



Iowa Department of Transportation

SPECIAL PROVISIONS FOR LIGHTWEIGHT FOAM CONCRETE FILL

Pottawattamie County
BRF-006-1(113)--38-78

Effective Date
February 16, 2010

THE STANDARD SPECIFICATIONS, SERIES 2009, ARE AMENDED BY THE FOLLOWING ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

090041.01 DESCRIPTION

This work shall consist of providing and placing Lightweight Foamed Concrete Fill, hereafter referred to as LFCF Material, as fill in existing cellular abutment areas and backfill for Mechanically Stabilized Earth Walls, hereafter referred to as MSE Walls, at locations designated on the Plans.

The LFCF Manufacturer and Installer shall coordinate its work with the MSE Wall Designer-Supplier and the MSE Wall Installer.

090041.02 MATERIALS

Materials shall meet the following requirements:

Portland Cement	Section 4101
Water	Section 4102
Air Entraining Admixtures	Section 4103
Water Reducing Admixtures	Section 4103
Set Retarding Admixtures	Section 4103
Curing Materials	Section 4105
Fly Ash	Section 4108
Burlap	Section 4104
Polyethylene Sheeting	Section 4106

Admixtures for water reducing, retarding, accelerating, improving the bond, and for other specific properties may be used when specifically designed by the LFCF Manufacturer.

The foaming agent from the selected manufacturer will produce a Lightweight Foamed Concrete Fill Material, complying with the specifications in Table 1, below.

TABLE 1. LFCF Specifications.

PROPERTY	REQUIREMENTS	TEST METHOD
Class IV - fill within the top 4-feet of finished grade only Maximum Cast Density (after pumping) Minimum Dry Density	42.0 pcf 30.0 pcf	Unit Weight (ASTM C 796)
Class II fill below the top 4- feet of finished grade: Maximum Cast Density (after pumping) Minimum Dry Density	30.0 pcf 25.0 pcf	Unit Weight (ASTM C 796)
Unconfined Compressive Strength	40 psi minimum at 28 days curing for Class II 120 psi minimum at 28 days curing for Class IV	ASTM C 796
Internal Friction Angle	45 degrees (min.)	AASHTO T236 (ASTM D3080-72)
Freeze-Thaw Resistance - minimum cycles @ relative Young's Modulus, E= 80%	300 cycles for Class IV 100 cycles for Class II	ASTM C 666
Coefficient of permeability	1×10^{-5} cm/sec @ 13.8 kPa (2.0 psi)	

090041.03 SUBMITTALS

The Contractor shall submit to the Engineer product data, plans, working drawings, and specifications as indicated below.

A. LFCF Placement Plan

Submit a LFCF quality control (QC) and placement plan. Placement of the LFCF Material shall be in accordance with the information provided in the QC plan. Submit the plan to the Engineer for review and approval no later than 3 weeks prior to LFCF placement. LFCF production shall not begin before the plan has been reviewed and accepted by the Engineer. The submitted plan shall provide, as a minimum, the following elements:

1. An organizational chart including names, telephone numbers, current certifications and/or titles, and roles and responsibilities of all those involved with the quality control program.
2. The process of communication by which quality control information will be disseminated to the appropriate persons, including materials suppliers. This shall include a list of recipients, the communication means that will be used, action time frames, and report formats.
3. Materials list of items proposed to be provided under this section.
4. Manufacturer's specifications, catalog cuts, and other engineering data needed to demonstrate compliance with the specified requirements.
5. Mix designs for the LFCF, prepared by the manufacturer, showing compliance with the specified properties.
6. Certification of batch, mixing and placing equipment by the LFCF manufacturer meeting the requirements of Article 090041.04, A.
7. Written evidence of acceptance of the certified producer/supplier by the foam agent manufacturer.

8. Written evidence that LFCF Installer is certified by and approved by the foam agent manufacturer.
9. LFCF curing procedures.
10. Location of equipment and batching areas.
11. Schedule for placement and sequencing plan of LFCF material, including volume anticipated with each lift placement, construction sequence for constructing the entire fill section, including drilled shafts, MSE Walls, utilities, LFCF, and roadway surface.

B. LFCF Installer Certification

Submit proof of LFCF Installer's compliance with the requirements in Article 090041.04, B, to include a list of projects with completion date, owner's name and phone number, and contact person.

C. Materials

Submit engineering data on all material proposed to be provided under this section including manufacturer's specifications, data sheets, catalog cuts, and other engineering data needed to demonstrate compliance with the specified requirements.

D. Mix Designs

Submit mix designs of all LFCF Material proposed to be provided under this section showing compliance with the specified properties.

E. Equipment

Submit catalog cuts and other data needed to demonstrate compliance with Article 090041.04, A, for all proposed equipment to be used in the production, batching and placement of the LFCF Material.

