

## 2.05 RESILIENT WATERSTOP

- A. Resilient waterstop, where called for on the Drawings, shall be either a bentonite or adhesive type material.
- B. Bentonite Waterstop:
  - 1. Material: 75 percent bentonite, mixed with butyl rubber-hydrocarbon containing less than 1.0 percent volatile matter, and free of asbestos fibers or asphaltics.
  - 2. Manufacturer's rated temperature ranges: For application, 5 to 125 degrees F; in service, -40 to 212 degrees F.
  - 3. Cross-sectional dimensions, unexpanded waterstop: One inch by 3/4 inch.
  - 4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.
- C. Adhesive Waterstop:
  - 1. Adhesive waterstop shall be at least 2 inches in diameter and shall be Synko-Flex preformed plastic adhesive waterstop by Synko-Flex Products, Inc., or equal. The waterstop shall meet or exceed requirements of Federal Specification SS-S-210A.
  - 2. The adhesive waterstop shall be supplied wrapped completely by a two part protective paper.
  - 3. The adhesive waterstop material shall have independent laboratory tests verifying that the material seals joints in concrete against leakage when subjected to a minimum of 30 psi water pressure for at least 72 hours.
  - 4. Primer, to be used on hardened concrete surfaces, shall be provided by the same manufacturer as the waterstop material.

## PART 3 EXECUTION

## 3.01 INSTALLATION

- A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for the extent of the joint; make splices necessary to provide such continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.
- B. Install waterstops in concrete on one side of joints, leaving other side exposed until the next pour. When a waterstop will remain exposed for 2 days or more, shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

**3.02 SPLICES IN WATERSTOPS**

- A. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with the manufacturer's printed instructions.
  - 1. Do not damage material by heat sealing.
  - 2. Splice tensile strength: At least 60 percent of unspliced material tensile strength.
  - 3. Maintain continuity of waterstop ribs and tubular center axis.
- B. Butt end-to-end joints of 2 identical waterstop sections may be made in the forms during placement of waterstop material.
- C. Prior to placement in formwork, prefabricate all waterstop joints involving more than 2 ends to be joined together, an angle cut, an alignment change, or the joining of 2 dissimilar waterstop sections, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon inspection and approval by the Resident Project Representative, install prefabricated waterstop joint assemblies in formwork, and butt-weld ends of the 24-inch strips to the straight-run portions of waterstop in the forms.
- D. Where a centerbulb waterstop intersects and is joined to a non-centerbulb waterstop, take care to seal the end of the centerbulb, using additional PVC material if needed.

**3.03 JOINT CONSTRUCTION**

- A. Setting Waterstops:
  - 1. Correctly position waterstops during installation. Support and anchor waterstops during progress of the work to ensure proper embedment in concrete. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.
  - 2. Flat-strip waterstop: Prevent folding over by concrete during placement. Unless otherwise shown, hold waterstops in place with wire ties on 12-inch centers passed through the waterstop edge and tied to reinforcing steel.
    - a. Horizontal waterstops (with flat face in vertical plane): Hold in place by fastening upper waterstop edge to continuous supports.
    - b. Horizontal waterstops (with flat face in horizontal plane): Work concrete under waterstops by hand to eliminate air and rock pockets.
  - 3. Place centerbulb waterstops in expansion joints centered on joint filler material.
  - 4. Where a waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to a waterstop in a future concrete placement, terminate the waterstop 6 inches below the top of the wall.

- B. **Joint Location:** Unless specifically noted otherwise, provide construction joints at 25-foot maximum spacing for concrete construction. Where joints are shown spaced greater than 40 feet apart, provide additional joints to maintain the 25-foot maximum spacing. Submit joint locations for review by the Engineer.
- C. **Joint Preparation:** Prepare surfaces in accordance with Section 03310 - Structural Concrete. Unless otherwise indicated, bonding is required at horizontal concrete joints in walls. Except on horizontal wall construction joints, wall-to-slab joints, or where otherwise shown or specified, at joints where waterstops are required, coat the joint face of the first pour with bond breaker as specified.
- D. **Replacement of Defective Field Joints:** Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying with Contract Documents.
- E. **Construction Joint Sealant:**
1. In water-bearing floor slabs and elsewhere where indicated, provide construction joints with tapered grooves filled with construction joint sealant. Leave groove-forming material in place until time grooves are cleaned and filled with joint sealant. After removing groove forms, remove laitance and fins and sand-blast the grooves. Allow grooves to dry thoroughly, then blow out, immediately prime surfaces, place bond-breaker tape in bottom of groove and fill with construction joint sealant. Use no sealant without a primer. Completely fill sealant grooves. Thoroughly clean areas designated to receive sealant, as specified for tapered grooves, prior to sealant application.
  2. Mix and install primer and sealant in accordance with manufacturer's printed instructions and recommendations. Do not coat sides of sealant groove with bond breaker, curing compound or other substance which would interfere with proper sealant bond. Allow at least 7 days for sealant to achieve final cure before filling structure with water.
  3. Thoroughly and uniformly mix 2-part catalyst-cured material.
  4. Remove and replace improperly cured sealants after the manufacturer's recommended curing time; thoroughly sandblast the groove to remove all traces of uncured or partially-cured sealant and primer, then re-prime and re-seal with specified sealant.
- F. **Resilient Waterstop:**
1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations except as otherwise indicated and specified.
  2. When requested by the Resident Project Representative, provide technical assistance by manufacturer's representative in the field at no additional cost to the Owner.
  3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.
  4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop a minimum of 6 inches and place in contact with the PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form a smooth joining surface.
  5. At the free top of walls without connecting slabs, stop the resilient waterstop and grooves (where used) 6 inches from the top in vertical wall joints.

6. Bentonite Waterstop:
  - a. Locate bentonite waterstop as near as possible to the center of the joint and extend continuous around the entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.
  - b. Where thickness of the concrete member to be placed on the bentonite waterstop is less than 12 inches, place waterstop in grooves at least 3/4 inch deep and 1-1/4 inches wide formed or ground into the concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.
  - c. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm the material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.
  - d. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth if necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using an epoxy grout which completely fills voids and irregularities beneath the waterstop material. Prior to installation, wire brush the concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.
  - e. In addition to the adhesive backing provided with the waterstop, secure bentonite waterstop in place with concrete nails and washers at 12-inch maximum spacing.
7. Adhesive Waterstop:
  - a. Thoroughly clean the concrete surface on which the waterstop is to be placed with a wire brush and coat with primer.
  - b. If the surface is too rough to allow the waterstop to form a complete contact, grind to form an adequately smooth surface.
  - c. Install the waterstop with the top protective paper left in place. Overlap joints between strips a minimum of 1 inch and cover back over with the protective paper.
  - d. Do not remove protective paper until just before final formwork completion. Concrete shall be placed immediately. The time that the waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

## G. Control Joints:

1. Where indicated, form in slabs by sawcutting, preformed plastic inserts or other means acceptable to Engineer. Minimum insert or sawcut: 1/4 slab depth.
2. Perform sawcutting during the curing period as soon as possible after concrete has reached its final set, has attained sufficient strength to support sawcutting operations without damage, and while it remains fully saturated.
3. Leave the removable portion of plastic inserts in place and protect sawcuts against damage and intrusion of foreign material until the end of the curing period and until concrete has dried sufficiently to allow sealant installation.
4. Sealant Installation: Blow foreign material from formed or sawcut space. Insert a foam backer rod to form a sealant depth equal to the width of the space but not less than 3/8 inch. Install sealant as specified elsewhere in the Contract Documents.

END OF SECTION

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## Section 03211

## REINFORCING STEEL

## PART 1 GENERAL

## 1.01 SECTION INCLUDES

- A. Structural concrete reinforcement and grouting of reinforcement dowel bars into hardened concrete.

## 1.02 UNIT PRICES

- A. No separate payment will be made for reinforcing steel or grouting that is part of the Work as bid. Include payment in unit price for structural concrete.
- B. Measurement for reinforcing steel installed as extra work is on a per-pound basis.

## 1.03 REFERENCES

- A. ACI 315 - Details and Detailing of Concrete Reinforcement.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.
- C. ASTM A 36 - Standard Specification for Structural Steel.
- D. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- E. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- F. ASTM A 497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
- G. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- H. ASTM A 675 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
- I. ASTM A 775/A 775M - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- J. ASTM C 881 - Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- K. AWS D 1.4 - Structural Welding Code - Reinforcing Steel.
- L. WRI - Manual of Standard Practice for Welded Wire Fabric.
- M. CRSI MSP-1 - Manual of Standard Practice.

REINFORCING STEEL

03211-1

IFB: 02-04-13

## 1.04 SUBMITTALS

- A. Conform to Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings:
1. Submit shop drawings detailing reinforcement fabrication, bar placement location, splices, spacing, bar designation, bar type, length, size, bending, number of bars, bar support type and other pertinent information, including dimensions. Provide sufficient detail for placement of reinforcement without use of Contract Drawings. Information shall correspond directly to data listed on bill of materials.
  2. Use of reproductions of Contract Drawings by Contractor, Subcontractor, erector, fabricator or material supplier in preparation of shop drawings (or in lieu of preparation of shop drawings) signifies acceptance by that party of information shown thereon as correct, and acceptance of obligation to pay for any job expense, real or implied, arising due to errors that may occur thereon. Remove references to Design Engineer, including seals, when reproductions of Contract Drawings are used as shop drawings.
  3. Detail shop drawings in accordance with ACI 315, Figure 6.
  4. Submit shop drawings showing location of proposed additional construction joints as required under Section 03151 - Joints in Concrete Structures, and obtain approval of Engineer, prior to submitting reinforcing steel shop drawings.
- C. Bill of Materials: Submit with shop drawings.
- D. Product Data:
1. Mechanical Bar Splices: Submit manufacturer's technical literature, including specifications and installation instructions.
  2. Epoxy grout proposed for anchoring reinforcing dowels to hardened concrete: Submit manufacturer's technical literature including recommended installation procedures.
- E. Certificates:
1. Submit steel manufacturer's certificates of mill tests giving properties of steel proposed for use. List manufacturer's test number, heat number, chemical analysis, yield point, tensile strength and percentage of elongation. Identify proposed location of steel in work.
  2. Foreign-manufactured reinforcing bars shall be tested for conformance to ASTM requirements by a certified independent testing laboratory located in United States. Certification from any other source is not acceptable. Submit test reports for review. Do not begin fabrication of reinforcement until material has been approved.

## 1.05 HANDLING AND STORAGE

- A. Store steel reinforcement above ground on platforms, skids or other supports. Protect reinforcing from mechanical injury, surface deterioration and formation of excessive, loose or flaky rust caused by exposure to weather. Protect epoxy-coated reinforcing from formation of any amount of rust.

## 1.06 QUALITY ASSURANCE

- A. Notify Resident Project Representative at least 48 hours before concrete placement so that reinforcement may be inspected, and errors corrected, without delaying Work.

## PART 2 PRODUCTS

## 2.01 MATERIAL

- A. Reinforcing Bars: Deformed bars conforming to ASTM A 615, grade as indicated on Drawings, except column spirals and those shown on Drawings to be smooth bars. Where grade is not shown on Drawings, use Grade 60.
- B. Smooth Bars: Where indicated on Drawings, use smooth bars conforming to ASTM A 36; ASTM A 615, Grade 60; or ASTM A 675, Grade 70.
- C. Column Spirals: Bars conforming to ASTM A 615, Grade 60, or wire conforming to ASTM A 82.
- D. Epoxy-Coated Deformed Bars, Column Spirals and Smooth Bars: Conform to ASTM A 775/A 775M.
- E. Welded Wire Fabric:
  - 1. Welded Smooth Wire Fabric: Conform to ASTM A 185.
  - 2. Welded Deformed Wire Fabric: Conform to ASTM A 497.
  - 3. Provide wire size, type and spacing as shown. Where type is not shown on Drawings, use welded smooth wire fabric.
  - 4. Furnish welded wire fabric in flat sheets only.
- F. Tie Wire: 16-1/2 gage or heavier annealed steel wire. Use plastic-coated tie wire with epoxy-coated reinforcing steel.
- G. Bar Supports: Provide chairs, riser bars, ties and other accessories made of plastic or metal, except as otherwise specified. Use bar supports and accessories of sizes required to provide required concrete cover. Where concrete surfaces are exposed to weather, water or wastewater, provide plastic accessories only; do not use galvanized or plastic-tipped metal in such locations. Provide metal bar supports and accessories rated Class 1 or 2 conforming to CRSI MSP-1 Manual of Standard Practice. Use epoxy-coated bar supports with epoxy-coated reinforcing bars.

- H. Slabs on Grade: Provide chairs with sheet metal bases or provide precast concrete bar supports 3 inches wide, 6 inches long, and thick enough to allow required cover. Embed tie wires in 3-inch by 6-inch side.
- I. Mechanical Bar Splices:
1. Conform to ACI 318; use where indicated on Drawings.
    - a. Compression splices shall develop ultimate stress of reinforcing bar.
    - b. Tension splices shall develop 125 percent of minimum yield point stress of reinforcing bar.
  2. Regardless of chemical composition of steel, any heat effect shall not adversely affect performance of reinforcing bar.
- J. Welded Splices:
1. Provide welded splices where shown and where approved by the Engineer. Welded splices of reinforcing steel shall develop a tensile strength exceeding 125 percent of the yield strength of the reinforcing bars connected.
  2. Provide materials for welded splices conforming to AWS D1.4.
- K. Epoxy Grout: High-strength rigid epoxy adhesive, conforming to ASTM C 881, Type IV, manufactured for purpose of anchoring dowels into hardened concrete and the moisture condition, application temperature and orientation of the hole to be filled. Unless otherwise shown, depth of embedment shall be as required to develop the full tensile strength (125 percent of yield strength) of dowel, but not less than 12 diameters.

## 2.02 FABRICATION

- A. Bending: Fabricate bars to shapes indicated on Drawings by cold bending. Bends shall conform to minimum bend diameters specified in ACI 318. Do not straighten or rebend bars. Fabricate epoxy-coated reinforcing steel to required shapes in a manner that will not damage epoxy coating. Repair any damaged epoxy coating with patching material conforming to Item 4.4 of ASTM A 775/A 775M.
- B. Splices:
1. Locate splices as indicated on Drawings. Do not locate splices at other locations without approval of Engineer. Use minimum number of splices located at points of minimum stress. Stagger splices in adjacent bars.
  2. Length of lap splices: As shown on Drawings.
  3. Prepare ends of bars at mechanical splices in accordance with splice manufacturer's requirements.
- C. Construction Joints: Unless otherwise shown, continue reinforcing through construction joints.
- D. Bar Fabrication Tolerances: Conform to tolerances listed in ACI 315, Figures 4 and 5.
- E. Standard Hooks: Conform to the requirements of ACI 318.

REINFORCING STEEL

03211-4

IFB: 02-04-13

- F. Marking: Clearly mark bars with waterproof tags showing number of bars, size, mark, length and yield strength. Mark steel with same designation as member in which it occurs.

### PART 3 EXECUTION

#### 3.01 PREPARATION

- A. Clean reinforcement of scale, loose or flaky rust and other foreign material, including oil, mud or coating that will reduce bond to concrete.

#### 3.02 INSTALLATION

- A. Placement Tolerances: Place reinforcement within tolerances of Table 03210A at the end of this Section. Bend tie wire away from forms to maintain the specified concrete coverage.
- B. Interferences: Maintain 2-inch clearance from embedded items. Where reinforcing interferes with location of other reinforcing steel, conduit or embedded items, bars may be moved within specified tolerances or one bar diameter, whichever is greater. Where greater movement of bars is required to avoid interference, notify Engineer. Do not cut reinforcement to install inserts, conduit, mechanical openings or other items without approval of Engineer.
- C. Concrete Cover: Provide clear cover measured from reinforcement to face of concrete as listed in Table 03210B at the end of this Section, unless otherwise indicated on Drawings.
- D. Placement in Forms: Use spacers, chairs, wire ties and other accessory items necessary to assemble, space and support reinforcing properly. Provide accessories of sufficient number, size and strength to prevent deflection or displacement of reinforcement due to construction loads or concrete placement. Use appropriate accessories to position and support bolts, anchors and other embedded items. Tie reinforcing bars at each intersection, and to accessories. Blocking reinforcement with concrete or masonry is prohibited.
- E. Placement for Concrete on Ground: Support bar and wire reinforcement on chairs with sheet metal bases or precast concrete blocks spaced at approximately 3 feet on centers each way. Use minimum of one support for each 9 square feet. Tie supports to reinforcing bars and wires.
- F. Vertical Reinforcement in Columns: Offset vertical bars by at least one bar diameter at splices. Provide accurate templates for column dowels to ensure proper placement.
- G. Splices:
  - 1. Do not splice bars, except at locations indicated on Drawings or reviewed shop drawings, without approval of Engineer.
  - 2. Lap Splices: Unless otherwise shown or noted, Class B, conforming to ACI 318-89, Section 12.15.1. Tie securely with wire prior to concrete placement, to prevent displacement of splices during concrete placement.
  - 3. Mechanical Bar Splices: Use only where indicated on Drawings or approved by the Engineer. Install in accordance with manufacturer's instructions.

- a. Couplers located at a joint face shall be of a type which can be set either flush or recessed from the face as shown. Seal couplers prior to concrete placement to completely eliminate concrete or cement paste from entering.
  - b. Couplers intended for future connections: Recess 1/2 inch minimum from concrete surface. After concrete is placed, plug coupler and fill recess with sealant to prevent contact with water or other corrosive materials.
  - c. Unless noted otherwise, match mechanical coupler spacing and capacity to that shown for the adjacent reinforcing.
- H. Construction Joints: Place reinforcing continuous through construction joints, unless noted otherwise.
- I. Welded Wire Fabric: Install wire fabric in as long lengths as practicable. Unless otherwise indicated on Drawings, lap adjoining pieces at least 6 inches or one full mesh plus 2 inches, whichever is larger. Lace splices with wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps. Conform to WRI - Manual of Standard Practice for Welded Wire Fabric.
- J. Field Bending: Shape reinforcing bent during construction operations to conform to Drawings. Bars shall be cold-bent; do not heat bars. Closely inspect reinforcing for breaks. When reinforcing is damaged, replace, Cadweld, or otherwise repair, as directed by Engineer. Do not bend reinforcement after it is embedded in concrete.
- K. Epoxy-coated Reinforcing Steel: Install in accordance with Paragraph 3.02J, Field Bending, and in a manner that will not damage epoxy coating. Repair damaged epoxy coating with patching material as specified in Paragraph 2.02A, Bending.
- L. Field Cutting: Cut reinforcing bars by shearing or sawing. Do not cut bars with cutting torch.
- M. Welding of reinforcing bars is prohibited, except where shown on Drawings.

### 3.03 GROUTING OF REINFORCING AND DOWEL BARS

- A. Use epoxy grout for anchoring reinforcing and dowel steel to existing concrete in accordance with epoxy manufacturer's instructions. Drill hole not more than 1/4 inch larger than steel bar diameter (including height of deformations for deformed bars) in existing concrete. Just before installation of steel, blow hole clean of all debris using compressed air. Partially fill hole with epoxy, using enough epoxy so when steel bar is inserted, epoxy grout will completely fill hole around bar. Dip end of steel bar in epoxy and twist bar while inserting into partially-filled hole.

Table 03210A  
REINFORCEMENT PLACEMENT TOLERANCES

PLACEMENT	TOLERANCE IN INCHES
Clear Distance - To formed soffit: To other formed surfaces: Minimum spacing between bars:	-1/4 "1/4 -1/4
Clear distance from unformed surface to top reinforcement - Members 8 inches deep or less: Members more than 8 inches deep but less than 24 inches deep: Members 24 inches deep or greater: Uniform spacing of bars (but the required number of bars shall not be reduced): Uniform spacing of stirrups and ties (but the required number of stirrups and ties shall not be reduced):	"1/4 -1/4, +1/2 -1/4, +1 "2 "1
Longitudinal locations of bends and ends of reinforcement - General: Discontinuous ends of members: Length of bar laps:	"2 "1/2 -1-1/2
Embedded length - For bar sizes No. 3 through 11: For bar sizes No. 14 and 18:	-1 -2

Table 03210B  
 MINIMUM CONCRETE COVER FOR REINFORCEMENT

SURFACE	MINIMUM COVER IN INCHES
Slabs and Joists - Top and bottom bars for dry conditions - No. 14 and No. 18 bars: No. 11 bars and smaller:	1-1/2 1
Formed concrete surfaces exposed to earth, water or weather; over, or in contact with, sewage; and for bottoms bearing on work mat, or slabs supporting earth cover - No. 5 bars and smaller: No. 6 through No. 18 bars:	1-1/2 2
Beams and Columns - For dry conditions - Stirrups, spirals and ties: Principal reinforcement: Exposed to earth, water, sewage or weather - Stirrups and ties: Principal reinforcement:	1-1/2 2 2 2-1/2
Walls - For dry conditions - No. 11 bars and smaller: No. 14 and No. 18 bars: Formed concrete surfaces exposed to earth, water, sewage or weather, or in contact with ground - Circular tanks with ring tension: All others:	1 1-1/2 2 2
Footings and Base Slabs - At formed surfaces and bottoms bearing on concrete work mat: At unformed surfaces and bottoms in contact with earth: Over top of piles: Top of footings -- same as slabs	2 3 2

END OF SECTION

## Section 03310

## STRUCTURAL CONCRETE

## PART 1 GENERAL

## 1.01 SECTION INCLUDES

- A. Cast-in-place normal-weight structural concrete and mass concrete.

## 1.02 UNIT PRICES

- A. Measurement for structural concrete is on lump-sum basis for each structure as bid. Payment includes related work performed on these structures in accordance with related sections of these Specifications.
- B. Measurement for extra structural concrete is on cubic-yard basis. Payment includes related work performed in accordance with related sections.

## 1.03 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 304.2R - Placing Concrete by Pumping Methods
- C. ACI 305R - Hot Weather Concreting.
- D. ACI 306.1 - Standard Specification for Cold Weather Concreting.
- E. ACI 309R - Guide for Consolidation of Concrete.
- F. ACI 315 – Manual of Standard Practice for Detailing Reinforced Concrete Structures.
- G. ACI 318 - Building Code Requirements for Reinforced Concrete.
- H. ACI 347 – Recommended Practice for Concrete Formwork.
- I. ACI 350R - Environmental Engineering Concrete Structures.
- J. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- K. ASTM C 33 - Standard Specification for Concrete Aggregates.
- L. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- M. ASTM C 42 - Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- N. ASTM C 88 - Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- O. ASTM C 94 - Standard Specifications for Ready-Mixed Concrete.

STRUCTURAL CONCRETE

03310-1

IFB: 02-04-13

- P. ASTM C 127 - Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
- Q. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- R. ASTM C 136 - Sieve Analyses of Fine and Coarse Aggregates.
- S. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- T. ASTM C 150 - Standard Specification for Portland Cement.
- U. ASTM C 157 - Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.
- V. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.
- W. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
- X. ASTM C 192 - Method of Making and Curing Concrete Test Specimens in the Laboratory.
- Y. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- Z. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- AA. ASTM C 330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
- BB. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
- CC. ASTM C 535 - Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- DD. ASTM C 567 - Standard Test Method for Unit Weight of Structural Lightweight Concrete.
- EE. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
- FF. Concrete Plant Manufacturer's Bureau (CPMB), Plant Mixer Manufacturers Division: Concrete Plant Mixer Standards.
- GG. National Ready-Mixed Concrete Association (NRMCA): Certification of Ready-Mixed Concrete Production Facilities (checklist with instructions).
- HH. John Wiley and Sons, Interscience Publishers Division, "Encyclopedia of Industrial Chemical Analysis," Vol. 15, Page 230 (alkalinity test procedure).

#### 1.04 DEFINITIONS

- A. Mass Concrete: Concrete sections 4 feet or more in least dimension.
- B. Hot Weather: Any combination of high air temperature, low relative humidity and wind velocity tending to impair quality of fresh or hardened concrete or otherwise resulting in abnormal properties.

STRUCTURAL CONCRETE

03310-2

IFB: 02-04-13

- C. Cold Weather: Period when, for more than 2 successive days, mean daily temperature is below 40 degrees F.
- 1.05 SUBMITTALS
- A. Conform to Section 01 33 00 - Submittals.
- B. Provide copy of current Texas Department of Transportation (TxDOT) Plant Certification.
- C. Mill Certificates: Required for bulk cement.
- D. Design Mixes:
1. Submit test data on proposed design mixes for each type of concrete in the Work, including each class, and variations in type, source or quantity of material. Include type, brand and amount of cementitious materials; type, brand and amount of each admixture; slump; air content; aggregate sources, gradations, specific gravity and absorption; total water (including moisture in aggregate); water/cement ratio; compressive strength test results for 7 and 28 days; and shrinkage tests for Class C and D concrete at 21 or 28 days of drying.
  2. Submit abrasion loss and soundness test results for limestone aggregate.
  3. A certified independent testing laboratory shall perform testing of aggregates, including sieve analysis. Tests shall have been performed no earlier than 3 months before Notice to Proceed.
  4. Provide standard deviation data for plant producing concrete. Data shall include copies of laboratory test results and standard deviation calculated in accordance with ACI 318, Item 5.3.1. Laboratory tests shall have been performed within past 12 months. When standard deviation data is not available, comply with ACI 318, Table 5.3.2.2.
  5. Review and acceptance of mix design does not relieve Contractor of responsibility to provide concrete of quality and strength required by these Specifications.
- E. Admixtures: Submit manufacturer's technical information, including following:
1. Air-Entraining Admixture: Give requirements to control air content under all conditions, including temperature variations and presence of other admixtures.
  2. Chemical Admixtures: Give requirements for quantities and types to be used under various temperatures and job conditions to produce uniform, workable concrete mix. Submit evidence of compatibility with other admixtures and cementitious materials proposed for use in design mix.
- F. High-range Water Reducer (Superplasticizer): When proposed for use, submit manufacturer's technical information and instructions for use of superplasticizer. State whether superplasticizer will be added at ready-mix plant or job site. When superplasticizer will be added at job site, submit proposed plan for measuring and adding superplasticizer to concrete mix at job site, and establish dosing area on site with holding tanks and metering devices. When superplasticizer is to be added at ready-mix plant, submit contingency plans for adding additional superplasticizer at job site when required due to delay in placing concrete. Identify portions of Work on which superplasticizer is proposed for use.
- G. Hot and Cold Weather Concreting: Submit, when applicable, proposed plans for hot and cold weather concreting. Review and acceptance of proposed procedure will not relieve Contractor

of responsibility for quality of finished product.

- H. Bar Lists and Placement Drawings: Submit detailed information, including the following:
1. Bar Lists: Schedules of reinforcing steel showing bar marking, quantities, size, shape, dimensions, bend pattern, bar support types, sizes, shapes spacing, and sequence. Bar lists shall be submitted with reinforcing bar fabricator's standard bend pattern chart. Bar lists shall be printed on placement drawings.
  2. Placement Drawings: Detailed drawings for the reinforcing bars in reinforced concrete shall be submitted for each structure. The drawings shall clearly show the number of bars, bar length, bar position, and bar mark with respect to bar lists. The drawings may also show bar support layouts and placing sequences. Drawings shall be to a field useable scale.
- I. Project Record Drawings: Accurately record actual locations of embedded utilities and components that are concealed from view.

