ASTM C 1019 – 11 is the Standard Test Method for Sampling and Testing Grout.

Scope

- Covers both field and laboratory testing
- Covers both Conventional Grout & SCG

Significance and Use

- This test is used to establish the compressive strength of grout under conditions that approximate the field conditions on the construction site.

TOPICAL OUTLINE

ASTM C 1019 – 11 Grout Specimens

- In order to approximate the conditions within the wall, the mold should consist of units of the same type.
- Take at least three specimens for each sample. If 7 day tests are desired in addition to 28 day test, two sets will need to be obtained.
- Usually one set per 5000 SF of wall, but check the specifications for exact requirements.

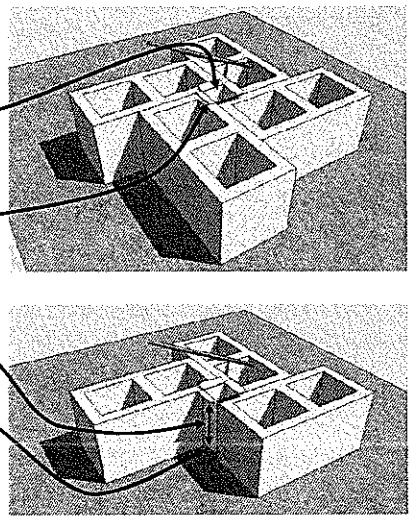
TOPICAL OUTLINE

ASTM C 1019 – 11 Grout Specimens

- Select a level location.
- Molds must remain undisturbed for 48 hrs.
- Line with permeable paper. No plastic, building wrap (Tyvek) or building felt.
- Fill in two layers. SCG is filled a single lift.
- Rod each layer 15 times. Do not rod SCG.
- Top off after 20 to 30 mins.
- Cover with damp cloth.

TOPICAL OUTLINE

- Square cross-section of 3 inches minimum.
- Permeable liner material.
- Twice as high as its width
- Nonabsorbent block



TOPICAL OUTLINE

ASTM C 1019 – 11 Grout Specimens

- Remove specimens from molds between 24 and 48 hrs.
- Transport within 8 hrs & store in moist room until tested.
- Indicator samples are often broken at 7 days but full results are from 28 day breaks.
- All 3 specimens are broken for each test & the results are averaged.
- Calculate psi by dividing the total load by the cross-sectional area.

TOPICAL OUTLINE

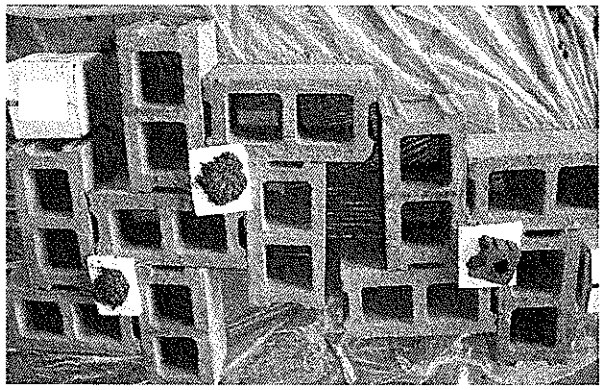
ASTM Standards - Grout Testing Chapter 2

ASTM C 1019 – 11 Grout Specimens

- Alternative forming methods must be approved by the specifier.
- Approval shall be based on comparative testing.
- Approval is limited to a single shape & size, a single forming method, a single grout mix and a single masonry unit.
- A conversion factor is developed from a minimum of 10 sets of specimens.

TOPICAL OUTLINE

ASTM C 1019 – 11 Grout Specimens



One set of samples with masonry units & one set with a cardboard box.

TOPICAL OUTLINE

ASTM C 143, C143M – 10a Slump Test

- For use with Conventional Grout
- Referenced in ASTM C 1019 - 11.
- Indicates fluidity of grout.
- Also indicates water to cement ratio.
- Grout should slump 8 inches to 11 inches.
- Highly fluid for ease of placement.
- Excess water absorbed by block to maintain good water to cement ratios.

TOPICAL OUTLINE

ASTM C 143, C143M – 10a Slump Test

- Avoid sampling from beginning or end of batch.
- Remix after sample is obtained.
- Record temperature.
- Rod each layer 25 times.
- Rod through layer and slightly into layer below.

