IRC and ACI 332

Alternative Tables for Basement & Foundation Walls

TECHNICAL BULLETIN . ENGINEERING DESIGN 1.05.06

Fox Blocks are a flat wall concrete forming system and are recognized as being code compliant with the CCRR-1010 Intertek Building Code Evaluation Report. Within this report the following specifications are listed for the design of the concrete walls:

- Concrete minimum strength of 2500 psi at 28 days
- Steel Reinforcing minimum yield strength of 60,000 psi

This document addresses concrete and steel reinforcement design for flat concrete foundation walls – 6" and 8" per IRC Section R404.1.3. The vertical reinforcement specifications utilize tables – R404.1.2(2), (3) and (8). The attached tables - 1 to 6, indicate alternative rebar sizes and spacing that meets engineering requirements as listed in 2015 IRC table R401.1.2(9) and ACI 332-14 table 8.2.1.3b.

In referencing these IRC tables, a majority of, the reinforcement bar size is #6 rebar with a yield strength of 60,000 psi. The notes in the tables allow for alternative bar sizes and spacing to be used following table R404.1.2(9). This table specifies a Minimum Spacing for Alternate Bar Sizes, basically providing an alternative to a #6 or #5 bar with conversion tables for #6 to #5 or #4 and #5 to #4. **The intent of the alternative design being that the same density of steel is installed in the wall only using smaller rebar but with a tighter spacing.**

Fox Blocks cost and labor analysis identifies that using #6 rebar has several drawbacks when building an ICF foundation wall -

- More expensive
- Heavier to handle on site
- More labor intensive to lift and insert into the top of the ICF wall
- Harder to cut and bend

Typically, in residential construction, the reinforcing used in most Fox Blocks walls is either #4 or #5 because it is lighter and easier to work with – cutting and bending. A material cost analysis shows that using #4 rebar, even with a tighter spacing, can be less expensive than using #5 rebar. Although, there may be less labor involved placing #5@24" than doing #4@12", the contractor needs to make that decision on which size and spacing to use to be cost effective.

This bulletin references residential design per - 2015 IRC and ACI 332-14 and only applies to US.

These tables do not comply with Seismic Design Categories D, E or F.

These codes and standards identify minimum requirements that meet the typical applicability limits as specified in the codes and standards.

These tables cannot be used, if the foundation wall design deviates from the actual wall configurations (heights and backfill heights) and the soil classifications as listed in the tables.

All foundations are to be laterally supported at the top.

In the attached tables 1 to 6 the most economical rebar design is highlighted in blue. Note, these are minimum requirements and may be adjusted to allow for a tighter spacing or heavy rebar, i.e. 4@25 could be revised to 4@24.

The Fox Blocks webs are spaced at 8" increments, so reducing the increments to work at a 4" or 8" spacing will be more efficient.

IRC and ACI 332

Alternative Tables for Basement & Foundation Walls

ACI 332-14 RESIDENTIAL CODE REQUIREMENTS FOR STRUCTURAL CONCRETE

The IRC code recognizes alternative engineering design from ACI 332, which includes ICF foundation walls. Similar vertical reinforcement tables for flat wall concrete foundations address 7.5", 9.5" and 11.5" concrete core sizes. This technical bulletin only references Table 8.2.1.3b - Vertical Reinforcing for 2500 psi concrete and 60,000 psi steel. The same wall heights, backfill heights and soil classifications as listed in the IRC tables applies.

The attached Tables using the ACI 332 table only reference 8" flat wall foundations. ACI 332-14 also has vertical rebar tables for higher strength concrete.

Reinforcement Location

All flat wall concrete foundation /basement shall have the vertical reinforcement placed toward the inside face or tension side of the wall. The minimum spacing between the center of the bar and the face of the concrete, as per 2015 IRC is 1¼". The design of the Fox Blocks connectors permits a horizontal bar to be placed in the first slot nearest the concrete face, this allows the vertical bar to be placed against the horizontal bar, approximately 2"± from the concrete face. Placement of the vertical bar is coordinated with the placement of horizontal bar on either side up the wall.

Refer to Fox Blocks CAD details 2-01 and 2-02 for reinforcement placement.

