NTTA®

NORTH TEXAS TOLLWAY AUTHORITY

DESIGN GUIDELINES

Man-01 Rev. 4 September 2012

ACKNOWLEDGEMENTS

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NTTA
NORTH TEXAS TOLLWAY AUTHORITY

RESOLUTION NO. 09-80

A RESOLUTION APPROVING
REVISED DESIGN GUIDELINES FOR NTTA TURNPIKE PROJECTS

March 16, 2009

WHEREAS, the North Texas Tollway Authority (the "NTTA") is a regional tollway authority governed by Chapter 366 of the Texas Transportation Code, known as the "Regional Tollway Authority Act" (the "Act"); and

WHEREAS, pursuant to the Act, the NTTA constructs and operates a system of turnpike projects known as the NTTA System; and

WHEREAS, by Resolution 03-57, adopted on June 18, 2003, the NTTA Board of Directors (the "Board") adopted certain design guidelines, referred to as the System-wide Design Guidelines, for use by NTTA staff and consultants in connection with the design of NTTA turnpike projects; and

WHEREAS, in November 2007, the NTTA instructed its General Engineering Consultant, HNTB Corporation, to prepare an updated version of these design guidelines; and

WHEREAS, HNTB Corporation has prepared an updated version of the design guidelines, which are referred to as the "NTTA Design Guidelines"; and

WHEREAS, the NTTA Design Guidelines respond to increased capacity and planned growth of the NTTA System and the desire for uniform design across NTTA turnpike projects; incorporate best construction practices, new and improved technologies, safety improvements, and innovations that impact roadway material selection, corridor system development, and overall product performance; call for context-sensitive design and strategies; take community aesthetics, culture, and environmental systems into account; and create a process for public participation; and

WHEREAS, the NTTA Design Guidelines also call for consistency in NTTA landscaping and NTTA logos on roadways, cross-street identification, and pier design; and

WHEREAS, NTTA staff recommends approval of the NTTA Design Guidelines;

NOW, THEREFORE, BE IT RESOLVED, that the NTTA Board of Directors hereby approves the attached NTTA Design Guidelines Manual and authorizes its use by NTTA staff and consultants in connection with the design of NTTA turnpike projects.

ATTEST:

Paul N. Wageman, Chairman

Ruby Franklin, Secretary

ABBREVIATION KEY

AATT	Addison Airport Toll Tunnel
AASHTO	American Association of State Highway and Transportation Officials
APPROX	Approximate
AVI	Automatic Vehicle Identifiers
B&B	Balled and Burlapped
CAL	Caliper
CCTV	Closed Circuit Television
CF	Construction Fund
CIF	Capital Improvement Fund
CL	Center Line
CMP	Corridor Master Plan
CONC	Concrete
CONT	Container
CTP	Chisholm Trail Parkway
DEG	Degree
DG	Design Guidelines
DGM	Design Guidelines Manager
DIA	Diameter
DMS	Dynamic Message Sign
DNT	Dallas North Tollway
EIS	Environmental Impact Statement
ETC	Electronic Toll Collection
F	Fahrenheit
FSF	Feasibility Study Fund
GA	Gauge
GAL	Gallon
GALV	Galvanized
HDPE	High Density Polyethylene
HMIP	High Mast Illuminating Poles
IH	Interstate Highway
ILA	Inter Local Agreement
IT	Information Technology
LED	Light Emitting Diode
LLTB	Lewisville Lake Toll Bridge
MAX	Maximum
MBGF	Metal Beam Guard Fence
MCLB	Mountain Creek Lake Toll Bridge
MIN	Minimum
ML	Mil
MPE	Mini Power Enclosure
MPO	Metropolitan Planning Organization
MSE	Mechanically Stabilized Earth
N/A	Not Applicable
NCHRP	National Cooperative Highway Research Program
NTTA	North Texas Tollway Authority
O.C.	On Center
PC/PT	Point of Curvature/Point of Tangency
PGBT	President George Bush Turnpike
PGBTWE	President George Bush Turnpike Western Extension
PH	Power of Hydrogen
PS&E	Plans, Specifications, and Estimates
PSI	Pounds Per Square Inch
PTZ	Pan, Tilt, Zoom
PVC	Polyvinyl Chloride
R	Radius
RE	Reference
RESM	Roadway Electrical Systems Manual
RF	Radio Frequency
RMPP TF	Regional Mobility Partnership Plan Task Force
ROW	Right of Way
SB 792	Senate Bill 792
SCH	Schedule
SH	State Highway
SHLD	Shoulder
SHSD	Standard Highway Sign Designs
SPOC	System Projects and Operations Committee
SQ	Square
SS	Stainless Steel
SSB	Single Slope Barrier
SSTR	Single Slope Traffic Rail
SWP	Southwest Parkway
Tx MUTCD	Texas Manual on Uniform Traffic Control Devices
TxDOT	Texas Department of Transportation
TYP	Typical
UV	Ultraviolet
VES	Violation Enforcement Systems
VQAM	Visual Quality Assurance Manager
VQP	Visual Quality Plan
VTC	Video Tolling Camera
W/	With

NTTA DRAWING SERIES ABBREVIATIONS

ABG	Aesthetic Bent Guidelines
COS	Cantilever Overhead Sign
CSI	Cross Street Identification Details
DRA	Drainage Details
ESC	Electrical Service Center
FRD	Fence Support Repair Details
GCD	Groundcover Details
IRS	Irrigation Sleeve Details
ITS	Intelligent Transport System Details
LSP	Landscape Details
MBD	Moisture Barrier Details
MGP	Main Lane Gantry Precast
MLG	Main Lane Gantry Details
MRK	Pavement Marking Details
MSD	Mow Strip Detail
OSB	Overhead Sign Bridge Details
RFD	Right of Way Fence Details
RG	Ramp Gantry Details
RGP	Ramp Gantry Precast
RID	Roadway Illumination Details
RMF	Rail Mounted Fence
RWD	Retaining Wall Details
SGN	Overhead and Small Sign Details
SSB	Single Slope Barrier
SSR	Light Support Details
SST	Single Slope Transition Details
SSTR	Single Slope Traffic Rail
STR	Various Structural Details
VFR	Traffic Rail Type T221
URD	Underbridge Riprap Details

NTTA MISSION STATEMENT

"The NTTA's mission is to provide a safe and reliable toll road system, increase value and mobility options for our customers, operate the Authority in a businesslike manner, protect our bondholders, and partner to meet our region's growing need for transportation infrastructure."

NTTA

The North Texas Tollway Authority (NTTA) is a political subdivision of the State of Texas under Chapter 366 of the Transportation Code. It is empowered to acquire, construct, maintain, repair and operate turnpike projects; to raise capital for construction projects through the issuance of Turnpike Revenue Bonds; and to collect tolls to operate, maintain and pay debt service on those projects.

The NTTA represents Collin, Dallas, Denton and Tarrant counties and is governed by a nine-member Board of Directors. Each of the four counties within the service area of the NTTA appoints two members. The governor of Texas appoints one member from a county adjacent to the NTTA's four-county service area. The members of the Board of Directors serve staggered, two-year terms, and no member may be an elected official. From their membership, the directors elect a chairman and vice chairman.

OVERVIEW

The passage of Senate Bill 792, a statewide transportation bill, ensures that Texas will continue to provide needed roads. It extends the powers of local transportation authorities to develop toll projects by mandating that every planned road construction project will move forward as scheduled and that all toll revenue will be used for transportation projects in the area where the funds were raised.

The NTTA, its customers, and the communities adjacent to its system have come to expect that the NTTA facilities will be adaptable and progressive to meet ever-changing needs and expectations in keeping with the NTTA's commitment to a higher level of service.

NTTA continues its dedication to environmental sustainability through adoption of the NTTA Design Guidelines. The design guidelines provide a foundation and benchmark for design of corridor elements with a focus on planning, construction, improvements, operation, and maintenance of high-performance NTTA toll facilities.

The design guidelines integrate improved innovations and technologies for material selection, corridor systems, and product performance. Context sensitive design decisions and strategies established and reflected within the NTTA Design Guidelines also provide for corridor elements and relationships that respect and enhance functional, aesthetic, cultural, and environmental systems.

It is the goal that implementation of these guidelines in relation to site-specific applications will improve the overall health, safety and welfare of NTTA Customers by improving energy conservation, air and water quality, and efficiencies during construction and life cycle operations, as well as, positively impact local and regional economic development and quality of life.

The Design Guidelines manual is established as a "living" document, which allows continued updating of the design guidelines to maintain a level of design continuity as NTTA responds to new technologies, increased growth needs, cost effective design, safety concerns and corridor context.

The Design Guidelines offers guidance to create a system with design continuity while maintaining individual corridor identity. The guidelines reflect a spirit of innovation, aimed at visual quality and design flexibility while exhibiting the need for increased service and convenience for NTTA customers now and in the future. Adherence to these guidelines is intended to create a unique and well-designed toll facility and to provide a responsible, cost-effective design direction to final design professionals.

Designers are responsible for all federal, state and local compliance issues and site applicability of the most current Design Guidelines as adopted by the NTTA.

It is imperative that the design guidance given on these pages represent the latest and best information available to the NTTA. Accordingly, the NTTA will review this manual annually to determine if an update is appropriate. The NTTA Design Guidelines Manager (DGM) will keep a log detailing concerns and suggestions pertaining to manual errors, detail modifications, and updates throughout the year. If it is determined that there are substantial changes needed to the Design Guidelines, the NTTA Design Guidelines manager will recommend that a formal review and update of the Design Guidelines be conducted in order for a refined version of the Design Guidelines to be developed and published.

President George Bush Turnpike and Highway 35E Interchange

The NTTA Board of Directors, as recommended by the Customer Service, Projects and Operations Committee (CSPOC), adopted a series of design policies that allow the NTTA to clearly outline objectives that inform adjacent communities and other public agencies of NTTA's responsibilities and community opportunities. The design policies are as follows:

System-wide solutions will emphasize the "view from the road" view shed.

All NTTA right of way (ROW) should be developed in accordance with the latest edition of the Design Guidelines. These guidelines place emphasis on the "view from the road" view shed to maximize customer experience. Community or neighborhood design treatment desired beyond those in the Design Guidelines must occur outside of the NTTA right-of-way and will be the sole financial and maintenance responsibility of others.

"**View from the road"**	Improvements within NTTA System's main lane view shed
"View to the road"	Improvements outside the NTTA main lane view shed

NOTE: All city, community and neighborhood identification signage will occur outside NTTA ROW and is the responsibility of the individual city, community or neighborhood.

If appropriate, secondary emphasis may be placed on "view to the road" elements where improvement opportunities may be limited for elements within the "view from the road" view shed.

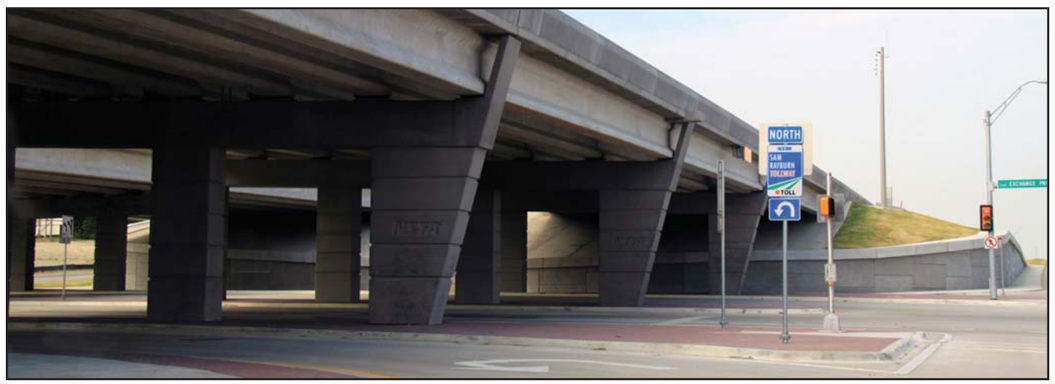
In some cases, communities may have established urban design committees or corridor review teams. The NTTA can work with these established groups and, where applicable, carry forward their concerns and suggestions into the corridor design process. All decisions related to final design issues will be the responsibility of the NTTA.

Create a system-wide consistency with individual identity.

The Design Guidelines provides system-wide image consistency with individual corridor identity which creates a unique image for the NTTA. This is achieved through the combined use of foreground elements and optional for each individual corridor. Foreground elements are those that visually dominate the corridor. Optional elements may collectively be as important in composing the corridor's visual character as the foreground elements.

With the expansion of the NTTA system, the replacement of the tolling plaza with the toll gantry, adoption of textures as well as minimizing paint use, and the understanding that improved technology may in fact change design elements within the corridor, it is likely that other elements be considered as foreground elements in certain corridors. The process of Visual Quality Management, as explained in the next chapter, that outlines how foreground elements will be identified and defined for the particular corridor being examined.

"View from the Roadway" Dallas North Tollway at Warren Parkway Underpass



"View to the Roadway" Sam Rayburn Tollway at Exchange Parkway Overpass

Foreground Elements

Foreground elements create a memorable experience for the motorist by establishing a sense of arrival to the system. They are continually reinforced throughout the driving experience to provide visual consistency. These elements may include:

Landscape

Landscape treatments enhance the toll road customer experience and help indicate transition points along the corridor. The use of landscape in focus areas, can provide a motorist with visual cues for interchanges, under/overpasses and gantries, which are possible driver transition points for entering the NTTA system. Where space permits, landscape design, allows a significant opportunity for corridor consistency. Landscape treatment is especially important in situations where existing corridor elements are inconsistent with the Design Guidelines. Inconsistencies occur most frequently in corridors that are converted to NTTA use or with existing NTTA corridors that are modified over time. Landscape treatments provide a flexible, cost effective solution for visual improvement and continuity.

President George Bush Turnpike at Waterview Parkway / Independence Parkway Underpass

Surface Finish Treatments

Finish and texture treatment unique to each corridor aid the motorist in identifying which toll corridor they are traveling on within the NTTA System, while also providing visual interest.

Toll Gantry

The combined use of columns, canopy treatments and column wash uplights for toll gantry design, offer visual impact and provide a strong recognizable element identified along corridors.

MSE Wall on Sam Rayburn Tollway

Ramp Gantry on Sam Rayburn Tollway

Optional Elements

If corridor constraints limit the success of one of the above mentioned foreground elements, the process of Visual Quality Management, as outlined in the following chapter, will allow for additional elements to take on foreground recognition.

Optional elements collectively create a higher level of visual quality along the NTTA System but do not stand out as individual elements. These elements are physically more distant from the traveler. Selection of optional elements will be determined for each individual corridor when an optional element is appropriate to maintain continuity. Optional elements help provide system wide consistency and include the following:

- **Bridge rail / traffic rail**
- **Cross street identification**
- **Fencing**
- **Landscape (when ROW restricts it from having foreground impact)**
- **Logo wall panel**
- **Pedestrian Lighting**
- **Roadway lighting**
- **Sign structures**
- **Surface texture (when foreground impact is minimal)**
- **Toll gantry (when foreground impact is minimal or technology makes it obsolete)**

The current NTTA System includes the Dallas North Tollway (DNT), the President George Bush Turnpike (PGBT), the Addison Airport Toll Tunnel (AATT), the Lewisville Lake Toll Bridge (LLTB), the Mountain Creek Lake Toll Bridge (MCLB) and the Sam Rayburn Tollway (SRT). NTTA continues to consider the opportunity for system expansion.

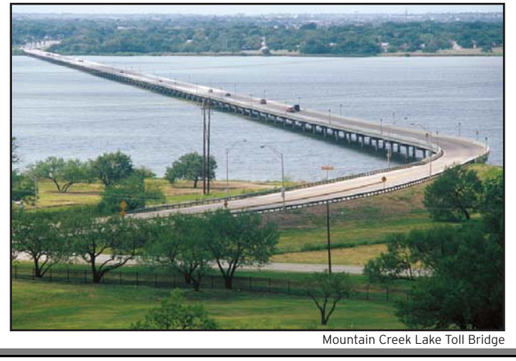
Sam Rayburn Tollway at Exchange Parkway

Dallas North Tollway at Cedar Springs Road

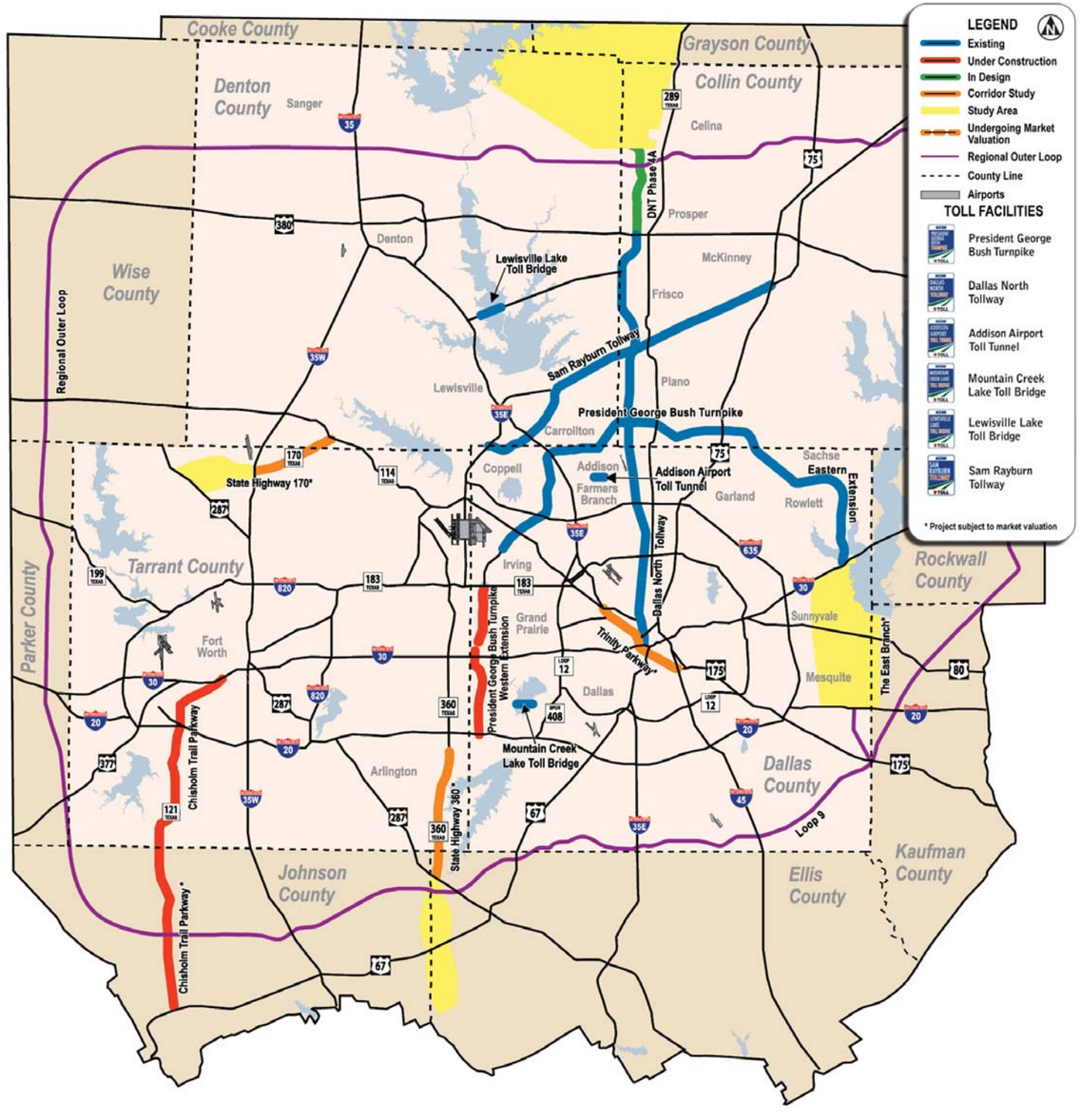
President George Bush Turnpike Interchange at Josey Lane

Lewisville Lake Toll Bridge

Addison Airport Toll Tunnel



Mountain Creek Lake Toll Bridge



The NTTA is keeping pace with the regional demand for transportation through expansion of North Texas' toll road system and implementation of improved technologies. The following is a list of planned corridors, future possibilities and considerations for additions to the NTTA System.

Chisholm Trail Parkway
The Chisholm Trail Parkway (formerly Southwest Parkway) is a proposed 27.6-mile tollroad that will extend from downtown Fort Worth south to Cleburne. More than 40 years in the making, the project is a collaboration between the North Texas Tollway Authority (NTTA), Texas Department of Transportation (TxDOT), the North Central Texas Council of Governments (NCTCOG), Tarrant and Johnson counties, the cities of Fort Worth, Burleson and Cleburne, Fort Worth and Western Railroad (FWWR) and Union Pacific Railroad (UPRR).

Originally defined as two distinct transportation projects, the Southwest Parkway and Chisholm Trail were combined to form the Southwest Parkway/Chisholm Trail project in October 2008. On May 12, 2011, Gov. Rick Perry signed HB 367 changing the name of the Southwest Parkway/Chisholm Trail corridor solely to Chisholm Trail Parkway. The bill took effect on September 1, 2011.

Dallas North Tollway Extension : Phases 4A/5B
The Dallas North Tollway (DNT) extension is proposed to extend from FM 428, providing a link between downtown Dallas and fast growing cities in Collin and Denton counties. The DNT Phase 4A/5B corridor is planned to extend the tollway from FM 428 north to approximately FM 121. Public meeteings are currently being held to provide information on the proposed alignment and receive input/comments from the public.

Trinity Parkway
The proposed Trinity Parkway will connect Interstate Highway (IH) 35E to U.S. 175, providing a new, approximately nine-mile relief route around the west and south sides of Dallas' central business district. If the NTTA elects to be the developer after the project partnering process, it will continue working on a strategy with project partners to complete the Trinity Parkway.

State Highway 190 East Branch
The East Branch / SH 190 corridor study was initiated by TxDOT in the late 1960s. TxDOT conducted the initial corridor studies and is processing the environmental impact statement for the project. The project may go through a market valuation joint effort process of the NTTA and TxDOT, resulting in a new, 11-mile link in the growing loop around Dallas and its suburbs.

State Highway 170
The SH 170 corridor study was initiated by TxDOT. TxDOT conducted the initial studies, processed the environmental reviews and obtained some right of way for the project. The NTTA is currently conducting further studies of the corridor. SH 170 may go through a market valuation process, a joint effort between TxDOT and the NTTA. The project is expected to result in an 11.8-mile tollroad in southwest Denton and northern Tarrant counties.

State Highway 360
The SH 360 corridor study was initiated by TxDOT. TxDOT conducted the initial studies, processed the environmental reviews and obtained portions of the ROW for the project. The NTTA is currently conducting further design, environmental and tolling studies of the corridor. SH 360 may go through a market valuation process, a joint effort of TxDOT and NTTA. The project is expected to result in a 9.7-mile extension of SH 360 in southern Tarrant, northwestern Ellis and northeastern Johnson counties.

For the purpose of this chapter, please also refer to the NTTA QMS Manual Procedure definition SD-06 for Visual Quality Management - Design.

VISUAL QUALITY MANAGEMENT

Background

The North Texas Tollway Authority (NTTA) originally developed the System-Wide Design Guidelines (SWDG) to coordinate the visual character of NTTA's tollways. The primary purpose of the SWDG was to establish a consistent look for new tollways as the NTTA network was expanded into new geographic areas. A related purpose of the SWDG was to provide aesthetic direction to projects that were being designed and constructed to improve the safety, mobility, or access of the existing system.

The NTTA Design Guidelines (DG) have been established to guide the development of construction plans for all projects on both new and existing corridors. Many lessons were learned as the design concepts illustrated in the SWDG were translated first into standard sheets, then incorporated into construction plans, and finally constructed as built projects. The Design Guidelines incorporates the lessons learned at each stage of the project delivery process and reinforces two over-arching goals 1) that the appearance of NTTA's corridors should be coordinated for system-wide conformance to the Design Guidelines and 2) that individual corridors should have an aesthetic consistency.

To achieve these goals under the new and wide range of conditions that now confront the NTTA, a flexible approach to the use of the Design Guidelines is needed. This flexible approach is described in a general way in this chapter and specifically by individual design element in the chapters that follow. By utilizing the flexibility inherent in this manual, the designer will be able to create transportation solutions that conform to the Design Guidelines requirements while being tailored to a particular project in a specific corridor.

A New Purpose

Designing a roadway that successfully integrates functional and aesthetic considerations is challenging. It must begin with an understanding of the functional requirements of the proposed roadway and the constraints and opportunities presented by the environmental, social, and economic context in which the road will be constructed.

It is the mission of the NTTA to "enhance mobility through responsible and innovative tolling solutions." This edition of the Design Guidelines is in conformance with that mission. It is premised on the concept that how a toll facility functions and looks is key to achieving NTTA's mission. The appearance of the NTTA corridor is the result of a thoughtful design process that considers the health, safety, and welfare of the highway user, the NTTA employee, and the community the toll facility serves as embodied in the NTTA values: Integrity, Leadership, Excellence, Teamwork, Accountability.

Many of the designs in this edition of the Design Guidelines are refinements of previous designs that reduce construction and maintenance schedules and costs. For example, the replacement of toll plazas with a single gantry for electronic toll collection (ETC) will reduce construction complexity and accelerate installation. It is also considered safer to the user because it allows for continued traffic flow. It is simple yet still commands being noticed because of its dynamic form. It is composed of durable materials, mostly concrete and metal, that will not require expensive maintenance. Paint and other coatings have been withheld and purposefully replaced with visually interesting forms and textures—all designed to reduce maintenance, which eliminates lane-closures and congestion, ultimately improving air quality and human health.

The designs in this manual coupled with the systematic maintenance practices of the NTTA, create an impression on the tollway user of a healthy and prosperous metropolitan area. The impression becomes a reality as good roads that function well and look well-cared for, attract and retain new and vibrant business and pleased residents. The NTTA is committed to sustainability. The Design Guidelines is one way the NTTA provides the Dallas-Ft. Worth Metroplex with a world-class transportation facility, promotes sustainability, and fulfills its mission of improving the quality of life for the people of North Texas.

Coordinating a corridor's appearance is straightforward when a corridor is completely new, and implementing the Design Guidelines achieves both system-wide conformance and aesthetic consistency. It becomes considerably more challenging when an existing roadway corridor is being reconstructed and the existing design elements do not match or complement the designs prescribed by the Design Guidelines.

The balance between system-wide conformance and corridor consistency is likely to be different for every corridor. In new corridors, the best way to create corridor consistency will be to apply Design Guidelines design requirements universally. To achieve visual consistency in older, existing corridors, it may be necessary to copy the designs that already exist in the corridor and blend them, selectively, with new elements that conform to the Design Guidelines.

The difficulty of achieving design consistency is compounded if the roadway corridor was

originally developed by a transportation agency other than the NTTA. Such a situation is becoming increasingly more common for the NTTA following passage of SB 792. This legislation broadened the role that NTTA has in developing the highway transportation system in North Texas. While the NTTA continues to enhance and extend its existing facilities, it now is beginning to complete or otherwise convert facilities that formerly were owned and operated by other transportation agencies. The diverse visual character of these corridors challenges the NTTA on how best to apply the Design Guidelines to such a wide range of existing facilities.

A New Method

To address these new challenges, a new method for applying the Design Guidelines to the design of the NTTA System is being implemented with the approval of this edition of the Design Guidelines. This new method is called *visual quality management.* Visual quality management is the method by which design flexibility is being introduced into the planning and design phases of NTTA's project development process. Visual quality management is based upon the concept that although conformance to the designs illustrated in the Design Guidelines is desired, visual consistency in each corridor is also important. The designer must be given the flexibility and exercise the creativity to develop solutions that balance system-wide conformance with individual corridor consistency to provide an integrated and branded appearance for all of NTTA's facilities.

The NTTA has created a system of tolled highways that is visually distinct from other highways in Texas. The distinctive visual quality of an NTTA Tollway is essential to the branding of the NTTA system. The concept of visual quality management will provide the necessary tools for perpetuating this distinction and the NTTA brand.

NTTA Project Delivery

Visual quality management should occur in the context of project delivery as defined in NTTA's Quality Management System (QMS) manual. It should begin as early as possible and prior to developing plans, specifications, and estimates (PS&E), preferably as early as the corridor viability phase, but may alternatively occur during the subsequent phases of corridor planning or project development. Completing the first three steps of visual quality management early in the planning and design process will typically provide the best opportunity to influence the visual character of the corridor at the lowest cost. Unless otherwise indicated in the specific corridor charter, responsibility for this task shall remain with the NTTA or its authorized representatives.

Corridor Types

The purpose of visual quality management is to provide the NTTA and its designers with a set of procedures for implementing the Design Guidelines in a variety of situations. How the Design Guidelines are implemented depends primarily on the type of corridor in which a specific project will be constructed. The NTTA has projects in three types of corridors:

1. Existing corridors - Projects on an existing NTTA tollway;
2. New corridors - Projects in a corridor not currently served by an existing highway or tollway;
3. Converted corridors - Projects that include portions of an existing highway or tollway that were previously controlled by another transportation entity.

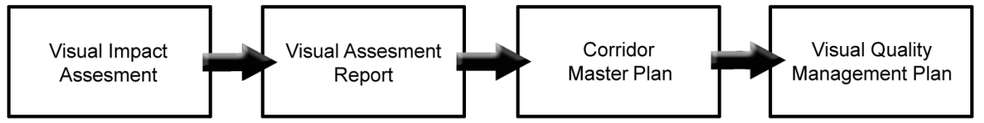
It is essential to manage the visual quality for all three types of corridors.

Steps and Products

Visual Quality Management has four steps. The first three steps are part of the planning and design process. The last step involves construction and maintenance. The four steps are:

1. Visual Impact Assessment (VIA)
2. Visual Assessment Report (VAR)
3. Corridor Master Plan (CMP)
4. Visual Quality Management Plan (VQMP)

NTTA Visual Quality Management Program



Diagrammatically the complete NTTA Visual Quality Management program produces four sequential products starting with a visual impact assessment followed by a visual assessment report, then a corridor master plan, and finally a visual quality management plan.

Visual Impact Assessment

A visual impact assessment (VIA) is required as part of the environmental review process. It's purpose is to ascertain if the construction or reconstruction of a transportation facility will affect the visual environment or viewers and if these effects will be beneficial or adverse. It also evaluates alternatives and suggests a preferred alternative based on visual issues. Finally it offers ways to mitigate adverse visual impacts and create a roadway that visually blends into the surrounding natural or cultural landscape, providing an aesthetically pleasing travel experience for the traveler and a visual asset to the community it serves.

A visual impact assessment is divided into three phases:

Inventory - The first phase identifies what visual resources and which viewers would be impacted by the proposed project. It also defines existing visual quality by determining what viewers visually like and dislike about the existing roadway corridor.

Analysis - The analysis phase determines if a particular project alternative will have adverse, beneficial, or no impact to existing visual quality. It also compares alternatives. Along with other environmental, engineering, and economic variables, this evaluation contributes to determining a preferred alternative.

Design - The last phase of the VIA process identifies mitigation requirements and enhancement opportunities for the preferred alternative. Of primary importance to the NTTA, this final phase documents any commitments made to maintaining, mitigating, or enhancing visual quality, including any commitment to continued public involvement during the subsequent phases of project development. Any commitment to maintaining, mitigating, or enhancing visual quality made in a visual impact assessment would be reported in the next document produced as part of the NTTA's visual quality program—the visual assessment report.

Visual Assessment Report

Following the VIA, a Visual Assessment Report (VAR) is completed. There are four components to the VAR:

1) Inventory of public commitments
2) Inventory of design elements
3) Design Guidelines conformance evaluation
4) Corridor consistency evaluation

Inventory of Public Commitments

Documentation of obligations that have been made to corridor aesthetics is the first item that should be included in the VAR. Commitments may include any promises made to continue public involvement; the establishment of a particular aesthetic design theme, style or motif; or the incorporation of a particular design element or feature.

These commitments may have been made as part of the environmental review process. Commitments to corridor aesthetics or the level of corridor aesthetics may also have been made during negotiations for funding right-of-way acquisition, design development, construction activities or corridor maintenance. Federal or state legislative or executive mandates also frequently include corridor aesthetic obligations. Commitments to aesthetics could also be recorded as part of agreements with municipalities and private land-owners.

The commitments are not limited to those involving only the tollway's mainlanes but may include ancillary commitments to the aesthetics of local, state, or federal roads, trails, or transit-ways passing over or under the tollway that will be constructed as part of NTTA's project.

Listing the commitments (or identifying that there are none) in the VAR will be critical to ensuring that any aesthetic agreements are incorporated into the design, construction, and maintenance of the tollway.

Inventory of Design Elements

The inventory of design elements has three steps:

1. Determine the type of corridor under evaluation. Is it an existing corridor -- one already owned, operated or otherwise controlled by the NTTA? Is it a new corridor that will be built, owned and operated by the NTTA where no other highway currently exists? Will it be a converted corridor where certain segments of an existing highway or tollway will be incorporated into the NTTA System? The VAR typically records this information in a narrative and on an associated corridor map.
2. Conduct a physical survey, which includes an inventory of existing design elements, noting the location and general appearance of all elements described and illustrated in the Design Guidelines (such as bridges, retaining walls, noise walls, fences, lights, etc.) including their forms, materials, finishes and, if distinctive, dimensions. This information is typically recorded in the VAR as a descriptive narrative with accompanying photographs and identified on a corridor map.

3. Identify which design elements still need to be constructed for the facility to become an NTTA toll highway. Again, these elements will be recorded in the VAR as a descriptive narrative with photographs or drawings and located on a corridor map.

Design Guidelines Conformance Evaluation

The Design Guidelines conformance evaluation will use the inventory of design elements to evaluate conformance to the guidance expressed in the Design Guidelines. The evaluator assumes, for this study, that those elements that will be constructed in the future will be built according to the Design Guidelines. The evaluator identifies whether the forms, dimensions, materials, and finishes for all the design elements are in or out of conformance with the Design Guidelines. The evaluator can document conformance with photographs and narratives laid out on a matrix or map.

Corridor Consistency Evaluation

Corridors that are existing NTTA tollways or are being converted from an existing tollway or highway, may not conform to the latest edition of the Design Guidelines, but they may still have internal consistency. For example, existing NTTA bridges may not have been constructed in conformance with the Design Guidelines but may still be aesthetically consistent if they were constructed as the same bridge type with identical or similar materials, forms, finishes.

It is important for the designer to know if the existing visual elements are visually consistent and if that consistency will be visually dominant in the finished corridor. If the corridor has its own, non-Design Guidelines consistency, the designer should consider the potential of continuing the existing visual elements for any new construction. The designer will use this evaluation to determine the content of the corridor master plan.

Corridor Master Plan

A corridor master plan (CMP) is required for all NTTA corridors prior to the development of any construction plans. A CMP explains how the intent of the Design Guidelines will be implemented in a particular corridor to balance system-wide conformance and corridor consistency. The CMP will be developed by the lead transportation Landscape Architect in collaboration with the NTTA corridor manager and the NTTA Design Guidelines Manager (DGM).

The CMP is composed of three sections:

1) VAR Executive Summary — An executive summary listing a) the commitments made to the community that affect visual quality; b) any vision statement that has been adopted to direct the aesthetic design of the corridor; and c) those design elements that will be in conformance with the Design Guidelines and what elements will have an appearance different than those prescribed by the Design Guidelines.

2) Design Guidelines – It will define and illustrate the visual character of those elements that are different from the Design Guidelines including their form, dimensions, materials, and finishes.

3) Construction and Maintenance Agreements – It will provide a summary of how and the extent to which the community will support the construction and maintenance of the corridor, including any cost-sharing agreements. (See Community Involvement section below.)

Determining system-wide conformance and corridor consistency are the necessary first steps in the development of a CMP. If system-wide conformance to the Design Guidelines is high, corridor design consistency will also be high and the CMP would document that the Design Guidelines will be implemented with no (or just minor) modifications. (Any minor modifications to the Design Guidelines would be identified and justified in the CMP.)

If system-wide conformance and corridor consistency are both low, the CMP will emphasize how Design Guidelines elements can be integrated with the existing design elements to improve system-wide conformance and corridor design consistency.

If system-wide conformance is low but corridor consistency is high, the CMP may potentially use those elements already in the corridor to maintain corridor consistency with Design Guidelines elements being added carefully where they will increase corridor consistency as well as system-wide conformance.

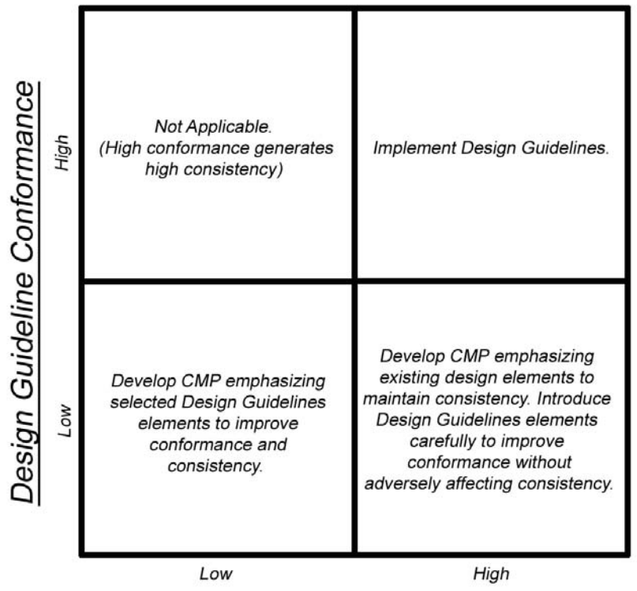
The CMP will be recommended for approval in the following order: first by the lead transportation Landscape Architect, the Visual Quality Assurance Manager (VQAM), the Design Manager and the Corridor Manager. The Corridor Manager will either approve the document if it is within their discretion to do so, or they will submit it to NTTA with their recommendation.

The NTTA approval process begins with the review by the Design Guidelines Manager (DGM) who may elect to have it reviewed by selected directors of operations before rendering a decision; followed by the Director of Project Delivery; followed by the Deputy Executive Director; and culminating with the Executive Director. At each level the reviewer may approve, reject, or advance the CMP.

1) *Approval with or without stipulations.* If in the opinion of the NTTA reviewer, the CMP will result in a corridor that meets the aesthetic policies of the Board of Directors, the reviewer may recommend approval of the CMP, issuing a notice that the designers proceed to create plans, specifications, and estimates in accordance with the Design Guidelines as modified by the CMP. The reviewer would inform the Deputy Executive Director through the NTTA chain of command of their decision. The Deputy Executive Director would report the decision to the Executive Director, who, in turn, would report it the Customer Service, Projects and Operations Committee and subsequently, the Board of Directors. The NTTA reviewer who approves the CMP may add stipulations to the approval. Such stipulations will, at a minimum, be attached to the CMP as an addendum. If the stipulations require modification to the CMP, those modifications will be made under the direction of the project manager, the lead transportation Landscape Architect, and the DGM and then resubmitted for approval.
2) *Rejection with or without comment.* If in the opinion of the NTTA reviewer the level of deviation from the Design Guidelines will likely result in rejection of the document by the Customer Service, Projects and Operations Committee or the Board of Directors, the reviewer will submit a memorandum to the DGM, outlining the reasons for rejecting the CMP and directing the designers to modify the document prior to resubmitting it. The Deputy Executive Director will report the reviewers actions to the Executive Director, the Customer Service, Projects and Operations Committee, and the Board of Directors.
3) *Advance with or without recommendation.* If in the opinion of the NTTA reviewer, it cannot be ascertained if the CMP will meet the expectations of the Board of Directors, the NTTA reviewer may advance the CMP with or without recommendation to their superior for review and approval.

All levels of NTTA approval have these same three approval options. If necessary, the Executive Director may advance the review and approval to the Board of Directors.

The Board of Directors may approve the CMP with or without stipulations or it may reject it with or without comment.



If the CMP is rejected, the VQAM will oversee that the required modifications are included prior to resubmitting the revised CMP for approval. If the CMP has been accepted but with stipulations, those stipulations will, at a minimum, be attached to the CMP as an addendum. If the stipulations require modification to the CMP, those modifications will be made under the direction of the VQAM and approved by the Deputy Executive Director.

All plans, specifications, and estimates for construction will be completed in accordance with the Design Guidelines as modified by the approved CMP.

Community Involvement

Involving the community can take many forms. The primary purpose is to understand community values and to apply those values, as appropriate and in accordance with negotiated agreements, to the design of the NTTA tollway. Community involvement typically occurs during environmental review but as a result of that review or other project-related negotiations, community involvement may be extended past the VIA and into other stages of NTTA's visual quality management program.

For example, the VIA may conclude that a city affected by the proposed NTTA project has an existing community development plan that dictates the aesthetics of local streets. The VAR may conclude that these local guidelines must be considered during the development of plans for the NTTA's tollway. Typically in such a situation, the NTTA would invite local representatives to participate in the development of the CMP.

Typically, integrating the aesthetic values of a community into the visual quality management process would be performed by landscape architects under the direction of a lead transportation Landscape Architect in coordination with the NTTA Corridor Manager and the DGM. The work would typically be initiated at the request of an NTTA Corridor Manager. Any use of community involvement tools would be conducted in accordance with the Quality Management Systems (QMS) manual, specifically Section 4.3 Public Involvement which includes procedures for conducting stakeholder advisory groups, public meetings, and other public involvement processes.

Understanding Community Values

One of the best ways to understand community values is to review existing plans that have been developed for the corridor, including state, regional, county, and municipal plans. In particular, the landscape architect should become familiar with the vision and goals these plans have for the corridor, especially any discussion related to the character of transportation and land use. This process may involve interviewing the authorities that produced these plans or others that have some sort of regulatory authority over community development, particularly transportation or land use. This inventory of public commitments is documented in the visual assessment report.

Conducting stakeholder advisory groups or other public meetings is another way to ascertain community values. Representatives appointed by local authorities can be very good sources of information. Informal public information meetings are a good way to garner information about community issues and vision. Public hearings are a more formal way to extract such information about a particular tollway project. Typically this would be done as part of the environmental documentation process but it may continue through the development of the corridor master plan if mitigation to adverse visual impacts is required.

Meeting with community groups, neighborhood associations, community service clubs, or professional associations can also generate important information on the value aesthetics has in the community.

The NTTA regularly informs its constituents and the adjoining community, at public information meetings, of decisions related to visual quality and aesthetic treatments which are planned in project designs.

Incorporating Community Values

By understanding what the community values, the landscape architect can determine how well the expectations of a community will be met by the improvements being proposed by the NTTA. If what the NTTA typically provides, according to the Design Guidelines, meets the community's expectations for aesthetic treatments, no substantial changes will need to be made to NTTA's development plans. However if the expectations of the local community are substantially different from what is typically offered by NTTA, it will be necessary for the landscape architect to identify how these expectations could be funded and incorporated into the proposed project without NTTA assistance.

Funding and Partnership Strategies

To fund additional enhancements, the NTTA and local authorities will need to define their respective roles and responsibilities. Mutual agreement is necessary to ascertain the level of enhancements to be incorporated into the project, how they will be funded, when they will be implemented, and how they will be maintained. This will be the basis of a written agreement between NTTA and local authorities in accordance with procedures outlined in the QMS manual. These agreements can be developed and signed as early as possible, preferably as early as the preliminary inter local agreement. At a minimum, agreements should be completed as part of the project development process and incorporated into the corridor master plan before the development of construction documents. Without such an agreement, the NTTA will develop the corridor as prescribed in Design Guidelines, as modified by the CMP.

Visual Quality Management Plan

The Visual Quality Management Plan (VQMP) is essential for achieving the NTTA's goal of creating visually attractive roadway corridors ensuring system wide conformance and sustainability. The VQMP is developed by the PD project manager at the beginning of any project after the CMP has been developed but before any construction documents are produced. The purpose of the VQMP is for the project manager to describe how the project team will achieve the visual quality and level of aesthetic treatment required by the Design Guidelines, as modified by the Corridor Master Plan, for the specific corridor or corridors affected by their project. The VQMP will:

1) Demonstrate that the project manager understands the guidance provided by the Design Guidelines and CMP;
2) Identify the key personnel that will be responsible for implementing the Design Guidelines and CMP including a project VQAM;
3) Identify how the project VQAM will participate in the design process and communicate with project designers and the NTTA VQAM and Design Guidelines Manager (DGM);
4) Identify why, where, and what may require a deviation from the design direction established by the Design Guidelines and CMP, offering a proposed design alternative that meets the intent of the Design Guidelines, the CMP, and the NTTA's mission statement.
5) Identify innovative alternatives that deviate from the design direction established by the Design Guidelines and CMP but nonetheless offer an opportunity to reduce costs, accelerate the schedule or further the mission of the NTTA while still meeting the intent of the Design Guidelines and CMP.

The VQMP will be delivered to the NTTA visual quality assurance manager for approval prior to the beginning of design work. The actual process for developing a VQMP is outlined in the QMS manual.

Discrepancies

During the development of final design plans, the design direction given in the Design Guidelines and CMP may need to be interpreted by designers. Any design that results from interpreting the Design Guidelines or CMP (and not simply applying their directives), must be accepted by the DGM as being appropriate for a particular location on the corridor. In practice, all design should be reviewed and accepted by the DGM through the NTTA VQAM.

If the project manager or corridor manager disagrees with the decision of the DGM, the parties shall prepare briefs for the Director of Project Delivery to review. The Director of Project Delivery will make a decision or ask the PD Program Manager or the GEC CIP Manager, as appropriate, to make a decision and/or recommend an appropriate solution. The PD Project Manager or the GEC Project Director may decide that the decision must be made by the NTTA, submitting the issue to the Authority with their recommendation to the Director of Project Delivery who may elect to have it reviewed by selected directors of operations before rendering a decision or to advance the issue to the Assistant Executive Director of Project Delivery; followed by the Deputy Executive Director; and culminating with the Executive Director. At each level the reviewer may make a decision or advance the issue.

The Executive Director may make a decision or refer the matter with or without comment to another committee and the NTTA Board of Directors for a decision. The Board of Directors may decide the matter or refer it to a committee for study. The committee will subsequently make a recommendation to the Board. The Board may accept or reject the recommendation.

At every level, every effort shall be made to reach a mutually agreeable decision. The decision will be reported to the Deputy Executive Director and Executive Director. The appropriate Exception Report or Project Change Request will be submitted to NTTA management and the Board, as required by the QMS manual.

Individual Design Elements

This chapter has outlined a general approach to visual quality management, culminating in the production of a corridor master plan. The individual design elements that are typically illustrated in a CMP include:

Toll Gantries, Bridges, Bridge Rails, Retaining Walls, Traffic Barriers, Noise Walls, Lighting, Signs Textures and Finishes, Landscape

The remainder of this manual will illustrate NTTA's preferred system-wide design guidance for each of these elements. As outlined in the previous pages, these preferred designs will not always be the selected design. How to apply the concepts of visual quality management to each design element is discussed in an introductory narrative for each element.

A flow chart for the visual quality management process, including the development of the VAR and the CMP, follows.

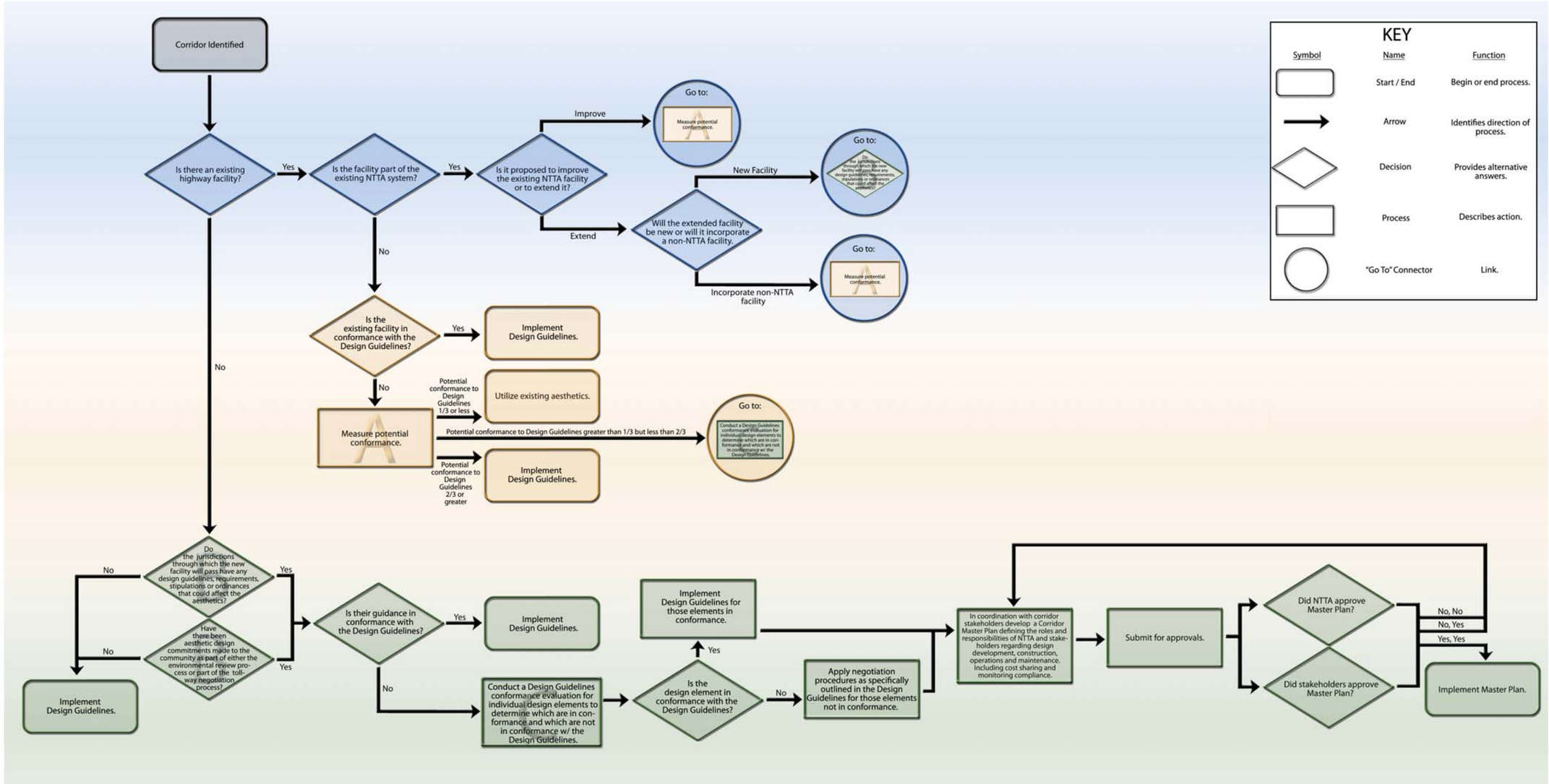
Flow Chart

NEW CORRIDOR

EXISTING CORRIDOR

NTTA FACILITY

NON NTTA FACILITY



01 TOLL GANTRY STRUCTURES

Electronic Toll Collection (ETC) with video tolling offers an innovative solution for collecting tolls. Aesthetically pleasing structures, sensitive to the community context, provide a unique and identifiable "brand" reflecting NTTA's vision for leadership and commitment to solving the transportation needs of North Texas. Modifications will be needed to convert most existing toll plazas to ETC with video tolling. Ultimately, all existing toll plazas will be removed and replaced with toll gantries.

In addition to operational benefits, the ETC with video tolling will:

- Reduce construction, maintenance, and operational costs.
- Accelerate construction schedules
- Reduce the need for right-of-way
- Eliminate stop-and-go traffic, merge-weave situations, enhancing safety, easing traffic congestion, and improving air quality

Visual Quality Management for Toll Gantries
NTTA toll gantries occur only within the NTTA right of way. New and replacement gantries will follow Design Guidelines guidance. Non-conforming gantries will not be allowed, improving corridor consistency and maintaining conformance with the Design Guidelines and other gantries in the NTTA System.

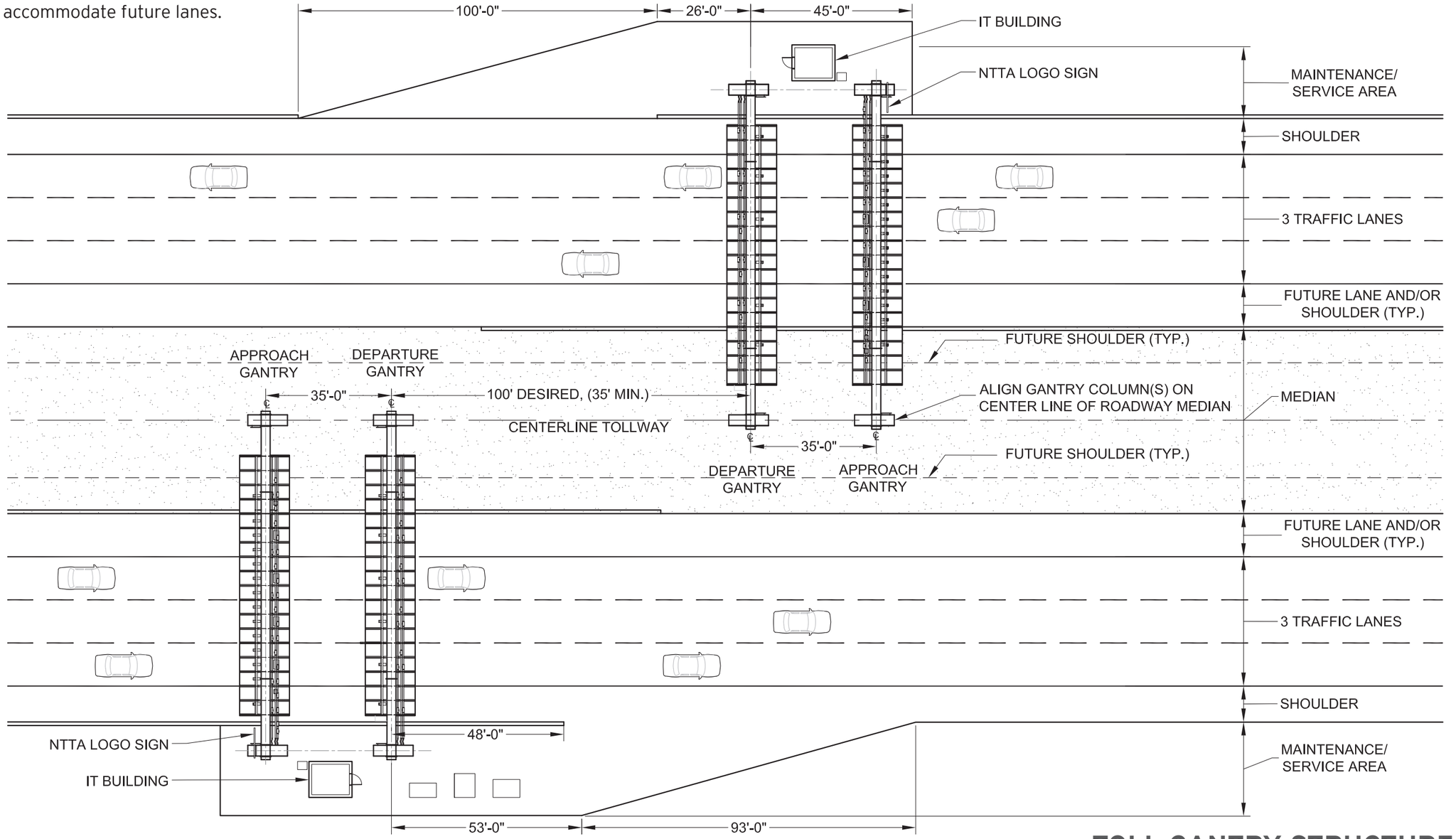
*For detailed design information reference the following NTTA standard drawings series:
MGP, MLG, RG, RGP

Prototype Rendering

Main Lane Gantry

Notes:

- Prototypical main lane gantry guideline represents layout with typical roadway configuration. (Site specific adaptation required)
- Coordinate location of main lane gantry with DGM for consideration of functional and aesthetic value relative to view shed and geometric conditions.
- Align gantry armatures with respective traffic lanes, unless future lane configuration prohibits it.
- Gantry to accommodate future lanes.

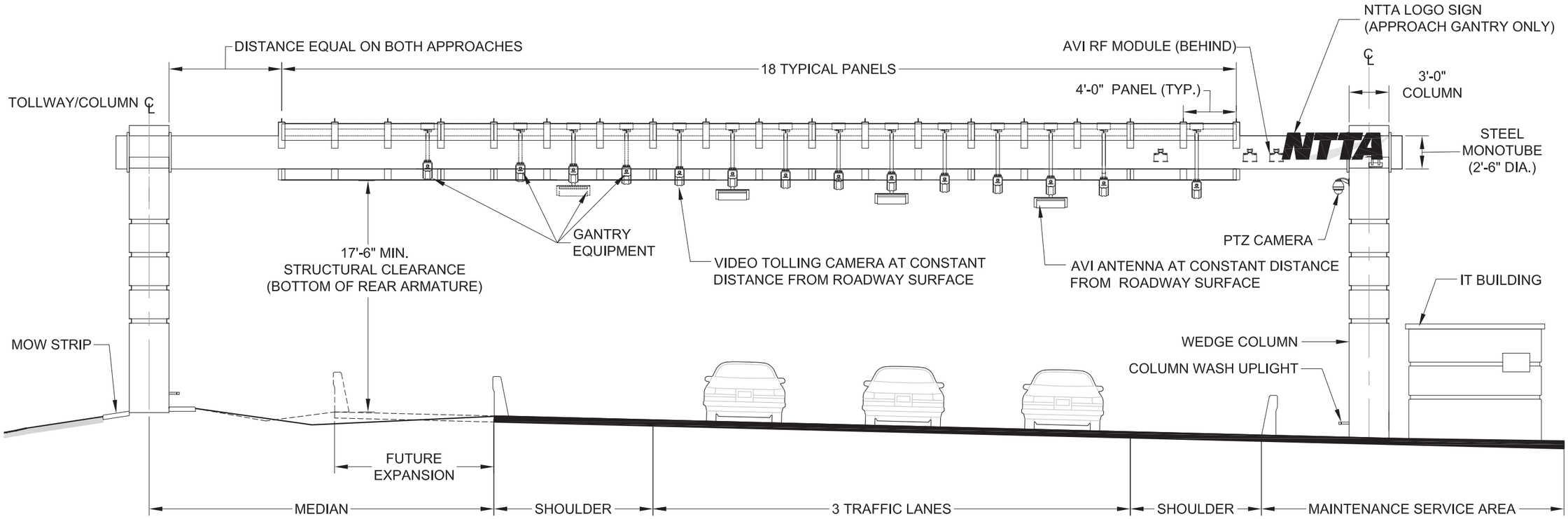


Plan

Main Lane Gantry

Notes:

- Median condition may vary.
- Wedge column height established from highest point of future pavement cross section relationship to the 17'-6" minimum structural clearance.
- Monotube is level across roadway.
- Gantry equipment height to follow constant cross slope of pavement.

