Concrete Products

Construction and Hardscape

CONTENTS

Special Thanks:

Besser Company extends our sincere thanks to the many people, companies and organizations that provided information and photographs for this project. Every effort was made to provide a comprehensive tool for the promotion of concrete masonry. Please bring any omissions or errors to our attention and every effort will be made to correct them in the next printing.

The intent of this brochure is to highlight many of the uses for concrete masonry units produced using Besser equipment. Because of space limitations, not all possible applications are shown. Additionally, some of the products shown may be patented, licensed or franchised. Please contact Besser Company for additional information.

*Be sure to check you national and local requirements. Technical data is provided only as a guideline.**

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Production of dense, strong, aesthetically pleasing concrete products is simple using a complete production system supplied and supported by Besser Company. Complete systems are capable of producing a wide range of concrete products, which is critical in today's competitive marketplace. Besser systems will produce all of the concrete products shown in this book – and more!

Concrete Products – The Perfect Building Material

Designers from around the globe incorporate concrete products in construction projects ranging from commercial and educational to residential. Low, mid and high rise structures perform equally well using concrete masonry. The popularity of concrete products can be attributed to the wide variety of shapes, sizes, textures and colors available all of which will meet any design criteria.

Split, split-fluted, striated, and slump block and concrete brick are just a few of the thousands of concrete products readily available for building construction applications. Additionally, imaginative designs of concrete products have emerged as highly desirable hardscaping products for use in industrial, commercial, municipal and residential construction. Paving stone, retaining wall units and slabs are integral elements of the concrete products industry.

There are many well-documented benefits of using concrete products. These include: aesthetics, strength, durability, fire resistance, thermal insulation, sound absorption and modular dimensioning. As the industry has grown, standards have risen steadily to ensure the consistent performance of concrete masonry units. Groups such as the American Society for Testing and Materials (ASTM), the National Concrete Masonry Association (NCMA), Interlocking Concrete Pavement Institute (ICPI) and The Masonry Society (TMS) are organizations whose mission is to safeguard the industry.

Concrete products producers strive for consistent, dimensionally precise, high strength units regardless of what type of concrete units are produced. Producers use specialized equipment, locally available aggregate, sand, cement and water to create the world's most perfect building material.

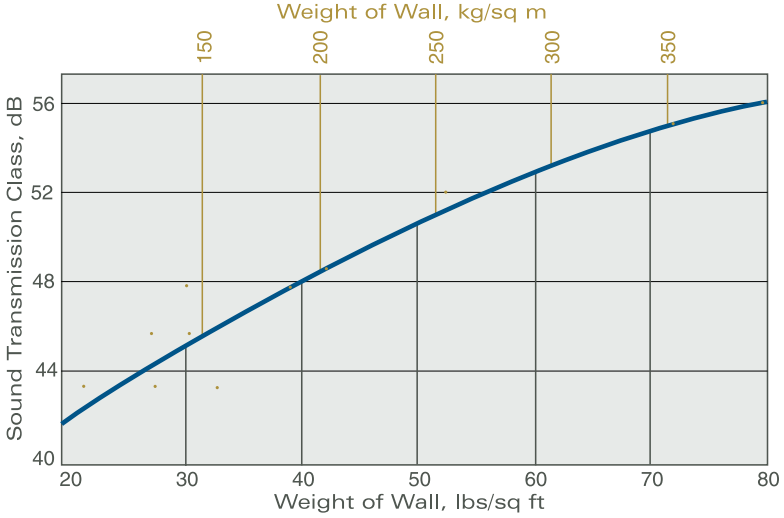
The intrinsic benefits of concrete products make them the perfect building material. The following technical data highlights these outstanding qualities.

Technical Data

Sound

Concrete products are especially effective in reducing the transmission of unwanted sound because of their mass and rigidity. The sound transmission class (STC) is a single-figure rating based on tests. The rating provides an estimate of the performance of the wall in common sound insulation problems. The heavier the wall, the greater the sound transmission rating.

Wall Weight vs. STC



Sound Level

Decibels	Sound
140	Jet plane takeoff
130	Threshold of discomfort
120	Riveting
110	Thunder-sonic boom
100	Hard rock band
90	Power lawnmower
80	Pneumatic jackhammer
70	Noisy office
60	Average radio
50	Normal conversation
40	Quiet street
30	Quiet conversation
20	Whisper at four feet
10	Normal breathing
3	Threshold of audibility

Relationship Between Sound Transmission Loss Through a Wall & Hearing Condition on Quiet Side*

Transmission Loss in Decibels	Hearing Condition	Rating
30 or less	Normal speech can be understood quite easily and distinctly through the wall.	Fair
30 to 35	Loud speech can be understood fairly well. Normal speech can be heard but not easily understood.	Fair
35 to 40	Loud speech can be heard, but is not easily intelligible. Normal speech can be heard only faintly, if at all.	Good
40 to 45	Loud speech can be faintly heard but not understood. Normal speech is inaudible.	Very good, recommended for dividing walls between apartments.
45 or more	Very loud sounds, such as loud singing, brass musical instruments, or a radio at full volume can be heard only faintly or not at all.	Excellent, recommended for band rooms, music practice rooms, radio and sound studios.

*This table is based on the assumption that a noise corresponding to 30 decibels is continuously present on the listening side and that noises passing through the wall are audible despite this noise level. A decibel is roughly equivalent to the smallest change in sound energy that the average ear can detect and 30 decibels corresponds approximately to the average background noise in a quiet apartment.

attractive
sound absorbing
loadbearing
low maintenance
energy efficient
fire resistant
durable

Fire

Concrete masonry wall systems are unsurpassed in functioning as barriers to contain the spread of fire. Masonry effectively resists the passage of flames and hot gases. Fire resistance ratings are commonly determined from tables. Data included in these tables is based on extensive testing of walls. The tables reflect the differences in raw materials and concrete masonry unit configuration. Units with greater equivalent thickness have greater fire resistance rating.

Thermal

Concrete masonry walls provide a wide array of options to increase comfort and insulating value. Changing the raw materials used may increase the performance. Special shapes can enhance the thermal resistance. Insulating materials and inserts improve the insulation and retain the hard, durable face of the wall that may be built using architectural units. Rigid insulation may be applied to one of the wall faces as an additional option. Many of these methods may be combined to produce an energy efficient wall suited to the specific use of the building.

Calculating
Equivalent Thickness

Equivalent thickness is the solid thickness that would be obtained if the same amount of concrete contained in a hollow unit were re-cast without core holes.

Calculating Estimated Fire Resistance Example:
An 8" hollow masonry wall is constructed of expanded slag units reported to be 56%* solid. What is the estimated fire resistance of the wall?
Eq Thickness = 0.56 x 7.625 = 4.3 inches
From table below: The wall has a 2-hour fire resistance rating.

* Percentage solid can be calculated average from net area or net volume values as determined by ASTM C 140 "Methods of Testing Concrete Masonry Units."

Estimated Fire Resistance Ratings
Concrete Masonry Walls

	Minimum required equivalent thickness inches (mm)				
Aggregate Type	4-Hour	3-Hour	2-Hour	1 ½-Hour	1-Hour
Calcareous or Siliceous Gravel	6.2 (157)	5.3 (135)	4.2 (107)	3.6 (91)	2.8 (71)
Limestone, Cinders or Slag	5.9 (150)	5.0 (127)	4.0 (102)	3.4 (86)	2.7 (69)
Expanded Clay, Shale or Slate	5.1 (130)	4.4 (112)	3.6 (91)	3.3 (91)	2.6 (66)
Expanded Slag or Pumice	4.7 (119)	4.0 (102)	3.2 (81)	2.7 (69)	2.1 (53)

R Values
hr-ft²-°F/Btu (m²-K/W)

Block density lb/ft³ (kg/m³)	Nominal wall thickness inches (mm)	Hollow concrete masonry units			Cavity wall with 3 5/8" (90 mm) veneer	
		Cores empty	Cores filled	4" high efficiency polystyrene inserts	2" (50 mm) expanded polystyrene	2" (50 mm) extruded polystyrene
Normal weight concrete						
135 (2150)	6 (150)	1.7 (0.3)	2.6 (0.5)	N/A	11.5 (2.0)	13.5 (2.4)
135 (2150)	8 (200)	1.0 (0.3)	3.3 (0.6)	4.7	11.7 (2.1)	13.7 (2.4)
135 (2150)	10 (250)	2.0 (0.4)	3.7 (0.6)	5.3	11.8 (2.1)	13.8 (2.4)
135 (2150)	12 (300)	2.0 (0.4)	4.4 (0.8)	5.7	11.8 (2.1)	13.8 (2.4)
Lightweight concrete						
95 (1525)	6 (150)	2.2 (0.4)	4.5 (0.8)	N/A	12.0 (2.1)	14.0 (2.5)
95 (1525)	8 (200)	2.4 (0.4)	5.9 (1.0)	8.9	12.2 (2.1)	14.2 (2.5)
95 (1525)	10 (250)	2.5 (0.4)	7.0 (1.2)	9.7	12.3 (2.2)	14.3 (2.5)
95 (1525)	12 (300)	2.6 (0.5)	8.5 (1.5)	9.9	12.4 (2.2)	14.4 (2.5)

Beyond aesthetics, concrete masonry units are loadbearing, providing a perfect choice for high rise construction.

