

Table of Contents

11.1.0 GENERAL 11-2

11.2.0 ABBREVIATIONS 11-2

11.3.0 RETAINING WALLS..... 11-2

 11.3.1 Definitions..... 11-3

 11.3.2 Use of Standard/Non-Standard Walls..... 11-4

 11.3.3 General Requirements 11-4

 11.3.4 Wall Location and Layouts 11-5

 11.3.5 Structural Requirements 11-6

 11.3.6 Material Requirements 11-7

 11.3.7 Internal Drainage..... 11-7

 11.3.8 External (Surface) Drainage..... 11-8

 11.3.9 Maintenance Provisions 11-8

 11.3.10 Safety Provisions 11-8

 11.3.11 Warning Devices 11-8

 11.3.12 Supplemental Construction 11-9

 11.3.13 Geotechnical Information 11-9

 11.3.14 Construction Drawings 11-9

 11.3.15 Technical Specifications..... 11-10

 11.3.16 Shop Drawings/Material Tests 11-11

 11.3.17 Changes in Design or Materials 11-11

 11.3.18 License Agreements/Construction Waivers 11-11

11.4.0 BRIDGES 11-11

 11.4.1 Structural Requirements 11-11

 11.4.2 Material Requirements..... 11-11

 11.3.18 License Agreements/Construction Waivers..... 11-11

11.5.0 CULVERT/STORMWATER DRAINAGE PIPE 11-11

 11.5.1 Structural Requirements..... 11-11

 11.5.2 Material Requirements 11-11

SECTION 11 - STRUCTURES IN THE RIGHT OF WAY AND IN EASEMENTS

11.1.0 GENERAL

This section presents structural design criteria for retaining walls, bridges, culverts and stormwater drainage pipe to be constructed in the right of way and in easements. Structural design of electric distribution and mass transit facilities and hydraulic design of structures for stormwater drainage are presented in other Criteria Manuals.

11.2.0 ABBREVIATIONS

AASHTO: American Association of State Highway and Transportation Officials

ACI: American Concrete Institute

ASTM: American Society for Testing and Materials

FHWA: Federal Highway Administration

MSE: Mechanically Stabilized Earth

NCMA: National Concrete Masonry Association

11.3.0 RETAINING WALLS

11.3.1 Definitions

A. Conditional / Incomplete Design

In a “conditional” design, the designer defers essential elements of the design to someone else. An example of conditional design is one in which, by a note on the drawings, the designer makes the contractor responsible for determining whether the subsurface materials will support the applied wall footing loads. An “incomplete” design does not address all of the requirements in this section. An example of incomplete design is one in which the designer checks only internal wall stability, with the implication being that someone else will check external stability.

B. Construction Waiver

A construction waiver grants the owner of abutting private property permission to construct, in the right of way, a minor structure that is non-standard or is of benefit only to that property. The waiver attaches to the property, being recorded with the County record of deeds. Construction waivers exempt the City from maintaining the structure and from financial liability for property damage or personal injury associated with the structure.

C. Excavation / Backfill Zone

The excavation / backfill zone of a utility is the wedge-shaped area above the utility formed by two inclined planar surfaces, one on each side of the utility, sloping upward at a 45 degree angle (.785 rad) (1 to 1 slope) from the outermost edge of the utility to the ground surface.

D. Fascia Wall

A fascia wall is constructed over the face of a stable slope to enhance its

appearance or to protect the slope from degradation due to weathering. The slope may be stable naturally or may be made stable by nailing or other forms of reinforcement. Fascia walls do not contribute to the overall stability of the slope.

E. License Agreement

A license agreement grants a second party, such as an individual private property owner, homeowners association or corporation, permission to use public right of way for a permanent structure that requires maintenance or that poses unusual risk to the City. The license agreement exempts the City from maintaining the structure and from financial liability for property damage or personal injury associated with the structure.

F. Mechanically Stabilized Earth Retaining Wall

A mechanically stabilized earth retaining wall is composed of facing units and metal strips or geosynthetic (geogrid) reinforcement connecting to the facing units and extending behind the wall into special backfill. The stability of these walls depends on the interaction of the facing units, strips or geogrid, and backfill, acting as a system.

G. Non-Standard Retaining Wall

A non-standard retaining wall is any wall not meeting the definition of a standard wall.

H. Product-Specific Information

Product-specific information describes the behavior, performance characteristics or qualities of a material or interacting materials or components and is based on results of standardized tests.

I. Retaining Wall

A retaining wall is a structure used to support a soil or rock embankment or slope in a vertical or near-vertical configuration in which it would otherwise be unstable because of gravitational forces or applied loads.

