

**2519 Cellular Concrete****2519.1 DESCRIPTION**

This Work consists of using cellular concrete to fill and backfill roadways and structures, fill abandoned pipes, and fill the annular space between existing pipe Culvert and a new liner.

**A Definitions**

For the purpose of the Work specified in section 2519, "Cellular Concrete," the Department defines:

**Cellular Concrete**

A mixture of cement, water, and preformed foam to create air voids. The mixture can include aggregate depending on the use. It is lightweight and highly flowable and able to fill spaces of any size or shape.

**Lightweight Cellular Concrete Fill (LCCF)**

LCCF is used for filling abandoned pipes, filling roadway embankments and bridge approaches and backfilling bridge abutments, retaining walls and other structures when minimal to no water is present.

**Low Density - Controlled Low Strength Material (LD-CLSM)**

LD-CLSM is used for grouting the annular space between existing pipe Culvert and a new liner or filling abandoned pipes and other structures when minimal to no water is present.

**High Density - Controlled Low Strength Material (HD-CLSM)**

HD-CLSM is used for grouting the annular space between existing pipe Culvert and a new liner and filling abandoned pipes when it is not possible to sufficiently dewater.

**2519.2 MATERIALS**

<b>A</b>	<b>Concrete .....</b>	<b>2461</b>
	Use mix 3G52 for concrete bulkheads.	
<b>B</b>	<b>Cement .....</b>	<b>3101</b>
	Use Type I or Type I/II cement.	
<b>C</b>	<b>Blended Hydraulic Cement .....</b>	<b>3103</b>
	Use Type II cement.	
<b>D</b>	<b>Fine Aggregate .....</b>	<b>3126</b>
<b>E</b>	<b>Water .....</b>	<b>3906</b>
<b>F</b>	<b>Admixtures .....</b>	<b>3113</b>
	Provide admixtures from the APL/QPL list.	

The Contractor may propose use of anti-washout admixture under all the following conditions:

- (1) Recommended by the foaming agent manufacturer
- (2) Meeting the requirements of U.S. Army Corps of Engineers CRD-C661-06, Specification for Anti-Washout Admixtures for Concrete
- (3) Included in the placement work plan, and
- (4) Approved by the Engineer, in conjunction with the Concrete Engineer

**G Foaming Agent**

Provide foaming agent meeting the requirements of *ASTM C869, Standard Specification for Foaming Agents Used in Making Preformed Foam for Cellular Concrete*. Test in accordance with *ASTM C796, Standard Test Method for Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam*.

**H Contractor Cellular Concrete Mix Design**

The Contractor assumes full responsibility for the mix design and performance of the cellular concrete. The Engineer determines final acceptance of the cellular concrete for payment based on satisfactory field placement and performance.

**G.1 Cellular Concrete Mix Design Requirements**

The Department defines the concrete mix design requirements for cellular concrete in accordance with Table 2519.3-1.

**Table 2519.3-1  
Cellular Concrete Mix Design Requirements**

Mix Number	Maximum Cast Density ASTM C796 (pounds/cubic foot) *	Maximum W/C Ratio	Minimum 28-Calendar Day Compressive Strength ASTM C495
LCCF	30	0.55	40 psi
LD-CLSM	45	0.55	100 psi
HD-CLSM	75	0.55	120 psi
* For concrete mix design purposes only.			

**G.2 Cellular Concrete Mix Design Submittal Requirements**

At least 21 Calendar Days before initial placement of the concrete, submit the appropriate *Cellular concrete mix design submittal* form to the Concrete Engineer for approval. Use the most current forms available from the MnDOT Concrete Engineering website.

Design the concrete base mix and cellular concrete mix to an absolute volume of 27 cubic feet. Include foaming agent test data complying with ASTM C869 with the mix design submittal.

The Concrete Engineer will review the mix design submittal and approve the Materials and mix design for compliance with the Contract.

**2519.3 CONSTRUCTION REQUIREMENTS**

**A Preparation for Cellular Concrete Placement**

The cellular concrete installer should be certified and approved by the foam agent manufacturer.

Use foam agent manufacturer's recommended foam generating equipment for the mixing and production of the cellular concrete. Provide the concrete base mix (slurry) from a Certified Ready-mix Plant meeting the requirements of 2461.3F, "Certified Ready-mix Concrete". Transit mixers and volumetric batching mixers are not acceptable unless approved by the Engineer, in conjunction with the Concrete Engineer.

Provide a pressure gauge to monitor pumping pressure during placement.

**A.1 Backfilling or Filling Roadways or other Structures**

Prepare the subgrade to the shape and grade as shown in the plans and in accordance with 2112, "Subgrade Preparation." Prior to placement of the LCCF, remove any water in the area. If necessary, provide continuous dewatering during placement of the LCCF to ensure the LCCF remains above the water table during construction. Do not place on frozen material.

Prior to backfilling against any walls or shoring, design any walls or shoring to support the LCCF's

hydrostatic force and pumping pressure.

#### **A.2 Filling Abandoned Pipes**

Remove any water and other residual materials from the pipe prior to placement of the LCCF. If necessary, provide continuous dewatering during placement of the LCCF mixture. If it is not possible to sufficiently dewater, use the high-density design (HD-CLSM) mixture.

