



Facilities Planning and Construction Design and Construction Standards

DIVISION 32 - Exterior Improvements

Preface

The Texas Tech University System's 'Design and Construction Standards', as administrated by Facilities Planning and Construction, are intended to serve as guidelines to the Design Professional and Construction Management teams for design development and construction administration of Texas Tech University System (TTUS) Capital Projects. They communicate the minimum expectations and requirements relative to specific building systems, design provisions, general specification requirements, and administrative procedures for new facilities being constructed on Texas Tech University System (ASU, MSU, TTU, TTUHSC, and TTUHSC El Paso) campuses. Several, but not all requirements for each component Institution or Agency within the TTU System are covered. Design Professionals, Construction Managers at Risk and/or Design-Build Firms shall also refer to provisions covered in their service Agreements, as well as within the project's Basis of Design (BOD) document.

In addition, the 'Design and Construction Standards' shall also be utilized in conjunction with the approved project specific Program and Schematic Design development. In the event of conflict between this document and specific project requirements, Design Professionals, Construction Managers at Risk and/or Design-Build Firms shall contact Facilities Planning & Construction for clarification.

The guidelines within the 'Design and Construction Standards' are not intended to prohibit the use of alternative design solutions, methods, systems, products or devices not covered in this document. Offered alternatives deviating from or not covered in these standards shall be documented by the Design Professional and/or Construction Management teams and submitted to Facilities Planning & Construction for approval prior to implementation.

Throughout the 'Design and Construction Standards' there are references to manufacturer specific products. These are to be considered the 'Basis of Design' to establish the expected

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minimum quality requirements. Design Professionals are encouraged to identify and include equivalent products and/or manufacturers offering comparable products to facilitate open bidding environments.

General Requirements for Exterior Improvements

Conform with requirements as indicated within this Design and Construction Standard.

TTU Grounds Maintenance is the Authority Having Jurisdiction (AHJ) for Division 32 Exterior Improvements.

32 12 16 Asphalt Paving

Asphalt paving is to be specified, constructed, and tested to meet the following requirements:

1. Hot Mix Asphaltic Concrete Pavement – Texas Department of Transportation (TxDOT) Item 340, Type C or D, most current specification. Mixing and Placing practices by the Asphalt Institute in their publication, MS-22, Principles of Construction of Hot-Mix Asphalt Pavements, current edition.
2. Hot Mix Asphaltic Concrete Base – TxDOT Item 340, most current specification,
3. Flexible Base Material – TxDOT Item 247, most current specification.

Design mix should be specified based on Performance Grade (PG) specification for asphalt binder grades used in hot mix asphalt (HMA) for the Lubbock area and approved by TTU Grounds Maintenance. All asphalt shall be a Performance Grade PG64-28 or better. For parking lots, a minimum of PG64-28 Type D asphalt will be specified. For roadways Specify Type C asphalt and the Performance Grade will be specified by the Design Professional with approval from the FP&C Design Team and TTU Grounds Maintenance.

If seal coating is specified, for parking lot seal coating, a minimum of TxDOT Tier 2 (medium traffic) will be specified, and for roadways seal coating, TxDot Tier 1 (heavy traffic) will be specified.

The thickness of the pavement section elements shall be recommended by the geotechnical consultant based on soil conditions and anticipated traffic loadings. The thickness of HMA C

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surface shall be a minimum of (2) inches.

Specify to furnish and provide all the submittals, labor, materials, and equipment necessary to deliver, place and compact Hot-Mix Asphalt Concrete (HMAC) pavement including prime coat and tack coats as shown and detailed on the Drawings.

Materials, parameters, and methods shall be in basic conformance with the TxDot Standard Specifications for Construction of Highways, Streets and Bridges, latest edition, and applicable ASTM standards.

Submit the Job-Mix Formula and mix design reports and laboratory test results for Base Course and Surface Course mixtures. Submit the Aggregate gradation test reports for coarse and fine aggregates used for Base Course and Surface Course mixtures. Submit the TxDot Mixing Plant certification documentation.

Coarse aggregate material to be sound, angular crushed stone complying with ASTM D692. Fine aggregate material shall comply with ASTM D1073. HMAC materials shall be hauled in trucks previously cleaned of all dirt and foreign material with the load completely covered. HMAC materials shall be delivered so that HMAC can be placed and rolled during daylight hours. Verify that the subgrade is dry and in suitable condition to support paving and imposed loads.

Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course. Ensure that prepared subgrade is ready to receive paving.

The Owner may engage a qualified independent testing agency to perform field inspections and tests, and to prepare test reports. When such testing indicates that Contractor's work does not comply with the specified requirements, additional testing shall be performed by the Owner's testing agency at no additional cost to the Owner to determine compliance of corrected Work with the specified requirements. Owner's material testing lab sampling at asphalt mixing plants outside of Lubbock County will be paid for by the Contractor.

32 13 13 Concrete Paving

All concrete products shall be designed, formed, transported, placed, tested, and finished in strict accordance with the American Society for Testing and Materials (ASTM) and the American Concrete Institute's (ACI) requirements.