#### 1.06 QUALITY ASSURANCE

- A. Provide necessary controls during evaluation of materials; mix designs, production and delivery of concrete, placement and compaction to assure that the Work will be accomplished in accordance with Contract Documents. Maintain records of concrete placement. Record dates, locations, quantities, air temperatures, and test samples taken.
- B. The concrete mixing plant shall be certified to supply concrete to TxDOT.
- C. Code Requirements: Concrete construction for buildings shall conform to ACI 318. Concrete construction for water and wastewater treatment and conveying structures shall conform to ACI 318 with modifications by ACI 350R, Item 2.6. Where this Specification conflicts with ACI 318 or ACI 350R, this Specification governs.
- D. Testing and Other Quality Control Services:
1. Concrete testing required in this section, except concrete mix design, limestone aggregate test data, and testing of deficient concrete, will be performed by an independent commercial testing laboratory in accordance with Section 01454 - Testing Laboratory Services.
  2. Provide material for and cooperate fully with testing laboratory technician in obtaining samples for required tests.
  3. Standard Services: The following testing and quality control services will be provided in accordance with Section 01454, Testing Laboratory Services:
    - a. Verification that plant equipment and facilities conform to NRMCA "Certification of Ready-Mix Concrete Production Facilities".
    - b. Testing of proposed materials for compliance with this Specification.
    - c. Review of proposed mix design submitted by Contractor.
    - d. Obtaining production samples of materials at plants or stockpiles during work progress and testing for compliance with this Specification.
    - e. Strength testing of concrete according to following procedures:

STRUCTURAL CONCRETE

03310-4

IFB: 02-04-13

- (1) Obtaining samples for field test cylinders from every 100 cubic yards and any portion less than 50 cubic yards for each mix design placed each day, according to ASTM C 172, with each sample obtained from a different batch of concrete on a representative, random basis. Selecting test batches by any means other than random numbers chosen before concrete placement begins is not allowed.
  - (2) Molding four specimens from each sample according to ASTM C 31, and curing under standard moisture and temperature conditions as specified in Sections 7(a) and (b) of ASTM C 31.
  - (3) Testing two specimens at 7 days and two specimens at 28 days according to ASTM C 39, reporting test results averaging strengths of two specimens. However, when one specimen evidences improper sampling, molding or testing, it will be discarded and remaining cylinder considered test result. When high-early-strength concrete is used, specimens will be tested at 3 and 7 days.
- f. Air content: For each strength test, determination of air content of normal weight concrete according to ASTM C 231.
- g. Slump: For each strength test, and whenever consistency of concrete appears to vary, conducting slump test in accordance with ASTM C 143.
- h. Temperature: For each strength test, checking concrete temperature in accordance with ASTM C 1064.
- i. Lightweight concrete: For each strength test, or more frequently when requested by Engineer, determination of air content by ASTM C 567 and unit weight by ASTM C 567.
- j. Monitoring of current and forecasted climatic conditions to determine when rate of evaporation, as determined by Figure 2.1.5 of ACI 305R, will produce loss of 0.2 pounds of water, or more, per square foot per hour. Testing lab representative will advise Contractor to use hot weather precautions when such conditions will exist during concrete placement, and note on concrete test reports when Contractor has been advised that hot weather conditions will exist.
- k. Class A and D Concrete Shrinkage Tests: Performance of drying shrinkage tests for trial batches as follows:
- (1) Preparation and Testing of Specimens: Compression and drying shrinkage test specimens will be taken in each case from the same concrete sample; shrinkage tests will be considered a part of the normal compression tests for the project. 4-inch by 4-inch by 11-inch prisms with an effective gage length of 10 inches, fabricated, cured, dried and measured in accordance with ASTM C 157, modified as follows:
    - (a) Wet curing: Remove specimens from molds at an age of 23 hours "1 hour after trial batching and immediately immerse in water at 70 degrees F "3 degrees F for at least 30 minutes;
    - (b) Measure within 30 minutes after first 30 minutes of immersion to determine original length (not to be confused with "base length");
    - (c) Then submerge in saturated limewater, at 73 degrees F "3 degrees F, for 7 days;

STRUCTURAL CONCRETE

03310-5

IFB: 02-04-13

- (d) Then measure at age 7 days to establish "base length" for drying shrinkage calculations ("zero" days drying age);
  - (e) Calculate expansion (base length expressed as a percentage of original length);
  - (f) Immediately store specimens in a temperature- and humidity-controlled room maintained at 73 degrees F, +3 degrees F and 50 percent +4 percent relative humidity, for the remainder of the test.
  - (g) Measure to determine shrinkage, expressed as percentage of base length. Compute the drying shrinkage deformation of each specimen as the difference between the base length (at "zero" days drying age) and the length after drying at each test age. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, disregard the results obtained from that specimen. Report results of shrinkage tests to the nearest 0.001 percent of shrinkage.
  - (h) Report shrinkage separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.
4. Additional Testing and Quality Control Services: The following will be performed by an independent commercial testing laboratory in accordance with Section 01454, Testing Laboratory Services, when requested by the Resident Project Representative.
- a. Checking of batching and mixing operations.
  - b. Review of manufacturer's report of each cement shipment and conducting laboratory tests of cement.
  - c. Molding and testing reserve 7-day cylinders or field cylinders.
  - d. Conducting additional field tests for slump, concrete temperature and ambient temperature.
  - e. Alkalinity Tests: For concrete used in sanitary structures, one test for each structure. Perform alkalinity tests on concrete covering reinforcing steel on the inside of the pipe or structure in accordance with "Encyclopedia of Industrial Chemical Analysis," Vol. 15, page 230.
5. Contractor shall provide the following testing and quality control services:
- a. Employ an independent commercial testing laboratory, acceptable to Owner, to prepare and test design mix for each class of concrete for which material source has been changed.
  - b. Notify commercial testing laboratory employed by Owner 24 hours prior to placing concrete.
6. Testing of deficient concrete in place:
- a. When averages of three consecutive strength test results fail to equal or exceed specified strength, or when any individual strength test result falls below

STRUCTURAL CONCRETE

03310-6

IFB: 02-04-13

specified strength by more than 500 psi, strength of concrete shall be considered potentially deficient and core testing, structural analysis or load testing may be required by Engineer.

- b. When concrete in place proves to be deficient, Contractor shall pay costs, including costs due to delays, incurred in providing additional testing and analysis services provided by the Engineer, or the independent commercial testing laboratory selected by the Owner.
- c. Replace concrete work judged inadequate by core tests, structural analysis or load tests at no additional cost to the Owner.
- d. Core Tests:
  - (1) Obtain and test cores in accordance with ASTM C 42. Where concrete in structure will be dry under service conditions, air dry cores (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for 7 days before test; test dry. Where concrete in structure will be more than superficially wet under service conditions, test cores after moisture conditioning in accordance with ASTM C 42.
  - (2) Take at least three representative cores from each member or area of concrete in place that is considered potentially deficient. Location of cores shall be determined by Engineer so as to least impair strength of structure. When, before testing, one or more cores shows evidence of having been damaged during or after removal from structure, replace the damaged cores.
  - (3) Concrete in area represented by core test will be considered adequate when average strength of cores is equal to at least 85 percent of specified strength, and when no single core is less than 75 percent of specified strength.
  - (4) Patch core holes in accordance with Section 03350 - Concrete Finishing.
- e. Structural Analysis: When core tests are inconclusive or impractical to obtain, Engineer may perform additional structural analysis at Contractor's expense to confirm safety of structure.
- f. Load Tests: When core tests and structural analysis do not confirm safety of structure, load tests may be required, and their results evaluated, in accordance with ACI 318.
- g. Testing by impact hammer, sonoscope, probe penetration tests (Windsor probe), or other nondestructive device may be permitted by Engineer to determine relative strengths at various locations in structure, to evaluate concrete strength in place, or for selecting areas to be cored. However, such tests, unless properly calibrated and correlated with other test data, shall not be used as basis for acceptance or rejection of structure's safety.

#### 1.07 STORAGE AND HANDLING OF MATERIALS

- A. Cement: Store cement in weather tight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set. When there is any doubt as to

STRUCTURAL CONCRETE

03310-7

IFB: 02-04-13

expansive potential of shrinkage-compensating cements because of method or length of storage and exposure, laboratory test cement before use.

- B. **Aggregate:** Arrange and use aggregate stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3 feet in thickness. Complete each layer before next is started.
- C. **Fine Aggregate:** Before using, allow fine aggregate to drain until uniform moisture content is reached.
- D. **Admixtures:** Store admixtures to avoid contamination, evaporation or damage. For those used in form of suspensions or non-stable solutions, provide suitable agitating equipment to assure uniform distribution of ingredients. Protect liquid admixtures from freezing and other temperature changes that would adversely affect their characteristics.
- E. **Lightweight Aggregates:** Uniformly pre-dampen lightweight aggregates as necessary to prevent excessive variations in moisture content. Allow pre-dampened aggregates to remain in stockpiles, under continuous fog spray, for minimum of 24 hours before use. Provide adequate drainage in stockpile areas to eliminate excess water and accumulation of contaminated fines.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. **Cement:**
  - 1. Use same brand of cement used in concrete mix design. Use only one brand of each type in each structure, unless otherwise indicated on Drawings.
  - 2. **Portland Cement:** ASTM C 150, Type I or Type II, gray in color. Use Type III only when specifically authorized by Engineer in writing. Use Type II, including the requirements of Table 2, in construction of liquid-containing structures and cooling towers, unless shown otherwise on Drawings.
- B. **Admixtures:** The use of chemical admixtures is not an acceptable substitute for proper mix proportioning, mix material quality control, or handling of wet concrete. If, based on site-specific project conditions, the Contractor deems that there is no practical alternative to meet the required quality constraints of this Section, he may request permission to use admixtures. Requests shall be made in writing and submitted to the Engineer for approval. Requests shall contain sufficient information to determine whether or not a change in the mix design is warranted. Submission of a request is not an approval. Each proposed addition of chemical admixture(s) must be approved by the Engineer prior to use. Proposed admixtures must be within the following constraints:
  - 1. Do not use calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions.
  - 2. **Air-Entraining Admixtures:** ASTM C 260, compatible with other admixtures used.
  - 3. **Chemical Admixtures:** Polymer type, non-staining, chloride-free admixtures conforming to ASTM C 494, Type A, C, D or E.
  - 4. **High-Range Water Reducer (Superplasticizer):** ASTM C 494, Type F or G, compatible with and by the same manufacturer as other admixtures.

STRUCTURAL CONCRETE

03310-8

IFB: 02-04-13

- C. **Mixing Water:** Use clean, potable water, free from harmful amounts of oils, acids, alkalis or other deleterious substances, meeting requirements of ASTM C 94.
- D. **Aggregates:** Use coarse aggregate from only one source, and fine aggregate from only one source, for exposed concrete in any single structure.
1. **Coarse Aggregate:** Gravel, crushed gravel or crushed limestone conforming to ASTM C 33.
  2. **Fine Aggregate:** Natural sand complying with ASTM C 33.
  3. **Limestone aggregate shall conform to ASTM C 33 and the following additional requirements:** Clean, hard, strong and durable particles free of chemicals and coatings of silt, clay, or other fine materials that may affect hydration and bond of cement paste. **Select crushed limestone:** High-calcium limestone (minimum 95 percent CaCO<sub>3</sub> and maximum 3.5 percent MgCO<sub>3</sub>) with maximum Los Angeles Abrasion loss of 38 percent, when tested in accordance with ASTM C 131 or ASTM C 535. Test aggregate for soundness in accordance with ASTM C 88; maximum loss shall not exceed 18 percent after 5 cycles of magnesium sulfate test.
  4. **Maximum size of coarse aggregate:**
    - a. Normal weight concrete, except as noted below: 1-1/2 inches.
    - b. Formed members 6 inches or less in least dimension: 1/5 least dimension.
    - c. Slabs: 1/3 depth of slab.
    - d. Drilled shafts: 1/3 clearance between reinforcing steel, but not greater than 3/4 inch.
    - e. Concrete fill, seal slabs and bonded concrete topping in clarifiers: 3/8 inch.
  5. **Coarse aggregate for lightweight concrete:** ASTM C 330. Grading limits: 3/4 inch to No. 4.
  6. **Abrasive Aggregate:** Conform to requirements of Section 03350 - Concrete Finishing.
- E. **Calcium Chloride:** Not permitted.
- F. **Evaporation Retardant:** Masterbuilders "Confilm", Euclid "Euco-bar", or equal.
- G. **Miscellaneous Materials:**
1. **Bonding Agent:** Two-component modified epoxy resin.
  2. **Vapor barrier:** 6 mil clear polyethylene film of type recommended for below-grade application.
  3. **Non-shrink grout:** premixed compound consisting of non-metallic aggregate, cement and water-reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

## 2.02 CONCRETE MIX

- A. Objective: Select proportions of ingredients to produce concrete having proper placeability, durability, strength, appearance, and other specified properties.
- B. Mix Design: Employ and pay an independent commercial testing laboratory, acceptable to Owner, to prepare and test mix designs for each type of concrete specified. Proportion mix design ingredients by weight. Submit mix designs and test results for approval.
1. During the trial batches, aggregate proportions may be adjusted by the testing laboratory using two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor. Concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the Contractor's preliminary mix design, or whether the proportions have been adjusted during the trial batch process. Prepare trial batches using the aggregates, cement and admixtures proposed for the project. Make trial batches large enough to obtain 3 drying shrinkage test specimens and 6 compression test specimens from each batch. Shrinkage testing is required only for Class A and D concrete.
  2. Determine compressive strength by testing 6-inch diameter by 12-inch high cylinders, made, cured and tested in accordance with ASTM C 192 and ASTM C 39. Test 3 compression test cylinders at 7 days and 3 at 28 days. Average compressive strength for the 3 cylinders tested at 28 days for any given trial batch shall be not less than 125 percent of the specified compressive strength.
  3. Perform sieve analysis of the combined aggregate for each trial batch according to of ASTM C 136. Report percentage passing each sieve.
  4. In mix designs for Class A and D concrete, fine aggregate shall not exceed 41 percent of total aggregate by weight.
- C. Shrinkage Limitations, Class A and D Concrete
1. Maximum concrete shrinkage for specimens cast in the laboratory from the trial batch: 0.036 percent as measured at 21-day drying age, or 0.042 percent at 28-day drying age. Use for construction only mix designs that meet trial batch shrinkage requirements. Shrinkage limitations apply only to Class A and D concrete.
  2. Maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.
  3. If the required shrinkage limitation is not met during construction, take any or all of the following actions, at no additional cost to the Owner, for securing the specified shrinkage requirements: Changing the source or aggregates, cement or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or its effects.
- D. Selecting Ingredient Proportions for Concrete:
1. Proportion concrete mix according to ACI 301, Chapter 3.

- 2. Establish concrete mix design by laboratory trial batches prepared by independent testing laboratory, or on basis of previous field experience in accordance with provisions of ACI 318, Item 5.3; however, minimum cement content for each class of concrete shall not be less than specified.
  - 3. Concrete mix design data submitted for review shall have average 28-day compressive strength calculated in accordance with ACI 318, Item 5.3.2.1. When data is not available to determine standard deviation in accordance with ACI 318, Item 5.3.1, average 28-day strength of mix design shall conform to ACI 318, Table 5.3.2.2.
- E. Water-Cement Ratios:
- 1. Maximum allowable water-cement ratios shall be as follows:
    - a. Concrete for liquid-containing structures: 0.45.
    - b. Concrete subjected to brackish water, salt spray or deicers: 0.40.
    - c. All other concrete: 0.55.
  - 2. Superplasticizer may be added to maintain specified maximum water-cement ratios. Include free water in aggregate in water-cement ratio computations.
- F. Adjustment of Mix Proportions: After sufficient data becomes available during construction, mix may be adjusted upon approval of Engineer, in accordance with ACI 318, Item 5.5; however, minimum cement content for each class of concrete shall not be less than specified.
- G. Entrained Air: Air-entrain all concrete except drilled shafts. Total air content in accordance with ASTM C 173: 4 to 6 percent.
- H. Consistency, Workability, and Slump:
- 1. The quantity of water in a batch of concrete shall be just sufficient, with a normal mixing period, to produce concrete which can be worked properly into place without segregation, and which can be compacted by vibratory methods as specified, to give the desired strength, density, impermeability and smoothness of surface. Change the quantity of water as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. Determine the consistency of the concrete in successive batches by slump tests in accordance with ASTM C 143. Slumps shall be as follows:

<u>Concrete Type</u>	<u>Minimum Slump</u>	<u>Maximum Slump</u>
Portland Cement Concrete:	2"	4"
Concrete to be dosed with superplasticizer:	1"	3"
Normal Weight Concrete after dosing with superplasticizer:	4"	9"
Lightweight Concrete after dosing with superplasticizer:	4"	7"
Drilled Shaft Concrete:	4"	8"

\* Minimum slump where drilled shafts are cast in temporary casings: 5 inches.

- 2. Specified slump shall apply at time when concrete is discharged at job site. Perform slump tests to monitor uniformity and consistency of concrete delivered to job site;

STRUCTURAL CONCRETE

03310-11

IFB: 02-04-13

however, do not use as basis for mix design. Do not exceed water-cement ratios specified.

- I. Admixtures: Proportion admixtures according to manufacturer's recommendations. Use of accelerator is permitted when air temperature is less than 40 degrees F. Use of retarder is permitted when temperature of placed concrete exceeds 65 degrees F.
- J. High-Range Water Reducers (Superplasticizers): When approved by the Engineer, use superplasticizer to improve workability of concrete or delay hydration of cement, in accordance with requirements and recommendations of product manufacturer and approved submittals. Superplasticizers will not be added at the ready-mix plant. When superplasticizer is added, it will be done in accordance with the plan approved by the Engineer for measuring and adding the superplasticizer to the concrete mix at the job site.

K. Concrete Classification and Strength:

- 1. Strength: Conform to values for class of concrete indicated on Drawings for each portion of Work. Requirements are based on 28-day compressive strength. If high early-strength concrete is allowed, requirements are based on 7-day compressive strength.

2. Classification:

<u>Class (Normal-weight)</u>	<u>Minimum 28-Day Compressive Strength (psi)</u>	<u>Minimum Cement Content Pounds per Cubic Yard</u>
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Concrete for Structures Containing Water or Wastewater

A	4000	564 (6 Sacks)
B	1500	329 (3-1/2 Sacks)
C	3000	470 (5 Sacks)
D	5000	658 (7 Sacks)
H	3000	611 (6-1/2 Sacks)

<u>Class (Normal-weight)</u>	<u>Minimum 28-Day Compressive Strength (psi)</u>	<u>Minimum Cement Content Pounds per Cubic Yard</u>
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Concrete for Buildings, Slabs on Grade and Miscellaneous Structures

AB	4000	Not Applicable
BB	1500	Not Applicable
CB	3000	Not Applicable
DB	5000	Not Applicable

<u>Class (Light-weight)</u>	<u>Minimum 28-Day Compressive Strength (psi)</u>	<u>Minimum Cement Content Pounds per Cubic Yard</u>
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E	3000	Not Applicable
F	4000	Not Applicable
G	5000	Not Applicable

- 3. Maximum size aggregate for Class H concrete: 3/8 inch. Maximum size aggregate for all other normal-weight concrete: 1-1/2 inches, except as specified in Paragraph 2.01D.4.

STRUCTURAL CONCRETE

03310-12

IFB: 02-04-13

4. When required strength is not obtained with minimum cement content as specified, add cement, lower water-cement ratio or provide other aggregates as necessary.
  5. In addition to conforming to specified strength, lightweight concrete must be within specified unit weight limits. Maximum air-dry unit weight is 118 pounds per cubic foot; minimum is 110 pounds per cubic foot unless shown otherwise on Drawings. Determine air-dry unit weight in accordance with ASTM C 567. Correlate air-dry unit weight with fresh unit weight of the same concrete as a basis for acceptance during construction.
- L. Use of Classes of Concrete:
1. Use classes of concrete as indicated on the Drawings and in other specifications.
  2. Liquid-containing structures: If not otherwise indicated, use the following classes for structures containing water or wastewater and for utility applications in the locations described:
    - a. Class A: All reinforced concrete and where not otherwise defined.
    - b. Class B: Unreinforced concrete used for plugging pipes, seal slabs, thrust blocks and trench dams, unless indicated otherwise.
    - c. Class H: Fill and topping. Where concrete fill thickness exceeds 3 inches in the majority of a placement and is not less than 1.5 inches thick, Class A concrete may be used.
  3. All other structures: If not otherwise indicated, use the following classes in the locations described:
    - a. Class AB: All reinforced concrete and where not otherwise defined.
    - b. Class CB: Duct banks; see Section 16402 - Underground Duct Banks for additional requirements.
    - c. Class BB: Unreinforced concrete fill under structures.

## 2.03 MIXING NORMAL WEIGHT CONCRETE

- A. Conform to ACI 301, Chapter 7.
- B. Ready-Mixed Concrete:
1. Measure, batch, mix and transport ready-mixed concrete according to ASTM C 94. Plant equipment and facilities shall conform to NRMCA "Certification of Ready Mixed Concrete Production Facilities".
  2. Provide batch tickets with information specified in ASTM C 94. Deliver batch ticket with concrete and give to Resident Project Representative.
- C. Batch Mixing at Site:
1. Mix concrete in batch mixer conforming to requirements of CPMB "Concrete Plant Mixer Standards". Use mixer equipped with suitable charging hopper, water storage tank and water measuring device. Batch mixer shall be capable of mixing aggregates, cement

and water into uniform mass within specified mixing time, and of discharging mix without segregation. Operate mixer according to rated capacity and recommended revolutions per minute printed on manufacturer's rating plate.

2. Charge batch into mixer so some water will enter before cement and aggregates. Keep water running until one-fourth of specified mixing time has elapsed. Provide controls to prevent discharging until required mixing time has elapsed. When concrete of normal weight is specified, provide controls to prevent addition of water during mixing. Discharge entire batch before mixer is recharged.
3. Mix each batch of 2 cubic yards or less for not less than 1 minute and 30 seconds. Increase minimum mixing time 15 seconds for each additional cubic yard or fraction of cubic yard.
4. Keep mixer clean. Replace pick-up and throw-over blades in drum when they have lost 10 percent of original depth.

D. Admixtures:

1. Charge air-entraining and chemical admixtures into mixer as solution using automatic dispenser or similar metering device. Measure admixture to accuracy within + 3 percent. Do not use admixtures in powdered form.
2. Two or more admixtures may be used in same concrete, provided that admixtures in combination retain full efficiency and have no deleterious effect on concrete or on properties of each other. Inject admixtures separately during batching sequence.
3. Add retarding admixtures as soon as practicable after addition of cement.

## E. Temperature Control:

1. When ambient temperature falls below 40 degrees F, keep as-mixed temperature above 55 degrees F to maintain concrete above minimum placing temperature.
2. When water or aggregate has been heated, combine water with aggregate in mixer before cement is added. Do not add cement to mixtures of water and aggregate when temperature of mixture is greater than 100 degrees F.
3. In hot weather, maintain temperature of concrete below maximum placing temperature. When necessary, temperature may be lowered by cooling ingredients, cooling mixer drum by fog spray, using chilled water or well-crushed ice in whole or part for added water, or arranging delivery sequence so that time of transport and placement does not generate unacceptable temperatures.
4. Submit hot weather and cold weather concreting plans for approval.

## 2.04 MIXING LIGHTWEIGHT CONCRETE

- A. Determining Absorption of Aggregates: Mixing procedures vary according to total absorption by weight of lightweight aggregates. Determine total absorption by weight before pre-dampening in accordance with ASTM C 127.
- B. Ten Percent or Less Absorption: Follow same requirements as for mixing normal-weight concrete when preparing concrete made with low-absorptive lightweight aggregates having 10 percent or less total absorption by weight. To be low-absorptive, aggregates must absorb less than 2 percent additional water in first hour after mixing.
- C. More Than 10 Percent Absorption: Batch and mix concrete made with lightweight aggregates having more than 10 percent total absorption by weight, as follows:
  1. Place approximately 80 percent of mixing water in mixer.
  2. If aggregates are pre-dampened, add air-entraining admixture and all aggregates. Mix for minimum of 30 seconds, or 5 to 10 revolutions of truck mixer.
  3. When aggregates have not been pre-dampened, mix aggregates and water for minimum of 1 minute and 30 seconds, or 15 to 30 revolutions of truck mixer. Then add air-entraining admixture and mix for additional 30 seconds.
  4. Then, in the following sequence, add specified or permitted admixtures (other than air-entraining agent), all cement, and mixing water previously withheld.
  5. Complete mixing using procedures for normal-weight concrete.

## 2.05 MASS CONCRETE

- A. Do not use high early-strength cement (Type III) or accelerating admixtures.
- B. Use high-range water-reducing admixture (superplasticizer) to minimize water content and cement content.

- C. Specified water-reducing retarding admixture may be required to prevent cold joints when placing large quantities of concrete, to permit re-vibration of concrete, to offset effects of high temperature in concrete or weather, and to reduce maximum temperature or rapid temperature rise.

#### 2.06 EQUIPMENT

- A. Select equipment of size and design to ensure continuous flow of concrete at delivery end. Conform to following equipment and operations requirements.
- B. Truck mixers, agitators and manner of operation: Conform to ASTM C 94. Use of non-agitating equipment for transporting concrete is not permitted.
- C. Belt conveyors: Configure horizontally, or at a slope causing no segregation or loss. Use approved arrangement at discharge end to prevent separation. Discharge long runs without separation into hopper.
- D. Chutes: Metal or metal-lined (other than aluminum). Arrange for vertical-to-horizontal slopes not more than 1 to 2, nor less than 1 to 3. Chutes longer than 20 feet or not meeting slope requirements may be used if concrete is discharged into hopper before distribution.
- E. Do not use aluminum or aluminum-alloy pipe or chutes for conveying concrete.

### PART 3 EXECUTION

#### 3.01 SPECIAL CONSIDERATIONS

- A. Concreting Under Water: Not permitted except where shown otherwise on Drawings or approved by Engineer. When shown or permitted, deposit concrete under water by methods acceptable to the Engineer so fresh concrete enters mass of previously placed concrete from within, causing water to be displaced with minimum disturbance at surface of concrete.
- B. Protection from Adverse Weather: Unless adequate protection is provided or Engineer's approval is obtained, do not place concrete during rain, sleet, snow or freezing weather. Do not permit rainwater to increase mixing water or to damage surface finish. If rainfall occurs after placing operations begin, provide adequate covering to protect Work.

#### 3.02 PREPARATION OF SURFACES FOR CONCRETING

- A. Earth Surfaces:
  - 1. Under interior slabs on grade, install vapor barrier. Lap joints at least 6 inches and seal watertight with tape, or sealant applied between overlapping edges and ends. repair vapor barrier damaged during placement of reinforcing and inserts with vapor barrier material; lap over damaged areas at least 6 inches and seal watertight.
  - 2. Other Earth Surfaces: Thoroughly wet by sprinkling prior to placing concrete, and keep moist by frequent sprinkling up to time of placing concrete thereon. Remove standing water. Surfaces shall be free from standing water, mud and debris at the time of placing concrete.

- B. Construction Joints:
1. Definition: Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been interrupted so that, in the judgement of the Engineer, new concrete cannot be incorporated integrally with that previously placed.
  2. Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, use forms or other means to shape the working face to secure proper union with subsequent work. Make construction joints only where acceptable to the Engineer.
  3. Preparation: Give horizontal joint surfaces a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, clean joint surfaces of laitance, loose or defective concrete and foreign material by hydroblasting or sandblasting (exposing aggregate), roughen surface to expose aggregate to a depth of at least 1/4 inch and wash thoroughly. Remove standing water from the construction joint surface before new concrete is placed.
  4. After surfaces have been prepared cover approximately horizontal construction joints with a 3-inch lift of a grout mix consisting of Class A concrete batched without coarse aggregate; place and spread grout uniformly. Place wall concrete on the grout mix immediately thereafter.
- C. Set and secure reinforcement, anchor bolts, sleeves, inserts and similar embedded items in the forms where indicated on Contract Drawings, shop drawings and as otherwise required. Obtain Engineer's acceptance before concrete is placed. Accuracy of placement is the sole responsibility of the Contractor.
- D. Place no concrete until at least 4 hours after formwork, inserts, embedded items, reinforcement and surface preparation have been completed and accepted by the Resident Project Representative. Clean surfaces of forms and embedded items that have become encrusted with grout or previously-placed concrete before placing adjacent concrete.
- E. Casting New Concrete Against Old: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), thoroughly clean and roughen the surface of the old concrete by hydro-blasting or sandblasting (exposing aggregate). Coat joint surface with epoxy bonding agent following manufacturer's written instructions, unless indicated otherwise. Unless noted otherwise, this provision does not apply to vertical wall joints where waterstop is installed.
- F. Protection from Water: Place no concrete in any structure until water entering the space to be filled with concrete has been properly cut off or diverted and carried out of the forms, clear of the work. Deposit no concrete underwater. Do not allow still water to rise on any concrete until concrete has attained its initial set. Do not allow water to flow over the surface of any concrete in a manner and at a velocity that will damage the surface finish of the concrete. Pumping, dewatering and other necessary operations for removing ground water, if required, are subject to Resident Project Representative review.
- G. Corrosion Protection: Position and support pipe, conduit, dowels and other ferrous items to be embedded in concrete construction prior to placement of concrete so there is at least a 2 inch clearance between them and any part of the concrete reinforcement. Do not secure such items in position by wiring or welding them to the reinforcement.

- H. Where practicable, provide for openings for pipes, inserts for pipe hangers and brackets, and setting of anchors during placing of concrete.
- I. Accurately set anchor bolts and maintain in position with templates while they are being embedded in concrete.
- J. Cleaning: Immediately before concrete is placed, thoroughly clean dirt, grease, grout, mortar, loose scale, rust and other foreign substances from surfaces of metalwork to be in contact with concrete.

### 3.03 HANDLING, TRANSPORTING AND PLACING CONCRETE

- A. Conform to applicable requirements of Chapter 8 of ACI 301 and this Section. Use no aluminum materials in conveying concrete.
- B. Rejected Work: Remove concrete found to be defective or non-conforming in materials or workmanship. Replace rejected concrete with concrete meeting requirements of Contract Documents, at no additional cost to the Owner.
- C. Unauthorized Placement: Place no concrete except in the presence of the Resident Project Representative. Notify the Resident Project Representative in writing at least 24 hours before placement of concrete.
- D. Placement in Wall Forms:
  - 1. Do not drop concrete through reinforcing steel.
  - 2. Do not place concrete in any form so as to leave an accumulation of mortar on form surfaces above the concrete.
  - 3. Pump concrete or use hoppers and, if necessary, vertical ducts of canvas, rubber or metal (other than aluminum) for placing concrete in forms so it reaches the place of final deposit without separation. Free fall of concrete shall not exceed 4 feet below the ends of pump hoses, ducts, chutes or buggies. Uniformly distribute concrete during depositing.
  - 4. Do not displace concrete in forms more than 6 feet in horizontal direction from place where it was originally deposited.
  - 5. Deposit in uniform horizontal layers not deeper than 2 feet; take care to avoid inclined layers or inclined construction joints except where required for sloping members.
  - 6. Place each layer while the previous layer is still soft. Rate of placement shall not exceed 5 feet of vertical rise per hour.
  - 7. Provide sufficient illumination in form interior so concrete at places of deposit is visible from the deck or runway.
- E. Conveyors and Chutes: Design and arrange ends of chutes, hopper gates and other points of concrete discharge in the conveying, hoisting and placing system so concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyors, if used, shall be of a type acceptable to the Resident Project Representative. Do not use chutes longer than 50 feet. Slope chutes so concrete of specified consistency will readily flow. If a conveyor is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyors and chutes shall be covered.