J. Soil or Rock Nail

Nailing is the reinforcement of slopes by installing anchors in horizontal or near-horizontal, pre-drilled holes in the soil or rock, usually followed by shotcreting of the slope face. The anchors are not tensioned although they may be proof-tested to confirm the efficiency of the anchor/grout/soil or rock interaction. A fascia wall usually covers the shotcrete surface.

K. Standard Retaining Wall

A standard retaining wall is a free-standing, cantilever or counterfort wall consisting of cast-in-place, reinforced concrete designed according to *AASHTO Standard Specifications for Highway Bridges*, latest edition.

L. Tiered Walls

Retaining walls constructed one behind the other, each wall creating a

bench or step, resulting in a terraced slope.

M. Utility Assignments

The pre-assigned horizontal and vertical positions of the utilities in the street right of way or easement.

N. Wall Height

The vertical distance from the top of the footing, or lowest structural component, to the top of the wall measured along the exposed face of the wall.

O. Wall Systems

Retaining walls whose performance relies on multiple components acting together as an integral unit. Examples are mechanically stabilized earth retaining walls and walls of any type with underdrains, filter media and porous backfill.

11.3.2 Use of Standard / Non-Standard Walls

Standard retaining walls will routinely be permitted in the street right of way or easement provided the requirements in this section have been satisfied. Non-standard walls will be considered on a case-by-case basis and may be permitted by the City Engineer, depending on wall type, wall height and layout, proximity to buried utilities, industry acceptance, availability of test data covering characteristics and performance of the proposed materials and documented long-term performance of similar walls in similar applications.

11.3.3 General Requirements

Retaining walls, regardless of type or height, must be designed by engineers licensed in the State of Texas, using current industry standards and accepted engineering practices. Retaining walls, regardless of type, must be constructed of materials meeting City of Round Rock *Standards and Standard Specifications Manual*, where applicable, or ASTM or AASHTO materials and test specifications. Walls for which there are no published, nationally recognized, design criteria or for which there are no ASTM or AASHTO materials or test specifications will not be permitted.

Conditional or incomplete designs will not be accepted for City review. All aspects of design must be addressed and clearly conveyed in the drawings and specifications.

Tiered walls and back-to-back walls will be permitted only under special circumstances and only with the approval of the City Engineer.

Retaining walls must be designed for external and internal stability. The design must include, as necessary, the effects of water or wastewater line breaks, the effects of inundation and rapid drawdown resulting from flooding or stormwater detention or retention, including hydrostatic pressures, internal erosion, and alteration of engineering characteristics and behavior of foundation and backfill materials. The walls must be designed to support, where applicable, surcharge

loads from traffic or structures and lateral loads from nearby guardrail or street light footings. Wall design must consider scour at the base, where appropriate.

Walls consisting of pre-cast segmental units, whether these units are facing or structural elements, must have a coping or capstone at the top of the wall. The coping may be pre-cast or cast in place. The coping or capstone must extend above the adjacent ground at least 4 inches (100 millimeters). If cast in place, the coping must be reinforced and must have control and expansion joints to accommodate differential movements in the wall. Pre-cast coping and capstone must be affixed to the upper layer of segmental wall by using epoxy, non-shrink grout or other methods or material as recommended by the manufacturer, appropriate for the material and installation.

Walls constructed using flexible facing elements, such as welded or woven wire, will be permitted only in drainage channel applications not affecting or related to roadway embankment. Metal prefabricated modular walls will not be permitted.

Where retaining walls are used as the exterior walls in stormwater retention structures, the walls must be cast-in-place reinforced concrete made watertight by using water stops in joints and using underdrains behind the walls, as necessary. Where retaining walls are used as the exterior walls in stormwater detention structures and the walls are not watertight, then the walls must be designed to provide free drainage of the backfill following drawdown.

11.3.4 Wall Location and Layout

A. General

The City will assume maintenance responsibility only for those walls in street right of way that support:

- 1) roadway embankment;
- 2) cut slopes that would experience mass instability without support provided by the retaining walls, or
- 3) channel slopes in drainage easements.

Retaining walls constructed only to control localized raveling or degradation of cut slopes or to cover or cosmetically treat cut slopes for purposes of enhancing or altering their appearance rather than leaving them in a natural condition must be built on private property and must be privately owned and maintained. Only in special cases approved by the City Engineer will retaining walls that support private property be allowed in public right of way. License agreements will be required for all retaining walls in the right of way that support private property.