Batch design mix will be specified by the Design Professional. Manufacturer's batching mixture and reinforcement certificate (when applicable) must be approved by the Design Professional and Owner's Representative prior to installation.

Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities. Delivery tickets shall be furnished with each load of concrete delivered to the project. Ticket shall show class and strength of concrete, number of pounds of cement, size of coarse aggregate, batching time, slump ordered and amount of admixture. Indicate amounts of mix water to be withheld for later addition at project site.

Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

Provide minimum 4" thick fiber mesh concrete for sidewalks as follows:

1. Compressive Strength: 4,000 psi
2. Slump: 3 to 5 inches
3. Air Entrained: 5.0 percent maximum. ($\pm 1\%$)

Provide minimum 8" thick concrete paving with steel reinforcement for roadways and fire lanes as follows:

1. Compressive Strength: Minimum 5,000psi, per Design Professional
2. Slump: Per Design Professional
3. Air Entrained: Per Design Professional
4. Steel Reinforcement: Per Design Professional

Unless otherwise discussed, provide concrete finishing as follows:

1. Concrete Paving: Heavy broom finish.
2. Sidewalk Paving: Light broom, radius to 3/8" radius, and trowel joint edges.
3. Direction of Texturing: Transverse to direction of traffic.
4. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions. Provide additional curing methods in harsh weather as directed by the Architect.

Pedestrian walkways will be provided on the campus in a variety of scales depending upon their location and use requirements. Major pedestrian walkways shall be between fourteen feet and twenty feet in width. Minor pedestrian walkways will be between eight feet and twelve feet in width. Testing of composite samples of fresh concrete obtained according to ASTM C 1702 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 1703, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
6. Compression Test Specimens: ASTM C 31; cast, mold and cure one set of four standard 6"X12" test cylinder specimens or five 4"X8" test cylinder specimens for each composite sample.

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7. Compressive-Strength Tests: ASTM C 39; for 6"X12" cylinders test one cured specimens at seven days for information only and two at 28 days to average compressive strength. Hold one sample for re-testing if required. For 4"X 8" cylinders test one cured specimens at seven days for information only and three at 28 days to average compressive strength. Hold one sample for re-testing if required.
 - a. A compressive-strength test shall be the average of the strengths of at least two 6"X12" cylinders or at least three 4"X8" cylinders made from the same sample of concreted and tested at 28 days.
8. Testing specimens are to be taken after all admixtures and/or field added water has been added and incorporated into concrete.

Defer joint filling until concrete has cured and per sealant manufacturers recommendations.

Concrete Curb and Gutter

All concrete products shall be designed, formed, transported, placed, tested, and finished in strict accordance with the American Society for Testing and Materials (ASTM) and the American Concrete Institute's (ACI) requirements.

Concrete and the equipment, workmanship and materials thereof, shall conform to applicable requirements of Division 3 of the contract specifications, except as hereinafter specified.

Concrete shall be standard-weight fiber mesh with minimum compressive strength of 4,000 psi at 28 days. Concrete shall have a slump of not more than 3 inches.

Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

Expansion joint filler material shall be asphalt-impregnated fiber strips 1/2" thick unless otherwise shown on drawings, Celotex "Fexcell" or equal, and shall be cut and shaped to the cross section of the curb, gutter and combination curb and gutter. Expansion joints shall be provided at ends of all returns and shall be provided directly opposite expansion joints of abutting concrete pavement and shall be of same type and thickness as joints in the pavement. Where curb and combination curb and gutter do not abut concrete pavement, expansion joints at least 1/2" in width shall be provided at intervals not exceeding 100'-0" unless the Drawings

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indicate joints at closer intervals. Expansion joints in gutter sections shall be sealed using same material as used for concrete paving.

Contraction joints shall be constructed by means of 1/8" thick separators, or a section conforming to cross section of the curb and combination curb and gutter. Contraction joints shall be constructed directly opposite contraction joints in abutting concrete pavement. Where curb, and combination curb and gutter, do not butt concrete pavements, contraction joints shall be so placed the monolithic sections between curb returns will not be less than 5'-0" nor greater than 15'-0" in length, generally 10'- 0" is acceptable. Separator shall be removed as soon as practicable after the concrete has set sufficiently to preserve width and shape of joint. After separator plates have been removed, all exposed edges of joints shall be rounded with proper edging tool to a radius of 1/4". Contraction joints may also be formed with a jointing tool after surface is finished to a minimum depth of 3/4".

Edges of gutter and top of curb shall be rounded with an edging tool to a radius of 1/4", and surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. The floated surfaces shall then be brushed with longitudinal strokes, using a fine-hair brush. Immediately after removing front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. While still wet, the surface shall be brushed in same manner as gutter and curb top. Top surface of gutter shall be finished to grade with a wood float. Except at grade changes or curbs, finished surfaces shall not vary, from testing edge of a 10-foot straight-edge, more than 1/8" for gutter and 1/4" for top and face of curb. Irregularities exceeding the above shall be satisfactorily corrected. Visible surfaces and edges shall be free of blemishes and form and tool marks, and shall be uniform in color, shape and appearance.