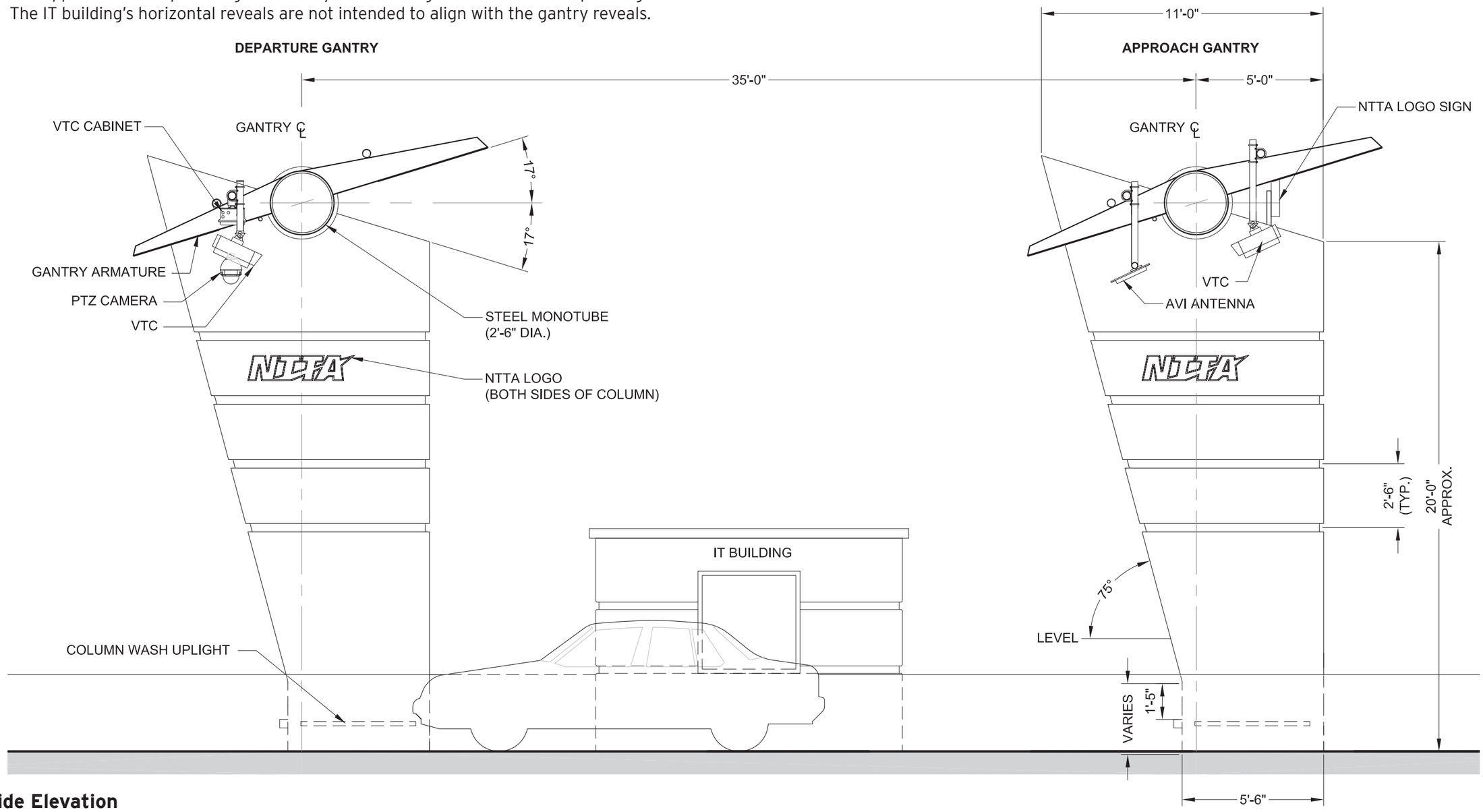


Elevation

Main Lane Gantry

Notes:

- The approach and departure gantries may differ in height elevation due to profile grade.
- The IT building's horizontal reveals are not intended to align with the gantry reveals.

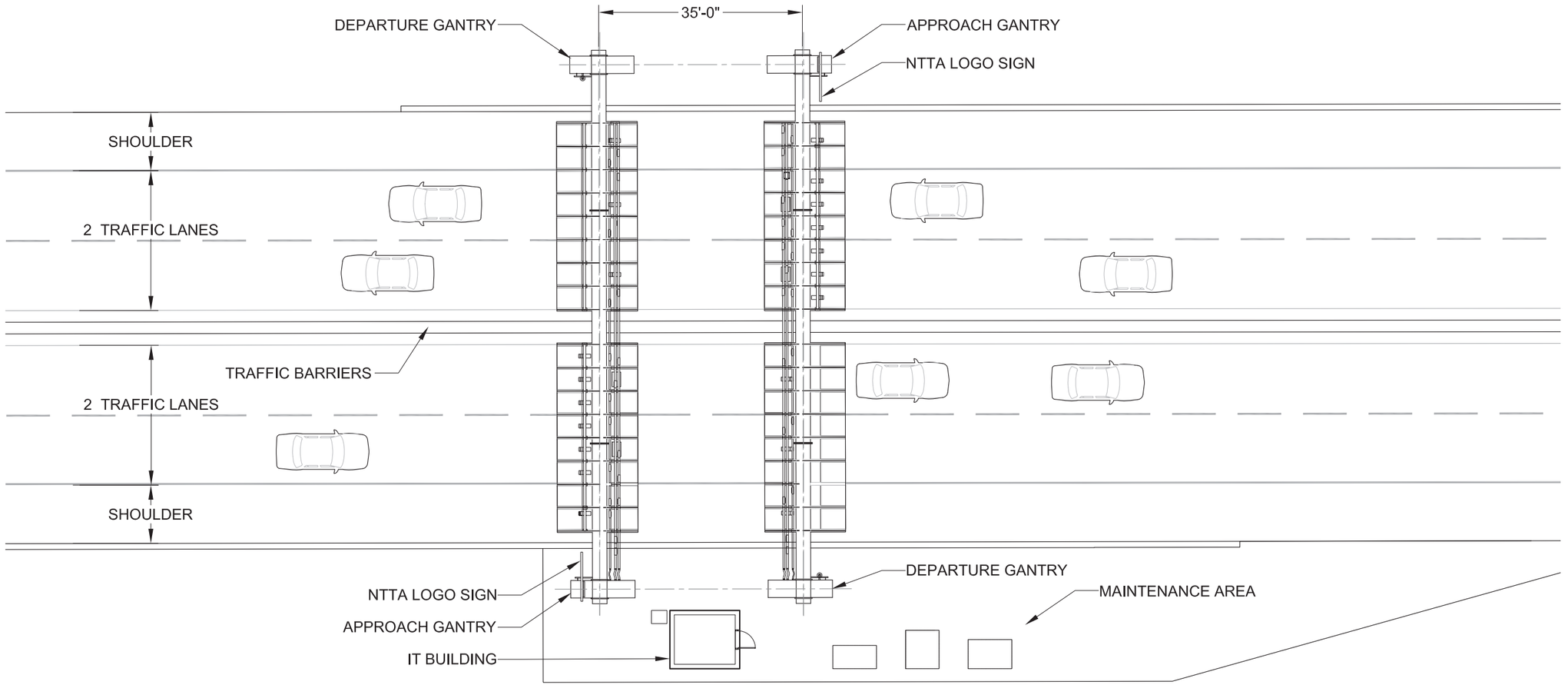


Side Elevation

Multi-Directional Gantry

Notes:

- The multi-directional gantry is a single span applied to two-lane separated roadway conditions. (example: Lewisville Lake Toll Bridge)
- Maximum span length for a multi-directional design is 104 feet.
- Prototypical for multi-directional gantry layout guideline with typical roadway configuration shown. (Site specific adaptation required)
- Coordinate location of main lane gantry with DGM for consideration of functional and aesthetic value.
- Align gantry armatures with respective traffic lanes, unless future lane configurations prohibit it.

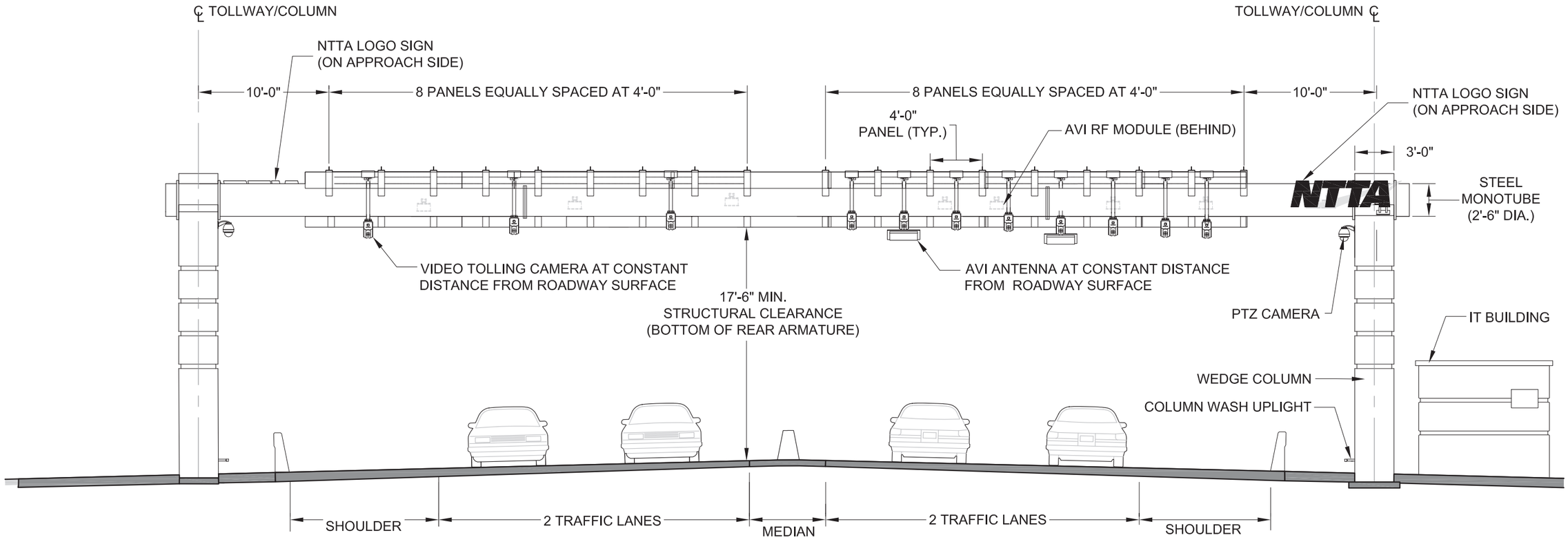


Plan

Multi-Directional Gantry

Notes:

- Median condition may vary.
- Monotube is level across roadway.
- Gantry equipment height to follow constant cross slope of pavement.

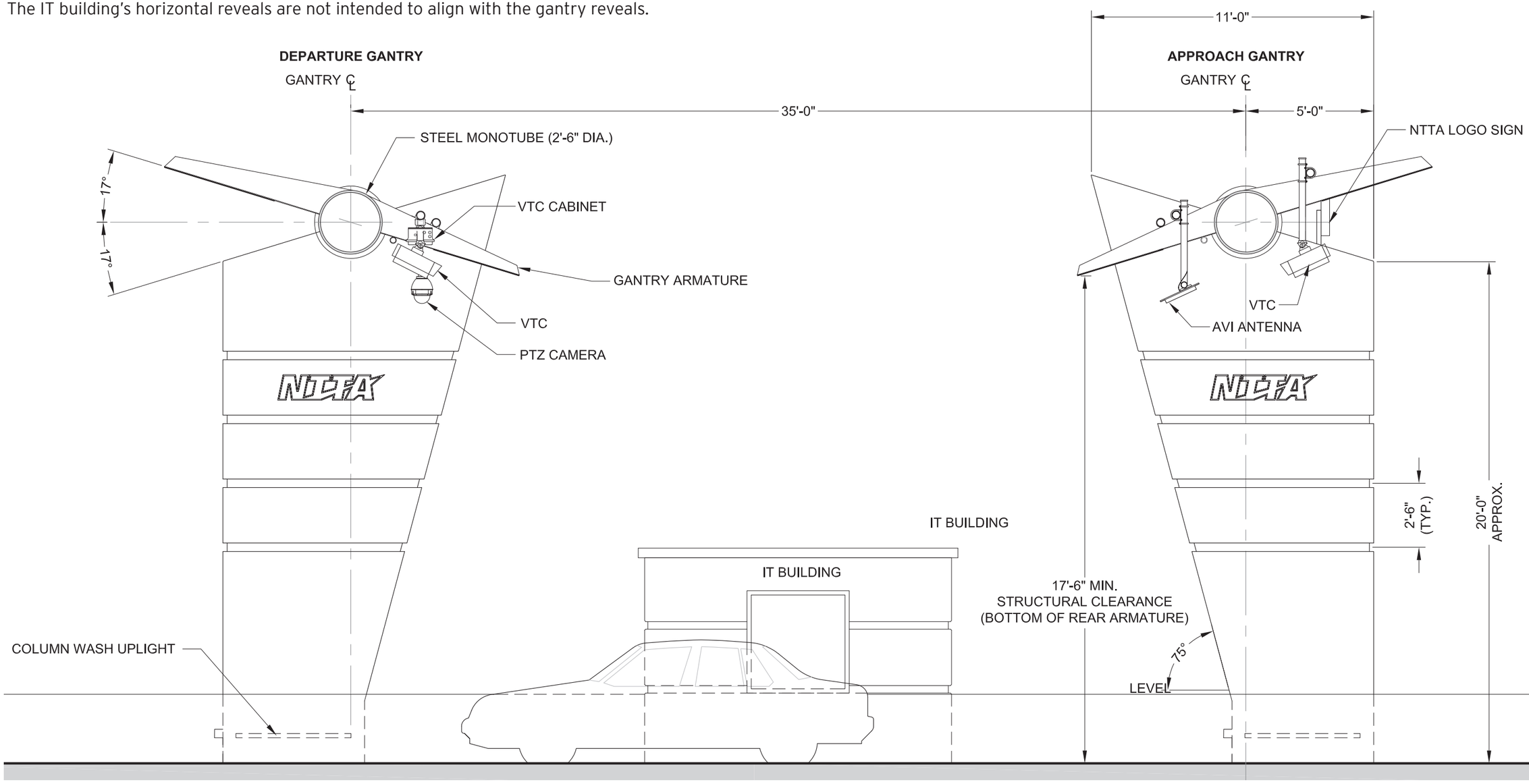


Elevation

Multi-Directional Gantry

Notes:

- The approach and departure gantries may differ in height elevation due to profile grade.
- The IT building's horizontal reveals are not intended to align with the gantry reveals.

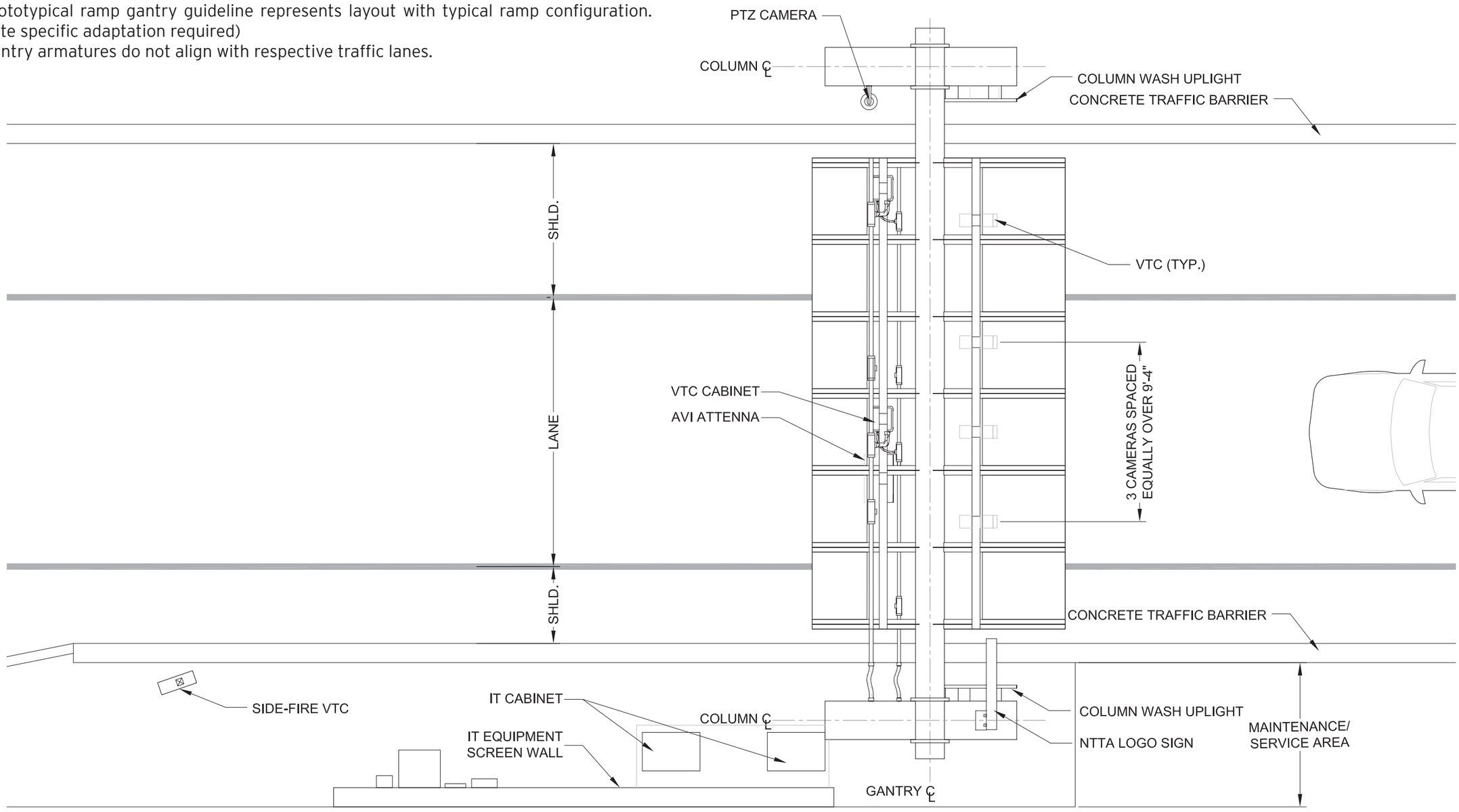


Side Elevation

Ramp Gantry

Notes:

- Prototypical ramp gantry guideline represents layout with typical ramp configuration. (Site specific adaptation required)
- Gantry armatures do not align with respective traffic lanes.

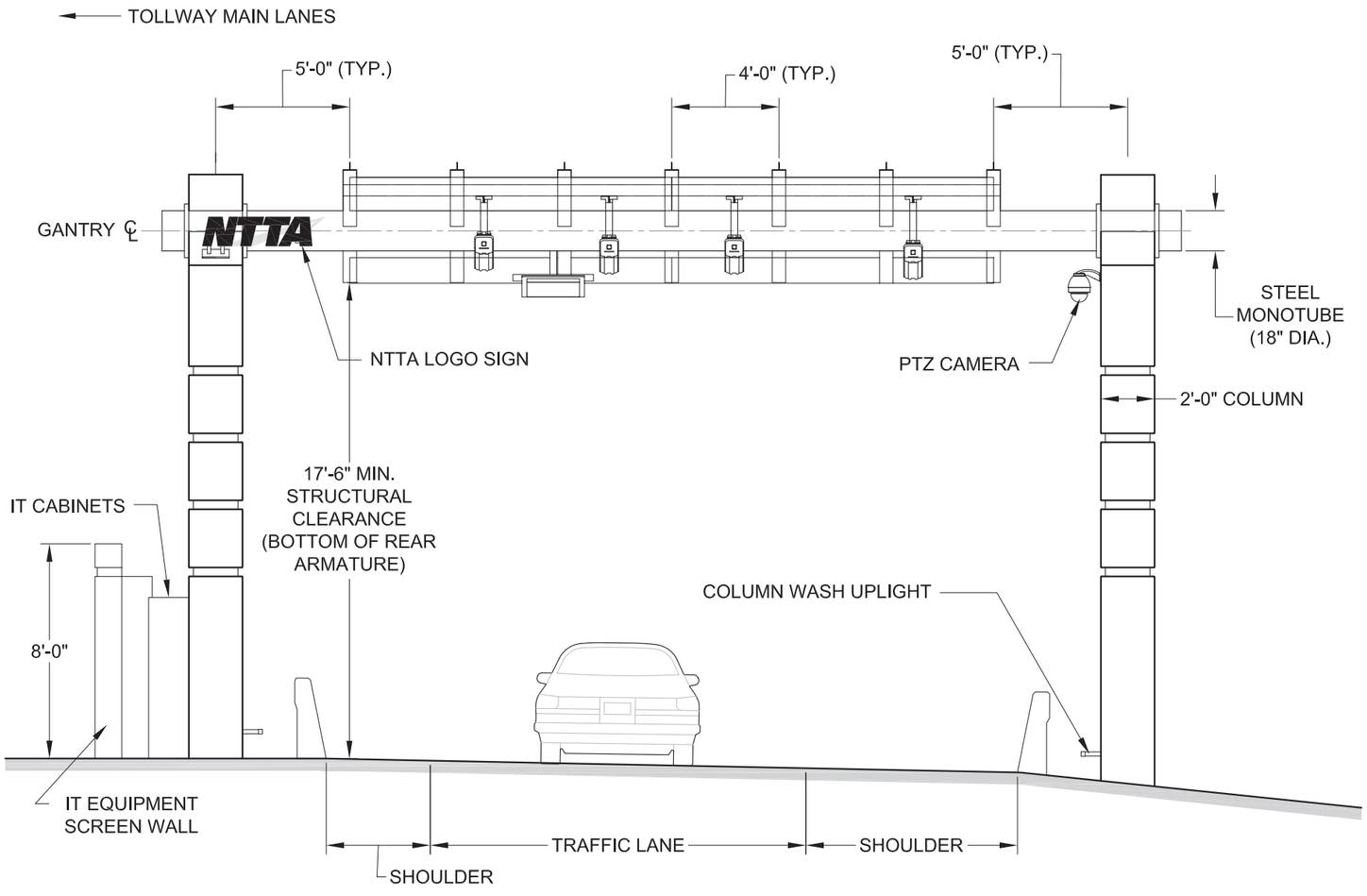


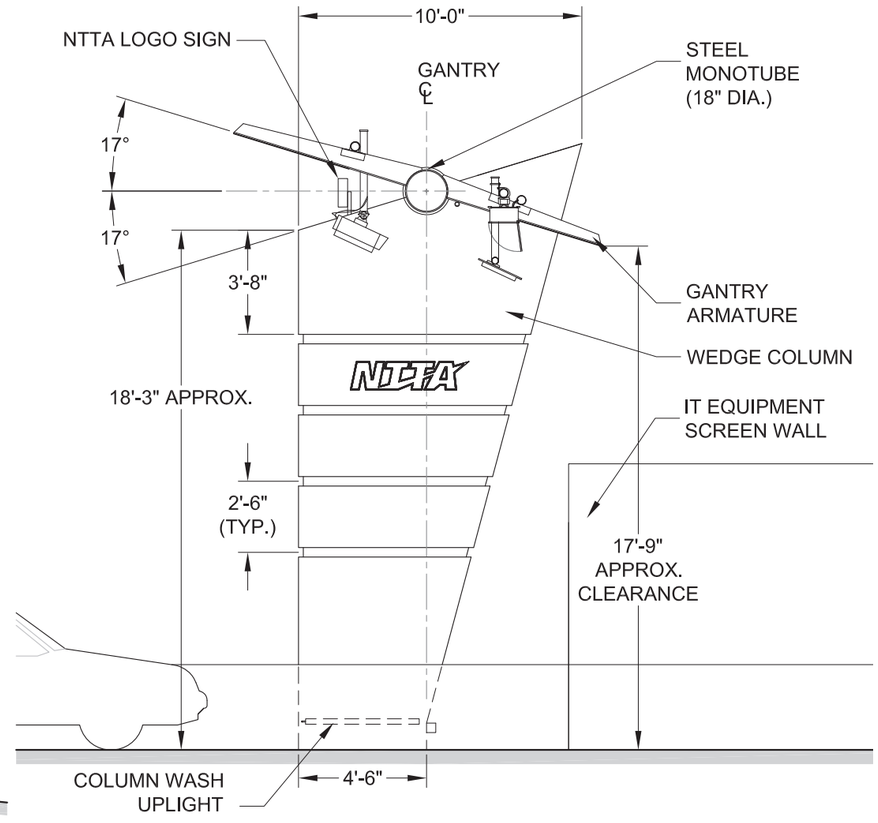
Plan

Ramp Gantry

Notes:

- Monotube is level across roadway.
- Gantry equipment height to follow constant cross slope of pavement.



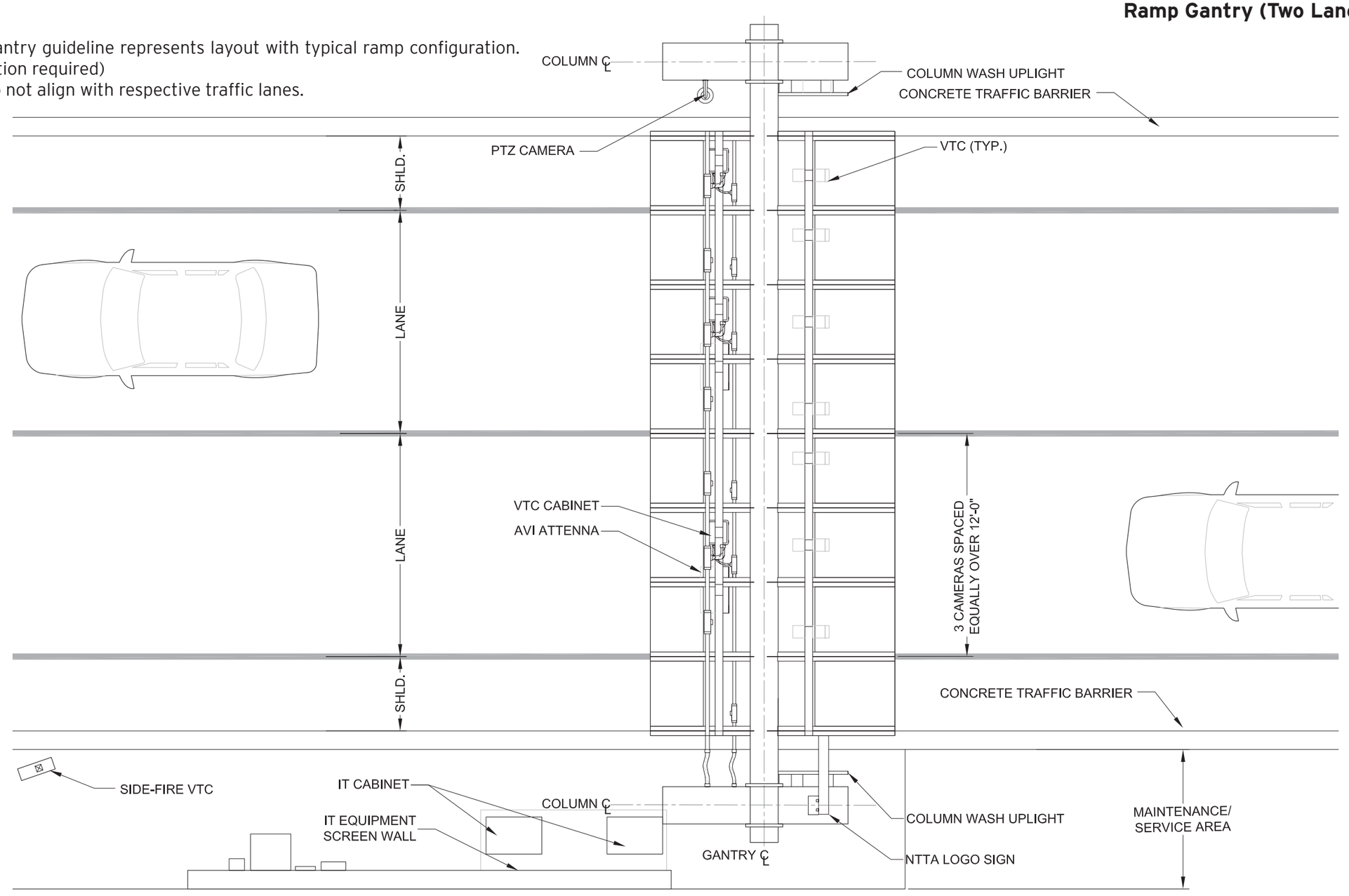


Elevation / Side Elevation

Ramp Gantry (Two Lane)

Notes:

- Prototypical ramp gantry guideline represents layout with typical ramp configuration. (Site specific adaptation required)
- Gantry armatures do not align with respective traffic lanes.

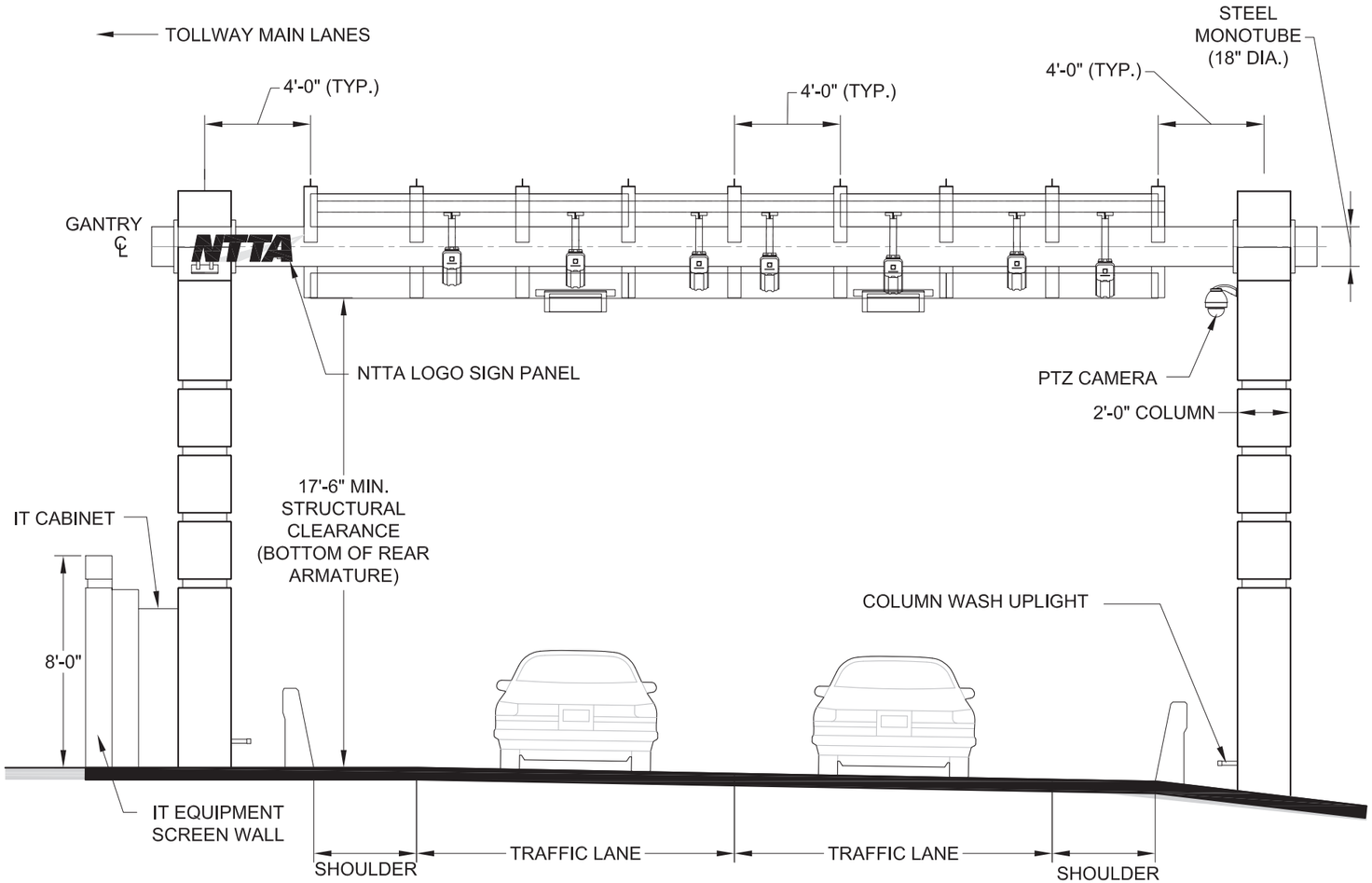


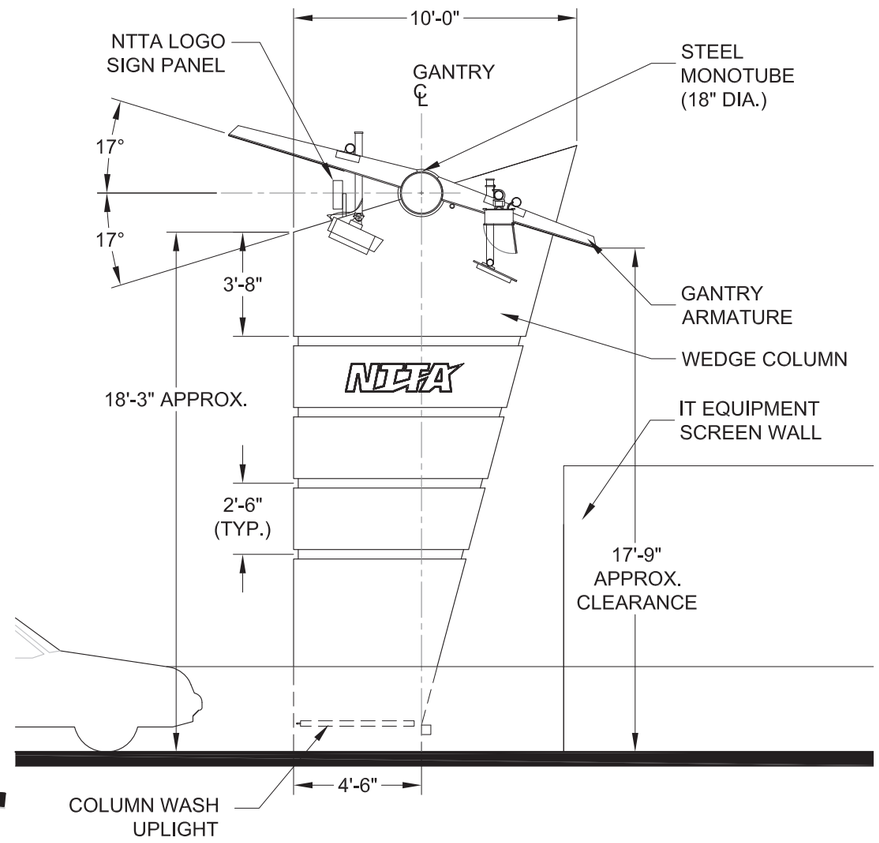
Plan

Ramp Gantry (Two Lane)

Notes:

- Monotube is level across roadway.
- Gantry equipment height to follow constant cross slope of pavement.





Elevation / Side Elevation

02 BRIDGE STRUCTURES

Bridge structures are visually significant elements. For the NTTA customer, they represent interaction with the system, a point of entrance, exit, or crossing. The system's bridges are distinctive, with sound structural and aesthetic design that identifies the NTTA brand.

Visual Quality Management for Bridges

There are six general types of bridges in the NTTA System:

1. Tollway bridges over local roads
2. Local road bridges over a tollway
3. Tollway and service road bridges over water bodies
4. Direct Connectors (system to system ramps)
5. Railroad bridges over a tollway
6. Pedestrian bridges over a tollway

The function and character of every bridge must be addressed during visual quality management. Coordination of bridge design with local vehicular, railroad, transit, bicycle, and pedestrian networks is essential. An understanding of the standard widths that a community uses for its sidewalks and bicycle lanes is essential for determining the cross section of a bridge. Roadway standards may need to become wider on or under a bridge in order to provide the same level of service and safety necessary to accommodate clear distances from railings, walls, and curbs or allow for the incorporation of lighting and signage.

NTTA is dedicated to providing an aesthetically pleasing experience to tollway patrons. Consequently, views from its facilities are a primary focus. Site inventory and negotiations with local authorities will determine how local streetscape guidelines are to be incorporated into the NTTA project. Provided that a construction and maintenance agreement can be executed, it is conceivable for local communities to implement streetscape standards under toll facilities. Alterations requested by local municipalities to bridges over the tollway, however, are typically not entertained for reasons of maintaining tollway corridor continuity.

The Design Guidelines Manager (DGM) will determine if it is preferable to implement the Design Guidelines or other bridge designs on new construction through a visual assessment. The goal is visual consistency within the corridor/system. A corridor master plan will be developed to identify which aesthetic treatments should be included.

Visual Quality Management for Bridge Rails
Bridge rails will follow the Design Guidelines design to maintain consistency throughout the corridor and conformance throughout the NTTA System.

In existing corridors (corridors currently controlled by the NTTA) or converted corridors (corridors previously owned and operated by other transportation authorities) with bridge rails, the NTTA designer will evaluate if adding the Design Guidelines bridge rail to the corridor will substantially detract from visual consistency. If adding compliant bridge rails substantially detracts from visual consistency, the NTTA project manager with assistance from the NTTA Visual Quality Assurance Manager will develop bridge rail design and location plan that is visually compatible with the bridge rails that already exist.

Visual Quality Management for Direct Connector Bridges
In existing NTTA corridors, converted corridors, and or existing TxDOT corridors, the NTTA designer, in coordination with the DGM, will evaluate if adding the Design Guidelines wall, rail, coping and other associated elements to the direct connector structure design (abutment, walls etc..) will substantially detract from or add to the visual consistency of each connecting corridor. The NTTA designer will work with the Visual Quality Assurance Manager to develop design and location plans that are visually compatible with each corridor adjacency and visability.

Visual Quality Management for Railroad Bridges
Railroad grade separation structures should be designed to optimize the primary aesthetic design components of a corridor master plan. While they may not be owned by the NTTA, they should be designed to replicate the prevailing structure type used in the corridor to the extent possible. When circumstances require a different structure type, railroad bridges should be designed with elements and treatments that do not visually distract or detract with those selected for the corridor. Every effort should be made to match or emulate the design of substructure components (such as the columns and cap features of bents, seats, abutments and mask walls).

If at all possible, the railroad bridge design engineer should be consulted during alignment (horizontal and vertical) studies. Close coordination should be maintained throughout the design phase of the project, so that the most prudent design from the standpoint of safety, functionality, aesthetics and economics of the total roadway (including the railroad bridge) can be achieved.

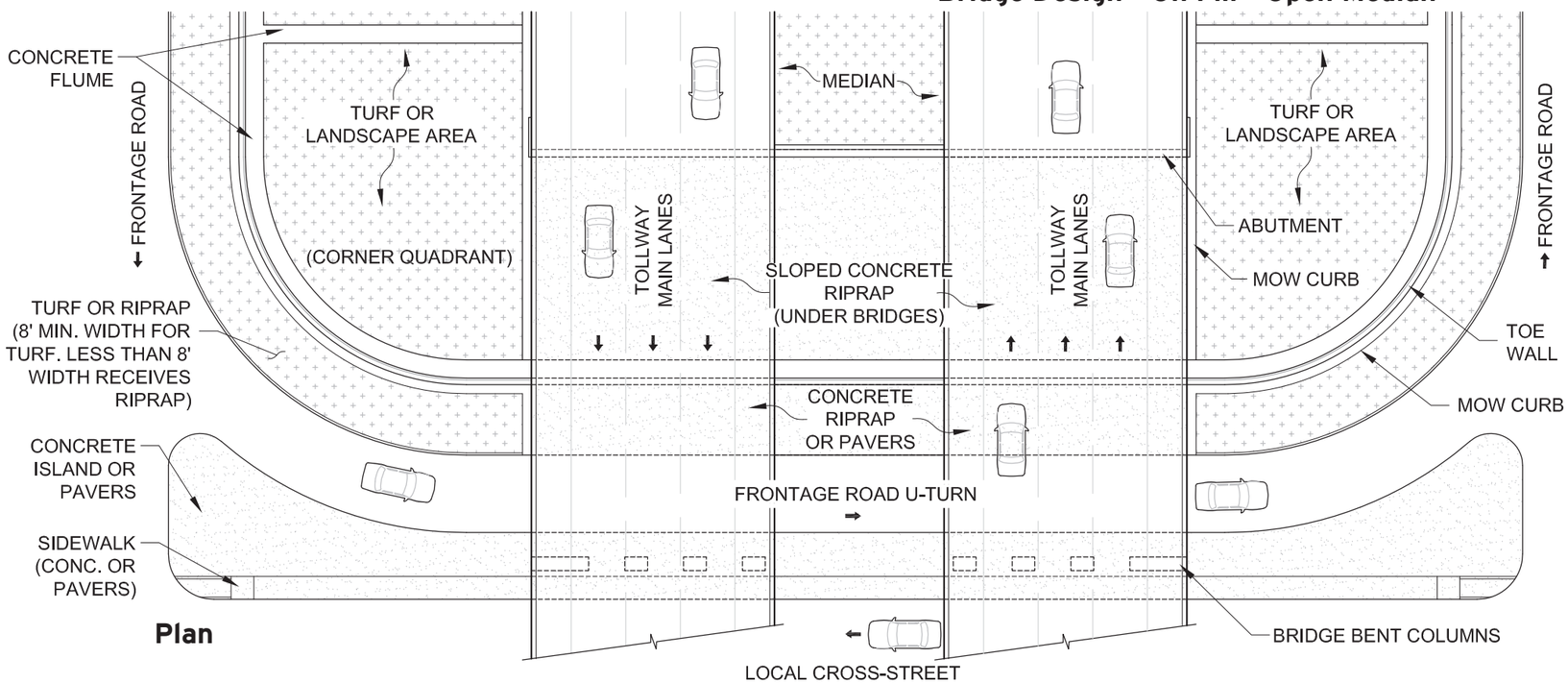
*For detailed design information reference the following NTTA standard drawings series:
RWD, SSB, ABG, CSI, SSR, STR, URD, RMF

Prototype Rendering

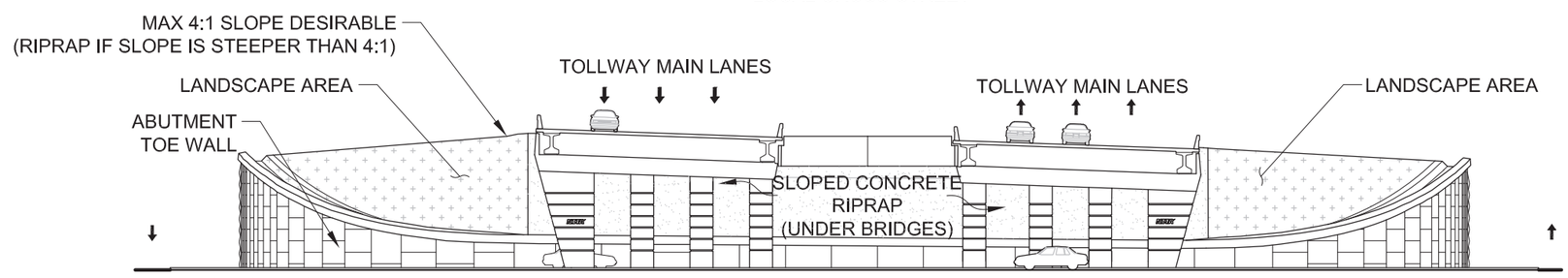
Notes:

- This bridge configuration represents a tollway crossing over a local road with a sloped abutment, toe walls and an open median. Abutment types vary according to geometric, structural and aesthetic design criteria.
- Aspects such as lane configurations, median width, island and sidewalk dimensions, ground plane treatments, bridge height, wall type, etc, will vary according to site-specific conditions.
- Bridge column spacing and back wall design must accommodate future widening. (Determine regular spacing for future regularity.)
- Coordinate with local municipality (if applicable) for stamped concrete or paver hardscape selection.
- Sloped concrete riprap to be standard grey concrete, unless specified for texture and color application in special use conditions.
- Provide landscaping area per landscape chapter if abutment is located within a landscape focus area, and if irrigation is available at that location. If irrigation is not feasible, provide turf or riprap as deemed appropriate during final design. Landscape could occur in corner quadrant only if access to water for irrigation is available.

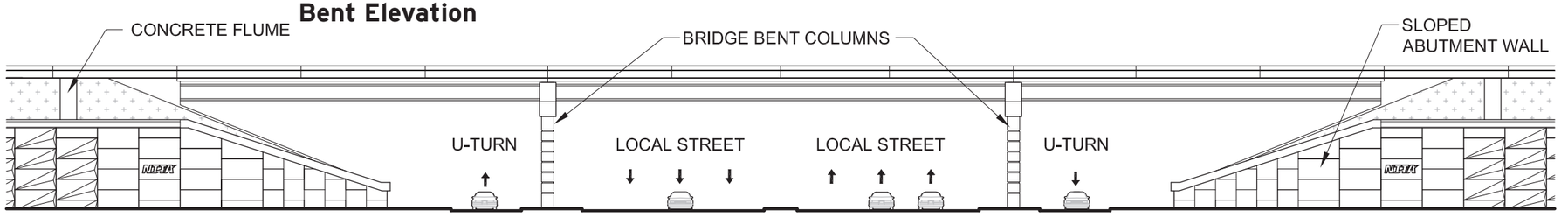
Bridge Design - On Fill - Open Median



Plan



Bent Elevation

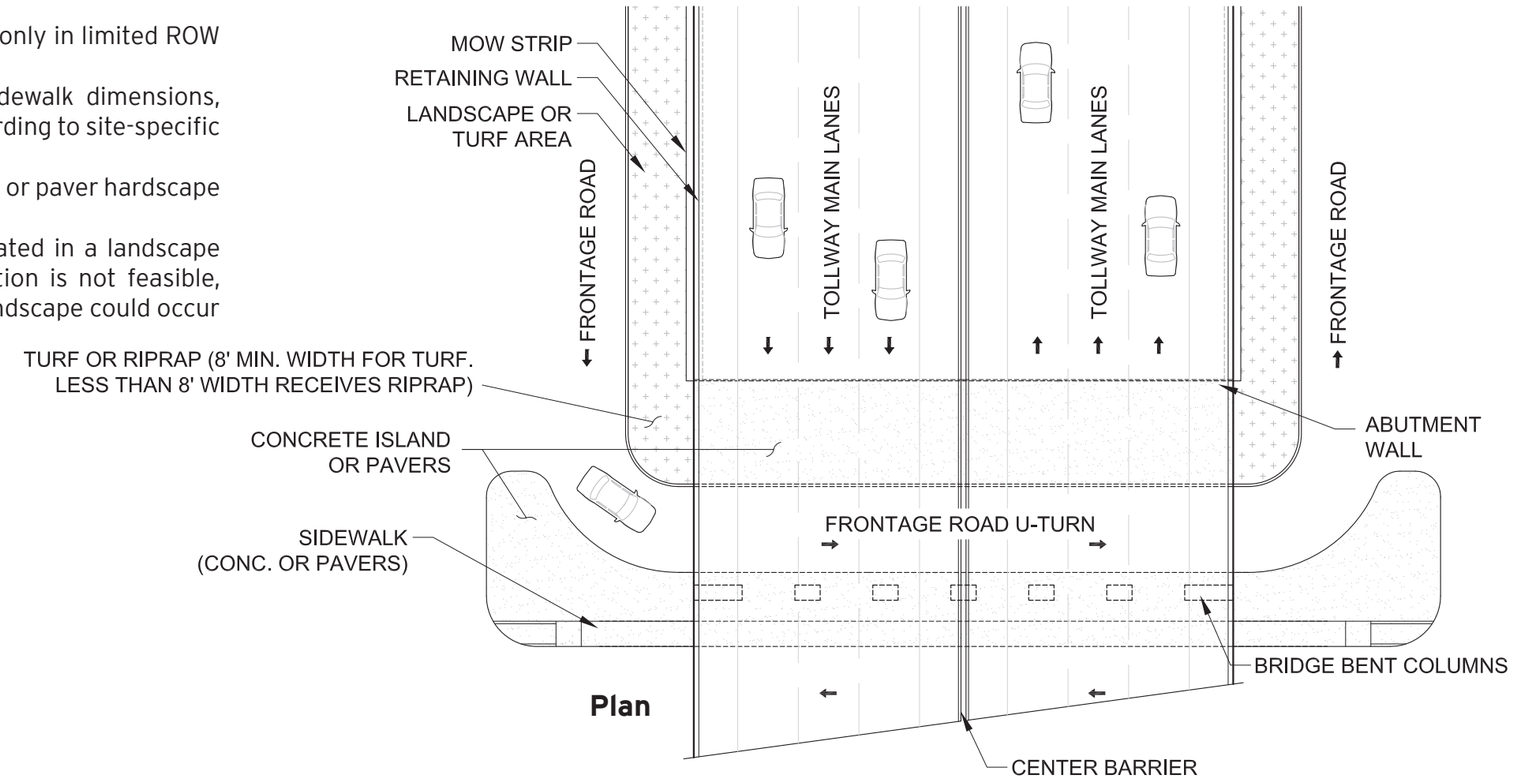


Side Elevation

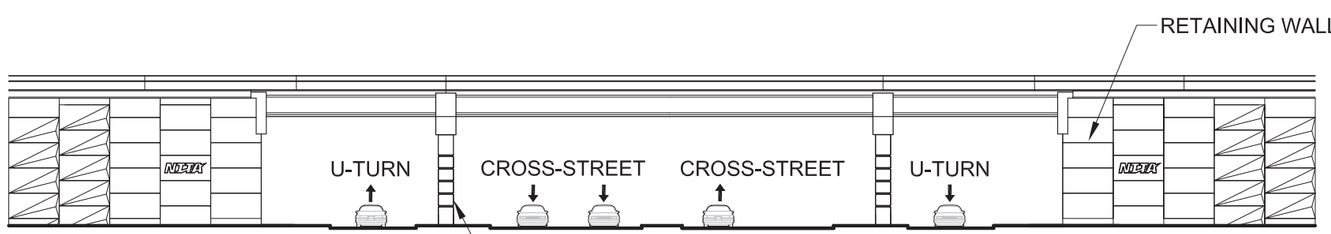
Bridge Design - On Fill - Closed Median (Nondivided)

Notes:

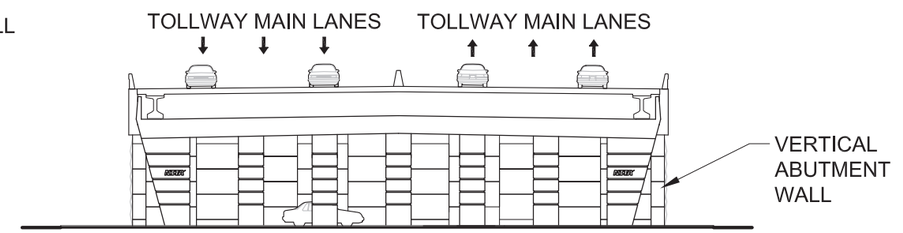
- This bridge configuration represents a tollway crossing over a local road with a vertical abutment, shoulder walls and closed median. Abutment types vary according to geometric, structural and aesthetic design criteria.
- Closed median (nondivided) design conditions should be considered only in limited ROW conditions and with consideration as a full build-out scenario.
- Aspects such as lane configurations, median width, island and sidewalk dimensions, ground plane treatments, bridge height, wall types etc., will vary according to site-specific conditions.
- Coordinate with local municipality (if applicable) for stamped concrete or paver hardscape selection.
- Provide landscaping area per landscape chapter if abutment is located in a landscape focus area, and if irrigation is available at that location. If irrigation is not feasible, provide turf or riprap as deemed appropriate during final design. Landscape could occur in corner quadrant only if access to water for irrigation is available.



Plan



Mainlane Elevation

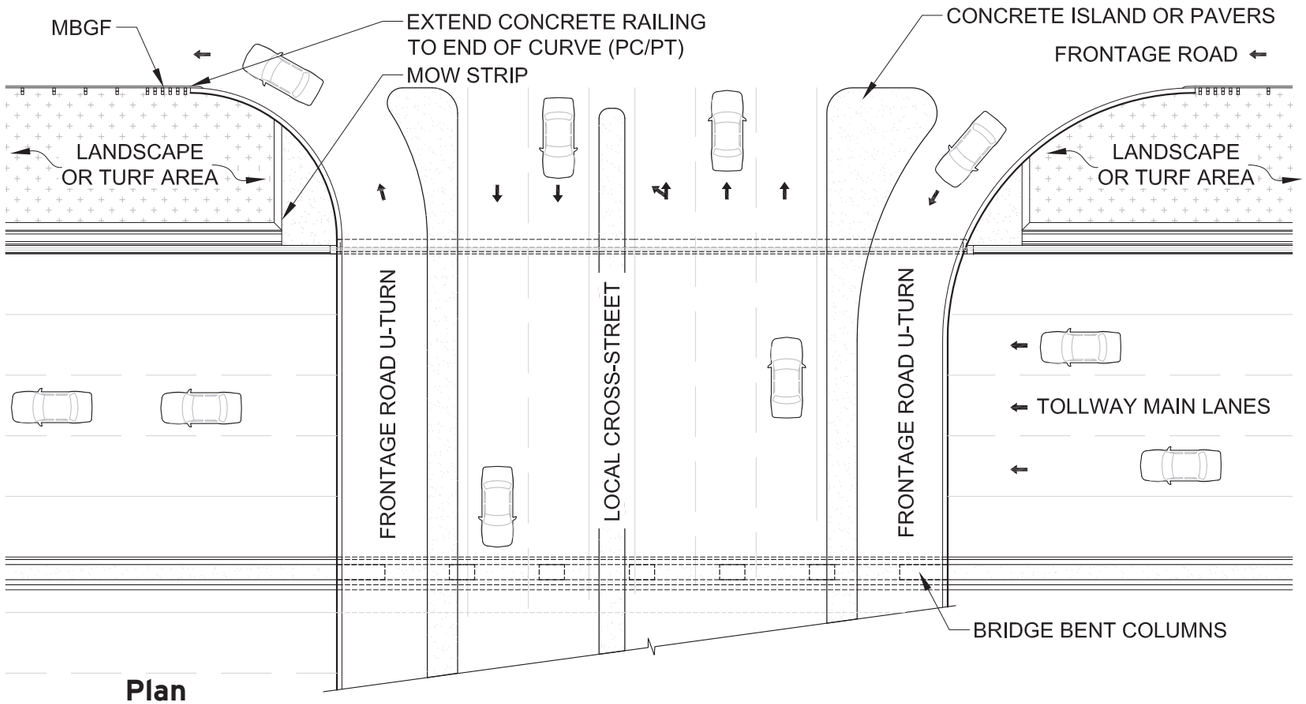


Abutment / Bent Elevation

Bridge Design - Over Cut - Cross Street

Notes:

- This bridge configuration represents a local road crossing over a tollway in a cut section. Abutment types vary according to geometric, structural and aesthetic design criteria.
- Aspects such as lane configurations, median width, island and sidewalk dimensions, ground plane treatments, bridge height, wall type etc. will vary according to site-specific conditions.
- Coordinate with local municipality (if applicable) for stamped concrete or paver hardscape selection.
- Provide landscaping area per landscape chapter if abutment is located in a landscape focus area, and if irrigation is available at that location. If irrigation is not feasible, provide turf or riprap as deemed appropriate during final design. Landscape could occur in corner quadrant only if access to water for irrigation is available.



