4LEAF, Inc. performed a Property Condition Assessment for 24730 Newport Road Menifee Ca Krikorian Theater, Pad 3 and 4, Property Condition Assessment consists of the scope of work defined by ASTM E2018 Standard Guide for Property Condition Assessments and in compliance with the 2022 California Building Code (CBC), 2022 California Mechanical Code (CMC), 2022 California Plumbing Code (CPC), 2022 California Electrical Code (CEC), 2022 California Energy Code (CEnC) (2022 Building Energy Efficiency Standards), 2022 California Green Building Standards Code (CALGreen), and the City of Menifee Municipal Code.

4LEAF's team will provide information on the site conditions and construction as it currently site in relation to site safety, fire, life safety and identify conspicuous and material defects, deficiencies, items of deferred maintenance and material building code violations (individually and collectively, physical deficiencies), site construction as a result of a non-intrusive walk-around visual survey, review of available applicable documents and research. Please note that no testing of any equipment, systems or materials is included in this scope of work.

4LEAF, Inc. team that included Jay Shih PE, CBO, CASp, Joe Nicholes PE and Marcus Johnson CBO. Team arrived on site 24730 Newport Road, Menifee CA, at 7:46 am on Thursday April 25th, 2024, weather partly cloudy 53 degrees.

Site generally long un kept weeds material scattered throughout the site, three buildings abandoned in partial state of construction. Building one exterior wall constructed of ICF blocks in partial state of construction, pad 3 building frame and sheeted server weathering of wood product without being weather protected. Pad 4 building red irons standing and various condition due to fire.

Building 1 Krikorian Theater

This project was to develop a 13 screen multi-plex with stadium seating. The facility includes a large format screen auditorium, concession stand, 2 bars, bowling alley, laser tag, restroom facilities and separate party rooms. The facility is a freestanding building with insulated concrete forms (ICF) exterior wall construction.

Materials (ICF Blocks)

ICF (Fox Block) has been in the sunlight since brought on site, yellowing of different degree on all blocks all blocks produce a powdery substance to the touch, foam in most areas seem to still be pliable and has not hardened or become brittle. Storage of un-used materials and in use materials have been exposed to UV rays for longer than a three (3) month period, manufacturer recommendation is to have exterior finished installed prior to more than three (3) month of UV expose. Protection of materials from excessive UV rays is recommended per manufacturer. Blocks have powdery film that must be removed prior to any application of exterior finishes or waterproofing membrane.

IFC blocks have been damaged in several areas creating holes and divots in the product. Patching of areas shall be conducted per manufacturer technical bulletins and recommendation. In many areas this has been done, Spray foam will quickly degrade and break down when exposed to UV light from the sun. Spray foam insulation that is left uncovered outside will be subjected to a great deal of sunlight and will only last a fraction of the time outdoors and exposed. Foam used to patch on site does not look to have any fire rating property.

ICF blocks have been hit with graffiti on both the inside and outsides of the walls foam products have been dissolved by the types of spray paints used. Large section of the exterior portion of the ICF product would require patching to maintain the product R values and properties. Product listing does not provide any patching recommendations for area of these sizes.

IFC blocks have been damaged in several areas creating holes and divots in the product. Patching of areas shall be conducted per manufacturer technical bulletins and recommendation. In many areas this has been done, Spray foam will quickly degrade and break down when exposed to UV light from the sun. Spray foam insulation that is left uncovered outside will be subjected to a great deal of sunlight and will only last a fraction of the time outdoors and exposed. Foam used to patch on site does not look to have any fire rating property. Current patches have been exposed to the UV for extended periods of time.

“Fox Block” is the manufacture of the product in use and placed onsite. All materials stored on site in open to the elements, have not been stored per the manufacture’s recommendations. All materials that are in-use are not part of a completed assembly in various stages of construction. The “Fox Block” ICF product as they stand currently allowed for water intrusion within uncompleted wall assemblies.

Material (On-site non protected)

Embeds, post bases, steal columns roof structures etc. have been on-site for an unspecified period. These materials have been through severe weather cycles unprotected from the elements. These weather cycles can produce expansion, contraction, rust, and deterioration of all materials.

Wall Construction

Per standards of plumbness tolerances block work Fox Blocks are a modular system of stay-in-place insulating concrete. The forms interlocks as the wall are built and by using an ICF specific alignment and bracing systems, during and after concrete placement, the walls can be aligned to be plumb and straight to string lines and laser levels. When constructing the cast-in-place concrete Fox Blocks walls, the walls must be built within certain construction tolerances to be straight, plumb and level. These tolerances may be found in the construction documents, codes, or relevant standards. The following ACI references are for information and may be used as a guide for maintaining a plumb wall:

ACI 318 – Building Code Requirements for Structural Concrete

> *(Does not specifically address tolerances other than saying walls to be true, square and plumb.)*

ACI 347 – Guide to Formwork for Concrete

7.4.1 Permanent forms

3.3.1 Tolerances – References ACI 117

ACI 117 – Specifications for Tolerances for Concrete

Construction and Materials

4.1.1.1.1 Deviation from plumb – for heights less than or equal to 83'-4" the lesser of 0.3% (0.003) times the height above the top of foundation or +/- 1"

(This is a reference standard only and not part of the building code and therefore not mandatory unless it is referenced in the construction documents.)

The engineer-architect of record may accept the element if it meets one of the following criteria:

- Exceeding the tolerances does not affect the structural integrity, legal boundaries, or architectural requirements
- The element or total assembly can be modified to meet all structural and architectural requirements

Exposed steel, anchor bolts, and embedment plates

Embed plates and tie rebar at intersection of 2nd lift that is not incased within the 2nd lift have notable rust that will need to have a determination that they are still within design specification after rust has been abated.

Anchor bolts at top of finished wall have received major water damage in some area. Rust must be abated prior to determining if bolt diameter still falls within design and construction parameters.

Anchor bolts at top of finished wall have received major water damage in some area. Rust must be abated prior to determining if bolt diameter still falls within design and construction parameters.

Beam poured in place

Poured in place beams at several location have cold joints that move across the beam, beams were poured separately from the 1st lift and were formed with wood. The formation of a concrete cold joint creates a weak bond between two concrete pours. It is due to the placement of concrete on concrete at has started hardening.

Auditorium wall and slab (Water issues)

Auditorium 1, 3 and bowling alley lane area are holding large pools of water. Auditoriums 2 and 4 have held water in the past per water level lines in the block walls, these rooms also show water has expelled at slab wall interception and at wall corner intersection. Plans do not indicate any type of below grade waterproofing at ICF foundation to slab connections. Pooling water auditoriums have been submerged for a decent period of time; this can create water absorption issued that could affect the proposed concrete mixture as designed. Areas where water was being held and has now found a way under the slab poses a secondary issue of large amounts of water saturating points under the foundation. These levels of saturation do not seem to be accounted for within the soils analysis that the slab and foundation were designed to.

Wall Bracing

ICF poured in place wall have construction bracing installed at all the exterior. Temp wall bracing shall be certified that it meets the requirements of Paragraph 12.5 of ANSI A10. 9-1970 requires masonry or concrete walls to be temporarily shored and braced until the designed lateral strength is reached, to prevent collapse due to wind or other forces.

Material ICF recommendation

All ICF blocks that are in use and all un-used (Fox Block) materials shall be verified / certified by manufacturer that the product is still within manufacturers specifications guidelines prior to being used to complete construction. Manufacturer to provide details for patching at large areas,

HERS rater to provide certification that exterior membrane complies with the prescribed R values per the approved building plans.

Material (On-site non protected) recommendation

All materials that will be used to complete the construction, that has been stored unprotected on site shall be certified from the manufacture or fabricator that the product is still within original design fabrications specifications and a second review from the design professional in charge that the materials are within the design parameters.

Wall Construction recommendation

Additional exploration shall be conducted on all poured wall to determine water intrusion, rust leakage from all heights of the wall indicate water intrusion. Provide samples within walls and at all various heights provide core samples to be PSI tested.

Provide pull samples of rebars, that they still are within diameter specifications and meet tensile straight after rust rebars have been mitigated.

At front wall above 2nd lift wall have been constructed to ultimate height but have not received the final concrete lifts. These walls are now sliding off level with a creation of a stress point at the top 2nd lift interception. Wall lines that have not been grouted pass the 2nd lift have exposed rebar and capillaries that have the potential to hold water in the cells of the ICF blocks, surface rust apparent at top of wall unable to verify the severity of rust at the 2nd lift intersection. Remove all blocks above lift line to expose the conditions at the laps of rebar and stress from wall shifting out of plumb both vertically and horizontally. Structural Engineer to provide a report of poured in place walls meet the specifications for tolerance for concrete construction and materials (ACI 117-10) and (ACI 117R-10).

Open unfilled ICF in place above 2nd lifts recommendation

The following is recommended to provide that the current constructions is within construction tolerances.

- The design professional in charge to perform a site evaluation of all the wall plumbness, level both horizontally and vertically that meet construction tolerances specified in the manufactures product manuals and meet the intent of the structural design.
- Remove ICF blocks above the 2nd un-poured lifts to expose rebar rust saturations at this intersection and any water intrusion into the lifts below.
    - Provide certification from special inspection testing agency that the rebar meets the following:
    - CRSI Engineering Data Report #54 **Field Inspection of Reinforcing Bars** Page 3 Surface Conditions of Bars, “A light surface coating of rust on reinforcing steel should not be a cause for rejection by the inspector

- ACI 318 **Building Code and Commentary** – Section 7.4.2, “Except for prestressing steel, steel reinforcement with rust and mill scale, or a combination of both, shall be considered satisfactory, provided the minimum dimensions and weight of a hand-wire-brushed test specimen comply with applicable ASTM specifications.” Section 7.4.3, “Prestressing steel shall be clean and free of oil, dirt, scale, pitting and excessive rust. A light coating of rust shall be permitted.
- ASTM A615 **Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement** – Section 12.2, “Rust, seams, surface irregularities, or mill scale shall not be cause for rejection, provided the weight, dimensions, cross-sectional area and tensile properties of a hand wire brushed test specimen are not less that the requirements of this specification.
- ASTM A706 **Standard Specification for Low-Alloy Deformed and Plain Bars for Concrete Reinforcement** – Section 11.2, “Rust, seams, surface irregularities, or mill scale shall not be cause for rejection, provided the weight, dimensions, cross-sectional area and tensile properties of a hand wire brushed test specimen are not less that the requirements of this specification.

Exposed steel, anchor bolts, and embedment plates recommendation

Exposed steel, anchor bolts, and embedment’s plates must be re certified by the licensed design professional and the certified shop they were produced. Special inspection will be required to verify any welding will still comply within construction tolerances after surface rust had been addressed diameter of anchor bolts, steel and rebar shall be accounted for to be within design parameters. Bolts, steel and rebar shall have random sample pull test to verify bolting to meet design designated up lifts.

- CRSI Engineering Data Report #54 **Field Inspection of Reinforcing Bars** Page 3 Surface Conditions of Bars, “A light surface coating of rust on reinforcing steel should not be a cause for rejection by the inspector
- ACI 318 **Building Code and Commentary** – Section 7.4.2, “Except for prestressing steel, steel reinforcement with rust and mill scale, or a combination of both, shall be considered satisfactory, provided the minimum dimensions and weight of a hand-wire-brushed test specimen comply with applicable ASTM specifications.” Section 7.4.3, “Prestressing steel shall be clean and free of oil, dirt, scale, pitting and excessive rust. A light coating of rust shall be permitted.
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Beam poured in place recommendation

Beams to have design professional in charge verify beams are in suitable condition for complete loading, Ultrasonic testing to verify the level of the cracking within the core of the beams or supporting member. Determination of cracking shall be in accordance with ACI 1171.14.

Auditorium wall slab recommendation (Water issues)

In the absence of waterproofing details at the wall below grade and under slab a Geotechnical Engineer shall provide an analysis of water inundation has not affected the bearing capacity at and under the foundation systems. The analysis should provide information on the condition of the soil around the foundation if the foundation is adequate to support the full load of the building. At auditorium 1, 3 and bowling alley lanes remove all standing water, provide sample testing of concrete slabs that indicate design PSI has been achieved.

Wall Bracing recommendation

Temp wall bracing shall be certified that it meets the requirements of Paragraph 12.5 of ANSI A10. 9-1970 requires masonry or concrete walls to be temporarily shored and braced until the designed lateral strength is reached, to prevent collapse due to wind or other forces.

Building Code

When a change of architect or engineer of record is desired prior to issuance of the permit, the new architect or engineer of record shall provide a statement that will include:

- A declaration that the new architect or engineer of record has reviewed all plans, documents, test and inspection reports, and other work performed by the previous architect or engineer and concurs with the statements, conclusions and recommendations therein including:
  - A statement that the new architect or engineer of record assumes all responsibility for any revisions to documents prepared by the previous architect or engineer of record subsequent to the date of hire.
  - A statement that the new architect or engineer of record assumes all of the responsibilities and obligations related to that portion of the documents the original architect or engineer of record prepared and was obligated to prepare by the laws of the State of California and the regulations of the City of Menifee.
- Provide all required special inspection reports and observations that have been performed up the date of project abandonment.
- Provide all required additional special inspections, observations, product testing, and manufacturers certifications to Building Official for determination of adequacy of current construction and materials.
- All reports of recertification shall be submitted to the Building Official for approval of “used” materials.
- Updated plan that meets the current code cycle shall be submitted to reinstate the project.

Conclusion of Recommendation

All aspects of the building systems have been left unfinished and open to the elements for a period of at least 4 years. These systems all have fallen out of normal construction tolerances. Extensive testing would be required to provide system could be salvage and accept at full design loading to complete the building systems. The degree of these testing is very invasive, sampling would be required in multiple areas both vertically and horizontally. This may take additional toll on system that are already stressed. The interior of the ICF poured concrete walls have the biggest issues as complete system would need to be taken down, samples of cores to be provide that the interior of the pervious poured in place walls have not absorbed water and held water within the ICF form for an extend period causing deterioration of rebar tensile strength and numerous cycles of water expanding and contracting within poured in place walls.

Slab and foundation will need an Geotechnical Engineer to provide testing to verify that water intrusion at multiple locations will not affect the design parameters of the loading dispersion as designed. The soils report was designed at normal code specified loading values with no wet soils condition.

With these issues and the current condition of the system on site, the serious nature of destructive testing that would need to take place to provide proof that system and materials could be salvaged would add undo stress to system that have already fallen out of construction tolerances and disrepair. Removal of vertical and horizontal systems would be recommended, as the time to conduct the required testing puts currently stressed system at a disadvantage.

Pad 3 (Shell Building)

Building proposed to be shell for multiple tenants.

Foundation

Foundation/ slab appear to be in good condition. Foundation doesn't seem to have any settling or movement. Slab as normal surface concrete cracking but nothing out of construction tolerances. Seal plate all appear to be in fair to good condition, hold downs, anchor bolts etc. have surface rust.

Foundation recommendation

Foundation/ slab appear to be in good condition will not require any additional investigation for foundation or slab. Seal plate may need to be replaced in certain areas, due to extreme exposer to the element's plywood will need to be replaced. In areas of 2,4,6 and 12 nailing seal plate may need to be replace due to over nailing. Structural observation will be required to determine what portion will need to be replaced vs. what will be allowed to stay.

Anchor bolts and hold down will need to have rust abated, all bolting at hardware will require tightening to manufacture specification.

Framing and Shear

Framing of pad 3 has be exposed to the weather and element since 2020. Existing OSB sheathing are damaged due to weather exposure. Over saturation has caused OSB to delaminate. Steel columns and strong walls show no sign of deterioration due to weather.

Framing and Shear recommendation

All OSB sheathing will need to be removed and replaced to match approved plan set. Structural observation will be required to determine what framing members will need to be replaced due to damage of OSB original nailing and removal of OSB.

All glulam and engineered wood products will need to be certified by manufacture.

Building materials with visible signs of water damage shall not be installed. Wall and floor framing shall not be enclosed when the framing members exceed 19 percent moisture content. Moisture content shall be verified in compliance with the following:

- Moisture content shall be determined with either a probe-type or contact-type moisture meter.
- Moisture readings shall be taken at a point 2 feet to 4 feet from the grade stamped end of each piece to be verified.
- At least three random moisture readings shall be performed on wall and floor framing with documentation provided immediately prior to enclosure of the wall and floor framing. Insulation product

Roof framing and Shear

Roof framing has taken on substantial amounts of water, plywood is delaminated and will need to be removed and replaced. TGI joist framing is in good condition top cord was not observed.

Roof framing and Shear recommendation

All OSB roof sheathing will need to be removed and replaced to match approved plan set. Structural observation will be required to determine what framing members will need to be replaced due to damage of OSB original nailing and removal of OSB.

All TGI joists will need to have a manufacturer certification after OSB had been removed and top cord can be inspected.

Building materials with visible signs of water damage shall not be installed. Wall and floor framing shall not be enclosed when the framing members exceed 19 percent moisture content. Moisture content shall be verified in compliance with the following:

- Moisture content shall be determined with either a probe-type or contact-type moisture meter.
- Moisture readings shall be taken at a point 2 feet to 4 feet from the grade stamped end of each piece to be verified.
- At least three random moisture readings shall be performed on wall and floor framing with documentation provided immediately prior to enclosure of the wall and floor framing. Insulation product

Pad 4 (Fire Damaged Building)

Proposed multitenant shell building, Building was at framed and sheathed prior to the fire.

Pad 4

Pad 4 was hit by fire sometime in late 2023, when site walk was performed on 4/30/24 post fire clean up had already occurred. Structural steel, electrical panels, and foundation are the building component in place on site. All wood has been removed.

Pad 4 recommendation

Building was involved in a major fire; most building components have been affected by the fire.

Foundation recommendation

The concrete foundations are exposed in several areas round the building. Remove and replace fire affected soils, regrade around building to get back to plan approved rough and finished grades.

Concrete curb detail shows a nail strip of wood for drywall, this wood had been fire damaged and causing a breaking point within the curb. All anchor bolts and hardware that is in this curb will need to be removed and replaced. Design to provide a reconstruction detail to for the removal of the curb and epoxy schedule for reinstallation of anchor bolts and hold downs.

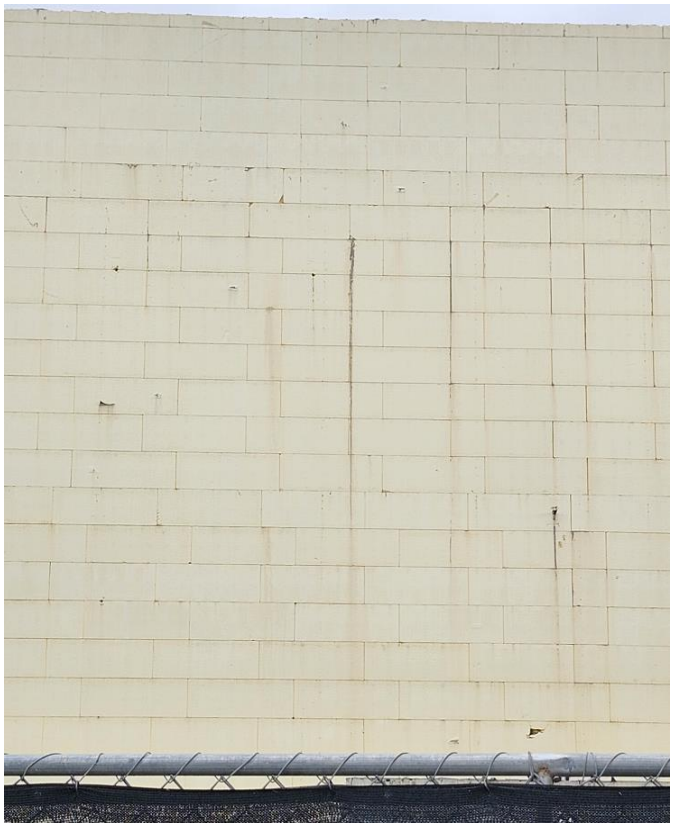
Steel Framing recommendation

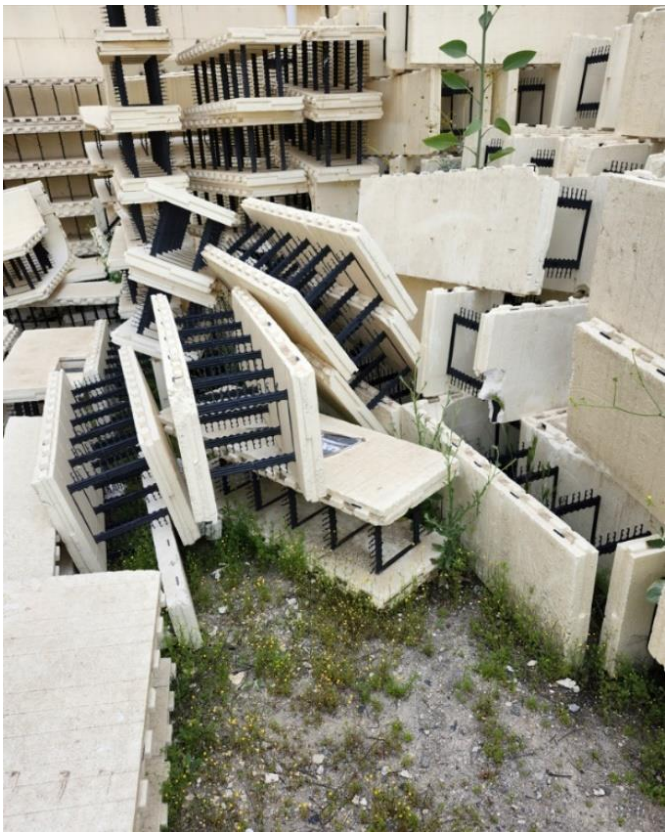
Steel posts have taken on stress from the fire and from load of falling structural members. Posts have bending and twisting issues that will need to be addressed by the steel fabricators. A survey will need to be preformed to indicate how much of the post is deformed and what will it take to either repair the steel post or will they need to be replaced.

Please review attached photos below, contact us for any questions or comments.

Jay Shih PE, CASp, CBO
C4684

Joe Nichlas PE
C58139





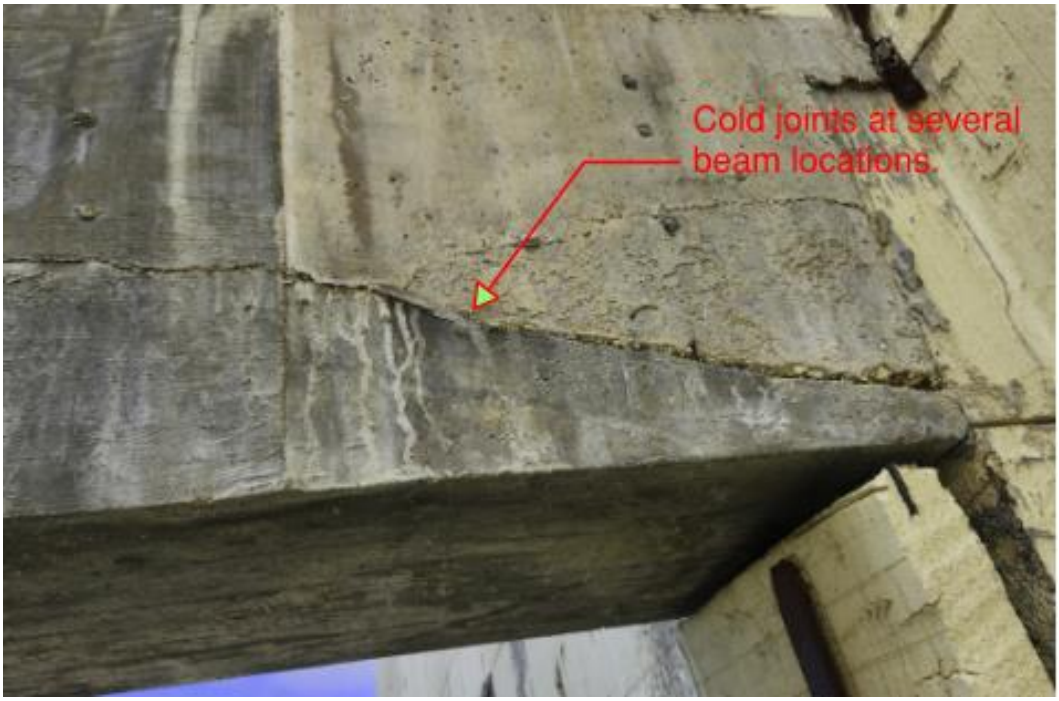

2nd lift line stress
from material and
weather exposure

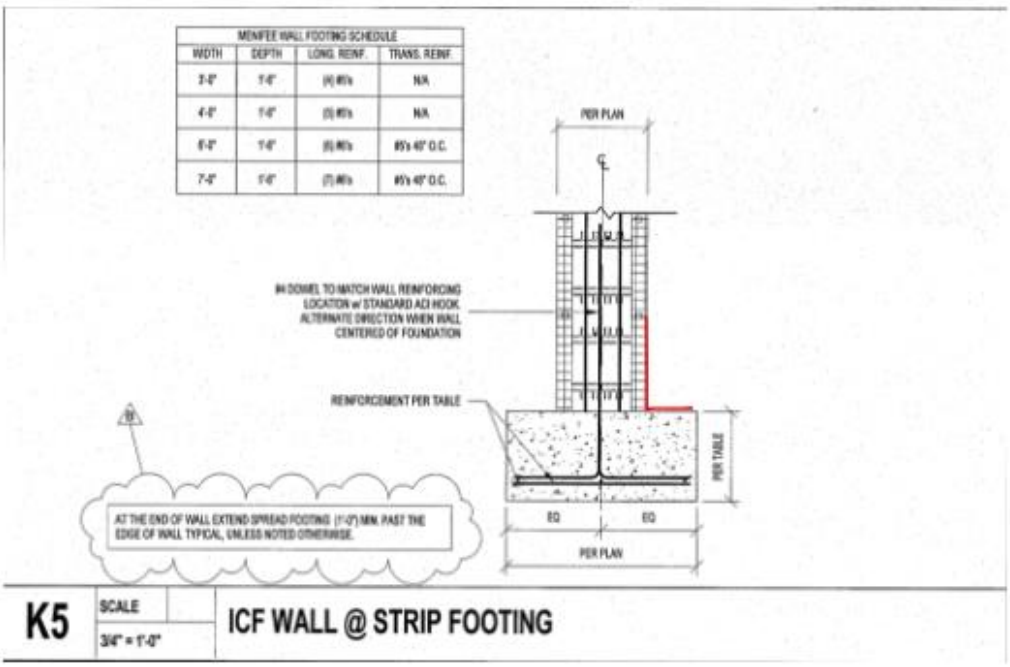

Wall at 2nd lift line
stressing to the inside
at wall line.

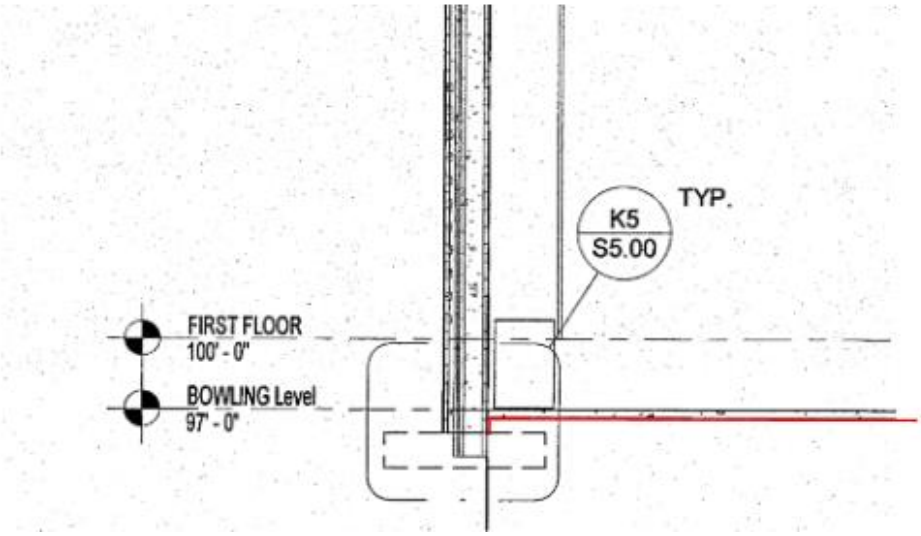

Rust at concrete
anchor bolt
connection


Excessive rust
damage at bolt
concrete connection


Cold joints at several
beam locations.


Cold joints at several
beam locations.


MENIFEE WALL FOOTING SCHEDULE
WIDTH
DEPTH
LONG. REINF.
TRANS. REINF.
3'-0"
1'-0"
(4) #5's
N/A
4'-0"
1'-0"
(5) #5's
N/A
6'-0"
1'-0"
(6) #5's
#5's 40" O.C.
7'-0"
1'-0"
(7) #5's
#5's 40" O.C.
PER PLAN
#4 DOWEL TO MATCH WALL REINFORCING LOCATION w/ STANDARD ACI HOOK. ALTERNATE DIRECTION WHEN WALL CENTERED OF FOUNDATION
REINFORCEMENT PER TABLE
PER TABLE
AT THE END OF WALL EXTEND SPREAD FOOTING (1'-0") MIN. PAST THE EDGE OF WALL TYPICAL, UNLESS NOTED OTHERWISE.
EQ
EQ
PER PLAN
K5
SCALE
3/4" = 1'-0"
ICF WALL @ STRIP FOOTING


TYP.
K5
S5.00
FIRST FLOOR
100' - 0"
BOWLING Level
97' - 0"


Area water collected
and expelled
Auditorium 2


Area water collected
and expelled
Auditorium 4


190
190
190
190
190
190
190
190


#20A
2153
#10 Bar 37

FOX BLOCKS TRUEGRID

TECHNICAL INFORMATION & PRODUCT GUIDE

TABLE OF CONTENTS

FOX BLOCKS

Fox Blocks are strong, durable products with a very substantial company behind them. Our team is committed to bringing the development, design and construction industry an extremely efficient building envelope with superior strength, sound, air quality and continuous double-insulated walls.

This Technical Information and Product Guide is a comprehensive overview of key technical elements of Fox Blocks products and applications. Accompanying this guide is the Installation Checklist which has a step-by-step process for project sequencing.

FOX BLOCKS WEBSITE . FOXBLOCKS.COM

Refer to the Fox Blocks website for more detailed information on products, accessories, code evaluations, testing, and technical documents.

The website has an extensive list of **Case Studies** for notable and award-winning Fox Blocks projects for all building types, residential and commercial. The **Resources** library has over 100 technical documents, including technical bulletins, reports, and engineering guides. The **Blog** library addresses current construction techniques, material applications and building product market research. Our **Project Estimator** is an amazing tool for detailed, accurate material estimates for any size project. The **Find a Dealer** tab locates an authorized Fox Blocks dealer anywhere in North America.

HOW TO USE THIS GUIDE

On specific pages in this Guide, the icons below direct you to our Resource Library or the Integrated Learning Center (ILC) Video Library for more detailed information on a specific topic or application.

TRAINING PROGRAMS & WALLET CARDS

INTEGRATED LEARNING CENTER BY FOX BLOCKS

FOX BLOCKS INTEGRATED LEARNING CENTER (ILC)

Fox Blocks Online Training and Video Library provide comprehensive, step by step, best practice installation courses, plus educational videos on the use and applications of Fox Blocks insulated concrete forms and accessory products. The experience of the Fox Blocks technical team will be expanding this educational portal, addressing all the bases to ensure a better and efficient build for all Fox Blocks applications.
Enroll, creating an account to follow the step-by-step online courses –

- Primary Installer
- Journeyman Installer
- Master Installer
- Elite Premier Installer

Upon completion of an ILC Training Course, you will receive a Certificate of Completion and Wallet card. In addition, the Primary Installer Course has been recognized for six continuing learning credits by some Contractors Associations.

Fox Blocks encourages every designer, contractor, and installer to understand the benefits of the products and utilize those benefits to have a great build through this Integrated Learning Center.

The ILC Video Library is an extensive selection of videos tackling product applications and unique details for any project. The video library is open to search and is constantly being enhanced with more instructional content.

CLICK THROUGH FOR VIDEOS

As Fox Blocks expands throughout North America, training courses follow to ensure proper knowledge and techniques are used during installations.

Trainings are tailored to the region and focus on contractors, building officials, engineers/architects, and building supply yards.

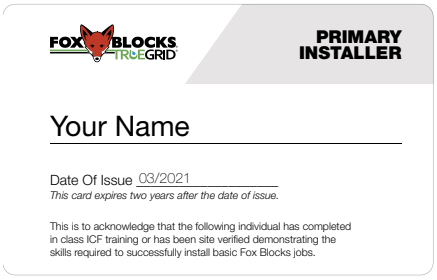
When installing contractors complete a training, they are required to complete the proper paperwork to earn a wallet card (see at right). This wallet card can be used when asked for by building officials.

As contractors gain experience, higher level wallet cards are earned. Tracking experience on successfully completed projects allows us to make appropriate recommendations on all jobs looking for a properly qualified installer.

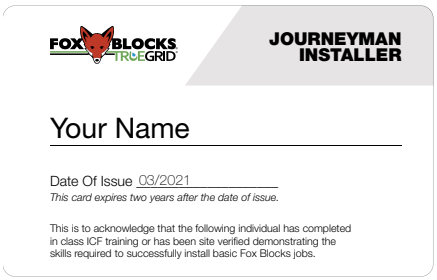
TRAINING OBJECTIVES

1) Understanding ICF
2) Estimating Your Job
3) Crew Sizing for Your Job
4) Basic Installation of the Fox Blocks Line-Up
5) Enhancing Your ICF Business Skills

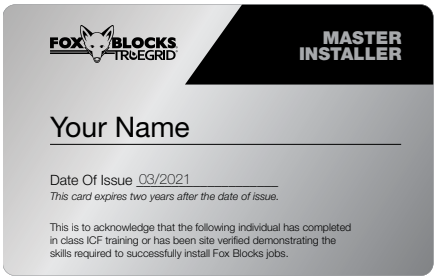
INSTALLER LEVELS



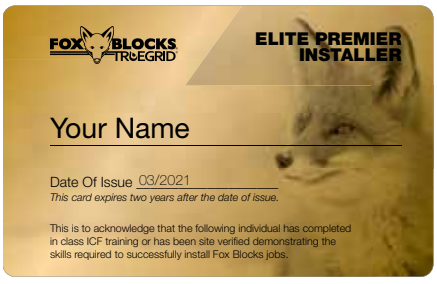
PRIMARY INSTALLER: Successfully completed one ICF project or completed in class training.



JOURNEYMAN INSTALLER: Successfully completed 5 Fox Blocks projects (or 1500+ Block).



MASTER INSTALLER: Successfully completed 15 Fox Blocks projects (or 4500+ Block). *Regional Manager & Dealer will Confirm*



ELITE PREMIER INSTALLER: Successfully completed 30 Fox Blocks projects (or 9000+ Block). *Regional Manager & Dealer will Confirm*

THE TRUE COST OF FOX BLOCKS

To help understand the cost advantage of using Fox Blocks Industrial Strength Insulated Concrete Forms (ICF) consider the following key points:

THREE KEY AREAS GIVE YOU THE TRUE ACCURATE COST OF THE ICF YOU CHOOSE:

1) ICF BLOCK COST
Most ICFs fall to within $0.10 per square foot of each other in block cost which is a minor portion of the overall cost of the wall construction. You must get "All-In" landed ICF System cost to accurately compare.

2) ANCILLARY PRODUCT COST
Add in all ancillary product costs that are not in the block quote. A common example is most ICF require internal truss wire to give needed strength to the system. Know what's required within system install guidelines to produce a straight wall. See next page for examples that will save you time & money on your next job.

3) MAN HOUR RATE TO INSTALL
Eliminating tasks will shave hours/days off the project. Installation labor is the largest portion of overall ICF cost. Seek full disclosure on man hour rates to install the ICF system you are considering. Listening to experienced installing contractors and gaining an understanding of the attributes of ICF products can make the difference between a streamlined, profitable job and one that is not.

AT FOX BLOCKS:

EXPERIENCE
Airlite Plastics Co., the parent company of Fox Blocks, manufactured many different brands of ICF over the past 15+ years. Much experience was gained while producing over a hundred million square feet of ICF. Designed, engineered and delivered to your local market.

COMPETENCE
Airlite Plastics controls all aspects of development and production = "Industry Leading Products."

COMMON SENSE
We went to the field and asked the professionals what they needed to be effective and efficient. After listening to them we produced an Industrial Strength ICF called Fox Blocks!

STABILITY
Since 1946 the family run Airlite Plastics business has grown and provided high quality proven products over the decades. We have and will continue to provide the highest quality products to the construction industry for years to come.

REMOVE COSTS ON YOUR ICF PROJECT

TWO PROVEN AREAS TO REMOVE COST:

1) CORNERS

PROBLEM: Historically, corner blocks have proved to be very difficult for installing contractors to hold the corner positioning or actually holding concrete during the consolidation process. Contractors have resorted to inserting internal ties, external strapping and bracing to gain needed strength. This adds cost in additional materials and man hour rates.

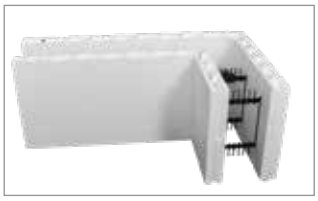
Some other ICF brands strap corners with lumber for strength during concrete placement.

SOLUTION: Our engineering staff at Fox Blocks developed more length to the corners and introduced the heaviest cross tie corner bracket on the market. Adding these features to our large/strong interlock stopped rotation and movement within the blocks during the pour and added needed burst strength. Having this bracket, and no less than two ties from each corner in all 45˚ and 90˚ block, eliminates need for additional strapping or internal ties.

RESULT: Confidence to the installing contractor, lower man hour rates, and lower material costs proven by over 10 years of successful projects. Utilizing our Fox Blocks “next generation” corner block design will save you money through time and material reductions.

COST: The Fox Blocks corners cost the same per square foot as the Fox Blocks straight block. Cost may appear higher than our competitors because our corners are 16" or more in length. In many cases, our corners are actually lower in cost per square foot and at the same time save you even more in time and materials.

The Fox Blocks extended 90˚ corner block showing it's stand alone strength during concrete placement.



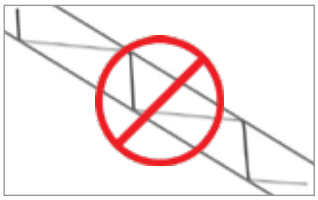
The Fox Blocks extended 90˚ corner block with an extra tie on each end for strength.

2) ELIMINATE TRUSS WIRE (FORM LOCK, BLOCK LOCK)

PROBLEM: Some ICF interlocks and slender plastic webs have caused the need for internal truss wire to aid in producing adequate strength to add rigidity to produce a straight wall.

SOLUTION: Two very simple Fox Blocks innovations cured this problem: 1) A bold and reversible interlock was created to help hold the wall true. 2) A full height internal tie was designed to use solid stacking strength to hold the wall from settling or racking.

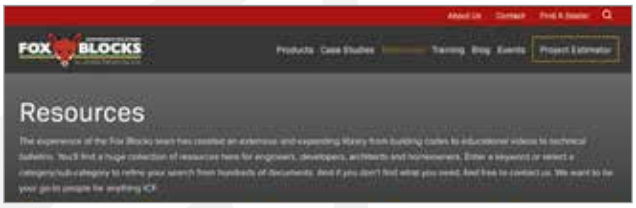
RESULT: A wall that, through design, eliminates the need for truss wire.



USING FOX BLOCKS ELIMINATES THE NEED FOR TRUSS WIRE
Truss wire costs over $0.50 per lineal foot and is called for at bottom of wall and then every 4 or 5 rows of block. Actual cost = Over $0.14 per sq ft in materials and at least $0.04 per sq ft labor for a total of $0.18 or more per sq ft cost. This is equivalent to $0.40 per block

FOX BLOCKS RESOURCES

Visit the Fox Blocks Resource Page to gain access to the essential resources, documentation and tools you need to plan and design your next innovative ICF project. Some of these key tools:



INTEGRATED LEARNING CENTER

Fox Blocks Integrated Learning Center (ILC) provides Comprehensive, free step by step training modules for all installer levels and a product knowledge course for dealers. Plus, access to an educational video library.

CONTINUING EDUCATION

AEC Daily website provides free access to Fox Blocks AIA approved online ICF courses for 1.0 HSW credits.

AUTOCAD DETAILS

Fox Blocks full product and construction detail library is available on CADdetails website. Details may be downloaded as dwg, pdf, 2D or 3D models. Specifications are also available.

BIMSMITH, BIM FORGE AND BIM MARKET

BIM 3D product details are available for download to use in Revit. BIM Forge creates 3D Fox Blocks wall assemblies for Revit designs. BIM Market provides product details descriptions and applications

MASTERSPEC

Fox Blocks specifications are AIA approved and listed by DELTEK on www.productmasterspec.com, in Section 031119.

YOUTUBE

In addition to the ILC educational videos, Fox Blocks has may installation videos listed on our YouTube channel

AND MUCH MORE

On the Resources Web Page - Technical Bulletins, Specifications, Testing, Building Science Reports, Code Compliance, Engineering Tables, Install Guidebooks and Checklists, etc.

Find everything you need to get started on at www.foxblocks.com.

FOX BLOCKS STUDS

You are a sheetrock, residential wood frame, commercial steel stud or siding contractor that has been trained, and are efficient with, a continuous 1½" wide attachment surface @ 16" on center.

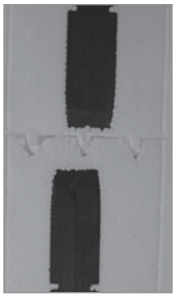
Our team agrees with this tradition and therefore created Fox Blocks with the same, continuous 1½" wide attachment surface, but increased it to 8" on center.

Just think, when attaching sheet rock or siding to Fox Blocks, you can use the same training you have used until now and understand.

Photo shows a wood stud on top of a Fox Blocks stud for size comparison.

FOX BLOCKS
- A full 1½" wide
- 8" o/c to achieve industry standard 16" o/c's
- No gap every 16" vertically due to ties touching
- Minimal settling due to ties touching
- Not effected by moisture, will not rot
- Will not move due to temperature and humidity changes
- Eliminates most sheetrock/drywall repairs
- Made of non-organic materials

ACTUAL FOX BLOCKS WALL
- Studs clearly marked @ 8" o/c
- Studs are in contact with each other vertically
- Studs buried into foam ⅝" for stucco application and thermal performance



OTHER ICF
- As narrow as 1" wide
- As much as 1¾" gap every 16" vertically due to ties not touching
- Settling due to ties not touching

WOOD STUDS TODAY
- Much larger grain than 15 years ago
- More knots and checks than 15 years ago
- Reject screws more than 15 years ago
- Prone to movement through seasons
- Prone to rot when sealed with moisture
- Prone to sheetrock/drywall repairs
- Food for insects

FOX BLOCKS STUDS
- Recycled polypropylene
- LEED credits*
- 120 lbs+ pullout / shear strength with screws**
- Use screws that are the thickness of material plus 1⅛" + in length.
- If the screws that you are using do not hold, try the next size longer. The tip of the screw must pass completely through the tie to achieve full strength.

* *See LEED documents at: http://www.foxblocks.com/Resource-Center/Technical-Resources/LEED-and-Environmental-Documents.aspx*

** *See testing results at: www.foxblocks.com/Resource-Center/Technical-Resources/Testing-Reports.aspx*

FOX BLOCKS INTERLOCK

THE OLD

For the past 20+ years, the interlock of most ICFs in the industry have been designed to be within ½" to 1" of the desired building dimension. Most contractors have been trained that it is acceptable to be this far off the desired dimension.

THE NEW

When the Fox Blocks interlock was designed, our engineering staff made the choice not to focus on being within ½" to 1" from the building dimension, but to give the strongest interlock possible. To do this they turned the projections and recesses of the interlock parallel to the block itself and for simplicity/strength they made them 1" wide and 2" long. ***Walls should be square and built to the building dimensions. For this reason, Fox Blocks recommends stacking seams when needed.***

Shows the large 2" long projections and recesses and the full height 1½" wide tie

Here is a job, post concrete, that has been constructed exactly to the building dimension by properly stacking seams.

BENEFITS OF THE LARGE INTERLOCK

- Minimized movement during concrete placement
- No adhesive required due to tightness of interlock
- Eliminates the need for truss wire within the wall
- The full height ties are always on top or 4" apart of each other

Review next page to see the proper procedure for stacking seams.

CUT LINES

Every block has cut lines inscribed on the face. The cut lines are spaced @ 2" o/c and when used will place the cut precisely at the end of the interlocking tooth on top and bottom of block. The design was made for simplicity and speed of construction.

When required to cut block, use the cut line to maintain a running bond on each course.

Note: In most cases, when not cutting precisely on a cut line a stacked seam will be created.

CLICK THROUGH FOR RESOURCES

THE NEW TRAINING

ROW ONE
Simply start from each corner to a point within the wall. Cut one of the blocks to fit perfectly. The cut does NOT need to be on the cut lines. Measure the cut block and mark its measurement to the side of that block large enough for everyone to see.

ROW TWO
Start at the corners again placing the corner block the opposite direction from row one to give an overlap with the block. When you reach the cut block on row one, cut the block above it to line up exactly. Again the cut does not need to be on the cut line. Measure the cut block and mark its measurement to the side of that block large enough for everyone to see.

ROW THREE
(five, seven, nine, etc)
Should be exactly the same as row one.

ROW FOUR
(six, eight, ten, etc)
Should be exactly the same as row two.

PRIOR TO CONCRETE
Simply connect the vertical seam that you created, at the one point in the wall, with strapping, or plywood, on both sides of each block. Use one 12" to 24" long strap, 3" to 6" wide, made out of 1 x wood boards or plywood sheathing attached with one screw in each tie on each side of seam.

RESULTS
We have found that the man hour rate will drop using this method because the crew spends less time thinking how they can get closer to the building dimension and more time actually being productive.

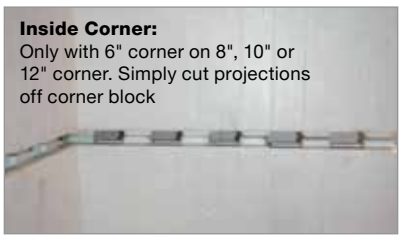
WRONG

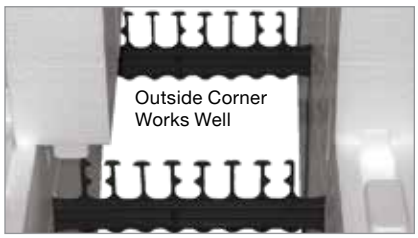
CORRECT

We have found it to be a waste of time and energy to attempt to offset or stagger the block, at the meeting point, as in the photo above-left. By creating a vertical stacked seam, you will be more accurate with the job dimensions and will increase your profit by gaining efficiency with your crew.

BUILDING MULTIPLE LEVELS WITH DIFFERENT SIZED BLOCK
All sizes of Fox Blocks fit well on top of each other for any type of configuration with little or no modifications needed. This is simple math. Fox Blocks are reversible with 2" projections and recesses which means you will work with a 4" offset. For this reason the 4", 8" and 12" block all work well together as they are all divisible by 4". Using the same math, the 6" block attaches to all sizes of Fox Blocks with a 2" difference in tie alignment. This is not a concern as this joint line will usually happen at a floor diaphragm.

6" CORNER BLOCK ON TOP OF 8", 10" OR 12" CORNER BLOCK:
The 6" corner works well on top of the 8", 10" or 12" corner blocks when going around an outside corner. For inside corners, simply remove the projections off the corner block and continue building. You may need to create a stacked seam on one or both sides of the inside corner at which time we recommend moving the stacked seams for each wall closer to that inside corner.





6" 90˚ corner block on top of 8", 10" or 12” 90˚ corner block

FOX BLOCKS ADVANTAGES

CONSTRUCTION ADVANTAGES
As a modular, easy to install building product (one block equals 5.33 sq. ft. of wall area), the construction process is expedited with less labor and faster completion timelines. As a 6 in 1 product, fewer materials are required to meet the requirements for high-performance wall assemblies. Fox Blocks may be used to construct below grade and above grade walls for all building types and sizes. There is a definite business advantage in being a Fox Blocks Installer/Contractor.

THERMAL COMFORT
The continuous, double insulated, mass concrete core performs better than the calculated R-value of R22+ for the wall assembly. Fox Blocks ICF wall assemblies meet and exceed current and pending energy codes for thermal comfort, in cold and hot climates zones. The use of the Fox Blocks Energy Stick enhances the R-value to R30+ or R39+.

AIR TIGHTNESS
The air tightness of a building envelope is one of the main contributors to energy efficiency and control of the indoor environment. Fox Blocks enables Air Changes per Hour (ACH) to be evaluated at much less than code requirements without extra sealants, tapes, or membranes. Another material and labor advantage.

INDOOR COMFORT
The high thermal performance and air tightness of the Fox Blocks wall assembly provides excellent indoor comfort and improves the buildings operational performance characteristics for the interior environment. They eliminate moisture intrusion, function as a vapor retardant, and maximize airtightness, all while managing the indoor air quality and allowing for healthy climate control and sound mitigation.

BUILDING SCIENCE
Fox Blocks ICFs address all four building science properties – air, moisture, vapor and thermal to create a comfortable and safe environment.

Conduction: Continuous Insulation, High R-Value Wall Assembly of R-22+
Convection: Airtightness with an ACH of less than 0.03
Radiation: High thermal Mass of Double Insulated Concrete Core
IAQ: The EPS or Concrete does not off-gas or contribute to mold or mildew growth

ENERGY EFFICIENCY
All the characteristics of a Fox Blocks building envelope provide 40% plus in operational costs savings, and enable a Net Zero Ready evaluation. The continuous double layer of insulation utilizes the thermal mass of the concrete core to moderate temperature transfer through the wall assembly. The EPS wall assembly will not deteriorate or lose R-value over time.

REDUCED HVAC
The performance characteristics of a Fox Blocks wall assembly, when initially evaluated or modelled for the design of HVAC equipment, dramatically reduces the first cost sizing and ongoing operational expenses of the heating and cooling systems, as well as the Photovoltaic (Solar) requirements.

RESILIENCY
Fox Blocks creates a reinforced concrete wall assembly that has certified fire testing for fire resistance ratings - 2HR for a 4" form and 4HR for a 6", 8", 10" or 12" forms. The wall assembly may be designed to resist high winds over 200 mph and flying debris. The concrete and EPS wall is not damaged from flood waters. FEMA recognizes ICFs for the construction of safe rooms and storm shelters.

PASSIVE SURVIVABILITY
Fox Blocks ICF high-thermal-mass wall systems significantly contribute towards passive survivability and resilient design. The continuous insulation with an R-value of 23 creates an airtight-building envelope, preventing heat loss through conduction, while its vapor retarder stops air and moisture infiltration through convection. The high-thermal mass of Fox Blocks ICF helps to stabilize and maintain a building's temperature during lengthy power outages.

DESIGN

Design professionals have easy access to product and application details in 2D or 3D CAD, or BIM libraries. The BIMsmith Forge free library allows for the construction of wall assemblies with a Fox Blocks ICF core. These libraries also provide PDF files, and specifications. Fox Blocks is also approved by the AIA and listed in MasterSpec library.

TECHNICAL SUPPORT AND EDUCATION

Fox Blocks provides technical support along with the extensive Resource reference library. The Integrated Learning Center (ILC) provides a comprehensive, free, Installer training course for all levels of Installers. There is also a Product Knowledge course for authorized distributors.

The ILC site also has an ever-expanding video library for product applications and techniques.

CLICK THROUGH FOR RESOURCES

6 IN ONE ICF WALL

1. Structure
2. Continuous Insulation
3. Air Barrier, WRB
4. Vapor Retardant
5. Attachment Surface
6. Reversible Interlock

FOX BLOCKS 6 IN 1 WALL CONSTRUCTION ASSEMBLY

The Fox Blocks 6 in 1 Wall Construction Assembly expedites the building process and creates faster results! By completing these steps all in one ICF wall, you can dramatically reduce the construction schedule vs. traditional multi-layer wall assemblies. A faster construction time means a faster move-in date to start enjoying your new home!

REVERSIBLE INTERLOCK
Reversible top & bottom interlock saves time and reduces product needs

REBAR SADDLE
Horizontal positioning and secured placement of lap splices

CONCRETE FORM
Exterior and interior

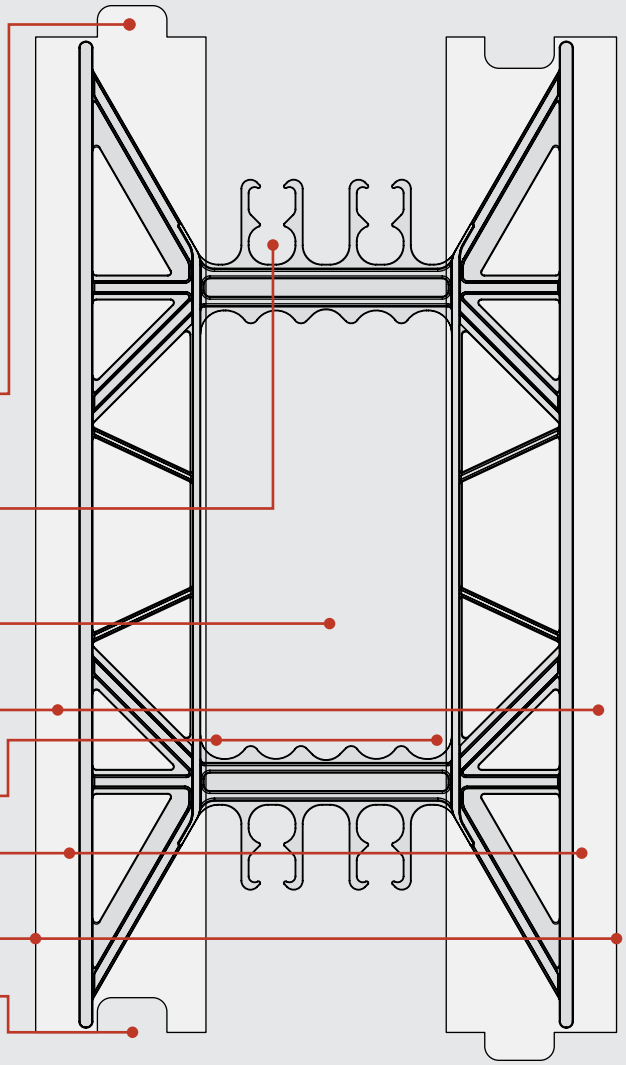
CONTINUOUS INSULATION
Embedded full height for exterior and interior

AIR BARRIER

FURRING
Embedded full height for exterior and interior

VAPOR RETARDER

REVERSIBLE INTERLOCK



FOX BLOCKS LINE-UP

With advice from leading contractors in the Insulated Concrete Form business, Fox Blocks has created an incredible group of blocks.