32 14 00 Unit Paving

A mockup may be requested by the Owner to demonstrate selections, aesthetics, and installation execution.

Do not use frozen materials or build on frozen subgrade or setting beds. Install bituminous setting bed only when ambient temperature is above 40 deg F and when base is dry. For Mortar

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and Grout, comply with cold and hot weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Do not apply mortar to substrates with temperatures of 100 deg F and higher.

Brick Pavers - 2 ¼" X 4" X 8" dense hard clay manufactured by Summit Brick Company, PUEBLO PLANT, 601 E 13th St., Pueblo, CO, 81001 - (seven19) 542-82seven8. Pavers must meet the requirements of *ASTM C 902 Standard Specification for Pedestrian and Light Traffic Paving Brick*, Application PS, Class SX. Pavers are to be Modular units, GRAIN texture, one-to-one ratio blended, Summit Brick 600/800 Series - 653 Inca (red clay) and 853 Andiron (charcoal black). Grounds Maintenance Department can provide Double T logo'd pavers for additional fee.

Graded Aggregate for base is to be sound, crushed stone or gravel. Sand for leveling course is to be sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate. Sand for joints is to be fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.

Do not exceed 1/16-inch unit-to-unit offset from flush (lippage) or 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.

Compact soil subgrade uniformly to at least 95 percent of ASTM D 698 laboratory density. Place leveling course and screed to a thickness of 1 to 1-1/2 inches, ensuring that moisture content remains constant, and density is loose and uniform until pavers are set and compacted. Treat leveling course with herbicide to inhibit growth of grass and weeds. Set pavers with a minimum joint width of 1/16 inch and a maximum of 1/8 inch, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch with pieces cut to fit from full-size unit pavers. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500 to 5000-lbf compaction force at 80 to 90 Hz. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

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Porous Unit Paving (Concrete Grid Pavers)

A mockup may be requested by the owner to demonstrate selections, aesthetics, and installation execution.

Concrete brick pavers to be Pavestone Grasstone II, 3 1/8" X 23 5/8" X 15 3/4" made from normal-weight aggregates complying with ASTM C 1319. Colors to be selected by Design Professional and Owner.

Graded aggregate for base course to be sound crushed stone or gravel. Sand for leveling course to be sound, sharp, washed, natural sand or crushed stone complying with requirements in ASTM C 33 for fine aggregate.

Soil for porous paving fill to be planting soil mix complying with requirements.

Do not exceed 1/16-inch offset from flush in plane variation between adjacent Units (Lipping).

Do not exceed 1/8" in 24" and 1/4" in 10 feet or a maximum of 1/2" in variation from level or indicated slope.

Provide edge restraints as indicated. Install edge restraints before placing unit pavers.

Compact soil subgrade uniformly to at least 95 percent of ASTM D 155seven laboratory density.

Place drainage geotextile over prepared subgrade, overlapping ends and edges at least 12 inches. Place aggregate base, compact to 95 percent of ASTM D 155seven maximum laboratory density, and screed to depth indicated. Place leveling course and screed to a thickness of 1/2-inch, ensuring that moisture content remains constant, and density is loose and constant until pavers are set and compacted.

Set unit pavers on leveling course, being careful not to disturb leveling base. If pavers have lugs or spacer bars to control spacing, place pavers hand tight against lugs or spacer bars. If pavers do not have lugs or spacer bars, place pavers with a 1/16-inch- minimum and 1/8-inch- maximum joint width. Align pavers with string line. Compact pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf compaction force at 80 to 90 Hz. After filling pavers with soil, sow seed at half the rate specified for seeding lawns. Sweep seed from surfaces of pavers into voids and water with fine spray. Spread an additional 3/16 inch of soil fill over seed and soak with water.

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Contractor is to water newly planted grass and keep moist until grass is established.

32 17 13 Parking Bumpers

Concrete Parking Bumpers (or equal)

<http://www.vaughnconcreteproducts.com/products>

32 17 23 Pavement Markings

Preinstallation Conference is required. Do not apply pavement-marking paint until layout, colors, and placement have been verified and approved with Owner.

Accessibility Standards: Comply with applicable provisions in 2012 Texas Accessibility Standards.

Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

Paint for parking spaces (straight and of uniform 4" width), lanes and restricted areas shall be yellow, traffic rated paint conforming to requirements in **TxDOT specification Item 666**, Type II. Paint for fire lanes shall be red with white stencils, traffic rated paint conforming to requirements in **TxDOT specification Item 666**, Type II. The minimum wet film thickness for all painted pavement areas (asphalt or concrete) shall be 15 mils by means of conventional traffic line striping equipment. Accessible ADA parking spaces are required to be scoped with **yellow** ADA wheelchair pavement logos. NOTE: ADA Wheelchair symbol **must face right**.

Allow bituminous pavement to cure for minimum 21-days before application of paint. Allow sealers to dry minimum 48-hours before application of paint. For existing and new pavement, surfaces to receive paint shall be thoroughly cleaned and entirely free of loose sand, stones, dust, oil, grease, water, and other substances that will be deleterious to the paint or will adversely affect the adhesion of the paint. Do not apply paint during high wind (over 15 miles per hour) or high humidity (over seven (7%) percent relative humidity). Apply paint only when ambient temperature is 40 degrees F and rising but not more than 95 degrees F.

