

Swimming Pool Engineering Design Guide



TECHNICAL BULLETIN . ENGINEERING DESIGN

1.05.08

PREScriptive ENGINEERING SPECIFICATIONS

The following notes, tables and drawings are intended to offer prescriptive structural design for the design of residential swimming pools utilizing reinforced concrete with Fox Blocks ICF. These documents attempt to cover an array of typical conditions, however, many unique scenarios, layouts, and conditions outside the scope of these documents may be encountered. Geotechnical Engineering and/or Structural Engineering assistance should be sought in those cases.

This document does not address plumbing, electrical or other requirements. Pool structural designs utilizing the prescriptive design provided herein shall also adhere to all applicable building code requirements including any local code requirements/amendments.

A specific engineered design is required for pools that are unique in shape, that are located in areas with poor soils, high water tables or expansive soils, areas of high seismicity, or otherwise do not meet the limitations of this document.

The general design procedure consists of two basic scenarios. One for the design of in-ground swimming pool walls and a second for walls that are primarily above ground. Many pools now utilize a combination of above ground and below ground walls (infinity edge pools are often dug in on one side, partially dug in on two sides, and primarily above ground on the infinity edge end). Thus, both procedures may apply on the same pool. Special engineering design shall be required for applications that do not meet the limitations of these procedures.

General notes that are applicable regardless of ICF pool type are provided. Following those are basic procedural outlines, wall thickness and reinforcing tables, and drawings for both above ground and in-ground pools.

In addition to these specific swimming pool requirements, the installer shall be familiar with all general/applicable Fox Blocks ICF construction methods and limitations. These documents do not alleviate the need for engineering judgment and shall not be considered to supersede any local building department regulations. Means and methods of construction are also beyond the scope of this document and are the responsibility of the installer.

REFERENCES

Table 1-1	6" ICF IN-GROUND SWIMMING POOL WALL AND FOOTING REINFORCING
Table 1-2	8" ICF IN-GROUND SWIMMING POOL WALL AND FOOTING REINFORCING
Table 2-1	6" ICF ABOVE GROUND SWIMMING POOL WALL AND FOOTING REINFORCING
Table 2-2	8" ICF ABOVE GROUND SWIMMING POOL WALL AND FOOTING REINFORCING
DRAWING No. SPW-1	ICF SWIMMING POOL WALL < 4'-0"
DRAWING No. SPW-2	ICF SWIMMING POOL WALL DETAIL HEIGHT > 4'-0"
DRAWING No. SPW-3	ICF SWIMMING POOL WALL DETAIL ABOVE GROUND – OPTION A
DRAWING No. SPW-4	ICF SWIMMING POOL WALL DETAIL ABOVE GROUND – OPTION B
DRAWING No. SPW-5	FOOTING DETAILS AT SLOPED FLOOR SLAB

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This engineering design guide is specific for pool wall heights above and below grade. The length and width of the pool design do not influence the engineering wall design following the tables herein.

FOUNDATIONS AND CONCRETE

1. Excavation for footings shall be cut to accurate size and dimensions as shown on plans. Contractor is responsible to maintain excavations and backfill materials at an appropriate moisture content for proper capacity and compaction. Concrete shall be placed as soon as possible after excavations are opened.
2. Shoring should be provided for any excavations that are cut at a slope steeper than 2 horizontal to 1 vertical.
3. Footings are designed for a minimum allowable soil bearing capacity of 2000 psf. If there is any question as to the suitability of soil a local geotechnical engineer shall be engaged to verify soil capacity. Adequate soil capacity is critical to the performance of walls constructed in this manner. All foundations shall be placed on native soils on an engineered fill placed in accordance with local geotechnical engineer recommendations.
4. Concrete shall be as follows (meet ASTM C 94):
 - 28-day compressive strength: 4,000 psi min.
 - Maximum water to cement ratio: 0.45 (0.50 for footings)
 - Slump: 5" $\pm$ 1"
 - Air-entrainment: 6% $\pm$ 1% (not required for footings but required for stem walls) Air-entraining admixture shall conform to ASTM C260.
 - Care shall be taken to ensure that concrete is well consolidated in the forms.
 - Concrete for pool slab shall contain a crystalline waterproofing admixture.
5. Reinforcing steel shall meet ASTM A 615, Grade 60. See next page for additional information.
6. No lime sand fine aggregate may be used.
7. When placing concrete in hot weather, refer to ACI 301, when placing concrete in cold weather, refer to ACI 306.1.
8. Drainage fill shall be a free-draining granular material. Use #57 stone or equal. Refer to ASTM D448 for gradation.
9. At retaining walls filter fabric shall be placed at the interface between the drainage fill and either natural or compacted subgrade. Perforated drains shall also be wrapped with filter fabric.

NOTES

- A. Swimming pool base slabs shall contain CRYSTALLINE waterproofing admixture, comply with all manufacturer's recommendations.

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REINFORCING STEEL

1. All reinforcing steel shall conform to ASTM A615 grade 60.
2. Detailing, materials, and installation of concrete reinforcing steel shall meet requirements as set forth by CRSI and the American Concrete Institute and the applicable building code.
3. Reinforcing steel in ICF walls to be placed at the center of the wall.
4. Splice/embed rebar per the tables below (for 4000 psi concrete).

