Recommended Practice

PCI Precast/Prestressed Concrete Institute

Recommended Practice for Embedded Clay Thin Brick in Precast Concrete

Prepared by
Architectural Precast Concrete Committee
Thin Brick Task Group

RP 152-25

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1. Selecting Thin Brick

Select a thin brick that meets the dimensional tolerances, material properties, and testing in accordance with the *PCI Specification for Embedded Clay Thin Brick* (see **Appendix A**).

The precast concrete producer should require that the thin brick manufacturer acknowledge the project requirements. The producer should also require that the thin brick manufacturer indicate that they have read and understand this document and will provide a **certificate of compliance** letter using the sample letter included herein (**Appendix B**).

1.1 Producing and Approving Embedded Thin Brick Samples

Final thin brick approval should occur after a precast concrete sample is created. The precast concrete sample should use the selected thin brick and be created using all proposed precast concrete production processes. When thin bricks (sand faces in particular) are cast into concrete and the panel finishing (such as cleaning, washing, and rinsing) is complete, the final brick appearance may differ from the thin brick manufacturer's sample board. In addition, a precast concrete sample is important because it will show the mortar joint created by the concrete mixture, the formliner profile, and the effects of the precast concrete cleaning and finishing techniques (that is, color and texture), thereby providing the designer with a more accurate representation of the finished product's appearance.

Note: When sampling brick-faced precast concrete, the precast concrete producer should follow PCI's recommended practice for sampling architectural precast concrete components, in accordance with PCI's MNL 116,[1] MNL 117,[2] and MNL 122.[3] This practice includes making 12 × 12 in. initial samples, 4 × 4 ft (or similar) range samples, and one or more full-sized production pieces (to be viewed at the precast concrete plant) that best represent the expected appearance and architectural features.

When the designer selects a brick product that does not meet all the requirements of PCI's specification, the precast concrete producer should require the thin brick manufacturer to provide a **letter of variance** (**Appendix C**) on the brick manufacturer's letterhead (similar to the certificate of compliance) that (a) explains the specific features of their products that do not meet PCI's specification; (b) documents any current testing data related to specific features and tests that are not in compliance (such as, material characteristics, water absorption, freezing-and-thawing resistance of assembly testing, size tolerances, and so on); and (c) describes the history (with precast concrete producer references) of past precast concrete projects that have used the proposed thin brick. This letter should be presented to the precast concrete producer before bidding the project.

Note: The precast concrete producer should share the letter of variance with the designer, construction team, and formliner provider to make all parties aware of the brick manufacturer's limitations and how the selected product differs from PCI's specification.

The thin brick manufacturer should provide the required quantities (including flat pieces and shapes) to the precast concrete producer so precast concrete sample and mock-up panels can be made in accordance with the project specification and at the request of the precast concrete producer. The thin brick provided for the precast concrete mock-up should represent the acceptable thin brick color range in accordance with the MNL 117[2] color-range sample process.

Note Color range is defined by the range of color shades (from light to dark) acceptable to the architect, owner, or other customer decision-maker after mock-up range samples are produced. The term "color range" is not defined as a brick's color blend or mingle.

1.2 Ordering Thin Brick

When ordering thin brick, the precast concrete producer should do the following:

1.2.1 Ask the thin brick manufacturer to provide a certificate of conformance letter using the sample letter included herein (**Appendix B**).

1.2.2 Recognize that thin brick, like full brick, is made of natural materials and produced in runs. Color and texture range within a run and between runs can be expected. This is a standard expectation in the brick industry. It is important to note that even though the brick delivered in the initial order is within an acceptable color range relative to the brick manufacturer's control sample, any subsequent orders of additional thin brick may not match to the original run.

1.2.3 Order thin brick using the manufacturer's name, plant location, thin brick name, and specific thin brick product code number, color, size, and texture.

1.2.3.1 Thin brick size should include the size name (that is, modular, utility, etc.) and specified dimensions (height × length × thickness) for each thin brick type and shape (**Fig. 1**).

1.2.3.2 For corner and edge-cap thin brick, size should include each facial dimension (that is, height × face length × leg length × thickness) for all sides of the unit. (**Fig. 1**)

1.2.3.3 For nonstandard thin brick units, provide the thin brick manufacturer with an approved signed and dimensioned drawing clearly demonstrating the size, shape, angle, thickness, and texture of each face for each type of thin brick unit.

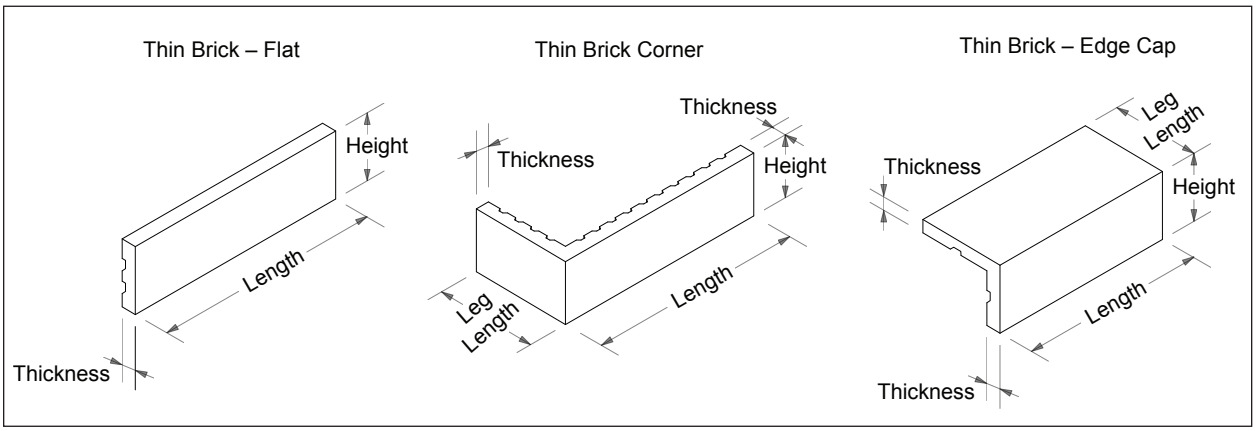

Figure 1. Thin brick dimensions. Note: When ordering thin brick, specify all face dimensions and thickness dimensions as noted in figures for each thin brick type required for the project.

1.2.4 Order thin brick in unit quantities as recommended by the specified thin brick manufacturer or distributor. Where no direction is provided by the thin brick manufacturer or distributor, determine quantities as follows:

1.2.4.1 Flat thin brick—order based on the square feet of wall coverage.

1.2.4.2 Corners, edge caps, edge cap corners, and other special shapes—order in piece counts.

Note: Consult with the thin brick manufacturer or thin brick distributor to determine appropriate conversion rates (linear feet to pieces).

1.2.4.3 As a general rule, allow for a minimum of 5% to 10% thin brick material waste and overage.

1.2.4.3.1 As a general rule, it is recommended to include a waste factor when ordering thin brick. The waste factor is needed to create the desired brick coursing and address

breakage. Accounting for the waste factor in the initial order will avoid production delays related to ordering and receiving more thin brick, and reduce the risk that the thin brick color range in the added order may not match the original order. If the thin brick manufacturer does not have any thin brick from the original run, they will need to run more thin brick, which could delay the project by weeks or months and lead the precast concrete producer to rebuild forms. When determining the amount of waste to be included in the precast concrete producer's project estimate, the precast concrete producer should consult with the thin brick manufacturer or thin brick distributor who has precast concrete knowledge.

1.2.4.3.2 The actual waste and overage amount should be determined by the precast concrete producer based on the specific project requirements. For example, a project with a simple coursing pattern and few cuts will require less overage (approximately 5%), whereas a project with many cuts will require more overage (approximately 10% or more).

1.2.4.3.3 Specific attention should be given to special shapes (corners, edge caps, edge-cap corners, and other special shapes), especially when small quantities are required. When the loss of one precast concrete panel could require a reorder of thin brick materials, it is not uncommon to order an extra 50% (or more) of these specially shaped materials.

1.2.5 Ensure appropriate thin brick face protection.

1.2.5.1 The thin brick manufacturer, formliner manufacturer, and precast concrete producer should collectively determine the best course of action to protect the thin brick face from concrete slurry during precast concrete production. The precast concrete producer or distributor should acknowledge that they are responsible for protecting the wax or other surface protectant once the thin brick is either delivered to and accepted by the precast concrete plant or received by the shipping company hired by the purchaser (precast concrete producer or distributor). The precast concrete producer is also responsible for removing wax or other surface protectant from the cast panel.

1.2.5.2 A coating of paraffin wax applied by the thin brick manufacturer is the most common type of protection, but there are options for form-release products and retarder-type products that can be applied at the precast concrete plant.

1.2.5.2.1 Paraffin wax coatings can be applied in different thicknesses and may have different melting points. Refer to the thin brick manufacturer for detailed wax specifications and recommended cleaning procedures.

1.2.5.2.2 Thin brick with applied wax should not be stored in high-heat environments (such as in direct sunlight or under a dark tarp) where temperatures within the pallet of thin brick or thin brick faces can soften the wax and/or exceed the wax melting point. The precast concrete producer is responsible for protecting the wax from softening and/or melting before thin brick placement.

1.2.5.2.3 Care should be taken to keep the coating off of the sides of the thin brick to ensure proper concrete adherence.

1.2.5.2.4 Some thin brick colors may contain minerals that react to certain chemicals that might be present in release or retarder formulas. It is recommended to test the production and cleaning process before actual precast concrete production begins.

2. Selecting Formliners

Most formliners can be categorized as either multiuse (urethane or rubber) or single-use (plastic) formliners. The precast concrete producer should become familiar with both types of formliners, including their various mortar joint profiles and how their use may affect production and schedules. Designers should limit the depth of the mortar joint so as to not expose the back profile of the thin brick to weather and to ensure adequate bond to the precast concrete.

A precast concrete producer can either make their own formliners or purchase formliners from a formliner producer or distributor. The information contained herein is primarily focused on recommended practices when using formliners from a formliner manufacturer, but it includes applicable practices for using formliners made by the precast concrete producer.

2.1 Ordering Formliners

When ordering formliners, the precast concrete producer should do the following:

2.1.1 Clearly communicate and document the total quantity of formliners required for the project. The quantity should include area (typically in square feet), field coursing, returns, projections, indentations, and any special coursing requirements (such as arches or course changes). The following are relevant points to consider when determining formliner quantities:

2.1.1.1 It is recommended to review, in detail, the formliner manufacturer's catalogs, cut sheets, and other information to fully understand the product's features, limitations, and recommended uses.

2.1.1.2 Consider sharing the construction documents or erection drawings with the formliner manufacturer (or multiple formliner manufacturers) to gain assistance with defining required quantities and liner types, including, but not limited to, field liner, corner liner, edge-cap liner, and other special liners and accessories.

2.1.2 Define pictorially and in writing the specific brick coursing pattern(s), brick coursing transitions, mortar joint profile, and any nonstandard brick coursing dimensions required for the project.

2.1.2.1 Be particularly aware of panel dimensions (length, width, and areas between non-brick features such as reveals, projections, or openings) where the brick area within a panel field does not follow standard brick coursing dimensions (or dimensional modules). These areas may require excessive thin brick cutting (including the potential of thinly sliced "sliver brick" or nonstandard kerfs) and could result in coursing that does not give the appearance of hand-laid brick.

2.1.3 Collaborate with the formliner manufacturer to determine the adequate amount of formliners, including overage (waste), required for the project.

2.1.3.1 Custom-made multiuse formliners will typically require some waste to accommodate multiple form changes as well as anticipated formliner breakdown associated with normal production practices.

2.1.3.2 Plastic, single-use formliners are sometimes provided as a stock item. The precast concrete producer should consult with the formliner manufacturer once the actual thin brick run samples are provided to determine whether a stock formliner profile can be used, thus reducing the amount of overage required.

2.1.4 Provide a thin brick sample from the actual thin brick production run to the formliner manufacturer for the purpose of establishing size compatibility (that is, fitting the formliner to the project-specific thin brick). A minimum of 25 thin brick flat pieces and 12 corner pieces are recommended to ensure the best formliner-to-brick compatibility results.

Note: When there are schedule conflicts, it may be necessary to produce the formliners before the

actual thin brick run is manufactured. Using thin brick from a production run other than the specific project's thin brick run for evaluation of the formliners may result in an unacceptable formliner fit, creating problems during precast concrete production and issues with the final appearance of the precast concrete components.

