CITY OF PORT ARANSAS

DESIGN SPECIFICATIONS

SEPTEMBER, 1988

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INDEX

CITY OF PORT ARANSAS

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Guidelines for construction of utilities within the City of Port Aransas, Texas.

SECTION 1 - DEFINITIONS:

1 - A Subdivisions

The division of any lot, tract of parcel of land.

1 - B City

The City of Port Aransas, Texas, a municipal corporation, acting by and through its governing body or its City Manager each of whom is required by charter to perform specific duties. Responsibility for final enforcement of contracts involving the City of Port Aransas is by charter vested in the City Manager.

1 - C City Attorney

The City Attorney of the City of Port Aransas, Texas, or his duly authorized assistants or agents.

1 - D City Council

The Council of the City of Port Aransas, Texas.

1 - E City Manager

The Manager of the City of Port Aransas, Texas.

1 - F Engineer

The Engineer retained by the City of Port Aransas, Texas, or his duly authorized assistants, agents, engineers or inspectors, acting within the scope of the particular duties entrusted to them.

1 - G Specifications

The direction, provisions and requirement contained herein and pertaining to the method and manner of performing the work or to the qualities or quantities of the material furnished.

1 - H "Shall" and "May"

As used herein, the word "shall" is mandatory, the word "may" is permissive.

SECTION 2 - PROVISIONS AND REQUIREMENTS

2 - A Line Locations

All City of Port Aransas storm sewer lines shall be located in utility easements or dedicated street rights-of-way or public alleys excepting off-street mains within shopping centers, apartment areas, multi-family dwelling areas and mobile home parks and travel trailer parks in which the mains shall be installed in paved drives or parking areas within dedicated easements and fire lines.

SECTION 3 - WATER DESIGN SPECIFICATIONS

3 - A Fire Hydrant Spacing

All extensions or additions to the Nueces County Water Control and Improvement District No. 4 water distribution system within the city limits and for a distance of one (1) mile thereof must meet the requirements as set forth in current Key Rate Schedule as promulgated by the Texas Board of Insurance for the installation of fire hydrants. Hydrants shall be located so that there will be a fire hydrant every 500 feet average distance as measured along dedicated streets in residential areas, including dedicated easements and fire lanes in mobile home parks and travel trailer parks.

Fire hydrants within mercantile areas containing apartments and apartment houses shall be located in dedicated streets or fire lanes behind curbs and be spaced not more than 300 feet hose lay from farthest point of any building to be served. Each distance to be measured down any standard fire hose laid from the fire hydrant to the building.

SECTION 4 - DRAINAGE DESIGN SPECIFICATIONS

4 - A Inlets

Inlets shall be curb type and shall conform to the details contained here within unless approved by the City Manager or designated representative. (See Standard detail)

4 - B Open Channels or Storm Sewer

All storm drainage shall be carried in closed storm sewer from drainage areas less than 100 acres. Major storm drainage (drainage from 100 acres or greater) may be transported in open ditches subject to approval by the City Manager.

4 - C Closed Storm Sewer

1. Pipe: Pipe shall be reinforced concrete pipe conforming to ASTM Specification C-76 Class III with a minimum wall thickness "B", unless an alternate material is approved by the City Engineer. The pipe shall be sized to transport the design flow (at velocity less than 10 fps), but in no case will be less than 15" in diameter. (See Specification 6-E)

2. Bridges and Box Culverts: Construction plans for bridges, concrete box culverts and related structures may be adaptations of Texas State Department of Highways and Public Transportation standards. (T.S.H.D.P.T.) Provide engineering computations for all bridges and culverts if T.S.H.D.P.T. standards are not used.

4 - D Open Ditches

Open ditches may be used to transport drainage from areas of 100 acres or larger.

1. Unlined Ditches:
   Unlined ditches shall be designed to accommodate the design flows at velocities of 4 FPS or less and will have side slopes no steeper than 4 to 1.

2. Concrete Lined Ditches:
   Lined ditches shall be used when the design flow yields velocities greater than 4 FPS or when the right-of-way width is too narrow to accommodate the unlined section. Lined ditches will have side slopes no steeper than 1 to 1.

3. Right-Of-Way Width:
   The right-of-way shall be sufficient width to accommodate the top width of the ditch plus a 10 foot maintenance road on the side or sides adjacent to a street of a 20 foot maintenance road on the side or sides not adjacent to a street. (See details/herewithin)

SECTION 5 - STREET DESIGN SPECIFICATIONS

The arrangement, character, extent, width, grade, and location of all streets shall conform to the general plan for the City and shall be considered in relation to existing

and planned streets, and in their appropriate relation to the proposed use of the land to be served by such streets.

The City Manager shall determine minimum street right-of-way and pavement widths on a case by case basis for all street types not covered by this document.

5 - A Street Right-of-Way Widths

Street right-of-way widths shall be as shown in the general plan for the city or when not shown shall not be less than as follows

Street Type	Right-of-way Width
Primary Arterial	80 feet
Secondary Arterial	60 feet
Collector Street	50 feet
Minor Street	50 feet

5 - B Dead End Streets

Dead-end streets, designed to be so permanently, shall not be longer than five hundred (500) feet and shall be provided at the closed end with a turn around having an outside roadway diameter of at least eighty (80) feet, and street property line diameter of at least one hundred (100) feet.

5 - C Street Grades

Street grades shall be established with due regard being had for topography, contemplated land use, and the existing land to be subdivided, provided that the minimum street grade shall be two-tenths of one percent (0.2%).

5 - D Street Crown

All streets shall have a crown located at the center line of the roadway and the pavement shall slope to the curb at a minimum of two and one half percent (2.50%).

5 - E Street Sub-Grade

Prior to the placing of the base material, the sub-grade for an area to include the width of the street plus the area which extends for a distance of one (1.0) foot beyond the back of the curb shall be tested by a commercial laboratory and shall have a minimum of ninety-five percent (95%) of the standard proctor maximum density as determined by moisture content.

5 - F Street Base

Street base shall be constructed of a minimum of four (4.0) inches of hot

Plant-Mix Stabilized Base (see Specification 6-I) or six (6.0) inches of eleven (11.0) percent Cement by Weight Cement Stabilizhed Base. (See Specification 6-H)

5 - G Street Surface

The street surface shall be Hot-Mix Asphaltic Concrete Pavement T.H.D. Type D-42. All streets with Hot Plant Mixed Asphalt Stabilized Base shall be surfaced with a minimum of one (1.0) inch of the above mentioned material. All streets with Cement Stabilized Base shall be surfaced with a minimum of one and one half (1.5) inches of the above material. (See Specification 6-K)

5 - H Pavement Width

Widths of paving for various types of street including two (2.0) foot curb and gutter shall not be less than the following:

Street Type	Pavement Width
Primary	40 feet
Secondary Arterial	40 feet
Collector Streets	28 feet
Minor Street	24 feet

5 - I Curbs

For residential development the curb and gutter shall be the City of Port Aransas standard four (4") inch rolled curb.

5 - J Utility Cuts on Existing Streets

For placement of utility lines below existing pavement, boring shall be required of all non gravity flow lines of less than 2" diameter, for lines of 2" or greater diameter open cut trenching may be required. (See Specification 6-Q) The placement of utility lines below existing pavement shall be by City permit only.

SECTION 6 - MATERIAL SPECIFICATIONS

6 - A PIPE TRENCH EXCAVATION AND BACKFILL

CONSTRUCTION METHODS:

General: The Contractor shall schedule the excavation of pipe trenches at such times and in such sequence as to present the least interference with other items of the work and the operation of the existing facilities. The Contractor shall pile excavated material in a manner that will not endanger the work, and will avoid obstructing sidewalks and driveways. Gutters shall be kept clear.

Vertical Sides: When necessary to protect existing or proposed structures or other improvements the Contractor shall maintain vertical sides of the trench. The minimum and maximum width of trench is set out hereinafter. The Contractor shall provide and install any sheeting, shoring, and bracing as necessary to provide a safe work area as required to protect workmen, structures, equipment, trees, etc. The Contractor shall be responsible for the design and adequacy of all shoring, bracing, and sheeting. The Contractor shall remove shoring, bracing, and sheeting, as the excavation is backfilled, in such a manner as to prevent injurious caving.

Sloping Sides: Where sufficient space is available, the Contrctor shall be allowed to back slope the trench starting 1 foot above the top of the pipe. The trench below the back slope shall conform to the requirements for vertical sides.

The back slope shall be such that the trench shall be safe from caving. The type of soil being trenched shall govern the back slope used. The Contractor shall be responsible for determining the back slope used, but in any case, the back slope shall be no steeper than 1 foot horizontal to 1 foot vertical.

Width of Trench: The Contractor shall excavate the trench within the limits set out below:

NOMINAL PIPE DIAMETER	MINIMUM WIDTH	MAXIMUM WIDTH
12" and smaller	outside pipe diameter plus 12 inches	outside pipe diameter plus 18 inches
15" and larger	outside pipe diameter plus 24 inches	outside pipe diameter plus 36 inches

Unauthorized Overexcavation: If the Contractor should excavate below the proposed trench grade (without authorization of the Engineer) the Contractor shall correct the grade by filling in with sand and tamping thoroughly as directed by the Engineer.

Trees, Stumps, or Roots: Where trees, stumps, or roots are encountered, they shall be removed and disposed of by the Contractor. Roots shall be cut off flush with the sides of the trench.

Rocks, Boulders, Existing Structures, Etc.: Where rocks, boulders, existing structures, or other unsuitable soil conditions are encountered, they shall be removed by the Contractor to a depth of 12 inches below the grade line for the full width of the trench and refilled with sand and tamped thoroughly as directed by the Engineer.

Maintenance of Flow in Sewers and Drains: The Contractor shall make adequate provision for maintaining the flow of sewers and drains encountered during construction.

Dewatering: The Contractor shall keep the pipe trench free from water by use of bailing, pumping, well points, or any combination as the particular situation may warrant. It is the intent of these specifications to install pipe on a firm dry bed. All dewatering methods and procedures are subject to the approval of the Engineer. The cessation of the dewatering operation will be accomplished during a sufficient period of time to insure that there is no diplacement of the pipe due to unequal hydrostatic pressure.

Unstable Trench Bottom: When the soil encountered at the established bedding grade is a quicksand, muck, or similar unstable material, the Contractor shall proceed as follows: All unstable soil shall be removed to a depth of 2 feet below bottom of pipe for pipe 2 feet or more in diameter and to a depth equal to the diameter of the pipe for pipe less than 2 feet in diameter. Such excavation shall be carried at least 1 foot beyond the horizontal limits of the pipe on all sides. All unstable soil so removed shall be replaced with suitable stable material, placed in uniform layers of suitable depth as directed by the Engineer, and each layer shall be wetted, if necessary, and compacted by tamping to at least 90% Standard Proctor Density. Soil which is considered to be of sufficient stability to sustain properly the adjacent sections of the roadway embankment will be considered a suitable foundation material for the sewer.

Unyielding Trench Bottom: When the soil encountered at the established bedding grade is ledgerock, rocky, or gravelly soil, hard pan, or other unyielding material, such materials shall be removed prior to bedding the pipe. These material shall be excavated for a minimum of 8 inches below the bottom of the pipe of 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than 3/4 of the nominal diameter of the pipe. The width of the excavation shall be 1 foot greater than the outside diameter of the pipe. The material removed shall be replaced with sand or other suitable granular material.

Shaping Trench Bottom: The bottom of the trench shall be shaped to support the bottom guadrant uniformly and for its entire length. Provide bell holes for bell and spigot pipe; for fittings and for couplings. The pipe shall be bedded, in a foundation of stable earth material accurately shaped to fit the lower part of the pipe exterior for at least 10 percent of its overall height. The Engineer may require use of a template necessary to secure reasonably accurate shaping of the foundation material.

Backfill Material:

a. Unless shown otherwise on the drawings, suitable material chosen from the excavation shall be free of large lumps, or clods, which will not readily break down under compaction. Backfill material shall be free of vegetation or other extraneous material. Material will be subject to approval by the Engineer. In areas not under existing or proposed pavement, the last 6 inches of backfill shall be topsoil.
b. Select Backfill Material: When "select" backfill material is shown on the drawings, it shall be granular in nature, free of large clods, and have a plasticity index (P.I.) of less than 10.

Initial Backfill: Initial backfill is defined as that backfill from the bottom of the trench to 1 foot above the top of the pipe. The Contractor shall place initial backfill in maximum 8 inch layers (loose measure) and mechanically tamp it to at least 95% Standard Proctor Density - A.S.T.M. Specification D-698. Backfill below the top of the pipe shall be placed and compacted along the sides of the pipe equally to prevent strain on or displacement of the pipe.

Final Backfill:

a. General: Final backfill is defined as that backfill from 1 foot above the top of the pipe to finished subgrade or ground line. See the drawings for locations where final backfill is mechanically tamped or water tamped.

   All excavations shall be confined to within the easement or right-of-way provided. Should the excavation extend beyond the easement or right-of-way then said excavation shall be compacted in 6" maximum compacted lifts to at least a 95% Standard Proctor Density - A.S.T.M. Specification D-698. The 95% density requirement under streets and outside of easements is a performance specification and the Contractor may use any method to achieve the specified results.

b. Mechanically Tamped: The Contractor shall place final backfill in maximum 8 inch layers (loose measure) and mechanically tamp it to at least 95% Standard Proctor Density - A.S.T.M. Specification D - 698.

c. Water Tamped: The Contractor shall place final backfill to a level of 18 inches below the surface of the ground. Backfill will be consolidated by jetting. When jetting, selected excavated material shall be placed in layers of not more than 6 to 8 feet in depth and jetted until all settlement cases. Water jets shall be long enough to reach through the material being tamped. It is the intent of these specifications that water tamping shall continue until all cavities have been eliminated and the material is completely consolidated. After jetting is completed to the satisfaction of the Engineer, the remaining 18 inches shall be placed in two equal layers and mechanically tamped to at least 90% Standard Proctor Density - A.S.T.M. Specification D-698.

Sand Embedment: When sand embedment is required on the drawings, the material used for sand shall be "builders sand", sandy loam, or other sand material that shall contain no more than 25% clay and shall be free of rock, lumps or clods. The Engineer shall be the sole judge as to the suitability of a material for use as sand embedment. Sand embedment shall be used only when the excavated material is not suitable for use as sand embedment. If the trench bottom is in a soil that conforms to the requirements for sand embedment the 6 inches below the pipe need not be undercut.

Gravel Embedment: When gravel embedment is required on the drawings, the material used for gravel embedment shall be crushed stone, 95% passing a 3/4" sieve and 95% retained on a No. 4 sieve.

Concrete Embedment: When concrete embedment is required on the drawings, the concrete shall conform to Section 6-N "Heavyweight Aggregate Concrete". Concrete embedment shall be allowed to cure for at least 24 hours before placing initial backfill and at least 48 hours before placing final backfill unless approved otherwise by the Engineer.

Excess and Unsuitable Material: All excess and/or unsuitable excavated material shall be loaded and hauled to the disposal area shown on the drawings.

6 - B INSTALLATION OF STORM SEWER PIPE

MATERIAL:

Reinforced Concrete Pipe: See Section 6-E.

CONSTRUCTION METHODS:

Handling of Material:

a. Handling and Care: Pipe and other materials shall be unloaded at the point of delivery, hauled to and distributed at the project site by the Contractor. They shall at all times be handled with care and in conformance with the manufacturer's recommendations. Whether moved by hand, skidways of hoists, material shall not be dropped or bumped against other material or objects already on the ground.

b. Distribution at Site of Work: Material may be unloaded opposite or near the place where it is to be used in the construction, provided it is to be incorporated into the work within 10 days.

   The Contractor shall distribute the material in such a manner so as not to cause the public any undue inconvenience.

   The interior of all pipe and accessories shall be kept free from dirt and foreign matter at all times.

c. Storing Material: Any material delivered to the project site that is not to be incorporated into the work within 10 days shall be stored on suitable blocks or platforms off the ground. Stacking of material shall be done in such a manner that the material is not damaged.

Alignment and Grade:

a. General: All pipe shall be laid and maintained to the required lines and grades.

b. Deviation with Engineer's Consent: No deviation shall be made from the required line or grade except with the written consent of the Engineer.

c. Batter Boards: The Contractor shall furnish and place in position as directed by the Engineer, all the necessary batter boards for controlling the work. The batter boards shall be of such size timber as the Engineer directs and shall be substantially supported. The boards and all location stakes must be protected from damage or change of location. The Contractor shall also furnish good sound twilled lines for use in giving lines and grades, and the necessary plummets and graduated poles of a form approved by the Engineer.

