Embedded Clay Thin Brick Best Practices

Selecting Thin Brick

Select a thin brick that meets the dimensional tolerances, material properties and testing in accordance with **PCI Specification for Embedded Clay Thin Brick** (PCI's Specification - **Appendix A**)**.** The precast producer should require the thin brick manufacturer to acknowledge the project requirements, that they have read and understand this document, and will provide a **Certificate of Conformance** letter using the sample letter included herein (**Appendix B**)

Thin Brick Sampling

Final thin brick selection should occur after thin brick is cast into a precast sample as to demonstrate the appearance after all precast production processes are complete. The reason is that some thin bricks (sand faces in particular) can have a different appearance after casting into concrete and completing panel processing (i.e., cleaning, acid washing, etc.) as compared to the thin brick manufacturer's sample board. In addition, the mortar joint created by the concrete mix design, form liner profile, and precast cleaning/finishing techniques (i.e., color and texture) will provide the designer with a more accurate representation of the finished product's appearance.

> **NOTE:** The precast producer should follow PCI's recommended practice for sampling brick faced precast the same as all other architectural precast components per PCI MNL 116, PCI MNL 117, and PCI MNL 122. This practice includes making 12 in. x 12 in. initial samples, 4 ft. x 4 ft (or similar) range samples and one or more full production pieces that best represent the final project's architectural features.

When the designer selects a brick product that does not meet all the requirements of PCI's Specification, the precast producer should require the brick manufacturer to provide a letter on brick manufacturer's letterhead (similar to the letter of conformance) explaining the specific features of their products that do not meet PCI specifications and any current testing data as it relates to material characteristics, water absorption, freeze/thaw assembly testing, size tolerance commitments, and history (with precast producer references) of past precast projects. This letter should be presented prior to bidding the project.

> **NOTE:** The precast producer should share this letter with the design/construction team and formliner provider to make all parties aware of the brick manufacturer's limitations and differences between PCI's Specification.

The thin brick manufacturer should provide the required thin brick quantity (including flat pieces and shapes) to the precast manufacturer so precast mockup panels can be made in accordance with PCI MNL 117. The thin brick provided for the precast mockup should represent the acceptable thin brick color range in alignment with PCI MNL 117 range sample process.

NOTE: Color range is defined by the range of acceptable color shades (from light to dark) acceptable to the architect, owner, or other customer decision maker after mockup range samples are produced. The term Color Range is not defined as a brick color blend or mingle.

Ordering Thin Brick

When ordering thin brick, the precast producer should:

- Ask the thin brick manufacturer to provide a **Certificate of Conformance** letter using the sample letter included herein (**Appendix B**).

- Order thin brick using the manufacturer's name, plant location, thin brick name and specific thin brick product code number, color, size, and texture.
    - Thin brick size should include the size name (i.e., modular, utility, etc.) and specified dimensions for each thin brick type and shape.
    - For corner and edge cap thin brick, size should include each facial dimension (i.e., height, length, and width) of all sides of the unit.
    - For non-standard thin brick units, provide the thin brick manufacturer with an approved and signed drawing clearly demonstrating the size, shape, angle, and thickness of each type of thin brick unit including all dimensions.

- Order thin brick in unit quantities as recommended by the specified thin brick manufacturer.
    - Flat thin brick – order in square foot of wall coverage.
    - Corner thin brick, edge cap and special shapes – order in piece counts.
        - Consult with the thin brick manufacturer or thin brick distributor for appropriate conversion rates (linear feet to pieces).

- Allow for a minimum of 5% to 10% thin brick material waste and overage as a general rule.
    - The actual waste and overage amount shall be determined by the precast producer based on the specific project requirements. For example, a project with simple coursing pattern and few cuts will require less overage (5%) while a project with a lot of cuts would require more overage (10% or more).
        - Special attention should be given to special shapes (corners, edge caps and non-standard shapes), especially when small quantities are required. It is not uncommon to order 50% more of these when the risk of losing one precast panel could require a reorder of thin brick materials.

- 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 process 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 to the brick manufacturer's control sample, any additional later orders of thin brick may not be a perfect match to the original run.
    - As a general rule, it is recommended to include a waste factor when ordering thin brick. The waste factor is required to create natural brick coursing, address breakage, will avoid wasting time ordering/receiving more thin brick and prevent the possibility that the thin brick 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 many weeks/months and cause the precast producer to re-build forms. The precast producer should consult with the thin brick manufacturer and/or thin brick

distributor who has precast knowledge when determining the amount of waste to be included in the precast producer's project estimate.

- The thin brick manufacturer, formliner manufacturer, and the precast producer should collectively determine the best course of action to protect the thin brick face from concrete slurry during precast production. The precast producer should recognize that once the thin brick is delivered to the precast plant and accepted, the responsibility for storing, protecting, and removing of wax from the cast panel is the precast producer's responsibility.
    - A coating of paraffin wax applied by the thin brick manufacturer is most common, but there are options for form release products and retarder type products that can be applied at the precast plant.
        - Paraffin wax can be applied in different thicknesses, have a different melting point, and should be considered thin brick manufacturer specific. Refer to thin brick manufacturer for detailed wax specifications and recommended cleaning procedures.
        - Thin Brick with applied wax should not be stored in high heat environments (i.e., in direct sunlight, under a dark tarp, etc.) where temperatures within the pallet of thin brick or thin brick faces can exceed the wax melting point. The precast producer is responsible for protecting the wax from melting into the thin brick before placement.
        - Care should be taken to keep the coating off of the sides of the thin brick to ensure proper concrete adherence.
        - Some thin brick colors might contain minerals that can have a reaction to certain chemicals that might be present in release or retarder formulas. It is recommended to test the process before actual precast production begins.

Formliner Selection

The majority of formliners can be categorized as either multi-use (urethane / rubber) or one-time-use (plastic). Both provide different types of mortar joint profiles and production, and schedule benefits. The precast producer should familiarize themselves with both types of liners.

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

Ordering Formliner

When ordering formliner, the precast producer should:

- Clearly communicate the total quantity of formliner required for the project. The quantity should include area (typically in sq ft) field coursing, returns, projections, indentations, and any special coursing requirements (i.e., arches, coursing changes, etc.). Some considerations include:
    - It is recommended to review, in detail, the formliner manufacturer's catalogues, cut sheets, etc. to fully understand the product's features and limitations.

    - Consider sharing the construction documents and/or erection drawings with the formliner manufacturer (or multiple liner manufacturers) to gain assistance with defining required quantities.

- Define, pictorially and/or in writing, the specific brick coursing pattern(s), brick coursing transitions, mortar joint profile and any non-standard brick coursing dimensions required for the project.
    - Be particularly aware of panel dimensions (length, height and between features such as reveals, projection or openings) where the brick area within a panel field does not follow standard brick coursing dimensions (or dimensional modules). These areas can cause the need for excessive thin brick cutting (including the potential of thin sliced 'sliver brick' or non-standard kerfed sized brick) and require coursing that does not yield a normal hand laid brick appearance.

