Concrete-Masonry – Stats and Facts

DID YOU KNOW?

One of the largest masonry contractors in the United States was the Western Construction Group in 2018. The company generated a revenue of 88.4 million U.S. dollars in that year. Those who work in the masonry industry are known as masons. There are several types of construction masons including brick masons (often called brick layers), cement masons, stone masons, and terrazzo masons, each working with different types of materials.

Masonry involves the building of structures from units that are usually bound together with mortar. Materials such as brick, marble, granite, limestone, and concrete block are often used in masonry construction. These common and durable materials are used to build walls, walkways, fences, and other structures. Masonry can protect buildings from fires as it is non-combustible and can be more resistant to projectiles like debris from storms. On the other hand, degradation can occur through expansion and contraction associated with freeze-thaw cycles; masonry is also heavy and must have a strong foundation; additionally, it is more susceptible to oscillation from events like earthquakes. Masonry construction requires more skilled labor than some other types of basic construction. The overall durability of the masonry construction can vary depending on the quality of materials used, the quality of the workmanship, and the pattern in which the units are assembled.

Biggest companies in the Masonry industry in the US

The Masonry industry exhibits an extremely low level of market share concentration, similar to other specialty contractor trade industries. In 2019, the top three largest operators are anticipated to collectively generate under 1.0% of annual industry revenue. Though there are no major players, Western Specialty Contractors, Northland Concrete and Masonry Co. LLC and McGee Brothers Inc. are notable names in the industry.

Minimal consolidation efforts keep market concentration low

Over the five years to 2019, the industry has continued to be defined by minimal merger and acquisition activity among key operators. The Masonry industry is characterized by low barriers to entry and a high number of participants, many of which operate on a nonemployer basis. These industry characteristics enable many industry participants to compete locally on the basis of price and quality of service.

Price points and quality drive internal competition

Masonry contractors largely compete on the bases of price and quality of service. Consequently, most operators rely on a good reputation for garnering new contracts, with many smaller contracts awarded based on a positive word-of-mouth recommendation. Furthermore, operators may promote their business through marketing efforts such as classified advertisements in local telephone directories and newspapers.

Each day, on average, two construction workers die of work-related injuries in the United States. In fact, one in five workplace fatalities are construction-related.

The top causes of construction-related fatalities are falls, struck-by an object, electrocution and caught between objects.

Generally, an employee cannot sue his or her employer for on-the-job injuries other than using the workers' compensation system. However, at times the owner of the premises, the general contractor or other contractors could be liable in cases where employees have been injured.

In 2016, 10.3 million U.S. workers were employed in construction, a 16% increase after construction employment bottomed out in 2012. The Bureau of Labor Statistics (BLS) expects construction employment to increase over the next eight years. Small businesses with fewer than 20 employees account for 92.5% of all construction establishments, and 41.4% of all construction employees work in small businesses. Construction workers are more likely to be male (90.0% versus 53.0%), Hispanic (29.9% versus 16.3%), and foreign-born (26.9% versus 18.1%) than the general U.S. workforce. Falls remain the leading cause of work-related deaths in construction, accounting for about one-third of the total number of fatalities in this industry (370 of the 991 construction fatalities recorded in 2016). Although fatal falls followed the overall injury trends, fall deaths rose faster than overall deaths in construction during the economic recovery that started in 2013. Nearly half of all deaths on construction sites occur in companies with ten or fewer employees or among those who are self-employed.

There were over **10 million** workers in the U.S. construction industry as of 2016.

The **Engineering & Construction** (E&C) industry is one of the world's largest sectors of the economy with **$10 trillion** spent on construction-related goods and services each year.

Construction Supervisors: #9 most dangerous job of 2018.

- 18 fatal injuries per 100,000 workers
- 134 fatalities

According to fatal work injury rates reported by the Bureau of Labors Statistics.

43% of construction workers plan to work past age 65, according to a health and retirement study by the Center for Construction Research & Training.

60% of OSHA inspections were in the construction industry as of 2016.

Projected **growth of the industry** and the number of **construction**

worker deaths are on the rise.

991 deaths out of 4,693 (21%) were in construction.

