28101-13

Introduction to Masonry

Overview

In this module, you will learn about the basic materials, tools, and techniques used by masons, as well as basic safety precautions and the skills, attitudes, and abilities exhibited by successful masons. With the guidance of your instructor, you will learn to mix mortar and lay brick. The challenge is to lay the units perfectly straight and level, and to complete the work to specification and on time, with a high degree of quality.

Module One

Trainees with successful module completions may be eligible for credentialing through NCCER's National Registry. To learn more, go to **www.nccer.org** or contact us at **1.888.622.3720**. Our website has information on the latest product releases and training, as well as online versions of our *Cornerstone* magazine and Pearson's product catalog.

Your feedback is welcome. You may email your comments to **curriculum@nccer.org**, send general comments and inquiries to **info@nccer.org**, or fill in the User Update form at the back of this module.

This information is general in nature and intended for training purposes only. Actual performance of activities described in this manual requires compliance with all applicable operating, service, maintenance, and safety procedures under the direction of qualified personnel. References in this manual to patented or proprietary devices do not constitute a recommendation of their use.

From *Masonry, Level One, Trainee Guide*, Fourth Edition. NCCER.
Copyright © 2013 by NCCER. Published by Pearson Education. All rights reserved.

28101-13
Introduction to Masonry

Objectives

When you have completed this module, you will be able to do the following:

1. Describe modern masonry materials and techniques.
   a. Explain how concrete masonry units (CMUs or block) are used in construction.
   b. Explain how clay masonry units (brick) are used in construction.
   c. Explain how stone is used in construction.
   d. Describe how mortar and grout are used in masonry construction.
   e. Describe how wall structures are created using masonry units.
2. Recognize the basic safety precautions when working with masonry materials.
   a. List basic safety practices.
   b. Describe personal protective equipment used in masonry.
3. Explain how to mix mortar and lay masonry units.
   a. Explain how to mix mortar.
   b. Describe how to lay masonry units.
4. Describe the skills, attitudes, and abilities needed to be a successful mason.
   a. Identify the skills of a successful mason.
   b. Identify the attitudes of a successful mason.
   c. Identify the abilities of a successful mason.
   d. Explore career ladders and advancement possibilities in masonry.
5. Summarize how to be connected to the industry through an organization like SkillsUSA.
   a. Understand the program, curriculum, and SkillsUSA Championships.
   b. Understand SkillsUSA membership.
   c. Understand the National Program of Work Standards.

Performance Tasks

Under the supervision of your instructor, you should be able to do the following:

1. Put on eye protection and respiratory protection.
2. Properly mix mortar by hand.
3. Properly spread mortar using a trowel.

Trade Terms

Admixture
Adobe
Aggregate
American Society for Testing and Materials (ASTM) International
Ashlar
Bed joint
Butter
Capital
Competent person
Concrete masonry unit (CMU)
Cored
Cornice
Course
Cube
Facing
Footing
Grout
Head joint
Joints
Manufactured stone veneer
Mason
Masonry unit
Mortar
Nonstructural
Occupational Safety and Health Administration (OSHA)
Parapet
Personal protective equipment (PPE)
Pilaster
Spread
Stringing
Structural
Tuckpointing
Uncored
Weephole
Wythe

Industry-Recognized Credentials

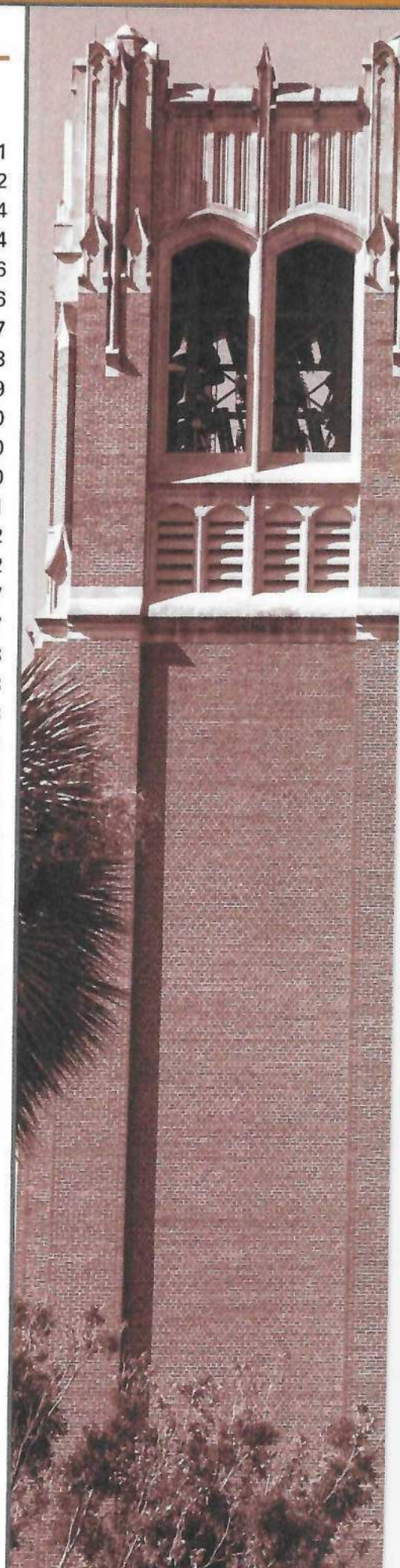
If you're training through an NCCER-accredited sponsor, you may be eligible for credentials from NCCER's Registry. The ID number for this module is 28101-13. Note that this module may have been used in other NCCER curricula and may apply to other level completions. Contact NCCER's Registry at 888.622.3720 or go to **www.nccer.org** for more information.

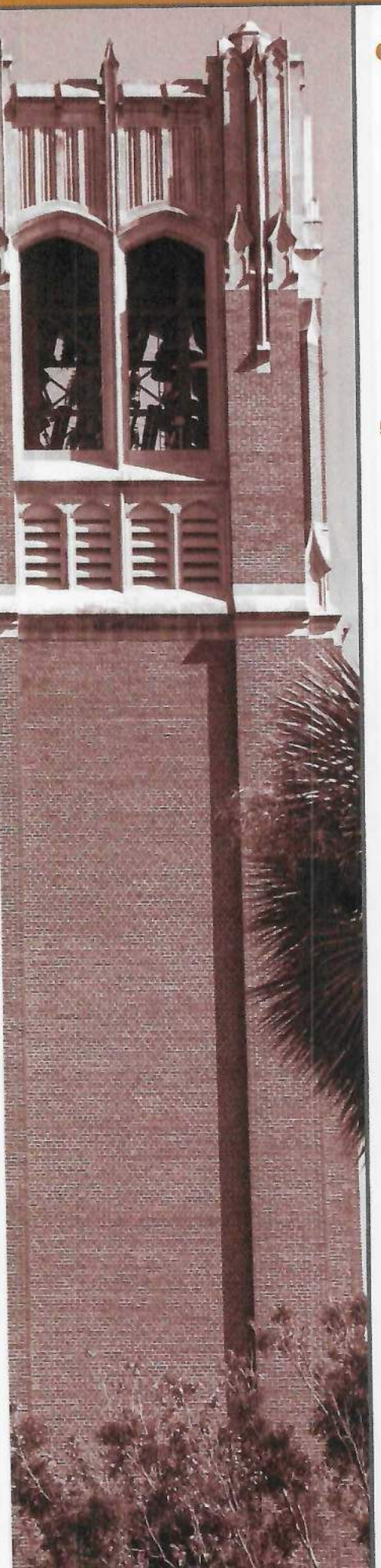
Code Note

Codes vary among jurisdictions. Because of the variations in code, consult the applicable code whenever regulations are in question. Referring to an incorrect set of codes can cause as much trouble as failing to reference codes altogether. Obtain, review, and familiarize yourself with your local adopted code.

Contents

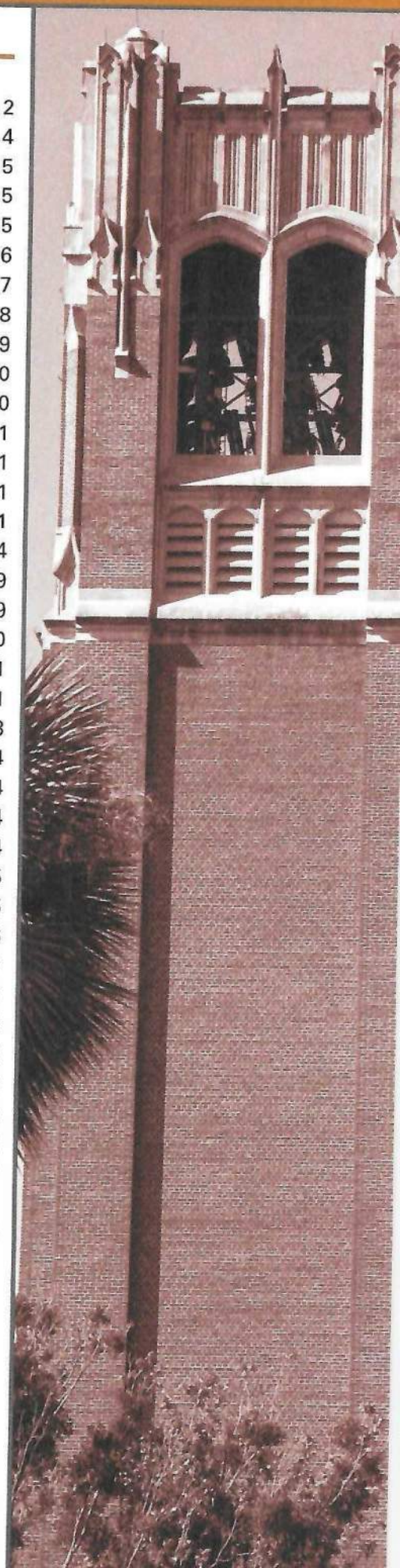
Topics to be presented in this module include:





Contents (*continued*)

Figures and Tables



SECTION ONE

1.0.0 MODERN MASONRY MATERIALS AND TECHNIQUES

Objective

Describe modern masonry materials and techniques.

a. Explain how concrete masonry units (CMUs or block) are used in construction.
b. Explain how clay masonry units (brick) are used in construction.
c. Explain how stone is used in construction.
d. Describe how mortar and grout are used in masonry construction.
e. Describe how wall structures are created using masonry units.

Trade Terms

Admixture: A chemical or mineral other than water, cement, or aggregate added to mortar immediately before or during mixing to change its setting time or curing time; to reduce water; or to change the overall properties of the mortar.

Adobe: Sun-dried, molded clay brick.

Aggregate: Materials such as crushed stone or gravel used as a filler in concrete and concrete block.

American Society for Testing and Materials (ASTM) International: The publisher of masonry standards.

Ashlar: A squared or rectangular cut stone masonry unit; or, a flat-faced surface having sawed or dressed bed and joint surfaces.

Capital: The top part of an architectural column.

Concrete masonry unit (CMU): A hollow or solid block made from portland cement and aggregates.

Cored: Brick that has holes extending through it to reduce weight.

Cornice: The horizontal projection crowning the wall of a building.

Course: A row or horizontal layer of masonry units.

Cube: A strapped bundle of approximately 500 standard brick, or 90 standard block. The number of units in a cube will vary according to the manufacturer.

Facing: That part of a masonry unit or wall that shows after construction; the finished side of a masonry unit.

Grout: A mixture of portland cement, lime, and water, with or without fine aggregate, with a high-enough water content that it can be poured into spaces between masonry units and voids in a wall.

Joints: The area between each brick or block that is filled with mortar.

Manufactured stone veneer: A premade veneer consisting of cast cementitious material with pigments and other added materials to give the appearance of natural stone. Also called adhered concrete masonry veneer (ACMV).

Mason: A person who assembles masonry units by hand, using mortar, dry stacking, or mechanical connectors.

Masonry unit: Any building block made of brick, cement, ashlar, clay, adobe, rubble, glass, tile, or any other material that can be assembled into a structural unit.

Mortar: A mixture of portland cement, lime, fine aggregate, and water, plastic or stiff enough to hold its shape between masonry units.

Nonstructural: Not bearing weight other than its own.

Parapet: A low wall or railing.

Structural: Bearing weight in addition to its own.

Uncored: Brick that has no holes extending through it.

Weephole: A small opening in mortar joints or faces to allow the escape of moisture.

Wythe: A continuous section of masonry wall, one masonry unit in thickness, or that part of a wall that is one masonry unit in thickness.

Masons are recognized as premier craftworkers at any construction site. Although masonry is one of the world's oldest crafts, masons also use 21st-century technology on the job. Masons build structures out of **masonry units**. The two main types of masonry units manufactured today are made of clay and concrete. Clay products are commonly known as brick and tile; concrete products are commonly known as **concrete masonry units (CMUs)** or block. Masonry units are also made from **ashlar**, glass, **adobe**, and other materials. In the most common forms of masonry, a mason assembles walls and other structures of clay brick or CMUs using **mortar** to bond the units together.

1.1.0 Learning about Concrete Masonry Units (CMUs or Block)

CMUs have not been around as long as brick. The first CMUs were developed in 1850. Block is made of water added to portland cement, **aggregates** (sand and gravel), and **admixtures**. Admixtures affect the color and other properties of the cement, such as freeze resistance, weight, and speed of setting.

The block is machine-molded into shape. It is compacted in the molds and cured, typically using live steam. After curing, the block is dried and aged. The moisture content is checked. It must be a specified minimum amount before the block can be shipped for use. *Figure 1* shows commonly used sizes and shapes of concrete block.

While CMUs are generally referred to as block, it's important to note that not all types of block are CMUs. Concrete units are classified according to their intended use, size, and appearance. **American Society for Testing and Materials (ASTM) International** standards exist for the following types of masonry units:

- Loadbearing and nonbearing concrete block
- Concrete brick
- Calcium silicate face brick
- Pre-faced or prefinished **facing** units
- Manholes and catch basin units

A concrete block is a large unit, typically with actual dimensions of 7 ⅝" × 7 ⅝" × 15 ⅝", with a hollow core. (Actual dimensions are the dimensions of the block itself; nominal dimensions include the thickness of the mortar in the measurement.) Block comes in modular sizes, and in colors determined by the cement ingredients, the aggregates, or any admixtures. A variety of surface and mixing treatments can give block varied and attractive surfaces. Newer finishing techniques can give block the appearance of brick, rough stone, or cut stone. Like clay masonry units, block can be laid in **structural** pattern bonds. *Figure 2* shows the names of the parts of a block.

Block takes up more space than other building units, so fewer are needed. Block bed **joints** usually need mortar only on the shells and webs, so there is less mortaring as well.

Concrete block comes in three weights: normal, lightweight, and aerated. Lightweight block is made with lightweight aggregates. The loadbearing and appearance qualities of the first two weights are similar; the major difference is that lightweight block is easier and faster to lay. Normal-weight block can be made of concrete with regular, high, and extra-high strengths. The last two are made with different aggregates and curing times. They are used to limit wall thickness in buildings over 10 floors high. Aerated block is made with an admixture that generates gas bubbles inside the concrete for a lighter block.

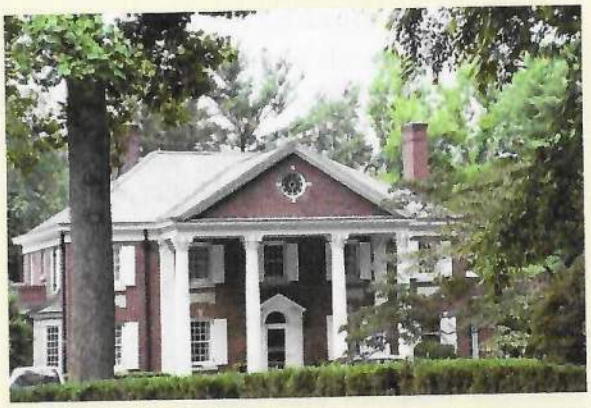
Concrete block is classified as hollow or solid. Like clay products, less than 75 percent of the surface area of a hollow unit is solid. Common hollow

Ancient Wonders

The famous Lion Gate in Istanbul, Turkey, is a fine example of ancient brick artistry. It is made of fired and glazed brick sculpted into high relief before firing. The kiln-firing techniques refined in ancient India, Babylonia, and Rome are still used today.

Brick in Construction

Brick is found in all types of construction, from tract houses to stately mansions. Brick is also used in the construction of banks, schools, churches, and office buildings. Brick not only provides an attractive appearance, it creates a sense of permanence.



28101-13_SA01.EPS

28101-13_SA02.EPS

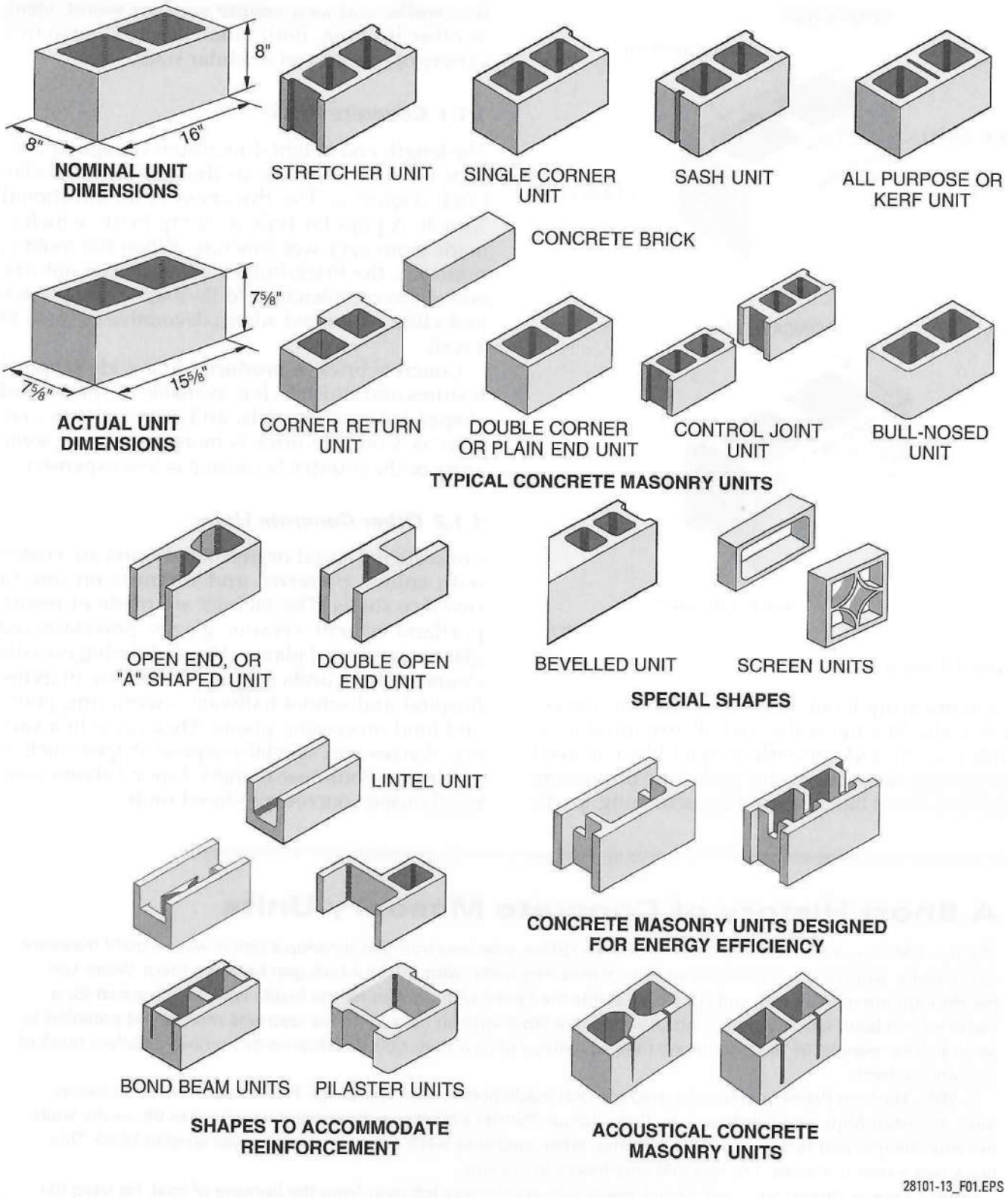


Figure 1 Common concrete block.

units have two or three cores. The hollow cores make it easy to reinforce concrete block walls. Grout alone, or steel reinforcing rods combined with grout, can be used to fill the hollow cores. Reinforcement increases loadbearing strength, rigidity, and wind resistance. Less than 25 percent of the surface area of a solid block is hollow. Normal and lightweight solid units are intended for special needs, such as structures with unusually high loads, drainage catch basins, manholes, and firewalls. Aerated block is made in an oversize solid unit used for buildings.