Pipe Trench Excavation and Backfill: See Section 6-A.

Lowering Pipe Into Trench:

a. General: Proper implements, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and efficient execution of the work. All pipes shall be carefully lowered into the trench by means of derrick, ropes or other suitable equipment in such manner as to prevent damage. Under no circumstances shall pipe be dropped or dumped into the trench. The Contractor shall not lay any pipe in the trench until the bedding and condition of the trench has been approved by the Engineer. The trench shall be free of water and maintained in that condition until the pipe has been laid and the joints have been completed.

b. Inspection of Pipe: The pipe shall be inspected for defects prior to lowering into trench. Any defective or unsound pipe shall be replaced.

c. Pipe Kept Clean: All foreign matter or dirt shall be rmeoved from the interior of pipe before lowering into the trench. Pipe shall be kept clean by means approved by the Engineer during and after laying.

Laying Pipe: Unless otherwise authorized by the Engineer, the laying of pipe on the prepared bedding shall be started at the outlet end with the tongue end pointing downstream and shall proceed toward the inlet end with the abutting sections properly matched, true to the required lines and and grades. The pipe shall be fitted and matched so that when laid on the bed it shall form a smooth uniform conduit.

Jointing Concrete Pipe: All pipe shall be joined tight and sealed with jointing material. The ends of the pipe shall be cleaned thoroughly and primed in accordance with recommendations by manufacturer. Excess jointing material shall be trimmed from pipe interior. On all pipe 30" and larger, a come along or other mechanical device shall be used to bring pipe home. Cement mortar is prohibited for jointing pipe except at manholes, pipe junctions, etc. or where especially approved. If approved, used 1 part cement, 2 parts sand, fill joint as completely as possible.

Jointing Concrete Pipe In Sandy Soil: All storm sewer constructed in sandy soil areas shall receive a one layer wrap of 10 mil. polyethylene at each joint. The wrap shall extend two feet either side of the joint and be lapped two feet at the ends.

Connections: Where pipes are connected to headwalls or inlets, and the section of pipe making the connection cannot be set flush with the inside wall face, the pipe shall be set or cut a minimum of 3 inches short of a junction with that face and the inside pipe diameter formed to complete the intersection.

Stub ends for the connection of future storm sewer pipe not included in this Contract shall be finished by inserting a suitable plug, of a design acceptable to the Engineer, into the free end of the pipe and securing it into place to form a watertight end which may be readily removed for future connections.

MATERIAL:

Concrete: Concrete shall have a minimum compressive strength of 3000 p.s.i. at 28 days and shall be in accordance with Section 6-N Heavy-weight Aggregate Concrete.

Reinforcing Steel: Reinforcing steel shall be new billet steel conforming to A.S.T.M. Specifications A615 Grade 60. Also see Section 6-M Concrete Reinforcing Steel.

Pre-Cast Concrete Manholes: Pre-cast manhole shall conform to the same requirements as reinforced concrete pipe. See Section 6-E.

Brick: Brick shall have a minimum size of 2-1/4" x 3-3/4" x 8" and a maximum size of 2-1/2" x 4" x 8-1/2".

Concrete brick shall conform to Grade "A" A.S.T.M. Specification C-55.

Clay brick shall conform to Grade "NA" or A.S.T.M. Specification C-32.

Mortar: The mortar for the masonry shall be 1 part Portland Cement to 3 parts clean hard and sharp mortar sand and shall be free of all foreign substances or injurious alkalis. The mortar for plastering the outside of the manholes shall be the same as specified for the brick work.

Manhole Ring and Cover: Manhole rings and covers shall be the round, roadway type, with solid cover and bottom flange. They shall be grey-iron castings boldly filleted at angles and the arrises shall be sharp and perfect. The castings shall be true to pattern, form and dimensions; free from cracks, sponginess, blow holes or other pouring faults affecting their strength and value for the service intended. Surfaces of the castings shall be free from burnt-on sand and shall be reasonably smooth. Runners, risers, fins, and other cast-on pieces shall be removed from the surfaces. Provide manhole ring and cover weighing not less than 320 lb. with machined joints, and having an inside diameter of 22-1/2 inches.

Manhole Steps: Manhole steps shall be 6 inch fiber reinforced polyester steps, yellow.

Joint Material: Joint material for pre-cast concrete manholes shall be the same as set out in Section 6-E.

Material for Fiberglass Manholes: See Section 6-D.

Epoxies: Epoxies shall be two component, 100% solids, and water insensitive.

CONSTRUCTION METHODS:

Excavation and Backfill: See Section 6-F "Structural Excavation and Backfill".

General Requirements: All manhole work shall be competed and finished in a careful and workmanlike manner, special care being given to sealing the joints around all pipe that extends through the wall of the manhole After finishing of walls has been completed, the bottom of the manhole shall be completed by installing sufficient additional concrete to shape or form the bottom of the manhole to conform with the requirements as shown on the drawings. Where old manholes are to be adjusted to meet new lines and grades, all old masonry or concrete shall be thoroughly cleaned and wetted before joining any new masonry or concrete to it. All work on manholes shall be done in a good and workmanship manner and in conformity with the usual practices used on such work. All materials for adjusting old manholes shall conform to the requirements set out in this Specification for manhole work.

Pre-Cast Concrete Manholes: The Contractor shall have the option of using fiberglass, pre-cast concrete manholes or brick manholes. The inside dimensions shown for brick manhole shall be maintained. Pre-cast sections will not be used until the manhole has been built up with brick to a level at the top of the highest pipe.

Brick Manholes: The Contractor shall have the option of using either concrete brick or clay brick. All brick work for manholes shall be laid in header courses and shall have a full bed of mortar. All mortar joints shall not exceed one-half inch; all mortar to be cement mortar. All inside mortar joints shall be neatly struck.
The masonry shall be built upon level courses true to line, grade and dimensions as shown on the drawings. Bats shall be used only when necessary to close joints. all brick shall be wet down immediately before being placed. The outside of the manhole shall receive a coat of cement mortar plaster. This plaster shall be applied as the construction of the manhole progresses. The bottom of the manhole shall be carefully formed and the invert shall be smoothly finished. All pipes shall be cut to fit the inside surface of the walls.

6 - D MATERIAL FOR FIBERGLASS MANHOLES

MATERIAL:

Resins: The resins used shall be a commercial grade unsaturated polyester resin.

Reinforcing Materials: Reinforcing materials shall be a commercial grade of glass in the form of mat, continuous roving, chopped roving and/or roving fabric having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

Fillers and Additives: Fillers and additives shall meet chemical requirements defined in this Section.

FABRICATION METHODS:

Laminate: The laminate shall consist of multiple layers of glass matting and resin. The surface exposed to the wastewater shall be resin rich and shall have no exposed fibers.

Assembly Joints: Cured components may be joined to form composit.

Manway Reducer: Manway shall be concentric with respect to the larger portion of t he manhole. The reducer shall be compatible with the manhole ring and cover as specified in this Section.

DEFECTS NOT PERMITTED:

Interior Surfaces:

a. Crazing
b. Delamination
c. Exposed fibers
d. Blisters over 1/2 inch in diameter
e. Pits and voids directly under surface that can be broken by finger pressure, over 5 per square foot.
f. Wrinkles over 1/8 inch

Exterior Surfaces:

a. Delamination
b. Exposed fibers
c. Blisters over 1/2 inch in diameter
d. Sharp projections; the surface shall be relatively smooth as to allow handling of manholes without the need for gloves or special protection.

REPAIRS: Repairs shall not be permitted unless the repaired manhole meets all requirements of an undamaged manhole and its components.

PHYSICAL REQUIREMENTS:

Load Bearing Capacity: The manhole minimum load rating shall be 16,000 lb. dynamic wheel load.

Structural Performance: All manholes shall meet the structural performance tests as defined in this Sction. In any case the manhole tested must be long enough to include at least one of all unique or repetitive features and the minimum length tested must be 3 feet for each cylinder.

a. When static load of 40,000 lb. is applied according to static load test, the manhole shall not suffer damage or fail.
b. All manholes shall not, deflect downward vertically more than 6.35 mm (1/4") when measured at the point of load application.
c. The manhole cylinder shall have a minimum pipe stiffness values as listed below.

Total Length of Manhole	Minimum Pipe Stiffness (PS)
1 to 1.8 m (3 to 6 ft.)	408 Kg/m2 (.72 psi)
1.9 to 3.7 m (7 to 12 ft.)	889 Kg/m2 (1.26 psi)
3.8 to 6.1 m (13 to 20 ft.)	1417 Kg/m2 (2.01 psi)
6.2 to 7.6 m (21 to 25 ft.)	2129 Kg/m2 (3.02 psi)
7.7 to 10.7 m (26 to 35)	3649 Kg/m2 (5.24 psi)

Laminate Properties: Significant laminate properties shall be established for each laminate construction. Laminate properties shall be established, if possible, on a section taken from a manhole manufactured according to the method of fabrication selected by the manufacturer. If it is not possible to take laminates from a manhole which will meet dimensional requirements for testing, the laminate may be made independent of the method but, in any case, must be consistent in all respects with the construction of the manhole.

Cured laminate must meet the following conditions:

Property	Test Method	Requirement
(1) Glass Content (% by weight)	ASTM D 25B4-6B	20 to 70%
(2) Compressive strength	D 695-69	Minimum 12,00 psi
(3) Flexural Strength	D 790-70	Minimum 12,00 psi
(4) flexural E-Modulus	ASTM D 790-70	Minimum 700,000 psi
(5) Surface Hardness	ASTM D 25B3 - 67	Minimum 90% of Resin's Normal Value

CHEMICAL REQUIREMENTS: Testing shall be performed according to Section 2G26.8 and the log of percent property retention versus log of time data graph should be extrapolated by a linear plot beyond the 12 month results to 10 years. The extrapolated data must assure retention of at least 50% of the initial properties in all categories.

METHOD OF TESTING:

Physical: The physical tests shall be performed to evaluate compliance with requirements set forth above.

a. Static Load Test: The manhole to be tested must ve complete with cover and supporting ring installed. The specified load shall be applied eccentrically on a 15 cm x 15 cm x 1.25 cm (6" x 6" x 1/2") steel plate resting on the manhole cover. the steel loading plate shall be located so that the center of the plate is within 10 cm (4") from the edge of the cover. Loading shall be done in 909 Kg (2000 lbs) increments with close inspection between increases. The specified load shall be maintained for not less than 15 minutes. Interior constraint may be used at the bottom, as required to maintain round shape during testing.
b. Deflection Test: The manhole shall be supported and loaded according to procedure set in this Section. When the applied load is 24,000 lb. the length that the manhole cover deflects vertically downward from its preloaded position shallbe recorded.
   The recorded value is defined as the deflection.
c. Stiffness Test: The circular cylindrical portion of the manhole shall have the minimum pipe stiffness values as listed below when tested according to ASTM D2412 (Parallel Plate Test).

d. Barcol Hardness Test: Equipment used shall be according to ASTM D2583, Standard Method of Testing for Identation Hardness of Plastics by means of a BarcolImpressor. The frequency of checks shall not be less than 3 random points per component part. The minimum acceptable value of cure shall not be less than 90% of the resin manufacturer's minimum value for the cured resin.

e. Composition Test: Conducted per ASTM D2584. For laminates with fillers and/or additives, the residue must be separated into its components (i.e. glass, sand, etc.) in order to determine the glass content.

f. Compressive Strength: Conducted per ASTM D695 (Note 1).

g. Flexural Strength and Modulus: Conducted per ASTM D790 (Note 1).

Note 1 - Strength property test methods require flat laminates consistent with the method of fabrication selected for the manhole. The frequency of check shall be at least once per five manholes.

h. Dimensions:

(1) Dimensions other than thickness shall be measured with a steel tap with graduations of 3 mm (1/8") or less.

(2) Thickness: Measure to the nearest percent 0.25 mm (0.01") with a micrometer, caliper, guage or other suitable instrument. A minimum of one thickness reading per 3 m2 (33.4 ft. 2) of laminate surface in areas of constant thickness shall be made. Through regions of wall taper, sufficient checks must be made to establish actual thickness. The test shall be run at least once per ten manholes.

Chemical Resistence: Testing procedures for measuring chemical resistence shall conform to STM C581. The percent retention of each property after immersion testing (versus the initial value) is to be plotted against the log of the immersion time.

CERTIFICATION: The manufacturer of fiberglass manhole shall certify that the manholes meet all physical an chemical requirements as listed in this Section. Certification shall be submitted to engineer in writing.

QUALITY CONTROL: Physical tests of manhole strength shall be conducted in accordance with this Sections. Each test shall be conducted at least once per shipment of manholes. Test of physical properties of laminate as specified in this specification shall be done on at least one of every 50 manholes. Results of testing shall be submitted in writing to engineer.

MARKING AND IDENTIFICATION: All manholes shall be marked on the inside. These markings shall be permanent and include:

(1) Manufacturer Identification (name)

(2) Manufacturing Serial No. (Number to appear in report for identification).

MATERIAL:

General: The Contractor shall furnish concrete pipe that conforms to A.S.T.M. Specification C-76. All pipe shall be Class III Wall B unless specifically shown otherwise. All pipe shall be machine-made by a process which will provide for uniform placement of the concrete in the for and compaction by mechanical devices which will assure a dense concrete.

Pipe must have met its 28 day strength requirement prior to being delivered to the job site.

Pipe shall be the standard sizes. The internal diameter of 12 inch to 24 inch pipe shall not vary more than ± 1.5 percent from the nominal diameter. The wall thickness shall not be less than that shown in the design by more than 5 percent of 3/16 inch, whichever is the greater. A wall thickness in excess of that required by the design shall not be cause for rejection.

Marking: Each section of pipe shall be clearly marked to indicate the class of pipe, date of manufacture and the name or mark of manufacturer.

Rejection of Pipe: All rejected pipe shall be plainly marked by the Engineer and shall be rpelaced by the Contractor with pipe which meets the requirements of these specifications. Such rejected pipe shall be removed immediately from the site of work. Pipe shall be subject to rejection on account of failure to conform to any of the specification requirements. Individual sections of pipe may be rejected because of any of the following:

a. Fractures or cracks passing through the shell, except for a single end crack that does not exceed the depth of the joint.
b. Defects that indicate imperfect proportioning, mixing and molding.
c. Surface defects indicating honeycombed or open texture.
d. Damaged ends, where such damage would prevent making a satisfactory joint (broken or badly cracked tongue or groove)
e. Careless dumping of pipe from truck. The Engineer shall be judge of aforesaid items.

Repairs: Pipe may be repaired if necessary, because of occasional imperfections in manufacture or accidental injury during handling and will be acceptable if, in the opinion of the Engineer, the repairs are sound and properly finished and cured and the repaired pipe conforms to the requirements of these specifications.

Jointing Material: The Contractor shall furnish a single gasket of preformed plastic. Gasket shall meet all requirements of Federal Specification SS-S-210A, "Sealing Compound, Preformed Plastic for Pipe Joints", Type I, rope-form and shall meet the following requirements:

a. Adhesion and Hydrostatic Pressure: The sealing compound shall not leak at the joints (while being tested at 10 psi) for a period of 24 hours.
b. Sag or Flow Resistance: (Vertical and overhead 1" wide joints.) No sagging shall be detected (while being tested at 135°F) for a period of 5 days.
c. Chemical Resistance: No visible deterioration of the sealing compound (when immersed separately in solution of acid alkalies and saturated hydrogen sulfide) for a period of 30 days.

The sealing compound shall be produced from blends of refined hyrdrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, irritating fumes or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive

strength. It shall be supplied in extruded rope-form of suitable cross-section and of such sizes as to seal the joint space whenthe pipes are laid. The sealing compound 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 to facilitate the application of the sealing compound. The flexible plastic gasket shall also meet the requirements as stated in the following table.

COMPOSITION	TEST	METHOD	MIN.	MAX.
Bitumen (Petroleum Plastic Content)	ASTM	D 4	50	70
Ash-Inert Mineral Matter	AASHO	T 111	30	50
Volatile Matter	ASTM	D 6	-	2.0
PROPERTY				
Specific Gravity @ 77°F	ASTM	D 71	1.20	1.30
*Ductility @ 77°F (cm)	ASTM	D 113	5.0	-
*Softening Point	ASTM	D 36	320°F	-
*Penetration 77°F (150 GMS) 5 sec	ASTM	D 217	50	120

*Due to the nature of the material, each sample to be tested must be manually kneaded, inlieu of heating and pouring, into various molds suggested by ASTM Standards to reduce the void content and improve testing accuracy and reproducibility.

Joint material shall be supplied for use on pipe in the following sizes which is the minimum that will be required.

