

**SPECIFICATIONS FOR MANUFACTURE and INSTALLATION
of CELL BLOCKS FOUNDATION SYSTEMS**

Date: Sept 2011

1. Description

- 1.1. Type: This work shall consist of furnishing and constructing a CELL BLOCKS foundation system 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. The purpose of the foundation system is to support a tower and other components. The foundation system shall be designed specifically for the design criteria set forth in the specifications and/or plans. The foundation system is a non-penetrating system and shall be comprised of multiple precast concrete blocks post tensioned together. The foundation system shall allow for increase in load capacity by adding additional precast blocks without disrupting the integrity of the existing foundation.
- 1.2. Designation: Precast reinforced concrete CELL BLOCKS units manufactured in accordance with this specification shall be designated by width x length x thickness. The precast blocks may be assembled in various configurations that when post tensioned together meet the loading requirements of the tower and other components. The individual blocks shall be shall be 7' x 7' in plan view. Maximum block unit weight shall not exceed 15,500 pounds. Each assembled precast foundation footprint shall be rectangular.
- 1.3. Special Considerations for specific projects are to be listed as follows:

2. Design

- 2.1. Specifications: The precast elements are designed in accordance with ACI-318 latest edition and in accordance with the applicable state building code..
- 2.2. Design Criteria: The applicable factored loads for the tower and other components are as follows:
 - 2.2.1. The foundation shall support _____.
 - 2.2.2. Overturning Moment is _____.
 - 2.2.3. Axial Load is _____.
 - 2.2.4. Uplift Reaction is _____.
 - 2.2.5. Other Criteria as follows: _____
- 2.3. Drawings and Calculations: All drawings and calculations shall be prepared in accordance with the specific state standards. All drawings shall be certified wet stamped by a licensed professional engineer in the state of the installation site. The engineering company for whom the professional engineer is employed shall have a minimum of 5 years experience in post tensioned type foundation structures.

3. Materials

- 3.1. Concrete The concrete for the precast elements 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 ASTM C260. The minimum concrete compressive strength shall be 5000 psi at 28 days..

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- 3.1.1. Portland Cement - Shall conform to the requirements of ASTM Specifications C150-Type I, Type II, or Type III cement.
 - 3.1.2. Coarse Aggregate - Shall consist of stone having a maximum size of 1 inch. Aggregate shall meet requirements for ASTM C33.
 - 3.1.3. 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.
 - 3.1.4. Calcium Chloride - The addition to the mix of calcium chloride or admixtures containing calcium chloride will not be permitted.
 - 3.1.5. 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.
- 3.2. Steel Reinforcement
- 3.2.1. The minimum steel yield strength shall be 60,000 psi, unless otherwise noted on the shop drawings.
 - 3.2.2. All reinforcing steel for the precast elements shall be fabricated and placed in accordance with the detailed shop drawings submitted by the manufacturer.
 - 3.2.3. Reinforcement shall consist of deformed billet steel bars conforming to ASTM Specifications A 615, A616 or A617 Grade 60.
- 3.3. Post Tensioning Steel and Hardware
- 3.3.1. Post tensioned steel shall consist of unbounded tendons joining the individual blocks. The steel shall be 1" dia, 1.25" or 1.375" diameter rods Grade 150 Dywdag bars or approved equivalent conforming to the ASTM A722 Specifications.(LARR #23835)
 - 3.3.2. All post tension rods shall be provided with a protective coating of either epoxy or galvanized/metalized coating. Epoxy coating shall conform to ASTM Specification A934 for the rods and ASTM Specification A775 for the connection hardware. Galvanized/Metalized coating shall conform to ASTM Specification A153 for the rods and A123 for the connection hardware.
 - 3.3.3. Any protective coating that is scratched or damaged due to construction efforts shall be repaired per the manufacturer's specifications. For the epoxy coating repair coating per ASTM 775.For the galvanized/metalized coating use a cold galvanizing compound conforming to ASTM 780.
4. Manufacture of Precast Elements: Subject to the provisions of Section 5, below, the precast element dimension and reinforcement details shall be as prescribed in the plan and shop drawings provided by the manufacturer.
- 4.1. Forms: The forms used in manufacture shall be sufficiently rigid and accurate to maintain the required precast element dimensions within the permissible variations given in Section 5 of these specifications. All casting surfaces shall be of a smooth material.
 - 4.2. Placement of Reinforcement

