



## Guide Specification for The Use of TXI Rotary Kiln Lightweight Aggregate for Internal Curing of Concrete

This guide specification supplements the architect/engineer's standard concrete specifications. Boxed comments precede or follow each specification section and should be deleted from the final specifications.

### PART 1. GENERAL

#### 1.1 Reference Standards

This guide specification follows the 16 Division Format of the Construction Specification Institute's, Section 03313 Concrete.

The enclosed text and commentary are intended to assist the architect/engineer write specifications that include appropriate limits so that quality internally cured concrete can be provided economically.

Reference Standards are incorporated in this guide specification and an appendix lists additional publications that will help the architect/engineer/designer prepare concrete specifications.

#### American Society for Testing & Materials (ASTM)

- C 31 *Practice for Making and Curing Concrete Test Specimens in the Field*
- C 33 *Specification for Concrete Aggregates*
- C 39 *Test Method for Compressive Strength of Cylindrical Concrete Specimens*
- C 94 *Specification for Ready-Mix concrete*
- C 127 *Test Method for Specific Gravity and Absorption of Coarse Aggregates*
- C 138 *Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete*
- C 143 *Test Method for Slump of Hydraulic Cement Concrete*
- C 150 *Specification for Portland Cement*
- C 172 *Practice for Sampling Freshly Mixed Concrete*

- C 173 *Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method*
- C 260 *Specification for Air-Entraining Admixtures for Concrete*
- C 330 *Specification for Lightweight Aggregates for Structural Concrete*
- C 494 *Specification for Chemical Admixtures for Concrete*
- C 567 *Test Method for Density of Structural Lightweight Concrete*
- C 595 *Specification for Blended Hydraulic Cements*
- C 618 *Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete*
- C 845 *Specification for Expansive Hydraulic Cement*
- C 989 *Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars*
- C 1017 *Specification for Chemical Admixtures for Use in Producing Flowing Concrete*
- C 1240 *Specification for Use of Silica Fume as A Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout*

#### American Concrete Institute (ACI)

- ACI 211.1 *Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete*
- ACI 301 *Specifications for Structural Concrete for Buildings*
- ACI 304.2 *Placing Concrete by Pumping Methods*
- ACI 318 *Building Code Requirements for Reinforced Concrete*
- ACI 213 *Guide for Structural Lightweight Aggregate Concrete*

#### 1.2 Performance

Except as modified or exceeded by these specifications. All concrete work shall conform to ACI 301.

### 1.3 Storage of Materials

**Cement:** Store in accordance with ACI 318.

**Aggregates:** Each grading and type shall be stockpiled separately. Storage shall minimize segregation and prevent contamination.

- 1.3.1 TXI lightweight aggregate must be pre-conditioned to a minimum moisture content of \_\_\_\_\_% of dry weight before batching the concrete.

Each lightweight aggregate source and gradation may have slightly different physical properties. The producer should be consulted to obtain the minimum % moisture content appropriate for the material to be used.

Testing for moisture content shall be according to ASTM-C-127 or ASTM-C-128.

## PART II. PRODUCTS

### 2.1 Materials

**Cement:** Shall meet ASTM C 150, C 595, or C 845

The effect and compatibility of various combinations of cement, pozzolans, and admixtures are generally the same in ESCS lightweight concrete as in normalweight concrete.

**Aggregate:** Expanded Shale, Clay, or Slate (ESCS) lightweight aggregate produced by the rotary kiln method shall meet ASTM C 330. Normalweight aggregate shall meet ASTM C 33.

Expanded Shale, Clay, or Slate (ESCS) is a unique ceramic lightweight aggregate prepared by expanding select minerals in a rotary kiln at temperatures of 1000°C.

**Water:** Shall meet ACI 318.

**Air-Entraining Admixtures:** Shall meet ASTM C 260.

Admixtures have demonstrated satisfactory performance with ESCS concretes. Consult the ESCS producer for information on admixture performance and recommendations, especially if the concrete is to be pumped.

**Chemical Admixtures:** Set-controlling and water-reducing admixtures shall meet ASTM C 494 and the manufacturer's recommendations.

