Overview of ACI 308R
Guide to External Curing of Concrete

Lawrence Taber, P.E., FACI
Black & Veatch
Chair, ACI 308 – Curing Concrete

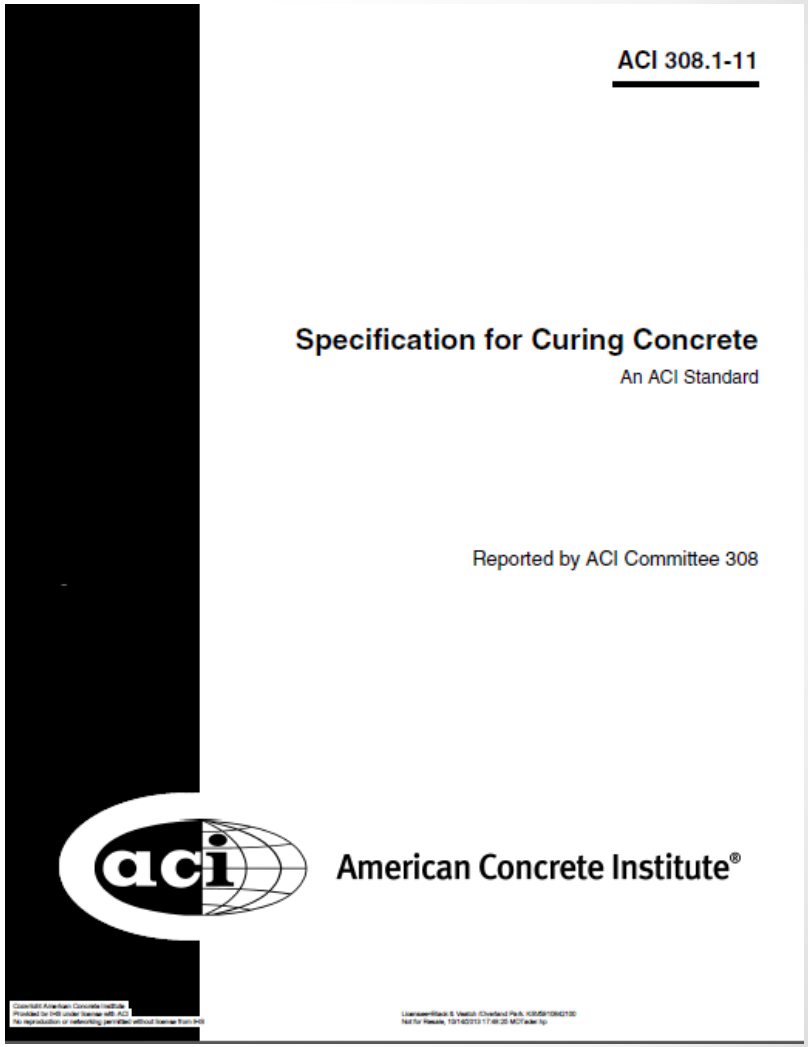
What I plan to cover today

- Curing documents overview

- Did the Guide to Curing Concrete need updated?
- What changed?
- What's next for the Guide?

Curing Specification

- ACI 308.1-11 (metric version is 308.1M-11)
- Reference specification
- Provides requirements for various ways to cure concrete elements
- Applies to external curing only (no IC)