FOX BLOCKS LINE-UP INCLUDES

(Please note: Fox Blocks are reversible. As an example, each corner block is a left or a right.)

A) STRAIGHT BLOCKS
Available in 4", 6", 8", 10" and 12".

B) STRAIGHT 1/2 BLOCK
Available in 4", 6", 8", 10" and 12".

C) EXTENDED 90° CORNERS
Available in 4", 6", 8", 10" and 12".

D) EXTENDED 90° CORNER 1/2 BLOCK
Available in 4", 6", 8", 10" and 12".

E) 45° CORNER BLOCKS
Available for 4", 6" and 8".

F) T-BLOCKS
Standard T: Available in 6" x 6" and 8" x 8"
Transition T: Available in 4" x 6", 6" x 4", 8" x 4", and 8" x 6"

G) CORBEL LEDGE BLOCKS
Available in 6" and 8".

H) RADIUS BLOCKS
For 5', 6', 7', 8', 9' and 10' radius.
Only available in the 6" blocks.

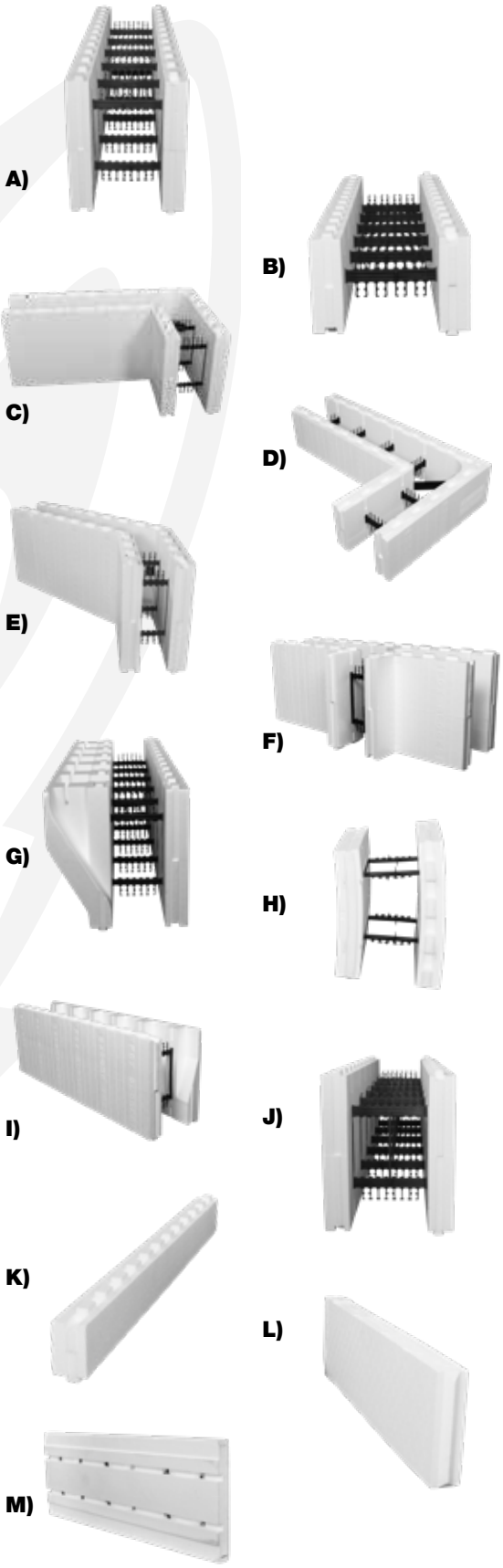
I) TAPER TOP BLOCK
Available in 6" and 8".

J) CURB BLOCK
Available in 8" and 10" Straight and 90°

K) 4" HIGH EXTENSION
When you need extra height or to help with openings.

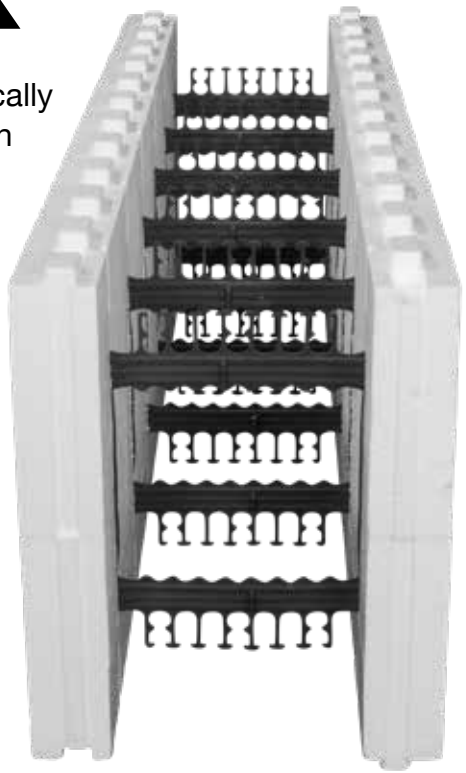
L) ENERGY STICKS
One size fits all.

M) FOX BUCK
Available in 4", 6", 8", 10" and 12".



FOX BLOCKS STANDARD (STRAIGHT) BLOCK

The standard block is the core of the product line, typically makes up between 80-85% of the ICF wall assembly on most residential and commercial jobs.



STANDARD BLOCKS

1) 16" high x 48" long available in concrete core sizes 4", 6", 8", 10" and 12"

2) One standard block is 5.33 sq. ft. of wall area

3) Solid 2⅝" thick EPS continuous insulation panels providing R4.1 per inch

4) Cross-ties, polypropylene recycled industrial plastic at 8" o.c.

5) Cross-ties are designed with a full height 1½" wide fastening strips at 8" o.c. on each side of the block

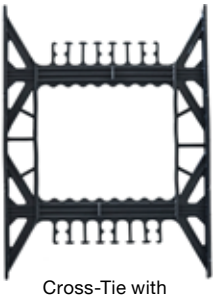
6) Rebar clips are built into the cross-ties to secure and space the rebar

7) Blocks have a robust, reversible, tight fitting interlocking system on the top and bottom

8) The locations of all cross ties are indicated on the exterior face of the block

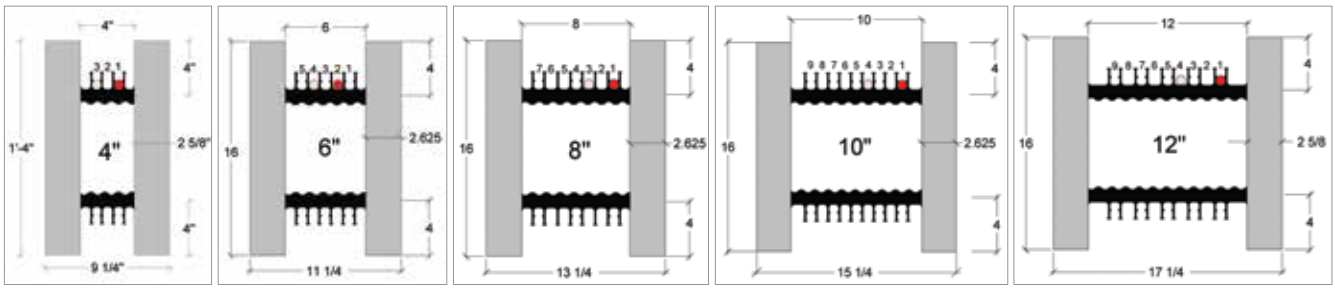
9) Cut lines are scribed on the exterior face of the block to allow cut blocks to maintain interlock

10) Fox Blocks creates a flat wall reinforced concrete wall assembly



Cross-Tie with Fastening Strip

FOX BLOCKS END VIEW SIZING

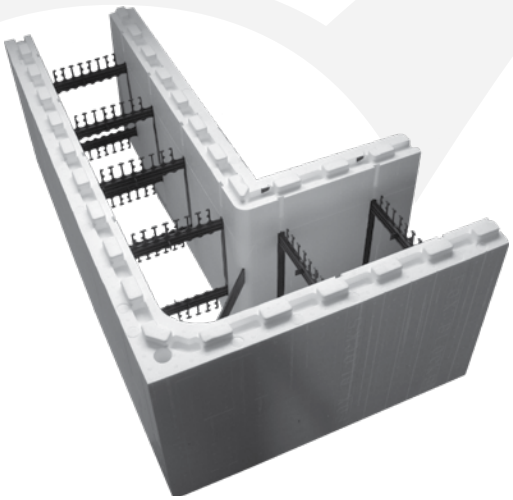


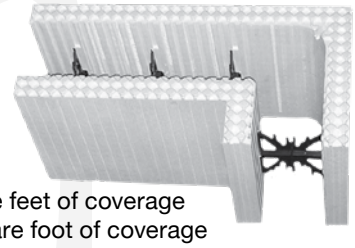
CONCRETE VOLUMES - CU.YD (CU.M)

4"	0.066	(0.05)	10"	0.165	(0.126)
6"	0.099	(0.075	12"	0.198	(0.151)
8"	0.132	(101)			

FOX BLOCKS EXTENDED 90° CORNER

Fox Blocks engineered the 90° corner to hold concrete without the need for extra strapping or external bracing.



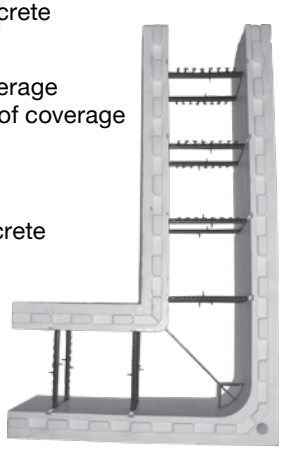


OTHER ICF 90s

- 5 to 5.33 total square feet of coverage
- More costly per square foot of coverage
- 16" shorter than Fox Blocks
- Only 4 ties
- Only one tie on short end
- More movement during concrete

FOX BLOCKS 90s

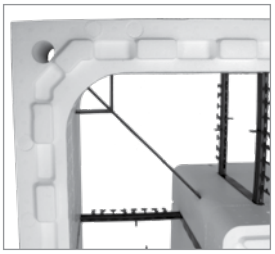
- 7.56 total square feet of coverage
- Less costly per square foot of coverage
- 16" longer than other ICF
- 6 ties
- Two ties on short end
- Less movement during concrete

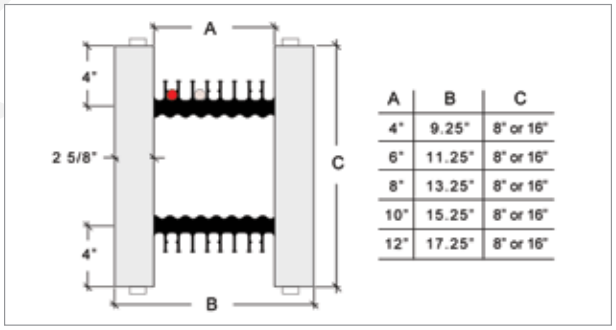


Being 16" longer than other ICF allows you to eliminate one full straight block for every three Fox Blocks corners used. This also saves you money!

Radius on the inside face of the Fox Blocks Corners are:
4", 6" and 8" Blocks = **3"** 10" and 12" Blocks = **8½"**
Additional EPS was added to the 10" and 12" Corner Blocks to give additional strength for the longer distance from corner to 1st tie.

Every Fox Blocks corner has a large 100 sq. inch fastening zone in the corner.





A	B	C
4"	9.25"	8" or 16"
6"	11.25"	8" or 16"
8"	13.25"	8" or 16"
10"	15.25"	8" or 16"
12"	17.25"	8" or 16"

Fox Blocks 90° Extended Corner Size Chart

FOX BLOCKS EXTENDED CORNER FEATURES

1) All blocks have Ties* at 8" o/c and are available in 4", 6", 8", 10" and 12" cavities.

** Ties are the black recycled polypropylene members that give the block strength and provide rebar positioning.*

2) Like all Fox Blocks, corner blocks are reversible so when you ask for a corner you will get the correct one every time. Each corner is left or right automatically!

3) Foam thickness is 2⅝" on all forms.

4) Tie allows rebar lap splices to lay on top of each other for good flowability during concrete placement.

5) Ties are clearly marked on EPS for attachments.

6) Tie flanges are 1½" wide and full height for ease of attachment.

7) Ties touch vertically when stacked, eliminating form settlement.

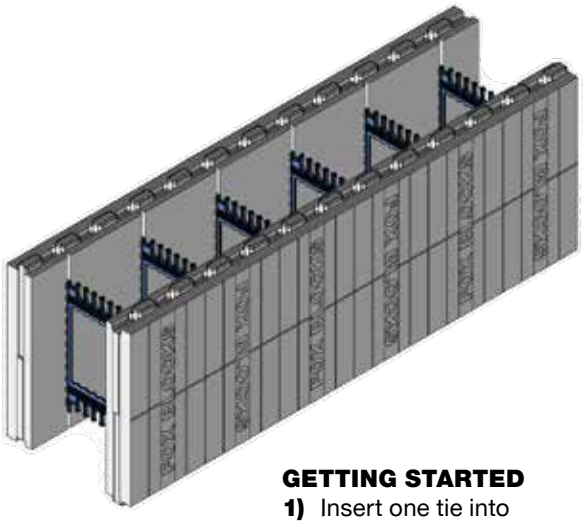
8) Each corner has a 1" hole strategically placed allowing the ICF contractor the option of inserting a full height ¾" PVC conduit to tie all courses together for extra form support.

OUTSIDE DIMENSIONS ARE:

4" Corner = 38" x 22"
6" Corner = 40" x 24"
8" Corner = 42" x 26"
10" Corner = 42" x 26"
12" Corner = 46" x 30"

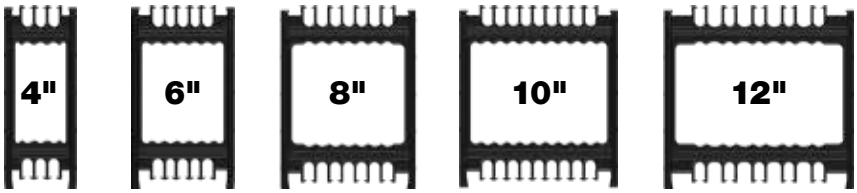
FOX BLOCKS COMPACT PRODUCT

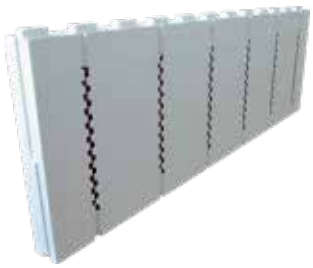
Fox Blocks Compact is a panelized product designed to stack seamlessly with the traditional Fox Blocks line. The Compact Block reduces freight costs by delivering flat. Ties are then easily inserted into the panels at the jobsite.



FOX BLOCKS COMPACT BLOCK APPLICATIONS

- Double Taper Top in any size
- Double Corbel in any size
- Emergency stock where storage is a premium
- Large block size required at a long distance from plant





STRAIGHT PANEL

CORBEL PANEL

TAPER PANEL

QUICK COMPACT BLOCK FACTS

- Dimensions are consistent with traditional Fox Blocks
- Rebar locations match traditional Fox Blocks ties
- Straight, Taper and Corbel panels available
- Ties lock into position when inserted into the panels
- Start with traditional Fox Blocks corners to anchor your wall
- When ties are locked into position use Fox Blocks HV Clips

GETTING STARTED

1) Insert one tie into one panel.
2) Lift this unit and slide the opposite side of the same tie to a second panel that is aligned with first panel.
3) Insert the remaining 5 ties into this unit to complete your first full block.
4) Press ties down until they lock into position.
5) Continue this procedure until first row is completed.

CONSECUTIVE ROWS

1) Lock two panels on top of lower row of block.
2) Insert 6 ties to complete the block.
3) Be sure to force ties down until they lock into position.

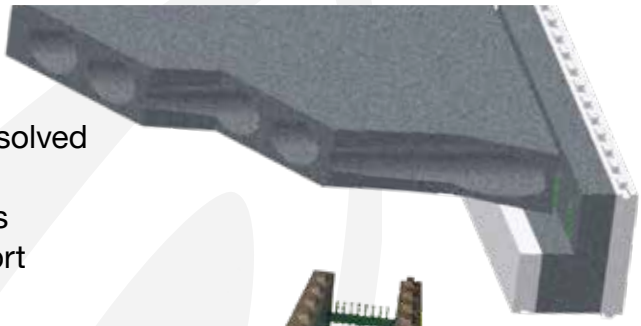
INTENSE REBAR CAGES

1) Install vertical rebar.
2) Assemble Compact Block around rebar.
3) Place and install stirrups as needed while assembling Compact Block.

GO TO FOXBLOCKS.COM FOR UPDATED INFORMATION

FOX BLOCKS CURB BLOCK

There has always been a need for a block that can create a ledge to support floor systems within the wall without limiting course heights. The Fox Blocks team has solved this by adding an extra attachment point within the tie. This patented solution allows you to form a curb with the block to support whatever you need to support.



USING THE CURB BLOCK

1) INSTALLATION
See following page for proper steps using the curb block.

2) SHAPES AVAILABLE WITH THE CURB BLOCK
Curb block is currently available in 8" and 10" straights, as well as 8" and 10" ninety degree corners.

3) RANGE OF USE
The Curb Block can be cut down as low as 11" from the top of the block. You can also cut up to as much as 11" from the bottom of the block to use when wrapping around concrete slabs. See page two for an example of this.

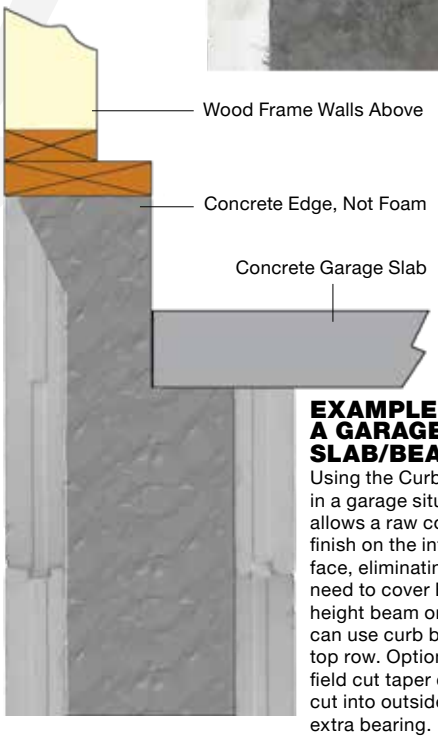
4) ESTIMATING
Straight blocks = 4'-0" long.
Formula: (Total linear footage of wall - total linear footage taken up by 90˚ corners)/ 4 = Number of straight curb blocks
90˚ corner blocks = 5'-4" each.
Formula: Number of 90˚ turns = Number of 90˚ corner blocks

5) IDENTIFICATION
The Curb Block has been designed with a green tie for easy identification. By producing the ties in green, supply yards will be able to identify and send you the proper block. This will also ensure your crew will not use it in the wall at the wrong time.

6) BUNDLE SIZES

8" straight block = 12 per bundle	8" 90˚ corner block = 6 per bundle
10" straight block = 9 per bundle	10" 90˚ corner block = 6 per bundle

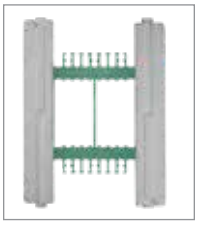
7) EXCESS BLOCK?
If you end up with extra Curb Block on site, you can save for next job or simply use them up within the walls you are building. The shape and size of the Curb Block is identical to the normal straight and 90˚ corner blocks.



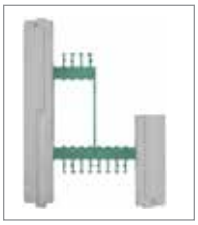
EXAMPLE OF A GARAGE SLAB/BEAM
Using the Curb Block in a garage situation allows a raw concrete finish on the interior face, eliminating the need to cover EPS. Any height beam or wall can use curb block on top row. Optionally, a field cut taper can be cut into outside face for extra bearing.

FOX BLOCKS CURB BLOCK INSTALLATION & USES

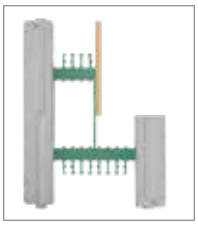
INSTALLATION STEPS:



STEP 1
Separate Curb Block bundles and set aside until needed. You can identify the Curb Block by the green ties.



STEP 2
Decide where you need the concrete shelf elevation to land and either mark and rip-cut the block with a circular saw or set a fence on a table saw and make your cut. Finish cut by cutting the tie with a handsaw.



STEP 3
Attach forming to the Curb Block inner ties. Simply screw two #8 coarse threaded screws to each tie to withstand concrete pressure. Fox Blocks recommends the use of ½" or thicker plywood or equivalent.

STEP 4
Place concrete as normal. For best results, Fox Blocks recommends properly consolidating entire wall including Curb Block.

STEP 5
After sufficient curing remove form boards. You now have a solid concrete ledge for supporting what you need supported.

STEP 6
If you need extra support, a taper can be cut prior to concrete placement to allow for up to a 6¼" ledge.

CURB BLOCK USES:

- Hollowcore
- Precast
- Dimensional Wood Floors
- Engineered Wood Floors
- Truss Floors
- Brick
- Garage Slabs
- Creating Recesses (See Below)
- Composite Floor Systems
- Pan Deck

EXAMPLE OF A WALL RECESS
This type of application will be treated as an opening in the wall and will require extra reinforcing within the concrete (rebar). The Curb Block will allow openings up to 22" in height using two blocks.

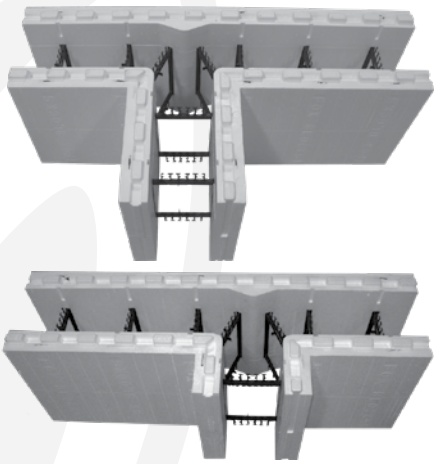
WOOD FLOORS
For the real life example above, we cut off 6" from the left side, turned the cut-off over and connected to the right side creating a 12" curb. This works well with wood floors, giving you ultra strength without any concerns of moisture in the future.

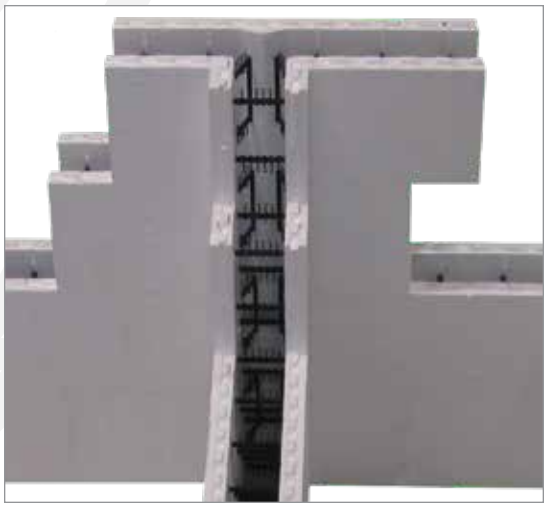
CLICK THROUGH FOR VIDEOS

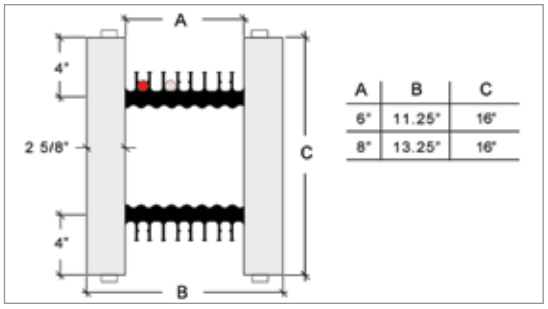
FOX BLOCKS T-BLOCK

Sure you can build T walls with a couple of straight block and some tie wire, but if you want to lower your man hour rate, you need the **Fox Blocks T-Block**.

When contractors said they needed a T-Block, Fox Blocks delivered with one that is easy to use and incredibly strong.







A	B	C
6"	11.25"	16"
8"	13.25"	16"

FOX BLOCKS T-BLOCK FEATURES

1) The T-Blocks are available in 6" and 8" concrete cores.

2) Six T-Blocks per bundle (3 short and 3 long)

3) Two ties* are used at the intersection of the "T" to give maximum strength and attachment. These ties are placed in such a way as to allow proper rebar placement and ultimate form strength.
** Ties are the black recycled polypropylene members that give the block strength and provide rebar positioning.*

4) Like all Fox Blocks, blocks are reversible which gives you double the options with just one block. You can choose to have the T section on the right or left of center simply by flipping the block over.

5) Foam thickness is 2⅝" on all blocks.

6) Ties allow proper rebar lap splices, for maximum flowability during concrete placement and consolidation.

7) Ties are clearly marked in EPS for attachments.

8) Tie flanges are 1½" wide and full height for ease of attachment.

9) Ties touch vertically when stacked eliminating form settlement.

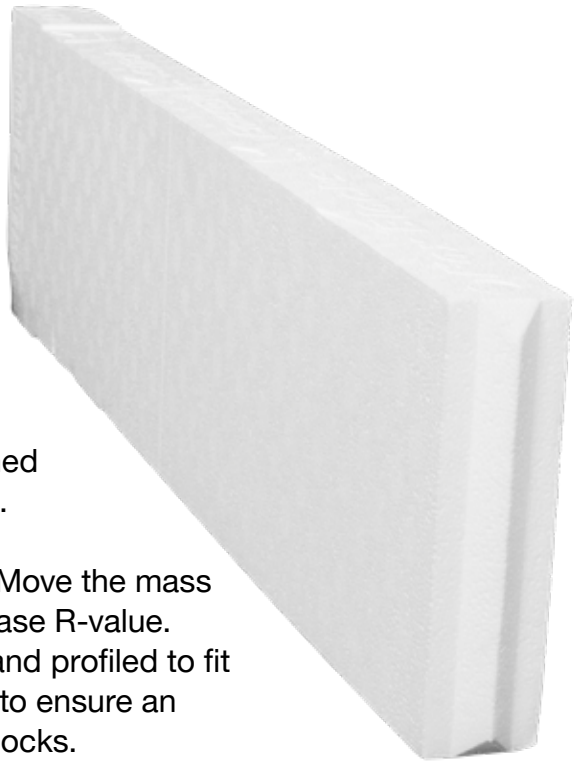
10) The T-Block will give you 8" of overlap most directions.

8" T-BLOCK INSTALLATION

The unique manufacturing challenges were overcome for the 8" T-Block by establishing a 4" offset. This off-set results in rows of ties staggered by 4" if placed with factory ends against each other. The easy fix to properly line up ties is to install the T-Block and create a stacked joint at the butt end of the long T leg. Strap stack joint prior to concrete placement.

OUTSIDE DIMENSIONS ARE:
6" T - Block Short = 44" x 4⅜"
6" T - Block Long = 44" x 12⅜"
8" T - Block Short = 44" x 4¾"
8" T - Block Long = 44" x 8¾"

FOX BLOCKS ENERGY STICK



How do you improve an Insulated Concrete Form wall that already out-perform most wall system in all climates? You move the concrete mass toward the living side of the wall. This unbalanced R-value will allow the mass to be closer to the living temperature of the conditioned space allowing for a more comfortable building.

The Fox Blocks design team had two goals: 1) Move the mass away from the harsh temperatures and 2) Increase R-value. Each Energy Stick is 8" wide, 32" tall, 2" thick and profiled to fit within all Fox Blocks. The Energy Stick is used to ensure an R-8 boost to the already high R-Value of Fox Blocks.

SIZING AND ACTUAL R-VALUE

6" Block + 1 Energy Stick (R-30+*) = 4" Concrete
8" Block + 1 Energy Stick (R-30+*) = 6" Concrete
10" Block + 1 Energy Stick (R-30+*) = 8" Concrete
10" Block + 2 Energy Sticks (R-39+*) = 6" Concrete
12" Block + 1 Energy Stick (R-30+*) = 10" Concrete
12" Block + 2 Energy Sticks (R-39+*) = 8" Concrete
12" Block + 3 Energy Sticks (R-48+*) = 6" Concrete

** This represents the overall average wall R-value. As an example in wood frame construction a wall with R-19 batt insulation will have an overall average wall R-value of less than R-16 due to thermal bridging.*

USING THE ENERGY STICK

1) INSTALLATION
Simply insert the patented Energy Sticks between the plastic ties and to the outside face of wall after every two rows of blocks have been placed.

2) CORNER BLOCKS
Fox Blocks corners are naturally thicker eliminating the need to insert Energy Sticks from the corner tie on. From the last straight tie to the corner tie you will need to wedge the Energy stick in place. A spot of expanding foam will also help to secure the Energy Stick from movement.

3) OPENINGS/STACKED SEAMS
Simply cut the Energy Stick to fit in locations that are narrower than 8". When larger than 8" use expanding foam to hold cut Energy Sticks.

4) RANGE OF USE
The Energy Stick will fit all Fox Blocks.

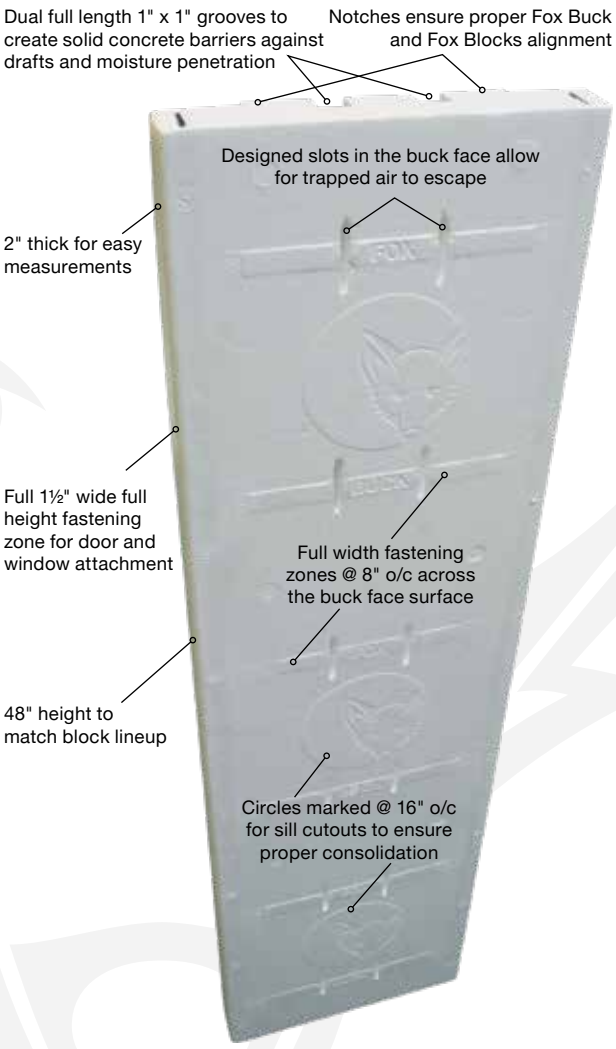
5) ESTIMATING
3 Energy Sticks for every block ordered.
One box = 36 Energy Sticks
One box of Energy Sticks will fill 12 blocks

6) MAN HOURS
Allow 4 minutes per box when inserting for the first time (= 950 square feet of wall per hour or .001 man hours per square foot)

7) BUNDLE SIZES
Each box of 36 Energy Sticks = approximately 24" x 24" x 33"

FOX BUCK CONTINUOUS INSULATION

The Fox Buck is a certified, fully integrated, continuous insulation window and door buck for commercial and residential ICF wall openings. Fox Buck completed 3rd party testing and obtained State of Florida product approval (FL 17775) for all of Florida, including Miami-Dade counties. To obtain certification and Florida code approval, the Fox Buck met and passed several tests related to wind and impact resistance, moisture and air infiltration, and fire related tests. The Fox Buck can be used in place of pressure treated wood bucks that tend to expand, contract, warp and move within the high moisture climates.



FOX BUCK NUMBERS					
Available Sizes	4"	6"	8"	10"	12"
Total Width	9¼"	11¼"	13¼"	15¼"	17¼"
Total Length	48"	48"	48"	48"	48"
Bag Quantity	10	10	10	10	10
Bag Weight	26 lbs	28 lbs	32 lbs	35 lbs	38 lbs

Photo above reveals consolidated concrete barriers created within the Fox Buck

The 1" x 1" notches create a dual barrier against drafts and moisture penetration. When installed properly, the concrete barrier protection is continuous around the entire opening. These barriers also anchor the Fox Buck to the wall with enough strength to hold in most weather* conditions

** Contact Fox Blocks for high wind anchoring recommendations.*

FOX BUCK INSTALLATION

INSTALLATION STEPS:

STEP 1
a) Build wall as normal with opening 4" larger than rough opening.
b) Ensure all opening rebar is properly placed and secured.
c) Double check opening measurements.

Temporary support can be attached to Fox Buck fastening zones.

STEP 2
a) Cut sides to length and notch each end 1" as in photo.
b) Place Fox Buck sides into place and hold with tape.
Option: Spray foam can be used to completely seal buck to block

STEP 3
a) Cut and place top and bottom Fox Bucks
Option: Spray foam can be used to completely seal buck to block
b) Penetrate all slots with a nail or screw to ensure entrapped air can escape during concrete placement.

STEP 4
Cut and remove all circles in sill. This will ensure proper concrete consolidation during concrete placement.

Notes:
It is preferred to have these circles cut out prior to placing the Fox Buck sill in place. This will eliminate any foam cutouts accidently falling into wall cavity.

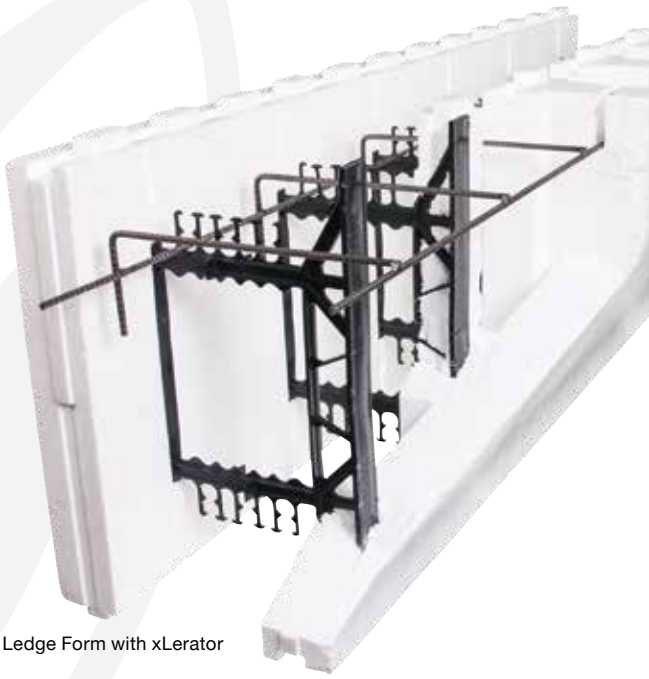
Holes can be cut square to allow maximum hole size for concrete placement.

STEP 5
Brace inside opening to hold square during concrete placement.

STEP 6
When openings are close to a corner, strapping is required to hold corner in place during concrete placement.

xLERATOR® LEDGE REINFORCEMENT

From foundation to finish, the Fox Blocks patented family of products helps you get the job done more efficiently. Combining industry feedback with the Fox Blocks product design team creativity, we offer an impressive array of product innovations that benefit the owner, the contractor, AND the design team.



Ledge Form with xLerator

FOX BLOCKS' xLERATOR – the only product of its kind in the industry and first one to meet ACI 318 guidelines – is a patented ICF ledge reinforcement system that offers unmatched versatile performance ideal for supporting brick and stone exterior finishes, as well as slabs, floors and other structural features.

The one-piece, 4-foot long, welded wire reinforcement piece simply drops into the pre-formed slots in Fox Blocks' ledge form.

There's never been a faster way to meet deadlines and building code requirements, all while significantly reducing labor costs and delays associated with pre-bent stirrups or in-field rebar reinforcement.

xLERATOR® Engineered Reinforcement System

xLerator Closeup
Covered by US Patent #7437858

Mitered Ledge Corner

BENEFITS INCLUDE

- **DROP & GO**
  Fully engineered ledge system allows you to easily place the ledge form, drop in the xLerator reinforcement piece and fill with concrete.
- **ACI 318 COMPLIANT**
  ONLY xLerator meets ACI 318 guidelines for ICF ledge reinforcement.
- **WEATHER RESISTANT**
  Hot-dipped galvanized to protect from corrosion for lasting durability.
- **FULLY ENGINEERED**
  Comes complete with full engineering details for multiple applications.
- **MAXIMUM STRENGTH**
  Reinforcement in all 6 ledge corbels.
- **VERSATILE**
  One size fits both 6" and 8" ledge forms.

WHY HOT-DIPPED GALVANIZED?

Hot-dip galvanization is the process of taking steel and dipping it into molten zinc to serve as a protective coating. If rebar in a ledge form is NOT galvanized, it's subject to corrosion because it is placed close to the outside edge of the brick ledge, sits in a foam slot, and is not completely encased in concrete. This allows water to reach the rebar and causes it to rust. As the rebar rusts, it expands, causes concrete to crack, and undermines the stability of the ledge.

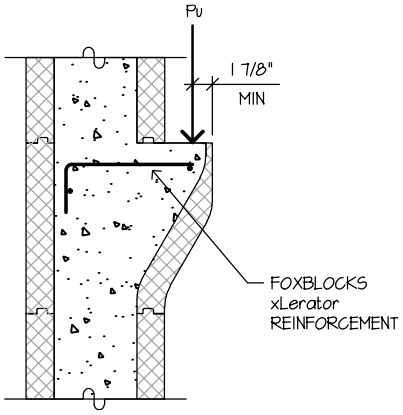
Since the xLerator is hot-dipped galvanized, it protects the reinforcement from rusting and maintains the integrity of the concrete meeting ACI 318 guidelines.

APPLICABLE ACI 318 GUIDELINES

Deformed Welded Wire Reinforcement (WWR)

- Reinforcement in every corbel
- WWR 60,000 PSI Yield Strength
- xLerator meets these guidelines

xLERATOR® ENGINEERING LOAD CAPACITY



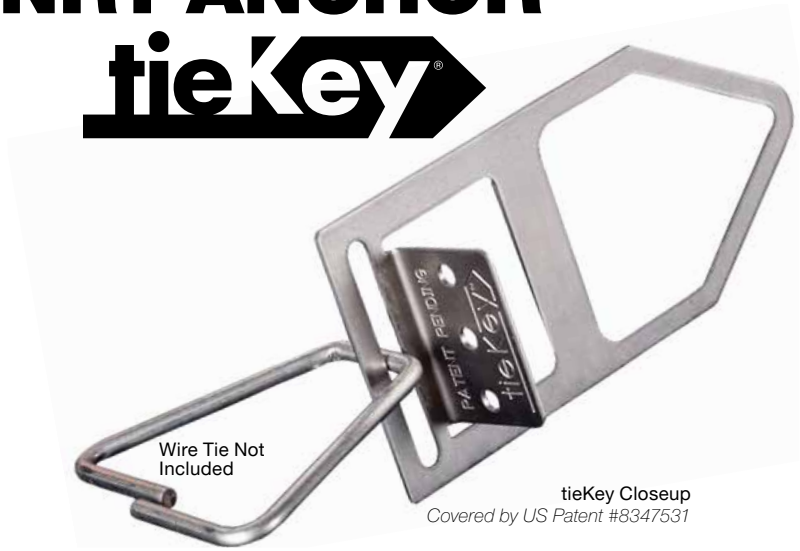
ULTIMATE LOAD CAPACITY, PU = 2000PLF	
Example Application	Calculated ultimate load tributary area X LoadX Load Factor
Brick	35 Ft. x 40 PSF x 1.4 = 1960 PLF
Stone	17½ Ft. x 80 PSF = 1960 PLF
Wood Floor Joists	22½ Ft. tributary area or 45 Ft. clear span 22½ Ft. X (20 PSF x 1.2 + 40 PSF x 1.6) = 1980 PLF
Precast Hollowcore Floor	14½ Ft. tributary area or 29 Ft. clear span 14½ Ft. x (60 PSF x 1.2 = 40 PSF x 1.6) = 1972 PLF

Notes:

1. *Load capacity is based on a concrete strength of 2500 PSI or greater and to KSI Fox Blocks' xLerator reinforcement meeting ASTM A496*
2. *Load factors are based on ACI 318-11.*
3. *Tributary floor span is the length of floor supported by the ledge form, which is commonly half of the clear span.*
4. *Acceptable masonry heights and floor spans shown in the table are based on the structural capacity of the ledge only and may be limited by other factors. Consult a design professional for acceptable heights or unsupported masonry and floor spans.*

tieKEY® MASONRY ANCHOR

Designed by Fox Blocks, the tieKey anchor is a patented, cast-in-place, adjustable masonry tie anchor that embeds into the concrete wall formed by Fox Blocks. This award winning product provides the strength and security required when installing brick or stone veneer finishes.



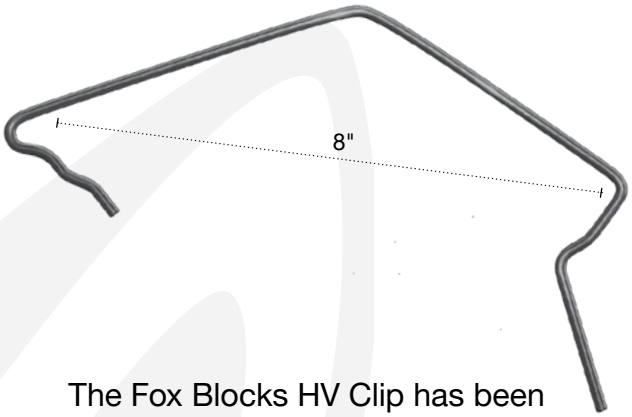
tieKey Closeup
Covered by US Patent #8347531

SEE HOW THE TIEKEY HAS BEEN PUT TO THE TEST

- Third party tested for tension and compression strength.
- Simplifies the installation of brick or stone exterior finishes.
- Adjustable wire tie accommodates construction tolerances and allows for larger differential movement for the brick finish.
- Provides strong resistance to negative and positive lateral forces.
- Available in two materials: hot-dipped galvanized steel or stainless steel.
- Recipient of the World of Concrete's Most Innovative Products Award.


tieKey In Use

FOX BLOCKS HV CLIP



Contractors asked for a wire clip to secure their Fox Blocks jobs together so the team at Fox Blocks went to work designing one. Fox Blocks ties are engineered to be perfectly balanced, spaced at 8" o/c Horizontally and Vertically, giving flat walls post concrete. This allowed us to put all of our design into one wire clip which helps everyone with only one SKU.

The Fox Blocks HV Clip has been engineered with eight bends allowing one clip to work horizontally or vertically.

HV CLIP PLACEMENT:

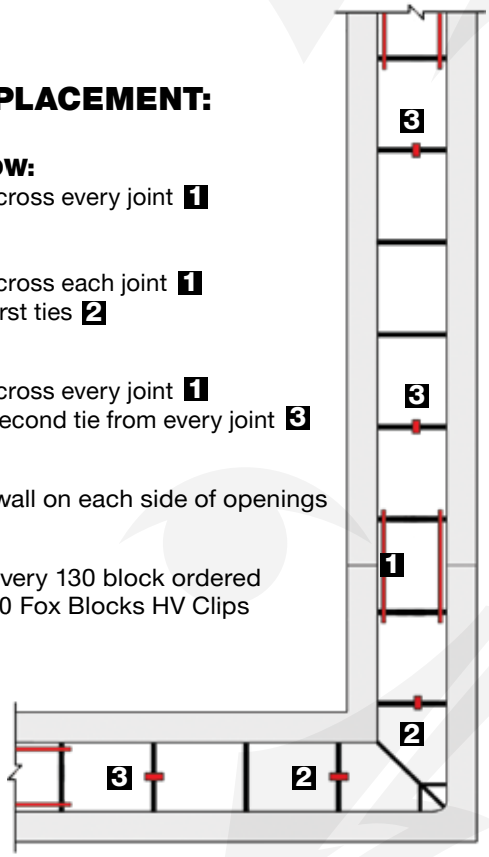
BOTTOM ROW:
Horizontally across every joint 1

CORNERS:
Horizontally across each joint 1
Vertically on first ties 2

TOP ROW:
Horizontally across every joint 1
Vertically on second tie from every joint 3

OPENINGS:
Vertically up wall on each side of openings

BUDGET:
One box for every 130 block ordered
One box = 250 Fox Blocks HV Clips



FOX BLOCKS HV CLIP POSITIONS

Vertical Clips in Place

Horizontal Clips in Place

Note: You can skew the HV Clip a notch or two for an even tighter fit, if needed.

FOX BLOCKS HV CLIP BEING USED ON JOBS

Vertical & Horizontal Clips in place close to corner

Showing HV Clips holding down a top row that has been cut down to +/- 8" in height

Using the Fox Blocks HV Clip eliminates the need for truss wire completely on your jobs. The result is that for about half the cost of the truss wire you will get a stronger and straighter job.

Product Label

ICF BRACING/SCAFFOLD

When building walls over three courses tall Fox Blocks recommends the use of an OSHA approved ICF Bracing/Alignment/Scaffolding system.

With proper kits, most systems can be used for walls up to 24' tall. *Contact Fox Blocks for walls over 24' tall. Systems are available for ICF tall walls 30' to 60' in height.*

ICF BRACING/SCAFFOLD HAVE THREE MAIN PARTS

1) **STIFF BACK WHICH IS ATTACHED TO THE STUDS IN THE WALL**
   Screw to ties in block which are 8" o/c. One screw per block row.

2) **TURNBUCKLE WHICH ADJUSTS THE WALL.**
   Threaded rod within the turnbuckles tilt wall in or out as you turn it.

3) **PLANK SUPPORT ARM FOR SCAFFOLD.**
   Will accept two 2 x 10s and toe kick.
   ** Guard rail posts are also provided for those taller jobs*

Most scaffold brands have racks to store and transport ICF Bracing.

Simply stake or screw the turnbuckle feet to the ground or floor.

Adjustable Turnbuckle on each set.

FACTS

Bracing is typically installed on inside wall face but can also be on the outer side.

Budget one brace set for every 6' of wall length. End user provides planks, railing & screws.

Typical bracing set is 3 pieces - Steel Strongback, Platform Bracket and Adjustable Brace Pole.

WHY WE USE ICF BRACING/SCAFFOLD

Safe work site and straight walls

ICF Bracing Systems provide adjustment to align the walls to a string line, enabling perfectly straight walls after concrete placement. No one has an eye good enough to straighten walls longer than 20'.

Typical Bracing / Scaffold Setup
AVAILABLE THROUGH FOX BLOCKS

Follow bracing/scaffold manufacturer recommendations.

FOX BLOCKS FIELD CUT 90° CORNERS

USING STANDARD FORMS FOR CORNERS

The versatility of Fox Blocks allows for the standard forms to be cut on-site to make 90° corners, angled-mitered corners or radius walls.

STEPS FOR FIELD CUT 90° CORNERS

1) Use a full block and a half length block to make the corner. This will allow for the running bond coursing in the wall.

2) Place one block on top of another block and mark the cut lines to allow the short block to butt against the long block.

3) This alignment requires that only one tie in each block needs to be cut.

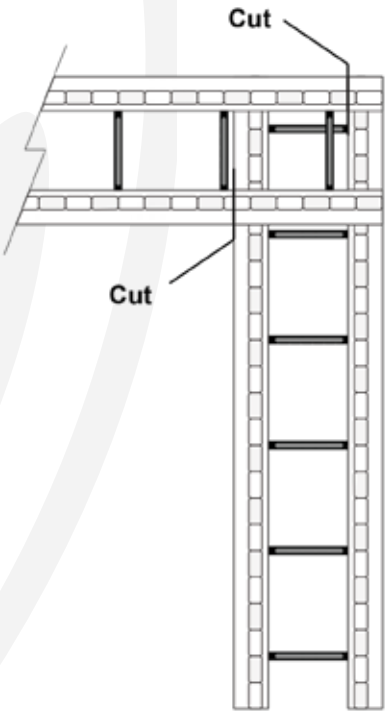
4) Align the blocks as per the second diagram.

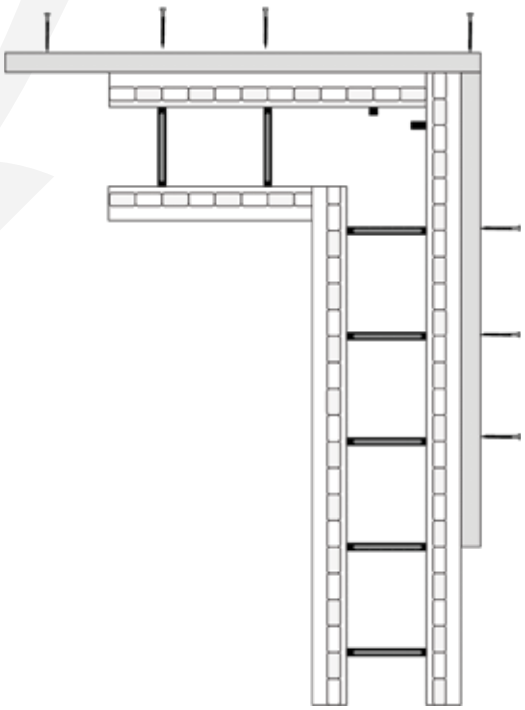
5) On the next course, use a full block over the short block and a short block over the full block. Cut the blocks having the same joint alternate the alignment joint configuration on each course.

6) After installing the strapping, spray foam the exterior vertical joint.

7) The outside of the corner will require robust strapping (2 x 4, two per course) on every course, as detailed to control the pressure during concrete placement.

8) In placing concrete, minimize the internal pressure at these corners by slowly allowing the concrete flow into the concrete.





Notes:

A) Field cut corners will interlock with standard corner forms.

B) For additional support, vertically brace the outside of each block at these corners.

C) Field cut corners will interlock with standard corner forms.

D) For additional support, vertically brace the outside of each block at these corners.

E) Refer to Technical Bulletin 1.02.09 for Field Cut Angle-Mitered Corners.

F) Refer to ILC Video Library on Field Cuts.

CLICK THROUGH FOR RESOURCES

FOX BLOCKS FIELD CUT ANGLES

WHEN A MITERED CORNER IS NEEDED

1) Place a straight block on top of another block and rotate to the desired angle. Take care to place plastic ties in a position that will minimize the amount of cutting.

2) When you are satisfied with the positioning mark both block on the outside faces where they meet. Notice in the example the block was positioned so no plastic ties are cut. *See Note B.*

3) Cut both block and position in the wall. Take care to ensure the block has been cut so that it does not force the wall apart. It is better to be a bit short than too long. *See Note A.*

4) Once wall is built, stitch and brace the outside with plywood or dimensional lumber. At this point some spray foam can be used to fill in any gaps as long as you have it braced together to keep the expanding spray foam from pushing angle apart.

5) Place concrete.

NOTE: Corner will have a very high load of concrete during placement. Please take the time to brace the corner properly.

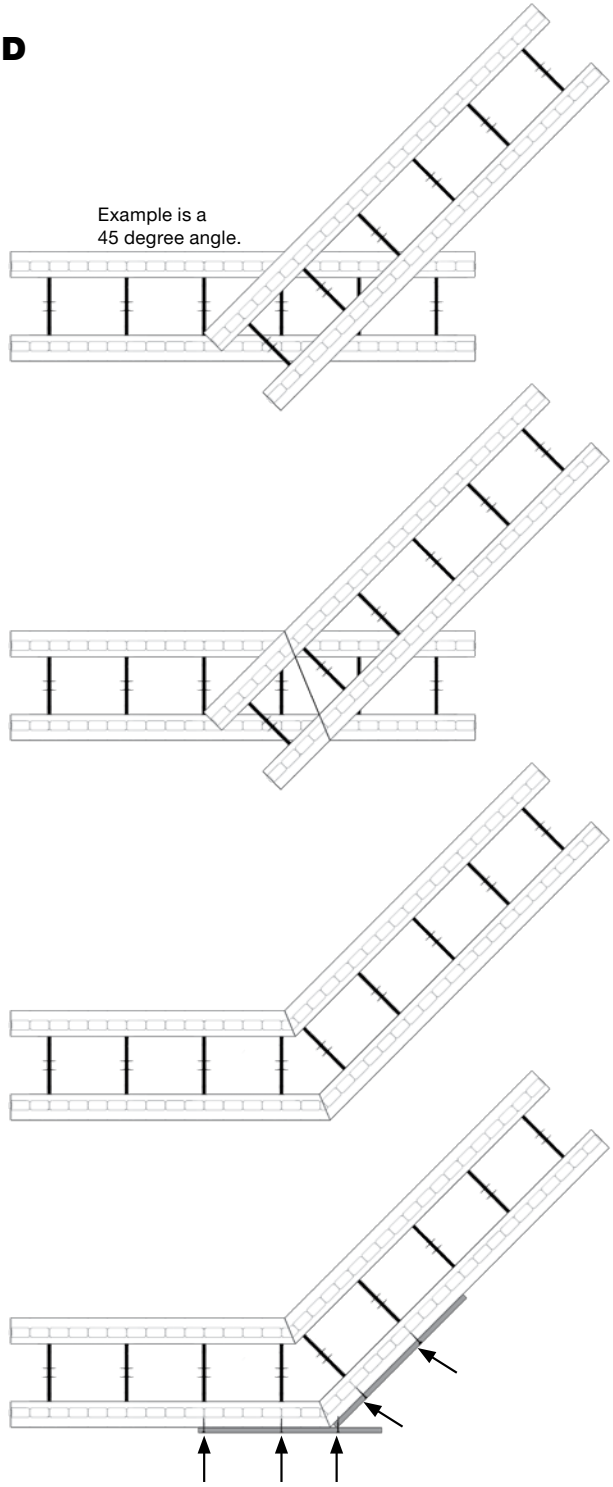
Notes:

A) It is better to be short than it is to be long when making cuts. If the cuts are short you can always use spray foam once the wall is completely built, leveled and plumbed.

B) Plastic ties can be cut if needed as the corner will be braced with lumber anyway. We just try to not cut through the plastic because it takes more effort.

C) When cutting remaining rows of block ensure the cut starts at the same location as the first row so that interlock will line up.

D) Use spray foam only after is completely stacked and prior to placing concrete.



