

10.0

ALIGNMENT, BRACING AND SCAFFOLDING SYSTEMS

10.0 ALIGNMENT, BRACING, SCAFFOLDING SYSTEMS

10.1 SYSTEMS OVERVIEW

The use of an alignment, bracing and scaffolding system is a key component of building with ICFs, because it aides in the construction of walls, provides a safe working platform around the perimeter of the project, provides support for the wall prior to concrete placement, provides an adjustable device for ensuring the walls are straight and plumb, and provides support for walls with liquid concrete.

There are several alignment, bracing and scaffolding systems readily available for use when building with ARXX ICFs. In addition, ARXX has its own alignment, bracing and scaffolding systems which are specifically designed for use with ARXX ICFs and to resist the lateral pressure of concrete placed in accordance with ARXX specifications and ACI 318 and ACI 332, CSA A23.3, and CSA A438.

- › The ARXX bracing, alignment and scaffolding systems R-100, C-120, and C-144 are designed only for use with ARXX forms.

10.2 RELEVANT CODES AND STANDARDS

When using bracing and scaffolding, the requirements of applicable national and local regulations for wind bracing and scaffolding should be review and implemented. The R-100, C-120, and C-144 systems by ARXX are designed to be in compliance with Occupational Health and Safety Administration (OSHA) scaffold standards and CAN/CSA S 269.2 standards to the indicated maximum wind speed.



THERE ARE MANY BRACING, ALIGNMENT AND SCAFFOLDING SYSTEM MANUFACTURERS THAT MAKE BRACING, ALIGNMENT AND SCAFFOLDING SYSTEMS THAT ARE SPECIFICALLY DESIGN FOR ICF CONSTRUCTION. CARE SHOULD BE TAKEN TO ENSURE THAT ANY SYSTEM USED ON AN ARXX PROJECT MEETS THE APPLICABLE SAFETY AND BUILDING CODE REQUIREMENTS.



THE USE OF AN ALTERNATIVE BRACING, ALIGNMENT OR SCAFFOLDING SYSTEM SHOULD BE REVIEWED TO ENSURE THAT THE SYSTEM MEETS THE BASIC REQUIREMENTS TO BUILD STRAIGHT AND PLUMB WALLS. THE USE OF THESE ALTERNATIVE SYSTEMS IS ACCEPTABLE ON ANY WALL BUILT WITH ARXX FORMS.

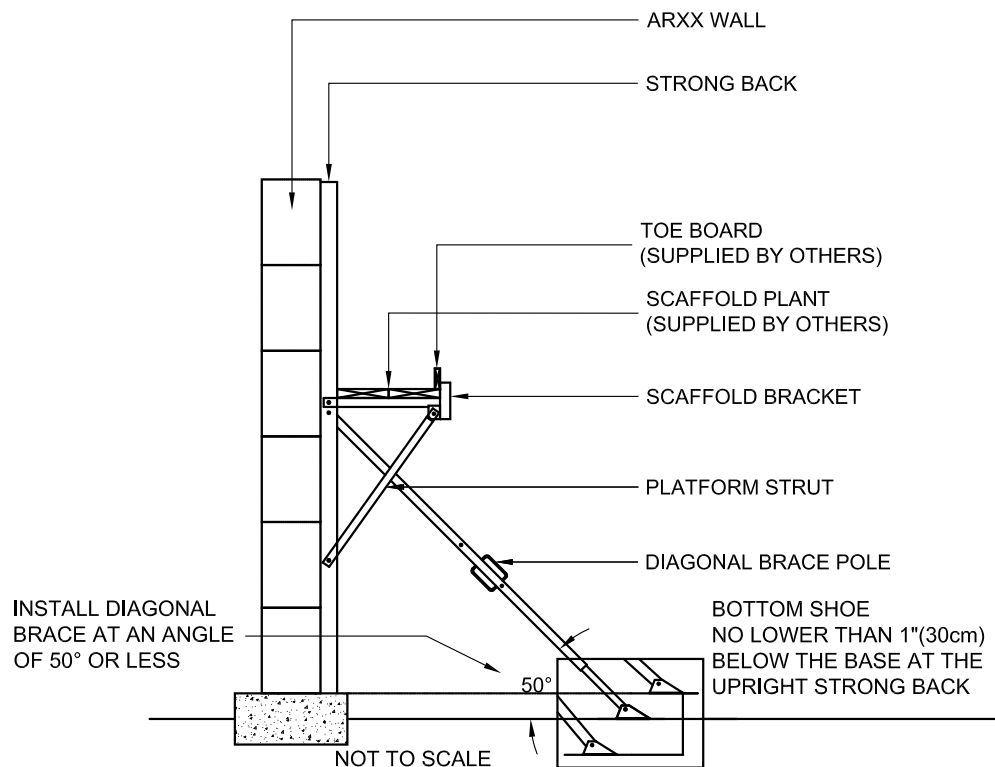
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10.3 ARXX ALIGNMENT, BRACING AND SCAFFOLDING SYSTEMS