Loadbearing Masonry

Using the concept of loadbearing wall construction, architects are designing concrete masonry structures over 28 stories. Loadbearing wall construction allows the combined action between the concrete floor and the masonry bearing walls to transfer loads to the foundation.

There are two main reasons for the popularity of this method of construction: economy and savings of construction time. Using high strength 6" (150 mm) units, loadbearing buildings up to 21 stories have been built for housing. The addition of reinforcing steel allows seismic resistant structures to be built economically. Detailed information on loadbearing masonry is available through the National Concrete Masonry Association as well as other organizations.

Low and mid-rise construction represents the largest segment of building construction in the world. Traditionally, low/mid-rises are defined as buildings up to seven stories. Residential housing is the most predominant use of this type of construction.

Around the world, masonry is the preferred material for housing construction. Concrete masonry is ideal for many types of residential buildings in different heights and in diverse geographical areas.

Concrete masonry is selected by builders desiring to provide economical, comfortable housing for residents. Residents appreciate the many properties of concrete masonry that provide comfort and safety. The most notable properties are fire resistance and low sound transmission.

Owners appreciate the low cost of building with concrete masonry as compared with other building materials. Another benefit is the extremely low cost of maintenance, especially when using architectural concrete masonry. The adaptability of concrete masonry permits varying design preferences for the same building system.

Designs of loadbearing concrete masonry systems vary depending on the floor system used. If precast hollow core planks are used, the walls at each end of the concrete plank must carry the load. Another system uses either precast floor slabs the size of the room or cast-in-place concrete slabs. The latter types normally bear weight on either three or four walls. Depending on the building height and floor plan, the concrete masonry units used can be normal strength or high strength to match the structural requirements.

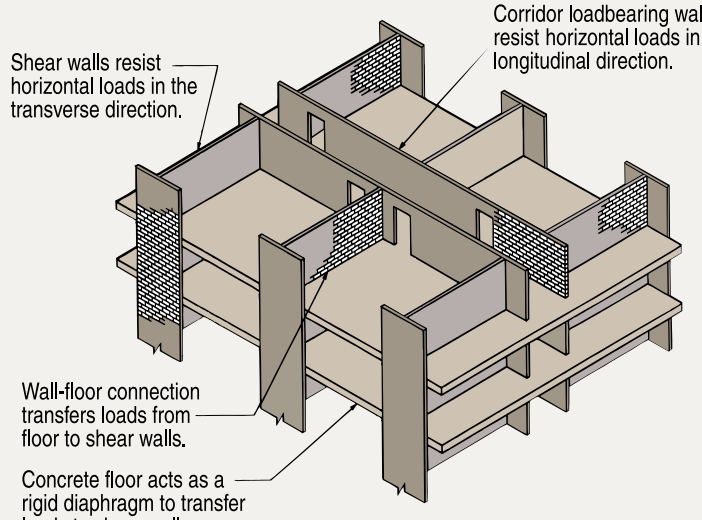
Concrete masonry is an outstanding material to use in the design and construction of high-rise housing structures. In countries around the globe there are many excellent examples of high-rise loadbearing masonry. All of these structures are evidence of the inherent advantages of using concrete masonry.

In many countries, loadbearing masonry construction is replacing outdated precast concrete systems. The result is an economical structure with the potential for many architectural treatments.

The Structural System

Higher strength units are used on the lower floors, with lower strengths meeting the structural requirements used on the upper floors. Reinforcing steel and grout are used only where necessary. The remaining cores are not filled. This provides a lighter, more economical structure.

Loadbearing masonry is a design combination of masonry walls and various concrete floor systems. The floor may be precast in a factory, cast-in-place or precast on-site. Concrete masonry permits the connection of the floors to the walls. The result is a very robust, economical structure.

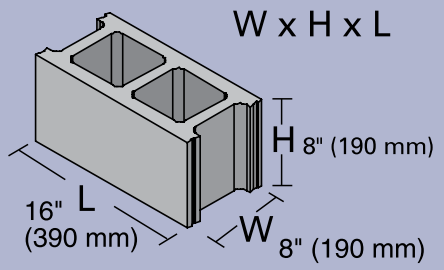


Concrete products provide a wide latitude of design possibilities and bountiful built-in qualities – at a traditionally low cost.

Nomenclature

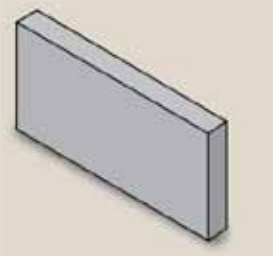
W x H x L is the common method of describing the size of a concrete products.

The unit to the right is described as 8" x 8" x 16" (190 mm x 190 mm x 390 mm) nominal size unit.

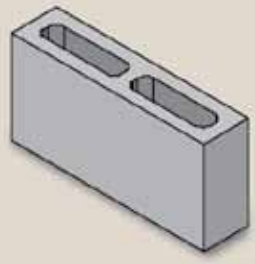


Standard Units

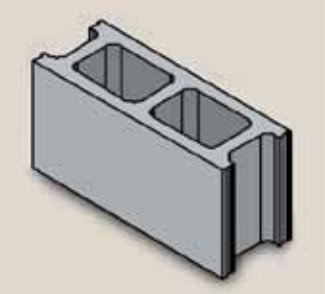
Common Size Units



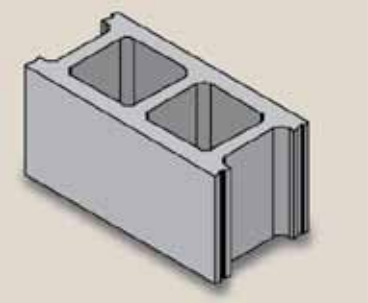
1-5/8" x 7-5/8" x 15-5/8"
(40 mm x 190 mm x 390 mm)



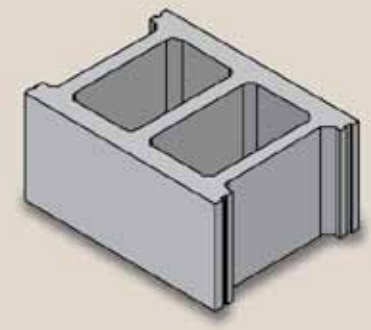
3-5/8" x 7-5/8" x 15-5/8"
(90 mm x 190 mm x 390 mm)



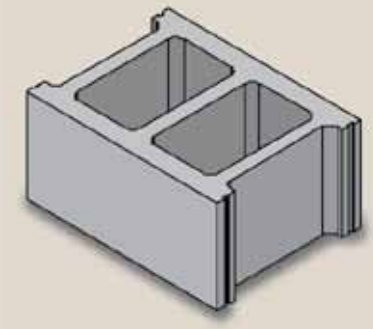
5-5/8" x 7-5/8" x 15-5/8"
(140 mm x 190 mm x 390 mm)



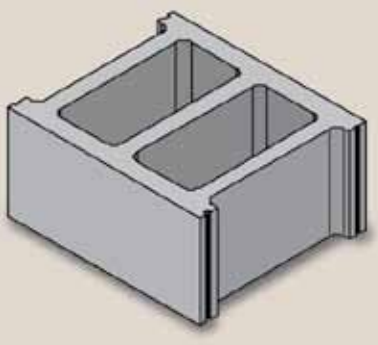
7-5/8" x 7-5/8" x 15-5/8"
(190 mm x 190 mm x 390 mm)



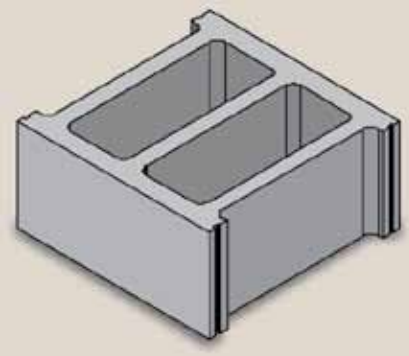
9-5/8" x 7-5/8" x 15-5/8"
(240 mm x 190 mm x 390 mm)



11-5/8" x 7-5/8" x 15-5/8"
(290 mm x 190 mm x 390 mm)



13-5/8" x 7-5/8" x 15-5/8"
(340 mm x 190 mm x 390 mm)



15-5/8" x 7-5/8" x 15-5/8"
(390 mm x 190 mm x 390 mm)

Dimensions

The concrete product dimensions are the actual/ modular dimensions.

Special purpose units are available to improve construction and reduce costs. In addition to those shown, it is possible to produce hundreds of other units in a variety of sizes. Most units are also available with architectural faces such as scored, split-face, split-rib, split-fluted or ground.