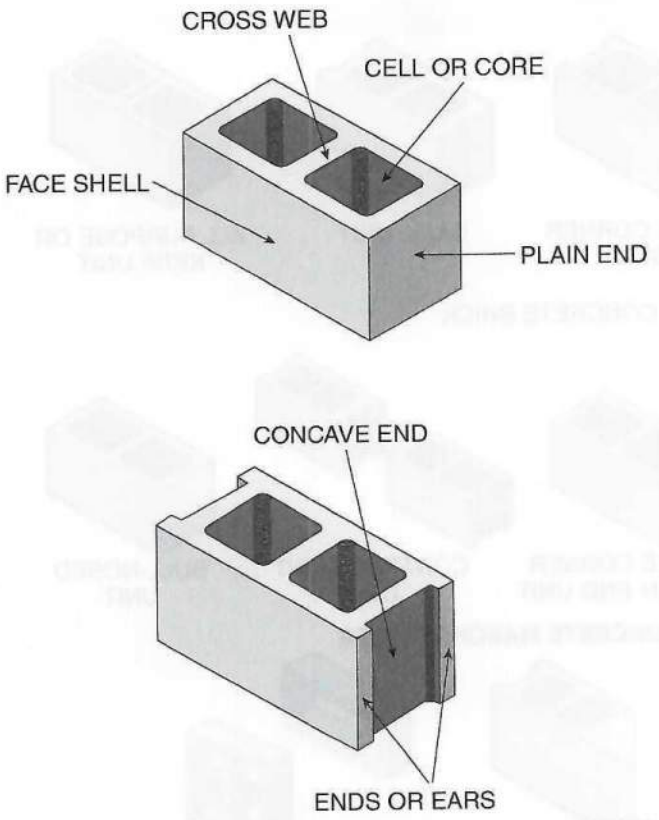


Figure 2 Parts of a block.

Loadbearing block is used as backing for veneer walls, bearing walls, and all structural uses. Both regular and specially shaped block is used for paving, retaining walls, and slope protection. Nonstructural block is used for screening, partition walls, and as a veneer wall for wood, steel, or other backing. Both kinds of block come in a variety of shapes and modular sizes.

1.1.1 Concrete Brick

The length and height dimensions of regular concrete brick are the same as those of standard clay brick (*Figure 3*). The thickness is an additional ⅛-inch. A popular type is slump brick, which is made from very wet concrete. When the mold is removed, the brick bulges because it is not dry enough to completely hold its shape. Slump brick looks like ashlar and adds a decorative element to a wall.

Concrete brick is produced in a wide range of textures and finishes. It is available in specialized shapes for copings, sills, and stairs, just as clay brick is. Concrete brick is more popular in some areas of the country because it is less expensive.

1.1.2 Other Concrete Units

Concrete pre-faced or precoated units are coated with colors, patterns, and textures on one or two face shells. The facings are made of resins, portland cement, ceramic glazes, porcelainized glazes, or mineral glazes. The slick facing is easily cleaned. These units are popular for use in gyms, hospital and school hallways, swimming pools, and food processing plants. They come in a variety of sizes and special-purpose shapes, such as ribbing and bullnose corners. *Figure 4* shows commonly used concrete pre-faced units.

A Short History of Concrete Masonry Units

The first CMUs were invented in 1850 by Joseph Gibbs, who was trying to develop a better way to build masonry cavity walls, which are made of two wythes of masonry units, with a 2- to 4-inch gap between them. Water can get through the outside wall and run down inside the cavity without wetting the inside wall. In his search for a faster way to build a cavity wall, Gibbs developed a block with air cells in it. This idea was refined and patented by several other people. In 1882, someone took advantage of new materials developments to make a hollow block of portland cement.

In 1900, Harmon Palmer patented a machine that made hollow concrete block. Palmer's block was 30 inches long, 10 inches high, and 8 inches wide. Even though Palmer's block was heavy and very hard to lift, cavity walls became cheaper and faster to build. Over time, other machines were developed to produce smaller block. This block was easier to handle, but was still very heavy for its size.

In 1917, Francis Straub patented a block made with the cinders left over from the burning of coal. He used the cinders to replace the sand and small aggregates in the concrete mix. This new cinderblock was lighter, cheaper, and easier to handle. Straub's block made it possible to build a one-wythe wall with a built-in cavity very quickly and inexpensively. Faster machinery was developed to keep up with the demand for this new masonry material.

The demand for block increased with the rise of engineered masonry in the United States. The production of concrete block surpassed that of clay brick in the 1950s. Since the 1970s, there have been more walls built of concrete block in the United States than those of clay brick and all other masonry materials together.

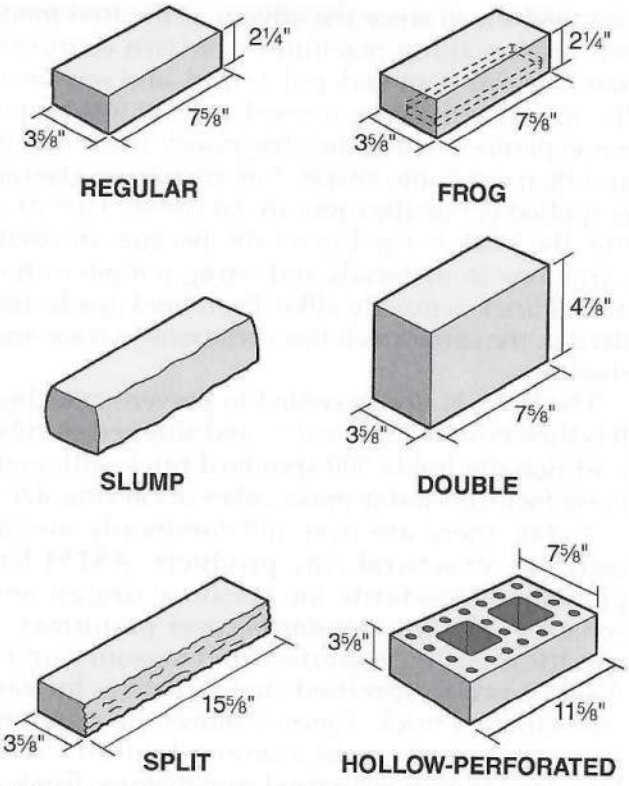


Figure 3 Concrete brick.

Concrete manhole and vault units are specially made with high-strength aggregates (*Figure 5*). They must be able to resist the internal pressure generated by the liquid in the completed compartment. Specially shaped block is manufactured for use on the top of a catchment vault. This type of block is engineered to fit the vault shape and is cast to specification. It is made with interlocking ends for increased strength.

Insulated block uses foam insulation inserts to provide better energy efficiency and soundproofing than standard block (*Figure 6*). The block is designed to provide a continuous and uninterrupted thermal barrier that absorbs and stores energy, allowing buildings to stay cooler in warm weather and warmer in cool weather. This allows designers

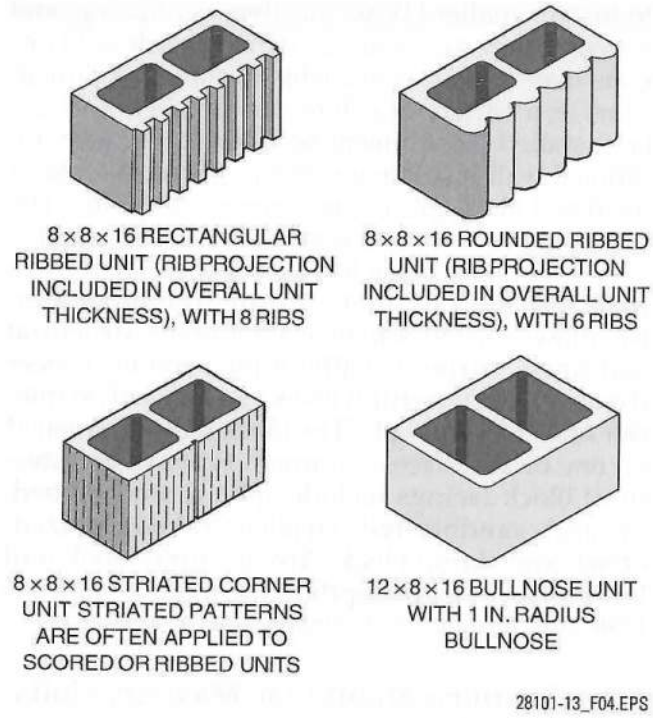


Figure 4 Common pre-faced concrete units.

Block Construction

Concrete block is often used in commercial construction. In some parts of the country, it is also used in the walls of residential construction in place of wood framing. The block can be painted on the outside or faced with brick, stucco, or other finish material.

28101-13_SA03.EPS

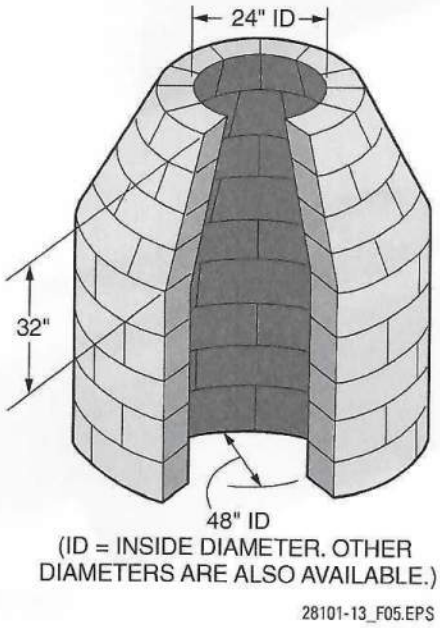


Figure 5 Manhole and vault unit.

to install smaller HVAC (heating, ventilating, and air conditioning) systems, which cost less to operate over time. It is available in standard dimensions in a variety of colors and finishes, and can be installed like conventional block. Because additional wall insulation is not required, the use of insulated block can reduce construction time. The foam inserts are nontoxic and moisture resistant.

Architectural block has a variety of surface finishes that affect the unit's texture. The surface finish allows the block to be used for both structural and finish purposes without the need for veneer (*Figure 7*). Architectural block can be used on interior and exterior walls. The block may be finished on one or both faces. Common types of architectural block facings include split, scored, ribbed, ground, sandblasted, striated (raked), glazed, offset, and slump block. Architectural block will be covered in more depth in the module *Masonry Units and Installation Techniques*.

1.2.0 Learning about Clay Masonry Units (Brick)

Brick has been developed and improved upon for centuries. The process of making brick has not changed much since the advent of the first modern brick-making machines over two centuries ago. The clay is mined, pulverized, and screened. It is mixed with water, formed, and cut into shape. Some plants extrude the clay, punch holes into it, and then cut it into shape. Any coating or glazing is applied before the units are air dried. After drying, the brick is fired in a kiln. Because of small variations in materials and firing temperatures, not all brick is exactly alike. Even brick made and fired in the same batch has variations in color and shading.

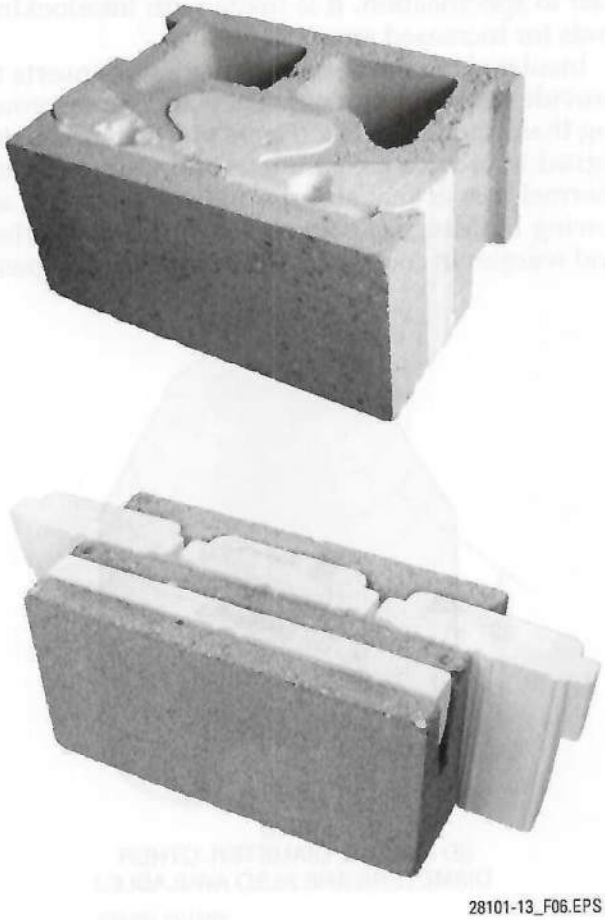


Figure 6 Insulated block.

The brick is slowly cooled to prevent cracking. It is then bundled into **cubes** and shipped. A cube traditionally holds 500 standard brick, although manufacturers today make cubes of varying sizes.

Today, there are over 100 commonly manufactured structural clay products. ASTM has published standards for masonry design and construction. The standards cover performance specifications for manufactured masonry units. ASTM has also specified standard sizes for various kinds of brick. *Figure 8* shows the standard sizes for today's most commonly used brick. The sizes shown are actual dimensions. Brick is also identified by nominal sizes, which include the thickness of the mortar joint. Some brick is specified by a name, while other brick is specified by its actual dimensions (width × height × length).

Structural clay products include the following:

- Solid masonry units, or brick
- Hollow masonry units, or tile
- Architectural terra-cotta units

The next sections provide more information about these products.

1.2.1 Solid Brick

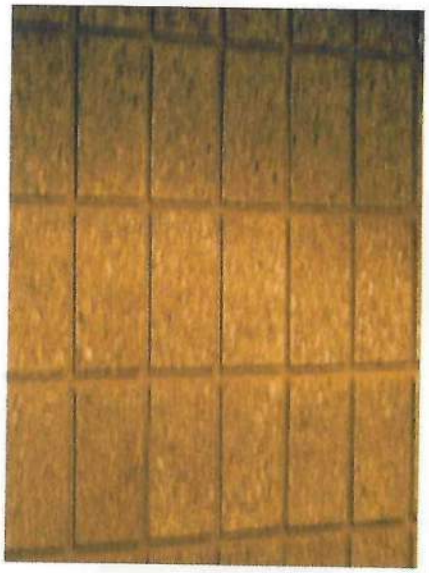
Brick is classified as solid if no more than 25 percent of its surface is **cored**, which means that the brick has holes extending through it to reduce weight. If the brick has no holes at all, it is called **uncored**. Brick is further divided into the following classifications: building, facing, hollow, paving, ceramic glazed, thin veneer, sewer, and manhole. ASTM standards exist for all of these types of brick. Fire brick has its own standard, but is not considered a major type classification.

Brick comes in modular and nonmodular sizes, in colors determined by the minerals in the clay or by additives. There is also a variety of face textures and a rainbow of glazes. The variety is dazzling. Brick can be laid in structural bonds to create patterns in the face of a wall or walkway.

SPLIT FACE AND GLAZED

FLUTED SPLIT FACE

SPLIT AND GROUND FACE



SCORED AND GROUND FACE

GLAZED

SLUMP BLOCK

28101-13_F07.EPS

Figure 7 Varieties of architectural block.

Figure 9 shows several examples of commonly used bond patterns. Some bond patterns are traditional in some parts of the country. The five most common basic structural bonds are the running bond, common (or American) bond, Flemish bond, English bond, and stack (or block) bond. By varying brick color and texture and joint types and color, many patterns can be created using these bonds.

Brick is also made in special shapes to form arches, sills, copings, columns, and stair treads. Custom shapes can be made to order for architectural or artistic use. *Figure 10* shows some commonly manufactured special shapes of brick.

1.2.2 Hollow Masonry Units

Hollow masonry units, or tile, are machine-made clay tiles extruded through a die and cut to the desired size. A masonry unit is classified as hollow if more than 25 percent of its surface is cored. Hollow units are classified as either structural clay tile or structural clay facing tile.

Clay tile comes in many shapes, sizes, and colors. It is divided into loadbearing and nonbearing types. Structural tile can be used for loadbearing on its side or on its end. In some applications, structural tile is used as a backing **wythe** behind brick. Nonbearing tile is designed for use as fireproofing, furring, or ventilating partitions.

