SECTION (_____)

CON/SPAN Underground Detention and Infiltration
Standard Specification

## 1.0 GENERAL

1.1 This work shall consist of constructing a CON/SPAN® vault in accordance with these specifications and in reasonably close conformity with the lines, grades, dimensions and design shown on the plans or as established by the Engineer. In situations where two or more specifications apply to this work, the most stringent requirements shall govern.

1.2 Precast reinforced concrete CON/SPAN® vault units manufactured in accordance with this specification shall be designated by span and rise. Precast reinforced concrete CON/SPAN® endwalls manufactured in accordance with this specification shall be designated by length and height.

1.3 Contractor shall furnish all labor, materials, equipment and incidentals necessary to install the system, appurtenances and incidentals in accordance with the Drawings and as specified herein.

1.4 A stormwater treatment device upstream of the system is recommended as the appropriate means of pretreating for the purpose of extending the maintenance interval on the system and reducing the life cycle cost. Both engineered solutions shall be provided by a single supplier/manufacturer. Filtration by wrapping a system with geotextile is not an acceptable means of pretreatment.

1.5 The following are various reference materials:

1.5.1 American Association of State Highway and Transportation Officials (AASHTO) Design, Construction and Standard Specifications

1.5.2 Standard Specifications for Highway Bridges" 17th Edition, adopted by the American Association of State Highway and Transportation Officials, 2002

1.5.3 ASTM C150: Standard Specification for Portland Cement

1.5.4 ASTM C33: Standard Specification for Concrete Aggregates

1.5.5 ASTM A185: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

1.5.6 ASTM A 615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

1.5.7 ASTM A497: Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete

1.5.8 ASTM A165: Standard Specification for Electrodeposited Coatings of Cadmium

1.5.9 ASTM A307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

1.5.10 ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

1.5.11 ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

1.5.12 ASTM C231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

1.5.13 ASTM C173: Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

1.6 Site layout drawings, product specifications, materials, hydraulic storage data and supported calculations of proposed alternatives shall be submitted to the EOR for review at a minimum of 10 working days prior to bid closing.

1.7 Shop drawings shall be annotated to indicate all materials to be furnished and installed under this section, and all applicable standards for materials, required tests of materials and design assumptions for structural analysis:

1.7.1 Before installation of the system, Contractor shall obtain the written approval of the EOR for the stormwater system and the installation drawings.

1.8 All proposed alternatives to the system shall conform to applicable above referenced specifications.

2.0 MATERIALS

2.1 The concrete for the structures shall be air-entrained when installed in areas subject to freeze-thaw conditions, composed of portland cement, fine and coarse aggregates, admixtures and water. Air-entrained concrete shall contain 6 ± 2 percent air. The air entraining admixture shall conform to AASHT0 M154.

2.1.1 Portland Cement: Shall conform to the requirements of ASTM Specifications C150-Type I, Type II, or Type lll cement.

2.1.2 Coarse Aggregate: Shall consist of stone having a maximum size of 1 inch. Aggregate shall meet requirements for ASTM C33.

2.1.3 Water Reducing Admixture: The manufacturer may submit for approval by the Engineer, a water-reducing admixture for the purpose of increasing workability and reducing the water requirement for the concrete.

2.1.4 Calcium Chloride: The addition to the mix of calcium chloride or admixtures containing calcium chloride will not be permitted.

2.2 All reinforcing steel for the structures shall be fabricated and placed in accordance with the detailed shop drawings submitted by the manufacturer.

2.2.1 Steel Reinforcement: Reinforcement shall consist of welded wire fabric conforming to ASTM Specification A185 or A497, or deformed billet steel bars conforming to ASTM Specification A615, Grade 60. Longitudinal distribution reinforcement may consists of welded wire fabric or deformed billet-steel bars.