STRUCTURAL CONCRETE

03310-18

IFB: 02-04-13

- F. Placement of Slabs: In hot or windy weather, conducive to plastic shrinkage cracks, apply evaporation retardant to slab after screeding in accordance with manufacturer's instructions and recommendations. Do not use evaporation retardant to increase water content of the surface cement paste. Place concrete for sloping slabs uniformly from the bottom of the slab to the top, for the full width of the placement. As work progresses, vibrate and carefully work concrete around slab reinforcement. Scream the slab surface in an up-slope direction.
- G. Concrete Temperature: When placed, not more than 90 degrees F nor less than 55 degrees F for sections less than 12 inches thick, nor less than 50 degrees for all other sections. Do not heat concrete ingredients to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. When concrete temperature is 85 degrees F or above, do not exceed 60 minutes between introduction of cement to the aggregates and discharge. When the weather is such that the concrete temperature would exceed 90 degrees F, employ effective means, such as pre-cooling of aggregates and mixing water, using ice or placing at night, as necessary to maintain concrete temperature, as placed, below 90 degrees F.
- H. Cold Weather Placement: Conform to ACI 306.1 - Standard Specification for Cold Weather Concreting, and the following.
1. Remove snow, ice and frost from surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6 inches. Warm reinforcement and embedded items to above 32 degrees F prior to concrete placement.
  2. Maintain concrete temperature above 50 degrees F for at least 3 days after placement.

#### 3.04 PUMPING OF CONCRETE

- A. If pumped concrete does not produce satisfactory results, in the judgement of the Resident Project Representative, discontinue pumping operations and proceed with the placing of concrete using conventional methods.
- B. Pumping Equipment: Use a 2-cylinder pump designed to operate with only one cylinder if one is not functioning, or have a standby pump on site during pumping.
- C. The minimum hose (conduit) diameter: Comply with ACI 304.2R.
- D. Replace pumping equipment and hoses (conduits) that do not function properly.
- E. Do not use aluminum conduits for conveying concrete.
- F. Field Control: Take samples for slump, air content and test cylinders at the placement (discharge) end of the line.

#### 3.05 CONCRETE PLACEMENT SEQUENCE

- A. Place concrete in a sequence acceptable to the Engineer. To minimize effects of shrinkage, place concrete in units bounded by construction joints shown. Place alternate units so each unit placed has cured at least 7 days for hydraulic structures, or 3 days for other structures, before contiguous unit or units are placed, except do not place corner sections of vertical walls until the 2 adjacent wall panels have cured at least 14 days for hydraulic structures and 7 days for other structures.

- B. Level the concrete surface whenever a run of concrete is stopped. To ensure straight and level joints on the exposed surface of walls, tack a wood strip at least 3/4-inch thick to the forms on these surfaces. Carry concrete about 1/2 inch above the underside of the strip. About one hour after concrete is placed, remove the strip, level irregularities in the edge formed by the strip with a trowel and remove laitance.

### 3.06 TAMPING AND VIBRATING

- A. Thoroughly settle and compact concrete throughout the entire depth of the layer being consolidated, into a dense, homogeneous mass; fill corners and angles, thoroughly embed reinforcement, eliminate rock pockets and bring only a slight excess of water to the exposed surface of concrete during placement. Use ACI 309R Group 3 immersion-type high-speed power vibrators (8,000 to 12,000 rpm) in sufficient number and with sufficient (at least one) standby units. Use Group 2 vibrators only when accepted by the Resident Project Representative for specific locations.
- B. Use care in placing concrete around waterstops. Carefully work concrete by rodding and vibrating to make sure air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, work concrete under waterstops by hand, making sure air and rock pockets have been eliminated. Give concrete surrounding the waterstops additional vibration beyond that used for adjacent concrete placement to assure complete embedment of waterstops in concrete.
- C. Concrete in Walls: Internally vibrate, ram, stir, or work with suitable appliances, tamping bars, shovels or forked tools until concrete completely fills forms or excavations and closes snugly against all surfaces. Do not place subsequent layers of concrete until previously placed layers have been so worked. Provide vibrators in sufficient numbers, with standby units as required, to accomplish the results specified within 15 minutes after concrete of specified consistency is placed in the forms. Keep vibrating heads from contact with form surfaces. Take care not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

### 3.07 PLACING MASS CONCRETE

- A. Observe the following additional restrictions when placing mass concrete.
  - 1. Use specified superplasticizer.
  - 2. Maximum temperature of concrete when deposited: 70 degrees F.
  - 3. Place in lifts approximately 18 inches thick. Extend vibrator heads into previously-placed layer.

### 3.08 REPAIRING SURFACE DEFECTS AND FINISHING

- A. Conform to Section 03350 - Concrete Finishing.

### 3.09 REPAIRING CRACKS

- A. Conform to Section 03932 – Concrete Crack Repair by Injection.

### 3.10 CURING

- A. Conform to Section 03390 - Concrete Curing.

## 3.11 PROTECTION

- A. Protect concrete against damage until final acceptance by the Owner.
- B. Protect fresh concrete from damage due to rain, hail, sleet or snow. Provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.
- C. Do not backfill around concrete structures or subject them to design loadings until all components of the structure needed to resist the loading are complete and have reached the specified 28-day compressive strength, except as authorized otherwise by the Engineer.

END OF SECTION

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## Section 03315

## CONCRETE FOR UTILITY CONSTRUCTION

## PART 1 GENERAL

## 1.01 SECTION INCLUDES

- A. Cast-in-place concrete work for utility construction or rehabilitation, such as slabs on grade, small vaults, site-cast bases for precast units, and in-place liners for manhole rehabilitation.

## 1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
  - 1. No payment will be made for concrete for utility construction under this Section. Include cost in applicable utility structure.
  - 2. Obtain the services of and pay for a certified testing laboratory to prepare design mixes.
- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

## 1.03 REFERENCES

- A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
- C. ACI 302.1R - Guide for Concrete Floor and Slab Construction.
- D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- E. ACI 308 - Standard Practice for Curing Concrete.
- F. ACI 309R - Guide for Consolidation of Concrete.
- G. ACI 311 - Batch Plant Inspection and Field Testing of Ready Mixed Concrete.
- H. ACI 315 - Manual of Standard Practice for Detailing Reinforced Concrete Structures.
- I. ACI 318 - Building Code Requirements for Reinforced Concrete.
- J. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- K. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- L. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- M. ASTM A 767 - Standard Specifications for Zinc-coated (Galvanized) Bars for Concrete Reinforcement.
- N. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- O. ASTM A 884 - Specification for Epoxy-coated Steel Wire and Welded Wire Fabric for Reinforcement.

CONCRETE FOR UTILITY CONSTRUCTION

03315-1

IFB: 02-04-13

- P. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- Q. ASTM C 33 - Standard Specification for Concrete Aggregates.
- R. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- S. ASTM C 42 - Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- T. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- U. ASTM C 138 - Standard Test Method for Unit Weight Yield and Air Content (Gravimetric) of Concrete.
- V. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- W. ASTM C 150 - Standard Specification for Portland Cement.
- X. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.
- Y. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.
- Z. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- AA. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- AB. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.
- AC. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
- AD. ASTM C 595 - Standard Specification for Blended Hydraulic Cements.
- AE. ASTM C 685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
- AF. ASTM C 1017 - Chemical Admixtures for Use in Producing Flowing Concrete.
- AG. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
- AH. ASTM C 1077 - Standard Practice for Laboratory Testing of Concrete and Concrete Aggregate for use in Construction and Criteria for Laboratory Evaluation.
- AI. ASTM D 746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- AJ. CRSI MSP-1 - Manual of Standard Practice.
- AK. CRSI - Placing Reinforcing Bars.

AL. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

AM. NRMCA - Concrete Plant Standards.

#### 1.04 SUBMITTALS

A. Conform to Section 01 33 00 - Submittal Procedures.

B. Provide copy of current Texas Department of Transportation (TxDOT) Plant Certification.

C. Submit proposed mix design and test data for each type and strength of concrete in the Work.

D. Submit laboratory reports prepared by an independent testing laboratory stating that materials used comply with requirements of this Section.

E. Submit manufacturer's mill certificates for reinforcing steel. Provide specimens for testing when required by the Resident Project Representative.

F. Submit certification from concrete supplier that materials and equipment used to produce and deliver concrete comply with this Specification.

G. When required on Drawings, submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details, and other pertinent information.

H. For waterstops, submit product information sufficient to indicate compliance with this Section, including manufacturer's descriptive literature and specifications.

#### 1.05 HANDLING AND STORAGE

A. Cement: Store cement off of the ground in a well-ventilated, weatherproof building.

B. Aggregate: Prevent mixture of foreign materials with aggregate and preserve gradation of aggregate.

C. Reinforcing Steel: Store reinforcing steel to protect it from mechanical injury and formation of rust. Protect epoxy-coated steel from damage to the coating.

### PART 2 PRODUCTS

#### 2.01 CONCRETE MATERIALS

A. Cementitious Material:

1. Portland Cement: ASTM C 150, Type II, unless the use of Type III is authorized by the Engineer; or ASTM C 595, Type IP. For concrete in contact with sewage use Type II cement.

2. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding 0.6 percent alkali content in the form of  $\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$ .

B. Water: Clean, free from harmful amounts of oils, acids, alkalis, or other deleterious substances, and meeting requirements of ASTM C 94.

- C. Aggregate:
1. Coarse Aggregate: ASTM C 33. Unless otherwise indicated, use the following ASTM standard sizes: No. 357 or No. 467; No. 57 or No. 67, No. 7. Maximum size: Not larger than 1/5 of the narrowest dimension between sides of forms, nor larger than 3/4 of minimum clear spacing between reinforcing bars.
  2. Fine Aggregate: ASTM C 33.
  3. Determine the potential reactivity of fine and coarse aggregate in accordance with the appendix to ASTM C 33.
- D. Air Entraining Admixtures: ASTM C 260.
- E. Chemical Admixtures: The use of chemical admixtures is not an acceptable substitute for proper mix proportioning, mix material quality control, or handling of wet concrete. If, based on site-specific project conditions, the Contractor deems that there is no practical alternative to meet the required quality constraints of this Section, he may request permission to use admixtures. Requests shall be made in writing and submitted to the Engineer for approval. Requests shall contain sufficient information to determine whether or not a change in the mix design is warranted. Submission of a request is not an approval. Each proposed addition of chemical admixture(s) must be approved by the Engineer prior to use. Only the following admixtures may, in accordance with the foregoing, be requested for use:
1. Water Reducers: ASTM C 494, Type A.
  2. Water Reducing Retarders: ASTM 494, Type D.
  3. High Range Water Reducers (Superplasticizers): ASTM C 494, Types F and G.
- F. Prohibited Admixtures: Admixtures containing calcium chloride, thiocyanate, or materials that contribute free chloride ions in excess of 0.1 percent by weight of cement.
- G. Reinforcing Steel:
1. Use new billet steel bars conforming to ASTM A 615, ASTM A 767, or ASTM A 775, grade 40 or grade 60, as shown on Drawings. Use deformed bars except where smooth bars are specified. When placed in work, keep steel free of dirt, scale, loose or flaky rust, paint, oil or other harmful materials.
  2. Where shown, use welded wire fabric with wire conforming to ASTM A 185 or ASTM A 884. Supply the gauge and spacing shown, with longitudinal and transverse wires electrically welded together at points of intersection with welds strong enough not to be broken during handling or placing.
  3. Wire: ASTM A 82. Use 16-1/2 gauge minimum for tie wire, unless otherwise indicated.
- H. Curing Compounds: Type 2 white-pigmented liquid membrane-forming compounds conforming to ASTM C 309.

## 2.02 FORMWORK MATERIALS

- A. Lumber and Plywood: Seasoned and of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay and other imperfections which would affect strength or impair the finished

surface of concrete. Use S4S lumber for facing or sheathing. Forms for bottoms of caps: At least 2-inch (nominal) lumber, or 3/4-inch form plywood backed adequately to prevent misalignment. For general use, provide lumber of 1-inch nominal thickness or form plywood of approved thickness.

- B. Formwork for Exposed Concrete Indicated to Receive Rubbed Finish: Form or form-lining surfaces free of irregularities; plywood of 1/4-inch minimum thickness, preferably oiled at the mill.
- C. Chamfer Strips and Similar Moldings: Redwood, cypress, or pine that will not split when nailed and which can be maintained to true line. Use mill-cut molding dressed on all faces.
- D. Form Ties: Metal or fiberglass of approved type with tie holes not larger than 7/8 inch in diameter. Do not use wire ties or snap ties.
- E. Metal Forms: Clean and in good condition, free from dents and rust, grease, or other foreign materials that tend to disfigure or discolor concrete in a gauge and condition capable of supporting concrete and construction loads without significant distortion. Countersink bolt and rivet heads on facing sides. Use only metal forms which present a smooth surface and which line up properly.

#### 2.03 PRODUCTION METHODS

- A. Use either ready-mixed concrete conforming to requirements of ASTM C 94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685.
- B. The concrete mixing plant shall be certified to supply concrete to TxDOT.

#### 2.04 MEASUREMENT OF MATERIALS

- A. Measure dry materials by weight, except volumetric proportioning may be used when concrete is batched and mixed in accordance with ASTM C 685.
- B. Measure water and liquid admixtures by volume.

#### 2.05 DESIGN MIX

- A. Use design mixes prepared by a certified testing laboratory in accordance with ASTM C 1077 and conforming to requirements of this Section.
- B. Proportion concrete materials based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this specification. Prepare mix design of Class A concrete so minimum cementitious content is 564 pounds per cubic yard. Submit concrete mix designs to the Engineer for review.
- C. Proportioning on the basis of field experience or trial mixtures in accordance with requirements at Section 5.3 of ACI 318 may be used, if approved by the Engineer.

D. Classification:

CLASS	TYPE	MINIMUM COMPRESSIVE STRENGTH (LBS/SQ. IN.)		MAXIMUM W/C RATIO; GAL/SACK	AIR CONTENT (PERCENT)	CONSISTENCY RANGE IN SLUMP (INCHES)
		7-DAY	28-DAY			
A	Structural	2400	3000	6.5	4±1	2 to 4*
B	Pipe Block Fill, Thrust Block	----	2000	8.0	4±1	5 to 7

\*When ASTM C 494, Type F or Type G admixture is used to increase workability, this range may be 6 to 9.

- E. Add steel or polypropylene fibers only when called for on the Drawings or in another section of these Specifications.
- F. Determine air content in accordance with ASTM C 138, ASTM C 173 or ASTM C 231.
- G. Use of Concrete Classes: Use classes of concrete as indicated on the Drawings and other Specifications. Use Class B for unreinforced concrete used for plugging pipes, seal slabs, thrust blocks, trench dams, and concrete fill unless indicated otherwise. Use Class A for all other applications.

2.06 PVC WATERSTOPS

- A. Extrude from virgin polyvinyl chloride elastomer. Use no reclaimed or scrap material. Submit waterstop manufacturer's current test reports and manufacturer's written certification that the material furnished meets or exceeds Corps of Engineers Specification CRD-C572 and other specified requirements.
- B. Flat Strip and Center-Bulb Waterstops:
  - 1. Thickness: not less than 3/8 inch

2.07 RESILIENT WATERSTOP

- A. Resilient Waterstop: Where shown on the Drawings; either a bentonite- or adhesive-type material.
- B. Bentonite Waterstop:
  - 1. Material: 75 percent bentonite, mixed with butyl rubber-hydrocarbon containing less than 1.0 percent volatile matter, and free of asbestos fibers or asphaltics.
  - 2. Manufacturer's rated temperature ranges: For application, 5 to 125 degrees F; in service, -40 to 212 degrees F.
  - 3. Cross-sectional dimensions, unexpanded waterstop: 1 inch by 3/4 inch.
  - 4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.

## C. Adhesive Waterstop:

1. Preformed plastic adhesive waterstop at least 1inch by ¾ inch.
2. Meets or exceeds requirements of Federal Specification SS-S-210A.
3. Supplied wrapped completely by a 2-part protective paper.
4. Submit independent laboratory tests verifying that the material seals joints in concrete against leakage when subjected to a minimum of 30 psi water pressure for at least 72 hours.
5. Provide primer, to be used on hardened concrete surfaces, from the same manufacturer who supplies the waterstop material.

## PART 3 EXECUTION

## 3.01 FORMS AND SHORING

- A. Provide mortar-tight forms sufficient in strength to prevent bulging between supports. Set and maintain forms to lines designated such that finished dimensions of structures are within the tolerances specified in ACI 117. Construct forms to permit removal without damage to concrete. Provide adequate cleanout openings. Before placing concrete, remove extraneous matter from within forms.
- B. Install rigid shoring having no excessive settlement or deformation. Use sound timber in shoring centering. Shim to adjust and tighten shoring with hardwood timber wedges.
- C. Design Loads for Horizontal Surfaces of Forms and Shoring: Minimum fluid pressure, 175 pounds per cubic foot; live load, 50 pounds per square foot. Maximum unit stresses: 125 percent of allowable stresses used for form materials and for design of support structures.
- D. Back formwork with a sufficient number of studs and wales to prevent deflection.
- E. Re-oil or lacquer the liner on the job before using. Facing may be constructed of 3/4-inch plywood made with waterproof adhesive backed by adequate studs and wales. In such cases, form lining will not be required.
- F. Unless otherwise indicated, form outside corners and edges with triangular 3/4-inch chamfer strips (measured on sides).
- G. Remove metal form ties to depth of at least 3/4 inch from surface of concrete. Do not burn off ties. Do not use pipe spreaders. Remove spreaders which are separate from forms as concrete is being placed.
- H. Treat facing of forms with approved form coating before concrete is placed. When directed by Resident Project Representative, treat both sides of face forms with coating. Apply coating before reinforcement is placed. Immediately before the concrete is placed, wet surface of forms which will come in contact with concrete.

**3.02 PLACING REINFORCEMENT**

- A. Place reinforcing steel accurately in accordance with approved Drawings. Secure steel adequately in position in forms to prevent misalignment. Maintain reinforcing steel in place using approved concrete and hot-dip galvanized metal chairs and spacers. Place reinforcing steel in accordance with CRSI Publication "Placing Reinforcing Bars." Request inspection of reinforcing steel by the Resident Project Representative and obtain acceptance before concrete is placed.
- B. Minimum spacing center-to-center of parallel bars: 2-1/2 times nominal bar diameter. Minimum cover measured from surface of concrete to face of reinforcing bar unless shown otherwise on the Drawings: 3 inches for surfaces cast against soil or subgrade, 2 inches for other surfaces.
- C. Detail bars in accordance with ACI 315. Fabricate reinforcing steel in accordance with CRSI Publication MSP-1, "Manual of Standard Practice." Bend reinforcing steel to required shape while steel is cold. Excessive irregularities in bending will be cause for rejection.
- D. Do not splice bars without written approval of the Engineer. Approved bar bending schedules or placing drawings constitute written approval. Splice and development length of bars shall conform to ACI 318, Chapters 7 and 12, and as shown on Drawings. Stagger splices or locate at points of low tensile stress.

**3.03 EMBEDDED ITEMS**

- A. Install conduit and piping as shown on Drawings. Accurately locate and securely fasten conduit, piping, and other embedded items in forms.
- B. Install waterstops as specified in other sections and according to manufacturer's instructions. Securely position waterstops at joints as indicated on Drawings. Protect waterstops from damage or displacement during concrete placing operations.

**3.04 BATCHING, MIXING AND DELIVERY OF CONCRETE**

- A. Measure, batch, mix, and deliver ready-mixed concrete in accordance with ASTM C 94, Sections 8 through 11. Produce ready-mixed concrete using an automatic batching system as described in NRMCA Concrete Plant Standards, Part 2 - Plant Control Systems.
- B. Measure, mix and deliver concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685, Sections 6 though 8.
- C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of the Engineer before adjustment and change of mix proportions.
- D. Ready-mixed concrete delivered to the site shall be accompanied by batch tickets providing the information required by ASTM C 94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing the information required by ASTM C 685, Section 14.
- E. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not mix concrete when air temperature is at or below 40 degrees F and falling. Concrete may be mixed when temperature is 35 degrees F and rising. Take temperature readings in the shade, away from artificial heat. Protect concrete from temperatures below 32 degrees F until the concrete has cured for a minimum of 3 days at 70 degrees F or 5 days at 50 degrees F.
- F. Clean, maintain and operate equipment so that it thoroughly mixes material as required.

- G. Hand-mix only when approved by the Engineer.

### 3.05 PLACING CONCRETE

- A. Give sufficient advance notice to the Resident Project Representative (at least 24 hours prior to commencement of operations) to permit inspection of forms, reinforcing steel, embedded items and other preparations for placing concrete. Place no concrete prior to the Resident Project Representative's approval.
- B. Schedule concrete placing to permit completion of finishing operations in daylight hours. However, if necessary to continue after daylight hours, light the site as required. If rainfall occurs after placing operations are started, provide covering to protect the work.
- C. Use troughs, pipes and chutes lined with approved metal or synthetic material in placing concrete so that concrete ingredients are not separated. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete. Allow no aluminum material to be in contact with concrete.
- D. Limit free fall of concrete to 4 feet. Do not deposit large quantities of concrete at one location so that running or working concrete along forms is required. Do not jar forms after concrete has taken an initial set; do not place any strain on projecting reinforcement or anchor bolts.
- E. Use tremies for placing concrete in walls and similar narrow or restricted locations. Use tremies made in sections, or provide in several lengths, so that outlet may be adjusted to proper height during placing operations.
- F. Place concrete in continuous horizontal layers approximately 12 inches thick. Place each layer while layer below is still plastic.
- G. Compact each layer of concrete with concrete spading implements and mechanical vibrators of approved type and adequate number for the size of placement. When immersion vibrators cannot be used, use form vibrators. Apply vibrators to concrete immediately after depositing. Move the vibrator vertically through the layer of concrete just placed and several inches into plastic layer below. Do not penetrate or disturb layers previously placed which have partially set. Do not use vibrators to aid lateral flow concrete. Closely supervise consolidation to ensure uniform insertion and duration of immersion.
- H. Handling and Placing Concrete: Conform to ACI 302.1R, ACI 304R and ACI 309R.

### 3.06 WATERSTOPS

- A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for the extent of the joint; make splices necessary to provide such continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.
- B. Install waterstops in concrete on one side of joints, leaving other side exposed until the next pour. When a waterstop will remain exposed for 2 days or more, shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

**C. Splicing PVC Waterstops:**

1. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with the manufacturer's printed instructions.
2. Butt end-to-end joints of two identical waterstop sections may be made in the forms during placement of waterstop material.
3. Prior to placement in formwork, prefabricate waterstop joints involving more than two ends to be joined together, an angle cut, an alignment change, or the joining of two dissimilar waterstop sections, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon inspection and approval by the Resident Project Representative, install prefabricated waterstop joint assemblies in formwork, and butt-weld ends of the 24-inch strips to the straight-run portions of waterstop in the forms.

**D. Setting PVC Waterstops:**

1. Correctly position waterstops during installation. Support and anchor waterstops during progress of the work to ensure proper embedment in concrete and to prevent folding over of the waterstop by concrete placement. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.
2. Where a waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to a waterstop in a future concrete placement, terminate the waterstop 6 inches below the top of the wall.

**E. Replacement of Defective Field Joints:** Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying to the Specifications.**F. Resilient Waterstop:**

1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations.
2. When requested by the Engineer, provide technical assistance by manufacturer's representative in the field at no additional cost to the Owner.
3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.
4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop a minimum of 6 inches and place in contact with the PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form a smooth joining surface.
5. At the free top of walls without connecting slabs, stop the resilient waterstop and grooves (where used) 6 inches from the top in vertical wall joints.

6. Bentonite Waterstop:
  - a. Locate bentonite waterstop as near as possible to the center of the joint and extend continuous around the entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.
  - b. Where thickness of concrete member to be placed on bentonite waterstop is less than 12 inches, place waterstop in grooves at least 3/4 inch deep and 1-1/4 inches wide formed or ground into concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.
  - c. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm the material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.
  - d. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth if necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using an epoxy grout which completely fills voids and irregularities beneath the waterstop material. Prior to installation, wire brush the concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.
  - e. In addition to the adhesive backing provided with the waterstop, secure bentonite waterstop in place with concrete nails and washers at 12-inch maximum spacing.
7. Adhesive Waterstop:
  - a. With a wire brush thoroughly clean the concrete surface on which the waterstop is to be placed and then coat with primer.
  - b. If the surface is too rough to allow the waterstop to form a complete contact, grind to form an adequately smooth surface.
  - c. Install the waterstop with the top protective paper left in place. Overlap joints between strips a minimum of 1 inch and cover back over with protective paper.
  - d. Do not remove protective paper until just before final formwork completion. Concrete shall be placed immediately. The time that the waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

### 3.07 CONSTRUCTION JOINTS

#### A. Definitions:

1. Construction joint: Contact surface between plastic (fresh) concrete and concrete that has attained initial set.
2. Monolithic: Manner of concrete placement to reduce or eliminate construction joints; joints other than those indicated on Drawings will not be permitted without written approval of Engineer. Where so approved, make additional construction joints with details equivalent to those indicated for joints in similar locations.

3. Preparation for Construction Joints: Roughen surface of concrete previously placed, leaving some aggregate particles exposed. Remove laitance and loose materials by sandblasting or high-pressure water blasting. Keep surface wet for several hours prior to placing of plastic concrete.

### 3.08 CURING

- A. Comply with ACI 308. Cure by preventing loss of moisture, rapid temperature change and mechanical injury for a period of 7 curing days when Type II or IP cement has been used and for 3 curing days when Type III cement has been used. Start curing as soon as free water has disappeared from the concrete surface after placing and finishing. A curing day is any calendar day in which the temperature is above 50 degrees F for at least 19 hours. Colder days may be counted if air temperature adjacent to concrete is maintained above 50 degrees F. In continued cold weather, when artificial heat is not provided, removal of forms and shoring may be permitted at the end of calendar days equal to twice the required number of curing days. However, leave soffit forms and shores in place until concrete has reached the specified 28-day strength, unless directed otherwise by the Engineer.
- B. Cure formed surfaces not requiring rubbed-finished surface by leaving forms in place for the full curing period. Keep wood forms wet during the curing period. Add water as needed for other types of forms. Or, at Contractor's option, forms may be removed after 2 days and curing compound applied.
- C. Rubbed Finish:
  1. At formed surfaces requiring rubbed finish, remove forms as soon as practicable without damaging the surface.
  2. After rubbed-finish operations are complete, continue curing formed surfaces by using either approved curing/sealing compounds or moist cotton mats until normal curing period is complete.
- D. Unformed Surfaces: Cure by membrane curing compound method.
  1. After concrete has received a final finish and surplus water sheen has disappeared, immediately seal surface with a uniform coating of approved curing compound, applied at the rate of coverage recommended by manufacturer or as directed by the Resident Project Representative. Do not apply less than 1 gallon per 180 square feet of area. Provide satisfactory means to properly control and check rate of application of the compound.
  2. Thoroughly agitate the compound during use and apply by means of approved mechanical power pressure sprayers equipped with atomizing nozzles. For application on small miscellaneous items, hand-powered spray equipment may be used. Prevent loss of compound between nozzle and concrete surface during spraying operations.
  3. Do not apply compound to a dry surface. If concrete surface has become dry, thoroughly moisten surface immediately prior to application. At locations where coating shows discontinuities, pinholes or other defects, or if rain falls on a newly coated surface before film has dried sufficiently to resist damage, apply an additional coat of compound at the specified rate of coverage.

**3.09 REMOVAL OF FORMS AND SHORING**

- A. Remove forms from surfaces requiring rubbing only as rapidly as rubbing operation progresses. Remove forms from vertical surfaces not requiring rubbed-finish when concrete has aged for the required number of curing days. When curing compound is used, do not remove forms before 2 days after concrete placement.
- B. Leave soffit forms and shores in place until concrete has reached the specified 28-day strength, unless directed otherwise by the Engineer.

**3.10 DEFECTIVE WORK**

- A. Immediately repair any defective work discovered after forms have been removed. If concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove and replace the entire section.

**3.11 FINISHING**

- A. Patch honeycomb, minor defects and form tie holes in concrete surfaces with cement mortar mixed one part cement to two parts fine aggregate. Repair defects by cutting out unsatisfactory material and replacing with new concrete, securely keyed and bonded to existing concrete. Finish to make junctures between patches and existing concrete as inconspicuous as possible. Use a stiff mixture and thoroughly tamp into place. After each patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off mortar flush with the surface.
- B. Apply a rubbed finish to exposed surfaces of formed concrete structures. After pointing has set sufficiently, wet the surface with a brush and perform first surface rubbing with No. 16 carborundum stone, or approved equal. Rub sufficiently to bring surface to paste, to remove form marks and projections, and to produce a smooth, dense surface. Add cement to form surface paste as necessary. Spread or brush material, which has been ground to paste, uniformly over surface and allow to reset. In preparation for final acceptance, clean surfaces and perform final finish rubbing with No. 30 carborundum stone or approved equal. After rubbing, allow paste on the surface to reset; then wash surface with clean water. Leave structure with a clean, neat and uniform-appearing finish.
- C. Apply a wood float finish to concrete slabs unless shown otherwise.

**3.12 FIELD QUALITY CONTROL**

- A. Testing shall be performed under provisions of Section 01454 - Testing Laboratory Services.
- B. Unless otherwise directed by Engineer, the following minimum testing of concrete is required. Testing shall be performed by qualified individuals employed by an approved independent testing agency, and conform to the requirements of ASTM C 1077.
  - 1. Take concrete samples in accordance with ASTM C 172.
  - 2. Make one set of four compression test specimens for each mix design at least once per day and for each 150 cubic yards or fraction thereof. Make, cure and test the specimens in accordance with ASTM C 31 and ASTM C 39.
  - 3. When taking compression test specimens, test each sample for slump according to ASTM C 143, for temperature according to ASTM C 1064, for air content according to ASTM C 231, and for unit weight according to ASTM C 138.

