CITY OF SAN ANGELO

ITEM 100

PREPARING RIGHT-OF-WAY

100.1. DESCRIPTION.

This Item shall govern the clearing and grubbing for the preparation of the Right-of-Way for construction operations by the removal and disposal of all obstructions from the Right-of-Way and from designated easements, where removal of all such obstructions is not otherwise shown on the Plans and specifications.

Such obstructions shall be considered to include remains of houses, foundations, floor slabs, concrete, brick, lumber, plaster, septic tank drain fields, basements, abandoned utility pipes or conduits, equipment, fences, retaining walls, outhouses, and shacks.

This Item shall also include the removal of trees and shrubs and other landscape features not designated for preservation, stumps, brush, roots, vegetation, logs, curb and gutter, driveways, paved parking areas, miscellaneous stone, sidewalks, drainage structures, manholes, inlets, abandoned railroad tracks, scrap iron and debris, whether above or below ground except live utility facilities.

100.2. CONSTRUCTION METHODS.

(1) General. All areas as shown on the Plans, shall be cleared of all structures and obstructions as defined above. Those trees, shrubs and other landscape features specifically designated by the City for preservation shall be carefully protected from abuse, marring, or damage during construction operations. Continual parking and/or servicing of equipment under the branches of trees marked for preservation will not be permitted. When trees and shrubs are designated for preservation and require pruning, they shall be trimmed as directed by the City and all exposed cuts over two (2) inches in diameter shall be treated with a material approved by the City.

Culverts, storm sewers, manholes and inlets shall be removed in proper sequence for maintenance of traffic and drainage.

Underground obstructions, except those items designated for preservation, shall be removed to the following depths:

(a) In areas to receive embankment: one (1) foot below natural ground, except when permitted by the Plans, trees and stumps may be cut off as close to natural ground as practicable on areas which are to be covered by at least three (3) feet of embankment.

(b) In areas to be excavated: one (1) foot below the low elevation of the excavation.

(c) All other areas: one (1) foot below natural ground.

(2) Disposal of Material. Unless otherwise shown herein, all materials and debris removed shall become the property of the Contractor, including all merchantable timber, and shall be removed from the Right-of-Way and disposed of in a manner satisfactory to the City, except that gravel, brick, stone, or broken concrete, when approved by the City, may be used in the roadway embankment. This material shall conform to the requirements of Item 132, "Embankment".

(a) State or National Forest or Park: The provisions shown on the Plans for removal of the timber shall apply. No timber shall be cut or defaced outside of the Right-of-Way lines or material pit limits as indicated on the Plans or by the City.

(b) Burning of Brush: When burning of brush is permitted under applicable laws and by the City, the following shall govern.

(i) Where construction is on new location, the brush shall be piled and burned in the center of the work area.

(ii) When a portion of the project falls within the limits of a state or National Forest or Park, the Contractor shall notify the responsible agencies prior to any burning.

(3) Backfill. Holes remaining after removal of all obstructions, objectionable material, trees, stumps, etc., shall be backfilled with approved material, compacted and restored to approximately its original contours by blading, bulldozing, or by other methods, as approved by the City. In areas to be immediately excavated, the backfilling of holes may not be required when approved by the City.

Before backfilling, the remaining ends of all abandoned storm sewers, culverts, conduits, and water or gas pipes over 3 inches in diameter, shall be plugged with an adequate quantity of concrete to form a tight closure.

100.3 MEASUREMENT.

(1) Methods of Measurement. This Item will be measured by one of the following methods:

(a) Preparing Right-of-Way (Acre). The work performed will be measured by the by the nearest tenth of an acre of Right-of-Way as shown on the Plans.

(b) Preparing Right-of-Way (Station). The work performed will be measured by the "100-Foot Station" regardless of the width of the Right-of-Way as shown on the Plans.

(c) Preparing Right-of-Way (Tree). The work performed will be measured by each tree removed of the diameter specified.

(2) General. Measurement for payment for "Preparing Right-of-Way (Acre)" and for "Preparing Right-of-Way (Station)" will be made only on areas indicated and classified on the Plans as "Preparing Right-of-Way". Work required by the City on additional areas (such as additional Right-of-Way, additional cut and embankment areas, etc.) shall be measured as specified above.

Areas other than those set forth above will not be measured for payment.

100.4. PAYMENT.

The work performed and material furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Preparing Right-of-Way," and/or "Preparing Right-of-Way (Trees)" of the diameter specified. This price shall be full compensation for trimming designated trees and shrubs; for removal and disposal of all obstructions and debris; for backfilling all holes; for furnishing and placing all concrete for plugs; for restoring areas to original condition; and for all labor, equipment, tools and incidentals necessary to complete the work.

All work performed in areas not so designated on the Plans as "Preparing Right-of-Way," except "additional areas" as defined under "Measurement" or specifically covered otherwise, will not be paid for directly but shall be considered as subsidiary work pertaining to the various bid items.

The total payment for this Item will not exceed ten (10) percent of the original contract amount until after the completion of the entire contract work to the satisfaction of the City. That portion of the contract amount for this Item in excess of ten (10) percent of the total contract amount will then be paid on the next estimate after the work is accepted and after the partial release of retainage.

CITY OF SAN ANGELO

ITEM 107

SEEDING FOR EROSION CONTROL

107.1 DESCRIPTION.

Seeding for Erosion Control shall consist of preparing the areas, providing for sowing of seeds, mulching with straw, hay or cellulose fiber and other management practices for the cut slopes and for the bottom of the channel detention pond area, embankments, dikes, beams and the other areas as shown on the Plans or as directed by the City excluding the rock surface in accordance with these specifications.

107.2 SEEDS.

All seeds shall meet the requirements of the Texas Seed Law including the labeling requirements for showing pure live seed, name and type of seed.

The pure live seed mixture shall consist of the following seeds in the amount noted per acre of planting area.

Green Sprangletop	- 1.2 lbs.
Common Bermuda	- 8.0 lbs.
Klien	- 1.0 lbs.
Perennial Rye	- 2.0 lbs.

Fertilizer, if specified on the Plans, shall be delivered in bags or containers clearly labeled showing the analysis. The fertilizer, if requested by the City, will be subject to testing by the Texas Department of Agriculture in accordance with the Texas Fertilizer Law. A pelleted or granulated fertilizer shall be used which has the analysis shown on the Plans. The rate of application shall be as shown on the Plans.

Straw mulch shall be oat, wheat, or rice straw. Hay mulch shall be prairie grass, Bermuda grass or other acceptable hay. The mulch shall be free of noxious weeds and foreign materials. It shall be kept in a dry condition and shall not be molded or rooted.

107.3 CONSTRUCTION METHODS.

After the areas designated for seeding are cut to the lines, grades, cross sections and to the configurations shown on the Plans, the area shall be cultivated to a depth of at least four inches. The seed bed shall be cultivated sufficiently to reduce the soil to a state of good tilth for proper germination of the grass seeds. The cross-section and configuration previously established shall be maintained throughout the process of cultivation and any necessary reshaping shall be done prior to planting of the seeds.

The seed mixture shall be uniformly distributed over the areas shown on the Plans or where directed by the City by the mechanical equipment. Seed and fertilizer (if called on the Plans) may be distributed at the same time provided that each component is uniformly applied at the specified rate. After planting, the planted area shall be rolled with corrugated roller of the "cultipacker" type. All rolling of the slope areas shall be on the contours. For areas smaller than half an acre, sowing of seeds by hand will be permitted. If sown by hand, the seeds shall be sown in two (2) directions at right angles to each other. Upon completion of planting of the seeds, straw or hay mulch shall be spread uniformly over the seeded area at the rate of approximately one half (1/2) to two (2) tons of hay or two (2) to two and a half tons (2 1/2)of straw per acre. The Contractor in lieu of placing the mulch by hand may use a mulching machine to shoot the mulch over the seeded area. If permitted by the City, cellulose fiber may be used in place of straw or hay mulch. The application rate for cellulose fiber as mulch shall be a minimum of twenty five hundred (2,500) lbs. per acre of area with flat surface and minimum of three thousand (3,000) lbs. per acre of area with sloped surfaces (greater than 10 percent).

Water shall be free of industrial wastes and other objectionable material. Water source to be approved by the City.

The criterion for acceptance of the work under this Item is "Good Stand of Grass." The "Good Stand of Grass" is defined as a minimum of one-half (1/2) inch of well established live grass covering at least 75 percent of the area designated for seeding. If it is necessary, the bald spots in the seeded area shall be selectively reseeded at the direction of the City.

107.4 METHOD OF MEASUREMENT.

The work performed in accordance with the specifications described herein will be measured by the acres, complete in place.

107.5 PAYMENT.

The work performed, materials furnished and measured will be paid for at the unit price bid for "Seeding for Erosion Control" which shall be full compensation for furnishing all materials and for performing all operations necessary to complete the work in an acceptable manner.

If the Contractor were to fail to provide the requirements of this Item as specified herein, the Owner shall reserve the right to engage another Contractor to complete the work and the cost thereof shall be deducted from monies payable to the Contractor for this Item.

CITY OF SAN ANGELO

ITEM 110

EXCAVATION

110.1. DESCRIPTION.

This Item shall govern for the roadway, channel and/or special excavation of the required material in the areas shown on the Plans and cross sections to the lines, grades, and typical sections as specified. Excavation shall include all materials encountered regardless of their nature or of the manner in which they are removed.

110.2. CONSTRUCTION METHODS.

All excavation shall be performed as specified herein and the completed roadway and/or channels shall conform to the alignment, grades, and typical sections as shown on the Plans or project cross sections or as established by the City.

Unsuitable excavation and excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor to be disposed of by him outside the limits of the right-of-way at a location approved by the City. Unsuitable material encountered below subgrade elevation in roadway cuts, when declared "Waste" by the City, shall be replaced with material from the roadway excavation or with other suitable material as approved by the City. This work shall be done in accordance with the provisions of the applicable bid items.

When excavated materials, including topsoil, are utilized in constructing the required roadway sections, payment of replacement will be made under the pertinent placement specification.

During construction the roadbed and ditches shall be maintained in such condition as to insure proper drainage at all times. Ditches and channels shall be so constructed and maintained as to avoid damage to the roadway section. During construction, channels shall be kept drained, insofar as practicable, and the work shall be prosecuted in a neat and workmanlike manner.

All slopes shall be accurately shaped, and care shall be taken that no material is loosened below or outside the required slopes. Exceptions shall be those slopes in rock or other material where, in the judgment of the City, some variation may be permitted. All breakage and slides shall be removed and disposed of in a manner acceptable to the City.

(1) Rock Cuts. The Contractor shall have the following options:

(a) Nonhomogeneous Rocks:

(i) Excavate to finish subgrade elevation, manipulate and compact the subgrade in accordance with Section 132.3.(3).(a) without removal.

(ii) Excavate below grade (undercutting) and replace with embankment material approved by the City. Compaction shall be in accordance with Section 132.3.(3).(a).

(b) Homogeneous Rock.

(i) Excavate to finish subgrade elevation.

(ii) Excavate to finish subgrade elevation, manipulate and compact the subgrade in accordance with Section 132.3.(3).(a) without removal.

(iii) Excavate below grade (undercutting) and replace with embankment material, limestone base material, or other material approved by the City. Compaction shall be in accordance with Section 132.3(3).(a).

(2) Earth Cuts. When base and/or pavement structure is placed under this project, all earth cuts shall be scarified to a uniform depth of at least six inches below the required finished subgrade elevation for the entire roadbed width. The material shall be mixed and reshaped by blading and then sprinkled and rolled in accordance with Section 132.3.(3).(a) or as shown on the Plans.

(3) Subgrade Tolerances. Tolerances shall be as follows:

(a) Stage Construction. Any deviation in excess of 0.1 foot in cross section and 0.1 foot in 16 feet measured longitudinally shall be corrected by loosening, adding or removing the material, reshaping and recompacting by sprinkling and rolling.

(b) Turn Key Construction. Any deviation in excess of half inch in cross section and half inch in 16 feet measured longitudinally shall be corrected by loosening, adding or removing the material, reshaping and recompacting by sprinkling and rolling.

110.3. MEASUREMENT.

This Item will be measured by the cubic yard in its original position as computed by the method of average end areas.

This is a Plans quantity measurement Item and the quantity to be paid for will be that quantity shown in the proposal and on the "Estimate and Quantity" sheet of the contract Plans, except as may be modified by special condition. If no adjustment of quantities is required, additional measurements or calculations will not be required.

Shrinkage or swellage factors will not be considered in determining the calculated quantities.

110.4. PAYMENT.

The work performed and materials furnished in accordance with the Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Excavation (Roadway)," "Excavation (Channel)." "Excavation (Special)" or "Excavation (Roadway and Channel)." This price shall be full compensation for all authorized excavation; for the undercutting subgrade and reworking or replacing the undercut material; for all hauling; for all work required for disposal of material not used elsewhere on the project and for furnishing all labor, materials, tools, equipment and incidentals necessary to complete the work.

CITY OF SAN ANGELO

ITEM 160

FURNISHING AND PLACING TOPSOIL

160.1 DESCRIPTION.

This Item shall govern for the furnishing and placing of approved topsoil to the depths and area shown on the Plans or as directed by the City.

160.2 MATERIALS.

(1) Topsoil. The topsoil shall be fertile soil, be easily cultivated, be free from objectionable material, have a relatively high erosion resistance and be readily able to support the growth of planting, seeding or sodding.

(2) Water. Water shall be free of industrial wastes and other objectionable material. Water source to be approved by the City.

160.3 SOURCES.

The topsoil may be obtained from the right-of-way at sites of proposed excavation or embankment when shown on the Plans or designated by the City.

The approximate quantity of acceptable topsoil to be salvaged from the project will be shown on the Plans. The topsoil may also be obtained from approved sources, which are outside of the right-of-way and have been secured by the Contractor.

160.4 CONSTRUCTION METHODS.

Any trash, wood, brush, stumps or other objectionable materials encountered at the source shall be removed and disposed of as approved by the City prior to beginning of work required by this Item. The source and stockpile areas shall be kept drained, insofar as practicable, during the period of topsoil removal. The source and stockpile areas shall be left in a neat and presentable condition upon completion of the removal of all material required.

The placement of the topsoil shall be undertaken as soon as the grading operations have been completed or at such time as specified by the City. The topsoil shall be spread so as to form a cover of uniform thickness (loose) as shown on the Plans. After the topsoil has been placed and shaped, it shall be sprinkled and/or rolled if directed by the City. Rolling shall be performed with a light corrugated drum roller of the type approved by the City.

(1) Right-of-Way Sources. The existing topsoil shall be moved from within the limits of construction as shown on the Plans and stockpiled in a windrow along the right-of-way line, or at designated locations. It also may be spread over an area that is ready for topsoil application in accordance with the Plans or as directed by the City.

(2) Contractor-Obtained Sources. The Contractor shall notify the City sufficiently in advance of the opening of any material source to permit inspection of the site and to prepare for any necessary measurement. Only material, which meets the approval of the City, shall be utilized.

160.5 MEASUREMENT.

This Item will be measured by one of the following methods as shown on the Plans.

When Class 1 measurement is specified, topsoil will be measured by the 100-foot station as measured along the baseline of each roadbed.

When Class 2 measurement is specified, topsoil will be measured by the square yard complete in place.

When Class 3 measurement is specified, topsoil will be measured by the cubic yard in vehicles at the point of delivery.

When Class 4 measurement is specified, topsoil will be measured in the stockpile and the volume computed in cubic yards by the method of average end areas.

When Class 5 measurement is specified, topsoil will be measured in its original position at the source and the volume computed in cubic yards by the method of average end areas.

160.6 PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Furnishing and placing Topsoil" of the class and depth specified. This price shall be full compensation for securing any necessary source(s) and any royalty involved; for furnishing all materials, for all excavation, loading, hauling, stockpiling and placing; and for furnishing all labor, tools, equipment and incidentals necessary to complete the work.

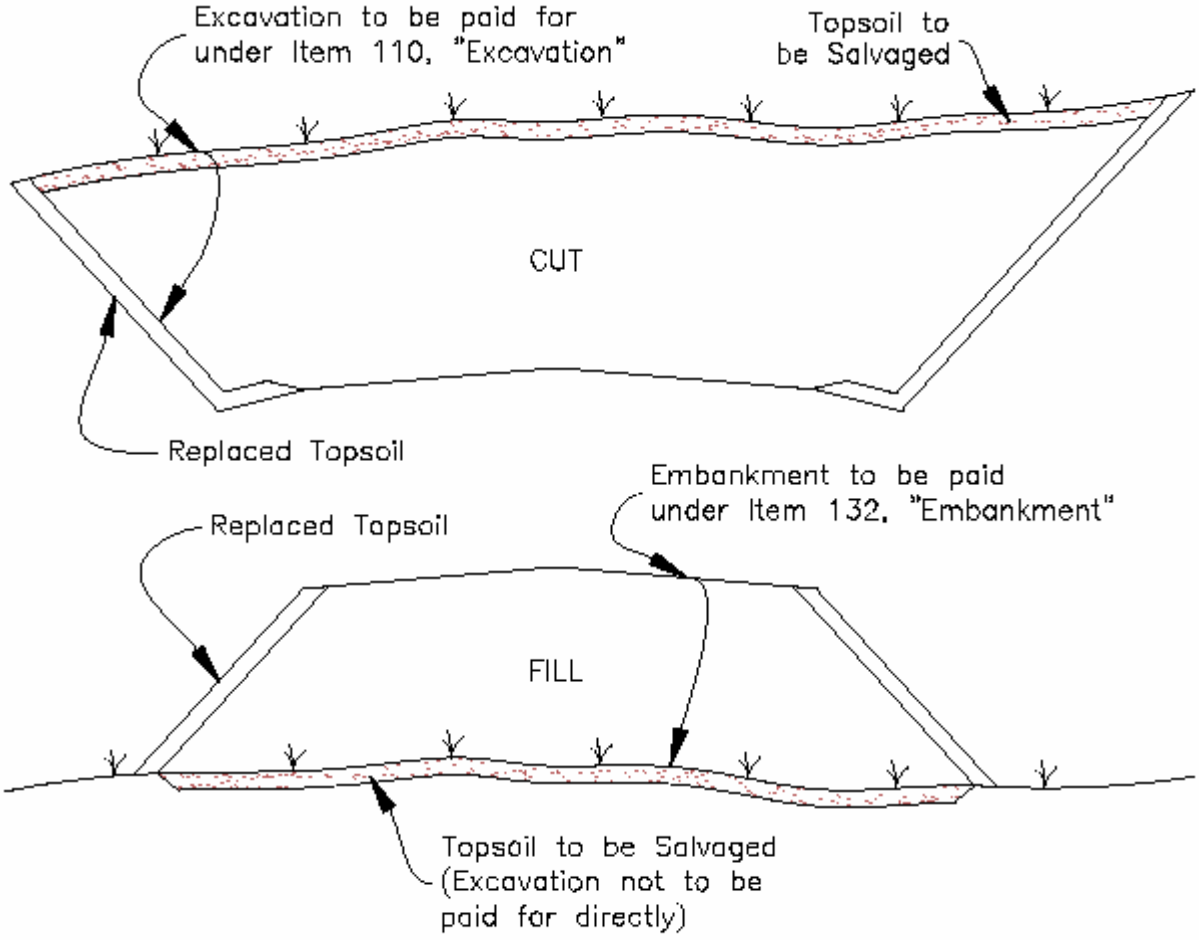
"Rolling" and "Sprinkling" will not be paid for directly, but will be considered subsidiary to this Item, unless otherwise shown on the Plans.

Payment will not be made for any material, which is used for purposes other than, that which is required by this Item.

Excavation required by this Item in cut sections will be measured and paid for in accordance with the provisions of the various excavation items involved, with the provision that excavation will be measured and paid for once only, regardless of the manipulations involved.

Excavation which will be paid for directly, in accordance with the various excavation Items involved, will include the original in-place volume of topsoil salvaged from cut sections, as well as the additional volume of excavation made necessary for placing the topsoil, in cut areas. Excavation, for topsoil, in areas upon which embankment will be placed will neither be measured nor paid for directly; its cost will be included in the unit price bid for this Item. The foregoing provisions are depicted in Figure 1.

Figure 1
Roadway Cross Sections Showing Payment for
Excavation and Embankment



CITY OF SAN ANGELO

ITEM 169

SOIL RETENTION BLANKET

169.1 DESCRIPTION.

This Item shall govern for providing and placing wood, straw or coconut fiber mat, synthetic mat, paper mat, jute mesh or other material as a soil retention blanket for erosion control on slopes or ditches or for short-term or long-term protection of seeded or sodded areas as shown on the Plans or as approved by the City.

169.2 MATERIALS.

(1) The soil retention blanket shall be one of the classes and types as shown on Plans or as listed below. Alternate materials may be used as approved by the City.

(a) Class 1. "Slope Protection"

i. Type A. Slopes 3:1 or flatter - Clay soils

ii. Type B. Slopes 3:1 or flatter - Sandy soils

iii. Type C. Slopes steeper than 3:1 - Clay soils

iv. Type D. Slopes steeper than 3:1 - Sandy soils

(b) Class 2. "Flexible Channel Liner"

i. Type E. Short-term duration (Up to 2 years)

Shear Stress (t_d) < 1.0 lb./sq. ft.

ii. Type F. Short-term duration (Up to 2 years)

Shear Stress (t_d) 1.0 to 2.0 lb./sq. ft.

iii. Type G. Long-term duration (Longer than 2 years)

Shear Stress (t_d) > 2.0 to < 5.0 lb./sq. ft.

iv. Type H. Long-term duration (Longer than 2 years)

Shear Stress (t_d) > or = to 5.0 lb./sq. ft.

(2) Fasteners. Fasteners shall conform to the requirements of the soil retention blanket manufacturer.

169.3 CONSTRUCTION METHODS:

(1) General. The soil retention blanket shall conform to the class and type shown on the Plans. The Contractor has the option of selecting an approved soil retention blanket conforming to the class and type shown on the Plans and according to the current approved material list.

(2) Installation. The soil retention blanket, whether installed as slope protection or as flexible channel liner in accordance with the approved materials list, shall be placed within 24 hours after seeding or sodding operations have been completed, or as approved by the City. Prior to placing the blanket, the area to be covered shall be relatively free of all rocks or clods over 1-1/2 inches in maximum dimension and all sticks or other foreign material which will prevent the close contact of the blanket with the soil. The area shall be smooth and free of ruts and other depressions. If as a result of rain, the prepared bed becomes crusted or eroded or if any eroded places, ruts or depressions exist for any reason, the Contractor shall be required to rework the soil until it is smooth and to re-seed or re-sod the area at the Contractor's expense.

Installation and anchorage of the soil retention blanket shall be in accordance with the manufacturer's recommendations.

(3) Literature. The Contractor shall submit one full set of manufacturer's literature and manufacturer's installation recommendations for the soil retention blanket selected in accordance with the approved material list.

169.4 MEASUREMENT.

This Item will be measured by the square yard of surface area covered.

169.5 PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Soil Retention Blanket” of the class and type shown on the Plans. This price shall be full compensation for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work. Anchors, checks, terminals or junction slots, and wire staples or wood stakes will not be paid for directly but will be considered subsidiary to this Item.

CITY OF SAN ANGELO

ITEM 200

SUBGRADE PREPARATION

200.1 DESCRIPTION.

This Item shall govern the scarifying, blading, and rolling of the subgrade to obtain uniform texture and density throughout the required depth as shown on the Plans.

200.2 TESTING.

The subgrade under areas to be paved shall be compacted to a minimum depth of **8 inches** and to a density of **not less than 95 percent for cohesive soils** or **100 percent for noncohesive soils** of the maximum density as determined by Test Method Tex-114-E / ASTM D 698**.** Noncohesive soils, for the purpose of determining compaction control, are those with a plasticity index (PI) of less than 6. The material to be compacted shall be **within +/- 2 percent of optimum moisture content** before rolled to obtain the prescribed compaction (except for expansive soils).

Field density determination will be made in accordance with Test Method Tex-115-E / ASTM D 2922 for field density and ASTM D 3017 for moisture content using a nuclear gage. If nuclear gages are to be used for density determination, the machines shall be calibrated in accordance with ASTM D 2922 using blocks of materials with densities that extend through a range representative of the density of the proposed embankment material.

Compaction is to be tested for density and moisture content acceptance as per Detail S-EE-1.

AASHTO T99 or T-180 (Moisture-Density) is required for soils that have more than 30 percent retained on the 3/4-inch sieve. The moisture-density relationship test procedures ASTM D 698 and D1557 are not applicable for materials with greater than 30 percent retained on the 3/4-inch sieve. A replacement procedure (ASTM D 4718) for the coarse material (greater than 3/4-inch) is used with ASTM methods but only until up to 30 percent is retained. Maximum density testing (ASTM D 4253) may be used but it also limits the material retained on the 1-1/2-inch sieve to 30 percent. The AASHTO T-99 and T-180 are similar to ASTM D 698 and D 1557, except they do not limit the replacement of the coarse material.

Stones or rock fragments larger than 4 inches (100 mm) in their greatest dimension will not be permitted in the top 6 inches (150 mm) of the subgrade. The finished grading operations, conforming to the typical cross section, shall be completed and maintained at least 1,000 feet (300 m) ahead of the paving operations or as directed by the City.

200.3 CONSTRUCTION METHODS.

The roadbed or parking lot subgrade, as case may be, shall be excavated and shaped in conformity with the typical sections shown on the Plans and to the lines and grades established by the City. All unstable or otherwise objectionable material shall be removed or otherwise broken off to a depth of not less than six (6) inches below the surface of the subgrade. Holes or depressions resulting from the removal of such material shall be backfilled with suitable material compacted in layers not to exceed six (6) inches. All soft and unstable material and other portions of the subgrade, which will not compact readily or serve the intended purpose, shall be removed as directed. No direct payment will be made for such removal.

The subgrade shall be scarified to the depth shown on the Plans, then bladed and compacted in the manner outlined in the following paragraph, "Finishing and Compaction". The surface of the subgrade shall be finished to line and grade as established, and be in conformity with the typical sections shown on the Plans. Any deviation in excess of one-half (1/2) inch in cross section and in a length of sixteen feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and compacting by sprinkling and rolling. Material excavated in the preparation of the subgrade shall be disposed in a manner acceptable to the City.

200.4 FINISHING AND COMPACTION.

The subgrade course, including an area one foot back of the proposed curb line, or as the case may be, shall be sprinkled as required and rolled as directed until a uniform compaction and the required density is obtained. Compaction of the subgrade may be done using any of the rolling equipment acceptable to the City. Rolling shall continue until the subgrade has been compacted to the required testing minimums per Section 200.2.

Tests will be made at the times and locations selected by the City. Notification will be a minimum of 24 hours.

Rolling shall progress gradually from the sides to the center of the lane under construction by lapping uniformly each preceding tract by at least 12 inches.

After rolling and watering, the subgrade shall be checked by the use of string line or instrument and all portions that do not conform to the lines and grades as shown on the Plans shall be scarified for at least six (6) inches, corrected and recompacted to correct elevations.

Until the base course or pavement is placed, the subgrade shall be maintained free from cuts and depressions, in a smooth and compacted condition true to lines and grade and to the density requirements contained herein. All of the Contractor's hauling and other equipment used in such a way as to cause rutting and raveling of the subgrade shall either be removed from the work or suitable run-ways or other equivalent means shall be provided to prevent rutting.

The Contractor shall be responsible for maintaining and protecting the roadbed or the parking lot subgrade, as the case may be, for the entire length of the project.

During construction, grading of the subgrade shall be conducted so that berms of earth or other material do not substantially impede the flow of storm waters. Ditches and drains along the subgrade shall be maintained so as to drain effectively.

200.5. MEASUREMENT.

The subgrade preparation will be measured by the number of square yards of subgrade prepared and accepted by the Owner.

200.6. PAYMENT.

The amount of subgrade area measured as outlined under "Measurement" will be paid for at a unit price bid for this Item which will be full compensation for removing excess material, shaping, fine grading and compacting the subgrade; for furnishing and hauling all materials, blading and finishing and all labor, tools and incidentals necessary to complete the work.

CITY OF SAN ANGELO

ITEM 210

ROLLING (FLAT WHEEL)

210.1 DESCRIPTION.

This Item shall govern for the compaction of embankment, flexible base, or surface treatments, by the operation of approved power rollers as herein specified and as directed by the City.

210.2 EQUIPMENT.

(1) Embankments and Flexible Bases. Power rollers shall be of the three-wheel, self-propelled type, weighing not less than ten (10) tons and shall provide compression on the rear wheels of not less than 325 pounds per linear inch of tire width. All wheels shall be flat; the rear wheels shall have a diameter of not less than 48 inches, and each shall have a tire width of not less than 20 inches.

210.3 CONSTRUCTION METHODS.

This work shall be done only when directed by the City. Sufficient rollers shall be provided to compact the material in a satisfactory manner. When operations are so isolated from one another that one roller unit cannot perform the required compaction satisfactorily, additional roller units shall be provided.

(1) Embankments and flexible Bases. The embankment layer or the base course shall be sprinkled if directed, and rolling with a power roller shall start longitudinally at the sides and proceed towards the center overlapping on successive trips by at least one-half (1/2) of the width of the rear wheel of the power roller. On superelevated curves, rolling shall begin at the low sides and progress toward the high sides. Alternate trips of the roller shall be slightly different in length. Rolling shall continue until discontinued by the City. The rollers, unless otherwise directed, shall be operated at a speed between two (2) and three (3) miles per hour.

(2) Surface Treatments. Rolling shall be done as called for in surface treatment items. The sequence of work shall be as specified for embankment layer or base course in accordance with Subarticle 210.3.(1) or as directed by the City. The operating speed shall be as directed by the City.

210.4 MEASUREMENT.

When shown on the Plans to be a pay item, this Item will be measured by the actual hours the power roller works as directed by the City.

210.5 PAYMENT.

The cost of furnishing and operating the equipment as prescribed by this Item will not be paid for directly but will be considered subsidiary to the various bid items of the contract, unless this Item is specified as a pay item in the contract.

When flat wheel rolling is specified as a pay item, the equipment furnished and operated in accordance with this item and measured and provided under "Measurement" will be paid for at the unit price bid for "Rolling (Flat Wheel)". This price shall be compensation for furnishing and operating all equipment; and for all labor, fuel, tools and incidentals necessary to satisfactorily perform the work.

CITY OF SAN ANGELO

ITEM 213

ROLLING (PNEUMATIC TIRE)

213.1 DESCRIPTION.

This Item shall govern for the compaction of embankment, flexible base, surface treatments, or pavements by the operation of approved pneumatic tire rollers as herein specified and as directed by the City.

213.2 EQUIPMENT.

(1) General. When used on seal coats, asphaltic surface treatments and bituminous mixture pavements, the roller shall be self-propelled and equipped with smooth tread tires whether "Rolling (Light Pneumatic Tire)" or "Rolling (Medium Pneumatic Tire)" is specified on the plans. The roller shall be so constructed as to be capable of being operated in both a forward and a reverse direction.

