

Specification for Tunnel Backfill Geofill LD Cellular Concrete (LDCC)

I – SCOPE OF WORK

This work consists of providing Geofill LD, a non-pervious closed cell, low density cellular concrete (LDCC) to fill the annular space between the host/casing pipe and the carrier pipe(s) from within the carrier pipe or from bulkheads at the end of each section per the plans and accordance with the details in the plans and these specifications. The annular space shall be completely grouted to support the liner and provide long-term stability and corrosion protection.

II – MATERIALS

- A. Portland cement shall comply with ASTM C150 (Type I, II or III).
- B. Fly ash shall be Class C or Class F and compatible with foaming agent.
- C. Water shall be free from deleterious substances.
- D. Foaming agent shall be Geofill Concentrate (Phone #888-820-3455) conforming to ASTM C796.
- E. Admixtures for water reducing, retarding, accelerating, and other specific properties may be used when recommended by the manufacturer of the foaming agent.
- F. Geofill LD shall have the following properties:

Range of Cast Density, PCF	50-60
Minimum Compressive Strength (28 Days), PSI	500
Flow Consistency per ASTM D6103	Greater than 6”

III – SUBMITTALS

- A. Mix design for LDCC, including materials to be used and their sources.
- B. Resume of contractor showing experienced as specified below, including qualifications of contractor’s superintendent and/or foreman.
- C. Description of equipment and placement procedures to verify compliance with specifications and assure annulus is completely filled.
- D. Drawings showing the method of preventing pipe floatation, buckling, excessive deflection and damage.

IV – PRODUCTION

- A. Foam generating equipment shall be used to produce a predetermined quantity of pre-formed foam which shall be mixed and blended with cementitious slurry. Equipment shall be calibrated to produce consistent foam that shall retain its stability until the cement sets to form a uniform cellular structure. The resulting LDCC shall have an essentially closed cell and low water absorptive characteristics.

- B. LDCC shall be produced utilizing specialized automated proportioning, mixing, and foam producing equipment, which is capable of meeting the specified properties.
- C. Avoid excessive handling of the material. After sufficient mixing of the foam with slurry, the material shall be conveyed promptly in its final location.
- D. All equipment used must be approved by the foam manufacturer.

V – INSTALLATION

- A. A bulkhead shall be constructed at the open end of each reach of tunnel section to be backfilled so the annular space will be completely backfilled in accordance with the contractor's submittal as approved by the engineer.
- B. All bulkheads and injection points installed shall be capable of withstanding a minimum of 30 PSI or the allowable maximum pressure, whichever is greater and shall be water tight.
- C. Place LDCC through various injection ports inside the carrier pipe or from the bulkhead through injection pipes in order to yield pumping pressures below the maximum allowable pressure, fill the annulus completely, and be in accordance with the contractor's submittal as approved by the engineer.
- D. Injection ports and pipes should be a minimum of 3" female threaded NPT.
- E. Injection ports and pipes shall also be used to provide ventilation and to monitor the flow of grout.
- F. All water and other residual materials must be removed from the annulus prior to initiating filling procedure. If required, dewatering shall be continuous during installation of LDCC.
- G. Backfilling of the annular space shall be accomplished by placing backfill in a monolithic lift provided that placement methods will not induce movement of the pipe, pipe overstressing or excessive deformation, otherwise two or more lifts may be required.
- H. Take necessary precautions to protect and preserve the interior of the pipe from damage. Spills shall be minimized and cleaned up immediately.
- I. Volume of LDCC backfill shall be measured, recorded and compared with anticipated volume per foot of pipe backfilled.

VI – QUALITY CONTROL AND QUALITY ASSURANCE

- A. Contractor shall have a record of experience and quality of work placing foam concrete that is satisfactory to the Engineer. Including the following:
 - 1. Shall be capable of developing a mix design, batching, mixing, handling, and placing LDCC.
 - 2. Shall be regularly engaged in the production and pumping of LDCC for tunnel backfilling.
 - 3. Shall have satisfactory completed at least five (5) similar LDCC projects during the last three (3) years.

4. Workers, including the contractor's superintendent and /or foreman, shall be fully qualified to perform the work and have had previous experience in production and pumping of LDCC under similar conditions.

B. TESTING

1. Field control tests, including unit weight (wet density), flow consistency, and compression tests shall be performed by owner or owner's representative.
2. A minimum of four (4) 3"x 6" cylinders shall be molded for each shift of operation.
3. LDCC may be tested at any age after three (3) days for compressive strength. At least two (2) specimens from each set should be tested at 28 days in accordance with ASTM C-495.
4. Measure flow consistency and unit weight (wet density) at the point of placement from the first batch mixed, every hour during the pour, and from each batch of LDCC from which compression test cylinders are made. Mix shall be adjusted as required to obtain the specified cast density at the point of placement.

VII – MEASUREMENT AND PAYMENT

- A. Geofill LD shall be paid for at the contract unit price per cubic yard for materials produced.