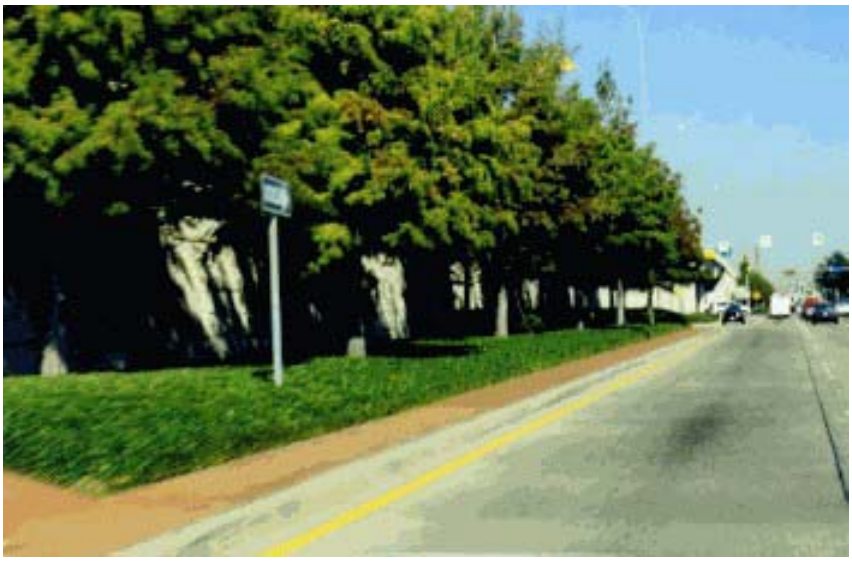

Figure 2-8. Plants are effective for visually softening tall retaining walls or noise walls.

Plant Selection Criteria

TxDOT is required to use regionally appropriate plants in highway right of way beautification projects.

Plants for the right-of-way must also be selected based on their anticipated maintenance needs and their adaptability to the roadside environment. The placement of plant material in the roadway is of critical importance because of its potential effect on driver safety. Plant placement will be discussed in a separate section (see Plant Material Relationship to Structures subsection).

Plants in the roadside are generally viewed at high speeds and are often only part of the driver's peripheral vision. Consequently, the variety of color and textures of complex, multi-species plantings is not appreciated by the viewer as it would be in residential or commercial applications. For ease of management, plant lists should be short and composed of species that have demonstrated an ability not just to survive but to thrive in the roadside environment. Many ornamental plants that do well in residential or commercial settings do not perform well in the stressful conditions of the right-of-way. High winds, exhaust fumes, and intense sunlight and heat make establishment difficult for even the hardiest plants.

While some native plants are suitable for the roadside, the roadside is very different compared to native environments. Roadside soils are subject to extremes of heat and cold due to the absence of tall grasses or litter layers present in most native plant communities. Understory trees such as Yaupon (Ilex decidua) that are attractive in a forest setting will generally not perform as well in the exposed conditions of the roadside. Additionally, slopes that assure well-drained conditions for roadbeds and structures lead to hot dry soils in the summer. Many native plants will be able to adapt over time to some of these harsh conditions but the fact they are native does not indicate any less need for carefully planned establishment programs.

Plant selection criteria deal with the following areas:

- water requirements
- adaptability to soils and climates
- appropriate size and shape of plants
- longevity
- insect and disease resistance
- noxious or invasive plants
- pruning

Water Requirements. TxDOT is mandated to adopt wise water-use techniques associated with landscape developments. Plants selected for use on the right-of-way must be sufficiently hardy to maintain themselves without regular, supplemental irrigation once they have become established. The goal of roadside landscape irrigation is to allow the plants to become established such that supplemental irrigation is no longer required. In most situations, irrigation systems that are three to five years old will not be repaired if damaged. System design should allow for scaling back the system to completely manual operation for plant replacement or during times of severe drought. (See Plant Irrigation.)

Adaptability to Soils and Climate: Plants must be adapted to the climate of the area and to the unique environment of the roadway. The roadway has been engineered to support a paved travel surface. Consequently, the soils are often re-consolidated and compacted substrate materials. These soils are usually droughty and often infertile. In determining the adaptability of a plant, consider also its preferred soil pH, drainage needs, and pollution tolerance. Plants sited close to swales or in low, poorly drained areas should be capable of thriving in wetter soils. Those planted on slopes or near the tops of embankments should be able to withstand drought and high wind conditions.

Appropriate Size and Shape of Plants. Plants selected should fit within their intended location without impairing safety or maintenance access when their mature size is attained. Plants must not obscure any unyielding structure within the 30-foot clear-zone.

Longevity. Plants should be long-lived for their plant type and purpose. In some cases this may be a native plant species but this is not a prerequisite to the consideration of a particular plant.

Insect and Disease Resistance. Avoid using plants that are known to attract and harbor damaging insects that are not easily controlled. Examples of plants to be avoided include (but are not limited to):

- euonymus (scale)
- photinia (aphids)
- non-native holly (aphids and scale)

Noxious or Invasive Plants. Do not use plants that are considered noxious or invasive. Examples of plants to be avoided include (but are not limited to):

- cottonwood
- chinese tallow
- chinaberry
- hackberry

Pruning. Plants requiring frequent pruning to look or perform well should not be used in the roadway. Plants such as wax myrtle, photinia, or sumac may be more appropriately used in naturalized areas where frequent maintenance is not intended and the plant is free to attain its full, mature size. **No plant should be placed where pruning will be required in the future to maintain safe sight-distances**.

Due to the open character of the roadway, plants are often exposed to high winds. Trees which are weak-wooded or that routinely generate excessive limb-fall such as pecan and mimosa can provide potential hazards to traffic or become projectiles during mowing operations. Plants that are susceptible to limb breakage should be avoided. Plants that produce large or popular fruits are not suitable for the roadside since these may entice pedestrians into the roadway or generate projectiles. Examples of plants to be avoided include but are not limited to:

- pomegranate
- persimmon
- bois d'arc
- fruiting plums
- pears
- pecan

Plant Container Sizes

Plant container sizes will vary according to the type of plant and to the species. Shrubs will usually be nominal sizes of one to five gallons. Trees should generally be installed in sizes large enough to guard against theft yet small enough to be handled without the use of heavy equipment. Generally, 20-30 gallon sizes meet these requirements in most situations. It is recommended that large trees (greater than 3 in (75 mm)) be used very sparingly if at all. Experience has shown that larger trees establish slower and are more susceptible to transplant shock than smaller specimens.

Refer to Item 192, Table 1A and 1B in the TxDOT *Standard Specifications for Construction of Highways, Streets and Bridges* for a listing of container dimensions and designations.

Vandalism

The potential for vandalism and theft of materials within the right-of-way is sometimes high. Projects that are most susceptible are those with portions of the site not visible from routine traffic or those which have structures like bridges or culverts that provide shelter in inclement weather. Irrigation systems near areas such as these should have no above ground parts and include lockable covers on valves to discourage vandalism by persons using the water for drinking or bathing.

Plant theft is also an occasional problem particularly if the project is near residential areas. In such cases, select plant sizes that discourage theft and avoid the use of small shrubs.

Using Trees in the Roadway

The size of trees at time of planting should be based on budget, visibility of the plant to mower operators, and susceptibility to theft. Generally, small tree sizes less than 2 inches caliper are more susceptible to being stolen, particularly when the installation occurs near a residential area. Large trees greater than 3 inches caliper are usually slower to establish in the right-of-way and often exhibit some dieback within the first two to three years. In most cases the middle range of sizes, 2 - 3 inches caliper is a reasonable compromise for ease of installation, establishment, visual impact, and costs.

In some cases, the use of large trees, greater than 3 inches caliper, may be desired for the immediate visual impact they provide. Other than this large trees should be used sparingly. History has shown that loss rates are higher with larger specimens, even container-grown materials, and the higher costs associated with purchase and installation are often impractical, given the amount of right-of-way being planted.

It is important to note that trees with mature caliper of 4 inches or greater cannot be planted within clear zone.

Trees will require weeding and this can add significantly to the cost of maintenance of the project. The design should consider the alternative maintenance practices available and make estimates on the anticipated maintenance costs for this item.

Using Shrubs in the Roadway

Massed shrub plantings are those shrubs that are planted in groups or rows and where each is planted into individual planting pits (no area soil tilling) with the intention of creating a continuous shrub cover over the planted area. This method is most frequently used for erosion control on slopes, filling areas that are difficult for mowers to access, and screening off-site areas (see Figure 2-9). The preferred species for these applications are the larger shrub varieties. Avoid shrubs with leggy growth habits (ex. Photinia) since these invite weed and grass growth that is difficult to access with mowing equipment. Species that carry their foliage close to the ground surface are pre-

ferred since this helps reduce weed growth near their trunk and reduces the need for hand weeding and the possibility of damage due to string trimmers or mowers.

Figure 2-9. Massed shrubs on slopes add visual interest in addition to improving mowing efficiency in tight corners.

Bed plantings are those areas of tilled, prepared soil planted with varying plant types, usually shrubs. Beds should always be contained within borders deep enough and wide enough to prevent grass and weed invasion by stolons or rhizomes (see Figure 2-10). A significant portion of a bed is generally open to weed invasion during the establishment period, necessitating frequent weeding activities either by hand weeding or with herbicides. Consequently, the maintenance costs for shrub beds can be a significant part of the overall maintenance budget.

Figure 2-10. Bedded plants in turf areas require substantial edge protection against invasive grasses.

Using Groundcovers and Seasonal Color Plants

Traditional groundcover plant species such as Asian jasmine, honeysuckle, Virginia creeper, English or Algerian ivy, and similar species are often not suited to the plant management goals of TxDOT due to their general lack of hardiness, specialized maintenance needs, and susceptibility to invasion by weeds. Low-growing evergreen shrubs are a better alternative for situations where groundcovers are desired. Refer to Figures 2-5 and 2-6 for examples of groundcover settings.

The use of seasonal, ornamental plants (i.e.: annual color) is discouraged within the right-of-way due to the high costs of maintenance and replacement. Such plantings should not be included in projects that will be under state maintenance contracts.

Plant Material Relationship to Structures

- Signs: No plants with the potential of blocking a sign should be placed in front of the face of any sign (see Figures 2-11 through 2-14).
- Retaining and Noise Walls: Plants should not be placed any closer to a wall structure than half the expected mature spread of the plant.
- Elevated Roadways: Plants should not be placed where foliage may intrude to within 10 feet of the travel lane of elevated roadways and bridges (see Figures 2-15).
- Storm Water Structures: Trees placed near drainage structures may inhibit mowing equipment and lead to excessive hand maintenance. Keep trees at least 20 feet from headwalls and culverts to allow mower access.

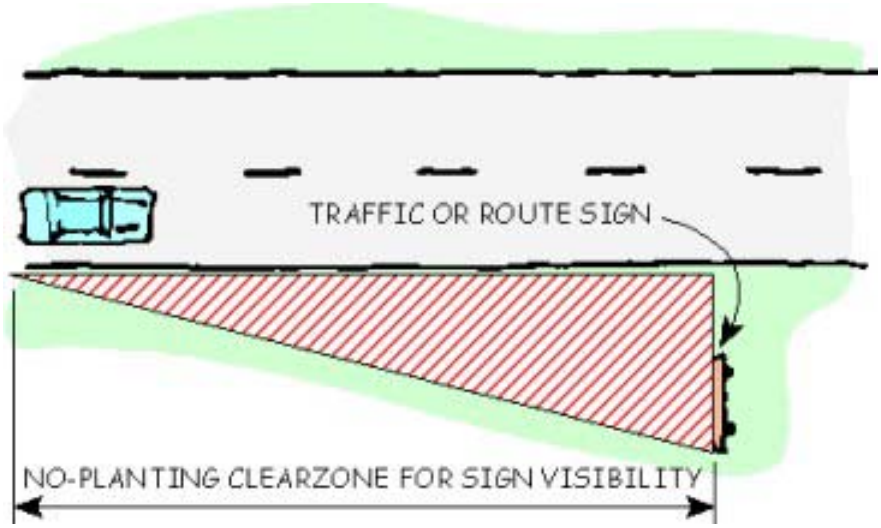

Figure 2-11. Plants must not be placed where they may obstruct any sign.

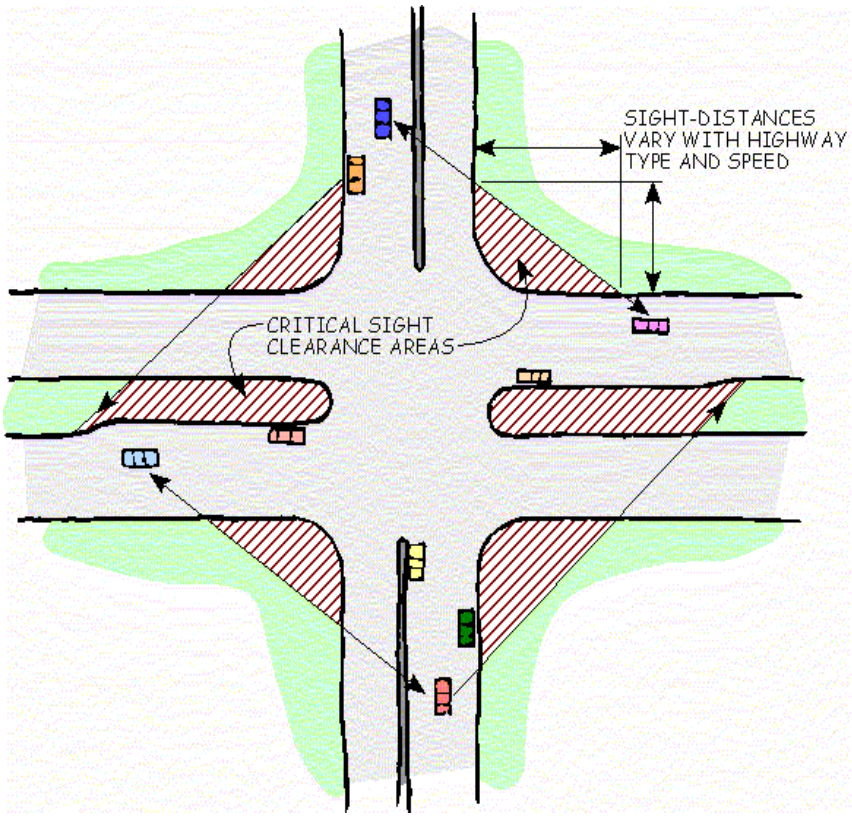

Figure 2-12. Visibility within intersections is always a primary goal. Plant use in intersection areas must be limited to low-growing varieties.

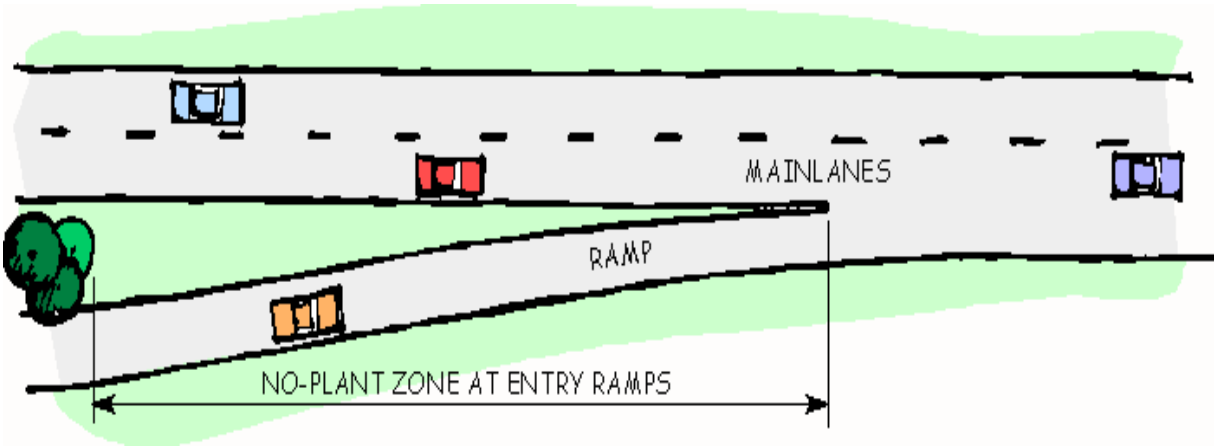

Figure 2-13. Approach ramps require long, unobstructed sightlines. Do not place plants near merging lanes.

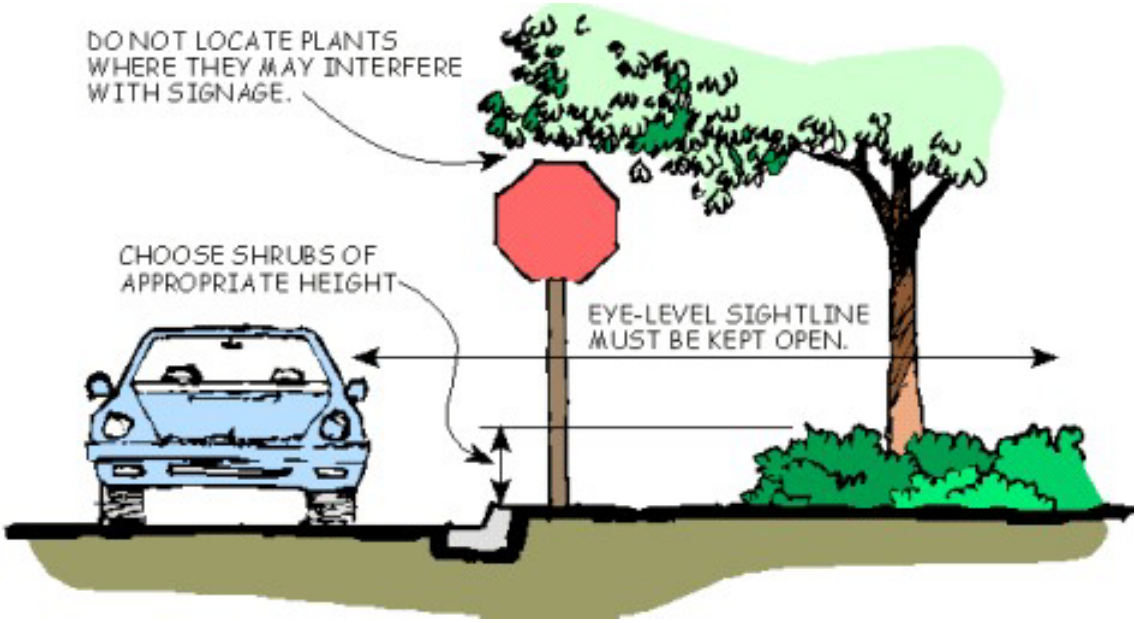

Figure 2-14. Select and maintain plants at intersections that provide open visibility in all directions.

Planning and Design for Landscape Maintenance

The suitability of any development for Texas roadways will finally be determined by its ability to be managed and maintained within the resource levels as determined by TxDOT. All proposals for development will include estimates of the extent, duration, and costs of maintenance into the future. (Estimating procedures are provided in the following chapters of this set of guidelines.)

Routine Maintenance Activities. Maintenance activities of one sort or another are constantly taking place within the right-of-way. These include but are not limited to litter pickup, mowing, trimming, structure inspections or repair, sign repair, guardrail repair, and herbicide application. Landscape development must be undertaken so that access is provided for normal maintenance operations. See Figures 2-16 and 2-17 for design considerations related to maintenance activities. Improvements must avoid the creation of unsafe conditions for motorists or maintenance personnel.

Figure 2-15. Trees should not be placed where their mature height or spread will interfere with utilities or encroach on travel lanes.

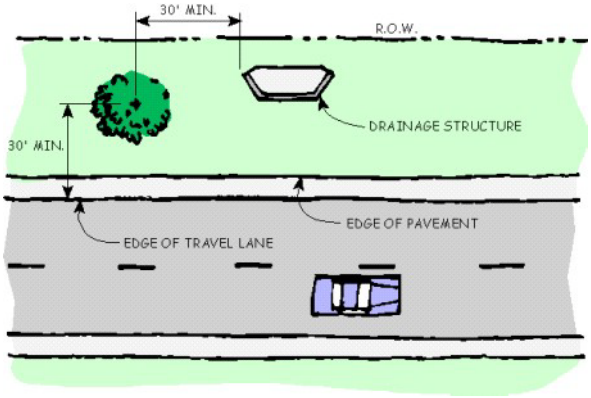

Figure 2-16. Allow ample room around drainage structures to facilitate maintenance.

Safety. Avoid situations that would require personnel and equipment to be on the driving lane side of guardrails and concrete barriers or on the shoulders of high-speed, main-lane traffic. On frontage roads, allow a minimum of 3 feet clear space between the back of curb and any area to be maintained for maintenance personnel (and their equipment) to stand well clear of moving traffic.