MINIMUM LAP SPLICE LENGTHS	
Bar Size	Splice Length
#4	25"
#5	31"
#6	37"

HOOKED DOWEL DEVELOPMENT LENGTHS		
Bar Size	Embedment	Extension
#4	9"	6"
#5	12"	7.5"
#6	14"	9"

HORIZONTAL REINFORCEMENT

1. Per the attached drawings SPW-1, 2, 3 and 4, the horizontal reinforcement shall be as specified:
 - 6" concrete core #4 @ 16" o.c
 - 8" concrete core #5 @ 16" o.c

REFERENCE CODES

1. BUILDING CODE FOR STRUCTURAL CONCRETE (ACI 318).
2. MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES (ASCE 7-10/16).
3. INTERNATIONAL RESIDENTIAL CODE (IRC 2015/18).
4. INTERNATIONAL BUILDING CODE (IBC 2015/18).

Prescriptive swimming pool design tables and drawings have been sealed by a Professional Engineer in the State of Missouri. Some counties/municipalities or other governing bodies may require specific design. Please consult Fox Blocks for assistance in this case.

REINFORCEMENT BAR CONVERSION

#4 = 10M #5 = 15M #6 = 20M

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GENERAL DESIGN PROCEDURES

IN-GROUND SWIMMING POOL WALLS

1. Determine the appropriate below ground wall reinforcement table:
 - Table 1-1: 6" ICF In-Ground Pool Wall
 - Table 1-2: 8" ICF In-Ground Pool Wall

Note: These tables DO NOT apply where expansive soils are prevalent. These soils can exert high forces on pool walls and require specific design. Where expansive soils are present additional guidance from qualified engineers should be sought.

2. Determine equivalent fluid pressure category of soil (this is pressure exerted on the walls by the soil).

SOIL TYPE	SAND	SILT	CLAY
Equivalent Fluid Pressure (pcf)	30	45	60

If needed, consult with a Professional Geotechnical Engineer to assist in determining an appropriate value from the table above. Where high water tables are present consult a Professional Engineer.

3. Determine the maximum pool wall height and use Detail SPW-1 for wall heights of 4'-0" or less and SPW-2 for greater than 4'-0" walls.
4. Determine dimensions and reinforcing for the footing from the appropriate table in conjunction with the detail determined in the previous step.
5. Determine ICF wall vertical reinforcing. This reinforcing shall be placed at the center of the wall.
6. ICF wall horizontal reinforcing per the attached drawings SPW-1, 2, 3 or 4 -
7. For partial in-ground pools where at least 5'-0" of the pool wall is below grade the wall may be allowed to extend up to 3'-0" above grade using the same vertical wall reinforcing as the below grade wall system.

NOTES

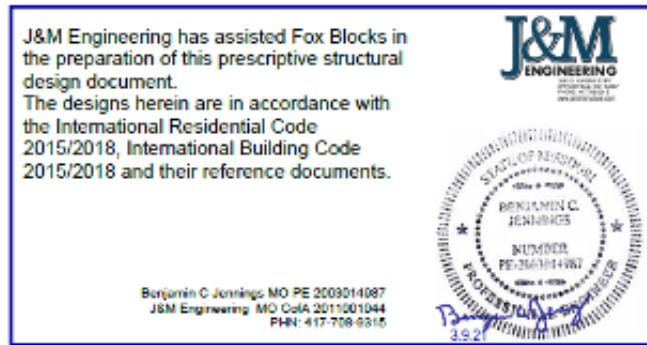
- A. No heavy equipment, vehicles, etc., shall be placed within a distance of the wall equal to the walls height until concrete has reached full strength and pool has been filled. Pool walls are not designed for surcharge loads.
- B. In-Ground swimming pools shall remain filled (per industry standards) at all times except for short periods as required for maintenance.

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ABOVE GROUND SWIMMING POOL WALLS

1. Determine the appropriate above ground wall reinforcement table:
 - Table 2-1: 6" ICF Above Ground Pool Wall
 - Table 2-2: 8" ICF Above Ground Pool Wall
2. Determine the maximum pool wall height and use Detail SPW-3/4.
3. Determine dimensions and reinforcing for the footing from the appropriate table in conjunction with the detail determined from the previous step.
4. Determine ICF wall vertical reinforcing. This reinforcing shall be placed at the center of the wall.
5. Determine ICF wall horizontal reinforcing.