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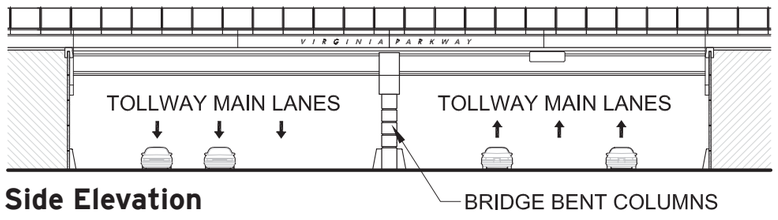
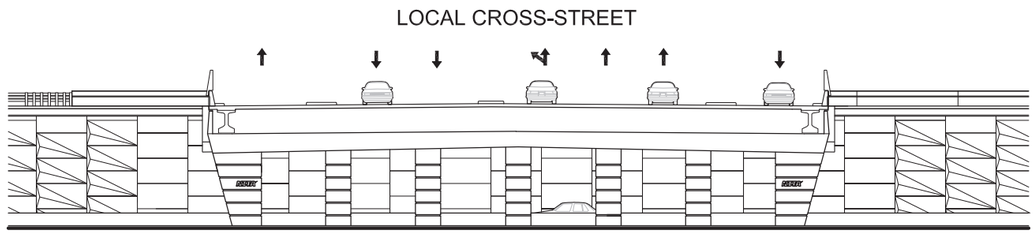


Side Elevation

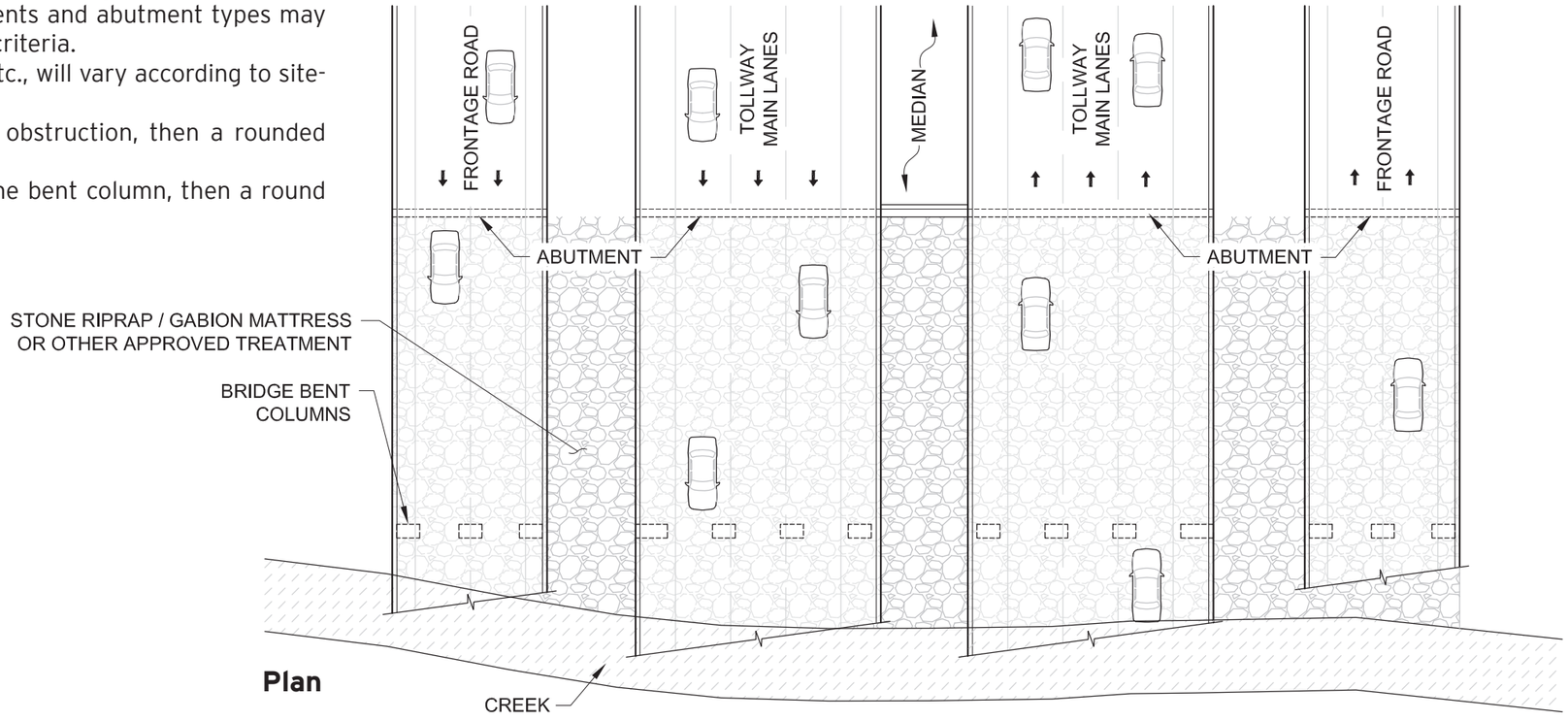


Bent Elevation

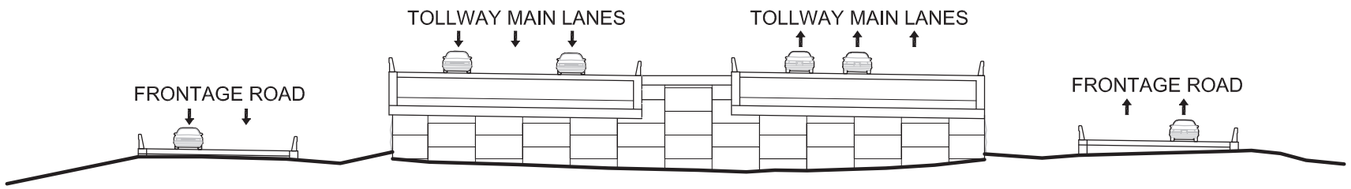
Bridge Design - Creek/River Crossing

Notes:

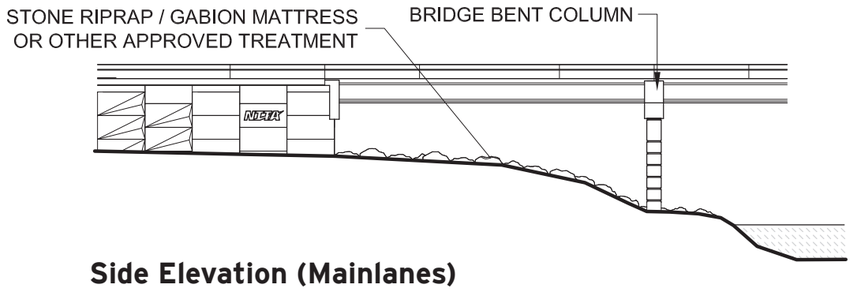
- This bridge configuration represents a tollway main lanes and frontage roads on vertical abutments, crossing a creek or river. The number of abutments and abutment types may vary according to geometric, structural and aesthetic design criteria.
- Lane configurations, median width, bridge height, wall type etc., will vary according to site-specific conditions.
- If the rectangular columns present a significant hydrologic obstruction, then a rounded column or bull-nose option will be utilized.
- If it is determined that there is not substantial visibility to the bent column, then a round column will be utilized.
- Abutment to be located beyond the 100-year floodplain.



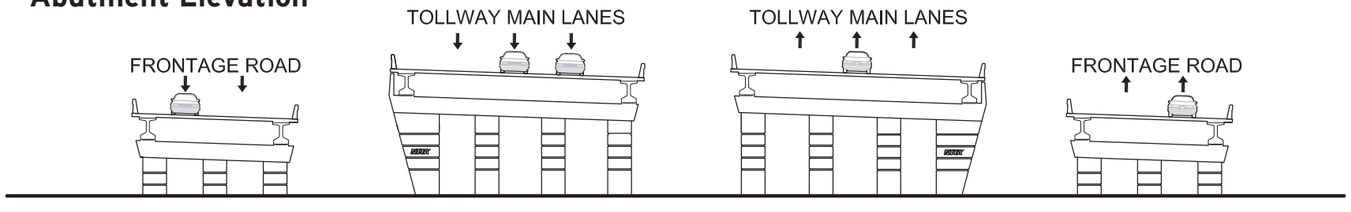
Plan



Abutment Elevation



Side Elevation (Mainlanes)

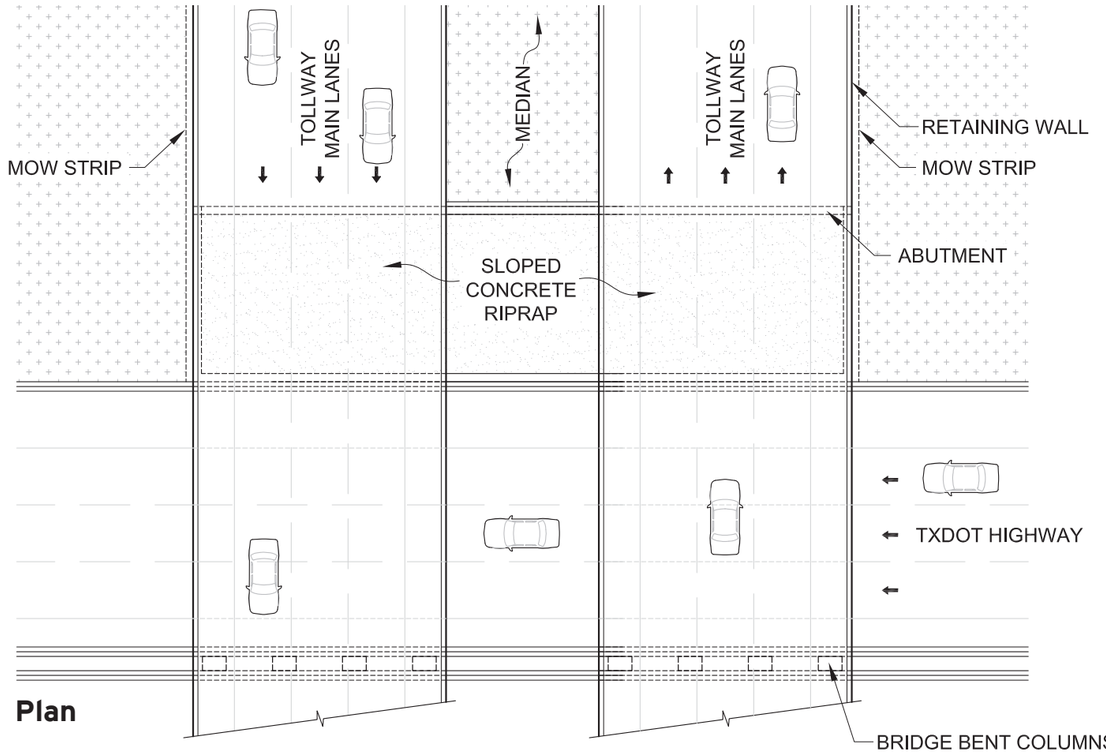


Bent Elevation

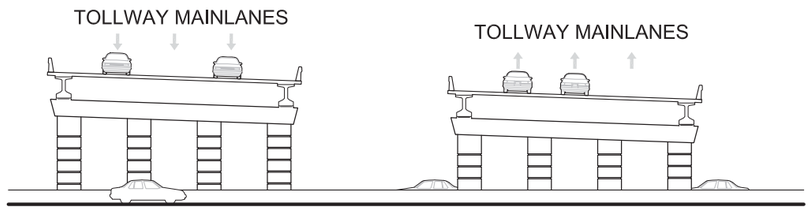
Bridge Design (with Toe Wall) - Over TxDOT Highway

Notes:

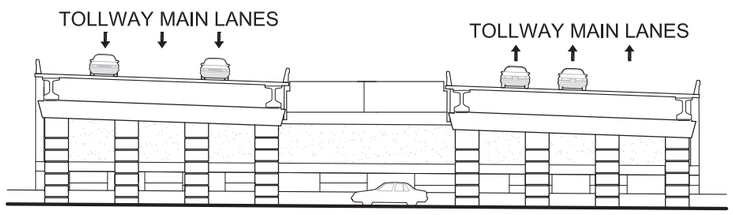
- This bridge configuration represents a tollway crossing over a TxDOT highway with a sloped abutment, shoulder walls and an open median. Abutment types may vary according to geometric, structural and aesthetic design criteria.
- Lane configurations, median width, island and sidewalk dimensions, ground plane treatments, bridge height, wall types etc., will vary according to site-specific conditions.
- Coordination is to occur on TxDOT corridor's established aesthetic visual appearance. Bridge features, wall panels, textures and colors may vary to provide visual continuity at adjacent communities and existing or proposed TxDOT corridors.
- Consider visual features of adjacent highway corridors when selecting aesthetic design treatments for structures.



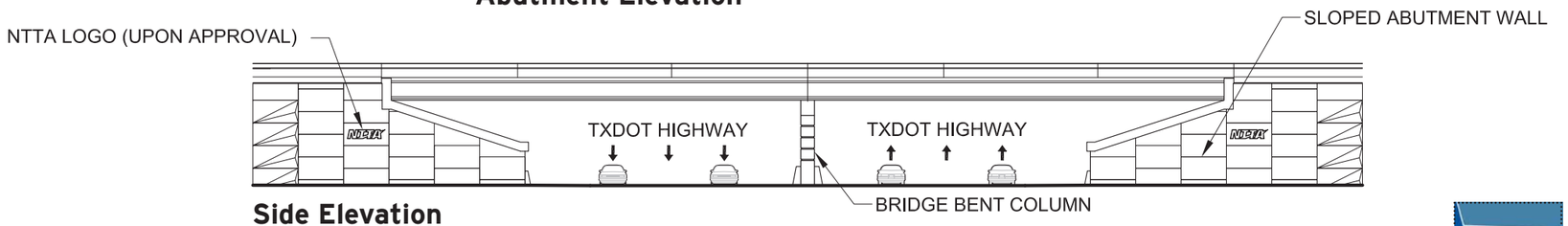
Plan



Bent Elevation



Abutment Elevation

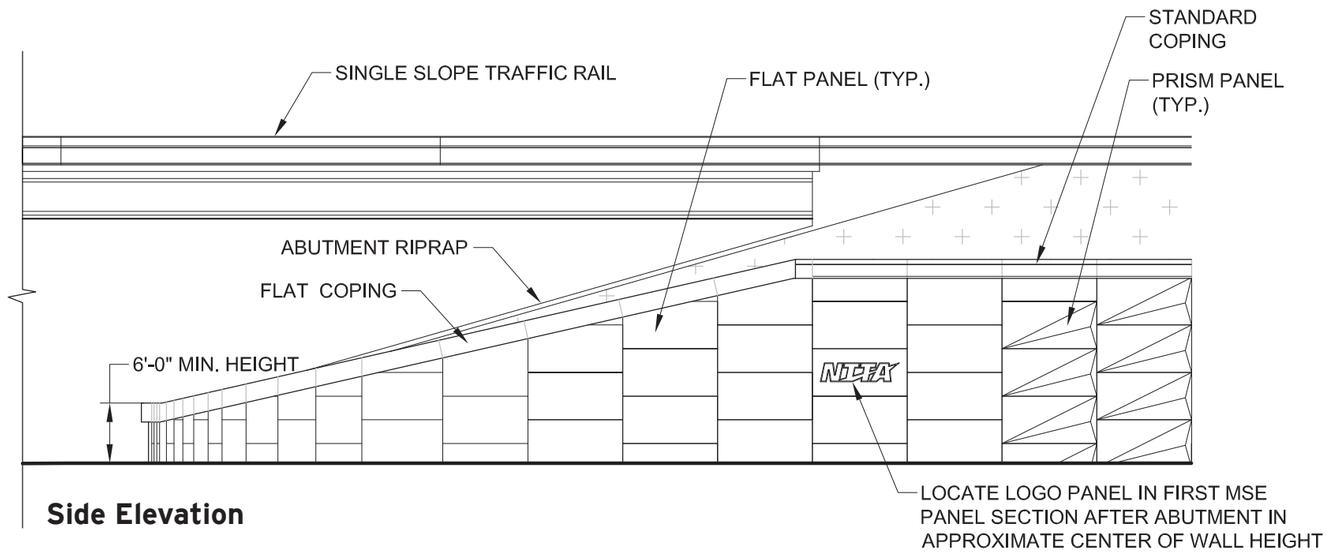


Side Elevation

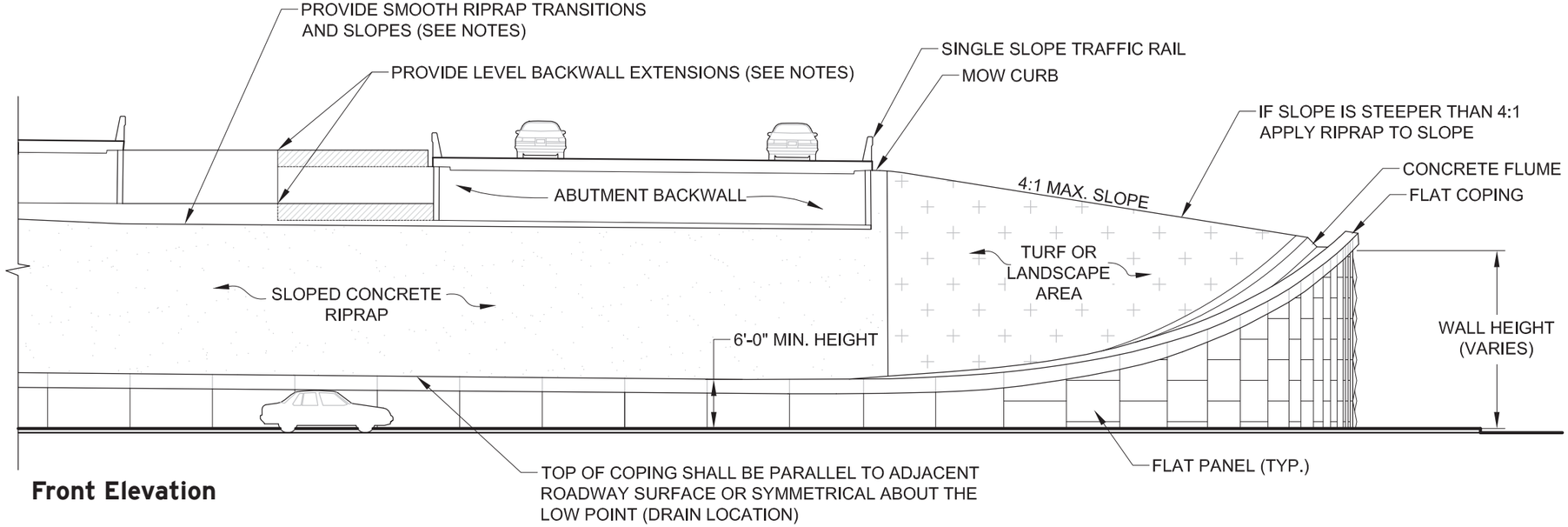
Sloped Abutment Wall - On Fill (with Toe Walls)

Notes:

- When adjacent abutment back wall extensions have different elevations, cast "sacrificial" concrete to create a level top line and abutment ledge. Match texture / pattern treatment over entire wall surface.
- Provide landscaping area per landscape chapter if abutment is within a landscape focus area, and if irrigation is available at that location. If irrigation is not feasible, use turf or riprap as deemed appropriate during final design. Landscape should only occur in corner quadrant if access to water for irrigation is available.
- Retaining wall height may be selected in order to provide a desired appropriate slope (4:1 maximum) for landscaping if site conditions and design criteria allow.
- Consider providing a full build-out of bridge and approach slabs for future expansion.
- Design sloped riprap pours to allow smooth transitions and grades across the overall face of the riprap surface. Riprap surfaces should not have jogs or noticeable angles.
- Sloped concrete riprap may have texture and color application.
- Coping shall be either cast in place or precast. (Not a combination)



Side Elevation

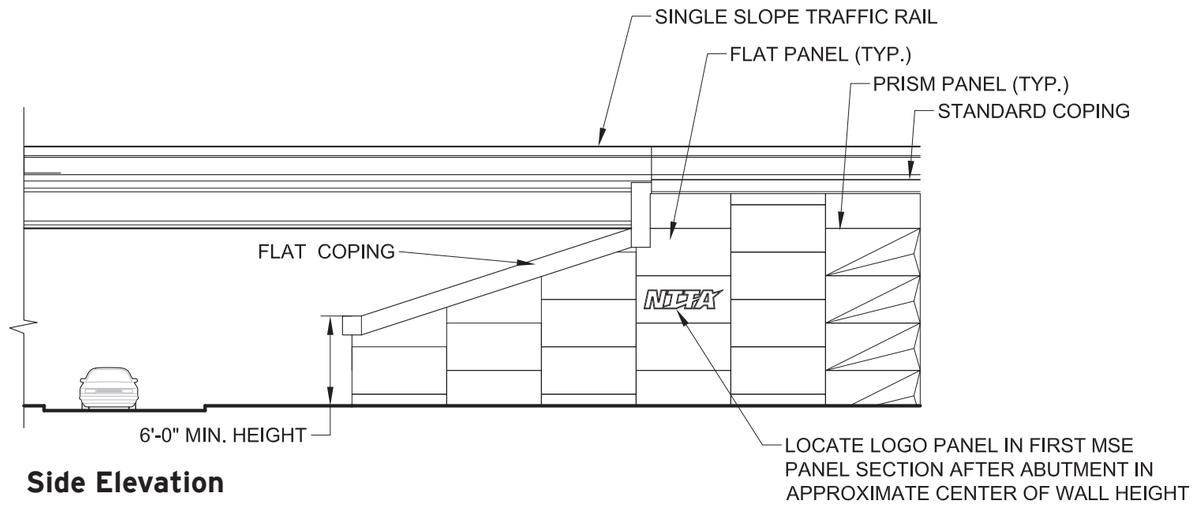


Front Elevation

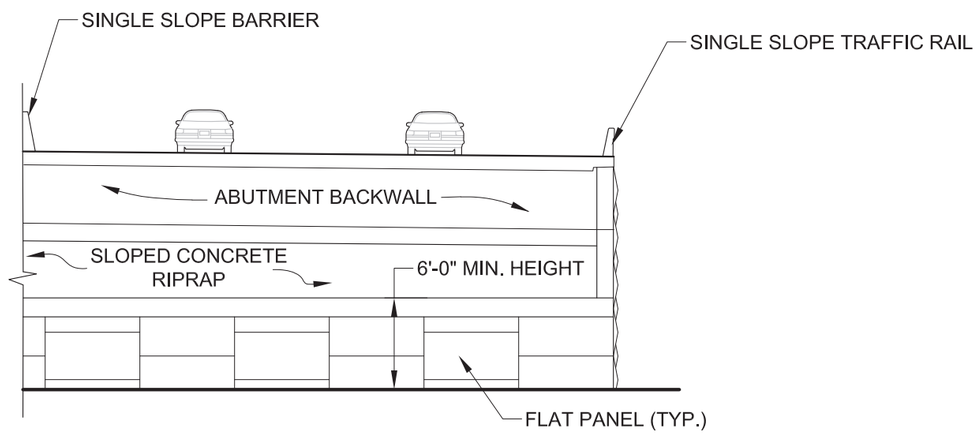
Sloped Abutment Wall - On Fill (with Shoulder Walls)

Notes:

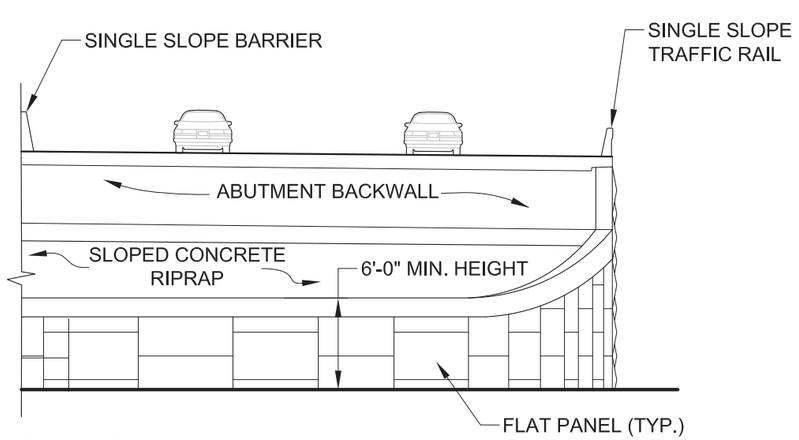
- Abutments with sloped riprap faces and shoulder walls may feature curved or angled toe wall transitions.
- Attention should be given to the top of coping slope to avoid lines that are incongruous to the adjacent roadways or sidewalks.
- Coping and flume runs shall be calculated so that, where feasible, the low point for drainage is in the center of the abutment toe wall in order to create a symmetrical configuration when viewed in elevation.
- Coping shall be either cast in place or precast. (Not a combination)



Side Elevation



Front Elevation 2
(90 Degree Angle)

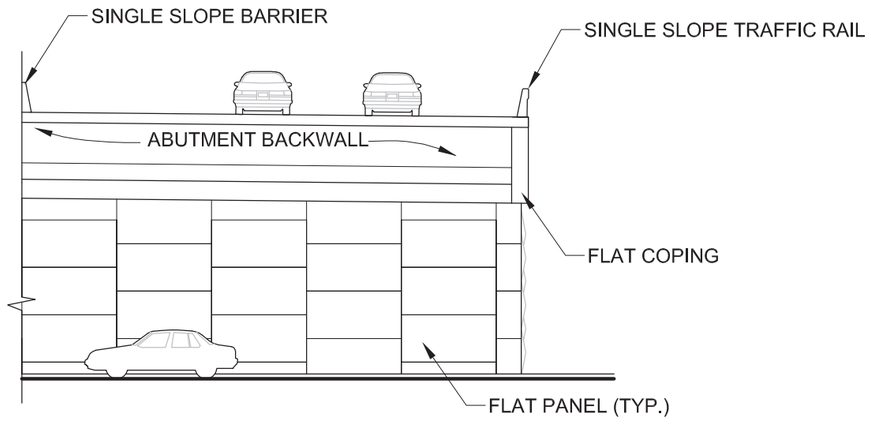


Front Elevation 1
(Curved)

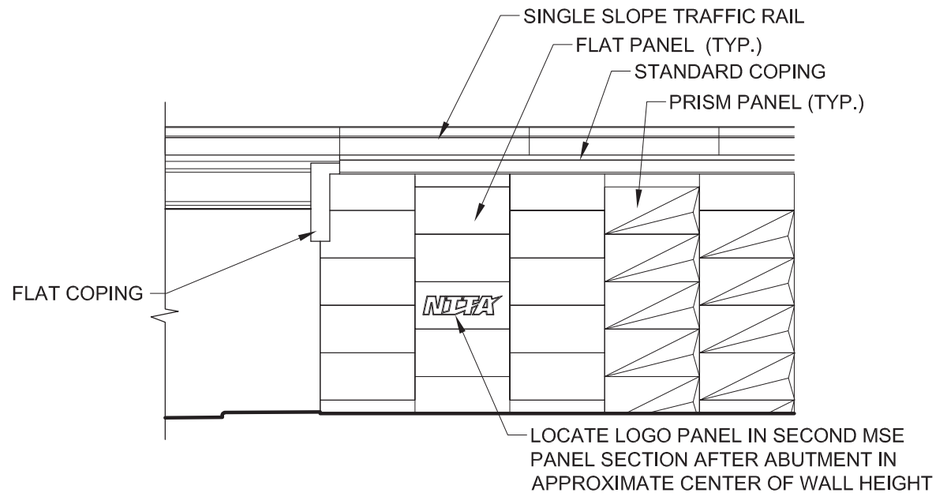
Vertical Abutment Wall

Notes:

- Attention should be given to the top of coping slope to avoid lines that are incongruous to the adjacent roadways or sidewalks.
- Abutment coping shall all be cast in place or precast. (Not a combination)
- Retaining wall coping shall all be cast in place or precast. (Not a combination)



Front Elevation

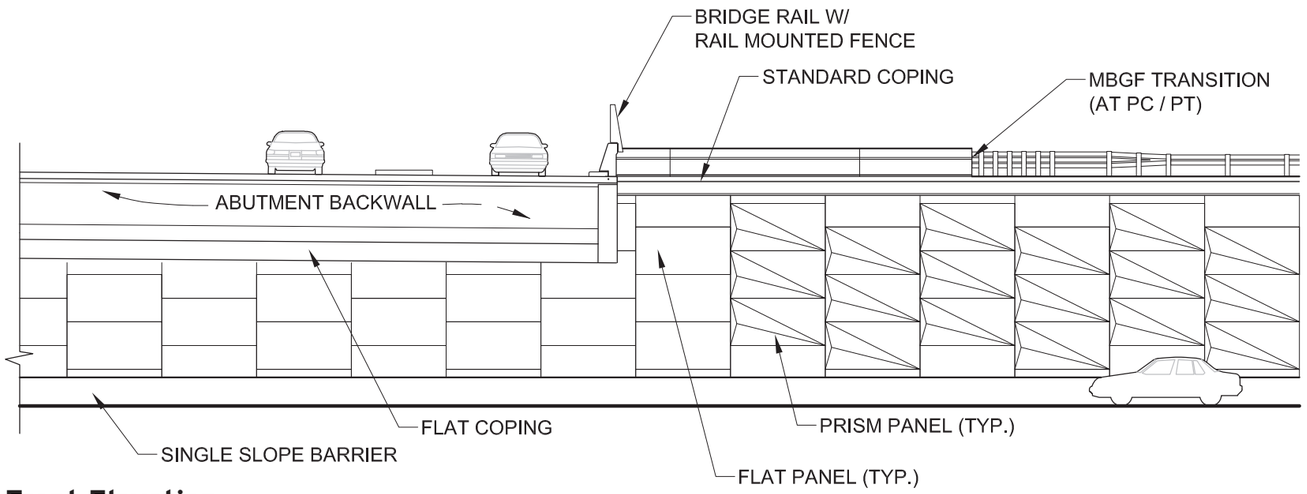


Side Elevation

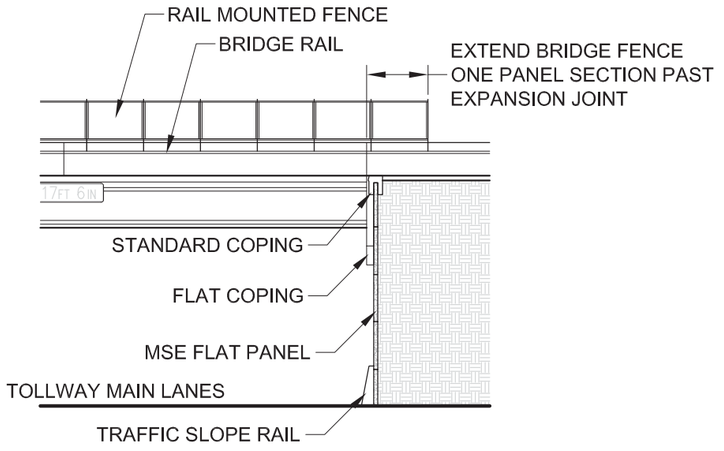
Vertical Abutment Wall - In Cut

Notes:

- The transition from bridge rail to metal beam guard fence shall occur at the point of curvature / point of tangency (PC/PT) of the frontage road U-turn lane, if present.
- Bridge fence on rail to be used only on local roads with design speeds lower than 45 mph.



Front Elevation

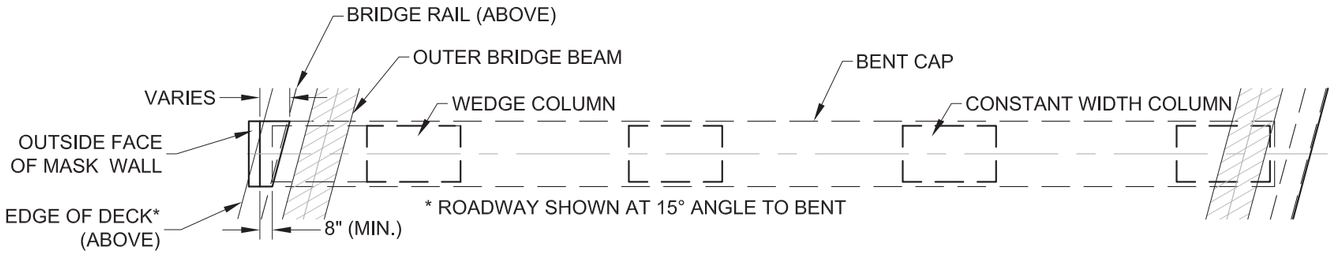


Side Elevation

Typical Multi-Column Bridge Bent Over Cross Streets

Notes:

- Variable-height column sections created by reveals above and below the column reveals are to be sized so that the lower section is taller than the upper section.
- The mask wall and bent cap should remain perpendicular to the column. Extend the length of the bent cap to account for skew.
- When a skew is less than 15°, the back wall will be perpendicular to the centerline of the bent cap.



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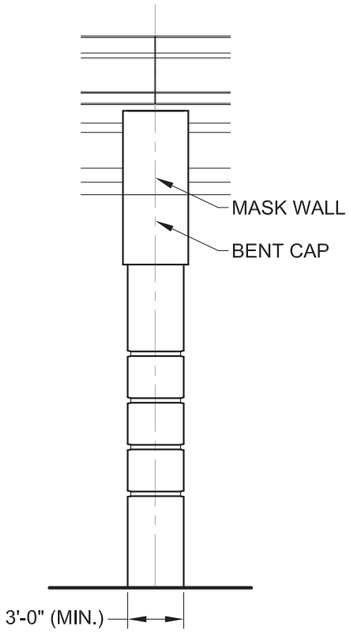
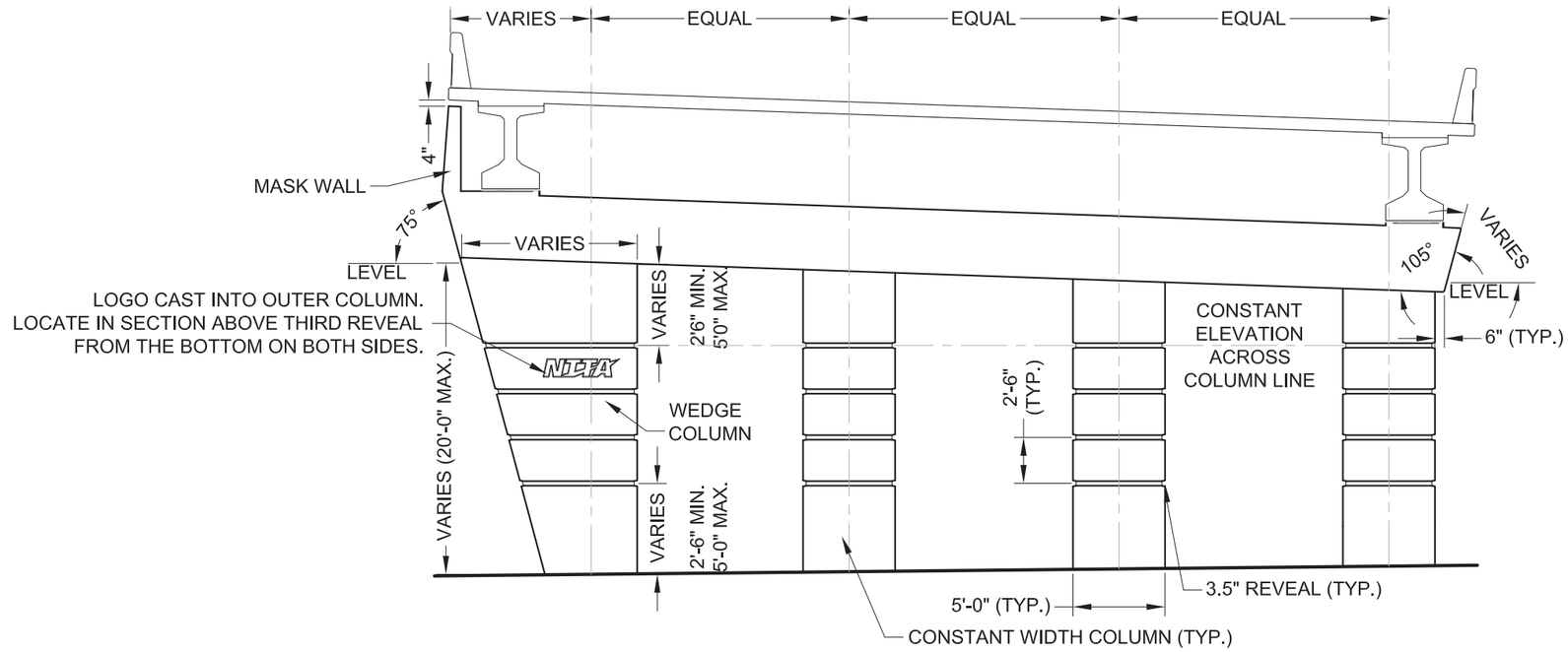


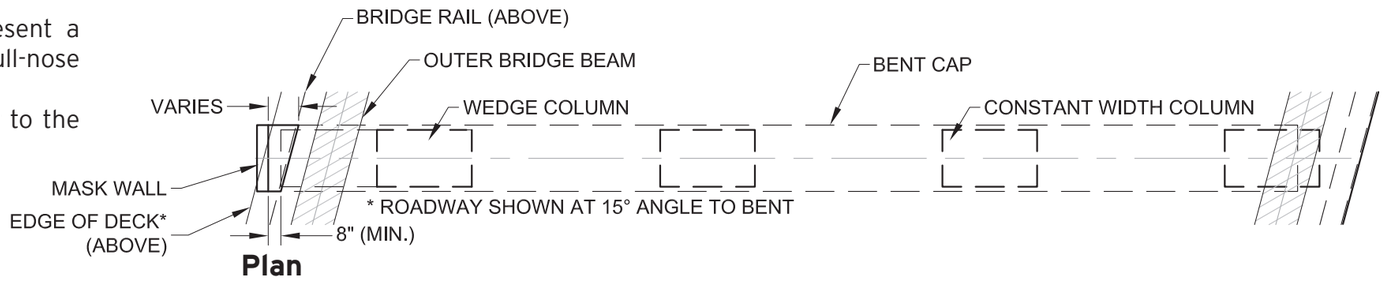


Elevations

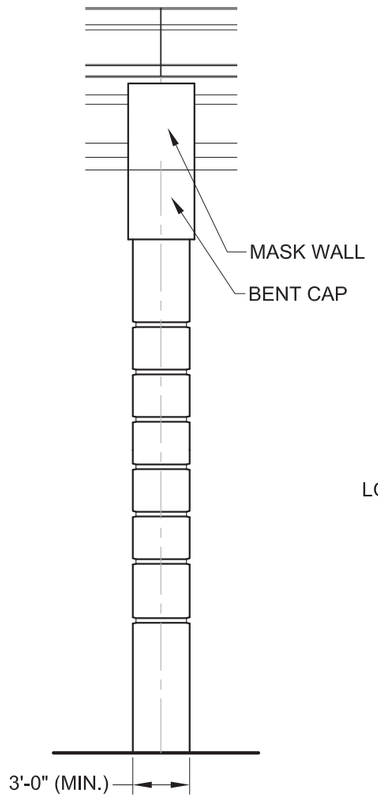
Tall Multi-Column Bridge Bent Over Cross Streets

Notes:

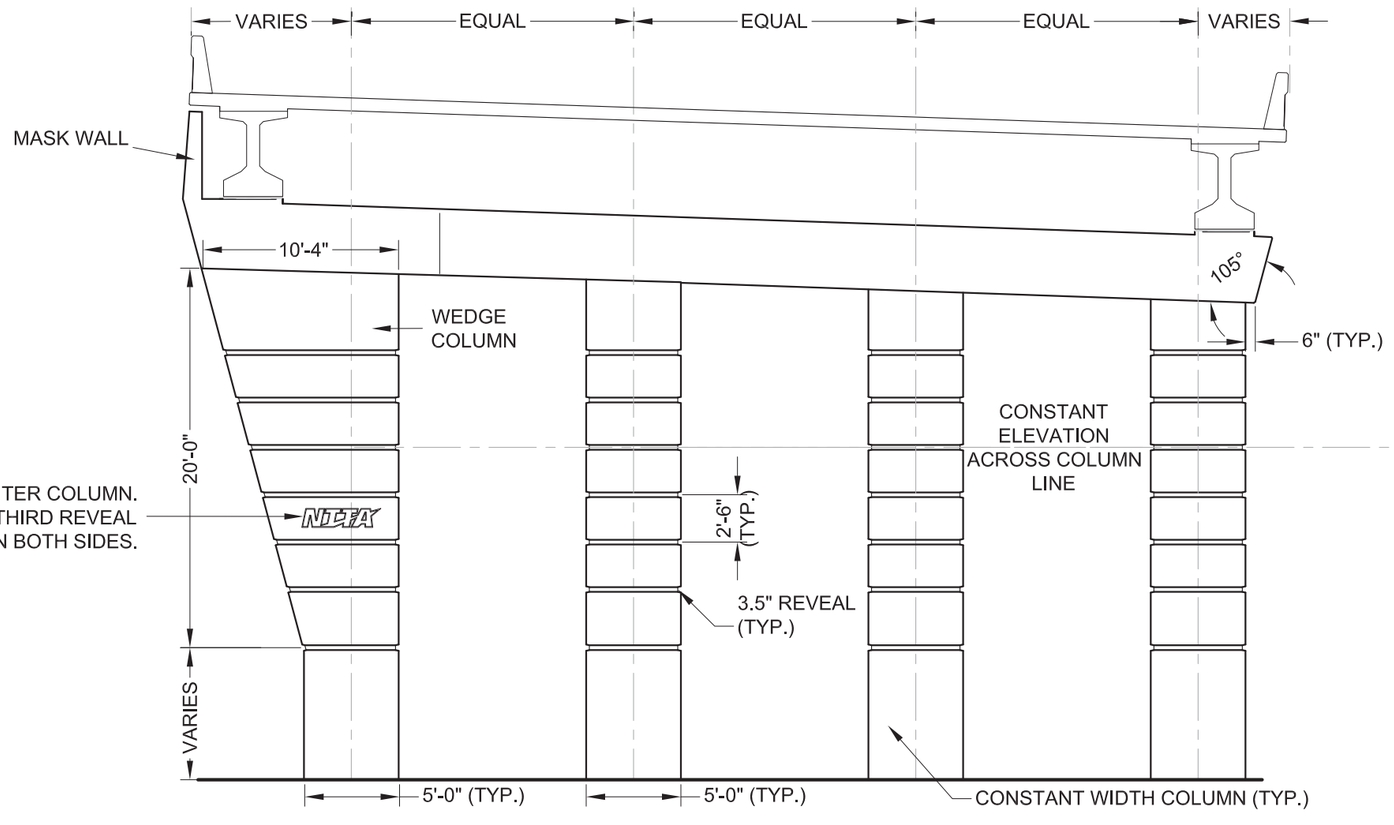
- For bridges over 20 feet in height (bottom of beam to finished grade)
- The mask wall and bent cap should remain perpendicular to the column. Extend the length of the bent cap to account for skew.
- For bents in creeks and waterways, if rectangular columns present a significant hydrologic obstruction, then a rounded column or bull-nose option will be utilized. (Minimize placement within channels)
- When a skew is less than 15°, the back wall will be perpendicular to the centerline of the bent cap.



Plan



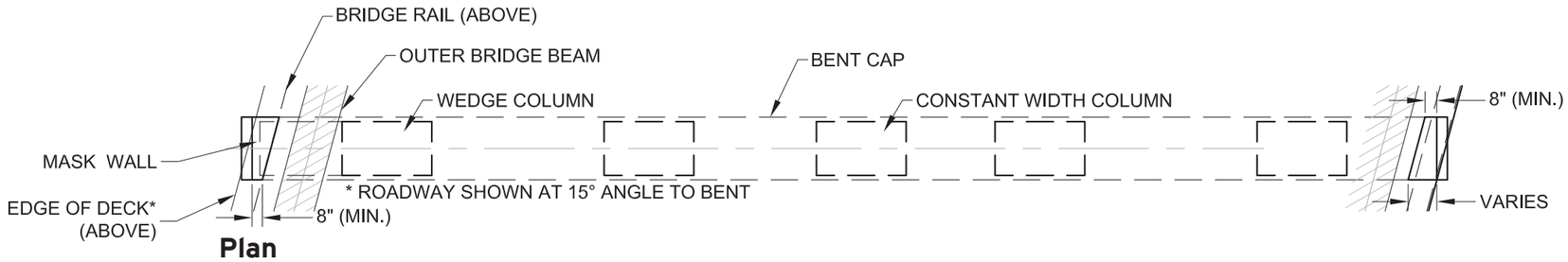
Elevations



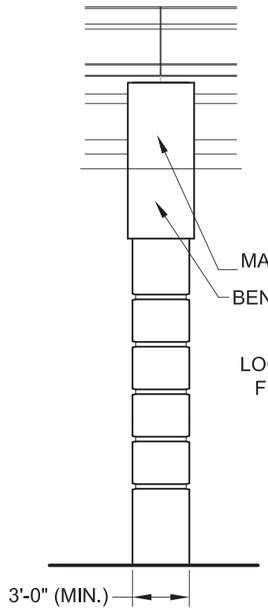
Multi-Column Bridge Bent Over Cross Streets - Closed Median

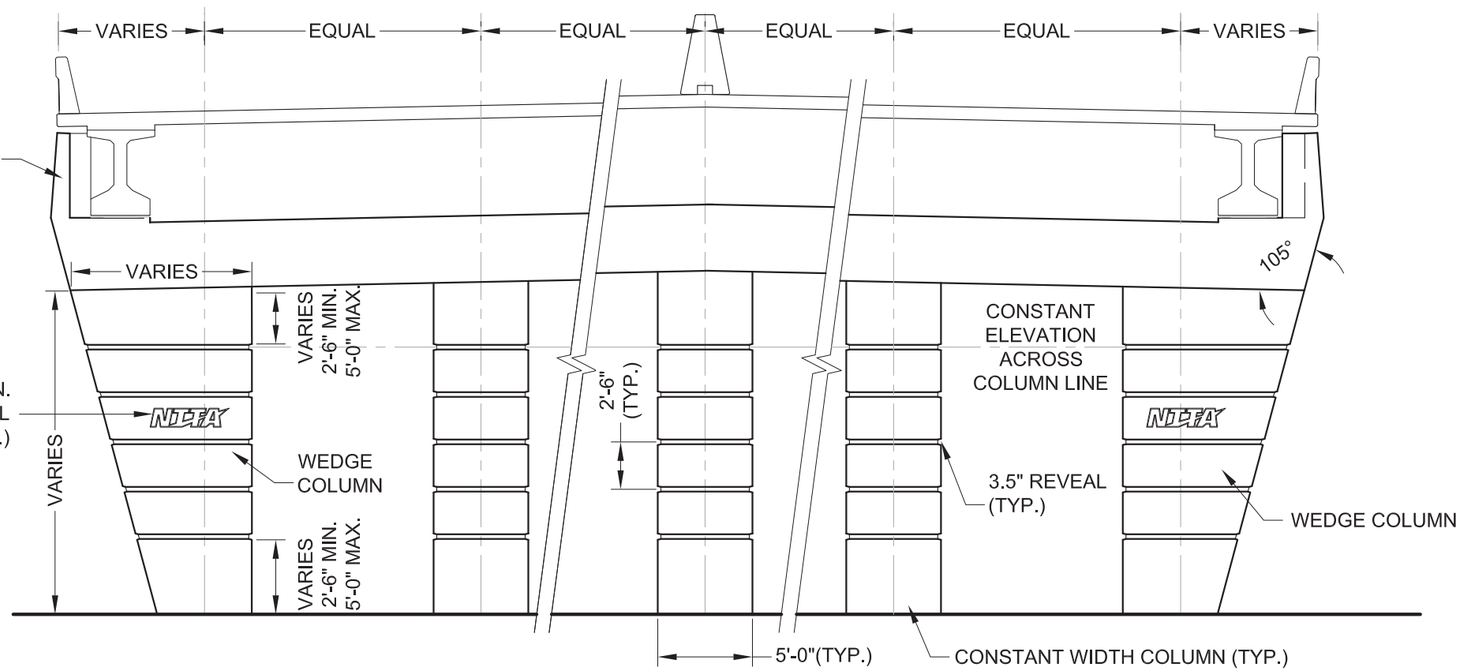
Notes:

- Consider future outside expansion by providing a full build-out of bridge and approach slabs or removal of the wedge column.
- The mask wall and bent cap should remain perpendicular to the column. Extend the length of the bent cap to account for skew.
- When a skew is less than 15°, the back wall will be perpendicular to the centerline of the bent cap.



Plan

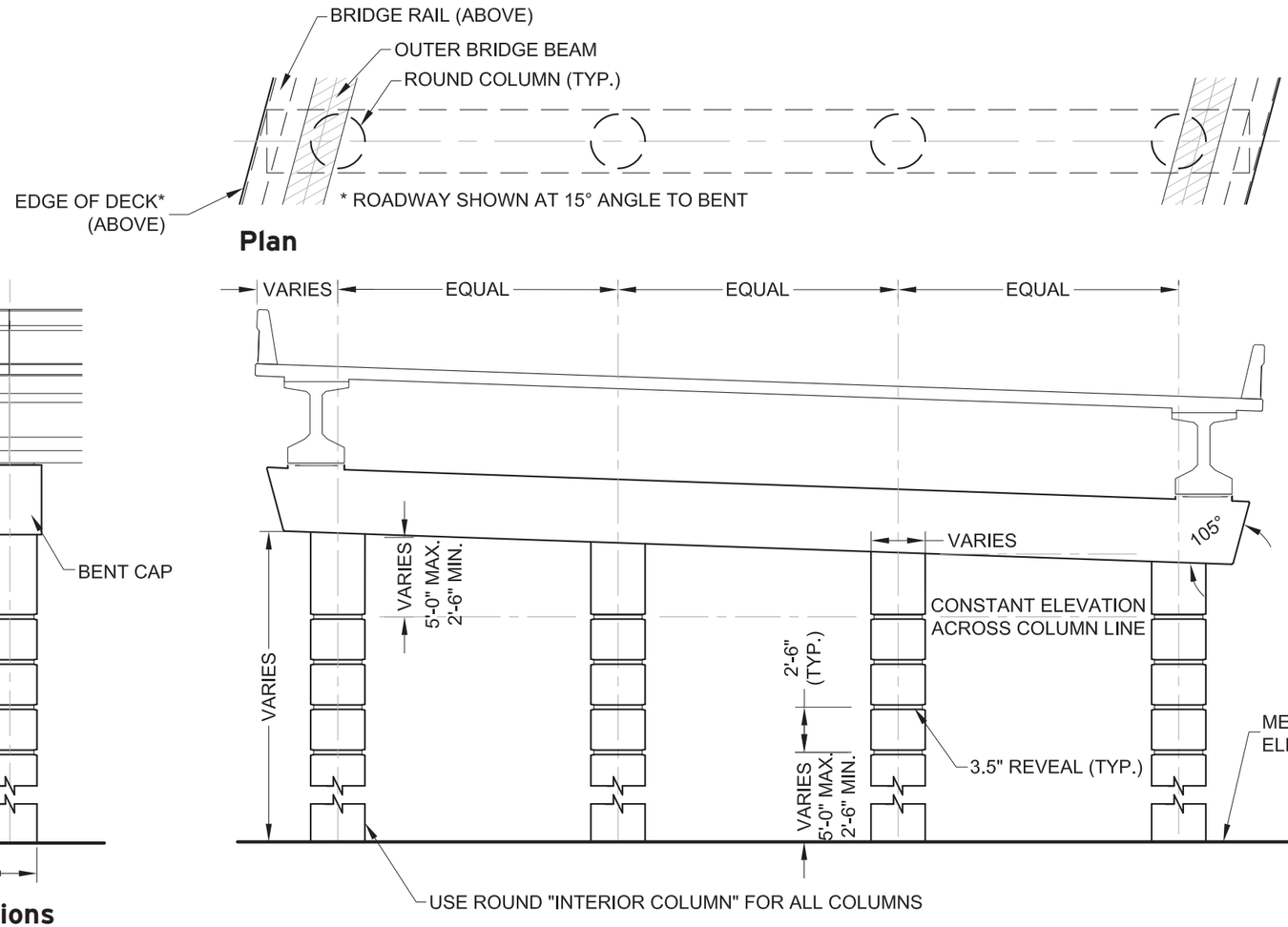




Elevations

Notes:

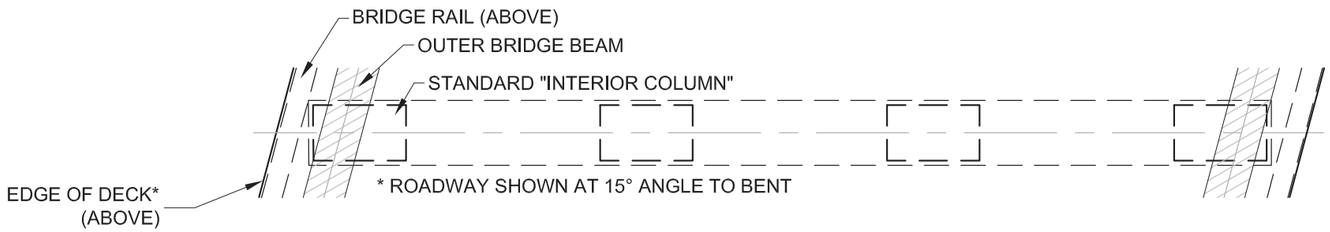
- For bents within creeks and waterways with limited exposure when viewed from adjacent frontage roads or property. If rectangular columns present a significant hydrologic obstruction, then a rounded column or bull-nose option will be utilized. (Minimize placement within channels)



Bridge Bent Over TxDOT Facilities & Frontage Roads

Notes:

- Coordination is to occur on TxDOT corridor's established aesthetic visual appearance. Bridge features, wall panels, textures and colors may vary to provide visual continuity at adjacent communities and existing or proposed TxDOT corridors.



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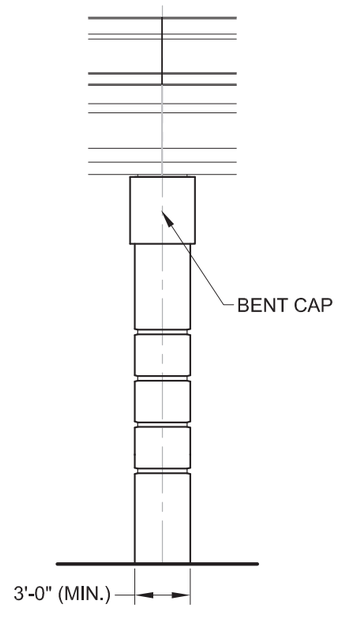
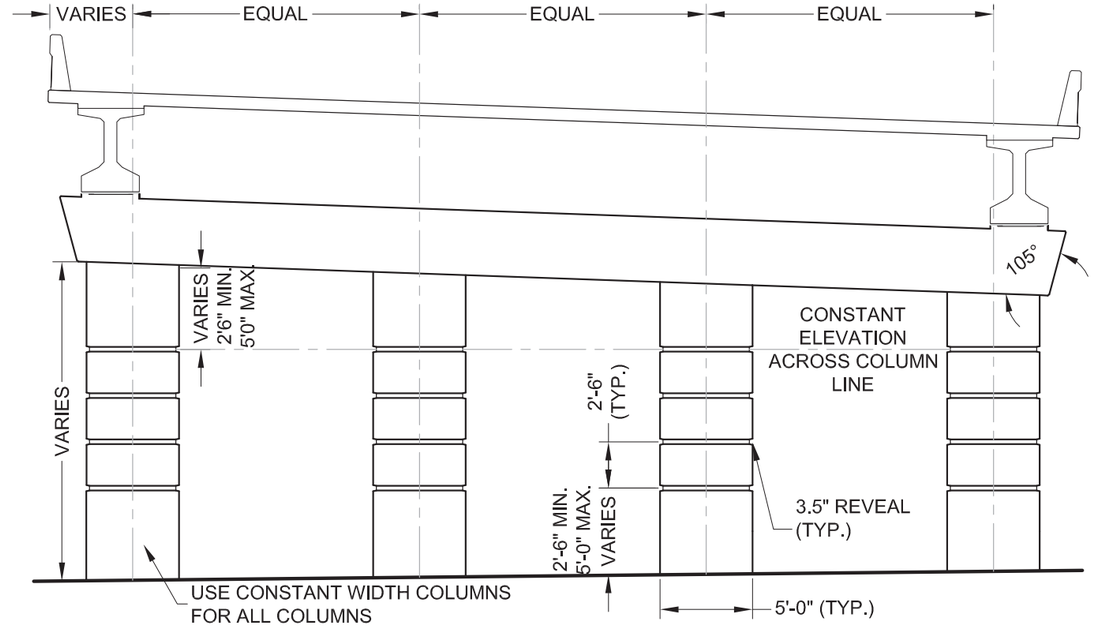


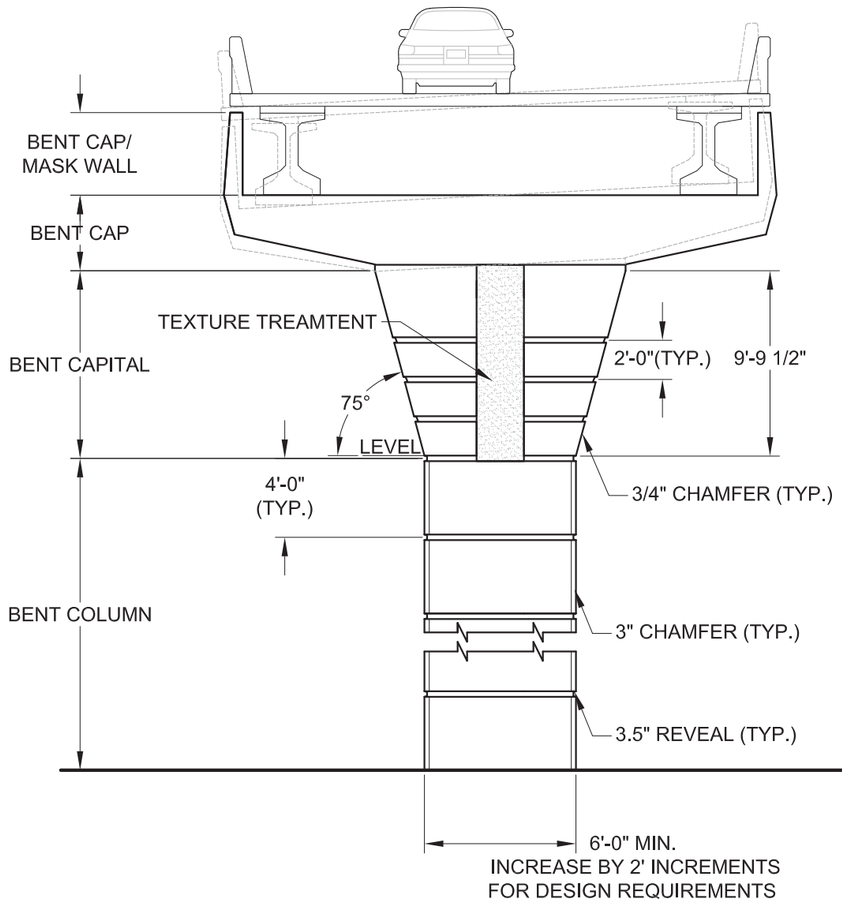
Elevations



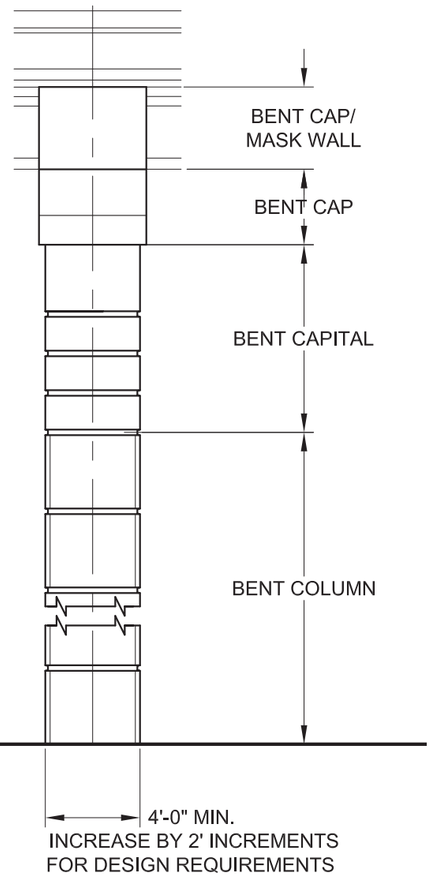
Interchange Bent - Prototypical

Notes:

- For use with 30 feet or more of clearance.
- The cross slopes of the deck and cap shall match.
- Drainage and electrical conduits will be internal to the bent and column structure.