TOPICAL OUTLINE

ASTM Standards - Grout Slump Test Chapter 2

ASTM C 143, C143M – 10a Slump Test

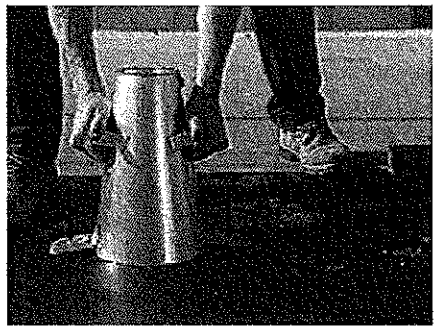
- Rod across the entire surface of the grout.
- Strike off top after the top 1/3 is rodded.
- Clean the area around to base of the cone.
- Take 5 seconds (± 2 secs.) to lift the cone.
- Lay the rod over the cone and measure to the center of the sample.
- Record to the nearest ¼ inch.

TOPICAL OUTLINE

Filling Slump Cone

Slump cones are for testing grout consistency prior to grouting.

Hold cone firmly in position so grout does not escape while filling the cone.

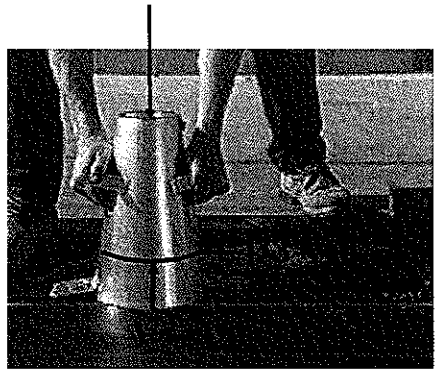


TOPICAL OUTLINE

Filling Slump Cone

Fill the bottom 1/3 and rod 25 times with the puddle rod.

Straight in and Straight out… do not stir.

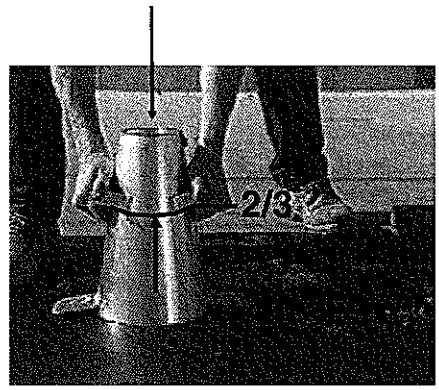


TOPICAL OUTLINE

Filling Slump Cone

Fill the middle 1/3 and rod 25 times.

Penetrate bottom 1/3 only slightly.

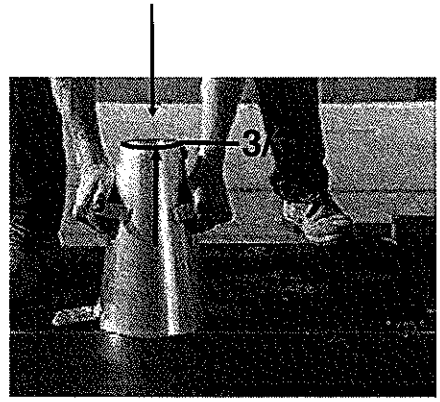


TOPICAL OUTLINE

Filling Slump Cone

Fill the top 1/3 and rod 25 times.

Penetrate middle 1/3 only slightly.

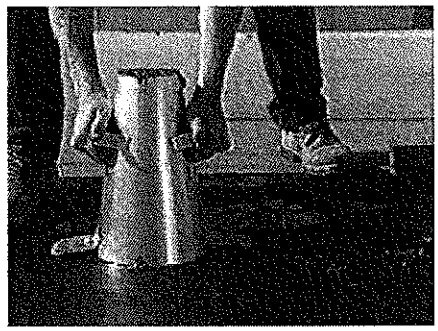


TOPICAL OUTLINE

Slump Test Video

Lift the cone slowly and straight up. Do not twist or turn.

Grout should slump 8 to 11 inches.



Click on picture to pause or animate.

TOPICAL OUTLINE

ASTM C 1611/C 1611/M – 09 is the Standard Test Method for Slump Flow of Self Consolidating Grout (or SC Concrete)

Scope

- Covers the determination of slump flow for self-consolidating concrete or masonry grout.
- May be used in laboratory or field.