2.2.2 Hardware: Inserts for endwall connections shall be AISI Type 304 stainless steel, F-58 Expanded Coil inserts as manufactured by Dayton Superior Concrete Accessories, Miamisburg, Ohio, (800) 745-3700. Coil rods and nuts used in endwall connections shall be AISI Type 304 stainless steel. Washers used in endwall connections shall be AISI Type 304 stainless steel plate washers.

2.2.3 Coil rods and nuts used in endwall connections shall be AISI Type 304 stainless steel. Washers used in endwall connections shall be AISI Type 304 stainless steel plate washers.

2.2.4 Reinforcing bar splices shall be made using the Dowel Bar Splicer System as manufactured by Dayton Superior Concrete Accessories, Miamisburg, Ohio, (800) 745-3700, and shall consist of the Dowel Bar Splicer (DB-SAE) and Dowel-In (DI).

2.2.5 Ferrule Loop Inserts shall be F-64 Ferrule Loop Inserts as manufactured by Dayton Superior Concrete Accessories, Miamisburg, Ohio, (800) 745-3700.

2.2.6 Hook Bolts used in endwall connections shall be ASTM A307.

2.3 The precast element dimension and reinforcement details shall be as prescribed in the plan and the shop drawings provided by the manufacturer, subject to the provisions of Sections 2.15 and 2.16. The minimum concrete compressive strength shall be as shown on the shop drawings. The minimum steel yield strength shall be 60,000 psi, unless otherwise noted on the shop drawings.

2.4 The precast elements are designed in accordance with the "Standard Specifications for Highway Bridges" 17th Edition, adopted by the American Association of State Highway and Transportation Officials, 2002. A minimum of one foot of cover above the crown of the vault units is required in the installed condition. (Unless noted otherwise on the shop drawings and designed accordingly.)

2.5 Placement of Reinforcement in Precast Vault Units: The cover of concrete over the outside circumferential reinforcement shall be 2 inches minimum. The cover of concrete over the

inside circumferential reinforcement shall be 1 1/2 inches minimum, unless otherwise noted on the shop drawings. The clear distance of the end circumferential wires shall not be less than one inch nor more than two inches from the ends of each section. Reinforcement shall be assembled utilizing single or multiple layers of welded wire fabric (not to exceed 3 layers), supplemented with a single layer of deformed billet-steel bars, when necessary. Welded wire fabric shall be composed of circumferential and longitudinal wires meeting the spacing requirements of 2.8, below, and shall contain sufficient longitudinal wires extending through the vault unit to maintain the shape and position of the reinforcement. Longitudinal distribution reinforcement may be welded wire fabric or deformed billet-steel bars and shall meet the spacing requirements of 2.8, below. The ends of the longitudinal distribution reinforcement shall be not more than 3 inches and not less than 1 1/2 inches from the ends of the vault unit.

2.6 Placement of Reinforcement for Precast Endwalls: The cover of concrete over the longitudinal and transverse reinforcement shall be 2 inches minimum. The clear distance from the end of each precast element to the end transverse reinforcing steel shall not be less than one inch nor more than two inches. Reinforcement shall be assembled utilizing a single layer of welded wire fabric, or a single layer of deformed billet-steel bars. Welded wire fabric shall be composed of transverse and longitudinal wires meeting the spacing requirements of 2.9, below, and shall contain sufficient longitudinal wires extending through the element to maintain the shape and position of the reinforcement. Longitudinal reinforcement may be welded wire fabric or deformed billet-steel bars and shall meet the spacing requirements of 2.9, below. The ends of the longitudinal reinforcement shall be not more than 3 inches and not less than 1 1/2 inches from the ends of the walls.

2.7 Bending of Reinforcement for Precast Vault Units: The outside and inside circumferential reinforcing steel for the corners of the vault shall be bent to such an angle that is approximately equal to the configuration of the outside corner of the vault.