DISCLAIMER AND LIMITATION OF LIABILITY

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TABLE 1-1: 6" ICF IN-GROUND SWIMMING POOL WALL AND FOOTING REINFORCING

MAX. WALL HEIGHT (FT)	REF. DETAIL	EQUIVALENT FLUID PRESSURE (PCF)																	
		30 PCF					45 PCF					60 PCF							
		WALL	FOOTING				WALL	FOOTING				WALL	FOOTING						
			Vertical Reinf.	W (Inch)	T (Inch)	REINFORCING		Vertical Reinf.	W (Inch)	T (Inch)	REINFORCING		Vertical Reinf.	W (Inch)	T (Inch)	REINFORCING			
						Long.					Trans.					Long.	Trans.	Long.	Trans.
3'-0"	SPW-1	#4 @ 16"	24	10	3 - #4 T&B	#4 @ 16" BOT	#4 @ 16"	24	10	3 - #4 T&B	#4 @ 16" BOT	#4 @ 16"	24	10	3 - #4 T&B	#4 @ 16" BOT			
4'-0"	SPW-1	#4 @ 16"	24	10	3 - #4 T&B	#4 @ 16" BOT	#4 @ 16"	30	12	3 - #4 T&B	#4 @ 16" BOT	#4 @ 16"	36	12	4 - #4 T&B	#4 @ 16" BOT			
5'-0"	SPW-2	#4 @ 16"	30	12	4 - #4 T&B	#4 @ 16" T&B	#4 @ 16"	32	12	4 - #4 T&B	#4 @ 16" T&B	#5 @ 16"	42	12	5 - #4 T&B	#4 @ 16" T&B			
6'-0"	SPW-2	#4 @ 16"	36	12	4 - #4 T&B	#5 @ 16" T&B	#5 @ 16"	42	12	4 - #4 T&B	#5 @ 16" T&B	#5 @ 12"	48	12	5 - #4 T&B	#5 @ 12" T&B			
7'-0"	SPW-2	#5 @ 16"	42	12	5 - #4 T&B	#5 @ 16" T&B	#5 @ 10"	48	12	5 - #4 T&B	#5 @ 16" T&B	NOT RECOMMENDED							
8'-0"	SPW-2	#5 @ 10"	48	12	6 - #4 T&B	#5 @ 14" T&B	NOT RECOMMENDED					NOT RECOMMENDED							
9'-0"	SPW-2	NOT RECOMMENDED					NOT RECOMMENDED					NOT RECOMMENDED							

T = Top Reinforcing

B or Bot = Bottom Reinforcing

Where vertical rebar is spaced at 10" or 12" o.c., bars may be spaced at 8" o.c. to avoid any possible interference with ICF cross ties. Bars at 8" spacing can be centered between ties. Dowels that interfere with ties must be field bent to avoid tie.

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TABLE 1-2: 8" ICF IN-GROUND SWIMMING POOL WALL AND FOOTING REINFORCING

MAX. WALL HEIGHT (FT)	REF. DETAIL	EQUIVALENT FLUID PRESSURE (PCF)																	
		30 PCF					45 PCF					60 PCF							
		WALL	FOOTING				WALL	FOOTING				WALL	FOOTING						
			Vertical Reinf.	W (Inch)	T (Inch)	REINFORCING		Vertical Reinf.	W (Inch)	T (Inch)	REINFORCING		Vertical Reinf.	W (Inch)	T (Inch)	REINFORCING			
						Long.					Trans.					Long.	Trans.	Long.	Trans.
3'-0"	SPW-1	#5 @ 16"	24	10	3 - #4 T&B	#4 @ 16" BOT	#5 @ 12"	24	10	3 - #4 T&B	#4 @ 16" BOT	#5 @ 16"	24	12	3 - #4 T&B	#4 @ 16" BOT			
4'-0"	SPW-1	#5 @ 16"	24	10	4 - #4 T&B	#4 @ 16" BOT	#5 @ 16"	30	12	4 - #4 T&B	#4 @ 16" BOT	#5 @ 16"	36	12	4 - #4 T&B	#4 @ 16" BOT			
5'-0"	SPW-2	#5 @ 16"	30	12	4 - #4 T&B	#4 @ 16" T&B	#5 @ 16"	32	12	4 - #4 T&B	#4 @ 16" T&B	#5 @ 16"	42	12	5 - #4 T&B	#4 @ 16" T&B			
6'-0"	SPW-2	#5 @ 16"	36	12	5 - #4 T&B	#4 @ 16" T&B	#5 @ 16"	42	12	4 - #4 T&B	#4 @ 16" T&B	#5 @ 16"	48	12	5 - #4 T&B	#4 @ 16" T&B			
7'-0"	SPW-2	#5 @ 16"	42	12	5 - #4 T&B	#5 @ 16" T&B	#5 @ 12"	48	12	5 - #4 T&B	#5 @ 16" T&B	#5 @ 12"	54	12	5 - #4 T&B	#5 @ 12" T&B			
8'-0"	SPW-2	#5 @ 12"	48	14	5 - #4 T&B	#5 @ 16" T&B	#5 @ 10"	60	14	6 - #4 T&B	#5 @ 16" T&B	#6 @ 8"	66	14	6 - #4 T&B	#5 @ 9" T&B			
9'-4"	SPW-2	#5 @ 8"	54	14	6 - #4 T&B	#5 @ 12" T&B	NOT RECOMMENDED					NOT RECOMMENDED							

T = Top Reinforcing

B or Bot = Bottom Reinforcing

Where vertical rebar is spaced at 10" or 12" o.c., bars may be spaced at 8" o.c. to avoid any possible interference with ICF cross ties. Bars at 8" spacing can be centered between ties. Dowels that interfere with ties must be field bent to avoid tie.