Pipe Size	Primer Per 100 Joints	Cut Lengths Per Joint
12"	1.5 Gals.	1-1/2 pcs. 1" x 2'5"
15"	1.9 Gals.	2 pcs. 1" x 2'5"
18"	2.7 Gals.	1-1/2 pcs. 1-1/2" x 3'5"
21"	3.8 Gals.	2 pcs. 1-1/2" x 3'5"
24"	6.2 Gals.	2 pcs. 1-1/2" x 3'5"
30"	8.5 Gals.	2-1/2 pcs. 1-1/2" x 3'5"
36"	9.5 Gals.	3 pcs. 1-3/4" x 3'5"
42"	12.0 Gals	3-1/2 pcs. 1-3/4" x 3'5"
48"	15.0 Gals	4 pcs. 1-3/4" x 3'5"
54"	20.0 Gals	4-1/2 pcs. 1-3/4" x 3'5"
60"	25.0 Gals	5 pcs. 1-3/4" x 3'5"

6 - F STRUCTURAL EXCAVATION AND BACKFILL

SCOPE: This specification shall govern for all work necessary to accomplish the structural excavation for all structures required to complete the project.

MATERIAL: Structural excavation shall include all material encountered including earth, asphalt, base material, concrete, masonry, rock, trees, stumps, and roots.

CONSTRUCTION METHODS:

General: The limit of excavation shall be such to allow for placing and removing forms, installing sheeting, shoring, bracing, etc. The Contractor shall pile excavated material in a manner that will not endanger the work and will avoid obstructing sidewalks and driveways. Gutters shall be kept clear.

Vertical Sides: When necessary to protect existing or proposed structures or other improvements, the Contractor shall maintain vertical sides of the excavation. The limit shall not exceed three feet outside the footing on a vertical plane parallel to the footing except where specifically approved otherwise by the Engineer. The Contractor shall provide and install any sheeting, shoring and bracing as necessary to provide a safe work area as required to protect workmen, structures, equipment, trees, etc. The Contractor shall be responsible for the design and adequacy of all sheeting, shoring, and bracing. The sheeting, shoring, and bracing shall be removed as the excavation is backfilled in such a manner as to prevent injurious caving.

Sloping Sides: Where sufficient space is available, the Contractor shall be allowed to back slope the sides of the excavation. The back slope shall be such that the excavation shall be safe from caving. The type of material being excavated shall govern the back slope used. The Contractor shall be responsible for determining the back slope used, but in any case the back slope shall be no steeper than 1 foot horizontal to 1 foot vertical.

Dewatering: The Contractor shall keep the excavation free from water by use of cofferdams, bailing, pumping, well point, or any combination as the particular situation may warrant. All dewatering devices shall be installed in such a manner as to provide clearance for construction, removal of forms, and inspection of exterior of form work. It is the intent of these specifications that the foundation be placed on a firm dry bed. The foundation bed shall be kept in a dewatered condition a sufficient period of time to insure the safety of the structure, but in no case shall dewatering be terminated sooner than 7 days after placing concrete. All dewatering methods and procedures are subject to the approval of the Engineer. The excavation shall be protected from excessive rainfall and drying. The excavation shall be inspected and approved by the Engineer before work on the structure is started. It is the intent of these specifications that the Contractor provide a relatively smooth, firm foundation bed for footings and slabs that bear directly on the undisturbed earth without additional cost to the Owner, regardless of the soil conditions encountered. The Engineer will be the judge as to whether these conditions have been met. The Contractor shall pile excavated material in a manner that will not endanger the work.

Unauthorized Overexcavation: Excavation for slabs, footings, etc., that bear on earth shall not be carried below the elevation shown on the drawings. In the event the excavation is carried on below the indicated elevation, the Contractor shall bring the slab, footing, etc., to the required grade by filling with concrete having a minimum compressive strength of at least 300 p.s.i. at 28 days (See Section 3C1).

Backfill Material: Unless shown otherwise on the drawings, suitable material chosen from the excavation shall be used for backfill. The material chosen shall be free of large lumps or clods, which will not readily break down under compaction. This material will be subject to approval by the Engineer. Backfill material shall be free of vegetation or other extraneous material. Excavated materials which are to be used for fill or backfill may be stockpiled on the site. Location of stockpiles shall be approved by the Engineer. Top soil should be stockpiled separately and used for finish grading around structure.

Schedule of Backfilling: The Contractor shall begin backfilling of concrete structures no sooner than 7 days but no later than 14 days, after they are cast. The Contractor shall backfill brick and mortar structures after they have been in place at least 3 days.

Backfill: Backfill shall be placed in layers of not more than 9 inches (loose measure) and mechanically tamped to at least 85% Standard Proctor Density - A.S.T.M. Specification D-698. Flooding will not be permitted. Backfill shall be placed in such a manner as to prevent any wedging action against the structure.

Excess and Unsuitable Material: All excess and/or unsuitable excavated material shall be loaded and hauled by the Contractor to the disposal area shown on the drawings.

6 - G CONCRETE INLETS

SCOPE: This specification shall govern for all work necessary to construct all concrete inlets required to complete the project.

MATERIAL:

Concrete: Concrete shall have a minimum compressive strength of 3000 p.s.i. at 28 days and shall be in accordance with Section 6-N Heavyweight Aggregate Concrete.

Reinforcing Steel: Reinforcing steel shall be new billet steel conforming to A.S.T.M. Specification A615 Grade 40. Also see Section 6-M Concrete Reinforcement.

Manhole Ring and Cover: Manhole rings and covers shall be the round sidewalk type with solid cover. They shall be grey-iron castings boldly filleted at angles and the arrises shall be sharp and perfect. The castings shall be true to pattern, form and dimensions; free from cracks, sponginess, blow holes or other pouring faults affecting their strength and value for the service intended. Surfaces of the castings shall be free from burnt-on sand and shall be reasonably smooth. Runners, risers, fins and other cast-on pieces shall be removed from the surfaces. Provide manhole ring and cover weighting not less than 175 lbs. and having an inside diameter of 22 inches.

CONSTRUCTION METHODS:

Excavation and Backfill: SEE Section 6-F "Structural Excavation and Backfill".

General Construction Methods: All items shall be installed as the work progresses to such points as where these installations shall be completed and finished in a careful and workmanlike manner, special care being given to sealing the joints around all pipe that extends through the wall of the inlet shall be completed by installing sufficient additional concrete as to shape or form the bottom of the inlet to conform with the requirements as shown on the inlet details shown on the drawings. Where existing inlets are to be adjusted to new lines and grades, the surface of such inlet which will be in contact with new construcion shall be thoroughly cleaned and coated with an epoxy bonding agent before new concrete is placed. Requirements for materials and construction, as herein specified, shall govern for adjusting or rebuilding existing inlets. The new portion of adjusted inlets shall conform to the dimensions as shown on the inlet details shown on the drawings, as nearly as possible.

Concrete Construction: SEE Section 6-L "Concrete Form Work" and 6-O "Concrete Structures".

6 - H SOIL-CEMENT BASE COURSE (PORTLAND CEMENT)

MATERIAL:

Portland Cement: Portland cement shall comply with the latest specifications for portland cement (ASTM C150, Type 1, CSA Standard A5, or AASHTO M85) or blended hydraulic cements (ASTM C595 or AASHTO M240, excluding slag cement Types S and SA) for the type specified.

Water: Water shall be free from substances deleterious to the hardening of the soil-cement.

Soil Material: Soil material shall consist of the material existing in the area to be paved, or approved borrow material, or a combination of these materials proportioned as directed.

Soil Cement Mixture: Both the soil and cement shall be of such quality that when properly proportioned and mixed, a satisfactory base material will be produced. The soil and cement shall be properly proportioned such that the finished base materials contain 11% cement by weight to be varied in the field as the situation dictates and as directed by the Engineer.

EQUIPMENT: Soil-cement may be constructed with any combination of machines or equipment that will produce the results meeting these specifications.

CONSTRUCTION METHODS:

General: The primary requirement of this specification is to secure a complete course of soil containing a uniform portland cement mixture, free from loose or segregated areas, of uniform density and moisture content, well bound and compacted for its full depth with a smooth surface suitable for placing surface courses.

Preparation: Before other construction operations are begun, the area to be paved shall be graded and shaped as required to construct the soil-cement in conformance with grades, lines, thicknesses, and typical cross section shown on the plans. Unsuitable soil material shall be removed and replaced with acceptable material.

The subgrade shall be firm and able to support without displacement the construction equipment and the compaction hereinafter specified. Soft or yielding subgrade shall be stabilized before construction proceeds.

Pulverization: Before cement is applied the soil material shall be so pulverized that at the completion of moist-mixing, 100% by dry wright passes a 1-in. sieve, and a minimum of 80% passes a No. 4 sieve, exclusive of gravel or stone retained of these sieves.

The Contractor shall insure that existing base material is uniformly distributed in the cement soil base and that all excavation of excess material shall be from the sub-base.

Cement Application, Mixing and Spreading: Mixing of the soil material, cement and water shall be accomplished by either the mixed-in-place or the central-plant-mixed method.

No cement or soil-cement mixture shall be spread when the soil or subgrade is frozen or when the air temperature is less than 40°F in the shade. The percent of moisture in the soil material, at the time of cement application, shall be the amount that assures a uniform and intimate mixture of soil material and cement during mixing operations. It shall not exceed the specified optimum moisture content for the soil-cement mixture. The operations of cement application, water application, mixing, hauling, spreading, compacting, and finishing shall be continuous and

completed in daylight. The total elapsed time between the addition of water to the soil-cement mixture and the completion of finishing shall not exceed four hours.
Any soil-and-cement mixture that has not been compacted and finished shall not remain undisturbed for more than 30 minutes.

a. Central-Plant-Mixed Method: The soil material, cement, and water shall be mixed at an approved central mixing plant by either continuous-flow or batch-type mixers using revolving blades, or rotary-drum mixers.
   The plant shall be equipped with feeding and metering devices that will add the soil material, cement, and water into the mixer sufficiently to prevent cement balls from forming when water is added.
   The mixing time shall be that which is required to secure an intimate, uniform mixture of soil material, cement, and water.
   Free access to the plant shall be provided to the engineer at all times for inspection of the plant's operation and for sampling of the soil-cement mixture and its components.
   The mixture shall be hauled to the paving area in trucks or other equipment having clean beds. The Contractor shall protect the soil-cement mixture whenever it is transported during unfavorable weather.
   Haul time should not exceed 30 minutes.
b. Mixed-In-Place Method: Soil material to be mixed with cement and water in a traveling pugmill mixer shall be formed into windrows soil material shall be flattened or slightly trenched to receive the cement.
   The quantity of cement specified shall be spread uniformly on the area to be paved or on the top of the windrowed material. Spread cement that has been displaced shall be replaced before mixing is started.
   After the cement is spread it shall be mixed with the soil material and water with a traveling pugmill, single or multiple transverse shaft mixer.
   The water may be applied through the mixing machine or separately by approved pressure-distributing equipment. The soil material and cement shall be mixed sufficiently to prevent cement balls from forming when water is added. Mixing shall be continued until the mixture is uniform in color and at the required moisture content throughout.
   Operations of cement spreading, water application, mixing, and spreading mixed material from a windrow, if required, shall result in a uniform soil, cement, and water mixture for the full depth.

Unsatisfactory Methods: When using either method above, any of the operation after the initial application of water to the soil-cement mixture is interrupted for more than thirty (30) minutes for any reason, or when the uncompacted soil-cement mixture is wetted by rain so that the average moisture content exceeds the tolerance given below at the time of final compaction, the entire section shall be reconstructed in accordance with this specification at the contractor's own expense. All material along longitudinal or transverse construction joints, not properly compacted, shall be removed and replaced with properly moistened and mixed soil-cement which shall be compacted to specified density.

Compaction: At the start of compaction, the percentage of moisture in the mixture and in unpulverized soil lumps shall not be below or more than two percentage points above the specified optimum moisture content, and shall be less than that quantity which will cause the soil-cement mixture to become unstable during compaction and finishing. The specified optimum moisture content and density shall be determined in the field by a moisture-density test, AASHTO T134 or ASTM D558, on representative samples of soil-cement mixture obtained from the area being processed at the time compaction begins.

Prior to compaction, the mixture shall be in a loose condition for its full depth. the loose mixtures shall then be compacted uniformly to the specified density. During compaction operations, initital shaping may be required to obtain uniform compaction and required grade and cross section.

All places inaccessible to rollers and/or finishing equipment, the mixture shall be thoroughly compacted by hand tamping and shaped and finished by hand methods.

At the end of the day, or in case of unavoidable interruption of operations that would form a joint in the base course, a transverse header shall be placed in such manner that the end of the base course can be satisfactorily compacted and shaped. On resuming operations, the header shall be removed and if the exposed edge of the base course is not approximately vertical, or if necessary to secure a satisfactory riding surface at the joint, the edge of the base course shall be cut back to leave a vertical face or as necessary to secure a satisfactory riding surface. All base course material removed shall be replaced by the Contractor at his own expense.

Finishing: When initial compaction is nearing completion, the surface of the soil-cement shall be shaped to the required lines, grades, and cross section. The moisture content of the surface material shall be maintained at not less than its specified optimum moisture content during finishing operations.

If necessary, the surface shall be lightly scarified to remove any tire imprints or smooth surfaces left by equipment. Compaction shall then be continued until uniform and adequate density is obtained. Rolling shall be supplemented by broom-dragging if required.

The soil cement shall be uniformly compacted to a minimum of 96% of maximum density.

Compaction and finishing shall be done in such a manner as to produce, in not longer than 2 hours, a smooth, dense surface free of compaction planes, cracks, ridges or loose material.

Curing, Protection and Cover: After the base course has been finished as specified herein, it shall be immediately protected against rapid drying by applying MC-1 or MC-70 asphaltic material at the rate of 0.20 gallons per square yard, or as necessary, in the opinion of the Engineer, to completely seal the surface and fill all voids. Immediately prior to application of the asphaltic material, the base course shall be wetted, by the use of water distributors, so that all voids in the soil-cement mixture are filled with water but without free water standing on the surface. The asphaltic material shall be applied while the surface of the soil-cement base is wet so that undue asphaltic penetration will be avoided.

It shall be the responsibility of the contractor to protect this asphaltic curing coat against picking up under traffic by sanding the surface. The bituminous curing coat shall remain in place for the proposed additional asphalt surface treatment, unless otherwise directed by the Engineer. Any finished portion of the soil-cement base adjacent to construction, which is traveled by equipment used in constructing an adjoining section, shall be covered with at least six (6) inches of earth to prevent equipment from marring the surface of the competed work.

Weather Limitations: During seasons of probably freezing temperatures, no cement shall be applied unless the temperature is at least forty (40) degrees Fahrenheit in the shade and rising. It is understood that the contractor is responsible for the quality of the finished base course under any other weather condition.

Maintenance: The contractor shall be required to maintain at his own expense the entire pavement area within the limits of his contract in good condition satisfactory to the Engineer from the time he first starts work until all work shall have been completed. Maintenance shall include immediate repairs of any defect that may occur in the base course after the cement has been applied, which work shall be done by the

contractor at his own expense and repeated as often as may be necessary to keep the area continuously intact. Repairs are to be made in a manner to insure restoration of a uniform surface and durability of the part repaired. Faulty work shall be replaced for the full depth of treatment. Any low area shall be remedied by replacing the material for the full depth of treatment, rather than adding a thin layer of soil-cement on the completed work.

6 - I HOT PLANT MIXED ASPHALT STABILIZED BASE
(Black Base)

MATERIALS:

Asphaltic Material:

a. Mixture: Asphalt for the mixture shall be Ac-10 asphalt cement and shall conform to Item 300 "Asphalt, Oil and Emulsions" of the Standard Specifications for Construction of Highways, Streets and Bridges, 1972 Edition; of the Texas Department of Highways and Public Transportation. The Contractor shall notify the Engineer of the source of his asphaltic material prior to design or production of the asphaltic mixture and this source shall not be changed during the course of the project except on written permission of the Engineer.

b. Tack Coat: The asphaltic material for tack coat shall meet the requirements for emulsified asphalt EA-11M, cut-back asphalt RC-2, or shall be cut-back asphalt made by combining 50 to 70 percent by volume of Ac-10 with 30 to 50 percent by volume of gasoline and/or kerosene. If RC-2 cut-back asphalt is used, it may, upon instructions from the Engineer, be diluted by the addition of an approved grade of gasoline and/or kerosene, not to exceed 15 percent by volume. Asphaltic materials shall meet the requirements of the aforementioned Item 300.