1.1. Laps, Welds, and Spacing for Precast Vault Units: Tension splices in the circumferential reinforcement shall be made by lapping. Laps may be tack welded together for assembly purposes. For smooth welded wire fabric, the overlap shall meet the requirements of AASHTO 8.30.2 and 8.32.6. For deformed welded wire fabric, the overlap shall meet the requirements of AASHTO 8.30.1 and 8.32.5. The overlap of welded wire fabric shall be measured between the outer most longitudinal wires of each fabric sheet. For deformed billet-steel bars, the overlap shall meet the requirements of AASHTO 8.25. For splices other than tension splices, the overlap shall be a minimum of twelve inches for welded wire fabric or deformed billet-steel bars. The spacing center to center of the circumferential wires in a wire fabric sheet shall be not less than 2 inches nor more than 4 inches. The spacing center to center of the longitudinal wires shall not be more than 8 inches. The spacing center to center of the longitudinal distribution steel for either line of reinforcing in the top slab shall be not more than 16 inches.

2.8 Laps, Welds, and Spacing for Precast Endwalls: Splices in the reinforcement shall be made by lapping. Laps may be tack welded together for assembly purposes. For smooth welded wire fabric, the overlap shall meet the requirements of AASHTO 8.30.2 and 8.32.6. For deformed welded wire fabric, the overlap shall meet the requirements of AASHTO 8.30.1 and 8.32.5. For deformed billet-steel bars, the overlap shall meet the requirements of AASHTO 8.25. The

spacing center-to-center of the wires in a wire fabric sheet shall be not less than 2 inches nor more than 8 inches.

2.9 Mixture: The aggregates, cement and water shall be proportioned and mixed in a batch mixer to produce a homogeneous concrete meeting the strength requirements of this specification. The proportion of portland cement in the mixture shall not be less than 564 pounds (6 sacks) per cubic yard of concrete.

2.10 Curing: The precast concrete vault units shall be cured for a sufficient length of time so that the concrete will develop the specified compressive strength in 28 days or less. Any one of the following methods of curing or combinations thereof shall be used:

2.10.1 Steam Curing: The units may be low pressure, steam cured by a system that will maintain a moist atmosphere.

2.10.2 Water Curing: The units may be water cured by any method that will keep the sections moist.

2.10.3 Membrane Curing: A sealing membrane conforming to the requirements of ASTM C309 may be applied and shall be left intact until the required concrete compressive strength is attained. The concrete temperature at the time of application shall be within ± 10 degrees F of the atmospheric temperature. All surfaces shall be kept moist prior to the application of the compounds and shall be damp when the compound is applied.

2.11 Forms: The forms used in manufacture shall be sufficiently rigid and accurate to maintain the structure dimensions within the permissible variations given in Sections 2.15 and 2.16. All casting surfaces shall be of a smooth material.

2.12 Handling: Handling devices or holes shall be permitted in each vault unit for the purpose of handling and setting.

2.13 Storage: The precast elements shall be stored in such a manner to prevent cracking or damage. The units shall not be moved until the concrete compressive strength has reached a minimum of 2,500 psi and shall not be stored in an upright position until the concrete compressive strength is a minimum of 4,000 psi.

2.14 The following sections address the permissible variations of the vault units:

2.14.1 Internal Dimensions: The internal dimension shall vary not more than 1% from the design dimensions nor more than 1-1/2 inches whichever is less. The haunch dimensions shall vary not more than 3/4 inch from the design dimension.

2.14.2 Slab and Wall Thickness: The slab and wall thickness shall not be less than that shown in the design by more than ¼ inch. A thickness more than that required in the design shall not be cause for rejection.

2.14.3 Length of Opposite Surfaces: Variations in laying lengths of two opposite surfaces of the vault unit shall not be more than 1/2 inch in any section, except where beveled ends for laying of curves are specified by the purchaser.

