

AGENDA ITEM

**DISCUSS AND CONSIDER
AMENDMENT TO THE
SUBDIVISIONS AND OTHER
DEVELOPMENTS ORDINANCE,
CHAPTER 26 CITY CODE, TO
INCORPORATE AN
INFRASTRUCTURE DESIGN AND
DEVELOPMENT STANDARDS
MANUAL**

ORIGINATION DEPARTMENT

PUBLIC WORKS

grk

BACKGROUND INFORMATION

In November 2011, the City Council adopted the current Drainage Design Manual (DDM). As part of that adoption process, a need for the city to provide standard details and specifications that supported the new requirements in the DDM was identified.

As required by the TCEQ and in conjunction with the requirements of the MS4 Permit, the City is required to implement its Phase II program over the course of five years from the issuance date. As part of this implementation, the City has adopted an Erosion and Sediment Control Ordinance, and must adopt a Post Construction Ordinance and post construction best management practices (BMP). The proposed Infrastructure Design and Development Standards Manual includes details and specifications that support the above listed ordinances and BMPs.

In addition, in order to reduce failures and costs to the City in rehabilitation and repair of new infrastructure the Public Works Department initiated an update process of the current construction detail sheets to make development standards consistent with current City CIP standards and practices followed by surrounding communities.

The intent of the proposed Infrastructure Design and Development Standards Manual is two-fold. Primarily the intent is to protect the health, safety and welfare of the citizens of Killeen by standardizing infrastructure construction practices. Secondly, the intent of the ordinance is to comply with the City's TCEQ issued MS4 permit by providing standard construction details that support the proposed Post Construction Storm Water Control Ordinance, proposed Post Construction Best Management Practices, adopted Erosion and Sediment Control Ordinance, and the adopted Drainage Design Manual (DDM).

DISCUSSION/CONCLUSION

This Infrastructure Design and Development Standards Manual was discussed and considered most recently at the June 27, 2012 community stakeholders' group formed for the purpose of implementing various ordinances required under the City's Phase II permit program. The stakeholder group previously met on two separate occasions to discuss various types of standard transportation and drainage specifications and construction details.

In sum, the attached proposed amendment addresses the need to standardize details and specifications within the City, supports requirements of the State's mandate, EPA'S mandate, and addresses input provided by Staff, and the Stakeholder's committee.

FISCAL IMPACT

There is no additional fiscal year 2011-2012 impact for to the City associated with this ordinance.

RECOMMENDATION

Recommend that the City Council adopt the Infrastructure Design and Development Standards Manual.

Attachment: 1) Proposed Standard Manual.

AN ORDINANCE AMENDING CHAPTER 26 OF THE CODE OF ORDINANCES OF THE CITY OF KILLEEN; AMENDING CHAPTER 26 TO INCORPORATE AN INFRASTRUCTURE DESIGN AND DEVELOPMENT STANDARDS MANUAL; AMENDING VARIOUS SECTIONS OF CHAPTER 26 AS A HOUSEKEEPING MATTER TO ENSURE CONSISTENCY WITH NEW PROVISIONS; PROVIDING FOR REPEAL OF CONFLICTING PROVISIONS; PROVIDING A SEVERABILITY CLAUSE; PROVIDING A PENALTY; PROVIDING FOR PUBLICATION AND AN EFFECTIVE DATE.

WHEREAS, the City of Killeen, Texas is a home-rule city acting under its charter adopted by the electorate pursuant to Article XI, Section 5 of the Texas Constitution and Chapter 9 of the Local Government Code; and,

WHEREAS, the City of Killeen has declared the application and enforcement of the City's subdivision regulations to be necessary for the promotion of the orderly development of the city, public safety, health, convenience, comfort, prosperity and general welfare of the City; and,

WHEREAS, the City Council finds that revisions to the City's subdivision and development regulations are necessary to adopt standard infrastructure specifications and construction details to ensure the construction of quality public infrastructure; and,

WHEREAS, the City Council finds that establishing infrastructure specifications and construction details is in the best interest of the City and its current and future Citizens and is further permitted in accordance with the Texas Local Government Code, Chapter 212 et seq.

NOW, THEREFORE BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF KILLEEN, TEXAS:

SECTION I. That the City of Killeen hereby adopts the City of Killeen's Infrastructure Design and Development Standards Manual, which is attached hereto and incorporated herein and into the City of Killeen's Code of Ordinances for all intents and purposes with the full effect of law.

SECTION II. That Chapter 26, Articles I, II, III and IV, Sections 26-2, 26-41, 26-51, 26-81, 26-85, 26-103, 26-104 and 26-105 of the City of Killeen Code of Ordinances are hereby amended to read as follows:

Sec. 26-2. Definitions.

Infrastructure Design and Development Standards Manual shall mean the City of Killeen's adopted infrastructure design and development standards manual, as amended, providing definitions, formulae, criteria, specifications, details, procedures, data, parameters and methodology governing the planning, design, construction, and maintenance of water, sewer, drainage, street and associated infrastructure and further detailing pollution control measures within the City's jurisdiction.

Sec. 26-41. Form, contents and required documentation.

(e) The engineering plans shall be in compliance with the city's currently adopted construction standards of the city, infrastructure design and development standards manual and the drainage design manual and shall consist of the following:

Sec. 26-51. Form, contents and required documentation.

(e) The engineering plans shall be in compliance with the city's currently adopted construction standards of the city, infrastructure design and development standards manual and the drainage design manual and shall consist of the following:

Sec. 26-81. Construction of infrastructure.

(a) Following approval of the final plat, the plat applicant shall submit full construction plans for all proposed infrastructure to be constructed for the platted property. Construction plans submitted shall be in conformance with the approved plat. The public works department shall review the submitted plans for compliance with the infrastructure design and development standards manual, the drainage design manual, and other applicable construction standards adopted by the city.

Sec. 26-85. Agreements with the city.

(d) Roads and drainage:

- (6) The developer may submit a request for a city/owner agreement for city participation in a regional detention facility. The regional detention facility must be identified in the city's adopted current drainage master plan, provide benefit to more than two (2) subdivisions, and meet the requirements of the current drainage design manual and infrastructure design and development standards manual.

Sec. 26-103. Drainage in special flood hazard areas.

- (a) Drainage improvements in areas of special flood hazard in the city shall comply with the provisions of chapter 12 of the city code of ordinances, ~~and the current drainage design manual and the infrastructure design and development standards manual~~ approved by the city council.

Sec. 26-104. Drainage not in special flood hazard areas.

- (a) Design of all drainage improvements shall be by a registered professional engineer in accordance with the current drainage design manual and the infrastructure design and development standards manual approved by the city council.

Sec. 26-105. Sidewalks.

- (e) All sidewalk and ramp construction shall conform to all applicable Texas Accessibility Standards and Americans with Disabilities Act design requirements, ~~and chapter 25 of the city of Killeen code of ordinances~~ and the infrastructure design and development standards manual.

SECTION III. That all ordinances or resolutions or parts of ordinances or resolutions in conflict with the provisions of this ordinance are hereby repealed to the extent of such conflict.

SECTION IV. That should any section or part of any section, paragraph or clause of this ordinance be declared invalid or unconstitutional for any reason, it shall not invalidate or impair the validity, force or effect of any other section or sections or part of a section or paragraph of this ordinance.

SECTION V. That the Code of Ordinances of the City of Killeen, Texas, as amended, shall remain in full force and effect, save and except as amended by this ordinance.

SECTION VI. That this ordinance shall be effective after its passage and publication according to law.

PASSED AND APPROVED at a regular meeting of the City Council of the City of Killeen, Texas, this _____ day of _____, 2012, at which meeting a quorum was present, held in accordance with the provisions of V.T.C.A., Government Code, §551.001 *et seq.*

APPROVED

Daniel A. Corbin, MAYOR

ATTEST:

APPROVED AS TO FORM:

Paula A. Miller, CITY SECRETARY

Kathryn H. Davis, CITY ATTORNEY

Infrastructure Design and Development Standards

Council Workshop

July 17, 2012



Environmental Services

- ▶ TCEQ MS4 (Phase II) Permit Implementation
- ▶ Plat and Construction Plan Review
- ▶ Maintenance of Drainage Infrastructure



Timeline

- ▶ 1992 Drainage Design Criteria
 - ▶ Erosion and Sediment Control Ordinance adopted July 2010
 - ▶ Drainage Design Manual (DDM) adopted in November 2011
 - ▶ Stakeholder Meetings
 - February 22, 2011
 - May 23, 2012
 - June 27, 2012
 - ▶ Post Construction Ordinance and Manual by August 12, 2012
- 

Section 26-2

- ▶ Infrastructure Design and Development Standards Manual (IDDSM) shall mean the City of Killeen's adopted infrastructure design and development standards manual, as amended, providing definitions, formulae, criteria, specifications, details, procedures, data, parameters and methodology governing the planning, design, construction, and maintenance of water, sewer, drainage, street and associated infrastructure and, further detailing pollution control measures within the City's jurisdiction.

Added Reference to IDDSM

- ▶ Section 26-51 Engineering Compliance
- ▶ Section 26-81 Construction
- ▶ Section 26-85 Agreements
- ▶ Section 26-103 SFHAs
- ▶ Section 26-104 Non- SFHAs
- ▶ Section 26-105 Sidewalks



Table of Contents

Section 300 - General Specifications

Section 400 - Drainage Specifications

Section 500 - Transportation Specifications

Section 800 - Concrete Specifications

Section 900 - Details

- 900.10 Pollution Control

- 900.20 Transportation

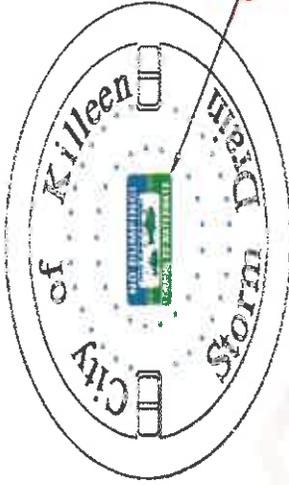
- 900.30 Drainage



07/17/12 Amendments

- ▶ 900.30 ▶ 900.20
- Drainage Details Transportation

- D-03
- D-04
- D-10
- D-11
- D-12
- D-21
- D-22
- D-25
- D-26
- T-05



NOTE: LID SHALL HAVE TWO (2) TYPE 4 PICK BARS AND AND LABELED "STORM DRAIN"

EMBLEM TO BE PROVIDED BY CITY OF KILLEEN PUBLIC WORKS

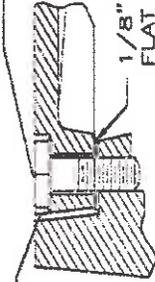
1320
1480 (WATERTIGHT & REVERSABLE)



THE WATER-TIGHT MANHOLE SETS FEATURE SIX STAINLESS STEEL BOLTS IN COUNTERSUNK POCKETS AND A SEALING FLAT GASKET IN THE RING SET. BOLTING PADS REDUCE THE STANDARD CLEAR OPENING BY TWO TO THREE INCHES.

1 3/8" [35mm] DIA. X 3/4" [13mm] COUNTERBORE

(6) 5/8" [19mm] - 11 X 2 1/4" [57mm] ZINC HEX HD BOLTS & WASHERS (DRILLED & TAPPED FOR MCGARD BOLTS REF. 117151) TO BE FURNISHED & INSTALLED BY CUSTOMER.



1/8" [3mm] THICK.

FLAT GASKET

WATER-TIGHT DETAIL

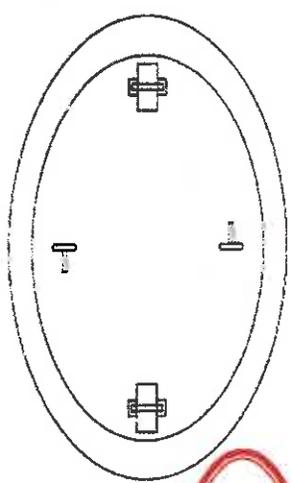
		DIMENSIONS				TOTAL WEIGHT		
	A	B	C	D	E	F		
1320	32	1 1/2	30	34	7/16	46	6 1/2	505 LBS
1480	32	1 1/2	30	32	1/4	38	4	350 LBS

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS
STANDARD STORM SEWER
MANHOLE SET

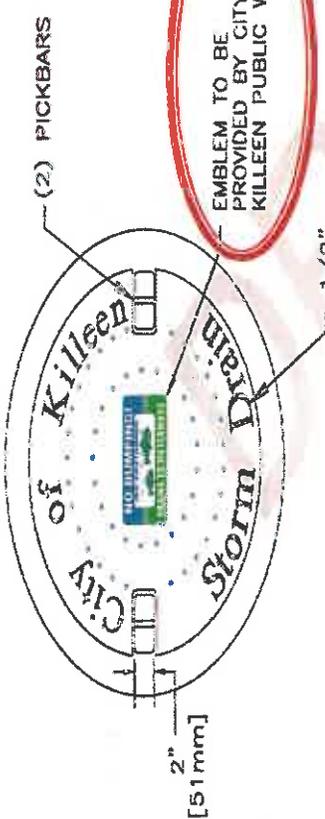
CONSTRUCTION STANDARDS AND DETAILS



D-03
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



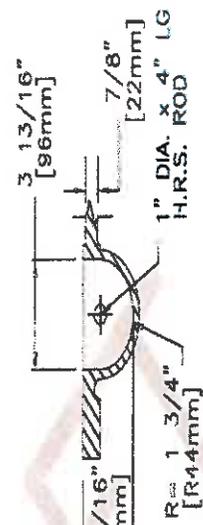
BOTTOM VIEW



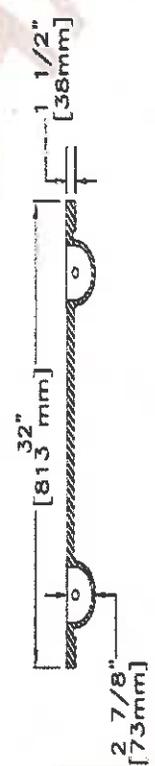
PLAN VIEW

1/2" RAISED LETTERING (REMOVABLE)

EMBLEM TO BE PROVIDED BY CITY OF KILLEEN PUBLIC WORKS



PICKBAR DETAIL



CROSS SECTION

V1432 LOGO COVER
 MANHOLE COVER MANUFACTURED BY : EAST JORDAN IRON WORKS, INC
 P.O. BOX 439 EAST JORDAN, MI. 49727
 1-800-874-110 FAX 231-536-4100

PRODUCT NUMBER: NCR02-1762 STM DRN
 CATALOG NUMBER: V1432
 EST. WT. COVER - 210 LBS / 95 kg
 MATERIAL SPEC: COVER - GRAY IRON ASTM A48 CL35
 LOAD RATING: HEAVY DUTY

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS
STANDARD STORM DRAIN
MANHOLE SET

CONSTRUCTION STANDARDS AND DETAILS



D-04
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

NOTES:

1. REPLACED BASE MATERIAL OVER TRENCH SHALL BE TWICE THE THICKNESS OF THE ORIGINAL BASE.
2. BASE MATERIAL SHALL BE IN LIFTS NOT TO EXCEED 8" AND EACH LIFT THOROUGHLY ROLLED OR TAMPED TO SPECIFIED MAXIMUM DENSITY.
3. ASPHALT CONCRETE PAVEMENT JOINTS SHALL BE MECHANICALLY SAWED.
4. SURFACE MATERIAL WILL BE CONSISTENT WITH THE EXISTING SURFACE.
5. A MINIMUM OF ONE DENSITY TEST SHALL BE TAKEN EVERY TWO HUNDRED FIFTY (250) FEET FOR EACH LIFT (INCLUDING LIFT TOP) FOR COMMON FILL OUTSIDE OF BACKFILL AND EACH OPERATIONAL CROSSING PROJECT. FOR MATERIALS USED IN BACKFILL, SHALL BE OBTAINED BY THE PERMITTED LABORATORY DENSITY TESTS SHALL BE CONDUCTED BY A CERTIFIED LABORATORY. THE PERMITTEE'S CONSULTANTS SHALL BE COMPLETED AND ACCEPTED ON EACH LAYER PRIOR TO ADDITIONAL BACKFILLING. A COPY OF ALL COMPLETED AND ACCEPTED DENSITY TESTS SHALL BE FURNISHED TO CITY OF KILLEEN.

6. THESE SPECIFICATIONS MAY BE SUPERSEDED BY THE GOVERNING AGENCY.
 7. FLEXIBLE BASE TYPE II: (SUPERFLEX)
 1xDOT TYPE A - CRUSHED LIMESTONE BASE COMPACTED (METHOD D) AT OPTIMUM MOISTURE +2% MAXIMUM DENSITY AS DETERMINED BY ASTM D1557 (METHOD D) TO THE CITY INSPECTOR.
 COMPACTED NATIVE MATERIAL: COMPACT PER FIELD DENSITY CONTROL REQUIREMENTS TABLE.
 SELECT MATERIAL: COMPACT PER FIELD DENSITY CONTROL REQUIREMENTS TABLE.

FIELD DENSITY CONTROL REQUIREMENTS

DESCRIPTION	DENSITY		MOISTURE CONTROL	
	TEX	115 - E		
PI ≤ 15	≥ 98%	MAXIMUM DRY DENSITY	≥ OPTIMUM MOISTURE CONTENT	
15 < PI ≤ 35	98%	MAX. DRY DENSITY ≤ 102%	≥ OPTIMUM MOISTURE CONTENT	
PI > 35	95%	MAX. DRY DENSITY ≤ 100%	≥ OPTIMUM MOISTURE CONTENT	

8. CONTRACTOR OR ENGINEER MAY USE FLOWABLE BACKFILL AS AN ALTERNATE BACKFILL MATERIAL. (SEE ITEM 808 FLOWABLE BACKFILL FOR THE SPECIFICATION).

9. PIPE SHALL BE REINFORCED CONCRETE PIPE CLASS III UNLESS THE DEPTH OF PIPE REQUIRES A STRONGER CLASS. PIPE SHALL HAVE A MINIMUM OF 24" COVER IN UNPAVED AREAS AND 18" OF COVER FROM BOTTOM OF SUBGRADE IN PAVED AREAS. WHERE LESS THAN 36" OF COVER IS PROVIDED, CLASS IV REINFORCED CONCRETE PIPE SHALL BE USED. IN NO CASE SHALL A STORM SEWER HAVE LESS THAN 12" OF COVER OVER THE TOP OF PIPE.
10. HIGH DENSITY POLYETHYLENE (HDPE) PIPE MAY BE USED UP TO 48-INCHES IN DIAMETER IN UNPAVED AREAS OUTSIDE OF CITY STREETS.
11. ALL FITTINGS AND WYES SHALL BE MANUFACTURED AND NOT CONSTRUCTED ON THE PROJECT WITHOUT PRIOR APPROVAL FROM THE CITY.
12. ALL JOINTS THAT ARE NOT SEALED WITH A WATERTIGHT CONNECTION SHALL BE WRAPPED WITH MARAFI-140-N GEOTEXTILE FABRIC OR APPROVED EQUIVALENT. THE JOINT SHALL BE WRAPPED WITH 18" WIDE FABRIC SPLITTING THE JOINT.

* - SEE D-09 FOR TRENCH WIDTH DEFINITION.

**** TYPICAL BEDDING SPECIFICATIONS:**

SIEVE SIZE	% RETAINED	3/8" F	% RETAINED	1/2" D	% RETAINED	WASHED GRAVEL	% RETAINED
1/2"	0		0		0		
3/8"	0-2		0-2		5-25		
4m	40-85		95-100		80-100		
10m	95-100				96-100		
3/4"							100

TRENCH EMBEDMENT AND BACKFILL STANDARDS

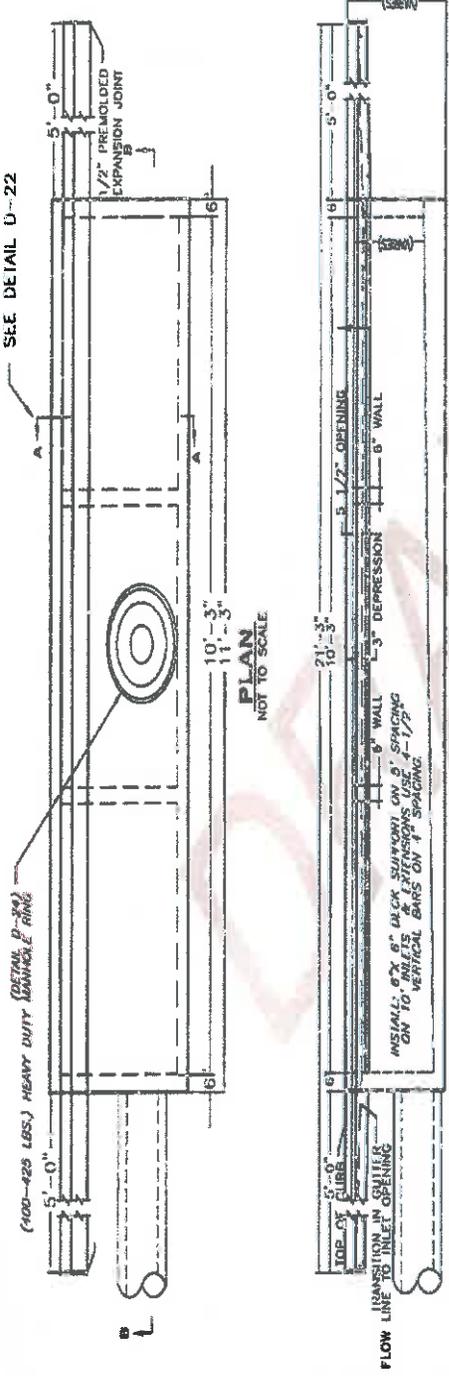
	TRENCH WIDTH *		TRENCH WIDTH * + 1'		TRENCH WIDTH * + 2'		
	EMBEDMENT UNDER PIPE	BEDDING OVER PIPE	BACKFILL MATERIAL (SEE NOTE 7)	2" H/MAC TYPE 'D'	2,000 PSI CONCRETE	COMPACTED COMMON FILL	TOPSOIL
UNDER EXISTING ROADWAY	6" MIN.	12" MIN.	24" MIN.	8" MIN.			
UNDER PROPOSED ROADWAY	6" MIN.	12" MIN.	24" MIN.	8" MIN.			
OUTSIDE OF ROADWAY	6" MIN.	12" MIN.					24" MIN.
CONCRETE TRENCH CAP	6" MIN.	12" MIN.			6"		24" MIN.



CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS
TRENCH AND EMBEDMENT NOTES
STORM SEWER

CONSTRUCTION STANDARDS AND DETAILS

D-10
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



PROFILE (SECTION E-B)
NOT TO SCALE



KEY-WAY SECTION
NOT TO SCALE

GENERAL NOTES

1. CONCRETE FOR ALL ITEMS ON THIS SHEET SHALL BE CLASS "A" 5 SACK, 3000 P.S.I. CONCRETE AT 28 DAYS UNLESS OTHERWISE SPECIFIED ON THE PLANS OR SPECIFICATIONS. ALL CONCRETE SHALL BE PLACED ON A 1/2" SAND AND GUTTER SECTION. ALL CONCRETE SHALL BE CURABLE. ALL CONCRETE SHALL BE PLACED AGAINST ALL REINFORCING SHALL HAVE 2" MINIMUM COVER. 3" MINIMUM IF PLACED AGAINST EARTH FORM.
2. ALL EXPOSED CORNERS TO BE TOOLED TO A 1/4" RADIUS.
3. EXPANSION JOINTS SHALL BE TOOLED TO A MAXIMUM OF EVERY FORTY FEET (40') FOR ALL CONCRETE DETAILS.
4. IN AREAS WHERE NEW OR EXISTING CURB AND GUTTER TIES INTO NEW OR EXISTING DRIVEWAYS AND SIDEWALKS, 3/8" X 10" REBAR OR 24" SMOOTH DOWEL 1IN WILL BE USED AT 24" O.C. UNLESS OTHERWISE SPECIFIED.

**CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS
COMBINATION INLET
DETAIL**

CONSTRUCTION STANDARDS AND DETAILS



D-21
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

NOTES:

1. MIN. 1.5" TYPE D HOT MIX ASPHALTIC CONCRETE.
2. FLEXBASE, TXDOT ITEM 247, GRADE 2 OR BETTER, SHALL BE PLACED IN LIFTS NOT EXCEEDING 6" COMPACTED DEPTH AND TO A MINIMUM 95% OF THE MAXIMUM DENSITY AS DETERMINED BY ASTM D1557 (METHOD D). THE BASE MATERIAL SHALL BE PLACED AT OPTIMUM MOISTURE \pm 2%.

3. REDUCE BASE MATERIAL THICKNESS WHEN PRESCRIBED BY A QUALIFIED GEOTECHNICAL REPORT IN LIEU OF THE MINIMUM BASE MATERIAL THICKNESS LISTED BELOW.
4. COMBINED THICKNESS OF FLEXIBLE BASE COURSE, TREATED SUBGRADE OR SUBBASE SHALL BE AS REQUIRED TO SUPPORT TRAFFIC LOADS AND VOLUME ON SUBGRADE.
5. SURGRADE/BASE SHALL BE EXTENDED 1'-0" BEHIND CURB FOR ALL STREET SECTIONS.
6. SUBGRADE SHALL BE AT OPTIMUM MOISTURE OR ABOVE PRIOR TO PLACING BASE MATERIAL.

PAVING SECTIONS

STREET TYPE	MIN. H/MAC TYPE 'D'	MIN. BASE MATERIAL BY SOIL GROUP CLASSIFICATION						
		GROUP I	GROUP II	GROUP III	GROUP IV	GROUP V	GROUP VI	GROUP VII
LOCAL STREET	1.5"	7.5"	8.5"	9.5"	12.0"	14.0"	16.0"	18.0"
MINOR COLLECTOR	1.5"	7.5"	9.0"	11.0"	14.0"	16.0"	18.0"	22.0"
MAJOR COLLECTOR	1.5"	7.5"	9.0"	11.0"	14.0"	16.0"	18.0"	22.0"
INDUSTRIAL STREET	1.5"	8.0"	10.0"	12.5"	15.0"	17.5"	20.0"	24.0"
MINOR ARTERIAL	2.0"	8.0"	10.0"	12.5"	15.0"	17.5"	20.0"	24.0"
MAJOR ARTERIAL	2.5"	8.5"	11.0"	13.5"	16.5"	19.0"	21.5"	26.0"
RURAL LOCAL	1.5"	7.5"	8.5"	9.5"	12.0"	14.0"	16.0"	18.0"
RURAL COLLECTOR	1.5"	7.5"	9.0"	11.0"	14.0"	16.0"	18.0"	22.0"

**CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS
CROSS SECTIONS
NOTES**



T-05
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

CONSTRUCTION STANDARDS AND DETAILS

Questions?



City of Killeen
Kristina Ramirez, P.E.
Director of Environmental Services
254-501-7629

City of Killeen, Texas



INFRASTRUCTURE DESIGN & DEVELOPMENT STANDARDS MANUAL July 24, 2012

Prepared By



KASBERG, PATRICK & ASSOCIATES, LP
CONSULTING ENGINEERS
TEMPLE, TEXAS

TABLE OF CONTENTS

SECTION 100 – ENGINEERING DESIGN GUIDELINES (RESERVED)

SECTION 200 - PROJECT REQUIREMENTS (RESERVED)

201	Development
202	Definition of Terms
203	Abbreviations
204	Summary of Work
205	Site Conditions
206	Contractor Use of Premises
207	Control of Work
208	Control of Materials
209	Legal Relations and Responsibilities to the Public
210	Environmental Protection Procedures
211	Submittals
212	Trench Safety Requirements
213	Testing of Pipelines
214	Summary of Testing (Miscellaneous)
215	Project Closeout
216	Project ID Signage
217	Warranty
218	Inspection of Projects

SECTION 300 - GENERAL SPECIFICATIONS

301	Barricades, Signs and Traffic Handling
302	Site Preparation
303	Site Clearing
304	Trenching, Backfilling and Compaction
305	Granular Fill Materials
306	Sedimentation and Temporary Erosion Control
307	Loaming, Hydroseeding and Permanent Erosion Control
308	Miscellaneous Work and Clean-up
309	Structural Excavation



SECTION 400 - DRAINAGE SPECIFICATIONS

- 401 Storm Sewer Manholes
- 402 Reinforced Concrete Pipe (RCP)
- 403 HDPE Pipe
- 404 Vortex Separators
- 405 Gabion Structures
- 406 Pile Repair Sleeves
- 407 Restraint and Blocking
- 408 Rock Riprap

SECTION 500 - TRANSPORTATION SPECIFICATIONS

- 501 Hot mix Asphaltic Concrete Pavement
- 502 Roadway Excavation
- 503 Embankment
- 504 Flexible Base
- 505 Striping
- 506 Lime Stabilization

SECTION 600 - WATER SPECIFICATIONS (RESERVED)

- 601 Ductile Iron Pipe and Fittings
- 602 Polyvinyl Chloride (PVC) Pipe Water
- 603 Valves, Hydrants and Appurtenances
- 604 Encasement Pipe

SECTION 700 - WASTEWATER SPECIFICATIONS (RESERVED)

- 701 Precast Concrete Manholes
- 702 Polyvinyl Chloride (PVC) Pipe-Wastewater
- 703 Connections to and Work on the Existing System
- 704 Abandoning Manholes
- 705 Lift Station Removal



SECTION 800 - CONCRETE SPECIFICATIONS

801	Concrete Structures
802	Concrete for Structures
803	Concrete Riprap
804	Concrete Curb and Gutter
805	Concrete Sidewalks, Driveways and Flatwork
806	Membrane Curing
807	Reinforcing Steel
808	Flowable Backfill
809	Concrete Paving
810	Shotcrete

SECTION 900 – DETAILS

900.10	POLLUTION CONTROL
PC-01	Interceptor Swale
PC-02	Diversion Dike Detail
PC-03	Slope Drain Detail
PC-04	Rock Riprap Size Selection
PC-05	Riprap Outlet Design
PC-06	Level Spreader – Schematic and Perspective
PC-07	Level Spreader – Lip Options
PC-08	Effect of Subsurface Drain
PC-09	Subsurface Drainage Patterns
PC-10	Surface Inlets for Subsurface Drains Schematic
PC-11	Subsurface Drain Envelope Schematic
PC-12	Typical Initial Anchor Trench For Blankets and Mats
PC-13	Typical Terminal Anchor Trench For Blankets and Mats
PC-14	Temporary Construction Entrance / Exit
PC-15	Cross-Section of a Construction Entrance / Exit
PC-16	Silt Fence Installation
PC-17	J-Hook Placement
PC-18	Triangular Filter Dike
PC-19	Tire Wash Facility
PC-20	Rock Berm Detail
PC-21	High Service Rock Berm
PC-22	Brush Berm Detail
PC-23	Rock Check Dam Detail
PC-24	Filter Fabric Inlet Protection



PC-25	Wooden Weir Curb Inlet Protection
PC-26	Sediment Trap Detail
PC-27	Sediment Basin Detail
PC-28	Utility Crossing or Excavation Within Creek Schematic
PC-29	Typical Temporary Ford Crossing Schematic
PC-30	Typical Temporary Culvert Crossing Schematic
PC-31	Typical Bridge Crossing
PC-32	Concrete Washout Areas
PC-33	Lined Waterway or Outlet
PC-34	Creek Buffer Zone
PC-35	Vegetated Swales
PC-36	Vegetated Filter Strips
PC-37	Permeable and Semi-Pervious Pavement
PC-38	Porous Asphalt Permeable and Semi-Pervious Pavement
PC-39	Discharge of Roof Drains to Pervious Surface
PC-40	Subsurface Treatment Devices SC – Type Separator
PC-41	Subsurface Treatment Devices CPS – Separator
PC-42	Subsurface Treatment Devices API – Separator
PC-43	Extended Detention Basin
PC-44	Retention Ponds
PC-45	Detention Pond Outlet for Erosion Protection and Storm Water Quality Benefits
PC-46	Cluster Design – Pre-Project
PC-47	Cluster Design – Post Project
PC-48	Preservation of Existing Tree Canopy



900.20**TRANSPORTATION**

T-01	Typical Half Cross – Sections for Local/Collector Streets
T-02	Typical Half Cross – Sections for Arterial/Industrial Streets
T-03	Typical Rural Paving Standard
T-04	Typical Rural (Collector) Paving Standard
T-05	Cross Sections Notes
T-06	Concrete Valley Gutter Standard
T-07	Local/Minor Collector Cul-de-Sac Plan
T-08	Industrial Cul-de-Sac Plan
T-09	Curb Stamp Standard
T-10	Curb and Gutter Standard
T-11	Mountable Curb and Gutter Standards
T-12	Ribbon Curb Standards
T-13	Sidewalk Section and Joint Standard
T-14	Hike and Bike Section Detail
T-15	Freespan Sidewalk Sections
T-16	Concrete Driveway Approach Typical
T-17	Concrete Dip Driveway Approach
T-18	Rural Residential Driveway Approach with Culvert Pipe
T-19	Rural Non-Residential Undivided Driveway Approach with Culvert Pipe
T-20	Standard Type III Barricade
T-21	Type III Barricade (Post Type) Typical Application
T-22	Universal Anchor System (Type III Barricade)
T-23	Poz-Loc (Driveable, Type III Barricade)
T-24	Standard Street Sign Detail
T-25	Triangular Slip Base System SMD(SLIP-1)-08
T-26	Project Sign Type II
T-27	Pedestrian Ramps General Notes
T-28	Typical Intersection Layout
T-29	Curb Ramps Placements at Intersections
T-30	Sidewalk Ramp Details Type 1-3
T-31	Sidewalk Ramp Detail Type 4
T-32	Sidewalk Ramp Detail Types 5-6
T-33	Sidewalk Ramp Detail Type 7
T-34	Sidewalk Treatment at Driveways
T-35	Driveway Aprons Types 12-13
T-36	Curb Ramp Details at Median Islands Type 20-21
T-37	Curb Ramp Detectable Warning Pavers



T-38	Removable Hand Rail
T-39	Temporary All Weather Driving Surface
T-40	Temporary All Weather Driving Surface Turn Around
T-41	Pedestrian Bridge – Elevation & Bearing Assembly
T-42	Pedestrian Bridge – Sections
T-43	Solar Powered Roadside Flashing Beacon Assembly Details (Aluminum)
T-44	Solar Powered Roadside Flashing Beacon Assembly

NOTE: IN THE ABSENCE OF CITY OF KILLEEN STANDARD TRANSPORTATION DETAILS, THE APPLICABLE TXDOT ROADWAY STANDARD DETAILS SHALL BE USED.

900.30 DRAINAGE

D-01	Curb Inlet Detail
D-02	Curb Drain Inlet Typical Section
D-03	Standard Storm Sewer Manhole Set
D-04	Standard Storm Drain Manhole Set
D-05	Standard Storm Sewer Manhole Plan
D-06	Standard Storm Sewer Manhole - Section
D-07	Typical Concrete Rip-Rap at Pipe
D-08	Energy Dissipator Detail
D-09	Trench and Embedment Detail for Storm Sewer
D-10	Trench and Embedment Notes Storm Sewer
D-11	HDPE Pipe Connection to Inlet/Manhole
D-12	Soil-Tight Structure Connection Type I Detail
D-13	Watertight Structure HDPE Connection Type I Detail
D-14	Watertight Structure Connection Type 2 Detail
D-15	Watertight Structure Connection Type 3 Detail
D-16	Grass Lined Channel
D-17	Concrete Lined Channel
D-18	Soil-Tight Structure Connection Detail
D-19	Drop Structure Detail
D-20	Area Inlet Detail
D-21	Combination Inlet Detail
D-22	Combination Inlet Detail (Top and Side)
D-23	Concrete Drainage Flume

NOTE: IN THE ABSENCE OF CITY OF KILLEEN STANDARD DRAINAGE DETAILS, THE APPLICABLE TXDOT BRIDGE STANDARD DETAILS SHALL BE USED.



W-01	Typical Utility Assignments
W-02	Typical and Embedment Standards
W-03	Concrete Trench Cap Standard
W-04	Typical Water Service - Elevation
W-05	Single Water Service - Plan
W-06	Double Water Service - Plan
W-07	Typical Valve Setting
W-08	Standard Blow – Off – Flush Assembly
W-09	Typical Fire Hydrant Installation
W-10	Typical Thrust Blocks for Water and Force Mains
W-11	Standard Air Release Valve for Water Main – Top Vent
W-12	Standard Air Release Valve for Water Main – Side Vent
W-13	Installation of PVC Pipe Through Casing
W-14	Concrete Encasement Standard (Under Natural Ground/Gravel)
W-15	Concrete Encasement Standard (Under Concrete/Pavement)
W-16	Trench and Embedment and Pavement Replacement Standard Under Existing Roadway
W-17	Fire Hydrant Sampling Point
W-18	Customer's Cut-Off
W-19	Meter Box (Non-Traffic Areas)
W-20	Dual Meter Box (Non-Traffic Areas)
W-21	Meter Vault

900.50 WASTEWATER (RESERVED)

WW-01	Typical Utility Assignments
WW-02	Standard Manhole - Plan
WW-03	Standard Manhole - Section
WW-04	Drop Connection – Precast Manhole Type “A”
WW-05	Drop Connection – Precast Manhole Type “B”
WW-06	Flow Patterns for Invert Channels
WW-07	Standard Wastewater Manhole Set
WW-08	48” x 5” to 33” x 8” x 36” Tall Eccentric Concrete Section
WW-09	48” Manhole Flat Lid Section (NOT USED)
WW-10	Flexible “Seal Boot” Connector
WW-11	Type 4- Pickbar (NOT USED)
WW-12	Sewer Clean – Out Standard
WW-13	Sewer Service Connections
WW-14	Gasketed Sewer Fitting for Sewer Service Connections to Existing Mains



WW-15	Standard Air Release Valve for Force Main – Top Vent
WW-16	Standard Air Release Valve for Force Main – Side Vent
WW-17	Trench and Embedment Standard Under Non-Paved Areas
WW-18	Trench and Embedment and Pavement Replacement Standard Under Existing Roadways
WW-19	Trench and Embedment Standard Under Proposed Roadway



SECTION 300 – GENERAL SPECIFICATIONS

ITEM 301. BARRICADES, SIGNS AND TRAFFIC HANDLING

301.1 SCOPE OF WORK

- A. This specification covers the requirements to provide, install, move, replace, maintain, clean and remove temporary or permanent street closure barricades, signs or other devices required to handle the traffic in conformance with the current edition of the Texas Manual on Uniform Traffic Control Devices for Streets and Highways (TMUTCD) and as indicated by the Engineer or the City.

301.2 SUBMITTALS

- A. Within 10 days after the Notice to Proceed, the Contractor shall submit to the Engineer a site-specific Traffic Control Plan. The Traffic Control Plan shall be sealed by a Professional Engineer Registered in the State of Texas as required by the Project Specifications, City, or Engineer.

301.3 CONSTRUCTION METHODS

- A. Prior to commencing the construction, suitable "Barricades, Signs and Traffic Handling" devices shall be installed to protect the workers and the public. A traffic control plan specific to the Project shall be designed and submitted to the City prior to the start of construction. If indicated by the Plans or requested by the City, the plan shall be designed by a qualified traffic engineer who is a Registered Professional Engineer in the State of Texas.
- B. The Contractor shall be responsible for installing all markers, signs and barricades conforming to the Texas Manual on Uniform Traffic Control Devices and/or as indicated. If, in the opinion of the Engineer, additional markers, signs or barricades are needed in the interest of safety, the Contractor will install such as are required or as directed by the Engineer.

301.4 MAINTENANCE AND INSPECTION

- A. It shall be the Contractor's responsibility to maintain, clean, move and replace if necessary, barricades, signs and traffic handling devices during the time required for construction of the Project. When no longer needed all temporary barricades, signs and traffic handling devices shall be removed and the area restored to its original condition or as directed by the Engineer.
- B. Bimonthly barricade inspections shall be conducted using a form similar to TxDOT Form 599 for temporary traffic controls. One inspection shall be made for traffic control during the day and one inspection shall be made for traffic control during the night, on separate days.

301.5 PAYMENT

- A. Payment shall be made for the work performed in accordance with this specification and the appropriate bid items of the Proposal and Bid Schedule.

END OF SECTION



SECTION 300 – GENERAL SPECIFICATIONS

ITEM 302. SITE PREPARATION

302.1 SCOPE OF WORK

- A. This specification covers the requirements for performing all clearing, grubbing and stripping of topsoil complete as shown on the Plans and as specified herein. Any items regarding site preparation that are not covered by this specification shall meet the requirements of Item 100, Texas Department of Transportation (TxDOT), Standard Specifications for Construction of Highways, Streets and Bridges.

302.2 SUBMITTALS

- A. None required unless specifically called for in the Plans, Standards or requested by the City or the Engineer.

302.3 CLEARING AND GRUBBING

- A. Except as otherwise directed, cut, grub, remove and dispose of all trees, stumps, brush, shrubs, roots and any other objectionable material within the limits defined on the Plans.
- B. All trees, stumps, brush, shrubs, roots and other objectionable material shall be cut, grubbed, removed and disposed of from areas to be occupied by buildings, structures, roads, pipelines and any other areas to be stripped. Trees and brush shall be removed to a depth at least three (3) feet below the finished grade.
- C. In addition, heavy growths of weeds or other plants shall be stripped from the surface in order to provide clear access to the work site and to prevent their inclusion in stockpiled soil which is to be reused later. Trees, stumps, surface plants and all debris removed from the site shall be disposed of off-site by the Contractor at his own expense.
- D. Before the start of construction, protect trees or groups of trees, designated by the Engineer to remain, from damage by all construction operations by erecting suitable barriers, or by other approved means. Clearing operations shall be conducted in a manner to prevent falling trees from damaging trees designated to remain.
- E. Areas outside the limits of clearing shall be protected from damage and no equipment or materials shall be stored in these areas.
- F. No stumps, trees, limbs, or brush shall be buried in any fills or embankments.

302.4 STRIPPING

- A. Strip topsoil from all areas to be occupied by buildings, structures, roadways and all areas to be excavated or filled. Avoid mixing topsoil with subsoil and stockpile topsoil in areas on the site as approved by the Engineer. Topsoil shall be free from brush, trash, large stones and other extraneous material and protected until it is placed as specified under Section 307- LOAMING, HYDROSEEDING AND PERMANENT EROSION CONTROL. Dispose of any remaining topsoil as directed by the City. All excess topsoil shall remain property of the City at its option, and Contractor shall place extra materials at a site designated by the City.



302.5

DISPOSAL OF MATERIALS

- A. All tree trunks, limbs, roots, stumps, brush, foliage, other vegetation and objectionable material shall be removed from the site and disposed of in a permitted disposal site in a manner satisfactory to the Engineer.
- B. Burning of cleared and grubbed materials will not be permitted unless approved by the Director of Public Works and a permit is obtained from the City of Killeen Fire Department.
- C. Disposal of Excavated Materials
 - 1. Suitable excavated materials may be stockpiled to be used for backfilling. Excess excavated materials and unsuitable backfill materials shall be disposed of by the Contractor in the following manner:
 - a. Clays, sands and gravel in excess of project requirements shall be disposed of by the Contractor at such locations and under consideration arranged by the Contractor at his expense.
 - b. Limestone and other rock excavation shall be disposed of by the Contractor at such locations and under consideration arranged by the Contractor at his expense.
 - 2. The classification of clays, sands, gravel, limestone and rock shall be made in accordance with the Unified Soil Classification System, U.S. Army Corps of Engineers, T.M. 3-357.
 - 3. Desirable topsoil, sod, or area fill shall be carefully removed and piled separately adjacent to the work when required. Excavated materials shall be handled at all times in such a manner as to cause a minimum of inconvenience to the City's operations, and to permit safe and convenient access to private and public property adjacent to the work

302.6

UNAUTHORIZED EXCAVATION

- A. Whenever the excavation is carried beyond or below the lines and grades as shown on the plans, except as specified above, all such excavated space shall be refilled with such material and in such a manner, as may be directed by the City, so as to insure the stability of the affected structure. Beneath all structures, space excavated without authority shall be refilled by the Contractor, at his own expense, with Class "C" concrete, crushed stone or selected fill materials, as directed by the City.

302.7

PAYMENT

- A. Payment will be made for work performed in accordance with this specification by the unit quantity for the item for right-of-way preparation in the Proposal and Bid Schedule.

END OF SECTION



SECTION 300 – GENERAL SPECIFICATIONS

ITEM 303. SITE CLEARING

303.1 SCOPE OF WORK

- A. This specification covers the requirements for site clearing operations for this Project.

303.2 SUBMITTALS

- A. None required unless specifically called for in the Plans, Standards, or requested by the City or the Engineer.

303.3 TRAFFIC

- A. Conduct site-clearing operations to ensure minimum interference with roads, streets, walks and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

303.4 PROTECTION

- A. Provide temporary fences, barricades, coverings, or other protection to preserve existing items indicated to remain and to prevent injury or damage to persons or property. Provide protection for adjacent properties as required.
- B. Restore damaged work to condition existing prior to start of work.
- C. Protect existing trees and vegetation that are indicated to remain from physical damage. Do not store materials or equipment within tree drip line. Replace damaged trees that cannot be restored to full growth, as determined by arborist, unless otherwise deemed acceptable by the Engineer or the City.
- D. Protect existing property and easement corners and pins. In the event that property or easement corners or pins are moved, disturbed or destroyed the Contractor shall replace them at his own expense. They shall be replaced by a Registered Professional Land Surveyor registered in the State of Texas.

303.5 EXISTING SERVICES

- A. Locations indicated are approximate; determine exact location before commencing work. Coordinate with local utility service requirements and comply with their instructions.

303.6 SITE CLEARING

- A. Remove trees, shrubs, grass and other vegetation, improvements, or obstructions as indicated or that interfere with new construction. Removal includes digging out stumps and roots, together with subsequent off-site disposal.
- B. Strip and stockpile topsoil that will be reused in the Work.
- C. Remove existing improvements, both above-grade and below-grade, to extent indicated or as otherwise required to permit new construction.



303.7 SALVAGEABLE ITEMS

- A. Carefully remove items indicated to be salvaged and store on the City's premises where indicated or directed.

303.8 AIR POLLUTION

- A. Control air pollution caused by dust and dirt; comply with governing regulations.

303.9 REGRADING

- A. Fill depressions and voids resulting from site-clearing operations. Using satisfactory soil materials, place in maximum six (6) inch deep horizontal layers and compact each layer to density of surrounding original ground.
- B. Grade ground surface to conform to required contours and to provide surface drainage.

303.10 DISPOSAL OF MATERIAL

- A. Dispose of waste materials including trash, debris and excess topsoil. No waste material shall remain on the City's property.
- B. Burning waste materials on site is not permitted.

303.11 PAYMENT

- A. No separate payment will be made for work performed in accordance with this specification, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION



SECTION 300 - GENERAL SPECIFICATIONS

ITEM 304. TRENCHING, BACKFILLING AND COMPACTION

304.1 SCOPE OF WORK

- A. This specification covers the requirements for furnishing all labor, equipment and material and performing all work necessary, in connection with excavation, trenching, embedment, encasement, and backfilling, for the installation of water lines, storm sewer lines, wastewater lines, etc. in this Project.

304.2 SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including a Trench Safety Plan (which shall be sealed by a Professional Engineer registered in the State of Texas, if required) embedment material (source, gradation and type), backfill material (source, gradation and type), encasement material (if required), equipment and all other pertinent data to illustrate conformance to the specification found within.

304.3 EXCAVATION

A. General

1. Excavation shall include the removal of any trees, stumps, brush, debris, or other obstacles that may obstruct the line of work, and the excavation and removal of all earth, rock or other materials to the extent necessary to install the pipe and appurtenances in conformance with the line and grades shown in the Plans, or as specified.

B. Maximum and Minimum Width of Trenches

1. The sides of all trenches shall be cut as nearly vertical as possible. Unless otherwise specified on the Plans, the minimum width of trench in which the pipe may be installed shall not be less than 12-inches plus the outside diameter of the pipe for pipe less than 20-inches in diameter and not less than 24-inches plus the outside diameter of the pipe for pipe greater than 20-inches in diameter. The maximum width shall not be more than 30-inches plus the outside diameter of the pipe, measured at an elevation in the trench which is 12-inches above the top of the pipe when it is laid to grade.
2. Wherever the prescribed maximum trench width is exceeded, the Contractor shall use the class embedment or encasement required by the Engineer to provide the load carrying capacity for the trench width as actually cut, and the additional cost incurred will be borne by the Contractor.

C. Sheeting and Shoring

1. Where required in the Contractor's Trench Safety System, or where required for other reasons in caving ground, or in wet, saturated or flowing materials, the sides of all trenches and excavations shall be adequately sheeted and braced so as to maintain the excavation free from slides or cave-ins.
2. Sheeting and shoring shall not be left in place unless its removal is impractical.



D. Dewatering Excavations

1. There shall be sufficient pumping equipment, in good working order, available at all times to remove any water that accumulates in excavations. Where the pipeline crosses natural drainage channels, the work shall be conducted in such a manner that unnecessary damage or delays in the prosecution of the work will be prevented. Provisions shall be made for the satisfactory disposal of surface water pumped so as to prevent damage to public or private property. The Contractor shall be responsible for maintaining safe working conditions and suitable construction techniques.

E. Disposal of Excavated Materials

1. Suitable excavated materials may be piled adjacent to the work to be used for backfilling. Excavated materials unsuitable for backfilling, or in excess of that required for backfilling, shall be disposed of by the Contractor. Desirable topsoil, sod, etc. shall be carefully removed and piled separately adjacent to the work when required. Excavated materials shall be handled at all times in such a manner as to cause a minimum of inconvenience to public travel. Suitable selected bedding or backfill material shall be provided at no additional cost to the City.

F. Trench Depth

1. Excavation for the pipeline shall be removed to a depth below the pipe barrel and pipe bell as shown in the Plans for the type of embedment specified, and the bottom of the trench brought to true subgrade with the embedment or encasement shown in the Plans.

G. Soft Subgrade

1. Where soft or spongy material is encountered in the excavation at subgrade level, it shall be removed to such a depth that a stable foundation is achieved by replacing the unsuitable material with tamped gravel, brought to the level of the bottom of bedding.
2. Gravel used shall be washed gravel or crushed stone and may fit any gradation of size up to three (3) inches. The particular gradation shall take into consideration the actual field conditions.

H. Excavated Materials

1. Excavated materials shall be piled adjacent to the work to be used for backfilling as required. After the trench has been refilled, topsoil shall be replaced to the extent that rock excavated from the trench will be completely covered and the area is returned to its original condition.
2. Where required on the Plans or when otherwise specified, desirable topsoil shall be piled separately in a careful manner and replaced in its original position.
3. Where a trench is required to cross a paved area, the asphalt or concrete shall be saw cut and removed for a total width that is two (2) feet greater than the trench width. The Contractor shall dispose of all excavated concrete, asphalt and subgrade material that is unsuitable for backfilling or in excess of that required for backfilling.

I. Damage to Existing Utilities

1. Where existing utilities are damaged, they shall be replaced immediately with material equal to or better than the existing material. Such work shall be at the entire expense of the Contractor.



EMBEDMENT AND ENCASEMENT

A. General

1. Embedment shall be as required in the Plans or Standards. All embedment materials shall be free of grass, roots, vegetation, and other deleterious materials. Embedment Standards are shown on the Plans or Standards.
2. When the pipe has been checked for line and grade, the trench shall be backfilled with enough granular material or concrete on both sides to hold the pipe firmly in position. When placing granular material or concrete around the pipe, care shall be taken to fill all voids around the pipe. The pipe shall not be floated. The embedment or encasement material shall be carefully tamped to assure uniform pipe support and density.

B. Embedment Materials

1. Material for embedment shall conform to the following sieve analysis:

<u>Sieve Size</u>	<u>3/8" F % Retained</u>	<u>1/2" D % Retained</u>	<u>Washed Gravel % Retained</u>
1/2"	0	0	0
3/8"	0-2	5-25	---
4m	40-85	80-100	---
10m	95-100	96-100	---
3/4"	---	---	100

2. Sand will not be allowed as an acceptable embedment material.

C. Concrete Embedment and Encasement

1. Concrete embedment and encasement and cap shall have a minimum compressive strength of 2,000 pounds per square inch at 28 days.
2. Dry mix will not be permitted. The concrete cushion portion of the embedment or encasement will be mixed moist or damp to give a slump of not more than one (1) inch. Concrete for the sides and top, if specified, shall be mixed to obtain a slump of not less than one (1) inch or more than three (3) inches.
3. After pipe joints are completed, the voids at the joints in the embedment section shall be filled with concrete, and the embedment shall be brought up to proper grade. Where concrete is placed over or along the pipe, it shall be placed in such a manner as not to damage or injure the joints or displace the pipe. Care shall be taken in the placement of concrete to assure that a uniform pad, free of voids and of specified thickness, is constructed under the entire pipe section.
4. A cleavage line between the base concrete and the side embedment concrete will not be allowed. Backfilling shall be done in a careful manner and at such time, after concrete embedment or encasement has been placed, as not to damage the concrete in any way.

BACKFILLING

A. General

1. Backfilling shall include the refilling and consolidating of the fill in trenches and excavations up to the surrounding ground surface or road grade at crossings. No backfill shall be placed



until the Engineer, the City or his authorized Inspector has inspected the trench and pipe in place and has authorized the placing of backfill.

2. Backfilling shall be done with native material, flexible base material, select backfill material, or flowable concrete backfill as described hereafter and shown on the Plans. No material of a perishable, spongy or otherwise unsuitable nature shall be used in backfilling.

B. Native Material

1. Native materials shall be placed over the top of the embedment/encasement material, where designated on the Plans and as shown in embedment Standards. Native material shall consist of material excavated from the trench, free from lumps, large stones, clay, debris, and organic materials. Native material used as backfill shall not have rocks with an average dimension larger than one (1) inch nor any dimension greater than two (2) inches.
2. Native material for backfill shall be compacted per the following table.

Field Density Control Requirements

Description	Density	Moisture Control
	Tex-115-E	
PI ≤ 15	≥ 98% Max. Dry Density	
15 < PI ≤ 35	98% ≥ Max. Dry Density ≤ 102%	≥ Optimum Moisture Content
PI > 35	95% ≥ Max. Dry Density ≤ 100%	≥ Optimum Moisture Content

3. It shall be the full responsibility of the Contractor to explore the project and subsurface materials to determine if the trench excavation will be suitable for use as backfill materials and to follow as closely as possible this Specification to insure a good, sound pipeline when completed.

C. Flexible Base Material

1. Flexible base material shall be placed over the top of the embedment/encasement material, where designated on the Plans and as shown in embedment Standards. Flexible base material shall consist of a TxDOT Type A - Grade 2 crushed limestone base compacted to 95% of the maximum density as determined by ASTM D1557 (Method D) at optimum moisture to +2%.

D. Select Backfill Material

1. Unless otherwise shown on the Plans, or approved by the Engineer, select material shall be used for backfill.
2. Select materials shall be placed over the top of the embedment/encasement material, where designated on the Plans and as shown in embedment Standards. Select material shall consist of a free-flowing material like sand or mixed sand and gravel, free from lumps, large stones, clay, debris, and organic materials. Select material may also include rock cuttings from a ditching machine (preferably wheel-type), provided that the largest chips shall have an average dimension in one place less than one (1) inch, and no dimension greater than two (2) inches.
3. If approved by the Engineer, good, sound earth may be used as select material for backfill over the pipe. Good, sound earth as defined as gravel, sandy loam or loam, free from excessive clay and having a Plasticity Index less than 20. Select material shall not have rocks with an average dimension larger than one (1) inch.
4. Select backfill shall be compacted per the following table.



Field Density Control Requirements

Description	Density	Moisture Control
	Tex-115-E	
PI ≤ 15	≥ 98% M ax. D ry D ensity	
15 < PI ≤ 35	98%	≤ ≥ O ptim um M oisture C ontent
PI > 35	95%	≤ ≥ O ptim um M oisture C ontent

5. It shall be the full responsibility of the Contractor to explore the project and subsurface materials to determine if the trench excavation will be suitable for use as select materials and to follow as closely as possible this Specification to insure a good, sound pipeline when completed.

E. Concrete Trench Cap

1. Where 36-inch minimum cover can not be obtained or due to potential surface loading, the City may require a cap to be installed.

F. Flowable Concrete Backfill

1. Where shown on the Plans, flowable concrete backfill shall be in accordance with Section 806, FLOWABLE BACKFILL. All material shall be mixed in a concrete mixer or transit mixed unless otherwise approved by the City.

G. Backfilling Operation

1. After the pipe and embedment or encasement have been placed in trenches under non-paved areas, the remainder of the trench shall then be filled with material described in Section 304.5 (B-F). Mechanical tamping in ten (10) inch maximum lifts shall be used (except for flowable concrete backfill). Backfill material shall be compacted as described in the appropriate section listed above. A minimum of one density test shall be taken every two hundred fifty (250') feet for each ten (10") inch lift of subgrade for all backfill materials except flowable concrete.

2. All trenches under proposed or existing concrete roadways, driveways and sidewalks, paved waterways, brick roadways, asphaltic roadways with concrete base, gravel roadways, and roadways with gravel base and asphalt surface, shall be backfilled by hand or mechanically tamping selected materials in maximum six (6) inch layers compacted as described in the appropriate section listed above. Jetting with water will not be permitted. A minimum of one density test shall be taken every two hundred fifty (250') feet for each six (6") inch lift of subgrade for all backfill materials except flowable concrete.

3. After the trench has been refilled, topsoil shall be replaced to the extent that rock excavated from the trench will be completely covered or removed and the area is returned to its original condition, except that in cultivated areas a minimum of six (6) inches of topsoil shall be replaced.

304.6

PAYMENT

A. No separate payment will be made for work performed under this Specification for excavating, trenching, embedment, and backfilling. All costs incurred shall be included in the contract price for the appropriate items in the Proposal and Bid Schedule.

B. No separate payment will be made for the bedding used in embedment. All costs incurred shall be included in the contract price for the appropriate bid item.



- C. Separate payment, if authorized by the City, will be made for crushed stone or washed gravel as described in these specifications under Section 304.3(G), SOFT SUBGRADE, at the contract unit price per cubic yard as provided in the Proposal and Bid Schedule under "Extra Gravel for Embedment."
- D. Separate payment will be made for 2,000 psi Concrete Encasement or Backfill at the contract unit price per cubic yard or linear foot as provided in the Proposal and Bid Schedule under 2,000 psi Concrete Encasement. Concrete and three (3) sack granular sand or rock material mix backfill will be measured in cubic yards or linear feet actually placed based on actual trench width not to exceed the specified maximum trench width and will be paid for at the contract price per cubic yard or linear foot as provided in the Proposal and Bid Schedule.
- F. Where authorized by the Engineer, gravel used to replace unsuitable material will be paid for at the unit bid price for Extra Gravel for embedment.

END OF SECTION



SECTION 300 – GENERAL SPECIFICATIONS

ITEM 305. GRANULAR FILL MATERIALS

305.1 SCOPE OF WORK

A. This specification covers the requirements for the use of granular fill materials for this Project.

305.2 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to Engineer or the City for approval, technical product literature including the source of the material, gradation, type of material, and all other pertinent data to illustrate conformance to the specification found within.

305.3 GENERAL

A. Granular fill materials are specified in this Section, but their use for bedding pipe, pavement base, are specified in detail in sections 304 TRENCHING, BACKFILLING AND COMPACTION and 504 FLEXIBLE BASE. The Engineer may respectively order the use of fill materials for purposes other than those specified in other Sections if, in his/her opinion, such use is advisable.

305.4 MATERIALS

A. Common fill shall consist of mineral soil, substantially free of clay, organic material, loam, wood, trash, and other objectionable material which may be compressible, or which cannot be compacted properly. Common fill shall not contain stones larger than six (6) inches in any dimension, broken concrete, masonry, rubble, asphalt pavement, or other similar materials. It shall have physical properties, as approved by the Engineer, such that it can be readily spread and compacted.

B. Select fill shall consist of suitable granular material with no stones larger than two (2) inches in its largest dimension, free from vegetation or other objectionable matter and reasonably free from lumps of earth. When tested by standard TxDOT laboratory methods Tex-105-E, Tex-106-E and Tex-107-E, the select fill shall meet the following requirements:

1. Liquid Limit shall not exceed 45.
2. Plasticity index shall not exceed 15.
3. Bar linear shrinkage shall not be less than 2.

C. Crushed Stone Backfill shall consist of hard, durable, particles of proper size and gradation, free from sand, loam, clay, excess fines and deleterious materials. The size of the particles shall be uniformly graded such that the following bedding specifications are met:

<u>Sieve Size</u>	<u>$\frac{3}{8}$" F % Retained</u>	<u>$\frac{1}{2}$" D % Retained</u>	<u>Washed Gravel % Retained</u>
$\frac{1}{2}$ "	0	0	0
$\frac{3}{8}$ "	0-2	5-25	---
4m	40-85	80-100	---
10m	95-100	96-100	---
$\frac{3}{4}$ "	---	---	100

D. Crushed Stone Base shall consist of sound, durable stone, free of any foreign material, angular in shape, free from structural defects and comparatively free of chemical decay. This material shall comply with TxDOT Item 247, Type "A", Grade 1 unless otherwise shown on the Plans or Standards. The stone shall have a maximum size of $\frac{7}{8}$ -inch.



- D. Cement Stabilization Sand Backfill shall consist of a mixture of ASTM C33 fine aggregate and Type I cement. The mix shall be proportioned of two (2) sacks of cement per cubic yard.
- E. Sand that is not cement stabilized will not be allowed as an acceptable backfill material.

305.5

PAYMENT

- A. No separate payment will be made for work performed in accordance with this specification, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION



SECTION 300 – GENERAL SPECIFICATIONS

ITEM 306. SEDIMENTATION AND TEMPORARY EROSION CONTROL

306.1 SCOPE OF WORK

- A. This specification covers the requirements necessary to perform all installation, maintenance, removal and area cleanup related to sedimentation control work as shown on the Plans and as specified herein.

306.2 SUBMITTALS

- A. Within 10 days after Notice to Proceed, the Contractor shall submit to the Engineer for approval, technical product literature for all commercial products to be used for sedimentation and erosion control.

306.3 GENERAL

- A. The work shall include, but not necessarily be limited to: triangular filter dike, rock berm, silt fence, curb inlet protection, stabilized construction entrance, tree protection, excelsior matting, and temporary mulching, sediment removal and disposal, device maintenance, removal of temporary devices, temporary mulching, excelsior matting installation and final cleanup. All sedimentation and erosion control shall be installed prior to the start of any construction activities.

306.4 QUALITY ASSURANCE

- A. The Contractor shall be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the movement of sediment from the construction site to off site areas or into the stream system via surface runoff or underground drainage systems. Measures in addition to those shown on the Plans necessary to prevent the movement of sediment off site shall be installed, maintained, removed, and cleaned up at the expense of the Contractor. No additional charges to the City will be considered.

306.5 MATERIALS

A. Triangular Filter Dike

1. Triangular filter dike sections shall be either 10-feet or 20-feet in length.
2. Geotextile fabric shall extend to 12-inches upstream of triangular filter dike structure.
3. Triangular filter dike structure shall be 18-inches in length on all three (3) faces.
4. Three (3) inch to five (5) inch open graded rock shall be placed over skirt to anchor it on the upstream side.
5. Structure shall be formed by six (6) gauge six inch by six inch (6" x 6") welded wire mesh.
6. Geotextile fabric shall be non-woven, 4.5 oz. minimum and 36-inches wide.

B. Rock Berm

1. Woven wire sheathing shall be 20-gauge with one (1) inch openings.
2. Rock shall be three inches to five inches (3" - 5") open graded.



C. Silt Fence

1. Steel posts shall be a minimum of four (4) feet in length, heavy weight T-Post.
2. Welded wire fabric shall be two-inch by four-inch (2"x4") mesh of 12-gauge by 12-gauge galvanized wire mesh.
3. Silt fence fabric shall be a 4.5 oz minimum non-woven geotextile filter fabric 36-inches wide.
4. Tie wires for securing silt fence fabric to wire mesh shall be light gauge metal clips (hog rings), or $\frac{1}{32}$ -inch diameter soft aluminum wire.
5. Prefabricated commercial silt fence may be substituted for built-in-field fence. Prefabricated silt fence shall be "Envirofence" as manufactured by Mirafi Inc., Charlotte, NC or equal.

D. Curb Inlet Protection

1. 4.5 oz. minimum non-woven geotextile filter fabric shall be used.
2. Sand bags shall be used to hold the filter fabric in place.

E. Stabilized Construction Entrance

1. Stabilized construction entrance shall have a minimum width of 12-feet and a minimum length of 50-feet.
2. An eight (8) inch high diversion ridge shall be constructed 15-feet from the edge of the existing roadway.
3. Stabilized construction entrance shall be graded to drain towards the existing roadway at a two-percent (2%) slope.
4. Rock shall be four-inches to eight-inches (4" -8") coarse aggregate.
5. Rock shall be placed to a depth of at least eight (8) inches.

F. Tree Protection – Chain Link Fence

1. Chain link fence shall be five (5) feet in height.
2. Fence shall be installed around the driplines of the trees to be protected.

G. Tree Protection – Wood Slats

1. Where any exceptions result in a fence being closer than four (4) feet to a tree trunk, protect the trunk with strapped-on-planking two inches by four inches (2"x4") wood slats to a height of eight (8) feet, or to the limits of lower branching in addition to the reduced fencing provided.
2. Trees most heavily impacted by construction activities should be watered deeply once a week during periods of hot, dry weather. Tree crowns should be sprayed with water periodically to reduce dust accumulation on the leaves.
3. Any trenching required for the installation of landscape irrigation shall be placed as far from existing tree trunks as possible.
4. No landscape topsoil dressing greater than four (4) inches shall be permitted within the dripline of a tree. No soil is permitted on the root flare of any tree.



H. Soil Retention Blankets

1. Soil retention blankets shall be installed in all seeded drainage swales and ditches as shown on the Plans or as directed by the Engineer. Only soil retention blankets included on TxDOT's Approved Products List will be considered acceptable for use on this Project.

I. Temporary Mulch

1. Temporary mulch shall be applied to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days of the completion of rough grading.

306.6

INSTALLATION

A. Triangular Filter Dike

1. Layout the filter dike following as closely as possible to the contour.
2. Clear the ground of debris, rocks, and plants that will interfere with installation.
3. Place the filter dike sections one (1) at a time, with the skirt on the uphill side towards the direction of flow anchoring each section to the ground before the next section is placed.
4. Anchors should be placed on two (2) foot centers alternating from front to back so that there is actually only one (1) foot in between anchors.
5. Securely fasten the skirt from one (1) section of filter dike to the next.
6. Filter dikes must maintain continuous contact with the ground.
7. After the site is completely stabilized, the dikes and any remaining silt should be removed. Silt should be disposed of in a manner that will not contribute to additional siltation.

B. Rock Berm Installation

1. Layout the rock berm following as closely as possible to the contour.
2. Clear the ground of debris, rocks or plants that will interfere with installation.
3. Place woven wire fabric on the ground along the proposed installation with enough overlap to completely encircle the finished size of the berm.
4. Place the rock along the center of the wire to the designated height.
5. Wrap the structure with the previously placed wire mesh secure enough so that when walked across, the structure retains its shape.
6. Secure with tie wire.
7. The ends of the berm should be tied into existing upslope grade and the berm should be buried in a trench approximately four (4) inches deep to prevent failure of the control.
8. The rock berm should be left in place until all upstream areas are stabilized and accumulated silt removed.



C. Silt Fence Installation

1. Layout the silt fence following as closely as possible to the contour.
2. Clear the ground of debris, rocks, and plants (including grasses taller than two (2) inches) to provide a smooth flow approach surface. Excavate six-inches deep by six-inches wide (6" x 6") trench on upstream side of face per Plans.
3. Drive the heavy duty T-post at least 12-inches into the ground and at a slight angle towards the flow.
4. Attach the two-inches by four-inches (2" x 4") 12-gauge welded wire mesh to the T-post with 11¹/₂-gauge galvanized T-post clips. The top of the wire to be 24-inches above ground level. The welded wire mesh to be overlapped six (6) inches and tied at least six (6) times with hog rings.
5. The silt fence to be installed with a skirt a minimum of 11-inches wide placed on the uphill side of the fence inside excavated trench. The fabric to overlap the top of the wire by one (1) inch.
6. Anchor the silt fence by backfilling with excavated dirt and rocks.
7. Geotextile splices should be a minimum of 36-inches wide attached in at least six (6) places.

D. Curb Inlet Protection Installation

1. Clear the pavement of debris, rocks, etc. to provide a smooth surface for installation.
2. Place the filter fabric over the inlet and extend to five (5) feet beyond inlet opening, upstream of inlet. Terminate fabric in street gutter with sand bags placed in gutter flowline.
3. Place sandbags on top of filter fabric around the perimeter of the protected area to secure the filter fabric.
4. Care shall be taken insure that the inlet protection will remain in place during periods of heavy runoff and that severe ponding will not occur in the street.

E. Stabilized Construction Entrance Installation

1. Clear the area of debris, rocks or plants that will interfere with installation.
2. Grade the area for the entrance to flow back on to the construction site. Runoff from the stabilized construction entrance onto a public street will not be allowed except for the first 15 feet connecting to the public street.
3. Place geotextile fabric if required.
4. Provide crushed aggregate for long and short-term construction entrances. Furnish aggregates that are clean, hard, durable, and free from adherent coatings such as salt, alkali, dirt, clay, loam, shale, soft, or flaky materials and organic and injurious matter. Use 4- to 8-in. aggregate for Type 1 and 2- to 4-in. aggregate for Type 3.

F. Tree Protection – Chain Link Fence

1. Tree protection fences shall be installed prior to the commencement of any site preparation work (clearing, grubbing or grading).



2. Fences shall completely surround the tree, or clusters of trees; will be located at the outermost limit of the tree branches (dripline), and will be maintained throughout the construction project in order to prevent the following:
 - a. Soil compaction in the root zone area resulting from vehicular traffic, or storage of equipment or materials.
 - b. Root zone disturbances due to grade changes greater than six (6) inches cut or fill or trenching not reviewed and authorized by the City.
 - c. Wounds to exposed roots, trunks or limbs by mechanical equipment.
 - d. Other activities detrimental to trees, such as chemical storage, cement truck cleaning and fire.
3. Exceptions to installing fences at tree driplines may be permitted in the following cases:
 - a. Where permeable paving is to be installed, erect the fence at the outer limits of the permeable paving area.
 - b. Where trees are close to a proposed building, erect the fence no closer than six (6) feet to building.

G. Tree Protection – Wood Slats

1. Any roots exposed by construction activity shall be pruned flush with the soil. Backfill root areas with good quality top soil as soon as possible. If exposed root areas are not backfilled within two (2) days, cover them with organic material in a manner which reduces soil temperature, and minimizes water loss due to evaporation.
2. Prior to excavation or grade cutting within tree dripline, make a clean cut between the disturbed and undisturbed root zones with a rock saw or similar equipment, to minimize damage to remaining roots.
3. Pruning to provide clearance for structures, vehicular traffic and equipment shall take place before construction starts.

H. Excelsior Matting

1. The area to be covered shall be properly prepared, fertilized and seeded with permanent vegetation before the blanket is applied.
2. When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area.
3. The blankets shall be applied in the direction of water flow, and stapled. Blankets shall be placed a minimum of three (3) rows, of four (4) foot wide (total approx. 12-foot width) within the drainage swale/ditch and stapled together in accordance with Manufacturer's instructions.
4. Side overlap shall be four (4) inch minimum. The staples shall be made of wire, 0.091-inch in diameter or greater, "U" shaped with legs 10-inches in length and a 1 $\frac{1}{2}$ -inch crown. The staples shall be driven vertically into the ground, spaced approximately two (2) linear feet apart, on each side, and one (1) row in the center alternately spaced between each size.
5. Upper and lower ends of the matting shall be buried to a depth of four (4) inches in a trench.



6. Erosion stops shall be created every 25-feet by making a fold in the fabric and carrying the fold into a silt trench across the full width of the blanket. The bottom of the fold shall be four (4) inches below the ground surface. Staple on both sides of fold.
7. Where the matting must be cut or more than one (1) roll length is required in the swale, turn down upper end of downstream roll into a slit trench to a depth of four (4) inches. Overlap lower end of upstream roll four (4) inches past edge of downstream roll and staple.
8. To ensure full contact with soil surface, roll matting with a roller weighing 100-pounds per foot of width perpendicular to flow direction after seeding, placing matting and stapling.
9. Thoroughly inspect channel after completion. Correct any areas where matting does not present a smooth surface in full contact with the soil below.

I. Temporary Mulching

1. Straw mulch shall be applied at rate of 100 lbs/1,000 ft² and tackified with latex acrylic copolymer at a rate of 1 gal/1,000 ft² diluted in a ratio of 30 parts water to one (1) part latex acrylic copolymer mix.

306.7

MAINTENANCE AND INSPECTIONS

A. Inspections

1. Contractor shall make a visual inspection of all sedimentation control devices once per week and promptly after every rain event exceeding 1/2-inch. Inspection reports shall utilize TxDOT Form 2118, or similar form. If such inspection reveals that additional measures are needed to prevent movement of sediment to offsite areas or into the vent trench, Contractor shall promptly install additional devices as needed. Sediment controls in need of maintenance shall be repaired promptly.

B. Device Maintenance

1. Triangular Filter Dikes

- a. Realign berms as needed to prevent gaps between the sections.
- b. Accumulated silt should be removed after each rainfall event, and disposed of in a manner which shall not cause additional siltation.

2. Rock Berm

- a. Remove sediment and other debris when buildup reaches six (6) inches and dispose of the accumulated silt in an approved manner.
- b. Repair any loose wire sheathing.
- c. Reshape as needed.
- d. Replace berm when the structure ceases to function as intended due to silt accumulation among the rocks, washout, construction traffic damage, etc.

3. Silt Fences

- a. Remove accumulated sediment when buildup reaches six (6) inches.
- b. Replace damaged fabric, or patch with a two (2) foot minimum overlap.



- c. Replace or repair any sections crushed or collapsed in the course of construction activity.
 - d. Make other repairs as necessary to ensure that the fence is filtering all runoff directed to the fence.
4. Curb Inlet Protection
- a. Repair any damaged fabric, or patch with a two (2) foot minimum overlap.
 - b. Replace any damaged sandbags.
 - c. Remove accumulated sediment.
5. Stabilized Construction Entrance
- a. Periodic top dressing with additional stone may be required as conditions demand to prevent tracking or flowing of sediment onto public rights-of-way.
 - c. Cleanout any measures used to trap sediment as needed.
 - d. All sediment spilled, dropped, washed or tracked on to public rights-of-way should be removed immediately by the Contractor.
 - e. When necessary, wheels should be cleaned to remove sediment prior to entrance onto public rights-of-way.
 - f. When washing is required, it should be done on an area stabilized with crushed stone that drains into an approved sediment trap or sediment basin.
 - g. All sediment should be prevented from entering any storm drain, ditch or water course by using approved methods.
6. Tree Protection – Chain Link Fence
- a. Repair or replace any chain link fence damaged by construction activities.
7. Tree Protection – Wood Slats
- a. Repair or replace any wood slats damaged by construction activities.
8. Excelsior Matting
- a. Replace matting as needed to prevent erosion from occurring.
9. Temporary Mulch
- a. Replace mulch as needed to prevent erosion from occurring.

306.8

REMOVAL AND FINAL CLEANUP

- A. Once the site has been fully stabilized against erosion, remove sediment control devices and all accumulated silt. Dispose of silt and waste materials in proper manner. Re-grade all areas disturbed during this process and stabilize against erosion with surfacing materials as indicated on the Plans.



306.9

PAYMENT

- A. Silt fence and rock berm will be paid per linear foot installed as listed in the Proposal and Bid Schedule.
- B. Stabilized Construction Entrance will be paid per each installed as listed in the Proposal and Bid Schedule.
- C. Tree protection will be paid per each installed as listed in the Proposal and Bid Schedule.
- D. Erosion Control Blankets will be paid per square yard as listed in the Proposal and Bid Schedule.
- E. Triangular Filter Dikes will be paid per linear foot as listed in the Proposal and Bid Schedule.
- F. No separate payment will be made for all other work performed in accordance with this specification, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION



SECTION 300 – GENERAL SPECIFICATIONS

ITEM 307. LOAMING, HYDROSEEDING AND PERMANENT EROSION CONTROL

307.1 SCOPE OF WORK

- A. This specification covers the requirements to provide erosion control and place topsoil, finish grade, apply fertilizer, hydraulically apply seed and mulch and maintain all seeded areas as shown on the Plans and as specified herein, including all areas disturbed by the Contractor.

307.2 SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, samples of all materials to be used and all other pertinent data to illustrate conformance to the specification found within.

307.3 TOPSOIL

- A. Topsoil shall be fertile, friable, natural topsoil typical of topsoil of the locality and shall be obtained from a well drained site that is free of flooding. It shall be without admixture of subsoil or slag and free of stones, lumps, plants or their roots, sticks, clay, peat and other extraneous matter and shall not be delivered to the site or used while in a frozen or muddy condition. Topsoil as delivered to the site or stockpiled shall have pH between 6.0 and 7.0 and shall contain not less than three (3) percent organic matter as determined by loss of ignition of moisture-free samples dried at 100 degrees Celsius.

The topsoil shall meet the following mechanical analysis:

	<u>Percentage Passing</u>
1-inch screen opening	100
No. 10 mesh	95 - 100
No. 270 mesh	35 - 75
0.002 mm*	5 - 25

* Clay size fraction determined by pipette or hydrometer analysis.

- B. At least 10 days prior to anticipated start of topsoiling operations, a one (1) pint sample of topsoil material shall be delivered by the Contractor to a laboratory for testing and approval. All testing shall be at the sole expense of the Contractor. Based on tests performed by the laboratory, the topsoil shall be identified as acceptable, acceptable with certain fertilizer and limestone applications or unacceptable. If the topsoil is found acceptable the fertilizer and lime requirements will be as specified or as recommended by the laboratory. If the topsoil is found unacceptable, the Contractor shall be responsible for identifying another source of topsoil and shall incur all expenses associated with testing additional samples. All topsoil incorporated into the site work shall match the sample provided to the laboratory for testing. Topsoil stockpiled under other Sections of these Specifications may be used subject to the testing and approval outlined above. Contractor will be responsible for screening stockpiled topsoil and providing additional topsoil as required at his/her own expense.
- C. Lime shall be ground limestone containing not less than 85-percent calcium and magnesium carbonates and be ground to such fineness that at least 50-percent shall pass a 100-mesh sieve and at least 90-percent shall pass a 20-mesh sieve.
- D. All planting shall be done between May 1 and September 15 except as specifically authorized in writing. If planting is authorized to be done outside the dates specified, the seed shall be planted with the addition of winter fescue (Kentucky 31) at a rate of 100 lbs. per acre.



- E. The seed shall be furnished and delivered premixed in the proportions specified within. A Manufacturer's Certificate of Compliance to the specified mixes shall be submitted by the Manufacturers for each seed type. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates.
- F. Seed shall be delivered in sealed containers bearing the dealer's guaranteed analysis.
- G. Mulch shall be a specially processed cellulose fiber containing no growth or germination-inhibiting factors. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air-dry weight content and not contain in excess of 10-percent moisture.
- H. Excelsior matting blanket installed in all drainage swales and ditches shall be in accordance with Section 306- SEDIMENTATION AND TEMPORARY EROSION CONTROL.

307.4

APPLICATION OF TOPSOIL

- A. Unless otherwise shown on the plans, topsoil shall be placed to a minimum compacted depth of four (4) inches on all parts of the site not covered with structures, pavement, or existing woodland.
- B. For all areas to be seeded:
 - 1. Fertilizer (10-20-10) shall be applied at the rate of 30-lbs. per 1,000-sq. ft. or as determined by the soil test.
 - 2. Seed shall be applied at the rate of five (5) lbs. per 1,000-sq. ft.
 - 3. Fiber mulch shall be applied at the rate of 40-lbs. per 1,000-sq. ft.
- C. After the topsoil is placed and before it is raked to true lines and rolled, limestone shall be spread evenly over the loam surface and thoroughly incorporated by heavy raking to at least one half the depth of topsoil.
- D. The application of fertilizer may be performed hydraulically in one (1) operation with hydroseeding and fiber mulching. The Contractor is responsible for cleaning all structures and paved areas of unwanted deposits of the hydroseeded mixture.

307.5

INSTALLATION OF TOPSOIL

- A. Previously established grades, as shown on plans shall be maintained in a true and even condition.
- B. Subgrade shall be prepared by tilling prior to placement of topsoil to obtain a more satisfactory bond between the two layers. Tillage operations shall be across the slope. Tillage shall not take place on slopes steeper than two (2) horizontal to one (1) vertical or where tillage equipment cannot be operated. Tillage shall be accomplished by disking or harrowing to a depth of nine (9) inches parallel to contours. Tillage shall not be performed when the subgrade is frozen, excessively wet, extremely dry or in other conditions which would not permit tillage. The subgrade shall be raked and all rubbish, sticks, roots and stones larger than two (2) inches shall be removed. Subgrade surfaces shall be raked or otherwise loosened immediately prior to being covered with loam.
- C. Topsoil shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the complete work will conform to the lines, grades and elevations indicated. No loam shall be spread in water or while frozen or muddy.



- D. After topsoil has been spread, it shall be carefully prepared by scari fying or harrowing and hand raking. All stiff clods, lumps, roots, litter and other foreign material shall be removed from the loamed area and disposed of by the Contractor. The areas shall also be free of smaller stones, in excessive quantities, as determined by the Engineer or the City. The whole surface shall then be rolled with a hand roller weighing not more than 100-lbs per foot of width. During the rolling, all depressions caused by settlement of rolling shall be filled with additional loam and the surface shall be regraded and rolled until a smooth and even finished grade is created.
- E. Seeding shall be done within 10 days following soil preparation. Seed shall be applied hydraulically at the rates and percentages indicated. The spraying equipment and mixture shall be so designed that when the mixture is sprayed over an area, the grass seed and mulch shall be equal in quantity to the specified rates. Prior to the start of work, the Contractor shall furnish the Engineer with a certified statement as to the number of pounds of materials to be used per 100-gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the Contractor's hydroseeder. Upon completion of seeding operations, the Contractor shall furnish the Engineer and the City with a certified statement on the actual quantity of solution applied.
- F. In order to prevent unnecessary erosion of newly topsoiled and graded slopes and unnecessary siltation of drainageways, the Contractor shall carry out seeding and mulching as soon as he/she has satisfactorily completed a unit or portion of the project. A unit or portion of the project shall be determined by the City or Engineer. When protection of newly loamed and graded areas is necessary at a time which is outside of the normal seeding season, the Contractor shall protect those areas by what ever means necessary as approved by the Engineer and the City and shall be responsible for prevention of siltation in the areas beyond the limit of work.
- G. When newly graded subgrade areas cannot be topsoiled and seeded because of season or weather conditions and will remain exposed for more than 30 days, the Contractor shall protect those areas against erosion and washouts in accordance with Section 306- SEDIMENTATION AND TEMPORARY EROSION CONTROL, or by other measures as approved by the Engineer and the City. Prior to application of topsoil, any such materials applied for erosion control shall be removed or thoroughly incorporated into the subgrade by disking. Fertilizer shall be applied prior to spreading of topsoil.
- H. On slopes, the Contractor shall provide against washouts by a method approved by the Engineer and the City. Any washout which occurs shall be regraded and reseeded at the Contractor's expense until a good sod is established.

307.6

HYDROMULCHING

- A. Fertilizer: 18-18-5, (Nitrogen, Phosphoric Acid, Potash) slow release granular at a rate of 25-lbs per 1,000-sq. ft.
- B. Water: The Contractor shall provide water necessary for grass planting and maintenance until acceptance by the City.
- C. Planting Seasons: Grass planting by sodding, sprigging, or hydromulching shall normally be done between May 1 and September 15.
- D. Hydromulching General
 - 1. Submit Manufacturer's product specifications and guaranteed purity analysis for fertilizer.
 - 2. Product Delivery, Storage and Handling
 - a. Deliver fertilizer to site in original unopened containers bearing Manufacturer's guaranteed chemical analysis, name, trademark and conformance to State Law.



- b. Store fertilizer in a dry location and protect from weather.

3. Guaranty and Replacement

- a. Provide guaranty for a period of one (1) year after final completion and acceptance of project, that the installed grass areas be at least the quality and condition as during acceptance.
- b. Rehydromulch unacceptable areas during the guaranty period. Guaranty shall not include damage or loss of lawn due to acts of God, acts of vandalism or negligence on the part of the City.

E. Native Grass Hydromulching-Products

- 1. Grass Seed: Common Bermuda grass, hulled, minimum 82% pure live seed. All grass seed shall be free from noxious weed, grade "A" recent crop, recleaned and treated with appropriate fungicide at time of mixing. Seed shall be furnished in sealed, standard containers with dealer's guaranteed analysis.
- 2. Mulch: Conwed regular wood fiber mulch or approved equal.
- 3. Fertilizer: 18-18-5, water-soluble or an approved equal.
- 4. Topsoil: Supply high quality imported topsoil of loamy character to the limits shown on the Plans, high in humus and organic content from local agriculture source. Topsoil to be free from clay, lumps, coarse sands, stones, roots and other foreign matter. There shall be no toxic amounts of acid or alkaline elements. Soil to be used for on-site mixing of backfill.

F. Native Grass Hydromulching-Execution

- 1. Preparation: Fine grade to final elevation removing any debris and insuring the seedbed is smooth.
- 2. Installation: Use a hydromulcher (sprayer) and apply the mixture at the following rate. (Mix in accordance with Manufacturer's recommendations.)
 - a. Hydromulch mixture shall contain 2.5-lbs. of common Bermuda grass seed per 1,000-sq. ft. hydromulch applied.
 - b. Mulch – 60-lbs. per 1,000-sq. ft.
 - c. Fertilizer – 25-lbs (18-18-5) per 1,000-sq. ft.
- 3. General Maintenance
 - a. Water the completed installation as necessary to insure germination of grass.
 - b. Maintain grass areas until complete germination and establishment of all areas.
 - c. Correct defective work as soon as apparent. Maintenance shall include, but not be limited to, weeding and fertilizing.
 - d. Clean up: Remove trash and debris from the site.
 - e. Acceptance: Substantial completion inspection to determine acceptance of grass areas will be made by the City after complete germination and coverage has been attained.



307.7

MAINTENANCE OF DEVELOPING GRASS

- A. The Contractor shall water and maintain all grassed areas until final acceptance. He shall also re-fertilize at the rate of one (1) pound of nitrogen and one (1) pound of phosphorous per 1,000-sq. ft. every 60 days until the grass is accepted.
- B. Areas which, due to settling or improper leveling, do not have positive drainage shall be re-leveled with topsoil and replanted with grass.
- C. Areas damaged by erosion, vehicle ruts and similar damage shall be re-leveled with topsoil and replanted. Finished ground surface shall be sufficiently smooth and level to facilitate mowing.

307.8

ACCEPTANCE

- A. Work under this section shall be considered acceptable when finish graded surfaces are level and well-drained, when there are no bare spots larger than three (3) square feet, when no more than 10 percent of the total area has bare spots larger than one (1) square foot, when not more than 15 bare spots larger than six (6) inches square and the grass is at least two (2) inches high, and when other requirements listed herein are met.
- B. Acceptance of work normally coincides with final acceptance of the entire project. However, seasonal factors may be cause for delay in grass planting, development, and acceptance.
- C. The City will accept responsibility for normal maintenance when grass is accepted. However, the Contractor shall remain responsible for any subsequent grass damage that he causes and for warranty of materials and workmanship for a period of not less than one (1) year from the time of acceptance.
- D. The Contractor shall furnish full and complete written instruction for maintenance of the seeded areas to the City at the time of acceptance.

307.9

PAYMENT

- A. No separate payment will be made for finish grading, placement of topsoil or grass planting and fertilizing. All related costs shall be included in the proper item of the Proposal and Bid Schedule.

END OF SECTION



SECTION 300 – GENERAL SPECIFICATIONS

ITEM 308. MISCELLANEOUS WORK AND CLEANUP

308.1 SCOPE OF WORK

- A. This specification covers the requirements to do the miscellaneous work not specified in other sections but obviously necessary for the proper completion of the work as shown on the Plans.

308.2 SUBMITTALS

- A. Within 10 days after the Notice to Proceed, the Contractor shall submit to the Engineer, in triplicate, a breakdown of any lump sum included in the Proposal and Bid Form. This breakdown shall be subject to approval by the Engineer and when so approved shall become the basis for determining progress payments and for negotiation of change orders, if required. In some contracts a lump sum item shall not be provided in the Proposal and Bid Form and shall be subsidiary to the other work items.

308.3 GENERAL

- A. When applicable, the Contractor will perform the work in accordance with other sections of this Specification. When no applicable specification exists the Contractor shall perform the work in accordance with the best modern practice and/or as directed by the Engineer.
- B. The work of this Section includes, but is not limited to, the following:
1. Crossing and Relocating Existing Utilities
 2. Restoring Driveways, Fences and Curbing
 3. Cleaning Up
 4. Incidental Work
 5. Restoring Easements and Rights-of-Way

308.4 CROSSING AND RELOCATING EXISTING UTILITIES

- A. This item includes any extra work required in crossing culverts, water courses including streams and drainage ditches, drains, gas mains, water mains and water services and other utilities. This work shall include but is not limited to the following: bracing, hand excavation and backfill (except screened gravel) and any other work required for crossing the utility or obstruction not included for payment in other items of this specification. Notification of Utility Companies shall be the Contractor's responsibility.
- B. In locations where existing utilities cannot be crossed without interfering with the construction of the work as shown on the Plans, the Contractor shall remove and relocate the utility as directed by the Engineer or Representative of the City or cooperate with the Utility Companies concerned if they relocate their own utility.
- C. At pipe crossings and where designated by the Plans, the Contractor shall furnish and place crushed stone bedding so that the existing utility or pipe is firmly supported for its entire exposed length. The bedding shall extend to the mid-diameter of the pipe crossed.



308.5 RESTORING OF DRIVEWAYS AND FENCES

- A. Existing public and private driveways disturbed by the construction shall be replaced. Paved drives shall be repaved to the limits and thicknesses existing prior to construction. Gravel dirt roads and drives shall be replaced and regraded.
- B. Fences in the vicinity of the work shall be protected from damage. If damaged, fences shall be replaced in condition equal to that prior to being damaged and the work shall be satisfactory to the City.

308.6 CLEANING UP

- A. The Contractor shall remove all construction material, excess excavation, buildings, equipment and other debris remaining on the job as a result of construction operations and shall restore the site of the work to a neat and orderly condition. All stored materials shall be kept in a neat manner, secured and protected from the public.

308.7 INCIDENTAL WORK

- A. Do all incidental work not otherwise specified, but obviously necessary to the proper completion of the Contract as specified and as shown on the Plans.

308.8 RESTORING THE EASEMENTS AND RIGHTS-OF-WAY

- A. Portions of the work may be within easements through private property. The Contractor shall be responsible for all damage to private property due to his/her operations. The Contractor shall protect from injury all walls, fences, cultivated shrubbery and vegetables, fruit trees, pavement, underground facilities, such as water pipes, or other utilities which may be encountered along the easement. If removal and replacement are required, it shall be done in a workmanlike manner so that replacement is equivalent to that which existed prior to construction.
- B. Existing lawn and sod surfaces damaged by construction in easements shall be replaced. The Contractor may cut and replace the lawn and sod, or may restore the areas with an equivalent depth and quality of loam, seeded and fertilized as specified in Section 307- LOAMING, HYDROSEEDING AND PERMANENT EROSION CONTROL if acceptable to the owner of the private property and the City. These areas shall be maintained and re-seeded or re-sodded at the option of the owner of the private property and the City, if necessary, until all work under this Contract has been completed and accepted. Any additional work required to restore easements to their original condition shall be performed by the Contractor.

308.9 PAYMENT

- A. No separate payment shall be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION



SECTION 300 – GENERAL SPECIFICATIONS

ITEM 309. STRUCTURAL EXCAVATION

309.1 SCOPE OF WORK

- A. This specification covers the requirements for excavation for the placing of structures, except pipe, for the disposal of such excavated material, and for the backfilling around completed structures to the level of the original ground.

309.2 SUBMITTALS

- A. None required unless specifically called for in the Plans, Standards or requested by the Engineer or the City.

309.3 CONSTRUCTION METHODS

- A. Excavation shall be done in accordance with the lines and depths indicated on the Plans or as established by the City. Unless otherwise specified on the Plans or permitted by the City no excavation shall be made outside a vertical plane three (3) feet from the footing lines and parallel thereto. When caissons are provided, no excavation will be permitted outside the outer faces of the caissons.
- B. To permit the City to judge the adequacy of a proposed foundation, the Contractor, if requested, shall make soundings or take cores to determine the character of the subgrade materials. The maximum depth of soundings or cores will in general, not exceed five (5) feet below the proposed footing grade. It is the intent of this provision that soundings shall be made at the time the excavation in each foundation is approximately complete.
- C. Excavations shall conform to elevations shown on the Plans, or raised or lowered by written order of the City, when such alterations are judged proper. When deemed necessary to increase or decrease the plan depth of footings, the alterations in the details of the structure shall be as directed by the City. The City shall have the right to substitute revised details resulting from consideration of changes in the design conditions.
- D. When a structure is to be placed on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and the final excavation to grade shall not be performed until just before the footing is placed.
- E. Excavated material required to be used for backfill may be deposited by the Contractor in storage piles at points convenient for its rehandling during the backfilling operations and with the approval of the City.
- F. For all single and multiple box culverts, pipe culverts, pipe arch culverts, and box sewers of all types, where the soil encountered at established footing grade is a quicksand, muck, or similar unstable material, the following procedure shall be used unless other methods are called for on the Plans:
 - 1. The depth to which unstable material is removed will be determined by the City. The depth will not exceed two (2) feet below the footing of culverts that are two (2) feet or more in height, and will not exceed the height of culverts of those less than two (2) feet high. Excavation shall be carried at least one (1) foot horizontally beyond the limits of the structure on all sides. All unstable soil removed shall be replaced with suitable stable material, in uniform layers of suitable depth for compaction as directed by the City. Each layer shall be wetted; if necessary, and compacted by rolling or tamping as required to provide a stable foundation for the structure. Soil which has sufficient stability to properly sustain the adjacent sections of the roadway embankment will be considered a suitable foundation material.



2. When in the opinion of the City, it is not feasible to construct a stable footing as outlined above, the Contractor shall construct it by the use of special materials, such as flexible base, cement stabilized base, cement stabilized backfill or other material, as directed by the City.
- G. When the material encountered at footing grade of a culvert is found to be partially rock, or incompressible material, and partially a compressible soil which is satisfactory for the foundation, the incompressible material shall be removed for a depth of six (6) inches below the footing grade and backfilled with a compressible material similar to that used for the rest of the structure.

309.4

BACKFILLING

- A. General: As soon as practicable, all portions of excavation not occupied by the permanent structure shall be backfilled. Back-fill material shall be free from large or frozen lumps, wood or other extraneous material.
1. That portion of backfill which will not support any portion of completed roadbed or embankment shall be placed in layers not more than 10-inches in depth (loose measurement) and shall be compacted to a density comparable with the adjacent, undisturbed material.
 2. That portion of the backfill which will support any portion of the roadbed or embankment or is within two (2) feet of the roadbed or embankment shall be placed in uniform layers not to exceed six (6) inches in depth (loose measurement) and each layer compacted to the density specified for the appropriate material. Each layer of backfill material, if dry, shall be wetted uniformly to the moisture content required to obtain the specified density and shall be compacted to that density by means of mechanical tamps, except that the use of rolling equipment of the type generally used in compacting embankments will be permitted on portions which are accessible to such equipment. All portions of embankment too close to any portion of a structure to permit compaction by the use of the blading and rolling equipment used on adjoining sections of embankment, shall be placed and compacted in the same manner as specified above for backfill material. These provisions require the mechanical compaction, by means of either rolling equipment or mechanical tamps, of all backfill and embankment adjoining the exterior walls and wingwalls of culverts. Unless otherwise provided by the Plans or Special Conditions, hand tamping will not be accepted as an alternate for mechanical compaction. As a general rule, material used in filling or backfilling the portions described in this paragraph shall be an earth free of any appreciable amount of gravel or stone particles more than four (4) inches in greatest dimension and of a gradation that permits thorough compaction. The percentage of fines shall be sufficient to fill all voids and insure a uniform and thoroughly compacted mass of proper density. When required by the Plans or by written order of the City, cement stabilized material shall be used for backfilling.
 3. All portions of fill and backfill described in the preceding paragraph shall be compacted to the same density requirements specified for the adjoining sections of embankment in accordance with the governing specifications therefore.
 4. Where no embankment is involved on the Project and no specifications therefor are included in the Contract, all backfill shall be compacted to a density comparable with the adjacent undisturbed material.
 5. Care shall be taken to prevent any wedging action of backfill against the structure, and the slopes bounding the excavation shall be stepped or serrated to prevent such action.
 6. Backfilling shall not proceed prior to inspection and approval of the inspector.



309.5

PIPE CULVERTS

- A. The following requirements shall apply to the backfilling of pipe culverts in addition to the pertinent portions of the general requirements given in the preceding and in pipe bedding Standards.
1. Backfilling shall be continued in this manner to the elevation of the top of the pipe. Special care shall be taken to secure thorough compaction of the material placed under the haunches of the pipe. In the case of pipe in trenches, that portion of the backfill above the top of the pipe which supports embankment or the roadbed or is within two (2) feet of the roadbed or embankment shall receive mechanical compacting as specified, and the portion which will not support any portion of embankment or roadbed shall be placed in layers not more than ten (10) inches in depth (loose measurement) and shall be compacted by whatever means the Contractor chooses, to a density comparable with the adjacent, undisturbed material.

309.6

PAYMENT

- A. No separate payment will be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END SECTION



SECTION 400 – DRAINAGE SPECIFICATIONS

ITEM 401. STORM SEWER MANHOLES

401.1 SCOPE OF WORK

- A. This specification covers the requirements to install precast concrete storm sewer manholes, frames and covers, and appurtenances as shown on the Plans and as specified herein.

401.2 SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval; shop drawings, product data, materials of construction, and details of installation shall be submitted in accordance with Section 211- SUBMITTALS. Submittals shall include the following: base sections, riser sections, eccentric conical top sections, flat slab tops, grade rings with notarized certificate indicating compliance with ASTM C478, pipe connection to manhole, manhole frame and cover with notarized certificate indicating compliance with ASTM A48, Class 30, method of repair for minor damage to precast concrete sections, manhole lining system.

B. Design Data

1. Precast concrete structures:

- a. Six (6) copies of sectional plan(s) and elevations showing dimensions and reinforcing steel placement.
- b. Six (6) copies of concrete design mix.

C. Test Reports

1. Precast concrete structures: Six (6) copies of concrete test cylinder reports from an approved testing laboratory certifying conformance with specifications.

401.3 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A48 - Specification for Gray Iron Castings.
2. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
3. ASTM C33 - Specification for Concrete Aggregates.
4. ASTM C150 - Standard Specification for Portland Cement.
5. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
6. ASTM D4101 - Specification for Polypropylene Plastic Injection and Extrusion Materials.

B. American Concrete Institute (ACI)

1. ACI 318 - Building Code Requirements for Reinforced Concrete.
2. ACI 350R - Concrete Sanitary Engineering Structures.



- C. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. Standard Specifications for Highway, Streets and Bridges.
- D. Occupational Safety and Health Administration (OSHA)
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

401.4

QUALITY ASSURANCE

- A. All material shall be new and unused.
- B. Materials' quality, manufacturing process and finished sections are subject to inspection and approval by Engineer or other City representative. Inspection may be made at place of Manufacture, at work site following delivery, or both.
- C. Materials will be examined for compliance with ASTM specifications, these Specifications and approved Manufacturer's drawings. Additional inspection criteria shall include: appearance, dimensions(s), blisters, cracks and soundness.
- D. Materials shall be rejected for failure to meet any Specification requirement. Rejection may occur at place of manufacture, at work site, or following installation. Mark for identification rejected materials and remove from work site immediately. Rejected materials shall be replaced at no cost to City.
- E. Repair minor damage to precast concrete sections by approved method, if repair is authorized by Engineer or the City.

401.5

PRODUCTS

- A. Reference to a Manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials/equipment shall be the end products of one Manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts and Manufacturer's service.
- C. Provide lifting lugs or holes in each precast section for proper handling.

401.6

PRECAST CONCRETE MANHOLE SECTIONS

- A. Precast concrete base sections, riser sections, transition top sections, flat slab tops and grade rings shall conform to ASTM C478 and meet the following requirements:
 - 1. Bottom slab thickness shall be 12-inches.
 - 2. Top section shall be flat slab with a minimum clear opening of 32 ⁷/₈-inches diameter.
 - 3. Base, riser and transition top sections shall have tongue and groove joints.
 - 4. Sections shall be cured by an approved method.
 - 5. Precast concrete sections shall be shipped after concrete has attained 3,000 psi compressive strength.
 - 6. Design precast concrete base, riser, transition top, flat slab top and grade ring for a minimum HS-20 loading plus earth load. Calculate earth load with a unit weight of 130 pounds per cubic foot.



7. Mark date of manufacture, name and trademark of Manufacturer on the inside of each precast section.
 8. Construct and install precast concrete base as shown on the Plans.
 9. Provide integrally cast knock-out panels in precast concrete manhole sections at locations, and with sizes shown on Plans. Knock-out panels shall have no steel reinforcing.
- B. Manhole diameter shall be as shown on the Plans, but not less than the diameter of the largest connecting pipe plus two (2) feet.
- C. Pipe Sections: Pipe sections shall conform to current specifications for Precast Reinforced Manhole Sections, ASTM Designation C478, with the following additions:
1. Pipe shall be machine made by a process which will provide for uniform placement of zero slump concrete in the form and compaction by mechanical devices which will assure a dense concrete in the finished product.
 2. Aggregates for the concrete shall consist of limestone aggregates in the proportion of at least 75% by weight of the total aggregates.
 3. Minimum wall thickness for the manhole risers shall be as listed under Wall "B" in the "Class Tables" of ASTM C76 for Class III pipe.
- D. Joints: Joints shall conform to the joint specifications in ASTM C478, C76, and ASTM C443. All manhole sections, including the bottom section, shall be furnished with "O-ring" type rubber gasket joints. The joints shall be furnished and installed with the bell down to resist groundwater infiltration. All joints shall be sealed with mortar or an approved non-shrink grout on the inside and the outside of the manhole. Grade rings shall be mortared to each other and on the inside and outside to provide a waterproof seal.
- E. Manhole Steps: Unless specifically approved by the City, manhole steps shall not be provided.