10.3.1 ARXX R-100 ALIGNMENT SYSTEMS

Component	Design
Upright Strongback	The main vertical component of the system, the strongback, must be secured to the footing or slab/floor, at the base of the wall. The strongback should be loosely fastened to the ARXX forms in the wall with one screw per course. Gravity pins and holes located on both sides of the strongback provide a connection for the diagonal brace and the scaffold bracket. The strongback is 8'-4" (2.54 m) tall and is designed for use with walls to heights of up to 6 courses.
Diagonal Brace Pole	This component has two fixed adjustment positions; select one and lock in place with a gross positioning pin. The brace pole has fine adjustments, which can adjust the length by turning the turnbuckle. The adjustment should always be set at the mid-point. At the end of the brace pole, there is a bottom shoe that anchors the diagonal brace pole to suitable substrates.
Scaffold Bracket	The bracket mounts with a gravity pin through holes in the side of the strongback in order to provide secure support for the scaffold loads. The R-100 has only one mounting height for the scaffold bracket. This scaffold bracket is designed to accept two 2" x 10" (38 mm x 235 mm) scaffold planks and a 1" (19 mm) thick toe board.

FIGURE 10.3.1-1 MODEL R-100 ASSEMBLY, 100" HIGH WALL (6 COURSES)



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FIGURE 10.3-2 GRAVITY PIN



FIGURE 10.3-3 GROSS POSITIONING PIN

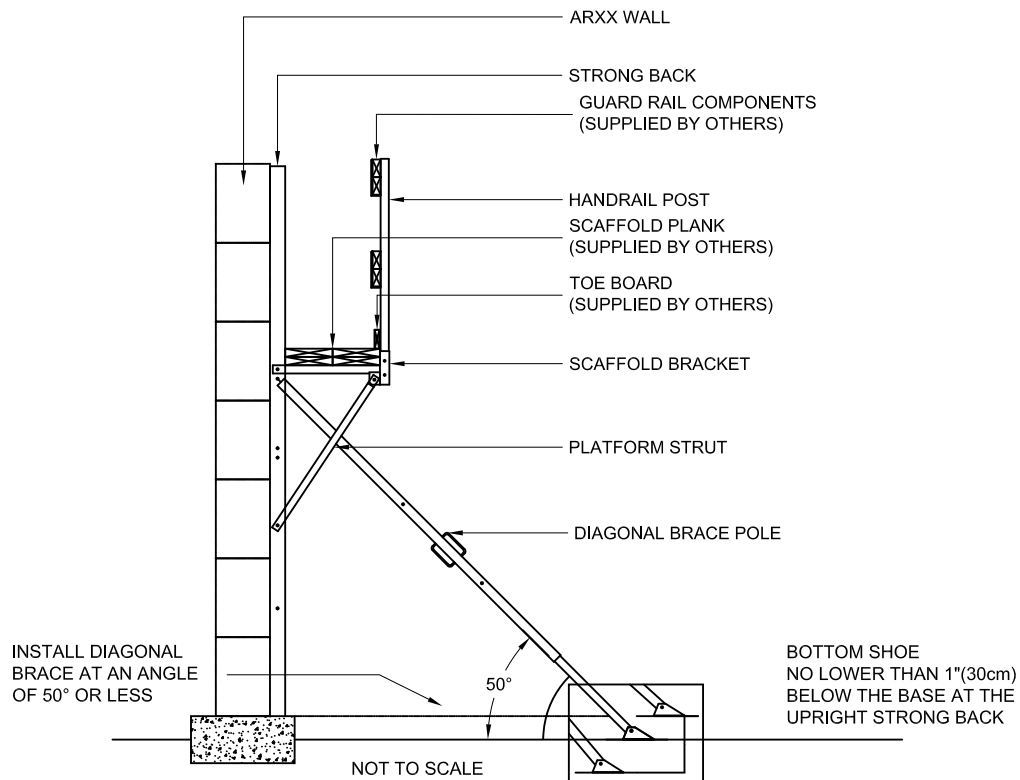


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10.3.2 ARXX C-120 ALIGNMENT SYSTEM