Figure 2-17. Always provide paved setbacks near traffic lanes for the safety of maintenance crews.

Mowing. Mowing roadway vegetation is an important maintenance activity. Landscape development projects must take into consideration the functional requirements of the operation to insure that safety and efficiency are not impaired. The consideration of mowing operations within a corridor must also recognize the relationship between time and equipment. Mowing costs are calculated by the acre for each mowing event and can be significant over time. The rate per acre is a function of the estimated time required to mow an area that is determined by equipment size and obstructions present. Areas that have no or few impediments can be mowed with larger equipment, thereby reducing time and lowering costs. Areas where access is limited will necessitate using smaller equipment, take longer, and increase costs.

The width of the mowing equipment determines turning radius and maneuverability and is impacted by the spacing and arrangement of elements within the site. In general, the design should allow for flowing movements of equipment and avoid sharp turning operations. Avoid the use of isolated obstacles that would impede mowing operations. Consideration should be given to how the equipment will enter and exit the site and how and where turning operations will be required.

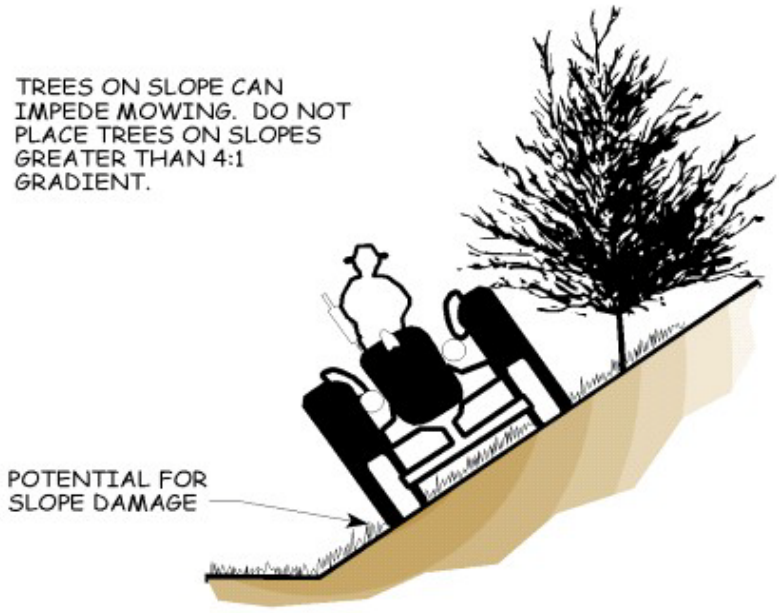

Figure 2-18. Trees on steep slopes can impose dangerous turning motions on mowers and often lead to damage of soil-holding grasses.

Weeding, Trimming, and Mowing. The most costly maintenance operations in landscape development projects are weeding, trimming, and mowing. When designing plantings for the roadway, careful consideration should be given to how these may minimize excess maintenance requirements while improving the overall maintenance efficiency of the roadside (see Figures 2-10 and 2-19).

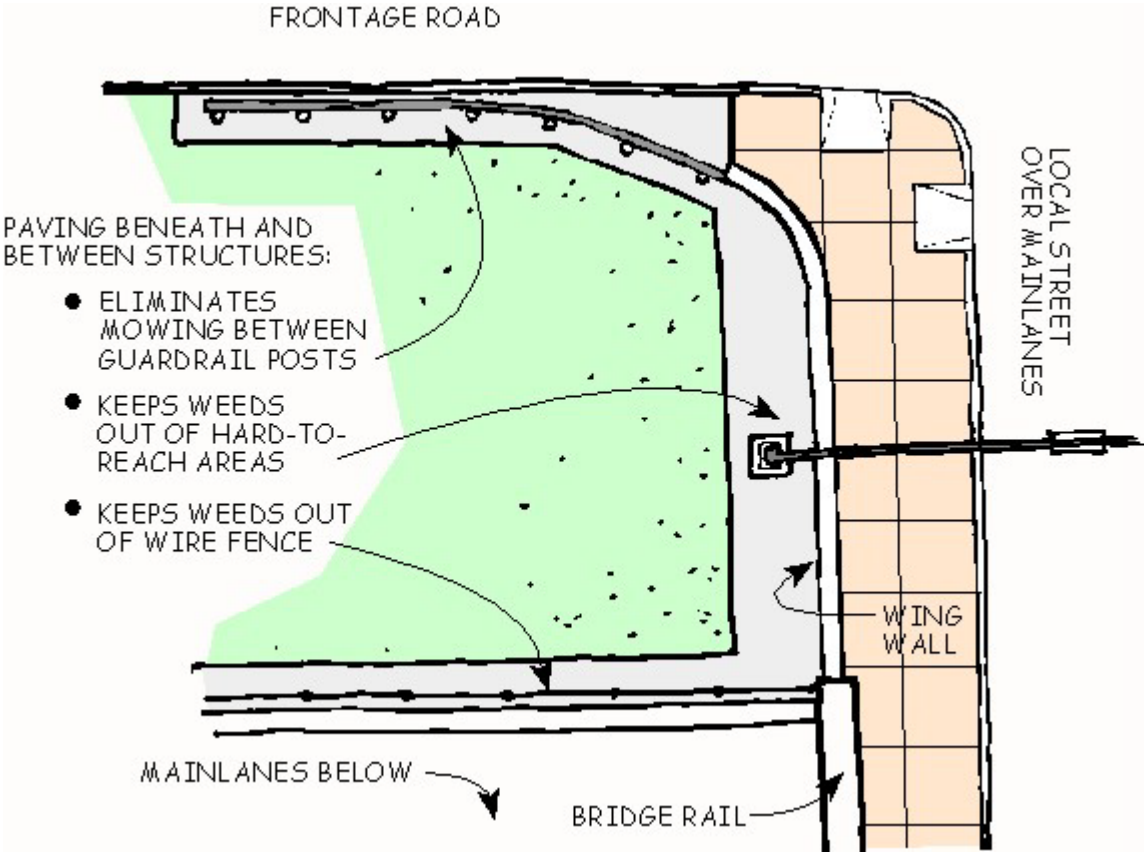

Figure 2-19. Concrete paving in hard-to-reach areas reduces maintenance costs and improves roadway appearance.

Specialized Maintenance Activities. It is important that proposed landscape developments be manageable within the resource capabilities of TxDOT. This includes anticipating the capabilities of the contractors responsible for executing maintenance contracts. In some cases, projects may be maintained by public agencies outside TxDOT. In these instances, the design should be tailored to the maintenance capabilities of the municipality or civic organization involved.

Plant Irrigation

Irrigation of landscape plants is generally recommended both to protect the monetary investment of the project and to help insure the plants' healthy development. Turf irrigation is not appropriate for the right-of-way except in those situations where responsibility for the maintenance and operation is assumed by other entities.

The conditions of the roadside determine the type of irrigation system suitable for use. Windy conditions can blow sprayed water onto pavement surfaces, possibly creating slick conditions where the driver does not expect them. Therefore, drip or bubbler irrigation techniques are preferred over those that discharge water in the form of sprays. In addition, keeping water on the desired target aids in water conservation.

Irrigation System Types

Drip system components may consist of barbed emitters in polyethylene tubing or in-line emitter tubing. Spaghetti tubing from multi-nozzle emitter heads should not be used due to ease of damage and numerous parts involved. Bubbler irrigation systems discharge water as a low pressure flow or as streams. Either of these may be appropriate depending on the type of plants and their spacing.

Irrigation systems should be designed so that no parts of the system are above ground in order to prevent vandalism, unauthorized use and to minimize exposure to damage. Valves or controllers that cannot be located below ground should be secured in locked boxes. Brass valves or nozzles should not be used due to their historically high incidences of theft for their salvage value.

Large irrigation systems should consider the use of automatic, electronic controllers. The use of solar power is permissible where costs make electric service impractical. Where possible, equipment selection shall match that of the systems already present on the roadside to create an economy of maintenance. Small irrigation systems may be able to rely on manual operation but the costs and unpredictability of manual operation should be considered. Truck irrigation is an option in isolated situations but unpredictable operators and damage to the site by the vehicles are important issues.

All irrigation systems will require routine inspection and maintenance. This factor should be considered in the development of long-term maintenance cost estimates.

Designing for Weed Control in Ornamental Landscape Plantings

The most costly aspect of the management of ornamental plantings is weed control. The application of design techniques that limit weed invasion is the first step towards reducing the overall cost of the project and extending its life.

Cost-effective, long-term weed control in shrub plantings is dependent on the rapid development of healthy plants. Therefore, intensive and timely procedures should be specified for the early stages of the project, particularly the 90-day establishment period.

Design Guidelines for Weed Control in Tree Plantings

Weeds at the bases of trees are unsightly and give the appearance of shoddy maintenance in addition to inhibiting the development of the tree. The following guidelines are recommended practices for controlling weeds in tree plantings.

Soil Amendments. The preferred backfill for new trees is the native soil excavated from the planting pit. Where native soils are rocky or filled with large clods, add compost or other specified material to fill voids in the backfill.

Soil amendments are best applied to the upper few inches of the backfilled pit to improve oxygen availability to the surface roots of the tree. Studies have shown that the addition of soil amendments creates a soil texture very different from the surrounding soils. This texture difference leads to a wicking-away effect on water applied to the plant, resulting in a water stress condition. If soil amendments are added to the backfill, irrigation schedules should be adjusted based on observation of soil moisture in the planting pit.

Fertilizers.

- Use soil tests to determine fertilizer needs of new tree plantings.
- Apply fertilizer to the surface or top two inches of the planting pit.
- Use a fertilizer drench once every 30 days during the 90-day establishment period.

Weed Control. For control of annual weeds in new plantings, include a granular pre-emergent to the surface of the planting pit prior to mulch installation. For control of perennial weeds, specify liquid post-emergent herbicide as needed and include removal of weed residue.

For control of annual weeds in post-construction or existing plantings, specify water- soluble or granular pre-emergent applied to surface of mulch layers. Follow with hand removal of weed residue.

For control of perennial weeds, specify liquid post-emergent as spot treatment as needed. Follow with hand-removal of weed residue.

Mulch. Pine bark mulches may be used on slopes less than 4:1. They are not recommended for slopes greater than 4:1 because they are easily dislodged and will migrate to the bottom of the slope. When using pine bark mulches specify a particle size of one-half to one inch, with an installed depth of two inches, unless otherwise shown on the plans.

Hardwood mulches are suitable for all slopes since they tend to “knit” together and resist erosion. Specify a particle size not longer than six inches at an installed depth of two inches, unless otherwise shown on the plans.

Irrigation. Conduct on-site field test to determine water infiltration rate to set minimum application per plant.

Design Guidelines for Weed Control in Beds and New Shrub Plantings

The goal of design for weed control in shrub beds or mass plantings is to quickly establish a dense cover of foliage so weeds are not able to effectively compete. Plantings should be designed so that at the end of two complete growing seasons, the plants form a complete, continuous canopy. This goal places strict requirements on the selection of plants for landscape projects. The requirements for shrubs or ground covers are:

- The plant should hold its foliage all year (evergreen); deciduous plants allow invasion by many annual weeds.
- The plant foliage must be dense enough to completely shade the ground surface.
- The plant should have a spreading growth habit rather than upright.
- The top of the mature foliage should be at least 12 in.

The following items highlight the design alternatives to be considered for controlling weeds in shrub plantings.

Bed Preparation. Specify a non-selective post-emergent herbicide to kill all vegetation and remove all existing sod to a depth of three inches. Specify weed-free replacement soil, or compost or other specified material.

Edgings. Beds should be edged with concrete to prevent weed invasion from adjacent vegetation. The edging should be a minimum of 12 inches wide and thick enough to withstand the weight of mowing equipment. Modular materials, such as concrete pavers and fieldstone have joints that allow weed invasion and should be used sparingly. Steel edging is not recommended because this material cannot hold up to mowing equipment.

Soil Amendments. Organic soil amendments such as bark, tree clippings, etc. are recommended for most bed plantings if they have been thoroughly composted and this should be specified clearly, refer to current compost specification. Uncomposted material such as fresh sawdust or tree trimmings should never be used.

Mulch. See mulch subsection for Design Guidelines for Weed Control in Tree Plantings.

Weed Barriers. Synthetic fabrics may be suitable for bed plantings but mulch on steep slopes could be easily dislodged by water runoff. All fabrics should be covered with appropriate mulch.

Weed Control. For control of annual weeds during 90-day establishment period apply granular pre-emergent to soil surface of planting pit prior to mulch installation.

For control of perennial weeds during 90-day establishment period apply liquid post-emergent spot treatment as needed. Follow with repeat application and specify follow-up for hand removal of weed residue.

Irrigation. Beds should be designed for permanent irrigation. Drip or bubbler systems are recommended (see Plant Irrigation) and watering rates should be set according to site conditions.

Chapter 3 — Project Development Process

Contents:

Section 1 — Overview

Landscape and aesthetic design is one part of the TxDOT's project development process. Each task in the process is described in detail in TxDOT's Project Development Process *Manual* (PDPM). The process is divided into several sub-processes that group associated tasks and events. The tasks are grouped into numbered chapters of the manual as follows:

- Chapter 1: Planning and Programming
- Chapter 2: Preliminary Design
- Chapter 3: Environmental
- Chapter 4: Right of Way and Utilities
- Chapter 5: PS&E Development
- Chapter 6: Letting

The Project Development Process *Manual* explains the overall process using a flowchart. The extent of involvement in each task depends on the needs of the individual project. Click LAFlow to see the flowchart.

The discussion in this chapter focuses on landscape and aesthetic issues that designers should be alert for and specific actions that should be taken. Most activities relate to Chapters 2, 3, and 5 of the PDPM. The numbers shown in the headings refer to specific task designations included in that manual. For more information about other activities included under a specific task, go to the referenced section of the PDPM.

Section 2 — Preliminary Design

Overview

Preliminary design steps include a number of activities to gather information and identify issues. A project's landscape architect may be involved in numerous preliminary design activities. This section covers the role of the landscape architect as it relates to the tasks highlighted below:

- data collection and preliminary design
- public meeting and design revision
- preliminary and geometric schematic design
- geometric schematic approval

Data Collection and Preliminary Design

During this step, landscape architects may be involved in tasks to:

- conduct preliminary design conference
- conduct early coordination with stakeholders
- obtain related data, plans, studies, and reports
- perform site visit

Conduct Preliminary Design Conference (2000)

A design division landscape architect should attend the pre-design concept conference. The landscape architect will advise the project manager of landscape and aesthetic issues that should be addressed during the preliminary design phase of the project. The objective is to identify the problems and issues early in the process so that the most cost-effective design options can be considered.

The landscape architect should be alert for:

- visually sensitive neighborhoods or natural landscapes
- environmental constraints that require design modification such as noise sensitive properties, wetlands, endangered habitat or plant species, cultural and historic resources
- urban corridors through special districts: retail, high-density housing, institutional, etc.
- issues related to bicycle and pedestrian accommodation within the right-of-way
- steps that should be taken to define the issues and identify actions to be taken in the preliminary design process to address identified issues successfully

Action items

- Advise the project manager of the need for a landscape architect on the design team with recommendations for in-house or consulting services.
- Identify specific areas of landscape and aesthetic concern.
- Identify issues related to bicycle and pedestrian accommodation.
- Provide written recommendations to the project manager.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Conduct Early Coordination with Stakeholders (2110)

The landscape architect assigned to the preliminary design team should coordinate with the project manager and individuals responsible for coordinating the environmental permitting process and attend meetings with natural resource agencies and other stakeholders.

The primary responsibility of the landscape architect in the preliminary design process is to identify landscape and aesthetic design issues that will impact the physical form of the project. Then, the landscape architect should coordinate with other members of the design team as the project progresses through schematic and final design.

The landscape architect should be alert for:

- resource agency demands that will require physical changes in the landscape, particularly such elements as deep cuts, elevated sections of roadway, complex interchanges, or ramps
- activities that require taking of right-of-way
- any activities that will impact wetlands or vegetation associated with vulnerable habitat
- established neighborhoods that will be significantly impacted

Action items

- Assist Environmental Affairs Division with the preparation of lists of data needs.
- Prepare documentation of specific landscape and aesthetic problems.
- Advise project manager in writing of any significant problems that may impact right-of-way needs or acquisition.
- Advise project manager in writing of any special data needs or studies that may be needed to address landscape and aesthetic issues.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading

Obtain Related Data, Plans, Studies and Reports (2160) and Perform Site Visit (1010)

Based on review of the site and preliminary meetings with resource agencies and identified stakeholders, landscape architects acquire and review existing documentation related to the landscape and aesthetic issues identified. Data collection phase should include a site visit and preliminary site analysis related to landscape and aesthetic issues.

The landscape architect should be alert for:

- ordinances, deed restrictions, or previous aesthetics related studies
- previous proposals for landscape development
- environmental reports or impact studies
- soils, geologic, climatic, vegetation, or development information that may inform the planning process
- grading and earth work requirements that will significantly impact the final form of the project or impact revegetation efforts
- gaps in the existing data that need to be filled

Action items

- Prepare a succinct site analysis that identifies landscape and aesthetic issues that will impact physical design. This may include structure location, vertical or horizontal alignment, earthwork, revegetation and drainage.
- Prepare requests or specifications for data collection that is needed to support landscape and aesthetic design activities.

For specific information on these project development tasks, refer to the PDPM under the task numbers referenced in the subsection heading.

Public Meeting and Design Revision

Public meetings conducted early in the process gather information from agencies, municipalities, and stakeholders about a project. This step is preliminary to the Environmental Affairs Division public participation process. It is important that the project landscape architect participate in initial public meetings and identify any landscape and aesthetic concerns that will impact the project.

Tasks in this step include:

- conduct public meeting(s)
- revise design based on public input

Conduct Public Meeting(s) (2260)

Several activities are associated with preparation for public meetings but not all activities will be required for every project.

Action items

- Prepare presentation materials related to landscape and aesthetic issues impacting the project.
- Review other exhibits and presentations.
- Attend public meeting.
- Prepare written summary of landscape and aesthetic issues for project manager.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Revise Design Based on Public Input (2270)

Public concerns about a project are often related to aesthetic issues. It is important that these issues be identified early and that positive responses are made to address the matters of concern. Doing so will usually minimize the costs associated with aesthetic treatments and avoid costly delays and retrofitting later in the design process.

Action item

- As needed, provide the project manager with recommendations or design alternatives that respond to landscape and aesthetic issues identified in the public meeting.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Preliminary and Geometric Schematic Design

During preparation of preliminary and geometric schematics, landscape architects may assist in the following tasks:

- evaluate corridor alternatives
- evaluate route alternatives
- evaluate geometric alternatives
- develop typical sections
- prepare assessment of landscape and aesthetic issues
- develop bicyclist/pedestrian accommodation concept

- develop preferred geometric alignment
- refine typical sections

Planning tasks that may involve landscape architects include those which:

- prepare mitigation plan for historic structures
- perform preliminary planning for bridges
- establish preliminary retaining and/or noise wall locations

Evaluate Corridor Alternatives (2300) and Evaluate Route Alternatives (2320)

The landscape architect should work with the design team to develop and evaluate route alternatives and configurations. Aesthetic issues are of increasing concern on urban projects where limited right-of-way is dictating that more of the traveled way be placed on structure. In rural settings landscape and aesthetic issues will more often be related to the visual character of the landscape and environmental concerns for protection of water resources and wildlife habitat.

During this phase of the work the project landscape architect should assist in developing alternatives by:

- advising on issues related to reestablishment and long-term sustainability of vegetation for erosion control, slope stabilization, drainage, and water management
- identifying earthwork and landform impacts
- listing geometric impacts on visual quality
- advising on the accommodation of bicycles and pedestrians

Action items

- Prepare a written assessment of advantages and disadvantages of each alternative related to landscape and aesthetic issues to include the accommodation of bicycles and pedestrians.
- Provide input as needed to the assessment of the “no-project” alternative.

  For specific information on these project development tasks, refer to the PDPM under the task numbers referenced in the subsection heading.

Evaluate Geometric Alternatives (2350)

During the development of preliminary geometric design the project landscape architect should focus on design issues that could significantly impact the visible landscape of the corridor and offer suggestions regarding possible alternative solutions. In addition the landscape architect should develop proposals for bicycle and pedestrian accommodation as appropriate to the specific project.