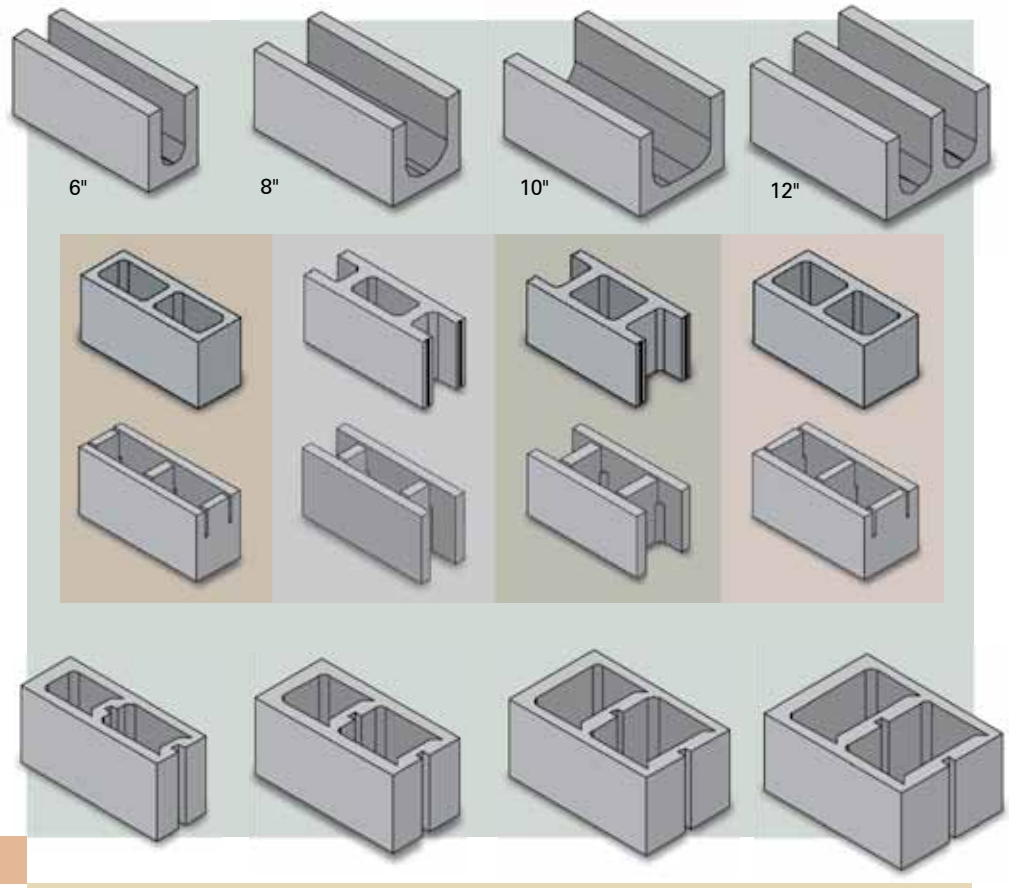
Special Purpose Units

Bond Beam

Bond beams are used over window and door openings and to form a continuous ring beam at the top of a wall. This beam distributes loads, ties walls together and provides a solid surface for the next floor or a roof system. Bond beams are available in both solid and open bottom versions. Open bottom bond beams can be made with cores that align with the cores of the units above and below. This alignment of cores makes the use of rebar simple.

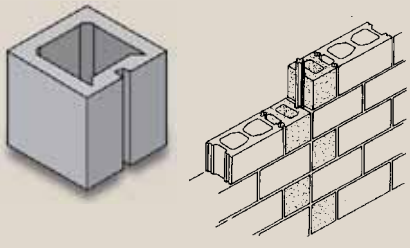
Multipurpose

Multipurpose concrete masonry units with sections that may be removed are used for many applications. Some of the uses are at the end of walls, at corners or with a special "cross-shaped" rubber extrusion to produce an easily installed control joint. By removing two of the three webs, the unit may be placed around electrical conduit or pipes. Once all the webs are removed, the unit may be rotated 90 degrees vertically and used as a deep beam over larger openings.



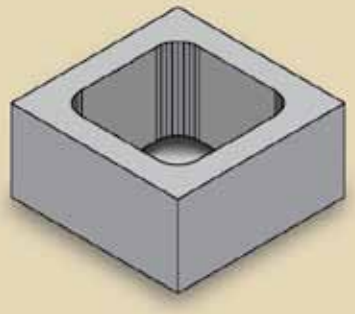
Control Joints

A sash masonry unit is used in conjunction with a "cross-shaped" rubber extrusion to produce an easily installed control joint.



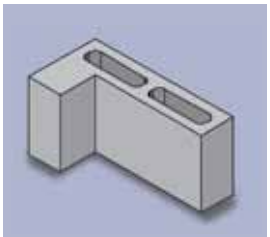
Chimney Units

Large chimney units are available which can be used with or without liners. Many different configurations are available in both solid and cored styles to comply with local building codes.

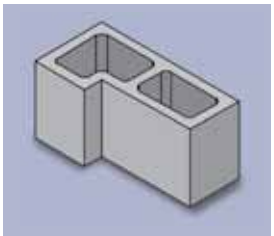


When working with concrete masonry, good structural and workmanship practices are essential. Location of control joints, quality of mortars, placement of lintels and bond beams play an important role in the construction of quality masonry structures.

