

SUPERSEDED BY EB 15-031 EFFECTIVE 9/28/15		New York State Department of Transportation ENGINEERING INSTRUCTION	EI 12-015								
Title: STANDARD SPECIFICATION §733-01 FLOWABLE FILL											
Target Audience: <table border="0"> <tr> <td>☐ Manufacturers (18)</td> <td>☐ Surveyors (33)</td> </tr> <tr> <td>☒ Local Govt. (31)</td> <td>☒ Consultants (34)</td> </tr> <tr> <td>☒ Agencies (32)</td> <td>☒ Contractors (39)</td> </tr> <tr> <td>☐ _____ ()</td> <td></td> </tr> </table>		☐ Manufacturers (18)	☐ Surveyors (33)	☒ Local Govt. (31)	☒ Consultants (34)	☒ Agencies (32)	☒ Contractors (39)	☐ _____ ()		Approved: <u>Anthony J. Torre</u> <u>05-03-2012</u> Anthony Torre, P.E. Date Acting Deputy Chief Engineer (Research)	
☐ Manufacturers (18)	☐ Surveyors (33)										
☒ Local Govt. (31)	☒ Consultants (34)										
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ADMINISTRATIVE INFORMATION:

- This Engineering Instruction (EI) is effective beginning with projects submitted for the letting of Sept 6, 2012.
- This EI modifies a portion of EI 09-027.
- The revisions issued with this EI will be incorporated into the next update of the Standard Specifications.

PURPOSE: The purpose of this EI is to issue revised Standard Specification §733-01 *Flowable Fill*.

TECHNICAL INFORMATION:

- A revised Standard Specification Section 204 *Controlled Low Strength Material*, the title of which is being changed to Section 204 *Flowable Fill*, is being issued concurrently via EI 12-014.
- An update regarding a revision to the *Controlled Low Strength Material Design Guidance* and addition of *Lightweight Concrete Fill Design Guidance* to Chapter 9 of the Highway Design Manual is being issued concurrently via EB 12-018.
- The revisions to the Standard Specifications include the following:
 1. The title of Section 204 has been changed to "Section 204 *Flowable Fill*" and the title of §733-01 has been changed to "§733-01 *Flowable Fill*".
 2. Use and installation requirements for Lightweight Concrete Fill have been added to Section 204 *Flowable Fill*. Material requirements for Lightweight Concrete Fill have been added to §733-01 *Flowable Fill*.
 3. Material requirements for grout backfill identified in §552-2.05 C.2. *Grout Backfill* have been revised to correspond with the subsection title change. This revision is being made in EI 12-014.

IMPLEMENTATION:

- The Main Office Design Quality Assurance Bureau will insert these standard specification revisions into contract proposals beginning with projects submitted for the letting of Sept. 6, 2012.

TRANSMITTED MATERIALS: Revisions to Standard Specification §733-01 *Flowable Fill*. Both metric and US Customary revisions are attached.

BACKGROUND:

- **Controlled Low Strength Material.** To achieve the Department's goal of completing construction projects in a timely manner, it is essential to use products which decrease installation time and effort over conventional materials. CLSM is used primarily as a self-leveling backfill material and does not require compaction. It is much lower in strength than concrete, making

future excavation possible. Due to the self-compacting properties of the material, construction personnel and equipment are not required in confined spaces for compaction operations. As a result, the width of excavations can be decreased, laid back slopes eliminated and flagging operations reduced.

- **Lightweight Concrete Fill.** Lightweight Concrete Fill is an engineered geotechnical material with a unique strength / density relationship which can be used to reduce loads on soft foundation soils, buried structures, or against retaining walls. Lightweight Concrete Fill consists of a Portland cement matrix containing uniformly distributed, non-interconnected air voids introduced by a foaming agent. The flowability and cementitious properties of this material provide a product that is self leveling and does not require compaction. Additives can be introduced to achieve grades of as much as $3\% \pm$ from the horizontal. The Geotechnical Engineering Bureau (GEB) provides earthwork and foundation engineering services for the design and construction of Departmental projects statewide. When subsurface explorations reveal that a project's underlying soils are soft or unstable, the GEB may utilize specialized treatment options to allow completion of the desired final product. Lightweight Concrete Fill is one such option. It is a lightweight fill used to reduce vertical stresses beneath embankments, or to reduce lateral stresses on retaining walls, abutments or foundations.

CONTACT: Questions or comments regarding this issuance should be directed to Randall J. Romer, P.E., of the Geotechnical Engineering Bureau at (518) 457-4714, or via e-mail at rromer@dot.state.ny.us. Questions or comments regarding the technical aspects of the revision to the Standard Specification should be directed to Don Dwyer, P.E., of the Geotechnical Engineering Bureau at (518) 457-4724, ddwyer@dot.state.ny.us.