The landscape architect should be alert to geometric proposals that would:

- generate objectionable views to or from the highway corridor
- cause highly visible scars or radical changes in the landform or would adversely impact the visual quality of the highway corridor
- limit pedestrian or bicycle accessibility or safety
- compromise the long-term safety or sustainability/maintainability of the roadside

Action items

- Provide written assessment and recommendations to the project manager regarding alternative alignments.
- Provide appropriate graphic files for special alignments required for bicycle and or pedestrian facilities to be incorporated.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Develop Typical Sections (2360)

The project landscape architect works with the engineer responsible for preliminary design to develop typical sections for the project. This includes looking at all parts of the projects: ramps, embankments, bridge approaches, cuts, retaining walls, guard rail and traffic barrier requirements, drainage channels, noise walls, and any special erosion control or reforestation measures that may be required.

The landscape architect's work must focus on issues of:

- slopes and permanent slope stabilization
- sustainability/maintainability
- visual integrity and fit with the adjacent landscape

Action item

- Provide the preliminary design engineers with written comments and appropriate graphic files for typical sections.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Prepare Assessment of Landscape and Aesthetic Issues (2370)

The purpose of this activity is to identify landscape and aesthetic issues that will have to be addressed as part of the project. These issues frequently overlap with environmental concerns, highway, and bridge design. Early identification of landscape and aesthetic issues allows designers to address the issues early in the design process thus avoiding costly changes or retrofitting in the later phases of design.

Chapter 2 of this manual describes the process for conducting a Landscape and Aesthetics Assessment. The purpose of the assessment and resulting is to identify and codify the issues that must be addressed as the project proceeds through the design process. The factors driving these design issues are often matters of public preference, or required to address environmental concerns. Issues are best identified through the public participation process and appropriate field investigation.

Action items

- Identify and review any existing "Landscape and Aesthetics Master Plans" (LAMPs) that have been prepared for the project corridor or adjacent corridors. If a LAMP exists it should be reviewed to be sure that it covers the needs of the current project. If no LAMP exists for the project corridor, the project landscape architect should advise the project manager that LAP is needed.
- Assist the project manager in securing or developing LAMPs as needed.
- Prepare or assist the project manager in preparing the Landscape and Aesthetic Assessment statement.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Develop Bicyclist/Pedestrian Accommodation Concept (2380)

During the preparation of the geometric alternatives the project landscape architect should review the preliminary profiles and sections and, where appropriate, prepare a concept for the accommodation of bicycles and pedestrians.

The concept should include specific recommendations for location, profiles and cross sections. All recommendations for bicycle and pedestrian facilities must comply with ADA requirements. Bicycle facilities must be designed in accordance with the adopted portions of the AASHTO *Guide for the Development of Bicycle Facilities*. Pedestrian facilities should meet applicable sections of the AASHTO's *A Policy on Geometric Design of Highways and Streets*. Basic design information is provided in this manual.

Action items

- provide the project engineer with a written concept statement for pedestrian and bicycle accommodation
- prepare appropriate profiles and sections for the bicycle and pedestrian accommodation concept

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Develop Preferred Geometric Alignment (2500)

Working with the design team the project landscape architect may be responsible for developing landscape and aesthetic concepts and bicycle and pedestrian access plans. It is important that these tasks occur concurrently to optimize the design.

The landscape architect should be alert for:

- opportunities to integrate the alignment of pedestrian and bicycle ways with the configuration of the highway (The objective should be to meet all ADA, safety, and special alignment considerations while taking maximum advantage of the roadway alignment to avoid additional costs.)
- opportunities to use the clearing, grading erosion control and revegetation process to enhance the aesthetic quality of the highway corridor

Action items

- Identify and offer solutions for areas with difficult slopes, areas of high erosion potential or other areas that will require special attention to meet erosion control and revegetation needs.
- As required, prepare preferred alignment for all pedestrian and bicycle access facilities to be included in the project.
- As required, prepare a revised Landscape and Aesthetic Assessment statement based on preferred alignment and available public input.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Refine Typical Sections (2520)

Roadway Design has the primary responsibility for refining the typical cross sections. However, the project landscape architect should coordinate with Roadway Design regarding issues related to revegetation, reforestation, bicycle and pedestrian accommodation, and roadside sustainability.

The landscape architect should be alert for:

- opportunities to keep existing native vegetation in place; this reduces clearing and grading, revegetation and erosion control costs, is more environmentally friendly, and reduces long-term maintenance costs
- areas that will need special treatments to reduce erosion hazard and revegetation expense
- areas that will be difficult to access for maintenance or will tend to collect trash and debris

Action items

- Advise the project manager in writing of any cross section refinements needed to accommodate pedestrian and bicycle access and safety.
- Advise the project manager in writing of any areas where grading or sectional adjustments should be adjusted to preserve desirable stands of native vegetation.
- Advise the project manager in writing, and with appropriate graphic files, of sectional design alternatives that can be employed to help ensure sustainability/maintainability.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Prepare Mitigation Plan for Historic Structures (2530)

The project landscape architect should coordinate with Environmental Affairs Division, Design Division, Bridge Division, and other design sections in the preparation of mitigation plans. The project landscape architect may be responsible for issues of site design, and the preparation of preliminary plans that document agreements made in the environmental process. The degree of involvement depends on the nature and scope of the project.

When cultural or historic resources are identified as a significant part of a project the project landscape architect should meet with Environmental Affairs Division representatives or the District Environmental Coordinator to determine the scope of work that may be required. In the case of historic urban districts or neighborhoods there is often a need to coordinate a wide range of design details so that the highway project fits into the existing landscape. When these situations are encountered the project landscape architect should take the lead in coordinating the design details through the entire design process. This provides for the greatest possible continuity.

The landscape architect should be alert for:

- architectural details and conventions that can be incorporated into the project with little or no increased cost
- sections of the project that may require special attention to architectural detail, planting, or earthwork
- special site requirements for access, preservation of views, structures, or other features related to the specific resource

Action item

- Prepare preliminary mitigation plan with appropriate documentation.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Perform Preliminary Planning for Bridges (2580)

Major urban highway interchanges are characterized by numerous bridges and deceptively larger areas of open space. In the preliminary review of interchange bridges the project landscape architect considers a variety of issues.

The landscape architect should be alert for:

- opportunities to preserve existing vegetation to minimize clearing, grading, revegetation, and long-term maintenance costs
- areas that will be difficult to revegetate or maintain vegetation cover
- areas that can serve as permanent wetlands, storm water management and pollution control structures
- areas that will require special architectural or landscape treatment to meet erosion control, reforestation, or to increased sustainability

Action item

- Provide the project manager written comments on the interchange layout with appropriate graphics support files.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Establish Preliminary Retaining and/or Noise Wall Locations (2590)

The project landscape architect should review the location of retaining and/or noise walls. The primary concerns at the preliminary design stage are maintainability and impact of the walls.

Noise walls are visually dominating structures when they are required as part of a project. They can also be controversial, particularly with respect to location and architectural detail. On any project that will require the use of noise walls the project landscape architect should review preliminary plans for location and be sure that appropriate provisions are included in the Landscape and Aesthetics Master Plan to guide the development of final design details.

In situations where the use of walls may be controversial, design alternatives should be developed along with appropriate graphic exhibits as a means of developing public consensus.

The landscape architect should be alert for:

- maintainability above and below the proposed locations of the walls
- impact of the walls on the visual character and quality of the corridor
- potential impact of walls on adjacent properties and alternatives for mitigation

Action items

- Review the retaining wall locations and advise the project manager in writing of actions or special design considerations that may impact the location or final design of retaining walls.
- As appropriate, prepare design alternatives for proposed walls and develop graphic displays for use in building public consensus.
- Advise the project manager in writing of any alternatives to wall location, to reduce maintenance or opportunities to use the natural grade and land form to reduce the size or minimize the use of walls.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Geometric Schematic Approval

The following subsections outline action items associated with specific steps in the schematic approval process. The landscape architect has a continuing role in the process to:

- obtain approval of geometric schematic
- review geometric schematic with stakeholders
- revise geometric schematic based on input from public hearing
- obtain approval of final geometric schematic

Obtain Approval of Geometric Schematic before Public Hearing (2880)

This part of the preliminary design process is iterative and is the initial point of internal and external review. During this part of the process, particularly projects involving developed urban corridors, it is important that the project landscape architect take an active role.

Because this is an initial point of contact with municipal jurisdictions and neighborhood groups it is the best time to begin educating the public about TxDOT's approach to the highway landscape, the concept of corridor development zones, and opportunities for partnering with TxDOT to accomplish special landscape and aesthetic treatments. Over the course of this part of the process the landscape architect can observe a number of conditions which may impact schematic approval and project design.

The project landscape architect should be alert for:

- opportunities to partner with communities and other agencies that wish to assume maintenance of adjacent rights-of-way with Zone I or Zone II landscape development
- community concerns for visual, aesthetic, and/or landscape design details or qualities
- issues of cultural or historical significance that may not have been obvious in the early phases of project planning
- opportunities to enhance the highway corridor by taking advantage of existing resources that may have been overlooked in the initial schematic studies

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Action item

- Assist the project manager in negotiations or in the preparation of support materials.

Review Geometric Schematic with Stakeholders (2860)

This is the initial review. If significant landscape and aesthetic design issues have been identified at this point in the process the project landscape architect should participate in these initial reviews.

Action items

- Explain current approach to landscape and aesthetic issues, the process and tools used to manage landscape and aesthetic issues, i.e. the Landscape and Aesthetic Assessment and Landscape and Aesthetic Master Plan.
- Provide written materials describing applicable programs available to communities for accomplishing special landscape and aesthetics treatments.

For specific inform ation on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Revise Geometric Schematic Based on Input from Public Hearing (2890)

Where landscape and aesthetics issues impact the final schematics, appropriate revisions should be made and submitted for review. In general the input at this stage would be to identify areas to be planted as living screens, areas to be reforested or naturalized, etc. It may also involve special landform manipulation.

Action item

- Prepare revisions to landscape and aesthetics schematic design and submit to the project manager.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Obtain Approval of Final Geometric Schematic (2920)

At this stage district personnel and project landscape architects may want to pursue potentials for partnering with outside entities for long-term maintenance of enhanced landscape and aesthetics treatments.

Action item

- On the basis of approved schematics follow up with the appropriate agencies on agreements or partnering possibilities related to landscape and aesthetic measures included in the final schematics.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Section 3 — Environmental Design

Overview

The work of the Environmental Affairs Division focuses on activities required to obtain and maintain permits from the regulatory agencies. This includes data collection, field studies, and planning activities required by statute. The project landscape architect can be a significant resource to the Environmental Affairs Division and the District Environmental Coordinator throughout the planning and permitting process.

The level of participation in environmental activities will depend on the type and scope of the individual project. There may be significant landscape and aesthetic issues involved in reforestation, wetland mitigation, water quality management, or cultural, historic, and scenic resources. If so, the landscape architect(s) may be deeply involved in the entire process.

In general it is the responsibility of the project landscape architect to be conversant with all environmental issues in the project related to landscape and aesthetic design issues and oversee or assist in the preparation of PS&E required to implement environmental agreements. The following activities assist the landscape architect in fulfilling this responsibility.

This section groups tasks into the following areas:

- preliminary environmental issues and interagency coordination
- environmental documentation
- public hearing

Preliminary Environmental Issues and Interagency Coordination

In the investigation of preliminary environmental issues, the landscape architect helps to:

- review scope, cost, and staff requirements of project development
- determine public involvement needs
- conduct meeting with affected property owners
- collect environmental data
- perform early coordination with review/resource agencies

During this part of the project development process, landscape architects participate in public meetings as described in the subsections.

Review Scope, Cost, and Staff Requirements of Project Development (1400)

The project schematics for all projects should be reviewed at this point since landscape and aesthetic issues may have been identified in initial meetings with municipalities, MPOs, government officials and other stakeholders. Environmental specialists may wish to consult with a district or division landscape architect in these cases. They may wish to involve a landscape architect at this time to assist in the development of environmental documents, particularly if the project will require physical design and construction documents.

Action item

- The landscape architect should review the project requirements, public hearing summary, and schematics. Make written recommendations to project manager regarding the need for landscape architectural services, in-house or consultant needs, tasks that should be accomplished, areas of overlap with other divisions and sections, and products that will need to be produced.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Determine Public Involvement Needs (3010)

During the schematic review the project landscape architect or reviewer should be alert to information needs related to landscape and aesthetic issues. The reviewer should be alert for secondary and tertiary issues that frequently involve landscape and aesthetic concerns. Some examples of these types of issues are:

- concerns about visibility to or from a site
- pedestrian or bicycle safety
- accessibility
- noise and vibration
- new elevated or depressed sections
- complex interchanges or ramp configurations

Frequently these concerns will involve special landscape or aesthetic treatments. For this reason it is vital to understand alternatives that will be accepted by public interests. Early attention to these issues can simplify later parts of the process.

Action items

- Notify District Environmental Coordinator of any public involvement needs and recommend items to be included in the public involvement plan.
- Advise the project manager in writing of any adjustments needed in the scope of work statement, revisions in cost estimates, and recommendations for personnel or outsourcing of work.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Conduct Meeting with Affected Property Owners (3020)

When there are significant landscape and aesthetic issues that will impact the physical design of the highway the project landscape architect should participate in initial meetings with property owners. The objective of these meetings is to identify concerns and develop an understanding of issues**. Suggestions related to solutions are inappropriate at this time.**

The landscape architect should focus on:

- individuals and organizations in leadership roles
- reasons for concern, noise, view, historic, or cultural precedent
- specific locations
- individual and group preferences for materials, color, etc.

Action item

- Develop a written assessment of landscape and aesthetic issues related to the affected property owners along with an initial assessment of design alternatives that could be used to satisfy the concerns identified. The assessment is forwarded to the project manager and the environmental coordinator.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Collect Environmental Data (3030)

Work with District Environmental Coordinator as required, developing necessary base data in cases where visual and aesthetic concerns are a significant part of the environmental component. This would include situations such as major projects in historic urban districts or through scenic landscapes such as national parks or forests.

Action items

- Collect historic maps, drawings, and photographs. Public libraries and historical societies are primary resources.
- Obtain copies of reports and plans prepared by federal, state, and local agencies.
- Perform visual analysis to identify the potential aesthetic or landscape conflicts that may be caused by project construction. Particular emphasis should be placed on identification of sensitive neighborhood characteristics or cultural, historic, or scenic resources.

- Prepare a visual analysis of the project area. Take care to ensure that the analysis addresses specific issues related to neighborhood, cultural, historic, and scenic resources that may be affected by project design.
- Provide the District Environmental Coordinator with description of constraints related to landscape and aesthetic resources.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Perform Early Coordination with Review/Resource Agencies (3100)

Where aesthetic issues have been identified or in cases that will involve landscape modification for wetlands, reforestation, or specialized erosion control landscape architects can be helpful in early reviews with regulators.

Action items

- Accompany District Environmental staff to meetings as appropriate to become familiar with regulatory issues.
- Advise District Environmental staff on design and constructability of options for avoidance, minimization, and mitigation.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Environmental Documentation

In producing environmental documentation, the landscape architect will be involved in tasks to:

- conduct natural resources study
- conduct cultural resources study
- determine right of way relocation impacts
- analyze existing environment
- determine project's environmental consequences
- prepare landscape recommendations
- prepare description of project alternatives
- prepare exhibits for environmental documentation
- prepare environmental mitigation plans

Conduct Natural Resources Study (3250)

The landscape architects should provide assistance to the District Environmental staff in preparation of natural resource studies as needed. The landscape architect can be of particular assistance in cases where there are aesthetic concerns.

Action item

- Assist District Environmental staff in the collection and interpretation of landscape and aesthetic data related to the environmental process.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Conduct Cultural Resources Study (3260)

The landscape architects should provide assistance to the District Environmental staff in preparation of cultural resource studies as needed. The landscape architect can be of particular assistance in cases where there are aesthetic concerns.

Action item

- Assist environmental staff in the collection and interpretation of landscape and aesthetic data related to the environmental process.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Determine Right of Way Relocation Impacts (3310)

Many times the right-of-way impacts involve site usability after a taking, or aesthetic issues related to new construction such as property visibility, shading, noise, or access. In many cases landscape architects can help by preparing plans or other visual media that can illustrate solutions to perceived problems.

Action items

- Assist right-of-way staff with site evaluations and reuse scenarios related to site usability, visual, and other environmental impacts; the objective is to demonstrate solutions that will minimize impact on the adjacent lands.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Analyze Existing Environment (3315)

Landscape architects should assist District Environmental staff in determining visual and aesthetic impacts to a project site. Particular care should be given to visual design elements that give a site a unique or sensitive character that might be altered by construction.

Action item

- Assist District Environmental staff with site evaluations related to aesthetic, visual, and other environmental impacts; the objective is to document the relative sensitivity of existing conditions along with actions that may be necessary to avoid, minimize, or mitigate construction impacts.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Determine Project's Environmental Consequences (3345)

Where landscape and aesthetic issues have been identified as having potential environmental impact, landscape architects should assist District Environmental staff in the determination of environmental consequences.

Action items

- Assist District Environmental staff with developing the statement of environmental consequences related to aesthetic, visual and other environmental impacts; the objective is to document the relative sensitivity of existing conditions along with actions that may be necessary to avoid, minimize, or mitigate construction impacts.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Prepare Landscape Recommendations (3350)

Based on constraints and research, prepare landscape and aesthetic recommendations. The project landscape architect has primary responsibility for this part of the environmental document. It is important that landscape related recommendations are consistent with TxDOT's policy on roadside development. Likewise, considerations of aesthetics need to be documented so that they can be coordinated through the detailed design process.

Action item

- The project landscape architect provides District Environmental staff with formal recommendations for landscape and aesthetic development; recommendations come from the Landscape

and Aesthetic Assessment, existing, Landscape and Aesthetics Master Plans, and information gathered in public participation forums.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Prepare Description of Project Alternatives (3360)

When landscape and aesthetics considerations have been identified as a significant component of the project, the landscape architect should assist in the preparation of project alternatives. Contributions of the landscape architects can be very important in relation to construction feasibility.

Action item

- The project landscape architect assists District Environmental staff with the preparation of alternatives and developing the relative merits of each; emphasis should be on cost effectiveness, maintainability, and constructability.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Prepare Exhibits for Environmental Documentation (3370)

Graphic exhibits in the form of rendered plans; sections and perspectives can be very useful in communicating environmental concepts. The landscape architect should work with environmental staff to develop appropriate graphic exhibits. It is important at this point that graphic representations clearly convey concepts without committing to any physical solution. For example it is wise to keep materials, colors and other design specifics neutral unless they are specifically at issue.

Action item

- The project landscape architect assists District Environmental staff with the preparation of exhibits to be included in the environmental documentation.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Prepare Environmental Mitigation Plans (3390)

Landscape architects can be helpful in the preparation of environmental mitigation plans, particularly with respect to issues related to constructability and the preparation of PS&E.

Types of mitigation projects where landscape architects can be of assistance are:

- earthwork modifications associated with aesthetics or wetland construction

- siting of structures and site development or reconstruction
- revegetation and reforestation for erosion control or environmental mitigation
- water harvesting and retention
- special architectural detailing
- site planning and development for cultural and historic sites
- planning and mitigation actions needed to meet visual quality constraints

Action item

- Provide design assistance needed to support Environmental Mitigation Plans appropriate to the scope and scale of the project.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Public Hearing

In the final stages of the preliminary environmental design process, the landscape architect may be involved in steps to:

- conduct public hearing
- conduct environmental re-evaluation and determine resulting plan changes

Conduct Public Hearing (3500)

When landscape and aesthetic issues are clearly involved in the project the project landscape architect should attend the public hearing and participate in the proceedings as appropriate. In most cases the focus should be on fact finding and developing an understanding of public concerns. Suggestions regarding solutions to problems should be avoided at this time. Proposals should be developed later with input from the entire TxDOT design team.

Issues that the project landscape architect should attempt to identify at this point of the process are:

- Specific sites that have landscape and/or aesthetic issues that impact the design or alignment of the highway and its facilities.
- Groups or individuals that are pressing landscape and aesthetic concerns.
- Design specific preferences that may be brought forward by special interests. This may be things as simple as plant types, material types and colors or it may be references to other sites that have preferred or acceptable characteristics.

- Site-specific characteristics that are considered significant from a landscape or aesthetic point of view. These often take the form of unique architectural details or structures, existing street furniture, or landmark views or topography that has local significance.

Action item

- Prepare a summary report on landscape and aesthetic issues identified during the public hearing along with appropriate comments, and submit to the project manager and appropriate environmental coordinator; these comments are to allow the responsible individual to respond to public hearing comments.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Section 4 — PS&E Development

Overview

This group of activities represents the final design stage of the project development process. The landscape architect(s) assigned to the project at this stage are responsible for guiding the development of the landscape and aesthetic related portions of the project as well as coordinating preparation of PS&E for related environmental mitigation called for in permits and agreements.