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TABLE 2-1: 6" ICF WALLS ABOVE GROUND SWIMMING POOL WALL AND FOOTING REINFORCING

MAX. WALL HEIGHT (FT)	REF. DETAIL	EQUIVALENT FLUID PRESSURE (PCF)				
		63 PCF				
		WALL	FOOTING			
		Vertical Reinf.	W (Inch)	T (Inch)	REINFORCING	
					Long.	Trans.
3'-0"	SPW-3 or 4	#4 @ 16"	30"	10"	3 - #4 BOT	#4 @ 16" BOT
4'-0"	SPW-3 or 4	#4 @ 16"	36"	10"	3 - #4 BOT	#4 @ 16" BOT
5'-0"	SPW-3 or 4	#5 @ 16"	48"	12"	4 - #4 BOT	#4 @ 16" BOT
6'-0"	SPW-3 or 4	#5 @ 12"	60"	12	5 - #5 BOT	#5 @ 16" BOT
7'-0"	SPW-3 or 4	NOT RECOMMENDED				
8'-0"	SPW-3 or 4	NOT RECOMMENDED				
9'-0"	SPW-3 or 4	NOT RECOMMENDED				

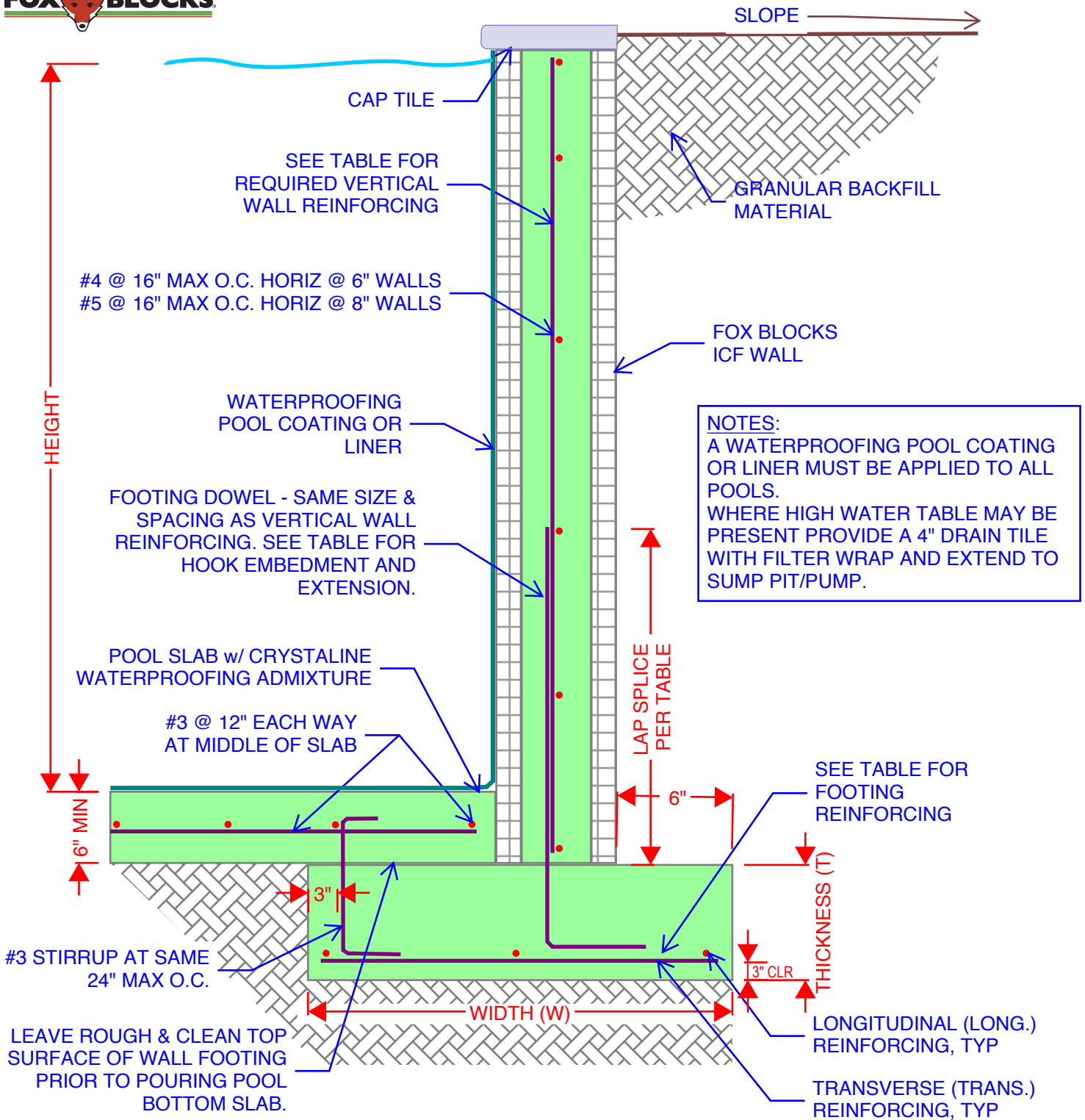
TABLE 2-2: 8" ICF WALLS ABOVE GROUND SWIMMING POOL WALL AND FOOTING REINFORCING

MAX. WALL HEIGHT (FT)	REF. DETAIL	EQUIVALENT FLUID PRESSURE (PCF)				
		63 PCF				