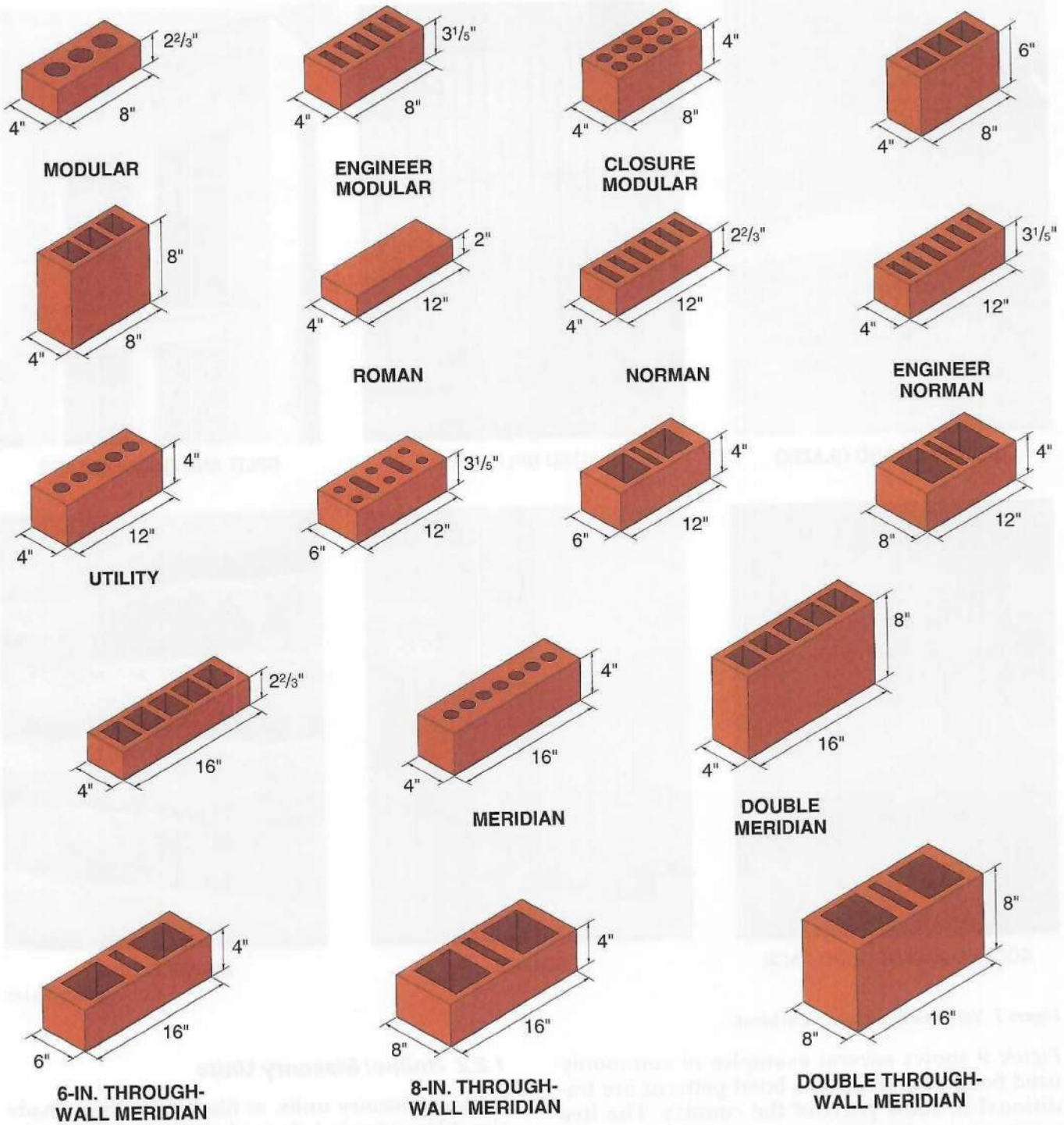


Figure 8 Standard brick.

Structural clay facing tile comes in modular sizes as either glazed or unglazed tile. It is designed for interior uses where precise tolerances are required. A special application of clay facing tile is as an acoustic barrier. The acoustic tiles have a holed face surface to absorb sound. Clay facing tile can also be patterned by shaping the surface face.

1.2.3 Architectural Terra-Cotta

Architectural terra-cotta is a made-to-order product with an unlimited color range. High-temperature-fired ceramic glazes are available in an unlimited color range and unlimited arrangements of parts, shapes, and sizes.

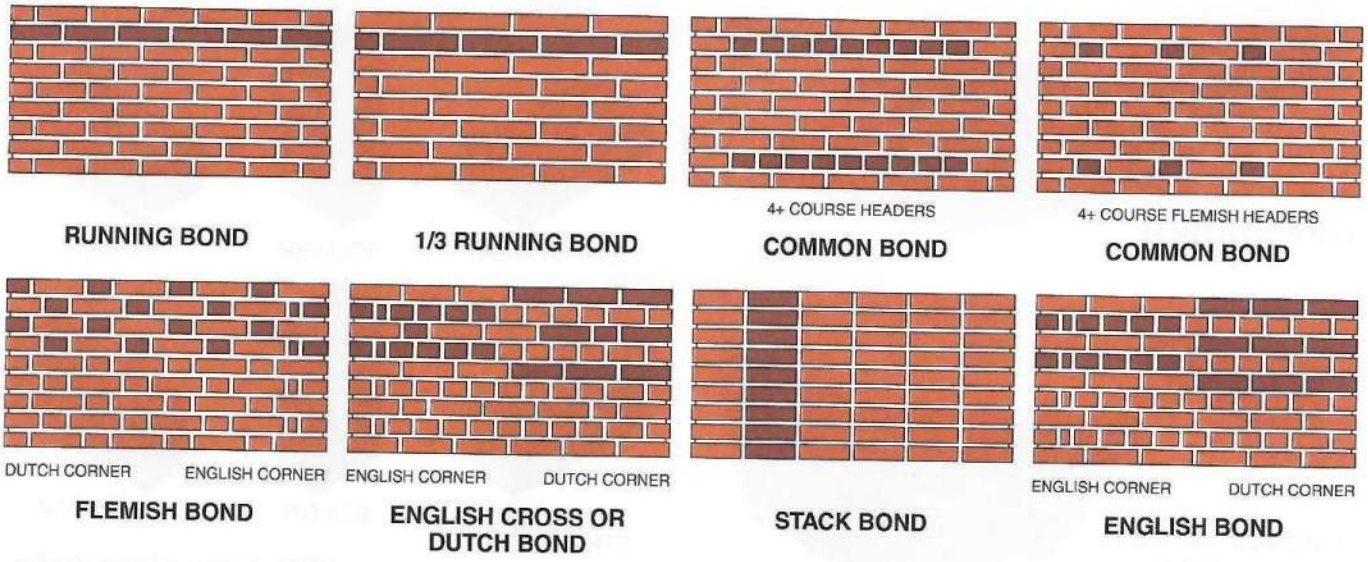


Figure 9 Common bond patterns.

Architectural terra-cotta is classified into anchored ceramic veneer, adhered ceramic veneer, and ornamental or sculptured terra-cotta. Anchored ceramic veneer is thicker than 1 inch, held in place by grout and wire anchors. Adhered ceramic veneer is no more than 1-inch thick, held in place by mortar. Ornamental terra-cotta is frequently used for **cornices** and column **capitals** on large buildings.

1.2.4 Brick Classifications

As previously stated, the three general types of brick masonry units are solid, hollow, and architectural terra-cotta. They may serve a structural function, a decorative function, or a combination of both. The three types differ in their formation and composition, and are specific in their use. Brick commonly used in construction includes the following:

- *Building brick* – Also called common, hard, or kiln-run brick, this brick is made from ordinary clays or shales and is fired in kilns. It has no special scoring, markings, surface texture, or color. Building brick is generally used as the backing wythes in solid and cavity brick walls because it does not have a finished face.
- *Face brick* – This is a better-quality brick and has better durability and appearance than building brick, so it is used on exposed wall faces. The most common face brick colors are various shades of brown, red, gray, yellow, and white.
- *Clinker brick* – This brick is oven burnt in the kiln. It is usually rough, hard, durable, and sometimes irregular in shape.
- *Pressed brick* – This brick is made by the dry-press process before kiln firing. It has regular smooth faces, sharp edges, and perfectly square corners. Ordinarily, it is used as face brick.
- *Glazed brick* – This has one surface coated with a white or other color of ceramic glazing. The glazing or texture forms when mineral ingredients fuse together in a glass-like coating during burning. Glazed brick is particularly suited to walls or partitions in hospitals, dairies, laboratories, and other structures requiring sanitary conditions and easy cleaning.
- *Fire brick* – This is made from a special type of fire clay to withstand the high temperatures of fireplaces, boilers, and similar constructions without cracking or decomposing. Fire brick is generally larger than other modular brick, and often is hand molded.
- *Cored brick* – This brick has 3, 5, or 10 holes extending through the brick to reduce weight. Three holes are most common. Walls built entirely from cored brick are not much different in strength than walls built entirely from uncored brick. Both have about the same resistance to moisture penetration. Whether cored or uncored, use the more easily available brick that meets building requirements.

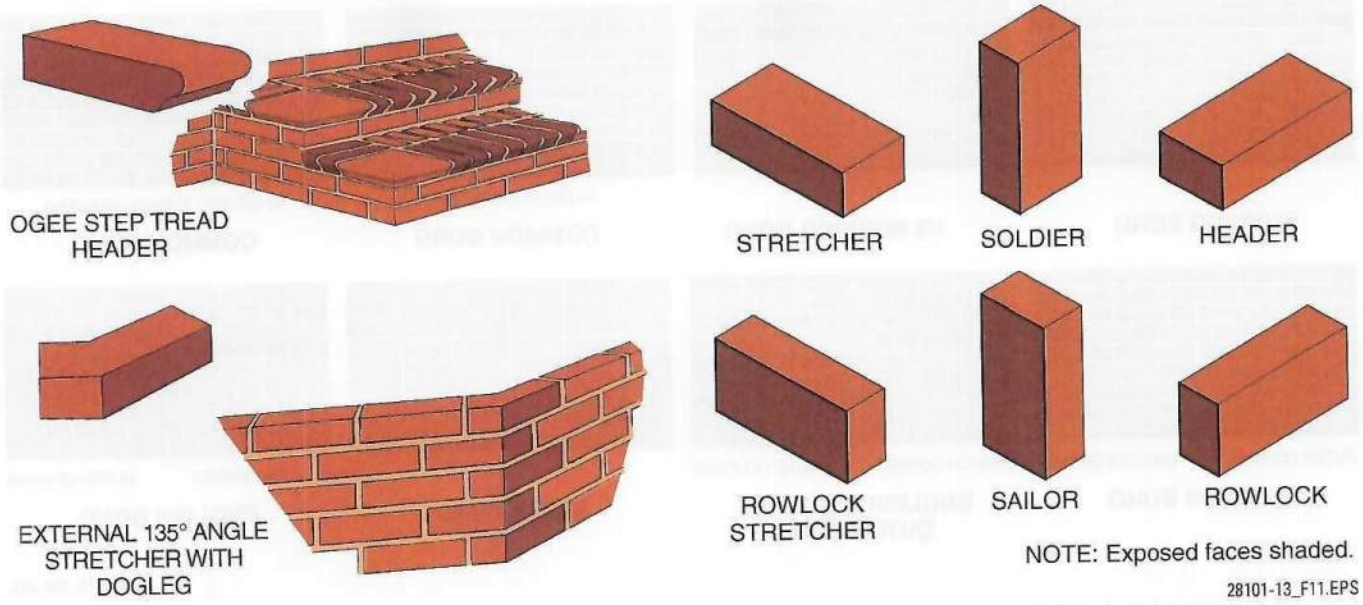


Figure 11 Wall brick positions.

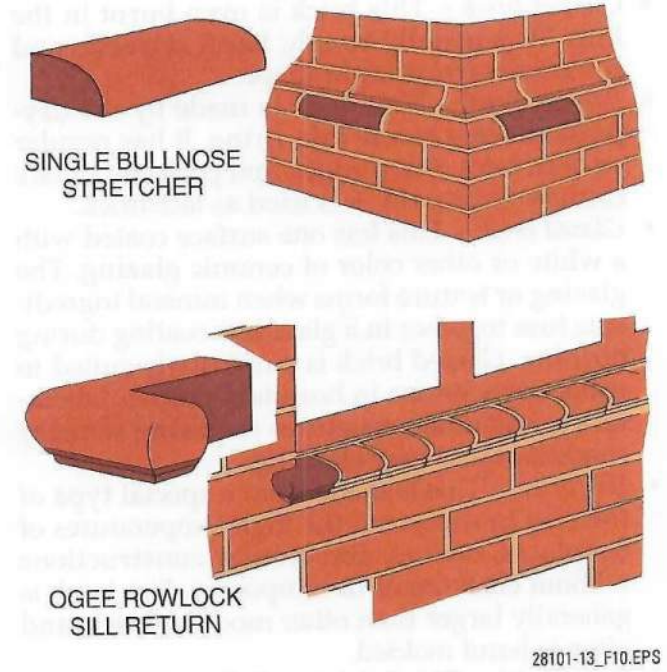


Figure 10 Special brick shapes.

1.2.5 Brick Masonry Terms

You need to know the specific terms that describe the position of brick and mortar joints in a wall (examples are shown in *Figure 11*). These terms include the following:

- Course – One of several continuous, horizontal layers (or rows) of masonry units bonded together
- *Wythe* – A vertical wall section that is the width of one masonry unit
- *Stretcher* – A masonry unit laid flat on its bed along the length of a wall with its face parallel to the face of the wall
- *Header* – A masonry unit laid flat on its bed across the width of a wall with its face perpendicular to the face of the wall; generally used to bond two wythes
- *Rowlock* – A header laid on its face or edge across the width of a wall
- *Rowlock stretcher* – A rowlock brick laid with its bed parallel to the face of the wall
- *Soldier* – A brick laid on in a vertical position with its face perpendicular to the courses in the wall

1.3.0 Learning about Stone

Stone was once used in the construction of all types of buildings, especially churches, schools, and government buildings. Today, it is more commonly used as a decorative material, such as the stone trim shown on the home in *Figure 12*.

1.3.1 Rubble and Ashlar

Rubble and ashlar are used for dry stone walls, mortared stone walls, retaining walls, facing walls, slope protection, paving, fireplaces, patios, and walkways. Rubble stone is irregular in size and shape. Stone collected in a field is rubble. Rubble from quarries is left where shaped block has been removed. It is also irregular with sharp edges. Rubble can be roughly squared with a brick hammer to make it fit more easily.

Ashlar stone is cut at the quarry. It has smooth bedding surfaces that stack easily. Ashlar is usu-

28101-13_F12.EPS

Figure 12 Stone facing used as decorative trim.

ally granite, limestone, marble, sandstone, or slate. Other stone may be common in different parts of the country.

Flagstone is used for paving or floors. It is 2 inches thick or less and cut into flat slabs. Flagstone is usually quarried slate, although other stone may be popular in different areas of the country.

Stone is often used as a veneer over brick or block. The wall shown in *Figure 13* is an example. The brownstone buildings in New York and the gray stone buildings of Paris are veneer over brick. Many of the government buildings and monuments in Washington, DC, are of stone veneer construction.

28101-13_F13.EPS

Figure 13 A block wall faced with stone.

Stone, including flagstone, can be laid in a variety of decorative patterns. Concrete masonry units are made in shapes and colorings to mimic every kind of ashlar. These units are called cast stone and are more regular in shape and finish than natural stone. ASTM specifications cover cast stone and natural stone.

1.3.2 Manufactured Stone Veneer

Manufactured stone veneer, also called adhered concrete masonry veneer (ACMV) is a pre-made veneer consisting of cast cementitious material with pigments and other added materials that give the veneer the appearance of natural stone (*Figure 14*). Manufactured stone can also be designed to be loadbearing as well as veneer, but if manufactured stone is used as veneer without backing, it is not structural. It can be installed using mortar on wood frame walls with rigid sheathing, as well as on other types of walls including masonry walls, poured-in-place concrete walls, concrete tilt-up panels, and even existing masonry surfaces, provided that the walls have been prepared in accordance with the manufacturer's instructions. The techniques used for installation are similar to those used for adhered ceramic veneer.

CAUTION

Do not install manufactured stone veneer where it will come into frequent water contact from sources such as lawn sprinklers, downspouts, and drainage pipes. Deicing materials, salt, and harsh proprietary cleaners should not be used on manufactured stone veneer. Prolonged exposure to them can discolor and damage the surface.

28101-13_F14.EPS

Figure 14 Manufactured stone veneer.

1.4.0 Learning about Mortar and Grout

Portland cement is made of ground earth and rocks burned in a kiln to make clinker. The clinker is ground to become the cement powder. Mixed with water, lime, and rocks, the cement becomes concrete. Mortar is somewhat different from concrete in consistency and use. The components and performance specifications are different also.

Modern mortar is mixed from portland cement or other cementitious material (something that has the properties of cement), along with lime, water, sand, and admixtures. The proportions of these elements determine the characteristics of the mortar.

The three main types of mortar are as follows:

- Cement-lime mortars are made of portland cement, hydrated lime, sand, and water. These ingredients are often mixed at the job site by the mason.
- Masonry cement mortars are premixed with additives. The mason only adds sand and water. The additives affect flexibility, drying time, and other properties.
- Preblended mortars are a dry mix of portland cement, hydrated lime, and dried masonry sand that have been weighed and mixed to ensure consistent proportions. All the mason has to do on the job site is to add the required amount of water and mix the mortar. Preblended mortars with color pigments are also available.

Mortar is mixed to meet four sets of performance specifications, as listed in *Table 1*.

Table 1 Mortar Composition

PROPERTY SPECIFICATIONS FOR LABORATORY-PREPARED MORTAR*			
Mortar Type	Minimum Compressive Strength, PSI at 28 days	Minimum Water Retention,%	Maximum Air Content,%**
M	2,500	75	12***
S	1,800	75	12***
N	750	75	14***
O	350	75	14***

* Adapted from *ASTM C270*.
** Cement-lime mortar only (except where noted).
***When structural reinforcement is incorporated in cement-lime or masonry cement mortar, the maximum air content shall be 12% or 18%, respectively.

Note: The total aggregate shall be not less than 2¼ and not more than 3½ times the sum of the volumes of the cement and lime.

28101-13_T01.EPS

- *Type M* – With high compressive strength, Type M mortar is typically used in contact with earth for foundations, sewers, and walks. This varies with geographic location.
- *Type S* – With medium strength, high bonding, and flex, Type S mortar is used for reinforced masonry and veneer walls.
- *Type N* – With heavy weather resistance, Type N mortar is used in chimneys, **parapets**, and exterior walls. Type N is the preferred mortar for most masonry veneer.
- *Type O* – With low strength, Type O mortar is used in nonbearing applications. It is not recommended for professional use.

Another type of mortar, Type K, has no cement materials but only lime, sand, and water. This type of mortar is used for the preservation or restoration of historic buildings.

Grout is a mixture of cement, water, and sand or other aggregate. Wet enough to be pumped or poured, it is used in reinforcement to bond masonry and steel together. It gives added strength to a structure when it is used to fill the cores of block walls.

NOTE

Even though mortar is no longer made of mud, masons still often call it *mud*.

