PRECAST REINFORCED CONCRETE THREE-SIDED FLAT-TOPPED DRAINAGE STRUCTURE

The Standard Specifications are revised as follows:

SECTION 723, BEGIN LINE 1, INSERT AS FOLLOWS:

SECTION 723 – REINFORCED CONCRETE THREE-SIDED FLAT-TOPPED DRAINAGE STRUCTURE

723.01 Description

This work shall consist of constructing a precast reinforced concrete three-sided flat-topped structure with headwalls and wingwalls in accordance with 105.03, 714 and ASTM C 1504. Wingwalls, headwalls, and spandrel walls may be precast or cast-in-place.

723.02 Materials

The materials shall be in accordance with the following:

Structure Backfill	*904*
Flowable Backfill	*213*
Geotextiles	*913.18*
Riprap	*904*
Sealer	*909.09 or 909.10*

Concrete for footings and base slabs shall be Class B in accordance with 702 The coarse aggregate for precast members shall be Size No. 91 in accordance with 904.

A water-reducing admixture from the Department's list of approved Water-Reducing Admixtures may be used.

Reinforcing steel in structure sections and precast wingwalls shall be welded wire fabric, welded deformed steel wire fabric, or deformed billet steel bars in accordance with 910.01, except as noted herein. Reinforcing steel in the cast-in-place wingwalls, pedestals, base slabs, headwalls, and footings shall be deformed billet steel bars in accordance with 910.01. Reinforcing steel in the headwalls and spandrel walls shall be epoxy coated. Reinforcing steel in the structure sections shall be epoxy coated where the height of cover, including the pavement section, is less than 2 ft (600 mm) as measured at the edge of travel lane.

Wingwalls, headwalls, and spandrel walls shall be connected to outside structure sections. Precast wingwalls shall be connected with bolted steel plates. Steel used in bolted connections of wingwalls to structure sections shall be in accordance with ASTM A 709 grade 36 (ASTM A 709M grade 250) and galvanized after fabrication in accordance with ASTM A 153 (ASTM A 153M), Class A or B. Bolts shall be in accordance with ASTM A 307 and galvanized in accordance with ASTM A 153 (ASTM A 153M).

Weep holes shall be provided in all wingwalls.

CONSTRUCTION REQUIREMENTS

723.03 Shop Drawings

The Contractor shall submit, for approval, three copies of design computations and five sets of shop drawings with each sheet signed by and bearing the seal of a professional engineer. A longhand example of the design methodology shall be furnished if the design calculations are in a computer printout format. The shop drawings shall include all details, dimensions, and quantities necessary to construct the structure, wingwalls, and headwalls if applicable and shall include, but not be limited to, the following information.

(a) Structure span and rise;

(b) Structure section details showing all concrete dimensions and reinforcing steel requirements;

(c) Design computations and details for pedestals, when required;

(d) Footing design computations and details showing all concrete dimensions, elevations, and reinforcing steel with bar size, bar bending diagrams, length, and spacing indicated. Footing plan and section views shall be provided. If a pile footing is required, the pile layout shall be shown. The actual soil bearing pressure shall be noted on the footing detail sheets.

(e) Wingwall design computations and details showing all concrete dimensions, reinforcing steel, bar bending diagrams, and anchorage details. Wingwall plan, elevation, and section views shall be provided.

(f) Headwall details, showing all concrete dimensions, reinforcing steel, bar bending diagrams, and anchorage details. Headwall elevation and section views shall be provided.

(g) Structure backfill type and limits for the structure and wingwalls.

(h) Minimum concrete strength for all precast portions of the structure.

Structure section or wingwall fabrication shall not begin until written approval of the shop drawings and design computations have been received from the Engineer.

723.04 Design

Except as modified herein, the structure sections shall be designed for:

a. the live load shown on the General Plan for the structure, or

b. HL-93 in accordance with the AASHTO LRFD Bridge Design Specifications, if no live load design criteria are shown on the General Plan.

