If the material fails to meet requirements based on the visual check or the D85 results, the Engineer will test the gradation using one of the following methods:

(1) FHWA Hydraulic Toolbox, 5-692.212 test method, listed in the Grading and Base Manual and form G&B-108a, "Riprap Gradation D85 and FHWA Hydraulic Toolbox"
(2) WipFrag or a similar image analysis software, as approved by the Engineer, and form G&B-108a, "Riprap Gradation D85 and FHWA Hydraulic Toolbox"
(3) The Wolman Count, 5-692.211 test method, listed in the Grading and Base Manual and form G&B-108b, "Riprap Gradation Wolman Method"

For riprap meeting 3601.2B, "Hand-placed Riprap," the Engineer will visually inspect the riprap to ensure it meets the requirements of 2511.3C.2, "Hand-Placed Riprap."

S-71 (2519) CELLULAR CONCRETE GROUT – CONTROLLED LOW STRENGTH MATERIAL

NEW 09/29/23

S-71.1 Delete and replace MnDOT 2519, "Cellular Concrete Grout – Controlled Low Strength Material" with the following:

S-72 (2519) Cellular Concrete

S-72 (2519) CELLULAR CONCRETE

NEW 09/29/23

S-72.1 DESCRIPTION

This Work consists of using cellular concrete to fill the annular space between existing pipe Culvert and a new liner, fill embankments, backfill structures and fill abandoned pipe in accordance with MnDOT 2104, MnDOT 2112 and MnDOT 2461.

A Definitions

For the purpose of the Work specified in MnDOT (2519) Cellular Concrete the Department defines:

Cellular Concrete
A lightweight and flowable mixture of cement, water, and foaming agent.

Segregated Areas
Areas where the surface exhibits a crunchy foamy top.

S-72.2 MATERIALS

A Concrete 2461
Use base mix (slurry) from a Certified Ready-mix Plant in accordance with MnDOT 2461.3F.
Use mix 3G52 for concrete bulkheads.

B Cement 3101
Use Type I or Type I/II cement.

C Blended Hydraulic Cement 3103
Use Type IL cement.

D Fine Aggregate 3126

E Water 3906

F Admixtures ..... 3113 and APL
Anti-Washout Admixtures U.S. Army Corps of Engineers CRD-C661-06

G Foaming Agent ..... ASTM C869

S-72.3 CONSTRUCTION REQUIREMENTS

A Mix Design

A.1 Cellular Concrete Mix Design

Design the cellular concrete mix to an absolute volume of 27 cubic feet in accordance with Table SP2519-1.

Table SP2519-1
Cellular Concrete Mix Design Requirements

Mix Number	Maximum Designed 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
CLSM LOW DENSITY	45	0.55	100 psi
CLSM HIGH DENSITY	75	0.55	120 psi

B Submittals

B.1 Cellular Concrete Mix Design

Submit form CONC-208 Cellular Concrete Mix Design a minimum of 21 Calendar days before the initial cellular concrete placement. The Concrete Engineer will review the mix design submittal for compliance with the Contract.

B.2 Placement Work Plan

Submit a written placement work plan detailing the specific application methods to complete the placement of cellular concrete a minimum of 15 Calendar Days before placing cellular concrete. The plan must include 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) Pressure monitoring process.
(4) Foaming agent manufacturer's approval of the maximum lift height if exceeding the lift height of 4 feet.
(5) Bulkhead construction installation procedures and locations.
(6) Hot or cold weather protection plan.
(7) Anti-washout Admixture product information including foaming agent's certification and approval for Anti-washout product.
(8) Removal methods for segregated cellular concrete.

B.3 Cellular Concrete Density at point of placement

Submit form CONC-701 Cellular Concrete Density Worksheet a maximum of 24 hours after placement.

C Placing Cellular Concrete

Incorporate foaming agent in accordance with the manufacturer's recommended foam generating equipment for the mixing and production of the cellular concrete.

Monitor pumping pressure during placement.

Remove standing water from the subgrade surface.

Temporarily suspend the mixing and placing operations and implement the Hot or Cold Weather Protection Plan if the National Weather Service forecast for the construction area predicts temperatures less than 33° F or greater than 100° F.

Temporarily suspend placing cellular concrete and protect the work area if the National Weather Service forecast predicts rain in the construction area within 24 hours or as approved by the Engineer.

C.1 CLSM Low Density and CLSM High Density

Secure the pipe liner to the invert of the existing pipe Culvert.

Install concrete bulkheads on both ends of the pipe Culvert.

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.

Place CLSM Low Density when minimal to no water is present in the annular space, otherwise use CLSM High Density. 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 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 APL.

C.2 Lightweight Cellular Concrete Fill (LCCF)

C.2.a Embankment Fill

Prepare the subgrade as shown in the Plans and in accordance with MnDOT 2112.

Provide temporary shoring to support the placement of the LCCF.

Place LCCF in maximum lifts of 4 feet. Move the discharge hose sufficiently to ensure level filling though the specified area. Avoid excessive handling of the LCCF to prevent segregation. 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.

Protect the final LCCF surface from backfilling or construction loading a minimum of 24 hours after placement or until the LCCF reaches a compressive strength of 20 pounds per square inch. Obtain Engineer acceptance of LCCF prior to backfilling or applying load on the final surface.

Temporarily cover the LCCF with polyethylene plastic sheet if the final LCCF surface is not backfilled within 36 hours of LCCF placement.

Remove and replace segregated areas.

C.2.b Backfilling Structures

Provide temporary shoring to support the placement of the LCCF, when required.

Place LCCF in maximum lifts of 4 feet. Move the discharge hose sufficiently to ensure level filling though the specified area. Avoid excessive handling of the LCCF to prevent segregation. 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.

Protect the final LCCF surface from backfilling or construction loading a minimum of 24 hours after placement or until the LCCF reaches a compressive strength of 20 pounds per square inch. Obtain Engineer acceptance of LCCF prior to backfilling or applying load on the final surface.

Temporarily cover the LCCF with polyethylene plastic sheet if the final LCCF surface is not backfilled within 36 hours of LCCF placement.

C.2.c Filling Abandoned Pipes

Remove and dispose of debris from the pipe in accordance with MnDOT 2104.3D.3. Place LCCF when minimal to no water is present in the pipe, otherwise place CLSM High Density.

Install concrete bulkheads with injection points capable of withstanding the required pumping pressure. Locate injection points at intervals to allow adequate inspection ports.

D Quality Control

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 on form CONC-701 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 with *ASTM C495, Standard Test Method for Compressive Strength of Lightweight Insulating Concrete*. Cure cylinders in accordance with MnDOT 2461.3G.5.b. The Department will transport the cylinders in accordance with MnDOT 2461.3G.5.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).

S-72.4 METHOD OF MEASUREMENT

The Engineer will measure cellular concrete by the volume as verified from the computerized Ready-mix Certificate of Compliances multiplied by the expansion factor of the cellular concrete identified on the approved Cellular Concrete mix design with consideration of any waste as agreed upon with the Engineer.

S-72.5 BASIS OF PAYMENT

The Contract Unit Price for cellular concrete is compensation in full for Equipment, Materials and labor required to complete the Work.

The Engineer will reject damaged cellular concrete in accordance with MnDOT 1503 and MnDOT 1512.

Use of CLSM High Density in place of CLSM Low Density or LCCF will be paid for as Extra Work in accordance with MnDOT 1402.2.

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

Item No.	Item	Unit
2519.607	CLSM Low Density	cubic yard
2519.607	CLSM High Density	cubic yard
2519.607	Lightweight Cellular Concrete Fill	cubic yard