PCI Design Handbook **ERRATA**

Precast and Prestressed Concrete

Seventh Edition

PCI
Precast/Prestressed
Concrete Institute

ERRATA

PCI Design Handbook

Precast and Prestressed Concrete, Seventh Edition

In 2010, the Precast/Prestressed Concrete Institute published the seventh edition of the *PCI Design Handbook—Precast and Prestressed Concrete* (MNL–120–10). Although careful efforts were made to provide an accurate document, some errors have been discovered. We suggest that you mark your seventh edition to reflect these errata so that the handbook is as accurate as possible.

As this edition of the handbook is used, additional errata may be discovered. You are urged to notify PCI of these items as well as any questions or comments you may have regarding the material in the handbook. Also, any comments on new material you think should be included in future editions are equally welcome.

Please direct your comments to PCI at IHBerrata@pci.org.

Additional errata will be posted on PCI's website from time to time.

Please go to http://pci.org/publications/errata/index.cfm.

PCI™ Precast/Prestressed Concrete Institute
200 West Adams Street | Suite 2100 | Chicago, IL 60606-5230
Phone: 312-786-0300 | Fax: 312-621-1114 | www.pci.org

Chapter 1

Page 1-12, First line of the second full paragraph: Add reference 22 after "(GFRC)."

Page 1-20, Right column, 13th line from bottom: Add references 20 and 25 after "…deck panels."

Page 1-23, Lines 6–9: Change references as follows: "…to good advantage in the construction of poles (Fig. 1.2.43),[19] piles,[21] railroad ties (Fig. 1.2.44), storage tanks (Fig. 1.2.45 and 1.2.46),[23, 24] monorails (Fig. 1.2.47) retaining walls, highway and runway pavements, and sound barriers (Fig. 1.2.48)."

Page 1-27: Reference 19 should read: ASCE Task Force - PCI Committee on Prestressed Concrete Poles Guide for the Design of Prestressed Concrete Poles Part 1, Part 2, and Part 3. 1997. *PCI Journal*, V. 42, No. 6 (November–December): pp. 94–134.

Page 1-27: Reference 21 should read: PCI Committee on Prestressed Concrete Piling. 1997. Recommended Practice for Design, Manufacture and Installation of Prestressed Concrete Piling. *PCI Journal*, V. 22, No. 2 (March–April).

Page 1-27: Reference 22 should read: GFRC-Recommended Practice-MNL-128-01, Recommended Practice for Glass Fiber Reinforced Concrete.

Chapter 3

Page 3-51, Design Aid 3.12.1 for 20 × 20 columns with 4 strands: f'_c between 7000 and 9000 should read 8000 psi, not 5000 psi.

Chapter 4

Page 4-22, Fig. 4.5.1: The locations of the center of rigidity and center of lateral load in the left diagram are not correct. The location of the center of lateral load in the right diagram is not correct. Replace with Fig. 4.5.1 as revised.