401.7

MANHOLE FRAME AND COVER

- A. Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30.
- B. Manhole covers shall have a diamond pattern, pickholes and the words STORM SEWER as appropriate cast in three (3) inch letters. Manhole frame and covers shall be Neenah Foundry, Western Iron Works, Vulcan Foundry, or equal. Model numbers refer to Western Iron works products:
 1. Manhole Frame and cover - WRM-36.

401.8

JOINTING PRECAST MANHOLE SECTIONS

- A. Seal tongue and groove joints of precast manhole sections with rubber "O"-ring gasket. O-ring gasket shall conform to ASTM C443.
- B. Completed joint shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.



401.9

PIPE CONNECTIONS TO MANHOLE

- A. Connect pipe to manhole in the following ways:
1. Flexible sleeve - Integrally cast sleeve in precast manhole section or install sleeve in a formed or cored opening. Fasten pipe in sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bituminous material to protect from corrosion. Flexible sleeve shall be Lock Joint Flexible Manhole Sleeve; Kor-N-Seal connector; PSX Press-Seal Gasket or equal.
 2. Compression gasket - Integrally cast compression gasket in precast manhole section. Insert pipe into compression gasket. Compression gasket shall be A-Lok, or equal.

401.10

INSTALLATION

A. Manhole Installation

1. Manholes shall be constructed to the dimensions shown on the Plans and as specified herein. Protect all work against flooding and flotation.
2. Place manhole base on a bed of screened gravel eight (8) inches in depth as shown on the Plans. Set manhole base so that a maximum grade adjustment of eight (8) inches is required to bring the manhole frame and cover to final grade.

Use precast concrete grade rings to adjust manhole frame and cover to final grade.

3. Set precast concrete barrel sections plumb with a 1/4-inch maximum out of plumb tolerance allowed. Seal joints of precast barrel sections with either a rubber "O" ring set in a recess or preformed flexible joint sealant in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with non-shrink mortar and finished flush with the adjoining surfaces. Caulk the inside of any leaking barrel section joint with non-shrink grout to the satisfaction of the Engineer and the City.
4. Allow joints to set for 14 hours before backfilling unless a shorter period is specifically approved by the Engineer or the City.
5. Plug holes in the concrete barrel sections required for handling with a non-shrinking grout or non-shrinking grout in combination with concrete plugs. Finish flush on the inside.
6. Core holes in precast sections to accommodate pipes prior to setting manhole sections in place to prevent jarring which may loosen the mortar joints.
7. Backfill carefully and evenly around manhole sections.

B. Manhole Pipe Connections: Construct manhole pipe connections, including pipe stubs, as specified above. Close or seal pipe stubs for future connections with a gasketed watertight plug.

C. Setting Manhole Frame and Cover: Set manhole covers and frames in a full mortar bed. Utilize precast concrete grade rings, a maximum of eight (8) inches thick, to assure frame and cover are set to the finished grade. Set manhole frame and cover to final grade prior to placement of permanent paving.

401.11

TESTS

- A. Test each manhole in accordance with Section 213- TESTING OF PIPELINES AND MANHOLES. Engineer or the City's representative shall observe each test.



401.12 CLEANING

- A. Thoroughly clean all new manholes of all silt, debris and foreign matter of any kind, prior to final inspections.

401.13 PAYMENT

- A. Payment for furnished and installed manholes shall be paid according to the unit price per each in the proper item of the Proposal and Bid Schedule.
- B. All work and materials to complete the reinforced concrete pipe including but not limited to excavation, bedding, backfill, connection to pipe, etc. shall be subsidiary to this item.

END OF SECTION



SECTION 400 - DRAINAGE SPECIFICATION

ITEM 402. REINFORCED CONCRETE PIPE

402.1 SCOPE OF WORK

- A. This specification covers the requirements for the placing of reinforced concrete pipe and for the material and incidental construction requirements for reinforced concrete pipe sewers. The culvert pipe shall be installed in accordance with the requirements of these specifications to the lines and grades shown on the Plans, and shall be of the classes, sizes and dimensions shown thereon. The installation of pipe shall include all joints or connections to new or existing pipe, headwalls, etc., as may be required to complete the work. The locations of private driveway and side road pipe may be varied as deemed necessary by the Engineer or the City.

402.2 SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including pipe Manufacturer, joint material, bedding material, fittings, geotextile fabric, and all pertinent data to illustrate conformance to the specification found within.

402.3 MATERIALS

- A. The pipe shall be of the Class specified on the Plans. The shell thickness, the amount of circumferential reinforcement and the strength of the pipe shall conform to the specified Class as summarized in ASTM Designation: C76 for Circular Pipe; C506 for Arch Pipe or C507 for Horizontal Elliptical Pipe.
1. All precast concrete pipe shall be machine made or cast by a process which will provide for uniform placement of the concrete in the form and compaction by mechanical devices which will assure a dense concrete. Concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the concrete can be assured. Transit mixed concrete will not be acceptable for use in precast pipe.
 2. Unless otherwise approved by the City, not more than two (2) holes may be placed in the top section of precast pipe for lifting and placing. The holes may be cast, cut, or drilled in the wall of the pipe. The holes shall not exceed three (3) inches in diameter at the inside of surface of the pipe wall. Not more than one (1) longitudinal wire or two (2) circumferential wires may be cut per layer of reinforcing steel when locating lift holes in the pipe wall. After the pipe is in place, lift holes shall be filled with concrete or mortar or precast concrete plugs to the satisfaction of the Engineer.
 3. The Contractor has the option of using portland cement or portland cement plus fly ash. When fly ash is used, then "cement" shall also be defined as "cement plus fly ash". "Cement plus fly ash" shall be composed of portland cement of the type specified and 20 to 35 percent fly ash by absolute volume. Type B fly ash shall not be used when Type II cement is shown on the plans. When portland cement is partially replaced, blended or otherwise modified by a pozzolan, the pozzolan is defined and limited to fly ash conforming to TxDOT Department Materials Specification D-9-8900, "Fly Ash".
- B. Jointing Materials
1. Cold Applied, Plastic Asphalt Sewer Joint Compound shall be suitable for jointing concrete pipe. It shall consist essentially of natural and/or processed asphalt base, suitable volatile solvents, and inert filler. The consistency is to be such that the ends of the pipe can be coated with a layer of the compound up to one-half ($\frac{1}{2}$) inch thick by means of a trowel. It shall cure to a firm, stiff plastic condition after application. The material shall be of a



uniform mixture and any small separation occurring in the container before use must be readily stirred back to form a uniform mix.

2. Mortar for joints shall consist of one (1) part cement, two (2) parts sand and sufficient water to make a plastic mix. The sealing of joints with mortar shall be in accordance with TxDOT Item 464 of the Standard Specifications for Construction of Highways, Streets and Bridges.
 3. Rubber gaskets shall conform to ASTM C361 or C443. The design of the joints and permissible variations in dimensions shall be in accordance with ASTM C443. The Contractor shall furnish the Engineer the Manufacturer's Certificate of Analysis. Rubber gaskets shall be installed according to the recommendations of the Manufacturer. Water tight joints will be required when using rubber gaskets. Backfilling may begin when approved by the City.
 4. Cold applied preformed plastic gaskets shall be suitable for sealing joints of tongue and groove concrete pipe in accordance with TxDOT Item 464 of the Standard Specifications for Construction of Highways, Streets and Bridges.
- C. Rubber Gaskets shall conform to ASTM Designation: C361 or C443, with the provision that the Contractor shall furnish the City the Manufacturer's Certificate of Analysis.
- D. Cold Applied Preformed Plastic Gaskets shall be suitable for sealing joints of tongue and groove concrete pipe. The gasket sealing the joint shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents, irritating fumes or obnoxious odors. The gasket joint sealer shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength, and shall be supplied in extruded rope-form of suitable cross-section. The size of the plastic gasket joint sealer shall be in accordance with the Manufacturer's recommendations and sufficient to obtain the squeeze-out as described under "Jointing". The gasket joint sealer shall be protected by a suitable removable two-piece wrapper. The two-piece wrapper shall be so designed that one-half may be removed longitudinally without disturbing the other half.
- E. All fittings and wyes shall be manufactured and not constructed on the project unless prior approval is granted by the City.
- F. All joints that are not sealed with a watertight connection shall be wrapped with MARFI-140-N geotextile fabric or equivalent. The joint shall be wrapped with 18-inch wide fabric splitting the joint (nine (9) inches on each side).

402.4

CONSTRUCTION METHODS

- A. **Excavation.** All excavation shall be in accordance with the requirements of Section 309-STRUCTURAL EXCAVATION. Before pipe is laid in a trench, the completed and shaped trench to receive the pipe shall be of sufficient width to provide free working space for satisfactory bedding and jointing and thorough tamping of the backfill and bedding material under and around the pipe. The Contractor shall make such temporary provisions as may be necessary to insure adequate drainage of the trench and bedding during the construction operation.
- B. **Bedding.** The pipe shall be bedded in accordance with the details shown on the Plans. Where the soil encountered at the established grade is quicksand, muck, or similar unstable material, unless special construction methods are called for on the Plans or in the special provisions, such unstable soil shall be removed and replaced in accordance with the requirements of Section 309-STRUCTURAL EXCAVATION.
- C. **Laying Pipe.** Unless otherwise authorized by the City, the laying of pipe on the prepared foundation shall be started at the outlet end with the spigot or tongue end pointing downstream and shall proceed toward the inlet. Where bell and spigot pipe are used, cross trenches shall be cut in the foundation to allow the barrel of the pipe to rest firmly upon the prepared bed. These cross trenches



shall be not more than two (2) inches larger than the bell ends of the pipe. Proper facilities shall be provided for hoisting and lowering the sections of pipe into the trench without disturbing the prepared foundation and the trench. The ends of the pipe shall be carefully cleaned before the pipe is placed. As each length of pipe is laid, the mouth of the pipe shall be protected to prevent the entrance of earth or bedding material. The pipe shall be fitted and matched so that when laid in the bed shall form a smoother, uniform conduit. When elliptical pipe with circular reinforcing or circular pipe with elliptical reinforcing is used, the pipe shall be laid in the trench in such position that the markings "Top" or "Bottom", shall not be more than five (5) degrees from the vertical plane through the longitudinal axis of the pipe.

Multiple installations of reinforced concrete pipe shall be laid with the centerlines of individual barrels parallel. When not otherwise indicated on the Plans, the following clear distances between outer surfaces of adjacent pipe shall be used.

Diameter of Pipe	18"	24"	30"	36"	42"	48"	54"	60" - 84"
Clear Distance Between Pipes	0' -9"	0' -11"	1' -1"	1' -3"	1' -5"	1' -7"	1' -11"	2' -0"

D. Jointing. All piping, if specified by the Plans, Details, or the City,

1. Joints sealed with Portland cement mortar shall be made as follows: mortar, composed of one (1) part portland cement and two (2) parts sand, so placed as to form a durable water-tight joint. The ends of the pipe shall be cleaned thoroughly and wetted before making the joint. After any section of pipe is laid and before any succeeding section is laid the lower half of the bell or groove of the pipe last laid shall be plastered thoroughly by troweling on an even layer of mortar. Next, mortar shall be applied to the upper portion of the tongue or spigot of the pipe section being laid.

The spigot or tongue end of the next section of pipe shall then be inserted and the joint pulled up tight, taking care that the inner surfaces of the abutting pipe section are flush and even. After the section is laid and uniformly matched and the sections have been fitted as close as the construction of the pipe will permit, the lower half of the inner circumference of the joints of pipe over 18-inches in diameter shall be sealed and packed with mortar and finished smooth and even with the adjacent section of pipe. Before this mortar has attained initial set, additional mortar then shall be applied from the outside and forced into the unfilled portion of the bell or grooved to fill completely the annular space around the spigot or tongue. For bell and spigot pipe, a bead shall be formed on the outside by troweling on mortar downward at an angle of 45 degrees from the outer edge of the bell to the spigot of the last laid section. For tongue and groove pipe, a bead shall be formed extending at least one (1) inch on either side of the joint and of approximately semicircular cross-section or triangular cross-section. If the triangular cross-section is used, it shall be formed by placing the mortar approximately 45 degrees outward from the extreme edges of the bead. For pipe too small to permit finishing of the inside surface of the joint, a tight stopper of burlap or other equivalent materials shall be dragged through the pipe past the new joint to remove any fins of mortar. Special care shall be exercised in placing adjacent pipe sections to avoid movement of the pipe in place and the breaking of the mortar bond at completed joints. After the initial set, the mortar on the outside shall be protected from air and sun with a thoroughly wetted earth or burlap cover or acceptable equivalent which shall be kept wet for a minimum of 48 hours or until the backfill has been completed. No jointing shall be done when the atmospheric temperature is at or below 40° F, and when necessary, because of a sudden drop in temperature, joints shall be protected against freezing for at least 24 hours. After placing, any pipe which is not in true alignment or which shows any undue settlement after laying or is damaged, shall be taken up and relaid or replace without extra compensation.



At the Contractor's option, and with the approval of the City for pipes which are large enough for a man to enter and perform the required work efficiently, pipe may be furnished with the groove not less than one-half ($\frac{1}{2}$) of an inch and not more than three-fourths ($\frac{3}{4}$) of an inch longer than the tongue. Such pipe may be laid without mortar joints and backfilled. Care shall be exercised to avoid displacing the joints during the backfilling operations. After the backfilling has been completed, the space between the end of the tongue and the groove shall be cleaned of all foreign material, thoroughly wetted and filled with mortar around the entire circumference of the pipe. Mortar for this use shall be of such consistency that it can be packed in the joint completely filling the space between adjacent pipes. The City will inspect this process to ascertain that the joints are being completely filled. If the City finds that this is not being accomplished, it may void this process and require that for the remainder of the project the pipe be jointed and backfilled in accordance with the provisions of the first paragraph of this section.

The Contractor shall make available for the use of the City an appropriate rolling device similar to an automobile mechanic's "Crepper" for conveyance through the small size pipe structures.

No mortar banding on the outside of pipe will be required for side drain culverts. No joint material will be required for temporary culverts.

Mortar joints will be required for irrigation wells, vents and similar vertical structures.

2. Joints using Cold Applied, Plastic Asphalt Sewer joint compound shall be made as follows: Both ends of the pipes shall be clean and dry and shall be coated with a suitable primer of the type recommended by the Manufacturer where they will be in contact with the joint material. Under no circumstance shall this type of joint be attempted on wet pipe. After the pipe has been set to proper line and grade in the trench, a one-half ($\frac{1}{2}$) of an inch thick layer of the compound shall be troweled or otherwise placed on the groove end of the pipe covering not less than two-thirds ($\frac{2}{3}$) of the joint face around the entire circumference. Next the tongue end of the next pipe shall be shoved home with sufficient pressure to make a tight joint. After the joint is made, any excess mastic projecting into may proceed as soon as the joint has been inspected and approved by the City. Special precautions shall be taken in placing and compacting backfill to avoid damage to the joints.
3. Joints using rubber gaskets shall be made as follows: Where rubber gasket pipe joints are required by the Plans, the joint assembly shall be made according to the recommendations of the gasket Manufacturer. Watertight joints will be required when using rubber gaskets.
4. Joints using cold applied preformed plastic gaskets shall be made as follows: A suitable primer of the type recommended by the Manufacturer of the gasket joint sealer shall be brush applied to the tongue and groove joint surfaces and the end surfaces and allowed to dry and harden. No primer shall be applied over mud, sand or dirt or sharp cement protrusions. The surface to be primed must be cleaned and dry when primer is applied.

Before laying the pipe in the trench, the plastic gasket sealer shall be attached around the tapered tongue or tapered groove near the shoulder or hub of each pipe joint. The paper wrapper shall be removed from one (1) side only of the two (2) piece wrapper on the gasket and pressed firmly to the clean, dry pipe joint surface. The outside wrapper shall not be removed until immediately before pushing the pipe into its final position.

When the tongue is correctly aligned with the flare of the groove, the outside wrapper on the gasket shall be removed and the pipe shall be set with sufficient force and power, (Back hoe shovel, chain hoist, ratchet hoist or winch), to cause the evidence of squeeze-out of the gasket material on the inside or outside around the complete pipe that would tend to obstruct the flow shall be removed. (Pipe shall be set in a straight line with all parts of the pipe on line and grade at all times). Backfilling of pipe laid with plastic gasket joints may proceed as soon as the joint has been inspected and approved by the City. Special



precautions shall be taken in placing and compacting backfill to avoid damage to the points.

When the atmospheric temperature is below 60° F, plastic joint seal gaskets shall either be stored in an area warmed to above 70° F, or artificially warmed to this temperature in a manner satisfactory to the City. Gaskets shall then be applied to pipe joints immediately prior to placing pipe in trench, followed by connection to previously laid pipe.

- E. Backfilling. After the pipe has been placed, bedded and jointed as specified, filling and/or backfilling shall be done in accordance with the applicable requirements of Section 309-STRUCTURAL EXCAVATION. When mortar joints are specified, no fill or backfill shall be placed until the jointing material has been cured for at least six (6) hours. Special precautions shall be taken in placing and compacting the backfill to avoid any movement of the pipe or damage to the joints. Joints consisting of material other than mortar may be backfilled immediately.
- F. Protection of Pipe. Unless otherwise shown on the Plans or permitted in writing by the City, no heavy earth moving equipment will be permitted to haul over the structure until a minimum of four (4) feet of permanent or temporary, compacted fill has been placed thereon. Pipe damaged by the Contractor's equipment shall be removed and replaced by the Contractor at no additional cost.

402.5

PAYMENT

- A. Payment for furnished and installed reinforced concrete pipe shall be paid according to the unit price per linear foot in the proper item of the Proposal and Bid Schedule. All work and materials to complete the reinforced concrete pipe including, but not limited to, excavation, bedding, backfill, connection to structures, etc., shall be subsidiary to this item.

END SECTION



SECTION 400 – DRAINAGE SPECIFICATIONS

ITEM 403. HIGH DENSITY POLYETHYLENE (HDPE) SOLID AND PROFILE WALL PIPE

403.1 SCOPE OF WORK

- A. This specification covers the requirements for the placing of high density polyethylene (HDPE) solid and profile wall pipe and for the material and incidental construction requirements for HDPE pipe sewers. The culvert pipe shall be installed in accordance with the requirements of these specifications to the lines and grades shown on the Plans, and shall be of the classes, sizes and dimensions shown thereon. The installation of pipe shall include all joints or connections to new or existing pipe, headwalls, etc., as may be required to complete the work. The locations of private driveway and side road pipe may be varied as deemed necessary by the Engineer or the City.

403.2 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with documented experience of minimum 5 years of pipe installations that have been in successful, continuous service for same type of service as proposed Work.

403.3 SUBMITTALS

- A. Conform to requirements of Section 211 - SUBMITTALS.
- B. Submit shop drawings showing design of pipe and fittings, laying dimensions, fabrication, fittings, flanges, and special details.
- C. Provide manufacturer's certificate of conformance to Specifications.

403.4 QUALITY CONTROL

- A. Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties.
- B. City Engineer reserves right to inspect pipes or witness pipe manufacturing. Inspection shall in no way relieve manufacturer of responsibilities to provide products that comply with applicable standards and these Specifications.
- C. Manufacturer's Notification: Should City Engineer wish to witness manufacture of specific pipes, manufacturer shall provide City Engineer with minimum three weeks notice of when and where production of those specific pipes will take place.
- D. Failure to Inspect. Approval of products or tests is not implied by City Engineer's decision not to inspect manufacturing, testing, or finished pipes.

403.5 MATERIALS

- A. General
1. For sewer pipe provide HDPE pipe as follows:
 - a. New Construction Pipe Products
Gravity Sanitary Sewer
Direct Bury



INSTALLATION SPEC NO.	GENERIC NAME	TRADE NAME OR MANUFACTURER	ASTM OR AASHTO	SDR (NUMERIC MAXIMUM)	PIPE STIFFNESS (NUMERIC MINIMUM)	SIZE RANGE
02505	Solid Wall Polyethylene (HDPE)	Chevron Flexco Phillips 66 Quail Poly Pipe	ASTM F-714	DR 17 DR 21	115 46	8" - 10" 12" - 48"
02531	Polyethylene Profile Wall	Spirolite	ASTM F-894	n/a	46	18" - 120"

b. Rehabilitation Construction Pipe Products
Slip lining of Sanitary Sewer

INSTALLATION SPEC NO.	GENERIC NAME	TRADE NAME OR MANUFACTURER	ASTM	SDR (NUMERIC MAXIMUM)	PIPE STIFFNESS (NUMERIC MINIMUM)	SIZE RANGE
02550	Solid Wall Poly	Chevron Flexco Quail Poly Pipe AmeriFlow by NAPCO AmeriFlow by KWH	F-714	DR 21	46	8" - 48" 3" - 12" 14" - 63"
02550	Polyethylene Profile Wall	Spirolite	F-894	n/a	46	18" - 120"

2. For Residential Driveway Culverts provide HDPE as follows:
 - a. N-12 and N-12 HC by Advanced Drainage Systems, Inc. (ADS).
 - b. Sure-Lok F477 by Hancor, Inc.
3. Furnish solid wall pipe with plain end construction for heat joining (butt fusion) conforming to ASTM D 2657. Utilize controlled temperatures and pressures for joining to produce fused leak-free joint.
4. Furnish profile-wall gravity sewer pipe with bell-and-spigot end construction conforming to ASTM D 3212. Joining will be accomplished with elastomeric gasket in accordance with manufacturer's recommendations. Use integral bell-and-spigot gasketed joint designed so that when assembled, elastomeric gasket, contained in machined groove on pipe spigot, is compressed radially in pipe bell to form positive seal. Design joint to avoid displacement of gasket when installed in accordance with manufacturer's recommendations.
5. Furnish solid wall pipe for sanitary sewer force mains with minimum working pressure rating of 150 psi, and with inside diameter equal to or greater than nominal pipe size indicated on Drawings.
6. Furnish corrugated polyethylene pipe (CPP) for gravity storm sewer pipe. Joints shall be installed such that connection of pipe sections will form continuous line free from irregularities in flow line. Suitable joints are:
 - a. Integral Bell and Spigot. Bell shall overlap minimum of two corrugations of spigot end when fully engaged.



- b. Exterior Bell and Spigot. Bell shall be fully welded to exterior of pipe and overlap spigot end so that flow lines and ends match when fully engaged.

B. Jointing

1. Gaskets

- a. Meet requirements of ASTM F 477. Use gasket molded into circular form or extruded to proper section and then spliced into circular form. When no contaminant is identified, use gaskets of properly cured, high-grade elastomeric compound. Basic polymer shall be natural rubber, synthetic elastomer, or blend of both.
- b. Pipes allowed to be installed in potentially contaminated areas, where free product is found near elevation of proposed sewer, shall have the following gasket materials for noted contaminants:

CONTAMINANT	GASKET MATERIAL REQUIRED
Petroleum (diesel, gasoline)	Nitrile Rubber
Other Contaminants	As recommended by pipe manufacturer

C. Materials For Sanitary Sewer

- 1. Pipe and Fittings: High density, high molecular weight polyethylene pipe material meeting requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D 1248. Material meeting requirements of cell classification in accordance with ASTM D 3350 are also suitable for making pipe products under these specifications.
- 2. Other Pipe Materials: Materials other than those specified in Paragraph 2.02A, Pipe and Fittings, may be used as part of profile construction, e.g., as core tube to support shape of profile during processing, provided that these materials are compatible with base polyethylene material and are completely encapsulated in finished product and in no way compromise performance of pipe products in intended use. Examples of suitable material include polyethylene and polypropylene.

D. Materials For Residential Driveway Culverts

- 1. Pipe and Fittings: High density, high molecular weight polyethylene HDPE virgin compound material meeting requirements of cell class outlined in AASHTO M 294, AASHTO MP7 and ASTM D 3350.
- 2. Types: CPP shall meet one or both of following:
 - a. Type S: Outer corrugated wall with smooth inner liner.
 - b. Type D: Inner and outer smooth walls braced circumferentially or spirally with projections or ribs.
- 3. Lubricant: Use lubricant for assembly of gasketed joints, which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

403.6

TESTING

A. Sanitary Sewer

- 1. Conditioning. Conditioning of samples prior to and during tests are subject to approval by City Engineer. When referee tests are required, condition specimens in accordance with Procedure A in



ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.

2. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.05A, in suitable press until internal diameter has been reduced to 40 percent of original inside diameter of pipe. Rate of loading shall be uniform and at 2 inches per minute. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles.
3. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except replace shear load transfer bars and supports with 6-inch-wide support blocks that can be either flat or contoured to conform to pipe's outer contour.
4. Purpose of Tests. Flattening and joint tightness tests are not intended to be routine quality control tests, but rather to qualify pipe to a specified level of performance.

B. Residential Culverts

1. Pipe stiffness at 5% deflection, when determined in accordance with ASTM D 2412, shall be as specified in Section 7.4 of AASHTO M 294.
2. Minimum inner wall thickness shall be as specified in Section 7.2.2 of AASHTO M 294.

403.7

MARKING

- A. Mark each standard and random length of pipe in compliance with these Specifications with following information:
1. Pipe size.
 2. Pipe class.
 3. Production code.
 4. Material designation.

403.8

CONSTRUCTION METHODS

- A. Excavation. All excavation shall be in accordance with the requirements of Section 309-STRUCTURAL EXCAVATION. Before pipe is laid in a trench, the completed and shaped trench to receive the pipe shall be of sufficient width to provide free working space for satisfactory bedding and jointing and thorough tamping of the backfill and bedding material under and around the pipe. The Contractor shall make such temporary provisions as may be necessary to insure adequate drainage of the trench and bedding during the construction operation.
- B. Bedding. If no undesirable foundation material is found, a minimum of 6-inches of bedding shall be placed and compacted on the foundation to equalize load distributions along the invert of the pipe. A stable and uniform bedding shall be provided for the pipe and any protruding features of its joints and/or fittings. The middle of the bedding, under the pipe invert, equal to 1/3 of the pipe O.D. should be loosely placed, with the remainder compacted to minimum standard proctor density per the manufacturer's recommendations.
- C. Installation. Installation of the pipe shall be in accordance with the manufacturer's recommendations. HDPE pipe is NOT approved in applications requiring augering of pipe.
- D. Jointing. All piping shall be jointed in accordance with the manufacturer's recommendations.



- E. Backfilling. After the pipe has been placed, bedded and jointed as specified, filling and/or backfilling shall be done in accordance with the applicable requirements of Section 309-STRUCTURAL EXCAVATION and manufacturer's recommendations. Special precautions shall be taken in placing and compacting the backfill to avoid any movement of the pipe or damage to the joints.

403.9

PAYMENT

- A. Payment for furnished and installed manholes shall be paid according to the unit price per each in the proper item of the Proposal and Bid Schedule.
- B. All work and materials to complete the HDPE pipe including but not limited to excavation, bedding, backfill, connection to pipe, etc. shall be subsidiary to this item.

END OF SECTION



SECTION 400 – DRAINAGE SPECIFICATIONS

ITEM 404. VORTEX SEPARATORS

404.1

SCOPE OF WORK

- A. Work described in this section includes furnishing all labor, equipment, materials, tools and incidentals required for a complete and operable installation of the Hydrodynamic Vortex Separator (HVS) stormwater treatment system as shown on the drawings and specified herein.
- B. The manufacturer shall design and supply the equipment listed herein and the Contractor shall install the equipment in accordance with the manufacturer's Handling, Storage, and Installation Instructions.

404.2

GENERAL REQUIREMENTS

- A. The HVS shall use an induced vortex to separate pollutants from stormwater runoff. The system shall be self-activating with no mechanical parts or external power requirements.
- B. Upon request, independently certified performance data and references shall be made available to the Engineer of Record for use in determining that the HVS meets the design criteria and performance requirements stated herein.

404.3

SUBMITTALS

- A. Submittals shall be provided and shall include the following:
 - 1. Site plan showing location and orientation of proposed pipe sizes, connections and excavation limits.
 - 2. Product installation drawings showing plan and elevation views with water elevations for the flow conditions specified herein.
 - 3. Performance data as required in Subsection 404.7.
 - 4. Inspection and maintenance procedures with accompanying maintenance video and upon request, three references for verifying successful completion of the maintenance procedures and associated costs.

404.4

QUALITY ASSURANCE

- A. The HVS shall be manufactured under the direction of an ISO 9001 Certified Company.
- B. Inspection. The HVS shall be subject to inspection by the Engineer of Record or the owner's representative at either the place of manufacture or the project site. Any and all observed defects shall be repaired to the satisfaction of the owner or owner's representative or replacement shall be made available.
- C. Warranty. The manufacturer shall guarantee the HVS from defects in materials and workmanship for a period of two years following installation. If during the warranty period defects in materials or workmanship are noted, then the manufacturer shall be promptly notified. The decision to repair or replace affected units shall be made at the discretion of the manufacturer.
- D. Patent Indemnity. Upon request, the manufacturer shall warrant that the HVS does not infringe upon or violate any patent, copyright, trade secret or any other proprietary right of any third party and shall indemnify the Owner against any loss, cost, expense or liability arising out of such claim whether or not such claim is successful.



- E. Certificate of Compliance. Upon request, the manufacturer shall provide a "Letter of Certification" to certify that the HVS adheres to the specifications required herein and complies with the project's stormwater management permit.

404.5

MANUFACTURER

- A. The HVS shall be supplied by a manufacturer regularly engaged in such work who has furnished similar installations that have been in successful and continuous operation for a minimum period of five years. The manufacturer shall be a Stormwater Equipment Manufacturer Association (SWEMA) member.
- B. The HVS shall be certified by an acceptable State agency, such as a State Department of Environmental Protection (DEP) or industry verification or assessment agency (e.g.: ETV, NJCAT, NETE).

404.6

STORMWATER HVS

- A. The HVS shall use a tangential inlet pipe to establish rotational flow within a cylindrical vortex chamber or be able to treat the Water Quality Flow Rate stated herein without re-suspending and releasing captured pollutants. The HVS shall not release captured floating pollutants during surcharge conditions.
- B. The HVS shall not exceed the pressure drop (headloss) for the design flow rates specified herein as determined by ASTM C1745 / C1745M – 11.
- C. The HVS shall fit within the limits of excavation (area and depth) as shown in the project plans and will not exceed the dimensions for the design flow rates specified herein.
- D. The storage capacities for pollutants that settle (sediment) and float (oil) shall not be less than the volumes listed in Table 1. The HVS shall operate as intended and perform as specified herein as pollutants accumulate. The storage capacity for pollutants that settle shall not reduce the volume required in the HVS for separation and for preventing re-suspension and washout, or reduce the floatables storage volume capacity.
- E. Minimum 24-inch openings shall provide access to the sediment storage volumes from the surface for inspection and maintenance. Two access openings shall be provided for systems larger than 4 feet in diameter or 4 feet square. Removal of pollutants from the HVS shall be possible without requiring confined space entry.

404.7

Performance

- A. Performance of the HVS shall be based on independent full-scale laboratory and/or field testing and shall adhere to the Performance Specifications listed in Table 1. The laboratory testing used as the basis of product performance shall be undertaken in accordance with testing protocols approved or endorsed by SWEMA or acceptable State agency, such as a State Department of Environmental Protection (DEP) or recognized verification agency (e.g.: ETV, NJCAT, NETE).
- B. Performance of the HVS shall be based on treating the Water Quality Flow rate (WQF) without internally bypassing and without re-suspension and washout of captured pollutants (scour). The Maximum Treatment Flow Rate(s) (MTFR-50 and/or MTFR-100) shall be greater than or equal to the WQF. The HVS shall remove greater than or equal to 80% of TSS based on the Target Particle Size (TPS) of 50 microns and/or 100 microns at MTFR-50 and MTFR-100, respectively.
- C. The HVS shall treat all flows without internally bypassing up to the Peak Treatment Flow Rate (PTFR). Full-scale independent laboratory scour testing shall demonstrate effluent control of less than or equal to 20 mg/L for all flows up to 150% of MTFR-100 without internal or external bypass.
- D. The HVS shall be capable of capturing and retaining fine silt and sand size particles. Analysis of captured sediment from full-scale field installations shall demonstrate particle sizes predominately in the 20-micron range.



- E. The HVS shall capture and retain 100% of all floating trash and debris and remove greater than 80% of hydrocarbons up to its rated storage capacities under conditions of a catastrophic spill such as might be experienced in an automobile or truck accident spill like conditions.

Table 1.

Hydrodynamic Vortex Separator Performance Specifications								
Diameter	Max Depth ¹	MTFR-50 ²	MTFR-100 ²	Scour Flow Rate ³	PTFR ⁴	Headloss ⁵	Oil Storage Capacity ⁶	Sediment Storage Capacity ⁶
(feet)	(feet)	(cfs)	(cfs)	(cfs)	(cfs)	(feet)	(gal.)	(gal.)
4	4.1	1.2	1.6	2.4	3	0.68	70	141
6	5.9	3.4	4.3	6.5	8	0.95	216	424
8	7.7	6.9	8.8	13.3	15	1.1	540	939
10	9.4	12	15	23.3	25	1.2	1,050	1,757
12	11.2	19	24	38	38	1.4	1,770	2,970

Notes:

1. Depth measurement is from the outlet invert to top of the bottom slab.
2. MTFR-50 and MTFR-100 are the Maximum Treatment Flow Rates for removing target particle sizes of 50 microns and 100 microns, respectively.
3. Scour Flow Rates are based on testing that demonstrates retention of captured sediment having a D50 of 100. Effluent concentrations shall not exceed 20 mg/L.
4. PTFR or Peak Treatment Flow Rate is based on the HVS maintaining positive removal efficiencies and headlosses no greater than those listed above for each model.
5. Headlosses are the difference in water elevations upstream and downstream of the HVS as determined by ASTM C1745 / C1745M - 11. The headlosses listed above for any particular model are for that HVS operating at the Peak Treatment Flow Rate.

404.8

EQUIPMENT

- A. The HVS shall be manufactured with materials typically used in stormwater drainage systems that have a minimum life expectancy of 30 years.
1. Materials of construction shall be cross-linked polyethylene (XLPE) and/or Type 304 stainless steel or carbon steel powder coated in accordance with ASTM 775/ ASTM A775M with a resulting thickness of 8-12 mils. All components shall be designed to withstand all normal loadings associated with fabrication, shipping, site installation, and normal operation of the equipment.
 2. Precast shall be manufactured with concrete that has attained a compressive strength of 4,000 psi after 28 days. The structure shall be reinforced to withstand an HS20-44 loading. Shiplap joints shall be sealed with butyl rubber mastic sealant conforming to ASTM C990. Slab tops shall be suitably reinforced and provided with manhole openings and covers as required. The cast iron manhole frames and covers shall be sized as per the manufacturer's drawings and shall be in accordance with ASTM A48, CL.35B and AASHTO M105. The masonry fixing bolts shall be Type 304 stainless steel.
 3. All piping connections and ancillary items not listed herein shall be provided by the Contractor.

404.9

EQUIPMENT DELIVERY



- A. The HVS components shall be delivered within six weeks of date of approved technical submittal.
- B. The HVS components shall be preassembled and delivered to the site fully fabricated and ready for the final assembly.
- C. Off-loading, storage, and installation shall be by the Contractor.
- D. The Contractor shall inspect and provide signed acceptance of equipment prior to unloading, or notify the manufacturer of any damage to equipment to effect proper remedial action. Failure to notify the manufacturer of damage to equipment prior to unloading will void all warranties pertaining to subject equipment.

404.10

EQUIPMENT INSTALLATION

- A. The system shall be installed in strict accordance with the site plans, and the manufacturer's general arrangement drawings and Handling, Storage and Installation Instructions. The Contractor shall be responsible for installing the equipment and all necessary site connections.
- B. The Manufacturer shall be notified immediately of any equipment which is damaged during unloading, storage, or installation. The damaged equipment shall be repaired or replaced at the discretion of the manufacturer and entirely at the Contractor's expense.
- C. The precast concrete structure shall be set on a granular or compacted sand sub-base in accordance with local requirements for standard manhole installation. In no instances shall the compacted sub-base material have a thickness of less than 12 inches.
- E. The precast concrete structure shall be set level and plumb to within 0.5%. E. Non-shrink grout or hydraulic cement conforming to ASTM C 595 shall be used to provide a water tight seal in the lift holes, any drain holes and around the concrete knock-outs for the inlet and outlet pipes.
- F. The Contractor shall, at the discretion of the owner or owner's representative, test the concrete structure for water tightness before backfilling.

404.11

PAYMENT

- A. Payment for furnished and installed HVS stormwater treatment systems shall be paid according to the unit price per each in the proper item of the Proposal and Bid Schedule. All work and materials to complete the installation of each HVS, including, but not limited to, excavation, bedding, backfill, connection to structures, etc., shall be subsidiary to this item.

END OF SECTION



SECTION 400 – DRAINAGE SPECIFICATIONS

ITEM 405. GABIONS AND REVET MATTRESSES

405.1

SCOPE OF WORK

- A. The work to be performed under this specification shall include furnishing, assembling, filling, and tying rock-filled wire mesh compartmented gabions and revet mattresses in accordance with the lines, grades, and dimensions shown on the Drawings or otherwise established in the field by the Engineer or designated representative. The type of construction (i.e. twisted woven mesh, welded mesh or both) and wire sizes [i.e. 13.5 gage (2.2 mm), 12 gage (2.7 mm) or 10 gage (3.4 mm)] shall be as defined in the Drawings or otherwise established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

405.2

MATERIALS

- A. Gabions and revet mattresses shall be constructed of galvanized steel wire with polyvinylchloride (PVC) flexible coating. The gabions and revet mattresses shall be of the construction and sizes specified in the Drawings and shall meet the specifications presented herein. Unless otherwise specified in the Drawings or approved by the Engineer or designated representative, the gabions and revet mattresses may be constructed of either double twist woven mesh or welded wire mesh.
- B. Gabions shall be furnished in the specified dimensions within a tolerance of ± 5 percent. Revet mattresses shall be furnished in the specified dimensions within a tolerance of 5 percent for the length and width and 10 percent for the height. For each individual gabion or revet mattress, the same mesh style shall be used for the base, front, ends, back, diaphragms and lid panels. Each gabion or revet mattress shall be manufactured and divided into cells of equal length, no greater than 3 feet (0.9 meter), by diaphragm panels.
1. Gabion and Revet Mattress Wire shall be galvanized steel, Class 3 or A coating, soft temper conforming to ASTM A 641, and shall specifically meet the requirements given below for gabions (12 gage wire) and/or revet mattresses (13.5 wire gage) as called for in the Drawings. PVC coating of the wire may be fusebonded or extruded onto the wire. Galvanization of welded wire shall be performed either before or after welding.

Table 1: Requirements – Mesh Wire for Gabions and Revet Mattress Units

Characteristic	Gabions	Revet Mattresses
Wire Gage	12 gage	13.5 gage
Maximum Tensile Strength (ASTM 641)	70,000 psi (483 mPa)	75,000 psi (517 mPa)
Nominal Wire Diameter (ASTM A641)	0.106 inch (2.7 mm)	0.0866 inch (2.2 mm)
Minimum Diameter (ASTM A 641, Table 3)	0.102 inch (2.6 mm)	0.0826 inch (2.9 mm)
Galvanized Zinc (ASTM A 641, Table 1)	0.80 oz/ft ² (245 gr/m ²)	0.70 oz/ft ² (215 gr/m ²)



2. Gabion Mesh

- a. Woven Mesh shall be of a uniform nonraveling, double twist hexagonal pattern nominally of dimensions 3.25 inches by 4.5 inches (83 mm by 114 mm). Selvedge wire shall be 10 gage (nominal diameter of 3.4 mm).
- b. Welded Mesh. Mesh opening shall be nominally 3 inches by 3 inches (75 mm by 75 mm). Strength of welds shall meet the following requirements when tested in accordance with section 13.4 of ASTM A-974:

Table 2: Minimum Weld Strength Requirements

Type of Structure	Wire Size (Diameter)	Minimum Average Weld Shear Strength
	Gage	English Units (SI Units)
Gabions	12 (2.7)	472 lbf (2.10 kN)
Revet Mattress	13.5 (2.2)	292 lbf (1.30 kN)

- c. Manufacturing. Twisted wire mesh gabions shall be manufactured in conformance with ASTM A-975, while welded wire mesh gabions shall be manufactured in conformance with ASTM A-974.

C. Revet Mattresses

- 1. Woven Mesh shall be of a uniform nonraveling, double twist hexagonal pattern, nominally of dimensions 2.5" x 3.25" (64 mm by 83 mm). Selvedge wire shall be 12 gage (nominal diameter of 2.7 mm).
- 2. Welded Mesh. Mesh opening shall be nominally 1.5" x 3.0" (38 mm by 76 mm). Strength of welds shall meet the requirements listed in Table 2 for 13.5 gage (2.2 mm) wire, when tested in accordance with section 13.4 of ASTM A-974:
- 3. Manufacturing. Twisted wire mesh revet mattresses shall be manufactured in conformance with ASTM A-975, while welded wire mesh revet mattresses shall be manufactured in conformance with ASTM A-974.

D. PVC Coating

- 1. All wire used in fabrication of the gabions, revet mattresses and wiring operations during construction shall, after zinc coating, have a fusebonded or extruded coating of PVC. The coating shall be gray in color. The thickness shall be nominally 0.020 inch (0.5 mm), and shall not be less than 0.015 inch (0.38 mm) in thickness. It shall be capable of resisting deleterious effects of natural weather exposure, and immersion in salt water.
- 2. For PVC-coated welded wire fabric panel, cutting of the panels shall not be allowed closer than 1/4 inch (1/8 inch (6 mm (3.18 mm) after fabrication in order to prevent exposure near the welds.



3. Initial Properties:

- a. Woven Mesh: The initial properties of the PVC coating material shall have a demonstrated ability to conform to the following requirements specified in ASTM A-975:
- i. Specific Gravity: The specific gravity as determined in accordance with ASTM D-792 shall be between 1.3 to 1.35.
 - ii. Durometer Hardness: The hardness as determined in accordance with ASTM D-2240 shall be between 50 to 60, Shore D.
 - iii. Tensile Strength: The tensile strength when tested in accordance with ASTM D-412 shall not be less than 2985 psi (20.6 mPa).
 - iv. Modulus of Elasticity at 100% Elongation: The Modulus of Elasticity when determined in accordance with ASTM D-412 shall not be less than 2700 psi (18.6 mPa).
 - v. Resistance to Abrasion: The percentage loss in weight (mass) during abrasion testing in accordance with ASTM D-1242 shall be less than 12%.
 - vi. Brittleness Temperature: The brittleness temperature shall not be higher than 150F (-9.00C) or a lower temperature specified by the Engineer, when tested in accordance with ASTM D-746. The maximum brittleness temperature should be at least 150F (80C) below the minimum temperature at which the gabion will be handled or filled.
- b. Welded Mesh: The initial properties of the PVC coating material shall have a demonstrated ability to conform to the following requirements specified in ASTM A-974:
- i. Specific Gravity: The specific gravity as determined in accordance with ASTM D-792 shall be between 1.20 and 1.40.
 - ii. Durometer Hardness: The hardness as determined in accordance with ASTM D-2240 shall not be less than 75, Shore A.
 - iii. Tensile Strength: The tensile strength when tested in accordance with ASTM D-638 shall not be less than 2275 psi (15.7 mPa).
 - iv. Modulus of Elasticity: The Modulus of Elasticity when determined in accordance with ASTM D-638 shall not be less than 1980 psi (13.7 mPa).
 - v. Resistance to Abrasion: The percentage loss in weight (mass) shall be less than 12 % during abrasion testing in accordance with ASTM D-1242, Method B, at 200 cycles, CSI-A abrader tape, 80 grit.
 - vi. Brittleness Temperature: The brittleness temperature shall not be higher than 150F (-9.00C) or a lower temperature specified by the Engineer, when tested in accordance with ASTM D-746. The maximum brittleness temperature should be at least 150F (80C) below the minimum temperature at which the gabion will be handled or filled.
 - vii. Adhesion: The PVC coating on the wire shall adhere to the wire such that the coating breaks rather than separates from the wire, when tested in



accordance with the PVC Adhesion Test described in Section 13.3 of ASTM A-974.

- viii. Mandrel Bend: The PVC-coated wire, when subjected to a single 3600 bend at 00F (-180C) around a mandrel ten times the diameter of the wire, shall not exhibit breaks or cracks in the PVC coating.

405.3

TESTING

- A. Performance Tests: The PVC coating shall have the demonstrated ability to withstand the specified exposure testing.
1. Exposure to Salt Spray: The PVC shall show no effect after 3000 hours of salt spray exposure in accordance with ASTM Test Method B-117.
 2. Exposure to Ultraviolet Rays: The PVC shall show no effect of exposure to ultraviolet light with test exposure of 3000 hours, using apparatus Type E and 145°F (63°C), when tested in accordance with ASTM Practice D-1499 and G-23.
- B. Properties after exposure tests: after conclusion of the salt spray and exposure to ultraviolet light tests, the PVC shall not show cracks, blisters or splits, or any noticeable change in color. In addition the PVC coating shall not show cracks or breaks after the wires are twisted in the fabrication of the mesh, nor shall there be any moisture intrusion under the PVC coating as a result of the test.

After completion of the exposure tests the following criteria shall also be met:

1. Woven Mesh:
 - a. The Specific Gravity shall not change more than 6% of its initial value.
 - b. The Durometer Hardness shall not change more than 10% of its initial value.
 - c. The Tensile Strength shall not change more than 25% of its initial value.
 - d. The Resistance to Abrasion shall not change more than 10% of its initial value.
 2. Welded Mesh:
 - a. The Specific Gravity shall not change more than 6% of its initial value.
 - b. The Modulus of Elasticity shall not change more than 25% of its initial value.
 - c. The Tensile Strength shall not change more than 25% of its initial value.
 - d. The Resistance to Abrasion shall not change more than 10% of its initial value.
 3. Salt Spray Resistance for Fastener:
 - a. The fasteners for twisted mesh wire gabions andrevet mattresses shall be subjected to Salt Spray Test of Test Method B-117 for a period of not less than 48 (1 hour cycle length. After testing the fasteners, the selvedge, or mesh wire confined by the fasteners shall show no rusty spots on any part of the surface excluding the cut ends.
- C. Stone
1. Gabion Basket Stones
 - a. Stone fill shall be durable and of suitable quality to ensure permanence in the structure. The stone used to fill the gabion baskets shall be a clean, sound, and durable rock meeting the following requirements. It shall have a wearing loss less than 35 percent when the stone is tested with the Los Angeles Abrasion Machine in accordance with ASTM Test Method C535 (TxDOT Test Method Tex-410A). The loss of material experienced during five cycles of magnesium sulfate



exposure conducted in accordance with TxDOT Test Method Tex411A for Rock RipRap shall not exceed 18 percent. The stone shall be well graded to produce a dense fill, angular in texture, while meeting the following gradation requirements:

Table 3: Gabion Stone Gradation Requirements

Sieve Size US (SI)	Percent by Weight (Mass) % Passing Each Individual Sieve
8 Inch (200 mm)	100
4 Inch (100 mm)	0 - 5
3 Inch (75 mm)	0

The minimum unit weight (unit mass) of a rockfilled gabion shall be 120 pcf [1.92 megagrams (mg) per cubic meter]. Verification of unit weight (mass) shall be performed when ordered by the Engineer, by constructing a test gabion with materials supplied for construction with the same effort and method intended for production gabions.

- D. **Revet Mattress Stone:** The stone used to fill the revet mattresses shall be as specified for gabions except that it shall have a maximum dimension of 5 inches (125mm) and a minimum dimension of 3 inches (75 mm). The majority of the stone shall be in the 3 to 4 inch (75 to 100 mm) range; cubical or rounded in shape. A tolerance of 5% shall be allowed on the upper and lower dimensions of the rock.

405.4

CONNECTIONS

- A. **Wire:** Lacing wire and connecting wire shall be 13.5 gage [0.087 inch (2.20 mm)] PVC coated galvanized steel, Class 3, soft temper, conforming to ASTM A-641. During testing, any separation of 2 inches (50 mm) or more between connecting wires shall be considered as a failure.
- B. **Spiral Binder for Welded Wire Mesh:** Spiral binders shall consist of 0.106 inch (2.7 mm) PVC coated wire for the gabion and 0.087 inch (2.2 mm) PVC coated wire for the revet mattresses. Spiral binders shall have a 3.0 inch (75 mm) maximum separation between continuous successive loops (3 inch or 75mm pitch).

The binder shall be made of galvanized steel, Class 3, soft temper, conforming to ASTM A-641.

- C. **Alternate Fasteners for Twisted Woven Mesh:** Alternate fasteners, acceptable for use by the intended gabion basket manufacturer, may be submitted to the Engineer for consideration and approval prior to construction. The fasteners may consist of split ring or interlocking fasteners. Alternate fasteners systems shall produce a joint that meets the requirements of ASTM A-975, Section 7, Table 2.

405.5

FASTENER SYSTEM

The Contractor shall provide a complete description of the fastener system, including the number of fasteners required for all vertical and horizontal connections for single- and multiple-basket joinings, as well as the number and size wires the fastener is capable of properly joining. The Contractor shall provide a description of a properly installed fastener, including test reports, drawings and/or photographs. Properly formed fasteners shall meet the requirements of ASTM A-974 for welded wire mesh or ASTM A-975 for twisted woven mesh.

- A. Each interlocking fastener shall be locked and closed.



- B. Each overlapping ring fastener shall be closed and the free ends shall overlap an average of 1 inch (25 mm).
- C. Spiral binders shall be screwed into position such that they pass through each mesh opening along the joint. In order to prevent unraveling, both ends of the spiral shall be crimped back around itself.
- D. Wire fasteners shall not be used to join more wires, or larger wires, than tested and approved for the application.

405.6

PANEL TO PANEL JOINT STRENGTH

The minimum strength of the joined panels shall be as specified in Section 7.3 of ASTM A-974 for Welded wire panels or Section 7.3 of ASTM A-975 for twisted woven mesh.

405.7

MISCELLANEOUS

Aggregate bedding, geotextiles or other materials shall conform to the requirements established on the Drawings.

405.8

CERTIFICATE OF COMPLIANCE

The Contractor shall submit Certificates of Compliance for all materials proposed for use to the Engineer for review and approval one week prior to construction.

405.9

CONSTRUCTION

- A. Twisted wire mesh Gabon's and revote mattresses shall be supplied in the forms allowed in ASTM A-975, while welded wire mesh Gabon's and revote mattresses shall be supplied in a form allowed in ASTM A-974.
- B. The Gabon/revote mattress manufacturer/supplier will be required to have a qualified representative on site at the start of gabion/revet mattress construction. The Contractor shall submit work experience documentation of the representative for review/approval by the Engineer or designated representative. The representative shall be available for consultation as needed throughout the gabion construction.
- C. Gabions and revet mattresses shall be constructed to the lines and grades shown on the Drawings. Individual or groups of gabions or revet mattresses, which deviate from line and grade, shall, at the direction of the Engineer or designated representative, be removed and replaced at no cost to the owner. Gabions or revet mattresses, which are constructed with bulges, and/or underfilled, loosely filled, or otherwise lacking a neat and compact appearance shall, at the direction of the Engineer or designated representative, be repaired/replaced at no cost to the owner. Underfilling of gabion/revet mattress corners to facilitate insertion of spirals shall not be permitted.

405.10

FOUNDATION PREPARATION

- A. The foundation shall be excavated to the extent shown on the Drawings or as directed by the Engineer or designated representative. All loose or otherwise unsuitable materials shall be removed. All depressions shall be carefully backfilled to grade. The depressions shall be backfilled with suitable materials from adjacent required excavation, or other approved source, and compacted to a density at least equal to that of the adjacent foundation. If pervious materials are encountered in the foundation depressions, the areas shall be backfilled with free draining materials.
- B. Any buried debris protruding from the foundation that will impede the proper installation and detrimentally impact the final appearance of the gabion, shall also be removed, and the voids carefully backfilled and compacted as specified above. Immediately prior to gabion or revet mattress placement, the prepared foundation surface shall be inspected and approved by the Engineer and no material shall be placed thereon until that area has been approved.



- C. Placement of filter material and/or filter fabric shall be as shown on the Drawings or directed by the Engineer.

405.11

GABION/RENET MATTRESS BASKET ASSEMBLY

- A. No work shall take place using PVC coated materials unless both the ambient air temperature and the temperature of the PVC materials are at least 15°F (8°C) above the brittleness temperature of the PVC materials.
- B. Assembly of gabions and renet mattresses shall consist of shaping and tying each individual basket. Baskets shall be assembled by connecting all untied edges including diaphragms with lacing wire, spirals or approved fasteners. The connections for the completed assemblies shall conform to the requirements of Section 7 of ASTM specifications A-974 (welded wire) and Section 7.3 and Table 2 of A-975 (double twisted).
- C. Assembly of baskets, connection of baskets together and lid closures shall be accomplished in accordance with one of the following approved procedures:
 - 1. Lacing Wire: Using lacing wire of appropriate length, secure one end of the wire onto the basket corner by looping and twisting the lacing wire together. Proceed along the joint by tying with double loops every other mesh opening at intervals not more than 6 inches (150 mm) apart, while pulling the basket elements tightly together. Secure the other end of the lacing wire again by looping and twisting the wire around itself.
 - 2. Spiral Binders for Welded Wire Mesh: Spiral binders, meeting the minimum acceptance criteria of article 594S.2(6)(c) shall be screwed into position such that they pass through each mesh opening along the joint. To prevent unraveling, each end of the spiral binder shall be crimped back against itself.
 - 3. Alternate Fasteners for Twisted Woven Mesh:
 - a. Interlocking fasteners meeting the minimum acceptance criteria of article 594S.2(6)(c), shall be installed with, as a minimum, one interlocking fastener in every other opening.
 - b. Ring fasteners meeting the minimum acceptance criteria of 594S.2(6)(c), shall be installed with, as a minimum, one split ring fastener in every opening, having a minimum 1 inch (25 mm) total overlap and securing only the number and diameter of wires for which tested.
 - c. Placing of gabions and renet mattresses shall consist of installing baskets to the lines and grades shown on the Drawings. Gabions and renet mattresses shall be securely fastened to each adjoining unit along the vertical and top reinforced edges of all contact surfaces. Overlying rows of baskets shall be staggered appropriately. Empty sections stacked on a filled line of gabions and renet mattresses shall be securely fastened to the bottom unit along the front, back and ends.
 - d. Prior to the placement of rock, the baskets used in the front vertical exposed faces of retaining walls shall be aligned. To facilitate alignment, tension may be applied to empty units at the direction of the Engineer or designated representative.

405.12

FILLING OF GABIONS AND RENET MATTRESSES

- A. The gabions and renet mattresses may be filled by machine, in maximum lifts of 12 inches (300 mm). The machine work shall be supplemented with handwork to avoid bulges and provide a compact mass with a minimum of voids. Care will be exercised so as not to damage the gabion/renet mattress elements or wire coating by limiting height of drop during filling to 3.0 feet



(0.9 meter) for Gabions and 1.5 feet (0.5 meter) for revet mattresses. Undue deformation or bulging of the mesh shall be corrected prior to further stone filling. Where specified on the Drawings, select large stone shall be hand placed on vertical outside faces to achieve a desired neat appearance.

- B. During placement, the depth of stone in any cell shall not exceed the depth in an adjoining cell by more than one foot (300 mm). Stone smaller than the mesh opening found against vertical faces shall be removed.
- C. Two connecting wires in each direction for end units and two parallel connecting wires perpendicular to the exposed face for exposed face units shall be installed at every 12 inch (300 mm) lift. The connecting wires shall loop around two mesh openings, and the ends of wires shall be securely twisted with a minimum of three twists after looping. Prefabricated connecting wire may be used in lieu of connecting wire.
- D. Connecting wires associated with 18inch (450 mm) gabions shall be installed when and as specified on the Drawings or as recommended by the gabion/revet mattress manufacturer.
- E. The gabion or revet mattress unit shall be overfilled by 1 1/2 to 2 inches (37.5 to 50 mm) and the lid shall be bent and stretched until it meets the perimeter edges of the front and end panels. The stretching shall be accomplished using an approved lid closing tool in order to prevent damage to the PVC coating. Crow bars or similar single point leverage devices will not be allowed. The lid shall then be securely tied with lacing wire, spirals or approved fasteners to the fronts, ends and diaphragms. Excessive deformation of the lid panel to facilitate closing of a bulging gabion or revet mattress will not be permitted.
- F. All backfill shall be placed and compacted in sequence with the filling of the baskets; however, care shall be exercised in compacting the fill behind a single row of baskets since excessive compaction effort can displace the gabions/revet mattresses from the desired alignment.
- G. Gabion or revet mattress units may be cut or shaped to fit odd length or odd shaped areas. They shall be cut at least 6" to 8" (150 mm to 200 mm) larger than the opening to allow sufficient material for overlap and lacing. All edges or faces formed in this manner shall be adjusted to present a finished and pleasing appearance.
- H. At all times, care shall be taken to turn all loose and projecting ends of wire into the gabion units to prevent injury.

405.13 WORKMANSHIP

Wire of proper grade and quality, when fabricated and installed in the manner herein required, shall result in a strong, serviceable mesh-type product having substantially uniform openings. It shall be fabricated and finished in a workmanlike manner, as determined by visual inspection, and shall conform to this specification.

405.14 MEASUREMENT

Measurement of acceptable "Gabions and Revet Mattresses", complete in place, will be made on the basis of volume determined by the actual length, width and height.

405.15 PAYMENT

The Gabion and revet mattress quantities, measured as described above, will be paid for at the unit bid prices per cubic yard (cubic meter: 1 cubic meter equals 1.308 cubic yards) of the various types indicated. The price shall include full compensation for furnishing, hauling and placing all materials, including filter fabric, wire containers, connectors, reinforcement stones and backfill; for all labor, tools, equipment and incidentals needed to complete the work.



Excavation and all subgrade preparation required for shaping the foundation for the wire containers shall be included in the unit bid price for "Gabions and Revet Mattresses".

Payment will be made under one of the following:

Gabions, Twisted Woven Wire	Per Cubic Yard
Gabions, Welded Wire	Per Cubic Yard
Revet Mattresses, Twisted Woven Wire	Per Cubic Yard
Revet Mattresses, Welded Wire	Per Cubic Yard

END OF SECTION



SECTION 400 – DRAINAGE SPECIFICATIONS

ITEM 406. PILE RESTORATION

406.1 SCOPE OF WORK

- A. This Section specifies requirements for restoring deteriorated piles using Fiber-Reinforced Laminate (FRL) encasement. The work shall consist of using a fiber-reinforced laminate to create a helical jacket around the pile to be restored, and filling the annulus between the jacket and the pile with underwater resin.
- B. Contractor shall provide all labor, materials, tools, and equipment required for the completion of the following Work, as shown on the Contract Documents and specified herein:
1. Prepare existing areas, as defined by these specifications and related Contract Drawings, designated to receive pile restoration
 2. Design, furnish, fabricate, and install all jackets, shores, and bracing
 3. Prepare installation and placement shop drawings listed below
 4. Prepare design drawings for shores, and bracing if required
 5. Furnish all submittals required by this Section of the Specifications
 6. Coordinate all work with other trades on site.

406.2 REFERENCES

- A. The latest edition and addenda of the following publications in effect on the date of Contract Award are part of this Specification and, where referred to by title or basic designation only, are applicable to the extent indicated by the specific reference:
- SOCIETY FOR PROTECTIVE COATINGS
 - SSPC SP-12 WJ-2 Surface Preparation and Cleaning of Metals by Water Jetting

406.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 211, Submittals.
- B. Details shall be carried out in accordance with the local building codes, and as shown on plans.
- C. Product Data:
1. Fiber-Reinforced Laminate catalog cuts showing material properties and strength.
 2. Fill resin catalog cuts showing material properties and strength.
 3. Adhesive resin catalog cuts showing material properties and strength.
 4. Fill and Adhesive Resin MSDS sheets.
 5. Miscellaneous fasteners, anchors, straps, spacers, etc. catalog cuts showing material properties.



- D. Shop Drawings
 - 1. Submit shop drawings that shall detail FRL jacket construction and support; overlap size; spacer size, arrangement and attachment; and sealing details.
- E. Design Data
 - 1. Overlap of laminate to ensure required confinement pressure.
 - 2. Resin selection to ensure required bearing strength.
 - 3. Size of annular space to ensure full resin encasement and bearing.
- F. Certifications
 - 1. Material certification for FR laminates to show date of fabrication.
 - 2. Material certification for fill and adhesive resin to show date of manufacture.
- G. Quality Assurance Documents
 - 1. Daily installation reports showing air and water temperatures
 - 2. Daily installation reports showing lot numbers of FR laminates and resins used on each pile

406.4

MATERIALS FOR FR LAMINATE ENCASEMENT

- A. Fiber-Reinforced Laminate
 - 1. The laminate shall be a high-strength Fiber Reinforced Polymer (FRP) laminate constructed with bidirectional carbon or glass fabrics that provides strength in both longitudinal and transverse directions.
 - 2. The laminate shall have the following properties per ASTM D3039
 - a. In the longitudinal direction Tensile Strength shall be a minimum of 62 ksi, Modulus of Elasticity shall be a minimum of 3,500 ksi, with the Ultimate elongation of 1.31%
 - b. In the transverse direction Tensile Strength shall be a minimum of 60 ksi, Modulus of Elasticity shall be a minimum of 3,650 ksi with the Ultimate Elongation of 1.06%
 - 3. The thickness of the laminate shall be between 0.025 to 0.030 inches;
 - 4. Barcol Hardness (ASTM D 2583) shall be a minimum of 50
 - 5. Water Absorption (ASTM D 570) shall be a maximum of 0.8%
 - 6. FRP Laminate shall be PileMedic™ PLG60.60 (www.PileMedic.com; 2055 E. 17th St., Tucson, AZ 85719 U.S.A.; Tel: +1.520.791.7000) or approved equal
- B. Adhesive Resin
 - 1. The adhesive resin shall be a two-component high-strength structural epoxy designed for underwater applications. It shall have an immediate high tack consistency both in air and water and shall trowel easily.



2. The adhesive resin shall be a 100% solids formulation with low toxicity and low odor during cure.
3. The adhesive resin's tensile strength shall be a minimum of 4,360 psi (ASTM D-638)
4. The adhesive resin's compressive strength shall be a minimum of 11,700 psi (ASTM D-695)
5. The adhesive resin's flexural strength shall be a minimum of 8,900 psi (ASTM D-790)
6. The adhesive resin's tensile elongation shall be a maximum of 5%
7. The adhesive resin shall be QuakeBond™ 220UR or approved equal

C. Fill Resin

1. The fill resin shall be a two-component, high-strength, low-viscosity structural epoxy. The resin shall cure underwater and shall provide excellent durability and chemical resistance. The resin shall be a 100% solids formulation with low toxicity and low odor during cure.
2. The fill resin's viscosity when mixed at 77 F shall be 780 cps (ASTM D-1290)
3. The fill resin's tensile strength shall be a minimum of 7,900 psi (ASTM D-638)
4. The fill resin's compressive strength shall be a minimum of 11,200 psi (ASTM D-695)
5. The fill resin's density when mixed shall be 1.11
6. The adhesive resin's tensile elongation shall be a maximum of 5%
7. The fill resin's Hardness, Shore D shall be a minimum of 86 (ASTM D-2240)
8. Add pigment to fill resin so that its color could show through the glass laminate
9. The fill resins shall be QuakeBond™ 320 LV Low Viscosity Resin or approved equal

D. Miscellaneous Anchors, Spacers and Fasteners

1. An epoxy adhesive compound capable of being installed underwater shall be used to secure any anchors, threaded rods, or reinforcing steel to existing concrete surfaces. The following products, or approved equal, shall be used to secure anchors, threaded rods, or reinforcing steel to existing concrete surfaces:
 - a. Hilti HIT RE500
 - b. Rockwater RockEpoxy Capsules
2. Self-tapping screws used for initially securing the laminate during the adhesive cure time shall be of the non-reactive type.
3. Spacers used to create an annulus around the pile shall be of the non-reactive type.

406.5

JOINTS AND EMBEDDED ITEMS

A. Construction and Expansion Joints

1. No construction or expansion joints shall be permitted. Each encasement shall be placed in a continuous manner from start to finish. Horizontal construction joints are prohibited.



B. Other Embedded Items

1. All inserts, anchors, dowels and other embedded items, including those required for adjoining work, or for its support, shall be in place prior to encasement. Anchor dowels and other items of miscellaneous metal shall be installed by the Contractor in accordance with manufacturer's recommendations and procedures.
2. All Work required to be installed before encasement shall be verified prior to placement of the jacket.
3. Dowel anchoring systems shall be maintained free from any deformation; and free from loose rust, loose scale, oil, mud, and any other deleterious substances.
4. Contractor shall provide all templates and devices necessary for the accurate positioning and setting of all embedded items specified herein or in other Sections of the Specification, and/or as indicated on the Contract Documents.

406.6

PREPARATION

A. Timber Piles

1. All timber piles scheduled to receive FRL encasements shall be cleaned using high pressure waterjetting with rating of 5000 psi. Contractor shall take precautions in order not to remove intact timber section from the existing timber piles during preparation activities. The purpose of this preparation is to remove all marine growth and any soft surface layer that may have accumulated on the piles. Severely deteriorated timber may be removed with water blast.
2. The elapsed time between the cleaning of a timber pile and the installation of the encasement on that timber pile shall not exceed 72 hours. If this time frame is exceeded contractor shall re-clean the pile prior to encasement.
3. Contractor shall remove any marine growth that has accumulated on the pile prior to the installation of the FRL jacket.

B. Concrete

1. All loose and deteriorated concrete shall be removed using hydraulic or air pressurized hand tools.
2. Contractor shall take precautions not to damage non-spalled or cracked concrete at location of schedule repair.
3. After loose concrete is chipped away, all concrete extension surfaces scheduled to receive encasements shall be cleaned using high pressure water-jetting with rating of 5000 psi. The purpose of this preparation is to remove all marine growth and any soft surface layer that may have accumulated on the extension. The elapsed time between the cleaning of the concrete surface and the installation of the FRL encasement shall not exceed 72 hours. If this time frame is exceeded contractor shall re-clean the pile prior to encasement.
4. Contractor shall remove any marine growth that has accumulated on the concrete surface prior to encasement.

406.07

APPLICATION

A. FR Laminate

1. The laminate jacket shall be uniform, smooth and free of deformations, gaps or kinks.



2. The laminate jacket shall be tight and shall provide a still water environment in the space to be filled with resin. Side forms shall extend above top of the resin as required. A diver shall be engaged by the Contractor to monitor the placement of the resin continuously and shall caulk any joints or leaks which show evidence of loss of resin such as in the form of a cloud of discoloration emanating from the jacket. No resin shall be permitted to escape the jacket during placement of the fill resin
3. Set spacers on the pile in order to create an annular space of the approved size. Fasten spacers to the piles per approved methods. Spacers shall be installed such as NOT to block the path of the fill resin during resin placement.

B. Adhesive Resin

1. The adhesive resin shall be mixed in small batches at the point of installation. Great care shall be given to application of the adhesive resin to the laminate. Thoroughly clean the laminate surface per manufacturer's recommendation prior to the application of the adhesive resin. Air, water and laminate surface temperature shall be between 50 and 90 degrees F. DO not begin application if air, water or laminate surface temperature is below 50 or expected to fall below 50 F within 12 hours of application. Do not begin application if the dew point is within 5 F of the temperature. Adhere strictly to Manufacturer's Recommendations.

C. Fill Resin

1. Mix fill resin at the point of installation. Introduce fill resin at the bottom of the annular space using tubes of the appropriate size. Minimum application temperature shall be 45 F. All epoxy components shall be conditioned to a temperature between 65 and 85 F prior to the time of mixing. Adhere strictly to Manufacturer's Recommendations.

D. Fill Resin Placement Equipment

1. Mixing and placement equipment used in mixing and handling of the fill resin shall be as recommended by the resin's manufacturer and approved by the Owner's Engineer. All oil and other rust inhibitors shall be removed from the mixing drums, stirring mechanisms and other portions of the equipment that would be in contact with the resin before the mixers are used.

E. Embedded Dowels

1. All dowels and anchoring systems which will be embedded in resin shall be cleaned of all debris, marine growth, loose rust and oily deposits.

F. Application

1. The fill resin of each encasement shall be placed in a continuous manner from start to finish over its full height. Horizontal construction joints are not permitted. Fill resin placement shall begin from the bottom of the laminate jacket until it reaches the top of the jacket.
2. A diver shall monitor the placement of the resin into the jacket.
3. Allow fill resin to overtop the jacket until all water and laitance has been removed from the inside of the jacket.

406.8

INSPECTION

1. The Work to be provided in accordance with this Section of the Specification shall be subject to inspection by Owner at any time(s) during the progress of the Work. Contractor



shall provide access and any labor, materials, tools, and equipment required by Owner to complete inspection of the Work as specified herein.

2. Completed installations shall be visually inspected to confirm the integrity of the laminate encasement and the resin fill. Any deficiencies shall be corrected at the Contractor's expense. The Contractor shall propose a repair method and submit it to the Engineer for approval prior to implementing said repair.
3. Acceptance of structure shall be contingent on the Work meeting all of the requirements of the Contract Documents as indicated by the results of all testing, inspection, and other quality assurance procedures required by Owner.

406.9

PAYMENT

- A. Payment for pile restoration shall be paid according to the unit price per each in the proper item of the Proposal and Bid Schedule. All work and materials to complete the pile restoration shall be subsidiary to this item.

END SECTION



SECTION 400 – DRAINAGE SPECIFICATIONS

ITEM 407. RESTRAINT AND BLOCKING

407.1 SCOPE OF WORK

This specification governs Portland Cement concrete restraint and blocking used to anchor underground pipe. Restraint and blocking shall be constructed as indicated on the Drawings or as directed by the Engineer or designated representative in accordance with these specifications.

407.2 SUBMITTALS

The submittal requirements of this specification item include:

- A. Class D Portland cement concrete mix design.
- B. Construction details (i.e. reinforcing steel, curing membrane).

407.3 MATERIALS

- A. Portland Cement Concrete
 - 1. The concrete materials used in construction under this item shall conform to Class D, Section 802 – CONCRETE FOR STRUCTURES.
- B. Reinforcement
 - 1. Reinforcement shall conform to Section 807 – REINFORCING STEEL.

407.4 CONSTRUCTION METHODS

- A. Prior to placement of Portland cement concrete, excavation for restraint and blocking shall be made to proper section and depth. If considered necessary by Engineer or designated representative, the bottom of the excavation shall be hand tamped and sprinkled. The excavated area for concrete restraint and blocking shall be moist when the Portland cement concrete is placed.
- B. After the Portland cement concrete has been placed, consolidated and shaped to conform to the dimensions indicated on the Drawings and after sufficiently set, it shall be given a moderately rough finish by floating with a wood float.
- C. No mortar or concrete work shall be undertaken, when the ambient temperature is below 35°F (1°C) and Work shall be protected from freezing. After completion of the concrete retard, exposed surfaces shall be covered with burlap, cotton mats or other approved covering and kept moist for a minimum period of 3 days. White pigmented curing compound conforming to Section 806 – MEMBRANE CURING, Type 2, will be permitted when applied to exposed surfaces.
- D. Unless directed otherwise by the Engineer or designated representative, the material excavated during trenching shall be disposed of at a permitted site.

407.5 MEASUREMENT

Concrete restraint and blocking will be measured either by the cubic yard per Drawing dimensions or on a unit basis complete in place.



PAYMENT

- A. Work performed and materials furnished as prescribed by this Standard Specification item, measured as provided under the "Measurement" section will be paid for by the cubic yard or the unit price bid for "Concrete Restraint and Blocking", as indicated in the Contract Documents. The bid pay item price shall include full compensation for excavation, reinforcing, furnishing, hauling and placing all materials required in the construction, the disposal of excavated material and any manipulation, labor, tools, equipment and incidentals necessary to complete the work.
- B. This item shall also govern any pumping, bailing and dewatering or drainage necessary to complete the work when concrete restraint and blocking are indicated on the Drawings or required by the Engineer or designated representative.

END OF SECTION



SECTION 400 – DRAINAGE SPECIFICATIONS

ITEM 408. RIPRAP FOR SLOPE PROTECTION

408.1 SCOPE OF WORK

This item shall govern the excavation of all materials encountered for placing riprap, disposal of excess material and backfilling around the completed riprap to the grade indicated on the Drawings. The work shall include all pumping and bailing, furnishing and placing riprap of rock or concrete in accordance with the details and to the dimensions indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text; the inch-pound units are given preference followed by SI units shown within parentheses. The work conducted under this item pertains to riprap for protection of slopes, cuts, fills, drainage facilities and other features susceptible to erosion.

408.2 SUBMITTALS

The submittal requirements for this specification item shall include:

- A. The type, size, gradation and source of riprap material (rock or broken concrete),
- B. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix,
- C. Proposed proportioning of materials for the mortar mix,
- D. Type, details and installation requirements for reinforcement, joint material, tie backs and anchors,
- E. Description of filter fabric including characteristics, test data and manufacturer's recommendations for installation.
- F. The type, size, gradation and source of granular filter material.

408.3 MATERIALS

- A. Rock used for riprap shall be hard, durable, and angular in shape and consist of clean field rock or rough unhewn quarry rock as nearly uniform in section as practicable. The rocks shall be dense, resistant to weathering and water action, free of overburden, spoils, shale and organic material; and shall meet the gradation requirements for the rock size specified. Neither the width nor the thickness of a single stone should be less than one third of its length. Shale, chalk and limestone with shale or chalk seams are not acceptable. Rounded rock (river rock) shall not be acceptable. Minimum density for acceptable dry rock riprap shall be 150 pounds per cubic foot or a specific gravity of 2.4.

The rock shall be suitable in all respects for the purpose intended. The sources from which the stone will be obtained shall be selected well in advance of the time when the stone will be required and pre-approved by the Engineer. Control of gradation and material adequacy will be accomplished by visual inspection and field measurement as needed for rock sizes that cannot be analyzed via sieve or mechanical sorting machines. The contractor shall provide two samples of rock meeting the gradation for the size class specified. The samples shall be used as frequent reference for judging the gradation of the riprap supplied. Any difference of opinion between the engineer and the contractor shall be resolved by dumping two random truckloads of stone and performing manual field measurements of individual stones to compute a gradation. Any measured rock size dimensions shall be based on the length of the intermediate axis of each stone. Labor, equipment and site location needed to assist in checking gradation shall be provided by the contractor at no additional cost to the owner.



- B. Concrete. Cast in place concrete shall be Class A Concrete and shall conform to Section 802 – CONCRETE FOR STRUCTURES.
- C. Grout and Mortar. Grout and mortar shall consist of 1 part Portland Cement and 3 parts sand, thoroughly mixed with water. Mortar shall have a consistency such that it can be easily handled and spread by trowel. Grout shall have a consistency such that it will flow into and completely fill all joints.
- D. Reinforcement shall conform to Section 807 – REINFORCING STEEL.
- E. Joints. Premolded expansion joint material shall conform to Section 801 – CONCRETE STRUCTURES.
- F. Tie Backs and Anchors. Galvanized tie backs and anchors shall be as indicated on the Drawings.
- G. Filter Fabric Filter Fabric shall conform to Section 306 – SEDIMENTATION AND EROSION CONTROL.
- H. Granular Filter. Aggregate used for granular filters shall conform to Section 801- CONCRETE STRUCTURES.

408.4

Construction Methods

Prior to commencement of this work, all required erosion control and tree protection shall be in place and utilities located and protected as set forth in the "General Conditions". Construction equipment shall not be operated within the drip line of trees unless indicated on the Drawings. Construction materials shall not be placed under the canopies of trees. No excavation or embankment shall be placed within the drip line of trees until tree wells are constructed. Spalls and small stones used to fill open joints and voids in rock riprap shall be rocked and wedged to provide a tight fit.

Unsuitable excavated materials or excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor and it shall become his sole responsibility to dispose of this material in an environmentally sound manner off the limits of the right of way at a permitted disposal site.

Areas to be protected by rock riprap shall be free of brush, trees, stumps and other objectionable materials and be graded to a smooth compacted surface. All soft or spongy material shall be removed and replaced with appropriate material to the depths shown on the plans or as directed by the engineer. Fill Areas, unless otherwise specified will be compacted in accordance with Section 503 - EMBANKMENT. Unacceptable subgrade conditions shall be reworked according to the Engineer's recommendations. Excavation areas shall be maintained until the riprap is placed.

408.5

Dry Rock Riprap

The mass of rock riprap shall be placed as to be in conformance with the required gradation mixtures, to the lines, grades and layers thickness that is shown on the drawings. The range of rock sizes for the mixture shall conform to the following recommended gradation requirements relative to the specified median rock size (D50).



Relative Stone Size (inches)	Percent of Gradation Smaller than	Stone Size Designation
1.7 - 2.0 * D50	100	D100
1.3 - 1.7 * D50	85	D85
1.0 - 1.3 * D50	50	D50
0.5 - 1.0 * D50	15	D15

At least 50% of the rocks shall weigh more than the D50 rock size. When the riprap will be placed on an erodible soil, as determined by the Engineer or designated representative, a layer of geotextile filter fabric or a granular filter layer shall be placed, prior to placement of the riprap material. In some cases multiple layers of granular filter material of varying gradations may be required. The median rock riprap size (D50), rock riprap layer thickness, filter type, when applicable the number of granular filter layers, granular filter aggregate gradations (grade/size classification), granular layer thicknesses shall be specified on the plans. The minimum granular filter layer thickness shall be 4 inches (102 mm). Geotextile filter fabric shall conform to Section 306 – SEDIMENTATION AND EROSION CONTROL and be installed with sufficient anchoring and overlap between seams according to the manufacturer's recommendations to ensure full filter barrier protection of the subgrade after riprap installation. When specified on the plans a four (4) inch minimum thickness granular cushion layer of gravel or sand may be placed over the filter fabric to prevent damage the fabric during placement of rock riprap.

Rock riprap shall be machine placed and distributed such that there will be no large accumulations of either larger or smaller sizes. Placing rock riprap by dumping into chutes or similar methods shall not be permitted. The rocks shall be placed in a single layer with close joints. The rock riprap layer thickness shall be no less than the maximum stone size (D100) or 1.5 times the D50, which ever produces the greater thickness. In areas exposed to flowing water the rock riprap layer thickness should be no less than 2.0 times the D50. The upright axis of the rocks shall make an angle of approximately 90 degrees with the embankment slope. The courses shall be placed from the bottom of the embankment upward, with the larger rocks being placed on the lower courses. Open joints shall be filled with spalls. Rocks shall be arranged to present a uniform finished top surface such that the variation between tops of adjacent rocks shall not exceed 3 inches (75 mm). Rocks that project more than the allowable amount in the finished work shall be replaced, embedded deeper or chipped.

408.6

Mortared Rock Riprap

Rock for this purpose, as far as practicable, shall be selected as to size and shape in order to secure fairly large, flat-surfaced rock which may be laid with a true and even surface and a minimum of voids. Fifty percent of the mass rock shall be broad flat rocks, weighing between 100 and 150 pounds (45 and 69 kilograms) each, placed with the flat surface uppermost and parallel to the slope. The largest rock shall be placed near the base of the slope. The spaces between the larger rocks shall be filled with rocks of suitable size, leaving the surface smooth, reasonably tight and conforming to the contour required on the Drawings. In general, the rocks shall be placed with a degree of care that will insure plane surfaces with variation from the true plane of no more than 3 inches in 4 feet (no more than 60 mm per meter). Warped and curved surfaces shall have the same general degree of accuracy as indicated for plane surfaces.

Before placing mortar, the rocks shall be wetted thoroughly and as each of the larger rocks is placed, it shall be surrounded by fresh mortar and adjacent rocks shall be shoved into contact. After the larger rocks are in place, all of the spaces or opening(s) between them shall be filled with mortar and the smaller rocks then placed by shoving them into position, forcing excess mortar to the surface and insuring that each rock is carefully and firmly embedded laterally. After the work described above has been completed, all excess mortar forced up shall be spread uniformly to completely fill all surface voids. All surface joints then shall be pointed up roughly, either with flush joints or with shallow, smooth raked joints.

408.7

MEASUREMENT

Measurement of acceptable riprap will be made on the basis of the (a) area in square yards (square meters: 1 square meter equals 1.196 square yards) indicated on the Drawings, complete in place or (b) the volume of



concrete placed in cubic yards (cubic meters: 1 cubic meters equals 1.308 cubic yards), complete in place as indicated on the Drawings for the thickness specified.

Concrete toe walls will not be measured separately but shall be included in the unit price bid for riprap of the type with which it is placed.

408.8

PAYMENT

The riprap quantities, measured as provided above, will be paid for at the unit bid prices per square foot or per cubic yard as indicated for riprap of the various classifications. The Unit Bid Price shall include full compensation for furnishing, hauling and placing all materials, including toe walls, geotextile filter fabric, granular filter material, granular cushion, reinforcement and premolded expansion joint material and for all labor, tools, equipment and incidentals necessary to complete the work.

Payment for excavation of toe wall trenches and for all necessary excavation below natural ground or the bottom of excavated drainage channels will be included in the unit bid price for riprap. Excavation, grading and fill materials required to shape drainage channels shall not be included in the unit bid price for riprap.

Payment for excavation required for shaping of slopes for riprap shall be included in the unit bid price for riprap, except for the situation when the header banks upon which the riprap is to be placed are built by prior contract. In this specific case the excavation for shaping of slopes, will be paid for conforming to Section 309 – STRUCTURAL EXCAVATION.

END OF SECTION



SECTION 500 – TRANSPORTATION SPECIFICATIONS

ITEM 501. HOT MIX ASPHALTIC CONCRETE PAVEMENT

501.1 SCOPE OF WORK

- A. This specification covers the requirements for furnishing and installing hot mix asphaltic concrete as shown in the Plans and specified within. Construction shall include a base course, a level-up course, a surface course or any combination of these courses as shown on the Plans, each course being composed of a compacted mixture of aggregate and asphalt mixed hot in a mixing plant, in accordance with the details shown on the Plans and the requirements herein.

501.2 SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer for approval, technical product literature including mix design, aggregate source, aggregate gradation, aggregate type, and all other pertinent data to illustrate conformance to the specification found within.

501.3 MATERIALS

- A. The mineral aggregate shall be composed of a coarse aggregate, a fine aggregate, and if required, a mineral filler. Coarse aggregate shall be that part of the aggregate retained on the No. 10 sieve and shall be stone, crushed slag, crushed gravel, or gravel. Fine aggregate shall be that part passing the No. 10 sieve and shall consist of sand or screenings. Mineral filler shall consist of dry stone dust, Portland cement, or fly ash. Mineral aggregate shall meet the requirements of Item 340 (or 341 or 3224 for wide roadways or high speed roadways), Texas Department of Transportation (TxDOT), Standard Specifications for Construction of Highways, Streets and Bridges. The plasticity index of fine aggregate portion passing the No. 40 sieve shall not be more than six (6).

501.4 ASPHALTIC MATERIAL

- A. Asphalt for the paving mixture shall meet the requirements of TxDOT Item 300 (or 341 or 3224 for wide roadways or high speed roadways) of the Standard Specifications for Construction of Highways, Streets and Bridges. The grade of asphalt used shall be designated by the Engineer or the City after design tests have been made using the mineral aggregate to be used in the job.

501.5 TACK COAT

- A. Tack coat shall be in accordance with TxDOT Item 300 (or 341 or 3224 for wide roadways or high speed roadways) of the Standard Specifications for Construction of Highways, Streets and Bridges. Asphaltic material shall be approved by the Engineer or the City.

501.6 TYPES OF ASPHALTIC CONCRETE

- A. The mixture shall be designed and tested in accordance with the current TxDOT Item 340 (or 341 or 3224 for wide roadways or high speed roadways) of the Standard Specifications for Construction of Highways, Streets and Bridges, Type C, and will have a laboratory density of not less than 94.5% nor more than 97.5%, and a stability of not less than 35.
- B. The asphaltic material shall form from four to eight (4–8) percent of the mixture by weight or from nine to nineteen (9-19) percent of the mixture by volume.



EQUIPMENTA Spreading and Finishing Machine

1. The spreading and finishing machine shall be a type approved by the Engineer, shall be capable of producing a surface that will meet the requirements of the typical cross section and the surface test, when required, and when the mixture is dumped directly into the finishing machine, shall have adequate power to propel the delivery vehicles in a satisfactory manner. The finishing machine shall be equipped with a flexible spring and/or hydraulic-type hitch sufficient in design and capacity to maintain contact between the rear wheels of the hauling equipment and the pusher rollers of the finishing machine while the mixture is being unloaded.
2. The use of any vehicle which requires dumping directly into the finishing machine and which the finishing machine cannot push or propel in such a manner as to obtain the desired lines and grades without resorting to hand-finishing will not be allowed. Unless otherwise permitted by the Plans, vehicles of the semi-trailer type are specifically prohibited from dumping directly into the finishing machine while in contact with the finishing machine. Vehicles dumping directly or indirectly into the finishing machine shall be so designed and equipped that unloading into the finishing machine can be mechanically and/or automatically operated in such a manner that overloading the finishing machine being used cannot occur and the required lines and grades will be obtained without resorting to hand-finishing.
3. Dumping of the asphaltic mixture in a windrow and then placing the mixture in the finishing machine with loading equipment will be permitted, provided that the loading equipment is constructed and operated in such manner that substantially all of the mixture deposited on the roadbed is picked up and loaded in the finishing machine without contamination of foreign material of the mixture, and excessive temperature loss is not encountered. The loading equipment will be so designed and operated that the finishing machine being loaded will obtain the required line, grade, and surface without resorting to hand-finishing. Any operation of the loading equipment resulting in the accumulation and subsequent shedding of this accumulated material into the asphaltic mixture will not be permitted.

B. Rolling Equipment

1. Rolling equipment shall consist of pneumatic tire rollers, two-axle tandem roller weighing not less than eight (8) tons, three-wheel roller weighing not less than 10-tons, three-axle tandem roller weighing not less than 10-tons, and trench rollers having a 20-inch wheeldrive and producing 325 pounds per linear inch of roller width at a speed of 1.8 miles per hour in low gear.

C. Straight Edges and Templates

1. The Contractor shall provide an acceptable 10-foot straight edge for surface testing.

CONSTRUCTION METHODS

- A. The prime coat, tack coat or the asphaltic mixture, when placed with a spreading and finishing machine, shall not be placed when the air temperature is below 50 degrees F and is falling, but it may be placed when the air temperature is above 40 degrees F and is rising. The air temperature shall be taken in the shade away from artificial heat. It is further provided that the prime coat, tack coat or asphaltic mixture shall be placed only when the humidity, general weather conditions and temperature and moisture condition of the base, in the opinion of the Engineer or the City, are suitable.



B. Prime Coat

1. A prime coat is required, and shall be applied at the rate determined by the Engineer but not less than 0.2-gallons per square yard of MC-1 asphalt. The asphaltic concrete shall not be applied on a previously primed flexible base until the primed base has completely cured to the satisfaction of the Engineer and the City. Water-based prime coat is prohibited.

C. Transporting Asphaltic Concrete

1. The asphaltic mixture, prepared as directed above, shall be hauled to the work site in tight vehicles previously cleaned of all foreign material. The dispatching of the vehicles shall be arranged so that all material delivered may be placed, and all rolling shall be completed during daylight hours. In cool weather, or for long hauls, canvas covers and insulating of the truck bodies may be required. The inside of the truck body may be given a light coating of oil, lime slurry or other material satisfactory to the Engineer and the City, if necessary, to prevent mixture from adhering to the body.
2. Contractor shall provide automated ticket printout for each truckload of material where payment is determined by weight. Each loading ticket must show the ticket number, truck number, gross weight, tare weight, and net weight, per TxDOT Item 520.

D. Placing

1. Asphalt shall be applied when the air temperature is above 50° F and rising. Asphalt shall not be applied when the air temperature is 60° F and falling. In all cases, asphalt shall not be applied when the surface temperature is below 60° F. Generally, the asphaltic mixture shall be dumped and spread on the approved prepared surface with the specified spreading and finishing machine, in such manner that when properly compacted, the finished pavement will be smooth, of uniform density, and will meet the requirements of the typical cross-sections and the surface tests. During the application of asphaltic material, care shall be taken to prevent splattering of adjacent pavement, curb and gutter, and structures. When the asphaltic mixture is placed in a narrow strip along the edge of an existing pavement, or used to level up small areas of an existing pavement, or placed in small irregular areas where the use of a finishing machine is not practical, the finishing machine may be eliminated when authorized by the Engineer or the City, provided a satisfactory surface can be obtained by other approved methods.

E. Compacting

1. Rolling: The pavement shall be compressed thoroughly and uniformly with the specified roller and/or other approved rollers. Rolling with the three-wheel and tandem rollers shall start longitudinally at the sides and proceed toward the center of the pavement, overlapping on successive trips by at least half the width of the rear wheel. Alternate trips of the roller shall be slightly different in length. Rolling with pneumatic-tire roller shall be done as directed by the Engineer. Rolling shall be continued until no further compression can be obtained and all roller marks are eliminated. One (1) tandem roller, one (1) pneumatic-tire roller, and at least one (1) three-wheel roller, as specified above, shall be provided for each job. If the Contractor elects, he may substitute the three-axle tandem roller for the two-axle tandem roller and/or the three-wheel roller; but in no case shall less than three rollers be in use on each job. Additional rollers shall be provided if needed. The motion of the roller shall be slow enough at all times to avoid displacement of the mixture. If any displacement occurs, it shall be corrected at once by the use of rakes and of fresh mixtures where required. The roller shall not be allowed to stand on pavement which has not been fully compacted. To prevent adhesion of the surface mixture to the roller, the wheels shall be kept thoroughly moistened with water, but an excess of water will not be permitted. All rollers must be in good mechanical condition. Necessary precautions shall be taken to prevent the dropping of gasoline, oil, grease, or other foreign matter on the pavement, either when the



rollers are in operation or when standing. Regardless of the method used for compaction, all rolling to achieve specified density shall cease when the Hot Mix Asphaltic Mixture drops below 175°F (80°C).

2. In-Place Density: The Hot Mix Asphaltic mixture shall be tested daily at the project site for conformance to specification requirements. Unless directed otherwise by the Engineer or designated representative, a bag sample and a core or section will be obtained for each 2000 square yards or portion of paving each day, with a minimum of three bag samples and three cores for each day's paving.

Bag samples shall be taken during lay-down operations. The primary sampling point for the bag samples shall be from the windrow if a windrow elevator is used. If a windrow elevator is not used, the sample shall be taken from the middle of the paving machine hopper. Gradation, asphalt content and stability value of the hot mix asphaltic mixture shall be reported for each of the bag samples. The stability value reported for each of the bag samples shall be the average of three (3) tests per bag.

Pavement thickness and in-place density shall be determined from the field cores or sections. The average of all hot mix asphaltic concrete pavement core or section thicknesses shall meet the minimum thickness of 2.0". No individual core or section thickness deficiency may be greater than 0.2 inches. Pavement that does not meet the thickness specification shall be removed and replaced as outlined below. The in-place density tests are intended for compaction-control tests and will be tested according to Test Method Tex-207-F. The core or section densities shall average from 91.0% to 96.0% of the maximum theoretical density except that the minimum acceptable density of an individual sample is 89.0% or the maximum acceptable density of an individual sample is 97.0%. There will be no two consecutive cores or section densities below 91.0% or above 96.0%. Asphalt pavement represented by a density less than 89.0%, more than 97.0% or two consecutive densities less than 91.0% or greater than 96.0% shall be removed and replaced.

Any pavement to be removed and replaced will be removed and replaced from curb to curb or edge of asphalt to edge of asphalt at the contractor's expense. Additional density tests shall be used to delineate the limits of the in-place hot mix asphaltic pavement that does not meet the density specification and the results of the tests shall not be used in the calculation of the overall average density. Protocol to assess the area of asphalt pavement removal and replacement shall start between the failing density or two consecutive densities that are less than 91.0% and the next passing density to either side of the failing pavement. Additional cores or sections will be required to quantify the area of replacement back to an in-place density of 91.0%. Backscattering (nuclear densities) shall not be used to determine the actual density of asphaltic pavement.

Pavements with low-density results may be retested; but the pavement shall not receive any additional compactive effort.

Final acceptance of the pavements shall be the responsibility of the Engineer.

3. Hand-Tamping: The edges of the pavement along curbs, headers and similar structures, and all places not accessible to the roller or in such position as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.

F. Surface Tests

1. The surface of the pavement, after compaction, shall be smooth and true to the established line, grade, and cross-section, and when tested with a 10-foot straightedge placed parallel to the centerline of the roadway or tested by other equivalent and acceptable means, except as



provided herein, the maximum deviation shall not exceed 1/4-inch in 10-feet, and any point in the surface not meeting this requirement shall be corrected.

501.09 INSPECTION

- A. If the TxDOT Item 341 specification is used for furnishing and installing hot mix asphaltic concrete, then 1A inspection per TxDOT shall be required.
- B. If the TxDOT Item 3224 specification is used for furnishing and installing hot mix asphaltic concrete, then 1A and 1B inspection per TxDOT shall be required.

501.10 ROADS DAMAGED BY CONSTRUCTION

- A. The Contractor shall reconstruct existing asphalt paved roads which are damaged as a result of construction of this project at no additional cost to the City. Reconstruction shall consist of reconstructing the road to an "as new condition" to the existing pavement cross section. The Contractor may use existing base material, adding new base material as needed. Contractor shall compact and reshape road subgrade to existing grade. The subbase and base shall be compacted in accordance with these specifications. The Contractor shall install at least two (2) inches of hot-mix asphalt pavement in accordance with these specifications.

501.11 PAYMENT

- A. Payment for furnished and installed hot mix asphaltic concrete pavement shall be paid according to the unit price per square yard in the proper item of the Proposal and Bid Schedule.
- B. All work and materials to complete the hot mix asphaltic concrete shall be subsidiary to this item.

END OF SECTION



SECTION 500 – TRANSPORTATION SPECIFICATIONS

ITEM 502. ROADWAY EXCAVATION

502.1 SCOPE OF WORK

- A. This specification covers the requirements for shaping and finishing of all earthwork on the entire length of roadway, and approaches to same, in conformity with the required lines, grades and typical cross sections and in accordance with specification requirements herein outlined. Compaction shall conform to the method of "Density Control" and/or "Ordinary Compaction" as shown on the Plans and Specifications.

502.2 SUBMITTALS

- A. None required unless specifically called for in the Plans, Standards, or requested by the City or Engineer.

502.3 CONSTRUCTION METHODS

- A. All roadway excavation and corresponding embankment construction shall be performed as specified herein and in Section 503- EMBANKMENT, and the completed roadway shall conform to the established alignment, grades and cross sections. Construction of roadway excavation shall be in accordance with TxDOT Item 110 of the Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.
- B. All suitable excavated materials shall be utilized, insofar as practicable, in constructing the required roadway sections. Unsuitable roadway excavation and roadway excavation in excess of that needed for the construction of the roadway shall be disposed of outside the limits of the right-of-way. Unsuitable material encountered below subgrade elevation in roadway cuts, shall be removed and replaced, as directed by the Representative of the City with material from the roadway excavation or with other suitable material.
- C. During construction, the roadbed and ditches shall be maintained in such condition as to insure proper drainage at all times and ditches and channels shall be so constructed and maintained as to avoid damage to the roadway section. Soils with plasticity index (PI) of 20 or more shall be stabilized with an amount of lime adequate to reduce the PI to less than 20.

NOTE: ALL UNDERGROUND UTILITIES SHALL BE INSTALLED PRIOR TO ANY LIME TREATMENT OR FLEXIBLE BASE PLACEMENT.

NOTE: Blue-tops will be set on the center and crown of the streets or roads at every 50-foot station. These grade stakes will be to finished grade and visible for inspection before flexible base is applied.

502.4 PAYMENT

- A. No separate payment will be made for work performed in accordance with this specification. Select back fill shall be paid for according to the unit price per cubic yard according to the appropriate item, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION



SECTION 500 – TRANSPORTATION SPECIFICATIONS

ITEM 503. EMBANKMENT

503.1 SCOPE OF WORK

- A. This specification covers the requirements for the placement and compaction of all materials obtained from roadway, borrow, channel and structural excavation for utilization in the construction of roadway embankments, levees and dikes (berms).

503.2 SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including the source of the material, equipment and all other pertinent data to illustrate conformance to the specification found within.

503.3 MATERIALS

- A. Where fill material is required for embankment, the material shall conform to the following class:

Class A (Select Borrow) – Class A Borrow material shall consist of suitable granular material, free from vegetation or other objectionable matter and reasonable free from lumps of earth. When tested by standard TxDOT laboratory methods Tex-104-E, Tex-106-E and Tex-107-E, the Class A, Select Borrow shall meet the following requirements:

1. Liquid Limit shall not exceed 45.
2. Plasticity index shall not exceed 15.
3. Bar linear shrinkage shall not be less than 2.

503.4 CONSTRUCTION METHODS

- A. Construction of embankment shall be in accordance with this specification and TxDOT Item 132 of the Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.
- B. Prior to placing any embankment, all “Preparing Right of Way” operations shall have been completed on the excavation sources and areas over which the embankment is to be placed. Stump holes or other small excavations in the limits of the embankments shall be backfilled with suitable materials and thoroughly tamped by approved methods before commencing embankment construction. The surface of the ground, including plowed loosened ground or surface roughened by small washes or otherwise shall be restored to approximately its original slope by blading or other methods. Where indicated on the Plans, the ground surface thus prepared shall be compacted by sprinkling and rolling.
- C. Unless otherwise indicated on Plans, the surface of the ground of all unpaved areas other than rock which are to receive embankment shall be loosened by scarifying or plowing to a depth of not less than six (6) inches. The loosened material shall be recompacted with the new embankment as hereinafter specified.
- D. Where directed the surface of hillsides to receive embankment shall be loosened by scarifying or plowing to a depth of not less than six (6) inches, or cut into steps before embankment materials are placed. The embankment shall then be placed in layers, as hereinafter specified, beginning at the low side in part width layers and increasing the widths as the embankment is raised. The material which has been loosened shall be recompacted simultaneously with the embankment material placed at the same elevation.
- E. Where embankments are to be placed adjacent to or over existing roadbeds, the roadbed slopes shall be



plowed or scarified to a depth of not less than six (6) inches and the embankment built up in successive layers, as hereinafter specified, to the level of the old roadbed before its height is increased. Then, if directed, the top of the old roadbed shall be scarified and recompactd with the next layer of the new embankment. The total depth of the scarified and added material shall not exceed the permissible depth of layer.

- F. Trees, shrubs, roots, vegetation or other unsuitable materials shall not be placed in embankment.
- G. Except as otherwise required by the plans, all embankment shall be constructed in layers approximately parallel to the finished grade of the roadbed and unless otherwise specified, each layer shall be so constructed as to provide a uniform slope of ¼-inch per foot from the center line of the roadbed to the outside, except that on superelevated curves each layer shall be constructed to conform to the superelevation required by the governing standard.
- H. Embankments shall be constructed to the grade established by the Engineer or the City and completed embankments shall correspond to the general shape of the typical sections shown on the plans and each section of the embankment shall correspond to the detailed section or slopes established by the Engineer. After completion of the roadway, it shall be continuously maintained to its finished section and grade until the project is accepted.

503.5

EARTH EMBANKMENTS

- A. Earth embankments shall be defined as those composed principally of material other than rock, and shall be constructed of accepted material from approved sources.
- B. Except as otherwise specified, earth embankments shall be constructed in successive layers for the full width of the individual roadway cross section and in such lengths as are best suited to the sprinkling and compaction methods utilized.
- C. Layers of embankment may be formed by utilizing equipment (which will spread the material as it is dumped, or formed by being spread by blading or other acceptable methods from piles or windrows dumped from excavating or hauling equipment in such amounts that material is evenly distributed.)
- D. Minor quantities of rock encountered in constructing earth embankment shall be incorporated in the specified embankment layers, or may be placed in accordance with the requirements for the construction of rock embankments in the deeper fills within the limits of haul shown on the Plans, provided such placement of rock is not immediately adjacent to structures. Also, rock may be placed in the portions of embankments outside the limits of the completed roadbed width where the size of the rock prohibits their incorporation in the normal embankment layers.
- E. Each layer of embankment shall be uniform as to material, density and moisture content before beginning compaction. Where layers of unlike materials abut each other, each layer shall be feather edged for at least 100-feet or the material shall be so mixed as to prevent abrupt changes in the soil. No material placed in the embankment by dumping in a pile or windrow shall be incorporated in a layer in that position, but all such piles or windrows shall be moved by blading or similar methods. Clods or lumps of material shall be broken and the embankment material mixed by blading, harrowing, disking or similar methods to the end that a uniform material of uniform density is secured in each layer.
- F. Water required for sprinkling to bring the material to the moisture content necessary for maximum compaction shall be evenly applied and it shall be the responsibility of the Contractor to secure a uniform moisture content throughout the layer by such methods as may be necessary.
- G. In order to facilitate uniform wetting of the embankment material, the Contractor may apply water at the material source if the sequence and methods used are such as not to cause an undue waste of water. Such procedure shall be subject to the approval of the Representative of the City.
- H. All earth cuts, full width or part width cuts in side hill, which are not required to be excavated below



subgrade elevation for base and backfilled, shall be scarified to a uniform depth of at least six (6) inches below grade, and the material shall be mixed and reshaped by blading and then sprinkled and rolled in accordance with the requirements outlined above for earth embankments and to the same density as that required for the adjacent embankment.

- I. Compaction of embankments shall be obtained by the method hereinafter described as "Ordinary Compaction" or the method hereinafter described as the "Density Control" method.

503.6

ORDINARY COMPACTION (outside of Roadway Pavement)

- A. When the "Ordinary Compaction" method is specified, the following provisions shall govern: Each layer shall not exceed eight (8) inches of loose depth, and shall be compacted until there is no evidence of further compaction. Prior to and in conjunction with the rolling operation, each layer shall be brought to the moisture content ordered by the Representative of the City, and shall be kept leveled with suitable equipment to insure uniform compaction over the entire layer.

