SHOULDICE STONE

LIFE'S BUILDING BLOCKS

Product Binder

shouldice.ca

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Building for Generations

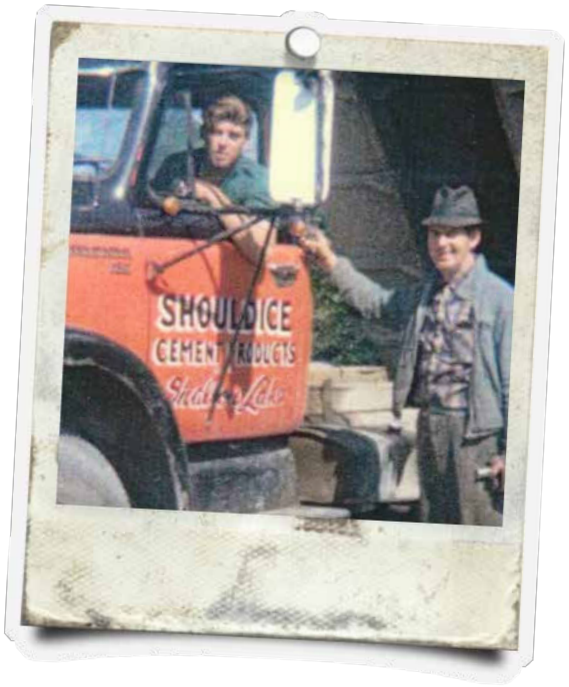
Our brand is our name. For three generations the Shouldice family has owned and operated Shouldice Stone. Our grandfather, Bev Shouldice, started the company in 1947. Our parents, Rob and June then grew the business by adding numerous innovations and new products to reflect our customer's expanding tastes. Today we are honoured to continue the family legacy and are growing our business for generations to come. We proudly carry on our grandfather's promise:
"Our word is our bond, and our handshake is a contract"

–**Steve** and **Brad Shouldice**

Our History

Life's Building Blocks

For more than 75 years, architects, builders, masons and homeowners have relied on Canadian made Shouldice Stone for durable, eye-catching results. Whether you are creating your dream home or working on a marquee project for your company, Shouldice masonry products are built to last.



Why Shouldice is your best choice:

Service comes first

As a third-generation, family-owned company, we take immense pride in our customer service. We are not happy until every one of our customers is happy.

Sustainable products

Ninety per cent of our materials are sourced from within 25 km of our Shallow Lake, Ontario, manufacturing facility. Our in-house R&D team continually looks for ways to make our products and processes more sustainable.

Durable by nature

Our products are built to last. Every Shouldice stone, brick and accessory comes with a lifetime warranty.

Diverse lineup

Our lineup of stone and brick products can be used to create any style of building, from a classic country farmhouse to an ultra-modern high rise.

Over 75 years of dedication to family values and Innovation, Quality, and Service.

Today, after more than 75 years, we take great pride in the products we produce and the wonderful relationships we are privileged to enjoy. We eagerly look forward to another 75 years of Innovation, Quality, and Service.

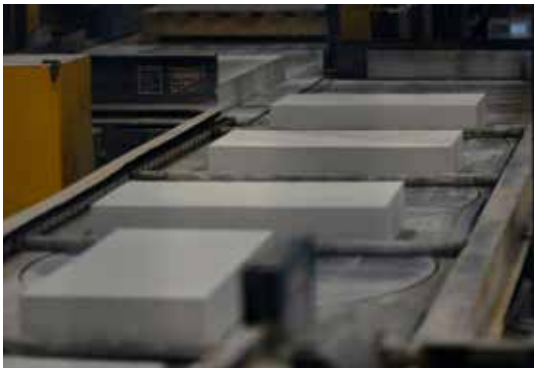
- The transformation of standard concrete block into decorative concrete block through the offering of a broad spectrum of solid and blended colours.
- The introduction of Designer Stone. Modifications to the production process and extensive research and development marked the genesis of our manufactured stone.
- The introduction of our Architectural Collection complemented the broad spectrum of existing Designer Stone choices. These Architectural Products transformed blocks of concrete into exclusive sizes and shapes for a dynamic expression on all modes of construction.
- The corporate name of Shouldice Cement Products Limited changed to Shouldice Designer Stone Limited. The new corporate name better reflected the nature of the business as stone profiles came to represent the major portion of sales.
- The introduction of Fusion Stone, a patented, mechanically fastened system based on thin veneer stone that can be installed on all interior and exterior walls using stainless steel screws and clips. Fusion Stone made masonry practically accessible to the Do-It-Yourself market for the very first time.