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- 4.2.1. Placement of Reinforcement in Precast Block Units - The cover of concrete over the top layer and bottom layer of reinforcement shall be 2 inches minimum. The cover of concrete over the reinforcement at vertical surfaces shall be 1 1/2 inches minimum, unless otherwise noted on the shop drawings. .
- 4.2.2. Bending of Reinforcement for Precast Block Units – The reinforcing steel for the units shall be done in accordance with ACI 318 latest edition.
- 4.3. Laps, Welds, Spacing
 - 4.3.1. Laps, Welds, and Spacing for Precast Block Units - All splices in the reinforcement shall be made by lapping. Laps may be tack welded together for assembly purposes. For deformed billet-steel bars, the overlap shall meet the requirements of ACI 318 latest edition. The spacing center to center of the steel for either line of reinforcing in the unit shall be not more than 12 inches.
- 4.4. Conduits: Each precast block shall have integral conduits perpendicular to each vertical surface to accommodate the post tensioning rods. The block and post-tensioning design shall ensure that there will be no movement between blocks once they are post-tensioned. Alignment keys shall ensure the top surface of each block is fully level with the top surface of each adjacent block once the blocks are post-tensioned.
 - 4.4.1. Alignment keys shall ensure a cumulative variance not to exceed 1/2” across the entire foundation in any direction will be acceptable.
 - 4.4.2. Variance from block to block shall not exceed 1/4”.
 - 4.4.3. Alignment keys shall ensure the top surface of each block is fully level with the top surface of each adjacent block once the blocks are post-tensioned
- 4.5. Curing: The precast concrete elements 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:
 - 4.5.1. Steam Curing - The precast elements may be low-pressure steam cured by a system that will maintain a moist atmosphere.
 - 4.5.2. Water Curing - The precast elements may be water cured by any method that will keep the sections moist.
 - 4.5.3. 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.
- 4.6. Storage, Handling & Delivery
 - 4.6.1. Storage: Precast concrete units shall be lifted and stored in “as-cast” position. The precast elements shall be stored in such a manner to prevent cracking or damage. Store elements using timber supports as

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appropriate. The units shall not be moved until the concrete compressive strength has reached a minimum of 2500 psi.,

4.6.2. Handling: Handling devices shall be permitted in each precast element for the purpose of handling and setting.

4.6.3. Delivery:

Precast concrete elements must not be shipped until the concrete has attained the specified design compressive strength, or as directed by the design Engineer. Precast concrete elements may be unloaded and placed on the ground at the site until installed. Store elements using timber supports as appropriate.

4.7. Quality Assurance The Precaster shall demonstrate adherence to the standards set forth in the NPCA Quality Control Manual.

4.7.1. Certification: The Precaster shall be certified by the National Precast Concrete Association's Plant Certification Program prior to and during production of the products covered by this specification.

4.7.2. Qualifications, Testing and Inspection

4.7.2.1. 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.

4.7.2.2. 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.

4.7.2.2.1. Air Content: C231 or C173

4.7.2.2.2. Compressive Strength: C31, C39, C497

4.7.2.3. The Precaster shall provide documentation demonstrating compliance with this section to CELL BLOCKS INC at regular intervals or upon request.

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

4.7.3. Documentation - The Precaster shall submit Precast Production Reports to CELL BLOCKS INC as required.

5. Permissible Variations

5.1. Block Units

5.1.1. External Dimensions - The external dimension shall vary not more than .3% from the design dimensions nor more than 3/16 inches whichever is less.

5.1.2. Thickness - The block thickness shall not be less nor more than that shown in the design by more than 1/4 inch. A thickness more than that required in the design shall not be cause for rejection.

5.1.3. Length of Opposite Surfaces - Variations in laying lengths of two opposite surfaces of the block unit shall not be more than 1/4 inch in any blocks.

