SECTION 33 46 00

SUBDRAINAGE

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Pipe and Fittings

B. Drainage Material

1.02 RELATED SECTIONS

A. Structure excavation and backfill are specified in Section 31 00 00, Earthwork.

B. Trenching and backfilling for pipelines are specified in Section 33 05 28, Trenching and Backfilling for Utilities.

C. Site drainage and surface run-off collection system are specified in Section 33 40 00, Storm Drainage Utilities.

1.03 MEASUREMENT AND PAYMENT

A. General

1. Subsurface Drainage System at Concrete Walls and Foundations: Measurement and payment for subsurface drainage systems, installed complete in place, will be by the lump-sum method as determined by the listing of the bid item for subsurface drainage systems indicated in the Bid Schedule of the Bid Form.

2. Composite Underdrains Along Trackway: Measurement and payment for composite underdrains, installed complete in place, will be either by the lump-sum method or by the unit price method as determined by the listing of the bid item for composite underdrains indicated in the Bid Schedule of the Bid Form.

3. Measurement: Excavating, trenching, and backfilling, filter aggregate, asphalt-treated permeable material, filter fabric, pipe fittings and joints, risers and cleanouts, preformed permeable drainage liner, and related fasteners and accessories will not be measured separately for payment, and all costs connected therewith will be considered as included in the lump-sum measurement for subsurface drainage systems and the lump-sum or unit-price measurement for composite underdrains.

B. Lump Sum: If the Bid Schedule indicates a lump sum for subsurface drainage systems and composite underdrains, the lump-sum method of measurement and payment will be in accordance with Section 01 20 00, Price and Payment Procedures, Article 1.02 Lump-Sum Measurement.

C. Unit Price: If the Bid Schedule indicates a unit price for composite underdrains along trackways, the unit-price method of measurement and payment will be as follows:

1. Measurement: Composite underdrains along trackways will be measured for payment by the linear foot, along the centerline of the pipe, installed complete in place.

2. Payment: Composite underdrains along trackways will be paid for at the indicated Contract unit price for the computed quantities as determined by the measurement method specified in Article 1.03.C.1.

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM C14	Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
2. ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
3. ASTM C425	Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
4. ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
5. ASTM C444	Standard Specification for Perforated Concrete Pipe
6. ASTM C654	Standard Specification for Porous Concrete Pipe
7. ASTM D1593	Standard Specification for Nonrigid Vinyl Chloride Plastic Film and Sheeting
8. ASTM D2564	Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
9. ASTM D2665	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
10. ASTM D2729	Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
11. ASTM F758	Standard Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage

B. State of California, Department of Transportation (Caltrans), Standard Specifications:

- Section 29 Treated Permeable Bases
- Section 96 Geosynthetics

1.05 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Shop Drawings: Submit detailed drawings that indicate subsurface drainage in plan and section, including relationship to other systems, interfaces, connections, alignment, grade, bedding, drainage and filter aggregates, and other pertinent data.

C. Product Data: Submit manufacturers' product data for pipe, pipe connection materials, permeable drainage liner for foundation walls and retaining walls, filter fabric (geotextiles), and impermeable sheet liner.

PART 2 – PRODUCTS

2.01 PIPE AND FITTINGS

A. Pipe Connection Requirements: Ends of pipe shall be bell-and-spigot, grooved, shiplapped, or secured with couplings, collars, or other connection fittings to assure continuous alignment of pipe.

B. Concrete Pipe:

1. Plain Pipe: ASTM C14, Class 3.
2. Reinforced Pipe: ASTM C76, Class III.
3. Perforated Pipe: ASTM C444, Type I perforations, and conforming to ASTM C14, Class 3.
4. Porous Pipe: ASTM C654.
5. Joints and Gaskets: ASTM C443.

C. Plastic Pipe:

1. Pipe:
   a. PVC Pipe, Perforated: ASTM F758. Holes for all pipe sizes shall be 3/8-inch size. Perforated 6-inch diameter pipe may be ASTM D2729 or ASTM F758.
   b. PVC Pipe, Solid Wall: ASTM D2665, ASTM D2729, or ASTM F758, as applicable.
2. Cement: ASTM D2564.