- The formliner manufacturer and precast producer should collectively determine the adequate amount of formliner waste required for the project.
    - Custom made; multi-use liners will typically require adequate waste to accommodate the many form changes along with any anticipated liner breakdown due to normal production practices.
    - Plastic, one-time use liners are sometimes provided as a stock item. Consult with your liner manufacturer once the actual thin brick run samples are provided to determine if a 'stocked' liner profile can be used, thus limiting the amount of waste.

- It is recommended to provide a thin brick sample from the actual thin brick production run to the formliner manufacturer for the purpose of establishing size compatibility (i.e., fitting the liner to the project specific thin brick). A minimum of 25 thin brick flat pieces and 12 corner pieces are required to assure the best liner-to-brick compatibility results.
    - Note: When there are schedule conflicts, it may be necessary to produce the liner before the actual thin brick run is manufactured. Using thin brick from a production run other than the specific project's thin brick run may result in an unacceptable form liner fit creating precast production and/or final precast appearance issues.
    - Clear communication between all parties should be maintained in the event the thin brick/liner fit is not ideal or is problematic.

- When the form liner manufacturer requires a form release agent, consult with the formliner manufacture and thin brick manufacturer to ensure the release agent is compatible with their products. Release agent should be a reactive type and dry to the touch before the thin brick is inserted into the liner.

Pre-Production

Upon receipt of the products at the precast plant, it is critical to properly measure each thin brick shape as soon as possible using calipers. Each shape should be evaluated per ASTM C67 Modified for Embedded Thin Brick Applications (see **Appendix C**). 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 you suspect a size, color, finish, or quality concern. Identifying

potential concerns early will maximize the time to take corrective action. A lot of problems can be resolved by taking this step and documenting the findings.

When thin brick is received, the precast producer should:

- Protect waxed thin brick from extreme temperatures (i.e., direct sunlight) to prevent wax melt and breakdown.
- Pull a sample set of thin brick from 5 different pallets (usually one carton from different pallet) from each full truck load of thin brick and verify that the material conforms to the purchase order. Follow this procedure for each thin brick size and shape.
    - 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 using calipers and measure per ASTM C67, Modified for Embedded Thin Brick Applications.
    - Coating: If the thin brick was ordered with a protective coating, observe if the coating is sufficiently applied and will protect the thin brick as expected.
    - Color/Texture: Compare the thin brick delivery with the approved sample to ensure the color is within the acceptable appearance range. It is recommended to cast a precast sample using the approved concrete mix to test the thin brick's fit within the liner, test the precast plants cleaning and finishing process and compare the sample with the approved color/finish sample before beginning project production.
        - When the purchased thin brick includes multiple colors, sizes or a blend of different colors and sizes, the precast producer should follow the above Color/Texture best practices for each thin brick color and size.

When formliner is received, the precast producer should:

- Inspect liner to ensure proper quantities and accessories are received.
- Store liners out of weather and in acceptable ambient temperatures to prevent damage.
- Dry fit an adequate amount of thin brick in the formliner to ensure proper fit.
    - Document findings with photos and/or videos and share with the formliner provider, thin brick manufacturer and/or distributor as applicable.
- Produce a precast sample as recommended by PCI MNL 116, PCI MNL 117, and PCI MNL 122 to ensure an acceptable final appearance. When applicable, gain designer approval in writing.
    - This sample should be produced even if you have already received an approved sample. Actual thin brick runs and liner pieces could be different than the original sample.

NOTE: To avoid potential staining of thin brick the precast producer should follow the thin brick manufacturer's recommendations including but not limited to the following.

- Precast producer should provide a test for any release product used to ensure it can be removed and cleaned properly without staining the thin brick.
    - do not use oil based release agents of any kind,
    - do not allow release or retarder to set on the face of thin brick longer than 48 hours,

- do not acid etch panels unless the panel has been thoroughly pre-wet with water beforehand, is thoroughly rinsed with water afterward, and uses properly diluted ratio of acid solution that has been tested on a sample panel prior to full-scale application,
- do not allow cleaning agents to set up or absorb into the thin brick,
- do not leech iron, salts, manganese, or any other constituent from concrete or thin brick,
- do not allow dyed joints or additives in face mixes or concrete backing to become soluble through improper curing, interaction with cleaning agents and/or acids, premature washing, or any other procedure that would allow dye / additives to deposit on the face of the thin brick and
- water used for cleaning or in the concrete must be clean and free from injurious amounts of any substances that may be deleterious to mortar or metal in the masonry.

Production Practices

- During Production
  - Lay out form liner per drawings and formliner manufacturer. Check coursing dimensions before each pour to ensure liner hasn't shrunk or stretched during handling or due to temperature changes.
    - Snap horizontal control lines on the casting bed and/or the side rails every few feet or as necessary prior to placing the thin brick to keep the thin brick on course.
    - Proper positioning of the formliner within each form will ensure that coursing lines up from panel to panel in the final, erected position.
  - Ensure form liner is clean and free of debris such as concrete chips, sand, and small rocks that could keep a thin brick from lying flat down on the form liner. This will avoid tipped and cracked thin bricks.
  - At corners or returns, use appropriate corner form liner to produce realistic mortar joints – do not use flat sheets of liner and try to miter them together.
  - Cut thin brick using a wet tile saw with a non-segmented wet diamond blade. Cut thin brick, face up, for a clean face cut edge.
    - Remove any debris from the face of the thin brick and ensure the cutting operation does not change the appearance of the thin brick.
    - Change water in saw regularly and wash cut thin brick.
      - Dry thin brick can soak up the dirty water and when dried will leave an even layer of dust that's unnoticeable and may reduce bond between thin brick and concrete.
  - It is not recommended to use thin brick that is cut and epoxied to make a shape. However, when unavoidable, follow the thin brick manufacturers recommended process.
  - When placing thin brick in formliner on the casting bed, it is important to utilize multiple thin brick cartons (boxes, packs, bundles, etc.) from several pallets (3 or more) and broadcast the pieces across the entire panel layout. Do not use thin brick from a single pallet for an individual panel.
    - Individual thin brick being placed should be pulled from multiple cartons to help achieve an even color/texture range.

- For thin brick on vertical form surfaces, secure to form liner using form liner recommended procedures. Test specific method to ensure finished product meets customer's appearance expectations. Effective methods include:
  - Spray adhesive or hot glue adhesive to hold thin brick in place.
  - Attaching a non-metallic strap behind the thin brick using non-corrosive fasteners at the mortar joints to hold the thin brick in place.
- Continually check every thin brick for tolerance conformance as thin bricks are being placed in the form liners. Set aside individual thin brick pieces that do not meet size tolerance and use those pieces for cuts required to complete brick coursing (i.e. half-length thin brick at the end of the panel).
  - Place any non-conforming thin brick neatly into a container to assist with obtaining an accurate count.
  - Calculate the percentage of thin brick that measure out of tolerance as to predict adequate thin brick quantities to complete the project.