2.1.4.1 Clear communication among all parties should be maintained and documented in the event that the thin brick–to–formliner fit is problematic.

2.2 Form-Release Agent Selection

When precast concrete production requires the use of a form-release agent, consult with the formliner manufacturer and thin brick manufacturer to ensure that the release agent is compatible with their products. The release agent should be a reactive type and should be dry to the touch before the thin brick is inserted into the formliner.

3. Preproduction

Upon receipt of the thin brick products at the precast concrete plant or other location, it is critical to properly measure each thin brick shape as soon as possible. Calipers should be used. Each shape should be evaluated in accordance with ASTM C67, *Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile*,[4] as modified for embedded thin brick applications (**Appendix D**). It is advisable to photograph the measuring process and report the findings to the thin brick provider. Inform the thin brick manufacturer and distributor if a size, color, finish, or quality concern is noted or suspected. Identifying potential concerns early will maximize the time to take corrective action. Many problems can be prevented and/or resolved without incident by taking this step and documenting the findings.

3.1 Thin Brick Procedures

When thin brick is received, the precast concrete producer should do the following:

3.1.1 Protect coated thin brick from extreme temperatures to prevent the coating from freezing, softening, melting, and degrading. For example, do not store waxed thin brick in direct sunlight.

3.1.2 Pull a sample set of thin brick from five different pallets (usually one carton from each pallet) from each full truckload of thin brick, and verify that the material conforms to the purchase order. Follow this procedure for each thin brick size and shape prior to placing thin brick in a formliner. Inform the thin brick manufacturer of any perceived quality concerns.

3.1.2.1 Size tolerances: Inspect all specific shapes required for the project (typically, flat thin brick, corner thin brick, and edge-cap thin brick). Check length, width, out-of-square, and warping dimensions by using calipers and measuring samples in accordance with the modified ASTM C67[4] method described in Appendix D.

3.1.2.2 Coating: If the thin brick was ordered with a protective coating, observe whether the coating is sufficiently applied and will protect the thin brick as expected. If the coating seems insufficient, set the thin brick units aside for review by the thin brick manufacturer or their agent.

3.1.2.3 Color and texture: Compare the thin brick that was delivered with the approved sample to ensure that the color and texture of the delivered material are within the acceptable appearance range. Before project production begins, it is recommended to confirm that the delivered order meets expectations by casting a precast concrete sample using the approved concrete mixture to test the thin brick's fit within the formliner, test the precast concrete plant's cleaning and finishing process, and compare the new sample with the approved color/finish sample.

3.1.2.4 When the purchased thin brick includes multiple colors, multiple sizes, or a blend of different colors and sizes, the precast concrete producer should follow the color/texture best practices described in 3.1.2.1, 3.1.2.2, and 3.1.2.3 for each thin brick color and size.

3.1.3 Promptly inform the thin brick manufacturer and distributor if a size, color, finish, protective coating, or quality concern is noted or suspected. Early identification of potential concerns will maximize the time available to take corrective action. If additional brick is required, be certain to source the brick from the same thin brick run, when possible, to ensure that the color and texture of the additional brick match the color and texture of the original order. Thin brick manufacturers record lot numbers for each shipment, and the manufacturer may have an inventory of a matching lot.

3.2 Formliner Procedures

When formliner is received, the precast concrete producer should do the following:

3.2.1 Inspect the formliners to verify that the proper quantities and accessories were received.

3.2.2 Store formliners where they will not be exposed to weather conditions and in acceptable ambient

temperatures to prevent damage or distortion.

3.2.3 Dry fit an adequate amount of thin brick in the formliner to verify a proper fit.

3.2.3.1 Document findings with photos or videos and share findings with the formliner provider, thin brick manufacturer, and distributors as applicable.

3.2.4 Use the formliner to produce a precast concrete sample as recommended by PCI MNL 116,[1] MNL 117,[2] and MNL 122[3] to ensure an acceptable final appearance. When applicable, gain designer approval of the sample in writing.

3.2.4.1 This sample should be produced even if a sample was previously approved. Actual thin brick runs and formliner pieces could be different than those used to generate the approved sample.

3.3 Staining Prevention Measures

To avoid potential staining of thin brick, the precast concrete producer should follow the thin brick manufacturer's recommendations as well as the following precautions:

3.3.1 Before using any release product, test it to ensure that it can be removed and will not stain the thin brick.

3.3.2 Do not use oil-based release agents of any kind.

3.3.3 Do not use silicone or any oil-based glue to secure the brick in the liner.

3.3.4 Do not allow the release or retarder agent to set on the face of the thin brick for more than 48 hours.

3.3.5 When acid-etching a panel, use a properly diluted ratio of acid solution that has been tested on a sample panel prior to full-scale application. Before applying the solution, thoroughly pre-wet the panel with water. Afterward, thoroughly rinse the panel with water.

3.3.6 Do not allow cleaning agents to set up or absorb into the thin brick.

3.3.7 Do not allow iron, salts, manganese, or any other constituent to leach from concrete or thin brick.

3.3.8 Do not allow dyed joints or additives in face mixtures or concrete backing to become soluble through improper curing, interaction with cleaning agents or acids, premature washing, or any other procedure that would allow dye or additives to deposit on the face of the thin brick.

3.3.9 Ensure that the water used for cleaning or preparing the concrete mixture is clean and free from harmful amounts of any substances that may be deleterious to the concrete or metal in the precast concrete panel.

4. Production Practices

4.1 Formliner Setup and Thin Brick Placement

4.1.1 Lay out the formliner as detailed on drawings and in accordance with the formliner manufacturer's recommendations. Check coursing dimensions before each pour to verify that the formliner has not shrunk or stretched during handling or due to temperature changes.

4.1.1.1 Before placing the thin brick in the form, snap horizontal control lines on the casting bed or the side rails. These lines should be snapped in dimensional increments (typically 2 to 4 ft) in accordance with the selected thin brick size to keep the thin brick on course.

4.1.1.2 Proper positioning of the formliner within each form will ensure that the brick courses will align across real panel joints (panel to panel) in the final, erected position on the building.

4.1.2 Ensure that the form surface and formliner are clean and free of debris such as concrete chips, sand, and small rocks that could keep a thin brick from lying flat on the formliner. Use of a clean, debris-free formliner will minimize the risk for tipped or cracked thin bricks.

4.1.3 At corners or returns, use an appropriate corner formliner to produce realistic mortar joints. Do not use flat sheets of formliner and try to miter them together.

4.1.4 Cut thin brick using a wet tile saw with a nonsegmented, wet diamond blade. Cut thin brick facing upward (brick face against the saw blade) to achieve a clean face-cut edge.

4.1.4.1 Remove any debris from the face of the thin brick and ensure that the cutting operation does not change the appearance of the thin brick.

4.1.4.2 Change the water in the saw regularly, and wash thin brick after it is cut.

4.1.4.2.1 Dry thin brick can soak up dirty water, which will leave behind an even layer of dust that is difficult to detect and clean, and which may reduce the bond between thin brick and concrete.

4.1.5 It is not recommended to use thin brick that is cut and epoxied to make a shape. If epoxied shapes are necessary, consult with the thin brick manufacturer to determine whether such shapes can be achieved.

4.1.6 When placing thin brick in a formliner on the casting bed, it is important to use thin brick from multiple cartons (boxes, packs, bundles, etc.) from multiple pallets (three or more), and distribute the pieces from each carton and pallet across the entire panel layout. Do not produce an individual panel exclusively from thin brick from a single pallet.

4.1.6.1 Individual thin brick being placed should be pulled from multiple cartons to help achieve an even color and texture range.

4.1.7 For thin brick on vertical form surfaces, secure thin brick to the formliner using recommended procedures. Test specific methods to ensure that the appearance of the finished product meets the customer's expectations and does not cause staining or discoloring of the thin brick. Effective methods may include the following:

4.1.7.1 Use spray adhesive or hot-glue adhesive to hold thin brick in place.

4.1.7.2 Attach a nonmetallic strap behind the thin brick and use noncorrosive fasteners at the mortar joints to hold the thin brick in place.

4.1.8 Continually check every thin brick for tolerance conformance as thin bricks are being placed in the formliners. Set aside individual thin brick pieces that do not meet size tolerances, and use those pieces for cuts required to complete brick coursing (for example, half-length thin brick at the end of the panel).

4.1.8.1 Place any nonconforming thin brick pieces neatly into a container to assist with obtaining an accurate piece count.

4.1.8.2 Calculate the percentage of thin brick pieces that measure out of tolerance so as to predict adequate thin brick quantities to complete the project.

4.1.9 If production personnel need to walk or kneel on thin brick already placed in the form, use protective mats (typically made from expanded rigid polystyrene or another compressible but rigid material) to help spread the worker's weight over multiple thin bricks and avoid cracking the thin bricks.

4.1.9.1 Thin brick sizes that are longer and more linear may be more susceptible to breakage caused by foot traffic.

4.1.10 Check every thin brick for proper placement before placing reinforcing bars or casting concrete. Misplaced thin brick or cracked thin brick should be identified, and then removed and replaced if necessary.

4.1.10.1 If a thin brick is cracked or dislodged from the formliner during reinforcement placement, it should be immediately removed, and the relevant production personnel informed so that it can be replaced before casting.

4.1.11 Perform a final thin brick check, including a visual check of the thin brick color blend when possible, during the pre-pour quality control inspection. Make any corrections before the concrete is cast.

4.1.12 Double-check brick coursing marks and formliner alignment after the final brick inspection and before placing embedment, and again before concrete is placed.

4.2 Concrete Placement Techniques

It is difficult to correct thin bricks that are out of plane in the finished product. Therefore, workers should be aware of and avoid any activity that could cause thin brick or formliner to shift during casting.

4.2.1 Carefully place concrete to ensure that the force created by pouring does not dislodge thin brick from the formliner pockets.

4.2.2 Minimize concrete vibration to prevent the dislodging of thin brick from the formliner pockets.

4.2.3 When using a self-consolidating concrete (SCC) mixture, minimize vibration to reduce the possibility of concrete slurry bleeding around the edges of thin brick and onto the face.

4.3 Procedures after Casting and Stripping Panels from the Mold

4.3.1 After removing the panel from the form (and removing the formliner if it is a single-use formliner), use a nonmetallic spatula to scrape off any concrete bleed from the face of the thin brick. Remove smaller particles using a nonmetal-fiber bristle brush. Rubbing stones and metal tools should not be used as they may damage the brickwork or leave behind fragments that oxidize and cause rust stains.

4.3.2 Visually inspect the panel to identify any thin brick that is misaligned in accordance with PCI MNL 135.[5] Use the observations to improve casting methods.

4.3.2.1 Communicate observations to plant workers and yard finishers so as to accomplish the following:

4.3.2.1.1 Identify the cause of production-related imperfections and take corrective action.

4.3.2.1.2 Establish acceptable tolerances for out-of-plane brick in accordance with the PCI specification (**Appendix A**).

4.3.2.1.3 Confirm that methods for repairing or replacing any misfitting or misaligned thin brick are in compliance with project specifications and aesthetic standards.

4.3.2.1.4 Using actual production results, confirm that allowances for repairing or replacing any misfitting or misaligned thin brick are sufficient to cover rates of repair required during actual fabrication and ensure that there is enough thin brick to complete the project.

4.3.2.2 Communicate findings to the thin brick manufacturer, thin brick distributor, or the formliner manufacturer as appropriate. Use photos, videos, or other means to clearly communicate the findings.

4.3.3 Clean panels immediately after stripping them in the plant, and inspect them to ensure that all wax or retardant is removed before the panels are transported to the jobsite.

4.3.3.1 Use recommended water temperature and pressure settings when removing wax from thin brick after casting. A sufficient hot water temperature, proper water pressure, and the correct power-washing and wax-removal techniques are key to ensure that all wax is removed. If the wax is not removed as soon as practical after a panel is cast, the wax may absorb into the brick and leave a stain that is difficult to remove.

4.3.3.1.1 A water temperature of 180°F (83°C) at the panel is usually adequate to effectively liquefy the wax. The precast concrete producer should follow recommendations from the thin brick and/or wax manufacturer regarding the optimal water temperature to melt the specific wax provided.

4.3.3.1.2 Measure the water temperature by spraying water into a bucket or other location and taking the temperature there. Water that is run through a sprayer may not be the same temperature as water in the holding tank. Use of a laser temperature gun on water as it is being sprayed may give artificially low temperature readings.