Mineral Aggregate:

a. General: The material shall be crushed or uncrushed and screened as necessary to meet the requirements hereinafter specified and shall consist of durable coarse aggregate particles mixed with approved binding materials.

b. Gradation:

Sieve Size	Percent by Weight Retained
2"	0
1-3/4"	0-5
No. 4	45-75
No. 40	60-85

c. Physical Requirements:

Wet Ball Mill . . . . . 50 Maximum
P.I. . . . . 15 Maximum
L.L. . . . . 55 Maximum

Sand equivalent value shall not be less than: 40

d. Testing of Mineral Aggregate:
Testing of the mineral aggregate shall be in accordance with the following Texas Department of Highways and Public Transportation Standard Laboratory Test procedures:

Preparation of Soil Constants and Sieve Analysis TEX-101-E
Liquid Limit. TEX-104-E
Plastic Limit TEX-105-E
Plasticity Index TEX-106-E
Sieve Analysis. TEX-110-E
Wet Ball Mill TEX-116-E
Sand Equivalent TEX-203-E

Samples for testing the material shall be taken prior to the mixing operations. Where more than one material is used, tests will be on the combined material.

e. Material Sources:

The material shall be obtained from sources secured by the Contractor and approved by the Engineer. Should the Contractor elect to produce the specified material from local pits, the material shall be secured from the available sources or approved by the Engineer. The material shall be crushed or uncrushed and screened as necessary to meet the requirements hereinafter specified and shall consist of durable particles of stone mixed with approved binding materials. These pits as utilized shall be opened up in such manner as to immediately expose the vertical faces of all the various strata of acceptable material and, the material shall be secured in successive vertical cuts extending through all of the exposed strata in order that a uniformly mixed material will be secured.

One or more types of material aggregate or binder may be used to produce the specified mixture.

MIXTURE:

General: The mixture shall consist of a uniform mixture of coarse aggregate, soil binder and asphaltic material.

Soil Binder: Soil binder shall form from 15% to 40% of the mixture by weight.

Asphaltic Material: The asphaltic material shall form from 4.0% to 9.0% of the mixture by weight.

Stability: The laboratory stability of the mixture (with the plus 7/8" material removed) shall be not less than 35%.

Tolerances: A reputable testing laboratory shall be retained to designate the exact grading of the aggregate and asphalt content, within the above limits, to be used in the mixture. The paving mixture produced should not vary from the designated grading and asphalt content by more than the tolerances allowed herein; however, the mixture produced shall conform to the limitations for master grading specified above.

a. Grading: Plus or Minus 10%
b. Asphalt: Plus or Minus 0.5%

Should the paving mixture produced vary from the designated grading and asphalt content by more than the above tolerances, proper changes are to be made until it is within these tolerances.

Extraction Test:

Samples of the mixture when tested in accordance with Test Method Tex-210-F shall not vary from the grading proportions of the aggregate and the asphalt content designated, by more than the respective tolerances specified above and shall be within the limits specified for master grading.

Sampling and Testing:

It is the intent of this specification to produce a mixture which when designed and tested in accordance with these specifications and methods outlined in the THD Bulletin C-14, will have the following laboratory density and stability.

Density (Percent)	Stability (Percent)	
Minimum	Maximum	Optimum
95	99	97

Stability and density are control tests. If the laboratory stability and/or density of the mixture produced has a value lower than that specified, and in the opinion of the Engineer is not due to change in source of quality of materials, production may proceed, and the mix shall be changed until the laboratory stability and density falls within the specified limits and as near the optimum value as is practicable. If there is, in the opinion of the Engineer, a fundamental change in any material from that used in the design mixtures, production will be discontinued until a new design mixture is determined by trial mixes. It is the intent of this specification that the mixture will be designed to produce a mixture of optimum density.

EQUIPMENT:

Mixing Plants: Mixing plants that will not continuously produce a mixture meeting all of the requirements of this specification will be condemned.

Mixing plants may be either the weight-batching type or the continuous mixing type. Both types of plants shall be equipped with satisfactory conveyors; power units; aggregate handling equipment; hot aggregate screens and bins; dust collectors; and shall be equipped with automatic proportioning and recording devices. Mixing plants shall conform to Item 292.4 "Equipment" of the Standard Specifications for Construction of Highways, Streets and Bridges, 1972 Edition; of the Texas Department of Highways and Public Transportation.

Paving Equipment:

a. Spreading and Finishing Machine: The spreading and finishing machine shall be of the screeding and troweling type or of a type approved by the Engineer and shall be capable of producing a surface that will meet the requirements of the typical cross-section and the surfact test.
b. Maintainer: The maintainer, if used, shall be a self-propelled power maintainer; it shall be equipped with pneumatic-tired wheels; shall have a blade length of not less than 12 feet; shall have a wheel base of not less than 16 feet; and shall be tight and in good operating condition and approved by the Engineer.
c. Pneumatic-Tired Roler: The pneumatic-tired roller shall consist of not less than 9 pneumatic-tired wheels, running on axles in such manner that the rear group of tires will not follow in the tracks of the forward group, and mounted in a rigid frame and provided with a loading platform or body suitable for ballast loading. The wheel base of the roller (the distance between the front and rear axles) shall not be less than 5 feet nor more than 10 feet. The front axle shall be attached to the frame in such manner that the roller may be turned within a minimum circle. The pneumatic-tired roller, under working conditions, shall have an effective rolling width of approximately 60 inches and shall be so designed that by ballast loading, the load may be varied uniformly from 100 pounds to 325 pounds per inch of width of tire tread. The pressure in the tires and the compression to be provided at any time shall be as directed by the Engineer. The roller, under working conditions, shall provide a uniform compression under all wheels. The total combined width of effective tire tread shall be not less than 85 percent of the effective rolling width. The pneumatic-tired roller shall be drawn either by a suitable pneumatic-tired tractor or a truck of adequate tractive efforts.
d. Tandem Roller: This roller shall be an acceptable power-driven tandem roller weighing not less than 8 tons.
e. Three-Wheel Roller: This roller shall be an acceptable power-driven three-wheel roller weighing not less than 10 tons.
f. Straight Edges and Templates: The Contractor shall provide acceptable 16 foot straight edge for surface testing. Satisfactory templates shall be provided as required by the Engineer.

STOCKPILING, STORAGE, PROPORTIONING AND MIXING: Stockpiling, storage, proportioning and mixing shall conform to the requirements of Item 292.5, 1972 Edition; of the Texas Department of Highways and Public Transportation.

CONSTRUCTION METHODS:

General: The asphaltic mixture or tack coat shall be placed only when the weather conditions, in the opinion of the Engineer, are suitable. The mixture shall not be placed when the air temperature is below 45°F.

Tack Coat: Tack coat will be applied as directed by the Engineer, but in no case shall it be applied in excess of 0.05 gal./s.y.

Before the asphaltic mixture is laid, the surface upon which it is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer. All contact surfaces of curbs and structures and all joints shall be painted with a thin uniform coat of tack coat material.

Transporting Asphaltic Concrete: The asphaltic mixture, prepared as specified above, shall be hauled to the work 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 shall have received its initial rolling in daylight. The inside of the truck body may be given a light coating of oil, if necessary, to prevent mixture from adhering to body.

Placing:

a. General: The asphaltic mixture shall be dumped and spread on the approved prepared surface with the specified spreading and finishing machine in such a manner that when properly compacted, the finished base course will be smooth, of uniform density and will meet the requirements of the typical cross-section and the surface tests. The sequence of compacting shall be such that undue displacement of the edge of the course does not occur. On deep lifts, the edge of the course may be rolled with a motor grader wheel or similar equipment.

b. Small Areas: 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 provided a satisfactory surface can be obtained by other approved methods.

Compacting:

a. General: The asphalt stabilized base shall be compressed thoroughly and uniformly with the specified rollers. In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Engineer, operate other compacting equipment that will produce equivalent relative compaction as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction as would be expected of the specified equipment, as determined by the Engineer, its use shall be discontinued. When directed by the Engineer, the initial compaction shall be accomplished with the pneumatic tire roller.

b. Rolling with the three wheel and tandem rollers shall be done longitudinally, overlapping on successive trips by at least half the width of the rear wheel unless otherwise directed by the Engineer. Alternate trips of the roller shall be slightly different in length. On superelevatd curves, rolling shall begin at the low side and progress toward the high side unless otherwise directed by the Engineer. Rolling with the pneumatic-tired roller shall be done as directed by the Engineer. Rolling shall be continued until no further compression can be obtained (or the required compaction is obtained) and all roller marks are

eliminated. One tandem roller, one pneumatic-tired roller and at least one 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 rollers; but three rollers shall be in use on each job. Additional rollers shall be provided if needed. The motion of the rollers 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 fresh mixture where required. The roller shall not be allowed to stand on any portion of the mixture which has not been fully compacted. To prevent adhesion of the mixture to the roller unless otherwise directed by the Engineer, the roller 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 roadway, either when the rollers are in operation or when standing.

c. Hand Tamping: In locations not accessible to the roller or in locations where thorough compaction cannot be obtained with the roller, compaction shall be accomplished by the use of lightly oiled lamps.

In Place Density: It is the intent of this specification that the material be placed and compacted to 96% of the laboratory density.

TESTING:

General: This paragraph sets out a list of tests that may be required.

Mix Design: A mix design shall be prepared for the asphalt stabilized base used on this project. This design shall be prepared by a reputable testing laboratory. The mix design does not have to be prepared specifically for this project but must apply to the materials being furnished and meet the requirements of these specifications.

Mix Control: A reputable testing laboratory shall control the proportioning and mixing of materials used in the asphalt stabilized base to assure the mix design is being followed.

Extraction Tests: A reputable testing laboratory shall take samples of the mixture during construction. These samples when tested in accordance with Texas Highway Department Test Method Tex-210-F shall not vary from the grading proportions of the aggregate and the asphalt content of the approved mix design.

Stability and Laboratory Density Tests: A reputable testing laboratory shall take samples of the mixture during construction. These samples when tested in accordance with THD Bulletin C-14 will have the required stability and laboratory density.

Field Density: A reputable testing laboratory shall be retained to determine the in place density of the asphalt stabilized base. The method used to determine the place density is subject to the approval of the Engineer.

Thickness Tests: The thickness of the compacted base course shall be determined by depth cores taken at intervals in such a manner that each test shall represent no more than 1000 square yards. When the wearing surface deficiency averages more than 1/4 inch but less than 3/4 inch the payment per square yard will be reduced proportionately. When the wearing surface deficiency averages 3/4 inch or more the Contractor shall overlay the entire surface with at least 1/2 inch of additional asphaltic concrete as required to meet the required thickness. The Contractor shall neatly repair all areas where thickness cores were taken. These thickness tests shall be made by the Contractor under the supervision of the Engineer.

Surface Tests: The surface of the pavement, after compression, and when smooth and true to the established line, grade and cross-section; and when tested with a 16' straight-edge placed parallel to the center of the roadway, it shall have no deviation in excess of 1/8" per foot from the nearest point of contact. The maximum ordinate measured from the face of the straight-edge shall not exceed 1/2" at any point. Any point in the surface not meeting these requirements shall be immediately corrected. These surface tests shall be made by the Contractor under the supervision of the Engineer.

6 - J PRIME COAT

MATERIAL: Asphaltic material shall conform to the requirements as set out in the Section entitled "Liquid Asphalt and Oils". If the type of asphaltic material is not shown on the drawings use MC-30 or MC-70.

APPLICATION RATE: When application rates are not shown on the drawings apply asphaltic material at the rate of 0.15 Gal. per square yard.

CONSTRUCTION METHODS: The Engineer shall approve the previously prepared base before prime coat is applied. The surface to be primed shall be cleaned by sweeping or other approved methods. The asphalt shall be applied uniformly at the specified rate or as modified by the Engineer. Material shall be applied using an approved type of self-propelled pressure distributor. Any "holidays shall be covered using a hand spray. Asphaltic material shall be heated and applied at a temperature between 125°F to 175°F. Attention is called to the fact that asphaltic materials are very inflamable. The Contractor shall be responsible for any fires or accidents which may result from heating the asphaltic material. Asphaltic material shall not be applied when air temperature is below 40°F.

The Contractor shall be responsible for the maintenance of primed surface until the work is accepted by the Engineer just prior to the application of the next course.

GENERAL: This specification shall govern for furnishing the following type of Hot Mix-Hot Laid Asphaltic Concrete.

Fine Graded Surface Course:

a. Standard:
   (1) Type "D-42"
   (2) Stability" 42% minimum
b. Special: (Use only when specifically allowed)
   (1) Type "D-37"
   (2) Stability: 37% minimum

Leveling Up Course:

a. Leveling Up Course - 2" thick or less
   (1) Type" "D-37"
   (2) Stability: 37% minimum
b. Leveling Up Course - Over 2" Thick
   (1) Type: "Black Base" as specified in section 2H4
   (2) Stability: 35% minimum

MATERIALS:

Mineral Aggregate: The mineral aggregate shall be composed of a coarse aggregate, a fine aggregate, and if required, a mineral filler. Combined mineral aggregate, after final processing by the mixing plant and prior to addition of asphalt and mineral filler, shall have a sand equivalent value of not less than 45, when tested in accordance with Test Method Tex-203-F. Mineral aggregate from each source will meet the quality tests specified hereafter.

a. Coarse Aggregate: Coarse aggregate shall be that part of the aggregate retained on the No. 1 sieve; shall consist of clean, tough, durable fragments of stone, crushed gravel, gravel crushed limestone rock asphalt or combination thereof meeting the requirements of this specification. When Type D-37 asphaltic concrete is allowed by the drawings coarse aggregate may include pea gravel provided all other requirements of this specification are complied with.
   When the coarse aggregate is tested in accordance with Test Method Tex-217-F, Part I and Part II; the amount of organic matter, clay, loam or particles coated therewith or other undesirable materials shall not exceed 2% and when the remaining part of the sample is further tested in accordance with Test Method Tex-217-F, Part II; the amount of material removed shall not exceed 1%.
   When it is required that coarse aggregate be sampled during delivery to the plant, from the stockpile, or from the cold bin, the material removed, when tested in accordance Test Method Tex-217-F Part II shall not exceed 2%.
   The coarse aggregate (each coarse aggregate when a combination of materials is used) shall have an abrasion of not more than 40% loss by weight when subjected to the Los Angeles Abrasion Test, Test Method Tex-410-A.
b. Fine Aggregate: The fine aggregate shall be that part of the aggregate passing the No. 10 sieve and shall consist of sand and/or screenings. When Type D-37 asphaltic concrete is allowed by the drawings sandstone screenings may be used provided all other requirements of this specification are complied with.
   Fine aggregate shall consist of durable particles, free from injurious foreign matter. Except where specifically allowed otherwise, screenings shall be of the same or similar material as specified for coarse aggregate. The plasticity index

of that part of the fine aggregate passing the No. 40 sieve shall be not more than 6 when tested in accordance with Test Method Tex-106-E. Fine aggregate from each source shall meet plasticity requirements.

Where limestone rock asphalt screenings are specified for use, they shall be screenings resulting from a crushing operation.

c. Mineral Filler: Mineral filler shall consist of thoroughly dry stone dust, portland cement, fly ash or other mineral dust approved by the Engineer. The material filler shall be free from foreign and other injurious matter.

When tested by Test Method Tex-200-F, (Parts I and II) it shall meet the following grading requirements.

	Percent By Weight
Passing a No. 30 Sieve	95 to 100
Passing a No. 80 Sieve, not less than	75
Passing a No. 200 Sieve, not less than	55

Asphaltic Materials:

a. Paving Mixture: Asphalt for the paving mixture shall be AC-10 asphalt cement and shall conform to Item 300 "Asphalt, Oil and Emulsions" of the Standard Specifications for Construction of Highways, Streets and Bridges, 1972 Edition; of the Texas Department of Highways and Public Transportation. The Contractor shall notify the Engineer of the source of his asphaltic material prior to design or production of the asphaltic mixture and this source shall not be changed during the course of the project except on written permission of the Engineer.

b. Tack Coat: The asphaltic material for tack coat shall meet the requirements for emulsified asphalt EA-11M, cut-back asphalt RC-2, or shall be cut-back asphalt made by combining 50 to 70 percent by volume of AC-10 with 30 to 50 percent by volume of gasoline and/or kerosene. If RC-2 cut-back asphalt is used, it may, upon instructions from the Enginer, be diluted by the addition of an approved grade of gasoline and/or kerosene, not to exceed 15 percent by volume.

Asphaltic materials shall meet the requirements of the aforementioned Item 300.

PAVING MIXTURES:

General: The paving mixtures shall consist of a uniform mixture of coarse aggregate, fine aggregate, asphaltic material and mineral filler, if required.

