

**ANCHOR INSTALLATION INFORMATION<sup>1</sup>**

SETTING INFORMATION	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER			
			1/4 inch	3/8 inch	1/2 inch	
Nominal Diameter	$d_o$	in. (mm)	1/4 (6.4)	3/8 (9.5)	1/2 (12.7)	
Drill Bit Diameter	$d_{bit}$	in. (mm)	1/4	3/8	1/2	
Minimum Hole Depth	$h_o$	in. (mm)	2 (51)	2 5/8 (67)	2 3/4 (70)	4 (102)
Minimum Base Plate Clearance Hole Diameter <sup>2</sup>	$d_c$	in. (mm)	5/16 (7.5)	7/16 (11.1)	9/16 (14.3)	
Installation Torque (Carbon Steel)	$T_{inst}$	ft-lbf (N-m)	8 (11)	30 (41)	80 (108)	
Embedment Depth	$h_{nom}$	in. (mm)	1 3/4 (44)	2 3/8 (60)	2 1/2 (64)	3 3/4 (95)
Effective Embedment Depth	$h_{ef}$	in. (mm)	1 1/2 (38)	2 (51)	2(51)	3 1/4(83)
Minimum Edge Distance	$c_{min}$	in. (mm)	1 3/4 (44)	2 1/4 (57)	6 1/2 (165)	4 (102)
Minimum Spacing	$s_{min}$	in. (mm)	2 1/4 (57)	3 3/4 (95)	7 1/4 (184)	5 (127)
Minimum Concrete Thickness	$h_{min}$	in. (mm)	4 (102)	4 (102)	5 (127)	6 (152)

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

<sup>1</sup>The information presented in this table must be used in conjunction with the design requirements of ACI 318 Appendix D. The clearance must comply with applicable code requirements for the connected element.

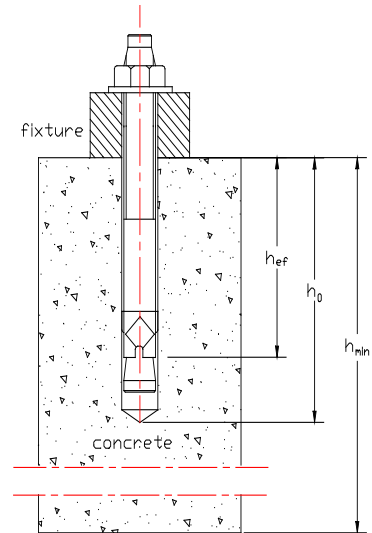
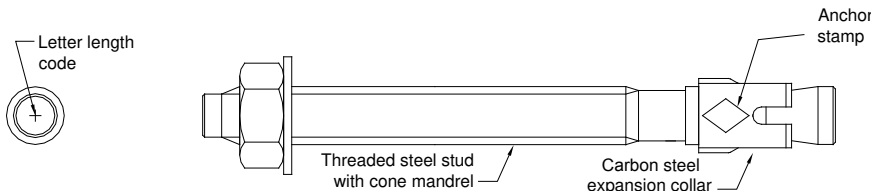


FIGURE 1—ANCHOR

FIGURE 2—ANCHOR (INSTALLED)

**LENGTH IDENTIFICATION SYSTEM (CARBON STEEL AND STAINLESS STEEL ANCHORS)**

Length ID marking on stud	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Length of anchor min ≥ (in.)	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	11	12	13	14	15
Length of anchor max < (in.)	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	11	12	13	14	15	16

