

ACI 332.1R-06

Guide to Residential Concrete Construction

Reported by ACI Committee 332



American Concrete Institute®



First printing
December 2006

American Concrete Institute®
Advancing concrete knowledge

Guide to Residential Concrete Construction

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ISBN 0-87031-226-X

Guide to Residential Concrete Construction

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This guide provides practical information about the construction of quality residential concrete. It covers concrete work for one- and two-family dwellings with a maximum height of two stories above grade and a basement that is either cast-in-place or placed as precast elements. Information on materials, proportions, production, delivery, and testing is provided. Separate chapters on footings, walls, and slabs provide information on subgrade, forms, reinforcement, placement, consolidation, finishing, and curing. Special considerations regarding insulation and hot and cold weather are included. Common problems and their repair are also addressed. The discussion of specific design provisions and all drawings provided by this guide are intended to offer illustrations of typical practice and should not be interpreted as meeting the requirements of specific codes or project specifications. Applicable codes and construction documents take precedence over the information contained in this document.

Keywords: finish; footing; form; slab; slab-on-ground; subgrade; tolerance; wall.

CONTENTS

Chapter 1—Introduction, p. 332.1R-2

- 1.1—Scope
- 1.2—Definitions

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Chapter 2—Concrete, p. 332.1R-6

- 2.1—Fundamentals
- 2.2—Materials
- 2.3—Mixture proportioning
- 2.4—Ordering
- 2.5—Production and delivery
- 2.6—Testing

Chapter 3—Footings, p. 332.1R-13

- 3.1—Purpose
- 3.2—Excavation
- 3.3—Soil
- 3.4—Footing types
- 3.5—Footing loads
- 3.6—Tolerances
- 3.7—Form types
- 3.8—Geometry
- 3.9—Concrete
- 3.10—Reinforcement
- 3.11—Placement
- 3.12—Curing and protection
- 3.13—Footing drainage

Chapter 4—Walls, p. 332.1R-22

- 4.1—Forming systems
- 4.2—Precast systems
- 4.3—Reinforcement
- 4.4—Geometry

ACI 332.1R-06 supersedes 332R-84 and became effective August 31, 2006.
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- 4.5—Wall construction
- 4.6—Curing and protection
- 4.7—Moisture protection
- 4.8—Backfilling
- 4.9—Safety

Chapter 5—Slabs, p. 332.1R-35

- 5.1—Slabs-on-ground
- 5.2—Elevated slabs
- 5.3—Concrete
- 5.4—Placing and finishing
- 5.5—Jointing
- 5.6—Curing

Chapter 6—Project considerations, p. 332.1R-41

- 6.1—Ordering ready-mixed concrete
- 6.2—Site considerations
- 6.3—Placement considerations
- 6.4—Special materials
- 6.5—Hot weather concreting
- 6.6—Cold weather concreting
- 6.7—Troubleshooting

Chapter 7—References, p. 332.1R-46

- 7.1—Referenced standards and reports
- 7.2—Cited references

CHAPTER 1—INTRODUCTION

Concrete is the most widely used construction material throughout the world. Concrete is used in commercial structures, transportation, water and waste management, public works, farm construction, and utility and residential structures. Based on the amount of concrete produced for each of these categories, residential construction accounts for the second largest application of concrete.

1.1—Scope

This guide provides practical information about the construction of quality residential concrete. It covers concrete work for one- and two-family dwellings with a maximum height of two stories above grade and a basement that is either cast-in-place or placed as precast elements. Information on materials, proportions, production, delivery, and testing is provided. Separate chapters on footings, walls, and slabs provide information on subgrade, forms, reinforcement, placement, consolidation, finishing, and curing. Special considerations regarding insulation and hot and cold weather are included. Common problems and their repair are also addressed. The discussion of specific design provisions and all drawings provided by this guide are intended to offer illustrations of typical practice and should not be interpreted as meeting the requirements of specific codes or project specifications. Applicable codes and construction documents take precedence over the information contained in this document.

Information not presented in this guide includes above-grade concrete walls, deep foundation systems (such as piles, drilled piers, or caissons), free-standing retaining walls (>4 ft [1.2 m]), post-tensioned slabs-on-ground, and elevated

concrete slabs. Information on the use of lightweight concrete is not covered in this guide. Guidance is available for these elements in other ACI documents. This guide also does not cover loading and design for seismic forces with the exception of guidance on types of connections between the sill plate and foundation wall commonly used in higher seismic design categories. Additional information on seismic loading and design can be found in the International Residential Code (IRC).

1.2—Definitions

accelerator—see **admixture, accelerating**.

admixture—a material other than water, aggregates, hydraulic cement, and fiber reinforcement; used as an ingredient of a cementitious mixture to modify its freshly mixed, setting, or hardened properties and is added to the batch before or during its mixing.

admixture, accelerating—an admixture that causes an increase in the rate of hydration of the hydraulic cement and thus shortens the time of setting, increases the rate of strength development, or both.

admixture, air-entraining—an admixture that causes the development of a system of microscopic air bubbles in concrete, mortar, or cement paste during mixing, usually to increase its workability and resistance to freezing and thawing.

admixture, retarding—an admixture that causes a decrease in the rate of hydration of the hydraulic cement and lengthens the time of setting.

admixture, water-reducing—an admixture that either increases slump of freshly mixed mortar or concrete without increasing water content or maintains slump with a reduced amount of water, the effect being due to factors other than air entrainment.

admixture, water-reducing (high-range)—a water-reducing admixture capable of producing large water reduction or great flowability without causing undue set retardation or entrainment of air in mortar or concrete.

agent, release—material used to prevent bonding of concrete to a surface.