TOPICAL OUTLINE

ASTM C 1611/C 1611/M – 09

- A smooth base of not less than 36" square or diameter is placed on a flat, level surface.
- A typical slump cone is placed in the center of the base plate, usually in an inverted position.
- Fill the cone with multiple scoops of grout, or from a bucket.
- Do not consolidate with a rod or by any other method.

TOPICAL OUTLINE

ASTM C 1611/C 1611/M – 09

- Fill to the top of the cone and carefully strike off the top of the grout.
- Remove any excess material from around the base of the cone.
- In 3 seconds, $\pm$ 1 second, raise the cone vertically 8 or 9 inches.
- Wait for the grout to stop flowing.

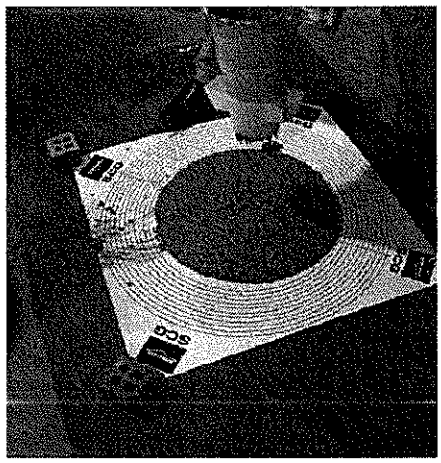
TOPICAL OUTLINE

ASTM C 1611/C 1611/M – 09

- Measure the largest diameter, then measure a second diameter perpendicular to the first measurement.
- Add the two diameters & divide by 2 to get the average flow.
- If the two diameters have more than a 2" difference the test is invalid.
- Slump flow shall be 24" to 30" (ASTM 476-10).

TOPICAL OUTLINE

ASTM C 1611/C 1611/M – 09



SCG Slump Flow Test

TOPICAL OUTLINE

ASTM C 1611/C 1611/M – 09

- In addition to the slump flow ASTM 476-10 requires Visual Stability Index of not greater than 1 for grout. This procedure is covered in the Appendix of ASTM 1611.
- This test requires the visual evaluation of the rate of flow and the amount of water bleed at the edges, the sheen on the surface and the distribution of the aggregate.
- The grout is evaluated using the following table:

TOPICAL OUTLINE

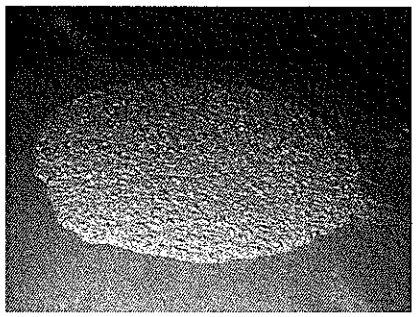
ASTM C 1611/C 1611/M – 09

Table X1.1 Visual Stability Index Values

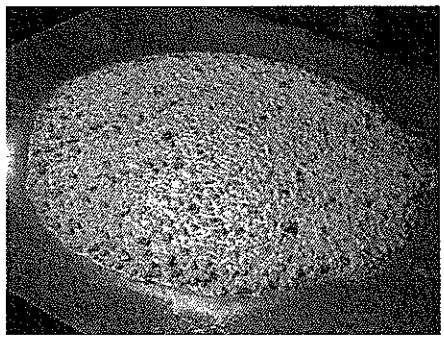
VSI Value	Criteria
0 = Highly stable	No evidence of segregation or bleeding
1 = Stable	No evidence of segregation and slight bleeding observed as a sheen on the grout mass
2 = Unstable	A slight mortar halo ≤ ½" and/or aggregate pile in center of the grout mass
3 = Highly unstable	Clearly segregating by evidence of a large mortar halo > ½" and/or a large aggregate pile in the center of the grout mass.