SUMMARY

The attached tables may be used for Fox Blocks - 6" and 8" foundation/basement wall designs, to be in compliance with the 2015 IRC and ACI 332-14 standards. The tables must be read in coordination with this document 1.05.11.

When utilizing the alternative table R404.1.2(9) or ACI 332 rebar designs ensure that the permit drawings and/or building department are aware of the reference and change of bar size and spacing.

Follow Fox Blocks installation instructions for placement of reinforcing and concrete.

For further Fox Blocks prescriptive engineering design including 10" and 12" walls and foundations wall of greater height than 10', refer to the 1.05.01 - Fox Blocks Prescriptive Design Guide US.

Note, the IRC Tables indicate that a 6" Flat Wall form is acceptable for typical foundation walls of 8 and 9 feet high and some 10' high. Some building departments may only allow a minimum of 8" foundation walls.

All designs below and above grade must meet the applicability limits in the building codes.

Terminology for rebar spacing i.e. 4@24" - the first number '4' is the rebar size, the second number '24' is the on center spacing of the bar placement in inches.

DISCLAIMER

The information supplied in this document and tables, for residential construction as covered in the 2015 IRC, represents the minimum 2015 IRC and ACI 332 requirements for vertical reinforcement for 6" and 8" flat wall concrete foundation/basement walls. When using the engineering in the 2015 IRC and ACI 332-14 there are more variables and applicability limits to be considered in the design and installation of flat concrete foundation walls, which are the USERS responsibility.

Fox Blocks is the manufacturer of stay-in-place formwork for cast-in-place flat, plain or steel reinforced concrete walls. The Fox Blocks formwork is not a structural component of the wall. The plain or steel reinforced concrete wall is the structural component.

IRC and ACI 332

Alternative Tables for Basement & Foundation Walls

1	**IRC TABLES - 6" FLAT CONCRETE - BASEMENT WALL VERTICAL REINFORCING** *per IRC 2015 Tables R404.1.2 (2), R404.1.2 (8) and R404.1.2(9)*						
WALL HEIGHT	**MAX BACKFILL HEIGHT**	**MINIMUM Vertical Reinforcement - 6" Flat Concrete Basement Walls**					
		Soil classes (psf per foot of depth)					
		30 PSF SOIL					
		R404.1.2(2)	**R404.1.2(8)**	**ACI 332-14**	**R404.1.2(9)** Alternate #4 for #5 Bar	**R404.1.2(9)** Alternate #4 for #6 Bar	**R404.1.2(9)** Alternate #5 for #6 Bar
8	4	4@48	4@48	Not applicable for 6"			
	5	4@48	4@48				
	6	5@39	4@37		4@25		
	7	6@48	5@40		4@26	4@22	5@34
	8	6@39	6@43			4@18	5@27
9	4	4@48	4@48	Not applicable for 6"			
	5	4@48	4@48				
	6	5@36	4@34		4@23		
	7	6@47	5@36		4@23	4@23	5@33
	8	6@34	6@38			4@15	5@24
	9	6@27	6@34			4@12	5@19
10	4	4@48	4@48	Not applicable for 6"			
	5	4@48	4@48				
	6	6@48	5@48		4@31	4@22	5@34
	7	6@43	6@47			4@20	5@30
	8	6@31	6@34			4@14	5@22
	9	6@24	6@34			4@11	5@17
	10	6@19	6@28			4@9	5@13
NOTES	1. Rebar size is first number - 4,5 or 6, second number, in inches, is vertical on center spacing 2. Minimum vertical rebar for 6" flat wall foundations is 4@48" on center 3. Tables are for 2500 psi concrete and Grade 60,000 psi rebar 4. Tables indicate foundation walls reinforcement supporting concrete above grade walls 5. Horizontal rebar is per IRC Table R404.1.2(1), Fox Blocks recommends as minimum #4@32 with top bar within 12" of top of concrete and a bar in the first block course 6. Foundation rebar is placed toward the inside face of the wall, with a minimum of 3/4" concrete coverage						
	Cells in this shade indicate the most cost efficient or minimum requirement						