- When production personnel are required to walk or kneel on thin brick already laid down in the form, use protective mats (typically made from Styrofoam or other compressible but rigid material) to help spread a worker's weight over multiple thin bricks to avoid cracking the thin bricks.
  - Thin brick sizes that are longer and more linear may be more susceptible to foot-traffic breakage.
- Check every thin brick for proper placement before placing rebar or casting concrete. Any misplaced thin brick or cracked thin brick should be inspected and/or removed and replaced.
  - If a thin brick is cracked or dislodged from the formliner during rebar placement, the individual thin brick(s) should be immediately removed, and proper production personnel informed so the thin brick(s) can be replaced before casting.
- Perform a final thin brick check during the pre-pour QC inspection prior to casting concrete and make any required corrections.
- Concrete Placement Techniques
  - Carefully place concrete to ensure force created by pouring does not dislodge thin brick from the form liner pockets.
  - Minimize concrete vibration to prevent dislodging thin brick from the form liner pockets.
  - When using a self-consolidating concrete (SCC) mix, minimize vibration to reduce chance of concrete slurry bleeding around edge of thin brick and onto face.
  - Workers should be mindful of the difficulty of correcting thin brick that are out of plane in the finished product. Therefore, they should be aware of and avoid any activity that could cause thin brick or liner shifting during casting.

- After casting and stripping panels from the mold
  - After removing the panel from the form (and removing formliner if one-time use), scrape off any concrete bleed that made its way onto the face of the thin brick.

        - Observe panel to identify any thin brick that are misaligned, cracked, tipped, etc. as a way to improve casting methods for the next day.
        - Communicate observations to plant workers and yard finishers as to
            - Identify production related imperfections and take corrective action.
            - Discuss the best method for repairing/replacing any misaligned thin brick.
            - Determine a strategy to predict the percentage of thin brick to be repaired/replaced and ensure you have enough thin brick to complete the project.
            - Communicate findings to the thin brick manufacturer, thin brick distributor and/or the formliner manufacturer. Use photos, videos, or other means to clearly communicate the findings.
    - Clean panels immediately after stripping in the plant and inspect to ensure all wax or retardant is removed prior to shipping panels to the jobsite.
        - It is recommended to start cleaning at the top of the panel and 'chase' the water stream (acid, wax, etc.) to the bottom of the panel in a 4 ft. to 6 ft. swath.
    - Remove wax on thin bricks after casting by using recommended water temperature and pressure settings. Having sufficient hot water temperature, proper water pressure, and the correct power washing/wax removal technique is key to ensure all wax is removed.
        - The water temperature required to effectively liquify the wax is typically 180 degree at the panel. The precast producer should follow the thin brick and/or wax manufacturer's recommended temperature.
        - Measure water temperature by spraying it into a bucket or other location. Water ran through sprayer may not be at same temperature as holding tank. Use of laser temperature gun on water as it is being sprayed may give artificially low temperature reading.
        - Recommended practice is to use water pressure of 1,000 PSI to 1500 PSI and use a sprayer tip that has a water spray angle of 45 degrees to 60 degrees.
        - Correct power washing/wax removal technique should be developed by the individual precast producer. A suggested method is to start from the top of the panel, 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 to prevent wax from re-solidifying on the panel and allow the wax to drip off the panel.
    - Protect the thin brick from any concrete texture application processes that may cause damage to the thin brick. Suggested processes include:
        - Leave wax on the thin brick until the exposed concrete texture is complete. The wax will act as a protectant to the thin brick appearance.
        - Tape off the thin brick area with either plastic tarp or plywood template to protect the thin brick during the panel finishing process.
        - Recommended practice is to test the preferred method during the precast sample production process.
    - In the case of any staining that cannot be repaired by use of hot water, consult the thin brick manufacturer for recommended cleaning products and follow

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 cause damage to the color and finish of another thin brick.

- Always test cleaning methods on a small scale or sample thin brick before applying on a large scale

- Compare approved precast mockup panels with finished panels (in a dry state and in the same lighting) to ensure the thin brick color, finish and/or blends match the mockup.
  - If concerned that the color does not match, photograph the observation(s), and immediately contact the thin brick manufacturer and/or thin brick distributor for remedial action.
  - Repeat this process weekly if not more often to ensure that the thin brick color remains consistent throughout the project.
- If using a brick sealant on the face, follow manufacturer's recommendations for removal.

Appendix A
PCI Specification for Embedded Clay Thin Brick

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 by 7⅝ in. (193.68 mm) long.
      b. Norman: 2¼ in. (57.15 mm) high by 11⅝ in. (295.28 mm) long.
      c. Closure modular: 3⅝ in. (92.08 mm) high by 7⅝ in. (193.68 mm) long.
      d. Utility: 3⅝ in. (92.08 mm) high by 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 corners, and end edge corners.
   5. Back surface texture: Scored, combed, wire roughened, ribbed, key backed, or dovetailed.

B. Dimensional Tolerances: Measure in accordance with ASTM C67. Modified for Embedded Thin Brick Applications (Appendix C of *PCI Embedded Clay Thin Brick Best Practices*)
   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. (200 mm) or less.
      b. +0 in. (+0 mm), –3/32 in. (–2.4 mm) for dimensions greater than 8 in. (200 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 per ASTM C67.
      b. Glazed thin brick: Maximum 5% when tested per ASTM C373.
   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 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 test described above.
   5. Pull-out strength: ≥ 150 psi (1.0 MPa) from base concrete before and after freeze-thaw testing when tested per modified ASTM E488.

6. Chemical resistance: Provide thin brick that has been tested according to modified ASTM C650 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, the following: **[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: In accordance with appropriate ASTM specifications except as specified in D.1.a.
    a. Exception for freeze thaw and pull out strength test: Ten (10) assembled specimen measuring 8 in. by 16 in. (200mm by 405mm) long with the thin brick embedded into the concrete substrate (assembled specimens). The ten (10) assembled specimens are divided into five (5) Sample A assemblies and five (5) Sample B assemblies. The precast concrete substrate shall have a minimum thickness of 2 – 1/2in. (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 of no less than 3/8 in. (9mm) wide and a depth not greater than ¼ in. (6mm) from the exterior face of the thin brick.

    One thin brick from the center of each sample assembly shall be tested for pullout strength. Each Sample B assembly shall first be tested for freeze thaw resistance. In place of anchor specified in ASTM E488, use 3/8 in. (9mm) minimum thickness steel plate of same size as a single thin brick face bonded with epoxy to a single thin brick face for each pullout strength test. The steel plate shall have a centrally located pull-rod welded to the plate.

2. The back surface texture of samples for pullout strength and freeze thaw resistance testing shall be the same.

3. Frequency of testing:
    a. Dimensional tolerances shall be checked prior to shipping on each run of thin brick supplied to the project.
    b. Cold water 24 hour absorption testing shall be conducted on every clay body/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 first shipment.
    c. All other tests specified shall be conducted for each clay body at an accredited laboratory at least every six years.