When used on bituminous mixture pavements, the roller shall have suitable provisions for moistening the surface of the tires while operating.

Where turning is impractical or detrimental to the work, and when specifically directed by the City, the roller shall be capable of being operated in a forward or backward motion.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the City, operate other compacting equipment that will produce equivalent relative compaction in the same period of time as would be expected of the specified equipment, as determined by the City, its use shall be discontinued and the Contractor will be required to furnish the specified equipment.

(2) The Light Pneumatic Tire Roller. It shall consist of not less than nine pneumatic tired wheels, running on axles in such manner that the rear group of tires will cover the entire gap between adjacent tires of the forward group, and mounted in a rigid frame and provided with a loading platform or body suitable for ballast loading. The front axle shall be attached to the frame in such manner that the roller may be turned within a minimum circle. The pneumatic tire roller under working conditions shall have an effective rolling width of approximately sixty inches and shall be so designed that by ballast loading, the total load may be varied uniformly from 9,000 to 18,000 pounds. The roller shall be equipped with tires that will afford ground contact pressures of 45 pounds per square inch (p.s.i.) or more. The operating load and tire air pressure shall be within the range of the manufacturer's charts or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished. The roller under working conditions shall provide a uniform compression under all wheels. Individual tire inflation pressures shall be within plus or minus five (5) p.s.i. of each other. The pneumatic tire roller shall be drawn by either a suitable crawler type tractor, a pneumatic tired tractor or a truck of adequate tractive effort, or may be of the self-propelled type,

and the roller, when drawn or propelled by either type of equipment, shall be considered a light pneumatic tire roller unit.

(3) The Medium Pneumatic Tire Roller (Type A). It shall consist of not less than seven (7) pneumatic tired wheels, running on axles in such manner that the rear group of tires will cover the entire gap between adjacent tires of the forward group, and mounted in a rigid frame and provided with a loading platform or body suitable for ballast loading. The front axle shall be attached to the frame in such manner that the roller may be turned within a minimum circle. The pneumatic tire roller under working conditions shall have an effective rolling width of approximately 84 inches and shall be so designed that by ballast loading the total load may be varied uniformly from 23,500 to 50,000 pounds. The roller shall be equipped with tires that will afford ground contact pressures to 80 p.s.i. or more. The operating load and tire air pressure shall be within the range of the manufacturer's chart as approved by the City. The roller under working conditions shall provide a uniform compression under all wheels. Individual tire inflation pressures shall be within plus or minus five (5) p.s.i. of each other.

The pneumatic tire roller shall be drawn by either a suitable crawler-type tractor, a pneumatic tired tractor or a truck of adequate tractive effort, or may be of the self-propelled type; and the roller, when drawn or propelled by either type of equipment, shall be considered a medium pneumatic tire roller unit. The power unit shall have adequate tractive effort to properly move the operating roller at variable uniform speeds up to approximately five (5) miles per hour.

(4) The Medium Pneumatic Tire Roller (Type B). It shall conform to the requirements for Medium Pneumatic Tire Roller, Type A as specified in Subarticle 213.2, except that the roller shall be equipped with tires that will afford ground contact pressures to 90 p.s.i. or more.

213.3 CONSTRUCTION METHODS.

This work shall be done only when directed by the City. The embankment layer or the base course shall be sprinkled if directed, and rolling with a pneumatic tire roller shall start longitudinally at the sides and proceed towards the center, overlapping on successive trips by at least one-half (1/2) of the width of the pneumatic tire roller. On superelevated curves, rolling shall begin at the low sides and progress toward the high sides. Alternate trips of the roller shall be slightly different in length. Rolling shall continue until discontinued by the City.

The light pneumatic tire roller shall be operated at speeds directed by the City which shall be between four (4) and twelve (12) miles per hour for asphalt surfacing work and between two (2) and six (6) miles per hour for all other work.

The medium pneumatic tire roller shall be operated at speeds as directed by the City.

Sufficient rollers shall be provided to compact the material in a satisfactory manner. When operations are so isolated from one another that one roller unit cannot perform the required compaction satisfactorily, additional roller units shall be provided.

213.4 MEASUREMENT.

When shown on the plans to be a pay item, this Item will be measured by the actual hours the pneumatic tire roller unit works as directed by the City.

213.5 PAYMENT.

The cost of furnishing and operating the equipment in accordance with this Item will not be paid for directly but will be considered subsidiary to the various bid items of the contract, unless this Item is specified as a pay item in the contract. When pneumatic rolling is specified as a pay item, the equipment furnished and operated in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Rolling (Light Pneumatic Tire)", "Rolling (Medium Pneumatic Tire) (Type A)" or "Rolling (Medium Pneumatic Tire) (Type B)". This price shall be full compensation for furnishing and operating all equipment, and for all labor, fuel, tools, and incidentals necessary to satisfactorily perform the work.

CITY OF SAN ANGELO

ITEM 216

ROLLING (PROOF)

216.1 DESCRIPTION.

This Item shall govern for furnishing and operating heavy pneumatic tired compaction equipment for locating unstable areas of earthwork or base.

216.2 EQUIPMENT.

The proofrolling equipment shall consist of not less than four (4) pneumatic tired wheels, running on axles carrying not more than two (2) wheels, and mounted in a rigid frame and provided with loading platform or body suitable for ballast loading. All wheels shall be arranged so that they will carry approximately equal loads when operating on uneven surfaces.

The proofroller under working conditions shall have a rolling width of from eight (8) feet to ten (10) feet, and shall be so designed that, by ballast loading, the gross load may be varied uniformly from 25 tons to 50 tons. The tires shall be capable of operating under various loads with variable air pressure up to 150 pounds per square inch. Tires shall be practically full of liquid. (Tires shall be considered as being practically full when liquid will flow from the valve stem of a fully inflated tire with the stem in the uppermost position). The operating load and tire pressure shall be within the range of the manufacturer's chart as directed by the Engineer. The Contractor shall furnish the Engineer charts or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loading for the particular tires furnished.

The proofroller shall be towed by a suitable crawler-type tractor or rubber-tired tractor of adequate tractive capacity, or may be of the self-propelled type. A proofroller unit shall consist of either a self-propelled roller or combination of roller and towing tractor.

There shall be a sufficient quantity of ballast available to load the equipment to a maximum gross weight of 50 tons.

Rubber tired tractive equipment shall be used on base courses and asphalt pavements. Other type tractive equipment may be used on embankment subgrade. The heavy pneumatic tire roller unit shall be capable of turning 180 degrees in the crown width or operating in forward and reverse modes.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Engineer, operate other compacting equipment that will produce equivalent results in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired results within the same period of time as would be expected of the specified equipment, as determined by the Engineer, its use shall be discontinued.

216.3 CONSTRUCTION METHODS.

This work shall be done only when directed by the Engineer. The subgrade and/or base layer shall be proofrolled to locate unstable areas when directed by the Engineer.

Within the ranges set forth in Article 216.2, the load and tire inflation pressures shall be adjusted as directed by the Engineer. It is proposed to use a contact pressure corresponding as nearly as practical to the maximum supporting value of the earthwork or base. A minimum of two (2) coverages of the proofroller shall be offset by not greater than one (1) tire width. Rollers shall be operated at speeds directed by the Engineer, which shall be between two (2) and six (6) miles per hour.

Where the operation of the proofroller unit shows an area to be unstable or non-uniform, it shall be corrected in accordance with the applicable Item of Work.

216.4 MEASUREMENT.

This Item will be measured by the actual hours the heavy pneumatic tire proofroller unit works as directed by the Engineer.

216.5 PAYMENT.

The equipment furnished and operated in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Rolling (Proof)". This price shall be full compensation for furnishing and operating all equipment; for all labor, tools, fuel and incidentals necessary to satisfactorily perform the work.

Unless otherwise provided on the Plans, payment for reworking unstable or uniform areas, removing and replacing materials, addition of stabilizing materials, and all compaction and incidentals necessary to correct all irregularities will not be made directly but will be considered as subsidiary to the various bid items.

CITY OF SAN ANGELO

ITEM 247

FLEXIBLE BASE

247.1. DESCRIPTION.

This Item shall govern for the delivery, stockpiling and/or the construction of foundation or base courses as herein specified and in conformity with the typical sections and to the lines and grades shown on the Plans or established by the City.

247.2. MATERIALS.

The flexible base material shall be crushed or uncrushed as necessary to meet the requirements herein, and shall consist of durable coarse aggregate particles and binding materials.

(1) Physical Requirements.

(a) General. All types shall meet the physical requirements for the specified grade(s) as set forth in Table 1. Additives, such as, but not limited to, lime, cement or fly ash, shall not be used to alter the soil constants or strengths shown in Table 1, unless otherwise shown on the Plans approved by the City.

The flexible base shall be:

(b) Type A. Type A material shall be crushed stone produced from oversize quarried aggregate, sized by crushing and produced from a naturally occurring single source. Crushed gravel or uncrushed gravel shall not be acceptable for Type A material. No blending of sources and/or additive materials will be allowed in Type A material, unless noted on the Plans or as approved by the City.

(2) Testing: Testing of flexible base materials shall be in accordance with the following TxDOT standard laboratory test procedures:

Moisture Content	Tex-103-E / ASTM D 2216
Liquid Limit	Tex-104-E / ASTM D 4318
Plasticity Index	Tex-106-E / ASTM D 4318
Bar Linear Shrinkage	Tex-107-E, (Part II) / NA
Sieve Analysis	Tex-110-E / ASTM D 422
Moisture-Density Determination	Tex-113-E / ASTM D 1557
Roadway Density	Tex-115-E / ASTM D 2922 and ASTM D 3017
Wet Ball Mill	Tex-116-E / NA
Triaxial Tests	Tex-117-E, (Part I or II as selected by the City) / NA
Particle Count	Tex-460-A, Part I / ASTM D 5821

Samples for testing the base material for triaxial class, soil constants, gradation, and wet ball mill will be taken prior to the compaction operations.

TABLE 1
MATERIAL REQUIREMENTS

Property	Test Method	Grade 2
Master gradation sieve Size (% retained)	Tex-110-E ./ ASTM D 422	
2-1/2 in.		0
1-3/4 in		0 - 10
7/8 in		---
3/8 in		---
No. 4		45 - 75
No. 40		60 - 85
Liquid Limit, % max. [1]	Tex-104-E / ASTM D 4318	40
Plasticity Index, max [1]	Tex-106-E / ASTM D 4318	12
Plasticity Index, max [1]		As shown on plans
Wet ball mill, % max.[2]	Tex-116-E / NA	45
Wet ball mill, % max. increase passing the No. 40 sieve		20
Classification [3]	Tex-117-E / NA	1.1 – 2.3
Minimum compressive strength [3], psi		
lateral pressure 0 psi		35
lateral pressure 15 psi		175

1. Determine plastic index in accordance with Tex-107-E / NA (linear shrinkage) when liquid limit is unattainable as defined in Tex-104-E / ASTM D 4318.
2. When a soundness value is required by the plans, test material in accordance with Tex-411-A / ASTM C 88.
3. Meet both the classification and the minimum compressive strength, unless otherwise shown on the plans.

(3) Tolerances. Unless otherwise shown on the Plans, the limits establishing reasonably close conformity with the specified gradation and plasticity index are defined by the following:

(a) Gradation. The City may accept the material, providing not more than one out of the most recent five (5) consecutive gradation tests performed are outside the specified gradation and plasticity index are defined by the following:

(b) Plasticity Index. The City may accept the material providing not more than one (1) out of the most recent five (5) consecutive plasticity index samples tested are outside the specified limit by no more than two (2) percentage points.

(4) Material Sources. The flexible base material shall be furnished by the Contractor. When a non-commercial source is utilized, it shall be opened in such manner as to immediately expose the vertical faces of all the various strata of acceptable material. Unless otherwise approved by the City, the material shall be secured and processed by successive vertical cuts extending through all of the exposed strata.

Unless otherwise shown on the Plans, the flexible base material shall be temporarily stockpiled prior to delivery to the roadway. Unless otherwise shown on the Plans, the stockpile shall not be less than ten (10) feet in height and shall be made up of layers not greater than two (2) feet in thickness. After a sufficient stockpile has been constructed, the Contractor may proceed with loading from the stockpile for delivery. In loading from the stockpile for delivery, the material shall be loaded by making successive vertical cuts through the entire depth of the stockpile.

When temporary stockpiles are to be tested for acceptance prior to delivery to its intended use, any stockpile that has been sampled and accepted shall not have material added or removed unless otherwise approved by the City. The Contractor will be charged for additional sampling and testing required as a result of material being removed from a previously approved stockpile without the approval of the City. Such charges will be deducted from the Contractor's estimates.

247.3. CONSTRUCTION METHODS.

(1) Complete in Place:

(a) Preparation of Subgrade or Existing Roadbed. Prior to delivery of the base material, the subgrade or existing roadbed shall be shaped to conform to the typical sections, shown on the Plans or established by the City. This work shall be done in accordance with the provision of the applicable bid items.

When shown on the Plans and directed by the City, the Contractor shall proof roll the roadbed in accordance with Item 216, “Rolling (Proof)”. Soft spots shall be corrected as directed by the City.

(b) First Course. It shall be the responsibility of the Contractor to deliver the required amount of base material to each 100-foot station. Base material shall be spread uniformly and shaped the same day as delivered. In the event inclement weather or other unforeseen circumstances render this impractical, the material shall be shaped as soon as practical.

Prior to compacting the flexible base, the flexible base material shall be bladed and shaped to conform to the typical sections as shown on the Plans. All areas of segregated coarse or fine material shall be corrected or removed and replaced with well-graded material, as directed by the City and at the Contractor's expense.

The Contractor shall sprinkle for dust control as directed by the City.

(c) Succeeding or Finish Courses. Construction methods shall be the same as required for the first course. Throughout this entire operation, the shape of each course shall be maintained by blading. Upon completion, the surface shall be smooth and in conformity with the typical section as shown on the Plans and the established lines and grades. Prior to placing the surfacing on the completed base, the base shall be cured to the extent directed by the City.

(d) Compaction Method. The flexible base shall be compacted by "Density Control" as shown on the Plans. Water used for compaction shall conform to the same water source requirements of Item 160.2(2).

The flexible base shall be sprinkled as required and compacted to the extent necessary to provide not less than 95 percent density as determined by TxDOT Test Method Tex-113-E / ASTM D 1557, unless otherwise shown on the Plans. After each section of flexible base is completed, tests as necessary will be made by the City in accordance with TxDOT Test Method Tex-115-E / ASTM D 2922 and ASTM D 3017. When the material fails to meet the density requirements, or it loses the required stability, density or finish before the next course is placed or the project is completed, it shall be reworked and retested in accordance with Section 247.3.(1)(e).

(e) Reworking a Section. Should the base course, due to any reason or cause, lose the required stability, density or finish before the surfacing is complete, it shall be reworked, recompacted and refinished at the sole expense of the Contractor.

(f) Tolerances. Tolerances shall conform to the following:

(i) Density Tolerances. The City may accept the work providing not more than one out of the most recent five consecutive density tests performed is below the specified density, and providing that the failing test is no more than three pounds per cubic foot below the specified density.

(ii) Grade Tolerances. In areas on which surfacing is to be placed, any deviation in excess of 1/4 inch in cross section or 1/4 inch in a length of 16 feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

(g) Thickness Measurement. When the measurement is by the square yard, the flexible base will be measured for depth in units of 4,000 square yards, or fraction thereof. The measurements will be at location(s) determined by the City and performed in accordance with Test Method Tex-140-E. In any unit where flexible base is deficient by more than 1/2 inch in thickness, the deficiency shall be corrected by scarifying, adding material as required, reshaping, recompacting and refinishing at the Contractor's expense.

(2) Roadway Delivery. It shall be the responsibility of the Contractor to deliver the required amount of base material to each 100-foot station. All processing or manipulations will be in accordance with the applicable bid items.

(3) Stockpile Delivery. It shall be the responsibility of the Contractor to prepare the stockpile site, to provide and deliver the required amount of base material to the designated stockpile site and to construct the stockpile. Unless otherwise shown on the Plans, the stockpile shall not be

less than ten (10) feet in height and shall be made up of layers not to exceed two (2) feet in thickness.

247.4. MEASUREMENT.

This Item will be measured by either Measurement Class 1, 2, 3, 4, or 5 as shown on the Plans:

(1) Measurement Class 1. Measurement will be by the cubic yard in vehicles of uniform capacity.

(2) Measurement Class 2. Measurement will be by the ton of 2,000 pounds dry weight in vehicles as delivered. A set of standard platform truck scales conforming to the requirements of TxDOT Item 520, "Weighing and Measuring Equipment", shall be furnished by the Contractor and placed at a location approved by the City. When the material is weighed during mixing or batching, re-weighing will not be necessary. The dry weight will be determined by deducting the weight of the moisture in the material at the time of weighing from the gross weight of the material. The moisture in the material will be determined in accordance with Test Method Tex-103-E / ASTM D 2216 at least once each day and more often if conditions warrant.

(3) Measurement Class 3. Measurement will be by the cubic yard in the final stockpile position. The volume of flexible base will be computed in place between the natural ground and the top of the stockpile by the method of average end areas.

(4) Measurement Class 4. Measurement will be by the cubic yard in the completed and accepted final position. The volume of base course will be computed in place between the original subgrade or subbase surfaces, and the lines, grades and slopes of the accepted base course as shown on the Plans by the method of average end areas.

Measurement Class 4 is plan quantity measurement Item and the quantity to be paid for will be that quantity shown in the proposal and on the "Estimate and Quantity" sheet of the contract Plans, except as may be modified by General Conditions of Contract Documents. If no adjustment is required, additional measurements or calculations will not be required. No payment will be made for thickness or width exceeding that shown on the typical section or provided on the Plans.

(5) Measurement Class 5. Measurement will be by the square yard of surface area in the completed and accepted position. The surface area of the base course will be based on the width of flexible base as shown on the Plans.

Measurement Class 5 is a plans quantity measurement Item and the quantity to be paid for will be that quantity shown in the proposal and on the "Estimate and Quantity" sheet of the contract Plans. If no adjustment is required, additional measurements or calculations will not be required. No payment will be made for thickness or width exceeding that shown on the typical section or provided on the Plans.

247.5. PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Flexible Base (Complete in Place)" of the type, grade and measurement class specified; for "Flexible Base (Roadway Delivery)" of the type, grade and measurement class specified; and for "Flexible Base (Stockpile Delivery)" of the type, grade and measurement class specified. This price shall be full compensation for securing and furnishing all materials, including royalty and freight involved; for furnishing scales and labor involved in weighing the material when required; for loosening, blasting, excavating, screening, crushing and temporary stockpiling when required; for loading all materials; for all hauling and delivering and for all manipulations; sprinkling; for rolling, except for proof rolling; sprinkling for dust control, for labor, tools and incidentals necessary to complete the work except as follows:

When the Plans specify "Flexible Base (Complete in Place)", the unit price bid shall be full compensation for shaping and fine grading the roadbed and for spreading, mixing, blading, compacting, shaping, finishing, and curing the base material.

When the Plans specify "Flexible Base (Roadway Delivery)", the unit price bid will not include processing at the roadway. Measurement will be only by Measurement Class 1 or 2.

When the Plans specify "Flexible Base (Stockpile Delivery)", the unit price bid also will be full compensation for preparing the stockpile area and for spreading and shaping the material in the stockpile. Measurement will be only by Measurement Class 1, 2, or 3.

When proofrolling is shown on the Plans, and when directed by the City, it will be considered subsidiary to the various bid items.

When subgrade is constructed under this project, correction of soft spots will be at the Contractor's expense.

CITY OF SAN ANGELO

ITEM 251

REWORKING BASE MATERIAL

251.1 DESCRIPTION.

This Item shall govern for reworking existing base material (with or without an asphaltic concrete pavement) in accordance with the requirements as herein specified and as shown on the Plans. This Item shall also govern for incorporation of new base material when shown on the Plans.

251.2 TYPES OF WORK.

Reworking base material shall consist of one (1) of the following types of work.

Type A. Scarifying only.

Type B. Scarifying, Salvaging and Replacing.

Type C. Scarifying, Salvaging and Stockpiling.

Type D. Scarifying, and Reshaping.

Scarifying shall consist of loosening and breaking the existing base material.

Salvaging shall consist of removing, saving and temporarily stockpiling, if necessary, the existing base material.

Stockpiling shall consist of final storage of the salvaged base material at the location shown on the Plans or as directed by the City.

Reshaping shall consist of reworking the in-place base material with or without additional new base material.

251.3 MATERIALS.

(1) Flexible Base. New base material shall meet the material requirements of Article 247.2 for the type and grade as shown on the Plans.

(2) Water. Water shall meet the same water source requirements of Item 160.2(2).

251.4. CONSTRUCTION METHODS.

(1) General. The work shall be performed to the width and depth shown on the typical sections and as specified below for the type of work shown on the Plans:

(2) Removal of Asphaltic Concrete Pavement. When shown on the Plans, any asphaltic concrete pavement, including any accompanying surface treatment, plant-mix seal and micro-surfacing, shall be removed prior to scarifying the existing base material. The Contractor shall make any necessary provision to prevent contamination of the asphaltic material during and after removal of the asphaltic material. Removal of the asphaltic material shall be in accordance with the applicable bid items. When the existing pavement consists only of a surface treatment, it will not be removed before scarifying.

(3) Type of Work.

(a) Type A (Scarifying only). The existing base, with or without existing asphaltic concrete pavement, shall be scarified for its full width and depth, unless otherwise shown on the Plans. All material shall be broken into particles of a maximum size as approved by the City, or as shown on the Plans.

(b) Type B (Scarifying, Salvaging and Replacing).

(i) Scarifying. The existing base, with or without existing asphaltic concrete pavement, shall be cleaned of all objectionable materials by blading, brooming or other approved methods, prior to scarifying. After cleaning, the existing material shall be scarified for its full width and depth, unless otherwise shown on the Plans. However, in no case shall the underlying subgrade be disturbed. Unless otherwise shown on the Plans, the material shall be broken into particles of not more than two and one-half (2 1/2) inches in size.

(ii) Salvaging. All salvaging operations, including temporary stockpiling or windrowing, shall be conducted in such a manner as not to interfere with traffic, proper drainage or the general requirements of the work. All material shown on the Plans to be salvaged shall be kept reasonably free of soil from the subgrade or roadbed during the salvaging operation. The scarified material shall be removed from the roadbed using equipment approved by the City. The salvaged material may be placed in temporary stockpiles or windrows until sufficient subgrade has been prepared to receive the material.

(iii) Replacing.

(a.) Preparation of Subgrade. Prior to replacing the salvaged material, the subgrade shall be constructed and shaped to conform to the typical sections as shown on the Plans or as established by the City. This work shall be done in accordance with the provisions of applicable bid items.

Prior to replacing the salvaged material, when shown on the Plans and when directed by the City, the Contractor shall proofroll the roadbed in accordance with Item 216, “Rolling (Proof)”. Soft spots shall be corrected as directed by the City.

(b.) Replacement of Salvaged Material. The salvaged material shall be deposited on the prepared subgrade, sprinkled if directed, bladed, and shaped to conform to the typical sections shown on the Plans or as directed by the City.

New base material, when shown on the Plans to be mixed with the salvaged base material, shall be placed and uniformly incorporated with the salvaged material.

All areas and nests of segregated material shall be corrected or removed and replaced with satisfactory and/or new material as directed by the City. All salvaged material shall be kept reasonably free of objectionable materials during the replacing operations.

The replaced material shall conform to the compaction requirements of Article 251.5 and the grade tolerances of Article 251.6.

(4) Type C (Scarifying, Salvaging and Stockpiling).

(a) Scarifying. The existing base, with or without existing asphaltic concrete pavement, shall be cleaned of objectionable materials by blading, brooming or other approved methods, prior to scarifying. After cleaning, the existing material shall be scarified for its full width and depth, unless otherwise shown on the Plans. However, in no case shall the underlying subgrade be disturbed. Unless otherwise shown on the Plans, the material shall be broken into particles of not more than two and one half (2-1/2) inches in size.

(b) Salvaging. All salvaging operations, including temporary stockpiling or windrowing, shall be conducted in such a manner as not to interfere with traffic, proper drainage or the general requirements of the work. All material shown on the Plans to be salvaged shall be kept reasonably free of soil from the subgrade or roadbed during the salvaging operation. The scarified material shall be removed from the roadbed using equipment approved by the City. Scarified material may be placed in temporary stockpiles or windrows prior to loading into approved equipment for hauling to the final stockpile site.

(c) Stockpiling. Trash, wood, brush, stumps and other objectionable materials at the final storage (stockpile) site shall be removed and disposed of as shown on the Plans or as approved by the City prior to the stockpiling of salvaged base material. The Contractor shall prepare stockpile site and shall deliver the salvaged material to the prepared final stockpile area. The material shall be worked into a neat stockpile as shown on the Plans or as approved by the City.

(5) Type D (Scarifying and Reshaping).

(a) Preparation of Subgrade. Prior to scarifying the existing base, if required, any new subgrade shall be constructed and shaped to conform to the typical sections as shown on the Plans or as established by the City. This work shall be done in accordance with the provisions of applicable bid items.

(b) Scarifying. The existing base, with or without existing asphaltic concrete pavement, shall be cleaned of all objectionable materials by blading, brooming or other approved methods, prior to scarifying. After cleaning, the existing material shall be scarified for its full width and depth, unless otherwise shown on the Plans. However, in no case shall the underlying subgrade be disturbed. Unless otherwise shown on the Plans, the material shall be broken into particles of not more than two and one-half (2 1/2) inches in size.

(c) Reshaping. After completion of scarifying, the existing base shall be mixed and shaped to conform to the typical sections shown on the Plans. However, in no case, shall the underlying subgrade be disturbed.

New base material, when shown on the Plans to be mixed with the scarified material, shall be placed on the existing scarified material, and uniformly incorporated.

The reshaped material shall conform to the compaction requirements of Article 251.3 and the grade tolerances of Article 251.6.

251.5 COMPACTION METHODS.

(1) General. The base material shall be compacted either by "Ordinary Compaction" or "Density Control" as shown on the Plans.

(2) Ordinary Compaction. When "Ordinary Compaction" is shown on the Plans, the following provisions shall apply:

The material shall be sprinkled and rolled as directed by the City. Compaction equipment shall be approved by the City. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas and recompacting by sprinkling and rolling.

Should the material lose the required stability, compaction or finish before the next course is placed, or the project is accepted, it shall be reworked in accordance with Subarticle 251.4(4). However, compaction shall be in accordance with "Ordinary Compaction".

(3) Density Control. When "Density Control" is shown on the Plans the following provisions shall apply:

Unless otherwise shown on the Plans, each course shall be sprinkled as required and compacted to the extent necessary to provide not less than 98 percent of the optimum density as determined by TxDOT Test Method Tex-113-E / ASTM D 1557. Roadway density testing will be as outlined in TxDOT Test Method Tex-115-E / ASTM D 2922 and ASTM D 3017.

When the material fails to meet the density requirements, or should the material lose the required stability, density or finish before the next course is placed, or the project is accepted, it shall be reworked in accordance with Subarticle 251.5(4).

(4) Reworking a Section. Should the reworked base material, due to any reason or cause, lose the required stability, density or finish before the next course is placed or the project is accepted, it shall be re-compacted and refinished at the Contractor's expense.

251.6 TOLERANCES.

Tolerances shall conform to the following:

(1) Density Tolerances. The City may accept the work providing not more than one (1) out of the most recent five (5) density tests performed is below the specified density provided the failing test is no more than three (3) pounds per cubic foot below the specified density.

(2) Grade Tolerances. In areas on which pavement is to be placed, any deviation in excess of one-quarter (1/4) inch in cross section or one-quarter (1/4) inch in a length of sixteen (16) feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

251.7 MEASUREMENT.

This Item will be measured by one of the following methods:

Class 1. Measurement will be by the 100-foot station measured along the centerline of each roadbed.

Class 2. Measurement will be by the square yard of the existing base or pavement in its original position. When Class 2 measurement is used, the limits of measurement will be as shown on the Plans.

This class is a plans quantity measurement and the quantity to be paid for will be that quantity shown in the proposal and on the "Estimate and Quantity" sheet of the contract Plans. If no adjustment of quantities is required, additional measurements or calculations will not be required. No payment will be made for thickness or width exceeding that shown on the typical sections or provided on the Plans.

Class 3. Measurement will be by the cubic yard of salvaged material in vehicles as delivered at the stockpile.

Class 4. Measurement will be by the cubic yard of salvaged material measured by the average-end-area method in the stockpile.

Class 5. Measurement will be by the cubic yard in its original position measured by the average-end-area method.

This class is a plans quantity measurement and the quantity to be paid for will be that quantity shown in the proposal and on the "Estimate and Quantity" sheet of the contract Plans. If no adjustment of quantities is required, additional measurements or calculations will not be required. No payment will be made for thickness or width exceeding that shown on the typical sections or provided on the Plans.

Class 6. Measurement will be by the ton of 2,000 pounds dry weight as delivered at the stockpile. When the Plans indicate that measurement of the material is to be by the ton, a set of standard platform truck scales shall be furnished by the Contractor and placed at a location

approved by the City. The dry weight will be determined by deducting the weight of the moisture from the gross weight. The moisture content in the material will be determined by Test Method Tex-103-E / ASTM D 2216, from samples taken at the time of truck weighing, at least once each day and more often if conditions warrant.

251.8 PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Reworking Base Material" of the type, class, scarified depth, and compaction method shown on the Plans, together with the following conditions.

Measurement and payment for "Reworking Base Material (Type A)" will be restricted to Class 1, 2.

Measurement and payment for "Reworking Base Material (Type B)" will be restricted to Class 1, 2, or 5.

Measurement and payment for "Reworking Base Material (Type C)" will not be restricted to any Class.

Measurement and payment for "Reworking Base Material (Type D)" will be restricted to Class 1, 2, or 5.

The unit price bid shall be full compensation for furnishing all labor, tools, equipment, materials, supplies, and incidentals necessary to complete the work, except as follows:

When new base material is mixed with the existing base material, furnishing and delivery of the new base will be paid for as "Flexible Base (Roadway Delivery)" for the type, grade, and class shown on the Plans, in accordance with Article 247.5. All manipulation including mixing, spreading, blading, shaping and finishing of the new and existing base material will not be paid for directly, but will be considered subsidiary to this Item.

When "Ordinary Compaction" is shown on the Plans, all sprinkling and rolling and proofrolling will be considered subsidiary to this Item, unless otherwise shown on the Plans.

When "Density Control" is shown on the Plans, all sprinkling and rolling and proofrolling will be considered subsidiary to this Item.

When proofrolling is shown on the Plans and when directed by the City, it will be considered subsidiary to the various Items.

