



5 - 8 DECEMBER 2022
DUBAI WORLD TRADE CENTRE

ACI 318 PLUS & ACI 318 Certification

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Concrete Talks/December 6, 2022/ACI 318 PLUS & Certification



ACI 318 PLUS

- Needs
- Features
- Product demonstration
- Access
- Future

The screenshot displays the ACI 318 PLUS web application. The interface includes a search bar, a sidebar with a table of contents, and the main content area showing the title page of the ACI 318-19 Building Code Requirements for Structural Concrete and its Commentary. The title page features the ACI logo, the title 'ACI 318-19 Building Code Requirements for Structural Concrete and Commentary', and the text 'An ACI Standard', 'Building Code Requirements for Structural Concrete (ACI 318-19)', 'Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19)', and 'Reported by ACI Committee 318'. The sidebar on the left lists the chapters of the standard, from Chapter 1: General to Chapter 22: Sectional Strength, and includes a section for 'Provisions for Other and Non-Standard'.

ACI 318 PLUS

Keyword Search

SEARCH

Advanced Search

Notes

MANAGE NOTES

SELECT USER NOTES

ACI 318-19 Building Code Requirements for Structural Concrete and Commentary

An ACI Standard

Building Code Requirements for Structural Concrete (ACI 318-19)

Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19)

Reported by ACI Committee 318

ACI 318-19

Provisions for Other and Non-Standard

Needs



Needs

- ACI Knowledge

 - Committee documents

 - Symposium publications

 - Periodicals

 - Non-print

- ACI 318

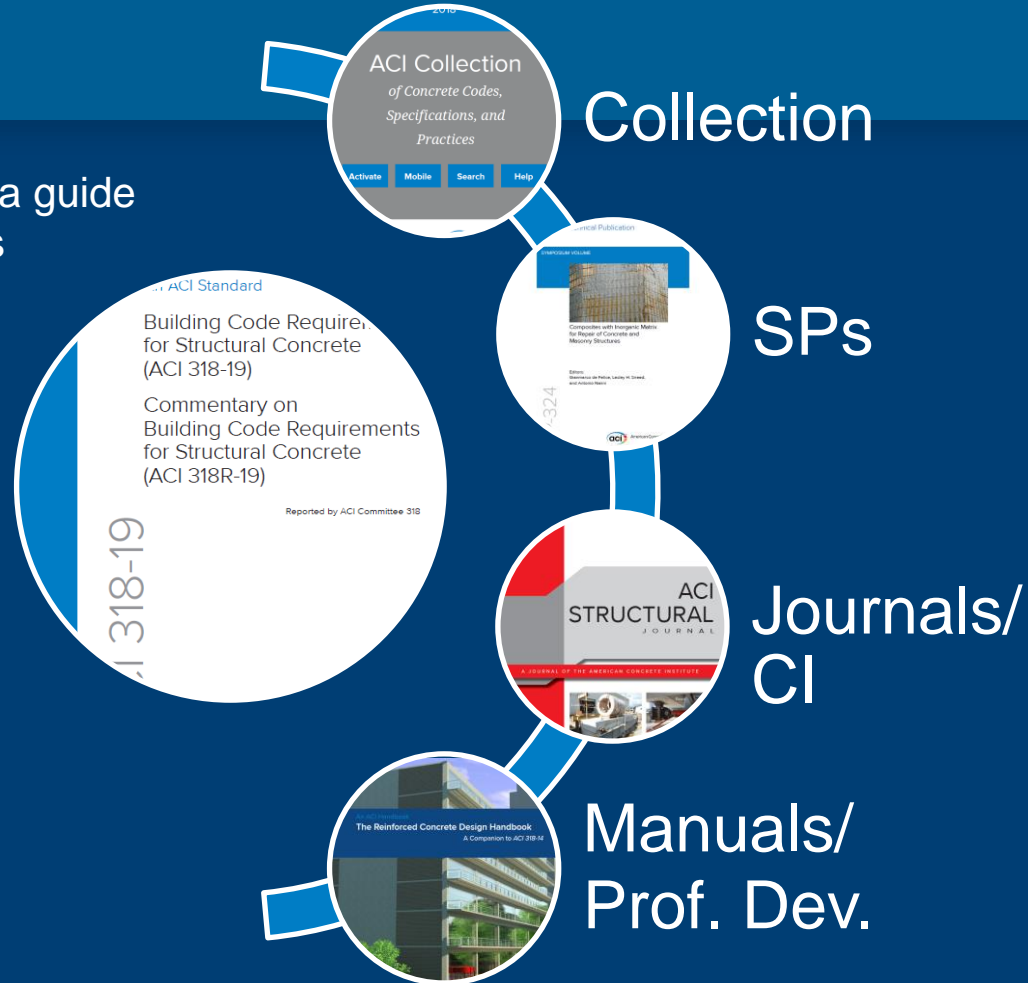
 - Most well-known document

 - Terse, mandatory language

 - Other documents?

ACI PLUS Platform

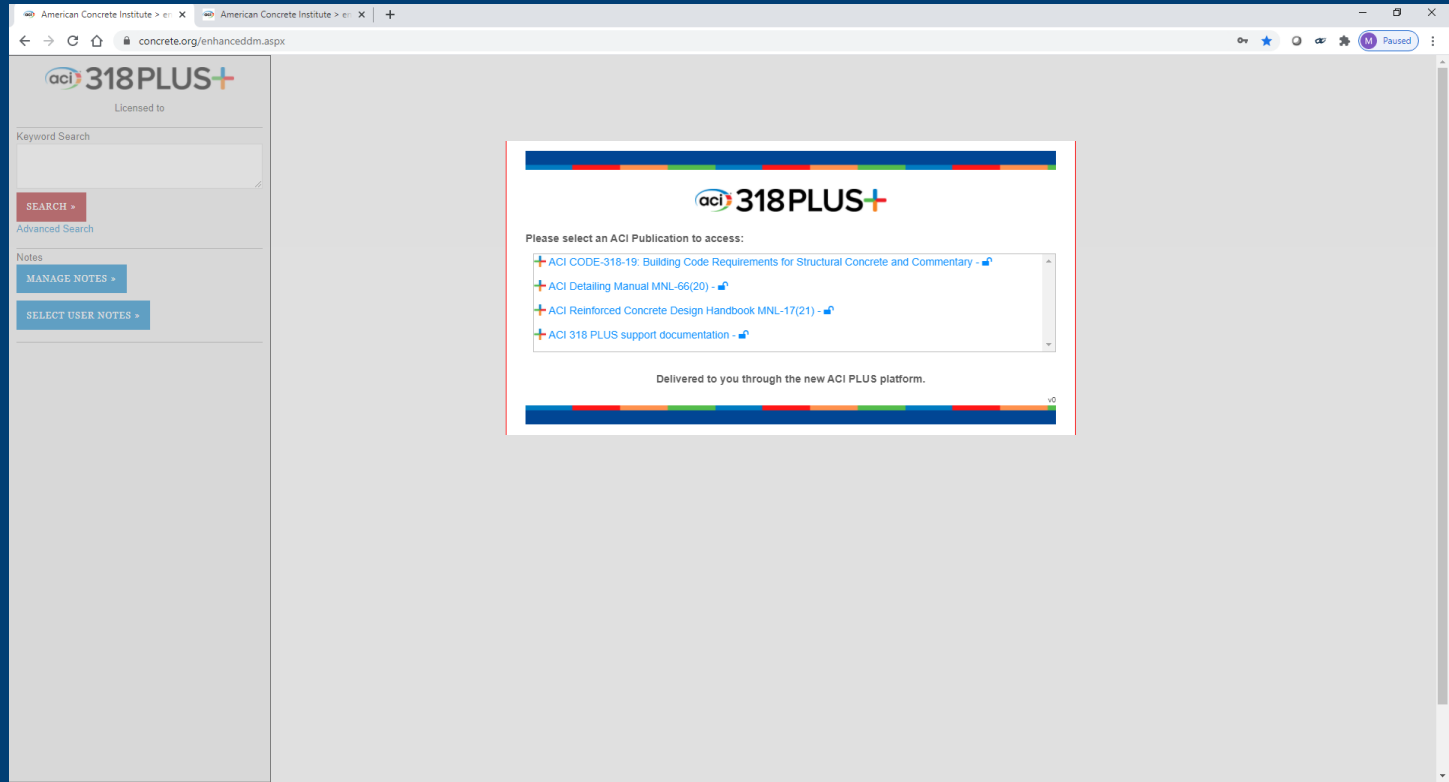
- Use ACI 318 as a guide to ACI resources



Features

- Web-based
- Connections
- User Notes
- Search
- 3-D Graphics
- More

Startup



Product Demonstration

The screenshot displays the ACI 318PLUS+ web application. The browser address bar shows the URL `concrete.org/enhancedddm.aspx?EDocumentKey=318.19`. The application header includes the ACI 318PLUS+ logo and a license notice: "Licensed to Dr Michael L Tholen exp: 12/31/2021". A sidebar on the left contains a "Keyword Search" field with a "SEARCH" button, an "Advanced Search" link, and "Notes" management buttons. A detailed table of contents is also visible in the sidebar, listing chapters from Frontmatter to Chapter 23. The main content area features the title "ACI 318-19: Building Code Requirements for Structural Concrete and Commentary" in a blue header. Below this, a unit selector shows "IN-LB" (Inch-Pound Units) is active. The title "An ACI Standard" is displayed in blue. The main title "Building Code Requirements for Structural Concrete (ACI 318-19)" is followed by the subtitle "Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19)". At the bottom right, it states "Reported by ACI Committee 318". A large, vertical "ACI 318-19" watermark is positioned on the left side of the main content area.

