

## Installation of Fluidized Thermal Backfill



### 1. Scope

This standard covers the mix, field, and testing requirements for the installation of Fluidized Thermal Backfill (FTB).

### 2. Application

This standard is intended to be used by Seattle City Light (SCL) crews, inspectors, reviewers, contractors, and customers when installation of FTB is specified.

### 3. Industry Standards

Construction shall meet the applicable requirements of the following industry standards:

**ASTM C31**; "Standard Practice for Making and Curing Concrete Test Specimens in the Field," 2012

**ASTM C39**; "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens," 2012

**ASTM C94**; "Standard Specification for Ready-Mixed Concrete," 2013

**ASTM C143**; "Standard Test Method for Slump of Hydraulic-Cement Concrete"

**ASTM 172**; "Standard Practice for Sampling Freshly Mixed Concrete"

City of Seattle; "Standard Specifications for Road, Bridge and Municipal Construction," 2014 (henceforth referred to as the "2014 Standard Specifications")

IEEE Standard 442; "IEEE Guide for Soil Thermal Resistivity Measurements"

#### **4. Mix Requirements**

##### **4.1 Mix Design**

Prior to placement, the contractor shall submit to SCL the proposed FTB mix design for approval. The mix design shall conform to SCL 7150.00, "Fluidized Thermal Backfill."

##### **4.2 Conformance to Mix Design**

Quantities of batched component materials shall match those specified in the FTB mix design within the tolerances specified in Section 6-02.3(5)C ("Conformance To Mix Design") of the 2014 Standard Specifications.

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#### **5. Field Requirements**

##### **5.1 Delivery Certificate**

The FTB supplier shall provide a Manufacturer's Certificate of Compliance for each truckload of FTB per Section 6-02.3(5)B ("Certification Of Compliance") of the 2014 Standard Specifications. The Certificate shall include the following information:

- Identification code
- Delivery location
- Quantity of water added to mix after batching

##### **5.2 Delivery Time Limit and Temperature**

The time for placement and temperature shall conform to Section 6-02.3(4)D ("Temperature and Time for Placement") of the 2014 Standard Specifications.

##### **5.3 Retempering**

Retempering is prohibited.

##### **5.4 FTB Placement**

FTB shall be placed per the applicable provisions of Section 6-02.3(6) ("Placing Concrete") of the 2014 Standard Specifications.

If the concrete is to drop more than 5 ft, it shall be deposited through a sheet metal (or other approved material) conduit. No aluminum conduits or tremies shall be used to pump or place concrete.

FTB shall flow readily and fill all voids during installation. Formation of air pockets during installation shall be cause for rejection.

Conduits to be encased in FTB shall be adequately anchored so that they do not float during FTB placement. The water content of FTB may not be reduced to mitigate conduit buoyancy.

##### **5.5 Vibration**

Should vibration be required to ensure that the conduits are fully encased in FTB, it shall be in conformance with Section 6-02.3(9) ("Vibration of Concrete") of the 2014 Standard Specifications.

## 6. Testing Requirements

For SCL power system construction projects that require more than 100 cubic yards of any combination of FTB materials, the project manager shall provide an FTB thermal test and FTB compressive strength test for each FTB mix design employed by the project.

The testing shall be done at the beginning of FTB placement for that project. Both thermal and compressive strength samples shall be drawn from the same batch of FTB. Test results shall be submitted to SCL for review.

Where thermal and compressive strength testing is done on the same batch of FTB, the samples shall have identical sample locations or other matching sample identification codes, assigned to both sets. The purpose is correlation of test data.

Field test parameters shall apply to field approvals of FTB encasement and backfill where required.

The thermal resistivity requirement will be evaluated by comparing the FTB thermal test report specified in section 6.2 to the resistivity benchmarks from SCL 7150.00.

### 6.1 Sampling

Sampling shall be in conformance with ASTM C172.

Sample containers shall be cylindrical, 3 inches in diameter and 6 inches tall. A set of three sample containers are required for each thermal test. The sample containers shall be prepared per ASTM C94, and sealed to prevent moisture loss.

Each sample container shall receive a label with the following information:

- Date of sample
- Location where sampled FTB was installed. The description of the location should be detailed enough to determine which duct bank, or portion thereof, was sampled.
- Project name and the SCL Work Order number, if known
- Type of FTB (high-strength or low-strength)
- FTB Producer
- FTB Producer's Mix Design number
- Name of the SCL Inspector, SCL Crew Chief, or person responsible for sampling

The concrete delivery ticket and batching compliance report shall be included with each set of samples. Only legible copies are acceptable.

The samples shall cure 24 hours prior to shipping. The samples shall be shipped in a cardboard box with adequate packing materials to prevent damage during shipping. The samples shall be shipped to an SCL-approved consultant for thermal testing.

### 6.2 Thermal Testing

Seattle City Light uses thermal testing results to assess FTB performance and to investigate FTB-related issues. FTB documentation shall be adequate to trace the source of each aggregate and the source of fluidizer material for each batch of FTB installed. Failure to systematically identify sources of materials shall be cause for rejection and disqualification.

Thermal testing shall be conducted in compliance with IEEE Standard 442.

The testing consultant shall provide a complete copy of the test report to SCL that includes:

- Name and contact information of the thermal testing consultant
- Report date
- Concrete delivery ticket number
- FTB Producer
- FTB Producer's Mix Design No.
- Dry density of each sample set, in pounds/cubic foot
- Thermal resistivity of each sample set (°C-centimeter/watt)

### 6.3 Strength Testing

Strength testing for high-strength FTB shall be performed in compliance with ASTM C39. A complete copy of the test report shall be provided to Seattle City Light.

Sampling shall be performed in compliance with ASTM C31, and the samples shall be labeled as described in the Thermal Testing Procedure.

### 6.4 Field Testing

When field testing is required, thermal testing shall be done by an SCL-approved consultant in compliance with IEEE Standard 442.

A field slump test shall be performed on each batch. The slump test shall conform to ASTM C143 and meet the performance values listed in Table 4 of SCL 7150.00.

One test is required per project or location. Additional testing is required when requested by SCL personnel. The test report shall contain the information specified in sections 6.2 and 6.3.

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## 7. Remedies for Installation of Unapproved FTB Mixes

Installation of an FTB mix, where specified, that has not been approved by Seattle City Light requires one of the following remedies:

- Removal and replacement of all noncompliant FTB with a Seattle City Light-approved mix.
- In-field thermal testing of all non-compliant FTB. Any unapproved FTB that does not meet the FTB Mix Design Requirements shall be removed and replaced with a Seattle City Light-approved mix.

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## 8. References

**SCL Material Standard 7150.00**, "Fluidized Thermal Backfill"

**SCL Design Standard 9266.06**, "Understanding Fluidized Thermal Backfill"

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## 9. Sources

**Lu, Curtis**; SCL Standards Engineer, and originator and subject matter expert for 0226.06 (curtis.lu@seattle.gov)

**Stewart, Bob**; SCL Civil Inspector and subject matter expert for 0226.06 (bob.stewart@seattle.gov)