Innovation

In a rapidly and ever changing environment innovation is not only desirable but a survival and growth necessity. Since our founding in 1947 we have purposefully adhered to a strategic commitment to innovation.

Our advanced research and development lab is dedicated to the full time quest for better technologies, better methodologies, better components and better products. This dedication has established us on the leading edge of product development in the stone business.

Our continuing quest for the new and the better has, time and again, brought delighted satisfaction to our many customers. From our unique and comprehensive palette of integral colours, to our wide variety of accessory styles, and the world's 1st mechanically fastened thin stone DIY system, our single-minded goal is to conceive, produce and service the most innovative products in the industry.



Quality

Producing a consistently high quality product doesn't happen by chance. Shouldice Designer Stone has become the premier choice of architects, designers, contractors, masons, corporations, and homeowners who are looking for the very best this industry has to offer.

Choosing Shouldice quality fulfills consumer dreams with not only lasting beauty but also real world investment value. There is nothing like stone to enhance the beauty of a home or to make a statement about good taste, consideration for future sustainability, and financial wisdom.

The combination of our stone and your professional installer enhance your investment value with stunning curb appeal. We are always happy to provide advice and recommendations for expert installation services appropriate to your particular needs.

There are many things that contribute to our guarantee of high quality standards:

- **We operate a full time quality control department dedicated to ensuring that our customers have only products of the highest quality with which to satisfy their creative desires.**
- **Operating from a single manufacturing facility provides us with comprehensive control over all aspects of the manufacturing process.**
- **Our state-of-the-art technology and equipment ensure Shouldice Designer Stone is produced only to highest quality standards that our customers can trust with absolute confidence.**
- **We have access to a very large supply of what is regarded as the best quality aggregate in the country. This not only guarantees quality but also consistency between colour lots.**
- **We are proud of our craftsmen that have decades of experience in meeting the exacting standards of architects and homeowners wishing to reflect their professional or personal creative visions.**

Service

Service is what gives real meaning and value to our customers from our commitment to Innovation and Quality. We strive everyday to ensure that our customers benefit from the innovative and unsurpassed quality, beauty, and range of Shouldice Designer Stone products by providing an equally high level of customer service.

You can pursue your design aspirations with confidence, knowing that we are here to support, advise and so much more. We are the only coast-to-coast full service, comprehensive masonry manufacturer / supplier in North America. We manufacture, sell and ship from a single location. As a result, we can guarantee product quality, colour consistency, and reliable delivery. As well, we can satisfy virtually all supply requirements including those of national commercial customers such as large retail chains.

Shouldice offers the industry's most extensive and comprehensive line of stone products, accents and accessories. We provide a range of full bed depth, load bearing and thin stone solutions to satisfy virtually any application requirement. There need be no limits to your inspirational or aspirational motivations.

Production Facility & Design Centre

Shouldice stone products are all manufactured and shipped from a single, multi-building, large acreage facility close to our supply of high quality aggregate. This concentration of supply, production and logistics guarantees a single-minded oversight of product quality and customer service levels that is unmatched by more widely dispersed competitors.

The same property also houses a large, beautiful design centre open to the public. A multitude of Shouldice products, many installed in consumer-friendly, real life applications, can be viewed in both interior and exterior settings.

Lifetime Warranty

Shouldice offers a Lifetime Warranty provided the initial purchaser is the product owner, the products are used according to local building codes and the products are installed according to specifications and installation guidelines.

Shouldice Top 10

1. Quality. Shouldice ships nothing but top grade stone products, made from the finest materials, using the most technologically advanced methods and processes.

2. Service. You can count on Shouldice service to be second to none every time.

3. Innovation. Shouldice is always on the leading edge of innovation both in terms of the products it produces and the production methods it applies.