503.7

DENSITY CONTROL

- A. When the "Density Control" method compaction is specified, each layer shall be compacted to the required density by any method, type and size of equipment which will give the required compaction. The depth of layers, prior to compaction, shall depend upon the type of sprinkling and compacting equipment used. However, maximum depth 16-inches loose and 12-inches compacted shall not be exceeded unless approved by a representative of the City. Prior to and in conjunction with the rolling operation, each layer shall be brought to the moisture content necessary to obtain the required density and shall be kept leveled with suitable equipment to insure uniform compaction over the entire layer.
- C. For each layer of earth embankment and select material, it is the intent of this specification to provide the density as required in the table below, unless otherwise shown on the Plans.

Field Density Control Requirements

Description	Density	Moisture Control
	Tex-115-E	
PI≤15	≥98% Max. Dry Density	
15<PI≤35	98% ≤ Max. Dry Density ≤ 102%	≥ Optimum Moisture Content
PI>35	95% ≤ Max. Dry Density ≤ 100%	≥ Optimum Moisture Content

Field density determinations will be taken every 750 square yards of roadbed surface at the Contractor's expense.

- C. After each layer of earth embankment or select material is complete, tests will be required. If the material fails to meet the density specified, the course shall be reworked as necessary to obtain specified density. Such procedure shall be determined by, and subject to, the approval of the Representative of the City.
- D. The Representative of the City may order proof rolling to test the uniformity of compaction of the embankment layers. All irregularities, depressions, weak or soft spots which develop shall be corrected immediately by the Contractor at his expense.
- E. Should the subgrade, due to any reason or cause, lose the required stability, density or finish before the pavement structure is placed, it shall be recompacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent layer or granular material. Excessive loss of moisture shall be construed to exist when the subgrade soil moisture content is more than four (4) percent below the optimum for compaction ratio density.



503.8

ROCK EMBANKMENTS

- A. Rock Embankments shall be defined as those composed principally of rock, and shall be constructed of accepted material from approved sources.
- B. Except as otherwise specified, rock embankments normally shall be constructed in successive layers for the full width of the individual roadway cross section and of 18-inches or less in depth.
- C. The maximum dimension of any rock used in embankment shall be less than the depth of the embankment layer. All oversized rock which is otherwise suitable for construction shall be broken to the required dimensions and utilized in embankment construction where proposed by Plans.
- D. Unless otherwise provided, the upper or final layer of the embankment shall contain no stones larger than four (4) inches in their greatest dimension, and, insofar as such is available by selection from the excavation, shall be composed of material so graded that the density and uniformity of the surface layer may be secured by the methods and requirements as set forth for "Ordinary Compaction" or "Density Control" method.
- E. When the "Ordinary Compaction" method of compaction is specified, each embankment layer shall be rolled as directed, and where the embankment materials require, shall be sprinkled when and to the extent directed by the Representative of the City.
- F. When the "Density Control" method of compaction is specified, each layer shall be compacted to the required density as outlined for "Earth Embankment", except in those layers where rock will make density testing difficult, the Representative of the City may require the layer to be proof rolled to insure proper compaction.

503.9

AT CULVERTS AND BRIDGES

- A. Embankments adjacent to culverts and bridges which cannot be compacted by use of the blading and rolling equipment used in compacting and adjoining sections of embankment shall be compacted in the manner prescribed under Section 309- STRUCTURAL EXCAVATION and Section 304- TRENCHING, BACKFILLING AND COMPACTION.
- B. Embankments placed around spill-through type abutments, shall be constructed in six (6)-inch loose layers of uniform suitable material placed in such manner as to maintain approximately the same elevation on each side of the abutment, and all materials shall be mixed, wetted and compacted as specified above.
- C. As a general rule, embankment material placed adjacent to any portion of any structure and in the first two (2) layers above the top of any culvert or similar structure shall be an earth, free of any appreciable amount of gravel or stone particles more than four (4) inches in greatest dimension and of such gradation as to permit thorough compaction. When, in the opinion of the Representative of the City, such material is not readily available, the use of rock or gravel mixed with earth will be permitted, in which case no particles larger than 12-inches in greatest dimension and six (6) inches in least dimension may be used and the percentage of fines shall be sufficient to fill all voids and insure a uniform and thoroughly compacted mass of proper density.

503.10

SELECTION OF MATERIALS

- A. In addition to the requirements in the excavation items of the specifications covering the general selections and utilization of materials to improve the roadbed, embankments shall be constructed in proper sequence to receive the select material layers shown on the plans, with such modifications as may be directed by the Representative of the City. The layer of embankment immediately preceding the upper layer of select material shall be constructed to the proper section and grade within a tolerance of not more than 0.10 foot from the established section and grade when properly compacted and finished to receive the select material layer.



NOTE: ALL UNDERGROUND UTILITIES SHALL BE INSTALLED PRIOR TO ANY LIME TREATMENT OR FLEXIBLE BASE PLACEMENT.

NOTE: Bluetops will be set on the center, crown, and back of curb of the streets or roads every 50-foot station. These grade stakes will be to finished grade and visible for inspection before flexible base is applied.

503.11

PAYMENT

- A. No separate payment will be made for work performed in accordance with this specification, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION



SECTION 500 – TRANSPORTATION SPECIFICATIONS

ITEM 504. FLEXIBLE BASE (Crushed Stone)

504.1 SCOPE OF WORK

- A. This specification covers the requirements for the use of “Flexible Base (Crushed Stone)” for this project.

504.2 SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer for approval, technical product literature including binding material, additives, aggregate source, aggregate type, aggregate gradation and all other pertinent data to illustrate conformance to the specification found within.

504.3 GENERAL

- A. “Flexible Base (Crushed Stone)” shall consist of a foundation course for surface course or for other base courses; shall be composed of crusher-run broken stone; and shall be constructed as herein specified and as specified in TxDOT Item 247 of the Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges in one or more courses in conformity with the typical sections shown on Plans and to the lines and grades as established by the Plans.

504.4 MATERIAL

- A. The material shall be crushed and shall consist of durable particles of stone mixed with approved binding material. The material source shall be approved by the Representative of the City, and conform to the requirements as follows:
- B. When properly slaked and tested by standard Texas Department of Transportation laboratory methods, the flexible base material shall meet the following requirements:

C. Physical requirements

1. General. All types shall meet the physical requirements for the specified grade(s) as set forth in Table 1.

Additives, such as, but not limited to, lime, cement or fly ash, shall not be used to alter the soil constants or strengths shown in Table 1, unless otherwise shown on the Plans.

Unless otherwise shown on the Plans, the base material shall have a minimum Bar Linear Shrinkage of two (2) percent as determined by Test Method Tex-107-E, Part II.

2. The flexible base shall be:

- a. Type A. Type A material shall be crushed stone produced from oversized quarried aggregate, sized by crushing and produced from a naturally occurring single source. Crushed gravel or uncrushed gravel shall not be acceptable for Type A material. No blending of sources and/or additive materials will be allowed in Type A material.

- i. Grade 1 Grade 1 material shall be used in all new roadway construction or existing roadway reconstruction / rehabilitation.

- ii. Grade 2 Grade 2 material shall be used in all trench repair under existing roadways as specified in the applicable Construction Standards.



TABLE 1 – Type A, Grade 1
PHYSICAL REQUIREMENTS

Grade 1	
Triaxial Class 1: Min. compressive strength, psi: 45 at 0 psi lateral pressure and 175 at 15 psi lateral pressure	
Master Grading	
1- ³ / ₄ "	0
⁷ / ₈ "	10-35
³ / ₈ "	30-50
No. 4	45-65
No. 40	70-85

Grade 1	
Max LL.....	35
Max PI.....	10
Wet Ball Mill	
Max.....	40
Max increase in	
Passing	
No. 40.....	20

1. Gradation requirements are percent retained on square sieves.
2. When a magnesium soundness value is shown on the Plans the material will be tested in accordance with Test Method Tex-411-A.

Sieve Analysis	Tex-110-E
Moisture-Density Determination	Tex-113-E
Roadway Density	Tex-115-E
Wet Ball Mill	Tex-116-E
Triaxial Tests (Part I or II as selected by the Engineer)	Tex-117-E
Particle Count	Tex-460-A, Part I

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

TABLE 2 – Type A, Grade 2
PHYSICAL REQUIREMENTS

Grade 2	
Triaxial Class 1: Min. compressive strength, psi: 45 at 0 psi lateral pressure and 175 at 15 psi lateral pressure	
Master Grading	
1- ³ / ₄ "	0-10
⁷ / ₈ "	-
³ / ₈ "	-
No. 4	45-75
No. 40	60-85

Grade 2	
Max LL.....	40
Max PI.....	12
Wet Ball Mill	
Max.....	45
Max increase in	
passing	
No. 40.....	20

1. Gradation requirements are percent retained on square sieves.
2. When a magnesium soundness value is shown on the Plans the material will be tested in accordance with Test Method Tex-411-A.



Sieve Analysis	Tex-110-E
Moisture-Density Determination	Tex-113-E
Roadway Density	Tex-115-E
Wet Ball Mill	Tex-116-E
Triaxial Tests (Part I or II as selected by the Engineer)	Tex-117-E
Particle Count	Tex-460-A, Part I

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

504.5

TOLERANCES

- A. The limits establishing reasonably close conformity with the specified gradation and plasticity index are defined by the following:
- B. The City may accept the material, providing not more than two (2) out of 10 consecutive gradation tests performed are outside the specified limit on any individual or combination of sieves by no more than five (5) percent and where no two (2) consecutive tests are outside the specified limit.
- C. The City may accept the material providing not more than 2 out of 10 consecutive plasticity index samples tested are outside the specified limit by no more than two (2) points and where no two (2) consecutive tests are outside the specified limit.

504.6

CONSTRUCTION METHODS

- A. Preparation of Subgrade
 - 1. The roadbed shall be excavated and shaped in conformity with the typical sections, lines and grades as shown on the Plans. All unstable or otherwise objectionable material shall be removed from the subgrade and replaced with approved material. All holes, ruts and depressions shall be filled with approved material, and if required, the subgrade shall be thoroughly wetted with water and reshaped and rolled to the extent directed in order to place the subgrade in an acceptable condition to receive the base material. The surface of the subgrade shall be finished to line and grade as established and in conformity with the typical section shown on the Plans, and any deviation in excess of 1/2-inch in cross section and in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling. Sufficient subgrade shall be prepared in advance to insure satisfactory prosecution of work.
- B. First Course
 - 1. Immediately before placing the base material, the subgrade shall be checked as to conformity with grade and section.
 - 2. The material shall be delivered in approved vehicles of a uniform capacity and it shall be the charge of the Contractor that the required amount of specified material shall be delivered in each 100-foot station. Material deposited upon the subgrade shall be spread and shaped the same day unless otherwise directed by the City in writing. In the event inclement weather or other unforeseen circumstances render impractical the spreading of the material during the first 24-hour period, the material shall be scarified and spread as directed by the City. The material shall be sprinkled, if directed, and shall then be bladed, dragged and shaped to conform to typical sections as shown on the Plans. The base layer shall be constructed in lifts not exceeding six (6) inches compacted thickness with each course being of equal thickness. All areas and "nests" of segregated coarse or fine material shall be corrected or removed and



replaced with well graded material, as directed by the City.

3. The course shall be compacted by the method of compaction hereinafter specified as the "Density Control" method of compaction.
 - a. The course shall be sprinkled as required and compacted to the extent necessary to provide not less than the percent density as hereinafter specified under "Density". In addition to the requirements specified for density, the full depth of flexible base shown on the Plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section of flexible base is completed, density tests shall be taken every 750 square yards of roadbed surface or every 250 linear feet, whichever is the least. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical section shown on the Plans and to the established lines and grades. In that area on which pavement is to be placed, any deviation in excess of 1/4-inch in cross section and in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling. Should the base course, due to any reason or cause, lose the required stability, density and finish before the surfacing is complete, it shall be recompacted and refinished at the sole expense of the Contractor. The base material shall be placed at the optimum moisture contents to \pm 3%.

C. Succeeding Courses

1. Construction methods and testing shall be the same as prescribed for the first course.

D. Density

1. The "Density Control" method of compaction shall be used. Each course of flexible base shall be compacted to the percent density indicated below. The testing will be as outlined in TEX 113E. It is the intent of this specification to provide in that part of the base included in the flexbase section as shown on the Plans immediately below the finished surface of the roadway, not less than 100 percent of the density as determined by the compaction ratio method. Moisture is to be determined at the beginning and during compaction in accordance with TEX-103-E.

E. Curing

1. Cure the finished section until the moisture content is at least 2 percentage points below optimum or as directed before applying the next successive course or prime coat.

504.7

NOTES

- A. Invoices showing total amount of flexible base delivered to each street or road shall be furnished to the City before asphalt is applied.
- B. Bluetops will be set on the center, crown and back of curb of the streets or roads every 50-foot station or sufficient to maintain line and grade. These grade stakes will be to finished grade and visible for inspection before asphalt is applied.



504.8

PAYMENT

- A. Payment for furnished and installed flexible base shall be paid according to the unit price per square yard in the proper item of the Proposal and Bid Schedule.
- B. All work and materials to complete the installation of flexible base shall be subsidiary to this item.

END OF SECTION



SECTION 500 – TRANSPORTATION SPECIFICATIONS

ITEM 505. STRIPING

505.1 SCOPE OF WORK

- A. This specification covers the requirements for furnishing and installing pavement markings as shown on the Plans and specified within.

505.2 SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including material type, test data, and all other pertinent data to illustrate conformance to the specification found within.

505.3 MATERIALS

- A. Unless otherwise shown on the Plans, all permanent pavement markings shall be thermoplastic type materials that require heating to elevated temperatures for application in accordance with TxDOT Items 662, 666, 668, 672, 677, and 678 of the Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. They shall conform to Texas Department of Transportation Materials Specification D-9-8220. Each container of thermoplastic material shall be clearly marked to indicate the color, weight, type of material, Manufacturer's name and the lot/batch number.
- B. Work zone pavement markings shall be provided in accordance with TxDOT Item 662.
- C. Temporary pavement markings shall be provided in accordance with TxDOT DMS-8200, "Traffic Paint."

505.4 EQUIPMENT

- A. All equipment used to place pavement markings shall be maintained in a satisfactory condition. The equipment shall be able to place markings at a rate that will produce a uniform product meeting all the requirements set within TxDOT Item 666 of the Standard Specifications for Construction of Highways, Streets and Bridges. It shall be capable of placing linear markings up to eight (8) inches in width in a single pass and able to place a center line and no passing barrier line configuration of one (1) broken line with two (2) solid lines at the same time to the alignment and spacing shown on the Plans. Equipment shall be capable of placing lines with clean edges of a uniform cross section within a tolerance of $\frac{1}{8}$ of an inch per four (4) inches width of marking. It shall have an automatic cut-off device with manual operating capabilities to provide clean, reasonably square marking ends to the satisfaction of the Engineer or the City and provide a method of applying broken line in an approximate stripe-to-gap ratio of 10 to 30. The length of the stripe shall not be less than 10-feet or more than 10.5-feet. The total length of any stripe-gap cycle shall not be less than 39.5-feet or more than 40.5-feet. It shall provide a continuous mixing and agitation of the pavement marking material. The use of pans, aprons or similar appliances will not be permitted for longitudinal striping applications. Beads shall be applied by an automatic bead dispenser that is attached to the pavement marking equipment in such a manner that the beads are dispensed uniformly and almost instantly as the marking is placed on the pavement surface. The bead dispenser shall have an automatic cut-off control, synchronized with the cut-off of the pavement marking equipment. A hand held thermometer shall be kept on the project during the placement of pavement markings capable of measuring the temperature of the pavement marking material.

505.5 CONSTRUCTION METHODS

- A. Pavement marking shall be applied with an approximate stripe-to-gap ratio of 10 to 30 when the application is broken line striping. The length of the broken stripe shall not be less than 10-feet nor



more than 10.50-feet. The total length of any stripe-gap cycle shall not be less than 39.50-feet nor more than 40.50-feet.

- B. With prior approval from the City of Killeen, pavement markings may be placed on roadways open to traffic. When markings are to be placed under traffic, a minimum of interference to the operation of the traffic flow shall be maintained. Traffic control shall be maintained as shown on the approved Traffic Control Plan. All markings placed under open-traffic conditions shall be protected from traffic damage and disfigurement.
- C. The deviation rate in pavement marking alignment shall not exceed one (1) inch per 200-feet of roadway and the maximum deviation shall not exceed two (2) inches nor shall any abrupt deviations be acceptable.
- D. Markings shall have a uniform cross section. The density and quality of the markings shall be uniform throughout their thickness. The applied markings shall have no more than five (5) percent, by area, of holes or voids and shall be free of blisters.
- E. Markings shall be reflectorized both internally and externally. Glass beads shall be applied to the materials at a uniform rate sufficient to achieve uniform and distinctive retroflective characteristics when observed in accordance with Test Method Tex-828-B.
- F. Pavement markings that are not in alignment or sequence, as shown on the Plans or Standards, shall be removed and replaced at the sole expense of the Contractor.

505.6

SURFACE PREPARATION

- A. New Portland cement concrete surfaces shall be cleaned to remove curing membrane, dirt, grease, loose and/or flaking existing construction markings and other forms of contamination.
- B. Older Portland cement concrete surfaces and asphalt surfaces that exhibit loose and/or flaking existing markings shall be cleaned to remove all loose and flaking markings.
- C. All pavement on which pavement markings are to be placed shall be completely dry.

505.7

APPLICATION

- A. Unless otherwise shown on the Plans, Portland cement concrete surfaces and asphaltic surfaces that are three (3) years old or older shall be sealed by the use of paint type striping. The paint type markings shall be placed a minimum of two (2) and a maximum of 30 calendar days in advance of placing the thermoplastic type pavement markings. If the paint type markings become dirty for any reason prior to placing the thermoplastic type markings, they shall be cleaned by washing, brushing, compressed air or other means approved. The pavement and paint type marking shall both be thoroughly dry before any thermoplastic type markings are placed. The color of the paint type markings shall be the same as the thermoplastic type markings.
- B. Pavement markings shall not be applied when the temperature and moisture limitations are beyond the Manufacturer's recommendation. The minimum thickness for thermoplastic markings shall be 0.060-inches (60-mil) for edgeline markings and 0.090-inches (90-mil) for stop bars, legends, symbols, gore and centerline/no passing barrier line markings, when measured in accordance with Test Method Tex-854-B. The maximum thickness of all thermoplastic type markings shall be 0.180-inches (180 mil).
- C. All markings which do not meet the specifications found within or are not satisfactory to the striping plan, installation of the markings, or do not meet the requirements of the project, shall be removed and replaced at the sole expense of the Contractor. In the event that damage is done to the pavement surface in the replacement operation, the damage shall be corrected to the satisfaction of the City at the sole expense of the Contractor.



505.8

MEASUREMENT AND PAYMENT

- A. Payment for furnished and installed pavement markings shall be paid according to the unit price per linear foot in the proper item of the Proposal and Bid Schedule.
- B. All work and materials to complete the pavement markings shall be subsidiary to this item.

END OF SECTION



SECTION 500 – TRANSPORTATION SPECIFICATIONS

ITEM 506. LIME TREATMENT FOR MATERIALS IN PLACE

506.1 SCOPE OF WORK

- A. This specification covers the requirements for the preparation and treatment of the subgrade, existing subbase or existing base by pulverizing the existing materials; furnishing and applying lime; mixing; mellowing for a minimum of 12 hours and compacting the mixed material to the required depth and density. This item applies to treatment of natural ground, embankment or existing pavement structure and shall be constructed as specified herein and in conformity with the typical sections, lines and grades on the drawings or as directed by the Engineer or designated representative. If the type of lime to be placed is not indicated on the drawings, the Contractor shall use Type B, Commercial Lime Slurry or Type C quick lime pebbles for all applications on areas larger than 100 square feet (10 square meters).

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

506.2 SUBMITTALS

The submittal requirements of this specification item may include:

- A. Mix design information (TxDOT Item 260, "Lime Treatment (Road-Mixed)"),
- B. Type of lime and rate of lime application, and
- C. Equipment proposed for use in proof rolling, pulverizing, mixing, placement and compaction operations.

506.3 MATERIALS

- A. Lime.
1. The lime shall meet the requirements of TxDOT Item 260, "Lime Treatment (Road-Mixed)" for the type of lime specified in the drawings or as directed by the Engineer or designated representative.
 2. When Type B, Commercial Lime Slurry, is specified, the Contractor shall select the "Dry Solids" content to be used in the slurry prior to construction and shall notify the Engineer in writing 5 working days before changing the "Dry Solids" content.
 3. When dry placement of Type C quicklime pebbles are indicated on the Drawings or approved by the Engineer or designated representative, the pebbles shall conform to TxDOT Grade DS (TxDOT Item 264) and shall have a gradation suitable for dry placement.
 4. If lime is furnished in bags, each bag shall bear the manufacturer's certified weight (mass). Bags varying more than 5 percent from that weight (mass) may be rejected and the average weight (mass) of bags in any shipment, as shown by weighing 10 bags selected at random, shall not be less than the manufacturer's certified weight (mass).
- B. Water. The water shall meet the material requirements of TxDOT Item No. 204, "Sprinkling"
- C. Asphalt. The asphalt shall conform to the requirements of TxDOT Item No. 300, "Asphalts, Oils and Emulsions"



506.4

EQUIPMENT

- A. The pulverizing, mixing and proof rolling machinery, tools and equipment, which are necessary for the proper execution of the work, shall be approved by the Engineer or designated representative. The equipment shall be located on the project site prior to the initiation of construction operations.
- B. During the conduct of the Work all in-use machinery, tools and equipment shall be maintained in a satisfactory and workmanlike manner.
- C. Hydrated lime shall be stored and handled in closed, weatherproof containers up to the time that mixing is initiated to form a slurry for distribution on the areas to be treated. If storage bins are used, they shall be completely enclosed. Hydrated lime in bags shall be stored in weatherproof buildings with adequate protection from ground dampness.
- D. If lime is furnished in trucks, each truck shall have the weight (mass) of lime certified on public scales or the Contractor shall place a set of standard platform truck scales or hopper scales at a location approved by the Engineer or designated representative.

506.5

CONSTRUCTION METHODS

A. General

- 1. Prior to commencement of the work, all required erosion control and tree protection measures shall be in place and the utilities located and protected as specified in the City of Killeen Standard Contract Document Section 205, "Site Conditions" and Section 206 "Contractor Use of Premises". Construction equipment shall not be operated within the drip line of trees unless otherwise indicated on the drawings or directed by the Engineer or designated representative. Construction materials shall not be stockpiled under the canopies of trees. Excavation or embankment materials shall not be placed within the drip line of trees until appropriate tree wells are constructed.
- 2. The placement of lime shall not be allowed to adversely impact vegetation, drainageways or waterways, storm water inlets or overflow channels. Structures shall be screened, blocked or protected to prevent lime from entering any structure or waterway.
- 3. It is the primary requirement of this specification to secure a completed course of treated material, which contains a uniform lime mixture at the rate specified on the drawings or directed by the Engineer or designated representative, is free from loose or segregated areas, exhibits uniform density and moisture content, is well bound for its full depth and displays a smooth surface suitable for placement of subsequent courses. It shall be the responsibility of the Contractor to: regulate the sequence of his work, use the proper amount of lime, maintain the work and rework the courses as necessary to meet the above requirements.

B. Preparation of Subgrade or Existing Base.

- 1. Unless indicated otherwise on the drawings or directed otherwise by the Engineer or designated representative, the Contractor shall proof roll the roadbed/subgrade in accordance with TxDOT Item No. 216, "Proof Rolling" prior to pulverization or scarification of the existing material and/or subgrade. Any unstable or spongy subgrade areas identified by proof rolling shall be corrected either by additional re-working, drying and compaction, or by removal and replacement of unsuitable materials. When specifically directed by the Engineer or designated representative, the Contractor shall re-work the subgrade in accordance with TxDOT Item 251, "Reworking Base Courses".
- 2. Prior to treatment of existing material and/or subgrade the layer to be treated shall be constructed shaped to conform to the typical sections, lines and grades as indicated on the Drawings or as established by the Engineer or designated representative. This work shall be



done in accordance with the provisions of applicable bid items. When shown on the Drawings, any existing asphaltic concrete pavement shall be removed and the work will be paid for in accordance with the applicable bid items.

3. When the Contractor elects to use a cutting and pulverizing machine that will process the material to the specified depth, the Contractor will not be required to excavate to the secondary grade or windrow the material. This method will be permitted only if a machine is provided, which will insure that the material is cut uniformly to the proper depth and which has cutters that will plane the secondary grade to a uniform surface over the entire width of the cut. The machine shall provide a visible indication of the depth of cut at all times.
4. The material, either before or after lime is applied, shall be excavated to the secondary grade (i.e. proposed depth of lime treatment) and removed or windrowed to expose the secondary grade. The secondary grade shall be blue topped at the edge, 1/4 points and along the centerline at not more than 50-foot (15.25 meters) centers. Any wet or unstable materials, located below the secondary grade, shall be corrected, as directed by the Engineer or designated representative, by removing the unstable material or by scarifying, adding lime and compacting until uniform stability is attained.
5. The Contractor shall instruct their crews in the proper handling of lime to ensure that the workers and the public are adequately protected during lime handling and application operations.

C. Premixing Surface

When any material is uncovered during the premixing operation that exhibits properties different from the anticipated material, the Engineer or designated representative shall secure a sample of the material for appropriate testing to establish a suitable rate of lime application for the material.

D. Lime Application

The percentage of lime to be added by weight (mass) in pounds per square yard (kilograms per square meter) shall be as directed in this document or in accordance with the Lime mix design indicated on the Drawings and may be varied by the Engineer or designated representative if conditions warrant.

Unless otherwise approved by the Engineer or designated representative, the lime operation shall not be started when the air temperature is below 41°F (5°C) and falling, but may be started when the air temperature is above 35°F (2°C) and rising. The temperature will be taken in the shade and away from artificial heat.

Lime shall not be placed when weather conditions in the opinion of the Engineer or designated representative are unsuitable.

Lime shall only be applied to those areas that can be properly processed during the same working day.

The application and mixing of lime with the existing material shall be accomplished by the methods hereinafter described as "Dry Placement" or "Slurry Placement." Dry placement will only be permitted for small isolated areas as indicated on the drawings or as directed by the Engineer or designated representative. The minimum rate of lime solids application shall be seven (7) percent by weight (mass), unless indicated otherwise on the Drawings or as directed by the Engineer or designated representative.

Any lime exposed to the air for more than six (6) hours and any lime lost or damaged before application due to rain, wind or other cause will be rejected and replaced by the Contractor at its own expense.



1. Dry Placement

The lime shall be spread by a spreader approved by the Engineer or designated representative or by bag distribution at the rates shown on the Drawings or as directed by the Engineer or designated representative.

The lime shall be distributed at a uniform rate and in such manner as to reduce the scattering of lime by wind. Lime shall not be applied when the wind conditions, in the opinion of the Engineer or designated representative, are such that blowing lime becomes objectionable to adjacent property owners or dangerous to traffic. A motor grader will not be used to spread Type A Hydrated lime but may be used to spread Type C Quicklime Grade "DS" pebbles.

The material shall be sprinkled, as approved by the Engineer or designated representative, until the proper moisture content has been secured.

2. Slurry Placement

The lime shall be mixed with water in a mixer or trucks with approved distributors to form a slurry with a solids content approved by the Engineer or designated representative. Application of the slurry shall be attained by successive passes over a measured section of roadway until the proper moisture and lime content has been secured. The distributor truck shall be equipped with an agitator, which will keep the lime and water in a uniform mixture.

E. Mixing

The mixing procedure shall be the same for "Dry Placement" or "Slurry Placement" as herein described.

During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of 6 hours or more or to excessive loss due to washing or blowing will not be accepted and the area shall be retreated.

In addition to the above, when Type C Quicklime, Grade "DS", is used under "Dry Placing", the material and lime shall be mixed as thoroughly as possible at the time of the lime application. Sufficient moisture shall be added during the mixing to hydrate the quicklime. After mixing, and prior to compaction, the mixture of material, quicklime and water, shall be moist cured for two (2) to seven (7) days, as approved by the Engineer or designated representative. After curing, mixing shall continue until the material and lime are thoroughly blended to the satisfaction of the Engineer or designated representative.

The material and lime shall be thoroughly mixed by road pulverizer equipment approved by the Engineer or designated representative. The material and lime shall be brought to the proper moisture content and the mixing shall be continued until a homogeneous, friable mixture of material and lime is obtained. The lime-material mixture shall be free from all clods or lumps so that, when all non-slaking aggregates retained on the #4 (4.75 mm) sieve are removed, the remainder of the material shall meet the following pulverization requirements, when tested in accordance with TxDOT Test Method Tex-101-E, Part III:



	Percent
Minimum Passing the 1 3/4 inch (45 mm) Sieve	100
Minimum Passing the 3/4 inch (19 mm) Sieve	85
Minimum Passing the No. 4 (4.75 mm) Sieve	60

When the lime-material mixture satisfies the requirements above, the mixture shall be allowed to “mellow” for a minimum of 12 hours prior to the initiation of compaction.

F. Compaction

Prior to initiation of compaction, the material shall be aerated or sprinkled as necessary to provide the optimum moisture. The lime-conditioned materials shall then be shaped and uniformly compacted to the sections; lines and grades indicated on the drawings or as directed by the Engineer or designated representative. Compaction shall continue until the entire depth of mixture is uniformly compacted as shown on the Drawings, as specified herein, or as directed by the Engineer or designated representative.

When shown on the Drawings or approved by the Engineer or designated representative, multiple lifts will be permitted; however the 12-hour “mellowing” procedure is required for each lift. Individual lift thickness should not exceed 8 inches (200 mm).

The course shall be sprinkled as required and compacted to the extent necessary to provide the density specified below:

Description	Density, Percent
For lime-conditioned subgrade, existing subbase or existing base that will receive subsequent subbase or base courses.	Not less than 95% of ‘optimum density’ or as otherwise indicated on the drawings.
For lime-conditioned existing base that will receive surface courses	Not less than 98% of ‘optimum density’ or as otherwise indicated on the drawings.

Testing for the ‘optimum density’ used for compaction control shall conform to TxDOT Test Method Tex-115-E. In addition to the requirements specified for density, the full depth of the material indicated shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed and proof rolled in accordance with Specification Section No. 236S, in place compaction tests will be conducted, as necessary, by the Engineer or designated representative in accordance with TxDOT Test Method, Tex 115-E. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout the entire operation the shape of the course shall be maintained by blading and the surface upon completion shall be smooth and in conformity with the typical sections, lines and grades as shown on the Drawings or as established by the Engineer or designated representative.

If the lime-conditioned material, due to any reason or cause, loses the required stability, density and finish before the next course is placed, it shall be re-compacted and refinished at the sole expense of the Contractor.

G. Reworking a Section

When a section is reworked within 72 hours after completion of compaction, the Contractor shall rework the section to provide the required compaction. When a section is reworked more than 72



hours after completion of compaction, the Contractor shall add 25 percent of the original specified rate of lime application during the reworking operation.

Reworking shall include loosening, road mixing as approved by the Engineer or designated representative, compacting and finishing. When a section is reworked, a new optimum density will be determined from the reworked material in accordance with TxDOT Test Method Tex-115-E.

506.6

FINISHING, CURING AND PREPARATION FOR SURFACING

- A. After the final layer or course of the lime conditioned subgrade, subbase or base has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections indicated on the drawings. The completed section shall then be "finished off" by rolling with a pneumatic tire or other suitable roller, approved by the Engineer or designated representative, that is sufficiently light in loading to prevent hair cracking.
- B. The Contractor shall set blue tops at edges, 1/4 point, and along the centerline at not more than 50 foot (15.25 meter) spacing. The completed section shall be maintained in a moist cured condition for the time specified in the table below either by maintenance of moist conditions by water sprinkling or by the prevention of moisture loss due to drying by the addition of an asphalt prime coat as indicated on the drawings or as directed by the Engineer or designated representative at the rate of 0.05 to 0.20 gallons per square yard (0.2 to 0.9 liters per square meter) before further courses are added or any through traffic is permitted, unless otherwise directed by the Engineer or designated representative. Curing shall continue for a minimum of seven (7) days before further courses are added or traffic is permitted access, unless a shorter curing period is approved by the Engineer or designated representative.

Minimum Curing Requirements Before Placing Subsequent Courses

Untreated Material	Curing (Days)
PI ≤ 35	2
PI > 35	5

- C. If the drawings require the lime-conditioned material to be sealed or covered by other courses of material, the seal or other course shall be applied within 14 days after final mixing is completed, unless otherwise directed by the Engineer or designated representative. If the 14 day limit cannot be achieved because of insufficient strength gain or other problem with the lime-treated layer, the Contractor shall rework the section in accordance with Section 203S.5(G) above.

506.7

SAMPLING AND TESTING

- A. The lime-conditioned mixture shall be tested daily at the Project site for conformance to specification requirements. The Engineer or designated representative shall determine sample locations based on the Contractor's anticipated production. Each day's anticipated production shall be sectioned into three (3) equal, single-pass, sub-area lots. Each day's sample locations shall be equally distributed over the three (3) sub-areas. Also, no more than one location of the three (3) sub-areas is to be located in an irregular shaped area such as a cul-de-sac.
- B. When, in the opinion of the Engineer or designated representative, test results appear unrepresentative, additional testing may be authorized. Retesting due to failures or to resolve unrepresentative results will be at the expense of the Contractor and the results of the retesting shall be averaged with the results of the original testing. If the results of retesting indicate that the original testing was erroneous, the original test results will be discarded.
- C. The Engineer will obtain samples of completed work to conduct the following tests:

Testing Requirement

TxDOT Test Procedure



Optimum Moisture Density	Test Method Tex-115E
In-Place Density of Lime Conditioning	Test Method Tex 115-E
Thickness of Lime Conditioning	Test Method Tex-140-E & Tex-600-J
PI Reduction	Test Method Tex-106-E

The contractor shall repair areas disturbed while obtaining samples.

506.8

TOLERANCES

A. In-Place Density

The Work may be accepted provided no more than one (1) out of the most recent five (5) density tests performed is below the specified density, provided that the failing test is not more than 3 pounds per cubic foot (50 kilograms per cubic meter) below the specified density.

B. Dimensional

Areas of lime conditioning which do not meet the tolerances specified below will be delineated and shall be corrected to drawing dimensions by scarifying, remanipulating and recompacting the deficient areas at the Contractor's sole expense.

1. Thickness Requirements:

Under thickness shall not exceed ¾ inch (19 mm). Overthickness will be waived at no additional cost to the City.

2. Widths Requirements:

Roadway under width shall not exceed 6 inches (150 mm). Shoulder underwidth shall not exceed 3 inches (75 mm). If lime conditioning for both roadway and shoulder is constructed at the same time, the 6-inch (150-mm) underwidth tolerance shall apply. Overwidth will be waived at no additional cost to the City.

506.9

MEASUREMENT

A. Lime-conditioning of the type, grade and rate of application on the subgrade, existing subbase and existing base shall be measured by the square yard (square meter: 1 square yard equals 0.836 square meters) to neat lines as shown on the typical sections.

B. Reworking a section to provide the proper compaction shall be measured by the square yard (square meter: 1 square yard equals 0.836 square meters).

506.10

PAYMENT

A. Work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for as follows:

"Lime Treated Subgrade," "Lime Treated Existing Subbase" and "Lime Treated Existing Base" will be paid for at the unit bid price per square yard.

B. The unit bid prices shall include full compensation for: preparing the roadbed; furnishing all materials; all freight involved; public scales weighing charges or furnishing scales and labor involved in weighing the material; loosening, mixing, pulverizing, spreading, drying, furnishing and application of lime, sprinkling, rolling, shaping, proof rolling, maintenance and all manipulations, reworking, labor, equipment, fuels, tools and incidentals necessary to complete the work.



- C. Reworking a section shall include full compensation for: loosening lime treated layer, furnishing and application of additional lime, road mixing, sprinkling, rolling, shaping, proof rolling, maintenance and all manipulations, labor, equipment, fuels, tools and incidentals necessary to complete reworking.

END OF SECTION



SECTION 800 – CONCRETE SPECIFICATIONS

ITEM 801. CONCRETE STRUCTURES

801.1 SCOPE OF WORK

- A. This specification covers the requirements for the construction of all types of structures involving the use of structural concrete, except where the requirements are waived or revised by other governing specifications.
- B. All concrete structures shall be constructed in accordance with the design requirements and details shown on the Plans; in conformity with the pertinent provisions of the items contracted for; the incidental items referred to; and in conformity with the requirements herein.

801.2 SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including the type of concrete, concrete mix design, concrete type and Manufacturer of precast structures, a description of curing methods used, and all other pertinent data to illustrate conformance to the specification found within.

801.3 MATERIALS

A. Concrete

- 1. All concrete shall conform to the provisions of Section 802, CONCRETE FOR STRUCTURES. The class of concrete for each type of structure or unit shall be as specified on the Plans, or by pertinent governing specifications.

B. Expansion Joint Material

- 1. Preformed Fiber Material - Preformed fiber expansion joint material shall be one-half (½) inch or as shown on the Plans. At the Contractor's option, the material shall be one of the following types, unless otherwise noted on the Plans:
 - a. "Preformed Bituminous Fiber Material" shall meet the requirements of the Standard Specifications for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, ASTM Designation: D1751.
 - b. "Preformed Non-Bituminous Fiber Material": shall meet the requirements of the Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction ASTM Designation: D1751, except that the requirements pertaining to bitumen content, density and water absorption shall be voided.
- 2. Joint Sealing Material - Unless otherwise noted on the Plans, the sealer shall be synthetic polymer Sikaflex - ICSL or equivalent.
- 3. Asphalt Board - Asphalt Board shall consist of two liners of 0.016 inches asphalt impregnated paper, filler with a mastic mixture of asphalt and vegetable fiber and/or mineral filler. Boards shall be smooth, flat and sufficiently rigid to permit installation. When tested in accordance with Test Method Tex-524-C, the asphalt board shall not deflect from the horizontal more than one (1) inch in three and one half (3 ½) inches.
- 4. Rebonded Neoprene Filler - Rebonded neoprene filler shall consist of ground closed-cell neoprene particles, rebonded and molded into sheets of uniform thickness of the dimensions



shown on Plans.

Filler material shall meet the requirements of ASTM Designations: D1752 Type 1 where applicable.

- C. Expansion Joints - Joints and devices to provide for expansion and contraction shall be constructed as indicated herein or on the Plans.
- D. Placing Reinforcements - Reinforcement in concrete structures shall be placed carefully and accurately and rigidly supported as provided in the Section 807 - REINFORCING STEEL.
- E. Placing Concrete-General - The minimum temperature of all concrete at the time of placement shall not be less than 50°F.
- F. The consistency of the concrete as placed should allow the completion of all finishing operations without the addition of water to the surface. When conditions are such that additional moisture is needed for finishing, the required water shall be applied to the surface by Fog Spray Only, and shall be held to a minimum amount. Fog spray for this purpose may be applied with hand operated fogging equipment.
- G. The maximum time interval between the addition of cement to the batch, and the placing of concrete in the forms shall not exceed the following:

Air or Concrete Temperature	Maximum Time (Without Retarding Agent)	Maximum Time (With Retarding Agent)
Non-Agitated Concrete		
Up to 80° F	30 Minutes	45 Minutes
Over 80° F	15 Minutes	30 Minutes
Agitated Concrete		
90° F or above	45 Minutes	75 Minutes
Above 75° F to 89° F	60 Minutes	90 Minutes
75° F and below	90 Minutes	120 Minutes

- H. Upon completion of the final finish, interim curing will be required for slab concrete in bridge decks and top slabs of direct traffic culverts as follows:
 - 1. Unless otherwise shown on the Plans, Type 1 membrane curing compound (Resin Base Only) shall be applied to the slab surface.
- I. Required water curing shall begin as soon as it can be done without damaging the concrete finish.
- J. The Contractor shall notify the City two (2) days in advance before placing concrete in any unit of the structure to permit the inspection of forms, reinforcing steel placement, and other preparations. Concrete shall not be placed in any unit prior to the completion of form work and placement of reinforcement therein.
- K. Concrete mixing, placing and finishing shall be done in daylight, hours, unless adequate provisions are made to light the entire site of all operations.
- L. Concrete placement will not be permitted when impending weather conditions will impair the quality of the finished work. If rainfall should occur after placing operations are started, the Contractor shall provide ample coverage to protect the work. In case of drop in temperature, the provisions set forth in Section 801.4- PLACING CONCRETE IN COLD WEATHER shall apply.
- M. The sequence of placing concrete shall be as provided on the Plans or as required herein. The placing



shall be regulated so the pressures caused by the plastic concrete shall not exceed the loads used in the form design. Form design shall be the sole responsibility of the Contractor.

- N. The method of handling, placing, and consolidation of concrete shall minimize segregation and displacement of the reinforcement, and produce a uniformly dense and compact mass. Concrete shall not have a free fall of more than 5 feet, except in the case of thin walls such as in culverts. Any hardened concrete splatter ahead of the plastic concrete shall be removed.
- O. The method and equipment used to transport concrete to the forms shall be capable of maintaining the rate of placement approved by the City. Concrete may be transported by bucket, chutes, buggies, belt conveyors, pumps or other acceptable methods.
- P. Each part of the forms shall be filled by depositing concrete as near its final position as possible. The coarse aggregate shall be worked back from the face and the concrete forced under and around the reinforcement bars without displacing them. Depositing large quantities at one point and running or working it along the forms will not be allowed.
- Q. Concrete shall be deposited in the forms in layers of suitable depth but not more than 36-inches in thickness, unless otherwise directed by the City.
- R. The sequence of successive layers or adjacent portions of concrete shall be such that they can be vibrated into a homogeneous mass with the previously placed concrete without a cold joint. Not more than one hour shall elapse between adjacent or successive placements of concrete. Unauthorized construction joints shall be avoided by placing all concrete between the authorized joints in one continuous operation.
- S. An approved retarding agent shall be used to control stress cracks, and/or unauthorized cold joints in mass placements where differential settlement and/or setting time may induce stress cracking, such as on false work, in deep girder stems, etc.
- T. Openings in forms shall be provided, if needed, for the removal of laitance or foreign matter of any kind.
- U. All forms shall be wetted thoroughly before the concrete is placed therein.
- V. All concrete shall be well consolidated and the mortar flushed to the form surfaces by continuous working with immersion type vibrators. Vibrators which operate by attachment to forms or reinforcement will not be permitted, except on steel forms.
- W. The concrete shall be vibrated immediately after deposit. Prior to the beginning of work, a systematic spacing of the points of vibrations shall be established to insure complete consolidation and thorough working of the concrete around the reinforcement, embedded fixtures, and into the corners and angles of the forms. Immersion type vibrators shall be inserted vertically, at points 18 to 30-inches apart, and slowly withdrawn. The vibrator may be inserted in a sloping or horizontal position in shallow slabs. The entire depth of each lift shall be vibrated, allowing the vibrator to penetrate several inches into the preceding lift. Concrete along construction joints shall be thoroughly consolidated by operating the vibrator along and close to but not against the joint surface. The vibration shall continue until thorough consolidation, and complete embedment of reinforcement and fixtures is produced, but not long enough to cause segregation. Vibration may be supplemented by hand spading or rodding, if necessary, to insure the flushing of mortar to the surface of all forms.

801.4

PLACING CONCRETE IN COLD WEATHER

- A. Cast-in-Place Concrete - Concrete may be placed when the atmospheric temperature is not less than 35° F. Concrete shall not be placed in contact with any material coated with frost or having a temperature less than 32° F.
- B. Aggregates shall be free from ice, frost and frozen lumps. When required, in order to produce the



minimum specified concrete temperature, the aggregate and/or the water shall be heated uniformly, in accordance with the following:

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

- C. All concrete shall be effectively protected as follows:
1. The temperature of slab concrete of all unformed surfaces shall be maintained at 50° F or above for a period of 72 hours from time of placement and above 40° F for an additional 72 hours.
 2. The temperature at the surface of all concrete in bents, piers, culvert walls, retaining walls, parapets, wingwalls, bottom of slabs, and other similar formed concrete shall be maintained at 40° F or above for a period of 72 hours from time of placement.
 3. The temperature of all concrete, including the bottom slabs of culverts placed on or in the ground, shall be maintained above 32° F for a period of 72 hours from time of placement.
- D. Protection shall consist of providing additional covering, insulated forms or other means, and if necessary, supplementing such covering with artificial heating. Curing as specified under Section 801.10- CURING CONCRETE, shall be provided during this period until all requirements for curing have been satisfied.
- E. When impending weather conditions indicate the possibility of the need for such temperature protection, all necessary heating and covering material shall be on hand ready for use before permission is granted to begin placement.

801.5 PLACING CONCRETE IN HOT WEATHER

- A. When the temperature of the air is above 85° F, an approved retarding agent will be required in all concrete used in superstructures, top slabs of direct traffic culverts, and will be required in all cased drilled shafts regardless of temperature. No concrete will be placed any time the temperature of the concrete at placement, exceeds 90° F. Ice will be used to decrease the temperature of concrete. The general formula will be, five (5) pounds of ice per yard of concrete per degree of temperature drop.

801.6 PLACING CONCRETE IN WATER

- A. Concrete shall be deposited in water only when specified on the Plans or with written permission of the City. The forms, cofferdams or caissons shall be sufficiently tight to prevent any water current passing through the space in which the concrete is being deposited. Pumping will not be permitted during concrete placing, nor until it has set for at least 36 hours.
- B. The concrete shall be placed with a tremie, closed bottom-dump bucket, or other approved method, and shall not be permitted to fall freely through the water nor shall it be disturbed after it has been placed. Its surface shall be kept approximately level during placement
- C. The tremie shall consist of a water-tight tube 14-inches or less in diameter. It shall be constructed so that the bottom can be sealed and opened after it is in place and fully charged with concrete. It shall be supported so that it can be easily moved horizontally to cover all the work area and vertically to control the concrete flow.
- D. The placing operations shall be continuous until the work is complete.



C. The following methods are permitted for curing concrete subject to the restrictions and the following requirements for each method of curing.

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

a. Wet Mat - Cotton mats shall be used for this curing method. They shall be placed as soon as possible after the surface has sufficiently hardened to prevent damage to the concrete. Damp burlap blankets made from nine (9) ounce stock may be placed on the damp concrete surface for temporary protection prior to the application of the cotton mats which may be placed dry and wetted down after placement.

The mats shall be weighted down adequately to provide continuous contact with all concrete surfaces where possible. The surfaces of the concrete shall be kept wet for the required curing time. Surfaces which cannot be cured by contact shall be enclosed with mats, anchored positively to the forms, or to the ground, so that outside air cannot enter the enclosure. Sufficient moisture shall be provided inside the enclosure to keep all surfaces of the concrete wet.

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

c. Ponding - This method required the covering of the surfaces with a minimum of two (2) inches of clean granular material, kept wet at all times, or a minimum of one (1) inch depth of water. Satisfactory provisions shall be made to provide a dam to retain the water or saturated sand.

2. Membrane Curing - Unless otherwise provided herein or shown on the Plans, either Type 1-D or Type 2 membrane curing compound in accordance with TxDOT DMS-4650 may be used where permitted. Materials Safety Data Sheets (MSDS) shall be furnished and complied with for the handling and application of membrane curing compounds.

a. For substructure concrete, only one (1) type of curing compound will be permitted on any one (1) structure. (Material requirements and construction methods shall be as required by Section 806 - MEMBRANE CURING except as changed herein.) Membrane shall be applied in a single, uniform coating at the rate of coverage recommended by the Manufacturer and as approved by the City, but not less than one (1) gallon per 180 square feet of area. Tests for acceptance shall be at this specified rate.

b. Membrane curing shall not be applied to dry surfaces, but shall be applied just after free moisture has disappeared. Formed surfaces and surfaces which have been given a first rub shall be dampened and shall be moist at the time of applications of the membrane. Use mechanically powered pressure sprayers, either air or airless, with appropriate atomizing nozzles for the application of membrane curing.

c. When membrane is used for complete curing, the film shall remain unbroken for the minimum curing period specified. Membrane which is damaged shall be corrected immediately by reapplication of membrane. Unless otherwise noted herein or on the Plans, the choice of membrane type shall be at the option of the Contractor, except that the City may require the same curing method for like portions of a single structure.



801.12 REMOVAL OF FORMS AND FALSEWORK

- A. Except as herein provided, forms for vertical surfaces may be removed when the concrete has aged not less than one (1) day when Type I or Type II cement is used, and not less than one-half ($1/2$) day when Type III cement is used, provided it can be done without damage to the concrete.

801.13 DEFECTIVE WORK

- A. Any defective work discovered after the forms have been removed shall be repaired as soon as possible in accordance with Section 801.14- FINISHING EXPOSED SURFACES.
- B. If the surface of the concrete is bulged, uneven or shows excess honeycombing or form marks, which in the opinion of the City, cannot be repaired satisfactorily, the entire section shall be removed and replaced at the expense of the Contractor.

801.14 FINISHING EXPOSED SURFACES

- A. Ordinary Surface Finish - An Ordinary Surface Finish shall be applied to all concrete surfaces either as a final finish or preparatory to a higher grade or class of finish. Higher grades and classes of finish shall be in accordance with the Plans, Standards or Special Conditions. Where neither a grade nor class of finish is specified, and Ordinary Surface Finish, only, will be required.
- B. Ordinary Surface Finish shall be provided as follows:
1. After form removal, all porous or honeycombed areas and spalled areas shall be corrected by chipping away all loose or broken material to sound concrete.
 2. Featheredges shall be eliminated by cutting a face perpendicular to the surface. Shallow cavities shall be repaired using adhesive grout or epoxy grout. If judged repairable by the Engineer or the City, large defective areas shall be corrected using concrete or other material approved by the City.
 3. Holes and spalls caused by removal of metal ties, etc., shall be cleaned and filled with adhesive grout or epoxy grout. Exposed parts of metal chairs on surfaces to be finished by rubbing, shall be chipped out to a depth of one-half ($1/2$) inch and the surface repaired.
 4. All fins, runs, dips or mortar shall be removed from surfaces which remain exposed. Form marks and chamfer edges shall be smoothed by grinding and/or dry rubbing.

801.15 PAYMENT

- A. No separate payment shall be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Bid Schedule.

END OF SECTION



SECTION 800 – CONCRETE SPECIFICATIONS

ITEM 802. CONCRETE FOR STRUCTURES

802.1 SCOPE OF WORK

- A. This specification covers the requirements for concrete related materials used for the storing and handling of concrete related materials; and for the proportioning and mixing of concrete for bridges, culverts, pre-stressed concrete, and incidental concrete construction.

802.2 SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including the type of concrete, concrete mix design, concrete type and Manufacturer of precast structures, a description of curing methods used, and all other pertinent data to illustrate conformance to the specification found within.

802.3 GENERAL

- A. The concrete shall be composed of Portland cement, aggregates (fine and coarse), admixtures if desired or required, and water, proportioned and mixed as hereinafter provided.
1. Cement - The cement shall be either Type, I, II, or III Portland Cement conforming to ASTM Designation: C150
 2. Mortar (Grout) - Mortar for repair of concrete, shall consist of 1 part cement, two (2) parts finely graded sand, and enough water to make the mixture plastic. When required to prevent color difference, white cement shall be added to produce the color required. When required by the City, latex adhesive shall be added to the mortar.
 3. Admixtures - Calcium Chloride will not be permitted. Unless otherwise noted, Air-entraining, retarding and water reducing admixtures may be used in all concrete and shall conform to the requirements of the Standard Specification for Construction of Highways, Streets, and Bridges of the Texas Department of Transportation, latest edition.

802.4 CLASSIFICATION AND MIX DESIGN

- A. It shall be the responsibility of the Contractor to furnish the mix design, using a Coarse Aggregate Factor acceptable to the City, for the class(es) of concrete specified. The mix shall be designed by a qualified concrete technician to conform with the requirements contained herein and in accordance with current Texas Department of Transportation standards. The Contractor shall perform, at his own expense, the work required to substantiate the design. Complete concrete design data shall be submitted to the City for approval.
- B. It shall also be the responsibility of the Contractor to determine and measure the batch quantity of each ingredient, including all water, so that the mix conforms to these specifications and any other requirements shown on the Plans.
- C. In lieu of the above mix design responsibility, the Contractor may accept a design furnished by the City, however, this will not relieve him of providing concrete meeting the requirements of these specifications.

802.5 QUALITY OF CONCRETE, GENERAL

- A. The concrete shall be uniform and workable. The cement content, maximum allowable water cement ratio, the desired and maximum slump and the strength requirements of the various classes of concrete



shall conform to the requirements of Tables 1 - 4 and as required herein.

Table 1

Concrete Designation	Desired Slump	Max. Slump
Structural Concrete		
(1) All Drill Shaft	6	7
(2) Uncased Drilled Shafts, Thin-Walled Sections (9" or less), and Prestressed Concrete Members	4	5
(3) Slabs, Caps, Columns, Piers, Wall Sections Over 9", etc.	3	4
Underwater or Seal Concrete	6	7
Riprap, Curb, Gutter and Other Miscellaneous Concrete	As specified by City	

NOTE: NO CONCRETE WILL BE PERMITTED WITH SLUMP IN EXCESS OF THE MAXIMUMS SHOWN.

B. Coarse Aggregate

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

Unless otherwise shown on the Plans, coarse aggregate from each source will be subjected to five (5) cycles of both the sodium sulfate and the magnesium sulfate soundness test in accordance with Test Method

Tex-411-A. When the loss is greater than 12-percent with sodium sulfate and/or 18 percent with magnesium sulfate, further testing will be required prior to acceptance or rejection of the material. A satisfactory record under similar conditions of service and exposure will be considered in the evaluation of material failing to meet these requirements.

When tested in accordance with Test Method Tex-401-A, the coarse aggregate, including combinations of aggregates when used, shall conform to the gradation requirements shown in Table 2.



Table 2
COARSE AGGREGATE GRADATION CHART

Percent Retained on Each Sieve										
Aggregate Grade No.	Nominal Size in.	2-1/2 in.	2 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 8
1	2	0	0-20	15-50		60-80			95-100	
2 (467)*	1-1/2		0	0-5		30-65		70-90	95-100	
3	1-1/2		0	0-5		10-40	40-75		95-100	
4 (57)*	1			0	0-5		40-75		90-100	95-100
5 (67)*	1/4				0	0-10		45-80	90-100	95-100
6 (7)*	1/2					0	0-10	30-60	85-100	95-100
7	3/8						0	5-30	75-100	
8	3/8						0	0-5	35-80	90-100

* Numbers in parenthesis indicate that these gradations conform to corresponding ASTM gradation in ASTM C33.

C. Fine Aggregate

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

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

When tested in accordance with Test Method Tex-401-A, the fine aggregate or combinations of aggregates, including mineral filler shall conform to the gradation requirements shown in Table 3.

Table 3
FINE AGGREGATE GRADATION CHART

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

1. Where manufactured sand is used in lieu of natural sand, the percent retained on the No. 200 sieve shall be 94 to 100.
2. Where the sand equivalent value is greater than 85, the retainage on the No. 50 sieve may be 65 to 94 percent.
3. Fine aggregate will be subjected to the Sand Equivalent Test (Test Method Tex-203-F). The sand equivalent shall not be less than 80 unless otherwise shown on the Plans.
4. For all classes of concrete, except class K, the fineness modulus shall be between 2.30 and 3.10 as determined by Test Method Tex-402-A. The fineness modulus for class K shall be 2.6 to



2.8 unless otherwise shown on the Plans.

5. Air-entrain all concrete except for Class B in accordance with Table 5 unless otherwise shown on the plans. Use moderate exposure values unless otherwise specified. If the air content is more than 1½ percentage points below or 3 percentage points above the required air, the load of concrete will be rejected. If the air content is more than 1½ but less than 3 percentage points above the required air, the concrete may be accepted based on strength tests.

Table 4
SLUMP REQUIREMENTS

Class of Conc.	Sacks of Cement per C.Y.	Min. Comp Strength 28 (f'c) 28 Day psi	Min Beam Strength 7 Day	Max. Water Cement Ratio gal/sack	Coarse Aggr. No.
A	5.0	3000	425 390 (3)	6.5	1-2-3-4-8 (1) (4)
B	4.5	2500	300	8.0	2-3-4-5-6-7
C	6.0	3600	510	6.0	1-2-3-4-5-
D	3.0	1500	215	11.0	2-3-4-5-6-7
E	6.0	3000	425	6.0	2-3-4-5
S	6.5	4000	570 525 (3)	5.0	2-3-4-5
P	5.0	NA	555 (2)	6.25	2-3
DC	8.75	5500	720	3.6	6
CO	7.0	4600	640	4.5	6
SS	7.0	3600	510	5.5	3-4-5

Table 5
AIR ENTRAINMENT

Nominal Maximum Aggregate Size, in.	% Air ¹	
	Moderate Exposure	Severe Exposure
3/8 (Grades 7 & 8)	6.0	7.5
1/2 (Grade 6)	5.5	7.0
3/4 (Grade 5)	5.0	6.0
1 (Grade 4)	4.5	6.0
1½ (Grades 2 & 3)	4.5	5.5
2 (Grade 1)	4.0	5.0

¹ For specified concrete strengths above 5,000 psi, a reduction of 1 percentage point is permitted.

1. Grade 8 aggregate for use in extended course, unless a larger size is approved by the Engineer or City.
2. Minimum running average of concrete pavement.
3. When Type II or Type I / II is cement is used.



4. Unless otherwise permitted by the Engineer, Grade I coarse aggregate may only be used in massive foundations with four (4) inch minimum clear spacing between reinforcing steel bars. Grade I aggregate may not be used in Drill Shafts.

CLASS OF CONCRETE	TYPICAL USAGE
A	Drill Shafts, Culverts, (except top of slab of Direct Traffic Culverts), Inlets, Manholes, Headwalls, Approach Slabs, Curb, Gutter, Curb and Gutter, Concrete Retards, Sidewalks, Driveways, Concrete Pavement, Back-up Walls and Anchors.
B	Rip Rap, Small Roadside Signs, and Anchors
C	Drilled Shafts, Bridge Substructures, Bridge Railing, Culverts (except top of slab of Direct Traffic Culverts), Wing Walls, Approach Slabs, Concrete Traffic Barriers
D	Rip Rap
E	Seal Concrete
S	Bridge Slab, Top Slab of Direct Traffic Culvert, Bridge Sub-structure
P	Concrete Pavement
DC	Dense Concrete Overlay
CO	Concrete Overlay
SS	Slurry Displacement Shafts, Underwater Drill Shafts

802.6 MIXING CONDITIONS

- A. The concrete shall be mixed in quantities required for immediate use. Retempering of concrete will not be permitted.
- B. In threatening weather, which may result in conditions that will adversely affect quality of the concrete to be placed, the City may order postponement of the work. Where work has been started and changes in weather conditions require protective measures, the Contractor shall furnish adequate shelter to protect the concrete against damage from rainfall, or freezing temperatures. If necessary to continue operations during rainfall, the Contractor shall also provide protective coverings for the material stock piles. Aggregate stock piles need to be covered only to the extent necessary to control the moisture conditions in the aggregates to adequately control the consistency of the concrete.

802.7 PLACING, CURING AND FINISHING

- A. The placing of concrete, including construction of forms and falsework, curing and finishing, shall be in accordance with Section 801- CONCRETE STRUCTURES, and Section 801.14- FINISHING EXPOSED SURFACES.

802.8 TESTING

- A. Fresh Concrete.
1. Air Content. TEX-414-A or TEX-416-A
 2. Slump. TEX-415-A
 3. Temperature. TEX-422-A
 4. Making and Curing Strength Specimens. TEX-447-A



- B. Hardened Concrete. Only compressive strength testing will be used unless otherwise specified or shown on the plans.
1. Compressive Strength. TEX-418-A
 2. Flexural Strength. TEX-448-A
 3. Maturity. TEX-426-A

802.9

PAYMENT

- A. No separate payment shall be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION



SECTION 800 – CONCRETE SPECIFICATIONS

ITEM 803. CONCRETE RIPRAP

803.1

SCOPE OF WORK

- A. This specification covers the requirements for the furnishing and placing of riprap concrete of the type indicated on the Plans.
 - 1. Bar reinforcement shall conform to the requirements of Section 807- REINFORCING STEEL. Wire reinforcement shall consist of welded fabric meeting the requirements of the Section 807- REINFORCING STEEL.
- B. Pre-molded expansion joint material shall conform to the requirements of Section 801- CONCRETE STRUCTURES.

803.2

SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including concrete mix design, expansion joint material, curing method, and all other pertinent data to illustrate conformance to the specification found within.

803.3

CONSTRUCTION METHODS

- A. The slopes and other areas to be protected shall be dressed to the line and grade shown on the Plans prior to the placing of riprap.

803.4

CONCRETE RIPRAP

- A. Concrete for riprap shall be placed in accordance with the details and to the dimensions shown on the Plans or as established by the City. Unless otherwise shown by a note on the Plans, concrete riprap shall be reinforced using wire or bar reinforcement.
- B. The class of concrete shall be "Class B", and shall be in accordance with Section 802- CONCRETE FOR STRUCTURES.
- C. If wire reinforcement is used, it shall be a six-inch by six-inch (6" x 6") No. 6 plain electric welded reinforcing fabric or its equal. A minimum lap of six (6) inches shall be used at all splices. At the edge of the riprap, the wire fabric shall not be less than one (1) inch or more than three (3) inches from the edge of the concrete and shall have no wires projecting beyond the last member parallel to the edge of the concrete.
- D. If bar reinforcement is used, the sectional area of steel in each direction shall not be less than the sectional area of the wire fabric described above. The spacing of bar reinforcement shall not exceed 18-inches in each direction and the distance from the edge of concrete to the first parallel bar shall not exceed six (6) inches.
- E. Reinforcement shall be supported properly throughout the placement to maintain in position approximately equidistant from the top and bottom surface of the slab.
- F. If the slopes and/or bottom of the trench for tow walls are dry and not consolidated properly, the City may require the entire area to be sprinkled, or sprinkled and consolidated before the concrete is placed. All surfaces shall be moist when concrete is placed.



- G. After the concrete has been placed, compacted and shaped to conform to the dimensions shown on the Plans, and after it has set sufficiently to avoid slumping, the surface shall be finished with a wooden float to secure a reasonably smooth surface. The concrete shall require a broomed finish in areas of pedestrian traffic.
- H. Immediately following the finishing operation the riprap shall be cured in accordance with Section 801-CONCRETE STRUCTURES.

803.5

PAYMENT

- A. Payment for concrete riprap shall be according to the square yard unit price of concrete placed as shown in the Plans or details. All work and materials involved in preparing forming reinforcing, finishing, etc. shall be subsidiary to the bid item.

END OF SECTION



SECTION 800 – CONCRETE SPECIFICATIONS

ITEM 804. CONCRETE CURB AND GUTTER

804.1 SCOPE OF WORK

- A. This specification covers the requirements for constructing concrete curb and gutter as shown on the Plans and specified herein.

804.2 SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including concrete mix design, expansion joint material, curing method, and all other pertinent data to illustrate conformance to the specification found within.

804.3 GENERAL

- A. "Concrete Curb and Gutter" shall consist of Portland cement combined concrete curb and gutter or separate concrete approved subgrade or foundation material in accordance with these specifications, in conformity with the lines and grades and details shown on the Plans.

804.4 MATERIALS

- A. Unless otherwise specified on the Plans, materials and proportions for concrete used in construction under this item shall conform to the requirements as specified for Class "A" concrete under Section 802- CONCRETE FOR STRUCTURES. Reinforcing steel shall conform to the requirements as specified in Section 807- REINFORCING STEEL. Expansion joint filler shall be pre-molded material meeting the requirements specified in Section 801- CONCRETE STRUCTURES.

804.5 EQUIPMENT

- A. If either, required by the Plans or Details, requested by the City or chosen by the Contractor, the curb and gutter shall be machine laid by an extrusion machine approved by the City. When machine laid curb and gutter is used for a project, the line for the top of curb shall be maintained from a guideline set by the Contractor from survey points as established by the Plans, details or contract. The forming tube of the extrusion machine shall be readily adjustable vertically during the forward motion of the machine, to provide the required variable height of the curb and gutter necessary to conform to the established gradeline. In order to provide a continual monitor to the proposed grade of the curb and gutter, a pointer or gauge shall be attached to the machine in such a manner that a comparison can be made between the curb and the guideline. Other methods may be used if prior approval is granted by the City.

804.6 CONSTRUCTION METHODS

- A. The subgrade or foundation shall be excavated and shaped to line, grade and cross section, and, if considered necessary in the opinion of the City, hand tamped and sprinkled. If dry, the subgrade or foundation material shall be sprinkled lightly immediately before concrete is deposited thereon.
- B. Outside forms shall be of wood or metal, of a section satisfactory to the City, straight, free of warp and of a depth equal to the depth of the curb and gutter. They shall be securely staked to line and grade, and maintained in a true position during the depositing of concrete. Inside forms for the curb shall be of approved material, shall be of such design as to provide the curb required and shall be rigidly attached to the outside forms. Where specifically permitted by the City in writing, the Contractor may place concrete curb and gutter with an extrusion machine.
- C. The reinforcing steel shall be placed in position as shown on the typical sections. Care shall be exercised to keep all steel in its proper locations. New curb and gutter shall be doweled into existing curb and gutter, where applicable.



- D. Concrete for curb and gutter shall be mixed in a manner satisfactory to the City. The curb and gutter shall be poured in sections of the length indicated on the Plans, and each section shall be separated by a pre-molded or board joint of cross section specified of the curb and gutter and of the thickness indicated on the Plans. In the event the curb and gutter is placed by an extrusion machine the approved mix shall be fed into the machine in such a manner and consistency that the finished curb and gutter will present a well compacted mass with a surface free from voids and honeycombs. It shall be true to the established shape, line and grade. Any additional surface finishing specified and/or required shall be performed immediately after extrusion.
- E. After the concrete has been struck off and after it has become sufficiently set, the exposed surfaces shall be thoroughly worked with a wooden float. The exposed edges shall be rounded by the use of an edging tool to the radius indicated on Plans. Unless specified otherwise on the Plans, when the concrete in the curb and gutter has become sufficiently set, the inside form shall be carefully removed and the surface shall be plastered with a mortar consisting of one part of Portland cement and two (2) parts fine aggregate. The mortar shall be applied with a template or "mule" made to conform to curb and gutter dimensions as shown on the Plans. All exposed surfaces of curb and gutter, or gutter, shall be brushed to a smooth and uniform surface.
- F. The completed curb and gutter shall be cured in accordance with the requirements of Section 806- MEMBRANE CURING, Type 2, white pigmented, unless shown otherwise on the Plans. Other methods of curing as outlined in Section 801- CONCRETE STRUCTURES will be acceptable with a required curing period of 72 hours.
- G. The curb and gutter shall be backfilled, to the full height of the concrete, tamped and sloped as directed. The curb shall not be backfilled until proper curing time has elapsed to prevent structural damage to the curb.
- H. Any damage to the curb or gutter shall be replaced or repaired at the option of the Engineer or the City at the sole expense of the Contractor.

804.7

PAYMENT

- A. Payment for furnished and installed concrete curb and gutter shall be paid according to the unit price per linear foot in the proper item of the Proposal and Bid Schedule. All work and materials to complete the concrete curb and gutter shall be subsidiary to this bid item.

END OF SECTION



SECTION 800 – CONCRETE SPECIFICATIONS

ITEM 805. CONCRETE SIDEWALKS, DRIVEWAYS AND FLATWORK

805.1 SCOPE OF WORK

- A. This specification covers the requirements for the construction of sidewalks and driveways on an approved subgrade with or without reinforcing steel, composed of Portland cement concrete, in conformity with the lines and grades established by the Engineer, and the details shown on the Plans.

805.2 SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer for approval, technical product literature including concrete mix design, expansion joint material, curing method, and all other pertinent data to illustrate conformance to the specification found within. TDLR approvals shall be submitted by the Engineer of Record.

805.3 MATERIALS

- A. Materials and proportions used in construction under this item shall conform to the requirements as specified for Class "A" Concrete under Section 802- CONCRETE FOR STRUCTURES unless otherwise shown on the Plans. Reinforcing steel, if required, shall conform to the requirements as specified in Section 807- REINFORCING STEEL. Expansion joint filler shall be pre-molded material meeting the requirements specified in Section 801- CONCRETE STRUCTURES.

805.4 CONSTRUCTION METHODS

- A. The subgrade shall be excavated and shaped to line, grade and cross section and if considered necessary in the opinion of the City hand tamped and sprinkled. The subgrade shall be moist at the time the concrete is placed.
- B. Forms shall be of wood or metal, of a section satisfactory to the City, straight, free from warp, and of a depth equal to the thickness of the finished work. They shall be securely staked to line and grade and maintained in a true position during the depositing of concrete.
- C. The reinforcing steel, if required, shall be placed in position as shown on the Plans. Care shall be exercised to keep all steel in its proper locations.
- D. Sidewalks shall be constructed in sections of the lengths shown on the Plans. The different sections shall be separated by a pre-molded or board joint of the thickness shown on the Plans, placed vertically and at right angles to the longitudinal axis of the sidewalk. Where the sidewalk or driveways abut a curb or retaining wall, approved expansion material shall be placed along their entire length. Similar expansion material shall be placed around all blockouts and obstructions protruding through sidewalks or driveways.
- E. Concrete shall be mixed in a manner satisfactory to the City, placed in the forms to the depth specified and shaped and tamped until thoroughly compacted and mortar entirely covers the surface. The top surface shall be finished with a wooden float to a rough texture. The outer edges and joints shall then be finished with approved tools to the radii shown on the Plans.
- F. Sidewalks shall be marked into separate sections, each four (4) feet in length, by the use of approved jointing tools.
- G. Sidewalks may be placed with Fibrous Concrete in lieu of reinforced concrete. All concrete for Fibrous Concrete shall conform to the requirements of Section 802- CONCRETE FOR STRUCTURES. Unless otherwise shown on the Plans the concrete shall be Class "A" as shown in Table 3 in Section 802-



CONCRETE FOR STRUCTURES. Reinforcing shall be 100% virgin polypropylene fibrillated fibers specially manufactured for use as concrete reinforcement and meeting the requirements of ASTM C-1116. The fibrous material shall not contain reprocessed olefia. Each container of fibrous material shall bear the Manufacturer's name and its trademark and the net weight of fibrous material in the package. The specific gravity of the fibrous material shall be 0.91 plus or minus 0.05. The lengths of fibrous material shall be $\frac{1}{2}$, $\frac{1}{4}$, $1\frac{1}{2}$, and 2 inches in length. Each cubic yard of concrete shall contain no less than 1.5 pounds of fibrous material unless otherwise shown on the Plans. The fibrous material shall be added to the concrete mix at the time the mix is batched.

805.5

PAYMENT

- A. Payment for work performed in accordance with this section of the specifications shall be made at the unit bid price per square yard under the proper items of the Bid Schedule.

END OF SECTION



SECTION 800 – CONCRETE SPECIFICATIONS

ITEM 806. MEMBRANE CURING

806.1 **SCOPE OF WORK**

- A. This specification covers the requirements for curing concrete pavement, concrete pavement (base), curbs, curb and gutters, retards, sidewalks, driveways, medians, islands, concrete riprap, cement stabilized riprap, concrete structures and other concrete as indicated on the plans by impervious membrane method.

806.2 **SUBMITTALS**

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including the type of membrane curing, the Manufacturer of the method used, a description of the water retention test to be used, and all other pertinent data to illustrate conformance to the specification found within.

806.3 **MATERIALS**

- A. The membrane curing compound shall comply with the “Standard Specification for Liquid Membrane-forming Compounds for Curing Concrete”, ASTM Designation: C 309, Type 1-D clear or translucent, or Type 2 white pigmented in accordance with TxDOT DMS-4650. The material shall have a minimum flash point of 80° F when tested by the “Pensky-Martin Closed Cup Method”.
- B. It shall be of such consistency that it can be satisfactorily applied as a fine mist through an atomizing nozzle by means of approved pressure spraying equipment at atmospheric temperatures above 40° F.
- C. It shall be of such nature that it will not produce permanent discoloration of concrete surfaces nor react deleteriously with the concrete or its components. Type 1-D compound shall contain a fugitive dye that will be distinctly visible for not less than four (4) hours or more than seven (7) days after application.
- D. The compound shall produce a firm, continuous, uniform moisture impermeable film free from pinholes and shall adhere satisfactorily to the surfaces of damp concrete. It shall, when applied to the damp concrete surface at the rate of coverage specified herein, dry to touch in not more than four (4) hours and shall adhere in a tenacious film without running off or appreciably sagging. It shall not disintegrate, check, peel or crack during the required curing period.
- E. The compound shall not peel or pick up under traffic and shall disappear from the surface of the concrete by gradual disintegration.
- F. The compound shall be delivered to the job only in the Manufacturer’s original containers, which shall be clearly labeled with the Manufacturer’s name, the trade name of the material, and a batch number or symbol with which test samples may be correlated.
- G. The water retention test shall be in accordance with Test Method Tex-219-F. Percentage loss shall be defined as the water lost after the application of the curing material was applied. The permissible percentage moisture loss (at the rate of coverage specified herein) shall not exceed the following:

24 hours after application.....2 percent
72 hours after application.....4 percent

806.4 **CONSTRUCTION METHODS**

- A. The membrane curing compound shall be applied after the surface finishing has been completed, and



immediately after the free surface moisture has disappeared. The surface shall be sealed with a single uniform coating of the specified type of curing compound applied at the rate of coverage recommended by the Manufacturer and directed by the City, but not less than one (1) gallon per 180 square feet of area. The Contractor shall provide satisfactory means and facilities to properly control and check the rate of applications of the compound.

- B. The compound shall be thoroughly agitated during its use and shall be applied by means of approved mechanical power pressure sprayers. The sprayers used to apply the membrane to concrete pavement or concrete pavement (base) shall travel at uniform speed along the forms and be mechanically driven. The equipment shall be of such design that it will insure uniform and even application of the membrane material. The sprayers shall be equipped with satisfactory atomizing nozzles. Only on small miscellaneous items will the Contractor be permitted to use hand powered spray equipment. For all spraying equipment, the Contractor shall provide facilities to prevent the loss of the compound between the nozzle and the concrete surface during the spraying operations.
- C. The compounds shall not be applied to a dry surface and if the surface of the concrete has become dry, it shall be thoroughly moistened prior to application of membrane by fogging or mist application. Sprinkling or coarse spraying will not be allowed.
- D. At locations where the coating shows discontinuities, pinholes, or other defects; or if rain falls on the newly-coated surface before the film has dried sufficiently to resist damage, an additional coat of the compound shall be applied immediately at the same rate of coverage specified herein.
- E. To insure proper coverage, the City shall inspect all treated areas after application of the compound for the period of time designated in the governing specification for curing, either of membrane curing or for other methods. Dry areas are identifiable because of the lighter color of dry concrete as compared to damp concrete. All suspected areas shall be tested by placing a few drops of water on the suspected areas. If the water stands in rounded beads or small pools which can be blown along the surface of the concrete without wetting the surface, the water-impervious film is present. If the water wets the surface of the concrete as determined by obvious darkening of the surface, or by visible soaking into the surface, no water-impervious film is present. Should the foregoing test indicate that any area during the curing period is not protected by the required water-impervious film, additional coat or coats of the compound shall be applied immediately, and the rate of application of the membrane compound shall be increased until all areas are uniformly covered by the required water-impervious film.
- F. When temperatures are such as to warrant protection against freezing, curing by this method shall be supplemented with an approved insulating material capable of protecting the concrete for the specified curing period.
- G. If at any time there is reason to believe that this method of curing is unsatisfactory or is detrimental to the work, the Contractor, when notified, shall immediately cease the use of this method and shall change to curing by one (1) of the other methods specified under this contract.

806.5

PAYMENT

- A. No separate payment shall be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION



SECTION 800 – CONCRETE SPECIFICATIONS

ITEM 807. REINFORCING STEEL

807.1 SCOPE OF WORK

- A. This specification covers the requirements for the furnishing and placing of reinforcing steel, deformed and smooth, of the size and quantity designated on the Plans and in accordance with these specifications.

807.2 SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including the type of steel, mill test results, cut list as required by Contract, Plans or Details, type and Manufacturer of spacers and/or chairs, and all other pertinent data to illustrate conformance to the specification found within.

807.3 MATERIALS

- A. Unless otherwise designated on the Plans, all bar reinforcement shall be deformed, and shall conform to one of the following:

1. ASTM A 615, Grades 40 or 60 open hearth, basic oxygen, or electric furnace new billet steel.
2. ASTM A617, Grades 40 or 60, axle steel.
3. ASTM A616, Grade 60, rail steel will be permitted in concrete pavement only. ASTM A616 bars shall be furnished as straight bars only and bending is prohibited. Bend tests will not be required.
4. ASTM A706, Grade 60, weldable reinforcing steel.
5. Smooth Bars for concrete pavement shall have a minimum yield strength of 60 ksi.

All other smooth bars, larger than No. 4, may be steel conforming to the above or may be furnished in any steel that meets the physical requirements of ASTM A36.

6. Spiral reinforcement shall be in accordance with TxDOT Item 440 of the Standards Specifications for Construction of Highways, Streets and Bridges and be either smooth or deformed bars, or wire, of the minimum size or gage shown on the plans, or as specified herein.

Bars for spiral reinforcement shall comply with ASTM A675, Grade 80 (reference to ASTM A29 is voided) A615 or A617, Grade 40, unless otherwise shown on the plans. Smooth wire shall comply with ASTM A82 and deformed wire shall comply with ASTM A496.

7. Wire for fabric reinforcement shall be in accordance with TxDOT Item 440 of the Standard Specifications for Construction of Highways, Streets and Bridges and conform to ASTM A82 or A496. Wire fabric shall conform to ASTM A185 or A497.
8. Epoxy coating material and the material used for the repair of the coating shall be in accordance with TxDOT Item 440 of the Standard Specifications for Construction of Highways, Streets and Bridges.



807.4

BENDING

- A. The reinforcement shall be bent cold, true to the shapes shown on the plans. Fabrication shall preferably be done in the shop. Field fabrication, if permitted, shall be done with equipment approved by the Engineer. Misfabricated, damaged or broken bars shall be rejected and replaced at the Contractor's expense. Damaged or broken bars imbedded in a previous concrete placement may be repaired with the approval of the Engineer. The inside diameter, unless otherwise shown on the plans, shall be in accordance with TxDOT Item 440 of the Standard Specifications for Construction of Highways, Streets and Bridges.

807.5

TOLERANCES

- A. Fabricating tolerances for bars, from plan dimensions, shall not be greater than shown in Figure 1 of TxDOT Item 440 of the Standard Specifications for Construction of Highways, Streets and Bridges.

807.6

STORING

- A. Steel reinforcement shall be stored above the surface of the ground upon platforms, skids, or other supports and shall be protected as far as practical from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, paint, grease, oil, or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum dimensions, cross-sectional area and tensile properties of a hand wire brushed specimen meets the physical requirements for the size and grade of steel specified.

807.7

SPLICES

- A. The splicing of bars, except when provided on the Plans, or specified herein, will not be permitted without written approval of the City.
- B. Splices not provided for on the plans will be permitted in slabs 15 inches or less in thickness, columns, walls and parapets, but will not be included for measurement, and subject to the following:
- C. Unless otherwise approved by the City, splices will not be permitted in bars 30 feet or less in plan length. For bars exceeding 30 feet in plans length, the distance center to center of splices shall not be less than 30 feet minus one splice length, with no more than one individual bar length less than 10 feet. Lap splices no shown on the plans, but permitted herein, shall be made in accordance with Table 1. The specified concrete cover and proper spacing shall be maintained at such splices and the lap spliced bars placed in contact and securely tied together.

Table 1 – Minimum Lap Requirements for Bar Sizes Through No. 11

SIZE	LAP LENGTH	
	UNCOATED	COATED
No. 3	1'-0"	1'-6"
No. 4	1'-6"	2'-3"
No. 5	1'-10"	2'-9"
No. 6	2'-3"	3'-4"
No. 7	3'-0"	4'-6"
No. 8	3'-9"	5'-7"
No. 9	4'-8"	7'-0"
No. 10	5'-7"	8'-4"
No. 11	6'-7"	9'-10"

Spiral steel shall be lapped a minimum of one turn. Bar sizes No. 14 and No. 18 may not be lapped.

- D. Welded splices shall conform to the requirements of the plans and TxDOT Item 448, "Structural Field



Welding”, of the Standard Specifications for Construction of Highways, Streets and Bridges. End preparation for butt welding reinforcing bars shall be done in the field. Delivered bars shall be of sufficient length to permit weld preparation.

- E. Welded wire fabric shall be spliced using a lap length that will include the overlap of a minimum of two (2) cross wires plus two (2) inches on each sheet or roll. Splices using bars which develop equivalent strength and lapped in accordance with Table 1 will be permitted.
- F. For box culvert extensions with less than one (1) foot of fill, the existing longitudinal bars shall have a lap with the new bars as shown in Table 1. For extensions with more than one (1) foot of fill, a minimum of six (6) inch lap will be required.

807.8

MECHANICAL COUPLERS

- A. When shown on the plans, or approved by the City, mechanical splices may be made in the reinforcing steel bars in accordance with TxDOT Item 440 of the Standard Specifications for Construction of Highways, Streets and Bridges.

807.9

PLACING

- A. Reinforcement shall be placed as near as possible in the position shown on the Plans. Unless otherwise shown on the Plans, dimensions shown for reinforcement are to the centers of the bars. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from plan placement by more than one-twelfth ($1/12$) of the spacing between bars. In the plane of the steel perpendicular to the nearest surface of concrete, bars shall not vary from plan placement by more than one-quarter inch. Cover of concrete to the nearest surface of steel shall meet the above requirements but shall never be less than one and a half (1 ½) inches.
- B. Vertical stirrups shall always pass around the main tension members and be attached securely thereto. The reinforcing steel shall be spaced its required distance from the form surface by means of approved galvanized metal spacers, metal spacers with plastic coated tips, stainless steel spacers, plastic spacers, or approved pre-cast mortar or concrete blocks. For approval of plastic spacers on a project, representative samples of the plastic shall show no visible indications of deterioration after immersion in a five (5) percent solution of sodium hydroxide for 120 hours.
- C. All reinforcing steel shall be tied at all intersections, except that where spacing is less than one (1) foot in each direction in which case reinforcing site shall be tied at alternate intersections. For reinforcing steel cages for other structural members, the steel shall be tied at a sufficient number of intersections to provide a rigid cage of steel.
- D. Before any concrete is placed, all mortar, mud, dirt, etc. shall be cleaned from the reinforcement. Precast mortar or concrete blocks to be used for holding steel in position adjacent to formed surfaces shall be cast in molds meeting the approval of the City and shall be cured by covering with wet burlap or cotton mats for a period of 72 hours. Mortar for blocks shall contain approximately one (1) part portland cement to three (3) parts sand. Concrete for blocks shall contain nine (9) sacks of portland cement per cubic yard of concrete.
- E. The blocks shall be cast in the form of a frustum of a cone or pyramid with the smaller face placed against the forms.
- F. A suitable tie wire shall be provided in each block, to be used for anchoring to the steel. Except in unusual cases, and when specifically otherwise authorized by the City, the size of the surface to be placed adjacent to the forms shall not exceed two and one-half (2½) inches square or the equivalent thereof in cases where circular or rectangular areas are provided. Blocks shall be cast accurately to the thickness required, and the surface to be placed adjacent to the forms shall be a true plane free of surface imperfections.



- G. Reinforcement shall be supported and tied in such manner that a sufficiently rigid cage of steel is provided. If the cage is not adequately supported to resist settlement or floating upward of the steel, overturning of truss bars, or movement in any direction during concrete placement, permission to continue concrete placement will be withheld until corrective measures are taken. Sufficient measurements shall be made during concrete placement to insure compliance with the first paragraph of the Article.
- H. Mats of wire fabric shall overlap each other sufficiently to maintain a uniform strength and shall be fastened securely at the ends and edges.
- I. No concrete shall be deposited until the City has inspected the placement of the reinforcing steel and given permission to proceed. If the reinforcement is not adequately supported or tied to resist settlement, floating upward, overturning of truss bars, or movement in any direction during concrete placement, concrete placement will be halted until corrective measures are taken.

807.10

EPOXY COATING OF REINFORCING STEEL

- A. When shown on the plans, coating with epoxy of reinforcing bars, plain wire, deformed wire or welded wire fabric to be used as reinforcement of concrete shall conform to the requirements of TxDOT Item 440 of the Standard Specifications for Construction of Highways, Streets and Bridges.

807.11

PAYMENT

- A. No separate payment shall be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION



SECTION 800 – CONCRETE SPECIFICATIONS

ITEM 808. FLOWABLE BACKFILL

808.1 SCOPE OF WORK

- A. This specification covers the requirements for the furnishing and placing of flowable backfill as indicated on the Plans.

808.2 SUBMITTALS

- A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including flowable backfill mix design, curing method, and all other pertinent data to illustrate conformance to the specification found within.

808.3 CONSTRUCTION METHODS

- A. All trenches to be backfilled shall be properly prepared according to the Plans and Specifications prior to placement of flowable backfill.

808.4 FLOWABLE BACKFILL

- A. Flowable backfill shall be placed in accordance with the details and to the dimensions shown on the Plans or as established by the City.
- B. The mixture shall consist of 188 pounds of Type III Portland cement, 94 pounds of fly ash and 3,000 pounds of sand per cubic yard of flowable backfill.
- C. The minimum allowable slump for flowable backfill is 6-inches.
- D. Immediately following the placement of flowable backfill, it shall be cured in accordance with Section 801- CONCRETE STRUCTURES.
- E. When the temperature of the air is above 85° F, an approved retarding agent will be required in all flowable backfill regardless of temperature. No flowable backfill will be placed any time the temperature of the flowable backfill at placement, exceeds 90° F. Ice will be used to decrease the temperature of flowable backfill. The general formula will be, five (5) pounds of ice per yard of flowable backfill per degree of temperature drop.
- F. The 28-day compressive strength range, when tested in accordance with Tex-418-A, must be between 80 psi and 150 psi unless otherwise directed. Two specimens are required for a strength test, and the compressive strength is defined as the average of the breaking strength of the 2 cylinders.

808.5 PAYMENT

- A. Payment for flowable backfill shall be subsidiary to the appropriate bid items of the Proposal and Bid Schedule.

END OF SECTION



SECTION 800 - CONCRETE SPECIFICATIONS

ITEM 809. CONCRETE PAVEMENT

809.1

SCOPE OF WORK

- A. This item shall consist of a pavement and/or base of Portland Cement concrete, with or without reinforcement as indicated on the Drawings, with or without monolithic curbs, constructed as herein specified, on prepared subgrade or base course in conformity with the thickness and typical cross sections indicated on the Drawings. Concrete to be considered of satisfactory quality provided it is made (a) of materials accepted for job, (b) in the proportions established by the Contractor and (c) mixed, placed, finished and cured in accordance with the requirements of this specification.
- B. This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

809.2

SUBMITTALS

The submittal requirements of this specification item may include:

- A. Mix design option(s) of the class of concrete required on the project,
- B. The supplier of the concrete mix design(s) and type of mixing equipment, and
- C. Type of admixtures to be used with the concrete mixes.

809.3

MATERIALS

A. Cementitious Materials

1. Portland cement shall conform to ASTM C 150, Type I (General Purpose) and Type III (High Early Strength). Type III cement shall be used when high early strength concrete is indicated on the Drawings. If the use of high early cement is not specified and the Contractor desires to use it, he shall obtain written permission from the Engineer or designated representative prior to its use and shall assume all additional costs incurred by the use of such cement. All cement shall be of the same type and from the same source for a project unless written permission is first received from the Engineer or designated representative.
2. Portland cement manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Commission on Environmental Quality (TCEQ) and the United States Environmental Protection Agency (USEPA). Supplier shall provide current TCEQ and EPA authorizations to operate the facility.
3. Bulk or sacked cement may be used and a bag shall contain 94 pounds (42.6 KG) net. All bags shall be in good condition at the time of inspection. Bulk cement shall be weighed on approved scales as herein prescribed.
4. All cement shall be stored in a suitable weather tight building or bin, which will protect the cement from dampness. The cement shall be so stored as to provide easy access for proper inspection. Any cement, which has become partially set or which contains hard lumps or cakes or cement salvaged from discarded or used bags, shall not be used.
5. Fly ash (denoted by Texas DOT designations Type A and Type B) may replace 20 to 35 percent of a mix design's Portland cement content by absolute volume. Fly ash shall not be used in mix designs with less than 5 sacks of Portland cement per cubic yard [six and a half



(6.5) sacks of Portland cement per cubic meter] unless specifically permitted by the Contract plans of project manual. Fly ash shall conform to the requirements of TxDOT Department Material Specification DMS-4610, "Fly Ash".

B. Admixtures

1. Concrete admixtures conforming to TxDOT DMS-4640, "Chemical Admixtures for Concrete" may be used when approved by the Engineer or designated representative to minimize segregation, improve workability, reduce the amount of mixing water and to provide normal hot weather concreting provisions. The use of admixtures shall not alter the approved mix designs, except for water content.

C. Coarse Aggregate

1. Coarse aggregate shall consist of durable particles of gravel, crushed blast furnace slag and/or crushed stone of reasonably uniform quality throughout, free from injurious amounts of salt, alkali, vegetable matter or other objectionable material, either free or as an adherent coating on the aggregate. It shall not contain more than 0.25 percent by weight of clay lumps nor more than 1.0 percent by weight of shale nor more than 5.0 percent by weight of laminated and/or friable particles when tested in accordance with TxDOT Test Method Tex-413-A.
2. Coarse aggregate shall have a wear of not more than 45 percent when tested according to TxDOT Test Method Tex-410-A and when tested by standard laboratory methods shall meet the following grading requirements:

Retained on 1 3/4 inch (43.75 mm) sieve	0%
Retained on 1 1/2 inch (37.5 mm) sieve	0 to 5%
Retained on 3/4 inch (19.0 mm) sieve	30 to 65%
Retained on 3/8 inch (9.5 mm) sieve	70 to 90%
Retained on No. 4 (4.75 mm) sieve	95 to 100%

Loss by Decantation TxDOT Test Method *Tex-406-A. 1.0% Maximum

* In the case of aggregate made primarily from crushing of stone. If the material finer than the 200 sieve is definitely established to be the dust of fracture essentially free from clay or shale as established by Part III of TxDOT Test Method Tex-406-A, the percent may be increased to 1.5.

3. When the plans do not require a monolithic pour of curb or curb and gutter, the Contractor may elect to use the following gradation of coarse aggregate for curb or curb and gutter:

Retained on 1 1/2 inch (37.5 mm) sieve	0%
Retained on 3/8 inch (9.5 mm) sieve	5 to 30%
Retained on No. 4 (4.75 mm) sieve	75 to 100%

4. Where the coarse aggregate is delivered on the job in 2 or more sizes or types, each type and/or size shall be batched and weighed separately.



5. All aggregates shall be handled and stored in such a manner as to prevent size segregation and contamination by foreign substances and maintain as nearly as possible in a uniform condition of moisture. When segregation is apparent, the aggregate shall be remixed with suitable equipment as required. At time of its use, the aggregate shall be free from frozen material and aggregate containing foreign materials will be rejected. Coarse aggregate that contains more than 0.5 percent free moisture by weight shall be stockpiled for at least 24 hours prior to use.
6. Adequate storage facilities shall be provided for approved materials. The intermixing of non-approved materials with approved materials either in stockpiles or in bins will not be permitted. Aggregates from different sources shall be stored in different stockpiles unless otherwise approved by the Engineer or designated representative.

D. Fine Aggregate

1. Fine aggregate shall be free from injurious materials of salt, alkali or vegetable matter. It shall not contain more than 0.5 percent by weight of clay lumps. When subjected to the color test for organic impurities, TxDOT Test Method Tex-408-A, the fine aggregate shall not show a color darker than standard.
2. Unless shown otherwise on the drawings, fine aggregate shall have an acid insoluble residue of at least 60% by weight when tested in accordance with Tex 612-J.
3. Unless specified otherwise, fine aggregate shall meet the following grading requirements:

Retained on 3/8 inch (9.5 mm) sieve	0%
Retained on No. 4 (4.75 mm) sieve	0 to 5%
Retained on No. 8 (2.36 mm) sieve	0 to 20%
Retained on No. 16 (1.185 mm) sieve	15 to 30%
Retained on No. 30 (0.600 mm) sieve	35 to 75%
Retained on No. 50 (0.300 mm) sieve	70 to 90%
Retained on No. 100 (0.150 mm) sieve	90 to 100%
Retained on No. 200 (0.075 mm) sieve	97 to 100%

4. Fine aggregate will be subjected to the Sand Equivalent Test, TxDOT Test Method Tex-203-F. The sand equivalent value shall not be less than 80.

E. Mineral Filler

1. Mineral filler shall consist of clean stone dust, crushed sand, crushed shell or other approved inert material. It shall meet the following requirements when tested in accordance with TxDOT Test Method Tex-401-A:

Retained on No. 30 (0.600 mm) sieve	0%
Retained on No. 200 (0.075 mm) sieve	0 to 35%

2. Where fine aggregate is delivered to the job in 2 or more sizes or types, each type and/or size of material shall be batched and weighed separately. Where mineral filler is used, it shall be batched and weighed separately. At the time of its use the fine aggregate shall be free from frozen material and aggregate containing foreign material will be rejected.



3. All fine aggregate shall be stockpiled for at least 24 hours prior to use.

F. Mixing Water

1. Water for use in concrete and for curing shall be free from oils, acids, organic matter or other deleterious substances and shall not contain more than 1,000 parts per million of chlorides as Cl nor more than 1,000 parts per million of sulfates as SO₄.
2. Water from municipal supplies approved by the State Health Department will not require testing. Contractor shall sample and test water from other sources and submit test results to the Engineer or designated representative for approval 10 days prior to proposed use.
3. Tests shall be made in accordance with "Standard Method of Test for Quality of Water to be used in Concrete," AASHTO Method T-26.

G. Transit-mixed Concrete

1. The use of transit-mixed (ready-mixed) concrete will be permitted by the Engineer or designated representative provided the batching plant and mixer trucks meet requirements of quality specified herein.
2. When ready-mixed concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to each batch to coat the drum of the mixer or agitator truck. Delivery of concrete to the site of the work and its discharge from the truck mixer, agitator or non-agitating equipment shall be in accordance with the requirements of Item TxDOT Item 421, "Hydraulic Cement Concrete."
3. Ready-mixed concrete, batching plant and mixer truck operation shall include the following:
 - a. A ticket system will be used that includes a copy for the construction inspector. The ticket will have machine stamped time/date of the concrete batch, weight of cement, sand and aggregates; exact nomenclature and written quantities of admixtures and water. Any item missing or incomplete on the ticket may be cause for rejection of the concrete.
 - b. Sufficient trucks will be available to support continuous slab placements. The Contractor will satisfy the Engineer or designated representative that adequate standby trucks are available to support monolithic placement requirements.
 - c. A portion of the mixing water, required by the batch design to produce the specified slump, may be withheld and added at the job site but only with the permission of the Engineer or designated representative and under the Inspector's observation. When water is added under these conditions, it will be thoroughly mixed before any slump or strength samples are taken.

H. Joint Sealer

1. Unless otherwise shown on the plans, joint sealant for concrete pavement used on airport runways and/or taxiways shall be TxDOT Class 5. All other joint sealant shall be TxDOT Class 2.
2. Joint sealant shall be placed in accordance with the manufacturer's recommended procedures. Apply the primer, when required, at the specified rate.



The sealant material shall have the following properties:

Color	Gray
Flow, MIL-2-8802D, Sec 4.8.4, max	0.2
Working time, minutes	10
Tack-free time at 77°F +/- 2°F (25°C +/- 1.1°C), MIL-2-8802D	
Sec 4.8.7, minutes	60
Cure time at 77°F (25°C), days	7-14
Full Adhesion, days	14-21

As Cured - after 7 days at 77°F (25°C) and 40% Relative Humidity

Elongation, minimum percent	1200
Durometer Hardness, Shore A, ASTM D 2240, min	15
Joint movement capability, percent	+100/-50
Tensile Strength, maximum elongation, percent	100
Peal strength, psi	25 (172 kPa)

- I. Backer Rod shall be expanded closed cell polyethylene foam compatible with sealant. No bond or reaction shall occur between rod and sealant. Backer Rod shall be of sufficient width to be in compression after placement.
- J. Joint Filler. Boards for expansion joint filler and for contraction and longitudinal joints shall be of the size, shape and type indicated.
 1. Board shall be obtained from Redwood, Cypress, Gum, Southern Yellow Pine or Douglas Fir timber. They shall be solid heartwood and shall be free from sapwood, knots, clustered birdseye, checks and splits. Occasional sound or hollow birdseye, when not in clusters, will be permitted provided the board is free from any other defects that will impair its usefulness as a joint filler. With the exception of Redwood and Cypress, all boards shall have a creosote or pentachlorophenol treatment of 6 pounds per cubic foot (96 kg/m³). When oven dried at 230°F (110°C) to a constant weight, the weight of the board per cubic foot (minus treatment), shall not be less than 20 pounds nor more than 35 pounds (not less than 320 nor more than 561 kgs per cubic meter).
- K. Asphalt Board
 1. Asphalt board when used as indicated shall be of required size, full depth of concrete placement and uniform thickness. When used in transverse joints, it shall conform approximately to shape of the pavement crown as indicated. Asphalt board shall consist of 2 liners of 0.016-inch (0.4 mm) asphalt impregnated paper filled with a mastic mixture of asphalt and vegetable fiber and/or mineral filler. Boards shall be smooth, flat and straight throughout and shall be sufficiently rigid to permit easy installation. Boards that crack or shatter during installing and finishing operations will not be acceptable. Board shall be furnished in lengths equal to 1/2 the pavement width or in lengths equal to the width between longitudinal joints and may be furnished in strips or scored sheets of the required shape. When tested in accordance with TxDOT Test Method Tex-524-C the asphalt boards shall not deflect from the horizontal more than 3/4 inch in 3 1/2 inches (19.3 cm in 90 cm). The asphalt board shall be placed such that they will not interfere with the bonding of the joint sealer.



L. Load Transmission Devices for Expansion and Contraction Joints

1. Approved load transmission devices, when indicated, shall meet the requirements specified herein:
2. Smooth steel bar dowels, used when indicated, shall be of the size and type indicated and shall be open-hearth, basic oxygen or electric-furnace steel conforming to the properties specified for grade 60 in ASTM A 615. The free end of dowel bars shall be smooth and free of shearing burrs.
3. When indicated, one end of each dowel bar shall be encased in an approved cap having an inside diameter of 1/16 inch (16 mm) greater than the diameter of the dowel bar. The cap shall be of such strength, durability and design as to provide free movement of the dowel bar and shall be approved by the Engineer or designated representative prior to use. One end of the cap shall be filled with a soft felt plug or shall be void in order to permit free movement of the dowel bar for a distance equivalent to 150 percent of the width of the expansion joint used. The dowel caps and dowel bars shall be held securely in place by bar ties as indicated on the drawings. Mechanical methods of implanting dowel bars in the plastic concrete may be used when approved by the Engineer or designated representative.
4. Where required, dowel bars shall be coated with a plastic material meeting the requirements indicated.
5. Where red lead and oil bar coating is indicated, the red lead may be of any standard commercial grade and the oil shall be clean and no lighter than Standard No. 30 SAE grade. Approved thinner and dryer may be added to the red lead, but the material upon application shall be of such consistency that will provide a uniform and heavy coating on the bar. Where asphalt bar coating is indicated, the material may be any standard grade of oil asphalt and shall be applied hot. Cutback asphalt will not be permitted for bar coating.

M. Metal Installing Devices for Joint Assembly

1. Metal installing devices for expansion and contraction joint assemblies (such as welded wire bar chairs, bar stakes and marker channels, channel caps, etc.) shall be as indicated or may be similar devices of equivalent or greater strength, approved by the Engineer or designated representative, that will secure joint assembly in correct position during the placing and finishing of concrete. Load transmission devices used in joint assemblies shall be secured in position by a transverse metal brace of the type and design indicated or may be secured in position by other approved devices of equivalent or greater strength that will provide positive mechanical connection between the brace and each unit (or than by wire tie) and prevent transverse movement of each load transmission device.

N. Steel Reinforcement

1. Steel reinforcing bars as required including tie bars shall be open-hearth, basic oxygen or electric-furnace new billet steel of Grade 60 or Grade 40 for concrete reinforcement as indicated. Bars that require bending shall be Grade 40 conforming to the requirements of ASTM A 615.
2. High yield reinforcing steel shall be either (a) open-hearth, basic oxygen or electric-furnace new billet steel conforming to ASTM A 615 Grade 60 or (b) rail steel bars for concrete reinforcement, conforming to ASTM A 616 Grade 60. Bars produced by piling method will not be accepted. High yield reinforcing steel bars shall be further identified by a special marking rolled into each bar. All reinforcing steel shall be deformed bars conforming to the requirements of pertinent ASTM Specifications.



3. Where prefabricated deformed wire mats are indicated or permitted, the wire shall be cold worked deformed steel wire conforming to the requirements of ASTM A 496, except that steel shall be made by open-hearth, electric-furnace or basic oxygen processes. The prefabricated deformed wire mats shall conform to the requirements of ASTM A 497, except that wires used shall be deformed and transverse wires shall project beyond the centerline of each edge longitudinal wire as indicated. Mats that have been bent or wires dislocated or parted during shipping or project handling shall be realigned to within 1/2 inch (13 mm) of original horizontal plane of the mat. Mats with any portion of the wires out of vertical alignment more than 1/2 inch (13 mm) after realignment and/or wires dislocated or mutilated so that, in the opinion of the Engineer, they do not represent the original mat, shall be rejected. The reinforcement may be clamped or wired so that the reinforcement will retain the horizontal and vertical alignment as indicated or as approved by the Engineer or designated representative. Deformed wire may be used for tie bars and load transfer bars that require bending. The nominal size, area and theoretical weight of reinforcing steel wires covered by this provision are as listed in Table II. When fabricated steel bars or rod mats are indicated, the mats shall meet requirements of ASTM A 184.