An estimated 2.3 million construction workers, or 65 percent of the construction industry, work on scaffolds. Protecting these workers from scaffold-related accidents may prevent some of the 4,500 injuries and over 60 deaths every year (Bureau of Labor Statistics (BLS), 2003 and 2004 data for the private sector), at a savings for American employers of $90 million in workdays not lost. In a recent BLS study, 72 percent of workers injured in scaffold accidents attributed the accident either to the planking or support giving way, or to the employee slipping or being struck by a falling object. All of these accidents can be controlled by compliance with OSHA standards.

The most frequently used products, are clay brick and concrete block by masons. Brick is man’s oldest manufactured product. Sun-baked clay bricks were used in the construction of buildings more than 6,000 years ago. In order to prevent distortion and cracking of the clay shapes, chopped straw and grass were added to the clay mixture. The next big step in enhancing brick production occurred about 4,000 B.C. At that time manufactures began producing brick in uniform shapes. Along with the shaping of brick, the move from sunbaking to firing was another important change. This improved the durability of the brick.

Through the centuries the methods for producing brick have continued to evolve. Today, the United States standard brick size is 2 1/2 x 3 3/4 x 8 inches. Brick is composed of shale and clay and is fired in kilns of approximately 2,000 degrees Fahrenheit. The firing process causes the clay particles to bond chemically.

As brick construction became more elaborate, the use of brick became more sophisticated. The evolution of brick construction design led, in part, to the development of concrete block.

The manufacturing and uses of concrete block evolved over a long period of time. This evolution was prompted by the development of cavity walls. When originally developed, cavity walls consisted of two separate brick or stone walls with about a 2-inch air space between them.

Cavity walls were developed to reduce the problems associated with water penetration. Water that would seep inside the outer wall would then run down that wall, while the inside wall would remain dry. Cavity walls soon became recognized as the best way to build, not only because they helped reduce problems with water penetration, but because they could support a heavy load such as a roof or floor. In 1850 a special block with air cells was developed. Over the years modifications to this product were introduced until the industry arrived at the standardized product we see today.

Concrete blocks are produced with a mixture of cement, sand, and crushed stone, or lightweight aggregate. Today's concrete block plants are totally automated. The raw materials are loaded from trucks or railroad cars into bins. From there the mix is weighed, transported to a mixer, and fed into the block machine. If necessary, color is added. It takes the machine about six seconds to mold a block. The freshly molded blocks are put into pallets and placed in steam-curing rooms. After the curing process, they are stacked and taken to a storage yard for delivery.

After more than 6,000 years, masonry is still used today. As you look around at office buildings, schools, houses, patios, and fireplaces, you will notice that there are many aspects of society where you will see some form of masonry.

KEEP IN MIND

Concrete masonry is a popular building material because of its strength, durability, economy, and its resistance to fire, noise, and insects. To function as designed however, concrete masonry buildings must be constructed properly.

This TEK provides a brief overview of the variety of materials and construction methods currently applicable to concrete masonry. In addition, a typical construction sequence is described in detail.

MATERIALS

The constituent masonry materials: concrete block, mortar, grout, and steel, each contribute to the performance of a masonry structure. Concrete masonry units provide strength, durability, fire resistance, energy efficiency, and sound attenuation to a wall system. In addition, concrete masonry units are manufactured in a wide variety of sizes, shapes, colors, and architectural finishes achieve any number of appearances and functions. The Concrete Masonry Shapes and Sizes Manual (ref. 4) illustrates a broad sampling of available units.

While mortar constitutes approximately 7% of a typical masonry wall area, its influence on the performance of a wall is significant. Mortar bonds the individual masonry units together, allowing them to act as a composite structural assembly. In addition, mortar seals joints against moisture and air leakage and bonds to joint reinforcement, anchors, and ties to help ensure all elements perform as a unit.

Grout is used to fill masonry cores or wall cavities to improve the structural performance and/or fire resistance of masonry. Grout is most commonly used in reinforced construction, to structurally bond the steel reinforcing bars to the masonry, allowing the two elements to act as one unit in resisting loads.

Reinforcement incorporated into concrete masonry structures increases strength and ductility, providing increased resistance to applied loads and, in the case of horizontal reinforcement, to shrinkage cracking.