When subgrade is constructed under this project, correction of soft spots will be at the Contractor's expense. *

Removal of any asphaltic material will be paid for in accordance with the applicable bid items.

*When Subgrade is not constructed on this project, corrections or soft spots will be in accordance with General Requirements and Covenants.

CITY OF SAN ANGELO

ITEM 360

CONCRETE PAVEMENT

360.1. DESCRIPTION.

This item shall govern for the construction of Portland Cement Concrete pavement with or without monolithic curbs on a prepared subgrade or sub-base course, in accordance with the typical sections shown on the Plans, the lines and grades established by the City and the requirements herein.

360.2. PAVING CONSTRUCTION PLAN.

The Contractor shall submit a paving construction plan for approval by the City prior to beginning pavement construction operations. The plan shall contain the mix design, methods of construction, and description of equipment to be used in mixing, placing, finishing, curing, and miscellaneous materials.

360.3. MATERIALS.

Unless otherwise shown on the Plans or required herein, all materials shall conform to the requirements of the pertinent Items of City of San Angelo Standard Specifications for Construction as follows:

Item 300, "Asphalts, Oils, and Emulsions"
Item 420, "Concrete Structures"
Item 421, "Portland Cement Concrete"
Item 433, "Joint Sealants and Fillers"
Item 437, "Concrete Admixtures"
Item 440, "Reinforcing Steel"
TxDOT Item 526, "Membrane Curing"

except for the following:

(1) Portland Cement Concrete. Classification and mix design shall conform to Class "P" Portland Cement Concrete as defined in Item 421, "Portland Cement Concrete", unless otherwise shown on the Plans.

(2) Joint Sealants and Fillers. These materials shall be of the size, shape and type shown on the Plans.

Unless otherwise shown on the Plans, the joint sealant materials to be used shall be self-leveling silicone pavement sealant as manufactured by Dow Corning, Crafco, Inc., or approved equal.

(3) Dowels for Expansion and Contraction Joints. Dowels shall be smooth, straight steel dowels of the size and type shown on the Plans and shall conform to the requirements of ASTM A615, Grade 60. The free end of dowels shall be smooth and free of burrs.

Coat dowels with a thin film of grease or other approved de-bonding material. Provide dowel caps on the lubricated end of each dowel bar used in an expansion joint. Provide dowel caps filled with a soft compressible material with enough range of movement to allow complete closure of the expansion joint.

(4) Positioning and Support Devices for Reinforcement and Joint Assemblies. These devices shall be of sufficient structural quality to prevent movement of the dowels or steel reinforcement during concrete placement and finishing. The devices shall be a type approved by the City.

Positioning and supporting devices (chairs) for steel reinforcement bars shall be either plastic or metal and of sufficient number to maintain the position of the bars within the allowable tolerances.

(5) Reinforcing Steel. ASTM A616 Grade 60 will be permitted for straight bars only. Reinforcing steel that requires bending shall be ASTM 615 Grade 40 with the spacing reduced to two thirds (2/3) of that shown for Grade 60 reinforcing steel. When shown on the Plans, corrosion protection shall be applied to dowels and tie bars.

(a) Tie Bars. Tie bars at weakened plane longitudinal joints shall be straight reinforcing bars. Tie bars at longitudinal construction joints shall be either multiple piece tie bars or straight reinforcing bars, when equipment or conditions permit.

(b) Multiple Piece Tie Bars. Multiple piece tie bars (threaded coupling or other adequate devices) shall develop a tensile strength over their entire length equal to 1-1/4 times the yield strength of the tie bars shown. Each end of multiple piece tie bars shall consist of deformed reinforcement of at least the size shown on the Plans, conforming to City of San Angelo Item 440, “Reinforcing Steel”.

360.4. EQUIPMENT.

(1) General. All equipment shall be maintained in good condition and approved by the City before the Contractor will be permitted to begin construction of the pavement. Weighing, measuring equipment and mixer at Portland Cement Concrete Plant, hauling equipment, agitator trucks, grade control equipment, shall conform to the requirements set forth in applicable City of San Angelo Specifications relative to production and installation of Portland Cement Concrete Pavement.

(2) Forms.

(a) Side Forms. Side forms shall be of metal except as otherwise provided herein and shall be of approved cross section. The length of form sections shall not be less than ten (10) feet, and each section shall provide for staking in position with not less than three (3) pins. Forms shall be of ample strength and shall be provided with adequate devices to secure them in place so the forms

will withstand, without visible springing or settlement, the impact and vibration of the spreading and finishing machinery. In no case shall the base of the form be less than eight (8) inches wide for a form depth of eight (8) inches or more in height. The forms shall be free from warps, bends or kinks, and shall be sufficiently true to provide a reasonably straight edge on the concrete.

Flexible or curved forms of wood or metal of proper radius shall be used for curves of 100-foot radius or less.

(b) Curb Forms. Outside curb forms shall be of wood or metal of a section satisfactory to the City, straight, free of warp, and shall be of a depth at least equal to the depth of the curb. They shall be securely mounted on the paving forms and maintained in true position during the placing of the concrete. Inside curb forms, if required, shall be of approved material and of such design as to provide the curb required and shall be rigidly attached to the outside curbs forms.

(3) Equipment for Spreading, Consolidating, Finishing Surface Texturing Concrete shall conform to the requirements set forth in Item 360, "Concrete Pavement".

360.5. QUALITY OF CONCRETE.

The quality of concrete shall be in accordance with Item 421, "Portland Cement Concrete".

360.6. SUBGRADE.

(1) Preparation of Subgrade or Subbase. The concrete pavement shall be constructed on prepared subgrade. When Slip Form equipment is used, a firm subgrade or subbase (stabilized or unstabilized) shall be maintained outside the limits of the pavement for the support of the Slip Form equipment. Refer to Item 200, "Subgrade Preparation" for additional information.

360.7. PLACEMENT OF REINFORCING STEEL AND JOINT ASSEMBLIES.

All reinforcing steel, including steel wire fabric reinforcement, tie bars, dowel bars, and load transmission devices shall be accurately placed and secured in position in accordance with Item 440, "Reinforcing Steel", and additional requirements set forth in Item 360, "Concrete Pavement".

360.8. CONCRETE MIXING AND PLACING.

(1) Mixing. Concrete mixing shall be in conformance with Items 421, "Portland Cement Concrete", and TxDOT Item 522, "Portland Cement Concrete Plants".

(2) Workability of Concrete. The concrete shall be workable, cohesive, possess satisfactory finishing qualities, and have a consistency conforming to the specified slump requirements. If detrimental bleeding occurs and this condition cannot be corrected by reasonable re-proportioning of the ingredients, the bleeding shall be immediately corrected by one or more of the following listed measures:

Redesign of the batch.
Addition of mineral filler to fine aggregate.

Increase of cement content.
Use of appropriate approved admixture.

When, in the opinion of the City, excessive bleeding occurs and corrective actions do not satisfactorily reduce bleeding, concrete placement operations shall cease until the concrete mixture has been redesigned.

When the method of transporting concrete produces excessive segregation and/or bleed water on the surface of the concrete, the method used shall be discontinued and a satisfactory method shall be provided. Such segregated concrete will be subject to rejection as directed by the City.

(3) Placing. Unless otherwise shown on the Plans, the concrete shall be placed using either forms or a slipform paver. Any concrete not placed as herein prescribed within the time limits specified will be rejected.

The Contractor shall provide a system satisfactory to the City for determining that concrete delivered to the site meets the specified requirements for mixing and time of placing as outlined under Item 360, "Concrete Pavement".

The concrete shall be placed as near as possible to its final location and in such manner as to minimize segregation and re-handling. Where hand spreading is necessary, concrete shall be distributed to the required depth by use of shovels. The use of rakes will not be permitted. Concrete shall be placed, consolidated and finished to conform to the required section and grade.

(a) Double Strike-Off Method. Unless otherwise shown on the Plans, when concrete placement is accomplished in two (2) lifts (double strike-off method) to allow placing the reinforcement after the first lift, the first lift shall be uniformly spread and/or struck off so that the final position of the longitudinal steel will be within one half (1/2) inch of the position shown on the Plans. The second lift shall be placed as soon as reinforcing steel is in place and prior to initial set of the first lift. The second lift shall not be placed later than 20 minutes after strike-off of the first lift.

(b) Placing Curbs. Where curbs are placed monolithically concrete for monolithic curbs shall be the same as for the pavement and must be placed while the pavement concrete is still plastic.

Where curbs are placed separately, they shall be placed in conformance with TxDOT Item 410, "Concrete Curb, and Gutter, Valley Gutter, Alley Apron, Driveways and Sidewalks".

(4) Consolidation. All concrete placed for pavement shall be consolidated by approved mechanical vibrators operated ahead of the finishing machine. Unless otherwise shown on the Plans, pan type vibrators shall be used for double lift placement of concrete and the immersion type vibrators shall be used for full-depth placement, unless otherwise approved by the City. Vibratory equipment shall extend across the pavement, but shall not come in contact with the side forms. Mechanically operated vibrators shall be mounted and operated in such manner as not to interfere with the transverse or longitudinal joints. Hand operated vibrators shall be used to consolidate concrete in areas not accessible to the machine mounted vibrators.

360.9. JOINTS.

(1) General. All transverse and longitudinal joints, when required in the pavement, shall be of the type or alternate type shown on the Plans and shall be constructed at the required location and alignment, in relationship to the tie bars and joint assemblies, and in accordance with details shown on the Plans. Stakes, braces, brackets or other devices shall be used as necessary to keep the entire joint assembly in true vertical and horizontal position.

Careful workmanship shall be exercised in the construction of all joints to insure that the concrete sections are completely separated by an open joint or by the joint materials and to insure that the joints will be true to the required section. Joints shall be cleaned and sealed in accordance with Item 438, "Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)". The sequence of construction of joints if deemed necessary shall be approved by the City.

Excessive spalling of the joint groove shall be repaired to the satisfaction of the City prior to the installation of the sealant.

When sawed joints are used, they shall be sawed to the depth as shown on the Plans as soon as sawing can be accomplished without damage to the pavement. Once sawing has commenced it shall be continued until completed and all such sawing must be completed within 12 hours of placement. Sawing must be accomplished even in rain and cold weather. Should the sawing for any day's placement fail to be completed within 12 hours, the following concrete placement shall be limited to the amount that was sawed on time. This limitation shall continue until the sawing crew demonstrates it can handle a larger volume of sawing. If marring of the surface occurs, the City may extend the 12-hour limit.

The Contractor shall keep a standby power driven concrete saw on the project at all times when concrete operations are under way.

When membrane curing is used, the part of the seal, which has been disturbed by sawing operations, shall be re-sprayed by the Contractor with additional curing compound.

(2) Expansion Joints. Transverse expansion joints shall be constructed in accordance with the details shown on the Plans. After the finishing machine and before the carpet drag and tining machines have passed over the joint the Contractor shall inspect the joint filler for correctness of position. The Contractor shall make any required adjustment in position of the filler and shall install the joint seal space form in accordance with the Plans. The concrete faces of the joint seal space shall be left true to line and section throughout the entire length of the joint.

(3) Weakened Plane Joints. Weakened plane joints shall consist of transverse contraction joints and longitudinal joints. Unless otherwise shown on the Plans, the transverse joints shall be formed or sawed perpendicular to the centerline and surface of the pavement.

The joints shall be constructed in the sequence of operations, as shown on the Plans.

Chalk line, string line, sawing template or other approved methods shall be used to provide a true joint alignment.

(4) Transverse Construction Joints.

When the placing of concrete is stopped, a bulkhead of sufficient cross sectional area to prevent deflection, accurately notched to receive the load transmission devices and shaped accurately to the cross section of the pavement shall be provided.

Intentional stoppage of the placing of concrete shall be either at an expansion joint or at a weakened plane joint, when load transmission devices are shown on the Plans. When the design for load transmission does not include dowels, intentional stoppage shall be in the middle of a slab.

When an unintended stoppage of the placing of concrete occurs, the Contractor shall immediately place the available concrete to a line and install the above described bulkhead at right angles to the centerline of the pavement, perpendicular to the surface and at the required elevation. Concrete shall be placed and finished to this bulkhead. Any concrete remaining on the subgrade ahead shall be removed and disposed of as directed by the City. When placement of concrete is resumed before the concrete has set to the extent that the concrete will stand on removal of the bulkhead, the new concrete shall be consolidated with the first. The edge created by construction joints of this type shall have a joint seal space and shall be sealed as required for contraction joints.

At transverse construction joints in continuously reinforced concrete pavement, the reinforcement or load transmission device immediately beyond the joint will be protected against vibration or impact by the Contractor until paving resumes.

(5) Longitudinal Construction Joints. Longitudinal construction joints shall be of the type and at the locations shown on the Plans.

(6) Joint Filler Boards. Joint filler boards shall be of the size, shape and type as shown on the Plans. Boards shall be anchored by appropriate methods against their displacement while placing concrete.

(7) Curb Joints. Joints in the curb shall be provided and shall be of the same type and location as the adjacent pavement. The expansion joint material shall be of the same thickness, type and quality as specified for the pavement. All expansion joints shall be carried through the curb.

When transverse sawed joints are provided for the pavement, the curb placement shall be delayed until all transverse joints in the pavement have been sawed. Dowel bars shall be placed as shown on the Plans while the pavement concrete is still plastic, unless otherwise approved by the City. The weakened plane joint in the monolithic curbs may be formed or sawed.

360.10 SPREADING AND FINISHING.

(1) Machine-Finishing. All concrete pavement shall be finished with approved self-propelled machines.

The consistency of the concrete as placed should allow the completion of all finishing operations without the addition of water to the surface. When field conditions require additional moisture for the final concrete surface finishing operation, the water shall be applied to the surface by a fine, light fog mist and the amount of water added shall be held to a minimum.

When required by the City, the Contractor shall perform sufficient checks with a long handled ten (10) foot straightedge on the plastic concrete to insure that the final surface will be within the tolerances specified below. The check shall be made with the straightedge parallel to the centerline. Each pass thereof shall lap half of the preceding pass. All high spots shall be removed and all depressions over 1/16-inch in depth shall be filled with fresh concrete and floated. The checking and floating shall be continued until the surface is true to grade and free of depressions, high spots, voids and rough spots.

Final finish shall consist of a combination of a carpet drag and metal tine finish, unless otherwise shown on the Plans. Final finish shall be completed before the concrete has attained its initial set.

The final finish shall be accomplished by first drawing the specified carpet drag longitudinally along the pavement. The actual contact surface shall be regulated so that a coarse texture satisfactory to the City is obtained.

Immediately following the carpet drag, the pavement surface shall be given a transverse metal-tine finish. The metal-tine device shall be operated to obtain randomly spaced grooves approximately 3/16-inch deep, with minimum depth of 1/8-inch and approximately .083 inch wide. Successive passes of the tines shall not overlap a previous pass. Manual methods for achieving similar results may be used on ramps and other irregular sections of pavement.

After completion of texturing, the edge of the slab and joints shall be carefully finished as directed by the City.

(2) Hand Finishing. Hand finishing if permitted shall conform to the requirements specified herein.

When hand finishing is permitted, the concrete shall be struck off with an approved strike-off screed to such elevation that, when consolidated and finished, the surface of the pavement shall conform to the required section and grade.

The pavement shall be straightedged prior to final finishing. Other operations and surface tests shall be as required for machine finishing.

360.11. CURING.

(1) General. All concrete pavement shall be cured for a period of not less than 72 hours from the beginning of curing operations. All exposed surfaces, including vertical surfaces of the placed concrete, shall be cured immediately after finishing operations have been completed, in accordance with the requirements specified herein.

Failure to maintain adequate curing shall be cause for immediate suspension of concreting operations.

The applied curing material may be removed as necessary to saw joints or to comply with the requirements for any surface test. The hardened concrete surface shall be maintained wet with a water spray, if required, and the curing material replaced immediately after completion of sawing, testing and any required surface correction.

(2) Polyethylene Film Curing. After the final finish and the concrete surface has attained initial set, the concrete surface shall be wetted with water, applied in the form of a fine spray and covered with the polyethylene film so placed and weighted as to remain in direct contact with the surface. The polyethylene film blanket shall be maintained in place continuously for not less than the specified curing period.

All joints shall be sealed in a manner acceptable to the City to provide a moisture-proof lap.

The polyethylene film blankets shall be adequately weighted to prevent displacement or billowing due to wind and the film folded down over the side of the pavement shall be secured by a continuous bank of earth or other approved material. Plowing of this windrow into place will not be permitted. Use of polyethylene film holes and cuts are not acceptable.

(3) Membrane Curing. After final finish and immediately after the free surface moisture has disappeared, the concrete surface shall be sprayed uniformly with a curing compound in accordance with the requirements set forth in TxDOT Item 526, "Membrane Curing".

Special care shall be taken to insure that the sides of the tining grooves are coated with the curing compound.

360.12. PROTECTION OF PAVEMENT AND OPENING TO TRAFFIC.

The pavement shall be closed to all traffic, including vehicles of the Contractor, until the concrete is at least four (4) days old. This period of closure to all traffic may be extended if in the opinion of the City, weather or other conditions may require an extension of the time of protection. When Type II cement is used one (1) additional day shall be required for a total of five (5) days.

At the end of this period the pavement may be opened for use by vehicles of the Contractor provided the gross weight (vehicle plus load) of such vehicles and/or equipment does not exceed 14,000 pounds. Such opening, however, shall in no manner relieve the Contractor from his responsibility for overall safety of the traffic and the general public.

On those sections of the pavement to be opened to traffic, all joints shall first be sealed and the pavement cleaned. Unless otherwise shown on the Plans, stable material shall be placed against the pavement edges before permitting vehicles thereon.

After the concrete in any section of pavement is seven (7) days old, such section of pavement may be opened to all traffic as directed by the City. When Type II cement is used one (1) additional day shall be required for a total of eight (8) days. For those sections of the pavement to be opened to traffic, all joints shall first be sealed, the pavement cleaned, stable material placed against the pavement edges unless otherwise shown on the Plans and all other work performed as required for the safety of traffic. Such opening, however, shall in no manner relieve the Contractor from his responsibility for overall safety of the traffic and the general public.

360.13. MEASUREMENT.

This Item will be measured by one of the following methods:

(1) Measurement by the Square Yard. When provided under this item, concrete pavement will be measured by the square yard of surface area of completed and accepted work. When concrete pavement is to be measured by the square yard and monolithic curb is required, monolithic curb will be considered as part of pavement. Surface area of the pavement will be computed by measuring dimensions to the back of monolithic curb.

If curb and gutter is poured separately, it shall be measured and paid in accordance with Item 529, "Concrete Curb, Gutter, and combined Curb and Gutter". Gutter, Alley Apron, Driveways, and Sidewalks and will not be included in the area of concrete pavement.

(2) Measurement by the Cubic Yard. When provided by this Item, concrete pavement, including monolithic curb when required, will be measured by the cubic yard computed on the basis of design depth of concrete pavement shown on the Plans.

360.14. PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for this Item. This price shall be full compensation for furnishing concrete; for placing and adjusting forms; for furnishing and installing all reinforcing steel; for furnishing all materials for sealing joints and placing longitudinal, expansion and weakened-plane joints, including all steel dowel caps and load transmission devices required; for mixing, placing, finishing, curing and sawing concrete; for cleaning and sealing concrete joints; and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

CITY OF SAN ANGELO

ITEM 400

EXCAVATION AND BACKFILL FOR STRUCTURES

400.1 DESCRIPTION.

This Item shall govern for the excavation bedding, backfill and/or Portland Cement Stabilized Backfill required for the construction of all structures. This Item shall also govern for any necessary sloping, pumping or bailing, for drainage, and for all sheeting and bracing of excavation walls up to five feet in depth. Excavation greater than five (5) feet in depth shall be protected as specified in TxDOT Item 402, "Trench Excavation Protection" or TxDOT Item 403, " Temporary Special Shoring". Unless otherwise provided, the work included herein shall provide for the removal of old structures or portions thereof (abutments, wingwalls, piers, house foundations; old sewers, sewer appurtenances, etc.), trees and all other obstructions to the proposed construction, the blocking of the ends of abandoned sewers cut and left in place, and the protection of existing utilities. Also governed by this Item are the cutting and restoration of pavement and base courses, the construction and removal of any required cofferdams, the hauling and disposition of surplus materials and the bridging of trenches and other provisions for maintenance of traffic or access.

400.2 EXCAVATION.

(1) General. Excavation shall conform to the lines and grades shown on the Plans or as directed by the City.

When trench and/or negative projecting conditions for concrete pipe culverts are required by design, an excavation diagram will be shown on the Plans. These limits of excavation shall not be exceeded.

(a) Disposal of Excavation. All materials from excavation operations not required for backfilling and that are considered satisfactory, may be placed in embankment in accordance with Item 132, "Embankment". All excess material or material not satisfactory for use in Embankment will become the property of the Contractor. All surplus material shall be removed from the work site promptly following the completion of the portion of the structure involved and disposed of in a manner satisfactory to the City and by permit from the City.

Whenever excavation is made for installing structures across private property or beyond the limits of the embankment, the top soil removed in the excavation shall be kept separate and replaced, as nearly as feasible.

(b) Excavation in Streets. Where structures are installed in streets, highways or other paved areas, the work shall include the cutting of pavement and base to neat lines and the restoration of pavement structure after structural excavation and backfill are completed. The type and thickness of replacement materials shall be as shown on the Plans. Any work done or any damage to base

and/or pavement incurred outside the limits shown on the Plans or authorized by the City, will not be measured for payment, but shall be restored at the Contractor's expense. Maintenance and control of traffic shall be in accordance with the approved traffic control plan and Manual on Uniform Traffic Control Devices.

(c) Protection of Utilities. The **Contractor** shall conduct his work with a minimum disturbance of existing utilities and it shall be his responsibility to coordinate all work in or near the utilities with the utility owners. The Contractor shall inform utility owners sufficiently in advance of his operations to enable them to identify and locate, reroute, provide temporary detours, or to make other adjustments to utility lines in order that work may proceed with a minimum of delay. The Contractor shall cooperate with all utility owners concerned for any utility adjustments necessary.

Particular care shall be exercised to avoid the cutting or damaging of underground utility lines that are to remain in place. Such lines if damaged shall be restored promptly. When active sanitary sewer lines are cut during excavation operations temporary flumes shall be provided across the excavation, while open, and the lines shall be restored when the backfilling has progressed to the original bedding lines of the cut sewer.

(d) Removing Old or Abandoned Structures. When old or abandoned structures or foundations are encountered in the excavation, such obstructions shall be removed for the full width of the excavation and to a depth of one (1) foot below the bottom of the excavation. When old inlets or manholes are encountered and no plan provision is made for adjustment or connection to the new structures, such manholes and inlets shall be removed completely to a depth one (1) foot below the bottom of the excavation. In each instance, the bottom of the excavation shall be restored to grade by backfilling and compacting by the methods provided hereinafter for backfill. Where the excavation cuts through abandoned sewers, these sewers shall be removed as required to clear the new structure and plugged in a manner approved by the City.

(e) Dewatering of Excavation Area. Structures shall not be constructed or laid in the presence of water unless approved by the City. Setting of precast members, placement of concrete, or pipe placing operations shall be performed on a dry firm bed. This shall be accomplished by removal of water from the surface of the bed by bailing, pumping, wellpoint installation, deep wells, drench drains, or any other method approved by the City.

For foundations placed in the presence of water, when approved by the City, pumping or bailing from the interior of any foundation enclosure shall be done in a manner which precludes the possibility of movement of water through or alongside any concrete being placed. No pumping or bailing will be permitted during the placing of structural concrete or for a period of at least 36 hours thereafter, unless from a suitable sump separated from the concrete work. Pumping or bailing during placement of seal concrete shall be only to the extent necessary to maintain a static head of water within the cofferdam. Pumping or bailing to dewater a sealed cofferdam shall not be started until the seal has aged at least 36 hours.

In the event that the excavation cannot be dewatered to the point where the subgrade is free of mud, or it is difficult to keep the reinforcing steel clean in cast-in-place structures, a special material shall be used in the bottom of the excavation. Such special material shall be a minimum depth of three

inches and shall consist of a lean concrete mixture (not less than three (3) sacks of cement per cubic yard), or other material approved by the City.

(2) Bridge Foundations and Retaining Walls. To determine the adequacy of a proposed foundation, the City may require the Contractor to make soundings or take cores to determine the character of the subgrade materials. The maximum depth of soundings or cores will not exceed five (5) feet below the proposed footing grade.

Care shall be taken not to disturb the material below the bottom of footing grade. Backfilling in a foundation to compensate for excavation which has extended below grade will not be permitted. Such areas below grade shall be filled with concrete at the time the footing is placed. The additional concrete involved shall be at the Contractor's expense.

Unless otherwise required herein or on the Plans, rock or other hard foundation material shall be free from all loose material, clean, and cut to a firm surface which may be level, stepped, or serrated, as directed by the City. All seams shall be cleaned out and filled with concrete at the time the footing is placed.

When the material encountered at footing grade of a retaining wall, bridge bent or pier is found to be partially of rock or incompressible material and partially of a compressible material, the foundation shall not be placed until the City has inspected the footing and authorized necessary changes to provide a uniform bearing condition.

(3) Culverts. For all single and multiple box culverts, pipe culverts, pipe arch culverts, long span structural plate structures, box sewers, and pipe sewers where the soil encountered at established footing grade is an unstable or incompressible material, the following procedure shall be used unless other methods are called for on the Plans:

Unstable material shall be removed to a depth not to exceed two (2) feet below the footing of the structure unless additional depth is authorized by the City. All soil removed shall be replaced with stable material in uniform layers not to exceed eight (8) inches in depth (loose measurement). Each layer shall have sufficient moisture to be compacted by rolling or tamping as required to provide a stable foundation for the structure.

When it is not feasible to construct a stable footing as outlined above, the Contractor shall use special materials, such as flexible base, cement stabilized base, cement stabilized backfill or other material, as directed by the City. This work will be paid for as provided in Article 400.8. Special material used, or additional excavation made, for the Contractor's convenience to expedite the work, will be at the Contractor's expense.

When the material encountered at the footing grade of a structure is found to be rock, partially rock or other incompressible material, the incompressible material shall be removed to a depth of six (6) inches below the footing grade and backfilled with a compressible material approved by the City and compacted in accordance with Section 400.5.

(4) Trench. Unless otherwise shown on the Plans, all sewer pipe structures shall be constructed in an open cut with vertical sides to a point one (1) foot above the pipe. When site conditions or the Plans do not prohibit the sloping of the cut, the excavation one (1) foot above the pipe may be

stepped and/or the sides laid back to a stable slope. Required vertical sides shall be sheeted and braced when necessary to maintain the required vertical excavation throughout the construction period.

For all pipe sewers to be constructed in fill above natural ground, the embankment shall first be constructed to an elevation not less than one (1) foot above the top of the pipe, after which excavation for the pipe shall be made as noted above.

Unstable or incompressible material shall be removed in accordance with Section 400.2(3). For unstable trench conditions requiring outside forms, seals, sheeting and bracing, or where ground water is encountered, any additional excavation and backfill required shall be done at the Contractor's expense for trenches up to five (5) feet in depth.

400.3 COFFERDAMS.

The term cofferdam designates any temporary or removable structure constructed to hold the surrounding earth, water, or both out of the excavation, whether the structure is formed of soil, timber, steel, concrete, or a combination of these. The "cofferdam" shall also include the use of pumping wells or well points used for the same purpose. The cost of cofferdams shall be included in the price bid for excavation except where temporary special shoring is shown on the Plans to provide excavation protection.

For sheet pile or other types of cofferdams, which require internal bracing, the Contractor shall submit details and design calculations bearing the seal of a Registered Professional City for review. The maximum stresses shall not exceed 125 percent of the working allowable stresses used by the City Engineering Department for the design of structures. The interior dimensions of cofferdams shall provide sufficient clearance for the construction, inspection (inside and outside), and removal of any required forms and to permit pumping outside the forms. In general, sheet pile cofferdams shall extend well below the bottom of the footings and any concrete seal and shall be well braced and as watertight as practicable.

When the City judges it to be impractical to de-water a cofferdam and a concrete seal is to be placed around piling driven therein, the excavation shall be deep enough to allow for swell of the material during pile driving operations. After driving the piling, all swelling material shall be removed to the bottom of the seal grade. Where it is possible to de-water the cofferdam without placing a seal, the foundation material shall be removed to exact footing grades after piling are driven. Backfilling a foundation to compensate for excavation, which has been extended below grade, will not be permitted. Such areas below grade shall be filled with concrete at the time the seals or footings are placed. The additional concrete quantities necessary to compensate for excavation below grade shall be at the Contractor's expense.

Unless otherwise provided, the Contractor shall remove cofferdams after the completion of the substructure without disturbing or damaging the structure.

400.4 SHAPING AND BEDDING.

For precast pipe and box sections, the excavation shall be undercut a minimum depth sufficient to accommodate the class of bedding indicated on the Plans and conforming to the bedding requirement of this Item. Where cement stabilized backfill is indicated on the Plans, the excavation shall be undercut a minimum of four (4) inches and backfilled with stabilized material to support the pipe at the required grade.

Three classes of bedding for trench or embankment conditions are shown in Figures 1, 2, and 3. Bedding shall be in accordance with Class C bedding unless otherwise shown on the Plans. The City may require the use of a template to secure reasonably accurate shaping of the foundation material.