In street right of way, a minimum of 36 inches (1 meter) of protective soil or rock cover must be provided over the upper layer or row of external structural components such as geogrid, strips, bars, tie bars or buried pre-cast units.

Utility mains and service lines must not pass through or under a retaining

wall unless the utility is installed in an encasement pipe meeting the approval of the affected Utility. The encasement pipe must extend beyond the retaining wall a sufficient distance to insure that future excavation to expose the ends of the casing will not endanger any external structural component of the wall, will not threaten the stability of the wall itself and will not encroach upon any components of the wall system. For utility services, the encasement pipe must extend from the main to the property line and must be large enough to pass valves, connections, couplings and other components that are integral parts of the service.

B. In Streets and Utility Easements

Utilities, utility appurtenances, and pavements have priority over retaining walls in street right of way and utility easements. As a consequence, retaining wall layout must take into account utility assignments in addition to allowing for future utility installation and future excavation for utility maintenance and repair, including mains as well as services. No component of the retaining wall that is essential to the stability of the wall or wall system (such as footings, underdrains, strips, geogrid, bars, tie bars, or buried pre-cast units) can be within the excavation / backfill zone of any utility main or service regardless of the type of utility. The wall or wall system must be stable under any scenario involving utility excavation in the excavation / backfill zone. External components of the retaining wall, such as geogrid, anchors, strips, tie bars or buried pre-cast units, which are essential to stability of the wall, cannot extend beyond the back of curb, under the street, or into utility easements unless the external components are at least 10 feet (3 meters) below the street surface and at least 3 feet (1 meter) below the deepest utility.

The distance between the street-side face of the wall and the back of curb must be such that sidewalk and ramps can be accommodated, but in no case can this distance be less than 5 feet (1.5 meters), with provisions for pedestrian and vehicular railing, as needed.

11.3.5 Structural Requirements

Retaining walls must be designed according to Division I Section 5 of AASHTO *Standard Specifications for Highway Bridges*, latest edition. The following additional requirements apply, depending on type of wall.

A. Design Life

Design must be based on a 100-year service life that, from a structural standpoint, is essentially maintenance-free.

B. Cast in Place Concrete

Joints, including waterstops where applicable, must be provided according to ACI Manual of Concrete Practice Standard 224.3R Chapter 8, latest edition.

C. Conventional Segmental Gravity Walls (without mechanically stabilized

backfill)

Internal stability of segmental gravity retaining walls without mechanically stabilized backfill (mortared or dry-stack rock, boulders or pre-cast concrete units) must be analyzed according to NCMA Design Manual for Segmental Retaining Walls, latest edition. The minimum factor of safety for internal shear capacity must be at least 1.5 if product-specific information is available; otherwise, it must be at least 4. External and overall, or global, stability shall be analyzed according to AASHTO Standard Specifications for Highway Bridges, latest edition.

D. Soil and Rock Nailing

Soil and rock nail walls must be designed according to FHWA Manual for Design & Construction Monitoring of Soil Nail Walls, latest edition, and the University of Texas Center for Transportation Research Report 1407-1F, Rock Nail Design Guidelines for Roadway Cuts in Central Texas, latest edition. Steel anchors must be corrosion-protected by epoxy coating or by encapsulation. Steel anchors protected only by grouting will not be permitted. In all cases, rock nails must be used in conjunction with shotcrete and a fascia wall.

Surface drainage must be prevented from infiltrating behind the wall or flowing over the wall by installing an interceptor ditch behind the top of the wall. To control groundwater seepage, composite geosynthetic face drains must be installed on the exposed rock face before shotcreting. The face drains must extend the full height of the wall and must connect to a base drain that discharges from behind the wall in a manner that water is not directed onto the adjacent sidewalk or into the street.

11.3.6 Material Requirements

Materials must meet the requirements of the City of Round Rock Standard Specifications Manual, where applicable. Otherwise, they must meet the requirements of the applicable Sections in Division II of AASHTO *Standard Specifications for Highway Bridges*, latest edition.

11.3.7 Internal Drainage

Retaining wall backfill must be free-draining, non-expansive material that is non-aggressive to external structural or drainage components. Weep holes and underdrains must be provided as necessary to prevent hydrostatic loading caused by local groundwater seepage, surface water infiltration, floodwater inundation or by water and wastewater line breaks. Geotextile fabric or graded granular filters must be provided as necessary to prevent migration of fine-grained soil particles from the surrounding soils into the backfill and drainage media. The fabric or granular filter must be designed not only to prevent migration of fine-grained soil particles but also not to become clogged by those particles. Underdrains must not discharge where drainage can flow onto adjacent sidewalk or into the street.