ACI 318PLUS+

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Keyword Search

SEARCH

Advanced Search

Notes

MANAGE NOTES

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ACI 318-19: Building Code Requirements for Structural Concrete and Commentary

IN-LB Inch-Pound Units

An ACI Standard

Building Code Requirements for Structural Concrete (ACI 318-19)

Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19)

Reported by ACI Committee 318

ACI 318-19

Navigation

The screenshot displays the ACI 318PLUS web application interface. The browser address bar shows the URL: `concrete.org/enhanceddm.aspx?EDocumentKey=318.19`. The page title is "ACI 318-19: Building Code Requirements for Structural Concrete and Commentary".

On the left side, there is a sidebar with the following elements:

- ACI 318PLUS+ logo
- Licensed to Dr Michael L Tholen exp: 12/31/2021
- Keyword Search input field
- SEARCH button
- Advanced Search link
- Notes section with MANAGE NOTES and SELECT USER NOTES buttons
- Navigation menu listing chapters from 1 to 23.

A red arrow points from the "Chapter 1 - General" item in the sidebar to a detailed list of chapters displayed in a central panel. This panel lists the following chapters:

- Chapter 1 - General
 - 1.1 - Scope of ACI 318
 - 1.2 - General
 - 1.2.1
 - 1.2.2
 - 1.2.3
 - 1.2.4
 - 1.2.5
 - 1.2.6
 - 1.2.7
 - 1.3 - Purpose
 - 1.4 - Applicability
 - 1.5 - Interpretation
 - 1.6 - Building official
 - 1.7 - Licensed design professional
 - 1.8 - Construction documents and design records
 - 1.9 - Testing and inspection
 - 1.10 - Approval of special systems of design, construction, or alternative construction materials
- Chapter 2 - Notation and Terminology
- Chapter 3 - Referenced Standards

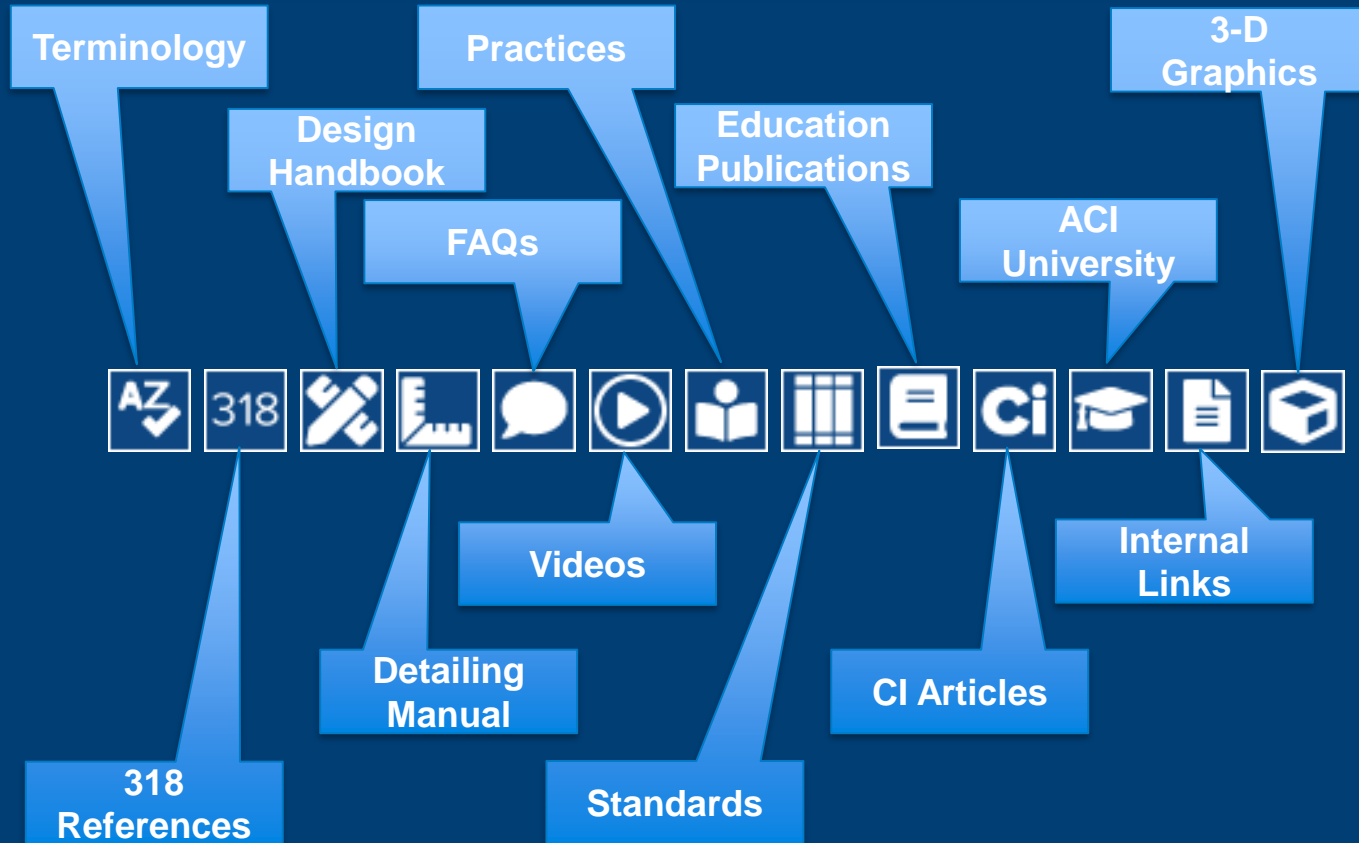
The main content area on the right shows the title "ACI 318-19: Building Code Requirements for Structural Concrete and Commentary" and a unit selection dropdown set to "IN-LB" (Inch-Pound Units). Below the title, the text "An ACI Standard" is visible. The bottom of the page indicates it is "Reported by ACI Committee 318".

Search

The image shows a web browser window displaying the ACI 318PLUS search interface. A red box highlights a search modal that is open over the main content. The modal has a title bar "Keyword Search" and a search input field containing the text "wobble". Below the input field are two buttons: "SEARCH >" and "NEW SEARCH >". Underneath these buttons are search filters: "Advanced Search" with checkboxes for "Document" (checked) and "Active Note Set" (checked), and radio buttons for "All Words" (selected) and "This Phrase". The search results within the modal show two entries: one for "9.6.3.1...for nonprestressed beams, minimum area of shear reinforcement, a_v , min, shall be provided in all regi..." and another for "20.3.2.6.2...calculated friction loss in post-tensioning tendons shall be based on experimentally determined wobb...". At the bottom of the modal, it says "Page 1 of 1" and "Results Per Page 5" with a dropdown arrow.

The background shows the ACI 318PLUS website. The left sidebar contains a navigation menu with sections like "Frontmatter", "Chapter 1 - General", "Chapter 2 - Notation and Terminology", "Chapter 3 - Referenced Standards", "Chapter 4 - Structural System Requirements", "Chapter 5 - Loads", "Chapter 6 - Structural Analysis", "Chapter 7 - One-Way Slabs", "Chapter 8 - Two-Way Slabs", "Chapter 9 - Beams", "Chapter 10 - Columns", "Chapter 11 - Walls", "Chapter 12 - Diaphragms", "Chapter 13 - Foundations", "Chapter 14 - Plain Concrete", "Chapter 15 - Beam-Column and Slab-Column Joints", "Chapter 16 - Connections Between Members", "Chapter 17 - Anchoring to Concrete", "Chapter 18 - Earthquake-Resistant Structures", "Chapter 19 - Concrete: Design and Durability Requirements", "Chapter 20 - Steel Reinforcement Properties, Durability, and Embedments", "Chapter 21 - Strength Reduction Factors", "Chapter 22 - Sectional Strength", and "Chapter 23 - Shear and Torsion". The main content area shows "Chapter 9" and "Section 9.1 - Shear". A red arrow points from the "SEARCH >" button in the sidebar to the search modal. A red circle highlights a small square icon in the right sidebar.