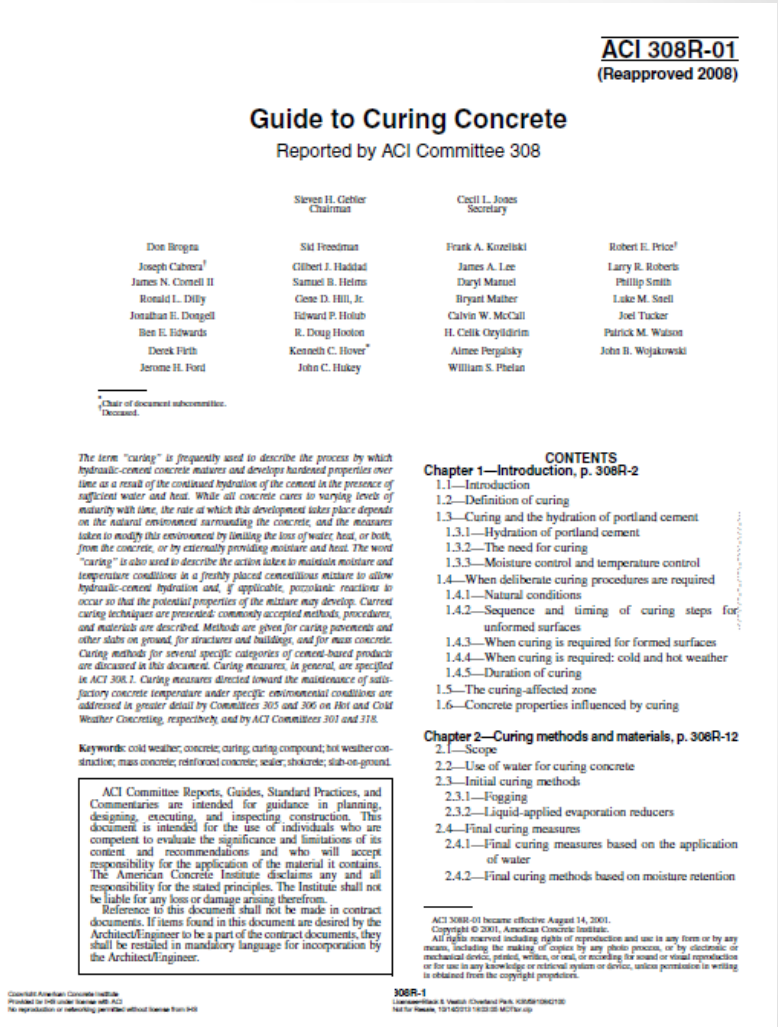


More on the Specification

- Written in mandatory language ('shall' is used)
- Uses standard 3-part specification format
- Do not reference if referencing ACI 301
- Contains three checklists which must be used
  - Mandatory Requirements
  - Optional Requirements
  - Submittals
- Covers cast-in-place concrete

Curing Guide

- Current is ACI 308R-01 (Reapproved 2008)
- Provides guidance on curing practices, procedures, materials and monitoring methods
- Updated version in final edits – complete this year!



ACI 308R-01
(Reapproved 2008)

Guide to Curing Concrete

Reported by ACI Committee 308

Steven H. Gebler, Chairman — Cecil L. Jones, Secretary

Don Brogna, Joseph Cabrera†, James N. Cornell II, Ronald L. Dilly, Jonathan E. Dongell, Ben E. Edwards, Derek Firth, Jerome H. Ford, Sid Freedman, Gilbert J. Haddad, Samuel B. Helms, Gene D. Hill, Jr., Edward P. Holub, R. Doug Hooton, Kenneth C. Hover*, John C. Hukey, Frank A. Kozelski, James A. Lee, Daryl Manuel, Bryant Mather, Calvin W. McCall, H. Celik Ozyildirim, Aimee Pergalsky, William S. Phelan, Robert E. Price†, Larry R. Roberts, Phillip Smith, Luke M. Snell, Joel Tucker, Patrick M. Watson, John B. Wojakowski

*Chair of document subcommittee.
†Deceased.

The term "curing" is frequently used to describe the process by which hydraulic-cement concrete matures and develops hardened properties over time as a result of the continued hydration of the cement in the presence of sufficient water and heat. While all concrete cures to varying levels of maturity with time, the rate at which this development takes place depends on the natural environment surrounding the concrete, and the measures taken to modify this environment by limiting the loss of water, heat, or both, from the concrete, or by externally providing moisture and heat. The word "curing" is also used to describe the 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. Current curing techniques are presented; commonly accepted methods, procedures, and materials are described. Methods are given for curing pavements and other slabs on ground, for structures and buildings, and for mass concrete. Curing methods for several specific categories of cement-based products are discussed in this document. Curing measures, in general, are specified in ACI 308.1. Curing measures directed toward the maintenance of satisfactory concrete temperature under specific environmental conditions are addressed in greater detail by Committees 305 and 306 on Hot and Cold Weather Concreting, respectively, and by ACI Committees 301 and 318.

Keywords: cold weather; concrete; curing; curing compound; hot weather construction; mass concrete; reinforced concrete; sealer; shotcrete; slab-on-ground.

CONTENTS

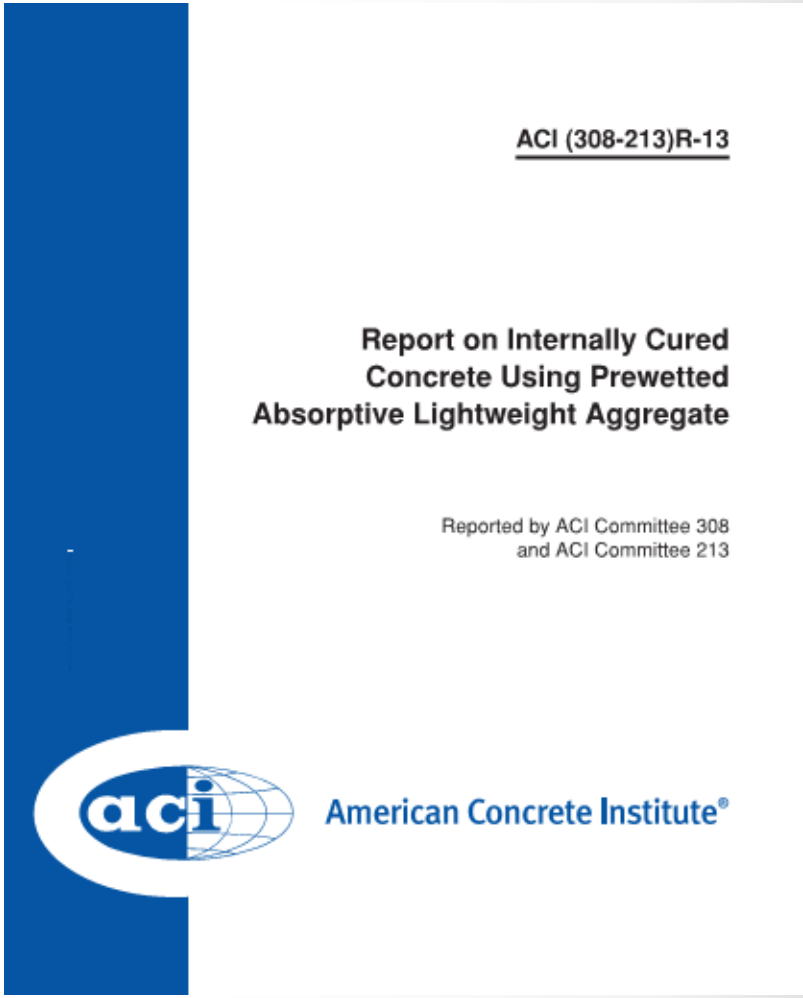
ACI 308R-01 became effective August 14, 2001.

More on the Guide

- No mandatory language ('should' is used)
- Use it to learn more about curing concrete
- Not intended to be directly referenced in project specifications – Don't do it!
- Committee is responding to final TAC comments for updated version – should be done soon

Report on Internal Curing

- Current version is ACI (308-213)R-13
- Provides an overview and guidance on using lightweight aggregate to internally cure concrete
- Technology is becoming more popular



When should I use what?

- Only reference the specification in your project specifications!
- Guide is for learning more about curing and provides the state-of-the-art on the subject
- Report on Internal Curing covers topic in lots of detail
- Do you need information on curing or need to tell contractor what needs done? This decides which document.