4. Reputation. Ask around – Shouldice has a great reputation built on a 70+ year tradition of quality, service and honest dealing.

5. Family ownership. Family ownership brings with it a pride and attention to detail simply not found elsewhere. Now in its third generation, the Shouldice family owners carry on this great tradition.

6. Canadian. Shouldice is a proudly owned Canadian company.

7. Raw material supply. The locally sourced aggregate utilized by Shouldice is of exceptional quality and is in large supply. This guarantees the consistency for which Shouldice is renowned.

8. Culture. The culture of the Shouldice organization is like that of a large family. Each member has their role, values the organization as a whole and strives every day to do a great job for their customers.

9. Selection. Shouldice produces a vast range of products, colours and textures to meet the most exacting needs of architects, builders and homeowners for ICI and residential applications.

10. Our customers. Everything we do is done with our customers in mind. A satisfied customer is a return customer.

Stone

Stone

Estate Stone

Estate Stone

Estate Stone is a timeless choice and our most popular residential stone. Suitable for both contemporary and traditional designs, the stones come in three different heights and varying lengths giving masons endless possibilities for design. The wide array of colour options make it easy to incorporate Estate Stone into any project.

Colours


Brockton


Bradford


Norton


Laurier


Kingston


Polar


Slate


Roberval


Wiarton


Hampton

Estate Stone

90mm x 90mm x (140mm–458mm)
3.5" x 3.5" x (5.5"–18")

90mm x 190mm x (140mm–458mm)
3.5" x 7.5" x (5.5"–18")

90mm x 290mm x (140mm–458mm)
3.5" x 7.5" x (5.5"–18")

Pieces per Sq. Ft.	Varies
Pieces per Cube	Varies
Weight per Piece	33 lbs.
Weight per Cube	2,750 lbs.
Cube Size	40" X 40"
Coverage per Cube	84 sq. ft.

Specifications

Estate Stone is a quality Concrete Masonry Unit.

Estate Stone exceeds the CSA A165.2 Series-04 and the ASTM C-55-11 specifications.

Estate Stone will not flake or deteriorate whether it is used above grade, at grade or even below grade.

Pre-formed to noted sizes for ease of installation.
Maximum water absorption by mass not to exceed 8 per cent.

Recommended to be installed with Type "N" masonry cement (see TEK 9-1A Mortars for Concrete Masonry).

Manufactured using an integral water-repellent agent which inhibits water absorption and efflorescence for a lifetime of performance.

Minimum compressive strength is 4,000 PSI.
Recommended mortar joint is 1/2".

Cold weather construction – refer to installation guidelines.

Manufactured under U.S. Patent 4,335,549 and Canadian Patents 1,169,265 and 2,127,191.

Stone

Smith Stone

Smith Stone

Smith Stone's natural stone finish is available in two different sizes and various lengths of each; perfect for creating random yet symmetrical, clean lines. It is available in two contemporary shades.

Colours


Polar


Oxenden

Smith Stone

Polar 90mm x 57mm x 194mm
3.5" x 2.25" x 8"

90mm x 124mm x 194mm
3.5" x 4.875" x 8"

90mm x 57mm x 600mm
3.5" x 2.25" x 24"

90mm x 124mm x 600mm
3.5" x 4.875" x 24"

90mm x 57mm x 295mm
3.5" x 2.25" x 12"

90mm x 124mm x 295mm
3.5" x 4.875" x 12"

90mm x 57mm x 397mm
3.5" x 2.25" x 16"

90mm x 124mm x 397mm
3.5" x 4.875" x 16"

Pieces per Sq. Ft.	Varies
Pieces per Cube	Varies
Weight per Sq. Ft.	31 lbs. & 33 lbs.
Weight per Cube	2,914 lbs. & 3,102 lbs.
Cube Size	47" Wide x 40" Deep
Coverage per Cube	94 Sq. Ft.

Specifications

Smith Stone is a quality Concrete Masonry Unit.

Smith Stone exceeds the CSA A165.2 Series-04 and the ASTM C-55-11 specifications.

Smith Stone will not flake or deteriorate whether it is used above grade, at grade or even below grade.