CONSTRUCTION METHODS

Mortared Construction

Most concrete masonry construction is mortared construction, i.e., units are bonded together with mortar. Varying the bond or joint pattern of a concrete masonry wall can create a wide variety of interesting and attractive appearances. In addition, the strength of the masonry can be influenced by the bond pattern. The most traditional bond pattern for concrete masonry is running bond, where vertical head joints are offset by half the unit length.

Excluding running bond construction, the most popular bond pattern with concrete masonry units is stack bond. Although stack bond typically refers to masonry constructed so that the head joints are vertically aligned, it is defined as masonry laid such that the head joints in successive courses are horizontally offset less than one quarter the unit length (ref. 2). **TEK 14-6**, Concrete Masonry Bond Patterns (ref. 3), shows a variety of bond patterns and describes their characteristics.

Dry-Stacked Construction

The alternative to mortared construction is dry-stacked (also called surface bonded) construction, where units are placed without any mortar, then both surfaces of the wall are coated with surface bonding material. Shims or ground units are used to maintain elevations. This construction method results in faster construction, and is less dependent on the skill of the laborer than mortared construction. In addition, the surface bonding coating provides excellent rain penetration resistance. **TEK 3-5A**, Surface Bonded Concrete Masonry Construction (ref. 9), contains further information on this method of construction.

CONSTRUCTION SEQUENCE

Mixing Mortar

To achieve consistent mortar from batch to batch, the same quantities of materials should be added to the mixer, and they should be added in the same order. Mortar mixing times, placement methods, and tooling must also be consistent to achieve uniform mortar for the entire job.

In concrete masonry construction, site-mixing of mortar should ideally be performed in a mechanical mixer to ensure proper uniformity throughout the batch. Mortar materials should be placed in the mixer in a similar manner from batch to batch to maintain consistent mortar properties. Typically, about half the mixing water is added first into a mixer. Approximately half the sand is then added, followed by any lime. The cement and the remainder of the sand are then added. As the mortar is mixed and begins to stiffen, the rest of the water is added. Specification for Masonry Structures (ref. 7) requires that these materials be mixed for 3 to 5 minutes. If the mortar is not mixed long enough, the mortar mixture may not attain the uniformity necessary for the desired performance. A longer mixing time can increase workability, water retention, and board life.

The mortar should stick to the trowel when it is picked up, and slide off the trowel easily as it is spread. Mortar should also hold enough water so that the mortar on the board will not lose workability too quickly, and to allow the mason to spread mortar bed joints ahead of the masonry construction. The mortar must also be stiff enough to initially support the weight of the concrete masonry units.

To help keep mortar moist, the mortarboard should be moistened when a fresh batch is loaded. When mortar on the board does start to dry out due to evaporation, it should be retempered. To retemper, the mortar is mixed with a small amount of additional water to improve the workability. After a significant amount of the cement has hydrated, retempering will no longer be effective. For this reason, mortar can be retempered for only 1 ½ to 2 ½ hours after initial mixing, depending on the site conditions. For example, dry, hot, and windy conditions will shorten the board life, and damp, cool, calm conditions will increase the board life of the mortar. Mortar should be discarded if it shows signs of hardening or if 2 ½ hours have passed since the original mixing.

Placing Mortar

Head and bed joints are typically ⅜ in. (10 mm) thick, except at foundations. Mortar should extend fully across bedding surfaces of hollow units for the thickness of the face shell, so that joints will be completely filled. Solid units are required to be fully bedded in mortar.

Although it is important to provide sufficient mortar to properly bed concrete masonry units, excessive mortar should not extend into drainage cavities or into cores to be grouted. For grouted masonry, mortar protrusions extending more than ½ in. (13 mm) into cells or cavities to be grouted should be removed (ref. 7).

The Importance of Laying to the Line

Experienced masons state that they can lay about five times as many masonry units when working to a mason line than when using just their straightedge. The mason line gives the mason a guide to lay the block straight, plumb, at the right height, and level. The line is attached so that it gives a guide in aligning the top of the course.

If a long course is to be laid, a trig may be placed at one or more points along the line to keep the line from sagging. Before work begins, the mason should check to see that the line is level, tight, and will not pull out.