But why update?

- Fundamentally required so we can incorporate new:
  - Curing technologies
  - Research
  - Construction types

- ACI rules require it to maintain its relevancy
- Correct previous errors and omissions
- Well, they are supposed to be 'state-of-the-art' documents after all!

How is the Guide organized?

- Six chapters including a short one
- Chapter 1 – Introduction
  - Discusses what curing is and when you need it
- Chapter 2 – Definitions
  - Short chapter, document generally relies on ACI Concrete Terminology (CT-13)
- Chapter 3 – Curing Methods and Materials
  - Discusses curing methods, when to stop them, etc

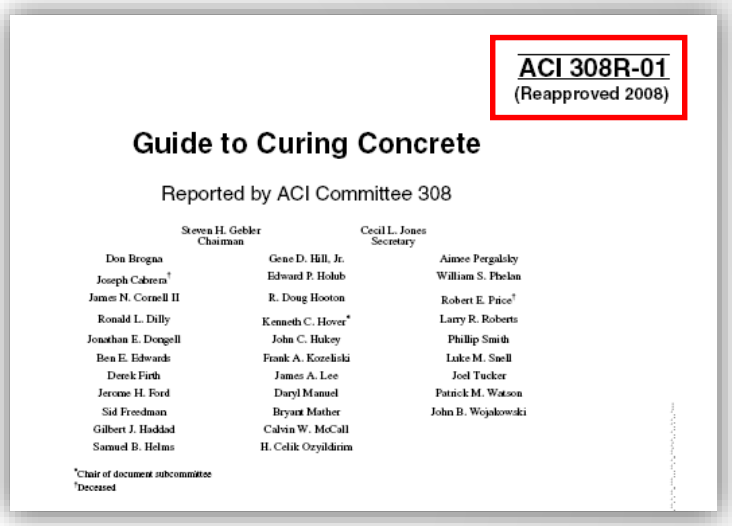
How is the Guide organized?

- Chapter 4 – Curing for Different Types of Construction
  - Pavements, buildings, bridges, mass concrete, etc
- Chapter 5 – Monitoring Curing and Curing Effectiveness
  - Evaluating environmental conditions, making sure curing is working, curing impact on concrete, etc
- Chapter 6 - References

When did we last change it?

- Last updated in 2001
- Re-approved in 2008

ACI 308R-01
(Reapproved 2008)



ACI 308R-01
(Reapproved 2008)

Guide to Curing Concrete

Reported by ACI Committee 308

Steven H. Gebler, Chairman — Cecil L. Jones, Secretary

Don Brogna
Joseph Cabrera†
James N. Cornell II
Ronald L. Dilly
Jonathan E. Dongell
Ben E. Edwards
Derek Firth
Jerome H. Ford
Sid Freedman
Gilbert J. Haddad
Samuel B. Helms
Gene D. Hill, Jr.
Edward P. Holub
R. Doug Hooton
Kenneth C. Hover*
John C. Hukey
Frank A. Kozeliski
James A. Lee
Daryl Manuel
Bryant Mather
Calvin W. McCall
H. Celik Ozyildirim
Aimee Pergalsky
William S. Phelan
Robert E. Price†
Larry R. Roberts
Phillip Smith
Luke M. Snell
Joel Tucker
Patrick M. Watson
John B. Wojakowski

*Chair of document subcommittee
†Deceased

- Re-approval was done to comply with ACI sunset rules – no real updates done

A new name!!