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- 5.1.4. Position of Reinforcement - The maximum variation in position of the reinforcement shall be $\pm 1/2$ inch. In no case shall the cover over the reinforcement be less than $1\ 1/2$ inches for the top and bottom or be less than 1 inch for the steel as measured to the external vertical surface of the block.
 - 5.1.5. 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.
6. Testing/ Inspection
- 6.1. Testing
 - 6.1.1. Type of Test Specimen - Concrete compressive strength shall be determined from compression tests made on cylinders. For cylinder testing, a minimum of 3 cylinders shall be taken for each lot of block units. (A lot is defined as the precast elements made using the same concrete mix during a single day's production.) Each lot shall be considered separately for the purpose of testing and acceptance.
 - 6.1.2. Compression Testing - Cylinders shall be made and tested as prescribed by the ASTM C 39 Specification.
 - 6.1.3. 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 these acceptance criteria, the unit and associated lot units are not acceptable.
 - 6.2. Inspection The quality of materials, the process of manufacture, and the finished precast elements shall be subject to inspection by the purchaser.
7. Joints The block units shall be produced with alignment keys in the vertical surfaces of the block units. The keys shall resist movement of between the blocks when post tensioned. The joint width between adjacent precast units shall not exceed $3/8$ inches.
8. Workmanship/ Finish The block units shall be substantially free of fractures. The faces of the block 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.
9. Repairs 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.

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10. Rejection 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:

- 10.1. Fractures or cracks passing through the wall, except for a single end crack that does not exceed one fourth the thickness of the wall.
- 10.2. Defects that indicate proportioning, mixing, and molding not in compliance with section 4 of these specifications.
- 10.3. Honeycombed or open texture.
- 10.4. Damaged ends, where such damage would prevent making a satisfactory joint.

11. Marking Each block unit shall be clearly marked by waterproof paint. The following shall be shown on the inside of the vertical leg of the bridge section:

- Width X Length x Thickness
- Date of Manufacture
- Name or trademark of the manufacturer

12. Installation Preparation: To ensure correct installation of the precast concrete foundation system, care and caution must be exercised in the preparation of the bedding material for the block units. Exercising special care will facilitate the rapid installation of the precast components.

12.1. Bedding for Precast Foundation

Do not over excavate unless directed by site soil engineer to remove unsuitable soil. The prepared surface shall be extended beyond the edges of the final foundation by a minimum of 12”.

The foundation shall bear on level native soil or compacted engineered granular fill with a minimum allowable bearing capacity of 1500 psf. The site soils engineer shall certify that the bearing capacity meets or exceeds the design requirements, prior to the contractor placing the precast units. A copy of the report shall be submitted to CELL BLOCKS INC prior to shipment of precast units.

Prior to placing the precast units, the existing soils shall be examined for proper compaction. The existing soils shall be properly compacted to achieve a density of at least 90% of the maximum dry density as established by ASTM D-1557.

The prepared surface shall be given a smooth screeded finish. The bedding 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.

Contractor shall provide a minimum of 2% grade within 10’ of the perimeter of the foundation system to allow surface water to drain away.

13. Installation

13.1. General: The plans and the project specifications shall be followed when installing the precast block units and post tensioning the tendons.

13.1.1. 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 provided in each unit are the only means to

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be used to lift the elements. The precast concrete elements must not be supported or raised by other means than those shown in the drawings.

- 13.2. Placement of Precast Block Units: The precast units 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 joint width between adjacent precast units shall not exceed 3/4 inches prior to post tensioning.
- 13.3. Joint Preparation: The joint between the individual precast block units shall be prepared by using 1/4" thick sponge rubber expansion joint material conforming to ASTM D1752, Type 1 (Sealtight Sponge Rubber by W. R. Meadows or approved equivalent) between all vertical faces of the precast units. The sponge rubber joint material shall be bonded to the concrete vertical surface with adhesive material compatible with the joint material...
- 13.4. Post Tensioning of Precast Block Units
 - 13.4.1. Post tension tendons shall be tensioned to the force shown on the plans to account for all losses due to shrinkage, creep, friction, and tendon relaxation for the specified stressing lengths in an effort to maintain a minimum effective post tensioning force as indicated in the structural calculations
 - 13.4.2. Maximum temporary force in tendons shall not exceed 80% of the ultimate strength of the tendons. In addition tendons shall be locked off at stress not greater than 70% of the ultimate strength of the tendons. The minimum net tension force applied to the tendons shall be as specified on the plans after all losses are considered.
 - 13.4.3. The post tension supplier shall base all elongation calculations on the modulus of elasticity as indicated on the mill certificates for the tendons being supplied to the site. All tendons shall have an attached tag indicating the heat number when provided by the post tension supplier..
 - 13.4.4. The post tensioning force shall be determined by checking pressure on hydraulic jacks. Records shall be maintained of proper calibration of the jacks.
 - 13.4.5. Contractor shall cut tails of post tensioned rods using an abrasive wheel or hydraulic shears. Tendon tail shall protrude a minimum of 1/2" beyond nut.