Note: This table is in coordination with, and must be read with the Technical Document 1.05.11

IRC and ACI 332

Alternative Tables for Basement & Foundation Walls

2	**IRC TABLES - 6" FLAT CONCRETE - BASEMENT WALL VERTICAL REINFORCING** *per IRC 2015 Tables R404.1.2 (2), R404.1.2 (8) and R404.1.2(9)*						
WALL HEIGHT	**MAX BACKFILL HEIGHT**	**MINIMUM Vertical Reinforcement - 6" Flat Concrete Basement Walls**					
		Soil classes (psf per foot of depth)					
		45 PSF SOIL					
		R404.1.2(2)	**R404.1.2(8)**	**ACI 332-14**	**R404.1.2(9)** Alternate #4 for #5 Bar	**R404.1.2(9)** Alternate #4 for #6 Bar	**R404.1.2(9)** Alternate #5 for #6 Bar
8	4	4@48	4@48	Not applicable for 6"			
	5	5@39	4@38				
	6	6@48	5@37			4@22	5@34
	7	6@34	6@37			4@17	5@26
	8	6@25	6@34			4@15	5@24
9	4	4@48	4@48	Not applicable for 6"			
	5	5@37	4@35		4@24		
	6	6@44	6@48			4@22	5@34
	7	6@30	6@34			4@15	5@24
	8	6@22	6@33			4@15	5@23
	9	6@17	6@26			4@12	5@18
10	4	4@48	4@48	Not applicable for 6"			
	5	5@35	4@33				
	6	6@41	6@45			4@20	5@32
	7	6@28	6@34			4@15	5@24
	8	6@20	6@30			4@14	5@21
	9	6@15	6@23			4@10	5@16
	10	DR	DR			DR	DR

NOTES

1. Rebar size is first number - 4,5 or 6 , second number, in inches, is vertical on center spacing
2. Minimum vertical rebar for 6" flat wall foundations is 4@48" on center
3. Tables are for 2500 psi concrete and Grade 60,000 psi rebar
4. Tables indicate foundation walls reinforcement supporting concrete above grade walls
5. Horizontal rebar is per IRC Table R404.1.2(1), Fox Blocks recommends as minimum #4@32 with top bar within 12" of top of concrete and a bar in the first block course
6. Foundation rebar is placed toward the inside face of the wall, with a minimum of 3/4" concrete coverage
7. DR - design required per ACI 318

Cells in this shade indicate the most cost efficient or minimum requirement

Note: This table is in coordination with, and must be read with the Technical Document 1.05.11

IRC and ACI 332

Alternative Tables for Basement & Foundation Walls

3	**IRC TABLES - 6" FLAT CONCRETE - BASEMENT WALL VERTICAL REINFORCING** *per IRC 2015 Tables R404.1.2 (2), R404.1.2 (8) and R404.1.2(9)*						
WALL HEIGHT	**MAX BACKFILL HEIGHT**	**MINIMUM Vertical Reinforcement - 6" Flat Concrete Basement Walls**					
		Soil classes (psf per foot of depth)					
		60 PSF SOIL					
		R404.1.2(2)	**R404.1.2(8)**	**ACI 332-14**	**R404.1.2(9)** Alternate #4 for #5 Bar	**R404.1.2(9)** Alternate #4 for #6 Bar	**R404.1.2(9)** Alternate #5 for #6 Bar
8	4	4@48	4@48	Not applicable for 6"			
	5	6@48	5@43		4@28	4@22	5@34
	6	6@35	6@37			4@17	5@26
	7	6@25	6@34			4@15	5@24
	8	6@18	6@27			4@12	5@19
9	4	4@48	4@48	Not applicable for 6"			
	5	6@48	5@40		4@26	4@22	5@34
	6	6@32	6@36			4@16	5@25
	7	6@22	6@33			4@15	5@23
	8	6@16	6@24			4@11	5@17
	9	D	6@19			4@9	5@13
10	4	4@48	4@48	Not applicable for 6"			
	5	6@48	5@38		4@25	4@22	5@34
	6	6@30	6@34			4@15	5@24
	7	6@20	6@30			4@14	5@21
	8	DR	6@22			4@10	5@16
	9	DR	DR		5@8		
	10	DR	DR		5@8		