1.5.0 Learning about Wall Structures

Masonry structures today take many forms in residential, commercial, and industrial construction. Modern engineering has added loadbearing strength so masonry can carry great weight without bulk. In addition to its loadbearing strength, masonry offers these advantages:

- Durability
- Ease of maintenance
- Design flexibility
- Attractive appearance
- Weather and moisture resistance

Another Name for Manufactured Stone Veneer

On the job, you may hear people refer to "lick and stick" or "lick 'em and stick 'em." This is a common way to refer to manufactured stone veneer (also called adhered concrete masonry veneer, or ACMV).

- Sustainability
- Competitive cost

Modern engineering and ASTM standards have been applied directly to everyday masonry work. There are several common classifications of structural wall built with masonry. Masonry walls can fit into more than one classification.

Cavity walls, as shown in *Figure 15A*, have two wythes with a 2- to 4½-inch space between them. Sometimes insulation is put in the cavity. The wythes are tied together with metal ties. Both wythes are loadbearing. Veneer walls, as shown in *Figure 15B*, are not loadbearing. A masonry veneer is usually built 1 to 2 inches away from a loadbearing stud wall or block wall. Veneer walls are used in high-rise and residential construction.

Composite walls have different materials in the facing (outer) and backing (inner) wythes. In a residential installation, the wythes are set with an air space between them of between 1 and 4½ inches and are tied together by metal ties. Unlike a veneer wall, both wythes of a composite wall are loadbearing.

Reinforced walls (*Figure 16*) have steel reinforcing embedded in the cores of block units or between two wythes. The steel is surrounded with grout to hold it in place. This very strong wall is used in high-rise construction and in areas subject to earthquake and high winds. Sometimes, grout is used alone for reinforcement. The grout is pumped into the cores of the block or into the cavity between the wythes.

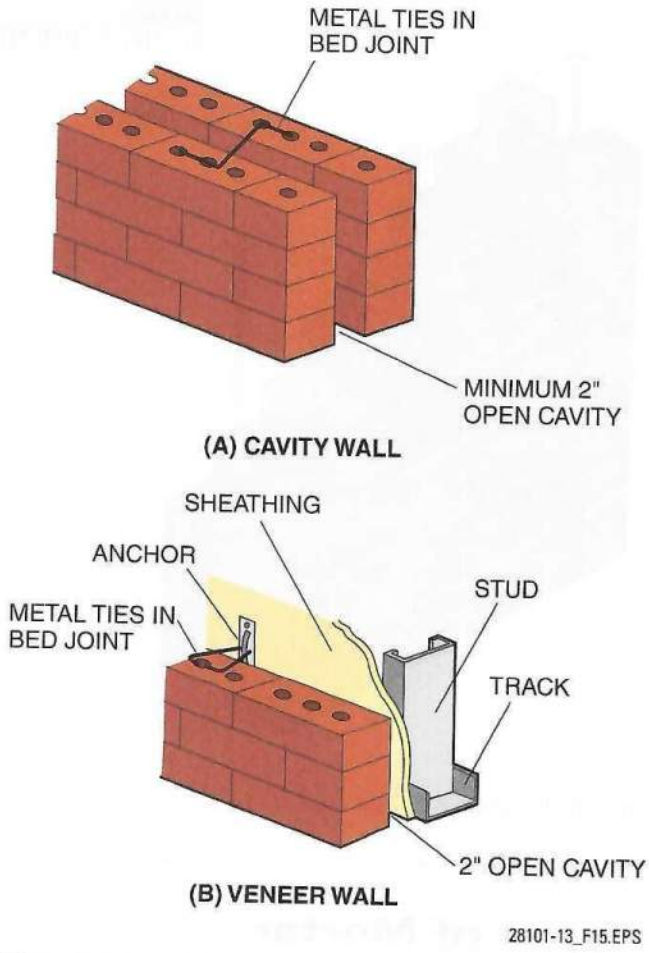
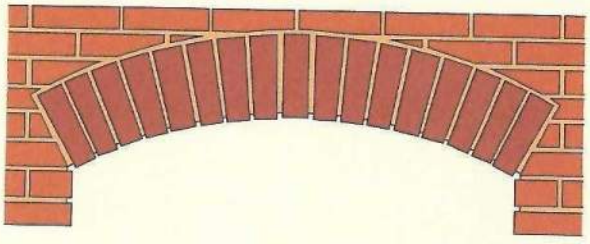


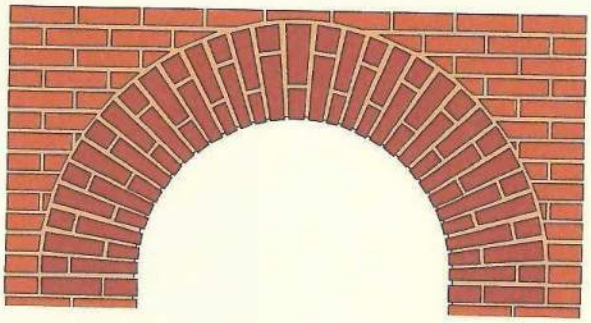
Figure 15 Types of masonry construction.

The Dome and Arch

The development of the dome and arch (in *Figure SA05* [below, left]) were important developments for brick architecture. With domes and arches, early masons could build larger and higher structures, with more open space inside.

The Romans refined arches and domes and built large-scale brickyards. They covered the Roman Empire with roads that spread Roman brick, mortar, and Roman designs for arches (*Figure SA06* [below, right]) and domes, along with Roman civilization, across Europe and North Africa.


28101-13_SA05.EPS


28101-13_SA06.EPS

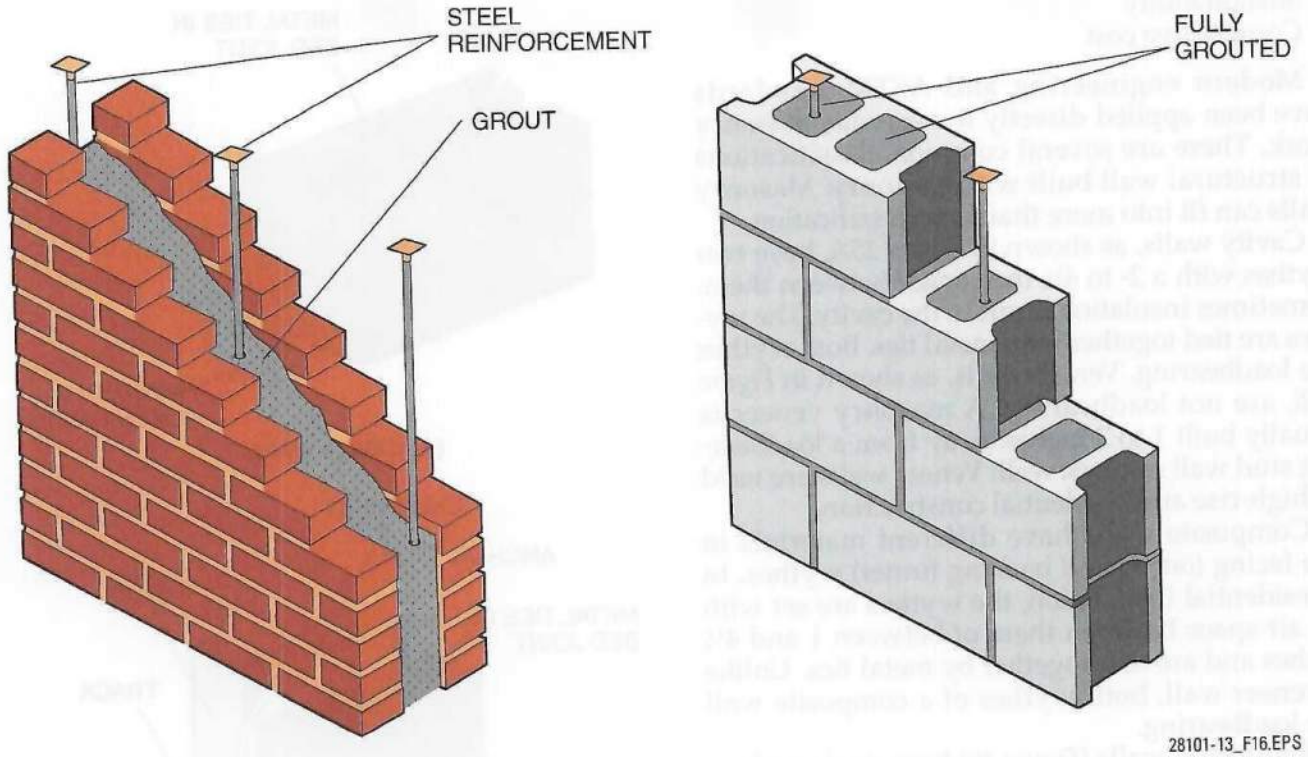


Figure 16 Reinforced walls.

Types of Mortar

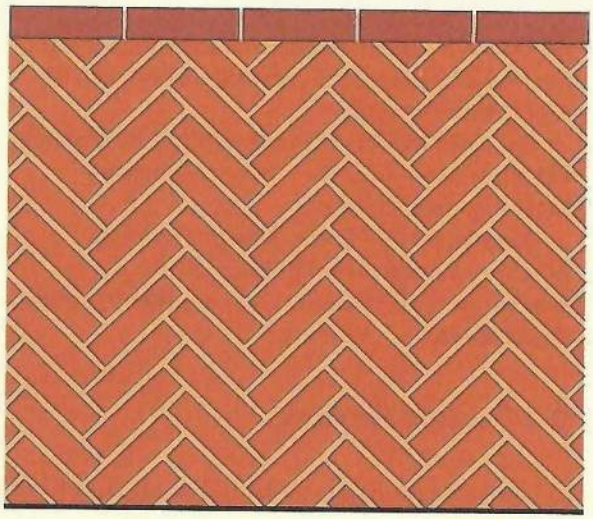
You can remember the five types of mortar (M, S, N, O, and K) by taking every other letter from the words *MaSoN wOrK*.

Contemporary masonry systems are designed not as barriers to water, but as drainage walls. Penetrated moisture is collected on flashing and expelled through **weepholes**. Design, workmanship, and materials are all important to the performance of masonry drainage walls.

Concrete, Not Cement

Though many people often use the terms *concrete* and *cement* interchangeably, they are not the same thing. Cement is one of the three ingredients of concrete, along with water and an aggregate such as sand. It's a sign of professionalism to use the terms correctly on the job, so take the time to learn the difference.

A Short History of Masonry



28101-13_SA04.EPS

Masonry is one of the world's oldest and most respected crafts. Masonry construction has been around for thousands of years. The remains of stone buildings date back 15,000 years, and the earliest manufactured brick unearthed by archaeologists is more than 10,000 years old. This brick was made of hand-shaped, dried mud. Among the most well known works of masons are the pyramids of ancient Egypt, the Hanging Gardens of Babylon, and Notre Dame Cathedral in Paris.

Brick is the oldest manufactured building material, invented thousands of years ago. The original hand-formed mud brick was reinforced with straw and dried in the sun, and stacked with wet mud between them—the first mortar. Sometimes they were covered with another coat of mud, which was decorated. This was a common and effective building technique for centuries.

At some point, someone had the idea of laying brick in different patterns instead of simply stacking them. The figure shows a herringbone pattern, seen in ancient walls still standing today. Not only were the Babylonians the first to fire and glaze brick, they also developed two new types of mortar by mixing lime or pitch (asphalt) with the mud.

The Romans refined the Babylonian lime mortar by developing a form of cement that was a waterproof mortar. This mortar was useful for both brick and stone construction. It was also applied as a finish coat to the exterior of the surface as an early form of stucco. Romans produced highly ornate brick architecture using specialized brick shapes and varied brick colors and glazes. The Romans standardized the sizes of their brick, and the standards they developed are recognized even today.

By the Roman period, sand was a common additive in mortar. Burnt limestone, or quicklime, was added to mortar as an ingredient around the first century BC. Experimenting with ways to waterproof mortar, the Romans added volcanic ash and clay. The resulting cement made a strong, waterproof mortar. This made it possible to build aqueducts, water tanks, water channels, and baths that are still in use today. Unfortunately, some of the Roman formula was lost over time.

When the Normans conquered England in 1066, they built many castles there using brick and masons to lay them, who they brought with them from Europe. This construction boom boosted the trade economy of Europe and, along with it, the status of masons. Not only that, but today the size of brick used by the Normans is still widely recognized and used, as are those used by the Romans as mentioned earlier.

As the demand for more elaborate construction grew, so did the need for skilled workers. By the middle 1300s, masons had organized into early unions, known as guilds, across most of Europe. Guilds controlled the practice of the craft by monitoring the skill level of the craft worker. The local guilds controlled the practice of the masons' craft for centuries, monitoring training, judging disputes, and sharing knowledge among members. They collected dues, provided some support to widows and the ill, and celebrated special masons' holidays.

In the early 1700s, Masonic Temples and Orders of Freemasonry were founded in Europe. These organizations were political and spiritual, but based on many of the ideas of the masons' guilds. The pyramid seal on the back of the American dollar bill is a legacy of the masons' guilds.

The modern age of brick manufacture began with the invention of the first brick-making machine. It was powered by a steam engine and patented in 1800. In 1824, portland cement was patented by Joseph Aspdin, a mason. He was trying to recreate the waterproof mortar of the Romans. By 1880, portland cement had become the major ingredient in mortar. The new, waterproof portland cement mortar began to replace the old lime and sand mixture.

Additional Resources

ASTM C270, Standard Specification for Mortar for Unit Masonry. 2012. West Consohocken, PA: ASTM International.

Concrete Masonry Shapes and Sizes Manual CD-ROM. Herndon, VA: National Concrete Masonry Association.

Installation Guide for Adhered Concrete Masonry Veneer, Third Edition. 2012. Washington, DC: Masonry Veneer Manufacturers Association.

1.0.0 Section Review

1. Concrete units are classified according to their _____.
   a. length, width, and height
   b. intended use, size, and appearance
   c. composition, appearance, and weight
   d. thickness, composition, and size

2. The traditional number of brick in a cube is _____.
   a. 90
   b. 100
   c. 500
   d. 750

3. Stone collected in a field is called _____.
   a. ashlar
   b. veneer
   c. clinker
   d. rubble

4. Mortar that is typically used in contact with earth for foundations, sewers, and walks is classified as Type _____.
   a. N
   b. O
   c. M
   d. S

5. In a residential installation, the minimum air space between wythes in a composite wall is set at _____.
   a. 1 inch
   b. 1½ inches
   c. 2 inches
   d. 2½ inches

SECTION TWO

2.0.0 INTRODUCTION TO MASONRY SAFETY

Objective

Recognize the basic safety precautions when working with masonry materials.

a. List basic safety practices.
b. Describe personal protective equipment used in masonry.

Performance Task 1

Put on eye protection and respiratory protection.

Trade Terms

Competent person: An individual who is capable of identifying existing and predictable hazards or working conditions that are hazardous, unsanitary, or dangerous to employees, and who has authorization to take prompt, corrective measures to eliminate or control these hazards and conditions.

Occupational Safety and Health Administration (OSHA): The division of the US Department of Labor mandated to ensure a safe and healthy environment in the workplace.

Personal protective equipment (PPE): Equipment or clothing designed to prevent or reduce injuries.

Safety is a particularly important issue for you as a masonry worker. You will often work at heights where falls and falling objects are major hazards. You must also be careful when working with mortar and concrete products because they can cause skin irritations and lung ailments if not handled properly. You will often work on sites where heavy equipment is used. For that reason, you must be especially vigilant. In this section, you will be introduced to basic safety practices and the various pieces of **personal protective equipment (PPE)** used in masonry. Safety and personal protective equipment will be covered in more detail in the module titled *Masonry Safety*.

2.1.0 Understanding Basic Safety Practices

Most accidents and injuries on a construction site are caused by worker carelessness, poor safety planning, lack of training, or failure of the employer or employee to follow safety regulations. Accidents do not only affect masons and their employers; they can also affect the health and safety of the public.

To help prevent accidents, your company must have a safety program. This program will provide you with the rules and safeguards you need to work safely. Safety must be part of all phases of the job and must involve employees at every level, including management. The United States Department of Labor's **Occupational Safety and Health Administration (OSHA)** requires that a company-appointed **competent person** be on site before you start any job. OSHA's regulation CFR (*Code of Federal Regulations*) 1926.32 defines a competent person as one who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary or dangerous to employees and who is authorized to take prompt, corrective measures to eliminate them. A competent person has experience and training for the job and knows the job's hazards, as well as the rules and regulations associated with the job.

In addition to its own rules, your company must comply with many local, state, and national regulations. For example, OSHA requires the following:

- An employer "shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees."
- An employer "shall comply with occupational safety and health standards" established in the federal Occupational Safety and Health Act.
- An employee "shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct."

This is called OSHA's General Duty Clause. OSHA also says that employees have a duty to fix a recognizable hazard when they see one. Safety regulations like these are intended to make work sites safe and accident free. Safety policies and procedures are available to help you and your company comply with OSHA regulations. Remember that there is a good reason for each regulation. Following good safety practices helps to save lives.

Unsafe acts often lead to serious injury and sometimes death. You can prevent unsafe acts by changing your behavior. It is your responsibility to recognize unsafe acts and stop them immediately. This can mean telling your co-workers to stop what they are doing. If your co-workers do not stop acting in an unsafe manner, stop what you are doing and move as far away from them as possible. In some cases, you may need to inform your supervisor of the problem. Here are some examples of the most common unsafe acts:

- Operating equipment at improper speeds
- Operating equipment without authority
- Using defective equipment
- Disabling a safety device
- Servicing equipment while it is in motion or energized
- Using equipment improperly
- Failing to use PPE
- Failing to warn co-workers of a dangerous or potentially dangerous situation
- Working in an improper position
- Working while impaired by alcohol or illegal drugs
- Operating tools or equipment when taking certain types of prescription drugs
- Lifting loads improperly
- Loading or placing equipment or supplies improperly
- Using cell phones or texting while working
- Working when tired or without enough sleep
- Wearing ear buds or earphones
- Horsing around

An unsafe act can also be defined as work that is not done correctly. Workers who fail to use proper PPE, follow safety procedures, or warn co-workers of potentially hazardous conditions can cause or worsen accidents. Keep yourself safe, and look out for the safety of others. Always follow safety rules, and use the right equipment for the job.

2.2.0 Recognizing Personal Protective Equipment Used in Masonry

PPE is designed to protect you from injury. You won't see all the potentially dangerous conditions on a job site just by looking around. Before doing any job, stop and consider what type of accidents could happen. Using common sense and PPE will greatly reduce your chances of getting hurt. The best PPE is of no use unless you do the following four things:

- Inspect it regularly, and replace any PPE that is damaged or worn.
- Care for it properly.
- Use it properly when it is needed.
- Avoid altering or modifying it in any way.