§733-01 – FLOWABLE FILL

Make the following changes to the Standard Specifications dated May 1, 2008 as modified by EI 09-027:

Delete entirely §733-01 and **Replace** it with the following:

§733-01 – FLOWABLE FILL

SCOPE. This specification covers the material requirements and methods of testing flowable fill. The following flowable fill types are evaluated in this specification:

- 733.0101 – Controlled Low Strength Material (CLSM)
- 733.0102 – Controlled Low Strength Material (CLSM) (No Fly Ash)
- 733.0103 – Lightweight Concrete Fill (Type A)
- 733.0104 – Lightweight Concrete Fill (Type B)

GENERAL.

A. Controlled Low Strength Material. Provide CLSM with certified test results supplied by a qualified independent testing laboratory for the mix design verifying the unconfined compressive strength meets the requirements of the specification. Design the CLSM mix so that it sets within the time stated in the contract documents. If no set time is required, design the set time to meet Contractor's operational requirements.

B. Lightweight Concrete Fill. Provide Lightweight Concrete Fill with certified test results supplied by a qualified independent testing laboratory for the mix design verifying the wet cast density and unconfined compressive strength meet the requirements of the specification for the type(s) identified in the contract documents. Design the Lightweight Concrete Fill utilizing a foaming agent appearing on the Departments Approved List.

MATERIAL REQUIREMENTS.

A. Controlled Low Strength Material.

1. Material. Provide CLSM containing cement and water. At the Contractor's option, it may also contain fly ash (unless the No Fly Ash item is specified), aggregate, or chemical admixtures in any proportions such that the final product meets the strength and flow consistency requirements included in this specification.

Provide materials meeting the requirements of Table 733-01A *CLSM Material Requirements*:

TABLE 733-01A CLSM MATERIAL REQUIREMENTS	
Material	Subsection
Portland Cement, Type 1 or Type 2	§701-01
Water	§712-01

If used, provide materials meeting Table 733-01B *Requirements for Optional CLSM Material*:

TABLE 733-01B REQUIREMENTS FOR OPTIONAL CLSM MATERIAL	
Material	Subsection
Aggregate Gradation	§703-07 <i>Concrete Sand</i>
Fly Ash	Provide fly ash that complies with the requirements of §711-10 <i>Fly Ash</i> except that the loss on ignition requirement is waived.

§733-01 – FLOWABLE FILL

TABLE 733-01B REQUIREMENTS FOR OPTIONAL CLSM MATERIAL

Chemical Admixtures	Provide admixtures that comply with §711-08 <i>Admixtures</i> . The mix may include high air generators manufactured for CLSM.
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2. Unconfined Compressive Strength. Provide CLSM with a mix design generating an unconfined compressive strength in Table 733-01C *CLSM Unconfined Compressive Strength*:

TABLE 733-01C CLSM UNCONFINED COMPRESSIVE STRENGTH	
Test Age	Unconfined Compressive Strength
28 days	40 psi ≤ q_u ≤ 150 psi

3. Sampling and Testing.

i. Spread Diameter. Provide CLSM that has, at the time of placement, a minimum diameter spread of 8 in. as determined by a Department Representative in accordance with ASTM D6103 *Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)*.

ii. Cylinder Cast. A Department Representative will cast three specimens (cylinders) for each batch of CLSM for QA testing. A batch is defined as the amount of material that can be mixed at one time.

B. Lightweight Concrete Fill.

1. Material. Provide materials meeting the requirements of Table 733-01D *Lightweight Concrete Fill Material Requirements*:

TABLE 733-01D LIGHTWEIGHT CONCRETE FILL MATERIAL REQUIREMENTS	
Material	Subsection
Portland Cement, Type 1, 2 of 3	§701-01
Water	§712-01
Admixtures	§711-08
Foaming Agent	See Below

The Foaming Agent shall conform to the requirements of ASTM C 869. Foaming Agents which are on the Approved List shall be accepted at the site on the basis of the brand name labeled on the Foaming Agent container and certified documentation provided by the supplier.

A Foaming Agent not on the Approved List will be evaluated based on submitted information and sample testing by the Materials Bureau (minimum of six months). For each class of material submitted for evaluation, specimens will be required for testing of compressive strength, air-dry density, freeze-thaw and water absorption characteristics, and other testing as deemed appropriate. For detailed information contact the Materials Bureau.

2. Concrete Fill Types. Provide lightweight concrete fill conforming to the type(s) specified in the contract documents and meeting the requirements identified in Table 733-01E *Lightweight Concrete Fill Density and Compressive Strength Requirements*.