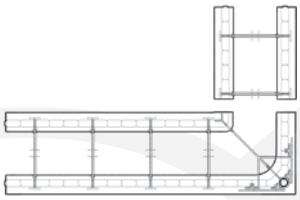
Use screws long enough to pass through the plastic ties completely. If your screws do not hold they need to be longer.

CLICK THROUGH FOR VIDEOS

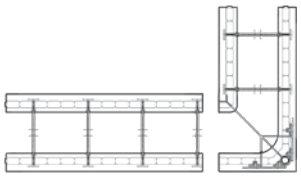
FOX BLOCKS FIELD CUT SHORT CORNERS

USING EXTENDED FOX BLOCKS CORNERS

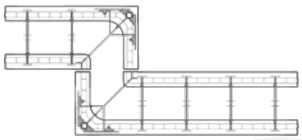
OPTION ONE



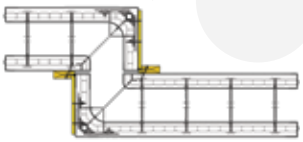
1) Cut block for long leg of corner (cut-off will give you an 8" off cut you can use elsewhere in your wall).



2) Cut block for short leg of corner (cut-off will give you a 24" off cut you can use elsewhere in your wall).



3) Build wall creating a stacked seam.

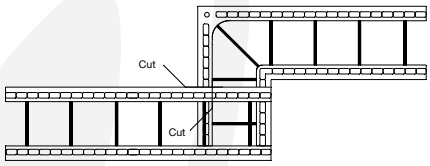


4) Once wall is built brace with plywood and 2 x 4s.
   a) Screw plywood to 2 x 4
   b) Screw 2 x 4 to Fox Blocks ties
   c) Screw plywood to Fox Blocks corners

5) Place concrete.

OPTION TWO

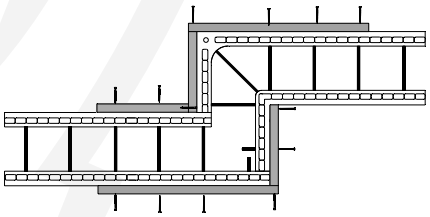
1) Place a Standard form over a Corner Form.



2) Mark the cut lines to cut one leg of the corner form and one side of the standard form.

3) Cut the forms and cut out one web in the corner and one in the standard form.

4) Build the wall creating a stack seam.



5) Once the wall is built brace with plywood and 2 x 4s.

SHORTEST RETURN POSSIBLE

4" = 9¼"
6" = 11¼"
8" = 13¼"
10" = 15¼"
12" = 17¼"

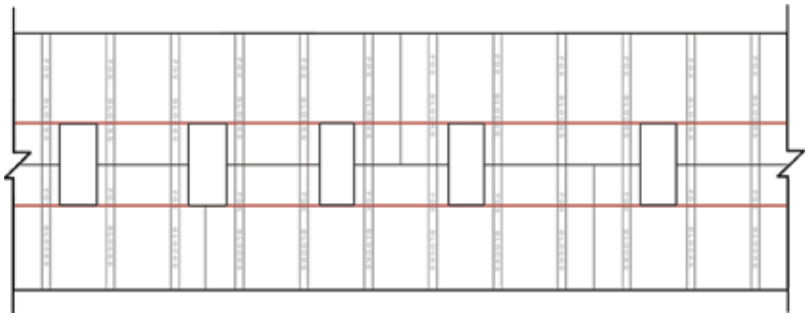
You may need to leave a gap at the stacked seam and use spray foam to fill prior to installing the bracing.

Each properly placed #8 deck screw will give you 27 pounds of holding power in straight pullout and 70 pounds in shear. This includes a safety factor of 5.

Note: Corner will have a very high load of concrete during placement. Please take the time to brace the corner properly.

FOX BLOCKS RIM JOIST ATTACHMENT

There are several ways to attach a floor diaphragm to a Fox Blocks wall. The most common has been to simply use common anchor bolts. See bottom of page for other options.



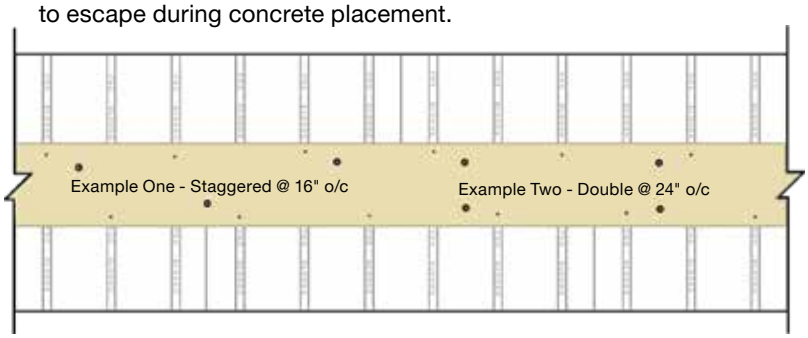
STEPS FOR RIM JOIST ATTACHMENT

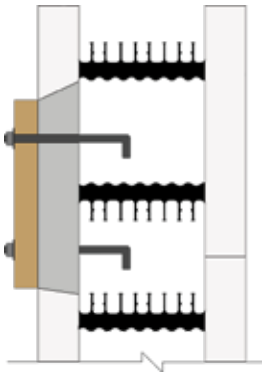
1) Build wall to within one row above rim joist location

2) Mark out top and bottom of rim joist location

3) Mark out o/c locations for anchor bolts

4) Cut out 4" x height of rim joist. Angle top cut up into block to allow air to escape during concrete placement.





End view of completed Rim Joist attachment

5) Place rim joist and attach to Fox Blocks ties with 3" deck screws

6) Mark out anchor bolt locations and drill holes

7) Reach inside the Fox Blocks wall and insert the anchor bolt through the hole you drilled

8) Place washer and nut onto anchor bolt. You are now ready for concrete.

OTHER OPTIONS INCLUDE

A) Simpson Strong-Tie ICF Ledger Connector
B) Fox Blocks Corbel Ledge

BASIC CONCRETE PLACEMENT

IMPORTANT STEPS TO A SUCCESSFUL CONCRETE PLACEMENT

A) VOLUME AND MIX DESIGN AND SLUMP

CALCULATING VOLUME

Fox Blocks are exactly 4", 6", 8", 10" or 12" in concrete width. Length x Height x Width to calculate volume needed.

CHOOSING MIX DESIGN

Follow building code and/or Engineer of Record specifications for your concrete mix design requirements.

Admixtures are not required but may help your concrete placement.

Concrete changes throughout North America due to different aggregate, sand, water quality and cement brand being used. Admixtures that work good in one area may not work in another area. Fox Blocks recommends you work closely with your local ready mix supplier for a mix design that will work on your project.

1) Fly ash replacement of cement content up to 30% works well in Fox Blocks walls to improve flow-ability and consolidation.
2) Mid-Range water reducers work well in Fox Blocks walls and will help in flow-ability and consolidation.
3) Gradated mix designs with optimum coarse, intermediate, and fine aggregate ratios can improve flow-ability and consolidation within Fox Blocks walls.

PROPER SLUMP

1) Slump should be as close to 5" to 6" (125mm to 150mm) as possible.
2) Exceeding this slump could cause wall to grow.
3) Less than recommended slump could create consolidation issues.
4) Slump can be roughly measured within the wall as you place the concrete. Use the chart below to know how far ahead your concrete should flow from your placement position when using the desired slump. This is only a rough guide and can change with concrete design and age.

HEIGHT OF LIFT	5" (125MM) SLUMP DISTANCE AHEAD	6" (150MM) SLUMP DISTANCE AHEAD
1½ Blocks (2' - 0")	2' - 4"	3' - 0"
2 Blocks (2' - 8")	3' - 0"	3' - 8"
2½ Blocks (3' - 4")	3' - 8"	4' - 4"
3 Blocks (4' - 0")	4' - 6"	5' - 6"

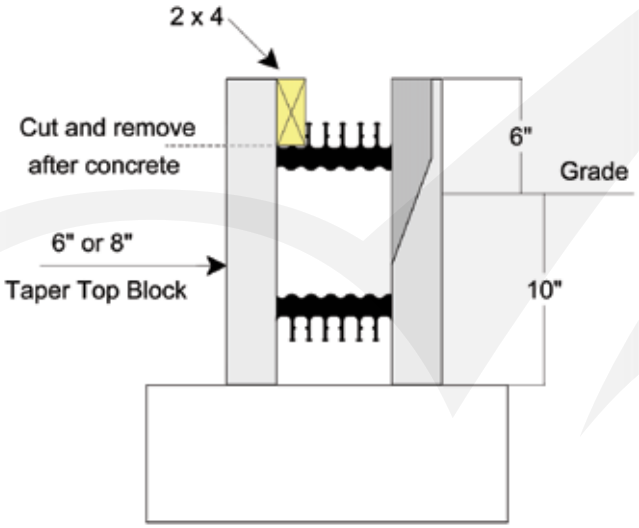
B) CONCRETE PLACEMENT PLAN

1) Start concrete placement away from corners. Freshly placed concrete will act as an anchor to hold wall in place as concrete enters the corners.
2) Divide wall height into lifts heights for a comfortable placement. Most wall 8' to 12' high will work best with three lifts of concrete.
3) Final lift of concrete should be no less than 16" and preferably 24". If the final lift is less than 16", concrete placement will be very difficult due to concrete pump needing to slow down.

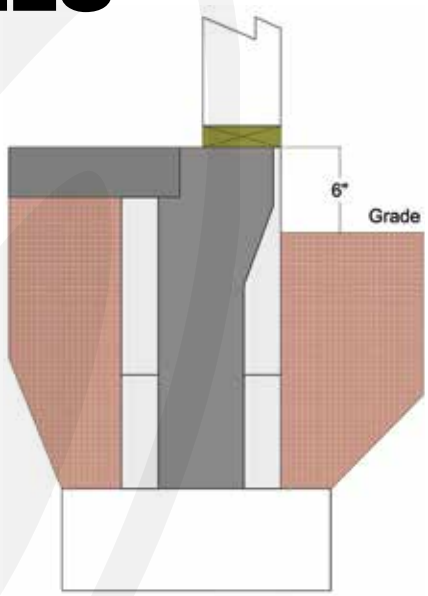
C) CONSOLIDATION PLAN

1) Fox Blocks walls require consolidation.
2) Internal, external or rodding are acceptable consolidation techniques.
3) Internal vibrator head should be 1" in diameter or less.
4) Consolidate each lift of concrete prior to placing the next lift.
5) Internal vibrator should be dropped to bottom of the current lift of concrete and then slowly brought to the surface (approximately 3" per second).
6) External vibration can be using an impact tool which will shake the internal ties which will ensure rebar is completely encased in concrete.
7) External consolidation should start at bottom of concrete lift and move to top of concrete lift to move entrapped air to the surface.

FOX BLOCKS SHALLOW FROST/STEM WALLS

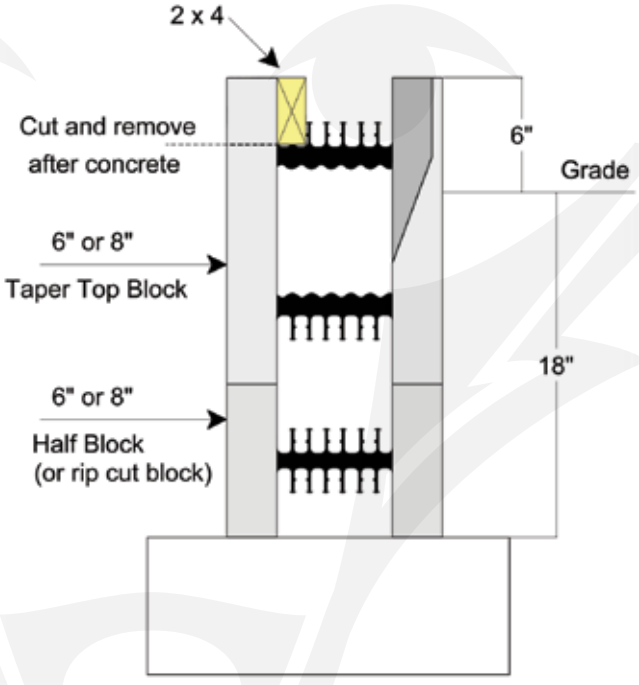


One row of Fox Blocks.
Fox Blocks is designed to accept a 2 x 4 resting on top of the tie.
Attach with screws through face of tie.

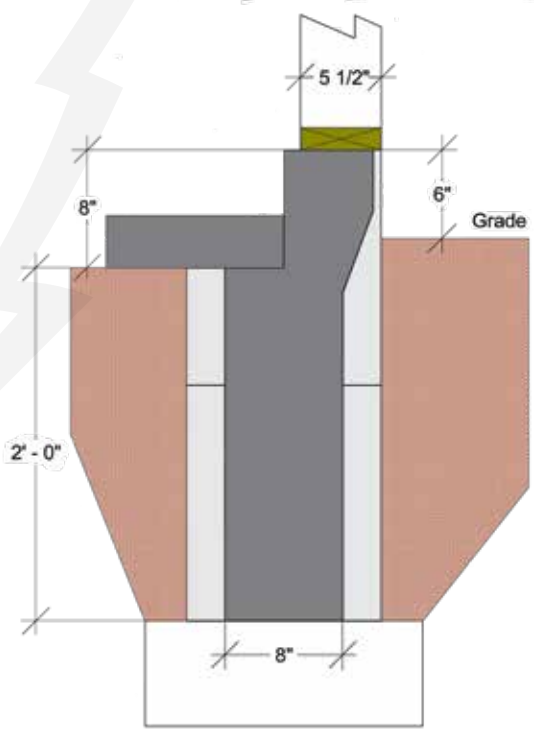


After concrete placement, cut block and remove 2 x 4 to create a shelf for slab to rest on.

Footings and reinforcing to meet local building codes.



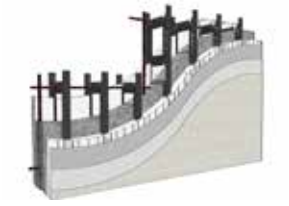
One and one half rows of Fox Blocks



Using Curb Block allows you to lower slab, giving a curb that does not require any finish. Taper is field cut into the top outside edge.

EXTERIOR FINISHES

Fox Blocks provide a high-performance solid wall substrate, with high thermal efficiency, as a weather resistive barrier, air and vapor barriers, with continuous fastening strips, equally spaced to meet specifications for attachment of all exterior finishing materials. The EPS and reinforced concrete provide a compatible and resilient substrate for all finishes, residential and commercial – either attached or directly applied.

EXTERIOR FINISH		FOX BLOCKS ADVANTAGES
SIDING		Vinyl or aluminum siding is attached directly to the blocks with screws at the specified spacing. The Fox Blocks fastening strips, continuous (no gaps) are spaced at 8" o.c. and indicated on the blocks. Fox Blocks corner forms have extra wide fastening strips to accommodate siding corner trim strips. Only Wood siding requires furring strips between the ICF and wood, providing air flow to dry the surface.
CEMENT BOARD		Cement board siding is directly attached to the blocks with self-counter sinking screws. Screw spacing is per siding manufacturers specifications. Vertical siding will require furring strips fastened to the Fox Blocks. *Review the Fox Blocks Fastener Technical Bulletin 1.08.08.*
MASONRY VENEER		The Fox Blocks 'tieKey' is a masonry anchor that is inserted through the EPS and cast into the concrete. Masonry veneer is supported on the Fox Blocks Corbel block or a Taper-Top block. No WRB is required over the Fox Blocks, once the concrete has been placed and the tieKeys are secure, masonry or stone can begin.
STONE VENEER		Simulated stone is a direct applied application with a base coat over the Fox Blocks. As a solid substrate, with minimum expansion or contraction, Fox Blocks provides an excellent substrate for simulated stone finishes. *Review the Manufactured Stone Veneer Technical Bulletin 1.08.06*
STUCCO		Fox Blocks EPS is Type II which is very compatible for the direct application of acrylic stucco, just prep the walls and apply the base coat. The metal lath for hard coat (traditional) stucco is directly fasten to the Fox Blocks fastening strips with screws or staples and finish coats are applied.
METAL		Industrial, flat or corrugated, metal siding is typically installed vertically, this will require metal girts installed directly the Fox Blocks. The girts provide an air space to dissipate and moisture behind the siding.

FOX BLOCKS ESTIMATOR PRO

Fox Blocks Estimator Pro is a simple program to achieve a full summary of all the materials required for a Fox Blocks project, residential or multi-story commercial. Using the program provides a clear and accurate estimate to which material and labor prices may be assigned to develop precise quotes and orders for any project. From the Fox Blocks website access the web based program and also find 'how to' documentation and videos.

PROJECT MENU
Create new or open existing estimates, export data, print, add pricing and notes.

PROJECT DATA
Insert the exact information regarding the project and create worksheet for each phase of the build.

WORKSHEET
Unlimited number of worksheets which user can name for reference.

WALL
Enter the exact info on each wall per worksheet.

FOX BLOCKS ACCESSORIES
Enter the required accessories per worksheet.

OPENINGS
Enter the opening sizes, remove concrete volumes, add buck material.

WALL DATA & WORKSHEET MATERIAL SUMMARY
Calculated summary of materials on worksheet and wall data.

FOX BLOCKS SUMMARY
The sum of all worksheets combined.

REBAR
Enter rebar size and spacing per worksheet.

CONCRETE
Calculates the concrete volume per worksheet, allows for waste. Can add for footings, slabs, piers, etc.

TRUEGRID
Calculate material quantities for TRUEGRID products.

COMPACT TILT
Calculate compact forms for tilt-up.

MAN HOURS
Calculates construction man hour rates using construction variables and crew size.

PROJECT WORKBOOK
Summarizes all input for project materials from all tabs. Allows user to input other costs for project.

The Estimator Pro has helpful hints and product information easily accessible within the program. It is a browser-based program that does not need to be downloaded or installed, and is compatible across all formats and all devices. Once opened, bookmark or save as a favorite, and you will be able to use it even when you do not have internet access.

MAN HOUR RATES

Man Hour Rates (MHR) are used to budget a job properly and efficiently based on square footage with a specific crew size. There are many variables in establishing the overall timeline to estimate and complete projects. Most contractors document their production rates without realizing that time /square footage built will give them a man hour rate, similar to one found in cost estimating programs, such as RS Means.

Over 25 years of history in the ICF business has allowed Fox Blocks to establish accurate numbers to budget future ICF jobs by using the Man Hour Rate tab in the Estimator Pro program.

This table lists examples of MHR based on project square footage and various conditions.

	MHR	JOB TYPE
1	.055 or less	Very efficient crew building a simple job with less than six corners, less than four openings and few or no embeds.
2	.06 .065 .07	Average job with less than eight corners, less than eight openings, and less than eight embeds.
3	.075 .08 .085	Most common MHR for new crews on moderate or large jobs. This covers complex residential jobs with 12 or less corners. This MHR area also works with large commercial jobs with basic 16" o/c rebar and few openings.
4	.085 .095 .10 .105	Very complex residential jobs with 12 or more corners and many openings and embeds. Also includes commercial jobs with many openings and embeds or more than 3 levels in height.
5	.11 and over	Jobs with at least three of the following: More than 8 short corners (30" or less), high seismic rebar design, more than 20 openings, many embeds, extreme weather, using the wrong scaffold for wall height, over 3 levels in height.

NOTES:
Size of job is not as big of a factor as you would think. The only time the size of job is really a factor is when the job is so large that the crew can gain speed while building, which lowers the MHR. This will usually be on jobs over 20,000 square feet using the same crew throughout.

WAYS TO LOWER YOUR MHR:
1. Pre-Plan Job
2. Proper Size Crew for Job
3. Stage Materials Close to Job
4. Use Proper Scaffold/Bracing
5. Pre-Build Opening Bucks
6. Proper Rebar Placement
7. Fox Training for Crew

Square Foot of Job (SFJ) = Length * Height (of Fox Walls being built)

SFJ * MHR = MAN HOURS TO BUILD JOB

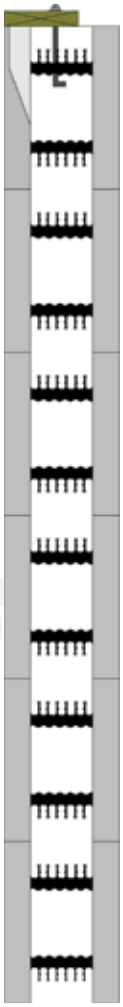
Example: Job has 180 Lineal feet (LF) of wall that is 12' tall. 180 * 12 = **2160** square feet (SF)
Job has 6 corners with 6 openings and basic 16" o/c rebar design. Crew has a bit of experience and ICF scaffold is used. We recommend aiming for a .075 MHR but use **.085** MHR as a budget number. With experience you will become more efficient, landing more work with more profit.
2160 * .085 = 183.6 Total Man Hours (TMH) for job
183.6 TMH / 6 man crew = 30.6 Total Crew Hours (TCH)

These numbers are estimates only. Many factors will effect the outcome of a job which needs to be taken into account. Please document all work and reflect back to your own crews history when completing budgets for upcoming work. We would like to thank contractors for sharing past history allowing us to build accuracy into this document.

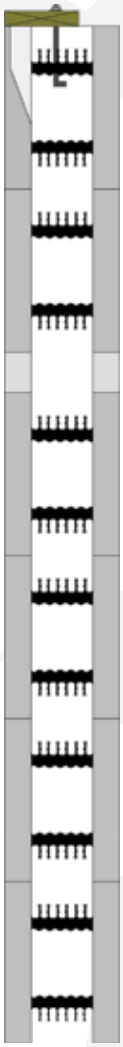
Estimator Pro is available, free, on the Fox Blocks website. Contractors are also encouraged to keep a history of MHRs to improve accurate for successfully quoting on future projects. Utilize the Fox Blocks Field Guide to record this information.

SAMPLE CROSS SECTIONS

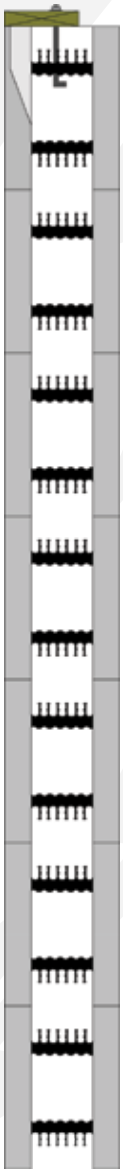
Fox Blocks are designed to make walls. Take the time to understand your on site height requirements to ensure accurate material takeoffs.



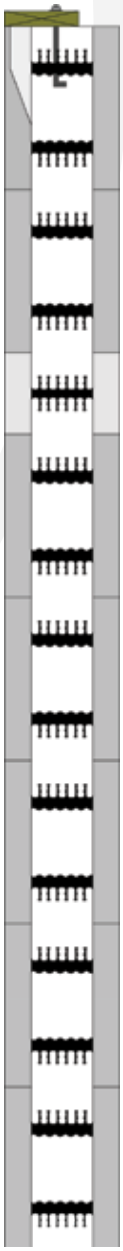
8' 0" WALL
6 - 16" Tall Block



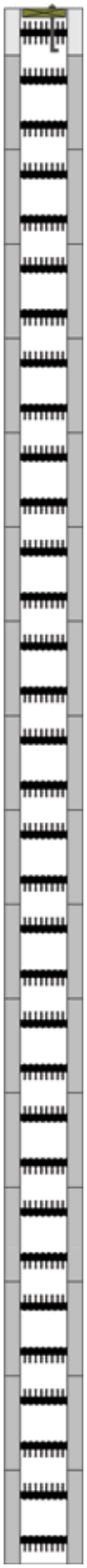
8' 4" WALL
6 - 16" Tall Block
1 - 4" Tall Block



9' 4" WALL
7 - 16" Tall Block



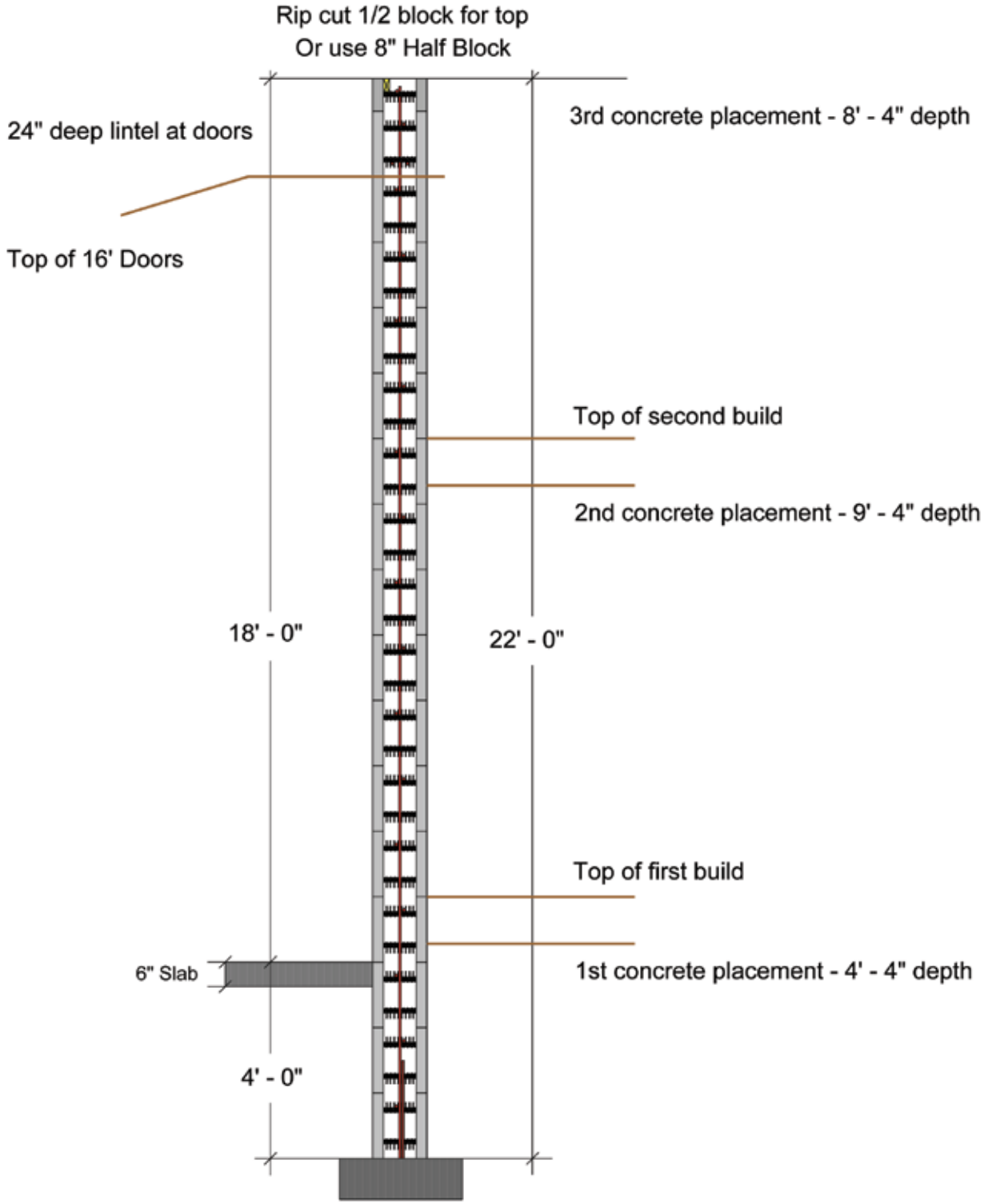
10' 0" WALL
7 - 16" Tall Block
1 - 8" Tall Half Block



22' 0" WALL
16 - 16" Tall Block
1 - 8" Tall Half Block

FOR ALL WALLS:

- Walls can be 4", 6", 8" 10" or 12" concrete thickness
- Taper Top Block at top of wall is optional
- Bearing on slab or footing designed to carry load
- Place proper rebar to meet local building codes or engineering



22'-0" TALL SAMPLE SHOP WALL

When planning any wall you want full understanding of the job for accurate takeoffs and low man hour rates. The above job required a 4'-0" stem / frost wall and 16'-0" tall door openings. The contractor used the same cross section to decide the concrete lift heights. The concrete lift heights decide the vertical rebar lengths.

FOX BLOCKS BY THE NUMBERS

	ITEM NUMBER	BLOCK TYPE	TOTAL WIDTH	TOTAL HEIGHT	OUTSIDE DIMENSIONS LENGTH/ SURFACE AREA		INSIDE DIMENSIONS LENGTH/ SURFACE AREA		CONCRETE VOLUME YD	CONCRETE VOLUME M	BUNDLE QUAN-TITY	ACTUAL BUNDLE SIZE LENGTH/WIDTH/ HEIGHT			WEIGHT BUNDLE/ PIECE	
4	FOX-S400	Straight Block	9.25	16	48	5.33	48	5.33	0.066	0.05	12	38	49	49	84	7
	FOX-S400HB	Straight Half Block	9.25	8	48	2.67	48	2.67	0.033	0.025	24	38	49	49	84	3.50
	FOX-EC490	90° Corner Block (38 x 22)	9.25	16	60	6.67	41.5	4.61	0.07	0.0535	12	46	47	49	95	7
	FOX-EC490HB	90° Corner Half Block	9.25	8	60	3.34	41.5	2.31	0.0348	0.027	24	46	47	49	95	3.5
	FOX-BUCK4	Fox Buck	9.25	2	48	3.08	N/A	N/A	N/A	N/A	10	48	9.25	23	29	2.9
	FOX-EC445	45° Corner Block (34 x 18)	9.25	16	52	5.78	44	3.57	0.066	0.05	9	40	50	49	58	6.4
	FOX-TBT4T6	Transition T Block (4" to 6")	9.25	16	36.75	4.083	4.75	0.528	0.066	0.05	12	49	38	49	87	7.25
6	FOX-S600	Straight Block	11.25	16	48	5.33	48	5.33	0.099	0.0757	12	45.5	49	49	90	7.5
	FOX-S600HB	Straight Half Block	11.25	8	48	2.67	48	2.67	0.494	0.0378	24	45.5	49	49	90	3.75
	FOX-EC690	90° Corner Block (40 x 24)	11.25	16	64	7.11	41.5	4.6	0.105	0.08	12	53	49	49	102	8.47
	FOX-EC690HB	90° Corner Half Block	11.25	8	64	3.56	41.5	2.31	0.0543	0.0415	24	53	49	49	102	4.25
	FOX-C645	45° Corner Block (26 x 18)	11.25	16	44	4.89	34.875	3.85	0.082	0.063	9	40	49	49	58	6.4
	FOX-TB600	T-Block Short	11.25	16	44	4.89	4.375	N/A	0.105	0.08	6 (3+3)	40.25	43.25	49	56	9.4
		T-Block Long	11.25	16	44	4.89	12.375	N/A	0.121	0.0925					56	9.4
	FOX-BL600	Corbel Ledge	11.25	16	48	5.33	N/A	N/A	0.129	0.099	9	45.25	49	49	80	8.8
	FOX-TT600	Taper Top	11.25	16	48	5.33	N/A	N/A	0.111	0.085	12	45.25	49	49	87	7.25
	FOX-RB60_	Radius	11.25	16	16	1.77	N/A	N/A	0.033	0.025	27	39	49	49	68	2.5
	FOX-BUCK6	Fox Buck	11.25	2	48	3.75	N/A	N/A	N/A	N/A	10	48	11.5	23	33	3.3
	FOX-TBT6T4	Transition T Block (6" to 4")	11.25	16	34.75	3.861	4.75	0.528	0.082	0.063	9	44	36	50	64	7.1
8	FOX-S800	Straight Block	13.25	16	48	5.33	48	5.33	0.132	0.101	12	54.5	49	49	90	7.5
	FOX-S800HB	Straight Half Block	13.25	8	48	2.67	48	2.67	0.065	0.05	24	54.5	49	49	90	3.75
	FOX-EC890	90° Corner Block (42 x 26)	13.25	16	68	7.56	41.5	4.6	0.153	0.117	6	41	44	49	60	9.83
	FOX-EC890HB	90° Corner Half Block	13.25	8	68	3.78	41.5	2.3	0.076	0.058	12	41	44	49	60	4.91
	FOX-C845	45° Corner Block (28 x 20)	13.25	16	48	5.33	37	4.11	0.117	0.089	9	53	47	49	58	6.4

continued...

	ITEM NUMBER	BLOCK TYPE	TOTAL WIDTH	TOTAL HEIGHT	OUTSIDE DIMENSIONS LENGTH/ SURFACE AREA		INSIDE DIMENSIONS LENGTH/ SURFACE AREA		CONCRETE VOLUME YD	CONCRETE VOLUME M	BUNDLE QUAN-TITY	ACTUAL BUNDLE SIZE LENGTH/WIDTH/ HEIGHT			WEIGHT BUNDLE/ PIECE	
8	FOX-TB800	T-Block Short	13.25	16	44	4.89	4.75	N/A	0.141	0.108	6 (3+3)	40.25	43.25	49	56	9.4
		T-Block Long	13.25	16	44	4.89	8.75	N/A	0.152	0.116					56	9.4
	FOX-BL800	Corbel Ledge	13.25	16	48	5.33	N/A	N/A	0.162	0.124	9	53.25	49.5	49	80	8.9
	FOX-TT800	Taper Top	13.25	16	48	5.33	N/A	N/A	0.144	0.11	12	54.5	49.25	49	87	7.3
	FOX-S800CB	Curb Block - Straight	13.25	16	48	5.33	N/A	N/A	0.132	0.101	12	54.5	49	49	91.2	7.6
	FOX-EC-890CB	Curb Block - 90˚ Corner	13.25	16	68	7.56	41.5	4.6	0.145	0.111	6	41	44	49	60	9.92
	FOX-BUCK8	Fox Buck	13.25	2	48	4.42	N/A	N/A	N/A	N/A	10	48	13.5	23	38	3.2
	FOX-TBT8T4	Transition T Block (8" to 4")	13.25	16	34.75	3.861	4.75	0.528	0.106	0.081	9	49	36	50	66	7.3
	FOX-TBT8T6	Transition T Block (8" to 6")	13.25	16	36.75	4.083	4.75	0.528	0.116	0.089	9	49	38	50	69	7.67
10	FOX-S1000	Straight Block	15.25	16	48	5.33	48	5.33	0.165	0.126	9	46	49	49	74	7.86
	FOX-S1000HB	Straight Half Block	15.25	8	48	2.67	48	2.67	0.0823	0.063	18	46	49	49	74	3.93
	FOX-EC1090	90˚ Corner Block (42 x 26)	15.25	16	68	7.56	41.5	4.6	0.181	0.138	6	41	44	49	68	10.5
	FOX-EC1090HB	90˚ Corner Half Block	15.25	8	68	3.78	41.5	2.3	0.092	0.07	12	41	44	49	68	5.25
	FOX-BUCK10	Fox Buck	15.25	2	48	5.08	N/A	N/A	N/A	N/A	10	48	15.5	23	42	4.2
	FOX-S1000CB	Curb Block - Straight	15.25	16	48	5.33	48	5.33	0.165	0.126	9	47	49	49	74	7.9
	FOX-EC-1090CB	Curb Block - 90 Corner	15.25	16	68	7.56	41.5	4.6	0.181	0.138	6	43	43	49	68	10.6
12	FOX-S1200	Straight Block	17.25	16	48	5.33	48	5.33	0.198	0.151	9	54	49	49	74	8.22
	FOX-S1200HB	Straight Half Block	17.25	8	48	2.67	48	2.67	0.099	0.076	18	54	49	49	74	4.12
	FOX-EC1290	90˚ Corner Block (46 x 30)	17.25	16	76	8.42	41.5	4.6	0.212	0.162	6	46.5	49.25	49	68	11.17
	FOX-EC1290HB	90˚ Corner Half Block	17.25	8	76	4.21	20.75	2.3	0.106	0.081	12	46.5	49.25	49	68	5.75
	FOX-BUCK12	Fox Buck	17.25	2	48	5.75	N/A	N/A	N/A	N/A	10	48	17.25	23	46	3.7
ALL	FOX-HV CLIP	HV Clips	8	4	N/A	N/A	N/A	N/A	N/A	N/A	250	11	11	7	7	0.028
	FOX-TIEKEY	tieKey	1.25	2.75	6	N/A	N/A	N/A	N/A	N/A	200	9.5	8.5	6.75	29	0.15
	FOX-XLERA-TOR	xLerator	48	10.31	N/A	N/A	N/A	N/A	N/A	N/A	9	52	13.5	6.5	22	2.45
	FOX-EXTR	4" High Block Extender	2.625	4	48	1.33	N/A	N/A	0.049	0.0378	20	49	17	14	13	0.65
	FOX-ESTICK	R8 Energy Stick	2	32	8	1.78	N/A	N/A	N/A	N/A	36	24	24	34	20	0.56

TECHNICAL PERFORMANCE DATA

Fox Blocks ICF Wall System

Intertek

C US Intertek

Find us in MasterSpec® a product of The American Institute of Architects

CONCRETE WALL CONSTRUCTION (4", 6", 8", 10" & 12" Reinforced Structural Concrete Core)

Design criteria for the structural concrete wall system	ACI 318 design standards for slender wall concrete construction
Recommended concrete consolidation	Fox Blocks Website Resource, Installation Checklist, ACI 309
Fox Blocks Installation Checklist	Fifth Edition (2021)
Prescriptive Design of Exterior Concrete Walls	PCA 100-2012, IRC R404.1, R608, ACI 332, ACI 318, ICFMA Can Part 9
Average weight of the reinforced structural concrete	150 lbs. / cu. ft. (including steel reinforcement)
Thermal Mass (form & 4" reinforced concrete core)	50 lbs. / sq. ft.
Thermal Mass (form & 6" reinforced concrete core)	75 lbs. / sq. ft.
Thermal Mass (form & 8" reinforced concrete core)	100 lbs. / sq. ft.
Thermal Mass (form & 10" reinforced concrete core)	125 lbs. / sq. ft.
Thermal Mass (form & 12" reinforced concrete core)	150 lbs. / sq. ft.
Recommended concrete core compressive strength	Minimum 3000 psi for the walls (minimum 2500 psi for footings)
Recommended concrete core slump flow for pump mix design	4" ICF - 6" to 7"; 6" ICF - 5.5" to 6.5"; 8", 10" or 12" ICF - 5" to 6"
Recommended aggregate size for the concrete mix design	4" ICF - 3/8" max.; 6" ICF 3/8" to 1/2" max; 8", 10" & 12" ICF - 1/2" to 3/4" max.

PRODUCT PERFORMANCE & THIRD PARTY TESTING

Expanded Polystyrene (EPS) Testing:

EPS Foam Resin	Modified low pentane, B/C bead size (resin is self-extinguishing)
EPS Average Manufacturing Density / Type	1.5 lbs. / cu. ft. (Type II, Rigid Cellular EPS Foam Plastic)
ASTM C578, EPS Thermal Insulation Properties	
CAN / ULC S701, EPS Thermal Insulation Properties	

Plastic Tie Strength Testing:

Fastener Withdrawal, ASTM D1761
Fastener Lateral (Shear), ASTM D1761
Tie Tensile and Shear, ASTM D638 and D732

Performance Testing:

Sound Transmission Class (STC), ASTM E90, STC 45-50+

Environmental, Safety & Energy Performance:

No HCFCs or CFCs emitted during the manufacturing process
No toxins or formaldehydes produced
Plastic ties are recycled and the EPS Foam forms are recyclable

Products & Energy Efficient Accessories:

Energy Stick	R-8 / Stick

Fire Safety & Testing:

Surface Burning Characteristics of Foam Plastics, ASTM E84 & ANSI / UL 723	
Flame spread from the EPS Foam	less than 25
Smoke Development of the EPS Foam	less than 450
Surface Burning Characteristics of Foam Plastics, CAN / ULC S102	
Fire Burning Characteristics of Plastic Ties	
ASTM D1929, Flash Ignition Temp	400 (C) 752 (F)
ASTM D1929, Spontaneous Ignition Temp	380 (C) 716 (F)
ASTM D635, Burn Rate	Meets Class CC1
Fire Resistance Rating, ASTM E119 (equivalent Standard Test Methods)	
4" Concrete Core	2 hrs.
6" Concrete Core	4 hrs.
8", 10" or 12" Concrete Core	4 hrs.
Fire Endurance Test of Building Construction Materials, CAN / ULC S101	
Room Fire Test, UL 1715 (with 1/2" gypsum board)	

SDS sheets available at www.foxblocks.com

Energy Efficiency Data & Performance:

Thickness of the EPS	2.625" / wall panel (5.25" total EPS thickness)
EPS Steady State R-Value (thermal resistance of the material)	R - 4.17 (@ 70 degrees Fahrenheit)
CTL Group Thermal Resistance R-Value Calculation Report	R - 23+ / Block (calculated in accordance with ASHRAE 90.1)
EPS U-Value (thermal conductivity of the material)	U - 0.04 / inch (@ 70 degrees Fahrenheit)
Air Leakage (infiltration rate) ASTM E283	0.002 cfm / ft²

Storm Safety:

Wind Capacity	Fox Blocks Walls can be designed to meet code requirements. Recognized by FEMA for Safe Rooms.
Seismic Zones	Fox Blocks Walls can be designed to meet code requirements

Fox Blocks is code compliant for foundations and Building Types I, II, III, and IV (noncombustible) any height.

BUILDING CODE REFERENCES

CCRR-1010, ICC Code Compliance
Florida Product Approval - FL7497-R5 City of New York - MEA 201-08-M City of Los Angeles - RR25689 State of Wisconsin - 20199008
ASTM E2634
CAN/ULC S717.1
AC 353 Acceptance Criteria for Flat Wall ICFs

LOCATIONS

Multiple Locations Across North America

Fox Blocks products are manufactured at locations throughout North America. We ship directly to dealers and projects from the nearest facility.

USE THE FIND A DEALER TAB AT FOXBLOCKS.COM.

Please go to:
FOXBLOCKS.COM

WHERE YOU WILL FIND:

Product Information
Local Dealer and Regional Advisor Contact Information
Downloadable Technical Files
Estimating Program
Case Studies
Training - Integrated Learning Center (ILC)
Links to 2D and 3D CAD and BIM Details
Educational Video Library (ILC)

TRUEGRIDPAVER.COM

HEAD OFFICE:
6110 Abbott Drive | Omaha, NE 68110 | 1-877-369-2562

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Fox Blocks Products

With advice from leading contractors in the Insulated Concrete Form business, Fox blocks has created an incredible group of blocks.

Key elements – all products are reversible with a robust interlock design, blocks have 2⅝" of EPS insulation, the product line accommodates any wall design configuration and building type - residential or commercial.

Product drawings, dimensions and application details in all formats are available from these links:
www.caddetails.com and market.bimsmith.com/foxblocks

FOX BLOCKS LINE-UP INCLUDES:

A) Straight Blocks
Available in 4", 6", 8", 10" and 12".

B) Straight ½ Block
Available in 4", 6", 8", 10" and 12".

C) Extended 90˚ Corners
Available in 4", 6", 8", 10" and 12".

D) Extended 90˚ Corner ½ Block
Available in 4", 6", 8", 10" and 12".

E) 45˚ Corner Blocks
Available for 4", 6" and 8".

F) T-Blocks
Standard T: Available in 6" x 6" and 8" x 8"
Transition T:Available in 4" x 6", 6" x 4", 8" x 4",and 8" x 6"

G) Corbel Ledge Blocks
Available in 6" and 8".

H) Radius Blocks
For 5', 6', 7', 8', 9' and 10' radius.
Only available in the 6" blocks.

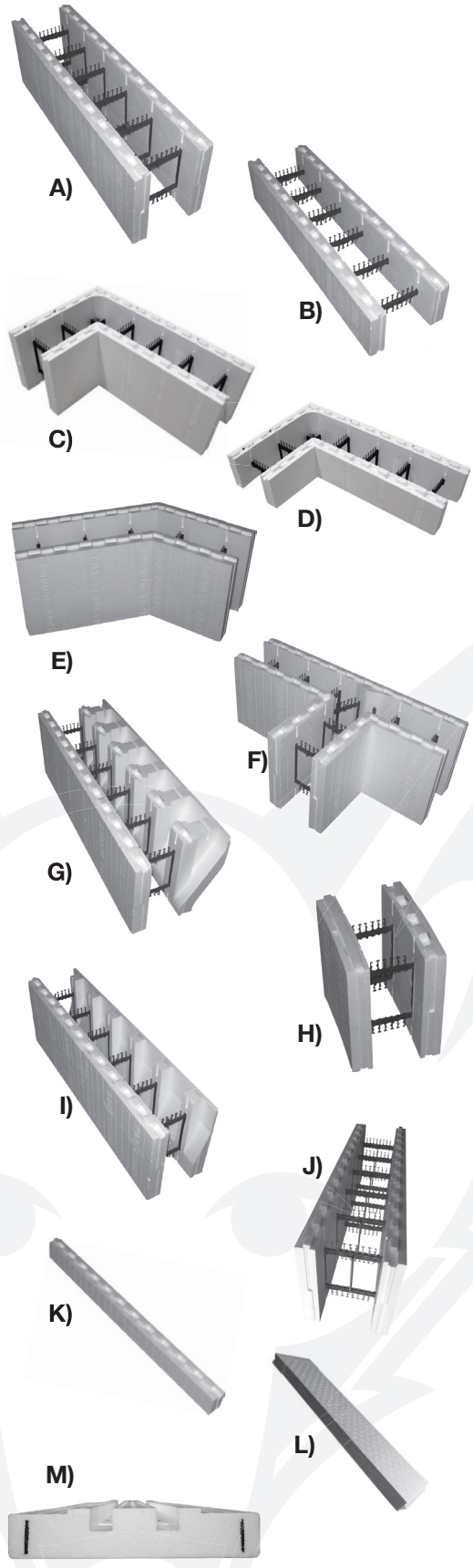
I) Taper Top Block
Available in 6" and 8".

J) Curb Block
Available in 8" and 10" Straight and 90˚

K) 4" High Extension
When you need extra height or to help with openings.

L) Energy Sticks
One size fits all.

M) Fox Buck
Available in 4", 6", 8", 10" and 12".



FOX BLOCKS STANDARD (STRAIGHT) BLOCK

The standard block is the core of the product line, typically makes up between 80-85% of the ICF wall assembly on most residential and commercial jobs.

STANDARD BLOCKS

1) 16" high x 48" long available in concrete core sizes 4", 6", 8", 10" and 12"

2) One standard block is 5.33 sq. ft. of wall area

3) Solid 2⅝" thick EPS continuous insulation panels providing R4.1 per inch

4) Cross-ties, polypropylene recycled industrial plastic at 8" o.c.

5) Cross-ties are designed with a full height 1½" wide fastening strips at 8" o.c. on each side of the block

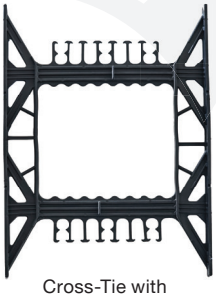
6) Rebar clips are built into the cross-ties to secure and space the rebar

7) Blocks have a robust, reversible, tight fitting interlocking system on the top and bottom

8) The locations of all cross ties are indicated on the exterior face of the block

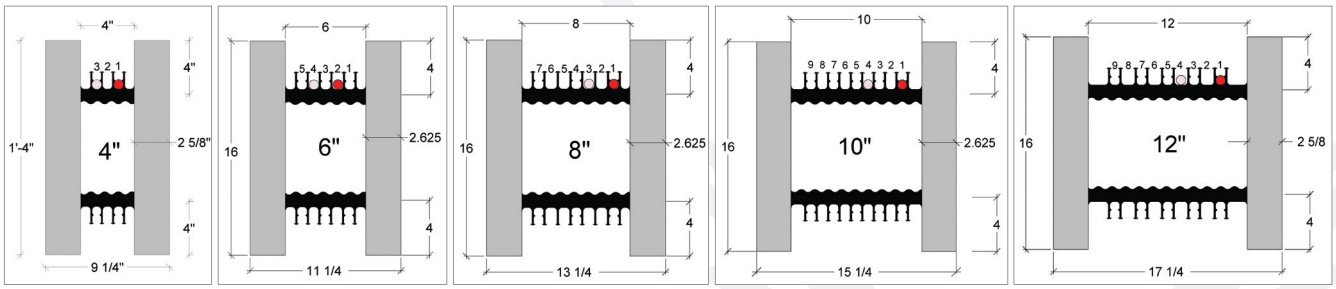
9) Cut lines are scribed on the exterior face of the block to allow cut blocks to maintain interlock

10) Fox Blocks creates a flat wall reinforced concrete wall assembly



Cross-Tie with Fastening Strip

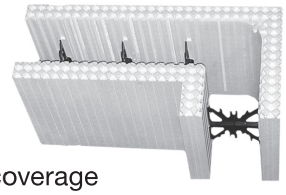
FOX BLOCKS END VIEW SIZING



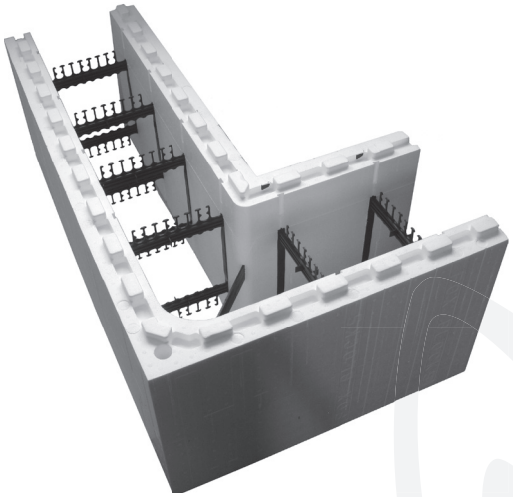
CONCRETE VOLUMES - CU.YD (CU.M)

4"	0.066 (0.05)	10"	0.165 (0.126)
6"	0.099 (0.075	12"	0.198 (0.151)
8"	0.132 (101)		

FOX BLOCKS EXTENDED 90° CORNER



Fox Blocks engineered the 90° corner to hold concrete without the need for extra strapping or external bracing.



FOX BLOCKS EXTENDED CORNER FEATURES

1) All blocks have Ties* at 8" o/c and are available in 4", 6", 8", 10" and 12" cavities.

** Ties are the black recycled polypropylene members that give the block strength and provide rebar positioning.*

2) Like all Fox Blocks, corner blocks are reversible so when you ask for a corner you will get the correct one every time. Each corner is left or right automatically!

3) Foam thickness is 2⅝" on all forms.

4) Tie allows rebar lap splices to lay on top of each other for good flowability during concrete placement.

5) Ties are clearly marked on EPS for attachments.

6) Tie flanges are 1½" wide and full height for ease of attachment.

7) Ties touch vertically when stacked, eliminating form settlement.

8) Each corner has a 1" hole strategically placed allowing the ICF contractor the option of inserting a full height ¾" PVC conduit to tie all courses together for extra form support.

OTHER ICF 90s

- 5 to 5.33 total square feet of coverage
- More costly per square foot of coverage
- 16" shorter than Fox Blocks
- Only 4 ties
- Only one tie on short end
- More movement during concrete

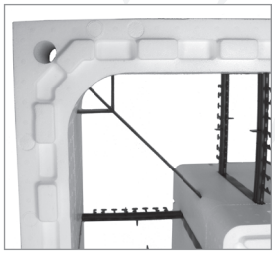
FOX BLOCKS 90s

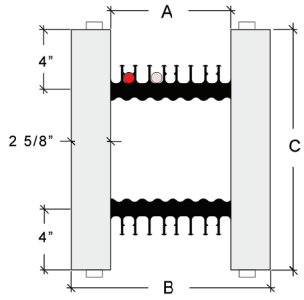
- 7.56 total square feet of coverage
- Less costly per square foot of coverage
- 16" longer than other ICF
- 6 ties
- Two ties on short end
- Less movement during concrete

Being 16" longer than other ICF allows you to eliminate one full straight block for every three Fox Blocks corners used. This also saves you money!

Radius on the inside face of the Fox Blocks Corners are:
4", 6" and 8" Blocks = **3"** 10" and 12" Blocks = **8½"**
Additional EPS was added to the 10" and 12" Corner Blocks to give additional strength for the longer distance from corner to 1st tie.

Every Fox Blocks corner has a large 100 sq. inch fastening zone in the corner.





A	B	C
4"	9.25"	8" or 16"
6"	11.25"	8" or 16"
8"	13.25"	8" or 16"
10"	15.25"	8" or 16"
12"	17.25"	8" or 16"

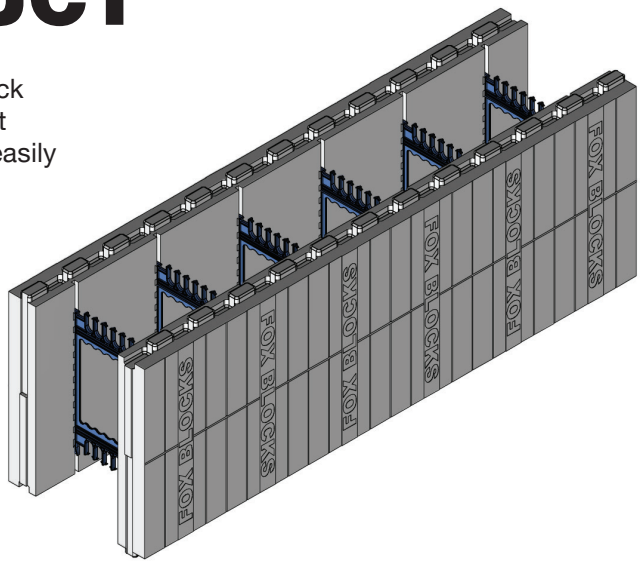
Fox Blocks 90° Extended Corner Size Chart

OUTSIDE DIMENSIONS ARE:

4" Corner = 38" x 22"
6" Corner = 40" x 24"
8" Corner = 42" x 26"
10" Corner = 42" x 26"
12" Corner = 46" x 30"

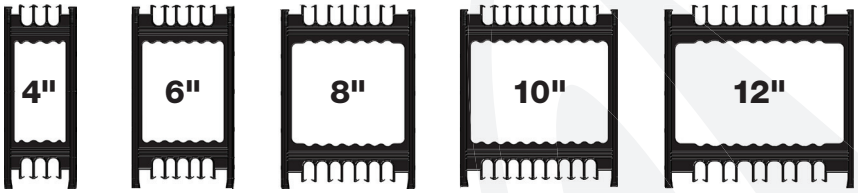
FOX BLOCKS COMPACT PRODUCT

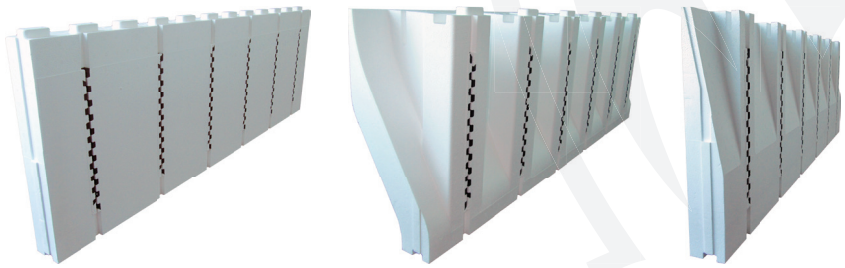
Fox Blocks Compact is a panelized product designed to stack seamlessly with the traditional Fox Blocks line. The Compact Block reduces freight costs by delivering flat. Ties are then easily inserted into the panels at the jobsite.