4. Steel wire fabric reinforcement shall be of the gage and spacing indicated and shall conform to the requirements of ASTM A 82. Longitudinal and transverse wires shall be electrically welded together at all points of intersection and the welds shall be of sufficient strength that they will not be broken during handling or placing. All welding and fabrication of fabric sheets shall conform to the requirements of ASTM A 185. Welded steel wire fabric shall be furnished in sheets as indicated and steel having been previously bundled into rolls will not be accepted. An approved hinge will be permitted in each sheet to provide for each sheet longitudinally. When wire fabric is used, it will replace only the longitudinal and transverse bars. The tie bars and load transmission units at joints will not be affected.

Table II: DIMENSIONAL REQUIREMENTS FOR DEFORMED STEEL WIRE FOR CONCRETE REINFORCEMENT

Deformed Wire Size No.	Unit Weight Pounds Per Ft. (Kgs per Meter)	Diameter Inches (Centimeters)	Cross-Sectional Area, Sq. Inches (Sq. Centimeters)	Perimeter Inches (Centimeters)
Column 1	Column 2	Column 3	Column 4	Column 5
D-1	0.034 (.051)	0.113 (.287)	0.01 (.06)	0.355 (.902)
D-2	0.068 (.101)	0.159 (.404)	0.02 (.13)	0.499 (1.267)
D-3	0.102 (.152)	0.195 (.495)	0.03 (.19)	0.612 (1.554)
D-4	0.136 (.202)	0.225 (.572)	0.04 (.26)	0.706 (1.793)
D-5	0.170 (.253)	0.252 (.640)	0.05 (.32)	0.791 (2.009)
D-6	0.204 (.304)	0.276 (.701)	0.06 (.39)	0.867 (2.202)
D-7	0.238 (.354)	0.296 (.752)	0.07 (.45)	0.936 (2.377)
D-8	0.272 (.405)	0.319 (.810)	0.08 (.52)	1.002 (2.545)
D-9	0.306 (.455)	0.338 (.859)	0.09 (.58)	1.061 (2.695)
D-10	0.340 (.506)	0.356 (.904)	0.10 (.65)	1.118 (2.840)
D-11	0.374 (.557)	0.374 (.950)	0.11 (.71)	1.174 (2.982)
D-12	0.408 (.607)	0.390 (.991)	0.12 (.77)	1.225 (3.112)
D-13	0.442 (.658)	0.406 (1.031)	0.13 (.84)	1.275 (3.239)



D-14	0.476 (.708)	0.422 (1.072)	0.14 (.90)	1.325 (3.366)
D-15	0.510 (.759)	0.437 (1.110)	0.15 (.97)	1.372 (3.485)
D-16	0.544 (.810)	0.451 (1.146)	0.16 (1.03)	1.416 (3.600)
D-17	0.578 (.860)	0.465 (1.181)	0.17 (1.10)	1.460 (3.708)
D-18	0.612 (.911)	0.478 (1.214)	0.18 (1.16)	1.501 (3.813)
D-19	0.646 (.961)	0.491 (1.247)	0.19 (1.23)	1.542 (3.917)
D-20	0.680 (1.012)	0.504 (1.280)	0.20 (1.29)	1.583 (4.021)
D-21	0.714 (1.063)	0.517 (1.313)	0.21 (1.35)	1.624 (4.125)
D-22	0.748 (1.113)	0.529 (1.344)	0.22 (1.42)	1.662 (4.221)
D-23	0.782 (1.164)	0.541 (1.375)	0.23 (1.48)	1.700 (4.318)
D-24	0.816 (1.214)	0.553 (1.405)	0.24 (1.55)	1.737 (4.412)
D-25	0.850 (1.265)	0.564 (1.433)	0.25 (1.61)	1.772 (4.500)
D-26	0.884 (1.316)	0.575 (1.461)	0.26 (1.68)	1.806 (4.587)
D-27	0.918 (1.366)	0.586 (1.488)	0.27 (1.74)	1.841 (4.676)
D-28	0.952 (1.417)	0.597 (1.516)	0.28 (1.81)	1.876 (4.765)
D-29	0.986 (1.467)	0.608 (1.544)	0.29 (1.87)	1.910 (4.851)
D-30	1.020 (1.518)	0.618 (1.570)	0.30 (1.94)	1.942 (4.933)
D-31	1.054 (1.569)	0.628 (1.595)	0.31 (2.00)	1.973 (5.011)

O. Polyethylene Film

1. Polyethylene film shall be opaque pigmented white in color and shall be manufactured from virgin resin without additives or scrap. It shall be sufficiently strong and tough to permit its use under the conditions existing on street paving work without being torn or otherwise rendered unfit for the purpose during the curing period. The film shall have a minimum thickness of 4 mils (0.004 inch), shall have a minimum tensile strength of 1,700 psi at 77°F (11,720 kPa at 25°C) in the longitudinal direction and 1,200 psi at 77°F (8,275 kPa at 25°C) in the transverse direction and shall have a minimum elongation of 200 percent at 77°F (25°C) in the longitudinal direction and 150 percent at 77°F (25°C) in the transverse direction. The permissible percent moisture loss shall not exceed 2 percent after 24 hours and 4 percent after 72 hours. Tests for tensile strength and elongation will be conducted in accordance with ASTM Designation: D 882, Method A. Tests for moisture retention will be conducted in accordance with ASTM Designation: C 156.

P. Membrane Curing Compound

1. The membrane curing compound shall comply with the "Standard Specification for Liquid Membrane-forming Compounds for Curing Concrete", ASTM Designation: C 309, Type 1 clear or translucent, or Type 2 white pigmented. The material shall have a minimum flash point of 80° F when tested by the "Pensky-Martin Closed Cup Method".

Q. Asphalt Curing

1. When an asphaltic concrete overlay is required, apply a uniform coating of asphalt curing at a rate of 90 to 180 sq. ft. per gallon as required. Apply curing immediately after texturing and just after the free moisture (sheen) has disappeared. Obtain approval to add water to the emulsion to improve spray distribution. Maintain the asphalt application rate when using diluted emulsions. Maintain the emulsion in a mixed condition during application.



EQUIPMENT

- A. General. All equipment necessary for construction of this item shall be on the Project and shall be approved by Engineer or designated representative as to conditions before the Contractor will be permitted to begin construction operations on which the equipment is to be used. When approved by the Engineer or designated representative in writing, a commercial or independently operated batching plant for measuring materials outside limits of the project may be used.
- B. Mixer. The mixer furnished may be either a paving mixer (operated at site of construction or centrally located), a stationary mixer (central mixer) or a paving mixer (truck mounted) that will produce adequately mixed concrete meeting the specified requirements. The mixer, or mixers, shall conform to the following requirements:
1. Each mixer shall have attached in a prominent place a manufacturer's plate showing rated capacity of the drum in terms of volume of mixed concrete and the recommended speed of rotation of the mixing drum or blades.
 2. The stationary mixer (central mixer) or truck mounted paving mixer shall be operated at the manufacturer's recommended speed.
 3. The size of the paving mixer shall not be less than that of a 27-E paver, as established by the Mixer Manufacturer's Bureau of Associated General Contractors. The paving mixer shall be operated at a drum speed of not less than 16 revolutions per minute and not more than 22 revolutions per minute. Pickup and throw over blades in the drum of the mixer shall be replaced when worn down 3/4 inch (19 mm) or more.
 4. Each truck mounted paving mixer shall be approved by the Engineer or designated representative prior to use on the project. It shall be classified as a "paving mixer" by the manufacturer and shall be so designed that a uniform and low slump concrete (approximately 1 1/2 inch [38 mm] slump) can be mixed without aggregate size segregation. The mixer shall be capable of discharging the low slump concrete at a speed of 10 seconds per cubic yard (13 seconds per cubic meter) or faster.
 5. Each mixer shall be equipped with an approved automatic device for satisfactorily timing the mix and locking the discharging device in order to prevent the discharging of the mixer before the end of the required mixing period. This timing device shall operate a sounding device to signal plainly the completion of the mixing time. When permitted by the Engineer a light signal device may be used.
 6. Multiple drum mixers will be permitted provided their operation is properly synchronized. The mixing time shall be determined exclusive of the time required to transfer concrete from one drum to the next drum.
 7. Each mixer shall be equipped with a water-measuring device so constructed that it will measure the water within 1 percent of the total amount required for each batch. Unless the water is to be weighed, the water measuring equipment shall include an auxiliary tank with a capacity greater than that of the measuring tank and from which the measuring tank will be filled by gravity flow. The measuring tank shall be open to the atmosphere and shall be so placed and constructed that the water for a batch can be discharged into a calibrated tank or weighing device for checking the accuracy of water measurement without seriously delaying the paving operations. The Contractor shall have a calibrated tank or weighing device available at all times at a location satisfactory to the Engineer or designated representative.
 8. If a paving mixer is furnished and operated at the site of construction, it shall be equipped with a power controlled boom and bucket, so designed as to permit uniform distribution of the concrete for the full width between pavement forms. Alternate equipment for distributing concrete may be substituted when approved by the Engineer in writing, provided uniform distribution is obtained without segregation.



9. If central mixed concrete is used on the project, the Contractor shall provide equipment designed to provide uniform distribution for the concrete for the full width between pavement forms without segregation.

C. Transit-mix Trucks

When transit-mix (ready-mix) concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to the batch to coat the drum of the mixer or agitator truck. This shall be required for every load of concrete. The mixing speed shall be attained as soon as all ingredients are in the mixer. Each complete batch (containing all the required ingredients) shall be mixed not less than 70 nor more than 100 revolutions of the drum at mixing speed.

A portion of the mixing water, required by the batch design to produce the desired slump, may be withheld and added at the job site, but only with permission of the Engineer and under his supervision. When water is added at the job site, 25 revolutions (minimum) at mixing speed, will be required to flush down the blades after charging shall be accurately measured and included in the quantity of mixing water. The introduction of the initial mixing water, except blade wash down water and that permitted in this Article shall be prior to or simultaneous with the charging of the aggregates and cementitious material.

Mixing and agitating speed shall be as designated by the mixer manufacturer. All revolutions after prescribed mixing shall be at agitating speed. Except for short periods of time during discharge, the drum shall be kept in continuous motion from the time the mixing is started until the discharge is completed.

Additional mortar, consisting of 1 sack cement, 3 parts sand and sufficient water, shall be added to the batch to coat the drum of the transit mixer or agitator truck. This shall be required for every load of concrete.

The loading of transit-mixers shall not exceed 63 percent of the drum volume. When used as an agitator only, the loading of truck mixers shall not exceed 80 percent of the drum volume.

The batching plant and transit-mix trucks shall operate under the following system:

1. A ticket system will be used that includes a copy for the construction inspector. The ticket will have machine stamped time/date of water/cement batch; weight of cement, fly ash (if applicable), water, sand and aggregates; exact nomenclature and quantities of admixture. Any item missing or incomplete on the ticket will be cause for rejection. Coded readouts may be used if approved in advance by the Engineer.
2. Sufficient trucks will be available to support continuous placements. The Contractor will satisfy the Engineer that adequate standby trucks are available to support monolithic placement when required.
3. A portion of the mixing water, required by the batch design to produce the desired slump, may be withheld and added at the job site, but only with the permission of the Engineer and under the Inspector's observation. When water is added under these conditions, it will be thoroughly mixed before any slump or strength samples are taken.

D. Hauling Equipment

1. Batch hauling equipment for the transportation of measured materials from the batching plant to the mixer shall be equipped with tight covers, which shall be used to prevent excessive evaporation of moisture or any loss of material.



2. If a central mixer is used, concrete may be transported to the point of delivery in truck agitators or non-agitating trucks.
3. If a truck mounted paving mixer is used, it may be used to transport the concrete after mixing is complete.
4. If non-agitator trucks are used they shall conform to the following requirements:
5. The bed of non-agitating hauling equipment shall be a smooth, mortar-tight, metal container. The hauling equipment shall be capable of delivering the concrete to the work site in a thoroughly mixed and uniform mass and capable of discharging the concrete at a satisfactory controlled rate without segregation. If in the opinion of the Engineer any appreciable segregation or accumulation of excess water and/or mortar occurs on the surface of the concrete, this may be cause for rejection and this method of transporting the concrete to the point of delivery shall be suspended as directed by the Engineer.

E. Subgrade or Subbase Planer and Templates

1. Unless a stabilized subbase is provided, an approved subbase planer shall be provided, mounted on visible rollers riding on the forms and having adjustable cutting blades which shall trim the subgrade to the exact section as indicated. The planer frame shall be heavy enough to remain on the forms at all times and shall be of such strength and rigidity that, under a test made by changing the support from the wheels to the center, it shall not develop a deflection for more than 1/8 inch (3 mm). Tractive power equipment used to pull the planer shall not be such as to produce ruts or indentations in the subgrade.
2. When the slip form method of paving is to be used, the subgrade planer will be operated on a prepared track grade or controlled by an electronic sensor system operated from a string line that establishes the horizontal alignment and the elevation of the subbase.
3. A template for checking the contour of the subbase shall be provided and operated by the Contractor. The template shall rest upon the side forms and shall be of such strength and rigidity that, under a test made by changing the support to the center, it shall not show a deflection of more than 1/8 inch (3 mm). It shall be provided with accurately adjustable rods projecting downward to the subgrade at 1-foot (30 cm) intervals and these rods shall be adjusted to the required cross section of the bottom of the slab when the template is resting upon the side forms. Where stabilized subbase is provided, use of a scratch template will be required.

F. Forms

1. Side forms shall be of metal of approved cross section. The preferred depth of the form shall be equal to the required edge thickness of the pavement. Forms with depth greater than the required edge thickness of the pavement will be permitted.
2. The length of form sections shall not be less than 10 feet (3.0 meters) and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200-foot (61 meter) radius or less. Forms shall be of ample strength and shall be provided with adequate devices for secure setting so that when in place they will withstand, without visible springing or settlement, the impact and vibration of the spreading and finishing machinery. In no case shall the base be less than 6 inches (15.2 cm) for a form 6 inches (15.2 cm) or more in height. The forms shall be free from warps, bends or kinks and shall be sufficiently true to provide a reasonably straight edge on the concrete. The top of each form section, when tested with a straightedge shall conform to the requirements specified for the surface of the completed pavement. Sufficient forms shall be provided for satisfactory prosecution of the work.



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

G. Concrete Spreader

1. Use of concrete spreader shall be required and it shall be a self-propelled machine having sufficient power and traction to spread and strike off concrete without slippage on the forms. It shall be equipped with a power driven device for spreading the concrete uniformly between the forms. The spreading device may be either a reciprocating blade, a screw conveyer or a belt conveyer. The spreader shall be capable of striking off the surface of the concrete between the forms in the longitudinal direction of the slab at any required elevation.
2. Mechanically operated concrete spreaders of other designs, which uniformly distribute the concrete with a minimum of segregation, may be used when approved by the Engineer.

H. Slipform Paver

1. With prior approval, the Contractor may place concrete with slip form paver. This paver shall be equipped with a longitudinal transangular finishing float adjustable to crown and grade and be satisfactory to the Engineer or designated representative. The float shall extend across the pavement practically to the side forms and/or the edge of slab. A "string line" shall be used to provide grade control for the paver.

I. Mechanical Vibratory Equipment

1. All concrete placed for pavement shall be consolidated by approved mechanical vibrators operated ahead of the transverse finishing machine and designed to vibrate the concrete internally and/or from the surface. Vibratory members shall extend across the pavement practically to, but shall not come in contact with the side forms. Mechanically operated vibrators shall be mounted in such manner as not to interfere with transverse or longitudinal joints. The internal-type vibrators shall be spaced at not more than 24 inches (61 cm) and shall be equipped with synchronized vibratory units. Separate vibratory units shall be spaced at sufficiently close intervals to provide uniform vibration and consolidation to the entire width of the pavement. The frequency in air of the interval spud type vibratory units shall be not less than 8,000 cycles per minute and not less than 5,000 cycles per minute for tube types and the method of operation shall be as directed by the Engineer or designated representative. The Contractor shall have a satisfactory tachometer available for checking vibratory the elements.
2. The pavement vibrators shall not be used to level or spread the concrete but shall be used only for purposes of consolidation. The vibrators will not be operated where the surface of the concrete, as spread, is below the elevation of the finished surface of the pavement, except for the first lift of concrete where double strike off method of placement is employed and the vibrators shall not be operated for more than 15 seconds while the machine upon which they are installed is standing still.
3. The pan type vibratory units shall apply the vibrating impulses directly to the surface of the concrete. The operating frequency shall be not less than 3,500 cycles nor more than 4,200 cycles per minute in air. The Contractor shall have a satisfactory tachometer available for checking the speed of the vibratory elements.
4. Approved hand manipulated mechanical vibrators shall be furnished in the number required for provision of proper consolidation of the concrete along forms, at joints and in areas not covered by mechanically controlled vibrators. These vibrators shall be sufficiently rigid to insure control of the operating position of the vibrating head.



5. Complete and satisfactory consolidation of the concrete pavement is a most important requirement of this specification. Cores taken shall be carefully examined for voids, honeycombing or other evidence of incomplete consolidation. If such evidence is present, changes in the consolidation procedures and/or equipment will be made to insure satisfactory consolidation.

J. Finishing Equipment

1. Transverse Finishing Machine

The Transverse finishing machine shall be provided with 2 screeds accurately adjusted to the crown of the pavement, shall be self-propelled and mounted in a substantial frame equipped to ride on the forms, or may be slip form finished, and shall be so designed and operated as to strike off and consolidate the concrete.

2. Longitudinal Finishing

- a. A transverse drag float may be used in lieu of the longitudinal finishing machine with the Engineer's approval. Finishing machines shall be maintained in a tight and good operating condition, accurately adjusted to the required crown or profile and free from deflection, wobble or vibration tending to affect the precision of finish. Machines failing to meet these requirements will be rejected by the Engineer or designated representative and the Contractor shall provide approved equipment.
- b. Where hand finishing is permitted under this specification, the Contractor shall provide a strike template and a tamping template both of 4 by 10 inch (10 by 25 cm) lumber or equivalent metal section and at least 2 feet longer than the width of the pavement. Both templates to conform to the crown section of the pavement and the tamp, if of wood, shall have a steel face not less than 3/8 inch (9.5 mm) in thickness. The Contractor shall also provide a longitudinal float of approved design and not less than 14 feet (4.25 meters) in length.
- c. The Contractor shall furnish and maintain at least two standard 10-foot (3.05 meter) steel straightedges on the work site at all times during the paving operations. The Contractor shall operate same in the presence of the Engineer or designated representative.
- d. The Contractor shall furnish a sufficient number of bridges to ride on the forms and span the pavement for finishing operations and for the installation and finishing of joints. All necessary finishing and edging tools shall be furnished as may be required to complete the pavement as indicated.

809.5

PROPORTIONING OF CONCRETE

A. Proportions

Concrete shall be composed of Cementitious Materials, fine aggregate, coarse aggregate, mineral filler and/or admixture if used and water, mixed in the proportions designated by the approved Mix Design and in the manner set forth in this specification. On the basis of job and laboratory investigations of the proposed materials, the Contractor will fix proportions by weight of water, coarse aggregate, fine aggregate, cementitious materials, admixture and mineral filler where required, in order to produce concrete of the specified strength and workability for the actual delivery time and site conditions to be encountered. Where curbs are placed separately, the Engineer or designated representative may allow aggregate gradation conforming to Class A Concrete, Section 801, "CONCRETE FOR STRUCTURES."



B. Concrete Strength

The concrete mix to be designed to produce a concrete with the following requirements:

Table 1: CONCRETE PAVEMENT		
Item	Test	Value
Entrained Air	Tex-416-A	3 to 6 percent
Water-Cement Ratio gal. (liter)/sack, Maximum		6.25 (23.66)
Sacks Cement, Minimum, 94 pounds (42.6 KG) ea		6 per cubic yard (7.85 per cubic meter)
Coarse Aggregate Factor		0.65 min - 0.85 max.
Compressive Strength after 7 Days, psi (kPa)	Tex-418-A	4000 (27,600)
Compressive Strength after 28 Days, psi (kPa)	Tex-418-A	4500 (31,000)
Maximum Concrete Mix Temperature °F (°C)		95 (35)
Retarder: Regular Concrete increase in time over 360S.7(3), minutes, Maximum		60
Table 2: HIGH EARLY STRENGTH CONCRETE		
Item	Test	Value
Cement Type		III
Entrained Air	Tex-416-A	3 to 6 percent
Water-Cement Ratio gal. (liter)/sack, Maximum		6.25 (23.66)
Sacks Cement, Minimum, 94 pounds (42.6 KG) ea		7 per cubic yard (9.16 per cubic meter)
Coarse Aggregate Factor		0.65 min-0.85 max
Slump, inches (Centimeters)	Tex-415-A	1/2 to 2 (1.25 to 5.0)
Compressive Strength, after 24 hours, psi (kPa)	Tex-418-A	2,100 (14,500)
Compressive Strength, after 3 Days, psi (kPa)	Tex-418-A	2,750 (19,000)
Compressive Strength, after 7 Days, psi (kPa)	Tex-418-A	4,500 (31,000)
Compressive Strength, after 28 Days, psi (kPa)	Tex-418-A	4,925 (34,000)
Maximum Concrete Mix, Temperature °F (°C)		95 (35)



The Contractor may submit a mix design using high range water reducing admixtures conforming to TxDOT Item 421, "Hydraulic Cement Concrete" in lieu of the concrete pavement mix specified and shall meet the following requirements:

Table 3: HIGH RANGE WATER REDUCING ADMIXTURES: SUPERPLASTERSIZER CONFORMING TO SPECIFICATION ITEM NO. 405S, "CONCRETE ADMIXTURES"

Item	Test	Value
Entrained Air	Tex-416-A	3 to 6 percent
Water-Cement Ratio, gal. (liter)/sack, Maximum		6.25
Sacks Cement, Minimum, 94 pounds (42.6 KG) ea		6 per cubic yard (7.85 per cubic meter)
Coarse Aggregate Factor		0.65 min. - 0.85 max.
Slump, inches (cms) before Admixture	Tex-415-A	1/2 to 2 (1.25 to 5)
Slump, Inches (cms) after Admixture	Tex-415-A	4 to 10 (2.5 to 25)
Compressive Strength, after 3 Days, psi (kPa)	Tex-418-A	3,125 (21,500)
Compressive Strength, after 7 Days, psi (kPa)	Tex-418-A	4,500 (31,000)
Compressive Strength, after 28 Days, psi (kPa)	Tex-418-A	4,925 (34,000)
Maximum Concrete Mix, Temperature, °F (°C)		100 (37.8)
Retarder, Regular Concrete Over 360S.7C, Minutes, Maximum		120

Number of Tests ^{2,3}	Standard Deviation, psi (mPa)				
	300 (20.6)	400 (2.75)	500 (3.44)	600 (4.13)	700 (4.82)
15	470 (3.24)	620 (4.27)	850 (5.85)	1,120 (7.71)	1,390 (9.57)
20	430 (2.96)	580 (3.99)	760 (5.23)	1,010 (6.95)	1,260 (8.67)
30 or more	400 (2.75)	530 (3.65)	670 (4.61)	900 (6.20)	1,130 (7.78)

Notes:

1. When designing the mix, add the tabulated amounts to the minimum design strength in Tables 1, 2 or 3. Maximum water-cement or water-cementitious ratio by weight
2. Number of tests of a concrete mixture used to estimate the standard deviation of a concrete production facility. Test of another mix within 1,000 psi (6.88 MPa) of the specified strength may be used.
3. If less than 15 prior tests are available, the overdesign should be 1,200 psi (8.26 MPa) for specified strengths from 3,000 to 5,000 psi (20.65 to 34.42 MPa) and 1,400 psi (9.64 MPa) for specified strengths greater than 5,000 psi (34.42 MPa).

High range water reducing admixtures shall be capable of maintaining the original slump until placement and screeding, which may be 2 hours, without the addition of water, additional admixture or other retempering or remixing techniques.

C. Workability of Concrete

Concrete shall be uniformly plastic, cohesive and workable. Workable concrete is defined as concrete which can be placed without honeycomb and without voids in the surface of the pavement after the specified finishing machine has been over a given area twice. Workability shall be



obtained without producing a condition such that free water appears on the surface of the slab when being finished as specified. Where water appears on the surface of the concrete after finishing and this condition cannot be corrected by reasonable adjustment in the batch design, the bleeding to be immediately corrected by one of the following measures or a combination of two or more of the following listed measures:

1. Redesign of the batch;
2. Addition of mineral filler to fine aggregates;
3. Increase of cement content; or
4. Use of an approved air entraining agent or approved admixture.

In the event that the measures taken do not eliminate the bleeding immediately, concrete placement operations will be suspended, as directed by the Engineer or designated representative, by placing a bulkhead or "header" as indicated and according to applicable requirements for intentional stoppage of placement of concrete under TxDOT Item 360, "Concrete Pavement" and will remain suspended until such time as additional trial mixes demonstrate that a non-bleeding batch design has been achieved. Failing to achieve a satisfactory laboratory batch design the Contractor will be required to use different materials and to submit samples thereof for additional trial mixes and pilot cylinders.

The mix will be designed with the intention of producing concrete, which will have a slump of 1 1/2 inches (3.8 cms). The slump shall not be less than 1/2 inch (1.25 cms) nor more than 2 inches (5 cms).

D. Mix Design

1. The Contractor shall perform at his own expense and be responsible for the design of the concrete mix. The mix design shall be prepared and sealed by a person qualified and experienced in such work. Establish proportions on the basis either of laboratory trial batches or of field experience with the materials to be employed.
2. When ice is used to lower the concrete temperature during hot weather, concrete placement (Section 801, "CONCRETE STRUCTURES"), the Contractor shall furnish a mix design (Section 800, "CONCRETE FOR STRUCTURES") acceptable to the Engineer or designated representative for class of concrete specified. The addition of ice shall not exceed 50 percent of the total mix water weight.
3. Complete concrete mix design data shall be submitted to the Engineer or designated representative for approval at least 10 days before concrete placement begins. Submittal of the mix shall be accompanied by such test data and certifications as may be necessary to demonstrate compliance with specification requirements. Approval of this mix design shall in no way relieve the Contractor of responsibility for the quality of the concrete.
4. It shall also be the responsibility of the Contractor to determine and measure batch quantity of each ingredient, including water, not only for batch designs but for all concrete produced for the project, so that the mix conforms to these specifications.
5. Trial batches shall be made and tested using all the proposed ingredients prior to the placing of concrete and also when the aggregate and/or type, brand or source of cement or admixture is changed. When the brand and/or source of cement only is changed, the Engineer or designated representative may waive trial batches only if a prior record of satisfactory performance of the cement has been established.



6. Mix designs used successfully on previous or concurrent jobs may be approved by the Engineer or designated representative without trial batches if it is shown that there is no substantial change in any of the proposed ingredients.
7. The Contractor shall prepare a minimum of four concrete test cylinders of each mix design, cure and test two each at the age of 7 and 28 days. From these preliminary tests the water-cement ratio required to produce concrete of the specified strength will be selected by the Contractor for approval by the Engineer or designated representative. The Contractor may at any time present in writing a suggested mix design and if the Engineer or designated representative concurs with the suggested design, the Contractor shall conduct trial batches necessary to determine its acceptability under these specification requirements.
8. The Contractor shall furnish and operate the mixer approved for use on this project unless the concrete is to be furnished from a transit mix (ready-mix) plant. For mixing the concrete to be used in making the preliminary test specimens, a minimum 1 cubic yard (1 cubic meter) batch shall be mixed or a batch of sufficient size to afford proper mixing, whichever is the greater. In lieu of the above mixer and procedure, the Contractor may furnish a portable mixer of sufficient rated capacity to mix a minimum 3-sack batch; in which case, the batch mixed for the preliminary test not to be less than the rated capacity of the mixer furnished. A coating batch will be mixed prior to mixing for test cylinders.
9. No additional compensation to be allowed for equipment, materials or labor involved in making job mix design test specimens.
10. After the mix proportions and water-cement ratio required to produce concrete of the specified strength have been determined, placing of the concrete may be started. The strength of the concrete in the completed pavement will be determined by a minimum of four compressive strength test specimens made, cured with a minimum of two each tested at 7 and 28 days as provided in TxDOT Bulletin C-11. Modifications of the mix design may be requested by the Contractor on basis of conformity of the strength of these test specimens with the requirements and intent of this specification.
11. Changes in the water-cement ratio and the mix design, including an increase in cement factor if necessary, will be made when the average 7 day and/or 28 day compressive strength of the concrete, as indicated by the last 10 compressive strength values obtained from tests of cylinders made from concrete of the same water-cement ratio, departs from the desired minimum average strength by more than 4 percent.

E. Construction Testing

1. Straightedge surface testing to be carried out as prescribed above.
2. The Engineer shall take test cylinders for compressive strength values on a random basis. The comparative results shall consist of the average of 2 cylinders each at 7 and 28 days for regular concrete, high early strength concrete and high range water reducing admixture concrete. Tests shall be made for each 500 square yards constructed, in accordance with TxDOT Bulletin C-11. Additional tests may be taken as determined by the concrete placement conditions or for adequately determining the strength of concrete where the early opening of the pavement to traffic is dependent upon concrete strength tests. No extra compensation will be allowed for materials and work involved in fulfilling these requirements.

809.6

CONSTRUCTION METHODS

A. Preparation of Subgrade

1. Where stabilized subbase is not provided, the subgrade shall be excavated as required, all unstable or otherwise objectionable material removed and all holes, ruts and depressions



filled with approved material and compacted. Rolling and sprinkling shall be performed when and to the extent required and the roadbed shall be completed to or above the plane of the typical sections, lines and grades indicated or as established by the Engineer or designated representative. The subgrade shall be proof rolled and any soft areas shall be repaired before the forms are placed. In the event that the proof rolled subgrade is exposed to rainfall or other conditions, which may soften the subgrade, corrective measures shall be taken and the subgrade shall be proof rolled again.

2. The subgrade planer shall be operated from approved forms immediately ahead of paving operations and the subgrade shall be finished to the exact section of the bottom of the pavement as indicated. Where traveling form pavers are used, the subgrade planer shall operate on a prepared track grade or be controlled by electronic sensors operating from a stringline that establishes line and grade. It shall be tested with the approved template, operated and maintained by the Contractor. The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the pavement is placed and shall be kept thoroughly wetted down sufficiently in advance of placing any pavement to insure its being in a firm and moist condition for at least 2 inches (5 cms) below the prepared surface. Sufficient subgrade shall always be prepared in advance to insure satisfactory prosecution of the work.
3. No equipment or hauling shall be permitted on the prepared subgrade, except by special permission of the Engineer or designated representative, which will be granted only in exceptional cases and only where suitable protection in the form of 2-ply timber mats or other approved material is provided.

B. Placing and Removing Forms

1. The subgrade under the forms shall be firm and cut true to grade so that each form section when placed will be firmly in contact for its whole length and base width and exactly at the established grade. Any subgrade under the forms below established grade shall be corrected, using suitable material, placed, sprinkled and rolled as directed. Forms shall be staked with at least 3 pins for each 10-foot (3-meter) section. A pin shall be placed at each side of every joint. Form sections shall be tightly joined and keyed to prevent relative displacement. Forms shall be cleaned and oiled each time they are used.
2. Forms shall be set for a sufficient distance in advance of the point where concrete is being placed to permit a finished and approved subgrade length of not less than 300 feet (90 meters) ahead of the mixer. Conformity of the grade and alignment of forms shall be checked immediately prior to placing concrete and necessary corrections made by the Contractor. Where any form has been disturbed or any subgrade becomes unstable, the form shall be reset and rechecked. In exceptional cases, the Engineer or designated representative may require suitable stakes driven to the grade of the bottom of the forms to afford additional support. Sufficient stability of forms to support the equipment operated and to withstand its vibration without springing or settlement shall be required. If forms settle and/or deflect over 1/8 inch (3 mm) under finishing operations, paving operations shall be stopped and the forms shall be reset to line and grade.
3. Forms shall be leveled using cement-stabilized material containing not less than 1 1/2 sacks of cement per ton (1 2/3 sacks of cement per MG) of mix as placed. The aggregate gradation and water content shall be determined by the Contractor. The cement-stabilized material shall be sufficiently plastic to insure filling voids underneath the paving forms. Paving equipment will not be permitted on the forms until the cement-stabilized material has cured for at least 12 hours.
4. Forms shall remain in place for not less than 8 hours after the concrete has been placed. Forms shall be carefully removed in such a manner that little or no damage will be done to the edge of the pavement. Any damage resulting from this operation shall be immediately repaired. After the forms have been removed, the ends of all joints shall be cleaned and



any honeycombed areas pointed up with approved mortar and the surfaces protected with curing material conforming to Section 806, "MEMBRANE CURING."

5. Immediately after pointing is complete, the form trench, if used, shall be filled with granular material or earth from the shoulders in such manner as to shed water from rainfall and prevent curing material from washing away from the edge of pavement. On completion of the required curing, the subgrade or shoulders adjacent to the pavement shall be placed and compacted in condition to maintain drainage.

809.7

CONCRETE MIXING AND PLACING

- A. Mixing Methods. The concrete shall be mixed in a mixer conforming to the requirements of this item.
- B. Mixing.
 1. The aggregates, mineral filler if required, cementitious materials and water shall be measured separately, introduced into the mixer and mixed for a period of not less than 50 seconds nor more than 90 seconds, measured from the time the last aggregate enters the drum to the time discharge of the concrete begins. The required water shall be introduced into the mixing drum during the first 15 seconds of mixing. The entire contents of the drum shall be discharged before any materials of the succeeding batch are introduced.
 2. The Engineer or designated representative may increase the minimum mixing time to that necessary to produce thoroughly mixed concrete based on inspection or appropriate uniformity tests. The mixing time may be varied at any time as necessary to produce acceptable concrete.
 3. If a central mixer is used, the concrete shall be discharged into the specified hauling equipment and delivered to the road site. If truck agitators are used, the concrete shall be continuously agitated at not less than 1 nor more than 6 rpm as directed by the Engineer or designated representative.
 4. The maximum size of the concrete batch, absolute volume, shall not exceed 120 percent of the rated size of the mixer (40.8 cubic feet maximum batch for 34 cubic foot paver – 1.2 cubic meter maximum batch for 1 cubic meter paver). Spilling of material from the mixer drum shall be corrected by reducing the size of the batch. Retempering or remixing of concrete will not be permitted.
 5. The initial batch of concrete mixed after each time the mixer is washed out shall be enriched by additional mortar. The additional mortar shall be 1 sack of cement and 3 parts of sand.
 6. When transit-mix (ready-mix) concrete is permitted, the batching plant shall meet the requirements of TxDOT Item 421 "Hydraulic Cement Concrete."
- C. Placement
 1. Unless otherwise indicated, the concrete may be placed by using forms or by use of a slipform paver. Any concrete not placed as herein prescribed within 30 minutes after mixing shall be rejected and disposed of as directed except as provided otherwise herein. If in the opinion of the Engineer or designated representative, the temperature, wind and/or humidity conditions are such that the quality of concrete will not be adversely affected, the specified placing time may be extended by a maximum of 45 minutes. Concrete with high range water reducing admixture shall not be placed after the slump has dropped by 3 inches (7.5 cms) or more. Except by specific written authorization of the Engineer or designated representative, concrete shall not be placed when the temperature is below 40°F (4.5°C)



and falling but may be placed when the temperature is above 35°F (1.7°C) and rising, the temperature being taken in the shade and away from artificial heat.

2. When the temperature of the air is above 85°F (29.4°C), an approved retarding agent will be required in concrete. The maximum temperature of all regular concrete placed shall not exceed 95°F (35.0°C), unless otherwise specified.
3. When concrete is being placed in cold weather, the Contractor shall have available a sufficient supply of an approved covering material to immediately protect concrete if the air temperature falls to 32°F (0°C) or below, before concrete has been placed 4 hours. Such protection shall remain in place during the period the temperature continues below 32°F (0°C) or for a period of not more than 5 days. Neither salt nor other chemical admixtures shall be added to the concrete to prevent freezing. The Contractor shall be responsible for the quality and strength of concrete under cold weather conditions and any concrete damaged by freezing shall be removed and replaced at his expense. Concrete shall not be placed before sunrise and shall not be placed later than will permit finishing of the pavement during sufficient natural light.
4. Concrete shall be placed only on approved subgrade or subbase and unless otherwise indicated on the drawings, the full width of the pavement shall be constructed monolithically. The concrete shall be deposited on the subgrade or subbase in such manner as to require as little rehandling as possible. Where hand spreading is necessary, concrete shall be distributed to the required depth by use of shovels. The use of rakes will not be permitted. Workmen will not be permitted to walk in the concrete with any earth or foreign material on their boots or shoes. The placing of concrete shall be rapid and continuous.
5. When the concrete is to be placed in separate lanes, the junction line shall not deviate from the true line more than 1/2 inch (1.25 cm) at any point and shall be finished as indicated on the drawings.
6. The mixer shall not be located on completed pavement, except as herein provided, but may be located on the subgrade of that lane of the pavement being constructed, as provided under "Preparation of Subgrade." When limited space, in the opinion of the Engineer or designated representative, requires operation of the mixer on completed pavement, the mixer may be so operated provided the concrete has attained the minimum average compressive strength required and provided suitable protection to the pavement in the form of 2 ply timber mats or otherwise approved material is provided.
7. Concrete shall be distributed to such depth that when consolidated and finished, the slab thickness indicated will be obtained at all points and the surface shall not, at any point, be below established grade. Special care shall be exercised in placing and spading concrete against forms and at all joints to prevent the forming of honeycombs and voids.
8. Concrete for the monolithic curbs shall be the same as for the pavement and if carried back from the paving mixer shall be placed within 20 minutes after being mixed. It may be placed from the separate mixer, if desired, but in any case must be placed while the pavement concrete is still plastic. When sawed joints are used, curbs shall be doweled as indicated and poured after sawing. Curbs doweled on and placed separately may be placed with an extrusion machine.
9. If a central mixer or batcher is used, the Contractor shall provide a system satisfactory to the Engineer or designated representative for determining that concrete delivered to the road meets the specified requirements for mixing and time of placing.
10. Unless otherwise indicated, 2 mixers or transit mixers will be required where the double strike off method is employed.



D. Reinforcing Steel and Joint Assemblies

1. All reinforcing steel, including steel, welded wire fabric reinforcement, tie bars, dowel bars and load transmission devices used in accordance with plan provisions shall be accurately placed and secured in position in accordance with details indicated on the drawings. Reinforcing bars shall be securely wired together at alternate intersections, following a pattern approved by the Engineer or designated representative and at all splices and shall be securely wired to each dowel intersected. When wire fabric is used, it shall replace only the longitudinal and transverse bars and shall be securely wired together at all splices and to each dowel intersected. When welded wire fabric is selected, the Contractor shall pour the lower half of the slab, place the welded wire fabric and place the remaining concrete. Tie bars shall be installed in the required position by the method and device indicated. Bar coating indicated and of material specified, shall be completed and the bars and coating shall be free of dirt or other foreign matter at the time of installation in the concrete.
2. Tightly adhered scale or rust which resists removal by vigorous wire brushing need not be removed except that excessive loss of section to the reinforcement due to rust shall be cause for rejection. Excessive loss of section shall be defined as loss of section to the extent that the reinforcement will no longer meet the physical requirements for the size and grade of steel specified.
3. Where indicated on the drawings, an assembly of parts at pavement joints, the assembly shall be completed, placed at required location and elevated and all parts rigidly secured in required position by the method and devices indicated on the drawings. Dowel bars shall be accurately installed in joint assemblies as indicated on the drawings, each parallel to the pavement surface and to the center line of the pavement and shall be rigidly secured in the required position by such means as indicated that will prevent their displacement during placing and finishing of the concrete. Unless specifically authorized by the Engineer or designated representative in writing, the load transmission devices shall be accurately installed in joint assemblies indicated, each unit vertical with its length parallel to the center line of the pavement and all units shall be rigidly secured in required position by such means as indicated that will prevent their displacement during placing and finishing of the concrete. Header boards, joint filler and other material used for forming joints shall be accurately notched to receive each load transmission device. All load transmission devices shall be free of rust and clean when installed in the concrete.
4. The Contractor has the option of substituting welded wire fabric in place of reinforcement bars. The welded wire fabric selected shall have an area and distribution of steel at least equal to the plan requirements. The Contractor shall submit their proposed design to the Engineer for approval before any material is ordered.
5. If welded wire fabric is used, the entire width of the bottom layer of concrete shall be struck off to conform to the cross section and elevation indicated on the drawings. The reinforcement shall then be placed immediately upon the concrete, after which the top layer of concrete shall be placed, struck off and screeded. Any portion of the bottom layer of concrete which has been placed more than 15 minutes without being covered with the top layer of concrete shall be removed and replaced with freshly mixed concrete at the Contractor's expense.

E. Joints

1. General
 - a. All transverse and longitudinal joints when required in the pavement shall be of the types indicated and shall be at required location, on required alignment, in required relationship to tie bars and joint assemblies and in accordance with details indicated. When no transverse joints are indicated, joints shall not exceed 40 feet (13.1 meters). Such stakes, braces, brackets or other devices shall be used as necessary to keep the entire joint assembly in true vertical and horizontal



position. Where concrete base is overlaid by asphaltic concrete, the joints to be prepared as specified herein, but joint sealing will not be required unless indicated.

- b. If necessary for proper installation of the sealer, excessive spalling of the joint groove shall be repaired to the satisfaction of the Engineer.
- c. Careful workmanship shall be exercised in the construction of all joints to insure that the concrete sections are completely separated by an open joint or by the joint materials and to insure that the joints will be true to the outline indicated on the drawings. The Contractor shall install joint materials, which will function as a compatible system. Joint sealer shall not be placed where a bond breaker is present.
- d. Green concrete or wet sawed joints are permitted provided the Contractor cleans the joint within 5 minutes after cutting with a 3,000 psi (20.7 mPa) water blast followed by a minimum of 7 day cure and sand blast the saw cut immediately prior to placing joint sealer.
- e. Dry sawed joints are permitted provided the Contractor sand blasts the saw cut immediately prior to placing joint sealer.

2. Expansion Joints

- a. Transverse expansion joints shall be formed perpendicular to the centerline and surface of pavement and shall be constructed in accordance with the sequence of operations indicated on the drawings. After the transverse finishing machine and before the longitudinal finishing machine have passed over the joint, the Contractor shall test the joint filler for correctness of position and make any required adjustment in the position of the filler and shall install the joint seal space form as indicated on the drawings. After removal of the joint seal form as indicated on the drawings, the joint seal space above the joint filler shall be thoroughly sandblasted or machine routed to remove all projecting concrete, laitance, dirt or foreign matter. The concrete faces of the joint seal space shall be left true to line and section throughout the entire length of the joint. On completion of curing of the pavement, the joint sealing filler of the type specified shall be placed as indicated. The faces of the joint seal space shall be clean and surface dry at the time joint sealing filler is placed. On completion of the joint seal, the pavement adjacent to the joint shall be left free of joint sealing material. The joint seal space shall be exactly above and not narrower than the joint filler with no concrete overhangings.

3. Weakened Plane Joints

- a. Weakened plane joints shall consist of transverse contraction joints and longitudinal joints and shall be formed or sawed as indicated on the drawings. When the joints are sawed, the saw shall be power driven, shall be manufactured especially for the purpose of sawing concrete and shall be capable of performing the work. Saw blades shall be as indicated. Tracks adequately anchored, the chalk, string line or other approved methods shall be used to provide true alignment of the joints. The concrete saw shall be maintained in good operating condition and the Contractor shall keep a standby power saw on the project at all times when concrete operations are under way.
- b. If membrane curing is used, the portion of the seal, which has been disturbed by sawing operations, shall be restored by the Contractor by spraying the areas with additional curing seal.



- c. Forming, finishing and sealing of the joint seal space shall conform to this item, described above and details indicated on the drawings.
4. Contraction Joints
- a. Transverse contraction joints shall be formed or sawed joints perpendicular to the centerline and surface of the pavement and shall be constructed by the method and in the sequence of operations as indicated. Where sawed joints are used, contraction joints at intervals indicated shall be sawed as soon as sawing can be accomplished without damage to the pavement and before 24 hours after the concrete has been placed, the exact time to be approved by the Engineer or designated representative. The remaining contraction joints shall be sawed in a uniform pattern as directed by the Engineer or designated representative and they shall be completed before uncontrolled cracking of the pavement takes place. All joints shall be completed before placing concrete in succeeding lanes and before permitting traffic to use the pavement.
5. Longitudinal Joints
- a. Longitudinal joints shall be of the type or alternate types indicated and shall be constructed of specified materials in accordance with provisions indicated on the drawings. Longitudinal joints shall be constructed accurately to required lines, shall be perpendicular to the pavement surface at the joint and the pavement surface over and adjacent to the joint shall be finished as specified on the drawings.
 - b. Longitudinal joints shall be sawed as soon as sawing can be accomplished without damage to the pavement. Sawing shall not cause damage to the pavement and the groove shall be cut with a minimum of spalling. No traffic (including construction traffic) shall be permitted on pavement until the longitudinal joint is cut.
6. Construction Joints. Intentional stoppage of the placing of the concrete shall be at either an expansion joint or at a weakened plane joint. The following provisions shall govern for each type of joint at which the placing of concrete is stopped:
- a. When the placing of concrete is stopped at an expansion joint, the complete joint assembly shall be installed and rigidly secured in required position as indicated. A bulkhead of sufficient cross sectional area to prevent deflection, accurately notched to receive the load transmission devices or dowels, as the case may be, and shaped accurately to the cross section of the pavement shall be provided and installed as a back-up for the joint filler and rigidly secured in required position to permit accurate finishing of the concrete up to the joint. After the concrete has been finished to the joint, formation of the joint seal space and finishing of the joint shall be executed as specified herein and as indicated. The backup bulkhead shall remain in place until immediately prior to the time when concrete placement is resumed, then it shall be carefully removed in such manner that no element of the joint assembly will be disturbed. The exposed portion of the joint assembly shall be free of adherent concrete, dirt or other material at the time placing of concrete is resumed.
 - b. When placing of concrete is stopped at a weakened plane joint, all applicable provisions of paragraph (a) above shall apply in addition to the following requirement:

The face of the bulkhead adjoining the slab end shall be notched and grooved to fit the exposed half section of the joint assembly and shall be shaped to form the slab end at the center of the joint as indicated on the drawings. The 1/2 width of joint seal space may be formed by a strip of required section placed and removed as indicated for construction of



transverse contraction joints. The Contractor shall have available a bulkhead shaped to section of the pavement. This bulkhead must be drilled to permit the continuation of all longitudinal reinforcing steel through the construction joint and shall be of sufficient section and strength to prevent deflection.

- c. When load transmission devices are not provided in the design, intentional stopping of placement of concrete shall occur in the middle of a slab. Provisions shall be made to provide a bulkhead, which will accommodate tie bars of the same length, size and spacing as tie bars used for the longitudinal joints. When the concrete placement is resumed, the bulkhead shall be removed without bending tie bars or damaging the concrete. The joint seal space and sealer shall be the same as for longitudinal joints.

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

F. Joint Sealers

1. Class 2 Material. This material shall conform to TxDOT DMS-6310, "Joint Sealants and Fillers".

For placement in vertical joints (curb faces, etc.) either of the following procedures may be used.

- a. An amount of the mixed material may be set aside until partial curing has taken place and carefully trowelled into the joint with a suitable tool.
 - b. The portion of the joint in the roadway shall be poured and cured. The vertical curb faces shall then be taped or formed and the material poured into the vertical joint from the top.
2. Class 5 Material. This material together with backer rods shall be applied as indicated in accordance with manufacturer's recommendations.

G. Asphalt Board

1. Premolded materials, wherever used, shall be anchored to the concrete on one side of the joint by means of copper wire or nails not lighter than No. 12 B and S gage. Such anchorage shall be sufficient to overcome the tendency of the material to fall out of the joint. The Contractor shall not contaminate joints to receive Class 5 Joint Material with asphalt from the asphalt board.

H. Curbs

1. The curb shall be constructed in lengths equal to the adjoining pavement slab lengths and expansion joints shall be provided in the curb opposite each transverse expansion joint in the pavement. Expansion joint material shall be of the same thickness, type and quality as indicated for the pavement and shall be of the section as indicated for the curb. All expansion joints shall be carried through the curb, sidewalk and retaining walls when these items are indicated.



2. When sawed joints are provided for the pavement, the curb placement shall be delayed until all transverse joints have been sawed. To provide bond for the curb, dowel bars shall be placed as indicated on the drawings, while the pavement concrete is still plastic.
3. Weakened plane joints shall be formed in monolithic curbs at a spacing to coincide with the joints in the concrete pavement. The joints shall be formed by inserting in the curb an asphaltic board strip cut to conform to the shape of the curb. When the concrete is sufficiently set, the joint on the top and face of curb shall be grooved with an approved type of grooving tool.
4. A finish coat of mortar shall be applied on the exposed surfaces of the monolithic curbs. The mortar shall be composed of 1 part of Portland Cement and 2 parts of fine aggregate. A mortar coat will not be required for extruded curbs.
5. The curb face, lower radius and top of curb shall be plastered with the sand-cement mortar. The mortar shall be applied with a template or "mule" made to conform to the curb dimensions as indicated. All exposed surfaces of the curb shall be finished with a steel trowel and brushed to a smooth and uniform surface. The mortar finish as required shall be included in the unit price bid for this item.

I. Machine Finishing

1. All concrete pavement shall be finished mechanically with approved self-propelled machines, except as herein provided. Hand finishing will be permitted on the transition from a crowned section to a superelevated section without crown on curves, on straight line superelevation sections less than 300 feet (91.4 meters) in length, on that portion of a widened pavement outside normal pavement width and on sections where the pavement width is not uniform, isolated, narrow in width or required monolithic widths are greater than that of available finishing machines.
2. Machine finishing of pavement shall include the use of power-driven vibrators, power-driven transverse strike off and screed or such alternate equipment as may be substituted and approved under this item.
3. All concrete pavement shall be consolidated by a mechanical vibrator. As soon as concrete has been spread between the forms, the approved mechanical vibrator shall be operated to consolidate the concrete and remove all voids. Hand manipulated vibrators shall be used for areas not covered by the mechanical vibratory unit.
4. The transverse finishing machine shall first be operated to compact and finish pavement to the required section and grade, without surface voids. The machine shall be operated over each area as many times and at such intervals as directed. At least 2 trips will be required and the last trip over a given area shall be a continuous run of not less than 40 feet (12.2 meters). After completion of finishing with the transverse finishing machine, a transverse drag float may be used.
5. The consistency of the concrete as placed should allow completion of finishing operations without the addition of water to the surface. When field conditions are such that additional moisture is needed for the final concrete surface finishing operation, the required water shall be applied to surface by fog spray only and shall be held to a minimum.
6. After finishing is complete and the concrete still workable, the surface shall be tested by the Contractor for trueness with an approved 10 foot (3.05 meter) straightedge. The straightedge shall be operated from the side of the pavement, placed parallel to the pavement centerline and passed across the slab to reveal any high spots or depressions. The straightedge shall be advanced along the pavement in successive stages of not more than 1/2 its length. Practically perfect contact of the straightedge with the surface will be required and the pavement shall be leveled to this condition, in order to insure conformity



with the surface test required below after the pavement has fully hardened. Any correction of the surface required shall be accomplished by adding concrete if required and by operating the longitudinal float over the area. The surface test with the straightedge shall then be repeated.

7. For one lane pavement placement and uniform widening, the equipment for machine finishing of concrete pavement shall be as directed by the Engineer or designated representative but shall not exceed requirements of these specifications.
8. After completion of the straightedge operation, as soon as construction operations permit, texture shall be applied with 1/8 inch (3 mm) wide metal tines with clear spacing between the tines being not less than 1/4 inch (6.3 mm) nor more than 1/2 inch (12.7 mm).
9. If approved by the Engineer or designated representative, other equipment and methods may be used, provided that a surface texture meeting the specified requirements is obtained. The texture shall be applied transversely. It is the intent that the average depth resulting from the number of tests directed by the Engineer or designated representative be not less than 0.060 inch (1.52 mm) with a minimum texture depth of 0.050 inch (1.27 mm) for any one test when tested in accordance with TxDOT Test Method Tex-436-A. Should the texture depth fall below that intended, the finishing procedures shall be revised to produce the desired texture.
 - a. Emergency Procedures
 - b. The Contractor shall have available at all times hand rakes with tines for the purpose of providing textures in the event of equipment breakdown.
 - c. The Contractor also shall have available a conventional garden spray type can containing a commercially available monomolecular film compound. This shall be applied in the case of equipment breakdown or other emergencies to prevent the pavement from drying too rapidly. The use of this product will give the Contractor additional time to provide adequate texturing.
 - d. After completion of texturing and about the time the concrete becomes hard, the edge of the slab and joints shall be carefully finished with an edger in a workmanlike manner and the pavement shall be left smooth and true to line.

J. Hand Finishing

1. Hand finishing shall be resorted to only in those conditions provided for above and upon specific authorization by the Engineer or designated representative. When hand finishing is permitted, concrete shall be struck off with an approved strike off screed to such elevation that when consolidated and finished the surface of the pavement to conform to the required section and grade. The strike template shall be moved forward with a combined transverse and longitudinal motion in the direction work is progressing, maintaining the template in contact with the forms and maintaining a slight excess of material in front of the cutting edge. The Concrete shall then be tamped with an approved tamping template to compact the concrete thoroughly and eliminate surface voids and the surface screed to required section.
2. After completion of a strike off, consolidation and transverse screeding, a hand-operated longitudinal float shall be operated to test and level the surface to the required grade.
3. Workmen shall operate the float from approved bridges riding on the forms and spanning the pavement. The longitudinal float shall be held in contact with the surface and parallel to the centerline and operated with short longitudinal strokes while being passed from one side of the pavement to the other. If contact with the pavement is not made at all points, additional concrete shall be placed, if required and screed and the float shall be used to produce a satisfactory surface. Care shall be exercised to keep the ends of the float from



digging into the surface of the pavement. After a section has been smoothed so that the float maintains contact with the surface at all points in being passed from one side to the other, the bridges may be moved forward half the length of the float and the operations repeated.

4. Other operations and surface tests shall be as required for machine finishing.

K. Surface Testing

After the concrete has been placed 12 hours or more, the Engineer or designated representative will test the surface of the pavement with a 10-foot (3.05 meter) straightedge placed parallel to the centerline. Unless specified otherwise, the surface shall not vary from the straightedge by more than 1/16 inch per foot (5 mm per meter) from the nearest point of contact and in no case shall the maximum ordinate from a straightedge to the pavement be greater than 1/8 inch (3 mm). Any high spots causing a departure from the straightedge in excess of that specified shall be ground down by the Contractor to meet the surface test requirements. Where the texture of the pavement is removed by extensive grinding, the texture shall be restored by grooving the concrete to meet the surface finishing specifications.

L. Curing

All concrete pavement shall be cured by protecting it against loss of moisture for a period of not less than 72 hours from the beginning of the curing operations. Immediately after finishing operations have been completed, the entire surface of the newly laid concrete shall be covered and cured in accordance with the requirements specified for whichever of the following methods the Contractor may elect. Newly laid concrete base to be overlaid by asphaltic concrete shall not be cured by "Membrane Curing" and surfaces not to be overlaid by asphaltic concrete shall not be cured by "Asphalt Curing." In all cases in which curing requires the use of water, the curing shall have prior right to water supply or supplies. Failure to provide sufficient cover material of the type the Contractor elects to use, failure to maintain saturation in wet curing methods, lack of water to adequately take care of both curing and other requirements or other failures to comply with curing requirements shall be cause for immediate suspension of concreting operations. The covering material used in curing shall be removed as necessary to saw joints or to comply with the requirements for "Surface Test." The concrete surface shall be maintained wet with a water spray if indicated and the covering material replaced immediately on completion of sawing and testing and any required surface correction.

1. Waterproofed Paper Curing

- a. Immediately after the finishing of the surface has been completed and the concrete has taken its initial set, it shall be wetted with water applied in the form of a fine spray and covered with waterproofed paper so placed and weighted as to cause it to remain in intimate contact with the surface. Waterproofed paper used for the curing of concrete pavement shall be of a type and quality approved by the Engineer. It shall be sufficiently strong and tough to permit its use under the conditions existing on street paving work without being torn or otherwise rendered unfit for the purpose during the curing period. The paper covering shall be maintained in place continuously for not less than the specified curing period.
- b. The waterproofed paper shall be prepared to form blankets of sufficient width to cover the entire surface and both edges of the pavement slab and such blankets shall not be more than 60 feet in length. All joints in the blankets occasioned by joining paper sheets shall lap not less than 5 inches (12.7 cms) and shall be securely sealed with asphalt cement having a melting point of approximately 180°F (82.2°C). Blankets shall be placed to secure an overlap of at least 12 inches (30.5 cms) and this lap securely weighted to form a closed joint.



- c. The waterproofed paper blankets shall be adequately weighted to prevent displacement or billowing due to wind and the paper folded down over the side of the pavement shall be secured by a continuous bank of earth. Plowing of this windrow into place will not be permitted.
- d. All tears or holes appearing in the paper during the curing period shall be immediately repaired by cementing patches over such defects. It shall be the Contractor's responsibility to prevent damage to paper blankets, which would affect their serviceability and effectiveness as a concrete curing method. Blankets may be rejected by the Engineer or designated representative at any time when, in his opinion, they do not provide an airtight covering.
- e. Paper blankets rejected on account of pinholes or minor tears may be continued in service by folding the blanket over lengthwise, first thoroughly spraying 1/2 the blanket with the asphalt cement used for seams. The 2 thicknesses shall be firmly pressed together and well cemented. Blankets shall be of a width sufficient to cover the pavement surface and both edges. Doubled blankets may be rejected for the same cause as provided for single blankets. All paper blankets rejected by the Engineer shall be immediately marked by the Contractor for identification and then destroyed or stored entirely separate from approved blankets.
- f. No walking on paper shall be permitted at any time and, in locations where pedestrian traffic cannot be entirely controlled, the Contractor shall provide walkways and barricades or shall substitute other permissible curing methods on such sections of pavement.

2. Polyethylene Film Curing

- a. Immediately after the finishing of the surface has been completed and the concrete has taken its initial set, it shall be wetted with water applied in the form of a fine spray and covered with the polyethylene film so placed and weighted as to cause it to remain in intimate contact with the surface. The polyethylene film covering shall be maintained in place continuously for not less than the specified curing period.
- b. The film shall be prepared to form blankets of sufficient width to cover the entire surface and both edges of the pavement slab. All joints in the blankets occasioned by joining film sheets shall lap not less than 12 inches (30.5 cms). All joints shall be sealed in a manner acceptable to the Engineer or designated representative to provide a moisture-proof lap.
- c. The polyethylene film blankets shall be adequately weighted to prevent displacement or billowing due to wind and the film folded down over the side of the pavement shall be secured by a continuous bank of earth. Plowing of this windrow into place not to be permitted.
- d. All tears or holes appearing in the polyethylene film during the curing period shall be immediately repaired by placing acceptable moisture proof patches over such defects or by replacing the blankets. It shall be the Contractor's responsibility to prevent damage to the film blankets, which would affect their serviceability and effectiveness as a concrete curing method. Blankets may be rejected by the Engineer at any time when, in his opinion, they do not provide an airtight covering.
- e. Polyethylene film blankets rejected on account of pinholes or minor tears may be continued in service when repaired to an airtight condition. All polyethylene film blankets rejected by the Engineer or designated representative shall be



immediately marked by the Contractor for identification and then destroyed or stored entirely separate from approved blankets.

- f. Should the film blanket be damaged or torn for any cause during the first 72 hours of the curing period such damage shall be repaired immediately.

3. Membrane Curing

Immediately after the finishing of pavement has been completed and after the free surface moisture has disappeared, the pavement shall be sprayed uniformly with a curing compound. Membrane curing shall conform to Section 806, "Membrane Curing," Type 2 white pigmented. Should the film of compound be damaged from any cause before the expiration of 72 hours after original application, the damaged portions shall be repaired with additional compound. Unless otherwise indicated on the drawings, membrane curing shall be used when the concrete (except that concrete to be used as a base) is placed with a slip form paver.

4. Asphalt Curing

Where emulsified asphalt is used for curing concrete base, the material shall conform to TxDOT Item 300, "Asphalts, Oils and Emulsions," for the type and grade shown on the drawings. The rate of application may vary between the limits of 1 gallon per 180 square feet and 1 gallon per 90 square feet (1 liter per 4.4 square meters and 1 liter per 2.2 square meters). The rate of application will be determined by the Engineer or designated representative, after observation of sections where amounts varying between the above limits have been applied. If it is found necessary to add water to the emulsion for the proper distribution through the spray, this may be done upon approval of the Engineer or designated representative. When the emulsion is diluted with water the amount of the applied mixture shall be increased to give a coverage of the original emulsion between the limits as set out herein. Care shall be taken to properly mix the emulsion and water and to keep the mixture well agitated during application.

M. Protection of Pavement

1. The Contractor shall erect and maintain the barricades indicated on the drawings and such other standard and approved devices as will exclude public traffic and traffic of the Contractor's employees and agents from the newly placed pavement for a minimum of 14 days. Portions of the roadway or crossings of the roadbed required to be maintained open for use by traffic shall not be obstructed by above required barricades. Crossings of the pavement indicated on the drawings or by construction sequence, during the period prior to opening to traffic as herein indicated, shall be provided with an adequate and substantial bridge approved by the Engineer or designated representative.
2. Curb shall be backfilled to the full height of the concrete, tamped and sloped as indicated on the drawings or as directed by the Engineer. The top 4 inches (10 cms) of backfill shall be of clean, friable soil capable of supporting plant life. This material shall also be free of stones and all other debris.

N. Opening Pavement to Traffic

1. The pavement shall be closed to traffic, including vehicles of the Contractor, until the concrete is at least 14 days old and has attained an average compressive strength acceptable to the Engineer or designated representative. This period of closure to traffic may be extended if, in the opinion of the Engineer or designated representative, weather or other conditions make it advisable to provide an extension of the time of protection.
2. At the end of the 14 day period and as long thereafter as ordered by the Engineer or designated representative and if so desired by the Contractor, the pavement may be opened



for use by vehicles of the Contractor provided the gross weight (vehicle plus load) of such vehicles does not exceed 14,000 pounds (6,350 KGs). Such opening, however, shall in no manner relieve the Contractor from his responsibility for the work. On those sections of the pavement thus opened to traffic, all joints shall first be sealed, the pavement cleaned and topsoil placed against the pavement edges or behind the curb where turf or vegetation is to be established before permitting vehicles thereon.

3. After the concrete in any section is 14 days old or as long thereafter as ordered by the Engineer, such section of pavement may be opened to all traffic indicated on the drawings or when so directed by the Engineer or designated representative. On those sections of the pavement thus opened to traffic, all joints shall first be sealed, the pavement cleaned and 4 inches (10 cms) of top soil placed against the pavement edges and all other work performed as required for the safety of traffic. Such opening, however, shall in no manner relieve the Contractor from his responsibility for the work.
4. When High Early Strength Concrete, resulting from the use of Type III cement as indicated on the drawings is used, the pavement may be opened to all traffic after the concrete is 7 days old or as long thereafter as ordered by the Engineer or designated representative, subject to the same provisions governing the opening after 14 days as above indicated.
5. Where the Contractor desires to move any equipment not licensed for operation on public streets, on or across any pavement opened to traffic, he shall protect the pavement from damage by means of 2 ply timber mats of 2 inch (5 cm) stock or runways of heavier material laid on a layer of earth, all as approved by the Engineer or designated representative.

a. Emergency Opening to Traffic

The Engineer or designated representative may require the opening of pavement to traffic prior to the minimum time specified above under conditions of emergency, which in his opinion require such action in the interest of the public. In no case will the Engineer or designated representative order opening of the pavement to traffic within less than 72 hours after the last concrete in the section is placed. The Contractor shall remove all obstructing materials, place earth against pavement edges and perform other work involved in providing for the safety of traffic as required by the Engineer or designated representative in ordering emergency opening. Orders for emergency opening of the pavement to traffic will be issued by the Engineer or designated representative in writing.

809.6

PENALTY FOR DEFICIENT PAVEMENT THICKNESS OR STRENGTH

The adjustment in unit prices provided for in this item will apply only when measurement for payment is by the square yard.

It is the intent of this specification that the pavement be constructed in strict conformity with the thickness, strength and typical sections indicated on the drawings. Where any pavement is found not so constructed, the following rules relative to adjustment of payment for acceptable pavement and to replacement of faulty pavement shall govern.

A. Pavement

1. The pavement will be core drilled after any grinding operations have been completed for surface corrections prior to final acceptance. Locations of core tests may be selected by the Engineer or designated representative; however, spacing interval for core tests, as specified herein, shall be maintained. The thickness of the pavement will be determined by measurement of the cores in accordance with TxDOT Test Method Tex-424-A.



2. For the purpose of establishing an adjusted unit price for pavement, units to be considered separately are defined as 1,000 linear feet of pavement in each traffic lane starting at the end of the pavement bearing the smaller station number. The last unit in each lane shall be 1,000 feet plus the fractional part of 1,000 feet remaining. Traffic lane width will be as shown on typical sections and pavement design standards.
3. For the purpose of establishing an adjusted unit price for ramps, widening, acceleration and deceleration lanes that are machine placed, isolated pavements of traffic lane width but less than 1,000 feet in length and other areas designated by the Engineer or designated representative, units will be considered separately and are defined as 1,000 square yards of pavement or fraction thereof.
4. One core will be taken at the location selected by the Engineer or designated representative or at random in each unit. When the measurement of the core from any unit is not deficient more than 0.2 inches from the plan thickness, full payment will be made. When the measurement of the core from any unit is deficient more than 0.2 inch but not more than 0.75 inch from the plan thickness, 2 additional cores will be taken from the unit and the average of the 3 cores determined. The 2 additional cores from any 1,000-foot unit will be taken at intervals of not less than 300 feet. The 2 additional cores from any 1,000 square yard unit will be taken at locations such that the pavement in the unit will be well represented. If the average measurement of these 3 cores is not deficient more than 0.2 inches from the plan thickness, full payment will be made. If the average thickness of the 3 cores is deficient by more than 0.2 inch but not more than 0.75 inch from the indicated thickness, an adjusted unit price as provided below will be paid for the areas represented by these cores.
5. In calculating the average thickness of the pavement, measurements which are in excess of the specified thickness by more than 0.2 inch will be considered as the specified thickness plus 0.2 inch and measurements which are less than the specified thickness by more than 0.75 inch will be considered as the specified thickness less 0.75 inch.
6. When the measurement of any core is less than the specified thickness by more than 0.75 inch, the actual thickness of pavement in this area will be determined by taking additional cores at 10 foot intervals parallel to the center line in each direction from the deficient core until, in each direction, a core is taken which is not deficient by more than 0.75 inch. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price. Exploratory cores are to be used only to determine the length of pavement in a unit that is to be left in place without pay and/or removed and replaced as provided herein.
7. For new Concrete Pavement roadways, and for Concrete Pavement rehabilitation and overlay projects, if cracks develop in the pavement surface within the one year warranty period, the Contractor shall seal the cracks in accordance with TxDOT Item 438, "Cleaning and Sealing Joints and Cracks (Rigid Pavement and Bridge Decks)", or perform other corrective measures as directed by the Engineer. Payment for this work will be considered subsidiary to Concrete Pavement, unless included as a separate pay item in the Contract.
8. Irrespective of an acceptable overall project average for any or all of the Pay-Adjustment Acceptance Factors, limited substandard portions of the work, as determined by the Engineer or designated representative, shall be remedied or removed and replaced to the satisfaction thereof.

B. Price Adjustments

1. After any grinding or milling operations have been completed to meet the surface-testing requirement of this specification, if average thickness of pavement is deficient in thickness



by more than 0.2 inch, but not more than 0.75 inch, payment will be made at an adjusted price as specified in the following table:

Concrete Pavement Deficiency	
Deficiency in Thickness Determined by Cores, Inches	Proportional Part of Contract Price Allowed
0.00 to 0.20	100 percent
0.21 to 0.30	80 percent
0.31 to 0.40	72 percent
0.41 to 0.50	68 percent
0.51 to 0.75	57 percent

1. Any area of pavement found deficient in thickness by more than 0.75 inch but not more than 1 inch or 1/8 of the indicated thickness, whichever is greater, shall be evaluated by the Engineer. If, in the judgment of the Engineer, the area of such deficiency should not be removed and replaced, there will be no payment for the area retained. If, in the judgment of the Engineer, the area of such deficiency warrants removal, the area shall be removed and replaced at the Contractor's entire expense, with concrete of the thickness indicated on the drawings.
2. Any area of pavement found deficient in thickness by more than 1 inch or more than 1/8 of the indicated thickness, whichever is greater, shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness indicated on the drawings.
3. No additional payment over the Contract unit price will be made for any pavement of a thickness exceeding that indicated on the drawings.
4. If the average compressive strength based on concrete test cylinders at 28 days is less than the specified minimum strength of the concrete, then payment will be made at an adjusted price as specified in the following table.

Pay Adjustment Factor for Deficient Compressive Strength	
Ratio of Average Strength from Test Cylinders to Specified Minimum Compressive Strength both at 28 Days	Proportional Part of Contract Price Allowed
More than 0.95	100 percent
0.90 to 0.95	85 percent
0.85 to 0.90	70 percent
0.80 to 0.85	60 percent
Less than 0.80	0 percent (Remove & Replace)

5. When, in the opinion of the Engineer or designated representative, the compressive strength test results appear unrepresentative, additional testing of field cores may be authorized. To be considered acceptable for consideration the field cores shall be acquired, properly handled and tested in accordance with ASTM C 42/C 42M, "Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete" within 45 days of the original concrete placement date. The retesting will be at the expense of the Contractor and the results of the retesting shall be averaged with the results of the original



testing. If the results of retesting indicate that the original test results were erroneous in the opinion of the Engineer or designated representative, the original test results will be discarded. In the instance of erroneous original test results the subsequent first set of retests will be at the expense of the City of Killeen.

6. When, in the opinion of the Engineer or designated representative, the concrete compressive strength is deemed unacceptable for the intended use of the pavement, the concrete shall be removed and replaced to the limits indicated by test results.

809.9

MEASUREMENT

- A. When indicated, concrete pavement will be measured by the square yard of surface area of completed and accepted work. The surface area shall be so measured to also include that portion of pavement slab extending beneath the curb. When concrete pavement is to be measured by the square yard and monolithic curb is required, measurements for "Monolithic Curb" will be by the linear foot complete in place.
- B. When indicated on the drawings, concrete pavement, including monolithic curb when required, will be measured by the cubic yard of absolute volume of materials entering the mixture.

809.10

PAYMENT

- A. The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Concrete Pavement," of the depth indicated on the drawings, "Concrete Pavement (High Early Strength)" of the depth indicated on the drawings and "Monolithic Curb" of the type indicated on the drawings (when pavement is measured by the square yard), as required or adjusted unit price for pavement of deficient thickness as provided under "Deficient Pavement Thickness", which price shall be full compensation for shaping and fine grading the roadbed, including furnishing and applying all water required; for furnishing, loading and unloading, storing, hauling and handling all concrete ingredients, including all freight and royalty involved; for placing and adjusting forms, including supporting material or preparing track grade; for mixing, placing, finishing, sawing, cleaning and sealing joints and curing all concrete; for furnishing and installing all reinforcing steel; for furnishing all materials for sealing joints and placing longitudinal, expansion and weakened plane joints, including all steel dowel caps and load transmission devices required and wire and devices for placing, holding and supporting steel bars, load transmission devices and joint filler material in proper position, for coating steel bars where complete the work.
- B. Excavation required by this item in the preparation of the subgrade and for completion of the parkway will be measured and paid for in accordance with provisions governing the Items of "Street Excavation" and "Borrow," respectively, with provision that yardage to be measured and paid for once only, regardless of manipulations involved. Measurement of subgrade excavation for payment shall be limited to a total width of that of pavement plus 1 foot on each side.
- C. Sprinkling and rolling required for the compaction of the rough subgrade in advance of fine grading will be measured and paid for as indicated in the governing items of excavation. Maintenance of a moist condition of the subgrade in advance of fine grading and concrete placing will not be paid for directly but shall be included in the unit price bid, as provided above.

END OF SECTION



SECTION 800 – CONCRETE SPECIFICATIONS

ITEM 810. SHOTCRETE

810.1 SCOPE OF WORK

The work shall consist of furnishing, mixing, applying and curing shotcrete. Except as otherwise specified, either a dry mix or wet mix process may be used.

810.2 MATERIALS

- A. Portland cement shall conform to the requirements TxDOT DMS-4600, "Hydraulic Cement" for the specified type.
- B. Aggregates shall conform to the requirements of ASTM C33 normal weight aggregate with combined gradation of coarse and fine aggregates conforming to ACI 506.2, Gradation No. 1 or Gradation No. 2 as applicable to the work.
- C. Admixtures, if specified, shall meet the requirements indicated. Non-chloride chemical admixtures shall conform to ASTM C 494. Air-entraining admixtures shall conform to ASTM C 260. Fly ash or pozzolanic materials shall conform to ASTM C 618. Calcium chloride shall conform to ASTM D 98 and shall be in flake or pellet form.
- D. Water used in mixing or curing shotcrete shall be clean and free from injurious amounts of oil, salt, acid, alkali, organic matter or other deleterious substances.
- E. Curing compound shall conform to the requirements of Section 806, MEMBRANE CURING.

810.3 STRENGTH AND QUALITY

- A. The compressive strength of shotcrete at the age of 28 days shall be not less than 4,000 psi.
- B. Shotcrete shall be uniform and dense, free from "drummy" areas that indicate laminations, voids, sand pockets, or disbanded material.

810.4 CONSISTENCY

- A. The proportion of water added to the mixture shall be accurately controlled to produce thorough and uniform hydration of the shotcrete. The consistency of the shotcrete shall be such that the surface of the shotcrete in place shall have a rich, glossy appearance and that the shotcrete shall adhere to the supporting surface without flowing, slumping or sloughing. For application to vertical or overhanging surfaces the mix proportions shall be adjusted so that the placed shotcrete will adhere to a minimum thickness of 3/4-inch without sagging or sloughing. For adjustment of consistency the addition of fly ash or pozzolanic material to the mixture in amounts not greater than 20-percent (by weight) of cement in the mixture will be permitted.

810.5 INSPECTION AND TESTING

- A. Procedures for preparing shotcrete test panels and the testing specimens sawed or cored from panels will be performed in accordance with ASTM Method C 1140. The compression test specimens will be cores taken from the test panels or from the structure.
- B. Similar panels not less than 18 inches square and not less than six (6) inches thick shall be made periodically as directed by the Engineer during the progress of the work.
- C. Cores, taken from the test panels, shall receive standard curing in lime-saturated water at 73.4° +/- 3.0° F within 24 hours after removal. Cores shall continue to receive the prescribed initial cure treatment until standard curing is commenced.



- D. For each strength test, three (3) cores will be tested in compression. The test result will be the average of the strengths of the three (3) specimens, except that if one specimen shows manifest evidence of improper sampling, coring, or testing, it will be discarded and the strengths of the remaining two (2) specimens will be averaged. If more than one (1) specimen representing a test shows such defects, the entire test will be discarded.
- E. The Contractor shall furnish the forms and make the required test panels and shall provide such facilities, materials and assistance as may be necessary for curing, handling, and protecting the panels. Test panels shall be cast only when the Engineer is present.

810.6

NOZZLE OPERATOR QUALIFICATIONS

- A. The nozzle operator shall be able to document a minimum of 3000 hours of experience as a nozzle operator and shall have completed at least one (1) similar application as a nozzle operator, unless otherwise specified.
- B. The nozzle operator and application crew members shall be required to meet pre-construction testing requirements administered by the Engineer on a test panel or an area as follows:
- C. The Engineer will carefully observe shooting of the test panel or area and note if the nozzle operator examinee:
 - 1. Cleans the shooting surface with air and water prior to shooting.
 - 2. Applies a bonding coat on the shooting surface ahead of the heavier shotcrete applications.
 - 3. Directs shotcrete application around reinforcement in a manner which prevents buildup on the face of the reinforcement and allows the shotcrete to flow and compact tightly around the back of the reinforcement.
 - 4. If applicable, directs the finisher or nozzle helper to cutout any sags, sand or rebound pockets.
 - 5. If applicable, and where necessary, directs the finisher or nozzle helper to broom the shotcrete surface prior to application of additional layers.

810.7

MEASURING MATERIALS

- A. The proportions of the shotcrete mix shall be controlled on the basis of the weight of each component material, except that water may be measured by volume. Materials shall have the following batch tolerances of their mix proportion weights: Cement, plus or minus two (2) percent; Aggregate, plus or minus four (4) percent; Admixtures, plus or minus six (6) percent. Weighing equipment used shall be accurate to within 0.4 percent of scale capacity.

810.8

EQUIPMENT

- A. The Contractor shall furnish all equipment necessary for batching, mixing and placing the shotcrete. The equipment shall meet the following requirements.
- B. The placing equipment for dry mix shotcrete shall be designed and equipped to receive the dry mix, introduce the mix into a stream of compressed oil free dry air, convey the mix pneumatically through a delivery hose to a nozzle at the point of discharge, inject water under pressure into the suspended stream of dry sand and cement within the nozzle, and spray the resulting shotcrete mix onto the surface of the work at a uniform rate and at a controlled velocity. The placing equipment shall be equipped with accurate gauges to indicate the air pressure and water pressure and with devices capable of accurately controlling the air pressure at any level between 50-psi and 80-psi, the



water pressure at any level between 50-psi and 100-psi, and the rate of application of water at the nozzle.

- C. The placing equipment for wet mix shotcrete shall be designed and equipped to receive the shotcrete from the mixer, convey it through a delivery hose to a nozzle at the point of discharge, accelerate it in the nozzle by means of compressed oil free dry air, and spray it onto the surface of the work. It shall be capable of delivering shotcrete to the nozzle uniformly and continuously and discharging it from the nozzle at a uniform rate and at a controlled velocity sufficient for all parts of the work.
- D. Batch and continuous mixing equipment shall include: a power-driven mixer capable of thoroughly mixing the materials at a rate adequate to insure uniform feeding of the mixture to the placing equipment; and a feeding apparatus capable of supplying the mixture to the placing equipment at an adequate and uniform rate.

810.9

MIXING

- A. Dry Mix Shotcrete The cement and admixtures and other additives (except accelerator) shall be mixed into a predampened homogeneous mass that thoroughly coats the aggregate before being fed through a vibratory screen into the placing equipment. Proper pre-dampening shall be indicated by the "ball-in-hand" test as follows: When a small amount of mix is tightly squeezed the resulting ball will hold together or crack slightly but essentially remain whole. The mix has too little pre-dampening moisture if the ball crumbles into discrete particles when the hand is opened and/or color is light gray. If moisture comes off on the hand, too much pre-dampening moisture is in the mix. The properly pre-dampened dry mix shall be used within 45 minutes after mixing (15 minutes in hot weather conditions with temperatures over 85° F) and any material that becomes dried out or caked after mixing shall be wasted. Rebound material shall not be remixed or reused.
- B. Wet Mix Shotcrete Air-entrainment and chemical admixtures may only be used in wet mix concrete. The cement, sand, admixtures (except accelerator) and water shall be thoroughly mixed in the mixer drum sufficiently to produce shotcrete of the required consistency that is uniform within each batch and uniform from batch to batch when discharged into the placing equipment.
- C. Accelerators, if specified, shall be mixed at the nozzle. Ready-mix concrete shall conform to the requirements of ASTM C 94 unless otherwise specified.
- D. The entire contents of the mixer shall be discharged from the drum before materials for a succeeding batch are placed therein. A mix that becomes difficult to pump shall be discarded; otherwise, a batch shall be gunned within 1 1/2 hours of batching in normal weather and within 45 minutes during hot weather conditions (temperatures over 85° F). Rebound material shall not be remixed or reused.

810.10

FORMS

- A. Forms shall be structurally adequate and of such design that rebound or accumulated loose sand can freely escape or be readily removed. Shooting strips shall be used at corners, edges, and on surfaces where necessary to obtain true lines and proper thickness. Where practicable, ground wires shall be installed as guides to accurately establish the specified contour of the finished surface of shotcrete. Ground wires shall be set and used as guides for templates in forming curved and molded surfaces. When shotcrete is to be placed on horizontal or sloping surfaces, headers and ground wires shall be provided to the extent necessary to insure control of slab thickness. Ground wires shall be tightened and kept taut, secure, and true to line and plane during placement of shotcrete and shall be removed when placement is completed.
- B. Header boards will be required where the drawings indicate a square edge and at required joints. Form surfaces shall be thoroughly cleaned and a form release agent applied before shotcrete is placed.

810.11

PREPARATION OF SURFACES TO RECEIVE SHOTCRETE



- A. All surfaces to receive or support shotcrete shall be carefully prepared and conditioned. All such prepared surfaces shall be inspected and approved by the Engineer prior to the application of shotcrete.
- B. Earth surfaces to which shotcrete is to be applied shall be firmly compacted and neatly trimmed to line and grade.
- C. Asphaltic concrete surfaces shall be thoroughly cleaned of any growths, earth, or any other material that would affect bond, or be detrimental to the shotcrete.
- D. Concrete, mortar, or rock surfaces shall be thoroughly cleaned by water blasting or sand blasting to remove all dirt, laitance, weak or unbonded mortar, loose material, grease or other deleterious substances.
- E. Surfaces on which the shotcrete is to be placed shall be sufficiently rough to insure the adherence of the shotcrete. Offsets which would cause an abrupt and substantial change in thickness of the shotcrete shall be removed or tapered.
- F. All surfaces shall be maintained in a moistened condition for three (3) hours before application of shotcrete. Shotcrete shall not be applied to mud, dried earth, uncompacted fill, rebound material, or surfaces on which free water exists. All ice, snow and frost shall be removed and the temperature of all surfaces, to be in contact with the new shotcrete shall be no colder than 40° F.

810.12

PLACING

- A. The Contractor shall have all equipment and materials required for curing available at the site and ready for use before placement of shotcrete begins. No shotcrete shall be placed except in the presence of the Engineer or authorized representative. The Contractor shall give reasonable notice to the Engineer each time shotcrete placement is scheduled. Such notice shall be far enough in advance to give the Engineer adequate time to inspect the surfaces to which the shotcrete is to be applied, the forms, steel reinforcement, and other preparations for compliance with the specifications prior to the start of placement operations.
- B. During placement of shotcrete the air pressure shall be adjusted as required to control rebound and density of shotcrete. For a given application, once the optimum operating pressures have been established they shall be maintained constant throughout the application. For dry mix shotcrete, the air pressure at the material outlet or air-inlet on the gun shall be not less than 40 psi plus 5 psi for each 50 feet of length of the discharge hose greater than 100 feet and 5 psi for each 25 feet the nozzle is above the gun (shotcrete delivery equipment). The water pressure at the nozzle shall be not less than 15 psi greater than the air pressure at the material outlet or air-inlet on the gun.
- C. For most applications the placing nozzle shall be held between two (2) and six (6) feet from and approximately normal to the surface of the work. At longer distances it may be necessary to increase the nozzle velocity so that the impact velocity will suit the requirements of the application. Corners shall be filled first.
- D. Shotcrete shall be applied in a single thickness or to a layer thickness no greater than that which will cause sagging, sloughing, or dropout. Sags and sloughs shall be cut out and regunned. Replacement shall be accomplished before the previously placed shotcrete has completely set. When shotcrete is placed on a vertical surface, application shall be started at the bottom and be completed at the top.
- E. In any case when the placing of shotcrete is interrupted for more than one (1) hour, the edge of the layer shall be sloped off at an angle of approximately 45 degrees to the surface being shot, and the sloped portion shall be covered with a double layer of six (6) ounce burlap and kept continuously moist until the application of shotcrete is resumed. Before applying new material, the sloped portion shall be thoroughly cleaned and wetted by means of an air and water blast or an equally effective method approved by the Engineer.



- F. Material that rebounds and accumulates on forms, subgrade surfaces or reinforcing steel ahead of the shotcrete being placed shall be removed and discarded.

810.13

FINISHING

- A. Rebound material shall be carefully swept off the finished shotcrete surface and discarded before it becomes too hard for removal. After the shotcrete has been placed to the depth required, the surface shall be checked with a straightedge or template and any low spots shall be brought up to grade by placing additional shotcrete. The finished surface of the shotcrete shall be left as a natural gun finish unless screeding and or further finishing are specified.
- B. When specified screeding shall be accomplished as follows: Place shotcrete a fraction beyond the guide strips, ground wires or forms. Allow the surface of the shotcrete to stiffen to the point it will not pull or crack under screeding or troweling. Trim, slice, or scrape excess material to true line and grade and remove the placing guides.
- C. A natural rod finish shall consist of the removal, by floating, of the impressions left after the guide strips or ground wires have been removed.
- D. A natural broom finish shall be that finish resulting from brooming the natural rod finish.
- E. A float finish shall be that finish resulting from floating the natural rod finish with a wood or rubber float.

810.14

CURING

- A. Shotcrete shall be prevented from drying for a curing period of at least seven (7) days after it is placed. Exposed surfaces shall be kept continuously moist for the entire period or until curing compound is applied as specified below. Moisture shall be maintained by sprinkling, flooding or fog spraying, or by covering with continuously moistened canvas, cloth mats, straw, sand or other approved material. Wood forms left in place during the curing period shall be kept wet. Formed surfaces shall be thoroughly wetted immediately after forms are removed and shall be kept wet until patching and repairs are completed. Water, or covering, shall be applied in such a way that the shotcrete surface is not eroded or otherwise damaged.
- B. Water for curing shall be clean and free from any substances that will cause discoloration of the shotcrete where finished surfaces will be exposed to view.
- C. Except for surfaces to which additional shotcrete is to be applied, shotcrete may be coated with curing compound as an alternative to the continued application of moisture.
- D. The compound shall be sprayed on the moist shotcrete surfaces as soon as rebound has been removed and any required repairs are completed, or as soon as water curing is discontinued.
- E. The curing compound shall be thoroughly mixed immediately before applied and continuously agitated during application. It shall be applied at a uniform rate of not less than one (1) gallon per 100 square feet of surface for natural gun finishes. Curing compound shall be applied in two (2) applications, one (1) in each direction. If a natural rod, broom, or float finish is specified, the curing compound application rate shall be at least one (1) gallon per 150 square feet. Curing compound shall not check, crack or peel, and shall be free from pinholes or other imperfections.
- F. Curing compound shall not be applied to subgrade surfaces or other surfaces requiring bond with subsequently placed shotcrete, such as construction joints, reinforcing steel and other embedded items.



- G. Surfaces subjected to heavy rainfall or running water within three (3) hours after the compound has been applied, or surfaces damaged by subsequent construction operations during the curing period shall be resprayed in the same manner as for the original applications.
- H. Surfaces covered by the membrane shall not be trafficked unless protected from damage and/or wear.

810.15

REPLACEMENT OR REPAIR

- A. When shotcrete lacks uniformity, exhibits segregation, honeycombing, or laminations, or contains dry patches, slugs, voids or sand pockets the Contractor shall remove and replace the defective shotcrete. The Engineer's concurrence in the extent of removal and replacement is required.
- B. Prior to starting significant removal and replacement work the Contractor shall obtain the Engineer's approval of their plan for making the repair. Such approval shall not be considered a waiver of the Contracting Officer's or owner's right to require complete removal of defective work if the completed repair does not produce shotcrete of the required quality and appearance.
- C. Repair work shall be performed only when the Engineer is present.
- D. Repair shall be made with shotcrete conforming to this specification. When removal of defective shotcrete is required, reinforcement damaged or destroyed shall be replaced prior to replacement of the shotcrete. At the edges of removed sections the sound shotcrete shall be carefully trimmed to the extent required to expose sufficient reinforcement for effecting competent splices. The sound shotcrete at the edges of removed sections shall be trimmed to a slope of approximately 45 degrees with the surface of the work and shall be thoroughly moistened prior to placement of the new shotcrete.
- E. Any portions of the work having thickness less than those specified may be repaired by the placement of additional layers of shotcrete, provided that such repair is expressly approved by the Engineer.
- F. Surfaces of the work to which additional shotcrete is to be applied shall be prepared as required by Section 810.11 of this specification.
- G. Curing as specified in Section 810.14 of this specification shall be applied to repaired areas immediately after the repairs are completed.

810.16

PLACING IN COLD WEATHER

- A. When the atmospheric temperature may be expected to drop below 40° F at the time shotcrete is placed, or at any time during the curing period, the following provisions shall also apply:
 - 1. Shotcrete placement shall be permitted when the air temperature is at least 40° F and rising. Placement shall be discontinued if the temperature falls to 40° F and is expected to continue to fall.
 - 2. The temperature of the shotcrete at time of placing shall not be less than 50° F nor more than 90° F. The temperature of neither aggregates nor mixing water shall be more than 100° F just prior to mixing with the cement.
 - 3. When the daily minimum temperature is less than 40° F, shotcrete shall be insulated or housed and heated after placement. The temperature of the shotcrete and air adjacent to the shotcrete shall be maintained at not less than 50° F nor more than 90° F for the duration of the curing period.
 - 4. Methods of insulating, housing and heating the structure shall be in accordance with "Standard Specification for Cold Weather Concreting," ACI Standard 306.1.



5. The use of accelerators or antifreeze compounds will not be allowed unless otherwise specified.
6. When dry heat is used to protect shotcrete, means of maintaining an ambient humidity of at least 40 percent shall be provided unless the shotcrete has been coated with curing compound as specified in this section or is covered tightly with an approved impervious material.

810.17.

PLACING IN HOT WEATHER

- A. When climatic factors such as high air temperature, reduced relative humidity and increased wind velocities are present, or conditions are such that the temperature of placed shotcrete exceeds 90° F at, or during the first 24 hours after placement, the following provisions shall also apply:
 1. The Contractor shall maintain the temperature of the shotcrete below 90° F during mixing, conveying, and placing using the methods given in items a, b, and c below.
 - a. Exposed shotcrete surfaces which tend to dry or set too rapidly shall be continuously moistened by means of fog sprays or otherwise protected from drying immediately after placement.
 - b. Shotcrete surfaces exposed to the air shall be covered as soon as the shotcrete has hardened sufficiently and shall be kept continuously wet for at least the first 24 hours of the curing period, and for the entire curing period unless curing compound is applied as specified in Section 810.14 of this specification.
 - c. If moist curing is discontinued before the end of the curing period, white pigmented curing compound shall be applied immediately, following the procedures specified in Section 810.14 of this specification.

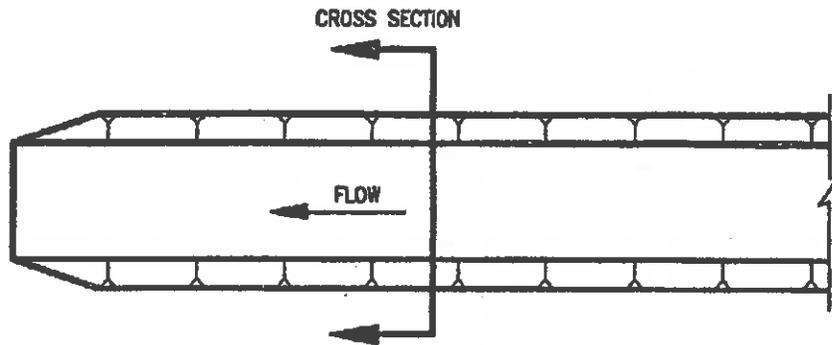
810.18

MEASUREMENT AND PAYMENT

- A. Payment will be made at the contract unit price per square foot for shotcrete. Such payment will constitute full compensation for completion of the work, including making and handling test panels but not including reinforcing steel or other items listed for payment elsewhere in the contract.
- B. Measurement and payment for furnishing and placing reinforcing steel will be made as specified in Section 807, REINFORCING STEEL.

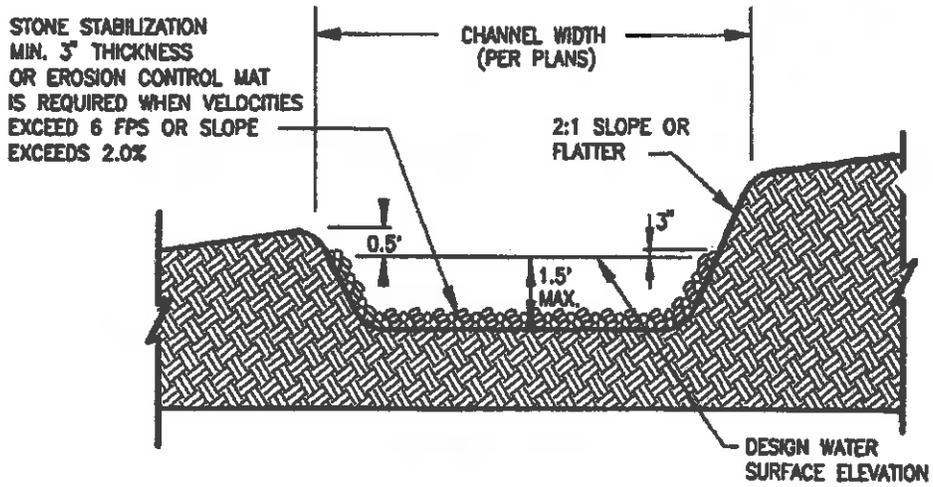
END OF SECTION





PLAN VIEW

N.T.S.



CROSS SECTION

N.T.S.

Figure B-1: Schematic Diagram of an Interceptor Swale

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**INTERCEPTOR
SWALE**

CONSTRUCTION STANDARDS AND DETAILS



PC-1
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

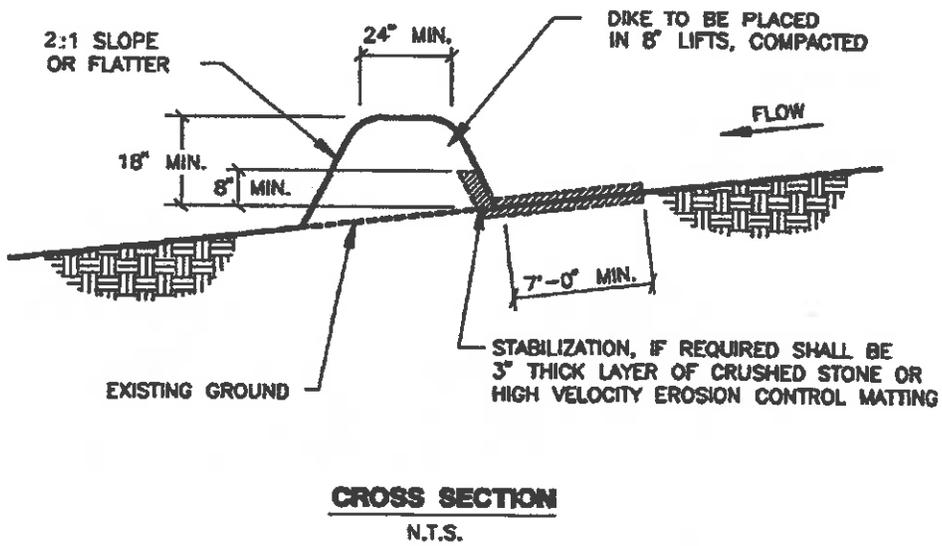
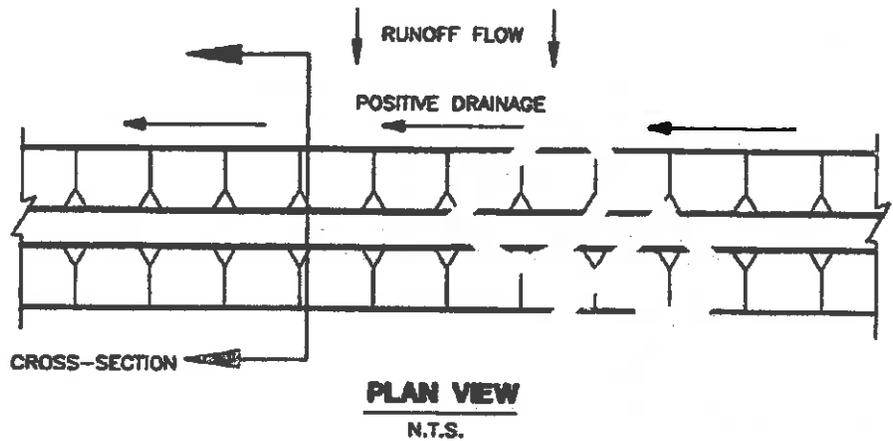


Figure B-2: Schematic of a Diversion Dike

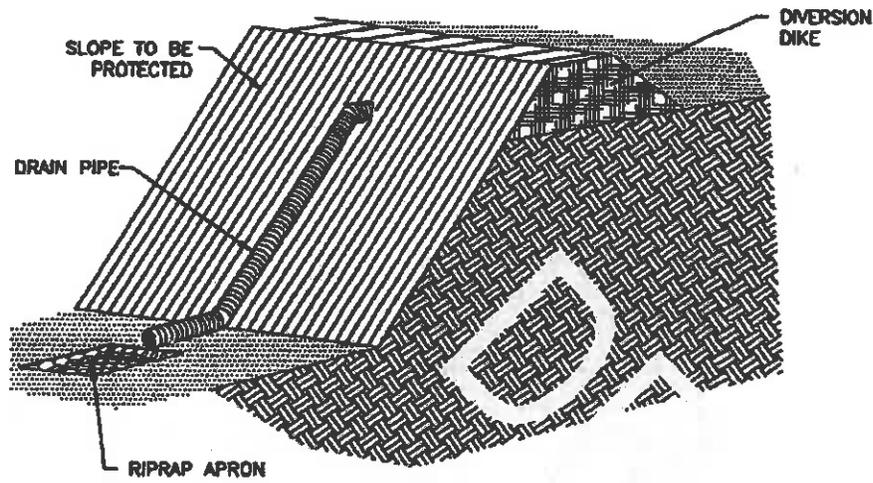
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

DIVERSION DIKE
DETAIL

CONSTRUCTION STANDARDS AND DETAILS

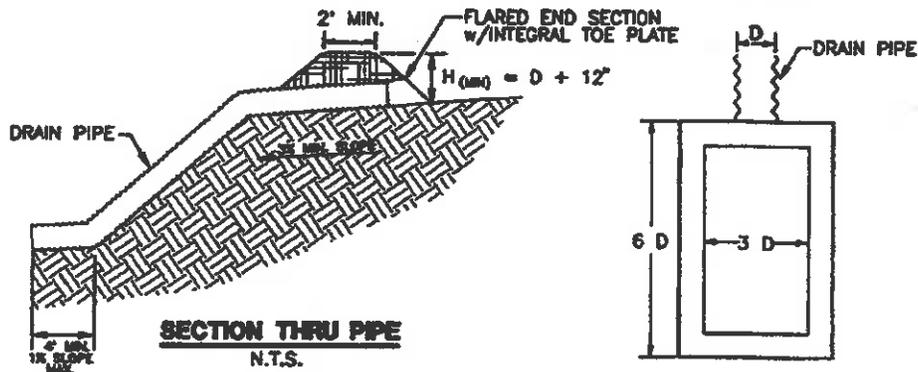


PC-2
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



ISOMETRIC PLAN VIEW

N.T.S.



SECTION THRU PIPE

N.T.S.

RIPRAP APRON PLAN VIEW

N.T.S.

RIPRAP SHALL CONSIST OF 50 TO 150 POUND STONES PLACED IN A LAYER OF NOT LESS THAN 12 INCHES. THE DEPTH OF THE APRON SHALL EQUAL THE PIPE DIAMETER BUT IN NO CASE SHALL IT BE LESS THAN 12 INCHES.

Figure B-3: Schematic Diagram of a Slope Drain

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

PIPE SLOPE DRAIN
DETAIL

CONSTRUCTION STANDARDS AND DETAILS



PC-3

SCALE: N.T.S.