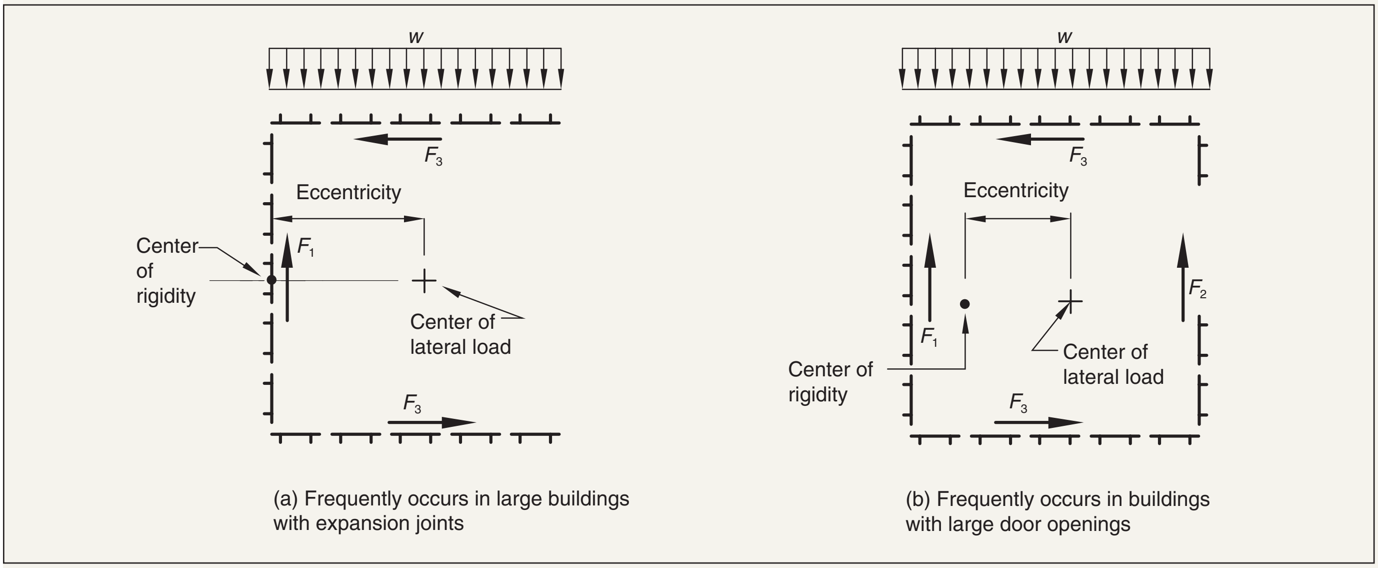


Fig. 4.5.1 (Revised in accordance with 2011 Errata) Unsymmetrical shear walls.

Page 4-58, Fig. 4.8.4: The peak line for the collector force demand should line up with the upper end of the lower shear wall. Replace with Fig. 4.8.4 as revised.