4.3.3.1.3 Recommended practice is to use water pressure of 1000 to 1500 psi and use a sprayer tip that has a water spray angle of 45 to 60 degrees. The precast concrete producer should use the thin brick or coating manufacturer's recommended pressure to achieve an acceptable appearance.

4.3.3.1.4 The precast concrete producer should develop the correct power-washing and wax-removal technique for the specific plant or project conditions. A suggested method is to start from the top of the panel, spraying water in arm-length swaths, to melt the wax. Follow the wax with the power-washing wand to the bottom of the panel in a manner that prevents wax from resolidifying on the panel, and allow the wax to drip off the panel. Be advised that once the wax is melted, it immediately forms a precipitate flake. This flake may contaminate other areas of the panels, including panel edges, where the contamination may interfere with caulk adherence.

4.3.4 Protect the thin brick from any concrete texture application processes that may cause damage to the thin brick. Suggested processes include the following:

4.3.4.1 Leave wax on the thin brick until the exposed concrete texture is complete. The wax will help protect the thin brick appearance.

4.3.4.2 Mask off the thin brick area with either a plastic tarp or plywood template to protect the thin brick during the panel-finishing process.

4.3.4.3 Recommended practice is to test the preferred method during the precast concrete sample production process.

4.3.5 In the case of any staining that cannot be repaired by use of hot water, ask the thin brick manufacturer to identify recommended cleaning products and follow the manufacturer's recommendations. Certain thin brick types and finishes respond differently to various chemical treatments. What may work well for one thin brick style may damage the color and finish of another thin brick.

4.3.5.1 Always test cleaning methods on a small scale or sample thin brick before applying them on a large scale.

4.3.6 Compare approved precast concrete mock-up panels with finished panels (in a dry state and in the same lighting) to verify that the thin brick color, finish, and blends match the mock-up.

4.3.6.1 If there are concerns that the finished panel's color does not match the color of the approved mock-up, photograph the observation(s), and immediately contact the thin brick manufacturer or thin brick distributor for remedial action.

4.3.6.2 Continually repeat this process weekly, to ensure that the thin brick color remains consistent throughout the project.

4.3.7 If using a brick sealant on the face, follow the thin brick manufacturer's recommendations for its removal.

5. References

1. Precast/Prestressed Concrete Institute (PCI). 2021. *Manual for Quality Control for Plants and Production of Structural Precast Concrete Products*. 5th ed. MNL 116-21. Chicago, IL: PCI. https://doi.org/10.15554/MNL-116-21.

2. PCI. 2013. *Manual for Quality Control For Plants and Production of Architectural Precast Concrete Products*. 5th ed. MNL 117-13. Chicago, IL: PCI. https://doi.org/10.15554/MNL-117-13.

3. PCI. 2007. *Architectural Precast Concrete*. 3rd ed. MNL 122-07. Chicago, IL: PCI. https://doi.org/10.15554/MNL-122-07.

4. ASTM International. 2021. *Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile*. ASTM C67/C67M-21. West Conshohocken, PA: ASTM International.

5. PCI. 2000. *Tolerance Manual for Precast and Prestressed Concrete Construction*. MNL 135-00. Chicago, IL: PCI. https://doi.org/10.15554/MNL-135-00.

Appendix A
PCI Specification for Embedded Clay Thin Brick
Effective February 1, 2025

A. Thin Brick Units:

1. Thickness: Not less than ½ in. (12.7 mm) but not more than 1 in. (25.4 mm).

2. Face size:

   a. Modular: 2¼ in. (57.15 mm) high × 7⅝ in. (193.68 mm) long.

   b. Norman: 2¼ in. (57.15 mm) high × 11⅝ in. (295.28 mm) long.

   c. Closure modular: 3⅝ in. (92.08 mm) high × 7⅝ in. (193.68 mm) long.

   d. Utility: 3⅝ in. (92.08 mm) high × 11⅝ in. (295.28 mm) long.

3. Face size, color, and texture:

   a. **[Match architect's samples.] [Match existing color, texture, and face size of adjacent brickwork.]**

   b. <Insert information on existing brick, if known.>

4. Special shapes: Include corners, edge caps and edge-cap corners.

5. Back surface texture: Scored, combed, wire roughened, ribbed, key backed, or dovetailed.

B. Dimensional Tolerances: Measure in accordance with ASTM C67,[1] as modified for embedded thin brick applications (see Appendix D of PCI's *Recommended Practice for Embedded Clay Thin Brick in Precast Concrete*).

1. Thickness: +0 in. (+0 mm), –1/16 in. (–1.6 mm).

2. Face size:

   a. +0 in. (+0 mm), –1/16 in. (–1.6 mm) for dimensions ≤ 8 in. (203 mm).

   b. +0 in. (+0 mm), –3/32 in. (–2.4 mm) for dimensions > 8 in. (203 mm).

3. Warpage: ≤1/16 in. (≤1.6 mm) either concave or convex from consistent plane.

4. Out of square: ±1/16 in. (±1.6 mm).

5. Variation of shape from specified angle: ±1 degree.

C. Properties: Properties shall be of the finished thin brick product as provided to the precast concrete producer and not tested as a full brick.

1. Modulus of rupture: ≥250 psi (≥1.7 MPa) when tested in accordance with ASTM C67.

2. Cold-water absorption at 24 hours:

   a. Nonglazed thin brick: Maximum 6% when tested in accordance with ASTM C67.

   b. Glazed thin brick: Maximum 5% when tested in accordance with ASTM C373.[2]

3. Efflorescence: Rated "not effloresced" when tested in accordance with ASTM C67.

4. Freezing-and-thawing resistance:

    a. Uncoated thin brick: No detectable deterioration (spalling, cracking, or breaking) after 300 cycles tested in accordance with ASTM C666[3] Method A or B on assembled specimens.

    b. Surface coloring: No observable difference in the applied finish when viewed at a distance of 20 ft (6 m) after 50 cycles tested in accordance with ASTM C67. In addition, the thin brick shall undergo ASTM C666 testing as described in the previous point.

5. Pull-out strength: ≥150 psi (≥1.0 MPa) from base concrete before and after freezing-and-thawing resistance testing when tested in accordance with the modified ASTM E488[4] method.

6. Chemical resistance: Provide thin brick that has been tested according to the modified ASTM C650[5] method and rated "not affected."

7. Products: Subject to compliance with requirements, products that may be incorporated into the work include, but are not limited to: **[provide the following] [provide one of the following] [available products that may be incorporated into the work include, but are not limited to, the following]**:

D. Testing Requirements:

1. Minimum number of test specimens: The number is determined in accordance with appropriate ASTM specifications except as specified in D.1.a.

    a. Exceptions for freezing-and-thawing resistance and pull-out strength testing: 10 assembled specimens measuring 8 × 16 in. (200 × 405 mm) in length and height, with the thin brick embedded into the concrete substrate (assembled specimens **Fig. A1**). The 10 assembled specimens are divided into 5 Sample A assemblies and 5 Sample B assemblies. The precast concrete substrate shall have a minimum thickness of 2½ in. (63 mm) plus the embedded thin brick thickness. The precast concrete shall have a minimum compressive strength of at least 5000 psi (34.5 MPa) and 4% to 6% entrained air. The embedded brick coursing pattern for testing purposes shall be modular-size thin brick on a half running bond pattern, with a formed, raked joint geometry, with a width of no less than ⅜ in. (9 mm) and a depth ≤¼ in. (≤6 mm) from the exterior face of the thin brick.

    One thin brick from the center of each sample assembly shall be tested for pull-out strength. Each Sample B assembly shall first be tested for freezing-and-thawing resistance. In place of the anchor specified in ASTM E488,[6] use a steel plate of ⅜ in. (9 mm) minimum thickness that is the same size as a single thin brick face bonded with epoxy to a single thin brick face for each pull-out strength test. The steel plate shall have a centrally located pull-rod welded to the plate.

2. Samples for pull-out strength and freezing-and-thawing resistance testing shall have the same back surface texture.

3. Frequency of testing:

    a. Dimensional tolerances for each run of thin brick supplied to the project shall be checked before thin brick is shipped.
    b. Cold-water 24-hour absorption testing shall be conducted on every clay body and color of project-specific thin brick prior to each shipment. Submit written documentation. The buyer reserves the right to conduct the same test prior to the first shipment.
    c. All other tests specified shall be conducted for each clay body at an accredited laboratory at least every six years.

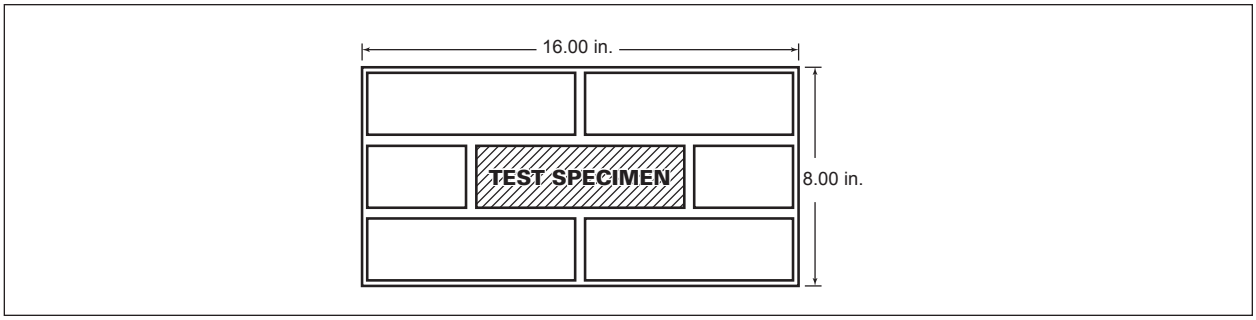

Figure A1. Assembled pull-out test specimen. Note: 1 in. = 25.4 mm.

References

1. ASTM International. 2021. *Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile*. ASTM C67/C67M-21. West Conshohocken, PA: ASTM International.

2. ASTM International. 2023. *Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products*. ASTM C373-18(2023). West Conshohocken, PA: ASTM International.

3. ASTM International. 2015. *Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing (Withdrawn 2024)*. ASTM C666/C666M-15. West Conshohocken, PA: ASTM International.

4. ASTM International. 2022. *Standard Test Methods for Strength of Anchors in Concrete Elements*. ASTM E488/E488M-22. West Conshohocken, PA: ASTM International.

5. ASTM International. 2020. *Standard Test Method for Determination of Resistance to Chemical Substances*. ASTM C650-20. West Conshohocken, PA: ASTM International.

Thin Brick Manufacturer Certificate of Compliance

(To be placed on the thin brick manufacturer's letterhead)

Project Name: [NAME OF PROJECT]

Project Location: [CITY AND STATE OF PROJECT JOBSITE]

Precast Concrete Producer: [NAME OF PRECAST CONCRETE PRODUCER]

Precast Concrete Producer Location: [CITY AND STATE OF PRECAST CONCRETE PLANT LOCATION]

The thin brick that is supplied or specified for the above-identified project has been, or will be, manufactured by:

Thin Brick Manufacturer: [NAME OF THIN BRICK MANUFACTURER]

Thin Brick Plant Location(s): [CITY AND STATE OF EACH BRICK MANUFACTURING PLANT]

Thin Brick Product Description: [COMPLETE THIN BRICK DESCRIPTION, INCLUDING PRODUCT NAME(S), PRODUCT NUMBER(S), BATCH NUMBER(S), COLOR(S), BLEND(S), TEXTURE(S), SIZE(S), AND OTHER DETAILS AS DEFINED IN THE SPECIFICATIONS OR THE THIN BRICK SUPPLIER'S/MANUFACTURER'S PROPOSAL]

This thin brick is manufactured to meet all requirements and standards as stated in the *PCI Specification for Embedded Clay Thin Brick*, including dimensional tolerances, physical properties, and testing criteria included in that specification.

All thin brick test results are available upon request by contacting [COMPANY NAME] at [COMPANY PHONE NUMBER].

The undersigned has read and understands the provisions of PCI's *Recommended Practice for Embedded Clay Thin Brick in Precast Concrete* RP 152-25.