Install bulkheads and injection points capable of withstanding the required pumping pressure. Provide maximum pumping pressure allowances for the project conditions. Place injection points at intervals to allow adequate inspection ports.

#### **A.3 Annular Space Grouting**

Use the low-density design (LD-CLSM) for annular space grouting applications when minimal to no water is present, and water does not intrude during the setting process.

Use the high-density design (HD-CLSM) for annular space grouting applications when it is not possible to sufficiently dewater or keep water out of the annular space during grouting.

Secure the pipe liner to the invert of the existing pipe Culvert to prevent the pipe liner from floating during the CLSM placement operations. Construct concrete bulkheads on both ends of the pipe Culvert with Mix No. 3G52 concrete. Finish the inlet end with a 45-degree mitered fillet-transition between the in-place pipe Culvert and the inside of the liner. Utilize a method of venting through the bulkheads or grouting ports at the crown to allow air to escape and to allow verification by the Engineer that the annular space has been filled.

#### **A.4 Placement Work Plan**

At least 15 days prior to the start of work, provide a work plan in writing to the Engineer for acceptance detailing the specific application methods to complete the placement of cellular concrete that includes the following where applicable:

- (1) Maximum hydrostatic pressure allowances for the backfilling of walls or shoring.
- (2) Maximum pumping pressure allowances for the project conditions.
- (3) Maximum lift height when exceeding 4 feet as recommended by the foaming agent manufacturer.
- (4) Bulkhead construction installation instructions and locations.
- (5) Hot or cold weather protection plan in accordance with 2519.3C.

### **B Placing Cellular Concrete**

For all cellular concrete applications, monitor pumping pressure during placement ensuring maximum pumping pressures are not exceeded per the placement work plan. Do not exceed the pipe liner manufacturer's recommended maximum pressure requirements.

Place LCCF in maximum lifts of 4 feet unless otherwise recommended by the foaming agent manufacturer and included in the placement work plan. Move the discharge hose sufficiently to ensure level filling through the specified area. Avoid excessive handling of the LCCF to prevent segregation. The Contractor may place subsequent LCCF lifts 12 hours after prior LCCF placement. Finish the final LCCF surface to within 0.05 feet above to 0.10 feet below the cross-section shown on the plans.

Place CLSM to grout the annular space between the existing pipe Culvert and pipe liner, including breaks or holes in the existing pipe Culvert. Completely fill the annular space along the entire length of the liner and pipe Culvert. Use cylindrical wooden plugs, or other equivalent material approved by the Engineer, to plug CLSM entry holes. After the CLSM has set, remove the plugs, and fill with Mix No. 3G52 concrete or an approved non-shrink grout listed on the *Approved/Qualified Products List*.

### **C Protection Against Hot and Cold Weather**

If the National Weather Service forecast for the construction area predicts temperatures less than 33° F or greater than 100° F within the next 24 hours and the Contractor wishes to place cellular concrete, submit a hot weather or cold weather protection Plan. Do not place cellular concrete until the

Engineer accepts the hot or cold weather protection Plan.

Do not place cellular concrete if the National Weather Service forecast predicts rain in the construction area within 24 hours.

**D Testing**

Sample and test cellular concrete in accordance with the *Schedule of Materials Control*.

Measure the density at the point of placement in accordance with ASTM C796. Record the density using the *Cellular Concrete Density Worksheet* and adjust the mix as required to obtain the specified cast density during placement. Maintain the cellular cast density within +/-3 pounds per cubic foot of the cast density design.

Cast cylinders in accordance ASTM C495. Cure cylinders in accordance with 2461.3G5.b. The Department will transport the cylinders in accordance with 2461.3G5.b(3) and test the cylinders at the Office of Materials and Road Research in accordance with ASTM C495 (do not oven dry before testing).

**E Backfill Construction**

Protect the final LCCF surface from backfilling or loading for at least 24 hours after placement or until the LCCF reaches a compressive strength of 20 pounds per square inch, whichever occurs first. The LCCF is considered stable enough when walked upon with limited impressions (no more than 1.0 inch in depth) left on the surface. The Engineer will inspect the LCCF prior to backfilling or applying load on the final surface. Remove and replace segregated areas (where the cement slurry settles and leaves a crunchy foam top at the surface the next day). Removal method determined by the Contractor as approved by the Engineer.

Perform the backfill or embankment construction to the elevations as shown on the Plans.

**F Workmanship**

The Engineer will reject damaged cellular concrete in accordance with 1503, "Conformity with Contract Documents," and 1512, "Unacceptable and Unauthorized Work."

**2519.4 METHOD OF MEASUREMENT**

The Engineer will measure cellular concrete produced as required by the Contract by the theoretical volume as verified by the computerized Ready-mix Certificate of Compliances multiplied by the expansion factor of the cellular concrete identified on the approved Cellular Concrete Mix Design. The Engineer will deduct accountable waste from the concrete measurement.

**2519.5 BASIS OF PAYMENT**

The Contract cubic yard price for cellular concrete includes the cost of mobilization, dewatering, production, placement, and bulkhead and inlet bevel construction.

The Department will pay for cellular concrete based on the following schedule:

Item No.	Item	Unit
2519.607	LCCF	cubic yard
2519.507	CLSM Low Density	cubic yard
2519.507	CLSM High Density	cubic yard