4. Inspect, sample and test concrete in accordance with ASTM C 94, Section 13, 14, and 15, and ACI 311-5R.

C. Test Cores: Conform to ASTM C 42.

D. Testing Type III Cement Concrete: When Type III cement is used in concrete, the specified 7-day and 28-day compressive strengths shall be applicable at 3 and 7 days, respectively.

E. If 7-day or 3-day test strengths (as applicable for type of cement being used) fail to meet established strength requirements, extended curing or resume curing on those portions of structure represented by test specimens may be required. If additional curing fails to produce the required strength, strengthening or replacement of portions of structure which fail to develop required strength may be required by the Engineer, at no additional cost to the Owner.

### 3.13 PROTECTION

A. Protect concrete against damage until final acceptance by the Owner.

B. Protect fresh concrete from damage due to rain, hail, sleet, or snow. Provide such protection while the concrete is still plastic, and whenever such precipitation is imminent or occurring.

C. Do not backfill around concrete structures or subject them to design loadings until components of the structure needed to resist the loading are complete and have reached the specified 28-day compressive strength, except as authorized otherwise by the Engineer.

END OF SECTION

## Section 03350

## CONCRETE FINISHING

## PART 1 GENERAL

## 1.01 SECTION INCLUDES

- A. Repairing surface defects.
- B. Finishing concrete surfaces including both formed and unformed surfaces.
- C. Sealing concrete surfaces.
- D. Installation of concrete fill and installation of concrete topping in bottoms of clarifiers and thickeners.

## 1.02 UNIT PRICES

- A. No separate payment will be made for concrete finishing under this Section. Include payment in unit price for structural concrete.

## 1.03 REFERENCES

- A. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.
- B. ASTM C 881 - Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- C. ASTM C 1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
- D. ASTM D 4587 - Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light-and Water-Exposure Apparatus.
- E. ASTM E 1155 - Standard Test Method for Determining Floor Flatness and Levelness Using the F Number System.

## 1.04 SUBMITTALS

- A. Conform to Section 01 33 00 - Submittal Procedures
- B. Submit manufacturer's technical literature on the following products proposed for use. Include manufacturer's installation and application instructions and, where specified, manufacturer's certification of conformance to requirements and suitability for use in the applications indicated.
  - 1. Floor hardener.
  - 2. Sealer.
  - 3. Epoxy floor topping.
  - 4. Epoxy penetrating sealer.
  - 5. Latex bonding agent.

CONCRETE FINISHING

03350-1

IFB: 02-04-13

6. Epoxy adhesive.
7. Abrasive aggregate.
8. Evaporation retardant.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. **Sealer/Dustproofers (VOC Compliant):** Water-based acrylic sealer; non-yellowing under ultraviolet light after 200-hour test in accordance with ASTM D 4587. Conform to local, state and federal solvent emission requirements.
- B. **Epoxy Floor Topping:** Two-component epoxy resin meeting ASTM C 881 Type III, resistant to wear, staining and chemical attack, blended with granite, sand, trap rock or quartz aggregate, trowel-applied over concrete floor. Topping thickness, 1/8 inch; color, gray.
- C. **Abrasive Aggregate for Nonslip Finish:** Fused aluminum oxide grit, or crushed emery aggregate containing not less than 40 percent aluminum oxide and not less than 25 percent ferric oxide. Material shall be factory graded, packaged, rustproof and nonglazing, and unaffected by freezing, moisture and cleaning materials.
- D. **Epoxy Penetrating Sealer:** Low-viscosity, two-component epoxy system designed to give maximum penetration into concrete surfaces. Sealer shall completely seal concrete surfaces from penetration of water, oil and chemicals; prevent dusting and deterioration of concrete surfaces caused by heavy traffic; and be capable of adhering to floor surfaces subject to hydrostatic pressure from below. Color, transparent amber or gray; surface, nonslip.
- E. **Latex Bonding Agent:** Non-redispersable latex base liquid conforming to ASTM C 1059. When used in water and wastewater treatment structures, bonding agent shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required.
- F. **Bonding Grout:** Prepare bonding grout by mixing approximately one part cement to one part fine sand meeting ASTM C 144 but with 100 percent passing No. 30 mesh sieve. Mix with water to consistency of thick cream. At Contractor's option, a commercially-prepared bonding agent used in accordance with manufacturer's recommendations and instructions may be used. When used in water and wastewater treatment structures, bonding agent shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required. Submit manufacturer's technical information on proposed bonding agent.
- G. **Patching Mortar:**
  1. Make patching mortar of same materials and of approximately same proportions as concrete, except omit coarse aggregate. Substitute white Portland cement for part of gray Portland cement on exposed concrete in order to match color of surrounding concrete. Determine color by making trial patch. Use minimum amount of mixing water required for handling and placing. Mix patching mortar in advance and allow to stand. Mix frequently with trowel until it has reached stiffest consistency that will permit placing. Do not add water.
  2. Proprietary compounds for adhesion or specially formulated cementitious repair mortars may be used in lieu of or in addition to foregoing patching materials provided that properties of bond

and compressive strength meet or exceed the foregoing and color of surrounding concrete can be matched where required. Use such compounds according to manufacturer's recommendations. When used in water and wastewater treatment structures, material shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required.

- H. Epoxy Adhesive: Two-component, 100 percent solids, 100 percent reactive compound developing 100 percent of strength of concrete, suitable for use on dry or damp surfaces. Epoxy used to inject cracks and as a binder in epoxy mortar shall meet ASTM C 881, Type VI. Epoxy used as a bonding agent for fresh concrete shall meet ASTM C 881, Type V.
- I. Non-shrink Grout: See Section 03600 - Structural Grout.
- J. Spray-Applied Coating: Acceptable products are Thoro System Products "ThoroSeal Plaster Mix" or equal. Color: Gray.
- K. Concrete Topping: Class H concrete with 3/8-inch maximum coarse aggregate size, as specified in Section 03310 - Structural Concrete.
- L. Concrete Fill: Class H concrete with 3/8-inch maximum coarse aggregate size, (Class C where fill thickness exceeds 3 inches throughout a placement), as specified in Section 03310 - Structural Concrete.
- M. Evaporation Retardant: Confilm, manufactured by Master Builders; Eucobar, manufactured by Euclid Chemical Company; or equal.

### PART 3 EXECUTION

#### 3.01 AGGREGATE CONCEALMENT

- A. Unless indicated otherwise on Drawings or approved by Engineer, all surfaces to be finished shall be free of exposed aggregate.

#### 3.02 REPAIRING SURFACE DEFECTS

- A. Defective Areas: Repair immediately after removal of forms. Remove honeycombed and other defective concrete down to sound concrete but in no case to a depth less than one inch. Make edges of cuts perpendicular to concrete surface. Thoroughly work bonding grout into the surface with a brush as that the entire surface is covered. Alternatively, a proprietary bonding agent may be used. Use bonding agent in accordance with manufacturer's instructions. While bonding coat is still tacky, apply premixed patching mortar. Thoroughly consolidate mortar into place and strike off to leave patch slightly higher than surrounding surface. To permit initial shrinkage, leave undisturbed for at least 1 hour before final finishing. Keep patched area damp for 7 days. Alternatively, a proprietary cementitious repair mortar may be used and placed in accordance with manufacturer's instructions. Do not use metal tools in finishing patches in formed walls which will be exposed.
- B. Tie Holes: Patch holes immediately after removal of forms. After cleaning and roughening with a wire brush on a rotary drill, thoroughly dampen tie hole and fill solid with patching mortar. Taper tie holes shall have the plug, specified in Section 03100 - Concrete Formwork, driven into the hole to the center of the wall before grouting. Completely fill taper tie holes with patching mortar except that non-shrink grout shall be used for all walls in contact with soil or liquid. On wall faces exposed to view, fill the outer 2 inches of the taper tie hole with patching mortar blended to match adjacent concrete.

### CONCRETE FINISHING

03350-3

IFB: 02-04-13

- C. Cracks: Repair cracks in excess of 0.01 inch by pressure injection of moisture-insensitive epoxy-resin system. Submit proposed material and method of repair for approval prior to making repairs.
- D. Structural Repair: When required, make structural repairs after prior approval of Engineer as to method and procedure, using specified epoxy adhesive or approved epoxy mortar.

### 3.03 FINISHING OF FORMED SURFACES

- A. Unfinished Surfaces: Finish is not required on surfaces concealed from view in completed structure by earth, ceilings or similar cover, unless indicated otherwise on Drawings.
- B. Rough Form Finish:
  - 1. No form facing material is required on rough form finish surfaces.
  - 2. Patch tie holes and defects. Chip off fins exceeding 1/4 inch in height.
  - 3. Rough form finish may be used on concrete surfaces which will be concealed from view by earth in completed structure, except concealed surfaces required to have smooth form finish, as shown on Drawings.
- C. Smooth Form Finish:
  - 1. Form facing shall produce smooth, hard, uniform texture on concrete. Use plywood or fiberboard linings or forms in as large sheets as practicable, and with smooth, even edges and close joints.
  - 2. Patch tie holes and defects. Rub fins and joint marks with wooden blocks to leave smooth, unmarred finished surface.
  - 3. Provide smooth form finish on the wet face of formed surfaces of water-holding structures, and of other formed surfaces not concealed from view by earth in completed structure, except where otherwise indicated on Drawings. Walls that will be exposed after future construction, at locations indicated on Drawings, shall have smooth form finish. Smooth form finish on exterior face of exterior walls shall extend 2 feet below final top of ground elevation. Exterior face of all perimeter grade beams shall have smooth form finish for full depth of grade beam.
- D. Rubbed Finish:
  - 1. Use plywood or fiberboard linings or forms in as large sheets as practicable, and with smooth, even edges and close joints.
  - 2. Remove forms as soon as practicable, repair defects, wet surfaces, and rub with No. 16 carborundum stone or similar abrasive. Continue rubbing sufficiently to bring surface paste, remove form marks and fins, and produce smooth, dense surface of uniform color and texture. Do not use cement paste other than that drawn from concrete itself. Spread paste uniformly over surface with brush. Allow paste to reset, then wash surface with clean water.

3. Use rubbed finish at locations indicated on Drawings, except where rubbed finish is indicated for a wall which will be containing a liquid, use spray-applied coating.

E. Spray-applied Coating: At Contractor's option, in lieu of rubbed finish, spray-applied coating may be applied after defects have been repaired and fins removed. Remove form oil, curing compound and other foreign matter that would prevent bonding of coating. Apply coating in uniform texture and color in accordance with coating manufacturer's instructions.

F. Related Unformed Surfaces: Tops of piers, walls, bent caps, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed. Float unformed surfaces to texture reasonably consistent with that of formed surfaces. Continue final treatment on formed surfaces uniformly across unformed surfaces.

3.04 HOT WEATHER FINISHING

A. When hot weather conditions exist, as defined by Section 03310 - Structural Concrete and as judged by the Engineer, apply evaporation retardant to the surfaces of slabs, topping and concrete fill placements immediately after each step in the finishing process has been completed.

3.05 FINISHING SLABS AND SIMILAR FLAT SURFACES TO CLASS A, B, AND C TOLERANCES

A. Apply Class A, B, and C finishes at locations indicated on Drawings.

B. Shaping to Contour: Use strike-off templates or approved compacting-type screeds riding on screed strips or edge forms to bring concrete surface to proper contour. See Section 03100 - Concrete Formwork for edge forms and screeds.

C. Consolidation and Leveling: Concrete to be consolidated shall be as stiff as practicable Thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade. Consolidate and level slabs and floors with vibrating bridge screeds, roller pipe screeds or other approved means. After consolidation and leveling, do not permit manipulation of surfaces prior to finishing operations.

D. Tolerances for Finished Surfaces: Check tolerances by placing straightedge of specified length anywhere on slab. Gap between slab and straightedge shall not exceed tolerance listed for specified class.

<u>Class</u>	<u>Straightedge Length in Feet</u>	<u>Tolerance in Inches</u>
A	10	1/8
B	10	1/4
C	2	1/4

E. Raked Finish: After concrete has been placed, struck off, consolidated and leveled to Class C tolerance, roughen surface before final set. Roughen with stiff brushes or rakes to depth of approximately 1/4 inch. Notify Engineer prior to placing concrete requiring initial raked surface finish so that acceptable raked finish standard may be established for project. Protect raked, base-slab finish from contamination until time of topping. Provide raked finish for following:

1. Surfaces to receive bonded concrete topping or fill.
2. Steep ramps, as noted on Drawings.
3. Additional locations as noted on Drawings.

F. Float Finish:

1. After concrete has been placed, struck off, consolidated and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when mix has stiffened sufficiently to permit proper operation of power-driven float. Consolidate surface with power-driven floats. Use hand floating with wood or cork-faced floats in locations inaccessible to power-driven machine and on small, isolated slabs.
  2. After initial floating, re-check tolerance of surface with 10-foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots to Class B tolerance. Immediately re-float slab to a uniform, smooth, granular texture.
  3. Provide float finish at locations not otherwise specified and not otherwise indicated on Drawings.
- G. Trowel Finish:
1. Apply float finish as previously specified. After power floating, use power trowel to produce smooth surface which is relatively free of defects but which may still contain some trowel marks. Do additional troweling by hand after surface has hardened sufficiently. Do final troweling when ringing sound is produced as trowel is moved over surface. Thoroughly consolidate surface by hand troweling operations.
  2. Produce finished surface free of trowel marks, uniform in texture and appearance and conforming to Class A tolerance. On surfaces intended to support floor coverings, remove defects which might show through covering by grinding.
  3. Provide trowel finish for floors which will receive floor covering and additional locations indicated on Drawings.
- H. Broom or Belt Finish:
1. Apply float finish as previously specified. Immediately after completing floated finish, draw broom or burlap belt across surface to give coarse transverse scored texture.
  2. Provide broom or belt finish at locations indicated on Drawings.
- 3.06 FINISHING SLABS AND SIMILAR FLAT SURFACES TO "F-NUMBER SYSTEM" FINISH
- A. Shaping to Contour: Use strike-off templates or approved compacting-type screeds riding on screed strips or edge forms to bring concrete surface to proper contour. Edge forms and screeds: Conform to Section 03100 - Concrete Formwork.
- B. Consolidation and Leveling: Concrete to be consolidated shall be as dry as practicable. Thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade. Consolidate and level slabs and floors with vibrating bridge screeds, roller pipe screeds or other approved means. After consolidation and leveling, do not manipulate surfaces prior to finishing operations.
- C. Tolerances for Finished Surfaces: Independent testing laboratory will check floor flatness and levelness in accordance with Paragraph 3.12, Field Quality Control.
- D. Float Finish:

1. After concrete has been placed, struck off, consolidated and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when mix has stiffened sufficiently to permit proper operation of power-driven float. Consolidate surface with power-driven floats. Use hand floating with wood or cork-faced floats in locations inaccessible to power-driven machine and on small, isolated slabs.
2. Check tolerance of surface after initial floating with a 10-foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots. Immediately refloat slab to uniform, smooth, granular texture to  $F_F20/F_L17$  tolerance, unless shown otherwise on Drawings.
3. Provide "F-Number System" float finish at locations indicated on Drawings.

E. Trowel Finish:

1. Apply float finish as previously specified. After power floating, use power trowel to produce smooth surface which is relatively free of defects but which may still contain some trowel marks. Do additional trowelings by hand after surface has hardened sufficiently. Do final troweling when ringing sound is produced as trowel is moved over surface. Thoroughly consolidate surface by hand troweling operations.
2. Produce finished surface free of trowel marks, uniform in texture and appearance and conforming to an  $F_F25/F_L20$  tolerance for slabs on grade and  $F_F25/F_L17$  for elevated slabs, unless shown otherwise on Drawings. On surfaces intended to support floor coverings, remove defects, which might show through covering, by grinding.
3. Provide "F-Number System" trowel finish at locations indicated on Drawings.

3.07 BONDED CONCRETE TOPPING AND FILL

A. Surface Preparation:

1. Protect raked, base-slab finish from contamination until time of topping. Mechanically remove oil, grease, asphalt, paint, clay stains or other contaminants, leaving clean surface.
2. Prior to placement of topping or fill, thoroughly dampen roughened slab surface and leave free of standing water. Immediately before topping or fill is placed, scrub coat of bonding grout into surface. Do not allow grout to set or dry before topping or fill is placed.

B. Concrete Fill:

1. Where concrete fill intersects a wall surface at an angle steeper than 45 degrees from vertical, provide a 1.5-inch deep keyway in the wall at the point of intersection; size keyway so that no portion of the concrete fill is less than 1.5 inches thick. Form keyway in new walls; create by saw cutting the top and bottom lines and chipping in existing walls.
2. Apply wood float finish to surfaces of concrete fill.
3. Provide concrete fill at locations shown on Drawings.

**C. Bonded Concrete Topping in Bottom of Clarifiers and Thickeners:**

1. Minimum thickness of concrete topping: 1 inch. Maximum thickness when swept in by clarifier and thickener equipment: 3 inches.
2. Compact topping and fill by rolling or tamping, bring to established grade, and float. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement. Coat surface with evaporation retardant as needed between finishing operations to prevent plastic shrinkage cracks.
3. Screed topping to true surface using installed equipment. Protect equipment from damage during sweeping-in process. Perform sweeping-in process under supervision of equipment manufacturer's factory representative. After topping has been screeded, apply wood float finish. During finishing, do not apply water, dry cement or mixture of dry cement and sand to the surface.
4. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the Engineer, fill the tank with sufficient water to cover the entire floor for 14 days.
5. Provide bonded concrete topping in bottom of all clarifiers and thickeners.

**3.08 EPOXY PENETRATING SEALER**

- A. Surfaces to receive epoxy penetrating sealer: Apply wood float finish. Clean surface and apply sealer in compliance with manufacturer's instructions.
- B. Rooms with concrete curbs or bases: Continue application of floor coating on curb or base to its juncture with masonry wall. Rooms with solid concrete walls or wainscots: Apply minimum 2-inch-high coverage of floor coating on vertical surface.
- C. Mask walls, doors, frames and similar surface to prevent floor coating contact.
- D. When coving floor coating up vertical concrete walls, curbs, bases or wainscots, use masking tape or other suitable material to keep a neat level edge at top of cove.
- E. Provide epoxy penetrating sealer at locations indicated on Drawings.

**3.09 EPOXY FLOOR TOPPING**

- A. Surfaces to receive epoxy floor topping: Apply wood float finish unless recommended otherwise by epoxy floor topping manufacturer. Clean surface and apply epoxy floor topping in compliance with manufacturer's recommendations and instructions. Thickness of topping: 1/8 inch.
- B. Rooms with concrete curbs or bases: Continue application of floor coating on curb or base to its juncture with masonry wall. Rooms with solid concrete walls or wainscots: apply 2-inch-high coverage of floor coating on vertical surface.
- C. Mask walls, doors, frames and similar surfaces to prevent floor coating contact.
- D. When coving floor coating up vertical concrete walls, curbs, bases or wainscots, use masking tape or other suitable material to keep a neat level edge at top of cove.
- E. Finished surface shall be free of trowel marks and dimples.
- F. Provide epoxy floor topping at locations indicated on Drawings.

CONCRETE FINISHING

03350-8

IFB: 02-04-13

## 3.10 SEALER/DUSTPROOFER

- A. Where sealer or sealer/dustproofer is indicated on Drawings, just prior to completion of construction, apply coat of specified clear sealer/dustproofing compound to exposed interior concrete floors in accordance with manufacturer's instructions.

## 3.11 NONSLIP FINISH

- A. Apply float finish as specified. Apply two-thirds of required abrasive aggregate by method that ensures even coverage without segregation and re-float. Apply remainder of abrasive aggregate at right angles to first application, using heavier application of aggregate in areas not sufficiently covered by first application. Re-float after second application of aggregate and complete operations with troweled finish. Perform finishing operations in a manner that will allow the abrasive aggregate to be exposed and not covered with cement paste.
- B. Provide nonslip finish at locations indicated on Drawings.

## 3.12 FIELD QUALITY CONTROL

- A. Flatness and levelness of slabs and similar flat surfaces that are indicated on Drawings to receive "F-Number System" finish will be checked by independent testing laboratory employed by Owner in accordance with Section 01454 - Testing Laboratory Services.

- B. Tolerances for "F-Number System" finished surfaces:

1. Floor tolerance shall be determined in accordance with ASTM E 1155.

2. Floor flatness and levelness tolerances:

a  $F_F$  defines maximum floor curvature allowed over 24 inches. Computed on the basis of successive 12-inch elevation differentials,  $F_F$  is commonly referred to as the "flatness F-Number."

b  $F_F = \frac{4.57}{\text{Maximum difference in elevation, in decimal inches, between successive 12-inch elevation differences.}}$

Maximum difference in elevation, in decimal inches, between successive 12-inch elevation differences.

c  $F_L$  defines relative conformity of floor surface to horizontal plane as measured over 10-foot distance.  $F_L$  is commonly referred to as "levelness F-number."

d  $F_L = \frac{12.5}{\text{Maximum difference in elevation, in inches, between two points separated by 10 feet.}}$

Maximum difference in elevation, in inches, between two points separated by 10 feet.

1. Achieve specified overall slab tolerance. Minimum local tolerance (1/2 bay, unless otherwise designated by Engineer): 2/3 of specified tolerance.
2. Tolerance for floated finish:  $F_F20/F_L17$ , unless otherwise shown on Drawings.
3. Tolerance for troweled finish:  $F_F25/F_L20$  for slabs on grade, and  $F_F25/F_L17$  for elevated slabs, unless otherwise shown on Drawings.

3.13 CURING

- A. Conform to requirements of Section 03390 - Concrete Curing.

END OF SECTION

## Section 03390

## CONCRETE CURING

## PART 1 GENERAL

## 1.01 SECTION INCLUDES

- A. Curing of structural concrete.

## 1.02 UNIT PRICES

- A. No separate payment will be made for concrete curing under this Section. Include payment in unit price for structural concrete.

## 1.03 REFERENCES

- A. ACI 308 - Standard Practice for Curing Concrete.
- B. ASTM C 171 - Standard Specifications for Sheet Materials for Curing Concrete.
- C. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- D. ASTM D 44587 - Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light-and Water-Exposure Apparatus.

## 1.04 DEFINITIONS

- A. Mass Concrete: Concrete sections 4 feet or more in least dimension.

## 1.05 SUBMITTALS

- A. Conform to Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit description of proposed curing method for concrete. When use of membrane-forming compound is proposed, submit manufacturer's technical information including material specifications, installation instructions and recommendations, and evidence that compound is satisfactory for intended application. State locations where curing compound will be used.
- C. When membrane-forming compounds are to be used, submit certification by the manufacturer of compliance with specified requirements and compatibility with toppings, coatings, finishes, and adhesives to be applied.

## PART 2 PRODUCTS

## 2.01 MATERIALS

- A. Membrane-forming Curing Compound: Conform to ASTM C 309, Type 1D, and following requirements.

CONCRETE CURING

03390-1

IFB: 02-04-13

1. Minimum solids content: 30 percent.
  2. Compound shall not permanently discolor concrete. When used for liquid- containing structures, curing compound shall be white-pigmented.
  3. When used in areas that are to be coated, or that will receive topping or floor covering, material shall not reduce bond of coating, topping, or floor covering to concrete. Curing compound manufacturer's technical information shall state conditions under which compound will not prevent bond.
  4. Conform to local, state and federal solvent emission requirements.
- B. Clear Curing and Sealing Compound (VOC Compliant): Conform to ASTM C 309, Type 1, Class B, and the following requirements: 30 percent solids content minimum; non-yellowing under ultraviolet light after 500-hour test in accordance with ASTM D 4587. Sodium silicate compounds are not permitted. Conform to local, state and federal solvent emission requirements.
- C. Sheet Material for Curing Concrete: ASTM C 171; waterproof paper, polyethylene film or white burlap-polyethylene sheeting.
- D. Curing Mats (for use in Curing Method 2): Heavy shag rugs or carpets, or cotton mats quilted at 4 inches on center; 12 ounce per square yard minimum weight when dry.
- E. Water for curing: Clean and potable.

### PART 3 EXECUTION

#### 3.01 CURING PROCEDURES

- A. Comply with ACI 308 and the requirements specified herein. Protect freshly-deposited concrete from premature drying and excessively hot or cold temperatures. Maintain minimal moisture loss and relatively constant temperature during time necessary for hydration of cement and proper hardening of concrete.
- B. Unformed Surfaces: For concrete surfaces not in contact with forms, use one of following procedures immediately after completion of placement and finishing.
1. Ponding or continuous sprinkling.
  2. Absorptive mat or fabric kept continuously wet.
  3. Sand or other covering kept continuously wet.
  4. Continuous steam bath (not exceeding 150 degrees F at surface of concrete).
  5. Vapor mist bath.
  6. Membrane-forming curing compound applied according to manufacturer's recommendations. After the curing compound has dried, wet slab surfaces and cover with waterproof paper, polyethylene film, or white burlap-polyethylene sheeting after the application of the curing compound. Tape sheet seams together and provide sufficient weights to keep the sheeting in place. Wet the slab surface again if the sheeting becomes dislodged, and replace the sheeting.

CONCRETE CURING

03390-2

IFB: 02-04-13

7. Other moisture-retaining coverings as approved by Engineer.
- C. Restrictions on Use of Curing Compounds: Unless curing compound manufacturer certifies that curing compound will not prevent bond to cured surface, do not use curing compound on surfaces that will be rubbed or receive additional concrete, mortar, topping, terrazzo or other cementitious finishing materials, on slabs under resilient floors or built-up roofing, or on surfaces to be waterproofed, sealed, hardened or painted.
- D. Curing and Sealing Compounds: At locations indicated, cure exposed interior slabs and troweled slabs receiving mastic-applied adhesives with specified clear curing and sealing compound in accordance with manufacturer's recommendations. Do not store materials directly on curing membranes. Use plywood to protect curing membrane from damage. Immediately repair membranes damaged by foot traffic or other operations.
- E. Duration of Curing: Continue curing until cumulative number of days or fractions of days during which ambient temperature is above 50 degrees F has totaled 7. Continue curing of water-retaining structures for a total of 14 days. When high-early-strength concrete has been used, continue curing for total of 3 days. Prevent rapid drying at end of curing period.
- F. Formed Surfaces: During the curing period keep wet steel forms heated by sun and wood forms in contact with concrete. When forms are to be removed during curing period, employ curing materials or methods immediately. Continue such curing for remainder of curing period.
- G. Temperature:
  1. Cold Weather. When mean daily temperature of atmosphere is less than 40 degrees F, maintain temperature of concrete between 50 and 70 degrees F for required curing period. When necessary, make arrangements for heating, covering, insulating or housing concrete work in advance of placement to maintain required temperature and moisture conditions. Prevent damage or injury due to concentration of heat. When combustion heaters are necessary in enclosed or protected area where concrete slabs are being placed, vent heaters.
  2. Hot Weather. In advance of placement make arrangements for shading, fog spraying, sprinkling, ponding or installation of windbreaks or wet covering of light color. Take such protective measures as quickly as concrete hardening and finishing operations will allow.
  3. Temperature Changes. Control so rate of change in temperature of concrete is as uniform as possible. Do not permit temperature change to exceed 5 degrees F in any one hour or 50 degrees F in any 24-hour period.
- H. Protection from Mechanical Injury. During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration. Protect finished concrete surfaces from damage caused by construction equipment, materials or methods, and by rain or running water. Do not load self-supporting structures in a way that over stresses concrete.

### 3.02 CURING MASS CONCRETE

- A. Observe the following additional restrictions when curing mass concrete.
  1. Minimum curing period: 2 weeks.

2. When ambient air temperature falls below 32 degrees F, protect surface of concrete against freezing.
3. Do not use steam or other curing methods that will add heat to concrete.
4. Keep forms and exposed concrete continuously wet for at least the first 48 hours after placing, and whenever surrounding air temperature is above 90 degrees F during final curing period.
5. During 2-week curing period, provide necessary controls to prevent ambient air temperature immediately adjacent to concrete from falling more than 30 degrees F in 24 hours.