(Signature of the thin brick manufacturer's authorized employee) (Date)

Title of Employee:

Thin Brick Manufacturer Letter of Variance

(To be placed on the thin brick manufacturer's letterhead)

Project Name: [NAME OF PROJECT]

Project Location: [CITY AND STATE OF PROJECT JOBSITE]

Precast Concrete Producer: [NAME OF PRECAST CONCRETE PRODUCER]

Precast Concrete Producer Location: [CITY AND STATE OF PRECAST CONCRETE PLANT LOCATION]

The thin brick that is supplied or specified for the above-identified project has been, or will be, manufactured by:

Thin Brick Manufacturer: [NAME OF THIN BRICK MANUFACTURER]

Thin Brick Plant Location(s): [CITY AND STATE OF EACH BRICK MANUFACTURING PLANT]

Thin Brick Product Description: [COMPLETE THIN BRICK DESCRIPTION, INCLUDING PRODUCT NAME(S), PRODUCT NUMBER(S), BATCH NUMBER(S), COLOR(S), BLEND(S), TEXTURE(S), SIZE(S), AND OTHER DETAILS AS DEFINED IN THE SPECIFICATIONS OR THE THIN BRICK SUPPLIER'S/MANUFACTURER'S PROPOSAL]

This thin brick is not manufactured to meet all requirements and standards as stated in the *PCI Specification for Embedded Clay Thin Brick*. The following is a description of the PCI specification requirements and standards that the thin brick material identified herein will meet and the specific requirements and standards that will not be met:

[COMPLETE THIN BRICK DESCRIPTION, INCLUDING PCI SPECIFICATION REQUIRMENTS THAT WILL BE MET AND PCI SPECIFICATION REQUIREMENTS THAT WILL NOT BE MET. INFORMATION SHALL BE AS COMPLETE AND DESCRIPTIVE AS POSSIBLE TO CLEARLY COMMUNICATE MATERIAL CHARACTERISTICS, INCLUDING SPEICIFC TESTING, TO BE COMPLETELY TRANSPARENT AND TO SET ACCURATE EXPECTATIONS FOR ALL PARTIES.]

All thin brick test results are available upon request by contacting [COMPANY NAME] at [COMPANY PHONE NUMBER].

The undersigned has read and understands the provisions of PCI's *Recommended Practice for Embedded Clay Thin Brick in Precast Concrete* RP 152-25.

(Signature of the thin brick manufacturer's authorized employee) (Date)

Title of Employee:

1. Measure of Face Size

1.1 Apparatus

Calipers, graduated in 1/1000 in. divisions and having parallel jaws, shall be used to measure the individual units.

Note: In the field, it is common to use a tape measure or steel rule to assess unit size. However, for determination of conformance to the *PCI Specification for Embedded Clay Thin Brick*, the apparatus defined herein shall be used.

1.2 Procedure

Measure 25 units that are dry and at ambient temperature. These units shall be representative of the entire lot and shall include the extremes of color range and size as determined by visual inspection. These units should be pulled from multiple boxes and pallets to best represent the entire lot.

Note: All individual shapes and sizes shall be tested.

Note: Any burs or rough or raised edges shall be smoothed and/or removed before measuring.

1.2.1 Individual measurements: Measure the **length** across the face at two locations between ¼ to ½ in. from the corners (**Fig. D1** and **D2**). Measure the **height** across the face at three locations, between ¼ to ½ in. from the corners and at midpoint of piece (**Fig. D3** and **D4**). Report each measurement to the nearest 1/1000 in. and identify any or all pieces that are larger or smaller than the allowable face size.

1.2.2 Allowable face size:

+0 in. (+0 mm), $-\frac{1}{16}$ in. (–1.6 mm) for dimensions ≤ 8 in. (≤ 203.2 mm)

+0 in. (+0 mm), $-\frac{3}{32}$ in. (–2.4 mm) for dimensions > 8 in. (> 203.2 mm)

Note: No individual thin brick measurements shall depart from the specified face size or thickness by more than the individual tolerance for the size-dimension classification.

Note: For corners, edge caps, and special shapes, follow the face-size measurement procedures for each exposed face.

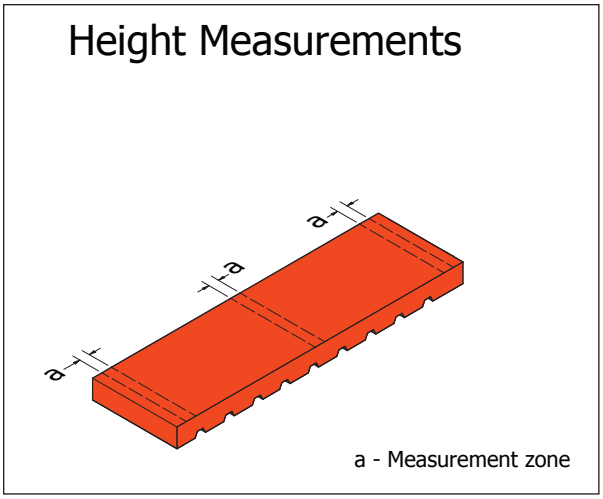

Figure D1. Height measurement of flat thin brick.

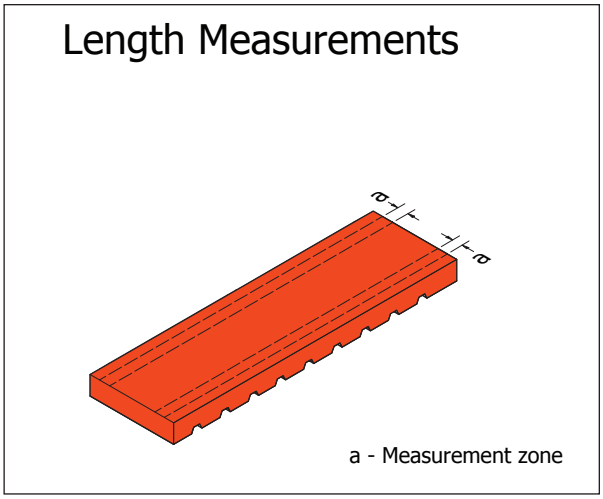

Figure D3. Length measurement of flat thin brick.

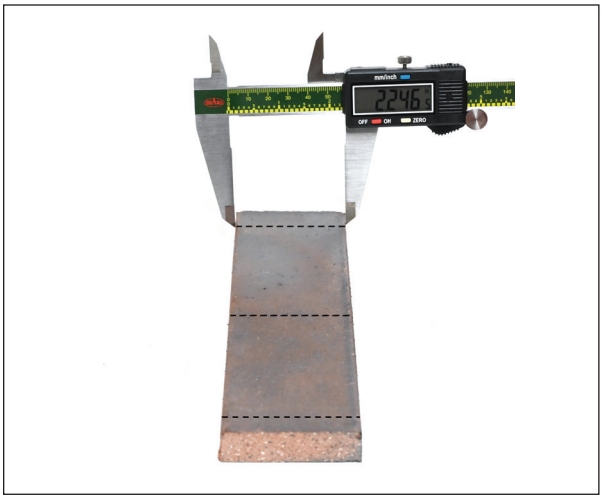

Figure D2. Proper technique for measuring the height of flat thin brick using calipers.

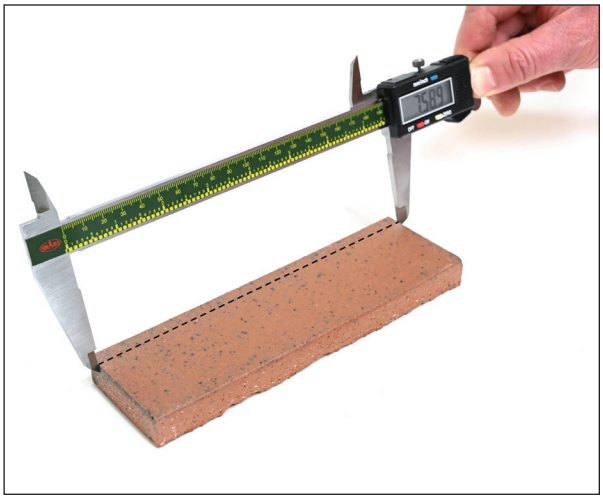

Figure D4. Proper technique for measuring the length of flat thin brick using calipers.

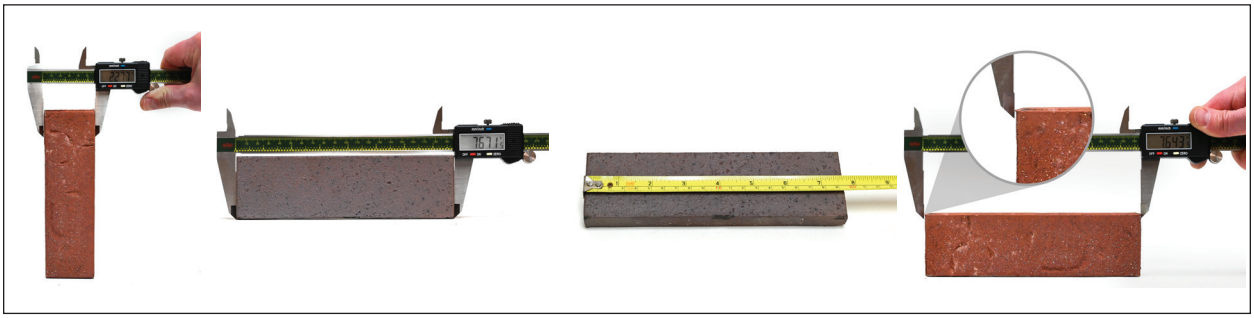

Figure D5. Improper techniques for measuring the height and length of flat thin brick.

2. Measurement of Thickness

2.1 Apparatus

Calipers, graduated in 1/1000 in. divisions and having parallel jaws, shall be used to measure the individual units.

2.2 Procedure

Measure the **thickness** (**Fig. D6** and **D7**) from face to the thickest part of the back at the thin brick's mid-point and at the corners of all four sides to the nearest 1/1000 in. Record and report each measurement of the thickness to the nearest 1/1000 in., and identify any or all points that are larger or smaller than the allowable face size or thickness tolerance.

Thickness and thickness tolerance: Thickness must be ≥½ in. and <1 in., with an overall tolerance of +0 in. (+0 mm), –1⁄16 in. (–1.6 mm) at the thinnest part of the thin brick, including the back face configuration.

Note: Specified thickness includes the highest (thickest) part and does not include the lowest (thinnest) part of the scores, ribs, key backs, dovetails, or other back surface textures.

Note: For corners, edge caps, and special shapes, follow the thickness measurement procedures for each exposed face.

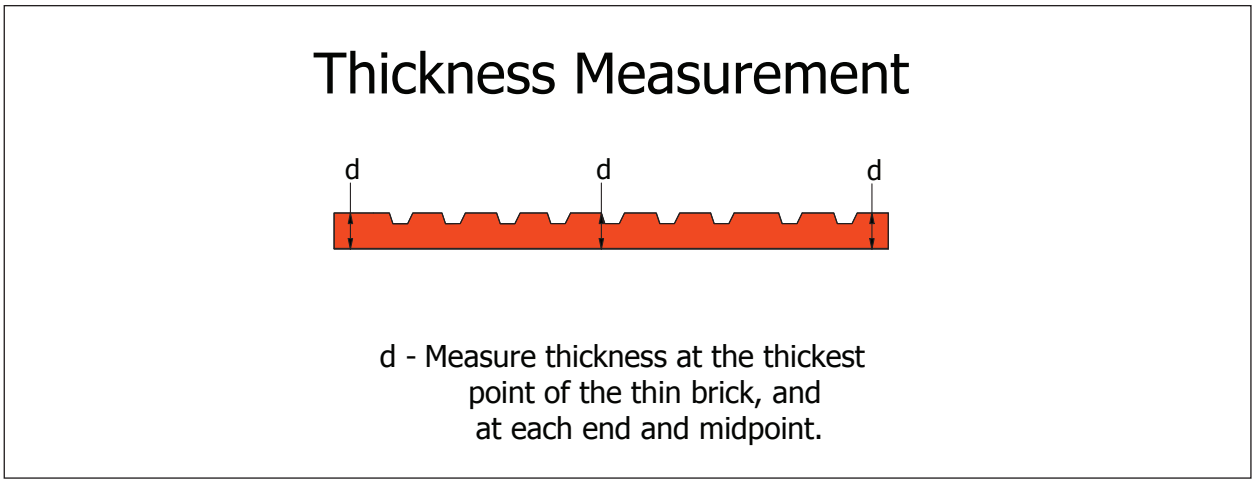

Figure D6. Proper technique for measuring the thickness of flat thin brick.