As a mason, you will most commonly use the following types of PPE:

- Hard hats
- Eye and face protection
- Gloves
- Safety shoes
- Hearing protection
- Fall protection
- Respiratory protection
- Proper clothing

Each of these items will be covered in more detail in the module titled *Masonry Safety*. The following sections review the basic personal protective equipment you will need to use to complete the basic masonry installation requirements in the section titled "Introduction to Masonry Installation".

2.2.1 Gloves

Gloves protect your hands from cuts, abrasion, dust and moisture, burns caused by mortar and portland cement, and other hazards (see *Figure 17*). Gloves used in masonry work often have a tightly knit fabric or nylon shell with palms and fingertips made from latex or synthetic rubber. This allows you to keep your sense of touch while wearing the gloves but still be able to grip effectively and protect your hands.

WARNING!

Wet portland cement can cause caustic burns that can cause blisters, dead skin, and discolored skin. Severe burns from portland cement can even reach the bone, causing scars and even disability. Exposure to portland cement can cause an allergic reaction that results in inflammation from repeated exposure.

Make sure that gloves fit snugly without being too loose or too tight. Always wash and dry your hands before wearing gloves. If the gloves are reusable, clean them after each use. If they are worn, damaged, or contaminated, exchange them for a fresh pair.

2.2.2 Eye, Ear, and Face Protection

Wear safety goggles, eyewear, and face shields (*Figure 18*) to prevent eye injury. Areas where there are potential eye hazards from falling or flying objects are usually identified, but you should always be on the lookout for other possible haz-

28101-13_F17.EPS

Figure 17 Gloves for masonry work.

ards, such as pressurized water. Safety goggles give your eyes the best protection from all directions. Regular safety glasses will protect you from objects flying at you from the front, such as large chips, particles, sand, or dust. You can add side shields for further protection.

28101-13_F18.EPS

Figure 18 Typical safety goggles, glasses, and face shield.

To protect yourself against the loss of hearing caused by loud noises, wear earmuffs or specially designed disposable earplugs that fit into your ears and filter out noise. Make sure that earmuffs fit snugly against your head to provide maximum protection.

2.2.3 Respiratory Protection

Wherever there is danger of suffocation or other breathing hazards, you must use a respirator. You must also wear a respirator when working with or near fire-resistant asbestos or where hazardous molds are growing. Mandatory special training is required for the use of respirators. It is important to do the following:

- Use the proper type of respiratory protection for the hazard
- Pass a cardiopulmonary fitness test before using respiratory protection
- Conduct a fit test with the respiratory protection equipment prior to use to ensure that it fits properly

CAUTION

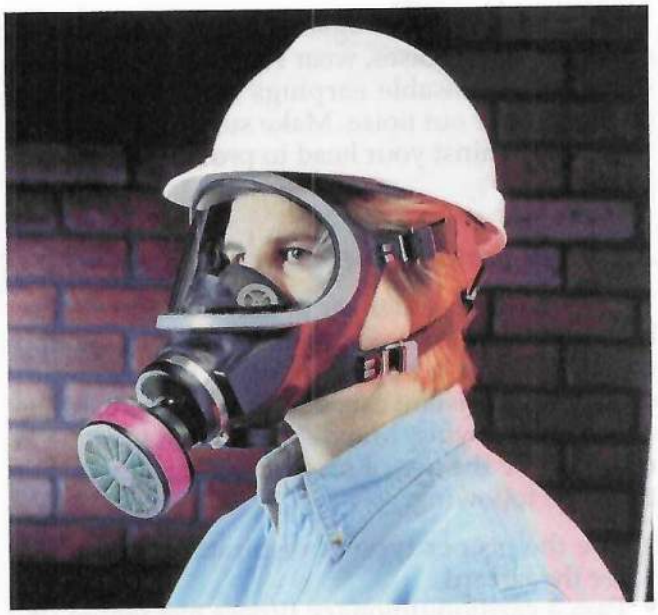
OSHA regulations require that workers undergo a cardiopulmonary test before using respiratory protection. Refer to your local applicable standards.

WARNING!

EPA's *Renovation, Repair & Painting Final Rule, 40 CFR 745,* requires that home renovations conducted for compensation, must be performed by certified firms using certified renovators if the home was built prior to 1978, if it qualifies as a child-occupied facility, and if the renovation disturbs over 6 square feet of lead paint per interior room area or 20 square feet of exterior area per wall. All masons working on pre-1978 homes are affected by this rule and need to be aware of their surroundings and test for the presence of lead in their work area.

WARNING!

If you encounter asbestos or mold, do not handle it or attempt to remove it. Tell your supervisor about the presence of these materials immediately. Asbestos and mold are linked to long-term illnesses. Only trained personnel who have the proper equipment for handling and disposing of these materials can deal with such situations.



FULL-FACEPIECE RESPIRATOR

HALF-MASK RESPIRATOR

DUST MASK

28101-13_F19.EPS

Figure 19 Full-facepiece respirator, half-mask respirator, and dust mask.

Reusable respirators are made in full-facepiece and half-mask styles; dust masks are also available to provide light-duty respiratory protection (*Figure 19*). These respirators require the replacement of cartridges, filters, and respirator parts. Their use also requires a complete respirator maintenance program. Half-mask air-purifying respirators have several limitations, so be sure to refer to the manufacturer's instructions before using. Dust masks should be discarded after a single use.

2.2.4 Clothing

Figure 20 shows a mason properly dressed and equipped for most masonry jobs. Wear close-fitting clothing that is appropriate for the job. Clothing should be comfortable and should not interfere with the free movement of your body. Clothing or accessories that do not fit tightly, or that are too loose or torn, may get caught in tools, materials, or scaffold. Wear a long-sleeved shirt to provide extra protection for your skin. Wear sturdy work boots or work shoes with thick soles (*Figure 21*). Never show up for work dressed in sneakers, loafers, or sport shoes.

Wear shirts tucked in, with the sleeves tight or buttoned. Do not wear loose-fitting shirts. Always wear your pants up, with the waistband above the hip bone. Some job sites specify that the crotch of the pants cannot be lower than 2 inches from the body.

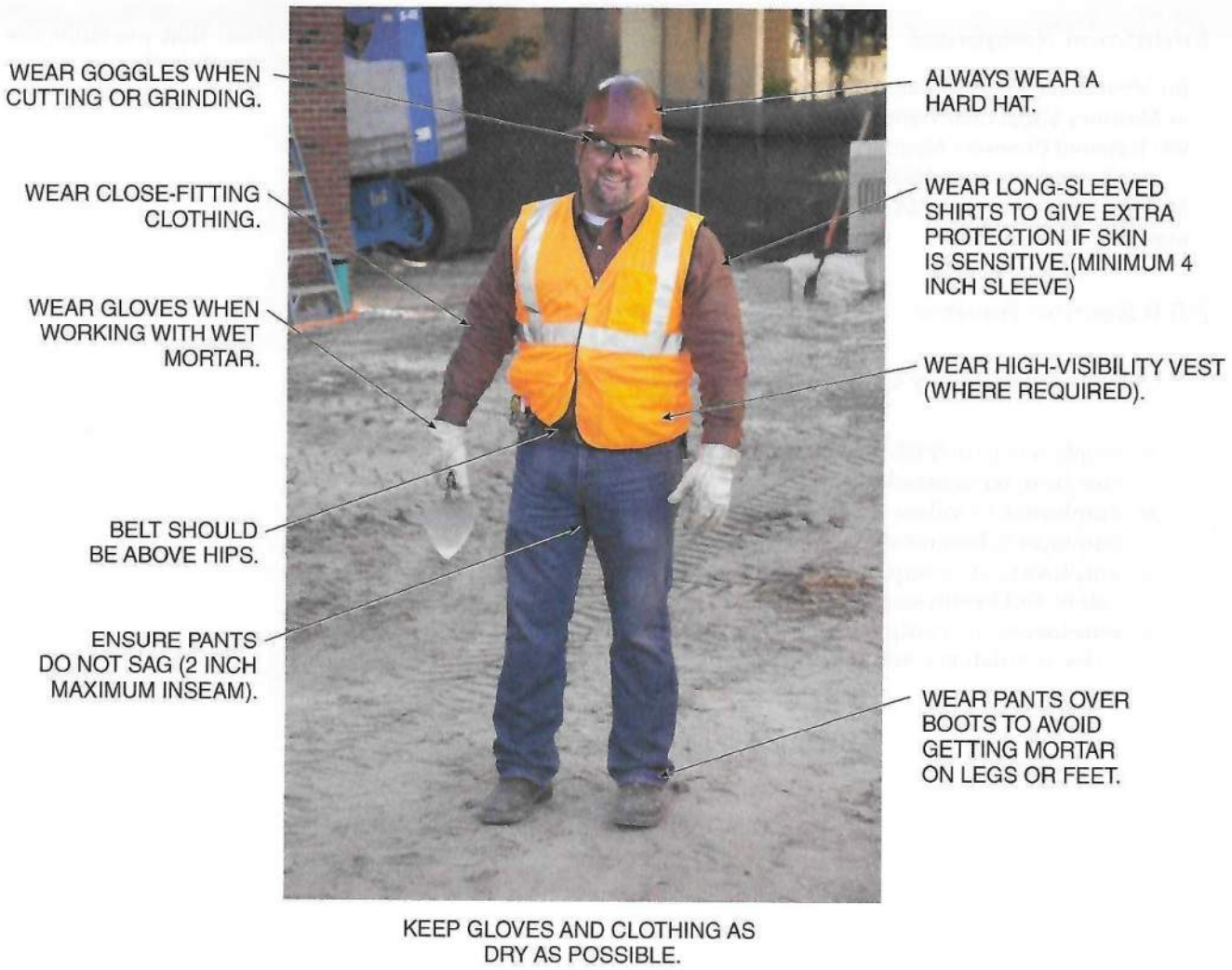


Figure 20 Dressed for masonry work.

Eye Injuries

The average cost of an eye injury is $1,463. That includes both the direct and indirect costs of accidents, not to mention the long-term effects on the health of the worker, which is priceless.

Figure 21 Work boot.

Additional Resources

Building Block Walls: A Basic Guide for Students in Masonry Vocational Training. 1988. Herndon, VA: National Concrete Masonry Association.

Hot & Cold Weather Masonry Construction Manual. 1999. Herndon, VA: National Concrete Masonry Association.

2.0.0 Section Review

1. OSHA's General Duty Clause does *not* require _____.
   a. employers to furnish a place of employment free from recognized hazards
   b. employees to follow the instructions of the employer's designated competent person
   c. employers to comply with occupational safety and health standards
   d. employees to comply with all pursuant rules, regulations, and orders

2. The type of eye protection that provides the best protection from all directions is _____.
   a. safety glasses
   b. regular eyeglasses
   c. face shields
   d. safety goggles

SECTION THREE

3.0.0 INTRODUCTION TO MASONRY INSTALLATION

Objective

Explain how to mix mortar and lay masonry units.

a. Explain how to mix mortar.
b. Describe how to lay masonry units.

Performance Tasks 2 and 3

Properly mix mortar by hand.

Properly spread mortar using a trowel.

Trade Terms

Bed joint: The horizontal joint between two masonry units in separate courses.

Butter: To apply mortar to a masonry unit prior to laying it.

Footing: The base for a masonry unit wall, or concrete foundation, that distributes the weight of the structural member resting on it.

Head joint: The vertical joint between two masonry units.

Pilaster: A square or rectangular pillar projecting from a wall.

Spread: A row of mortar placed into a bed joint.

Stringing: Spreading mortar with a trowel on a wall or footing for a bed joint.

In this section, you will learn the basic elements of bricklaying. When you have completed the section, you should be able to set up a job, mix mortar, and lay brick as directed by your instructor.

Masons use a number of specialized hand and power tools. As you will learn in the module *Masonry Tools and Equipment*, there are many kinds of special trowels, though for this module you will only need to know how to use a basic brick trowel (*Figure 22*). There are also at least six kinds each of hammers, chisels, and steel joint-finishing tools, and seven kinds of measuring and leveling tools. Power tools include several kinds each of saws, grinders, splitters, and powder-actuated tools. Mortar can be mixed by hand, using special equipment, or in a power mixer. Cranes, hoists, and lifts bring the masonry units to the masons working on one of four types of steel scaffold.

While masonry tools have changed over the centuries, one thing has not: the relation between the mason and the masonry unit. The mason uses today's wealth of tools and equipment to perform the following tasks:

- Calculate the number and type of units needed to build a structure
- Estimate the amount of mortar needed
- Assemble the units near the workstation
- Lay out the wall or other architectural structure
- Cut units to fit, as needed
- Mix the appropriate type and amount of mortar
- Place a bed of mortar on the **footing**
- **Butter** the **head joints** and place masonry units on the bed mortar
- Check that each unit is level and true
- Lay courses in the chosen bond pattern or create a new pattern
- Install ties as required for loadbearing
- Install flashing and leave weepholes as required for moisture control
- Clean excess mortar off the units as the work continues
- Finish the joints with jointing tools
- Give the structure a final cleaning
- Complete the work to specification, on time

Masonry work is still very much a craft. The relation between the mason and the masonry unit is personal. The straightness and levelness of each masonry unit in a structure—brick, block, or stone—depend on the hands and the eyes of the mason. These things have not changed in 10,000 years.

The tradition of masonry calls for a bit of art, too. The mason gets trained by work to see the subtle shadings and gradations of color, and learns to create a pattern and to select the right unit to complete the pattern or the shading. The mason grows skilled in building something that is both enduring and attractive.

28101-13_F22.EPS

Figure 22 Brick trowel.

3.1.0 Mixing Mortar

Mortar (*Figure 23*) is a mixture of portland cement, lime, sand, and water. The first three ingredients are determined by the type of mortar being mixed. Water is added until the mix is at the proper consistency. The ability to mix mortar properly, and to produce the same consistency time after time, can only be developed through practice.

You will probably mix (or chop) your first few batches by hand in a wheelbarrow, pan, or mortar box.

For small jobs, manual mixing of the mortar usually makes the most sense. The preliminary steps are the same as those for mechanical or power mixing. Position the material near the mortar box. Ensure that the mortar box is level and stable. Have the mix recipe written down. Make sure that there is enough room at the two ends of the mortar box for you to stand while mixing the mortar. There is no particular height required for the box. It should be at a height that will be convenient for the mason when using the hoe to mix the mortar.

The basic steps for mixing mortar by hand are as follows:

Step 1 Fill a cubic foot box with sand (*Figure 24*). Place half of the sand in the box and spread it out evenly across the bottom of the box.

Step 2 Place the desired amount of cement, lime, or masonry cement over the sand in the box (*Figure 25*). For small batches of mortar, you may wish to use standard shovelsful of material rather than bags as your measuring device. Use a shovel to spread out the remaining sand across the cement and lime layer.

28101-13_F23.EPS

Figure 23 Masonry mortar.

28101-13_F24.EPS

Figure 24 A cubic foot box can be used to measure sand.

28101-13_F25.EPS

Figure 25 Portland cement is added to the sand.

Step 3 Blend the dry ingredients together using the shovel or hoe. When they are thoroughly mixed, push them to one end of the box (*Figure 26*).

28101-13_F26.EPS

Figure 26 Dry ingredients are moved to one end before water is added.

Step 4 Add half the water to the empty end of the box. Begin mixing this water into the dry materials. This can be easily done from the water end of the box, using the hoe with short pull-and-push strokes. Continue in this fashion with the hoe at a 45-degree angle until all the material is well mixed. Add the remaining water to obtain the desired consistency.

Step 5 After the mortar is mixed, pull it to one end of the box to prevent it from drying out.

Step 6 At this time, the mortar can be checked to see if it is of the proper consistency and workability. Pick up a small amount of mortar on a trowel, and set it firmly on the trowel by tapping it once on the side of the box. Turn the trowel upside down. If the mortar is the proper consistency, it will remain on the trowel (*Figure 27*). This is also a measure of the mortar's adhesion, or its ability to stick to a surface.

Step 7 Transport the mortar to the work site with a wheelbarrow or other equipment, but wet the inside surface with water before loading the mortar. This will prevent the mortar from sticking to the sides of the container. When only a small amount of mortar is needed, it can be mixed directly in the wheelbarrow.

28101-13_F27.EPS

Figure 27 Mortar consistency test.

28101-13_F28.EPS

Figure 28 Transferring mortar to mortarboard.

Step 8 Load the mortar from the wheelbarrow to a mortarboard or pan with a shovel. The mortar should be sticky and not runny (*Figure 28*).

Step 9 The final step is to clean the mixing equipment of all mortar as soon as possible after the mixing box or wheelbarrow is no longer needed. A water hose with a spray nozzle and a stiff brush are the best tools to use when cleaning your masonry tools. You can also use a water barrel as a bath to keep the mortar from drying on your tools.

WARNING!

Dry cement and wet concrete are harmful. Dry cement dust can enter open wounds and cause blood poisoning. The cement dust, when it comes in contact with body fluids, can cause chemical burns to the membranes of the eyes, nose, mouth, throat, or lungs. It can also cause a fatal lung disease known as silicosis. Wet cement or concrete can also cause chemical burns to the eyes and skin. Always wear appropriate personal protective equipment when working with dry cement or wet concrete. If wet concrete enters waterproof boots from the top, remove the boots and rinse your legs, feet, boots, and clothing with clear water as soon as possible. Repeated contact with cement or wet concrete can also cause an allergic skin reaction known as cement dermatitis.

3.2.0 Laying Masonry Units

After the mortar is mixed, pick it up on your trowel and spread it. Filling and emptying the trowel is an important skill. Applying the mortar, or spreading it, is the next step. In this section, you will learn how to hold the trowel, pick up the mortar, and lay it down. Then you will learn how to spread and cut mortar, and butter a brick. At this point, you will learn something to be experienced rather than memorized. The techniques in the next sections should be practiced until you feel comfortable using them. Note that the instructions in this section apply to laying brick.

3.2.1 Picking Up Mortar

There are several ways of using the trowel to pick up mortar. This section will introduce you to a general method for picking up mortar from a board and a general method for picking up mortar from a pan. There are many different ways to do these tasks. The instruction here begins with some tips on holding the trowel. All of these instructions are only approximations of the work itself. You can only learn this through watching a skilled mason and practicing until you feel comfortable with these movements.

3.2.2 Holding the Trowel

Pick up your trowel by the handle. Put your thumb along the top of the handle with the tip on the handle, not the shank, as shown in *Figure 29*.

Keep your second, third, and fourth fingers wrapped around the handle of the trowel. Keep the muscles of your wrist, arm, and shoulder relaxed so you can move the trowel freely.

28101-13_F29.EPS

Figure 29 Holding the trowel.

Most of your work with the trowel will require holding the blade flat, parallel to the ground, or rotating the blade so it is perpendicular to the ground.