11.3.8 External (Surface) Drainage

Surface runoff that flows toward the retaining wall from the retained slope must be collected in a vegetated or paved interceptor ditch behind the wall and transmitted to a stormwater inlet or let-down structure to prevent water from flowing over the wall, collecting in low points behind the wall or eroding the slope at the ends of the wall.

11.3.9 Maintenance Provisions

A 20-foot (6 meters) wide truck-accessible maintenance access zone must be provided at the base of walls higher than 10 feet (3 meters) that support roadway embankment. The maintenance access zone must be free of obstacles to vehicles, relatively smooth and level, all-weather accessible, and able to support loads from maintenance vehicles. The maintenance access zone may consist of easement or right of way, or both.

11.3.10 Safety Provisions

Handrail must be provided on any wall that supports roadway embankment where the wall height exceeds the distance between the street-side face of the wall and the closest edge of the sidewalk or, in the absence of a sidewalk, the back of curb. Handrail must be provided on any wall not supporting roadway embankment if the ground surface behind the wall slopes toward the wall and this surface is part of a park, playground, single or multi-family residence. A chain link fence may be preferable to and substituted for handrail in many of these installations.

A roadside barrier, such as metal beam guardrail or concrete barrier curb, must be provided wherever the height of a wall supporting roadway embankment exceeds 6 feet (1.8 meters) for local streets and 3 feet (1 meters) for collector and arterial streets, or the distance between the back of curb and street-side face of the wall is less than 10 feet (3 meters), regardless of street classification. Roadside barriers must be designed according to the latest editions of *AASHTO Roadside Design Guide* and *AASHTO Standard Specifications for Highway Bridges*.

11.3.11 Warning Devices

Walls supporting roadway embankment and having structural components (geogrid, strips, tie bars, or pre-cast units) extending behind the wall must have plaques placed in the coping or capstone along the top of the wall at intervals not exceeding 100 feet (30 meters). The plaques must be made of durable metal, at least 5 inches (125 millimeters) by 8 inches (200 millimeters), with ½ inch (12.5 millimeters) raised lettering that reads “Do not excavate between the retaining wall and street / No excave entre el muro de contención y la calle.” The plaque must have at least two studs attached to the back so it can be mounted flat against the coping or capstone by inserting the studs into holes drilled into the side or top of the coping or capstone. The plaque must be set in epoxy or non-shrink grout covering the mounting surface and filling the holes.

Walls not supporting roadway embankment, but having structural components (geogrid, strips, tie bars, or pre-cast units) extending behind the wall must have warning plaques as described above but which say “Do not excavate behind the wall within ____ feet / No excave detrás del muro de contención dentro de una distancia de ____ meters.”

Warning tape must be placed 6 inches (150 millimeters) above the uppermost layer of geogrid or strips used in MSE walls. The tape must be placed in a criss-cross pattern on 24-inch (600 millimeters) spacing.

11.3.12 Supplemental Construction

Conduits must be installed adjacent to retaining walls that support roadway embankment wherever geogrid, tie bars, rods or pre-cast units extend behind the wall. Two 4-inch (100 millimeters) diameter, Schedule 40 polyvinyl chloride (PVC) pipes must be provided between the retaining wall and street, parallel to the back of curb along the entire wall, to provide for future installation of utilities such as communications cables. Pull-boxes must be installed at the ends of the pipe and at intermediate points, as appropriate, but in no case shall the distance between pull-boxes exceed 200 feet (60 meters).

11.3.13 Geotechnical Information

A geotechnical investigation must be performed for retaining walls constructed on fill, on soils subject to shrink/swell behavior and on soils mapped (See Garner, L. E., and K.P. Young, *Environmental Geology of the Austin Area: An aid to Urban Planning*, Bureau of Economic Geology, University of Texas at Austin, Report of Investigations No. 86, 1976) as Taylor Clay, Del Rio Clay, or Eagle Ford Formation, as well as for walls higher than 10 feet (3 meters) regardless of the subsurface materials and conditions.

11.3.14 Construction Drawings

The drawings must contain a design summary report listing the design assumptions, material properties and all factors of safety and reduction factors compared to the recommended values or criteria in the AASHTO, NCMA or FHWA design criteria, whichever applies, and in the project geotechnical report.

The retaining wall and any external structural elements, such as geogrid, tie bars or pre-cast units, must be shown on the plan and profile sheets for street, drainage and utility construction and on the site plan for drainage structures so that the location of the retaining wall and related components will be obvious to anyone reading the drawings.