Resources / Links



Resources / Links

Terminology



318
References

Terminology

American Concrete Institute > > > American Concrete Institute > > > concrete.org/enhanceddm.aspx?EDocumentKey=318.19#P6252

ACI 318PLUS+

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Keyword Search

SEARCH >

Advanced Search

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ACI 318-19: Building Code Requirements for Structural Concrete and Commentary

Frontmatter

Chapter 1 - General

Chapter 2 - Notation and Terminology

Chapter 3 - Referenced Standards

Chapter 4 - Structural System Requirements

Chapter 5 - Loads

Chapter 6 - Structural Analysis

Chapter 7 - One-Way Slabs

Chapter 8 - Two-Way Slabs

Chapter 9 - Beams

Chapter 10 - Columns

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Chapter 15 - Beam-Column and Slab-Column Joints

Chapter 16 - Connections Between Members

Chapter 17 - Anchoring to Concrete

Chapter 18 - Earthquake-Resistant Structures

Chapter 19 - Concrete: Design and Durability Requirements

Chapter 20 - Steel Reinforcement Properties, Durability, and Embedments

Chapter 21 - Strength Reduction Factors

Chapter 22 - Sectional Strength

Chapter 23 - Reinforced-Tie Method

ACI 318-19: Building Code Requirements for Structural Concrete and Commentary

Chapter: 25 Reinforcement Details Section: 25.4 Development of reinforcement Provision: 25.4.2.1

Terminology references

- ♦ c_b : lesser of: (a) the distance from center of a bar or wire to nearest concrete surface, and (b) one-half the center-to-center spacing of bars or wires being developed, in.
- ♦ **concrete**: mixture of portland cement or any other cementitious material, fine aggregate, coarse aggregate, and water, with or without admixtures.
- ♦ d_b : nominal diameter of bar, wire, or prestressing strand, in.
- ♦ **development length**: length of embedded reinforcement, including pretensioned strand, required to develop the design strength of reinforcement at a critical section.
- ♦ f_c' : specified compressive strength of concrete, psi
- ♦ K_{tr} : transverse reinforcement index, in.
- ♦ ℓ_d : development length in tension of deformed bar, deformed wire, plain and deformed welded wire reinforcement, or pretensioned strand, in.
- ♦ **reinforcement**: steel element or elements embedded in concrete and conforming to 20.2 through 20.4. Prestressed reinforcement in external tendons is also considered reinforcement.

25.4.1.4

R25.4.1.4

The values of $\sqrt{f_c'}$ used to calculate ℓ_d shall not exceed 100 psi.

25.4.2

Development of deformed bars and wires

25.4.2.1

Development length ℓ_d for deformed bars and wires in tension shall be the greater of (a) and (b).

(a) Length calculated in accordance with applicable modification factors of 25.4.2.2.

(b) 12 in.

25.4.2.2

Modification factors for development length

25.4.2.2.1

For bars and wires in concrete with very high compressive strength, brittle anchorage failure may occur for bars with inadequate transverse reinforcement. In lap splice tests of No. 8 and No. 11 bars in concrete with an f_c' of approximately 15,000 psi, transverse reinforcement improved ductile anchorage behavior.

318 References

ACI STRUCTURAL JOURNAL
Title no. 93-S32

Development Length Criteria for Relative Rib Area Reinforcing Bars

by David Darwin, Jun Zuo, Michael L. Tholen, and Emmanuel K. Idun

Statistical analyses of 153 splice and development specimens in which the bars are not confined by transverse reinforcement and 166 specimens in which the bars are confined by transverse reinforcement are used to develop an expression for the bond force at failure as a function of concrete strength, cover, bar spacing, development/splice length, transverse reinforcement, and the geometric properties of the developed/spliced bar. Results are used to formulate design criteria that incorporate a reliability-based strength reduction (ϕ) factor that allows the calculation of a single value for both development and splice length for given material properties and member geometry.

As with earlier studies, the analyses demonstrate that the relationship between bond force and development or splice length is linear but not proportional. Thus, to increase the bond force (or bar stress) by a given percentage requires more than the percentage increase in $f_c f_y^{1/2}$ does not provide an accurate representation of the effect of concrete strength on bond strength over the full range of concrete strengths in use today; development/splice strength is underestimated for low-strength concrete and overestimated for high-strength concrete. $f_c f_y^{1/2}$ provides an accurate representation of the effect of concrete strength on bond strength for concrete with compressive strengths between 2500 and 16,000 psi (17 and 110 MPa). The most accurate representation of the effect of transverse reinforcement on bond strength obtained in the current analysis includes parameters that account for the number of transverse reinforcing bars that cross the development/spliced bar, the area of the transverse reinforcement, the number of

The provisions in Chapter 12 of the 1995 ACI Building Code (ACI 318-95) will make the design process easier and reflect development and splice strength better than any previous code procedures. The new expressions are based, in part, on a statistical analysis carried out over 20 years ago (Orangun, Jirsa, and Breen 1975) and on recommendations based on that analysis provided by ACI Committee 408 (1990). As with previous versions of the ACI Code, the calculated development/splice lengths are proportional to the bar stress (the actual relationship is linear but not proportional), and most splice lengths are 30 percent greater than the corresponding development lengths.

Over the past 20 years, additional data has become available, and analyses of the expanded database (presented in this paper) have exposed a number of shortcomings in the ability of both the code expressions and the original statistically-based expressions to accurately represent the development and splice strength of reinforcing bars, as used in current practice. Specifically, the analyses demonstrate that the square root of the concrete compressive strength f_c does

sufficiently accurate for values of $\sqrt{f_c}$ up to 100 psi, and because of the long-standing use of the $\sqrt{f_c}$ in design, ACI Committee 318 has chosen not to change the exponent applied to the compressive strength used to calculate development and lap splice lengths, but rather to set an upper limit of 100 psi on $\sqrt{f_c}$.

318 References links

ACI 318-19: Building Code Requirements for Structural Concrete and Commentary
Chapter: 25 Reinforcement Details Section: 25.4 Development of reinforcement Provision: 25.4.1.4

[Darwin et al. 1996: General reference for deformed bar development and lap splice length requirements for high strength and normal strength concrete, 32 pp.](#)

R25.4.2

Development of deformed bars and deformed wires in tension

R25.4.2.1

This provision gives a two-tier approach for the calculation of tension development length. The user can either use the simplified provisions of 25.4.2.3 or the general development length equation (Eq. (25.4.2.4a)), which is based on the expression previously endorsed by ACI 408.1R. In Table 25.4.2.3, d_d is based on two preselected values of $(c_b + K_{tr})/d_b$, whereas d_d from Eq. (25.4.2.4a) is based on the actual $(c_b + K_{tr})/d_b$.

Although there is no requirement for transverse reinforcement along the tension development or lap splice length, research (Azizinamini et al. 1999a,b) indicates that in concrete with very high compressive strength, brittle anchorage failure may occur for bars with inadequate transverse reinforcement. In lap splice tests of No. 8 and No. 11 bars in concrete with an f_c of approximately 15,000 psi, transverse reinforcement improved ductile anchorage behavior.

Chapter 18 - Earthquake-Resistant Structures
Chapter 19 - Concrete: Design and Durability Requirements
Chapter 20 - Steel Reinforcement Properties, Durability, and Embedments
Chapter 21 - Strength Reduction Factors
Chapter 22 - Sectional Strength
Chapter 23 - Shear and Torsion

25.4.2.2

Resources / Links



Design Handbook (MNL-17)

American Concrete Institute > X American Concrete Institute > X

concrete.org/enhanceddm.aspx?EDocumentKey=MNL-17(21)

ACI Reinforced Concrete Design Handbook MNL-17(21)

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ACI Reinforced Concrete Design Handbook MNL-17(21)

- (X) Frontmatter
- (X) Chapter 1 - INTRODUCTION
- (X) Chapter 2 - STRUCTURAL SYSTEMS
- (X) Chapter 3 - STRUCTURAL ANALYSIS
- (X) Chapter 4 - DURABILITY
- (X) Chapter 5 - ONE-WAY SLABS
- (X) Chapter 6 - TWO-WAY SLABS
- (X) Chapter 7 - BEAMS
- (X) Chapter 8 - DIAPHRAGMS
- (X) Chapter 9 - COLLUMS
- (X) Chapter 10 - STRUCTURAL REINFORCED CONCRETE WALLS
- (X) Chapter 11 - FOUNDATIONS
- (X) Chapter 12 - RETAINING WALLS
- (X) Chapter 13 - SERVICEABILITY
- (X) Chapter 14 - STRUT-AND-TIE METHOD
- (X) Chapter 15 - ANCHORING TO CONCRETE
- (X) Backmatter

Chapter 7 - BEAMS

Section 7.1 - Introduction

Structural beams resist gravity and lateral loads, and any combination thereof, and transfer these loads to girders, columns, or walls. Code Chapter 9 applies to both nonprestressed and prestressed beams as well as composite beams. Composite beams are composed of elements constructed in separate placements that are connected such that they act as a single unit. Special provisions are included in the chapter covering one-way joists (Section 9.8) and deep beams (Section 9.9). Deep beams are also addressed in Code Chapter 23, Strut-and-Tie Method.

