

Guide for Cellular Concretes Above 50 pcf, and for Aggregate Concretes Above 50 pcf with Compressive Strengths Less Than 2500 psi

Reported by ACI Committee 523

George C. Hoff
Chair

Leo E. Rivkind
Secretary

Frank M. Coda
Robert A. Crist
Richard J. Frazier*
Richard E. Galer

Ernst Gruenwald
W. C. Hansen
Leo M. Legatski
Albert Litvin

Robert G. Mathey
Fred C. McCormick
Richard J. O'Heir
Thomas W. Reichard

Owen L. Scha
Robert E. Tobin
Rudolph C. Valore Jr.
William F. Wescott

*Deceased

Members of the committee voting on the 1993 revisions:

Fouad H. Fouad
Chair

Leo A. Legatski
Secretary

Theodore W. Bremner
Philip M. Carkner
Hubert T. Dudley
Werner H. Gumpertz

Michael Healy
George C. Hoff
Gordon D. Lerch

Albert Litvin
William R. MacDonald
Henry N. Marsh Jr.

Jan R. Prusinski
Leo E. Rivkind
Rudolph C. Valore Jr.

This guide presents information on materials, fabrication, properties, design, and handling of cellular concretes with oven-dry densities greater than 50 pcf (800 kg/m³) and aggregate concretes with oven-dry densities above 50 pcf (800 kg/m³) but whose compressive strengths are less than 2500 psi (17.24 MPa). The usual density range of the concrete considered is 50 to 120 pcf. Those concretes in the lower portion of this range are generally used for thermal and sound insulation walls for roofs, walls, and floors. At the higher densities they are used for cast-in-place walls, floors, and roofs, and also for precast elements such as wall and floor panels.

Keywords: cellular concretes; compressive strength; concrete construction; fire resistance; formwork (construction); insulating concretes; lightweight aggregate concretes; lightweight concretes; mixture proportioning; modulus of elasticity; precast concrete; shear properties; splitting tensile strength; structural design; thermal conductivity.

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CONTENTS

Introduction, p. 2

Chapter 1—General, p. 2

- 1.1—Scope
- 1.2—Objective
- 1.3—Definitions
- 1.4—Standards and ACI documents cited in this report

Chapter 2—Materials, p. 3

- 2.1—Aggregates
- 2.2—Portland cement
- 2.3—Mixing water
- 2.4—Foam concrete
- 2.5—Fibers
- 2.6—Admixtures
- 2.7—Pozzolans

Chapter 3—Mixing and handling, p. 5

- 3.1—Storage of materials

ACI 523.3R-93 supersedes ACI 523.3R-75 (Revised 1982) and became effective November 1, 1993.

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- 3.2—Mixing procedures
- 3.3—Conveying

Chapter 4—Forming and placing, p. 5

- 4.1—Form systems
- 4.2—Placing
- 4.3—Finishing

Chapter 5—Properties, p. 6

- 5.1—General
- 5.2—Notation
- 5.3—Cellular concrete properties
- 5.4—Group I ASTM C332 aggregate concrete properties
- 5.5—Group II ASTM C332 aggregate concrete properties

Chapter 6—Design considerations, p. 10

- 6.1—General
- 6.2—Structural design

Chapter 7—Proportioning of mixtures, p. 10

- 7.1—General
- 7.2—Material properties
- 7.3—Selection of quantities

Chapter 8—Fire resistance, p. 12

References, p. 14

INTRODUCTION

The concretes that are the subject of this guide have applications ranging from insulating fills to structural elements. This is made possible mainly by the control of density which in turn affects other properties such as strength, modulus of elasticity, and thermal conductivity. Some of the present commercial uses of these concretes are:

1. Fills for thermal and sound insulation of floors, walls, and roofs
2. Cast-in-place walls, floors, and roofs
3. Precast elements such as wall and floor panels

The steadily increasing use of these concretes and the fact that they are specifically not covered in other ACI guides and standards have led to the preparation of this guide.

CHAPTER 1—GENERAL

1.1—Scope

This guide applies to all cellular concretes that weigh more than 50 pcf (800 kg/m³) oven-dry and also to aggregate concretes that weigh more than 50 pcf (800 kg/m³) oven-dry but have a compressive strength less than 2500 psi (175 kgf/cm²). High weight aggregate concretes of higher strength are, by definition, within the scope of ACI Committee 213, Lightweight Aggregates and Lightweight Aggregate Concrete.

For precast and cast-in-place concretes are within the scope of this guide.

1.2—Objective

The objective is to assemble, in this guide, the presently available information relating to the properties and use of the subject concretes. It is intended that such information

will be an aid in the selection, proportioning, production, and use of these concretes.

1.3—Definitions

The terms “cellular concrete” and “aggregate concrete” are used throughout this guide. These terms have many meanings throughout the various areas of concrete technology but are defined as follows for use in this guide:

1.3.1 Cellular concretes—The cellular concretes referred to in this guide are lightweight concretes that contain stable air or gas cells uniformly distributed in the mixture. In the density range covered by this guide, cellular concretes commonly include natural or manufactured sand aggregate. Other types of aggregates may be added; for example, manufactured lightweight aggregates such as expanded clay, shale, slate, sintered fly ash, perlite, and vermiculite as well as natural lightweight aggregates such as pumice, scoria, or tuff. The air cells are usually added at the mixer as a stable preformed foam metered from a calibrated nozzle and thoroughly blended into the mixture. The air cells may also be formed mechanically by entraining air during high-speed mixing of the concrete materials containing a foaming agent. It is likewise possible to form gas cells in the mixture as the product of a chemical reaction. This guide does not cover products or processes that use gas-evolving chemical reactions. The air cells in cellular concrete are predominantly macroscopic bubbles as contrasted with the predominantly microscopic bubbles in air-entrained concrete.

1.3.2 Aggregate concretes—The aggregate concretes referred to in this guide are made with lightweight aggregates such as expanded clay, shale, slate, slag, sintered fly ash, perlite, and vermiculite or natural aggregates such as pumice, scoria, or tuff. These aggregates are used with or without the addition of sand. By definition, these concretes contain no air cells in the paste other than that entrapped by normal mixing and from conventional air-entraining agents.

1.4—Standards and ACI documents cited in this report

The standards of the various standards-producing organizations and ACI documents referred to in this document are listed below with their serial designation.

1.4.1 ACI documents

- 211.2 Standard Practice for Selecting Proportions for Structural Lightweight Concrete
- 212.3R Chemical Admixtures for Concrete
- 213R Guide for Structural Lightweight Aggregate Concrete
- 318 Building Code Requirements for Reinforced Concrete
- 347R Guide to Formwork for Concrete
- 408.1R Suggested Development Splice and Standard Hook Provisions for Deformed Bars in Tension
- 426R Shear Strength of Reinforced Concrete Members
- 517.2R Accelerated Curing of Concrete at Atmospheric Pressure
- 544.1R Report on Fiber-Reinforced Concrete

1.4.2 ASTM standards

- C33 Standard Specification for Concrete Aggregates