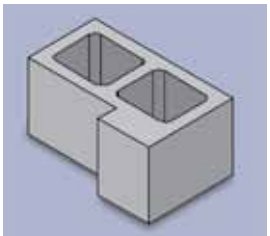
Corner, Floor & Seismic Cons



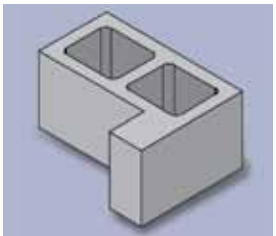
4" (100 mm) L corner



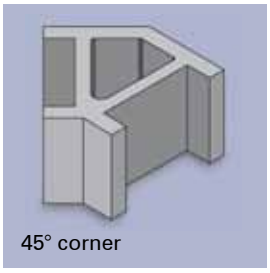
6" (150 mm) L corner



10" (250 mm) L corner



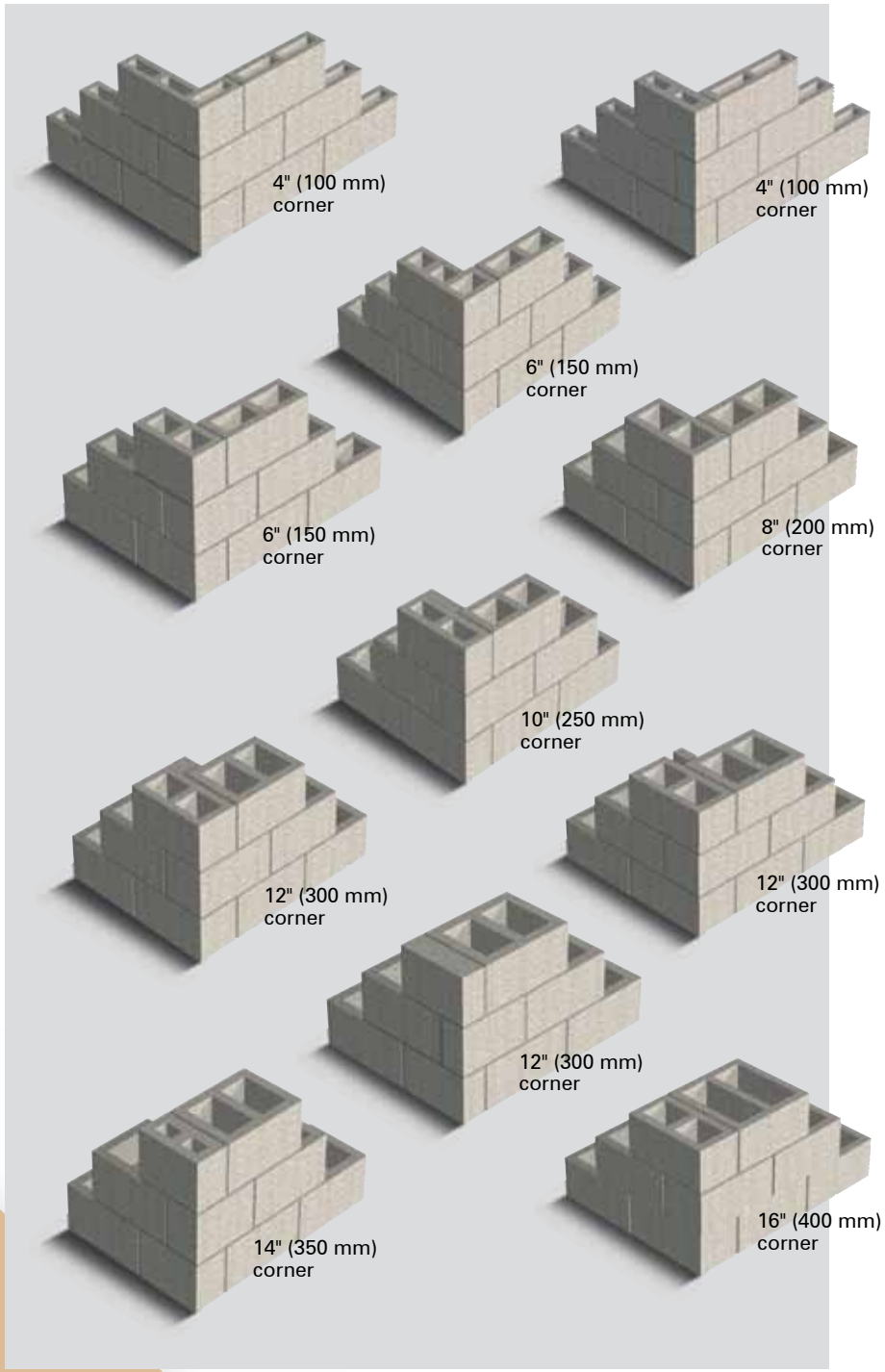
12" (300 mm) L corner

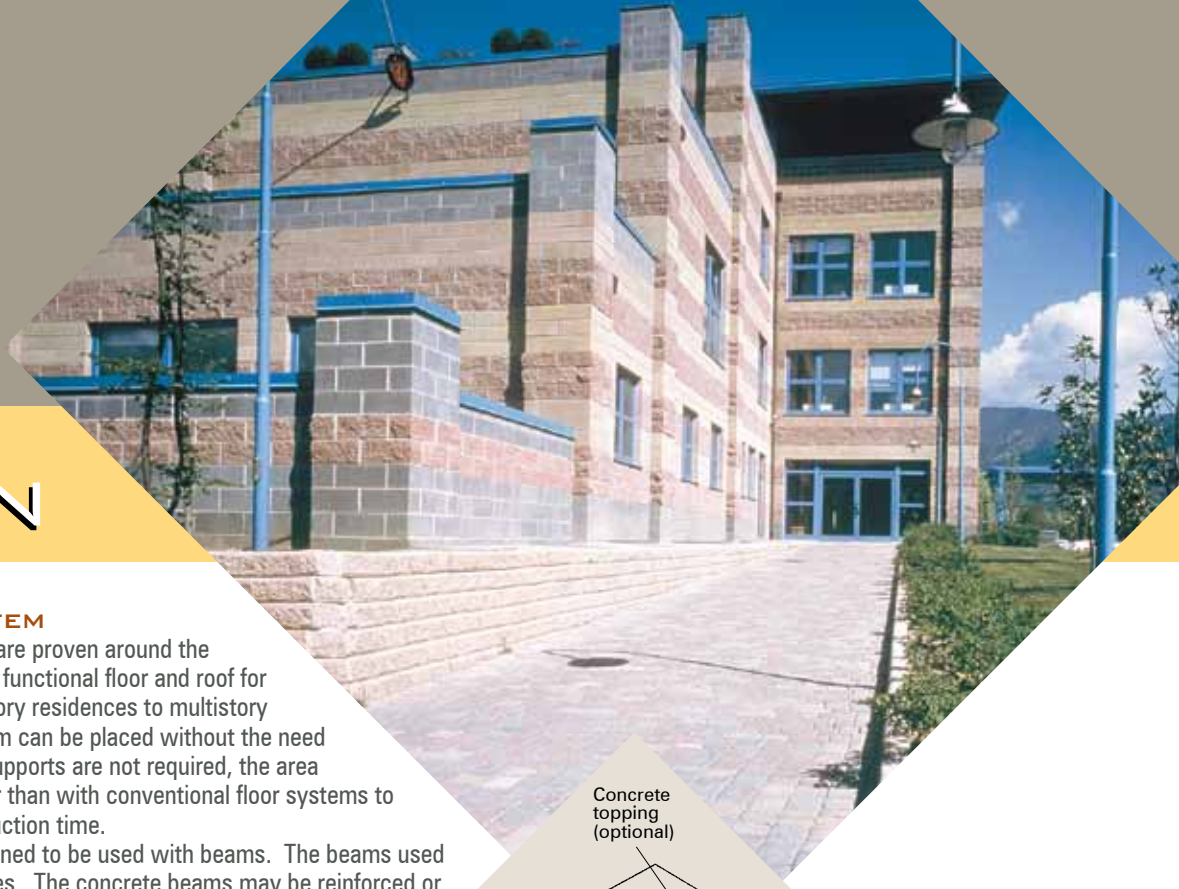


45° corner

Corner Construction

Corners may be constructed using standard units of different sizes or special corner units. Often the special units provide for stronger construction and make construction details easier to grout and reinforce. Corner units also preserve the modularity and economy of a well-designed structure. In addition to the corner construction details shown, additional details may be used.





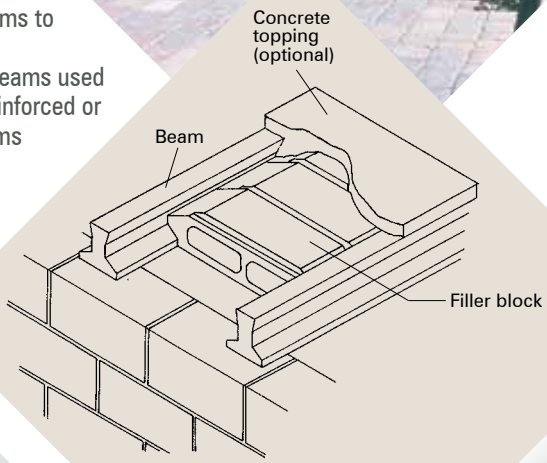
STRUCTION

Masonry Floor System

Concrete masonry floor systems are proven around the world. They provide an economical, functional floor and roof for all types of structures from single story residences to multistory buildings. Components of the system can be placed without the need for large cranes. Since temporary supports are not required, the area below may be finished much quicker than with conventional floor systems to decrease the overall building construction time.

Concrete masonry units are designed to be used with beams. The beams used in the system may be of several types. The concrete beams may be reinforced or prestressed. Steel joist beams or combination steel joist/concrete beams may also be used.

Electrical service may be placed in unit cores and ceiling fixtures may be installed much easier than with solid floors. Heating pipes and electrical utilities may be installed in the optional concrete floor topping.

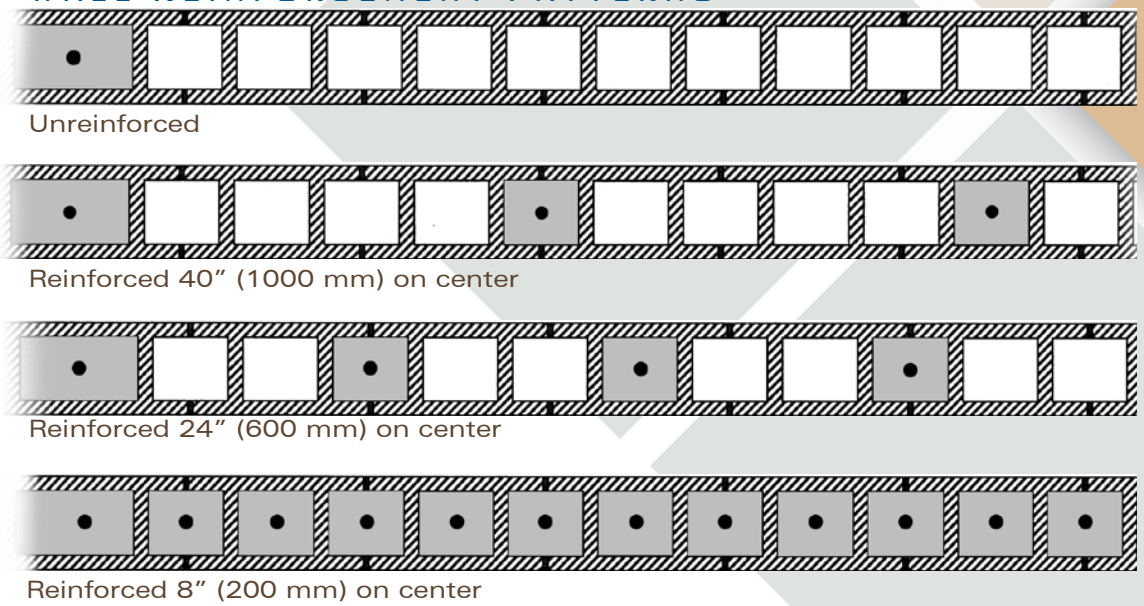


▲ Floor filler block can be designed to be used with many different types of beams.

Seismic Construction

Many areas of the world are located in high seismic zones. For these regions, reinforced masonry construction is the answer. With the use of reinforcing steel and grout, standard concrete masonry units can form a structure that can withstand some of the toughest seismic forces in the world. This type of construction has survived earthquakes in California, New Zealand and Japan.

Wall Reinforcement Patterns



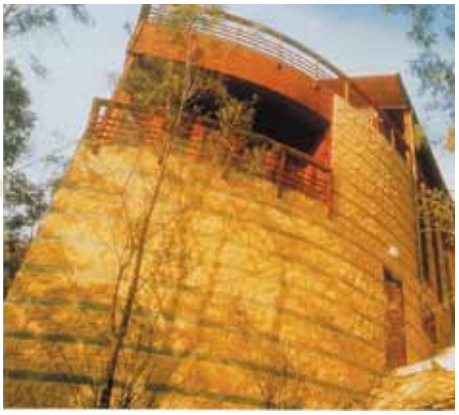
◀ Concrete masonry walls are reinforced only where necessary to provide the most economical building possible.