Many of the elements that impact on landscape and aesthetic design overlap into all parts of the final design process. Typically these areas include:

- bridge design
- lighting design
- roadway design
- hydraulics
- environmental mitigation

Each of these design areas will have responsibility for roadway components that must be coordinated to meet landscape and aesthetic design goals of the project. The TxDOT landscape architects together with any consultants have the responsibility for coordination between the various areas of responsibility.

This section groups tasks into the following areas:

- design conference and detailed design plan
- final alignment profiles
- roadway design
- operational design
- bridge design
- drainage design
- retaining/noise walls and miscellaneous structures
- PS&E assembly and design review

A final note in this section discusses the nature and timing of the process, which may vary slightly based on specific situations in each project.

Design Conference and Detailed Design Plan

The primary instruments for ensuring that landscape and aesthetic goals will be met are the Landscape and Aesthetics Assessment and the Landscape and Aesthetics Master Plan. (LAMP) The following subsections describe how the landscape architect may participate in the project development steps to obtain additional or updated data and conduct design conference.

After the design conference, the landscape architect will participate in detailed design and follow through to final design plans, specifications, and estimates. Subsections in this section describe how landscape architects contribute to the process for the following design areas:

- plan sequence of construction
- design environmental mitigation details
- review data collection needs

Obtain Additional or Updated Data (5010)

Action items

- Visit the site and prepare brief summary of existing conditions; note any conditions that will require additional field information.
- Advise the project manager of any additional data requirements necessary to complete landscape and aesthetic based plan work.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Conduct Design Conference (5020)

The project landscape architect should attend all design concept meetings to be aware of all the concerns impacting on the final design.

Action items

- Provide the project manager with information related to landscape and aesthetic issues that will impact the preparation of the work plan and schedule; be alert to seasonal timing related to revegetation and reforestation of all types.
- Advise the project manager in writing of any needs for special consultants or recommendations for in-house staff assignments.
- Prepare scope of services for landscape and aesthetics related consultants.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Plan Sequence of Construction (5040)

The construction sequence often involves a variety of water quality measures and temporary erosion control issues where the landscape architects expertise can be utilized.

Action item

- Project landscape architect advises the project manager of suggested order of revegetation, erosion control, and reforestation; consideration should be given to phased planting early in the construction process to minimize cost of temporary erosion control.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Design Environmental Mitigation Details (5100)

Different groups depending on the project, the district, and the nature of the work prepare Environmental mitigation plans. In most cases the landscape architect is the professional with knowledge of design involving biologic processes and the skills needed to coordinate the preparation of technical PS&E. The goal of this part of the process is to meet the environmental commitment with the most cost effective and sustainable solution.

Action item

- Provide services necessary to coordinate the preparation of final PS&E for biological mitigation plans.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Review Data Collection Needs (5120)

Review data requirements for developing final PS&E for landscape and aesthetic elements and for any environmental mitigation work that is being included in the contract.

Action item

- Advise the project manager of any additional data needs for preparation of PS&E.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Final Alignment Profiles

The project landscape architect should review the development of final alignments and advise the project manager of issues related to revegetation and reforestation and erosion control.

Design Final Vertical and Horizontal Alignments (5200)

As the alignments are finalized the project landscape architect should finalize the work schedule for completion of PS&E for landscape and aesthetic design.

Action item

- Review final alignments; advise the project manager in writing of any special requirements for erosion control, revegetation, or reforestation related to alignment decisions.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Roadway Design

During this step, the landscape architect will assist with tasks to:

- design landscape/aesthetics plans
- develop plan and profile sheets
- design bicyclist and pedestrian facilities
- design miscellaneous details

Design Landscape/Aesthetics Plans (5280)

Action items

- Distribute the corridor LAMP elements to all design sections involved in the project; indicate those portions of the plan that may have a significant impact on final design.
- Provide coordination services with all design units related to landscape and aesthetic concerns.
- Hold a landscape and aesthetics conference to review specific landscape and aesthetic goals and to discuss issues that need to be addressed in preparation of the final plans.
- Distribute copies of the LAMP for the project corridor.
- Advise each section in writing of special provisions that may impact the final design.
- Coordinate the preparation of final plans that relate to landscape and aesthetic issues.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Develop Plan and Profile Sheets (5290)

On projects where reshaping of the land is desirable for reasons of aesthetics or to assist in the revegetation and erosion control process the landscape architect should work with appropriate design sections to achieve the design goals.

Action item

- Advise roadway design of any areas involving special earthwork; this would relate back to work in development of the final alignments.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Design Bicyclist and Pedestrian Facilities (5300)

Action item

- Prepare plans for pedestrian and bicycle accommodation; coordinate with roadway design or other appropriate design sections on alignments and special pavement treatments.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Design Miscellaneous Details (5330)

Action items

- Prepare miscellaneous details for landscape and aesthetics related treatments; this includes details for walls, pedestrian accommodation and amenities, special surface treatments, etc.
- Develop special details related to pedestrian, bicycle, or landscape treatment and forward to roadway design.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Operational Design

This step encompasses a plan for illumination design.

Design Illumination (5380)

Action item

- Forward recommendations for special hardware, poles etc. to bridge and roadway design to coordinate the aesthetic character of the corridor.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Bridge Design

In the bridge design step, the landscape architect may be called upon to assist with detailed bridge design plans.

Prepare Bridge Details (5500)

Landscape and aesthetic details of the project should be coordinated with bridge details. It is important that bridge details are consistent with and complementary to the elements of the LAMP.

Action item

- Coordinate aesthetic design details with bridge design; work with bridge section to integrate all landscape and aesthetic details.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Drainage Design

In drainage design, the landscape architect contributes to tasks that:

- prepare culvert and storm drain details
- design storm water pollution prevention plan

Prepare Culvert and Storm Drain Details (5570)

There are a number of structures involved in the final design of the drainage system. As appropriate, details of drainage structures should be developed to fit into the landscape and aesthetics scheme of the corridor. This includes elements such as head- and end-walls, guardrails, and pumping facilities. The primary goal is to ensure that the style, finishes, and materials are consistent with the LAMP.

Action item

- Advise the hydraulics section of any design inconsistencies with the LAMP.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Design Storm Water Pollution Prevention Plan (SW3P) (5600)

Action items

- Recommend seeding and planting for temporary and permanent erosion control; advise on the application and PS&E for use of bio-technical stabilization techniques.
- Forward details for permit purposes.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Retaining/Noise Walls and Miscellaneous Structures

This step includes efforts to prepare retaining and/or noise wall layouts, plans, and detailed design.

Prepare Retaining and/or Noise Wall Layouts (5640) and Prepare Retaining and/or Noise Wall Plans and Details (5680)

Action items

- Work with appropriate design section(s) on landscape and aesthetic issues related to wall locations.
- Review retaining wall layouts and details; make recommendations for finishes and treatments the fit the LAMP.

For specific information on these project development tasks, refer to the PDPM under the task numbers referenced in the subsection heading.

PS&E Assembly and Design Review

During PS&E assembly and design review, the landscape architect will be involved with work to conduct environmental re-evaluation and determine resulting plan changes. The landscape architect may also help the prepare PS&E package and be involved as the district performs final review of PS&E.

Conduct Environmental Re-Evaluation and Determine Resulting Plan Changes (5810)

This is the step in the process that brings together activities in the Preliminary Design Process with the Environmental Process during Plans Specification and Estimate (PS&E) development.

Action item

- Project landscape architect provides project manager written comments documenting changes in approved preliminary schematics as a result of the environmental process.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Prepare PS&E Package (5830)

Action item

- Provide project manager with all PS&E documents prepared by landscape section.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

District Performs Final Review of PS&E (5900)

Action item

- District landscape architect or consultant participates in the review of PS&E Package.

For specific information on this project development task, refer to the PDPM under the task number referenced in the subsection heading.

Nature and Timing of the Process

The process as outlined here, and in other manuals, appears linear. This is not the case. The process is iterative and seldom follows an orderly pattern. Each project will be different and involve varying degrees of input at each point in the process. What is important is that the landscape architects or appropriate consultants be active in the process, and provide input on landscape and aesthetic issues to ensure that the highway corridor meets department and client expectations.

Chapter 4 — Landscape and Aesthetics Guidelines for Common Structural Elements

Contents:

Section 1 — Overview

Section 5 of Chapter 1 lists the common structural design elements of transportation facilities. The sections in this chapter provide recommendations and guidelines for landscape and design considerations of those elements. Sections are:

- Bridges
- Retaining Walls and Noise Walls
- Topography and Grading
- Adjacent Properties
- Surface Finishes
- Traffic Barriers and Guard Fences
- Signals and Signs
- Illumination
- Bicycle and Pedestrian Access
- Public Art
- Medians and Traffic Islands

Section 2 — Bridges

Bridge Aesthetics

Bridges and their approaches are the largest single structures in the roadway. Their appearances may have a positive or negative affect on the image of the highway and the surrounding community.

One of the primary design goals of the bridge designer is to unite the bridge with its immediate environs or set the architectural tone for future development. This approach provides the designer with direction and guidance in the design process and helps assure that the aesthetic properties of the bridges are appropriate and effective.

A more detailed discussion of bridge design, including aesthetic considerations can be found in the Bridge Design Manual.

Section 3 — Retaining Walls and Noise Walls

Overview

Retaining walls and noise walls are strong visual elements since they are vertical and often quite tall. The Roadway Design *Manual* provides information on placement and structural detailing of walls. This section will discuss walls in terms of their visual relationship to the surrounding landscape and selection of surfaces and finishes.

Wall Color and Finish

Because walls are strong vertical elements they can dominate the field of view. The color, texture, and pattern of walls have a commanding influence on driver perception of the highway landscape (see Figure 4-1). Depending on the color and texture they will tend to blend or contrast with the background. In most cases the designer should pick colors that blend with the natural surroundings. Scale is also an issue, particularly in residential neighborhoods. Wall heights can be so commanding that they overpower the surrounding homes.

Figure 4-1. The apparent height of noise walls can be reduced with plant material, architectural detailing, and use of color.

It is important to consider both sides of the wall. The highway side should be designed to fit the driver's eye view but the opposite side of the wall should consider the impact on the adjacent properties (see Figure 4-2). When tall walls are placed next to single story residences, light colors and fine textures are the most effective. Colors should be muted so that they do not conflict with the color of the residence or its accessories. See the Surface Finishes section for more information on finishes.

Figure 4-2. The house side of sound walls can be a positive visual element for a neighborhood.

Some design considerations that will help guide the selection of colors and finishes include the following:

- Consider using horizontal patterns on the “house-side” of walls to de-emphasize the height.
- Vertical texture and rustication patterns tend to be most effective when long sections of wall are visible from the driving lanes. This tends to minimize the apparent visual length of the wall. (See Figure 4-3.)
- Where practical, vary the grade along the face of the wall and integrate with planting to minimize the apparent height of the wall. (See Figure 4-4 and refer to Figure 2-8.)

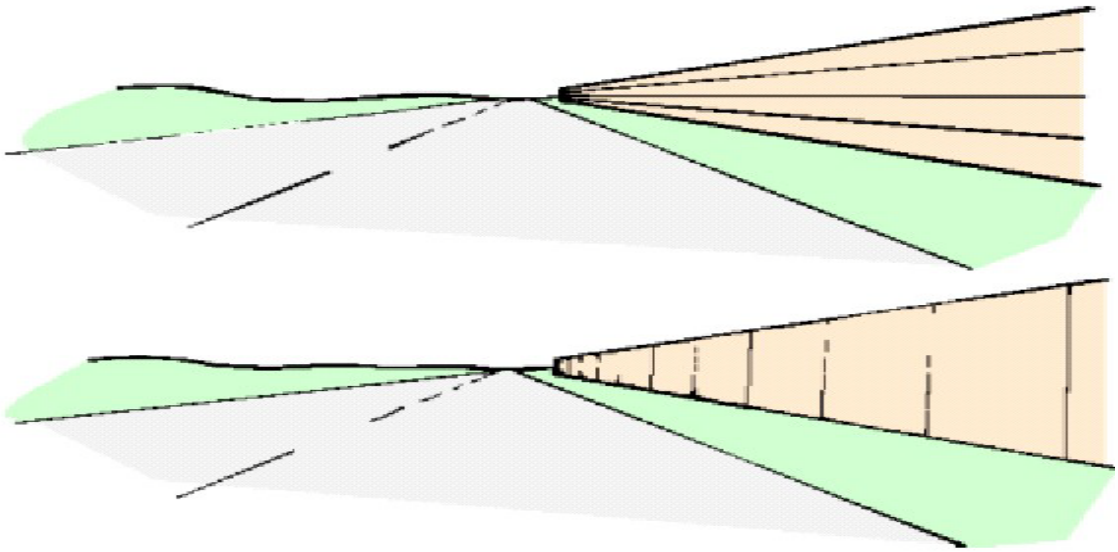

Figure 4-3. The dominant textural lines of walls affect their apparent height.

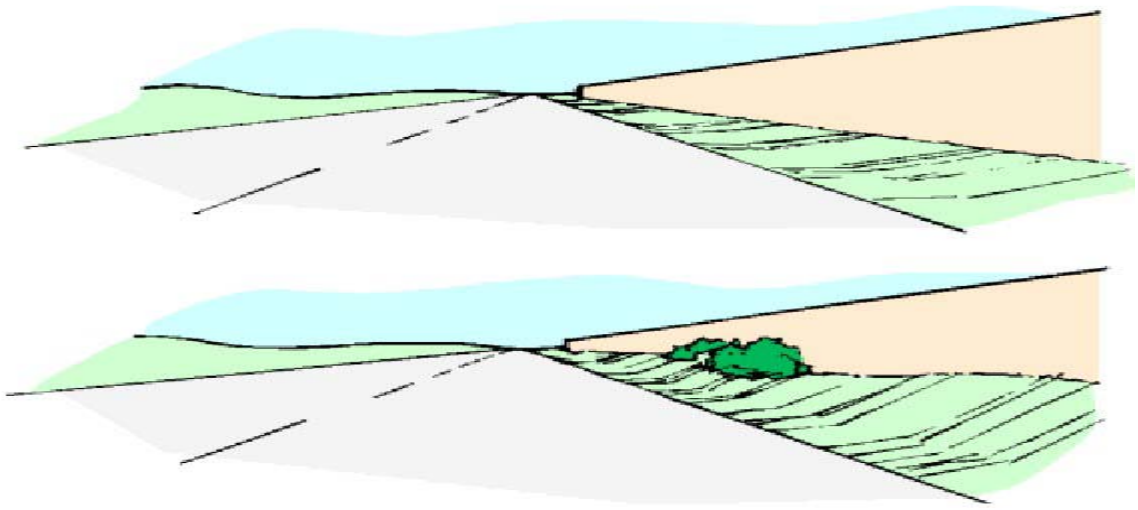

Figure 4-4. Plants and grade changes can add interest and reduce the apparent size of the wall.

Vertical Alignment

A significant aspect of wall design from an aesthetic standpoint is the contrast of the horizontal line of the wall with other elements near or behind it. Walls are viewed with the rest of the world as their background. For this reason their elevation view should be considered carefully.

The upper edge of a wall usually contrasts with elements in front of and behind it. This relationship should be considered to avoid visual conflicts with the immediate surroundings comparison. Wall caps that incorporate step-downs to make grade changes may contrast well with the smooth flowing

lines of adjacent landscapes (see Figure 4-5). This highlights the wall by setting it apart from the background, making it an even more dominant visual element. The same elevation may add an element of visual confusion to an urban scene filled with a lot of multistory buildings (see Figure 4-6).

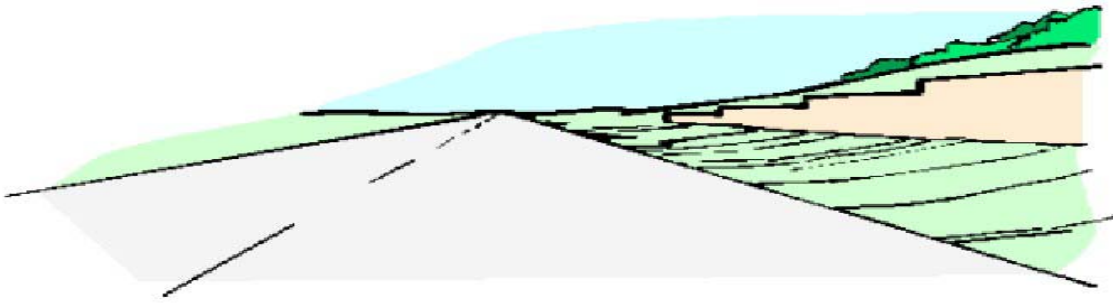

Figure 4-5. Wall profiles that increase the contrast between the wall and background make the wall more visually prominent.

This highlights the wall by setting it apart form the background, making it an even more dominant visual element.

The same elevation may add an element of visual confusion to an urban scene filled with a lot of multistory buildings(see Figure 4-6).

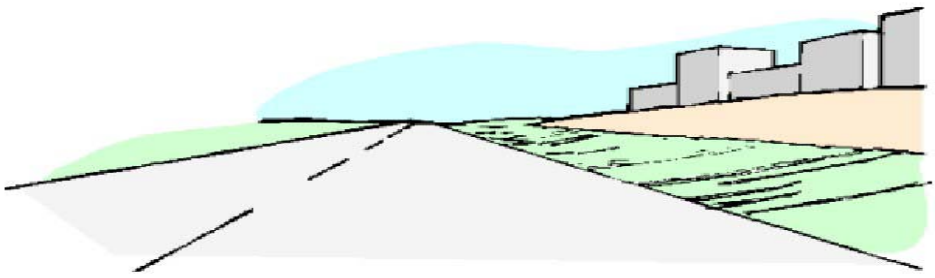

Figure 4-6. A smooth wall profile is often a pleasant contrast to more complex urban backdrops.

Wall caps that mimic or follow the shape of the background will tend to be less obtrusive (given similar influences of color, etc.) by blending its form with the surrounding landscape (see Figure 4-7). Wall caps should generally use their entire length to make grade changes if possible. If this is not feasible, elevation changes should be spaced uniformly within the varying section to provide a sensible, uniform rhythm. Avoid oddly spaced or uneven elevation changes and inconsistent angles or radiuses.

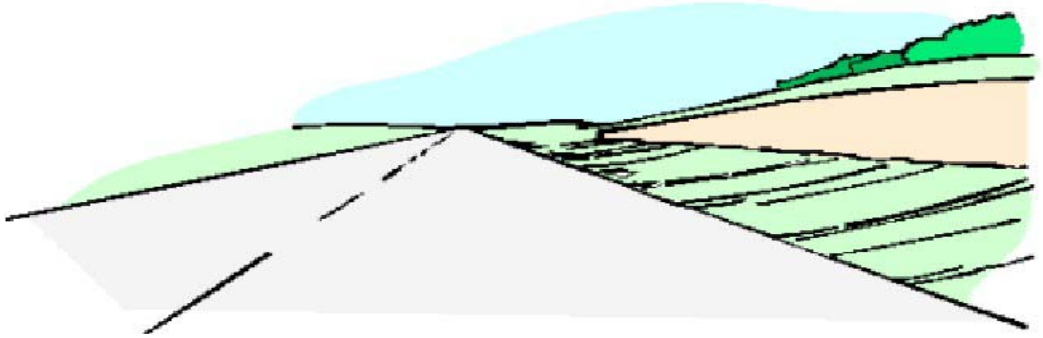

Figure 4-7. Wall profiles that mimic their backgrounds are less visually prominent.

Section 4 — Topography and Grading

Overview

The landform has a major influence on driver perception of the highway and the surrounding landscape. The alignment and profile of the roadway and right-of-way are set early in the design process. These early decisions actually determine the overall character of the subsequent landform.

Alignments that are set perpendicular to the natural lines of terrain will generally be the most problematic because they will require the greatest modification in grade. Typically radical changes result in step cut slopes and deep fills. Depending on the terrain and the type of substrate, these deeper changes in landform can be visually objectionable and difficult to maintain. (See Figures 4-8 and 4-9.)

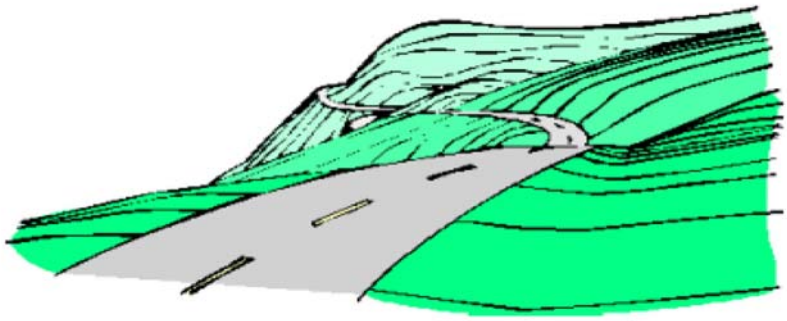

Figure 4-8. Road alignments which minimize deep cuts offer a flowing, gentle appearance.