2.14.4 Length of Section: The underrun in length of a section shall not be more than 1/2 inch in any vault unit.

2.14.5 Position of Reinforcement: The maximum variation in position of the reinforcement shall be ± 1/2 inch. In no case shall the cover over the reinforcement be less than 1 1/2 inches for the outside circumferential steel or be less than 1 inch for the inside circumferential steel as measured to the external or internal surface of the vault. These tolerances or cover requirements do not apply to mating surfaces of the joints.

2.14.6 Area of Reinforcement: The areas of steel reinforcement shall be the design steel areas as shown in the manufacturer's shop drawings. Steel areas greater than those required shall not be cause for rejection. The permissible variation in diameter of any reinforcement shall conform to the tolerances prescribed in the ASTM Specification for that type of reinforcement.

2.15 The following sections address the permissible variations of the endwall units:

2.15.1 Wall Thickness: The wall thickness shall not vary from that shown in the design by more than 1/2 inch.

2.15.2 Length and Height of Wall sections: The length and height of the wall shall not vary from that shown in the design by more than 1/2 inch.

2.15.3 Position of Reinforcement: The maximum variation in the position of the reinforcement shall be ± 1/2 inch. In no case shall the cover over the reinforcement be less than 1 ½ inches.

2.15.4 Size of Reinforcement: The permissible variation in diameter of any reinforcing shall conform to the tolerances prescribed in the ASTM Specification for that type of reinforcing. Steel area greater than that required shall not be cause for rejection.

2.16 The manufacturer of the system shall be one that has regularly been engaged in the engineering design and production of these systems for at least fifteen (15) years and which has a history of successful production, acceptable to the EOR. In accordance with the Drawings, the system shall be supplied by:

Contech Engineered Solutions
9025 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

## 3.0 PERFORMANCE

3.1 The system proposal shall be sized in accordance to the design provided and approved by the Engineer of Record (EOR). Any Contractor deviating from the design shown on the plans, to include: material, footprint, etc., shall provide to the EOR a summary report on stage-storage curves, design calculations, HydroCAD modeling and engineering drawings.

3.2 The system shall comprise of manhole access with minimum dimensions of 24 inches diameter to provide adequate inspection and maintenance without restrictions and obstructions to entry into interior of the system. Manholes shall be provided to allow full entry into and visual inspection of the complete system, at a minimum as to allow full maintenance of the system. Cleanouts or inspection ports are not acceptable access points for maintenance and inspection nor are any other alternatives which do not allow for full entry into the system.

3.3 The system shall meet HS-20/HS-25 loading requirements with a minimum of 12-inches of cover to bottom of flexible pavement.

3.4 The system shall be designed so as the hydraulic grade line will increase evenly throughout whereas transverse movement from one storage compartment to another shall not be permitted. All storage compartments shall be connected via manifold (or connecting pipe) versus by transporting stormwater through stone.

3.5 A stormwater pretreatment device is recommended upstream of the system as follows:

3.5.1 Infiltration: Where feasible, the selected stormwater treatment device upstream of an infiltration system shall be a filter system and have General Use Level Designation (GULD) for Basic Treatment by the Washington State Department of Ecology or demonstrate equivalent performance in independently verified field testing following a peer reviewed testing protocol, and must be sized consistent with the system producing those results.

3.5.2 Detention: Where feasible, the selected Stormwater treatment device upstream of a detention system shall be a separator system and have GULD for Pretreatment by the WADOE or demonstrate equivalent performance in independently verified field testing following a peer reviewed testing protocol, and must be sized consistent with the system producing those results.

3.5.3 Selected pretreatment stormwater device shall incorporate a physical barrier capable of capturing and retaining trash and debris (i.e.: floatable and neutrally buoyant materials) for all flows up to the treatment capacity of the device.

3.5.4 The application of wrapping a system with geotextile of any branding or material type, that allows the passage of stormwater, shall not be regarded as an acceptable treatment or pretreatment device.

3.5.5 The manufacturer of the selected Stormwater treatment device shall have been regularly engaged in the engineering design and production of systems for the physical treatment of Stormwater runoff for 15 years.