Architectural Units

Each style of unit has its own appeal and while different, each style provides the intrinsic qualities of concrete masonry.

- High Durability: Concrete masonry is solid and is not affected by the elements.
- Low Maintenance: High durability means fewer repairs, plus the color and brilliance of masonry will withstand the outdoor elements.
- Fireproof: The investment in the building and its contents is protected.
- Structural Integrity: Concrete masonry can be used with all roofing and flooring systems, has excellent loadbearing capacity for supporting roofs and additional floors, plus resists the forces of heavy snows, high winds and earthquakes.
- Low Insurance Rates: Concrete masonry construction provides better protection from break-ins, fires and severe weather conditions, keeping insurance rates lower than with other types of construction.
- Insulation: Concrete masonry walls insulate against outside temperatures which maintains constant temperatures inside while reducing heating and cooling costs.
- Unique and Personalized Image: Concrete masonry is available in a wide variety of colors, textures and styles providing a distinctive look and professional image for building projects.
- Available Locally: Concrete masonry is made using local materials, resulting in an economical building material.

Each of the architectural units shown throughout this book is available as a loadbearing or veneer unit.



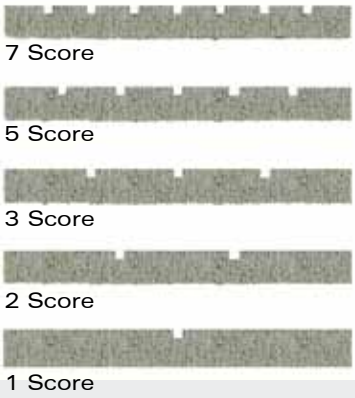
Split

Split face units are solid or hollow units that are molded "Siamese style." The "Siamese" units are split by a guillotine-like machine after coming out of the kiln and before palletizing (cubing).

Split face units have an attractive, naturally rugged, stone-like texture. Different aggregates and pigments provide a variety of appearances. This variety is the reason why split face units are a popular choice for building owners and architects. Split face concrete masonry units create numerous possibilities for enhancing buildings of all types and sizes.

Architectural Units

Scoring Options



Scored

Scoring refers to the process of creating a new face size for the concrete masonry unit by saw cutting the face either horizontally or vertically. Another common method is to mold depressions into the face of the concrete masonry unit as it is being formed by the concrete products machine. Scored units are very similar to plain units only two parts of a mold are changed to create this appearance.

Scored units are available with any number of scores as illustrated on this page. Scoring can take place on either side or both sides of the unit. Corner units with scores on the end are also available. In addition to being scored, these units can be made with a split or stri-face.

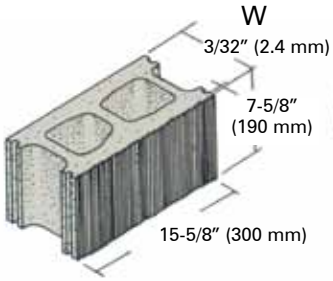
The number of patterns that can be created using scored units is limited only by the imagination.

Fluted and Ribbed

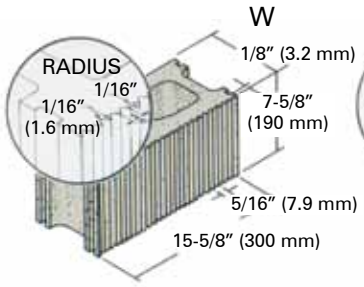
Special molds are used to produce fluted and ribbed concrete masonry units. The flutes or ribs are formed in the mold box as the product is produced by the concrete products machine. If the product is created "Siamese style" it is cured before being split using a guillotine-like machine.

Flutes and ribs give an added dimension to the buildings they adorn. This visual appeal makes them a favorite with architects, designers and building owners. Their versatility allows them to be blended with other concrete masonry units and building materials.

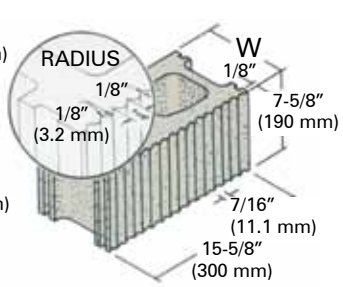
Architectural Units



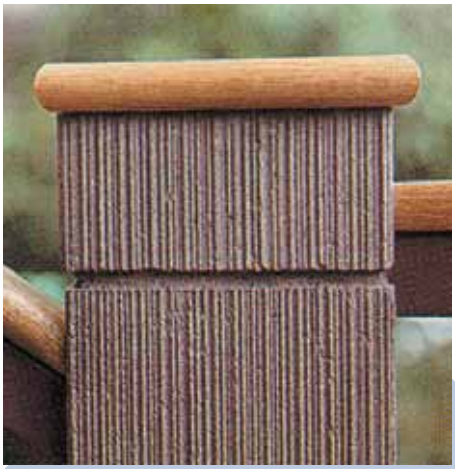
S-100
Random Cut



S-200



S-300



Shadowal

The use of units with faces of varying heights and textures adds a dramatic flair to buildings when used to accent or highlight specific areas. Shadowal units can also be used for the entire project to create a memorable impression. These types of units are available in a wide variety of sizes, shapes and textures.

Stri-face

The unique brushed appearance of stri-face units is achieved in the mold box while the concrete masonry units are being formed. Shallow vertical grooves add a subtle texture to the units.

Many architectural styles can be achieved using stri-face units. The subtle texture easily blends well with other concrete masonry units and building materials, creating projects of distinction. Stri-face units are available with or without scores.

Slump

Using concrete that is slightly wetter than normal is the first step in producing slump units. The next step in the production process is to apply pressure to the top of the units, creating units with irregular, slumped or overhanging faces.

Slump units are available in a wide variety of colors and sizes to suit many applications.

The possibilities are unlimited with concrete brick – bark, worm, thumbprint, split, smooth and stri-face in a variety of colors and blends.

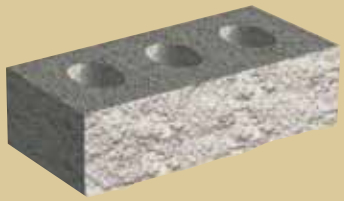
Concrete Brick

Concrete brick are ecologically friendly alternative to clay brick they are easily produced by concrete products machines. A variety of faces are produced while the brick are being molded. Face styles include bark, worm, thumbprint, split, smooth and stri-face. Additionally, concrete brick can be produced in three configurations: cored, frogged and solid to suit the preference of the marketplace.

Variegated patterns can be created by blending colors used to produce the concrete brick. Interesting architectural effects are possible depending on the laying pattern, color of mortar used and type of joint selected.

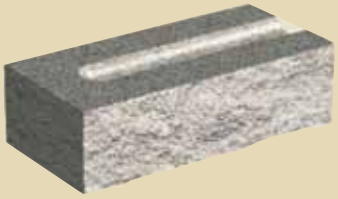
Cored Brick

Cored brick are produced using less material and as a result are light in weight. Cored brick can be manufactured "on the flat" by a mold with vertical cores or "on edge" by a mold that requires the use of a core puller. Cored brick can be made with a smooth, split or stri-face. Worm, bark and thumbprint faces can also be created when using the core puller and heated stripper shoes.



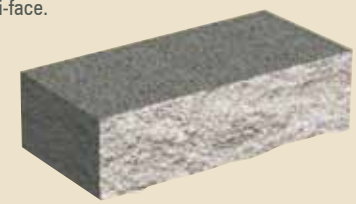
Frogged Brick

Frogged brick are made with a 1/4" (6 mm) deep by 1-3/8" (35 mm) wide indentation that protrudes 6-1/2" (165 mm) down the unit. The brick is less likely to move while being laid. Frogged brick are made "on end," with a smooth, split or stri-face.



Solid Brick

Solid brick are the easiest of the three styles to produce and may be manufactured "on end." Solid brick can be made with a smooth, split or stri-face.



Architectural Units

Ground Face

Once the concrete masonry units are cured the faces of the units are ground. This process can be done by hand or by using a machine designed for this process. Typically 1/16" to 1/8" (1 mm to 3 mm) is ground off revealing the various colors and sizes of the natural aggregates while creating a smooth, silky texture. By incorporating different aggregate sizes, types and colors and various cement colors a wide variety of effects can be created. Clear glazes or sealers are frequently used to enhance the appearance and to aid in cleaning the unit.

Ground face units are used for accenting specific areas of a building or to provide interesting contrast between building materials.

Antiqued

The antiqued appearance is achieved once the units are cured. The faces of the units are distressed by a machine positioned in-line, or by tumbling the units in a large drum. Both methods give new units the marks of age.

Antiqued units add instant appeal to projects of any size.

Sandblasted/Shotblasted

Once cured the units are sandblasted or shot blasted exposing the larger aggregate contained in the concrete masonry unit.