TOPICAL OUTLINE

ASTM C 1611/C 1611/M – 09



VSI = 0



VSI = 1

TOPICAL OUTLINE

ASTM C 1314- 11

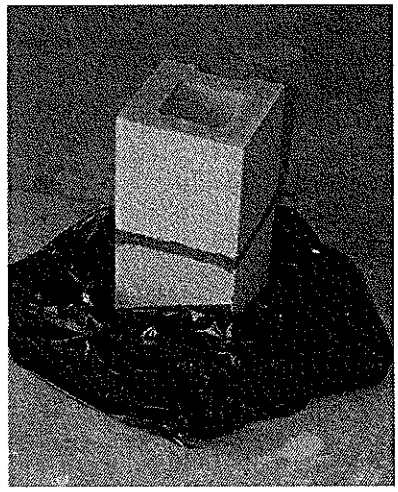
Standard Test Method for Compressive Strength of Masonry Prisms

- The compressive strength of a wall, the entire assembly, is referred to as the f'm of the wall.
- The compressive strength will include the strength of the masonry unit, the strength of the mortar and if applicable the strength of the grout.
- Determination of the f'm of a wall is critical in structural masonry design.

TOPICAL OUTLINE

ASTM C 1314- 11

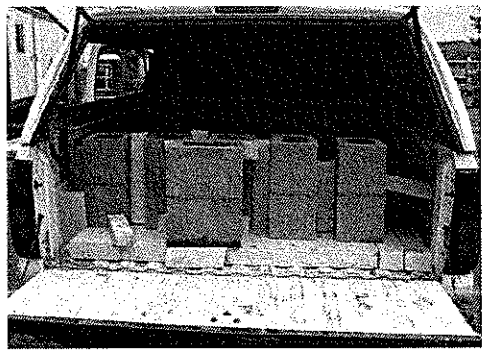
- The prism test consists of masonry units of the type used in the wall, assembled along with the specified mortar and grout if required.



TOPICAL OUTLINE

ASTM C 1314- 11

- If prisms are required for the job, 1 prism test is composed of 3 prism specimens
- The resulting tested strength is an average strength from the three prisms



TOPICAL OUTLINE

ASTM C 1314- 11

- Construct prisms on a flat, level base
- Use units representative of the units used in the corresponding construction
- Build each prism in an opened moisture-tight bag which is large enough to enclose and seal the completed prism
- Construct prism a single wythe in thickness and lay up in stack bond

Masons should construct prisms! Acceptance or rejection is based on the results – so don't leave this to a technician or tender.

TOPICAL OUTLINE

ASTM C 1314 - 11

- Prisms may also be cut from existing work in place
- Must be approved by building official
- Be at least 28 days old
- One set for every 5000 sf of wall in question
- Each set must contain 3 prisms
- Cannot contain reinforcement
- Acceptable repair of the wall can be difficult.

TOPICAL OUTLINE

ASTM C 90 – 11a

Standard Specification for Loadbearing CMU

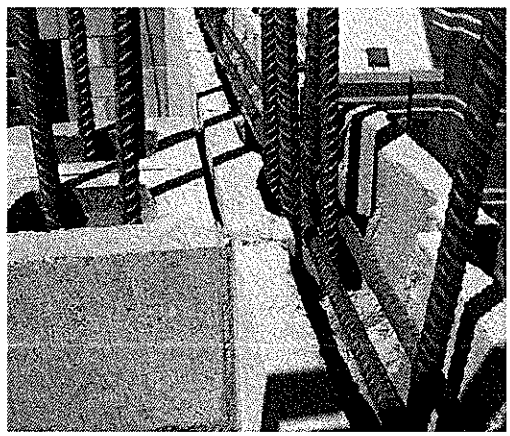
- Covers physical size requirements & tolerances
- Establishes minimum compressive strength
- Establishes requirements for higher strength cmu
- Establishes requirements for finish & appearance

TOPICAL OUTLINE

ASTM C 90 – 11a

Standard Specification for Loadbearing CMU

C 90 CMU represent the most commonly specified masonry unit for structural masonry.



TOPICAL OUTLINE

ASTM C 90 – 11a

Table 2 Strength, Absorption & Density					
Density	Oven Dry Density Ave of 3 units	Max water Absorption lbs / ft³ Avg of 3 units	Individual units	Min Net Area Compressive Strength (psi) Avg of 3 units	Individual units
Lightweight	less than 105	18	20	1900	1700
Medium Weight	105 to > 125	15	17	1900	1700
Heavy Weight	125 or more	13	15	1900	1900

If units fail the manufacture can remove the units and select a second set If they pass then the remaining units meet the spec. If the second set fail then the entire shipment fails to meet the spec.