Appendix B

Thin Brick Manufacturer Certificate of Compliance

(To be placed on brick manufacturer letter head)

Project Name: [NAME OF PROJECT]

Project Location: [CITY AND STATE OF PROJECT JOB SITE]

Precast Producer Name [NAME OF PRECAST PRODUCER]

Precast Producer Location: [CITY AND STATE OF PRECAST 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: [THIN BRICK MANUFACTURER]

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

The Brick Product Description: [COMPLETE THIN BRICK DESCRIPTION INCLUDING PRODUCT NAME(S), PRODUCT NUMBER, COLOR, BLEND, TEXTURE, SIZE, ETC. AS DEFINED IN THE SPECIFICATIONS OR 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 (2016) including dimensional tolerances and physical properties and testing criteria included within.

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

(Signature of thin brick manufacturer authorized employee) *(DATE)*

(Title of employee)

Appendix C

Procedures for Measuring Dimensional Tolerances – in accordance with ASTM C67, modified for embedded thin brick applications.

Measurement of Face Size

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 assess unit size using a tape measure or steel rule. However, for determination of conformance to the PCI Specification for Embedded Clay Thin Brick, the apparatus defined herein shall be used.

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.

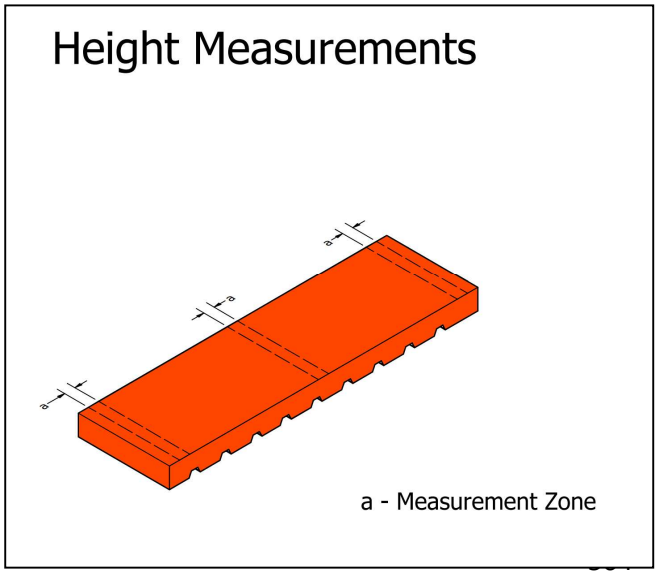
Note: Any burs, rough, or raised edges shall be smoothed and/or removed before measuring.

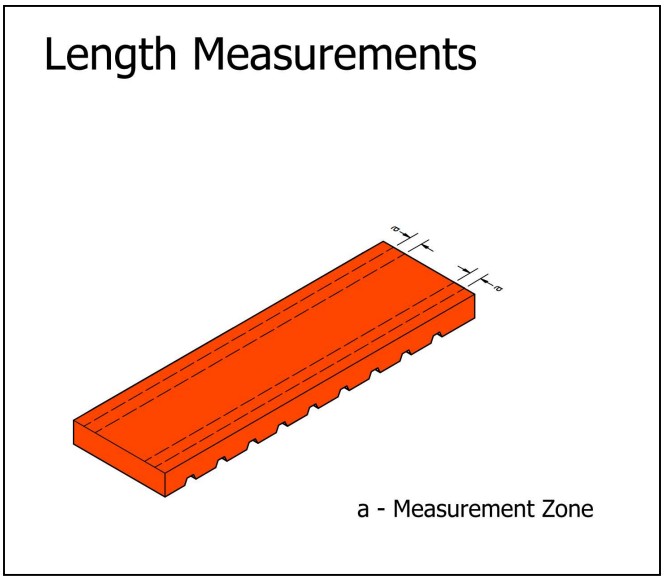
Individual Measurements – Measure the **Length** across the face at two locations between ¼" to ½" from the corners. Measure the **Height** across the face at three locations, between ¼" to ½" from the corners and at midpoint of piece. Report each measurement to the nearest 1/1000 in. and identify any or all pieces that are larger or smaller than the allowable Face Size.

Face Size: Plus 0 in., minus 1/16 in. (0.0625 in.) for dimensions 8 in. or less.
Plus 0 in., minus 3/32 in. (0.09375 in) for dimensions greater than 8 in.

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: Corners, Edge Caps and Special Shapes – follow the above procedures for each exposed face.





Measurement of Thickness

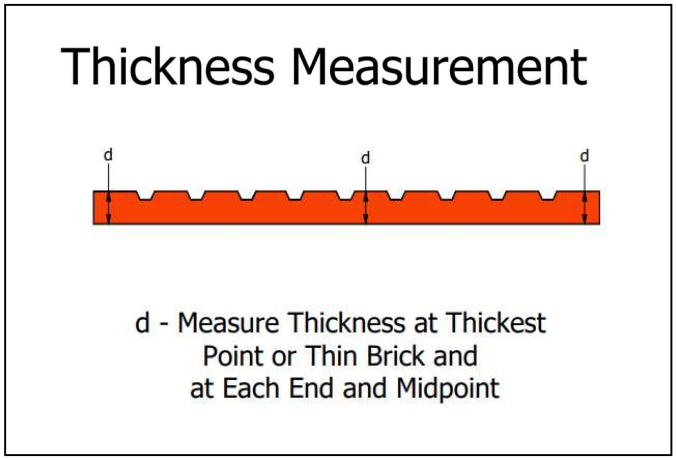
Apparatus – Calipers, graduated in 1/1000 in. divisions, and having parallel jaws, shall be used to measure the individual units.

Procedure – Measure the **Thickness** from face to the thickest part of the back at the mid-point of all 4 sides to the nearest 1/1000 in. See diagram. Report each measurement of the Thickness to the nearest 1/1000 in. and identify any or all pieces that are larger or smaller than the allowable Face Size or Thickness tolerance.

Thickness: Not less than 1/2 in. and no more than 1 in. thick with an overall tolerance of plus 0 in., minus 1/16 in. (0.0625 in.) at the thinnest part of the thin brick including the back face configuration.

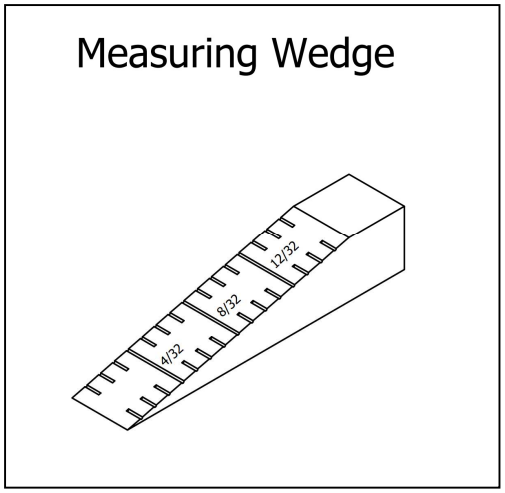
Note: Specified thickness includes scores, ribs, key backs, dovetails or other back surface textures.