The minimum design concrete compressive strength for structure sections shall be 5,000 psi (35 000 kPa) and for wingwalls, and headwalls it shall be 4,000 psi (27 600 kPa). Wingwalls and headwalls shall be designed based on a minimum equivalent fluid pressure of 40 lb/ft^3 (6.3 kN/m^3). If flowable mortar backfill is to be used, the Contractor

shall consider the effects of hydrostatic pressure on the structure. Horizontal pressures shall be increased for sloping backfill surfaces and live load surcharge. Footings shall be designed for the allowable soil bearing shown on the plans. Wingwalls and wingwall footings shall be designed in accordance with the soil parameters shown on the plans. Wingwall footings and headwall or spandrel wall connections shall be checked for sliding and for overturning. Headwalls with bridge rail mounted on top and the anchorage of the headwall or spandrel wall to the structure section shall be designed for AASHTO traffic railing loadings.

Continuity shall be established between the structure footing and the wingwall footing.

1. Placement of Reinforcement

The cover dimension over the top mat of reinforcement shall be a minimum of 2 in. (50 mm). The cover over the lower mat of reinforcement in the structure top shall be a minimum of 1.5 in. (40 mm). The clear distance of the end circumferential reinforcement shall not be less than 1 in. (25 mm) nor more than 2 in. (50 mm) from the ends of the structure section. The ends of the longitudinal distribution reinforcement shall not be more than 2 in. (50 mm) from the ends of the structure section.

Cover for wingwall, pedestal, headwall and spandrel wall reinforcement shall be a minimum of 2 in. (50 mm). Cover for footing and base slab reinforcement shall be 3 in. (75 mm) for the top and sides and 4 in.(100 mm) for the bottom.

2. Splicing and Spacing of Reinforcing Steel

Except as noted herein, reinforcing steel splicing and spacing requirements shall be in accordance with the AASHTO document shown on the General Plan for the structure or the AASHTO LRFD Bridge Design Specifications if no AASHTO document is shown. Tension splices in circumferential reinforcement shall be made by lapping. Deformed billet steel bars used for longitudinal distribution reinforcement shall have a center to center spacing not to exceed 12 in. (300 mm) in flat-topped structure sections.

The maximum spacing for wingwall reinforcing steel shall be 18 in. (450 mm) for horizontal bars and 12 in. (300 mm) for vertical bars.

Exterior corner reinforcement shall be fully developed beyond the point where it is no longer required to resist flexure.

723.05 Manufacture

Handling devices or holes will be permitted in each structure or wingwall section. However, not more than six holes shall be cast or drilled in each section. Cast holes shall be tapered.

The section ends shall be of such design and shall be so formed that when the structure sections are erected, they shall make a continuous line of structure with a smooth interior free of irregularities.

The structure sections, wingwalls, headwalls, and spandrel walls shall be free of fractures. The ends of the structure sections shall be normal to the walls and centerline,

except where beveled ends are specified. The surface of the structure sections shall be a smooth steel form or troweled surface. Trapped air pockets causing surface defects shall be considered as part of a smooth steel form finish.

Wingwalls shall be given a finish in accordance with 702.21.

The structure units shall not be stored in an upright position until the designated handling and storage compressive strength, as shown on the shop drawings, has been achieved.

723.06 Marking

Each structure section and wingwall shall be clearly marked with waterproof paint. The following information shall be shown on the inside face of each wingwall and on a vertical leg of each structure section.

1. *structure span and rise (structure sections only)*
2. *date of manufacture*
3. *name or trademark of the manufacturer*
4. *design earth cover*

723.07 Testing

1. Type of Test Specimen

Concrete compressive strength shall be determined from compression tests made on cylinders or cores. For cylinder testing, a minimum of four cylinders shall be taken during each production run of structure sections or wingwalls. For core testing, one core shall be cut from a structure section selected at random from each group of 15 structure sections or less of a particular size and production run. One core shall be cut from each group of four or fewer wingwalls. For each continuous production run, each group of 15 structure sections of a single size or fraction thereof or four wingwalls shall be considered separately for the purpose of testing and acceptance. A production run shall be considered continuous if not interrupted for more than three consecutive days.