TOPICAL OUTLINE

ASTM C 90 – 11a

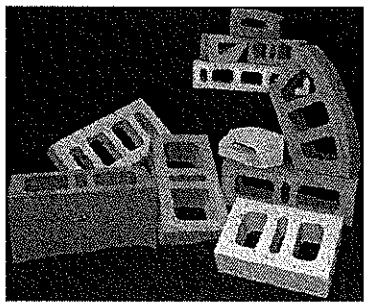
Masonry Unit being tested for strength (psi)

TOPICAL OUTLINE

Reinforceable options:

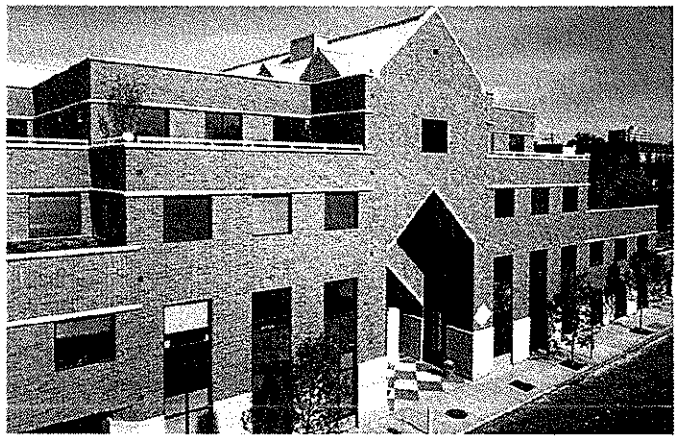
Hollow Brick shapes ASTM 652

- Hollow bricks are available in numerous sizes, shapes, colors and textures.
- Structural clay products can be produced with very high psi values, 5000 psi to 13,000 psi are possible.
- Higher strength and attractive appearance can be beneficial in some applications.



TOPICAL OUTLINE

Reinforceable options:



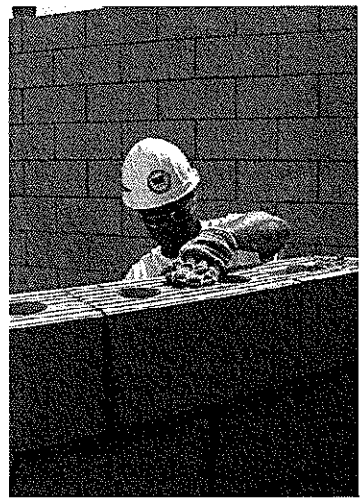
Structural Brick Veneer

TOPICAL OUTLINE

Reinforceable options:

Structural Clay Tile ASTM C 34

- Structural clay tile is a specialty material typically found in institutional projects.
- Strong, attractive and with a durable finish it can be a good option for a finished loadbearing application.

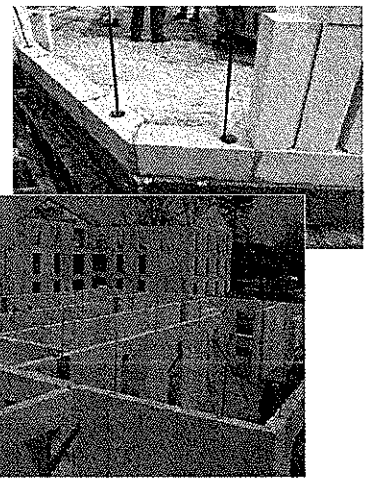


TOPICAL OUTLINE

Reinforceable options:

Autoclaved Aerated Concrete (AAC) ASTM 1692 & 1694

- AAC is a reinforceable structural option with many advantages:
- High fire resistance
- Great sound transmission resistance
- Good R- values
- Lightweight and easy to work with.