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Traffic shall not be permitted to use the painted areas for a minimum of 60 minutes after painting has been completed.

32 17 26 Tactile Warning Surfaces

Furnish truncated warning surface composite tiles cast in concrete. Install as indicated on drawings or specified.

Basis of Design: ADA-C truncated cast in place tiles manufactured by Armor-Tile or approved equal. Tiles shall be Colonial Red in color.

32 31 19 Decorative Metal Fences and Gates

Decorative Steel Fences: Fences made from steel tubing, bars and shapes.

Basis of Design: Ameristar Fence Products, Montage Plus (Majestic), Permacoat in Bronze (corrosion tested), Fully Welded Panel w/ Profusion Technology, Epoxy Coated surface protection, 20-year warranty, made in the USA.

Pickets: ¾" square (18-gauge min.)

Rails: 1 ½" x 1 7/16" ribbed channel rails (14-gauge min.)

Posts: 4" square posts (12-gauge min.); spacing 95" max.

Height: 84" min above grade

Footing: 36" min post footing set in 3,000psi concrete with integral mow strip

Brackets, Fasteners: Security fasteners required; matching fence finish

Gates: Montage Plus gate options (swing gates or sliding gates)



32 32 23 Segmental Retaining Walls

A preinstallation conference is to be conducted at Project site.

Engage a qualified professional engineer to design segmental retaining walls. Structural performance and design shall be in accordance with NCMA's Design Manual for Segmental Retaining Walls and based on the Design Professional's requirements.

Provide Product Certificates for each type of segmental retaining wall unit manufactured.

Testing Agency providing data must be qualified according to ASTM E 329. Indicate location of material manufacturer and point of extraction, harvest, or recovery for each raw material.

Provide samples for each color and texture of concrete unit specified.

Mockups are required to verify selections made under Sample submittals and to demonstrate aesthetic effects.

Build mockup of segmental retaining wall as indicated on Drawings approximately 72 inches long by not less than 36 inches high above finished grade at front of wall. Include typical soil reinforcement, typical base and cap or finished top construction, and backfill to typical finished grades at both sides of wall.

Preconstruction Testing: Engage a qualified testing agency to perform the following preconstruction testing:

- Soil reinforcement and backfill materials for pullout resistance according to ASTM D 6706.
- Soil reinforcement and backfill materials for coefficient of friction according to ASTM D 5321.

Concrete Units: ASTM C 1372, Normal Weight. Maximum water absorption shall not exceed 7 percent by weight and units shall not differ in height more than plus or minus 1/16" from specified dimension. Units must be consistent in color with little variegation.

Examine areas and conditions, with Installer present, for compliance with requirements for excavation tolerances, condition of subgrades, and other conditions affecting performance of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.

32 33 00 Site Furnishings

Site Benches shall comply with the campus standard, as fabricated and provided by TTU Grounds Maintenance, unless noted otherwise. Refer to Appendix C.

Site benches consist of steel ends with sealed cedar wood slat seats and backs with steel frame support and square tube posts.

Site benches are installed either set into the ground with cast in concrete footings or bolted to concrete paving with seats at 17" above grade. Site benches are offered in 72" and 96" lengths (24" tall seat backs with 24" deep seats), with Double T logo at the arm rest ends. These Site benches are preferred over premanufactured steel benches as all metal bench seats get too hot in the summer months to sit on. In addition, these benches conform with the TTU Master Plan standard requirements and are a more cost-effective solution.



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Tables / Umbrellas shall be steel, *Carousel* with *Solstice* umbrellas as manufactured by *Landscape Forms*, in bronze. Provisions for accessible seating is to be provided.

https://www.landscapeforms.com/en-us/Product%20Data/LF_Carousel_ProductData.pdf

<https://www.landscapeforms.com/en-US/product/Pages/Solstice-Umbrella.aspx>

Trash Receptacles shall be 30-gallon (25" X 33" top opening) *Scarborough* flat top litter receptacle as manufactured by *Landscape Forms*. Trash receptacles shall be of steel construction with bronze colored powder coated finish bolted to hardscape paving.

<https://www.landscapeforms.com/en-US/product/Pages/Scarborough-Litter-Receptacle.aspx>

Bike Racks shall be provided adjacent to side or rear entrances of building(s) in areas that are not visually obtrusive. Bike racks shall be steel construction, hoop style in 10'-0" lengths as fabricated and provided by TTU Grounds Maintenance. Finish is to be bronze powder-coat. Confirm number required during design development and provide to TTU Grounds Maintenance for fabrication.



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Solar Pedestrian & Traffic Signs

<https://www.tapconet.com/solar-led-division/pedestrian-crosswalk-solutions>

Steel Bollards (refer to Division 05 – Metals)

Concrete Bollards located in the Historic and Moderate Historic Districts of the campus shall be traditional design equal to offerings from Wasau Tile; constructed of a colored spun or cast concrete. In the HSC/Research District and the Museum District, bollard materials may be cast stone, concrete, or GFRC.