Elevation

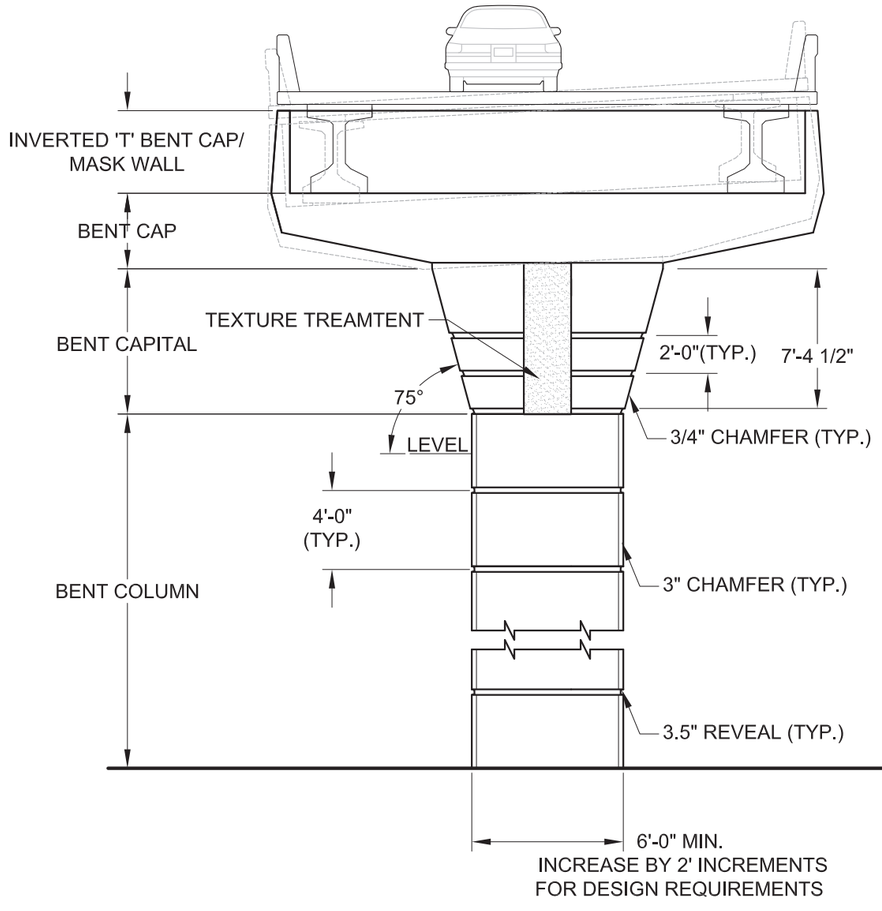


Side Elevation

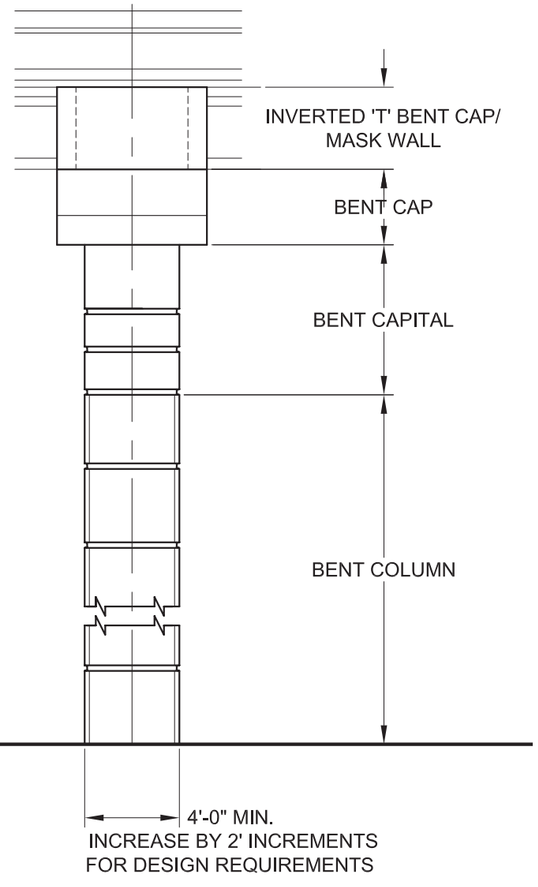
Interchange Bent - Prototypical Inverted 'T'

Notes:

- For use with less than 30 feet of clearance.
- The cross slopes of the deck and cap shall match.
- Drainage and electrical conduits will be internal to the bent and column structure.
- When an inverted 'T' cap is used because of clearance and / or structural requirements, consistency in the quantity as well as location of matching and dissimilar cap and bents must be coordinated to provide visual continuity.



Elevation

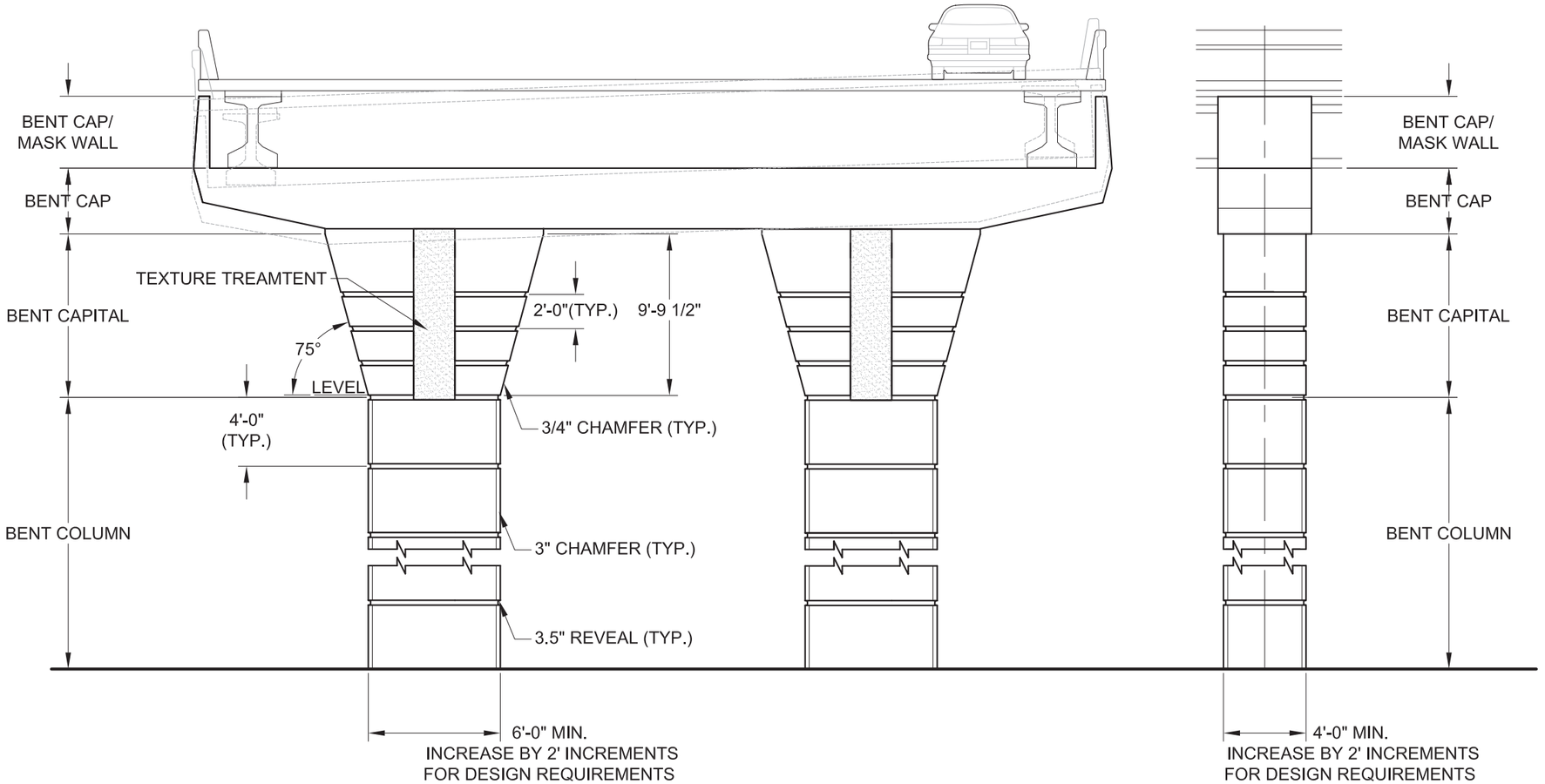


Side Elevation

Interchange Bent - Tall Multi-Column

Notes:

- For use with 30 feet or more of clearance.
- The cross slopes of the deck and cap shall match.
- Drainage and electrical conduits will be internal to the bent and column structure.



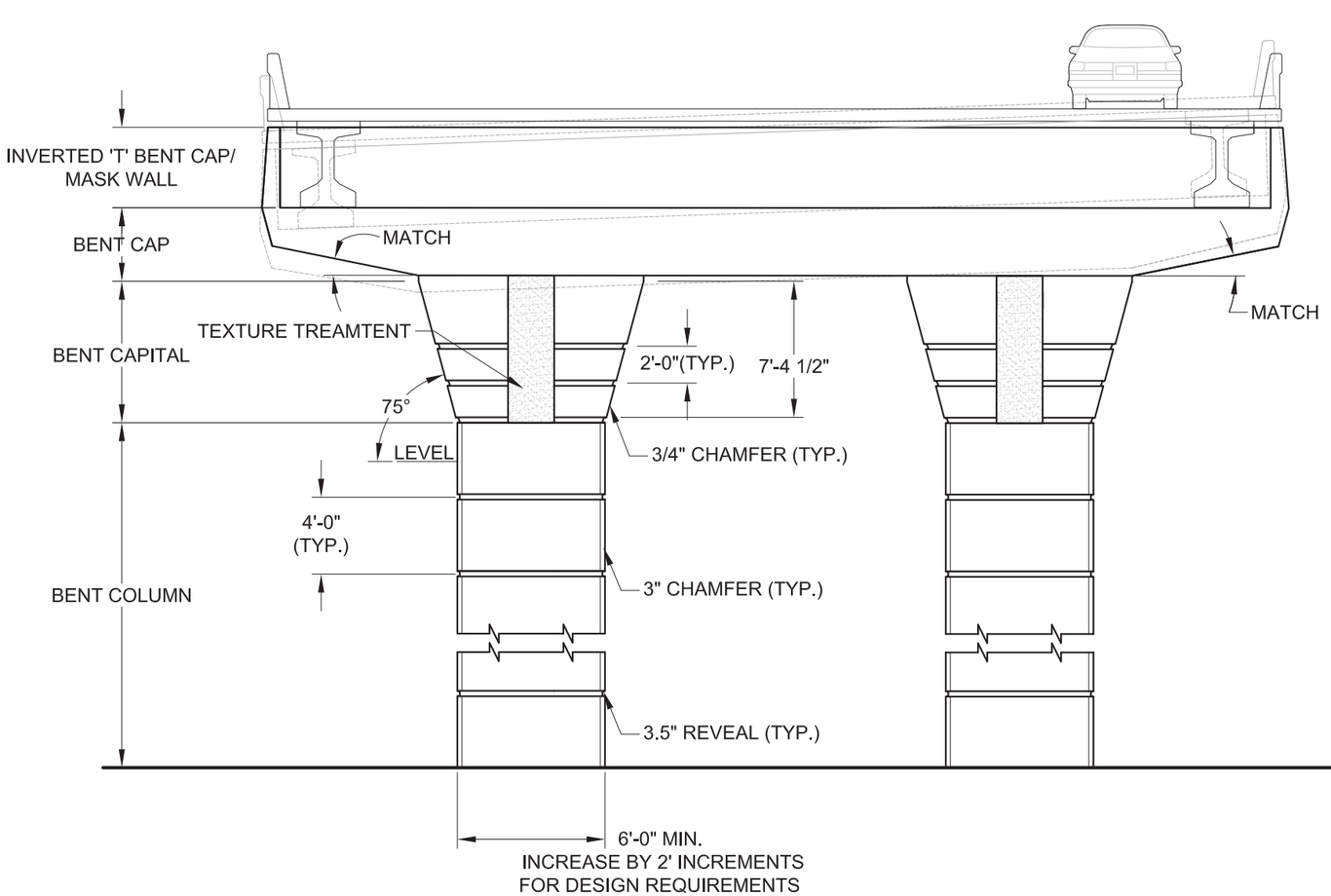
Elevation

Side Elevation

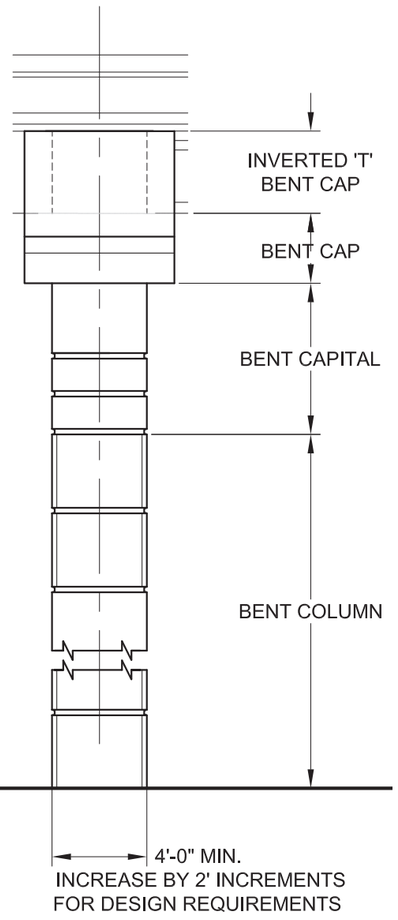
Interchange Bent - Short Multi-Column

Notes:

- Use short multi-column when required by conditions with constrained horizontal clearances and vertical clearances below 30 feet.
- Careful attention should be paid to ordered "groupings" of short and prototypical direct connect bents.
- The cross slopes of the deck and cap shall match.
- Drainage and electrical conduits will be internal to the bent and column structure.



Elevation

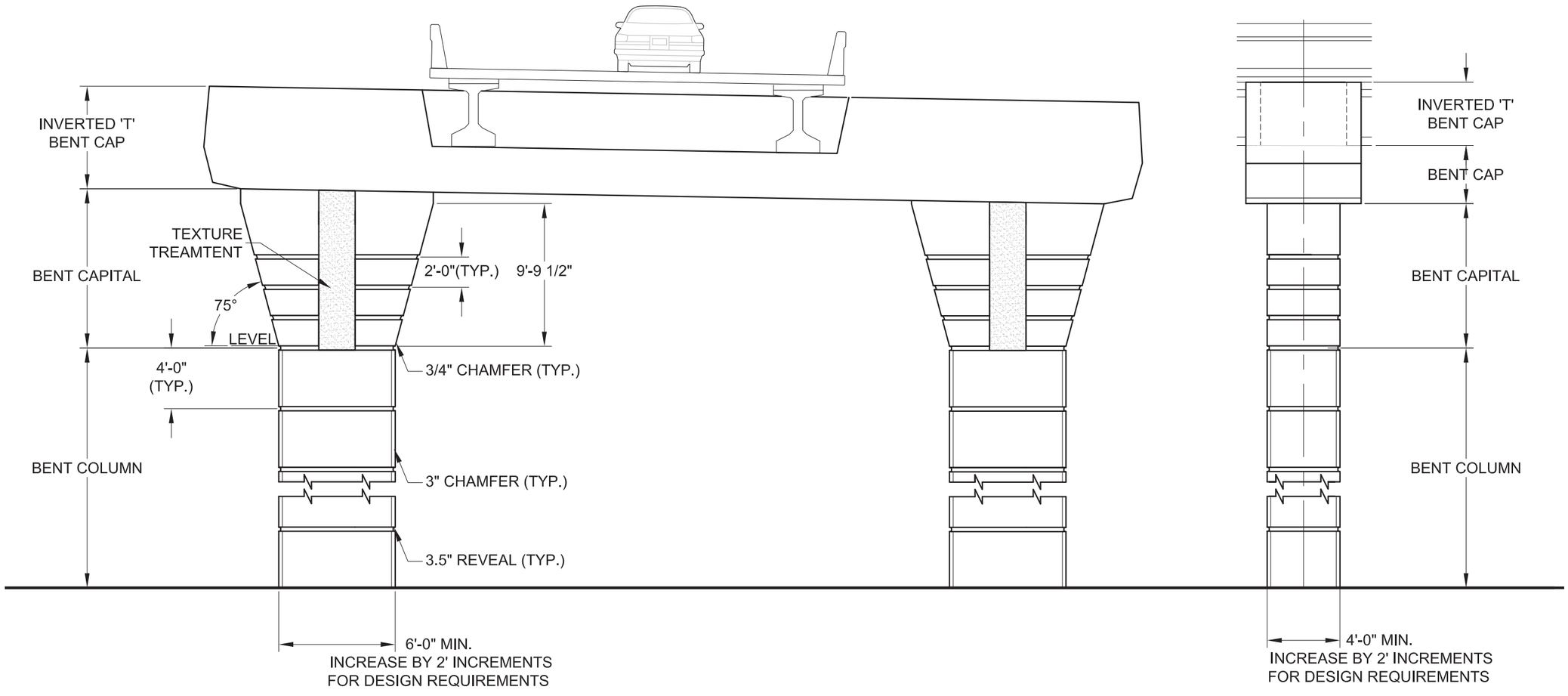


Side Elevation

Interchange Bent - Straddle

Notes:

- Inverted 'T' cap straddle bent may require vertical variation between capital and column.
- The cross slopes of the deck and cap shall match.
- Drainage and electrical conduits will be internal to the bent and column structure.
- Horizontal reveals do not necessarily align from one column to another.

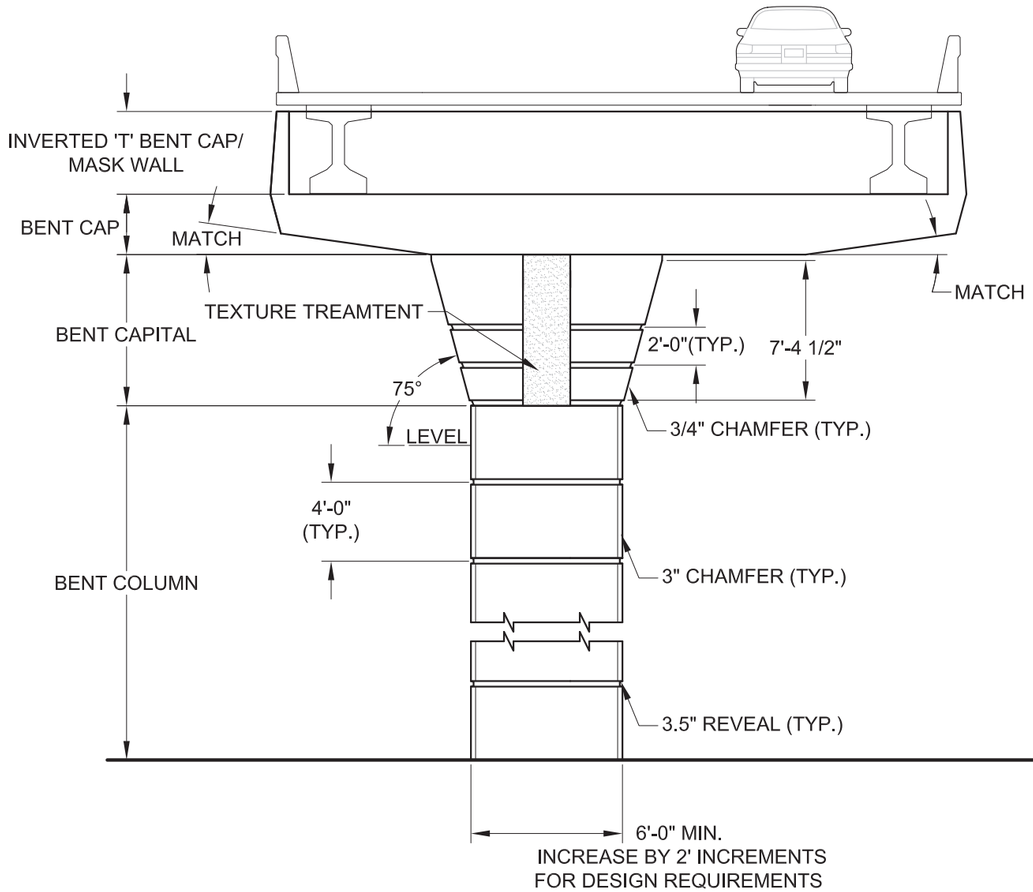


Elevation **Side Elevation**

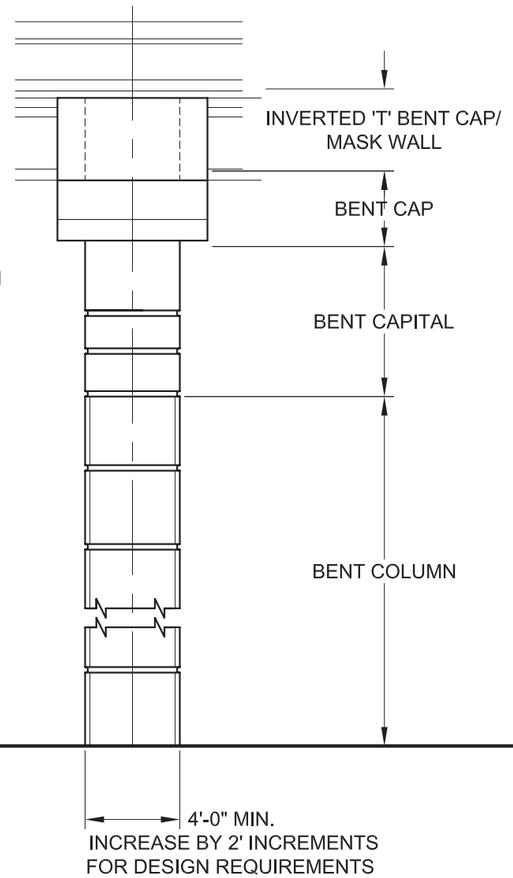
Interchange Bent - Cantilever

Notes:

- The cross slopes of the deck and cap shall match.
- Drainage and electrical conduits will be internal to the bent and column structure.
- Use 7'-4 1/2" for bent columns less than 30'. Use 9'-9 1/2" for bent columns 30' and greater.



Elevation

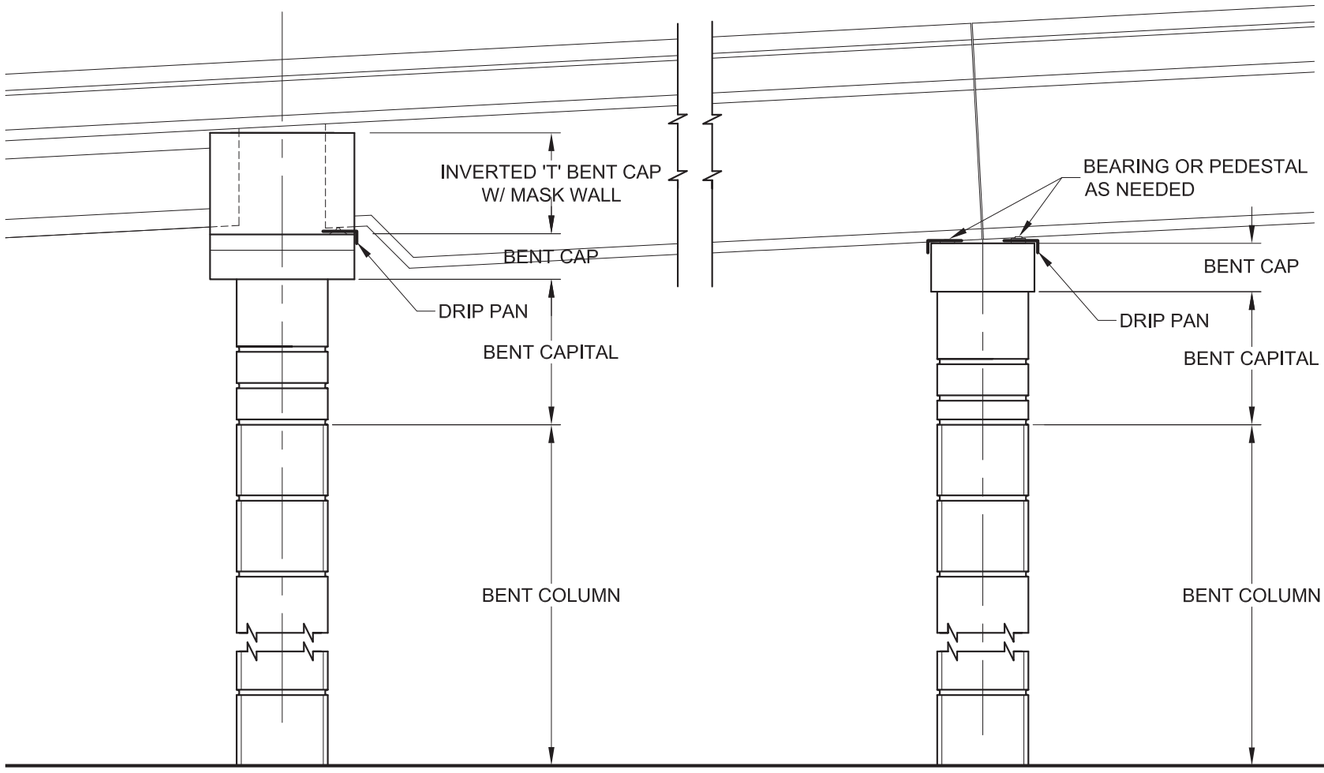


Side Elevation

Interchange Bent - Beam Transitions

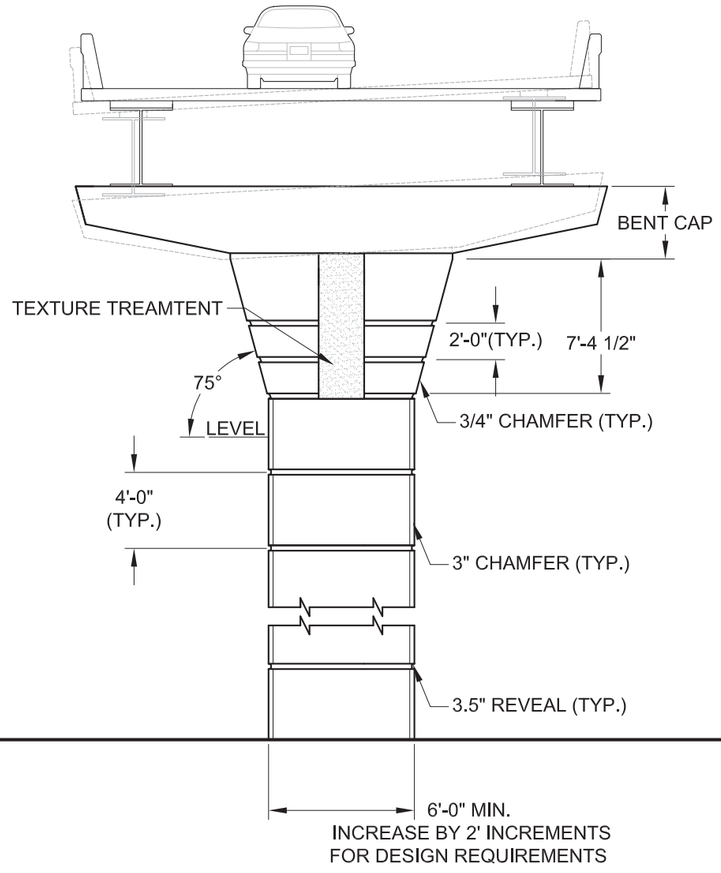
Notes:

- For direct connector bridges requiring steel girder spans, the steel girder span segments must be conituous until they transition into concrete beam segments or abutments. Alternating multiple steel girder spans between multiple concrete beam spans within a direct connector bridge will not be allowed.
- Provide drip bars, drip pans and anti-graffiti coating to prevent rust stain on columns or capitals when weathering steel girders are used.



Concrete Beam to Steel Beam

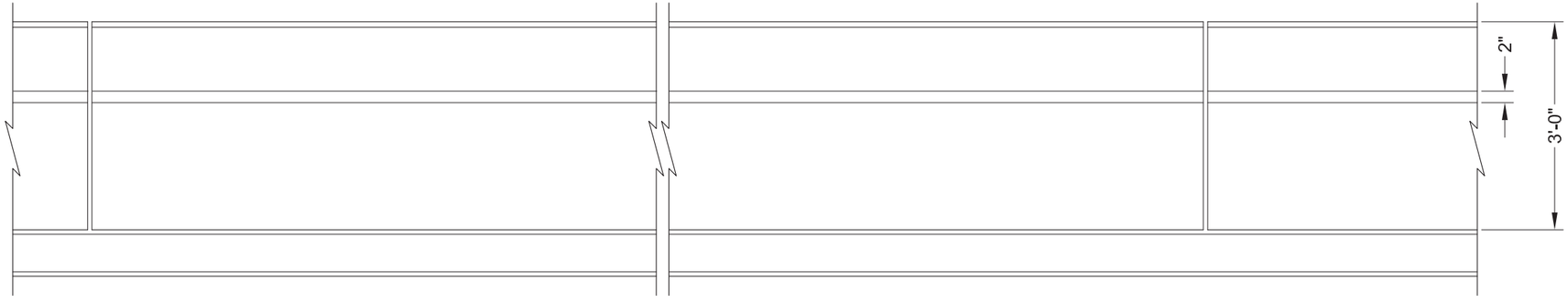
Steel Beam to Steel Beam



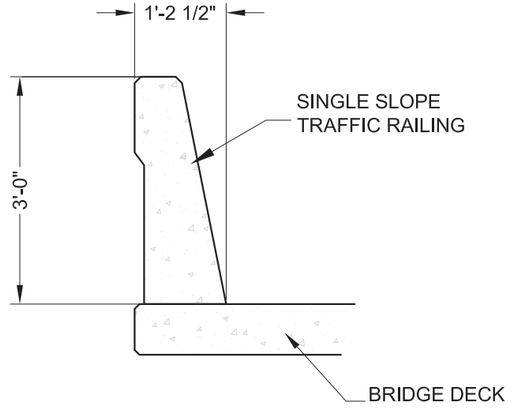
Interchange Bent with Steel I-Girders

Notes:

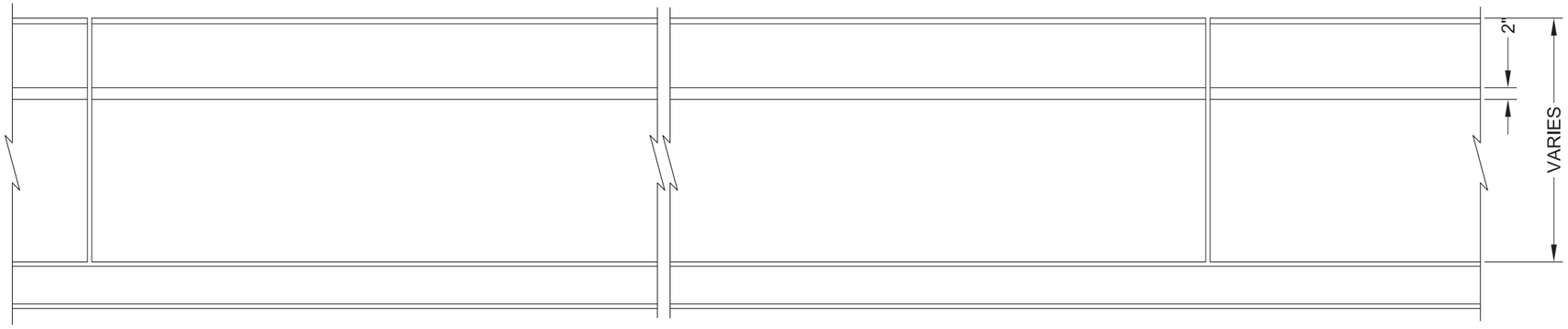
- Single slope traffic rail to match TxDOT standard for SSTR.
- The vertical face rail should be used on bridges that feature sidewalks against the outside edge and local cross-streets with a bridge fence on rail.
- Vertical face rail to match TxDOT standard for T221.
- Align rail and bridge joints.
- Texture is permissible. Reference the corridor master plan.



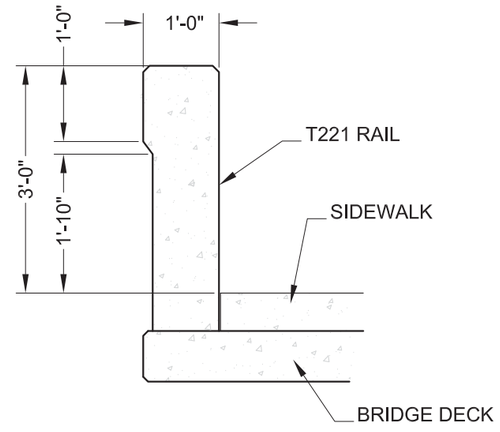
Single Sloped Traffic Railing - SSTR
Outside Elevation



Typical Section



Vertical Face Railing - T221
Outside Elevation

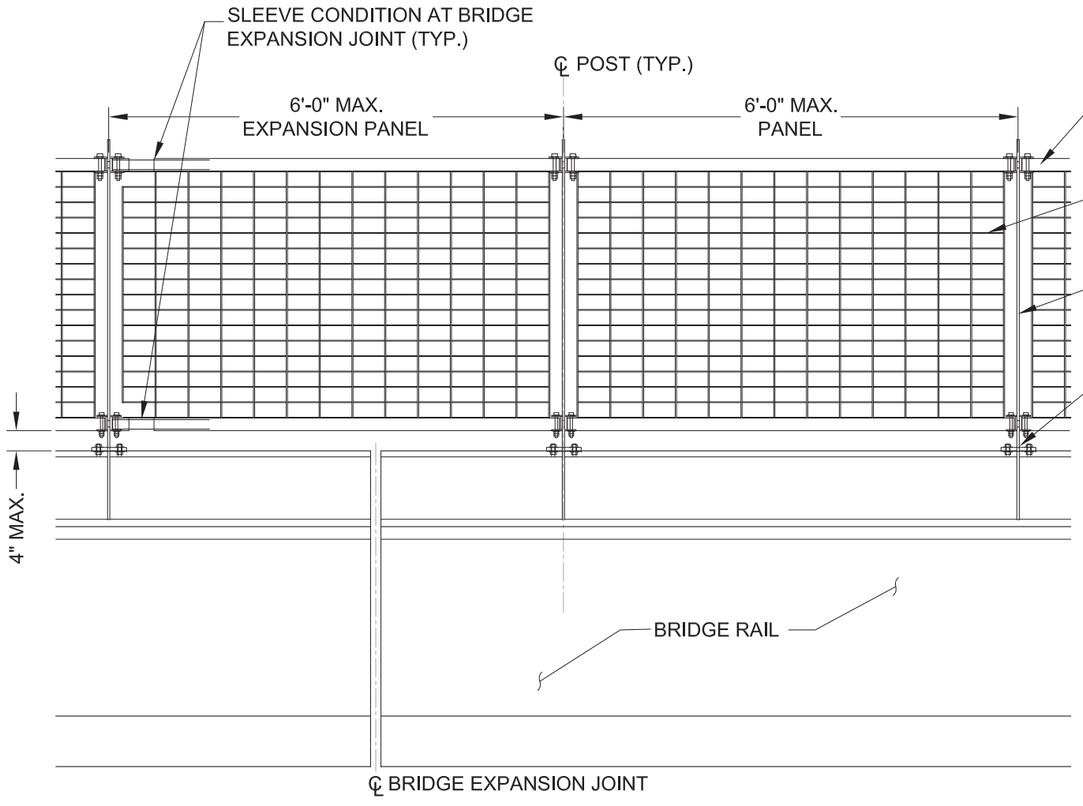


Typical Section

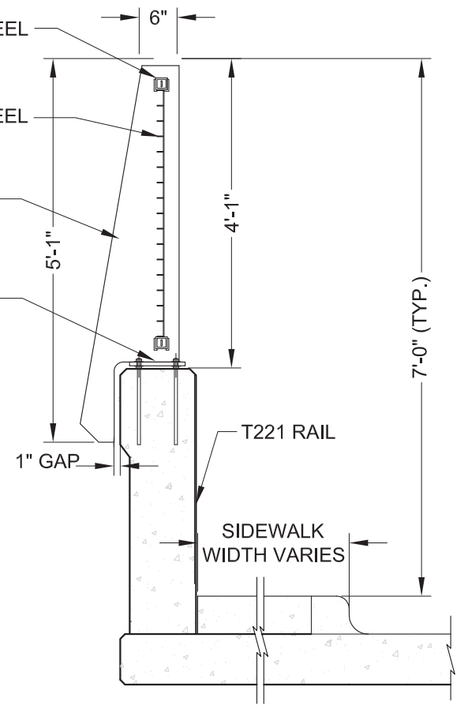
Rail Mounted Fence

Notes:

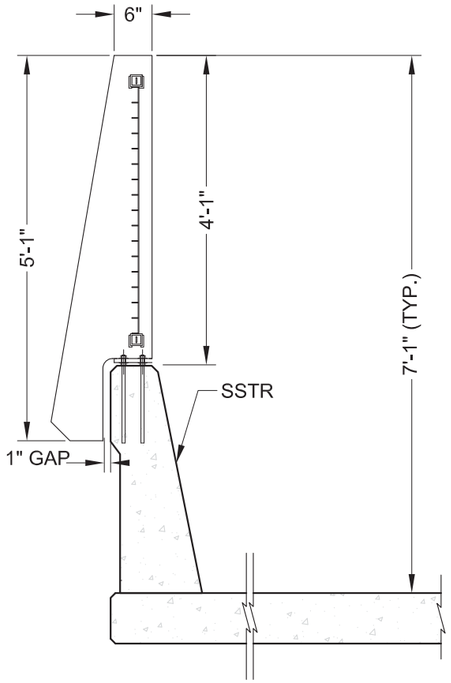
- Bridge fence on rail will be used only on local roads with design speeds lower than 45 mph.
- Texture is permissible on bridge rail. Reference the corridor master plan.



Front Elevation



Typical Section - T221

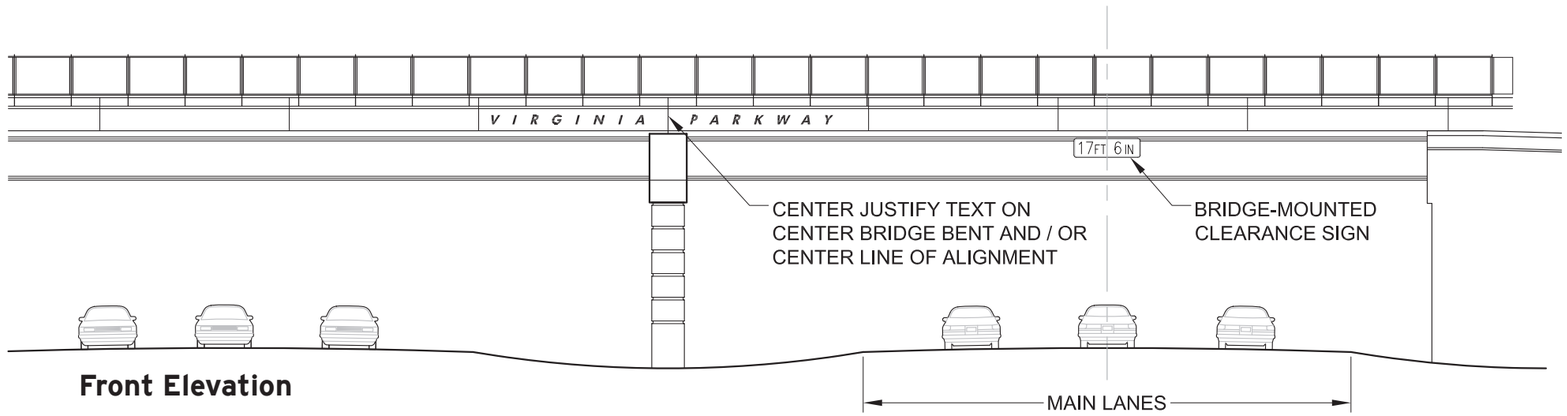


Typical Section - SSTR

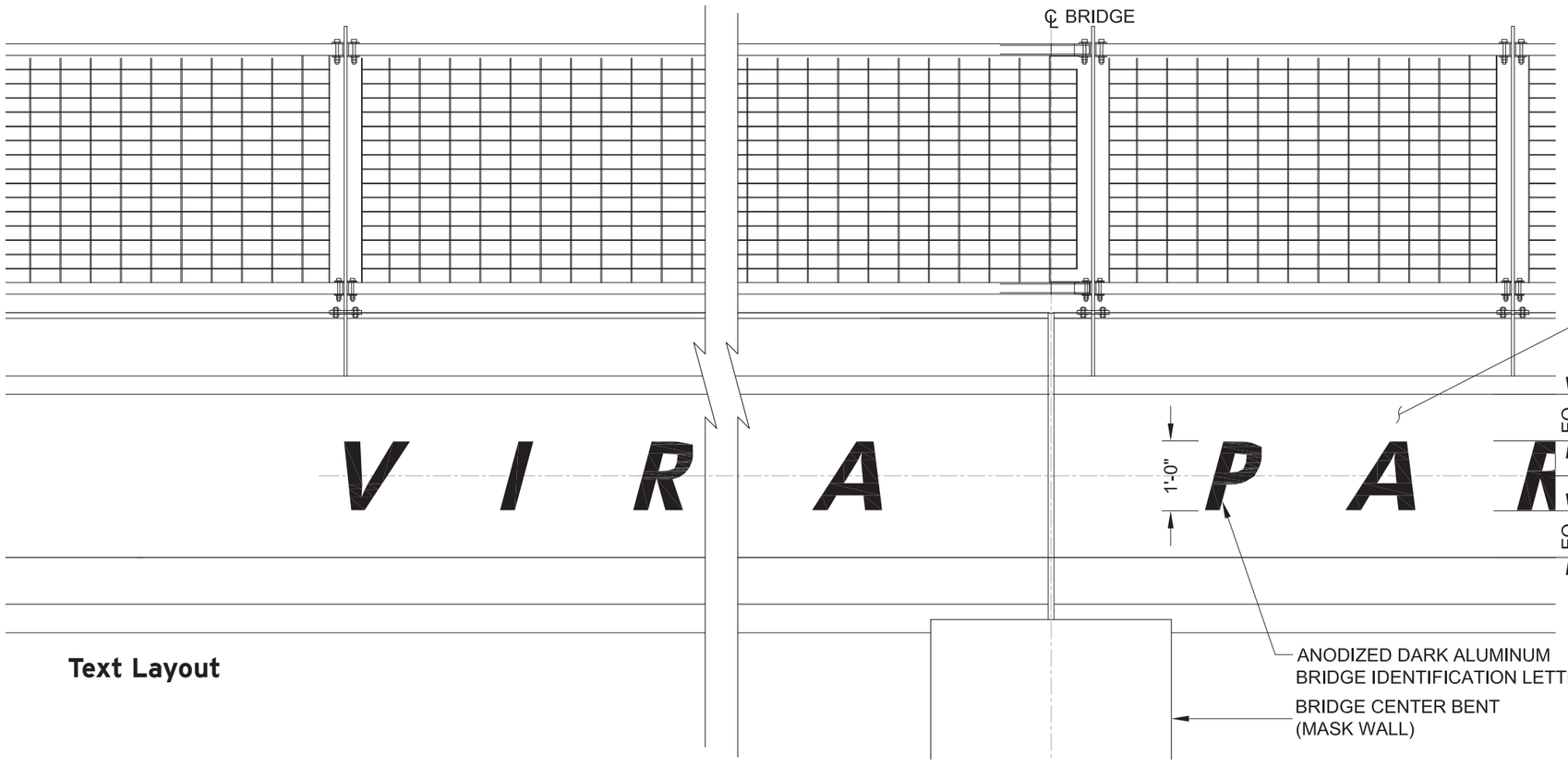
Cross Street Identification

Notes:

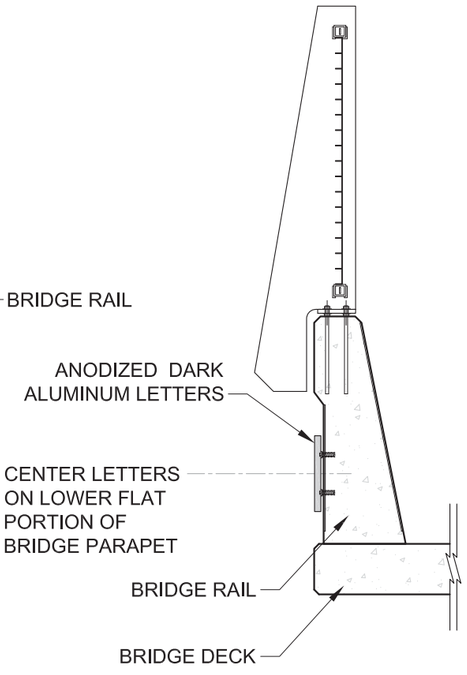
- Letter font and spacing to match NTTA standard drawings.
- For single span cross street bridges, text to be center justified along center of bridge.



Front Elevation



Text Layout



Typical Section

03 MAIN LANE ELEMENTS

Visual Quality Management for Retaining Walls

Retaining walls along an NTTA corridor either face inward to the NTTA main lanes or outward to the surrounding neighborhood. Retaining walls facing inward to the tollway are primarily seen by tollway users, while those facing outward are primarily seen by tollway neighbors. There are, however, some locations (such as office towers adjacent to the tollway) where a neighbor can see what a tollway user can see. Similarly, there are very few locations where a tollway user can see a retaining wall that faces a neighborhood unless they are on a service road.

NTTA has defined a unified approach to the design of its retaining walls when using mechanically stabilized earth (MSE) panels. The primary visual attribute of its panel system is that it incorporates the joints between panels into the actual design of the wall rather than trying to mask their existence. Very few MSE walls adequately incorporate or mask the joint between panels as part of their aesthetic design.

If local authorities prefer the use of a panel design different than the preferred Design Guidelines panel, the NTTA will evaluate whether the wall can be viewed from the neighborhood and not from the tollway or service roads. If local authorities would like to use a different panel facing the tollway, the NTTA will only negotiate if the entire corridor is willing to change the panel design. There is more flexibility given for panels facing the neighborhood.

The NTTA project manager needs to understand the context of implementing the Design Guidelines. The primary motive of implementing the Design Guidelines is to create visual consistency in the corridor. As part of developing the corridor master plan, the NTTA project manager must evaluate the existing corridor, determine the impacts of applying the Design Guidelines, and suggest the most practical way to achieve visual consistency in the corridor.

In new corridors, achieving visual consistency for retaining walls will be achieved by implementing the Design Guidelines guidance. However, in some new corridors (or existing corridors being reconstructed), the community may request a different retaining wall design. The NTTA will consider incorporating a different design for MSE walls if three different conditions are met:

1. Corridor consistency is not compromised.
2. The design is developed at the expense of the local authority.
3. If the panel design, in the opinion of the Design Guidelines Manager (DGM) adequately masks the joints between panels.
4. Any additional costs above what the NTTA usually expends on constructing and maintaining a retaining wall is borne by the local authority.

In existing corridors (corridors currently owned or operated by the NTTA) or converted corridors (corridors previously owned and operated by other transportation authorities) with existing retaining walls, the NTTA project manager will evaluate if adding the Design Guidelines retaining walls to the corridor will substantially detract from visual consistency. If adding the Design Guidelines compliant walls substantially detracts from visual consistency, the NTTA project manager with assistance from the DGM will develop a retaining wall design that is visually compatible with the existing retaining walls.

Visual Quality Management for Traffic Barriers
Only traffic barriers that meet the criteria for crash-worthiness established by NCHRP 350 and TxDOT requirements will be allowed on the NTTA system. Any aesthetic treatments allowed, will not jeopardize the barriers effectiveness and will generally be limited to the outside of the barrier.

The NTTA project manager should follow the Design Guidelines design to maintain consistency throughout the corridor and conformance throughout the NTTA system. Nonetheless, in new or reconstructed corridors, the NTTA will consider a different design for traffic barriers provided the following conditions are met:

1. The design is approved by all communities that are or will be adjacent to the corridor
2. The design is developed at the expense of the local authorities
3. The unique traffic barrier is functionally adequate and compatible with other traffic barriers on the NTTA system
4. The unique traffic barrier and replacement parts are readily obtained
5. Any additional costs above what the NTTA usually expends on constructing and maintaining traffic barriers is borne by the local authority

In existing corridors or converted corridors with traffic barriers, the NTTA project manager with assistance from the DGM will evaluate if adding the Design Guidelines traffic barriers to the corridor will substantially detract from visual consistency. If adding the Design Guidelines compliant traffic barriers substantially detracts from visual consistency, the NTTA project manager will develop traffic barriers and a traffic barrier location plan that is visually compatible with the traffic barriers that already exist.

Visual Quality Management for Noise Walls
Noise walls have two faces, one oriented to the neighborhood and one oriented to the tollway. The primary concern of the NTTA is visual consistency, particularly on the tollway side of the noise wall. The greatest latitude that NTTA has for incorporating independent texture aesthetics is on the neighborhood side of noise walls.

In new corridors, achieving visual consistency is usually created for noise walls by simply implementing the Design Guidelines guidance. However, it may occur that the local community will want a different architectural surface treatment developed for noise walls on the neighborhood side of the wall. NTTA may consider utilizing a different design on the neighborhood side if four conditions are met:

1) The design is developed at the expense of the local authority
2) It is structurally adequate
3) It is readily constructed
4) Additional costs above what the NTTA usually expends on constructing and maintaining a screen wall is borne by the local authority.

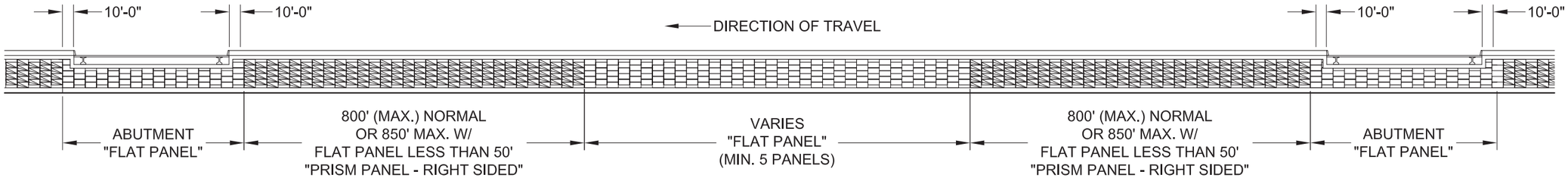
In existing corridors (corridors currently controlled by the NTTA) or converted corridors (corridors previously owned and operated by other transportation authorities) with existing noise walls, the NTTA project manager, with assistance from the DGM, will evaluate if adding the Design Guidelines noise walls to the corridor will substantially detract from visual consistency. If adding the Design Guidelines compliant walls substantially detract from visual consistency, the NTTA project manager and DGM will develop a noise wall design that is visually compatible with the existing noise walls.

*For detailed design information reference the following NTTA Standard Drawings series:
FRD, ITS, MSD, MSE, RFD, RWD, SSB, SSR, STR, RMF

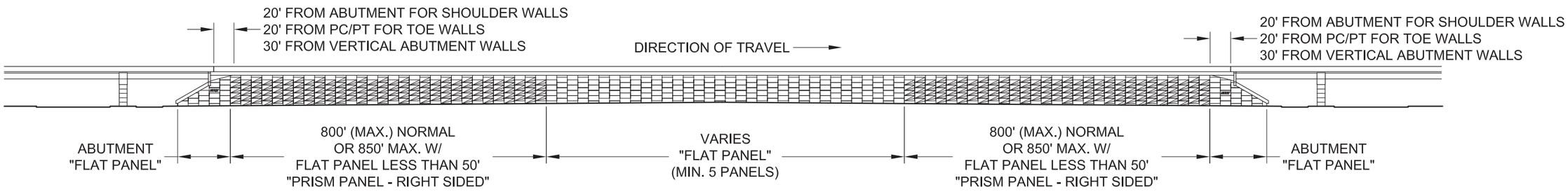
Prototype Rendering

Notes:

- Prism panels will be oriented in the direction shown, relative to traffic flow.
- Where end of flat panel horizontal wall run is less than 50 feet (five panels) continue with prism panel.



Main Lane In Cut ("View From" Main Lane Condition)



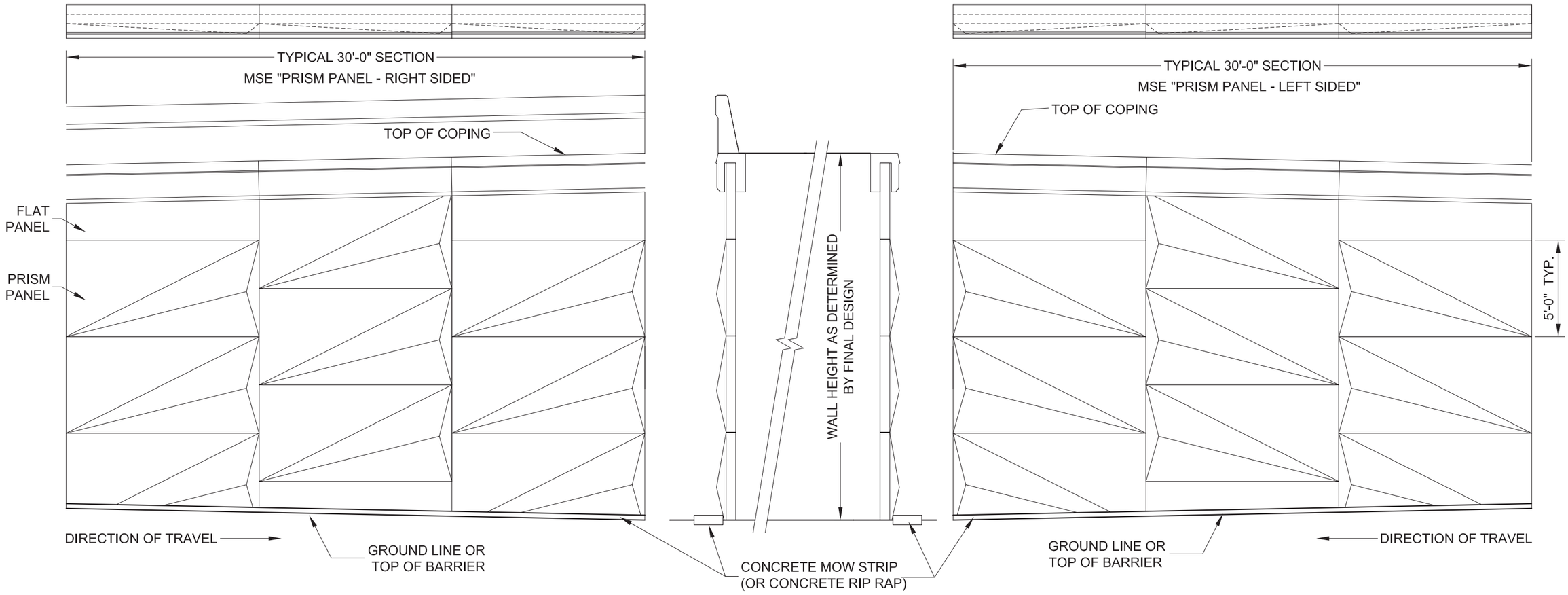
Main Lane On Fill ("View To" Frontage Road Condition)

Elevation

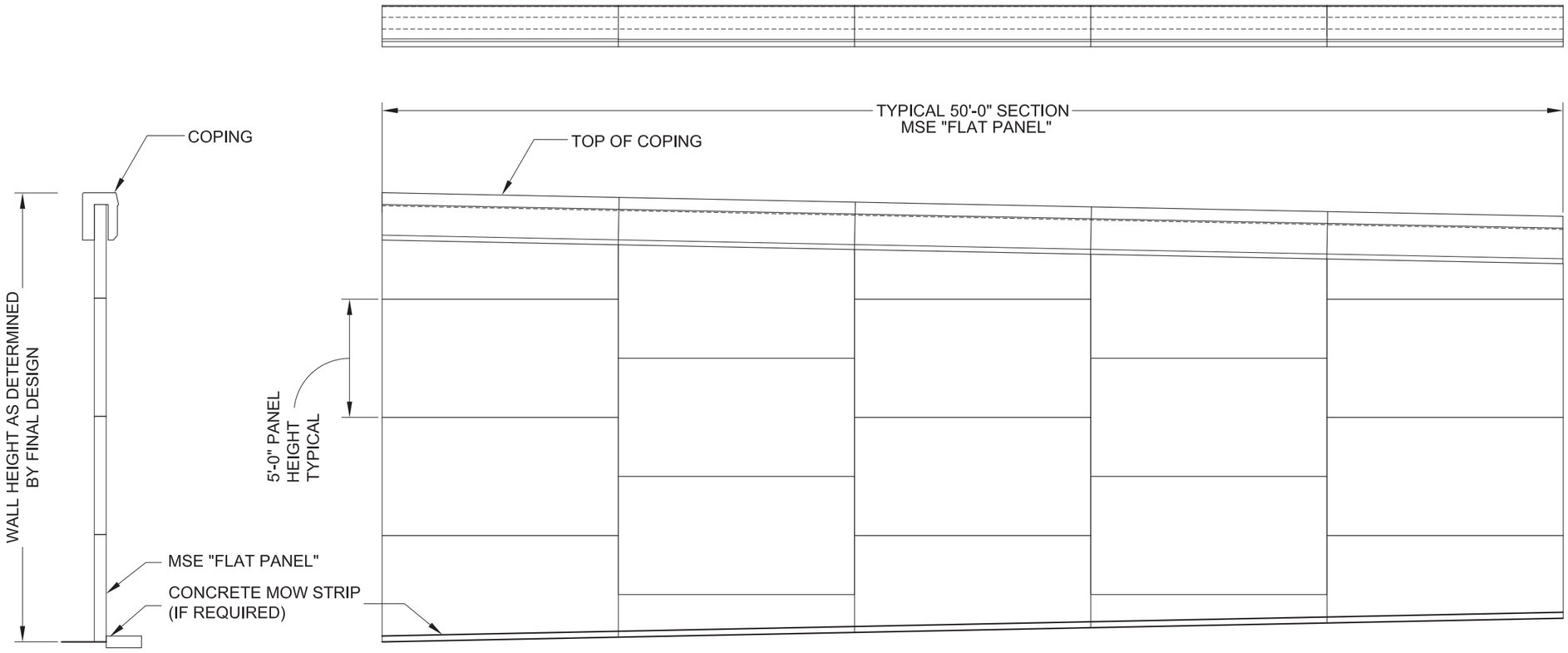
Retaining Walls - "Prism Panel" Layout

Notes:

- Prism panels will be oriented with the wider prism side on the departure side direction. (as shown)
- Use flat panel for upper most panels on retaining wall where less than 3 feet of panel is exposed.
- To establish the proper orientation of the panel in both the main lane cut condition and the frontage road fill condition, the prism panel (left sided & right sided) will require two fabrication forms that are mirror images of each other.



