

SECTION 03 48 21
PRECAST CONCRETE BURIAL CRYPTS
(DOUBLE DEPTH LAWN CRYPT)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work of this Section is to furnish all labor, materials, manpower, tools and equipment required to complete the manufacturing and installation of the precast concrete burial crypts as specified and/or shown, including but not limited to the work to:
1. Fabricate
 2. Transport and deliver to site
 3. Unload units on dunnage or gravel
 4. Store and/or install precast concrete burial crypts (units or crypts)
 5. Install sub base foundation and drainage
 6. Install units in the prepared crypt fields
 7. Backfill between and around the crypts
 8. Install sand and/or backfill on top of crypts
 9. Compact fill materials
 10. Topsoil
 11. Provide additional Materials:
 - a. Three (3) OSHA -approved crypt lid lifting apparatus
 - b. Five (5) extra concrete crypt lids
 - c. A device to easily retrieve and lower the inside shelf by one man without entering the crypt.
 12. Other Associated Work

1.2 DESIGN OVERVIEW

- A. The design of the units shall be as described in this Section and their installation layout shall be as illustrated on the Drawings. Design requirements shall be as follows:
1. All perimeter crypts shall be structurally designed for overhead and lateral soil pressure plus live loads specified hereafter.
 2. All designs will require that the manufacturer provide fabrication drawings stamped by a Professional Engineer indicating that the design meets or exceeds the structural requirements contained herein.
 3. Alternative crypt component designs may be proposed if all the following requirements are met:

- a. Comply with the design criteria and the functional tests of this specification.
- b. All provisions of this specification shall apply to any proposed alternative design.
- c. The Government may accept or reject part or all of any proposed alternative design. The Contractor will pay for all cost for alternate designs, submittals, and reviews.

1.3 RELATED WORK

- A. Excavation and Backfill: Division 31 "EARTHWORK."
- B. Materials Testing and Inspection during Fabrication and Construction: Division 1 Section TESTING LABORATORY SERVICES.

1.4 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project // local/regional materials, // low-emitting materials, // recycled content, // certified wood // _____// requirements.
- B. Blended Cement: It is the intent of this specification to reduce CO2 emissions and other environmentally detrimental effects resulting from the production of portland cement by requiring that all concrete mixes, in aggregate, utilize blended cement mixes to displace portland cement typically included in conventional construction. Provide the following submittals:
 - 1. Copies of concrete design mixes for all installed concrete.
 - 2. Copies of typical regional baseline concrete design mixes for all compressive strengths used on the Project.
 - 3. Quantities in cubic yards of each installed concrete mix.
- C. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit <http://www.biopreferred.gov>.

1.5 REGULATORY REQUIREMENTS FOR RECYCLED CONTENT

- A. Products and Materials with Post-Consumer Content and Recovered Materials Content:
 - 1. Contractor is obligated by contract to satisfy Federal mandates for procurement of products and materials meeting recommendations for

- post-consumer content and recovered materials content; the list of designated product categories with recommendations has been compiled by the EPA - refer to <http://www.epa.gov/wastes/consERVE/tools/cpg/products/>
2. Materials or products specified by this section may be obligated to satisfy this Federal mandate and Comprehensive Procurement Guidelines program.
 3. The EPA website also provides tools such as a Product Supplier Directory search engine and product resource guides.
- B. Fulfillment of regulatory requirements does not relieve the Contractor of satisfying sustainability requirements stipulated by Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, as it relates to recycled content; additional product and material selections with recycled content may be required, as determined by Contractor's Sustainability Action Plan.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Bid documents shall include documentation that manufacturer has a minimum of three years of experience with pre-casting units of similar type. Current plant certification for the location(s) that will be producing units for this project from the National Precast Concrete Association (NPCA) shall be provided as a submittal prior to any work being performed.
- B. Provide a written stamped certification from a licensed Structural Engineer that certifies that the units being manufactured conform to the specified design and performance requirements.
- C. Installation Qualifications: Provide written documentation that verifies:
 1. The installer has been regularly engaged, for at least three years, in installation of pre-cast concrete similar to this project.
- D. Fabricate crypts to the interior dimensions described below.
 1. Replace or repair units that do not comply with the individual dimensions and tolerances.
- E. Prior to, or in the initial stage of crypt production, furnish at the site:
 1. Proposed shelf removal tool.
 2. Two (2) perimeter crypts.
 3. One (1) interior crypt.
 - a. The three (3) crypts shall:
 - 1) Demonstrate acceptable quality of construction.

- 2) Be used to conduct the on-site buried crypt functional load test as described herein below.