Component	Design
Upright Strongback	The main vertical component of the system, the strongback, must be secured to the footing or slab/floor, at the base of the wall. The strongback should be loosely fastened to the ARXX forms in the wall with one screw per course. Gravity pins and holes located on both sides of the strongback provide a connection for the diagonal brace and the scaffold bracket. The strongback is 9' 8¾" (2.96 m) tall and is designed for use with walls to heights of up to 7 courses.
Diagonal Brace Pole	This component has two fixed adjustment positions; select one and lock in place with a gross positioning pin. The brace pole has fine adjustments, which can adjust the length by turning the turnbuckle. The adjustment should always be set at the mid-point. At the end of the brace pole, there is a bottom shoe that anchors the diagonal brace pole to suitable substrates.
Scaffold Bracket	The bracket mounts with a gravity pin through holes in the side of the strongback in order to provide secure support for the scaffold loads. The C-120 has two mounting positions for the scaffold bracket. This scaffold bracket is designed to accept two 2" x 10" (50 mm x 250 mm) scaffold planks and a 1" (25 mm) thick toe board.
Guardrail Post	A vertical guard support accommodates guardrail members. This component has two fastening points for attaching it to the scaffold bracket.

FIGURE 10.3.2-1 MODEL C-120 ASSEMBLY, 120" HIGH WALL (7 COURSES)

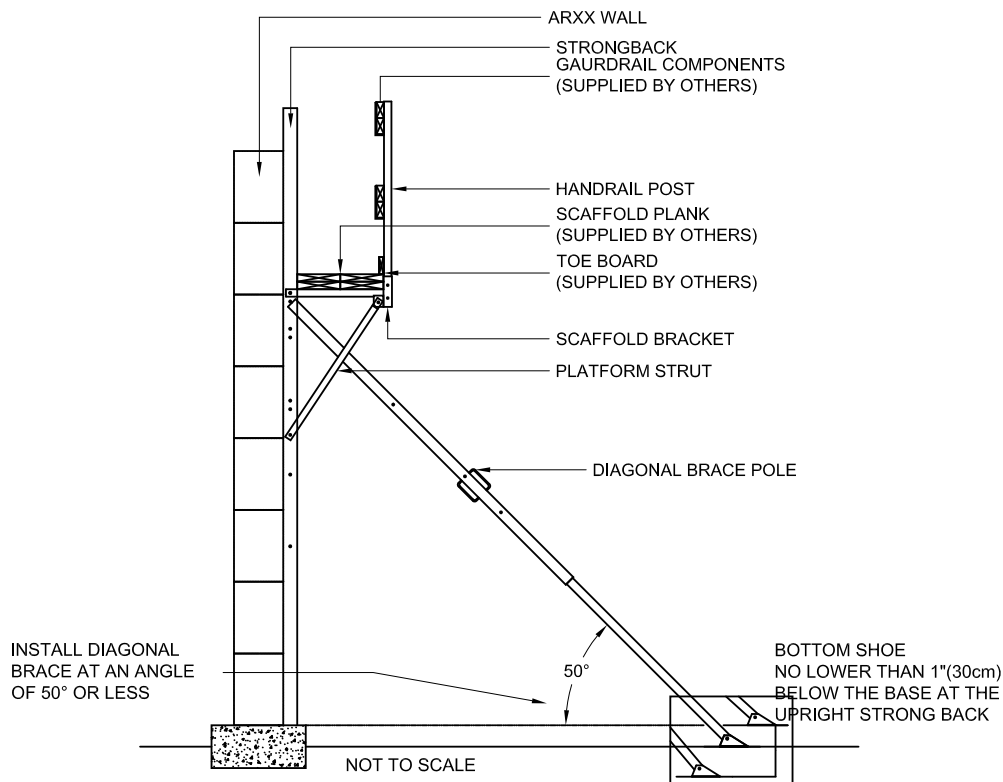


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10.3.3 ARXX C-144 ALIGNMENT SYSTEM

