1. Description
	1. Type This work shall consist of furnishing and constructing EXPRESS® Foundations in accordance with these specifications and in reasonably close conformity with the lines, grades, design and dimensions 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.
	2. Designation Precast Reinforced Concrete EXPRESS® foundation units manufactured in accordance with this specification shall be designated by length, height and width.
2. Design
	1. Specifications The precast foundation unit elements are designed in accordance with the "AASHTO LRFD Bridge Design Specifications" 9th Edition, adopted by the American Association of State Highway and Transportation Officials, 2020.
3. Materials
	1. Concrete The concrete for the precast and cast-in-place elements of the EXPRESS® Foundations System 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. The minimum concrete compressive strength shall be as shown on the shop drawings.
		1. Portland Cement - Shall conform to the requirements of ASTM Specifications C150-Type I, Type II, or Type lIl cement.
		2. Coarse Aggregate - Shall consist of stone having a maximum size of 1 inch. Aggregate shall meet requirements for ASTM C33.
		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.
		4. Calcium Chloride - The addition to the mix of calcium chloride or admixtures containing calcium chloride will not be permitted.
		5. 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. Steel Reinforcement
		1. The minimum steel yield strength shall be 60,000 psi, unless otherwise noted on the shop drawings.
		2. All reinforcing steel for the precast and cast-in-place elements shall be fabricated and placed in accordance with the detailed shop drawings submitted by the manufacturer.
		3. Reinforcement shall consist of welded wire reinforcing conforming to ASTM Specification A 1064, or deformed billet steel bars conforming to ASTM Specification A 615, Grade 60. Longitudinal distribution reinforcement may consist of welded wire fabric or deformed billet-steel bars.
	3. Steel Hardware
		1. Mechanical splices of reinforcing bars 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), or as manufactured by Barsplice Products Inc, Dayton, Ohio, (937) -275-8700, and shall consist of Barsplice XP Type 2 System.
4. Manufacture of Precast Foundation Unit Elements Subject to the provisions of Section 5, below, the precast foundation unit element dimensions and reinforcement details shall be as prescribed in the plan and shop drawings provided by the manufacturer.
	1. Forms The forms used in manufacture shall be sufficiently rigid and accurate to maintain the required precast foundation unit element dimensions within the permissible variations given in Section 5 of these specifications. All casting surfaces shall be of a smooth material.
	2. Placement of Reinforcement
		1. Placement of Reinforcement for Precast Foundation Units – The cover of concrete over the bottom reinforcement shall be 3 inches minimum. The cover of concrete for all other reinforcement shall be 2 inches minimum. The clear distance from the end of each precast element to the end of reinforcing steel shall not be less than 2 inches nor more than 3 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 4.3, 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 4.3, below.
	3. Laps, Welds, Spacing
		1. Laps, Welds, and Spacing for EXPRESS® Foundations - Splices in the reinforcement shall be made by lapping. 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.
	4. Curing The precast concrete foundation 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:
		1. Steam Curing - The precast concrete foundation units may be low-pressure steam cured by a system that will maintain a moist atmosphere.
		2. Water Curing - The precast concrete foundation units may be water cured by any method that will keep the sections moist.
		3. Membrane Curing - A sealing membrane conforming to the requirements of ASTM Specification 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.
	5. Storage, Handling & Delivery
		1. Storage

Precast foundation units are cast, stored and shipped in a flat position.

The precast foundation unit elements shall be stored in such a manner to prevent cracking or damage. Store precast concrete foundation unit elements using timber supports as appropriate. The units shall not be moved until the concrete compressive strength has reached a minimum of 2500 psi, and they shall not be stored in an upright position.

* + 1. Handling

Handling devices shall be permitted in each precast concrete foundation units for the purpose of handling and setting.

Spreader beams may be required for the lifting of precast foundation unit elements to preclude damage from bending or torsion forces.

* + 1. Delivery

Precast concrete foundation units must not be shipped until the concrete has attained the specified design compressive strength, or as directed by the design Engineer.