Rotating the blade gives you a cutting edge. The best edge for cutting is the edge on the side closest to your thumb. It is best this way because you can see what you are cutting. When you turn the trowel edge to cut, rotate your arm so your thumb moves down. This will rotate the trowel so that the bottom of the blade turns away from you. If you rotate only your wrist, after a while you will strain it. Use the larger muscles in your arm and shoulder to rotate the trowel.

Rotating the blade also gives you a scooping motion. Turning your thumb down will give you a forehand scoop. Turning your thumb up will rotate the bottom of the blade toward you and give you a backhand scoop. Using a forehand or backhand movement will depend on the position of the material you are trying to scoop.

3.2.3 Picking Up Mortar from a Board

After putting the mortar on the board, follow these steps:

Step 1 Work the mortar into a pile in the center of the board, and smooth it off with a backhand stroke.

Step 2 Use the trowel edge to cut off a slice of mortar from the edge.

Step 3 Pull and roll the slice of mortar to the edge of the board. Work the mortar into a long, tapered roll, as shown in *Figure 30.*

Step 4 Slide the trowel under the mortar, then lift the mortar up with a light snap of your wrist. Raising the trowel quickly will break the bond between the mortar and the board. If done correctly, the mortar will completely fill the trowel blade.

28101-13_F30.EPS

Figure 30 Picking up mortar from a board.

3.2.4 Picking Up Mortar from a Pan

Try this method when the mortar is in a pan:

Step 1 Cut a slice of mortar, as shown in *Figure 31.*

Step 2 Without removing the trowel from the mortar, slide the trowel under the mortar so the blade becomes parallel to the floor.

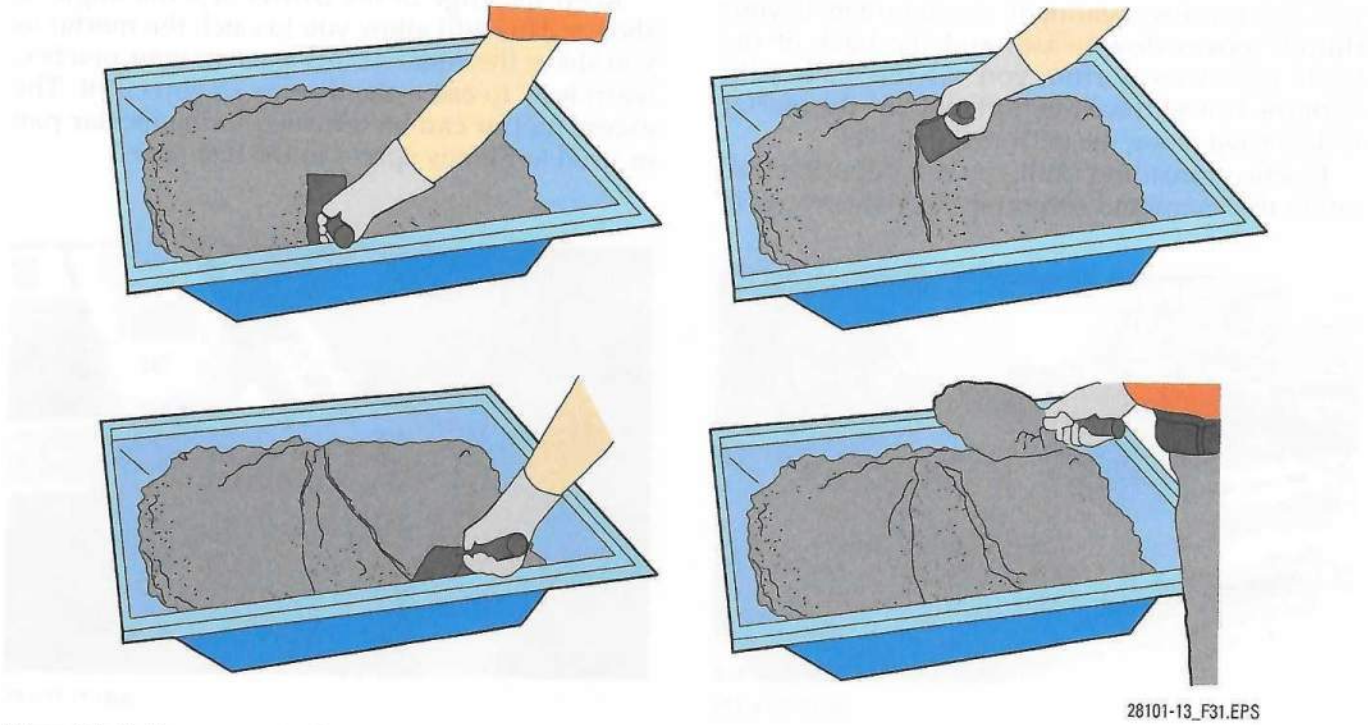
Step 3 Firmly push the trowel, with the blade parallel to the floor, toward the middle of the pan. The mortar will pile up on the blade.

Step 4 Lift the trowel from the mortar at the end of the stroke. The trowel should be fully loaded with a tapered section of mortar.

Step 5 To prevent the mortar from falling off the trowel, snap your wrist slightly to set the mortar on the trowel as you lift.

3.2.5 Spreading

Now you will learn about spreading the mortar and shaping its edges. You can practice spreading and cutting the mortar along a 2 × 4 board spread between two cement block or other props. Prac-



28101-13_F31.EPS

Figure 31 Picking up mortar from a pan.

tice until you feel comfortable with these movements.

Mortar application should adhere to the following guidelines:

- The joints are completely filled with no small voids for water to enter.
- The mortar is still pliable while you level and plumb the unit.
- The finished joint is the specified thickness after you level and plumb the masonry unit.
- The mortar does not smear the face of the masonry unit.

Spreading the mortar means applying it in a desired location at a uniform thickness (see *Figure 32*). Mortar is spread for **bed joints**. The process of spreading the mortar for the bed joint is also called **stringing** the mortar. The spreading motion has two components to it, and they occur at the same time.

The first component of the spreading motion is a horizontal sweep back toward you from the starting point or the point where the last spread of mortar ended. The mortar deposited is called a **spread**. Try to make the spread about two brick long to begin with. If you are working with block, try to string the spread about one block long at first. After practice, you should be able to string the spread three to four brick long, or two block long.

The second component of the motion is a vertical rotation. The trowel starts with its blade horizontal. As you move the trowel back toward you, you are also rotating it. As you rotate it, your thumb moves downward, and the back of the blade moves away from you. As the blade tilts, with the trowel traveling horizontally, the mortar is deposited along the path of the trowel.

Practice spreading until you can deposit a trail rather than a mound of mortar. Keep the trowel in the center of the wall for the length of the spread, so mortar will not get thrown on the face of the masonry. Start with a goal of 16 inches and work up to a spread of 24 to 32 inches.

Full joint spreads are used for all brick but not for all block. Block is usually mortared on its face shells and not its webs. However, block needs a full bed joint when it fits into any of the following categories:

- The first or starting course on a foundation, footing, or other structure
- Part of masonry columns, piers, or **pilasters** designed to carry heavy loads
- In a reinforced masonry structure, where all cores are to be grouted

Check the specifications to be sure. After the first course, the remaining block is mortared on shells, or shells and webs, according to specifications.

Whether you work with block or brick, you will need to know how to spread a full bed joint and cut it.

3.2.6 Cutting or Edging

After each spread, use the edge of the trowel to cut off excess mortar. To cut, hold the edge of the trowel at about a 60-degree angle, perpendicular to the edge of the mortar. Use the edge of the trowel to shave off the edge of the mortar. *Figure 33* shows the correct angle for shaving the edge of the spread.

Keep the edge of the trowel at a flat angle as shown. This will allow you to catch the mortar as you shave the edge. At this stage in your practice, learn how to catch the mortar as you cut it. The excess mortar can be returned to the mortar pan or used to fill any spaces in the bed joint.

28101-13_F32.EPS

Figure 32 Mortar spread at a uniform thickness.

28101-13_F33.EPS

Figure 33 Cutting an edge.

Catching the mortar as you shave it means you do not have to go back and pick it up afterwards. On the job, having mortar stuck to the face of the masonry unit or lying in piles at the foot of a wall is unacceptable. Mortar is hard to remove after it dries, but easy to clean when it is fresh. Learn to clean mortar as you lay it.

3.2.7 Buttering Joints

Buttering the head joint involves applying mortar to a header surface of a masonry unit. Buttering occurs after the bed joint is spread and the first masonry unit is laid in the bed. Buttering techniques are different for block and brick.

Buttering brick is a two-handed job. Begin by spreading the mortar on the bed joint. Keeping the trowel in your hand, pick up the first brick with your other hand. Press this brick into position in the mortar. Cut off the excess mortar on the outside face with the edge of the trowel.

Keeping the trowel in your hand, pick up a second brick in your brick hand. As you hold it, apply mortar to the header end of the brick. *Figure 34* shows a properly buttered head joint.

The buttered mortar should cover all of the header surface but should not extend past the edges of the brick. Hold the trowel at an angle to the header surface to keep the mortar off the sides of the brick.

When the brick is buttered, use your brick hand to press it into position next to the first brick (*Figure 35*). After placing the brick, cut off the excess mortar with the edge of your trowel.

Unlike block, you can easily hold a brick in one hand. Take advantage of this to use both hands for laying brick. Try to develop a rhythmic set of movements. This will make the work faster and easier on you. Remember to use your shoulders and arms, not just your wrists.

28101-13_F34.EPS

Figure 34 A buttered head joint.

28101-13_F35.EPS

Figure 35 Placing the brick.

After you have laid six brick, check them for placement. Use your mason's level to check both plumb and level (*Figure 36*). If a brick is out of line, tap it gently with the handle of your trowel. Do not tap the level. Do not use the point or blade of your trowel or it will lose its edge.

3.2.8 General Rules

The way you work the mortar determines the quality of the joints between the masonry units. The mortar and the joints form a vital part of the structural strength and water resistance of the wall. Learning these general rules and applying them as you spread mortar will help you build good walls:

- Use mortar with the consistency of mud, so it will cling to the masonry unit, creating a good bond.
- Butter the head joints fully for block and brick; butter both ears of the head joints for block.

28101-13_F36.EPS

Figure 36 Checking the level.

- When laying a unit on the bed joint, press down slightly and sideways, so the unit goes against the one next to it.
- If mortar falls off a moving unit, replace the mortar before placing the unit.
- Put down more mortar than the size of the final joint; remember that placing the unit will compress the mortar.
- The length of a spread is determined by the moisture content of the units. Do not string a spread that is longer than what can be laid before water evaporates from the units and the spread becomes too stiff to bond properly.
- Do not move a unit once it is placed, leveled, plumbed, and aligned.
- If a unit must be moved after it is placed, remove all the mortar on it and rebutter it.
- After placing the unit, cut away excess mortar with your trowel and put it back in the pan, or use it to butter the next joint.
- Throw away mortar after 2 hours. At that point, it is beginning to set and will not give a good bond.

Additional Resources

Bricklaying: Brick and Block Masonry. Reston, VA: Brick Industry Association.

Concrete Masonry Handbook. Skokie, IL: Portland Cement Association.

Concrete Masonry Shapes and Sizes Manual CD-ROM. Herndon, VA: National Concrete Masonry Association.

3.0.0 Section Review

1. Adhesion means the ability of mortar to ____.
   a. dry quickly
   b. be mixed to a given consistency
   c. stick to a surface
   d. spread evenly
2. Once you have put the mortar on the board, you should work the mortar ____.
   a. into a pile in the center of the board
   b. into an evenly distributed layer across the board
   c. into a pile at the closest end of the board
   d. into small piles in each of the corners of the board

SECTION FOUR

4.0.0 SUCCESS IN THE MASONRY TRADE

Objective

Describe the skills, attitudes, and abilities needed to be a successful mason.

a. Identify the skills of a successful mason.
b. Identify the attitudes of a successful mason.
c. Identify the abilities of a successful mason.
d. Explore career ladders and advancement possibilities in masonry.

Trade Term

Tuckpointing: Filling fresh mortar into cutout or defective joints in masonry.

Becoming a good mason takes more than the ability to lay a masonry unit and level it. A competent mason is one who can be trusted to perform the required work and meet the project specifications. This mason must have the necessary knowledge, skills, and ability, as well as good attitudes about the work itself, about safety, and about quality. This section explains the skills, attitudes, and abilities of successful masons, and discusses the career opportunities available to them.

4.1.0 Identifying the Skills of a Successful Mason

Masons need to know how to handle all aspects of masonry work, including all of the following:

- Read and interpret drawings and specifications
- Calculate and estimate quantities, lengths, weights, and volumes
- Select the proper materials for the job
- Lay masonry units into structural elements
- Work productively alone or as part of a team
- Assemble and disassemble scaffold
- Keep tools and equipment in good repair and safe condition
- Follow safety precautions to protect themselves and other workers on the job

4.1.1 Job-Site Knowledge

Masons need to be skilled in applying their knowledge to the challenges they face each day on the job. The best way to do the work at a particular job site will depend on the layout of the work, what is happening around the masonry site, and the conditions surrounding the project.

Most masonry work is done outside in temperature and weather variations. You must be able to work under these conditions and not be distracted by them. You must know how to react to changing conditions around you.

Much of this knowledge can be learned as you work, if you will pay attention. Notice what others do and ask questions. Ask your supervisor questions, too. Learn to respond to conditions at the job site.

4.1.2 Learning More

Masons need to keep on learning after they finish their apprenticeships. They need to keep updating their skills all the time. The environment, tools, and expectations about masonry have evolved and will continue to change. Craftworkers and contractors alike will need to change the way they think about their work and how they do it.

National, regional, and local organizations offer continuing education for masons. Technical seminars, training sessions, publications, and classes are often free or low cost. They can bring you the latest information about tools, materials, and methods. To succeed, you must be alert to change and willing to learn new ways.

4.1.3 Quality

Quality in work is not a new idea. Those who work in masonry construction and finishing have been concerned about quality for thousands of years. The quality of masonry depends on many factors. When building a wall, you may have little control over its design or the choice of masonry units. But you do have control over the quality of the completed job. A wall out of level or with poorly finished joints is your responsibility.

The quality of the finished masonry structure depends directly on your knowledge, skill, and ability. Good work is easily recognized. Poor work is seen even more easily. Given the durability of masonry, the quality of the work is a monument to your skill for a very long time. The skilled, proud mason always strives for the highest quality that can be achieved.

4.2.0 Identifying the Attitudes of a Successful Mason

Attitude can build an invisible bridge, or build an invisible wall, between people. No one wants to hang around a grouch or count on someone who is not dependable. No one minds helping someone who can do something in return or working with a friendly, cooperative partner. On top of knowledge, skills, and ability, you need the right attitude. Your attitude comes from how you think and feel about your work and yourself.

4.2.1 Dependability

You must be dependable. Masonry work, like all construction, is a closely timed operation. Once started, it cannot stop without waste of material and money. Employers need workers who report to work on time. An undependable, absent worker will slow or stop masonry work and cost the project time and money. An undependable worker will not be able to depend on having a job for very long.

4.2.2 Responsibility

You must be responsible for doing the assigned work in a proper and safe manner, be responsible enough to work without supervision, and work until the task is complete.

Being responsible for your own work includes admitting your mistakes. It also includes learn-

Smartphone Apps for Construction

Although the craft of masonry has been around for centuries, not everything in masonry is old. Smartphones are becoming an increasingly popular form of communication, and also offer a great deal of versatility for craftworkers. Smartphone cameras can be used to document on-the-job activities or potential safety violations. Best practices can be communicated to crewmembers using video clips. Construction calculators can be downloaded, providing craftworkers with the same (or even greater) capabilities than a handheld calculator.

The smartphone version of Calculated Industries, Inc.'s popular Construction Master® Pro, for example, lets craftworkers calculate and convert dimensions, plot right-angle conversions, find area and volume, and determine measures such as board feet, cost per unit, and even the angles of an equal-sided polygon. Calculated Industries, Inc., also makes an app version of its ConcreteCalc™ Pro app (see the figure), which masons can use to calculate stair dimensions, the length and weight of rebar, and the number of brick loads and mortar bags needed for a job.

28101-13_SA07.EPS

ing from your mistakes. Nobody is expected to be perfect. Everyone is expected to learn and to grow more skilled.

Employers are always in need of workers who are ambitious and want to become leaders. Being responsible for what others do may be your career goal. The path to that goal starts with being responsible for what you do.

4.2.3 Adaptability

On any construction project, a large amount of work must be done in a short time. Planning and teamwork are needed in order to work efficiently and safely. Supervisors sometimes form teams of two or more workers to do specific tasks. You may work in a team to erect a scaffold, then work alone for most of the day, then team with someone else to do a cleanup.

On a job site, you may find yourself teaming with different people at different times. The ability to be a team player is an important part of being a mason. Team players accept instruction and direction. They communicate clearly, keep an eye out for potential problems, and share information. They meet problems squarely with constructive ideas, not criticism.

All team players treat each other with respect. Everyone must be willing to work together. Everyone must be willing to bring their best attitude to the team. Team members need to be able to depend on each other. Team priorities must be more important than individual priorities.

4.2.4 Pride

Pride in what you do comes from doing high-quality work in a timely manner and from knowing you are doing your best. Being proud of what you do can overflow into other areas. Proud workers take pride in their personal appearance. Their work clothes are clean, safe, neat, and suitable. Proud masons take pride in their tools. They have a complete set of well-maintained tools and other special equipment they need to do their jobs. They keep their tools safe and orderly, and know how to use the right tool for the work at hand.

Proud masons work so that they can continue to be proud of what they do and how they do it. Being proud of what you do is an important part of being proud of who you are.

4.2.5 Ethics

Members of the construction trades are expected to observe the following ethical principles:

- *Honesty* – Be honest and truthful in all dealings. Conduct business according to the highest professional standards. Faithfully fulfill all contracts and commitments. Do not deliberately mislead or deceive others.
- *Integrity* – Demonstrate personal integrity and the courage of your convictions by doing what is right even when there is great pressure to do otherwise. Do not sacrifice your principles for expediency, be hypocritical, or act in an unscrupulous manner.
- *Loyalty* – Be worthy of trust. Demonstrate fidelity and loyalty to companies, employers, fellow craftspeople, and trade institutions and organizations.
- *Fairness* – Be fair and just in all dealings. Do not take undue advantage of another's mistakes or difficulties. Fair people display a commitment to justice, equal treatment of individuals, tolerance for and acceptance of diversity, and open-mindedness.
- *Respect for others* – Be courteous and treat all people with equal respect and dignity, regardless of sex, race, or national origin.
- *Law abiding* – Abide by laws, rules, and regulations relating to all personal and business activities.
- *Commitment to excellence* – Pursue excellence in performing your duties, be well informed and prepared, and constantly endeavor to increase your proficiency by gaining new skills and knowledge.
- *Leadership* – By your own conduct, seek to be a positive role model for others.

