TEC Services
Testing • Engineering • Consulting

September 22, 2010

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Subject: **Report of ASTM C 331 *Standard Specification for Lightweight Aggregates for Concrete Masonry Units* on Tank D Lightweight Fine Aggregate**
TEC Services Project No.: 04-0514
TEC Services Sample ID: 10-051

Dear Mr. Wall:

Testing Engineering & Consulting Services Inc. (TEC Services), an AASHTO R18 and ISO 17025 accredited independent materials laboratory is pleased to present this report of our testing on the Tank D lightweight fine aggregate submitted to our laboratory. The results of this testing pertain only to the samples tested. The aggregate was tested in accordance to ASTM C 331-05 *Standard Specification for Lightweight Aggregates for Concrete Masonry Units* as authorized by the service agreement (TEC-PRO-04-0514) signed by you on March 29, 2005.

This specification covers lightweight aggregates intended for use in concrete masonry units when a prime consideration is to reduce the density of the units. The maximum and minimum requirements for this specification are presented in Section 4 *Chemical Composition* and Section 5 *Physical Properties* of ASTM C 331 and are listed in Table 1. Based on the results to date, the Tank D lightweight fine aggregate submitted to our laboratory meets and/or exceeds the requirements of ASTM C 331-05.

Table 1. Summary of Test Results

Section 4 - Chemical Composition	**Test Results**	**ASTM C 331-04 Requirements**
Organic Impurities (Color change)	0	3 max
Staining (Stain index)	0	60 max
Loss on Ignition	1.03%	5% max
Section 5 – Physical Properties		
Clay Lumps and Friable Particles (Dry mass)	0.0%	2% max
Bulk Density (Loose)	59 lbs/ft^3	70 lbs/ft^3
Drying Shrinkage at 100 Days	0.060	0.10% max
Popouts	0	0 max
Grading	See Section 5.1.2 Below	
Resistance to Freezing and Thawing Average Cumulative Weight Loss Average Percent Weight Loss	 12.2 g 1.1%	 ---- ----

A concrete mixture containing the Tank D lightweight fine aggregate was batched in order to make test samples for drying shrinkage. The material sources and amount of material used in the concrete mix are presented in Table 2.

Concrete Mix Proportions

Table 2: Mix Proportions

Material	**Source**	**Amount (lbs)**
Cement	Lafarge	**385**
Lightweight Aggregate	D-Tank	**2310**
Water	Lawrenceville City Water	**185**
Total		**2880**

Concrete had a slump of 2.25 inches.

Test Results

Section 4.1.1 Organic Impurities

Requirement- Lightweight aggregate subjected to the test for organic impurities shall not produce a darker color than standard.

Result- The Tank D lightweight fine aggregate did not show any color change.

Section 4.1.2 Staining

Requirement- Lightweight aggregate shall have a stain index of less than sixty.

Result- The Tank D lightweight fine aggregate showed no stain, which indicates an index of zero.

Section 4.1.3 Loss on Ignition

Requirement- Lightweight aggregate shall have a loss of ignition not more than five percent.

Result- The Tank D lightweight fine aggregate had a loss on ignition of 1.03 percent.

Section 5.1.1 Clay Lumps and Friable Particles

Requirement- The amount of clay lumps and friable particles shall not exceed two percent by dry mass.

Results- The Tank D lightweight fine aggregate had 0.0 percent clay lumps and friable aggregate.

Section 5.1.2 Grading

The grading shall be by mutual agreement between interested parties. The Grading and the suggested range is listed in Table 3.

Table 3: Grading and suggested range

Sieve Size	% Retained Each Sieve	% Range Suggested
3/8 in	0	0-2
No. 4	8.1	0-10
No. 8	28.4	15-35
No. 16	21.5	15-35
No. 30	14.6	5-20
No. 50	9.7	5-15
No. 100	7.1	5-15
Pan	10.6	8-20

Section 5.1.4 Bulk Density (Loose)

Requirement- Maximum Bulk density (loose) for fine aggregate is 70 lbs/ft^3.

Result- The lightweight fine aggregate had an average bulk density (loose) of 59 lbs/ft^3**.**

Section 5.2.1 Popouts

Requirement- There shall be no popouts observed after test concrete made with the tested lightweight is subjected to an autoclave in accordance with ASTM C 151.
Result - No popouts were observed.

Section 5.2.2 Resistance to Freezing and Thawing

Resistance to freezing and thawing was performed in water in accordance with ASTM C 1262 *Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units* as stated in section 8.2 of ASTM C 331 – 05. Testing was performed on five separate samples. The results from all samples were averaged to produce a single result.

All samples were cured for 28 day in a 50 percent humidity chamber at a temperature of 72˚F prior to testing.

Freeze-Thaw durability results are presented in Table 4.

Table 4. Freeze-Thaw Durability.

Sample ID	Residue Weight grams	Initial Dry Weight grams	Final Dry Weight grams	Percent Weight Loss
10-051-1	10.9	1079.1	1068.2	1.0
10-051-2	12.9	1120.1	1107.1	1.1
10-051-3	9.9	1094.0	1084.1	0.9
10-051-4	13.2	1198.9	1185.7	1.1
10-051-5	13.9	1141.4	1127.5	1.2
Average	**12.2**			**1.1**

Section 5.2.3 Drying Shrinkage

Three length change beams (2” x 2” x 11¼”) were moist cured for seven days. Upon the completion of the moist curing, an initial reading was obtained, which was used as the base

length for the drying shrinkage calculations. The samples were then placed in a curing cabinet maintained at 73.5 ± 3.5 ºF with a relative humidity of 50 ± 5%.

Requirement- Drying shrinkage shall not exceed 0.10 % at 100 days. The results are presented in Table 5.

Table 5: Drying Shrinkage at 28 days and 100 days.

Concrete Age	**28 Days**	**100 Days**
Curing Method	Air Cured	Air cured
Date	10/26/2008	1/6/2009
Sample ID	Length Change (%)	Length Change (%)
10-051-A	-0.046	-0.059
10-051-B	-0.043	-0.052
10-051-C	-0.048	-0.056
Average	**-0.046**	**-0.056**

We appreciate the opportunity to provide our services to you on this project. Should you have any questions or comments regarding this report, please feel free to contact us at your convenience

Sincerely,

Testing, Engineering & Consulting Services, Inc.

Steven Maloof
Project Manager

Shawn P. McCormick
Laboratory Manager