2.02 DRAINAGE MATERIALS

A. Drainage and Filter Aggregates: Aggregate drainage and filter material (permeable material) for filling trenches under, around, and over underdrains, behind foundation and retaining walls, and for pervious blankets shall consist of clean, coarse sand and gravel or crushed stone, conforming to the following grading requirements:

Sieve Size	Percentage Passing Sieve
1 inch	100
3/4 inch	70-100
3/8 inch	40-100
No. 4	25-55
No. 10	0-40
No. 200	0-5

B. Asphalt Treated Permeable Material: Provide asphalt treated permeable base conforming with Caltrans Standard Specifications, Section 29.

C. Filter Fabric: Geotextile engineering fabric conforming to the Caltrans Standard Specifications, Section 96 Geosynthetics, for Filter Fabric for Underdrains.

D. Preformed Permeable Drainage Liner: Prefabricated composite plastic drainage panels designed to provide hydrostatic relief for concrete foundation walls and retaining walls as indicated. Panels shall be a button-pattern or other raised dimple feature which forms a drain core with flow channels at least 3/8 inch in thickness or clear depth, with geotextile filter fabric bonded to the raised pattern to prevent soil from entering the core channels and blocking the flow of water. Furnish drainage liner complete with installation accessories.

1. Drainage Matting: Hydrostatic-relief drainage liner may be a composite drainage matting, consisting of a nylon or polypropylene core geomatrix of open, three-dimensional design, with a geotextile filter fabric bonded to the core to prevent soil from entering the core and blocking the flow of water. Minimum thickness or clear depth shall be 1/2 inch. Furnish drainage matting complete with installation accessories.

E. Impermeable Sheet Liner: Flexible membrane sheeting, polyvinyl chloride conforming to ASTM D1593, minimum 10 mils thick.

1. Adhesive: Synthetic rubber base cement, manufactured for use with polyvinyl chloride or synthetic rubber membrane material for cold application.

2. Tape: Tape for sealing of laps and joints shall be a pressure-sensitive neoprene or vinyl-chloride rubber adhesive tape as recommended by the manufacturer of the sheet liner material or a heavy-duty cloth masking tape, minimum 3 inches wide.

PART 3 – EXECUTION

3.01 INSTALLATION OF PIPE

A. Excavate trenches for underdrain pipe as indicated. When not indicated, excavate to a width equal to the outside diameter of the pipe plus 12 inches and to a depth of 2 inches minimum below the grade established for the invert of the pipe. Coordinate with Section 31 00 00, Earthwork, and Section 33 05 28, Trenching and Backfilling for Utilities, as applicable.

B. Lay impermeable sheet liner over prepared and compacted sub grade where indicated. Lap edges not less than four inches and ends not less than six inches, with all laps sealed continuously with adhesive and tape. Repair punctures and tears in liner sheets that occur during subsequent construction operations.

C. Lay pipe to line and grade indicated. If pipe is of the bell-and-spigot type, lay bells in crosscuts cut in trench. Lay pipe with bell end uphill.

D. Fill space below the pipe invert with a layer of drainage aggregate as indicated, upon which the pipe shall be laid with perforations down. Sections shall be joined with sleeve couplings furnished by the pipe manufacturer or other appropriate method as determined by the pipe-ends configuration and approved by the Engineer. Employ appropriate equipment to draw pipe sections together.

E. Rocks, bricks, broken concrete or asphalt shall not be used to give intermediate support to pipes. Large stones or other hard objects shall not be left in contact with the pipes.

F. Fill excavations for underdrains with drainage or filter aggregates as indicated. Place drainage aggregate and compact as required to fill voids and prevent settlement, without damaging the underdrain pipe.

3.02 COMPOSITE UNDERDRAINS

A. Construct composite underdrains as indicated. Surround perforated pipe with filter aggregates and envelope the composite underdrain with filter fabric as indicated. Provide solid-wall PVC pipe risers and cleanouts, including installation accessories, as indicated.

3.03 INSTALLATION OF PERMEABLE DRAINAGE LINER

A. Apply preformed permeable drainage liner or drainage matting to below-grade concrete walls as indicated. Apply panels in accordance with the manufacturer’s instructions, with filter fabric side out.

B. Shingle each course, overlapping panels in the direction of water flow. Provide side laps in accordance with manufacturer’s instructions.

C. Provide interface with subsurface drainage piping at footings where indicated. Follow manufacturer’s instructions for correct interface installation.

END OF SECTION 33 46 00