F. Functional Load Tests: Functional on-site load tests will be made at the Contractor's expense to insure the units are capable of supporting loads stated. The functional tests will consist of following loading conditions:

1. Confined Loading: An interior unit between two perimeter units shall:
 - a. Be placed in a hole dug in the ground on site and covered with 600 mm (24 inches) of soil or covered to the maximum depth as shown on the plans, whichever is greater.
 - 1) The soil will be compacted to Standard Proctor (AASHTO T-99) density along the sides of 95% and reduced density over the lid, both as shown on the plans.
 - a) Impact type of equipment shall not be used on the sides of the crypts as they can cause conditions that exceed the design parameters.
 - b. An axle load of 5500 kg (12,000 lbs.) shall be passed over the covered crypts for a minimum of 10 times in repetition as follows:
 - 1) In a manner that causes maximum lateral pressure due to wheel load on the sides of the crypts.
 - c. The crypts shall then:
 - 1) Be fully excavated, exposed and the lids removed to allow careful examination inside and outside.
 - a) The crypts must not show any signs of stress or cracking.
2. Shelf Load Testing for the intermediate shelf shall be as follows:
 - a. Apply load to individual support struts. Use one worker with a minimum weight of 90kg (200 lbs.)
 - 1) Worker shall carefully walk on individual supports to confirm structural integrity and load bearing capability.
 - a) Worker shall adhere to all safety regulations while performing test.
 - b. Upon completion of shelf load testing, the inside shelf shall be removed by the removal tool as follows:
 - 1) Without entering the crypt and by one man.
 - 2) Inspected, and lowered back into the crypt in the 2nd interment position.

- 3) The inside shelf must not show any signs of stress, cracking or deflection.
3. Demonstrate the removal and replacement process for the inside shelf. The functioning of the shelf removal tool shall be approved by the NCA Crypt Specialist.
- G. Commence production of crypts only after the written submittal(s) are approved and on-site load testing and demonstration have been scheduled for witnessing by the NCA Crypt Specialist.

1.7 DESIGN CRITERIA

- A. Design Criteria (Double Depth Crypt): All design calculations and drawings shall be signed and sealed by qualified licensed Structural Engineer.
1. The units shall be of the following type, style, and size:
 - a. Type: Precast concrete.
 - b. Style: One-piece box with separate outer lid and the following:
 - 1) A removable one-piece inside shelf
 - 2) Four casket risers or two casket support bars
 - 3) Drain Holes 100 mm (4-inch) diameter in the floor bottom as follows:
 - a) Two drain holes at opposite ends when there are casket risers.
 - b) Three drain holes at opposite ends and in middle, when there are two support bars.
 - c. Crypt interior size: Interior minimum dimensions are as follows:
 - 1) 750 mm (30") minimum width at the inside bottom floor and for the full height of the crypt
 - 2) 2.2 m (86") minimum length along the inside bottom floor and for the full height of the crypt
 - 3) 640 mm (25") minimum clear height from the highest part of the inside shelf to the underside of the lid
 - 4) 640 mm (25") minimum clear height from the lowest part of the inside shelf to the top of the casket risers
 - 5) 20 mm (3/4") minimum height casket risers from the crypt floor spaced 500 mm (20") from crypt centerline to eliminate pinching of the lowering straps during removal. Four risers required.
 - e. Crypt height and wall thickness:

- 1) Exterior maximum height dimension: 1.6 m (60") including the lid.
 - 2) Crypt wall thickness: 50 mm minus 12mm (2-inches minus 1/2 inch) for inside shelf bearing.
 - 3) Perimeter crypts are allowed thicker walls where additional reinforcing is included.
 - 4) Crypt wall sections at support slots originated from the top for the inside shelf may be of lesser thickness.
- f. Layout:
- 1) Crypts shall fit in a 920 mm by 2450 mm (3-foot by 8-foot) plot or a lesser plot size as noted on the plans.
 - 2) The lesser plot size shall govern. If the proposed crypts will not fit into the designed/indicated plot size, with adequate room for the between crypt backfill, or if a different plot size is suggested, the Contractor, at no cost to the Owner, shall prepare a revised Layout/Size Plan and submit it for review and approval by the RE/COR.
2. Load Conditions for design of units shall be as follows:
- a. A burial depth with soil cover as indicated on the plans.
 - b. A center point load of 2700 kg (6,000 lbs.) on one square foot, prior to burial.
 - c. Passage of a wheel axle load of 5500 kg (12,000 lbs.) after burial.
 - d. A 900 mm (3-foot) tall pile of excavated material on top of or adjacent to buried crypts.
3. Submit to the Resident Engineer/Contracting Officer's Representative RE/COR for approval the following:
- a. Five sets of design documentation showing structural design of the units. **In addition, the Contractor shall provide one additional set to NCA Crypt Specialist.**
 - 1) This documentation shall include dimensions, methods of construction, and calculations.
 - b. The Structural Engineer that stamps the design calculations and drawings shall provide:
 - 1) Written recommendations indicating the extent of voids that are allowable in the produced units, without causing any degradation of loading capacity from the design load values.