F. Trial Batch Design and Testing

At least 5 weeks prior to placement, a trial batch shall be prepared and trial batch testing results submitted for each LFCF mix design showing that the proposed LFCF material properties comply with the requirements of this specification and design requirements of the MSE wall. This shall include certified test results of the LFCF reinforcing pullout resistance and pullout friction factor, meeting the minimum requirements of the MSE wall design and written certification that the reinforcing material is not susceptible to corrosion when in contact with the proposed LFCF material. The accepted trial batch mix design and tested properties will become the standard of the material furnished under this section. The District Material's Engineer of the Iowa Department of Transportation reserves the right to perform an independent verification test of the LFCF material properties. The Contractor and LFCF manufacturer shall make all proposed materials available for a verification test if requested by the Iowa Department of Transportation.

G. Mix Verification Samples

At least 2 weeks prior to placing, the Contractor shall submit 10 each 3-inch diameter by 6-inch high cylinder samples of the as designed and tested LFCF to the Iowa Department of Transportation District Office. Specimens shall be covered after casting to prevent loss of moisture and shall not be oven dried. At the option of the Contracting Authority, the samples may be tested for strength and density in accordance with the requirements of ASTM C495 and ASTM C796 to verify the submitted test results and validate the contractor's testing procedures and quality of the furnished product.

090041.04 CONSTRUCTION

A. Specialized Batching, Mixing, and Placing Equipment

Batching, mixing, and placing equipment shall be automated with bulk handling equipment approved by the LFCF manufacturer. Bulk cement shall be weighed on a scale that operates within a tolerance of 1.5% per batch. Cement and water may be premixed and delivered to the site. Foam shall be

added and mixed at the site using the aforementioned equipment. Transit mixers and volumetric batching mixers are not acceptable for these low density applications.

B. LFCF Manufacturer & Approved Installer Requirements

The LFCF manufacturer and approved LFCF Installer shall be regularly engaged in the placement of LFCF including completion of mass fills for Federal & State Highways having a minimum of 15,000 cubic yards in the past five years. Engineered Fill shall have been applied on at least 5 projects that have performed satisfactorily for at least 3 years. Furthermore, the approved LFCF Installer shall be pre-qualified and approved in writing by the LFCF foam material manufacturer.

C. Personnel Requirements

The LFCF Installer, shall be certified and approved in writing by the foam agent manufacturer of the LFCF material. The Installer's foreman shall have a minimum of 2 years experience in this work and shall have worked on at least one of the three successful LFCF projects.

The Installer shall use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are familiar with the specified requirements and the methods needed for proper performance of the Work noted in this Section.

The Manufacturer's Representative shall be experienced in the placement of LFCF and shall be on site full-time during placement.

D. Required Contractor Testing

The contractor is responsible for conducting acceptance testing and providing test results to the Engineer prior to and during the installation of the LFCF. The testing lab shall be certified and pre-approved by the Contracting Authority.

1. Cast Density

Test cast density in accordance with ASTM C 495

- a. Prior to placement of the initial batch, the Installer shall check the density and adjust the mix as required to obtain the manufacturer's specified cast density at point of placement.
- b. At hourly intervals during placement, the contractor shall monitor the density and adjust as necessary to maintain the specified cast density.

2. Strength Testing

Conduct strength testing in accordance with ASTM C 495

- a. The contractor shall furnish a sufficient quantity of molded and cured cylinders measuring 3-inches in diameter by 6-inches high for required strength tests. The Contractor shall provide molds, and a curing environment conforming to the requirements of ASTM C 495.
- b. At a minimum, prepare a set of 4 test cylinders for each 50 cubic yards of LFCF placed or a minimum of 2 sets of 4 cylinders each per day (whichever is greater). One cylinder from each set shall be tested for strength at 1, 2, 7, and 28 days. Provide certified strength test results to the Engineer for acceptance.

3. Foam Density

Foam density will be taken twice per day per operating unit by the Installer with Quality Assurance observed by the Contracting Authority for compliance with the approved submitted mix design. Test Method D 3574 test A.

E. Site Conditions

The contractor shall examine the areas under which work of this Section will be performed to inspect special constraints. Correct conditions that will be detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected. Subgrade shall be graded and compacted to the lines and grades shown on the plans.

F. Preparation

The installation of the LFCF shall be in accordance with procedures provided by the manufacturer. The fill area shall not have standing water in it. The Contractor shall ensure that the LFCF remains above the water table at all times during construction. Items encased in the fill shall be set and stable prior to installing the LFCF Material.

G. Placement

LFCF shall be a homogeneous mixture and all materials shall be approved prior to use.