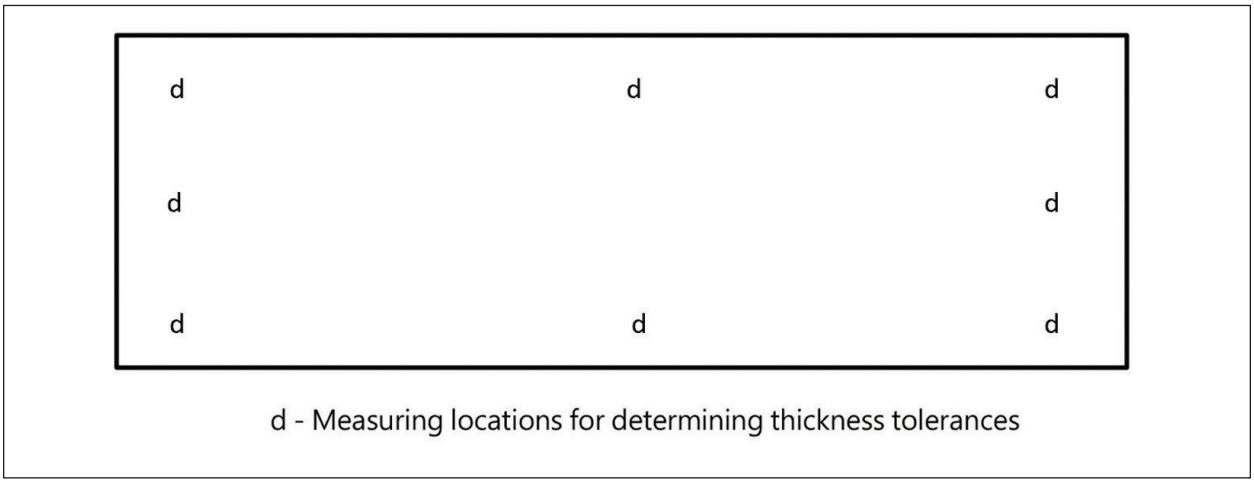

Figure D7. Identification of measuring points used to measure the thickness of flat thin brick.

3. Measurement of Warpage

3.1 Apparatus

A straightedge or flat surface of steel or glass. A steel measuring wedge tapered in 1/32 in. divisions (**Fig. D8**) or calipers, graduated in 1/1000 in. divisions (with metric conversions) and having parallel jaws, shall be used to measure the gaps between the straightedge or flat surface and thin brick piece.

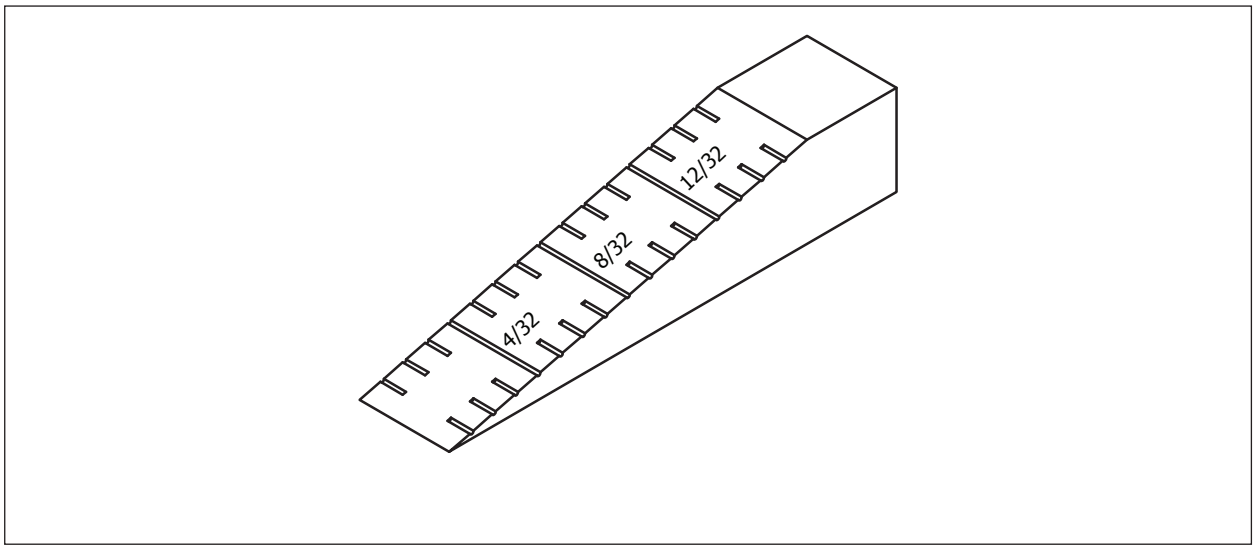

Figure D8. Measuring wedge.

Report each warpage measurement of the 25 sample units to the nearest 1/32 in. (0.8 mm) and identify any or all pieces exceed the allowable warpage tolerance of ≤1/16 in. (≤1.6 mm) either concave or convex from consistent plane.

3.2 Procedure

Measure warpage of concave and convex faces and edges, in accordance with the following methods.

3.2.1 Concave face: Where the warpage to be measured is a concave face, place the thin brick on a flat surface or place the straightedge lengthwise or diagonally along the face to be measured. Select the greatest distance from the unit face to the straightedge. Using the straightedge/calipers or wedge, measure this distance to the nearest 1/32 in. (0.8 mm) and record the distance as the concave warpage of the face (**Fig. D9, D10,** and **D11**).

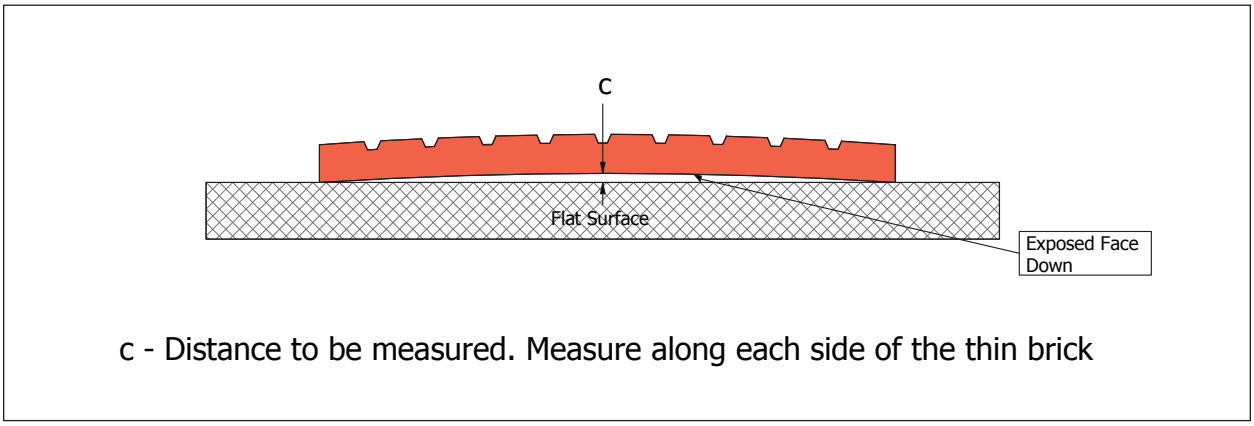

Figure D9. Measurement of concave face warpage.

Figure D10. Measurement of concave face warpage using calipers.

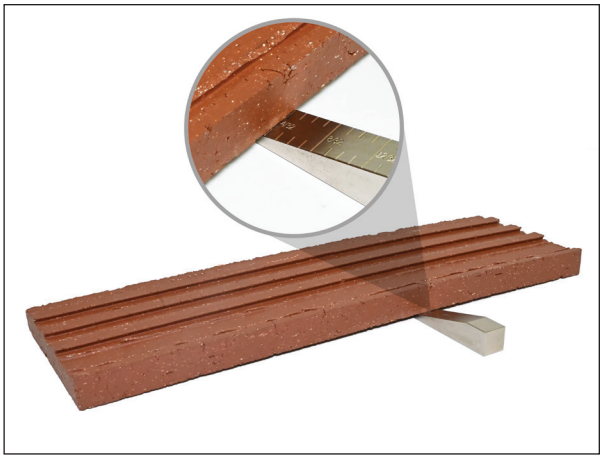

Figure D11. Measurement of concave face warpage using a measuring wedge.

3.2.2 Concave edges: Where the warpage to be measured is a concave edge, place the straightedge lengthwise along the edge to be measured. Select the greatest distance from the unit edge to the straightedge. Using the straightedge, calipers, or wedge, measure this distance to the nearest 1⁄32 in. (0.8 mm) and record the distance as the concave warpage of the edge (**Fig. D12**).

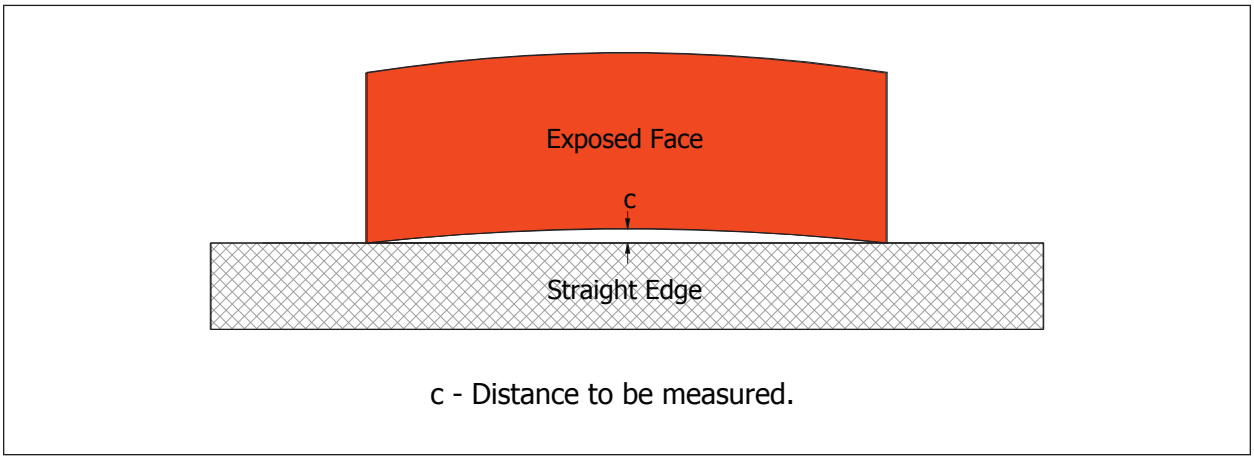

Figure D12. Measurement of 'concave warpage of an edge.

3.2.3 Convex face: Where the warpage to be measured is a convex face, place the thin brick unit face down on a flat surface. Using a measuring wedge or calipers, measure the greatest distance from the flat surface to the face of the thin brick to the nearest 1⁄32 in. (0.8 mm) and record the distance as the convex warpage of the face (**Fig. D13**, **D14**, and **D15**).

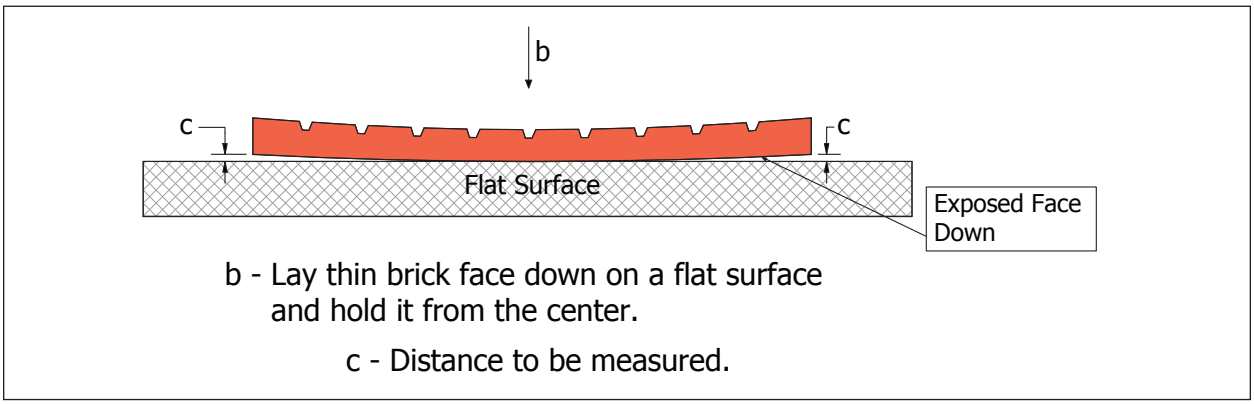

Figure D13. Measurement of convex face warpage.