**Fly Ash:** Shall meet ASTM C 618.

**Ground Granulated Blast-Furnace Slag:** Shall meet ASTM C 989.

**Silica Fume:** Shall meet ASTM C 1240.

### 2.2 Concrete Properties

Repeat this section if the design requires more than one type of concrete. ACI 211.1 provides guidance for proportioning mixtures.

**Strength:** Materials shall be proportioned to produce concrete with a minimum compressive strength \_\_\_\_\_psi (\_\_\_\_\_MPa) at 28 days.

ESCS aggregate has been used in concrete for practically every type of structural application. It has been furnished at all compressive strength levels common to construction practices today.

**Slump:** Concrete shall be delivered at the minimum slump necessary for efficient mixing, placing, and finishing. The maximum slump shall be \_\_\_\_\_ in. (\_\_\_\_\_ mm) with a tolerance of  $\pm$  \_\_\_\_\_ in. (\_\_\_\_\_ mm). Consult ASTM C 94 for guidance on tolerances.

**Air:** The air content shall be \_\_\_\_\_ percent by volume with a tolerance of  $\pm$  1.5 percent.

**Mixture Proportions:** The contractor shall furnish the mixture proportions that will meet the strength and other requirements of the concrete specified. The mixture proportion shall be prepared in accordance with ACI 318, and subject to the approval of the architect/engineer. The addition of lightweight aggregate shall be at \_\_\_\_\_ pounds/ cubic yard (kilograms/cubic meter)

It is recommended that the writer contact the producer of the lightweight aggregate to be used on the project for guidance on the optimum dosage of TXI lightweight aggregate. Alternately the formula found in "Mixture Proportioning for Internal Curing" by Dale Bentz et al, in the February 2005 issue of Concrete International, may be used to calculate the quantity to specify. [http://ciks.cbt.nist.gov/bentz/ICnomographEnglis\\_hunit.pdf](http://ciks.cbt.nist.gov/bentz/ICnomographEnglis_hunit.pdf)

**Batching and Mixing:** The concrete shall be batched and mixed in accordance with the applicable section of ACI 301 and ASTM C 94.

The concrete producer's quality control personnel or a qualified laboratory should establish and maintain the mixture proportions based on the material producer recommendation.

### PART III. FIELD CONTROL

**3.1 Control:** The control of the concrete shall be under the supervision of the architect/engineer. Field-testing shall be performed by an ACI Certified Field Technician.

**Pumping:** If the concrete is to be pumped, follow the recommendations of ACI 304.2R.

**Sampling:** Samples of concrete shall be obtained in accordance with ASTM C 172 and shall be transported to a place on the site where tests can be made and cylinders stored without being disturbed for the first 24 hours. If the concrete is placed by pumping, samples shall be obtained from the end of the pump discharge line.

Pumping may result in the reduction of slump and/or air content. Therefore, the concrete mixture should be proportioned to provide the desired fresh concrete properties at the point of placement.

**Concrete Specimens:** Compressive strength specimens shall be made in accordance with ASTM C 31 and tested in accordance with ASTM C 39. Density, slump, and air content of fresh concrete shall be determined from each batch of concrete sampled for compressive strength tests. Fresh density, slump, and air content shall be determined by ASTM C 138, C 143, and C 173 respectively.

**APPENDIX:** The following publications will assist the architect/engineer when preparing structural concrete specifications.

<i>ACI 212.3R</i>	<i>Chemical Admixtures for Concrete</i>
<i>ACI 213R</i>	<i>Guide for Structural Lightweight Aggregate Concrete</i>
<i>ACI 304R</i>	<i>Guide for Measuring, Mixing, Transporting and Placing Concrete</i>
<i>ACI305R</i>	<i>Hot Weather Concreting</i>
<i>ACI306R</i>	<i>Cold Weather Concreting</i>
<i>ACI311.1R</i>	<i>ACI Manual of Concrete Inspection</i>
<i>ACI311.4R</i>	<i>Guide for Concrete Inspection</i>
<i>ACI347R</i>	<i>Guide to Formwork for Concrete</i>
<i>ASTM STP 169 C</i>	<i>Significance of Tests and Properties of Concrete and Concrete-Making Materials.</i>

Additional information on internal curing can be found at the following links.

[http://www.txiesc.com/apps\\_internalcuring.htm](http://www.txiesc.com/apps_internalcuring.htm)  
<http://ciks.cbt.nist.gov/lwagg.html>