<http://www.wausaumade.com/products>

All products shall be covered against material and workmanship defects for three (3) years from date of substantial completion.

32 84 00 Planting Irrigation

Please reference Appendix A for the TTU Grounds Maintenance’s Irrigation Systems Specification. The specification is intended to be a guideline for development of the Landscape Architect’s specification. It is not to be issued as the specification for the project.

The sprinkler system shall use the most current models of Hunter sprinkler heads and Hunter ICV Series electric valves. Controller shall be Rain Master DX3 with remote communications device. Any substitution request shall be submitted with samples, catalog sheets, and specifications to the Texas Tech Office of Grounds Maintenance no later than two weeks prior to bid date.

Valve boxes for electric, manual, and gate valves shall be 18-inch diameter, 24-inch depth and shall have corrugated galvanized steel sides with cast iron tops and lids.

Controller shall be enclosed in an 18-gauge Jet Coat cold rolled steel cabinet with a powder-coated polyurethane finish suitable for wall or pedestal mounting.

The main supply lines shall be Class 200 PVC pipe approved with Schedule-40 PVC fittings

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approved for potable water systems. All fittings 6 inches and larger, ring-tite pipe shall conform to commercial standard CS-256-63 and be furnished with ring-tite joints. The ring-tite joint shall be an integral part of the pipe with thickened wall at the bell. All pipe and couplings shall be joined by means of rubber ring gaskets. The lateral water lines shall be Class 200 PVC pipe approved for potable water systems. All PVC pipe shall conform to commercial standard CS-256-63 and be furnished with solvent weld joints.

Concrete thrust blocks are required at all turns, dead ends, etc., on pipe sizes 3 inches and above in diameter and on pipe of smaller size, if so directed by the University Representative so that pipe will not be forced out of slip joints of fittings as a result of internal water pressure and/or expansion and contraction.

Provide reduced pressure backflow preventer meeting City, County, State and Federal requirements. Backflow assemblies shall be tested upon installation by a recognized Backflow Prevention Assembly tested and certified to be operational within specifications. A copy of the test report shall be submitted to the Owner with the completed as-built drawings. A copy of the test report shall be submitted to the City of Lubbock.

Ground or common wire shall be No. 12, white, Type UF Copper direct bury type made for the irrigation industry. Power wire for operation of equipment shall be No. 14, red, Type UF copper direct bury type made for the irrigation industry. Wiring shall be taped together at ten (10) foot intervals. Wiring shall be coiled at fifty (50) feet intervals. An electrical wiring plan shall be included with the As Built drawings.

The Contractor shall be a current Texas-licensed Landscape Irrigator who has completed irrigation systems similar in material, design, and extent to that indicated for project that have resulted in construction with a record of successful in-service performance.

The Contractor is responsible for providing the line tap and meter or tie-in to University irrigation mains. Meter location or irrigation well tie-ins are indicated on the drawings. The meter size shall be as required to supply the irrigation system with adequate water volume and pressure. Water meter may be obtained from the City of Lubbock or from local authority having jurisdiction for placement on the Texas Tech University Campus at no additional charge.

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Do not commence installation of underground irrigation system until equipment has been submitted and approved by the Texas Tech Office of Grounds Maintenance. A Licensed Irrigator or a Licensed Irrigation Technician employed by the irrigator shall be on the jobsite daily for direct supervision of employees on design, installation, maintenance or repair of the irrigation system including the connection of such system to the water supply.

Before installation is started, the Contractor shall place a flag where each and every sprinkler is to be located in accordance with the plans and the flagging shall be approved in writing by the Texas Tech Office of Grounds Maintenance before installation is started. Sprinkler heads and quick couplers shall be located 12 inches from any adjacent hard surface such as curbs, sidewalks, or buildings.

Contractor shall work in harmony with the University. Watering of plants and lawns shall be accomplished in conformity with the intent of the sprinkler system design. Contractor will not be allowed any extra compensation for any extra sprinklers, pipe, fittings, labor, etc., that may be necessary to accomplish full coverage due to any shifting of trees, plants and shrubs from the location on the plan for aesthetic reasons.

No machine trenching is to be done within the drip line of trees. Trenching shall be accomplished by hand, by tunneling, or by boring under the root system by a method approved beforehand by the Texas Tech Office of Grounds Maintenance.

It is understood that the piping layout drawing is diagrammatic, and that piping will be routed around trees and shrubs in such a manner as to avoid damaging plant materials. Where roots are encountered, no root over $\frac{3}{4}$ inches in diameter shall be cut without approval by the Texas Tech Office of Grounds Maintenance. Any cuts shall be clean, without frayed ends. Any roots encountered that are 2 inches and greater shall be tunneled under. In situations where trenching within the drip line of a tree is approved by Texas Tech Office of Grounds Maintenance, the initial cut of the side of the trench closest to the tree shall be made with a rock saw, to create a minimum 2 inch wide cut to the required depth; the remainder of the trench can then be excavated normally.