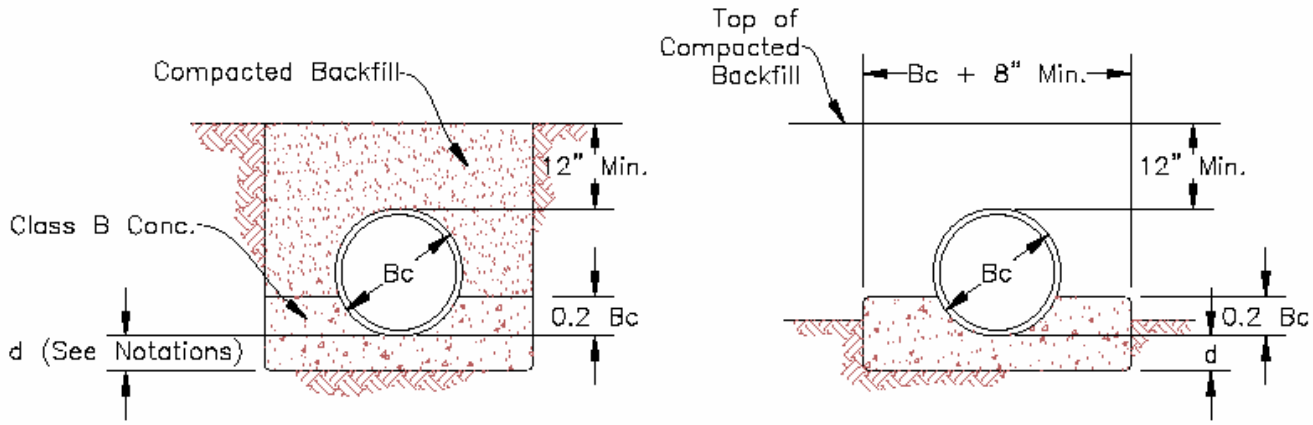
DEPTH OF BEDDING MATERIAL BELOW PIPE

D	d (Min.)
27" & smaller	3
30" to 60"	4
66" & larger	6

LEGEND

Bc = Outside Diameter or Horizontal Dimension
B'c = Vertical Dimension
H = Backfill Cover Above Top of Pipe in Inches
D = Inside Diameter of Pipe
d = Depth of Bedding Material Below Pipe in Inches

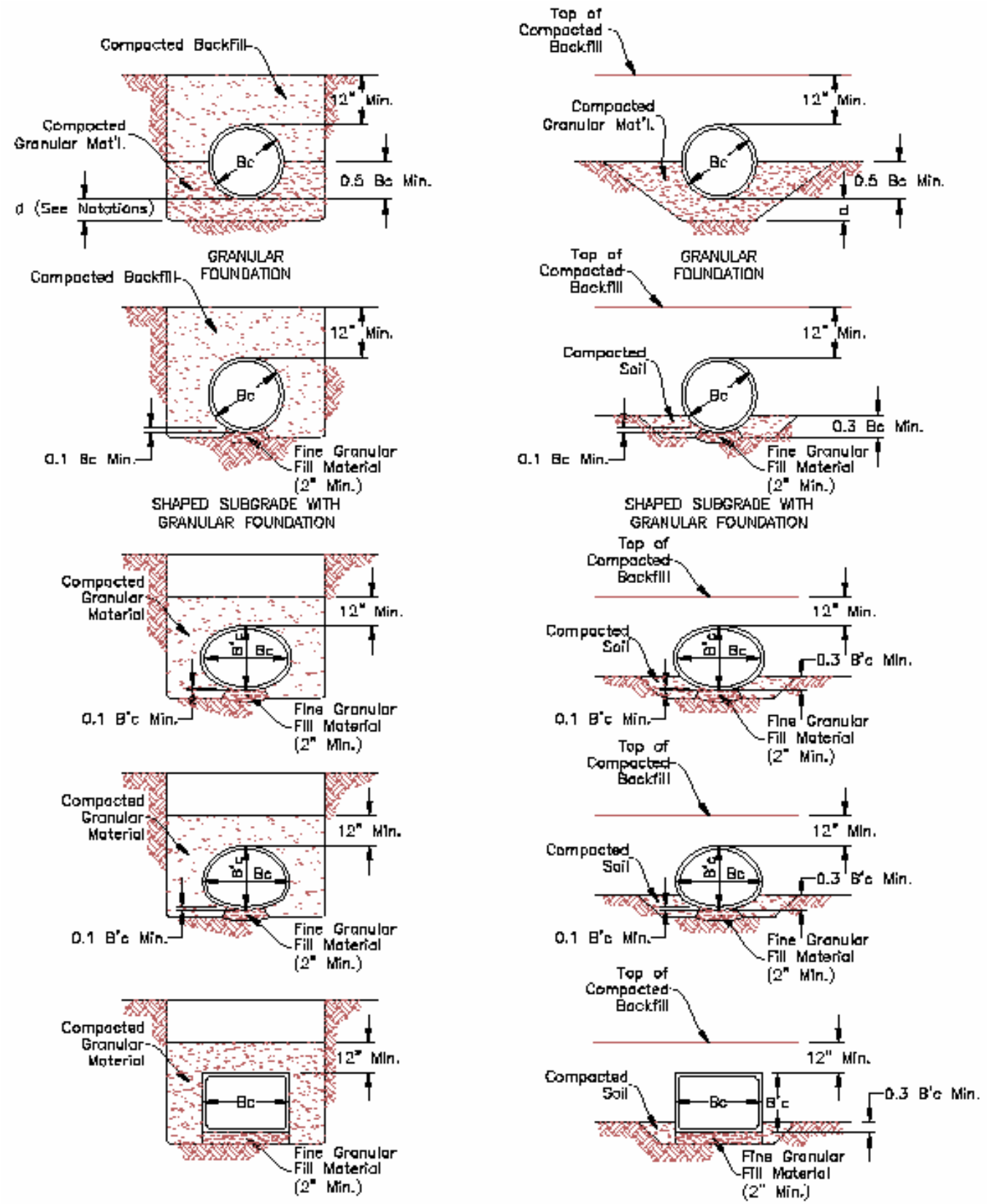
NOTATIONS FOR FIGURES 1, 2 & 3



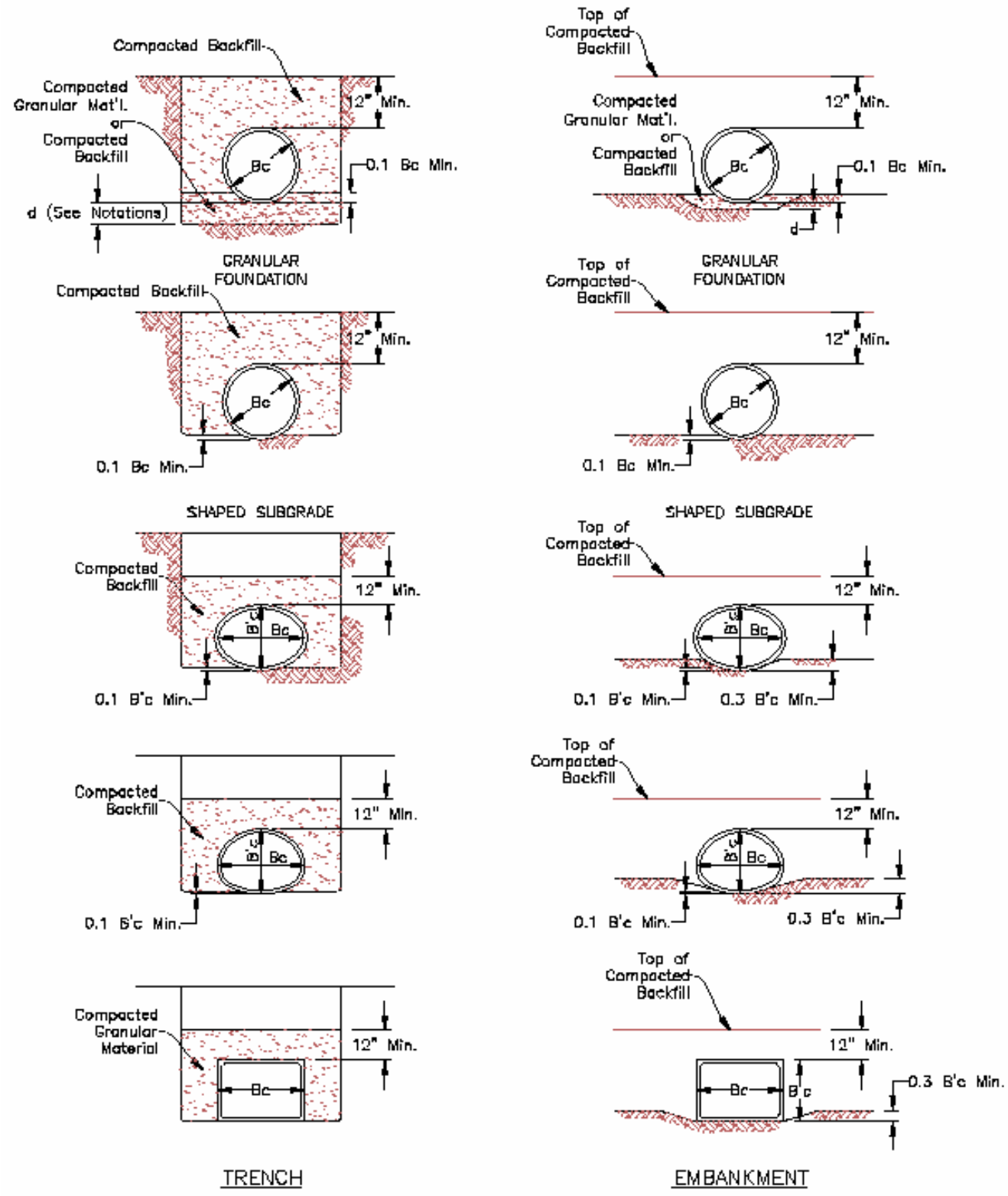
CONCRETE CRADLE TRENCH

CONCRETE CRADLE EMBANKMENT

CLASS A
(Figure 1)



TRENCH EMBANKMENT



CLASS C
(Figure 3)

400.5 BACKFILL.

(1) General. As soon as practical, all portions of the excavation not occupied by the permanent structure shall be backfilled. Backfill material may be obtained from excavation or from other sources. Backfill material shall be free from stones of such size as to interfere with compaction; free from large lumps which will not break down readily under compaction; and free from frozen lumps, wood, or other extraneous material.

Backfill which will not support any portion of the completed roadbed or embankment shall be placed in layers not more than ten (10) inches in depth (loose measurement). Backfill which will support any portion of the roadbed or embankment shall be placed in uniform layers not to exceed eight inches in depth (loose measurement). Each layer of backfill shall be compacted to a density comparable with the adjacent undisturbed soil or as shown on the Plans.

Each layer of backfill material, if dry, shall be wetted uniformly to the moisture content required to obtain a density comparable with the adjacent undisturbed soil or as shown on the Plans and shall be compacted to that density by means of mechanical tamps or rammers. The use of rolling equipment of the type generally used in compacting embankments will be permitted on portions which are accessible to such equipment.

When tamping equipment is furnished which, when proven to the satisfaction of the City, will adequately compact the backfill material to the density required, the eight (8) inch and ten (10) inch lifts (loose measurement) specified above may be increased to lifts not to exceed 12 inches.

Cohesionless materials, such as sand, may be used for general backfilling purposes. Compaction of cohesionless materials shall be done with vibratory equipment, water ponding or a combination thereof.

(2) Bridge Foundations, Retaining Walls, and Culverts. No backfill shall be placed against any structure until the concrete has reached the minimum flexural strength required in Item 421, "Portland Cement Concrete".

The material used for backfilling shall be free of any appreciable amount of gravel or stone particles more than four inches in greatest dimension and shall be of a gradation that permits thorough compaction. The use of rock or gravel mixed with soil will be permitted, provided the percentage of fines is sufficient to fill all voids and insure a uniform and thoroughly compacted mass of proper density.

When the excavation has been made through a hard material resistant to erosion, the City may require the backfill around piers and in front of abutments and wings to be of stone or lean concrete. Unless otherwise provided, such backfill will be measured and paid for as extra work in accordance with Part I, General Provisions – Division I, General Requirements and Covenants.

Embankment which is too close to a structure to permit compaction by the use of the blading and rolling equipment used on adjoining sections of embankment, shall be placed and compacted in

accordance with Section 400.5(1). Mechanical tamps or rammers shall be required when the structure being backfilled could sustain damage from other compacting operations.

Care shall be taken to prevent any wedging action of backfill against the structure, and the slopes bounding the excavation shall be stepped or serrated to prevent such action. Backfill placed around piers shall be deposited uniformly.

(3) Pipe. After the bedding and pipes have been installed as required, the selected backfill materials shall be brought to proper moisture condition, placed along both sides of the pipe equally, in uniform layers not exceeding eight (8) inches in depth (loose measurement), and each lift thoroughly compacted mechanically. Special care shall be taken to secure thorough compaction of the materials placed under the haunches of the pipe and to prevent damage or displacement of the pipe. Filling and/or backfilling shall be continued in this manner to the elevation of the top of the pipe. Backfill above the top of the pipe shall be placed and compacted in accordance with Subarticle 400.5(1). During construction, protection of the pipe shall be in accordance with the pertinent pipe item. Pipe damaged by the Contractor during construction shall be replaced at the Contractor's expense or repaired to the satisfaction of the City.

The City may reject any material containing more than 20 percent by weight of material retained on a three (3) inch sieve, or material excavated in such a manner as to produce large lumps not easily broken down or which cannot be spread in loose layers. In general, material excavated by means of a trenching machine will meet the requirements above, provided large stones are not present.

Where sewers extend beyond the toe of slope of the embankment and the depth of cover provided by backfill to the original ground level is less than the minimum required by the specifications for the type of pipe involved, additional material shall be placed and compacted, as herein specified for backfill outside the limits of the roadbed, until this minimum cover has been provided.

400.6 CEMENT STABILIZED BACKFILL.

When shown on the Plans, the excavation shall be backfilled to the elevations shown with cement stabilized backfill. Unless otherwise shown on the Plans, cement stabilized backfill shall contain aggregate, water and a minimum of seven (7) percent Portland Cement based on the dry weight of the aggregate, in accordance with Test Method Tex-120-E / ASTM D 1633. Aggregate shall be as shown on the Plans or as approved by the City.

Cement stabilized backfill below the top of sewers, manholes, inlets, or other structures shall be placed equally along all sides of the structure so as to prevent strain on or displacement of the structure. Cement stabilized backfill shall be placed in a manner that will completely fill all voids in the trench. Should compaction be required to fill all voids, hand operated tampers may be used.

400.7 MEASUREMENT.

Excavation and backfill will be measured by the cubic yard. Cutting and restoring of pavement will be measured by the square yard.

This is a Plans quantity measurement Item and the quantity to be paid for will be that quantity shown in the proposal and on the "Estimate and Quantity" sheet of the contract Plans, except as may be modified by General Conditions of Contract Documents. If no adjustment of quantities is required, additional measurements or calculations will not be required.

Unless otherwise shown on the Plans, structural excavation for pipe headwalls, inlets, manholes, culvert widening (extensions) 15 feet or less in length, bridge abutments, retaining walls and side road and private entrance pipe culverts will not be measured but shall be considered subsidiary to the various bid items.

For culvert widening (extensive) greater than 15 feet, quantities for structural excavation will be shown on the Plans.

Structural excavation will be measured by the cubic yard computed by the method of average end areas using the following limits to establish templates for measurement:

(1) For all excavation requiring measurement, except that required for the barrels of pipe culverts; for structural plate structures no material outside of vertical planes one (1) foot beyond the edges of the footings and parallel thereto will be included, unless otherwise shown on the Plans. When the Plans provide the Contractor the option of cast-in-place or precast boxes, measurement will be based on the cast-in-place option.

(2) For pipes 42 inches or less in nominal or equivalent diameter, no material outside of vertical planes one foot beyond the horizontal projection of the outside surfaces of the pipe and parallel thereto will be included. For pipes more than 42 inches in nominal or equivalent diameter, no material outside of vertical planes located two (2) feet beyond the horizontal projection of the outside surfaces of the pipe and parallel thereto will be included. Excavation for pipes shall be measured between the extreme ends of the completed structure, including any end appurtenances, as shown on the Plans and from centerline to centerline of inlets, manholes, etc., therein. When excavation for appurtenances is measured for payment, the limits of excavation for the pipes shall not overlap those of the appurtenances.

(3) For structural plate structures no material outside of vertical planes three (3) feet beyond the horizontal projection of the outside surfaces of the structure(s) and parallel thereto will be included. When the quality of the existing soil or embankment is less than that of the proposed backfill material, the excavation shall be extended for measurement to vertical planes located at one-half of the span beyond the horizontal projection of the outside surfaces of the structure(s) and parallel thereto.

(4) If a cofferdam is used, the limitations of Section 400.7(1) shall apply just as if no cofferdam were used. Excavation quantities for foundations shown on the Plans and in the proposal where

cofferdams are required shall be considered as final quantities and no further measurement will be made.

(5) Where excavation, in addition to that allowed for the footings, is required for other portions of the structure, such as for the cap, cross strut, or tie beam of a pier or bent or for the superstructure, measurement for such additional excavation will be limited laterally by vertical planes one (1) foot beyond the face of the member and parallel thereto and vertically to a depth of one (1) foot below the bottom of such member.

(6) No measurement will be made of any excavation necessary for placing forms or falsework except as allowed by the above conditions.

(7) At all structure sites except at culverts and trench excavations, the measurement of structural excavation will include only material below or outside the limits of the completed road or channel excavation.

Trench excavation in fill above natural ground, as specified in Section 400.2(4), will be measured for payment. Quantities will include that area as specified in Section 400.7(2) plus one (1) foot above the top of the pipe, regardless of the height of fill previously made.

(8) Excavation required for shaping the slopes of header banks which were built by prior contract and upon which riprap is to be placed will be measured as "Structural Excavation, (Riprap)".

(9) For all culverts, except for side road and private entrance culverts, all excavation within the limits of the structure and below or outside the limits of the completed roadway excavation, will be measured as culvert excavation. Where the overall normal width of the culvert is 12 feet or less, measurement will be as "Structural Excavation, culvert, Small". Where the overall normal width of the culvert exceeds 12 feet, measurement will be as "Structural Excavation, Culvert, Large".

(10) Where excavation diagrams are shown on the Plans, they shall take precedence over these provisions.

(11) Measurement will not include materials removed below footing grades to compensate for anticipated swelling due to pile driving, nor will it include material required to be removed due to swelling beyond the specified limits during pile driving operations.

(12) Measurement will not include additional volume caused by slips, slides, cave-ins, sitting, or fill material resulting from the action of the elements or the Contractor's operation.

(13) Where rock or other incompressible or unstable material is undercut to provide a suitable foundation for pipe or box sections, such material below grade, which is directed by the City to be removed, will be measured for payment.

(14) No allowance will be made for any variance from plan quantity incurred by an alternate bid.

(15) Additional measurement will be made of the volume of excavation involved in the lowering or raising of the elevation of a footing, foundation, or structure unit, when such grade change is authorized by the City.

(16) Cement stabilized backfill will be measured in accordance with the backfill diagram shown on the Plans. The quantity of "Cement Stabilized Backfill" shown on the Plans shall be considered as final quantities and no further measurement will be required. Changes in alignment or grade as authorized by the City will be measured for payment.

(17) The work to be done in the cutting and restoring of pavement will be measured in accordance with the dimensions shown on the Plans. The excavation below the pavement and/or base shall be measured as structural excavation of the pertinent type.

400.8 PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Structural Excavation", "Structural Excavation (Bridge)", "Structural Excavation (Culvert, Small)", "Structural Excavation (Culvert, Large)", "Structural Excavation (Trench)", "Structural Excavation (Riprap)", "Cement Stabilized Backfill" and "Cutting and Restoring Pavement".

Payment for removal and replacement of unstable or incompressible material below the footing grades of culverts as provided for in Section 400.2.(3) will be made as follows:

When the Plans specify or when the City directs the use of special materials such as flexible base, cement stabilized base, cement stabilized backfill or other special material, payment for excavation below the footing grades shall be made at the unit price bid for "Structural Excavation" of the pertinent type. Payment for furnishing, hauling, placing and compacting the flexible base, cement stabilized base, cement stabilized backfill or other special materials will be made at the unit price bid for these items in the contract or in accordance with General Requirements and Covenants, in cases where the required material is not a bid item.

Where special materials are not required or specified, payment for the removal and replacement of unstable and/or incompressible material will be made at a price equal to 200 percent of the unit price bid per cubic yard for "Structural Excavation" of the pertinent type. This price shall be full compensation for removing the unstable or incompressible material, furnishing, hauling, placing and compacting suitable replacement material and for all labor, equipment, tools, and incidentals necessary to complete the work.

If no direct method of payment is provided in the contract for culvert excavation and no special materials are required or specified, the removal and replacement of unstable or incompressible material, when such work is authorized by the City, will be measured and paid for at fifteen dollars ($15.00) per cubic yard.

Should the City deem it necessary to lower a bridge foundation to an elevation below the grade shown on the Plans, such over excavation below plan will be paid for as "Structural Excavation" at an adjusted unit price as defined herein. Payment will be made at a unit price equal to 115

percent of the contract unit price bid for all over excavation where the revised footing grade does not vary from plan grade by more than five feet.

Payment will be made at a unit price of 125 percent of the contract unit price bid for all over excavation where the revised grade varies from plan grade by more than five (5) feet but not in excess of ten (10) feet. In cases where the revised footing grade varies from plan grade by more than ten (10) feet, a supplemental agreement shall be prepared to establish a unit price with which to make payment for the over excavation.

No direct payment will be made for backfilling ground structures. Payment for the backfilling and compacting of areas which were removed as structural excavation shall be included in the unit price bid for "Structural Excavation".

Unless otherwise shown on the Plans, structural excavation, which has been completed to the satisfaction of the City, but not backfilled, a partial payment of 50 percent of the price bid, will be made. The remaining amount will be paid upon the satisfactory completion of the backfilling.

This price shall be full compensation for all excavation, bedding, and backfill including placing, sprinkling and compaction of material; all soundings; cleaning and filling seams; constructing all cofferdams; all de-watering; and for furnishing all materials, hauling, labor, equipment, tools, sheeting and/or bracing of excavations up to and including five feet in depth, pumps, drills, explosives, disposition of surplus material, cutting pavement and base to neat lines; and for incidentals necessary to complete the work..

CITY OF SAN ANGELO

ITEM 420

CONCRETE STRUCTURES

420.1. DESCRIPTION.

This Item shall govern for the construction of all types of structures involving the use of cast-in-place concrete. All structures shall be constructed in accordance with the details shown on the Plans and this Item.

420.2. MATERIALS.

(1) Concrete. All concrete shall conform to the provisions of Item 421, "Portland Cement Concrete".

The class of concrete for each type of structure or unit shall be as shown on the Plans, or by pertinent governing specifications.

(2) Reinforcing Steel. All reinforcing steel shall conform to the provisions of Item 440, "Reinforcing Steel".

(3) Expansion Joint Material. The following materials shall conform to the requirements of Item 433, "Joint Sealants and Fillers".

(a) Preformed Fiber Material. Preformed fiber expansion joint material shall conform to the dimensions shown on the Plans. Unless otherwise specified, "Preformed Bituminous Fiber Material" shall be used.

(b) Joint Sealing Material. Unless shown otherwise, the sealer shall be a "Low Modulus Silicone Sealant".

(c) Asphalt Board. Asphalt board shall conform to the dimensions shown on the Plans.

(d) Rebonded Neoprene Filler. Rebonded neoprene filler shall conform to the dimensions shown on the Plans.

(4) Waterstop.

(a) Rubber waterstop or polyvinyl chloride (PVC) waterstop shall be in conformance with TxDOT Item 435, "Elastomeric Materials".

(b) Other types **s**hall be as shown on the Plans.

(5) Curing Materials.

(a) Membrane curing shall conform to TxDOT Item 526, "Membrane Curing".

(b) Cotton mats shall consist of a filling material of cotton "bat" or "bats" (min. twelve (12) oz. per sq. yd.); covered with unsized cloth (min. six (6) oz. per sq. yd.); tufted or stitched to maintain stability; shall be free from tears; and shall be in good general condition.

(c) Polyethylene sheeting shall be four (4) mil. minimum thickness and free from visible defects. It shall be clear or opaque white except when the temperature during the curing period does not exceed 60°F or when applicable to control temperature during mass pours.

(d) Burlap-polyethylene mats shall be made from burlap impregnated on one (1) side with a film of opaque white pigmented polyethylene and free from visible defects.

(e) Laminated mats shall have not less than one layer of an impervious material such as polyethylene, vinyl plastic or other acceptable material (either as a solid sheet or impregnated into another fabric) and shall be free of visible defects.

(6) Admixtures. Concrete admixtures shall comply with the requirements of TxDOT Item 437, "Concrete Admixtures".

(7) Epoxy. Unless otherwise specified, epoxy materials shall conform to TxDOT Item 575, "Epoxy".

420.3. GENERAL REQUIREMENTS.

Before starting work, the Contractor shall inform the City fully of the construction methods he proposes to use, the adequacy of which shall be subject to the approval of the City.

Concurrence on the part of the City of any proposed construction methods, approval of equipment, or of form and falsework Plans does not relieve the Contractor of the responsibility for the safety or correctness of the methods, the adequacy of his equipment or from carrying out the work in full accordance with the contract.

Unless otherwise shown on the Plans, the time sequence in which construction operations may be carried on and in which completed structures may be opened to traffic shall be governed by the following:

(1) Superstructure members, forms, falsework, or erection equipment shall not be placed on the substructure before the concrete therein has attained a flexural strength of 425 psi.

(2) Storage of materials on completed portions of a structure will not be permitted until all curing requirements for those particular portions have been met.

(3) A minimum flexural strength of 340 psi will be required for the following:

(a) Forms erected on concrete footings supported by piling or drilled shafts.

(b) Forms on individual drilled shafts.

Such work may begin on spread footings and culvert footings, after the concrete therein has aged at least two curing days. Concrete may be placed as soon as the forms and reinforcing steel are approved.

(4) The support of tie beam and/or cap forms by falsework placed on previously placed tie beams will be permissible provided such beams have attained 425 psi flexural strength, curing requirements are completed, and the member is properly supported to eliminate stresses not provided for in the design.

(5) Bridges and direct traffic culverts shall not be opened to construction traffic or to the traveling public until authorized by the City in accordance with the following:

After the last slab concrete has been in place at least 14 days, authorization may be given for construction traffic on structures not to exceed three quarter (3/4) ton vehicles.

After the last slab concrete has been in place at least 21 days, authorization may be given for other construction traffic or for the traveling public when necessary. Vehicles exceeding the legal load limit will be allowed in accordance with TxDOT Item 6, "Control of Materials".

(6) Box culverts in fills may be opened to backfilling and compaction equipment when the concrete in the top slab has attained 425 psi flexural strength, and may be opened to other traffic as soon as sufficient backfill and/or embankment has been placed over the top to protect the culverts against damage from heavy construction equipment. The Contractor shall repair, at his expense, any damage inflicted on the culvert by construction traffic.

420.4. DRAINS.

Weep holes and roadway drains shall be installed and constructed as shown on the Plans.

420.5. EXPANSION JOINTS.

Joints and devices to provide for expansion and contraction shall be constructed in accordance with plan details and the requirements of this Item.

The bearing area under the expansion ends of concrete slabs and slab and girder spans shall be given a steel trowel finish, and finished to the exact grades required.

Bridging of concrete or mortar around expansion joint material in bearings and expansion joints shall be prevented.

All open joints and joints to be filled with expansion joint material shall be constructed using forms adaptable to loosening or early removal. To avoid expansion or contraction damage to the adjacent concrete, these forms shall be loosened as soon as possible after final concrete set to permit free movement of the span without requiring full form removal.

When a "Type A" joint is shown on the Plans, preformed fiber joint material shall be used in the vertical joints of the roadway slab, curb, median, or sidewalk and the top one (1) inch thereof shall be filled with the joint sealing material shown herein or shown on the Plans.

The sealer shall be installed in accordance with TxDOT Item 438, "Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)", and the manufacturer's recommendations.

Where preformed fiber joint material is used, it shall be anchored to the concrete on one side of the joint by light wire or nails.

Finished joints shall conform to the plan details with the concrete sections completely separated by the specified opening or joint material.

Soon after form removal and again where necessary after surface finishing, all concrete shall be removed from within the joint opening to insure full effectiveness of the expansion joint.

420.6. CONSTRUCTION JOINTS.

The joint formed by placing plastic concrete in direct contact with concrete that has attained its initial set shall be deemed a construction joint. The term monolithic placement shall be interpreted to mean that the manner and sequence of concrete placing shall not create a construction joint.

Construction joints shall be of the type and at the locations shown on the Plans. Construction joints other than those shown on the Plans will not be permitted in bridge slabs. Additional joints in other members will not be permitted without written authorization from the City. When additional joints are authorized, they shall have details equivalent to those shown on the Plans for joints in similar locations.

Unless otherwise provided, construction joints shall be square and normal to the forms. Bulkheads shall be provided in the forms for all vertical joints.

Construction joints requiring the use of joint sealing material shall be as shown on the Plans.

A concrete placement terminating at a horizontal construction joint shall have the top surface roughened thoroughly as soon as practicable after initial set is attained.

The hardened concrete surface shall be thoroughly cleaned of all loose material, laitance, dirt or foreign matter and saturated with water. All free water shall be removed and the surface shall be in a moist condition when concrete and/or bonding grout is placed against it.

Forms shall be drawn tight against the existing concrete to avoid mortar loss and offsets at joints.

When shown on the Plans or in other specifications, the joint surface shall be coated with bonding mortar, grout or other specified material.

When shown on the Plans, Type V epoxy material shall be used for bonding fresh concrete to hardened concrete. The bonding epoxy shall be placed on a clean, dry surface and shall be tacky when the fresh concrete is placed.

420.7. SEAL FOR FOUNDATIONS.

Concrete for foundation seals, unless otherwise specified, shall be in accordance with Item 400, "Excavation and Backfill for Structures".

420.8. FALSEWORK.

Falsework shall be designed and constructed to safely carry the maximum anticipated loads, including wind loads, and to provide the necessary rigidity. Details of falsework construction shall be subject to review and approval by the City in accordance with the provisions of Section 420.3.

For evaluating the adequacy of job fabricated falsework, a weight of 150 pounds per cubic foot shall be assumed for concrete, and a live load allowance of 50 pounds per square foot of horizontal surface of the form work shall be included. The maximum stresses shall not exceed 125 percent of the allowable stresses used by the Department for the design of structures.

Commercially produced structural units used in falsework shall not exceed the manufacturer's maximum allowable working load for moment, and shear or end reaction. The maximum allowable working load shall include an allowance of 35 pounds per square foot of horizontal form surface and sufficient details and data shall be submitted to the City for approval.

All timber used in falsework shall be sound, in good condition, and free from defects which would impair its strength.

When wedges are used to adjust falsework to desired elevations, the wedges shall be used in pairs to insure even bearing. The use of wedges to compensate for incorrectly cut bearing surfaces will not be permitted. Wedges shall be hardwood or metal.

Sills or grillages shall be large enough to support the superimposed load without settlement, and unless founded on solid rock, shale or other hard materials, precautions shall be taken to prevent yielding of the supporting material.

Falsework, which cannot be founded on a satisfactory spread footing, shall be placed on piling or drilled shafts having a bearing capacity sufficient to support the superimposed load without settlement. Falsework piling shall be driven to the required resistance determined by the applicable formula given in TxDOT Item 404, "Driving Piling". Drilled shafts for falsework shall be designed to carry the superimposed load using both skin friction and point bearing.

Welding, when used, shall conform to the requirements of TxDOT Item 448, "Structural Field Welding". Each falsework bent shall be securely braced to provide the stiffness required with the bracing securely fastened to each pile or column it crosses.

The falsework shall be removed when no longer required. Falsework piling shall be pulled or cut off not less than six (6) inches below finished ground level. Falsework, piling or drilled shafts in a stream, lake, or bay shall be completely removed to a point specified by the City to prevent any obstruction to the waterway.

420.9. FORMS.

All forms shall be constructed in accordance with the following:

(1) General. Except where otherwise specified, forms may be of either timber or metal.