Elevation / Section

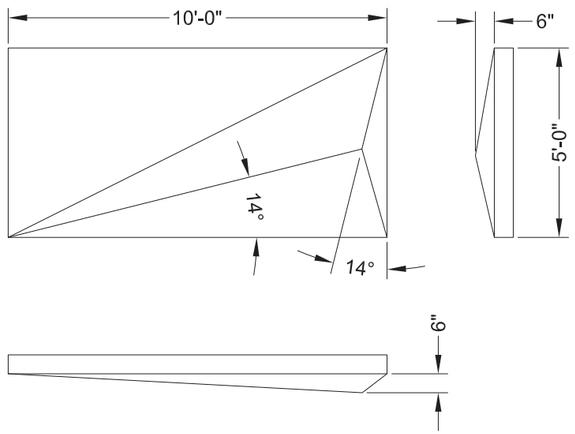


Elevation / Section

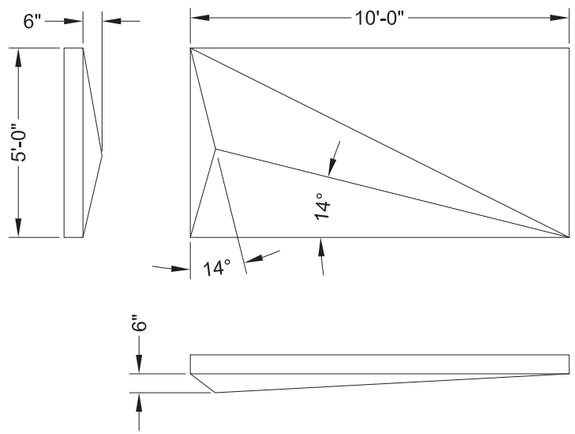
MSE Panel - Panel Details

Notes:

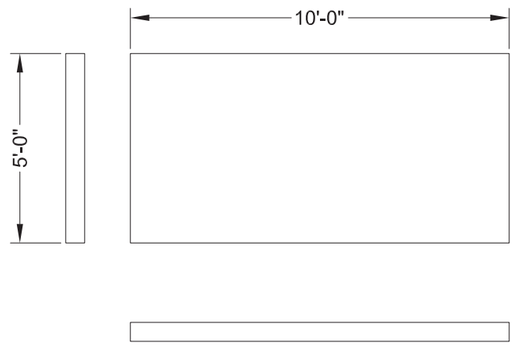
- The frontage road prism panel and the main lane prism panel will require two separate fabrication forms that are mirror images of each other.
- Refer to surface finish treatment chapter for texture treatment.



"PRISM PANEL - RIGHT SIDED"



"PRISM PANEL - LEFT SIDED"



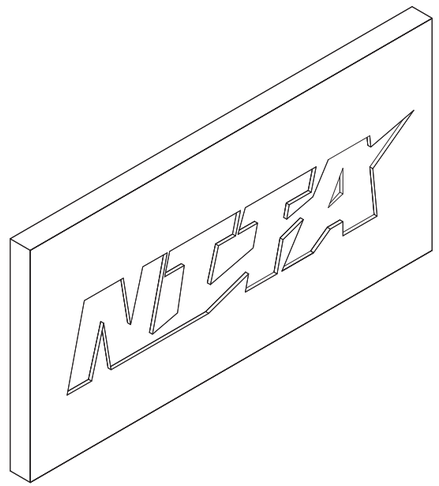
"FLAT PANEL"

Enlargements

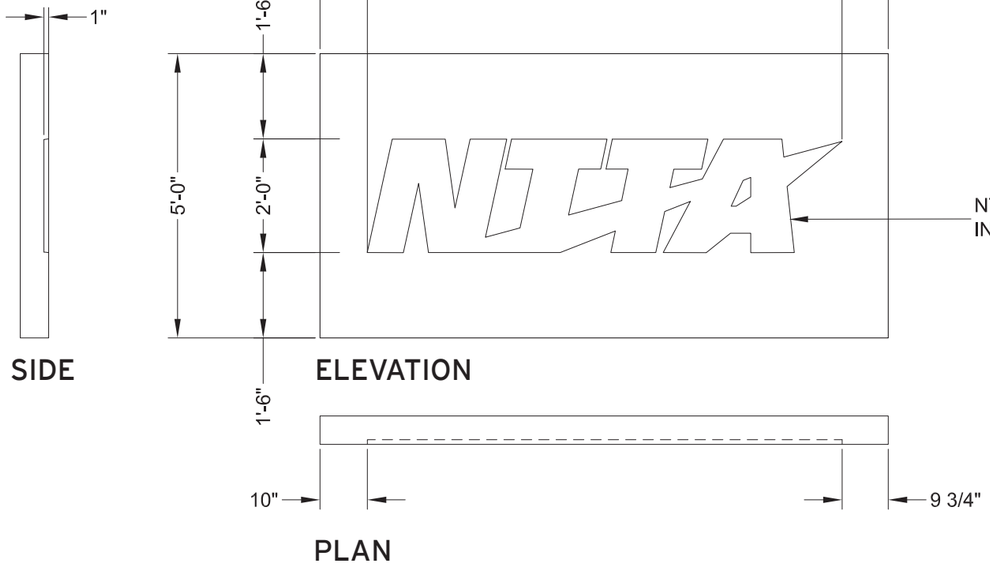
MSE Panel - Logo Panel

Notes:

- Refer to surface finish treatment chapter for texture treatment.

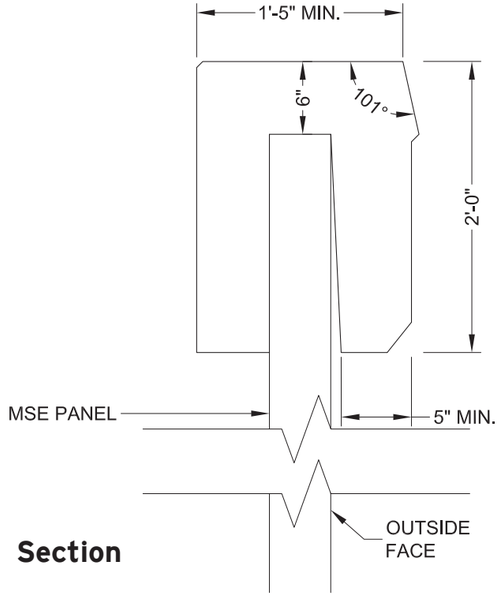


Logo Panel (Reveal)

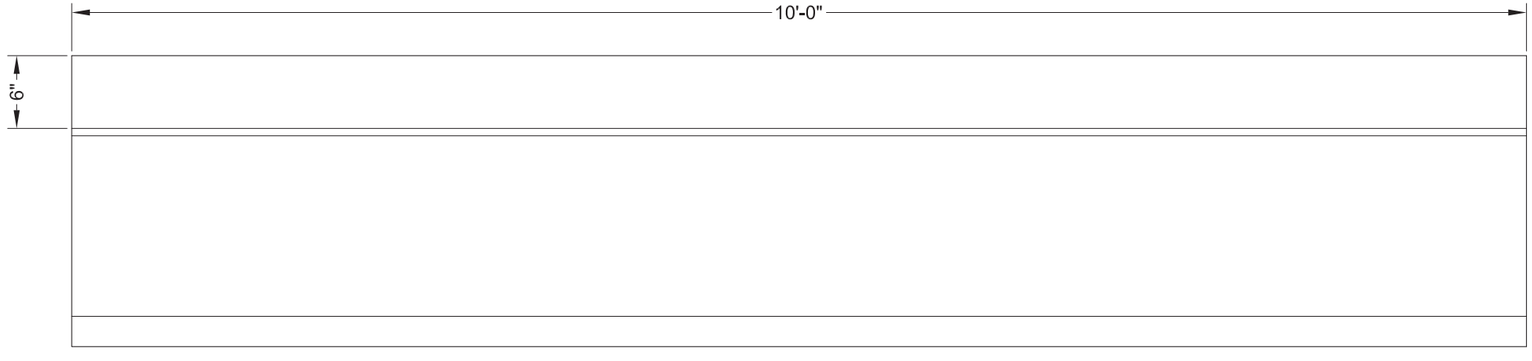


Enlargements

Coping

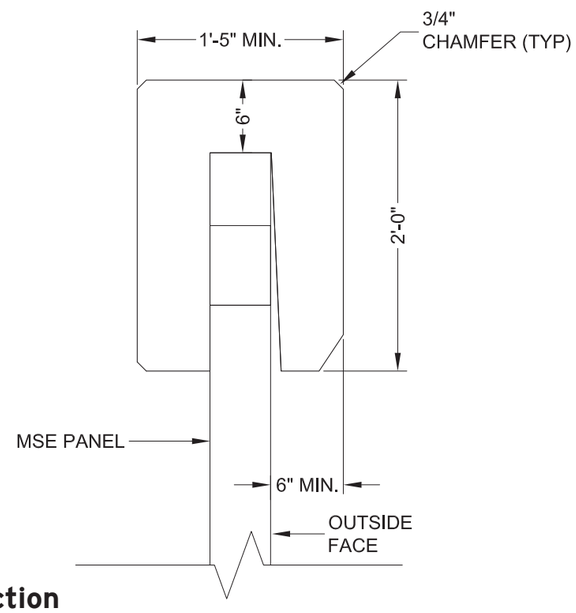


Section

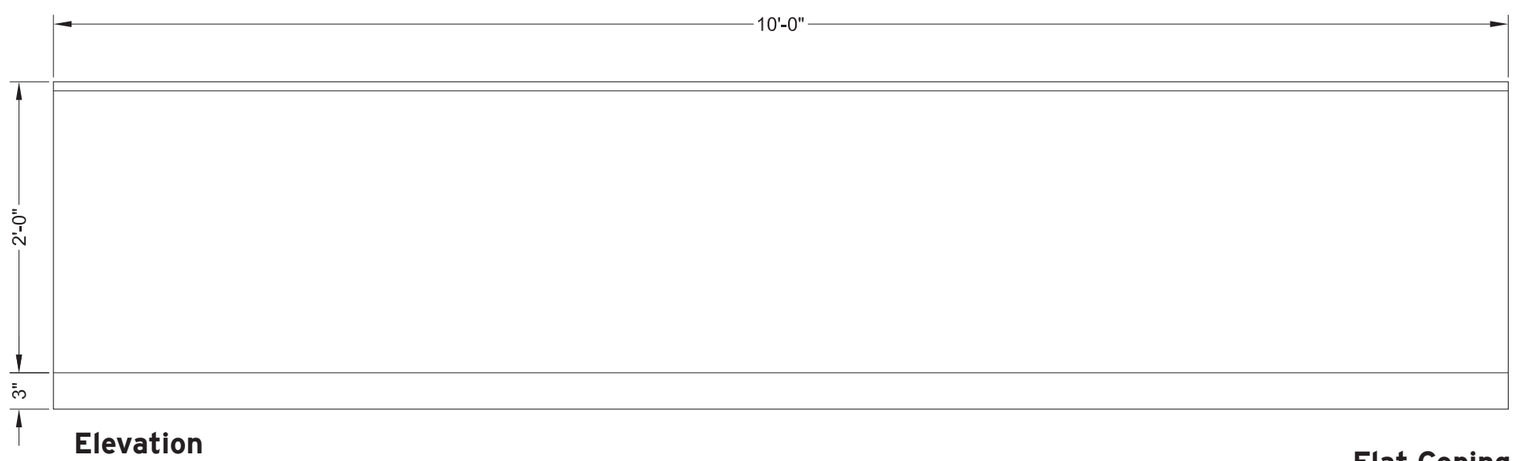


Elevation

Standard Coping



Section



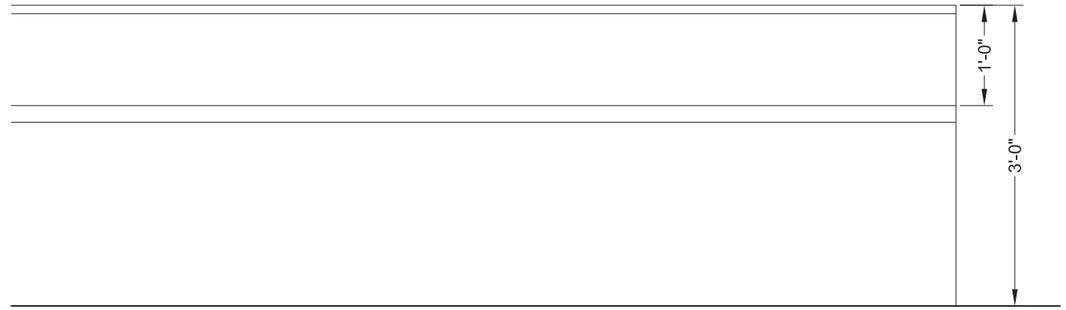
Elevation

Flat Coping

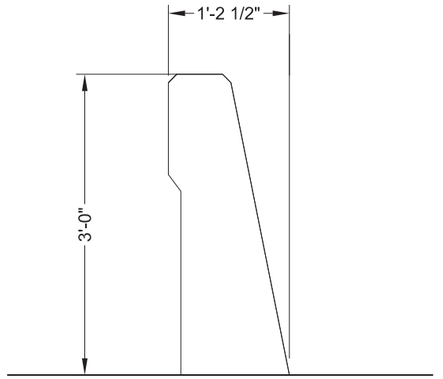
Notes:

- Traffic sloped rail to match TxDOT standard for SSTR
- Single slope barrier to match TxDOT standard for SSB
- When traffic barrier is attached to coping, the joint spacing in the barrier shall match alignment of the joint spacing of precast coping.
- Add texture if required by corridor master plan.

Single Sloped Traffic Rail - SSTR

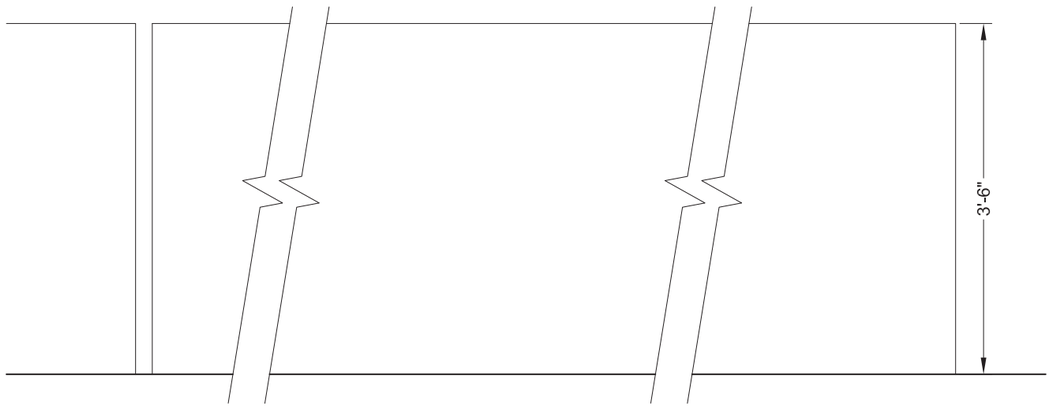


Outside Elevation

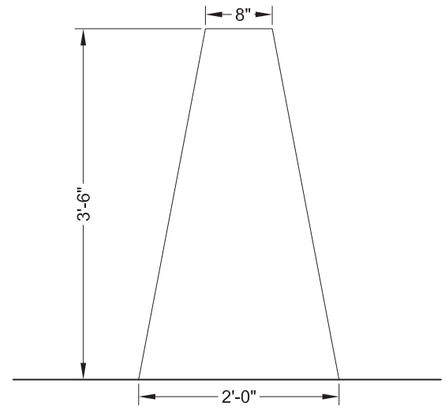


Typical Section

Single Slope Barrier - SSB



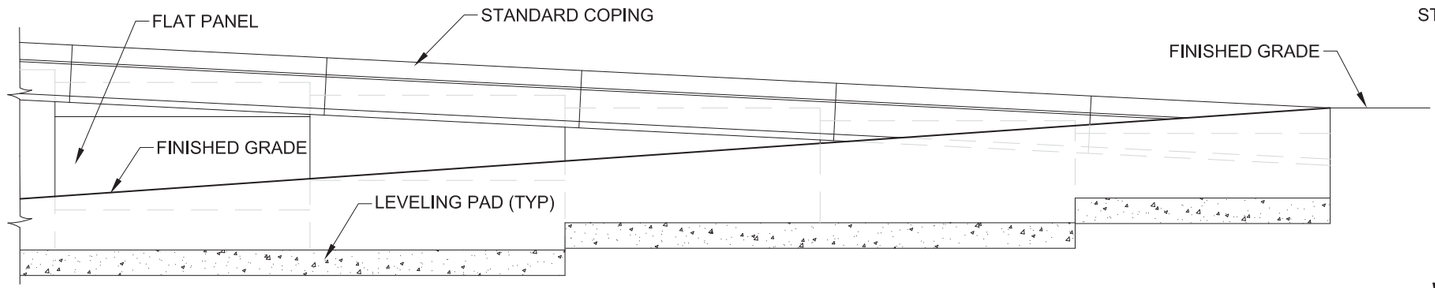
Outside/ Inside Elevation



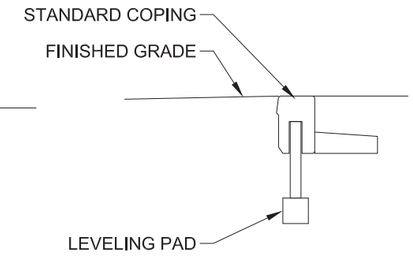
Typical Section

Notes:

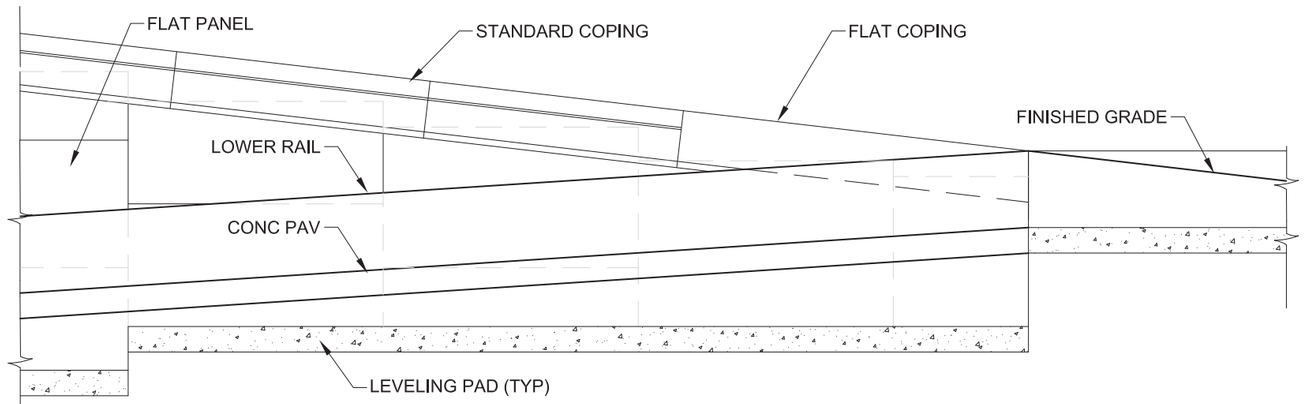
- Design applies where main lanes converge or diverge with adjacent ramp pavement with retaining walls.



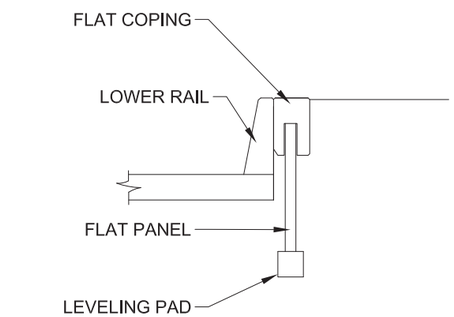
Elevation



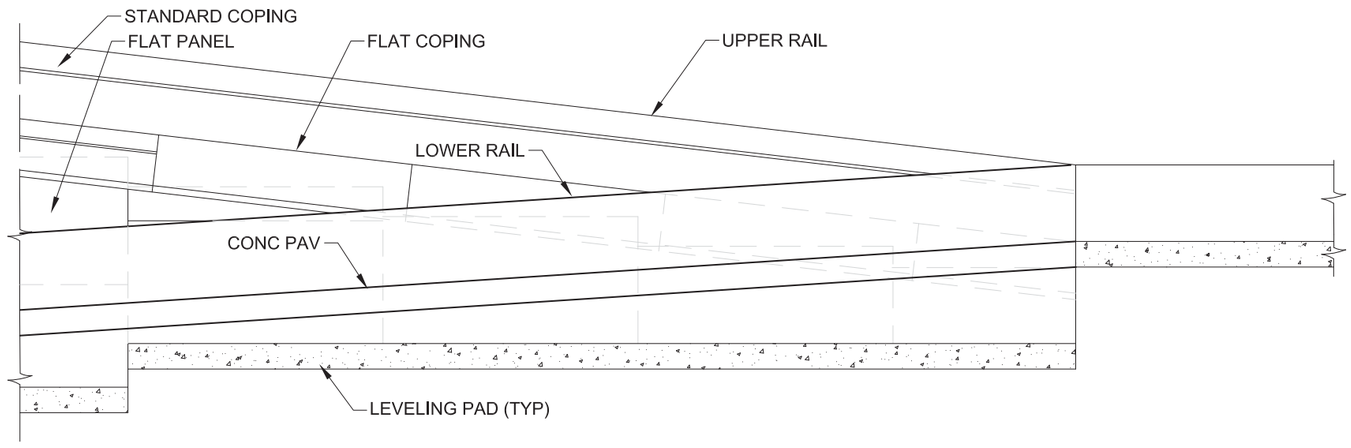
Wall Without Railing



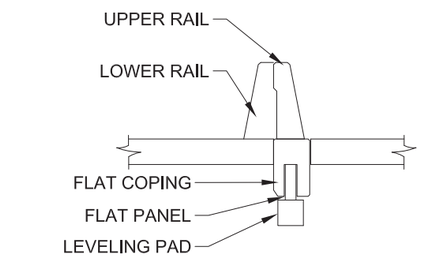
Elevation



Wall With Lower Railing



Elevation



Wall With Upper and Lower Railing

Notes:

- Reference NTTA crash attenuator guidelines for further information on type and usage.
- Coordinate to provide for consistency of attenuator specifications between projects and the highest level of visually continuity between all corridor and adjacent hardware elements.

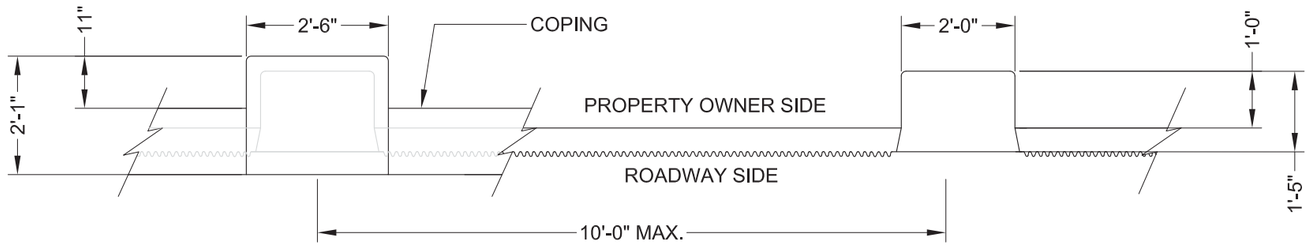
- Example attenuators, refer to NTTA Crash Attenuator Guidelines for current approved manufacturers and models.

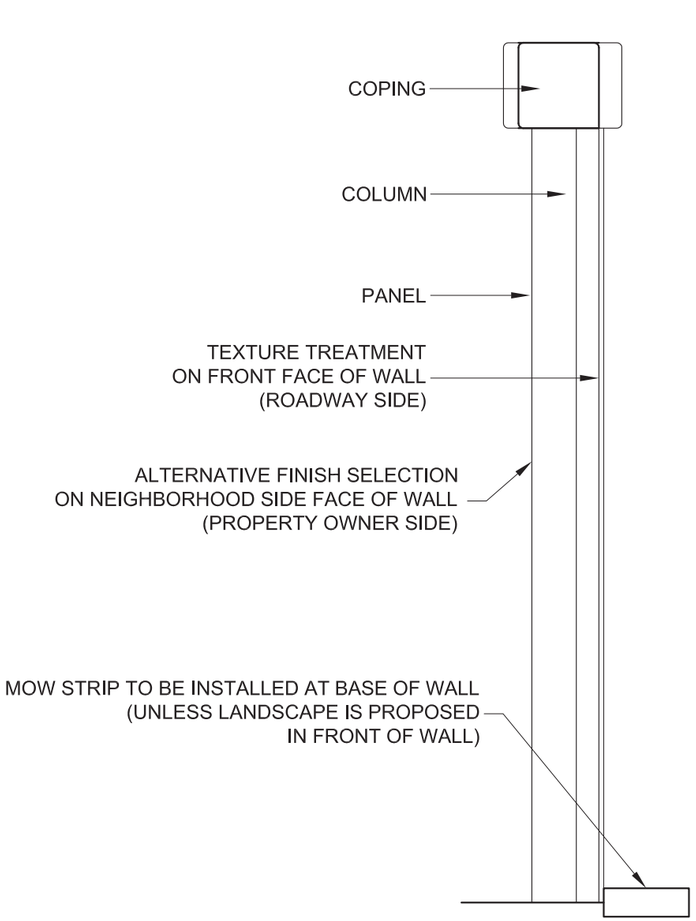
- Example MBGF

Noise Wall

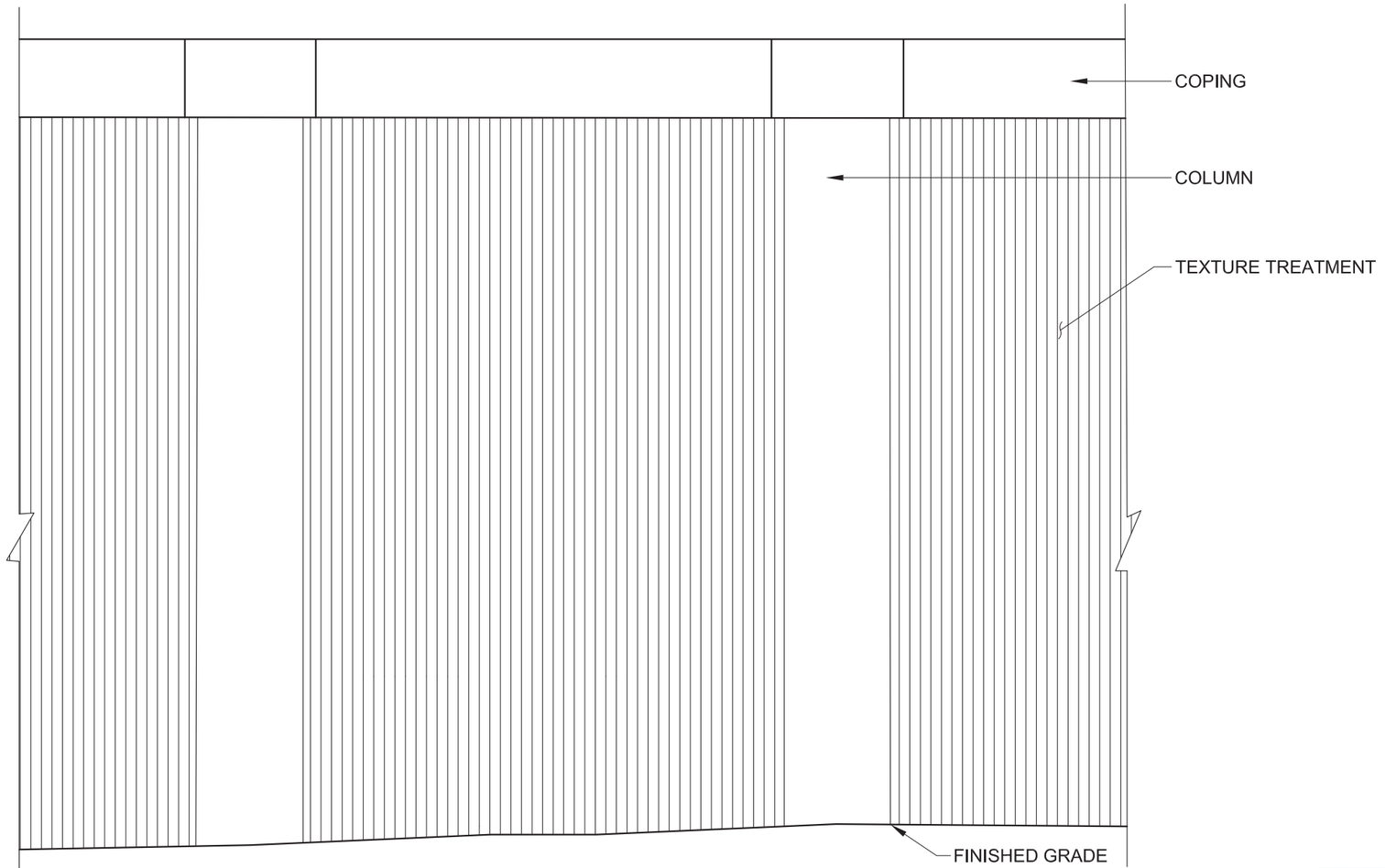
Notes:

- Stepping of wall may occur at column.
- Consider visual continuity and functional accessibilities for proper back of wall maintenance access conditions.





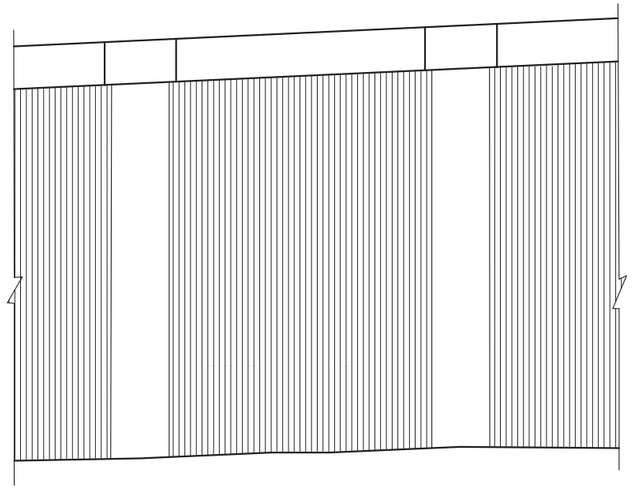
Elevation / Section



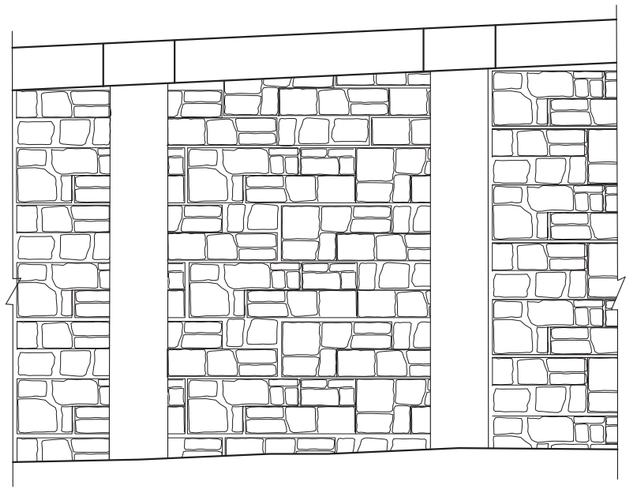
Noise Wall Finishes - Property Owner Side

Notes:

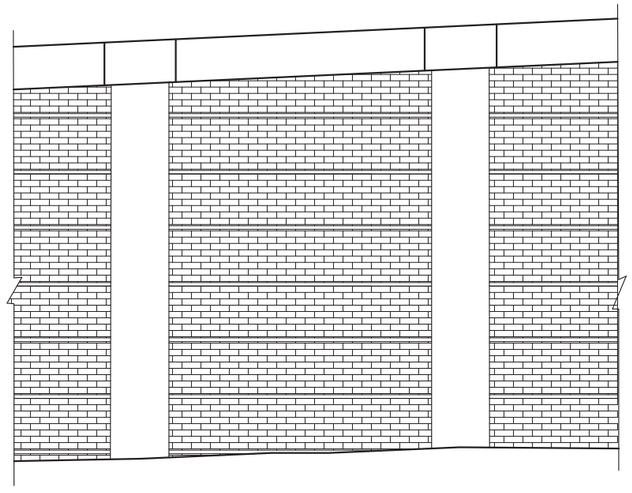
- Noise wall finishes alternatives to be precast concrete form liner application.
- Refer to surface finish treatment chapter for finish options.



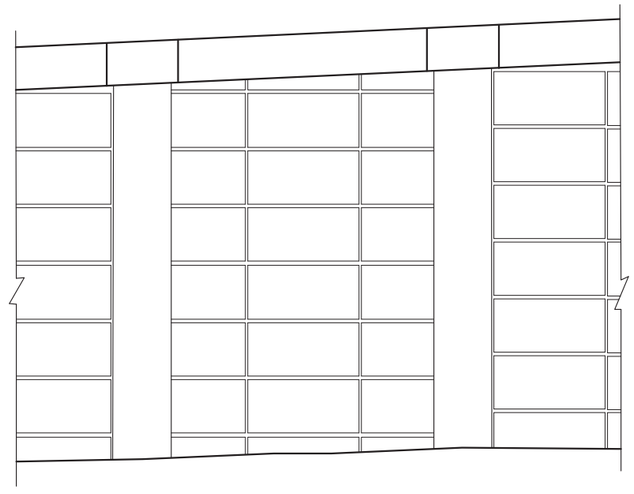
Fluted / Fractured Fin Finish - Standard



Slate Stone Finish - Alternative



Brick Masonry Finish - Alternative



Architectural Reveal Finish - Alternative

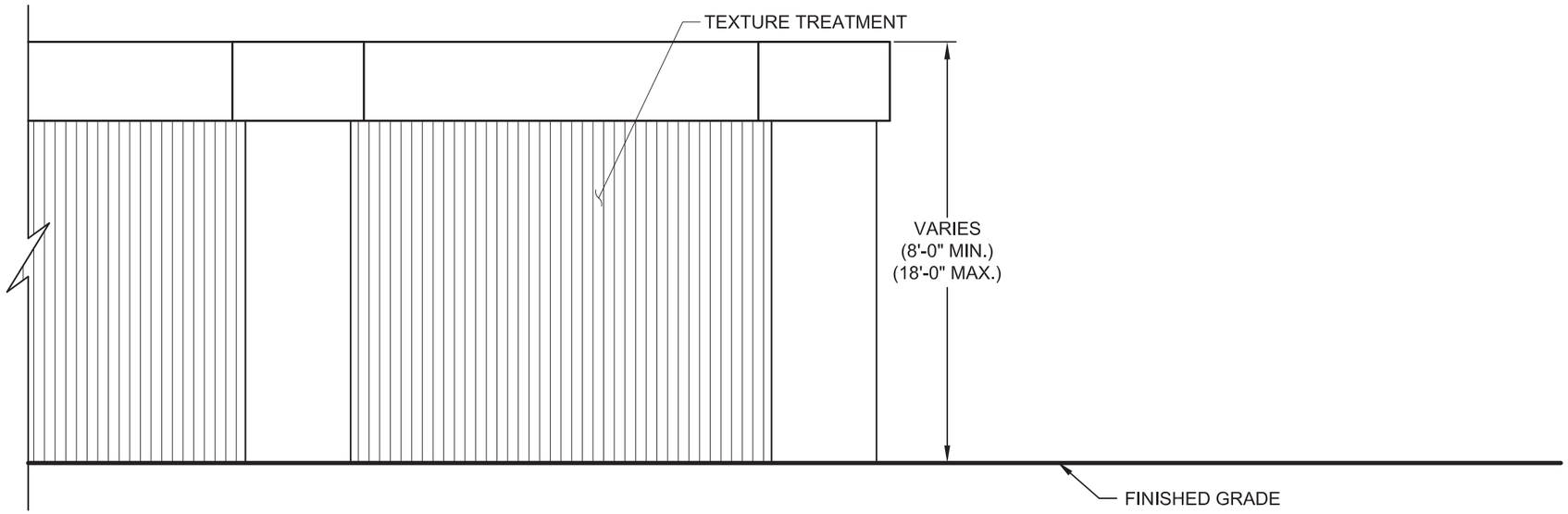
Elevation

Noise Wall Terminations

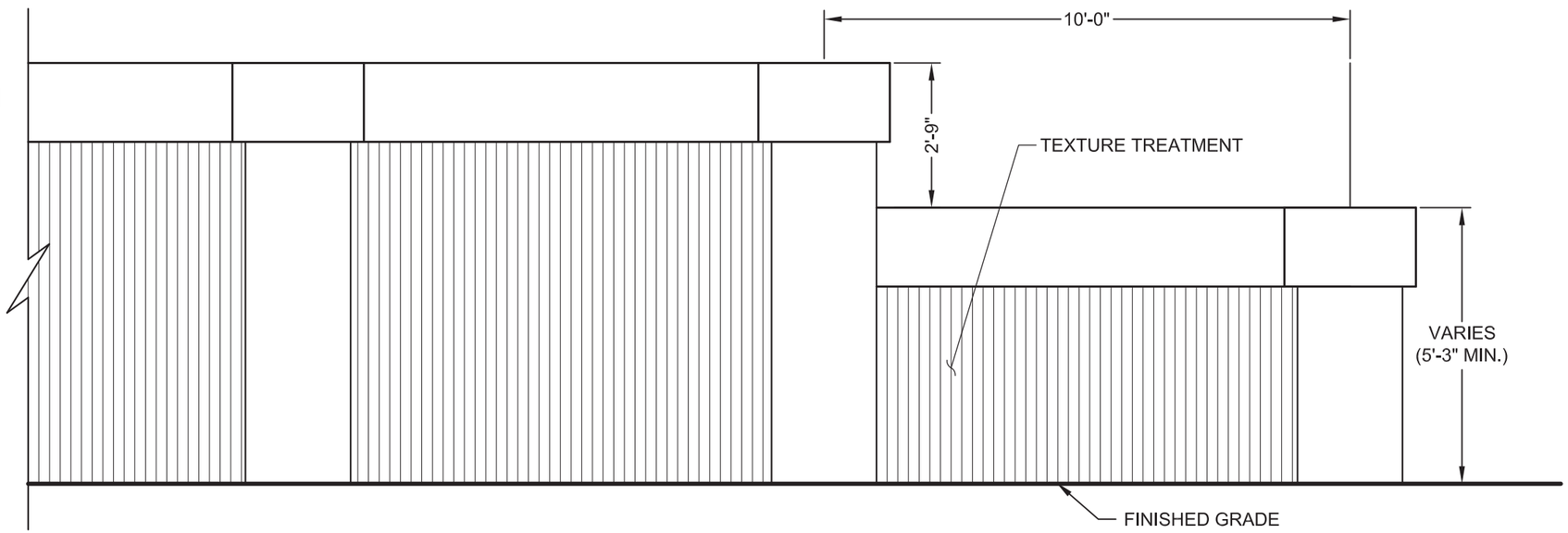
Notes:

- Where noise wall terminates at a local cross street, apply a tiered step down as shown. (unless required by sound study)
- Where noise wall does not terminate at a cross street, end with standard end wall.

Standard End Wall



Tiered End Wall

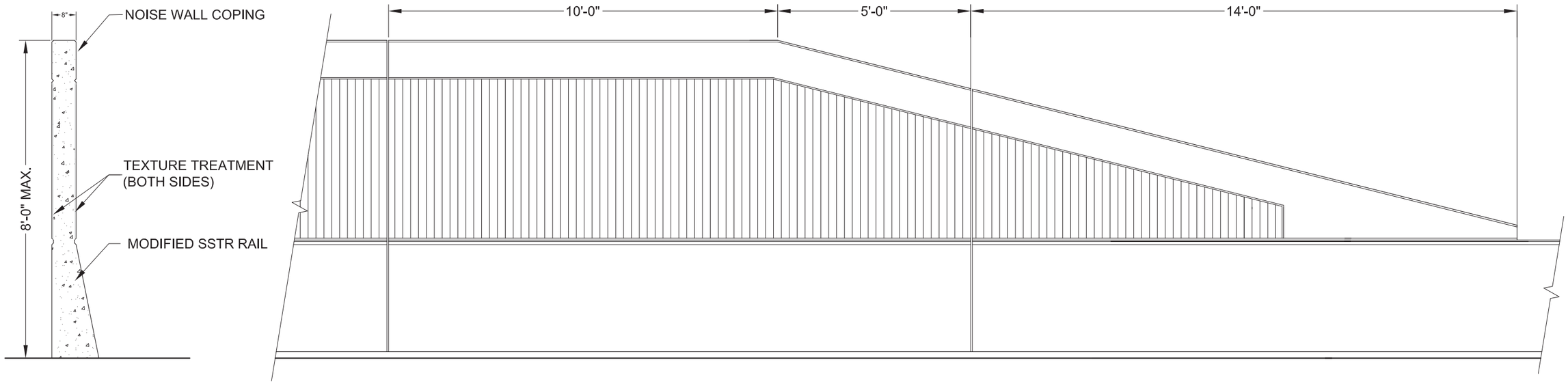


Elevation

Noise Wall on Barrier

Notes:

- Refer to TxDOT standard T501-NB (SPL)

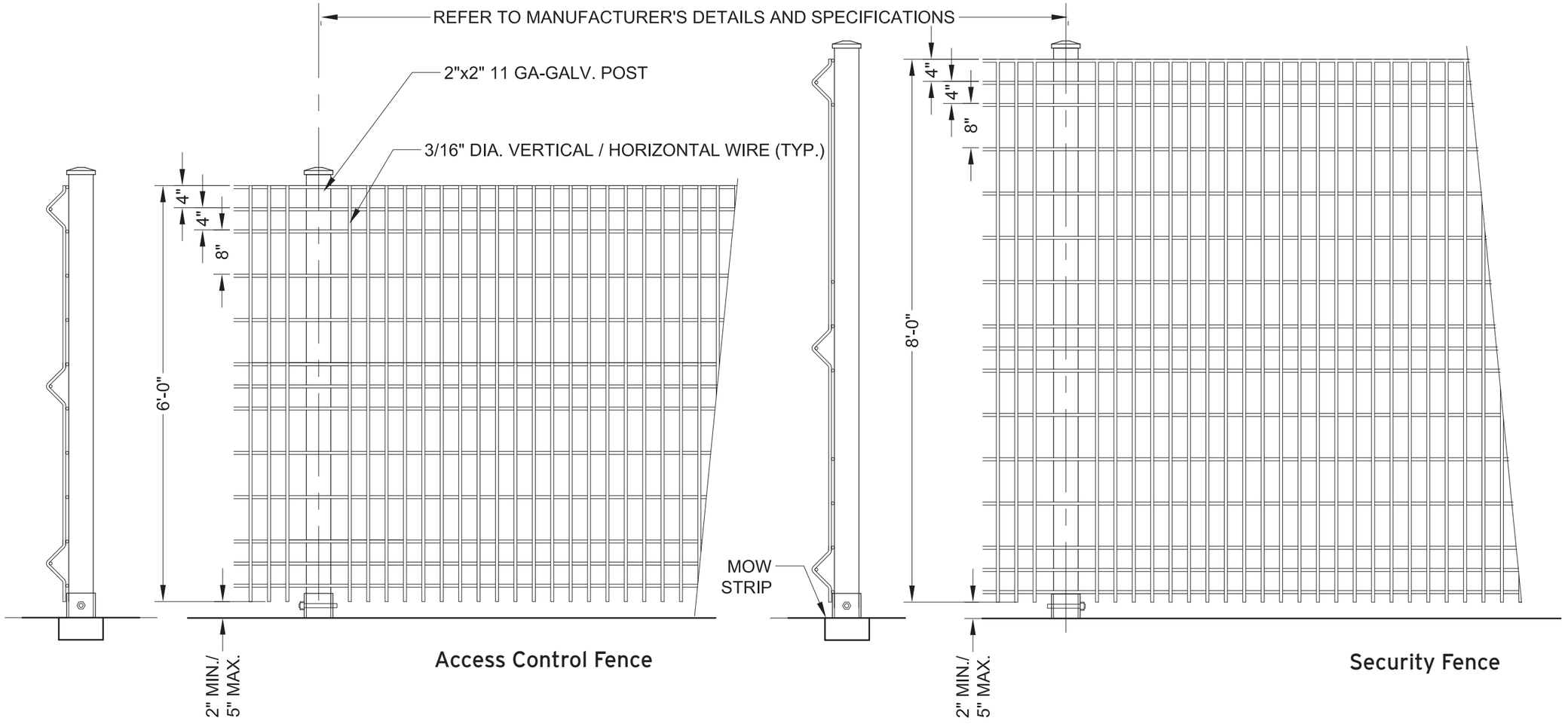


Section / Elevation

High Visibility Access Control & Security Fence

Notes:

- Access control fencing is intended as a vehicular toll avoidance deterrent.
- This fencing is intended for use when conditions require an access control fence near traffic and a high degree of visibility. Due to its cost and maintenance considerations, special attention should be paid to the length and placement of the access control fence.
- Access control fence is not to be located within the clear zone.
- Security fencing is a higher fence intended for use at the sand stockpile sites and other facility sites sensitive to public access. (i.e. Toll collection facilities)
- Fence shall meet AASHTO Standards.

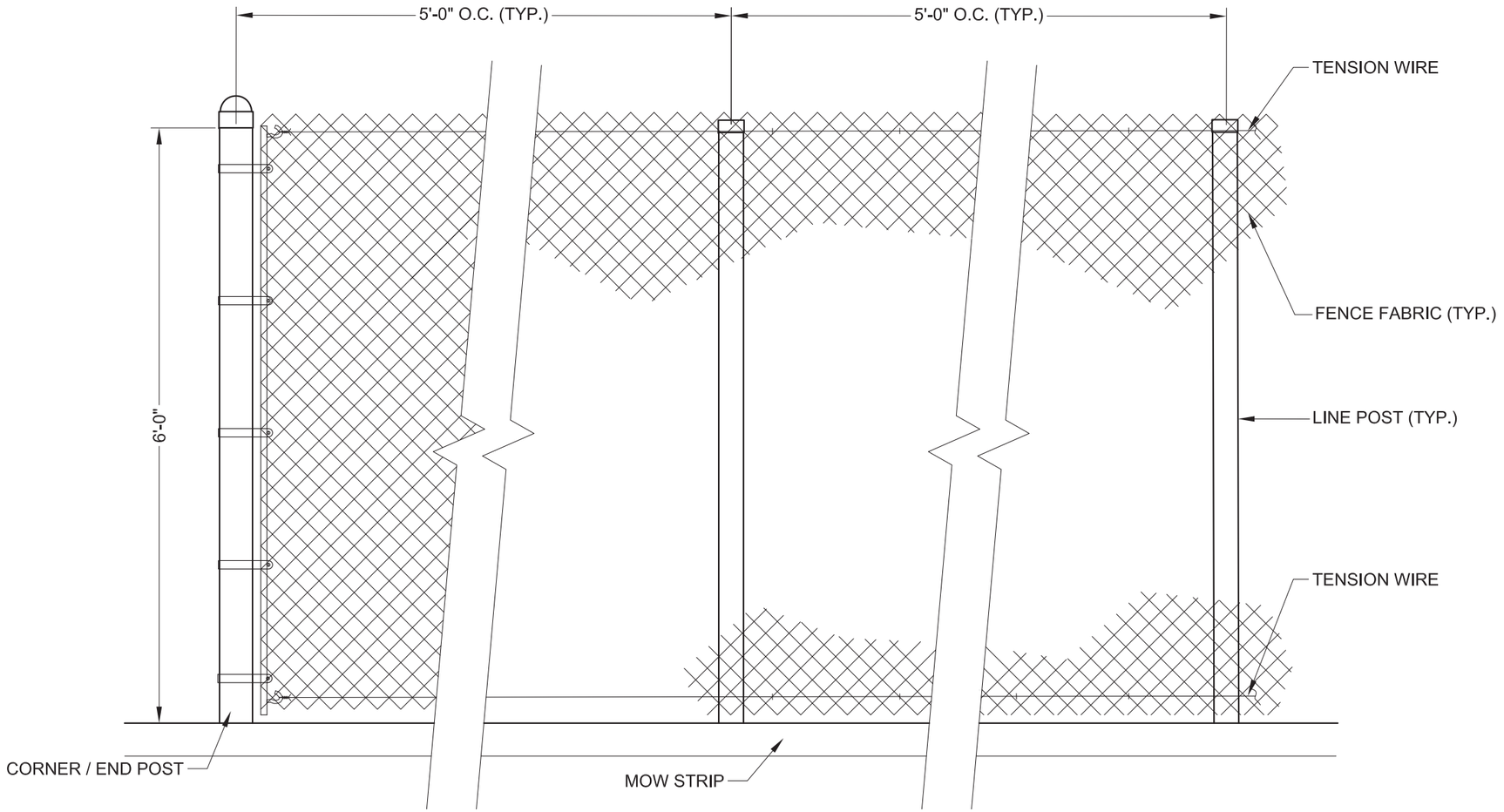


Section / Elevation

Low Visibility Access Control Fence

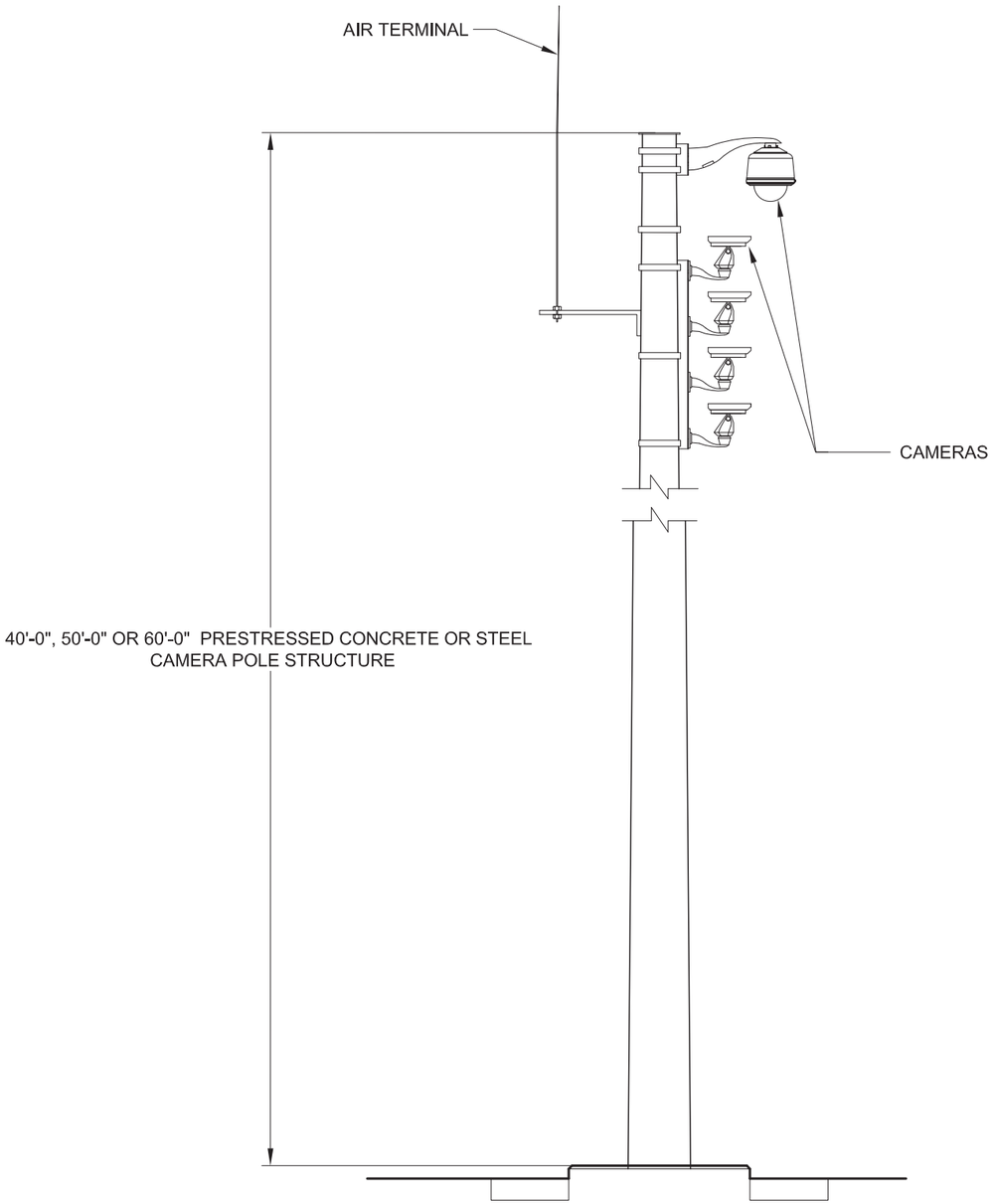
Notes:

- Galvanized chain link fencing is intended for required access control fence conditions that maintain a low degree of visibility due to the distance away from the roadway, or from natural or man made obstruction. Due to aesthetic considerations, special attention should be paid to the placement of this access control fence.
- Access control fence is not to be located within the clear zone.



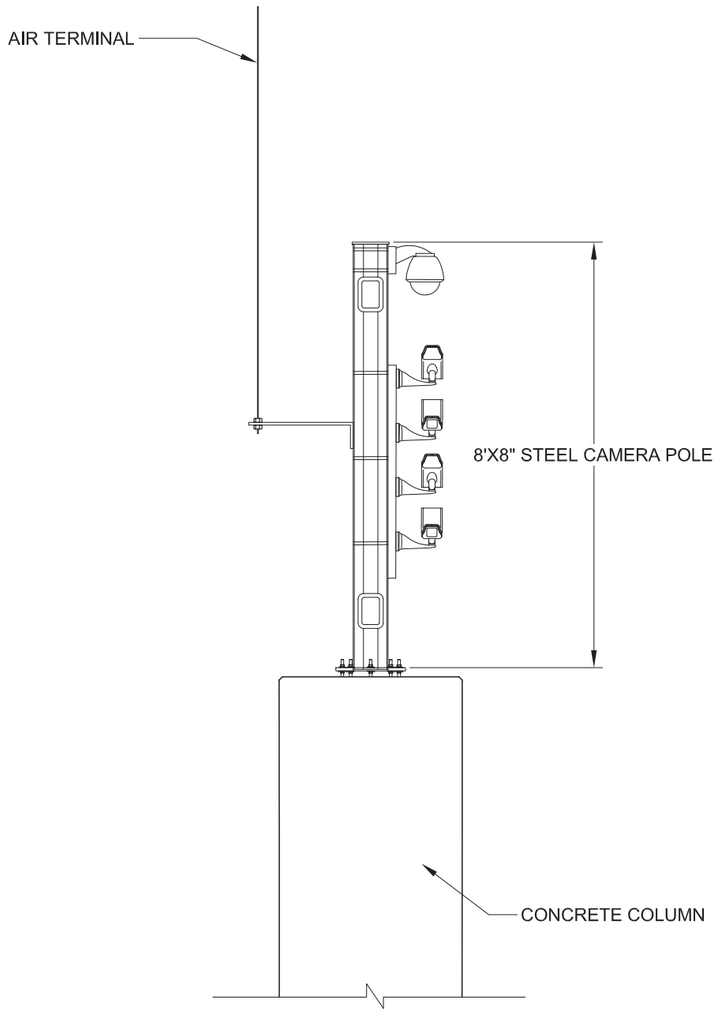
Elevation

ITS CCTV Camera Pole



Elevation

Ground Mounted Condition

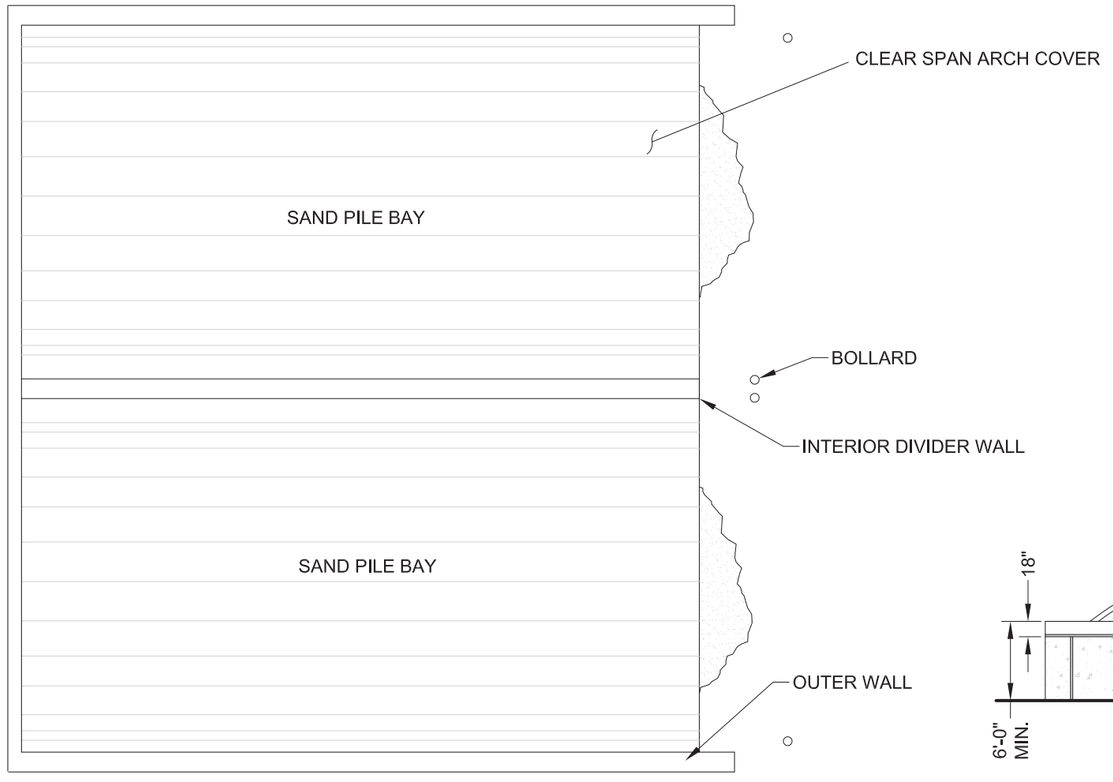


Concrete Column Condition

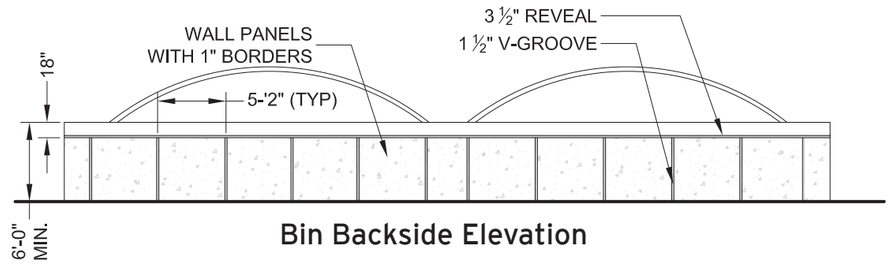
Sand Stockpile - Covered

Notes:

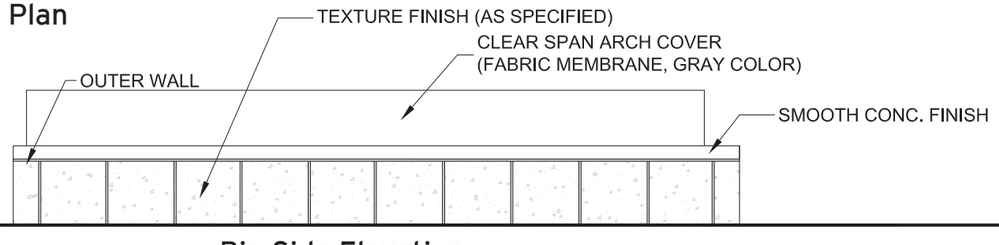
- The covered sand stockpiles are located in the ROW directly adjacent to or visibly near the mainlanes.
- Careful consideration to community visibility and visual continuity should be paid to the site selection of covered stand alone sand stockpile locations.
- The number and configuration of stockpile bins vary at individual sites. Where feasible and necessary, provide landscape and earthwork screening.
- Provide and coordinate necessary rest room facilities and area lighting.
- A screen wall extension will be added only in visually sensitive conditions and only in partnership agreements with adjacent communities.
- Texture finish, wall height and configuration aesthetics may vary as dictated by visual and budgetary appropriateness.