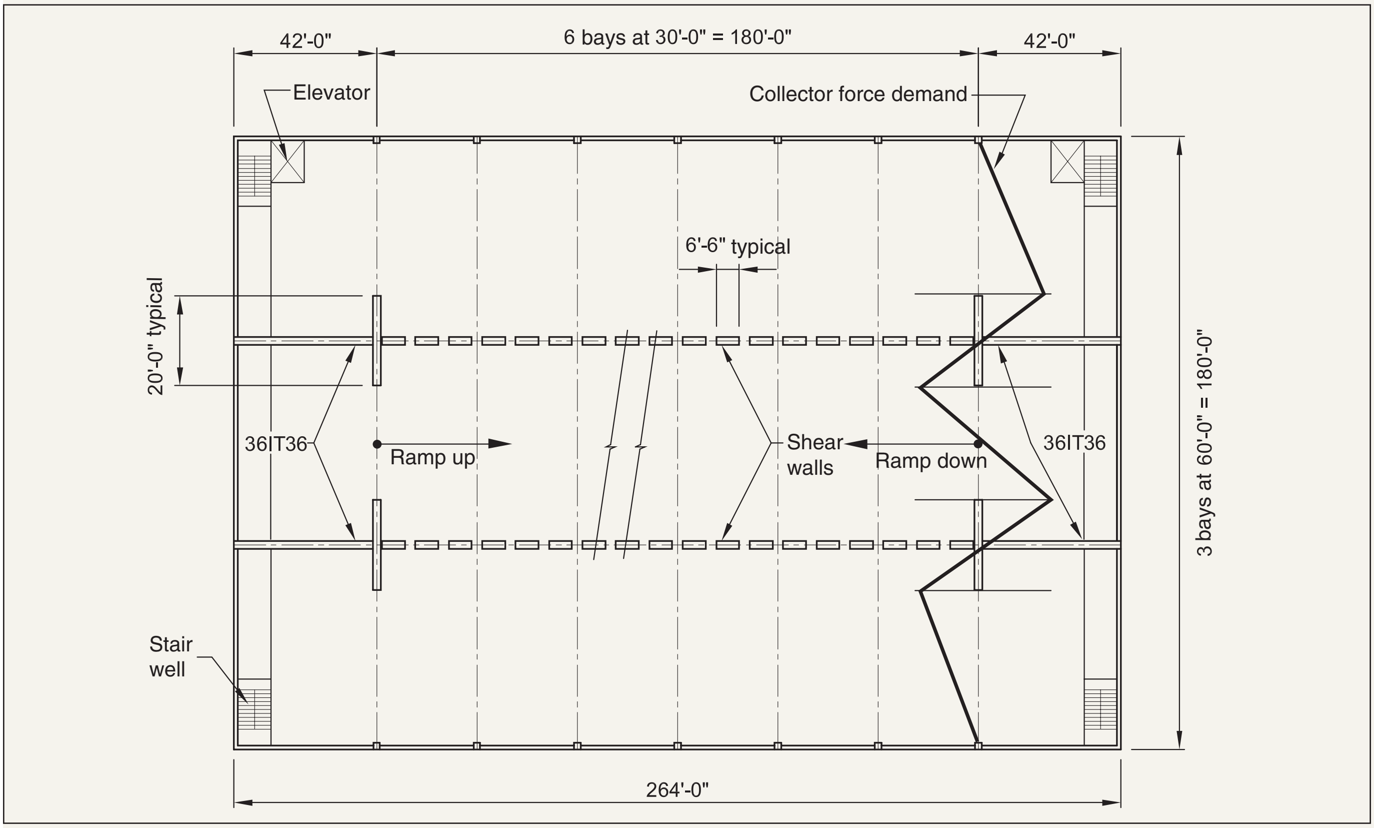


Fig. 4.8.4 (Revised in accordance with 2011 Errata) Collector force demand diagram for shear walls in a parking garage.

Page 4-92: Design Aid 4.11.20 makes reference to Design Aid 4.11.1 for seasonal temperature change. This reference should be to Design Aid 4.11.11.

Chapter 5

Page 5-36, left column, third line: Fig. 5.2.7 should read Fig. 5.2.8.

Page 5-36, left column, third line: Design Aid 5.13.4 should read Design Aid 5.14.4.

Page 5-38, Example 5.2.3.2: The example does not coincide with the text in that it does not properly account for the load in the partially developed strand. Replace with Example 5.2.3.2 as revised.

Page 5-58, Table 5.3.1: The 0.30 factor in the bottom right block should be 0.20.

Page 5-78, 9th line from bottom: Design Aid 15.2.9 should read Design Aid 15.4.4.

Page 5-78, 2nd line from bottom: Insert an equals sign (=) between the term with notation and the term with numbers. It should read as follows:

$$A_{sh} = \frac{\left(A_{vf} + A_n\right) f_y}{\mu_e f_{ys}} = \frac{0.94\left(60,000\right)}{3.4\left(60,000\right)} = 0.28 \text{ in.}^2$$

Page 5-82, 5th line of item 3: A'_s should be A'_{sh}

Page 5-91, last calculation for Δ_{cr}: I_g in the denominator should be I_{cr}

Page 5-116, Fig. 5.9.7: Curve for h′/r = 0 should not have the slight uptick at zero bending moment. Replace with Fig. 5.9.7 as revised.