Component	Design
Upright Strongback	The main vertical component of the system, the strongback, must be secured to the footing (slab/floor) at the base of the wall. The strongback should be loosely fastened to the wall forms, with one screw per course. Gravity pins and holes located on both sides of the strongback provide a connection for the diagonal brace and the scaffold bracket. The component is 12' 0" (3.66 m) tall and is designed for use with walls to heights of up to 8.5 courses.
Diagonal Brace Pole	This component has two three adjustment positions; select one and lock in place with a gross positioning pin. The brace pole has fine adjustments, which can adjust the length by turning the turnbuckle. The adjustment should always be set at the mid-point. At the end of the brace pole, there is a bottom shoe that anchors the diagonal brace pole to suitable substrates.
Scaffold Bracket	The bracket mounts with gravity pins through holes in the side of the strongback in order to provide secure support for the scaffold loads. The C-144 has three mounting positions for the scaffold bracket. The scaffold bracket is designed to accept two 2" x 10" (50 mm x 250 mm) scaffold planks and a 1" (25 mm) thick toe board.
Guardrail Post	A vertical guard support accommodates guardrail members. This component has two fastening points for attaching it to the scaffold bracket.

FIGURE 10.3.3-1 MODEL C-144 ASSEMBLY, 142" HIGH WALL (8.5 COURSES)



10.4 INSTALLATION OF THE ALIGNMENT SYSTEM

10.4.1 INSTALL

Any users of the bracing, alignment and scaffolding systems are responsible to research and comply with all applicable local codes.

Generally the bracing, alignment and scaffolding system is erected after the third or fourth course of forms has been installed, and usually on the inside face of the wall. Depending on site conditions, the system also may be installed on the exterior face of the wall. The system provides a continuous working platform around the entire perimeter, making it easier to place forms, concrete and rebar.

Prior to installation of the bracing, alignment and scaffolding system, the placement of the alignment, corner spacing, and spacing around any openings should be planned. The spacing should be set so that the brace poles do not interfere with each other at the corners.

The method of erection is as follows:

1. Reference should be made to the applicable labor regulations such as Occupational Safety and Health Administration (OSHA) in the United States, and the applicable provincial Occupational Health and Safety Acts (OHSA) in Canada. The maximum spacing is typically 6' (1830 mm), and must not exceed 7' (2130 mm). Spacing may be reduced to accommodate the build.
2. The strongback should be loosely fastened to the wall at 16" (406 mm) vertical on center spacing. Ensure that it is fastened into the fastening strip of the web of the forms. It is recommended to use screws with #10 hex heads or pan head self tapping screws that have threads to the underside of head when attaching the strongback to the wall.
 - a) In order to allow the forms to settle during concrete placement and ensure they do not get hung-up on the alignment system, one screw should be placed per course at the top of the slot in the back of the strongback. To allow for proper settling of the forms during concrete placement, care should be taken to not over tighten the screws, as this may prevent the block from settling.
 - b) The base of the strongback should be attached to the concrete footing, or sub-floor, with screws or nails that can resist a horizontal force in any direction, vertical uplift forces, and vertical downward forces (see Section 10.4.8 – Anchor Requirements). When fastening the base of the strongback to a subfloor, it is recommended that the base plate be connected in a way that will allow the forces to be transferred directly into the floor joists or main structural members.
3. The diagonal brace pole is connected to the strongback using a gravity pin, or the equivalent bolts.
 - a) The diagonal brace pole should be adjusted to the center of its thread.
 - b) The bottom shoe of the diagonal brace pole should be fastened to the ground, sub floor, concrete slab, or concrete deadman anchor to resist forces in any direction (Figures 10.4.8-3, 10.4.8-4, 10.4.8-5).
 - i) When fastening the diagonal brace to a sub floor, it is recommended that the bottom shoe be connected in a way that allows the forces to be transferred directly into the floor joists or main structural members.
 - ii) Prior to fastening the bottom shoe, it is important to ensure that the brace pole is installed with an angle that is less than 50 degrees (see Figures 10.3.1-1, 10.3.2-1, 10.3.3-1).

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- iii) The bottom shoe of the brace pole should not be more than 12" (305 mm) vertical distance lower than the strongback base connection.
 - iv) When the substrate conditions are poor or questionable, it is recommended to consult a design professional.
4. Using a level, the wall should be plumbed at the box section by rotating the turnbuckle in the diagonal brace pole. Alternatively, the corners can be plumbed, then a string line run from corner to corner, and then the wall plumbed to the string line.
5. The alignment systems may be removed after the concrete has cured adequately to achieve sufficient strength.
6. If the walls are backfilled prior to the first floor being installed, adequate bracing must be furnished in order for the walls to withstand the pressures of the backfill. This alignment system is not designed to hold back earth pressure. Support for earth pressure must be supplied by other means.
7. All diagonal brace poles should be returned to the center of their adjustments and all parts cleaned and anti-seize compound applied to all moving parts prior to storage.

