

Structural Engineering Design Guide for

Fox Blocks Insulating Concrete Form (ICFs) Walls

The purpose of this document is to provide the structural engineer with an overview of some specific design aspects. This information is useful in clarifying some information as well as providing an efficient design that is cost effective and efficient to construct.

The Fox Blocks product is a stay-in-place insulating concrete form (ICF) formwork for a cast-in-place solid concrete wall. The ICF formwork is not a “system” and is not a structural component. The cast-in-place concrete wall formed by the ICF is the structural component.

The concrete wall is designed to the current ACI 318, Building Code Requirements for Structural Concrete, design code just like any other cast-in-place concrete wall. Utilize all of the relevant design code requirements applicable within the ACI 318.

The Fox Blocks products provide formwork for a 4”, 6”, 8”, 10” and 12” cast-in-place concrete wall.

The primary ACI 318 chapters relevant to the structural design include Chapter 10 Flexure and Axial Loads, Chapter 14 Walls and Chapter 22 Structural Plain Concrete.

One important aspect that should be recognized when determining the steel reinforcement schedule is the horizontal and vertical rebar spacing. For ease and efficiency of construction, the horizontal rebar should be placed on 16” incremental spacing (16”, 32”, or 48”). Horizontal rebar spacing on 8” increments (8”, 16”, 24”, 32”, 40”, or 48”) is also achievable but not quite as efficient to construct as it would be with 16” increments. To allow for efficient placement, the vertical rebar should be designed to be placed at 8” increment spacing (8”, 16”, 24”, 32”, 40”, or 48”).

Steel reinforcement non-contact lap splices can be designed and placed in the Fox Block ICF forms according to the ACI 318 requirements.

ACI, Section 14.2.7, allows the spacing of horizontal and/or vertical rebar spacing to be spaced greater than 18” on center as long as structural analysis shows adequate strength and stability.

Any size of steel reinforcement may be used in the design. Contractors like to work with #4 rebar as it is easier to bend and cut in the field.

The minimum amount of concrete cover for reinforcement of the ICF wall shall be $\frac{3}{4}$ ” for concrete not exposed to weather. The formwork stays in place on each face of the concrete wall protecting it from the weather.

The Fox Block ICF formwork offers horizontal rebar chairs to position the rebar. Refer to the product details that indicate the center to center dimensions of these rebar chairs. This location of these rebar chairs offers options to place rebar in the most efficient tension side of the wall.



Many of the openings can be designed with a concrete lintel or beam above the opening to carry the axial loads around the opening. Fox Blocks offers prescriptive lintel design tables. These tables can be used for uniform loading. The tables are set up so that the structural engineer would calculate the factored uniform load for the lintel. The concrete lintel is then designed by using the prescriptive table as long as the load and other design information is within the prescriptive criteria.

Many times the structural engineer likes to place diagonal reinforcement at the corners of openings. This is an efficient geometric way to control the cracks at the corners of openings. While this can be constructed with the ICF stay-in-place formwork, it is time consuming and labor intensive. In lieu of placing diagonals, it is recommended to extend the horizontal and vertical rebar further at the corners to achieve the same results. This will make for a much more efficient way to install.

Some projects may require a double mat of reinforcement. This can be accomplished with the Fox Blocks formwork. Again, follow the recommended horizontal and vertical rebar spacing schedules discussed earlier.

Reinforcement cages are sometimes necessary to support large axial loads or for some seismic design criteria. Reinforcement cages can be constructed either within the wall or as an external pilaster or column. The main issue to consider when designing the cages is the spacing of the tie reinforcement or stirrups. Again, similar to horizontal reinforcement, the recommended spacing is 8" or 16" increments.

Steel embed plates can be designed and anchored to the face of the ICF wall to support structural steel components. See the embed detail in the Fox Blocks manual shows how this can be installed.

The 11 1/4" and 13 1/4" forms have a Ledge Form available to support brick or stone veneer or some floor applications. Fox Blocks also has a product called the xLerator that is used to reinforce the concrete ledge or corbel. The patented xLerator is a cost effective and efficient way to reinforce the ledge. It saves time in lieu of cutting, bending, placing and tying stirrups in each corbel. The Ledge Form reinforced with the xLerator has an ultimate uniform load capacity of 2,000 PLF.

A taper top form is available for some specific applications such as demising walls with precast hollowcore planks or as a termination form for a foundation wall that will have framed construction above it.

The Fox Blocks stay-in-place form has plastic tie inserts embedded into the formwork. A plastic flange is on the inside and outside face of the wall to fasten gypsum drywall and exterior finishes. Fox Blocks has conducted direct withdrawal and lateral tests with different screws into the plastic flange. The test results are available to design the fastening of any exterior finish.

There are a few ICF prescriptive structural design options available as well. These are primarily for residential construction.



Industrial Strength Insulated Concrete Forms (ICF's)

Fox Blocks
Airlite Plastics Co.
6110 Abbott Street
Omaha, NE 68110
877.369.2562
www.FoxBlocks.com

- PCA Standard 100 2007 – Prescriptive Design of Exterior Concrete Walls for One and Two Family Dwellings. This standard has tables for above grade and below grade walls.
- International Residential Code (IRC), Section R404.4 for below grade ICF walls and Section R611 for above grade ICF walls.
- ACI 332, Code Requirements for Residential Concrete
- Various building code foundation tables IBC Section 1805.5 and Table 1805.5(5), IRC Section R404.1.2 and Table R404.1.1 (5), BNBC Section 1812.3.2 and Tables 1812.3.2(1) and 1812.3.2(2) and 1812.3.2(2), SBC Section 1804.6 and Table 1804.6.1(A)
- Fox Blocks has above and below grade and lintel prescriptive engineering tables

Additional design, details and testing information can be found in the Fox Blocks Product Manual.



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