NOTES

1. Rebar size is first number - 4,5 or 6 , second number, in inches, is vertical on center spacing
2. Minimum vertical rebar for 6" flat wall foundations is 4@48" on center
3. Tables are for 2500 psi concrete and Grade 60,000 psi rebar
4. Tables indicate foundation walls reinforcement supporting concrete above grade walls
5. Horizontal rebar is per IRC Table R404.1.2(1), Fox Blocks recommends as minimum #4@32 with top bar within 12" of top of concrete and a bar in the first block course
6. Foundation rebar is placed toward the inside face of the wall, with a minimum of 3/4" concrete coverage
7. Rebar indicate for 10' wall ht. with 9' & 10' backfill is Fox Blocks Prescriptive Engineering
8. DR - design required per ACI 318

Cells in this shade indicate the most cost efficient or minimum requirement

Indicates Fox Blocks Prescriptive Design

Note: This table is in coordination with, and must be read with the Technical Document 1.05.11

IRC and ACI 332

Alternative Tables for Basement & Foundation Walls

4	**IRC TABLES - 8" FLAT CONCRETE - BASEMENT WALL VERTICAL REINFORCING** *per IRC 2015 Tables R404.1.2 (3), R404.1.2 (8), R404.1.2(9) and ACI 332-14 Table 8.2.1.3b*						
WALL HEIGHT	**MAX BACKFILL HEIGHT**	**MINIMUM Vertical Reinforcement - 8" Flat Concrete Basement Walls**					
		Soil classes (psf per foot of depth)					
		30 PSF SOIL					
		R404.1.2(2)	**R404.1.2(8)**	**ACI 332-14**	**R404.1.2(9)** Alternate #4 for #5 Bar	**R404.1.2(9)** Alternate #4 for #6 Bar	**R404.1.2(9)** Alternate #5 for #6 Bar
8	4	NR	NR	NR			
	5	NR	NR	NR			
	6	NR	NR	NR			
	7	NR	NR	NR			
	8	6@41	5@47	NR	4@30	4@19	5@29
9	4	NR	NR	NR			
	5	NR	NR	NR			
	6	NR	NR	NR			
	7	NR	NR	NR			
	8	6@36	5@41	NR	4@26	4@16	5@25
	9	6@35	6@46	NR		4@21	5@32
10	4	NR	NR	NR			
	5	NR	NR	NR			
	6	NR	NR	NR			
	7	NR	NR	NR			
	8	6@35	5@38	4@27	4@25	4@16	5@25
	9	6@34	6@41	4@21		4@19	5@29
	10	6@27	6@33	DR		4@15	5@23

NOTES

1. Rebar size is first number - 4,5 or 6 , second number, in inches, is vertical on center spacing
2. NR - no vertcal rebar required
3. Tables are for 2500 psi concrete and Grade 60,000 psi rebar
4. Tables indicate foundation walls reinforcement supporting concrete above grade walls
5. Horizontal rebar is per IRC Table R404.1.2(1), Fox Blocks recommends as minimum #4@32 with top bar within 12" of top of concrete and one bar in first block course
6. Foundation rebar is placed toward the inside face of the wall, with a minimum of 3/4" concrete coverage
7. DR - design required per ACI 318

Cells in this shade indicate the most cost efficient or minimum requirement

Note: This table is in coordination with, and must be read with the Technical Document 1.05.11