Precast concrete foundation units may be unloaded and placed on the ground at the site until installed. Store precast concrete foundation unit elements using timber supports as appropriate.

* 1. Quality Assurance The Precaster shall demonstrate adherence to the standards set forth in the NPCA Quality Control Manual. The Precaster shall meet either Section 4.6.1 or 4.6.2
		1. Certification: The Precaster shall be certified by the Precast/Prestressed Concrete Institute Plant Certification Program or the National Precast Concrete Association's Plant Certification Program prior to and during production of the products covered by this specification.
		2. Qualifications, Testing and Inspection
			1. 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.
			2. The Precaster shall show that the following tests are performed in accordance with the ASTM standards indicated. Tests shall be performed as indicated in Section 6 of these specifications.
				1. Air Content: C231 or C173
				2. Compressive Strength: C31, C39, C497
			3. The Precaster shall provide documentation demonstrating compliance with this section to CONTECH® Engineered Solutions at regular intervals or upon request.
			4. The Owner may place an inspector in the plant when the products covered by this specification are being manufactured.
		3. Documentation - The Precaster shall submit Precast Production Reports to CONTECH® Engineered Solutions as required.
1. Permissible Variations
	1. Foundation Units
		1. Wall Thickness - The wall thickness shall not vary from that shown in the design by more than 1/2 inch.
		2. Length/ Height/Width of Foundation sections - The length, height and width of the foundation units shall not vary from that shown in the design by more than 1/2 inch.
		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 1/2 inches.
		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. Testing/ Inspection
	1. 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 4 cylinders shall be taken for each foundation element. For core testing, a minimum of 2 cores shall be taken for each foundation element. Each element shall be considered separately for the purpose of testing and acceptance.
		2. Compression Testing - Cylinders shall be made and tested as prescribed by the ASTM C 39 Specification. Cylinders shall be cured in the same environment as the foundation elements. Cores shall be obtained and tested for compressive strength from each element in accordance with the provisions of the ASTM C42 specification..
		3. Acceptability of Cylinder Tests - When the average compressive strength of all cylinders tested of the same age is equal to or greater than the design compressive strength, and no cylinder tested has a compressive strength less than 90% of required concrete strength, then the element shall be accepted. When the compressive strength of the cylinders tested does not conform to these acceptance criteria, the acceptability of the element may be determined as described in section 6.1.4, below.
		4. Acceptability of Core Tests - The compressive strength of the concrete in a foundation element is acceptable when each core test strength is equal to or greater than the design concrete strength. When the compressive strength of a 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 foundation element is acceptable.
			1. When the compressive strength of any recore is less than the design concrete strength, the precast element from which that core was taken shall be rejected.
			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.
			3. Test Equipment - Every manufacturer furnishing precast elements under this specification shall furnish all facilities and personnel necessary to carry out the test required.
	2. Inspection The quality of materials, the process of manufacture, and the finished precast elements shall be subject to inspection by the purchaser.
3. Joints The precast foundation units shall be produced with flat butt ends. The ends shall be such that when the sections are laid together they will make a continuous line with a smooth interior free of appreciable irregularities, all compatible with the permissible variations in section 5, above. The joint width between adjacent precast units shall not exceed 3/4 inches.
4. Workmanship/ Finish The foundation units shall be substantially free of fractures. The faces of precast foundation units shall be parallel to each other, within the limits of variations given in section 5, above. 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.
5. Repairs Precast concrete foundation unit 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.
6. Rejection The precast concrete foundation unit 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:
	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.
	2. Defects that indicate proportioning, mixing, and molding not in compliance with section 4 of these specifications.
	3. Honeycombed or open texture.
	4. Damaged ends, where such damage would prevent making a satisfactory joint.
7. Marking Each precast concrete foundation unit shall be clearly marked by waterproof paint. The following shall be shown on the outside of the vertical face of the foundation section:

Piece Mark

Date of Manufacture

Name or trademark of the manufacturer

1. Installation Preparation To ensure correct installation of the precast foundation units, care and caution must be exercised in shaping the foundation subgrade. Exercising special care will facilitate the rapid installation of the precast components.
	1. Footings

Do not over excavate foundations unless directed by site soil engineer to remove unsuitable soil.