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Trenching shall be at depth to allow main lines minimum 24 inches cover and the lateral lines 18 inches cover. All trenching backfill shall be flooded in order to prevent settling. All settling and low areas that occur within the first twelve (12) months will be the responsibility of the Contractor to fill and level. All trenches shall be examined by the Texas Tech Office of Grounds Maintenance before backfilling. All trenches shall be backfilled with the material removed except where special backfill specifications of certain pipe may specify otherwise. In this case, the special backfill specifications shall take precedence over this general specification. All trenches backfill shall be flooded in order to prevent after settling. All settling and low areas that occur within the first twelve (12) months will be the responsibility of the Contractor to fill and level.

Provide drip irrigation near buildings and hardscape areas. Provide a sand filter for systems containing drip irrigation.

Provide seven-days written notice in advance of system start up and demonstration.

Before final acceptance of the installed system, the Contractor shall make the following tests under the supervision of the Texas Tech Office of Grounds Maintenance.

1. Perform hydrostatic test of piping and valves before backfilling trenches. Piping may be tested in sections to expedite work. Cap and subject the piping system to a static water pressure of 50 psi above the operating pressure without exceeding pressure rating of piping system materials. Isolate test source and allow to stand 4 hours. Leaks or a loss of more than 4 psi in test pressure constitute defects that must be repaired.
2. Each section of sprinklers shall be tested for coverage. Tests shall be made by actual measurement of the radius of spray of sprinklers.
3. Each section of sprinklers shall be tested for operating pressure at the sprinkler heads.

All tests shall be completed prior to backfilling. However, sufficient backfill material may be placed in trenches between fittings to insure the stability of the line under pressure. In all cases, fittings and couplings must be opened to visual inspection for a full period of the test.

Provide two additional sprinkler heads of each type, two adjustment wrenches, two controller cabinet keys, and two cover lifting devices for valve boxes to Owner. Provide record drawings, two copies of product data cut sheets, and operating and maintenance instructions to Owner. Contractor is to provide a minimum one-year warranty on all products and workmanship and one-year of maintenance on the system.

32 91 13 Soil Preparation

Provide 6 inches of topsoil and fine grading of areas to receive seed and 18 inches of topsoil with organic material incorporated for all planting beds. Perform Heavy aeration or disking of the sub soil to break up hard pan before adding new topsoil.

Topsoil shall be fertile agricultural soil, typical of the locality capable of sustaining plant growth and taken from a drained site, free of subsoil, rocks larger than 2 inches. Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil. Soil amendment shall include a minimum of 6 cubic yards compost per 1000 square feet of bed area and 10 pounds of pre-plant fertilizer (15-12-13). 8-12 Agriform tablets shall be applied to all tree planting pits.

Fertilizer

Slow-Release Fertilizer: Granular or pellet fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

- Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

32 92 00 Turf and Grasses

Provide seeding for all lawn areas as a base price unless Owner recommends areas for lawn sod. Provide trees, shrubs, groundcovers, vines, perennials, organic mulch and any miscellaneous landscape material such as weed control fabric or stone mulch as noted on plans.

Lawn seed shall be fresh, clean and a new crop seed mixture labeled in accordance with the Federal Seed Act. Sod shall be viable certified turf grass without thatch, disease, nematodes, insects, and weeds. Bermuda seed and sod shall be typical of grass used on the Texas Tech campus.

Contractor is to provide Initial maintenance of all lawn areas and planting beds until final

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acceptance. Contractor is to provide a one-year full replacement warranty of all plant materials. Provide concrete splash block at downspouts along building perimeters inside planter beds and sodded areas where not discharging onto a concrete or asphalt surface.

No more than 10% of the project landscape area shall utilize decomposed granite (DG) as a finish material. The areas that will have DG shall be broken into sub-areas in some fashion. All DG solutions shall be approved by the VC of FP&C. DG shall not be used as an infill between small plantings such as native grasses, shrubs, etc. All landscape architects and architects must indicate the percentage of DG coverage in SD, DD, and CD sets of drawings.

Seed is to be delivered in original sealed, labeled, and undamaged containers. If sod is required, harvest, deliver, store, and handle sod according to requirements in TPI's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

1. May 15th to August 31st for Bermuda seeding.
2. Overseeding – Annual Rye Grass
 - a. If Bermuda seeding cannot be established by September 15, lawn areas are to be over-seeded with annual rye grass at a rate of 4-lbs/1,000sf. If this is required, the Contractor shall maintain the annual grass lawn, as needed, including, but not limited to irrigation and, mowing to maintain a maximum height of 3", and edging, as required.
 - b. This annual rye grass maintenance shall be considered as a separate item from the 90-day maintenance period specified for the seeded Bermuda grass.
 - c. The Contractor shall apply a minimum of two applications of Roundup herbicide to the annual rye grass in early spring in preparation for Bermuda grass seeding. The two applications should be separated by a period of 10-14 days and Contractor should notify the Landscape Architect of the schedule of Roundup application.