Note: Corners, Edge Caps and Special Shapes – follow the above procedures for each exposed face.

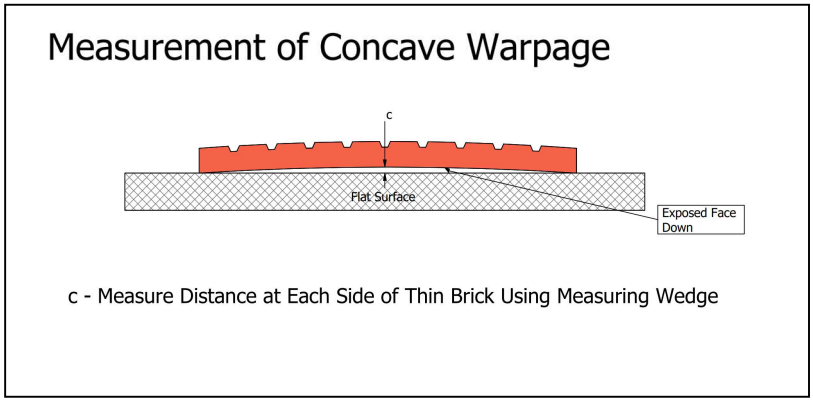


Measurement of Warpage

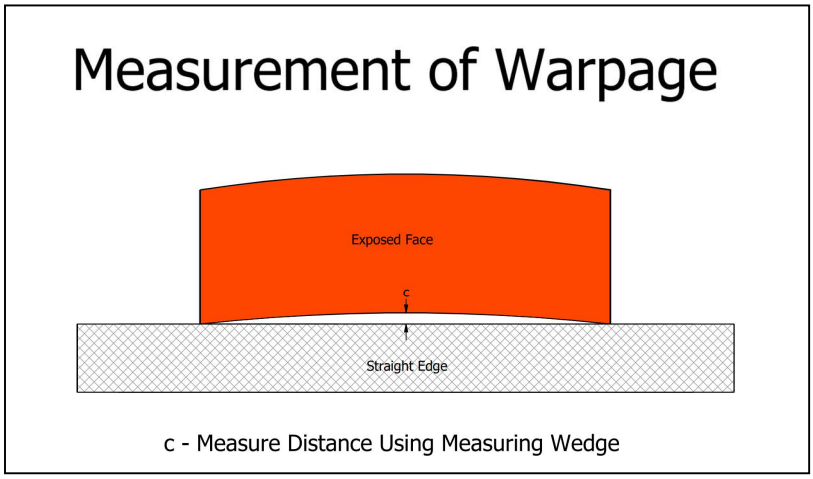
Apparatus – A flat surface, of steel or glass, a steel rule graduated from one end in 1/32 in. divisions (or calipers) or a steel measuring wedge/taper wedge graduated in 1/32 in. divisions.



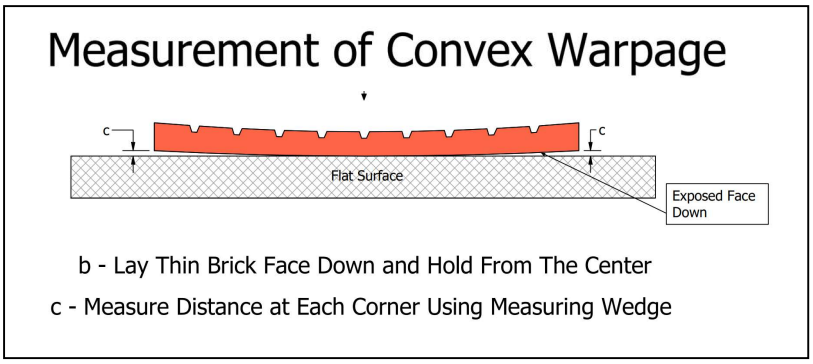
Concave Face – Where the warpage to be measured is a concave face, place the straightedge lengthwise or diagonally along the face to be measured, selecting the location that gives the greatest departure from the unit face to the straightedge. Using the steel rule/calipers or wedge, measure this distance to the nearest 1/32 in. and record as the concave warpage of the face.



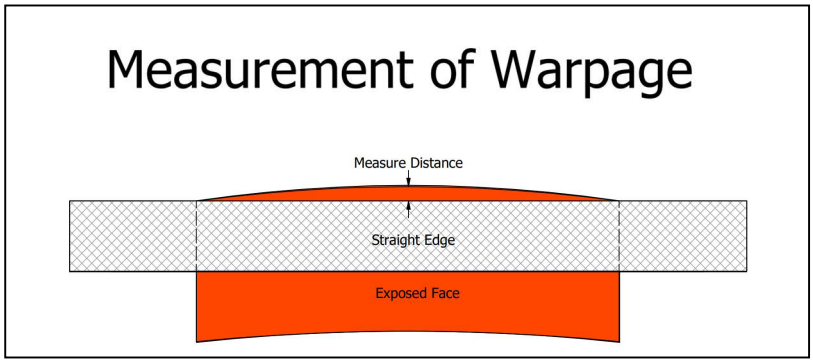
Concave Edges – Where the warpage to be measured is a concave edge, place the straightedge lengthwise along the edge to be measured. Select the greatest distance from the unit edge to the straightedge. Using the steel rule/calipers or wedge, measure this distance to the nearest 1/32 in. and record as the concave warpage of the edge.



Convex Face – Where the warpage to be measured is a convex face, place the straightedge lengthwise on the edge of the unit from corner to corner of the convex face. Using the steel rule/calipers, measure the greatest distance from the straight edge to the nearest 1/32 in. and record as the convex warpage of the face.



Convex Edge – 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/calipers, measure the greatest distance from the straight edge to the nearest 1/32 in. and record as the convex warpage of the edge.



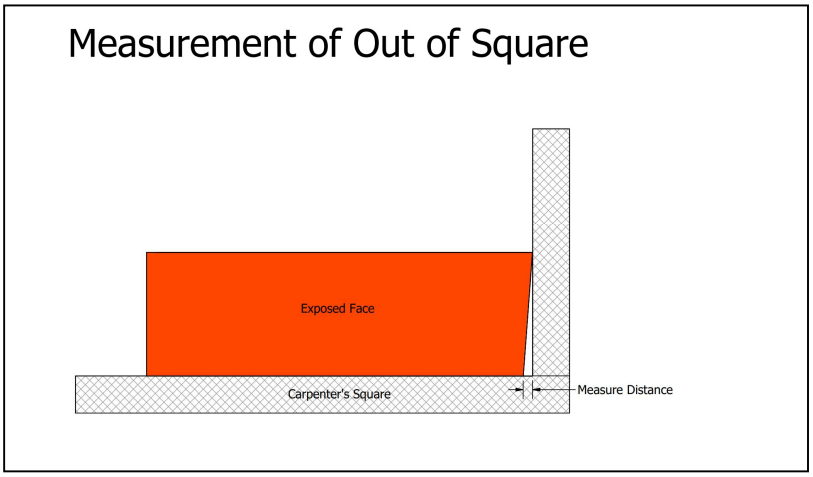
Report each measurement of the Thickness of the 25 sample units to the nearest 1/32 in. and identify any or all pieces that are larger or smaller than the allowable Warpage tolerance.

