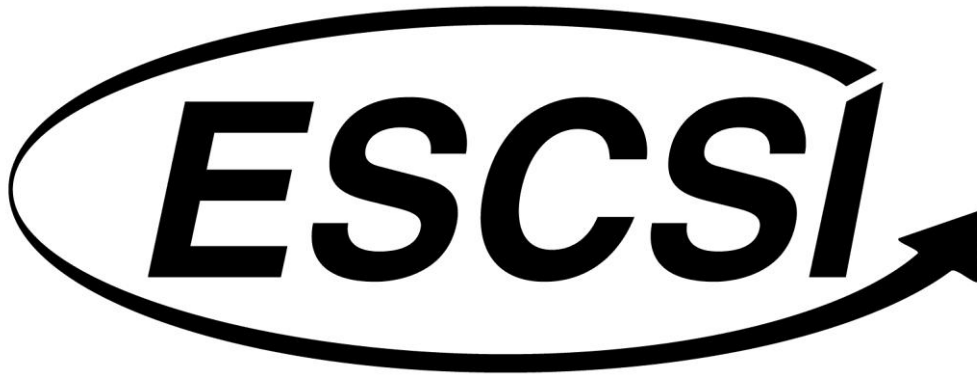


EXPANDED SHALE, CLAY AND SLATE INSTITUTE



ROTARY KILN PRODUCED STRUCTURAL LIGHTWEIGHT AGGREGATE

Reference Manual for the Properties and Applications of Expanded Shale, Clay and Slate Lightweight Aggregate

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Preface and Table of Contents

Preface

Although the terms lightweight aggregate and lightweight concrete are twentieth century expressions, the concept of lowering the self-weight of structures by incorporating cellular aggregates is more than 2,000 years old. This Reference Manual is intended to be an in-depth reference book for use by designers, users and Expanded Shale, Clay & Slate (ESCS) manufacturers. Its purpose is to provide sufficient information on a wide range of properties, applications and specifications so that interested parties will have a general understanding of the contribution (ESCS) materials can make to the construction industry.

The reference manual is designed as a living document, to be continuously amended and upgraded as new technology emerges. As such the loose-leaf format, with each page dated will allow for the insertion of new data developed by the Institute, member companies and the design and construction communities. If you have new information that will expand the lightweight industry or see errors or misrepresentation in the manual please pass this information on to The Expanded Shale, Clay & Slate Institute.

A number of published papers and reports as well as, ACI and ASTM documents have provided a basis for this manual. Chief among these references are:

- ACI 213, 2003 “*Guide to Structural Lightweight Concrete*”.
- ASTM 169 D, 2006 “*Significance of Tests and Properties of Concrete and Concrete Making Materials*”, Chapter 48, Structural Lightweight Aggregate and Concrete.
- “*Lightweight Concrete, History, Applications, Economics*”, ESCSI 1971.
- U.S. Army Corps of Engineers Report, “*State-of-the-Art Report on High-Strength, High-Durability, Structural Low-Density Concrete for Applications in Severe Marine Environment*”, August 2000.
- Numerous ESCSI publications, brochures, information sheets, specifications.
- ASTM Standard Specifications and Standard Method of Tests.
- Peer reviewed articles published by ACI, ASTM and in the proceedings of International Symposia.
- The ESCS industry is especially grateful for the many fundamental contributions to technical journals of Professor Theodore W. Bremner, PE, PhD., and the ground breaking theoretical insight contained in this doctoral thesis, “*Influence of Aggregate Structure on Low Density Concrete*”, Imperial College of Science and Technology, London, U.K., 1981.

It should be understood that while the manual provides generalized base-line data, data specific to the physical and structural properties of member company aggregates and the concrete products produced with them takes precedence over values reported in this reference manual.

Although this document will have several hundred pages of text and more than 40 appendixes providing additional information and specifications it should be recognized that each chapter presents only a brief overview of the subject discussed. Fully presenting comprehensive information would make this “stand-alone” source an encyclopedia and totally unwieldy. Appropriate references are included on the page where the subject is discussed, and are listed in Chapter 17.

Permission to reprint and distribute any portion of this manual needs to be obtained in writing from the Expanded Shale, Clay and Slate Institute.