END OF SECTION

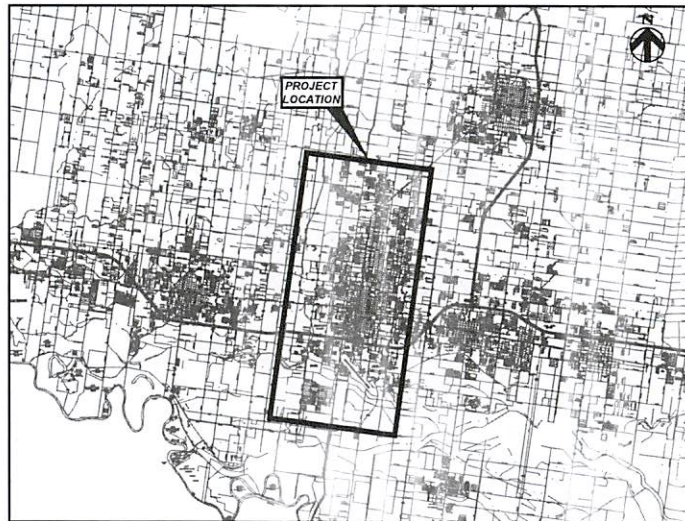
# McALLEN INDEPENDENT SCHOOL DISTRICT PARKING LOT AND STREET IMPROVEMENTS PROJECT

McALLEN, TEXAS



McALLEN ISD BOARD MEMBERS

SAM SALDIVAR JR ..... PRESIDENT  
 DANIEL VELA ..... VICE-PRESIDENT  
 HILDA GARZA ..... SECRETARY  
 ERICA DE LA GARZA ..... ASSISTANT SECRETARY  
 DEBBIE CRANE ALISEDA ..... BOARD MEMBER  
 JAVIER FARIAS ..... BOARD MEMBER  
 JOSEPH CAPORUSSO ..... BOARD MEMBER



LOCATION MAP  
NTS

SHEET INDEX

SHEET	DRAWING NO.	TITLE
<b>GENERAL</b>		
1	0000G-001	COVER SHEET & SHEET INDEX
2	0000G-002	LOCATION MAP
3	0000G-003	GENERAL NOTES, COMMON SYMBOLY & LEGEND
4	0000C-001	EROSION CONTROL GENERAL DETAILS
5	0000C-002	CIVIL DETAILS
<b>SITE</b>		
6	0100C-001	GARZA ELEMENTARY SCHOOL STAFF PARKING & DRIVEWA EXISTING TOPOGRAPHY AND EROSION CONTROL LAYOUT
7	0100C-002	ELEMENTARY SCHOOL STAFF PARKING & DRIVEWAY- GRADING AND OVERLAY LAYOUT
8	0100C-003	GARZA ELEMENTARY SCHOOL STAFF PARKING & DRIVEWA STRIPING LAYOUT
9	0200C-001	LAMAR ACADEMY PARKING LOT- EXISTING TOPOGRAPHY AND EROSION CONTROL LAYOUT
10	0200C-002	LAMAR ACADEMY PARKING LOT- GRADING AND OVERLAY LAYOUT
11	0200C-003	LAMAR ACADEMY PARKING LOT- STRIPING LAYOUT
12	0300C-001	CHRISTA MCAULIFFE ELEMENTARY SCHOOL PLAY AREA- EXISTING TOPOGRAPHY AND EROSION CONTROL LAYOUT
13	0300C-002	CHRISTA MCAULIFFE ELEMENTARY SCHOOL PLAY AREA- GRADING AND OVERLAY LAYOUT
14	0300C-003	CHRISTA MCAULIFFE ELEMENTARY SCHOOL PLAY AREA- STRIPING LAYOUT
15	0400C-001	MEMORIAL HIGH SCHOOL STUDENT PARKING LOT- EXISTING TOPOGRAPHY AND EROSION CONTROL LAYOUT
16	0400C-002	MEMORIAL HIGH SCHOOL STUDENT PARKING LOT- GRADING AND OVERLAY LAYOUT
17	0400C-003	MEMORIAL HIGH SCHOOL STUDENT PARKING LOT- STRIPING LAYOUT
18	0500C-001	BEN MILAM ELEMENTARY PARKING LOT- EXISTING TOPOGRAPHY AND EROSION CONTROL LAYOUT
19	0500C-002	BEN MILAM ELEMENTARY PARKING LOT- GRADING AND OVERLAY LAYOUT
20	0500C-003	BEN MILAM ELEMENTARY PARKING LOT- STRIPING LAYOUT
21	0600C-001	THEODORE ROOSEVELT ELEMENTARY PARKING LOT- EXISTING TOPOGRAPHY AND EROSION CONTROL LAYOUT
22	0600C-002	THEODORE ROOSEVELT ELEMENTARY PARKING LOT- GRADING AND OVERLAY LAYOUT
23	0600C-003	THEODORE ROOSEVELT ELEMENTARY PARKING LOT- STRIPING LAYOUT
24	0700C-001	McALLEN HIGH SCHOOL BULLDOG DRIVE AND ALLEY DRN EXISTING TOPOGRAPHY AND EROSION CONTROL LAYOUT
25	0700C-002	McALLEN HIGH SCHOOL BULLDOG DRIVE AND ALLEY DRN GRADING AND OVERLAY LAYOUT
26	0700C-003	McALLEN HIGH SCHOOL BULLDOG DRIVE AND ALLEY DRN STRIPING LAYOUT

**DANNENBAUM**

ENGINEERING COMPANY - McALLEN, LLC  
 T.B.P.E. FIRM REGISTRATION #8999  
 1109 NOLANA LOOP, STE 208 McALLEN, TX 78504 (956) 682-3677

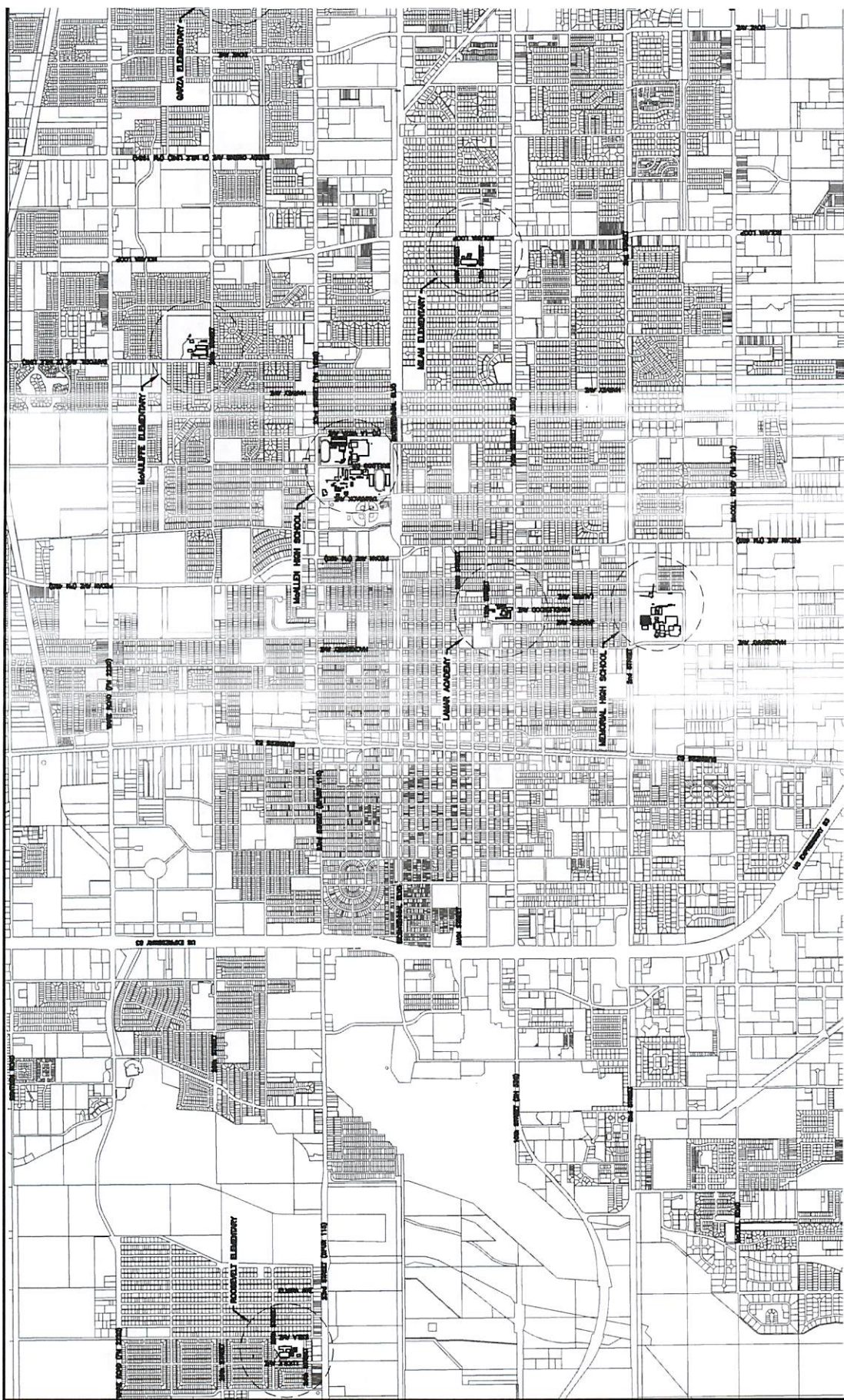
**FEBRUARY 2013**



PROJECT  
4657-01  
DRAWING  
0000G-001  
SHEET No

REVISIONS			
No	DATE	DESCRIPTION	APP
	FEBRUARY 2013	ISSUED FOR BID	

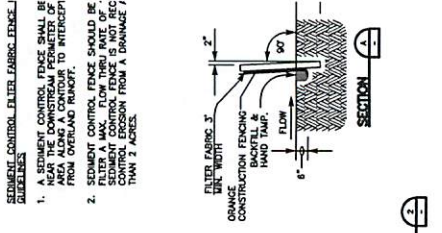
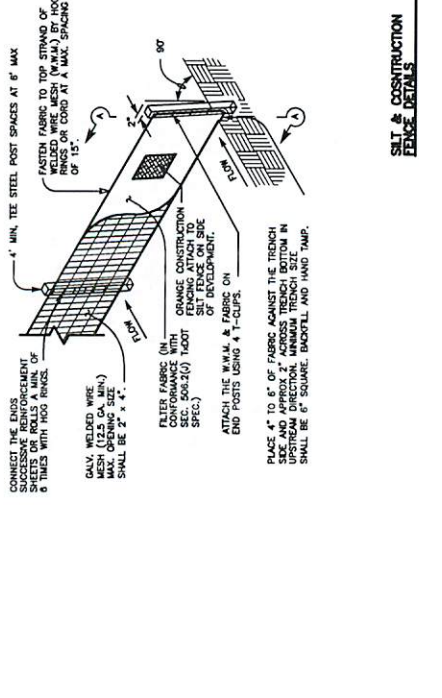
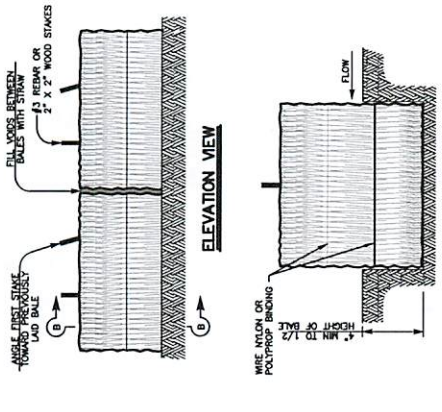
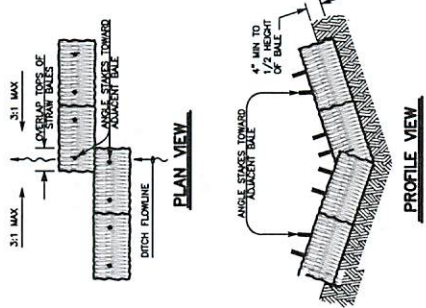
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LOCATION MAP  
 1" = 1200'

DESIGNED BY HRV/HR	REVISIONS	PROJECT	<p>SCALE BAR IS ONE INCH ON ORIGINAL DRAWINGS</p>
DRAWN BY HRV/HR	NO. DATE DESCRIPTION	4637-01	
CHECKED BY CA	1. 12/10/2011	MCALLEN INDEPENDENT SCHOOL DISTRICT PARKING LOT AND STREET IMPROVEMENTS PROJECT	
APPROVED BY SLM		CITY OF MCALLEN MISD PROJECT LOCATIONS MAP	
DATE FEBRUARY 2013			<p><b>DANNENBAUM</b>          ENGINEERING COMPANY - MCALLEN, LLC          TILPE FIRM REGISTRATION #8999          1108 INDUSTRIAL LOOP, STE. 200, MCALLEN, TX 78504-1699 952-3877</p>



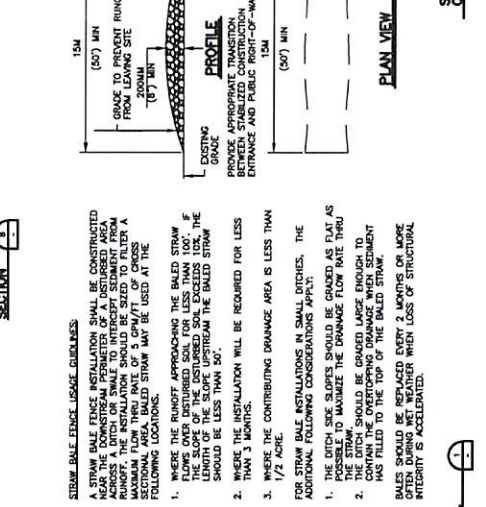


**NOTES:**

1. WHERE MINIMUM CLEARANCE IS REQUIRED, THE FENCE SHALL BE SECURED WITH CONCRETE IN PLACE TO MAINTAIN A MINIMUM CLEARANCE OF 3.0 M (10 FT) TO THE UNDERPASS OR OVERPASS.
2. THE FENCE SHALL BE SECURED WITH CONCRETE IN PLACE TO MAINTAIN A MINIMUM CLEARANCE OF 3.0 M (10 FT) TO THE UNDERPASS OR OVERPASS.
3. THE FENCE SHALL BE SECURED WITH CONCRETE IN PLACE TO MAINTAIN A MINIMUM CLEARANCE OF 3.0 M (10 FT) TO THE UNDERPASS OR OVERPASS.
4. THE FENCE SHALL BE SECURED WITH CONCRETE IN PLACE TO MAINTAIN A MINIMUM CLEARANCE OF 3.0 M (10 FT) TO THE UNDERPASS OR OVERPASS.
5. THE FENCE SHALL BE SECURED WITH CONCRETE IN PLACE TO MAINTAIN A MINIMUM CLEARANCE OF 3.0 M (10 FT) TO THE UNDERPASS OR OVERPASS.

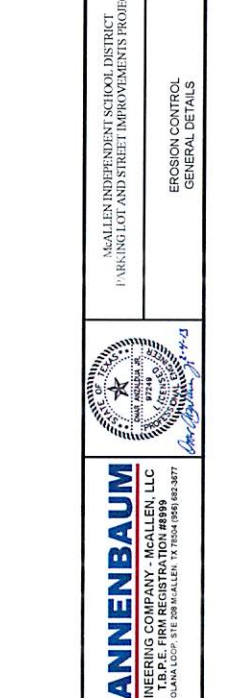
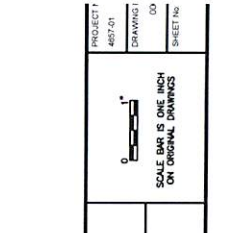
**NOTES:**

1. STONE SIZE 75-125 mm (3-5") OPEN GRADED FLOOR.
2. LENGTH: AS EFFECTIVE BUT NOT LESS THAN 15 m (50').
3. THICKNESS: NOT LESS THAN 200 mm (8").
4. WIDTH: NOT LESS THAN FULL WIDTH OF ALL POINTS OF IMPRESS/EXPRESS.
5. WASHING: WHEN NECESSARY, VEHICLE WHEELS SHALL BE CLEANED TO REMOVE SEDIMENT PRIOR TO ENTERING THE FENCE. WASHING IS REQUIRED. IT SHALL BE DONE ON AN APPROVED WASHING STATION. ALL SEDIMENT SHALL BE PREVENTED FROM ENTERING THE FENCE. WASHING STATIONS SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRAVEL ON OR THROUGH THE FENCE. WASHING STATIONS SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRAVEL ON OR THROUGH THE FENCE. WASHING STATIONS SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRAVEL ON OR THROUGH THE FENCE.
6. MAINTENANCE: THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRAVEL ON OR THROUGH THE FENCE. WASHING STATIONS SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRAVEL ON OR THROUGH THE FENCE. WASHING STATIONS SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRAVEL ON OR THROUGH THE FENCE.
7. DRAINAGE: ENTRANCE MUST BE PROPERLY GRADED OR INCORPORATE A DRAINAGE SWALE TO PREVENT RUNOFF FROM LEAVING THE CONSTRUCTION SITE.

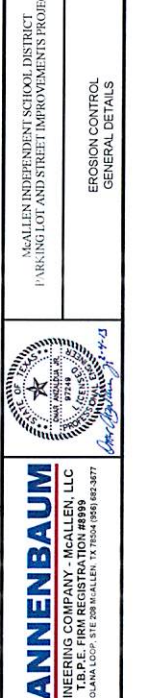
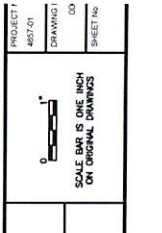


**STRAW BALE FENCE USAGE GUIDELINES:**

1. STRAW BALE FENCE SHALL BE CONSTRUCTED AS A DITCH OR SWALE TO INTERCEPT SEDIMENT FROM THE CONSTRUCTION SITE. THE FENCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRAVEL ON OR THROUGH THE FENCE.
2. THE FENCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRAVEL ON OR THROUGH THE FENCE.
3. THE FENCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRAVEL ON OR THROUGH THE FENCE.
4. THE FENCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRAVEL ON OR THROUGH THE FENCE.
5. THE FENCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRAVEL ON OR THROUGH THE FENCE.
6. THE FENCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRAVEL ON OR THROUGH THE FENCE.
7. THE FENCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRAVEL ON OR THROUGH THE FENCE.



DESIGNED BY		REVISED	
NO.	DATE	DESCRIPTION	APP. OR
1	FEBRUARY 2013		
DRAWN BY: HRV/AR			
CHECKED BY: OA			
APPROVED BY: SLM			
DATE: FEBRUARY 2013			



**McALLEN**  
INDEPENDENT SCHOOL DISTRICT

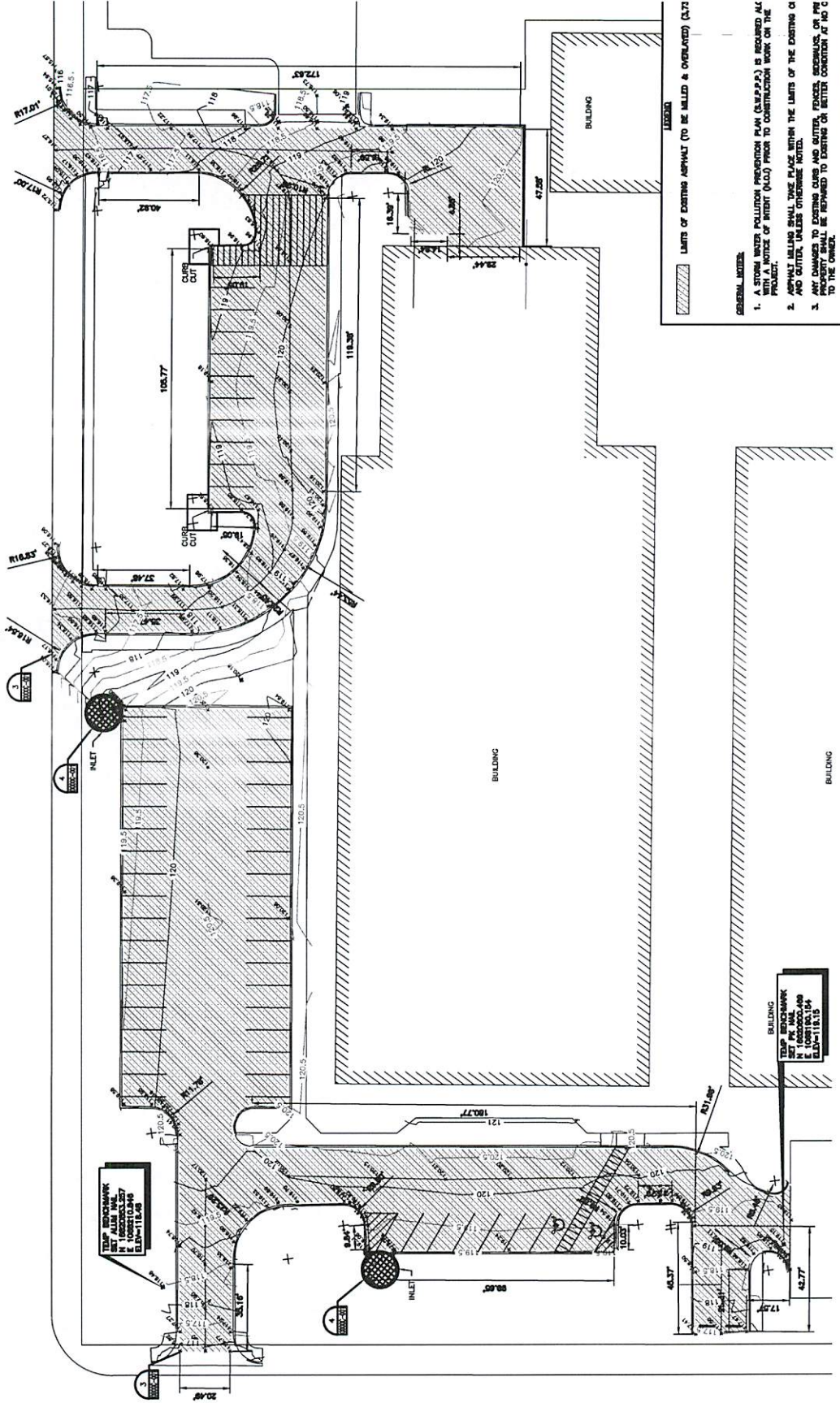
**DANNENBAUM**  
ENGINEERING COMPANY - McALLEN, LLC  
1108 McALLEN BLVD., STE 200, McALLEN, TX 78104 (936) 863-3877

PROJECT: McALLEN INDEPENDENT SCHOOL DISTRICT PARKING LOT AND STREET IMPROVEMENTS PROJECT  
DRAWING: 03  
SHEET NO.: 03

EROSION CONTROL GENERAL DETAILS



LARK AVE



29th ST

**LIMITS OF EXISTING ASPHALT (TO BE MILLED & OVERLAIN) (L7)**

**GENERAL NOTES:**

- A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) IS REQUIRED AS PER 19.05401(1) PRIOR TO CONSTRUCTION WORK ON THE PROJECT.
- ANY WORK SHALL BE PLACED WITHIN THE LIMITS OF THE EXISTING OR PROPOSED CURB AND GUTTER UNLESS OTHERWISE NOTED.
- ANY GRASS TO BE EXPOSED DURING CONSTRUCTION SHALL BE MAINTAINED TO EXISTING OR BETTER CONDITION AS PER C-1 TO THE OWNER.

PROJECT: 48721  
 DRAWING: 01  
 SHEET NO: 16

SCALE BAR IS ONE INCH ON ORIGINAL DRAWING

MCALLEN INDEPENDENT SCHOOL DISTRICT  
 PARKING LOT AND STREET IMPROVEMENTS PROJECT

GARZA ELEMENTARY SCHOOL STAFF PARKING & DRIVEWAY  
 EXISTING TOPOGRAPHY AND  
 EROSION CONTROL LAYOUT



**DANNENBAUM**  
 ENGINEERING COMPANY - MCALLEN, LLC  
 T.E.P.E. FIRM REGISTRATION #8999  
 1108 N. OLAMA LOOP, STE 200, MCALLEN, TX 78204 (956) 965-3877

**MCALLEN**  
 INDEPENDENT SCHOOL DISTRICT

DESIGNED BY	DATE	REVISIONS	DATE	DESCRIPTION	BY	CHK
HRV/HR	FEBRUARY 2013	A	FEBRUARY 2013	REVISION FOR R.O.	HRV	OK
DRAWN BY						
CHECKED BY						
APPROVED BY						
DATE	FEBRUARY 2013					

REV/APP	DATE	DESCRIPTION
1	FEBRUARY 2013	ISSUED FOR BID

DATE	APPROVED BY	SCALE
FEBRUARY 2013	SLM	SCALE BAR IS ONE INCH ON ORIGINAL DRAWINGS

**McALLEN**  
 INDEPENDENT SCHOOL DISTRICT

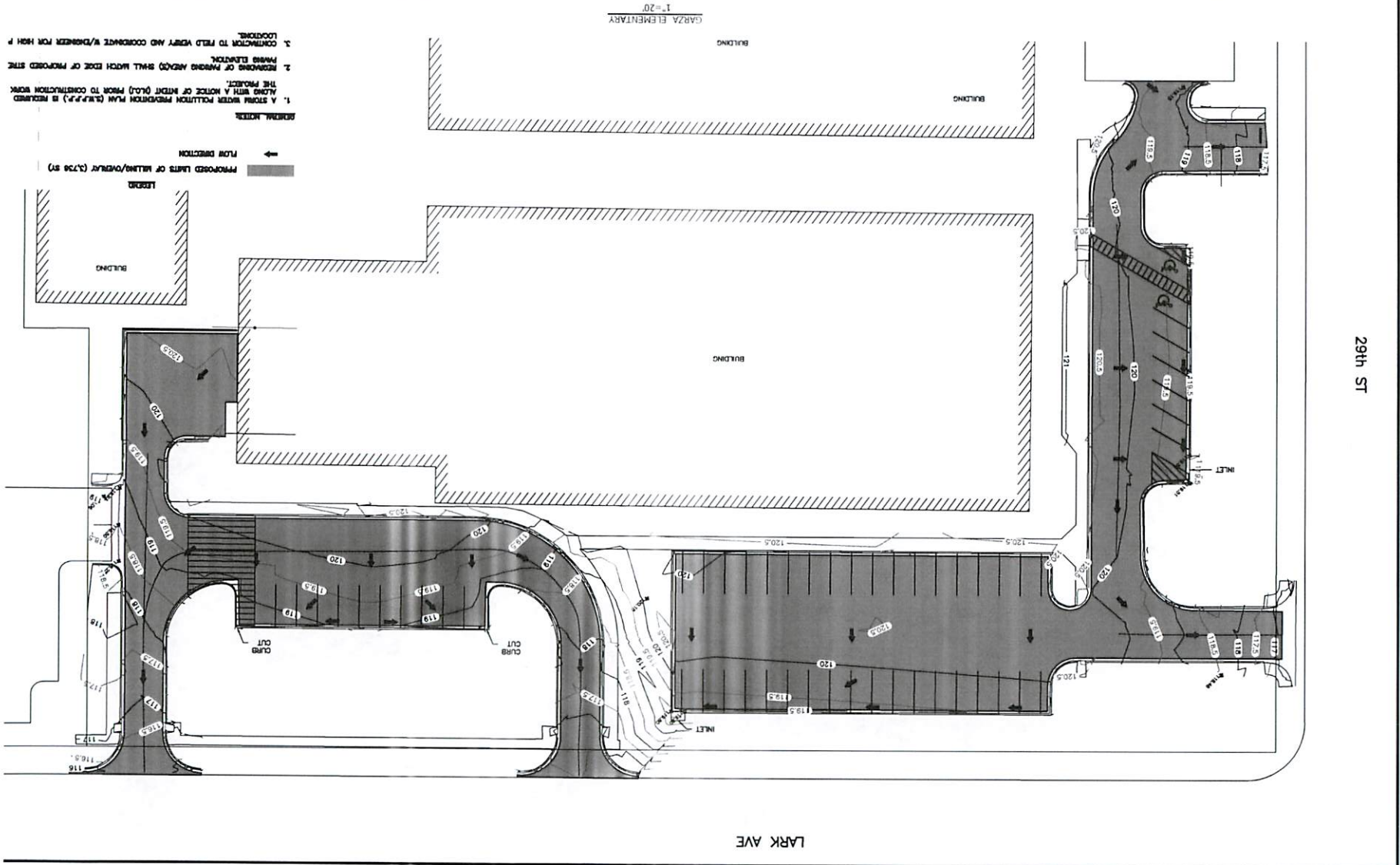
**DANNENBAUM**  
 ENGINEERING COMPANY - McALLEN, LLC  
 T. B. P. E. FIRM REGISTRATION #8999  
 1109 HOLMAN LOOP, STE 208 McALLEN, TX 78204 (505) 822-8277



MALLEN INDEPENDENT SCHOOL DISTRICT  
 PARKING LOT AND STREET IMPROVEMENTS PROJECT

GARZA ELEMENTARY SCHOOL STAFF PARKING & DRIVEWAY  
 - GRADING AND OVERLAY LAYOUT

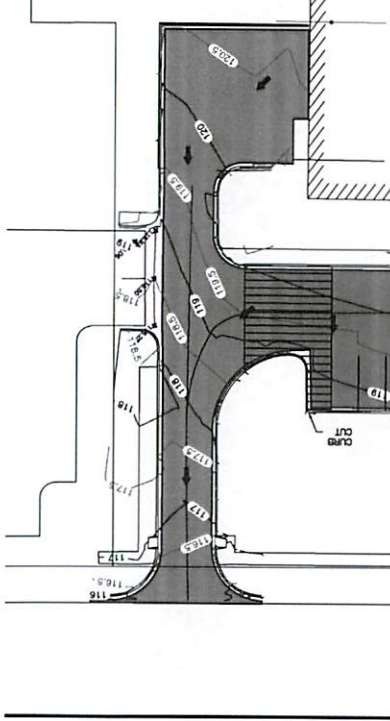
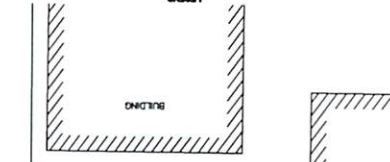
PROJECT: 4657-01  
 DRAWING: 01  
 SHEET NO. 01



- GENERAL NOTES:**
1. A STORM WATER RETENTION POND (S.W.R.P.) IS REQUIRED ALONG WITH A NOTICE OF INTENT (NOI) PRIOR TO CONSTRUCTION WORK.
  2. FINISH ELEVATIONS OF PARKING AREAS SHALL MATCH EDGE OF PROPOSED DRIVEWAY.
  3. CONNECTION TO FIELD VERIFY AND CORRECT W/ DIMENSIONS FOR HIGH POINT LOCATION.