Forms for round columns exposed to view shall be of steel, except that other materials will be allowed with written permission of the City.

Studs, joists, wales or other devices used for form supports shall be of sufficient section and rigidity to withstand undue bulging or settling of the forms. Any device or method used for form support shall be subject to the approval of the City.

Forms shall be designed for the pressure exerted by a liquid weighing 150 pounds per cubic foot. The rate of placing the concrete shall be taken into consideration in determining the depth of the equivalent liquid. Job fabricated forms shall be designed for an additional live load of 50 pounds per square foot of horizontal surface. The maximum unit stresses shall not exceed 125 percent of the allowable stresses used by the City Engineering Department for the design of structures.

Commercially produced structural units used in formwork shall not exceed the manufacturer's maximum allowable working load for moment, shear or end reaction. The maximum working load shall include a live load of 35 pounds per square foot of horizontal form surface and sufficient details and data shall be submitted to the City for review.

Forms shall be practically mortar-tight, rigidly braced and strong enough to prevent bulging between supports and shall be maintained to the proper line and grade during concrete placement. Forms shall be maintained in a manner to prevent warping and shrinkage.

Offsets at form joints shall not exceed 1/16 inch. Form supports for slabs shall not be welded to the top flange of I-beams or girders except in accordance with the provisions of Section 420.3.

Deflections due to cast-in-place slab concrete and railing shown in the dead load deflection diagram shall be taken into account in the setting of slab forms.

All forms and footing areas shall be cleaned of any extraneous matter before placing concrete.

Permission to place concrete will not be given until all preparatory work is complete to the satisfaction of the City.

If, at any stage of placement, the forms show signs of bulging or sagging, the portion of the causing such condition shall be removed immediately, if necessary, and the forms shall be reset and securely braced against further movement.

(2) Timber Forms. Lumber for forms shall be properly seasoned, of good quality, and free from imperfections which would affect its strength or impair the finished surface of the concrete

Forms or form lumber to be reused shall be maintained clean and in good condition. Any lumber which is split, warped, bulged, marred, or has defects that will produce inferior work shall not be used and shall be promptly removed from the work.

Form lining will be required for all formed surfaces, except for the inside of culvert barrels, inlets, manholes and box girders; the bottom of bridge decks between beams or girders; surfaces that are subsequently covered by backfill material or are completely enclosed and any surface formed by a single finished board. Lining will not be required when plywood forms are used.

Form lining shall be of an approved type such as Masonite or plywood. Thin membrane sheeting such as polyethylene sheets shall not be used for form lining.

Commercial form liners used to imprint a pattern or texture on the surface of the concrete shall be as shown on the Plans and/or as approved by the City.

Forms may be constructed of plywood not less than one-half (1/2) inch in thickness. The grain of the face plies on plywood forms shall be placed parallel to the span between the supporting studs or joists.

Plywood used for forming surfaces which remain exposed shall be equal to that specified as B-B Plyform Class I or Class III Exterior of the U.S. Department of Commerce, National Institute of Standards and Technology, U.S. Product Standard, latest edition.

Studs and joists shall be spaced so that the facing form material remains in true alignment under the imposed loads.

Wales shall be spaced close enough to hold forms securely to the designated lines and scabbed at least four feet on each side of joints to provide continuity. A row of wales shall be placed near the bottom of each placement.

Facing material shall be placed with parallel and square joints and securely fastened to supporting studs.

Forms for surfaces receiving only an ordinary finish and exposed to view shall be placed with the form panels symmetrical, i.e., long dimensions set in the same direction. Horizontal joints shall be continuous.

Molding for chamfer strips or other uses shall be made of materials of a grade that will not split when nailed and which can be maintained to a true line without warping. Wood molding shall be mill cut and dressed on all faces. Unless otherwise provided herein or shown on the Plans, forms shall be filleted at all sharp corners and edges with triangular chamfer strips measuring three fourth (3/4) inch on the sides.

Except at structures where railing is to be attached, culvert headwall heights shall be adjusted as necessary to provide a maximum projection of three (3) inches above the roadway slope unless otherwise directed by the City. At the entrance of all culverts, a three-inch chamfer shall be provided along the bottom edge of the top slab. Reinforcing steel shall be adjusted as necessary to

provide a minimum 1-1/4 clear cover. No changes will be made in quantities and no additional compensation will be allowed for this work.

All forms shall be constructed to permit their removal without marring or damaging the concrete. The forms may be given a slight draft to permit ease of removal.

Metal form ties of an approved type or a satisfactory substitute shall be used to hold forms in place and shall be of a type that permits ease of removal of the metal as hereinafter specified.

All metal appliances used inside of forms for alignment purposes shall be removed to a depth of at least one-half (1/2) inch from the concrete surface. The appliances shall be made so the metal may be removed without undue chipping or spalling of the concrete, and when removed, shall leave a smooth opening in the concrete surface. Burning off of rods, bolts or ties will not be permitted.

Any wire ties used shall be cut back at least one-half (1/2) inch from the face of the concrete.

Devices holding metal ties in place shall be capable of developing the strength of the tie and adjustable to allow for proper alignment.

Metal and wooden spreaders, which are separate from the forms, shall be removed entirely as the concrete is being placed.

Adequate clean-out openings shall be provided for narrow walls and other locations where access to the bottom of the forms is not readily attainable.

The facing of all forms shall be treated with bond breaking coating of such composition that would not discolor or otherwise injuriously affect the concrete surface. Care shall be exercised to prevent coating of the reinforcing steel.

(3) Metal Forms. The foregoing requirements for timber forms regarding design, mortar-tightness, filleted corners, beveled projections, bracing, alignment, removal, reuse and wetting shall also apply to metal forms, except that these will not require lining, unless specifically noted on the Plans.

The thickness of form metal shall be as required to maintain the true shape without warping or bulging. All bolt and rivet heads on the facing sides shall be countersunk. Clamps, pins or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms which do not present a smooth surface or which line up improperly shall not be used. Metal shall be kept free from rust, grease or other foreign materials.

(4) Form Supports for Overhang Slabs. Form supports which transmit a horizontal force to a steel girder or beam, or to a prestressed concrete beam will be permitted, providing a satisfactory structural analysis has been made of the effect on the girder or beam and approval is granted by the City.

When overhang brackets are used on prestressed concrete beam spans with slab overhangs not exceeding three (3) feet six (6) inches, bracing requirements shall conform to the details shown on the Plans.

For spans in which the overhang exceeds three feet six inches, additional support will be required for the outside beams regardless of the type beam used. Details of the proposed support system shall be submitted by the Contractor for approval.

Holes in steel members for support of overhang brackets may be punched or drilled full size or may be torch cut to one-fourth (1/4) inch under size and reamed full size. In no case shall the holes be burned full size. The hole shall be left open unless otherwise shown on the Plans. The holes shall never be filled by welding.

420.10. PLACING REINFORCEMENT.

Reinforcement shall be placed as provided in Item 440, "Reinforcing Steel". Reinforcing steel supports shall not be welded to I-beams or girders or to reinforcing steel except where shown on the Plans to be permissible.

Post tensioning ducts shall be placed in accordance with TxDOT Item 426, "Prestressing". The Contractor shall maintain all ducts free of obstructions until all post tensioning operations are complete.

420.11. PLACING CONCRETE-GENERAL.

The Contractor shall give the City sufficient advance notice before placing concrete in any unit of the structure to permit the inspection of forms, reinforcing steel placement and other preparations.

The sequence of placing concrete shall be as shown on the Plans or as required herein.

Concrete placement will not be permitted when impending weather conditions would impair the quality of the finished work. If conditions of wind, humidity, and temperature are such that concrete cannot be placed without cracking, concrete placement shall be done in the early morning or at night. When concrete mixing, placing, and finishing is done in other than daylight hours, provisions shall be made to adequately light the entire placement site. The City will approve the adequacy of such lighting before operations are begun.

Where work has been started and changes in weather conditions require protective measures, the Contractor shall furnish adequate shelter to protect the concrete against damage from rainfall, or from freezing temperatures as outlined in Section 420.12. If necessary to continue operations during rainfall, the Contractor shall also provide protective coverings for the material stockpiles. Aggregate stockpiles need to be covered only to the extent necessary to control the moisture conditions in the aggregates.

After concrete has achieved initial set, at least one (1) curing day shall elapse before placing strain on projecting reinforcement in order to prevent damage to the concrete**.**

(1) Placing Temperature. The temperature of all concrete at the time of placement shall be not less than 50° F.

The temperature of cast-in-place concrete in bridge slabs and top slabs of direct traffic structures shall not exceed 85° F when placed. Concrete diaphragms, parapets, concrete portions of railing, curbs, and sidewalks, unless monolithically placed with the slab, will not be subject to the above maximum. Other portions of structures, when shown on the Plans, shall require the temperature control specified.

For mass concrete placements, as defined in Section 420.11 (10), the concrete temperature at the time of placement shall not exceed 75° F.

(2) Transporting Time. The maximum time interval between the addition of cement to the batch and the placing of concrete in the forms shall conform to the requirements in Table 1.

TABLE 1
TEMPERATURE TIME REQUIREMENTS

Concrete Temperature (at point of placement)	Max. Time (No Retarding Agent) Minutes	Max. Time (1) (With Retarding Agent) Minutes
Non-Agitated Concrete		
Above 80ºF	15	30
80ºF and Below	30	45
Agitated Concrete		
Above 90ºF	45	75
Above 75ºF thru 90ºF	60	90
75ºF and Below	90	120

(1) Normal dosage of retarder

(3) Transporting Equipment. The method and equipment used to transport concrete to the forms shall be capable of maintaining the rate of placement shown on the Plans or required by the City. Concrete may be transported by buckets, chutes, buggies, belt conveyors, pumps, or other methods.

When belt conveyors or pumps are used, sampling for testing should be done at the discharge end. When in the opinion of the City, it is deemed impractical to sample at the discharge end, sampling may be done at the mixer provided that correlation testing is performed and documented to ensure specification requirements are met at the discharge end.

Concrete transported by conveyors shall be protected from sun and wind, if necessary, to prevent loss of slump and workability. Pipes through which concrete is pumped shall be shaded and/or wrapped with wet burlap, if necessary, to prevent loss of slump and workability. Concrete shall not be transported through aluminum pipes, tubes, or other aluminum equipment.

Pump lines shall conform to the following:

For Grade 2 coarse aggregate and smaller, the minimum size pump line shall be five (5) inches ID.

For Grade 1 coarse aggregate, the minimum size pump line shall be eight (8) inches ID.

Chutes, troughs, conveyors or pipes shall be arranged and used so that the concrete ingredients will not be separated. When necessary to prevent segregation, such equipment shall terminate in vertical downspouts. Open troughs and chutes shall extend, if necessary, down inside the forms or through holes left in the forms.

All transporting equipment shall be kept clean and free from hardened concrete coatings. Water used for cleaning shall be discharged clear of the concrete.

(4) Forms. Openings in forms shall be provided, if needed, for the removal of laitance or foreign matter.

All forms, prestressed concrete panels, T-beams, and concrete box beams on which concrete is to be placed shall be wetted thoroughly prior to placing concrete thereon. Any remaining puddles of excess water shall be removed. The top of such members shall be in moist surface dry condition when concrete is placed on them.

(5) Handling, Placing, and Consolidation. The method of handling, placing, and consolidation of concrete shall minimize segregation of the concrete and displacement of the reinforcement. A uniform dense compact mass shall be produced.

(a) Handling and Placing. Concrete shall not have a free fall of more than five (5) feet, except in the case of thin walls such as in culverts or as specified in other items. Any hardened concrete splatter ahead of the plastic concrete shall be removed.

Each part of the forms shall be filled by depositing concrete as near its final position as possible. Depositing large quantities at one (1) point and running or working the concrete along the forms will not be allowed.

Concrete shall be deposited in the forms in layers of suitable depth but not more than 36 inches in thickness, unless otherwise directed by the City.

Cold joints in a monolithic placement shall be avoided. The sequence of successive layers or adjacent portions of concrete shall be such that they can be vibrated into a homogeneous mass with the previously placed concrete. Not more than one (1) hour shall elapse between adjacent or successive placements of concrete except as otherwise required by an approved placing procedure when revibration of the concrete is shown on the Plans or specifications. This time requirement may be extended by one-half (1/2) hour when the concrete contains not less than a normal dosage of retarding admixture.

An approved retarding agent shall be used to control stress cracks and/or cold joints in placements where differential settlement and/or setting time may induce stress cracking.

(b) Consolidation. All concrete shall be well consolidated and the mortar flushed to the form surfaces with immersion type vibrators. Vibrators which operate by attachment to forms or reinforcement will not be permitted, except on steel forms. At least one (1) stand-by vibrator shall be provided for emergency use in addition to those required for placement.

The concrete shall be vibrated immediately after deposit. A systematic spacing of the points of vibration shall be established to insure complete consolidation and thorough working of the concrete around the reinforcement, embedded fixtures, and into the corners and angles of the forms. The vibrator may be inserted in a sloping or horizontal position in shallow slabs. The entire depth of each lift shall be vibrated, allowing the vibrator to penetrate several inches into the preceding lift. Concrete along construction joints shall be thoroughly consolidated by operating the vibrator along and close to but not against the joint surface. The vibration shall continue until thorough consolidation and complete embedment of reinforcement and fixtures is produced, but not long enough to cause segregation. Vibration may be supplemented by hand spading or rodding, if necessary, to insure the flushing of mortar to the surface of all forms.

(6) Slabs. Unless otherwise shown on the Plans or other specifications, slab concrete shall be mixed in a plant located off the structure. Carting or wheeling concrete batches over completed slabs will not be permitted until the slabs have aged at least four (4) full curing days. For the remainder of the curing period, timber planking will be required for carting of the concrete. Carts shall be equipped with pneumatic tires. Curing operations shall not be interrupted for the purposed of wheeling concrete over finished slabs.

The storing of reinforcing or structural steel on completed roadway slabs generally shall be avoided and, when permitted, shall be limited to quantities and distribution that will not induce excessive stresses.

A longitudinal screed may be placed directly on previously placed concrete slabs for the purpose of checking and grading of an adjacent slab after the previously placed slab has aged not less than 24 hours. Actual screeding may be done after the previously placed slabs have aged at least 48 hours.

(7) Continuous Placements. For continuous placement of the deck on steel units, the initial set of the concrete shall be retarded sufficiently to insure that the concrete remains plastic in not less than three (3) spans immediately preceding the slab being placed. For simple spans, retardation shall be required only if necessary to complete finishing operations or as required by Section 420.13.

(8) Fogging and Interim Curing. From the time of initial strike off of the concrete until finishing is completed and required interim curing is in place, the unformed surfaces of slab concrete in bridge decks and top slabs of direct traffic culverts shall be fogged when necessary to replace water loss due to evaporation.

Fogging equipment shall be capable of applying water in a fine mist, not a spray. The fog shall be produced using equipment, which pumps water or water and air under high pressure through a suitable atomizing nozzle. The equipment shall be hand operated and sufficiently portable for use in the direction of any prevailing wind. It shall be adaptable for intermittent use as directed by the City to prevent excessive wetting of the concrete.

Interim curing will be required for slab concrete in bridge decks and top slabs of the direct traffic culverts, immediately upon completion of final finish. Type 1-D membrane curing compound (Resin Base Only) will be required. Water curing will be required in accordance with Section 420.20 and shall be commenced as soon as possible without damaging the surface finish.

(9) Installation of Dowels and Anchor Bolts. Dowels and anchor bolts may be cast-in-place or installed by grouting with grout, epoxy or epoxy mortar. Holes for grouting may be formed or drilled.

(a) General. Holes for anchor bolts shall accommodate the bolt embedment required by the Plans. Holes for dowels shall be a minimum of 12 inches deep unless otherwise shown on the Plans. When grout or epoxy mortar is used, the diameter of the hole shall be not less than twice the dowel or bolt diameter or more than the diameter plus 1 1/2 inches. When using epoxy, the hole diameter shall be one-sixteenth (1/16) inch to one-fourth (1/4) inch greater than the dowel or bolt diameter.

Holes shall be thoroughly cleaned of all loose material, oil, grease, or other bond breaking substance and blown clean with filtered compressed air. Holes shall be in a surface dry condition when epoxy type material is used. Holes shall be in a surface moist condition when Portland cement grout is used. The Contractor shall develop and demonstrate a procedure for cleaning and preparing the holes for installation of the dowels and anchor bolts that is satisfactory to the City. The void between the hole and dowel or bolt shall be completely filled with grouting material.

(b) Cast-in-Place or Grouted Systems. Portland cement grout, epoxy, epoxy mortar, or other prepackaged grouts as approved by the City may be used.

Portland cement grout shall conform to the pertinent provisions of Item 421, "Portland Cement Concrete". Epoxy

(Type V) and Epoxy Mortar (Type VIIII) shall conform to TxDOT Item 575, "Epoxy". Grout, epoxy or epoxy mortar may be used as the binding agent unless otherwise indicated on the Plans.

(c) Other Anchor Systems. These systems shall be in accordance with the Plans and approved by the City.

(10) Mass Placements. Unless otherwise shown on the Plans, for monolithic mass placements having a least dimension greater than five (5) feet, the Contractor shall develop a plan to assure that during the heat dissipation period, the temperature differential between the central core of the placement and the exposed concrete surface does not exceed 35°F.

A detailed plan, along with an analysis of the associated heat generation and dissipation (heat flow analysis) shall be submitted to the City for approval. No concrete shall be placed until this plan is approved.

This plan may include a combination of the following:

1. Selection of concrete ingredients to minimize heat of hydration.

2. Using ice or cooling concrete ingredients.

3. Controlling rate of concrete placement.

4. Using insulation to control heat loss.

5. Using supplemental heat to control heat loss.

6. Use of fly ash.

The Contractor shall furnish and install two sets of strip chart temperature recording devices or approved equivalent at locations designated by the City. These devices shall be accurate to within +/- 2°F within the range of 32°F to 212°F and shall be used to simultaneously measure the temperature of the concrete at the core and the surface.

420.12. PLACING CONCRETE IN COLD WEATHER.

The Contractor is responsible for the protection of concrete placed under any and all weather conditions. Permission given by the City for placing during cold weather will not relieve the Contractor of the responsibility for producing concrete equal in quality to that placed under normal conditions. Should concrete placed under such conditions prove unsatisfactory, it shall be removed and replaced.

Concrete may be placed only when the atmospheric temperature is greater than 35°F. Concrete shall not be placed in contact with any material coated with frost or having a temperature less than 32°F.

Aggregates shall be free from ice, frost and frozen lumps. When required, in order to produce the minimum specified concrete temperature, the aggregate and/or the water shall be heated uniformly, in accordance with the following:

The water temperature shall not exceed 180°F, nor shall the aggregate temperature exceed 150°F. The heating apparatus shall heat the mass of aggregate uniformly. The temperature of the mixture of aggregates and water shall be between 50°F and 85°F before introduction of the cement.

The Contractor shall provide and install recording thermometer(s) or other suitable temperature measuring device(s) to verify that all concrete is effectively protected as follows:

(a) The temperature of all unformed surfaces of bridge decks and top slabs of direct traffic culverts shall be maintained at 50°F or above for a period of 72 hours from time of placement and above 40°F for an additional 72 hours.

(b) The temperature at the surface of all concrete in bents, piers, culvert walls, retaining walls, parapets, wingwalls, bottom of slabs, and other similar formed concrete shall be maintained at 40°F or above for a period of 72 hours from time of placement.

(c) The temperature of all concrete, including the bottom slabs (footings) of culverts placed on or in the ground, shall be maintained above 32°F for a period of 72 hours from the time of placement.

Protection shall consist of providing additional covering, insulated forms or other means, and if necessary, supplementing such covering with artificial heating. Curing as specified under Section 420.20 shall be provided during this period until all requirements for curing have been satisfied.

When impending weather conditions indicate the possibility of the need for such temperature protection, all necessary heating and covering material shall be on hand and ready for use before permission is granted to begin placement.

Sufficient extra test specimens will be made and cured with the placement to ascertain the condition of the concrete as placed to form removal and acceptance.

420.13. PLACING CONCRETE IN HOT WEATHER.

Unless otherwise directed by the City, when the temperature of the air is above 85°F, an approved retarding agent will be required in all concrete used in superstructures and top slabs of direct traffic culverts.

420.14. PLACING CONCRETE IN WATER.

Concrete shall be deposited in water only when shown on the Plans or with the written permission of the City. The forms or cofferdams shall be sufficiently tight to prevent any water current passing through the space in which the concrete is being deposited. Pumping of water will not be permitted during the concrete placing, nor until it has set for at least 36 hours.

The concrete shall be placed with a tremie, or other approved method, and shall not be permitted to fall freely through the water nor shall the concrete be disturbed after being placed. The concrete surface shall be kept approximately level during placement.

The tremie shall consist of a watertight tube of a diameter which will permit adequate placement of the concrete, but not greater than 14 inches. The tremie shall be constructed so that the bottom can be sealed and opened after the tremie is in place and fully charged with concrete. The tremie shall be supported so that it can be easily moved horizontally to cover all the work area and vertically to control the concrete flow. The lower end of the tremie shall be submerged in the concrete at all times.

The placing operations shall be continuous until the work is complete.

Unless otherwise specified, all classes of concrete placed under water, except Class E and Class SS, shall be redesigned to contain an additional sack of cement per cubic yard more than the mix design being used. Pilot beam tests may be waived by the City for this redesign.

420.15. PLACING CONCRETE IN SUPERSTRUCTURE.

Unless otherwise shown on the Plans, simple span bridge slabs shall be placed without transverse construction joints by using either a mechanical longitudinal screed or a self propelled transverse finishing machine. For small placements or for unusual conditions, the City may waive the mechanical screed requirement and permit the use of manually operated screeding equipment. The screed shall be adequately supported on a header or rail system sufficiently stable to withstand the longitudinal or lateral thrust of the equipment. Unless otherwise shown on the Plans, temporary intermediate headers will be permitted for placements exceeding 50 feet in length for the longitudinal screed, provided the rate of placement is rapid enough to prevent a cold joint, and that these headers are designed for early removal to permit satisfactory consolidation and finish of the concrete at their locations.

Unless otherwise shown on the Plans, slabs on continuous units shall be placed in one (1) continuous operation without transverse construction joints using a mechanical longitudinal screed or a self propelled transverse finishing machine. For unusual conditions, such as widening, variable cross slopes or transitions, the City may waive the mechanical screed requirement and permit the use of manually operated screeding equipment. Rails for transverse finishing machines, which are supported from the beams or girders, shall be installed so that the supports may be removed without damage to the slab. Bond between removable supports and the concrete shall be prevented in a manner acceptable to the City. Rail support parts, which remain embedded in the slab, shall not project above the upper mat of reinforcing steel. Rail or screed supports attached to I-beams or girders shall be subject to the requirements of Section 420.3.

Unless otherwise shown on the Plans, for transverse screeding, the minimum rate of concrete placement shall be 30 linear feet of bridge deck per hour. The Contractor shall furnish personnel and equipment capable of placing, finishing and curing the slab at an acceptable rate to insure compliance with the specifications.

The profile gradeline may require adjustment, due to variation in beam camber and other factors, to obtain the required cover over the slab reinforcement. Beams shall be set in a sufficient number of spans so that when adjustment is necessary, the profile gradeline can be adjusted over suitable increments and the revised gradeline will produce a smooth riding surface.

One or more passes shall be made with the screed over the bridge deck segment prior to the placement of concrete thereon to insure proper operation and maintenance of grades and clearances.

Slab concrete shall be deposited between the exterior beam and the adjacent beam prior to placing concrete in the overhang portion of the slab.

For transverse screeding, concrete shall be placed in transverse strips. Additionally, on profile grades greater than 1-1/2 percent, placement shall begin at the lowest end.

For longitudinal screeding, concrete shall be placed in longitudinal strips starting at a point in the center of the segment adjacent to one (1) side, except as provided herein, and the strip completed by placing uniformly in both directions toward the ends, except that for spans on a grade of 1-1/2 percent or more placing shall start at the lowest end.

The width of strips shall be such that the concrete therein will remain plastic until the adjacent strip is placed. Where monolithic curb construction is specified, the concrete shall be placed therein in proper sequence to be monolithic with the adjacent longitudinal strips of the slabs.

An approved system of checking shall be used to detect any vertical movement of the forms or falsework. Forms for the bottom surface of concrete slabs, girders and overhangs shall be maintained to the required vertical alignment during concrete placing.

Unless otherwise shown on the Plans, girders, slab and curbs of slab and girder spans shall be placed monolithically. Concrete girder stems shall be filled first and the slab concrete placed within the time limits specified in Section 420.11.

Construction joints, when permitted for slab placements on steel and prestressed concrete beams, shall be as shown on the Plans. Where Plans permit segmental placing without specifying a particular order of placement, any logical placing sequence which will not result in the overstressing of any of the supporting members will be permitted subject to the approval of the City.

Any falsework under steel girder or truss spans shall be released and the spans swung free on their permanent supports before placing any slab concrete thereon.

When the curb forms are filled, the top of curb and sidewalk section shall be brought to the correct camber and alignment and finished as described in Sections 420.18 and 420.23.

420.16. PLACING CONCRETE IN BOX CULVERTS.

Where the top slab and walls are placed monolithically in culverts more than four feet in clear height, an interval of not less than one (1) or more than two (2) hours shall elapse before placing the top slab to allow for settlement and shrinkage in the wall concrete.

The footing slab shall be accurately finished at the proper time to provide a smooth uniform surface. Top slabs, which carry direct traffic, shall be finished as specified in Section 420.19. Top slabs of fill-type culverts shall be given a float finish.

420.17. PLACING CONCRETE IN FOUNDATION AND SUBSTRUCTURE.

Concrete shall not be placed in footings until the depth and character of the foundation has been inspected by the City and permission has been given to proceed.

Placing of concrete footings upon seal concrete will be permitted after the cofferdams are free from water and the seal concrete cleaned. Any necessary pumping or bailing during the concreting operation shall be done from a suitable sump located outside the forms.

All temporary wales or braces inside the cofferdams shall be constructed or adjusted as the work proceeds to prevent unauthorized construction joints.

When footings can be placed in a dry excavation without the use of cofferdams, forms may be omitted, if approved by the City, and the entire excavation filled with concrete to the elevation of

the top of footing. In this case, measurement for payment will be based on the footing dimensions shown on the Plans.

Concrete in columns shall be placed monolithically between construction joints unless otherwise provided. Columns and caps and/or tie beams supported thereon may be placed in the same operation. To allow for settlement and shrinkage of the column concrete, it shall be placed to the lower level of the cap or tie beam and placement delayed for not less than one (1) hour nor more than two (2) before proceeding.

420.18. TREATMENT AND FINISHING OF HORIZONTAL SURFACES EXCEPT ROADWAY SLABS.

All unformed upper surfaces shall be struck off to grade and finished. The use of mortar topping for surfaces under this classification will not be permitted.

After the concrete has been struck off, the surface shall be floated with a suitable float. Bridge sidewalks shall be given a wood float or broom finish or may be striped with a brush, as specified by the City.

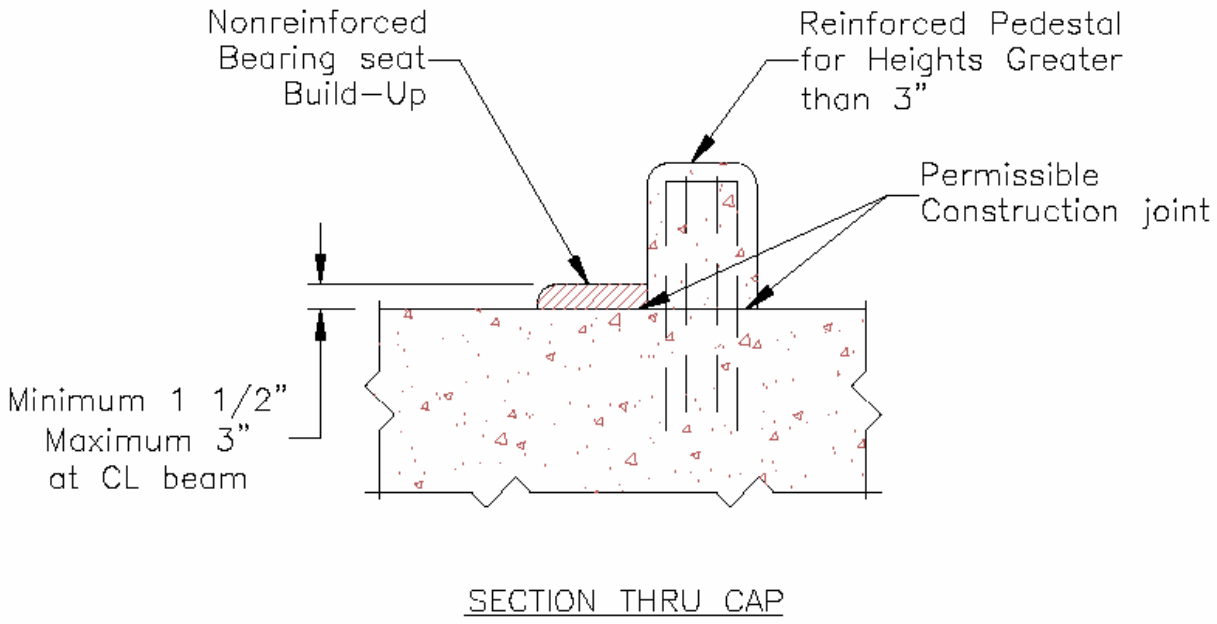
The tops of caps and piers between bearing areas shall be sloped slightly from the center toward the edge, and the tops of abutments and transition bents sloped from the backwall to the edge, as directed by the City, so that the water drains from the surface. The concrete shall be given a smooth trowel finish. When shown on the Plans, the top of caps and piers shall be coated with Type X epoxy material except for areas under shoes and bearing pads. Unless otherwise shown on the Plans, the color shall be concrete gray. The color of the epoxy may be adjusted to concrete gray by the use of a black universal type tinting paste. Bearing areas for steel units shall be constructed in accordance with TxDOT Item 441, “Steel Structures”.

Bearing seat build-ups or pedestals for concrete units may be cast integrally with the cap or with a construction joint as follows:

The bearing seat build-ups shall be constructed of a latex-based mortar or an epoxy mortar, mixed in accordance with the manufacturer's recommendation. Pedestals shall be constructed of Class “C” concrete, reinforced as shown on the Plans.

Bearing areas under elastomeric pads or non-reinforced bearing seat build-ups shall be given a textured, wood float finish.

FIGURE 1



420.19. FINISH OF ROADWAY SLABS.

In all roadway slab-finishing operations, camber for specified vertical curvature and transverse slopes shall be provided.