The grading of each constituent of mineral aggregate shall be such as to produce, when properly proportioned, a mixture which, when tested in accordance with Test Method Tex-200-F, wil conform to the limitations for master grading for the types of asphaltic concrete as set out hereinafter.

Types of Asphaltic Concrete:

a. Type "D-42" - Fine Graded Surface Course:

Sieve Size	Percent By Weight
Passing 5/8" sieve	100
Passing 1/2" sieve	97 to 100
Passing 3/8" sieve	90 to 100
Passing No. sieve, retained on No. 10 sieve	10 to 30
Total retained on No. 10 sieve	40 to 64
Passing No. 10 sieve, retained on No. 40 sieve	0 to 30
Passing No. 40 sieve, retained on No. 80 sieve	4 to 25
Passing No. 80 sieve, retained on No. 200 sieve	3 to 25
Passing No. 200 sieve	0 to 8

The asphaltic material shall form from 4.0 to 8.0 percent of the mixture by weight.

b. Type "D-37" - Fine Graded Surface Course
& Leveling Up Course:

Sieve Size	Percent Weight By Weight
Passing 5/8" sieve	100
Passing 1/2" sieve	97 to 100
Passing 3/8" sieve	90 to 100
Passing 3/8" sieve, retained on No. 4 sieve	15 to 50
Passing No. sieve, retained on No. 10 sieve	10 to 30
Total retained on No. 10 sieve	40 to 64
Passing No. 10 sieve, retained on No. 40 sieve	0 to 30
Passing No. 40 sieve, retained on No. 80 sieve	4 to 25
Passing No. 80 sieve, retained on No. 200 sieve	3 to 25
Passing No. 200 sieve	2 to 8

The asphaltic material shall form from 4.0 to 8.0 percent of the mixture by weight.

Tolerances: A reputable testing laboratory shall be retained to designate the exact grading of the aggregate content, within the above limits, to be used in the mixture produced should not vary from the designated grading and asphalt content by more than the tolerances allowed herein; however, the mixture produced shall conform to the limitations for master grading specified above.

	Percent By Weight
Passing 7/8" sieve retained on 3/8" sieve	plus or minus 5
Passing 5/8" sieve, retained on 3/8" sieve	Plus or minus 5
Passing 3/8" sieve, retained on No. 4 sieve	Plus or minus 5
Passing No. 4 sieve, retained on No. 10 sieve	Plus or minus 5
Total retained on No. 10 sieve	Plus or minus 5
Passing No. 10 sieve, retained on No. 40 sieve	Plus or minus 3
Passing No. 40 sieve, retained on No. 80 sieve	Plus or minus 3
Passing No. 80 sieve, retained on No. 200 sieve	Plus or minus 3
Passing No. 200 sieve	Plus or minus 3
Asphalt Material	Plus or minus 0.5

Should the paving mixture produced vary from the designated grading and asphalt content by more than the above tolerances, proper changes are to be made until it is within these tolerances.

Extraction Test:
Samples of the mixture when tested in accordance with Test Method Tex-210-F shall not vary from the grading proportions of the aggregate and the asphalt content designated, by more than the respective tolerances specified above and shall be within the limits specified for master grading.
When limestone rock asphalt screenings are used, the extraction requirements relative to asphalt content are waived.
Sampling and Testing:
It is the intent of this specification to produce a mixture which when designed and tested in accordance with these specifications and methods outlined in THD Bulletin C-14, will have the following laboratory density and stability.

Density (Percent)			Stability (Percent)
Minimum	Maximum	Optimum	
95	99	97	See paragraph 2H11.2

Stability and density are control tests. If the laboratory stability and/or density of the mixture produced has a value lower than that specified, and in the opinion of the Engineer is not due to change in source or quality of materials, production may proceed, and the mix shall be changed until the laboratory stability and density falls within the specified limits and as near the optimum value as is practicable. If there is, in the opinion of the Engineer, a fundamental change in any material from that used in the design mixtures, production will be discontinued until a new design mixture is determined by trial mixes. It is the intent of this specification that the mixture will be designed to produce a mixture of optimum density.
EQUIPMENT:
Mixing Plants: Mixing plants that will not continuously produce a mixture meeting all of the requirements of this specification will be condemned.
Mixing plants may be either the weight-batching type or the continuous mixing type. Both types of plants shall be equipped with satisfactory conveyors; power units; aggregate handling equipment; hot aggregate screens and bins; dust collectors; and shall be equipped with automatic proportioning and recording devices. Mixing plants shall conform to Item 340.4 "Equipment" of the Standard Specifications for Construction of Highways, Streets and Bridges, 1972 Edition; of the Texas Department of Highways and Public Transportation.
Paving Equipment:

a. Spreading and Finishing Machine: The spreading and finishing machine shall be of the screening and troweling type or of a type approved by the Engineer and shall be capable of producing a surface that will meet the requirements of the typical cross-section and the surface test.
b. Maintainer: The maintainer, if used, shall be a self-propelled power maintainer; it shall be equipped with pneumatic-tired wheels; shall have a blade and shall be tight and in good operating condition and approved by the Engineer.
c. Pnuematic-Tired Roller: The pneumatic-tired roller shall consist of not less than 9 pneumatic-tired wheels, running on axles in such manner that the rear group of tires will not follow in the tracks of the forward group, and mounted in a rigid frame and provided with a loading platform or body suitable for ballast loading. The wheel base of the roller (the distance between the front and rear axles) shall not be less than 5 feet nor more than 10 feet. The front axle shall be attached to the frame in such manner that the roller may be turned within a minimum circle. The pneumatic-tired roller, under working conditions, shall

have an effective rolling width of approximately 60 inches and shall be so designed that by ballast loading, the load may be varied uniformly from 100 pounds to 325 pounds per inch of width of tire tread. The pressure in the tires and the compression to be provided at any time shall be as directed by the Engineer. The roller, under working conditions, shall provide a uniform compression under all wheels. The total combined width of effective tire tread shall be not less than 85 percent of the effective rolling width. The pneumatic-tired roller shall be drawn either by a suitable pneumatic-tired tractor or a truck of adequate tractive effort.

d. Tandem Roller: This roller shall be an acceptable power-driven tandem roller weighing not less than 8 tons.
e. Three-Wheel Roller: This roller shall be an acceptable power-driven three-wheel roller weighing not less than 10 tons.
f. Straight Edges and Templates: The Contractor shall provide acceptable 16 foot straight edge for surface testing. Satisfactory templates shall be provided as required by the Engineer.

STOCKPILE, STORAGE, PROPORTIONING AND MIXING: Stockpiling, storage, proportioning and mixing shall conform to the requirements of Item 340.5, 1972 Edition, of the Texas Department of Highways and Public Transportation.

CONSTRUCTION METHODS:

General: The asphaltic mixture or tack coat shall be placed only when the weather conditions, in the opinion of the Engineer, are suitable. The mixture shall not be placed when the air temperature is below 45°F.

Tack Coat: Tack coat will be applied as directed by the engineer, but in no case shall it be applied in excess of 0.05 gsl./s.y.

Before the asphaltic mixture is laid, the surface upon which it is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer. All contact surfaces of curbs and structures and all joints shall be painted with a thin uniform coat of tack coat material.

Transporting Asphaltic Concrete: The asphaltic mixture, prepared as specified above, shall be hauled to the work 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 shall have received its initial rolling in daylight. The inside of the truck body may be given a light coating of oil, if necessary, to prevent mixture from adhering to body.

Placing:

a. General: The asphaltic mixture shall be dumped and spread on the approved prepared surface with the specified spreading and finishing machine in such a manner that when properly compacted, the finished pavement will be smooth, of uniform density and will meet the requirements of the typical cross-section and the surface tests.
b. Small Areas: 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 provided a satisfactory surface can be obtained by other approved methods.
c. Flush Structures: Adjacent to flush curbs, gutter liners and structures, the surface shall be finished uniformly high so that when compacted, it will be slightly above the edge of the curb and flush structures.

Compacting:
Rolling with the 3 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 wheels. Alternate trips of the roller shall be slightly different in length. On super-elevated curves, rolling shall begin at the low side and progress toward the high side. Rolling with the pneumatic roller shall be done as directed by the Engineer. Rolling shall be continued until no further compression can be obtained or the specified density is obtained and all roller marks are eliminated. One tandem roller and at least one 3-wheel roller as above specified shall be provided if needed. Rolling with pneumatic rollers will be required where satisfactory compaction cannot be secured with flat wheel rollers. The motion of the roller shall be slow enough at all time to avoid displacement of the mixture. If any displacement occurs, it shall be corrected at once by the use of rakes and of fresh mixture to the roller, the wheels shall be kept thoroughly moistened with water, but an excess of water will not be permitted. Necessary precautions shall be taken to prevent the dropping of gasoline, oil, grease, cinders, or other foreign matter on the pavement, either when the rollers are in operation or when standing.
In Place Density: It is the intent of this specification that the material be placed and compacted to 95% of the laboratory density.
TESTING:
General: This paragraph sets out a list of tests that may be required.
Mix Design: A mix design shall be prepared by a reputable testing laboratory. The mix design does not have to be prepared specifically for this project but must apply to the materials being furnished and meet the requirements of these specifications.
Mix Control: a reputable testing laboratory shall control the proportioning and mixing of materials used in the asphaltic concrete to assure the mix design is being followed.
Extraction Tests: A reputable testing laboratory shall take samples of the mixture during construction. These samples when tested in accordance with Texas Highway Department Test Method Tex-210-F shall not vary from the grading proportions of the aggregate and the asphalt content of the approved mix design.
Stability and Laboratory Density Tests: A reputable testing laboratory shall take samples of the mixture during construction. These samples when tested in accordance with THD Bulletin C-14 will have the required stability and laboratory density.
Field Density: A reputable testing laboratory shall be retained to determine the in place density of the asphaltic concrete. The method used to determine in place density is subject to the approval of the Engineer.
Thickness Tests: The thickness of the compacted wearing surface shall be determined by depth cores taken at interval in such a manner that each test shall represent no more than 1000 square yards. When the wearing surface deficiency averages more than 1/8 inch but less than 3/8 inch the payment per square yard will be reduced proportionately. When the wearing surface deficiency averages 3/8 inch or more the Contractor shall overlay the entire surface with at least 1/2 inch of additional asphaltic concrete as required to meet the required thickness. The Contractor shall neatly repair all areas where thickness cores were taken. These thickness tests shall be made by the Contractor under the supervision of the Engineer.
Surface Tests: The surface of the pavement, after compression, shall be smooth and true to the established line, grade and cross-section; and when tested with a 16'

straight-edge placed parallel to the center of the roadway, it shall have no deviation in excess of 1/16" per foot from the nearest point of contact. The maximum coordinate measured from the face of the straight-edge shall not exceed 1/4" at any point. Any point in the surface not meeting these requirements shall be immediately corrected.

These surface tests shall be made by the Contractor under the supervision of the Engineer.

6 - L CONCRETE FORMWORK

SCOPE

SCOPE: This specification shall govern for all work necessary for providing and installing concrete forms for any concrete structure (including curb an gutter, inlets, sidewalk and driveways) required to complete the project.

MATERIAL

WOOD FORMS: Form lumber shall be seasoned, of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay or other imperfections which would affect its strength or impair the finished surface of the concrete. Lumber used for facing or sheathing shall be surfaced on at least one side and two edges. All exposed concrete edges shall be chamfered. Molding used for chamfer strips shall be of redwood, cypress or pipe of quality that will not split when nailed and which can be maintained to true lines. Chamfer strips to predetermined elevations just prior to placing final lift.

STEEL FORMS: Metal forms shall provide a smooth straight surface and shall line up properly. Rivets and bolt heads in contact with concrete will be countersunk, level with surrounding surface. Metal surfaces in contact with concrete will be free from rust, paint or other foreign material that will disfigure or discolor concrete. Mount chamfer strip by Engineer approved methods and maintain as to grade and alignment.

FORM LINING: Surfaces to be given a rubbed finish are to have form surfaces or form lining surfaces free of irregularities. Lining is to be of plywood made with waterproof adhesive, of 1/4 inch minimum thickness, preferably oiled at the mill an then re-oiled of lacquered on the job before using. An alternate to the plywood lining is tempered masonite concrete form presswood having a minimum 3/16 inch thickness. Keep presswood moist at least 12 hours before applying to sheathing. Use smooth hard face as concrete contact surface. Facing may be constructed of 3/4 inch plywood made with waterproof adhesive, backed by adequate studs and wales; and, in this case, form lining will not be required. Carefully align edges and faces of adjacent panels.

FORM TIES: Form ties for exposed work shall be the threaded rod type using a threaded rod at least 1-1/2 inches shorter than the wall thickness so as to provide a minimum break-back of 3/4 inch from the wall face, leaving a small clean hole to be grouted. Form tie holes shall be not larger than 7/8 in diameter. The use of wire ties without providing break-back will not be permitted where the concrete surface will be exposed to weathering, or at any point where discoloration will be objectionable. Temporary form spreaders will be removed as concrete is placed.

CONSTRUCTION METHODS

FALSEWORK: Falsework shall be of rigid construction to prevent excessive settlement or deformation under imposed loading and to insure the safety of the workmen and the structure. Only sound timber shall be used for falsework. Falsework shall be designed using 150 pounds per square foot of horizontal surface of form.

FORMS - GENERAL: Forms are to be constructed and placed in such a manner as to insure mortar tightness, rigidity to prevent excessive settlement or deformation under imposed loading and to insure the safety of the workmen and the structure.

Forms shall be constructed in such a manner as to allow cleanout before placing of concrete; adequate access by tremies and vibrators; and removal without damage to concrete. Adequate cleanout openings shall be provided as directed by the Engineer. If excessive settlement or deformation occur, remove the concrete and steel, reset forms, replace the steel and pour fresh concrete. If existing steel is to be reused, Section B-6 must be met.

FORMS - CURB AND GUTTER, SIDEWALKS AND DRIVEWAYS: Form shall be straight durable and have a depth equal to the required concrete depth; they shall be securely staked to line and grade in such manner that there will be no movement when the concrete is placed.

FORMS - DESIGN: Forms shall be designed for a fluid pressure of 150 pounds per cubic foot and a live load of 50 pounds per square foot on horizontal surfaces with maximum unit stress of 125% of allowable stresses.

OILING FORMS: All surfaces of forms that will be in contact with concrete will be treated with an approved form oil before concrete is placed. The Contractor shall apply form oil in such a manner so as to insure that no excess oil accumulates on the reinforcing or previously placed concrete. Immediately prior to placing concrete, the Contractor shall wet forms which will come in contact with concrete.

REMOVAL OF FORMS FROM SURFACES TO BE RUBBED: Forms shall be removed when concrete has attained adequate strength to prevent damage and only as rapidly as rubbing operation progresses. Forms left in place longer than 24 hours will be rewet to keep moist.

REMOVAL OF FORMS AND FALSEWORK FROM SURFACES NOT TO BE RUBBED: Forms and falsework shall be removed after concrete has aged the following number of curing days.

a. Slabs, Beams, or Girders - 7 curing days.
b. Walls, Columns and Piers - 2 curing days.

SETTING FORMS OR FALSEWORK ON SUBSTRUCTURES: Forms or falsework shall not be erected on a concrete structure until the concrete in the substructure has cured at least 7 curing days.

SETTING FORMS OR FALSEWORK ON FOOTINGS: Forms or falsework shall not be erected on a concrete footing until the concrete in the footing has cured at least 3 curing days.

CURING DAY: A curing day is any calendar day on which the temperature near the structure is above 50°F for at least 19 hours.

6 - M CONCRETE REINFORCEMENT

SCOPE

SCOPE: This specifications shall govern for all work necessary for furnishing reinforcing steel, bar supports, welding, tools, supplies, equipment and services, and placing of concrete reinforcement of the shape and dimensions shown on the contract drawings, and as called for by these specifications required to complete the project.

MATERIAL

REINFORCING STEEL: All reinforcing bars, except column, shall be deformed as defined in ASTM Specifications.

All reinforcing bars, unless noted on the structural drawings, shall be Grade 60 as defined by the American Society for Testing and Materials. "Specifications for Steel Bars for Concrete Reinforcement" (A615 A616 or A617).

Spiral reinforcing steel shall be fabricated from cold drawn with (ASTM A82) or hot rolled plain or deformed bars conforming to ASTM A625, Grade 60.

Welded smooth wire fabric shall conform to ASTM A185 "Welded Steel Wire Fabric for Concrete Reinforcement" (ACI 318-71 limits the wire spacing to 12 inches maximum).