Figure D14. Proper technique for measuring convex face warpage using calipers.

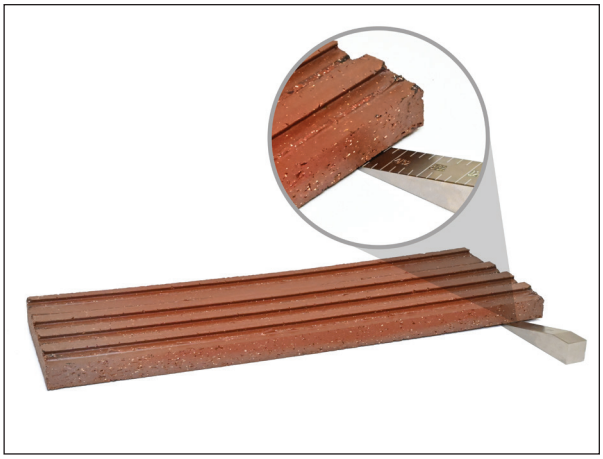

Figure D15. Proper technique for measuring convex face warpage using a measuring wedge.

3.2.4 Convex edges: Where the warpage to be measured is a convex edge, place the straightedge lengthwise on the face of the unit from corner to corner of the convex edge. Using the steel rule or calipers, measure the greatest distance from the straight edge to the nearest 1⁄32 in. (0.8 mm) and record as the convex warpage of the edge (**Fig. D16**).

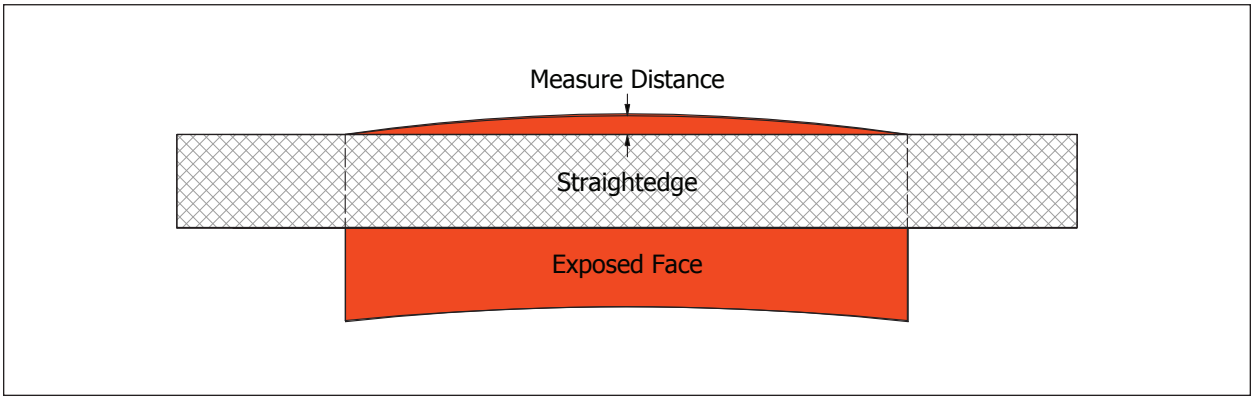

Figure D16. Measurement of warpage of a convex edge.

4. Measurement of Out of Square

4.1 Apparatus

A carpenter's square and a steel rule or calipers. Calipers, graduated in 1/1000 in. divisions (with metric conversions) and having parallel jaws, shall be used to measure the individual units.

4.2 Procedure

Place a sample unit on the carpenter's square with the unit's length against the long edge of the square and the unit's height against the short edge. Measure the deviation due to the departure from the 90-degree angle at each corner of the face. Record the measurement of each corner to the nearest 1⁄32 in. (0.8 mm) as the unit's deviation from square (**Fig. D17** and **D18**).

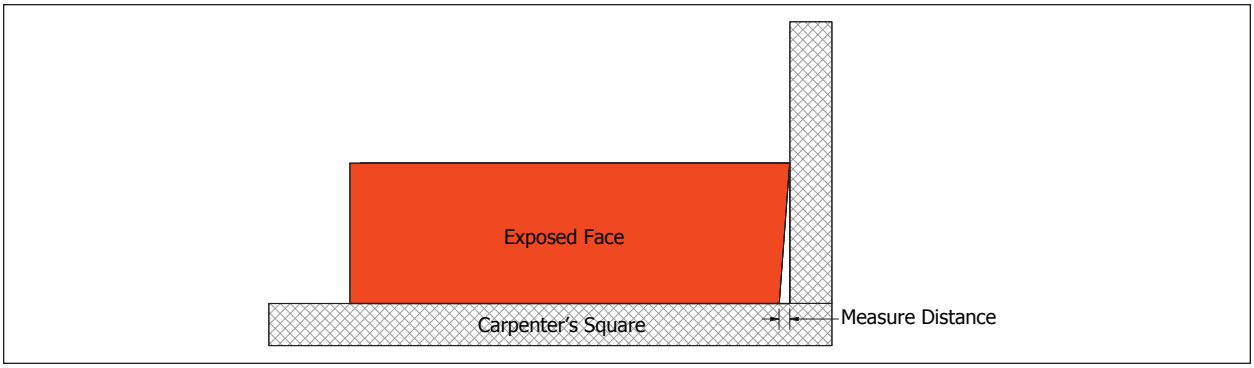

Figure D17. Measurement of out of square.

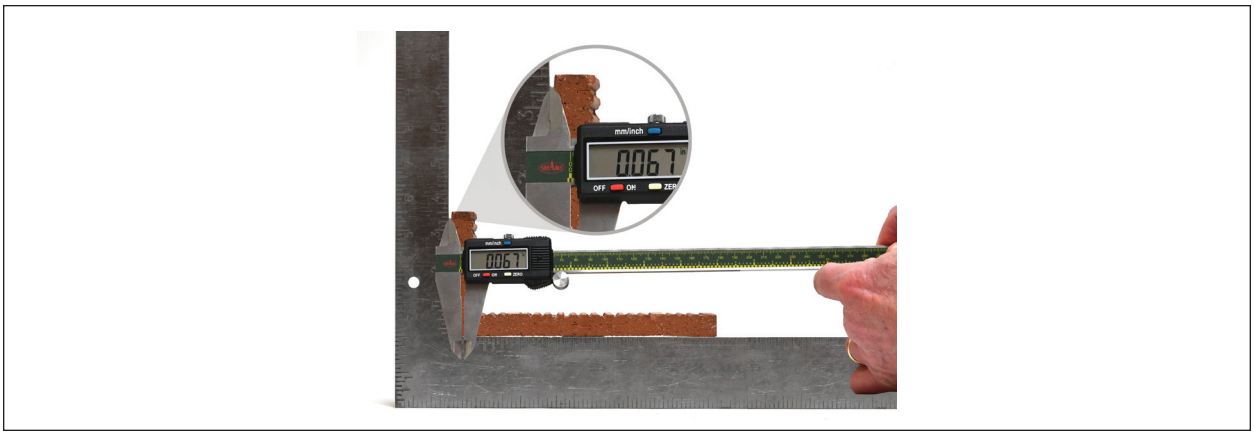

Figure D18. Proper technique for measuring out of square using calipers.

5. Measurement of Shape Angle

5.1 Apparatus

A carpenter's square, steel rule, digital angle finder, protractor, micrometer, and/or calipers. The calipers shall have parallel jaws and be graduated in 1/1000 in. divisions (with metric conversions). The deviation from the specified angle shall be measured with the micrometer or calipers.

5.2 Procedure

Place shape on the carpenters' square with the long leg horizontal and measure the deviation of the short leg due to the departure from the specified angle with a micrometer or calipers (**Fig. D19** and **D20**). Alternatively, use a digital angle finder to measure the shape's angle by placing the arms of the device flat along the long and short legs of the thin brick piece and measure the deviation of the specified angle (**Fig. D21**). Record the measurement of each unit as the shape's angle (**Table D1**).

Angle tolerance: ±1 degree.

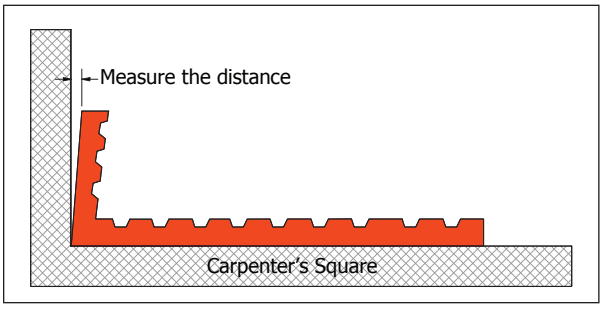

Figure D19. Measuring the shape of an acute angle.

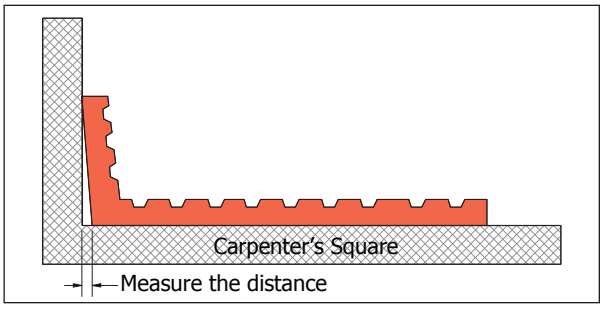

Figure D20. Measuring the shape of an obtuse angle.

Figure D21. Proper technique for measuring the angle of a corner thin brick using a digital angle finder.

Table D1. Measure of shape angle

Measurement of shape angle			
Leg length, in.	3⅝	7⅝	11⅝
Measurement of a 1-degree angle, in.	0.06327	0.13309	0.20291
Approximate dimension in fraction, in.*	1/16	⅛	3/16
Note: 1 in. = 25.4 mm. *Fractions are provided as a simple measurement for reference only; micrometer decimal measurements take precedence.			

This guide defines the most popular and easiest thin brick sizes and courses to execute.

The designer should clearly define the thin brick size(s), shapes, coursing patterns, and placing locations via the specifications, construction drawings, and three-dimensional modeling.

The thin brick coursing pattern, placing locations, and joint shapes and widths are established by accurately placing a suitable formliner in the precast concrete form.

Consideration should be given to the dimensional layout of the thin brick material within each precast concrete component. Whenever possible, the height and length of the precast concrete component should be a multiple of nominal masonry-unit heights and lengths. The actual specified dimensions may be less than the cumulative nominal brick dimension coursing as determined by the actual width of the precast concrete component. The designer should consult with precast concrete producer to define the brick coursing dimensions and details at each edge of the panel and within brick fields to avoid slender pieces of thin brick that are difficult to hold in the mold and produce an unrealistic brick coursing detail.

The following sections illustrate the most typical brick sizes with suggested coursing dimensions. It is recommended that the designer consult with the local brick distributor and precast concrete producer to determine actual brick sizes and course layout for the specific project.

1. Modular Size Brick Coursing

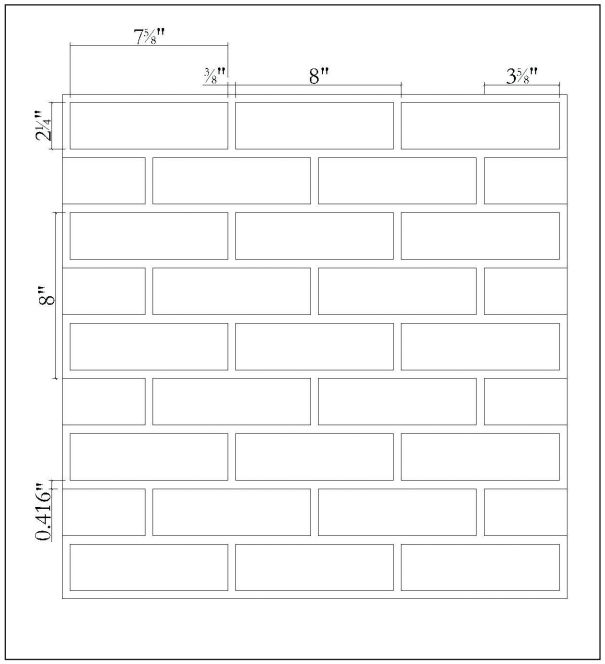

Figure E1. Modular one-half running bond.
Note: 1" = 25.4 mm.