FOX BLOCKS COMPACT BLOCK APPLICATIONS

- Double Taper Top in any size
- Double Corbel in any size
- Emergency stock where storage is a premium
- Large block size required at a long distance from plant





STRAIGHT PANEL CORBEL PANEL TAPER PANEL

QUICK COMPACT BLOCK FACTS

- Dimensions are consistent with traditional Fox Blocks
- Rebar locations match traditional Fox Blocks ties
- Straight, Taper and Corbel panels available
- Ties lock into position when inserted into the panels
- Start with traditional Fox Blocks corners to anchor your wall
- When ties are locked into position use Fox Blocks HV Clips

GETTING STARTED

1) Insert one tie into one panel.
2) Lift this unit and slide the opposite side of the same tie to a second panel that is aligned with first panel.
3) Insert the remaining 5 ties into this unit to complete your first full block.
4) Press ties down until they lock into position.
5) Continue this procedure until first row is completed.

CONSECUTIVE ROWS

1) Lock two panels on top of lower row of block.
2) Insert 6 ties to complete the block.
3) Be sure to force ties down until they lock into position.

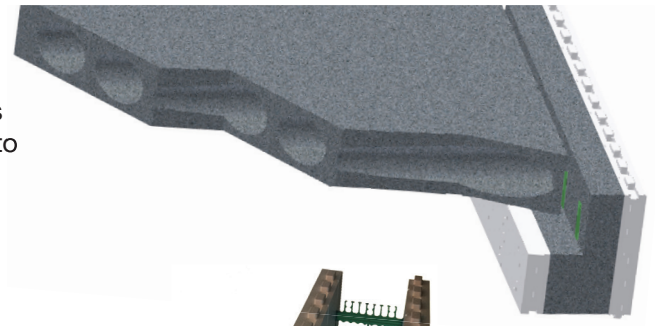
INTENSE REBAR CAGES

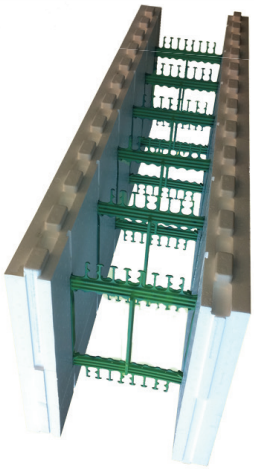
1) Install vertical rebar.
2) Assemble Compact Block around rebar.
3) Place and install stirrups as needed while assembling Compact Block.

GO TO FOXBLOCKS.COM FOR UPDATED INFORMATION

FOX BLOCKS CURB BLOCK

There has always been a need for a block that can create a ledge to support floor systems within the wall without limiting course heights. The Fox Blocks team has solved this by adding an extra attachment point within the tie. This patented solution allows you to form a curb with the block to support whatever you need to support.





USING THE CURB BLOCK

1) INSTALLATION
See following page for proper steps using the curb block.

2) SHAPES AVAILABLE WITH THE CURB BLOCK
Curb block is currently available in 8" and 10" straights, as well as 8" and 10" ninety degree corners.

3) RANGE OF USE
The Curb Block can be cut down as low as 11" from the top of the block. You can also cut up to as much as 11" from the bottom of the block to use when wrapping around concrete slabs. See page two for an example of this.

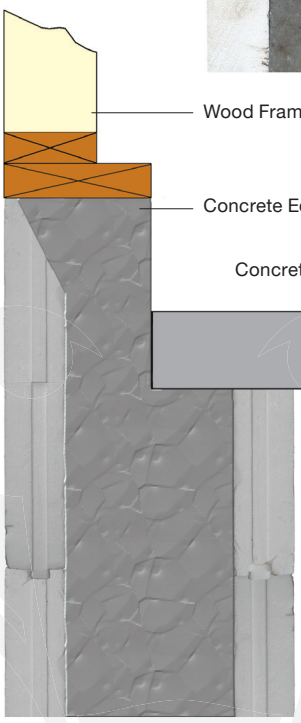
4) ESTIMATING
Straight blocks = 4'-0" long.
Formula: (Total linear footage of wall - total linear footage taken up by 90˚ corners)/ 4 = Number of straight curb blocks
90˚ corner blocks = 5'-4" each.
Formula: Number of 90˚ turns = Number of 90˚ corner blocks

5) IDENTIFICATION
The Curb Block has been designed with a green tie for easy identification. By producing the ties in green, supply yards will be able to identify and send you the proper block. This will also ensure your crew will not use it in the wall at the wrong time.

6) BUNDLE SIZES

8" straight block = 12 per bundle	8" 90˚ corner block = 6 per bundle
10" straight block = 9 per bundle	10" 90˚ corner block = 6 per bundle

7) EXCESS BLOCK?
If you end up with extra Curb Block on site, you can save for next job or simply use them up within the walls you are building. The shape and size of the Curb Block is identical to the normal straight and 90˚ corner blocks.

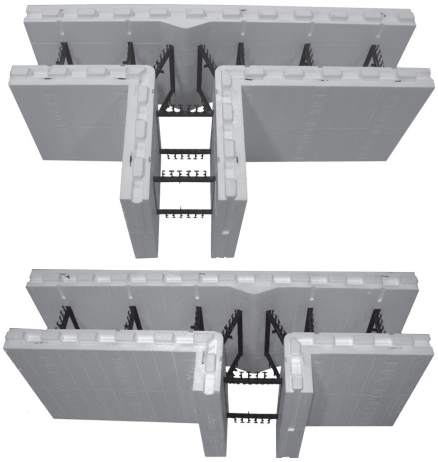


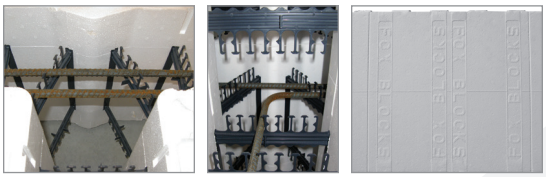
EXAMPLE OF A GARAGE SLAB/BEAM
Using the Curb Block in a garage situation allows a raw concrete finish on the interior face, eliminating the need to cover EPS. Any height beam or wall can use curb block on top row. Optionally, a field cut taper can be cut into outside face for extra bearing.

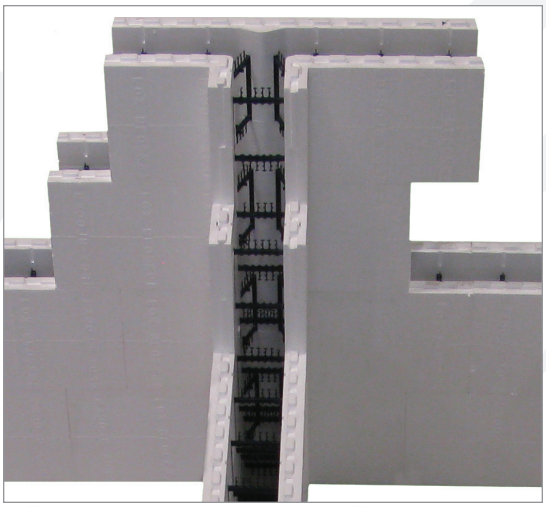
FOX BLOCKS T-BLOCK

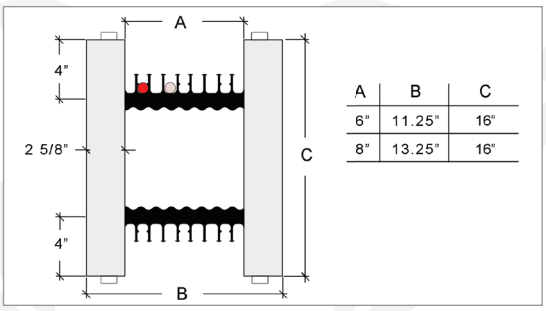
Sure you can build T walls with a couple of straight block and some tie wire, but if you want to lower your man hour rate, you need the **Fox Blocks T-Block**.

When contractors said they needed a T-Block, Fox Blocks delivered with one that is easy to use and incredibly strong.









A	B	C
6"	11.25"	16"
8"	13.25"	16"

FOX BLOCK T-BLOCK FEATURES

1) The T-Blocks are available in 6" and 8" concrete cores.

2) Six T-Blocks per bundle (3 short and 3 long)

3) Two ties* are used at the intersection of the "T" to give maximum strength and attachment. These ties are placed in such a way as to allow proper rebar placement and ultimate form strength.
** Ties are the black recycled polypropylene members that give the block strength and provide rebar positioning.*

4) Like all Fox Blocks, blocks are reversible which gives you double the options with just one block. You can choose to have the T section on the right or left of center simply by flipping the block over.

5) Foam thickness is 2⅝" on all blocks.

6) Ties allow proper rebar lap splices, for maximum flowability during concrete placement and consolidation.

7) Ties are clearly marked in EPS for attachments.

8) Tie flanges are 1½" wide and full height for ease of attachment.

9) Ties touch vertically when stacked eliminating form settlement.

10) The T-Block will give you 8" of overlap most directions.

8" T-BLOCK INSTALLATION

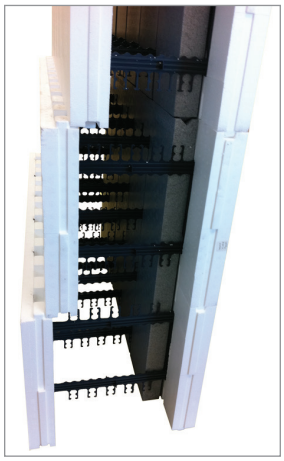
The unique manufacturing challenges were overcome for the 8" T-Block by establishing a 4" offset. This off-set results in rows of ties staggered by 4" if placed with factory ends against each other. The easy fix to properly line up ties is to install the T-Block and create a stacked joint at the butt end of the long T leg. Strap stack joint prior to concrete placement.

OUTSIDE DIMENSIONS ARE:
6" T - Block Short = 44" x 4⅜"
6" T - Block Long = 44" x 12⅜"
8" T - Block Short = 44" x 4¾"
8" T - Block Long = 44" x 8¾"

FOX BLOCKS ENERGY STICK

How do you improve an Insulated Concrete Form wall that already out-perform most wall system in all climates? You move the concrete mass toward the living side of the wall. This unbalanced R-value will allow the mass to be closer to the living temperature of the conditioned space allowing for a more comfortable building.

The Fox Blocks design team had two goals: 1) Move the mass away from the harsh temperatures and 2) Increase R-value. Each Energy Stick is 8" wide, 32" tall, 2" thick and profiled to fit within all Fox Blocks. The Energy Stick is used to ensure an R-8 boost to the already high R-Value of Fox Blocks.



SIZING AND ACTUAL R-VALUE

6" Block + 1 Energy Stick (R-30+*) = 4" Concrete
8" Block + 1 Energy Stick (R-30+*) = 6" Concrete
10" Block + 1 Energy Stick (R-30+*) = 8" Concrete
10" Block + 2 Energy Sticks (R-39+*) = 6" Concrete
12" Block + 1 Energy Stick (R-30+*) = 10" Concrete
12" Block + 2 Energy Sticks (R-39+* = 8" Concrete
12" Block + 3 Energy Sticks (R-48+*) = 6" Concrete

** This represents the overall average wall R-value. As an example in wood frame construction a wall with R-19 batt insulation will have an overall average wall R-value of less than R-16 due to thermal bridging.*

USING THE ENERGY STICK

1) INSTALLATION
Simply insert the patented Energy Sticks between the plastic ties and to the outside face of wall after every two rows of blocks have been placed.

2) CORNER BLOCKS
Fox Block corners are naturally thicker eliminating the need to insert Energy Sticks from the corner tie on. From the last straight tie to the corner tie you will need to wedge the Energy stick in place. A spot of expanding foam will also help to secure the Energy Stick from movement.

3) OPENINGS/STACKED SEAMS
Simply cut the Energy Stick to fit in locations that are narrower than 8". When larger than 8" use expanding foam to hold cut Energy Sticks.

4) RANGE OF USE
The Energy Stick will fit all Fox Blocks.

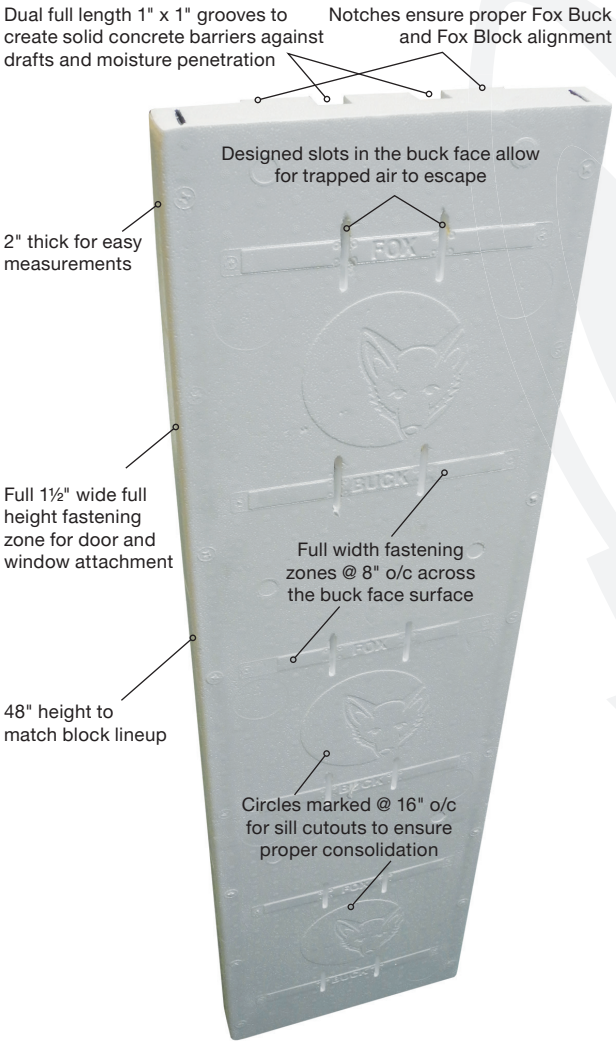
5) ESTIMATING
3 Energy Sticks for every block ordered.
One box = 36 Energy Sticks
One box of Energy Sticks will fill 12 blocks

6) MAN HOURS
Allow 4 minutes per box when inserting for the first time (= 950 square feet of wall per hour or .001 man hours per square foot)

7) BUNDLE SIZES
Each box of 36 Energy Sticks = approximately 24" x 24" x 33"

FOX BUCK CONTINUOUS INSULATION

The Fox Buck is a certified, fully integrated, continuous insulation window and door buck for commercial and residential ICF wall openings. Fox Buck completed 3rd party testing and obtained State of Florida product approval (FL 17775) for all of Florida, including Miami-Dade counties. To obtain certification and Florida code approval, the Fox Buck met and passed several tests related to wind and impact resistance, moisture and air infiltration, and fire related tests. The Fox Buck can be used in place of pressure treated wood bucks that tend to expand, contract, warp and move within the high moisture climates.



FOX BUCK NUMBERS					
Available Sizes	4"	6"	8"	10"	12"
Total Width	9¼"	11¼"	13¼"	15¼"	17¼"
Total Length	48"	48"	48"	48"	48"
Bag Quantity	10	10	10	10	10
Bag Weight	26 lbs	28 lbs	32 lbs	35 lbs	38 lbs

Photo above reveals consolidated concrete barriers created within the Fox Buck

The 1" x 1" notches create a dual barrier against drafts and moisture penetration. When installed properly, the concrete barrier protection is continuous around the entire opening. These barriers also anchor the Fox Buck to the wall with enough strength to hold in most weather* conditions

** Contact Fox Blocks for high wind anchoring recommendations.*

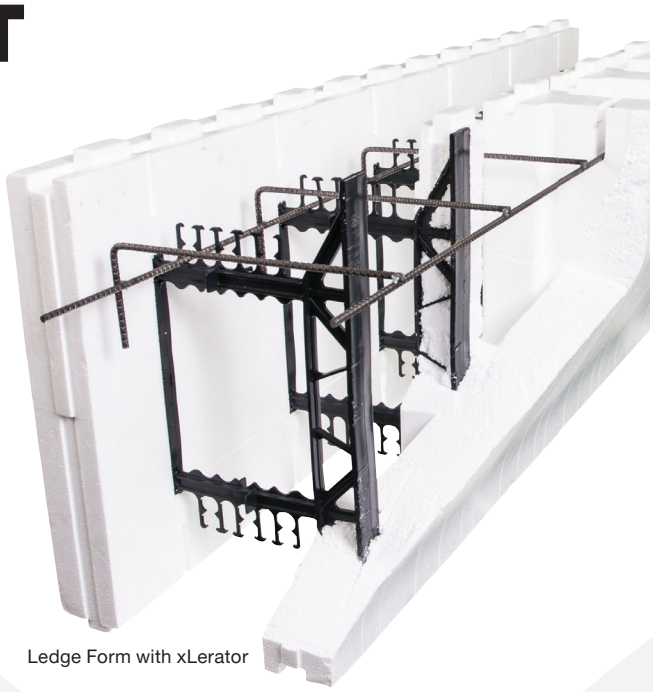
xLERATOR® LEDGE REINFORCEMENT

From foundation to finish, the Fox Blocks patented family of products helps you get the job done more efficiently. Combining industry feedback with the Fox Blocks product design team creativity, we offer an impressive array of product innovations that benefit the owner, the contractor, AND the design team.

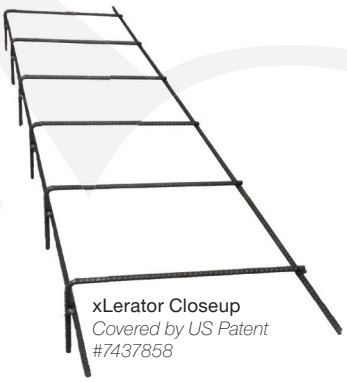
FOX BLOCKS' XLERATOR – the only product of its kind in the industry and first one to meet ACI 318 guidelines – is a patented ICF ledge reinforcement system that offers unmatched versatile performance ideal for supporting brick and stone exterior finishes, as well as slabs, floors and other structural features.

The one-piece, 4-foot long, welded wire reinforcement piece simply drops into the pre-formed slots in Fox Blocks' ledge form.

There's never been a faster way to meet deadlines and building code requirements, all while significantly reducing labor costs and delays associated with pre-bent stirrups or in-field rebar reinforcement.



Ledge Form with xLerator



xLerator Closeup
Covered by US Patent #7437858

Mitered Ledge Corner

BENEFITS INCLUDE

- **DROP & GO**
  Fully engineered ledge system allows you to easily place the ledge form, drop in the xLerator reinforcement piece and fill with concrete.
- **ACI 318 COMPLIANT**
  ONLY xLerator meets ACI 318 guidelines for ICF ledge reinforcement.
- **WEATHER RESISTANT**
  Hot-dipped galvanized to protect from corrosion for lasting durability.
- **FULLY ENGINEERED**
  Comes complete with full engineering details for multiple applications.
- **MAXIMUM STRENGTH**
  Reinforcement in all 6 ledge corbels.
- **VERSATILE**
  One size fits both 6" and 8" ledge forms.

WHY HOT-DIPPED GALVANIZED?

Hot-dip galvanization is the process of taking steel and dipping it into molten zinc to serve as a protective coating. If rebar in a ledge form is NOT galvanized, it's subject to corrosion because it is placed close to the outside edge of the brick ledge, sits in a foam slot, and is not completely encased in concrete. This allows water to reach the rebar and causes it to rust. As the rebar rusts, it expands, causes concrete to crack, and undermines the stability of the ledge.

Since the xLerator is hot-dipped galvanized, it protects the reinforcement from rusting and maintains the integrity of the concrete meeting ACI 318 guidelines.

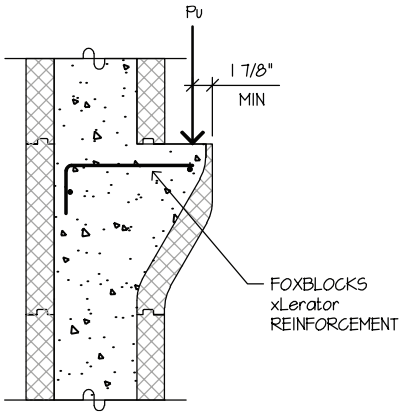
APPLICABLE ACI 318 GUIDELINES

Deformed Welded Wire Reinforcement (WWR)

- Reinforcement in every corbel
- WWR 60,000 PSI Yield Strength
- xLerator meets these guidelines

xLERATOR® LEDGE REINFORCEMENT

xLERATOR® ENGINEERING LOAD CAPACITY



ULTIMATE LOAD CAPACITY, PU = 2000PLF	
Example Application	Calculated ultimate load tributary area X LoadX Load Factor
Brick	35 Ft. x 40 PSF x 1.4 = 1960 PLF
Stone	17½ Ft. x 80 PSF = 1960 PLF
Wood Floor Joists	22½ Ft. tributary area or 45 Ft. clear span 22½ Ft. X (20 PSF x 1.2 + 40 PSF x 1.6) = 1980 PLF
Precast Hollowcore Floor	14½ Ft. tributary area or 29 Ft. clear span 14½ Ft. x (60 PSF x 1.2 = 40 PSF x 1.6) = 1972 PLF

Notes:

1. *Load capacity is based on a concrete strength of 2500 PSI or greater and to KSI Fox Blocks' xLerator reinforcement meeting ASTM A496*
2. *Load factors are based on ACI 318-11.*
3. *Tributary floor span is the length of floor supported by the ledge form, which is commonly half of the clear span.*
4. *Acceptable masonry heights and floor spans shown in the table are based on the structural capacity of the ledge only and may be limited by other factors. Consult a design professional for acceptable heights or unsupported masonry and floor spans.*

tieKEY® MASONRY ANCHOR

Designed by Fox Blocks, the tieKey anchor is a patented, cast-in-place, adjustable masonry tie anchor that embeds into the concrete wall formed by Fox Blocks. This award winning product provides the strength and security required when installing brick or stone veneer finishes.

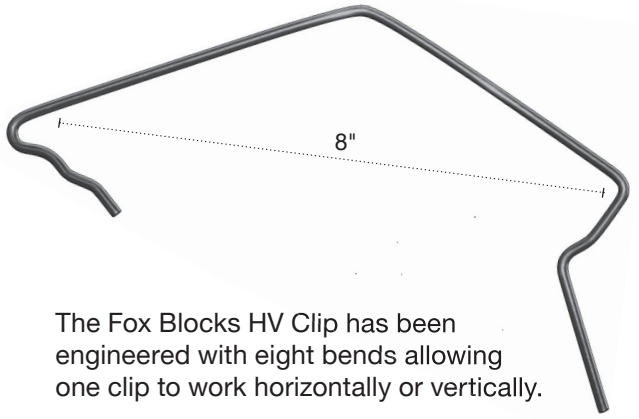
SEE HOW THE TIEKEY HAS BEEN PUT TO THE TEST

- Third party tested for tension and compression strength.
- Simplifies the installation of brick or stone exterior finishes.
- Adjustable wire tie accommodates construction tolerances and allows for larger differential movement for the brick finish.
- Provides strong resistance to negative and positive lateral forces.
- Available in two materials: hot-dipped galvanized steel or stainless steel.
- Recipient of the World of Concrete's Most Innovative Products Award.

tieKey Closeup
Covered by US Patent #8347531

FOX BLOCKS HV CLIP

Contractors asked for a wire clip to secure their Fox Blocks jobs together so the team at Fox Blocks went to work designing one. Fox Blocks ties are engineered to be perfectly balanced, spaced at 8" o/c Horizontally and Vertically, giving flat walls post concrete. This allowed us to put all of our design into one wire clip which helps everyone with only one SKU.



The Fox Blocks HV Clip has been engineered with eight bends allowing one clip to work horizontally or vertically.

HV CLIP PLACEMENT:

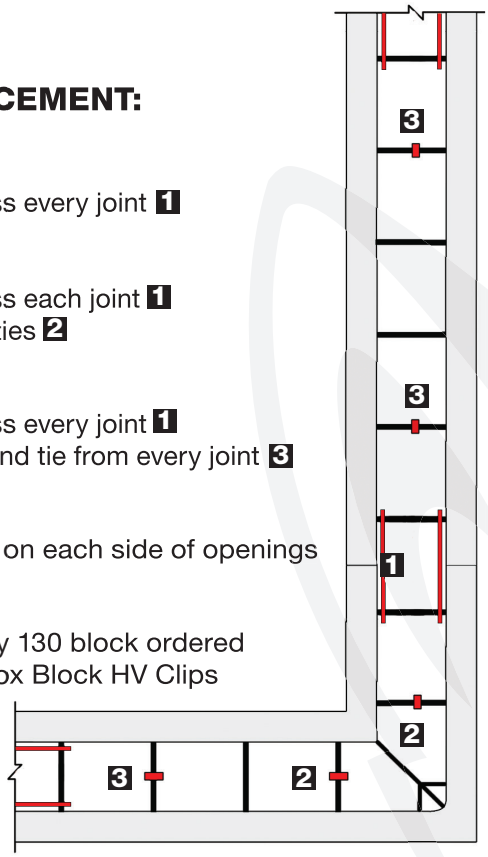
BOTTOM ROW:
Horizontally across every joint 1

CORNERS:
Horizontally across each joint 1
Vertically on first ties 2

TOP ROW:
Horizontally across every joint 1
Vertically on second tie from every joint 3

OPENINGS:
Vertically up wall on each side of openings

BUDGET:
One box for every 130 block ordered
One box = 250 Fox Block HV Clips



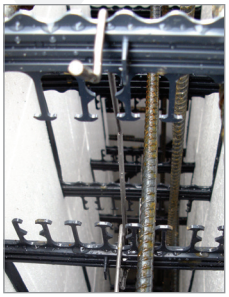
FOX BLOCKS HV CLIP POSITIONS

Vertical Clips in Place

Horizontal Clips in Place

Note: You can skew the HV Clip a notch or two for an even tighter fit, if needed.

FOX BLOCKS HV CLIP BEING USED ON JOBS



Vertical & Horizontal Clips in place close to corner

Showing HV Clips holding down a top row that has been cut down to +/- 8" in height

Using the Fox Blocks HV Clip eliminates the need for truss wire completely on your jobs. The result is that for about half the cost of the truss wire you will get a stronger and straighter job.

Product Label

Standards for Plumbness Tolerances

Fox Blocks are a modular system of stay-in-place insulating concrete forms. The forms interlocks as the wall is built and by using an ICF specific alignment and bracing systems, during and after concrete placement, the walls can be aligned to be plumb and straight to string lines and laser levels.

When constructing the cast-in-place concrete Fox Blocks walls, the walls must be built within certain construction tolerances to be straight, plumb and level. These tolerances may be found in the construction documents, codes, or relevant standards. The following ACI references are for information and may be used as a guide for maintaining a plumb wall:

ACI 318 – Building Code Requirements for Structural Concrete
(Does not specifically address tolerances other than saying walls to be true, square and plumb.)

ACI 347 – Guide to Formwork for Concrete
- 7.4.1 Permanent forms – nothing
- 3.3.1 Tolerances – References ACI 117

ACI 117 – Specifications for Tolerances for Concrete Construction and Materials
- 4.1.1.1.1 Deviation from plumb – for heights less than or equal to 83'-4" the lesser of 0.3% (0.003) times the height above the top of foundation or +/- 1".

(This is a reference standard only and not part of the building code and therefore not mandatory unless it is referenced in the construction documents.)

The engineer-architect of record may accept the element if it meets one of the following criteria:

a. Exceeding the tolerances does not affect the structural integrity, legal boundaries, or architectural requirements
b. The element or total assembly can be modified to meet all structural and architectural requirements

For any walls that are deemed unacceptably out of tolerance for a finish application, either exterior of interior, the EPS panels ⅝" thick to face of fastening strip) may be rasped down to meet provide an acceptable surface tolerance.

Fox Blocks walls for tall walls, gymnasiums and theaters have been built from 18' to 40' height.

Fox Blocks maintains a quality control standard for the manufacturing of the blocks, which is monitored by a certified third-party testing laboratory.

Standards & Building Codes

The ICF industry over the last decade has successfully completed major steps in the testing and evaluation of the components and wall assembly attributes for insulated concrete forms.

Working with the International Code Council - Evaluation Services (ICC-ES) and the Canadian Construction Materials Council (CCMC), standards and acceptance criteria have been established to test and evaluate ICFs to meet building codes. This has resulted in ICFs being specifically recognized in the building and energy codes across North America.

Fox Blocks and the ICF industry, in co-ordination with the ICC-ES, ASTM and ULC have developed standards for the manufacturing and design of flat wall ICFs. These standards are now recognized in building codes and must be included in the evaluations process for product approval.

The ICC-ES has also developed a list of Acceptance Criteria, to meet code compliance, for the materials used in the manufacturing of an ICF, plus the characteristic requirements for the application of ICFs in all building types. Fox Blocks maintains a comprehensive list of third party certified lab testing to demonstrate compliance to these standards, acceptance criteria and building codes. The main compliance report has been developed by Intertek – CCRR-1010. The manufacturing of all products is monitored by a quality control program with inspections conducted by Intertek Testing Services to be in compliance to ICC -ES requirements.

These main standards or acceptance criteria for Fox Blocks ICFs code compliance are:

- AC353 – Acceptance Criteria for Stay-in-place, foam Plastic Insulating Form systems for Solid Concrete Walls
- ASTM E2634-11 - Standard for Flat Wall ICF Systems
- Can/ULC S717.1-12 – Standard for Flat Wall ICF Units

Within these standards are testing requirements that are required to be successfully completed to show compliance for various aspect of the building code, some of these are shown below:

- Fire, ignition and smoke
- Form capacity for hydrostatic pressure
- Tensile and shear strength of the ties
- Lateral and shear capacity or the ties for fasteners
- Structural design criteria
- Fire resistance ratings
- Air and vapor characteristics
- Thermal resistance

The ICC- IBC recognizes ICFs are a forming system for reinforced concrete walls following ACI 318 concrete design criteria

The ICC- IBC recognizes ICFs specifically in these sections R404 and R611.

The IECC recognizes ICFs as mass walls and as an integral part of a whole wall assembly utilizing the U-factor.

Fox Blocks is an approved product and code compliant across North America, to be designed and utilized on any building type from foundation to any height.

Fox Blocks Code Compliance Report CCRR-1010 is available in the Resource Center at www.foxblocks.com.

Review the Fox Blocks specifications (1.04.02) for a listing of compliance testing.

Technical Performance Data

CONCRETE WALL CONSTRUCTION (4", 6", 8", 10" & 12" Reinforced Concrete Core):

Design Criteria For Structural Concrete Wall System:	ACI 318 and CSA A23.2 concrete design for slender walls
Recommended Concrete Consolidation:	ACI 309 and Tech Bulletin 1.06.05
Prescriptive Engineering for Exterior Concrete Walls:	PCA100-2012, IRC R404, R611, ACI 332
Average weight of Reinforced Structural Concrete:	150 lbs /cu. ft. (including steel reinforcement)
Thermal Mass (Form & 4" Reinforced Concrete Core):	50 lbs. / sq. ft.
Thermal Mass (Form & 6" Reinforced Concrete Core):	75 lbs. / sq. ft.
Thermal Mass (Form & 8" Reinforced Concrete Core):	100 lbs. / sq. ft.
Thermal Mass (Form & 10" Reinforced Concrete Core):	125 lbs. / sq. ft.
Thermal Mass (Form & 12" Reinforced Concrete Core):	150 lbs. / sq. ft.
Recommended Concrete Compressive Strength:	Minimum 2500 recommended 3000 psi for walls
Recommended Concrete Slump for ICFs:	4" ICF - 6" to 7"; 6" ICF - 5.5" to 6.5"; 8", 10" or 12" ICF - 5" to 6"
Recommended Aggregate Size for Concrete Mix Design:	4" ICF - 3/8" max.; 6" ICF 3/8" to 1/2" max; 8", 10" & 12" ICF - 1/2" to 3/4" max.
Recommended Steel Reinforcing Compressive Strength:	Minimum yield strength 60,000 psi

PRODUCT PERFORMANCE & THIRD PARTY TESTING:

Expanded Polystyrene (EPS) Testing:

EPS Foam Resin: Modified low pentane, B/C bead size (resin is self-extinguishing)
EPS Average Manufacturing Density: 1.5 lbs / cu. ft. (Type II, Rigid Cellular EPS Foam Plastic)
ASTM C578, EPS Thermal Insulation Properties
CAN /ULC S701, EPS Thermal Insulation Properties

Plastic Tie (Web) Strength Testing:

Fastener Withdrawal and Lateral Shear - ASTM D1761
Tie Tensile and Shear – ASTM D638 and D732

Performance Testing:

Sound Transmission Classification (STC) - ASTM E90
4"=STC 46, 6" & 8" = STC 50+

Environmental, Safety & Energy Performance:

No HCFCs or CFCs emitted in the manufacturing process
No toxins, formaldehydes are produced, no off-gassing.
Plastic ties are made from 100% recycled material.
EPS forms, concrete and rebar are recyclable products.
SDS sheets are available on website.

Energy Efficiency and Performance

Thickness of EPS insulation: 2.625" per panels (total 5.25" EPS insulation)
EPS, Type II, Thermal Resistance R-Value: R-4.17 per inch (@ 70˚F)
Engineered Thermal Resistance Calculations: R-23+, U-factor 0.0425 whole wall assembly per ASHRAE 90.1
Air Leakage (infiltration rate) ASTM E283: 0.002 cfm / sq. ft.
No Thermal Bridging, Continuous Insulation
Energy Enhancement with Energy Stick: 2" EPS insert for additional R-8
Fox Buck Insulated Opening Buck

Resiliency Design:

High Wind Capacity: Fox Blocks reinforced concrete walls can be designed to exceed building code wind requirements.
Seismic Zones: Fox Blocks reinforced concrete walls can be designed for all seismic zones and used for FEMA approved safe rooms

FIRE TESTING

Surface Burning Characteristics of Foam Plastic:
ASTM E84, ANSI/UL723, CAN / ULC S102
Flame Spread – less than 25
Smoke Development – less than 450

Fire Burning Characteristics of Plastic Ties:
ASTM D1929 Flash Ignition Temp: 752˚ F (400˚C)
ASTM D1929 Spontaneous Ignition Temp: 716˚ F (380˚C)
ASTM D635 Burn Rate – Meets Class CC1

Fire Resistance Rating – ASTM E119 (Equivalent Standard Test Methods)

4" Fox Blocks	2 hours
6" Fox blocks	4 hours

BUILDING CODES AND STANDARDS

ICC Code Compliance: Intertek CCRR-1010
AC 353: Acceptance Criteria for Flat Wall ICFs
ASTM E2634: Standard for Flat Wall ICFs
CAN/ULC S717.1: Standards for Flat Wall ICFs

Fox Blocks is code compliance for foundations and Building Types I,II, III and IV (noncombustible) any height.

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Find us in MasterSpec® a product of The American Institute of Architects

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SDS sheets are available on website.

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Thickness of EPS insulation: 2.625" per panels (total 5.25" EPS insulation)
EPS, Type II, Thermal Resistance R-Value: R-4.17 per inch (@ 70˚F)
Engineered Thermal Resistance Calculations: R-23+, U-factor 0.0425 whole wall assembly per ASHRAE 90.1
Air Leakage (infiltration rate) ASTM E283: 0.002 cfm / sq. ft.
No Thermal Bridging, Continuous Insulation
Energy Enhancement with Energy Stick: 2" EPS insert for additional R-8
Fox Buck Insulated Opening Buck

Resiliency Design:

High Wind Capacity: Fox Blocks reinforced concrete walls can be designed to exceed building code wind requirements.
Seismic Zones: Fox Blocks reinforced concrete walls can be designed for all seismic zones and used for FEMA approved safe rooms

FIRE TESTING

Surface Burning Characteristics of Foam Plastic:
ASTM E84, ANSI/UL723, CAN / ULC S102
Flame Spread – less than 25
Smoke Development – less than 450

Fire Burning Characteristics of Plastic Ties:
ASTM D1929 Flash Ignition Temp: 752˚ F (400˚C)
ASTM D1929 Spontaneous Ignition Temp: 716˚ F (380˚C)
ASTM D635 Burn Rate – Meets Class CC1

Fire Resistance Rating – ASTM E119 (Equivalent Standard Test Methods)

4" Fox Blocks	2 hours
6" Fox blocks	4 hours

BUILDING CODES AND STANDARDS

ICC Code Compliance: Intertek CCRR-1010
AC 353: Acceptance Criteria for Flat Wall ICFs
ASTM E2634: Standard for Flat Wall ICFs
CAN/ULC S717.1: Standards for Flat Wall ICFs

Fox Blocks is code compliance for foundations and Building Types I,II, III and IV (noncombustible) any height.

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Find us in MasterSpec® a product of The American Institute of Architects

Safety Data Sheet

SECTION 1: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Manufacturer's Name
Fox Blocks – Airlite Plastics
6110 Abbott Drive
Omaha, NE 68110

Emergency Telephone
877-369-2562

SDS Competent Person info@foxblocks.com

Date Prepared June 3, 2016
Revisions Date June 9, 2016
Product Name Fox Blocks
Formula Substance
Product Use For use as a stay-in-place formwork for a cast-in-place concrete wall used in residential and commercial exterior and interior walls.

SECTION 2: HAZARDS IDENTIFICATION

GHS Hazard Class Not applicable. This product does not meet the physical, health or environmental classification criteria of GHS (Globally Harmonized System).

Hazards not otherwise classified (HNOC) – None

Hazard Classification Not classified as hazardous based on IATA, IMDG, and DOT.

Fire and Explosion Not considered flammable or combustible, but this product will burn if involved in a fire.

Potential Health Effects <0% of mixture consists of ingredients of unknown acute toxicity.

Appearance White EPS foam and black plastic ties.

NFPA Rating

COMPONENT	HEALTH (BLUE)	FLAMMABILITY (RED)	REACTIVITY (YELLOW)	SPECIAL (WHITE)
Fox Blocks	1	2	0	–

SECTION 3: COMPOSITION, INFORMATION ON INGREDIENTS

PRODUCT COMPOSITION	APPROX %	CAS NUMBER	EC NUMBER	CANADA DSL
EPS RESIN				
Expanded Polystyrene (EPS)	> 95	9003-53-6	500-008-9	Y
Pentanes	< 1	109-66-0	203-692-4	Y
Flame Retardant	< 1	TS	TS	Y
Coatings	< 1	-	-	N
PP RESIN				
Recycled Polypropylene	> 95	9010-79-1	-	Y
Stabilizers and Additives	< 5	Mixture	-	N

Some items on this SDS may be designated as trade secrets (TS). Bonafide requests for disclosure of trade secret information to medical personnel must be made in accordance with the provisions contained in 29 CFR 1910.1200 I 1-13.

SECTION 4: FIRST AID MEASURES

Description of First Aid Measures

Inhalation Remove to fresh air. If not breathing, provide CPR (Cardio Pulmonary Resuscitation). Get immediate medical attention.

Skin Contact Wash skin with plenty of soap and water. If hot material gets on skin, immediately flush affected area with large amounts of cool water. Do not attempt to remove the material from the skin, or to remove contaminated clothing. Get immediate medical attention.

Eye Contact Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses if present and safe to do so. If hot material comes in contact with eyes hold the eyelids apart and flush the eye with a large amount of cool water for at least 15 minutes. Get immediate medical attention.

Ingestion If swallowed do NOT induce vomiting, rinse mouth with water. Never give anything to an unconscious person. Get immediate medical attention.

Most Important Symptoms and Effects, Both Acute and Delayed

Symptoms/Injuries After Inhalation Dust and/or vapors may cause respiratory tract irritation. In confined or poorly ventilated areas, vapors can readily accumulate and can cause unconsciousness and death.

Symptoms/Injuries After Skin Contact May cause skin irritation. Symptoms may include redness, drying, defatting, and cracking of the skin.

Symptoms/Injuries After Eye Contact May cause eye irritation. Symptoms may include discomfort or pain, excess blinking and tear production, with possible redness and swelling.

Symptoms/Injuries After Ingestion May be harmful if swallowed. May cause stomach distress, nausea, or vomiting.

Indication of any Immediate Medical Attention and Special Treatment Needed

Inhalation: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.
Eyes: Hot material may cause burns to the eyes. Early opthalmologic evaluation is recommended.
Skin: Hot material may cause skin burns. Immerse skin covered with hot material in cool water to limit tissue damage and prevent spread of liquid material.

Symptoms may not appear immediately. In case of accident or if you feel unwell, seek medical advice immediately.

SECTION 5: FIRE-FIGHTING MEASURES

Suitable Extinguishing Media Use foam, dry chemical, or carbon dioxide. Do not use solid water stream as it may scatter and spread fire.

Special Hazards Arising from the Substance or Mixture Combustion may produce hazardous decomposition products and other decomposition products in the case of incomplete combustion. These may include simple hydrocarbons to toxic and irritating gases such as carbon, carbon monoxide, carbon dioxide, styrene, acids, ketones, and aldehydes. Material is a solid containing an extremely flammable liquid and vapor. Material will burn on contact with flame or exposure to high temperature. Hazardous melting and dropping may occur at elevated temperatures. Explosion hazard if exposed to extreme heat. This material releases a flammable blowing agent. Extremely flammable vapors form flammable or explosive mixtures with air at room temperature. Vapor or gas may spread to distant ignition sources and flash back. Eliminate ignition sources (including static spark) and prevent vapor accumulation. This material, as produced and not in its finely divided form as dust, is not explosive as defined by established regulatory criteria. When in its finely divided form as dust, this material presents an explosion hazard when dispersed in a confined area and ignited in air. Risk of dust-air explosion is increased if flammable vapors are present. This material may accumulate static charge which can cause an electrical spark (ignition source) in some cases. To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before transferring material.

Protective Actions Fire-Fighters	Wear standard protective equipment and self contained breathing apparatus for firefighting if necessary.
Further Information	Use water spray to cool unopened containers.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures
Wear proper personal protective equipment. Avoid breathing dust, fine particulate, vapors and/or mist.

Environmental Precautions
Prevent further leakage or spillage if safe to do so. Prevent spills or contaminated rinse water from entering sewers or watercourses.

Methods and Materials for Containment and Cleaning Up

For Small Spill: In the event of a small spill, clean up area with non-sparking tools and place into an appropriate container for disposal. Avoid the generation of dust clouds and contamination of waterways.

For Large Spill: In the event of a large spill, keep unnecessary people away. Isolate area for at least 25 meters (75 feet) in all directions to preserve public safety. If downwind consider initial evacuation for at least 100 meters (300 feet). Eliminate all sources of ignition (no smoking, flares, sparks or flames in immediate area). Prevent or minimize formation of a dust could or layer during cleanup. This material releases a flammable blowing agent. In its finely divided form, this material may present an explosion hazard when dispersed in a confined area and ignited in air.

Water Spill: Use appropriate containment to avoid run off or release to sewer or other waterways.

Land Spill: Use appropriate containment to avoid run off or release to ground.

SECTION 7: HANDLING AND STORAGE

Precautions for Safe Handling

Take precautionary measures against static discharge.
Keep away from heat, sparks, flame, direct sunlight, and other possible sources of ignition.
Use only with adequate ventilation.
Do not inhale dust or vapors.
Avoid spilling and releasing dust and vapor.
Wear proper protective equipment when handling this material.
Avoid contact with skin, eyes, or clothing.
Wash hands after handling this material.
Appropriate container should be used for disposal.
For precautions see Section 2.

Conditions for Safe Storage, Including any Incompatibilities

Store upright in a cool, dry place.
Keep container closed when not in use.
Prevent build-up of electro-static charges (e.g. by grounding).
Keep away from heat, sparks, flame, direct sunlight, and other possible sources of ignition.
Do not store with acid, metallic oxide, amines, and combustible materials.
Utilize chemical segregation.
Follow all applicable local regulations for handling and storage.

Specific Uses

This product is intended for use as a stay-in-place formwork for a cast-in-place concrete wall used in residential and commercial exterior and interior walls.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Control Parameters

PRODUCT COMPOSITION	ACGIH TLV	OSHA PEL	NIOSH REL
EPS RESIN			
Expanded Polystyrene (EPS)	TWA 3 mg/m^3** 10 mg/m^3**	TWA 5 mg/m^3** 15 mg/m^3**	TWA 3 mg/m^3** 10 mg/m^3**
Pentanes	TWA 120 ppm (350 mg/m^3)	TWA 1000 ppm (2950 mg/m^3)	TWA 120 ppm (350 mg/m^3) C 610 ppm (1800 mg/m^3) [15-minute]
Coatings	-	-	-
PP RESIN			
Recycled Polypropylene	-	-	-
Stabilizers and Additives	-	-	-

* *PNOR (Particulates Not Otherwise Regulated): OSHA 5 mg/m^3 Respirable Fraction (R), 15 mg/m^3 Total Particulates*
** *PNOS (Particulates Not Otherwise Specified): ACGIH 3 mg/m^3 Respirable Fraction (R), 10 mg/m^3 Total Particulates, total dust less than 1% quartz.*

Exposure Controls

Ventilation Always provide good general, mechanical room ventilation where this chemical/material is used.

Special Ventilation Controls Use explosion-proof equipment if high dust/air concentrations are possible. Use only appropriately classified electrical equipment and powered industrial trucks. If user operations generate dust, fume or mist,

use ventilation to keep exposure to airborne contaminants below the exposure limit. It is recommended that all dust control equipment such as local exhaust ventilation and material transport systems involved in handling of this product contain explosion relief vents, an explosion suppression system or an oxygen deficient environment. Ensure that dust-handling systems (such as exhaust ducts, dust collectors, vessels, and processing equipment) are designed in a manner to prevent the escape of dust in to the work area (i.e. there is no leakage from the equipment).

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or the CEN European Standards (EU). Use a NIOSH/MSHA or European Standard (EN) approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Protective Gloves Neoprene, butyl, or nitrile rubber glove are recommended.

Eye Protection Recommend eye protection using safety glasses or goggles.

Skin Protection Suitable protective clothing to prevent skin contact.

Work/Hygiene Practices Avoid breathing dust or vapor. Avoid contact with eyes. Wash hands after handling.

Other Equipment Make safety shower, eyewash stations, and hand washing equipment available in the work area.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

	PRODUCT CRITERIA - EPS	PRODUCT CRITERIA - PP
Appearance - Color	White or Grey	Charcoal to Black
Physical State	Solid	Solid
Odor	Very Slight Hydrocarbon Odor	Mild to Odorless
Odor Threshold	Data Not Available	Data Not Available
PH	Data Not Available	Data Not Available
Melting Point / Freezing Point	70˚C (160˚F)	90˚C (200˚F)
Initial Boiling Point and Boiling Range	Data Not Available	Data Not Available
Flash Point	400˚C (752˚F)	Data Not Available
Evaporation Rate	Data Not Available	Data Not Available
Flammability (Solid, Gas)	Data Not Available	Data Not Available
Upper/Lower Flammability or Explosive Limits	Data Not Available	Data Not Available

	PRODUCT CRITERIA - EPS	PRODUCT CRITERIA - PP
Vapor Pressure	Data Not Available	Data Not Available
Vapor Density (Air = 1)	Data Not Available	Data Not Available
Specific Gravity (H20 = 1)	0.60 - 2.0 (Estimated)	0.85 - 0.1 (Estimated)
Density (@25˚C)	1.35 - 1.65 lbs/cubic feet	1.02 g/ml
Solubility (IES)	Insoluble	Insoluble
Oxidizing Properties	Data Not Available	Data Not Available
Partition Coefficient: n-octanol/water	Data Not Available	Data Not Available
Auto Ignition Temperature	380˚C (716˚F)	Data Not Available
Decomposition Temperature	Data Not Available	Data Not Available
Viscosity	Data Not Available	Data Not Available
Explosive Properties	Data Not Available	Data Not Available

SECTION 10: STABILITY AND REACTIVITY

Reactivity Not Reactive

Chemical Stability Stable under normal conditions.

Possibility of Hazardous Reactions Will not occur under normal temperatures and pressures.

Conditions to Avoid Unventilated areas, heat, open flame, sparks and ungrounded electrical equipment.

Incompatibility (Materials to Avoid) Solvents including hydrocarbons, esters, aldehydes, and amines. Also avoid strong oxidizers.

Hazardous Decomposition Products Decomposition of the product can include trace amounts of hydrocarbons. Primary combustion products include carbon monoxide, carbon dioxide, styrene, hydrogen halide, nuisance particulate, carbon (soot) and pentanes.

SECTION 11: TOXICOLOGICAL INFORMATION

There is no toxicological information available for the product.

GHS REQUIRED CRITERIA	TOXICITY CRITERIA	TOXICITY INFORMATION	COMMENTS	CHEMICAL CONSTITUENT
Acute Toxicity	LD50 (Oral/Rat)	2,000 mg/kg	No mortality	Pentane
	LC50 (Inhalation/Rat)	205.45 mg/L, 4hr		Pentane
Skin Corrosion/Irritation	There was no stimulativeness to the human skin by the 24-hour patch test in the humans and there was no stimulativeness in practice by the skin irritation study in a rabbit (the erythema and dropsy with the average values of Draize score of 0.67).			Pentane
Serious Eye Damage/ Eye Irritation	EYE-RABBIT:	Transient conjunctivitis was seen, however, it recovered within 72 hours.	Category 2B	Pentane
Respiratory or Skin Sensitization	No sensitizing properties seen in the Maximization Test using the guinea pigs.			Pentane
Germ Cell Mutagenicity	Negative micronucleus tests using rat myeloid cells of in vivo.			Pentane
Carcinogenicity	NTP	Not Listed		
	IARC	Group 3		Polystyrene
	OSHA	Not Listed		
Reproductive Toxicity	There is a description that no influence on dam and fetus was observed in the teratogenicity test by oral administration using rats, even at the highest dose of 1000mg/kg/day.			Pentane
STOT* - Single Exposure	There were anesthetic actions and respiratory irritant through inhalation exposure to laboratory animals.		Category 3	Pentane
STOT* - Repeated Exposure		Data Not Available		
Aspiration Hazard		Data Not Available		

* *STOT = Specific Target Organ Toxicity*

SECTION 12: ECOLOGICAL INFORMATION

		CHEMICAL CONSTITUENT
Toxicity	48-Hour EC50 = 2.7mg/L, Crustacea (Daphnia magna)	Pentane
Persistence and Degradability	Data Not Available	
Bioaccumulative Potential	Data Not Available	
Mobility in Soil	Data Not Available	
PBT and vPvB Assessment	PBT/vPvB assessment not available as chemical assessment not required /not conducted.	
Other Adverse Effects	Data Not Available	

SECTION 13: DISPOSAL CONSIDERATIONS

Waste from Residue/ Unused Products Follow the waste disposal requirements of your country, state, or local authorities.

Contaminated Packaging Contaminated packaging material should be disposed of as stated above for resides and unused product.

Rinsate Do not dispose of rinse water containing product in a sanitary sewer system or stormwater drainage system.

SECTION 14: TRANSPORT INFORMATION

DOT Transport		Not Regulated
ADR = International Carriage of Dangerous Goods by Road		Not Regulated
Sea Transport	IMDG	Not Regulated
Air Transport	IATA/ICAO	Not Regulated

SECTION 15: REGULATORY INFORMATION

Toxic Substance Control Act (TSCA) Status
This product is in compliance with rules, regulations, and orders of TSCA. All components are either listed on a federal chemical inventory or are considered exempt.

Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III Section 313 Supplier Notification
This regulation requires submission of annual reports of toxic chemical(s) that appear in Section 313 of the Emergency Planning and Community Right To Know Act of 1986 and 40 CFR 372. This information must be included in all SDSs that are copied and distributed for the material.

California Proposition 65

This regulation requires a warning for California Proposition 65 chemical(s) under the statute.
The California proposition 65 chemical(s) contained in the product are: This material may contain low levels of Styrene and Ethyl Benzene with exposure of no significant risk.

State Right-To-Know Toxic Substance or Hazardous Substance List

Massachusetts Hazardous Substance(s):	Pentane
Pennsylvania Hazardous Substance(s):	Pentane
New Jersey:	Pentane

Canada

WHMIS-2015	This SDS is in compliance with WHMIS 2015 (HPR/new HPA).

European Union

This product has been reviewed for compliance with the following European Community Directives: REACH 1907/2006; Regulation (EC) No 1272/2008 on classification, labeling, and packaging (CLP) of substances and mixtures.

SECTION 16: OTHER INFORMATION

Initial Issue Date	June 3, 2016
Final Revision Date	June 9, 2016
Revision Number	0
Revision Explanation	Initial Version
Information Sources	RTECS, ECHA, REACH, OSHA 29 CFR 1910.1200

Disclaimer

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This SDS complies with GHS Revision 5, OSHA 29CFR 1910.1200

SDS AUTHORED BY

Aegis Environmental Strategies

Safety and Environmental Compliance

WWW.AEGIS-EHS.COM

Concrete Design & Placement

Fox Blocks forms are designed, tested and approved as formwork for reinforced concrete. Following the specification for a concrete mix design and manufacturers recommendations for consolidation will results in a safe and successful build.

CONCRETE MIX DESIGN

One of the most important aspects of concrete placement is the proper concrete mix design. Proper concrete mix will save time on labor, facilitate concrete consolidation and ensure a successful Fox Blocks wall pour.

Concrete mix can vary from region to region throughout the country because the raw materials differ from region to region. There are many factors that govern the design of the concrete mix:

- Structural Design Requirements
- Temperature
- Water Content
- Additives
- Delivery Times
- Placement Methods (Typically by a Concrete Pump)

Therefore, the contractor must work closely with the local concrete supplier and inform the supplier that the concrete mix design will be placed in an ICF wall system.

Fox Blocks provides concrete specifications and mix guidelines, and the local ready-mix supplier will provide the specific mix design following these specifications, dependent on the local environmental requirements in your area. Additional admixtures such as fly ash, plasticizers and super plasticizers may be added to increase the workability and concrete flow. The contractors should be experienced and knowledgeable about any additives and how they will impact the placement and curing times.