ISSUE DATE: XX-XX-XX

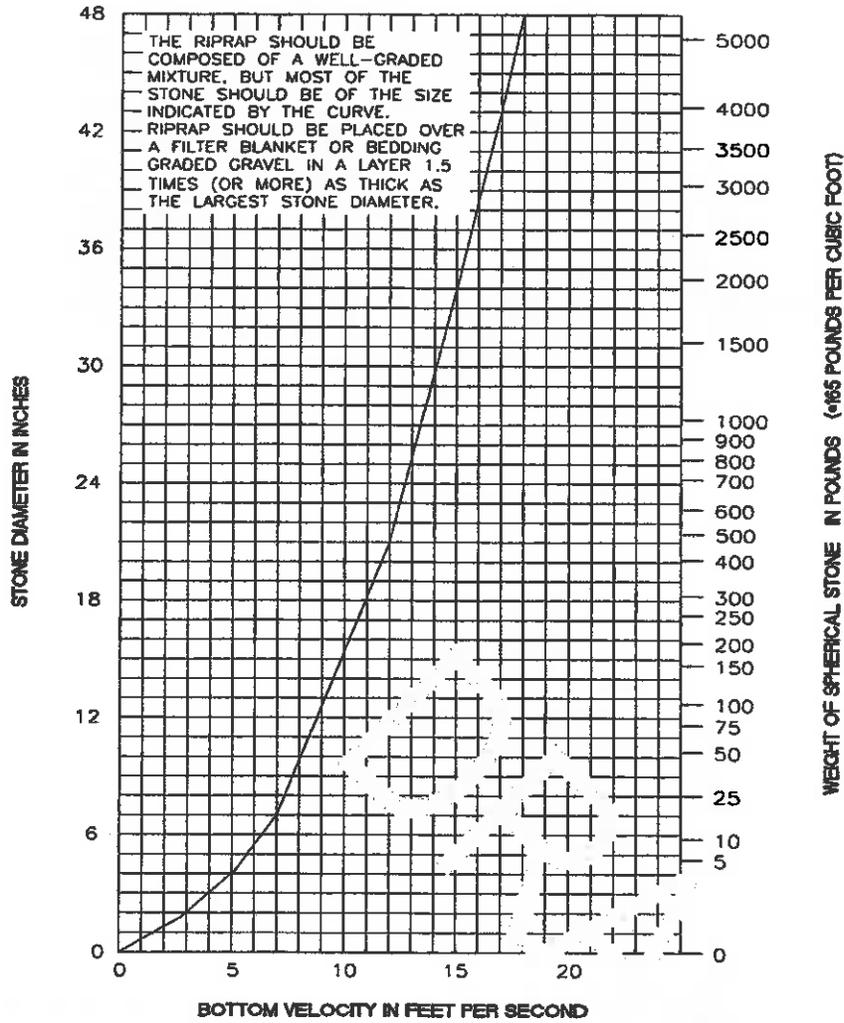


Figure B-4: Rock Riprap Size Selection

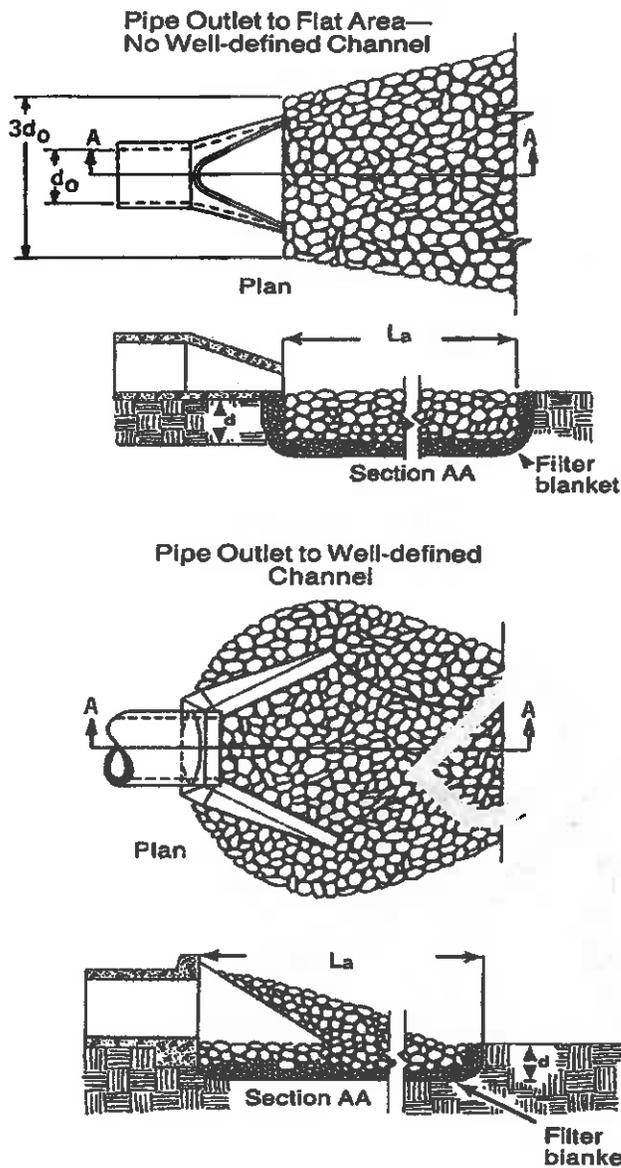
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

ROCK RIPRAP
SIZE SELECTION

CONSTRUCTION STANDARDS AND DETAILS



PC-4
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



Notes

1. L_a is the length of the riprap apron.
2. $d = 1.5$ times the maximum stone diameter but not less than 6".
3. In a well-defined channel extend the apron up the channel banks to an elevation of 6" above the maximum tailwater depth or to the top of the bank, whichever is less.
4. A filter blanket or filter fabric should be installed between the riprap and soil foundation.

Figure B-5: Schematic Riprap Outlet Design

**CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS**

**RIPRAP OUTLET
DESIGN**

CONSTRUCTION STANDARDS AND DETAILS



PC-5
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

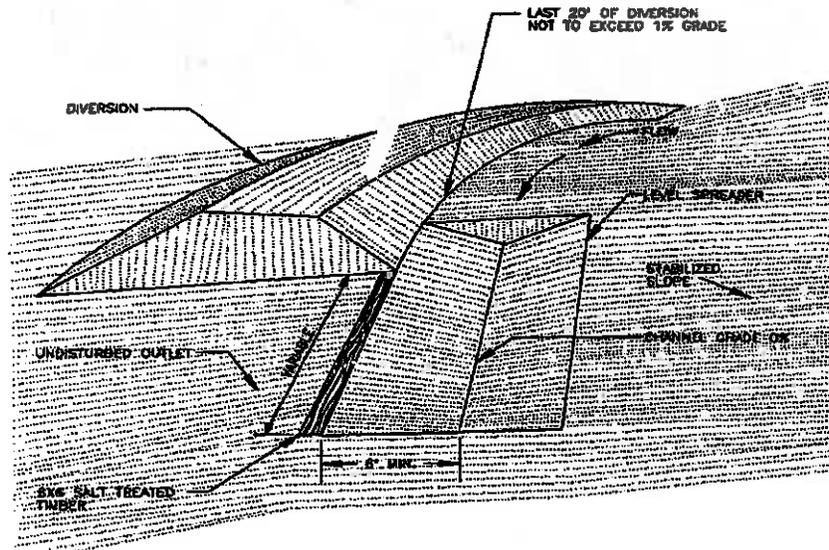
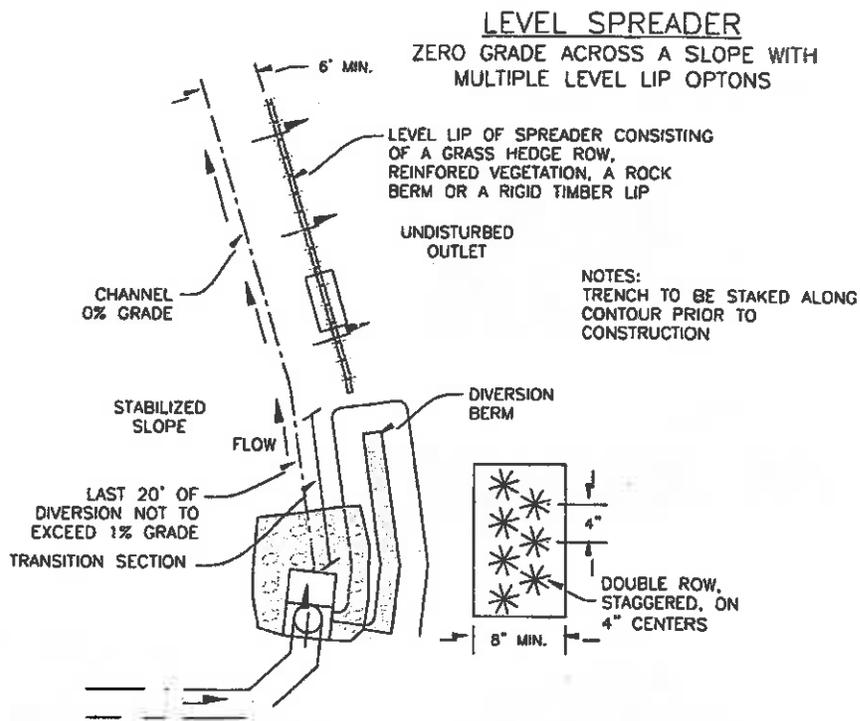


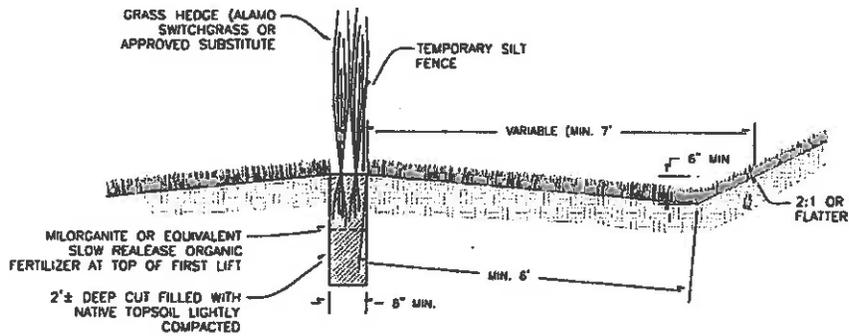
Figure B-6: Level Spreader Schematic and Perspective

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

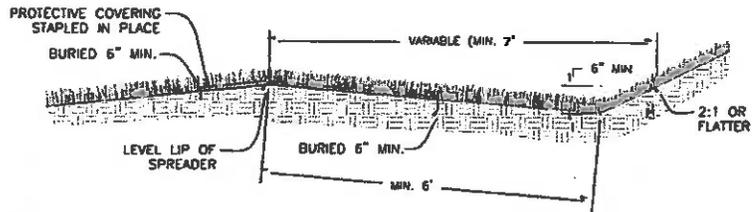
LEVEL SPREADER
SCHEMATIC AND PERSPECTIVE
CONSTRUCTION STANDARDS AND DETAILS



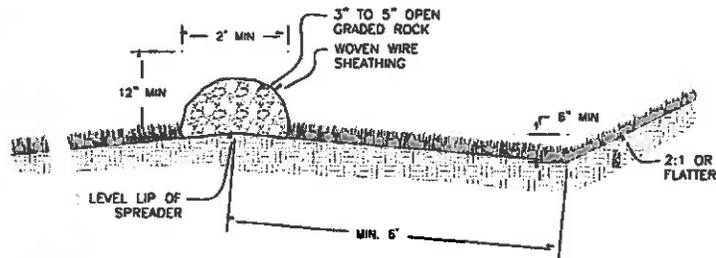
PC-6
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



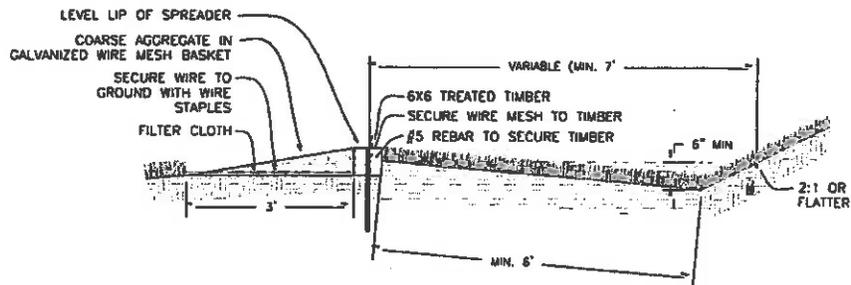
LEVEL SPREADER WITH GRASS HEDGE ROW



LEVEL SPREADER WITH REINFORCED VEGETATED LIP



LEVEL SPREADER WITH ROCK BERM LIP



LEVEL SPREADER WITH RIGID TIMBER LIP

Figure B-7: Level Spreader Lip Options

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

LEVEL SPREADER
LIP OPTIONS

CONSTRUCTION STANDARDS AND DETAILS



PC-7
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

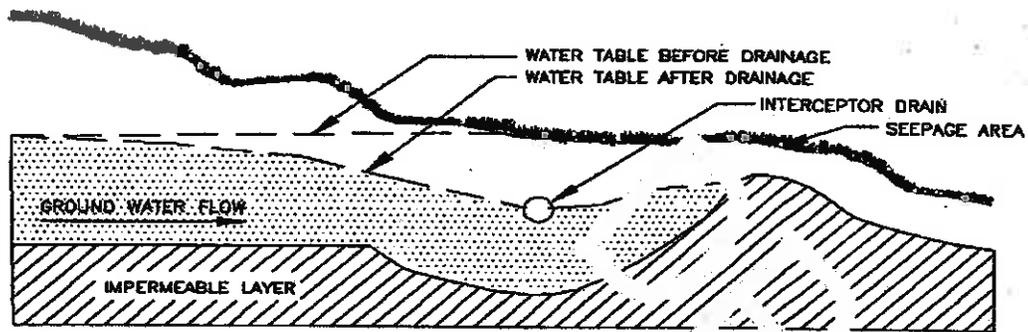


Figure B-8: Effect of Subsurface Drain

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

EFFECT OF
SUBSURFACE DRAIN

CONSTRUCTION STANDARDS AND DETAILS



PC-8
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

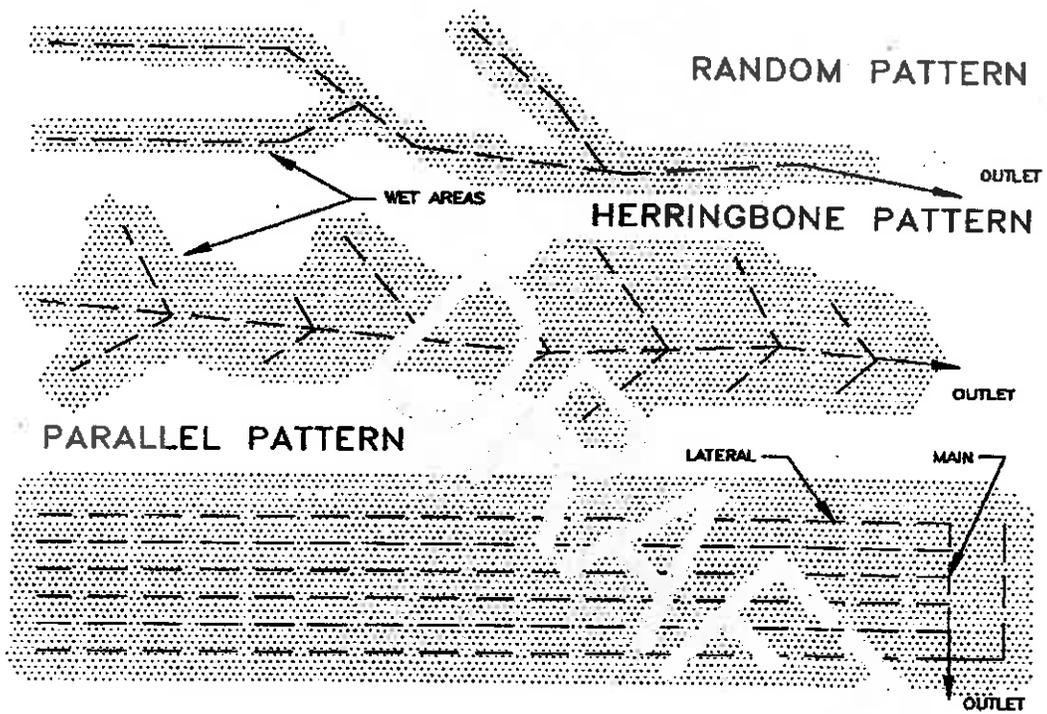


Figure B-9: Subsurface Drainage Patterns

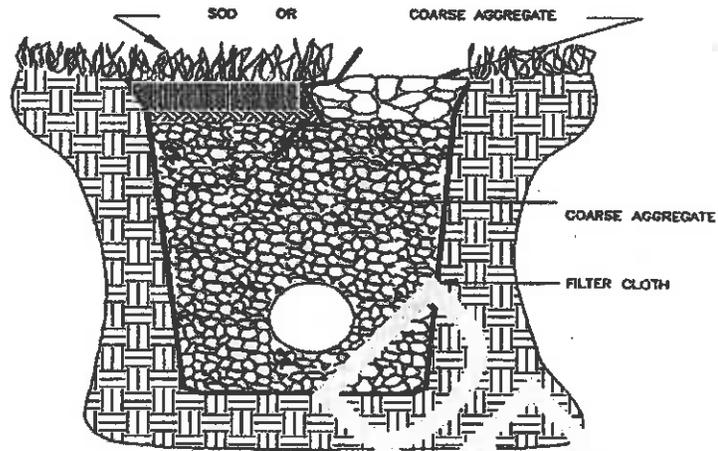
CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

**SUBSURFACE
 DRAINAGE PATTERNS**

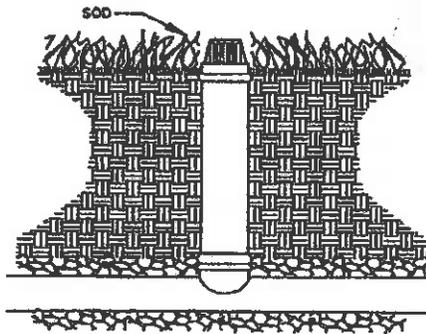
CONSTRUCTION STANDARDS AND DETAILS



PC-9
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



NATURAL INLET



GRATED INLET

Figure B-10: Surface Inlets for Subsurface Drains Schematic

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

SURFACE INLETS FOR
SUBSURFACE DRAINS SCHEMATIC

CONSTRUCTION STANDARDS AND DETAILS



PC-10
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

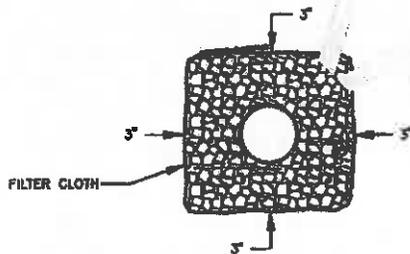


Figure B-11: Subsurface Drain Envelope Schematic

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

SUBSURFACE DRAIN
ENVELOPE SCHEMATIC

CONSTRUCTION STANDARDS AND DETAILS



PC-11
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

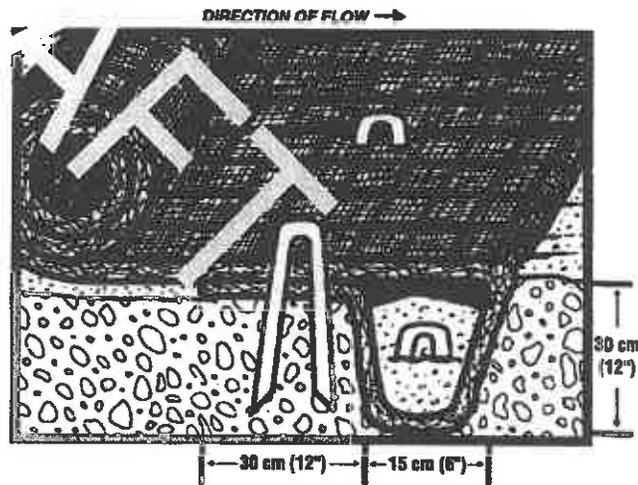


Figure B-12: Typical Initial Anchor Trench for Blankets and Mats

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

TYPICAL INITIAL ANCHOR TRENCH
FOR BLANKETS AND MATS

CONSTRUCTION STANDARDS AND DETAILS



PC-12
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

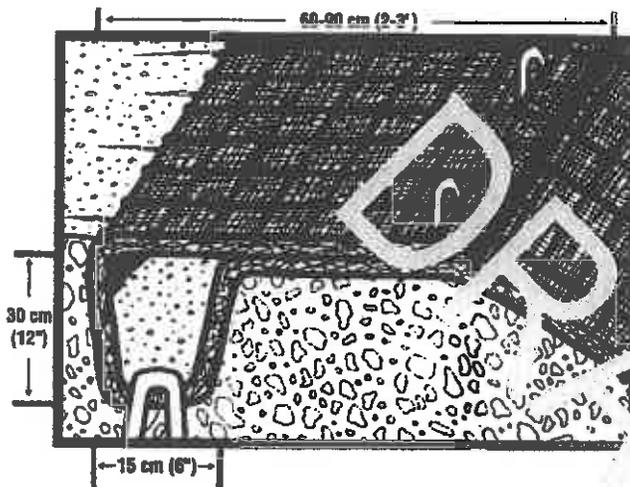


Figure B-13: Typical Terminal Anchor Trench for Blankets and Mats

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**TYPICAL TERMINAL ANCHOR TRENCH
 FOR BLANKETS AND MATS**

CONSTRUCTION STANDARDS AND DETAILS



PC-13
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

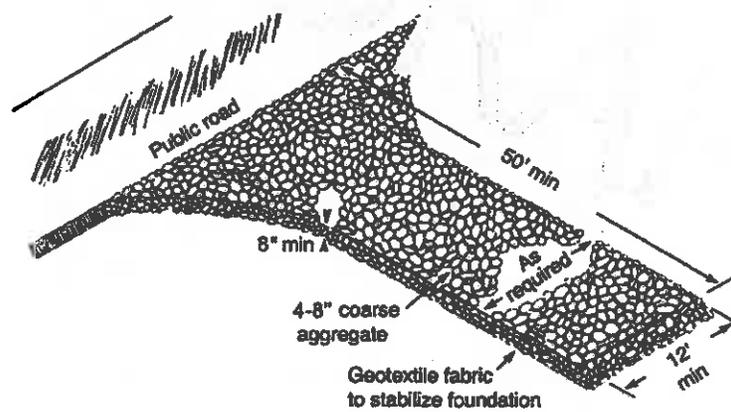


Figure B-14: Schematic of Temporary Construction Entrance/Exit

CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

**TEMPORARY CONSTRUCTION
 ENTRANCE/EXIT**

CONSTRUCTION STANDARDS AND DETAILS



PC-14
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

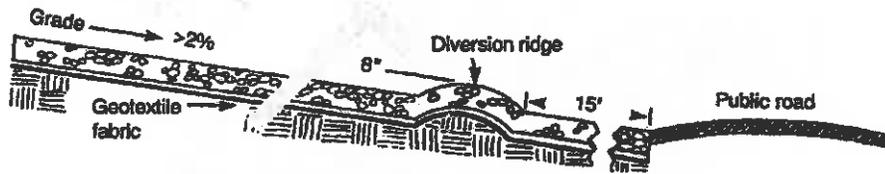


Figure B-15: Cross-section of a Construction Entrance/Exit

CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

**CROSS-SECTION OF A
 CONSTRUCTION ENTRANCE/EXIT**

CONSTRUCTION STANDARDS AND DETAILS



PC-15
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

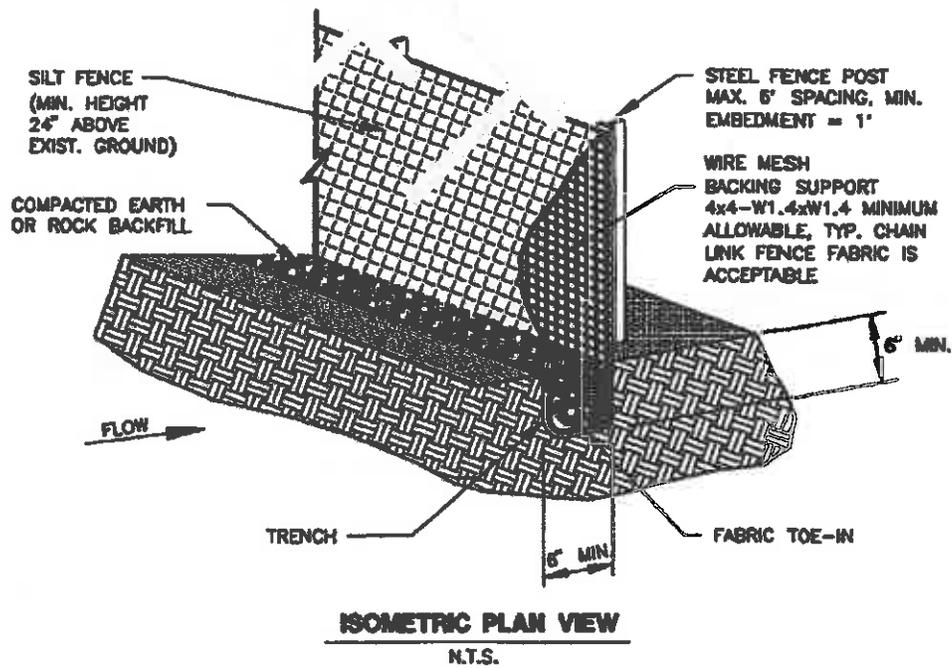


Figure B-16: Schematic of a Silt Fence Installation

CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

**SILT FENCE
 INSTALLATION**

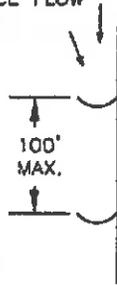
CONSTRUCTION STANDARDS AND DETAILS



PC-16
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

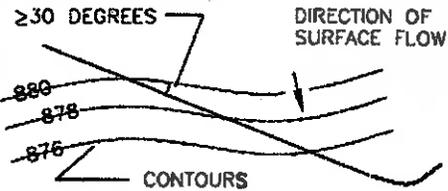
I. SPACING REQUIREMENTS

DIRECTION OF SURFACE FLOW



PLAN VIEW

NOTE:
J-HOOKS SHALL BE USED WHEN THE SILT FENCE IS INSTALLED AT AN ANGLE OF 30 DEGREES OR GREATER FROM PARALLEL TO THE CONTOURS.



II. SIZING REQUIREMENTS: J15, J25

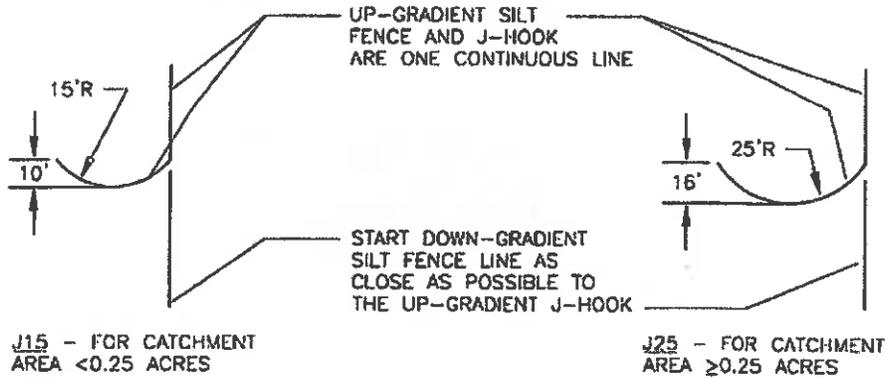


Figure B-17: Schematic J-hook Placement

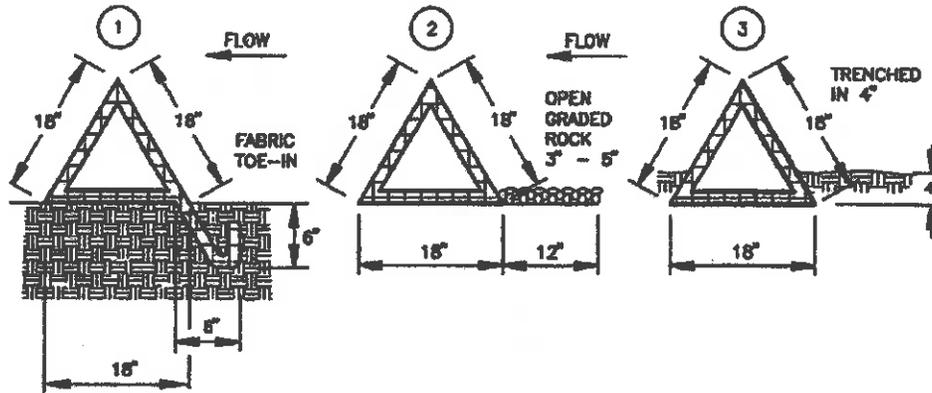
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

J-HOOK
PLACEMENT

CONSTRUCTION STANDARDS AND DETAILS



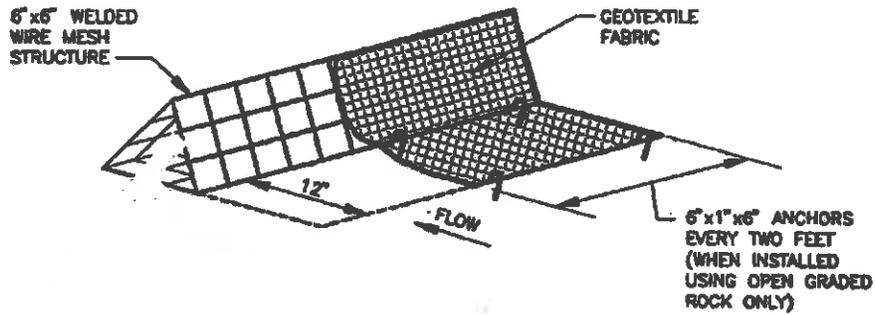
PC-17
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



CROSS SECTION OF INSTALLATION OPTIONS

N.T.S.

1. TOE-IN 6" MIN
2. WEIGHTED W/ 3" - 5" OPEN GRADED ROCK
3. TRENCHED IN 4"



ISOMETRIC PLAN VIEW

N.T.S.

Figure B-18: Schematic of a Triangular Filter Dike

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

TRIANGULAR
FILTER DIKE

CONSTRUCTION STANDARDS AND DETAILS



PC-18
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

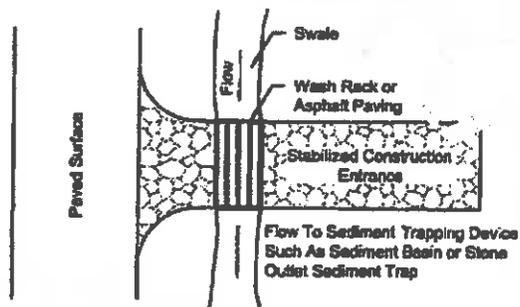


Figure B-19: Schematic Tire Wash Facility

CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

**TIRE WASH
 FACILITY**

CONSTRUCTION STANDARDS AND DETAILS



PC-19
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

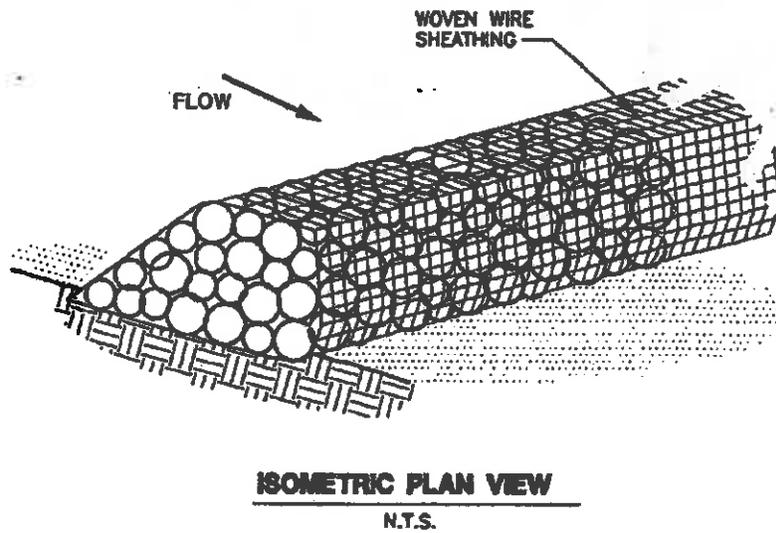
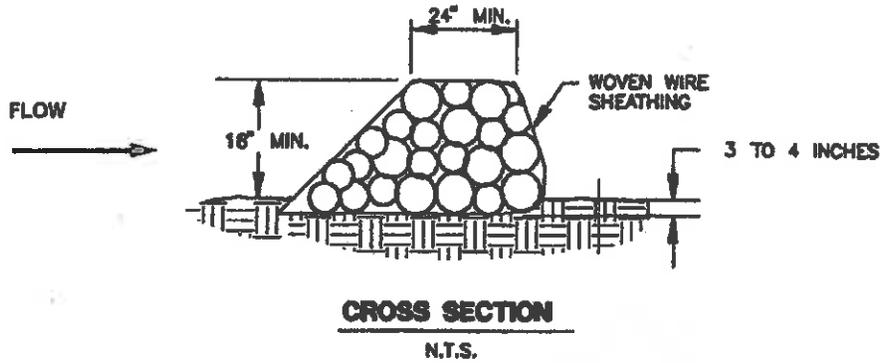


Figure B-20: Schematic Diagram of a Rock Berm

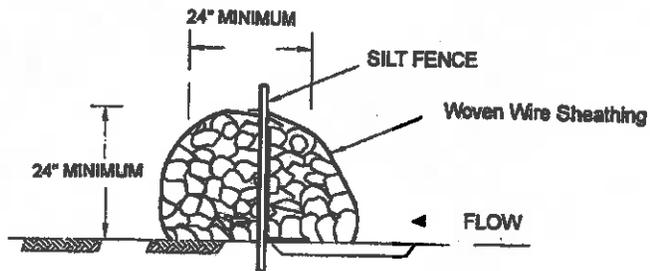
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**ROCK BERM
DETAIL**

CONSTRUCTION STANDARDS AND DETAILS



PC-20
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



Cross - Section

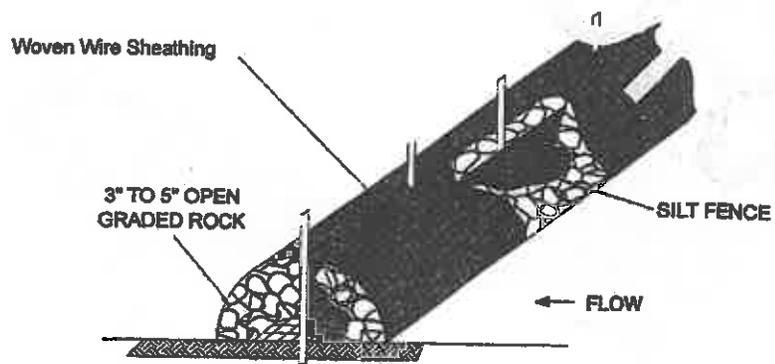


Figure B-21: Schematic Diagram of High Service Rock Berm

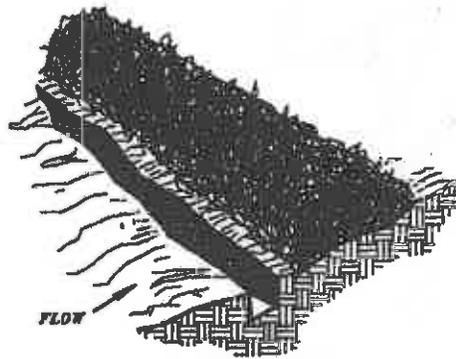
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

HIGH SERVICE
ROCK BERM

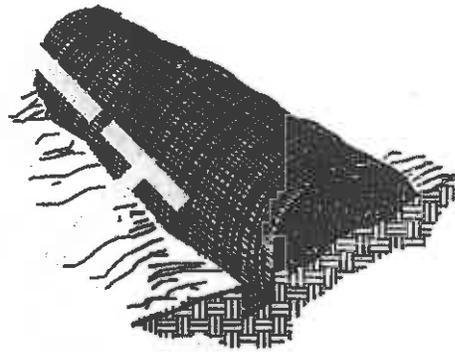
CONSTRUCTION STANDARDS AND DETAILS



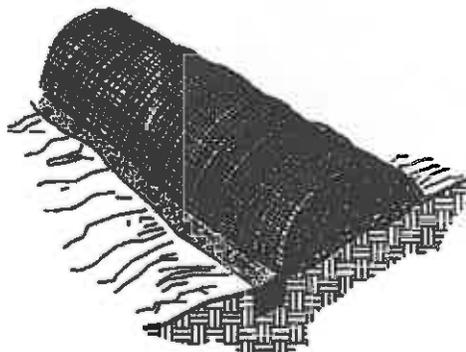
PC-21
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



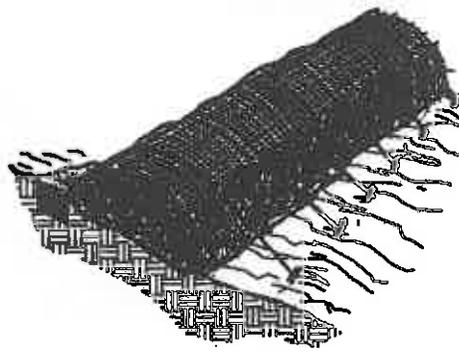
1. EXCAVATE A 4" X 4" TRENCH ALONG THE UPHILL EDGE OF THE BRUSH BARRIER.



2. DRAPE FILTER FABRIC OVER THE BRUSH BARRIER AND INTO THE TRENCH. FABRIC SHOULD BE SECURED IN THE TRENCH WITH STAKES SET APPROXIMATELY 36" O.C.



3. BACKFILL AND COMPACT THE EXCAVATED SOIL.



4. SET STAKES ALONG THE DOWNHILL EDGE OF THE BRUSH BARRIER, AND ANCHOR BY TYING TWINE FROM THE FABRIC TO THE STAKES.

Figure B-22: Schematic Diagram of a Brush Berm

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

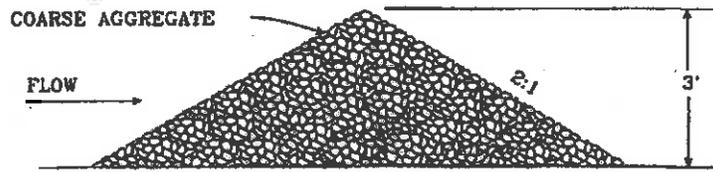
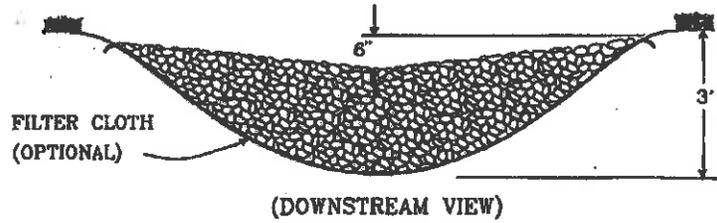
BRUSH BERM
DETAIL

CONSTRUCTION STANDARDS AND DETAILS



PC-22
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

2 ACRES OR LESS OF DRAINAGE AREA:



2-10 ACRES OF DRAINAGE AREA:

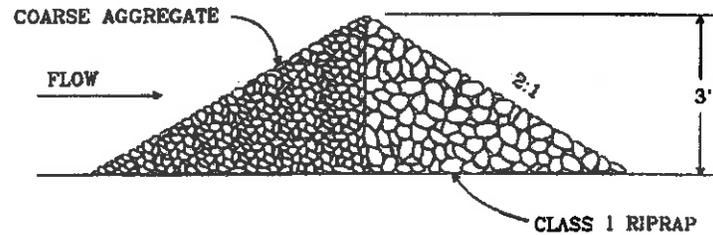
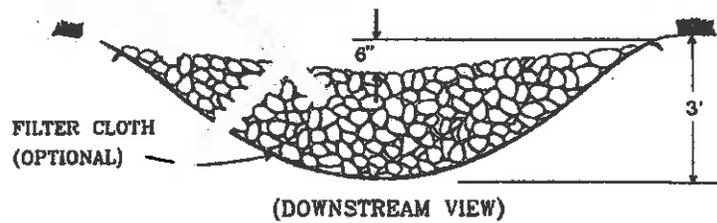


Figure 8-23: Schematic Diagram of a Rock Check Dam

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

ROCK CHECK DAM
DETAIL

CONSTRUCTION STANDARDS AND DETAILS



PC-23
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

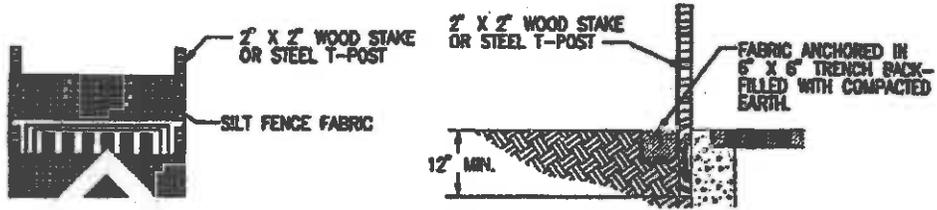


Figure B-24: Filter Fabric Inlet Protection

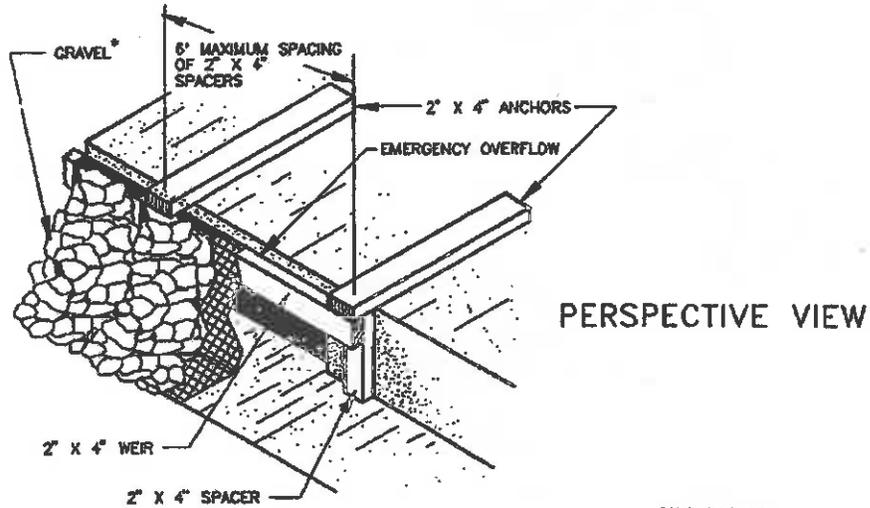
CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

**FILTER FABRIC
 INLET PROTECTION**

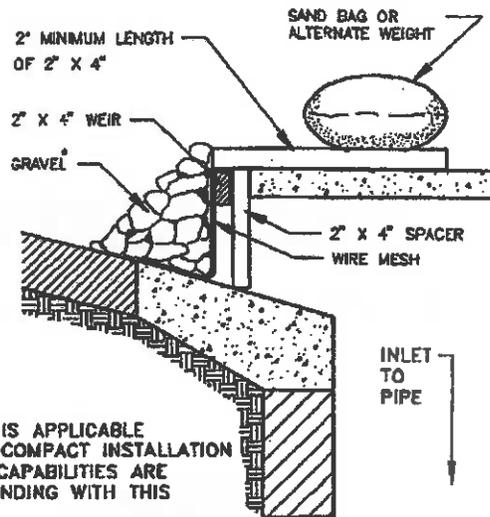
CONSTRUCTION STANDARDS AND DETAILS



PC-24
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



SIDE ELEVATION



SPECIFIC APPLICATION

THIS METHOD OF INLET PROTECTION IS APPLICABLE TO CURB INLETS WHERE A STURDY, COMPACT INSTALLATION IS DESIRED. EMERGENCY OVERFLOW CAPABILITIES ARE MINIMAL, SO EXPECT SIGNIFICANT PONDING WITH THIS MEASURE.

Figure B-25: Wooden Weir Curb Inlet Protection

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

WOODEN WEIR CURB INLET
PROTECTION

CONSTRUCTION STANDARDS AND DETAILS



PC-25
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

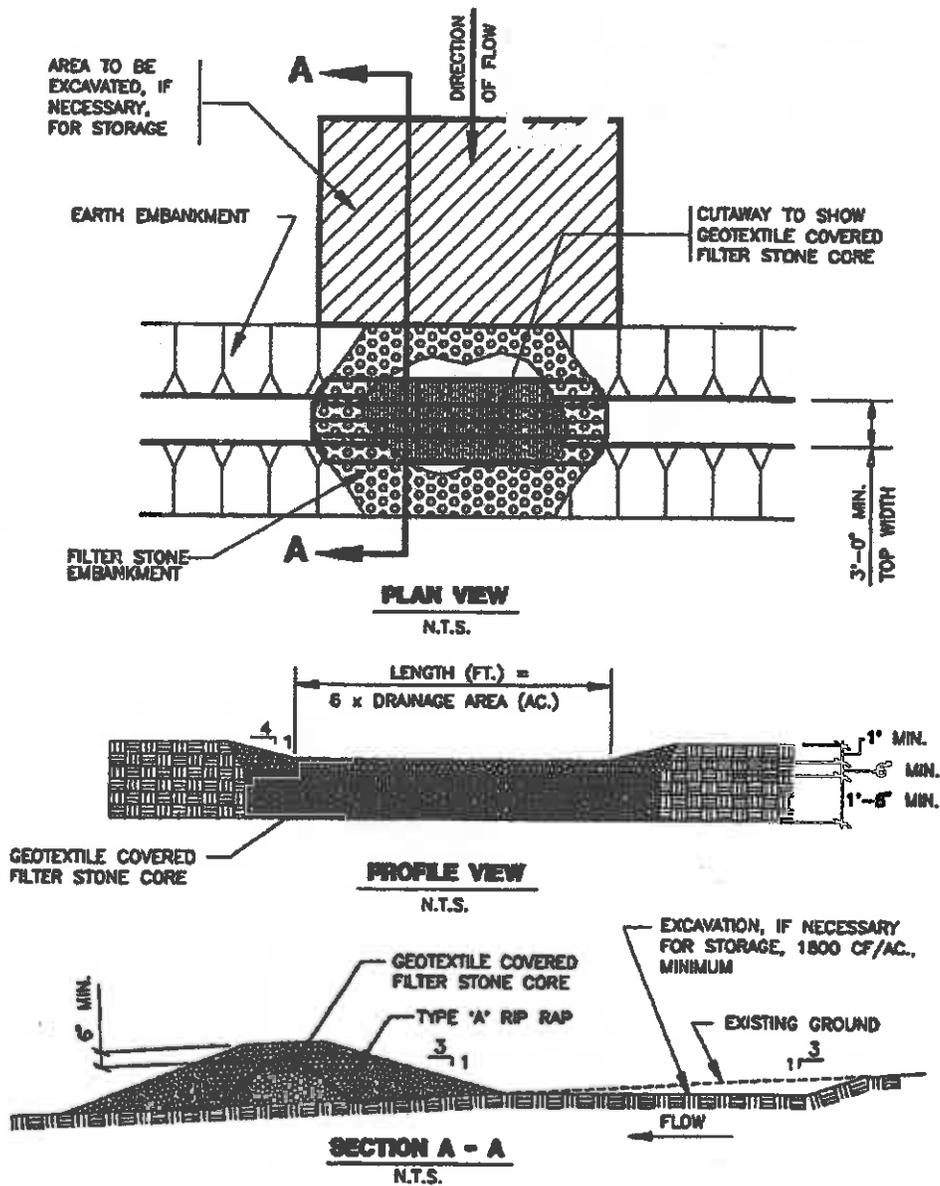


Figure B-26: Schematic Diagram of a Sediment Trap

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

SEDIMENT TRAP
DETAIL

CONSTRUCTION STANDARDS AND DETAILS



PC-26
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

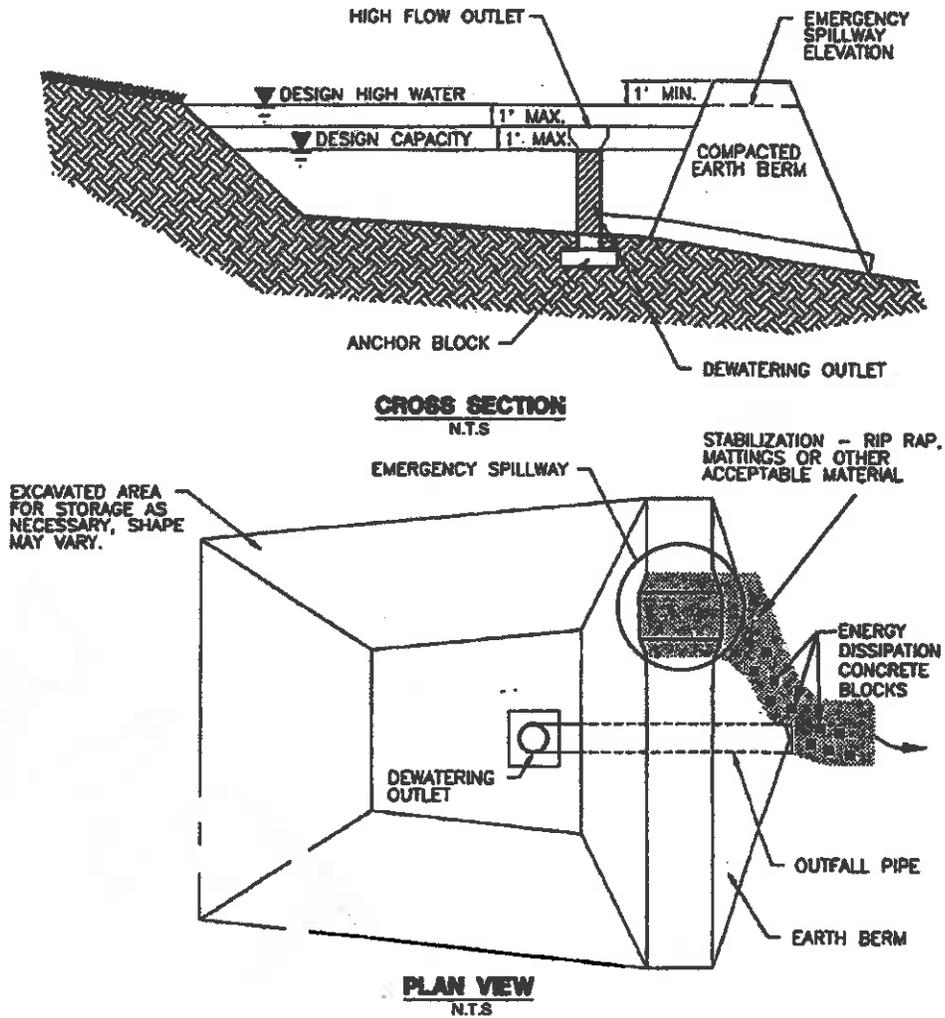


Figure B-27: Schematic of a Sediment Basin

CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

SEDIMENT BASIN
 DETAIL

CONSTRUCTION STANDARDS AND DETAILS



PC-27
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

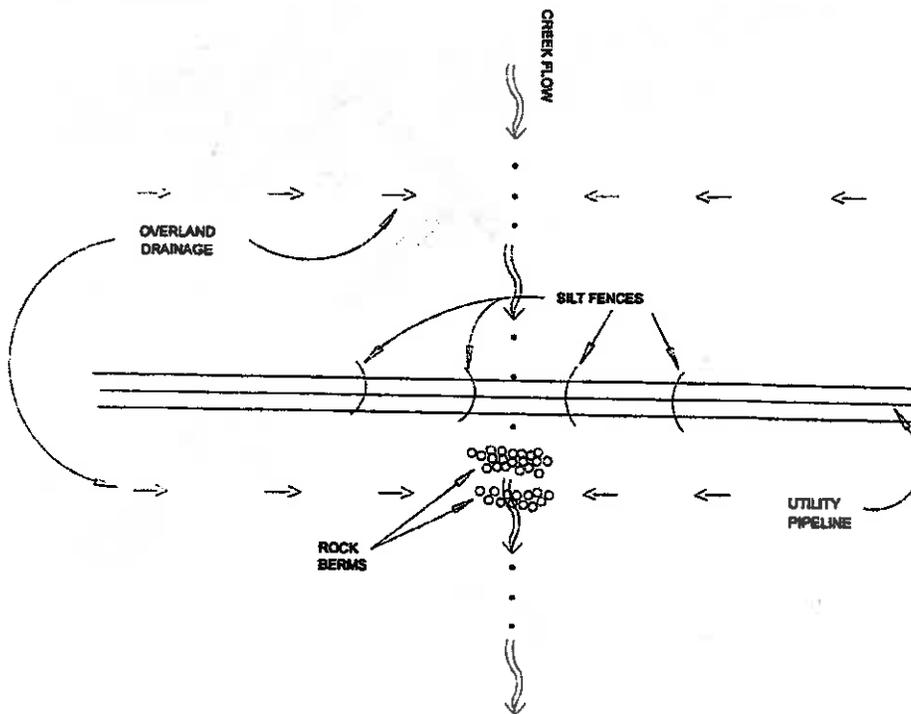


Figure B-28: Utility Crossing or Excavation within Creek Schematic

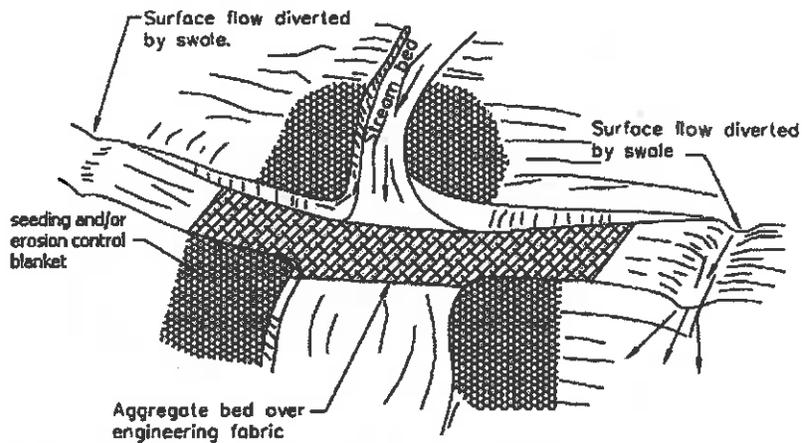
CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

**UTILITY CROSSING OR EXCAVATION
 WITHIN CREEK SCHEMATIC**

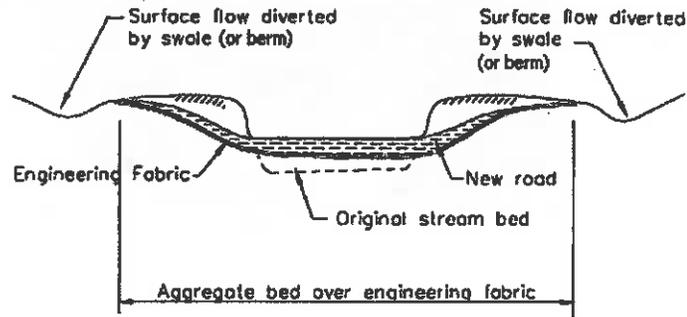
CONSTRUCTION STANDARDS AND DETAILS



PC-28
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



Aggregate approach
1:5 (V:H) Maximum slope on road



TYPICAL FORD CROSSING
NOT TO SCALE

Figure B-29: Typical Temporary Ford Crossing Schematic

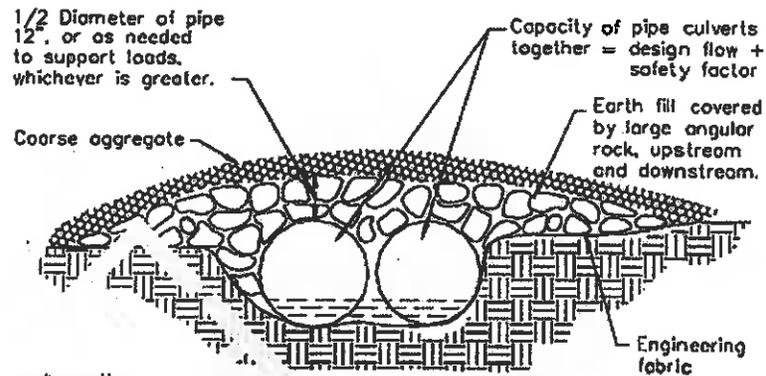
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

TYPICAL TEMPORARY
FORD CROSSING SCHEMATIC

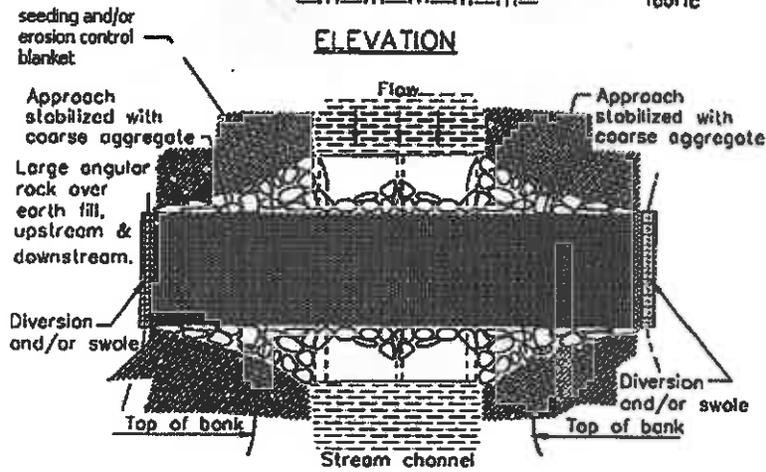
CONSTRUCTION STANDARDS AND DETAILS



PC-29
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



ELEVATION



PLAN VIEW

**TYPICAL CULVERT CROSSING
NOT TO SCALE**

Figure B-30: Typical Temporary Culvert Crossing Schematic

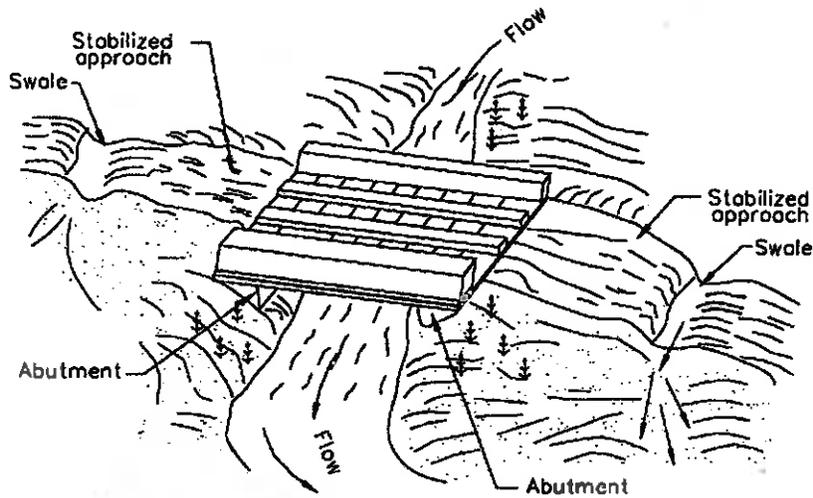
**CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS**

**TYPICAL TEMPORARY
CULVERT CROSSING SCHEMATIC**

CONSTRUCTION STANDARDS AND DETAILS



PC-30
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



NOTE:
Surface flow of road diverted
by swale and/or dike.

TYPICAL BRIDGE CROSSING
NOT TO SCALE

Figure B-31: Typical Temporary Bridge Crossing Schematic

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**TYPICAL BRIDGE
CROSSING**

CONSTRUCTION STANDARDS AND DETAILS



PC-31
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

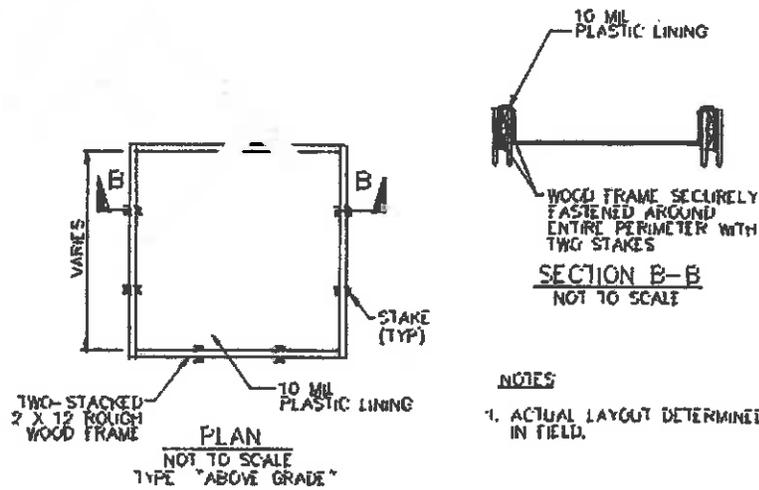
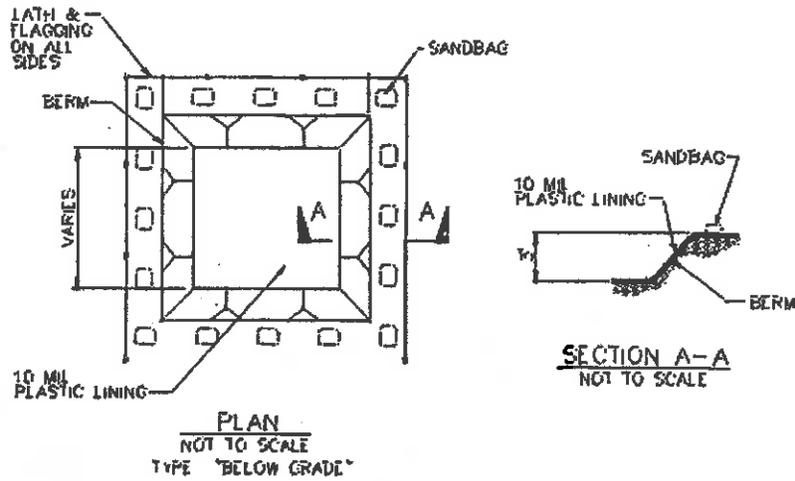


Figure B-32: Schematic Diagrams of Concrete Washout Areas

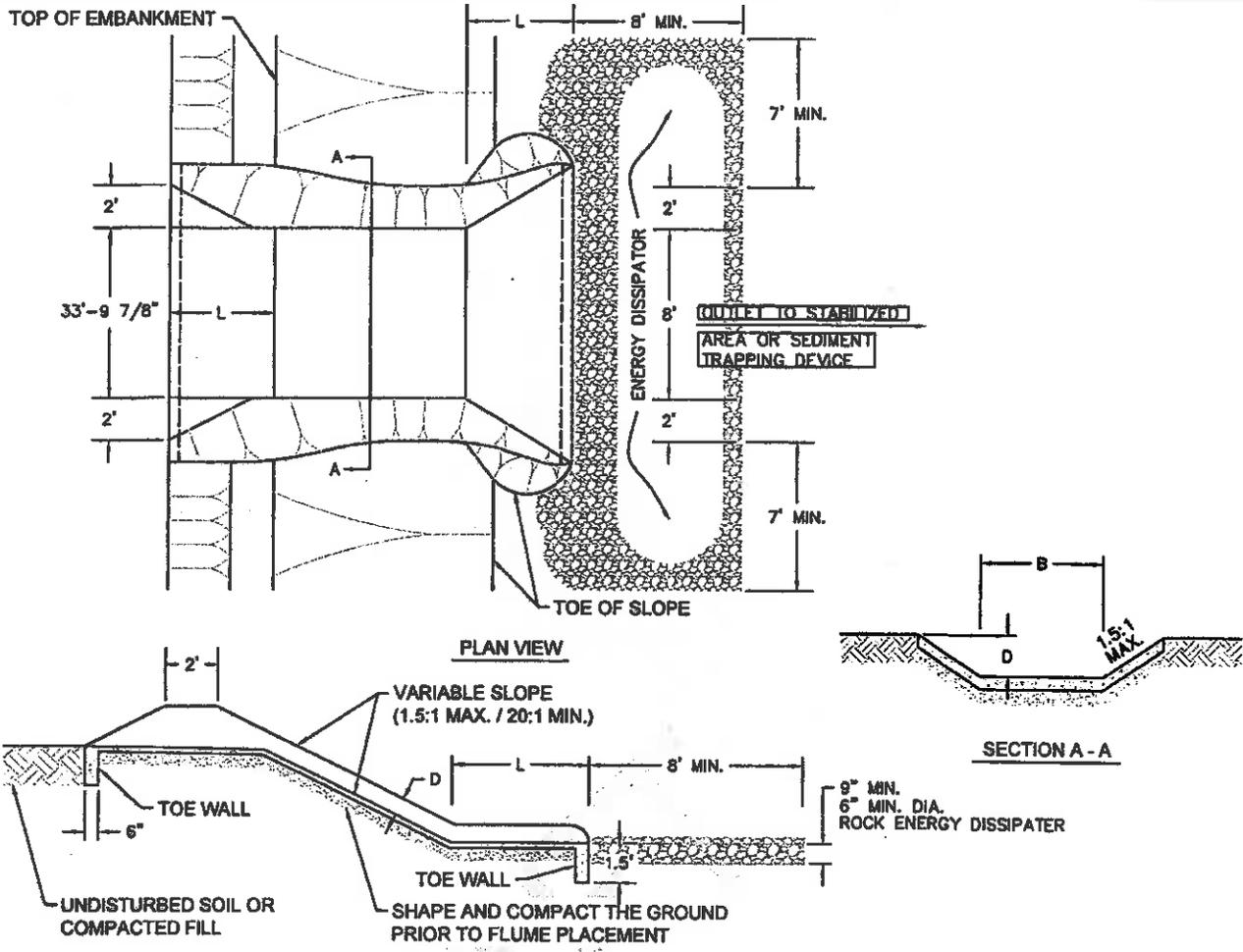
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**CONCRETE WASHOUT
AREAS**

CONSTRUCTION STANDARDS AND DETAILS



PC-32
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



GENERAL NOTES

1. THE GROUP/SIZE IS A DESIGNATOR FOR THE DIMENSIONS OF THE PAVED FLUME. THE GROUP/SIZE IS DESIGNATED BY A LETTER (A OR B) AND THE BOTTOM (B) DIMENSION. THE APPROPRIATE SIZE SHALL BE INDICATED ON THE CONSTRUCTION PLANS.
2. FOR HIGH VELOCITY FLOWS, THE AGGREGATE OF THE ENERGY DISSIPATOR SHOULD BE SECURED WITH 20-GAUGE GALVANIZED WOVEN WIRE MESH WITH 1" DIAMETER HEXAGONAL OPENINGS. THE AGGREGATE SHOULD BE PLACED ON THE MESH TO THE DIMENSIONS SPECIFIED. THE MESH SHALL BE FOLDED AT THE UPSTREAM SIDE OVER THE AGGREGATE AND TIGHTLY SECURED TO ITSELF ON THE DOWNSTREAM SIDE USING WIRE TIES OR HOG RINGS.
3. THE GUIDELINES SHOWN HEREON ARE SUGGESTIONS ONLY AND MAY BE MODIFIED BY THE ENGINEER.

PAVED FLUME USAGE GUIDELINES

A PAVED FLUME SHOULD BE CONSTRUCTED TO DRAIN CONCENTRATED SURFACE RUNOFF SAFELY DOWN SLOPES WITHOUT CAUSING EROSION. THE DRAINAGE AREA CONTRIBUTING RUNOFF TO A PAVED FLUME SHOULD NOT EXCEED THAT GIVEN IN THE DESIGN CRITERIA ABOVE. THE PAVED FLUME SHOULD BE SIZED TO DRAIN THE PEAK RATE OF RUNOFF WITHOUT OVERTOPPING THE EMBANKMENT AT THE EARTH DIKE ENTRANCE. A 25 YEAR STORM FREQUENCY MAY BE USED TO CALCULATE THE FLOW RATE.

DESIGN CRITERIA					
GROUP/SIZE	B BOTTOM WIDTH	H MIN.	D MIN.	L MIN.	MAXIMUM DRAINAGE AREA
A-2	2'	1.5'	8"	5'	5 ACRES
A-4	4'	1.5'	8"	5'	8 ACRES
A-6	6'	1.5'	8"	5'	11 ACRES
A-8	8'	1.5'	8"	5'	14 ACRES
A-10	10'	1.5'	8"	5'	18 ACRES
B-4	4'	2'	10"	6'	14 ACRES
B-6	6'	2'	10"	6'	20 ACRES
B-8	8'	2'	10"	6'	25 ACRES
B-10	10'	2'	10"	6'	31 ACRES
B-12	12'	2'	10"	6'	36 ACRES

NOTE: FOR ILLUSTRATIVE PURPOSES ONLY

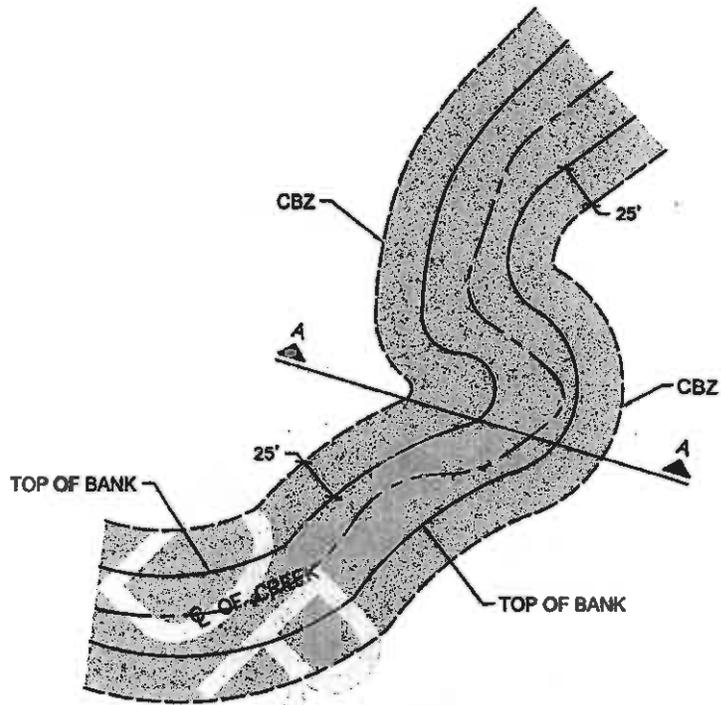
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS



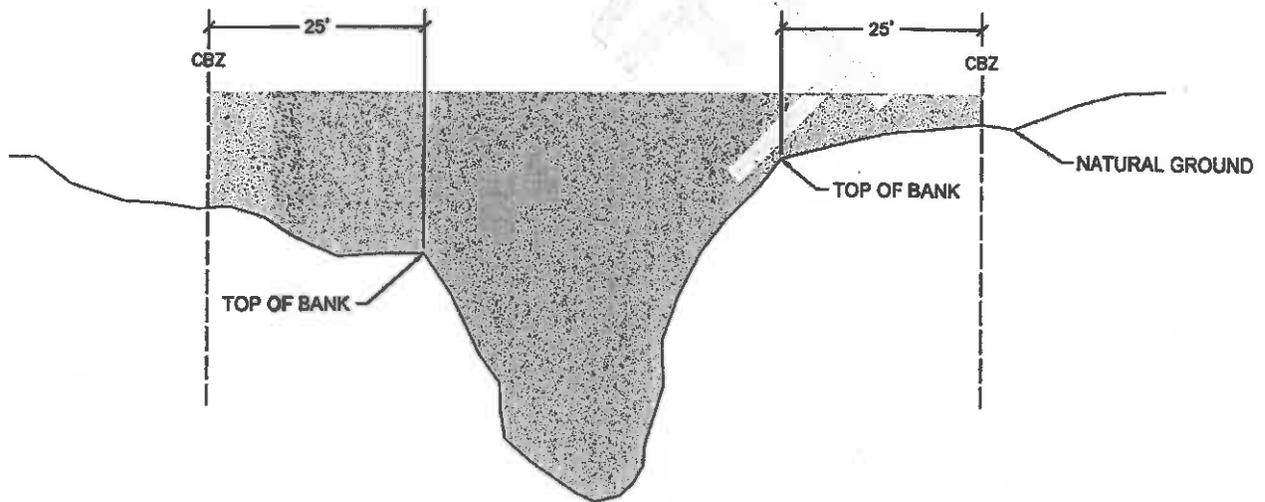
LINED WATERWAY
OR OUTLET

CONSTRUCTION STANDARDS AND DETAILS

PC-33
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



PLAN VIEW



☐ — CREEK BUFFER ZONE

PROFILE SECTION A-A

NOTE: FOR ILLUSTRATIVE PURPOSES ONLY

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

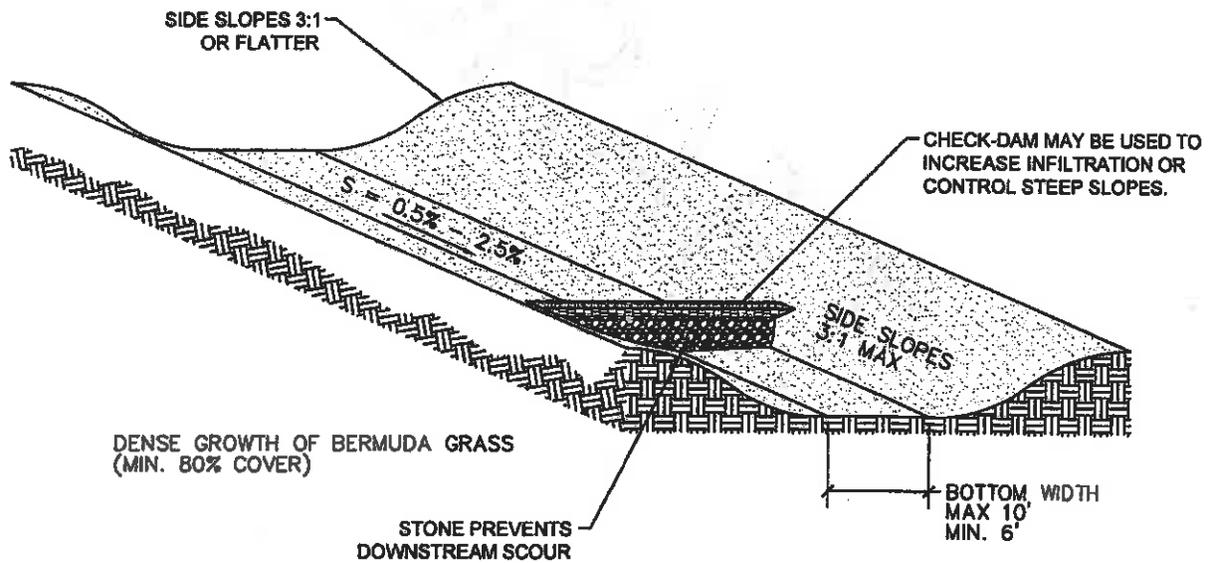
CREEK BUFFER ZONE

CONSTRUCTION STANDARDS AND DETAILS



PC-34
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

SWALE SLOPES AS CLOSE TO ZERO AS DRAINAGE WILL PERMIT



NOTE: FOR ILLUSTRATIVE PURPOSES ONLY

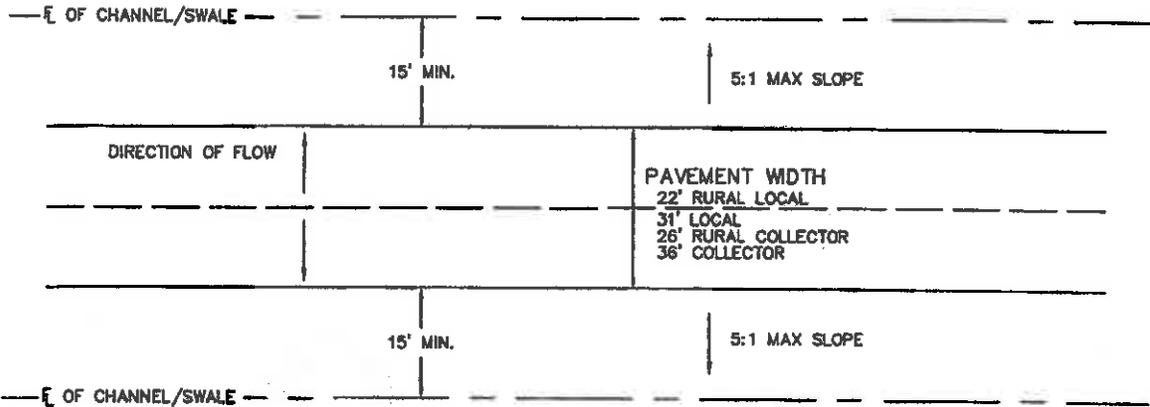
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

VEGETATED
SWALES

CONSTRUCTION STANDARDS AND DETAILS

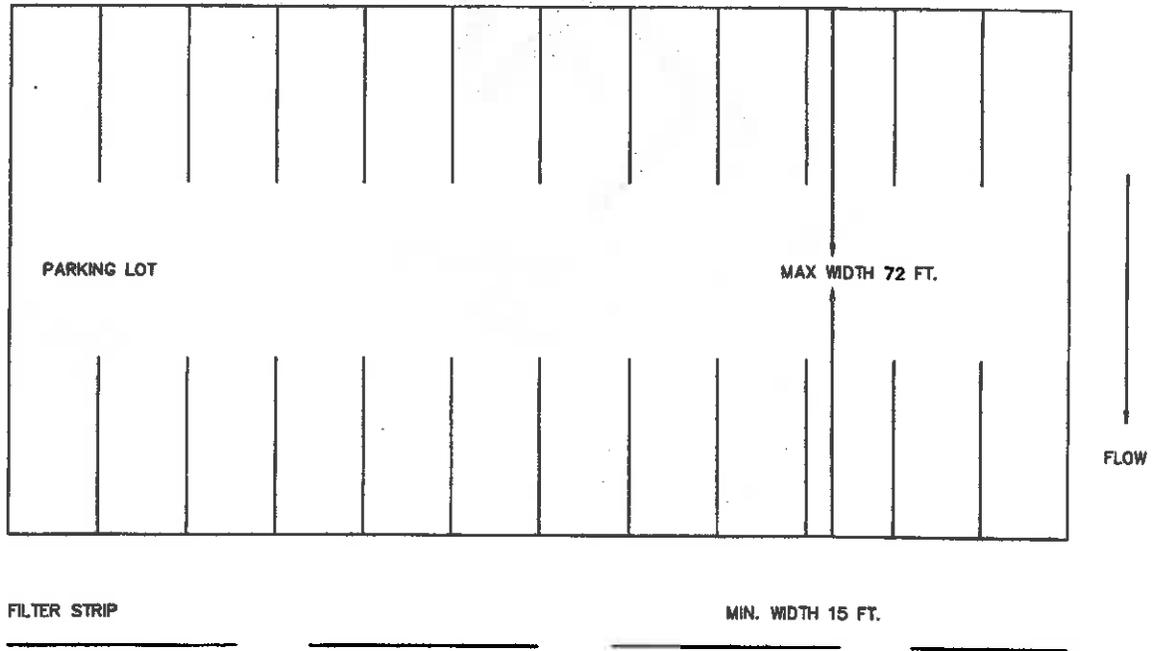


PC-35
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



NOTE 1: MINIMUM VEGETATIVE COVER (BERMUDA GRASS) = 80%

VEGETATED FILTER STRIP ALONG ROADWAY



VEGETATED FILTER STRIP ALONG PARKING LOT

NOTE: FOR ILLUSTRATIVE PURPOSES ONLY

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS



VEGETATED FILTER STRIPS

PC-36
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

CONSTRUCTION STANDARDS AND DETAILS

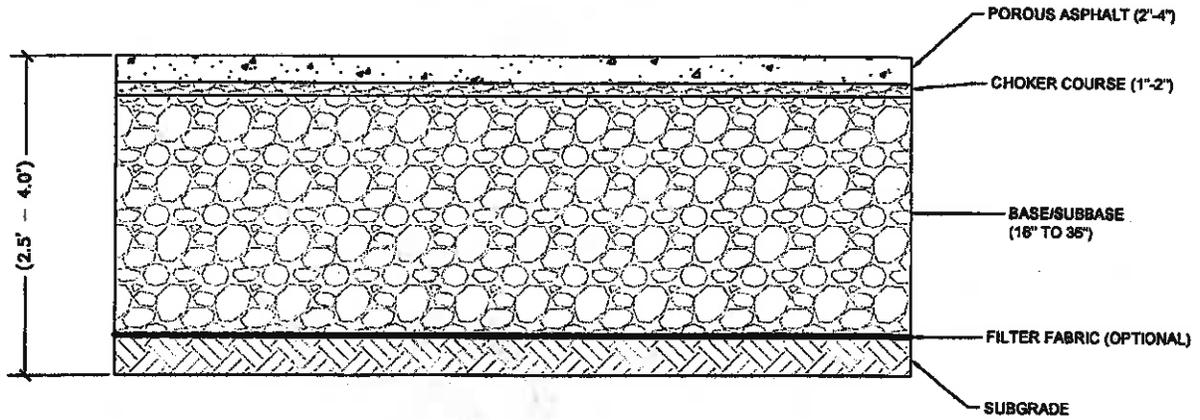


TABLE 1. ASPHALT MIX (ADAMS, 2003)

SIEVE SIZE	% PASSING
1/2 IN	100
3/8 IN	95
#4	35
#8	15
#16	10
#30	2

PERCENT BITUMINOUS ASPHALT 5.75-6.0% BY WEIGHT

NOTE: FOR ILLUSTRATIVE PURPOSES ONLY

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

POROUS ASPHALT

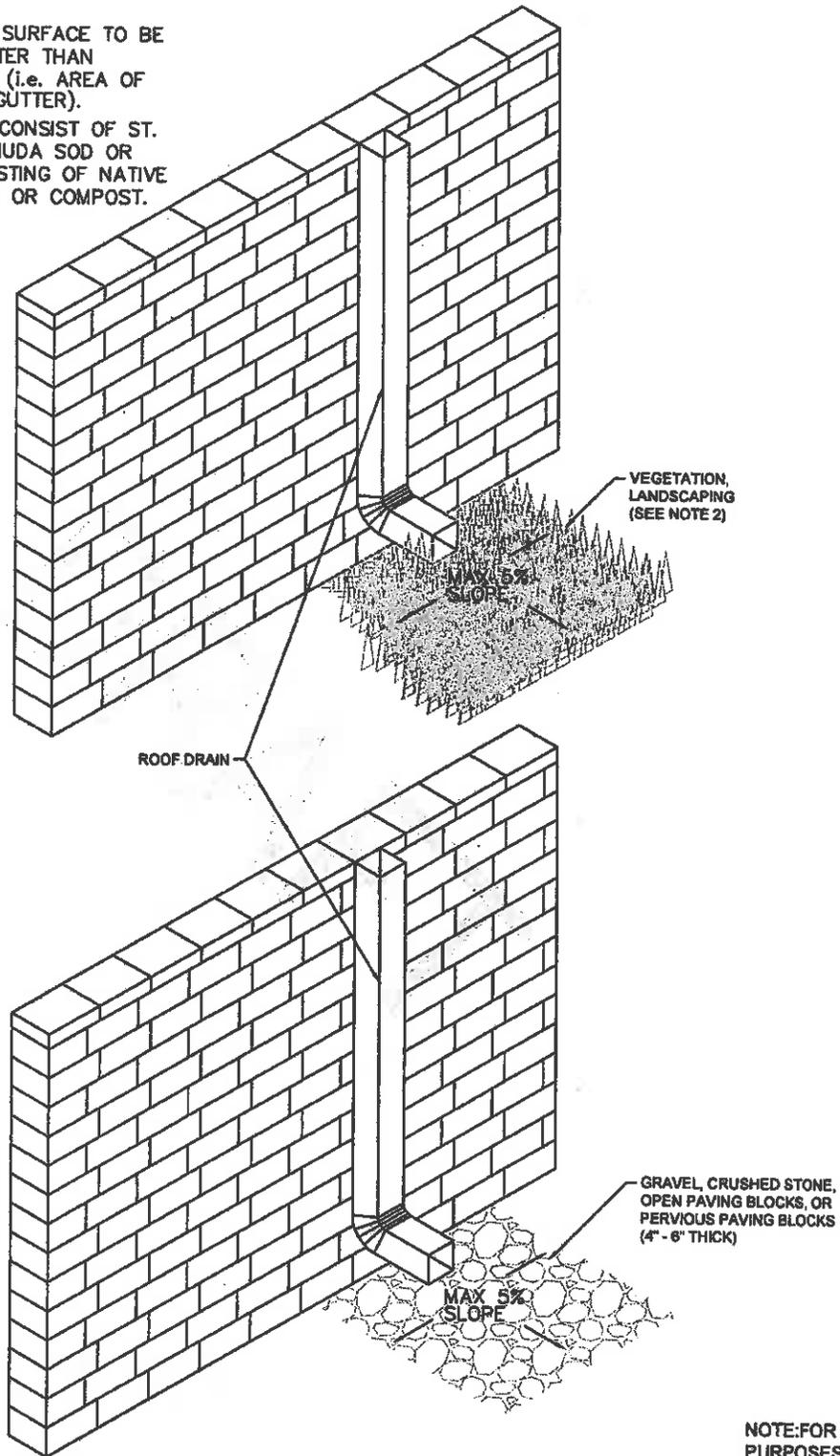
CONSTRUCTION STANDARDS AND DETAILS



PC-38
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

NOTES:

- 1) AREA OF PERVIOUS SURFACE TO BE EQUAL TO OR GREATER THAN CONTRIBUTING AREA (i.e. AREA OF ROOF DRAINING TO GUTTER).
- 2) VEGETATION SHALL CONSIST OF ST. AUGUSTINE OR BERMUDA SOD OR LANDSCAPING CONSISTING OF NATIVE PLANTS WITH MULCH OR COMPOST.



NOTE: FOR ILLUSTRATIVE PURPOSES ONLY

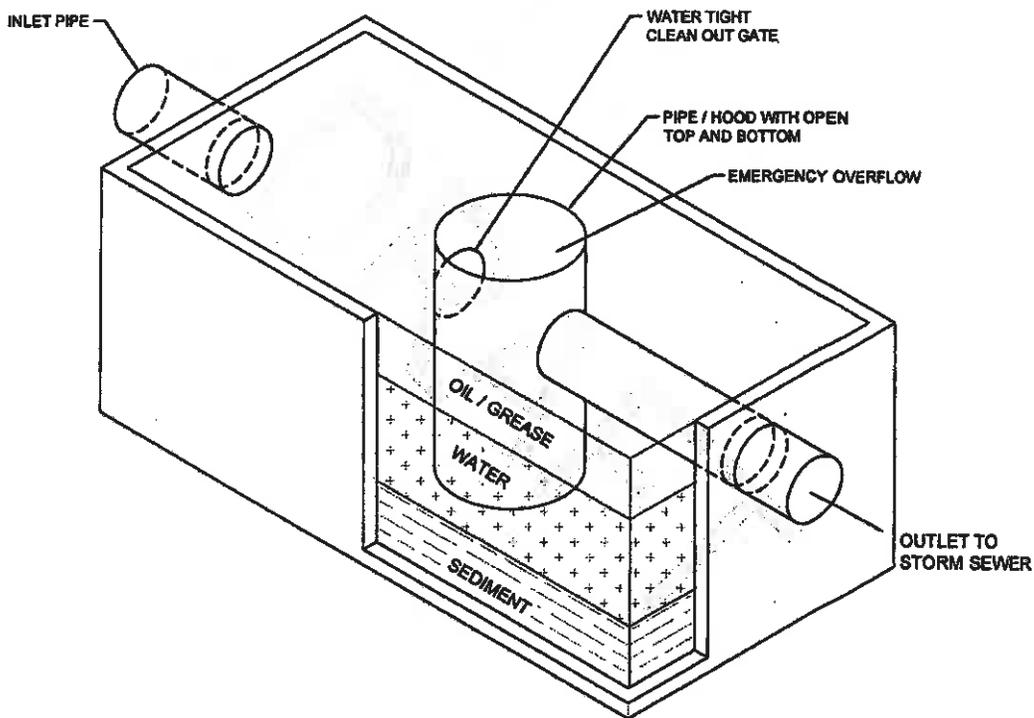
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**MINIMIZE DIRECTLY CONNECTED
IMPERVIOUS AREA**

CONSTRUCTION STANDARDS AND DETAILS



PC-39
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



CROSS SECTION VIEW

OIL/GRIT SEPARATOR:
SC - TYPE SEPARATOR

NOTE: FOR ILLUSTRATIVE
PURPOSES ONLY

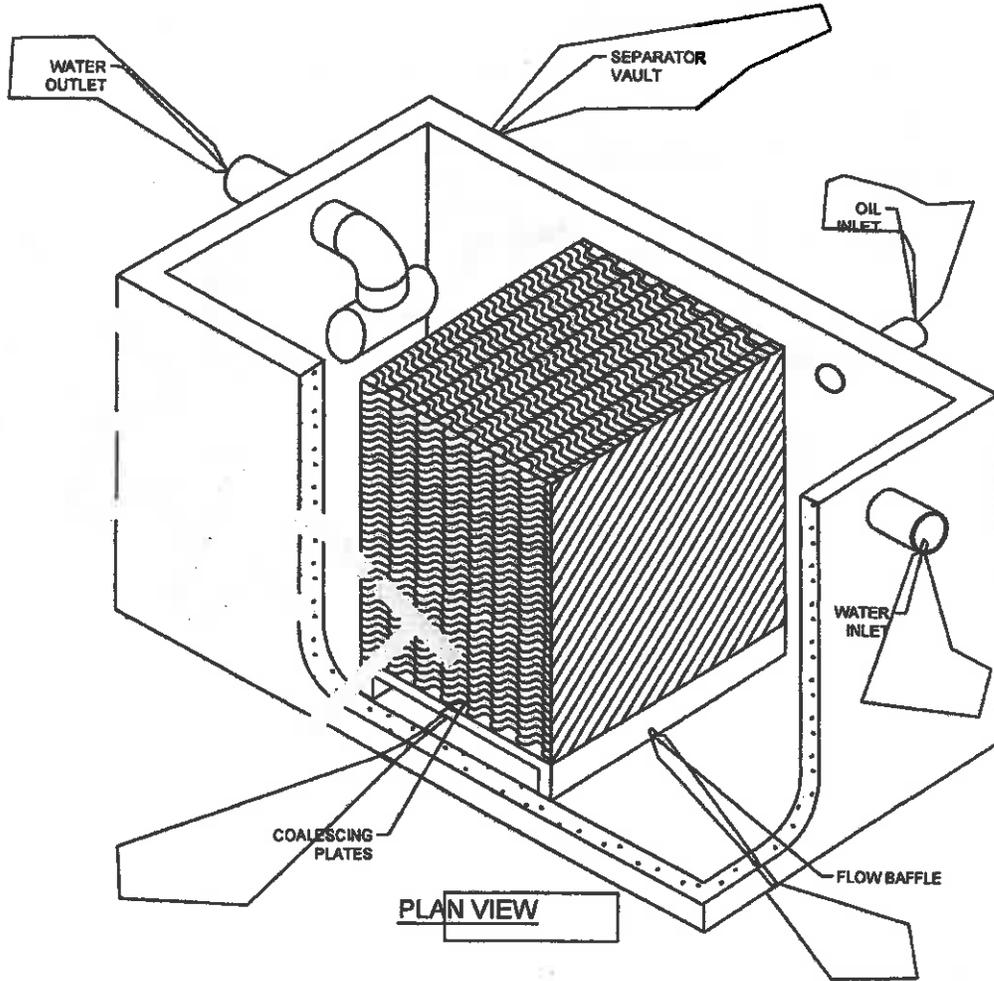
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

SUBSURFACE TREATMENT DEVICES
SC - TYPE SEPARATOR

CONSTRUCTION STANDARDS AND DETAILS



PC-40
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



PLAN VIEW

OIL/GRIT SEPARATOR:
CPS - SEPARATOR

NOTE: FOR ILLUSTRATIVE
PURPOSES ONLY

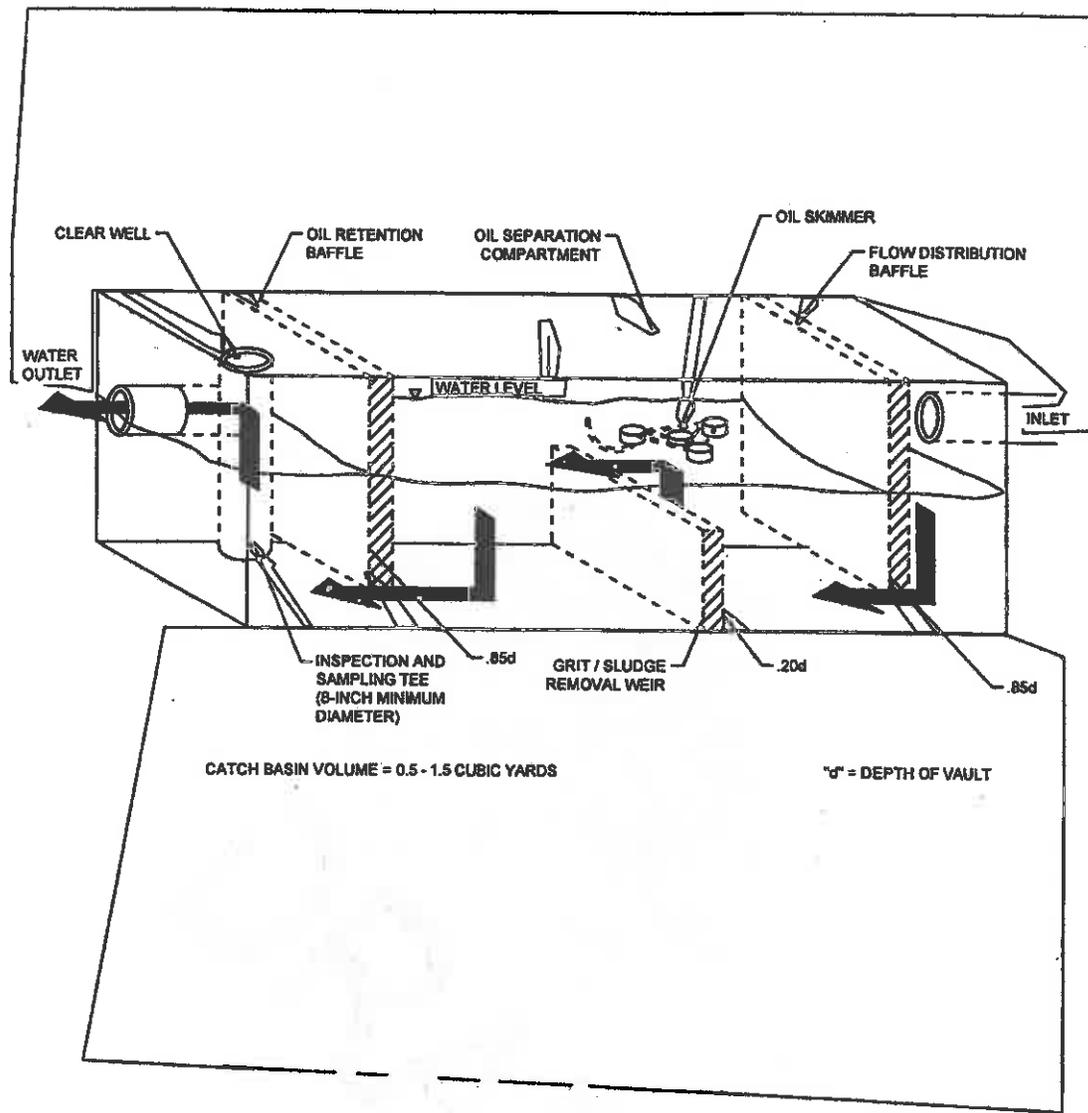
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

SUBSURFACE TREATMENT DEVICES
CPS - SEPARATOR

CONSTRUCTION STANDARDS AND DETAILS



PC-41
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



OIL/GRIT SEPARATOR:
API - SEPARATOR

NOTE: FOR ILLUSTRATIVE PURPOSES ONLY

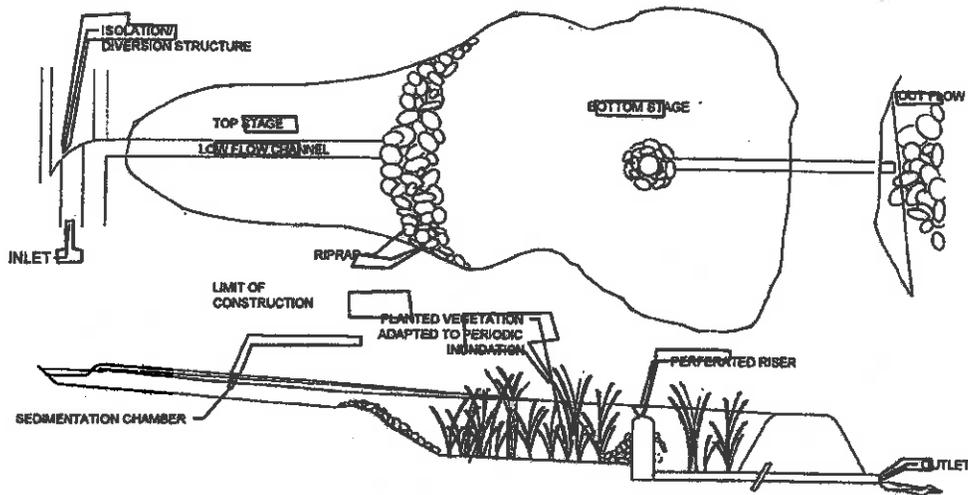
CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

SUBSURFACE TREATMENT DEVICES
API - SEPARATOR

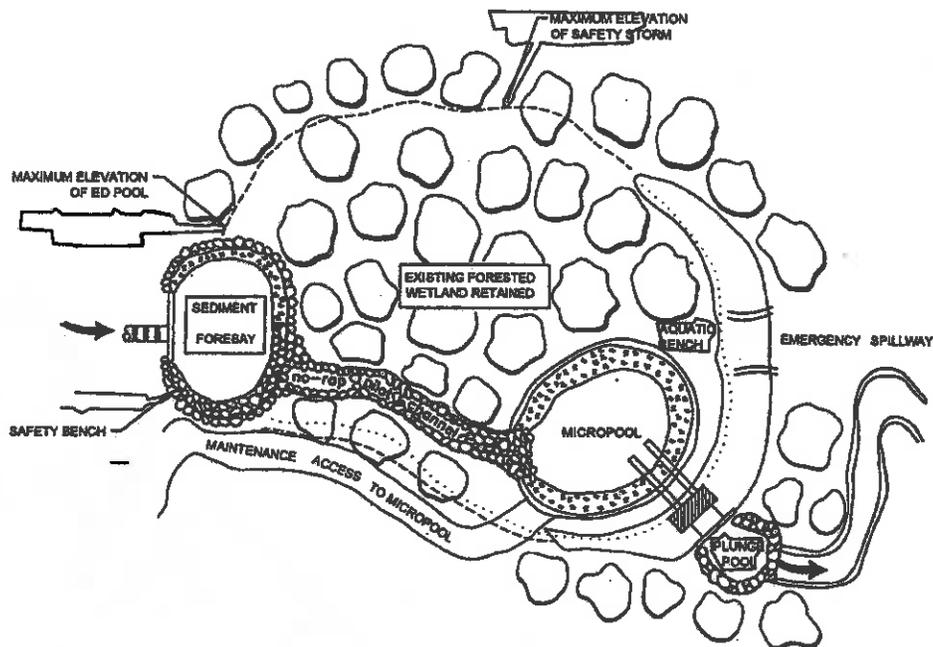
CONSTRUCTION STANDARDS AND DETAILS



PC-42
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



SCHMATIC OF A TWO STAGE EXTENDED DETENTION BASIN (LCRA, 1998)



Source: Schueler, 1991

SCHMATIC OF AN ENHANCED EXTENDED DETENTION BASIN (SCHUELER, 1992)

NOTE: FOR ILLUSTRATIVE PURPOSES ONLY

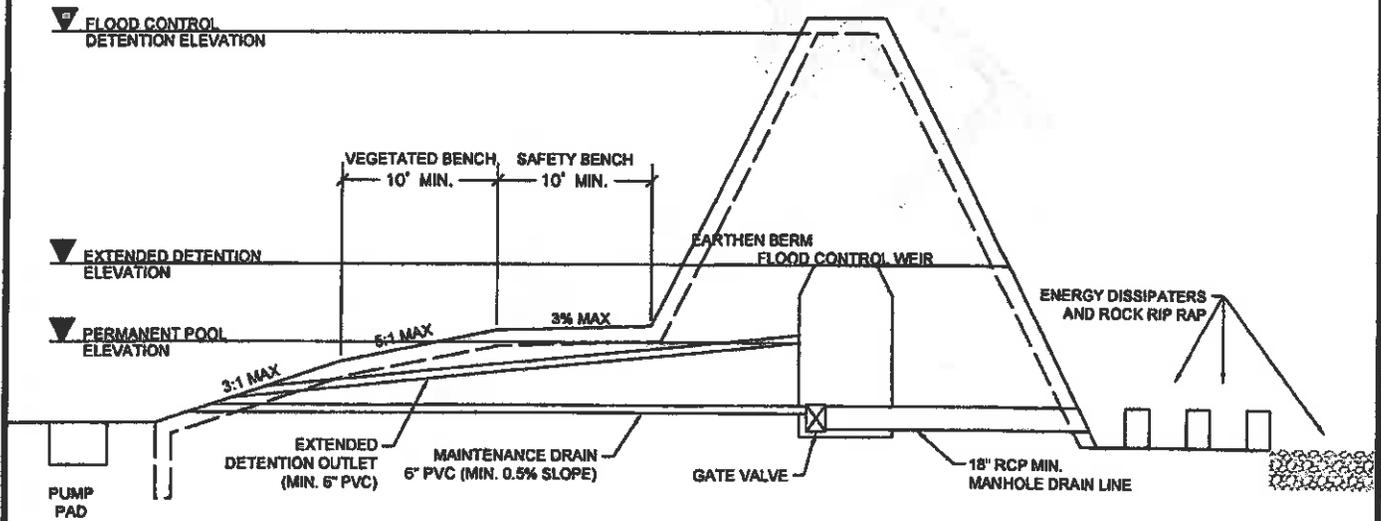
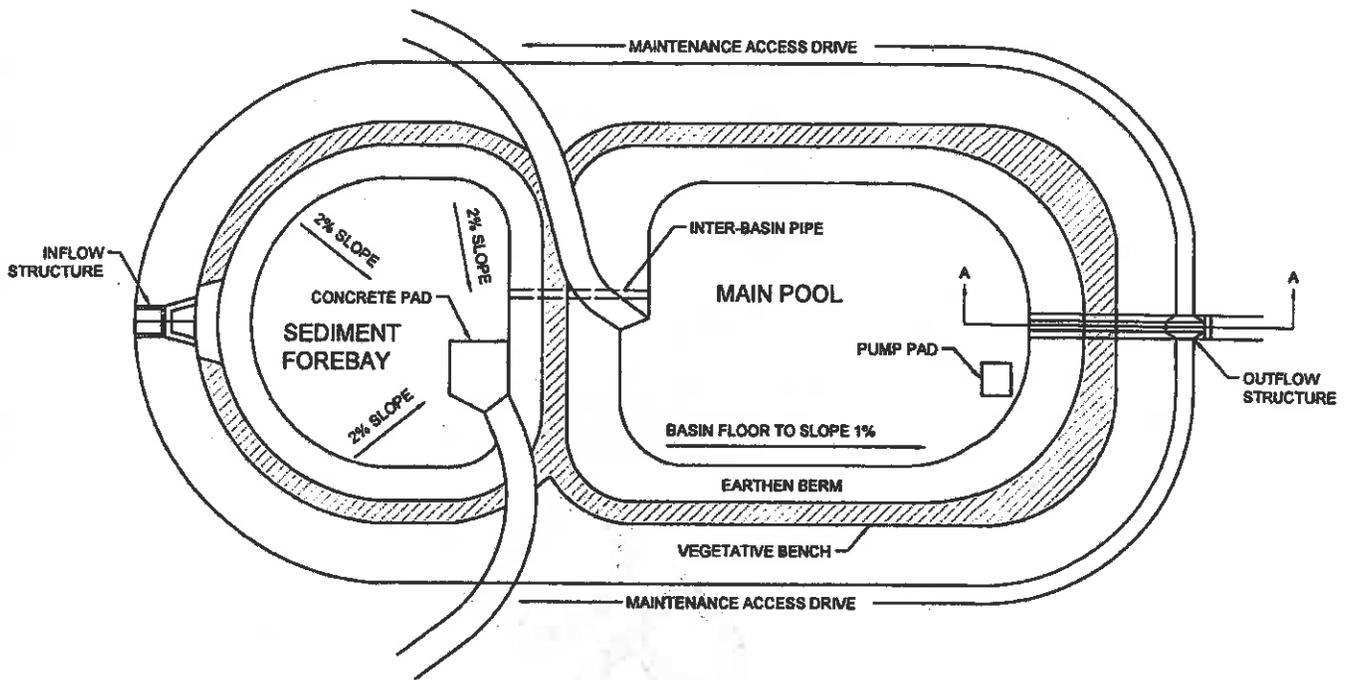
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

DRY EXTENDED DETENTION
BASIN

CONSTRUCTION STANDARDS AND DETAILS



PC-43
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



SECTION A-A

NOTE: FOR ILLUSTRATIVE PURPOSES ONLY

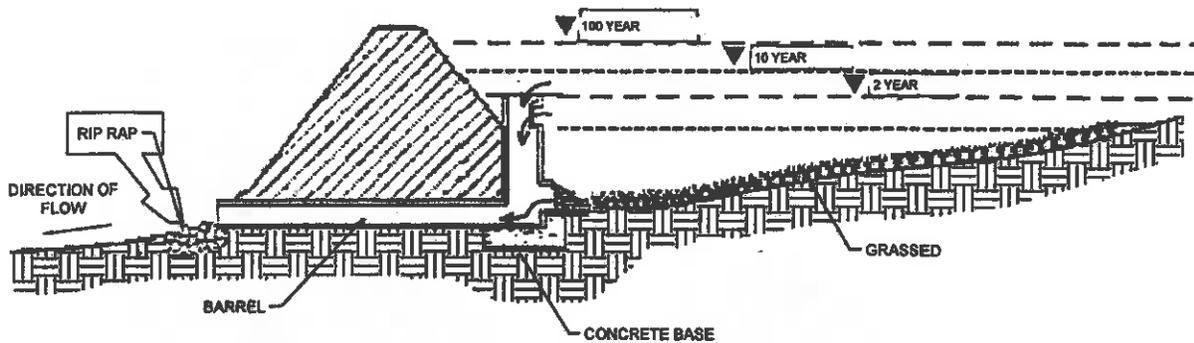
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

WET
PONDS

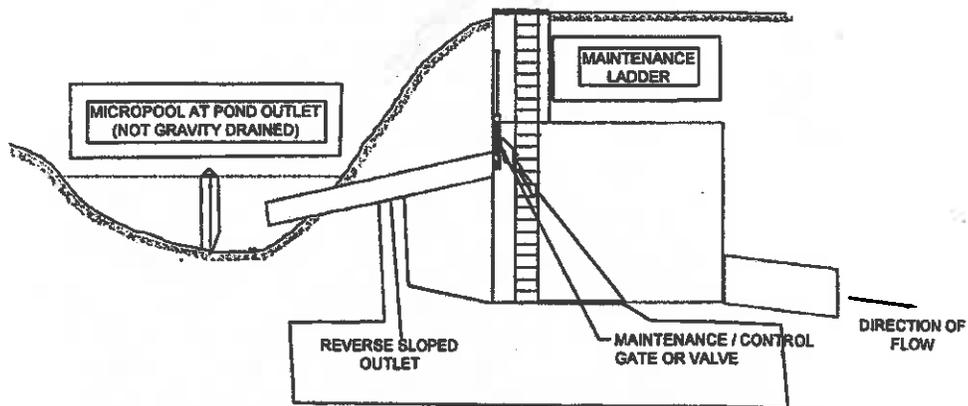
CONSTRUCTION STANDARDS AND DETAILS



PC-44
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



TYPICAL DRY POND
 Source: NVPDC, 1992.