3.5.6 In order to not restrict the Owner's ability to maintain the stormwater pretreatment device, the minimum dimension providing access from the ground surface to the sump chamber shall be 20 inches in diameter.

## 4.0 EXECUTION

4.1 The system shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents.

4.2 Minimum cover may vary, depending on local conditions. The contractor must provide the additional cover required to avoid damage to the units. Minimum cover is measured from the top of the unit to the top of the maintained construction roadway surface.

4.3 The contractor shall follow Occupational Safety and Health Association (OSHA) guidelines for safe practices in executing the installation process in accordance with the manufacturer/supplier installation recommendations.

4.4 Supplier will conduct an on-site preconstruction meeting with the contractor prior to the scheduled delivery date of the units.

4.5 The vault units shall be produced with flat butt ends. The ends of the vault units shall be such that when the sections are laid together they will make a continuous line of with a smooth interior free of appreciable irregularities, all compatible with the permissible variations in Sections 2.15 and 2.16. The joint width shall not exceed 3/4 inches.

4.6 The precast vault units and endwalls shall be substantially free of fractures. The ends of the vault units shall be normal to the walls and centerline of the vault section, within the limits of the variations given in Sections 2.15 and 2.16 except where beveled ends are specified. The faces of the endwalls and vault units shall be parallel to each other, within the limits of variations given in Sections 2.15 and 2.16. The surface of the precast elements 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.

4.7 Precast elements may be repaired, if necessary, because of imperfections in manufacture or handling damage and will be acceptable if, in the opinion of the purchaser, the repairs are sound, properly finished and cured, and the repaired section conforms to the requirements of this specification.

4.8 The quality of materials, the process of manufacture, and the finished structures shall be subject to inspection by the purchaser.

4.9 The precast elements shall be subject to rejection on account of any of the specification requirements. Individual precast elements may be rejected because of any of the following:

4.9.1 Fractures or cracks passing through the wall, except for a single end crack that does not exceed one half the thickness of the wall.

4.9.2 Defects that indicate proportioning, mixing, and molding not in compliance with Sections 2.10 through 2.15 of these specifications.

4.9.3 Honeycombed or open texture.

4.9.4 Damaged ends, where such damage would prevent making a satisfactory joint.

4.10 Each vault unit shall be clearly marked by waterproof paint. The following shall be shown on the inside of the vertical leg of the vault section: Vault Span X Vault Rise, Date of Manufacture and Name or trademark of the manufacturer.

4.11 Footings: The vault units and endwalls shall be installed on either precast or cast-in-place concrete footings. The design size and elevation of the footings shall be as determined by the Engineer. A three inch deep keyway shall be formed in the top surface of the vault footing three inches clear of the inside and outside faces of the bridge units, unless specified otherwise on the plans. A keyway is also required in the footings for the endwalls, unless otherwise specified. The footings shall be given a smooth float finish and shall reach a compressive strength of 2,000 psi before placement of the bridge and endwall elements. The completed footing surface shall be constructed in accordance with grades shown on the plans. When tested with a 10 foot straight edge, the surface shall not vary more than 1/4 inch in 10 feet. If a precast concrete footing is used, the contractor shall prepare a 4 inch thick base layer of compacted granular material the full width of the footing prior to placing the precast footing.

4.12 Placement of the Vault Units and Endwalls: The vault units and endwalls shall be placed as shown on the Engineer's plan drawings. Special care shall be taken in setting the elements to the true line and grade. The vault units and endwalls shall be set on 6" x 6" masonite or steel shims. A minimum gap of 1/2 inch shall be provided between the footing and the bottom of the unit's vertical legs or the endwall. The gap shall be filled with cement grout (portland cement and water or cement mortar composed of portland cement, sand and water) with a minimum 28-day compressive strength of 3,000 psi. If units have been set with temporary ties (cables, bars, etc.) grout must attain a minimum compressive strength of 1,500 psi before ties may be removed.