Each mason working to the same line needs to be careful not to lay a unit so it touches the line. This will throw the line off slightly and cause the rest of the course to be laid out of alignment. The line should be checked from time to time to be certain it has remained in position.

Operators in the Masonry industry provide services such as stone setting, bricklaying, brick-to-glass block laying and exterior marble, granite and slate work. Industry activities also include additions, alterations, maintenance, repairs and new construction.

Masonry workers, also known as *masons,* use bricks, concrete and concrete blocks, and natural and manmade stones to build walkways, walls, and other structures.

Duties

Masons typically do the following:

- Read blueprints or drawings to calculate materials needed
- Lay out patterns, forms, or foundations according to plans
- Break or cut materials to required size
- Mix mortar or grout and spread it onto a slab or foundation
- Clean excess mortar with trowels and other handtools
- Construct masonry walls
- Align structures, using levels and plumbs
- Clean and polish surfaces with handtools or power tools
- Fill expansion joints with caulking materials
- Lay out and install rainscreen water systems

Masons build structures with brick, block, and stone, some of the most common and durable materials used in construction. They also use concrete—a mixture of cement, sand, gravel, and water—as the foundation for everything from patios and floors to dams and roads.

The following are examples of types of masons:

Brickmasons and ***blockmasons***—often called *bricklayers*—build and repair walls, fireplaces, and other structures with brick, terra cotta, precast masonry panels, concrete block, and other masonry materials. *Pointing, cleaning, and caulking workers* are brickmasons who repair brickwork, particularly on older structures. *Refractory masons* are brickmasons who specialize in installing heat- and fire-resistant masonry materials in high-temperature areas such as boilers, furnaces, and soaking pits in industrial buildings.

Cement masonsandconcrete finishers place and finish concrete. They may color concrete surfaces, expose small stones in walls and sidewalks, or make concrete beams, columns, and panels. Throughout the process of pouring, leveling, and finishing concrete, cement masons use their knowledge of how conditions may affect concrete and take steps to prevent defects. On small jobs, such as constructing sidewalks, cement masons may use a supportive wire mesh called a lath. On large jobs, such as constructing building foundations, reinforcing iron and rebar workers install the reinforcing mesh.

Stonemasons build stone walls and set stone exteriors and floors. They work with two types of stone: natural-cut stone, such as marble, granite, and limestone; and artificial stone, made from concrete, marble chips, or other masonry materials. Using a special hammer or a diamond-blade saw, workers cut stone into various shapes and sizes. Some stonemasons specialize in setting marble, which is similar to setting large pieces of stone.

Terrazzo workers and finishers, also known as *terrazzo masons*, create decorative walkways, floors, patios, and panels. Much of the preliminary work of pouring, leveling, and finishing concrete for terrazzo is similar to that of cement masons. Terrazzo workers create decorative finishes by blending fine marble chips into the epoxy, resin, or cement, which is often colored. Once the terrazzo is thoroughly set, workers correct imperfections with a grinder. Terrazzo workers also install decorative microtoppings or polishing compounds to new or existing concrete.

The Ministry of Labour is increasing enforcement of the Occupational Health and Safety Act (OHSA) and the Regulations for Construction Projects and promoting awareness of safety measures to improve the safety of high rise and low rise concrete forming, masonry, siding and built-up roofing (also known as “flat-roofing”) trades.

The lost-time injury (LTI) rate for these five trades ranges from almost double to four times higher than average injury rates for the construction industry in general. This is based on an analysis of 10 years of Workplace Safety and Insurance Board (WSIB) data by the Ministry and Infrastructure Health and Safety Association (IHSA).

General duties of workplace parties under the OHSA

Employers

Employers and supervisors must ensure compliance with the provisions of the OHSA and its regulations.