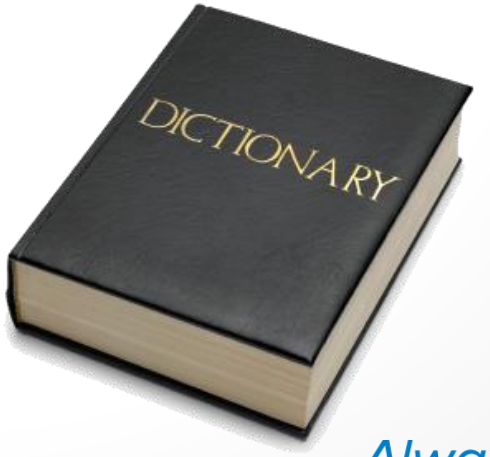
- Guide is now called "Guide to External Curing of Concrete"
- Changed to better reflect what the document actually deals with
- Last-minute change
- Internal curing drove the change
- Recognizes curing of concrete can be external and internal

Chapter 1 – Introduction

- Lots of additional citations to new reference material
- Directs user to new Internal Curing report (ACI (308-213)R-13) for internal curing of concrete
- Adds information on the effects of elevated curing temperatures
- Sustainability as it relates to curing is discussed

Chapter 2 – Definitions

- New chapter
- Very short
- Directs user to ACI's Concrete Terminology on the ACI website (CT-13)
- Majority of definitions used for curing are already included in CT-13 and are not repeated in Guide
- Defines:
  - Curing-affected zone
  - Evaporativity



Chapter 3 – Methods & Materials

- Simplified scope for curing methods and materials section – better reference to Specification (ACI 308.1)
- Additional discussion on final curing measures
  - Current practices, environmental concerns, etc
- Better referencing to elevated curing temps when discussing accelerated curing
- New section and table on elevated curing temperatures with recommendations based on temperature

New Table 3.10 – Elevated Temps

Maximum Concrete Temperature (T)	Level of Prevention Required
T ≤ 158°F (70°C)	No prevention required

158°F (70°C) < T ≤ 185°F (85°C)	Use one of the following approaches to minimize the risk of expansion:
	• Use portland cement that meets the requirements of ASTM C150/C150M for Type II, IV, or Type V cement and has a fineness value ≤ 400 m^2/kg
	• Use portland cement with a 1-day mortar strength (ASTM C109/C109M) ≤ 2905 psi (20 MPa)
	• Use the following proportions of pozzolan or slag in combination with ASTM C150/C150M Portland cement or cements meeting ASTM C595 or ASTM C1157
	  • ≥25 percent fly ash meeting the requirements of ASTM C618 for Class F fly ash
	  • ≥35 percent fly ash meeting the requirements of ASTM C618 for Class C fly ash
	  • ≥35 percent slag meeting the requirements of ASTM C989/C989M
	  • ≥5 percent silica fume (meeting ASTM C1240) in combination with at least 25 percent slag
	  • ≥10 percent metakaolin meeting ASTM C618

T > 185°F (85°C)	The internal concrete temperature should not exceed 185°F (85°C) under any circumstances.

Ch. 4 – Curing for Different Types of Construction

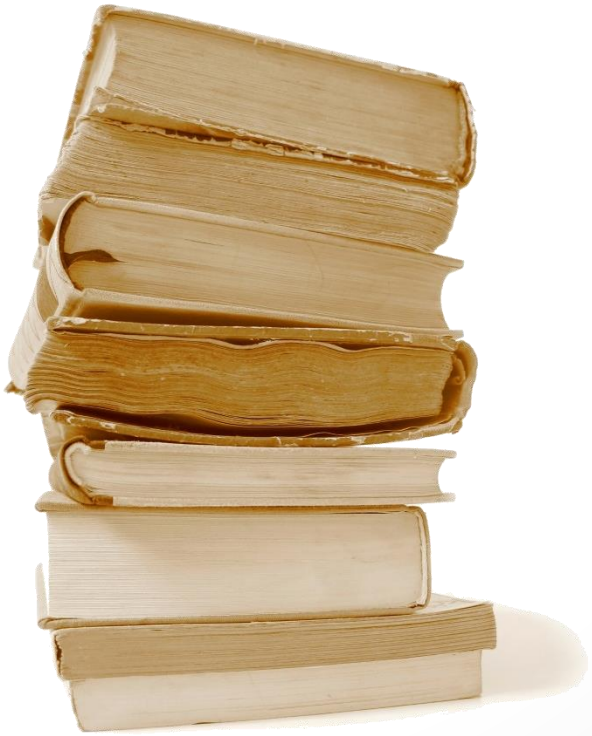
- General revisions updating for current industry practice
- New section covering moisture sensitive flooring
- Additional discussion on curing of mass concrete
  - Provide recommendations on sensors and methods to measure and reduce thermal shock