**ANCHOR CHARACTERISTIC TENSION STRENGTH DESIGN INFORMATION<sup>1</sup>**

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER			
			1/4 inch	3/8 inch	1/2 inch	
Anchor Category	1,2 or 3	-				
Embedment Depth	$h_{nom}$	in. (mm)	1 3/4 (44)	2 3/8 (60)	2 1/2 (64)	3 3/4 (95)
<b>Steel Strength in Tension (ACI 318 D.5.1)</b>						
Specified Yield Strength (Carbon Steel)	$f_{ya}$	psi (N/mm <sup>2</sup> )	50,000 (344)	50,000 (344)	50,000 (344)	
Specified Tensile Strength (Carbon Steel)	$f_{uta}$	psi (N/mm <sup>2</sup> )	75,000 (517)	75,000 (517)	75,000 (517)	
Effective Tensile Stress Area	$A_{se}$	in <sup>2</sup> (mm <sup>2</sup> )	0.0220 (14.2)	0.0531(34.3)	0.1018 (65.7)	
Tension Resistance of Steel (Carbon Steel)	$N_{sa}$	lbf (kN)	1,650 (7.33)	3,982 (17.7)	7,635 (34)	
Strength Reduction Factor-Steel Failure <sup>2</sup>	$\Phi_{sa}$	-	0.75	0.75	0.75	
<b>Concrete Breakout Strength in Tension (ACI 318 D.5.2)</b>						
Effective Embedment Depth	$h_{ef}$	in. (mm)	1 1/8(29)	1 1/2(38)	1 7/8 (48)	3 1/4 (83)
Critical Edge Distance	$c_{ac}$	in. (mm)	2 3/4	4	5	6
Effectiveness Factor-Uncracked Concrete	$k_{uncr}$	-	24(10)	24(10)	24(10)	
Strength Reduction Factor-Concrete Breakout Failure <sup>3</sup>	$\Phi_{cb}$	-	0.65	0.65	0.65	
<b>Pull-Out Strength in Tension (ACI 318 D.5.3)</b>						
Pull-Out Resistance Uncracked Concrete ( $f'_c = 2,500$ psi) <sup>5</sup>	$N_{pn,uncr}$	lbf (kN)	N/A	2,870 (12.8)	3,220 (14.3)	5,530 (24.6)
Strength Reduction Factor-Pullout Failure <sup>6</sup>	$\Phi_p$	-	0.65	0.65	0.65	

For SI: 1 inch = 25.4mm, 1lbf = 4.45N, 1 lb/in = 0.175 N/mm, 1 psi = 0.00689 MPa = 0.00689 N/mm<sup>2</sup>, 1 in<sup>2</sup> = 645 mm<sup>2</sup>, 1 lb/in = 0.175 N/mm.

<sup>1</sup> The information presented in this table must be used in conjunction with the design requirements of ACI 318 Appendix D.

<sup>2</sup> The tabulated value of  $\Phi_{sa}$  applies when the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used. If the load combinations of Section 1909.2 of the UBC or ACI 318 Appendix C are used, the appropriate value of  $\Phi_{sa}$  must be determined in accordance with ACI 318 D.4.5. The 3/8 inch, 1/2 inch and 5/8 inch diameter anchors are ductile steel elements as defined in ACI 318 D.1.

<sup>3</sup> The tabulated value of  $\Phi_{cb}$  applies when both the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are satisfied. For installations where complying supplementary reinforcement can be verified, the  $\Phi_{cb}$  factors described in ACI 318 D.4.4 for Condition A are allowed. If the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4 for Condition A are satisfied, the appropriate value of  $\Phi_{cb}$  must be determined in accordance with ACI 318 D.4.4(c). If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\Phi_{cb}$  must be determined in accordance with ACI 318 D.4.5.

<sup>4</sup> As described in Section 4.1.3 of this report, N/A (Not Applicable) denotes that pullout resistance is not critical and does not need to be considered.

<sup>5</sup> The characteristic pull-out resistance for greater concrete compressive strengths may be increased by multiplying the tabular value by  $(f'_c / 2,500)^{0.5}$ .

<sup>6</sup> The tabulated value of  $\Phi_p$  or  $\Phi_{ev}$  applies when both the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are satisfied. Condition B applies where supplementary reinforcement is not provided or where pullout strength governs. For installations where complying supplementary reinforcement can be verified, the  $\Phi$  factors described in ACI 318 D.4.4 for Condition A are allowed. If the load combinations of ACI 318 Appendix C are used, appropriate value of  $\Phi$  must be determined in accordance with ACI 318 D.4.5.