IRC and ACI 332

Alternative Tables for Basement & Foundation Walls

5	**IRC TABLES - 8" FLAT CONCRETE - BASEMENT WALL VERTICAL REINFORCING** *per IRC 2015 Tables R404.1.2 (3), R404.1.2 (8), R404.1.2(9) and ACI 332-14 Table 8.2.1.3b*						
WALL HEIGHT	**MAX BACKFILL HEIGHT**	**MINIMUM Vertical Reinforcement - 8" Flat Concrete Basement Walls**					
		Soil classes (psf per foot of depth)					
		45 PSF SOIL					
		R404.1.2(2)	**R404.1.2(8)**	**ACI 332-14**	**R404.1.2(9)** Alternate #4 for #5 Bar	**R404.1.2(9)** Alternate #4 for #6 Bar	**R404.1.2(9)** Alternate #5 for #6 Bar
8	4	NR	NR	NR			
	5	NR	NR	NR			
	6	NR	NR	NR			
	7	5@41	NR	NR	4@26		
	8	6@43	5@47		4@30	4@20	5@30
9	4	NR	NR	NR			
	5	NR	NR	NR			
	6	NR	NR	NR			
	7	5@37	NR	4@26	4@24		
	8	6@38	5@41	4@19	4@26	4@17	5@27
	9	6@30	6@46			4@21	5@32
10	4	NR	NR	NR			
	5	NR	NR	NR			
	6	NR	NR	NR			
	7	6@48	NR	4@24		4@22	5@34
	8	6@34	5@38	4@18	4@25	4@15	5@24
	9	6@27	6@41	4@14		4@19	5@29
	10	6@23	6@33			4@15	5@23
NOTES	1. Rebar size is first number - 4,5 or 6 , second number, in inches, is vertical on center spacing 2. NR - no vertical rebar required 3. Tables are for 2500 psi concrete and Grade 60,000 psi rebar 4. Tables indicate foundation walls reinforcement supporting concrete above grade walls 5. Horizontal rebar is per IRC Table R404.1.2(1), Fox Blocks recommends as minimum #4@32 with top bar within 12" of top of concrete and one bar in first block coourse 6. Foundation rebar is placed toward the inside face of the wall, with a minimum of 3/4" concrete coverage						
	Cells in this shade indicate the most cost efficient or minimum requirement						

Note: This table is in coordination with, and must be read with the Technical Document 1.05.11

IRC and ACI 332

Alternative Tables for Basement & Foundation Walls

6	IRC TABLES - 8" FLAT CONCRETE - BASEMENT WALL VERTICAL REINFORCING *per IRC 2015 Tables R404.1.2 (3), R404.1.2 (8), R404.1.2(9) and ACI 332-14 Table 8.2.1.3b*						
WALL HEIGHT	MAX BACKFILL HEIGHT	MINIMUM Vertical Reinforcement - 8" Flat Concrete Basement Walls					
		Soil classes (psf per foot of depth)					
		60 PSF SOIL					
		R404.1.2(2)	R404.1.2(8)	ACI 332-14	R404.1.2(9) Alternate #4 for #5 Bar	R404.1.2(9) Alternate #4 for #6 Bar	R404.1.2(9) Alternate #5 for #6 Bar
8	4	NR	NR	NR			
	5	NR	NR	NR			
	6	6@37	5@43	NR	4@28	4@17	5@26
	7	6@35	6@43			4@20	5@30
	8	6*26	6@32			4@15	5@23
9	4	NR	NR	NR			
	5	NR	NR	NR			
	6	6@35	6@39	NR		4@18	5@27
	7	6@32	6@38			4@17	5@27
	8	6@23	6@29			4@13	5@20
	9	6@18	6@23			4@10	5@16
10	4	NR	NR	NR			
	5	NR	NR	NR			
	6	6@35	5@37	4@26	4@24	4@16	5@25
	7	6@29	6@35	4@18		4@16	5@25
	8	6@21	6@26	4@13		4@12	5@18
	9	6@16	6@22	4@10		4@10	5@16
	10	6@13	6@22			4@10	5@16

NOTES

1. Rebar size is first number - 4,5 or 6 , second number, in inches, is vertical on center spacing
2. NR - no vertical rebar required
3. Tables are for 2500 psi concrete and Grade 60,000 psi rebar
4. Tables indicate foundation walls reinforcement supporting concrete above grade walls
5. Horizontal rebar is per IRC Table R404.1.2(1), Fox Blocks recommends as minimum #4@32 with top bar within 12" of top of concrete and one bar in first block course
6. Foundation rebar is placed toward the inside face of the wall, with a minimum of 3/4" concrete coverage
7. DR - engineering design required per ACI 318

Cells in this shade indicate the most cost efficient or minimum requirement

Note: This table is in coordination with, and must be read with the Technical Document 1.05.11