Ch. 5 – Monitoring Curing & Curing Effectiveness

- General revisions which reflect current practice and cleaner discussion
- Reference to an electronic version of the evaporation rate nomograph added
  - ACI now has an app for the iPhone as well!
- Added discussion on curing meters and curing compound effectiveness evaluation

Chapter 6 – References

- Updated references based on additional items in the Guide and other changes in the industry

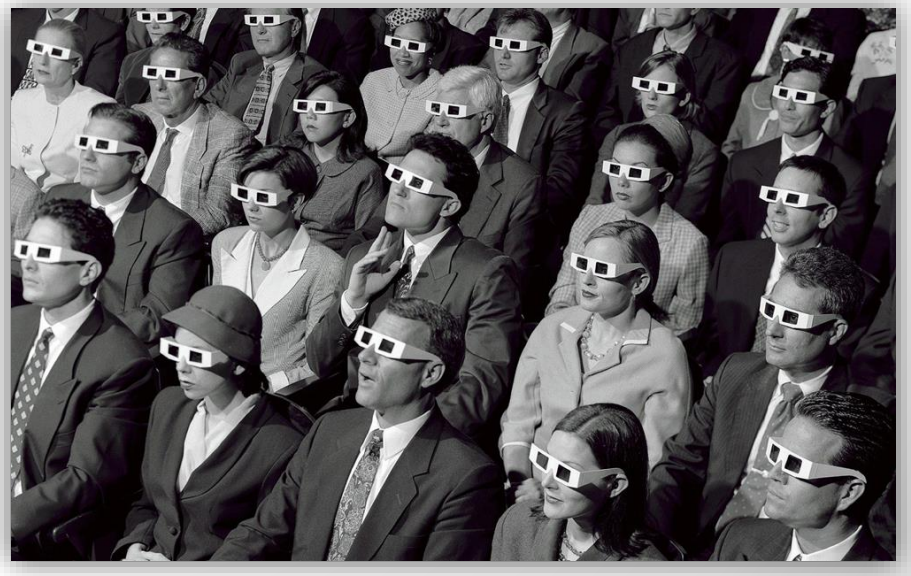


What does the future hold?

- Several TAC comments and other new business to review for next revision
  - Debate if Internal Curing is incorporated in Guide
  - Rework organization of Introduction chapter
  - Review new technologies for possible inclusion
    - Drip-ring fans
  - Work with ACI 310 on techniques and new research to cure Decorative Concrete
  - New diagrams and guidance
    - How much to overlap sheeting?
    - Measuring diagram to use evaporation rate nomograpgh

Audience Participation!

- Curing Committee has discussed developing TechNotes for Curing
  - Narrowly focused, single topic guide, typically practice oriented with pictures, figures, etc
- Residential Curing?
- Other curing?
- Something else?
- Your thoughts?



Let's wrap this thing up!

- ACI 308 has three documents currently
  - Specification for Curing Concrete
  - Guide to Curing Concrete
  - Report on Internally Cured Concrete
- Guide should be out this year!
- Internal Curing Report is published
- Guide tweaked it's name
- Elevated curing temperature better addressed throughout document

Let's wrap this thing up!

- Final curing discussion enhanced
- New section covering moisture sensitive flooring
- More guidance for Mass concrete
  - Sensor locations
  - Reducing thermal shock
- ACI has an iPhone app for evaporation!
- More guidance on curing meters and curing compound evaluation
- Lots of new business for next revision!