2. Compression Testing

Cylinders shall be made and tested in accordance with ASTM C 39. Cores shall be obtained and tested for compressive strength in accordance with ASTM C 497 (ASTM C 497M).

3. Acceptability of Core Tests

The compressive strength of the concrete in each group of sections as defined above will be acceptable when the core test strength is equal to or greater than the design concrete strength. The random selection and testing of the cores taken by the manufacturer will be performed by the Department.

If the compressive strength of the core tested is less than the design concrete strength, the structure section or wingwall from which that core was taken may be

recored. If the compressive strength of the recore is equal to or greater than the design concrete strength, the compressive strength of the concrete in that group of sections will be acceptable.

If the compressive strength of a recore is less than the design concrete strength, the structure section or wingwall from which that core was taken will be rejected. Two structure sections or wingwalls from the remainder of the group shall be selected at random. One core shall be taken from each. If the compressive strength of both cores is equal to or greater than the design concrete strength, the remainder of the structure sections or wingwalls in that group will be acceptable. If the compressive strength of either of the two cores tested is less than the design concrete strength, the remainder of the structure sections or wingwalls in the group will be rejected. However, at the option of the manufacturer, each remaining structure section or wingwall in the remainder of the group may be cored and accepted individually. The sections which have cores with less than the design concrete strength will be rejected.

4. Plugging Core Holes

The core holes shall be plugged and cured by the manufacturer in such a manner that the structure will meet all the test requirements of these specifications. Structure sections or wingwalls repaired accordingly will be considered satisfactory for use.

5. Test Equipment

The manufacturer shall furnish all facilities, equipment, and personnel necessary to conduct the required testing.

723.08 Rejection

Structure sections or wingwalls will also be rejected due to the following conditions.

1. *fractures or cracks pass through the wall, except for a single end crack which does not exceed one half the thickness of the wall;*

2. *defects which indicate proportioning, mixing, or molding which are not in accordance with this specification;*

3. *honeycombed or open texture; or*

4. *damaged section ends, where such damage prevents making a satisfactory joint*

723.09 Repairs

Structure sections or wingwalls may be repaired, if necessary, due to imperfections in manufacture, handling damage, or construction. Repairs will be acceptable if it is determined that the repairs are sound, properly finished and cured, and if the repaired structure section or wingwall is in accordance with the requirements herein.

723.10 Trench Compaction

The soils in the bottom of the excavation shall be compacted to 95% of the

maximum dry density. If 95% of the maximum dry density cannot be obtained in the bottom of the excavation or in other areas, the Office of Geotechnical Engineering shall be contacted for additional recommendations. If during construction, soft soils are encountered at depths that make removal impractical, the Office of Geotechnical Engineering shall be contacted for additional recommendations.

723.11 Footings

Footings may be cast-in-place or precast. When a precast footing is utilized, a 4 in. (100 mm) layer of coarse aggregate No. 53 in accordance with 301 shall be placed under the full width of the footing. All footings shall be given a smooth float finish. The footing concrete shall reach a compressive strength of 2,000 psi (13 800 kPa) before placement of the structure sections or wingwalls. The surface shall not vary more than 1/4 in. in 10 ft (6 mm in 3 m) when tested with 10 ft (3 m) straightedge.

723.12 Pedestals

When a reinforced concrete pedestal is required between the base of the structure leg and the top of the footing, the Contractor shall have the option of providing a structure with extended legs or constructing the pedestals.

