Guide for Structural Lightweight-Aggregate Concrete

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SYNOPSIS

The guide summarizes the present state of technology, presents and interprets the data on lightweight-aggregate concrete from many laboratory studies and the accumulated experience resulting from its successful use, and reviews performance of structural lightweight aggregate concrete in service.

This guide includes a definition of lightweight-aggregate concrete for structural purposes and discusses, in a condensed fashion, the production methods for and inherent properties of structural lightweight aggregates. Current practices for proportioning, mixing, transporting, and placing; properties of hardened concrete; and the design of structural concrete with reference to ACI 318 are all discussed.

Keywords: abrasion resistance; aggregate; bond; contact zone; durability; fire resistance; internal curing; lightweight aggregate; lightweight concrete; mixture proportion; shear; shrinkage; specified density concrete; strength; thermal conductivity.

CONTENTS

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CHAPTER 1—INTRODUCTION AND SCOPE

1.1—Introduction

The objectives of this guide are to provide information and guidelines for designing and using lightweight concrete. By using such guidelines and construction practices, the structures can be designed and performance predicted with the same confidence and reliability as normalweight concrete and other building materials.

This guide covers the unique characteristics and performance of structural lightweight-aggregate (LWA) concrete. General historical information is provided along with detailed information on LWA and proportioning, mixing, and placing of concrete containing these aggregates. The physical properties of the structural LWA, along with design information and applications, are also included.

Structural lightweight concrete has many and varied applications, including multistory building frames and floors, curtain walls, shell roofs, folded plates, bridge decks and girders, prestressed or precast elements of all types, and marine structures. In many cases, the architectural expression of form, combined with functional design, is achieved more readily with structural lightweight concrete than with any other medium. Many architects, engineers, and contractors recognize the inherent economies and advantages offered by this material, as evidenced by the many impressive lightweight concrete structures found throughout the world.

Because much of the properties and performance of lightweight concrete are dependent on the type of LWA used, the ready mix supplier, LWA producer, or both, might be an important source of specific information for attaining the project objectives.

1.2—Scope

1.2.1 *Historical background*—The first known use of lightweight concrete dates back over 2000 years. There are several lightweight concrete structures in the Mediterranean region, but the three most notable structures were built during the early Roman Empire and include the Port of Cosa, the Pantheon Dome, and the Coliseum.

Built in approximately 273 BC, the Port of Cosa used lightweight concrete made from natural volcanic materials. These early builders learned that expanded aggregates were better suited for marine facilities than the locally available beach sand and gravel. They traveled 25 mi. (40 km) to the northeast to quarry volcanic aggregates at the Volcine complex for use in the harbor at Cosa (Bremner et al. 1994). This harbor on the west coast of Italy consists of a series of