Beams are designed in accordance with Code Chapter 9 for strength and serviceability. Beams are assumed to be approximately horizontal, with rectangular or T-shaped (a stem and a flange) cross sections. The flange width of T-shaped beams is geometrically limited by Code Sections 6.3.2 for flexure and 9.2.4.4 for torsion, respectively. The flange is assumed to contribute to the beam's flexural and torsional strength.

Beams, either nonprestressed or prestressed, that are monolithic with the floor framing, can be considered laterally braced. For beams that are not monolithic with the floor, Code Section 9.2.5.1 provides guidance on the spacing of lateral bracing.

For cast-in-place construction, connections to other members is covered in Code Chapter 15 and for precast members connections are covered in Code Section 16.2.

Section 7.2 - Service limits

7.2.1 - BEAM DEPTH

The engineer determines the beam's concrete strength, steel strength, and other material characteristics to achieve the design performance criteria for strength and service life.

After defining the material properties and the beam's design loads, the engineer chooses the beam's dimensions. These are either provided by architectural constraints, attained from experience, or reached by assuming a depth and width and then adjusting iteratively until the beam design meets the designated constraints. Beam depth is addressed in Code Table 9.3.1.1, which applies if a beam is nonprestressed, not supporting concentrated loads along its span, and not supporting or attached to partitions that may be damaged by deflections.

For prestressed beams, the Code does not provide a minimum span-to-depth ratio, but rather requires that both immediate and time-dependent deflections be calculated in accordance with Code Section 24.2 and checked against the limits in Code Section 24.2.2. For a superimposed live load in the range of 60 to 80 lb/ft², a usual span-to-depth ratio is in the range of 20 to 30. Table 9.3 of The Post-Tensioning Manual (Post-Tensioning Institute [PTI] 2006) lists span-to-depth ratios for different members that have been found from experience to provide satisfactory structural performance.

The slab thickness is considered as part of the overall beam depth if the beam and slab are monolithic or if the slab is composite with the beam in accordance with Code Chapter 16.

concrete.org/enhanceddm.aspx?EDocumentKey=MYC-17(21)ENKPG3G

ACI Reinforced Concrete Design Handbook MNL-17(21)

STEP 6 - SHEAR DESIGN

Step 6: Shear design

Exterior spans

9.5.1.1 Shear strength
 $\phi V_n \geq V_u$

9.5.3.1 $V_n = V_c + V_s$

22.5.1.1

9.4.3.2 Because conditions (a), (b), and (c) of Section 9.4.3.2 are satisfied, the design shear force is taken at critical section at distance d from the face of the support (Fig. E1.6).

22.5.5.1 2019 Code introduced size effect for shear design in which the shear strength of an element that does not contain shear reinforcement is not directly proportional to its depth. This effect is addressed by incorporating a size effect factor k_{sz} into the concrete contribution equation. If shear reinforcement is not present, then the concrete contribution to shear strength must be reduced by the size effect factor. If minimum shear reinforcement is provided, then Eq. (22.5.5.1a) can be used to calculate V_c .

Minimum shear reinforcement is required where $V_u > \phi k_{sz} \sqrt{f'_c b_o d}$

For this example, use minimum shear reinforcement over entire length of beam. The concrete contribution to shear strength is then:
 $V_c = 2\sqrt{f'_c b_o d}$ (22.5.5.1a)

21.2.1b Shear strength reduction factor:

9.5.1.1 Check if $\phi V_c \geq V_u$

Prior to calculating shear reinforcement, check if the cross-sectional dimensions satisfy Eq. (22.5.1.2):

22.5.1.2 $V_u \leq \phi(V_c + 8\sqrt{f'_c b_o d})$

21.2.1b $\phi = 0.75$

Fig. E1.6—Shear at the critical section.

V_u , $V_u @ d$, d , $l_n/2$

$V_{u@ d} = (72 \text{ kip}) - (3.7 \text{ kip/ft})(27.5 \text{ in./12}) = 63.5 \text{ kip}$

$V_c = 2\sqrt{5000 \text{ psi}(18 \text{ in.})(27.5 \text{ in.})}/1000 = 70 \text{ kip}$

$\phi_{bswp} = 0.75$
 $\phi V_c = (0.75)(70 \text{ kip}) = 52.5 \text{ kip}$

$\phi V_c = 52.5 \text{ kip} < V_{u@ d} = 63.5 \text{ kip}$ NG
Therefore, shear reinforcement is required.

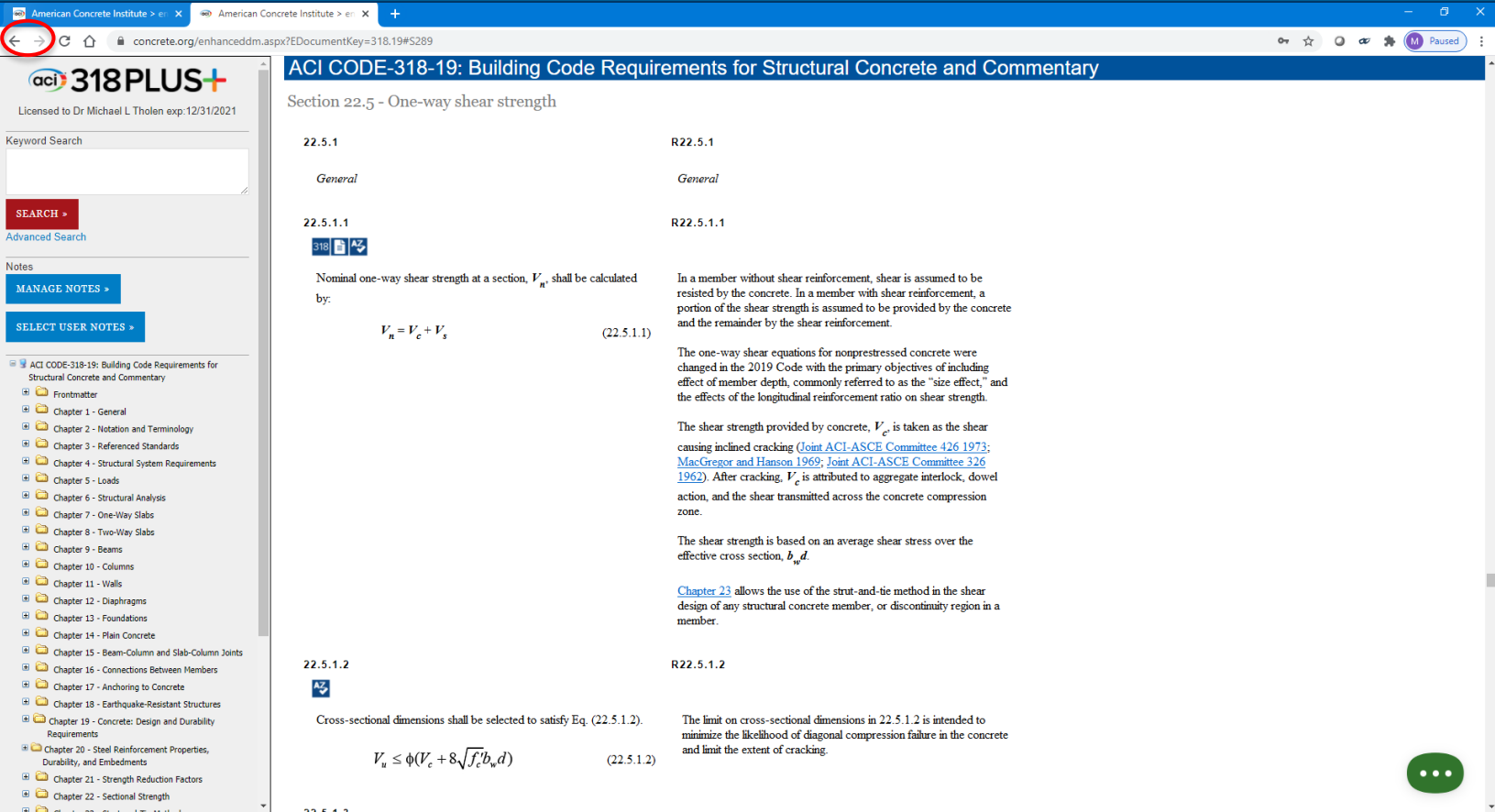
$V_u \leq \left(70 \text{ kip} + \frac{8\sqrt{5000 \text{ psi}(18 \text{ in.})(27.5 \text{ in.})}}{1000 \text{ lb/kip}} \right)$

Resources / Links



Internal
Links

Internal Links



American Concrete Institute > en: x American Concrete Institute > en: x +

concrete.org/enhanceddm.aspx?EDocumentKey=318.19#S289

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ACI CODE-318-19: Building Code Requirements for Structural Concrete and Commentary

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- Chapter 23 - Strut-and-Tie Method

ACI CODE-318-19: Building Code Requirements for Structural Concrete and Commentary

Section 22.5 - One-way shear strength

22.5.1

General

22.5.1.1

Nominal one-way shear strength at a section, V_n , shall be calculated by:

$$V_n = V_c + V_s \quad (22.5.1.1)$$

In a member without shear reinforcement, shear is assumed to be resisted by the concrete. In a member with shear reinforcement, a portion of the shear strength is assumed to be provided by the concrete and the remainder by the shear reinforcement.