4.13 External Protection of Joints: The butt joint made by two adjoining vault units shall be covered with a 7/8" x 1 3/8" preformed bituminous joint sealant and a minimum of a 9 inch wide joint wrap. The surface shall be free of dirt before applying the joint material. A primer compatible with the joint wrap to be used shall be applied for a minimum width of nine inches on each side of the joint. The external wrap shall be either EZ-WRAP RUBBER by PRESS-SEAL GASKET CORPORATION, SEAL WRAP by MAR MAC MANUFACTURING CO. INC. or approved equal. The joint shall be covered continuously from the bottom of one vault section leg, across the top of the arch and to the opposite vault section leg. Any laps that result in the joint wrap shall be a minimum of six inches long with the overlap running downhill.

4.13.1 In addition to the joints between vault units, the joint between the end vault unit and the endwall shall also be sealed as described above. Also, if lift holes are formed in the arch units, they shall be primed and covered with a 9" x 9" square of joint wrap.

4.13.2 During the backfilling operation, care shall be taken to keep the joint wrap in its proper location over the joint.

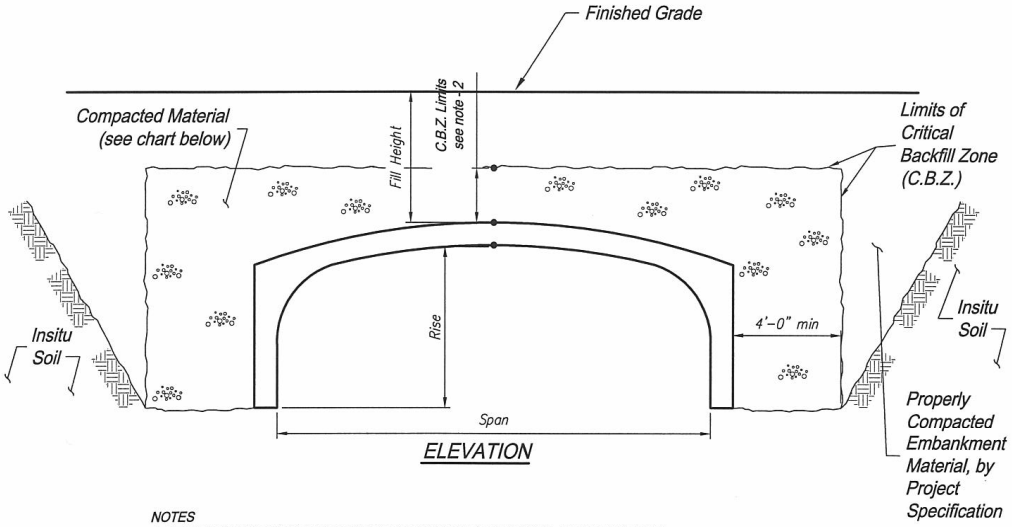
4.13.3 Internal Protection of Joints: Certain vaults may require additional joint protection to ensure that the structure is water-tight. Various joint sealing details including elastomaric, urethane, or liquid sealing may be shown on the plans. Any internal joint sealing shall be performed as indicated on the construction plans.

4.14 Backfill: Backfill shall be considered as all replaced excavation and new embankment adjacent to the CON/SPAN® vault units and endwalls. The project construction and material specifications which include the specifications for excavation for structures and roadway excavation and embankment construction, shall apply except as modified in this section. No backfill shall be placed against any structural elements until approved by the Engineer.