A considerable amount of basic aggregate/concrete technology is repeated in several locations. This approach was designed to allow various parts of this reference manual to be used individually, or collectively as in the case of Chapters 10, 11, and 12 which can serve the ESCSI stand alone report on lightweight aggregate masonry industry. In other cases the chapters were designed to parallel other documents such as ACI 211 proportioning.

This manual also represents ESCSI’s commitment to sustainability through the use of products that improve structural efficiency and have a low energy requirement, thereby reducing the amount of new raw material and energy needed to expand and maintain a healthy and productive global social structure.

Although not always immediately successful, our industry continually makes a major effort to provide an optimized building material while striving to have a positive effect on the natural environment. The ESCS industry is committed to moving forward by providing a quality lightweight construction material, while avoiding the potential traps as suggested in Proverbs, Chapter 27 verse 3.

***“A stone is heavy, and sand is weighty,
But the annoyance caused by a fool is heavier than both”***

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 - 15.4** Sports Field Applications
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 - 15.5** Surface Applications
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 - Sub-Surface Insulating Loose LWA Fill
 - Pipe Back Fill
 - High Temperature Protection
 - Under Slab on Grade
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 - 15.6** Specialized Non-Structural Concretes
 - Roof Fill (Insulation and Slope to Drain)
 - Topping on Wood Floors
 - Pre-Mixed Bag Concretes
 - Shotcrete
 - Flair (Fine Lightweight Aggregate Internal Reservoirs-Admix DLYY system)
 - 15.7** References
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- Appendix 15A** ASTM D 5268 “*Standard Specification for Topsoil Used for Landscaping Purposes*”.
 - Appendix 15B** ASTM D 5883 “*Standard Guide for Use of Rotary Kiln Produced Expanded shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes*”.
 - Appendix 15C** “*Horticulture Applications for Lightweight Aggregate*”, C. Friedrich, RLA, ASLA, Midyear 2000 ESCSI Meeting at Boulder, CO.
 - Appendix 15D** “*Dissolved Phosphorus Retention of Light-Weight Expanded Shale and Masonry Sand Used in Subsurface Flow Treatment Wetlands*”, Forbes

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- Appendix 15E** *“Introducing the Friendly material: Rotary Kiln Produced Lightweight Soil Conditioner”*, ESCSI Publication #8600 August 2002.
- Appendix 15F** *“Amending Soils for Turf”*, ESCSI Publication 8620
- Appendix 15G** *“GreenRoofs”*, ESCSI Publication #8621
- Appendix 15H** Concrete Pipe News October 1974 “Double Barrel Pipe”

Chapter 16 Geotechnical Use and Applications of Expanded Shale, Clay and Slate Structural Lightweight Aggregates (Separate Manual)

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- 16.2** Physical Properties of Structural Lightweight Aggregate
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- Grading of Lightweight Aggregate
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- 16.3** Geotechnical Properties of Lightweight Backfill
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- Rhode Island State House of Providence River
- Lightweight Aggregate Fill on Elevated Structures
- Barney Allis Plaza, Kansas City, MO
- Lightweight Aggregate Fill over Soft Soils
- Load Compensation for Sinking Road Bed, Colonial Parkway, VA.
- Lightweight Aggregate Fill Reduces Settlement Over Unstable Soils, Morgan City, LA.
- Lightweight Aggregate Fill for Airport Runway, Norfolk, VA.

Lightweight Aggregate Backfill for Reduced Settlement of Levees
Lightweight Aggregate Fill for Bridge Applications
Charter Oak Bridge, Hartford, CT
Rehabilitation of Existing Bridge Abutments, Duke Street Bridge, VA.
Lightweight Aggregate Fill for Slope Stability
Lightweight Aggregate Backfill Over Buried Pipes
Lightweight Fill for Intermediate Layers
Lightweight Aggregate Backfill Behind Concrete Masonry Segmental Retaining
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Lightweight Aggregate Backfill for High Thermal Resistance
Lightweight Aggregate Backfill Provides Free Draining For Leachate In Waste
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16.5 Economic Implications

Appendix 16A References
Appendix 16B Electrochemical Resistivity
Appendix 16C Compaction
Appendix 16D ESCSI Publications
Appendix 16E Published Articles

Chapter 17 References