**ANCHOR CHARACTERISTIC SHEAR STRENGTH DESIGN INFORMATION<sup>1</sup>**

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER		
			<sup>1</sup> / <sub>4</sub> inch	<sup>3</sup> / <sub>8</sub> inch	<sup>1</sup> / <sub>2</sub> inch
Anchor Category	1,2 or 3	-			
Embedment Depth	$h_{nom}$	in.	1 3/4 (44)	2 3/8 (60)	2 1/2 (64)   3 3/4 (95)
<b>Steel Strength in Shear ( ACI 318 D.6.1)</b>					
Specified Yield Strength for Shear (Carbon Steel)	$f_{ya}$	psi (N/mm <sup>2</sup> )	50,000 (344)	50,000 (344)	50,000 (344)
Specified Tensile Strength for Shear (Carbon Steel)	$f_{uta}$	psi (N/mm <sup>2</sup> )	75,000 (517)	75,000 (517)	75,000 (517)
Effective Shear Stress Area	$A_{se}$	in <sup>2</sup> (mm <sup>2</sup> )	0.0220 (14.2)	0.0531(34.3)	0.1018 (65.7)
Shear Resistance of Steel (Carbon Steel)	$V_{sa}$	lbf (kN)	1105 (4.9)	2,668 (11.9)	5,115 (22.7)
Strength Reduction Factor-Steel Failure <sup>2</sup>	$\Phi_{sa}$	-	0.65	0.65	0.65
<b>Concrete Breakout Strength in Shear (ACI 318 D.6.2)</b>					
Nominal Diameter	$d_o$	in.	1/4 (6.4)	3/8 (9.5)	1/2 (12.7)
Load Bearing Length of Anchor in Shear	$l_e$	in.	1 1/4(32)	1 7/8(48)	2(51)
Strength Reduction Factor-Concrete Breakout Failure <sup>3</sup>	$\Phi_{cb}$	-	0.7	0.7	0.7
<b>Concrete Pryout Strength in Shear (ACI 318 D.6.3)</b>					
Coefficient for Pryout Strength	$k_{cp}$	-	2	2	2
Strength Reduction Factor-Concrete Pryout Failure <sup>4</sup>	$\Phi_{cp}$	-	0.7	0.7	0.7

For SI: 1 inch = 25.4mm, 1 lbf = 4.45 N, 1 psi = 0.00689 MPa = 0.00689 N/mm<sup>2</sup>, 1 in<sup>2</sup> = 645 mm<sup>2</sup>.

<sup>1</sup> The information presented in this table must be used in conjunction with the design criteria of ACI 318 Appendix D.

<sup>2</sup> The tabulated value of  $\Phi_{sa}$  applies when the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are satisfied. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\Phi_{sa}$  must be determined in accordance with ACI 318 D.4.5. The <sup>3</sup>/<sub>8</sub> inch, <sup>1</sup>/<sub>2</sub> inch and <sup>5</sup>/<sub>8</sub> inch diameter anchors are ductile steel elements as defined in ACI 318 D.1.1.

<sup>3</sup> The tabulated value of  $\Phi_{cb}$  applies when both the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are satisfied. Condition B applies where supplementary reinforcement is not provided or where pryout strength governs. For installations where complying supplementary reinforcement can be verified, the  $\Phi$  factors described in ACI 318 D.4.4 for Condition A are allowed. If the load combinations of Section 1605.2.1 of the IBC or ACI 318 9.2 are used and the requirements of ACI 318 D.4.4 for Condition A are satisfied, the appropriate value of  $\Phi$  must be determined in accordance with ACI 318 D.4.4(c). If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\Phi$  must be determined in accordance with ACI 318 D.4.5.