DRY POND MICROPOOL AND REVERSED-SLOPE OUTLET PIPE
 Source: Ontario Ministry of the Environment, 1999.

NOTE: FOR ILLUSTRATIVE PURPOSES ONLY

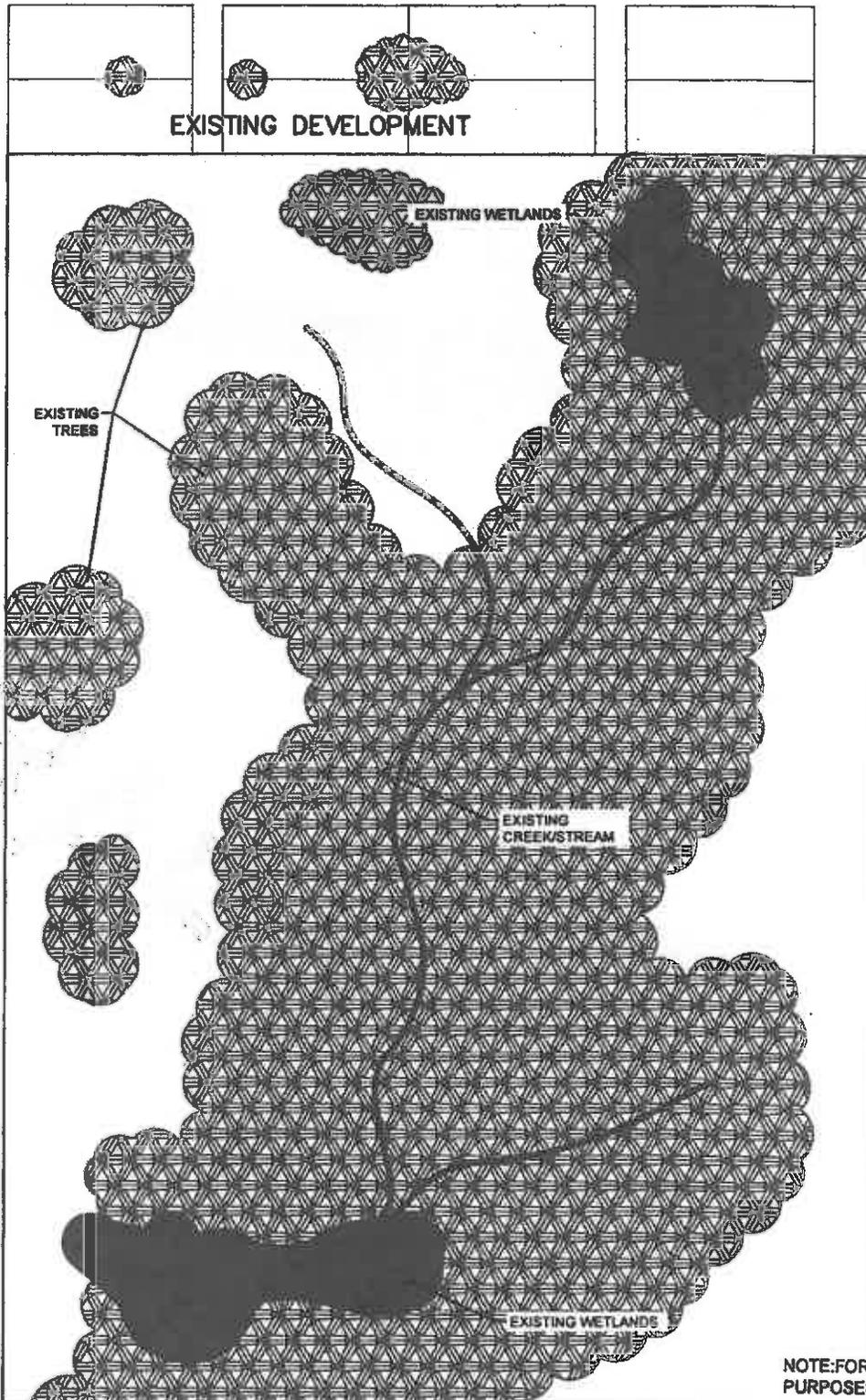
CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS



**DETENTION POND OUTLET FOR EROSION PROTECTION
 AND STORM WATER QUALITY BENEFITS**

CONSTRUCTION STANDARDS AND DETAILS

PC-45
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



NOTE: FOR ILLUSTRATIVE PURPOSES ONLY

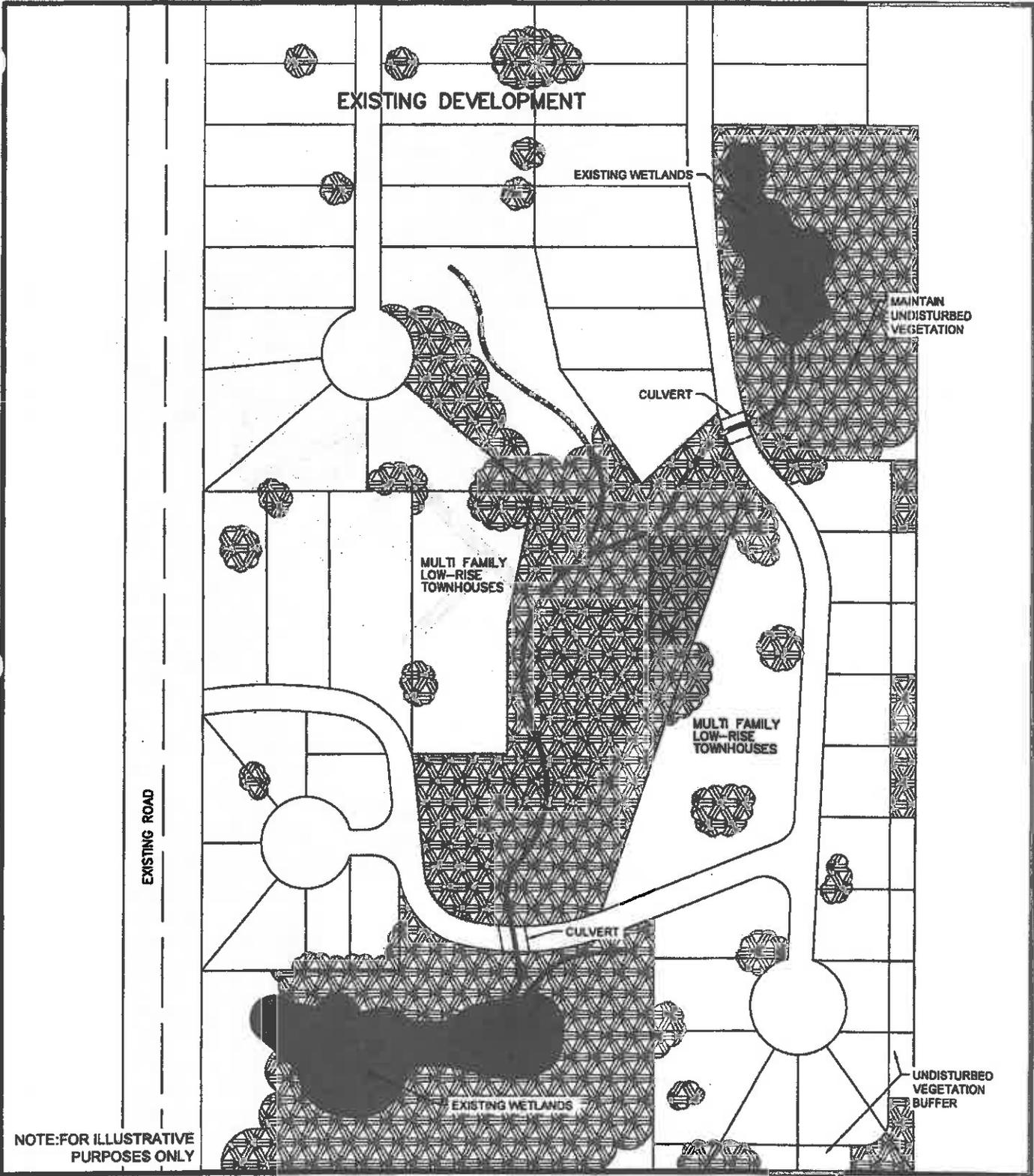
CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

OPEN SPACE / CLUSTER DESIGN
 PRE-PROJECT

CONSTRUCTION STANDARDS AND DETAILS



PC-46
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



NOTE: FOR ILLUSTRATIVE PURPOSES ONLY

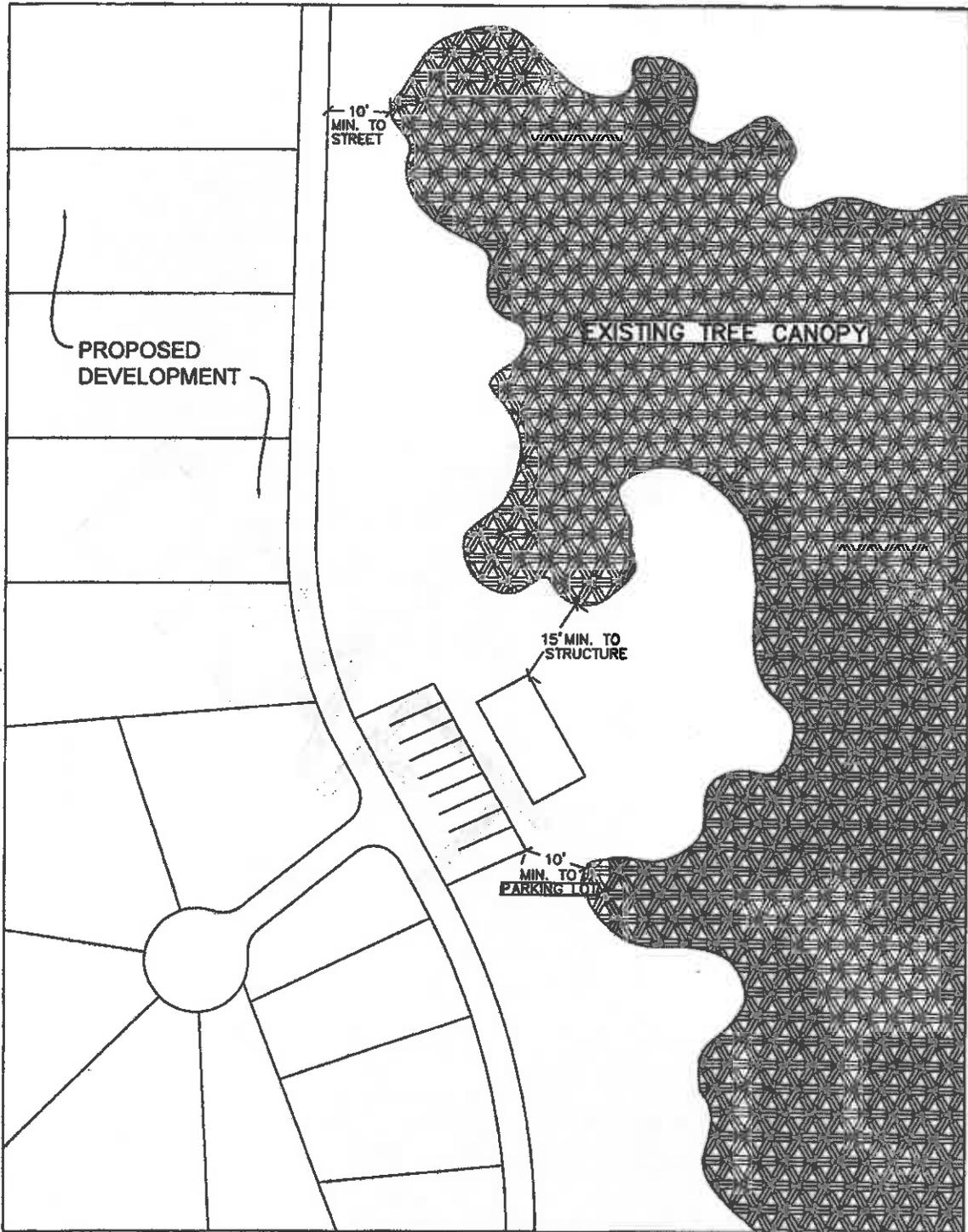
CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

OPEN SPACE / CLUSTER DESIGN
POST PROJECT

CONSTRUCTION STANDARDS AND DETAILS



PC-47
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



NOTE: FOR ILLUSTRATIVE PURPOSES ONLY

CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

URBAN FORESTRY

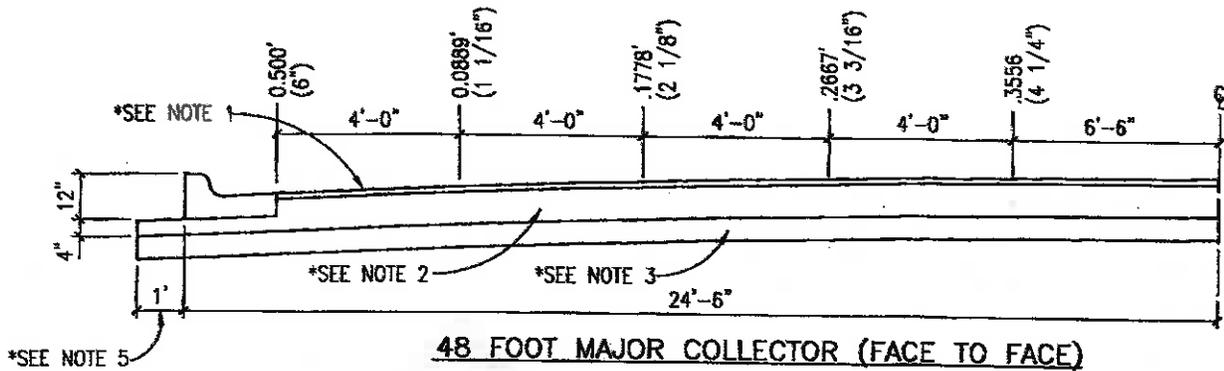
CONSTRUCTION STANDARDS AND DETAILS



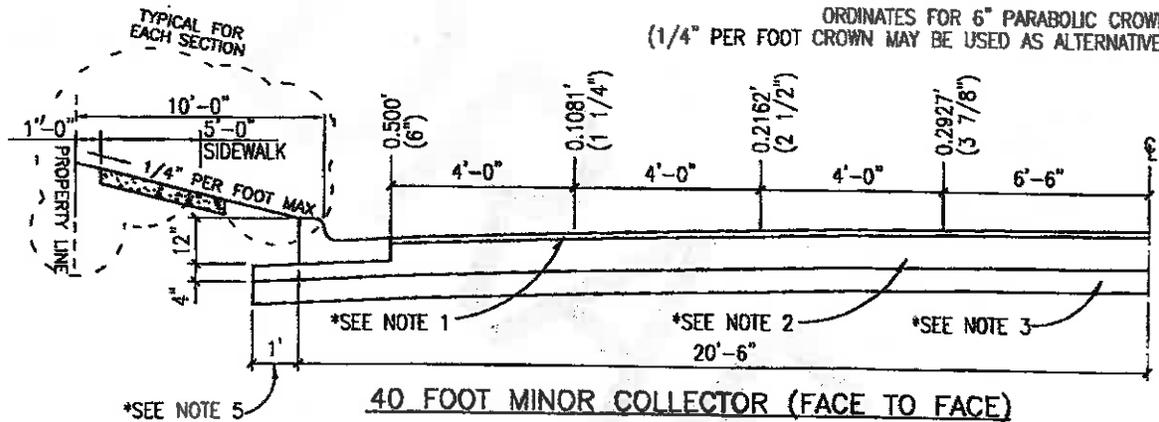
PC-48
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

* - SEE SHEET T-05 FOR NOTES.

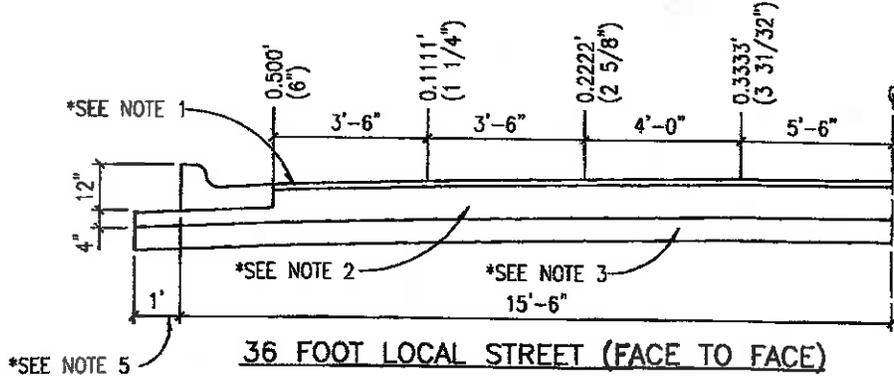
ORDINATES FOR 6" PARABOLIC CROWN
(1/4" PER FOOT CROWN MAY BE USED AS ALTERNATIVE)



ORDINATES FOR 6" PARABOLIC CROWN
(1/4" PER FOOT CROWN MAY BE USED AS ALTERNATIVE)



ORDINATES FOR 6" PARABOLIC CROWN
(1/4" PER FOOT CROWN MAY BE USED AS ALTERNATIVE)



CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

TYPICAL HALF CROSS SECTIONS
FOR LOCAL/COLLECTOR STREETS

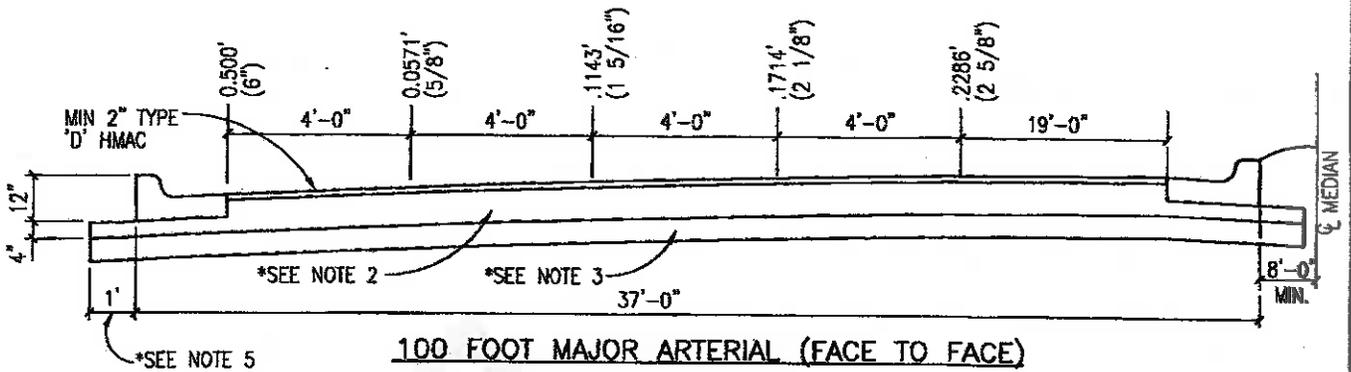
CONSTRUCTION STANDARDS AND DETAILS



T-01
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

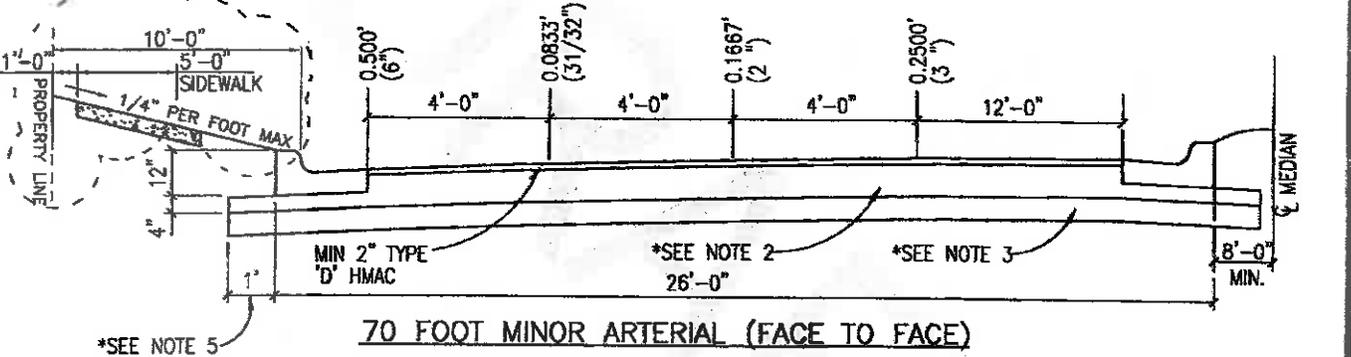
* - SEE SHEET T-05 FOR NOTES.

ORDINATES FOR 6" PARABOLIC CROWN
(1/4" PER FOOT CROWN MAY BE USED AS ALTERNATIVE)



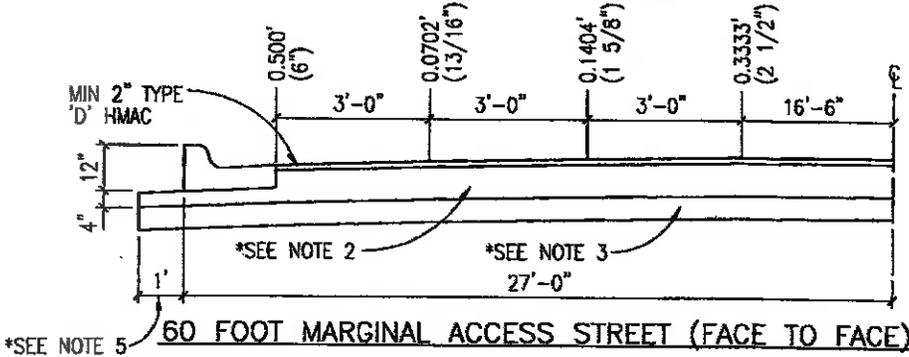
TYPICAL FOR EACH SECTION

ORDINATES FOR 6" PARABOLIC CROWN
(1/4" PER FOOT CROWN MAY BE USED AS ALTERNATIVE)



TYPICAL FOR EACH SECTION

ORDINATES FOR 6" PARABOLIC CROWN
(1/4" PER FOOT CROWN MAY BE USED AS ALTERNATIVE)



CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

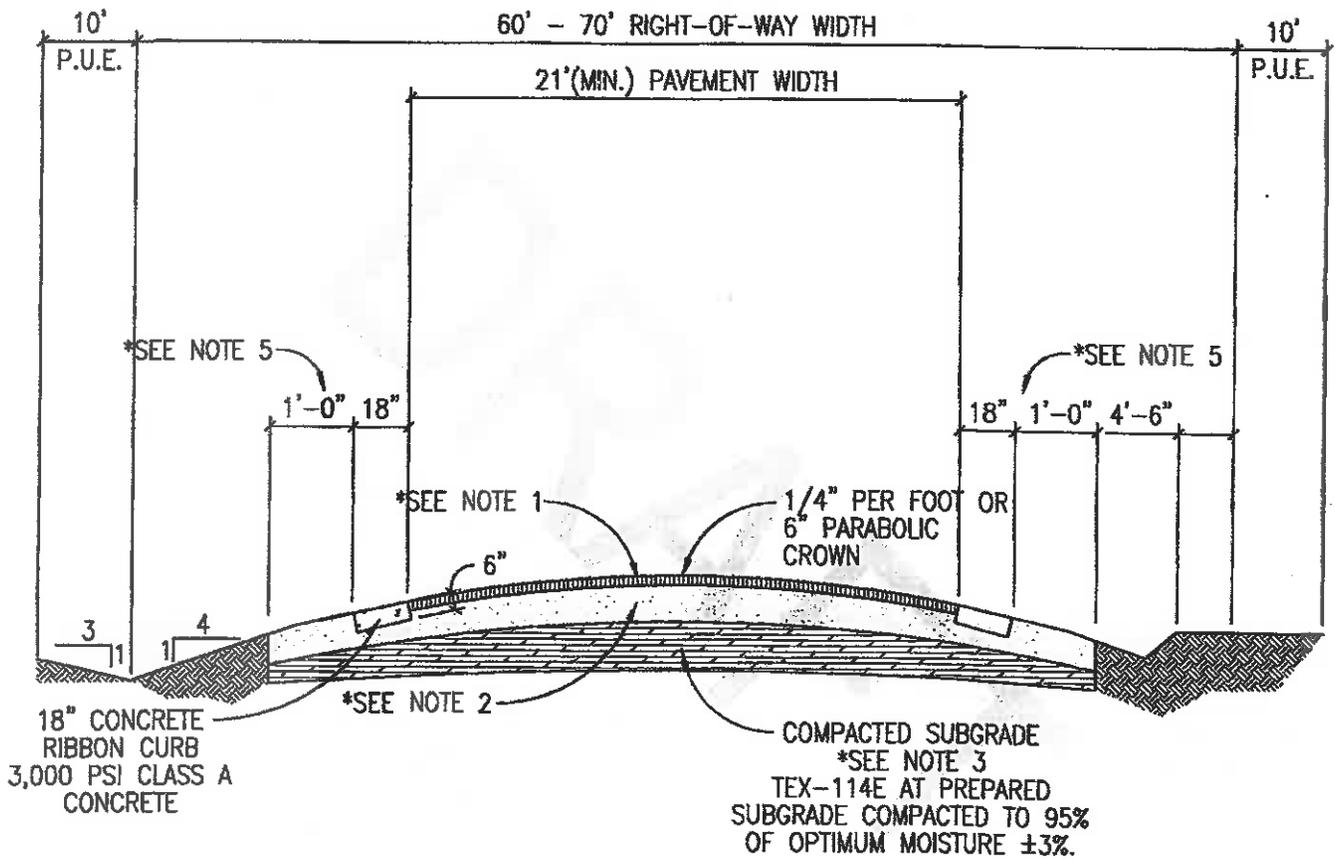
**TYPICAL HALF CROSS SECTIONS
FOR ARTERIAL/INDUSTRIAL STREETS**

CONSTRUCTION STANDARDS AND DETAILS



T-02
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

* - SEE SHEET T-05 FOR NOTES.



CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

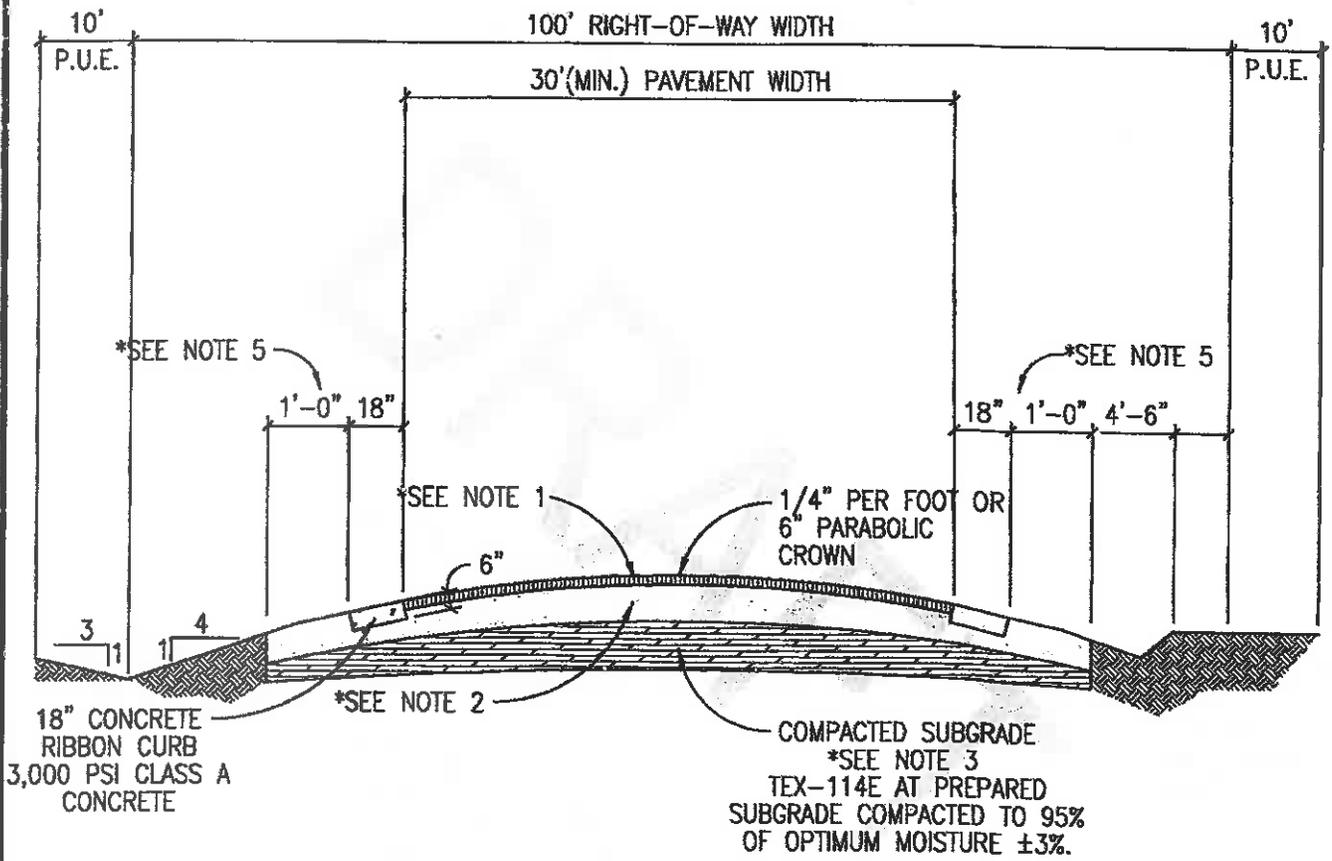
TYPICAL RURAL PAVING
STANDARD

CONSTRUCTION STANDARDS AND DETAILS



T-03
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

* - SEE SHEET T-05 FOR NOTES.



CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**TYPICAL RURAL (COLLECTOR) PAVING
STANDARD**

CONSTRUCTION STANDARDS AND DETAILS



T-04
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

NOTES:

1. MIN 1.5" TYPE 'D' HOT MIX ASPHALTIC CONCRETE.
2. FLEXBASE, TXDOT ITEM 247, GRADE 2 OR BETTER, SHALL BE PLACED IN LIFTS NOT EXCEEDING 6" COMPACTED DEPTH AND TO A MINIMUM 95% OF THE MAXIMUM DENSITY AS DETERMINED BY ASTM D1557 (METHOD D). THE BASE MATERIAL SHALL BE PLACED AT OPTIMUM MOISTURE \pm 2%.
3. LIME STABILIZATION OR GEOGRID MAY BE USED TO REDUCE BASE MATERIAL THICKNESS WHEN PRESCRIBED BY A QUALIFIED GEOTECHNICAL REPORT IN LIEU OF THE MINIMUM BASE MATERIAL THICKNESS LISTED BELOW:
4. COMBINED THICKNESS OF FLEXIBLE BASE COURSE, TREATED SUBGRADE OR SUBBASE SHALL BE AS REQUIRED TO SUPPORT TRAFFIC LOADS AND VOLUME ON SUBGRADE.
5. SUBGRADE/BASE SHALL BE EXTENDED 1'-0" BEHIND CURB FOR ALL STREET SECTIONS.
6. SUBGRADE SHALL BE AT OPTIMUM MOISTURE OR ABOVE PRIOR TO PLACING BASE MATERIAL.

PAVING SECTIONS		MIN. BASE MATERIAL BY SOIL GROUP CLASSIFICATION						
STREET TYPE	MIN. HMAC TYPE 'D'	GROUP I	GROUP II	GROUP III	GROUP IV	GROUP V	GROUP VI	GROUP VII
LOCAL STREET	1.5"	7.5"	8.5"	9.5"	12.0"	14.0"	16.0"	18.0"
MINOR COLLECTOR	1.5"	7.5"	9.0"	11.0"	14.0"	16.0"	18.0"	22.0"
MAJOR COLLECTOR	1.5"	7.5"	9.0"	11.0"	14.0"	16.0"	18.0"	22.0"
INDUSTRIAL STREET	1.5"	8.0"	10.0"	12.5"	15.0"	17.5"	20.0"	24.0"
MINOR ARTERIAL	2.0"	8.0"	10.0"	12.5"	15.0"	17.5"	20.0"	24.0"
MAJOR ARTERIAL	2.5"	8.5"	11.0"	13.5"	16.5"	19.0"	21.5"	26.0"
RURAL LOCAL	1.5"	7.5"	8.5"	9.5"	12.0"	14.0"	16.0"	18.0"
RURAL COLLECTOR	1.5"	7.5"	9.0"	11.0"	14.0"	16.0"	18.0"	22.0"

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

CROSS SECTIONS
NOTES

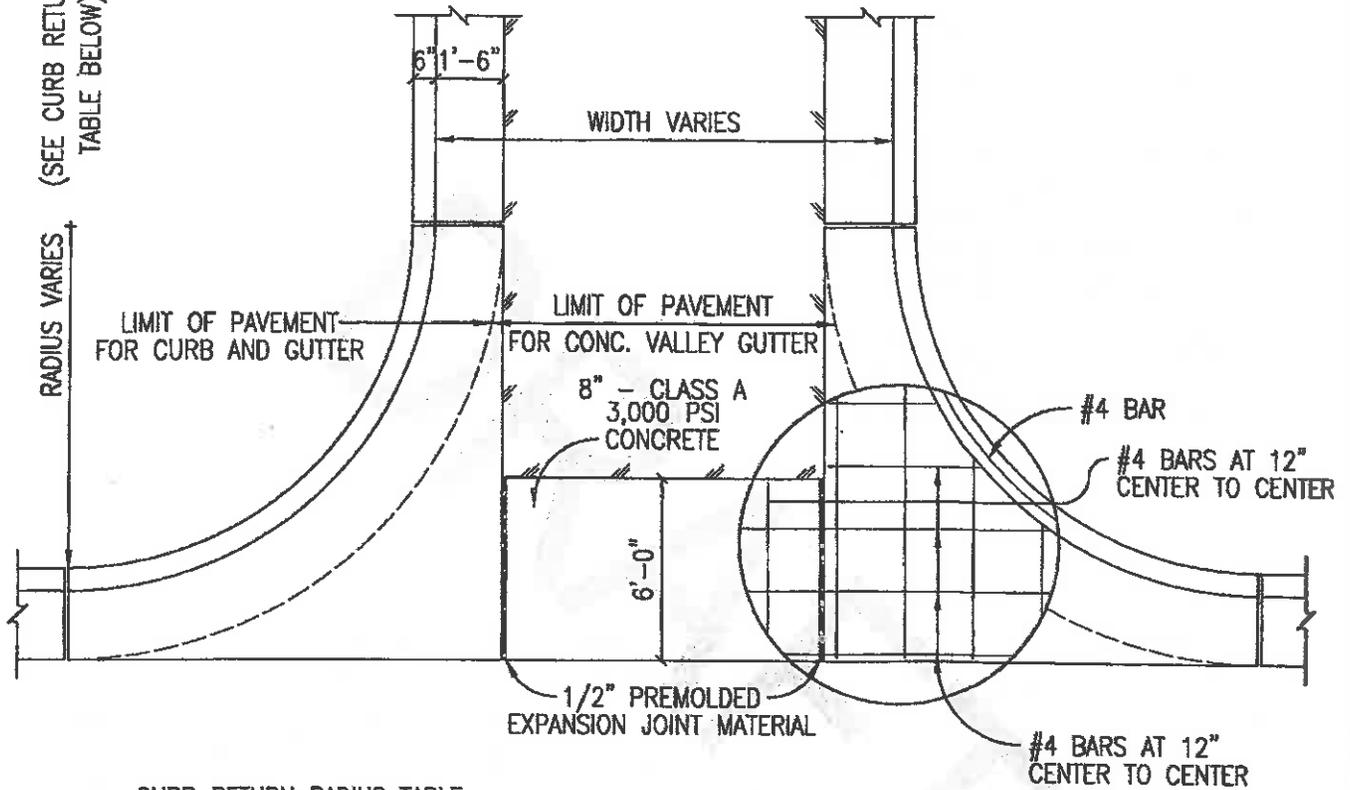
CONSTRUCTION STANDARDS AND DETAILS



T-05
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

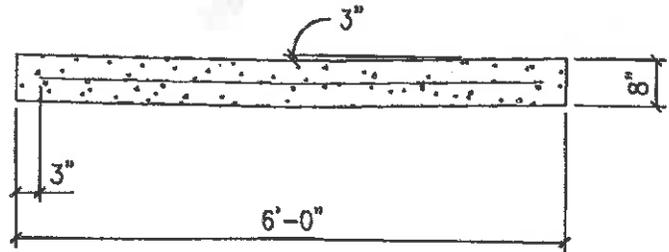
(SEE CURB RETURN TABLE BELOW)

RADIUS VARIES



CURB RETURN RADIUS TABLE

<u>CATEGORY</u>	<u>RADIUS (FT)</u>
MAJOR ARTERIAL	25
MINOR ARTERIAL	25
INDUSTRIAL STREET	50
MAJOR COLLECTOR	25
MINOR COLLECTOR	25
LOCAL STREET	15



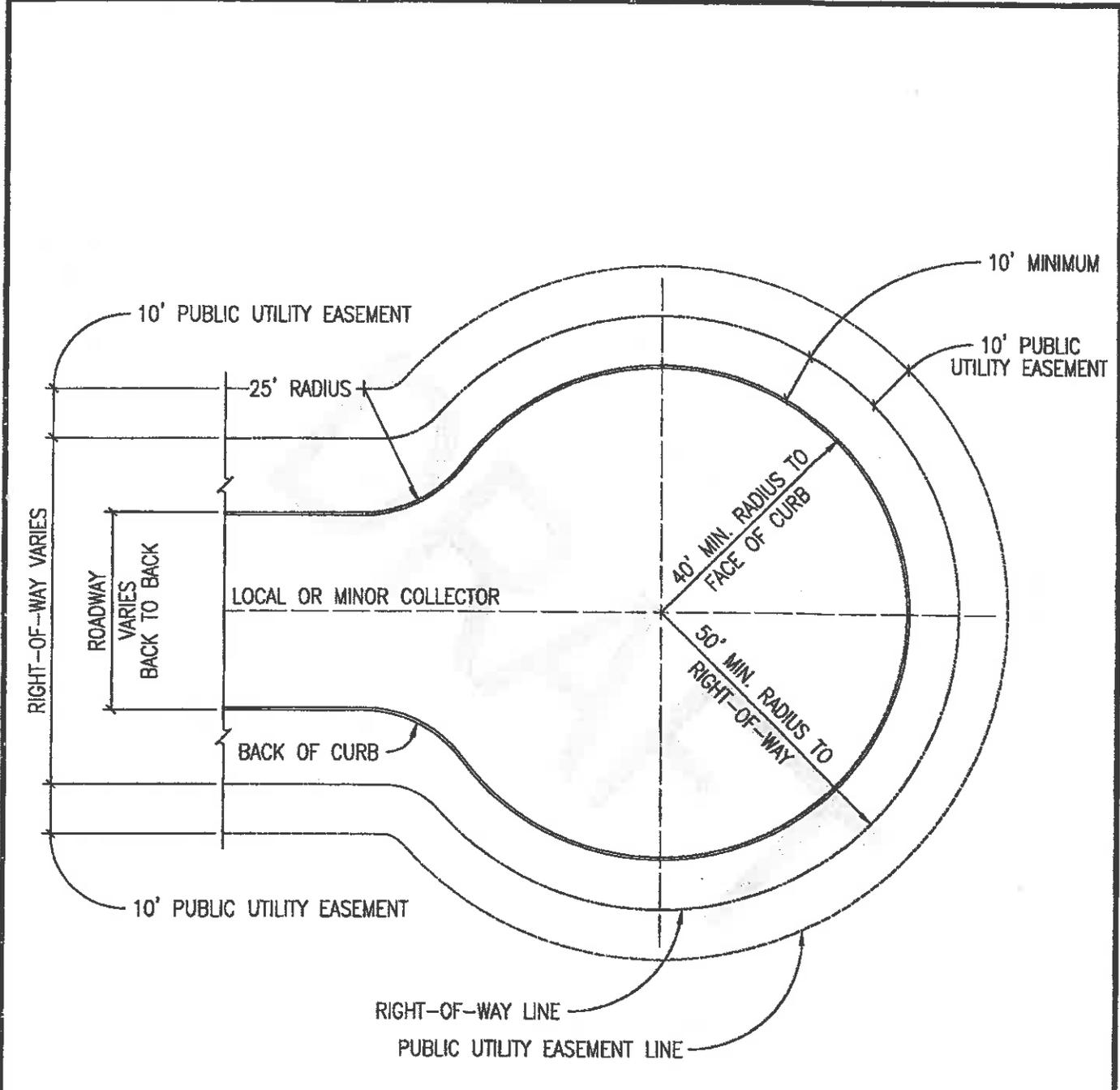
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**CONCRETE VALLEY GUTTER
STANDARD**

CONSTRUCTION STANDARDS AND DETAILS



T-06
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



NOTE:
 1. CUL-DE-SAC SHALL BE CONSTRUCTED WITH A 7-INCH CROWN, GIVING A 1.5% CROSS SLOPE.

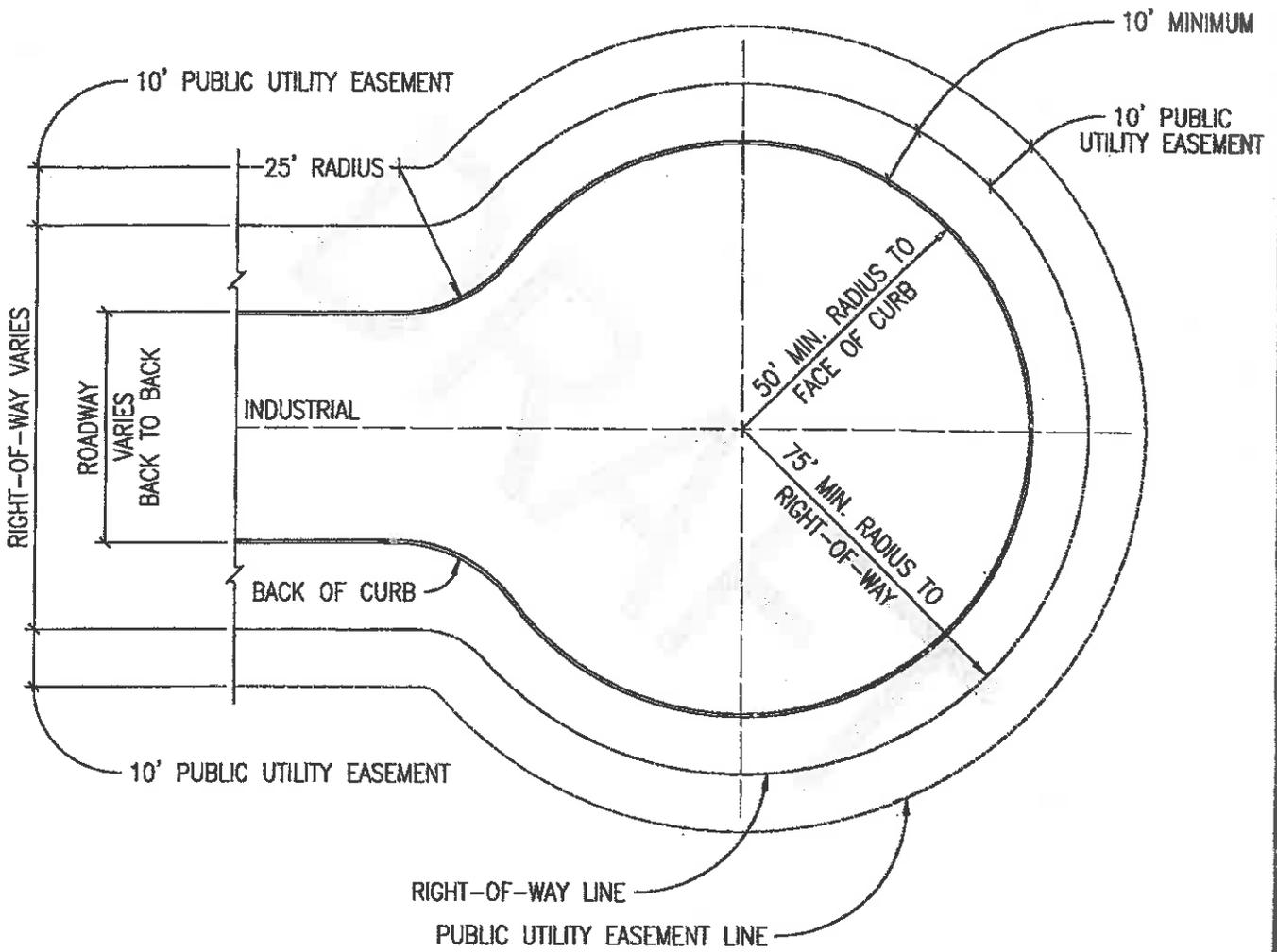
CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

LOCAL/MINOR COLLECTOR
CUL-DE-SAC PLAN

CONSTRUCTION STANDARDS AND DETAILS



T-07
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



NOTE:

1. CUL-DE-SAC SHALL BE CONSTRUCTED WITH A 9-INCH CROWN, GIVING A 1.5% CROSS SLOPE.

CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

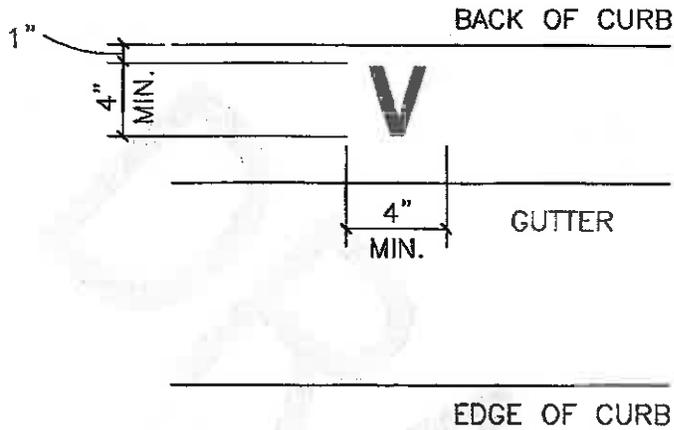
INDUSTRIAL
CUL-DE-SAC PLAN

CONSTRUCTION STANDARDS AND DETAILS



T-08
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

(EX. WATER VALVE)



PLAN VIEW
(TYPICAL)

NOTES:

1. ALL WATER SERVICE, WASTE WATER SERVICE AND VALVE LOCATIONS SHALL BE APPROXIMATELY MARKED AS FOLLOWS:

WATER SERVICE	"W"	TOP OF CURB
WASTE WATER SERVICE	"S"	TOP OF CURB
VALVE	"V"	TOP OF CURB

2. LETTERS SHALL HAVE A 1/2" MAX. WIDTH.

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**CURB STAMP
STANDARD**

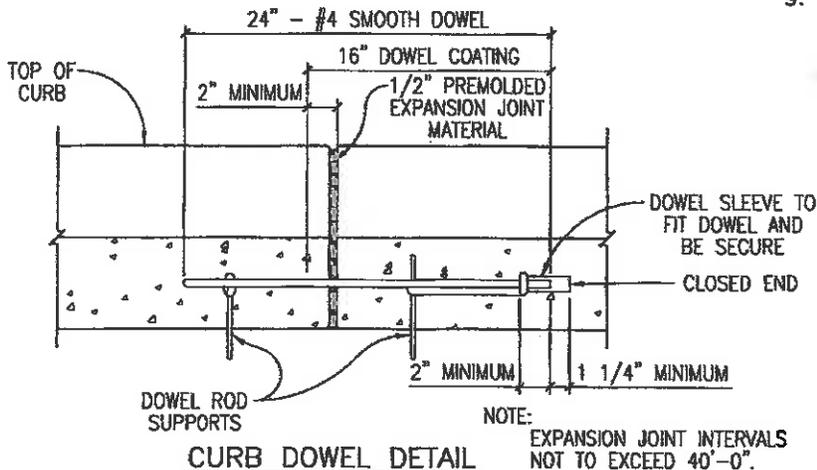
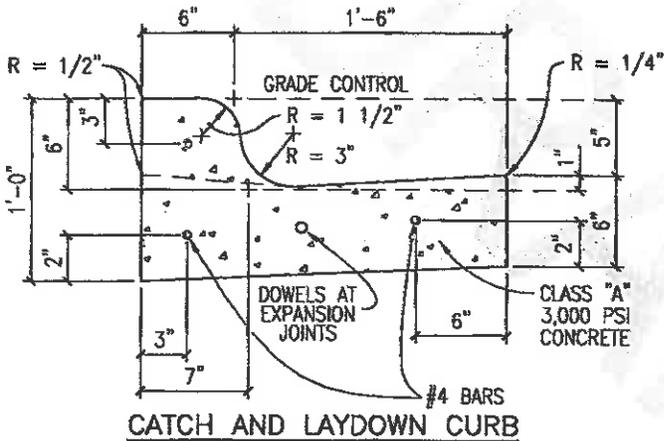
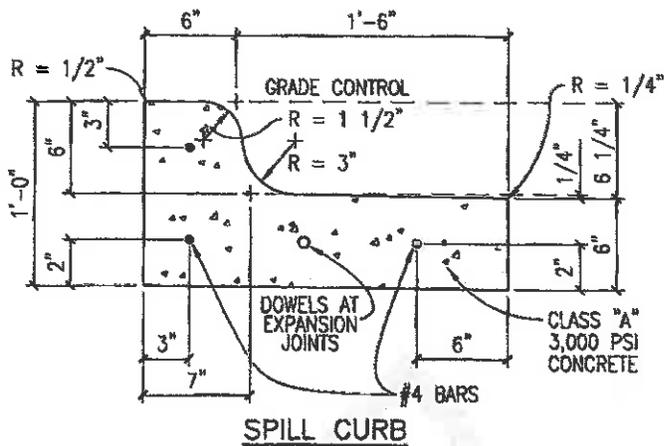
CONSTRUCTION STANDARDS AND DETAILS



T-09

SCALE: N.T.S.

ISSUE DATE: XX-XX-XX



NOTES:

1. ALL WORK AND MATERIAL SHALL CONFORM TO ASTM A615, A615M, C309, AND D1752. BROOM FINISH EXPOSED SURFACE.
2. CONTRACTION JOINT SPACING 10' MAX.
3. EXPANSION JOINTS AS PER STD. ASTM D-1752.
4. 1/2" EXPANSION JOINT MATERIAL SHALL BE PROVIDED WHERE CURB IS ADJACENT TO SIDEWALK OR RIP-RAP.
5. TRANSITIONS BETWEEN CURBS OR DIFFERING CROSS SECTIONS SHALL OCCUR OVER A 20 FOOT LENGTH AS APPROVED BY THE ENGINEER OR THE CITY OF KILLEEN.
6. ALL CONCRETE SHALL BE CLASS A, 3000 PSI.
7. ALL SURFACES THAT ARE CHIPPED OR OTHERWISE DAMAGED DURING CONSTRUCTION SHALL BE REPAIRED.
8. ONE OF THE FOLLOWING SCHEMES OF REINFORCEMENT SHALL BE REQUIRED. THE MANNER OF PLACEMENT AND LOCATION SHALL BE TO THE SATISFACTION OF THE ENGINEER OR THE CITY OF KILLEEN.
 - A. CURB AND GUTTER (REINFORCED) SHALL HAVE LONGITUDINAL REINFORCING BARS AS FOLLOWS: TWO #4.
 - B. ALL TYPES OF CURB (REINFORCED) SHALL HAVE #4 BAR FOR LONGITUDINAL REINFORCEMENT.
9. REINFORCING BARS SHALL BE LAPPED A MINIMUM OF 15 INCH.

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**CURB AND GUTTER
STANDARD**

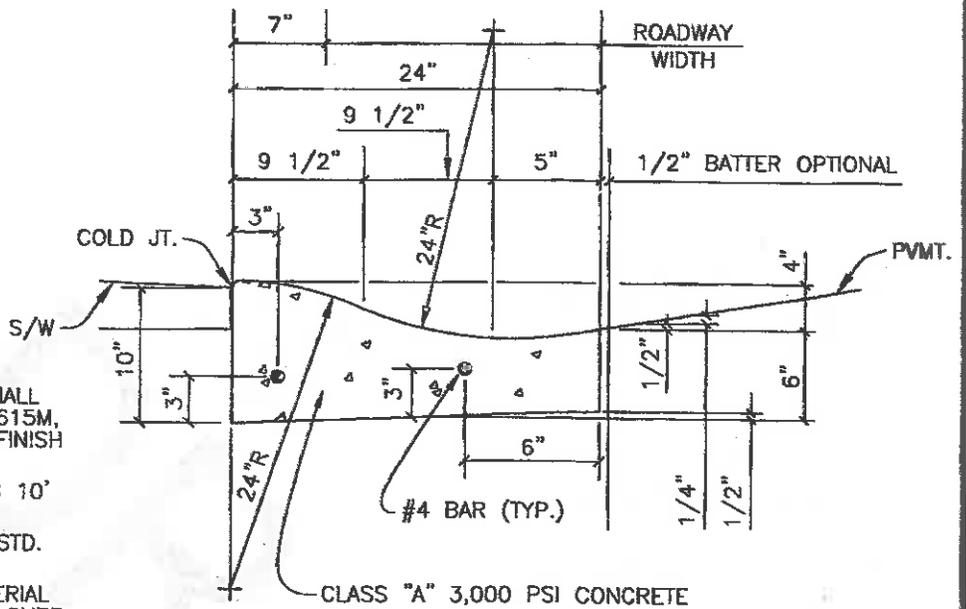
CONSTRUCTION STANDARDS AND DETAILS



T-10

SCALE: N.T.S.

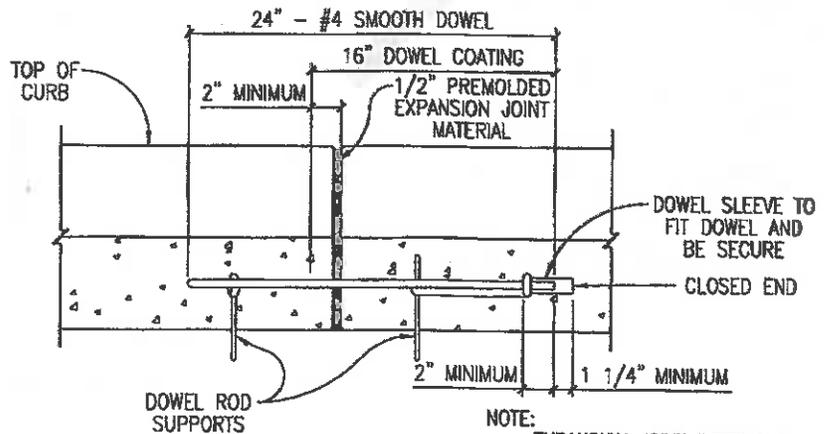
ISSUE DATE: XX-XX-XX



NOTES:

1. ALL WORK AND MATERIAL SHALL CONFORM TO ASTM A615, A615M, C309, AND D1752. BROOM FINISH EXPOSED SURFACE.
2. CONTRACTION JOINT SPACING 10' MAX.
3. EXPANSION JOINTS AS PER STD. ASTM D-1752.
4. 1/2" EXPANSION JOINT MATERIAL SHALL BE PROVIDED WHERE CURB IS ADJACENT TO SIDEWALK OR RIP-RAP.
5. TRANSITIONS BETWEEN CURBS OR DIFFERING CROSS SECTIONS SHALL OCCUR OVER A 20 FOOT LENGTH AS APPROVED BY THE ENGINEER OR THE CITY OF KILLEEN.
6. ALL CONCRETE SHALL BE CLASS A, 3000 PSI.
7. ALL SURFACES THAT ARE CHIPPED OR OTHERWISE DAMAGED DURING CONSTRUCTION SHALL BE REPAIRED.
8. ONE OF THE FOLLOWING SCHEMES OF REINFORCEMENT SHALL BE REQUIRED. THE MANNER OF PLACEMENT AND LOCATION SHALL BE TO THE SATISFACTION OF THE ENGINEER OR THE CITY OF KILLEEN.
 - A. CURB AND GUTTER (REINFORCED) SHALL HAVE LONGITUDINAL REINFORCING BARS AS FOLLOWS: TWO #4,
 - B. ALL TYPES OF CURB (REINFORCED) SHALL HAVE #4 BAR FOR LONGITUDINAL REINFORCEMENT.
9. REINFORCING BARS SHALL BE LAPPED A MINIMUM OF 15 INCH.

MOUNTABLE CURB



CURB DOWEL DETAIL

NOTE: EXPANSION JOINT INTERVALS NOT TO EXCEED 40'-0".

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

MOUNTABLE CURB AND GUTTER
STANDARDS

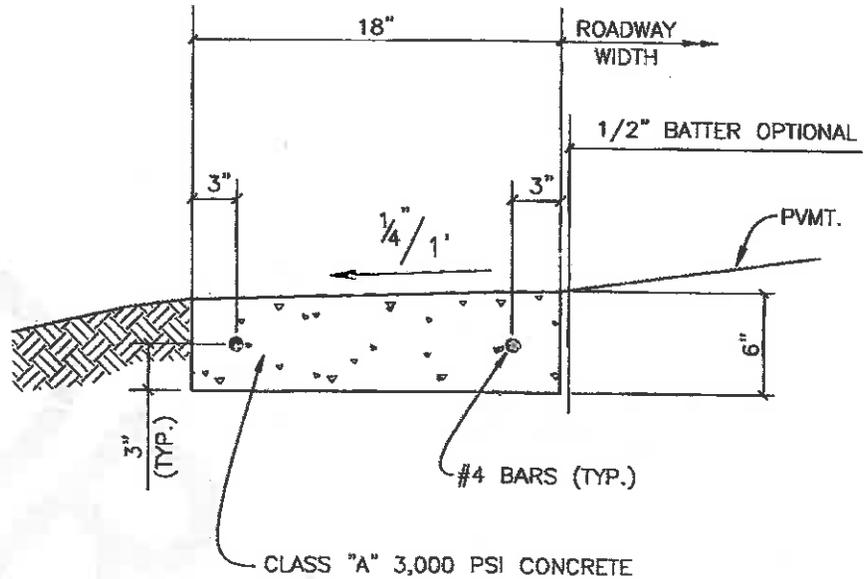
CONSTRUCTION STANDARDS AND DETAILS



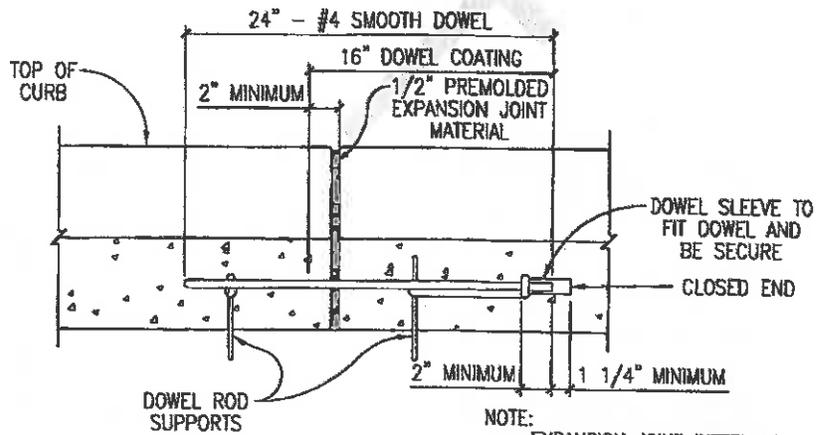
T-11
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

NOTES:

1. ALL WORK AND MATERIAL SHALL CONFORM TO ASTM A615, A615M, C309, AND D1752. BROOM FINISH EXPOSED SURFACE.
2. CONTRACTION JOINT SPACING 10' MAX.
3. EXPANSION JOINTS AS PER STD. ASTM D-1752.
4. 1/2" EXPANSION JOINT MATERIAL SHALL BE PROVIDED WHERE CURB IS ADJACENT TO SIDEWALK OR RIP-RAP.
5. TRANSITIONS BETWEEN CURBS OR DIFFERING CROSS SECTIONS SHALL OCCUR OVER A 20 FOOT LENGTH AS APPROVED BY THE ENGINEER OR TH CITY OF KILLEEN.
6. ALL CONCRETE SHALL BE CLASS A, 3000 PSI.
7. ALL SURFACES THAT ARE CHIPPED OR OTHERWISE DAMAGED DURING CONSTRUCTION SHALL BE REPAIRED.
8. ONE OF THE FOLLOWING SCHEMES OF REINFORCEMENT SHALL BE REQUIRED. THE MANNER OF PLACEMENT AND LOCATION SHALL BE TO THE SATISFACTION OF THE ENGINEER OR THE CITY OF KILLEEN.
 - A. CURB AND GUTTER (REINFORCED) SHALL HAVE LONGITUDINAL REINFORCING BARS AS FOLLOWS: TWO #4.
 - B. ALL TYPES OF CURB (REINFORCED) SHALL HAVE #4 BAR FOR LONGITUDINAL REINFORCEMENT.
9. REINFORCING BARS SHALL BE LAPPED A MINIMUM OF 15 INCH.



RIBBON CURB



CURB DOWEL DETAIL

NOTE: EXPANSION JOINT INTERVALS NOT TO EXCEED 40'-0".

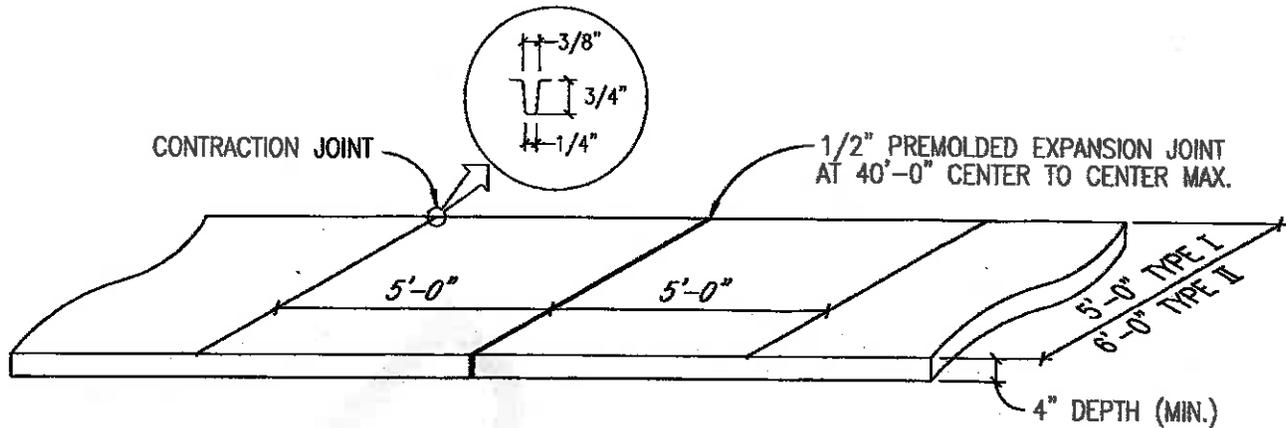
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

RIBBON CURB
STANDARD

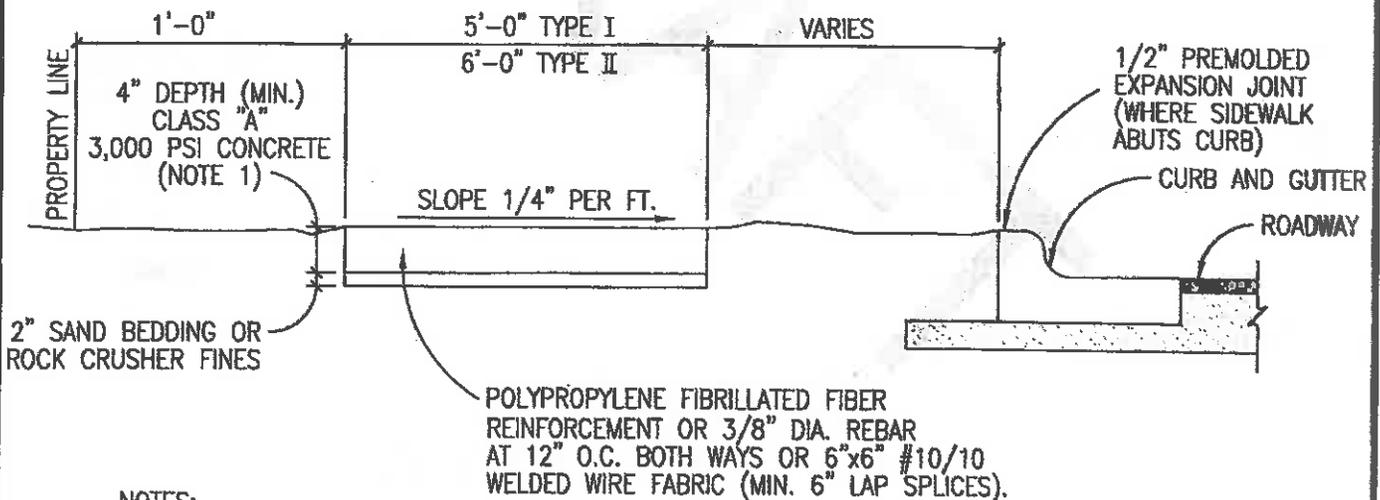
CONSTRUCTION STANDARDS AND DETAILS



T-12
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



TYPE I -- AS REQUIRED FOR RESIDENTIAL LOTS AND LOTS ADJACENT TO LOCAL STREETS AND MINOR COLLECTORS.
 TYPE II -- AS REQUIRED FOR COMMERCIAL LOTS AND LOTS ADJACENT TO MAJOR AND MINOR ARTERIAL STREETS, MAJOR COLLECTORS AND INDUSTRIAL STREETS.



NOTES:

1. FOR ROLLER STAMPED SIDEWALK: MATCH TO SPECIFICATIONS.
2. STANDARD LOCATION OF SIDEWALK IS OFF BACK OF CURB. SPECIAL DESIGNS MAY BE APPROVED BY THE CITY ENGINEER, PRIOR TO FINAL DESIGN.
3. SIDEWALK SHALL CONFORM TO CURRENT AMERICANS WITH DISABILITIES ACT STANDARDS.
4. ALL SIDEWALKS SHALL BE SUBMITTED AND APPROVED BY THE TEXAS DEPARTMENT OF LICENSING AND REGULATION BY THE ENGINEER OF RECORD.
5. ANY VARIANCE IN TEXTURE, GRADE OR ALIGNMENT MUST BE APPROVED BY THE TEXAS DEPARTMENT OF LICENSING AND REGULATION.
6. ALL CONCRETE SURFACES SHALL RECEIVE A LIGHT BROOM FINISH UNLESS NOTED OTHERWISE IN THE PLANS.

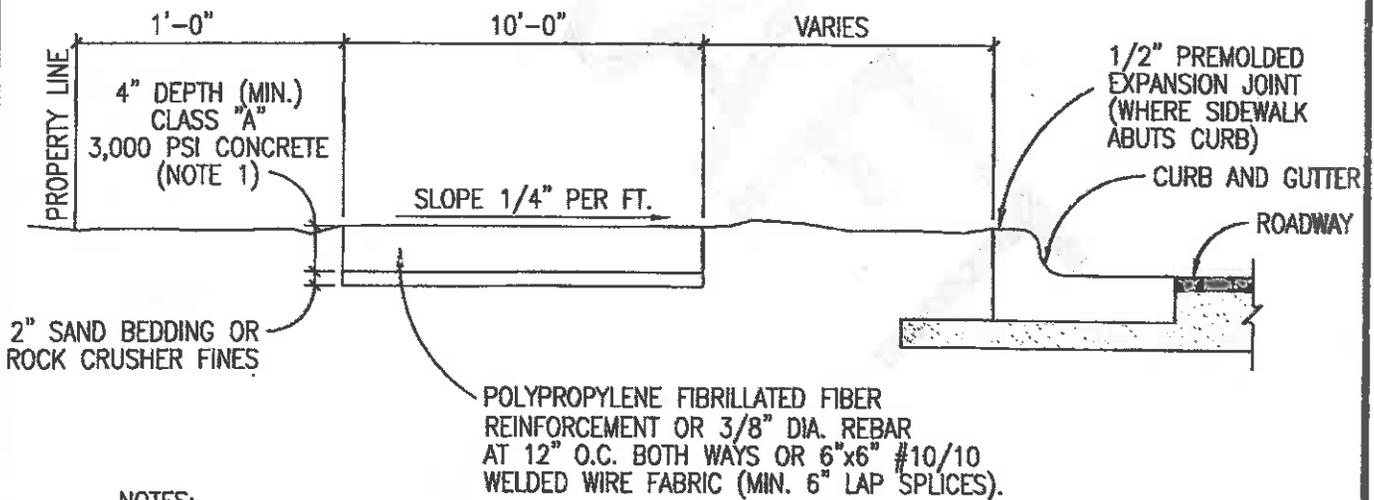
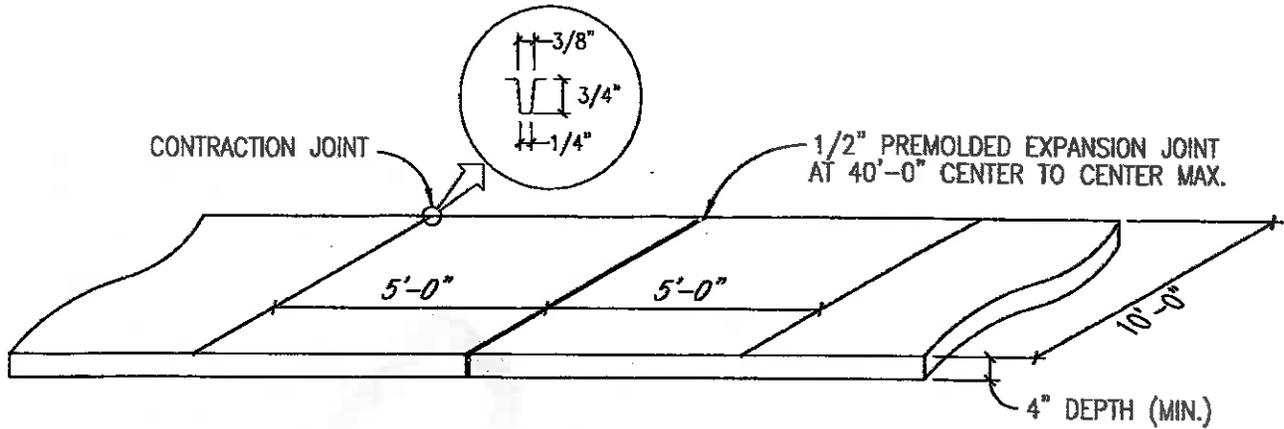
CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

SIDEWALK SECTION
STANDARD

CONSTRUCTION STANDARDS AND DETAILS



T-13
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



NOTES:

1. FOR ROLLER STAMPED HIKE AND BIKE: MATCH TO SPECIFICATIONS.
2. STANDARD LOCATION OF HIKE AND BIKE IS OFF BACK OF CURB. SPECIAL DESIGNS MAY BE APPROVED BY THE CITY ENGINEER, PRIOR TO FINAL DESIGN.
3. HIKE AND BIKE SHALL CONFORM TO CURRENT AMERICANS WITH DISABILITIES ACT STANDARDS.
4. ALL HIKE AND BIKES SHALL BE SUBMITTED AND APPROVED BY THE TEXAS DEPARTMENT OF LICENSING AND REGULATION BY THE ENGINEER OF RECORD.
5. ANY VARIANCE IN TEXTURE, GRADE OR ALIGNMENT MUST BE APPROVED BY THE TEXAS DEPARTMENT OF LICENSING AND REGULATION.
6. ALL CONCRETE SURFACES SHALL RECEIVE A LIGHT BROOM FINISH UNLESS NOTED OTHERWISE IN THE PLANS.

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

HIKE AND BIKE
SECTION DETAIL

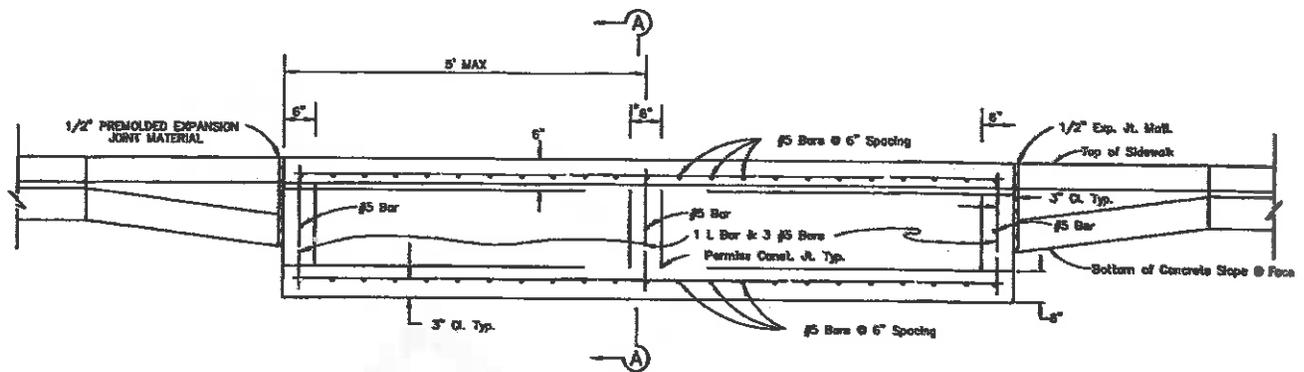
CONSTRUCTION STANDARDS AND DETAILS



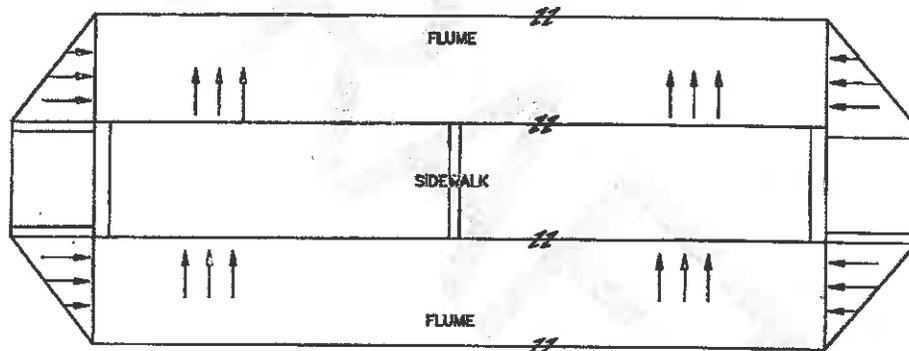
T-14

SCALE: N.T.S.

ISSUE DATE: XX-XX-XX



SECTION A-A



PLAN VIEW

NOTE:

1. CONCRETE SHALL BE CLASS "A" 3,000 PSI COMPRESSIVE STRENGTH AT 28 DAYS.
2. REINFORCEMENT STEEL SHALL CONFORM TO ASTM A 615, GRADE 60.
3. ALL CONCRETE SURFACES SHALL RECEIVE A LIGHT BROOM FINISH UNLESS OTHERWISE SPECIFIED IN THE PLANS.

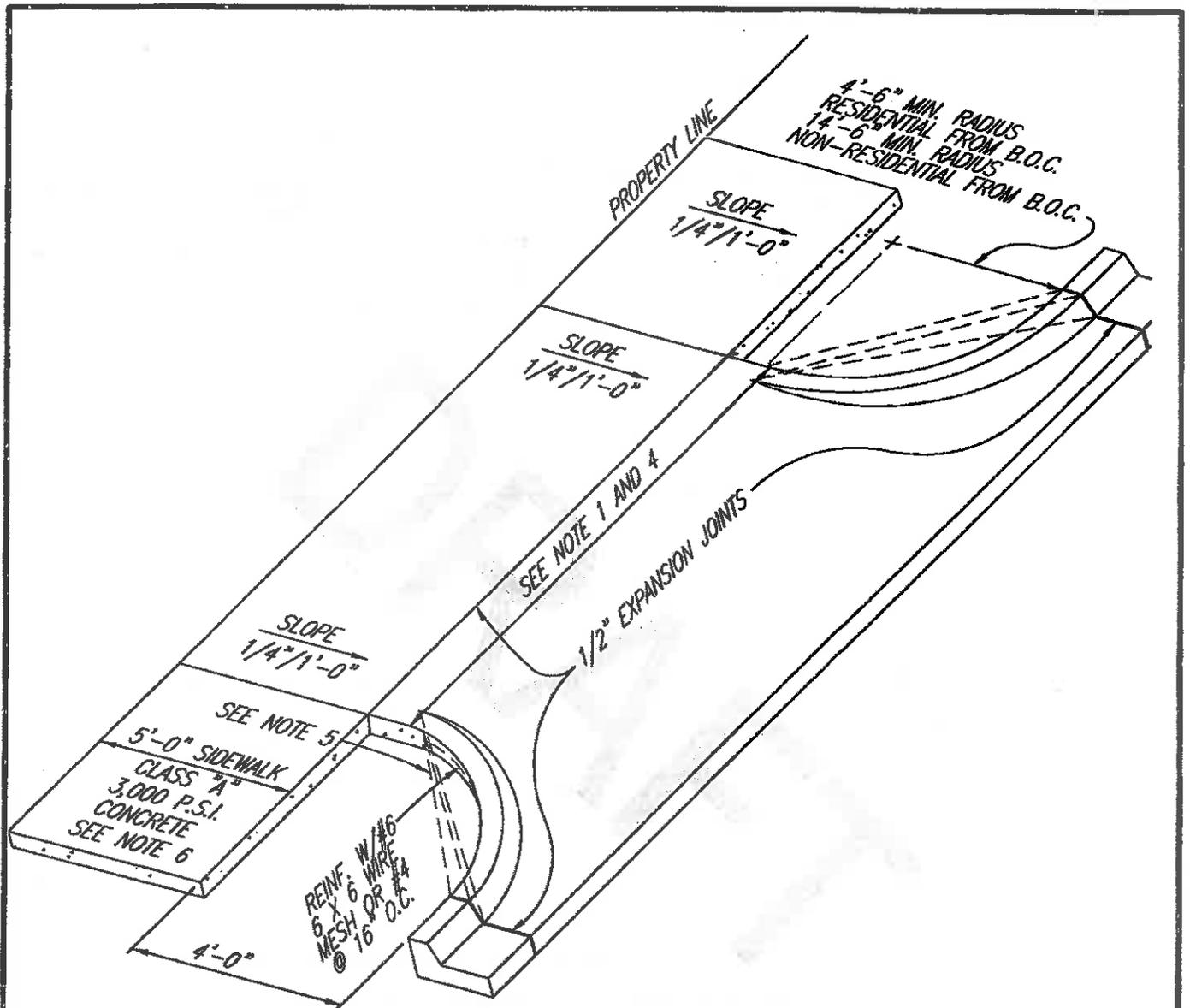
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

FREESPAN SIDEWALK
SECTIONS

CONSTRUCTION STANDARDS AND DETAILS



T-15
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



NOTES:

1. MAXIMUM WIDTH OF APPROACH SHALL BE 24'-0" FOR RESIDENTIAL, 35'-0" FOR NON-RESIDENTIAL.
2. DRIVEWAY PERMITS TO BE ACQUIRED FROM CITY HALL.
3. SPACING OF DRIVEWAY CUTS SHALL BE AS REQUIRED BY THE CITY ENGINEER.
4. MINIMUM WIDTH OF APPROACH SHALL BE 10'-0" FOR RESIDENTIAL AND 15'-0" FOR NON-RESIDENTIAL.
5. LINEAR "RADIUS" AT CORNERS, PERMITTED FOR "SINGLE FAMILY" OR "TWO FAMILY" RESIDENTIAL DRIVEWAY APPROACH.
6. SIDEWALK LOCATION TO BE APPROVED BY CITY ENGINEER PRIOR TO FINAL DESIGN.

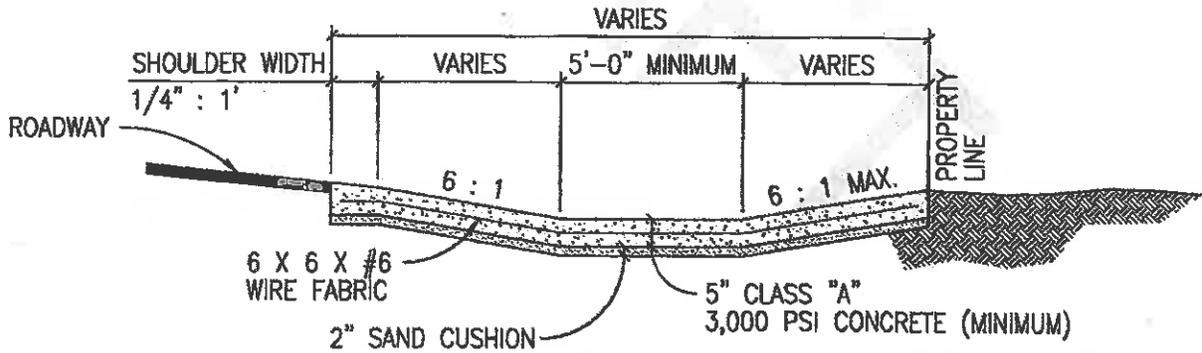
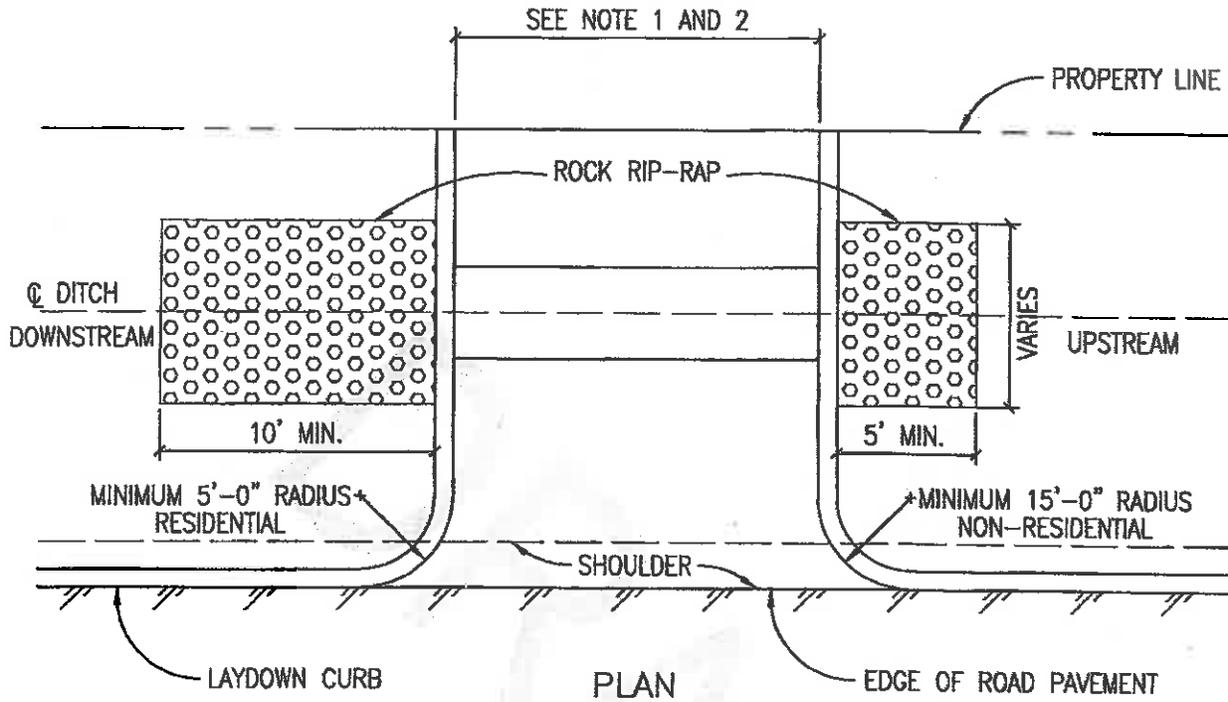
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

CONCRETE DRIVEWAY APPROACH
TYPICAL

CONSTRUCTION STANDARDS AND DETAILS



T-16
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



NOTES:

1. MINIMUM WIDTH OF APPROACH SHALL BE 12'-0" FOR RESIDENTIAL AND 15'-0" FOR NON-RESIDENTIAL.
2. MAXIMUM WIDTH OF APPROACH SHALL BE 24'-0" FOR RESIDENTIAL, 30'-0" FOR NON-RESIDENTIAL
3. ROCK RIP-RAP SHALL EXTEND 10' MINIMUM FROM THE DOWN STREAM SIDE AND 5' MINIMUM FROM THE UPSTREAM SIDE USING THE AVERAGE STONE SIZE DIA. OF 8" AT A DEPTH OF 16" (MINIMUM).
4. MINIMUM CHANNEL SIDE SLOPE SHALL BE 4:1.

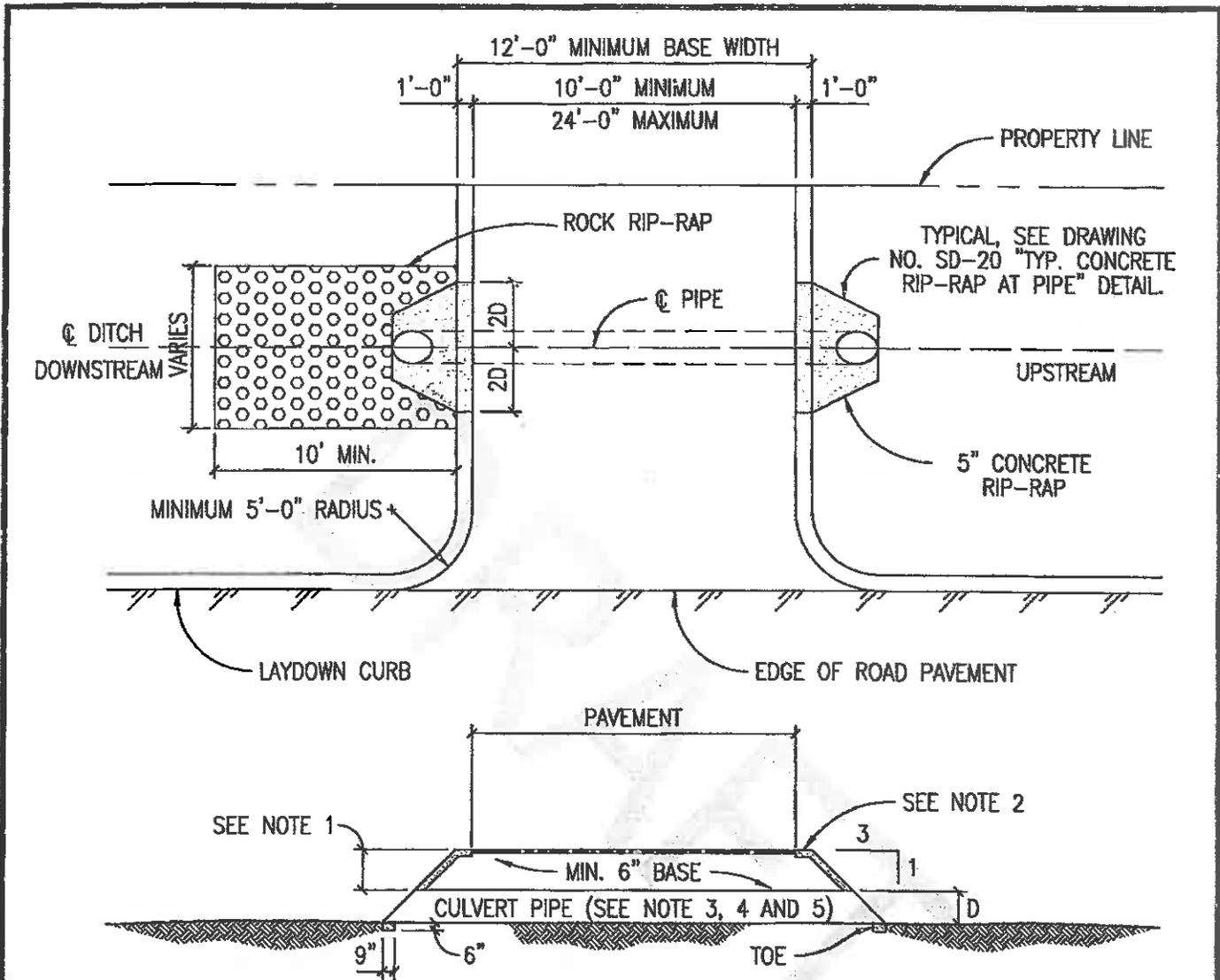
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

CONCRETE DIP
DRIVEWAY APPROACH

CONSTRUCTION STANDARDS AND DETAILS



T-17
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



NOTES:

1. MINIMUM COVER OVER CULVERT PIPE SHALL BE 6" (SEE NOTE 5).
2. 5" CONCRETE RIP-RAP SHALL BE INSTALLED.
3. CULVERT PIPE TO BE MINIMUM OF 18" DIAMETER.
4. CULVERT PIPE MATERIAL TO BE R.C.P. (CLASS IV), UNLESS PRIOR APPROVAL IS GRANTED BY THE CITY OF KILLEEN.
5. MINIMUM COVER OVER CULVERT PIPE SHALL PROVIDE H2O LOADING.
6. BACKFILL AROUND CULVERT PIPE SHALL BE SELECT MATERIAL TO BE PLACED AND COMPACTED TO 95% TEX-114E.
7. RIP-RAP SHALL EXTEND 10' FROM THE DOWN STREAM SIDE USING THE NOMINAL STONE SIZE DIA. OF 8" TO A DEPTH OF 16" (MINIMUM).
8. MINIMUM CHANNEL SIDE SLOPE SHALL BE 4:1.

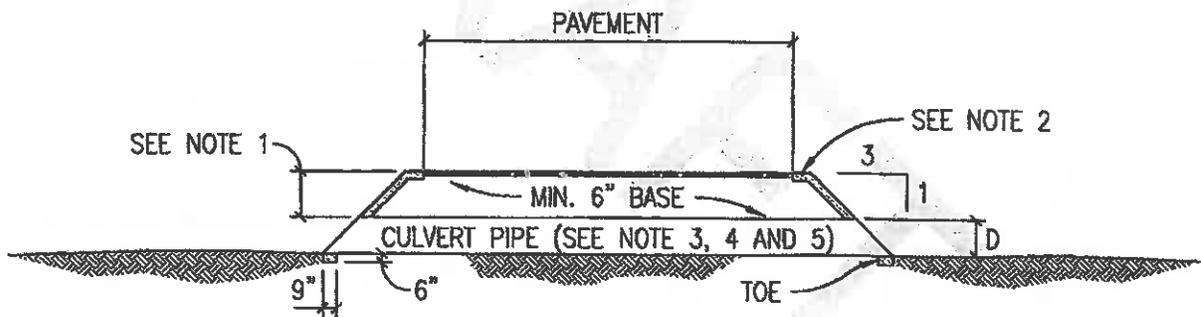
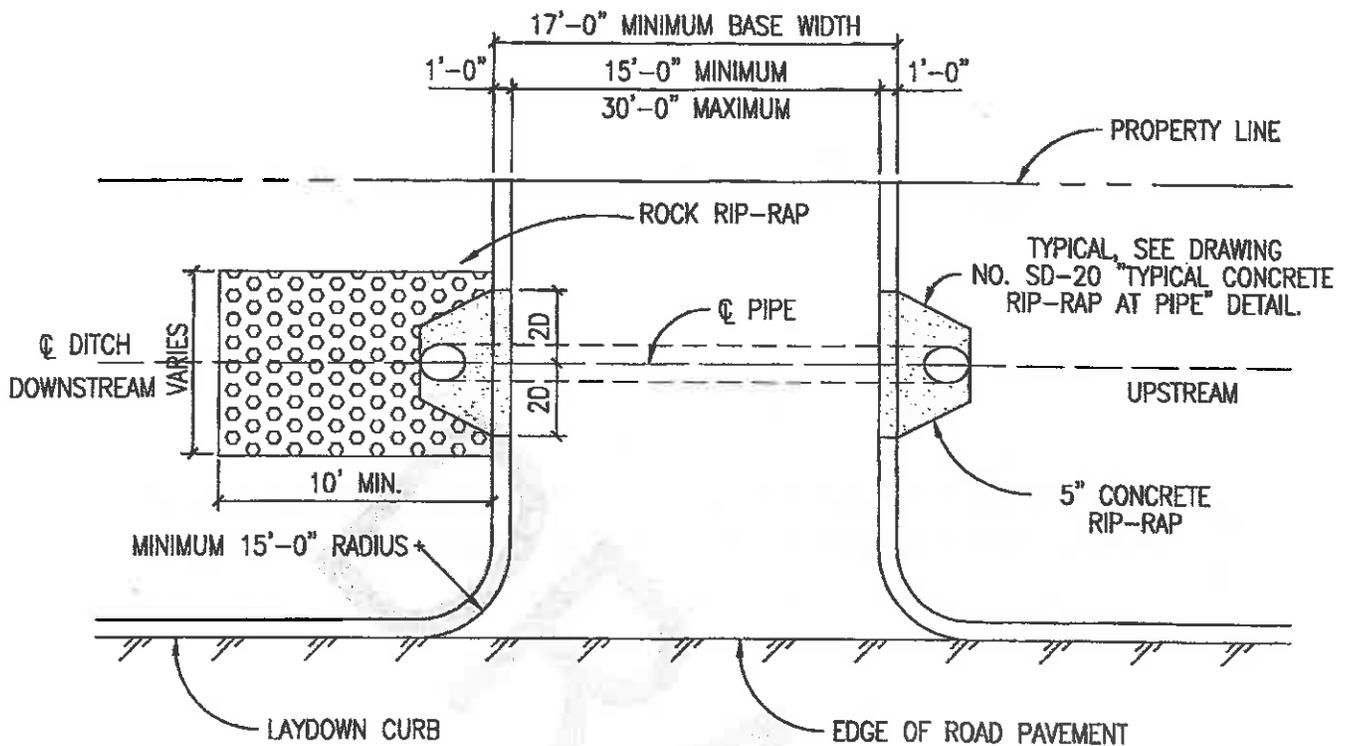
**CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS**

**RURAL RESIDENTIAL DRIVEWAY APPROACH
WITH CULVERT PIPE**

CONSTRUCTION STANDARDS AND DETAILS



T-18
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



NOTES:

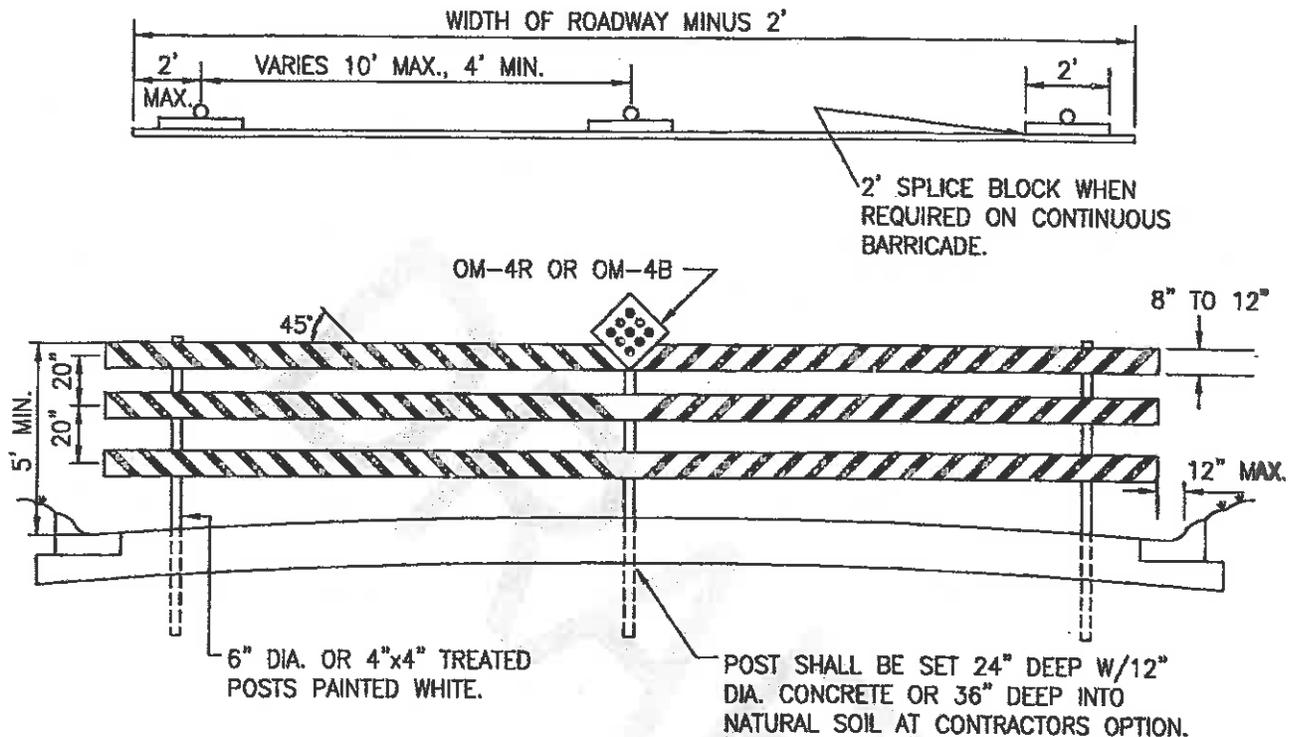
1. MINIMUM COVER OVER CULVERT PIPE SHALL BE 6" (SEE NOTE 5).
2. 5" CONCRETE RIP-RAP SHALL BE INSTALLED.
3. CULVERT PIPE TO BE MINIMUM OF 18" DIAMETER.
4. CULVERT PIPE MATERIAL TO BE R.C.P. (CLASS IV), UNLESS PRIOR APPROVAL IS GRANTED BY THE CITY OF KILLEEN.
5. MINIMUM COVER OVER CULVERT PIPE SHALL PROVIDE H2O LOADING.
6. BACKFILL AROUND CULVERT PIPE SHALL BE SELECT MATERIAL TO BE PLACED AND COMPACTED TO 95% TEX-114E.
7. ROCK RIP-RAP SHALL EXTEND 10' FROM THE DOWN STREAM SIDE USING THE AVERAGE STONE SIZE DIA. OF 8" AT A DEPTH OF 16" (MINIMUM).
8. MINIMUM CHANNEL SIDE SLOPE SHALL BE 4:1.