		WALL	FOOTING			
		Vertical Reinf.	W (Inch)	T (Inch)	REINFORCING	
					Long.	Trans.
3'-0"	SPW-3 or 4	#5 @ 16"	30	10	3 - #4 BOT	#4 @ 16" BOT
4'-0"	SPW-3 or 4	#5 @ 16"	36	12	3 - #4 BOT	#4 @ 16" BOT
5'-0"	SPW-3 or 4	#5 @ 16"	48	12	4 - #4 BOT	#4 @ 16" BOT
6'-0"	SPW-3 or 4	#5 @ 16"	60	12	5 - #4 BOT	#5 @ 16" BOT
7'-0"	SPW-3 or 4	#5 @ 10"	66	12	7- #4 BOT	#5 @ 12" BOT
						#4 @ 12" TOP
8'-0"	SPW-3 or 4	#6 @ 8"	78	14	9 - #5 BOT	#5 @ 12" BOT
						#4 @ 12" TOP
9'-0"	SPW-3 or 4	NOT RECOMMENDED				

T = Top Reinforcing

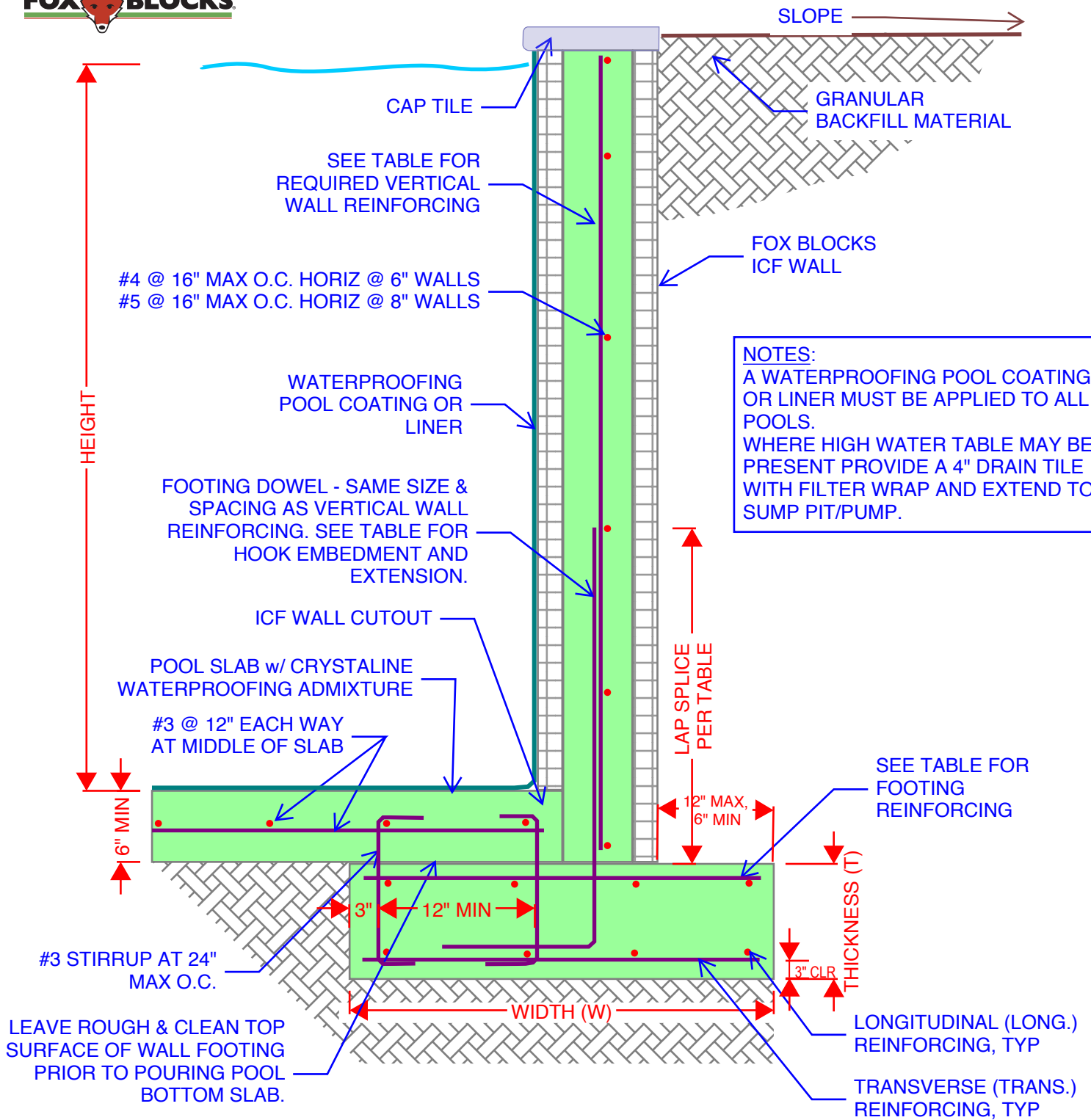
B or Bot = Bottom Reinforcing

Where vertical rebar is spaced at 10" or 12" o.c., bars may be spaced at 8" o.c. to avoid any possible interference with ICF cross ties. Bars at 8" spacing can be centered between ties. Dowels that interfere with ties must be field bent to avoid tie.