§733-01 – FLOWABLE FILL

TABLE 733-01E LIGHTWEIGHT CONCRETE FILL DENSITY AND UNCONFINED COMPRESSIVE STRENGTH REQUIREMENTS		
Type	Maximum Cast Wet Density (pcf)	Minimum Unconfined Compressive Strength – 28 days (psi)
A	30	40
B	42	100

The Contractor shall be responsible for designing the mix so that each type of lightweight concrete fill meets the corresponding criteria listed above. The lightweight concrete fill shall be mixed in accordance with the recommendations of a representative of the supplier of the foaming agent.

3. Sampling and Testing.

i. **Density.** A Department Representative will sample and test the wet cast density. After the initial test and approval to proceed, the density will be monitored at 30 minute intervals during placement for QA purposes.

ii. **Cylinder Cast.** A Department Representative will cast four specimens (cylinders) at the point of placement for each day's pour or each 100 yd³ of material placed, whichever is more frequent, for QA purposes.

BASIS OF APPROVAL.

A. Controlled Low Strength Material. Mix designs will be approved based on certified test results supplied by a qualified independent testing laboratory for the unconfined compressive strength in accordance with the specification. The methods of installation will be approved based on an evaluation of the equipment's appropriateness with respect to the site conditions.

B. Lightweight Concrete Fill. Mix designs will be approved based on (1) certified test results supplied by a qualified independent testing laboratory for the maximum wet cast density and minimum unconfined compressive strength in accordance with the specification, and (2) the brand name labeled on the foaming agent appearing on the Approved List. The methods of installation will be approved based on an evaluation of the equipment's appropriateness with respect to the site conditions.

BASIS OF ACCEPTANCE.

A. Controlled Low Strength Material. CLSM material will be accepted on the jobsite upon submission of certified test results of the mix design to the Engineer.

CLSM material will be accepted after employment of the approved method of installation and upon acceptable test results for spread diameter and unconfined compressive strength.

B. Lightweight Concrete Fill. Lightweight Concrete Fill material will be accepted on the jobsite upon submission of a certified mix design to the Engineer and confirmation that the brand name labeled on the foaming agent appears on the Approved List.

Lightweight Concrete Fill material will be accepted after employment of the approved method of installation and upon acceptable test results for density and unconfined compressive strength.

§733-01 – FLOWABLE FILL

Make the following changes to the Standard Specifications dated May 4, 2006 as modified by EI 09-027:

Delete entirely §733-01 and Replace it with the following:

§733-01 – FLOWABLE FILL

SCOPE. This specification covers the material requirements and methods of testing flowable fill. The following flowable fill types are evaluated in this specification:

- 733.0101 – Controlled Low Strength Material (CLSM)
- 733.0102 – Controlled Low Strength Material (CLSM) (No Fly Ash)
- 733.0103 – Lightweight Concrete Fill (Type A)
- 733.0104 – Lightweight Concrete Fill (Type B)

GENERAL.

A. Controlled Low Strength Material. Provide CLSM with certified test results supplied by a qualified independent testing laboratory for the mix design verifying the unconfined compressive strength meets the requirements of the specification. Design the CLSM mix so that it sets within the time stated in the contract documents. If no set time is required, design the set time to meet Contractor's operational requirements.

B. Lightweight Concrete Fill. Provide Lightweight Concrete Fill with certified test results supplied by a qualified independent testing laboratory for the mix design verifying the wet cast density and unconfined compressive strength meet the requirements of the specification for the type(s) identified in the contract documents. Design the Lightweight Concrete Fill utilizing a foaming agent appearing on the Departments Approved List.

MATERIAL REQUIREMENTS.

A. Controlled Low Strength Material.

1. Material. Provide CLSM containing cement and water. At the Contractor's option, it may also contain fly ash (unless the No Fly Ash item is specified), aggregate, or chemical admixtures in any proportions such that the final product meets the strength and flow consistency requirements included in this specification.

Provide materials meeting the requirements of Table 733-01A *CLSM Material Requirements*:

TABLE 733-01A CLSM MATERIAL REQUIREMENTS	
Material	Subsection
Portland Cement, Type 1 or Type 2	§701-01
Water	§712-01

If used, provide materials meeting Table 733-01B *Requirements for Optional CLSM Material*:

TABLE 733-01B REQUIREMENTS FOR OPTIONAL CLSM MATERIAL	
Material	Subsection
Aggregate Gradation	§703-07 <i>Concrete Sand</i>
Fly Ash	Provide fly ash that complies with the requirements of §711-10 <i>Fly Ash</i> except that the loss on ignition requirement is waived.