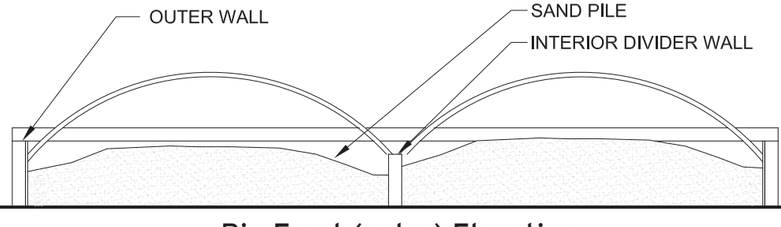
Plan



Bin Backside Elevation



Bin Side Elevation

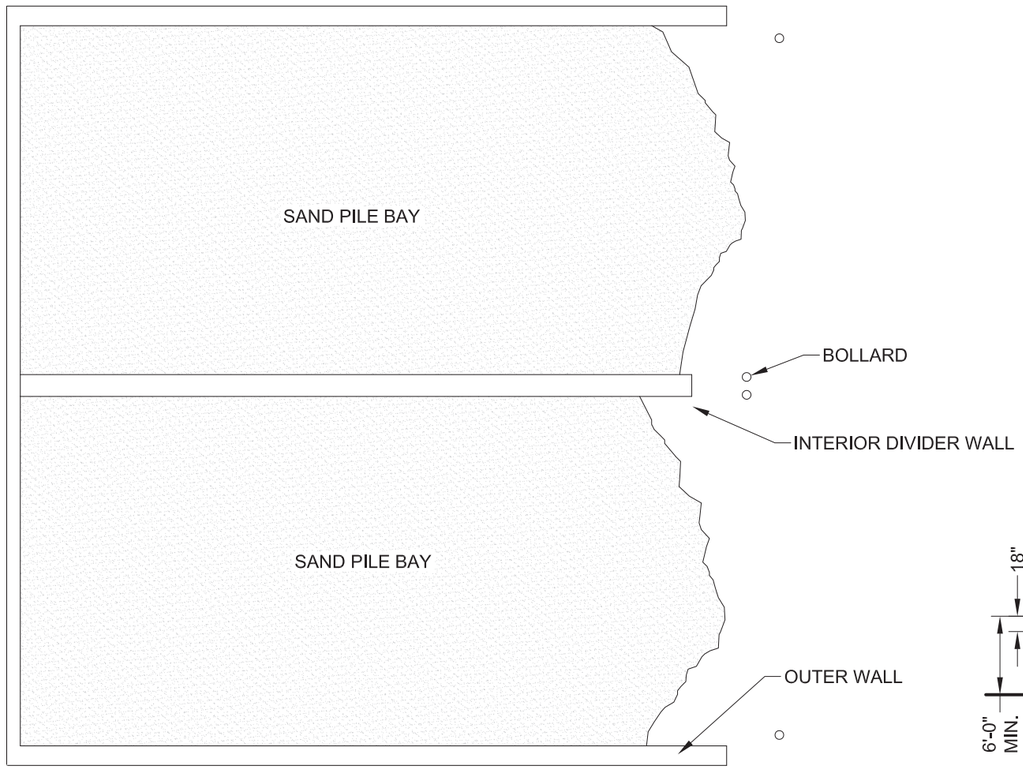


Bin Front (entry) Elevation

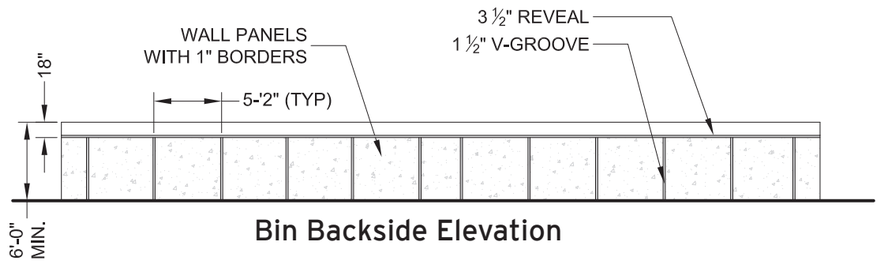
Sand Stockpile - Under Bridge

Notes:

- Under bridge locations are the preferred location for sand stockpile storage.
- The sand stockpile will be fully beneath the bridge structure to provide full coverage.
- Careful attention to community visibility and visual continuity should be paid in site selection of under bridge sand stock pile locations.
- Number of and configuration of stockpile bins varies per individual site. Where feasible and necessary, provide landscape and earthwork screening.
- Provide necessary rest room facilities, area lighting and security access control fencing.
- Texture finish, wall height and configuration aesthetics may vary as dictated by visual and budgetary appropriateness.

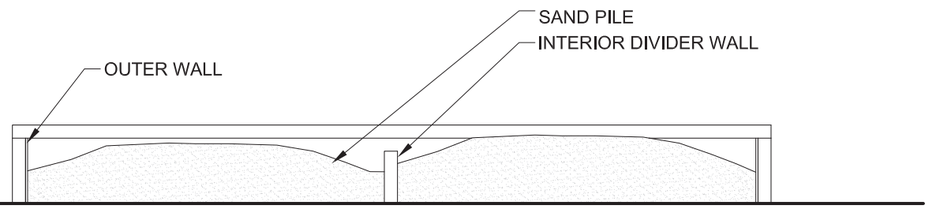


Plan



Bin Backside Elevation

Bin Side Elevation



Bin Front (entry) Elevation

04 SIGN STRUCTURES AND SIGNAGE

Visual Quality Management for Sign Structures
The aesthetic design of sign structures will typically follow the Design Guidelines to maintain consistency throughout the corridor and conformance throughout the NTTA System. In new corridors, the NTTA will not consider a different design for sign structures.

In existing corridors or converted corridors with existing sign supports, the NTTA project manager (PM) and the Design Guidelines Manager (DGM) will evaluate if adding the Design Guidelines sign supports to the corridor will substantially detract from visual consistency. If adding compliant sign supports substantially detracts from visual consistency, the DGM will develop sign supports and a sign location plan that is visually compatible with the sign supports that already exist.

For specific information regarding design, location and use of signage please reference the following documents:
NTTA Roadway Naming Policy
NTTA Sign Policy
NTTA Signs and Traffic Control Devices Guidelines
Texas Manual on Uniform Traffic Control Devices (Texas MUTCD)
The Texas Department of Transportation (TxDOT) Standard Highway Sign Designs for Texas (SHSD)
TxDOT Freeway Signing Handbook

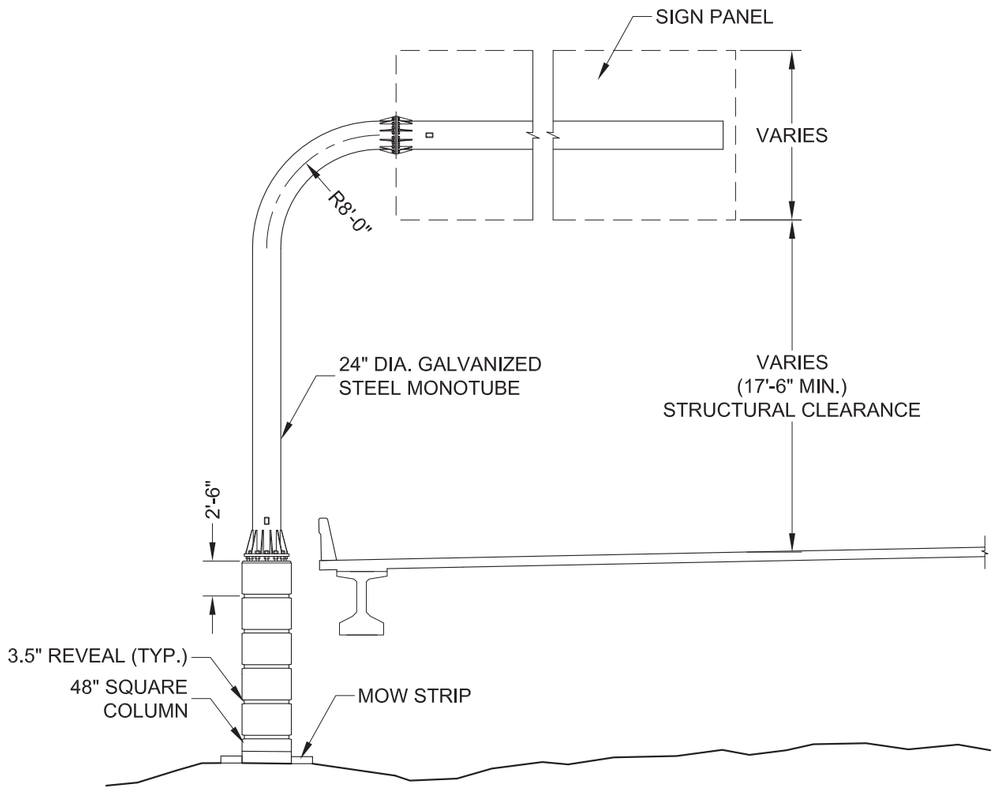
*For detailed design information reference the following NTTA Standard Drawings series:
COS, ITS, OSB, SGN

Prototype Rendering

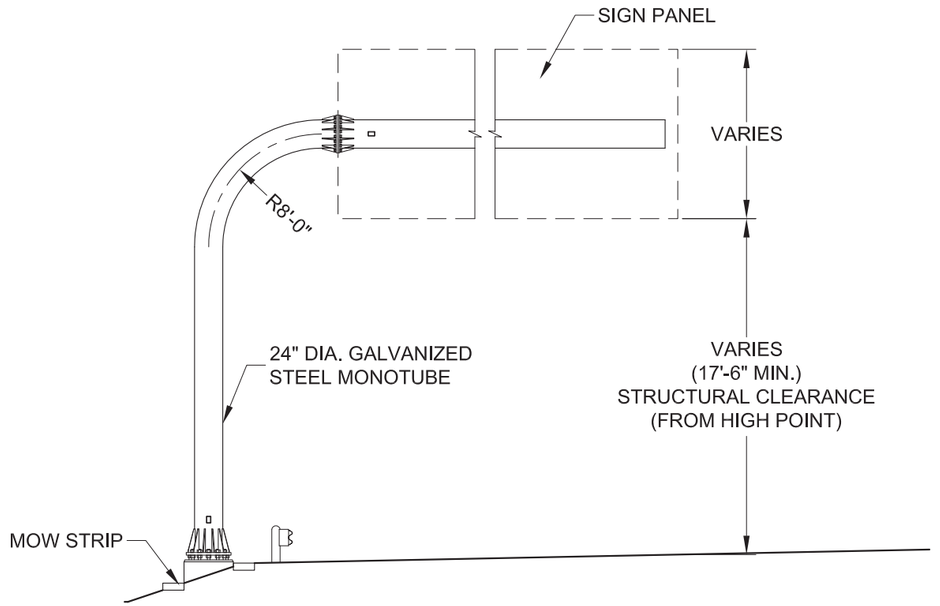
Monotube Overhead Sign Structure (Cantilever)

Notes:

- Sign height shown is for standard sign panel mounting only. Multiple signs panels shall match the tallest sign on that structure and align equally.
- Maximum cantilever is 40 feet.



Bridge Elevation



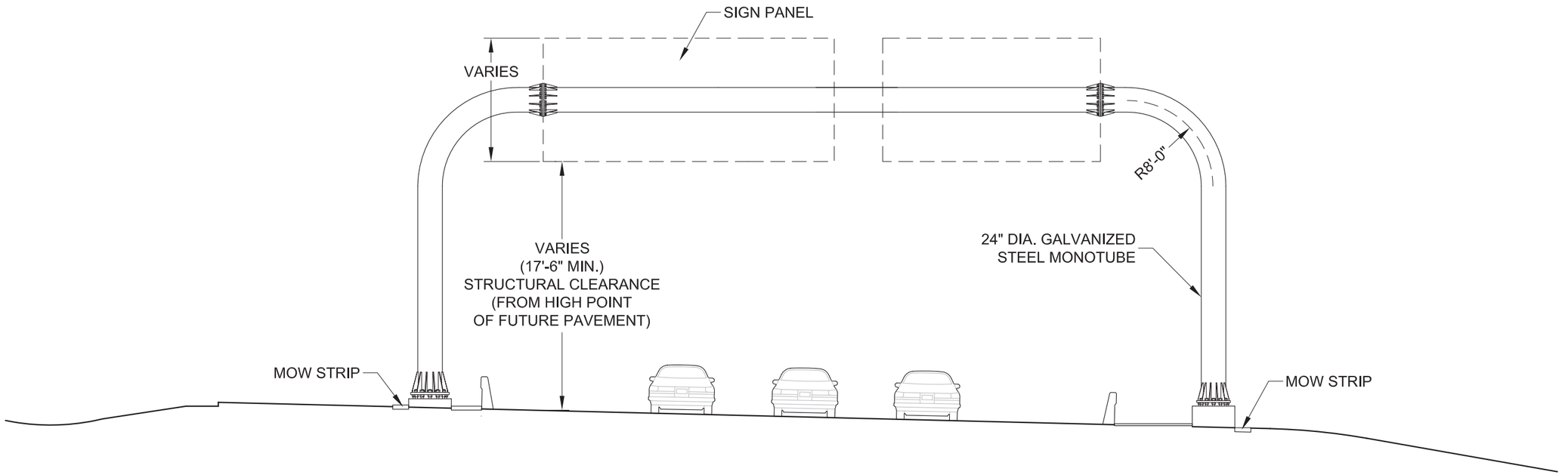
Roadway Elevation

Elevation

Monotube Overhead Sign Structure (Bridge)

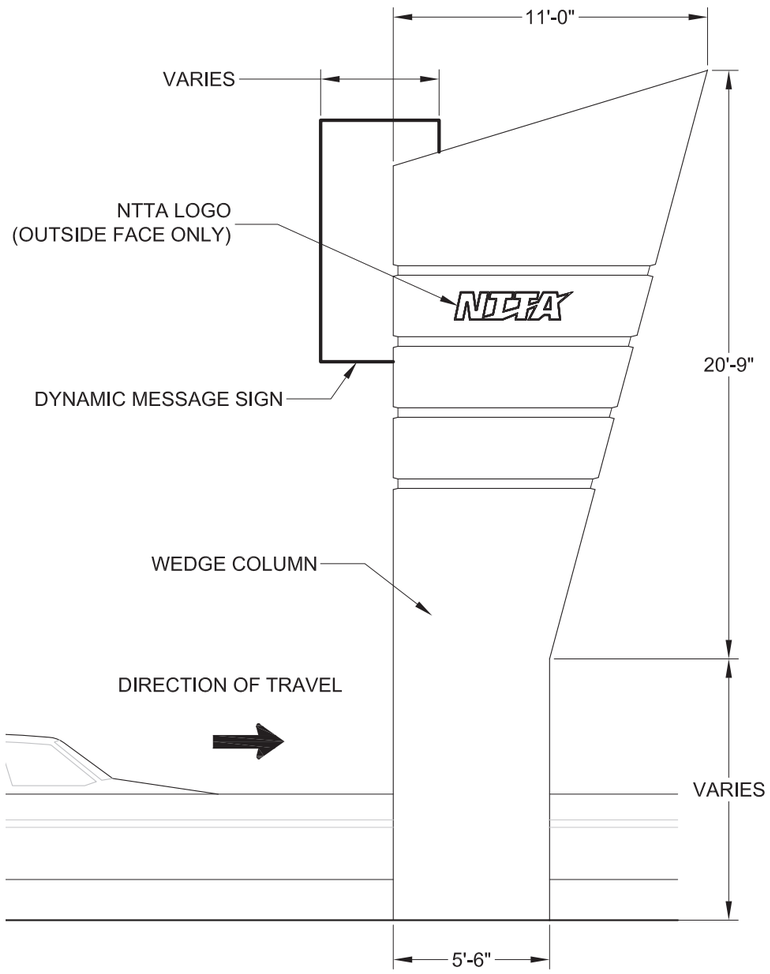
Notes:

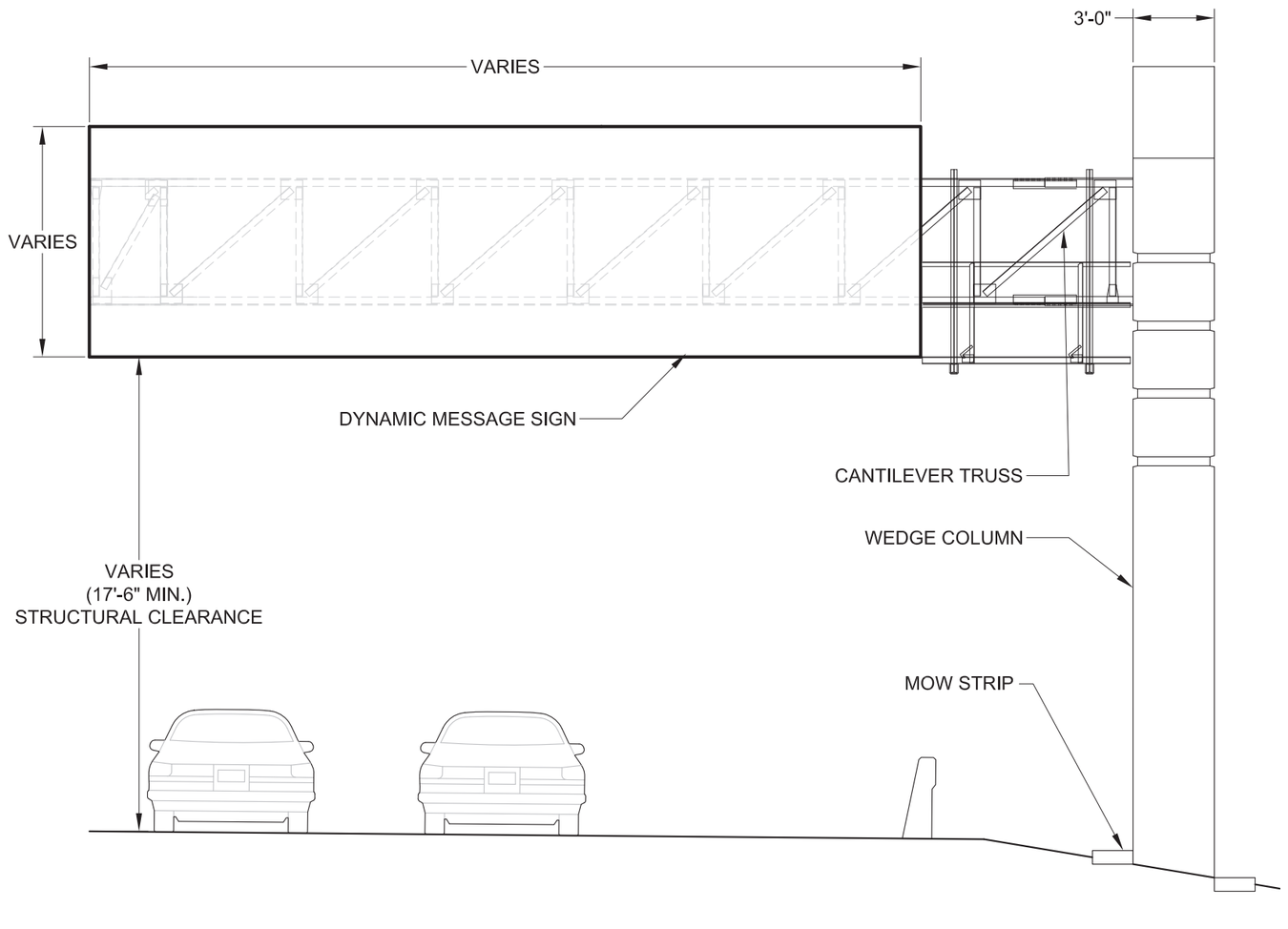
- Sign height shown is for standard sign panel mounting only. Multiple signs panels shall match the tallest sign on that structure and align equally.



Elevation

Dynamic Message Sign (DMS) Structure



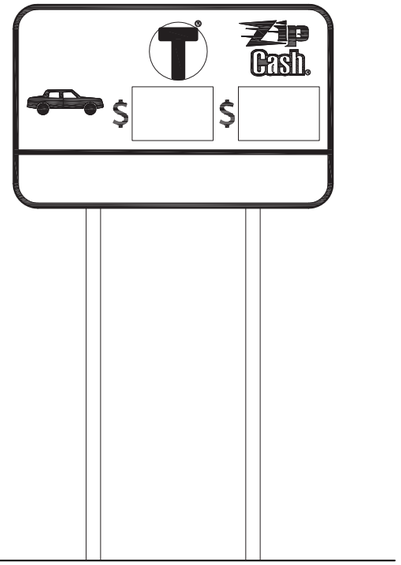


Side Elevation / Elevation

Toll Rate Signing / Dynamic Insets

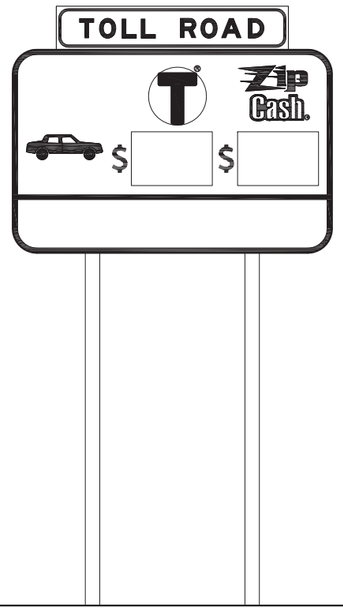
Notes:

- Cantilever monotube mounted signs are located approximately 1,000 feet in front of gantry locations.
- Ground mounted signs will be located at a minimum 300 feet from the gantry to allow for the design flexibility and effective separation from main lane exit sign structure.
- Dynamic pricing insets are LED mounted on face of sign or through extruded panel.
- Signs and signing to be designed by engineer per NTTA Sign Policy.

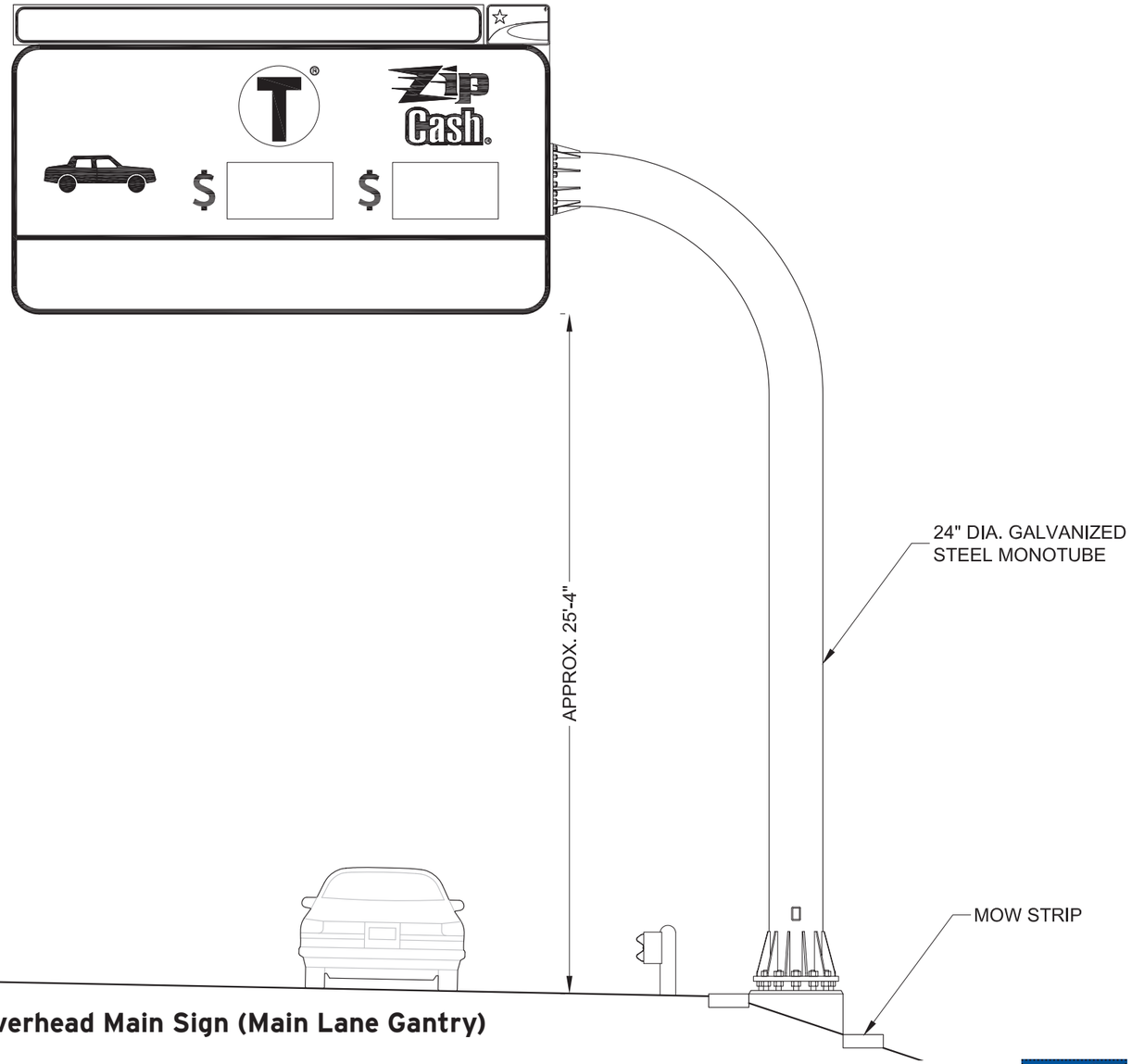


Ground Mount Sign (Exit Ramp)

Elevation



Ground Mount Sign (Entrance Ramp)



Overhead Main Sign (Main Lane Gantry)

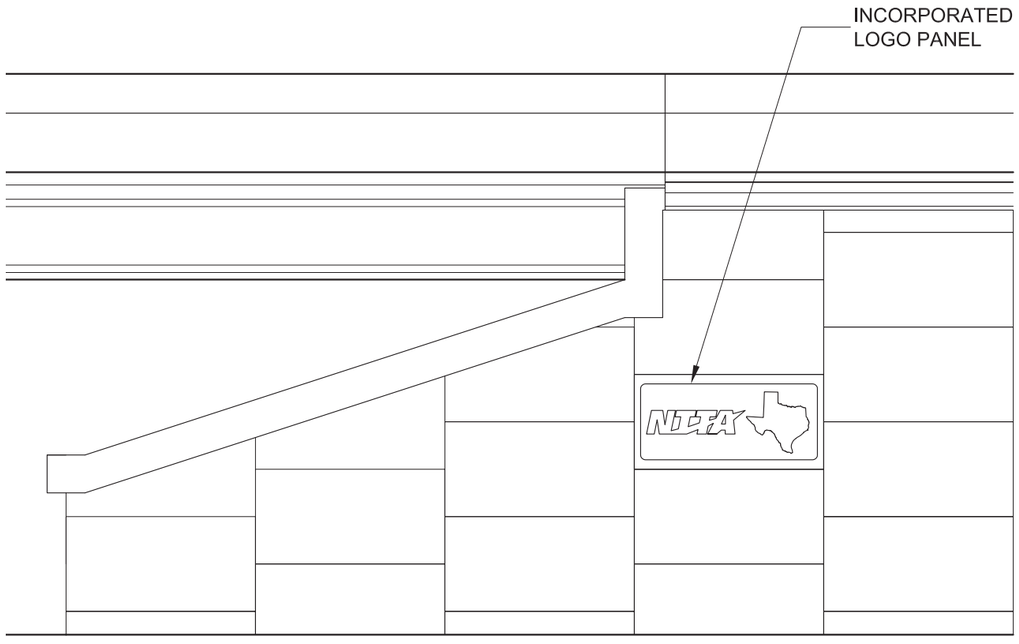
Notes:

- Trailblazer signs are adapted per individual corridor name.

- Example trailblazer signs. Refer to NTTA Roadway Naming Policy, NTTA Sign Policy, and NTTA Signs and Traffic Control Devices, for current signing standards

Notes:

- An NTTA logo sign will be installed onto existing TxDOT facilities when it becomes a NTTA facility.
- Site specific and project specific conditions may require an alternative proposed location and/or solution.



DUAL LOGO PANEL (PANEL TO BE LOCATED OVER EXISTING MAP OF TEXAS EMBLEM)

Elevation

05 LIGHTING

For further detailed design, requirements and policies, refer to the Roadway Electrical System Manual (RESM)

Visual Quality Management for Lighting
Many communities served by NTTA facilities have unique lighting fixtures as part of local streetscapes. Often these fixtures are part of the branding of a community's character. The NTTA will consider incorporating local lighting into service roads, on bridges carrying local streets over the tollway, and on local streets passing under the tollway if visual continuity for the tollway is not adversely impacted substantially.

In new corridors, achieving system-wide conformance and corridor consistency for lighting can be achieved by implementing the Design Guidelines. It may also be achieved by consistently placing the same type of lighting in the same type of locations. This may allow the community to select its own style of lighting on local roads passing over or under the tollway. The NTTA is more receptive to using lights other than those identified in the Design Guidelines if they are not visible from the tollway. However, it is possible for unique lighting to be used on the tollway in a variety of circumstances. The NTTA may consider utilizing a different style of lighting if five conditions are met:

1. The lights are either not seen from the tollway or if seen do not detract in the opinion of the Design Guidelines Manager (DGM) from the character or visual consistency of the corridor.
2. The design is developed at the expense of the local authority.
3. It is functionally adequate and compatible with other lights on the NTTA System.
4. It and replacement parts are readily obtained.
5. Costs above what the NTTA usually expends on constructing and maintaining lighting is borne under agreement by the local authority.

In existing corridors or converted corridors with existing lighting, the NTTA project manager (PM) with assistance from the DGM will evaluate if adding the Design Guidelines lighting to the corridor will substantially detract from visual consistency. If adding compliant lighting substantially detracts from visual consistency, the NTTA PM, and the DGM will develop a lighting plan visually compatible with the lighting that already exists.

Although not limited to power distribution, any utility conductors either crossing or constructed parallel to an NTTA tollway must be hidden from the view of travelers on the tollway or its service roads. Conductors for electricity or telecommunications should be placed underground or hidden from view where incorporated into overhead structures (such as conduits in sidewalks or between beams on bridges). In no case shall conduit be directly viewed by travelers, attached on the outside of a bridge or supported by poles adjacent to or on a bridge.

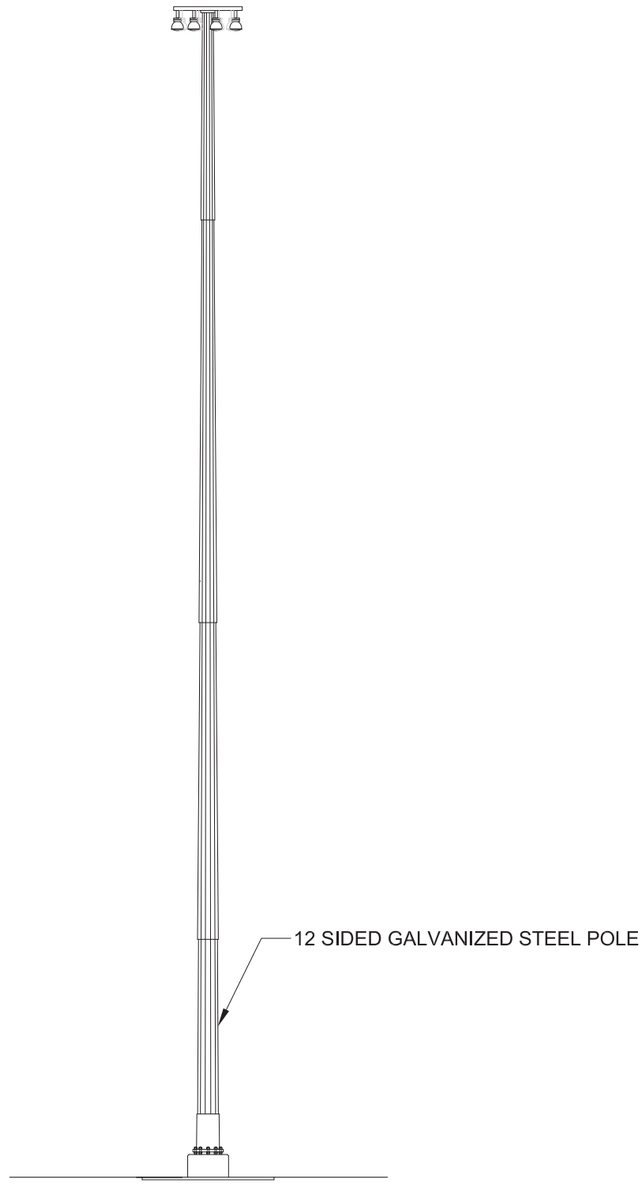
*For detailed design information reference the following NTTA Standard Drawings series:
RWD, SSB, ABG, CSI, SSR, STR, URD, RMF

Prototype Rendering

High Mast Lighting

Notes:

- High mast illumination poles located primarily in interchange conditions. (other corridor lighting conditions may apply)
- Coordinate with adjacent communities for ordinance compliance.
- Pole heights are 125 foot, 150 foot or 175 foot height.
- Refer to TxDOT HMIP standards
- If applicable, pole height and detection to comply with FAA regulations.

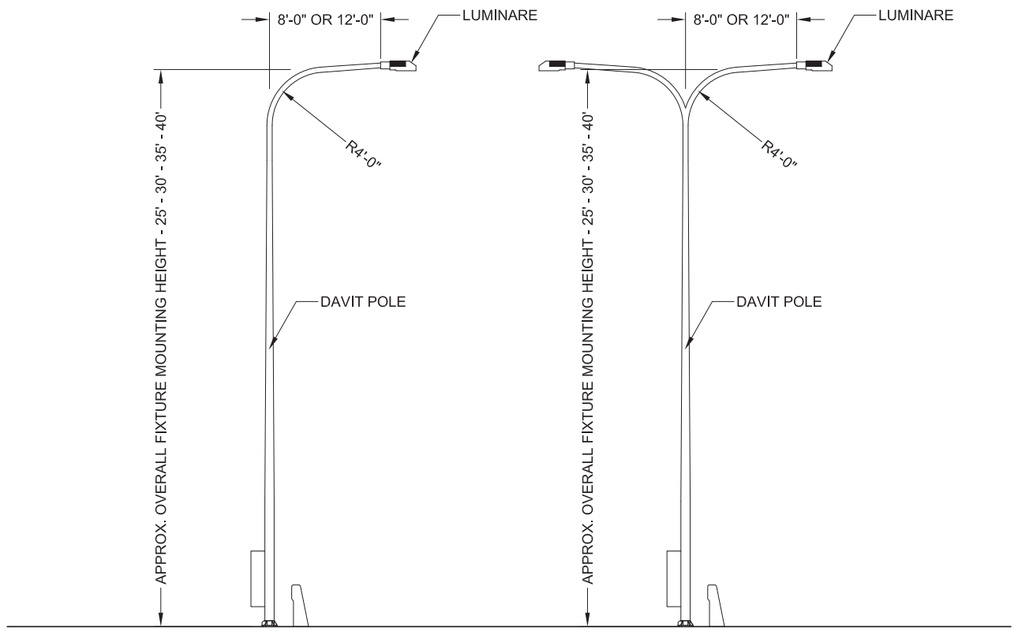


Elevation

Roadway Lighting

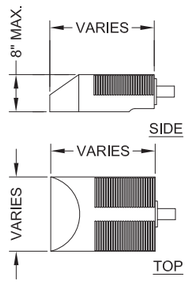
Notes:

- Roadway lighting to be provided on outside edge of main lane only.
- Center median mounted roadway lighting is prohibited.
- House-side shield hardware to be installed on fixture where applicable.
- Locate roadway or ramp lighting fixture directly over the centerline of the available shoulder.



Elevation

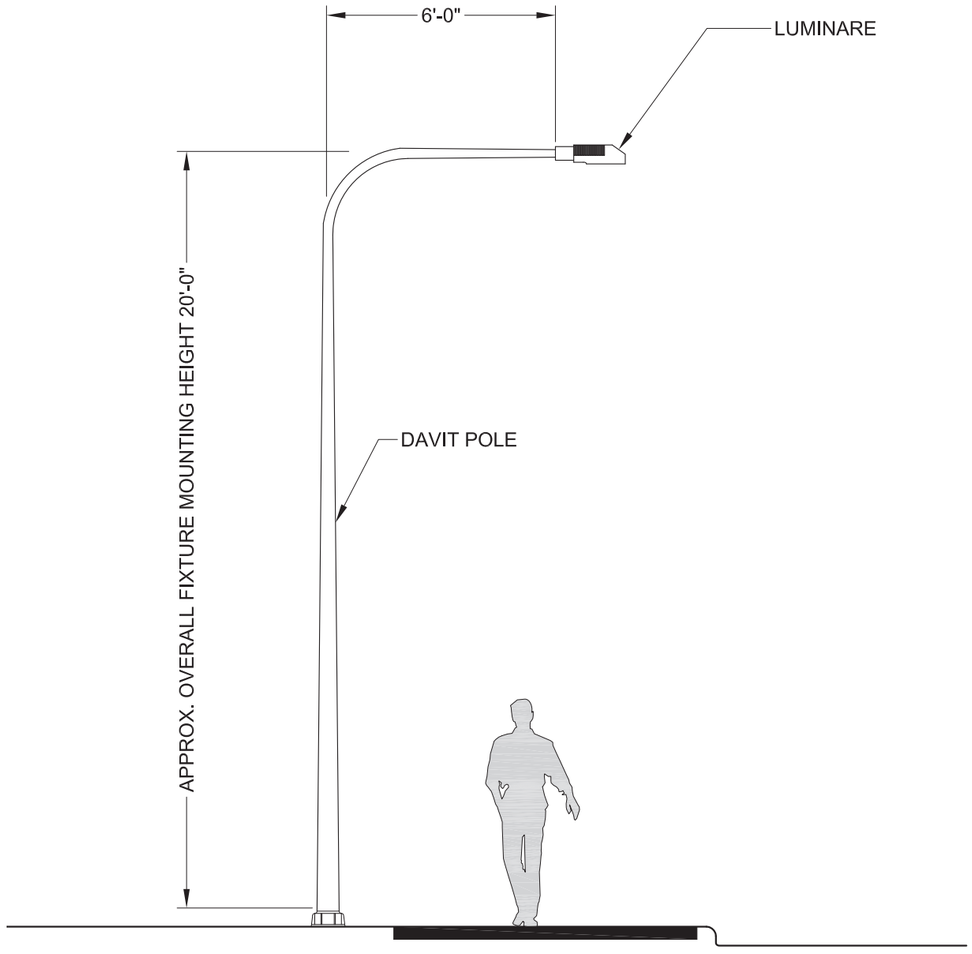
LUMINAIRE
TYPE: LOW PROFILE (NO GREATER THAN 8")
FIXTURE: FLAT LENS WITH FULL CUTOFF,
FINISH: PLATINUM SILVER COLOR
250 OR 400 W. HPS. 480 V.



Pedestrian Lighting - Pole Mounted

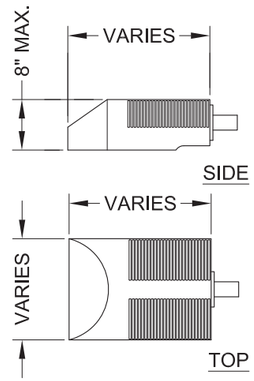
Notes:

- House-side shield hardware to be installed on fixture where applicable.



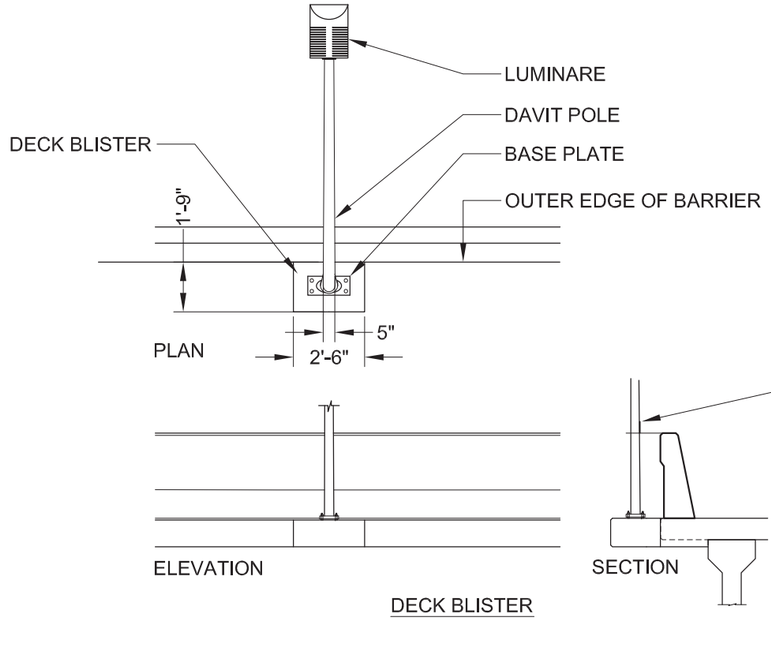
Elevation

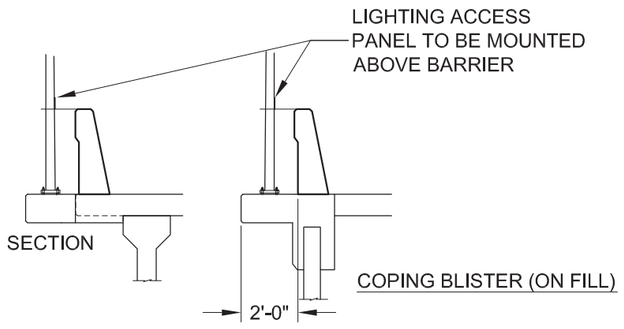
LUMINAIRE
TYPE: LOW PROFILE (NO GREATER THAN 8")
FIXTURE: FLAT LENS WITH FULL CUTOFF,
FINISH: PLATINUM SILVER COLOR
250 W. HPS 480 V.

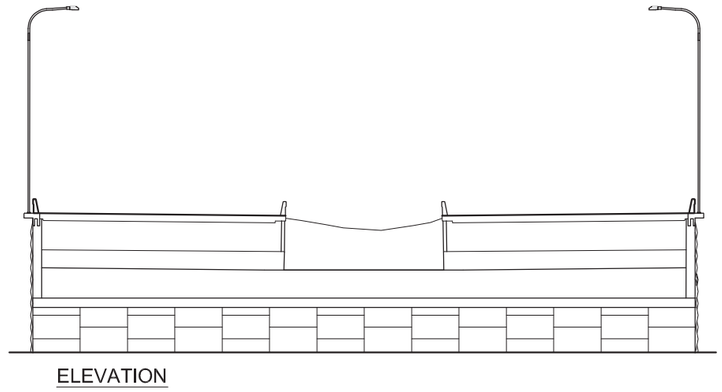


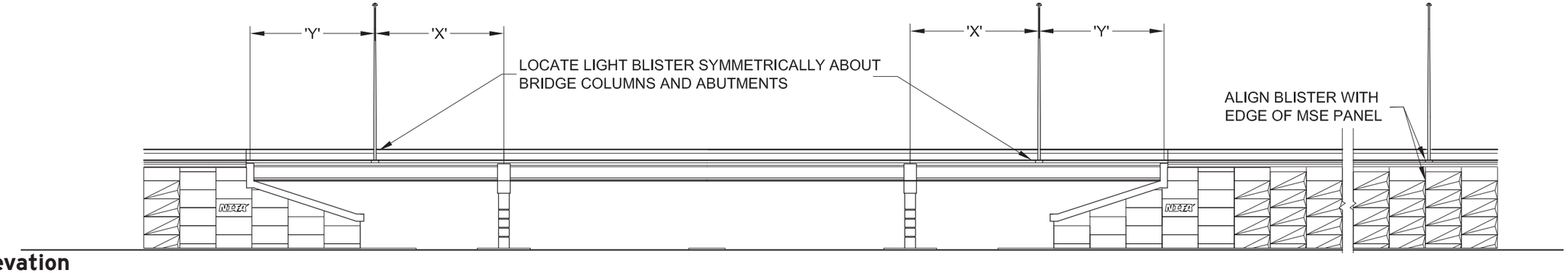
Notes:

- Roadway lighting to be provided on outside edge of main lane only.
- Center median mounted roadway lighting is prohibited.
- House side shield hardware to be installed on fixture where applicable.
- Lighting layout to be coordinated to maximize layout potential for mid span location as shown.







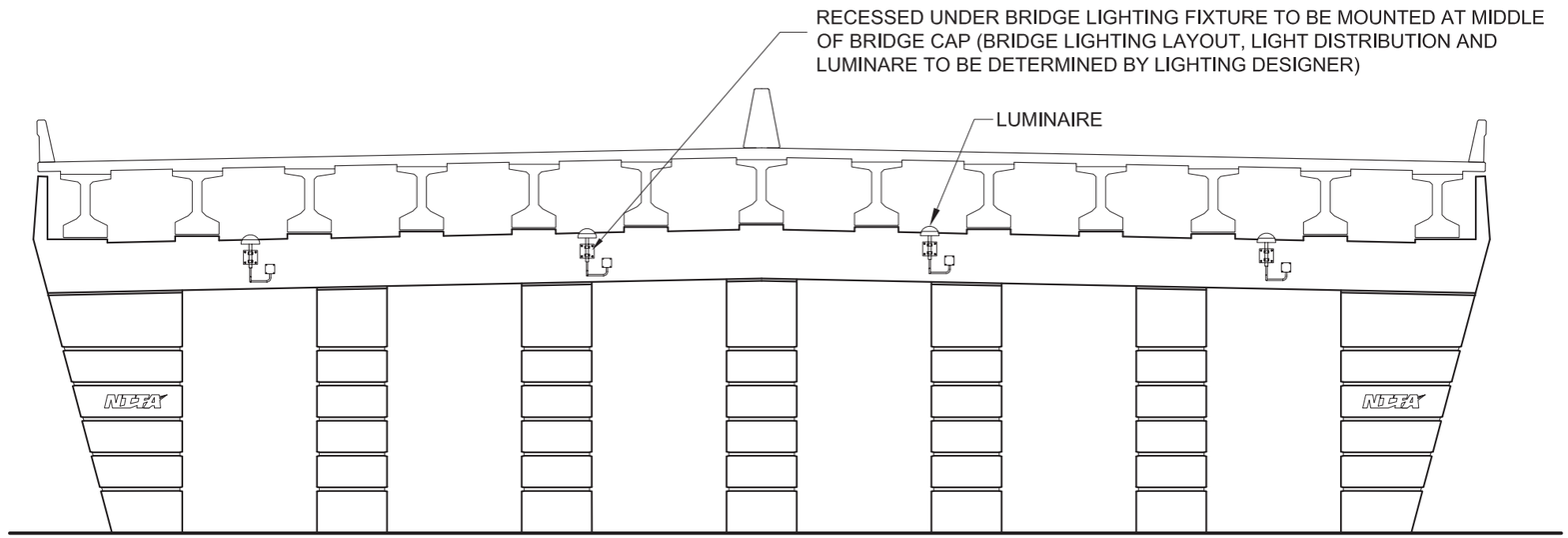


Elevation

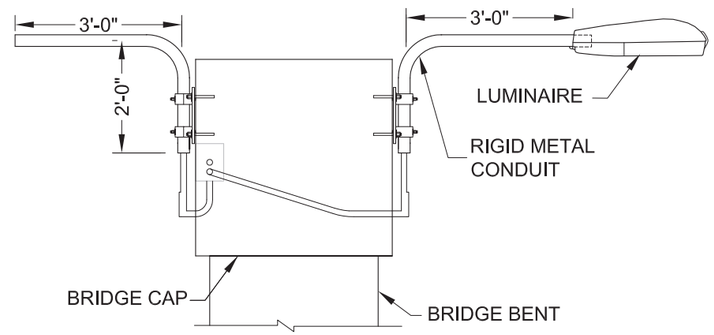
Under Bridge Lighting

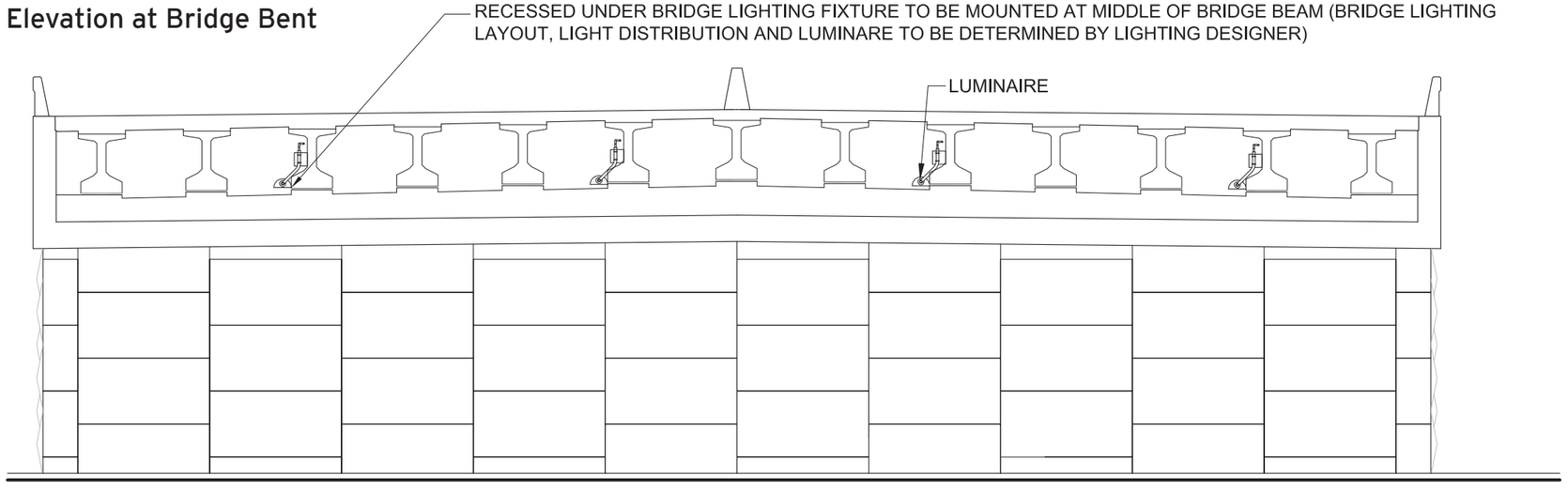
Notes:

- Bridge bent mounting is the preferred attachment location. Bridge abutment mounting should only be used when span lengths are too great to allow for adequate illumination if located over traffic lanes.

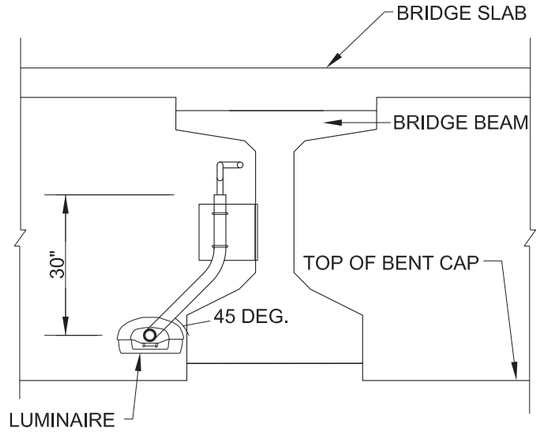


Elevation at Bridge Bent





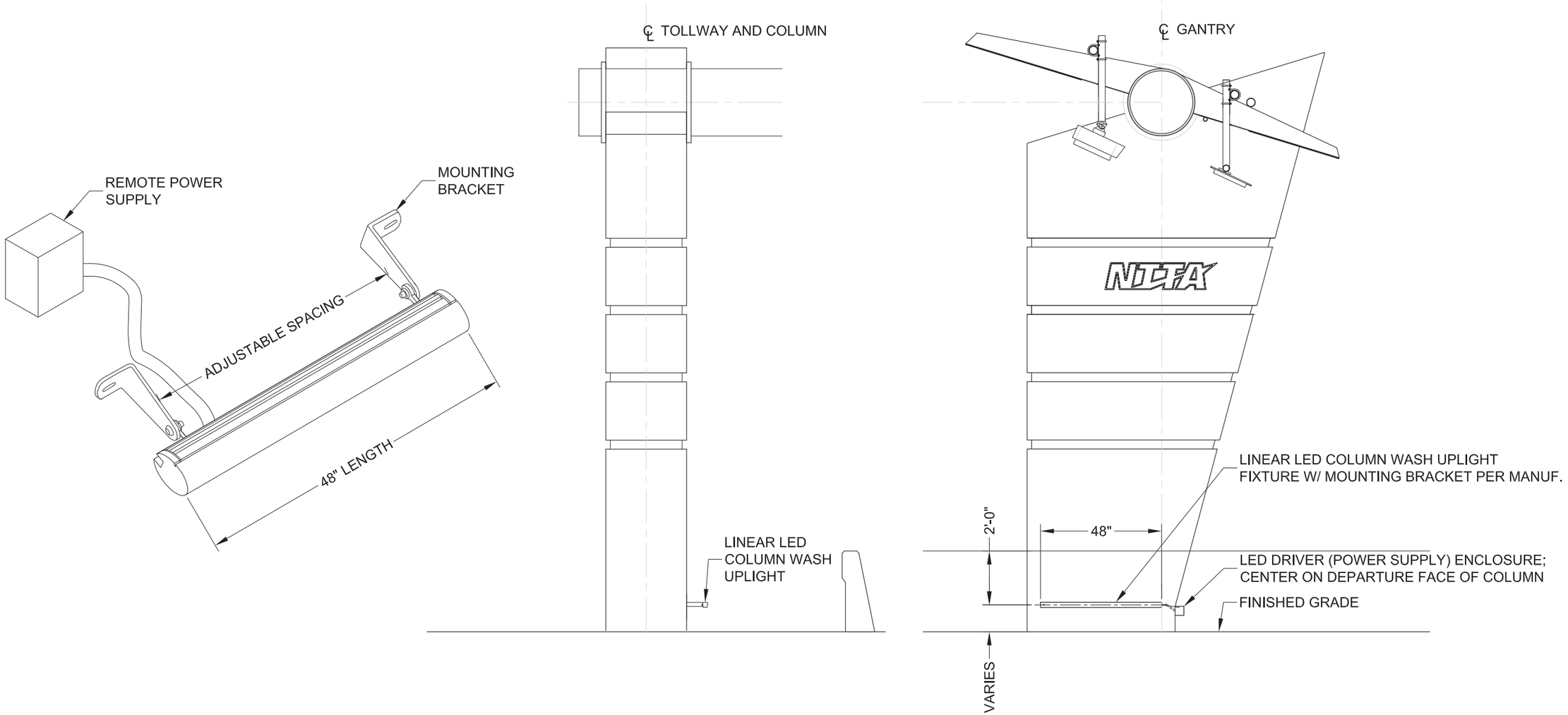
Elevation at Bridge Abutment



Column Wash Uplight

Notes:

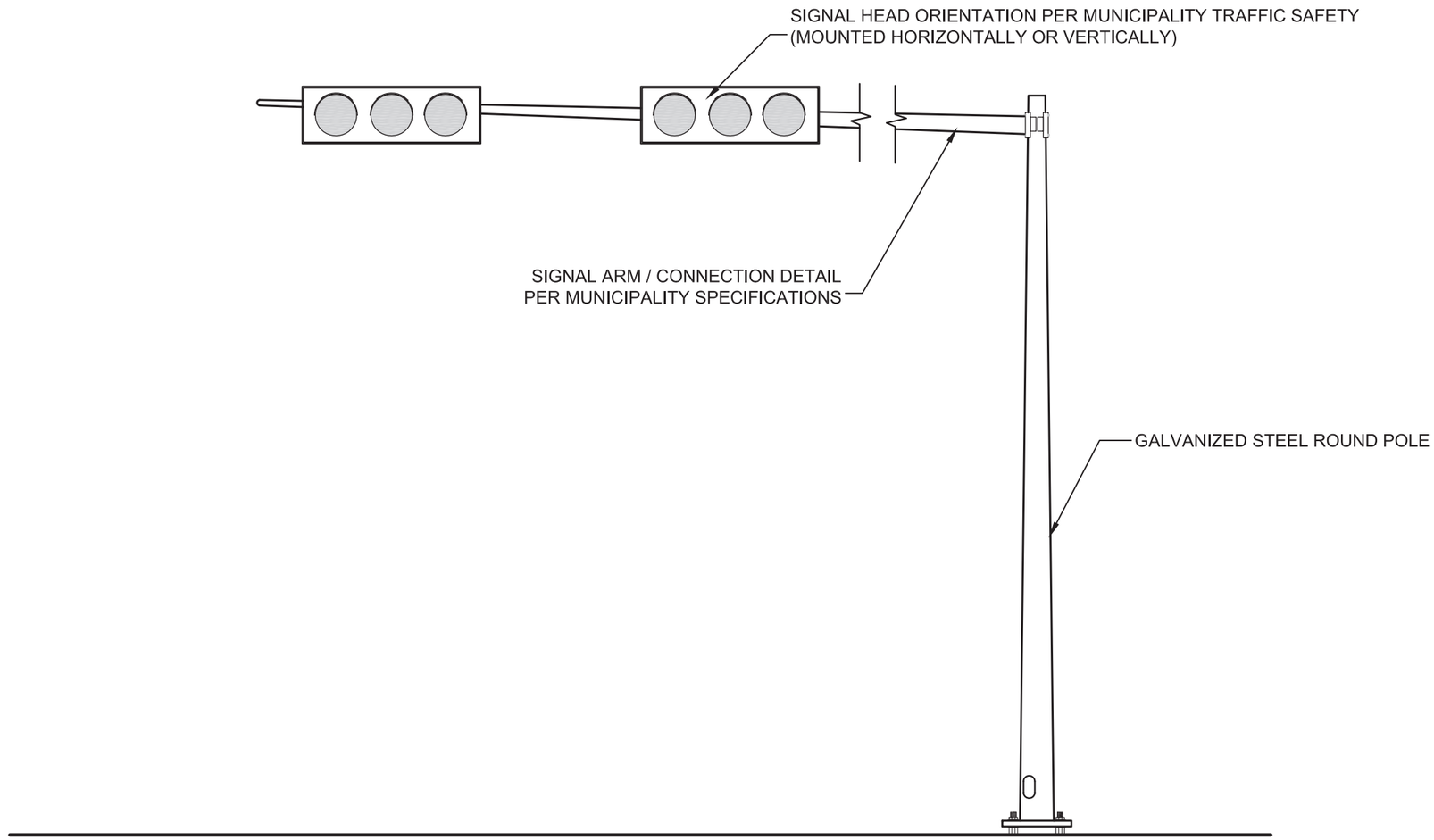
- LED column wash, accent light intended for decorative accent light to gantry column.
- Mounting height varies on site conditions and gantry column base height.
- Coordinate with adjacent municipality on adherence to dark sky policy.
- 48 inch linear LED column wash uplight applied to both main lane and ramp gantry columns.