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- d. After sufficient annual grass kill has been verified by the Landscape Architect, lawn areas should be tilled to a depth of 2"-3" prior to seeding the Bermuda grass as specified.

Begin maintenance immediately after each area is planted and continue until acceptable lawn is established but not for less than 60 days from date of Substantial Completion.

Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. Bermuda grass (*Cynodon dactylon*) (Note: Celebration Bermuda is only available as sod).
2. Annual Ryegrass (*Lolium multiflorum*).
3. Turfgrass Sod Species to be Tiftonio Bermudagrass (*Cynodon dactylon*) "Tifton 10".

Topsoil: ASTM D 5268, pH range of 5.5 to seven, a minimum of 2 percent organic material content; free of stones ¾ inch or larger in any dimension or other extraneous materials harmful to plant growth.

1. Topsoil Source: Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - a. Surface soil may be supplemented with imported or manufactured topsoil from off- site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from playa lake areas.

Hardscaping (Rock, Decomposed Granite, Gravel Mulch)

1. Desert Rock & Stone – El Paso, Tx
<http://www.desertrockco.com/>
Golden Brown, Bone River Rock, and a few others. The Golden Brown is most used. Anything from 3/8" up to 1-1/2".
2. Collier Materials - <https://colliermaterials.com/>
¼" to ½" Fairland Pink –RESTRICTED only for repairs of existing DG planters and medians

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3. Granite Trucking - <http://www.granitetrucking.com/>
1-1/2" High Plains Cobble
4. Others as submitted and approved.

32 93 00 Plants

Please reference Appendix B for the TTU Grounds Maintenance list of preferred plants proven to be resistant and having the ability to be hardy and thrive in West Texas soils and climate. The landscape installer must be qualified with minimum three (3) years previous experience of size and scope commensurate with this project and whose work has resulted in successful establishment of exterior plants.

Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock" and any additional comments listed on the plans.

Landscape Architect may observe trees and shrubs at place of growth, supplier, or approved remote site before planting for compliance with requirements for genus, species, variety, size, and quality.

Landscape Architect retains the right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site and supply acceptable material at no additional cost.

Notify Landscape Architect of sources of planting materials fourteen days in advance of delivery to site.

Measure trees and shrubs according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches for roots tip-to-tip.

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Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants in shade, protect from weather and mechanical damage, and keep roots moist.

1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
2. Do not remove container-grown stock from containers before time of planting.
3. Water root systems of exterior plants stored on-site with a fine mist spray. Water as often as necessary to maintain root systems in a moist condition.

Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: February 1 to June 15.
2. Fall Planting: September 1 to October 31.

For trees and shrubs, maintain for the following maintenance period by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings. Maintenance period of six months from date of Substantial Completion. Remove all tree staking from trees one year from Substantial Completion.

For ground cover and plants, maintain for the following maintenance period by watering, weeding, fertilizing, and other operations as required to establish healthy, viable plantings provide a maintenance period of six months from date of Substantial Completion.

Warrant the following exterior plants, for the warranty period indicated, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond Contractor's control.

1. Warranty Period for Trees and Shrubs: One year from date of Substantial Completion.
2. Warranty Period for Ground Cover and Plants: One year from date of Substantial Completion.

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3. Remove dead exterior plants as directed by Landscape Architect. Replace immediately unless required to plant in the succeeding planting season.
4. Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
5. A limit of one replacement of each exterior plant will be required, except for losses or replacements due to failure to comply with requirements.

All trees, shrubs, grasses, mulch, and all compost shall be manufactured within 500 miles of the project site from materials that have been extracted, harvested, or recovered, as well as manufactured within, 500 miles.

Planting Bed Establishment

1. Loosen subgrade of planting beds to a minimum depth of 12 inches. Remove stones larger than $\frac{3}{4}$ inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - a. Apply fertilizer directly to subgrade before loosening.
 - b. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.
 1. Delay mixing fertilizer with planting soil if planting will not proceed within five days.
 - c. Spread planting soil mix to specified depths, but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen muddy, or excessively wet.
 1. Spread approximately one-half the thickness of planting soil mix over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil mix.
 2. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
 3. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

Tree and Shrub Planting

1. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball 1 inch above adjacent finish grades.
 - a. Remove burlap and wire baskets from tops of root balls and partially form sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - b. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
2. Set balled and potted and container-grown stock plum and in center of pit or trench with top of root ball 1 inch above adjacent finish grades.
 - a. Carefully remove root ball from container without damaging root ball or plant.
 - b. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
3. Set fabric bag-grown stock plumb and in center of pit or trench with top of root ball 1 inch above adjacent finish grades.
 - a. Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - b. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pickets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
4. Organic Mulching: Apply 2-inch average thickness of organic mulch extending 12 inches beyond edge of planting pit or trench. Do not place mulch within 6 inches of trunks or stems.

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5. Wrap trees of 2-inch caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half of width, and securely attach without causing girdling. Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping.

Tree and Shrub Pruning

1. Prune, thin, and shape trees and shrubs as directed by Landscape Architect.
2. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character. Shrub sizes indicated are sizes after pruning.