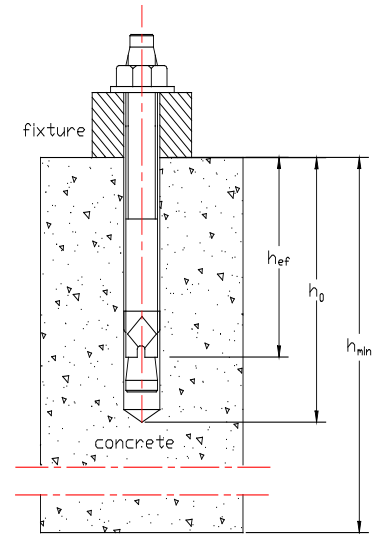
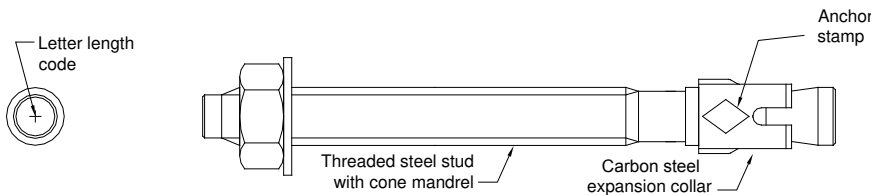
<sup>4</sup> The tabulated value of  $\Phi_{cp}$  applies when both the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are satisfied. Condition B applies where supplementary reinforcement is not provided or where pryout strength governs. For installations where complying supplementary reinforcement can be verified, the  $\Phi$  factors described in ACI 318 D.4.4 for Condition A are allowed. If the load combinations of ACI 318 Appendix C the appropriate value of  $\Phi$  must be determined in accordance with ACI 318 D.4.5.

**ANCHOR INSTALLATION INFORMATION<sup>1</sup>**

SETTING INFORMATION	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER			
			<sup>5</sup> / <sub>8</sub> inch		<sup>3</sup> / <sub>4</sub> inch	
Nominal Diameter	$d_o$	in. (mm)	5/8 (15.9)		3/4 (19)	
Drill Bit Diameter	$d_{bit}$	in. (mm)	5/8		3/4	
Minimum Hole Depth	$h_o$	in. (mm)	3 3/4 (95)	5 (127)	4 1/4 (108)	6 (152)
Minimum Base Plate Clearance Hole Diameter <sup>2</sup>	$d_c$	in. (mm)	11/16 (17.5)		13/16 (20.6)	
Installation Torque (Carbon Steel)	$T_{inst}$	ft-lbf (N-m)	100 (136)		120 (163)	
Embedment Depth	$h_{nom}$	in. (mm)	3 3/8 (86)	4 5/8 (117)	4 (102)	5 3/4 (146)
Effective Embedment Depth	$h_{ef}$	in. (mm)	2 3/4 (70)	4 (102)	3 1/8 (79)	5 (127)
Minimum Edge Distance	$c_{min}$	in. (mm)	6 (152)	4 1/4 (108)	5 (127)	4 1/2 (114)
Minimum Spacing	$s_{min}$	in. (mm)	11 (279)	4 1/4 (108)	6 (152)	5 (127)
Minimum Concrete Thickness	$h_{min}$	in. (mm)	6 (152)	7 (178)	6 (152)	8 1/2 (216)

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

<sup>1</sup>The information presented in this table must be used in conjunction with the design requirements of ACI 318 Appendix D. The clearance must comply with applicable code requirements for the connected element.



**FIGURE 1—ANCHOR**

**FIGURE 2—ANCHOR (INSTALLED)**

**LENGTH IDENTIFICATION SYSTEM (CARBON STEEL AND STAINLESS STEEL ANCHORS)**

Length ID marking on stud	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Length of anchor min ≥ (in.)	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	11	12	13	14	15
Length of anchor max < (in.)	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	11	12	13	14	15	16