Maximum water absorption by mass not to exceed 8 per cent.

Recommended to be installed with Type "N" masonry cement (see TEK 9-1A Mortars for Concrete Masonry).

Smith Stone is manufactured using an integral water-repellent agent which inhibits water absorption and efflorescence for a lifetime of performance.

Minimum compressive strength 4,000 PSI.

Recommended mortar joint 3/8".

Cold weather construction – refer to installation guidelines.

Stone

Shale Stone

Shale Stone

Shale Stone is unique in the marketplace. It elicits distinct impressions of legacy, permanence, protection and strength. Shale Stone has a striking, rounded rocky surface that creates a powerful, natural stone wall presentation.

Colours


Hudson


Tundra

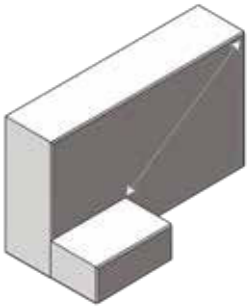

Slate


Sedona


Roberval


Polar

Shale Stone



90mm x (64mm–254mm) x (190mm–508mm)
3.5" x (2.5"–10") x (8"–20")

Pieces per Sq. Ft.	Varies
Pieces per Cube	Varies
Weight per Sq. Ft.	34 lbs.
Weight per Cube	2,850 lbs.
Cube Size	40" Wide x 40" Deep
Coverage per Cube	84 sq. ft. – 7.81 sq. m

Specifications

Shale Stone is a quality Concrete Masonry Unit.

Shale Stone exceeds the CSA A165.2 Series-04 and the ASTM C-55-11 specifications.

Shale Stone will not flake or deteriorate whether it is used above grade, at grade or even below grade.

Pre-formed to noted sizes for ease of installation.

Maximum water absorption by mass not to exceed 8 per cent.

Recommended to be installed with Type “N” masonry cement (see TEK 9-1A Mortars for Concrete Masonry).

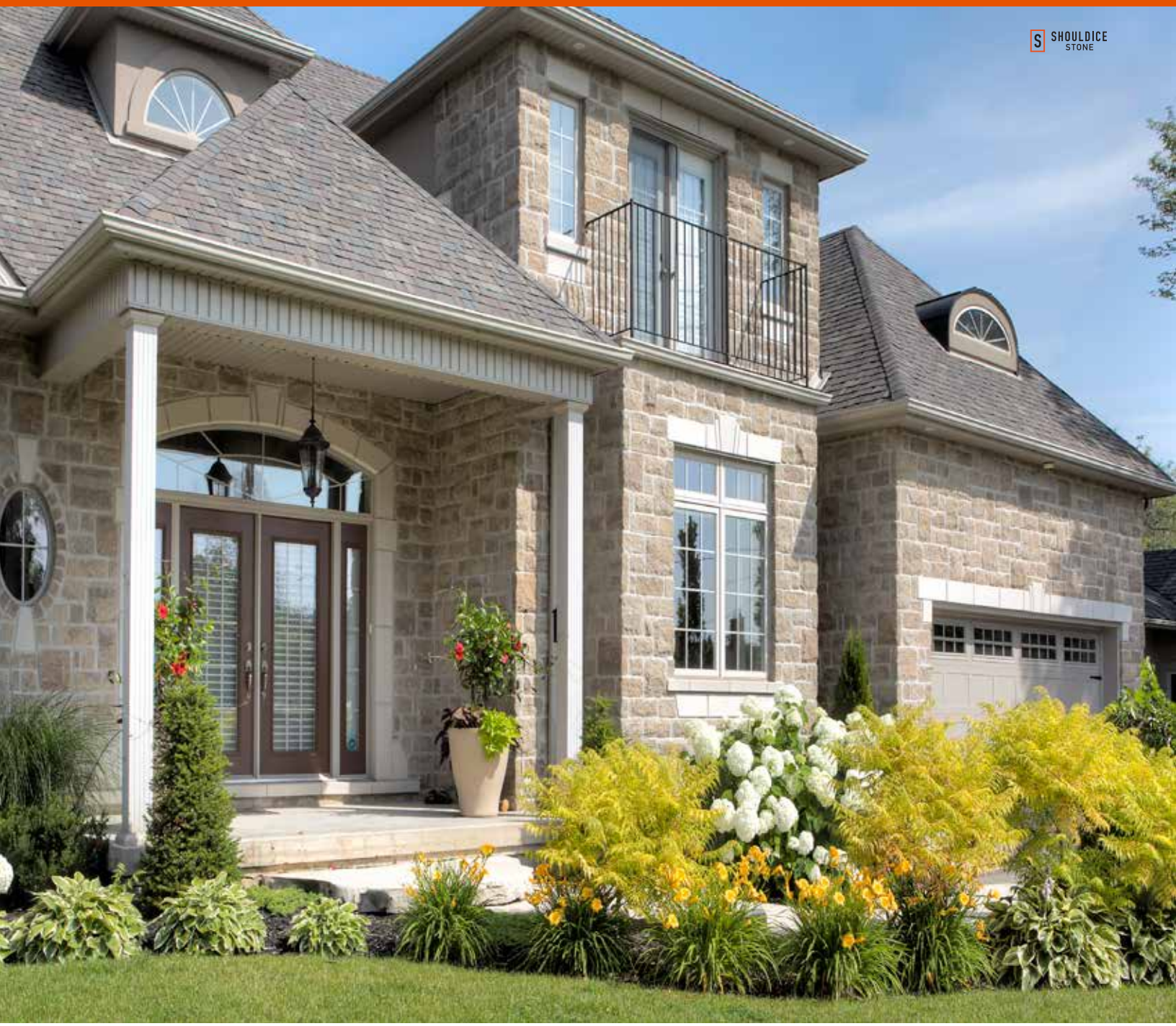
Manufactured using an integral water-repellent agent which inhibits water absorption and efflorescence for a lifetime of performance.