Welded deformed wire fabric shall conform to ASTM A497 "Welded Deformed Steel Wire Fabric for Concrete Reinforcement." (ACI 318-71 limits the wire spacing to 16 inches maximum)

TIE WIRE: The tie wire used shall be black annealed wire, 16 gauge or heavier.

REINFORCING BAR SUPPORTS: Bar supports shall conform to the "Bar Supports Specifications" contained in "Manual of Standard Practice", as published by the Concrete Reinforcing Steel Institute and the Western Concrete Reinforcing Steel Institute.

The Contractor shall provide such accessories as metal spacers, chairs, and other approved devices necessary for properly assembly, spacing and supporting the reinforcing steel.

CONCRETE ACCESSORIES: All reinforcement that bears on the ground shall be held up with pre-cast concrete blocks 2-1/2 inches thick by 3 inches wide by 6 inches long. Concrete blocks shall have No. 16 wire ties embedded in the 3 inch side. Space reinforcing steel in walls the required distance from face of the forms by the use of concrete blocks. Concrete blocks shall be in the form of a frustrum of a cone of a pyramid with the small end not exceeding 2-1/2 inches. Concrete blocks shall have suitable wire ties for securing to steel.

MILL CERTIFICATES: Two certified copies of mill tests on each grade of reinforcing steel delivered showing physical and chemical analysis shall be provided, upon request, at the time of shipment.

SURFACE CONDITION: Metal reinforcement at the time concrete is placed shall be free from mud, oil, or other non-metallic coatings that adversely affect bonding capacity.

Metal reinforcement, except prestressing steel, with rust, mill scale, or a combination of both shall be considered as satisfactory, provided the minimum dimensions, including height of deformations and weight of a hand wire brushed test specimen, are not less than the applicable ASTM specification requirements.

REINFORCING STEEL OF FOREIGN MANUFACTURER: No reinforcing steel of foreign manufacture shall be allowed on the project site. Any foreign steel accidentally delivered to the project site must be removed immediately.

CONSTRUCTION METHODS

STORAGE: The Contractor shall store all reinforcement above the surface of the ground on platforms, skids or other suitable supports.

PROTECTION: The Contractor shall protect all reinforcement from mechanical injury, from surface deterioration caused by exposure to conditions producing rust, and from non-metallic coatings that adversely affect bonding capacity.

STANDARD PRACTICE: All requirements of concrete reinforcement not covered in these specifications or on the structural drawings shall be in accordance with "Manual of Standard Practice", as published by the Concrete Reinforcing Steel Institute and the Western Concrete Reinforcing Steel Institute.

All hooks shall conform to bend dimensions defined as "ACI Standard Hooks" in "Manual of Standard Practice", as published by the Concrete Reinforcing Steel Institute and the Western Concrete Reinforcing Steel Institute, unless otherwise shown on the structural drawings. All reinforcing bars shall be bent cold.

Reinforcing bars shall not be bent or straightened in a manner that will injure the material.

Reinforcing bars shall conform accurately to the dimensions shown on the structural drawings and within the fabricating tolerances shown in "Manual of Standard Practice", as published by the Concrete Reinforcing Steel Institute and the Western Concrete Reinforcing Steel Institute.

PLACING REINFORCING STEEL: The placement of bars should conform to the recommended practices in "Placing Reinforcing Bars", as published by the Concrete Reinforcing Steel Institute.

Bars should be securely tied to prevent displacement during the concreting operation and all dowels must be wired in place before depositing concrete. All splicing of bars, concrete cover, placing tolerances and bar spacing shall conform to "Building Code Requirements for Reinforced Concrete" (ACI318), as published by the American Concrete Institute, and to recommended practices in "Reinforcing Bar Splices" by the Concrete Reinforcing Steel Institute.

Lap reinforcing steel a minimum of 24 bar diameters at splices unless stated otherwise on the drawings.

REINFORCING ROD COATING (To Be Used Where Specifically Called For On Drawings): Briner #723 Rod Coat or equal should be used. Rod coat should be mixed an hour or more before using. It is a one part base to one part activator.

Reinforcing rods should be very thoroughly cleaned by hand cleaning with a wire brush before the application of rod-coat. Thoroughly stir both components before mixing. Add a small amount of thinner, Briner #85 or equal, (less than 10%) to remove contents from both containers. Use a mechanical mixer to get a homogeneous blend, and to keep aggregate in suspension. Should application be made by dip method, keep vat under frequent agitation. Flow coating, brush, and roller methods can be used also. Dip or flow coat method of application will result in a 4 to 5 dry mil. film on the reinforcing rod.

SHOP DRAWINGS: The Contractor shall furnish, 6 copies of the placing drawings and bar lists in accordance with the latest revision of "Manual of Standard Practice for Detailing Concrete Structures" (ACI315), as published by the American Concrete Institute. Reinforcing steel shall not be fabricated until shop drawings have been approved by the Engineer.

6 - N HEAVYWEIGHT AGGREGATE CONCRETE

SCOPE: This specification shall govern for all work necessary for providing all Portland Cement Concrete with heavyweight coarse aggregate required to complete the project.

MATERIAL:

Portland Cement: Portland Cement shall conform to ASTM Specification I-150 and shall be Type I. Other types of cement shall be used only when approved by the Engineer.

Water: Water shall be reasonably clean and free from injurious amounts of oils, acid, salt, alkali, organic matter or other deleterious substances. Questionable water shall be tested by a testing laboratory in accordance with ASTM Specification C-94. The cost of testing will be borne by the Contractor. Potable water need not be tested.

Fine Aggregate: Fine Aggregate shall consist of natural sand, or sand prepared from product obtained by crushing stone or gravel. Sampling of fine aggregate shall be in conformance with ASTM Specification D-75. Sieve analysis shall be in accordance with ASTM Specification C-136. Fine aggregate shall conform to the following grading requirements:

Retained on 3/8" screen	0%
Retained on 1/4" screen	0 to 5 %
Retained on 20 mesh sieve	15 to 50%
Retained on 100 mesh sieve	85 to 100%

Deleterious substances shall not be present in excess of following percentage by weight.

Material removed by decantation	3%
Clay Lumps	0.5%
Other substances such as coal, shale, and friable particles	2.0%

Fine aggregate shall be of such quality that when made into mortar and tested in accordance with ASTM Specification C087 the mortar shall develop a compressive strength at 7 days and 28 days of not less than 95 percent of that developed by the mortar specified as the basis for comparison. Sand shall not contain organic impurities in amounts that, when the sand is tested in accordance with ASTM Specification C-40, would cause it to show a color darker than the standard color.

Fine aggregate shall have a fineness modulus conforming to the following:

a. All strength concrete - not less than 2.0
b. 2,000 psi concrete and less - not more than 3.25
c. 2,500 psi concrete and greater - not more than 3.50

The fineness modulus shall be determined by adding total percentages retained on the following U.S. Standard sieves and dividing by 100:

3 in., 1-1/2 in., No. 4, No. 8, No. 16, No. 30, No. 50 and No. 100.

Heavyweight Coarse Aggregate: Coarse aggregate shall consist of crushed stone or gravel. Sampling of coarse aggregate shall be in conformance with ASTM Specification D-75. Sieve analysis shall be in accordance with ASTM Specification C-136. Coarse aggregate shall conform to the following grading requirements:

Retained on 2" screen	0%
Retained on 1-1/2" screen	0 to 5%
Retained on 3/4" screen	25 to 60%
Retained on 1/4" screen	95 to 100%

Deleterious substances shall not be present in excess of following percentages by weight:

Material removed by decantation	1.0%
Shale or slate	1.0%
Clay lumps	0.25%
Soft fragments	3.0%

Sum of all deleterious ingredients, exclusive of material removed by decantation, shall not exceed 4% by weight.

Coarse aggregate shall not exceed the following:

a. Soundness test (Sodium sulphate) weighted average loss at 5 cycles 15%

b. absorption test 3%

Coarse aggregate shall not have a wear equivalent of more than 40 when tested for abrasion in conformance with ASTM Specification C-131.

Retarder - Densifier: When a retarder-densifier is required it shall be Sika's "Plastiment", Sonneborn's "Sonotar" or an approved equal. Mixing shall be done in strict conformance with manufacturer's recommendations.

Air - Entrainment Agent: The use of air-entrainment admixture is required for all concrete. Air-entrainment shall be at least 3% but shall not exceed 5%. Mixing shall be done in strict conformance with manufacturer's recommendation. ASTM Specification C-138, or C-173, or C-231 shall govern.

PROPORTIONING OF CONCRETE: It is the intent of this specification to obtain concrete of a homogeneous structure that will be of such consistency and composition that it can be worked readily into corners and angles of forms and around the reinforcement without permitting materials to segregate or free water to collect on the surface. The concrete when it hardens will have a resistance to weathering and the required compressive strength. The general requirements for different compressive strength concrete are as follows:

Min. 28-day Compressive Strength	Max. Allowable Water-Cement Content Gal. per sack of Cement	Min. Cement Content-Sacks per Cubic Yard	Slump Range
1500 psi (Class E)	10.5	3.0	2"-6"
Seal Slab (Class D)		4.0	6"-8"
2000 psi (Class C)	7.5	4.0	2"-5"
2500 psi (Class B)	6.75	4.5	2"-5"
3000 psi (Class A)	6.25	5.25	2"-5"
4000 psi (Class A)	5.0	6.0	
5000 psi (Class A)	4.0	7.0	

Maximum allowable net water content will be the amount added at the mixer, plus free water in the aggregate and minus absorption of the aggregate based on the thirty minute absorption period. No allowances will be made for evaporation of water after batching.

MIX DESIGN:

3C1.4.1 General: It is the intent of these specifications that the Contractor is responsible for providing a mix design that will produce a concrete meeting the requirements of this specification.

3C1.4.2 Mix Design Report: The Contractor shall submit to the Engineer for approval six (6) copies of a mix design prepared by a reputable testing laboratory. The mix design shall include mix proportions, water cement ratio, slump and workability characteristics required to produce the specified compressive strength concrete. The mix design shall be established by making, curing and testing an minimum of 5 standard size test cylinders for each strength concrete. Cylinders shall be made, cured and tested in conformance with ASTM Specifications C-192 and C-39. The mix design does not have to be prepared especially for this project, but it must apply to the materials being furnished. the mix design must be delivered to the Engineer four (4) days prior to the first pour. The Contractor shall have written notice from the Engineer approving the mix design before placing any concrete. If, during progress of the work, it is found impossible to secure concrete of required workability and strength with material being furnished by Contractor, the Engineer may order such changes as may be necessary to secure desired properties, subject to limiting requirements shown in this specification. Any changes so ordered shall be made at the Contractor's expense, and no extra compensation will be allowed by reason of such change.

CONSISTENCY:

General: The quantity of water to be used shall be determined by the Engineer and shall be such as to give a mixture containing the minimum of water consistent with the required workability. The quantity of water shall be varied only by the Engineer. The Contractor shall provide a concrete that has a consistency that conforms to the following:

a. The mortar will cling to the coarse aggregate.
b. The concrete is not sufficiently fluid to segregate to the place of deposit.
c. The concrete, when dropped directly from the discharge chute of the mixer, will flatten out at the center of the pile, but the edged of the pile will stand up and not flow.
d. The mortar will show no free water when removed from the mixer.
e. The concrete will settle into place when deposited in the forms; and when transported in metal chutes at an angle of 30 degrees with the horizontal, it will slide and not flow into place.
f. The surface of the finished concrete will be free from laitance or a surface film of free water.

Concrete Failing To Meet Consistency Requirements: Any concrete mix failing to meet the above outlined consistency requirements, although meeting the slump requirements, will be considered unsatisfactory; and the mix shall be changed to correct such unsatisfactory conditions. The slump test will be made by the Engineer in accordance with the methods outlined in ASTM C-143.

MIXING:

General: The Contractor shall have the option of mixing the concrete on the site or procuring concrete from a "transit-mixed" concrete plant. Aggregates shall be proportioned by weight unless a satisfactory volumetric method of measurement is approved by the Engineer. The use of fractional sacks of cement will not be permitted unless the cement is proportioned by weight. Water shall be measured by an accurate measuring device which can be adjusted to compensate for variations in the free moisture content of the aggregate.

The concrete shall be mixed in quantities required for immediate use, and any concrete which is not in place within one hour after start to mixing shall not be used unless otherwise authorized by the Engineer. In threatening weather, which in the opinion of the Engineer may result in conditions that will adversely affect the quality of the concrete to be placed, the Engineer may order postponment of the work. Where work has been started and changes in weather conditions require protective measures to be used, the Contractor shall furnish adequate shelter to protect the concrete against damage from rainfall or damage due to freezing temperatures. In case it is necessary to continue mixing operations during rainfall, the Contractor shall provide protective covering for the material stock piles as well as for the concrete being placed. The covering for aggregate stock piles will be required only to the extent as may be necessary to control the moisture conditions in the aggregate so that adequate control of the consistency of the concrete mix may be maintained.

No concrete shall be mixed without the approval of the Engineer when the air temperature is at or below 40°F. (taken in the shade away from artificial heat) and falling. If authorized for concrete placement during cold weather, the concrete will be placed in accordance with the PCA "Design and Control of Concrete Mixtures".

The maximum temperature of cast-in-place concrete (Type I, Portland Cement and Type K, Shrinkage Compensating Cement) shall not exceed 98°F. If adjustments of the mixture for temperature control are required, then the procedure for hot-weather mixing, placing and curing shall be in accordance with ACI 305 Recommended Practice for Hot Weather Concreting.

"Job-Mixed" Concrete: The aggregate shall be stock-piled separately and handled in such a manner as to prevent the inclusion of any foreign materials. Except for emergency hand-mixing under approved conditions, all concrete shall be machine mixed in an approved type mixer for a minimum period of 1-1/2 minutes in a drum rotating at a peripheral speed of 200 feet per minute. An increase of 15 seconds for each one-half cubic yard over one cubic yard of capacity of the mixer.

"Transit-Mixed" Concrete: The mixing and the transporting operations shall conform with ASTM Specification C-94. Mixing water shall not be added after a truck has left the plant except by permission of the Engineer or his representative. No concrete shall be used in the work which has been held longer than 1 hour in a mixer truck, unless approved by the Engineer. If dry-batched to the job site, the batching plant operations shall conform with ASTM Specification C-94. Transportation of the dry materials shall be performed in such a manner as to prevent loss, segregation or contamination of ingredients.

LABORATORY TESTING OF CONCRETE: Moisture content check will be made at sufficient intervals to maintain accurate batching and proportioning. All sampling will be done in accordance with ASTM sampling and testing procedures. A set of test cylinders shall consist of 3 test cylinders. One cylinder shall be tested for strength at the age of 7 days, one cylinder at the age of 28 days, and one cylinder shall be held in reserve to be tested for strength when directed by the Engineer. The cylinders shall be made and cured in conformance with ASTM Specification C-192. Curing facilities shall be provided in accordance with ASTM C-31. Cylinders shall be tested in conformance with ASTM C-39.

FAILURES TO MEET STRENGTH REQUIREMENTS: Should the strength shown by the test specimens made and tested fall below the values required, the Engineer shall have the right to require changes in proportions, or to require additional curing on those portions of the structure represented by the test specimens which failed. If additional curing does not give the strength or removal and replacement of those portions which fail to develop required strength. Specimens will be considered to have failed when average strength for any period of placing is less than values indicated in the following table:

No. Days Consecutive Placing of Any One Class Of Concrete	Percent of Strength Specified
1	85
2	95
3	95
5 or more	100

When additional curing of portions of the structure is ordered by the Engineer, it shall be done at Contractor's expense and no claim for extra compensation for such additional curing shall be allowed. In no case shall the Contractor be required to provide such additional curing beyond a total of 21 days, except where average strengths of specimens, representing concrete placed on any three consecutive days, fall below 80% of the value specified in this specification. In this case, curing shall be contained until cores drilled from portions of the structure involved show an average strength equal to that specified in this specification. Cores shall have diameter of approximately three times the maximum size of aggregate and shall be tested in accordance with ASTM Specification C-42.

STORAGE OF MATERIALS: Cement shall be stored off the ground in a well-ventilated, weatherproof building. Aggregate shall be stored in a manner that will prevent the mixing of foreign materials and in a manner to prevent segregation of the aggregate.

MEASUREMENT OF MATERIALS: The measurement of materials, except water, used in the batches of concrete shall be by weight. The different grades of aggregate shall be weighed separately. Cement may be measured by the bag. Water may be measured by volume. Allowance will be made for water content where moist aggregates are used.

SCOPE: This specification shall govern for all work necessary to construct all structures required to complete the project.

MATERIAL:

Concrete: Concrete shall have a minimum compressive strength of 3000 psi at 28 days (unless specifically specified otherwise) and shall be in accordance with Section B-7 "Heavyweight Aggregate Concrete".