The site soils engineer shall certify that the bearing capacity meets or exceeds the footing design requirements, prior to the contractor setting the precast foundation units. The size and elevation of the footings shall be as designed by the Engineer.

The footings shall be given a smooth float finish and shall reach a compressive strength of 2,000 psi before placement of the superstructure. Backfilling shall not begin until the footing has reached the full design compressive strength.

The 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.

The contractor shall prepare a 4-inch thick minimum base layer of compacted granular material the full width of the footing prior to placing the precast foundation units.

The precast concrete foundation units must be connected by reinforcement to form one monolithic body. Expansion joints shall not be used.

The contractor shall be responsible for the construction of the foundations per the plans and specifications.

1. Installation
	1. General The installation of the precast concrete foundation units shall be as explained in the publication, EXPRESS® *Foundations Installation Manual*.
		1. Lifting It is the responsibility of the contractor to ensure that a crane of the correct lifting capacity is available to handle the precast concrete units. This can be accomplished by using the weights given for the precast concrete components and by determining the lifting reach for each crane unit. Site conditions must be checked well in advance of shipping to ensure proper crane location and to avoid any lifting restrictions. The lift anchors or holes provided in each unit are the only means to be used to lift the elements. The precast concrete foundation units must not be supported or raised by other means than those given in the manuals and drawings without written approval from CONTECH® Engineered Solutions.
	2. Placement of Precast Foundation Units

The precast foundations shall be placed as shown on the plan drawings. Special care shall be taken in setting the elements to the true line and grade.

* 1. Grouting
		1. Grouting shall not be performed when temperatures are expected to go below 35° for a period of 72 hours.
		2. All grout shall have a maximum aggregate size of ¼ inch.
		3. Lifting and erection anchor recesses shall be filled with grout.
	2. Cast-in-place Concrete
		1. Cast-in-place concrete portion of EXPRESS® Foundations shall be in accordance with the Precast Reinforced Concrete EXPRESS® Foundation Notes on the foundation plan.
	3. Backfill
		1. Do not perform backfilling during wet or freezing weather.
		2. No backfill shall be placed against any structural elements until they have been approved by the Engineer.
		3. Backfill shall be considered as all replaced excavation and new embankment adjacent to the precast concrete elements. 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.
		4. Backfill Zone
* Backfill around sides of precast foundation units shall be Zone A.
	+ 1. Required Backfill Properties
			1. Zone A

Zone A requires fill material with specifications and compacting procedures equal to that for normal road embankments.

* + - 1. Geotechnical engineer shall review gradations of all interfacing materials and, if necessary, recommend geotextile filter fabric (provided by contractor).
		1. Placing and Compacting Backfill

Dumping for backfilling is not allowed any nearer than 3 ft from the foundation unit.

The fill must be placed and compacted in layers not exceeding 8 inches. The maximum difference in the surface levels of the fill on opposite sides of the bridge must not exceed 2 feet.

The backfill of Zone A shall be compacted to a minimum density of 95% of the Standard Proctor, as required by AASHTO T-99.

Soil within 1 foot of concrete surfaces shall be hand-compacted. Elsewhere, use of rollers is acceptable. If vibrating roller-compactors are used, they shall not be started or stopped within Zone A and the vibration frequency should be at least 30 revolutions per second.

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

* + 1. Monitoring

The contractor shall check settlements and horizontal displacements of the foundations to ensure that they are within the allowable limit provided by the engineer. These measurements should give an indication of the settlements and deformations along the length of the foundations.

The first measurement should take place after the erection of all precast foundation units, a second after completion of backfilling, and a third after the superstructure is completed. Further measurements may be made according to local conditions.