The drawings must contain a separate plan and profile sheet for the wall itself, drawn to a 1 inch = 30 feet (1 to 400), or larger detail plan view and 1 inch = 3 feet (1 to 40), or larger detail profile view. The plan view drawing must show all buried utilities, structures and other constructed features, both existing and proposed, within a horizontal distance of 2 times the wall height. The following must be included: wastewater mains, services and manholes; stormwater drainage pipe, inlets, junction boxes and manholes; water mains, services and hydrants;

electrical lines and services; gas mains and services; communications and entertainment lines and services; pavement curb and gutter; sidewalk; guardrail, pull boxes, sign footings, street light footings, and the limits of geogrid, strips, tie bars or nail tendons or rods and other features as required.

The profile view drawing must include the top of wall elevations, footing elevations, locations of changes in top of wall; locations of warning plaques; the elevations of each layer of geogrid, strips or tie bars, if used; the existing ground line at the base of the wall; the proposed ground line at the back of wall; all utilities shown on the plan view, and other features as required. Exact locations of existing utilities must be provided, based on “pot holing” if necessary.

The drawings must contain cross-sections of the wall at points where the wall height is maximum, where drainage structures penetrate the wall, where the utility excavation / backfill zone is most critical and where structures behind the wall fall within the zone of geogrid, strips, tie bars or pre-cast units, if used. The cross sections must be drawn to scale and must show utilities, utility excavation / backfill zone, sidewalks, pavements, wall units, backfill, filter fabric, handrail, guardrail, geogrid, strips, or tie bars, inlets, headwalls, the existing ground line, and other features as required.

Typical sections of the wall must be provided, showing all components necessary to construct the wall and appurtenances.

Details of appurtenances such as handrail, guardrail and headwalls, must be included in the drawings.

11.3.15 Technical Specifications

Technical specifications must describe all materials that comprise the wall, using City of Round Rock Standard Specifications Manual, where applicable. Specific—rather than generic—products, brands, models or styles should be referenced, if possible, and locally produced materials should be specified by producer and product designation, listing alternative sources and products. Alternately, materials may be specified by their composition and physical and chemical properties and characteristics, in which case, the design engineer and the City must approve each product, based on the contractor’s submittals including the requisite test results and certifications.

The specifications must state that the contractor, producer or manufacturer are responsible for quality control testing during production or manufacture of the materials and for testing of materials for the purpose of demonstrating, before construction, that they meet the project specifications. The specifications must also require that a Texas-licensed professional engineer certify that the materials meet the project specifications. Test results, including a summary comparison of the tests to the project specifications, must be submitted with the certification. The certification must be accepted by the City before construction. This testing and certification is to be performed at no cost to the City and is separate from and precedes quality control testing performed by the City during construction.

All materials that comprise the wall appurtenances, such as guardrail and hand-

rail, must be described.

The specifications must state that chipped, cracked or honeycombed pre-cast concrete units, and marred or damaged geosynthetic, metal straps, tie bars or other components must not be incorporated into the project.

11.3.16 Shop Drawings / Materials Tests

The specifications must require submittal of shop drawings, concrete mix designs, and other technical information, as required, for pre-cast wall components, geogrid, strips, tie bars, filter fabric and other components of non-standard walls.

11.3.17 Changes in Design or Materials

Material substitutions or changes in wall components, design or configuration are not permitted after the City has issued a development permit unless revised drawings and, if required, revised technical specifications are submitted for City review and approval before construction.

11.3.18 License Agreements / Construction Waivers

License agreements are required for all retaining walls in the right of way that do not support roadway embankment or drainage channel slopes.

Construction waivers may be granted for retaining walls less than 3 feet (1 meter) high and not supporting roadway embankment.

11.4.0 BRIDGES

11.4.1 Structural Requirements

Bridges must be designed according to the latest edition of AASHTO Standard Specifications for Highway Bridges, latest edition, or AASHTO LRFD Bridge Design Specifications, latest edition.

11.4.2 Material Requirements

Materials must meet the requirements in City of Round Rock Standard Specifications Manual, where applicable. Otherwise, they must meet ASTM and / or AASHTO requirements.

11.5.0 CULVERTS / STORMWATER DRAINAGE PIPE

11.5.1 Structural Requirements

Culverts must be designed according to the latest edition of AASHTO *Standard Specifications for Highway Bridges* or AASHTO *LRFD Bridge Design Specifications*.

11.5.2 Material Requirements

Materials must meet the requirements in City of Round Rock Drainage Criteria Manual and Standard Specifications Manual, where applicable. Otherwise, they must meet ASTM and / or AASHTO requirements.