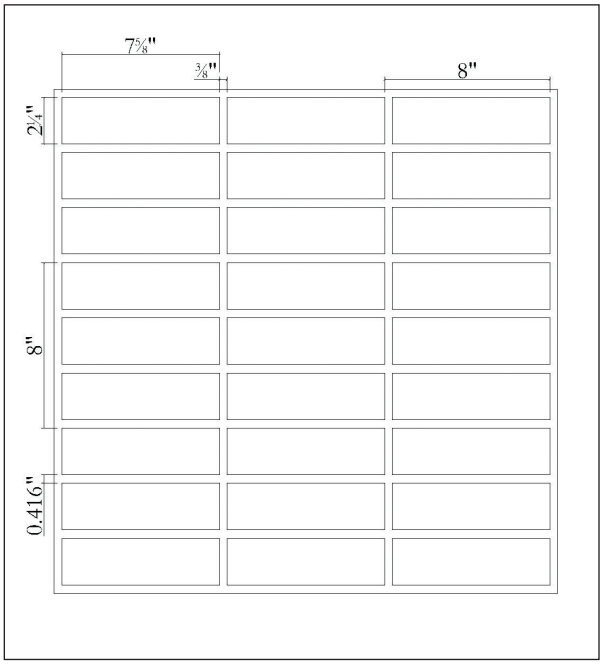

Figure E2. Modular stacked.
Note: 1" = 25.4 mm.

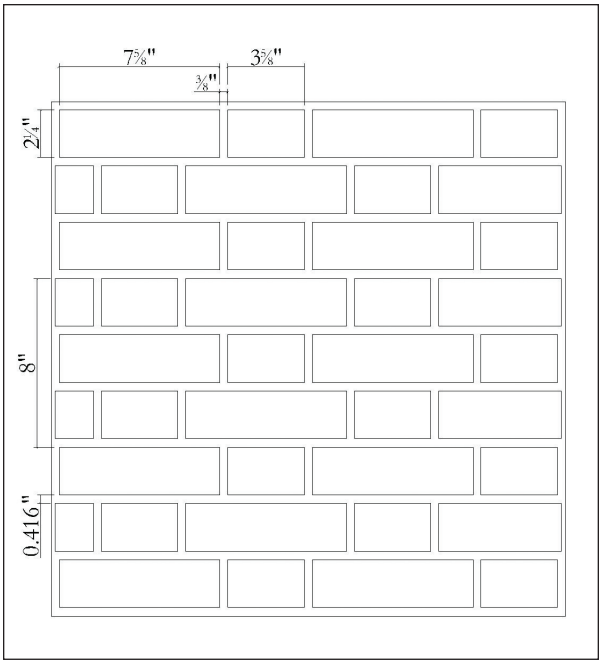

Figure E3. Modular Flemish.
Note: 1" = 25.4 mm.

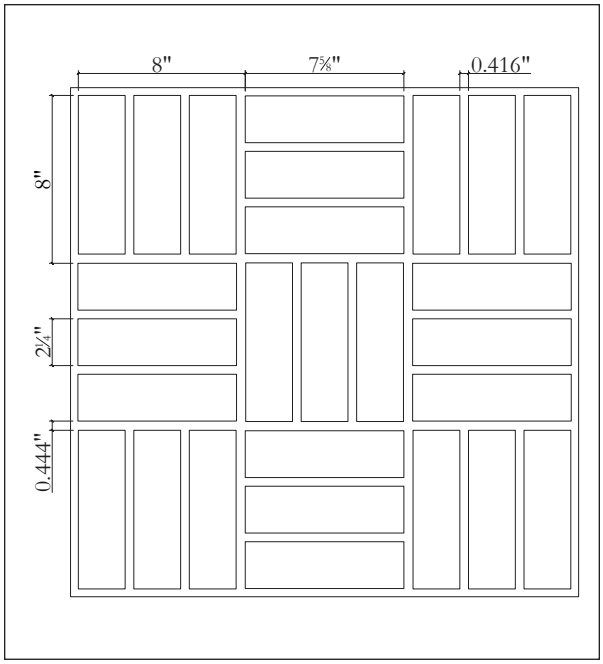

Figure E4. Modular basket weave.
Note: 1" = 25.4 mm.

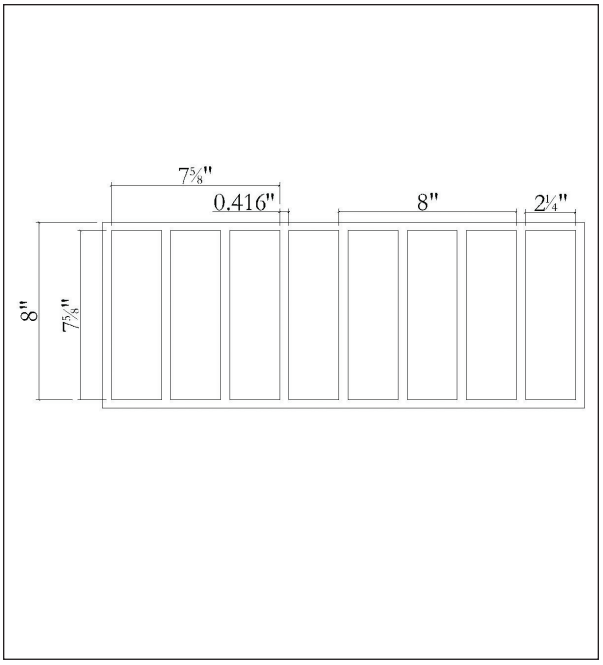

Figure E5. Modular soldier.
Note: 1" = 25.4 mm.

2. Norman Size Brick Coursing

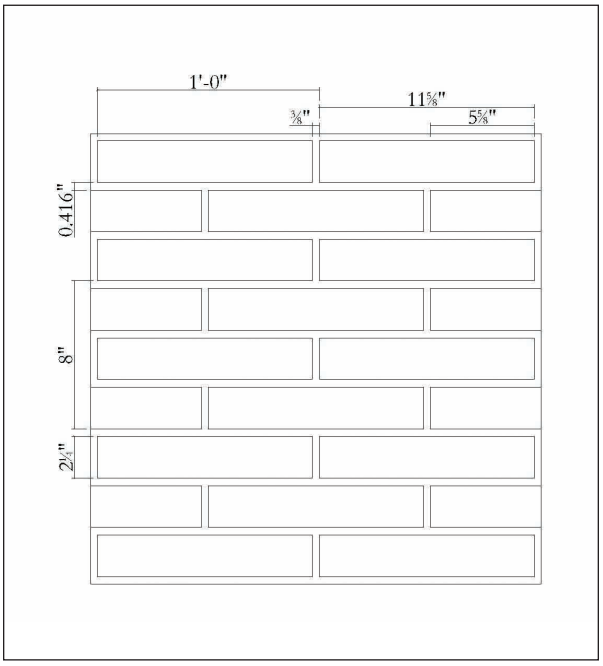

Figure E6. Norman one-half running bond.
Note: 1" = 25.4 mm.

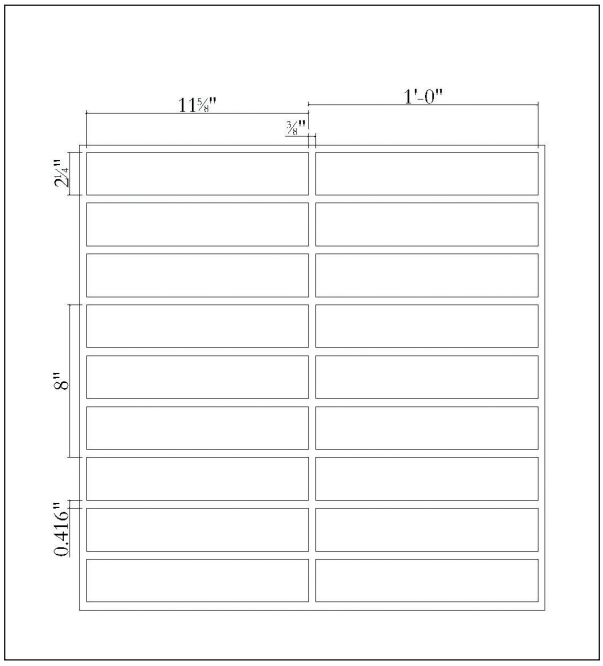

Figure E7. Norman stacked.
Note: 1" = 25.4 mm.

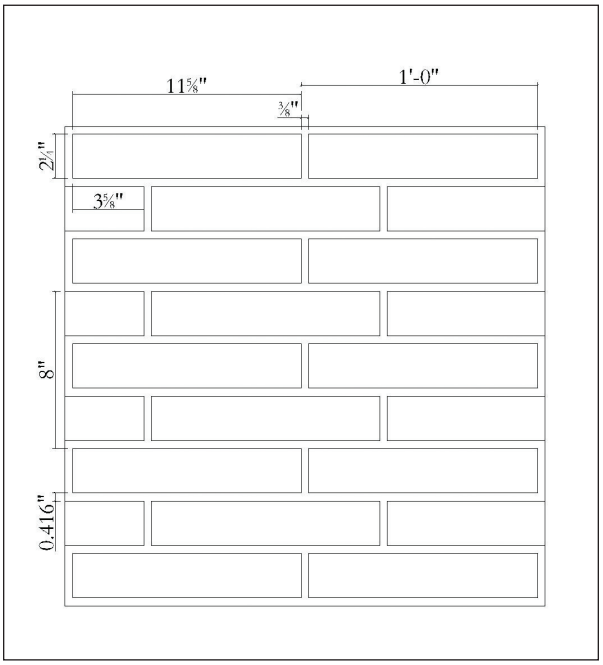

Figure E8. Norman one-third stepped.
Note: 1" = 25.4 mm.

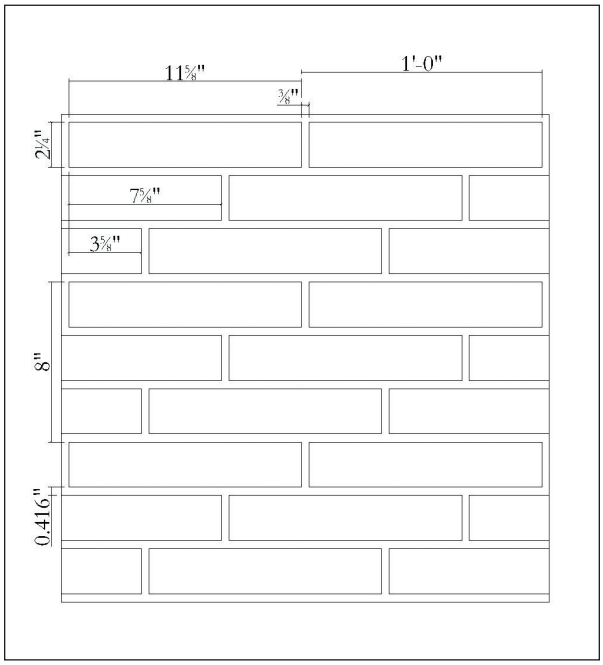

Figure E9. Norman one-third running bond.
Note: 1" = 25.4 mm.

3. Closure Size Brick Coursing

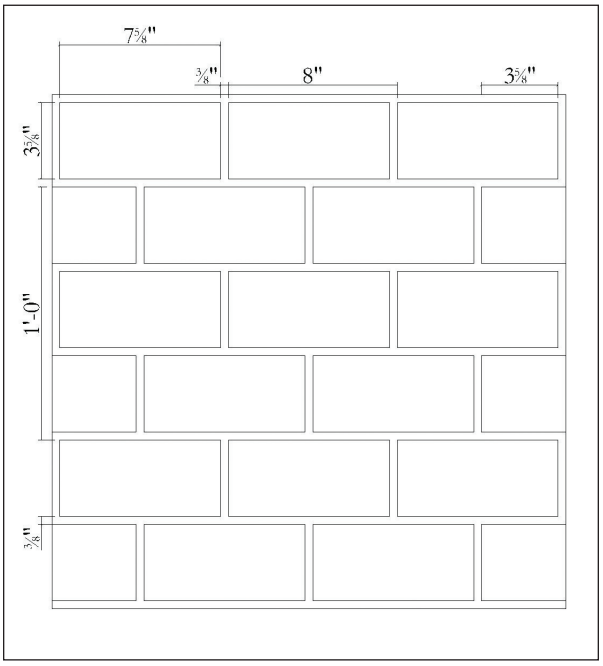

Figure E10. Closure one-half running bond.
Note: 1" = 25.4 mm.