CONCRETE MIX GUIDELINES

The following concrete mix guidelines must be conveyed to the concrete supplier:

- Compressive Strength
- Aggregate Size
- Slump

Concrete Placement

In most areas, Ready Mix Concrete suppliers are familiar with ICFs and have a specific ICF mix design.

Fox Blocks insulate the concrete in cold weather permitting the placement of concrete in winter temperatures with supplemental heating. Refer to Technical Bulletin 1.06.01 Cold Weather Concrete.

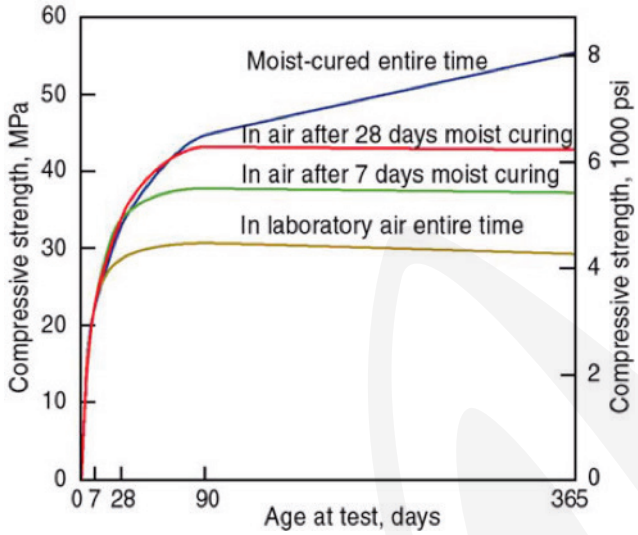
Cutting corners on the concrete mix can add cost and problems when you place the concrete into the Fox walls.

Concrete Compressive Strength

The 28-day compressive strength of the concrete must be specified to meet the strength used in the design of the Fox Blocks walls. The minimum strength that should be specified is 2,500 psi (17 MPa). A slightly higher compressive strength of 3,000 to 4,000 psi (20 to 30 MPa) can help the flowability and pumpability of the concrete and provide additional strength to the walls with minimal or no additional costs.

Compressive Strength Chart for ICFs

The characteristics of ICFs provide a very high early compressive strength to the concrete and continued high strength.



Concrete Aggregate

It is recommended that the aggregate used in the concrete design for Fox Blocks forms follow these specifications.

Fox Blocks Form	4" Form	6" Form	8" Form	10" & 12" Form
Aggregate Size	⅜"	⅜" - ½"	½" - ¾"	¾"

Using a larger aggregate size, than specified in the 4" and 6" forms, may cause congestion between the form wall and the reinforcement resulting in voids. When using various size forms on a project ensure the aggregate in the mix design is compatible to the small form size.

Refer to a Fox Blocks Technical Representative before using a self-consolidating concrete mix design.

Slump

The proper slump allows the concrete to flow and be pumped at an efficient rate. A normal slump for Fox Blocks forms is 5" to 6" which is higher than a concrete mix for a floor, which may be at a 3" slump.

Additional water, added to mix on-site, will reduce the compressive strength of the concrete and affect the water to cement ratio.

- Lower slumps can create voids and honeycombing in the walls, plus may damage the forms during placement.
- Higher slumps create more hydrostatic pressure within the wall that may cause damage to the forms.

The following table has recommended slumps for various Fox Blocks sizes:

Fox Blocks Form	4" Form	6" Form	8" Form	10" & 12" Form
Concrete Slump	6" - 7"	5½" -6½"	5" - 6"	5" - 6"

The slump specified must be the slump that arrives in the ready-mix truck at the job site. Water should not be added to the concrete at the job site. The following chart provides a visual check of the slump rate as the concrete is placed.

Height of Lift	5" (125mm) Slump Distance Ahead	6" (150mm) Slump Distance Ahead
1 1/2 Blocks (2' - 0")	2' - 4"	3' - 0"
2 Blocks (2' - 8")	3' - 0"	3' - 8"
2 1/2 Blocks (3' - 4")	3' - 8"	4' - 4"
3 Blocks (4' - 0")	4' - 6"	5' - 6"

CONCRETE PLACEMENT RATES

The speed of concrete placement has many variables that must be considered prior to initiating placement of the concrete in the cavity of a Fox Blocks wall. These variables may be:

- Linear Length of Wall
- Wall Height
- Concrete Volume
- Temperature
- Weather
- Manpower

The one uncontrollable factor is weather and temperature. Temperature influences the flow rate for concrete placement.

The American Concrete Institute has developed tables related to concrete placement rates at specific temperatures. Pour rates in the

Slump Test

Additional water, added to mix on-site, will reduce the compressive strength of the concrete and affect the water to cement ratio.

Installation Checklist

Pre-plan the placement of concrete and utilize the Fox Blocks concrete checklists - Prior to Placement and Post Concrete Placement from the Installation Checklist 1.02.01.

following table reflect a 2:1 safety factor, as suggested by ACI. These rates assume normal density concrete (150 pcf (2400 kg/m3) or less) combined with air temperature.

ACI PLACEMENT RATE TABLE	
Temperature ˚F (˚C)	**Feet/Hour (mm/hour)**
40˚ (4˚)	2.2 ft (670 mm)
50˚ (10˚)	2.9 ft (890 mm)
60˚ (15˚)	3.4 ft (1040 mm)
70˚ (21˚)	4.0 ft (1220 mm)
80˚ (27˚)	4.6 ft (1400 mm)
90˚ (32˚)	5.2 ft (1585 mm)

Placement

Fox Blocks builders have found that using an overhead boom pump is the most efficient way to place the concrete in the ICF walls. When using the overhead boom pump, it is important to slow the velocity of the concrete by reducing the diameter of the hose near the end of the line. Avoid using heavyweight metal devices near the end of the hose.

The concrete is placed in 4 foot (1.22 m) lifts to ensure proper consolidation. If more than one pour (i.e. a multi-story project) is required, the walls are typically planned to be placed one story at a time. Placement is recommended to begin in the center of a wall and proceed around the perimeter of the project.

Concrete should be placed below every window opening through the opening left in the sill of the window buck.

Fox Block walls must be checked to ensure walls are plumb, square and straight before, during and after the concrete is placed.

Refer to Technical Bulletin 1.06.02 Concrete Placement - Lift and Fall Heights

Placement of concrete from the top of the wall is not an issue for aggregate separation.

Avoid placing concrete directly into corner forms, concrete should flow into the corners. Refer to Technical Bulletin 1.06.03 Concrete Placement in Corner Forms.

In cold weather (freezing or below) always protect the top of walls and/or any exposed concrete areas with temporary insulation or insulated tarps.

CONCRETE CONSOLIDATION

The first step towards ensuring a well consolidated solid concrete wall is having the correct slump for a good flowable concrete mix. To prevent voids and honeycombing and ensuring solid contact is made with the reinforcement bars, it is very important to consolidate the concrete. While ICF professionals often employ various methods to accomplish this, Fox Blocks recommends using an internal vibration method.

Consolidation should directly follow the placement of the concrete, continuously around the perimeter of the wall.

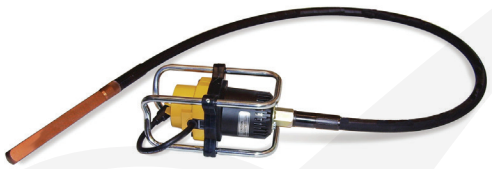
Internal vibration can be used with a light-duty pencil vibrator. The wand should not be greater than 1" (25.4 mm) in diameter. When vibrating the wall internally, always keep the vibrator moving fast in and slow out.

Refer to Technical Bulletin 1.06.05 Concrete Consolidation

Consolidate concrete during each lift, following the person placing the concrete. Extend the vibrator into the lift below, in order to blend the two lifts and avoid any cold joints.

Always vibrate around openings to ensure good consolidation around the reinforcement.

Prior to concrete placement ensure vibrator is in working order and can reach every wall.



Tools for externally consolidation may be used, but it is recommended to vibrate on both sides of the wall.

Concrete Placement – Lift and Fall Heights

The placement of concrete in Fox Blocks needs to follow the recommended procedures for flow rates, lifts heights, and consolidation, plus the specifications for concrete design mix, slump and aggregate size. All of these aspects are specific to the design and placement of concrete in an ICF wall, and vary from the specifications for regular concrete forming systems.

Concrete design and placement, fall heights, lift heights, and consolidation are all details that must be considered individually to work together for a successful Fox Blocks build. In reality, these are all independent issues that must each be considered individually for a Fox Blocks build.

Refer to Technical Bulletin 1.06.01 Concrete Design and Placement

The American Concrete Institute (ACI) does not directly address the height of concrete placement.

CONCRETE PLACEMENT RATE

The speed or flow rate at which concrete is placed has many variables that must be considered prior to placement. For example:

- Linear Length
- Height of Wall
- Temperature
- Concrete Mix
- Placement Method
- Available Manpower
- Overall Time From Start to Finish.

Refer to Technical Bulletin 1.06.01 for Concrete Placement Rates

Pre-planning is essential for a successful placement.

Prior to placement to concrete refer to the Fox Blocks Installation Checklist 1.02.01

Installation Checklist

Concrete Placement – Lift and Fall Heights

CONCRETE PLACEMENT LIFT HEIGHTS

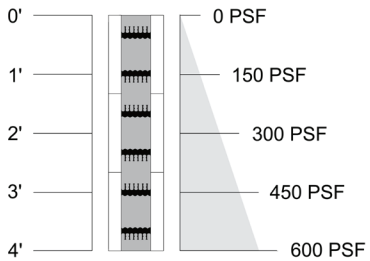
Concrete placement is recommended in 4 feet lift heights. This does not mean that the concrete cannot be placed greater than 4 feet in height. The concrete is typically placed in a continuous operation in multiple lifts - two, three or four lifts, by making continuous passes around the perimeter or section of the wall to achieve the full height required.

In typical residential construction, concrete is commonly placed in a wall to a maximum of 10 to 12 feet in height during one concrete pour. This is done in multiple lifts of around 4 feet or less. In commercial construction walls may be higher -14 to 18 feet. These walls also have the concrete placement in multiple lifts following the same procedure.

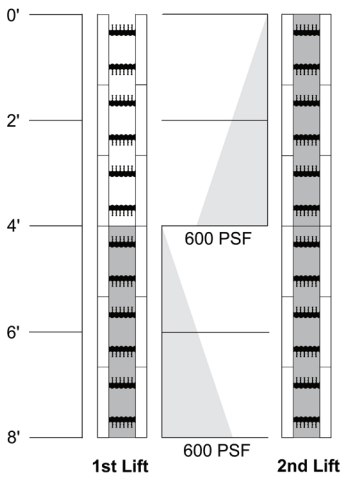
In the planning of placement lift heights, the top lift should be a minimum of 2 feet or more.

This placement method is a standard practice in the ICF industry. The 4 foot lift height is a recommendation, as a guideline, to minimize liquid concrete hydrostatic pressure on the forms and to avoid exceeding the formwork's designed capacity. This method allows the lower lift of concrete to begin setting up, providing support to the next lift as concrete is placed in the full wall.

Fox Blocks concrete mix design has a high slump of 5" to 6". Refer to Technical Bulletin 1.06.01



Form Pressure Gradient



Form Pressure Lift

Consolidation is required in every lift to eliminate any honeycombing or voids and blend the lifts to eliminate cold joints in the wall.

Refer to Technical Bulletin 1.06.05 Concrete Consolidation

Concrete Placement – Lift and Fall Heights

CONCRETE FALL HEIGHTS

A structural engineer, a specifier, or an inspector may want to limit the maximum free fall height of concrete placement with the intent to prevent segregation. Concrete placement operations in a Fox Blocks wall are planned to allow for the free fall of concrete from the top of the formwork. The concrete mix design with a high slump of 5" to 6" is advantageous for the specified fall heights in a Fox Blocks wall assembly.

The American Concrete Institute (ACI) does not directly address the height of concrete placement. Neither ACI 301, "Specifications for Structural Concrete," nor ACI 318 "Building Code Requirements for Structural Concrete," limits the maximum distance concrete can free fall. Field studies have shown that free fall from great distances does not reduce concrete quality or compressive strength.

In the specification notes to owner's representative, ACI 336 states that recent research on free-fall concrete has confirmed that free fall does not cause segregation, at least for fall heights up to 60 feet.

The American Society of Concrete Contractors (ASCC) has written a Position Statement #17 addressing the free fall of concrete. At least four field studies have shown that free fall from great distances does not reduce concrete quality. The ASCC position statement goes on to state that although the field studies have been for caissons, the results should also apply to other structural elements such as walls, columns, and mat foundations.

ASCC references a 1994 FHWA study the provided test data leading the investigators to conclude that "the general expectation that concrete striking of the rebar cage will cause segregation or weakened concrete is invalid and they found "no segregation or strength differences between low and high slump concrete mixtures."

Fox Blocks recommends placing concrete, with Fox Blocks specified mix design and slump, following ACI standards and safety factors in lifts as detailed. Typically, the concrete fall height for a Fox Blocks wall would be 9' to 12' + high, is some commercial applications the fall height may 16' +.

Bruce Suprenant, article "Free Fall of Concrete" June 2001, Concrete International Magazine summarizes many of the findings discussed in this technical brief.

Restricting free-fall heights, decreases concrete production rates, which increases owners' costs without increasing concrete quality.

Concrete Placement – Lift and Fall Heights

The placement of concrete in Fox Blocks needs to follow the recommended procedures for flow rates, lifts heights, and consolidation, plus the specifications for concrete design mix, slump and aggregate size. All of these aspects are specific to the design and placement of concrete in an ICF wall, and vary from the specifications for regular concrete forming systems.

Concrete design and placement, fall heights, lift heights, and consolidation are all details that must be considered individually to work together for a successful Fox Blocks build. In reality, these are all independent issues that must each be considered individually for a Fox Blocks build.

Refer to Technical Bulletin 1.06.01 Concrete Design and Placement

The American Concrete Institute (ACI) does not directly address the height of concrete placement.

CONCRETE PLACEMENT RATE

The speed or flow rate at which concrete is placed has many variables that must be considered prior to placement. For example:

- Linear Length
- Height of Wall
- Temperature
- Concrete Mix
- Placement Method
- Available Manpower
- Overall Time From Start to Finish.

Refer to Technical Bulletin 1.06.01 for Concrete Placement Rates

Pre-planning is essential for a successful placement.

Prior to placement to concrete refer to the Fox Blocks Installation Checklist 1.02.01

Installation Checklist

Concrete Placement – Lift and Fall Heights

CONCRETE PLACEMENT LIFT HEIGHTS

Concrete placement is recommended in 4 feet lift heights. This does not mean that the concrete cannot be placed greater than 4 feet in height. The concrete is typically placed in a continuous operation in multiple lifts - two, three or four lifts, by making continuous passes around the perimeter or section of the wall to achieve the full height required.

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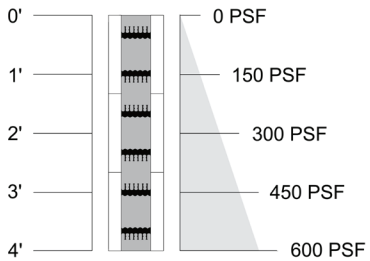
Fox Blocks concrete mix design has a high slump of 5" to 6". Refer to Technical Bulletin 1.06.01



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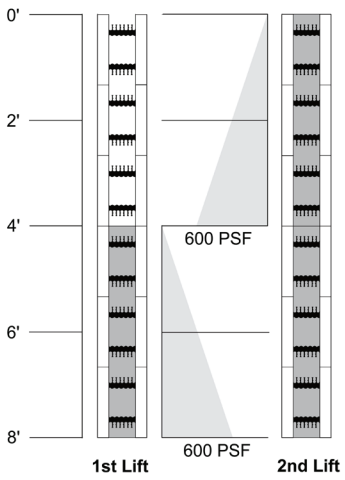

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Restricting free-fall heights, decreases concrete production rates, which increases owners' costs without increasing concrete quality.

Water (Weather) Resistive Barrier

GENERAL OVERVIEW

Building codes specify that exterior walls require a weather resistant exterior wall envelope that is designed and constructed to prevent the accumulation of water within the wall assembly. The exterior wall has a finishing material or veneer that is the first layer of protection, but the codes require a secondary, specific layer or membrane as a water (weather)-resistive barrier (WRB) to provide continuous protection for the envelope.

The intended purpose of a specifically designed membrane as a WRB is to prevent water and/or to resist water and air from penetrating the envelope. In cavity wall construction (wood or steel framing), any breach that allows exterior water in the cavity will result in the deterioration of the assembly.

FOX BLOCKS TESTING

A Fox Blocks wall assembly is comprised of an exterior and interior layer of continuous EPS insulation (2⅝" thick each side) over a monolithic concrete core. In all applications the exterior face of the ICF wall assembly is covered with some form of exterior finish, which is either directly applied over the EPS to the Fox Blocks fastening strips or installed as veneer, like brick and masonry.

Fox Blocks third party testing, per ASTM E2634 and ASTM E331, for water tightness under a specified pressure differential and a water spray rate of a least 8" of rain per hour for 2 hours resulted in no water leakage.

Another test for air tightness ASTM E283 tabled that the Fox Blocks wall assembly bested code minimum requires for air infiltration.

Refer to Technical Bulletin
1.12.01 Air Barrier

FOX BLOCKS ADVANTAGE

A Fox Blocks wall assembly is not classified as a cavity wall type of construction but is recognized as a mass wall assembly. The materials - EPS and concrete, are not prone to any degradation in performance or deterioration from any possible water or moisture intrusion from the exterior or interior.

Fox Blocks EPS does not absorb water or moisture and will not degrade as part of a finished wall assembly. Any water or moisture that would possibly penetrates the exterior finish will drain down the face of the EPS layer. All openings require perimeter flashing installed on all sides.

Refer to Technical Bulletin
1.02.16 Window Flashing

Water (Weather) Resistive Barrier

Third party testing has shown that the Fox Blocks wall assembly itself provides a water and air resistive barrier.

No additional WRB membrane is required over a Fox Blocks wall assembly.

In the applications of some exterior finishes, that provide a warranty, the application of a WRB may be required to satisfy the warranty. In most applications over a Fox Blocks wall assembly this may not be required. Check with product manufacture.

Refer to Technical Bulletin 1.12.06 Indoor Air Quality

Concrete Pre-Placement Checklist

PRE-PLACEMENT OF CONCRETE PROCEDURES

Prior to placing concrete, it is very important to follow a checklist to ensure everything has been installed correctly, walls are supported, strapped as required and the crew is ready. Once you begin to place concrete you are committed to keep going without distractions until the concrete placement is to the desired height.

The following is an enhancement of the Fox Blocks Installation Checklist and is recommended to be reviewed prior to placing concrete:

PRE-PLACEMENT CHECKLIST:

- ☐ Review weather for favorable forecast on placement day
- ☐ Follow correct procedures for above normal hot or cold weather concrete placement
- ☐ Is site clear and prepared for concrete trucks and pump truck
- ☐ Does rebar installation require inspection approval prior to concrete placement
- ☐ Check concrete volumes, set delivery times and co-ordinate lead time for pump truck set-up
- ☐ Ensure the pump boom is safe from overhead hazards and the boom can reach all the walls
- ☐ Establish with pump truck operator concrete placement direction, lift heights, speed of placement and co-ordinate communication signals
- ☐ Does pumptruck have a reducer
- ☐ Review all wall dimensions per plan requirements
- ☐ Has additional support and strapping been installed at stacked joints, any laps 8” or less, or where required (both sides of wall if required)
- ☐ Is rebar installed per plans and specifications in correct locations to top of wall
- ☐ Do all the lintels over openings have the specified reinforcing and, if needed, stirrups installed
- ☐ Check alignment/bracing is secure and the scaffold planks provide a clear, continuous and safe walkway around the whole perimeter for all walls
- ☐ Are all opening bucks supported and is the sill open for concrete placement
- ☐ If wood bucks are used, is there proper anchorage into the concrete
- ☐ Embedments, anchor bolts and floor system connectors installed and ready to be set in concrete

Print and use this Fox Blocks checklist and have all members of the crew be aware of the checks.

Refer to the following checklists:
1.02.01 Fox Blocks Installation Checklist
1.14.05 Step by Step Project Checklist
1.14.07 Concrete Post Placement Checklist

Cold joints are not permitted in foundation walls supporting backfill.

Keys to a successful concrete placement is pre-planning and having everyone involved understand methods and procedures.

Ensure your concrete volumes and order is adequate, co-ordinate the timelines in ordering material, pump truck requirements.

Plan crew time allocations for concrete placement, consolidation and clean-up.

- ☐ Check all service penetrations sleeves are installed and, if needed, supported
- ☐ Beam pockets installed and secured
- ☐ String lines installed and ready at top of all walls
- ☐ Use alignment system to straighten walls and adjust walls by tilting inward slightly
- ☐ If block will continue, Is the top block interlock protected with tape, from concrete spillage
- ☐ Check interior of wall cavity is clear of any debris, snow or ice
- ☐ Are dowels or anchor bolts ready for wet set installation into top of wall for cold joint or sill plate
- ☐ Are concrete tools ready – towel, check vibrator, batteries or extension cords
- ☐ Check that vibrator can reach all walls
- ☐ Have materials ready in the event of a problems – buckets, shovels, screws, drill, and plywood
- ☐ Review tasks with crew members, who is doing what during concrete placement and consolidation, plus safety procedures
- ☐ Have gloves and eye protection for crew members installing and consolidating concrete
- ☐ Walk around the project, inside and outside, to view both sides of every wall to make sure everything is ready
- ☐ Check that the concrete mix meets specs for strength, slump and aggregate size

SUMMARY

This checklist should become a best practice procedure before any concrete is placed. The more attention to these details means fewer problems, better efficiency and a safer build during this busy stage of placing and consolidating concrete in the Fox Blocks wall assemblies.

Add to the checklist as required

Refer to Technical Bulletin 1.14.07 Concrete Post-Placement Checklist

Refer to Fox Blocks website Resource Center and YouTube video library for more information

LISTING INFORMATION OF Fox Block Insulating Concrete Forms (Fox Block ICFs)

SPEC ID: 32745

Fox Blocks, a Division of Airlite Plastics Co.
6110 Abbott Drive
Omaha, NE, 68110-2805
USA

Fox Block ICFs are Insulated Concrete Form (ICF) systems that are formed of expanded polystyrene with polypropylene plastic cross-ties. Fox Block ICFs are pre-assembled ICF forms with a reversible, interlocking connection design. The systems are available in the following sizes and configurations:

- 4" Straight
- 4" 90° Corner
- 4" 45° Corner
- 6" Straight
- 6" 90° Corner
- 6" 45° Corner
- 6" Corbel Ledge
- 6" Taper Top
- 6" T-Block (Short)
- 6" T-Block (Long)
- 6" Radius Blocks (5',6',7',8',9' &10')
- 8" Straight
- 8" 90° Corner
- 8" 45° Corner
- 8" Corbel Ledge
- 8" Taper Top
- 8" T-Block (Short)
- 8" T-Block (Long)
- 8" Curb Block
- 10" Straight
- 10" 90° Corner
- 12" Straight
- 12" 90° Corner

RATINGS

Product/Assembly	Standard	Rating (if applicable)
Fox Block ICFs	ASTM E119	Design no. FXB/ICF 240-01
	CAN/ULC S101	
	ASTM E2634, including: ASTM C578 (EPS) ASTM D635 (cross-tie) ASTM D638 (cross-tie) ASTM D732 (cross-tie) ASTM D1761 (cross-tie) ASTM D1929 (cross-tie) ASTM E84 (EPS) UL 1715 (ICF)	Type II EPS CC1 classification Min. tensile strength: 32.3 kN/m^2 (675 lb/ft^2) Min. shear strength: 3080 psi Refer to Table 2 of IRR-1010 Min. Ignition Temp. 350°C (662°F) FS ≤ 25, SD ≤ 450 Meets ASTM E2634 Section 6.3.1
	ICC-ES AC353	IRR-1010

	ASTM E283 (4” ICF)	Max air infiltration 0.02 cfm/ft^2
	ASTM E331 (4” ICF)	No water leakage after 2 hours; 15 psf pressure differential
	CAN/ULC S717.1, including: CAN/ULC S701 (EPS) ASTM D635 (cross-tie) ASTM D638 (cross-tie) ASTM D732 (cross-tie) ASTM D1761 (cross-tie) ASTM D1929 (cross-tie)	 Type 2 EPS CC1 classification Min. tensile strength: 32.3 kN/m^2 (675 lb/ft^2) Min. shear strength: 3080 psi Refer to Table 2 of IRR-1010 Min. Ignition Temp. 350°C (662°F)

MANUFACTURING LOCATIONS

The following facilities are certified to manufacture Fox Block ICFs that comply with the ratings described in IRR-1010 and the table in the section above.

Airlite Plastics Co. 525 Kansas Avenue Omaha, NE 68110 USA	APTCO LLC 31381 Pond Road MacFarland, CA 93250 USA
Poly Foam Corporation 2355 Providence Road PO Box 906 Northbridge, MA 01534 USA	Tegrant Diversified Brands 1100 Garden of the Gods Rd Colorado Springs, CO 80907 USA
FMI-EPS, LLC (Post Falls) 9456 N McGuire Road Post Falls, ID 83854 USA	Cellofoam NA Inc. 11237 Astronaut Blvd Orlando, FL 32837 USA
FMI-EPS, LLC (Jerome) 280 Rose Street Jerome, ID 83338 USA	Polymos Inc. 3333 F.X. Tessier, Vaudreuil-Dorion, QC J7V 5V5 Canada
Modern Polymers Inc LLC 901 West Academy Cherryville, NC 28021 USA	EPS Molders Inc. Box 4, Site 1, RR 4 Ponoka, AB T4J 1R4 Canada

Schaumaplast Foam Molders LP 21 N.39th Avenue Phoenix, AZ 85009 USA	HW Manufacturing Inc. Mile Ten Road Starbuck, MB R0G 2P0 Canada
Insulfoam 628 Western Drive Anchorage, AK 99501 USA	

The following facility is under Intertek inspection for the quality control of the Fox Blocks Cross-Ties:

Airlite Plastics Co. 6110 Abbot Drive Omaha, NE 68110 USA

Attribute	Value
Code Reports	Yes
Criteria	CAN / ULC S701 (2005)
Criteria	ASTM E283 (2004)
Criteria	CAN / ULC S101 (2007)
Criteria	ASTM C578 (2008)
Criteria	ICC-ES AC353 (2007)
Criteria	ASTM E331 (2009)
Criteria	ASTM C578 (2009e1)
Criteria	ASTM E119 (2010)
Criteria	CAN / ULC S701 (2011)
Criteria	ASTM C578 (2010a)
Criteria	ASTM C578 (2011)
Criteria	ASTM C578 (2012)
Criteria	CAN/ULC S717.1 (2012)
Criteria	ASTM E2634 (2011)
CSI Code	03 10 00 Concrete Forming and Accessories
Intertek Services	Certification
Listed or Inspected	LISTED

Listing Section	CONCRETE FORMS
Report Number	3103050; 3103255; 3114608; 3182745; 3186516; 3193147; 3193149; 100061415; 100146783; 100155912; 100412773; 100546682; 100675099COQ; 100756430MID; 100955609COQ; 100749979COQ; 101217382COQ; 101240281COQ; 101463741COQ; 101539455COQ
Spec ID	32745

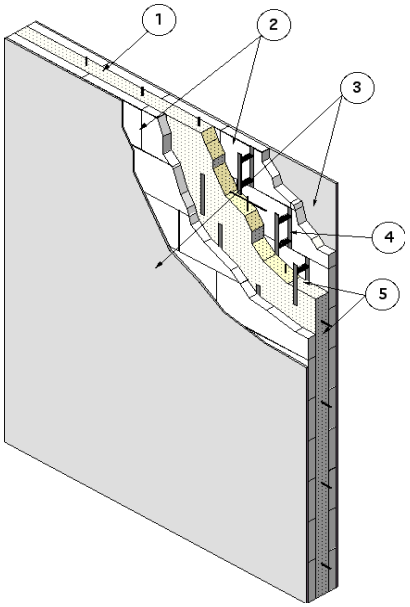
DRAWING INDEX

2013-06-24 Fox Blocks 100546682 FXB - ICF 240-01

2013-06-24 Fox Blocks 100546682 FXB - ICF 240-01

Division 03 – Concrete
03 11 00 Concrete Forming
03 11 19 Insulating Concrete Forming

Design Number FXB/ICF 240-01
FOX BLOCK INSULATED CONCRETE FORMS
Fox Blocks, a Division of Airlite Plastics Co.
ASTM E119-11a
ULC / CAN S101-07
Fire Rating Only - Load Rating Not Within The Scope Of This Listing
Assembly Rating – 2, 3 and 4 hours



FORMED WALL THICKNESS	MAX FIRE RATING
4 in. (102 mm)	2 Hour
6 in. (152 mm)	4 Hour
8 in. (203 mm)	4 Hour
10 in. (254 mm)	4 Hour
12 in. (305 mm)	4 Hour

1. CONCRETE: Pour normal weight concrete (density typically between 145-155 pcf) having a minimum 21 MPa (3,000 psi) nominal compressive strength into the forming system (Item 2).
2. CERTIFIED MANUFACTURER: Airlite Plastics Co.

CERTIFIED PRODUCT: Fox Block Insulated Concrete Forms (ICF)

FORMING SYSTEM: The Fox Block ICF forming system consists of Type 2 (CAN/ULC S701) or Type II (ASTM C578) molded expanded polystyrene (EPS) foam panels with embedded polypropylene ties that come

Date Revised: June 26, 2013
Project No: 100546682

2013-06-24 Fox Blocks 100546682 FXB - ICF 240-01 (page 2 of 2)

preassembled as blocks and are produced in nominal concrete core widths of 4 in. (102 mm), 6 in. (152 mm), 8 in. (203 mm), 10 in. (254 mm), and 12 in. (305 mm) widths. The Fox Block ICFs are produced in 48 in. length x 16 in. height (1220 mm x 410 mm) for all core thicknesses. All Fox Block ICF products have an EPS panel thickness of 2-5/8 in. (66.7 mm). The top and bottom of the EPS panels have an interlocking system which aligns the forms together as they are stacked together. Fox Block ICF systems have polypropylene ties spaced at 8 in. (203 mm) on center (oc) in the cavity of the ICF that include flanges acting as furring strips for mechanical fastening.

3. SHEATHING AND EXTERIOR FINISHES (OPTIONAL): Not required for the fire resistance ratings described in this listing.

   An approved thermal barrier may be installed subject to the requirements of the applicable Building Code.

   When desired, exterior finishes may be applied to the exterior side of the forming system (Item 2) wall assembly without diminishing the assembly rating. Exterior Insulation Finish System (EIFS), any exterior stucco, brick or brick veneer, stone or stone veneer, cultured stone and siding made from vinyl, aluminum, wood, or steel may be used. Apply exterior finishes in accordance with the manufacturer's instructions.

4. POLYPROPYLENE FORM TIES: Each 48 in. (1220 mm) of length, Fox Block ICF have six polypropylene ties. The polypropylene ties are spaced nominally 8 in. (203 mm) oc. The polypropylene ties are open to allow concrete to flow easily, and to allow seating for the placement of horizontal and vertical rebar placement.

5. STEEL REINFORCEMENT: Place the steel reinforcement before filling the forming system with concrete (Item 1). The rebar used is to be designed and placed per the applicable code requirements and approved by a registered design professional with the appropriate license for the Authority Having Jurisdiction.

6. WALL ASSEMBLY: The Fox Block ICF wall assembly may be used as either an interior or exterior wall. ICFs exposed to the interior of a building shall have a thermal barrier (item 3) attached. Exterior walls are only required to have a thermal barrier on the side facing the interior of the building. The fire resistance rating is applicable to the Fox Block ICF wall assembly from either side.

Expansion of Wetted Plywood and OSB Panels

By Felix Martin, S.E.

Winter's rains provides the opportunity to examine problems caused by expansion of OSB and plywood wood panels due to excessive moisture. Design engineers tend to think of the structure as a finished product and sometimes give little attention to structural problems that may arise in the construction process.

With flat roofs (or floors exposed to weather), during extended periods of exposure to rain, wood sheathing that has not been roofed or covered has an opportunity to be kept constantly wet. Once this happens water will be absorbed by the sheathing, resulting in thickness swell and linear expansion of the sheets.

Concern has typically been focused on increases in the thickness of the panel. In plywood sheets, as the panel expands in thickness, nail heads are pulled through and, in extreme cases, punch through the top ply, rendering the panel useless in shear. Moisture penetration in plywood panels can also lead to delamination of the plies, despite the widespread use of exterior grade glues.

"OSB also tends to larger thickness swells than plywood,..."

In the case of Oriented Strand Board (OSB), thickness swell primarily occurs along panel edges. This is because of capillary action at end grain fibers, although OSB panels are typically surface and end sealed. OSB also tends to larger thickness swells than plywood, due to the use of a more porous wood product and to the release of compression set from the panel manufacturing process. Once the panel thickness has been expanded by wetness, when back to its original moisture content, it will not completely return to its original thickness.

However, because of the multi-layered and random direction of the wood chips, there is a smaller chance for total nail head punch-through in OSB than plywood. An American Plywood Association (APA) publication (TT-012) provides a suggested guideline for determining whether the shear capacity of a wood diaphragm has been compromised by buried nail heads caused by either overdriving or thickness swell due to moisture. The publication does not address OSB and plywood separately, although nail heads can penetrate completely through the face layer of three-ply plywood. OSB really has no definable face layer.

In 1985 the APA performed a series of tests on the effect of wetting OSB shear wall panels (test results were not published by the APA). The research involved performing static load tests on six 7/16-inch thick shear wall panels. Three panels were tested dry. The remaining three panels were wetted by placing them in an almost horizontal position and using a sprinkler to spray the sheathing approximately eight hours per day for three consecutive days. The walls were then allowed to dry approximately two weeks and tested.

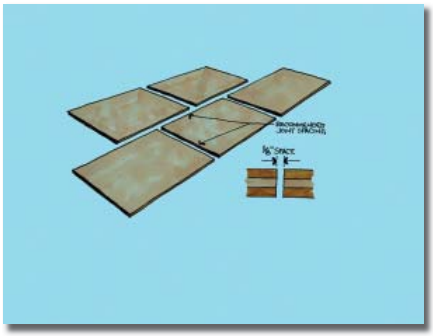
The wetted walls had an average final moisture content of 4-5% after drying, versus an average moisture content of 3-4% for the walls not wetted. The wetted walls showed a slight decrease in ultimate load capacity when compared with the dry walls. They also had increases in total deflection and permanent (residual) set. The decrease in ultimate load capacity plus the increases in total deflection and set were judged by the APA as insignificant enough to conclude that wetting of OSB shear walls, such as by rainfall during construction, did not adversely affect the strength of the walls.

These test results may be extended to horizontal diaphragms to similarly conclude that extended exposure to wetting of OSB horizontal diaphragms will not adversely affect the strength of those diaphragms.

A concern not usually taken into account is the linear expansion of the panel length and width due to moisture infiltration. Some of this expansion is taken up through partial restraint crushing along the fasteners and by panel end crushing; some is taken by allowing a small gap between sheets during installation.

OSB sheets come factory-cut to allow a 1/8-inch installation gap in both directions. The typical installation procedure used by experienced framing contractors is to drop 16d nails between the wood panels. Because 16d nails are approximately 1/8-inch in diameter, this provides a method of automatic spacing between panels.

Testing by the APA (Publication TT-028) has shown that wetted plywood/OSB panels will expand a maximum of ¼-inch in the long direction and 3/16-inch in the short direction. The APA test took the panels from an oven dry condition to complete saturation, conditions not normally encountered in the field where variations in moisture content are not so extreme. Using the APA extreme linear expansion values, for an eighty foot long roof, assuming a ¼-inch linear expansion per eight foot panel length, an average 1/8-inch gap between sheets and an average 1/8-inch fastener/end crushing per panel, would result in a net linear lengthening of the roof of zero.



However, personal experience has suggested field net linear expansion values may be larger than those calculated above. This may have been due partially to installation procedures that may have placed the panels without the 1/8-inch gap between sheets, although this alone would not account for the extent of the discrepancies observed. The APA acknowledges the potential problem in Research Report 144, by addressing the buckling potential of structural panels resulting from linear expansion. Buckling of panels from linear expansion is more likely to occur in structures restrained from lateral expansion.

A net linear expansion in laterally unrestrained diaphragms is the type of thing that pulls walls and columns out of plumb. This is more likely to happen if the linear expansion occurs in construction when the shear walls may not yet be in place; or if one end of the building is laterally restrained and the other end is free to expand. Once linear expansion has taken place, as explained before, it will not completely shrink back to its original dimensions when the sheets dry again. In other words, walls and columns stay out of plumb and may have to be forced to their original state through expensive and time-consuming mechanical means.

from experience

It is important to recognize damage due to linear expansion once it occurs, as problems associated with it can be easily misdiagnosed. Damage may first be observed in walls and columns previously installed plumb. These may be subsequently observed to be out-of-plumb following exposure of the roof plywood to rain days to a few weeks prior. Positive proof that linear expansion has taken place may be found in tight-fitting horizontal panels with crushed edges. This will indicate panel expansion has taken place, with no available expansion relief possible.

Moisture exposure is not limited to areas of high rainfall. Where the conscientious contractor covers the sheathing with plastic, the sheathing may be soaked continuously over an extended period of time even in low moisture areas. Though the plastic keeps moisture away for short periods of time, rain lasting a few days water will leak in along joints or tears in the plastic. Moisture will then be retained by the very plastic intended to keep it out.

The APA has in the past espoused the use of expansion joints in wood sheathed roofs and floors over eighty feet in length. A temporary expansion joint may be used in the middle field of a long roof when extended periods of moisture are expected or just simply included as a general specification for roof lengths eighty feet and beyond. Once the horizontal sheathing is ready to be waterproofed, the "fill-in" panels can be installed just before roofing is applied.

Although not specifically a design concern, the potential problems associated with thickness swell and linear expansion due to moisture intrusion during construction are worth considering by the design engineer. The inclusion of temporary expansion joints for long roofs or for wet weather may well avoid the possibility of frantic field calls, construction delays and expensive repairs. Anything done to assist a project to be trouble-free during construction is usually time well spent.▪

Felix Martin has a BS and a MS in Engineering from the California State University at Long Beach. He is owner and principal engineer of Marcon Forensics, a structural forensics firm with offices in Laguna Beach, CA and Las Vegas, NV.

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LISTING INFORMATION OF

Fox Blocks Compact Insulating Concrete Forms

SPEC ID: 26976

Fox Blocks, a Division of Airlite Plastics Co.
6110 Abbott Drive
Omaha, NE 68110-2805

Fox Blocks Compact ICFs are Insulated Concrete Form (ICF) systems that are formed of expanded polystyrene with polypropylene plastic cross-ties. Fox Blocks Compact ICFs are pre-assembled ICF forms with a reversible, interlocking connection design. The systems are available in the following sizes and configurations:

- 4” Straight
- 4” 90° Corner
- 4” Taper Top
- 6” Straight
- 6” 90° Corner
- 6” 45° Corner
- 6” Corbel Ledge
- 6” Taper Top
- 8” Straight
- 8” 90° Corner
- 8” 45° Corner
- 8” Corbel Ledge
- 8” Taper Top
- 10” Straight
- 10” Corbel Ledge
- 10” Taper Top
- 12” Straight
- 12” Corbel Ledge
- 12” Taper Top

"Webex" cross-tie extenders can be used to connect cross-ties to form 14", 16", 18", 20", 22", or 24" thick cavities within forms.

RATINGS ACHIEVED

Product/Assembly	Standard	Rating (if applicable)
Fox Blocks Compact ICF	ASTM E119	Design no. FXB/ICF 180-01
	CAN/ULC S101	
	ICC-ES AC353 (2012) ASTM C578 (EPS) ASTM D635 (cross-tie) ASTM D1761 (cross-tie) ASTM D1929 (cross-tie) ASTM E84 (EPS) UL 1715 (ICF)	CCRR-1013 Type II EPS CC2 classification Refer to Table 2 of CCRR-1013 Min. Ignition Temp. 350°C (662°F) FS ≤ 25, SD ≤ 450 Meets AC353 (2012) Section 3.4

CODE COMPLIANCE RESEARCH REPORT

Evaluation Method	Building Code	CCRR Number

ICC-ES AC353	2009 and 2006 IBC 2009 and 2006 IRC	CCRR-1013

Attribute	Value
Code Reports	Yes
Criteria	CAN / ULC S101 (2007)
Criteria	ASTM C578 (2008)
Criteria	ICC-ES AC353 (2007)
Criteria	ASTM C578 (2009e1)
Criteria	ASTM E119 (2010)
Criteria	ASTM C578 (2010a)
Criteria	ASTM C578 (2011)
Criteria	ASTM E119 (2012)
Criteria	ASTM C578 (2012)
Criteria	ICC-ES AC353 (2012)
Criteria	CAN / ULC S101 (2014)
Criteria	ASTM E119 (2016a)
CSI Code	03 10 00 Concrete Forming and Accessories
Intertek Services	Certification
Intertek Services	Code Compliance Research Report
Listed or Inspected	LISTED
Listing Section	CONCRETE FORMS
Report Number	491-7808; 481-1431; 3140509; 3182745; G100067916; G100155912; G100675099; G100756430; G101572919; G102879340
Spec ID	26976

DRAWING INDEX

CCRR-1013
FXB-ICF 240-02

CCRR-1013

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Code Compliance Research Report
CCRR-1013

Revision Date: 09-08 2017
Renewal Date: 01-01-2018

DIVISION: 03 00 00—CONCRETE
Section: 03 11 19—Insulating Concrete Forming

REPORT HOLDER:
Airlite Plastics Co.
6110 Abbott Drive
Omaha, Nebraska 68110
(402) 341-7300 or (402) 408-5032
www.foxblocks.com

REPORT SUBJECT:
Fox Blocks Compact Insulating Concrete Forms (ICFs)

1.0 SCOPE OF EVALUATION

This Research Report addresses compliance with the following Codes:

- 2015, 2012, and 2009 *International Building Code®* (IBC)
- 2015, 2012, and 2009 *International Residential Code®* (IRC)

NOTE: This report references 2015 Code sections with [2012, 2009] Code sections shown in square brackets where they differ.

The Fox Blocks Compact ICF system has been evaluated for the following properties:

- Physical properties
- Surface-burning characteristics
- Attic and crawl space fire evaluation
- Fire-resistance-rated construction
- Exterior walls in Types I, II, III, and IV construction

See Table 1 for applicable Code sections related to these properties.

2.0 USES

Fox Blocks Compact insulating concrete forms (ICFs) are used as stay-in-place formwork for structural concrete load-bearing and non-loadbearing exterior and interior walls, concrete beams, lintels, foundation walls, and retaining walls. The forms may be installed in attics and crawl spaces without a covering on the interior side when installed in accordance with Section 4.3.2. The forms may be used in fire-resistance-rated construction, provided installation is in accordance with Section 4.8. The forms may be used in Types I, II, III, or IV (noncombustible) construction provided installation is in accordance with Section 4.9.

3.0 DESCRIPTION

3.1 General:

The Fox Blocks Compact ICFs consist of two 2.625 inch thick (66.7 mm) expanded polystyrene (EPS) foam plastic panels, and injection-molded polypropylene plastic cross-ties that are connected at the job site to "grippers", which are molded into the EPS panels. The cross-ties maintain the EPS panel facings at a clear distance of 4 inches, 6 inches, 8 inches, 10 inches, or 12 inches. If a larger cavity is desired, a polypropylene web extension gripper is used to connect two cross-ties to form 14-, 16-, 18-, 20-, 22-, or 24 inch wide cavities. The Fox Blocks Compact ICF system is a flat ICF system as defined in IRC Section R608.3 [R611.3]. In addition to straight forms, corbel ledge, and taper top forms are also available. See Figure 1 for illustrations of the forms.

3.2 Foam Plastic Panels:

The EPS foam plastic panels have a nominal density of 1.5 pcf, a flame-spread index of 25 or less and a smoke-developed index of 450 or less when tested in accordance with ASTM E84. The foam plastic complies with Type II requirements when tested in accordance with ASTM C578.

3.3 Cross-ties:

The polypropylene cross-ties connect the EPS panels at a fixed clear distance. The cross-ties fit into polypropylene grippers, have openings to permit concrete placement, and have slots to support horizontal steel reinforcing bars. The cross-ties and grippers are spaced horizontally at 8 inches on center. The plastic flange of the polypropylene grippers, which is recessed 0.625 inches below the outer EPS surface, is used to attach exterior and interior finish materials. The flange is 1.44 inches wide by 16 inches high by 0.23 inch thick.

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3.4 Concrete:

Concrete must be normal-weight concrete complying with the IBC, with a maximum 3/4 inch aggregate size. Concrete must have a minimum compressive strength of 3000 psi at 28 days. Under the IRC, concrete must comply with IRC Sections R404.1 (foundation walls and retaining walls) and R608.5.1 [2012, 2009 – 611.5.1] (walls), as applicable.

3.5 Reinforcement:

Deformed steel reinforcement bars must have a minimum yield stress of either 40 ksi or 60 ksi, depending on the structural design. Under the IBC, the deformed steel bars must comply with Section 3.5.3.1 of ACI 318 and IBC Section 1903. If construction is based on the IRC, reinforcement must comply with IRC Sections R404.1.3.3.7 [2012, 2009 – R404.1.2.3.7] (foundation walls and retaining walls) and R608.5.2 [2012, 2009 – 611.5.2] (walls).

4.0 INSTALLATION

4.1 General:

Design and installation of the Fox Blocks Compact ICFs must comply with this report, the applicable Code, and the manufacturer's published installation instructions, which must be available on the jobsite during installation.

4.2 Design:

4.2.1 IBC Method: Solid concrete walls must be designed and constructed in accordance with IBC Chapter 16 and 19, as applicable. Footings and foundations must be designed in accordance with IBC Chapter 18.

4.2.2 Alternative IBC Wind Design Method: Solid concrete walls may be designed and constructed in accordance with the provisions of Section 209 of ICC 600, subject to the limitations found in IBC Section 1609.1.1.1 in accordance with Exception 1 to Section 1609.1.1.1. Design and construction under the provisions of ICC 600 are limited to resisting wind forces.

4.2.3 IRC Method: Solid concrete walls, footings and foundations must be designed in accordance with IRC Sections R608 [R611] and R404.1.3 [2012, 2009 – 404.1.2], as applicable for flat wall systems.

4.2.4 Alternative IRC Methods: When used to construct buildings that do not conform to the applicability limits of IRC Sections R404.1.3 [2012, 2009 – R404.1.2] and R608.2 [R611.2], construction must be in accordance with the prescriptive provisions of the 2007 Prescriptive Design of Exterior Concrete Walls (PCA 100), or the structural analysis and design of the concrete must be in accordance with ACI 318, ACI 332 and IBC Chapters 16, 18 and 19. For jurisdictions adopting the 2006 IBC the structural analysis and design of the concrete must be in accordance with ACI 318 and IBC Chapter 19 as applicable.

4.3 Interior Finish:

4.3.1 General: ICF units exposed to the building interior must be finished with an approved 15-minute thermal barrier, such as minimum 1/2 inch thick regular gypsum wallboard complying with ASTM C1396, installed vertically or horizontally, and attached to the cross-tie flanges with minimum 1-1/2 inch long, No. 6, Type S, fine-thread gypsum board screws spaced a maximum of 12 inches on center vertically and 16 inches on center horizontally. The screws must penetrate a minimum of 1/4 inch through the flange. Gypsum board joints and screw heads must be taped and finished with joint compound in accordance with ASTM C840 or GA216. See Section 4.3.2 for installation details for crawl space applications without an ignition barrier on the interior face.

4.3.2 Attic and Crawl Space Installations: When the ICFs are used for walls of attic or crawl spaces, an ignition barrier complying with IBC Section 2603.4.1.6, or IRC Sections R316.5.3 or R316.5.4, is required, except when all of the following conditions are met:

- Entry to the attic or crawl space is only to service utilities, and no storage is permitted.
- There are no interconnected attic or basement areas.
- Air in the attic or crawl space is not circulated to other parts of the building.
- Under-floor (crawl space) ventilation is provided that complies with IBC Sections 1203.3 or IRC Section R408.1, as applicable.
- Attic ventilation is provided when required by IBC Section 1203.2 or IRC Section R806, as applicable.
- Combustion air is provided in accordance with IMC (*International Mechanical Code*) Section 701.
- The ICFs must have at least one label (described in Section 7.0) visible in every 160 square feet of wall area.

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4.4 Exterior Finish:

4.4.1 Above Grade: The exterior surface of the ICF must be covered with an approved wall covering in accordance with the applicable Code or a current evaluation report. A water-resistant exterior wall envelope is not required for concrete walls complying with IBC Section 1403.2, Exception 1 and IRC Section R703.1.1, Exception 1. Concrete walls are deemed to comply with the air barrier requirements of IECC Section C402.4 and R402.4 provided joints are sealed.

When the wall covering is mechanically attached to structural members, the wall covering must be attached to the flanges of the embedded cross-ties with fasteners, described in Table 2, having sufficient length to penetrate through the flange a minimum of 1/4 inch. The fasteners have an allowable fastener withdrawal and lateral shear strength as noted in Table 2.

The fastener spacing must be designed to support the gravity loads of the wall covering and to resist the negative wind pressures. The negative wind pressure capacity of the exterior finish material must be the same as that recognized in the applicable Code for generic materials, or that recognized in a current evaluation report for proprietary materials and must not exceed the maximum withdrawal capacity of the fasteners listed in Table 2.

4.4.2 Below Grade: Materials used to dampproof or waterproof basement walls must be acceptable to Airlite Plastics Co., the designer or the contractor, and must comply with the applicable Code or a current evaluation report. The material must be compatible with the ICF foam plastic units, and free of solvents that will adversely affect the EPS foam plastic panels. Dampproofing, waterproofing and drainage requirements must comply with the applicable Code. No backfill may be applied against the wall until the complete floor system is in place or the wall is adequately braced, unless the wall is designed as a freestanding wall that does not rely on the floor system for structural support.

4.5 Foundation Walls:

The ICF system may be used as a foundation stem wall when supporting wood-framed construction, provided the structure is supported on concrete footings complying with the applicable Code. For jurisdictions adopting the IRC, compliance with Section R404 is required. For jurisdictions adopting the 2006 IBC, compliance with Section 1805.5 is required.

4.6 Retaining Walls:

The ICF system may be used to construct retaining walls, with reinforcement designed in accordance with accepted engineering principles, Section 4.2 of this report and the applicable Code.

4.7 Protection Against Termites:

Where the probability of termite infestation is defined by the Code official as "very heavy", the foam plastic must be installed in accordance with IBC Section 2603.8 [2012 – 2603.9] or IRC Section R318.4, as applicable. Areas of very heavy termite infestation must be determined in accordance with IBC Figure 2603.8 or IRC Figure R301.2(6).

4.8 Fire-resistance-rated Construction:

The ICFs may be used to construct fire-resistance-rated wall assemblies as described in Intertek Design Listing FXB/ICF 240-02. See Intertek Listing "Fox Blocks Compact Insulating Concrete Forms" at https://bpdirectory.intertek.com for current details.

4.9 Use in Buildings Required to be of Types I, II, III, and IV Construction:

4.9.1 General: Exterior walls constructed with the ICFs for use in buildings required to be of Type I, II, III, or IV construction must comply with the applicable conditions cited in Sections 4.9.2 through 4.9.4.

4.9.2 Interior Finish:

4.9.2.1 Buildings of Any Height: The ICFs must be finished on the interior with an approved 15-minute thermal barrier, such as 1/2 inch thick gypsum board, as required by the IBC. The gypsum board must be installed and attached as described in Section 4.3.1.

4.9.2.2 Alternate Interior Finish for One-story Buildings: For one-story buildings, the interior finish may be in accordance with IBC Section 2603.4.1.4, provided all the conditions in that section are met.

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4.9.3 Exterior Finish:

4.9.3.1 Buildings of Any Height: The ICFs must be finished on the exterior with materials described in Sections 4.9.3.1.1, 4.9.3.1.2, 4.9.3.1.3, and 4.9.3.1.4. The ICFs must have at least one label as described in Section 7.0 visible in every 160 square feet of wall area prior to applying the wall covering.

4.9.3.1.1 Exterior Finish – EIFS and One-coat Stucco: EIFS and one-coat stucco wall coverings may be applied over the ICF, provided the wall covering system is recognized in a current evaluation report and is recognized for use in Types I, II, III and IV construction. The wall covering system must be installed in accordance with the respective evaluation report and the maximum mass per wall surface area [lbs/ft^2] qualified in the wall covering evaluation report must be greater than 0.361 lbs/ft^2 (which is the max-tolerance mass of the EPS panel on the exterior side of the concrete wall). Acceptable EIFS wall coverings include the following:

- BASF Corporation Acrocrete Acrowall-ES EIFS as described in ESR-2164;
- BASF Corporation Finestone Pebbletex EIFS as described in ESR-2165;
- Sto Corp. StoTherm Essence as described in ESR-1720.

4.9.3.1.2 Exterior Plaster: Exterior plaster must comply with the applicable Code, and the exterior plaster must be a minimum of 7/8 inch thick. The lath must be attached to the flanges of the cross-ties with fasteners described in Section 4.4.1.

4.9.3.1.3 Exterior Finish – Brick Veneer: Anchored brick veneer must be attached to the flanges of the cross-ties with fasteners as described in Section 4.4.1. The 4 inch thick (102 mm) brick veneer must comply with the IBC and must be installed with a minimum 1 inch air gap between the face of the exterior EPS panel and the brick. The brick must be installed with a steel shelf angle attached to the concrete and installed at each floor line and at the top of each window and door opening.

4.9.3.1.4 Other Exterior Wall Coverings: Other wall coverings must be demonstrated to the satisfaction of the building official as meeting the requirements of IBC Section 2603.5. Assemblies tested in accordance with NFPA 285 must include EPS having a maximum mass per wall surface area (in lbs/ft^2) greater than 0.361 lbs/ft^2 (1.76 kg/m^2) (which is the maximum-tolerance mass of the EPS panel on the exterior side of the concrete wall).

4.9.4 Fireblocking: Foam plastic on the interior side of exterior walls and on both sides of interior walls must be discontinuous at floor lines. The intersections must be constructed to prevent the passage of flame, smoke and hot gases from one floor to another.

4.10 Special Inspection:

4.10.1 IBC: Special inspection is required as noted in IBC Section 1705 [1704] for placement of reinforcing steel and concrete, and for concrete cylinder testing. When an EIFS wall covering is applied, special inspection in accordance with IBC Sections 1704 [1704.1] and 1705/16 [2012 – 1705.15, 2009 – 1704.14] is required.