§733-01 – FLOWABLE FILL

TABLE 733-01B REQUIREMENTS FOR OPTIONAL CLSM MATERIAL	
Chemical Admixtures	Provide admixtures that comply with §711-08 <i>Admixtures</i> . The mix may include high air generators manufactured for CLSM.

2. Unconfined Compressive Strength. Provide CLSM with a mix design generating an unconfined compressive strength in Table 733-01C *CLSM Unconfined Compressive Strength*:

TABLE 733-01C CLSM UNCONFINED COMPRESSIVE STRENGTH	
Test Age	Unconfined Compressive Strength
28 days	$275 \text{ kPa} \leq q_u \leq 1030 \text{ kPa}$

3. Sampling and Testing.

i. Spread Diameter. Provide CLSM that has, at the time of placement, a minimum diameter spread of 200 mm as determined by a Department Representative in accordance with ASTM D6103 *Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)*.

ii. Cylinder Cast. A Department Representative will cast three specimens (cylinders) for each batch of CLSM for QA testing. A batch is defined as the amount of material that can be mixed at one time.

B. Lightweight Concrete Fill.

1. Material. Provide materials meeting the requirements of Table 733-01D *Lightweight Concrete Fill Material Requirements*:

TABLE 733-01D LIGHTWEIGHT CONCRETE FILL MATERIAL REQUIREMENTS	
Material	Subsection
Portland Cement, Type 1, 2 of 3	§701-01
Water	§712-01
Admixtures	§711-08
Foaming Agent	See Below

The Foaming Agent shall conform to the requirements of ASTM C 869. Foaming Agents which are on the Approved List shall be accepted at the site on the basis of the brand name labeled on the Foaming Agent container and certified documentation provided by the supplier.

A Foaming Agent not on the Approved List will be evaluated based on submitted information and sample testing by the Materials Bureau (minimum of six months). For each class of material submitted for evaluation, specimens will be required for testing of compressive strength, air-dry density, freeze-thaw and water absorption characteristics, and other testing as deemed appropriate. For detailed information contact the Materials Bureau.

2. Concrete Fill Types. Provide lightweight concrete fill conforming to the type(s) specified in the contract documents and meeting the requirements identified in Table 733-01E *Lightweight Concrete Fill Density and Compressive Strength Requirements*.

§733-01 – FLOWABLE FILL

TABLE 733-01E LIGHTWEIGHT CONCRETE FILL DENSITY AND UNCONFINED COMPRESSIVE STRENGTH REQUIREMENTS		
Type	Maximum Cast Wet Density (kN/m ³)	Minimum Unconfined Compressive Strength – 28 days (kPa)
A	4.7	275
B	6.6	690

The Contractor shall be responsible for designing the mix so that each type of lightweight concrete fill meets the corresponding criteria listed above. The lightweight concrete fill shall be mixed in accordance with the recommendations of a representative of the supplier of the foaming agent.

3. Sampling and Testing.

i. **Density.** A Department Representative will sample and test the wet cast density. After the initial test and approval to proceed, the density will be monitored at 30 minute intervals during placement for QA purposes.

ii. **Cylinder Cast.** A Department Representative will cast four specimens (cylinders) at the point of placement for each day's pour or each 75 m³ of material placed, whichever is more frequent, for QA purposes.

BASIS OF APPROVAL.

A. Controlled Low Strength Material. Mix designs will be approved based on certified test results supplied by a qualified independent testing laboratory for the unconfined compressive strength in accordance with the specification. The methods of installation will be approved based on an evaluation of the equipment's appropriateness with respect to the site conditions.

B. Lightweight Concrete Fill. Mix designs will be approved based on (1) certified test results supplied by a qualified independent testing laboratory for the maximum wet cast density and minimum unconfined compressive strength in accordance with the specification, and (2) the brand name labeled on the foaming agent appearing on the Approved List. The methods of installation will be approved based on an evaluation of the equipment's appropriateness with respect to the site conditions.

BASIS OF ACCEPTANCE.

A. Controlled Low Strength Material. CLSM material will be accepted on the jobsite upon submission of certified test results of the mix design to the Engineer.

CLSM material will be accepted after employment of the approved method of installation and upon acceptable test results for spread diameter and unconfined compressive strength.

B. Lightweight Concrete Fill. Lightweight Concrete Fill material will be accepted on the jobsite upon submission of a certified mix design to the Engineer and confirmation that the brand name labeled on the foaming agent appears on the Approved List.

Lightweight Concrete Fill material will be accepted after employment of the approved method of installation and upon acceptable test results for density and unconfined compressive strength