4.14.1 Backfill against a waterproofed surface shall be placed carefully to avoid damage to the waterproofing material.

4.14.2 Mechanical tampers or approved compacting equipment shall be used to compact all backfill and embankment immediately adjacent to each side and over the top of each vault unit until it is covered to a minimum depth of one foot, unless the design fill height is less than 1'-0". The backfill within the Critical Backfill Zone (shown in the following diagram) shall be placed in lifts of eight inches or less (loose depth). Heavy compaction equipment shall not be operated in this area or over the bridge until it is covered to a depth of one foot, unless the design fill height is less than 1'-0".

| BACKFILL DESCRIPTION (AASHTO M 145-91) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Group Classification | A-1 | | A-3 | A-2 | | | | A-4 |
| | A-1-a | A-1-b | | A-2-4 | A-2-5 | A-2-6 | A-2-7 | |
| Sieve Analysis, Percent Passing (100% Passing 3" Sieve) | | | | | | | | |
| No. 10 | 50 max. | | | | | | | |
| No. 40 | 30 max. | 50 max. | 51 min. | | | | | |
| No. 200 | 15 max. | 25 max. | 10 max. | 35 max. | 35 max. | 35 max. | 35 max. | 36 min. |
| Characteristics of Fraction Passing No. 40 | | | | | | | | |
| Liquid Limit | | | | 40 max. | 41 min. | 40 max. | 41 min. | 40 max. |
| Plasticity Index | 6 max. | | N.P. | 10 max. | 10 max. | 11 min. | 11 min. | 10 max. |
| Usual Types of Significant Constituent Materials | Stone Fragments, Gravel & Sand | | Fine Sand | Silty or Clayey Gravel and Sand | | | | Silty Soils |
| General Rating as Subgrade | Excellent to Good | | | | | | | Fair to Poor |




ELEVATION

NOTES
1. SEE CON/SPAN® SPECIFICATIONS SECTION 15.4 FOR BACKFILL SPECIFICATIONS.
2. FOR FILL HEIGHTS GREATER THAN 2'-0", C.B.Z. LIMIT SHALL BE 2'-0" ABOVE ARCH CROWN. FOR FILL HEIGHTS LESS THAN 2'-0", THE FINISHED GRADE SHALL BE THE BOUNDARY LINE FOR THE C.B.Z.
3. BACKFILLING OPERATIONS WITHIN THE C.B.Z. SHALL BE PERFORMED IN LIFTS OF 8" OR LESS (LOOSE DEPTH).
4. MAXIMUM DRY DENSITY SHALL BE DETERMINED BY AASHTO T-99 OR OTHER APPROVED METHODS.
5. BACKFILL SHALL BE COMPACTED IN LAYERS UNTIL THE DENSITY IS NOT LESS THAN 95 % OF THE MAXIMUM DRY DENSITY.

| SPAN | FILL HEIGHT | ACCEPTABLE MATERIAL INSIDE C.B.Z. | ACCEPTABLE MATERIAL OUTSIDE C.B.Z. |
|---|---|---|---|
| ≤ 24'-0" | ≥ 12'-0" | A1, A3 | ** |
| ≤ 24'-0" | < 12'-0" | A1, A2, A3, A4 | ** |
| > 24'-0" | ALL | A1, A3 | ** |

** EMBANKMENT MATERIAL PER PROJECT SPECIFICATIONS

BACKFILL REQUIREMENTS

4.14.3 Lightweight dozers and graders may be operated over vault units having one foot of compacted cover, but heavy earth moving equipment (larger than a D-4 Dozer weighing in excess of 12 tons and having track pressures of eight psi or greater) shall require two feet of cover unless the design cover is less than two feet. In no case shall equipment operating in excess of the design load (HS20 or HS25) be permitted over the vault units unless approved by CON/SPAN®.

4.14.4 Any additional fill and subsequent excavation required to provide this minimum cover shall be made at no additional cost to the project.

4.14.5 As a precaution against introducing unbalanced stresses in the vault, when placing backfill at no time shall the difference between the heights of fill on opposite sides of the vault exceed 24".