Key requirements for employers include:

- instruct, inform and supervise workers to protect their health and safety [Section 25(2)(a)]
- appoint competent persons as supervisors [Section 25(2)(c)]
- take every precaution reasonable in the circumstances for the protection of a worker [Section 25(2)(h)]
- prepare and review at least annually a written occupational health and safety policy, and develop and maintain a program to implement that policy **if** the workplace has six or more full-time employees [Section 25(2)(j)]
- post a copy of the occupational health and safety policy in the workplace, where workers will be most likely to see it [Section 25(2)(k)]

Supervisors

The OHSA also sets out specific duties for workplace supervisors. A supervisor must:

- ensure workers work in compliance with protective devices, measures and procedures required by the act and regulations [Section 27(1)(a)]
- ensure workers use or wear any equipment, protective device or clothing required by the employer [Section 27(1)(b)]
- advise workers of any potential or actual health or safety dangers known by the supervisor [Section 27(2)(a)]
- if required, provide workers with written instructions on the measures and procedures to be taken for the workers' protection [Section 27(2)(b)]
- take every precaution reasonable in the circumstances for the protection of workers [Section 27(2)(c)]

Health and safety considerations

Employers and supervisors should consider the following to ensure a healthy and safe workplace:

- Have work-related hazards been identified and specific measures taken to mitigate any risk of injury to workers?

Ensure that adequate safety and emergency planning for the scope of work is done before starting the work.
- Have workers been adequately informed and instructed? Ensure that workers are instructed about the safety and emergency planning for the work.
- Will any work be performed from ladders, scaffolds, and work platforms?
- Have young workers been hired to work in the concrete forming, masonry, siding and built-up roofing trades? Ensure young workers are adequately trained and supervised at all times.
- Are surface conditions free from debris that may cause slips, trips and falls? Ensure that work surfaces are clear of debris and treated with sand if slippery.
- Are workers adequately supervised by a competent supervisor? Ensure that a competent supervisor is supervising the work when there are five or more workers on site.

Concrete forming

Some common hazards:

- Falls from unguarded edges
- Slips, trips and falls due to surface conditions
- Being struck by objects and equipment while stripping forms
- Inadequate site planning and supervision
- Inadequate training and instructions for workers

Safe practices include:

Good planning, instruction, communication and supervision are the key to preventing high-rise and low-rise forming injuries.

Protect form workers from fall hazards by:

- ensuring all high-rise workers are protected by required guardrails or fall protection systems at all times, including guard rails along the edge and perimeter of concrete and an opening in the slabs

- ensuring workers limit the length of their travel-restraint systems so that they cannot reach a work position where it is possible to fall
- keeping horizontal, working surfaces free from debris and slippery conditions during high-rise and low-rise forming operations
- ensuring adequate measures and procedures are in place to prevent material from falling on workers
- ensuring scaffolds, ladders and elevating devices are used and maintained in accordance with the Construction Regulation and manufacturer’s instructions and recommendations

Siding

Hazards:

- Falls resulting from the unauthorized setup and use of ladders
- Unsafe work platforms such as modified pump jack systems
- Material falling on workers
- Slips and trips due to poor surface conditions

Safe practices include:

- Workers must be provided with, and use, adequate fall protection if no suitable guardrails are reasonably possible to install
- Follow the recommended best practices on safe ladder use in the PLMHSC Guideline on Ladder Use in Construction
- Follow the manufacturer’s instructions and recommendations on the safe setup, use and inspection of scaffold systems
- Ensure measures and procedures are in place to prevent workers from walking under a raised platform and to prevent material from falling on a worker
- Ensure surfaces remain free from debris and slippery conditions

Masonry

Hazards:

- Fall hazards between levels
- Slips, trips and falls
- Material falling on workers

Safe practices include:

- When erecting masonry scaffolds, follow the construction industry’s best practices found in the
- PLMHSC Health and Safety Fall Protection Guideline on Masonry Scaffold Erection
- When using ladders, follow the best practices recommended in the PLMHSC Guideline on Ladder Use in Construction
- Keep scaffold platforms and other surfaces free from debris and slippery conditions
- Ensure adequate measures and procedures are in place to prevent workers from being struck by objects

Built-up roofing

Some common Hazards:

- Falls between levels
- Material falling on workers
- Slips, trips and falls

Safe practices include:

- Always use a fall-arrest or travel-restraint system attached to an adequate rooftop anchor
- When using ladders, follow the best practices recommended in the PLMHSC Guideline on Ladder Use in Construction
- Use barriers on flat roofs to make workers aware of the roof’s edges
- Ensure appropriate measures and procedures are in place to

prevent material from falling on workers

- Ensure surfaces are free from debris and slippery conditions