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**RURAL NON-RESIDENTIAL UNDIVIDED DRIVEWAY
APPROACH WITH CULVERT PIPE
CONSTRUCTION STANDARDS AND DETAILS**



T-19
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



GENERAL NOTES FOR THIN WALL TUBE TYPE SIGN SUPPORT:

1. THE BASE SOCKET IS FORMED FROM 2 7/8" O.D. X 12 GAUGE GALVANIZED PIPE.
2. THE WEDGE IS FORMED FROM 11 GAUGE STEEL GALVANIZED PER ASTM A525.
3. THE SIGN POST IS 2.375" O.D. X 0.085" THIN WALL STEEL TUBING.
4. STEEL SUPPORTS SHALL BE MADE FROM NEW MATERIAL AND SHALL BE CORROSION RESISTANT. STEEL SUPPORTS SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM DESIGNATIONS A123 OR A525 (G-90 OR BETTER).
5. SUPPORTS SHALL BE STRAIGHT WITHIN 1/4" PER 5 FEET OF LENGTH AND SHALL HAVE A SMOOTH, UNIFORM FINISH FREE FROM DEFECTS AFFECTING STRENGTH OR APPEARANCE. ANY BOLT HOLES AND SHEARED ENDS SHALL BE FREE FROM BURRS. BASES OF MULTISECTION SUPPORTS SHALL NOT EXTEND MORE THAN 5 INCHES ABOVE GROUND WHEN INSTALLED.
6. BOLTS, NUTS, SCREWS, WASHERS AND OTHER MISCELLANEOUS HARDWARE SHALL BE GALVANIZED IN ACCORDANCE TO ASTM DESIGNATION: A153 CLASS C OR D, OR B695 CLASS 50.
7. BARRICADE SUPPORTS SYSTEMS USED ON THIS SHEET MAY BE SUITABLE FOR ONLY CERTAIN SOIL TYPES. THE CONTRACTOR IS RESPONSIBLE FOR SELECTING THE APPROPRIATE SUPPORT SYSTEM FOR SOIL CONDITIONS ON EACH PROJECT.
4. STRIPING OF RAILS, FOR THE RIGHT SIDE OF THE ROADWAY, SHOULD SLOPE DOWNWARD TO THE LEFT. FOR THE LEFT SIDE OF THE ROADWAY, STRIPING SHOULD SLOPE DOWNWARD TO THE RIGHT.
5. IDENTIFICATION MARKINGS MAY BE SHOWN ONLY ON THE BACK OF THE BARRICADE RAILS. THE MAXIMUM HEIGHT OF LETTERS AND/OR COMPANY LOGOS USED FOR IDENTIFICATION SHALL BE 1".
6. BARRICADES SHALL NOT BE PLACED PARALLEL TO TRAFFIC UNLESS AN ADEQUATE CLEAR ZONE IS PROVIDED.
7. WARNING LIGHTS SHALL NOT BE INSTALLED ON BARRICADES.
8. WHERE BARRICADES REQUIRE THE USE OF WEIGHTS TO KEEP FROM TURNING OVER, THE USE OF SANDBAGS WITH DRY, COHESIONLESS SAND IS RECOMMENDED. THE SANDBAGS WILL BE TIED SHUT TO KEEP THE SAND FROM SPILLING AND TO MAINTAIN A CONSTANT WEIGHT. ROCK, CONCRETE, IRON, STEEL OR OTHER SOLID OBJECTS WILL NOT BE PERMITTED. SANDBAGS SHOULD WEIGH A MINIMUM OF 35 LBS A MAXIMUM OF 50 LBS. SANDBAGS SHALL BE MADE OF A DURABLE MATERIAL THAT TEARS UPON VEHICULAR IMPACT. RUBBER (SUCH AS TIRE INNER TUBES) SHALL NOT BE USED FOR SANDBAGS. SANDBAGS SHALL ONLY BE PLACED ALONG OR UPON THE BASE SUPPORTS OF THE DEVICE AND SHALL NOT BE SUSPENDED ABOVE GROUND LEVEL OR HUNG WITH ROPE, WIRE, CHAINS OR OTHER FASTENERS.

TYPE III BARRICADES:

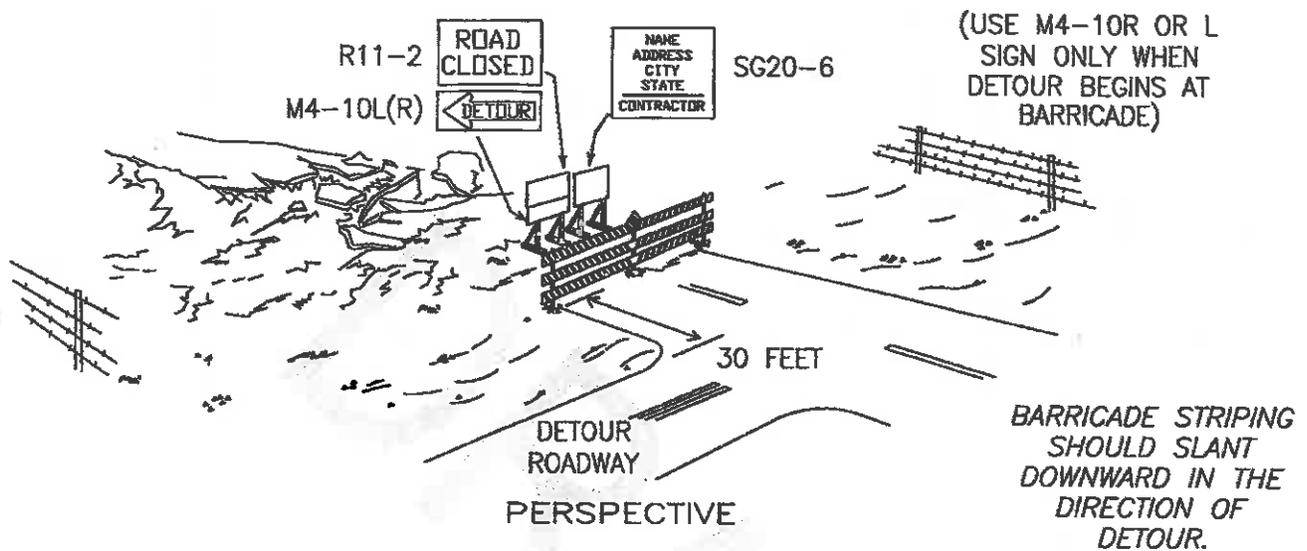
1. REFER TO THE COMPLIANT WORK ZONE TRAFFIC CONTROL DEVICES LIST (CWZTCD) FOR DETAILS OF THE TYPE III BARRICADES AND A LIST OF ALL MATERIALS USED IN THE CONSTRUCTION OF TYPE III BARRICADES.
2. TYPE III BARRICADES SHALL BE USED AT EACH END OF CONSTRUCTION PROJECTS CLOSED TO ALL TRAFFIC.
3. BARRICADES EXTENDING ACROSS A ROADWAY SHOULD HAVE STRIPES THAT SLOPE DOWNWARD IN THE DIRECTION TOWARD WHICH TRAFFIC MUST TURN IN DETOURING. WHEN BOTH RIGHT AND LEFT TURNS PROVIDED, THE CHEVRON STRIPING MAY SLOPE DOWNWARD IN BOTH DIRECTIONS FROM THE CENTER OF THE BARRICADE.

**CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS**

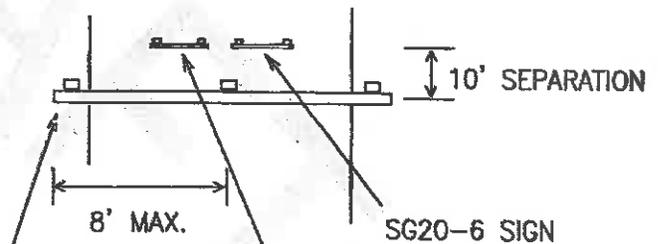


**STANDARD
TYPE III BARRICADE
CONSTRUCTION STANDARDS AND DETAILS**

T-20
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



EACH ROADWAY OF DIVIDED HIGHWAY SHALL BE BARRICADED, IN THE SAME MANNER.



BARRICADES RAILS SHALL BE REFLECTORIZED ON ALL SIDES THAT FACE TRAFFIC.

PLAN

- 1). R11-2 AND M4-10 SIGNS SHOULD BE MOUNTED ON INDEPENDENT SUPPORTS AT 7' MOUNTING HEIGHT IN CENTER OF ROADWAY.
- 2). ADVANCE SIGNING, INCLUDING CONSTRUCTION WARNING, SIGNS AND DETOUR SIGNING SHALL BE AS SPECIFIED ELSEWHERE IN THE PLANS.

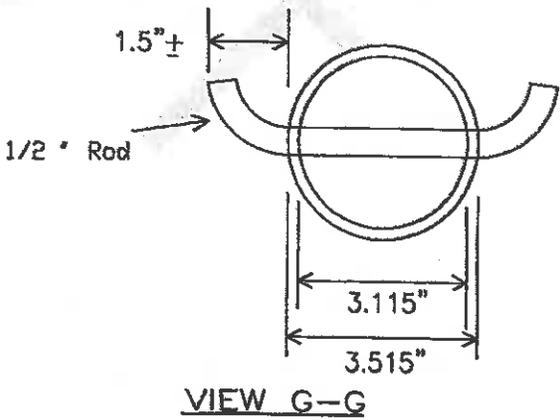
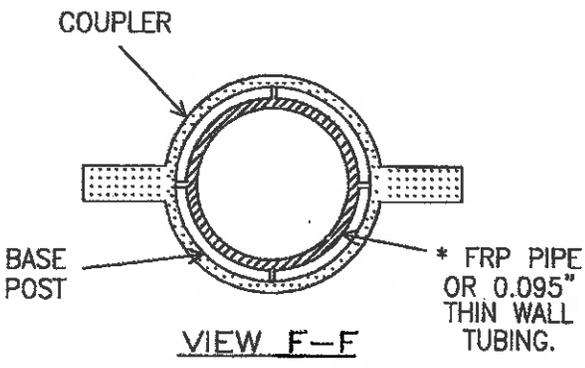
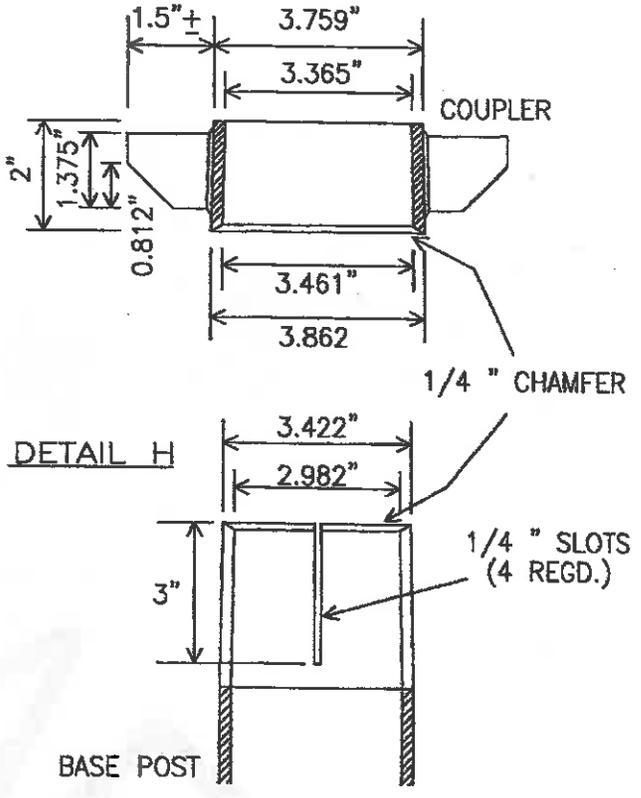
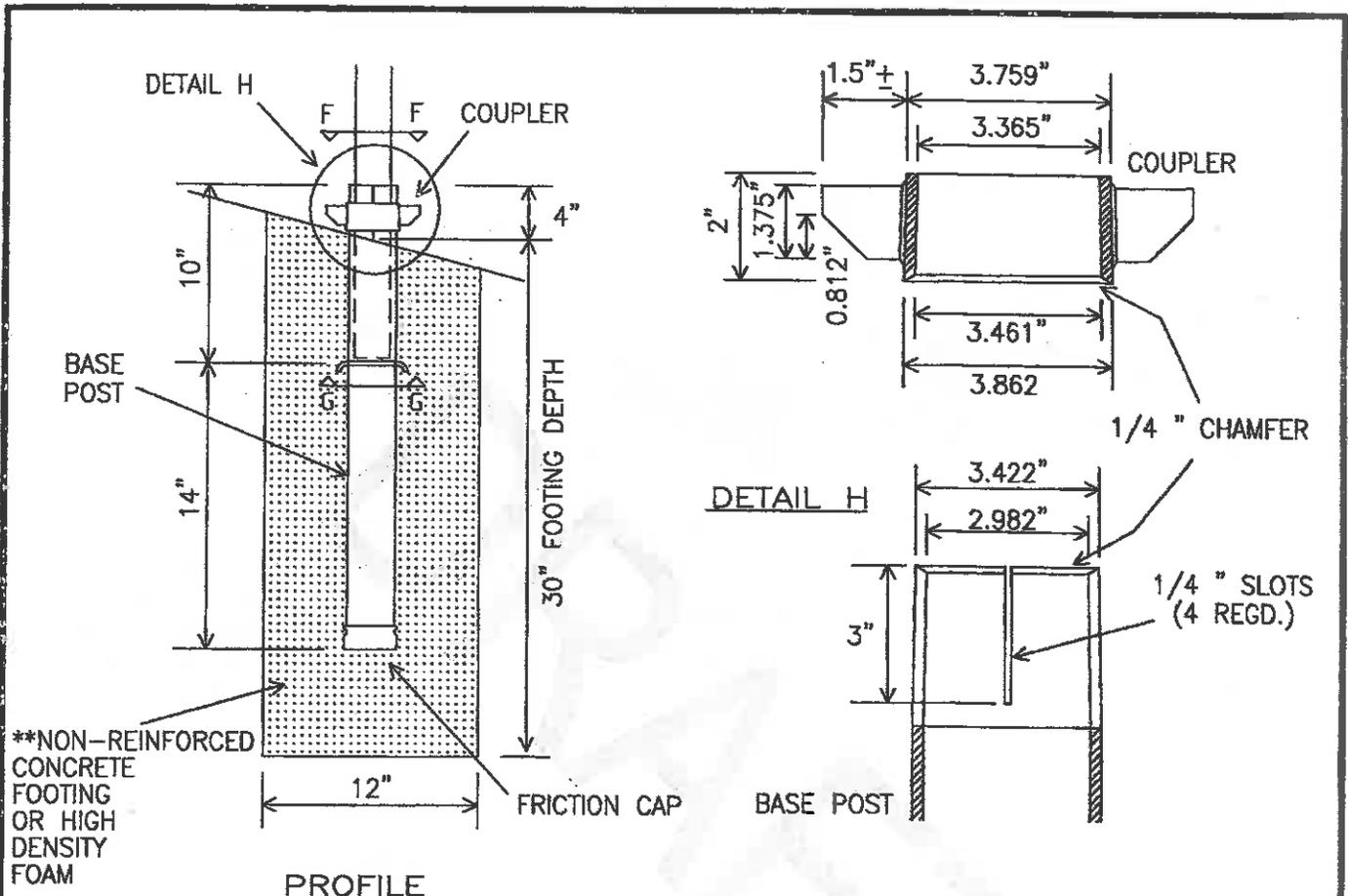
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

TYPE III BARRICADE (POST TYPE)
TYPICAL APPLICATION

CONSTRUCTION STANDARDS AND DETAILS



T-21
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



* PLASTING INSERT MUST BE USED WITH 1/16" THIN WALL TUBING.
 ** FOOTING SHALL BE REMOVED AND BACKFILLED WHEN BARRICADE IS REMOVED.

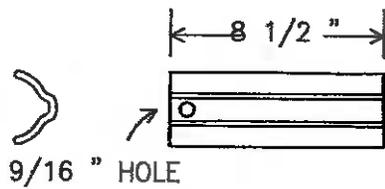
CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

UNIVERSAL ANCHOR SYSTEM
 (TYPE III BARRICADE)

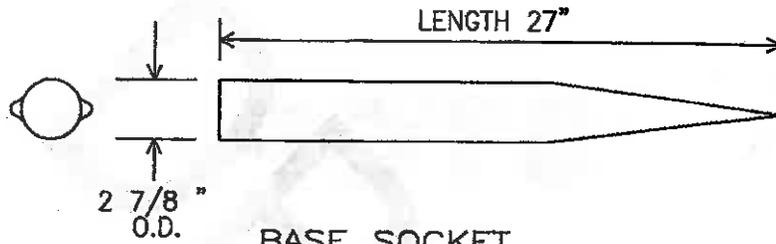
CONSTRUCTION STANDARDS AND DETAILS



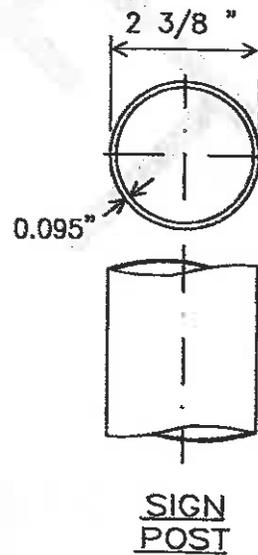
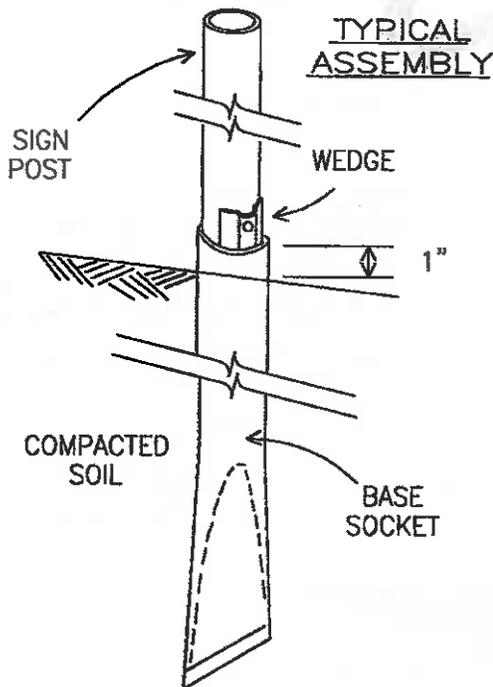
T-22
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



WEDGE



BASE SOCKET



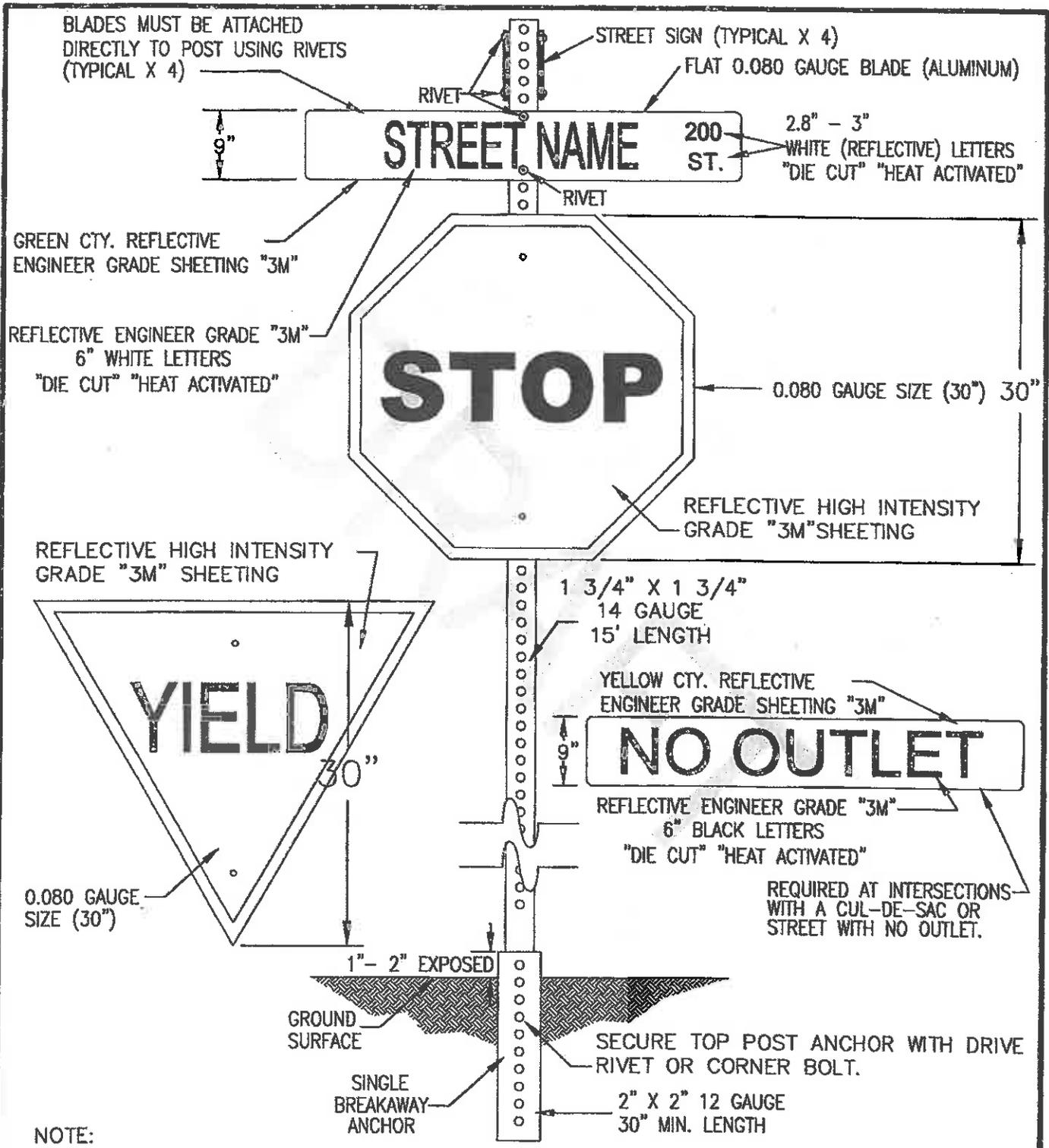
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

POZ-LOC
(DRIVEABLE, TYPE III BARRICADE)

CONSTRUCTION STANDARDS AND DETAILS



T-23
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



NOTE:
 1. 7-FOOT MIN. HEIGHT FROM GROUND TO BOTTOM OF SIGN.

CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

STANDARD STREET SIGN
 DETAIL

CONSTRUCTION STANDARDS AND DETAILS

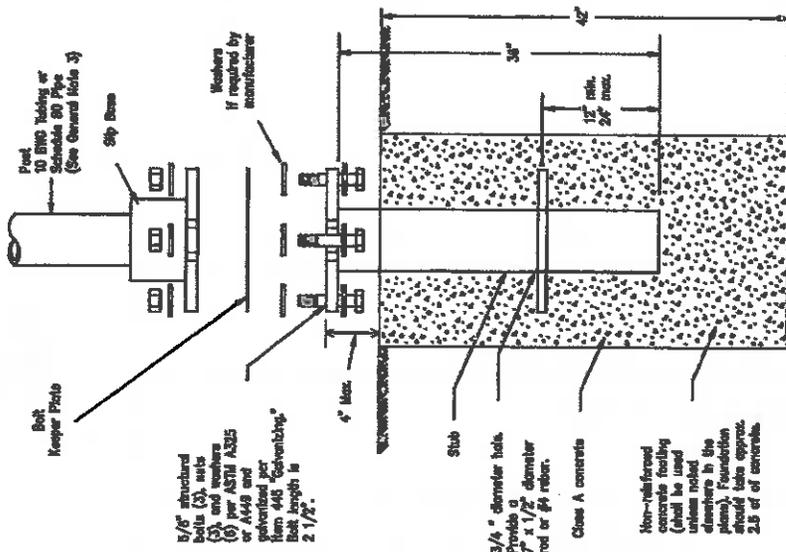


T-24
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

TRIANGULAR SLIPBASE INSTALLATION GENERAL REQUIREMENTS

NOTE

There are various devices approved for the Triangular Slipbase System. Please reference the Material Producer List for approved slip base systems. http://www.txdot.gov/business/producer_list.htm. The devices shall be installed per manufacturer's recommendations. Installation procedures shall be provided to the Engineer by Contractor.



Post
10 BRN Tubing or
Schedule 80 Pipe
(See General Note 3)

Slip Base

Washers
if required by
manufacturer

4" Max.

36"

12" dia.
24" dia.

12" Dia

Stud

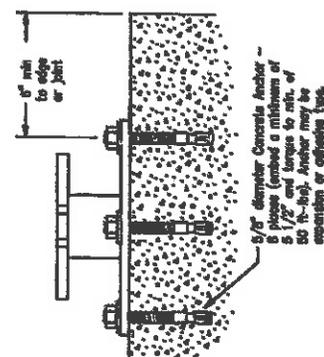
3/4" diameter hole
Provide 2
7 x 1/2" diameter
rod or #4 rebar.

Class A concrete

Non-reinforced
concrete footing
(shall be used
unless noted
otherwise in the
plans). Foundation
should take approx.
2.5 ft of concrete.

SI 10 501 ASSE TY X0000(754)(-XXXX)

CONCRETE ANCHOR



5/8" diameter Concrete Anchor -
5 pieces (embed a minimum of
5 1/2" and longer to min. of
50 ft - 50). Anchor may be
expansion or ordinary type.

SI 10 501 ASSE TY X0000(754)(-XXXX)

GENERAL NOTES

- Slip base shall be permanently marked to indicate manufacturer, method, design, and location of marking are subject to approval of the TxDOT Traffic Standards Engineer.
- Material used on post with this system shall conform to the following specifications:
 - 10 BRN Tubing (2.675" outside diameter)
 - 0.135" nominal wall thickness
 - Schedule 80 Pipe (2.675" outside diameter)
 - Steel shall be A513 Gr B or ASTM A1011 or ASTM A1098
 - Other steels may be used if they meet the following:
 - 50,000 PSI minimum yield strength
 - 70,000 PSI minimum tensile strength
 - 205 minimum elongation in 2"
 - Wall thickness (uncoated) shall be within the range of 0.122" to 0.138"
 - Outside diameter (uncoated) shall be within the range of 2.667" to 2.683"
 - Conformations per ASTM A125 or ASTM A852. For precast slab tubing (ASTM A852), resect tube outside diameter will seem by manufacturing with size up to per ASTM B333.
 - Schedule 80 Pipe (2.675" outside diameter)
 - 0.275" nominal wall thickness
 - Steel tubing per ASTM A513 Gr. C
 - Other grades of steel-concrete welded steel tubing or pipe with equivalent outside diameter and wall thickness may be used if they meet the following:
 - 45,000 PSI minimum yield strength
 - 62,000 PSI minimum tensile strength
 - 235 minimum elongation in 2"
 - Wall thickness (uncoated) shall be within the range of 0.248" to 0.264"
 - Outside diameter (uncoated) shall be within the range of 2.655" to 2.685"
 - Conformations per ASTM A125
- See the Traffic Operations Division website for detailed drawings of sign drums and Texas Inland Triangular Slipbase System components. The website address is: <http://www.txdot.gov/publications/traffic.htm>
- Sign supports shall not be spliced except where shown. Sign support parts shall not be spliced.

ASSEMBLY PROCEDURE

Foundation

- Prepare 12-inch diameter by 48-inch deep hole. If solid rock is encountered, the depth of the foundation may be reduced such that it is embedded a minimum of 18 inches into the solid rock.
- The Engineer may permit batches of concrete less than 2 cubic yards to be mixed with a portable, motor-driven concrete mixer. For small placements less than 3.5 cubic yards, hand mixing in a suitable container may be allowed by Engineer. Concrete shall be Class A.
- Place the pipe out of the slip base into the center of the concrete. Rotate the pipe back and forth while pushing it down into the concrete to ensure good contact between the concrete and steel.
- Stamp the pipe, allow a minimum of 4 days to set, unless otherwise directed by the Engineer.
- The triangular slipbase system is reinforced and is designed to release when struck from any direction.

Support

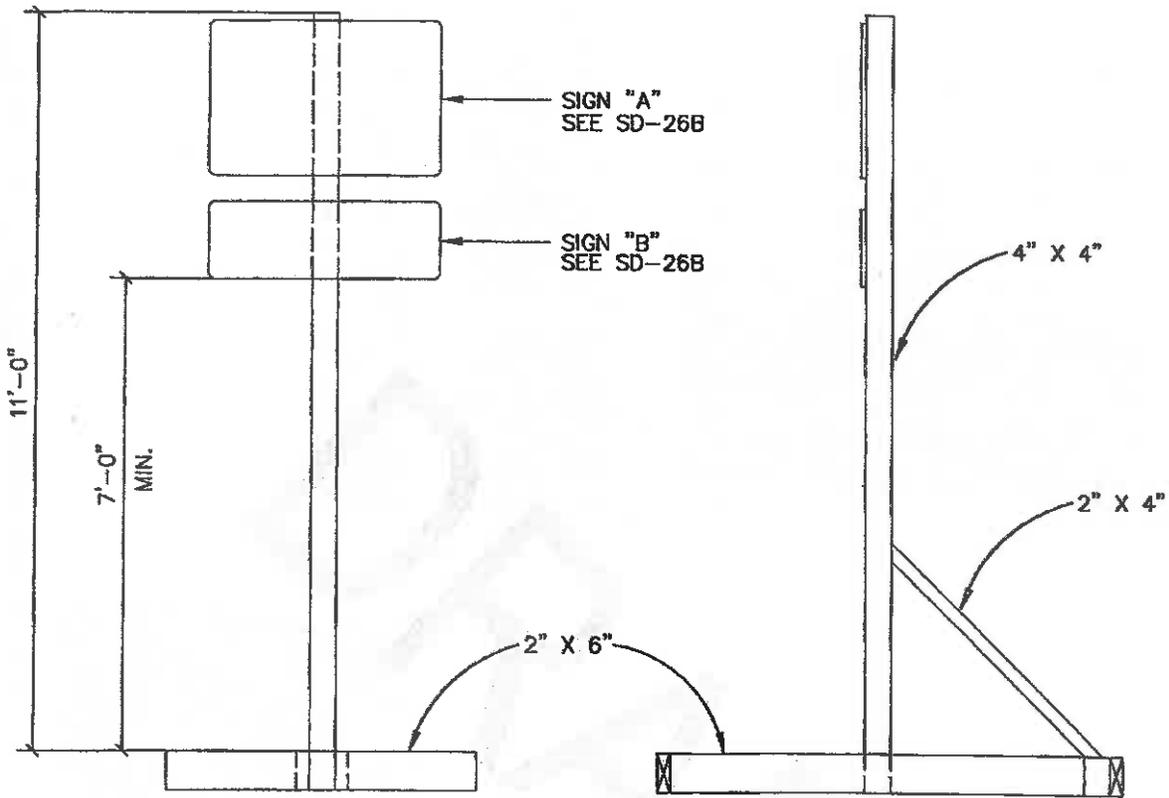
- Cut support so that the bottom of the sign will be 7 to 7.5 feet above the edge of the roadway (i.e., edge of the closest lane) when slip pipe is below the edge of pavement or 7 to 7.5 feet above side grade when the slip pipe is above the edge of the roadway. The cut shall be made and straight.
- Attach sign to support using cross-tension chains. When multiple signs are installed on the same support, ensure the minimum clearance between each sign is maintained. See SMD(SUP-2) for clearances based on sign type.



CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS
CONSTRUCTION STANDARDS AND DETAILS

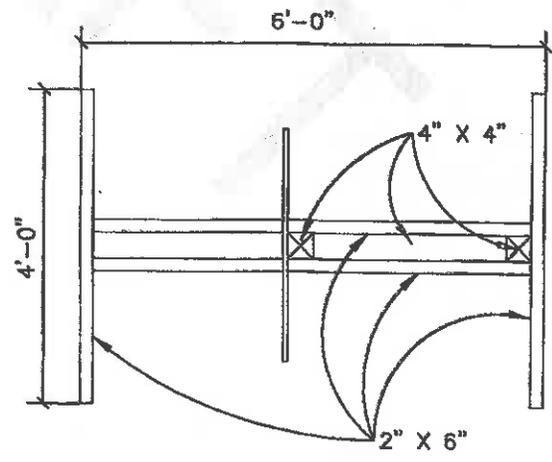
**TRIANGULAR SLIPBASE
SYSTEM SMD(SLIP-1)-08**

ISSUE DATE: XX-XX-XXXX
SCALE: N.T.S.
T-25



FRONT VIEW

SIDE VIEW



TOP VIEW

NOTES:

1. ALL MATERIALS SHALL BE FURNISHED BY THE CONTRACTOR WITH THE EXCEPTION OF THE CITY OF KILLEEN LOGO WHICH WILL BE FURNISHED BY THE CITY.
2. LUMBER DIMENSIONS ARE NOMINAL DIMENSIONS.
3. ANCHORS OR SANDBAGS SHALL BE USED TO HOLD PROJECT SIGN IN PLACE.

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

PROJECT SIGN
TYPE II

CONSTRUCTION STANDARDS AND DETAILS



T-26
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

NOTES:

1. COMMERCIAL SIDEWALK WIDTHS - 6'
RESIDENTIAL SIDEWALK WIDTHS - 5'
2. ALL SLOPES ARE MAXIMUM ALLOWABLE. FLATTER SLOPES THAT WILL STILL DRAIN PROPERLY ARE ENCOURAGED.
3. ALL CONCRETE SURFACES SHALL RECEIVE A LIGHT BROOM FINISH UNLESS NOTED OTHERWISE IN THE PLANS.
4. FOR PURPOSES OF WARNING, THE CURB RAMPS SHALL HAVE A LIGHT REFLECTIVE VALUE AND TEXTURE THAT SIGNIFICANTLY CONTRASTS WITH THAT OF ADJOINING PEDESTRIAN ROUTES.
5. TEXTURES MAY CONSIST OF PAVERS WITH TRUNCATED DOMED SURFACES. TEXTURES ARE REQUIRED TO BE DETECTABLE UNDERFOOT. SURFACES THAT WOULD ALLOW WATER TO ACCUMULATE ARE PROHIBITED. TEXTURES SHALL BE AT LEAST 2- FEET IN LENGTH IN THE DIRECTION OF THE RAMP AND COVER THE WIDTH OF THE RAMP.
6. COLOR CONTRAST, FOR EXAMPLE, CAN BE ACCOMPLISHED WITH COLORED CONCRETE PAVERS THAT HAVE TRUNCATED DOMES WHICH WOULD PROVIDE A CONTRAST WITH TYPICALLY LIGHT COLORED CONCRETE.
7. ADDITIONAL INFORMATION ON CURB RAMP LOCATION, DESIGN, VISIBILITY AND TEXTURE MAY BE FOUND IN THE CURRENT EDITION OF THE TEXAS ACCESSIBILITY STANDARDS (TAS) PREPARED AND ADMINISTERED BY THE TEXAS DEPARTMENT OF LICENSING AND REGULATION (TDLR).
8. RAISED MEDIANS SEPARATE OPPOSING DIRECTIONS OF TRAFFIC AND PROVIDE A REFUGE AREA FOR PEDESTRIANS IF THEY ARE UNABLE TO CROSS THE ENTIRE ROADWAY IN THE ALLOTTED SIGNAL PHASE. TO SERVE AS A REFUGE AREA, THE MEDIAN SHOULD BE A MINIMUM OF 6 FEET WIDE. MEDIANS SHOULD BE DESIGNED TO PROVIDE ACCESSIBLE PASSAGE OVER OR THROUGH THEM.
9. ALL SIDEWALK PLANS AND DETAILS SHALL BE SUBMITTED TO AND APPROVED BY THE TEXAS DEPARTMENT OF LICENSING AND REGULATION (TDLR).
10. ANY PART OF THE ACCESSIBLE ROUTE WITH A SLOPE GRATER THAN 1:20 (5%) SHALL BE CONSIDERED A RAMP. IF A RAMP HAS A RISE GREATER THAN 6 INCHES OR A HORIZONTAL PROJECTION GREATER THAN 72 INCHES, THEN IT SHALL HAVE HANDRAILS ON BOTH SIDES. THE ONLY EXCEPTION IS AT CURB RAMPS. HANDRAILS ARE NOT REQUIRED ON CURB RAMPS. CURB RAMPS SHALL BE PROVIDED WHEREVER AN ACCESSIBLE ROUTE CROSSES (PENETRATES) A CURB. CURB RAMPS ARE GENERALLY INTERPRETED AS ONLY THE PORTION TYING DIRECTLY INTO THE ROADWAY.
11. TRAFFIC SIGNAL OR ILLUMINATION POLES, GROUND BOXES, CONTROLLER BOXES, SIGNS, DRAINAGE FACILITIES AND OTHER ITEMS SHALL BE PLACED SO NOT TO OBSTRUCT THE ACCESSIBLE ROUTE.
12. ALL SIDEWALKS WILL BE DOWELED INTO EXISTING SIDEWALKS, DRIVEWALKS, DRIVEWAYS, INLET BOXES, RETAINING WALLS, ETC.

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS



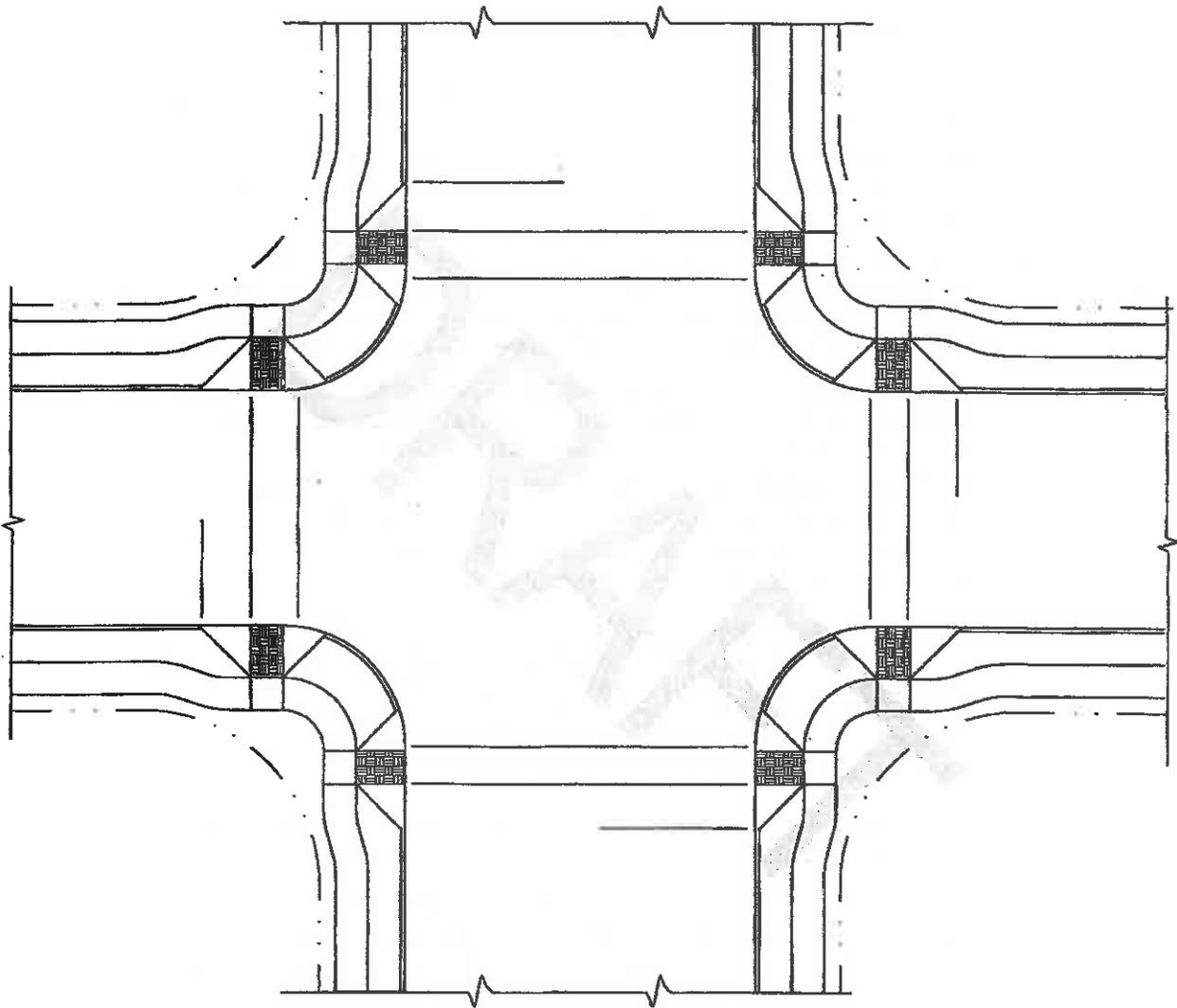
PEDESTRIAN RAMPS
GENERAL NOTES

CONSTRUCTION STANDARDS AND DETAILS

T-27

SCALE: N.T.S.

ISSUE DATE: XX-XX-XX



OFFSET SIDEWALKS

NOTE: CURB RAMPS WITH RETURNED CURBS
 INSTEAD OF SIDE FLARES ARE PERMITTED
 WHERE PEDESTRIANS WOULD NOT NORMALLY
 WALK ACROSS THE RAMP

CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

TYPICAL
 INTERSECTION LAYOUT
 CONSTRUCTION STANDARDS AND DETAILS

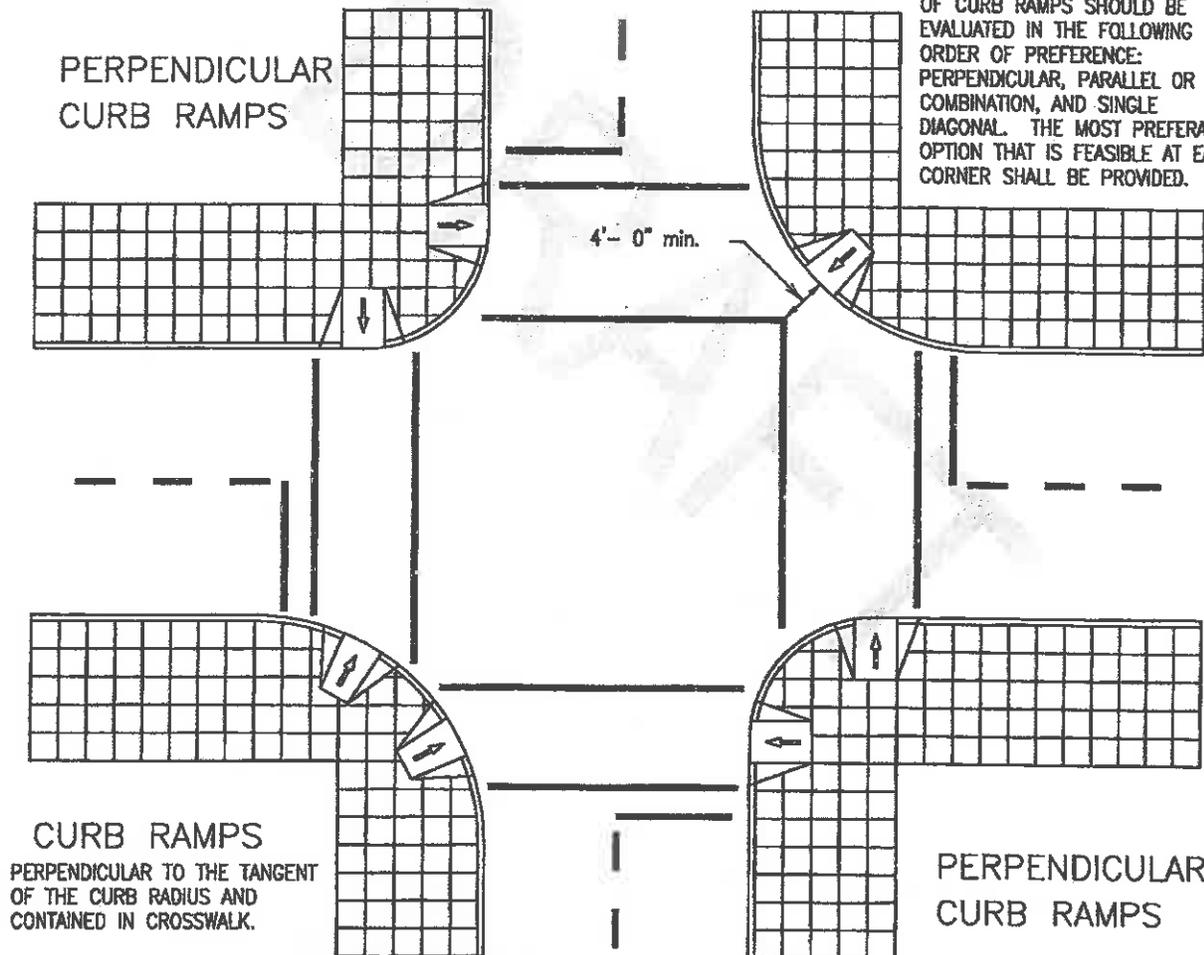


T-28
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

SINGLE DIAGONAL CURB RAMP

FOR ON-SYSTEM NEW CONSTRUCTION, RECONSTRUCTION AND REHABILITATION PROJECTS WHERE PEDESTRIAN FACILITIES ARE NEWLY CONSTRUCTED OR SUBSTANTIALLY ALTERED, CONSTRUCTION OF SINGLE DIAGONAL RAMPS IS NOT PERMITTED.

FOR ON-SYSTEM PROJECTS SUCH AS RESTORATION, SEAL COAT AND OVERLAY PROJECTS, PLACEMENT OF CURB RAMPS SHOULD BE EVALUATED IN THE FOLLOWING ORDER OF PREFERENCE: PERPENDICULAR, PARALLEL OR COMBINATION, AND SINGLE DIAGONAL. THE MOST PREFERABLE OPTION THAT IS FEASIBLE AT EACH CORNER SHALL BE PROVIDED.

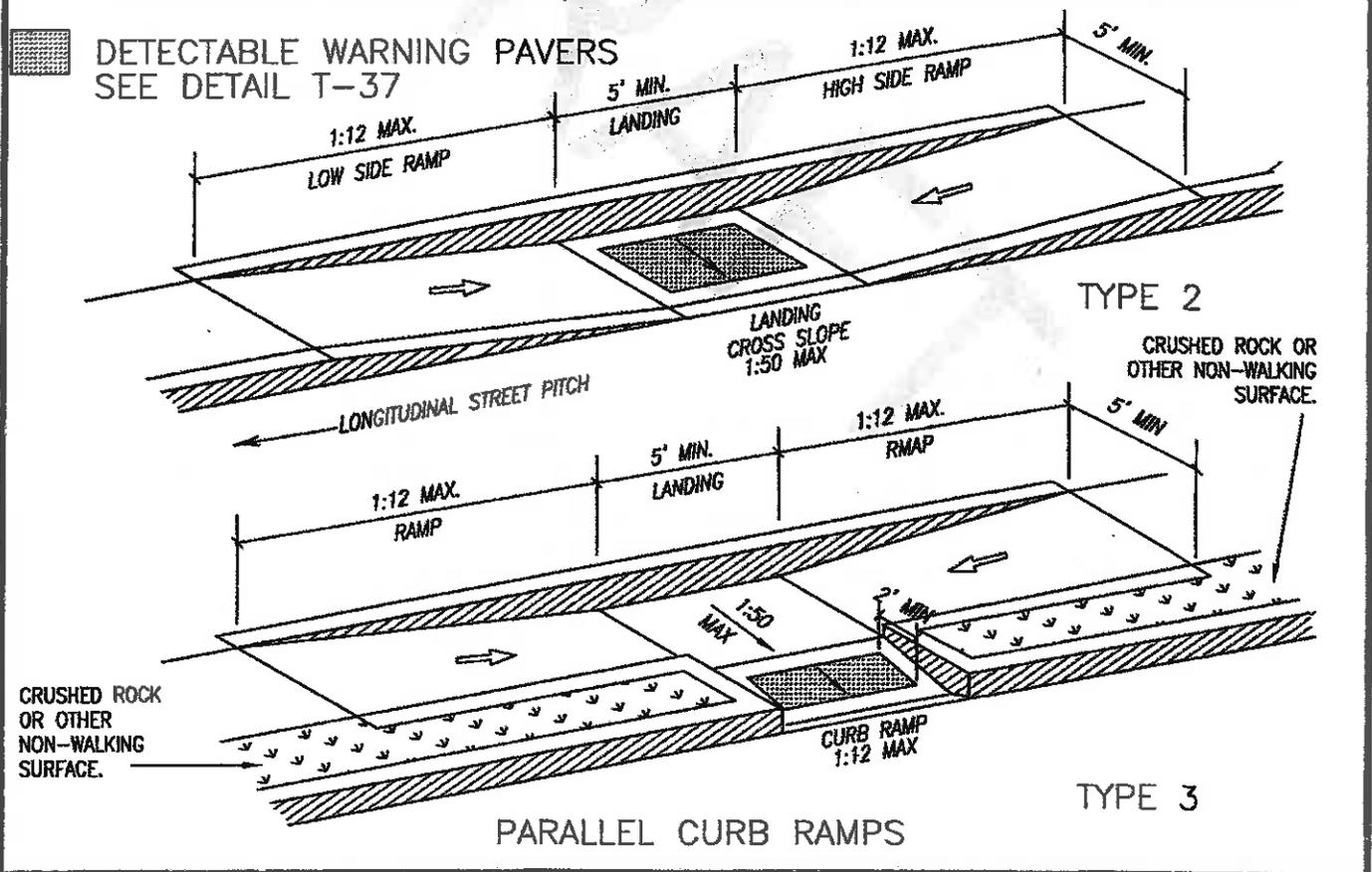
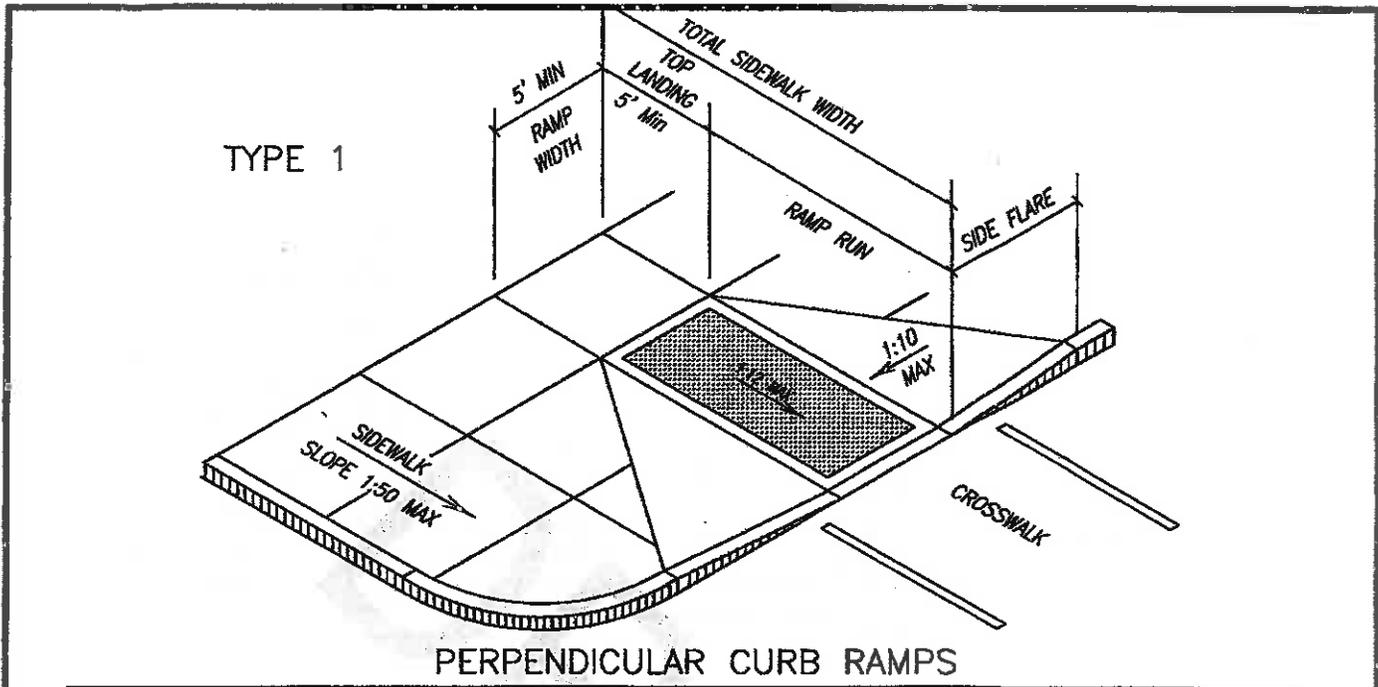


CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

CURB RAMPS
PLACEMENTS AT INTERSECTIONS
CONSTRUCTION STANDARDS AND DETAILS



T-29
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

SIDEWALK RAMP DETAILS
TYPE 1-3

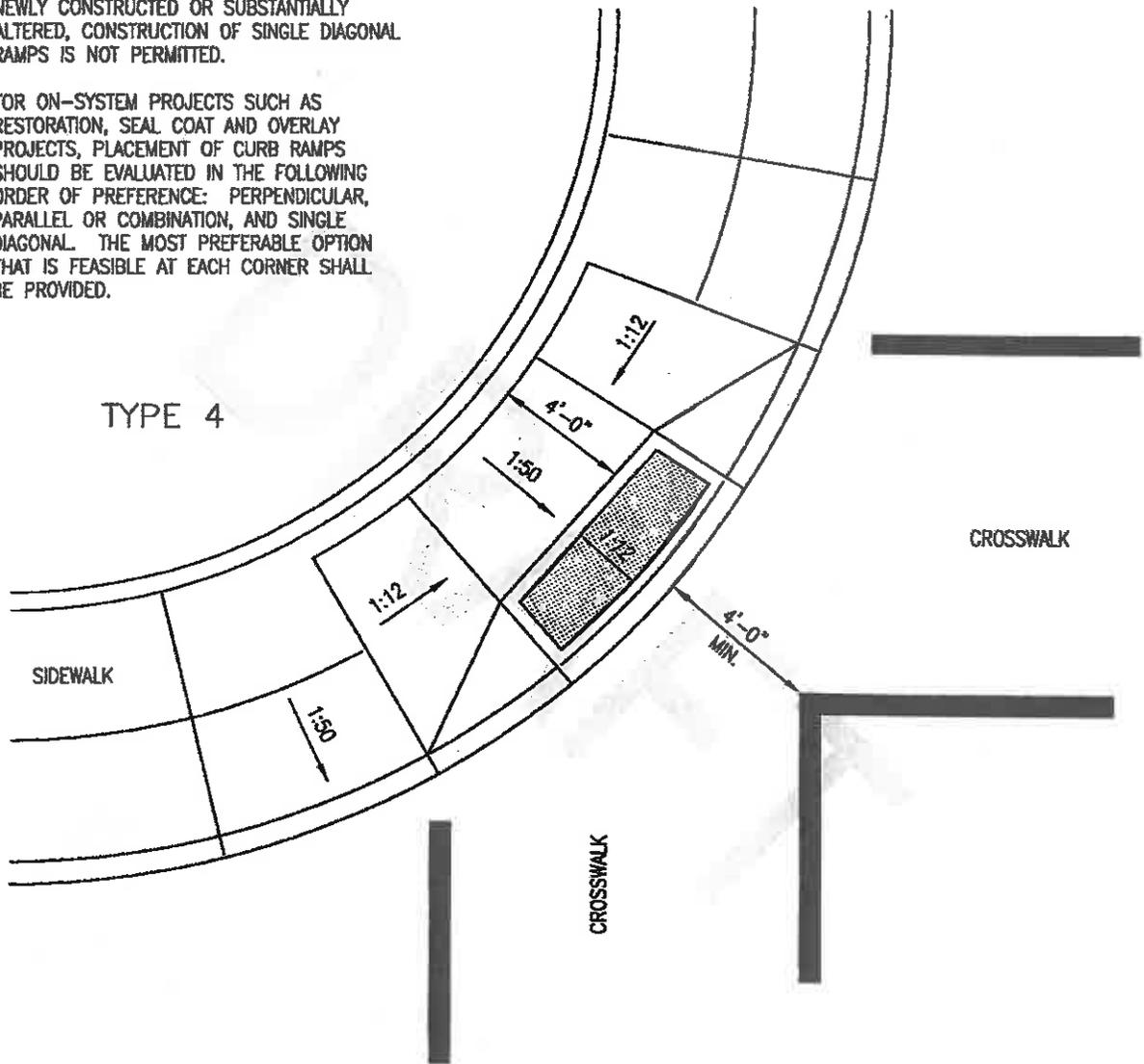
CONSTRUCTION STANDARDS AND DETAILS



T-30
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

FOR ON-SYSTEM NEW CONSTRUCTION, RECONSTRUCTION AND REHABILITATION PROJECTS WHERE PEDESTRIAN FACILITIES ARE NEWLY CONSTRUCTED OR SUBSTANTIALLY ALTERED, CONSTRUCTION OF SINGLE DIAGONAL RAMPS IS NOT PERMITTED.

FOR ON-SYSTEM PROJECTS SUCH AS RESTORATION, SEAL COAT AND OVERLAY PROJECTS, PLACEMENT OF CURB RAMPS SHOULD BE EVALUATED IN THE FOLLOWING ORDER OF PREFERENCE: PERPENDICULAR, PARALLEL OR COMBINATION, AND SINGLE DIAGONAL. THE MOST PREFERABLE OPTION THAT IS FEASIBLE AT EACH CORNER SHALL BE PROVIDED.



SINGLE DIAGONAL CURB RAMP

PERPENDICULAR TO THE TANGENT OF THE CURB RADIUS AND CONTAINED IN CROSSWALK.

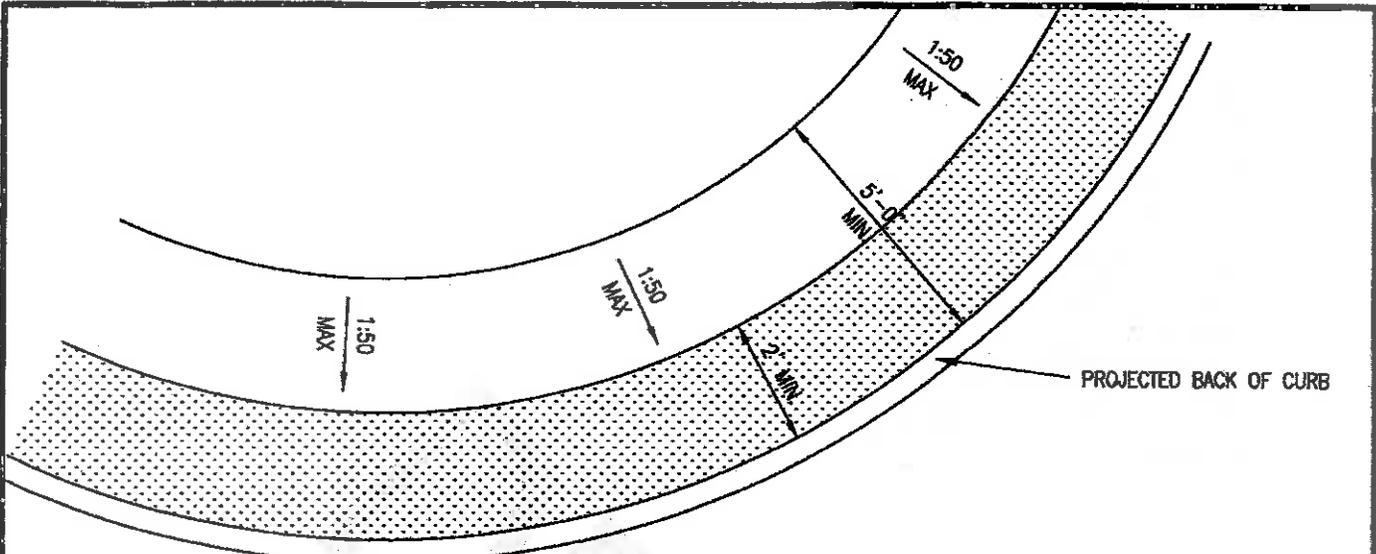
**CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS**

**SIDEWALK RAMP DETAILS
TYPE 4**

CONSTRUCTION STANDARDS AND DETAILS



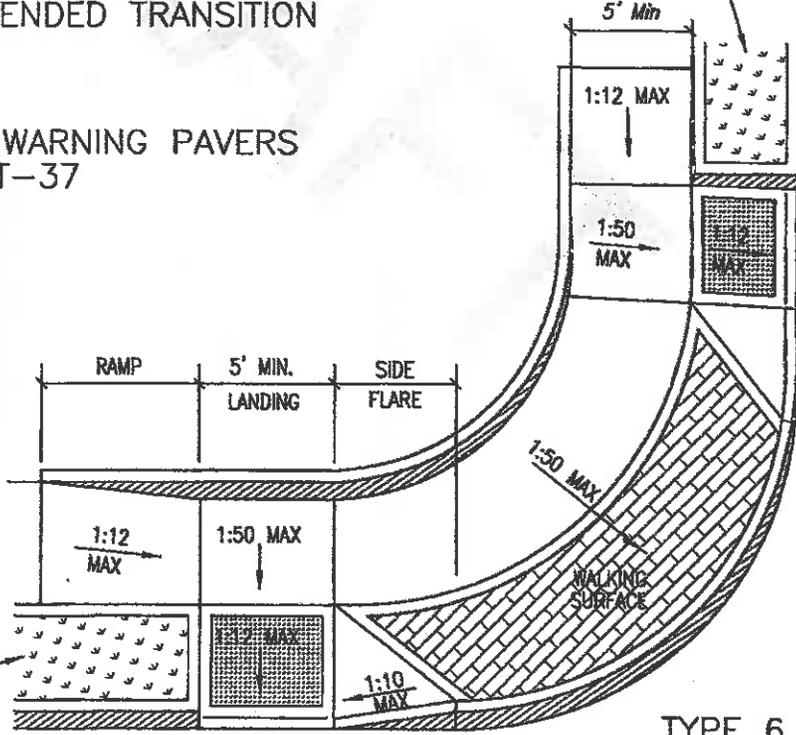
T-31
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



TYPE 5
BLENDED TRANSITION

 DETECTABLE WARNING PAVERS
SEE DETAIL T-37

PLANTING
OR OTHER
NON-WALKING
SURFACE.



PLANTING
OR OTHER
NON-WALKING
SURFACE.

TYPE 6
COMBINATION CURB RAMP

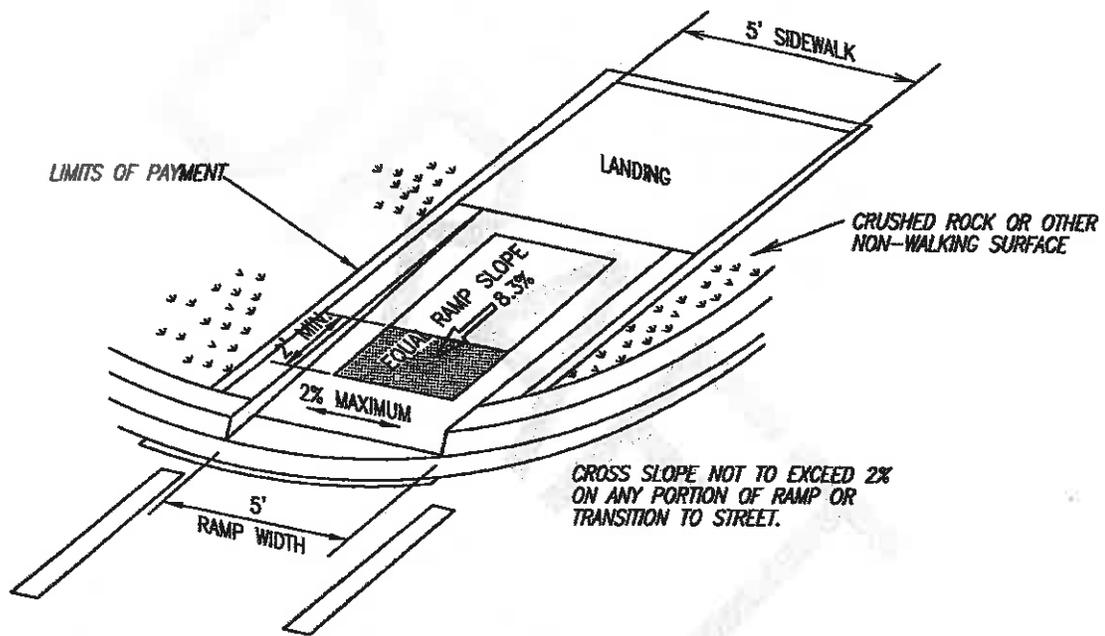
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS



SIDEWALK RAMP DETAILS
TYPE 5-6

CONSTRUCTION STANDARDS AND DETAILS

T-32
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



TYPE 7

DIRECTIONAL RAMP WITHIN RADIUS

 DETECTABLE WARNING PAVERS
SEE DETAIL T-37

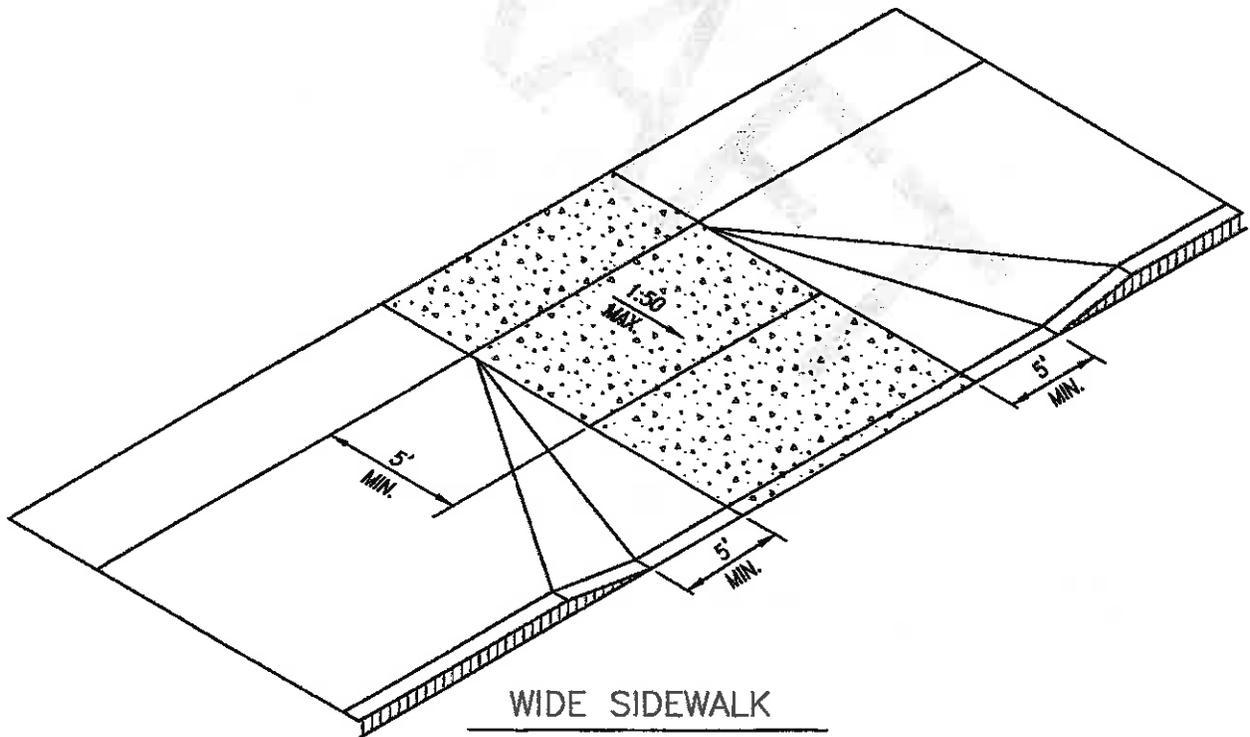
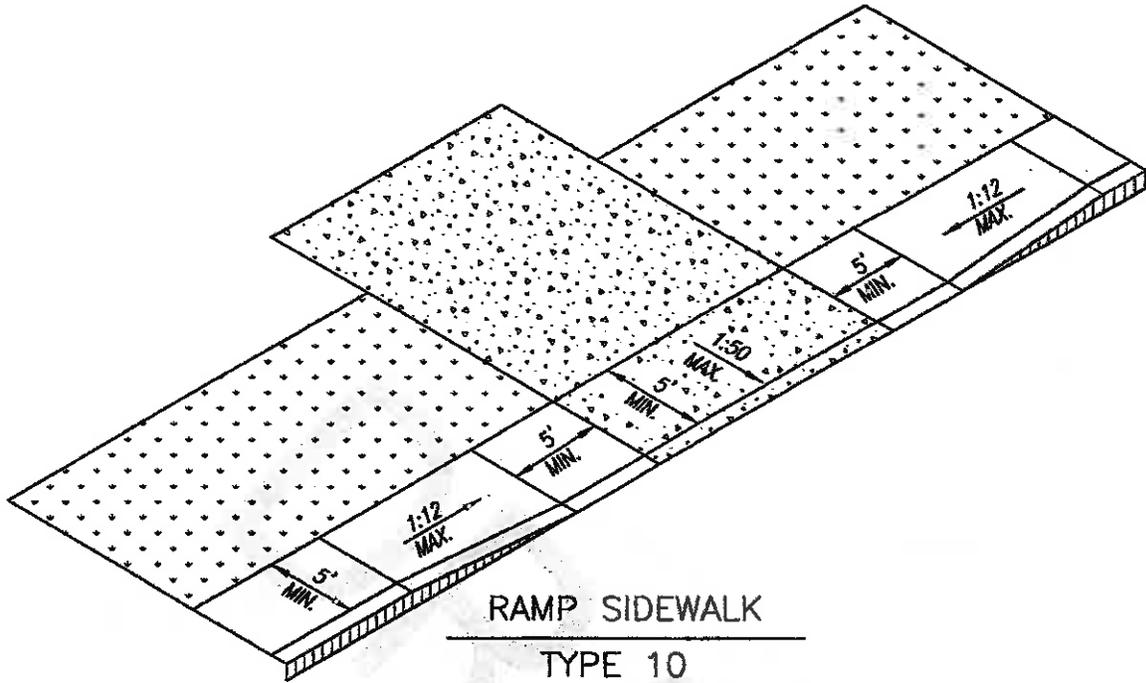
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

SIDEWALK RAMP DETAILS
TYPE 7

CONSTRUCTION STANDARDS AND DETAILS



T-33
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

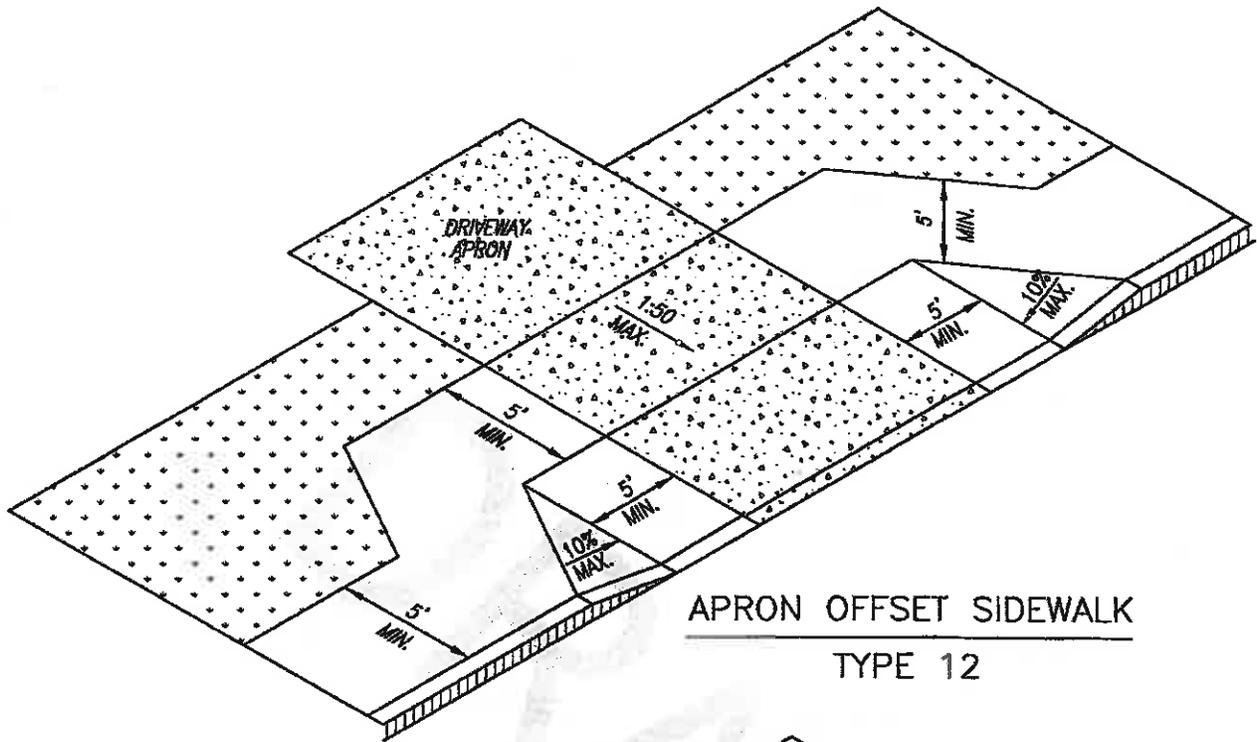


CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

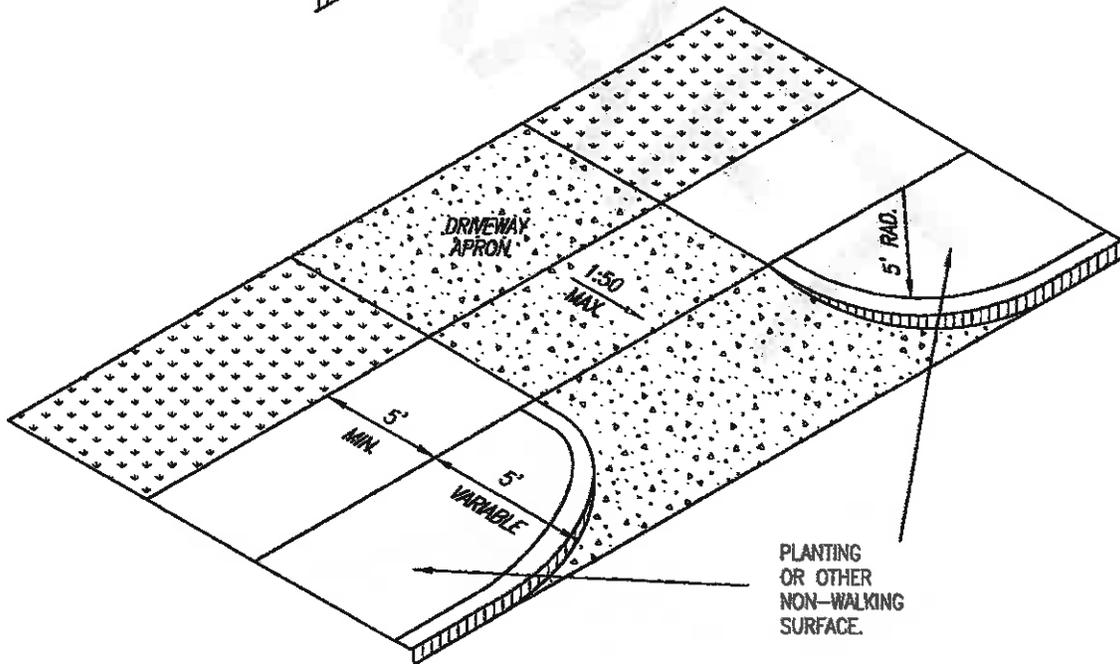
SIDEWALK TREATMENT
AT DRIVEWAYS
CONSTRUCTION STANDARDS AND DETAILS



T-34
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



APRON OFFSET SIDEWALK
TYPE 12



SETBACK SIDEWALK
TYPE 13

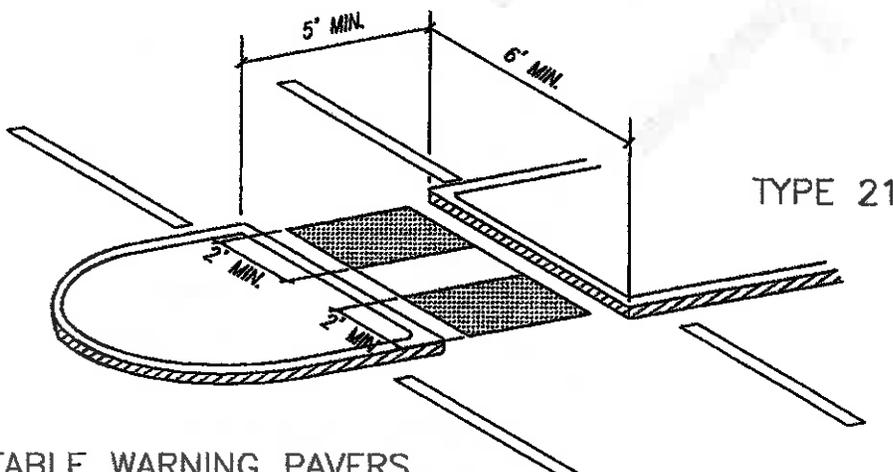
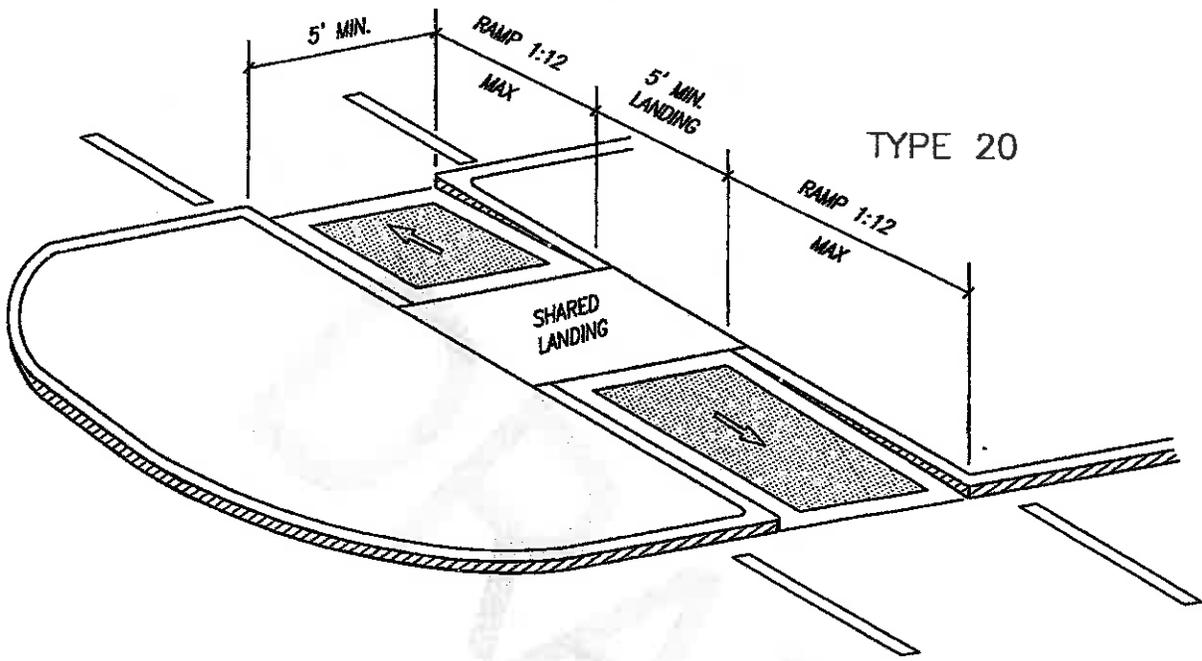
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

DRIVEWAY APRONS
TYPE 12-13

CONSTRUCTION STANDARDS AND DETAILS



T-35
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



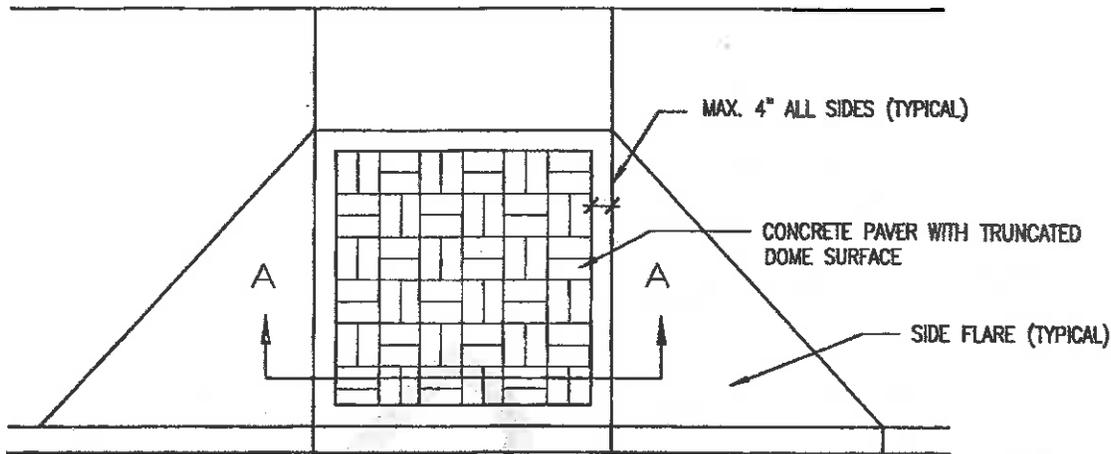

 DETECTABLE WARNING PAVERS
 SEE DETAIL T-37

CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

CURB RAMP DETAILS AT
 MEDIAN ISLANDS TYPE 20-21
 CONSTRUCTION STANDARDS AND DETAILS



T-36
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



TRUNCATED DOME PATTERN CURB RAMP

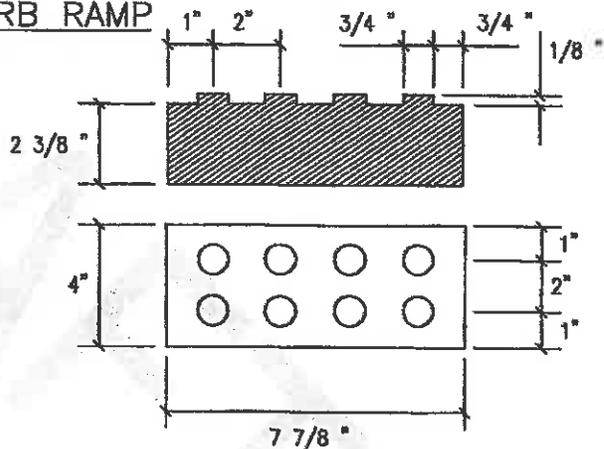
GENERAL NOTES

CONCRETE PAVER UNITS SHALL MEET ALL REQUIREMENTS OF ASTM C-936, C-33, AND SHALL BE LAID IN A TWO BY TWO UNIT BASKET WEAVE PATTERN, UNLESS SHOWN OTHERWISE IN THE PLANS.

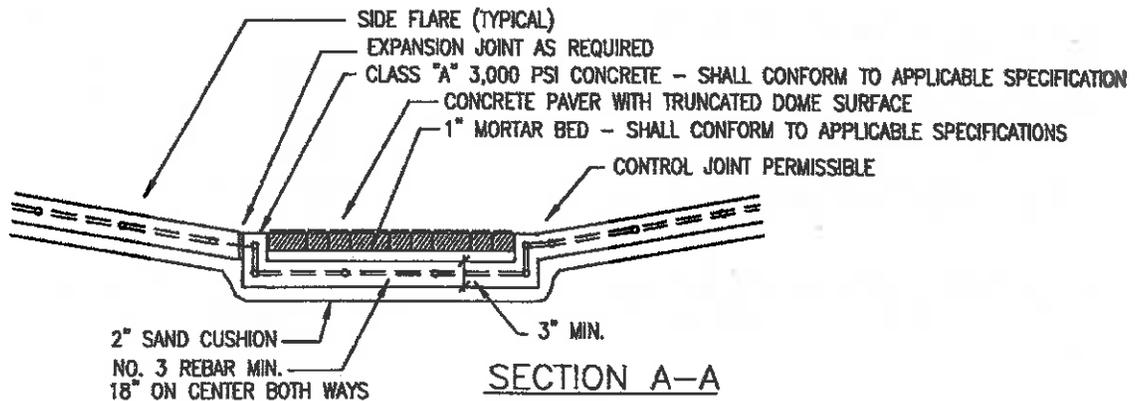
CONCRETE PAVER UNIT SHALL HAVE A TRUNCATED DOME TOP SURFACE FOR DETECTABLE WARNING TO PEDESTRIANS.

CONCRETE PAVER UNIT COLOR FOR THE RAMP SHALL BE A CONTRASTING COLOR TO THE ADJACENT SURFACES. THE COLOR OF THE CONCRETE PAVER UNITS SHALL BE SHOWN ELSEWHERE IN THE PLANS. (ADJACENT SURFACES INCLUDE SIDE FLARES).

CONCRETE PAVER UNITS SHALL BE SAW CUT ONLY AND ANY CUT UNIT SHALL BE NOT LESS THAN 25 PERCENT OF A FULL UNIT.



CONCRETE PAVER WITH TRUNCATED DOME SURFACE



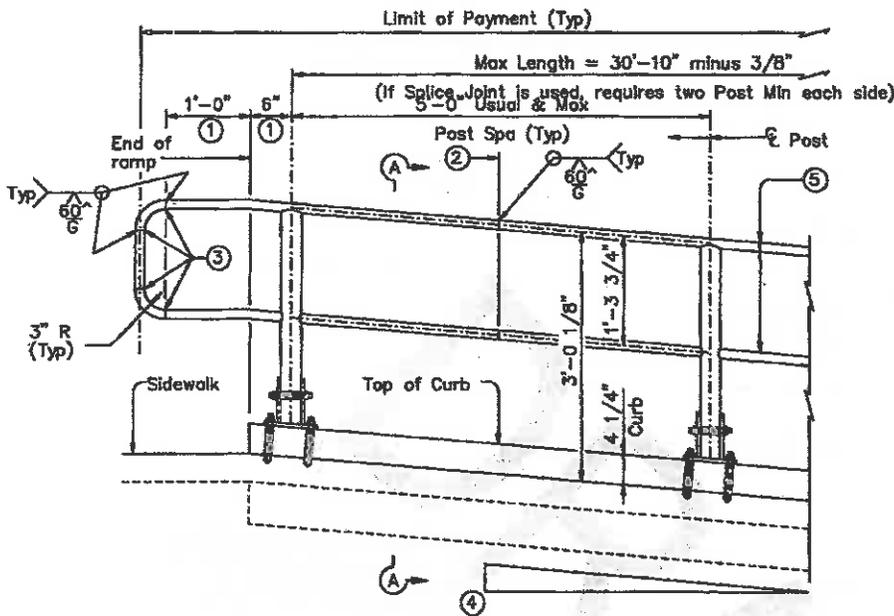
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**CURB RAMP DETECTABLE
WARNING PAVERS**

CONSTRUCTION STANDARDS AND DETAILS



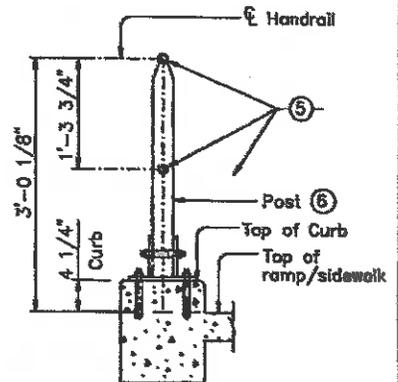
T-37
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



TxDOT TY A

ELEVATION

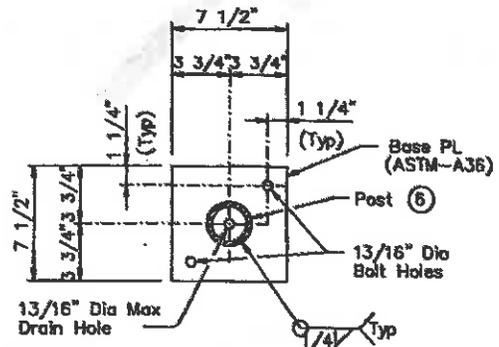
(Shop Splices and Splice Joints only shown on one Type for clarity)



SECTION A-A

(Showing Handrail Ty A)

- ① Parallel to ground.
- ② One shop splice per panel is permitted with minimum 85 percent penetration. The weld may be square groove or single vee groove. Grind smooth.
- ③ Shop splice is permitted with minimum 85 percent penetration. The weld may be square groove or single vee groove. Grind smooth.
- ④ See Ramp Details located elsewhere in plans for ramp slope and dimensions. Maximum ramp slope will not exceed 8.3 percent. Level landing required for each 30" rise if grade exceeds 5 percent.
- ⑤ 1" Dia Extra Heavy Pipe (1.315" O.D., 0.179" wall thickness). Parallel to ramp/sidewalk. Provide holes as needed in 1" Dia pipe for galvanizing drainage and venting.
- ⑥ 2" Dia Standard Pipe (2.875" O.D., 0.203" wall thickness). Plumb all posts. See "Post Mount Detail" for crimping and trimming post to fit Dia of top rail. Provide holes as needed in post for galvanizing drainage and venting.



TYPICAL POST
BASE PLATE DETAIL

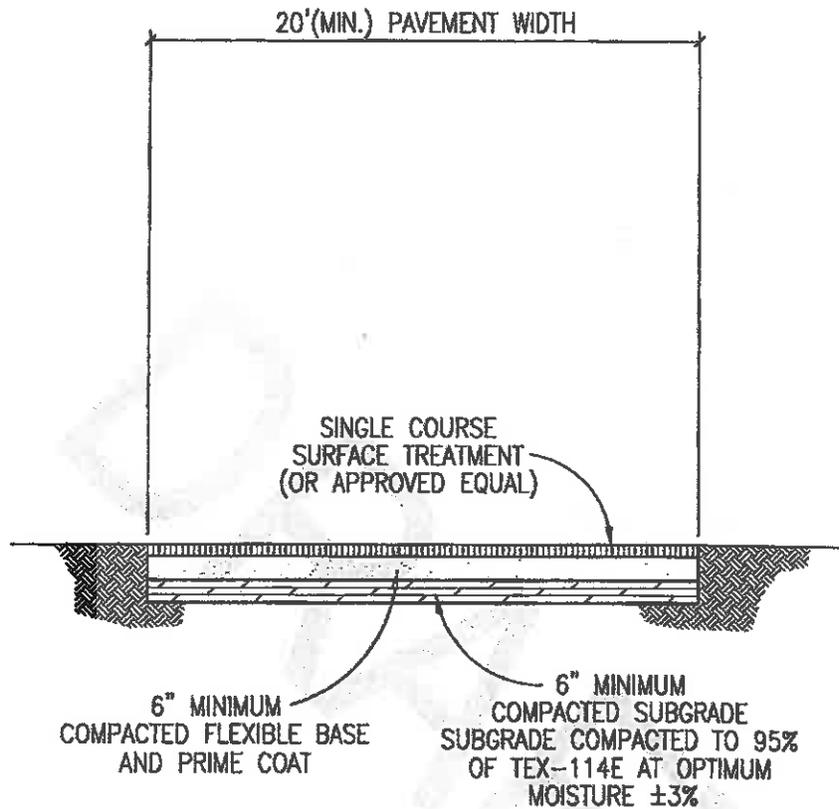
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

REMOVABLE
HAND RAIL

CONSTRUCTION STANDARDS AND DETAILS



T-38
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



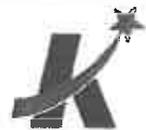
NOTES:

1. EVERY BUILDING CONSTRUCTED SHALL BE ACCESSIBLE TO EMERGENCY APPARATUS BY WAY OF TEMPORARY ALL WEATHER DRIVING SURFACES.
2. A TEMPORARY ALL WEATHER DRIVING SURFACE SHALL EXTEND TO WITHIN 150' OF ALL EXTERIOR PORTIONS OF BUILDINGS
3. TEMPORARY ALL WEATHER DRIVING SURFACES SHALL BE CONSTRUCTED AS SHOWN ON CONSTRUCTION PLANS AND IN ACCORDANCE WITH ITEM 316 SURFACE TREATMENTS OF THE TXDOT STANDARD SPECIFICATIONS FOR CONSTRUCTION OF HIGHWAYS, STREETS AND BRIDGES.
4. TEMPORARY ALL WEATHER DRIVING SURFACES SHALL BE CAPABLE OF SUPPORTING A DESIGN WHEEL LOAD OF 16,000 LB. (H-20 LOADING) IN ORDER TO SUPPORT A GROSS VEHICLE WEIGHT OF 80,000 LB. IF SUBGRADE CONDITIONS CHANGE OR ARE VERY UNSTABLE, AN ADDITIONAL GEOTECHNICAL AND/OR ENGINEERING DESIGN MAY REQUIRE A GREATER CROSS SECTION.
5. CONTRACTOR OR DEVELOPER SHALL MAINTAIN TEMPORARY ALL WEATHER DRIVING SURFACE THROUGHOUT CONSTRUCTION.
6. APPLICABLE SIGNAGE SHALL BE INSTALLED BY THE CONTRACTOR TO DISALLOW PARKING (NO PARKING - FIRE LANE).
7. TEMPORARY ALL WEATHER DRIVING SURFACES SHALL BE INSTALLED PRIOR TO THE ERECTION OF ANY STRUCTURAL FRAMING ABOVE THE FOUNDATION SLAB. CONTACT FIRE SERVICES FOR THE COORDINATION OF TEMPORARY ALL WEATHER DRIVING SURFACES FOR CONSTRUCTION.

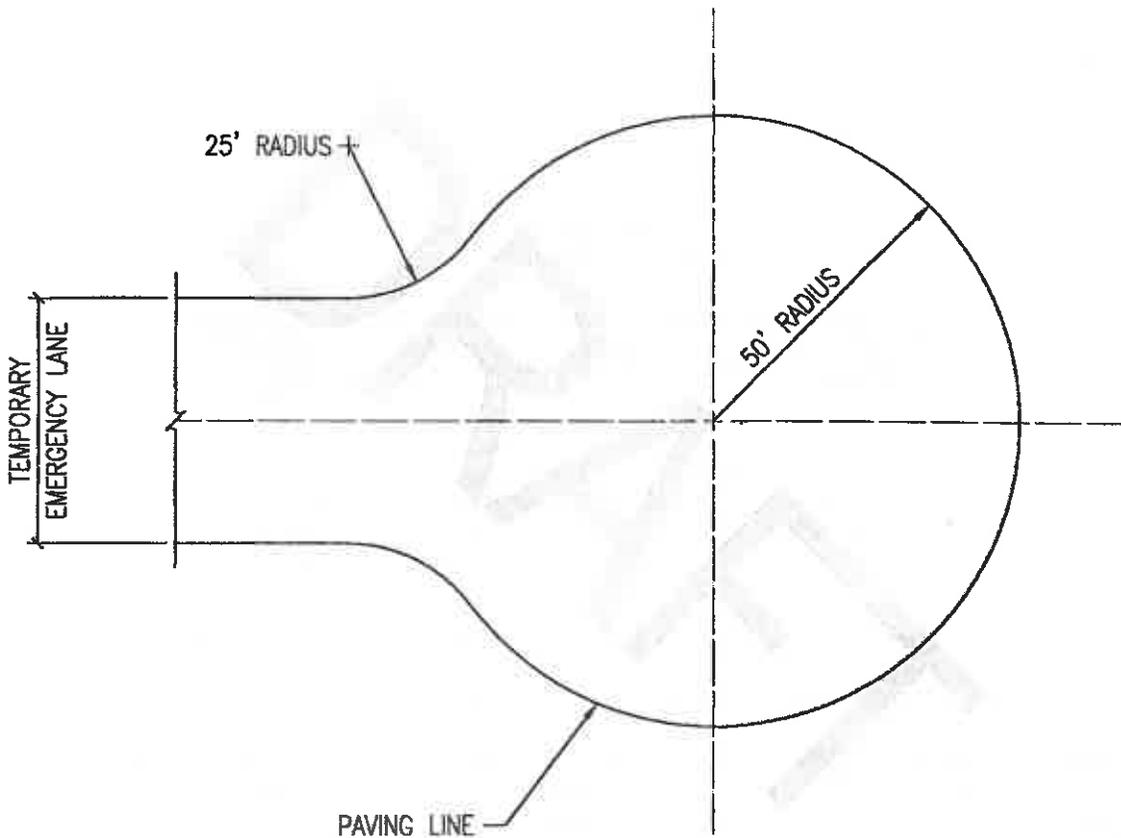
**CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS**

**TEMPORARY ALL WEATHER
DRIVING SURFACE**

CONSTRUCTION STANDARDS AND DETAILS



T-39
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



NOTES:

1. CONSTRUCTION OF TEMPORARY ALL WEATHER DRIVING SURFACE TURN AROUND SHALL BE IN ACCORDANCE WITH DETAIL T-39.

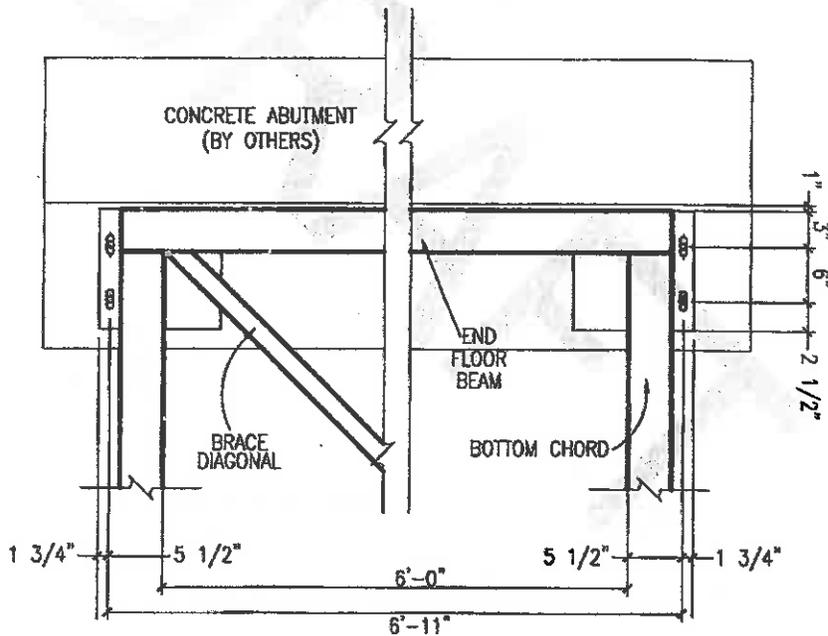
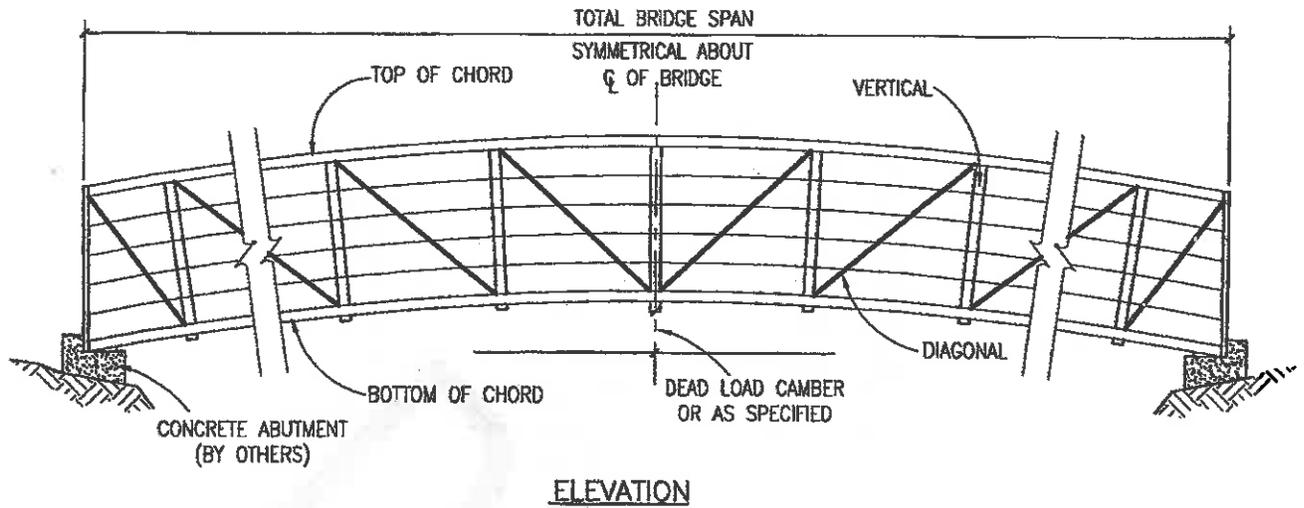
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

TEMPORARY ALL WEATHER
DRIVING SURFACE TURN AROUND

CONSTRUCTION STANDARDS AND DETAILS



T-40
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



NOTES:

1. PEDESTRIAN BRIDGE SHALL BE MANUFACTURED BY CONTINENTAL BRIDGE OR APPROVED EQUAL.
2. DIMENSIONS SHOWN ARE BASED ON 15' BRIDGE SPAN. DIMENSIONS FOR OTHER BRIDGE SPANS SHALL BE VERIFIED BY PROJECT ENGINEER.
3. COLOR OF PEDESTRIAN BRIDGE TO BE DETERMINED BY CITY OF KILLEEN PARKS DIRECTOR.

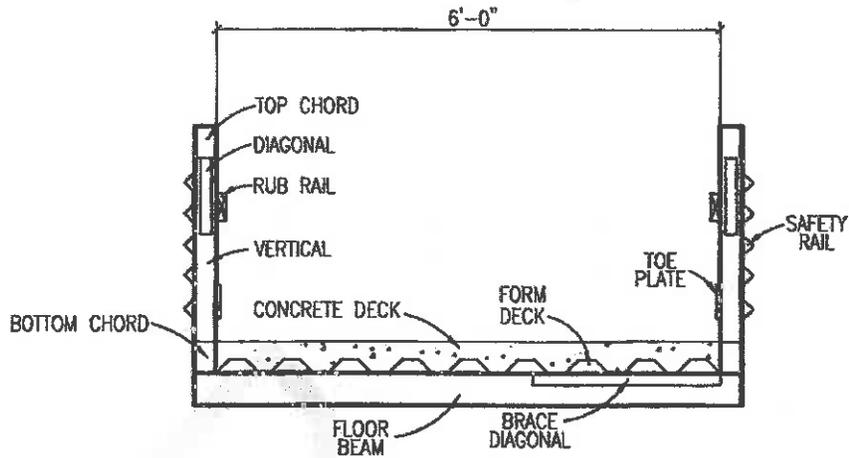
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

PEDESTRIAN BRIDGE
ELEVATION AND BEARING ASSEMBLY

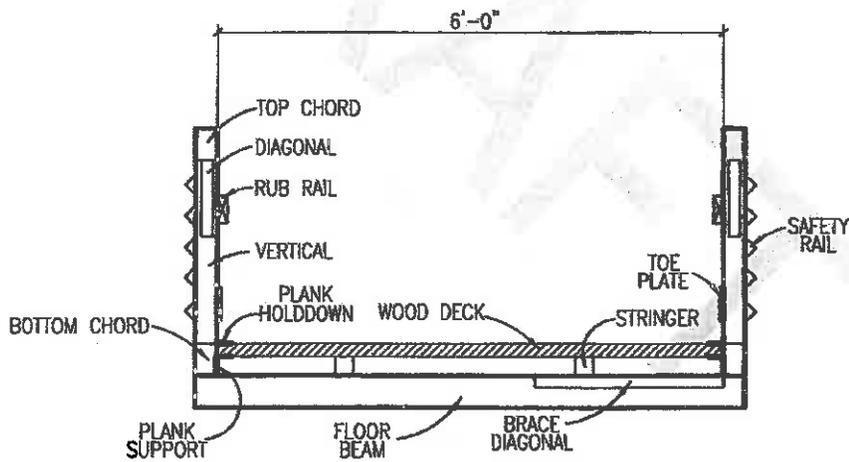
CONSTRUCTION STANDARDS AND DETAILS



T-41
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



BRIDGE SECTION



BRIDGE SECTION

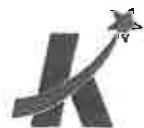
NOTES:

1. PEDESTRIAN BRIDGE SHALL BE MANUFACTURED BY CONTINENTAL BRIDGE OR APPROVED EQUAL.
2. DIMENSIONS SHOWN ARE BASED ON 15' BRIDGE SPAN. DIMENSIONS FOR OTHER BRIDGE SPANS SHALL BE VERIFIED BY PROJECT ENGINEER.
3. COLOR OF PEDESTRIAN BRIDGE TO BE DETERMINED BY CITY OF KILLEEN PARKS DIRECTOR.