4.3.0 Identifying the Abilities of a Successful Mason

A mason must be a responsible person with a high degree of concern for the safety of workers and the quality of the work.

4.3.1 Willingness to Take Responsibility

In general, responsibility should be delegated and not assumed; once responsibility has been delegated to a mason, the mason should continue to perform the duties without further direction. Every mason should have the responsibility for working safely. Most contractors expect their masons to see what needs to be done, then go ahead and do it. It is very tiresome to have to ask again and again that a certain job be done.

4.3.2 Willingness to Follow Rules and Regulations

People can work together well only if there is some understanding about what work is to be done, when it will be done, and who will do it. Rules and regulations are a necessity in any work situation.

4.3.3 Willingness to Avoid Tardiness and Absenteeism

Tardiness means being late for work and absenteeism means being off the job for one reason or another. Consistent tardiness and frequent absences are an indication of poor work habits, unprofessional conduct, and a lack of commitment to your contractor.

Work life is governed by the clock. All members of a masonry crew are required to be at work at a specific time. Failure to get to work on time results in confusion, lost time, and resentment on the part of those who do come on time. In addition, frequent tardiness or absenteeism may lead to penalties, including dismissal. When accepting a job with a contractor, you agree to the terms of work. Perhaps it will allow you to see the picture more clearly if viewed from the supervisor's point of view. Supervisors cannot keep track of people if they come in any time they please. It is not fair to others to ignore tardiness. Failure to be on time may hold up the work of other masons and craftworkers. Better planning of your morning routine will often keep you from being delayed and so prevent a breathless, late arrival. In fact, arriving a little early indicates your interest and enthusiasm for your work, which is appreciated by contractors. The habit of being late is another one of those things that stand in the way of promotion.

It is sometimes necessary to take time off from work. No one should be expected to work when sick or when there is a serious issue at home. However, it is possible to get into the habit of letting unimportant and unnecessary matters keep you from the job. This results in lost production and hardship on those who try to carry on the work with less help. The contractor that hires you has a right to expect you to be on the job unless there is some very good reason for staying away. Certainly, do not let some trivial reason keep you home. Do not stay up late at night and be too tired to go to work the next day. If you are ill, spend the time at home to recover quickly. This, after all, is no more than what you would expect of a person you hired, and on whom you depended to do a certain job.

If it is necessary to stay home, then at least notify your supervisor early in the morning so the supervisor can find another worker for the day, if needed. Some workers remain at home without contacting the contractor, which is the worst possible way to handle the matter. It leaves those at work uncertain about what to expect. They have no way of knowing whether you have merely been held up and will be in later, or whether immediate steps should be taken to assign your work to someone else. Courtesy alone demands that you let the supervisor know if you cannot come to work.

The most frequent causes of absenteeism are illness or death in the family, accidents, personal business, and dissatisfaction with the job. Some of the causes are legitimate and unavoidable, while others can be controlled. For most situations, you can carry on most personal business affairs after working hours. Frequent absences will reflect unfavorably on a worker when promotions are being considered.

Contractors sometimes resort to docking pay, demotion, and even dismissal in an effort to control tardiness and absenteeism. No contractor likes to impose restrictions of this kind. However, in fairness to those workers who do come on time and who do not stay away from the job, a contractor is sometimes forced to discipline those who will not follow the rules.

4.4.0 Exploring Career Ladders and Advancement Possibilities in Masonry

Masonry offers a rewarding career for people who want to work with their hands. As masons, they will be skilled workers who understand the principles and practices of masonry construction.

The Customer

When you are on a job site, consider yourself to be working for both your contractor and the customer. If you are honest and maintain a professional attitude when interacting with customers, everyone will benefit. Your contractor will be pleased with your performance, and the customer will be happy with the work that is being done. Try seeing things from a customer's point of view. A good, professional attitude goes a long way toward ensuring repeat business.

They will earn good pay and be rewarded for initiative. They will have opportunity for advancement.

Masons will continue to play an important part in building homes, schools, offices, and commercial structures. They can add artistic elements to their work and create beauty. They can be proud of their skills and the fact that they produce something people need.

Masons work on different projects, so each job is different and never boring. If they like to travel, masons can find good jobs all over the country. They can be independent and creative while working outdoors. Masons will be in demand as long as buildings are being constructed.

Masons can find work on large construction projects for commercial buildings, as well as projects for building homes, patios, sidewalks, or walls. They can also specialize in repair work, cleaning, and **tuckpointing** old buildings. They can specialize in restoring historic brick buildings, which is a recognized craft specialty in some parts of the country. Historically, they have been well paid.

Masonry is more than physical labor. It is a skilled occupation that calls for good hand-eye coordination, balance, and strength. It also requires good mental skills. This means ongoing study, concentration, and continued learning in an environment free from substance abuse.

Because masonry is a highly skilled craft, it takes time to learn. Your learning starts with this course, combined with, or followed by, an apprentice's job. Masons usually work as part of a team, so you will also learn to be a good team player. Masons work outdoors and do a lot of lifting and bending, so you will learn to keep yourself in good shape. Masons work on high scaffolds, so you will learn safety rules and practices. Masons bring their skills and tools wherever they go.

Late for Work

Showing up on time is a basic requirement for just about every job. Your contractor is counting on you to be there at a set time, ready to work. While legitimate emergencies may arise that can cause you to be late for or even miss work, starting a bad habit of consistent tardiness is not something you want to do. What are the possible consequences that you could face as a result of tardiness and absenteeism?

4.4.1 Career Stages

Masons were among the first workers to band together. During the Middle Ages, they formed influential groups that still shape trade practices. Today, as in the past, masons' organizations recognize several stages of skill:

- Tender
- Apprentice
- Journeyman
- Supervisor
- Superintendent
- Contractor

The tender is a laborer, not a mason. The tender carries masonry materials, tools, and mortar and gets things for the mason. The tender mixes mortar, cleans tools, and learns by watching the mason at work. Sometimes, tenders decide they want to become masons. If they do, they may enter an apprenticeship program. Apprentices are at the beginning level of the masonry career path. Their training will lead them to full participation in the mason's trade and the opportunity for higher job levels.

4.4.2 Apprentice

An apprentice is a person who has signed an apprenticeship agreement with a local joint apprenticeship committee. The committee works with local contractors who have agreed to take apprentices. The US Department of Labor regulates the apprenticeship process. In most states, the state department of labor is also involved, as state labor regulations provide guidelines on legal age requirements, pay, hours, and other aspects of apprenticeship.

The length of the apprenticeship will vary. The US Department of Labor program is three years and 4,500 hours with a minimum of 432 hours of classroom instruction. Programs such as the NCCER Standardized Craft Training program are used for classroom instruction or as part of apprenticeship training.

The apprentice is assigned to work with a contractor and to take classes. The apprentice must study and work under supervision. The apprentices agree to do the following:

- Perform the work assigned by the contractor.
- Abide by the rules and regulations of the contractor and the committee.
- Complete the hours of instruction.
- Keep records of work experience, training, and instruction.
- Learn and use safe working habits.

- Work with the assigned contractors for the entire apprenticeship period, unless reassigned by the committee.
- Conduct themselves in an ethical manner, realizing that time, money, and effort are being spent to afford them this opportunity to become a skilled worker.
- Remain free from drug and alcohol abuse.

A typical three-year apprenticeship is divided into six periods of six months each. The first six months is a trial period. The committee reviews the apprentice's performance and may end the agreement.

The apprentice attends classes and works under the supervision of a journeyman mason. As part of the supervised work, the apprentice learns to lay masonry units and perform other craftwork. The apprentice's pay increases for each six-month period as skill and performance increase. At the end of the period, the apprentice receives a certificate of completion from the craft-training program. A certificate from NCCER (*Figure 37*) is known and accepted everywhere in the United States. After completing three years of training, an apprentice can become a journeyman mason.

4.4.3 Journeyman

Unlike an apprentice, a journeyman is a free agent who can work for any contractor. A journeyman can work without close supervision and is skilled in most tasks. The successful journeyman knows that the end of the apprenticeship is not the end of learning. Masons' organizations recognize the journeyman to be the highest stage of skill for a mason.

Journeymen are people with an excellent trade. They earn good wages in a trade that is always in demand. They have the satisfaction of creating and the opportunity to grow as masonry artists. They also have the opportunity to grow as layout persons, trainers, and supervisors.

An experienced and skilled journeyman can work as a layout person. For a pay premium, the layout person lays out the work and lays the leads. Less experienced masons and apprentices work between the leads set by the layout person. Experienced and skilled journeymen also train apprentices and supervise their work. With further experience, journeymen can supervise crews.

Journeymen can continue to learn by studying and handling more complex tasks. They can continue to develop their skills as they work. Further education in masonry innovations and techniques is available, as is training in leadership and supervision.

4.4.4 Supervisors, Superintendents, and Contractors

Supervisors are responsible for managing and supervising a group of workers. This job requires a high degree of knowledge about masonry and leadership skills. Supervisors are typically responsible for training workers in safety measures and keeping work areas safe. They also train workers in new techniques and easier ways of working. They solve daily problems, keep on top of materials and supplies, and make sure workers meet job schedules. They check work to ensure it is done to standards. Supervisors may be called crew leaders or forepersons, depending on the company that hires them.

Superintendents have several supervisors reporting to them. Usually, the superintendent is the lead person on a large job. For a smaller company, the superintendent may be in charge of all the work in the field for the contractor. The superintendent oversees the work of the supervisors and makes major decisions about the job under construction. The superintendent must have strong masonry, leadership, and business skills.

A masonry contractor owns the company. The contractor bids on jobs, organizes the work and the workers, inspects the work, confers with the clients, and runs the business. The contractor needs to be able to plan ahead to keep up with change.

Contractors, along with journeymen, supervisors, and superintendents, need to keep up with the latest materials and methods. Like apprentices, they need to continue learning their trade.

4.4.5 The Role of NCCER

This course is part of a curriculum produced by NCCER. NCCER is an independent, private educational foundation founded and funded by the construction industry to provide quality instruction and instructional materials for a wide variety of crafts. The basic idea of the NCCER is to supplant governmental control and credentialing of the construction workforce with industry-driven training and education programs. NCCER has departed from traditional classroom learning and has adopted a pure competency-based training regimen. Competency-based training means that instead of requiring specific hours of classroom training and set hours of on-the-job training (OJT), you simply have to prove that you know what is required and can demonstrate that you can perform the specific skill. NCCER also uses the latest technology, such as interactive computer-based training, to deliver the classroom

28101-13_F37.EPS

Figure 37 Example of apprenticeship training recognition.

portions of the training. All completion information for every trainee is sent to NCCER and kept within the National Registry. The National Registry can then confirm training and skills for workers as they move from company to company, state to state, or even within their own company.

The dramatic shortage of skills within the construction workforce, combined with the shortage of new workers coming into the industry, is providing an opportunity for the construction industry to design and implement new training initiatives. When enrolling in an NCCER program, it is critical that you work for a contractor who supports a national, standardized training program that includes credentials to confirm your skill development.

The construction industry knows that the future construction workforce will largely be recruited and trained in the nation's secondary and postsecondary schools. Schools know that to prepare their students for a successful construction career they must use the curriculum that is developed and recognized by the industry. Nationwide, thousands of schools have adopted NCCER's standardized curricula.

The primary goal of NCCER is to standardize construction craft training throughout the country so that both you and your employer will benefit from the training, no matter where you and your job are located. As a trainee in a NCCER-accredited program, you will be listed in the National Registry. You will receive a certificate for each level of training you complete (*Figure 37*), which can then travel with you from job to job as you progress through your training. In addition, many technical schools and colleges use NCCER's programs.

Additional Resources

Hot & Cold Weather Masonry Construction Manual. 1999. Herndon, VA: National Concrete Masonry Association.

4.0.0 Section Review

1. Masons should update their skills _____.
   a. with the permission of their employer
   b. when classes are available
   c. all the time
   d. until they have finished their apprenticeship

2. Being a team player involves communicating clearly, keeping an eye out for potential problems, and _____.
   a. reading and interpreting drawings
   b. sharing information
   c. making decisions on your own
   d. seeking opportunities for advancement

3. A legitimate cause of absenteeism is _____.
   a. car problems
   b. traffic conditions on the way to work
   c. oversleeping
   d. illness

4. A mason who is a free agent who can work for any contractor is called a(n) _____.
   a. supervisor
   b. journeyman
   c. apprentice
   d. superintendent

Section Five

5.0.0 SkillsUSA

Objective

Summarize how to be connected to the industry through an organization like SkillsUSA.

a. Understand the program, curriculum, and SkillsUSA Championships.
b. Understand SkillsUSA membership.
c. Understand the National Program of Work Standards.

SkillsUSA is a partnership of students, teachers, and industry representatives working together to ensure America has a skilled workforce. SkillsUSA is a national organization serving teachers and high school and college students who are preparing for careers in technical, skilled, and service occupations, including masonry and other building trades occupations. More than 320,000 students and advisers, who are organized into more than 17,000 sections and 54 state and territorial associations, join SkillsUSA annually. Combining alumni and lifetime membership, the total number impacted is more than 320,000. SkillsUSA has served more than 10.5 million members in its history.

The mission of SkillsUSA is to assist its members in becoming world-class workers, leaders, and responsible citizens. SkillsUSA is an applied method of instruction for preparing America's high-performance workers in public career and technical programs. It provides quality education experiences for students in leadership, teamwork, citizenship, and character development. SkillsUSA builds and reinforces self-confidence, positive work attitudes, and communications skills. It emphasizes total quality at work: high ethical standards, superior work skills, lifelong education, and pride in the dignity of work. SkillsUSA also promotes understanding of the free-enterprise system and involvement in community service. SkillsUSA helps each student to excel.

5.1.0 Understanding the Program, Curriculum, and SkillsUSA Championships

SkillsUSA programs help to establish industry standards for job skill training in the lab and classroom, and promote community service. SkillsUSA is recognized by the US Department of Education and is cited as a "successful model of employer-driven youth development training program" by the US Department of Labor.

SkillsUSA Championships include local, state, and national competitions in which students demonstrate occupational and leadership skills. The SkillsUSA Championships is the showcase for the best career and technical students in the nation. This is a multimillion-dollar event that occupies a space equivalent to 16 football fields. In 2011, there were more than 5,700 contestants in 94 separate events. Nearly 1,500 judges and contest organizers from labor and management make the national event possible. The philosophy of the Championships is to reward students for excellence, to involve industry in directly evaluating student performance, and to keep training relevant to employers' needs. The national masonry competition at the SkillsUSA Championships is sponsored by NCCER.

Learn more about the SkillsUSA Championships: **http://www.skillsusa.org/compete/skills.shtml**

5.2.0 Understanding SkillsUSA Membership

In 2011, more than 16,600 teachers and school administrators served as professional SkillsUSA members and advisers. More than 1,100 business, industry, and labor sponsors actively support SkillsUSA at the national level through financial aid, in-kind contributions, and involvement of their people in SkillsUSA activities. Many more work directly with state associations and local chapters. NCCER and SkillsUSA have a long-standing partnership, as both organizations share the goal of a skilled workforce.

5.2.1 The Value for Students

For many students, SkillsUSA is the first professional organization they will join. The experiences and knowledge gained provide an excellent platform for career development and success. SkillsUSA also sets the stage for involvement in other professional and service organizations. Advantages include:

- Teamwork and leadership development
- Reinforcement of employability skills
- Competition in a nationally recognized contest program
- Community service opportunities

- Access to scholarships
- Networking with potential employers

5.2.2 The Value for the Classroom and School

Great instructors are always looking for ways to engage students and build relationships. SkillsUSA provides the tools to do both. As a student-run organization, members feel a sense of empowerment and belonging. SkillsUSA is a motivator for students to put forth their best effort in the classroom, making daily lessons even more relevant to career success. As a SkillsUSA adviser, the activities, projects, and contests provide opportunities for instructors to build stronger relationships with students. Chapter activities and accomplishments can build a positive image for participating schools and their programs. Benefits include:

- Recognition for the school within the community
- Opportunities to meet educational standards
- Development of career technical education (CTE) pathways
- Improved recruitment and enrollment
- More graduates equipped with essential skills

5.3.0 Understanding the National Program of Work Standards

The heart of SkillsUSA is the Program of Work (POW), or what each chapter is going to do during the school year. It is the activities and projects—the plan of action—that a chapter will carry out.

The National Program of Work sets the pace for SkillsUSA nationwide. The expectation is that each chapter will carry out this Program of Work. All of the SkillsUSA programs are in some way related to the following seven major goals: professional development, community service, employment, ways and means, SkillsUSA Championships, public relations, and social activities.

Professional development – The goal of professional development is to prepare each SkillsUSA member for entry into the workforce and provide a foundation for success in a career. Becoming a professional does not stop with acquiring a skill, but involves an increased awareness of the meaning of good citizenship and the importance of labor and management in the world of work.

Community service – The goal of the community service standard is to promote and improve goodwill and understanding among all segments of the community through services donated by SkillsUSA chapters. In addition, SkillsUSA hopes to instill in its members a lifetime commitment to community service.

Employment – The goal of this standard is to increase student awareness of quality job practices and attitudes, and to increase the opportunities for employer contact and eventual employment.

Ways and means – The ways and means goal is to plan and participate in fundraising activities to allow all members to carry out the chapter's projects.

SkillsUSA Championships – The goal of the SkillsUSA Championships is to offer students the opportunity to demonstrate their skills and be recognized for them through competitive activities in occupational areas and leadership.

Public relations – The goal of the public relations standard is to make the general public aware of the good work that students in career and technical education are doing to better themselves and their community, state, nation, and world.

Social activities – The goal of this standard is to increase cooperation in the school and community through activities that allow SkillsUSA members to get to know each other in something other than a business or classroom setting.

Learn more about the Program of Work standards: **http://www.skillsusa.org/educators/chapmanage5.shtml**
http://skillsusa.org/courses/07_Program/player.html

5.3.1 Chapter Activity Planner

Chapter members should discuss and develop their own program of work. Instructors will assist in selecting activities that relate to students' vocational training and will guide them in developing their personal skills in communications, organization, planning, and follow-through.

Chapter activities provide some of the best opportunities for students to learn by doing. A successful program of work creates a positive learning atmosphere in the classroom, and allows students to learn how to accept responsibility, work as a team, manage a budget, and handle success and failure.

5.3.2 Chapter Elections and Training

Effective chapter officers ensure the chapter functions effectively and efficiently. Officers frequently are responsible for routine management tasks, such as organizing meetings, conducting

meetings, scheduling work, and leading chapter activities. This helps students learn simple supervisory skills and creates responsible team spirit.