The one-way shear equations for nonprestressed concrete were changed in the 2019 Code with the primary objectives of including effect of member depth, commonly referred to as the "size effect," and the effects of the longitudinal reinforcement ratio on shear strength.

The shear strength provided by concrete, V_c , is taken as the shear causing inclined cracking ([Joint ACI-ASCE Committee 426 1973](#); [MacGregor and Hanson 1969](#); [Joint ACI-ASCE Committee 326 1962](#)). After cracking, V_c is attributed to aggregate interlock, dowel action, and the shear transmitted across the concrete compression zone.

The shear strength is based on an average shear stress over the effective cross section, $b_w d$.

[Chapter 23](#) allows the use of the strut-and-tie method in the shear design of any structural concrete member, or discontinuity region in a member.

22.5.1.2

Cross-sectional dimensions shall be selected to satisfy Eq. (22.5.1.2).

$$V_u \leq \phi(V_c + 8\sqrt{f'_c}b_w d) \quad (22.5.1.2)$$

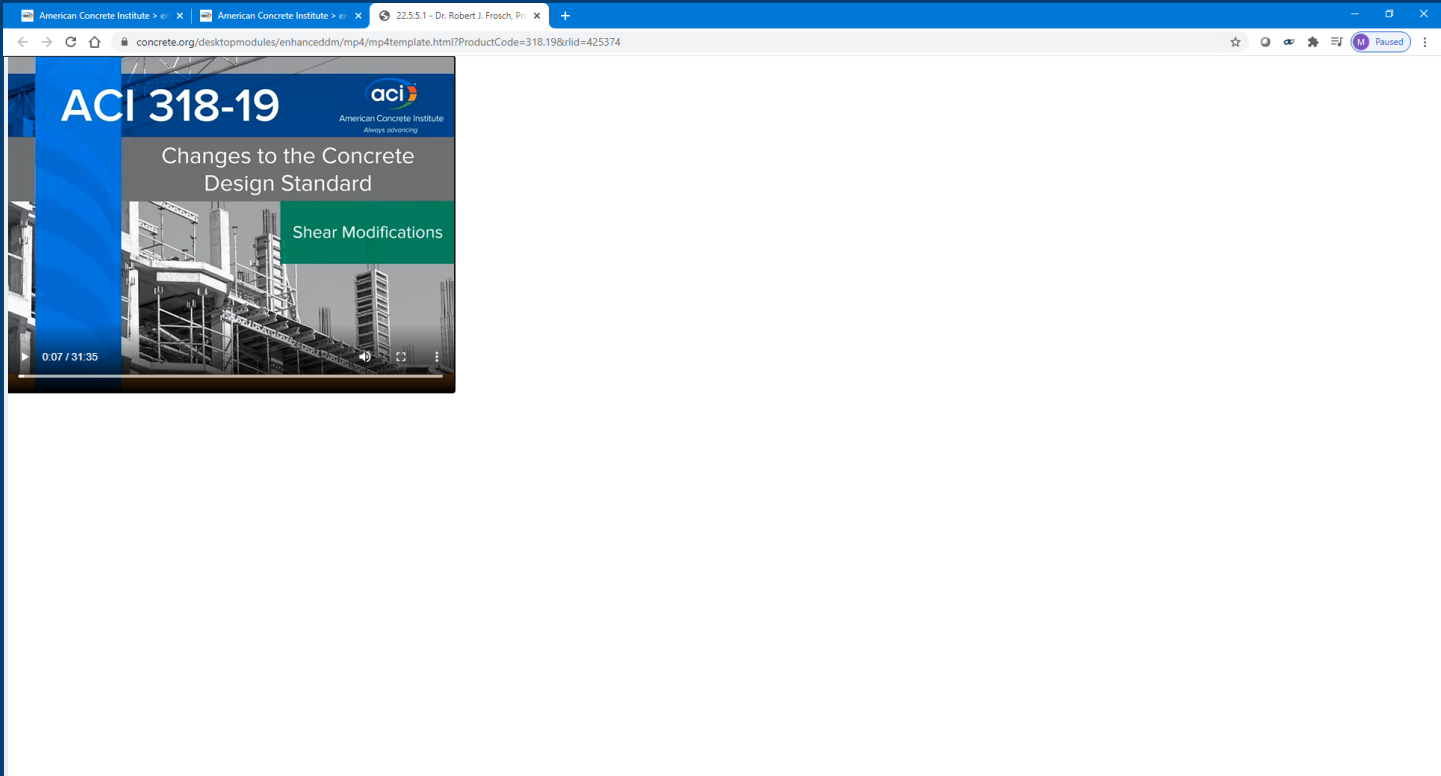
The limit on cross-sectional dimensions in 22.5.1.2 is intended to minimize the likelihood of diagonal compression failure in the concrete and limit the extent of cracking.

Resources / Links



Videos

Videos



Resources / Links



**Detailing
Handbook**

ACI Detailing Manual

ACI Detailing Manual MNL-66(20)

Frontmatter

Chapter 1 - ACI 318R-18 - Guide to Presenting Reinforcing Steel Design Details

Chapter 2 - DETAILS

Chapter 3 - REFERENCES

CI - Concrete International articles

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3 The Forming Tolerance Cloud

4 Detailing and Fabrication Tolerances

5 Calculating the Length of Bent Reinforcing Bars

6 Interference between Reinforcing Bars and Mechanical Waterstops

7 Beam-Column Joints

8 Designing to Minimum Concrete Dimensions

9 Shearwalls and Boundary Elements

10 Avoiding the Dead Zone

11 Constraints on Reinforcing Bar Modeling

12 Reinforcement Placing Drawings are not Shop Drawings

13 Reinforcing Bars Exceeding Stock Lengths

14 Sloped Versus Stepped Footings for Walls

15 Grade Beam Depth and Dowel Embedment

16 Alternating Bar Sizes

17 Corner Details for Wall and Horizontal Bars

18 Detailing Corner Rfbs 09-3, 09-4, and 09-5

19 Layering Reinforcing Bars

20 Wide Beam Stirrup Configurations

21 Concrete Cover at Rustications, Drip Grooves, and Fomlins

22 Using Standees

23 Avoiding Ambiguous Reinforcing Bar Callouts

24 Bar Detailing at Wall Openings

ACI Detailing Manual MNL-66(20)

20 - WIDE BEAM STIRRUP CONFIGURATIONS

Detailing Corner

Wide Beam Stirrup Configurations

A beam-slab floor system becomes shallower, wide reinforced concrete beams are being used to directly carry applied loads or serve as transfer girders in the framing scheme. Making beams wider than the column width is also a key constructibility concept to avoid interference between longitudinal beam corner bars and column corner bars. In this discussion, a wide reinforced concrete beam has a width b_f that exceeds its effective depth d .

A wide beam will likely have a number of longitudinal tension reinforcing bars distributed across the cross section.

Wide beams can also have high shear demands, necessitating the use of stirrups to contribute to the shear capacity. Proper stirrup detailing in these members is imperative to ensure that the distributed longitudinal flexure reinforcement and stirrups are fully effective and behave efficiently.

Wide beam shear behavior has been investigated by Leonhardt and Walther;¹ Anderson and Ramirez;² and Lubell, Bentz, and Collins.³ These studies have shown that locating the stirrups solely around the perimeter of the beam core is not efficient in beams under high shear demand. When viewed as a truss, the internal diagonal compressive struts need to be equilibrated at the internal truss joints. This requires a vertical stirrup leg in close proximity to an internal longitudinal bar used to resist flexure.

Based on previous and current test results, Lubell, Bentz, and Collins summarized some simple design guidelines for transverse spacing of vertical stirrup legs in a wide beam:

- Transverse stirrup leg spacing s_v should be the lesser of d or 24 in. (600 mm); but
- The governing s_v should be halved when the nominal shear strength V_n exceeds $\lambda\sqrt{f'_c}b_d$ lb (0.6 $\lambda\sqrt{f'_c}b_d$ N), where f'_c is the specified concrete strength in psi (MPa).