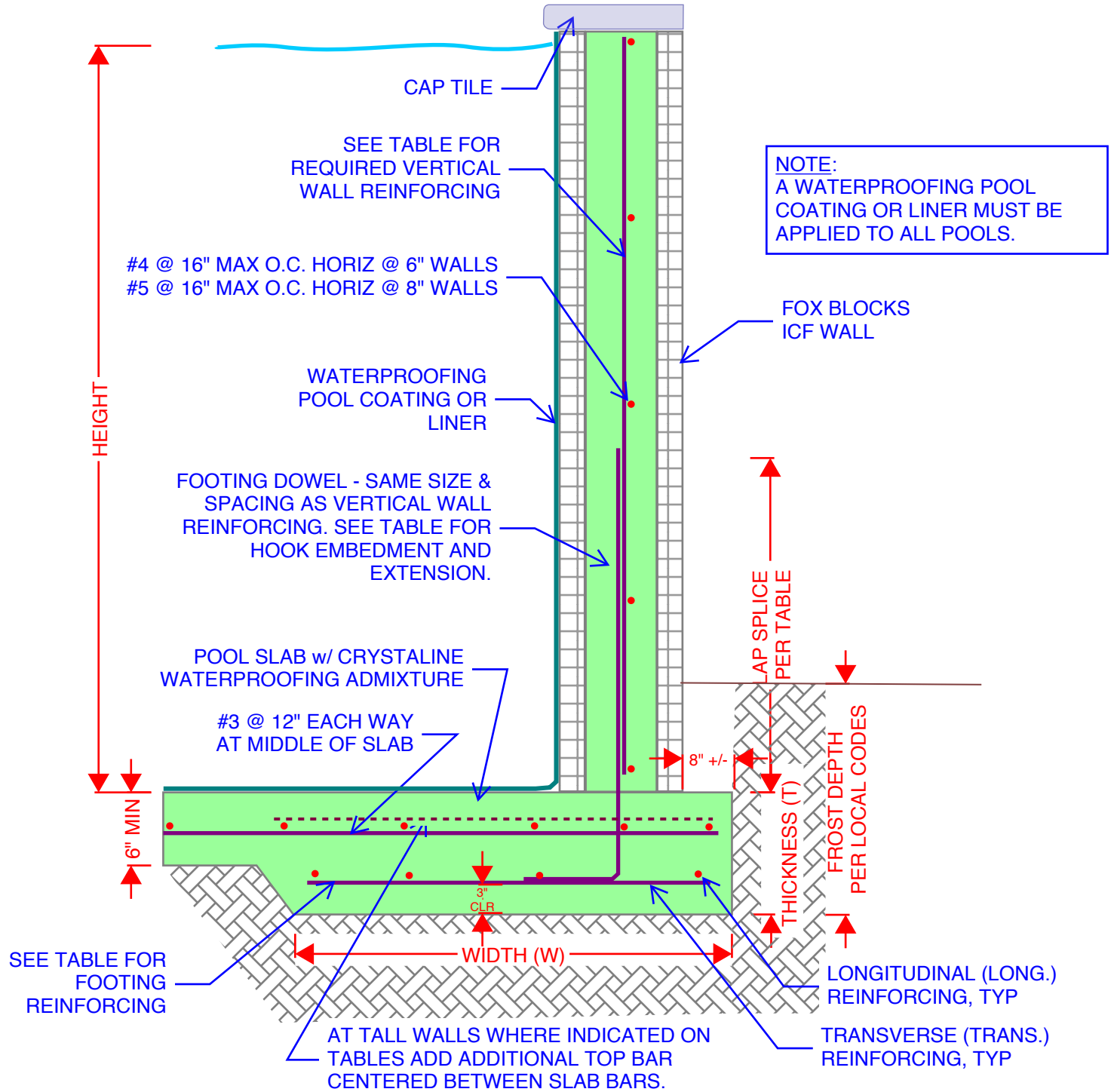
SPW-1 ICF SWIMMING POOL WALL DETAIL
HEIGHT < 4'-0"

DRAWING TITLE: IN-GROUND SWIMMING POOL WALL DETAIL	PROJECT: FOX BLOCKS SWIMMING POOLS	DATE: 02/09/2021 DRAWN BY: AN CHECKED BY: BCJ	J&M ENGINEERING 3045 S. KANSAS EXPY. SPRINGFIELD, MO 65807 PHONE: 417.708.9315 www.landstructural.com
DRAWING NUMBER: SPW-1			