TOPICAL OUTLINE

Chapter 3

Reinforcement & Connectors

TOPICAL OUTLINE

Reinforcing Bar (rebar) Requirements

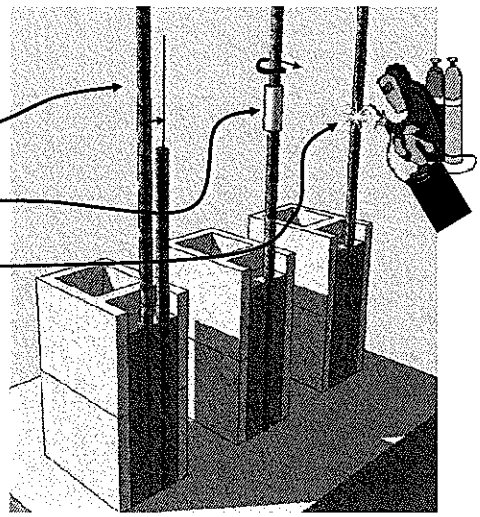
- Permissible sizes: #3 through #11 but some engineering requirements limit bar size to #9.
- Rebar strength is measured in yield strength:
  - 40,000 psi = Grade 40
  - 50,000 psi = Grade 50
  - 60,000 psi = Grade 60
- Most rebar used in masonry is Grade 60.
- Rebar must be relatively clean, free of heavy rust, mill scale.

TOPICAL OUTLINE

Rebar Splices:

Three Types

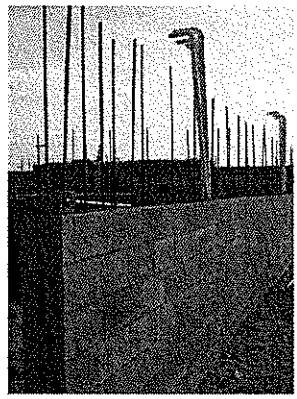
- Lapped
- Mechanical
- Welded



TOPICAL OUTLINE

Lap splices

- Lap splices are specified by the engineer based on necessary strength requirements.
- They may be contact splices (touching) , or non-contact with up to 8" of separation.
- **Contractors should not assume responsibility for determining lap splices or locations.**



Pre-cut rebar shown here help to set this wall up for low lift grouting and correct lap splices.

TOPICAL OUTLINE

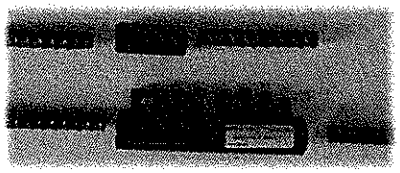
Joint Reinforcement

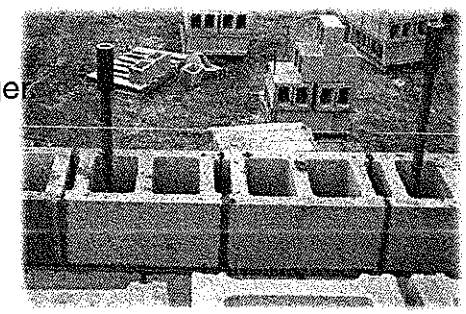
- Six inch minimum lap is required for longitudinal wire reinforcement
- Ensure that all ends of the wire reinforcement are embedded in mortar at laps

TOPICAL OUTLINE

Couplers

- Rebar couplers have gained popularity as better systems have been introduced and also due to the rising cost of steel rebar.
- They are often cost effective from about #6 rebar and larger.
- IBC requires them on #10 & #11 rebar.
- Couplers may also be advantageous in congested applications.

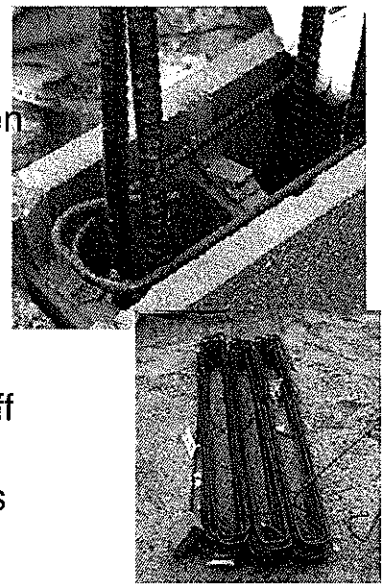




TOPICAL OUTLINE

Ties

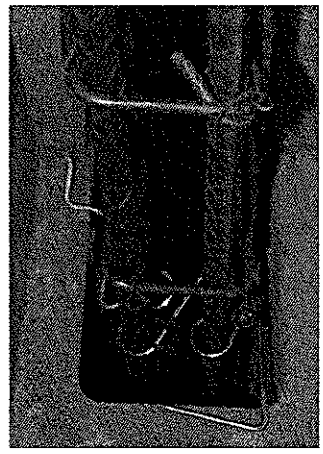
- Ties can be used to strengthen masonry reinforcement. They are commonly used when the engineer discovers the reinforcement may encounter compressive loads.
- Ties are typically fabricated off site to ensure accuracy in the bends as placement tolerances inevitably become a concern.