4.14.6 For fill heights over 12 feet, no backfilling may begin until a backfill compaction testing plan has been coordinated with and approved by CON/SPAN®. Cost of the backfill compaction testing shall be included in the cost of the precast units. This included cost applies only to projects with fill heights over 12 feet (as measured from top crown of arch to finished grade).

## 5.0 INSPECTION

5.1 Type of Test Specimen: Concrete compressive strength shall be determined from compression tests made on cylinders or cores. For cylinder testing, a minimum of 4 cylinders shall be taken during each production run. For core testing, one core shall be cut from each of 3 precast elements selected at random from each production group. A production group shall be defined as 15 or fewer vault units (of a particular size), or endwalls in a continuous production run. For each continuous production run, each production group or fraction thereof shall be considered separately for the purpose of testing and acceptance. A production run shall be considered continuous if not interrupted for more than 3 consecutive days.

5.2 Compression Testing: Cylinders shall be made and tested as prescribed by the ASTM C39 Specification. Cores shall be obtained and tested for compressive strength in accordance with the provisions of the ASTM C497 Specification.

5.3 Acceptability of Cylinder Tests: When the average compressive strength of all cylinders tested is equal to or greater than the design compressive strength, and not more than 10% of the cylinders tested have a compressive strength less than the design concrete strength, and no cylinder tested has a compressive strength less than 80% of the design compressive strength, then the lot shall be accepted. When the compressive strength of the cylinders tested does not conform to this acceptance criteria, the acceptability of the lot may be determined as described in Section 5.4.

5.4 Acceptability of Core Tests: The compressive strength of the concrete in each production group as defined in Section 5.1 is acceptable when the average core test strength is equal to or greater than the design concrete strength. When the compressive strength of the core tested is less than the design concrete strength, the precast element from which that core was taken may be re-cored. When the compressive strength of the re-core is equal to or greater than the design concrete strength, the compressive strength of the concrete in that production group is acceptable.

5.4.1 When the compressive strength of any record is less than the design concrete strength, the precast element from which that core was taken shall be rejected. Two precast elements from the remainder of the group shall be selected at random and 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 compressive strength of the remainder of that group is acceptable. If the compressive strength of either of the two cores tested is less than the design concrete strength, the remainder of the group shall be rejected or, at the option of the manufacturer, each precast element of the remainder of the group shall

be cored and accepted individually, and any of these elements that have cores with less than the design concrete strength shall be rejected.

5.4.2 Plugging Core Holes: The core holes shall be plugged and sealed by the manufacturer in a manner such that the elements will meet all of the test requirements of this specification. Precast elements so sealed shall be considered satisfactory for use.

5.4.3 Test Equipment: Every manufacturer furnishing vault structures under this specification shall furnish all facilities and personnel necessary to carry out the test required.

5.5 The Precaster shall demonstrate adherence to the standards set forth in the National Precast Concrete Association (NPCA) Quality Control Manual. The Precaster shall meet either Section 5.6 or 5.7.

5.6 Certification: The Precaster shall be certified by the Precast/Prestressed Concrete Institute Plant Certification Program or the NPCA's Plant Certification Program prior to and during production of the products covered by this specification.

5.7 The Precaster shall have been in the business of producing precast concrete products similar to those specified for a minimum of three years. He shall maintain a permanent quality control department or retain an independent testing agency on a continuing basis. The agency shall issue a report, certified by a licensed engineer, detailing the ability of the Precaster to produce quality products consistent with industry standards.

5.8 The Precaster shall show that Air Content (ASTM C231 or C173) and Compressive Strength (ASTMM C39, C497) are performed in accordance with the ASTM standards indicated. Tests shall be performed for each 150 cubic yards of concrete placed, but not less frequently than once per production run, as defined in Sections 5.1 through 5.4.

5.9 The Precaster shall provide documentation demonstrating compliance with this section to CON/SPAN® at regular intervals or upon request.

5.10 The Owner may place an inspector in the plant when the products covered by this specification are being manufactured.