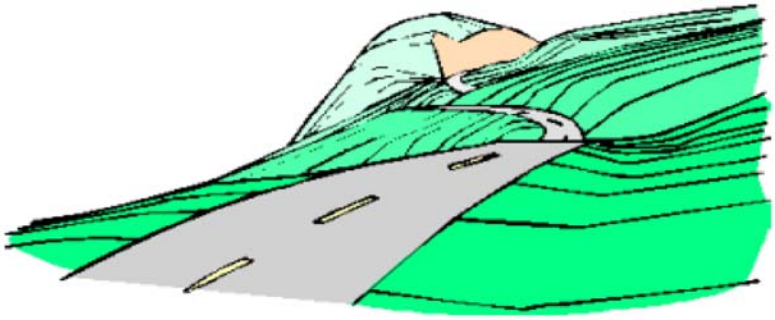

Figure 4-9. Deep cuts can be visually dominating, presenting a scarred appearance often difficult to re-vegetate.

During the design process considerations should be given to the landform that will result from any particular alignment. Primary considerations include:

- potential aesthetic qualities
- consideration of difficulties that may be encountered in stabilizing the resulting cut and fill slopes

Overall topics covered in this section are: landform manipulation for aesthetic purposes, designing for erosion prevention, limiting erosion potential, and ground surface protection for erosion control.

Landform Manipulation for Aesthetic Purposes

Manipulation of the landform is a very effective tool for modifying the visual scale of roadside elements. Landform manipulation will also add variety to the setting and reduce the sense of visual clutter common to urban centers and complex interchanges.

Design solutions that employ landform modification are most cost effective when undertaken in concert with the horizontal and vertical alignment of the roadway. Designers are encouraged to collaborate with landscape architects on projects where landform modifications can be used as part of the overall landscape and aesthetics design concept. Areas where landform modification should be considered as part of the overall solution include:

- large, multi-level interchanges
- rights-of-way that require noise walls
- medians
- embankments

Large, Multi-Level Interchanges

Large interchanges are sometimes visually confusing as a result of numerous bridge supports. When approaching the interchange this may appear as a forest of concrete columns that have no pattern. These large highway interchanges frequently provide sufficient space to generate significant grade changes that provide a gentle contrast to a rigid architectural scene. Skillful manipulation of landform can help to reduce the visual scale and bring a better sense of visual order to the interchange.

Figure 4-10. Landform modifications in interchanges can reduce the apparent scale of the structure and make landscapes more visible to overhead lanes.

Rights-of-Way that Require Noise Walls

Noise walls, because of their length and height, may be visually overpowering in terms of relative scale. To be effective the walls often must be higher than the buildings they are designed to protect. Where possible, use landform modifications or plant material to gain this elevation difference. This technique minimizes the visual dominance of the walls and blends the wall into the landscape.

Medians

Where space and drainage patterns allow, berms may reduce or prevent median crossings and reduce headlight glare. Careful consideration should be given to the cross section to ensure driver recovery, mowing access, and drainage. No berms should be placed within the sight triangles at intersections or at crossovers on multi-lane divided highways.

Embankments

Roadway embankments often form large physical landmarks so their aesthetic character can have a significant impact on the surrounding community. Excessively steep and abrupt embankment slopes do not blend well visually with adjoining landscapes, are difficult to maintain, may erode easily, and may limit or prevent the use of other landscape enhancements.

Many visual problems associated with embankments are related to the degree of difficulty in maintaining vegetation on steep slopes, near or between barrier devices, in inaccessible areas close to structures, signs, or luminaires. To reduce these problems, consider the following practices:

- employ measures to prevent vegetation growth within or between barrier devices (See Figures 4-11 through 4-14 for examples)

- provide paved mow-strips along the edges of walls or other structures (See Figures 4-15 and 4-16)
- reduce slopes where possible to increase maintainability and reduce the chance of erosion and slope failures
- combine signage and structures where possible to reduce obstacles to maintenance

Figure 4-11. Grass under guard fences is a continuous maintenance problem, requiring mechanical trimming or herbicide control.

Figure 4-12. Concrete paving under guard fences is effective at vegetation control but may be difficult to replace if damaged.

Figure 4-13. Open holes for posts allow replacement in case of damage but are susceptible to weed invasion.

Figure 4-14. Patterned concrete and color are options to add visual appeal under guard fences.

Figure 4-15. Concrete mow-strips are effective and recommended for reducing maintenance and improving appearance.

Figure 4-16. Weedy vegetation against structures tends to make the entire area appear untidy and trashy.

Designing for Erosion Prevention

Erosion of the ground surfaces in the roadway threatens the stability of the pavement and structures, increases costs for cleaning of drainage structures, and contributes to siltation and turbidity of nearby streams and lakes. The costs associated with the control and repair of erosive surfaces can be significant and sometimes directly impact driver safety. Many erosion problems can be prevented by fitting the roadway alignment to the terrain and keeping slopes as flat as possible. Desirable cross sectional properties of a highway are as follows:

- slopes as flat as economically practical (max. 3:1, 6:1 preferred)
- rounded top and bottom slopes
- stepped cut-slopes where suitable rock is encountered

- incorporation of streamlined cross-section design techniques to help reduce wind erosion (See the AASHTO web site at http://www.transportation.org)

The areas most susceptible to erosion are slopes (15:1 and greater) associated with embankments and drainage channels. Embankments often receive concentrated runoff from pavement surfaces that, depending on soil and slope conditions, may lead to significant erosion problems.

Limiting Erosion Potential

Sheet flows on slopes are the primary mechanism for transporting soil down the face of the slope. Erosion can be limited by intercepting any surface flow at the top of the slope and conveying it in a suitable channel to the base of the slope.

Concentrated flows should be intercepted at the top of the slope in diversion channels and conveyed in turf reinforced channels to the bottom of the slope. Turf reinforced channels use a permanent geosynthetic fabric to reinforce the channel and prevent scour of the channel surface. Paved gutters on the face of embankment slopes are not recommended. Paved channels interfere with mowing activities and frequently break up as embankments settle.

Designers can limit erosion potential through the use of approaches such as:

- vegetation maintenance on slopes
- drainage channels
- ponds and water quality structures
- ground surface protection for erosion control
- compost or mulch
- erosion control compost or soil retention blankets
- channel liners
- bioengineering techniques for erosion control and streambank stabilization

Vegetation Maintenance on Slopes

Many visual problems associated with embankments are related to the degree of difficulty in maintaining vegetation on steep slopes, near structures or between barrier devices, or in inaccessible areas close to structures, signs, or luminaires. The following practices help prevent potential problems in these areas.

- Employ measures to prevent vegetation growth within or between barrier devices.

Solid-surface paving materials such as concrete and asphalt have been successfully used in these areas. Asphalt paving should incorporate concrete edging in turf areas to protect it from deteriora-

tion. Textures and colors may be added to these materials to add variety and interest. These materials are preferred over loose aggregates and pavers since the latter are easily invaded by weeds. (See Figures 4-11 through 4-14.)

- Provide paved mow-strips along the edges of walls or other structures.

Concrete is the preferred material for use as mow-strips along beds and walls. Asphalt is not suited since its edges are easily invaded by weeds and grass and the edges are susceptible to damage by mowing equipment unless a concrete edge is included. (See Figures 4-15 and 4-16.)

- Reduce slopes where possible to reduce erosion and failures, and increase maintainability.
- Combine signage and structures where possible to reduce obstacles to maintenance.

Figure 4-17. Careful attention to sign/structure relationship can greatly improve maintainability and appearance.

Drainage Channels

Drainage channels are important components of the roadway and are detailed in the Hydraulic Design Manual (look for it to be available online in the near future). In addition to hydraulic design, channels should be designed to prevent long-term soil erosion. Design characteristics that will prevent or reduce erosion are as follows:

- maintain gentle well vegetated side slopes on borrow ditches and drainage ways
- utilize an approved channel lining material

Narrow, steep-sided channels are susceptible to erosion by high water-flow velocities making permanent vegetation difficult to establish. In addition, weedy growth in narrow channels is difficult to remove mechanically, requiring increased use of herbicides.

Ponds and Water Quality Structures

As highways and interchanges increase in size, larger land areas are incorporated within the right-of-way. Interchanges and intersections have become increasingly important as sites of water collection, detention, and/or metering as part of broader water quality management and storm water control. These areas help meet environmental requirements and can add to the aesthetic quality of the highway and the surrounding landscape.

Water detention basins and ponds are used to provide flood control and remove silt and contaminants from highway runoff to protect downstream water bodies. Properly designed ponds rely on the bio-filtration and particulate-capture capabilities of the soil and vegetation. The design of these structures begins with clearly defined goals for the hydrological needs for water control integrated with a thorough understanding of vegetation and ecosystem properties and their management. Design parameters that relate to the development of PS&E for wetlands, detention ponds, and water quality structures are as follows:

- provide setbacks and side slopes that allows driver recovery of errant vehicles (see Figure 4-18)
- protect the structure with curbs or other barrier devices where appropriate
- gentle side slopes to allow maintenance equipment access for mowing and other activities (6:1 max.)
- use natural, freeform design of the edges of the ponds (see Figure 4-19)
- select vegetation types adapted to the hydraulic and soil regime of the region and zone of the structure
- use proper botanical names for all plants
- prepare a detailed grading plan to establish shape and grades of the structures
- prepare appropriate cross sections of weirs, dams, outlet structures, subdrainage, and spillways
- prepare specifications for filter sands, soil additives, clay or fabric liners, and temporary erosion control

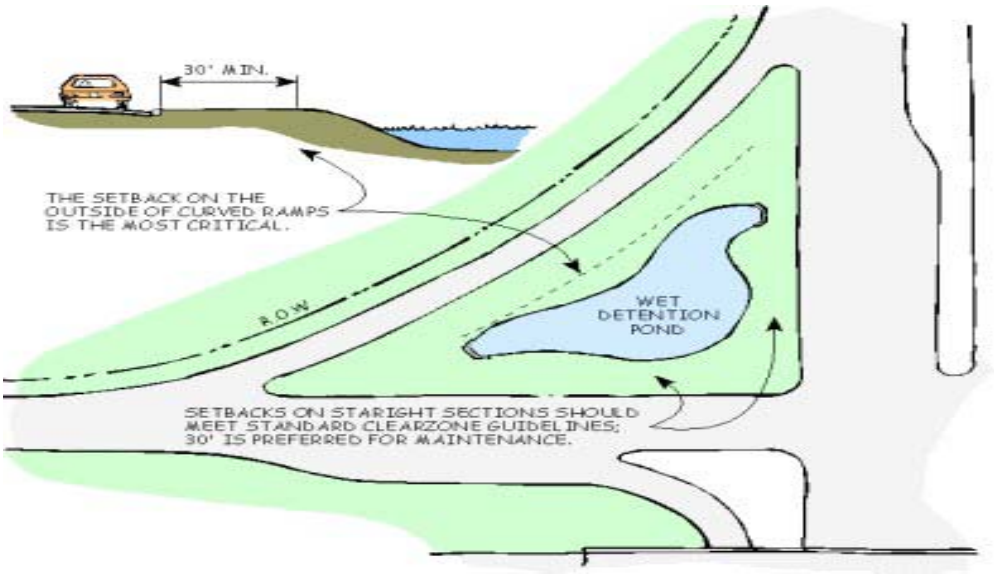

Figure 4-18. Allow adequate recovery areas around ponds and basins.

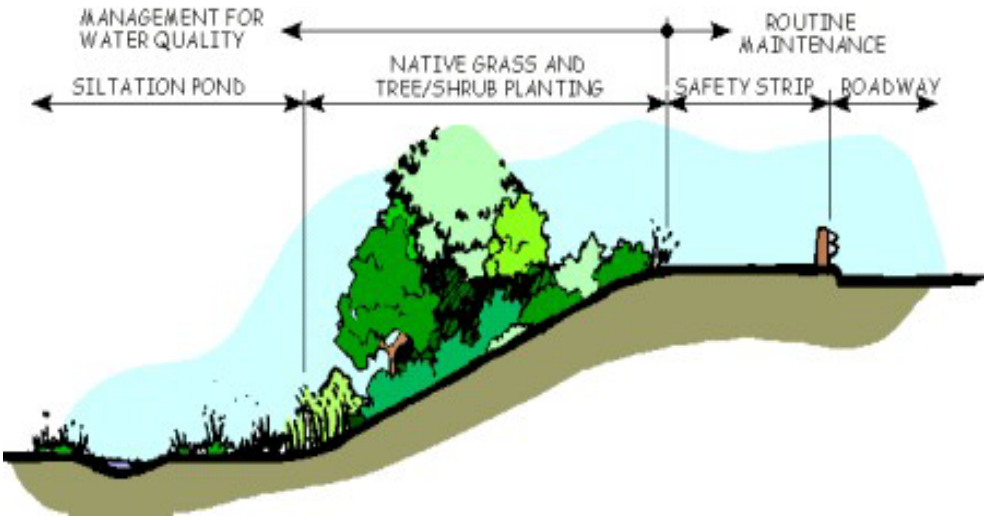

Figure 4-19. Use native vegetation at basin edges to provide a natural appearance.

Ground Surface Protection for Erosion Control

The primary material used for erosion control on the roadside and in drainage channels is vegetation. However, prior to establishing permanent vegetative cover it is usually necessary to protect the soil surface from immediate erosion. There are a variety of natural and synthetic materials available for temporary erosion control.

There are two primary considerations in selecting an appropriate temporary erosion control measure: soil type and slope. Research shows that soils with greater than 17 percent fine sand or silt particles are highly erosive. Soils with less than 17 percent sand or clay particles can be considered cohesive soils or clays.

As the degree of slope increases, the potential for sheet erosion increases. Sandy soils can be protected with hydraulically applied mulch or straw or compost on slopes up to 7 percent (14:1). Above 7 percent an approved soil retention blanket or erosion control compost should be considered. Cohesive clays can be protected with mulches on slopes up to 20 percent (5:1). Above 20 percent, riprap should be considered.

Compost or Mulch

The primary function of mulch is to maintain moisture in the soil and foster seed germination and plant development. There are three types of mulch used for erosion control:

- straw or hay mulch
- cellulose fiber mulch
- compost

Straw and Hay Mulch. Straw and hay mulch are used as surface covers in conjunction with some type of tacking agent (tackifier). The tackifier helps form a uniform mat and prevents migration of the material down the hill. Straw can also be crimped to help prevent material loss or migration.

Cellulose Fiber Mulches. Cellulose fiber mulches are hydraulically applied. Cellulose mulches may be applied with the seed mix and a tacking agent to form a more consolidated mat on the surface. TxDOT maintains a list of approved cellulose mulch materials. Depending on the soil type, hydraulically applied mulches can be used on slopes up to 3:1. If the soil is very sandy cellulose mulches would not be recommended on slopes over 6:1.

Compost. Compost may be blended to make compost manufactured topsoil in flat areas. Slopes up to 3:1 should utilize Erosion Control Compost.

Erosion Control Compost or Soil Retention Blankets

TxDOT maintains an Approved Materials List for Soil Retention Blankets at `http://www.txdot.gov/business/resources/erosion-control.html`. This list describes the conditions for application and provides a list of materials approved for each group of uses.

Erosion Control Compost. Erosion Control Compost may be pneumatically applied on slopes 3:1 or flatter or spread with a blade up to 3:1., (refer to the current Compost Specification). This material not only provides short term erosion control with mulch chips but also works to improve the existing soil.

Channel Liners

TxDOT maintains an Approved Materials List for channel liners at `http://www.txdot.gov/business/resources/erosion-control.html`. This list describes the conditions for application and provides a list of materials approved based on its resistance to tensile stress.

There are two broad types of channel lining material: organic/organic composites and synthetics. In general, organic and composite lining materials are used for vegetation establishment and offer no long-term channel protection. The synthetic materials are longer lived and work with the root matrix of the vegetation to provide long term protection of the channel. Synthetic materials are preferred in ditches and channels that will have frequent flows at depths greater than 8 in (200 mm).

Bioengineering Techniques for Erosion Control and Streambank Stabilization

Bioengineering is the use of live plant materials or plant materials with geosynthetics to accomplish slope and streambank stabilization needs and erosion control. TxDOT is developing technical data for the selection, design and specification of bioengineering technologies appropriate to Texas. Information from this project will be included here at a later date.

Plant Materials

Plant materials are an integral part of bio-technical or bioengineering erosion control methods. Success of any technique relies on the proper selection and handling of plant materials.

Herbaceous plants. Herbaceous plants do not develop any woody tissue and will generally follow a seasonal cycle of growth, reproduction and die back. Grasses and forbs are the most common types of herbaceous vegetation used in erosion control. Native grasses used for erosion control must be selected for their ability to persist in specific environmental conditions and should have physical properties suited to erosion control.

Woody Plants. Woody plants used in bioengineering are those materials that will root easily from woody stock. The most common species are the willows (Salix) and the poplars (Populus).

Live cuttings. Research is being conducted on handling live cuttings for this application. Information from research will be included here at a later date.

Other Bioengineering Techniques

Wattle fence and wattles, living cribs, reed plantings, live fascines, and other bioengineering techniques are being investigated for this application. Research findings will be included here when they become available.

Section 5 — Adjacent Properties

Overview

A critical part of understanding the context of design is the character of adjacent properties. The visual relationship between a transportation corridor and the adjacent properties is critical when making landscape and aesthetics decisions. The aesthetic quality of a transportation facility and adjacent structures must be considered from the viewpoint of the vehicle operator and adjacent property users. Regardless of the land use, the objective is to achieve an appropriate visual fit between the transportation facility and its surroundings.

Aesthetic design decisions should be based on information from two primary sources. The first consideration is the character of the existing properties adjacent to the corridor. Base information should be gathered in the field such as dominant colors, materials, and scale. The second source of information is the public participation process. Very often public objections, particularly regarding expansion projects, relate to aesthetic concerns. It is essential that the public participation process be used to identify these concerns and, to the extent possible, address them in making landscape and aesthetics decisions.

In most cases, aesthetic issues will involve one of the following design objectives:

- blend the highway with the surrounding landscape
- contrast the highway with the surrounding landscape
- screen the highway from the adjoining properties

Blend the Highway

The goal of context sensitive design is to visually blend the highway with adjacent properties. This option is generally the least expensive and simply requires attention to detail, landform, and issues of scale. Several design tools can be used to accomplish this objective:

- Employ materials similar to those in the adjacent landscape. This is particularly important in urban centers where the built landscape is dominant. For example, if the adjacent neighborhood is single-family brick veneer houses, brick or pavers will help blend structures into the setting.
- Use similar colors. Quite often it is impractical to use or attempt to match the materials of the adjacent landscape. In these cases color becomes the single most important tool.
- Use similar plant materials to blend the landscape. In the rural setting landscape materials can be used to supplement and link existing landscape features. Considerations of cost and maintenance prevent more large-scale changes to the dominant landscape. In urban centers use plants to accent and visually connect with other landscape elements near the highway. For example, if

there are street trees adjacent to the right-of-way repeat the same trees to help blend the highway setting.

- Be sensitive to the visual character of the landform. Landform can be a dominant element of the roadway, particularly in hilly or mountainous terrain. Exposed rock faces, steep cut slopes, and high fills can be dramatic in scale but are often objectionable if they bisect existing landscape features considered visually pleasant or socially significant. It is important to consider the landform in the alignment stage of the design process, and be sure that there will be no adverse reaction to the resulting landform. Cuts through white, limestone, or tall cut slopes that are silhouetted against the skyline will contrast sharply with the surrounding landscape and are usually objectionable from a visual standpoint. Dealing with these issues early in the design process will avoid costly aesthetic remediation activities later.
- Use complementary street furniture. The street furniture should be selected to blend with the architectural qualities of the adjacent properties, as in Figure 4-20. Remote regions tend to be less sensitive to the details of guardrails, traffic barriers, signs, light standards delineators etc. However, in urban areas there is often a need to develop details that will blend with surrounding architecture. This can be particularly important in sections of highway that go through special or historic districts of the city. In these situations, additional expense may be justified to achieve the desired results.

Figure 4-20. Appropriate architectural details complement the urban context and help blend the highway with its surroundings.

Contrast the Highway

There are occasions where the design objective is to have the highway contrast with its surroundings. There are cases where there is a lack of variety in the surrounding landscape or the surroundings may be so visually confused that there are few redeeming qualities to the views from the road. In these cases it may be desirable to manipulate the aesthetic qualities of the road so that it becomes the dominant visual feature. Tools that can be used to achieve this objective include the following.