Glazed

Adding a punch of color, introducing a new design element or highlighting a special feature are typical uses for glazed block.

A decorative impervious face is bonded to plain concrete masonry units using a heat induced process to create an attractive, durable, easy to clean masonry unit. The units are available in many colors with or without scores.

Fusion Stone™

Fusion Stone is a manufactured concrete thin stone veneer system. The thin stone and thin brick are mechanically fastened to the wall by using stainless steel Fusion clips and screws. This ensures that even with movement in the walls, the stones stay in place. Installation can be done by do-it-yourself homeowners or building trade professionals.

Fusion Stone is produced in a variety of sizes, colors and textures. In addition to the units themselves–sills, corners and keystone units are available. Fusion Stone can add beauty to existing and new projects and can be used outdoors and indoors.

Novabrik™

Quality concrete siding units may be produced in many different styles and colors. These units are attached directly to the side of the structure, so no footing or additional supports are required. This method of construction permits the products to be used economically for both new structures and in the renovation of existing buildings. The durability, range of colors and pleasant appearance make siding units a popular choice to clad a building.

Acoustical

Noise control within an area can be accomplished economically by the use of special masonry units or raw materials. Individually or combined, these choices create walls that minimize sound reflection or echoes.

Standard concrete masonry units can be used for noise control. Raw materials, which produce coarse textured units, can increase sound absorption and improve acoustics within an area. Materials such as sand or grout may be placed in the cores to increase the wall weight and economically reduce the sound transmission through a wall.

Architectural units such as split-face, split-rib and split-fluted create a textured wall surface that disperses sound and softens the acoustics.

Specially designed acoustical concrete masonry units do an excellent job controlling acoustics. These licensed units are designed with openings on the face that absorb sound and reduce the noise level. Inserts within the cores absorb and disperse sound to prevent reflection back into the room. Inserts may be metallic, fibrous or a combination of these materials. Different combinations of opening sizes and insert materials can optimize the acoustic performance for noises within specific frequency ranges.

Additionally, many of the special units may be reinforced or grouted to increase strength and reduce sound transmission.

The combination of faces and textures provides an economical, durable wall that effectively reduces noise and controls acoustics.

Appealing designs, rich colors and an assortment of shapes make paving stone a favorite among architects, contractors and home owners.

Hardscaping

Application	Thickness of Subbase		Thickness of Concrete Masonry Paving Units
	Well-Drained Dry Areas	Low Wet Areas	
Light Duty			
Residential: Driveways, Patio, Pool Decks, Walkways, Parking, Bicycle Paths, Erosion Control, Temporary Paving	0 to 3 inches (0 to 75 mm)	4 to 8 inches (100 to 200 mm)	2-3/8 inches (60 mm)
Medium Duty			
Sidewalks, Camping Areas, Shopping Malls, Mobile Home Parks, Residential Streets, Canal Lining, Public Parking, Safety Zones, Bus Stops, Maintenance Areas, Service Roads, Farm Equipment Storage, Cross Walks, City Streets, Parking Lots	4 to 6 inches (100 to 150 mm)	10 inches (255 mm)	3-1/8 inches (80 mm)
Heavy Duty			
City Streets, Intersections, Gas Stations, Loading Docks, Loading Ramps, Industrial Floors, Stables	8 inches (205 mm)	12 inches (305 mm)	4 inches (100 mm)

Paving Stone

Solid interlocking paving stone have the unique ability to transfer loads and stresses laterally by means of an arching or bridging action between units. Spreading the load over a larger area reduces the stress, thereby allowing heavier loads and traffic over subgrades which would normally require heavily reinforced concrete.

The solid interlocking units are available in an array of colors and patterns which lend themselves to the creation of interesting designs.

In addition to breaking the monotony of a flat paved area, concrete paving stone can be used to permanently mark such areas as parking bays, traffic lanes and crosswalks.

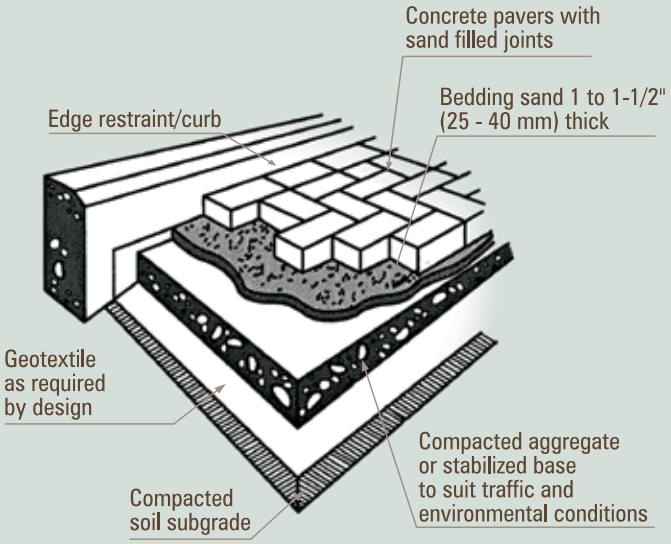
Concrete paving stone offer an ecological solution to the increasing concern for the environment because pavers place the moisture from rainfall back into the earth rather than letting it run off as waste. This is especially true when the open type stone is used.

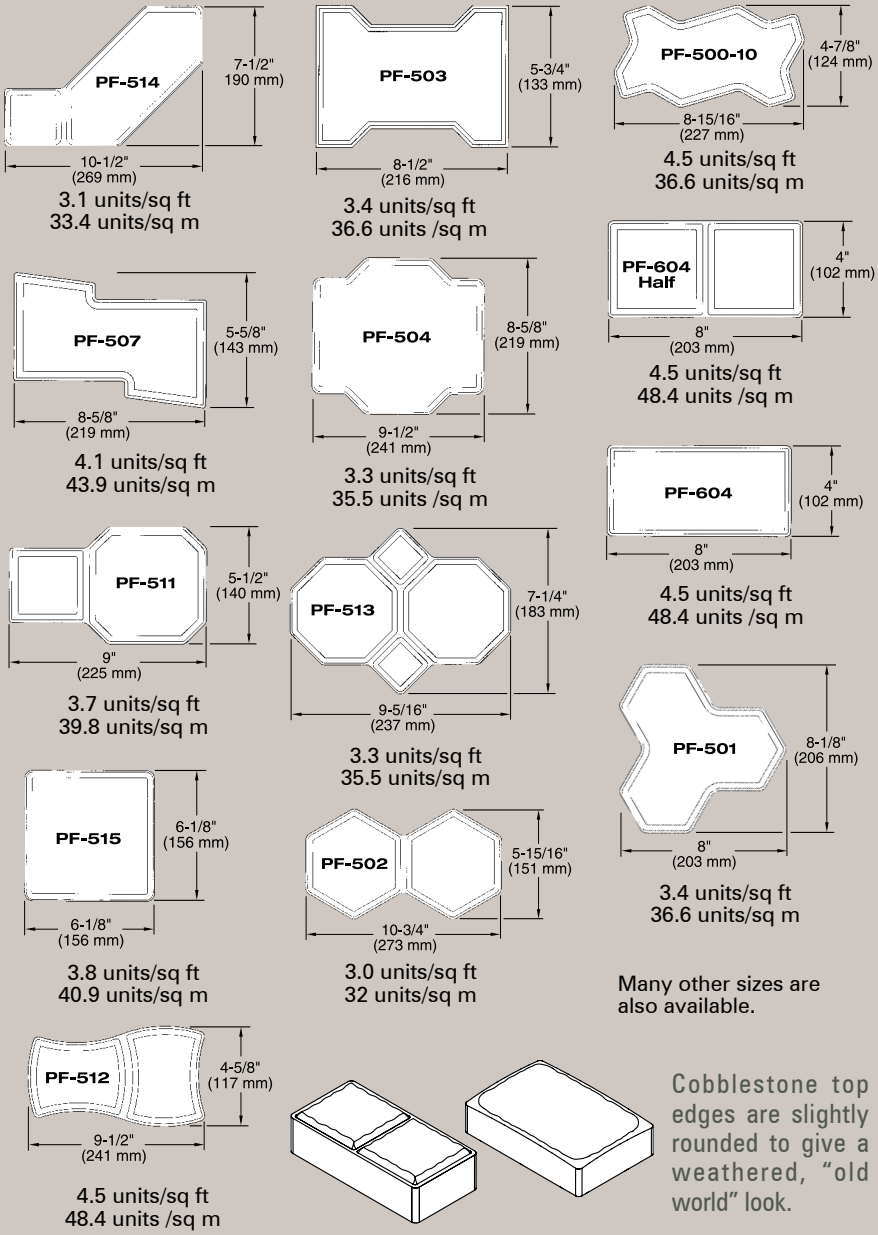
The use of paving stone makes the repair to utilities beneath paved areas quick and easy. Paving stone are simply removed before the work is done and replaced when finished.

As shown in the table to the left, solid interlocking paving stone are available in different thicknesses ranging from 2-3/8" to 4" (60 mm to 100 mm).

Pavers can be aged for a weathered appearance.