PROPOSED LIMITS OF BILLOW/OVERLAY (2.75% BY)

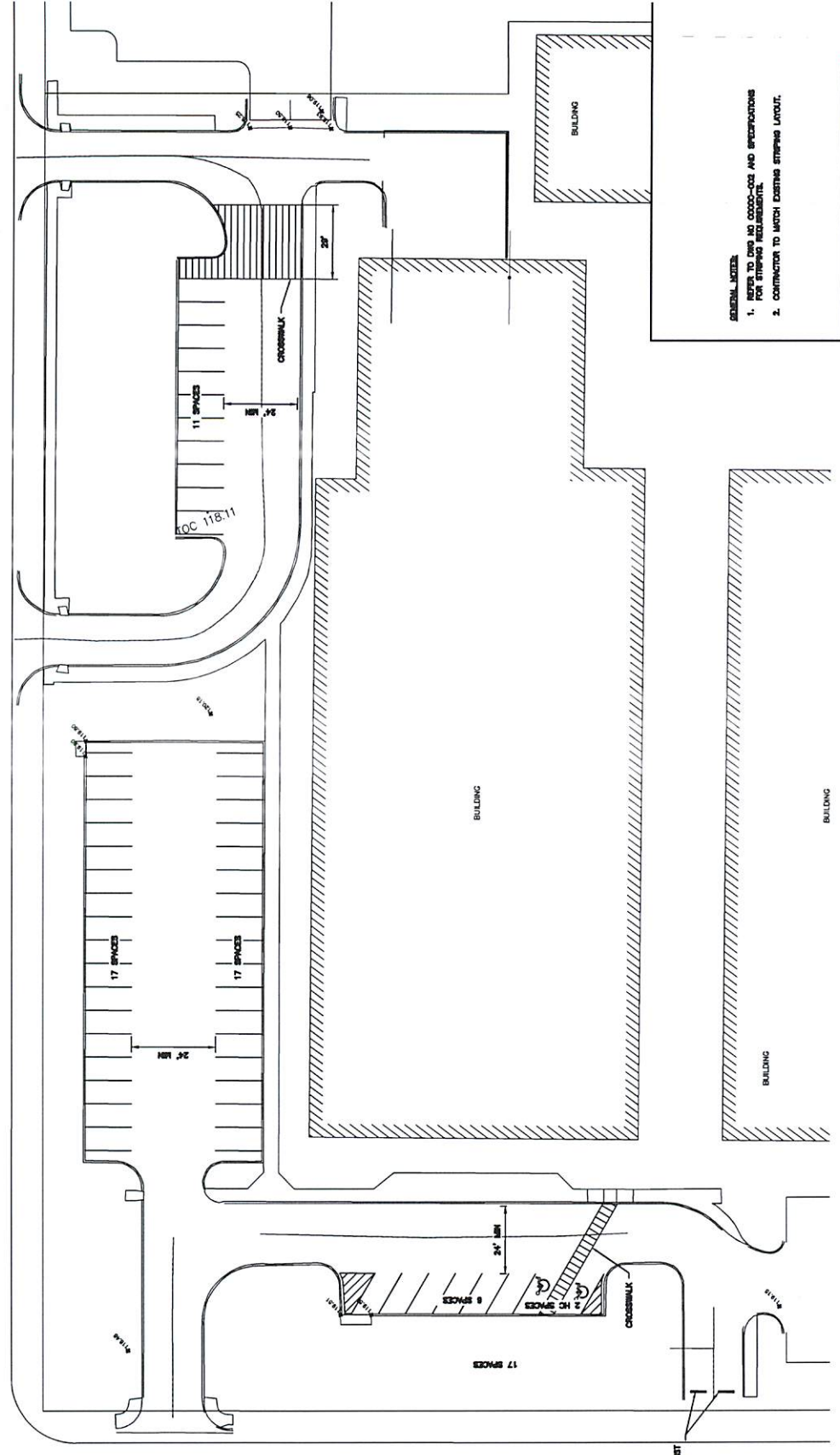
FLOW DIRECTION



LARK AVE

29th ST

LARK AVE



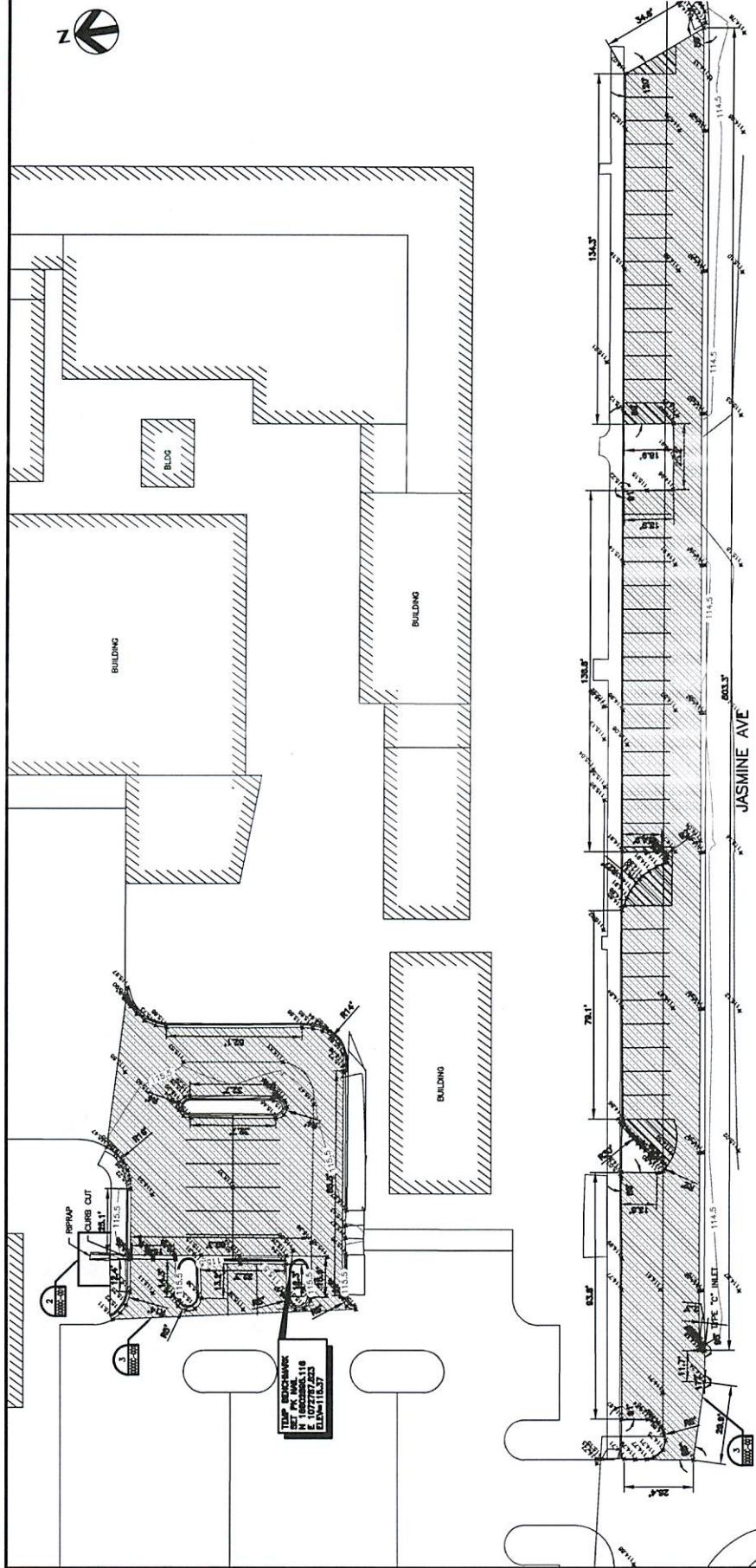
**GENERAL NOTES:**  
 1. REFER TO THE NO CONCURE AND SPECIFICATIONS FOR STRIPING REQUIREMENTS.  
 2. CONTRACTOR TO MATCH EXISTING STRIPING LAYOUT.

GARZA ELEMENTARY  
 1"=20'

DESIGNED BY: HRV/HR	REVISIONS	PROJECT: 4027.01
DRAWN BY: HRV/HR	No. DATE DESCRIPTION	DRAWING I:
CHECKED BY: CA	1. FEBRUARY 2013	DRAWING II:
APPROVED BY: SLM		DRAWING III:
DATE: FEBRUARY 2013		SHEET NO:
<b>McALLEN</b> INDEPENDENT SCHOOL DISTRICT		McALLEN INDEPENDENT SCHOOL DISTRICT PARKING LOT AND STREET IMPROVEMENTS PROJECT GARZA ELEMENTARY SCHOOL STAFF PARKING & DRIVEWAY - STRIPING LAYOUT
<b>DANNENBAUM</b> ENGINEERING COMPANY - McALLEN, LLC TULSA, OKLA. FIRM REGISTRATION #8999 1108 N. GARDNER STREET, McALLEN, TX 79204-1099 (937) 483-3977		SCALE BAR IS ONE INCH ON ORIGINAL DRAWING

29th ST

CONTRACTOR TO REMOVE EXIST CURB STOPS



**GENERAL NOTES:**

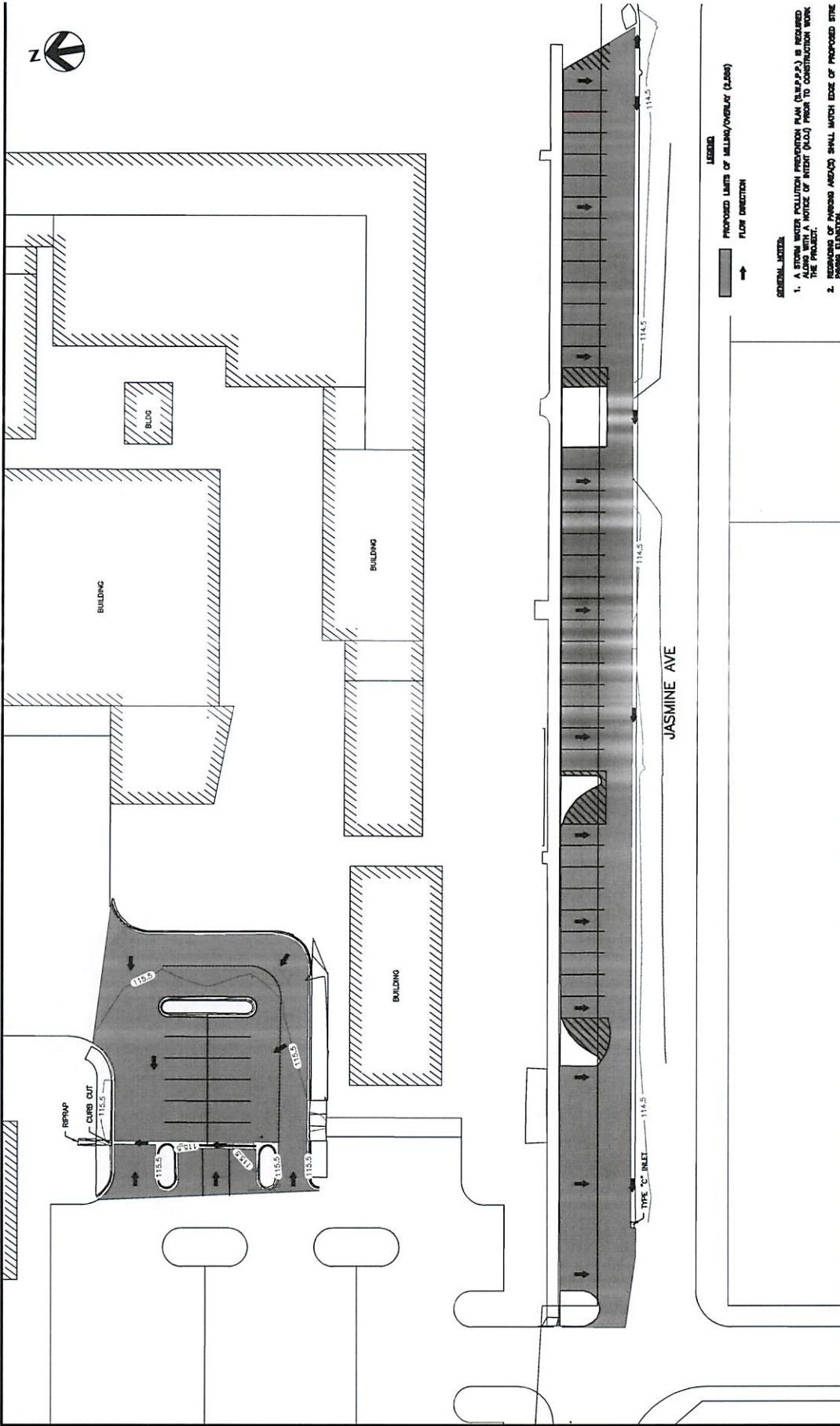
1. A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) IS REQUIRED / PROVIDED AT THE NOTICE OF INTENT (NOI) PRIOR TO CONSTRUCTION WORK ON THE PROPERTY.
2. ASPHALT PATCHES SHALL BE PLACED WITHIN THE LIMITS OF THE EXISTING AND CUTTER, UNLESS OTHERWISE NOTED.
3. ANY DAMAGES TO EXISTING CURB AND CUTTER, PAVEMENT, SIGNALS, OR PROPERTY SHALL BE REPAIRED TO ORIGINAL OR BETTER CONDITION AT THE OWNER'S RISK.

**LEGEND:**

- [Hatched Area] LIMITS OF EXISTING ASPHALT (TO BE MAINTAINED & OVERLAPPED) (2)

LAMAR ACADEMY  
1"=20'

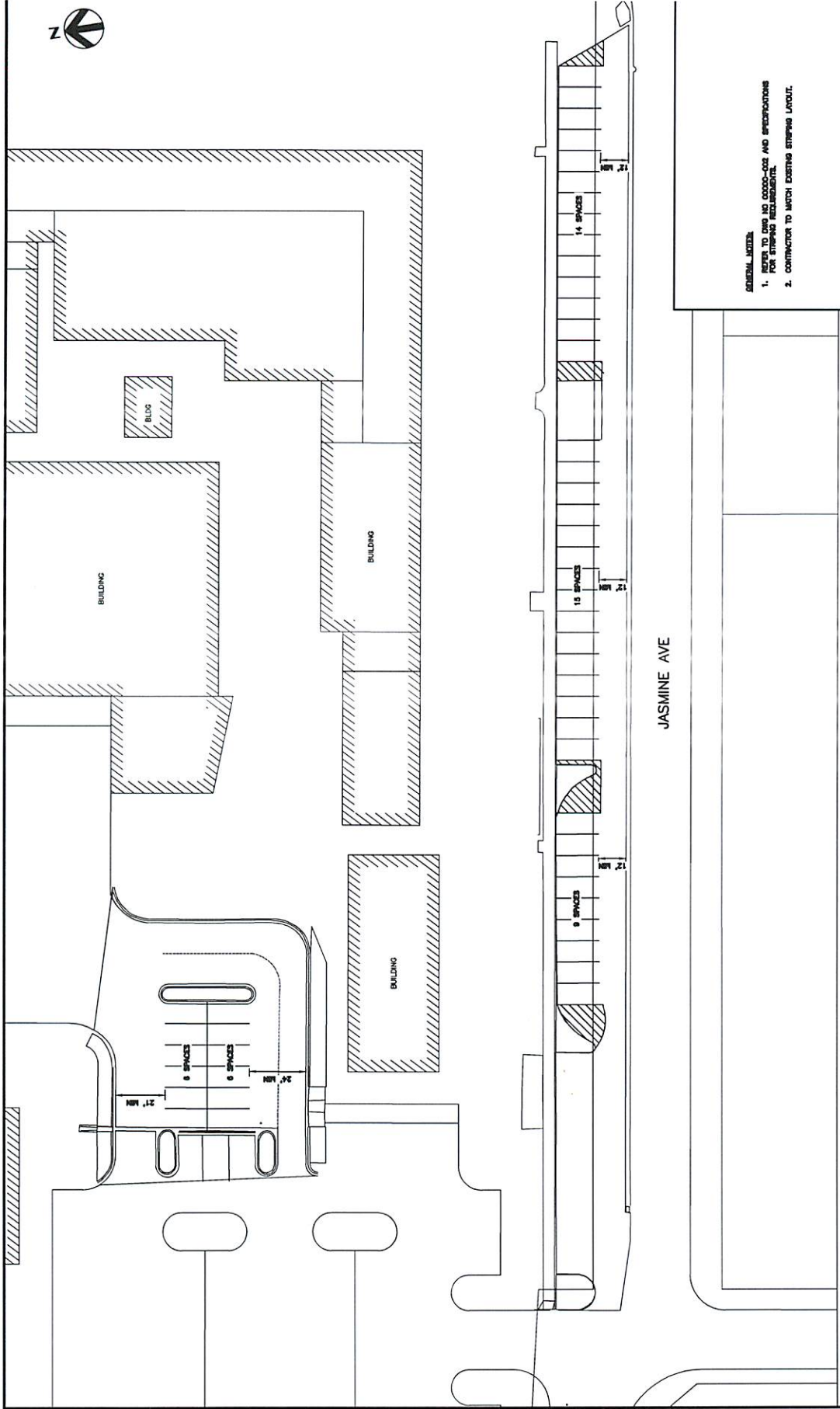
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No.	DATE	DESCRIPTION	DESIGNED FOR NO.	APP'D BY	DATE											
1	FEBRUARY 2013															
DANNENBAUM ENGINEERING COMPANY - McALLEN, LLC TILPE FIRM REGISTRATION #8999 1108 N. DUNN LANE, STE. 200, McALLEN, TX 78401-6501 (956) 835-3977		LAMAR ACADEMY PARKING LOT EXISTING TOPOGRAPHY AND EROSION CONTROL LAYOUT			SCALE BAR IS ONE INCH ON ORIGINAL DRAWING											



- GENERAL NOTES:**
1. A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) IS REQUIRED ALONG WITH A NOTICE OF INTENT (NOI) PRIOR TO CONSTRUCTION WORK BEING PERFORMED.
  2. REVISIONS OF THESE DETAILS SHALL MATCH EDGE OF PROPOSED SITE PER PLAN.
  3. CONTRACTOR TO FIELD VERIFY AND COORDINATE W/DRAINAGE FOR EACH P LOT.

LAMAR ACADEMY  
1"=20'

DESIGNED BY HRV/AR	DATE FEBRUARY 2013	REVISIONS	PROJECT NO. 467-01
DRAWN BY HRV/AR	DATE FEBRUARY 2013	DESCRIPTION	DRAWING NO. 02
CHECKED BY CA	DATE FEBRUARY 2013	STATUS FOR	SHEET NO.
APPROVED BY SLM	DATE FEBRUARY 2013		
<p><b>McALLEN</b> INDEPENDENT SCHOOL DISTRICT</p>			<p>McALLEN INDEPENDENT SCHOOL DISTRICT PARKING LOT AND STREET IMPROVEMENTS PROJECT</p>
<p><b>DANNENBAUM</b> ENGINEERING COMPANY - McALLEN, LLC T.E.P.E. FIRM REGISTRATION #8999 1108 N. DANA LOOP, STE 200, McALLEN, TX 78204 (957) 665-3877</p>			<p>LAMAR ACADEMY PARKING LOT - GRADING AND OVERLAY LAYOUT</p>

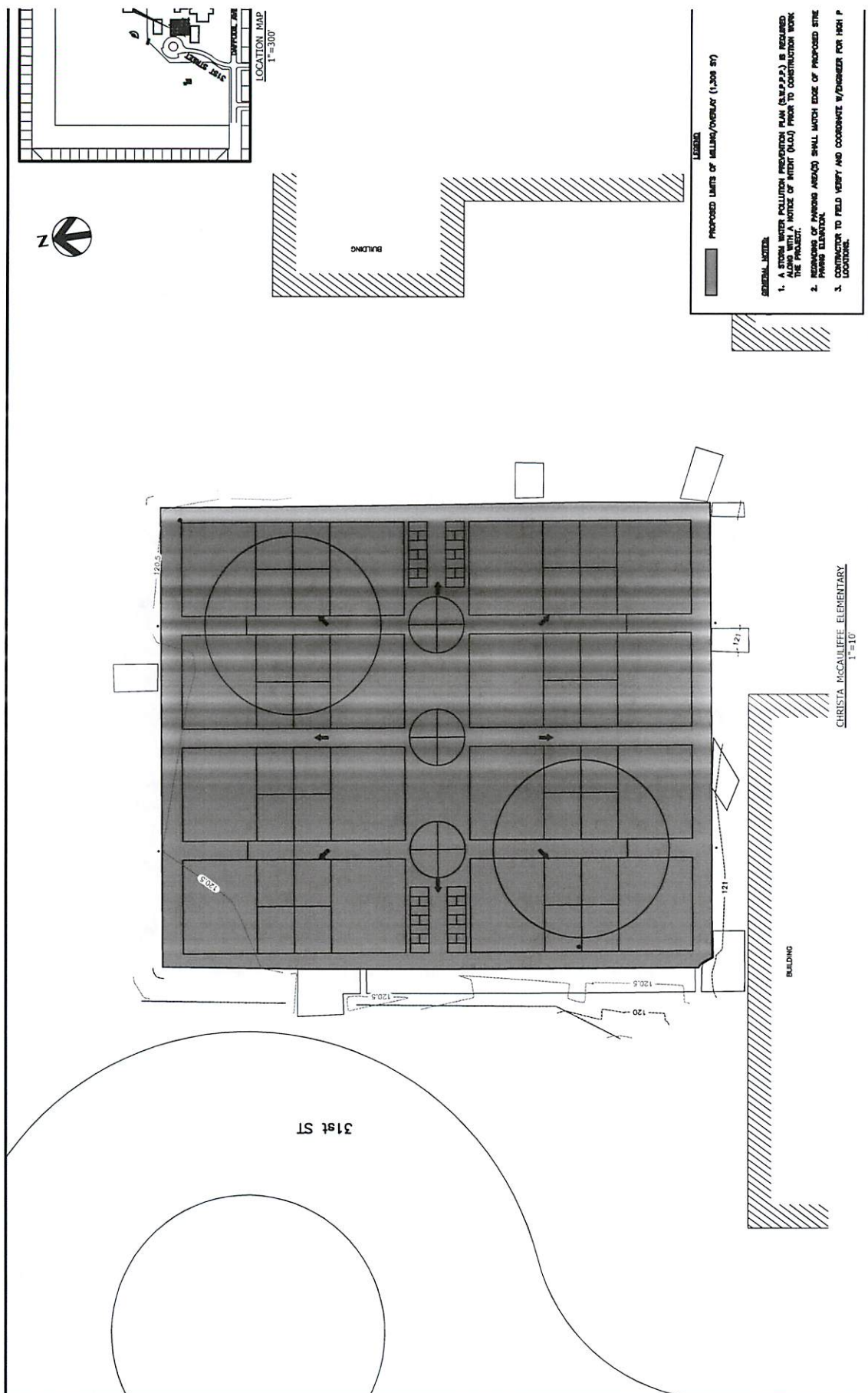


**GENERAL NOTES:**  
 1. REFER TO ALL 0000-000 AND SPECIFICATIONS FOR STRIPING REQUIREMENTS.  
 2. CONTRACTOR TO MATCH EXISTING STRIPING LAYOUT.

LAMAR ACADEMY  
 1" = 20'

DESIGNED BY HRV/MR	NO. DATE A. FEBRUARY 2013	REVISIONS DESCRIPTION ISSUED FOR	APP. OF	PROJECT 4027.02
DRAWN BY HRV/MR				DRAWING NO. 02
CHECKED BY CA				SHEET NO. 02
APPROVED BY SLM				
DATE FEBRUARY 2013				
				 SCALE BAR IS ONE INCH ON ORIGINAL DRAWING
<b>McALLEN</b> INDEPENDENT SCHOOL DISTRICT		<b>DANNENBAUM</b> ENGINEERING COMPANY - McALLEN, LLC T.S.P.E. FIRM REGISTRATION #8998 1108 N. DUNA CANYON STE. 200 McALLEN, TEXAS 79701-862-9877		McALLEN INDEPENDENT SCHOOL DISTRICT PARKING LOT AND STREET IMPROVEMENTS PROJECT LAMAR ACADEMY PARKING LOT STRIPING LAYOUT

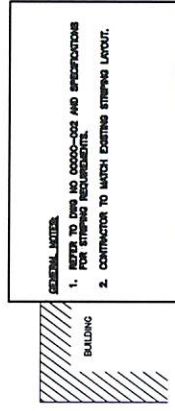
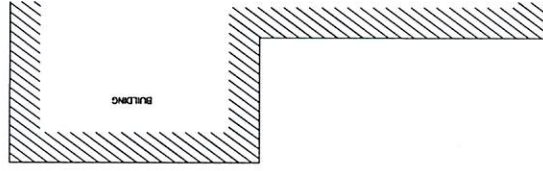
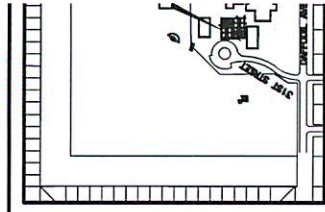




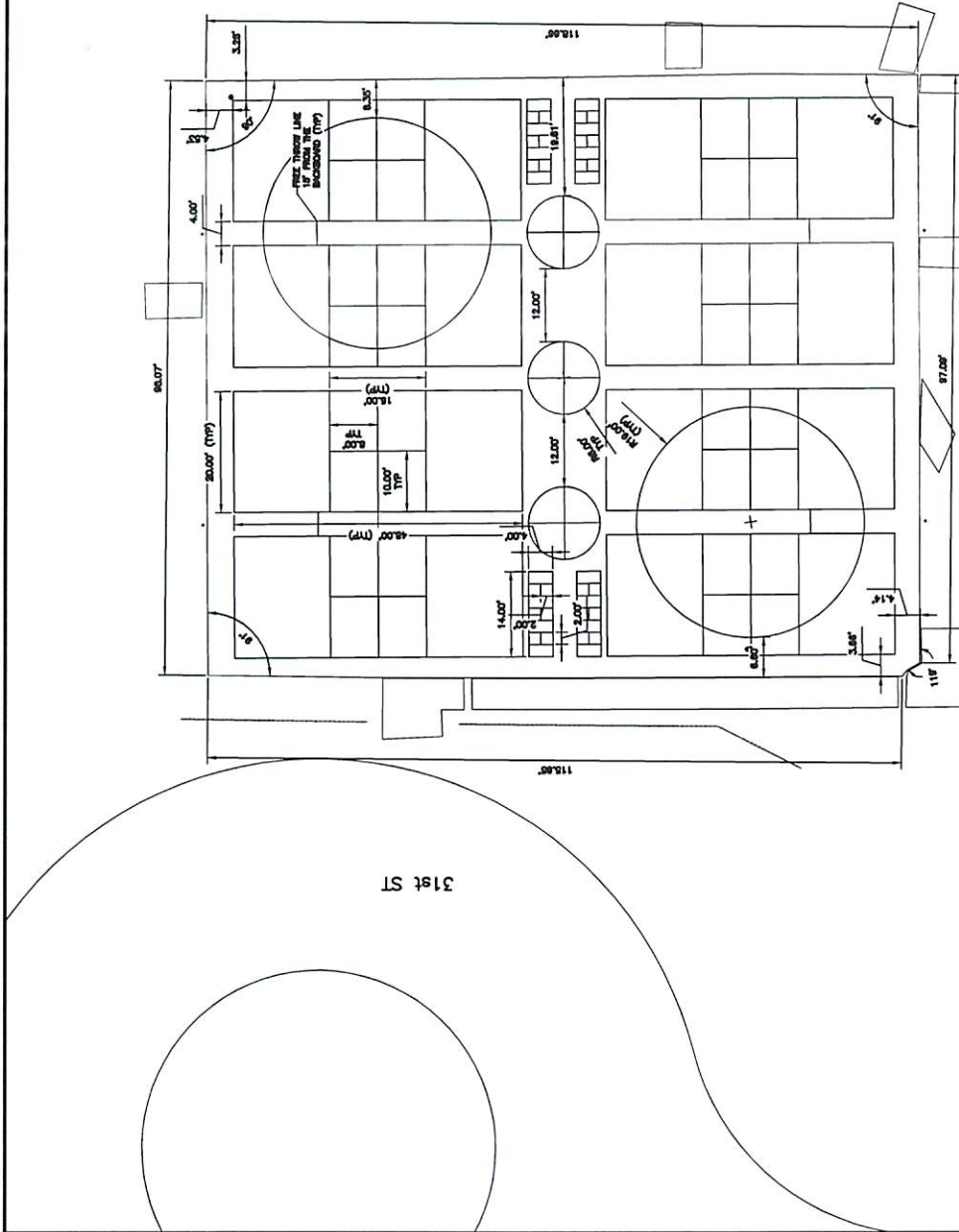
DESIGNED BY: HRV/HR	REVISIONS	PROJECT
DRAWN BY: HRV/HR	NO. DATE	4637-01
CHECKED BY: OA	1. FEBRUARY 2013	DRAWING 1
APPROVED BY: SLM		03
DATE: FEBRUARY 2013		SHEET NO.
<b>McALLEN</b> INDEPENDENT SCHOOL DISTRICT		
<b>DANNENBAUM</b> ENGINEERING COMPANY - McALLEN, LLC T.B.P.E. FIRM REGISTRATION #8998 1109 McALLEN LOOP, STE 200 McALLEN, TX 78504 (957) 682-3877		
McALLEN INDEPENDENT SCHOOL DISTRICT PARKING LOT AND STREET IMPROVEMENTS PROJECT CRISTA McCALLIFFE ELEMENTARY SCHOOL - GRADING AND OVERLAY LAYOUT		

**GENERAL NOTES:**

- A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) IS REQUIRED AND MUST BE SUBMITTED WITH A NOTICE OF INTENT (NOI) PRIOR TO CONSTRUCTION WORK. THE PLAN SHALL BE REVIEWED AND APPROVED BY THE DISTRICT ENGINEER.
- ALL GRADING SHALL BE IN ACCORDANCE WITH THE DISTRICT SPECIFICATIONS AND SHALL MATCH EDGE OF PROPOSED STREETS AND ADJACENT PROPERTIES.
- CONTRACTOR TO FIELD VERIFY AND CORRECTIVE W/ADJUST FOR HIGH POINT LOCATIONS.