Warpage Tolerance: Not more than 1/16 in. either concave or convex from consistent plane.

Measurement of Out of Square

Apparatus – A Carpenter's square and a steel rule or calipers.

Procedure – Place sample unit on the carpenter's square with the length against the long edge and the 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. as the unit's deviation from Square.

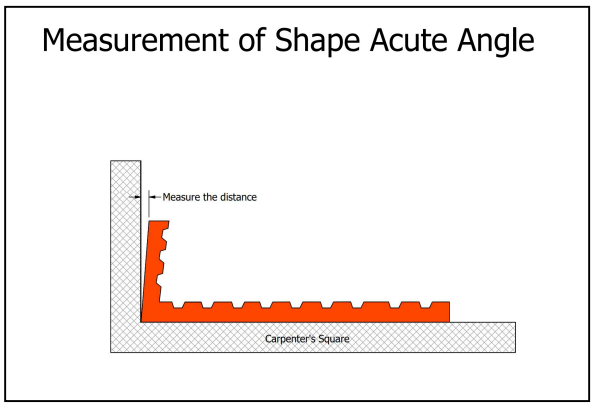


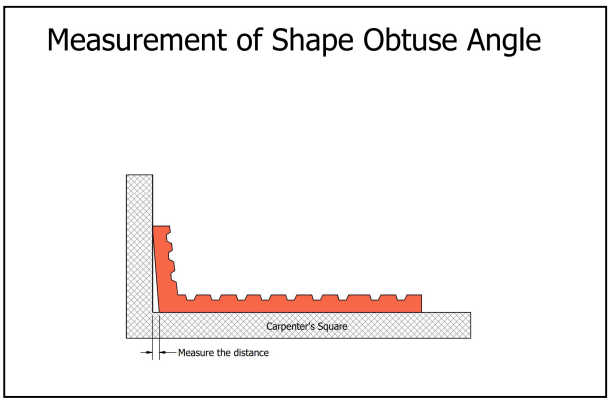
Measurement of Shape Angle

Apparatus – A carpenter's Square, steel rule/calipers or protractor. Use a micrometer to measure deviation from 90-degree angle.

Procedure – Place shape on the carpenter's square with long leg horizontal and measure the deviation of the short leg due to the departure from 90-degree angle (Fig _____). Record the measurement of each unit as the shape's Angle.

Angle Tolerance – Plus or minus 1 degree.





Measurement of Shape Angle			
Leg Length	3 5/8"	7 5/8"	11 5/8"
Measurement of a 1^{o} Angle	0.06327"	0.13309"	0.20291"
Approximate dimension in fraction*	1/16"	1/8"	3/16"
*Fractions are provided as a simple measurement for reference only, micrometer decimal measurements take precedence.			

Appendix D
Thin Brick Coursing Guide

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

The designer should clearly define via the specifications, construction drawing and 3D modeling; the thin brick size(s), shapes, coursing patterns and placing locations.

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

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

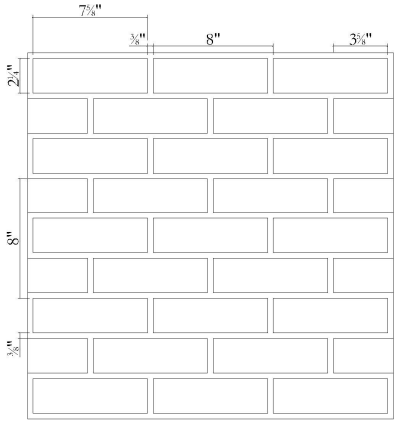
When executing the thin brick course layout, be mindful to prevent the need for small thin brick pieces to complete the coursing when brick coursing dimensions do not align with precast component size requirements.

Included below are the most typical brick sizes with recommended coursing dimensions.

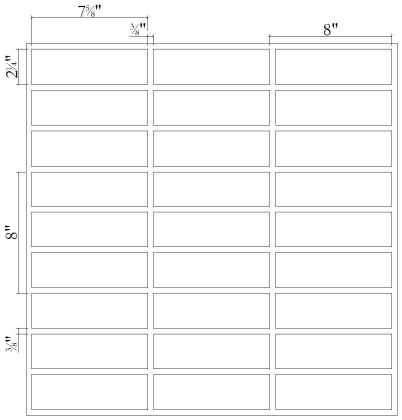
Modular Size Thin Brick Flats: 2 ¼" high x 7 5/8" long

Modular Size Thin Brick Corners: 2 ¼" high x 7 5/8" long with 3 5/8" return leg

Modular $\frac{1}{2}$ RB



Modular Stacked



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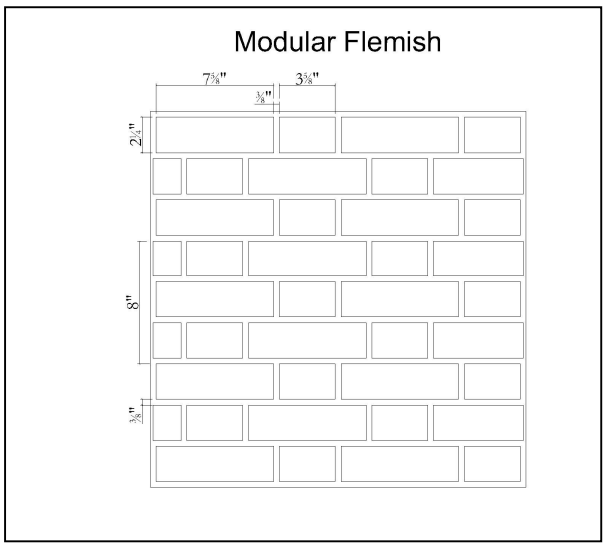