4.10.2 IRC: For walls designed in accordance with Section 4.2.3 or PCA 100 (Section 4.2.4), special inspection is not required. When walls are designed in accordance with the IBC, as described in Section 4.2.4, special inspection is required as described in Section 4.8.1.

5.0 CONDITIONS OF USE

The Fox Blocks Compact Insulating Concrete Forms described in this Research Report comply with, or are a suitable alternative to, what is specified in those Codes listed in Sections 1.0 and 2.0 of this report, subject to the following conditions:

5.1 The ICFs must be manufactured, identified, and installed in accordance with this Research Report, the manufacturer's published installation instructions and the applicable Code. The provisions in this report take precedence over the provisions in the manufacturer's instructions.

5.2 When required by the Code official, calculations showing compliance with the general design requirements of the applicable Code must be submitted to the building official for approval, except where calculations are not required under IRC Section R608.1 [R611.1]. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

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5.3 When required by the Code official, calculations and details showing compliance with IRC Section R608.5.3 [R611.5.3] and R404.1.3.3.6 [R404.1.2.3.6] must be submitted, establishing that the ICFs provide sufficient strength to contain concrete during placement and the cross-ties are capable of resisting the forces created by fluid pressure of fresh concrete. The calculations and details must be prepared by registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.4 The ICFs must be separated from the building interior with an approved 15-minute thermal barrier, except for attic and crawl space construction as described in Section 4.3.2.

5.5 The plastic cross-ties must be stored indoors away from direct sunlight.

5.6 Special inspection must be provided in accordance with Section 4.10 of this report.

5.7 The forms are manufactured by Airlite Plastics Co. in Omaha, NE, and are produced under a quality control program with inspections conducted by Intertek Testing Services NA Ltd. (AA-647).

6.0 SUPPORTING EVIDENCE

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Stay-in-place, Foam Plastic Insulating Concrete Form (ICF) Systems for Solid Concrete Walls (AC353), dated October 2012, editorially revised October 2015.

6.2 Data in accordance with ASTM E2634-11.

6.3 Intertek Listing Report "Fox Blocks Compact Insulating Concrete Forms".

7.0 IDENTIFICATION

The Fox Blocks Compact forms are identified by a marking bearing the report holder's name (Airlite Plastics Co.), the product name, the manufacturing location, the serial number, the Intertek Mark, and the Code Compliance Research Report number (CCRR-1013).

When use in an attic or crawl space without an ignition barrier, as described in Section 4.2.2.2, one label bearing the evaluation report number and the phrase "Acceptable for use in attics and crawl spaces" must be visible in every 160 square feet of exposed exterior wall area.

When use is in buildings required to be of Type I, II, III, or IV construction, one label must be visible in every 160 square feet of wall area.

8.0 OTHER CODES

This section is not applicable.

9.0 CODE COMPLIANCE RESEARCH REPORT USE

9.1 Approval of building products and/or materials can only be granted by a building official having legal authority in the specific jurisdiction where approval is sought.

9.2 Code Compliance Research Reports shall not be used in any manner that implies an endorsement of the product by Intertek.

9.3 Reference to https://bpdirectory.intertek.com is recommended to ascertain the current version and status of this report.

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TABLE 1 – PROPERTIES EVALUATED

PROPERTY	IBC SECTION	IRC SECTION
Physical properties	NA	R404.1.3.3.6.1 [2012, 2009 – R404.1.2.3.6.1; and R608.4.4 [2012, 2009 – R611.3]
Surface Burning Characteristics	2603.3	R316.3 [R316.1]
Attic and crawl space applications	2603.4.1.6 and 2603.9	R316.5.3, R316.5.4 [R316.1] and R316.6
Fire Resistance	703.2	R302.1
Exterior walls in Types I – IV construction	2603.5	NA

TABLE 2 – ALLOWABLE WITHDRAWAL AND LATERAL CAPACITIES OF FASTENERS IN CROSS-TIE FLANGES

FASTENER[1]	ALLOWABLE LOAD CAPACITY (lbf)	
	Lateral	Withdrawal
2-1/2 inch long, No.10 wood screw	68	38
1-5/8 inch long, No. 6 coarse-thread drywall screw	45	29
1-5/8 inch long, No. 6 fine-thread drywall screw	37	32
2 inch long, 0.098 inch diameter ring shank drywall nail	19	16
2 inch long, No. 8 saw tooth-thread exterior deck screw	71	36

[1]Fasteners must be of sufficient length to penetrate through the flange a minimum of ¼ inch

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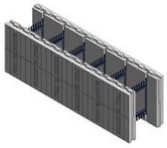
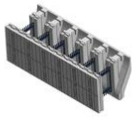


Straight Block

Taper Top

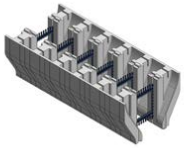


Corbel Ledge

Knock-down Taper Top

Knock-down Corbel Ledge

Double Taper Top



Double Corbel Ledge

Figure 1 – Fox Blocks Compact ICF System Type Illustrations

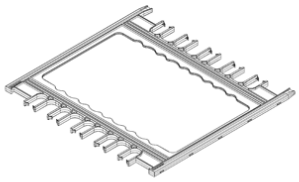


Figure 2 – Fox Blocks Compact ICF System Web Connector

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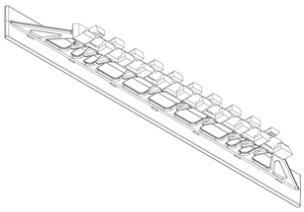

Figure 3 – Fox Blocks Compact ICF System Web Grippers

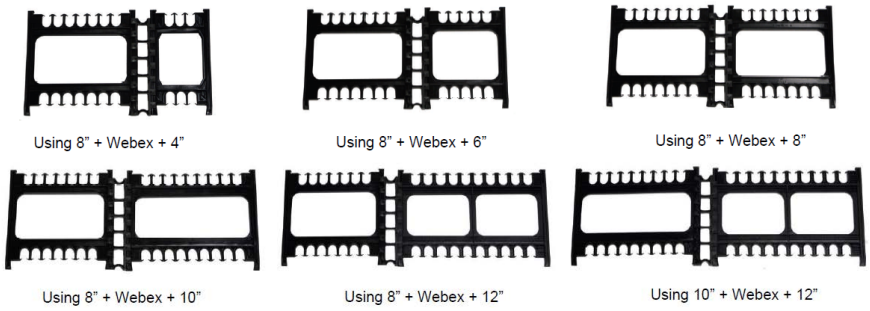

Figure 4 – Fox Blocks Compact ICF System Web Extension Configurations

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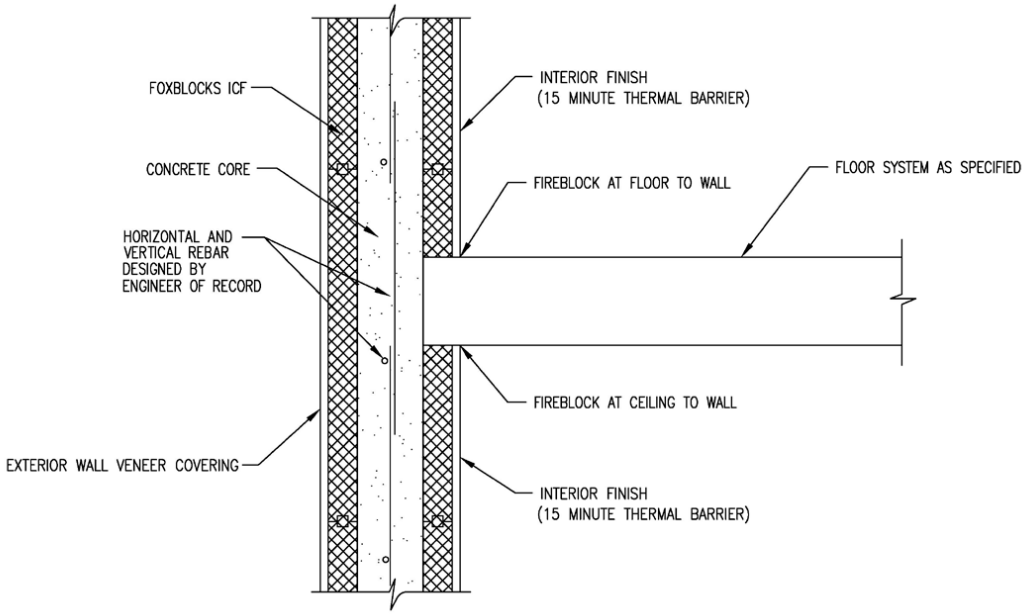

Figure 5 – Typical Wall-to-Floor Intersection for Types I, II, III, and IV Construction

FXB-ICF 240-02

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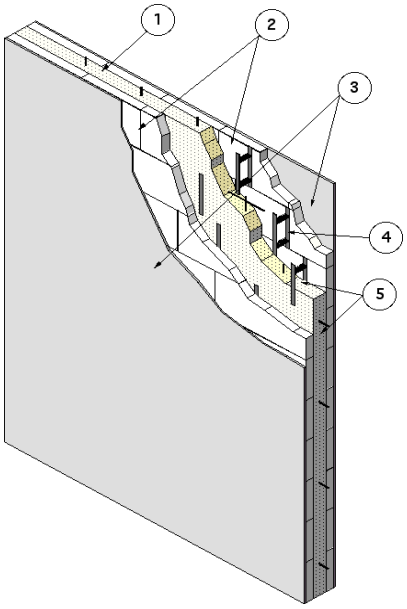
Division 03 – Concrete
03 11 00 Concrete Forming
03 11 19 Insulating Concrete Forming

Airlite Plastics Co.
Design No. FXB/ICF 240-02
Fox Blocks Compact Insulating Concrete Forms
ASTM E119 and CAN/ULC-S101
Fire Rating Only - Load Rating Not Within The Scope Of This Listing
Assembly Rating – 2 and 4 Hour



FORMED WALL THICKNESS	MAX FIRE RATING
4 in. (102 mm)	2 Hour
6 in. (152 mm)	4 Hour
8 in. (203 mm)	4 Hour
10 in. (254 mm)	4 Hour
12 in. (305 mm)	4 Hour

1. **CONCRETE:** Pour normal weight concrete (density typically between 145-155 pcf) having a min. 21 MPa (3,000 psi) nominal compressive strength into the forming system (Item 2).

2. **CERTIFIED MANUFACTURER:** Airlite Plastics Co.

CERTIFIED PRODUCT: Fox Blocks Compact Insulating Concrete Forms (ICF)

FORMING SYSTEM: The Fox Blocks Compact ICF forming system consists of Type 2 (CAN/ULC-S701) or Type II (ASTM C578) molded expanded polystyrene (EPS) foam

FXB-ICF 240-02 (2 of 2)

panels with embedded polypropylene ties that come preassembled to form nominal concrete core thicknesses of 4 in. (102 mm), 6 in. (152 mm), 8 in. (203 mm), 10 in. (254 mm), and 12 in. (305 mm). The Fox Blocks Compact ICFs are produced in 48 in. length x 16 in. height (1220 mm x 410 mm) for all core thicknesses. Fox Blocks Compact ICFs have an EPS panel thickness of 2-5/8 in. (63.5 mm). The top and bottom of the EPS panels have an interlocking system which aligns the forms together as they are stacked. The Fox Blocks Compact ICF system has polypropylene ties spaced at 8 in. (203 mm) on center (oc) in the cavity of the ICF that include flanges acting as furring strips for mechanical fastening.

3. **SHEATHING AND EXTERIOR FINISHES:** An approved thermal barrier must be installed in accordance with the applicable Building Code.

   When desired, exterior finishes may be applied to the exterior side of the forming system (Item 2) wall assembly without diminishing the assembly rating. Exterior Insulation Finish System (EIFS), any exterior stucco, brick or brick veneer, stone or stone veneer, cultured stone, and siding made from vinyl, aluminum, wood, or steel may be used. Apply exterior finishes in accordance with the manufacturer's instructions.

4. **POLYPROPYLENE FORM TIES:** Each 48 in. (1220 mm) of length of Fox Blocks Compact ICFs have six polypropylene ties. The polypropylene ties are spaced nominally 8 in. (203 mm) oc. The polypropylene ties are open to allow the flow around of concrete, and to allow seating for the placement of horizontal and vertical rebar placement.

5. **STEEL REINFORCEMENT:** Place the steel reinforcement before filling the forming system with concrete (Item 1). The rebar used is to be designed and placed per the applicable Code requirements and approved by a registered design professional with the appropriate Authority Having Jurisdiction.

6. **WALL ASSEMBLY:** The ICF (Item 2) wall assembly may be used as either an interior or exterior wall. ICFs exposed to the interior of a building shall have a barrier (Item 3) attached. Exterior walls are only required to have a thermal barrier on the side facing the interior of the building. The fire resistance rating is applicable to the ICF (Item 2) wall assembly from either side.

ACI 117-10
(Reappoved 2015)

Specification for Tolerances for Concrete Construction and Materials (ACI 117-10) and Commentary (ACI 117R-10)

An ACI Standard

Reported by ACI Committee 117

American Concrete Institute®

First printing
June 2010

American Concrete Institute®
Advancing concrete knowledge

Specification for Tolerances for Concrete Construction and Materials and Commentary

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www.concrete.org

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A metric version of this document (ACI 117M-10) is available at **www.concrete.org**

ACI 117-10
(Reapproved 2015)

Specification for Tolerances for Concrete Construction and Materials (ACI 117-10) and Commentary (ACI 117R-10)

An ACI Standard

Reported by ACI Committee 117

Eldon G. Tipping
Chair

Scott Michael Anderson
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Thomas J. Downs	Michael W. Lee	William R. Nash	Bruce A. Suprenant
Ron Eldridge	Michael L. Leming	Bob L. Payne	Michael A. West

Specification synopsis: This specification provides standard tolerances for concrete construction and materials. This document is intended to be used by specification writers and ACI committees writing standards as the reference document for establishing tolerances for concrete construction and materials.

Commentary synopsis: This report is a commentary on the "Specifications for Tolerances for Concrete Construction and Materials (ACI 117)." It is intended to be used with ACI 117 for clarity of interpretation and insight into the intent of the committee regarding the application of the tolerances set forth therein.

Keywords: architectural concrete; concrete; construction; drilled piers; formwork; foundation; mass concrete; pier; prestressed concrete; reinforced concrete; reinforcement; specification; splice; tilt-up concrete; tolerances.

ACI 117 Specification and Commentary are presented in a side-by-side column format, with code text placed in the left column and the corresponding commentary text aligned in the right column. To distinguish the specification from the commentary, the specification has been printed in Helvetica, which is the typeface for this paragraph.

The Commentary is printed in Times Roman, which is the typeface for this paragraph. Commentary section numbers are preceded by the letter "R" to distinguish them from specification section numbers. The commentary is not a part of ACI Specification 117-10.

ACI 117-10 supersedes ACI 117-06 and was adopted March 1, 2010 and published June 2010.

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INTRODUCTION

SPECIFICATION

COMMENTARY

This commentary pertains to "Specifications for Tolerances for Concrete Construction and Materials (ACI 117-10)." The purpose of the commentary is to provide an illustrative and narrative complement to the specification; it is not a part of the specification.

No structure is exactly level, plumb, straight, and true. Tolerances are a means to establish permissible variation in dimension and location, giving both the designer and the contractor limits within which the work is to be performed. They are the means by which the designer conveys to the contractor the performance expectations upon which the design is based or that the project requires. Such specified tolerances should reflect design assumptions and project needs, being neither overly restrictive nor lenient.

Necessity rather than desirability should be the basis of selecting tolerances.

As the title "Specifications for Tolerances for Concrete Construction and Materials (ACI 117)" implies, the tolerances given are standard or usual tolerances that apply to various types and uses of concrete construction. They are based on normal needs and common construction techniques and practices. Specified tolerances at variance with the standard values can cause both increases and decreases in the cost of construction.

Economic feasibility—The specified degree of accuracy has a direct impact on the cost of production and the construction method. In general, the higher degree of construction accuracy required, the higher the construction cost, and the lower the degree of construction accuracy, the higher the cost of required repairs.

Relationship of all components—The required degree of accuracy of individual parts can be influenced by adjacent units and materials, joint and connection details, and the possibility of the accumulation of tolerances in critical dimensions.

Construction techniques—The feasibility of a tolerance depends on available craftsmanship, technology, materials, and project management.

Compatibility—Designers are cautioned to use finish and architectural details that are compatible with the type and anticipated method of construction. The finish and architectural details used should be compatible with achievable concrete tolerances.

SPECIFICATION

COMMENTARY

Contract document references

ACI specification documents—The following American Concrete Institute standards provide mandatory tolerance requirements for concrete construction and can be referenced in Contract Documents:

117	Specification for Tolerances for Concrete Construction and Materials and Commentary
ITG-7	Specification for Tolerances for Precast Concrete
301	Specifications for Structural Concrete
303.1	Standard Specification for Cast-in-Place Architectural Concrete
336.1	Specification for the Construction of Drilled Piers
TMS 602/530.1/ ASCE 6	Specification for Masonry Structures and Commentary

ACI informative documents—The documents of the following American Concrete Institute committees cover practice, procedures, and state-of-the-art guidance for the categories of construction as listed:

General building..... ACI 302, 303, 304, 305, 311, 315, 336, 347
Special structures.....ACI 207, 307, 313, 325, 332, 334, 358
Materials.....211, 223
Other.....228

SECTION 1—GENERAL REQUIREMENTS

SPECIFICATION

1.1—Scope

1.1.1 This specification designates standard tolerances for concrete construction.

1.1.2 The indicated tolerances govern unless otherwise specified.

Tolerances in this specification are for typical concrete construction and construction procedures and are applicable to exposed concrete and to architectural concrete. Materials that interface with or connect to concrete elements may have tolerance requirements that are not compatible with those contained in this document.

This specification does not apply to specialized structures, such as nuclear reactors and containment vessels, bins, prestressed circular structures, and single-family residential construction. It also does not apply to precast concrete or to shotcrete.

Tolerances for specialized concrete construction that is outside the scope of this specification shall be specified in Contract Documents.

1.1.3 A series of preconstruction tolerance coordination meetings shall be scheduled and held prior to the commencement of the Work. The Contractor, subcontractors, material suppliers, and other key parties shall attend. All parties shall be given the opportunity to identify any tolerance questions and conflicts that are applicable to the work with materials, prefabricated elements, and Work assembled/installed in the field by the Contractor.

1.2—Requirements

1.2.1 Concrete construction and materials shall comply with specified tolerances.

COMMENTARY

R1.1—Scope

R1.1.2 Specification of more restrictive tolerances for specialized construction, such as architectural concrete, often results in an increase in material cost and time of construction.

R1.1.3 Preconstruction tolerance coordination meetings provide an opportunity for key participants to identify and to resolve tolerance compatibility issues prior to construction.

R1.2—Requirements

An example of a specific application that uses a multiple of toleranced items that together yield a toleranced result is the location of the face of a concrete wall. The wall has a tolerance on location (Section 4.2.1), measured at the foundation of the wall, and is allowed to deviate from the specified plane (Sections 4.1 and 4.8.2). The application of the location tolerance (Section 4.2.1) cannot be used to increase the plumb tolerance contained in Section 4.1. Similarly, the tolerance on member thickness (Section 4.5) shall not be allowed to increase the tolerance envelope resulting from the application of Sections 4.1, 4.2.1, and 4.8.2. If the base of the wall is incorrectly located by the maximum amount allowed by Section 4.2.1, then the plumb tolerance (Section 4.1) dictates that the face of the wall move back toward the correct location, and at a rate that does not exceed the provisions of Section 4.8.2. Refer to Fig. R1.2.3.

SPECIFICATION

COMMENTARY

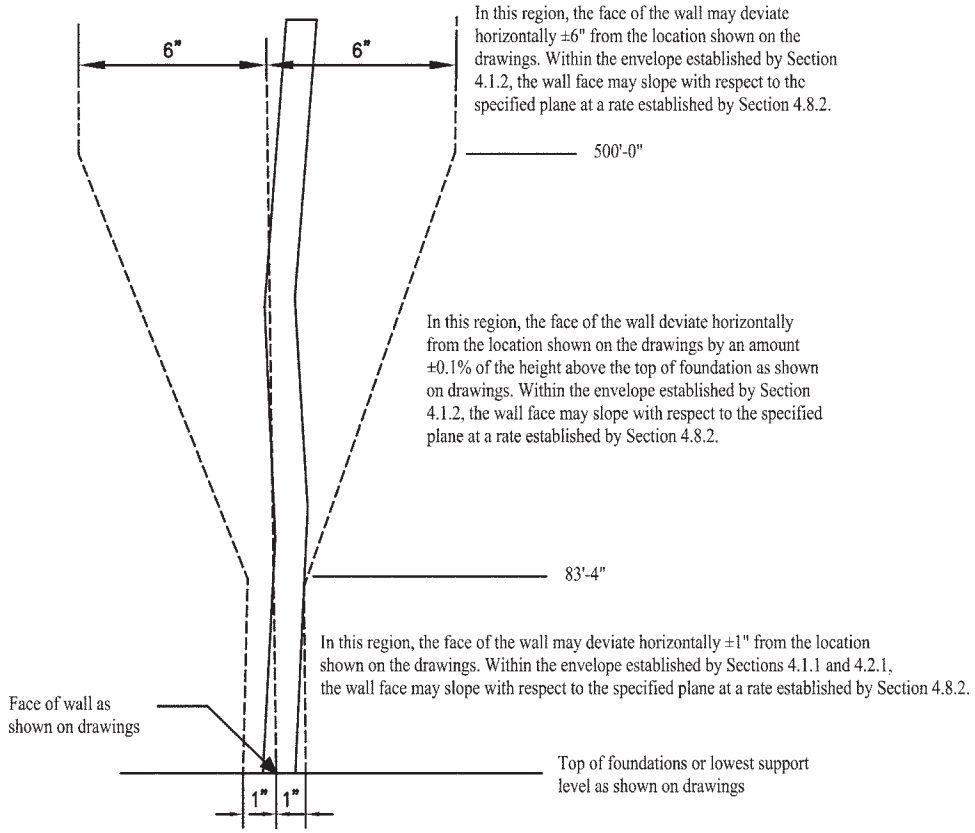


Fig. R1.2.3—Use of multiple of toleranced items to yield toleranced result.

1.2.2 Tolerances shall not extend the structure beyond legal boundaries. Tolerances are measured from the points, lines, and surfaces defined in Contract Documents. If application of tolerances causes the extension of the structure beyond legal boundaries, the tolerance must be reduced.

R1.2.2 If the application of tolerances causes the extension of the structure beyond legal boundaries, the Architect/Engineer should be notified to initiate conflict resolution.

1.2.3 Tolerances are not cumulative. The most restrictive tolerance controls.

R1.2.3 Accumulations of individual tolerances on a single item should not be used to increase an established tolerance. Individual tolerances are unique to their specific application and should not be combined with other tolerances to form a tolerance envelope. The separately specified tolerances must remain separate and not cumulative.

Each tolerance stands alone when evaluating the acceptability of concrete construction. Refer to Fig. R1.2.3.

1.2.4 Plus (+) tolerance increases the amount or dimension to which it applies, or raises a deviation from level. Minus (–) tolerance decreases the amount or dimension to which it applies, or lowers a deviation from level. Where only one signed tolerance is specified (+ or –), there is no specified tolerance in the opposing direction.

SPECIFICATION

1.2.5 If the tolerances in this document are exceeded for structural concrete, refer to Contact Documents for acceptance criteria. For other concrete, the Architect/Engineer may accept the element if it meets one of the following criteria:

a) Exceeding the tolerances does not affect the structural integrity, legal boundaries, or architectural requirements of the element; or

b) The element or total erected assembly can be modified to meet all structural and architectural requirements.

1.3—Definitions

ACI provides a comprehensive list of definitions through an online resource, "ACI Concrete Terminology," http://terminology.concrete.org. Definitions provided here complement that resource.

Architect/Engineer—architectural firm, engineering firm, or architectural and engineering firm issuing contract documents, administering the work under contract documents, or both (also called engineer-architect).

arris—the sharp external corner edge that is formed at the junction of two planes or surfaces.

bowing—deviation of the edge or surface of a planar element from a line passing through any two corners of the element.

bundled bar equivalent area—total area of reinforcing bars contained in the bundle.

concrete, exposed—concrete surfaces formed so as to yield an acceptable texture and finish for permanent exposure to view.

Contract Documents—a set of documents supplied by the owner to the contractor that serve as the basis for construction. These documents contain contract forms, contract conditions, specifications, drawings, addenda, and contract changes.

Contractor—the person, firm, or entity under contract for construction of the Work.

COMMENTARY

R1.2.5 For acceptance criteria for structural concrete, refer to ACI 301, Section 1.7.

R1.3—Definitions

arris—refer to Fig. R1.3.1.

bowing—refer to Fig. R1.3.2.

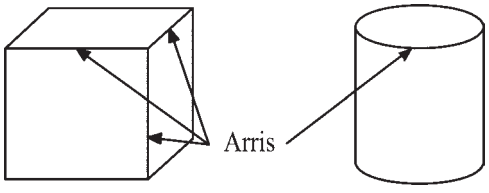


Fig. R1.3.1—Arris.

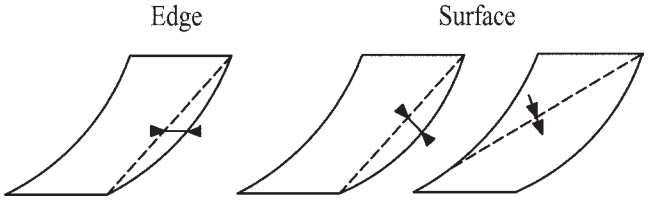


Fig. R1.3.2—Bowing.

SPECIFICATION

cover—the least distance between the surface of embedded reinforcement and the surface of the concrete.

deviation—departure from an established point, line, or surface; measured normal (perpendicular) to the reference line or surface.

deviation from plane—the distance between a point on a reference plane and the corresponding point on the actual plane.

COMMENTARY

cover—refer to Fig. R1.3.3.

deviation—refer to Fig. R1.3.4.

deviation from plane—refer to Fig. R1.3.5(a) and (b).

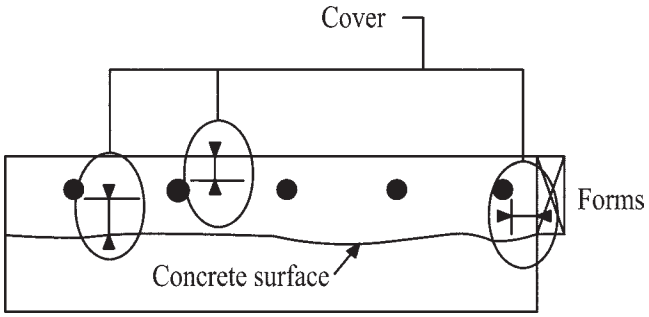


Fig. R1.3.3—Cover.

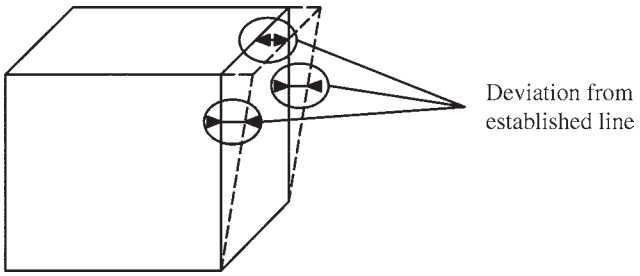


Fig. R1.3.4—Deviation.

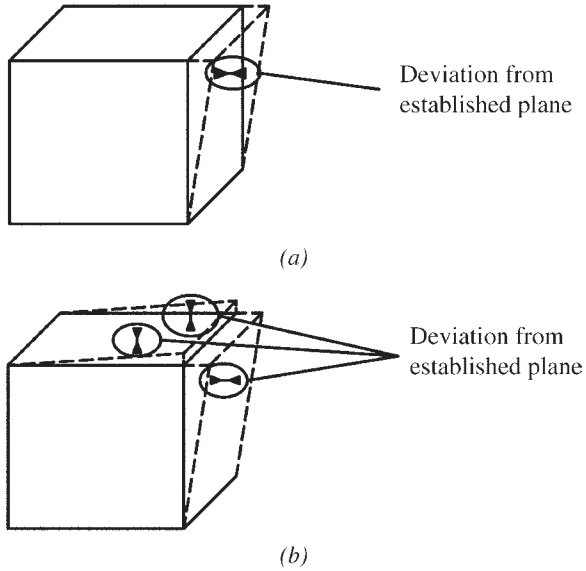


Fig. R1.3.5—Deviation from plane.

SPECIFICATION

deviation, horizontal—departure from an established point, line, or surface, measured normal (perpendicular) to a vertical line through the point of interest.

deviation, vertical—departure from an established point, line, or surface, measured normal (perpendicular) to a horizontal line through the point of interest.

COMMENTARY

deviation , horizontal—refer to Fig. R1.3.6(a), (b), and (c).

deviation, vertical—refer to Fig. R1.3.7(a) and (b).

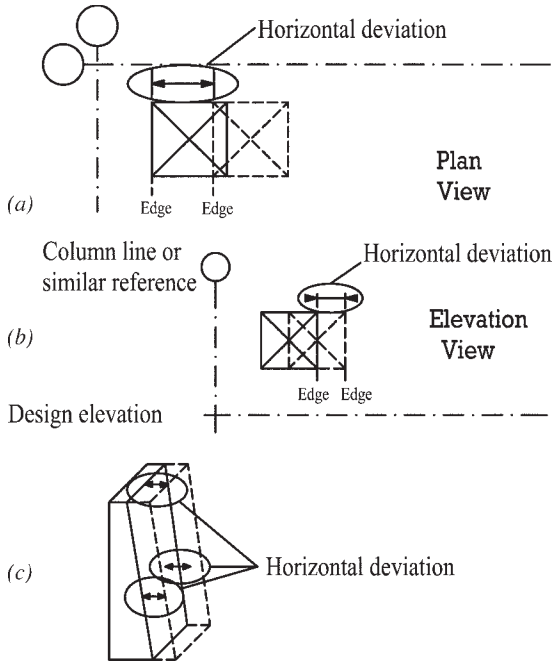


Fig. R1.3.6—Horizontal deviation.

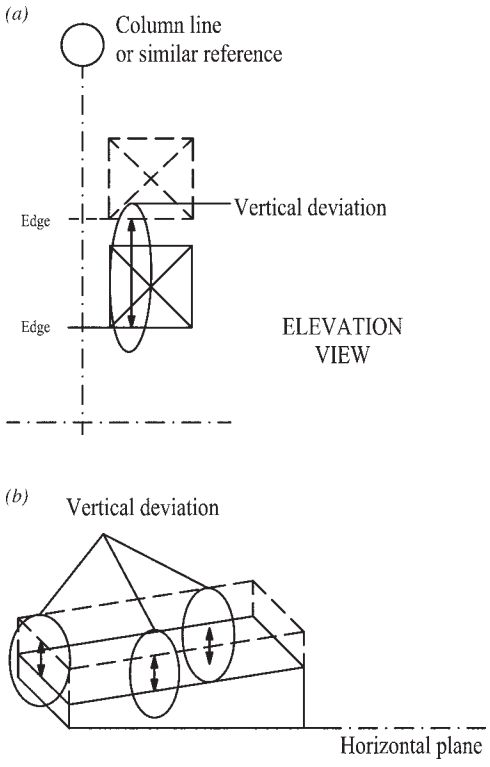


Fig. R1.3.7—Vertical deviation

SPECIFICATION

flatness—deviation of a surface from a plane.

footing—a structural element of a foundation that transmits loads directly to the soil.

foundation—a system of structural elements that transmit loads from the structure above to the earth.

levelness—deviation of a line or surface from a horizontal line or surface.

Project Drawings—graphic presentation of project requirements.

Project Specification—the written document that details requirements for the Work in accordance with service parameters and other specific criteria.

tolerance—the permitted deviation from a specified dimension, location, or quantity.

Work—the entire construction or separately identifiable parts thereof required to be furnished under Contract Documents.

COMMENTARY

Vertical deviation, horizontal deviation, and deviation from plumb are individually used to establish a tolerance envelope for each deviation type within which permissible variations can occur. Deviation from plane is used to determine the rate of change of adjacent points (slope tolerance) occurring within the tolerance envelope. In this fashion, the slope and smoothness of surfaces and lines within a tolerance envelope are controlled. Abrupt changes such as offsets, saw-toothing, and sloping of lines and surfaces properly located within a tolerance envelope may be objectionable for exposed concrete. The acceptable relative alignment of points on a surface or line is determined by using a slope tolerance. Effective use of a slope tolerance requires that the specific distance over which the slope is to be measured is established, and that the measurement device only contacts the surface at this specific distance.

flatness—refer to Fig. R1.3.8.

levelness—refer to Fig. R1.3.8.

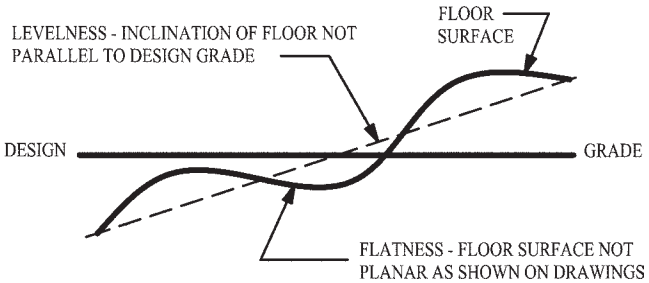


Fig. R1.3.8—Flatness and levelness.

SPECIFICATION

1.4—Reference standards

ASTM International

C94/C94M-09	Standard Specification for Ready-Mixed Concrete
C174/C174M-06	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
C1383-04	Standard Test Method for Measuring the P-Wave Speed and the Thickness of Concrete Plates Using the Impact-Echo Method
D4748-06	Standard Test Method for Determining Thickness of Bound Pavement Layers Using Short-Pulse Radar
E1155-96 (2008)	Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers
E1486-98 (2004)	Standard Test Method for Determining Floor Tolerances Using Waviness, Wheel Path and Levelness Criteria

COMMENTARY

R1.4—Informative references

The documents listed below are revised frequently. The reader is advised to contact the proper sponsoring group if it is desired to refer to the latest version.

American Concrete Institute

301	Specifications for Structural Concrete
304.6R	Guide for the Use of Volumetric-Measuring and Continuous Mixing Concrete Equipment
318	Building Code Requirements for Structural Concrete and Commentary

American Institute of Steel Construction

Design Guide 1: Base Plates and Anchor Rod Design

American Society of Concrete Contractors

Position Statement #14—Anchor Bolt Tolerances

ASTM International

C685/C685M	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing

Concrete Reinforcing Steel Institute

10MSP	Manual of Standard Practice

Precast/Prestressed Concrete Institute

MNL-116	Manual for Quality Control for Plants and Production of Structural Precast Concrete Products
MNL-135	Tolerance Manual for Precast and Prestressed Concrete Construction

National Ready Mixed Concrete Association

Quality Control Manual—Section 3; Certification of Ready Mixed Concrete Production Facilities (Checklist)

Volumetric Mixer Manufacturers Bureau

VMMB 100	Volumetric Mixer Standards of the Volumetric Mixer Manufacturers Bureau

These publications may be obtained from:

American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331
www.concrete.org

American Institute of Steel Construction
One East Wacker Dr., Suite 700
Chicago, IL 60601
www.aisc.org

SPECIFICATION

COMMENTARY

American Society of Concrete Contractors
2025 Brentwood Blvd.
St. Louis, MO 63144
www.ascconline.org

ASTM International
100 Barr Harbor Dr.
West Conshohocken, PA 19428
www.astm.org

Concrete Reinforcing Steel Institute
933 North Plum Grove Rd.
Schaumburg, IL 60173
www.crsi.org

Precast/Prestressed Concrete Institute
200 W. Adams St., #2100
Chicago, IL 60606
www.pci.org

National Ready Mixed Concrete Association
900 Spring Street
Silver Spring, MD 20910
www.nrmca.org

Volumetric Mixer Manufacturers Bureau
900 Spring Street
Silver Spring, MD 20910
www.vmmb.org

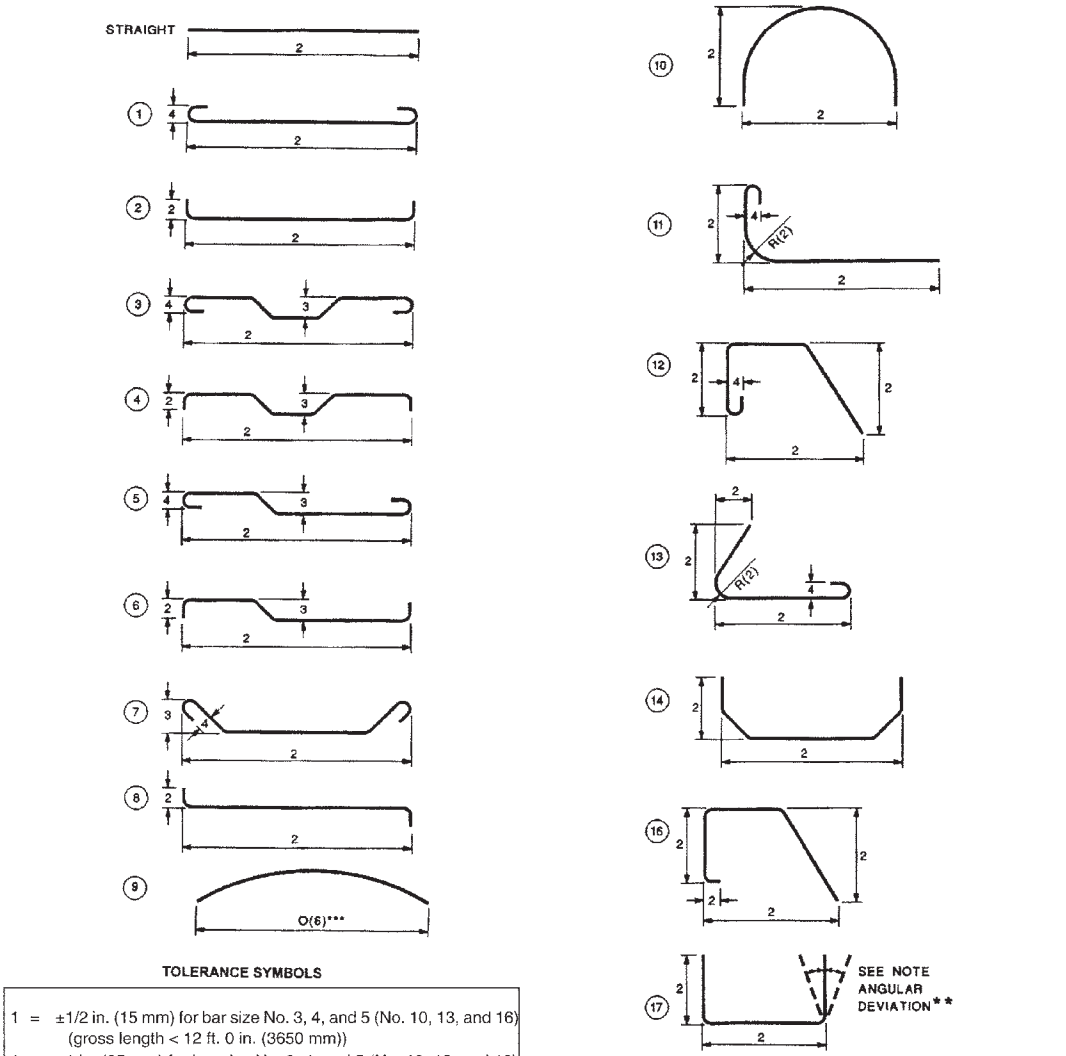
SECTION 2—MATERIALS

SPECIFICATION

2.1—Reinforcing steel fabrication and assembly

For bars No. 3 through 11 in size, refer to Fig. 2.1(a).

For bars No. 14 and 18 in size, refer to Fig. 2.1(b).



TOLERANCE SYMBOLS

1	=	±1/2 in. (15 mm) for bar size No. 3, 4, and 5 (No. 10, 13, and 16) (gross length < 12 ft. 0 in. (3650 mm))
1	=	±1 in. (25 mm) for bar size No. 3, 4, and 5 (No. 10, 13, and 16) (gross length ≥ 12 ft. 0 in. (3650 mm))
1	=	±1 in. (25 mm) for bar size No. 6, 7, and 8 (No. 19, 22, and 25)
2	=	± 1 in. (25 mm)
3	=	+ 0, -1/2 in. (15 mm)
4	=	±1/2 in. (15 mm)
5	=	±1/2 in. (15 mm) for diameter ≤ 30 in. (760 mm)
5	=	±1 in. (25 mm) for diameter > 30 in. (760 mm)
6	=	± 1.5% × "O" dimension, ≥ ± 2 in. (50 mm) minimum

Note: All tolerances single plane and as shown.

*Dimensions on this line are to be within tolerance shown but are not to differ from the opposite parallel dimension more than 1/2 in. (15 mm).

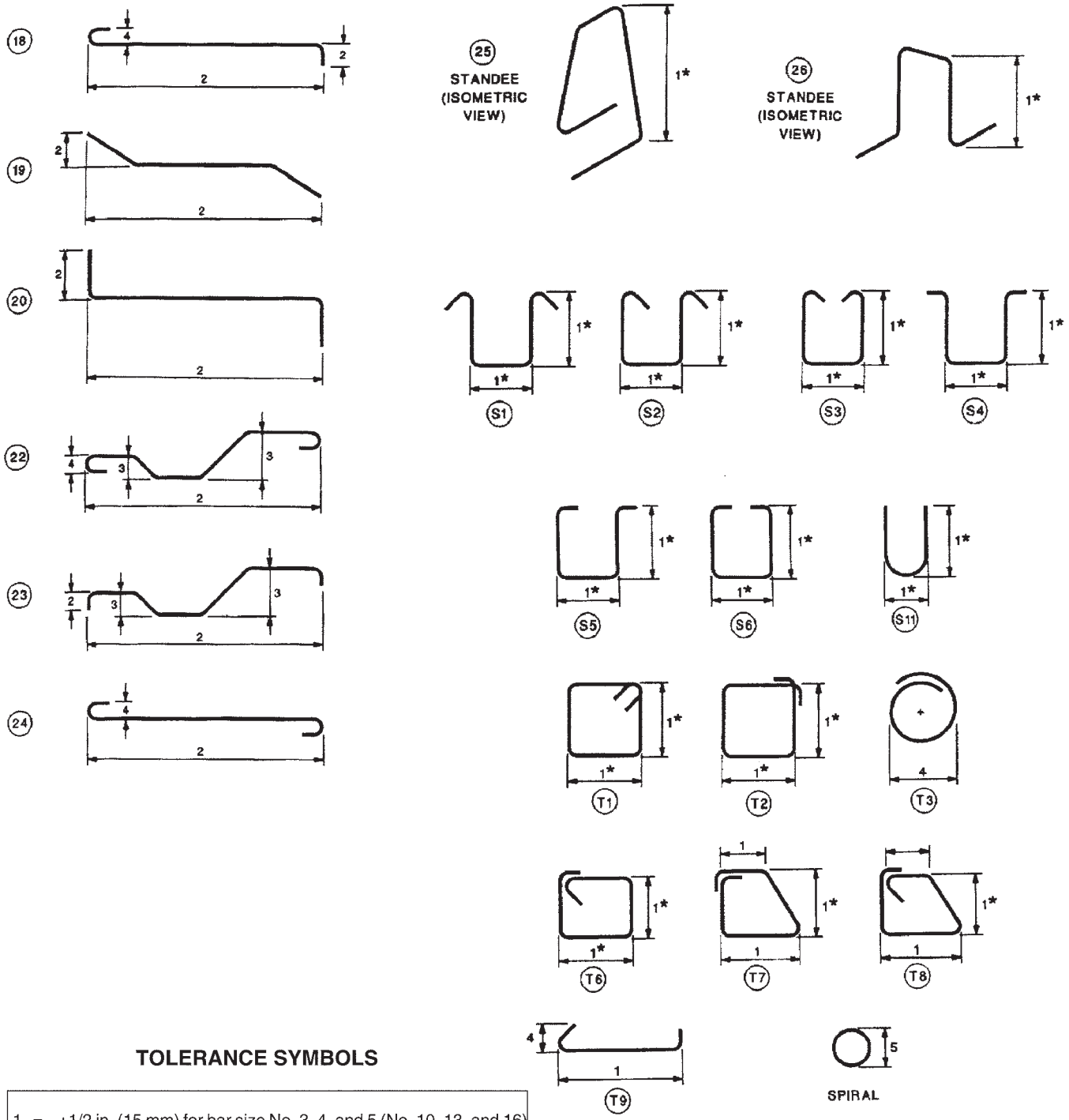
**Angular deviation—maximum ± 2-1/2 degrees or ± 1/2 in./ft (40 mm/m), but not less than 1/2 in. (15 mm) on all 90 degree hooks and bends.

***If application of positive tolerance to Type 9 results in a chord length > the arc or bar length, the bar may be shipped straight.

Tolerances for Types S1-S6, S11, T1-T3, T6-T9 apply to bar size No. 3 through 8 (No. 10 through 25) inclusive only.

Fig. 2.1(a)—Standard fabricating tolerances for bar sizes No. 3 through 11. (Figure courtesy of Concrete Reinforcing Steel Institute.)

SPECIFICATION



TOLERANCE SYMBOLS

1	=	±1/2 in. (15 mm) for bar size No. 3, 4, and 5 (No. 10, 13, and 16) (gross length < 12 ft. 0 in. (3650 mm))
1	=	±1 in. (25 mm) for bar size No. 3, 4, and 5 (No. 10, 13, and 16) (gross length ≥ 12 ft. 0 in. (3650 mm))
1	=	±1 in. (25 mm) for bar size No. 6, 7, and 8 (No. 19, 22, and 25)
2	=	± 1 in. (25 mm)
3	=	+ 0, -1/2 in. (15 mm)
4	=	±1/2 in. (15 mm)
5	=	±1/2 in. (15 mm) for diameter ≤ 30 in. (760 mm)
5	=	±1 in. (25 mm) for diameter > 30 in. (760 mm)
6	=	± 1.5% × "O" dimension, ≥ ± 2 in. (50 mm) minimum

Note: All tolerances single plane and as shown.

*Dimensions on this line are to be within tolerance shown but are not to differ from the opposite parallel dimension more than 1/2 in. (15 mm).

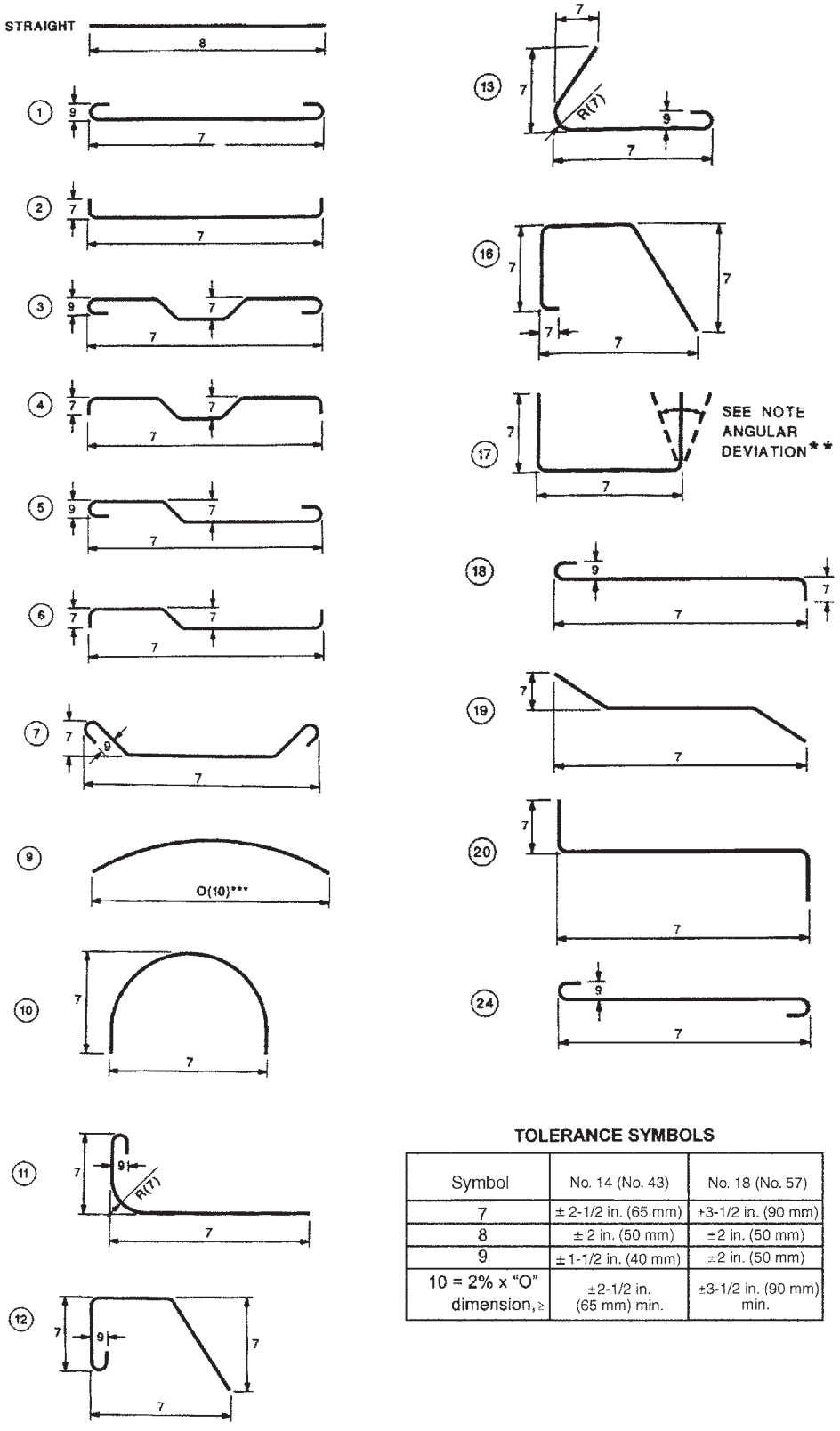
**Angular deviation—maximum ± 2-1/2 degrees or ± 1/2 in./ft (40 mm/m), but not less than 1/2 in. (15 mm) on all 90 degree hooks and bends.

***If application of positive tolerance to Type 9 results in a chord length ≥ the arc or bar length, the bar may be shipped straight.

Tolerances for Types S1-S6, S11, T1-T3, T6-T9 apply to bar size No. 3 through 8 (No. 10 through 25) inclusive only.

Fig. 2.1(a) (cont.)—Standard fabricating tolerances for bar sizes No. 3 through 11. (Figure courtesy of Concrete Reinforcing Steel Institute.)

SPECIFICATION



TOLERANCE SYMBOLS

Symbol	No. 14 (No. 43)	No. 18 (No. 57)
7	± 2-1/2 in. (65 mm)	+3-1/2 in. (90 mm)
8	± 2 in. (50 mm)	±2 in. (50 mm)
9	± 1-1/2 in. (40 mm)	±2 in. (50 mm)
10 = 2% x "O" dimension, ≥	±2-1/2 in. (65 mm) min.	±3-1/2 in. (90 mm) min.

Note: All tolerances single plane as shown.
*Saw-cut both ends—Overall length ± 1/2 in. (15 mm).
**Angular deviation—Maximum ± 2 1/2 degrees or ± 1/2 in./ft (40 mm/m) on all 90 degree hooks and bends.
***If application of positive tolerance to Type 9 results in a chord length ≥ the arc or bar length, the bar may be shipped straight.

Fig. 2.1(b)—Standard fabricating tolerances for bar sizes No. 14 and 18. (Figure courtesy of Concrete Reinforcing Steel Institute.)

SPECIFICATION

For bars No. 8 through 18 in size used in end-bearing splices, refer to Fig. 2.1(c).

For all end-bearing splice assemblies, refer to Fig. 2.1(d).

For all bar sizes, specified minimum inside radius of bend ..... –0 in.

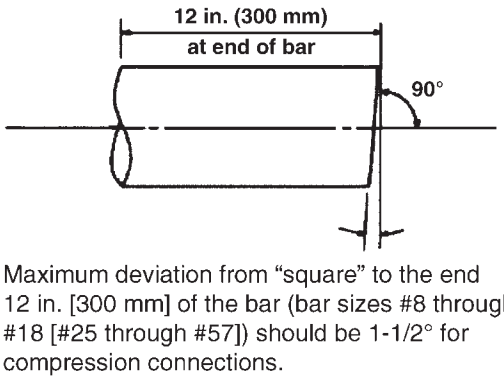


Fig. 2.1(c)—Maximum end deviation for bars No. 8 through 18 in size used in end-bearing splices. (Figure courtesy of Concrete Reinforcing Steel Institute.)

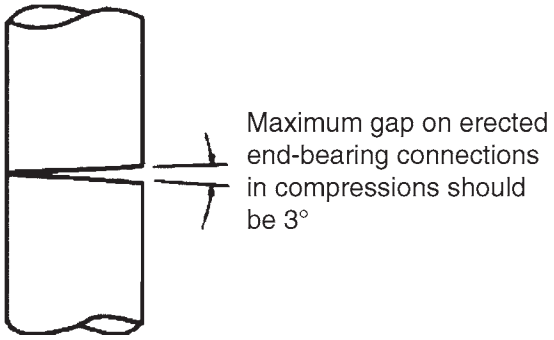


Fig. 2.1(d)—Maximum assembled gap for all bars used in end-bearing splices. (Figure courtesy of Concrete Reinforcing Steel Institute.)

COMMENTARY

SPECIFICATION

2.2—Reinforcement location

2.2.1 *Placement of nonprestressed reinforcement*
When member depth (or thickness) is 4 in. or less .....±1/4 in.

When member depth (or thickness) is over 4 in. and not over 12 in. .....±3/8 in.

When member depth (or thickness) is over 12 in. .....±1/2 in.

2.2.2 *Concrete cover measured perpendicular to concrete surface*
When member depth (or thickness) is 12 in. or less .....–3/8 in.

When member depth (or thickness) is over 12 in. .....–1/2 in.

Reduction in cover shall not exceed 1/3 the specified concrete cover.

Reduction in cover to formed soffits shall not exceed 1/4 in.

2.2.3 Vertical deviation for slab-on-ground reinforcement .....±3/4 in.

COMMENTARY

R2.2—Reinforcement location

The tolerance for ***d***, as stated in ACI 318, is for use in a strength calculation and should not be used as a placement tolerance for construction.