Figure 1, which is a reproduction of Fig. 10 from Reference 3, illustrates how large transverse stirrup leg spacing can significantly reduce the full shear capacity of a wide beam. When the stirrup legs are concentrated around the perimeter of the wide beam, the shear

DETAILING CORNER

Joint ACI-CRS Committee 315-R, Details of Concrete Reinforcement-Constructability, has developed forums dealing with constructibility issues for reinforced concrete. To assist the Committee with disseminating this information, staff at the Concrete Reinforcing Steel

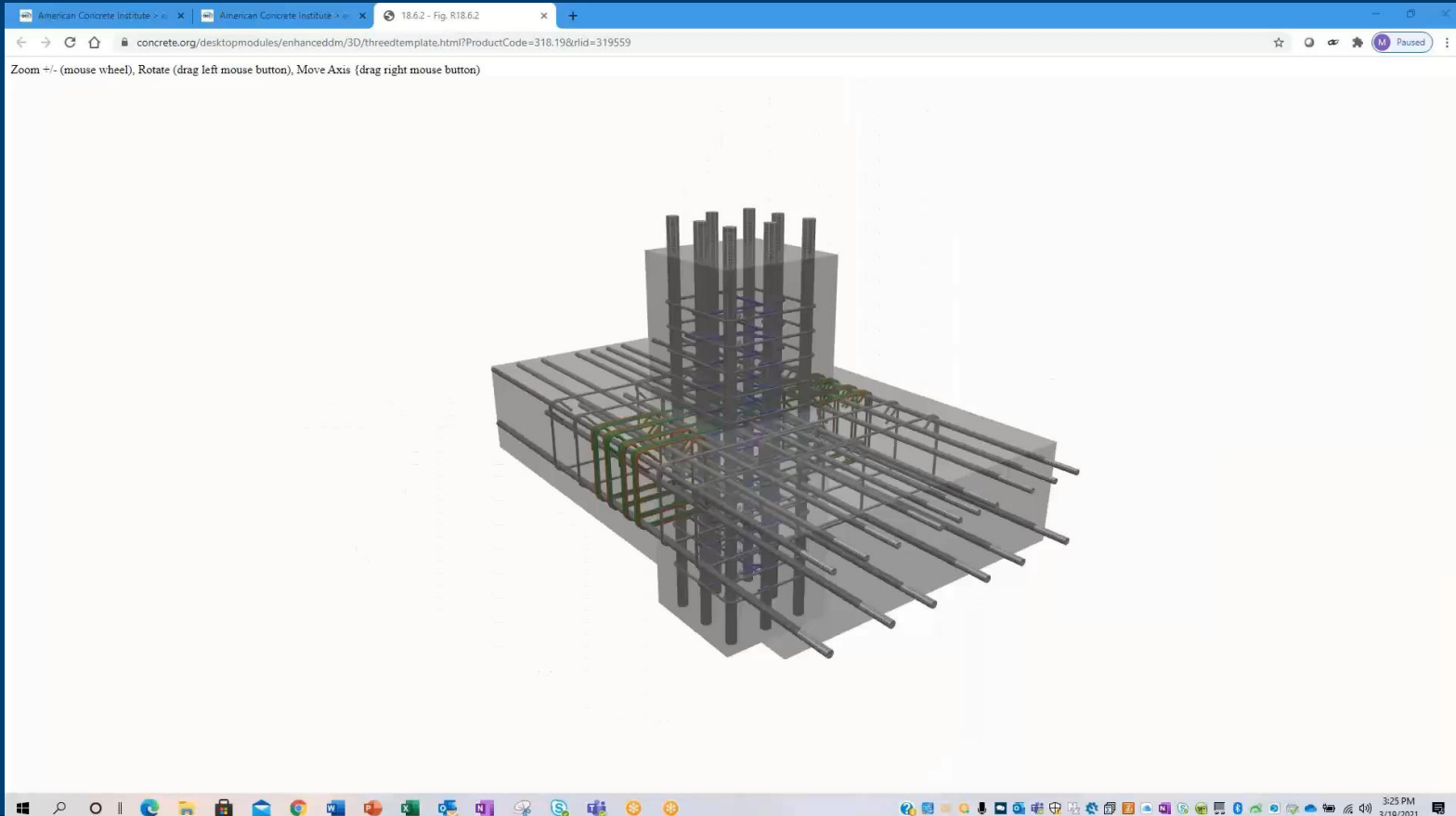
CRSI

Resources / Links

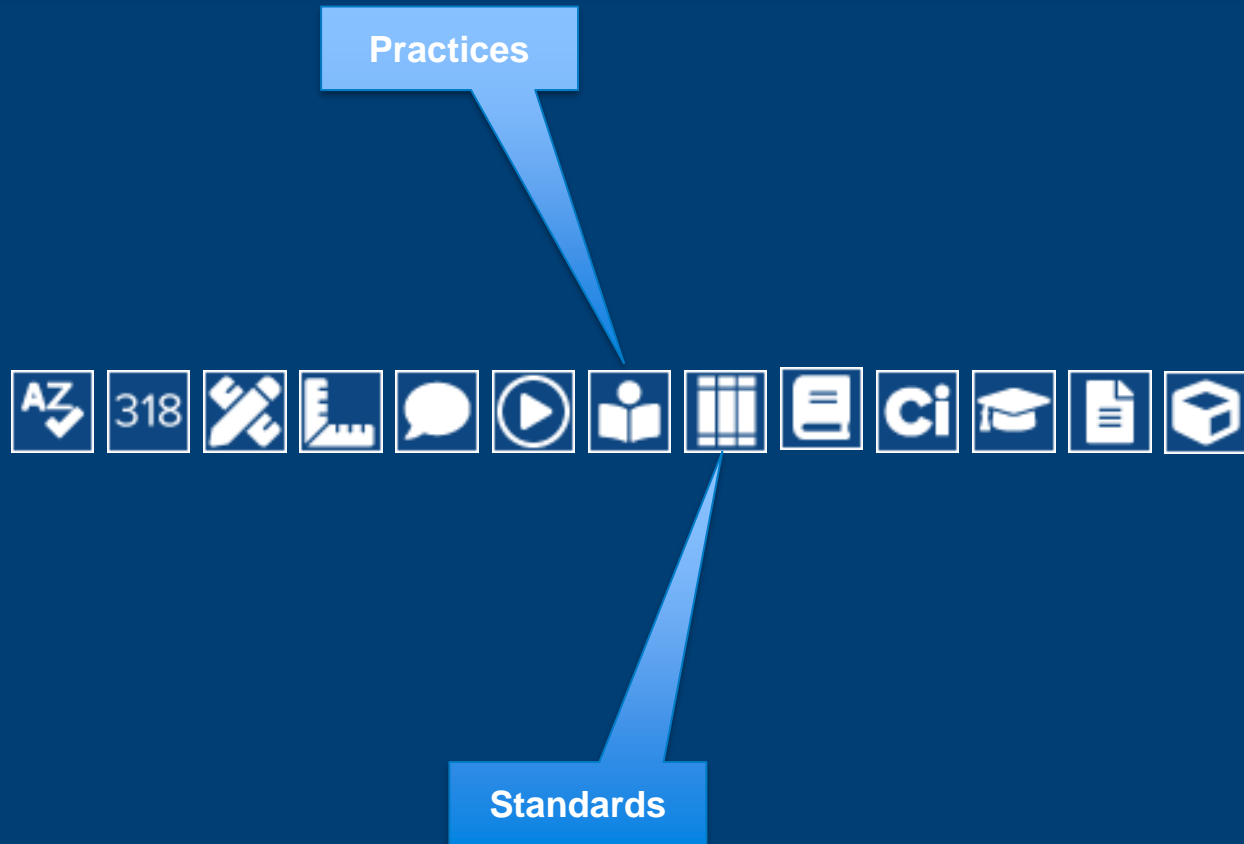
3-D
Graphics



3-D Graphics




Resources / Links



The image displays two web pages side-by-side. The left page is the 'ACI CODE-318-19: Building Code Requirements' document. It features a table of contents with sections 13.4.4.2, 13.4.5, 13.4.5.1, 13.4.5.2, 13.4.5.3, and 13.4.5.4. The right page is the 'International Concrete Abstracts Portal' for report 336.3R-14: Report on Design and Construction of Drilled Piers. It includes fields for Title, Author(s), Publication, Volume, Issue, and Date, as well as a detailed Abstract. A large red diagonal watermark reading 'Non-Member' is superimposed over the right page.

FAQs & CI Articles



The navigation bar contains 13 icons in a row: 'AZ' (alphabetical), '318' (code reference), a wrench and screwdriver (tools), a bar chart (charts), a speech bubble (FAQs), a play button (videos), an open book (books), a list of three items (lists), a document with a checkmark (documents), 'ci' (CI Articles), a graduation cap (education), a document with a magnifying glass (search), and a 3D cube (3D models).