10.4.2 USEFUL TIPS

It is easier to plumb a wall by pushing the wall with the adjustable brace pole than it is to pull the wall. Therefore, it is recommended to tilt the wall inwards $\frac{1}{4}$ " to $\frac{1}{2}$ " (6 mm to 13 mm) at the top of the wall prior to concrete placement.

With 3' to 6' (915 mm to 1830 mm) wide door and window openings, it may be advantageous to adjust the bracing spacing, keeping the opening clear for the installation of bucks, by setting the alignment unit on each side of these openings. On all other openings, the specified spacing should be maintained.

When in doubt, regardless of the bracing specification, add bracing for circumstances such as multiple corners, small wall segments, etc.

The alignment system should be inspected prior to each use, which allows the construction crew to detect wear and tear or other damage that may be detrimental in its use and performance. Worn or damaged parts should be repaired or replaced.

10.4.3 INSTALLATION OF THE SCAFFOLD

1. To begin assembling the scaffold, place the scaffold bracket so that the connection point is directly on top of diagonal brace pole's fastening position to the strongback. In this position the scaffold bracket can be fastened to the strongback with a bolt through the holes provided. The platform strut is bolted into position at this point so that the scaffold bracket provides the necessary support for the scaffold planks.
2. Place the scaffold grade planks on the scaffold bracket. The scaffold planks must be lapped, in accordance with applicable code requirements, and secured in place with screws. The toe board should also be installed so that it is a minimum of 4" (100 mm) above the scaffold planks.
3. The ends of the planks should be secured at all corners or turns to maintain a safe walking platform.

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10.4.4 INSTALLATION OF THE GUARDRAIL

The guardrail post is placed into the U straps on the scaffold bracket. The guardrail components are then placed and secured with screws into the guardrail post.

10.4.5 WIND RESISTANCE

The ARXX bracing, alignment and scaffolding systems are designed to resist wind loads acting on ARXX walls. Either the scaffolding should be vacated or additional supports should be provided when wind speeds are in excess of 20 mph (32 kph). When using bracing, alignment or scaffolding systems other than ARXX, the manufacturer's recommendations and instructions should be followed and may differ from the recommended installation and tolerances of the ARXX bracing, alignment and scaffolding system.

10.4.6 BRACE POLE: INSTALLATION LIMITATIONS

When installing the pole brace, it is recommended that the diagonal brace should be installed at an angle of 50° or less (see Figures 10.3.1-1, 10.3.2-1, 10.3.3-1) and it should be installed less than 12" (305 mm) below (vertical distance) the bottom of the foot of the strongback.

10.4.7 LIMITATIONS OF THE SCAFFOLD

Depending on the applicable code and site conditions, some job sites require a guardrail. In these cases, the C-120 or C-144 should be used, as the R-100 system does not have a guardrail available.



THE C-120 AND C-144 SCAFFOLD BRACKETS ARE NOT COMPATIBLE WITH THE R-100 SYSTEM.

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10.4.8 ANCHOR REQUIREMENTS

TABLE 10.4.8-1 (IMPERIAL)

MAXIMUM EXTERNAL CONNECTION FORCES (lbf)*				
Model No. Force	Connection	Uplift Force	Downward Force	Horizontal
R100	Strongback Brace	450	1125	450
	Brace Pole Shoe	1125	1125	1125
C120	Strongback Brace	450	1125	450
	Brace Pole Shoe	1125	1125	1125
C144	Strongback Brace	450	1125	450
	Brace Pole Shoe	1125	1125	1125

TABLE 10.4.8-2 (METRIC)

MAXIMUM EXTERNAL CONNECTION FORCES (kN)*				
Model No. Force	Connection	Uplift Force	Downward Force	Horizontal
R100	Strongback Brace	2.0	5.0	2.0
	Brace Pole Shoe	5.0	5.0	5.0
C120	Strongback Brace	2.0	5.0	2.0
	Brace Pole Shoe	5.0	5.0	5.0
C144	Strongback Brace	2.0	5.0	2.0
	Brace Pole Shoe	5.0	5.0	5.0

NOTES:

1. *The above connection forces were determined based on the following assumptions:
 - i. No load and/or safety factors have been applied to any of the loads and/or load combinations (i.e. connection forces are based on specified/working loads).
 - ii. The dead load of the wall and of the ARXX® alignment system was neglected in terms of its contribution to resist the uplift forces.
 - iii. The brace shoe connection was not more than 0.3 m (vertical distance) lower than the upright base connection.
2. These connection forces may be adjusted based on a review by a licensed professional engineer to reflect the actual configuration(s).

