Guide to Concrete Floor and Slab Construction

Reported by ACI Committee 302

ACI 302.1R-15

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First Printing
June 2015
ISBN: 978-1-942727-25-5

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The quality of a concrete floor or slab is highly dependent on achieving a hard and durable surface that is flat, relatively free of cracks, and at the proper grade and elevation. Properties of the surface are determined by the mixture proportions and the quality of the concreting and jointing operations. The timing of concreting operations—especially finishing, jointing, and curing—is critical. Failure to address this issue can contribute to undesirable characteristics in the wearing surface such as cracking, low resistance to wear, dusting, scaling, high or low spots, poor drainage, and increasing the potential for curling.

Concrete floor slabs employing portland cement, regardless of slump, will start to experience a reduction in volume as soon as they are placed. This phenomenon will continue as long as any water, heat, or both, is being released to the surroundings. Moreover, because the drying and cooling rates at the top and bottom of the slab are not the same, the shrinkage will vary throughout the depth, causing the as-cast shape to be distorted and reduced in volume.

This guide contains recommendations for controlling random cracking and edge curling caused by the concrete's normal volume change. Application of present technology permits only a reduction in cracking and curling, not elimination. Even with the best floor designs and proper construction, it is unrealistic to expect completely crack- and curl-free floors. Consequently, every owner should be advised by both the designer and contractor that it is completely normal to expect some amount of cracking and curling on every project, and that such an occurrence does not necessarily reflect adversely on either the adequacy of the floor's design or the quality of its construction (Ytterberg 1987).

This guide describes how to produce high-quality concrete slabs-on-ground and suspended floors for various classes of service. It emphasizes such aspects of construction as site preparation, concrete materials, concrete mixture proportions, concrete workmanship, joint construction, load transfer across joints, form stripping procedures, finishing methods, and curing. Flatness/levelness requirements and measurements are outlined. A thorough preconstruction meeting is critical to facilitate communication among key participants and to clearly establish expectations and procedures that will be employed during construction to achieve the floor qualities required by the project specifications. Adequate supervision and inspection are required for job operations, particularly those of finishing.

Keywords: admixture; aggregate; consolidation; contract documents; curing; curling; deflection; durability; form; fracture; joint; mixture proportioning; placing; quality control; slab-on-ground; slabs; slump test.

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Reference to this document shall not be made in contract documents. If items found in this document are desired by the Architect/ Engineer to be a part of the contract documents, they shall be restated in mandatory language for incorporation by the Architect/Engineer.

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ACI 302.1R-15 supersedes ACI 302.1R-04 and was adopted and published June 2015.

CHAPTER 1—INTRODUCTION

1.1—Purpose

This guide presents information relative to the construction of slab-on-ground and suspended-slab floors for industrial, commercial, and institutional buildings. It is applicable to the construction of normalweight and structural lightweight concrete floors and slabs made with conventional portland and blended cements. This guide identifies the various classes of floors based on use, construction design details, necessary site preparation, concrete type, and other related materials. In general, characteristics of the concrete slab surface and joint performance have a powerful impact on the serviceability of floors and other slabs. Because the eventual success of a concrete floor installation depends on the mixture proportions and floor finishing techniques used, considerable attention is given to critical aspects of achieving the desired finishes and the required floor surface tolerances.

1.2—Scope

This guide emphasizes choosing and proportioning of materials, design details, proper construction methods, and workmanship. Slabs specifically intended for the containment of liquids are beyond the scope of this guide. Whereas this guide does provide a reasonable overview of concrete floor construction, each project is unique and circumstances can dictate departures from the recommendations given in this guide. Contractors and suppliers should, therefore, thoroughly review contract documents before bid preparation (Chapter 3).

CHAPTER 2—DEFINITIONS

ACI provides a comprehensive list of definitions through an online resource, "ACI Concrete Terminology," http://www.concrete.org/store/productdetail.aspx?ItemID=CT13. Definitions provided herein complement that resource.

differential set time—difference in timing from initial introduction of water to concrete mixture at batch plant to initial power floating.

dry-shake—dry mixture of hydraulic cement and fine aggregate (either mineral or metallic) that is distributed evenly over the surface of concrete flatwork and worked into the surface before time of final setting and then floated and troweled to desired finish.

mixture optimization indicator—intersection of the coarseness factor value and the workability factor on the coarseness factor chart.

rutting—creation of troughs in the soil support system in response to applied wheel loads.

score—creation of lines or notches in the surface of a concrete slab.

soil pumping—vertical displacement and rebound of the soil support system in response to applied moving loads.

water slump—magnitude of slump, measured in accordance with ASTM C143/C143M, which is directly attributed to the amount of water in the concrete mixture.

window of finishability—time period available for finishing operations after the concrete has been placed, consolidated, and struck-off, and before final troweling.

workability factor—percentage of combined aggregate that passes the No. 8 (2.36 mm) sieve.

CHAPTER 3—PREBID AND PRECONSTRUCTION MEETINGS

3.1—Prebid meeting

The best forum for a thorough review of contract documents before the bid preparation is a prebid meeting. This meeting offers bidders an opportunity to ask questions and to clarify their understanding of contract documents before submitting their bids. A prebid meeting also provides the owner and the owner's slab designer an opportunity to clarify intent where documents are unclear and to respond to last-minute questions in a manner that provides bidders an opportunity to be equally responsive to the contract documents.

3.2—Preconstruction meeting

Successful construction of slabs-on-ground or suspended floors or slabs involves the coordinated efforts of many subcontractors and material suppliers. The slab designer should schedule a preconstruction meeting to establish and coordinate procedures that will enable key participants to produce the best possible product under the anticipated field conditions. This meeting should be attended by responsible representatives of organizations and material suppliers directly involved with either the design or construction of floors.

3.2.1 *Agenda items*—The preconstruction meeting should confirm and document the responsibilities and anticipated interaction of key participants involved in slab-on-ground or suspended floor or slab construction. Following is a list of agenda items appropriate for such a meeting, including ones for which the contract documents should establish a clear responsibility. The following list is not all-inclusive:

a) Site preparation
b) Grades for drainage, if any
c) Work associated with installation of auxiliary materials, such as vapor barriers, vapor retarder/barriers, edge insulation, electrical conduit, mechanical sleeves, drains, and embedded plates
d) Class of floor
e) Floor thickness
f) Reinforcement, when required
g) Construction tolerances: base (rough and fine grading), forms, slab thickness, surface configuration, and floor flatness and levelness requirements (including how and when measured)
h) Joints and load-transfer mechanism
i) Materials: cements, fine aggregate, coarse aggregate, water, and admixtures (usually by reference to applicable ASTM standards)
j) Special aggregates, admixtures, or monolithic surface treatments, where applicable
k) Concrete specifications including:
   1) Compressive strength, flexural strength, or both
   2) Recommended cementitious material content, if applicable
   3) Maximum size, grading, and type of coarse aggregate