For concrete slab or concrete slab girder spans cast in place on falsework, an additional amount of camber shall be provided to offset the initial and final deflections of the span. The additional amount of camber shall be determined from the dead load deflection diagram shown on the Plans. When dead load deflection is not shown on the Plans, the additional amount of camber shall be one-eighth (1/8) inch per ten (10) foot of span length but not to exceed one-half (1/2) inch. For pan girder spans, the additional camber for initial and final deflections shall be approximately one-half (1/2) inch for 30-foot spans and five-eighths (5/8) inch for 40-foot spans unless otherwise directed by the City.

Roadway slabs supported on prestressed concrete, steel beams or girders shall receive no additional camber, except that for slabs without vertical curvature, the longitudinal camber shall be approximately one-fourth (1/4) inch.

Dead load deflection shall be taken into account in setting the grades of headers and rail systems.

Work bridges or other suitable facilities shall be provided by the Contractor from which to perform all finishing operations and check measurements for slab thickness and reinforcement cover.

As soon as the concrete has been placed and vibrated in a section of sufficient width to permit working, the surface shall be approximately leveled, struck off and screeded, carrying a slight

excess of concrete ahead of the screed to insure filling of all low spots. The screed shall be rigid enough to hold true to shape and shall have sufficient adjustments to provide for the required camber or section. A vibrating screed may be used if heavy enough to prevent undue distortion. The screeds, except those of the roller drum type, shall be provided with metal cutting edges.

Longitudinal screeds shall be moved across the concrete with a saw-like motion while their ends rest on headers or templates set true to the roadway grade or on the adjacent finished slab.

The surface of the concrete shall be screeded a sufficient number of times and at such intervals to produce a uniform surface, true to grade and free of voids.

If necessary, the screeded surface shall be worked to a smooth finish with a long handled wood or metal float, or hand floated from bridges over the slab.

When required by the City, the Contractor shall perform sufficient checks with a long handled ten 10 foot straightedge on the plastic concrete to insure that the final surface will be within the tolerances specified below. The check shall be made with the straightedge parallel to the centerline. Each pass thereof shall lap half of the preceding pass. All high spots shall be removed and all depressions over one-sixteenth (1/16) inch in depth shall be filled with fresh concrete and floated. The checking and floating shall be continued until the surface is true to grade and free of depressions, high spots, voids or rough spots.

Rail support holes shall be filled with concrete and finished to match the top of the slab.

Unless otherwise shown on the Plans, when no additional wearing course is to be placed, the bridge deck surface shall be given a grooved steel tine finish. The grooves shall be approximately one-eighth (1/8) to three-sixteenth (3/16)-inch deep, approximately one-eighth (1/8) inch wide. The tines shall be randomly spaced approximately three-fourths (3/4) to one (1) inch apart. The grooves shall run perpendicular to the structure centerline when a longitudinal screed is used. Areas, which receive insufficient texture depth, shall receive additional texturing, when directed by the City, by saw grooving in accordance with the procedure given below.

At the option of the Contractor, or when shown on the Plans, the surface shall be given its final texture by saw grooving to meet the above requirements. Saw grooving may be done a minimum of four days after the slab concrete has been placed. If saw grooving is done prior to the completion of curing, the curing shall be continued after sawing to provide the minimum curing time required.

When shown on the Plans that a concrete overlay is to be placed on the slab (new construction), or on prestressed concrete box beams or other precast elements, the slab or the top surface of shear key and diaphragm concrete shall be given a broom finish. The finish shall have an average texture depth of approximately 0.035 inches with any individual test, not falling below 0.020 inches unless otherwise shown on the Plans, when tested in accordance with Test Method Tex-436-A. Should the texture depth fall below that intended, the finishing procedures should be revised to produce the desired texture.

When the Plans require that an asphaltic seal, with or without overlay, on the slab (new construction), or on prestressed concrete box beams or other precast elements, the slab or top surface of shear key and diaphragm concrete shall be given a lightly textured broom finish having

an average texture depth of approximately 0.025 inches when tested in accordance with Test Method Tex-436-A.

Straightedge requirements will be required on slabs (new construction) to be overlaid.

After the concrete slab has attained final set, the City may require that the finished surface be tested with a standard ten (10) foot straightedge. The straightedge shall be used parallel to the centerline of the structure to bridge any depressions and touch high spots. Ordinates of the irregularities, measured from the face of the straightedge to the surface of the slab, should normally not exceed one-eighth (1/8) of an inch, making proper allowances for camber. Vertical curve and surface texture; however, occasional variations exceeding this will be acceptable if, in the opinion of the City, the variations will not produce unacceptable riding qualities.

When directed by the City, irregularities exceeding the above shall be corrected. Areas that are corrected to produce satisfactory riding qualities shall be provided with an acceptable surface texture in a manner approved by the City.

420.20. CURING CONCRETE.

The Contractor shall inform the City of the methods proposed for curing; shall provide the proper equipment and material in adequate amounts; and shall have the proposed methods, equipment and material approved prior to placing concrete.

Unless otherwise noted herein or shown on the Plans, the choice of curing methods shall be at the option of the Contractor, except that the City may require the same curing methods for like portions of a single structure.

Inadequate curing and/or facilities shall be cause for the City to delay all concrete placement on the job until remedial action is taken.

All concrete shall be cured for a period of four curing days except as noted herein.

TABLE 2
EXCEPTION TO 4 DAY CURING

Description	Type of cement	Required Curing Days
Upper Surfaces of bridge slabs, top slab of direct traffic culverts, and concrete overlays	I or III	8
	III or I/III*	10
	All types with fly ash	10
Concrete Piling Build-ups	All	6

*Meets the requirements of both Type I and Type III

When the air temperature is expected to drop below 40°F, the concrete shall be covered with polyethylene sheeting, burlap-polyethylene blankets, mats or other acceptable materials to provide the protection required by Section 420.12.

A curing day is defined as a calendar day when the temperature, taken in the shade away from artificial heat, is above 50°F for at least 19 hours, or on colder days if satisfactory provisions are made to maintain the temperature of all surfaces of the concrete above 40°F for the entire 24 hours. The required curing period shall begin when all concrete therein has attained its initial set.

The following methods are permitted for curing concrete subject to the requirements of Table 3 and the following additional requirements for each method of curing:

(1) Form Curing. When forms are left in contact with the concrete, other curing methods will not be required except for exposed surfaces and for cold weather protection.

(2) Water Curing. All exposed surfaces of the concrete shall be kept wet continuously for the required curing time. The water used for curing shall meet the requirements for concrete mixing water as specified in Item 421, "Portland Cement Concrete". Seawater will not be permitted. Water, which stains or leaves an unsightly residue, shall not be used.

(a) Wet Mat Curing. This curing method shall consist of keeping the concrete continuously wet by maintaining wet cotton mats in direct contact with the concrete for the required curing time. Damp burlap blankets made from nine (9) ounce stock may be placed on the damp concrete surface for temporary protection prior to the application of cotton mats. The cotton mats may then be placed dry and wetted down immediately after they are placed. The mats shall be weighted down adequately to provide continuous contact with all concrete where possible. Surface, which cannot be cured by direct contact, shall be covered with mats forming an enclosure well anchored to the forms or ground so that outside air cannot enter the enclosure. Sufficient moisture shall be provided inside the enclosure to keep all surfaces of the concrete wet. Wet mat curing will be required for Part A in Table 3 when the anticipated ambient temperature is expected to remain above 40^{o} F for the first 72 hours of the curing period.

Polyethylene sheeting, burlap-polyethylene blankets, laminated mats or insulating curing mats placed in direct contact with the slab will be required when the air temperature is expected to drop below 40°F during the first 72 hours of the curing period. These curing materials shall be weighted down with dry mats to maintain direct contact with the concrete and to provide insulation against cold weather. Supplemental heating or insulation may be required in cold and/or wet weather if the insulating cotton mats become wet or if the concrete drops below the specified curing temperature.

(b) Water Spray. This curing method shall consist of overlapping sprays or sprinklers that keep all unformed surfaces continuously wet.

(c) Ponding. This curing method requires the covering of the surfaces with a minimum of two inches of clean granular material, kept wet at all times, or a minimum of one (1) inch depth of water. Satisfactory provisions shall be made to provide a dam to retain the water or saturated granular material.

(3) Membrane Curing. Unless otherwise provided herein or shown on the Plans, either Type 1-D or Type 2, membrane curing compound may be used where membrane curing is permitted, except that Type 1-D (Resin Base Only), will be required for bridge slabs and top slabs of direct traffic culverts. All other surfaces which may require a higher grade of surface finish.

TABLE 3
CURING REQUIREMENTS

STRUCTURE UNIT DESCRIPTION	REQUIRED		PERMITTED	
	Water for Complete Curing	Membrane for Interim Curing	Water for Complete Curing	Membrane for Interim Curing
A. Upper surfaces of Bridge Roadway, Median and Sidewalk slabs of Direct Traffic Culverts	X	X (Resin Base)		
B. Top Surface of any Concrete Unit upon which Concrete is to be placed and bonded at a later interval (Stub Walls, Risers, etc.).	X			
C. All Substructure Concrete, Culverts, Box Sewers, Inlets, Manholes, Retaining Walls, Riprap, Railing			*X	*X
All other concrete	As specified in other items.			

*Polyethylene Sheeting, Burlap-Polyethylene Mats or Laminated Mats in close intimate contact with the concrete surfaces will be considered equivalent to water or membrane curing.

For substructure concrete only one type of curing compound will be permitted on any one structure. Material requirements and construction methods shall be as required by TxDOT Item 526, "Membrane Curing", except as changed herein.

Membrane curing shall not be applied to dry surfaces, but shall be applied just after free moisture has disappeared. Formed surfaces and surfaces, which have been given a first rub, shall be dampened and shall be moist at the time of application of the membrane.

When membrane is used for complete curing, the film shall remain unbroken for the minimum curing period specified. Membrane, which is damaged, shall be corrected immediately by reapplication of membrane. Unless otherwise noted herein or shown on the Plans, the choice of membrane type shall be at the option of the Contractor.

420.21. REMOVAL OF FORMS AND FALSEWORK.

Except as herein provided, forms for vertical surfaces may be removed when the concrete has aged not less than 12 hours, provided the removal can be done without damage to the concrete.

Forms for inside curb faces may be removed at such time the removal can be done without damage to the curb.

Weight supporting forms and falsework for all bridge components and culvert slabs, except as noted herein, shall remain in place a minimum of four curing days. The forms then may be removed if the concrete has attained a flexural strength of 425 psi, as evidenced by strength tests using test beams made from the same concrete and cured under the same conditions as the portion of the structure involved. Forms for other structural components may be removed as specified by the City.

Inside forms (walls and top slabs) for box culverts and sewers may be removed after concrete has aged not less than one day (24 hrs.) and has acquired a flexural strength of not less than 255 psi, provided an overhead support system, approved by the City, is used to transfer the weight of the top slab to the walls of the box culvert or sewer before the support provided by the forms is removed.

When all test beams made for the purpose of form removal have been broken without attaining the required strength, forms shall remain in place for a total of 14 curing days.

The above provisions relative to form removal shall apply only to forms or parts thereof which are constructed to permit removal without disturbing forms or falsework required to be left in place for a longer period on other portions of the structure.

All forms and falsework shall be removed unless otherwise approved by the City.

420.22. DEFECTIVE WORK.

Any defective work shall be repaired as soon as possible.

Any defect, which in the opinion of the City cannot be repaired satisfactorily to the extent required by the City, shall be removed and replaced at the expense of the Contractor.

420.23. FINISHING EXPOSED SURFACES.

A Surface Finish shall be applied to all concrete surfaces and shall be in accordance with TxDOT Item 427, “Surface Finishes for Concrete”.

420.24. MEASUREMENT.

The quantities of concrete of the various classifications which will constitute the completed and accepted structure or structures in place will be measured by the cubic yard, each, square foot, square yard, or linear foot as shown on the Plans. Measurement will be as follows:

(1) General.

(a) All concrete quantities will be placed on the dimensions shown on the Plans or those established in writing by the City. Diaphragm concrete, when required, will be included in the slab measurement.

(b) In all determining quantities, no deductions will be made for chamfers less than two (2) inches, embedded portions of structural steel or prestressed concrete beams, piling, anchor bolts, reinforcing steel, drains, weep holes, junction boxes, electrical or telephone conduit, conduit and/or voids for prestressed tendons or for embedded portions of light fixtures.

(c) For pan girder spans, a quantity will be included for the screed setting required providing proper camber in the roadway surface after form removal.

(d) For slabs on steel and prestressed beams, a quantity for the haunch between the slab and beams will be included when required. No measurement will be made during construction for variation in the amount of haunch concrete due to deviation from design camber in the beams.

(e) For slabs on panels, T-beams, or box beams, the combination of span length, theoretical camber in beams, computed deflections, and plan vertical curve will be taken into account in determining the quantity for the slab.

Additional concrete, which may be required by an adjustment of the profile grade line during construction, to insure proper slab thickness, will not be measured for payment.

(f) Variation in concrete headwall quantity incurred when an alternate bid for pipe is permitted will not be measured for payment.

(g) Quantities revised by a change in design, measured as specified herein, will be increased or decreased, as the case may be, and included for payment.

(2) Plan Quantity. For structure elements designated in Table 4, and when measured by the cubic yard, this is a Plans quantity measurement Item and the quantity to be paid for will be that quantity shown in the proposal and on the "Estimate and Quantity" sheet of the contract Plans. If no adjustment of quantities is required, additional measurements or calculations will not be required.

When the quantity for a complete structure element has been erroneously included or omitted from the Plans, the quantity shown on the Plans for that element will be added to or deducted from the plan quantity and included for payment. A complete structure element will be the smallest portion of a total structure for which a quantity is included on the Plans.

When the plan quantity for a complete structure element is in error by five (5) percent or more, a recalculation will be made and the corrected quantity included for payment.

(3) Measured in Place. For those items not measured for plan quantity payment, measurement will be made in place.

TABLE 4

PLAN QUANTITY PAYMENT
(CUBIC YARD MEASUREMENT ONLY)

Culverts and Wingwalls	Slabs on Steel Spans
Headwalls for pipe	Slabs on Prestressed Spans
Retaining Walls	Pan Girder Spans
Inlets and Manholes	Pile Bent Caps
Slab Spans	Shear Key Concrete
Slab and Girder Spans	Abutments

Note: Other structure elements may be paid for as "plan quantity", including pier and bent concrete, when shown on the Plans.

For those portions of structures not listed in Table 4, the concrete quantities, measured as provided in Sub Section 420.24.(1) will be paid for at the unit price bid per "Cubic Yard", per "Each", per "Square Foot", per "Square Yard", or per "Linear Foot", in place, for the various classifications of concrete shown.

420.25. PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for the various structure elements specified of the various classes of concrete. This price shall be full compensation for furnishing, hauling and mixing all concrete materials; for furnishing, bending, fabricating, splicing, welding and placing the required reinforcement; for all clips, blocks, metal spacers, ties, wire or other materials used for fastening reinforcement in place; for placing, finishing and curing all concrete; for all grouting and pointing; for furnishing and placing drains; for furnishing and placing metal flashing strips; for furnishing and placing expansion-joint material required by this Item; and for all forms and falsework, labor, tools, equipment and incidentals necessary to complete the work.

Concrete which fails to meet minimum strength requirements may be rejected or a structural review may be made by the City. Such concrete which is proven structurally adequate may be accepted at an adjusted price based on the following formula:

$$\mathbf{A = 0.10 \times Bp + 0.75 \times (Sa/Ss)^2 \times Bp}$$

Where:

A = Amount to be paid per unit of measure

Bp = Unit bid price

Sa = Actual strength from beams or cores (average value if more than one test taken)

Ss = Minimum required strength (specified)

CITY OF SAN ANGELO

ITEM 421

PORTLAND CEMENT CONCRETE

421.1. DESCRIPTION.

This Item shall govern for Portland Cement Concrete to be used in concrete pavement, concrete structures and other concrete construction.

421.2. MATERIALS.

The concrete shall be composed of Portland Cement, (with or without) fly ash, fine and coarse aggregates and water.

(1) Cement. Portland Cement shall conform to TxDOT Item 524, "Hydraulic Cement".

(2) Mixing Water. Water for use in concrete and for curing shall be free from oils, acids, organic matter or other deleterious substances and shall not contain more than 1000 parts per million of chlorides as CI nor more than 1000 parts per million of sulfates as SO_4.

Water from municipal supplies approved by the State Health Department will not require testing, but water from other sources will be sampled and tested before use in concrete. Tests shall be made in accordance with AASHTO T26.

Water used in white Portland Cement Concrete shall be free from iron and other impurities which may cause staining or discoloration.

(3) Coarse Aggregate. Coarse aggregate shall be washed and shall consist of durable particles of gravel, crushed blast furnace slag, crushed stone, or combinations thereof and shall be free from frozen material or injurious amounts of slat, alkali, vegetable matter, or other objectionable material either free or as an adherent coating. When white Portland cement is specified, the coarse aggregates used in the concrete shall be light colored. Quality shall be reasonably uniform throughout. Coarse aggregate shall not contain more than 0.25 percent by weight of clay lumps, nor more than one (1) percent by weight of shale, nor more than five (5) percent by weight of laminated and/or friable particles when tested in accordance with Test Method Tex-413-A. Coarse aggregate from each source shall have a wear of not more than 40 percent when tested in accordance with Test Method Tex-410-A.

When tested in accordance with Test Method Tex-401-A, the coarse aggregate, including combinations of aggregates when used, shall conform to the gradation requirements shown in Table 1.

TABLE 1
COARSE AGGREGATE GRADATION CHART

Aggregate Grade No.	Nominal Size Inches	Percent Retained on Each Sieve								
		2-1/2 in.	2 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 8
1	2	0	0-20	15-50		60-80			95-100	
2	1-1/2		0	0-5		30-65		70-90	95-100	
3	1-1/2		0	0-5		10-40	40-75		95-100	

The loss by decantation in accordance with Test Method Tex-406-A plus the allowable weight of clay lumps, shall not exceed one (1) percent, or the value shown on the Plans, whichever is smaller. In the case of aggregates made primarily from the crushing of stone, if the material finer than the 200 sieve is definitely established to be the dust of fracture, essentially free from clay or shale, as established by Part III of Test Method Tex-406-A, the percent may be increased to 1.5.

(4) Fine Aggregate. Fine aggregate shall be washed and consist of clean, hard, durable and uncoated particles of natural or manufactured sand or a combination thereof, with or without a mineral filler. When white Portland Cement is specified the fine aggregate used in the concrete shall be light colored. It shall be free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material and it shall not contain more than 0.5 percent by weight of clay lumps. When the aggregate is subjected to the color test for organic impurities in accordance with Test Method Tex-408-A, the test result shall not show a color darker than standard.

Unless otherwise shown on the Plans, the acid insoluble residue of fine aggregate used in concrete subject to direct traffic shall be not less than 60 percent by weight when tested in accordance with Test Method Tex-612-J.

When tested in accordance with Test Method Tex-401-A, the fine aggregate or combinations of aggregates, including mineral filler, shall conform to the gradation requirements shown in Table 2.

TABLE 2
FINE AGGREGATE GRADATION CHART

Aggregate Grade No.	Percent Retained on Each Sieve							
	3/8 in.	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
1	0	0 to 5	0 to 20	15 to 50	35 to 75	65 to 90	90 to 100	97 to 100

Where manufactured sand is used in lieu of natural sand, the percent retained on the No. 200 sieve shall be 94 to 100.

Where the sand equivalent value is greater than 85, the retainage on the No. 50 sieve may be 65 to 94 percent.

Fine aggregate will be subjected to the Sand Equivalent Test (Test Method Tex-203-F / ASTM D 2419). The sand equivalent shall not be less than 80 unless otherwise shown on the Plans.

For all classes of concrete, the fineness modulus shall be between 2.30 and 3.10 as determined by Test Method Tex-402-A.

(5) Mineral Filler. Mineral filler shall consist of stone dust, clean crushed sand, or other approved inert material. When tested in accordance with Test Method Tex-401-A, it shall conform to the following gradation:

Retained on No. 30 Sieve	0 percent
Retained on No. 200 Sieve	0-35 percent

(6) Admixtures. Admixtures and their use shall conform to the requirements of TxDOT Item 437, "Concrete Admixtures". Calcium chloride will not be permitted.

(7) Mortar and Grout. Unless otherwise specified or approved by the City, mortar and grout shall consist of one part Portland cement, two parts finely graded sand and sufficient water to provide the desired consistency. Mortar may contain admixtures.

Post tensioning grout shall be in accordance with TxDOT Item 426, "Prestressing".

Mortar shall have a consistency such that the mortar can be easily handled and spread by trowel. Grout shall have a consistency such that the grout will flow into and completely fill all voids.

When required to prevent color difference, white cement shall be added to produce the color required. When shown on the Plans or in the specifications, or when required by the City, latex adhesive conforming to the requirements of TxDOT Departmental Material Specification D-9-8110 shall be added to the mortar.

421.3. STORAGE OF MATERIALS.

(1) Cement, and Mineral Filler. All cement and mineral filler shall be stored in well-ventilated weatherproof buildings or approved bi**n**s, which will protect them from dampness or absorption of moisture. Each shipment of packaged cement shall be kept separated to provide easy access for identification and inspection.

(2) Aggregates. The method of handling and storing concrete aggregates shall prevent contamination with foreign materials. If the aggregates are stored on the ground, the sites for the stockpiles shall be clear of all vegetation and shall be level. The bottom six-inch layer of aggregate shall not be disturbed or used without re-cleaning.

(3) Admixtures. Admixtures shall be stored in accordance with TxDOT Item 437, "Concrete Admixtures".

421.4. MEASUREMENT OF MATERIALS.

Except as noted below, the measurement of materials used in batches of concrete shall be by weight.

Water may be measured by volume or by weight.

Cement shall be weighed separately from other materials. Weighing of sacked cement will not be required. When sacked cement is used, the quantity of cement per batch shall be based upon using full bags of cement. Batches involving use of fractional bags will not be permitted except for small hand mixed batches of approximately five (5) cubic feet or less and when an approved method of volumetric measurement is used.

Where two (2) or more sizes or types of aggregates are used, each type and/or size shall be measured separately.

When determining aggregate batch weights, proper allowance shall be made for the water content in the aggregate (free water and/or absorption).

Admixtures shall be measured and dispensed in accordance with TxDOT Item 437, "Concrete Admixtures".

Measuring materials by volumetric methods may be used where permitted by the specifications. When a mixer using volumetric batching of materials is used, an accurate method of measuring by volume shall be provided. Continuous volumetric mixers shall be calibrated to assure correct measurement of materials.

The amount of each ingredient in the batch shall be measured to within plus or minus one percent of required amount except that water shall be measured to within plus or minus one gallon and admixture tolerances shall be in accordance with TxDOT Item 437, "Concrete Admixtures".

421.5. EQUIPMENT.

(1) Weighing and Measuring Equipment. Weighing and measuring equipment shall conform to TxDOT Item 520, "Weighing and Measuring Equipment".

(2) Mixing Equipment.

(a) General. All equipment, tools, and machinery used for hauling materials and performing any part of the work shall be maintained in such condition as to insure completion of the work under way without excessive delays for repairs or replacement.

The mixer shall be of an approved type and size that will produce uniform distribution of the material throughout the mass and shall be capable of producing concrete meeting the requirements of these specifications.

For all mixers, an adequate water supply and an accurate method of measuring the water shall be provided.

Delivery of concrete to the work site and the discharge from the hauling equipment, agitating, or non-agitating, shall be in accordance with the requirements shown on the Plans or in the governing specifications.

Specific requirements for batch plants, mixers and other equipment shall be in accordance with Item 360, "Concrete Pavement", or TxDOT Item 522, "Portland Cement Concrete plants", or other specifications.

421.6. MIXING.

(1) General. Mixed concrete, which does not conform to specification requirements, shall not be placed. Mixing shall be in accordance with TxDOT Item 522, "Portland Cement Concrete plants", except that mixing with continuous volumetric mixers will be in accordance with Section 421.6.(2) and except as set out in Section 421.6.(3).

(2) Continuous Volumetric Mixers. Mixing shall be in accordance with mixer manufacturer's recommendations unless otherwise revised by the City.

(3) Mixing of concrete by hand methods or by the use of a small motor driven mixer will be permitted for small placements of approximately two (2) cubic yards or less when authorized by the City. Hand mixed batches shall not exceed a two-sack batch in volume. For such placements the mix may be proportioned by approved volumetric methods.

421.7. CLASSIFICATION AND MIX DESIGN.

The Contractor shall furnish the mix design, using a coarse aggregate factor acceptable to the City, for the class(s) of concrete specified, to conform with the requirements contained herein and in accordance with Construction Bulletin C-11. The Contractor shall perform, at his entire expense, the work required to substantiate the design. Sampling and testing of concrete will be the responsibility of the City. Complete concrete design data shall be submitted to the City for approval.

The Contractor shall determine and measure the batch quantity of each ingredient, including all water, not only for batch designs but also for all concrete produced for the project. The mixes shall conform to these specifications and other requirements shown on the Plans.

The Contractor may accept a design from the City; however, this acceptance will not relieve the Contractor of the responsibility of providing concrete meeting the requirements of these specifications.

Mix designs from previous or concurrent jobs may be used without trial batches if it is shown that no substantial change in any of the proposed ingredients has been made.

No charge will be made for existing designs furnished by the City. The cost to the City of preparing a new mix design will be charged to the Contractor and deducted from the payment for the work.

Concrete for pneumatically placed concrete shall be in accordance with Item 431, "Pneumatically Placed Concrete".

The Contractor shall have the option of using chemical admixtures with all classes of concrete in accordance with Item 437, "Concrete Admixtures", except where the use of specific admixtures is required or prohibited in this or other items. For example, a mid-range water reducer can help maintain the water/cement ratio below the maximum allowed and provide a better workability to the concrete mix than if a mid-range water reducer was not used.

When a retarding admixture is required for hot weather concreting, the amount to be used will be as required in TxDOT Item 437, "Concrete Admixtures", subject to change by the City when required. When used for extended retardation, the amount to be used will be established by several trial batches with varying retarder content and simulating the placing conditions to be encountered and tested in accordance with Tex-440-A.

When entrained air is required, the concrete shall be designed to entrain five (5) percent air when Grade 1 or 2 coarse aggregate is used, six (6) percent when Grade 3 or 4 coarse aggregate is used, and seven (7) percent for Grades 5,6 or 7 unless otherwise specified by the City. Concrete as placed shall contain the proper amount of entrained air as required herein with a tolerance of plus or minus 1-1/2-percentage points. Acceptance of concrete with occasional variations between 1-1/2 and three (3) percentage points over the specified amount will be based on strength tests as required by the City. When the quantity of entrained air is found to be more than three (3) percentage points over or two (2) percentage points under those values given herein, the concrete will be rejected.

Entrained air will be required for bridge slabs, top slabs of direct traffic culverts, concrete pavement, dense and regular concrete overlays, piers, bents, precast piling (non-prestressed), drilled shafts placed in water, bridge railing, concrete traffic barrier and for other items of work as may be specified, on the Plans or in other specifications.

TABLE 3
SLUMP REQUIREMENTS

Concrete Designation	Desired Slump Inches	Max Slump Inches
A. Structural Concrete		
(1) All drilled shafts	6	7
(2) Thin-Walled Section (9" or less)	4	5
(3) Slabs, Concrete Overlay, Caps, Columns, piers, Wall sections over 9", etc.	3	4
(4) Prestressed Concrete Members	4	5
(5) Concrete traffic Barrier (cast-in-place or precast), Concrete Bridge Railing	4	5
(6) Dense concrete overlay	¾	1
(7) Concrete placed underwater	6	7
(8) Concrete with High Range Water Reducer	-	8
B. Concrete Pavement	1-1/2	3 max 1 min
C. Riprap, curb, gutter, slipformed and extruded concrete	As Approved by the City	

Note: No concrete will be permitted with a slump in excess of the maximums shown. When high-range water reducing admixtures are used, the slump shall not exceed eight (8) inches.

421.8. QUALITY OF CONCRETE.

The concrete shall be uniform, workable and of a consistency acceptable to the City. The cement content, maximum allowable water/cement ratio, the desired and maximum slump, the proper amount of entrained air and the strength requirement for all classes of concrete shall be the responsibility of the Contractor to provide concrete meeting these requirements.

During the progress of the work, a certified testing laboratory technician will cast test cylinders and/or beams, perform slump and entrained air tests and will make temperature checks, as required, to ensure compliance with the specifications.

Unless otherwise shown on the Plans, the Contractor shall furnish and properly maintain all test molds. The test molds shall meet the requirements of Test Methods Tex-418-A / ASTM C 39 and Tex-448-A / ASTM C 78 and, in the opinion of the City, must be satisfactory for use at the time of use. In addition, the Contractor shall be responsible for furnishing personnel to remove the test specimens from the molds and transport them to the proper curing location at the schedule designated by the City and in accordance with the governing specification. For all concrete items

the Contractor shall have a wheelbarrow, or other container acceptable to the City, available to use in the sampling of the concrete.

All labor and equipment furnished by the Contractor will be considered subsidiary to the various bid items and will not be paid for directly.

A strength test is defined as the average of the breaking strength of two (2) cylinders or two (2) beams as the case may be. Each specimen will be tested in accordance with Test Methods Tex-418-A / ASTM C 39 or Tex-448-A / ASTM C 78.

Slump tests will be performed in accordance with Test Method Tex-415-A / ASTM C 143. Entrained air tests will perform in accordance with Test Method Tex-416-A / ASTM C 231.

If the required strength or consistency of the class of concrete being produced cannot be secured with the minimum cement specified or without exceeding the maximum water/cement ratio, the Contractor will be required to furnish different aggregates, use a water reducing agent, an air entraining agent or increase the cement content in order to provide concrete meeting these specifications.

All test specimens, beams or cylinders, representing tests for removal of forms and/or falsework shall be cured using the same methods and under the same conditions as the concrete represented.

"Design Strength" beams and cylinders shall be cast and cured in accordance with Test Method Tex-447-A / ASTM C 31.

When the specified concrete strength is by 28-day compressive strength tests, job control testing will be by 7-day compressive strength tests. The minimum strength requirement for 7-day tests will be 70 percent of the specified minimum 28-day compressive strength. If the required 7-day strength is not obtained with the quantity of cement specified in Table 4, changes in the batch design will be made as specified in this article. For an occasional failure of the 7-day compressive test, the concrete may be tested at 28-days for final evaluation. Strength test requirements for Type II cement will govern when Type I/II cement is used.