It should be noted that the forces given in the table must be modified by applicable factors in accordance with relevant local building codes, standards, and/or regulations. For example, some safety standards state that the scaffolding system must be designed using a factor of safety against overturning of not less than 2 (this means that to achieve this safety factor, the resistance of the external connections would have to be a minimum of two times the forces shown in Tables 10.4.8-1 and 10.4.8-2).

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FIGURE 10.4.8-3 FASTENER REQUIREMENTS - MODEL R-100

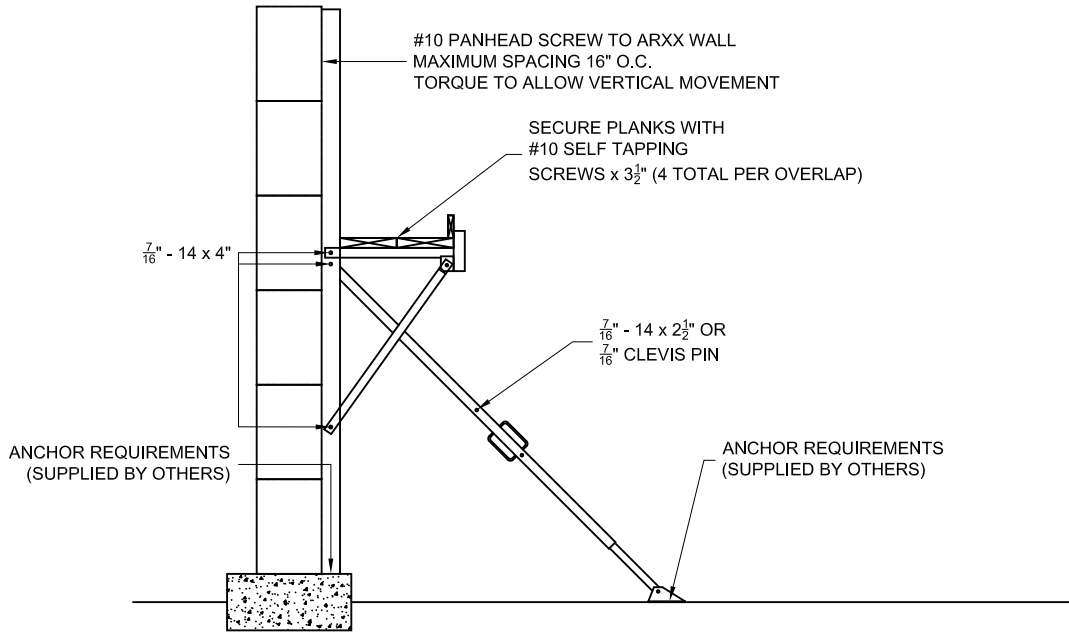
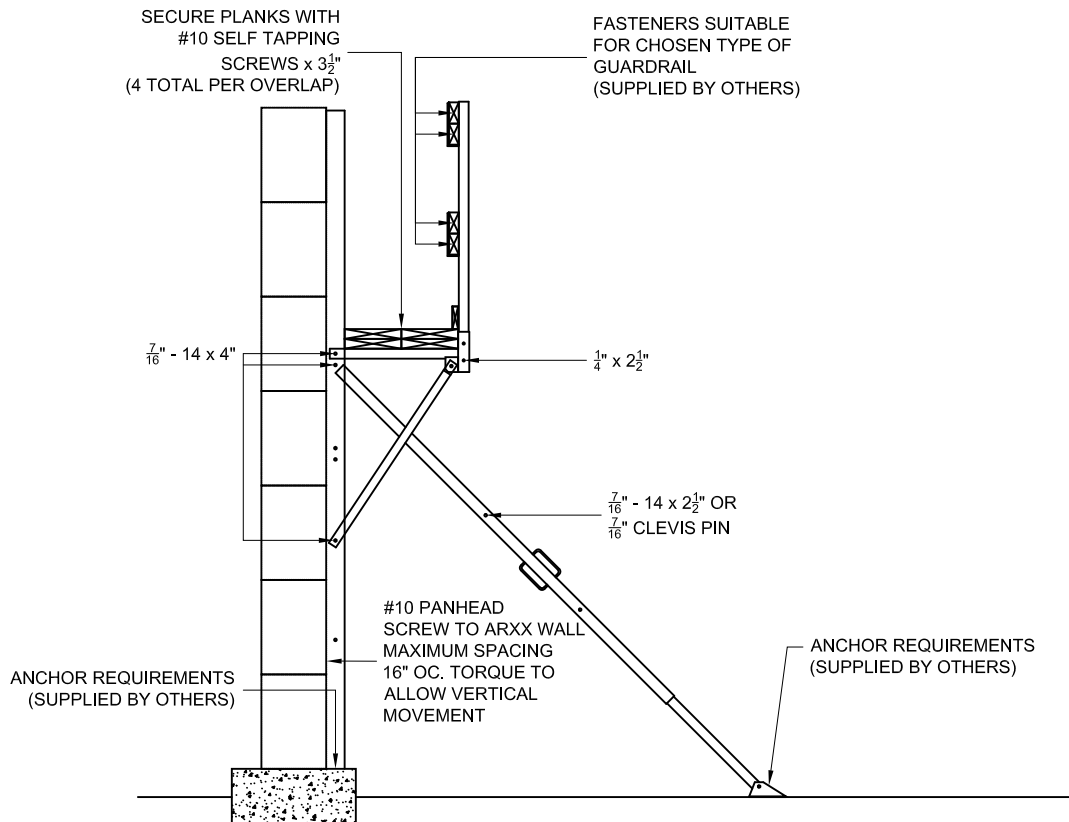
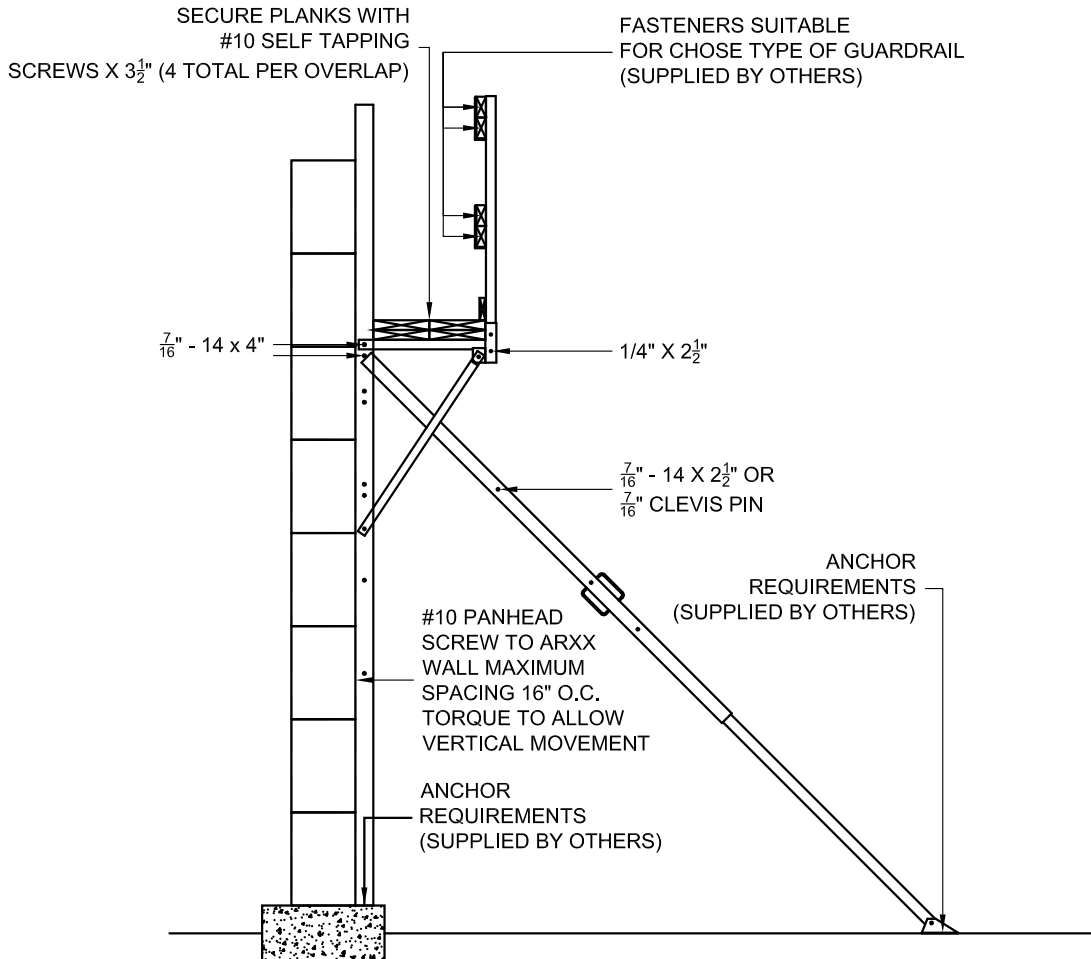