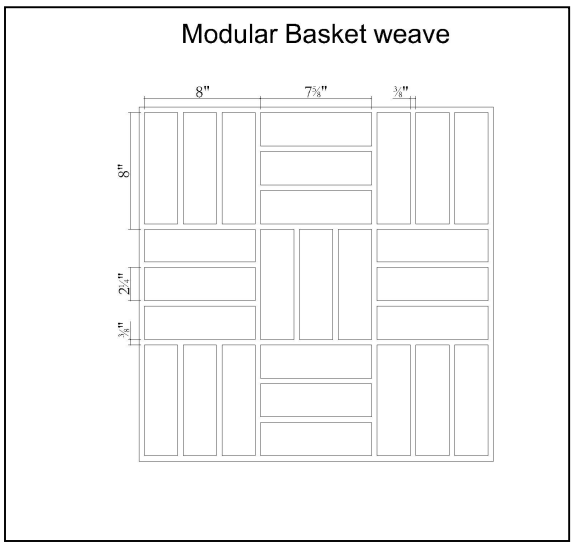

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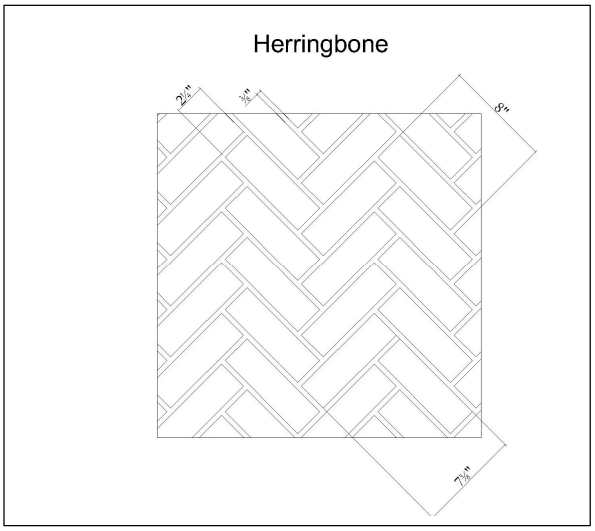

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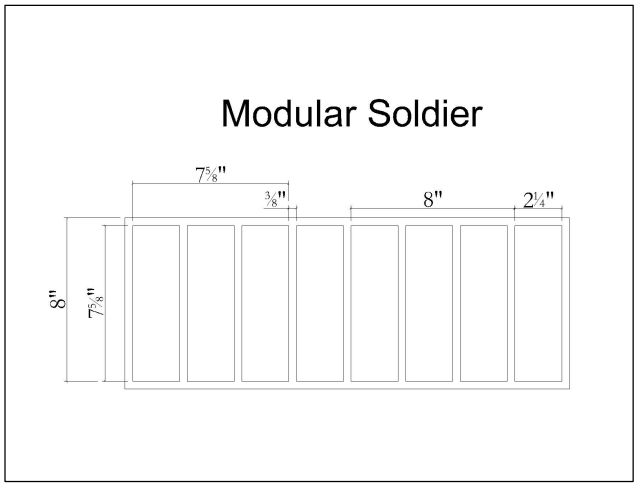

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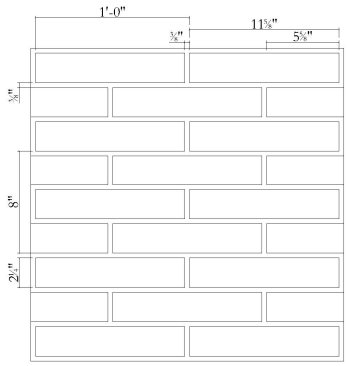
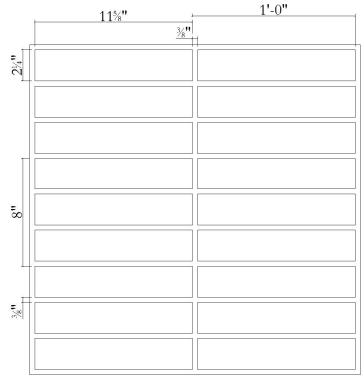
Norman Size Thin Brick Flats: 2 ¼” high x 11 5/8” long

Norman Size Thin Brick Corners: 2 ¼” high x 11 5/8” long with 3 5/8” return leg

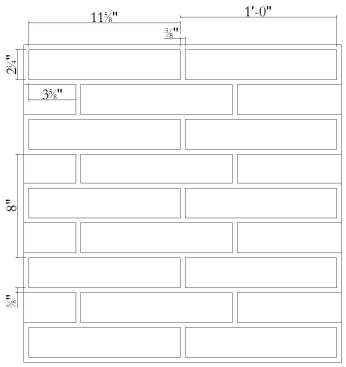
Norman $\frac{1}{2}$ RB



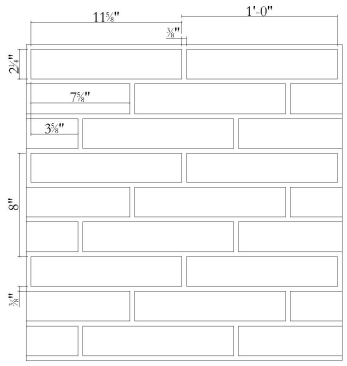
Norman Stacked



Norman 1/3 RB



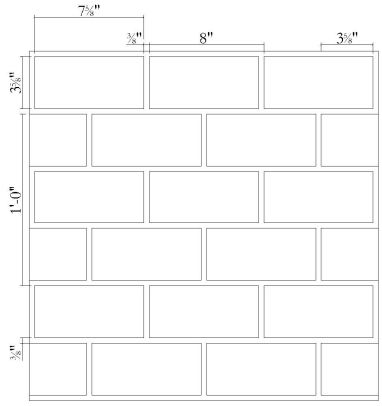
Norman 1/3 Stepped



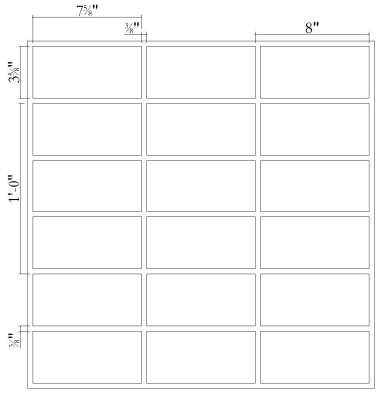
Closure Size Thin Brick Flats: 3 5/8” high x 7 5/8” long

Norman Size Thin Brick Corners: 3 5/8” high x 7 5/8” long with 3 5/8” return leg

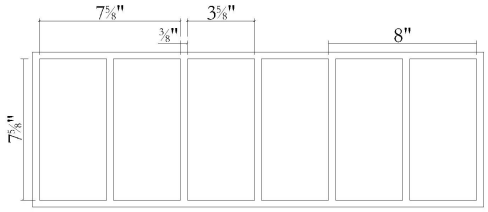
Closure $\frac{1}{2}$ RB



Closure Stacked Bond



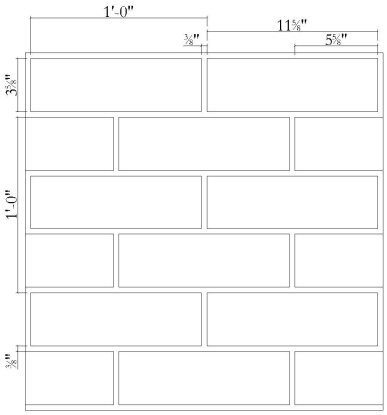
Closure Soldier



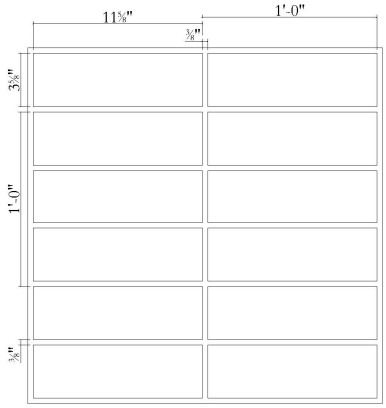
Utility Size Thin Brick Flats: 3 5/8” high x 11 5/8” long