Typical components of an interlocking concrete pavement system





Paving Stone Designs

It's easy to add intriguing design textures and patterns to drives, walkways and plazas with the versatile paver shapes available. The design possibilities of paving stone are limited only by the imagination.

Concrete paving stone are available in a variety of colors. Interesting patterns can be achieved by mingling different colors. Color is an effective tool when directional flow is to be indicated–for example "in" or "out" entrance/exit, no parking areas and bicycle paths. While the color is permanent, it can be changed easily by replacing the stone if another effect is desired.

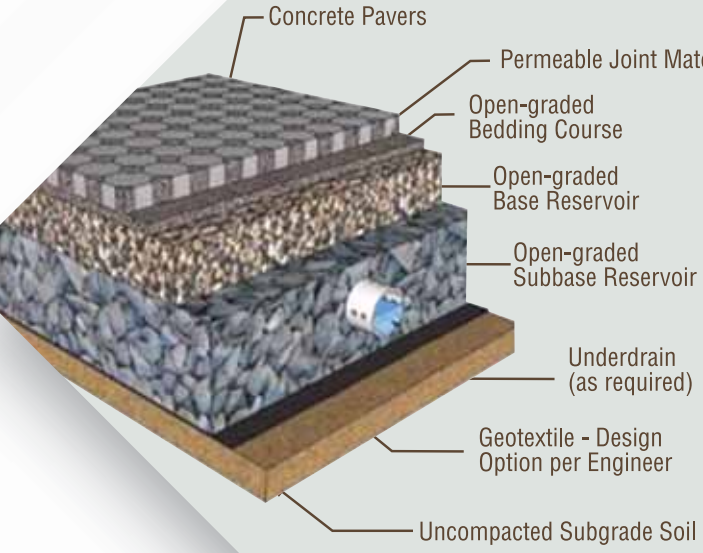
PICP fits "Green" or sustainable development approaches.

Hardscaping

Permeable interlocking concrete pavement (PICP)

Permeable interlocking concrete pavement (PICP) consists of manufactured concrete units that reduce stormwater runoff volume, rate, and pollutants. The impervious units are designed with small openings that create permeable joints. The openings typically comprise 5% to 15% of the paver surface area and are filled with highly permeable, small-sized aggregates. The joints allow stormwater to enter a crushed stone aggregate bedding layer and base that supports the pavers while providing storage and runoff treatment. PICPs are highly attractive, durable, easily repaired, require low maintenance, and can withstand heavy vehicle loads.

Components of permeable interlocking concrete pavement system



Slabs

Precast concrete paving slabs come in many sizes and shapes. Slabs can be made with a variety of finishes and textures, so the design options are unlimited. Paving slabs are most commonly used for walkways, patios, and driveways in addition to garden and landscape applications.

Grass Units

Grass units are open paving units which allow the growing of grass when employed in parking areas, along the shoulders of highways and airport runways, as a lining in canals and in recreational areas. These units permit rain to be absorbed while allowing the area to be used for parking or an access path.

Illustrated is only one of the many styles of grass units that are available.

Stepping Stones

Round. Square. Rectangular. Octagonal. Stepping stones are a terrific element to be introduced near entranceways, for patios, near water features and gardens. Smooth or with exposed aggregate faces, concrete stepping stones are an economical option for adding charm.

Lawn Edging

Lawn edgers have either smooth or scalloped tops and can be straight or curved. Edging units are ideal to run along gardens, driveways and sidewalks. They are a perfect complement to any landscaping project.

Fence Units

A wide variety of textures, colors and heights are available to add elegant interest to fence units.

Erosion Control

There are a wide variety of concrete erosion control systems available, each with special characteristics. All of these systems are able to provide attractive solutions to erosion problems. Erosion control construction with concrete units requires no mortar, and in many cases, no heavy equipment. Concrete units are ideal for waterfronts to add beauty and help prevent erosion.

Interlocking concrete block provide a stable, flexible and permeable erosion control system with specific physical and hydraulic characteristics.

Segmental retaining wall units (SRWs) are produced in a variety of appearances: antiqued, smooth, split and stri-face in virtually any color. Segmental wall units are flexible in design. They can accommodate corners, curves, tiers and grade changes and are used along roadsides, for shoreline protection and for landscaping.

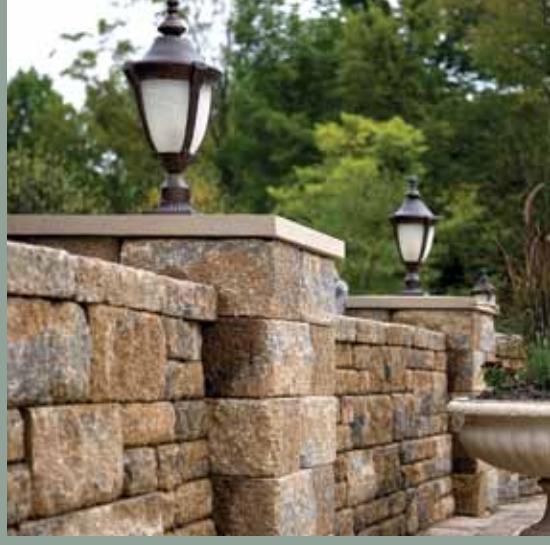
Hardscaping

Segmental Retaining Walls

Segmental retaining walls are constructed from dry-stacked concrete masonry units (without mortar). Units can be connected using concrete shear keys, mechanical connectors or lips on the units themselves. Segmental retaining wall units are available in a variety of colors, sizes, shapes, styles and configurations and provide a wide choice of aesthetically pleasing wall textures and appearances.

Landscaping walls, structural walls for changes in grade, bridge abutments, stream channelization, waterfront structures, tunnel access walls, wing walls and parking area support are some of the many uses for segmental retaining wall units.

Segmental retaining walls have been designed and built up to 50 feet (almost 18 meters) in height. Detailed information about construction using segmental retaining wall units is available from the National Concrete Masonry Association and product licensors.



Concrete products are produced in virtually every country around the world because of their high quality and the universal demand for economical building materials. Local raw materials are used to produce concrete products in a limitless array of sizes, shapes and colors.

The Production of Concrete Products

Raw materials

The main raw materials used to produce concrete products are cement, sand and aggregate. Normally these materials area available locally and delivered to the plant by truck, rail, or barge. Cement is pneumatically transferred to storage silos equipped with dust collectors. When the sand and aggregates arrive at the plant they are typically stockpiled in the yard and transferred, as needed, into storage bins. Transferring materials from stockpiles to bins can be accomplished with a front-end loader or with conveyor belts and stackers.

Aggregates used to produce normal weight concrete products include sand, gravel and crushed stone. The sand and gravel may be either natural or produced by crushing at the aggregate source. Aggregates used to produce lightweight concrete products include fired expanded shale, clay, slate and expanded blast furnace slag, sintered fly ash, coal cinders and natural materials such as pumice and scoria blended with sand.

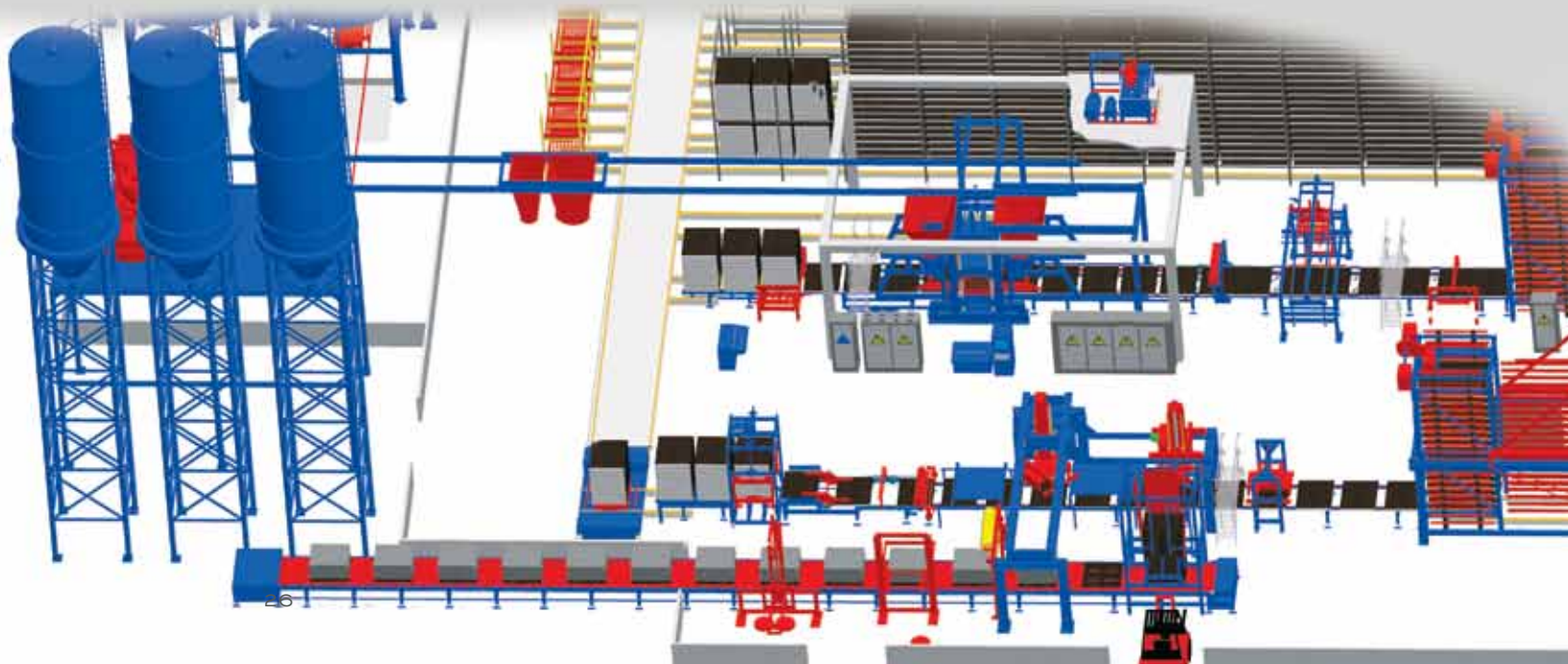
The ingredients that bond these aggregates together are cement, fly ash and other pozzolanic materials. To reduce curing costs and to obtain faster turn around times some plants use more expensive "high early strength" type lll cement instead of normal cement. In some geographic regions, fly ash and other pozzolanic materials are waste products and therefore more economical to purchase than cement. Many producers choose to use these materials as cement replacements to reduce overall production costs.