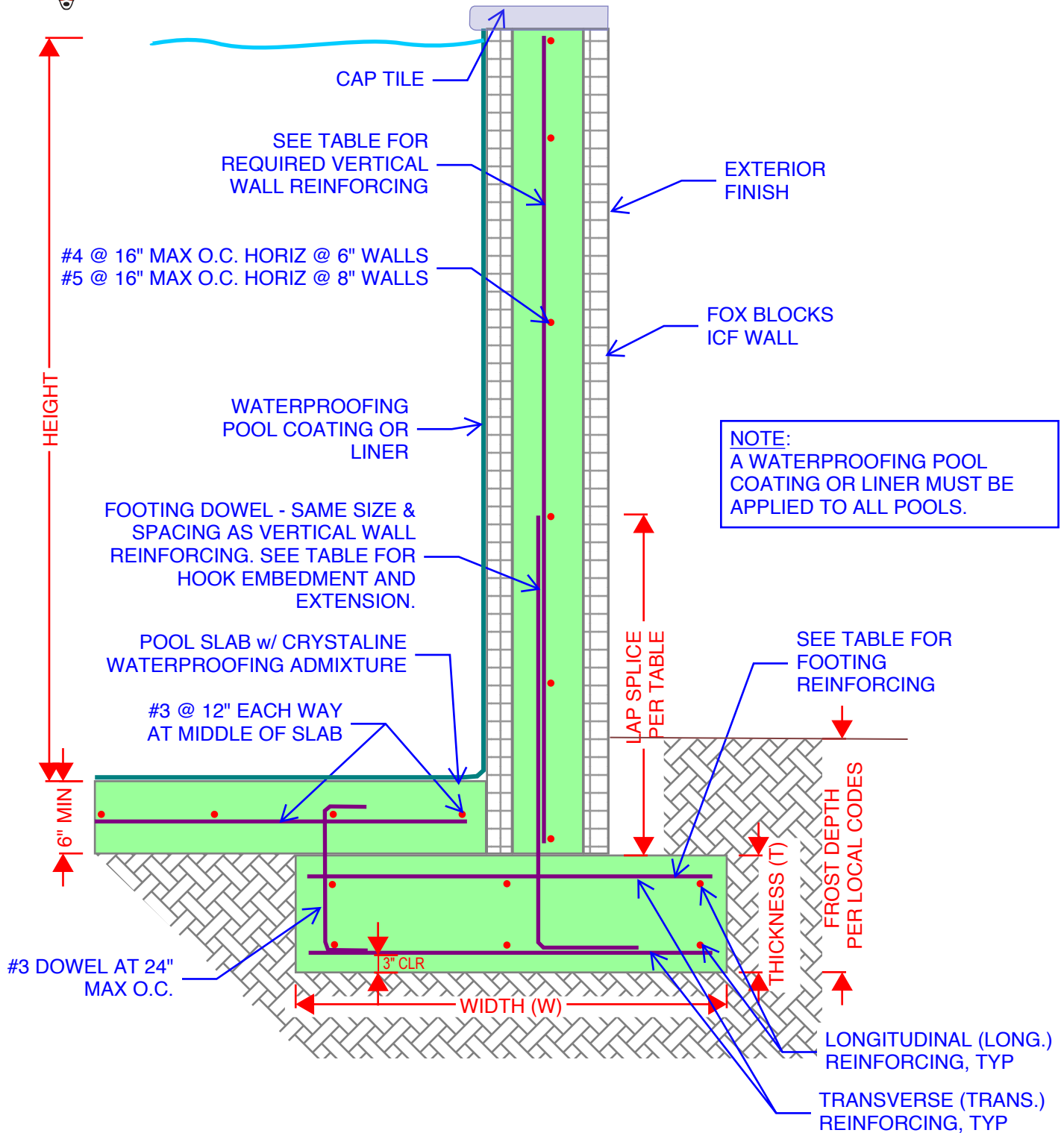
SPW-2 ICF SWIMMING POOL WALL DETAIL
HEIGHT > 4'-0"

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SPW-2			



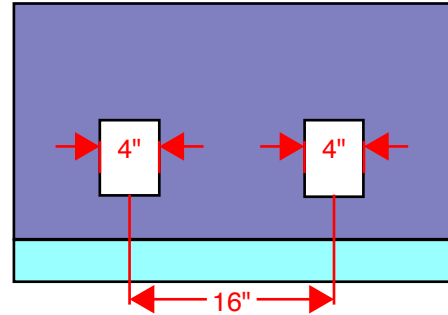
SPW-3 ICF SWIMMING POOL WALL DETAIL
ABOVE GROUND OPTION A

DRAWING TITLE: ABOVE GROUND SWIMMING POOL WALL DETAIL DRAWING NUMBER: SPW-3	PROJECT: FOX BLOCKS SWIMMING POOLS	DATE: 02/09/2021 DRAWN BY: AN CHECKED BY: BCJ	J&M ENGINEERING 3045 S. KANSAS EXPY. SPRINGFIELD, MO 65807 PHONE: 417.708.9315 www.landstructural.com Page 12 of 13
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SPW-4 ICF SWIMMING POOL WALL
ABOVE GROUND OPTION B