- 2) Written recommendations on the conditions where repairs will be allowed, and materials and methods to be used for repairs.
- 3) Written statement that all repairs to the units shall only be allowed if they are performed according to the written recommendations of the Structural Engineer.

SPEC WRITER NOTES:

1. Edit the following paragraph regarding the use of the plastic anchor cover. The plastic anchor cover may be eliminated, if approved by the Project Manager following discussion with operations personnel that are familiar with the problems regarding using these plastic caps where frost occurs. Substitution of a small well washed gravel has by experience made it easier for the staff to remove the gravel and ice that accumulates in the lifting bowls.

B. Design Criteria (Concrete Lids):

1. To be removable and replaceable.
2. Lid lifting shall be from top positioned hot-dipped galvanized anchors (4-required per lid) with //removable anchor covers to prevent dirt from entering the anchor bowl and installed in such a manner as to stay in-place when excavating equipment is scraping backfill off the top of the lid//the lifting bowls filled with well washed rounded stone//.
 - a. Furnish the cemetery with three (3) OSHA approved and tag certified wire rope lifting devices for removing the lid. No chain lifting devices allowed.

C. Design Criteria (Inside shelf):

1. One piece rigid construction
2. Fully conceal the lower casket with a rigid barrier
3. Weigh 18 kg (40 lbs.) or less
4. Allow for easy casket lowering belt removal
5. Capable of holding 180 kg (400 lbs.) indefinitely.
6. The entire inside shelf should be rigid, non-brittle, non-deteriorating, and have a maximum 6 mm (1/4 inch) gap from all shelf edges to the crypt wall to create a visual barrier.
7. Have one lifting hole in the middle about 50 mm (2-inches) from the edge 19 mm (3/4-inch) maximum diameter.

D. Design Criteria (Inside Shelf Removal Tool(s)):

1. Be constructed so one man can easily retrieve and install the shelf from ground level without entering the crypt.

a. Demonstrate the use and functionality of said tool at the crypt buried load testing, for the conditions that will occur at the cemetery during the interments at the crypt sections(s).

E. Design Criteria (Quad Crypt):

1. An alternate concrete Quad unit (one piece) may be used as an approved equal in lieu of two (2) double depth lawn crypt units.

The Quad units shall conform to all other specified herein including:

a. The shared interior concrete wall thickness may be increased to allow for a gap between lids as deemed appropriate to meet layout requirements.

F. Design Criteria (Oversized Crypt):

1. Oversized crypts shall conform to all provisions of this section with the exception that the Interior dimensions and Wall thickness are as follows:

a. 1065 mm by 2335 mm (42-inches by 92-inches) inside clear span

b. Oversized crypt wall thickness: 65 mm - 12 mm (2-1/2 inches minus 1/2 inch) for inside shelf bearing.

G. Miscellaneous manufacturing requirements:

1. The concrete lid shall be beveled along the entire top perimeter. Chamfer top edge of lid with a 1:1 chamfer beginning 12 mm (1/2 inch) down from top.

2. The design of casket risers, whether individual spots or bars crossing the bottom, shall allow the casket to rest a minimum of 19 mm (3/4 inch) above the inside floor of the crypt and above the top of the inside shelf in order to aid in casket lowering straps removal. In addition, rests location shall not exceed 530 mm (21 inches) from crypt centerline.

3. The crypt outside lifting wire shall be designed for transport and installation along with provisions for removal/abandonment of crypt lifting wire once crypt has been installed.

1.8 ALLOWABLE TOLERANCES

A. Tolerances of individual units shall be as follows:

1. Variation in overall crypt outside dimensions of unit (height, length and width): 3 mm (1/8") plus or minus. There is zero tolerance for any lesser crypt inside minimum clear dimensions.

2. Variation in thickness of precast panels and elements: 1.5 mm (1/16") plus or minus.
3. Maximum height differential in final placement in the ground: 6 mm (1/4") above or below design grade.
4. Cracks greater than 0.75 mm (0.030 inches) in width are cause for crypt rejection. With evidence of fiber or steel reinforcement, any cracking 0.75 mm (0.030") or lesser width that does **not** extend thru wall is acceptable. Any cracking 0.4 mm (0.016 inch) or lesser that extends thru wall is acceptable. All other cracks are cause for rejecting crypts that shall be repaired or removed and replaced at no cost to VA.

1.9 SUBMITTALS

- A. In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, within 45 days of the approval of the shop drawings, furnish to the RE/COR and the NCA Crypt Specialist the following:
 1. Samples: deliver to the site for testing and inspection:
 - a. Two perimeter crypts and one interior crypt.
- B. Submit a detailed concrete Mix Design of Self Consolidating Concrete (SCC) with a **15% minimum requirement** of a cement substitute of fly ash and/or other pozzalons.
- C. Submit Shop Drawings:
 1. Installation Narrative:
 - a. Method of transportation.
 - b. Method of handling and placement.
 2. Production Drawings:
 - a. Elevation view of each unit.
 - b. Plan view of unit.
 - c. Sections and details to show quantities, sizes and position of reinforcing steel, inserts, and essential embedded hardware for fabrication, handling, transportation and installation.
 - d. Section, details and location of specialty lid lifting anchors, caps, and lid lifting system.
 - e. Dimensions and finishes.
- D. Submit Product Design Data:
 1. Structural adequacy calculations of units (crypts), performed by a licensed Structural Engineer.
 2. Loadings for Design Calculations:
 - a. Initial handling and erection stresses.

- b. Dead and live loads specified.
 - c. Other loads specified for units as applicable.
 - d. Deflection of precast members.
 - e. Product test reports:
 - 1) The concrete shall be tested for the compressive strength and beam flexural strength as specified herein. An approved independent, commercial testing laboratory shall perform tests. Certified copies of test reports, including test data and results shall be submitted to the RE/COR immediately after the strength tests have been completed. The tests shall be as specified herein.
 - 2) Prior to backfilling over crypts and at contractor expense, the RE/COR may pick a single crypt for coring another bottom slab drainage hole by an independent lab with said core being analyzed (petrography testing) and results submitted verifying evidence of fly ash or other pozzalons as specified.
 - 3) Based on failed testing, the RE/COR may request more frequent testing to ensure quality of the product and pozzalons content is present, again at contractor expense.
3. Manufacturer's Literature and Data:
- a. Each type of anchorage, angle, and fastener.

1.10 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling: Units shall be transported, stored and handled so as to prevent damage to surfaces, edges and corners and to prevent development of stresses and cracks. Provide temporary bracing protection devices and measures as necessary to prevent damage to the units during handling, transportation and storage. Transportation, storage and handling of units without damage is required. Any damage caused by accident or negligence on the Contractor's part shall be corrected at the Contractor's expense. Use the designed crypt lifting wire system to transport crypts. On the job site, forklift handling of crypts may be approved by the RE/COR only following:
- 1. Verification that the structural design is adequate.
 - 2. Verification by the manufacturer and demonstration that the field procedures will cause no crypt damage.
 - 3. Submission of written safety procedures to be followed so the procedure is maintained as SAFE.
- B. Storage:

1. Units may be stored within crypt fields being constructed on gravel, or at other designated locations(s) on site, as long as they are set on blocking, gravel or other approved methods to prevent damage or plugging of the bottom drainage holes.

C. Markings and Identifications:

1. Markings, including logos, trademarks and proprietary information are prohibited on surfaces of crypts.
2. Date of manufacture (month, day, and year) shall be written on the box and lid with permanent ink or an equivalent marking.

1.11 COORDINATION

- A. Coordinate the manufacture, delivery, storage and installation of the units with related work.

1.12 GUARANTEE

- A. After erection, completed work will be, subject to terms of Article, GUARANTEE in Division 01, GENERAL CONDITIONS, except guarantee period is extended to five years.

1.13 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

SPEC WRITER NOTES:

1. Remove reference citations that do not remain in Part 2 or Part 3 of edited specification.
2. Verify and make dates indicated for remaining citations the most current at date of submittal; determine changes from date indicated on the TIL download of the section and modify requirements impacted by the changes.

- B. American Association of State Highway and Transportation Officials

T99-01(2011)	Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop.
T180-01(2011)	Moisture-Density Relations of Soils using a 4.54 kg (10 lb) Rammer and a 457 mm (18 inch) Drop.
- C. American Concrete Institute:

ACI Manual of Concrete Practice 2011 Edition.	
ACI 318-05	Building Code Requirements for Structural Concrete

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

A36/A36M-12	Standard Specification for Carbon Structural Steel.
A153/A153M-09	Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
A615/A615M-13	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A1064/A1064M-13	Standard Specifications for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
C31/C31M-12	Standard Practice for Making and Curing Concrete Test Specimens in the Field.
C33/C33M-13	Standard Specification for Concrete Aggregates
C39/C39M-14	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimen
C78/C78M-10e1	Standard Test Method for Flexural Strength for Concrete (Using Simple Beam with Third-Point Loading)
C150/C150M-12	Standard Specification for Portland Cement.
C172/C172M-14	Standard Practice for Sampling Freshly Mixed Concrete.
C260/C260M-10a	Standard Specification for Air-Training Admixtures for Concrete.
C494/C494M-13	Standard Specification for Chemical Admixtures for Concrete
C595/C595-13	Standard Specification for Blended Hydraulic Cement.
C1017/C1017M-13	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
C1116/C1116M-10a	Standard Specification for Fiber-Reinforced Concrete.
C1157/C1157M-11	Standard Performance Specification for Hydraulic Cement
C1399/C1399M-10	Standard Test Methods for Obtaining Residual-Strength of Fiber-Reinforced Concrete.
C1602/C1602M-12	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Precast Concrete: All crypts shall be of concrete with the following:
1. A minimum 28 days compressive strength of 35 MPa (5,000 psi)
 2. Self-Consolidating Concrete (SCC) containing structural fiber with an inverted slump between 550 mm and 700 mm (22" and 28")
 3. A minimum of 15% cement substitute of fly ash and/or other pozzalons. Fiber is not required for crypt lids
 4. Hydraulic Cement: ASTM C150 or ASTM C1157 or ASTM C595
 5. Normal weight Aggregates: ASTM C 33
 6. Water: ASTM C1602
 7. Chemical Admixtures:
 - a. Water reducers, accelerating and retarding: ASTM C 494
 - b. Air Entraining: ASTM C260
 - c. Admixtures for flowing concrete: ASTM C1017
 - d. Admixtures with no standard designation shall be used only with approval of VA.
 8. Prohibited Admixtures: Calcium Chloride thycyanates or admixtures containing more than 0.1 percent chloride ions.
- B. Reinforcement:
1. Welded Steel Wire Fabric: ASTM A1064.
 2. Steel Wire Reinforcement: ASTM A82, cold drawn.
 3. Steel Reinforcement: ASTM A615 Grade 60, deformed.
 4. Inserts, Anchors, Dowels and Accessories: Steel, ASTM A36, zinc coated ASTM A153 hot-dipped galvanized finish G90.
 5. Fiber: Macrofiber complying with ASTM C1116
- C. Form Coatings:
1. Use commercial formulation form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces.
- D. Paint:
1. Use commercial Concrete & Garage Floor Epoxy Acrylic Paint for crypt concrete lid & inside wall surface numbering. Paint as manufactured by BEHR Deep Base #930 or approved equal. The use of an approved equivalent spray paint product, if approved by the NCA Crypt Specialist, shall only be for use on the interior crypt numbers.

2.2 FABRICATION

- A. General:

1. Units shall be fabricated in accordance with the minimum interior dimensions and tolerances indicated herein, with concrete surfaces that are smooth and free of irregularities.

B. Finishes:

1. Surface holes 6 mm (1/4") and smaller caused by air bubbles, normal color variations, normal form joint marks, small chips 6mm (1/4") and smaller and spalling no more than 0.1 square meter (one square foot) total per unit are permitted.
2. Exposed steel reinforcing, honeycomb, bugholes, and cracks not within tolerances are not permitted.

SPEC WRITER NOTES:

1. Use plastic caps on each of the lifting bowls, unless specifically directed otherwise by the Project Manager with approval of the NCA Crypt Specialist.
 2. Modify the following paragraph to reflect the decision whether or not to use the plastic cap over the lifting bowl.
3. The lid lifting system shall be as follows:
 - a. Top mounted and consist of hot dip galvanized steel anchors (four per lid) each in a 65 mm (2-1/2") diameter minimum recessed bowl of depth sufficient to easily connect lifting device as designated compatible by anchor manufacturer.
 - b. Anchors to be installed at locations to ensure maximum lid lifting stability.
 - c. //A removable plastic cap secured to the anchor which prevents fill material from entering the anchor bowl. Cap to be flush mounted to ensure the entire assembly is not an obstruction for crypt excavating equipment. //The lifting bowl will be filled with rounded stone as indicated on the drawings, to facilitate removal in the winter//.
 4. Concrete shall have no evidence of segregation of materials.

C. Reinforcement:

1. Provide steel and fiber reinforcing as required for casting, handling, erection loads, lateral and overhead fill, and equipment live loads.
2. Reinforcing steel shall be free of dirt, mill scale, rust, oil, grease, ice, snow, water and placed within approved tolerances in

accordance with ACI 318. Careful placement of reinforcing is required to avoid overlapping at thin points of the units.

D. Concrete Placement:

1. Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics.
2. Units shall be cast in steel forms designed to suit shape and finish required. Each element of the unit shall be cast as an integral piece free of joints and seams.

E. Curing:

1. 75% of specified concrete compressive strength shall be attained before transportation of units to the cemetery or storage site.
2. Units shall be cured as required to develop specified structural characteristics and shall be stored in a manner that will permit all surfaces to cure equally.
3. Units shall be properly cured in accordance with the applicable provisions of the current ACI Manual of Concrete Practice.

F. Surface Treatment and Corrective Work:

1. Units that have minor chipping of edges and corners shall be repaired by a method approved by the RE/COR.
2. Cracked/damaged units exceeding tolerances shall be removed by the contractor at no cost to the government.
3. Any corrective work beyond what the RE/COR determines is minor, shall be handled according to written procedures from the Structural Engineer that stamped the design for the units. Otherwise, the units shall be removed and replaced.

2.3 TESTING AND INSPECTION

A. Contractor's Responsibility for Inspection: The Contractor is responsible for the performance of all inspection requirements including:

1. Removal of lids
2. Number painting inside crypts
3. Replacement of the lids for inspection by the RE/COR.
 - a. The RE/COR reserves the right to perform any of the inspections set forth in the specification when deemed necessary to assure that the units conform to prescribed requirements.

PART 3 - EXECUTION**3.1 CRYPT FIELD QUALITY ASSURANCE**

- A. Testing: The contractor shall procure an independent qualified testing agency to perform concrete tests during crypt production and prepare test reports.
1. Concrete Cylinder testing for compressive strength:
 - a. Three cylinders per day of crypt production to be taken in accordance to ASTM C172 as applicable to SCC.
 - b. Strength to exceed 35 MPa (5000 psi) after 28 days curing in accordance to ASTM C31 & C39.
 - c. Test inverted slump when cylinders are made.
 2. Beam testing to confirm design flexure strength:
 - a. Once at the beginning of crypt production, a minimum of three beams with fiber shall be taken for testing of Flexural Performance of Fiber-Reinforced Concrete in accordance with ASTM C78 and C1399. All beams' flexural strength shall exceed the crypt design flexural strength requirements and residual strength of fiber reinforced concrete, and shall exceed capacity of conventionally reinforced concrete wall design as submitted by the Structural Engineer and approved by VA. Fiber Manufacturer shall verify type and dosage rate of the test beams are identical in crypt production.
 3. A single verification test of fly ash in the crypt concrete mix required at the discretion of the RE/COR.

3.2 GENERAL LAYOUT CONTROL

- A. A professional registered Land Surveyor shall establish sufficient lines, grades and control for the horizontal placement, slope of the base and top, and vertical alignment for the sides of units in accordance with the design drawings.

3.3 PREPARATION

- A. Before beginning installation, inspect work of other trades insofar as it affects the work of this section. Commencing installation of units will be construed as accepting as suitable the work of other trades.
- B. Verify by survey, rough grading of aggregate for first row of crypts to be installed in a field. Provide a certification by the professional surveyor to the RE/COR that the rough grading for the base stone for the first row of crypts to be installed, as well as that the survey control points for crypt setting have been set according to the plans,

prior to the Contractor starting to set crypts in the field. The Surveyor shall indicate to the RE/COR where the control points are located and how they are protected.

- C. Verify by testing, compaction of prepared subgrade and subbase to meet Standard Proctor (AASHTO T-99).
- D. Verify by survey locations and elevations of units relative to control points indicated on plans. Submit new control point layout if a crypt size other than specified is used.

3.4 HANDLING, INSTALLATION AND PAINTING

A. Handling:

- 1. Units shall be handled in a vertical plane at all times and stacked vertically on wood supports of adequate strength, or placed on gravel until erected. Use of approved designed OEM lifting cable system that has been deemed to be safe for handling the units shall be used during the setting process, where workers are nearby.
- 2. Lift units with suitable lifting devices at points provided by manufacturer.
- 3. Provide temporary wood bracing to comply with manufacturer's recommendations to keep crypt bottom off ground during storage.

B. Installation and Painting:

- 1. Install units by competent erector crews trained and certified as competent by units manufacturer.
- 2. Use all means necessary to protect units from being damaged in transport and during and after installation. Lids or other parts of the crypt that show damage from bouncing during transport shall be replaced by the contractor at no cost to the Owner.
- 3. Accurately install by aligning and leveling units in accordance with plans. Assure that crypts are in straight horizontal alignment.
- 4. After crypt installation and prior to backfill, remove lids with the specified lifting apparatus for crypt inspection by the RE/COR inspector and numbering. Numbers furnished by NCA shall be painted on the outside of the crypt lids and on the upper inside crypt short wall, both at the headstone end. Numbers shall be permanent paint as specified and approximately twelve inches high. Crypt lid number painting must be applied to a clean, dust-free surface requiring paint application **within 10 seconds** of surface cleaning. After completion of inspection and marking, the Contractor shall replace

the lids. Any damage to lids or crypts will be the responsibility of the contractor.

3.5 PROTECTION OF WORK

- A. Use all means necessary to protect units from being damaged during and after installation.

3.6 REPLACEMENT AND REPAIR

- A. Remove and replace units that the RE/COR has determined are damaged, cracked beyond tolerances, broken, improperly fabricated, or otherwise defective and are structurally unsound and unacceptable.
- B. Units having minor defects not affecting serviceability or appearance may be repaired when approved by NCA Inspector.
- C. Proposed repair work shall be sound, permanent, and flush with adjacent surfaces and submitted for approval by NCA Crypt Specialist.
- D. Replacements and repairs shall be done at no additional cost to the Government.

3.7 BACKFILLING AND CRYPT FIELD PROTECTION

- A. Prior to the backfill being placed between the crypts, a professional registered Land Surveyor shall:
 - 1. Survey the in place crypts and provide a written certification that they are, within allowable tolerances installed:
 - a. At the design locations
 - b. Properly aligned
 - c. At correct elevations and slopes
- B. The following documents shall be provided to the RE/COR:
 - 1. An electronic drawing of the as-built conditions for the installed crypts.
 - 2. A paper copy at appropriate scale so the crypt field is fully shown on a maximum sheet size of 600 mm x 900 mm (24" x 36") with all indications of variances in the placement from the design drawings shown.
 - 3. A written certification that during the manufacturing, handling, setting, and or crypt numbering process that each of the lifting bowls were operated using the designed lifting device, and that any excessive concrete debris has been removed to allow free operation of the lifting bowls. A description of when in the process each of the lifting bowls were used shall also be provided.
- C. When all of the crypts in a specific field are installed as indicated in the design drawings and details, and the surveyor has so certified,

the RE/COR will approve the Contractor proceeding with the backfill between the crypts. The Contractor is responsible for insuring that the crypts do not move during the backfill operations, including but not limited to providing adequate blocking at the base of the units, if deemed necessary, to prevent them from moving during the backfill operations.

- D. Protect installed crypt units during backfill operations.
- E. Install approved backfill against outside walls of all units, insuring no voids are remaining. Approved backfill shall:
 - 1. Contain no materials that will cause a concentrated point load.
 - 2. The perimeter wall backfill shall be compacted to Standard Proctor (AASHTO T-99) to 95% density to the level equal to the top of the crypts.
 - 3. Shall be compacted without using large vibratory equipment near crypts as impact loading may cause damage or failure of the crypt.
- F. Backfill between the crypts where gap is less than 50mm (2-inches) shall be as follows:
 - 1. Install approved (rounded) gravel that meets the specified gradation into gaps between crypts leaving no voids.
 - a. At RE/COR's discretion, a non-rounded stone may be considered as a substitute for the rounded stone. The RE/COR may accept the (non-rounded) stone only following demonstration, through an approved submittal process, that rounded stone is not available for less than 4 times the cost of a cut/crushed angular (non-rounded) aggregate substitute. Largest size for the non-rounded stones shall not exceed the gradation size for the rounded stones. (A smaller gradation size will be required for the non-rounded stones to insure that the stones are not larger than their rounded counterparts.) The non-rounded stone shall only be considered when with the largest size of the stone passing a sieve size does not exceed the allowable stone size for the rounded stone gradations. The non-rounded stone may be approved when the size is as described above, and with a successful demonstration that filling gaps between crypts leaves no voids, because the stones fall into place without bridging as should occur when using rounded stones.
 - 2. Use rodding to assure no bridging occurs and void areas are eliminated.

3. No sand allowed.
4. As a resource saving measure, the use of angular stone of suitable gradation (typically the same stone used as drainage stone for below the crypts) shall be allowed in the space between the head and foot of the crypts only, if the Contractor demonstrates a successful method of placement that prevents the larger angular stone from spreading into the gaps along the long sides of side by side crypts.

Aggregate Size No.	Grading Requirements - Amounts finer than Each Sieve (Square Openings), Mass Percent					
	12.5 mm (1/2")	9.5 mm (3/8")	4.75 mm (No. 4)	8.36 mm (No. 8)	1.18 mm (No. 16)	300 μ (No. 50)
8	100	85 to 100	10 to 30	0 to 10	0 to 5	
89	100	90 to 100	20 to 55	5 to 30	0 to 10	0 to 5

SPEC WRITER NOTES:

1. Modify the following as needed following discussion with the current operations staff regarding the sand layer (adjust the thickness, or eliminate.)
 2. Coordinate the thickness of topsoil based upon recommendations from the current Cemetery operations, if applicable, and based upon the soil conditions below the topsoil, to ensure adequacy for roots, and efficient use of water.
- G. Install backfill on top of units and compact. Backfill shall be as shown on plans. In absence of plan detail, backfill on top of units working from bottom up consists of 50 mm (2 inches) of identification sand, soil to specified level, and 100 mm (4 inches) minimum of topsoil as the final layer. The entire backfill atop units shall be compacted to 85% density (Standard Proctor (AASHTO T-99)).
- H. Install drainage board for pea gravel flow containment located in perimeter crypt gaps in areas shown on Drawings.
1. Drainage board shall be installed at the perimeter of crypt field in locations where standard or oversize traditional gravesite burial spaces are identified on the drawings and other areas so designated.
 2. Drainage board shall be as appropriate to fill gap and stop pea gravel flow, and provide for drainage rates of 1000 L/hr/m (100 gal/hr/lf) in any direction.

3. The drainage board shall be made of "non-deteriorating" recycled materials and be able to be compressed and return to its original thickness.
 4. Drainage board shall contain pea gravel between Crypts. Attach board to Crypt wall exterior with fastening method approved during functional load testing. Ensure board material re-expands to original thickness if compressed. Drainage board shall be installed from bottom of Crypt to bottom of lid. Exterior edge of board shall be inset at least 50 mm (2 inches) from edge of crypt and extend 600 mm (2 feet) in between Crypts.
- I. No equipment over the crypts should exceed crypt design loads as specified herein 5500 kg (12,000 lbs axle), which includes compacting equipment. No vibratory compaction equipment over or along side crypts unless impact loads are shown not to exceed crypt design loads.
 - J. Immediately during crypts install, mark the crypt field edges with temporary driven 5-foot tall lathes & signage for easy identification by vehicles carrying fill, topsoil, compost, sod, water or other. Signage shall state **"5500-kg axle load maximum. Keep 9 m away"** ("**12,000-lb axle load maximum. Keep 10 yards away**") and placed minimum 15 m (50-ft) apart.
 - K. Lathes & signage to be maintained in-place during backfilling thru final acceptance of the crypt field.
 - L. Finish grading and prepare topsoil as indicated on plans.
 - M. Do not store or stockpile any stone, sand, backfill, crypts or any other material over 1200 mm (4-feet) high within 9 m (10 yards) of ground on top of installed crypts. Affected crypts subject to said loading condition as determined by the RE/COR shall be inspected for possible damages with all excavation, lid lifting, fill replacement and all other work as necessary, all at contractor's expense.
 - N. Do not allow any vehicle that exceeds a 5500 kg (12,000-lb) axle load, 2700 kg (6000-lb) wheel load or equivalent pressure per square inch to traverse or park within 9 m (10 yards) of or on top of installed crypts. Affected crypts subject to said loading condition as determined by the RE/COR shall be inspected for possible damages with all excavation, lid lifting, fill replacement and all other work as necessary, all at contractor's expense.

SPEC WRITER NOTES:

1. Delete or modify Paragraph A.2 as directed by the Project Manager.

3.8 INSPECTION AND ACCEPTANCE

A. Final inspection and acceptance will be by RE/COR following receipt of:

1. Recommendations from NCA Crypt Specialist and/or A/E team, as applicable.
2. Electronic DWG files of each individual crypt field, with coordinates of the monument markers indicated, and each burial plot being indicated with a closed polygon, and corresponding NCA burial plot identification number, along with the section markers and number for the section.

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