FIGURE 10.4.8.4 FASTENER REQUIREMENTS - MODEL C-120



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FIGURE 10.4.8.5 FASTENER REQUIREMENTS - MODEL C-144



10.5 ALTERNATIVE BRACING, ALIGNMENT AND SCAFFOLDING SYSTEMS

There are many bracing, alignment and scaffolding system manufacturers that make bracing, alignment and scaffolding systems that are specifically designed for ICF construction. Care should be taken to ensure that any system used on an ARXX project meets the applicable safety and building code requirements.

The use of an alternative bracing, alignment or scaffolding system should be reviewed to ensure that the system meets the basic requirements to build straight and plumb walls. The use of these alternative systems is acceptable on any wall built with ARXX forms.

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10.6 WOOD BRACING

For some applications, quality wood bracing may be used. This bracing should be constructed by using 2" x 6" (38 mm x 140 mm) for strongbacks and 2" x 4" (38 mm x 89 mm) as bracing members. The system must be adequately secured in place to withstand the vibration of concrete placement. Consideration must be made on how to adjust the walls, if they require adjustments to be straight and plumb.

Individual wood braces are typically used to provide additional support at corners, T-walls, vertical joints, and small wall segment.

Also, temporary wood bracing may be installed for walls that require support prior to the installation of a floor or roof system, but have had the bracing, alignment and scaffolding systems removed.

10.7 ARXX STEEL AND STEEL WAFFLE BRACING

To assist in supporting and securing the corner forms on the ARXX Steel and ARXX Steel Waffle Grid forms, an additional corner brace may be installed on the outside face of the corner. Some bracing manufacturers have specific corner braces. Wood bracing can also be used. This is an optional application for consideration when using ARXX Steel and ARXX Steel Waffle Grid.

10.8 SUPPLEMENTAL SUPPORT OR STRAPPING

In some applications additional temporary wall support may be required for the EPS prior to the placement of concrete. This supplemental support can be achieved by screwing sections of nominal lumber either 1" x 4" (19 mm x 89 mm) or 1" x 6" (19 mm x 140 mm) to the webs.

For vertical joints or form cuts, fastening the strapping to the web on both sides of the joint should provide more support.

Before concrete placement, it is recommended to always check the walls inside and outside for areas that may require additional supplemental support. During concrete placement, it is wise to be prepared with material to apply additional support if required.

Locations where temporary or additional supplemental support or strapping may be required:

- › vertical form cuts with unsupported EPS that is more than 4" (100 mm) from the web on ARXX Prime and ARXX Edge forms and 3" (75 mm) from the ARXX Steel webs
- › small wall segments or cut form sections that are less than 8" (203 mm) wide
- › horizontal butt joints where the interlock has been removed
- › any continuous vertical joints in a wall
- › damaged blocks
- › T-walls
- › corners

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10.9 POST CONCRETE PLACEMENT

The bracing system may be removed once the concrete has cured adequately to achieve sufficient strength.

10.9.1 HANDLING AND MAINTENANCE

1. The components should be inspected before each use and components that are bent or damaged should not be used.
2. The folding joint of the scaffold bracket should be sprayed with a lubricant to avoid component seizure.
3. The brace pole has a swivel at the top end of the pole that is packed with a zinc-based anti-seize compound when it was manufactured. A spray-on anti-seize compound should be sprayed into the joint of the fitting after each use to avoid seizure of the components.
4. The fine adjuster, located inside the brace pole, is zinc plated and the nut is packed with a similar material at the time of assembly. Anti-seize compound should be applied as required to avoid component seizure.
5. After each use, it is recommended that the contractors inspect the components of the scaffolding systems for damage. Any damaged components should be repaired or replaced.

10.10 TALL WALL - SYSTEM SCAFFOLD

ARXX ICFs are not limited to 10' (3 m) high walls. ARXX ICFs have been designed and built to heights between 12' (3.6 m) and over 60' (18 m), between lateral supports for large-scale, commercial projects.

The Tall Wall Scaffolding System that is designed specifically to work with ARXX ICFs has the ability to align and support walls to heights up to 150' (45 m). This fully engineered system should meet all applicable safety standards.



CONTACT ARXX FOR MORE INFORMATION ON TALL WALL SCAFFOLDING.

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FIGURE 10.10-1 TALL WALL SYSTEM SCAFFOLD