Utility Size Thin Brick Corners: 3 5/8” high x 11 5/8” long with 3 5/8” return leg

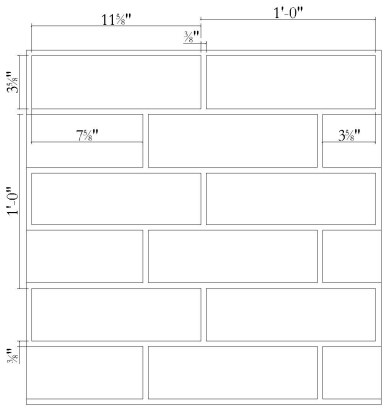
Utility $\frac{1}{2}$ RB



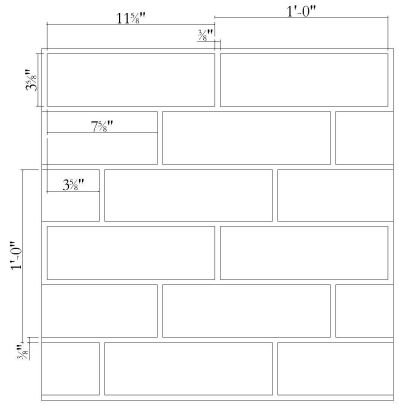
Utility Stacked Bond



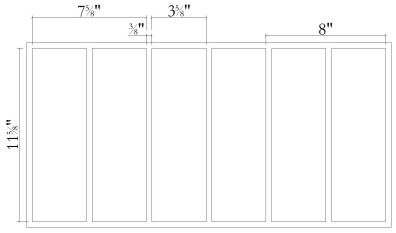
Utility 1/3rd RB



Utility 1/3rd Stepped



Utility Soldier



Queen Size Thin Brick Flats: 2 ¾” high x 7 5/8” long

Queen Size Thin Brick Corners: 2 ¾” high x 7 5/8” long with 3 5/8” return leg

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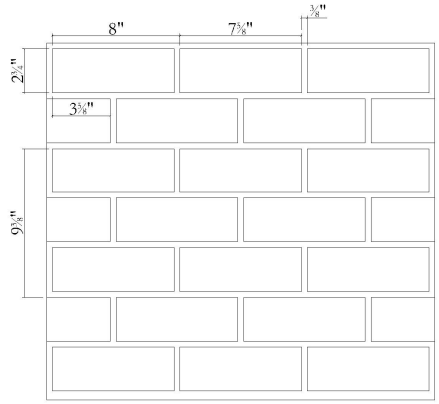
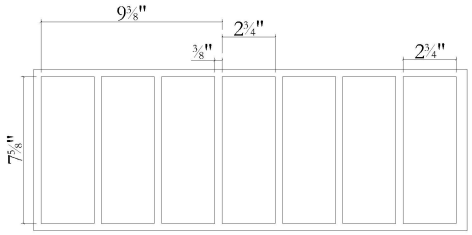
Queen $\frac{1}{2}$ RB



Queen Soldier



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Roman Size Thin Brick Flats: 1 5/8” high x 11 5/8” long

Roman Size Thin Brick Corners: 1 5/8” high x 11 5/8” long with 3 5/8” return leg

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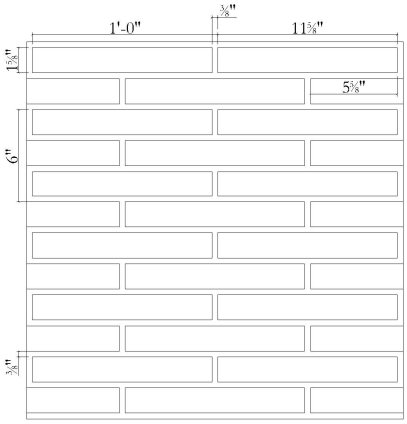
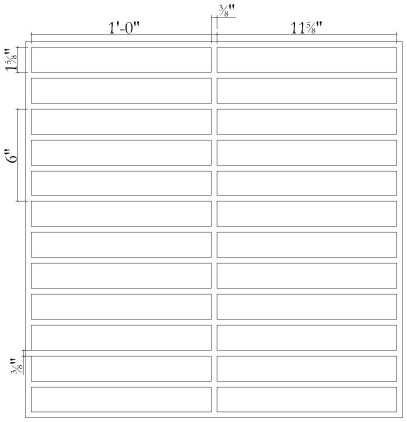
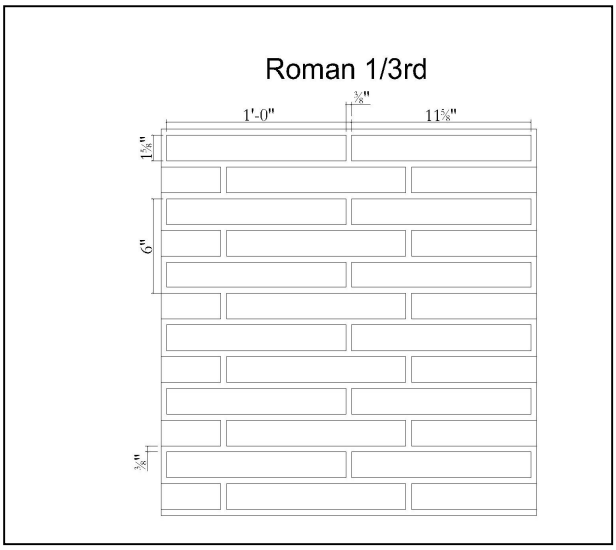
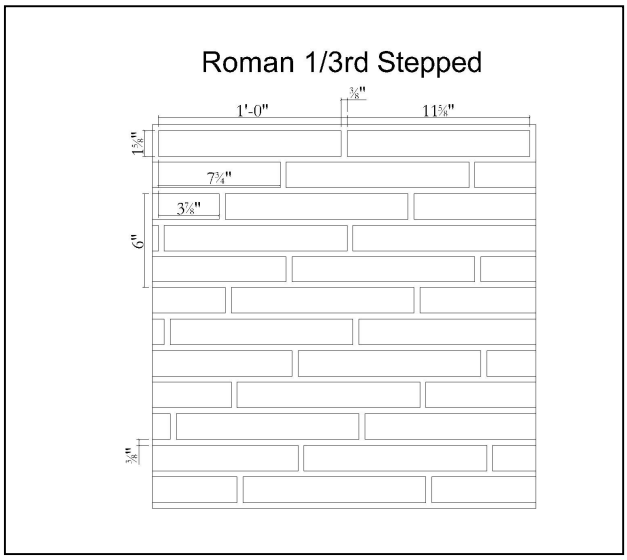
Roman 1/2RB



Roman Stacked







End of Document

Reference MNL 122 in the preface for the document.