



Expanded Shale, Clay and Slate Institute
Rotary Kiln Structural Lightweight Aggregate

NEWS RELEASE

For Immediate Release

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STUDY FINDS SIGNIFICANTLY INCREASED CONCRETE DURABILITY AND SERVICE LIFE USING 100-YEAR-OLD TECHNOLOGY

CHICAGO, May 30, 2017 – Owners and designers of many new structures currently specify a design life of 100 years or more to ensure durability and sustainability. Tourney Consulting Group, LLC in Kalamazoo, MI, a globally recognized leader in quantifying concrete durability, service life prediction, and developing service life solutions, recently conducted a study to determine the effects of lightweight coarse and fine aggregates on the transport properties and other durability related properties of concrete. Transport properties are used in several service life programs including STADIUM[®], Life 365[™] and analysis according to *fib* Bulletin 34: *Model Code for Service Life Design*. Their study has confirmed that the time to corrosion in a reinforced concrete structure will be increased by approximately 25% when lightweight concrete mixtures are used compared to a comparable mixture with normalweight aggregates. The study also found that some lightweight concrete mixtures increased the time to corrosion by a factor of approximately two to three times.

Ten expanded shale, clay and slate (ESCS) lightweight coarse aggregates from across the United States were used in concrete mixtures (“sand lightweight concrete”) that were compared to a normalweight concrete with respect to transport properties. In addition, one mixture with normalweight coarse aggregate and lightweight sand (an “inverted mixture”); one mixture with lightweight coarse aggregate and lightweight fine aggregate (“all lightweight concrete”); and one mixture with normalweight aggregate with a partial replacement of normalweight sand with lightweight sand (an “internally cured mixture”) were evaluated for transport properties. Each of the thirteen lightweight concrete mixtures and the normalweight control mixture used 658 pounds per cubic yard of Type I Portland cement. No supplementary cementitious materials, corrosion inhibitors, or corrosion resistant reinforcing bars were used so that the effect of lightweight aggregates alone on the transport properties could be demonstrated.

After the transport properties had been determined by physical testing, service life analysis was performed for the mixtures using Life 365[™] and STADIUM[®] software. A bridge deck subjected to deicing salts in Detroit, MI was modeled.

The STADIUM[®] software results showed that the service life will be increased compared to the control as follows:

- By approximately 25% for lightweight coarse aggregate mixtures with normalweight sand (“sand lightweight concrete”)

- By approximately 76% for complete replacement of normalweight sand with lightweight sand (“inverted mixture”)
- By approximately 32 % for mixtures with lightweight coarse aggregate and lightweight fine aggregate (“all lightweight concrete”)
- By approximately 25% for mixtures with normalweight aggregate with a partial replacement of normalweight sand with lightweight sand (an “internally cured mixture”)

Life 365™ analysis showed similar results for lightweight coarse aggregate mixtures, but approximately a two-to-three times increase in service life for lightweight sand replacing the normalweight sand.

These service life predictions are estimates for uncracked concrete. As part of their testing program, Tourney Consulting Group also evaluated properties of lightweight concrete related to cracking potential. The addition of a small quantity of lightweight fines for internal curing was shown to reduce restrained shrinkage cracking and to increase compressive strength and the service life. Tourney’s findings agree with studies by others that find that lightweight concrete also has reduced potential for cracking compared to the control concrete, providing further benefit for increasing the service life of concrete structures. For complete information on the tests performed to determine the transport and durability properties of concrete, as well as the assumptions for this service life analysis, view the full report, [“Determination of Transport Properties of Lightweight Aggregate Concrete for Service Life Modeling”](#).

Lightweight aggregate concrete made with ESCS has been used in concrete structures for nearly 100 years, demonstrating its superior durability and service life. Structural lightweight concrete has strengths comparable to normalweight concrete, yet is typically 20% to 25% lighter offering design flexibility and substantial cost savings by reducing dead load, improving seismic structural response, allowing longer spans, providing better fire ratings, and permitting thinner sections, decreased story height, smaller size structural members, reduced reinforcing steel, and lower foundations costs. The excellent durability performance of structural lightweight concrete made with ESCS lightweight aggregate is a result of reduced cracking due to internal curing and other factors, and reduced permeability due to the improved bond between the lightweight aggregate and the cementitious matrix.

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