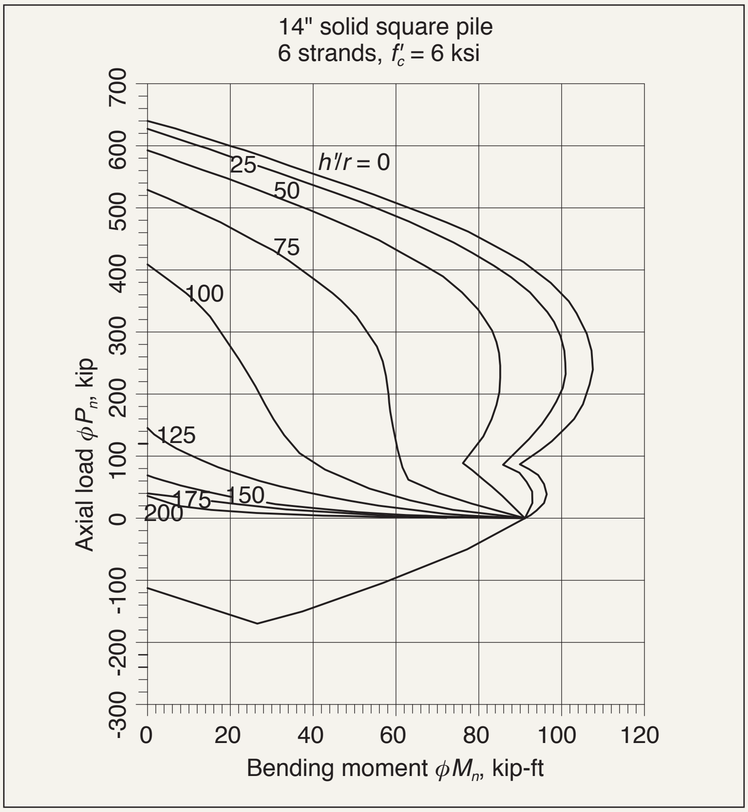


Fig. 5.9.7 (Revised in accordance with 2011 Errata) Typical pile interaction curve.

Page 5-132, Example 5.12.1.1, 3rd line from bottom: The reference to Design Aid 15.5.1 should read Design Aid 15.5.3.

EXAMPLE 5.2.3.2 (Revised in accordance with 2011 Errata)

Moment Capacity of Component with Debonded Strands in Development Region

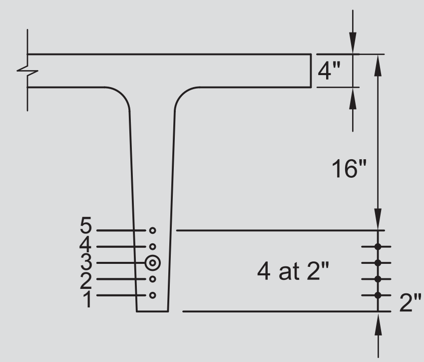
Given:

10-ft-wide double-tee, one stem shown

b = 10 ft = 120 in.

(10) $^1/_2$-in.-diameter, 270 ksi strands (five each stem)

A_{ps} = 10(0.153) = 1.53 in.^{2}



Concrete:

f'_c = 5000 psi, normalweight

E_c = 4300 ksi

Prestressing strands:

f_{pu} = 270 ksi

f_{se} = 170 ksi

E_{ps} = 28,500 ksi (based on strand data)

ε_{se} = 170/28500 = 0.0060

Problem:

Strand #3 is debonded for 5 ft from the end.

Find M_n at 12 ft from the end.

Solution:

Maximum f_{ps} for fully bonded strand (from separate analysis) = 269 ksi.

Transfer length = $(f_{se}/3)d_b$ = (170/3)(0.5) = 28.33 in.

For debonded strands, double the transfer and development length per ACI 318-05, Section 12.9.3.

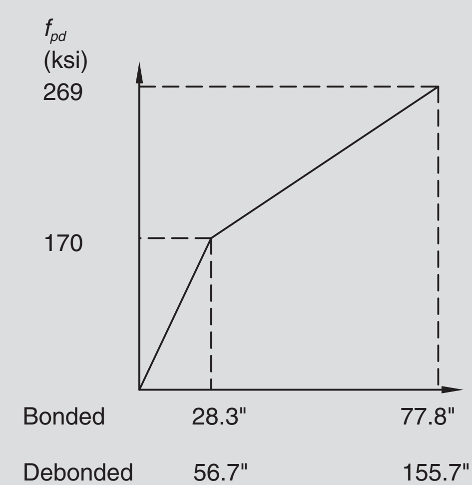
Transfer length for debonded strands = 2(28.33) = 56.7 in.

ℓ_d = $[f_{ps} - (2/3)f_{se}]d_b$ = (269 – 113.3)(0.5) = 77.85 in.

ℓ_d for debonded strands = 2(77.85) = 155.7 in.

The maximum strength the strand can develop at 12 ft from the end (7 ft or 84 in. from the point of debonding) is given by:

$$f_{pd} = 170 + \frac{84 - 56.7}{155.7 - 56.7}\left(269 - 170\right) = 197.3 \text{ ksi}$$



Distance from point of debonding
(end of component for fully bonded strains)

Note: Due to the presence of underdevolped strand adjacent to fully developed strand the assumption of strain compatibility is not valid at this section. At capacity the underdeveloped strand will slip while maintaining partial development as necessary for the fully developed strands to adequately strain in order to yield.

T = 8(0.153)269 + 2(0.153)197.3 = 389.6 kip

$$a = \frac{T}{0.85f'_c b} = \frac{389.6}{0.85\left(5\right)\left(120\right)} = 0.76 \text{ in.}$$

EXAMPLE 5.2.3.2 (Revised in accordance with 2011 Errata)

Moment Capacity of Component with Debonded Strands in Development Region (cont.)

Since this is less than the flange thickness, the design is like a rectangular beam.

$$M_n = T\left(d - \frac{a}{2}\right) = 389.6\left(20 - \frac{0.76}{2}\right) = 7644 \text{ kip-in.} = 637 \text{ kip-ft}$$

ϕ of the debonded strand at 12 ft from the end: (by interpolation)

$$\phi = (0.9) - \left[\left(\frac{269 - 197.3}{269 - 170}\right)(0.9 - 0.75)\right] = 0.79$$

Where ϕ of the fully bonded strand at 12 ft from the end = 0.9
And ϕ for the debonded strands through their transfer length = 0.75 (ACI 318-05, Section 9.3.2.7)
Then, flexural ϕ at section 12 ft from the end:

$$\phi = \frac{2(0.79) + 8(0.9)}{10} = 0.88$$

In this case:

ϕM_n = 0.88(637) = 560 kip-ft

Chapter 6

Page 6-72, last line: An equals sign (=) should replace the minus sign (-) between the term with notation and the term with numbers. It should read as follows:

$$e_h = \frac{N_p}{1.26 f'_c d_o C_{crp}} = \frac{20}{1.26(4)(1)(1.0)}$$

Page 6-100: Reference 19 should read: American Welding Society (AWS). 2005. *Structural Welding Code-Reinforcing Steel*, AWS D1.4-05. Miami, FL: AWS.

Page 6-101, Design Aid 6.15.1: Replace with Design Aid 6.15.1 as revised.

Page 6-102, Design Aid 6.15.3: Replace with Design Aid 6.15.3 as revised.

Page 6-103, Design Aid 6.15.4: Replace with Design Aid 6.15.4 as revised.

Page 6-104, Design Aid 6.15.5: Replace with Design Aid 6.15.5 as revised.

Page 6-105, Design Aid 6.15.6: The first bolt diameter shown in the left column as 1½ in. should be 1¼ in.

6.15 Design Aids

Design Aid 6.15.1 (Revised in accordance with 2011 Errata)
Allowable and Design Stress for Fillet and Partial Penetration Welds[a]

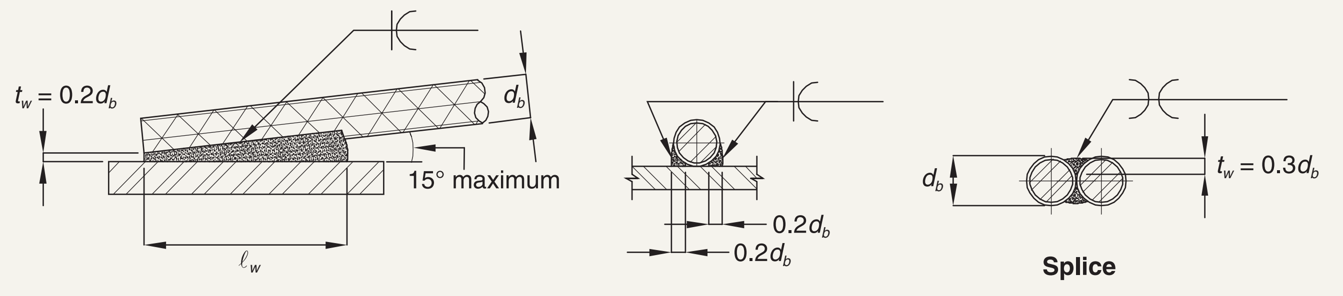
Electrode	Allowable[b] working stress, ksi	Design[c] strength, ksi
E70	21	31.5
E80	24	36.0
E90	27	40.5
E100	30	45.0

a. For partial penetration welds loaded in shear parallel to the axis of the weld.

b. Based on AISC *Steel Construction Manual*.[4]

c. Based on AISC *Steel Construction Manual*. Includes ϕ = 0.75.

Design Aid 6.15.3 (Revised in accordance with 2011 Errata) Minimum Length of Weld to Develop Full Strength of Bar. Weld Parallel to Bar Length[a,b,c]



Electrode	Bar size, # \ Plate thickness, in.	Minimum length of weld, in.[a]					Min.[e] splice length, in.
		1/4	5/16	3/8	7/16	1/2	
E70	3	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/4
	4	2	2	2	2	2	1 3/4
	5	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2
	6	3	3	3	3	3	2 1/2
	7	3 3/4	3 1/4	3 1/4	3 1/4	3 1/4	2 3/4
	8	5	4	3 3/4	3 3/4	3 3/4	3 1/4
	9	6 1/4	5	4 1/4	4 1/4	4 1/4	3 1/2
	10	8	6 1/4	5 1/4	4 3/4	4 3/4	4
	11	9 3/4	7 3/4	6 1/2	5 1/2	5 1/4	4 1/2
E80[d]	3	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1
	4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 1/2
	5	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	1 3/4
	6	2 3/4	2 1/2	2 1/2	2 1/2	2 1/2	2
	7	3 3/4	3	3	3	3	2 1/2
	8	5	4	3 1/2	3 1/2	3 1/2	2 3/4
	9	6 1/4	5	4 1/4	3 3/4	3 3/4	3
	10	8	6 1/4	5 1/4	4 1/4	4 1/4	3 1/2
	11	9 3/4	7 3/4	6 1/2	5 1/2	4 3/4	4
E90[d]	3	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1
	4	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/4
	5	2	2	2	2	2	1 1/2
	6	2 3/4	2 1/4	2 1/4	2 1/4	2 1/4	2
	7	3 3/4	3	2 3/4	2 3/4	2 3/4	2 1/4
	8	5	4	3 1/4	3	3	2 1/2
	9	6 1/4	5	4 1/4	3 3/4	3 1/2	2 3/4
	10	8	6 1/4	5 1/4	4 1/2	4	3 1/4
	11	9 3/4	7 3/4	6 1/2	5 1/2	5	3 1/2

a. Lengths above the heavy line are governed by weld strength. Lengths below the heavy line are governed by plate shear.
Basis: bar f_y = 60 ksi; plate F_y = 36 ksi; shear on plate limited to 0.9(0.6)(36) = 19.44 ksi.

b. Weld length listed is the required effective length of weld. Engineer should consider whether weld at start and stop is fully effective.

c. Refer to Design Aid 15.7.2 for specifications of flare bevel groove welds.

d. Refer to AWS D1.4-05, Table 5.1 for matching weld metal and AWS D1.4-05, Table 2.1 for cases where matching filler metal is required and unmatched filler metal may be used.

e. Values shown represent 1.25f_y in accordance with ACI 318-05, Section 12.14.2.4. For bar sizes #5 and smaller, a waiver is permitted if ACI 318-05, Section 12.15.4 is satisfied.

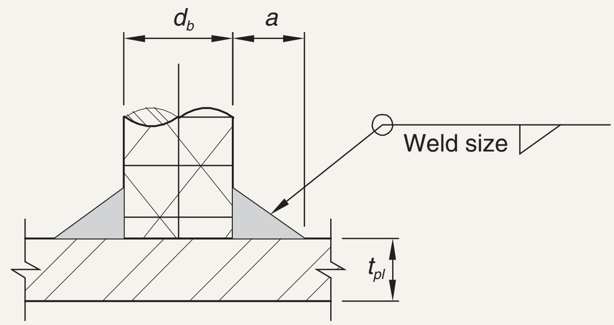
Design Aid 6.15.4 (Revised in accordance with 2011 Errata)
Size of Fillet Weld Required to Develop Full Strength of Bar. Butt Weld.

BAR PERPENDICULAR TO PLATE, WELDED ONE SIDE

$$\ell_w = \pi\left(d_b + \frac{a}{2}\right)$$

Plate = F_y = 36 ksi

Plate area = $\pi(d_b + 2_a)t_{pl}$



Bar size, #	E70 electrode		E80 electrode[a]		E90 electrode[a]	
	Weld size,[b] in.	Minimum plate thickness,[c] in.	Weld size,[b] in.	Minimum plate thickness,[c] in.	Weld size,[b] in.	Minimum plate thickness[c] t_{pl}, in.
Grade 40 bar						
3	3/16	1/4	3/16	1/4	3/16	1/4
4	1/4	1/4	3/16	1/4	3/16	1/4
5	1/4	1/4	1/4	1/4	1/4	1/4
6	5/16	1/4	1/4	1/4	1/4	1/4
7	3/8	5/16	5/16	5/16	5/16	5/16
8	7/16	5/16	3/8	5/16	5/16	3/8
9	7/16	3/8	7/16	3/8	3/8	3/8
10	1/2	3/8	7/16	7/16	7/16	7/16
11	9/16	7/16	1/2	7/16	7/16	1/2
Grade 60 bar						
3	1/4	1/4	3/16	1/4	3/16	1/4
4	5/16	1/4	1/4	1/4	1/4	1/4
5	3/8	1/4	5/16	1/4	5/16	5/16
6	7/16	5/16	3/8	5/16	3/8	5/16
7	1/2	3/8	7/16	3/8	3/8	3/8
8	9/16	3/8	1/2	7/16	7/16	7/16
9	5/8	7/16	9/16	1/2	1/2	1/2
10	11/16	1/2	5/8	1/2	9/16	9/16
11	3/4	9/16	11/16	9/16	5/8	5/8

a. Refer to AWS D1.4-05, Table 5.1 for matching weld metal and AWS D1.4-05, Table 2.1 for cases where matching filler metal is required and unmatched filler metal may be used.

b. A minimum of 3/16 in. weld size is suggested.

c. Theoretical thickness for shear stress on base metal = 0.9(0.6)(36) ksi. A more practical thickness might be taken as 1/2 d_b as used with headed studs. A minimum of 1/4 in. plate thickness is suggested.

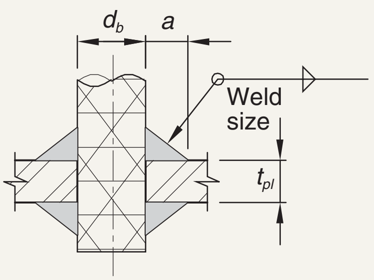
Design Aid 6.15.5 (Revised in accordance with 2011 Errata)
Size of Fillet Weld Required to Develop Full Strength of Bar. Weld Through Hole.

BAR PERPENDICULAR TO PLATE, WELDED BOTH SIDES

$$\ell_w = \pi\left[d_b + \frac{a}{2}\right]^2$$

Plate = F_y = 36 ksi

Plate area = $\pi(d_b + 2_a)t_{pl}$



Grade 40 bar						
Bar size, #	E70 electrode		E80 electrode[a]		E90 electrode[a]	
	Weld size,[b] in.	Minimum plate thickness,[c] [c] in.	Weld size,[b] in.	Minimum plate thickness,[c] in.	Weld size,[b] in.	Minimum plate thickness,[c] in.
3	3/16	1/4	3/16	1/4	3/16	1/4
4	3/16	1/4	3/16	1/4	3/16	1/4
5	3/16	1/4	3/16	1/4	3/16	1/4
6	3/16	5/16	3/16	5/16	3/16	5/16
7	3/16	3/8	3/16	3/8	3/16	3/8
8	1/4	3/8	3/16	7/16	3/16	7/16
9	1/4	7/16	1/4	7/16	3/16	7/16
10	5/16	1/2	1/4	1/2	1/4	1/2
11	5/16	9/16	5/16	9/16	1/4	9/16
Grade 60 bar						
3	3/16	1/4	3/16	1/4	3/16	1/4
4	3/16	1/4	3/16	5/16	3/16	5/16
5	3/16	5/16	3/16	3/8	3/16	3/8
6	1/4	3/8	1/4	7/16	3/16	7/16
7	5/16	7/16	1/4	1/2	1/4	1/2
8	5/16	1/2	5/16	9/16	1/4	9/16
9	3/8	9/16	5/16	5/8	5/16	5/8
10	3/8	5/8	3/8	11/16	5/16	11/16
11	7/16	11/16	3/8	3/4	3/8	3/4

a. Refer to AWS D1.4-05, Table 5.1 for matching weld metal and AWS D1.4-05, Table 2.1 for cases where matching filler metal is required and unmatched filler metal may be used.

b. A minimum of 3/16 in. weld size is suggested.

c. Theoretical thickness for shear stress on base metal = 0.9(0.6)(36) ksi. A more practical thickness might be taken as 1/2 d_b as used with headed studs. A minimum of 1/4 in. plate thickness is suggested.

Chapter 11

Page 11-24, Table 11.2.3: ICC in the footnote should be IIC.

Chapter 12

Page 12-4: Eq. 12-4 should read $f_n = \left(\frac{1.58}{\ell^2}\right)\sqrt{\frac{gE_dI}{w}}$.

Chapter 14

Page 14-24, Section 14.4.2.2, last sentence: Replace MNL-130-91 with MNL-130-09.

Page 14-27, Section 14.4.6.1: Replace MNL-130-91 with MNL-130-09.

Page 14-28, Section 14.4.8.3: Replace MNL-130-91 with MNL-130-09.

Page 14-28, Section 14.4.9.2, last sentence of the section: Replace Section 14.2 with Section 14.4.11.2.

Page 14-30, Section 14.4.10: Replace MNL-130-91 with MNL-130-09.

Page 14-35, Section 14.5.3, last sentence of second paragraph: Replace Section 14.3.1 with Section 14.4.3.2.

Chapter 15

Page 15-54, Design Aid 15.8.1, Circle: The value of c should read c = $\frac{d}{2}$ = R.

Appendix

Page A-20, Chapter 15: On page 15-39, the equation for compression development length should now include a lambda (λ) factor in the denominator where λ is in conformance with ACI 318-08, Section 12.2.4 (d).