R2.2.1, R2.2.2, and R2.2.3 Tolerances for fabrication, placement, and lap splices for welded wire reinforcement are not covered by ACI 117 and, if required, should be specified by the Specifier. Before placement of concrete, inspection of reinforcing bars for conformance to specified placement tolerances may involve measurements to formwork or soil. Refer to Fig. R2.2.1(a),(b), and (c). An absolute limitation on one side of the reinforcement placement is established by the limit on the reduction in cover. Refer to Fig. R2.2.2(a) to (d) and Fig. R2.2.3.

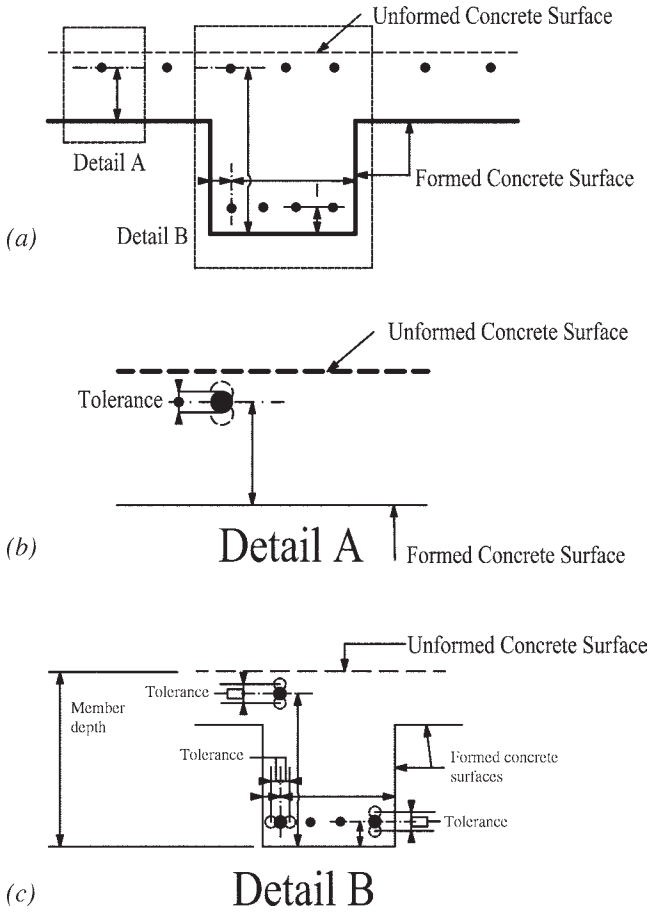


Fig. R2.2.1—Placement.

SPECIFICATION

COMMENTARY

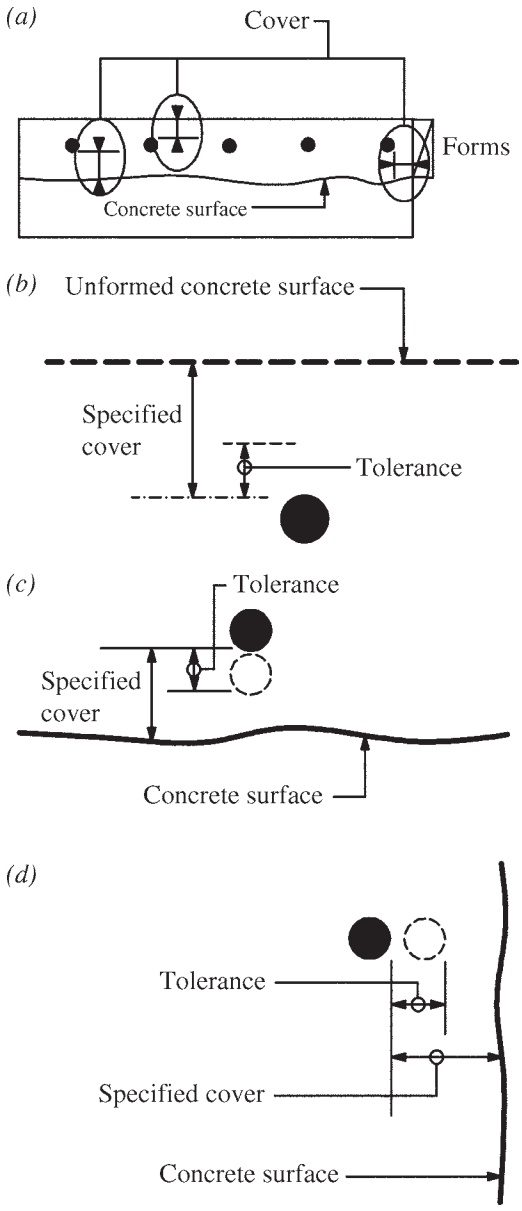


Fig. R2.2.2—Cover.

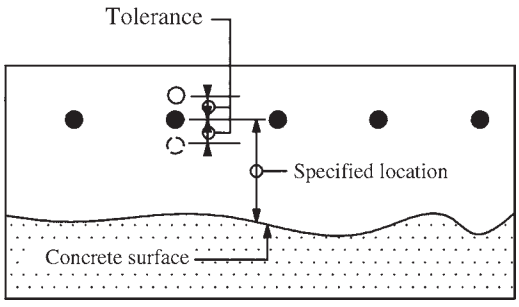


Fig. R2.2.3—Vertical placement.

SPECIFICATION

2.2.4 *Clearance between reinforcement or between reinforcement and embedment*
One-quarter specified distance not to exceed
.....±1 in.

Distance between reinforcement shall not be less than the greater of the bar diameter or 1 in. for unbundled bars.

For bundled bars, the distance between bundles shall not be less than the greater of 1 in. or a bar diameter derived from the equivalent total area of all bars in the bundle.

2.2.5 *Spacing of nonprestressed reinforcement, measured along a line parallel to the specified spacing*
Except as noted below.....±3 in.

Stirrups, the lesser of ±3 in. or ±1 in. per ft of beam depth

Ties, the lesser of ±3 in. or ±1 in. per ft of least column width

The total number of bars shall not be fewer than that specified.

COMMENTARY

R2.2.4 and R2.2.5 The spacing tolerance of reinforcement consists of an envelope with an absolute limitation on one side of the envelope determined by the limit on the reduction in distance between reinforcement. In addition, the allowable tolerance on spacing should not cause a reduction in the specified number of reinforcing bars used. Designers are cautioned that selecting a beam width that exactly meets their design requirements may not allow for reinforcement placement tolerance. This sometimes happens when lap-spliced bars take up extra space and cannot accommodate the placement tolerance. Where reinforcement quantities and available space are in conflict with spacing requirements of these sections, the Contractor and designer might consider bundling a portion of the reinforcement. Bundling of bars requires approval of the designer. Refer to Fig. R2.2.4(a) to (e) and R2.2.5.

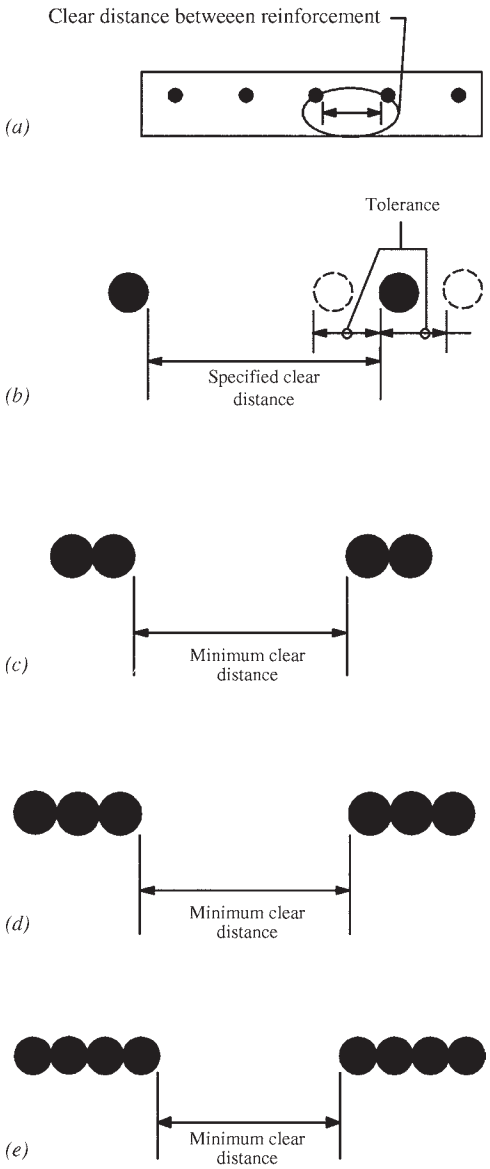


Fig. R2.2.4—Clear distance.

SPECIFICATION

COMMENTARY

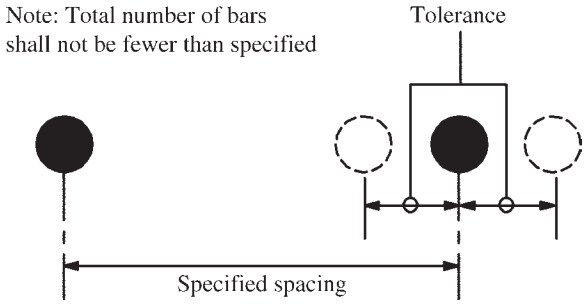


Fig. R2.2.5—Reinforcement spacing.

2.2.6 *Placement of prestressing reinforcement or prestressing ducts, measured from form surface*

2.2.6.1 *Horizontal deviation*

Element depth (or thickness) 24 in. or less .....±1/2 in.

Element depth (or thickness) over 24 in. ..... ±1 in.

2.2.6.2 *Vertical deviation*

Element depth (or thickness) 8 in. or less ..... ±1/4 in.

Element depth (or thickness) over 8 in. and not over 24 in. ..... ±3/8 in.

Element depth (or thickness) more than 24 in.... ±1/2 in.

R.2.2.6 The vertical deviation tolerance should be considered in establishing minimum prestressing tendon covers, particularly in applications exposed to deicer chemicals or salt-water environments where use of additional cover is recommended to compensate for placing tolerances. Slab behavior is relatively insensitive to horizontal location of tendons. Refer to Fig. R2.2.6(a) and (b).

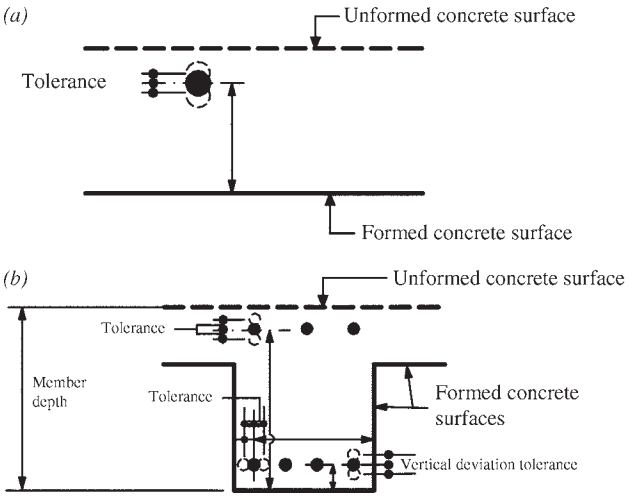


Fig. R2.2.6—Prestressing reinforcement placement.

2.2.7 *Longitudinal location of bends in bars and ends of bars*

At discontinuous ends of corbels and brackets ... ±1/2 in.

At discontinuous ends of other elements ..... ±1 in.

At other locations..... ±2 in.

2.2.8 *Embedded length of bars and length of bar laps*

No. 3 through 11 bar sizes ..... –1 in.

No. 14 and 18 bar sizes..... –2 in.

R2.2.7 and R2.2.8 The tolerance for the location of the ends of reinforcing steel is determined by these two sections.

SPECIFICATION

2.2.9 Bearing plate for prestressing tendons, deviation from specified plane
..... ±1/4 in. per ft, but not less than ±1/8 in.

2.2.10 *Placement of smooth rod or plate dowels in slabs-on-ground*

2.2.10.1 Centerline of dowel, vertical deviation measured from bottom of concrete slab at the joint for element depth 8 in. or less.....±1/2 in.

When element depth is over 8 in. .....±1 in.

2.2.10.2 Spacing of dowels, measured along a line parallel to the specified spacing.....±3 in.

The total number of dowels shall not be fewer than that specified.

2.2.10.3 Centerline of dowel with respect to a horizontal line that is perpendicular to the plane established by the joint
Horizontal deviation .....±1/2 in.

Vertical deviation.....±1/2 in.

COMMENTARY

R2.2.9 The tolerance for conformance of prestressing tendon bearing plates to the specified plane is established by this section. Refer to Fig. R2.2.9.

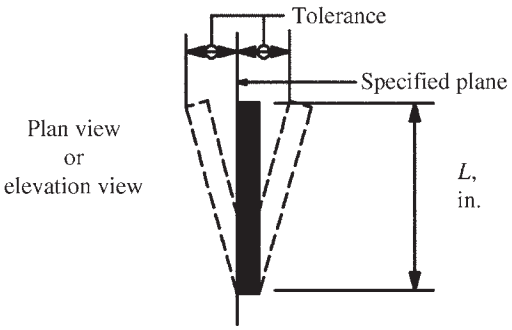


Fig. R2.2.9—Bearing plate for prestressing tendons.

R2.2.10 The tolerance for placement of dowels is determined by this section. Refer to Fig. R2.2.10.1, R2.2.10.2, and R2.2.10.3.

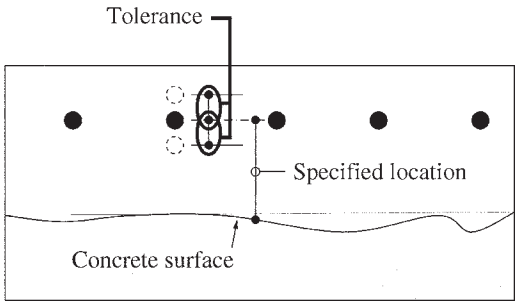


Fig. R2.2.10.1—Dowel placement.

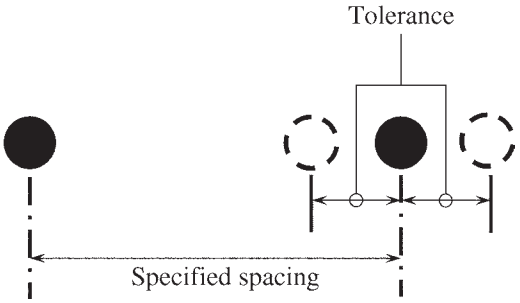


Fig. R2.2.10.2—Dowel spacing.

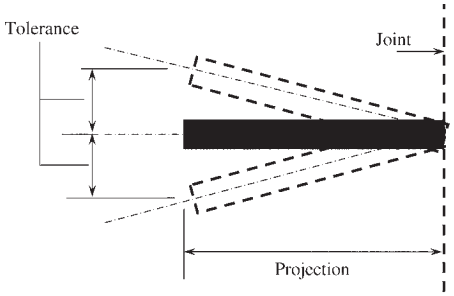


Fig. R2.2.10.3—Dowel deviation from line.

SPECIFICATION

2.3—Placement of embedded items, excluding dowels in slabs-on-ground

2.3.1 Clearance to nearest reinforcement shall be the greater of the bar diameter, largest aggregate size, or ..... 1 in.

2.3.2 *Centerline of assembly from specified location*

Horizontal deviation ..... ±1 in.

Vertical deviation ..... ±1 in.

2.3.3 *Surface of assembly from surface of element*

Assembly dimension 12 in. or smaller ..... ±1/2 in. per 12 in.
but not less than ..... ±1/4 in.

Assembly dimension greater than 12 in. ..... ±1/2 in.

2.3.4 *Anchor bolts in concrete*

2.3.4.1 *Top of anchor bolt from specified elevation*
Vertical deviation ..... ±1/2 in.

2.3.4.2 *Centerline of individual anchor bolts from specified location*

Horizontal deviation
for 3/4 in. and 7/8 in. bolts ..... ±1/4 in.
for 1 in., 1-1/4 in., and 1-1/2 in. bolts ..... ±3/8 in.
for 1-3/4 in., 2 in., and 2-1/2 in. bolts ..... ±1/2 in.

COMMENTARY

R2.3—Placement of embedded items, excluding dowels in slabs-on-ground

R2.3.1 The minimum clearance between reinforcement and embedded items is determined by this section. Refer to Fig. R2.3.1(a) and (b).

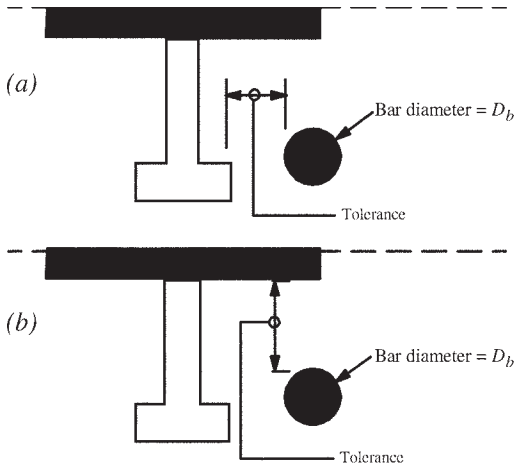


Fig. R2.3.1—Clear distance.

R2.3.3 The tolerance for the elevation of the top of anchor bolts is consistent with that contained in the American Institute of Steel Construction's Code of Standard Practice (AISC 303-10). The tolerance for the location of anchor bolts is based on using oversized holes per the *AISC Design Guide 1: Base Plates and Anchor Rod Design*, recommendations of the Structural Steel Educational Council, and concrete contractor anchor bolt placement techniques. Refer to the American Society of Concrete Contractor's *Position Statement #14*.

SPECIFICATION

2.4—Concrete batching

Refer to Table 2.4.

Table 2.4—Concrete batching tolerances (ASTM C94/C94M)

Material	Tolerance
Cementitious materials	
30% of scale capacity or greater	±1% of required mass
Less than 30% of scale capacity	–0 to +4% of the required mass
Water	
Added water or ice, and free water on aggregates	±1% of the total water content (including added water, ice, and water on aggregates)
Total water content (measured by weight or volume)	±3% of total water content
Aggregates	
Cumulative batching:	
Over 30% of scale capacity	±1% of the required mass
30% of scale capacity or less	±0.3% of scale capacity or 3% of the required mass, whichever is less
Individual material batching	±2% of the required mass
Admixtures	±3% of the required amount or plus or minus the amount of dosage required for 100 lb of cement, whichever is greater

2.5—Concrete properties

2.5.1 *Slump*

Where slump is specified as "maximum" or "not to exceed"
For all values.....+0 in.

Specified slump 3 in. or less.....–1-1/2 in.

Specified slump more than 3 in.....–2-1/2 in.

Where slump is specified as a single value
Specified slump 2 in. and less..... ±1/2 in.

Specified slump more than 2 in. but not greater than 4 in.....±1 in.

Specified slump more than 4 in.....±1-1/2 in.

Where slump is specified as a range.....no tolerance

COMMENTARY

R2.4—Concrete batching

Refer to ASTM C94/C94M and ACI 304.6R for additional information regarding concrete batching. ASTM C685/C685M provides information for concrete made with materials continuously batched by volume. The Volumetric Mixer Manufacturers Bureau (VMMB 100) provides standardized information concerning volumetric mixers.

R2.5—Concrete properties

R2.5.1 Where the specification has specified slump as a maximum, the Project Specifications should provide for one addition of water at the job site for slump adjustment, per ASTM C94/C94M, Section 6. Concrete slump should include a tolerance that allows for both plus or minus deviations so that concrete slumps are not underdesigned to avoid rejection. The water added at the job site should be within the water-cementitious material ratio (*w*/*cm*) limitations of the specifications or approved mixture proportions.

Flowing concrete achieved by the incorporation of high-range water-reducing admixtures (HRWRAs) (also called superplasticizers) are regularly used at specified slumps of 7-1/2 in. or greater. In addition, it is difficult to measure high slumps accurately. Consideration should be given to eliminating a maximum slump when a HRWRA is used to achieve flowing concrete. When HRWRAs are used, concrete slump should be specified for the concrete mixture prior to the addition of the HRWRA.

The slump specified should always be evaluated to determine if it is suitable for delivery, placing, and reinforcement clearance.

SPECIFICATION

2.5.2 *Air content: where no range is specified, the air content tolerance is* ..... ±1-1/2%

COMMENTARY

R2.5.2 When an air content range is specified, care should be given to address aggregate size and job-site requirements. The range should be adequately wide to accommodate the preceding.

SECTION 3—FOUNDATIONS

SPECIFICATION

3.1—Deviation from plumb

Excavation shall be measured before concrete placement.

3.1.1 *Category A*—For unreinforced concrete piers extending through materials offering no or minimal lateral restraint (for example, water, normally consolidated organic soils, and soils that might liquefy during an earthquake)—±12.5% of shaft diameter.

3.1.2 *Category B*—For unreinforced concrete piers extending through materials offering lateral restraint (soils other than those indicated in Category A)—±1.5% of shaft length.

3.1.3 *Category C*—For reinforced concrete piers—±2.0% of shaft length.

COMMENTARY

R3.1—Deviation from plumb

Refer to Fig. R3.1.1, R3.1.2, and R3.1.3.

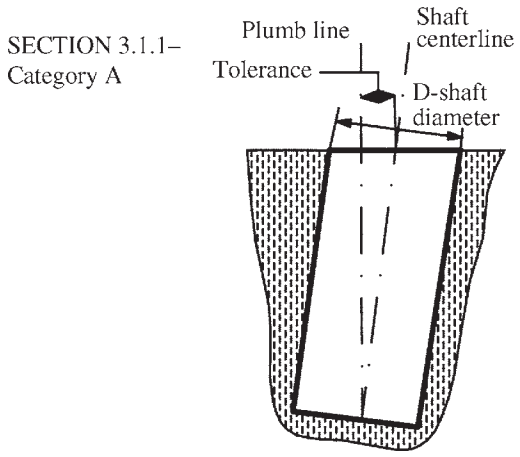


Fig. R3.1.1—Category A.

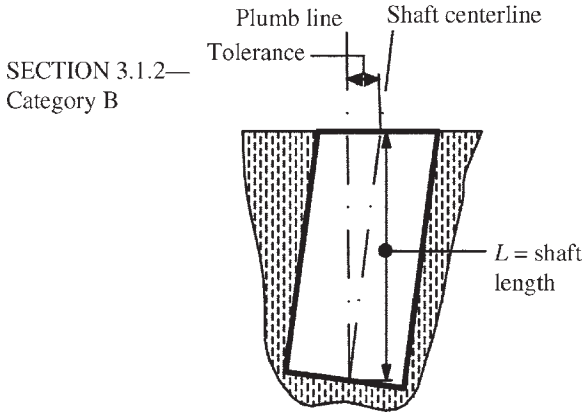


Fig. R3.1.2—Category B.

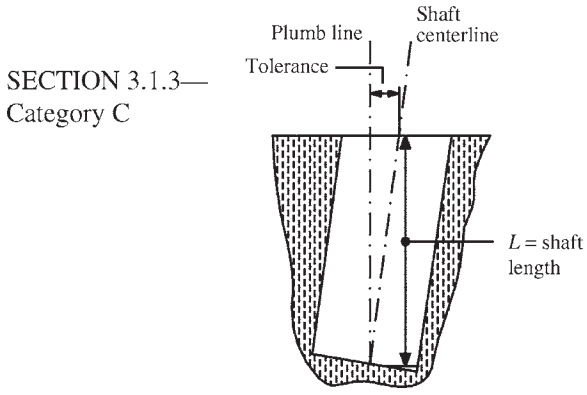


Fig. R3.1.3—Category C.

SPECIFICATION

3.2—Deviation from location

3.2.1 *Foundations, unless noted otherwise in this section*

Horizontal deviation of the as-cast edge:
Where dimension is 8 ft or more ..... ±2 in.

Where dimension is less than 8 ft
....the greater of ±2% of specified dimension or 1/2 in.

COMMENTARY

R3.2—Deviation from location

R3.2.1 Determines the permissible location of foundations or piers. The allowable deviation for the location of foundations or piers is governed by the dimension of the foundations or piers with an absolute limit, depending on whether the foundations or piers support concrete or masonry. Refer to Fig. R3.2.1(a) and (b).

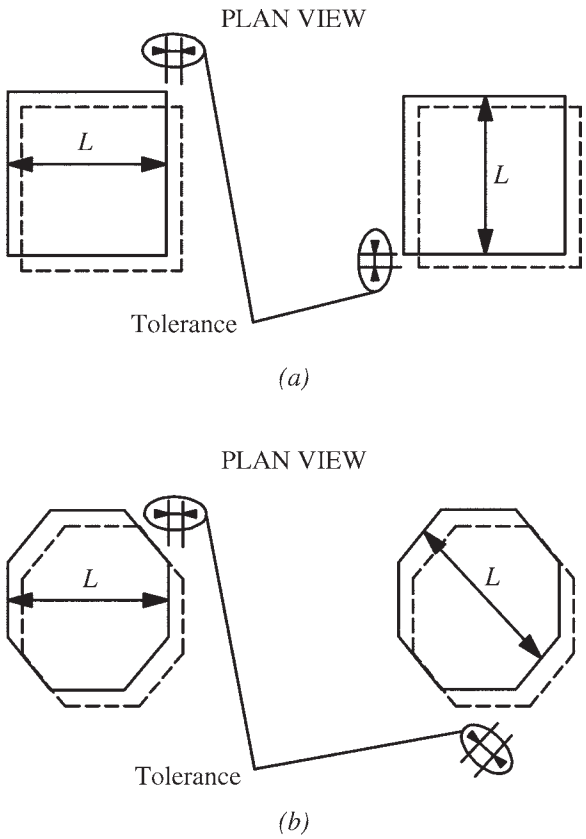


Fig. R3.2.1—Foundations, unless otherwise noted.

SPECIFICATION

3.2.2 *Foundations supporting masonry*

Horizontal deviation of the as-cast edge shall be the lesser of ±2% of the foundation's width or ±1/2 in.

COMMENTARY

R3.2.2 *Foundations supporting masonry*

Refer to Fig. R3.2.2(a) and (b).

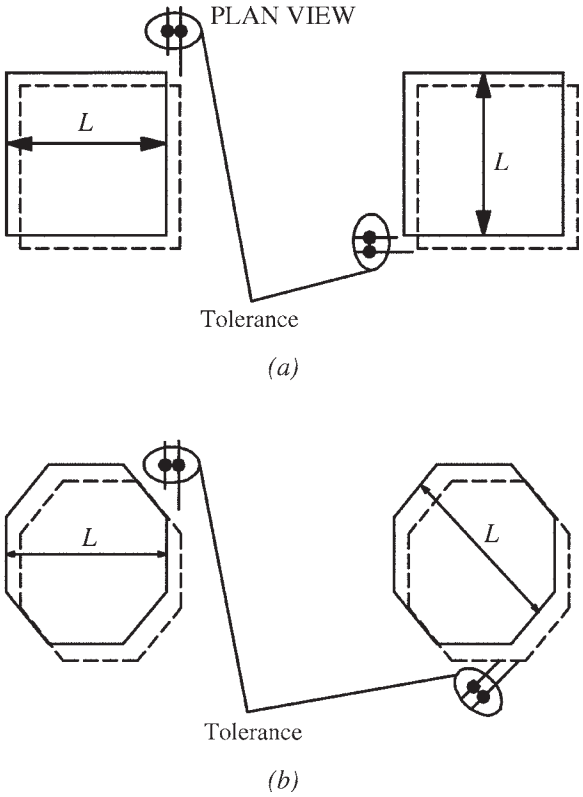


Fig. R3.2.2—Foundations supporting masonry.

3.2.3 *Top of drilled piers*

Horizontal deviation of the as-cast center shall be the lesser of 4.2% of the shaft diameter or ±3 in.

R3.2.3 *Top of drilled piers*

Refer to Fig. R3.2.3.

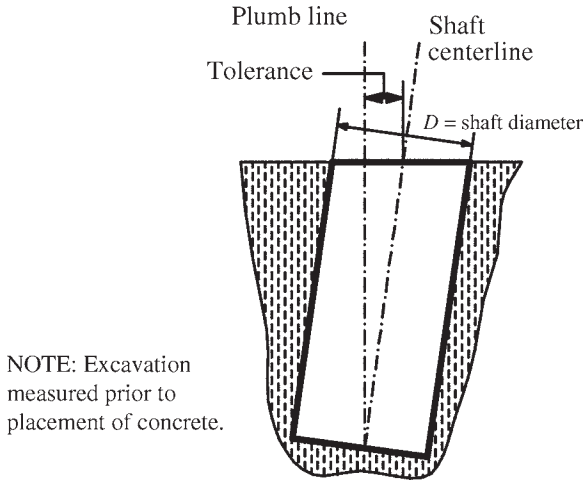


Fig. R3.2.3—Top of drilled piers: horizontal deviation.

SPECIFICATION

3.3—Deviation from elevation

3.3.1 *Top surface of foundations*
Vertical deviation ..... +1/2 in.
..... –2 in.

3.3.2 *Top surface of drilled piers*
Vertical deviation ..... +1 in.
..... –3 in.

3.4—Deviation from plane

3.4.1 *Base of bell pier*

The lesser of 10% of the bell diameter or ±3 in.

3.4.2 *Top surface of footings at interface with supported element*

Maximum gap between the concrete and the near surface of a 10 ft straightedge, measured between the support points, shall not exceed +1/2 in.

COMMENTARY

R3.3—Deviation from elevation

Determines the location of any point on the top surface of a footing relative to the specified plane. Refer to Fig. R3.3.1 and R3.3.2.

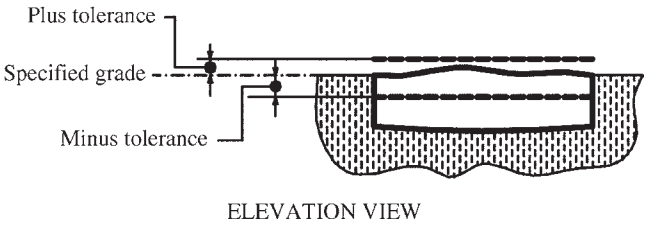


Fig. R3.3.1—Top surface of foundations: vertical deviation.

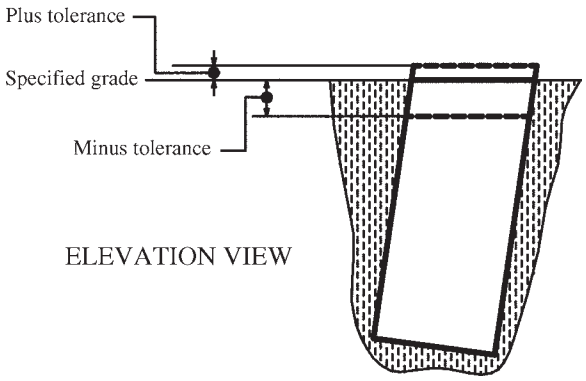


Fig. R3.3.2—Top surface of drilled piers: vertical deviation.

R3.4—Deviation from plane

Determines the allowable slope of the base of a bell pier. Refer to Fig R3.4.1.

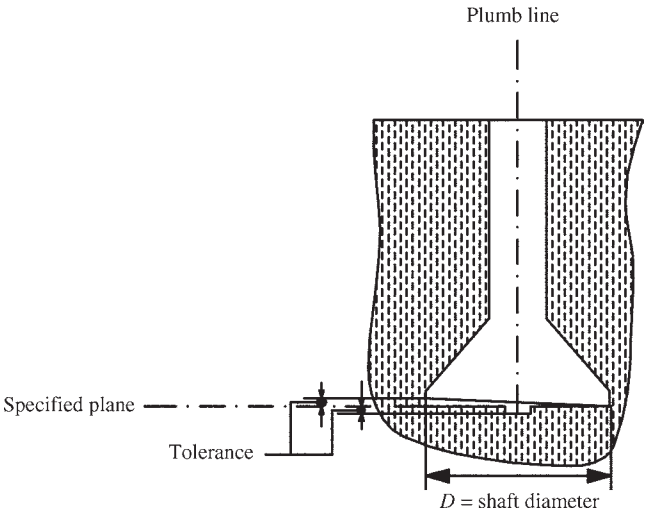


Fig. R3.4.1—Base of bell pier.

SPECIFICATION

3.5—Deviation from cross-sectional dimensions of foundations

3.5.1 *Formed foundations*

Horizontal deviation .....+2 in.
.....–1/2 in.

3.5.2 *Unformed foundations cast against soil*

Horizontal deviation from plan dimension. Excavation shall be measured before concrete placement. Tolerance shall apply at all locations.

Where dimension is 2 ft or less .....+3 in.
.....–1/2 in.

Where dimension is more than 2 ft.....+6 in.
.....–1/2 in.

3.5.3 Deviation from foundation thickness (*T*)..... –0.05*T*

COMMENTARY

R3.5—Deviation from cross-sectional dimensions of foundations

Determines the permissible size of a foundation. Refer to Fig. R3.5.1, R3.5.2, and R3.5.3.

R3.5.2 Inspection for conformance to specified thickness tolerances may involve measurements prior to placement of concrete. Specified tolerances apply to the completed concrete element.

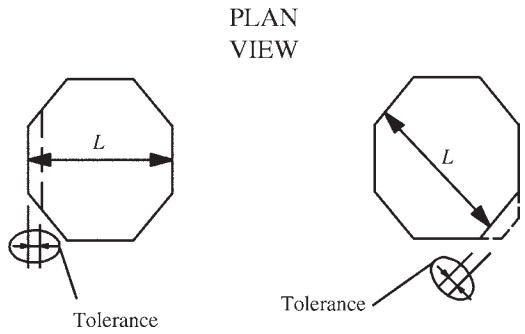


Fig. R3.5.1—Formed foundations: cross-sectional dimensions.

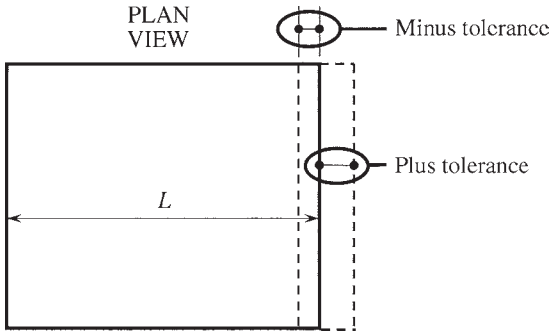


Fig. R3.5.2—Unformed foundations cast against soil.

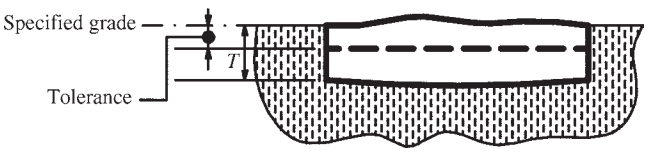


Fig. R3.5.3—Deviation from foundation thickness.

Notes

SECTION 4—CAST-IN-PLACE CONCRETE FOR BUILDINGS

SPECIFICATION

4.1—Deviation from plumb

4.1.1 *For heights less than or equal to 83 ft 4 in.*

For lines, surfaces, corners, and arrises: the lesser of 0.3% times the height above the top of foundations or lowest support level as shown on Project Drawings or ±1 in. This section shall not be used to evaluate local departure from a specified plane or form irregularities. Refer to Section 4.8.2 and 4.8.3, respectively.

For the outside corner of an exposed corner column and grooves in exposed concrete: the lesser of 0.2% times the height above the top of foundations or lowest support level as shown on Project Drawings or ±1/2 in. This section shall not be used to evaluate local departure from a specified plane or form irregularities. Refer to Section 4.8.2 and 4.8.3, respectively.

COMMENTARY

R4.1—Deviation from plumb

R4.1.1 The tolerance for plumb varies with the height above the top of foundation or the lowest support level of the structure. Between the top of foundation and a height of 83 ft 4 in., the tolerance is 0.3% of the height until a maximum dimension of 1 in. is reached. Refer to Fig. R4.1.1(a) and (b). The tolerance for the outside corner of exposed corner columns and for contraction joint grooves in exposed concrete is more stringent.

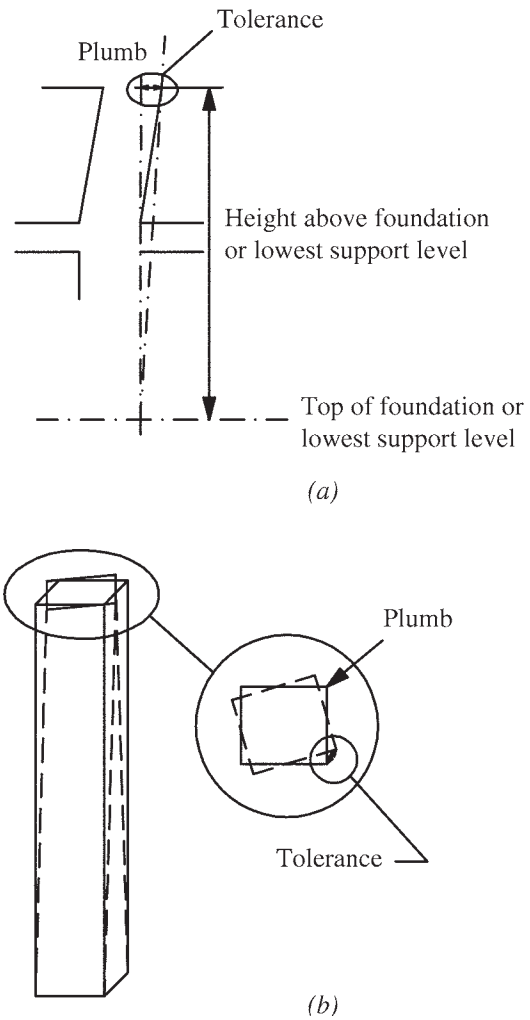


Fig. R4.1.1—Deviation from plumb.

SPECIFICATION

4.1.2 *For heights greater than 83 ft 4 in.*

For lines, surfaces corners, arrises, and elements: the lesser of 0.1% times the height above the top of foundations or lowest support level as shown on Project Drawings or ±6 in. This section shall not be used to evaluate local departure from a specified plane or form irregularities. Refer to Section 4.8.2 and 4.8.3, respectively.

For the outside corner of an exposed corner columns and contraction joint grooves in concrete exposed to view: the lesser of 0.05% times the height above the top of foundations or lowest support level as shown on Project Drawings or 3 in. This section shall not be used to evaluate local departure from a specified plane or form irregularities. Refer to Section 4.8.2 and 4.8.3, respectively.

4.1.3 Vertical edges of openings larger than 12 in., measured over the full height of the opening..... ±1/2 in.

COMMENTARY

R4.1.2 From 83 ft 4 in. to 500 ft above the top of foundation, the tolerance for plumb is 1/1000 (0.1%) times the height. The maximum tolerance is 6 in. at heights more than 500 ft above the top of foundation of the structure. The structure and exterior cladding should not extend beyond legal boundaries established by the Contract Documents. Refer to Fig. R4.1.2(a) and (b).

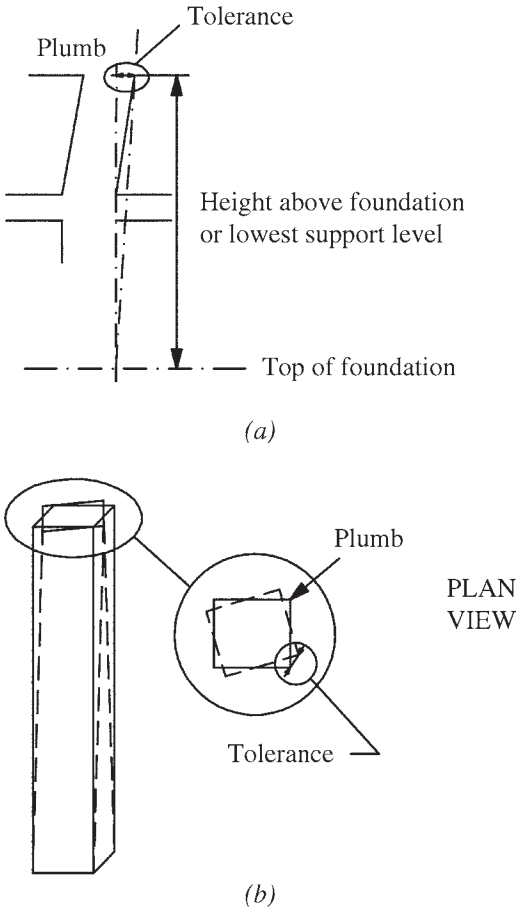


Fig. R4.1.2—Deviation from plumb.

R4.1.3 The plumb tolerance for edges of openings larger than 12 in. is established by this section. Refer to Fig. R4.1.3.

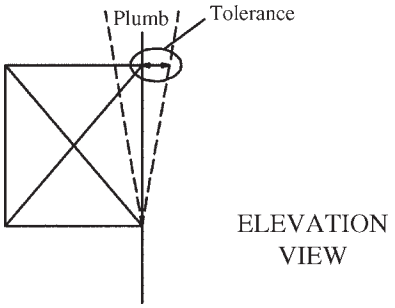


Fig. R4.1.3—Deviation from plumb.

SPECIFICATION

4.2—Deviation from location

4.2.1 *Horizontal deviation*

Vertical elements, measured at the top of element foundation or lowest support level .....±1 in.

Other elements .....±1 in.

Edge location of all openings.....±1/2 in.

Sawcuts, joints, and weakened plane embedments in slabs .....±3/4 in.

COMMENTARY

R4.2—Deviation from location

R4.2.1 Horizontal deviation is defined in Section 1.3. The tolerance for horizontal deviation would apply to the plan location of items such as the vertical edge of a floor opening or of a wall, beam, or column. The tolerance for horizontal deviation would also apply to items such as the vertical edges of openings in walls, beams, or columns. Refer to Fig. R4.2.1(a) to (c). The tolerance on sawcut location is driven by aesthetic concerns. Research (Martinez and Davenport 2005) suggests that for an 18 in. dowel the sawcut can be offset from the center as much as 3 in. without impacting joint performance.

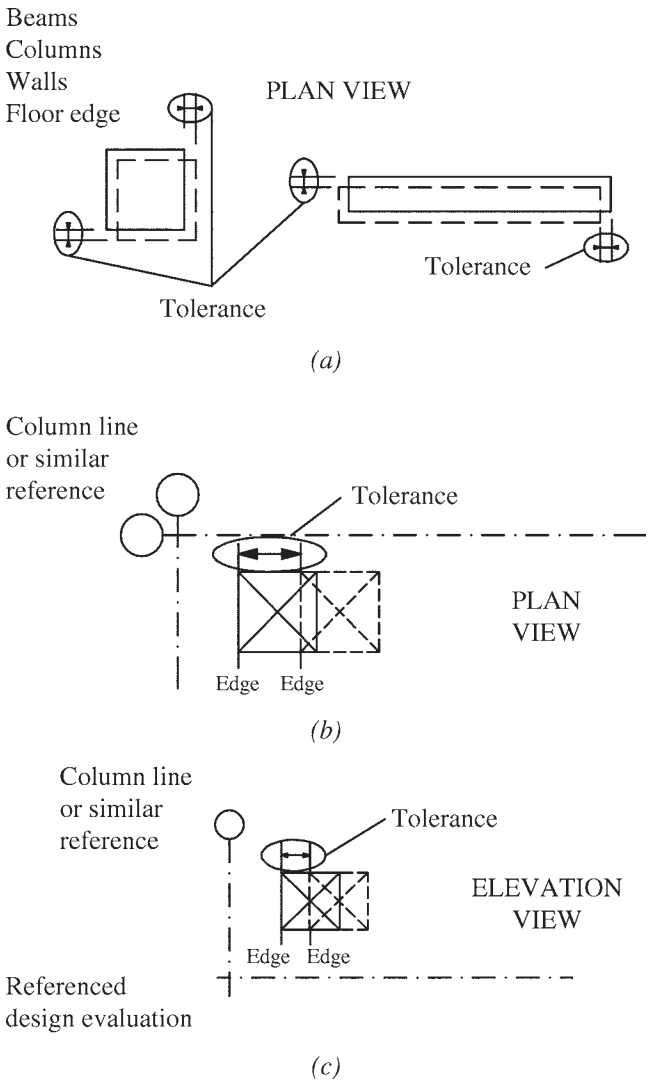


Fig. R4.2.1—Horizontal deviation.

SPECIFICATION

4.2.2 *Vertical deviation*

Elements ..... ±1 in.

Edge location of all openings ..... ±1/2 in.

COMMENTARY

R4.2.2 Vertical deviation is also defined in Section 1.3. The tolerance for vertical deviation would apply to the location of items such as the horizontal edges of a wall or column opening. The tolerance for vertical deviation would also apply to items such as the horizontal edges of openings in walls, beams, or columns. Refer to Fig. R4.2.2(a) and (b).

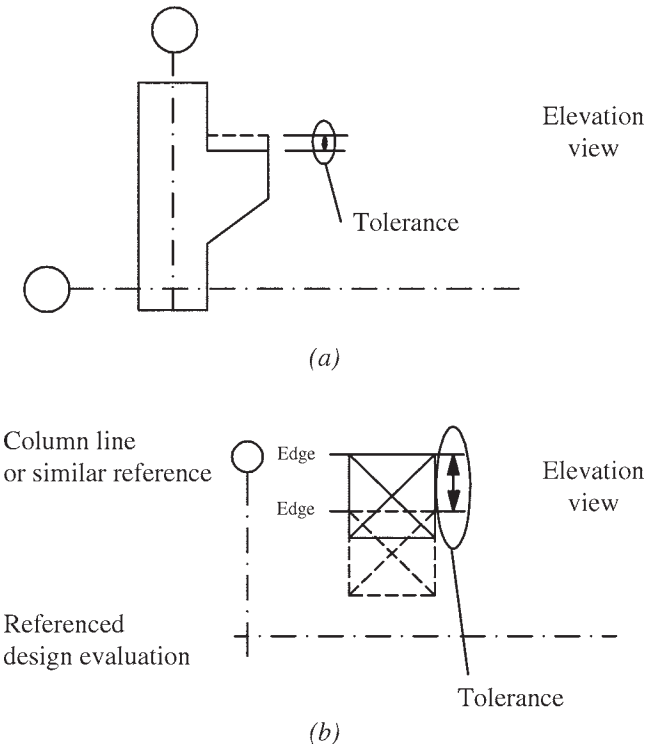


Fig. R4.2.2—Vertical deviation.

4.3—Not used

4.4—Deviation from elevation

4.4.1 *Top surface of slabs*

Slabs-on-ground ..... ±3/4 in.

Formed suspended slabs, before removal of supporting shores ..... ±3/4 in.

Slabs on structural steel or precast concrete ..... no requirement

R4.4—Deviation from elevation

R4.4.1 The top elevation for slabs on structural steel or precast concrete will be determined by elevation of the supporting steel or precast concrete, plus or minus variations in slab thickness, as specified in Section 4.5.3. In situations where this procedure may result in unsatisfactory slab elevations (for example, unshored beams that deflect or supporting steel or precast set with large deviations from specified elevation), the Architect/Engineer should specify, or the contractors involved should agree on, a satisfactory procedure. The concrete flooring contractor cannot control elevations of steel or precast concrete members upon which concrete slabs are cast. In the instance of slabs cast on metal deck, there is also a practical limitation on the increase of slab thickness to accommodate differential elevations or deflections. If the Specifier requires the concrete slab to be placed level on deflecting or cambered supporting steel or precast, the plus tolerance is likely to be exceeded.

SPECIFICATION

4.4.2 Formed surfaces before removal of shores
.....±3/4 in.

4.4.3 Lintels, sills, parapets, horizontal grooves, and other lines in exposed concrete .....±1/2 in.

4.4.4 Top of walls .....±3/4 in.

4.4.5 Fine grade of soil immediately below slabs-on-ground.....±3/4 in.

4.5—Deviation from cross-sectional dimensions

4.5.1 Thickness of elements, except slabs, where specified cross-sectional dimension is
12 in. or less .....+3/8 in.
.....–1/4 in.

More than 12 in., and not more than 36 in.....+1/2 in.
.....–3/8 in.

More than 36 in.....+1 in.
.....–3/4 in.

4.5.2 *Unformed beams and walls cast against soil*

Horizontal deviation from plan dimension:
Where dimension is 2 ft or less.....+3 in.
.....–1/2 in.

Where dimension is more than 2 ft.....+6 in.
.....–1/2 in.

COMMENTARY

R4.4.3 The term "exposed concrete" is used as defined in *ACI Concrete Terminology.* Exposed Concrete is addressed in the Mandatory Requirements Checklist, Section 1.1.2.

R4.4.5 The elevation of the soil upon which a slab-on-ground is to be placed is generally more difficult to control than that of the concrete surface. The intent of establishing an elevation tolerance of ±3/4 in. for fine grading below slabs-on-ground is to provide an environment in which a slab-on-ground installation can successfully comply with the thickness requirements established in Section 4.5.4. If more stringent tolerance requirements are deemed necessary by the Specifier, consider a fine grade elevation tolerance of ±1/2 in. This tolerance is reasonable for industrial applications because more sophisticated equipment is normally used to establish the fine grade elevation and because of the performance requirements for industrial slabs.

R4.5—Deviation from cross-sectional dimensions

Cross-sectional dimensions determine the permissible thickness of concrete members, or variation in opening width.

R4.5.1 Inspection of formwork for conformance to specified placement thickness tolerances may involve measurements prior to placement of concrete. Specified tolerances apply to the completed concrete element.

SPECIFICATION

4.5.3 *Thickness of suspended slabs* ..... –1/4 in.

4.5.3.1 Samples for slab thickness, when taken, shall conform to the requirements of Sections 4.5.4.1 through 4.5.4.6.

4.5.4 *Thickness of slabs-on-ground*
Average of all samples ..... –3/8 in.

Individual sample..... –3/4 in.

4.5.4.1 Minimum number of slab thickness samples, when taken, shall be four (4) for each 5000 ft^2 or part thereof.

4.5.4.2 Samples shall be taken within seven (7) days of placement.

4.5.4.3 Samples shall be randomly located over the test area and shall be taken by coring of the slab or by using an impact-echo device.

4.5.4.3.1 Where concrete core samples are taken, the length of each core sample shall be determined using ASTM C174/C174M.

COMMENTARY

R4.5.3 Suspended (elevated) slabs require only that a tolerance for elevation and cross-sectional dimension be established. Thickness of suspended slabs is of primary concern because insurance carriers establish a fire rating of the structure, depending on the occupancy. The fire rating is derived in part from the insulating properties of concrete and the thickness of the concrete slab. Achieving the minimum period of fire separation between floors depends in part on achieving a minimum thickness.

Variations in the elevation of erected steel or precast concrete and in deflections of the supporting metal deck and frame under weight of concrete often make it necessary to provide additional slab thickness in local areas where the intent is to produce a relatively level slab. Care should be taken to ensure that providing additional concrete in local areas does not overload the supporting formwork or metal deck. Significant increase to slab thickness can have a negative impact on structural performance.

R4.5.4 Specifiers should anticipate localized occurrences of reduced thickness for slabs-on-ground. The slab-on-ground thickness tolerance has been set with respect to both average thickness for all the samples measured and a minimum thickness for individual samples.

Where the Specifier determines requirements of this section are inadequate for a particular application, the Specifier should incorporate within the Project Specifications specific sampling procedures and acceptance criteria for all elements impacting thickness of slabs-on-ground (Sections R4.4.1, R4.4.5, and R4.5.4). In such an instance, consideration might be given to statistical control of the subgrade, elevation of the concrete surface, and slab thickness.

R4.5.4.1 Thickness samples are sometimes taken in combination with other testing, and the information gathered from that testing is valid for information purposes. Thickness samples taken for purposes of evaluating the slab with respect to tolerances in this specification, however, must meet the requirements of this section.

R4.5.4.2 Sampling after the specified 7-day period will not adversely affect the measured values; however, it may affect the ability to take corrective action.

R4.5.4.3 ACI 228.2R contains a discussion of the advantages and limitations of the various test methods. A short-pulse radar device can also provide slab thickness data. The precision of this method may require that a larger number of samples be taken to provide the same degree of reliability as the methods identified in this section. Proper use of the equipment requires calibration as established in ASTM D4748 and data collection in accordance with the provisions of ASTM D4748 using a non-contact horn antenna.

SPECIFICATION

4.5.4.3.2 An impact-echo device, when used, shall be calibrated using a minimum of three random locations within the test area where the actual concrete thickness is known. The impact-echo test shall be conducted in accordance with ASTM C1383.

4.5.4.4 Test results shall be reported in a manner that will allow the data to be verified or the test to be replicated.

4.5.4.5 When computing the average of all samples, samples with a thickness more than 3/4 in. above the specified thickness shall be assumed to have a thickness 3/4 in. more than the specified thickness.

4.5.4.6 When corrective action is required, additional samples shall be taken in the vicinity of unacceptable results to establish the extent of corrective action.

4.6—Deviation from formed opening width or height

4.6.1 Opening width or height.....–1/2 in.
.....+1 in.

4.7—Deviation from relative elevations or widths for stairs

4.7.1 *Stairs, measured along a line parallel to the stair axis*

Difference between largest and smallest tread or riser in any flight shall not exceed 3/8 in.

Difference in height of adjacent risers measured at the nose shall not exceed 3/16 in.

Difference in depth of adjacent treads shall not exceed 3/16 in.

4.8—Deviation from slope or plane

4.8.1 Stair tread from back to nosing.....±1/4 in.

COMMENTARY

ASTM D4748 may not be appropriate for use on ACI 302 Class 6-8 floors. ASTM D4748, Table 1, shows that concrete has a dielectric constant range of 6 to 11 for portland-cement concrete, but does not distinguish between high-density or low-density concrete, which could magnify any error associated with incorrectly assuming the average dielectric constant. Section 1.2 of the ASTM test method shows pavements with increased attenuation of the electromagnetic signal should not be measured with this method. The ASTM Standard, Section 7.2.1 requires either actual cores for calibration or “best guess” practices from field operators. It is recommended that “best guess” not be used for purposes of this document.

SPECIFICATION

4.8.2 *Formed surfaces over distances of 10 ft*

All conditions, unless noted otherwise in this section .....±0.3%

Outside corner of exposed corner column .....±0.2%

Contraction joint grooves in exposed concrete...±0.2%

4.8.3 *Formed surface irregularities (gradual or abrupt)*

Abrupt irregularities shall be measured within 1 in. of the irregularity. Gradual surface irregularities shall be measured by determining the gap between concrete and near surface of a 5 ft straightedge, measured between contact points.

Class A Surface..... +1/8 in.

Class B Surface..... +1/4 in.

Class C Surface..... +1/2 in.

Class D Surface..... +1 in.

4.8.4 Random traffic floor surface finish tolerances shall meet the requirements of Section 4.8.5 or 4.8.6, as specified in the Contract Documents.

4.8.4.1 A specified overall area is the entire floor surface specified to conform to a particular surface classification.

