The Reorganized ACI 318-14 Code: Benefits, Rationale and Availability

318-14

The Reorganized ACI 318-14 Code
Benefits, Rationale and Availability

ACI Committee 318
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American Concrete Institute
Always advancing

318-11 vs. 318-14

by
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Overview of Presentation

- A brief history of ACI 318
- The rationale for reorganization
- How 318-14 is organized
- 318-14 style
- Available resources and process timetable

History

- Founded in 1904
- HQ in Farmington Hills, Michigan, USA
History

• 1910 – first code published: “Standard Building Regulations for the Use of Reinforced Concrete”

• Structural provisions assumed a working stress limit through 1956

• “Ultimate Strength” approach firmly established in 1971 edition.

• ACI 318 organization based on behavior of cast-in-place reinforced concrete
Significant changes (since 1971)

• Development lengths
• Torsional strength
• Seismic design and detailing
• Integrity reinforcement
• Concrete exposure classes
• Strain-based strength reduction factors
• Anchoring to concrete

History

• 1971 Code had 750 provisions
• 2011 Code has more than 2,500 provisions

ACI 318-11 compared to ACI 318-71
Overview of Presentation

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318 Organization Since 1971

- Chapters 7 – 12 are central to organization
  - Analysis
  - Serviceability (Deflections, Crack Control, etc.)
  - Strength (Flexure, Shear, etc.)
  - Related Reinforcement Details

ACI 318-11 Organization

- Shear Strength, Chapter 11
- Flexural and Axial Strength, Chapter 10
- Strength Reduction Factors, \( \phi \), Chapter 9
- Lap Splice, 12.15-12.17
- Ties in Joint, 11.10.2
- Slope, 7.8.1.1
- Ties, 7.10.5
- Cover, 7.7

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**318-11 Organization (since 1971)**

- Specialty Chapters
  - Two-way Slabs (Ch 13)
  - Footings (Ch 15)
  - Precast (Ch 16)
  - Prestressed (Ch 18)
  - Seismic (Ch 21)

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**Need to find a tool?**
ACI 318-14 Reorganization Process

- 2003: committee began discussion
- 2006: surveyed users, held focus groups / workshops
  - Engineers want all related information for a member’s design and detailing easily located
  - Engineers want the code to be configured parallel to how they design members
- 2007: outline developed
- 2008: committee approved effort

Major goals of reorganizing 318

- Find the information you need quickly
- Increase certainty that a design fully meets the Code
- “Clean the Garage!”
And so the reorganization began…

Need to find a tool?
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What does 318-14 look like?
ACI 318-14 Organization

General Chapters
- General – Scope, Application, Interpretation
- Notation and Terminology
- Referenced Standards
- Concrete Design Properties
- Steel Design Properties
ACI 318-14 Organization

- General
- Systems
- Members
- Joints and Connections
- Toolbox
- Construction

ACI 318-14 Organization

System Chapters

- Structural Systems (new)
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ACI 318-14 Organization

System Chapters

- Structural Systems (new)
- Loads and Load Combinations
- Structural Analysis
- Earthquake Resistant Structures

ACI 318-14 Organization

- General
- Systems
- **Members**
- Joints and Connections
- Toolbox
- Construction
ACI 318-14 Organization

Members Chapters

- One-Way Slabs
- Two-Way Slabs
- Beams
- Columns
- Walls
- Diaphragms (new)
- Foundations
- Plain Concrete Members

Example: Chapter 10 – Columns

10.1 Scope
10.2 General
10.3 Design Limits
10.4 Required Strength
10.5 Design Strength
10.6 Reinforcement Limits
10.7 Reinforcement Detailing
### ACI 318-14 Organization

#### Example:

<table>
<thead>
<tr>
<th>Chapter 10 – Columns</th>
<th>Chapter 9 – Beams</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1 Scope</td>
<td>9.1 Scope</td>
</tr>
<tr>
<td>10.2 General</td>
<td>9.2 General</td>
</tr>
<tr>
<td>10.3 Design Limits</td>
<td>9.3 Design Limits</td>
</tr>
<tr>
<td>10.4 Required Strength</td>
<td>9.4 Required Strength</td>
</tr>
<tr>
<td>10.5 Design Strength</td>
<td>9.5 Design Strength</td>
</tr>
<tr>
<td>10.6 Reinforcement Limits</td>
<td>9.6 Reinforcement Limits</td>
</tr>
<tr>
<td>10.7 Reinforcement Detailing</td>
<td>9.7 Reinforcement Detailing</td>
</tr>
</tbody>
</table>

### ACI 318-11 Organization

- Shear Strength, [Chapter 11](#)
- Flexural and Axial Strength, [Chapter 10](#)
- Strength Reduction Factors, $\phi$, [Chapter 9](#)
- Lap Splice, 12.15-12.17
- Ties in Joint, 11.10.2
- Slope, 7.8.1.1
- Ties, 7.10.5
- Cover, 7.7
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ACI 318-14 Organization

- General
- Systems
- Members
- Joints and Connections
- Toolbox
- Construction

Shear Strength, 10.5.3
Flexural and Axial Strength, 10.5.2
Strength Reduction Factors, \( \phi \), 10.5.1
Lap Splice, 10.7.5
Ties in Joint, 10.2.2
Slope, 10.7.4
Ties, 10.7.6.1
Cover, 10.7.1

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ACI 318-14 Organization

Joints / Connections

- Beam-column and slab-column joints
- Connections between members
- Anchoring to concrete

ACI 318-14 Organization

- General
- Systems
- Members
- Joints and Connections
- Toolbox
- Construction
ACI 318-14 Organization

Toolbox Chapters

- Strength Reduction Factors
- Sectional Strength
- Strut-and-Tie
- Serviceability
- Reinforcement Details

ACI 318-14 Organization

Member Chapter

9.5 — Design strength
9.5.2 — Moment
9.5.2.1 — If $P_u < 0.10f'cA_g$, $\phi M_n$ shall be calculated in accordance with 22.3.
If $P_u \geq 0.10f'cA_g$, $\phi M_n$ shall be calculated in accordance with 22.4.

Toolbox Chapter

22.3 — Moment strength...
22.4 — Axial strength or combined moment and axial strength...
ACI 318-14 Organization

• General
• Systems
• Members
• Joints and Connections
• Toolbox
• Construction

Chapter 26 – CONSTRUCTION DOCUMENTS AND INSPECTION

• 318 is written to the engineer, not the contractor.
• Construction requirements must be communicated on the construction documents.
• In 318-11, construction requirements are often located with the design requirement.
• In 318-14, all construction requirements are gathered together in Chapter 26.
**ACI 318-11 Language**

**21.9.9 — Construction joints**
All construction joints in structural walls shall conform to 6.4 and contact surfaces shall be roughened as in 11.6.9.

**6.4.3 — Construction joints shall be so made and located as not to impair the strength of the structure. Provision shall be made for transfer of shear and other forces through construction joints. See 11.6.9.**

**11.6.9 — When concrete is placed against previously hardened concrete, the interface for shear transfer shall be clean and free of laitance. If \( \mu \) is assumed equal to 1.0, \( \lambda \), interface shall be roughened to a full amplitude of approximately 1/4 in.**

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**ACI 318-14 Language**

(draft) **26.4.7 – Joints in concrete**

**26.4.7.1 – Design information:**

(a) Locations and details of construction, isolation and contraction joints if required by the design.

(b) Provisions required for transfer of shear and other forces through construction joints.

(c) Surface preparation requirements including intentional roughening.
Overview of Presentation

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ACI 318-11 Style

7.6.7.1—Center-to-center spacing of pretensioning tendons at each end of a member shall be not less than 4$d_b$ for strands, or 5$d_b$ for wire, except that if specified compressive strength of concrete at time of initial prestress, $f_{ci}'$, is 4000 psi or more, minimum center-to-center spacing of strands shall be 1-3/4 in. for strands of 1/2 in. nominal diameter or smaller and 2 in. for strands of 0.6 in. nominal diameter. See also 3.3.2.
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**ACI 318-14 Style**

Same requirements in a table

<table>
<thead>
<tr>
<th>$f_{c''}$, psi</th>
<th>Nominal strand diameter in.</th>
<th>Minimum $s$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&lt; 4000$</td>
<td>All</td>
<td>$4d_p$</td>
</tr>
<tr>
<td>$\geq 4000$</td>
<td>$\leq 0.5$ in.</td>
<td>1-3/4 in.</td>
</tr>
<tr>
<td></td>
<td>0.6 in.</td>
<td>2 in.</td>
</tr>
</tbody>
</table>

Table 25.2.4 — Minimum center-to-center spacing of pretensioned strands at ends of members

**ACI 318-11 Style**

Chapter 18 – Prestressed Concrete

18.1.2 — All provisions of this Code not specifically excluded, and not in conflict with provisions of Chapter 18, shall apply to prestressed concrete.

18.1.3 — The following provisions of this Code shall not apply to prestressed concrete, except as specifically noted: Sections 6.4.4, 7.6.5, 8.12.2, 8.12.3, 8.12.4, 8.13, 10.5, 10.6, 10.9.1, and 10.9.2; Chapter 13; and Sections 14.3, 14.5, and 14.6, except that certain sections of 10.6 apply as noted in 18.4.4.
ACI 318-14 Style

- **9.6 — Reinforcement limits**
  - 9.6.1 — Minimum flexural reinforcement in nonprestressed beams
  - 9.6.2 — Minimum flexural reinforcement in prestressed beams

- **9.7 — Reinforcement detailing**
  - 9.7.3 — Flexural reinforcement in nonprestressed beams
  - 9.7.4 — Flexural reinforcement in prestressed beams

Benefits of ACI 318-14

- Organized from a designer's perspective
- Easier to find specific requirements
- Intuitive location of information
- Reduced cross references
Benefits of ACI 318-14

- Tables improve speed of understanding
- Consistent language in text
- Single idea for each requirement

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Schedule to Publication

- Committee work ended October 2013
- Internal ACI review late fall 2013
- Public comment period spring 2014
- Committee response summer 2014
- Publication fall 2014

Publication

- ACI 318-14 will be published in:
  - English
  - Spanish
  - Chinese

- ACI 318-14 will be published in:
  - US Customary units
  - SI units

- It will be available in an variety of formats, including:
  - Printed copy
  - Enhanced PDF
  - EPUB, MOBI
Additional Resources

- Transition key – maps:
  - ACI 318-11 to ACI 318-14
  - ACI 318-14 to ACI 318-11
- ACI Reinforced Concrete Design Manual will be consistent with 318-14
- Online learning
- In-person seminars

How To Get Involved:

- [www.concrete.org/ACI318](http://www.concrete.org/ACI318) for more information
- Review 318-14 during public discussion period
- Join the conversation on Twitter by using #ACI318 and #ConcreteCode
- [www.facebook.com/AmericanConcreteInstitute](http://www.facebook.com/AmericanConcreteInstitute)
Heruclean Effort:

- 96,000 man-hours
- 46 man-years
- Over $14 million in volunteer time

Thank You!

Provide us with your feedback. Please complete and submit your survey.

The American Institute of Architects has approved this session for 1 AIA/CES LU Learning Unit. Sign-in sheet located at registration.
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Learning Objectives

1. Provide a general overview of ACI 318-14

2. Highlight the organization of information within each member chapter of 318-14

3. Identify the benefits of the newly reorganized ACI 318-14 Code

4. Provide examples of additional information ACI will make available to assist in the transition to the new code
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Questions?

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