**ANCHOR CHARACTERISTIC TENSION STRENGTH DESIGN INFORMATION<sup>1</sup>**

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER			
			<sup>5</sup> / <sub>8</sub> inch		<sup>3</sup> / <sub>4</sub> inch	
Anchor Category	1,2 or 3	-				
Embedment Depth	$h_{nom}$	in. (mm)	3 3/8 (86)	4 5/8 (117)	4 (102)	5 3/4 (146)
<b>Steel Strength in Tension (ACI 318 D.5.1)</b>						
Specified Yield Strength (Carbon Steel)	$f_{ya}$	psi (N/mm <sup>2</sup> )	50,000 (344)		50,000 (344)	
Specified Ultimate Strength (Carbon Steel)	$f_{uta}$	psi (N/mm <sup>2</sup> )	75,000 (517)		75,000 (517)	
Effective Tensile Stress Area	$A_{se}$	in <sup>2</sup> (mm <sup>2</sup> )	0.1626 (104.9)		0.2376 (150.9)	
Tension Resistance of Steel (Carbon Steel)	$N_{sa}$	lbf (kN)	12,195 (54.2)		17,820 (79.2)	
Strength Reduction Factor-Steel Failure <sup>2</sup>	$\Phi_{sa}$	-	0.75		0.75	
<b>Concrete Breakout Strength in Tension (ACI 318 D.5.2)</b>						
Effective Embedment Depth	$h_{ef}$	in. (mm)	2 3/4 (70)	4 (102)	3 1/8 (79)	5 (127)
Critical Edge Distance	$c_{ac}$	in. (mm)	6	7	7	8
Effectiveness Factor-Uncracked Concrete	$k_{uncr}$		24(10)		24(10)	
Strength Reduction Factor-Concrete Breakout Failure <sup>3</sup>	$\Phi_{cb}$		0.65		0.65	
<b>Pull-Out Strength in Tension (ACI 318 D.5.3)</b>						
Pull-Out Resistance Uncracked Concrete ( $f'_c = 2,500$ psi) <sup>5</sup>	$N_{pn,uncr}$	lbf (kN)	N/A		N/A	
Strength Reduction Factor-Pullout Failure <sup>6</sup>	$\Phi_p$	-	0.65		0.65	

For SI: 1 inch = 25.4mm, 1lbf = 4.45N, 1 lb/in = 0.175 N/mm, 1 psi = 0.00689 MPa = 0.00689 N/mm<sup>2</sup>, 1 in<sup>2</sup> = 645 mm<sup>2</sup>, 1 lb/in = 0.175 N/mm.

<sup>1</sup> The information presented in this table must be used in conjunction with the design requirements of ACI 318 Appendix D.

<sup>2</sup> The tabulated value of  $\Phi_{sa}$  applies when the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used. If the load combinations of Section 1909.2 of the UBC or ACI 318 Appendix C are used, the appropriate value of  $\Phi_{sa}$  must be determined in accordance with ACI 318 D.4.5. The <sup>3</sup>/<sub>8</sub> inch, <sup>1</sup>/<sub>2</sub> inch and <sup>5</sup>/<sub>8</sub> inch diameter anchors are ductile steel elements as defined in ACI 318 D.1.

<sup>3</sup> The tabulated value of  $\Phi_{cb}$  applies when both the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are satisfied. For installations where complying supplementary reinforcement can be verified, the  $\Phi_{cb}$  factors described in ACI 318 D.4.4 for Condition A are allowed. If the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4 for Condition A are satisfied, the appropriate value of  $\Phi_{cb}$  must be determined in accordance with ACI 318 D.4.4(c). If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\Phi_{cb}$  must be determined in accordance with ACI 318 D.4.5.

<sup>4</sup> As described in Section 4.1.3 of this report, N/A (Not Applicable) denotes that pullout resistance is not critical and does not need to be considered.

<sup>5</sup> The characteristic pull-out resistance for greater concrete compressive strengths may be increased by multiplying the tabular value by  $(f'_c / 2,500)^{0.5}$ .

<sup>6</sup> The tabulated value of  $\Phi_p$  or  $\Phi_{eq}$  applies when both the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are satisfied. Condition B applies where supplementary reinforcement is not provided or where pullout strength governs. For installations where complying supplementary reinforcement can be verified, the  $\Phi$  factors described in ACI 318 D.4.4 for Condition A are allowed. If the load combinations of ACI 318 Appendix C are used, appropriate value of  $\Phi$  must be determined in accordance with ACI 318 D.4.5.

**ANCHOR CHARACTERISTIC SHEAR STRENGTH DESIGN INFORMATION<sup>1</sup>**

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ANCHOR DIAMETER			
			<sup>5</sup> / <sub>8</sub> inch		<sup>3</sup> / <sub>4</sub> inch	
Anchor Category	1,2 or 3	-				
Embedment Depth	$h_{nom}$	in.	3 3/8 (86)	4 5/8 (117)	4 (102)	5 3/4 (146)
<b>Steel Strength in Shear ( ACI 318 D.6.1)</b>						
Specified Yield Strength for Shear (Carbon Steel)	$f_{ya}$	psi (N/mm <sup>2</sup> )	50,000 (344)	50,000 (344)		
Specified Ultimate Strength for Shear (Carbon Steel)	$f_{uta}$	psi (N/mm <sup>2</sup> )	75,000 (517)	75,000 (517)		
Effective Shear Stress Area	$A_{se}$	in <sup>2</sup> (mm <sup>2</sup> )	0.1626 (104.9)	0.2376 (150.9)		
Shear Resistance of Steel (Carbon Steel)	$V_{sa}$	lbf (kN)	8,170 (36.3)	11,940 (53.1)		
Strength Reduction Factor-Steel Failure <sup>2</sup>	$\Phi_{sa}$	-	0.65	0.65		
<b>Concrete Breakout Strength in Shear (ACI 318 D.6.2)</b>						
Nominal Diameter	$d_o$	in.	5/8 (15.9)	3/4 (19)		
Load Bearing Length of Anchor in Shear	$l_e$	in.	2 7/8(73)	3 1/2(88.9)		
Strength Reduction Factor-Concrete Breakout Failure <sup>3</sup>	$\Phi_{cb}$	-	0.7	0.7		
<b>Concrete Pryout Strength in Shear (ACI 318 D.6.3)</b>						
Coefficient for Pryout Strength	$k_{cp}$	-	2	2		
Strength Reduction Factor-Concrete Pryout Failure <sup>4</sup>	$\Phi_{cp}$	-	0.7	0.7		

For SI: 1 inch = 25.4mm, 1 lbf = 4.45 N, 1 psi = 0.00689 MPa = 0.00689 N/mm<sup>2</sup>, 1 in<sup>2</sup> = 645 mm<sup>2</sup>.

<sup>1</sup> The information presented in this table must be used in conjunction with the design criteria of ACI 318 Appendix D.

<sup>2</sup> The tabulated value of  $\Phi_{sa}$  applies when the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are satisfied. If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\Phi_{sa}$  must be determined in accordance with ACI 318 D.4.5. The <sup>3</sup>/<sub>8</sub> inch, <sup>1</sup>/<sub>2</sub> inch and <sup>5</sup>/<sub>8</sub> inch diameter anchors are ductile steel elements as defined in ACI 318 D.1.1.

<sup>3</sup> The tabulated value of  $\Phi_{cb}$  applies when both the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are satisfied. Condition B applies where supplementary reinforcement is not provided or where pryout strength governs. For installations where complying supplementary reinforcement can be verified, the  $\Phi$  factors described in ACI 318 D.4.4 for Condition A are allowed. If the load combinations of Section 1605.2.1 of the IBC or ACI 318 9.2 are used and the requirements of ACI 318 D.4.4 for Condition A are satisfied, the appropriate value of  $\Phi$  must be determined in accordance with ACI 318 D.4.4(c). If the load combinations of ACI 318 Appendix C are used, the appropriate value of  $\Phi$  must be determined in accordance with ACI 318 D.4.5.

<sup>4</sup> The tabulated value of  $\Phi_{cp}$  applies when both the load combinations of Section 1605.2.1 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are satisfied. Condition B applies where supplementary reinforcement is not provided or where pryout strength governs. For installations where complying supplementary reinforcement can be verified, the  $\Phi$  factors described in ACI 318 D.4.4 for Condition A are allowed. If the load combinations of ACI 318 Appendix C the appropriate value of  $\Phi$  must be determined in accordance with ACI 318 D.4.5.