The election of chapter SkillsUSA officers is often one of the highlights of the SkillsUSA year. The outcome of the election affects the entire group's chances for having a successful program. Officers not only spark enthusiasm in the organization, but also carry on the routine business affairs that keep the program moving.

Being elected as a SkillsUSA officer provides an opportunity to hone leadership abilities. The officer selection process is an excellent way to learn valuable, practical lessons in leadership and teamwork.

5.3.3 Chapter Meetings

Valuable skills are learned and practiced through organized activities. Well-run meetings are a good example. Learning how to plan and work cooperatively with others is an important skill set. As individuals, everyone has good ideas, but when people combine their ideas and efforts, great things can occur.

Additional Resources

SkillsUSA Professional Development Resources.
http://www.skillsusa.org/store/curricula.html

5.0.0 Section Review

1. The national masonry competition at the SkillsUSA Championships is sponsored by _____.
   a. the Mason Contractors Association of America
   b. local contractors
   c. NCCER
   d. chapter officers
2. The number of business, industry, and labor sponsors that actively support SkillsUSA at the national level is more than _____.
   a. 60
   b. 600
   c. 900
   d. 1,100
3. Which of the following is *not* a goal of the SkillsUSA Program of Work?
   a. Community service
   b. Professional development
   c. Social activities
   d. Improved recruitment and enrollment

SUMMARY

Masonry is a craft that has existed for thousands of years. Science and engineering have brought masonry into the modern age. With modern construction techniques, masonry is now used in high-rise buildings as well as residential and commercial projects. This allows for widespread use of masonry construction throughout North America.

Modern clay products are categorized as solid and hollow brick, structural and nonstructural tile, and made-to-order architectural terra-cotta. Clay has been joined by concrete as a modern masonry material. Stone, the oldest recovered building material, is still laid by masons. Mortars and grouts have evolved from mud to special-purpose, high-strength cements.

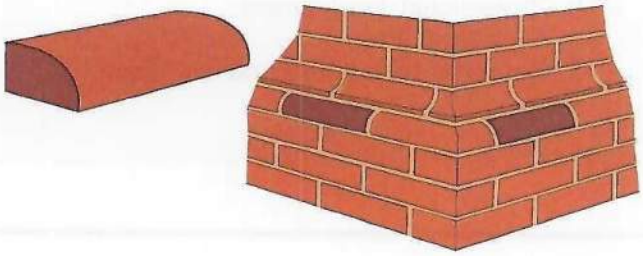
Masonry offers advancement through the recognized career steps of apprentice, journeyman, layout person, supervisor, superintendent, and masonry contractor. Your success as a mason requires the willingness to keep on learning.

Review Questions

1. Concrete masonry units are usually cured by using _____.
   a. hot air
   b. live steam
   c. sunlight
   d. infrared heaters

2. Drainage openings in masonry walls are called _____.
   a. scuppers
   b. drip vents
   c. cores
   d. weepholes

3. The custom brick shape shown in *Review Question Figure 1* is a(n)_____.
   a. water table rowlock
   b. ogee step tread header
   c. single bullnose stretcher
   d. internal radial



28101-13_RQ01.EPS

Figure 1

4. For ease of cleaning, the type of brick often used in dairies and laboratories is _____.
   a. glazed
   b. faced
   c. fired
   d. pressed

5. A brick positioned to bond two wythes of masonry is a _____.
   a. rowlock
   b. header
   c. soldier
   d. stretcher

6. Stone is often laid over brick or block to form a _____.
   a. screen
   b. face course
   c. moisture barrier
   d. veneer

7. Ashlar stone _____.
   a. is irregular in size and shape
   b. has smooth bedding surfaces
   c. has poor weather resistance
   d. is 2 inches thick or less

8. Cement-lime mortar is a type of mortar in which _____.
   a. all the ingredients (cement, sand, lime, and water) are often mixed on the job site
   b. cement, water, and fine aggregates form a mixture wet enough to be pumped
   c. the mason only adds sand and water to a premixture of cement, lime, and additives
   d. only water must be added to preblended dry ingredients

9. The number of wythes in a cavity wall is _____.
   a. four
   b. three
   c. two
   d. one

10. Loadbearing walls with different materials in the facing and backing wythes are called _____.
    a. veneer walls
    b. composite walls
    c. cavity walls
    d. reinforced walls

11. OSHA's regulation *CFR 1926.32* defines the duties and responsibilities of a(n) _____.
    a. legally liable person
    b. competent person
    c. enforcement person
    d. responsible person

12. To allow masons to keep their sense of touch while still being able to grip effectively and protect their hands, many gloves used in masonry work have palms and fingertips made from _____.
    a. canvas or nylon
    b. felt
    c. latex or synthetic rubber
    d. cotton

13. For safety on the job, a mason should wear appropriate clothing that is _____.
    a. loose fitting
    b. polyester
    c. disposable
    d. close fitting

14. The straightness and levelness of each masonry unit in a structure depends upon the _____.
    a. quality of the supplied materials
    b. hands and eyes of the mason
    c. time available to complete the job
    d. skill and experience of the architect

15. Before using a wheelbarrow to transport mortar to the work site, you should _____.
    a. check whether the wheelbarrow is right handed or left handed
    b. oil the inside surface of the wheelbarrow
    c. wet the inside surface of the wheelbarrow
    d. grease the wheelbarrow's axle

16. In *Review Question Figure 2*, mortar has been placed on the header end of the brick in a process known as _____.
    a. buttering
    b. spreading
    c. smoothing
    d. bedding

28101-13_RQ02.EPS

Figure 2

17. To be sure of a good bond, excess mortar should be thrown away after _____.
    a. 1½ hours
    b. 2 hours
    c. 3 to 4 hours
    d. 8 hours

18. In the following list, the highest stage of skill recognized by masons' organizations is _____.
    a. journeyman
    b. tender
    c. sawman
    d. apprentice

19. Apprentices are trained and supervised by _____.
    a. OSHA
    b. journeyman masons
    c. the US Department of Labor
    d. foremen

20. The activities and projects a SkillsUSA chapter will carry out during a school year are outlined in the _____.
    a. Master Schedule of Events
    b. Activities Planner and Guide
    c. National Program of Work
    d. National Action Plan

Trade Terms Quiz

Fill in the blank with the correct term that you learned from your study of this module.

1. The division of the US Department of Labor mandated to ensure a safe and healthy environment in the workplace is called the _____.
2. _____ is materials such as crushed stone or gravel used as a filler in concrete and concrete block.
3. A square or rectangular pillar projecting from a wall is called a(n) _____.
4. A(n) _____ is any building block made of brick, cement, ashlar, clay, adobe, rubble, glass, tile, or any other material that can be assembled into a structural unit.
5. To apply mortar to the end of a masonry unit prior to laying it is to _____ it.
6. A continuous section of masonry wall, one masonry unit in thickness, or that part of a wall that is one masonry unit in thickness, is called a(n) _____.
7. _____ is spreading mortar with a trowel on a wall or footing for a bed joint.
8. An individual who is capable of identifying existing and predictable hazards or working conditions that are hazardous, unsanitary, or dangerous to employees, and who has authorization to take prompt, corrective measures to eliminate or control these hazards and conditions, is called a _____.
9. A (n) _____ is a chemical or mineral other than water, cement, or aggregate added to mortar immediately before or during mixing to change its setting time or curing time; to reduce water; or to change the overall properties of the mortar.
10. The horizontal projection crowning the wall of a building is called a(n) _____.
11. The _____ is that part of a masonry unit or wall that shows after construction.
12. Pre-made veneer consisting of cast cementitious material with pigments and other added materials to give the appearance of natural stone is called _____.
13. _____ is the publisher of masonry standards.
14. A mixture of portland cement, lime, and water, with or without fine aggregate, with a high-enough water content that it can be poured into spaces between masonry units and voids in a wall, is called _____.
15. The _____ is the top part of an architectural column.
16. A vertical joint between two masonry units is called a(n) _____.
17. _____ are the area between each brick or block that is filled with mortar.
18. A person who assembles masonry units by hand, using mortar, dry stacking, or mechanical connectors is called a(n) _____.
19. _____ brick has holes extending through it to reduce weight.
20. A wall that does not bear weight other than its own is _____.
21. _____ is sun-dried, molded clay brick.
22. Brick that has no holes extending through it is called _____.
23. A(n) _____ is a strapped bundle of approximately 500 standard brick.
24. Equipment or clothing designed to prevent or reduce injuries is called _____.
25. A(n) _____ is a hollow or solid block made from portland cement and aggregates.

26. The base for a masonry unit wall, or concrete foundation, that distributes the weight of the structural member resting on it is called a(n) _____.

27. A(n) _____ is a row or horizontal layer of masonry units.

28. A row of mortar placed into a bed joint is called a(n) _____.

29. A(n) _____ is a small opening in mortar joints or faces to allow the escape of moisture.

30. A wall that bears weight in addition to its own is called _____.

31. _____ is filling fresh mortar into cutout or defective joints in masonry.

32. A mixture of portland cement, lime, fine aggregate, and water, plastic or stiff enough to hold its shape between masonry units is called _____.

33. A(n) _____ is a low wall or railing.

34. A squared or rectangular cut stone masonry unit; or, a flat-faced surface having sawed or dressed bed and joint surfaces is called _____.

35. A(n) _____ is the horizontal joint between two masonry units in separate courses.

Trade Terms

Admixture
Adobe
Aggregate
American Society for Testing and Materials (ASTM) International
Ashlar
Bed joint
Butter
Capital
Competent person
Concrete masonry unit (CMU)
Cored
Cornice
Course
Cube
Facing
Footing
Grout
Head joint
Joints
Manufactured stone veneer
Mason
Masonry unit
Mortar
Nonstructural
Occupational Safety and Health Administration (OSHA)
Parapet
Personal protective equipment (PPE)
Pilaster
Spread
Stringing
Structural
Tuckpointing
Uncored
Weephole
Wythe

Cornerstone of Craftsmanship

Moroni Mejia

Workforce Development Committee Chairman
Mason Contractors Association of America

Ancient architecture inspired Moroni Mejia to pursue a career in construction from the ground up. Today, Moroni inspires young craft professionals to seek the same sense of challenge and opportunity that had also inspired him.

How did you get started in the construction industry?
My first day on a real job came in 1997. I can still remember how amazed I was at the huge machinery and powerful tools that were used. I can also remember how invincible I felt back then and how humbling it was to work through the fear I felt as I tended to a team of bricklayers on a temporary work platform several stories above the ground.

Who or what inspired you to enter the industry? Why?
I'd always admired the magnificence of the stone structures built by our ancestors all around the world. After visiting the Aztec and Mayan ruins in southern Mexico in my teenage years, I knew I wanted to be a part of creating buildings. My original goal was to become an architect, and I felt that by serving an apprenticeship in masonry I would learn about buildings from the ground up. The apprenticeship also allowed me to earn money so I could support myself and pay for college. Not long after enrolling, I fell in love with the trade, realized the tremendous earning potential associated with it, and ran with it.

What do you enjoy most about your career?
I feel a deep sense of satisfaction when I drive around the state and see the projects I've been involved in being enjoyed or put to use. When I do, I remember all the different challenges that had to be overcome to build the projects successfully. Properly designed and built masonry work gives a building character, identity, and leaves a lasting impression on our communities.

Why do you think training and education are important in construction?
First and foremost, finish high school. Enroll in any construction technology courses your school offers, or seek out other places near you that offer them. Once you decide on a trade, complete an accredited, certified apprenticeship program.

Continuing education is critical if you want to keep up with the constantly evolving construction industry and advance your career.

Would you recommend construction as a career to others?
The career opportunities offered by the masonry industry are extremely diverse and rewarding. Whatever type of work you enjoy and challenges you seek, there is a career in the masonry industry that will help you achieve your goals. I absolutely recommend exploring a career in masonry to anyone who is interested. My masonry career has had an unbelievably positive impact on my life.

What does craftsmanship mean to you?
There are quite a few things that contribute to craftsmanship: quality, professionalism, efficiency, and reliability. When you boil it all down, though, it's about respecting yourself and your craft enough to do your very best work on every unit, every time, no matter who is watching.

Trade Terms Introduced in This Module

Admixture: A chemical or mineral other than water, cement, or aggregate added to mortar immediately before or during mixing to change its setting time or curing time; to reduce water; or to change the overall properties of the mortar.

Adobe: Sun-dried, molded clay brick.

Aggregate: Materials such as crushed stone or gravel used as a filler in concrete and concrete block.

American Society for Testing and Materials (ASTM) International: The publisher of masonry standards.

Ashlar: A squared or rectangular cut stone masonry unit; or, a flat-faced surface having sawed or dressed bed and joint surfaces.

Bed joint: The horizontal joint between two masonry units in separate courses.

Butter: To apply mortar to a masonry unit prior to laying it.

Capital: The top part of an architectural column.

Competent person: An individual who is capable of identifying existing and predictable hazards or working conditions that are hazardous, unsanitary, or dangerous to employees, and who has authorization to take prompt, corrective measures to eliminate or control these hazards and conditions.

Concrete masonry unit (CMU): A hollow or solid block made from portland cement and aggregates.

Cored: Brick that has holes extending through it to reduce weight.

Cornice: The horizontal projection crowning the wall of a building.

Course: A row or horizontal layer of masonry units.

Cube: A strapped bundle of approximately 500 standard brick, or 90 standard block. The number of units in a cube will vary according to the manufacturer.

Facing: That part of a masonry unit or wall that shows after construction; the finished side of a masonry unit.

Footing: The base for a masonry unit wall, or concrete foundation, that distributes the weight of the structural member resting on it.

Grout: A mixture of portland cement, lime, and water, with or without fine aggregate, with a high-enough water content that it can be poured into spaces between masonry units and voids in a wall.

Head joint: The vertical joint between two masonry units.

Joints: The area between each brick or block that is filled with mortar.

Manufactured stone veneer: A premade veneer consisting of cast cementitious material with pigments and other added materials to give the appearance of natural stone. Also called adhered concrete masonry veneer (ACMV).

Mason: A person who assembles masonry units by hand, using mortar, dry stacking, or mechanical connectors.

Masonry unit: Any building block made of brick, cement, ashlar, clay, adobe, rubble, glass, tile, or any other material that can be assembled into a structural unit.

Mortar: A mixture of portland cement, lime, fine aggregate, and water, plastic or stiff enough to hold its shape between masonry units.

Nonstructural: Not bearing weight other than its own.

Occupational Safety and Health Administration (OSHA): The division of the US Department of Labor mandated to ensure a safe and healthy environment in the workplace.

Parapet: A low wall or railing.

Personal protective equipment (PPE): Equipment or clothing designed to prevent or reduce injuries.

Pilaster: A square or rectangular pillar projecting from a wall.

Spread: A row of mortar placed into a bed joint.

Stringing: Spreading mortar with a trowel on a wall or footing for a bed joint.

Structural: Bearing weight in addition to its own.

Tuckpointing: Filling fresh mortar into cutout or defective joints in masonry.

Uncored: Brick that has no holes extending through it.

Weephole: A small opening in mortar joints or faces to allow the escape of moisture.

Wythe: A continuous section of masonry wall, one masonry unit in thickness, or that part of a wall that is one masonry unit in thickness.

Additional Resources

This module presents thorough resources for task training. The following reference material suggested for further study.

ASTM C270, *Standard Specification for Mortar for Unit Masonry*. 2012. West Consohocken, PA: ASTM International.

Bricklaying: Brick and Block Masonry. Reston, VA: Brick Industry Association.

Building Block Walls: A Basic Guide for Students in Masonry Vocational Training. 1988. Herndon, VA: National Concrete Masonry Association.

Concrete Masonry Handbook. Skokie, IL: Portland Cement Association.

Concrete Masonry Shapes and Sizes Manual CD-ROM. Herndon, VA: National Concrete Masonry Association.

Hot & Cold Weather Masonry Construction Manual. 1999. Herndon, VA: National Concrete Masonry Association.

Installation Guide for Adhered Concrete Masonry Veneer, Third Edition. 2012. Washington, DC: Masonry Veneer Manufacturers Association.

SkillsUSA Professional Development Resources. **http://www.skillsusa.org/store/curricula.html**

Figure Credits

Courtesy of National Concrete Masonry Association, Figure 1, Figure 2, Figure 4, Figure 7

Provided by Haskell, SA03

Courtesy of Portland Cement Association, Figure 3, Figure 5

Courtesy of NRG Insulated Block, Figure 6 (top)

COURTESY OF RAE PARAVIA, LV, NV, Figure 6 (bottom)

Courtesy of the Brick Industry Association, Figure 8, Figure 9, Figure 11, E01

Hanson Brick, Figure 10, SA05, SA06, RQ01

Courtesy of Cultured Stone® by Boral®, Figure 14

Adapted, with permission, from C270-12a Standard Specification for Mortar for Unit Masonry, copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, **www.astm.org**., T01

West Chester Holdings, Inc., Figure 17

Courtesy of Honeywell Safety Products, Figure 18 (top right, bottom left)

Courtesy of MSA, Figure 19 (top, middle), E02

Anna Mead, Figure 21

Bon Tool Co., Figure 22, E03

The QUIKRETE Companies, Figure 23

Courtesy of Calculated Industries, SA07

Section Review Answer Key

Answer	Section Reference	Objective
Section One		
1. b	1.1.0	1a
2. c	1.2.0	1b
3. d	1.3.0	1c
4. c	1.4.0	1d
5. a	1.5.0	1e
Section Two		
1. b	2.1.0	2a
2. d	2.2.0	2b
Section Three		
1. c	3.1.0	3a
2. a	3.2.3	3b
Section Four		
1. c	4.1.2	4a
2. b	4.2.3	4b
3. d	4.3.3	4c
4. b	4.4.3	4d
Section Five		
1. c	5.1.0	5a
2. d	5.2.0	5b
3. d	5.3.0	5c

NCCER CURRICULA — USER UPDATE

NCCER makes every effort to keep its textbooks up-to-date and free of technical errors. We appreciate your help in this process. If you find an error, a typographical mistake, or an inaccuracy in NCCER's curricula, please fill out this form (or a photocopy), or complete the online form at **www.nccer.org/olf**. Be sure to include the exact module ID number, page number, a detailed description, and your recommended correction. Your input will be brought to the attention of the Authoring Team. Thank you for your assistance.

Instructors – If you have an idea for improving this textbook, or have found that additional materials were necessary to teach this module effectively, please let us know so that we may present your suggestions to the Authoring Team.

NCCER Product Development and Revision
13614 Progress Blvd., Alachua, FL 32615
Email: curriculum@nccer.org
Online: www.nccer.org/olf

❑ Trainee Guide ❑ Lesson Plans ❑ Exam ❑ PowerPoints Other _____

Craft / Level: Copyright Date:

Module ID Number / Title:

Section Number(s):

Description:

Recommended Correction:

Your Name:

Address:

Email: Phone: