



TECHNOTES

CFA-TN-001

Using ACI 332 with the IRC

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Goal and Purpose

This edition of Tech Notes explains the two major consensus standards that cover residential concrete construction and the potential benefits of using them together.

A standard, while written in mandatory code language, does not become a code until it is adopted by a government jurisdiction responsible for enacting and adopting codes. Most city and county governments adopt one or more standard documents developed by the ICC (International Codes Council), ACI, NEC and other standards developing organizations.

The two most relevant residential standards currently are:

ACI 332 STANDARD

The ACI 332 Committee—Residential Concrete, has developed a standard for concrete construction in residential applications. The complete title is *Requirements for Residential Concrete Construction (ACI 332-04)*. The '07 edition has expanded content for a broad range of concrete construction applications (available in 2008).

INTERNATIONAL RESIDENTIAL CODE (IRC)

Instead of totally rewriting the IRC to include the provisions of ACI 332, the proponents of the document (CFA, NAHB, ACI, and NRMCA) have taken the approach of having several chapters or sections of the ACI 332 Standard referenced in the IRC. The 2006 Edition of the IRC was the first to reference ACI 332-04. The 2006 Edition references the use of ACI 332 in the design of foundation walls, (Section R404) as follows:

R404.1 Concrete and masonry foundation walls. Concrete and masonry foundation walls shall be selected and constructed in accordance with the provisions of Section 404 or in accordance with the ACI 318, ACI 332, NCMA TR68-A or ACI 530/ASCE 5/TMS 402 or other approved structural standards. When ACI 318, ACI 332 or ACI 530/ASCE 5/TMS 402 or the provisions of Section R404 are used to design concrete or masonry foundation walls, project drawings, typical details and specifications are not required to bear the seal of the architect or engineer responsible for design, unless otherwise required by the state law of the jurisdiction having authority.

This simple reference enables a concrete foundation contractor in a jurisdiction that has adopted the IRC 2006 to use the provisions of Chapter 7 and Appendix A of ACI 332-04 for the design of residential foundation walls. A primary advantage is the Prescriptive Tables that offer greater flexibility and broader recognition for plain structural concrete. The tables offer concrete strengths ranging from 2500 psi to 4500 psi and wall heights up to 10 feet in height – a considerably wider range than IRC tables allow.

On the following page is a portion of one of the ten tables that are provided by 332. Each table combines both plain structural concrete requirements as well as reinforced concrete requirements to simplify the decision of wall design for the user.

ACI 332 results in an increased application of plain structural concrete. However, it should be noted that if reinforcement is required you may be better served by remaining in the 2006 IRC and using those combined tables. The IRC provides for what is termed “Moderately Reinforced Design” which prescribed less steel than the minimum amount permitted by ACI 318. The 332 committee plans to address this disconnect in future editions of the standard.

2009 IRC

The 2009 Edition of the IRC will reference the '07 edition of the 332 Standard in the existing Section R404 as well as R402 and R403. This broadens the application to address more of the advantageous information found in the updated 332 Standard.

The IRC Section R402.2—Concrete will reference the 332 Materials chapter (Chapter 3) as:

Materials used to produce concrete and testing thereof shall comply with the applicable standards listed in Chapter 3 of 'ACI 318' or 'ACI 332'.

The most significant advantage to this reference is the first mandatory reference to accepting contaminants on reinforcement...

3.2.4 Surface conditions of reinforcement—At the time concrete is placed, deformed bar and welded wire reinforcement shall be free of materials deleterious to development.

R3.2.4 Surface contaminants such as concrete splatter, form oil or other release agents, will not prevent the reinforcing bars from achieving design values cited in the code requirements.

The IRC Section 403.1 will reference the footings chapter (Chapter 6) as:

Concrete footings shall be selected and constructed in accordance with the provisions of Section R403 or in accordance with 'ACI 332' or other approved structural standards.

Some of the relevant and important provisions that the inclusion of this chapter brings into the code include the acceptance of discontinuous footings, and the placement of footing dowels.

TABLE A.4
VERTICAL REINFORCING BAR SPACING FOR CONCRETE BASEMENT WALLS

Unsupported wall height, ft.	$f'_c = 3,000$ psi		MAXIMUM EQUIVALENT FLUID PRESSURE OF SOIL, PSF/FT												
	$f'_y = 60,000$ psi		30			45			60			100			
	Unbalanced backfill, ft.	Reinforcing bar	Minimum wall thickness, in.												
			7.5	9.5	11.5	7.5	9.5	11.5	7.5	9.5	11.5	7.5	9.5	11.5	
8	5	#4 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain
		#5 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain
		#6 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain
	6	#4 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	18	Plain	Plain
		#5 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	28	Plain	Plain
		#6 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	39	Plain	Plain
	7	#4 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	22	Plain	Plain	13	17	Plain
		#5 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	33	Plain	Plain	20	26	Plain
		#6 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	46	Plain	Plain	28	37	Plain
10	5	#4 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	25	Plain	Plain
		#5 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	38	Plain	Plain
		#6 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	53	Plain	Plain
	6	#4 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	16	Plain	Plain
		#5 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	24	Plain	Plain
		#6 @ ... in.	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	33	Plain	Plain
	7	#4 @ ... in.	Plain	Plain	Plain	24	Plain	Plain	18	Plain	Plain	11	14	Plain	
		#5 @ ... in.	Plain	Plain	Plain	37	Plain	Plain	28	Plain	Plain	16	22	Plain	
		#6 @ ... in.	Plain	Plain	Plain	52	Plain	Plain	39	Plain	Plain	23	31	Plain	
	8	#4 @ ... in.	Plain	Plain	Plain	18	Plain	Plain	13	17	Plain	9	10	13	
		#5 @ ... in.	Plain	Plain	Plain	27	Plain	Plain	20	27	Plain	14	16	20	
		#6 @ ... in.	Plain	Plain	Plain	38	Plain	Plain	29	38	Plain	21	23	28	
	9	#4 @ ... in.	21	Plain	Plain	14	18	Plain	10	14	17	8	8	10	
		#5 @ ... in.	32	Plain	Plain	21	28	Plain	16	21	26	12	12	15	
		#6 @ ... in.	45	Plain	Plain	30	39	Plain	22	29	37	17	17	22	

Notes:

1. The term "plain" refers to concrete where no vertical reinforcement is required other than reinforcement consistent with 7.2.9 of this code.
2. This table is applicable to walls of specified height, unbalanced backfill height, equivalent fluid pressure of soil, concrete strength, and the yield strength of reinforcement.
3. This table is applicable only when the structure is not assigned to Seismic Design Category D, E, or F or located in Seismic Zones 3 or 4.
4. Values in this table are derived in accordance with ACI 318-02 and 7.2 of this code.

DISCONTINUOUS WALL FOOTINGS

ACI 332 states:

6.2.5 Discontinuous wall footings—Where a wall footing is discontinuous due to an abrupt elevation change, the maximum horizontal discontinuity of the wall footing shall be 4 ft. In addition, the reinforcement in the foundation wall at such a location shall conform to the requirements of 7.2.9.

R6.2.5 Abrupt elevation changes, commonly referred to as steps, usually occur in locations such as walk-out basements, grade changes, and transitions to garage foundations. At such locations, the wall spans the horizontal discontinuity of the footing. Refer to Fig. R6.2.

FOOTING DOWELS

ACI 332 states:

6.3.4.1 A No. 4 dowel shall extend at least 12 in. into the wall and 6 in. into the footing at a maximum of 24 in. on-center along the footing. To facilitate positioning before concrete placement, vertical dowels are permitted to be driven into the grade in the bottom of the footing. ■

ABOUT THE CFA

The Concrete Foundations Association (CFA) was formed in 1975 to serve the interests of poured wall contractors. As an international nonprofit trade association with a diverse membership spread throughout the United States and Canada, maintains a network that permits individuals with needs and interests to seek advice and professional experience while curating forums where contractors exchange ideas and gain insight for technological and practice advancements.