Elevation

Notes:

- NTTA standard traffic pole for overpass intersection to be standard galvanized pole unless an approved alternate pole assembly is required by the adjacent municipality.



Elevation

06 PUBLIC ART

Public Art and Public Art Opportunity

Texas has a tradition of innovative public art. The NTTA corridors can provide potential opportunities for cities, foundations, organizations and private donors to commission and install public art. Public Art presents an exciting opportunity to connect people to the tollway, its natural and built environments, and the adjoining neighborhoods.

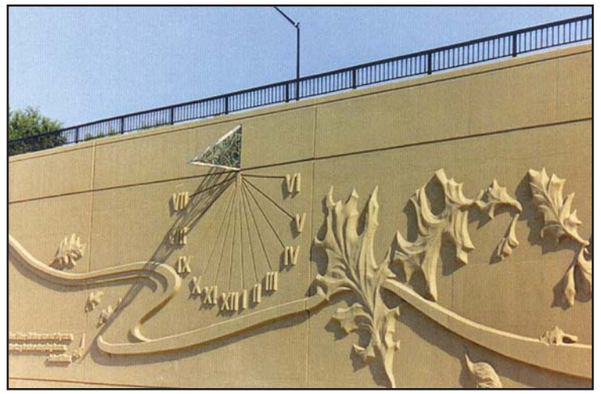
The NTTA's position and process for implementing public art will be developed on an individual project basis. The responsibility for funding and/or maintenance of public art will be done by public or private agencies or governmental authorities other than the NTTA. The NTTA will retain the right of refusal for all proposed art work. Implementation will require combined efforts from the NTTA, municipalities, civic and private institutions, TxDOT, their consultants, contractors, and artists to develop a comprehensive agreement on funding, construction and maintenance. Many public art projects can be implemented following corridor project construction. Other projects will require that the artist work with the design and engineering team early in the final design plans, specifications, and estimates (PS&E) process, as the projects must be accomplished simultaneously with roadway construction.

A key goal for developing public art in the NTTA is to provide a strong, conceptual framework for aesthetic and perceptual experiences and to create physical and emotional links to the corridor's physical infrastructure, natural processes, unique places, and community connections. Public art should consider the corridor's place within the framework of the region, its multiplicity, and within its land-use and natural characteristics. At the same time, the project should be humanized, calling for more intimate experiences that express ideas about aesthetics, nature, and infrastructure.

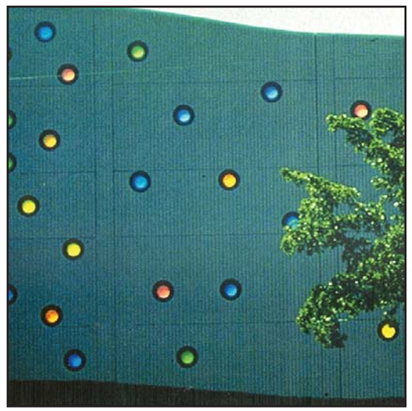
Public Art Projects considers artworks within three contexts
1) The corridor's place within the regional system.
2) The corridor's driving experience.
3) The corridor's more intimate gateways, neighborhoods, and process connections.

Considerations for art enhancements include opportunities for elements such as:

- Fencing
- Railings and Barriers
- Paving Insets
- Tile Wall Murals
- Cast in Plane Reliefs
- Lighting of Bridges
- Landscape/ Earthwork
- Drainage/ water Filtration and Conveyance
- Pedestrian Interfaces (trail heads, underpasses, bridges)
- Neighborhood Interfaces (sound walls, gateways, arterial crossings, retaining walls, community parks)







** images are only for representational purposes of public art by other agencies or municipalities, none of which are proposed or approved for use by NTTA.*

07 SURFACE FINISH TREATMENTS

Visual Quality Management for Surface Finish Treatments

In the past, the use of color was limited on the NTTA System. As part of continued sustainable development, the NTTA has elected to eliminate the use of an applied general painted background or accent color. Paint coating applied to the surface of elements within the corridor will not be accepted. Eliminating paint color eliminates the possibility of paint substances and particles in the environment as removal or deterioration occurs. It reduces the safety hazards of lane closures for maintenance purposes; and it optimizes construction cost and continued maintenance requirements, thereby, providing a sustainable solution.

Therefore, natural grey concrete will be used in all NTTA corridors.*

Natural grey concrete is preferred for all concrete elements within all NTTA corridors. In new corridors, natural grey concrete will be the standard background visual. Approved surface finishes, as outlined in this chapter, provide alternatives to design. In existing or converted corridors with an existing background color, the NTTA designer will evaluate if immediate removal of color is preferred or if waiting until removing color as part of a regular maintenance cycle is sufficient for establishing visual consistency. In no instance will adding paint color to newly placed concrete be allowed.

The use of a painted accent color will be replaced with sustainable alternatives including natural surface finish for all materials. No accent paint color will be applied on new construction and it will be removed during regular maintenance cycles on existing construction. Only bridge beams and other steel elements limited to these circumstances will be coated in a manner that will mimic the color of naturally weathering steel. On corridors with new steel girders, weathering steel will be used on bridge beams. For weathering steel designs, drip bars, drip pans, anti-graffiti coatings and additional measures, if necessary, will be employed on bridge stuctures to minimize rust stains from the beams on to other stuctures.

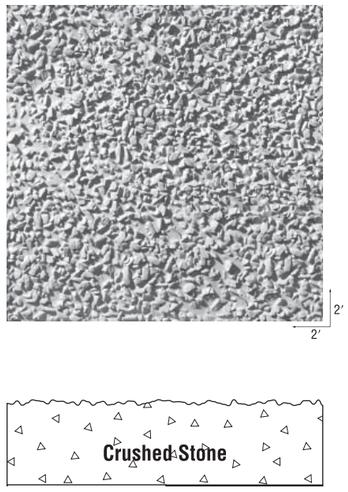
Careful consideration will be required and coordinated with the VQAM for texture, reveals and visibility for cast-in-place (CIP) wall and or other conditions. Every effort should be made to integrate a seamless visual design between pre-cast elements to adjoining and adjacent CIP elements through the use of textures, patterns and reveals.

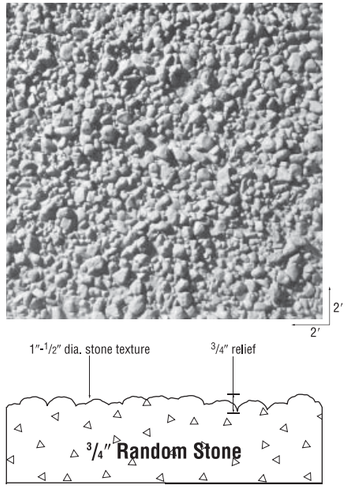
*For detailed design information reference the special specification ITEM 850.1 "Natural Grey or Integral Color Concrete":

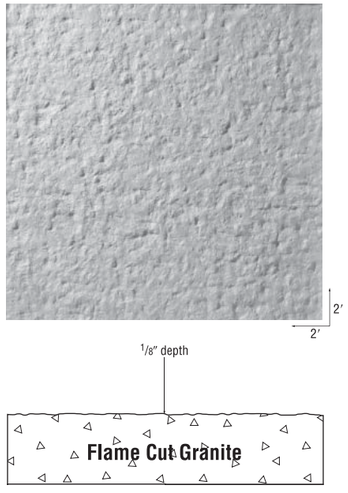
Wall Textures

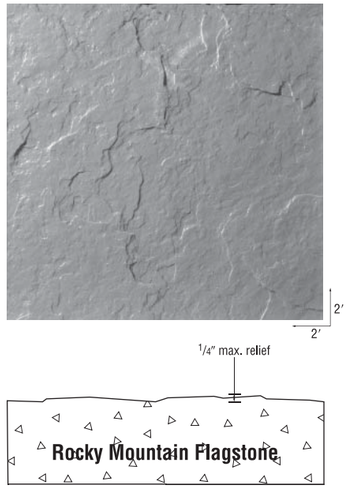
Notes:

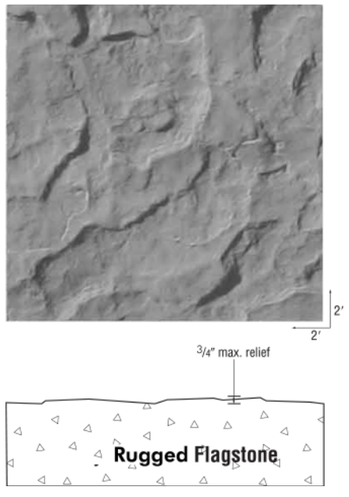
- Details concerning approved form liner products and patterns are on file with Project Delivery. Contact the Visual Quality Assurance Manager for assistance.

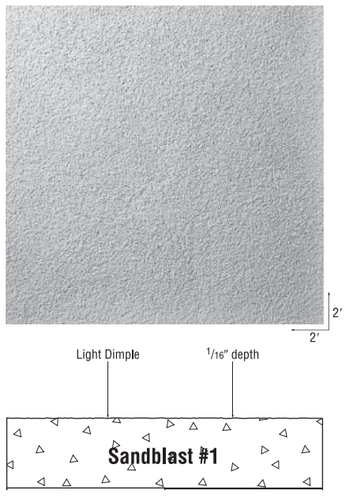


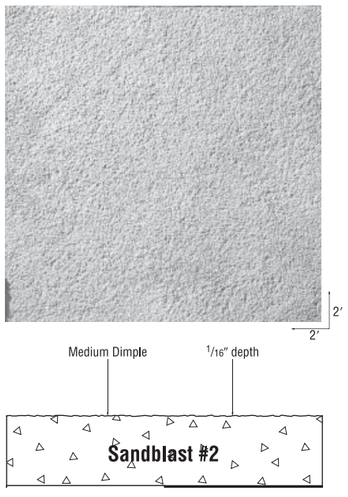












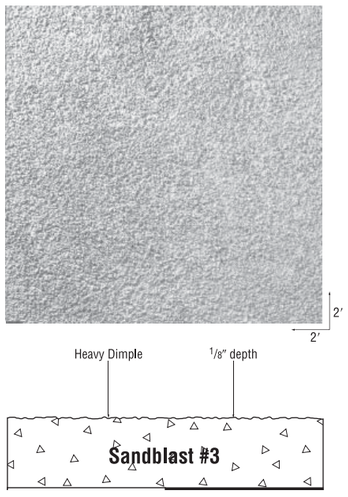
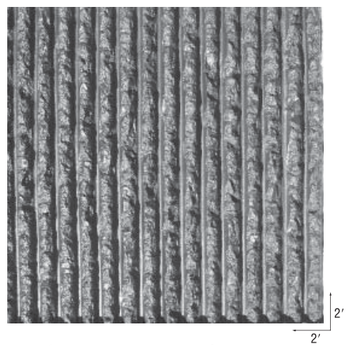
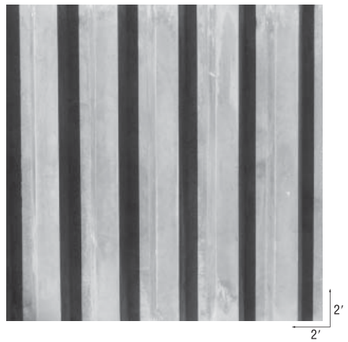


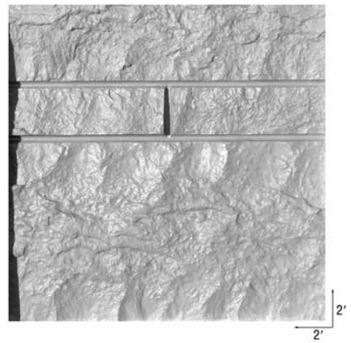
Photo Credit: Scott System Inc.

Noise Wall Textures





Standard Finishes - Roadway Side



Standard Finishes at Corridor ROW Line and adjacent properties

Photo Credit: Scott System Inc.

Prism Panel Finish Alternatives

Notes:

- The following texture combinations represent various texture combinations for application to the prism panel faces. Alternative texture combinations can be developed on a project by project basis.
- The selected texture combination for the prism panel shall be applied uniformly within a planned corridor or planned project segment of an existing corridor.
- Do not mix panel texture combination types within contiguous walls.

	PRISM PANEL
Top Half of Panel	Rugged Flagstone
Top Half of Prism	Finished Smooth
Bottom Half of Prism	Rugged Flagstone
Short Side of Prism	Smooth Finished

PANEL TYPE A0	PRISM PANEL
Top Half of Panel	Smooth Finished
Top Half of Prism	Smooth Finished
Bottom Half of Prism	Crushed Stone
Short Side of Prism	Smooth Finished

	PRISM PANEL
Top Half of Panel	Flame Cut Granite
Top Half of Prism	Smooth Finished
Bottom Half of Prism	Rocky Mountain Flagstone
Short Side of Prism	Smooth Finished

	PRISM PANEL
Top Half of Panel	Smooth Finished
Top Half of Prism	Smooth Finished
Bottom Half of Prism	Random Stone
Short Side of Prism	Smooth Finished

Prism Panel Finish Alternatives

Notes:

- The following texture combinations represent various texture combinations for application to the prism panel faces. Alternative texture combinations can be developed on a project by project basis.
- The selected texture combination for the prism panel shall be applied uniformly within a planned corridor or planned project segment of an existing corridor.
- Do not mix panel texture combination types within contiguous walls.

	PRISM PANEL
Top Half of Panel	Heavy Sandblast
Top Half of Prism	Medium Sandblast
Bottom Half of Prism	Crushed Stone
Short Side of Prism	Medium Sandblast

	PRISM PANEL
Top Half of Panel	Flame Cut Granite
Top Half of Prism	Smooth Finished
Bottom Half of Prism	Flame Cut Granite
Short Side of Prism	Smooth Finished

	PRISM PANEL
Top Half of Panel	Heavy Sandblast
Top Half of Prism	Medium Sandblast
Bottom Half of Prism	Crushed Stone
Short Side of Prism	Medium Sandblast

Flat Panel Finish Alternatives

Notes:

- The following texture combinations represent various texture combinations for application to the flat panel.
- The selected flat texture panel shall be applied uniformly within a planned corridor or planned project segment of an existing corridor. Do not mix panel texture combination types within contiguous walls.

FLAT PANEL	
Flat	Heavy Sandblast

FLAT PANEL	
Flat	Rugged Flagstone

FLAT PANEL	
Flat	Flame Cut Granite

08 LANDSCAPE

The following guidelines shall be used when preparing landscape plans in association with the design of new corridors and renovations to existing corridor facilities.

Visual Quality Management for Landscape
Vegetation is used to accent the location of gantries, bridges, interchanges and other focus areas along NTTA corridors. Plants will increasingly introduce color into NTTA corridors as other materials are no longer coated with a paint or colored coating. The plant material NTTA uses have been selected for hardiness to North Texas climatic extremes. Irrigation is used extensively but water is conserved through sophisticated controls and by selecting plants for their drought resistance. Both native and adapted species are being used effectively. NTTA would prefer to continue to use these proven plants, planted in similar locations and conditions throughout its system. NTTA recognizes that local communities may, however, have plant palettes different from its own that also may be viable in North Texas.

On new corridors, existing corridors, and converted corridors, input on landscape treatments from local communities will be considered by the NTTA based on the following criteria:

1. The plant palette and planting concepts are compatible with the overall corridor landscape and irrigation plans and applicable NTTA Design Guidelines.
2. The selected plants meet NTTA performance requirements for plant material.
3. The plants are readily obtained and easily installed.
4. Any additional costs above what the NTTA usually expends related to the design, construction, and maintenance of the locally proposed landscape treatment(s), including water costs, will be funded by the local authority proposing the work.
5. Decisions involving local participation will be considered on a case by case basis. Funding or maintenance responsibilities will be set forth in an Interlocal Agreement (ILA).

*For detailed design information reference the following NTTA standard drawings series:
LSP, MBD, MSD

The NTTA policy to implement a landscape program that is well designed and sustainable includes the following components:

Design Use of landscape elements to accentuate the concepts of "motion and movement"

Sustainability Use of native and adapted plant palette to North Central Texas with required soil preparation and irrigation system to ensure initial establishment of plant material.

Implementation Develop prototypical landscape plans for the focus areas listed below that should be used on all NTTA System corridors. The focus area types are: *Interchanges, Overpasses, Underpasses and Gantry Areas.*

Intent
It is the intent of the NTTA to provide a pleasant customer experience throughout the system. Well designed landscapes are an integral foreground element that enhances the driving experience. Thriving plant material can soften hard lines, emphasize significant architectural elements, screen undesirable views, provide erosion control, create an even safer facility by buffering headlight glare, better define driving lanes and serve as an art form in itself. The NTTA landscape should result in cohesive design solutions that serve to unify and provide a sense of identity for the NTTA System.

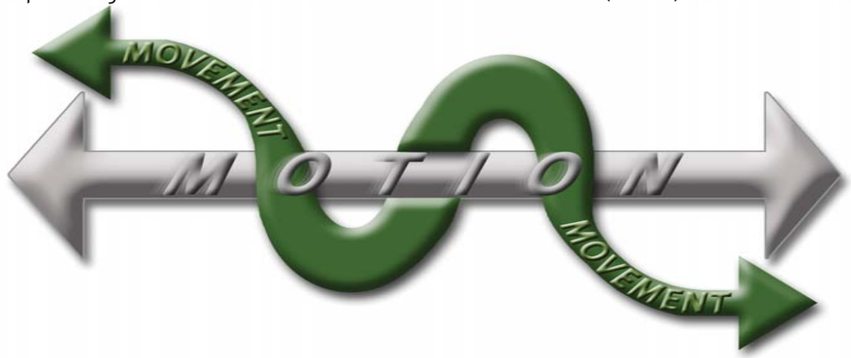
Concept: 'Motion and Movement'
Transportation systems are built to move people and goods from one place to another. The landscape design developed for the NTTA System uses landscape materials and elements to reinforce that same sense of motion and movement. The designer should develop a design that arranges the chosen plant materials to emphasize travel direction, speed and motion. The specific plant palette used in any given area should reflect the vernacular of that area and connect the toll facility with the surrounding community.

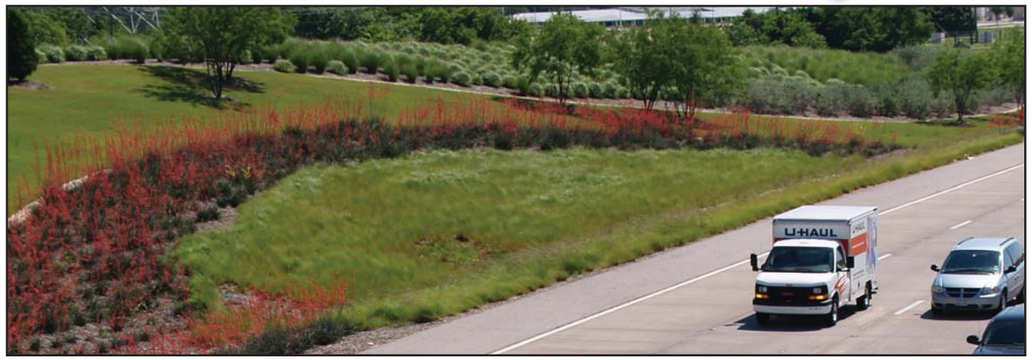
Safety
Roadside landscapes must be designed with safety of the public and maintenance workers as the top priority. Plant selection and location must maintain sight distances and clear zone recovery areas.

Clear zones provide areas for drivers of errant vehicles to regain control after running off the roadway. The clear zone determination, at particular locations, defines the minimum clearance between the edge of the outermost travel lane and unyielding objects such as trees. Clear zone setbacks are based on traffic volumes, speeds and roadside geometry and require judgement by the designer when applying them. Technical resources such as AASHTO (*American Association of State Highway and Transportation Officials*) Roadside Design Guide and the TxDOT (*Texas Department of Transportation*) Roadway Design Manual should be consulted. Thirty feet is generally considered a minimum clear zone setback along high volume, high speed roadways with recoverable slopes (4:1 or less away from road). Trees may be planted in the clear zone setback only where they will not constitute a fixed object; for example, above a retaining wall or in areas protected behind guard fence or concrete barriers.

A safety setback, must also be applied when placing landscape elements, to maintain, horizontal and vertical sight distance necessitated in the design speed of the facility. Sight distance setbacks restrict the height of plants or the horizontal distance of plants from the roadway. Particular areas of concern include ramp connections, inside of curves at interchange loops, frontage road intersections and at driveway locations.

Landscape should not be placed where maintenance is hindered or proves detrimental to adjacent roadway elements such as plant foliage in guardrail. Coordination is also necessary to ensure planting does not obstruct closed circuit television (CCTV) camera view shed.





President George Bush Turnpike

Landscape Design Process – Step 1: Determine Potential Focus Areas

Providing intensive landscape plantings along the entire length of an NTTA corridor is cost prohibitive. For impact, landscape improvements will be concentrated at select focus areas along toll facility and areas that serve as important interfaces with the surrounding communities.

Potential focus areas include location at:

- Interchanges
- Underpasses
- Overpasses
- Gantry Areas

For many corridors, it may not be wise to provide landscape plantings at every potential focus area because of physical constraints or budgetary limitations. The process of examining the potential focus areas and selecting priority focus areas to target landscape plantings is examined in the steps that follow.

Interchange

Dallas North Tollway and President George Bush Turnpike Interchange

Underpass

President George Bush Turnpike at Waterview Parkway / Independence Parkway Underpass

Overpass

President George Bush Turnpike at Coit Road Overpass

Gantry Area

Sam Rayburn Tollway Main Lane Toll Gantry

After potential focus areas are identified, a comprehensive site analysis should be conducted to provide a basis for selecting priority focus areas and informing the design development work. Key components of this initial analysis work are described as follows:

View Shed Analysis

The visibility of potential planting sites varies considerably. Experience has shown that the goals of the Design Guidelines is best fulfilled where landscape plantings are placed in locations that are highly visible to the NTTA customers from the main lanes of the facility. This is referred to as a "view from the roadway". Key factors that typically influence visibility include the following:

Sections in Cut

Portions of focus areas located in cut sections typically have slope faces that are highly visible from main lanes.

Where retaining walls are used in cut sections, the height of the wall and the resulting slope above the wall should be considered in evaluating visibility. Available planting locations in front of walls next to main lanes should also be given high priority.

Sections in Embankment (Fill)

Portions of focus areas located in embankment sections typically have slope faces that recede away from main lanes and are generally less visible than cut sections.

As side slopes become steeper in embankment sections, less of the planting can be seen from the main lanes. The use of taller planting can help with visibility of landscape.

Planting sites located at the bottom of retaining walls in embankment sections tend to have very limited visibility from the main lanes, but are more visible from the frontage road and/or the "view to the roadway" vantage point. These locations are considered lower priority planting locations, particularly if other, more visible locations are available.

Planting sites in embankment areas located on the inside of horizontal curves have improved visibility from those on the outside, particularly as one approaches the location.

Medians

Corridors with center median areas will, typically, have barrier protection along one side of the median. The presence and type of median barriers influence visibility of planting sites. Median planting locations have high visibility from main lanes when not obscured by barriers. Main lane visibility from the barrier side is limited to distant views when approaching the planting site and where plants are tall enough to be seen over the barrier. Consideration should also be given to plant material selection and layout/placement in the medians with the potential widening of the facility.

The view shed analysis should take into account these determinants and document planting sites that exhibit high visibility, moderate visibility and "view to the roadway" visibility for consideration in selecting priority focus areas.

President George Bush Turnpike

Site Analysis

The feasibility of planting along roadsides is influenced by physical characteristics present at each location. At the planning level, it is important to identify factors that could restrict or limit the feasibility of implementing landscape improvements to better qualify the selection of priority focus areas. Key site determinants that can influence feasibility or impose extraordinary costs include the following:

Site Drainage

Drainage swale locations, particularly in a roadside setting should be identified. Placement of mulched landscape planting beds must be offset from drainage swales to avoid potential impacts from concentrated flows. Swales should be densely vegetated with turf grasses, typically with sod. In some circumstances, other methods for permanently stabilizing swales may be considered. However, in all cases, swales must be designed to preclude particulate matter from entering inlets to the storm drainage system and to prevent erosion. The placement of swales often divides potential planting areas and can result in potential planting sites which may be too narrow to be effective.

Roadway Drainage

Mulch planting beds can generally accommodate sheet (storm water) flow entering from roadway shoulders in a normally crowned roadway section. However, deviations that result in concentrated flows can cause erosion. These deviations can include factors such as vertical alignment changes, concentrations at ends of bridges or rail openings and minor disturbances like mulch buildup along the shoulder.

Runoff departing from super elevated roadway sections tends to cause erosion in mulch planting areas. The analysis should account for this by offsetting the planting bed from the roadway shoulder to avoid these locations.

Erosion potential of bed areas along the high-side of super elevated sections is very slight since the quantity of sheet flow (storm water) entering from the roadway is minimal.

Irrigation Feasibility

Potential focus areas may not have access to public water sources for irrigation. Preliminary investigations should be made into the availability of water and/or the status of planned water facilities. In some cases, NTTA may want to pursue the planning for landscape in focus areas in anticipation of planned water improvements.

The presence of retaining walls may limit the ability to route irrigation lines to serve an intersection or a portion of an intersection. This should be identified in the site analysis, as it may be a determinant in establishing priority improvement locations.

Provisions for electrical service and communication for the irrigation controller should also be considered. Low pressure location concerns and booster pump costs should also be considered. Refer to the irrigation section for more detail.

President George Bush Turnpike

Site Analysis Continued

Elevated Roadways

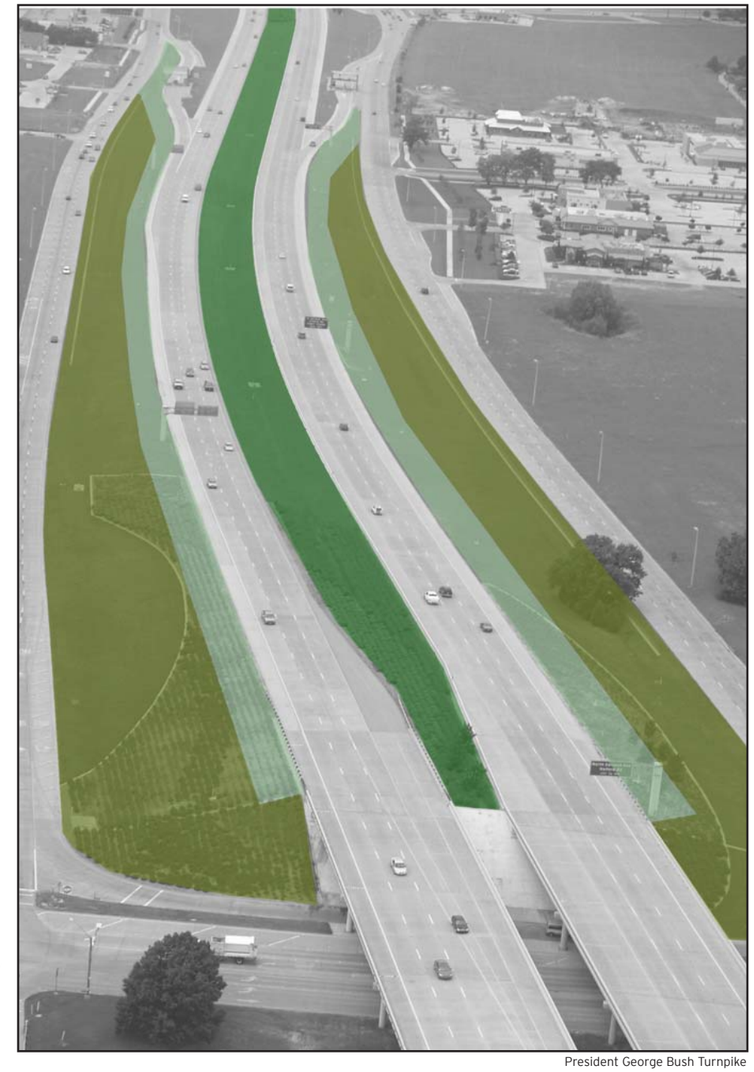
The site analysis should identify portions of the corridor that are on elevated structures. The "views from" these structures to landscape areas differ from at-grade roadways. Examples include locations where main lanes at interchanges are elevated, which results in poor visibility of potential planting sites below.

Planned Projects

Roadway corridors are dynamic environments where future road widenings, extensions, crossings and other improvement projects are likely to occur. Efforts are required during the planning stage to identify planned projects that could occur in the corridor, with particular attention to the time frame for construction activities. Landscape improvements should be directed elsewhere or deferred where construction is anticipated to occur in the short term. Longer term planned projects need to be evaluated on a case-by-case basis to determine if landscape opportunities in these areas should occur.

Corridor and Site Specific Issues

Site analysis should consider other factors that impact plant material selection and location including, existing vegetation, utilities, moisture barriers, noise and screen walls, continuous traffic rails, steep slopes and, unusual soil conditions, and other determinative conditions that impact plant material selections and locations.

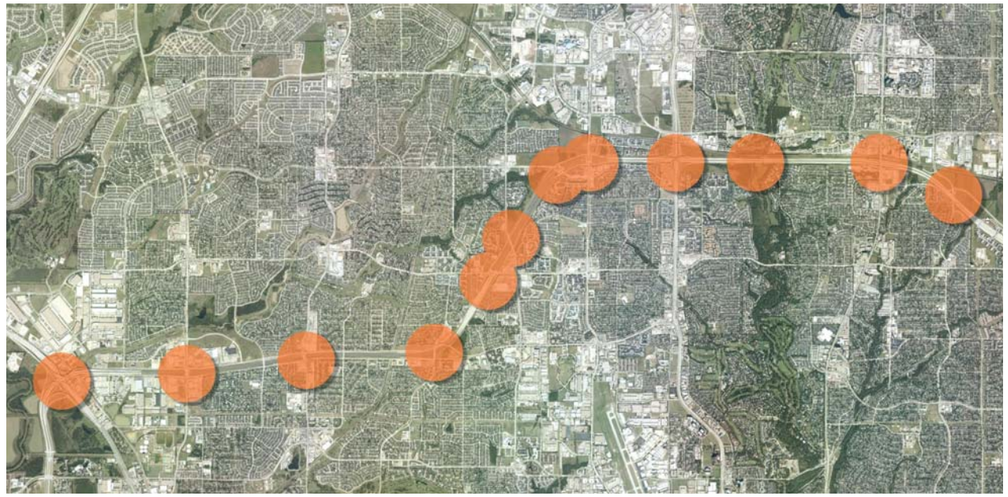


President George Bush Turnpike

After potential focus areas are identified and site analysis work is completed priority focus areas should be identified to advance to more detailed design. The process of identifying priority focus areas begins by establishing cost limitations that would limit the number and/or coverage of landscape improvements. For some corridors, this may require that some potential focus areas are excluded.

Selection of priority focus areas must also consider the distribution of focus areas along the corridor. Distribution of focus areas does need not to be mathematically precise; instead the distribution should create a pleasant driving experience. Consideration should also be given to the placement of focus areas based on achieving equity between the cities that neighbor the facility. Equity is impacted by the length of frontage, the quantity of possible focus areas by jurisdiction as well as the site and view opportunities and limitations.

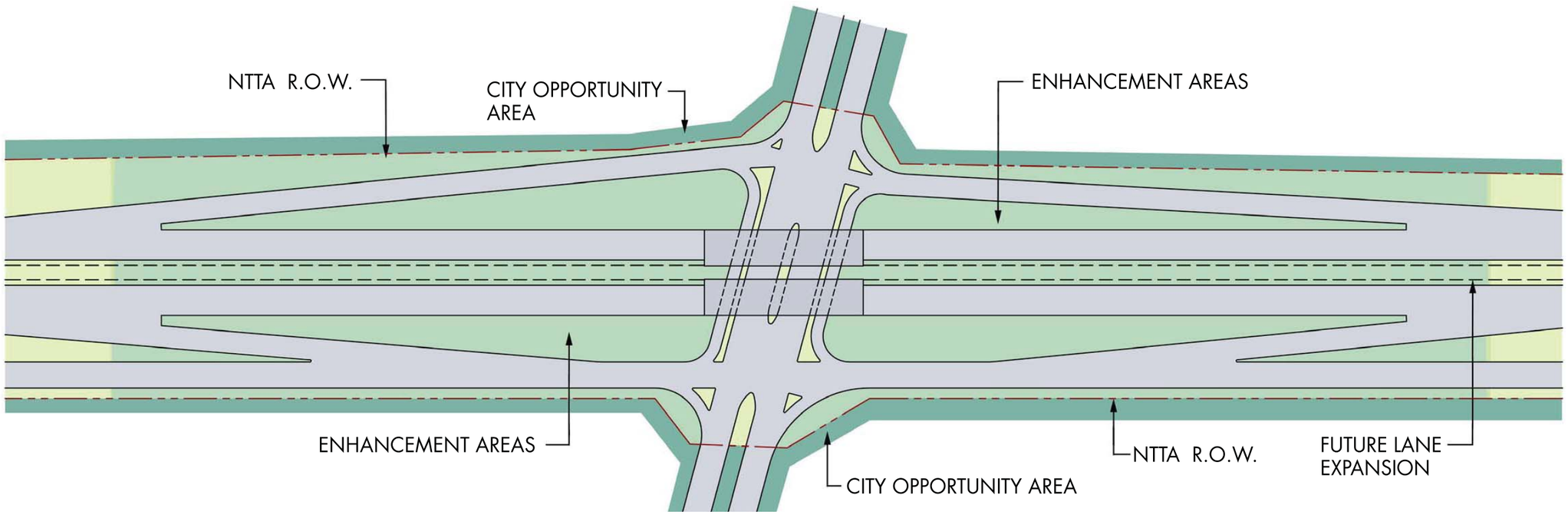
President George Bush Turnpike



Focus Area

After priority focus areas are determined, design application in a particular focus area can begin. All design should place landscape plantings in the NTTA right-of-way. Areas immediately outside of the NTTA right-of-way are opportunities for the adjacent communities to participate in the focus area treatments. Landscape shall only be in areas where NTTA controls maintenance of the area.

See the graphic below for further demonstration of such opportunity areas.

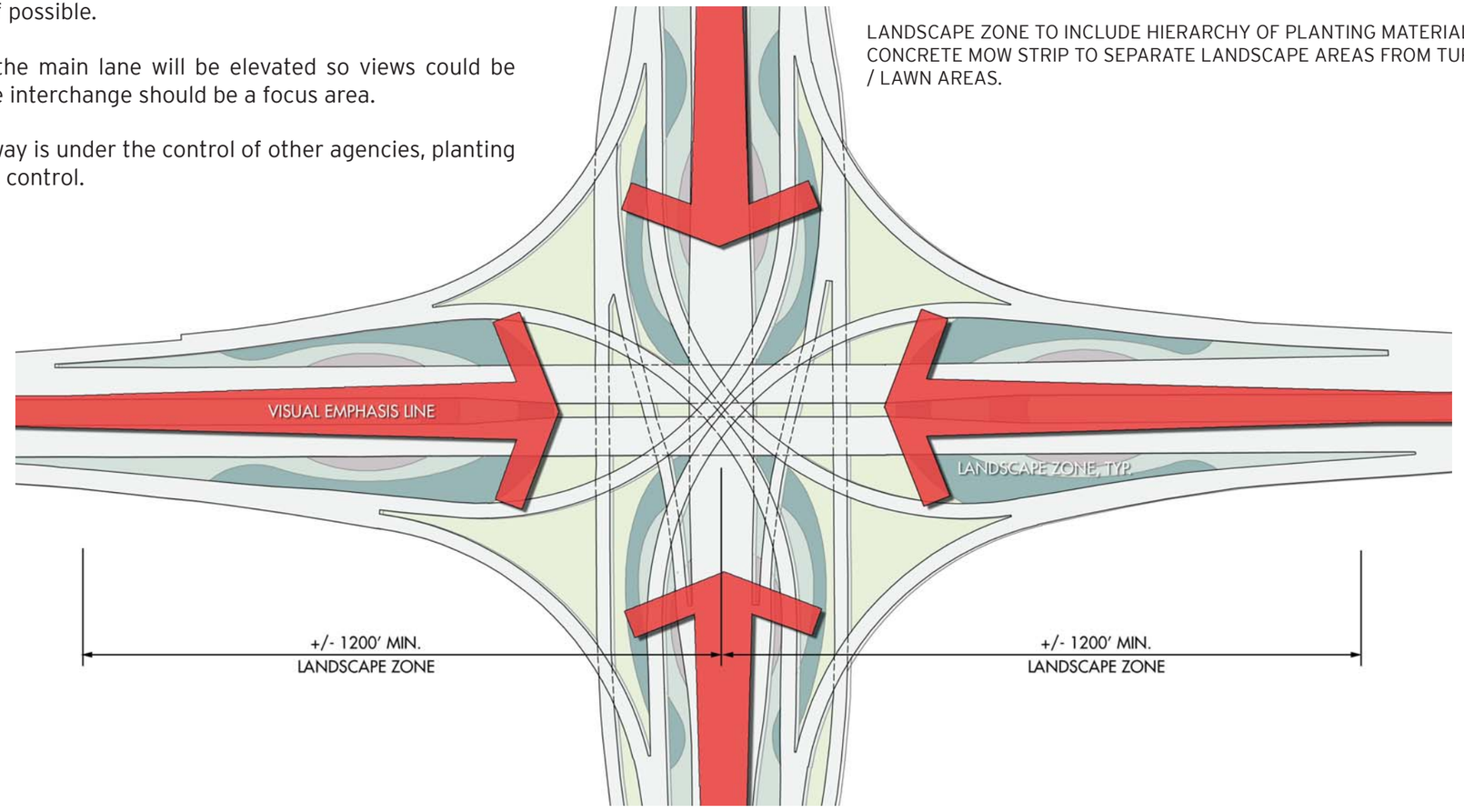


The following pages demonstrate prototypical schematic design approaches for interchanges, underpasses, overpasses, and gantry areas. For each prototype, the design intent is illustrated by a conceptual layout plan.

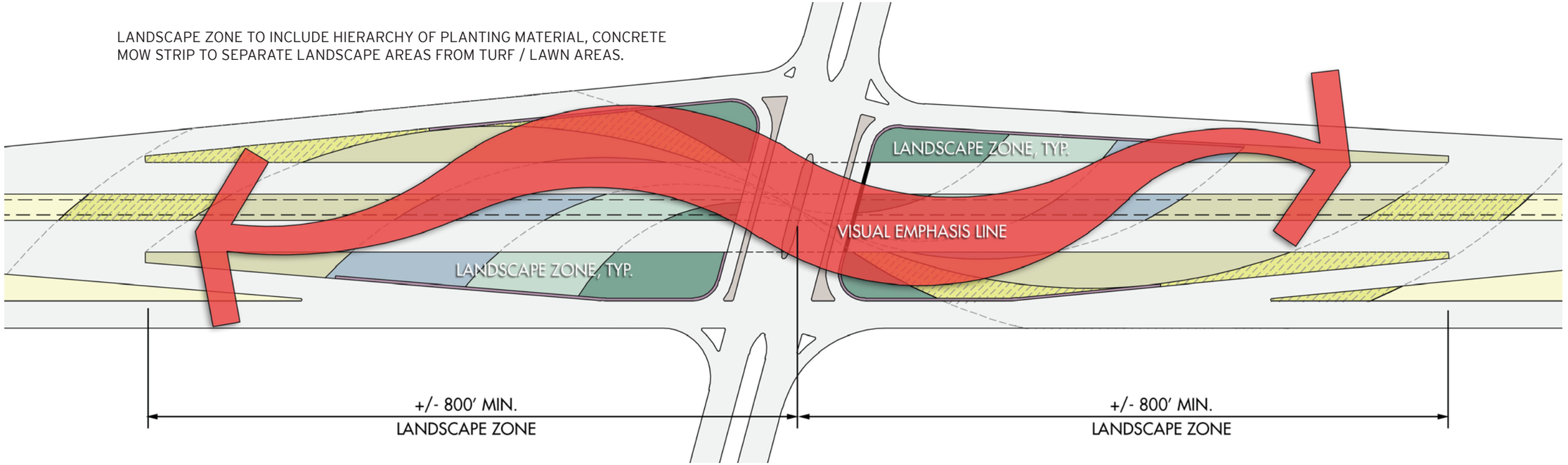
Major interchanges provide great potential for landscape treatments with large "view from the roadway" opportunity areas. Visibility from many vantage points should be considered when designing landscape treatments for these areas. Plant materials should emphasize movement and motion by relating to a ribbon banding pattern, if possible.

Each interchange will be different; sometimes the main lane will be elevated so views could be limited. A view shed analysis will determine if the interchange should be a focus area.

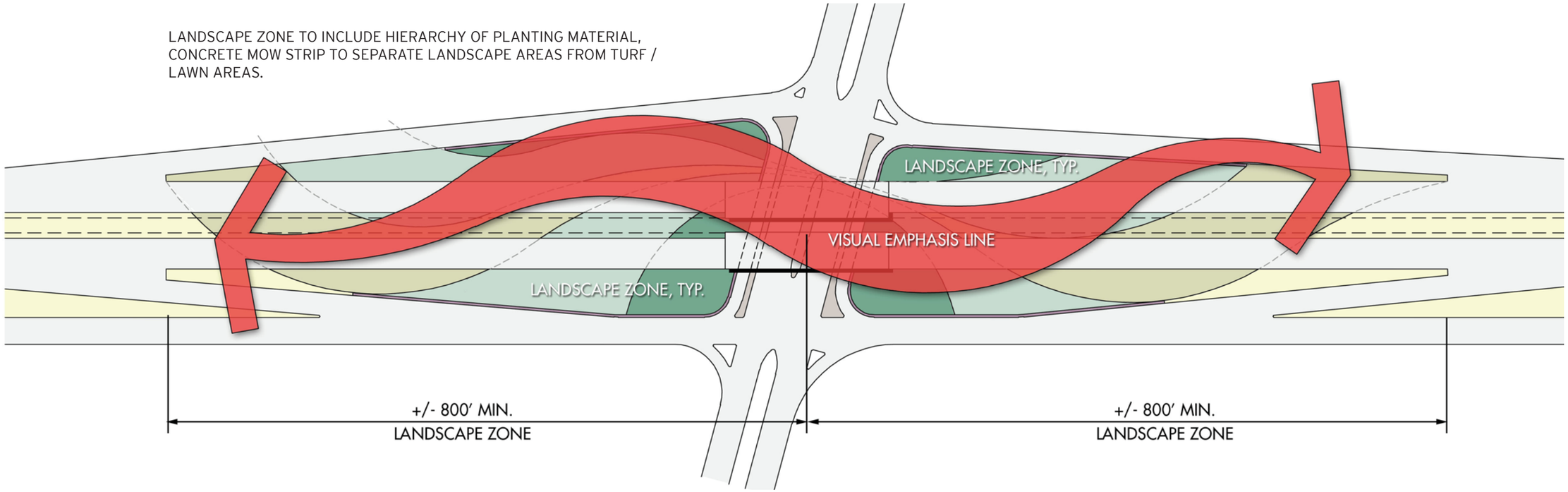
At interchanges where a portion of the right-of-way is under the control of other agencies, planting sites should only be located in areas under NTTA control.



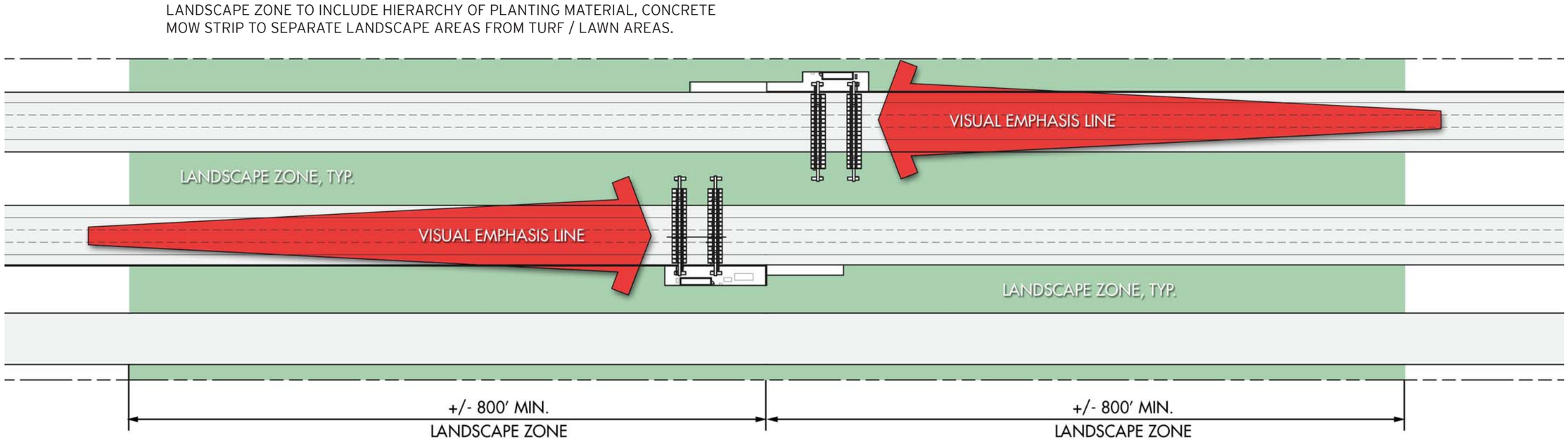
Locations where the toll road passes under a cross street will typically have highly visible slopes. Planting designs should take advantage of the visibility. The view impact of retaining walls, when used, should be considered in the design.



Locations where the toll road passes over a cross street typically has sides which slope away from the toll road toward the access roads or ramps. In such cases landscape treatments should be focused toward the tops of the slopes nearest the toll road for maximum visibility from the toll facility. As an alternative, taller plant materials can be used instead to maximize visibility from the main lane. The view impact of retaining walls, when used, should be considered in the design.



Main lane gantries on NTTA roads are designed to be foreground elements and should be emphasized. Establishing landscape focus areas at main lane gantries reinforces the gantry as a memorable element and increases the apparent scale of gantry elements. Trees and plant materials should not obstruct function and view shed of closed circuit television (CCTV) and gantry cameras.



Median Landscape Design

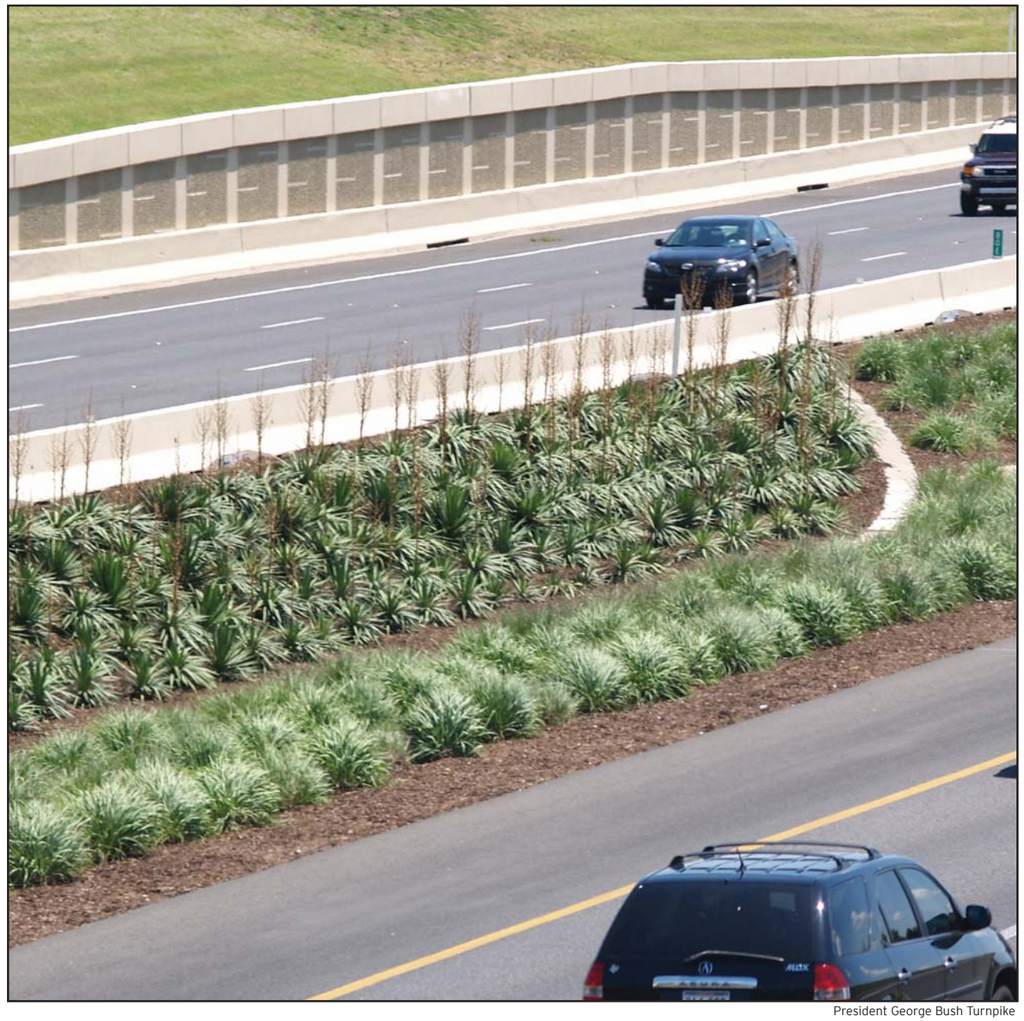
Median areas can offer interesting, high value landscape opportunities. The size and configuration of median areas vary throughout the system. In an urban corridor, like the south end of the DNT, the main lanes are separated by a center barrier with no planting opportunity. In other sections, where the right of way width allows, a wider median is typically provided.

NTTA facilities include cross-over protection along the median, typically in the form of a concrete barrier placed along one of the inside shoulders. Landscape placed at the back-side of the barrier is highly visible to those in the main lanes on the opposite side of the barrier. Plants taller than the barrier are also visible from the main lanes on the barrier side of the roadway. Distant views of median planting should also be considered. Trees may only be included in medians where the trees will not interfere with highway safety standards.

Medians are normally designed with a swale to collect and convey runoff to inlets. As inlet placement becomes further apart, the quantity and depth of runoff tends to increase. Experience has shown that mulch planting beds must be offset from swales for drainage purposes. This offset distance varies, based on the swale drainage design. Typically, planting locations in medians should be avoided where excessive runoff goes into the bed, especially from super elevated sections. Coordination is necessary with the engineering designers regarding drainage flows and inlet placements.

Planting can be placed on one or both sides of a median if the active portion of the swale can be stabilized with turf or other material such as stone riprap. Swale dimensions and the median width must be examined to verify the resulting planting area width is of adequate scale.

Many medians are sized to accommodate future additional lanes. Construction of these additional lanes will almost always require removal of all landscape plantings. Input on the timing of adding future lanes that would encroach on the median should be obtained during the landscape planning process so that a determination can be made if landscape improvements are warranted.



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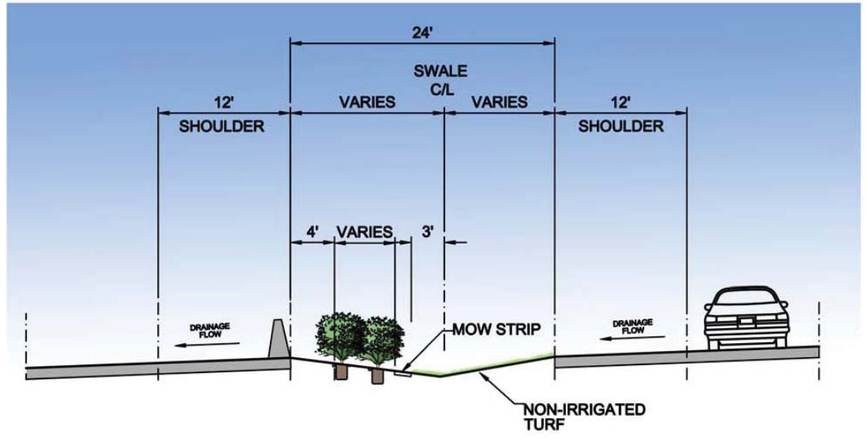
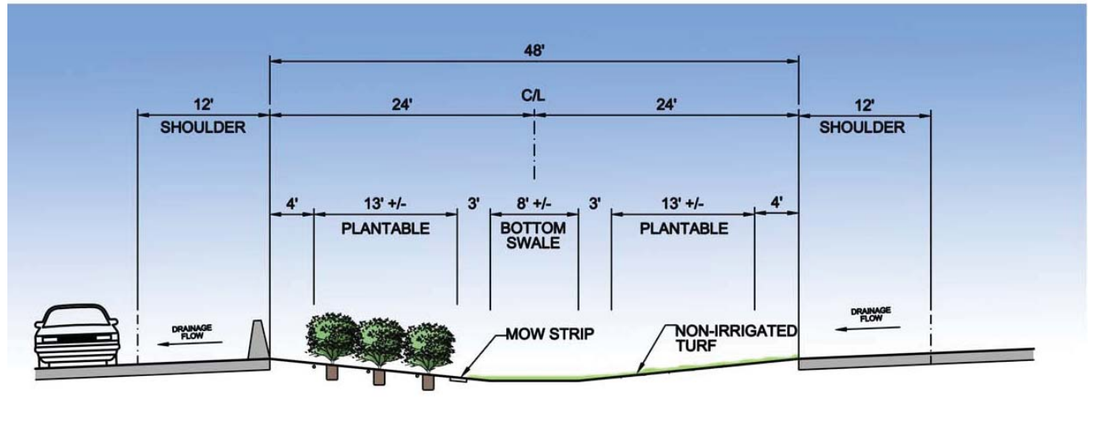
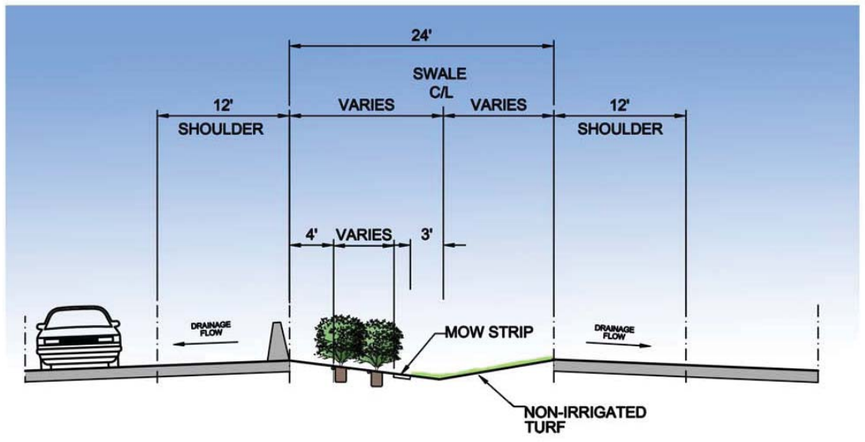
Note:
Mow strips should never cross ditch / swale flow lines. Landscape shall be designed in conjunction with drainage design.