**GENERAL NOTES**  
 1. REFER TO DWG NO. 00000-002 AND SPECIFICATIONS FOR STRIPING REQUIREMENTS.  
 2. CONTRACTOR TO MATCH EXISTING STRIPING LAYOUT.



CHRISTA MCCALLIFFE ELEMENTARY  
 1"=10'

PROJECT: 4697.01  
 DRAWING: 03  
 SHEET NO.

MCALLEN INDEPENDENT SCHOOL DISTRICT  
 PARKING LOT AND STREET IMPROVEMENTS PROJECT  
 CRISTA MCCALLIFFE ELEMENTARY SCHOOL  
 STRIPING LAYOUT

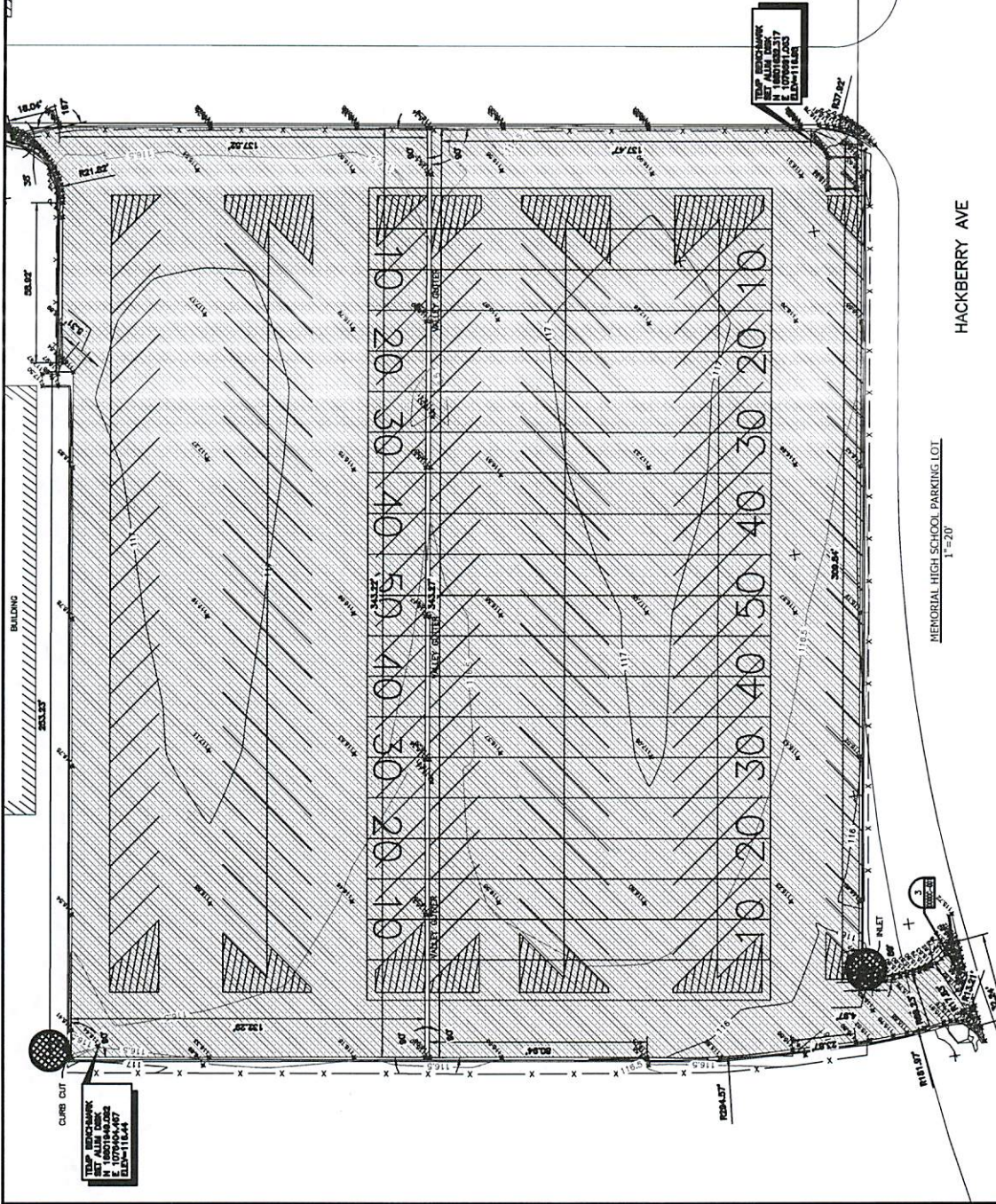
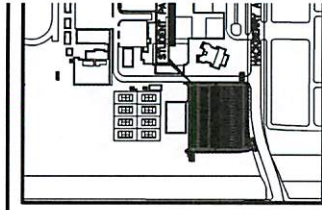


**DANNENBAUM**  
 ENGINEERING COMPANY - MCALLEN, LLC  
 T.E.P.E. FIRM REGISTRATION #8999  
 1128 N. OLANA LOOP, STE 208 MCALLEN, TX 78541 (956) 862-3877

**MCALLEN**  
 INDEPENDENT SCHOOL DISTRICT

NO.	DATE	REVISIONS	BY	CHKD.
1	FEBRUARY 2013	DESIGNATION	HRV/AR	OK
2		REVISION FOR BID	HRV/AR	OK

DESIGNED BY: HRV/AR  
 DRAWN BY: HRV/AR  
 CHECKED BY: OK  
 APPROVED BY: SLU  
 DATE: FEBRUARY 2013

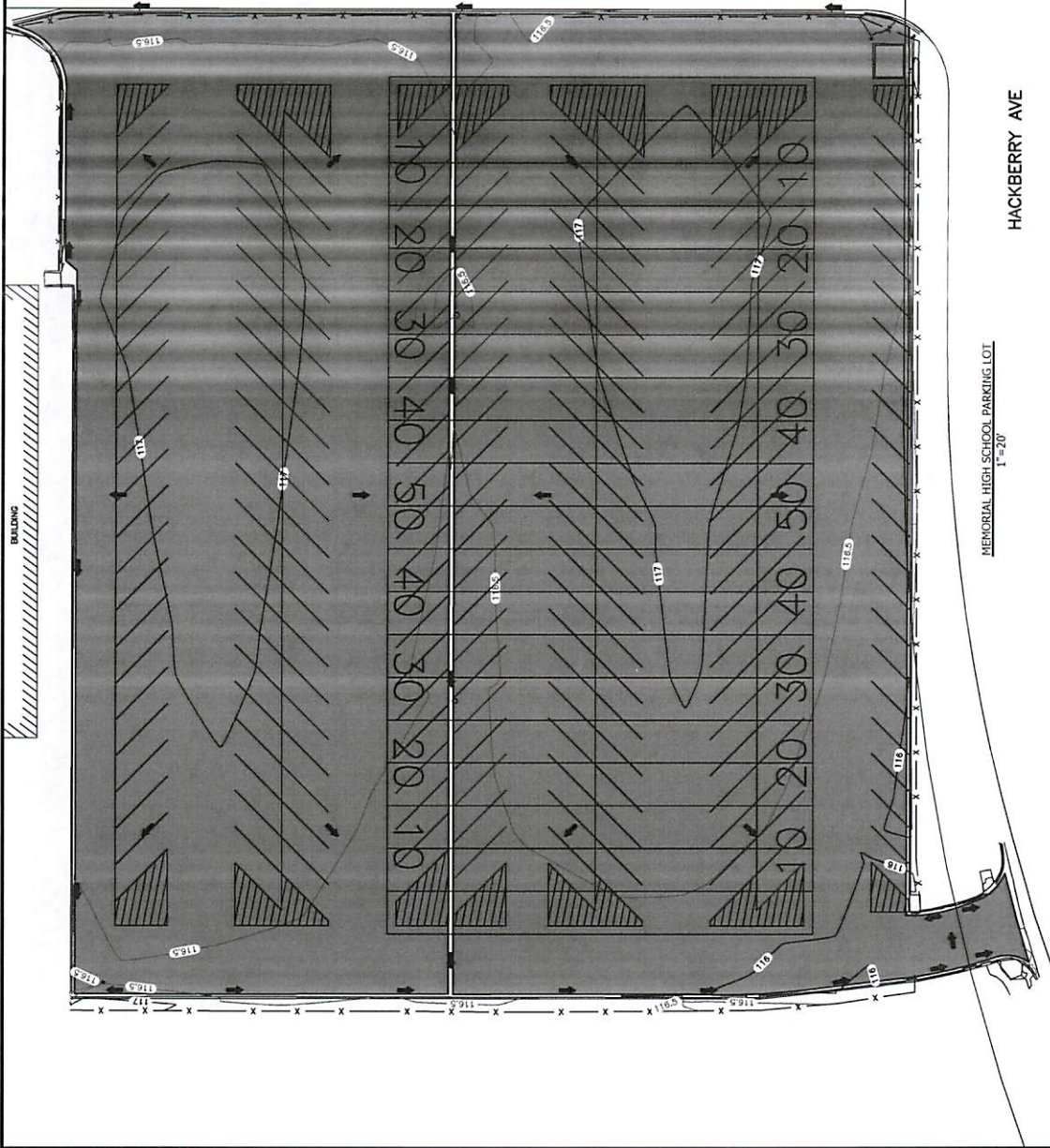
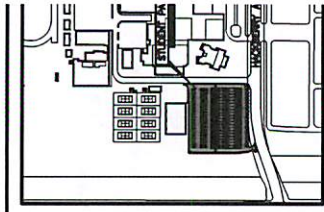


**LEGEND**  
 Hatched pattern: LINES OF EXISTING ASPHALT (TO BE MILLED & OVERLIFTED)  
 (11,279 SF)

**GENERAL NOTES**

1. A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) IS REQUIRED / MUST BE IN PLACE PRIOR TO CONSTRUCTION WORK ON THE PROPERTY.
2. ASPHALT LINES SHALL TAKE PLACE WITHIN THE LIMITS OF THE EXISTING AND GUTTER, UNLESS OTHERWISE NOTED.
3. ANY DAMAGES TO EXISTING CURB AND GUTTER, PAVEMENT, OR OTHER PROPERTY SHALL BE REPAIRED TO EXISTING OR BETTER CONDITION AT THE OWNER'S RISK.

DESIGNED BY: HRV/MR DRAWN BY: HRV/MR CHECKED BY: CA APPROVED BY: SLM DATE: FEBRUARY, 2013		REVISIONS <table border="1"> <thead> <tr> <th>NO.</th> <th>DATE</th> <th>DESCRIPTION</th> <th>ISSUED FOR</th> <th>APP. OF</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>FEBRUARY 2013</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		NO.	DATE	DESCRIPTION	ISSUED FOR	APP. OF	1	FEBRUARY 2013			
NO.	DATE	DESCRIPTION	ISSUED FOR	APP. OF									
1	FEBRUARY 2013												
<p><b>McALLEN</b> INDEPENDENT SCHOOL DISTRICT</p>		<p><b>DANNENBAUM</b> ENGINEERING COMPANY - McALLEN, LLC TULSA, OKLA. FIRM REGISTRATION #8999 1108 N. GARDNER STREET, McALLEN, TX 78901-6903-3877</p>											
		McALLEN INDEPENDENT SCHOOL DISTRICT PARKING LOT AND STREET IMPROVEMENTS PROJECT MEMORIAL HIGH SCHOOL STUDENT PARKING LOT - EXISTING TOPOGRAPHY AND EROSION CONTROL LAYOUT											
PROJECT # 1457-01 DRAWING # 04 SCALE BAR IS ONE INCH ON ORIGINAL DRAWING		SHEET NO.											



**LEGEND**

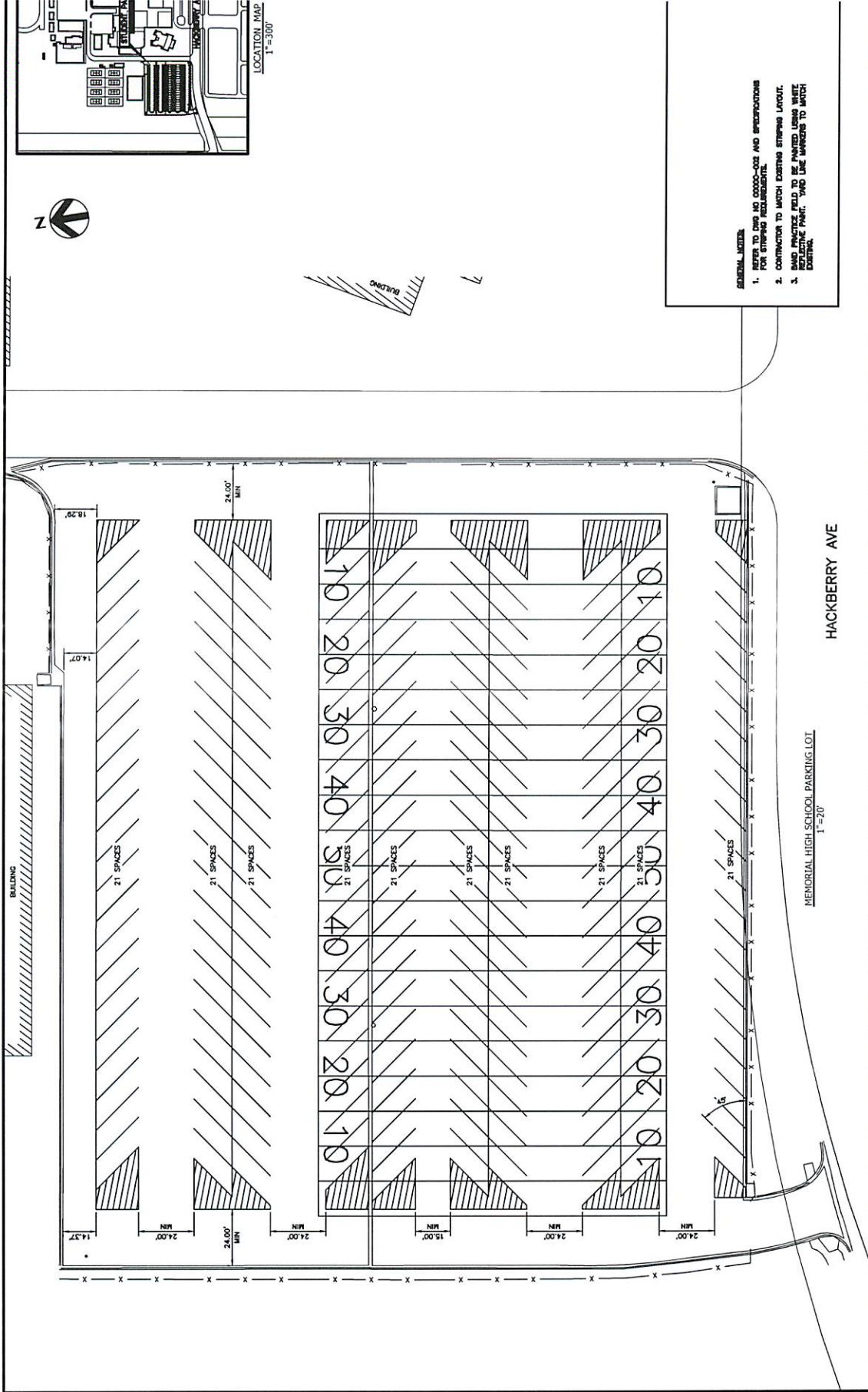
PROPOSED LIMITS OF MILLING/OVERLAY (11.279 ST)

FLOW DIRECTION

**GENERAL NOTES**

1. A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) IS REQUIRED ALONG WITH A NOTICE OF INTENT (NOI) PRIOR TO CONSTRUCTION WORK THE PROJECT.
2. REMEDIATION OF PONDING AREAS SHALL MATCH EDGE OF PROPOSED SITE FROM ELEVATION.
3. CONTRACTOR TO FIELD VERIFY AND COORDINATE W/DRAWER FOR HIGH P LOCATIONS.

DESIGNED BY HRV/AR	DATE FEBRUARY 2013	REVISIONS	PROJECT 467-01
DRAWN BY HRV/AR	DATE FEBRUARY 2013	DESCRIPTION	DRAWING 04
CHECKED BY OA	DATE FEBRUARY 2013	REVISIONS	SHEET NO.
APPROVED BY SLM	DATE FEBRUARY 2013	REVISIONS	
<p><b>DANNENBAUM</b> ENGINEERING COMPANY - McALLEN, LLC T.E.P.E. FIRM REGISTRATION #8999 1108 N. OLANA LOOP, STE 208 McALLEN, TX 75504 (959) 865-3877</p>		<p>McALLEN INDEPENDENT SCHOOL DISTRICT PARKING LOT AND STREET IMPROVEMENTS PROJECT</p> <p>MEMORIAL HIGH SCHOOL STUDENT PARKING LOT - GRADING AND OVERLAY LAYOUT</p>	

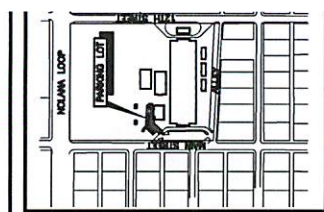


**GENERAL NOTES:**

1. REFER TO THE NO COORDINATE AND DIMENSIONS FOR STRIPING REQUIREMENTS.
2. CONTRACTOR TO MATCH EXISTING STRIPING LAYOUT.
3. PAINT STRIPING TO BE PAINTED USING WHITE EMULSIVE PAINT. VMD LINE MARKERS TO MATCH EXISTING.

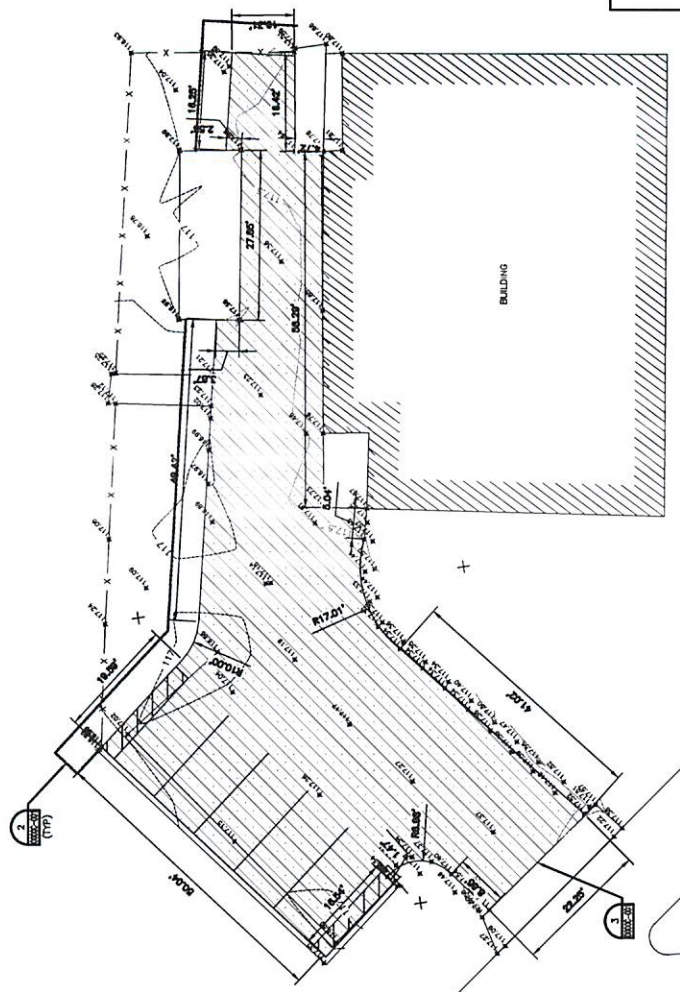
HACKBERRY AVE  
 MEMORIAL HIGH SCHOOL PARKING LOT  
 1"=20'

DESIGNED BY HRV/MR	REVISIONS	PROJECT 4637-01	 SCALE BAR IS ONE INCH ON ORIGINAL DRAWING
DRAWN BY HRV/MR	NO. DATE DESCRIPTION ISSUED FOR NO.	DRAWING NO. 04	
CHECKED BY CA	1. FEBRUARY 2013	MCALLEN INDEPENDENT SCHOOL DISTRICT PARKING LOT AND STREET IMPROVEMENTS PROJECT	 Dannenbaum Engineering Company, McAllen, LLC P.E. FIRM REGISTRATION #8998 1108 HODGSON ST., MCALLEN, TX 78504-4943
APPROVED BY SLM	DATE FEBRUARY 2013	MEMORIAL HIGH SCHOOL STUDENT PARKING LOT - STRIPING LAYOUT	



TEMP BENCHMARK  
 2  
 N 1073431.700  
 E 1073431.122  
 ELEV=1118.87

TEMP BENCHMARK  
 1  
 N 1073431.700  
 E 1073431.122  
 ELEV=1118.87



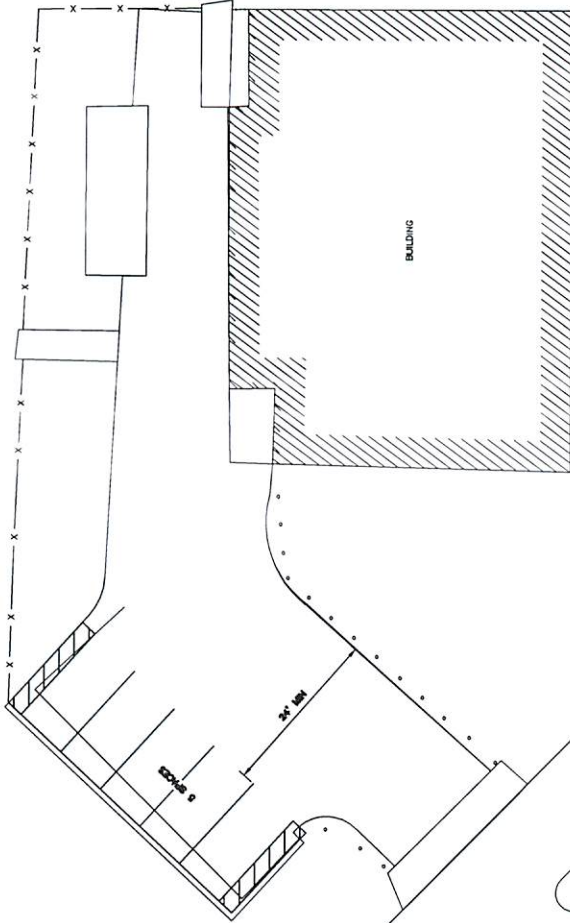
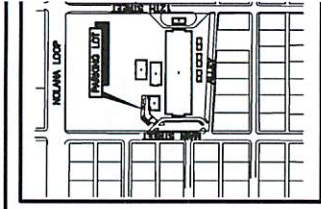
**LEGEND**  
 LIMITS OF EXISTING ASPHALT (TO BE MILLED & OVERLAYED) (A)

- GENERAL NOTES**
1. A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) IS REQUIRED / MUST BE SUBMITTED TO THE CITY OF TIJUPE PRIOR TO CONSTRUCTION WORK ON THE PROJECT.
  2. ASPHALT REPAIRS SHALL TAKE PLACE WITHIN THE LIMITS OF THE EXISTING AND GUTTER, UNLESS OTHERWISE NOTED.
  3. ANY DAMAGES TO EXISTING CURBS AND GUTTERS, FENCES, SIGNALS, OR OTHER PROPERTY SHALL BE REPAIRED TO EXISTING OR BETTER CONDITION AT THE OWNER'S RISK.

BEN MILAN ELEMENTARY PARKING LOT  
 1"=10'

DESIGNED BY HRV/MR	DRAWN BY HRV/MR	CHECKED BY CA	APPROVED BY SLM	DATE FEBRUARY, 2013	REVISIONS No. DATE DESCRIPTION A. FEBRUARY 2013 ISSUED FOR BID		<b>DANNENBAUM</b> ENGINEERING COMPANY - McALLEN, LLC TIJUPE FIRM REGISTRATION #8999 1108 NOLANA LOOP, SUITE 200, McALLEN, TX 78204-1699 (956) 883-8877		<b>McALLEN</b> INDEPENDENT SCHOOL DISTRICT	PROJECT # 1011111111 DRAWING # 05 SHEET NO. 01	<p>SCALE BAR IS ONE INCH ON ORIGINAL DRAWINGS</p>	PROJECT # 1011111111 DRAWING # 05 SHEET NO. 01

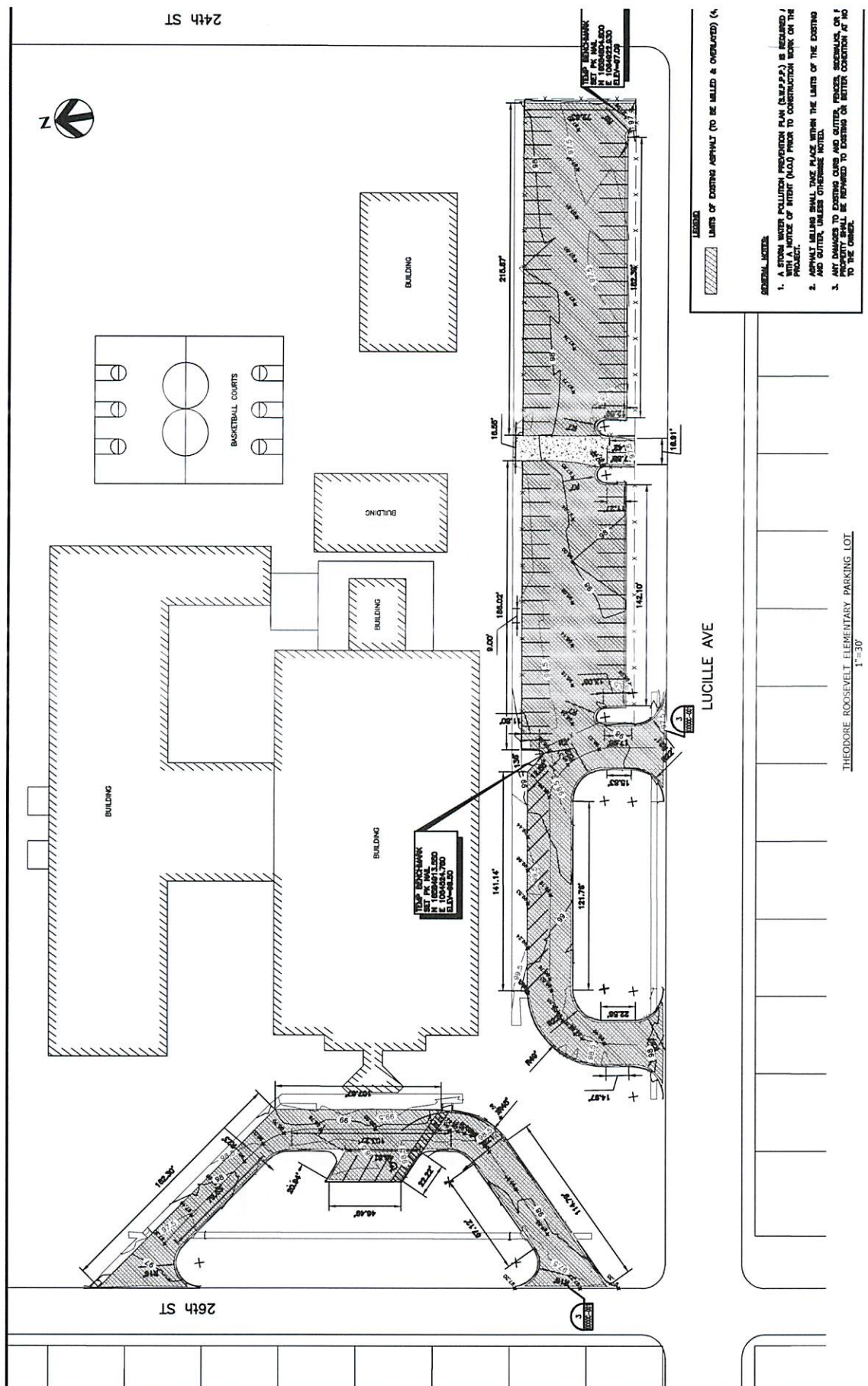




- GENERAL NOTES:**
1. REFER TO DWG NO 00000-002 AND ALL SPECIFICATIONS FOR STRIPING REQUIREMENTS.
  2. CONTRACTOR TO MATCH EXISTING STRIPING LAYOUT.