- Use curbs and concrete traffic barriers to visually and physically delineate the driving lanes. This is particularly effective on urban streets. Where practical, use colors to achieve contrast. See Figures 4-21 through 4-26 for examples.
- Vegetated medians offer excellent contrast to the travel lanes, making their edges more clearly evident. Additionally, turf areas offer visual relief and glare reduction in large expanses of pavement in multilane highways. Medians with turf also hide small litter objects better than bare pavement, helping to keep the roadway neater in appearance.
- Materials and textures can be manipulated more economically on small paved surfaces such as walks and drive aprons. Likewise, the colors and textures selected can be used to reinforce the contrast between the highway right-of-way and the surrounding properties.

Figure 4-21. Gore areas should be paved so that maintenance is reduced around signs and delineators.

Figure 4-22. Exit ramps provide entry into communities from the highway. Treating the gore areas can enhance visibility and aesthetic character.

Figure 4-23. Gores with the same colors and textures as the travel lane may not be readily distinguished from the travel lanes.

Figure 4-24. Add color to increase contrast and improve visibility of lane separations.

Figure 4-25. Color and texture highlights at crosswalks improve safety and aesthetics.

Figure 4-26. Adding color to traffic islands improves visibility and delineates travel lanes.

Screen the Highway

Screening adjacent properties from view is usually the most expensive alternative depending on the length of the corridor that needs to be screened. Before the screening objective is adopted be sure that the goal can be effectively met. Many times it is impossible to completely screen an objectionable view and attempts to create a screen simply call more attention to the problem.

Keep in mind that the experience of a highway is a cumulative impression rather than an impression of a single point in time. In most cases the most realistic screening scenarios are when the view of the highway needs to be screened from an adjacent property.

When screening is the design objective the following design tools should be considered:

- Place the screen material as close as possible to the viewer. The closer the screen is to the viewer the greater the area screened from view.
- Be sure that screens observe setback and sight triangle requirements.
- Use appropriate choices of structure and vegetation. Architectural solutions such as walls and fences generally require less frequent maintenance than the use of plant materials (see Figure 4-26). Established trees with natural understory have favorable maintenance properties after establishment (see Figures 4-27 and 4-28). However, this solution requires sufficient space and may not be acceptable in tight urban conditions.
- Consider time constraints. Where time is a consideration, architectural solutions give the most immediate results. Planting by itself will take time to develop but is more visually appealing when mature. Where possible, combining architectural features with planting will produce the most favorable long-term result.

Figure 4-27. Brick is compatible with residential areas but can be visually dominating. Vegetation in front will help reduce the apparent height of architectural structures.

Figure 4-28. Plants reduce the scale of walls and prevent long, continuous sections from becoming monotonous.

Figure 4-29. Vegetation with low maintenance properties is a good choice for screening.

Section 6 — Surface Finishes

Overview

The surface finishes of elements such as bridges, walls, posts, and pavement have a great influence on the visual character of the landscape scene and should be considered carefully during the design process. Special finishes may be used on virtually any structure or roadside element as long as its function is not impaired. Generally, special finishes used on any item considered an obstruction should seek to highlight the presence of the object rather than blend it into the background.

All surfaces are perceived by a combination of their color, texture, and pattern. These combinations are, in turn, modified by scale and distance.

Color

Color plays a principal role in our ability to make sense of the landscape. The various highlights and contrasts of the scene we see enable us to readily distinguish elements from one another and to pick those that are most important to us at the moment. In this regard, color is an important element in the roadway. It should be considered as a tool to improve driver perception and therefore the safety of the roadway in addition to its aesthetic value, as shown in Figure 4-30.

Figure 4-30. Coordinated colors and appropriate graphics can enhance entrances into communities.

Choosing colors. The colors selected for a transportation facility should be suitable for the intended purpose. That is, colors should help increase the safety and ease of use of the facility as well as increasing the visual appeal. Some basic guidelines that can be followed to aid in making color selections are:

- Link elements widely separated by space. Colors used to link elements should be similar in shade and brightness (see Figure 4-31).

- Highlight certain elements to attract attention. Highlighted elements need colors brighter than those round them (see Figure 4-32).
- Reduce the visual prominence of an element. Muted colors that reflect less light than other elements near or behind them will attract less attention.
- Contrast one element with another to enable quick identification. High-contrast colors used close to one another will attract attention to that spot.

Figure 4-31. Colors can visually unite different structures in a scene.

Figure 4-32. Bright colors create interest with contrast and attract attention to the area.

The Effect of Distance on Color. Atmospheric conditions can reduce or enhance the intensity of colors. Where transportation facilities are concerned, the effect of most atmospheric conditions (haze, fog, rain) is to wash out the intensity and brightness of the actual color. Colors that appear bright or very intense in close proximity will appear much grayer in actual field conditions. Colors

that are intended to be distinguished at long distances should generally be brighter than one would normally select for objects intended to be viewed from close range to compensate for this phenomenon. Figures 4-33 and 4-34 show examples of bright colors used along the roadway.

Narrow lines of color will quickly be lost unless they are very bright. Color lines only a few inches in width, meant to accent an element, will not be visible for long distances.

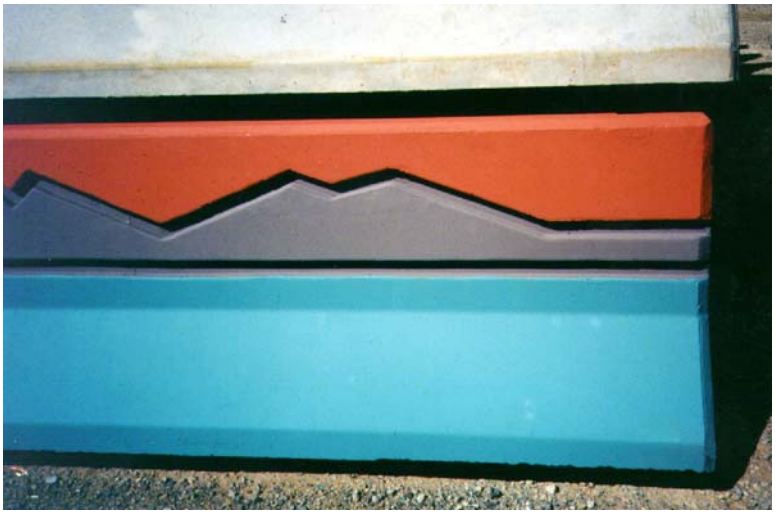

Figure 4-33. Concrete traffic barriers are easily molded to reflect local themes. Bright colors are necessary for visibility at long distances.

Figure 4-34. Bright colors tend to appear muted in light-saturated roadways.

The Effects of Scale on Color. The size of the roadway creates a relationship between color, texture, pattern, and scale that should be noted. In order to be appreciated, a color, pattern, or texture must be visible. The size of treated areas should not be so small as to have little visual effect. Inversely, too much of a single treatment can become boring or overpowering. There are no hard-and-fast rules to determine when these lines have been crossed but generally, special treatments should accent rather than dominate a landscape scene.

Texture

The material that provides the greatest flexibility in selecting texture is Portland Cement concrete. Textures on concrete may be achieved through the use of form-liners, sandblasting, or washing to expose the integral aggregate. The moldability of concrete allows unique patterns to be included in the design at a reasonable cost.

Choosing textures. Textures are most visually effective where traffic speeds are slower as at controlled intersections or where structures are close to the travel lane. Textures should be rougher if they are to be seen from longer distances. Rougher textures create more shadows on their surfaces and so create a high contrast with the sunlit areas of the surface, thereby providing a more visually prominent surface. Figures 4-35 and 4-36 show effects of distance on texture appearance.

Figure 4-35. Deep shadow-lines increase the distance at which texture can be perceived.

Figure 4-36. Coarse textures appear relatively smooth past a few hundred feet.

Textures on horizontal surfaces (pavements) will not be very prominent from the driver's perspective unless they are very coarse or very near the driving lanes. Textures on pavement may be used to highlight different use areas such as pedestrian ways, bike lanes, and important decision points for handicapped persons.

Pattern

Patterns are another method of adding visual interest to an element or scene. These are most commonly found in the modular patterns of retaining walls where the shape of the panel provides the pattern. These decorative patterns are very successful at adding interest to otherwise plain surfaces (see Figures 4-37 through 4-39).

Ideally, the patterns should be coordinated through a corridor. This does not mean that all wall patterns should be the same. In some cases the patterns may help distinguish a particular site from others, avoiding monotony and creating interest. On the other hand, too many patterns in a small area can create visual confusion. If varied patterns are desired, a good rule of thumb is to limit any one view to only two different patterns.

Figure 4-37. The smooth, strong line of the cap is a good contrast to the angular lines of the panels in this wall.

Figure 4-38. This wall cap steps down with the panels and adds interest to the wall.

Figure 4-39. Plant material may be incorporated with a pattern to add interest and soften visual impact of a wall.

Special Finish Options

Special finish options vary according to the type of structure and surface to be treated. Figure 4-39 shows the use of a form liner to create a special finish. The most common structural material used in the roadway is concrete but special finishes have also been used on asphalt surfaces.

Figure 4-40. Form liners incorporated with architectural details create interesting patterns.

The suitability of any option must be considered in relation to the climate and other factors affecting the durability of the finish. Visiting sites where proposed finishes have been used is a good way the assess the suitability of an option. It is strongly recommended that samples of surface finishes be constructed to gauge the effects of the color selection and to establish proper application procedures. **Ideally, these samples should be near the site so that the sample can be judged in the same quality of light as when it will be finally applied.** The samples should be adequate in size to accurately determine the effects of the finish both near and far from the surface. In some cases, sample sizes ten feet square or greater may be required.

Finishes may be grouped based on whether they are to be applied to vertical surfaces or horizontal surfaces surface.

Vertical Surfaces

Special finish options for vertical surfaces include:

- form liners
- sandblasting
- exposed aggregate
- pigmented coatings
- integral dyes
- concrete coatings
- architectural veneers
- modular structural units

Form Liners. Form liners are widely used and very effective at introducing texture contrasts to concrete structures (see Figure 4-34). Common form liner patterns include a raised or indented vertical pattern but other patterns such as brick and stone are also available (see Figure 4-40). Strong vertically oriented textures will tend to emphasize the height of structures while horizontal textures will de-emphasize height and highlight the structure's linear character.

The choice of pattern may be determined by looking for visual clues from the area in which the structure is located. A heavily developed urban area may suggest a formal architectural pattern. Rural areas or locations with prominent natural features may warrant the use of form liner patterns suggestive of local native materials.

Figure 4-41. Form liners come in a wide array of patterns. This wall uses a plastic form for a stone pattern.

Sandblasting. Sandblasting has been used on bridge columns and abutments as a relatively inexpensive method of adding textural interest. Sandblasting removes the flat, cured finish and imparts a softer appearance to the structure. These textures will not be visible at long distances since sandblasting only affects a shallow depth of the surface. Consequently, this technique is best used where traffic speeds are lower and the structures are near the travel lane.

Sandblasting entire structures may make the edges of the structures less distinct and blended into the background. A band of untreated surface at the edges of the structure will prevent this and make the texture contrast more visually effective.

Color variation in cement and aggregate may result in different effects, even on the same structure. If sandblasting is to be used, specify that aggregate sources and cement rates remain the same in the areas to be treated.

Exposed Aggregate. Exposed aggregate finishes have been used in the past and they provide a durable finish that is usually more prominent than sandblasting but not as heavy as form liner finishes. The quality of the finish is highly variable, depending on the quality of the aggregate, cement content and the amount of cement removed from the surface. This last factor is very difficult to control and can result in a high degree of variation. If too much surface material is removed, aggregate may be dislodged, resulting in a pitted surface.

These factors have led to a decline in the usage of this technique. The best areas for this option are probably small areas where the number of washing operators is fewer and increased quality control is possible (see Figure 4-42).

Figure 4-42. Exposed aggregate may be used on vertical columns but the texture will not be apparent from any great distance.

Pigmented Coatings (Paints and Stains). Pigmented coatings are a relatively inexpensive method of adding visual interest to structures (see Figure 4-43). Paints have proven to be less durable than stains, requiring reapplication due to flaking, and are not recommended for concrete structures. Acrylic stains have proven to be much more long-lived in concrete applications and are available in a wide range of colors.

Pigment coatings such as stains are highly affected by the quality of the surface before application. Concrete surfaces must be completely and properly cured to avoid unsightly salt-streaking problems. Surface imperfections due to damage or to inadequate vibration during pouring will be clearly visible once the stain is applied.

Figure 4-43. Pigmented coatings and sealers may be used on vertical as well as horizontal surfaces.

Integral Dyes. Integral dyes color the entire quantity of concrete used in the structure. Their advantage is that later damage to the surface will be less obtrusive since the pigment extends throughout the pour. This may be less true for old surfaces that have become weathered.

For large structures such as bridge components, integral dyes may not be feasible due to the cost of the dye and given the fact that much of the dye is wasted in the interior of the structure where it will not be seen. In addition, variation in the quality of cement can result in different shades of color for the same amount of dye. This makes matching earlier pours very difficult when adding new sections or repairing existing damaged areas.

The best use of integral dyes is in less massive, thinner concrete structures such as paving where quality control is easier and there is less likelihood of variation in the cement.

Concrete Coatings. Concrete coatings are thin applications of masonry quality cements that have been pigmented with color (see Figure 4-44). Depending on the specific proprietary method, substrates of reinforcing meshes may be used. A wide variety of texture effects may be added prior to the cement setting up. Some applications include removable templates that leave very realistic representations of brick, tile, and stone finishes.

Figure 4-44. Concrete with latex additives may be sprayed on vertical or horizontal surfaces. Patterns may be achieved with templates.

These coatings have been widely used in commercial projects and their use in highway applications has been limited. The durability of the coatings appears adequate for many applications since they

are composed of cement. However, since the surface finish usually has a stucco-like texture, pores and irregular surfaces may catch dust or hold moisture, resulting in mildew and staining.

Specific applications within highway design are yet to be determined but this technology may have a role in retrofitting existing structures for aesthetic goals. They may be applied to horizontal as well as vertical surfaces and have been used on driving and pedestrian surfaces in light-duty residential and commercial applications.

Architectural Veneers. Non-structural veneers of various materials may be installed over other structures such as walls, abutments, columns, or riprap. The veneers may be stone, modular concrete pavers, or brick, and in some cases, tile. Veneers may be useful in creating a visual link between unconnected elements such as bridges by retrofitting some portions of the surfaces with the same material. Veneers of local materials from the natural environment of the area can also relate the structure to the environment and highlight special areas, as shown in Figure 4-45.

The process of selection of a suitable veneer follows the same procedures as for any other finish. Local preferences should be considered and clues can be gathered from the surrounding architecture and environment and balanced with the issues of cost, maintenance, and safety.

Figure 4-45. Local materials may be used as veneers to improve visual connection to the surrounding context.

Modular Structural Units. Modular units are most prominent in the use of pre-cast panel, Retained Earth Walls (see Figure 4-46). A smaller unit scale is found in Modular Block retaining wall systems (see Figure 4-47). These systems impart patterns to wall surfaces that provide visual interest and help prevent large surfaces from becoming oppressively monotonous.

Figure 4-46. Standard retained-earth walls are available in a range of finish options.

Figure 4-47. Modular concrete block walls come in a variety of finishes and generally provide a coarse-textured surface.

The patterns provided by these systems can result from two components: the shape of the modular unit and the pattern created by the arrangement of different colored or textured units (see Figure 4-48). The scale of the structure and the type of unit affect the decision to add pattern in this way. Generally, larger structures require larger units and smaller structures need smaller units.

Figure 4-48. Concrete masonry units come in a wide variety of patterns and colors. Combinations of units create broad patterns.

Horizontal Surfaces

Horizontal paved surfaces suitable for special finishes include sidewalks, pedestrian crossings, paved medians, traffic control islands, and riprap. The finishes described below are often pedestrian-oriented (excepting riprap) but may also be suitable wherever slower traffic speeds allow their visual impact to be appreciated.

Special finish options for horizontal surfaces include:

- scoring
- patterned concrete
- concrete coatings
- concrete finishing techniques
- pigmented coatings
- concrete dyes
- modular paving units

Scoring. Scoring is simply using a jointing tool or saw to score the surface of concrete paving to create a pattern. These may be regularly spaced parallel lines, cross-hatched patterns or even randomly-spaced designs. A great deal of visual texture can be added to plain concrete by simply adding a well conceived scoring pattern.

Scoring the surface in a linear pattern is probably the least expensive means of adding texture. Likewise, there are few disadvantages to scoring a concrete surface. Scored patterns act as a network of control joints which help control thermal cracks.

Patterned Concrete. Similar to scoring, patterning concrete uses pre-fabricated dies to impress patterns into partially cured concrete (see Figure 4-49). Color may be added with integral dyes but most frequently is accomplished with a dry-shake method of applying surface dyes. The range of patterns available is quite large and varies with the manufacturer. Compare Figure 4-48 to Figure 4-50 to see different patterns in use.

Figure 4-49. Metal stamps are used to impress a pattern into wet concrete. Brick patterns work well in pedestrian areas.

Figure 4-50. Patterned concrete comes in a variety of styles.

This technique may be used on any horizontal or slightly sloped surface (see Figure 4-51). Its advantage is its durability when subjected to vehicular traffic, its relative ease of installation, and its reasonable cost.

The process of selecting a suitable pattern and color follows the same procedures as for any other finish. Local preferences should be considered and clues can be gathered from the surrounding architecture and environment and balanced with the issues of cost, maintenance, and safety. In addition, special attention should be given to the roughness of texture of the pattern since some patterns impart deep impressions. Pattern texture must be evaluated for its impact on bicycles, walking assistance devices, wheelchairs, strollers, and its potential to trip elderly or very young users (see Figure 4-52).

Figure 4-51. Concrete can be used to form patterns to accent and complement existing structures.

Figure 4-52. Patterns of impressed asphalt pavements need to be evaluated for impact on potential use.

Concrete Coatings. The same concrete coatings used for vertical surfaces are generally appropriate for horizontal surfaces (see Figures 4-44 and 4-53).

Figure 4-53. Sprayed textures can be customized for special applications.

Concrete Finishing Techniques. A variety of textures can be applied to concrete surface through the finishing process. As long as the surface roughness is adequate to provide safety for the user, different troweling techniques can be used to add variety. When troweling is combined with scoring, very pleasing effects can be achieved.

Common finishing techniques for plain concrete surfaces include broom textures over steel trowel finish, wood float finishes, and magnesium float finishes. Each of these offers a slightly different texture finish that may be used alone or in combination with others. Exposed aggregate, as discussed for vertical surfaces, (see Figure 4-54) has been widely used as a pedestrian walk finish but the slick surface of this material when wet often leads to dangerous conditions, especially on sloped walkways.

Figure 4-54. The fine texture of exposed aggregate will become secondary to its color over even short distances, and its surface may become slippery when wet.

Pigmented Coatings (Paints and Stains). Paints and stains may form a slick surface when wet and should be applied over rough textures if chosen for areas used by vehicles or pedestrians (see Figure 4-43). (See Pigmented Coatings under vertical surfaces.)

Concrete Dyes. Color may be added to concrete paving with integral dyes but care should be taken when using this technique. (See Integral Dyes under vertical surfaces.) A more commonly used technique is the application of surface dyes during the curing and finishing processes. This technique is reasonable in cost and the results are much more predictable than with integral dyes. In either case, the experience of the contractor will be a major factor.

The process of color selection for paved surfaces is discussed in the Color subsection above. Using color in paved surfaces, especially in pedestrian areas, has specific benefits. Color can reduce glare, improving the visual character and safety of intersections. Color can also provide a clear distinction between pedestrian and vehicular surfaces, adding clarity and, again, improving safety in a critical zone.

Modular Paving Units. Modular paving units such as bricks and concrete pavers have proven to be both a durable and cost efficient paving material. Depending on the specific character of the units themselves, each has been used in both vehicular and pedestrian applications. Pavers have commonly been used in pedestrian areas and raised medians. Applications may include pavers used as banding or edging in otherwise typical concrete flatwork (see Figures 4-55 through 4-58).

Figure 4-55. "Before" picture of riprap at a bridge abutment. See Figure 4-56 for an "after" photo.

Figure 4-56. Pavers added to riprap brighten this intersection and include a graphic that reflects local character in this "after" shot of the bridge abutment shown in Figure 4-55.

Figure 4-57. Concrete pavers are available in a wide variety of colors and are well suited for narrow islands.

Figure 4-58. Concrete pavers easily introduce patterns into medians.

The advantage of flexible paving units is that access to subsurface utilities and repair is easier than with poured-in-place concrete and the units can be salvaged for use in other areas. The biggest disadvantage is the susceptibility to deformation under vehicular traffic, especially heavy trucks. This problem can be solved by making sure that the paving foundation is adequate to meet the traffic loads.