The areas to be filled shall not have any standing water in it prior to placement of the LFCF. The contractor shall ensure the LFCF remains above the water table at all times during construction. Subdrains, if required, shall be installed in accordance with the manufacturer's recommendations and submitted to the Engineer for approval.

Subgrade for LFCF fill will be prepared in accordance with Section 2107 of the Standard Specifications.

Material shall be protected before, during and after installation, and the Installer shall protect the work and materials of other trades. In the event of damage, immediately make replacements and repairs to the acceptance of the Contracting Authority at no additional cost to the State.

Precast panels and MSE steel reinforcing strips to be fully or partially encased in the LFCF shall be properly set and stable prior to the installation of the LFCF.

If the LFCF must be placed in freezing conditions, the manufacturer shall be consulted as to what precautions are necessary to assure installation of an acceptable LFCF. LFCF shall not be placed at a temperature of less than 32°F, nor when freezing conditions are expected within 24 hours, unless precautions as dictated by the manufacturer are taken to maintain temperatures above freezing. Do not place LFCF on frozen ground.

Cure LFCF in accordance with the accepted installation plan.

LFCF shall only be proportioned, mixed, and placed using equipment approved by the manufacturer as indicated in the accepted LFCF placement plan. Once mixed, the LFCF concrete shall be conveyed promptly to the location of placement without excessive handling.

LFCF shall be placed in lifts not exceeding 24 inches in depth. The first lift shall be 2 inches at a minimum below the top of the lowest MSE wall precast panel.

Prior to placing LFCF, vertical and horizontal joints between MSE wall panels shall be covered with polyester fabric on the backface of the panels, in accordance with the Standard Specifications for Mechanically Stabilized Earth (MSE) Retaining Wall.

Scarify each lift before placing the next lift. Each lift shall be scarified to a minimum depth of 0.5 inch at a maximum of 2 inch centers using a hand rake or other suitable means. Scarifying shall be done in a manner to not disturb the alignment of the MSE Wall reinforcing strips/mesh. Scarifying shall be done after sufficient curing time such that foot traffic will not excessively damage the lift surface (no greater than 0.25 inch indentation).

Allow a minimum of 24 hours between subsequent lifts. Prior to verification of the minimum specified compressive strength by testing, additional lifts may be placed at the Contractor's risk. Any material that does not meet the minimum specified strength within 28 days shall be removed and replaced by the Contractor at no additional cost.

Move the discharge hose(s) sufficiently to ensure level filling through the specified fill area. Uneven filling is not permitted.

Limit the area of placement to the volume that can be placed within 1 hour, up to the maximum 2 foot lift height. Each vertical lift shall be adequately staggered with the preceding lift so that vertical construction joints are spaced at least 2 feet apart.

The discharge hose length shall not exceed 800 feet in length.

Paving machines, heavy construction equipment or other unusual loading of the LFCF shall not be permitted until it has attained the specified 28 day compressive strength.

Sawing or ripping of the LFCF for utilities, underdrain or other conflicts will be by methods approved by the Contracting Authority.

Any material that does not comply with the minimum specified criteria shall be removed and replaced at no additional cost to the State.

The Surface of the LFCF shall be stepped at six inch vertical intervals to match the profile of the grade line while maintaining the minimum aggregate sub-base as shown on the plans. Run of step shall be sloped at a minimum of 1% to provide positive drainage. Additional drainage items, if required, shall be installed in accordance with the Manufacturer's recommendations and submitted to the Engineer for approval.

H. Acceptance

The contractor shall rectify any LFCF material rejected by the engineer that does not meet the minimum required material properties or is not installed in accordance with this specification. Corrective measures are subject to the approval of the Engineer. Accepted corrected measures will be performed by the contractor at no additional cost to the State or extension of contract time. This includes removal and replacement of rejected LFCF material not meeting the minimum material requirements or installed in accordance with this specification.

090041.05 METHOD OF MEASUREMENT

The quantity of Lightweight Foamed Concrete Fill for which payment will be made will be the quantity shown in the contract documents that is acceptably placed. The total volume of the respective classes of Lightweight Foamed Concrete Fill placed will be computed in cubic yards by the Engineer from dimensions shown in the contract documents, with the changes that have been made in accordance with a written order from the Engineer.

090041.06 BASIS OF PAYMENT

The net volume of Lightweight Foamed Concrete Fill, computed as specified above, will be paid for at the contract unit price per cubic yard for each respective class of Lightweight Foamed Concrete Fill material.

Payment shall be full compensation for preparation of written submittals, material testing, coordination of and scheduling of LFCF placement with MSE retaining wall erection, onsite manufacture representative, specialized equipment to mix, transport and place LFCF, groundwater control and temporary shoring, and include all associated costs such as materials, labor, equipment and incidentals necessary to complete the work in accordance with the contract.