FAQs

CI Articles

FAQs links

ACI 318-19: Building Code Requirements for Structural Concrete and Commentary
Chapter: 4 Structural System Requirements Section: 4.7 Serviceability Provision: 4.7.1

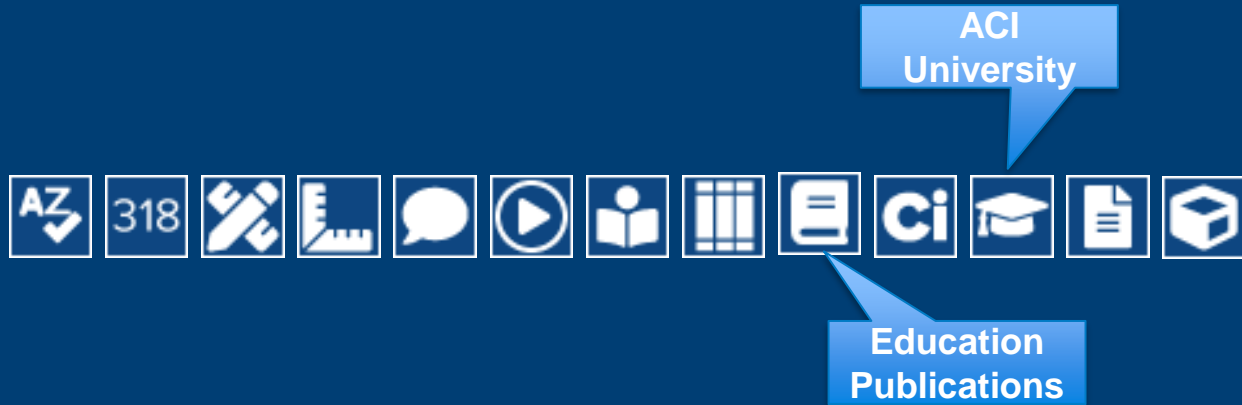
♦ What is considered as acceptable concrete cracking in cast-in-place foundation walls and slabs per ACI documents?

CI Articles links

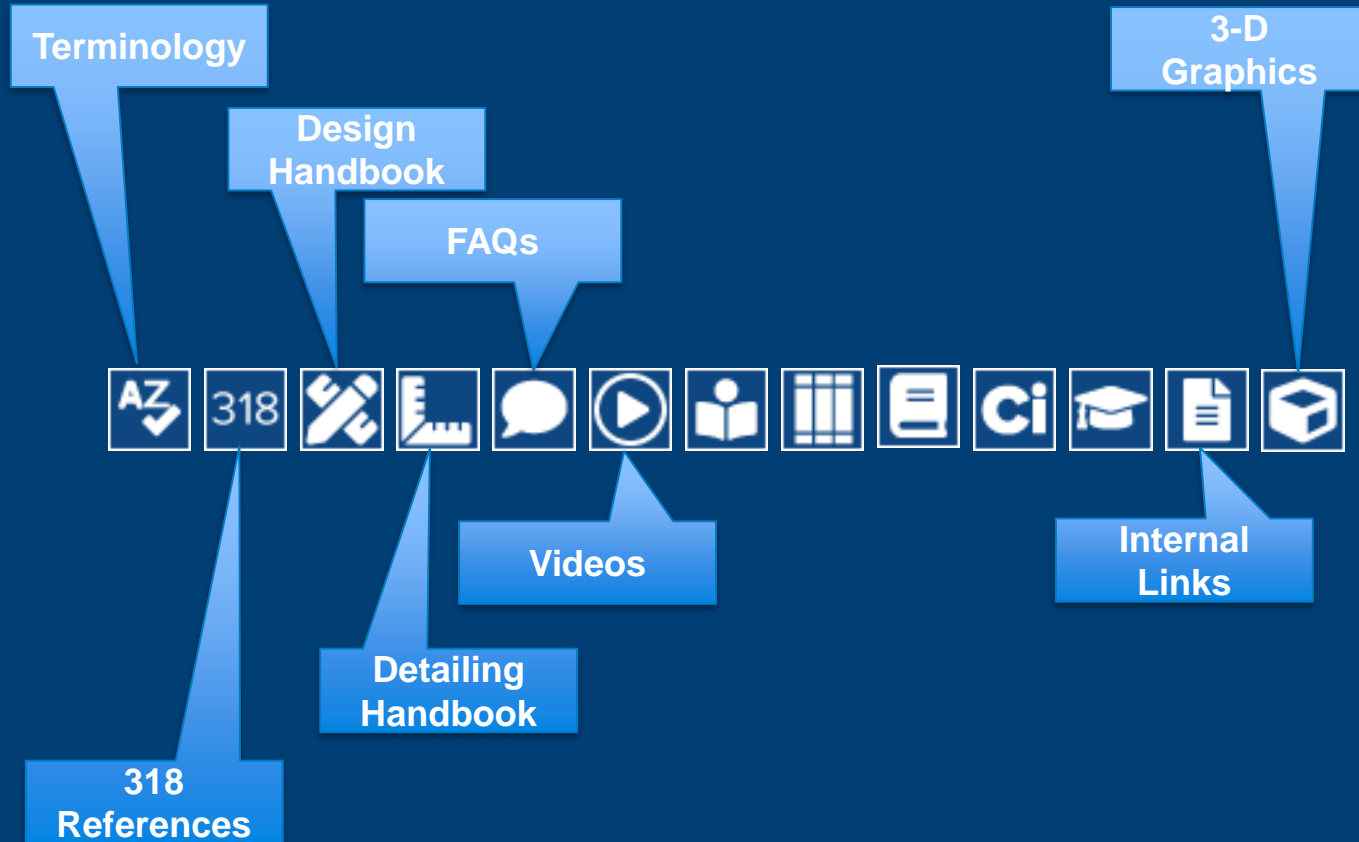
ACI CODE-318-19: Building Code Requirements for Structural Concrete and Commentary
Chapter: 6 Structural Analysis Section: 6.2 General Provision: 6.2.5.3

♦ Key: M126968 This CI Q&A provides second-order analysis design approach of slender columns supporting combined flexural and axial load.

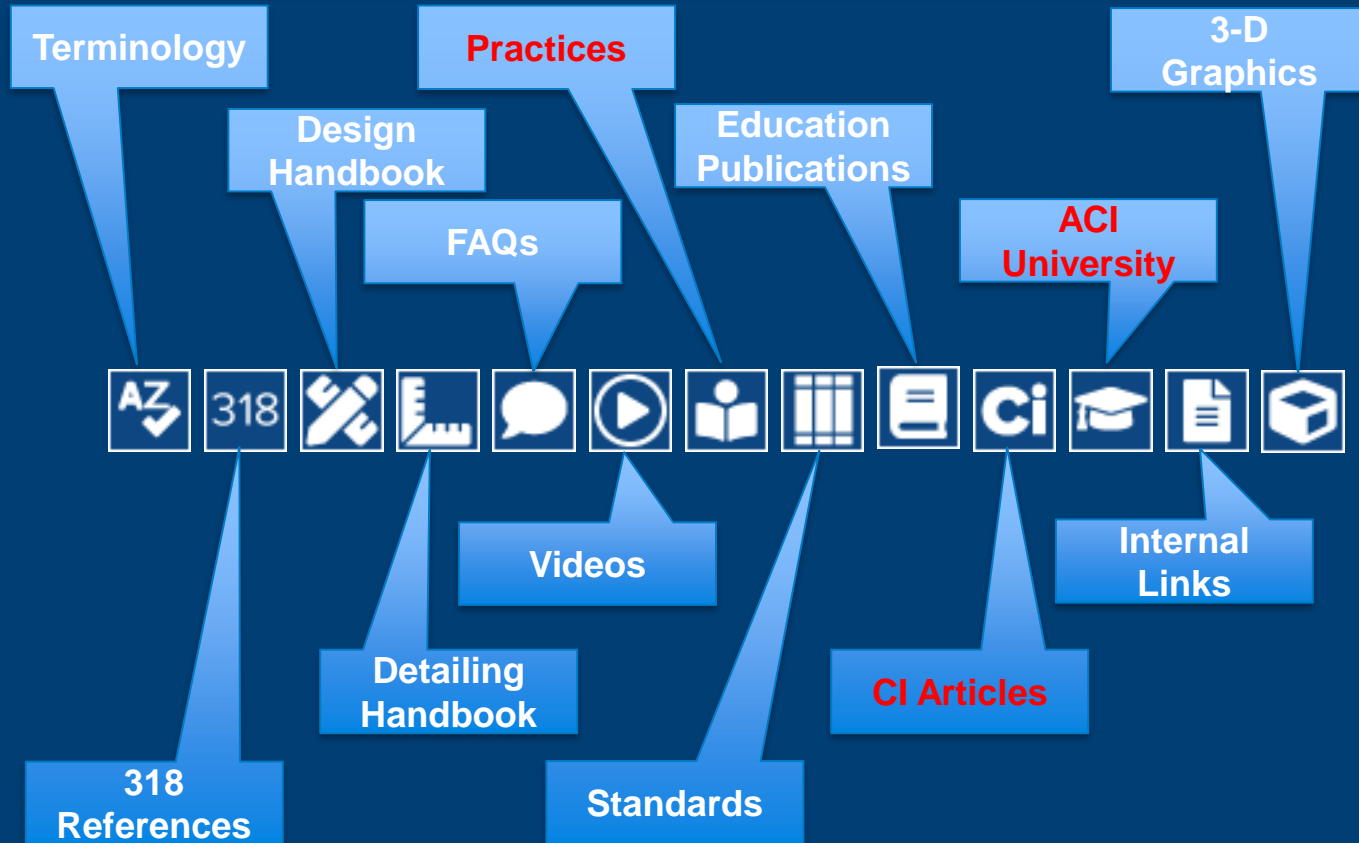
ACI University Courses and Educational Publications