Mulches

Non-Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following

1. Type: 4" depth Fairland Pink, available from Collier Materials, Inc., 201 CR 121, Marble Falls, Texas seven8654, 8sevenseven.603.3030.
2. Type: 4" depth ¼" minus decomposed granite gravel, available from Collier Materials, Inc., 201 CR 121, Marble Falls, Texas seven8654, 8sevenseven.603.3030.

Mulch backfilled surfaces of planting beds and other areas indicated.

1. Apply 4-inch average thickness of mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

Organic Mulch, minimum 2" – 3" in random sizing, free from deleterious materials and suitable as a top dressing for trees and shrubs. Mulch must be non-combustible, equivalent to

Timberline Hardwood Bark Mulch, or **Timberline No Float Cypress Blend Mulch**. Samples must be submitted for approval.

Stakes and Guys

Stakes and guys shall be the ROOT ANCHOR™ underground tree staking system from Tree Stake Solutions or metal stakes (no ratchet straps). You can Tree Stake product information at <http://www.treestakesolutions.com/>.

<p>Root Anchor™ Safety Stake Below Ground Safety Stake www.treestakesolutions.com</p>	<p>Product Drawing & Installation Instructions</p>	<p>Tree Stake Solutions, LLC info@treestakesolutions.com O 713-591-4151 F 832-383-5145</p>
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Plant staking materials: Contractor shall use "Root Anchor Safety Stake" below grade rootball anchoring system manufactured by Tree Stake Solutions as necessary to meet the requirements of the specification, subject to approval. Refer to details for staking and/or guy requirements.

A. Trees that are not capable of standing upright without falling or leaning shall be staked or guyed. The Contractor is responsible for material remaining plumb and straight for all given conditions through the guarantee period. Tree support shall be performed as outlined below.

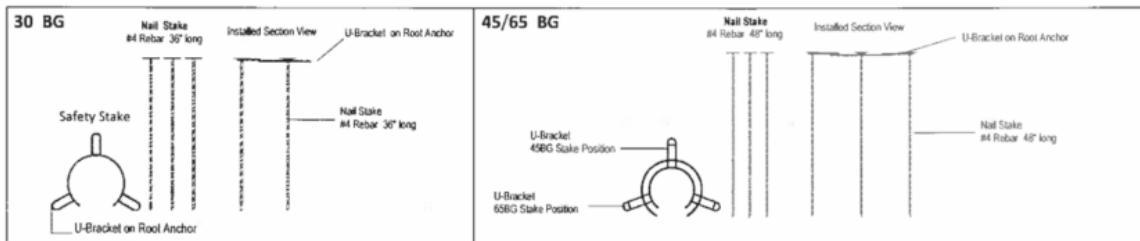
B. Rootball, Container and Box size, will determine Root Anchor Safety Stake model to be installed on all trees or shrubs that require staking or guying. Root Anchor is designed for trees and shrubs that conform with the latest American Standards for Nursery Stock, www.anla.org.

C. Brace plants vertically using Tree Stake Solutions "Safety Stake" Model BG Root Anchor. Select correct Root Anchor using manufacturers Rootball Sizing Chart. Select Root Anchor large enough to overlap the edge of rootball.

D. Auxiliary stem stakes shipped with trees shall be removed after planting.

**Root Anchor™ below grade safety stake
Sizing Chart**

Item#	Description	Nail Length x 3 pcs (Included)
5 BG	5 gallon or 10" rootball	#4 x 24"
15 BG	10/15 gallon or 17" rootball	#4 x 36"
30 BG	20/30 gallon or 22" rootball	#4 x 36"
45/65 BG	45/65 gallon or 27-30" rootball	#4 x 48"
100 BG	95/100 gallon or 36" rootball	#5 x 48"
150 BG	150 gallon or 42" rootball	#5 x 60"
200 BG	200 gallon or 48" rootball	#5 x 72"
300 BG	300 gallon or 58" rootball	#5 x 72"



32 94 43 Tree Grates and Frames

This section covers the requirements for cast iron tree grates and frames only. For specifics on other cast iron grates, rings, and covers, refer to Section 05 54 20 Steel or Cast-Iron Frames, Grates, Rings, and Covers.

Reference ASTM A48 Standard Specification for Gray Iron Castings and ASTM A536 Standard Specification for Ductile Iron Castings for all cast grates and covers.

Minimum 5 years' experience manufacturing similar products. Minimum 2-years' experience installing similar products.

Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation. Handle materials to avoid damage. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

Manufacturer's Warranty: One-year warranty from date of Substantial Completion.

Finish: Manufactured true to pattern; component parts fit together in satisfactory manner. Uniform quality free of blowholes, porosity, hard spots, shrinkage distortion or other defects. Cleaned by blasting.

Examine paving or other substrates for compliance with manufacturer's requirements for placement and location of embedded items, condition of substrate, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

Tree Grates

Tree grates shall be from East Jordan, Neenah Foundry, or Reliance Foundry. The Basis of Design is EJCO V7500 Series solid trench drain cover rated for vehicular travel. Trench drain covers shall be flush with the adjacent walking surfaces.

APPENDICES