The surface texture of the units should be selected to meet the requirements of safety for pedestrians and vehicles if the units will be part of the traveled way. Sizes and colors should be selected based on issues discussed in the Color subsection above. Colors should be selected that make a clear distinction between pedestrian and vehicular surfaces.

Section 7 — Traffic Barriers and Guard Fences

Overview

Concrete traffic barriers, metal beam guard fences, and pedestrian control fences are visually prominent features of the highway. The aesthetic properties of these structures that can be manipulated to achieve aesthetic objectives are:

- color
- finish
- materials
- location

Color. Color of the base material should be considered before electing other finishing options. The color of natural concrete or galvanized steel is not particularly bad when it blends well with the background and the immediate surroundings. However, when these colors will not blend other options should be considered.

Finish. The finish of a barrier, guard beam, or fence can be manipulated to change the color or texture. Concrete surfaces can be manipulated to create different textures and colors. The section on Surface Finishes discusses the options in more detail.

Materials. New technologies provide an abundance of materials that can be used for traffic barriers, guard beams, and fences. Vinyl coatings with integral color are now available for steel products, so chain link fences and even guard beams do not necessarily have to show galvanized finishes. Some of these products are expensive but prices are becoming more reasonable over time. Other materials such as Coreten steel are popular materials where a weathered, rustic look is desired.

Location. The location of barriers, rails, and fences is equally important. Concrete traffic barriers and steel guard beam fences are usually close to the driving lanes. At high speeds the perception of detail is limited to shape and color. As speeds decrease around intersections or on urban streets surface texture and detail become more apparent.

Design Coordination

To achieve the aesthetic goals along a specific highway the design of barriers, guard beams, and fences should be visually coordinated with other design elements. Basic design tools that will assist in blending concrete traffic barriers, metal guard beams, and pedestrian control fences into the visual context of the highway are as follows:

- Select barriers to blend or contrast with the background.

- Colors that contrast with the surroundings will be more prominent visually. For guard beams and concrete traffic barriers placed between traffic lanes, sharp contrast will improve visibility. Colors similar to the pavement will decrease depth perception.
- Colors that have the same value as the surroundings will blend in. For barriers placed between the traffic lanes and adjacent properties it is often desirable to blend the barriers and allow the background views to be more dominant.

◆ Use textured forms for concrete traffic barriers to establish regional themes.

- The smooth, strong line of these elements can add definition and clarity to the roadway, reducing the visual complexity of the roadway. The introduction of colors or textures can heighten the barrier's ability to serve as a unifying visual feature through long distances of corridor, and tie widely separated features together (see Figure 4-33). Color may be added in the form of stains and textures or patterns may be added during the manufacturing process.
- Special themes can be developed in the patterns used on traffic barriers to avoid the look of a universal interstate highway. The barriers designed for El Paso, for example, reflect the patterns and culture of the mountainous desert southwest.

◆ Add pedestrian control fencing.

- Utilize vinyl coated chain link fabric to take advantage of longer life and more color options.
- Galvanized chain-link fabric exposed to the pollutants associated with highways will rust very early. This is visually objectionable and may stain supporting structures.

Section 8 — Signals and Signs

Overview

This section discusses the landscape and aesthetics aspects of highway signs and graphics. The configuration of signs used on the highway follows set guidelines that are based on safety and visibility criteria. This information is provided in the Manual of Uniform Traffic Control Devices (MUTCD), accessible at this Internet address: http://mutcd.fhwa.dot.gov.

Signs have a marked impact on the aesthetic character of the roadway. The purpose of a sign is to convey specific information and/or elicit specific driver behaviors. However, from an aesthetics point of view, signs increase the number of objects, lines, and edges contributing to the visual complexity of the scene. This can be particularly worrisome in urban areas where traffic signs are competing with other commercial messages.

In a majority of cases it is not possible to have fewer signs. So the focus from an aesthetics point of view becomes the composition of the signs and the hardware used to mount and support the signs.

This section discusses signals and signs in terms of:

- visual complexity
- large route information signs
- directional and traffic signs
- traffic control signs and signals

Visual Complexity

The concept of "visual complexity" relates to the amount of visual stimuli within the driver's view at any one time. Visual complexity is increased as more objects fill the scene. As these objects get overlaid on one another, the ability to detect particular objects will depend greatly on the object's contrast with its background.

Even objects that have little surface area can contribute to this complexity. Posts, poles, and wires add lines and edges that can significantly increase visual complexity. While it is not feasible to eliminate these elements, care should be taken to reduce their number wherever possible. Figures 4-59 through 4-61 show an example of combined signs and reduced complexity.

The more complex the scene, the more likely it is that important information will not be detected. In these cases, safety may be compromised.

Figure 4-59. Too many individual signs and posts contribute to a visually complex scene.

Figure 4-60. Combining signage where possible, reduces visual complexity and improve visibility of the signed information.

Figure 4-61. Combining signs on a single post where possible reduces the number of poles and further reduces the clutter of the scene.

Large Route Information Signs

These signs may be mounted on freestanding posts, sign bridges, or on bridges. These signs are large, usually 8 ft horizontally but of variable vertical dimension. When several signs are mounted on the same structure several simple rules can be followed to help improve the aesthetic quality.

- A sign bridge, or other supports, should be made of materials and style that fit with the visual quality of the surroundings.
- Where practical keep the signs mounted on a structure the same size.
- Keep the tops of the signs aligned, even if signs are different sizes. This helps minimize the lines and edges silhouetted against the horizon and is most important in urban areas where there are numerous signs (see Figures 4-62 and 4-63).

Figure 4-62. Large sign bridges can contribute to complex scenes through their lack of uniformity and structural detail.

Figure 4-63. Uniform sign sizes and hidden structures improve appearance and readability despite a visually complex background.

Directional and Traffic Signs

Minimize the number of signs and sign clusters. When several signs are needed, such as at the intersections of several state-maintained routes, the signs should be clustered to minimize the number of posts. This reduces the visual complexity of the scene as well as the number of obstructions to maintenance (see example in Figures 4-64 through 4-66). Where possible and appropriate, the number of delineator posts should be reduced by incorporating reflectors into other posts and structures.

Figure 4-64. The placement of these posts restricts vegetation control to hand-operated equipment.

Figure 4-65. Incorporating signs onto nearby structures eliminates trimming around two objects.

Figure 4-66. Paving between immovable structures eliminates all need for hand maintenance.

Traffic Control Signs and Signals

Traffic control signs (stop, yield, one way, etc.) are essential for safe and efficient operation. Numerous options exist for mounting or housing signals and signs. The primary concern should be to complement the elements of the intersection and adjacent land use. Street name signs can often be incorporated into the adjacent buildings or other structural elements. There are numerous hardware, color, and form options available for mounting traffic signals. All of these options should be explored as part of a total design concept for a particular transportation corridor.

Section 9 — Illumination

Overview

This section discusses the aesthetic considerations associated with roadway lighting. Lighting design standards are covered in the Roadway Design Manual.

The aesthetic considerations of highway lighting design include:

- lighting for visual effect
- aesthetic character of luminaires and poles
- color of light
- lighting and plant materials

Lighting for Visual Effect

In addition to lighting the traveled way for minimum visibility, designers should consider the illumination of significant elements such as bridges and walls to provide clarity and interest. Urban areas are usually the most appropriate for the addition of highlighting. However, significant rural interchanges may also benefit from such increased contrast and visibility. A well-lighted structure or design element along the highway can do a lot to improve the overall perception of a highway corridor.

Aesthetic Character of Luminaires and Poles

Luminaires and poles should be considered for their aesthetic fit into the immediate surroundings, as shown in Figure 4-67. The chief design considerations are the color, the architectural character, and pole spacing.

- The color of the hardware should reflect the colors in the immediate surroundings and the materials used on the highway.
- The shape form of the luminaire should fit with the character of the surroundings. New contemporary buildings usually suggest luminaires with clean lines that fit the lines of the structures. In historic districts more nostalgic hardware is appropriate.
- Widely spaced poles are read as single objects in the landscape and should be carefully fitted to the surrounding landscape. Closely spaced poles form a visual element that tends to define the corridor. Their combined design character becomes critical, particularly the color of the poles. In general, use colors that blend well with the background so that the combined effect of multiple elements is unobtrusive.

Figure 4-67. Luminaries are a highly visible roadway component and their aesthetic character should be considered as part of an overall aesthetics plan.

Color of Light

Most transportation applications utilize electric discharge lamps of high-pressure sodium, mercury vapor, or metal halide. These light sources have distinct color properties that should be considered when developing the illumination plan.

High-pressure sodium lamps are the most efficient sources of light in terms of lumens per watt. However, sodium produces a light color in the orange to orange-yellow range. This color is not particularly flattering to human flesh tones and makes green vegetation appear brown.

Plain mercury vapor lamps produce light in the green to blue-green spectrum. In mercury vapor light the green color of plant material is enhanced but, like high-pressure sodium, mercury vapor is not flattering to human flesh tones. Without some color correction people appear very pale.

Metal halide is a longer-lived, color corrected type of mercury vapor lamp. It produces a near white light, which gives the best color rendering of all the electric discharge lamps.

In areas such as toll plazas, urban streets, or any area that will be frequented by pedestrians, consideration should be given to the use of metal halide lamps for illumination. For areas that have ornamental landscape development, such as the signalized portions of freeway interchanges or along urban streets without high pedestrian traffic, mercury vapor will produce good results. For other applications where color rendering is not important high-pressure sodium is the best choice for reasons of energy efficiency.

Lighting and Plant Materials

The placement of plant materials must be done with knowledge of the illumination plans for the highway. In general, high mast lighting will not be significantly affected by plant material placement. Because of the height of the light source shadows will be cast almost vertically and shadows or dark spots will not be a problem.

Where standard, pole mounted fixtures are used, placement of plant materials becomes more critical. Trees must be placed so future growth will not interfere with the light source. As a rule trees should not be placed forward of any light standard.

Section 10 — Bicycle and Pedestrian Access

Overview

The need to integrate bicycle and pedestrian facilities into the overall transportation system was first recognized in the Intermodal Transportation Efficiency Act (ISTEA) of 1991. The act provided for improvements to the surface transportation system to facilitate use by pedestrians and bicyclists (see Figure 4-68). The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) further reinforces the provisions of ISTEA, providing additional funding and planning and policy tools needed to develop pedestrian and bicycle friendly cities. TEA-21 provides important definitions for bicycle facilities and pedestrians.

- "A bicycle transportation facility is a new or improved lane, path, or shoulder for use by bicyclists and a traffic control device, shelter, or parking facility for bicycles."
- The definition of a pedestrian includes not only a person traveling by foot but also "any mobility impaired person using a wheelchair."
- Subsections in this section cover bicycle facilities design and pedestrian facilities design.

Figure 4-68. Bicycles are important transportation and recreation vehicles. Attention to the needs of bicycle users saves lives and enhances community transportation.

Bicycle Facilities Design

The design criteria for bicycle facilities depend on whether the cyclist has an independent location or is located on an existing roadway.

There are a variety of improvements that can be made on existing roadways to make them more bicycle friendly. These improvements generally increase the convenience and safety of both the bicyclist and the driver.

The design standards in this manual are, unless specifically noted, in accordance with the recommendations of the AASHTO *Guide for the Development of Bicycle Facilities*, 1999. (See also *Roadway Design Manual*, Chapter 6, Section 4.) The primary features that should be considered for improvement are as follows:

- drainage inlets
- railroad crossings
- pavement surfaces
- traffic control devices
- shoulders
- wide curb lanes
- bicycle lanes, routes, and paths

Drainage Inlets

- Drainage inlets, grates and manhole covers should be located outside the lane used by bicycles.
- Side inlets should be used instead of surface inlets. Avoid deeply swaled entrances to curb inlets that might endanger cyclists.
- When drainage inlets are in the bicycle lane, the grate slots must be set perpendicular or no more than 45 degrees to the direction of travel.
- All grates and manhole covers must be set flush with the surface.
- Use bicycle safe grates that are rated for hydraulic efficiency. Neenah Foundry, Neenah, WI, has an excellent section on bicycle safe grates in their catalog material.
- If grates cannot be replaced, as a temporary measure, weld steel cross straps or bars to the existing grate. This is a temporary measure only.
- MUTCD has special markings to identify dangerous grates. However, markings must be used with great caution because there is a danger that they will not be seen in the dark or that traffic may force a bicyclist into the grate causing injury.

Railroad Crossings

- Pavement approaches to crossings should be level with the tracks.
- Rails should be perpendicular to the direction of travel.
- If tracks must cross at 45 degrees or greater, widen the outside driving lane if possible (12 ft min.

- If tracks cross the pavement at 45 degrees or greater, consider the use of compressible flangeway fillers.
- If tracks are abandoned they should be removed.
- Install warning signs and pavement markings per the MUTCD.

Pavement Surfaces

- Pavements must be free of irregularities that may trap bicycle tires and cause loss of control.
- Pavement should be a uniform width.
- Fill expansion joints that could trap bicycle tires.
- Reset all valve boxes, manhole covers, and grates flush with the paved surface.

Traffic Control Devices

- On multi-lane streets, short clearance times should not be used to allow bicycles enough time to cross safely. A bicycle speed of 10 mph with a perception/reaction/braking time of 2.5 seconds is recommended.
- Provide bicycle sensitive sensors at traffic-actuated signals.
- Place sensors in bicycle lanes and in turn lanes.
- Where bicycle sensitive sensors are not appropriate, provide cyclist actuated buttons. Buttons must be mounted so that cyclists are not required to dismount to press the button.
- Directional (programmed visibility) signal heads must be visible to cyclists.
- The MUTCD should be consulted for all pavement markings, signals, and signage.

Shoulders

- Wide, paved shoulders are the best way to accommodate bicycles on rural roads.
- Pavements on shoulders must be smooth.
- Pavement edge lines should be used to delineate the shoulder.
- Rumble strips should be avoided on shoulders intended for bicycle use.
- Paved shoulders should be a minimum of 4 ft.
- Additional shoulder width is desirable where traffic speeds exceed 35 mph, and traffic includes a high percent of trucks or heavy vehicles.

Wide Curb Lanes. On urban streets where paved shoulders are not possible a minimum curb lane width of 14 ft is recommended.

Bicycle Lanes, Routes, and Paths. Bicycle routes are highways that are designated and marked for bicycle travel. They do not necessarily have designated bicycle lanes. Bicycle lanes are delineated

and marked lanes on streets and highways. Bicycle paths are off-highway routes developed specifically for bicycle travel. Detailed standards for the alignment, design, and marking of these facilities can be found in the AASHTO Guide for the Development of Bicycle Facilities, August 1999.

Pedestrian Facilities Design

The safe accommodation of pedestrian traffic is a primary concern within the highway right-of-way. The primary means of accommodation is the provision of pedestrian paths or sidewalks. Other considerations involve facilitating pedestrian crossing of the vehicular traffic stream.

At this time, AASHTO has not published its guidelines for pedestrian accommodation. For this reason this section of the manual is based on recommendations from NCHRP Report Number 294 A, *Planning and Implementing Pedestrian Facilities in Suburban and Developing Rural Areas*.

Primary features for potential design improvement include:

- medians and refuge islands
- sidewalk bulbouts
- signals
- sidewalks
- lighting

Medians and Refuge Islands. Intersections are the main point of conflict between pedestrian and vehicular traffic. Medians and refuge islands are a predominant tool in facilitating safe pedestrian crossing of facilities with four or more lanes (see Figure 4-69). By providing a median or refuge island, pedestrian exposure to traffic is minimized. Likewise, the pedestrian is required to observe traffic in only one direction at a time.

Figure 4-69. Crosswalks recessed at medians offer better pedestrian protection and meet ADA requirements.

Sidewalk Bulbouts. Sidewalk bulbouts are a narrowing of the pavement at intersections and points of potential pedestrian crossing. Narrowing the pavement reduces crossing time and exposure of the pedestrian.

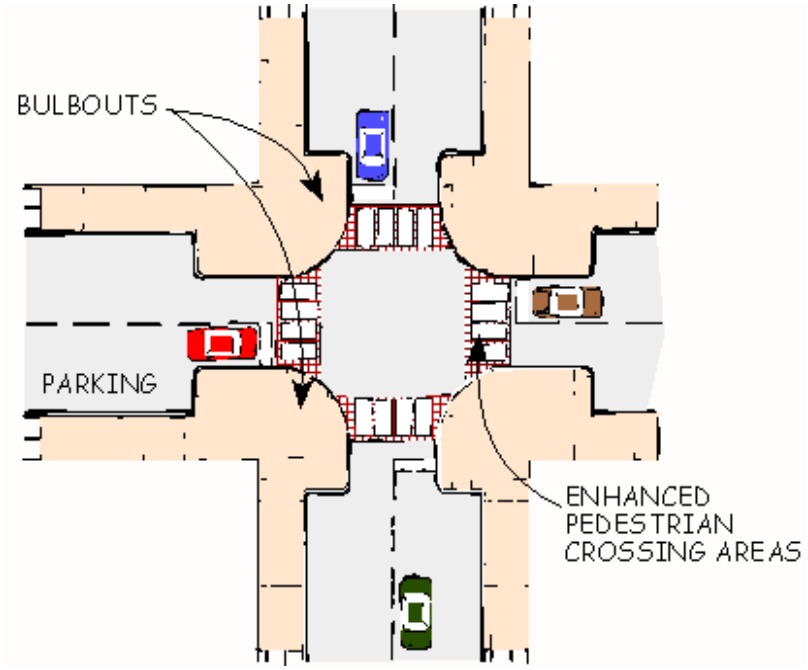

Figure 4-70. Sidewalk bulbouts provide improved safety in areas with high pedestrian use.

Signals. Signal timing must be set to so that slower pedestrians will have time to cross. Short light cycles should be avoided. Button activation should be provided where detector operated signals are utilized. Signals are generally timed to accommodate pedestrian movement of four feet per second. Designers should be aware that the disabled and the elderly may require more time.

Dedicated traffic signals for pedestrians may be appropriate in some special situations, but are not generally required.

Sidewalks. In urban areas, sidewalks may be set back from the curb, creating what is often termed a landscape buffer. These provide a higher sense of security for pedestrians near high traffic volume roadways. In addition, landscape buffers make *Americans with Disabilities Act Accessibility Guidelines* (ADAAG) compliance easier at driveways and provide more space for signs and utilities. See Figure 4-71 for graphic representation of pedestrian path options.

Where a landscape buffer is provided it should meet the following minimum standards.

- Landscape buffer should be a minimum of 3 ft.
- The paved walk should be a minimum of 5 ft.
- A more generous tree lawn of 6 ft to 8 ft is desirable where right-of-way will permit.

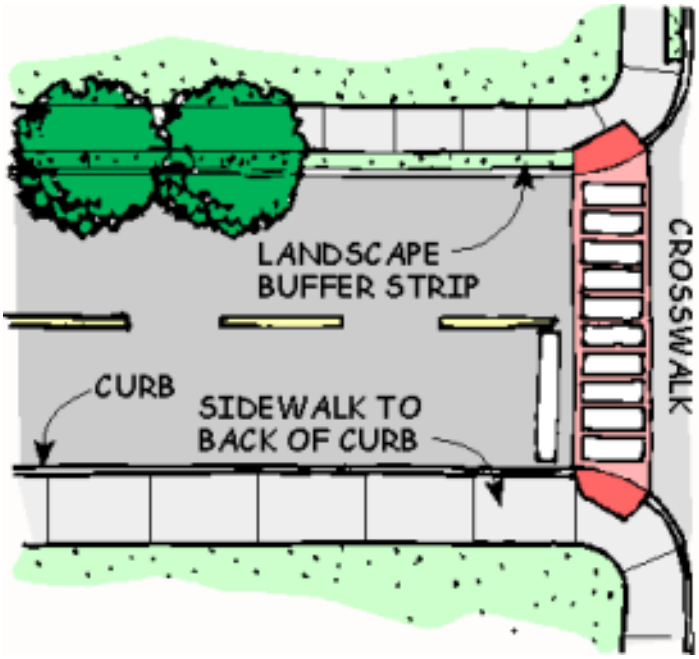

Figure 4-71. Options for pedestrian paths on urban roadways.

The use of a tree lawn in northern areas provides snow storage in the winter. However, in the south, provision of a tree lawn increases maintenance costs. While the tree lawn does seem to provide a higher sense of security for pedestrians along heavily traveled collectors and arterial streets, there is no evidence that the tree lawn actually increases the safety of the pedestrian. For this reason provision of a tree lawn should be considered carefully.

The preferred solution for reasons of maintenance is to provide a wider sidewalk that begins at the back of the curb. This eliminates the problem of maintaining a narrow strip of vegetation next to the street.