Reinforcing Steel: See Section 6-M "Concrete Reinforcement".

Premolded Expansion Joint Filler: Premolded expansion joint filler shall conform to ASTM Specification D-544, Type I.

Non-Shrinkage Grout Aggregate: Shall be "Embeco 636" or "Masterflow 713" as manufactured by Master Builders Company, or "Ferrolith G" as manufactured by L. Sonneborn and Sons, Inc., or approved equal.

Waterstops: Waterstops shall be premolded polyvinylchloride being "Dura-joint" No. 5 as manufactured by Electrovert, Inc., or "Sealtight" No. 6380 as manufactured by W.T. Meadows, Inc., or "Synko-flex" plaster (Bitumen) continuous waterstop or approved equal unless otherwise designated on plans.

Membrane Curing Compound: Membrane curing compound shall be a resin base compound in accordance with ASTM Specification C-309, Type I, with light red tint of fugitive dye.

Cotton Mats for Curing: Cotton mats for curing shall be mats which uniformly contain a minimum of 3/4 pound of cotton per square yard, with Osnaburg covering cloth being a weight of not less than 6 ounces per square yard. The mats shall be a size which may be easily handled and having 6 inch wide flap for overlaps.

Floor Hardener: Where drawings call for integral concrete coloring, "Sonobrite" as manufactured by L. Sonneborn and Sons, or "Staybrite" as manufactured by A.C. Horn Company, or an approved equal shall be used.

Integral Concrete Coloring: Where drawings call for integral concrete coloring, "Sonobrite" as manufactured by L. Sonneborn and Sons, or "Staybrite" as manufactured by A.C. Horn Company, or an approved equal shall be used.

CONSTRUCTION METHODS:

Required Approval: Prior to starting work, the Engineer may require the Contractor to furnish for approval any or all of the following:

a. Methods of construction.
b. Drawings for all form and falsework.
c. Amount and type of equipment to be used on the project.
d. The concrete placing schedule which take into account concrete shrinkage.
e. A schedule showing all surfaces to receive a rubbed finish.

The Engineer's approval of the above listed items does not relieve the Contractor of any responsibility for safety or correctness of methods, adequacy of equipment, or for carrying out work in accordance with his contractual obligations.

Time Sequence of Operation:

a. All sub-structure concrete work shall be cured for a minimum of four days before erecting forms or placing structural steel thereon.
b. All sub-structure concrete work shall cure for a minimum of 7 days before pouring super-structure concrete thereon.
c. All wall footings shall cure fo a minimum of 2 days before placing wall forms thereon.
d. All super-structure shall cure for a minimum of 10 days before being used.

Expansion Joints: The Contractor shall remove forms as soon as possible to permit free expansion of concrete. Premolded expansion joint fillers will be anchored to concrete on side of joint by means of copper wire No. 12 B and C guage or heavier or copper nails of approved size. Concrete sections are to be completely separated by open joint or by joint material.

Construction Joints:

a. General: "Construction Joint" is defined as a contact surface between plastic concrete and concrete that has attained initial set. "Mono-lithic" means concrete placed without construction joints. Waterstops shall be provided in all construction joints in structures containing liquids up to a point one foot above the maximum water surface elevation and in all construction joints in structures with walls adjacent to soil, below a point one foot above the finished grade. The Contractor shall obtain written authorization of the Engineer to permit construction joints other than those indicated. Where such authorization is obtained, make additional construction joints with details and waterstops equivalent to those shown for similar joints.

b. Construction: The Contractor shall leave surfaces rough with aggregate surface prior to placing of new concrete. Immediately prior to placing concrete on horizontal joint surfaces, slush surface with mortar coating. Mortar is to consist of regular to concrete mix less coarse aggregate. On vertical surface, mortar is to be brushed on and worked into irregularities on surface. Keyways are to be formed so as to permit easy removal of forms without damaging the concrete. Waterstops are to extend into both old and new pour an equal distance, or according to manufacturer's recommendations as approved by the Engineer.

Concrete Form Work: See Section 6-L - "Concrete Form Work".

Placing Reinforcement: See Section 6-M - "Concrete Reinforcement".

Seal Slabs: Seal slabs will be placed in all excavations for structures which require reinforcing steel in base slab. Excavate 2 inches minimum below bottom of structural slab and pour seal slab concrete to structural slab bottom elevation. Rough float finish seal slab. No direct payment will be made for seal slab concrete.

Authorization to Place Concrete: The Contractor shall notify the Engineer at least 24 hours in advance of a scheduled concrete placement. The Contractor shall not begin mixing concrete (or place an order for concrete) until the Engineer has inspected the forms, reinforcing steel, and given his approval. Before concrete is placed, all embedded items shall be accurately and securely fastened in place. The Contractor shall not place any concrete until he has at least 2 mechanical vibrators, or an approved type, on the project site that are in good operating order.

Scheduling of Concrete Placement: The Contractor shall schedule the concrete placement so as to insure completion during the hours of daylight. If it is necessary to continue pouring during hours of darkness, light the site in such a manner as to insure competent and safe operation. The Engineer can order postponement of placing operations when impending weather conditions threaten to impair the quality of the finished work. Should rainfall occur after placing operations have started, provide covering to protect work. If conditions occur which would be detrimental to placement and setting of concrete, such as pile driving or other vibration, stop the cause of such condition when concrete is being placed and until concrete has aged 12 hours.

Handling and Transporting Concrete: The Contractor shall use metal or metal lined chutes, troughs, and/or pipes in placing concrete to prevent separation of concrete ingredients. When pouring down steep slopes, chutes will be equipped with baffles to reverse lateral direction of movement. Downpipe will be provided at end of chute. A maximum slope of one vertical to two horizontals will be used. Chutes and troughs

will be kept free from coatings of hardened concrete or other harmful material. Chutes in excess of 35 feet in length may be used by authorization of the Engineer only. Pumping of concrete may be done by authorization of Engineer only.

Placing Concrete: Free fall of concrete will be limited to 4 feet. The Contractor shall place concrete in walls and other inaccessible places by use of tremies. Concrete will be placed as close as possible to its final location. Vibrators will not be used to work concrete along the forms. Concrete, reinforcing steel or forms will not be jarred, moved, or otherwise disturbed after concrete has taken initial set. Concrete will be placed in continuous horizontal layers approximately 12 inches thick. Each successive layer will be placed while the layer below is still plactic. If excessive water forms on the surface of concrete, use concrete to a point approximately 1 foot below finish elevation and allow to settle. To avoid cold joint, resume placement of concrete after partial stiffening. Retempering of concrete or mortar which has partially hardened will not be permitted.

Consolidating Concrete: Consolidation of concrete will be done by means of spading implements and mechanical vibrators of approved type. Use of vibrators of the type which operate by attachment to forms will be by authorization of the Engineer only. Vibration of concrete will begin immediately after placement and will go completely through to next layer below to insure mixture of both layers. Vibration will not be used for flowing concrete laterally.

Placing Concrete on The Ground: The Contractor shall prepare the subgrade in accordance with the applicable earthwork specifications. Apply membrane waterproofing if called for on the drawings and/or specified elsewhere. If membrane waterproofing is not required, moisten subgrade just prior to placing concrete, to decrease absorption of moisture from the concrete. If necessary, pump or bail during placing operations from suitable slump located outside of forms. Pumping will be continued until concrete has attained initial set. Side forms may be omitted when authorized by the Engineer.

Placing Concrete in Water: The Contractor shall place concrete in water only by specific authorization of the Engineer. Concrete placed in or under water will contain a minimum of 6-1/2 sacks of cement per cubic yard of concrete. The Contractor shall insure that there is no movement or flow of water in which concrete is being placed for at least 36 hours after placement. Do not disturb concrete after placement and maintain approximately horizontal surfaces at all times. Placement will be by use of watertight tremies of a maximum of 10 inches in diameter. When concrete is placed in tremies, raise tremie slightly, but not out of concrete until batch discharges to bottom of hopper. Stop flow by lowering tremie. Placement will be continuous.

Curing Concrete:

a. General: The Contractor shall have the option of using curing compound or cotton mats with the exception of the following: Membrane curing compound will not be used on surfaces to be rubbed, painted or to which waterproofing material or liquid floor hardener is to be applied. Membrane curing compound will not be used on concrete which will have additional concrete placed on it later. Membrane curing will be used for curing surfaces which cannot be satisfactorily cured with mats. Curing mats will be kept moist and in contact with concrete for 7 consecutive days. High early strength concrete will be cured for 3 consecutive curing days.
b. Use of Membrane Curing Compound: Membrane curing compound will be delivered on job site in original containers, labeled to show name of compound, manufacturer, and batch number. Compound will be kept thoroughly mixed and sprayed on the structure using pressure-tank type spraying equipment. The Contractor shall apply curing compound to the concrete immediately upon

removing forms at a rate of one gallon per 200 square feet. Apply compound to slabs or other exposed surfaces immediately after finishing or after excess moisture has disappeared. Membrane will be kept intact and protected from abrasive action for 14 days to obtain equivalent to 7-day moist curing. Protect against traffic and apply protective coating no sooner than 24 hours after application of membrane. Damage to membrane during 14-day period will be repaired immediately.

Removal of Forms and Falsework: See Section 6-L - "Concrete Form Work".

Defective Work: All work which is deemed by the Engineer to be defective will be repaired immediately by the Contractor in accordane with the Engineer's instructions.

Monolithic Slab Finish: Unless otherwise specified, slabs, platforms, and steps will be finished monolithically. Unless otherwise specified, slabs will be level. The Contrator shall place screeds accurately and rigidly prior to placement of concrete. Concrete will be tamped to force coarse aggregate away from surface ; then float finish and steel trowel to finish building floors. "Dusting" of floor surfaces with dry materials will not be permitted. Edges of all expansion joints will be rounded at all expansion joints with suitable jointing or edging tool.

Concrete Floor Topping and Finish: Where specified, concrete floor topping shall be applied by the Contractor to structural slabs after equipment has been set. Topping will be placed without Engineer's authorization. Structural slab will be broomed to expose aggregate when concrete is green. Structural slab will be cleaned and kept moist 12 hours prior to placing topping. Immediately before placing concrete topping, broom in slush coat of cement and water mixed to consistency of thick paint. Use 1 part Portland Cement, 1 part sand, and 1-1/2 parts pea gravel for concrete topping. Use no more than 5 gallons of water per sack of cement. Add 5 pounds of non-shrinking grout aggregate per sack of cement in mix. Steel trowel finish will be provided. If specified, the Contractor shall apply liquid floor hardener in accordance with manufacturer's recommendations. If specified, the Contractor shall apply integral concrete coloring in accordance with manufacturer's recommendations.

Filling for Tie and Bolt Holes: The Contractor shall fill holes solid with cement mortar. Add white cement to mortar so that patches will not appear darker than adjacent concrete surface. Mortar will be placed into holes as dry as possible. Holes passing entirely through concrete will be filled from inside of structure with pressure gun or other device that will force mortar through to outside face. Strike off excess mortar flush with surface and finish to make hole as inconspicuous as possible.

Patching: Slight honey-comb and other minor defects in concrete surfaces will be patched with cement mortar mixed 1 part cement to 2 parts fine aggregate. The Contractor shall repair by cutting out unsatisfactory material and replacing it with new concrete, securely keyed and bonded to old concrete and finish so as to make joints as inconspicuous as possible. Mixture will be as stiff and dry as possible. For hydraulic structures, repair areas in which honey-comb occurs sufficiently to cause leakage through concrete, using mortar to which nonshrinking grout aggregate has been added at the rate of 5 pounds per sack of cement.

Rub-Finish Surfaces:

a. Extent Required: Exposed vertical and battered surfaces will be rub-finished from 6 inches below surface or from below water level to the top, except for small structures which extend 12 inches or less above finished grade.
b. Procedure: The Contractor shall start the rubbing operations immediately after form removal. Do necessary pointing as forms are removed. Remove forms only as rubbing progresses in No. 16 Cororundum Stone or equal. Rub sufficiently to bring to surface paste and to produce smooth dense surface without

irregularities. Add no cement to form surface paste. Spread or brush material which has been ground to paste uniformly over surface and allow to take reset. Do not rub chamfered corners in first surface rubbing. First rubbing will be completed within 36 hours after completion of concrete placement. In preparation for final finish, rub with No. 30 Carborundum Stone or equal. After rubbing, strip surface with brush and allow mortar on surface to take reset; then wash surface with clean water. Leave structure with clean, neat, and uniform appearing finish.

Rough Finish: For concrete having no special finish indicated, remove ties, fill holes, and remove fins and rough edges.

Waterstops: Waterstop material will be completely imbedded in concrete and shall extend an equal distance into both the old and the new concrete. Waterstops will be continuous. Splices will be made in accordance with manufacturer's recommendations and approved by the Engineer.

Grouting:

a. Mixture: The Contractor shall mix grout (proportion by weight) as follows:
For Setting New Equipment: Where clearance is 1 inch or less in thickness, the Contractor shall use 1 part Portland Cement, 1 part clean sharp sand, 7/10 part nonshrinking grout aggregate. No more than 5-1/2 gallons water per sack of cement. Where clearance is over 1 inch in thickness, the Contractor shall use 1 part Portland Cement, 1 part clean sharp sand, and 1-1/2 parts 1/4 inch pea gravel, 7/10 part nonshrinking grout aggregate. No more than 6 gallons of water per sack of cement.
Other: For general purpose grouting, the Contractor shall use 1 part Portland Cement and 2 parts sand. When space to be grouted is less than 1 inch, and it is impossible to tamp grout, use 1 to 1 mixture. Use stiff mixture for grout to be tamped. To obtain stiff grout mix mortar using amount of water required to thoroughly mix ingredients, then continue mixing without additional water until grout is stiff enough to be compacted by tamping when placed. For grouting blockouts for embedded pipes and similar items, use grout to which 5 pounds of non-shrinking grout aggregate per sack of cement has been added.

b. Procedure for Grouting Equipment: The surfaces of foundations that are to receive grout will be free of all laitance, grease, oil, organic matter and loose particles. Bolt holes will be cleaned of all extraneous matter. Concrete will be chipped in order to obtain a firmer bond as directed by the Engineer. Forms for the grout will be set true, level, and tight, and shall be well braced. All equipment to be grouted shall be assembled at the grouting site before grouting operations begin. Base plates and items to be embedded shall be cleaned and set in their final positions prior to the start of grouting operations. All equipment shall be so shimmed as to facilitate the removal of the shims. Shims shall be removed only after the grout has attained its full strength. The areas to receive grout shall be kept wet for a minimum of 12 hours prior to grouting. Neat cement mortar slush coat shall applied with a stiff brush, and shall be scrubbed into the concrete foundation and applied to the sides and bottom of the base plate or other item to be set. The mortar shall be thoroughly mixed and an excess of water in the mixture shall be avoided. The grout shall be continuously worked and rodded while it is being placed in the forms. All grout destroyed in the removal of shims shall be replaced with grout of the exact same composition and consistency. All grout containing non-shrinkage grout aggregate shall be cut off vertically below the outside edge of the base plate or the base of the embedded equipment, and normal cement mortar shall be used to cover the edge of the grout. All exposed surfaces of the grout shall be steel troweled. all exposed areas

shall be protected against rapid drying out. Items embedded in grout shall not be stressed. The machinery embedded in the grout shall not be operated for 36 hours.

6 - P CONCRETE CURB AND GUTTER AND CONCRETE VALLEY GUTTER

MATERIALS:

Reinforcing Steel and Dowel Bars: Billet steel, ASTM A615 Grade 40. When not shown on the drawings, provide:

a. Reinforcing Steel 3-No. 4 bars (deformed bars).
b. Dowels 2-No 5. bars (smooth bars).

If plans specifically show no steel in details, then plan details shall apply.

Concrete: Concrete shall be specified in Section 6-O "Concrete Structures" and Section 6-N "Heavyweight Aggregate Concrete," Class B.

Expansion Joint Material: Expansion joint material shall be redwood material.

a. Redwood expansion joint material shall be 3/4", preshaped to the curb and gutter dimensions. The material shall be free of knots and splits and shall be fabricated with not more than two (2) separate pieces of material.

Mortar Topping:

a. Cement: ASTM C-150, Type I.
b. Water: ASTM C-94. Potable water need not be tested.
c. Sand: ASTM C-33
d. Mix: 1 part cement and 2 parts sand

CONSTRUCTION METHODS:

Excavation: Excavation, preparation of subgrade and backfill shall be in conformance with the section of these specifications entitled 'Street Excavation and Backfill", Section 6-S.