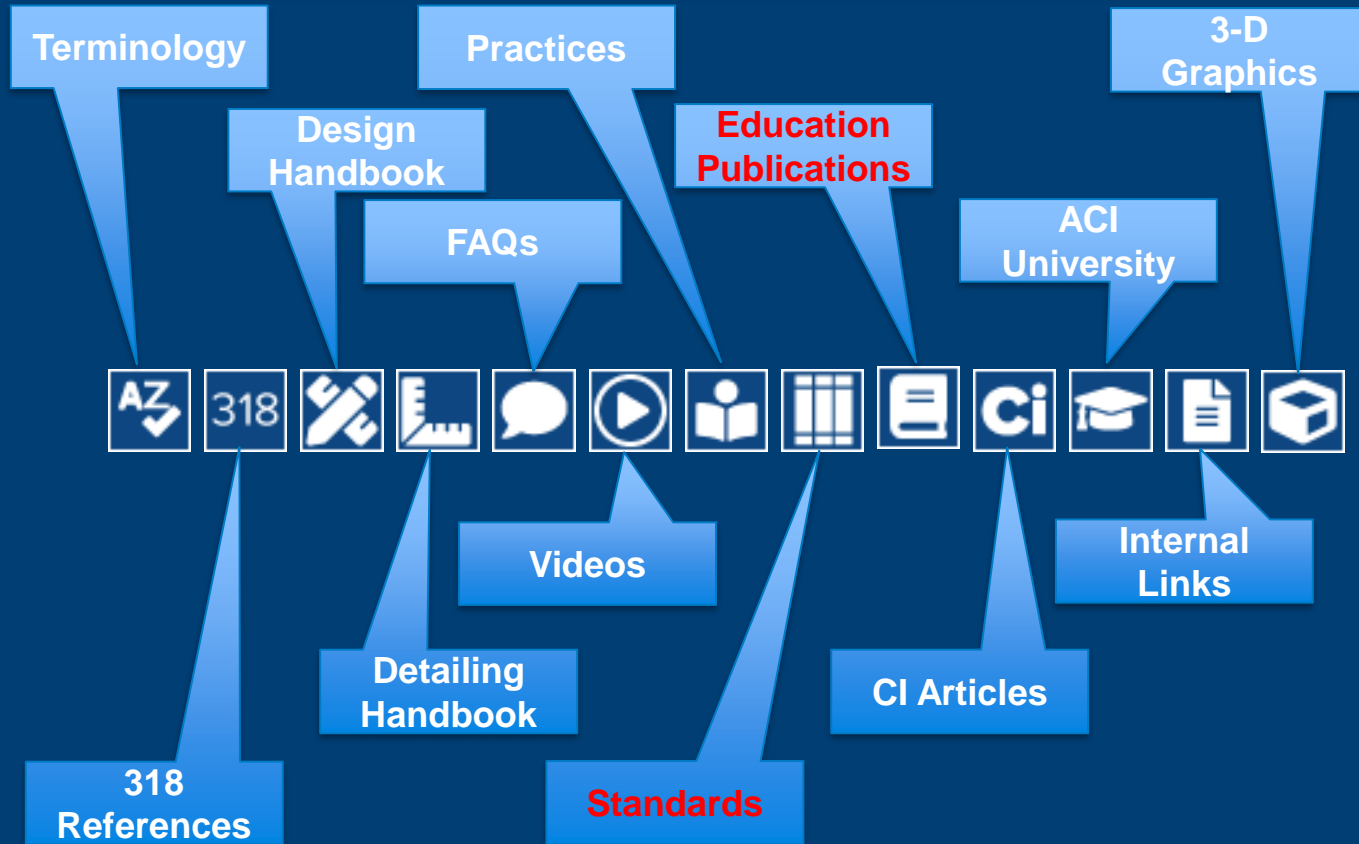
Access – Free to All



Access – Free With Membership



Resources / Links



User Notes

- Ability for user customization
- Resources outside ACI
- Up to 10 sets per user
- Shareable
- Allows others to build on the PLUS platform

Engineering companies

Professors

Textbook publishers

User Notes

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Maximum of 10

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ACI CODE-318-19: Building Code Requirements for Structural Concrete and Commentary

Frontmatter

Chapter 1 - General

Chapter 2 - Notation and Terminology

Chapter 3 - Referenced Standards

Chapter 4 - Structural System Requirements

Chapter 5 - Loads

Chapter 6 - Structural Analysis

Chapter 7 - One-Way Slabs

Chapter 8 - Two-Way Slabs

Chapter 9 - Beams

Chapter 10 - Columns

Chapter 11 - Walls

Chapter 12 - Diaphragms

Chapter 13 - Foundations

Chapter 14 - Plain Concrete

Chapter 15 - Beam-Column and Slab-Column Joints

Chapter 16 - Connections Between Members


Chapter 17 - Anchoring to Concrete

Chapter 18 - Earthquake-Resistant Structures

Chapter 19 - Concrete: Design and Durability


ACI CODE-318-19: Building Code Requirements for Structural Concrete and Commentary

17.6.5.2



Basic single anchor bond strength, N_{ba}


17.6.5.2.1



Basic bond strength of a single adhesive anchor in tension in cracked concrete, N_{ba} , shall be calculated by Eq. (17.6.5.2.1)


$$N_{ba} = \lambda_a \tau_a c' d_a h_{ef} \quad (17.6.5.2.1)$$

17.6.5.2.2




Characteristic bond stress, τ_{cr} , shall be taken as the 5 percent fractile of results of tests performed and evaluated in accordance with [ACI 355.4](#).

17.6.5.2.3



If analysis indicates cracking at service load levels, adhesive anchors shall be qualified for use in cracked concrete in accordance with [ACI 355.4](#).

17.6.5.2.4



R17.6.5.2

Basic single anchor bond strength, N_{ba}

R17.6.5.2.1

The equation for basic bond strength of adhesive anchors as given in Eq. (17.6.5.2.1) represents a uniform bond stress model that has been shown to provide the best prediction of adhesive anchor bond strength based on numerical studies and comparisons of different models to an international database of experimental results ([Cook et al. 1998](#)). The basic bond strength is valid for bond failures that occur between the concrete and the adhesive as well as between the anchor and the adhesive.

R17.6.5.2.2


Characteristic bond stresses should be based on tests performed in accordance with [ACI 355.4](#) and should reflect the particular combination of installation and use conditions anticipated during construction and during anchor service life. If product-specific information is unavailable at the time of design, Table 17.6.5.2.5 provides lower-bound default values.

Note set: Mike's notes

Note set: Mike's notes

Note set: Mike's notes
03/17/2021, 03:22 PM
My Note:
Adhesive Anchor design values for ABC anchor from XYZ corporation are found on page 100 of their [catalog](#).
 τ_{cr} given on page 102.

Note set: Mike's notes



Future enhancements

- More documents
- Company or Educator note sets
- Edition comparisons
- Continuous update of draft documents
- SI units

ACI 318 Certification

Introduction

- Countries around the world have adopted ACI 318
- Engineers using ACI 318 w/o qualification
- Engineers educated using specific version

ACI 318 Certification

Engineers in the US keep abreast through

- Seminars



ACI 318 Certification

Certification program

- Assessing engineer's understanding of basic concrete fundamentals
- Test individual's knowledge and appropriate application of Code provisions in that particular version

ACI 318 Certification

- Engineers certified for the version of ACI 318 on which tested
- Subsequent versions of ACI 318 will require certification

ACI 318 Certification

- Study guides:
- MNL-17 – Reinforced Concrete Design Handbook
- MNL-66 – Detailing Manual
- Concrete Fundamentals

THANK YOU



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