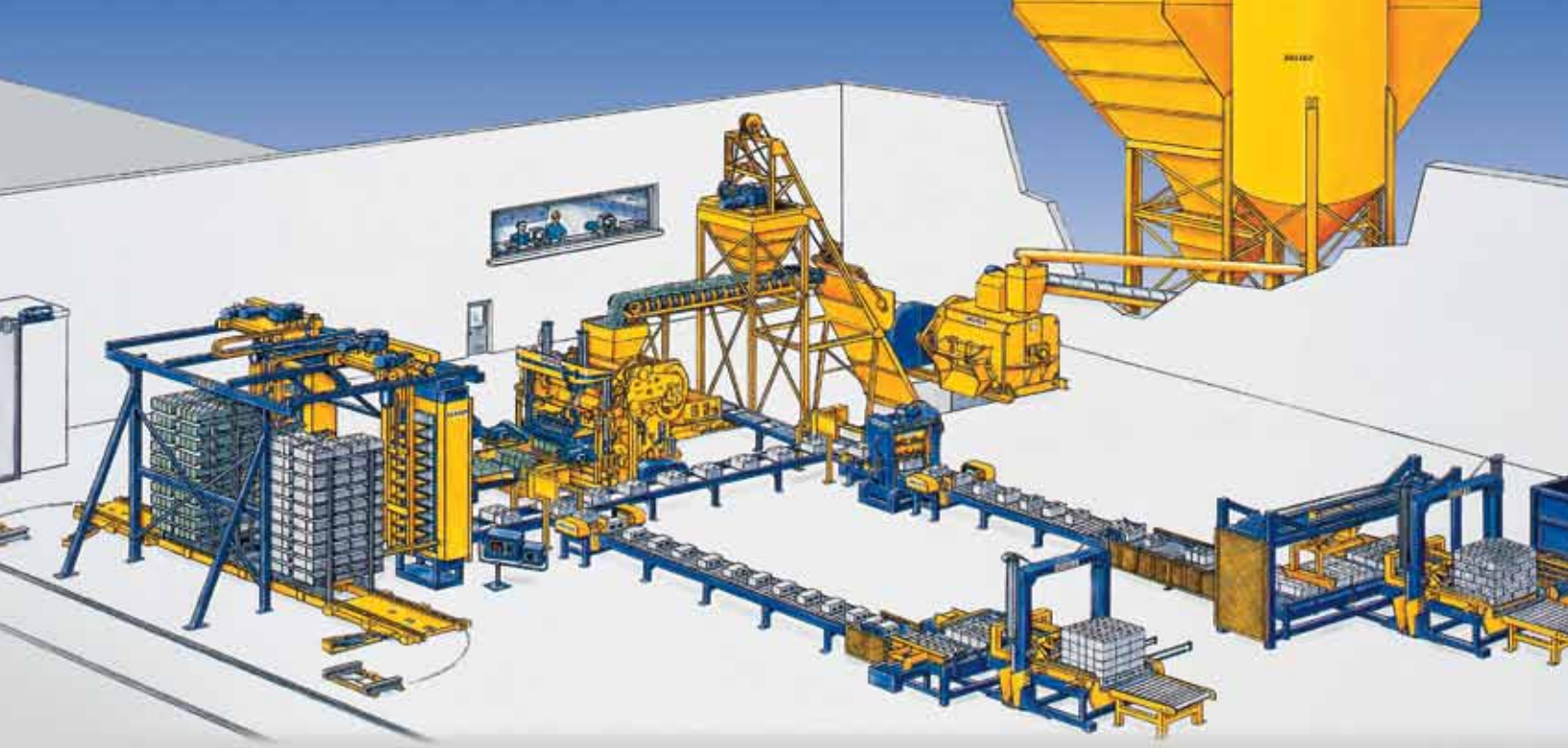
Batching and mixing

The raw materials in the storage bins and silos are transported to a weighing or batching system as needed. Weighing raw materials for each batch is necessary to ensure consistency. Each product produced has a specific mix design, programmed into the batching controls so that it can be easily reproduced.

There are many types of mixers available but their function is the same – to create zero slump concrete. After dry mixing the raw materials a small amount of water is added to the mixer using a computer controlled electronic water meter which ensures consistency. Regardless of the type of mixer that is used abrasive materials are being combined so replaceable, hardened liners form the inside of the mixer and are replaced as needed.

Admixtures, such as water repellents and coloring agents, are added as the materials are being combined. After more mixing the consistency of the batch is automatically checked and additional water may be added. Total mixing time is dictated by the type of mixer and the type of concrete products being produced. Once thoroughly mixed the concrete is ready to be converted into products.





Molding

A wide variety of sizes and types of machines are available; the production system that best suits your need is determined by the quantity and type of products you want to produce.

The concrete is transferred to the concrete products machine where it is fed into a mold. The configuration of the mold determines the size and style of the products produced. Changing molds allows the producer to make a wide range of products including split and scored architectural units, brick, paving stone, retaining wall units, edgers and slabs – all using the same equipment in the same facility. A single mold box can make many different shapes by altering the combination of parts that are assembled. Depending upon the demand for products the mold is changed after several hours, days or weeks.

Once placed into the mold the concrete is compacted and consolidated by a combination of pressure and controlled vibration. When using Besser equipment vibration is tailored precisely to each product being produced ensuring high quality products with maximum compaction, uniformity and strength. At the end of the molding cycle products are extruded from the mold onto a pallet or board depending upon your specific requirements. This process differs from the multi-piece molds used in other industries where mold sections are removed in opposite directions.

As the products leave the concrete products machine either a rotating brush or a short blast of air is used to remove loose pieces of concrete. At this point the products are referred to as "green" or uncured.

Curing

Once a rack is filled with steel pallets of green units, or a finger car is completely loaded, the products are automatically taken to the kiln. Some plants are not fully automated and a fork truck is used to transport racks to the curing chamber.

Kilns, or curing chambers, operate at atmospheric pressure. Generally the concrete products are held in the kiln for 12 – 24 hours. In some climates the heat generated by the chemical process, referred to as the heat of hydration, is sufficient to raise the temperature to desired levels without the use of steam.

Concrete products are normally cured at a maximum temperature of between 120° - 180° (55 - 70° C) which is significantly less than 800° F (425° C) needed to cure clay brick. When the temperature reaches a predetermined level, the steam, if used, is automatically shut off and the products are allowed to cure for an additional period of time. Steam, if used is turned on to maintain 100% humidity in the curing chamber. The entire curing process normally takes 24 hours but can be shortened by adjusting the mix design and curing temperatures. Products generally achieve 90% of their ultimate strength when only two to four days old.

Palletizing and storing

Cured concrete products are removed from the kilns and moved to a processing area where optional operations, such as splitting or inline aging may be performed to enhance the appearance of the units. The units are then "cubed" or palletized.

Cubing of products consists of turning individual units and creating interlocking patterns that are then placed in alternating layers to create a cubic shape of products that can be handled efficiently. The cubing is normally done by a piece of equipment that is programmed to automatically create pre-determined patterns based on the products dimensions and shape. The cube of products can be placed on a wood pallet or handled by a forklift using the cores of the product as lifting locations. At this point some producers use "out-of-line" product enhancement methods including shotblasing, grinding or tumbling in a separate location at the site. Once these processes are complete the products are re-cubed.

Some producers choose to protect cubes with plastic bags or shrink-wrap. Complete cubes are taken by fork truck to the yard where they generally are stacked four cubes high. Cubes remain in the yard, in inventory, until delivered to a jobsite.


TARGET