Minimum compressive strength 4,000 PSI.

Recommended mortar joint 1/2".

Cold weather construction - refer to installation guidelines.

Manufactured under U.S. Patent 4,335,549 and Canadian Patents 1,169,265 and 2,127,191.



Stone

Q Stone

Q Stone

Q-Stone features a distinctly antiqued rock face with larger stones than most product offerings. These are harmoniously blended together into a rugged, yet timelessly beautiful effect. A broad range of colour tones is available to create a truly unique and personalized design. Shouldice quality backs all of this for a lifetime of performance.

Colours


Amabel


Rideau


Belmont


Silverado


Cambria

Q Stone

90mm x 290mm x 390mm
3.5" x 11.5" x 15.5"

90mm x 290mm x 267mm
3.5" x 11.5" x 10.5"

90mm x 290mm x 127mm
3.5" x 11.5" x 5"

90mm x 140mm x 390mm
3.5" x 5.5" x 15.5"

90mm x 140mm x 290mm
3.5" x 5.5" x 11.5"

90mm x 140mm x 200mm
3.5" x 5.5" x 8"

Pieces per Sq. Ft.	Varies
Pieces per Cube	Varies
Weight per Sq. Ft.	140mm = 35 lbs. 293mm = 40 lbs.
Weight per Cube	140mm = 2835 lbs. 293mm = 2560 lbs.
Cube Size	47" Wide x 40" Deep
Coverage per Cube	64 Sq. Ft.

Specifications

Q Stone is a quality Concrete Masonry Unit.

Q Stone exceeds the CSA A165.2 Series-04 and the ASTM C-55-11 specifications.

Q Stone will not flake or deteriorate whether it is used above grade, at grade or even below grade.

Multiple noted sizes for ease of installation.

Maximum water absorption by mass not to exceed 8 per cent.

Recommended to be installed with Type "N" masonry cement (see TEK 9-1A Mortars for Concrete Masonry.