4.8.4.2 The surface classification of all floors shall be specified in the Contract Documents.

4.8.4.3 Each individual slab placement shall constitute a separate test surface.

COMMENTARY

R4.8.2 This is one of several paragraphs that address the proper location of formed surfaces. Local departure of the formed surface from the specified slope or plane is addressed in this section. A departure of 0.3% is approximately 3/8 in. over a distance of 10 ft. Tolerances are based on a 10 ft measured length. Interpolation or extrapolation of tolerances for dimensions greater than or less than 10 ft are not permitted. Other sections, such as Sections 4.1 and 4.4.2, establish a global tolerance for elements.

R4.8.3 Specifiers should anticipate local irregularities in formed surfaces. The purpose of establishing different classes of surface is to define the magnitude of irregularities in a manner that is consistent with the exposure of the concrete when in service. As stated in Section R4.4.3, the term “exposed concrete” is used as defined in *ACI Concrete Terminology.* Exposed Concrete is addressed in the Mandatory Requirements Checklist, Section 1.1.2. The Specifier should also anticipate abrupt transitions at the surface of members where segmental steel void forms are used to form floor framing members. The Specifier should refer to the Mandatory Requirements Checklist.

R4.8.4 The purpose of establishing floor surface tolerances is to define surface characteristics that are of importance to those who will be using the surface. The two surface characteristics thought to be of greatest importance for concrete floors are flatness and levelness. Flatness can be described as bumpiness of the floor, and is the degree to which a floor surface is smooth or plane. Levelness is the degree to which a floor surface parallels the slope established on the project drawings. Two methods are identified for use in the evaluation of floor surface finish tolerances. The F-Number System uses data taken at regular intervals along lines located in random locations on the test surface. The described methods use different criteria to evaluate the as-constructed data. Therefore, it is important that the Specifier select the method most applicable to the end user of the floor. The Waviness Index may be used instead of the two methods identified in Sections 4.8.5 and 4.8.6 by specifying parameters established in the Optional Checklist. Before contracting to build to any floor tolerance specification, it is suggested the constructor evaluate data from tests of its own floors. Data should be processed using the proposed floor tolerance specification to confirm an understanding of the specific approach and its implications on proposed construction means and methods. Specifiers may require the constructor to demonstrate proven ability by testing an existing floor slab installed by the constructor.

Each of the methods described herein will yield a slightly different result. Each of the described approaches uses a different method to evaluate flatness. The F-Number System

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uses only 2 ft slope changes (center offset from a 2 ft chord). The manual straightedge and computerized simulation of the manual straightedge methods both use maximum offsets from chords of varying lengths up to 10 ft.

To develop an understanding of the relationship among these approaches, the committee undertook a study of six groups of 100 individual profiles each (600 total). The profiles included all quality levels likely to be produced using current construction techniques; each of the profiles was 100 ft long. Table R4.8.4 shows partial results of that study. Evaluation of the results resulted in the tolerance values contained in Sections 4.8.5 and 4.8.6.

Floor surface classifications shown in Sections 4.8.5 and 4.8.6 vary from conventional at the low end to super flat at the high end of the flatness/levelness spectrum. Although there is no direct correlation among the described tolerancing methods, similarly classified floors in Sections 4.8.5 and 4.8.6 should provide the user with floor surfaces of approximately the same flatness and levelness.

Floor surfaces in the conventional category can be routinely produced using strikeoff and finishing techniques that include no restraightening operations after initial strikeoff. This classification of floor surface is generally not compatible with floor coverings such as carpeting and vinyl flooring. Conventional floor surface tolerances are appropriately applied to areas such as mechanical rooms, nonpublic areas, or surfaces under raised computer flooring or thick-set tile.

The moderately flat classification of surface tolerances will routinely require the use of float dish attachments to the power float machines or some restraightening of the concrete surface during finishing operations to consistently achieve flatness requirements. The moderately flat surface can routinely be produced by using a wide bull float (8 to 10 ft) to smooth the concrete and a modified highway straightedge

Table R4.8.4—Methods to evaluate flatness

Floor classification	F_F flatness (SOF_F)	10 ft manual straightedge maximum gap, in.
Conventional	20	0.628 to 0.284
Moderately flat	25	0.569 to 0.254
Flat	35	0.359 to 0.163
Very flat	45	0.282 to 0.144
Super flat	60	0.253 to 0.135
Floor classification	**10 ft manual straightedge maximum gap, in.**	**SOF_F range**
Conventional	1/2	17.4 to 27.7
Moderately flat	3/8	20.3 to 34.9
Flat	1/4	24.0 to 45.9
Very flat	3/16	31.7 to 64.3
Super flat	1/8	37.7 to 109.3

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to restraighten the surface after completion of the initial power float pass. The use of a rider with float dishes attached to the trowel blades can reduce the amount of restraightening required by the modified highway straightedge. An appropriate use of floor surfaces with this classification would be carpeted areas of commercial office buildings or industrial buildings with low-speed vehicular traffic.

Flat floor tolerances are appropriate for concrete floors under thin-set ceramic, vinyl tile, or similar coverings. Flat floor tolerances are also appropriate for use in warehouses employing conventional lift trucks and racks. The flat classification requires restraightening after floating and is the highest feasible tolerance level for suspended slabs.

Very flat floor tolerances are generally restricted to high-end industrial applications, such as might be required for successful operation of high-speed lift trucks, air pallets, or similar equipment. Multiple restraightenings in multiple directions following both the floating and initial finishing phases are required to produce floors conforming to very flat tolerances. The use of a laser screed or rigid edge forms up to 30 ft apart can achieve the required degree of levelness.

The super-flat category is the highest quality random traffic floor surface classification that can be routinely produced using current technology. Only skilled contractors, using sophisticated equipment, will be able to achieve this level of quality. Restraightening operations for this floor category are more rigorous than that described for the very flat category. The super-flat random traffic category is only appropriate for limited applications, such as TV production studios.

Another type of super-flat floor surface, one that falls outside the scope of random traffic specifications, is that which is required for defined traffic applications, such as narrow aisle industrial warehouse floors. The aisle width in these installations is typically about 5 ft wide, and the narrow clearance between the vehicles and racks requires construction of an extremely smooth and level surface. The tolerance requirements normally dictate strip placement of concrete using closely spaced rigid forms (approximately 15 ft on center), but they can occasionally be achieved without narrow strip placement by skilled contractors using sophisticated equipment.

The evaluation of the super-flat defined traffic surface classification requires specialized techniques that should be agreed on by all parties before construction. The test method should measure:

1. The maximum transverse elevation difference between wheel tracks;
2. The maximum elevation difference between front and rear axle; and
3. The maximum rate of change per foot for 1 and 2 as the vehicle travels down the aisle.

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Flatness of defined traffic wheel tracks can also be specified by reference to ASTM E1486, Section 4.9.

The remedy for noncompliance with specified defined flatness tolerances should be included in specification language. For random traffic slabs-on-grade, the remedy can range from liquidated damages, to localized grinding, to application of a topping, to removal and replacement, depending on the purpose for which the slab is being installed. The remedy for defined traffic installations is generally grinding of high spots.

4.8.4.4 Floor test surfaces shall be measured and reported within 72 hours after completion of slab concrete finishing operations and before removal of any supporting shores.

R4.8.4.4 The purpose for establishing a default 72-hour time limit on the measurement of floor surfaces is to avoid any possible conflict over the acceptability of the floor and to alert the Contractor of the need to modify finishing techniques on subsequent placements, if necessary, to achieve compliance. All slabs will shrink; joints and cracks in slabs-on-ground will curl with time, resulting in a surface that is less flat with the passage of time. If the needs of the user are such that a delay in testing is necessary to allow successful installation of subsequent Work, this requirement for delayed testing should be clearly stated in the specifications.

4.8.4.5 Test reports shall be distributed to the Owner, the Architect, the General Contractor, and the flatwork contractor.

4.8.4.6 Test surface measurements shall not cross planned changes in floor surface slope.

R4.8.4.6 Ramped (sloped) surfaces can be toleranced by reference to ASTM E1486 or the average slope of 15 ft least squares fit of each survey line calculated in accordance with ASTM E1486, Section 4.11 and Eq. (21), (22), and (23). Survey lines should be parallel to the direction of slope. In instances where the Specifier chooses to provide a tolerance at construction joints, specific provisions for data collection should be included in the Project Specifications.

4.8.4.7 Test results shall be reported in a manner that will allow the data to be verified or the tests to be replicated.

4.8.5 Random traffic floor finish tolerances as measured in accordance with ASTM E1155 shall conform to the following requirements:

R4.8.5 The F-Number System evaluates the flatness of a floor surface by measuring slope changes over a distance of 2 ft. Specifics of the test procedure are dictated by ASTM E1155. The 2 ft slope change data are evaluated to develop an estimate of the floor's flatness. The system evaluates the levelness of a floor surface by measuring elevation changes relative to a horizontal plane and between points separated by a distance of 10 ft. These 10 ft elevation differences are evaluated to develop an estimate of the floor's levelness. Higher numbers indicate better quality in the surface characteristic being reported.

4.8.5.1 Specified overall values for flatness (SOF_F) and levelness (SOF_L) shall conform to the specified Floor Surface Classifications, as listed in Table 4.8.5.1.

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Table 4.8.5.1—ASTM E1155 method

Floor surface classification	Specified overall flatness SOF_F	Specified overall levelness SOF_L
Conventional	20	15
Moderately flat	25	20
Flat	35	25
Very flat	45	35
Super flat	60	40

4.8.5.2 The SOF_F and SOF_L values shall apply solely to the specified overall area and no subdivision thereof.

4.8.5.3 Minimum local values for flatness (MLF_F) and levelness (MLF_L) shall equal 3/5 of the SOF_F and SOF_L values, respectively, unless noted otherwise.

4.8.5.4 The SOF_L and MLF_L levelness tolerances shall apply only to level slabs-on-ground, or to level suspended slabs that are shored when tested.

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R4.8.5.2 The specified overall values SOF_F and SOF_L are the F_F and F_L numbers to which the completed project floor surface must conform viewed in its entirety. Daily F_F/F_L results may vary above and below SOF_F/SOF_L without consequence, provided: a) that the cumulative results ultimately equal or exceed SOF_F/SOF_L, and b) that the specified MLF_F and MLF_L values are satisfied at all locations. The F-Number System provides daily running totals of the aggregate in-place areas that are less than, equal to, and better than SOF_F and SOF_L. Consequently, after the entire floor has been installed, the system permits the immediate calculation of liquidated damages based on the final aggregate areas defective relative to either SOF_F or SOF_L (whichever yields the larger penalty).

R4.8.5.3 Some local variation in floor surface quality should be anticipated by the Specifier, much as one should anticipate variations in results of concrete compressive tests. These variations can be caused by normal occurrences, such as inconsistent setting time of concrete, changes in ambient conditions, or delays in delivery or placement of the concrete. The specified MLF_F and MLF_L values establish the minimum surface quality that will be acceptable anywhere on any of the concrete placements. Experience has shown that the use of tools and techniques that will generally meet specific SOF_F/SOF_L requirements for the overall concrete placement are also sufficient to meet the associated MLF_F/MLF_L requirements in the minimum local areas. Acceptance or rejection of a minimum local area requires that data collection within the minimum local area in question meet the requirements of ASTM E1155. Because MLF_F and MLF_L, in theory, define the minimum usable floor, MLF_F/MLF_L defects normally require physical modification (that is, grinding, topping, or removal and replacement) of the entire affected minimum local area.

R4.8.5.4 Initial camber, curling, and deflection all adversely affect the conformance of a floor surface to a plane. Limiting the use of F_L to evaluation of level slabs-on-ground and level suspended slabs before shores or forms are removed ensures that the floor's levelness is accurately assessed.

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4.8.6 Random traffic floor finish tolerances as measured by manually placing a freestanding (unleveled) 10 ft straightedge anywhere on the slab and allowing it to rest naturally upon the test surface shall conform to the following requirements:

4.8.6.1 The gap under the straightedge and between the support points shall not exceed either of the values as listed for the specified Floor Surface Classification in Table 4.8.6.1.

Table 4.8.6.1—Manual straightedge method

Floor surface classification	Maximum gap 90% compliance Samples not to exceed	Maximum gap 100% compliance Samples not to exceed
Conventional	1/2 in.	3/4 in.
Moderately flat	3/8 in.	5/8 in.
Flat	1/4 in.	3/8 in.
Very flat	N/A	N/A
Super flat	N/A	N/A

4.8.6.2 The following minimum sampling requirements shall apply for test surfaces evaluated using this tolerance method:

4.8.6.2.1 A test surface is deemed to meet specified tolerances if it complies with the maximum-gap-under-the-straightedge limitations given in Section 4.8.6.1 above. The maximum disparity between a taut string stretched between the bottom corners at the ends of the straightedge and the underside of the straightedge shall not exceed 1/32 in. at any point.

4.8.6.2.2 The minimum number of samples = (0.01) area for floor areas measured in ft^2. A sample is a single placement of the straightedge.

4.8.6.2.3 Orientation of the straightedge shall be parallel, perpendicular, or at a 45-degree angle to longest construction joint bounding the test surface.

4.8.6.2.4 An equal number of samples shall be taken in perpendicular directions.

4.8.6.2.5 Samples shall be evenly distributed over the test surface.

4.8.6.2.6 Straightedge centerpoint locations for samples shall not be closer than 5 ft.

4.8.6.2.7 Test results shall be reported in a manner that will allow the data to be verified or the test to be replicated, such as a key plan showing straightedge centerpoint location and straightedge orientation.

COMMENTARY

R4.8.6 The manual straightedge approach evaluates the flatness of a floor surface by placing a 10 ft long straightedge on the floor surface and measuring the maximum gap that occurs under the straightedge and between the support points.

R4.8.6.1 Measurements should be taken between straightedge support points and perpendicular to its base. Smaller gaps between the straightedge and supporting surface are indicative of higher flatness quality. The use of this approach requires that 90% of the data samples should comply with values in the second column, and 100% of the data samples should comply with values in the third column. This method is not sufficiently precise to evaluate very flat and super-flat categories.

R4.8.6.2 At the time the document was prepared, no nationally accepted specification has been developed to govern evaluation of a floor surface using this procedure; therefore, minimum sampling requirements have been established in this section. The Specifier may provide alternative procedures as long as specific testing requirements and acceptance criteria are established. Test results should be reported in a manner that will allow the data to be verified or the test to be replicated. When using this approach to evaluate floor surfaces, levelness is subject to the provisions of Section 4.4.1; the manual straightedge approach does not directly measure levelness.

SPECIFICATION

4.8.6.3 A computerized simulation of a freestanding 10 ft straightedge test shall be permitted to be used as an alternative to the test procedure established in the Contract Documents or the previous paragraph. Data collection procedures and evaluation of data shall comply with the requirements established in the Contract Documents or Section 4.8.6.2.

4.8.7 Root mean square (RMS) levelness tolerance in in./ft for floors purposely pitched in one direction shall be obtained per the requirements of Paragraph 4.11 of ASTM E1486. Each survey line used in the RMS levelness calculation shall be parallel with the others and all lines shall be in the direction of the pitch or tilt.

4.9—Sawcut depth in slab-on-ground

4.9.1 Depth of sawcut joint ..... ±1/4 in.

COMMENTARY

R4.8.6.3 A computerized simulation of a manual straightedge approach can be used to evaluate the flatness of a floor surface. Data are taken using an instrument other than a straightedge and processed using a computer to produce results similar to that achieved using a manual straightedge. This method requires that data be collected along lines in a manner similar to that described by ASTM E1155 or ASTM E1486. The flatness is evaluated by moving a simulated 10 ft long straightedge along each data line at 1 ft intervals. No ASTM standard has been developed to govern evaluation of a floor surface using this procedure, so the Specifier should provide specific testing requirements and acceptance criteria as described in the Mandatory Requirements Checklist. Results should be reproducible. When using this approach to evaluate floor surfaces, levelness is subject to the provisions of Section 4.4.1; the computerized simulation of a manual straightedge approach does not directly measure levelness. The Specifier is advised that current available software for computerized simulation of a freestanding 10 ft straightedge does not meet the requirements of Section 4.8.6.2.

SECTION 5—CAST-IN-PLACE CONCRETE AT INTERFACE WITH PRECAST CONCRETE (EXCEPT TILT-UP CONCRETE)

SPECIFICATION

COMMENTARY

Tolerances for construction and erection of precast concrete units are not part of this standard. Refer to ITG-7 "Specification for Tolerances for Precast Concrete" for precast concrete tolerances. Tolerances in this standard apply to cast-in-place concrete elements that interface with precast concrete elements.

Tolerances for tilt-up concrete are specified in Section 15.

5.1—Deviation from elevation—cast-in-place concrete

5.1—Deviation from elevation—cast-in-place concrete

5.1.1 *Isolated footing* .....+1/2 in.
.....–2 in.

R5.1.1 *Isolated footing*—Refer to Fig. R5.1.1.

5.1.2 *Continuous footing* .....+1/2 in.
.....–1 in.

R5.1.2 *Continuous footing*—Refer to Fig. R5.1.2.

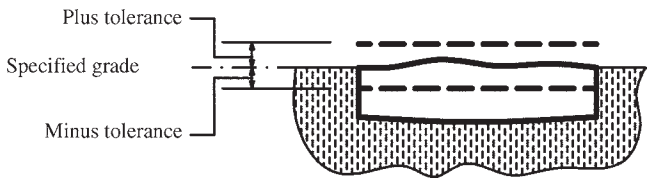

Fig. R5.1.1—Isolated footing: elevation view.

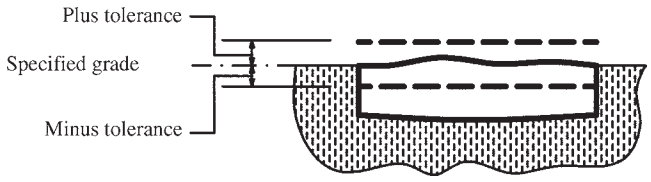

Fig. R5.1.2—Continuous footing: elevation view.

SPECIFICATION

5.1.3 *Pilasters, pedestals, and columns* ..... +1/4 in.
..... –3/4 in.

5.1.4 *Individual corbels* ..... +1/4 in.
..... –1/2 in.

5.1.5 *Continuous ledges* ..... +1/4 in.
..... –1/2 in.

5.1.6 *Walls* ..... +1/4 in.
..... –3/4 in.

5.1.7 *Embedded fabricated bearing surface assemblies* ..... +1/4 in.
..... –1/2 in.

5.1.8 *Grout-filled steel sleeve splice* ..... ±1/2 in.

5.1.8.1 Top of embedded dowel ..... ±1/2 in.

5.1.8.2 Top of embedded sleeve ..... +1 in.
..... –1/4 in.

5.1.9 *Anchor bolts* .....refer to Section 2.3.4

5.1.10 *Embedded plates* ..... ±1 in.

5.1.11 *Inserts and assemblies with inserts* ..... ±1/2 in.

5.1.12 *Embedded items flush with unformed concrete surface except grout-filled sleeves* ..... ±1/2 in.

COMMENTARY

R5.1.3 *Pilasters, pedestals, and columns*—Refer to Fig. R5.1.3.

R5.1.4 and R5.1.5 *Individual corbels and continuous ledges*—Refer to Fig. R5.1.4 and R5.1.5.

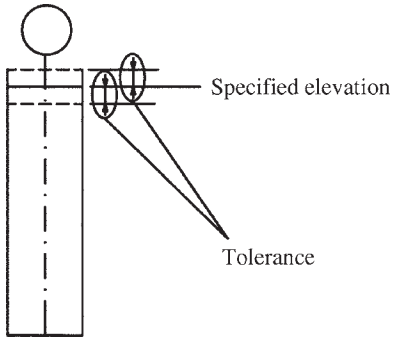

Fig. R5.1.3—Pilasters, pedestals, and columns: elevation view.

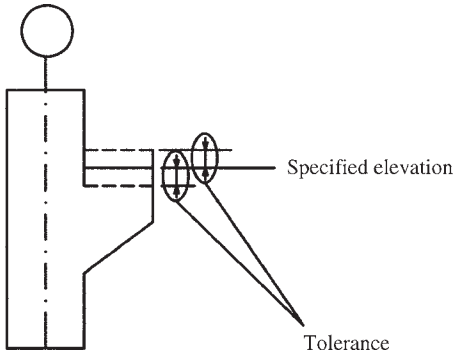

Fig. R5.1.4 and R5.1.5—Individual corbels or continuous ledges: elevation view.

SPECIFICATION

5.2—Deviation from location—cast-in-place concrete

5.2.1 *Horizontal deviation*

5.2.1.1 To a step down in continuous footing....+1 in. .....–3 in.

5.2.1.2 Pilasters, pedestals, and columns.....±1 in.

5.2.1.3 Individual corbels.....±1 in.

5.2.1.4 Top of walls.....±1/2 in.

5.2.1.5 Fabricated bearing surface assemblies flush with concrete surface.....±1/2 in.

5.2.1.6 Grout-filled steel sleeve splice

5.2.1.6.1 Embedded dowel or sleeve.....±1/4 in.

5.2.1.7 Anchor bolts..... refer to Section 2.3.4

5.2.1.8 Distance between vertical surfaces at opposite ends of a precast member .....±1 in.

5.2.1.9 Embedded plates.....±1 in.

5.2.1.10 Inserts and assemblies with inserts....±1/2 in.

5.2.1.11 Embedded items flush with formed concrete surface .....±1/2 in.

COMMENTARY

5.2—Deviation from location—cast-in-place concrete

R5.2.1.1 *To a step down in continuous footing*—Refer to Fig. R5.2.1.1.

R5.2.1.2 *Pilasters, pedestals, and columns*—Refer to Fig. R5.2.1.2.

R5.2.1.3 *Individual corbels*—Refer to Fig. R5.2.1.3.

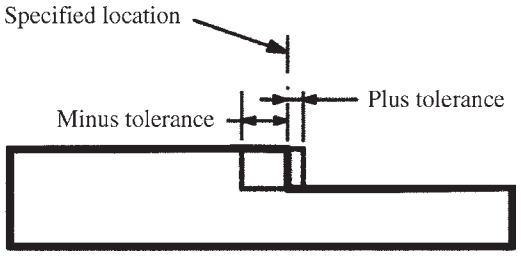

Fig. R5.2.1.1—Continuous footing: elevation view.

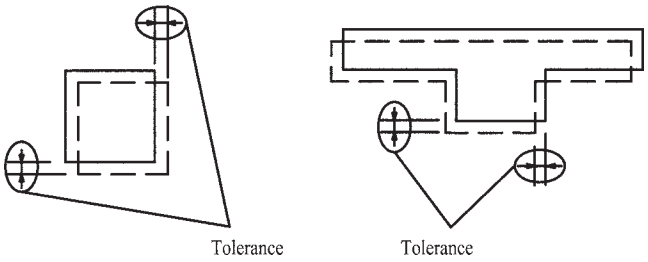

Fig. R5.2.1.2—Pilasters, pedestals, and columns: plan view.

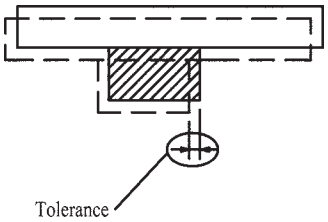

Fig. R5.2.1.3—Individual corbel: plan view.

SPECIFICATION

5.3—Deviation from dimension—cast-in-place concrete

5.3.1 *Specified length*

5.3.1.1 Projection of individual corbels and continuous ledges from face of support ..... ±3/8 in.

5.3.1.2 Walls or beams where precast members abut both ends ..... –1 in.
..... +1/2 in.

5.3.1.3 Steel sleeve for grout-filled steel sleeve splice ..... –1/4 in.

5.3.2 *Specified width*

5.3.2.1 Individual corbels ..... ±3/8 in.

5.3.2.2 Walls, where specified width is 12 in. or less
..... +3/8 in.
..... –1/4 in.

More than 12 in. but not more than 36 in.
..... +1/2 in.
..... –3/8 in.

More than 36 in. ..... +1 in.
..... –3/4 in.

5.3.2.3 Exposed vertical exterior joint with a precast panel

5.3.2.3.1 Up to ±1/3 of the joint width and not to exceed ±1/2 in.

5.3.2.3.2 Variation in width over any 10 ft portion of the joint length or the full length if less than 10 ft
..... ±1/2 in.

COMMENTARY

5.3—Deviation from dimension—cast-in-place concrete

R5.3.1.1 *Projection of individual corbels and continuous ledges from face of support*—Refer to Fig. R5.3.1.1(a) and (b).

R5.3.2.1 *Individual corbels*—Refer to Fig. R5.3.2.1.

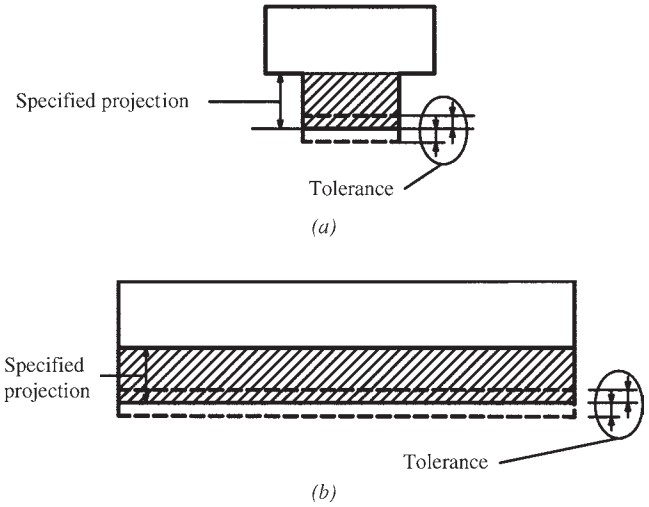

Fig. R5.3.1.1—Projection of individual corbel and continuous ledges: plan view.

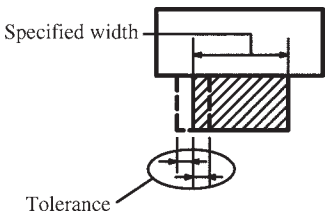

Fig. R5.3.2.1—Width of individual corbel: plan view.

SPECIFICATION

5.4—Deviation from plane at bearing surface—cast-in-place concrete measured over length or width of bearing surface

5.4.1 Walls where specified width is
12 in. or less ..... ±1/8 in.
Greater than 12 in. ..... ±1/4 in.

5.4.2 Individual corbels ..... ±1/8 in.

5.4.3 Continuous ledges ..... ±1/8 in.

COMMENTARY

R.5.4—Deviation from plane at bearing surface—cast-in-place concrete measured over length or width of bearing surface

Refer to Fig. R5.4.

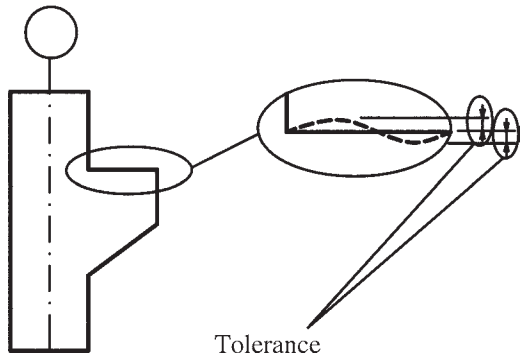

Fig. R5.4—Deviation from plane at bearing surface: elevation view.

Notes

SECTION 6—MASONRY

SPECIFICATION

This specification does not address masonry construction. Refer to ACI 530.1, "Specification for Masonry Structures and Commentary," for masonry tolerances.

COMMENTARY

For guidance and tolerances for masonry, the Specifier should refer to the most recent edition of "Specification for Masonry Structures (TMS 602/ACI 530.1/ASCE 6)."

Notes

SECTION 7—CAST-IN-PLACE, VERTICALLY SLIPFORMED BUILDING ELEMENTS

SPECIFICATION

7.1—Deviation from plumb for buildings and cores

7.1.1 *Translation and rotation from a fixed point at the base of the structure*

Heights 100 ft or less..... ±1/2 in. per level
..... ±2 in. maximum

Heights greater than 100 ft
..... ±1/600 times the height
..... ±1/2 in. per level
..... ±6 in. maximum

7.2—Horizontal deviation

7.2.1 Between adjacent elements ..... ±1 in.

7.2.2 *Horizontal elements*

Edges of openings, sleeves, and embedments 12 in. or smaller..... ±1 in.

Edges of openings, sleeves, and embedments greater than 12 in..... ±2 in.

COMMENTARY

R7.1—Deviation from plumb for buildings and cores

Refer to Fig. R7.1.

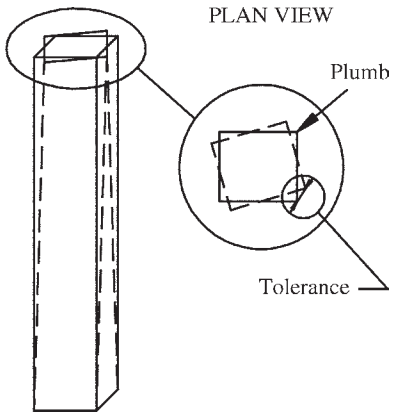

Fig. R7.1—Deviation from plumb for buildings and cores.

R7.2—Horizontal deviation

Refer to Fig. R7.2.1 and R7.2.2.

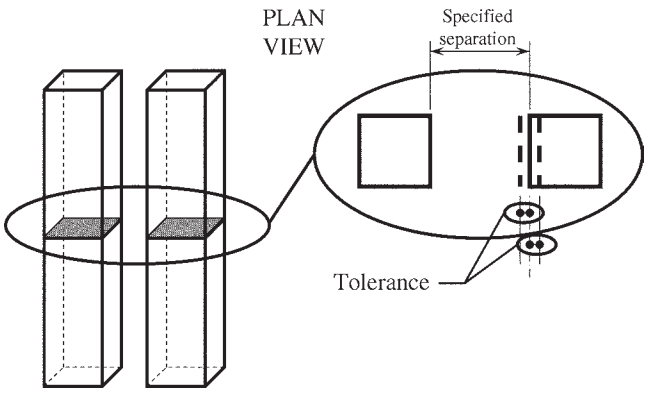

Fig. R7.2.1—Horizontal deviation.

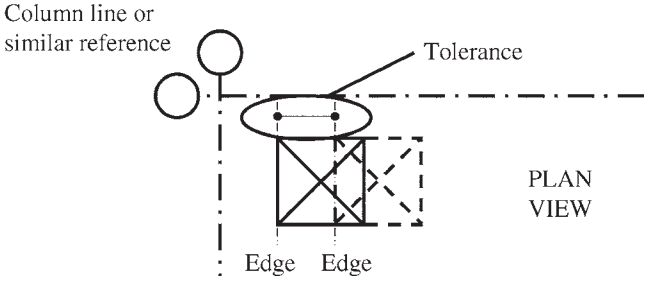

Fig. R7.2.2—Edges of openings, sleeves, and embedments.

SPECIFICATION

7.3—Cross-sectional dimensions

7.3.1 *Columns and walls*
12 in. or less ..... +3/8 in.
..... –1/4 in.

More than 12 in. and less than 36 in.
..... +1/2 in.
..... –3/8 in.

More than 36 in. ..... +1 in.
..... –3/4 in.

7.4—Openings through elements

7.4.1 *Door openings or walk-through type openings*
7.4.1.1 Length or width of opening ..... +1-1/2 in.
..... –1/4 in.

7.4.2 *Other openings and sleeves*
7.4.2.1 Length or width of opening ..... +1 in.
..... –0 in.

7.5—Embedded plates

7.5.1 Length or width of plate ..... + 2 in.
..... –0 in.

7.6—Deviation from plumb for slipformed and jumpformed silos

7.6.1 *Deviation from plumb*
Translation of silo centerline, or rotation of silo wall from a fixed point at the base of the structure
100 ft or less ..... ±3 in.
More than 100 ft ..... ±1/400 of height

7.6.2 *Inside diameter or distance between walls*
Horizontal deviation ..... ±1/2 in. per 10 ft
..... ±3 in.

7.6.3 Cross-sectional dimensions of component
..... +1 in.
..... –3/8 in.

7.6.4 *Location of openings, embedded plates, and anchors*
Vertical deviation ..... ±3 in.
Horizontal deviation ..... ±1 in.

COMMENTARY

R7.3—Cross-sectional dimensions

Refer to Fig. R7.3.1.

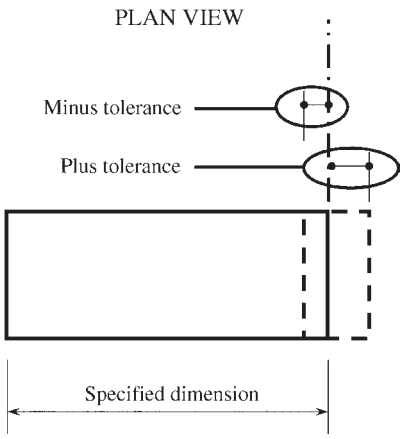

Fig. R7.3.1—Cross-sectional dimensions.

SECTION 8—MASS CONCRETE

SPECIFICATION

8.1—Deviation from plumb

8.1.1 *Surfaces*
Visible surfaces.....±1-1/4 in.
Concealed surfaces.....±2-1/2 in.

8.1.2 Side walls for radial gates and similar watertight joints.....±3/16 in.

8.2—Horizontal deviation

Visible surfaces.....±1-1/4 in.
Concealed surfaces.....±2-1/2 in.

8.3—Vertical deviation

8.3.1 *General*
Visible flatwork and formed surfaces.....±1/2 in.
Concealed flatwork and formed surfaces.....±1 in.

8.3.2 Sills of radial gates and similar watertight joints
.....±3/16 in.

8.4—Cross-sectional dimension

Thickness.....+1 in.
.....–3/4 in.

8.5—Deviation from plane

8.5.1 Slope of formed surfaces with respect to the specified plane shall not exceed the following amounts:

8.5.1.1 *Slopes, vertical deviation*
Visible surfaces..... ±0.2%
Concealed surfaces..... ±0.4%

8.5.1.2 *Slopes, horizontal deviation*
Visible surfaces..... ±0.4%
Concealed surfaces..... ±0.8%

COMMENTARY

The Specifier should review the ACI standards referenced in this document and designate which portions of the structure are mass concrete.

R8.1, R8.2, R8.3, R8.4, and R8.5

Refer to commentary Sections R4.1.1, R4.2.1, R4.2.2, R4.5, and R4.8.2, respectively.

Notes

SECTION 9—CANAL LINING

SPECIFICATION

9.1—Horizontal deviation

9.1.1 *Surfaces*
Visible surfaces.....±1-1/4 in.

9.1.2 Alignment of curves .....±4 in.

9.1.3 Width (W) of section at any height
.....±(0.0025W + 1 in.)

9.2—Vertical deviation

9.2.1 Profile grade .....±1 in.

9.2.2 Surface of invert .....±1/2 in.

9.2.3 Surface of side slope .....±1/2 in.

9.2.4 Height (h) of lining..... ±(0.005h + 1 in.)

9.3—Cross-sectional dimensions

Thickness of lining cross section
..... ±10% of specified thickness

COMMENTARY

R9.1, R9.2, and R9.3

Refer to commentary Sections R4.2.1, R4.2.2, and R4.5, respectively.

Notes

SECTION 10—MONOLITHIC WATER-CONVEYING TUNNELS, SIPHONS, CONDUITS, AND SPILLWAYS

SPECIFICATION

10.1—Horizontal deviation

10.1.1 Centerline alignment.....±1/2 in.

10.1.2 Inside dimensions
.....±0.5% times inside dimension

10.2—Vertical deviation

10.2.1 Profile grade .....±1/2 in.

10.2.2 Surface of invert.....±1/4 in.

10.2.3 Surface of side slope .....±1/2 in.

10.3—Cross-sectional dimensions

10.3.1 *Cross section thickness at any point*
Increase thickness: greater of 5% of thickness, or
.....+1/2 in.

Decrease thickness: greater of 2.5% of thickness, or
.....–1/4 in.

10.4—Deviation from plane

10.4.1 Slope of formed surfaces with respect to the specified plane shall not exceed the following amounts when measured with a 10 ft straightedge:

10.4.1.1 *Vertical deviation*
Visible surfaces..... ±0.2%
Concealed surfaces ..... ±0.4%

10.4.1.2 *Horizontal deviation*
Visible surfaces..... ±0.4%
Concealed surfaces ..... ±0.8%

COMMENTARY

R10.1, R10.2, R10.3, and R10.4

Refer to commentary Sections R4.2.1, R4.2.2, R4.5, and R4.8.2, respectively.

Notes

SECTION 11—CAST-IN-PLACE BRIDGES

SPECIFICATION

11.1—Deviation from plumb

11.1.1 Exposed surfaces .....±3/4 in.

11.1.2 Concealed surfaces .....±1-1/2 in.

11.2—Horizontal deviation

11.2.1 Centerline alignment.....±1/2 in.

11.2.2 Centerline of bearing .....±1/8 in.

11.2.3 Abrupt form offset at barrier rail.....±1/8 in.

11.2.3.1 Location of openings through concrete elements .....±1/2 in.

11.3—Vertical deviation

11.3.1 Profile grade .....±1 in.

11.3.2 *Top of other concrete surfaces and horizontal grooves*
Exposed.....±3/4 in.
Concealed.....±1 in.

11.3.3 Location of openings through concrete elements
.....±1/2 in.

11.4—Length, width, or depth of specified elements

11.4.1 Bridge slab thickness.....+1/4 in.
.....–1/4 in.

11.4.2 Elements such as columns, beams, piers, and walls.....+1/2 in.
.....–1/4 in.

11.4.3 Openings through concrete elements .....±1/2 in.

COMMENTARY

R11.2—Horizontal deviation

R11.2.2 Centerline of bearing refers to the primary girders or stringers. On highway plans, dimensions are usually given in hundredths of a foot. Inches are used here to conform to the rest of this document.

R11.3—Vertical deviation

R11.3.1 Profile grade refers to the upper surface of an overpass. If the structure creates a highway underpass, then the clearance from the profile grade to the bottom of the lowest structural element should be +1 in., –0 in.

SPECIFICATION

COMMENTARY

11.5—Deviation from plane

11.5.1 Slope of formed and unformed surfaces with respect to the specified plane shall not exceed the following amounts in 10 ft:

Watertight joints ..... ±1/8 in.
Other exposed surfaces ..... ±1/2 in.
Concealed surfaces..... ±1 in.

11.5.2 Driving surface finish tolerances and method of measuring.....not specified

11.6—Deck reinforcement cover

..... +1 in.
..... –0 in.

11.7—Bearing pads

11.7.1 Horizontal deviation of centerline ..... ±1 in.

11.7.2 Edge dimensions in plan ..... ±1 in.

11.7.3 Deviation from plane.....±0.10%

SECTION 12—EXTERIOR PAVEMENTS AND SIDEWALKS

SPECIFICATION

12.1—Horizontal deviation

12.1.1 Placement of dowels.....±1-1/4 in.

12.1.2 *Alignment of dowels, relative to centerline of pavement*
18 in. or less projection.....±1/4 in.
Greater than 18 in. projection .....not established

12.2—Vertical deviation of surface

12.2.1 Mainline pavements in longitudinal direction, the gap below a 10 ft unleveled straightedge resting on highspots shall not exceed ..... not specified

12.2.2 Mainline pavements in transverse direction, the gap below a 10 ft unleveled straightedge resting on highspots shall not exceed ..... not specified

12.2.3 Ramps, sidewalks, and intersections, in any direction, the gap below a 10 ft unleveled straightedge resting on highspots shall not exceed.....+1/4 in.

12.2.4 Driving surface finish tolerances as specified in Contract Documents.

COMMENTARY

R12.2.1 and R12.2.2 Smoothness tolerances are not addressed within this document. Engineers and contractors should refer to the regional and local highway and roadway departments, including the American Association of State Highway and Transportation Officials (AASHTO).

Notes

SECTION 13—CHIMNEYS AND COOLING TOWERS

SPECIFICATION

13.1—Deviation from plumb

Translation, rotation, or variance from the vertical axis shall not exceed the greater of ±0.1% times the height at time of measurement or ±1 in.

In any 10 ft of height, the geometric center of the chimney or cooling tower element shall not change more than.....±1 in.

13.2—Outside shell diameter

Outside shell diameter ±1% of the specified diameter plus 1 in.

13.3—Wall thickness

The average of four wall thickness measurements taken over a 60-degree arc shall not exceed:

specified wall thickness 10 in. or less

.....+1/2 in.

.....–1/4 in.

specified wall thickness greater than 10 in.

.....+1 in.

.....–1/2 in.

COMMENTARY

Tolerance requirements for openings and items embedded within concrete chimneys must be established on an individual basis depending on the specific nature of their use.

Notes

SECTION 14—CAST-IN-PLACE NONREINFORCED PIPE

SPECIFICATION

14.1—Wall thickness

Wall thickness at any point shall be equal to the specified wall thickness of the pipe but no greater than the specified thickness plus 0.07 multiplied by the specified inside diameter
.....–0 in., + 0.07 × the specified inside diameter

14.2—Pipe diameter

The internal diameter at any point shall not be less than 98% of the design diameter.

14.3—Offsets

At form laps and horizontal edges shall not exceed:
For pipe with an internal diameter not less than 42 in.
.....±1/2 in.

For pipe with an internal diameter greater than 42 in. or less than or equal to 72 in. .....±3/4 in.

For pipe with an internal diameter greater than 72 in.
.....±1 in.

14.4—Surface indentations

Maximum allowable .....±1/2 in.

14.5—Grade and alignment

14.5.1 Vertical deviation from grade
.....±1 in. per 10 ft
..... ±1-1/2 in. maximum

14.5.2 Horizontal deviation from alignment
.....±2 in. per 10 ft
..... ±4 in. maximum

14.6—Concrete slump

For pipe with an internal diameter less than 42 in.
.....±1-1/2 in.

For pipe with an internal diameter from 42 in. up to 72 in.
.....±1 in.

For pipe with an internal diameter greater than 72 in.
.....±1/2 in.

COMMENTARY

Cast-in-place concrete pipe tolerances relate to the accuracy of construction that can be achieved using machinery and equipment consistent with the standard practice for local soil types.

Notes

SECTION 15—TILT-UP CONCRETE

SPECIFICATION

COMMENTARY

15.1—Panel forming

15.1.1 *Deviation from specified height or width*

Where specified height or width is 20 ft or less.....±1/4 in.
Each additional 10 ft or part thereof .....±1/8 in.
Not to exceed.....±1/2 in.

15.1.2 *Deviation from specified thickness, measured (before edge form removal) using a string stretched taut over 1/2 in. thick blocks attached to the tops of the edge forms*

Unformed surface .....–1/4 in.
.....+1/2 in.

R15.1.2 To conform to the +1/2 in. thickness tolerance, the unformed surface of the panel should not touch the string at any location. To conform to the –1/4 in. tolerance, the panel should not be more than 3/4 in. below the string at any location.

Rather than measuring the panel thickness directly, string testing the upper panel surface before form removal infers compliance with the specified thickness tolerances by assuming that:

- The edge form height equals the nominal panel thickness;
- The edge forms are erected directly on the casting bed; and
- The surface profile of the casting bed is no worse than F_F-18/F_L-13.

Note that F_F-18/F_L-13 is the lowest-quality floor profile discussed in ACI 302.1R, and panels cast on such an irregular surface may have aesthetic problems.

15.1.3 *Difference in length of the two diagonals, of a rectangular member or opening, where length of diagonal is*

6 ft or less .....±1/8 in.
Each additional 6 ft or part thereof .....±1/8 in.
Not to exceed.....±1/2 in.

15.1.4 Opening dimension.....±1/4 in.

R15.1.4 A perfectly rectangular opening or member will have diagonals of equal length.

15.2—Deviation from plumb

15.2.1 *For heights less than or equal to 83 ft 4 in.*

The lesser of 0.3% times the height above the top of foundations as shown on Project Drawings or.....±1 in.

15.2.2 *For heights greater than 83 ft 4 in.*

The lesser of 0.1% times the height above the top of foundations as shown on Project Drawings or .....±2 in.

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15.3—Deviation from elevation

Top of exposed individual panel ..... ±1/2 in.

Top of non-exposed individual panel ..... ±3/4 in.

Difference at top of adjacent exposed panels .. ±1/2 in.

Difference at top of adjacent non-exposed panels
..... ±3/4 in.

Foundations..... +1/4 in.
..... –1/2 in.

Base of erected panel ..... ±1/4 in.

Bearing plates or seats..... ±1/4 in.

15.4—Deviation from location

15.4.1 *Fabrication*
Edge of opening in panel..... ±1/4 in.

Inserts, bolts, sleeves ..... ±3/8 in.

Flashing reglets ..... ±1/2 in.

Lifting inserts ..... ±1/2 in.

Weld plates..... ±1 in.

Bearing plates or seats..... ±1/2 in.

15.4.2 *Erection*
From centerline of steel (governs over grid datum)
..... ±1/2 in.

From building grid datum, measured at base of panel
..... ±1/2 in.

15.5—Deviation from slope or plane

15.5.1 *Fabrication*
Weld plates..... ±1/4 in.

Bearing plates and seats..... ±1/8 in.

Edge of panel from centerline of panel..... ±3/8 in.

15.5.2 *Erection*

15.5.2.1 *Bowing (due to erection stresses), measured within 72 hours after erection*
.....1/360 times the panel diagonal dimension, but not more than ±1 in.

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15.5.2.2 Differential bowing, as erected, between adjacent members of the same design.....±1/2 in.

15.5.2.3 *Warping (due to erection stresses), measured within 72 hours after erection*
.....1/16 in. per foot from nearest adjacent corner, but not more than ± 1 in.

15.5.2.4 *Joint taper*
Over panel height .....±1/2 in.
Per 10 ft .....±3/8 in.

15.5.2.5 *Offset in alignment of adjacent matching faces*
Exposed.....±3/8 in.
Non-exposed .....±3/4 in.

Corners, exposed and non-exposed.....±1/2 in.

15.6—Deviation from relative widths

Joint width (governs over variation in joint width)
.....±3/8 in.

Variation in joint width over length of panel.....±1/2 in.

Notes

COMMENTARY

NOTES TO SPECIFIER

ACI Specification 117-10 is incorporated by reference in the Project Specification using the wording in G3 of the General Notes. The Specifier may include information from the Mandatory Requirements Checklist and Optional Requirements Checklist that follow the Specification. The Specifier, however, must select the items and include them separately in the Project Specifications.

General notes

G1. ACI Specification 117-10 is intended to be used by reference or incorporation in its entirety in the Project Specification. Do not copy individual Sections, Parts, Articles, or Paragraphs into the Project Specification, because taking them out of context may change their meaning.

G2. If Sections or Parts of ACI Specification 117-10 are copied into the Project Specification or any other document, do not refer to them as an ACI specification because the specification has been altered.

G3. A statement such as the following will serve to make ACI Specification 117-10 a part of the Project Specification: "Work on (Project Title) shall conform to all requirements of ACI 117-10, published by the American Concrete Institute, Farmington Hills, Michigan, except as modified by these Contract Documents."

G4. Each technical section of ACI Specification 117-10 in this Standard associated with items in the Mandatory Requirements Checklist are accompanied by text indicating an item in the section is specified in the Contract Documents. Sections in this Standard associated with items in the Optional Requirements Checklist establish a default value and are accompanied by the following text, "unless noted otherwise." The language in each technical Section of ACI Specification 117-10 is imperative and terse.

G5. ACI Specification 117-10 is written to the Contractor. When a provision of this Specification requires action by the Contractor, the verb "shall" is used. If the Contractor is allowed to exercise an option when limited alternatives are available, the phrasing "either... or..." is used. Statements provided in the specification as information to the Contractor use the verbs "may" or "will." Informational statements typically identify activities or options that "will be taken" or "may be taken" by the Owner or Architect/Engineer.

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FOREWORD TO CHECKLISTS

F1. This Foreword is included for explanatory purposes only; it does not form a part of ACI Specification 117-10.

F2. ACI Specification 117-10 may be referenced by the Specifier in the Project Specification for any building project, together with supplementary requirements for the specific project. Responsibilities for project participants must be defined in the Project Specifications. ACI Specification 117-10 cannot and does not address responsibilities for any project participant other than the Contractor.

F3. Checklists do not form a part of ACI Specification 117-10. Checklists assist the Specifier in selecting and specifying project requirements in the Project Specifications.

F4. Building codes set minimum requirements necessary to protect the public. ACI Specification 117-10 may stipulate requirements more restrictive than the minimum. The Specifier shall make adjustments to the needs of a particular project by reviewing each of the items in the checklists and including those the Specifier selects as mandatory requirements in the Project Specifications.

F5. The Mandatory Requirements Checklist indicates Work requirements regarding specific qualities, procedures, materials, and performance criteria that are not defined in ACI Specification 117-10.

F6. The Optional Requirements Checklist identifies Specifier choices and alternatives. The Checklist identifies the Sections, Parts, and Articles of the Reference Specification 117-10 and the action required or available to the Specifier. The Specifier should review each of the items in the Checklist and make adjustments to the needs of a particular project by including those selected alternatives as mandatory requirements in the Project Specifications.

F7. *Recommended references*—Documents and publications that are referenced in the Commentary of ACI Specification 117-10 are listed below. These references provide guidance to the Specifier and are not considered to be part of ACI Specification 117-10.

Martinez, J., and Davenport, B., 2005, "The Relationship Between Sawed Joints and Dowel Bars," *Concrete Pavement Progress*, The American Concrete Pavement Association, Skokie, IL, V. 41, No. 3, Mar., 12 pp.; also as an electronic newsletter: http://www.pavement.com/CPP/2005/CPP-March05.pdf. (accessed March 16, 2010)

MANDATORY REQUIREMENTS CHECKLIST

Section/Part/Article	Notes to the Specifier
Section 1—General requirements	
1.1.2 Scope	Tolerance values affect construction cost. Specific use of a tolerance item may warrant less or more stringent tolerances than contained in the specification. Identify in the Contract Documents any tolerances the Contractor is required to achieve, but are not addressed in ACI 117. Designate Exposed Concrete and Architectural Concrete in the Contract Documents. Coordinate tolerances for concrete construction and those of any materials that interface with, or attach to, the concrete structure. Specify concrete tolerances that are more or less stringent than those contained in this specification. Specification of more restrictive tolerances for specialized constructions, such as architectural concrete, often results in an increase in material cost and time of construction. The Specifier should specify dimensional tolerances considered essential to successful execution of the design. Success may require one or more of the individual tolerances to be more restrictive than those contained in ACI 117. The preconstruction meeting provides an opportunity for the design/construction team to identify and resolve, before actual construction, any tolerance compatibility issues relative to concrete Work and materials with which concrete interfaces. Successful resolution of any questions will almost certainly require active participation of the Design Professional. Specify acceptance criteria in accordance with ACI 301 or equivalent.
Section 2—Materials	
2.2 Reinforcement	Tolerances for fabrication, placement, and lap splices for welded wire reinforcement must be specified by the Specifier.
Section 3—Foundations	
3.1 Drilled piers	Specify category of drilled pier. The Specifier should be aware that the recommended vertical alignment tolerance of 1.5% of the shaft length indicated in Category B drilled piers is based on experience in a wide variety of soil situations combined with a limited amount of theoretical analysis using the beam on elastic foundation theory and minimum assumed horizontal soil restraint.
Section 4—Cast-in-place concrete for buildings	
4.8.3 Form offsets	Designate class of surface (A, B, C, D) (also refer to ACI 301 and 347): Class A: For surfaces prominently exposed to public view where appearance is of special importance; Class B: Coarse-textured, concrete-formed surfaces intended to receive plaster, stucco, or wainscoating; Class C: General standard for permanently exposed surfaces where other finishes are not specified; and Class D: Minimum quality surface where roughness is not objectionable, usually applied where surfaces will be concealed.
4.8.4 Floor finish	Designate Section 4.8.5 and 4.8.6. Refer to Table R4.8.4.
4.8.4.1	Designate the surface classification for all floors. Refer to Tables 4.8.5.1 and 4.8.6.1.
4.8.5.1	Designate Floor Surface Classification.
4.8.6.1	Designate Floor Surface Classification.

COMMENTARY

MANDATORY REQUIREMENTS CHECKLIST (cont.)

Section 5—Precast concrete	
	Specify tolerances for precast concrete.
Section 6—Masonry	
	Specify tolerances for masonry elements.
Section 11—Cast-in-place bridges	
11.5.2 Driving surface finish tolerances	Specify driving surface finish tolerances and method of testing.
Section 12—Exterior pavements and sidewalks	
12.2.4	Specify driving surface finish tolerances. Specify method of testing.

OPTIONAL REQUIREMENTS CHECKLIST

Section/Part/Article	Notes to the Specifier
Section 1—General requirements	
1.1 Scope	Specialized concrete construction or construction procedures require the Specifier to include specialized tolerances. ACI committee documents covering specialized construction may provide guidance on specialized tolerances. Specify tolerances for Architectural Concrete. Refer to ACI 303.1 for guidance.
Section 2—Materials	
2.2	CRSI 10MSP, Appendix C, provides valuable information concerning development of details for placement of reinforcement.
2.2.2 Concrete cover	The tolerance for reduction in cover in reinforcing steel may require a reduction in magnitude where the reinforced concrete is exposed to chlorides or the environment. Where possible, excess cover to other protection of the reinforcing steel should be specified instead of reduced tolerance because of the accuracy of locating reinforcing steel using standard fabrication accessories and installation procedures.
2.2.6.1	The Specifier may elect to specify alternate tolerance for horizontal deviation of prestressing reinforcing or prestressing ducts.
2.3.2 Embedded items	Tolerance given is for general application. Specific design use of embedded items may required the Specifier to designate tolerances of reduced magnitude for various embedded items.
Section 3—Foundations	
3.1, 3.2, 3.3, 3.4, and 3.5	Tolerances given are for general application. Refer to ACI 336.1 for guidance.
3.5.3	Plus tolerance for the vertical dimension is not specified because no limit is imposed. Specifier should designate plus tolerance if desired.
Section 4—Cast-in-place concrete for buildings	
4.5.3	Chose plus tolerance for slab thickness.
4.6.1	Specifiers are cautioned that a tighter tolerance should be specified where there is a potential for cutting reinforcement.
4.8	Choose Waviness Index as alternative to methods specified in Section 4.8.5 or 4.8.6. Testing shall be in accordance with ASTM E1486. Specified Overall Surface Waviness Index and Minimum Local Surface Waviness Index must be specified.
4.8.4.3	Designate testing agency.
4.8.4.4	Designate distribution of test reports.
4.8.6.3	Choose computerized simulation of manual straightedge. Specify minimum number of samples, test procedure (must be reproducible), and acceptance criteria.

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Specification for Tolerances for Concrete Construction and Materials and Commentary

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