TABLE 4

CLASSES OF CONCRETE

Class of Concrete	Cement per C.Y. Min. (sacks)	Min. Comp. Strength 28 day psi	Min. Flexural Strength 7 day psi	Max. Water / Cement Ratio Gal/sk	Coarse Aggregate Grade No.	General Usage (information only)
A	5.0	3,000	425 390 (c)	6.5	1-2- 3-4- 8 (a) (d)	Drilled Shafts; Culverts, except Top Slab of Direct Traffic Culverts; Inlets; Manholes, Headwalls; Approach Slabs; Curb; Gutter, Conc. Retards; Sidewalks; Driveways; Conc. Pavement; Back-up Walls; Anchors
B	4.0	2,000	280	8.0	2-3-4-5-6-7	Riprap, Small Roadside Signs and Anchors
C	6.0	3,600	510 470 (c)	6.0	1-2-3-4-5 (d)	Drilled Shafts; Bridge Substructure; Bridge Railing; Culverts, except Top Slab of Direct Traffic Culverts; Wing Walls; Approach Slab; Concrete Traffic Barrier (cast-in-place)
D	2.0 to 3.0	1,000 to 1,500	215±	11.0±	2-3-4-5-6-7	Riprap Fill Voids Fills
E	6.0	3,000	425	6.0	2-3-4-5	Seal Concrete
S	6.5	4,000	570 525 (c)	5.0	2-3-4-5	Bridge Slab; Top Slab of Direct Traffic Culvert; Bridge Substructure
P	5.0	3,500	555 (b)	6.25	2-3	Concrete Pavement
DC	8.75	5,500	720	3.6	6	Dense Concrete Overlay
CO	7.0	4,600	640	4.5	6	Concrete Overlay

(a) Grade 8 aggregate for use in extruded curbs, unless the City approves a larger size.
(b) Minimum running average for concrete pavement (in accordance with Construction Bulletin C-II).
(c) When Type II or Type I/II cement is used.
(d) Unless otherwise permitted by the City, Grade I coarse aggregate may be used only in massive foundations with four (4) inch minimum clear spacing between reinforcing steel bars. Grade I aggregate may be used in drilled shafts.

421.9. MEASUREMENT AND PAYMENT.

The work performed, materials furnished and all labor, tools, equipment and incidentals necessary to complete the work under this Item will not be measured or paid for directly, but will be considered subsidiary to the various bid items of the contract.

CITY OF SAN ANGELO

ITEM 433

JOINT SEALANTS AND FILLERS

433.1. DESCRIPTION.

This Item shall govern the material requirements for joint sealants, backing materials and joint fillers.

433.2. MATERIALS.

The materials for this item shall conform to the following:

(1) Joint Sealant Materials. Joint sealant material shall be the class indicated on the Plans or in the governing specifications. The various classes of sealant described herein shall be in accordance with TxDOT Material Specification D-9-6310. Copies of specification D-9-6310 are available from TxDOT, Director of Materials and Tests, 125 E. 11th Street, Austin, TX 78701-2483.

(2) Storage. Class 1 and 2 sealants shall be stored at temperatures between 40ºF and 100ºF. Class 4 and 5 sealants shall be stored in sealed containers at a temperature of 100ºF or below and the material must be used within two (2) months of receipt on the project.

(3) Classes of Joint Sealants.

(a) Class 1. Two Component, Synthetic Polymer, Non-sag. The components shall be proportioned and mixed in accordance with the manufacturer's recommendations.

(b) Class 2. Two Component, Synthetic Polymer, Self-leveling. The components shall be proportioned and mixed in accordance with the manufacturer's recommendations.

(c) Class 3. Hot Poured Rubber. This sealant shall be a rubber asphalt compound which when heated shall melt to the proper consistency for pouring and shall solidify on cooling to ambient temperatures.

(d) Class 4. Non-sag Low Modulus Silicone. The material shall be a single component formulation not requiring addition of a catalyst.

(e) Class 5. Self-leveling Low Modulus Silicone. The material shall be a single component formulation not requiring addition of a catalyst.

(f) Class 6. Preformed Joint Sealant (PJS). The preformed joint sealant shall be an extruded elastomeric material having a multi-channeled shape.

(g) Class 7. Self-leveling, Rapid Curing, Low Modulus Silicone. The material shall be a two component, rapid curing, self-leveling, low modulus formulation. The components shall be proportioned and mixed in accordance with the manufacturer's recommendations.

The size shown on the Plans shall be the nominal width of the sealant. The uncompressed depth of the seal shall be equal to or greater than the width.

All preformed joint sealants installed by the Contractor shall have been pre-qualified for compliance with the requirements. Each size and configuration of seal produced by a manufacturer must be approved by the City prior to use on City of San Angelo projects. For a sealant manufacturer to pre-qualify and obtain approval of a sealant, detailed dimensions and configuration of each size of sealant and certified test results indicating compliance with TxDOT Material Specification D-9-6310 and any requirements shown on the Plans and specifications shall be submitted to the City.

Submission shall be done sufficiently in advance of work to allow for testing and evaluation of the material.

The City will confirm by visual inspection that the sealant proposed for installation is the same size, configuration and manufacture as shown on Plans. The City will examine the sealant for any undue distortions, such as dissymmetry, warping, thick webs or uneven width, which are likely to impair the performance of the joint. If the magnitudes of the distortions are sufficient to create doubt as to the performance of the sealant, the City may direct that the sealant be replaced or that samples representing the worst of the lot be subjected to further testing to verify their performance.

(4) Backer Rods and Backing Materials. These materials shall be capable of holding the fluid sealant in open joints in place. In all cases these materials shall be of such a type that will not bond to the sealant. The backing materials shall meet the requirements of the sealant manufacturer. They shall be compressible type materials, such as closed-cell, resilient foam or sponge rubber stock of vinyl, butyl or neoprene, or expanded polyethylene or polyurethane.

The diameter of the backer rod shall be at least 25 percent larger than the joint reservoir width.

(5) Joint Fillers. Joint fillers shall be of the size, shape and type indicated on the Plans and shall conform to the following requirements.

(a) Timber Boards. Timber boards shall be obtained from redwood, cypress, gum, southern yellow pine or Douglas fir timber. They shall be sound heartwood and shall be free from sapwood, knots, clustered bird's eye, checks and splits. Occasional sound or hollow bird's-eye, when not in clusters, will be permitted provided the board is free from any other defects that will impair its usefulness as a joint filler. All boards, except redwood and cypress, shall have a creosote or pentachlorophenol treatment conforming to TxDOT Item 492 "Timber Preservative and Treatment", Table 1. When oven dried at 230ºF to a constant weight, the weight of the board per cubic food (minus treatment) shall not be less than 20 pounds or more than 35 pounds.

(b) Asphalt Boards. Asphalt boards shall consist of two (2) suitable asphalt-impregnated liners filled with a mastic mixture of asphalt and vegetable fiber and/or mineral fiber. Asphalt boards shall be smooth, flat and sufficiently rigid to permit installation. When tested in accordance

with Test Method Tex-524-C, the horizontal deflection shall not be more than one inch in 3-1/2 inches.

(c) Preformed Fiber Material.

i. Preformed Bituminous Fiber Material. Preformed bituminous fiber material shall meet the requirements of ASTM D1751.

ii. Preformed Non-bituminous Fiber Material. Preformed non-bituminous fiber material shall meet the requirements of ASTM D1751, except that the requirements pertaining to bitumen content, density and water absorption shall be voided.

(d) Rebonded Neoprene Filler. Rebonded neoprene filler shall consist of ground closed-cell neoprene particles, rebonded and molded into sheets of uniform thickness of the dimensions shown on the Plans, meeting the requirements of ASTM D1752, Type 1. Certification that the material meets these requirements shall be furnished to the City.

433.3. MEASUREMENT.

The work performed, materials furnished and all labor, tools, equipment and incidentals necessary to complete the work.

433.4. PAYMENT.

This Item will be paid for by the linear feet as measured in place.

CITY OF SAN ANGELO

ITEM 437

CONCRETE ADMIXTURES

437.1 DESCRIPTION.

This Item shall govern for the admixtures used in Portland Cement Concrete, in accordance with the Plans, specifications and requirements herein.

437.2 MATERIALS.

Admixtures shall be in a liquid state and conform to the following requirements:

Chemical Admixtures – ASTM C494
Air Entraining Admixtures – ASTM C260

437.3 APPROVAL OF ADMIXTURES.

The City reserves the right to perform any or all of the tests required by ASTM C260 and ASTM C494 as a check on the tests reported by the manufacturer. In case of any variance, the City test will govern. Any change in formulation of an admixture shall require retesting, and shall be approved by the City.

A change in formulation discovered by any of the tests prescribed herein, or other means, and not reported and retested, may be just cause to remove a manufacturer from the pre-certified list for City projects.

All documentation and correspondence shall be submitted to the City Engineer, San Angelo, Texas.

437.4 DISPENSING EQUIPMENT.

Each admixture shall be measured and dispensed by a separate readily adjustable dispenser. When set to a predetermined volume, the dispenser shall fill to the preset amount and hold it without leakage until the operator releases the content by some positive means. Unless otherwise shown on the Plans, completely automatic dispensing will not be required, except for use with a fully automatic Plant.

The calibrated container shall be constructed in such a manner that the level of the admixture is visible at all times. A strip gauge with one (1) ounce increments for air-entraining admixtures and ten (10) ounce increments for water reducing and/or retarding admixtures, shall be attached securely to the measuring apparatus. This strip shall be a material possessing weather-resistant qualities. The accuracy required for these systems shall be plus or minus three (3) percent. The equipment shall visibly show the total amount to be dispensed for ready check by the City.

For individual concrete placements of less than two (2) cubic yards at the placement site, the City may waive the requirements for mechanical dispensing equipment.

437.5 CONSTRUCTION USE OF ADMIXTURES.

When used in accordance with the governing specification, the Contractor will be allowed to use any admixture, which has been approved. The Contractor shall submit to the City one (1) copy of the invoice showing the admixture or admixtures to be used on the project. Prior to using an admixture in the work, trial mixes shall be made and tested in the field using the materials and equipment to be used on the project. If more than one (1) admixture is used, they shall be used in such manner that the desirable effects of teach are realized.

Mix designs from previous or concurrent jobs may be used without trial batches if it is shown that no substantial change in any of the proposed ingredients has been made.

The volume of liquid admixtures shall be taken into account when determining the water/cement ratio of the mix.

The dosage rate for air-entraining admixtures shall be adjusted as necessary to produce the required air content in the concrete. The air content shall be in accordance with Item 421, "Portland Cement Concrete", unless otherwise shown on the Plans.

When a retarding admixture is required for extended retardation, the amount to be used shall be established by several trail batches with varying retarder contend and simulating the placing conditions to be encountered. When water reducing or retarding agents are used at the option of the Contractor, reduce dosage of the admixture will be permitted.

Accelerators will be used only to meet special requirements and will require the written approval of the City on each specific project. Accelerating admixtures will not be permitted in bridge decks, top slab of direct traffic culverts, nor when Type II cement is specified.

All accelerating admixtures dosages will be based on trial mixes and approved by the City.

High range water reducers will be used only to meet special requirements and will require written approval of the City on each specific project. A Work Plan for control shall be submitted by the Contractor for approval and an evaluation of the concrete containing the admixture will be performed by the City. Recommended guidelines for developing a Work Plan are shown in TxDOT Construction Bulletin C-11.

Suitable measures shall be taken to prevent admixtures from freezing. Admixtures shall be agitated as required to prevent separation or sedimentation of solids. Air agitation of entraining agents will not be permitted.

Air entraining agents shall be charged into the mixer with the first one-third (1/3) of the mix water. Retarding or water reducing admixtures, except for high-range water reducers, shall be charged into the mixer during the last one-third of the mix water. Each admixture shall be dispensed separately but at the same time as the mixing water. No admixture shall be dispensed on dry aggregates.

Alternate charging sequences based on trial batches may be used subject to approval by the City.

High range water reducing admixtures shall be used and/or dispensed in accordance with the approved Work Plan.

Should the desired effects of an admixture not be achieved in the concrete, the City may take a sample of the admixture being used for further testing. Further use of the admixture will not be allowed until the results of such rest confirm that the admixture has not been changed or altered in any way.

437.6 MEASUREMENT AND PAYMENT.

The work performed, materials furnished and all labor, tools, equipment, and incidentals necessary to complete the work under this Item will not be measured or paid of directly, but will be considered subsidiary to the various bid Item of the contract.

CITY OF SAN ANGELO

ITEM 440

REINFORCING STEEL

440.1. DESCRIPTION.

This Item shall govern for the furnishing and placing of deformed and smooth reinforcing steel, of the sizes and details shown on the Plans and in accordance with this Item. All reinforcing steel to be epoxy coated will be designated on the Plans. Epoxy coating of reinforcing steel shall be in accordance with "Epoxy Coating of Reinforcing Steel" of this Item.

440.2. MATERIALS.

Unless otherwise shown on the Plans or specified herein, the reinforcing steel shall be Grade 60 and all bar reinforcement shall be deformed, conforming to one of the following:

(1) ASTM A615, Grades 40 or 60, open hearth, basic oxygen, or electric furnace new billet steel.

(2) ASTM A617, Grades 40 or 60, axle-steel.

(3) ASTM **A**616, Grade 60, rail steel will be permitted in concrete pavement only. ASTM A616 bars shall be furnished as straight bars only and bending is prohibited. Bend tests will not be required.

(4) ASTM A706, Grade 60, weldable reinforcing steel.

(5) Smooth Bars. Smooth bars for concrete pavement shall have a minimum yield strength of 60 ksi.

All other smooth bars, larger than No. 4, may be steel conforming to the above or may be furnished in any steel that meets the physical requirements of ASTM A36.

(6) Spiral reinforcement shall be either smooth or deformed bars, or wire, of the minimum size or gage shown on the Plans, or as specified herein.

Bars for spiral reinforcement shall comply with ASTM A675, Grade 80 (reference to ASTM A29 is voided) A615 or A617, Grade 40, unless otherwise shown on the Plans. Smooth wire shall comply with ASTM A82 and deformed wire shall comply with ASTM A496.

In cases where the provisions of the Item are in conflict with the provisions of the ASTM Specification, the provisions of this Item shall govern.

Reinforcing steel to be structurally welded shall comply with ASTM A706 or shall have a carbon equivalency (C.E.) of not more than 0.55%. A report of chemical analysis, showing the percentages of all elements necessary to establish the carbon equivalency, will be required for all reinforcing steel that is to be structurally welded. The above requirements do not pertain to miscellaneous welds on reinforcing steel as defined in Item 448, "Structural Field Welding".

Carbon equivalency will be calculated using the following formula:

$$C.E. = \%C + \frac{\%MN}{6} + \frac{\%Cu}{40} + \frac{\%Ni}{20} + \frac{\%Cr}{10} - \frac{\%Mo}{50} - \frac{\%V}{10}$$

The nominal size, area and weight of reinforcing steel bars covered by this specification are as follows:

Bar Size Number	Nominal Diameter In.	Nominal Area Sq. In.	Weight Per Linear Foot
2	0.250	0.05	0.167
3	0.375	0.11	0.376
4	0.500	0.20	0.668
5	0.625	0.31	1.043
6	0.750	0.44	1.502
7	0.875	0.60	2.044
8	1.000	0.79	2.670
9	1.128	1.00	3.400
10	1.270	1.27	4.303
11	1.410	1.56	5.313
14	1.693	2.25	7.65
18	2.257	4.00	13.60

Smooth round bars shall be designated by size number through No. 4. Smooth bars above No. 4 shall be designated by diameter in inches.

(7) Wire for fabric reinforcement shall conform to ASTM A82 or A496. Wire fabric shall conform to ASTM A185 or A497.

When wire is ordered by size numbers, the following relation between size number, diameter in inches and area shall apply unless otherwise specified. Where deformed wire is required, the size number shall be preceded by “D”, and for smooth wire the prefix shall be “W”.

Size Number	Nominal DAMETER IN.	Nominal Area Sq. In.
31	0.628	0.310
30	0.618	0.300
28	0.597	0.280
26	0.575	0.260
24	0.553	0.240
22	0.529	0.220
20	0.505	0.200
18	0.479	0.180
16	0.451	0.160
14	0.422	0.140
12	0.391	0.120
10	0.357	0.100
8	0.319	0.080
7	0.299	0.070
6	0.276	0.060
5.5	0.265	0.055
5	0.252	0.050
4.5	0.239	0.045
4	0.226	0.040
3.5	0.211	0.035
3	0.195	0.030
2.5	0.178	0.025
2	0.160	0.020
1.5	0.138	0.015
1.2	0.124	0.012
1	0.113	0.010
0.5	0.080	0.005

Note: Fractional sizes between the sizes listed above are also available and acceptable for use.

Welded wire fabric will be designated as shown in the following example:

> 6 x 12 - W16 x W8; indicated six (6) inch longitudinal wire spacing and 12 inch transverse wire spacing with smooth Number 16 wire longitudinally and smooth Number 8 wire transversely.

(8) Epoxy Coating. The epoxy coating material and the material used for the repair of the coating shall comply with the TxDOT Departmental Materials Specification D-9-8130, "Epoxy Powder Coating For Reinforcing Steel". Copies of the Departmental Materials Specifications are available from the TxDOT, Division of Materials and Tests, 125 East 11th Street, Austin, Texas 78701-2483. An eight-ounce sample of epoxy powder and manufacturer's certifications will be required for each lot of epoxy powder used to coat materials for City projects.

440.3. BENDING.

The reinforcement shall be bent cold, true to the shapes shown on the Plans. Fabrication shall preferably be done in the shop. Field fabrication, if permitted, shall be done with equipment approved by the City. Misfabricated, damaged or broken bars shall be rejected and replaced at the Contractor's expense. Damaged or broken bars imbedded in a previous concrete placement may be repaired with the approval of the City.

Unless otherwise shown on the Plans, the inside diameter of bar bends, in terms of the nominal bar diameter (d), shall be as follows:

Bends of 90º and greater in stirrups, ties and other secondary bars that enclose another bar in the bend shall be:

#3, #4, #5	4d
#6, #7, #8	6d

All bends in main bars and in secondary bars not covered above shall be:

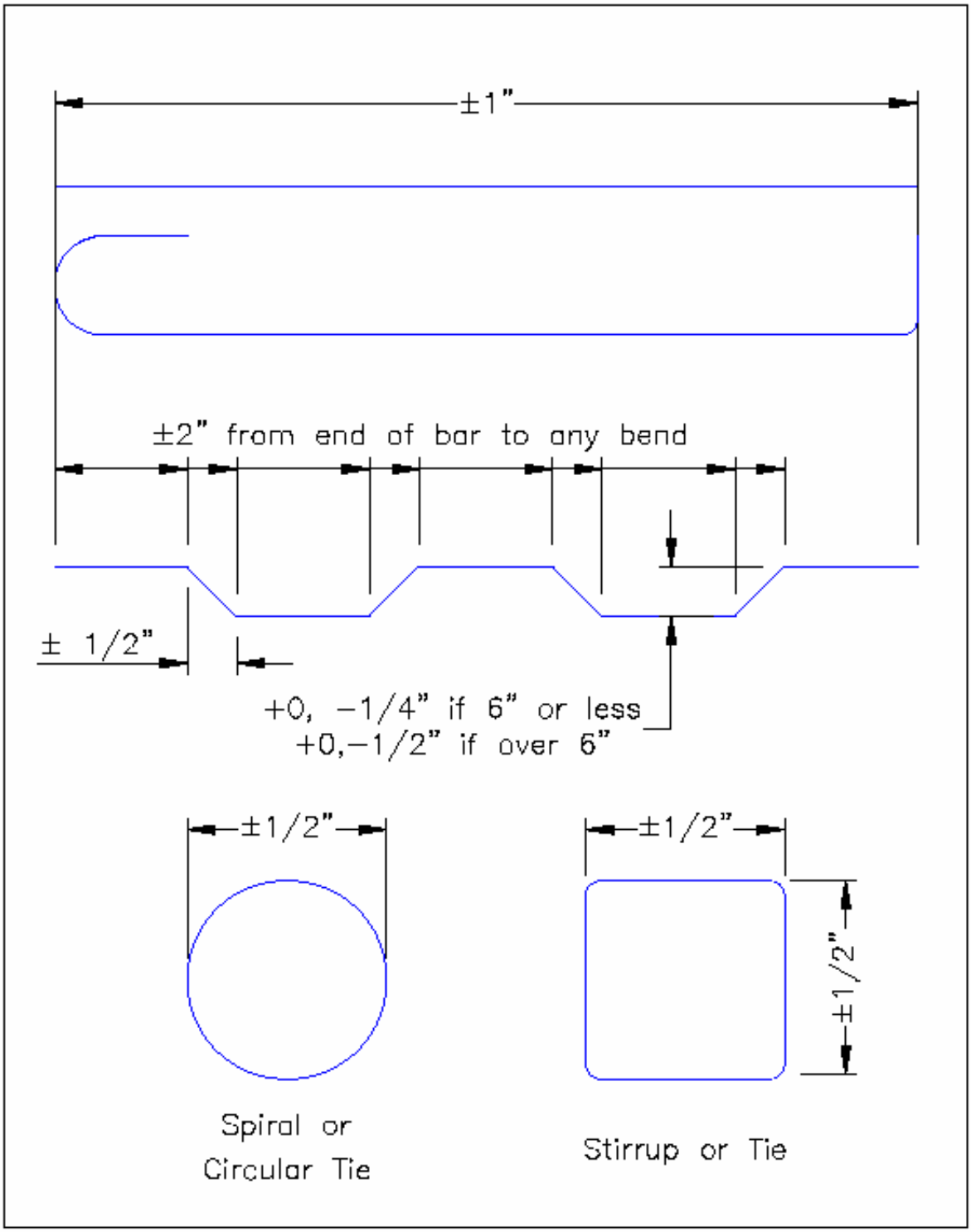
#3 thru #8	6d
#9, #10, #11	8d
#14, #18	10d

Where bending of Grade 60 bars, sizes No. 14 or No. 18 is required, bend testing shall be performed on representative specimens as described for smaller bars in the applicable ASTM Specification. The required bend shall be 90º degrees around a pin having a diameter of ten (10) times the nominal diameter of the bar.

440.4. TOLERANCES

Fabricating tolerances for bars, from Plan dimensions, shall not be greater than shown in Figure 1.

FIGURE 1



440.5. STORING.

Steel reinforcement shall be stored above the surface of the ground upon platforms, skids, or other supports and shall be protected from damage and deterioration as approved by the City. When placed in the work, reinforcement shall be free from dirt, paint, grease, oil, or other foreign materials. Reinforcement shall be free from defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scales will not be cause for rejection, provided the minimum cross-sectional area of a hand wire brushed specimen meets the requirements for the size of steel specified.

440.6. SPLICES.

Splicing of bars, lap spliced or welded, shall be as shown on the Plans or specified herein. Additional splices will require written approval of the City.

Splices not provided for on the Plans will be permitted in slabs 15 inches or less in thickness, columns, walls and parapets, but will not be included for measurement, subject to the following:

Unless otherwise approved by the City, splices will not be permitted in bars 30 feet or less in Plan length. For bars exceeding 30 feet in Plan length, the distance center to center of splices shall not be less than 30 feet minus one splice length, with no more than one individual bar length less than ten (10) feet. The specified concrete cover and proper spacing shall be maintained at such splices and the lap spliced bars placed in contact and securely tied together.

TABLE 1

MINIMUM LAP REQUIREMENTS FOR BAR SIZES THROUGH NO. 11

SIZE	LAP LENGTH	
	UNCOATED	COATED
No. 3	1’-0”	1’-6”
No. 4	1’6”	2’-3”
No. 5	1’-10”	2’-9”
No. 6	2’-3”	3’-4”
No. 7	3’-0”	4’-6”
No. 8	3’-9”	5’-7”
No. 9	4’-8”	7’-0”
No. 10	5’-7”	8’-4”
No. 11	6’-7”	9’-10”

Spiral steel shall be lapped a minimum of one turn.
Bar sizes No. 14 and No. 18 may not be lapped.

Welded splices shall conform to the requirements of the Plans and TxDOT Item 448, "Structural Field Welding". End preparation for butt welding reinforcing bars shall be done in the field. Delivered bars shall be of sufficient length to permit weld preparation.

Welded wire fabric shall be spliced using a lap length that will include the overlap of a minimum of two (2) cross wires plus two (2) inches on each sheet or roll. Splices using bars, which develop equivalent strength and lapped in accordance with Table 1 will be permitted.

For box culvert extensions with less than one (1) foot of fill, the existing longitudinal bars shall have a lap with the new bars as shown in Table 1. For extensions with more than one (1) foot of fill, a minimum of six-inch lap will be required.

440.6. MECHANICAL COUPLERS.

(1) General. When shown on the Plans, mechanical splices may be made in the reinforcing steel bars using one of the following types:

Sleeve-Filler Type
Sleeve-Threaded Type
Sleeve-Swaged Type
Sleeve-Wedge Type

A pre-qualified manufacturer shall produce all couplers furnished by the Contractor. Pre-qualification shall be in accordance with TxDOT Departmental Material Specification D-9-4510. Sleeve-wedge type couplers will not be permitted on coated reinforcing.

(2) Project Samples. For purposes of sampling couplers for use on an individual project, a lot of couplers shall be defined as 500 couplers, or fraction thereof, for each size and type. Prior to use on the project, three (3) test specimens shall be assembled using couplers selected at random from each lot received on the project. All test specimens shall be assembled from materials consigned to the project and shall be assembled in the presence of the City. A test specimen shall consist of a coupler connecting two (2) 21 inch, or longer, bars using the same splice materials, position, equipment and procedures to be used to make splices in the work. The assembled test specimens shall be submitted to the Division of Materials and Tests for testing. Each lot of couplers shall be identified with tags or markings identifying the lot from which the samples were taken.

(3) Testing. Project samples will be tested to 125% of specified yield strength and for total slip requirements. When a test representing a lot of couplers fails to meet the requirements, four (4) additional couplers from that lot will be tested. If all four (4) tests meet the requirements, the lot will be accepted for use in the work. If any of the four (4) tests fail to meet the requirements, that lot of couplers will be rejected and not used in the work.

(4) Construction Methods. All coupling devices shall be installed in accordance with the manufacturer's recommendations. Protection of threaded male or female connections shall be provided and the threaded connections shall be clean when making the connection. Damaged threads shall not be repaired.

(5) Alternate Equivalent Strength. Alternate equivalent strength arrangements to be accomplished by substituting larger bar sizes, or more bars, will be considered if approved by the City, in writing, prior to the fabrication of the systems.

440.7. PLACING.

Unless otherwise shown on the Plans, dimensions shown for reinforcement are to be the centers of the bars. Reinforcement shall be placed as near as possible in the position shown on the Plans. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from Plan placement by more than one-twelfth (1/12) of the spacing between bars. In the Plane of the steel perpendicular to the nearest surface of concrete, bars shall not vary from Plan placement by more than 1/4-inch. Cover of concrete to the nearest surface of steel shall meet the above requirements but shall never be less than one (1) inch.

For bridge slabs, the clear cover tolerance for the top mat of reinforcement shall be -0, + 1/2 inch.

The reinforcement shall be accurately located in the forms, and firmly held in place, before and during concrete placement, by means of bar supports, adequate in strength and number in order to prevent displacement and to keep the steel at the proper distance from the forms. Bars shall be supported by standard bar supports with plastic tips, plastic bar supports approved by the City or precast mortar or concrete blocks when supports are in contact with removable or stay-in-place forms. Bright basic bar supports may be used to support reinforcing steel placed in slap overlays on concrete panels or on existing concrete slabs. Bar supports in contact with soil or subgrade shall be as approved by the City.

For bar supports with plastic tips, the plastic protection shall have a minimum thickness of 3/32 of an inch and extend upward on the wire to a point at least one-half (1/2) inch above the formwork.

All accessories such as tie wires, bar chairs, supports or clips used with epoxy coated reinforcement shall be of steel, fully coated with epoxy or plastic. Plastic supports approved by the City may also be used with epoxy coated reinforcement.

Mortar or concrete blocks shall be cast to uniform dimensions with adequate bearing area. A suitable tie wire shall be provided in each block for anchoring to the steel. The blocks shall be accurately cast to the thickness required in molds approved by the City. The surface placed adjacent to the form shall be a true Plane, free of surface imperfections. The blocks shall be cured by covering with wet burlap or mats for a period of 72 hours. Mortar for blocks shall contain approximately one (1) part Portland Cement to three (3) parts sand. Concrete for blocks shall contain nine (9) sacks of Portland Cement per cubic yard of concrete.

Individual bar supports shall be placed in rows at four (4) foot maximum spacing in each direction. Continuous type bar supports shall be placed at four (4) feet maximum spacing. Continuous bar supports will be required when permanent metal deck forms are used.

Individual bar supports shall be placed in rows at four-foot maximum spacing in each direction. Continuous type bar supports shall be placed at four (4) feet maximum spacing. Continuous bar supports will be required when permanent metal deck forms are used.

The exposure of the ends of longitudinals, stirrups and spacers used to position the reinforcement in concrete pipe and precast box culverts or sewers shall not be cause for rejection.

Reinforcing steel for bridge slabs, top slabs or direct traffic culverts and the top slabs of prestressed box beams shall be tied at all intersections except that where the spacing is less than one (1) foot in each direction, alternate intersections only need to be tied. For reinforcing steel cages for other structural members, the steel shall be tied at a sufficient number of intersections to provide a rigid cage of steel. Mats of wire fabric shall be fastened securely at the ends and edges.

Before concrete placement, all mortar, mud, dirt, etc., shall be cleaned from the reinforcement. Concrete shall not be placed until authorized by the City.

If the reinforcement is not adequately supported or tied to resist settlement, floating upward, overturning of truss bars, or movement in any direction during concrete placement, concrete placement will be halted until corrective measures are taken.

440.8. EPOXY COATING OF REINFORCING STEEL.

(1) General. When shown on the Plans, coating with epoxy of reinforcing bars, plain wire, deformed wire or welded wire fabric to be used as reinforcement for concrete shall conform to the requirements herein.

(2) Surface Preparation. The reinforcing steel shall be free of surface contaminants such as oil, grease or paint when received at the manufacturer's Plant and prior to cleaning and coating. The surface of steel to be coated shall be cleaned by abrasive blast cleaning. All traces of grit and dust from the blast cleaning shall be removed prior to coating. Other methods of cleaning may be submitted to the City for approval.

(3) Application of Coating. The applicator shall notify the City at least 30 days before the date of production. The coating shall be applied as recommended by the manufacturer of the coating material.

The coating shall be applied to the cleaned surface as soon as possible after cleaning and before oxidation of the surface discernible to the unaided eye occurs. The coating shall be a smooth uniform coat and shall have a thickness of from 7 to 12 mils, after curing. The thickness of the coating shall be measured using magnetic thickness testing gages in accordance with Test Method Tex-728-I.

The coating film shall be fully cured. Sufficient checks shall be made to assure that each coated production lot is supplied in a fully cured condition.

(4) Continuity of Coating. The applicator shall check the coating for continuity after curing. The coating shall be free from holes, voids, cracks, contamination and damaged areas discernible to the unaided eye.