723.13 Placement of Structure Sections and Wingwalls

The structure sections and wingwalls shall be set on masonite or steel shims. A minimum gap of 0.5 in. (13 mm) shall be provided between the footing and the bottom of each section or wingwall. The gap shall be filled with a mortar in accordance with 707.09.

723.14 Sealing

Sealer shall be applied in accordance with 709 on the top surface of the structure section. Such sealer shall extend 5 ft (1.5 m) vertically down each vertical leg of the structure. Sealer material shall not be placed in keyway joints, if present. The sealer shall be provided for the full length of the structure. Surface preparation and application procedures shall be as recommended by the sealer manufacturer.

723.15 Joints

The structure sections with less than 3 ft (0.9 m) of cover shall be produced with a minimum 4 in. (100 mm) deep by 1.5 in. (40 mm) wide keyway joint. Structures with 3 ft (0.9 m) or more of cover may be produced with either the above keyway or butt joints. Mortar in accordance with 707.09 shall be placed in the keyway joint.

All butt joints between structure sections shall be covered with a joint wrap in accordance with ASTM C 877 (ASTM C 877M), type II. The surface shall be free of dirt before the joint material is applied. The entire joint shall be continuously covered. Joints between structure sections and wingwalls and between structure sections and headwalls shall be covered with either the same wrap used between structure sections or with geotextile in accordance with 918.03.

The joint wrap shall be kept in its proper location over the joint and care shall be taken to prevent damage during the backfilling operation.

723.16 Backfilling

Tapered or drilled holes for handling shall be filled in accordance with 907.05. Prior to backfilling the structure, all holes shall be covered with joint wrap material with a minimum width of 9 in. (225 mm).

Structure backfill shall be placed and compacted in accordance with 211.

When the level of structure backfill reaches the top of the structure, two lifts shall be spread and hand compacted over the structure without traversing the structure with heavy equipment. Compaction with heavy equipment will not be allowed until a minimum of two lifts have been placed, hand compacted, and tested.

Structure backfill shall be placed and compacted to the same elevation on both sides of the structure before proceeding to the next layer.

When the height of cover as shown on the plans is 12 in. (300 mm) or less, the structure under the paved portion of the roadway and shoulders shall be backfilled with flowable backfill to the top of the vertical leg of the structure.

The operation of equipment over the structure shall be in accordance with the structure manufacturer's recommendations.

723.17 Scour Protection

If riprap is used, geotextile shall first be placed on the in-situ soil in accordance with 616.11. Riprap shall then be placed in accordance with 616. For concrete base slabs, concrete shall be placed in accordance with 702.

723.18 Method of Measurement

Structures and wingwalls will not be measured for payment. The accepted quantities for payment will be the quantities shown in the Schedule of Pay Items.

Structure backfill will be measured in accordance with 211.09. Flowable backfill will be measured in accordance with 213.06. Geotextile and riprap will be measured in accordance with 616.11.

723.19 Basis of Payment

The accepted quantities of structure will be paid for at the contract unit price per linear foot (meter) for structure, precast three-sided, of the span and rise specified. The accepted quantities of wingwalls will be paid for at the contract unit price per square foot (square meter) for wingwalls. Structure backfill will be paid for in accordance with 211.10. Flowable backfill will be paid for in accordance with 213.07. Geotextiles and riprap will be paid for in accordance with 616.12.

Payment will be made under:

Pay Item	***Pay Unit Symbol***
Structure, Precast three-Sided,	
_____ in. x _____ in. _____ (mm x _____ mm)	*LFT (m)*
span rise span rise	

Wingwall ..... SFT (m2)

The cost of designing, coring, testing, pedestals or extended legs, reinforcing steel, excavation, repairs, plugging core and handling holes, mortar, sealer, and necessary incidentals shall be included in the cost of the structure.

The cost of the headwalls, the concrete base slab, the footings, and the aggregate base under precast footings shall be included in the cost of the structure. The cost of the footings for wingwalls and the aggregate base under the wingwall footings shall be included in the cost of the wingwall.