aggregate—granular material, such as sand, gravel, crushed stone, crushed hydraulic-cement concrete, or iron blast-furnace slag, used with a hydraulic cementing medium to produce either concrete or mortar.

aggregate, coarse—aggregate predominantly retained on the 4.75 mm (No. 4) sieve, or that portion retained on the 4.75 mm (No. 4) sieve.

aggregate, fine—aggregate passing the 9.5 mm (3/8 in.) sieve, almost entirely passing the 4.75 mm (No. 4) sieve, and predominantly retained on the 75 μ m (No. 200) sieve; or that portion passing the 4.75 mm (No. 4) sieve and predominantly retained on the 75 μ m (No. 200) sieve.

air-entraining agent—see **admixture, air-entraining**.

air entrainment—the incorporation of air in the form of microscopic bubbles (typically smaller than 1 mm) during the mixing of either concrete or mortar.

alkali—salts of alkali metals, principally sodium or potassium; specifically, sodium and potassium occurring in

constituents of concrete and mortar, usually expressed in chemical analyses as the oxides Na_2O and K_2O .

alkali-silica reaction—see **reaction, alkali-silica**.

allowable bearing capacity—the maximum pressure to which a soil or other material should be subjected to guard against shear failure or excessive settlement.

anchor bolt—see **bolt, anchor**.

anchor strap—a galvanized light gauge steel device designed to transfer uplift and/or lateral forces from wood framing members to concrete foundations. The device is cast into the concrete foundation wall with attachment points for anchorage of the building deck.

bar—an element, normally composed of steel, with a nominally uniform cross-sectional area used to reinforce concrete.

bar, deformed—a reinforcing bar with a manufactured pattern of surface ridges intended to reduce slip and increase pullout resistance of bars embedded in concrete.

bar diameter—the proper designation of the sizes for reinforcement bars used in concrete construction, expressed as d_b .

bar support—hardware used to support or hold reinforcing bars in proper position to prevent displacement before and during concreting.

barrier, vapor—see **retarder, vapor**.

blast-furnace slag—the nonmetallic product consisting essentially of silicates and aluminosilicates of calcium and other bases that is developed in a molten condition simultaneously with iron in a blast furnace.

bleeding—the autogenous flow of mixing water within, or its emergence from, newly placed concrete or mortar; caused by the settlement of the solid materials within the mass; also called water gain.

blockout—a space within a concrete structure under construction in which fresh concrete is not to be placed.

bolt, anchor—a metal bolt or stud, headed or threaded, that is cast in place, grouted in place, or drilled into finished concrete, and used to hold various structural members or embedments in the concrete, and to resist shear, tension, and vibration loadings from various sources such as wind and machine vibration; also known as a hold-down bolt or a foundation bolt.

boring—a sample of soil or concrete for tests.

calcium chloride—a crystalline solid, CaCl_2 ; in various technical grades, it is used as a drying agent, as an accelerator of concrete, as a deicing chemical, and for other purposes. (See also **admixture, accelerating**.)

cement, blended—a hydraulic cement consisting essentially of an intimate and uniform blend of granulated blast-furnace slag and hydrated lime; or an intimate and uniform blend of portland cement and granulated blast-furnace slag, portland cement and pozzolan, or portland blast-furnace slag cement and pozzolan, produced by intergrinding portland cement clinker with the other materials or by blending portland cement with the other materials, or a combination of intergrinding and blending.

cement, portland—a hydraulic cement produced by pulverizing portland-cement clinker, and usually in combination with calcium sulfate.

cement paste—binder of concrete and mortar consisting essentially of cement, water, hydration products, and any admixtures together with very finely divided materials included in the aggregates.

cementitious—having cementing properties.

chair—see **bar support**.

chute—a sloping trough or tube for conducting concrete, cement, aggregate, or other free-flowing materials from a higher to a lower point.

compound, curing—a liquid that can be applied as a coating to the surface of newly placed concrete to retard the loss of water or, in the case of pigmented compounds, to reflect heat so as to provide an opportunity for the concrete to develop its properties in a favorable temperature and moisture environment.

compressive strength—see **strength, compressive**.

concrete—a composite material that consists essentially of a binding medium within which is embedded particles or fragments of aggregate (usually a combination of fine aggregate and coarse aggregate) in portland-cement concrete; the binder is a mixture of portland cement and water, with or without admixtures.

concrete, ready mixed—concrete manufactured for delivery to a purchaser in a fresh state.

consolidation—the process of inducing a closer arrangement of the solid particles in freshly mixed concrete or mortar during placement by the reduction of voids, usually by vibration, centrifugation, rodding, tamping, or some combination of these actions; also applicable to similar manipulation of other cementitious mixtures, soils, aggregates, or the like. (See also **rodding** and **tamping**).

construction joint—see **joint, construction**.

contraction joint—see **joint, contraction**.

controlled low-strength cementitious material—material that is intended to result in a compressive strength of 1200 psi (8.3 MPa) or less.

cover—in reinforced concrete, the least distance between the surface of embedded reinforcement and the outer surface of the concrete.

creep—time-dependent deformation due to sustained load.

curing—action taken to maintain moisture and temperature conditions in a freshly placed cementitious mixture to allow hydraulic cement hydration and (if applicable) pozzolanic reactions to occur so that the potential properties of the mixture may develop. (See ACI 308R.)

curing compound—see **compound, curing**.

curling—the distortion of an originally (approximately) linear or planar member into a curved shape, such as the warping of a slab to differences in temperature or moisture content in the zones adjacent to its opposite faces.

darby—a hand-manipulated straightedge, usually 3 to 8 ft (1 to 2.5 m) long, used in the early stage of leveling operations of concrete or plaster preceding supplemental floating and finishing.