Subgrade: The subgrade under the curb and gutter shall be compacted to the density shown on the drawings. When a density is not shown on the drawings, compaction shall be 95% Standard Proctor Density (AASHO T-99).

Forms: The forms shall be straight, durable and have a depth equal to the required concrete depth. The forms shall be securely staked to line and grade in such a manner that there shallbe no movement when the concrete is placed. The subgrade shall be free of loose material and wet down before placing concrete. Concrete shall not be placed until forms have been approved by the Engineer.

Reinforcing Steel: Reinforcing steel, expansion joints with dowels and transverse marking shall be located and accomplished in accordance with the drawings.

Concrete Placement: The concrete shall be placed in such a manner so that segregation does not occur. The concrete shall be thoroughly tamped with a "jitterbug" or other approved tool.

Shaping: The curb and gutter shall be shaped using a "mule" approved by the Engineer.

Mortar Topping: The mortar topping shall be placed no longer than on hour after the initial set of the concrete. The mortar topping shall be smoothed with an approved "mule", all joints and edges shall be tooled, then the topping shall be lightly broomed with a hair broom.

Curing: Immediately after the brooming has been completed, curing compound shall be evenly applied. The quantity applied shall be as directed by the Engineer.

Removal of Forms: Back forms and lip forms shall be left in place for at least 24 hours. All honey comb shall be plastered before backfilling is accomplished.

Backfilling: The concrete curb and gutter shall be carefully backfilled with material taken from the excavation. All excess material shall be hauled off the site by the Contactor. The area adjacent to the curb and gutter shall be uniformly graded so as to provide positive drainage towards the street.

SCOPE: This specification shall govern all work necessary to complete the open cutting of existing roadways.

GENERAL: This section includes furnishing all equipment, labor, materials and the performance of all operations required to open cut and repair existing roadways.

CONSTRUCTION METHODS:

General: The primary requirement of this specification is to perform a controlled cut and removal of existing pavement and base material, excavate a ditch therein, backfill the cut area in such a manner as to minimize future settlement from occurring, and place either a base coarse and HMAC pavement for roads previously paved or a limestone base for unpaved roads.

Initial Pavement Cut: The initial pavement cut shall be of sufficient dimensions to allow for excavation of required ditch and side slopes within. A pneumatic hammer or equivalent tool should be used to perform this cut uniformly around the area to be excavated.

EXCAVATION AND BACKFILL:

General: The Contractor shall obtain written authorization to cut a city street prior to any construction beginning. A traffic plan may be required as determined by the City Manager or his representative.

Vertical Side: When possible to minimize the width of the street cut the Contractor shall maintain vertical sides of the trench. The contractor shall install any sheeting, dewatering, shoring and bracing as necessary to provide a safe work area as required to protect workmen and the adjacent street structure.

Backfill Material: Shall be existing material unless the existing material containes large lumps, or clods, which will not readily breakdown under compaction.

Initial Backfill: Initial backfill is defined as that backfill from the bottom of the trench to 1 foot above the top of the pipe. The contractor shall place initial backfill in maximum 8" layers (loose measured and mechanical) tamp it to at least 90% standard proctor density - ASTM Specification D-698. Backfill below the top of the pipe shall be placed and compacted along sides of the pipe equally.

Final Backfill: Final backfill is defined as that backfill from 1 foot above the pipe to the street subgrade. The material shall be placed in loose layers not exceeding 18" and compacted by water jetting. The Contractor is responsible for securing stable backfill of a density equivalent to adjoining ground as checked by probe rod or density test.

Water Jetting: Water jetting shall be accomplished by pumping water into the backfill be means of a pump and not less than a 1-1/2" pipe which is of sufficient length to reach the bottom of the trench excavation. During jetting dewatering equipment should not be operated in order to assure that the entire backfill is completely saturated with water. Consolidation of the saturated backfill may be required by means of a vibratory roller or other means of vibration as may be deemed necessary by the City Manager or his representative.

Final Pavement Cut: After backfill operations are complete to the underside of the existing base course, the existing pavement shall be saw cut back to a point 9 inches beyond the area disturbed by construction. The area disturbed by construction to be determined in the field by the City's representative.

Base Course: The base course shall be equal to the thickness of the road being cut but in no case shall be less than 6". For roads with flexible base material (if caliche, shell or limestone), the patch base material shall be limestone compacted to 98% Std. proctor density. For semi-ridged pavements (cement stabilized sand) the base material shall be cement stabilized sand and shall be placed in accordance with Section 6-H.

Prime Coat: Shall comply with Specification 6-J, Section 6 of this document.

Hot Mixed-Hot Laid Asphaltic Concrete Pavement: Shall be equal in thickness to the existing pavement but in no case shall be less than 1-1/2" and shall comply with Specification 6-K, Section 6 of this document.

WARRANTY: The Contractor performing the street cut shall guaranty the cut to be free from subsidence for a period of 2 years from time complete of the cut.

6 - R CONCRETE SIDEWALK AND CONCRETE DRIVEWAYS

SCOPE: This specification shall govern for all work necessary to provide the concrete sidewalk and/or conrete driveways required to complete the project.

MATERIALS:

Reinforcing Steel Dowel Bars: Bilet Steel, ASTM A615 Grade 40.

When not shown on the drawings, provide:

a. Reinforcing steel 6" x 6" - No. 6 x No. 6 wire mesh reinforcing.

b. Dowels - No. 4 Bars (smooth bars) according to the following schedule:

Width of Walk	No. of Dowels per Joints
3 ft.	2
4 ft.	3
5 ft.	4
6 ft.	5
7 ft.	6
8 ft.	6

Concrete: Concrete shall be as specified in Section 6-O "Concrete Structures" and Section B-7 "Heavyweight Aggregate Concrete", Class B.

Expansion Joint Material: Expansion joint material shall be premolded bituminous expansion joint material conforming to ASTM D-994 (not wood-fiber type) or straight and sound Redwood without holes or splits. Unless shown otherwise on the drawings, provide 1/2 inch thick bituminous expansion joint material or 3/4 inch Redwood.

Curing Compound: Resin base ASTM C309 Type I, with light red tint of fugitive dye.

Snad-cement Mixture:

a. Cement - ASTM C-150, type I

b. Sand - ASTM C33

CONSTRUCTION METHODS:

Excavation: Excavation shall include all classes of material, including old concrete.

Subgrade: Subgrade under the sidewalk and/or driveway shall be thoroughly compacted and shall be true to line and grade. The subgrade shall be free from soft sopts and loose material. Compaction under concrete driveways shall be 95% Standard Proctor Density (ASTM D-698) unless shown otherwise on the drawings.

Forms: Forms shall be straight, durable and have a depth equal to the required concrete depth (Commercial size lumber may be used provided full depth of concrete is obtained). The forms shall be securely staked to line and grade in such a manner that there shall be no movement when the concrete is placed. The subgrade shall be wet down before placing concrete. The forms shall be cleaned and oiled before placing concrete. Concrete shall not be placed until forms have been approved by the Engineer.

Reinforcing Steel: Reinforcing steel, expansion joints with dowels and transverse marking shall be located and accompolished in accordance with the drawings. When not shown o the drawings, provide doweled expansion joints at changes of direction and at maximum 0 feet spacing. Transverse markings when not shown on the drawings shall be 1/8 inch wide and 1/2 inch (min.) depth.

Expansion Joints and Transverse Markings: Expansion joints and transverse markings shall be square with the sidewalk and/or concrete driveway.

Concrete Placement: The concrete shall be placed in such a manner so that segregation does not occur. The concrete shall be thoroughly tamped with a "jitterbug" or other approved tool.

Jointing and Tooling: All joints and edges shall be tooled and the finished surface shall be lightly broomed (with a hair broom) to provide a non-skid surface. When directed by the Engineer, the Contractor shall apply an approved sand-cement mixture to the surface just before the final floating and troweling.

Curing: Immediately after the brooming has been comleted, curing compound shall be evenly applied. The quantity applied shall be as directed by the Engineer.

Removing Forms: Form shall be carefully removed so that the sidewalk and/or concrete driveway is not damaged. All "honey comb" shall be plastered before backfilling is accomplished.

Joining New and Old Concrete: When joining new and old concrete, the old concrete shall be thoroughly cleaned, then painted with an epoxy bonding agent. The epoxy bonding agent shall be applied in strict conformance with manufacturer's recommendations.

Backfilling: The concrete sidewalk shall be carefully backfilled with material taken from the excavation. All excess material shall be hauled off the site by the Contractor. The area adjacent to the sidewalk and/or driveway shall be uniformly graded so as to provide positive drainage towards the street.

6 - S STREET EXCAVATION AND BACKFILL

SCOPE: This specification shall govern for all work necessary to accomplish the street excavation and backfill required to complete the project.

MATERIAL: Street excavation shall include all materials encountered, including dirt, asphalt, base material, concrete masonry, rock, trees, stumps and roots.

CONSTRUCTION METHODS:

Excavation: The Contractor shall excavate all materials encountered to conform to the grades and sections shown on the drawings for finished subgrade. All unstable or unsuitable material shall be removed from the subgrade and replaced with approved material.

Embankment: The provisions of compacted embankment shall apply.

Subgrade Preparation: The surface of the subgrade shall be finished to the grades and sections shown on the drawings. The subgrade shall be protected from excessive wetting and/or drying until the base course is placed. If necessary, the subgrade shall be wetted, reshaped and rolled as directed by the Engineer to place the subgrade in an acceptable condition to receive the base material (moisture content shall be within 5% above or below the optimum). The Contractor shall not place the base material until the subgrade has been inspected and approved by the Engineer.

Density of Subgrade: It is the intent of this specification that the top 6" of the subgrade be compacted to a minimum dry density of 95% Standard Proctor Density as prescribed by A.A.S.H.O. Standard Method T-99.

Backfilling: The Contractor shall backfill from the back of the curb to the structure with the best material taken from either structural excavation, pipe trench excavation and/or street excavation as directed by the Engineer.

Density of Backfilling: It is the intent of this specification that the top 12" of backfill behind the curb be compacted to at least 85% Standard Proctor Density as prescribed by A.A.S.H.O. Standard Method T-99. All other fill and backfill shall be compacted to the density required for embankment.

Grading: The provision of "Site Grading" shall apply.

Excess and Unsuitable Excavated Material: All excess and/or unsuitable excavated material shall be loaded and hauled to the disposal area shown on the drawings.

6 - T FIRE HYDRANT

SCOPE: This specification shall govern for all work necessary to provide all fire hydrants required to complete the project.

MATERIAL:

Concrete: Concrete shall have a minimum compressive strength of 2000 p.s.i. at 28 days and shall be in accordance with Section 6-N "Heavyweight Aggregate Concrete".

Fire Hydrants: The fire hydrants shall conform to A.W.W.A. C-502, latest revision thereof, except for changes, additions and supplementary details specifically outlined herein:

a. Hydrants shall be of the traffic model type equipped with a safety flange or collar on both the hydrant barrel and stem.
b. Type of Shutoff - The shut off shall be of the compression type only.
c. Inlet Connection - The inlet shall be A.W.W.A. C111 (latest revision thereof) mechanical joint for six (6") inch, Class 50 ductile iron pipe. A complete set of joint material shall be furnished with each hydrant.
d. Delivery Clasifications - Each hydrant shall have two hose nozzles and one pumper nozzle. Nozzle shall be threaded into the hydrant.
e. Bury Length - The hydrants shall be furnished in the bury length as specified.
f. Diameter (Nominal Inside) of Hose and Pumper Nozzles - The hose nozzles shall be two and one-half (2-1/2") inches inside diameter and the pumper nozzle shall be four (4") inches inside diameter.
g. Hose and Pumper Nozzle Threads - The hose nozzles shall have two and one-half (2-1/2) inch National Standard Thread (7-1/2 threads per inch). The pumper nozzle shall have six (6) threads per inch with an outside diameter of 4.658 inches, pitch diameter of 4.543 inches, and a root diameter of 4.406 inches.
h. Harnessing Lugs - None required.
i. Nozzle Cap Gaskets - Required.
j. Drain Opening - Drain opening is required. Tapping of the drain opening for pipe threads is not required.
k. The Valve Seat Ring - The valve seat ring shall not be made an integral part of the shoe. The valve seat ring shall be bronze and shall thread into a bronze drain ring.
l. Nozzle Cap Chains - Hydrants shall be furnished with nozzle cap chains.
m. Direction to Open - The hydrants shall open left (counter clockwise).
n. Color of Finish Above Ground Line - That portion of the hydrant above the ground line shall be painted chrome yellow.
o. Shape and Size of Operating and Cap Nuts - The operating and cap nuts shall be tapered pentagon one and one-fourth (1-1/4") inch point to face at base and one and one-eight (1-1/8") inch point to face at top of nut.
p. Size of Fire Hydrant - The main valve opening shall not be less than five and one-fourth (5-1/4") inches inside diameter.

q. Valve Facing - The main valve facing of the hydrant shall be rubber with 90± one (1) durometer hardness. When the main valve lower washer and stem nu are not an integral casting then the bottom stem threads shall be protected with ductile and/or bronze cap nut and a stainless steel and/or bronze lock nut.

r. Barrel Sections - The hydrant shall be made in two or more barrel sections with flanges connecting the barrel to the elbow and to the packing plate.

s. Breakable Coupling - Hydrants shall be equipped with a breakable coupling on both the barrel section and the stem. The couplings shall be so designed that in case of traffic collision, the barrel and stem collar will break before any other part of the hydrant breaks. These couplings shall be at least two (2) inches above the finished grade line.

t. Hydrant Adjustment - The hydrant shall be designed as to permit its extension without excavating after the hydrant is completely installed.

u. Breakable Collars, Barrel and Stem - Weakened steel or weakened cast iron bolts that are used in the breakable barrel couplings will not be acceptable.

v. Operating Stem - Stems that have operating threads located in the waterway shall be made of manganese bronze, everdure, or other high quality non-corrodible metal. Stems that do not have operating threads located in the waterway must be sealed by a packing gland or "O" ring seal located between the stem threads and the waterway. Iron or steel stems shall be constructed with a bronze sleeve extending through the packing "O" ring seal area. The sleeve shall be of sufficient length to be in the packing or "O" ring seal in both open and closed positions of the main valve. The sleeve shall be secured to the steel stem so as to prevent water leakage between the two when subjected to 300 pounds hydrostatic test pressure.

w. Drain Valve Mechanism - Drain valves operating through springs or gravity are not acceptable.

x. Operating Stem Nut - The operating stem nut shall be designed to prevent seepage, rain, or sleet and the accumulation of dust between the operating nut and the hydrant top. The operating stem nut shall be made of bronze.

y. Packing Gland or "O" Ring Seal - Fire hydrants having the threaded part of the stem at the hydrant top shall be equipped with a packing gland or an "O" ring seal immediately below the threaded section of the stem.

CONSTRUCTION METHODS:

General: Fire hydrants shall be located in accordance with the lines and grades shown on the drawings. Fire hydrants shall stand plumb and hose nozzle shall be parallel to curb and street with the pumper nozzle facing the street.

Location: It is the intent of these specifications that the fire hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than 12-inches nor more than 18-inches from the back of the curb and the bury line on the barrel shall be level with the top of the curb. It is also intended that no portion of the hydrant or nozzle cap shall be within 6-inches of the sidewalk. If the established lines and grades violate any of the above stated conditions, notify the Engineer immediately so that remedial instructions can be given to the Contractor.

Connection to Main: Each hydrant shall be connected to the main with a six (6") inch branch line controlled by an independent six (6") inch gate valve, open left. All pipe from the main tee to the fire hydrant shall be Class 150 - 6 inch cast iron pipe, swivel or anchor fittings shall be used to connect the fire hydrant gate valve to the waterline.

Thrust Blocking: The bowl of each hydrant shall be securely braced against undisturbed earth at the end of the trench with concrete thrust blocking.

Drainage Pit: A drainage pit 2 feet in diameter and 2 feet in depth shall be excavated below each hydrant and filled compactly with coarse sand, under and around the bowl of the hydrant and to a level 6-inches above the waste opening. No hydrant drainage pit shall be connected to a sewer.

Washing and Sterilizing Fittings: Valves, hydrants and fittings shall be stored on t timbers and kept clean. Where soil or other substances have come in contact with the water surfaces of the fittings, the interior shall be washed and sterilized with an approved sterilizing agent.

Certification: The manufacturer shall upon request furnish two (2) certified sets of prints showing complete details and dimensions of the hydrant. The manufacturer shall upon request furnish one (1) certified copy of the physical tests of all metals used in the manufacture of the fire hydrant that is normally manufactured and that will meet these specifications. The manufacturer shall upon request furnish a certified letter of compliance stating that their fire hydrant meets these specifications.