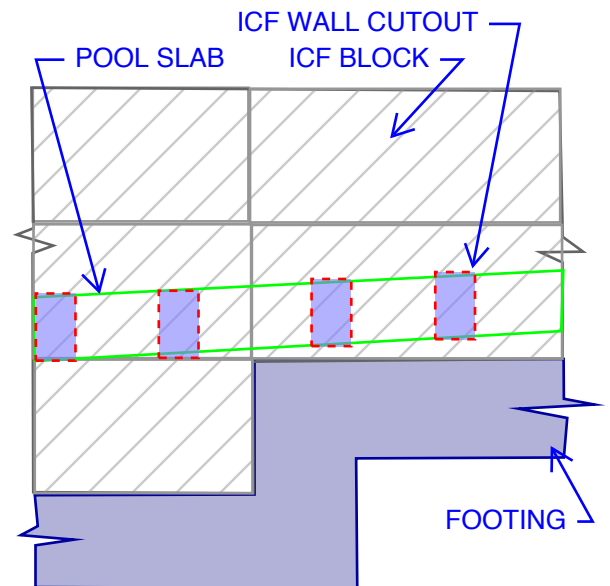
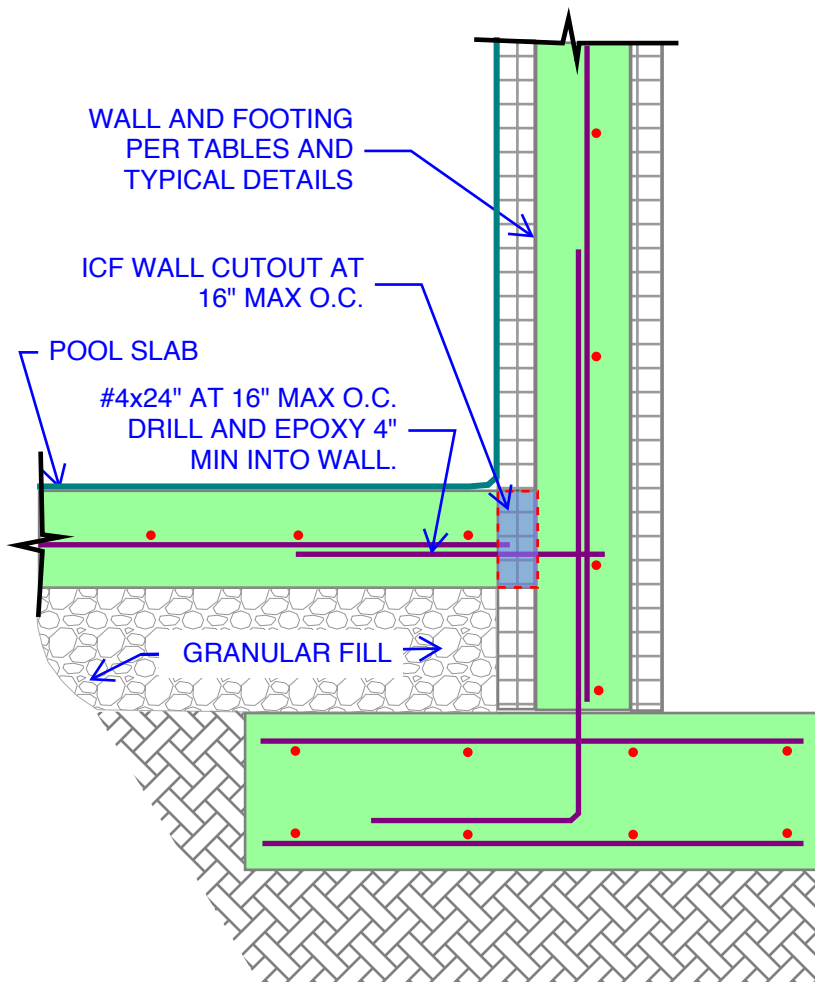
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DRAWING NUMBER: SPW-4			



A ICF WALL CUT OUTS

NOTES:

1. IDEAL FOOTING STEPS SHALL BE 16" VERTICAL (HALF ICF BLOCK 8" INCREMENTS CAN BE UTILIZED) AND AT 48" HORIZONTAL INCREMENTS (HALF ICF BLOCK 24" INCREMENTS CAN BE UTILIZED).
2. STEPPED ICF WALL CUTOUTS AND DOWELS ARE NOT REQUIRED WHERE DISTANCE FROM BOTTOM OF SLAB TO TOP OF FOOTING IS LESS THAN 8", SLAB IS THICKENED TO BEAR ON FOOTING, AND DOWELS FROM SLAB TO FOOTING PER TYPICAL DETAILS ARE PROVIDED.



SPW-5 SWIMMING POOL WALL AT SLOPED BASE - SECTION

SPW-5 STEPPED FOOTING AND WALL AT SLOPED BASE - ELEVATION

DRAWING TITLE: SWIMMING POOL WALL AND FOOTING DETAILS AT SLOPED SLAB DRAWING NUMBER: SPW-5	PROJECT: FOX BLOCKS SWIMMING POOLS	DATE: 02/09/2021 DRAWN BY: AN CHECKED BY: BCJ	J&M ENGINEERING 3045 S. KANSAS EXPY. SPRINGFIELD, MO 65807 PHONE: 417.708.9315 www.landstructural.com MISSOURI CERTIFICATE OF AUTHORITY #2011011004
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