Guidelines for accommodating pedestrians in the right-of-way include:

- Provide a minimum 8 ft walk beginning at the back of the curb.
- On rural highways in developing suburban areas it is recommended that separate sidewalks be provided on both sides of the road. When this is not possible due to considerations of grade or right-of-way limitations, a paved shoulder should be provided (see Figure 4-72). Recommended minimum dimensions are as follows.
- Separation between driving lanes and edge of sidewalk should be 5 ft or greater.
- Sidewalk should be at least 4 ft wide.
- Paved shoulder should be at least 6 ft.

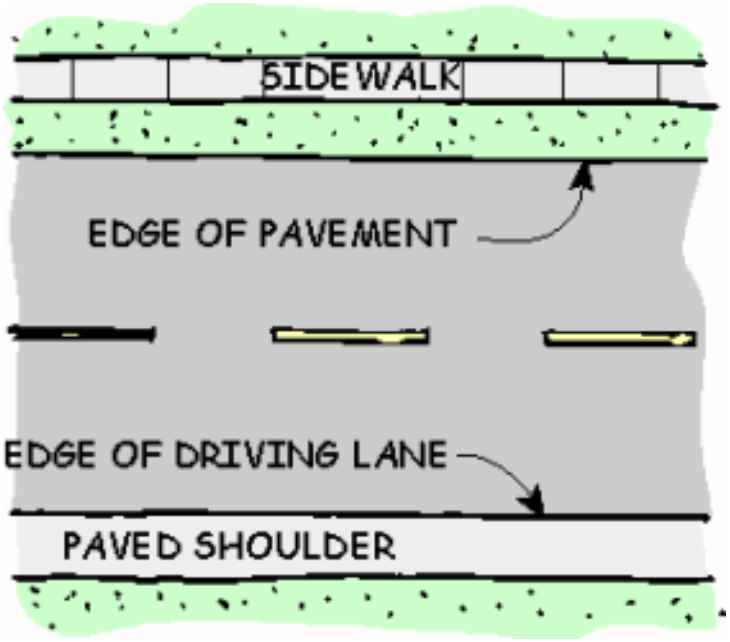

Figure 4-72. Options for pedestrian paths along rural roadways.

Lighting. Lighting at pedestrian crossings should be sufficient for drivers to see pedestrians and for pedestrians to see oncoming traffic. Often illumination does not provide adequate lighting beyond the curb line. No specific recommendation is made for light level. However, lighting along the pedestrian walk should be at least equal to the level of lighting on the roadway.

Section 11 — Public Art

Overview

Urban centers may have an active interest in acquiring or placing public art on the right-of-way (see Figures 4-73 and 4-74). Some examples of TxDOT accommodation of public art projects are the murals in El Paso and Dallas and the Sam Houston statue in Huntsville. The primary concern is that public art projects meet the environmental demands of the roadside and the minimum requirements governing safety, access, and management of the highway.

Figure 4-73. Public art may occupy otherwise unused areas of the roadway. See Figure 4-73 for a public art project implemented in the space shown in this photo.

Figure 4-74. Public art projects can be a viable way to allow residents to express their sense of community in creative ways.

Projects that are a joint effort with city officials and volunteer arts have the best chance of success (see Figures 4-75 and 4-76). The following subsections outline design considerations in evaluating public art projects proposed for state rights-of-way.

Figure 4-75. Drab concrete surfaces set a somber tone and often invite graffiti.

Figure 4-76. Experience shows that appropriate themes can enhance a corridor and discourage graffiti vandalism.

Safety

- If public access is allowed to the artwork, all ADA requirements must be met.

- Reflective surface finishes should be avoided to minimize visibility hazard to highway users.

Finishes

- Durable, all weather finishes are essential. Finishes should be evaluated for their reflectivity, ability to resist pollutants associated with highway environments, and weathering characteristics.
- Finishes should be used that will allow repair if the structure or art piece is damaged.
- Finishes should be selected that allow the removal of graffiti.

Location

- Unless proper facilities are provided, the placement of artwork should not invite viewers to stop or access the piece on foot.
- All setbacks and sight triangle requirements must be met based on the type of highway.

Vandalism

- Sites that are subject to vandalism should be avoided.
- Night lighting should be provided to discourage vandalism and highlight the artwork.

Theme

- Symbols, motifs, or colors must be sensitive to cultural issues.
- Review all art pieces to be sure that they do not consciously or unconsciously include gang or high school colors, logos, symbols, or images that could be racially or ethnically biased.

Complexity

- Artwork placed on the right-of-way should be simple. Complex pieces can distract drivers or will not be understood or appreciated.
- Avoid placing artwork in locations where there are important driver orientation signs.

Section 12 — Medians and Traffic Islands

Overview

The primary function of medians and traffic islands is safety. They are provided to separate traffic streams and to guide turning movements at intersections. It is important that medians and traffic islands be delineated in a way that makes them visible and distinguishes them from the adjacent driving lanes.

Medians and traffic islands also provide an opportunity to add aesthetic quality to the highway setting by manipulating the materials used. This section deals specifically with the aesthetic considerations of median and traffic island design.

Subsections in the section cover the functional elements and aesthetic elements of medians and traffic islands.

Functional Elements

Medians and traffic islands provide a visual separation between driving lanes and help direct traffic. In order to accomplish this task it is important that the medians and traffic islands visually contrast with the driving lanes, particularly at night. Visual contrast may be achieved by manipulating color and materials. The following guidelines can be used to assist in color and material selection.

- Select materials that have a strong color contrast with the pavement (refer to Figures 4-26 and 4-58). Warm earth tones in the sienna to terra cotta range provide an excellent contrast. These colors are common in clay and concrete paving units. Avoid pavers in the gray range with blue or violet tones.
- Choose materials with integral color to avoid the maintenance associated with stains and other surface color treatments. Aggregate may be suitable for groundcover in low-rainfall areas.
- When selecting colors for the ground select more intense colors than might be selected for interior use. Colors will be washed out by bright sunlight and will not appear as bright as they are indoors (see Figures 4-77 and 4-78).
- Limit planting in medians to grasses and low growing ground covers or shrubs rather than trees unless there is sufficient width to meet the setback requirements (see Figure 4-79).
- Locate woody plants so that drainage in the median will not be obstructed.
- Modular materials are well-suited to medians because they can be removed and replaced when necessary.

Figure 4-77. Unfinished medians lend an untidy character to the entire corridor.

Figure 4-78. In low-rainfall areas where weed invasion is minimal, loose aggregate adds color and texture to medians.

Figure 4-79. Paved medians can still provide places for trees through the use of tree grates.

Aesthetic Elements

Medians and traffic islands separate the primary lanes and help visually relieve what would otherwise be a continuous sheet of pavement. Because they are located within the driver's primary cone of vision they have a greater influence on the overall perception of the highway. Designers should take advantage of this and seek to add architectural details that will enhance the overall appearance.

Some specific situations that should be considered are as follows:

- Medians often have turning lanes, tapered ends, or gores, that will be observed at low speeds. These are ideal locations to use colored pavers and other special surface finishes. (See the section on Surface Finishes for more information.)
- The narrow areas of medians, turn lanes, and gores usually require several signs such as: Do Not Enter, Yield, One Way, and Stop. These signs plus the narrowing of the median make maintenance difficult. These areas are best paved with a material that will require little maintenance and provide a sharp color contrast with the pavement. (see Figure 4-80)
- Traffic islands are usually too small to effectively maintain vegetation. Use of vegetation is not recommended for reasons of maintenance and the potential to reduce visibility (refer to Figure 4-57).

Figure 4-80. Paving islands and gores where signs are located reduces maintenance and provides a neat appearance.

Chapter 5 — Landscape and Aesthetics Guidelines for Common Transportation System Features

Contents:

Section 1 — Overview

Section 6 of Chapter 1 lists common transportation features. The sections in this chapter suggest recommendations and guidelines for landscape and design considerations of those elements. Sections are:

- Intersections
- Elevated Driving Lanes
- Interchanges
- Depressed Driving Lanes
- Entrance and Exit Ramps

Section 2 — Intersections

Overview

This section refers to at-grade intersections. Intersections are the most complex transportation elements. Because there is crossing traffic and numerous potential turning movements, intersections account for a majority of all traffic accidents. For this reason landscape and aesthetics development in an intersection requires careful consideration to ensure that safety is not compromised. Issues affecting aesthetics and design of intersections are:

- visibility
- high concentration of visual information in the form of signage, signals, off-site activities, and advertising
- complex patterns of shade, shadow, and reflection
- placement of design elements
- pedestrian movements (including bicycle)
- future off-site development
- accessibility
- aesthetics of intersections

Visibility

The visibility of intersections must never be compromised. A sight triangle that allows full view of crossing and oncoming traffic must be provided for all turning movements at an intersection. (Refer to Figure 2-12.) The exact dimensions of the site triangle are a function of highway function and speed. (See the *Roadway Design Manual*, Chapter 2, Section 5 for specific guidelines.)

Since traffic slows at intersections, development and design detail are more visible and appropriate aesthetic treatment becomes more important.

Concentration of Visual Information

Intersections have high concentrations of visual information in the form of traffic signs, signals, other commercial signs and icons (see Figures 4-59 through 4-61). This visual confusion can lead to driver disorientation and may increase the potential for mistakes that lead to accidents. Where possible designers should use landscape and aesthetics tools to reduce the visual complexity at intersections. It is not always possible to simply screen out objectionable background elements, particularly in commercial areas. In these areas designers should focus on the use of visual con-

trasts in material textures and colors to make the functional components of the highway intersection visually prominent.

Figure 5-1. Addition of color to highlight the traffic island enhances visual character of the scene.

Shade, Shadow, and Reflection

The structures, signs, and other hardware associated with an intersection interact with the quality of light and cast a variety of light, shade, and shadow patterns on an intersection. These patterns of light and dark shift depending on the time of day and the amount and angle of natural or artificial light.

Placement of Design Elements

Many times the placement of design elements can add to the overall visual complexity and contribute to other types of hazards at intersections. For example, the use of evergreen trees with dense canopies will shade the pavement in winter, resulting in conditions which contribute to icing of the intersection.

Pedestrian Movements

- Use color or texture changes to highlight pedestrian lanes.
- Check that no elements hide pedestrians near cross-walks.
- Provide visible, vertical separation such as curbs between pedestrians and the travel lane.
- Use ample lighting for pedestrian and bicycle areas.

Future Off-Site Development

Design all intersections, including those in undeveloped areas, to include room for future addition of pedestrian access. This may include wider medians or traffic islands. Leave ample space in islands between the curb and any bridge columns and barrier devices.

Accessibility

Accessibility for maintenance must also be considered. If a development cannot be maintained it will become an aesthetics liability. Likewise the high level of activity at intersections can make maintenance activities very dangerous to crews and highway users. Landscape and aesthetics goals must be balanced against considerations of long term maintenance.

Figure 5-2. Areas that are difficult to maintain may lead to a negative visual character for an entire corridor.

Aesthetics of Intersections

The aesthetics goal within intersections should focus on ensuring visibility and clarity of traffic-related activities. Several design techniques are available to meet this goal.

- Use contrasting textures and colors to visually mark different zones of activity such as cross-walks and islands.
- Maintain and enhance lines of sight through the intersection.
- Select plant materials that will not obstruct critical views as they mature.
- Maintain appropriate setbacks for plantings or screening structures.
- Provide a neutral visual background to the intersection where possible.

Landscape and aesthetics considerations must be maintainable. Weeds and collected road debris will reduce the aesthetic quality.

- Where turf is used as the primary roadside surface, be sure that there is safe, direct access for mowing machinery.

- Bedded plant materials must be accessible for weed control

Use aesthetic elements to reduce the visual complexity of an intersection. Visual complexity can be reduced by:

- dividing the travel sequence into visual segments with screens set perpendicular to the driving lanes
- providing visual background that helps the structural and operational features of the intersection to be interpreted more easily
- screening distracting views

Select and place plant materials so that they will not interfere with views to the intersection.

- Plants should help focus the view on the intersection.
- Plants should be selected and placed so that they will not block views of the intersection when mature. For example, high branching trees are preferred over trees that tend to branch close to the ground.
- Shrubs should be avoided within the appropriate sight triangle at an intersection.

Section 3 — Elevated Driving Lanes

Overview

Elevated driving lanes are becoming more prevalent in developed urban centers. The first uses of elevated driving lanes were to carry freeways across closely spaced street level intersections. More recently elevated structures are being used to increase the number of lanes inside existing rights-of-way when additional right-of-way is cost prohibitive.

Reasons for Community Resistance

The addition of elevated lanes has met with considerable resistance in many urban centers. In practically all cases objections relate issues of aesthetics. The most common concerns cited in relation to elevated rights-of-way are:

- reduced visual access to adjacent properties
- reduced physical access to businesses
- reduced natural light due to shading by the structures
- reduced communication among neighborhoods
- unpleasant architectural detail and finishes
- increased and magnified noise generated by traffic
- use of resulting structures as shelter for transients and homeless

Many of these concerns are difficult to solve but they can usually be resolved using a team design approach involving the stakeholders. The community and the designers must be involved very early in the design process and dialog must continue through final design.

Aesthetic Design Considerations

Some important design considerations for elevated driving lanes include:

- To minimize the dominant scale of the elevated structures, select colors and materials that do not contrast with the immediate environs. Use similar materials where possible.
- Use colors and materials that will not show weather and water stains.
- Use more intense colors on areas of structure that will be in predominant shade to brighten areas below the structure.
- Incorporate lighting, graphics, signage, and other information devices into the structure. For example, street names can become part of the structure rather than being posted on posts.

Making these elements part of the structure reduces visual clutter. Considering aesthetic appeal in signals and signage results in attractive intersection design, as shown in Figure 5-3.

- Be sure that drainage from upper level is properly controlled.
- To the extent possible maintain views to business properties and screen objectionable views.

Figure 5-3. Because of their visibility, attractive signals and signage have a positive influence on overall design.

Section 4 — Interchanges

Overview

This section addresses the following topics related to interchange design:

- types of interchange
- interchange size
- safety
- drainage
- planting
- shade
- gores
- pedestrian circulation

Types of Interchange

Interchanges are intersections that merit separate consideration because of complexity. The primary feature of an interchange is vertical grade separation of the intersecting routes to increase safety and efficiency. Grade separation is achieved using a series of ramps and bridges to accommodate the various directional movements.

Within each interchange type there are numerous variations in the ramp placement and configuration related to availability of right-of-way and traffic volumes.

Interchange Size

Interchanges occupy deceptively large land areas. The bridges, along with their approach embankments, dominate the visual field. Attention to aesthetic design can enhance the appearance of interchanges.

Figure 5-4. The character of a large interchange can be enhanced with attention to the colors and details of its elements.

Because of the sinuous architectural qualities of interchanges they tend to be the primary focus of landscape and **aesthetics** design concerns. There are several good reasons for this:

- Interchanges have a high level of visual interest because of the structures and landforms involved.
- Interchanges mark entrances to adjacent communities and business properties and therefore strongly influence first impressions of that community.
- Because traffic is slower in the entrance and exit ramps of the interchange, architectural detail is more visible and more aesthetically important.
- TxDOT has full control over the design of the interchange.
- Interchanges are usually associated with freeways in heavily urbanized areas. Because of their size they dominate the visual landscape even in areas with large buildings.

Because the interchange is so important to the overall perception of an urban freeway and adjacent communities, it requires careful attention to landscape and aesthetics design properties. The following considerations will affect interchange landscape and aesthetics design decisions:

- safety
- drainage
- planting
- shade
- gores

Pedestrian circulation and balanced design detail also affect interchange aesthetic design decisions.

Safety

Safety must be the primary consideration in the design of the interchange.

- Maintaining sight distances and the clear communication of traffic patterns is a paramount concern.
- Design elements, such as night lighting, must complement the structures and not interfere with operational requirements of the interchange.
- Design elements should not have reflective surfaces or be placed so that they cause visual interference.

Drainage

Because of its size and the amount of open space occupied by an interchange, it is usually an integral part of the area or regional drainage network. Landscape and aesthetics design decisions must not adversely effect the drainage pattern.

- Plant materials should be selected and placed so that mature specimens will not interfere with the function of drainage channels or structures.
- Drainage facilities and channels should be incorporated into the overall aesthetic design scheme. Wetlands, detention, and retention basins can be visual assets if designed as part of the landscape and aesthetics treatment.

Planting

Planting in interchanges should be done as part of a comprehensive landscape and aesthetics plan. The design of the planting must be done so that it achieves the aesthetic goals for the specific corridor and facilitates maintenance of the interchange.

- Planting is most effective in areas of low slope. Planting on the slopes is difficult to maintain and will shade out grass cover, which leads to erosion.
- Planting is most effective when placed in the driver's line of sight and where the background is either sky or light colored structures.

Shade

Design solutions must be sensitive to deeply shaded areas and areas that are difficult to access (see Figure 5-5).

- Bridges and tall embankments will shade areas of an interchange, making the establishment of a vegetative cover nearly impossible. These areas should be either eliminated structurally using walls, or surfaced with an appropriate non-living material.

- Shaded areas tend to collect debris, attract graffiti, and are sometimes occupied by transients. These areas should be eliminated structurally if possible. When this is not possible the views should remain open to allow visual policing.

Figure 5-5. A paved surface is a better solution than plants where shade from structures prevents vegetation establishment.

Gores

Gore areas between ramps and weaving lanes often contain crash attenuation barriers that are not particularly attractive. The triangular area between the diverging lanes tends to accumulate trash. Design actions appropriate in these areas are:

- use colors on pavement that contrast sharply with the driving lane pavement
- avoid rough textures that will trap and hold trash and debris
- group signs to provide a uniform horizon even if the signs are of different dimensions; such groupings contribute a sense of visual order (see Figures 4-61 and 4-62)

Pedestrian Circulation

Pedestrian access through interchanges is a major consideration in urban centers.

The primary consideration in providing for pedestrian crossings at interchanges is to direct the pedestrian to crossing points that will:

- provide full view of the approaching traffic and the pedestrian
- minimize the distance the pedestrian is required to cross
- place crossings at points where traffic speeds may be reduced, such as entrance and exit ramps
- limit the traffic to a single direction if possible

- provide pedestrian refuge where multiple lanes must be crossed
- where possible, provide physical barriers between vehicles and pedestrians

Section 5 — Depressed Driving Lanes

Overview

Depressed driving lanes are usually the result of alignment geometry that requires deep cuts in order to maintain acceptable gradients.

The development of new, depressed sections in existing urban centers is generally cost prohibitive due to costs associated with excavation and utility relocation. However, there are situations where considerations of coast may be justified. The potential benefits of a depressed section are:

- reduced visual separation from adjacent properties
- decreased traffic noise

From an aesthetics point of view the design considerations of the depressed section are similar to those of an at-grade section. The primary difference will be in selecting special treatments for steep slopes and aesthetic details of retaining walls.

Aesthetic Desgin Considerations

Some important design considerations for depressed driving lanes include:

- to moderate the dominate scale of the depressed structures, select colors and materials that minimize the concrete tunnel effect of a depressed section
- use consistent materials where possible
- use colors and materials that will not show weather and water stains
- use more intense colors on areas of cross structures that will be in predominant shade
- incorporate lighting, graphics, signage, and other information devices into cross structures (for example, street names can become part of the structure rather than being posted on posts); combining these elements reduces visual clutter

Section 6 — Entrance and Exit Ramps

Overview

Entrance and exit ramps are the primary means of accessing freeways and other controlled access facilities. The unique feature of these elements is that vehicles are either accelerating or decelerating and merging with other traffic. For this reason there is significant potential for driver error that could lead to an accident.

Safety Considerations

Safety is a primary consideration in ramp design. Drivers must be able to see the approaching traffic stream with sufficient time to adjust their speeds and merge with the traffic safely. Extra care must be taken in the design of the areas around a ramp to ensure that nothing will obstruct a clear view of approaching traffic.

Visibility

Careful consideration must be given to the design of planting or other above ground improvements in the vicinity of an entrance or exit ramp. Plants in particular should be selected and placed with care so that growth over time will not create a visual obstruction.

Placement of Plants and Other Features

Some basic rules that should be observed when developing landscape and aesthetics plans in the vicinity of entrance and exit ramps include:

- avoid placing any vertical obstruction between the ramp and the traveled lanes over its entire length
- plants should be avoided in the zone between the beginning of the ramp and the gore of the acceleration or deceleration lane
- if trees are placed between the frontage road and the ramp they must of a type that have an ascending branch pattern that will remain at least 6 ft above the ground
- shrubs and ground cover materials should not be used in the gore or zone between active travel lanes and the ramp since they could become a visual obstruction