TOPICAL OUTLINE

Hooks

- Hooks are used at the ends of ties & stirrups and can vary from 90° to 180° of bend.
- For Grade 60 rebar minimum bending diameters are 6 bar diameters for #3 - #8 and 8 bar diameters for #9 - #11.

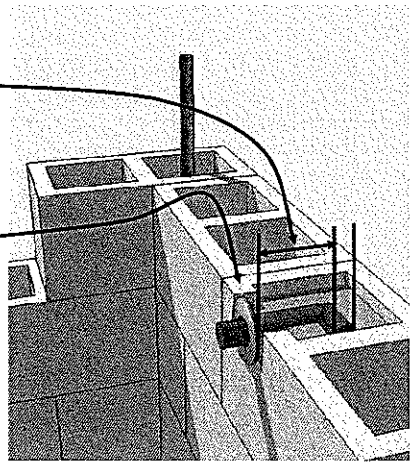


The hooks shown here are approximately a 135° bend.

TOPICAL OUTLINE

Anchor Bolts

- Should be embedded four times their diameter or 2" min.
- The hole should be large enough for grout to flow around the bolt.
- The 2011 MSJC allows drilled holes.



TOPICAL OUTLINE

IMI Works For You

Rebar splice lengths have caused no small amount of concern in the masonry industry in the past few years. IMI has worked hard to get splice lengths back to a reasonable standard.

Rebar Positioners

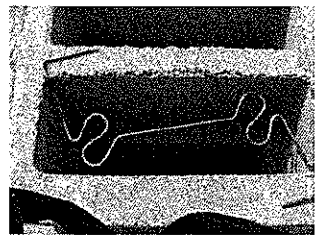
- Rebar positioners hold the rod in their correct position within the CMU cell.
- It is essential that rebar be placed in the position intended by the design professional.
- Incorrectly placed rebar may not develop the necessary strength to resist all the calculated loads.
- Check the project documents to determine if they are required on your project. They are not mandated by the TMS 402.

TOPICAL OUTLINE

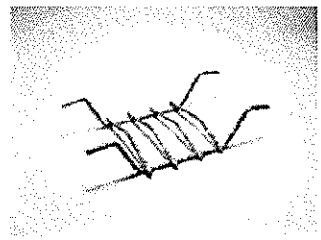
Rebar Positioners

- Positioners are not required by code, however, rebar placement within allowable tolerances must be met.
- Typically positioners are found near the top and bottom courses of masonry and usually not closer than 200 bar diameters.

Vertical / Lap



Horizontal / Lap



TOPICAL OUTLINE

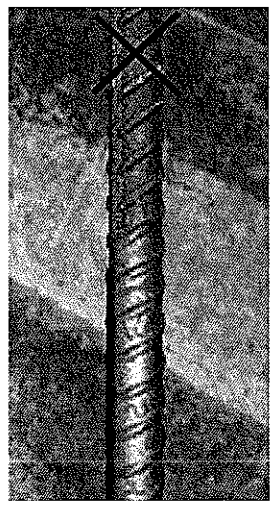
Rebar Placement Requirements

- The diameter of the rebar cannot exceed ½ of the smallest clear dimension of the cell or bond beam.
- When placing rebar parallel to each other, horizontally or vertically, do not place closer than the 1" or the diameter of the rebar.
- In columns or pilasters, never closer than 1½" or 1 ½ x dia. of the rebar.
- Rebar must be placed in the grout spaces prior to grouting!

TOPICAL OUTLINE

Rebar Requirements

- Rebar must be relatively clean when installed.
- Rebar must be free of heavy rust, large amounts of mill scale, oil or mud.
- Light rust or small amounts of mill scale are OK.
- "Clean but not pristine"



TOPICAL OUTLINE