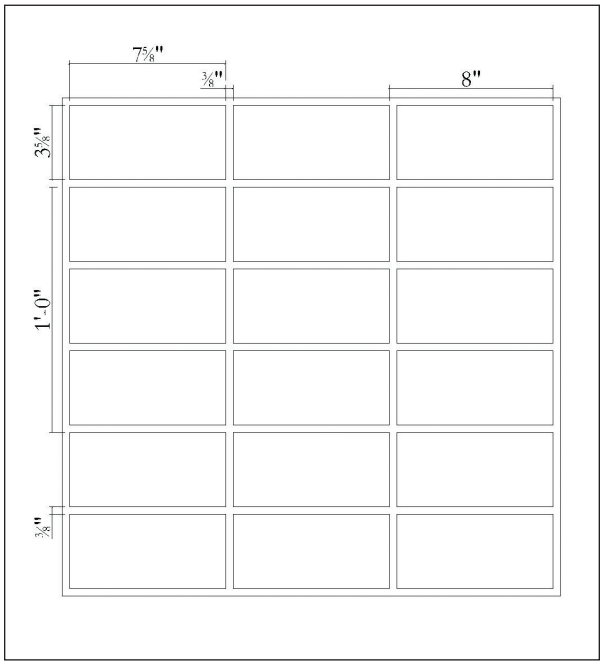

Figure E11. Closure stacked bond.
Note: 1" = 25.4 mm.

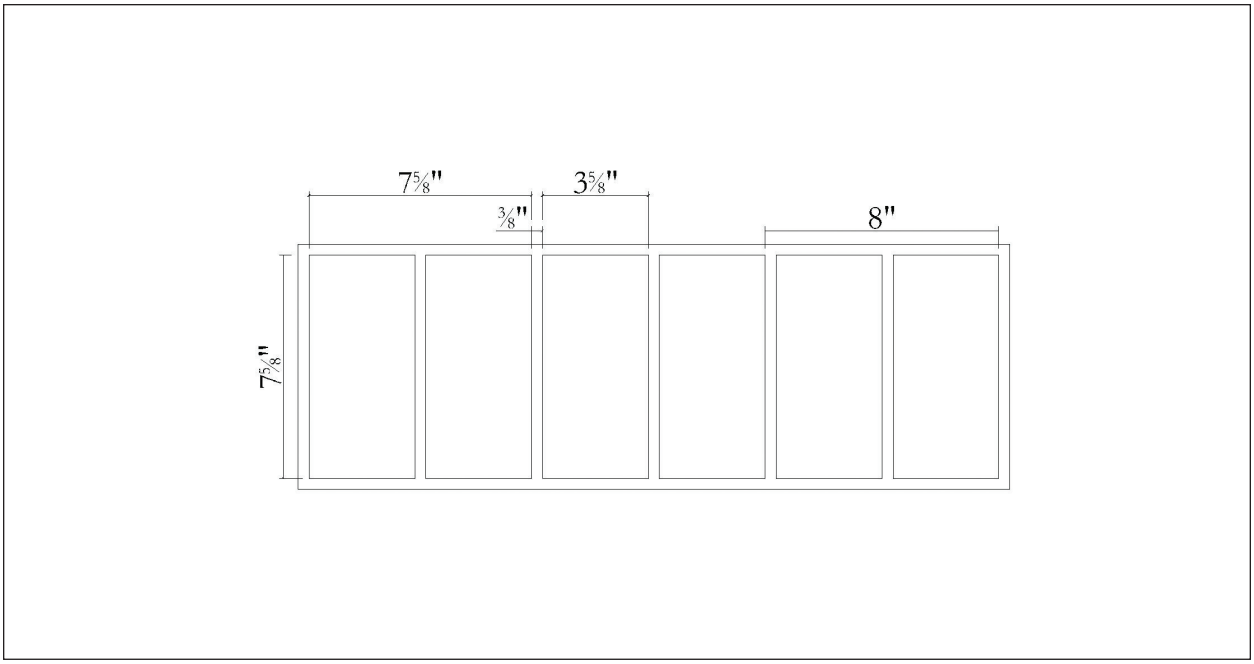

Figure E12. Closure soldier.
Note: 1" = 25.4 mm.

4. Utility Size Brick Coursing

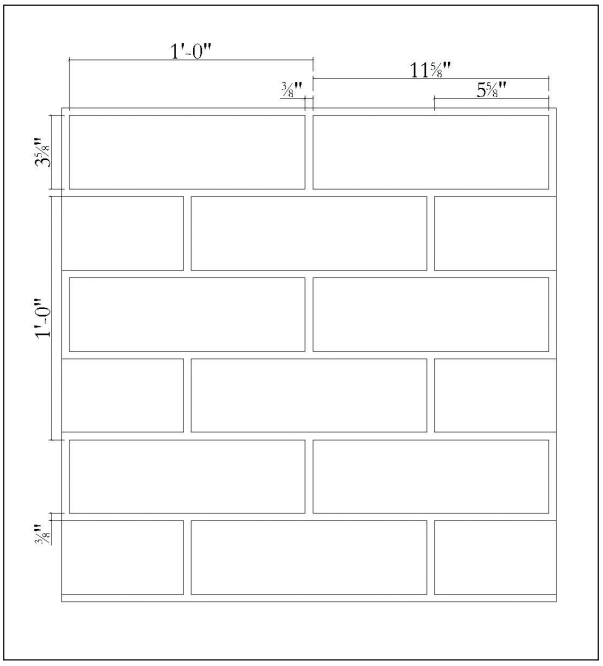

Figure E13. Utility one-half running bond.
Note: 1" = 25.4 mm.

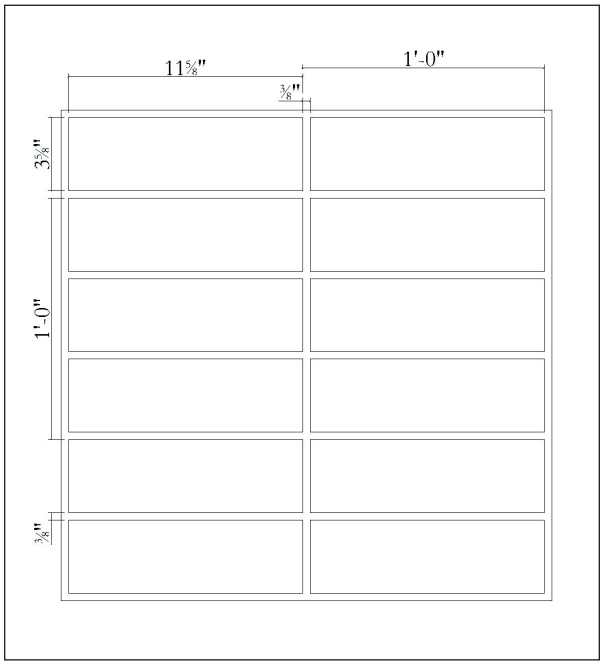

Figure E14. Utility stacked bond.
Note: 1" = 25.4 mm.

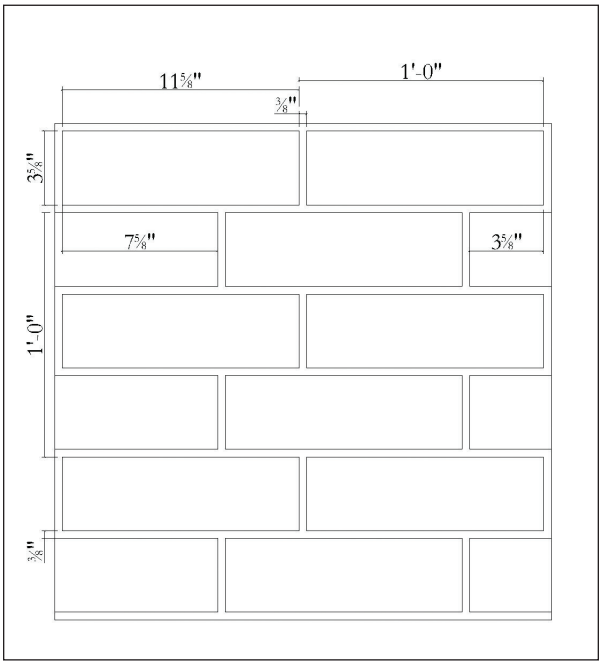

Figure E15. Utility one-third running bond.
Note: 1" = 25.4 mm.

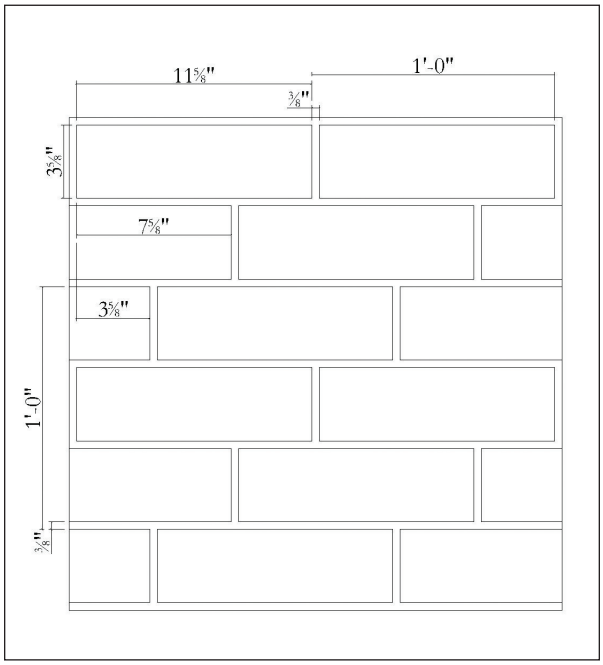

Figure E16. Utility one-third stepped.
Note: 1" = 25.4 mm.

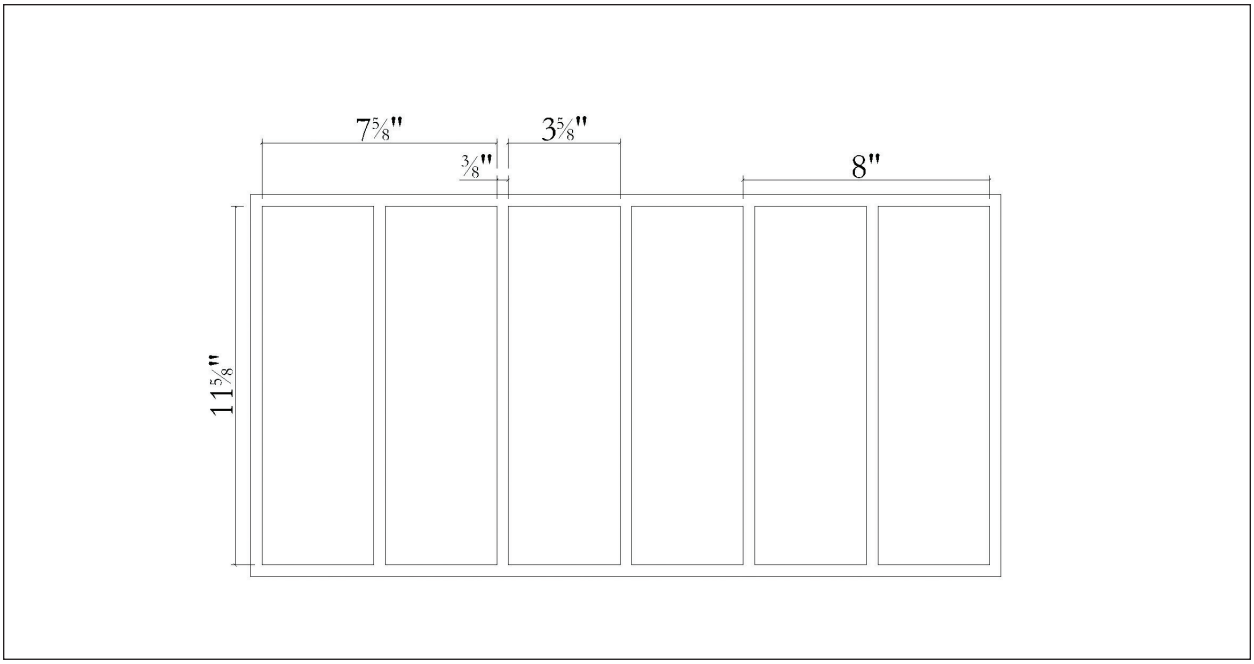

Figure E17. Utility soldier.
Note: 1" = 25.4 mm.

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