BEN MILAM ELEMENTARY PARKING LOT  
1"=10'

DESIGNED BY: HRV/HR DRAWN BY: HRV/HR CHECKED BY: OA APPROVED BY: SLM DATE: FEBRUARY 2013	<b>REVISIONS</b> <table border="1"> <thead> <tr> <th>NO.</th> <th>DATE</th> <th>DESCRIPTION</th> <th>APPROVED FOR</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>FEBRUARY 2013</td> <td></td> <td></td> </tr> </tbody> </table>	NO.	DATE	DESCRIPTION	APPROVED FOR	1.	FEBRUARY 2013				<b>DANNENBAUM</b> ENGINEERING COMPANY - MCALLEN, LLC T.E.P.E. FIRM REGISTRATION #8999 1108 AQUANA LOOP, STE 200 MCALLEN, TX 78204 (956) 862-3877	PROJECT: 4827-01 DRAWING: 05 SHEET NO.
NO.	DATE	DESCRIPTION	APPROVED FOR									
1.	FEBRUARY 2013											
			<b>MCALLEN</b> INDEPENDENT SCHOOL DISTRICT	MAALLEN INDEPENDENT SCHOOL DISTRICT PARKING LOT AND STREET IMPROVEMENTS PROJECT	SCALE BAR IS ONE INCH ON ORIGINAL DRAWING							
				BEN MILAM ELEMENTARY PARKING LOT STRIPING LAYOUT								



DESIGNED BY: HRV/MR	REVISIONS	PROJECT
DRAWN BY: HRV/MR	NO. DATE DESCRIPTION	457-01
CHECKED BY: OA	1. FEBRUARY 2013	DRAWING I
APPROVED BY: SLM		DATE
DATE: FEBRUARY 2013		SHEETING
<p><b>McALLEN</b> INDEPENDENT SCHOOL DISTRICT</p>		<p>THEODORE ROOSEVELT ELEMENTARY PARKING LOT - EXISTING TOPOGRAPHY AND EROSION CONTROL LAYOUT</p>
<p><b>DANNENBAUM</b> ENGINEERING COMPANY - McALLEN, LLC REGISTERED PROFESSIONAL ENGINEER 1109 N. GULF AVE., SUITE 200, McALLEN, TX 78104-1802-3077</p>		<p>McAllen, TX Professional Seal No. 1000000000 Exp. 12/31/2013</p>
<p>THEODORE ROOSEVELT ELEMENTARY PARKING LOT 1"=30'</p>		<p>SCALE BAR IS ONE INCH ON ORIGINAL DRAWING</p>

- GENERAL NOTES**
1. A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) IS REQUIRED / APPROVED BY THE CITY OF McALLEN PRIOR TO CONSTRUCTION WORK ON THE PROJECT.
  2. ASPHALT PLACEMENT SHALL TAKE PLACE WITHIN THE LIMITS OF THE EXISTING ASPHALT AND GUTTER, UNLESS OTHERWISE NOTED.
  3. ANY DAMAGES TO EXISTING CURBS AND GUTTERS, FENCES, SIDEWALKS, OR OTHER PROPERTY SHALL BE REPAIRED TO EXISTING OR BETTER CONDITION AT NO COST TO THE OWNER.

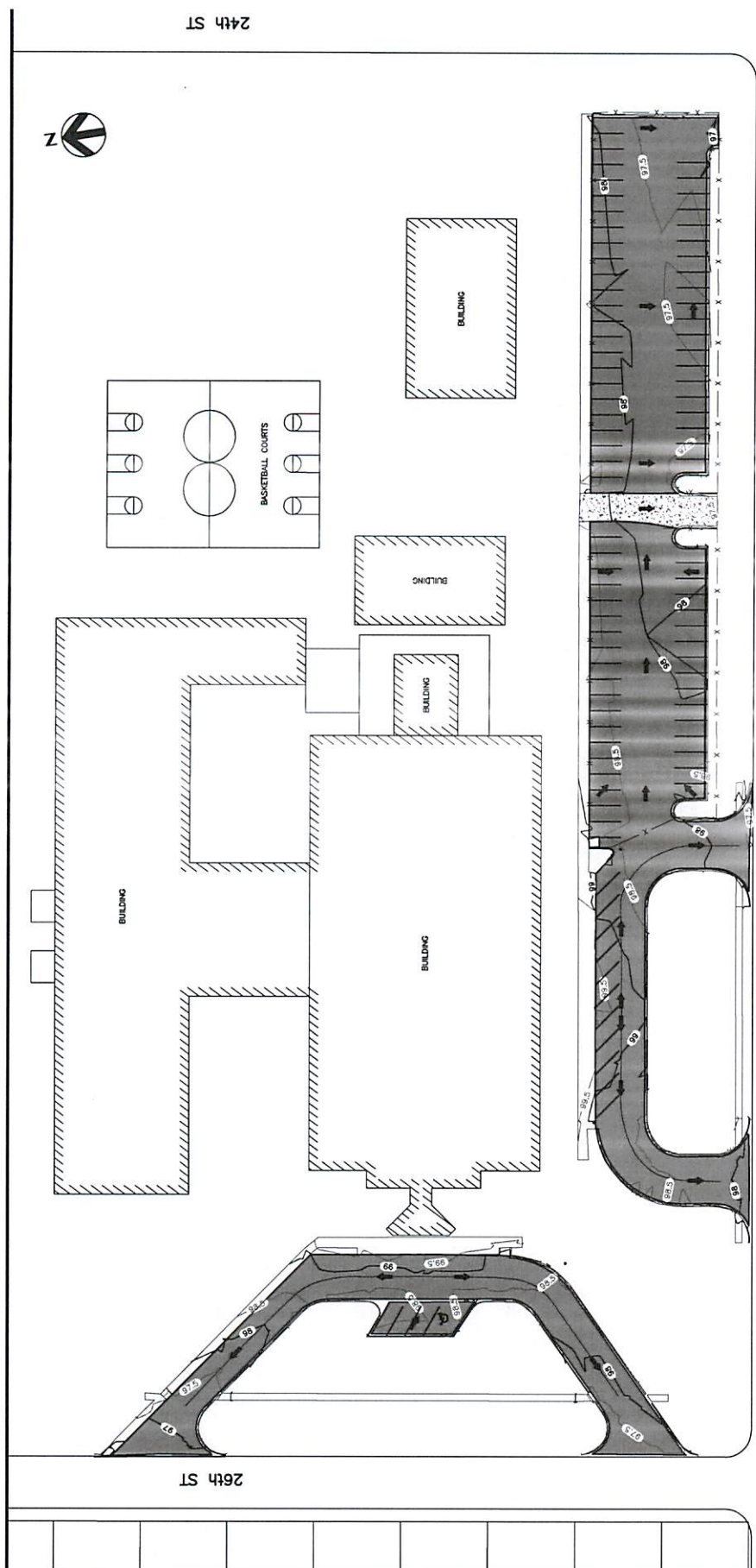
**LEGEND**

▨ LIMITS OF EXISTING ASPHALT (TO BE MAINTAINED & OVERLAYED) (\*)

24th ST

26th ST

LUCILLE AVE



**GENERAL NOTES:**

- A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) IS REQUIRED FOR THIS PROJECT. A NOTICE OF INTENT (NOI) PRIOR TO CONSTRUCTION WORK SHALL BE SUBMITTED TO THE T.R.P.E. FIRM REGISTRATION #8999.
- PROPOSED LIMITS OF MALLING/OVERLAY SHALL MATCH EDGE OF PROPOSED SITE BOUNDARIES.
- CONTRACTOR TO FIELD VERIFY AND CORRECTIVE W/ADJUSTER FOR HIGH P LOCATIONS.

**THEODORE ROOSEVELT ELEMENTARY PARKING LOT**  
 1"=30'

LUCILLE AVE

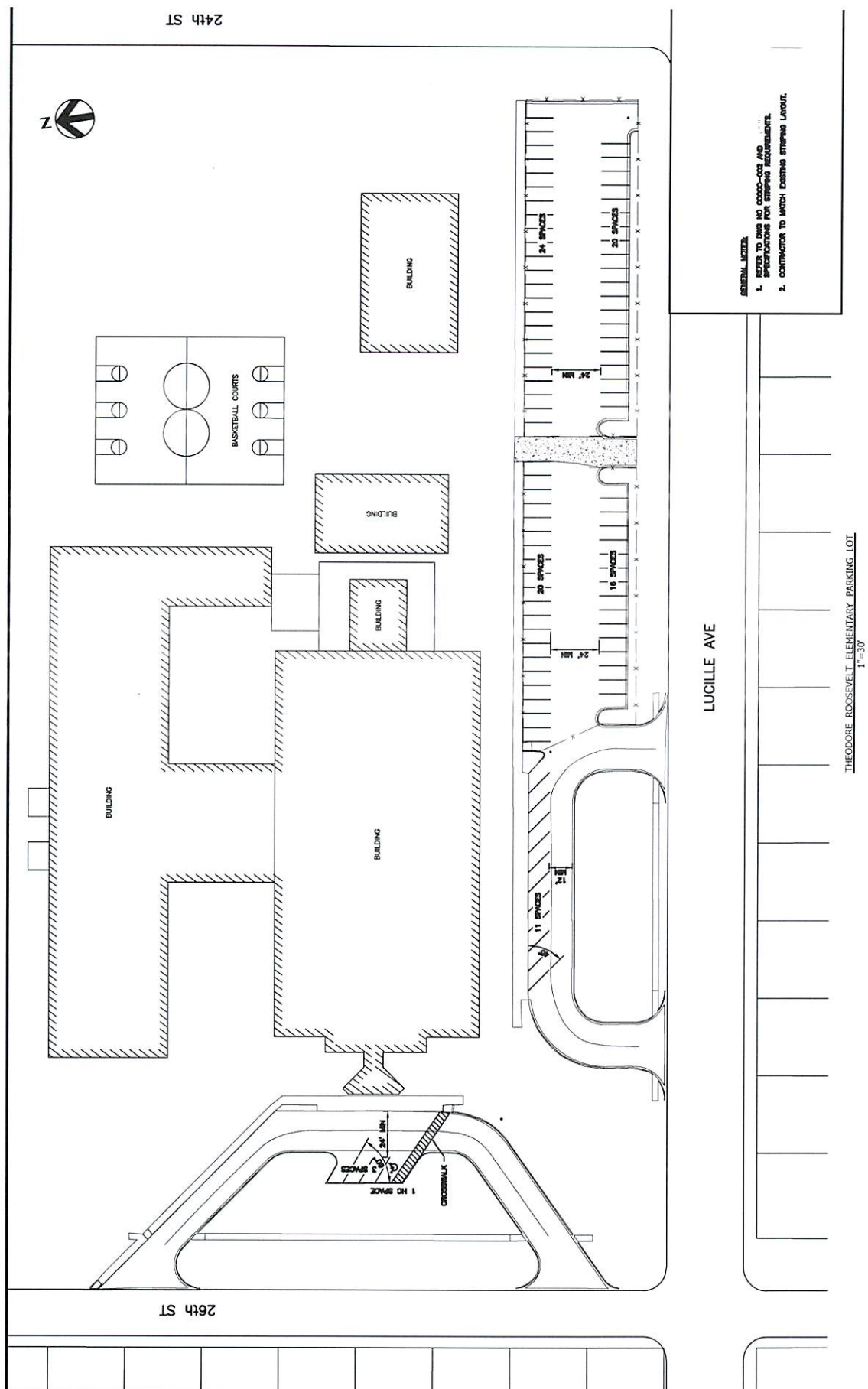
NO.	DATE	DESCRIPTION	APP.	OR.
1	FEBRUARY 2013	ISSUED FOR BID		

DESIGNED BY: HRV/MR  
 DRAWN BY: HRV/MR  
 CHECKED BY: OA  
 APPROVED BY: SLM  
 DATE: FEBRUARY 2013

PROJECT 4657-01		PROJECT DRAWING I 09 SHEET NO.
<b>DANNENBAUM</b> ENGINEERING COMPANY - McALLEN, LLC T.R.P.E. FIRM REGISTRATION #8999 1109 N. GARDEN STREET, McALLEN, TEXAS 78103-8637		McALLEN INDEPENDENT SCHOOL DISTRICT
McALLEN INDEPENDENT SCHOOL DISTRICT PARKING LOT AND STREET IMPROVEMENTS PROJECT		THEODORE ROOSEVELT ELEMENTARY PARKING LOT - GRADING AND OVERLAY LAYOUT

24th ST

26th ST



**GENERAL NOTES:**  
 1. REFER TO DWG NO 00000-002 AND ALL SPECIFICATIONS FOR STRIPING REQUIREMENTS.  
 2. CONTRACTOR TO MATCH EXISTING STRIPING LAYOUT.

THEODORE ROOSEVELT ELEMENTARY PARKING LOT  
 1"=50'

DESIGNED BY HRV/MR	DATE FEBRUARY 2013	NO. A	REVISIONS	DESCRIPTION	APPROVED BY
DRAWN BY HRV/MR					
CHECKED BY OA					
APPROVED BY SLM					
DATE FEBRUARY 2013					

PROJECT # 457-01	
DRAWING # 00	
McALLEN INDEPENDENT SCHOOL DISTRICT PARKING LOT AND STREET IMPROVEMENTS PROJECT	
THEODORE ROOSEVELT ELEMENTARY PARKING LOT STRIPING LAYOUT	

	<b>DANNENBAUM</b> ENGINEERING COMPANY - McALLEN, LLC T.E.P.E. FIRM REGISTRATION #8999 1109 McALLEN LOOP, STE 200 McALLEN, TX 78204 (509) 662-3877
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	<b>McALLEN</b> INDEPENDENT SCHOOL DISTRICT
--	---

REV	DATE	DESCRIPTION
1	FEBRUARY 2013	ISSUED FOR BID

DESIGNED BY	HRV/MR
DRAWN BY	HRV/MR
CHECKED BY	SM
APPROVED BY	SLM
DATE	FEBRUARY 2013

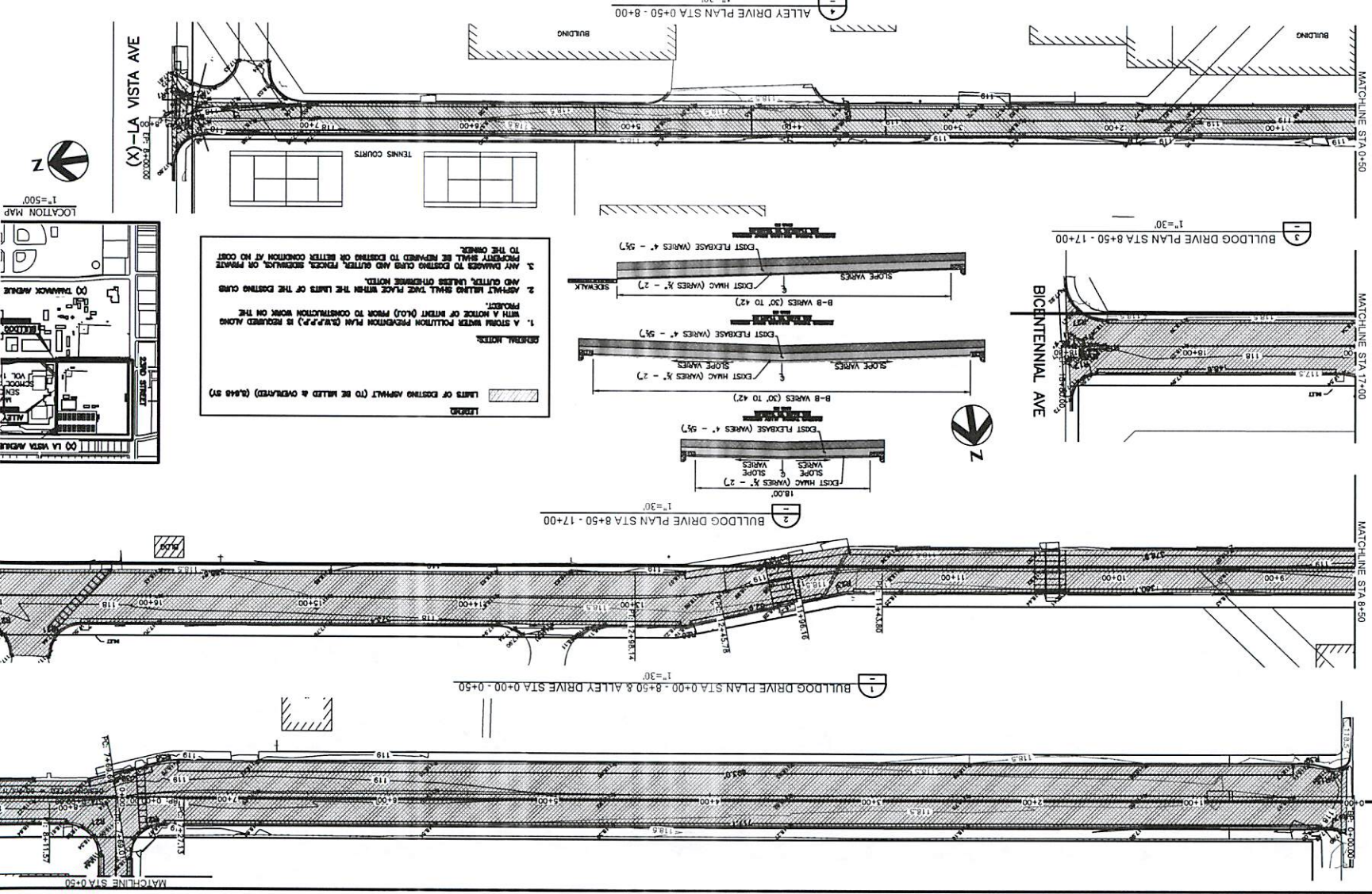
**McALLEN**  
 INDEPENDENT SCHOOL DISTRICT

**DANNENBAUM**  
 ENGINEERING COMPANY - McALLEN, LLC  
 T.B.P.E. FIRM REGISTRATION #8999  
 1109 NOKALA LOOP, STE 208 McALLEN, TX 78204 (956) 822-2777



McALLEN INDEPENDENT SCHOOL DISTRICT  
 PARKING LOT AND STREET IMPROVEMENTS PROJECT  
 McALLEN HIGH SCHOOL  
 BULLDOG DRIVE AND ALLEY DRIVE  
 -EXISTING TOPOGRAPHY AND EROSION CONTROL LAYOUT

PROJECT: 4637-01  
 DRAWING: 07  
 SHEET NO. 01  
 SCALE BAR IS ONE INCH ON ORIGINAL DRAWINGS

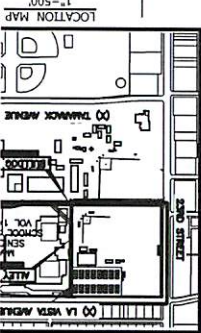


**GENERAL NOTES:**

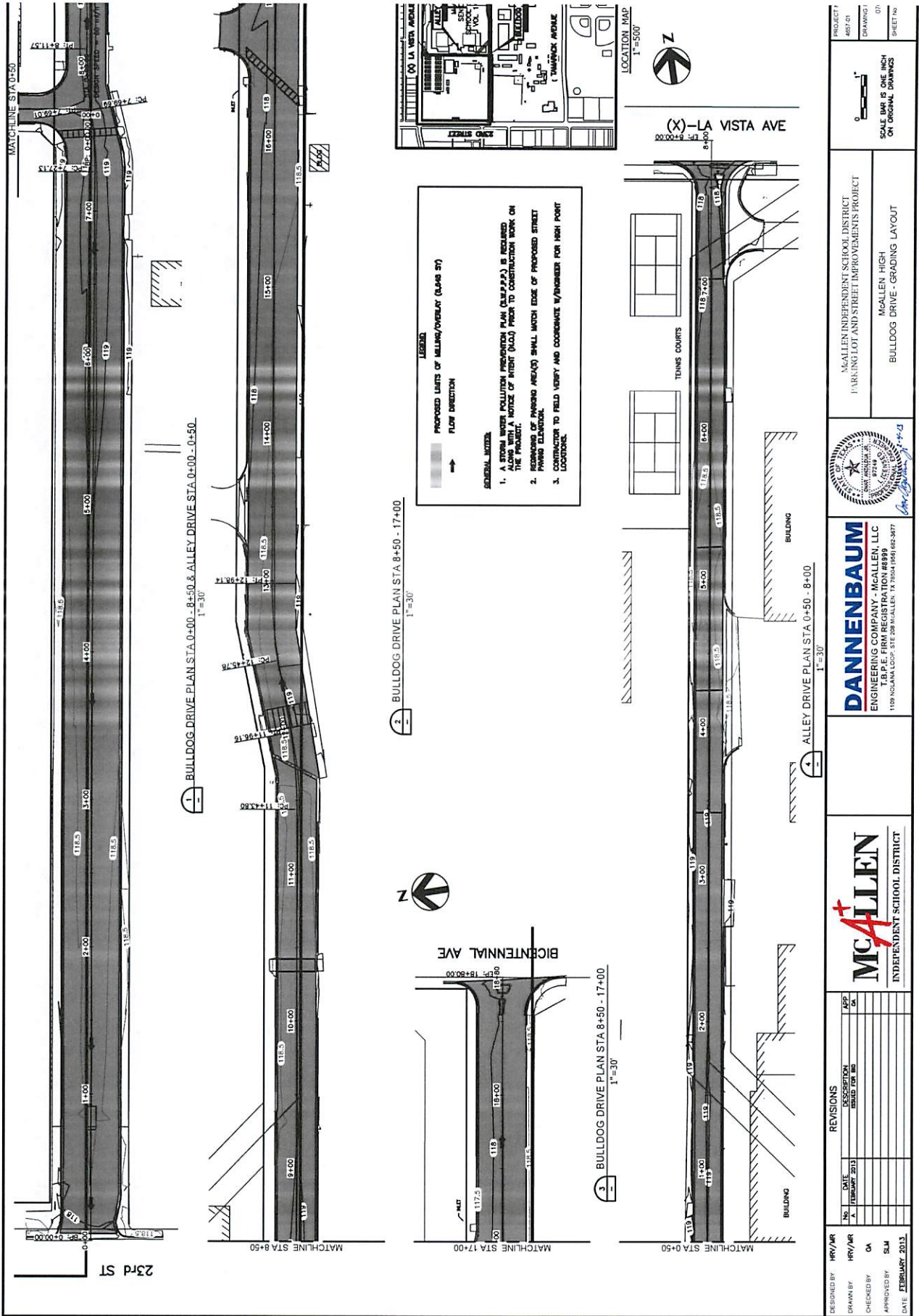
1. A STOP WORK POLLUTION PREVENTION PLAN (SWPPP) IS REQUIRED ALONG WITH A NOTICE OF INTENT (NOI) PRIOR TO CONSTRUCTION WORK ON THE PROJECT.
2. ASPHALT PATCHES SHALL BE PLACED WITHIN THE LIMITS OF THE EXISTING CURB AND GUTTER, UNLESS OTHERWISE NOTED.
3. ANY DAMAGES TO EXISTING CURB AND GUTTER, FENCES, SIDEWALKS OR PRIVATE PROPERTY SHALL BE REPAIRED TO EXISTING OR BETTER CONDITION AT NO COST TO THE OWNER.

**LEGEND:**

- LIMITS OF EXISTING ASPHALT (TO BE PATCHED & OVERLAPPED) (0.464 87)



23rd ST



**LEGEND**

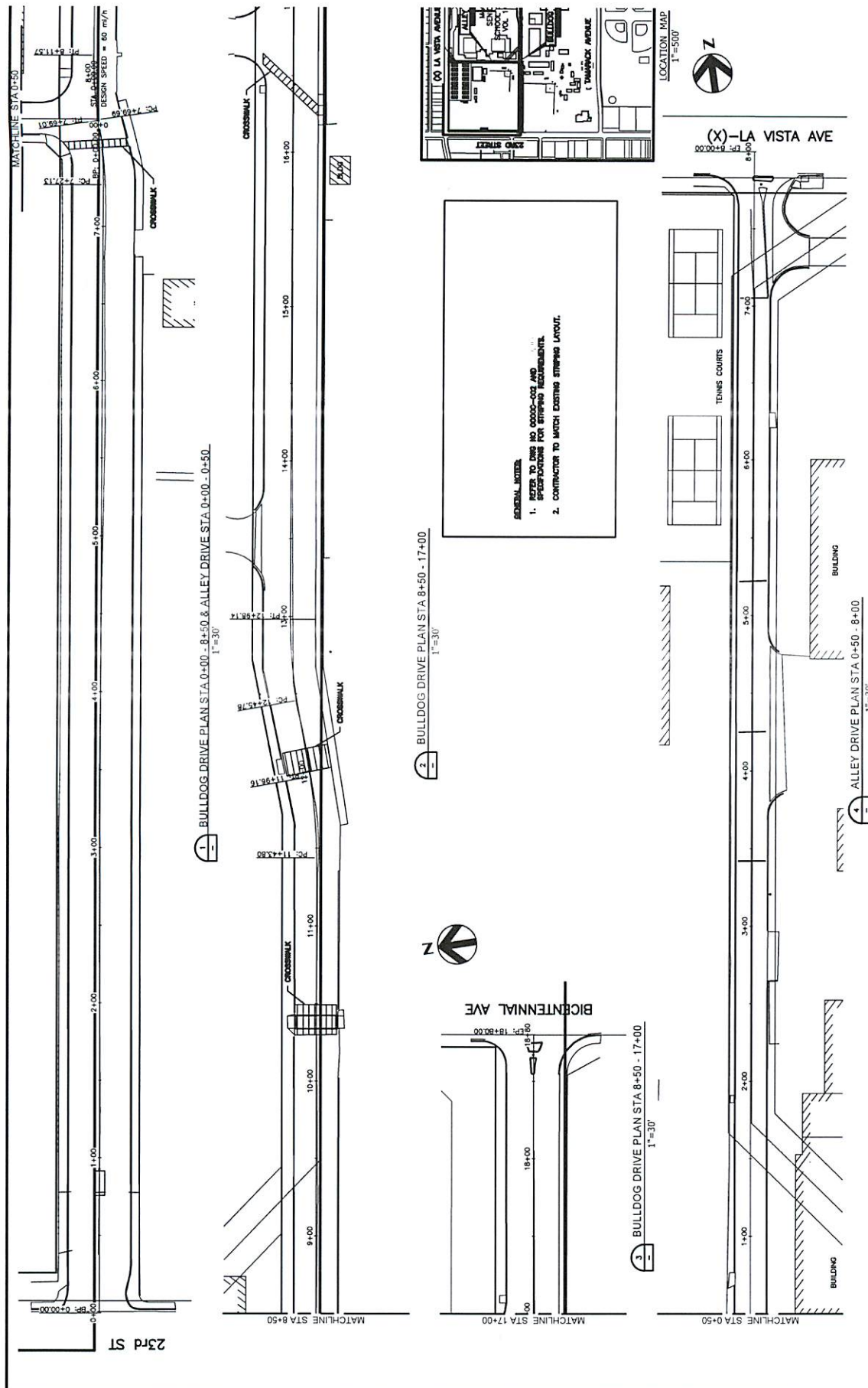
PROPOSED LIMITS OF MILLING/OVERLAY (SLAB ST)

FLOW DIRECTION

**GENERAL NOTES**

1. A SPECIAL WATER POLLUTION PREVENTION PLAN (SWPPP) IS REQUIRED ALONG WITH A NOTICE OF WORK (NOW) PRIOR TO CONSTRUCTION WORK ON THE PROJECT.
2. REVISIONS OF PAVING AREA(S) SHALL MATCH EDGE OF PROPOSED STREET PAVING ELEVATION.
3. CONTRACTOR TO FIELD VERIFY AND COORDINATE WITH ENGINEER FOR HIGH POINT LOCATIONS.

DESIGNED BY HRV/HR	REVISIONS	<table border="1"> <tr> <th>NO.</th> <th>DATE</th> <th>DESCRIPTION</th> <th>APPROVED FOR</th> </tr> <tr> <td>1</td> <td>FEBRUARY 2013</td> <td></td> <td></td> </tr> </table>	NO.	DATE	DESCRIPTION	APPROVED FOR	1	FEBRUARY 2013		
NO.	DATE		DESCRIPTION	APPROVED FOR						
1	FEBRUARY 2013									
DRAWN BY HRV/HR	<table border="1"> <tr> <td>DATE</td> <td>APPROVED BY</td> </tr> <tr> <td>FEBRUARY 2013</td> <td>SLM</td> </tr> </table>	DATE	APPROVED BY	FEBRUARY 2013	SLM	<p><b>MCALLEN</b> INDEPENDENT SCHOOL DISTRICT</p>				
DATE	APPROVED BY									
FEBRUARY 2013	SLM									
CHECKED BY CA		<p><b>DANNENBAUM</b> ENGINEERING COMPANY - McALLEN, LLC T.B.P.E. FIRM REGISTRATION #8999 1109 N. OLIVIA COURT, STE 200, McALLEN, TX 78504 (956) 662-3877</p>								
APPROVED BY SLM		<p>McALLEN INDEPENDENT SCHOOL DISTRICT PARKING LOT AND STREET IMPROVEMENTS PROJECT</p>								
DATE FEBRUARY 2013		<p>BULLDOG DRIVE - GRADING LAYOUT</p>								
		<p>PROJECT # 4657/01</p>								
		<p>DRAWING 07</p>								
		<p>SHEET # 16</p>								



1 BULLDOG DRIVE PLAN STA 0+00 - 8+50 & ALLEY DRIVE STA 0+00 - 0+50.  
 1"=30'

2 BULLDOG DRIVE PLAN STA 8+50 - 17+00.  
 1"=30'

3 BULLDOG DRIVE PLAN STA 8+50 - 17+00.  
 1"=30'

4 ALLEY DRIVE PLAN STA 0+50 - 8+00.  
 1"=30'

GENERAL NOTES:  
 1. REFER TO THE NO. 8000-003 AND 8000-004 SPECIFICATIONS FOR STRIPING REQUIREMENTS.  
 2. CONTRACTOR TO MATCH EXISTING STRIPING LAYOUT.



SCALE BAR IS ONE INCH ON ORIGINAL DRAWING

PROJECT # 4637-01  
 DRAWING 07  
 SHEET # 01

McALLEN INDEPENDENT SCHOOL DISTRICT  
 PARKING LOT AND STREET IMPROVEMENTS PROJECT  
 McALLEN HIGH SCHOOL  
 BULLDOG DRIVE AND ALLEY DRIVE  
 - STRIPING LAYOUT



**DANNENBAUM**  
 ENGINEERING COMPANY - McALLEN, LLC  
 T.B.P.E. FIRM REGISTRATION #8999  
 1105 NOLAN COURT, STE 200, McALLEN, TX 78504 (957) 662-3877

**McALLEN**  
 INDEPENDENT SCHOOL DISTRICT

NO.	DATE	REVISION	APPROVED FOR
1	FEBRUARY 2013	DESCRIPTION	OR

DESIGNED BY: HRV/MR  
 DRAWN BY: HRV/MR  
 CHECKED BY: CA  
 APPROVED BY: SLM  
 DATE: FEBRUARY 2013