For reinforcing bars a 67-1/2 volt D.C. in-line holiday detector, such as Tinker and Rasor Model M-1 or approved equivalent, shall be used to check the coating for holidays. There shall be no more

than two (2) holidays (pinholes not visually discernible) in any linear foot of a coated reinforcing bar.

Holiday checks to determine acceptability of wire or welded wire fabric shall be made at the manufacturer's Plant with a 67-1/2 volt D.C. in-line holiday detector. For wire, there shall not be more than an average of two (2) holidays per linear foot of wire. For welded wire fabric, there shall not be more than an average of four (4) holidays per linear foot of wire in welded wire fabric when the wire spacings are four (4) inches or more, or six (6) holidays per linear foot of wire when the spacings are less than four (4) inches. Uncoated areas at cut ends shall not be counted, nor shall sharp edges (weld spurs) at intersections be counted as holidays. When measuring the number of holidays, at least one-half (1/2) inch of wire must be included on each side of the intersections being checked.

(5) Repair of Coating. Material for repair of the coating shall comply with the requirements in "Epoxy Coating" of this Item. Repairs shall be made in accordance with procedures recommended by the manufacturer of the epoxy coating powder. Areas to be patched shall receive at least the same coating thickness as required for the original coating.

All visible damage to the coating shall be repaired.

Sawed and sheared ends, cuts, breaks and/or other damage shall be repaired promptly before additional oxidation occurs. Areas to be repaired shall be clean and free from surface contaminants. Repairs shall be made in the shop or in the field as required.

The acceptable amount of patched area at the applicator shall not exceed one-quarter (1/4) inch total length in any linear foot.

(6) Sampling and Testing. Sampling and testing of coated reinforcement shall be in accordance with Test Method Tex-739-I.

(7) Identification and Documentation. Identification of all reinforcing shall be maintained throughout the coating and fabrication process and until delivery to the project site.

For all production of coated reinforcing steel to be used on City projects, the manufacturer shall furnish to the City two copies of a written certification that the coated reinforcing steel meets the requirements of this specification and two copies of the manufacturer's control tests.

(8) Handling. All systems for handling coated reinforcement shall have padded contact areas. Bundling bands shall be padded or suitable banding shall be used to prevent damage to the coating. Bundles of coated reinforcement shall be lifted with a strong back, spreader bar, multiple supports, or a platform bridge. The bundled reinforcement shall be transported with care and stored on protective cribbing. The coated reinforcement shall not be dropped or dragged.

(9) Construction Methods. Flame cutting will not be permitted on coated reinforcement. Saw or shear cutting will be permitted with permission of the City. Cut ends shall be coated as specified in "Repair of Coating" of this Item.

Welding or mechanical coupling of coated reinforcing steel will not be permitted except where specifically shown on the Plans. The epoxy coating shall be completely removed a minimum of six (6) inches beyond the weld limits prior to welding and two (2) inches beyond the limits of the coupler prior to assembly. After welding or coupling, the steel shall be cleaned of all oil, grease, moisture, dirt, welding contamination (slag and/or acid residue) and rust to a near white finish. The existing epoxy shall be checked for damage. Any damaged or loose epoxy shall be removed back to sound epoxy coating.

After proper cleaning, the splice area shall be coated with epoxy repair material to a thickness of 7 to 12 mils. A second application of repair material shall be applied to the bar and coupler interfaces to insure complete sealing of the joint.

440.9. MEASUREMENT AND PAYMENT.

Except as specified below, the work performed, materials furnished, and all labor, tools, equipment and incidentals necessary to complete the work under this Item will not be measured or paid for directly, but will be considered subsidiary to the various bid items of the contract.

The quantities of reinforcing steel shown on the Plans are estimates and are for the Contractor's information.

Compensation for adjustment of reinforcing steel quantities will be as follows:

(1) When the reinforcing steel quantity for a complete structure element has been erroneously included in or omitted from the quantities shown on the Plans, the quantity for that element will be added or deducted for payment. A complete structure element will be the smallest portion of a total structure for which a corresponding quantity of concrete is included on the Plans. Additional payment or reduction in payment for quantities revised in this manner will be made accordingly, in accordance with TxDOT Item 4.3.

(2) When the Plan quantity for reinforcing steel for a complete structure element is in error by five (5) percent or more, a recalculation will be made and payment will be increased or reduced accordingly in accordance with contract documents..

(3) When quantities for reinforcing steel are revised by a change in design, the change in quantities will be calculated. Additional payment or reduction in payment for quantities revised in this manner will be made accordingly, in accordance with contract documents.

The party to the contract requesting the adjustment shall present to the other one (1) copy of the description and location, together with calculations of the quantity for the structure element involved. When this quantity is certified correct by the City, it will become the basis for additional or reduced payment.

CITY OF SAN ANGELO

ITEM 529

CONCRETE CURB, GUTTER AND COMBINED CURB AND GUTTER

529.1. DESCRIPTION.

This Item shall govern for construction of concrete curb, gutter and combined curb and gutter, with or without reinforcing steel, composed of Portland Cement concrete on approved subgrade, foundation material or finished surface in accordance with the lines and grades established by the City and in conformance with the details shown on the Plans.

As used in this Item, the word "curb" refers to concrete curb, concrete gutter and combined concrete curb and gutter.

529.2. MATERIALS.

All materials shall conform to the pertinent requirements of the following Item:

Item 421, "Portland Cement Concrete"

Concrete used in conventionally formed and slipformed construction shall be Class "A" concrete or concrete as specified for concrete pavement. Unless otherwise shown on the Plans, concrete for extruded construction shall be Class "A", except that the coarse aggregates shall meet the requirements of Grade 8. Other grades of coarse aggregate may be substituted, if approved by the City.

529.3. CONSTRUCTION METHODS.

(1) Conventionally Formed Concrete. Prior to curb construction, the subgrade, foundation or pavement surface shall be shaped to the line, grade and cross section shown on the Plans and, if considered necessary by the City, hand tamped and sprinkled. When directed by the City, the subgrade or foundation material shall be sprinkled. When directed by the City, the subgrade or foundation material shall be sprinkled lightly immediately before concrete is deposited thereon.

Forms shall be of wood, metal or other approved material, of a section satisfactory to the City, straight, free of warp and of the depth required. They shall be securely staked to line and grade, and maintained in a true position during the placing of concrete.

The reinforcing steel, if required, shall be placed as shown on the Plans. Care shall be exercised to keep all steel in its proper location during concrete placement.

Unless other methods are shown on the Plans or approved by the City, the concrete shall be placed into the forms and then struck off with a template, which is approximately 1/4" to 3/8" less than the dimension of the finished curb. After the concrete has been struck off and after it has become sufficiently set, the surface shall be plastered with a mortar consisting of one part of Portland

Cement and two (2) parts fine aggregate. The mortar shall be applied with a template made to conform to the finished curb dimensions as shown on the Plans. Exposed edges shall be rounded by the use of an edging tool to the radius shown on the Plans. All exposed surfaces shall be brushed to a smooth and uniform surface.

Curbs, gutters and combined curb and gutters shall be placed in sections of 50-foot maximum length unless otherwise approved by the City.

Joints shall be of the type and spacing shown on the Plans. Preferably on ten (10) foot spaces if not shown on Plans.

Hand finishing will be permitted.

The completed work shall be cured with an approved curing compound.

(2) Extruded or Slipformed Concrete. The concrete shall be placed with self-propelled equipment approved by the City. When placement is directly on subgrade or foundation materials, the foundation shall be hand-tamped and sprinkled if considered necessary by the City. If the concrete is placed directly on the surface material or pavement, such surface shall be thoroughly cleaned. If required by Plan details, the cleaned surface shall then be coated with an approved adhesive or other coating as specified at the rate of application shown.

The reinforcing steel, if required, shall be placed as shown on the Plans. Care shall be exercised to keep all steel in its proper location during concrete placement.

The line shall be maintained from a guideline set by the Contractor based on the alignment data shown on the Plans. The outline shall strictly conform to the details shown on the Plans. The forming tube of the extrusion machine or the form of the slipform machine shall be readily adjustable vertically during the forward motion of the machine to provide required variable heights necessary to conform to the established grade line. To provide a continual check on the grade, a pointer or gauge shall be attached to the machine in such a manner that a comparison can be made between the extruded or slipform work and the guideline. Other methods may be used, if approved in writing by the City.

Concrete shall be fed into the machine in such a manner and at such consistency that the finished work will present a well-compacted mass with a surface free from voids and honeycomb, and true to the required shape, line and grade.

Any additional surface finishing specified and/or required shall be performed immediately after extrusion or slipforming. Expansion joints shall be at the beginning and ending of radius and every 100' between radii.

Hand finishing will be permitted.

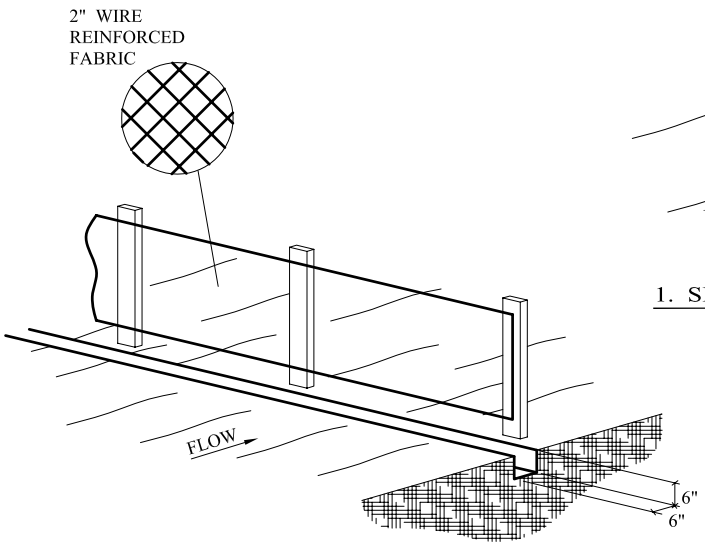
All exposed surfaces shall be cured with an approved curing compound.

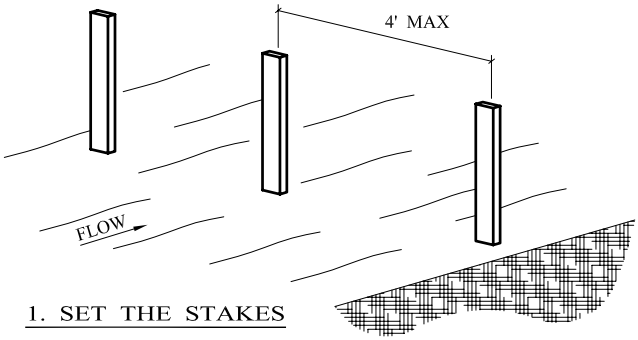
529.4. MEASUREMENT.

This Item will be measured by the linear foot, complete in place.

529.5. PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Concrete Curb", "Concrete Gutter" or "Concrete Curb and Gutter" of the type specified. This price shall be full compensation for furnishing all materials required; for surface preparation of base; and for all manipulations, labor, tools, equipment, and incidentals necessary to complete the work.



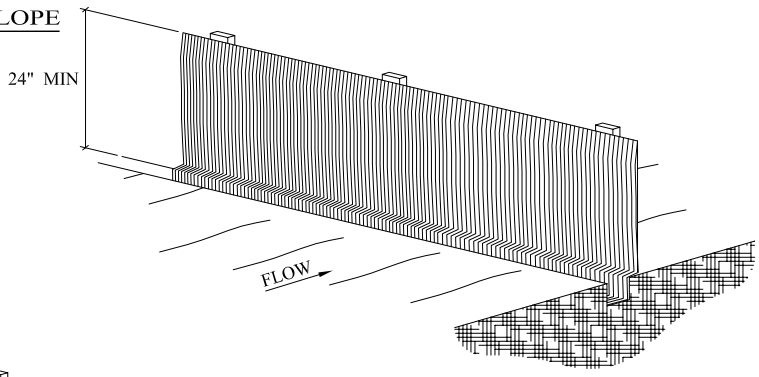


1. SET THE STAKES

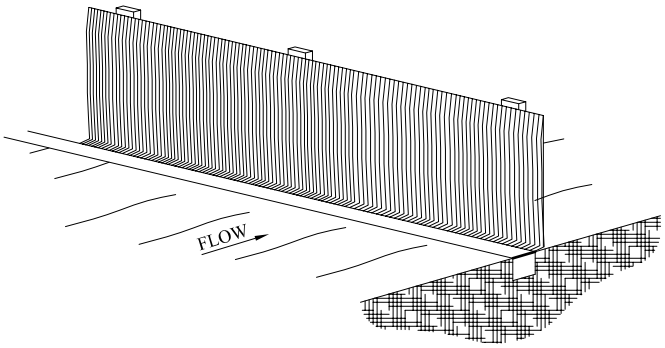
NOTE:

WOODEN STAKES OR STEEL TEE POST ACCEPTABLE. WIRE REINFORCED FABRIC SHALL BE SECURELY ATTACHED TO THE POST. FABRIC WILL ALWAYS BE ON THE SIDE FACING THE FLOW.

2. EXCAVATE A 6" x 6" TRENCH UPSLOPE ALONG THE LINE OF STAKES



3. STAPLE OR TIE FILTER MATERIAL TO STAKES AND EXTEND IT INTO THE TRENCH



4. BACKFILL AND COMPACT THE EXCAVATED SOIL

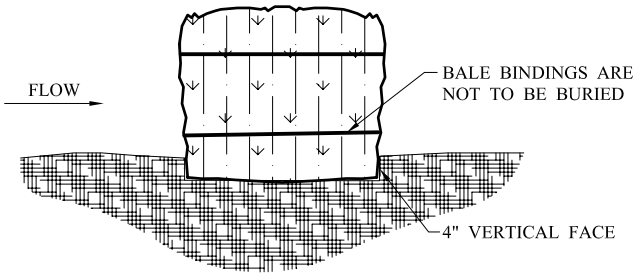
NOTES:

1. STEEL POSTS WHICH SUPPORT THE SILT FENCE SHALL BE INSTALLED ON A SLIGHT ANGLE TOWARD THE ANTICIPATED RUNOFF SOURCE. POST MUST BE EMBEDDED A MINIMUM OF ONE FOOT.
2. A CITY-APPROVED FILTER FABRIC WILL BE USED.
3. THE TRENCH MUST BE MINIMUM OF 6 INCHES DEEP AND 6 INCHES WIDE TO ALLOW FOR THE SILT FENCE FABRIC TO BE LAID IN THE GROUND AND BACKFILLED WITH COMPACTED MATERIAL.
4. SILT FENCE SHOULD BE SECURELY FASTENED TO EACH WOODEN OR STEEL SUPPORT POST. THERE SHALL BE A 3 FOOT OVERLAP, SECURELY FASTENED, WHERE ENDS OF FABRIC MEET.
5. INSPECTION SHALL BE MADE WEEKLY OR AFTER EACH $\geq$1/2" RAINFALL EVENT AND REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.
6. SILT FENCE SHALL BE REMOVED WHEN THE SITE IS COMPLETELY STABILIZED SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.
7. ACCUMULATED SILT SHALL BE REMOVED WHEN IT REACHES A DEPTH OF 6 INCHES. THE SILT SHALL BE DISPOSED OF IN AN APPROVED SITE AND IN SUCH A MANNER AS TO NOT CONTRIBUTE TO ADDITIONAL SILTATION.

CITY OF SAN ANGELO

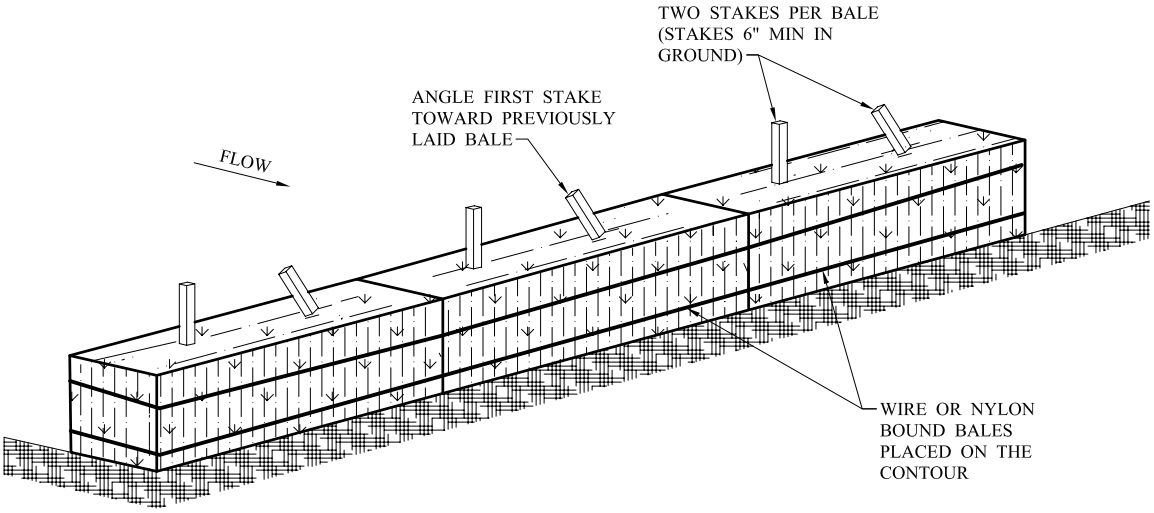
SILT FENCE STANDARDS

S-CC-1



EMBEDDING DETAIL

NOT TO SCALE



ANCHORING DETAIL

NOT TO SCALE

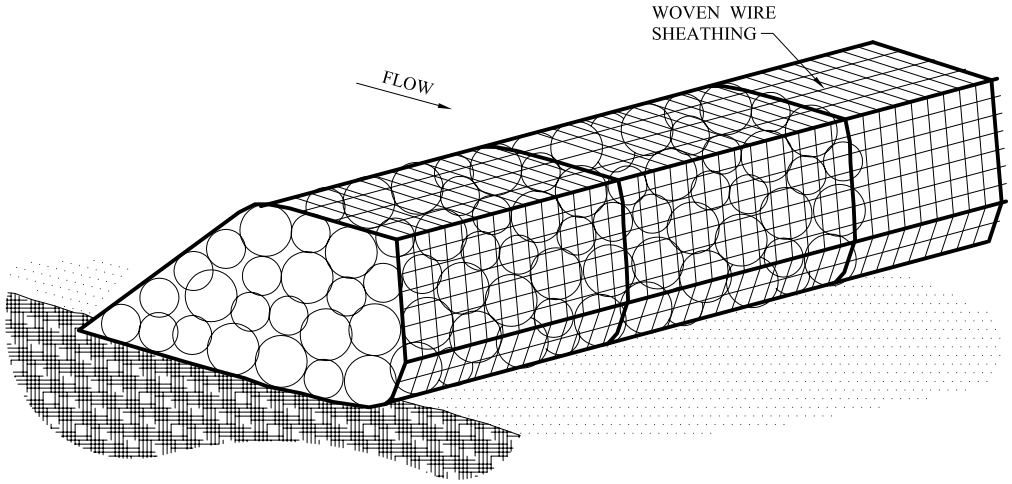
STRAW BALE DIKE GENERAL NOTES:

1. EACH BALE SHALL BE EMBEDDED IN THE SOIL A MINIMUM OF FOUR INCHES.
2. BALES SHALL BE SECURELY ANCHORED IN PLACE BY 2" x 2" WOOD STAKES DRIVEN THROUGH THE BALES. THE FIRST STAKE IN EACH BALE SHALL BE ANGLED TOWARD THE PREVIOUSLY LAID BALE TO FORCE THE BALES TOGETHER.
3. INSPECTION SHALL BE MADE EVERY TWO WEEKS AND AFTER EACH $\geq$1/2" RAINFALL EVENT. REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED BY THE CONTRACTOR.
4. WHEN SILT REACHES A DEPTH OF 6 INCHES, IT SHALL BE REMOVED AND DISPOSED OF IN AN APPROVED MANNER.
5. AFTER THE DISTURBED AREAS OF THE SITE ARE COMPLETELY STABILIZED, THE BALES SHALL BE REMOVED AND DISPOSED OF AT AN APPROVED SPOIL DISPOSAL SITE.

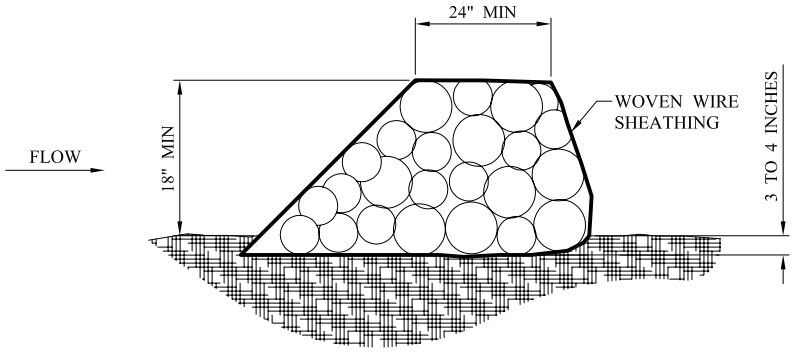
CITY OF SAN ANGELO

STRAW BALE DIKE

S-CC-2



ISOMETRIC PLAN VIEW
NOT TO SCALE



CROSS SECTION
NOT TO SCALE

ROCK BERM GENERAL NOTES:

1. USE ONLY OPEN GRADED ROCK 4-8 INCHES IN DIAMETER FOR STREAM FLOW CONDITION. USE OPEN GRADED ROCK 3-5 INCHES IN DIAMETER FOR OTHER CONDITIONS.

2. THE ROCK BERM SHALL BE SECURED WITH A WOVEN WIRE SHEATHING HAVING A MAXIMUM OPENING OF 1 INCH AND A MINIMUM WIRE SIZE OF 20 GAUGE AND SHALL BE BURIED IN A TRENCH APPROXIMATELY 3 TO 4 INCHES DEEP.

3. THE ROCK BERM SHALL BE INSPECTED EVERY TWO WEEKS OR AFTER EACH $\geq$ 1/2" RAIN EVENT AND SHALL BE REPLACED WHEN THE STRUCTURE CEASES TO FUNCTION AS INTENDED DUE TO SILT ACCUMULATION AMONG THE ROCKS, WASHOUT, CONSTRUCTION TRAFFIC DAMAGE, ETC.

4. WHEN SILT REACHES A DEPTH EQUAL TO ONE-THIRD OF THE HEIGHT OF THE BERM OR ONE FOOT, WHICHEVER IS LESS, THE SILT SHALL BE REMOVED AND DISPOSED OF PROPERLY.

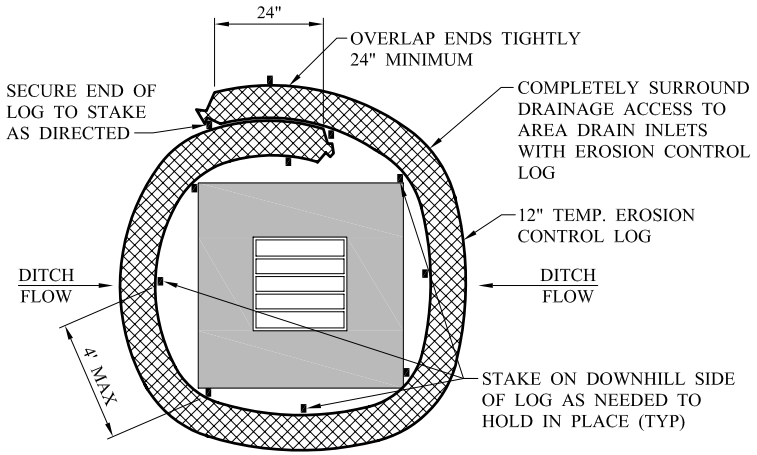
5. WHEN THE SITE IS COMPLETELY STABILIZED, THE BERM AND ACCUMULATED SILT SHALL BE REMOVED AND DISPOSED OF IN AN APPROVED MANNER.

6. ROCK BERM SHOULD BE USED AS CHECK DAMS FOR CONCENTRATED FLOW AND ARE NOT INTENDED FOR USE IN PERIMETER PROTECTION.

CITY OF SAN ANGELO

ROCK BERM

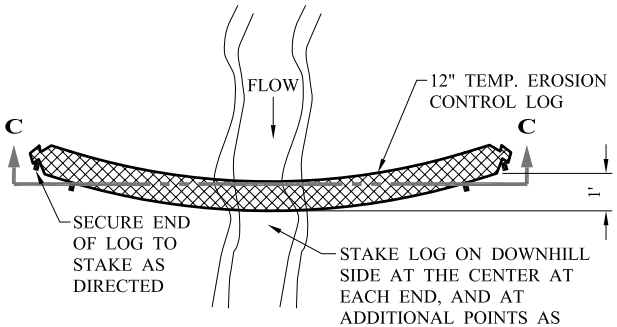
S-CC-3



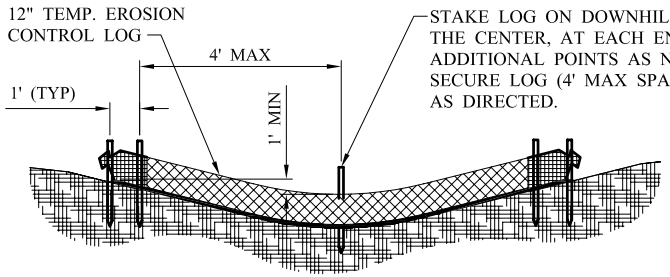
LOGS PLACED AT AREA DRAIN INLETS
NOT TO SCALE

GENERAL NOTES:

1. LENGTHS OF EROSION CONTROL LOGS SHALL BE IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND AS REQUIRED FOR THE PURPOSE INTENDED. MAXIMUM LENGTH OF LOGS SHALL BE 60' FOR 18" DIAMETER OR 30' FOR 12" DIAMETER LOGS.
2. UNLESS OTHERWISE DIRECTED, USE BIODEGRADABLE OR PHOTODEGRADABLE CONTAINMENT MESH ONLY WHERE LOG WITH REMAIN IN PLACE AS PART OF A VEGETATIVE SYSTEM. FOR TEMPORARY INSTALLATIONS, USE RECYCLABLE CONTAINMENT MESH.
3. STUFF LOGS WITH SUFFICIENT FILTER MATERIAL TO ACHIEVE DENSITY THAT WILL HOLD SHAPE WITHOUT EXCESSIVE DEFORMATION.
4. STAKES SHALL BE 2" x 2" WOOD OR T-POSTS 4' LONG, EMBEDDED SUCH THAT 2" PROTRUDES ABOVE LOG, OR AS DIRECTED.
5. DO NOT PLACE STAKES THROUGH CONTAINMENT MESH.



PLAN VIEW
NOT TO SCALE



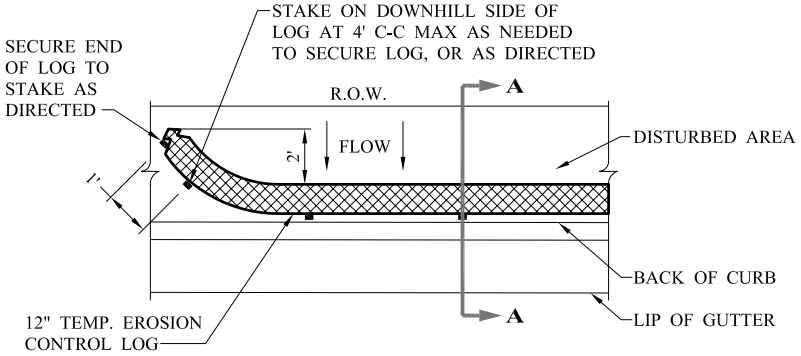
SECTION C-C
NOT TO SCALE

EROSION CONTROL LOG CHECK DAM
NOT TO SCALE

CITY OF SAN ANGELO

TEMPORARY EROSION
CONTROL LOGS

S-CC-4



PLAN VIEW
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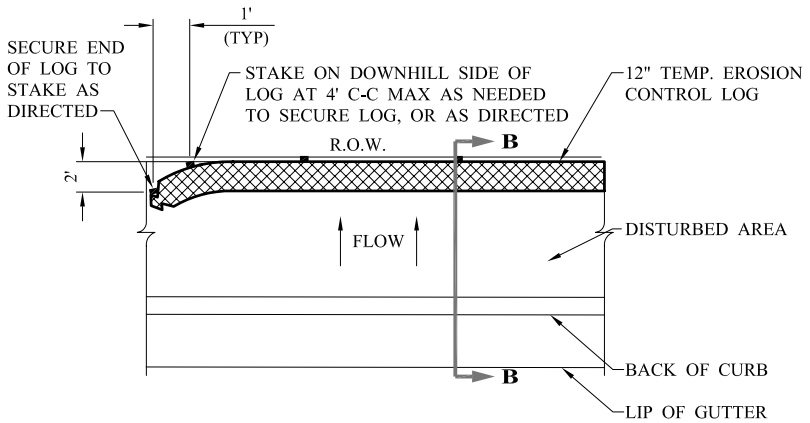

PLAN VIEW
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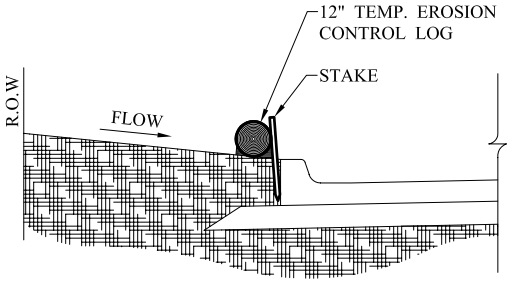
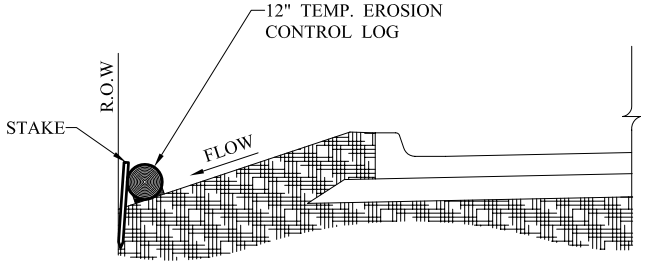


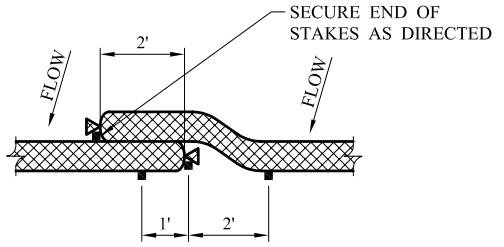
SECTION A-A

LOG PLACED AT BACK OF CURB
NOT TO SCALE



SECTION B-B

LOG PLACED AT EDGE OF RIGHT-OF-WAY
NOT TO SCALE



LAP DETAIL
NOT TO SCALE

NOTES

SEE SHEET S-CC-4 FOR GENERAL NOTES.

CITY OF SAN ANGELO

TEMPORARY EROSION
CONTROL LOGS

S-CC-5