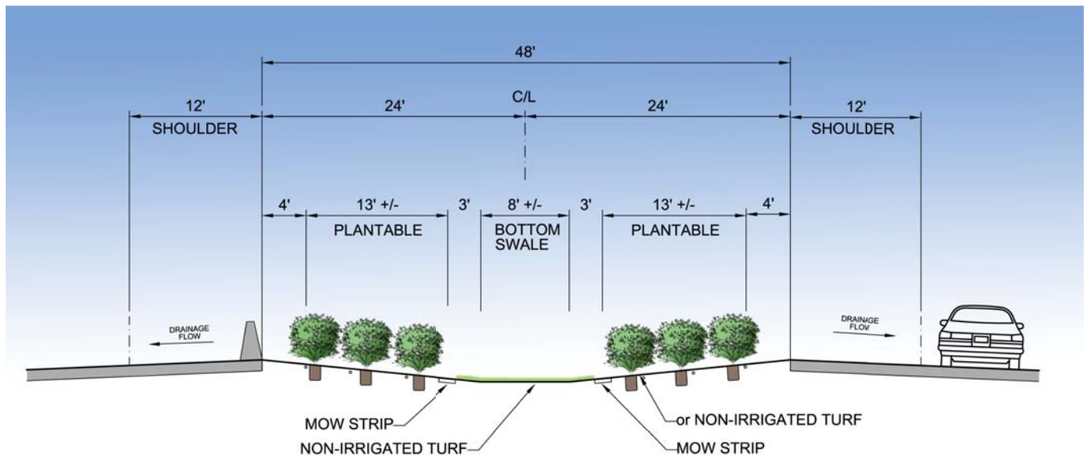
Median Planting at Super-Elevated Roadway Section Option (24′ Median)



Median Planting at Super-Elevated Roadway Section Option (48′ Median)

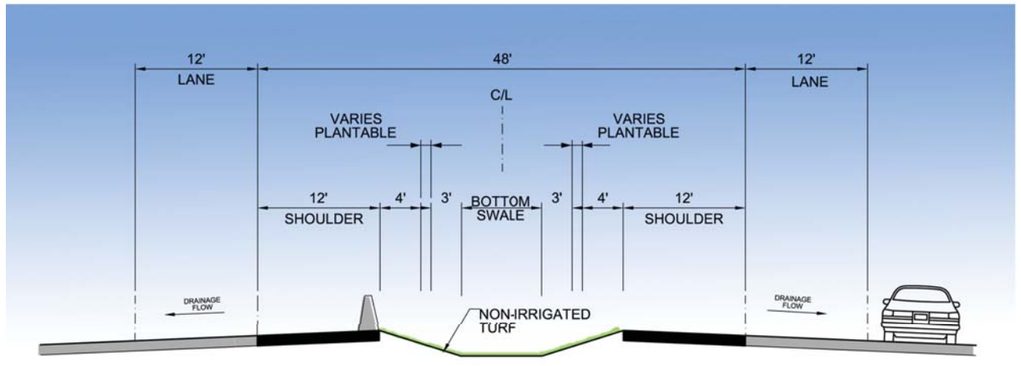


Median Planting at Crowned Roadway Section Option (24′ Median)

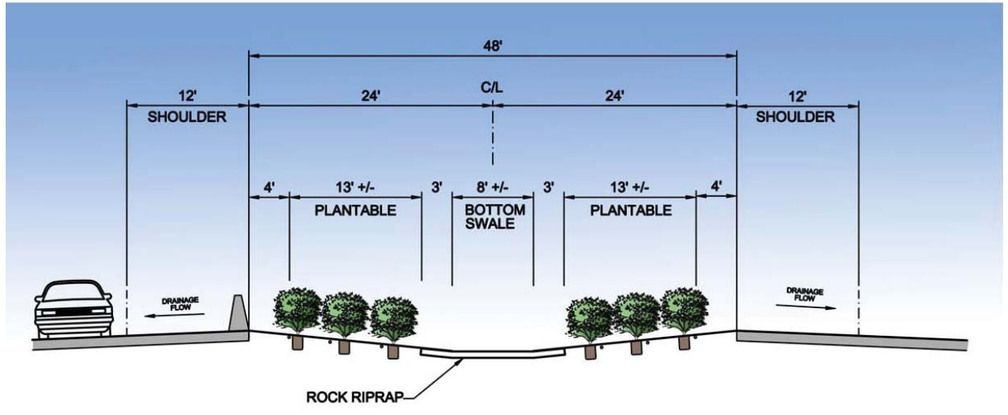


Median Planting at Crowned Roadway Section Option (48′ Median)

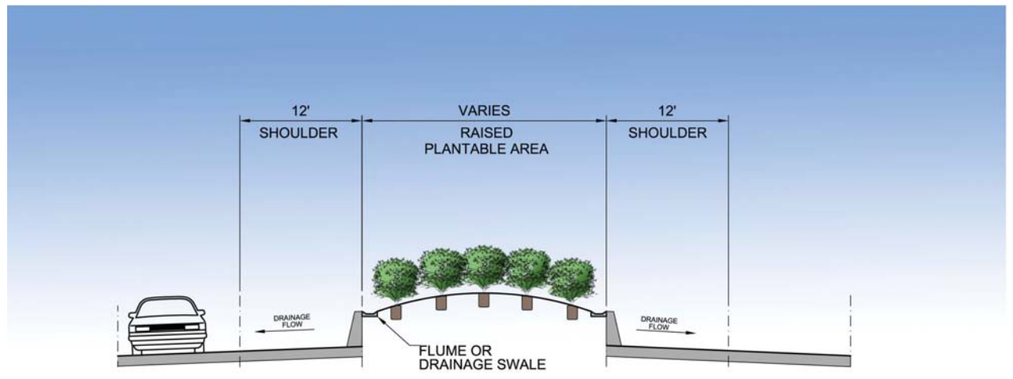
Note:
Mow strips should never cross ditch / swale flow lines. Landscape shall be designed in conjunction with drainage design.



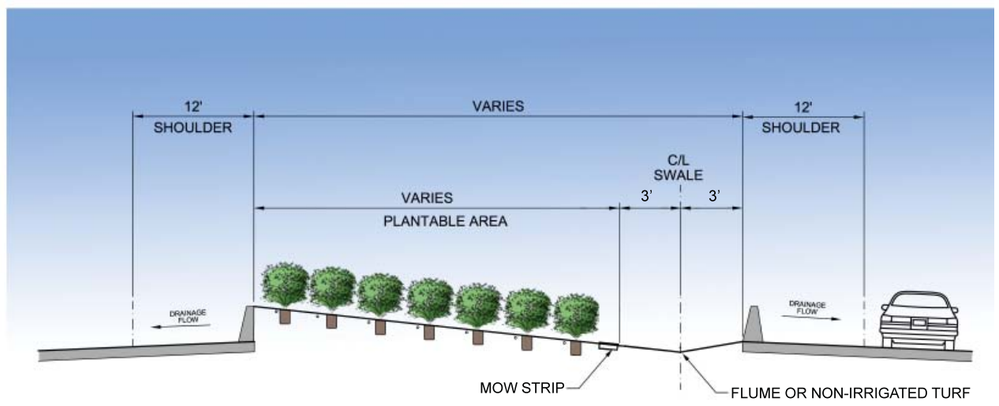
Turf Median Option



Median Planting with Rock Riprap at Crowned Roadway Section Option



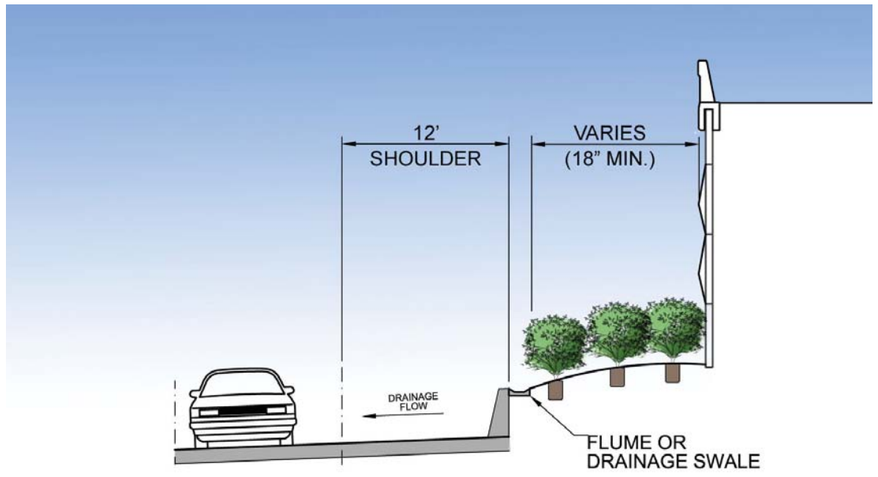
Raised Median Planting Option



Raised Median Planting with Slope to Grade Option

Landscape Design at Shoulder

Shoulder planting is another source for landscape opportunity. Focus Area determination, allowable space and visibility will determine applicability and plant material selection. The size and configuration of shoulder planting areas vary throughout the system. An 18 inch minimum planting width for vines may be considered at some locations.



Raised Planting at Shoulder Option

Right of Way Areas

This section discusses how to integrate existing vegetation with proposed landscape treatments. Included is the decision process for 'mow to' limits at right of way edge.

Background

The landscape and irrigation improvements identified in these guidelines for focus areas require significant costs to construct and maintain. There may be locations or corridors where this level of investment may not be warranted or a more 'naturalized' treatment is preferred. This 'naturalized' approach could take many forms and may need to be evaluated and approved as a Design Guidelines exception.

Examples of Application

Corridors that border existing natural areas (wooded or prairie) may be able to preserve these features in the NTTA right of way.

Large, undeveloped, right of way areas may be candidates for less frequent mowing (field mowing). These field mowing areas should be defined and maintained at a fixed height. By carefully defining these mow limits the 'naturalized' areas can be given bold, sweeping limits that interact with the contours of the site.

Field mow areas may also be candidates to receive supplemental tree plantings. By reducing mowing frequency, the task of mowing around individual trees would be eased.

Establishment of a maximum distance of construction disturbance will ensure protection of existing vegetation.

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Landscape Materials

A basic means of unifying proposed corridors and/or with existing corridors is to use a consistent palette of materials, which includes:

- Native and Adapted North Central Texas plant palette
- Drainage treatments
- Edging treatments

A plant palette has been assembled as a guide. Plant materials have been selected for specific characteristics, including low water requirements, native or adapted qualities, and seasonal interest. A wide range of plants are utilized within these palettes to give the designer flexibility in situations, such as urban or suburban settings, or site constraints. Each species in the palette has proven successful in previous applications throughout the NTTA's existing four county system area. These plant materials are grouped according to size and/or function. Seasonal characteristics are noted; allowing the designer to add interest at specific locations as determined by view shed analyses of the focus areas.

The plant palette should be reviewed by NTTA periodically for plant availability and performance. Suitable plant substitutions may be allowed with approval by NTTA. A small percentage of planting areas may include trial plant species to promote plant diversity and increase NTTA's field experience with potential alternative plans. Use of trial plant species must be acceptable to the NTTA landscape manager.

Some native and adapted plant species require moist soils, therefore, may not survive extended periods of drought without irrigation.

Refer to the following pages for specific plant palettes. Minimum sizes and spacing shown are recommendations. Based on specific project site conditions and requirements, sizing and spacing may vary.

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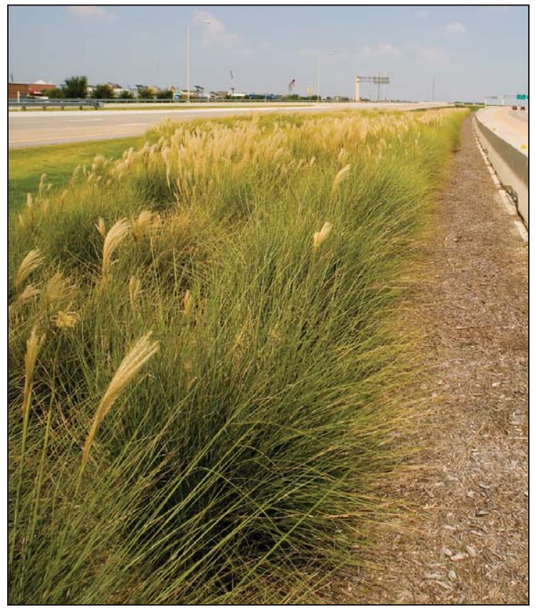

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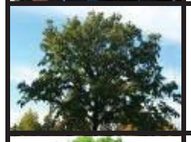
Mountain Creek Lake Toll Bridge

SHADE / CANOPY TREES*

Plant Image	Common / Botanical Names	Install Size	Minimum Spacing	Remarks
	SHUMARD RED OAK Quercus shumardii	2-3" cal. Min. Cont. or B&B 6' - 8' Spread 12' - 14' Height	30' on center	Deciduous tree - Full Sun Does well in heavy clay soils and limestone; Fast growing; Easy to maintain and drought tolerant tree once established; Ensure selection of true species with parentage tolerant of akaline soils.
	BUR OAK Quercus macrocarpa	2-3" cal. Min. Cont. or B&B 6' - 8' Spread 12' - 14' Height	30' on center	Deciduous tree - Full Sun Drought tolerant; Does well in many different soil types from sand to heavy clays.
	CHINQUAPIN OAK Quercus muhlenbergii	2-3" cal. Min. Cont. or B&B 6' - 8' Spread 12' - 14' Height	20' on center	Deciduous tree - Full Sun Drought tolerant; Alkaline adaptable.
	LIVE OAK Quercus virginiana	2-3" cal. Min. Cont. or B&B 6' - 8' Spread 12' - 14' Height	40' on center	Semi-Evergreen tree - Full Sun Tolerant of poor conditions; Moderate growth rate, 'High Rise' for spacing less than 40'.
	CEDAR ELM Ulmus crassifolia	2-3" cal. Min. Cont. or B&B 6' - 8' Spread 12' - 14' Height	20' on center	Deciduous tree - Full Sun Drought tolerant; Handles reflected heat from pavement; Easy to grow in a wide range of soils.
	BIG TOOTH MAPLE Acer grandidentatum	2-3" cal. Min. Cont. or B&B 6' - 8' Spread 12' - 14' Height	20' on center	Deciduous tree - Full Sun or Part Sun Drought tolerant; high heat tolerance; Grows in a variety of well-drained soils from sand to clays and also white limestone rock areas.

* AVOID INSTALLATION FROM JULY 15TH THROUGH SEPTEMBER 15TH.

SHADE / CANOPY TREES*

Plant Image	Common / Botanical Names	Install Size	Minimum Spacing	Remarks
	BALD CYPRESS Taxodium distichum	2-3" cal. Min. Cont. or B&B 6' - 8' Spread 12' - 14' Height	25' on center	Deciduous conifer tree - Full Sun Drought tolerant; Moderately fast growth rate; Does best in moist conditions but root 'knees' will appear; Likes well-drained soils best.
	CHINESE PISTACHE Pistacia chinensis	2-3" cal. Min. Cont. or B&B 6' - 8' Spread 12' - 14' Height	20' on center	Deciduous tree - Full Sun Drought tolerant; Easy to grow in any well-drained soil.
	TEXAS RED OAK Quercus texana	2-3" cal. Min. Cont. or B&B 6' - 8' Spread 12' - 14' Height	30' on center	Deciduous tree - Full Sun Does well in heavy clay soils and limestone; Fast growing; Easy to maintain and drought tolerant tree once established; Ensure selection of true species with parentage tolerant of akaline soils.

* AVOID INSTALLATION FROM JULY 15TH THROUGH SEPTEMBER 15TH.

EVERGREEN AND BROADLEAF EVERGREEN TREES*

Plant Image	Common / Botanical Names	Install Size	Minimum Spacing	Remarks
	EASTERN RED CEDAR Juniperus virginiana	Cont. or B&B 4' - 6' Spread 8' - 10' Height	15' on center	Full Sun Drought tolerant; Grows in any soils; females only, if solid screen is desired, plant at 10' o.c..
	BLUE POINT JUNIPER Juniperus chinensis ' Blue Point'	Cont. or B&B 4' - 6' Spread 8' - 10' Height	6' on center	Full Sun Grows well in a moist well-drained sites.
	CHERRY LAUREL Prunus caroliniana	Cont. or B&B 4' - 6' Spread 8' - 10' Height	10' on center	Semi-Evergreen tree - Full Sun Tolerant of poor conditions; Moderate growth rate.
	SAVANNAH HOLLY Ilex opaca X atenuata ‘Savannah’	Cont. or B&B 4' - 6' Spread 8' - 10' Height	8' on center	Full Sun or Part Shade Prefers well-drained sites; Moderate fast growth rate; Do not plant as mass plantings along roadside; intended in low light environments/selected locations; Color: Fall/Winter red berries.
	NELLIE R. STEVENS HOLLY Ilex x 'Nellie R. Stevens'	Cont. or B&B 4' - 6' Spread 8' - 10' Height	4' on center	Full Sun or Shade Extremely durable; More compact and healthy in full sun but can tolerate fairly heavy shade; Tolerates severe weather conditions; Do not plant as mass plantings along roadside; intended in low light environments/selected locations.; Color: Fall/Winter red berries.
	ELDARICA PINE Pinus eldarica	Cont. or B&B 6' - 8' Spread 12' - 14' Height	20' on center	Full Sun Drought tolerant; Fast growing upright tree with medium green needles.

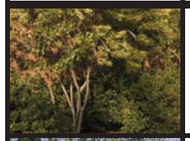
* AVOID INSTALLATION FROM JULY 15TH THROUGH SEPTEMBER 15TH.

UNDERSTORY / ACCENT TREES*

Plant Image	Common / Botanical Names	Install Size	Minimum Spacing	Remarks
	DESERT WILLOW Chilopsis linearis	Cont. or B&B 4' - 6' Spread 8' - 10' Height	15' on center	Deciduous Tree - Full Sun Drought tolerant; No known pests of major concern; Does not do well in moist conditions; Color: Summer pink flowers; yellow fall color.
	MESQUITE Prosopis glandulosa	Cont. or B&B 4' - 6' Spread 8' - 10' Height	20' on center	Deciduous tree - Full Sun Drought tolerant; does well in many different soil types from sand to heavy clays; thornless only; limited use.
	MEXICAN PLUM Prunus mexicana	Cont. or B&B 4' - 6' Spread 8' - 10' Height	15' on center	Deciduous Tree - Full Sun or Shade Drought resistant; Color: White spring flowers; orange fall color.
	POSSUMHAW Ilex decidua	Cont. or B&B 4' - 6' Spread 8' - 10' Height	12' on center	Semi-Evergreen tree - Full Sun Tolerant of poor conditions; Moderate growth rate.
	EASTERN REDBUD Cercis canadensis	Cont. or B&B 4' - 6' Spread 8' - 10' Height	15' on center	Deciduous Tree - Full Sun or Part Shade Drought resistant; Color: Spring pink/purple flowers.
	FLAMELEAF SUMAC Rhus lanceolata	Cont. or B&B 4' - 6' Spread 8' - 10' Height	5' on center	Deciduous Tree - Full Sun or Part Shade Drought tolerant; Locate on open; sunny well-drained sites for best growth; Color: Red/Orange fall foliage; Aggressive rhizomes; Use in enclosed areas, planter walls, or within a controlled area of field mowing.

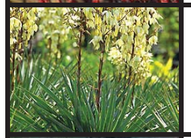
* AVOID INSTALLATION FROM JULY 15TH THROUGH SEPTEMBER 15TH.

UNDERSTORY / ACCENT TREES*

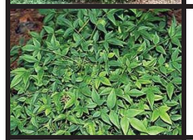
Plant Image	Common / Botanical Names	Install Size	Minimum Spacing	Remarks
	WAX MYRTLE Myrica cerifera	Cont. or B&B 3-5 cane min. 4' - 6' Spread 8' - 10' Height	5' - 6' on center	Semi-Evergreen Tree - Full Sun or Part Shade Drought Tolerant; Moderately fast growth rate; Grows in most soils; Color: small blue berries; Prefers moist soils, but adaptable.
	VITEX Vitex agnus-castus	Cont. or B&B 3-5 cane min. 4' - 6' Spread 8' - 10' Height	10' on center	Deciduous Tree - Full Sun Drought tolerant; Easy to grow in most well-drained soils; Color: Summer light-purple flowers.
	YAUPON HOLLY Ilex vomitoria	Cont. or B&B 3-5 cane min. 4' - 6' Spread 8' - 10' Height	10' on center	Evergreen Tree - Full Sun or Part Shade Drought tolerant; Easy to grow in most soils; Can grow in moist soil as well; Color: Red berries.
	SHANTUNG MAPLE Acer truncatum	Cont. or B&B 4' - 6' Spread 8' - 10' Height	20' on center	Deciduous Tree - Full Sun Drought tolerant; Moderate growth rate; Requires moist, well-drained soil; Color: Fall leaves in yellow, orange, red.
	CRAPE MYRTLE Lagerstromia indica	Cont. or B&B 3-5 cane min. 4' - 5' Spread 7' - 8' Height	10' on center	Deciduous Tree - Full Sun Moderately fast growth rate; Bark interest; Adapted to North Texas soils and climate; Varieties as approved by NTTA landscape manager.

* AVOID INSTALLATION FROM JULY 15TH THROUGH SEPTEMBER 15TH.

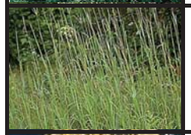
LARGE / MEDIUM SHRUBS

Plant Image	Common / Botanical Names	Install Size	Minimum Spacing	Remarks
	ABELIA 'EDWARD GOUCHER' Abelia x grandiflora 'Edward Goucher'	3 or 5 Gallon 18" - 24" Spread 18" - 24" Height	36" on center	Evergreen shrub - Full Sun - Part Shade Drought tolerant; Easy to grow in any soil; Suckers,/water sprouts/long shoots should not be sheered; Color: Small summer white/pink flowers.
	RED YUCCA Hesperaloe parviflora	3 or 5 Gallon 18" - 24" Spread 18" - 24" Height	36" on center	Evergreen shrub - Full Sun Drought tolerant; Does well in many different soil types from sand to heavy clays; Use with caution near drainage areas; Consider giant variety and yellow variety.
	SOFTLEAF YUCCA Yucca recurvifolia	3 or 5 Gallon 18" - 24" Spread 18" - 24" Height	24" on center	Evergreen shrub - Full Sun Tough plant; Will grow almost anywhere; Prefers well-drained soils; Use with caution near drainage areas; Color: Large white flowers in summers.
	TEXAS SAGE Leucophyllum frutescens 'Compacta'	3 or 5 Gallon 18" - 24" Spread 18" - 24" Height	36" on center	Semi-Evergreen shrub - Full Sun Tolerant of poor conditions; Moderate growth rate.
	DWARF WAX MYRTLE Myrica pusilla	3 or 5 Gallon 18" - 24" Spread 18" - 24" Height	36" on center	Evergreen shrub - Full Sun or Part Shade Drought Tolerant; Moderately fast growing; Grows in most soils; Color: small blue berries.
	EARTH-KIND ROSE Rosa x	3 or 5 Gallon 18" - 24" Spread 18" - 24" Height	36" on center	Semi-Evergreen shrub - Full Sun Drought Tolerant; Low maintenance; Varieties as approved by NTTA landscape manager.

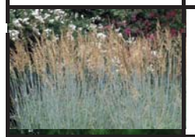
MEDIUM / SMALL SHRUBS

Plant Image	Common / Botanical Names	Install Size	Minimum Spacing	Remarks
	TAM JUNIPER Juniperus sabina 'Tamariscifolia'	1 or 3 Gallon 18" - 24" Spread 18" - 24" Height	24" on center	Evergreen shrub - Full Sun Tall groundcover juniper; Requires well-drained soils.
	DWARF YAUPON HOLLY Ilex vomitoria 'nana'	1 or 3 Gallon 18" - 24" Spread 18" - 24" Height	24" on center	Evergreen shrub - Full Sun Drought tolerant; Does well in many different soil types from sand to heavy clays.
	CARISSA HOLLY Ilex cornuta 'Carissa'	1 or 3 Gallon 12" - 18" Spread 18" - 24" Height	24" on center	Evergreen shrub - Full Sun or Shade Drought resistant; Grows in most soils; Do not plant as mass plantings along roadside; intended in low light environments/selected locations.
	DWARF NANDINA Nandina domestica	1 or 3 Gallon 12" - 18" Spread 12" - 18" Height	18" on center	Semi-Evergreen shrub - Full Sun Tolerant of poor conditions; Moderate growth rate. Varieties as approved by NTTA landscape manager.
	AUTUMN SAGE Salvia greggii	1 or 3 Gallon 12" - 18" Spread 12" - 18" Height	24" on center	Semi-Evergreen sub-shrub - Full Sun Drought tolerant and tolerant of poor soils, but needs drainage.

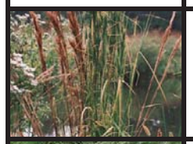
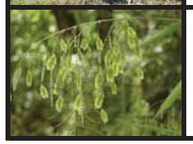
TALL GRASSES

Plant Image	Common / Botanical Names	Install Size	Minimum Spacing	Remarks
	MISCANTHUS 'ADAGIO' Miscanthus sinensis 'Adagio'	1 or 3 gallon 8" - 12" Spread 12" - 18" Height	3' on center	Full Sun Prefers well-drained, moist soils in hot conditions; Cut back in winter; Foliage: silvery
	BIG BLUESTEM Andropogon gerardii	1 or 3 gallon 8" - 12" Spread 12" - 18" Height	5' on center	Full Sun Drought tolerant; Does well in many different soil types from sand to heavy clays; Cut back in winter.
	MISCANTHUS 'GRAZIELLA' Miscanthus sinensis 'Graziella'	1 or 3 gallon 8" - 12" Spread 12" - 18" Height	4' on center	Full Sun Prefers well-drained, moist soils in hot conditions; Cut back in winter; Foliage: green with large white blooms in summer.
	MAIDEN GRASS Miscanthus sinensis 'Gracillimus'	1 or 3 gallon 8" - 12" Spread 12" - 18" Height	4' on center	Full Sun Tolerant of poor conditions; Moderate growth rate; Cut back in winter.
	YAKU JIMA SILVER GRASS Miscanthus sinensis 'Yaku Jima'	1 or 3 gallon 8" - 12" Spread 12" - 18" Height	5' on center	Full Sun or Bright Shade Prefers fertile soil; Needs ample water in hot, dry conditions; Cut back in winter; Foliage: green.
	HAMELN GRASS Pennisetum alopecuroides "Hameln"	1 or 3 gallon 8" - 12" Spread 12" - 18" Height	2' on center	Full Sun - Light Shade Drought tolerant; Prefers well-drained soils; Foliage: green; Cut back in winter.

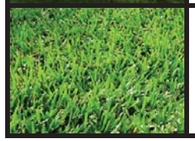
TALL GRASSES

Plant Image	Common / Botanical Names	Install Size	Minimum Spacing	Remarks
	INDIAN GRASS Sorghastrum nutans	1 or 3 gallon 8" - 12" Spread 12" - 18" Height	5' on center	Full Sun - Light Shade Drought tolerant; Prefers well-drained soils; Cut back in winter; Aggressive rhizomes, easily controlled with mowing; Foliage: blue-green
	MISCANTHUS 'MORNING LIGHT' Miscanthus sinensis 'Morning Light'	1 or 3 gallon 8" - 12" Spread 12" - 18" Height	4' on center	Full Sun Prefers well-drained, moist soils in hot conditions; Cut back in winter; Foliage: green/white
	GULF MUHLY Muhlenbergia capillaris	1 or 3 gallon 8" - 12" Spread 12" - 18" Height	2' on center	Full Sun Drought tolerant; Foliage: blue-green, purple fall color; Cut back in winter.
	LINDHEIMER'S MUHLY Muhlenbergia lindheimeri	1 or 3 gallon 8" - 12" Spread 12" - 18" Height	3' on center	Full Sun Drought tolerant; Prefers well-drained soils; Foliage: gray-silver; Cut back in winter.

MEDIUM GRASSES

Plant Image	Common / Botanical Names	Install Size	Minimum Spacing	Remarks
	BUSHY BLUESTEM Andropogon glomeratus	1 or 3 gallon 8" - 12" Spread 12" - 18" Height	3' on center	Full Sun Drought tolerant; Does well in many different soil types from sand to heavy clays; Cut back in winter.
	MEXICAN FEATHER GRASS Stipa tenuissima	1 or 3 gallon 12" - 18" Spread 8" - 18" Height	2' on center	Full Sun Prefers well-drained soils; Cut back in fall; Foliage: green.
	PINE MUHLY Muhlenbergia dubia	1 or 3 gallon 8" - 12" Spread 12" - 18" Height	3' on center	Full Sun Tolerant of poor conditions; Moderate growth rate; Cut back in winter.
	INLAND SEA OATS Chasmanthium latifolium	1 or 3 gallon 8" - 12" Spread 12" - 18" Height	2' on center	Full Sun - Part Shade Drought tolerant once established; Prefers well-drained soils; Foliage: light-green; Cut back in winter.

LOW GRASSES

Plant Image	Common / Botanical Names	Install Size	Minimum Spacing	Remarks
	BUFFALO GRASS Buchloe dactyloides	solid sod	n/a	Full Sun Drought and heat tolerance; Well-drained soils; Mow periodically for weed control; Foliage: gray-green.
	WEEPING LOVEGRASS Eragrostis curvula	seed or 1 gallon 8" - 12" Spread 8" - 12" Height	12" o.c. for 1 gal.	Full Sun Drought tolerant; Does well in many different soil types from sand to heavy clays; Cut back in winter.
	WINTER RYE Secale cereale	seed	n/a	Full Sun Overseed turf areas in fall for winter green accents; Foliage: green; Mow periodically. Use for temporary erosion control purposes.
	COMMON BERMUDA GRASS Cynodon dactylon	sod	n/a	Full Sun Tolerant of poor conditions; Moderate growth rate. Mow periodically. Solid sod only (no bermuda grass seed) will be allowed.

GROUNDCOVER / VINES

Plant Image	Common / Botanical Names	Install Size	Minimum Spacing	Remarks
	BOSTON IVY Parthenocissus tricuspidata	1 gallon	36" on center	Full Sun Offers erosion control; Extremely Hardy; Fast grower; High climber (about 30'); and wide-spreading; Foliage: green.
	CORAL HONEYSUCKLE Lonicera sempervirens	1 gallon	24" on center	Full Sun Needs supports; Easy Care Plant; Extremely Hardy; High climber (about 30'); and wide-spreading;Foliage: green, showy flowers in summer.
	VIRGINIA CREEPER Parthenocissus quinquefolia	1 gallon	36" on center	Full Sun - Part Shade Drought tolerant; Prolific climbing vine which thrives in most soils; High climber (about 30'); and wide-spreading; Foliage: green
	PURPLELEAF WINTERCREEPER Euonymus fortunei 'Coloratus'	4" pots or 1 gallon	18" on center	Full Sun Tolerant of poor conditions; Moderate growth rate; Moderate climber (about 15'); Utilize in select locations only, not intended for mass planting along roadside
	CROSSVINE Bignonia capreolata	1 gallon	18" on center	Full Sun / Part Shade High climber (about 30'); Heat tolerant; Red funnel shaped flowers in spring.

SWALES

Use only turf lined swales or rock riprap in swales. No rock riprap swales shall be located in turf and other mow areas for safety of maintenance. Mow strips should never cross ditch / swale flow lines.

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CONCRETE FLUMES

Use concrete flumes to address drainage at tops of walls and from ends of bridge rails. Throats and flumes must be designed to capture and contain 100 percent of the flow from designed storm events.

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Mow Strips

Reinforced concrete mow strips that are minimum of 12 inches wide x 4 inches deep should be provided to separate all planted areas from turf areas and to separate grasses from other plant materials. Depending on variety, ground covers may require edging from other plant materials. All mow strips shall have true radii and be tangent to adjacent segments.

Place mow strips at base of retaining walls adjacent to turf areas. Mow strips should never cross ditch / swale flow lines.

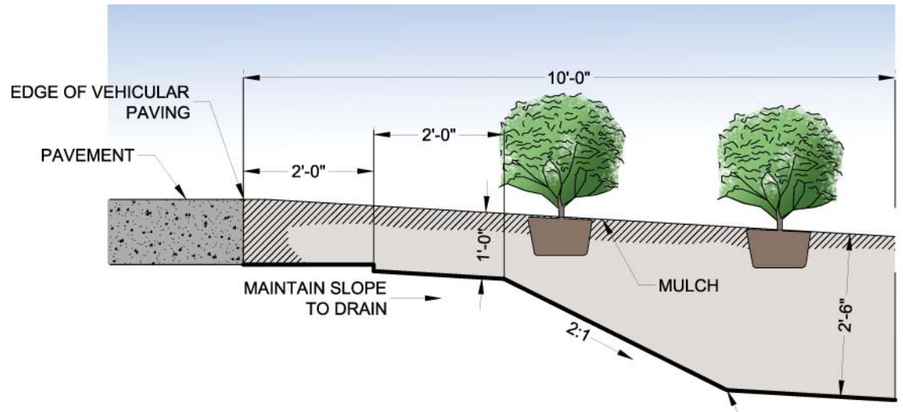
Mountain Creek Lake Bridge

Moisture Barrier

The NTTA is beginning to use moisture barriers to help moderate soil moisture conditions beneath roadway paving on some of their projects. Moisture barriers are typically located along the length of the roadway and are normally 10 feet wide, measured from the pavement edge. These barriers consist of 10 mil polyethylene sheet placed under planting beds at a minimum depth of 12 inches.

Landscape planning and roadway design efforts must coordinate about the use of moisture barriers and if planting in this 10 foot zone. The Section Engineer should be advised to turn down the barrier to allow greater soil depth. In locations where the 12" barrier depth is used, the planting bed will need to be located outside of the 10 feet moisture barrier zone or modifications to the depth of the moisture barrier must be implemented to allow planting.

Moisture Barrier with Landscape Bed Offset at Shoulder



*REFER TO NTTA STANDARD SHEETS FOR MODIFICATIONS

Landscape Methods and Practice

Soil Amendments

Amend existing soils in planting bed areas by placing a 4 inch layer of general use compost over existing, bare soil. Then thoroughly till the soil to a total mixed depth of 12 inches. The compost used should have characteristics similar to the following: (as measured by Solvita testing)

- PH range of 6.0 - 7.5
- High in organic matter
- Free from viable weed or plant seeds
- Meet Federal and Texas Commission on Environmental Quality (TCEQ) health and safety regulations.
- Meet TxDOT Standard Specifications for Item 161 - Compost.

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Maintenance Practices

The success of a landscape project depends highly on the maintenance activities conducted after installation, particularly in the initial years of plant establishment. For larger projects, an 18 month to two-year maintenance period performed by the installing contractor is typical. The NTTA has developed standard General Notes that should be incorporated in the final landscape plans with project-specific maintenance refinements that may be needed.

Shrubs have been selected that do not require shearing just occasional pruning to remove dead or damaged branches. Several of the grasses specified require cutting back either annually or biannually.

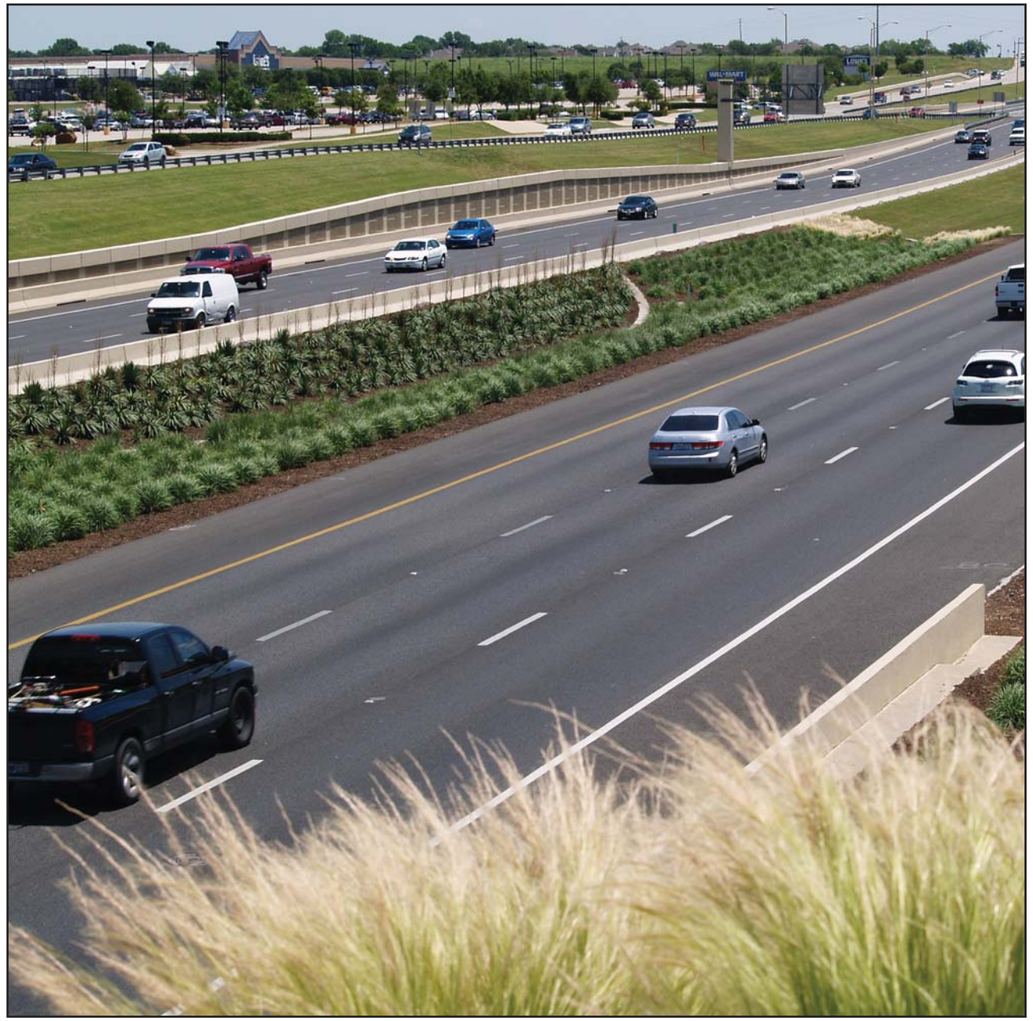
Dallas North Tollway

Contractor Qualification Process

A qualification process is recommended to ensure that all bidders proposing on the project will have the necessary experience and resources to be considered a "responsible bidder".

This process typically requires potential bidders to submit an application for qualification that is reviewed and scored by an NTTA Review Committee. This review is based on criteria set forth in the contract documents.

The details involved in qualifying bidders will be tailored to each project and may involve a "one-step" or "two step" procurement process.



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09 IRRIGATION

*For detailed design information reference the following NTTA Standard Drawings series:
IRS

System Description

Irrigation systems should be centrally controlled with an automatic field controller located for each point of connection. Daily irrigation schedules can be adjusted by a weather station also connected to the cental controller.

System Components

Central Controller System: The central control system will be connected via fiber optic cable or ethernet to each field controller throughout the entire system. The central system is capable of connecting to a weather station that will compute run times based on daily evapotranspiration data. Additional weather stations may be added on a project specific basis.

Field Controller: Provide field controllers compatible with the NTTA Central Control System. Controller location must consider operational requirements of flow sensor and criteria for connection to the NTTA ITS System. Furnish handheld units as requested by NTTA.

Rain and Temperature Sensor: Each field controller should include a rain and temperature sensor programmed to interrupt a cycle during a rain event or when the temperature dips below 38 degrees Fahrenheit (38ºF). Locate the sensors adjacent to the field controller on a galvanized pole.

Wind Sensor: Install wind sensors that shut off above ground spray irrigation during periods of high wind (shut down points are adjustable), then automatically resets the system when conditions are more favorable. This system improves irrigation efficiency and minimizes drift.

Water Meters: Provided based on project specific requirements as described in 'Water Source.' (see next page)

Backflow Prevention Devices: Backflow prevention devices can be double-check valve assemblies unless city codes require a more stringent device. Typically, the assembly should be the same size as the water meter.

Flow Meters: Irrigation system must include a flow sensor and master valve to facilitate automatic shut down of the irrigation in the event of a mainline pipe break and other high flow events that reach preset thresholds.

Master Valve: Irrigation master valve must be normally closed, so that irrigation main line is under pressure only while the system is scheduled to irrigate.

Pressure Regulators: If necessary, provide regulators to limit outflow pressure at each watering device to within 25 percent of the optimum working pressure. This may be an integral part of the remote control valve.

Remote Control Valves: Valves should be sized to prevent a pressure loss exceeding five PSI during projected flow. Each valve should have a flow control stem.

Pipe: Class 200 PVC can be used for pressure piping. Fittings that account for thermal expansion should be used in connections between HDPE and PVC piping. HDPE piping should be used at all large radius sweeps and riser sections.

Filters: Drip zones should have a 200 mesh filter installed prior to the lateral distribution lines.

Drip Tubing: Drip tubing should contain in-line emitters with integral spacing, typically at 12" or 18" centers. Emitters should be pressure compensating. Tubing should be UV and clog resistant, installed 4 inches below grade and staked to remain beneath the mulch layer. An indicator can be installed in each zone to provide maintenance staff with visual confirmation when it is operating.

Spray Sprinklers: Spray sprinklers should be pressure regulating and contain seals to contain up to 10 vertical feet of water in the lateral lines when not operating. Pop up height should consider effective plant material height.

Rotor Sprinklers: Rotor sprinklers should contain nozzles with a minimum flow of three (3) gallons per minute to limit the effects of wind and evaporation. Nozzles should be selected to assure matched precipitation rates. Pop up height should consider effective plant material height.

Quick Coupling Valves: Provide quick coupling valves for on-site water access. Installation and products should be easy to operate, durable and must comply with regulatory requirements.

Field Contoller / Wind Sensor on President George Bush Turnpike

Moisture Sensors: Include on a case by case basis to automatically stop irrigation when the proper soil moisture has been reached.

Design Standards

Irrigation should be zoned to afford appropriate control of the water application to plants. Typically this is achieved by zoning by plant species or by water usage needs. Zoning of irrigation should also consider position on slopes. Separate tree rings or bubblers should be provided for trees installed at large sizes (2" cal. or greater).

To minimize potential spray onto the pavement, rotors and spray heads should not be used within 10 to 12 feet of the edge of pavement. It is strongly recommended that drip tubing be installed in these locations.

Areas for Treatment - Turf grasses will not typically be irrigated. The intent of the irrigation system is to protect the investment of nursery stock materials during establishment and during severe periods of drought. Irrigation treatment of specific plant types should be as follows:

Trees, Shrub, and Ornamental Grasses: To conserve water, a grid of in-line drip tubing should be installed at each planted row and fed by sub-surface PVC lateral lines. The tubing should be installed at a four-inch depth. See "Drip Line Diagram" on the following page for a graphic representation of the anticipated layout.

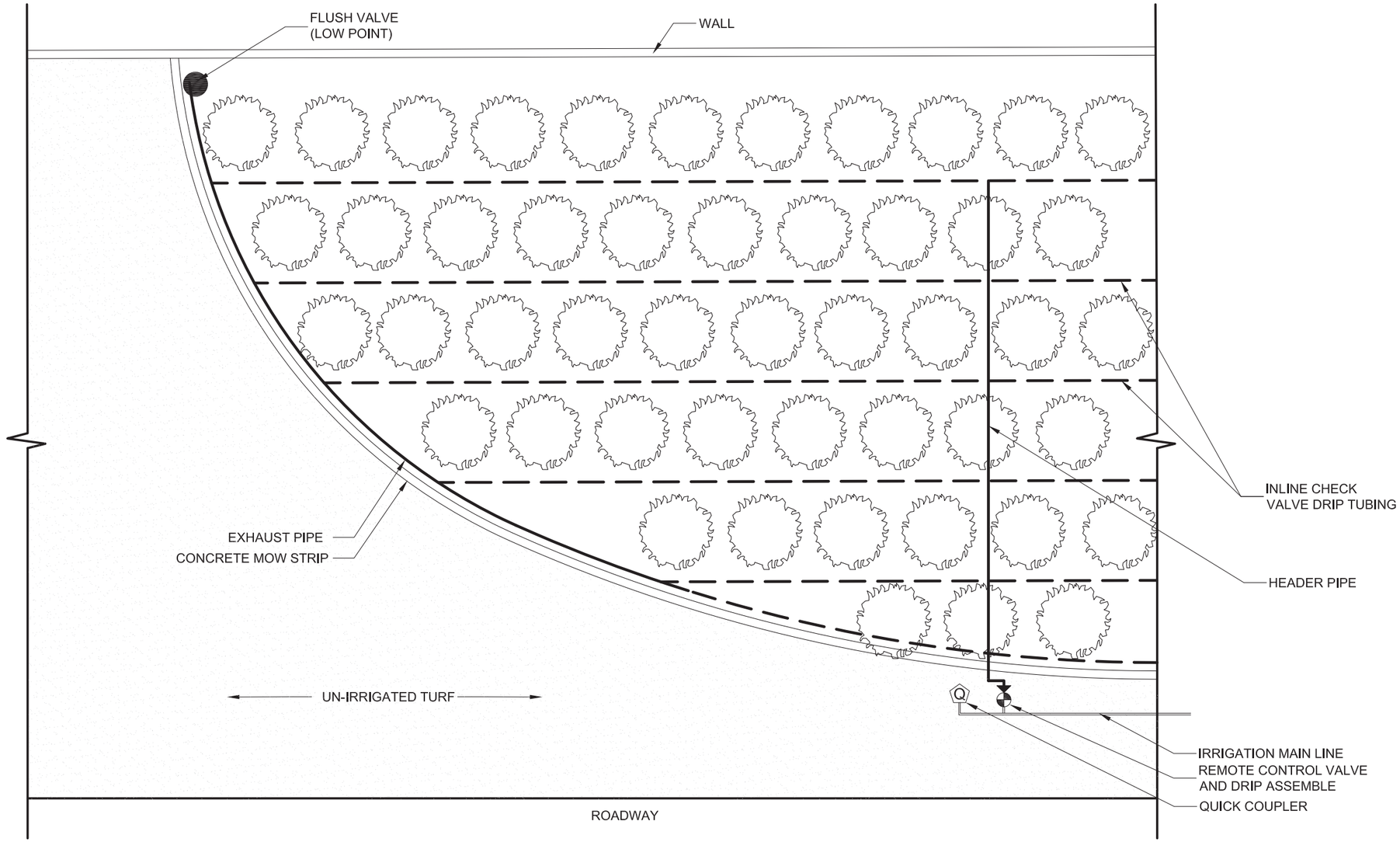
Minimize use of conventional pop-up spray and rotor sprinklers. However, areas anticipated for masses of spreading plant materials, particularly when seeded, may require the use of conventional pop-up sprays and rotor sprinklers. Spacing should be in a head-to-head coverage pattern. Prevailing wind conditions should be factored into the layout of the sprinklers.

Water Source - Water used throughout the system should be potable water purchased from the city where the landscape improvement area is located. During conceptual design, the irrigation consultant should contact the city water department to determine availability of water and pressure limitations.

Meter locations and city code requirements should be coordinated with the water department and local building department. Cities are encouraged to provide water taps and meters. This process will require coordination between the NTTA and the cities involved to resolve any issues involving installation costs.

Power Source - Power service to connect the irrigation controller should utilize existing NTTA power sources. New metered services for irrigation controls should be avoided. Coordinate irrigation contoller power and communication requirements with ITS MPE provisions.

Drip Line Diagram



Plan

Sleeving for Irrigation System (Included in Roadway Plans)

Overview

Sleeving is needed to allow installation of irrigation piping and control wiring under pavements. Roadway plans should indicate the locations of sleeving for future irrigation use. By including these sleeves on the roadway plans, the installation can be made by the open trench method which should reduce costs. Sleeving that can not be installed by the open trench method will normally be installed by horizontal drilling at the time of the irrigation system installation.

Materials

Sleeving installed by the open trench method should be Schedule 80 PVC pipe. Each crossing should include a six-inch sleeve for irrigation piping and a four-inch sleeve for control wiring. Different sleeve types may be required at crossings under frontage roads or cross streets not under NTTA control. Standard ground boxes and delineators should be located at the ends of each crossing to mark the locations of the sleeves. In addition, trace wire should be provided along the length of each sleeve, with coiled ends of the wire terminated in ground boxes.

Locations

Provisions for sleeves should be made at planned landscape focus areas. The section engineer may need to determine approximate locations of these sleeves if the landscape and irrigation consultants are not under contract. While general guidance for the sleeve locations can be provided, procedures for each focus area will vary. Sleeve locations should follow the likely route of irrigation mains from the most likely source of public water to each of the intersection quadrants and the center median. This routing should avoid crossing under retaining walls and should not depend on hanging irrigation piping from under bridges.

Special Conditions

It may be determined that sleeving must cross under or through the base of a retaining wall. To minimize excavation behind the wall by the irrigation contractor, these sleeves should include a large radius sweep to allow for future irrigation pipe placement behind the wall with a vertical riser extending up to a ground box. It is very important that any vertical sleeves be installed at the time that the wall is constructed. (Refer to standard sheet IRS-001(1)-2008)

Depth and Length

The depth of sleeve installation should be determined by the section engineer but should allow no less than four feet of cover from the paving surface to the top of sleeve. Sleeving must extend beyond the paving structure a distance of at least five feet. At locations that will have a moisture barrier extending beyond the roadway paving the section engineer should provide additional sleeve length to clear the moisture barrier. Additional sleeve length should also be provided to clear future roadway widening by at least five feet.

Overview

Sleeving is needed to allow installation of irrigation piping and control wiring under pavements. Irrigation plans should indicate the locations of existing sleeving and other sleeving needed for the irrigation system. Roadway pavements are typically built before the irrigation construction begins. This requires the use of horizontal drilling techniques to install irrigation sleeving under the existing pavement.

Materials

Sleeving installed by horizontal drilling methods can be either Schedule 80 PVC pipe or thick walled HDPE piping. HDPE sleeving is the preferred material when placing sleeving by horizontal drilling. Each crossing should typically include a 6 inch sleeve for irrigation piping and a 4" sleeve for control wiring. Different sleeve types may be required at crossings under frontage roads or cross streets not under NTTA control.

Locations

Provisions for sleeves should be made at planned landscape focus areas. While general guidance for the sleeve locations can be provided, the procedure for each focus area will vary. Sleeve locations should follow the likely route of irrigation mains from the most likely source of public water to each of the intersection quadrants and the center median. This routing should avoid crossing under retaining walls and should not depend on hanging irrigation piping from under bridges.

Depth and Length

The depth of sleeves installed by horizontal drilling should be deeper than sleeving placed by open trench to ensure that the procedures involved in the drilling do not cause deflection (heaving or settling) of the paving structure above.

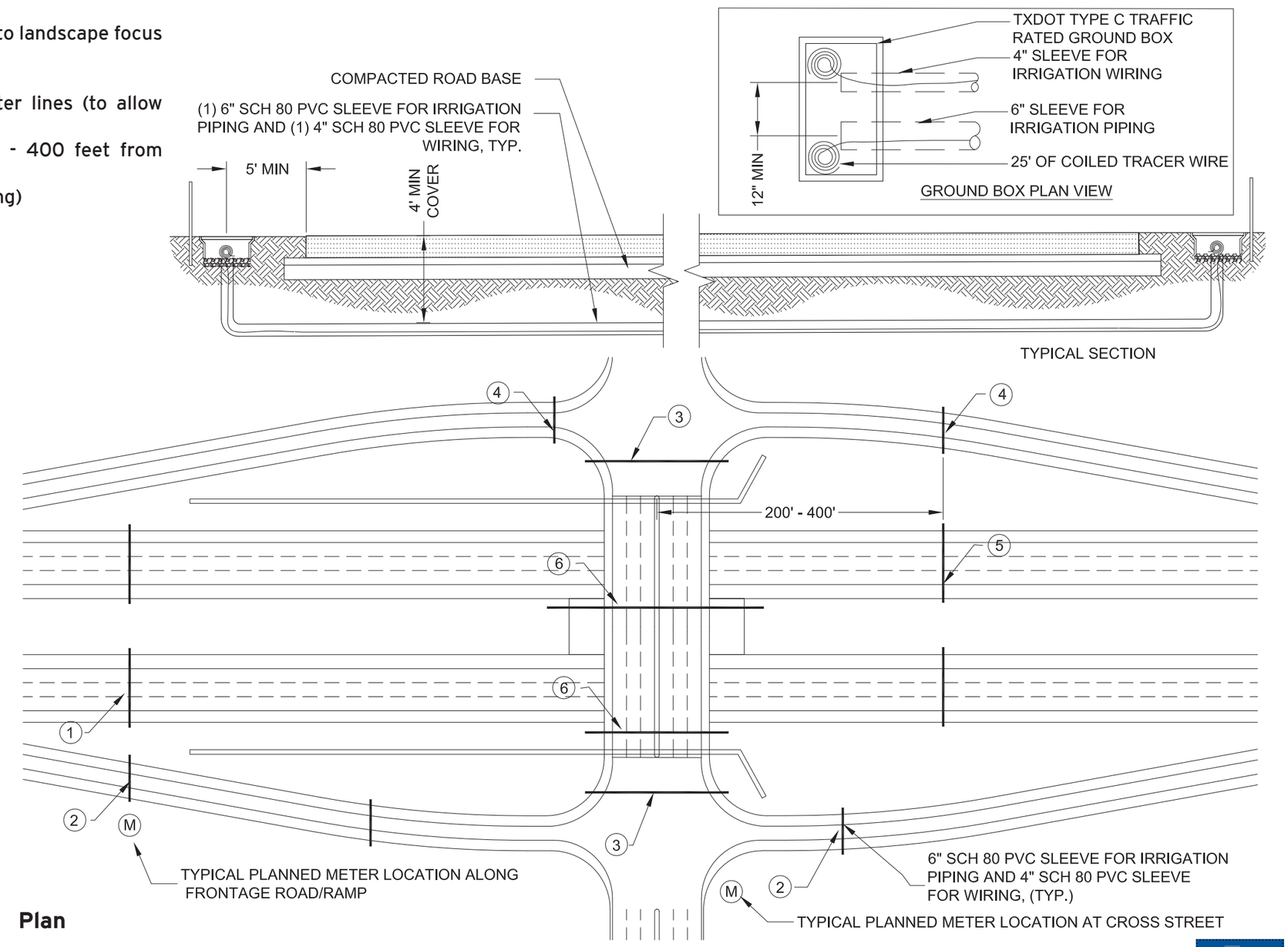
The depths of sleeving installed by boring should allow for a minimum of six feet of cover at ramps and at the outside edge of mainlane shoulders, a minimum of ten feet of cover at mainlane roadways and a minimum of four feet of cover at frontage roads. These depths are subject to change by the NTTA.

Sleeving must extend beyond the paving structure a distance of at least five feet. At locations that have a moisture barrier extending beyond the roadway paving, additional sleeve length should be provided to clear the moisture barrier. Consideration should also be given to providing additional sleeve length to clear future roadway widening. This added length for widening may be installed by open trench methods after boring is completed.

Notes:
Locate sleeves beyond retaining wall limits.

1. Locate sleeves to provide route from public water lines to landscape focus areas (typically at cross streets and frontage roads).
2. Provide sleeves at cross streets where possible.
3. Provide additional sleeves to access other public water lines (to allow options).
4. Sleeve locations away from walls generally 200 feet - 400 feet from intersection.
5. Provide sleeves under bridge. (typically has riprap paving)
    - Ground boxes to have NTTA irrigation labels.

Prototypical Underpass Sleeving Diagram

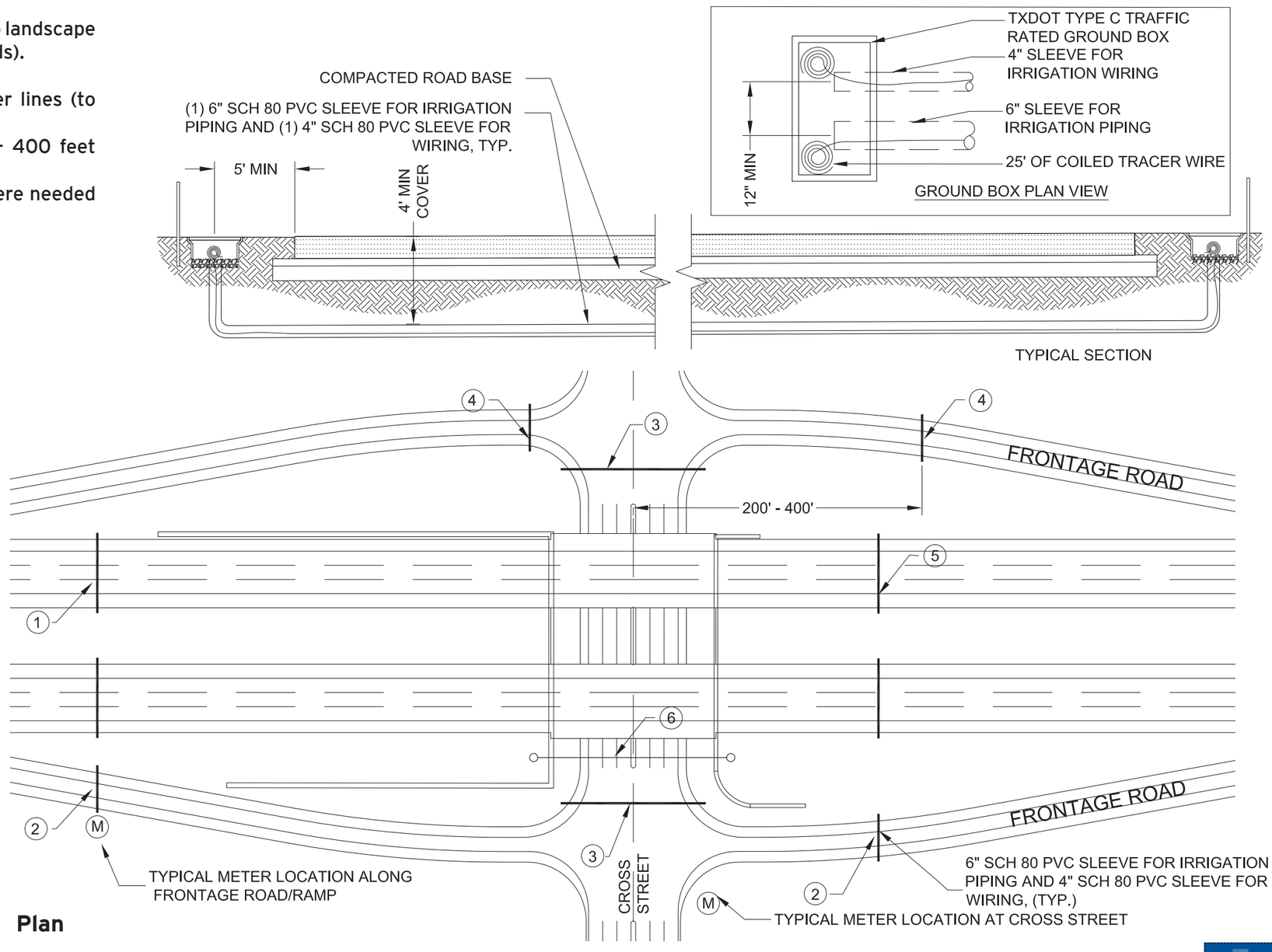


Plan

Notes:

1. Locate sleeves beyond retaining wall limits.
2. Locate sleeves to provide route from public water lines to landscape focus areas (typically at cross streets and frontage roads).
3. Provide sleeves at cross streets where possible.
4. Provide additional sleeves to access other public water lines (to allow options).
5. Sleeve locations away from walls generally 200 feet - 400 feet from intersection.
6. Provide sleeves with large radius sweeps and risers where needed to access across cross streets at bridge abutements.
    - Ground boxes to have NTTA irrigation labels.

Prototypical Overpass Sleeving Diagram



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