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

PEDESTRIAN BRIDGE
SECTIONS

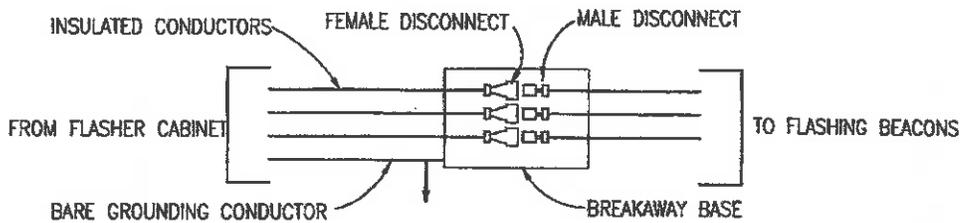
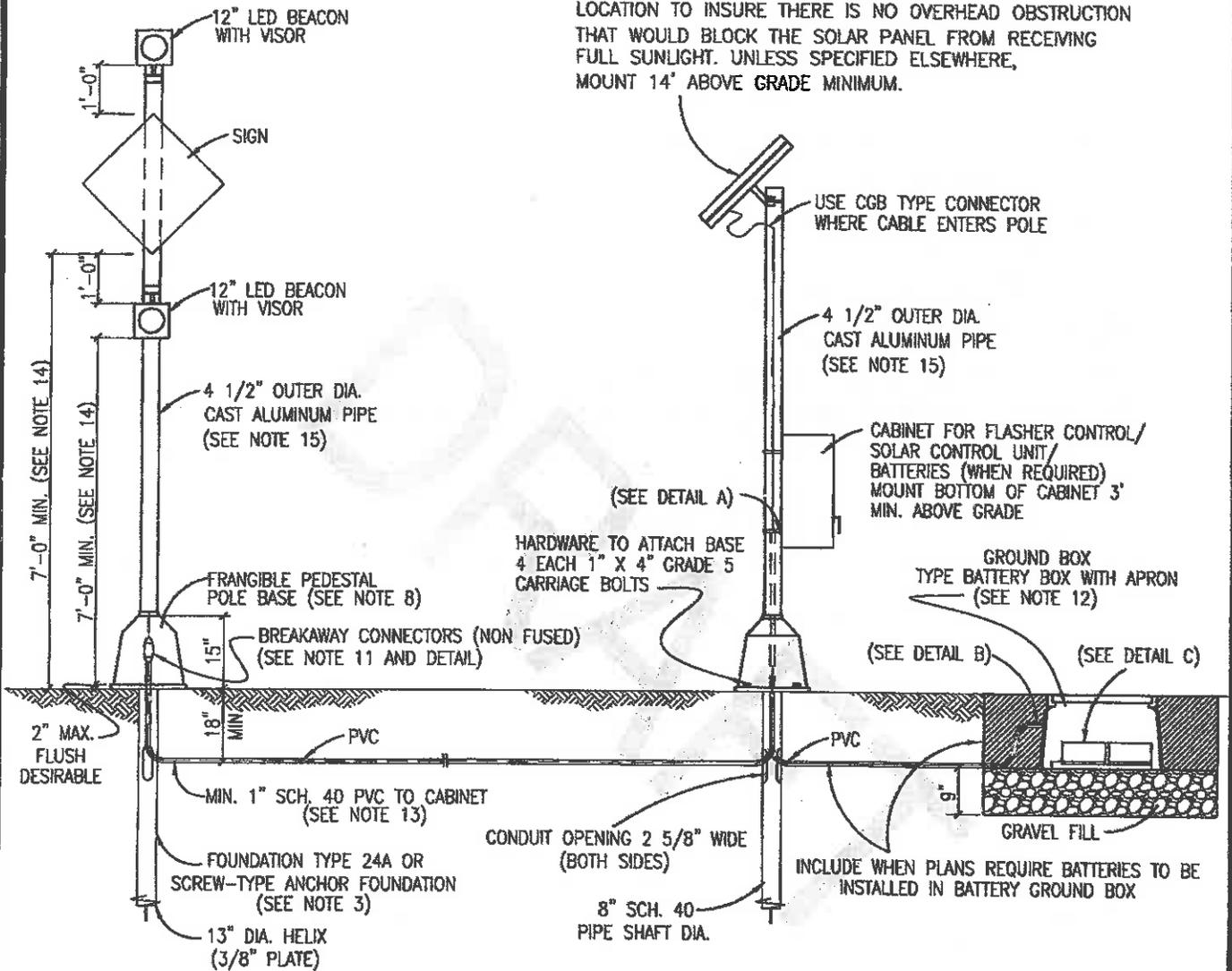
CONSTRUCTION STANDARDS AND DETAILS



T-42
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

* - SEE SHEET T-44 FOR NOTES.

ORIENT PANEL FOR OPTIMUM EXPOSURE TO SUNLIGHT (FACE TO SOUTH). PRIOR TO INSTALLATION, CHECK THE LOCATION TO INSURE THERE IS NO OVERHEAD OBSTRUCTION THAT WOULD BLOCK THE SOLAR PANEL FROM RECEIVING FULL SUNLIGHT. UNLESS SPECIFIED ELSEWHERE, MOUNT 14' ABOVE GRADE MINIMUM.



BREAKAWAY ELECTRICAL CONNECTORS

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**SOLAR POWERED ROADSIDE FLASHING BEACON
ASSEMBLY DETAILS (ALUMINUM)**

CONSTRUCTION STANDARDS AND DETAILS



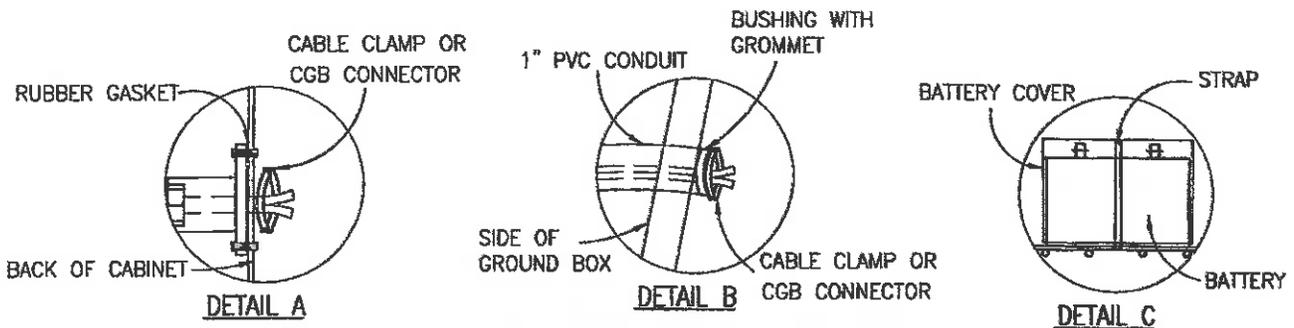
T-43
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

NOTES:

1. DETAILS SHOW A TYPICAL WARNING SIGN WITH TWO FLASHING BEACON HEADS, OTHER ARRANGEMENTS ARE POSSIBLE WHEN ONLY ONE BEACON IS REQUIRED, INSTALL THE UPPER BEACON.
2. SEE TxDOT ITEM 685, "ROADSIDE FLASHING BEACON ASSEMBLIES" FOR FURTHER REQUIREMENTS.
3. USE EITHER A SCREW-IN TYPE ANCHOR FOUNDATION OR 24" DRILL SHAFT FOUNDATION. INSTALL THE SCREW IN TYPE ANCHOR FOUNDATION AS SHOWN. ON SLOPE, INSTALL ONE EDGE AT GROUND LEVEL.
4. WHEN USED, PROVIDE ONE OF THE FOLLOWING SCREW IN TYPE ANCHOR FOUNDATION:
A.B. CHANCE, MODEL C11242NG4VP, COMPONENT PRODUCTS INC. MODEL CPI-SLSF-5TX,
PELCO PRODUCTS INC. MODELS PB-5359, PB-5360 OR PB 5375 O OR APPROVED EQUAL.
5. PROVIDE CLEARANCE AS SHOWN ABOVE THE SIDEWALK OR PAVEMENT GRADE AT THE EDGE OF THE ROAD. WHEN A BOTTOM BEACON IS NOT USED, MOUNT THE SIGN AT LEAST 7' ABOVE THE SIDEWALK OR PAVEMENT GRADE AT THE EDGE OF THE ROAD.
6. USE MATERIALS SPECIFICALLY DESIGNED FOR ATTACHING CABINETS, BEACON HEADS, SOLAR PANELS, ECT. TO POLES.
7. CONDUIT IN FOUNDATION AND WITHIN 6" OF FOUNDATION IS SUBSIDIARY TO THE ITEM 685, "ROADSIDE FLASHING BEACON ASSEMBLIES."
8. PER MANUFACTURER'S RECOMMENDATIONS, ENGAGE ALL THREADS ON THE PEDESTAL POLE BASE AND PIPE UNLESS THE PIPE IS FULLY SEATED INTO BASE. IN HIGH WINDS, USE A POLE AND BASE COLLAR ASSEMBLY TO ADD STRENGTH AND PREVENT LOOSENING ON CONNECTION.
9. INSTALL BEACON HEADS AS SHOWN HERE, AS SHOWN ELSEWHERE ON THE PLANS, OR AS DIRECTED. USE HARDWARE SPECIFICALLY DESIGNED FOR MOUNTING BEACON HEADS ON POLES.
10. LOCATE THE TYPE LB CONDUIT BODY ATTACHMENT IN THE BOTTOM THIRD OF THE BACK OF THE CABINET.
11. PROVIDE NON FUSED WATERTIGHT BREAKAWAY ELECTRICAL CONNECTORS FOR BREAKAWAY POLES.
(BUSSMANN HET, LITTLEFUSE LET, FERRAZ-SHAMUT FEBN OR APPROVED EQUAL)
12. INSTALL THE BATTERIES ON A 3/16" THICK PLASTIC SHEET AND CONNECT TOGETHER. PLACE A PLASTIC COVER (BATTERY BELL JAR) OVER THE TOP OF EACH BATTERY AND SECURE THE BATTERY BELL JAR TO THE BATTERY WITH A STRAP THE BATTERIES, BELL JARS, STRAPS AND 3/16" PLASTIC SHEET ARE SUBSIDIARY TO THE ITEM 685, "ROADSIDE FLASHING BEACON ASSEMBLIES." WHEN REQUIRED, INSTALL BATTERIES IN THE FLASHER CABINET. WIRE BATTERIES ACCORDING TO MANUFACTURES RECOMMENDATIONS.
13. UNLESS OTHERWISE RECOMMENDED BY THE MANUFACTURER, USE THE FOLLOWING TABLE TO DETERMINE THE WIRE SIZE FROM CABINET TO BEACONS.

DISTANCE FROM CABINET TO BEACONS (FT)	MINIMUM REQUIRED WIRE SIZE (AWG)
0 - 35	#14
35 - 60	#12
60 - 100	#10
> 100	#8

14. PROVIDE CLEARANCE AS SHOWN ABOVE THE SIDEWALK OR PAVEMENT GRADE AT THE EDGE OF THE ROAD. WHEN A BOTTOM BEACON IS NOT USED, MOUNT THE SIGN AT LEAST 7' ABOVE THE SIDEWALK OR PAVEMENT GRADE AT THE EDGE OF THE ROAD.
15. UNLESS OTHERWISE SHOWN ON THE PLANS, POLE SHAFT SHALL BE ONE PIECE, SCH. 40 ALUMINUM PIPE, ASTM B429 OR B221 (ALLOY 6061-T6 ONLY). ALUMINUM CONDUIT WILL NOT DEVELOP THE NECESSARY STRENGTH AND WILL NOT BE ALLOWED.



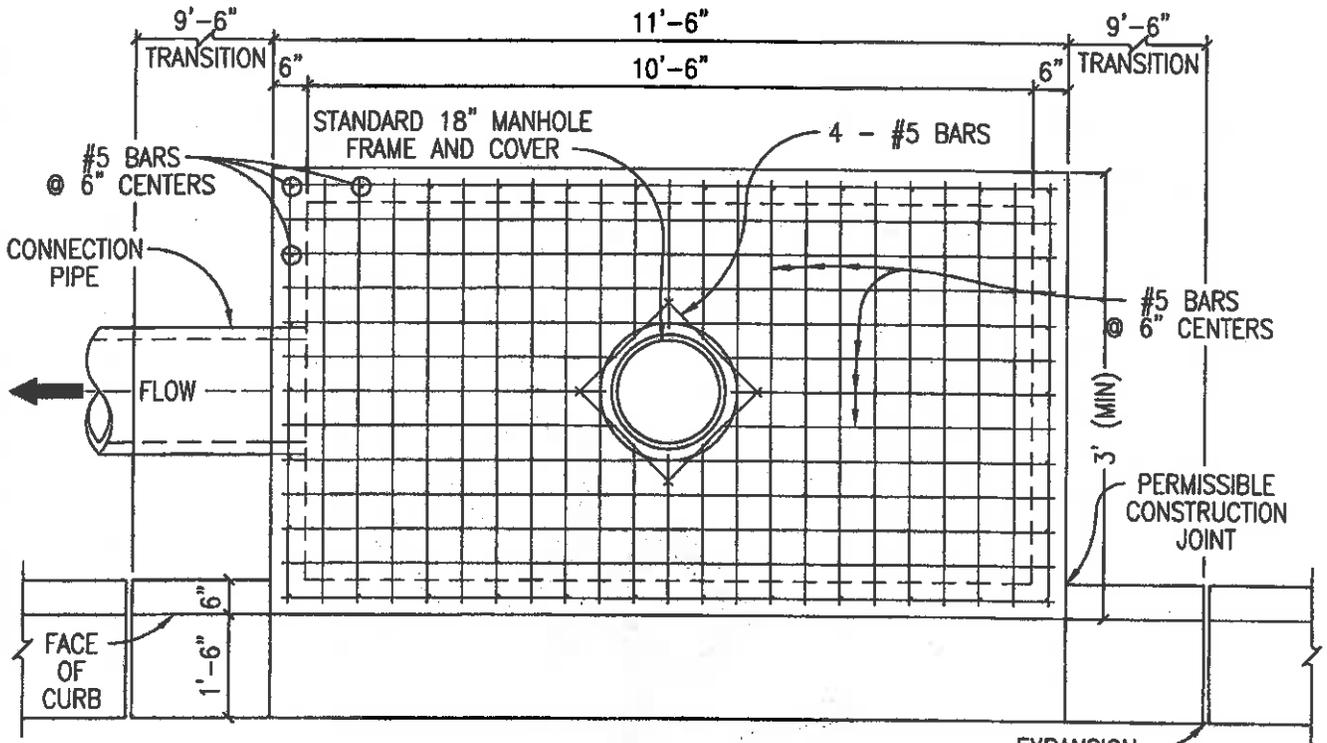
**CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS**

**SOLAR POWERED ROADSIDE FLASHING BEACON
ASSEMBLY**

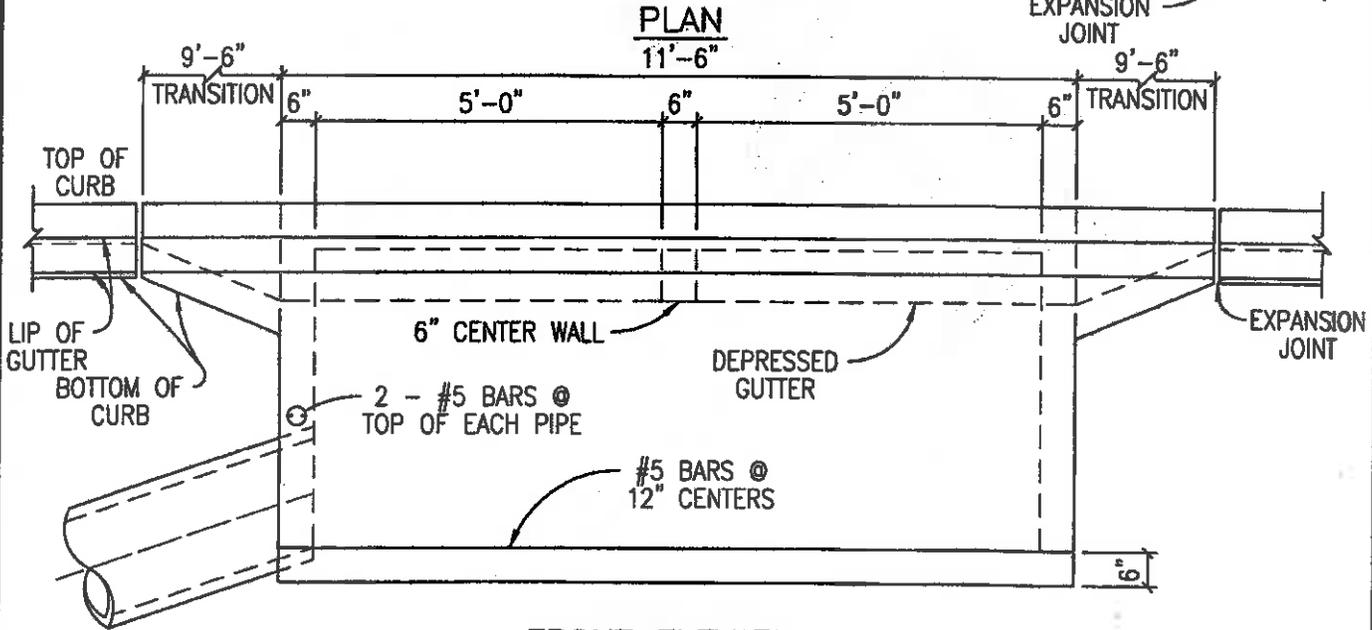
CONSTRUCTION STANDARDS AND DETAILS



T-44
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



PLAN



FRONT ELEVATION

NOTES:

1. ALL CONCRETE SHALL BE CLASS "A" 3,000 PSI CONCRETE.
2. STORM SEWER PIPE MATERIAL TO BE AS PRESCRIBED IN SECTION 103-DRAINAGE OF THE ENGINEERING DESIGN GUIDELINES UNLESS OTHERWISE APPROVED BY THE CITY OF KILLEEN.

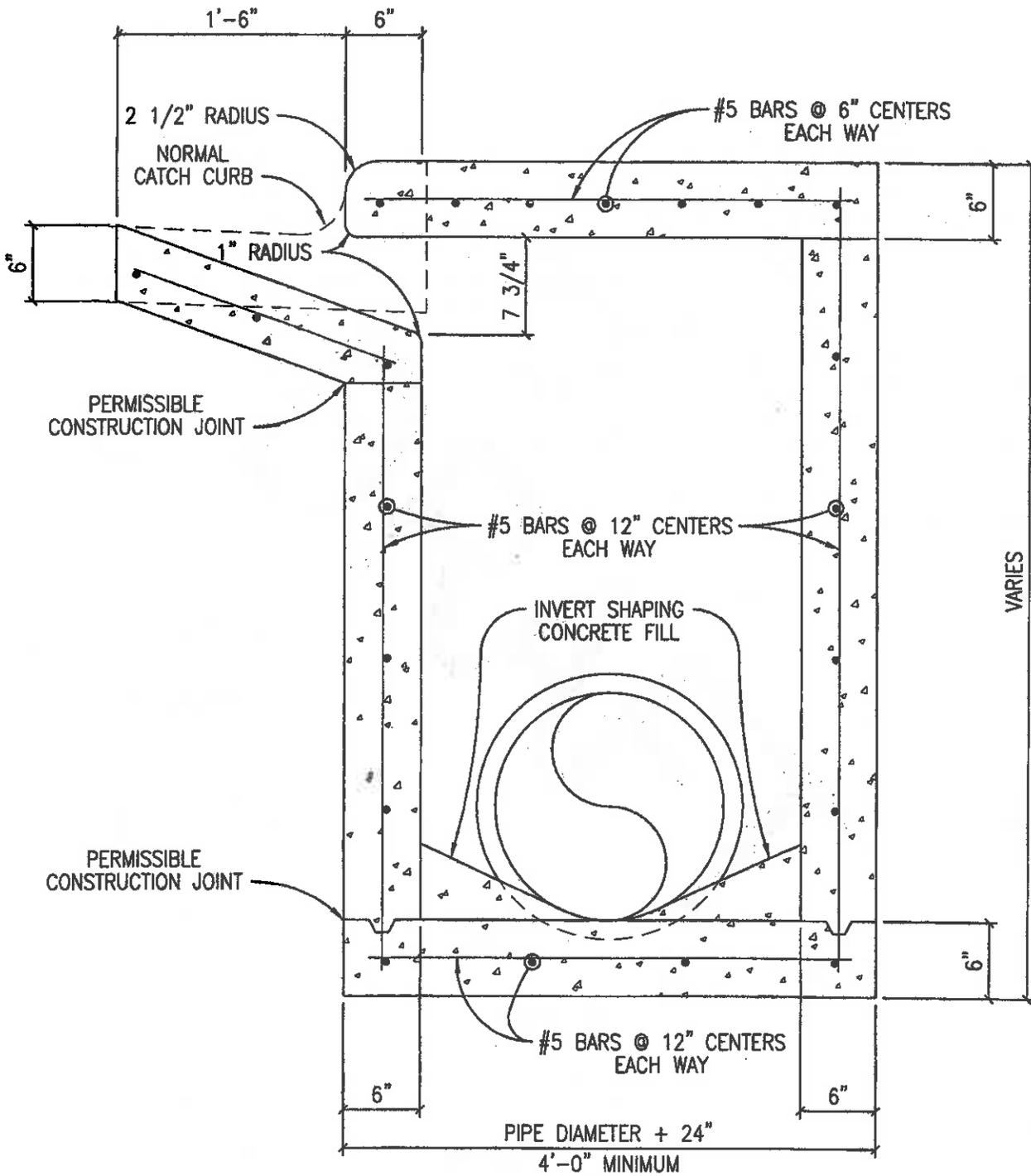
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

CURB INLET
DETAIL

CONSTRUCTION STANDARDS AND DETAILS



D-01
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



NOTES:

1. ALL CONCRETE SHALL BE CLASS "A" 3,000 PSI CONCRETE.
2. STORM SEWER PIPE MATERIAL TO BE R.C.P. (CLASS III) UNLESS OTHERWISE APPROVED BY THE CITY OF KILLEEN.

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

CURB DRAIN INLET
TYPICAL SECTION

CONSTRUCTION STANDARDS AND DETAILS



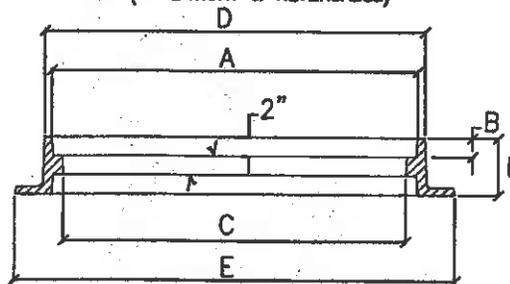
D-02
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



NOTE:
LID SHALL HAVE TWO (2)
TYPE 4 PICK BARS AND
AND LABELED "STORM DRAIN"

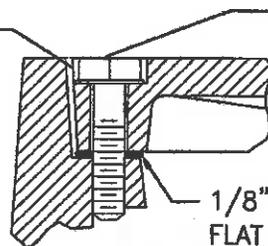
EMBLEM TO BE PROVIDED BY
CITY OF KILLEEN PUBLIC WORKS

1320
1480 (WATERTIGHT & REVERSABLE)



THE WATER-TIGHT MANHOLE SETS FEATURE SIX STAINLESS STEEL
BOLTS IN COUNTERSUNK POCKETS AND A SEALING FLAT GASKET IN THE RING SET.
BOLTING PADS REDUCE THE STANDARD CLEAR OPENING BY TWO TO THREE INCHES.

1 3/8" [35mm] DIA.
X 3/4" [13mm]
COUNTERBORE



(6) 5/8" [16mm]-11 X 2 1/4" [57mm]
ZINC HEX HD BOLTS & WASHERS
(DRILLED & TAPPED FOR McGARD BOLTS
REF. 117151) TO BE FURNISHED &
INSTALLED BY CUSTOMER.

1/8" [3mm] THICK.
FLAT GASKET

WATER-TIGHT DETAIL

	DIMENSIONS						TOTAL
	A	B	C	D	E	F	WEIGHT
1320	32	1 1/2	30	34 7/16	46	6 1/2	505 LBS
1480	32	1 1/2	30	32 1/4	38	4	350 LBS

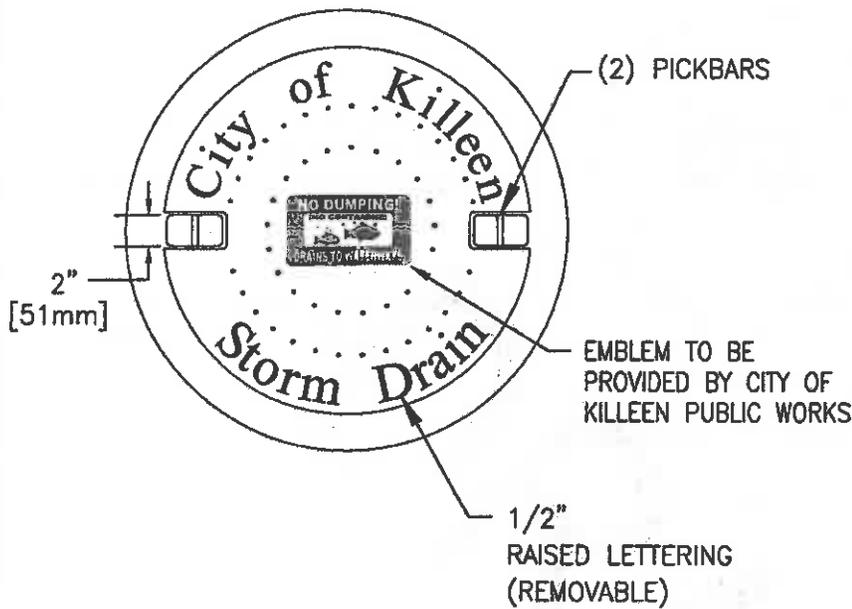
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**STANDARD STORM SEWER
MANHOLE SET**

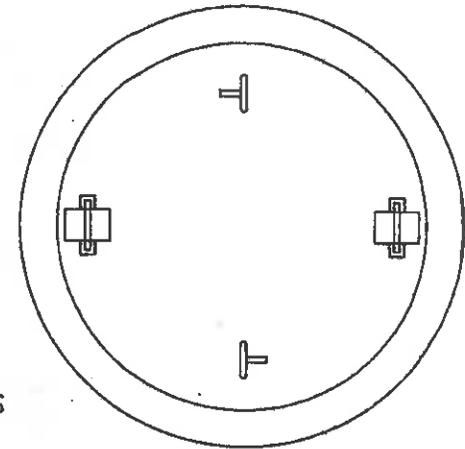
CONSTRUCTION STANDARDS AND DETAILS



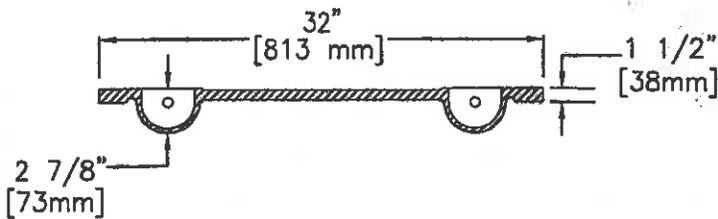
D-03
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



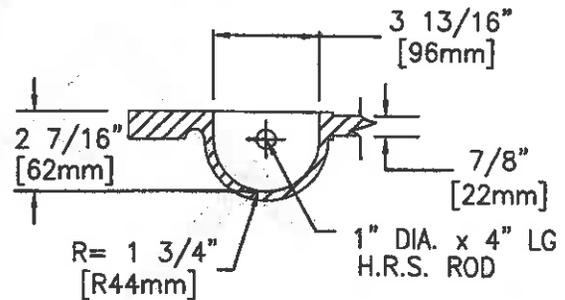
PLAN VIEW



BOTTOM VIEW



CROSS SECTION



PICKBAR DETAIL

V1432 LOGO COVER

MANHOLE COVER MANUFACTURED BY : EAST JORDAN IRON WORKS, INC
 P.O. BOX 439 EAST JORDAN, MI. 49727
 1-800-874-410 FAX 231-536-4100

PRODUCT NUMBER: NCR02-1762 STM DRN

CATALOG NUMBER: V1432

EST. WT. COVER - 210 LBS / 95 kg

MATERIAL SPEC: COVER - GRAY IRON ASTM A48 CL35

LOAD RATING: HEAVY DUTY

CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

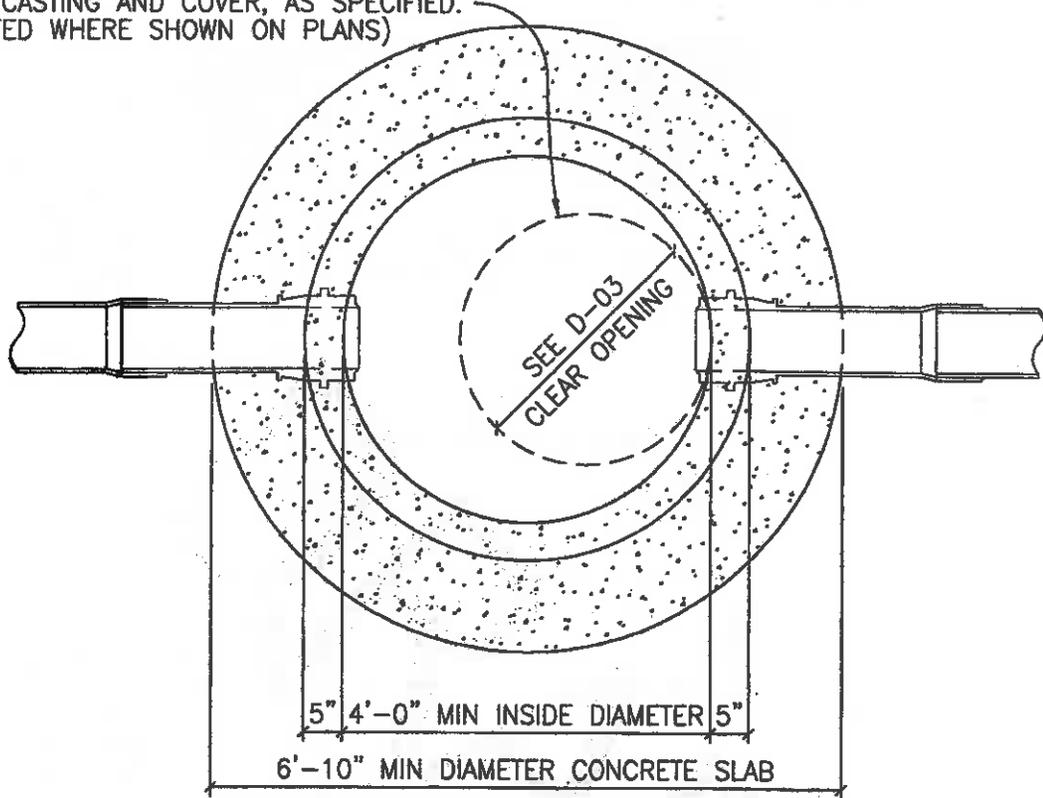
**STANDARD STORM DRAIN
 MANHOLE SET**

CONSTRUCTION STANDARDS AND DETAILS



D-04
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

STANDARD CASTING AND COVER, AS SPECIFIED.
(BOLTED WHERE SHOWN ON PLANS)



MANHOLE PLAN

CITY OF KILLEEN NOTES:

MANHOLE DETAILS SHALL REFLECT THE CITY'S MINIMUM SPECIFICATIONS, AS STATED BELOW:

- A. ALL MANHOLES SHALL BE 48" I.D., R.C.P., CLASS III, WITH RUBBER O-RING GASKET JOINTS CONFORMING TO ASTM C478, C433 AND C76.
- B. ALL MANHOLES SHALL HAVE FRAME AND COVER, AS MANUFACTURED BY EAST JORDAN IRON WORKS (AS PER DETAIL # D-03/D-04) OR APPROVED EQUIVALENT.
- C. ALL MANHOLES SHALL BE CONCRETE WITH CAST IRON FRAME AND COVER.
- D. ALL MANHOLES SHALL HAVE AN ECCENTRIC CONE.
- E. INVERTS AND FLEXIBLE SEAL BOOTS, PER ASTM C-923, SHALL BE CAST INTO BASE SECTION.
- F. MINIMUM DROP BETWEEN INVERTS SHALL BE ONE-TENTH OF A FOOT (0.1').
- G. GRADE RINGS WITH AN I.D. TO MATCH FRAMES CLEAR OPENING WITH A MAXIMUM OF THREE (3) GRADE RINGS ALLOWED.

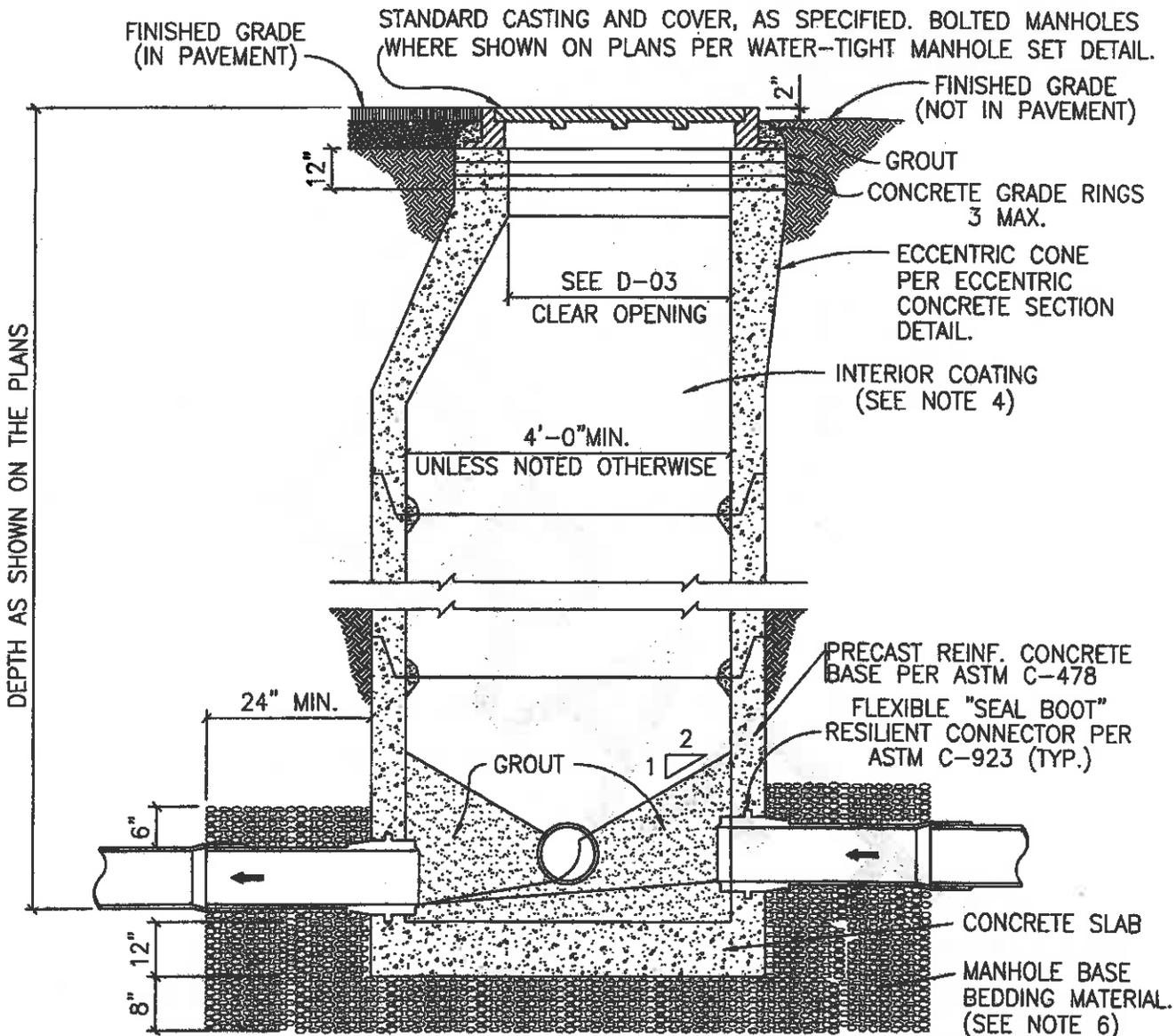
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**STANDARD STORM SEWER
MANHOLE - PLAN**

CONSTRUCTION STANDARDS AND DETAILS



D-05
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



NOTES:

1. MANHOLES SHALL BE PRECAST ASTM C-478 BELL AND SPIGOT WITH "O" RING JOINTS.
2. SEE PLANS AND MANHOLE SCHEDULE, FOR MANHOLE SIZE, LOCATION, CONFIGURATION, TYPE OF TOP SECTION, VENTING REQUIREMENTS, PIPE SIZE AND TYPES.
3. SEE SPECIFICATIONS ON MATERIALS AND CONSTRUCTION.
4. ALL MANHOLE COVERS SHALL BE BOLTED AND GASKETTED WHEN MANHOLES ARE LOCATED OUT FROM PAVEMENT.
5. MANHOLES ARE TO BE DESIGNED TO RESIST LATERAL AND VERTICAL SOIL FORCES RESULTING FROM MANHOLE DEPTH. ADDITIONALLY, MANHOLES LOCATED IN PAVEMENT TO BE DESIGNED FOR HS-20 TRAFFIC LOADS.
6. MANHOLE BASE BEDDING MATERIAL SPECS. FOR 3/4" WASHED GRAVEL: SIEVE SIZE 2", PERCENT (%) RETAINED 0 SIEVE SIZE 1 1/2", % RETAINED 0-10 SIEVE SIZE 1", % RETAINED 45-80 SIEVE SIZE 3/4", % RETAINED 85-100 SIEVE SIZE 3/8", % RETAINED 95-100

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

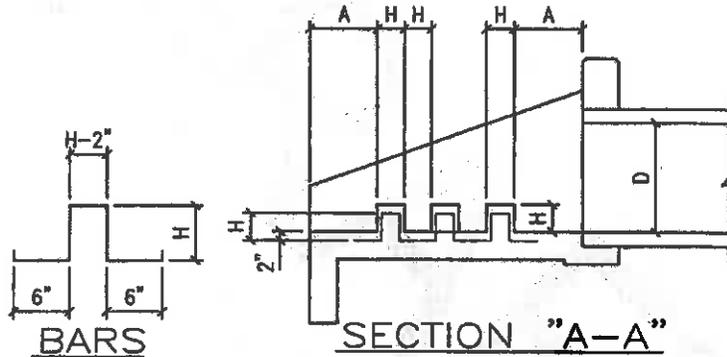
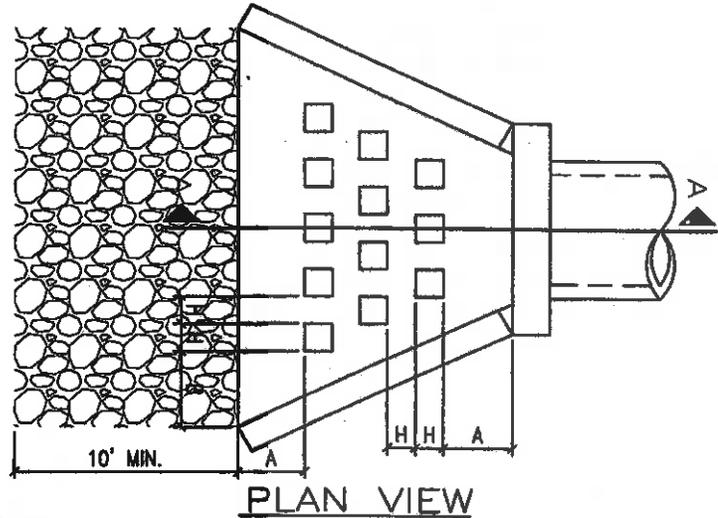
STANDARD STORM SEWER
MANHOLE - SECTION

CONSTRUCTION STANDARDS AND DETAILS



D-06
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

ROCK RIPRAP			
CLASS	D ₅₀ (IN)	APRON LENGTH	APRON DEPTH
1	5	4D	3.5 D ₅₀
2	6	4D	3.3 D ₅₀
3	10	5D	2.4 D ₅₀
4	14	6D	2.2 D ₅₀
5	20	7D	2.0 D ₅₀
6	22	8D	2.0 D ₅₀



NOTES:

1. USE CLASS "A" CONCRETE, 3,000 PSI AT 28 DAYS, UNLESS NOTED.
2. REINFORCING STEEL - ASTM A615, GRADE 40, UNLESS NOTED.
3. LAP REINFORCING 30 BAR DIAMETERS MIN. AT SPLICES, UNLESS NOTED.
4. CHAMFER EXPOSED EDGES OF CONCRETE 3/4", UNLESS NOTED.
5. PLACE REINFORCING WITH THE CENTER OF THE OUTSIDE BARS 2 INCHES FROM THE SURFACE OF THE CONCRETE.

TABLE OF DIMENSIONS FOR ENERGY DISSIPATOR DETAIL

D PIPE DIAMETER (INCHES)	NUMBER OF ROWS OF DISSIPATORS	NUMBER OF DISSIPATORS IN FRONT ROW	H (INCHES)	A (INCHES)	B (INCHES)
12	1	3	4	4	9.1875
18	2	4	4 1/2	9 1/2	15.5625
24	2	5	6	14 3/4	16 1/2
30	3	6	7 1/2	12 1/2	14 3/8
36	3	6	9	16 1/4	18 5/16
42	3	6	10 1/2	20	22 1/4
48	3	6	12	23 3/4	26 1/4
54	3	6	13 1/2	27 1/2	27 3/4
60	3	6	15	31 1/4	31 5/8

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

ENERGY DISSIPATOR
DETAIL

CONSTRUCTION STANDARDS AND DETAILS



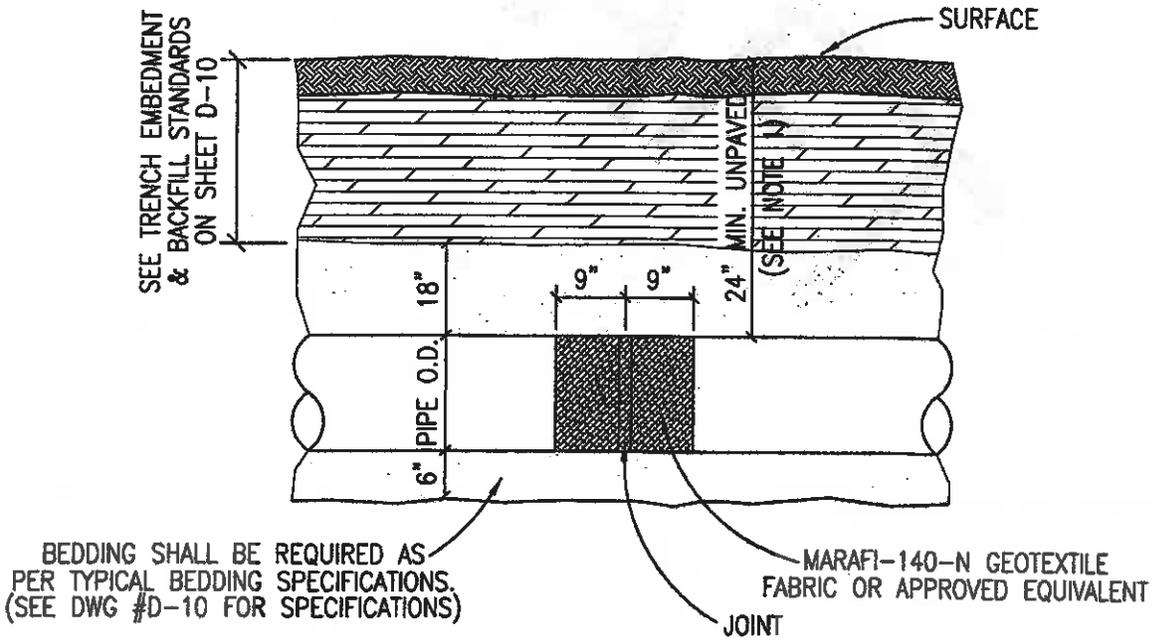
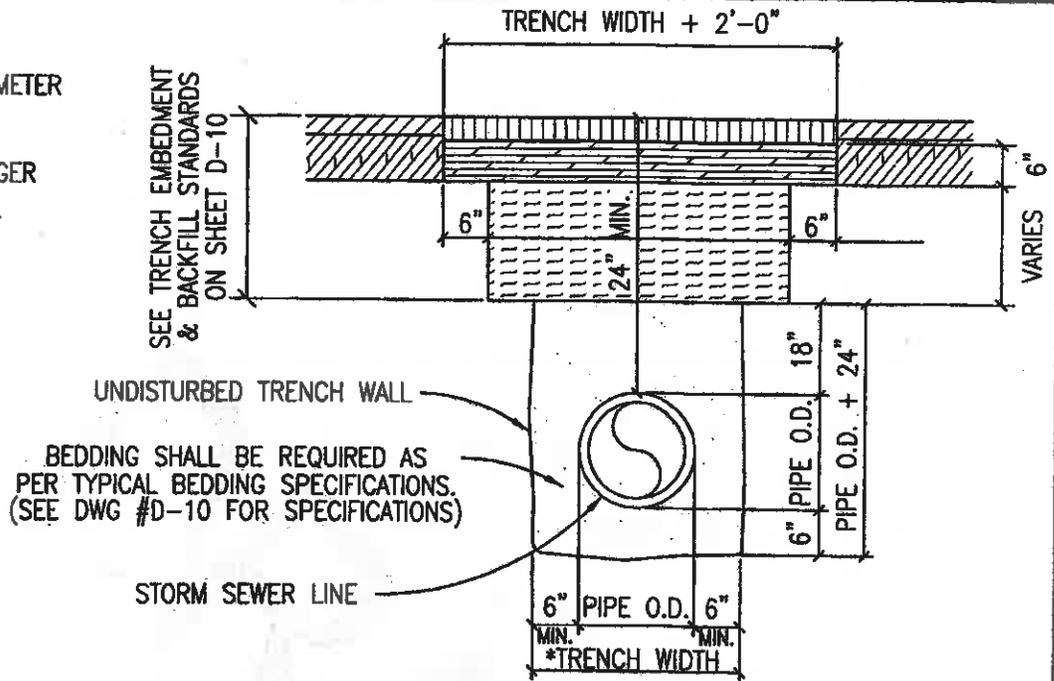
D-08

SCALE: N.T.S.

ISSUE DATE: XX-XX-XX

***TRENCH WIDTH**

PIPE LESS THAN 20" DIAMETER
 1'-0" + PIPE O.D.
 20" DIAMETER AND LARGER
 2'-0" + PIPE O.D.



CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

**TRENCH AND EMBEDMENT
 DETAIL FOR STORM SEWER**

CONSTRUCTION STANDARDS AND DETAILS



D-09
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX

NOTES:

1. REPLACED BASE MATERIAL OVER TRENCH SHALL BE TWICE THE THICKNESS OF THE ORIGINAL BASE.
2. BASE MATERIAL SHALL BE IN LIFTS NOT TO EXCEED 8" AND EACH LIFT THOROUGHLY ROLLED OR TAMPED TO SPECIFIED MAXIMUM DENSITY.
3. ASPHALT CONCRETE PAVEMENT JOINTS SHALL BE MECHANICALLY SAWED.
4. SURFACE MATERIAL WILL BE CONSISTENT WITH THE EXISTING SURFACE.
5. A MINIMUM OF ONE DENSITY TEST SHALL BE TAKEN EVERY TWO HUNDRED FIFTY (250) FEET FOR EACH SIX (6) INCH LIFT (10" FOR COMMON FILL OUTSIDE OF ROADWAY) OF SUBGRADE AND EACH OPEN CUT CROSSING. PROCTORS FOR MATERIALS USED IN BACKFILLING SHALL BE OBTAINED BY A CERTIFIED LABORATORY. DENSITY TESTS SHALL BE CONDUCTED BY A CERTIFIED LABORATORY OR THE PERMITTEE'S CONSULTANTS. THE PERCENTAGE OF MAXIMUM DENSITY REQUIRED SHALL BE AS STATED IN NOTE 7. ALL DENSITY TESTS SHALL BE COMPLETED AND ACCEPTED ON EACH LAYER PRIOR TO ADDITIONAL BACKFILLING. A COPY OF ALL COMPLETED AND ACCEPTED DENSITY TESTS SHALL BE FURNISHED TO CITY OF KILLEEN.
6. THESE SPECIFICATIONS MAY BE SUPERSEDED BY THE GOVERNING AGENCY.
7. FLEXIBLE BASE TYPE II: (SUPERFLEX)
 TxDOT TYPE A - GRADE 2 CRUSHED LIMESTONE BASE COMPACTED TO 95% OF MAXIMUM DENSITY AS DETERMINED BY ASTM D1557 (METHOD D) AT OPTIMUM MOISTURE +2%. PROCTER TO BE PROVIDED BY THE CONTRACTOR TO THE CITY INSPECTOR.
 COMPACTED NATIVE MATERIAL: COMPACT PER FIELD DENSITY CONTROL REQUIREMENTS TABLE.
 SELECT MATERIAL: COMPACT PER FIELD DENSITY CONTROL REQUIREMENTS TABLE.

FIELD DENSITY CONTROL REQUIREMENTS

DESCRIPTION	DENSITY		MOISTURE CONTROL	
	TEX - 115 - E			
PI ≤ 15	≥ 98% MAXIMUM DRY DENSITY			
15 < PI ≤ 35	98% ≥ MAX. DRY DENSITY ≤ 102%	≥ OPTIMUM MOISTURE CONTENT		
PI > 35	95% ≥ MAX. DRY DENSITY ≤ 100%	≥ OPTIMUM MOISTURE CONTENT		

8. CONTRACTOR OR ENGINEER MAY USE FLOWABLE BACKFILL AS AN ALTERNATE BACKFILL MATERIAL (SEE ITEM 808 FLOWABLE BACKFILL FOR THE SPECIFICATION).
9. PIPE SHALL BE REINFORCED CONCRETE PIPE CLASS III UNLESS THE DEPTH OF PIPE REQUIRES A STRONGER CLASS. PIPE SHALL HAVE A MINIMUM OF 24" COVER IN UNPAVED AREAS AND 18" OF COVER FROM BOTTOM OF SUBGRADE IN PAVED AREAS. WHERE LESS THAN 36" OF COVER IS PROVIDED, CLASS IV REINFORCED CONCRETE PIPE SHALL BE USED. IN NO CASE SHALL A STORM SEWER HAVE LESS THAN 12" OF COVER OVER THE TOP OF PIPE.
10. HIGH DENSITY POLYETHYLENE (HDPE) PIPE MAY BE USED UP TO 48-INCHES IN DIAMETER IN UNPAVED AREAS OUTSIDE OF CITY STREETS.
11. ALL FITTINGS AND WYES SHALL BE MANUFACTURED AND NOT CONSTRUCTED ON THE PROJECT WITHOUT PRIOR APPROVAL FROM THE CITY.
12. ALL JOINTS THAT ARE NOT SEALED WITH A WATERTIGHT CONNECTION SHALL BE WRAPPED WITH MARAFI-140-N GEOTEXTILE FABRIC OR APPROVED EQUIVALENT. THE JOINT SHALL BE WRAPPED WITH 18" WIDE FABRIC SPLITTING THE JOINT.

**** TYPICAL BEDDING SPECIFICATIONS:**

* - SEE D-09 FOR TRENCH WIDTH DEFINITION.

SIEVE SIZE	3/8" F % RETAINED	1/2" D % RETAINED	WASHED GRAVEL % RETAINED
1/2"	0	0	0
3/8"	0-2	5-25	-
4m	40-85	80-100	-
10m	95-100	96-100	-
3/4"	-	-	100

TRENCH EMBEDMENT AND BACKFILL STANDARDS

	TRENCH WIDTH *		TRENCH WIDTH* + 1'	TRENCH WIDTH* + 2'				
	EMBEDMENT UNDER PIPE	BEDDING OVER PIPE	BACKFILL MATERIAL (SEE NOTE 7)	COMPACTED FLEXIBLE BASE (TYPE II)	2" HMAC TYPE 'D'	2,000 PSI CONCRETE	COMPACTED COMMON FILL	TOPSOIL
UNDER EXISTING ROADWAY	6" MIN.	12" MIN.	24" MIN.	8" MIN.	1.5"			
UNDER PROPOSED ROADWAY	6" MIN.	12" MIN.	24" MIN.	8" MIN.	1.5"			
OUTSIDE OF ROADWAY	6" MIN.	12" MIN.					24" MIN.	6" MIN.
CONCRETE TRENCH CAP	6" MIN.	12" MIN.				6"	24" MIN.	6" MIN.

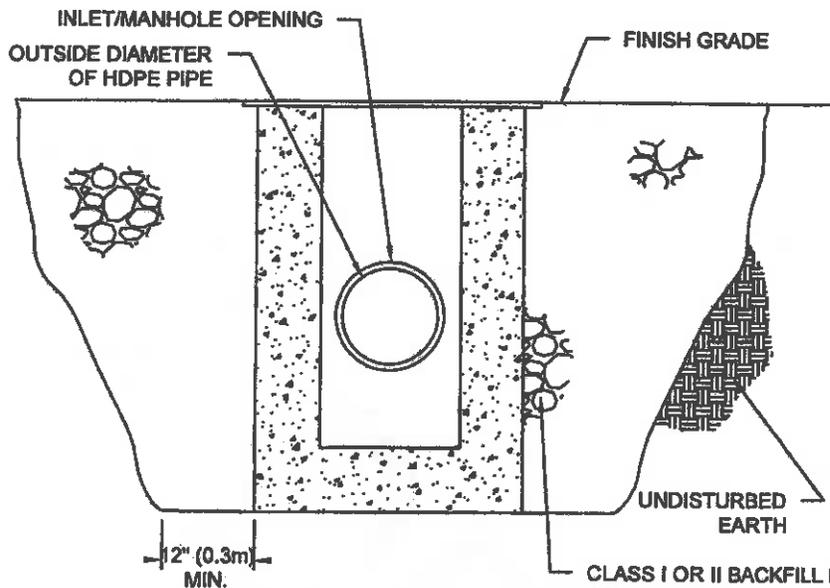
CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

TRENCH AND EMBEDMENT NOTES
STORM SEWER

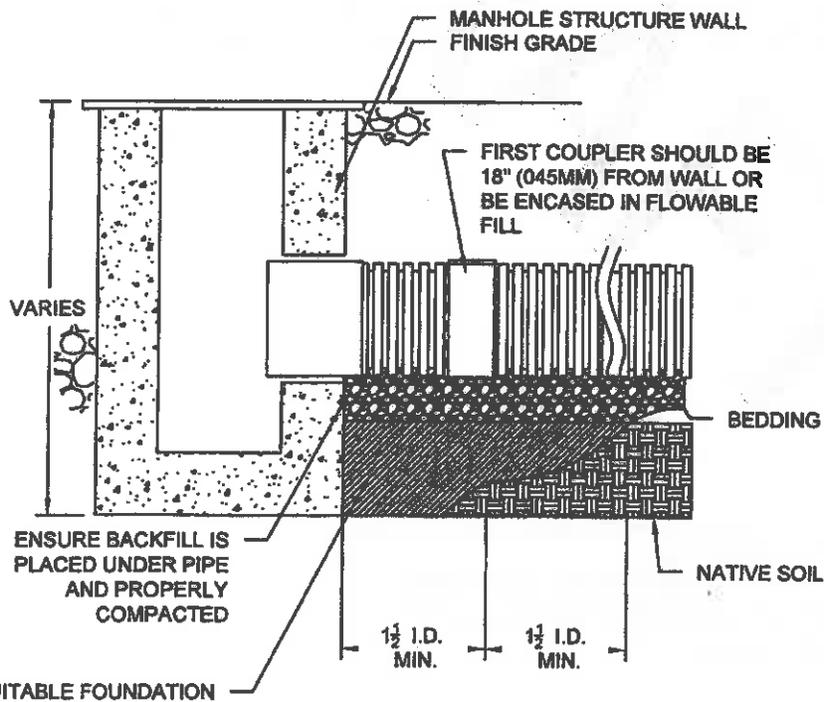
CONSTRUCTION STANDARDS AND DETAILS



D-10
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



CLASS I OR II BACKFILL PER ASTM D2321. COMPACTED IN 8" (0.2M) MAX. LIFTS TO A MIN. OF 90% MAX. STANDARD PROCTOR DENSITY



NOTES:

1. MAXIMUM INSERTION ANGLE SHALL NOT EXCEED REQUIREMENTS AS SPECIFIED BY THE MANUFACTURER.
2. SEE STANDARD DETAILS D-12 THROUGH D-15 FOR STRUCTURE CONNECTION. PRODUCT INFORMATION AND DIMENSIONAL PIPE DATA.
3. CONTRACTOR SHALL ENSURE MANHOLE GASKET IS UNIFORMLY SEATED AROUND STRUCTURES ADAPTER. EXTRA PRECAUTIONS SHALL BE TAKEN TO PREVENT DIFFERENTIAL SETTLEMENTS BETWEEN THE PIPE AND INLET MANHOLE.

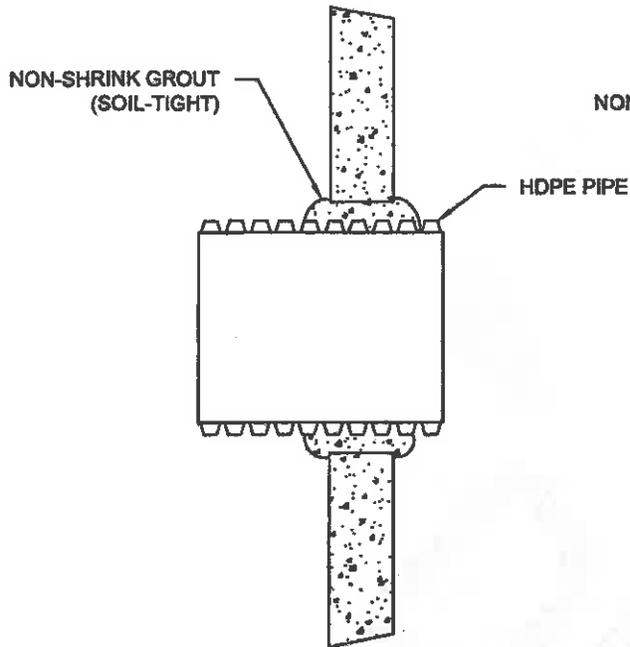
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**HDPE CONNECTION
TO INLET / MANHOLE**

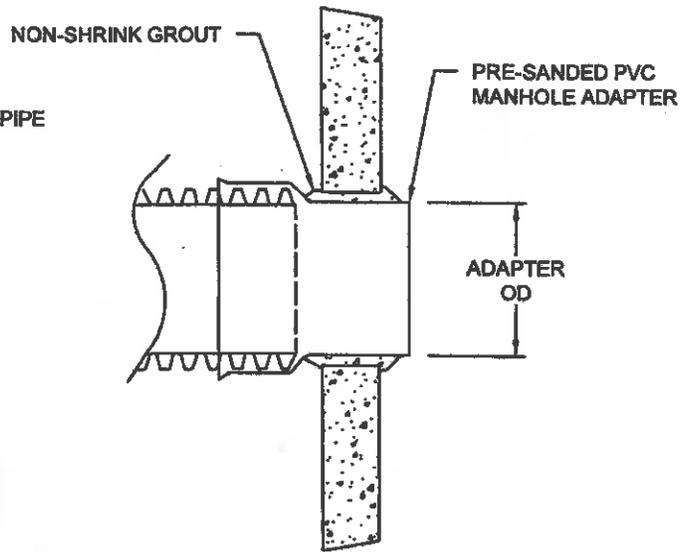
CONSTRUCTION STANDARDS AND DETAILS



D-11
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



TYPE 1: SOIL-TIGHT USING NON-SHRINK GROUT AND CORRUGATED PIPE



TYPE 2: SANDED PVC MANHOLE ADAPTER GROUTED INTO MANHOLE WALL

PIPE SIZE (IN)	ADAPTER OD (IN)	HANCOR PRODUCT CODES
18	18.7	1877AG
24	24.8	2477AG
30	32.0	3077AG

****FOR USE WITH A PROFILE PIPE ONLY****

NOTE:

1. SEE STANDARD DETAIL D-11 AND MANUFACTURER'S SPECIFICATIONS FOR INSTALLATION RECOMMENDATIONS.
2. CONTRACTOR SHALL ENSURE MANHOLE GASKET IS UNIFORMLY SEATED AROUND STRUCTURE ADAPTER. EXTRA PRECAUTIONS MUST BE TAKEN TO PREVENT DIFFERENTIAL SETTLEMENT BETWEEN THE PIPE AND MANHOLE.

SEE STANDARD DETAIL D-11 AND MANUFACTURER'S SPECIFICATIONS FOR INSTALLATION RECOMMENDATIONS.

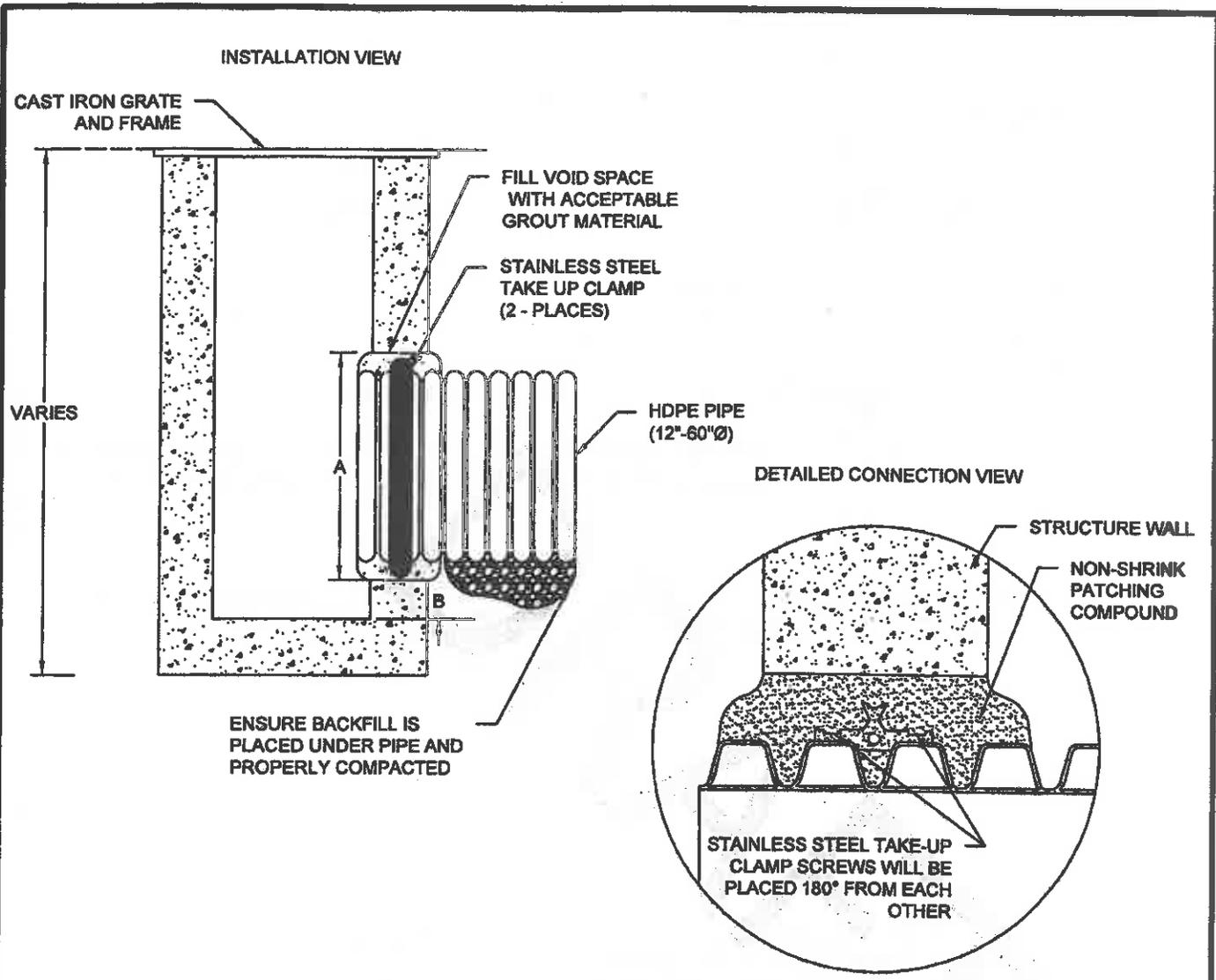
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

SOIL-TIGHT STRUCTURE CONNECTION TYPE 1 DETAIL

CONSTRUCTION STANDARDS AND DETAILS



D-12
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



TYPE 3: WATERSTOP GASKET W/
CORRUGATED HDPE PIPE

INSTALLATION RECOMMENDATIONS ARE ALSO SPECIFIED IN
INSTALLATION GUIDE 1.06: WATERSTOP INSTALLATION

PIPE SIZE (IN)	PIPE OD (IN)		"A" MIN. HOLE Ø (IN)	"B" MIN. DISTANCE PIPE TO STRUCTURE INVERT (IN)	MANUFACTURER'S PRODUCT CODE
	A-PROFILE	H-PROFILE			
12	14.5	14.2	19.50	3.7	1202PS
15	17.6	17.8	23.00	4.0	1502PS
18	21.2	21.5	26.50	4.2	1802PS
24	27.8	28.4	33.25	4.5	2402PS
30	36.1	35.5	40.50	5.2	3002PS
36	41.1	41.4	47.50	5.5	3602PS
42	47.7	48.0	53.00	5.7	4202PS
48	53.6	54.0	59.00	5.7	4802PS
60	66.3	67.3	72.00	6.4	6002PS

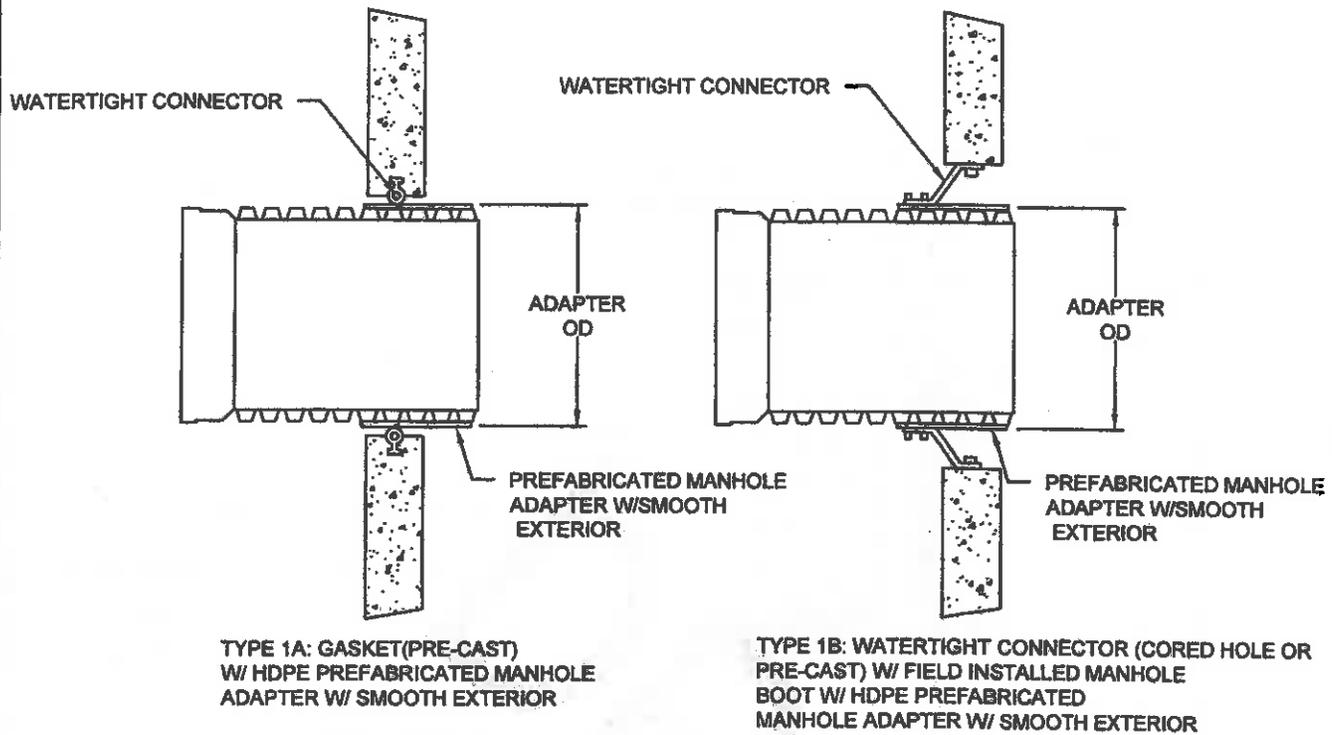
CITY OF KILLEEN
 DEPARTMENT OF PUBLIC WORKS

SOIL-TIGHT STRUCTURE
CONNECTION TYPE 2 DETAIL

 CONSTRUCTION STANDARDS AND DETAILS



D-13
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



NOTE:

1. SEE STANDARD DETAIL D-11 AND MANUFACTURER'S SPECIFICATIONS FOR INSTALLATION RECOMMENDATIONS.
2. CONTRACTOR SHALL ENSURE MANHOLE GASKET IS UNIFORMLY SEATED AROUND STRUCTURE ADAPTER. EXTRA PRECAUTIONS MUST BE TAKEN TO PREVENT DIFFERENTIAL SETTLEMENT BETWEEN THE PIPE AND MANHOLE.

SEE STANDARD DETAIL D-11 AND MANUFACTURER'S SPECIFICATIONS FOR INSTALLATION RECOMMENDATIONS.

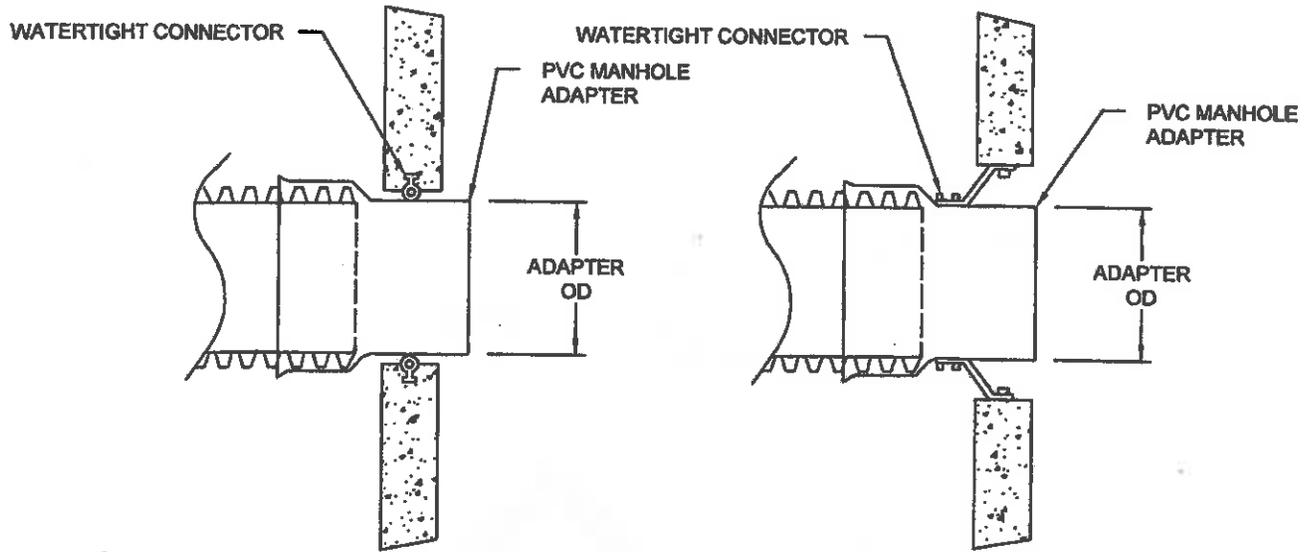
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**WATERTIGHT STRUCTURE
HDPE CONNECTION TYPE 1 DETAIL**

CONSTRUCTION STANDARDS AND DETAILS



D-14
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



TYPE 2A: (PRE-CAST) MANHOLE GASKET W/ PVC ADAPTER

TYPE 2B: WATERTIGHT CONNECTOR (CORED HOLE OR PRE-CAST) W/ FIELD INSTALLED MANHOLE BOOT W/ PVC MANHOLE ADAPTER

NOTE:

1. SEE STANDARD DETAIL D-11 AND MANUFACTURER'S SPECIFICATIONS FOR INSTALLATION RECOMMENDATIONS.
2. CONTRACTOR SHALL ENSURE MANHOLE GASKET IS UNIFORMLY SEATED AROUND STRUCTURE ADAPTER. EXTRA PRECAUTIONS MUST BE TAKEN TO PREVENT DIFFERENTIAL SETTLEMENT BETWEEN THE PIPE AND MANHOLE.

SEE STANDARD DETAIL D-11 AND MANUFACTURER'S SPECIFICATIONS FOR INSTALLATION RECOMMENDATIONS.

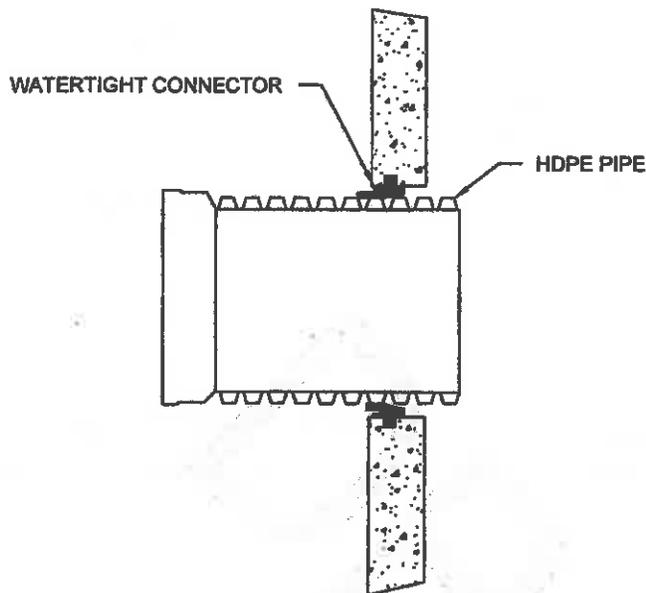
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

WATERTIGHT STRUCTURE CONNECTION TYPE 2 DETAIL

CONSTRUCTION STANDARDS AND DETAILS



D-15
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



**TYPE 4: WATERTIGHT CONNECTOR (PRE-CAST MANHOLE GASKET)
SECURED DIRECTLY TO EXTERIOR
PIPE CORRUGATIONS**

NOTE:

1. SEE STANDARD DETAIL D-11 AND MANUFACTURER'S SPECIFICATIONS FOR INSTALLATION RECOMMENDATIONS.
2. CONTRACTOR SHALL ENSURE MANHOLE GASKET IS UNIFORMLY SEATED AROUND STRUCTURE ADAPTER. EXTRA PRECAUTIONS MUST BE TAKEN TO PREVENT DIFFERENTIAL SETTLEMENT BETWEEN THE PIPE AND MANHOLE.

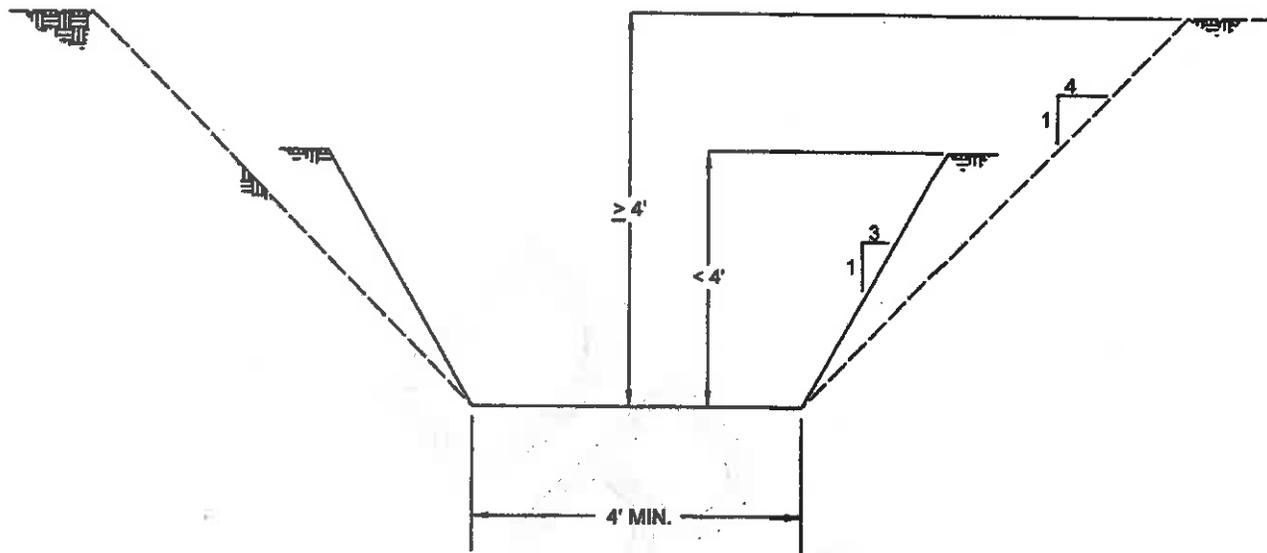
SEE STANDARD DETAIL D-11 AND MANUFACTURER'S SPECIFICATIONS FOR INSTALLATION RECOMMENDATIONS.

**CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS**

**WATERTIGHT STRUCTURE
CONNECTION TYPE 3 DETAIL
CONSTRUCTION STANDARDS AND DETAILS**



D-16
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



NOTES:

1. MINIMUM LONGITUDINAL SLOPE OF CHANNEL IS 0.5%. FOR CHANNEL SLOPES LESS THAN 1.0%, A CONCRETE PILOT CHANNEL MAY BE REQUIRED BY THE DIRECTOR OF PUBLIC WORKS.
2. CHANNELS SHALL BE VEGETATED BY HYDRO-MULCHING, SODDING OR SEEDING.

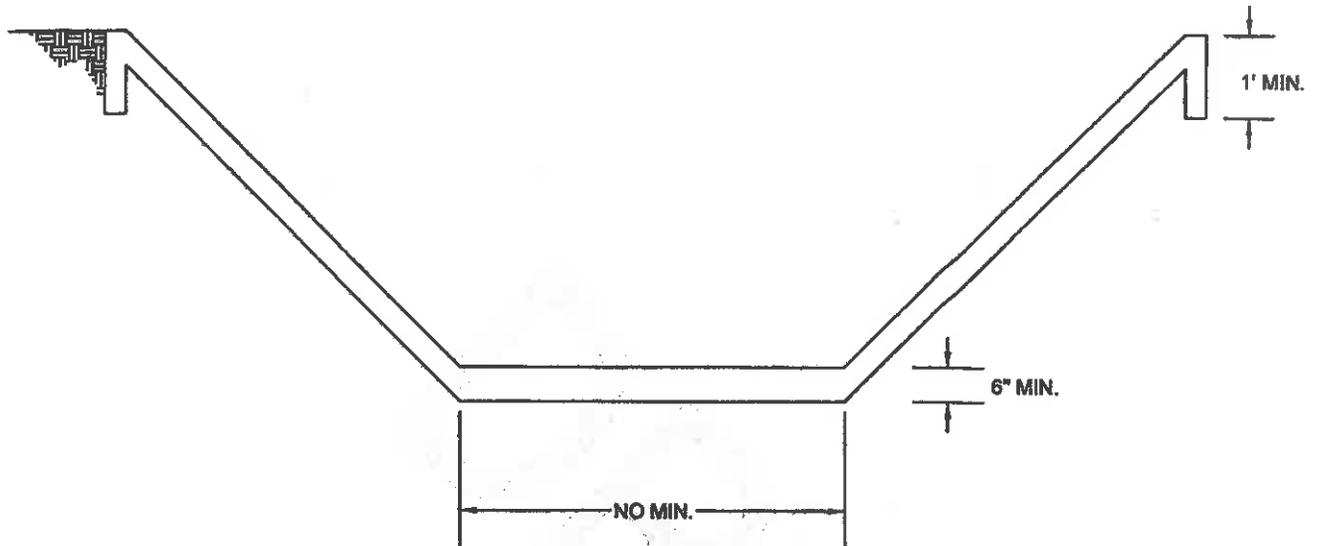
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

GRASS
LINED CHANNEL

CONSTRUCTION STANDARDS AND DETAILS



D-17
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



NOTES:

1. CONCRETE SHALL BE MINIMUM 3,000 PSI COMPRESSIVE STRENGTH (28-DAYS).
2. MINIMUM LONGITUDINAL SLOPE OF CHANNEL IS 0.5%.
3. CONCRETE SHALL BE MINIMUM 6 - INCHES THICK WITH 1 - FOOT MINIMUM TOES AT EDGES.
4. REINFORCEMENT SHALL BE #4 ASTM A-615 GRADE 60 BARS, 12" ON CENTER EACH WAY. 6" x 6" # 6 WIRE MESH MAY BE SUBSTITUTED FOR # 4 REBAR. REINFORCEMENT TO HAVE 2" MINIMUM COVER.
5. ALL CONCRETE SHALL BE GIVEN A BROOM FINISH UNLESS OTHERWISE SPECIFIED.
6. SIDE SLOPES MAY BE AS STEEP AS VERTICAL.

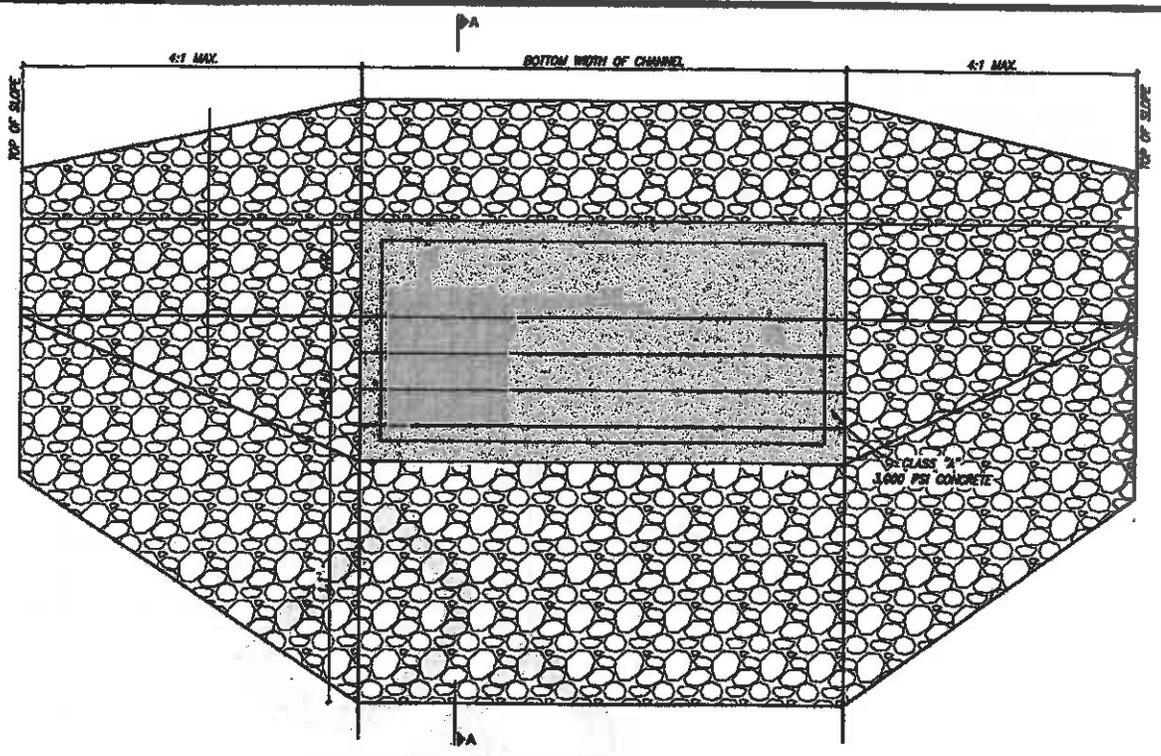
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

CONCRETE
LINED CHANNEL

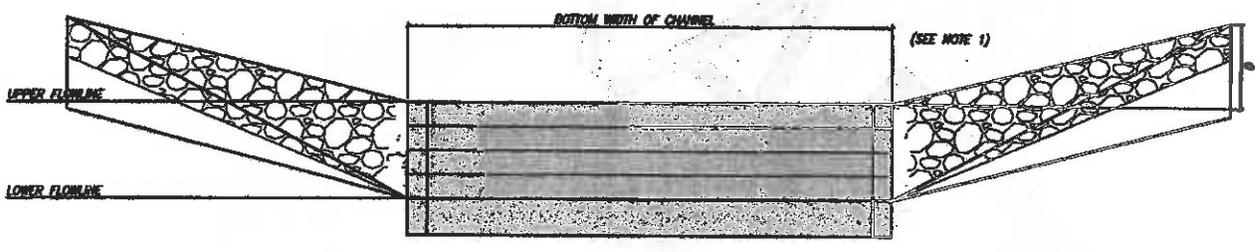
CONSTRUCTION STANDARDS AND DETAILS



D-18
 SCALE: N.T.S.
 ISSUE DATE: XX-XX-XX



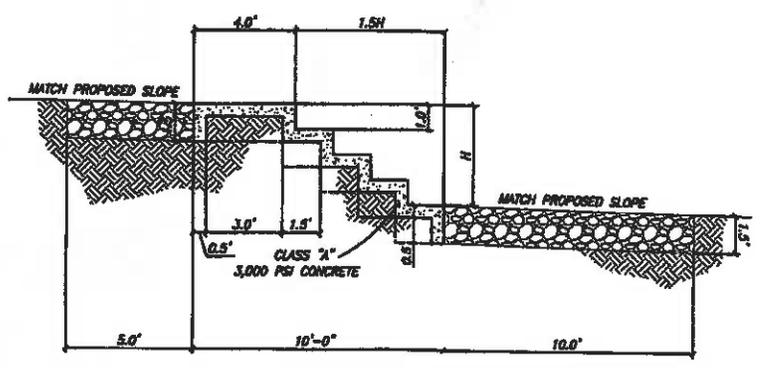
PLAN VIEW
NOT TO SCALE



ELEVATION
NOT TO SCALE

NOTES:

1. ALL CONCRETE SHALL BE A MINIMUM OF 3000psi.
2. REINFORCING SHALL BE #4 ASTM A-615 GRADE 60 BARS, 12" ON CENTER EACH WAY, 6 X 6 #6 WIRE MESH MAY SUBSTITUTED FOR #4 REBAR.
3. ROCK RIP-RAP SHALL EXTEND 10' FROM THE DOWNSTREAM SIDE AND 5' FROM THE UPSTREAM SIDE. SIZE OF RIP RAP SHALL BE DETERMINED BY DESIGN ENGINEER AND APPROVED BY CITY ENGINEER.
4. ALL EDGES OF CONCRETE DROP STRUCTURE SHALL HAVE 6 - INCH WIDE, 18 - INCH DEEP TOE.



SECTION "A-A"
NOT TO SCALE

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

DROP STRUCTURE
DETAIL

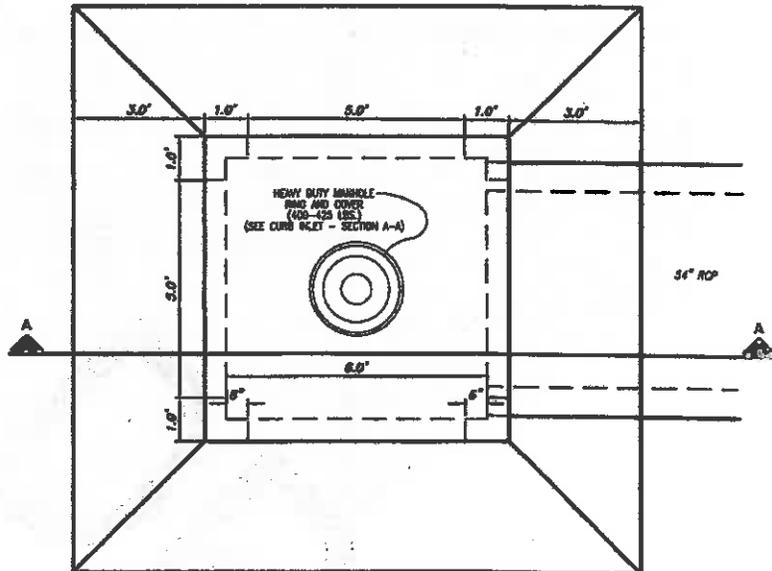
CONSTRUCTION STANDARDS AND DETAILS



D-19
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

NOTES:

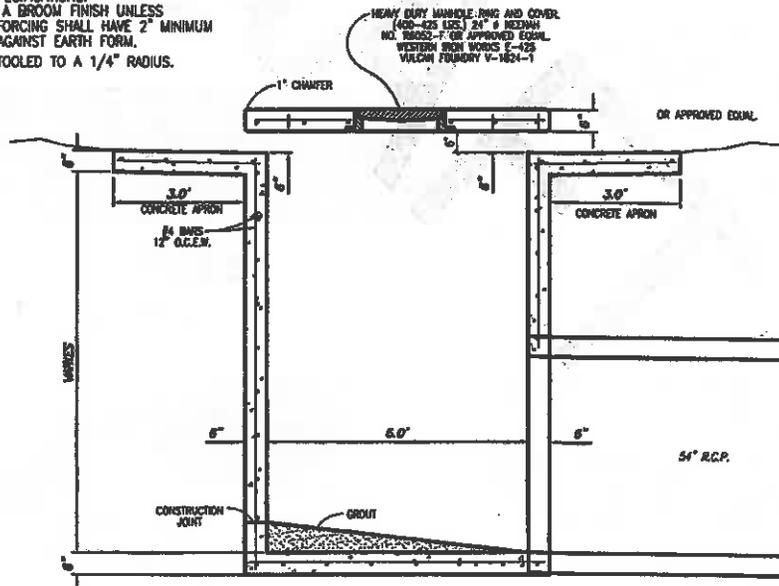
1. ALL CONCRETE SHALL BE A MINIMUM OF 3000psi.
2. REINFORCING FOR CONCRETE RIP-RAP SHALL BE #4 ASTM A-615 GRADE 60 BARS, 12" ON CENTER EACH WAY, 6 X 6 #5 WIRE MESH MAY SUBSTITUTED FOR #4 REBAR.
3. SEE SHEET D-02 FOR CONCRETE BOX CULVERT REBAR DETAILS.
4. SEE SHEET D-03 FOR CONCRETE BOX CULVERT MANHOLE DETAILS.
5. ALL 12" DIA. ROCK RIP-RAP SHALL BE A MIN. 1'-6" IN DEPTH.



PLAN
NOT TO SCALE

NOTES:

1. CONCRETE FOR ALL ITEMS ON THIS SHEET SHALL BE CLASS "A", 5 SACK, 3000 P.S.I. CONCRETE AT 28 DAYS UNLESS OTHERWISE SPECIFIED ON THE PLANS OR SPECIFICATIONS. ALL CONCRETE SHALL BE GIVEN A BROOM FINISH UNLESS OTHERWISE SPECIFIED. ALL REINFORCING SHALL HAVE 2" MINIMUM COVER, 3" MINIMUM IF PLACED AGAINST EARTH FORM.
2. ALL EXPOSED CORNERS TO BE TOOLED TO A 1/4" RADIUS.



SECTION A-A
NOT TO SCALE
6' X 6' AREA INLET DETAIL

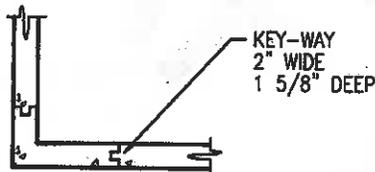
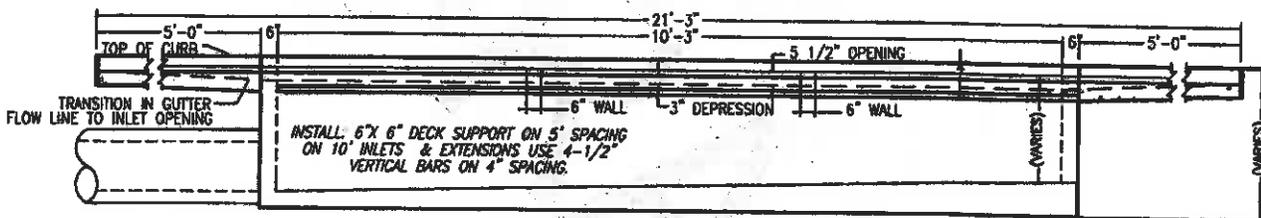
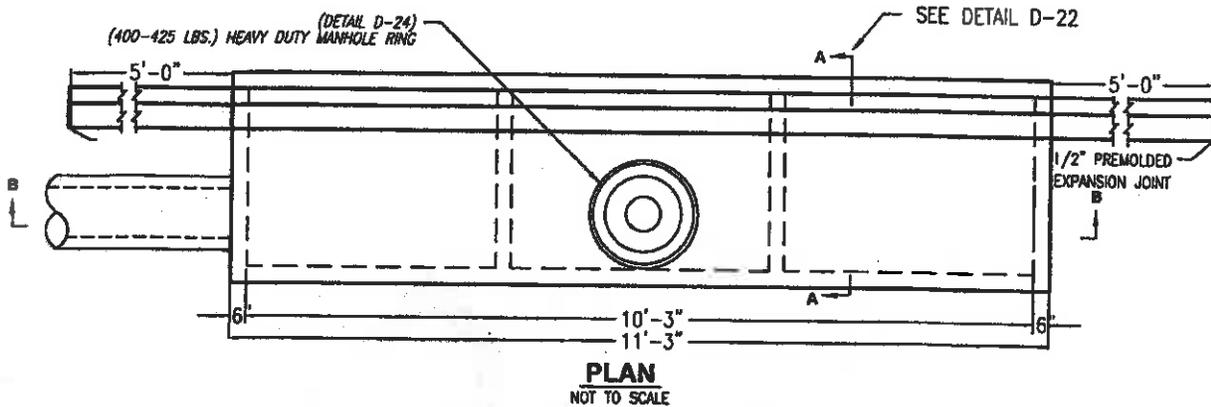
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**AREA INLET
DETAIL**

CONSTRUCTION STANDARDS AND DETAILS



D-20
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



ALL HORIZONTAL & VERTICAL
CONSTRUCTION JOINTS ON SLABS
WILL BE KEYPED.

KEY-WAY SECTION
NOT TO SCALE

GENERAL NOTES

1. CONCRETE FOR ALL ITEMS ON THIS SHEET SHALL BE CLASS "A", 5 SACK, 3000 P.S.I. CONCRETE AT 28 DAYS UNLESS OTHERWISE SPECIFIED ON THE PLANS OR SPECIFICATIONS. A 1 1/2" 9 SACK CEMENT GROUT TOPPING IS ALLOWED ON CURB AND GUTTER SECTION. ALL CONCRETE SHALL BE GIVEN A BROOM FINISH UNLESS OTHERWISE SPECIFIED. ALL REINFORCING SHALL HAVE 2" MINIMUM COVER, 3" MINIMUM IF PLACED AGAINST EARTH FORM.
2. ALL EXPOSED CORNERS TO BE TOOLED TO A 1/4" RADIUS.
3. EXPANSION JOINTS SHALL BE INSTALLED A MAXIMUM OF EVERY FORTY FEET (40') FOR ALL CONCRETE DETAILS.
4. IN AREAS WHERE NEW OR EXISTING CURB AND GUTTER TIES INTO NEW OR EXISTING DRIVEWAYS AND SIDEWALKS, 3/8" X 10" REBAR OR 24" SMOOTH DOWEL PIN WILL BE USED AT 24" O-C UNLESS OTHERWISE SPECIFIED.

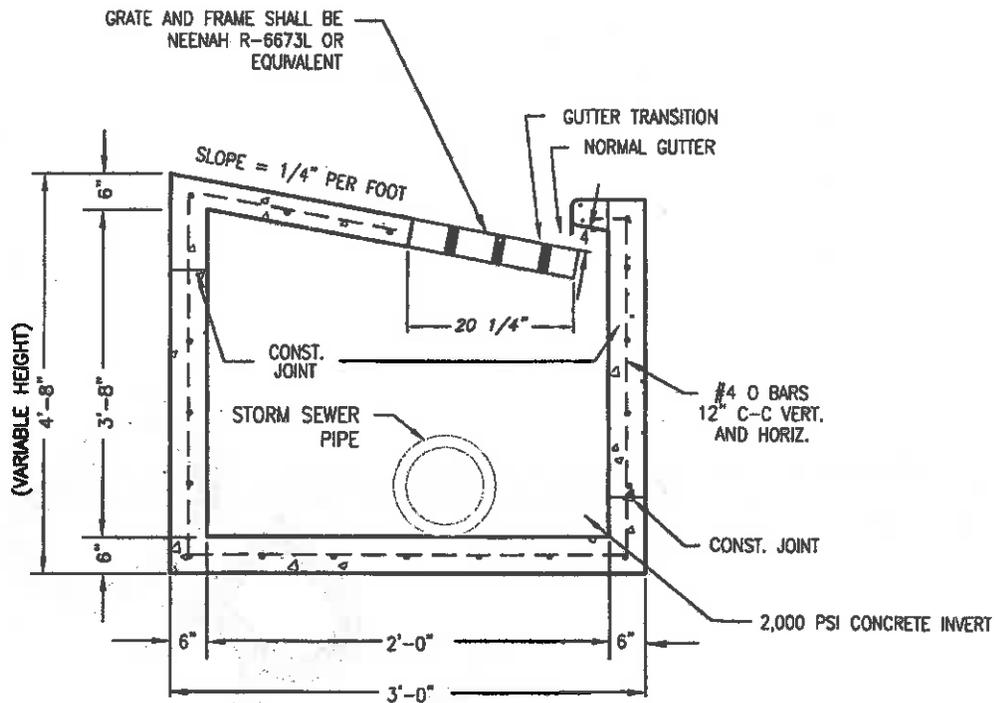
CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

**COMBINATION INLET
DETAIL**

CONSTRUCTION STANDARDS AND DETAILS

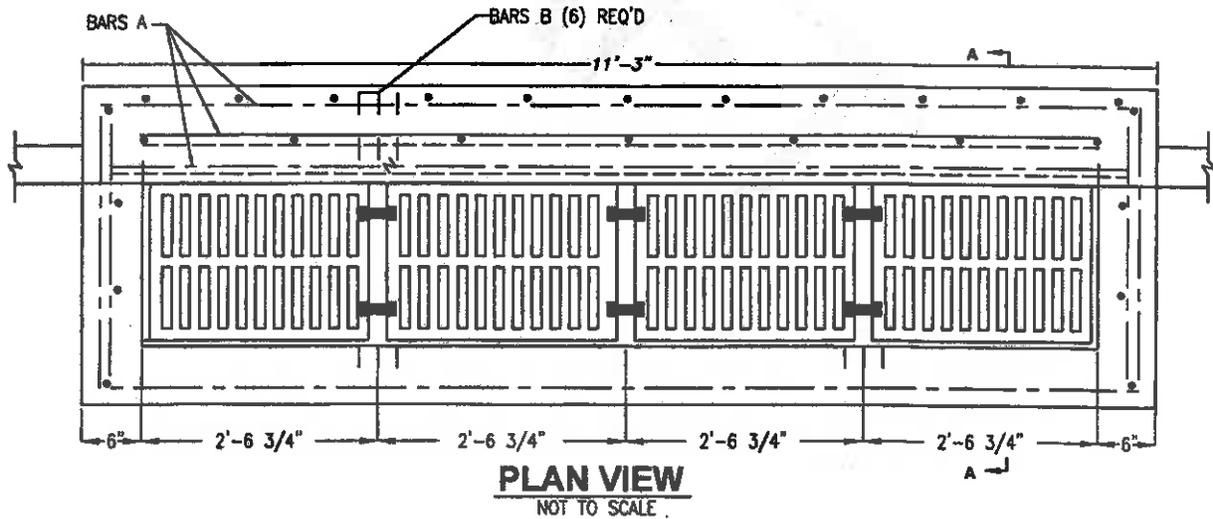


D-21
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX



SECTION A-A

NOT TO SCALE



PLAN VIEW

NOT TO SCALE

CITY OF KILLEEN
DEPARTMENT OF PUBLIC WORKS

COMBINATION INLET
DETAIL (TOP & SIDE)

CONSTRUCTION STANDARDS AND DETAILS



D-22
SCALE: N.T.S.
ISSUE DATE: XX-XX-XX