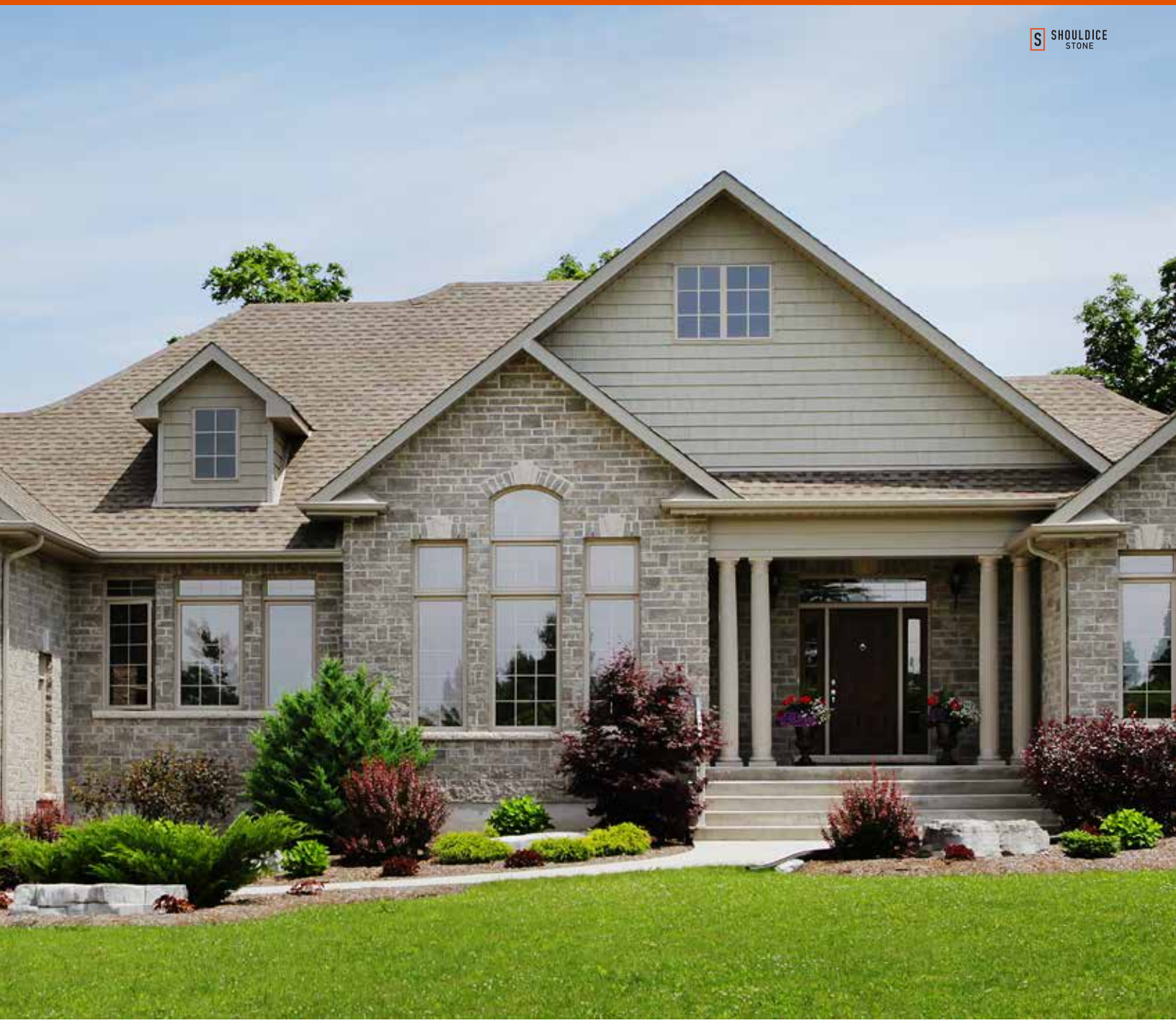
Q Stone is manufactured using an integral water-repellent agent which inhibits water absorption and efflorescence for a lifetime of performance.

Minimum compressive strength 4,000 PSI.

Recommended mortar joint 1/2".

Cold weather construction – refer to Q Stone installation guidelines.

Manufactured Under U.S. Patent 4,335,549 and Canadian Patents 1,169,265 and 2,127,191.



Stone

Newport Stone

Newport Stone

Newport Stone has two stone sizes that combine to produce a striking and distinctly natural look. A percentage of the stones have a rocked profile to add depth, substance and intensity to any wall. This evokes an arresting impression of enduring and assured discernment.

Colours


Aberdeen


Cambria


Amabel

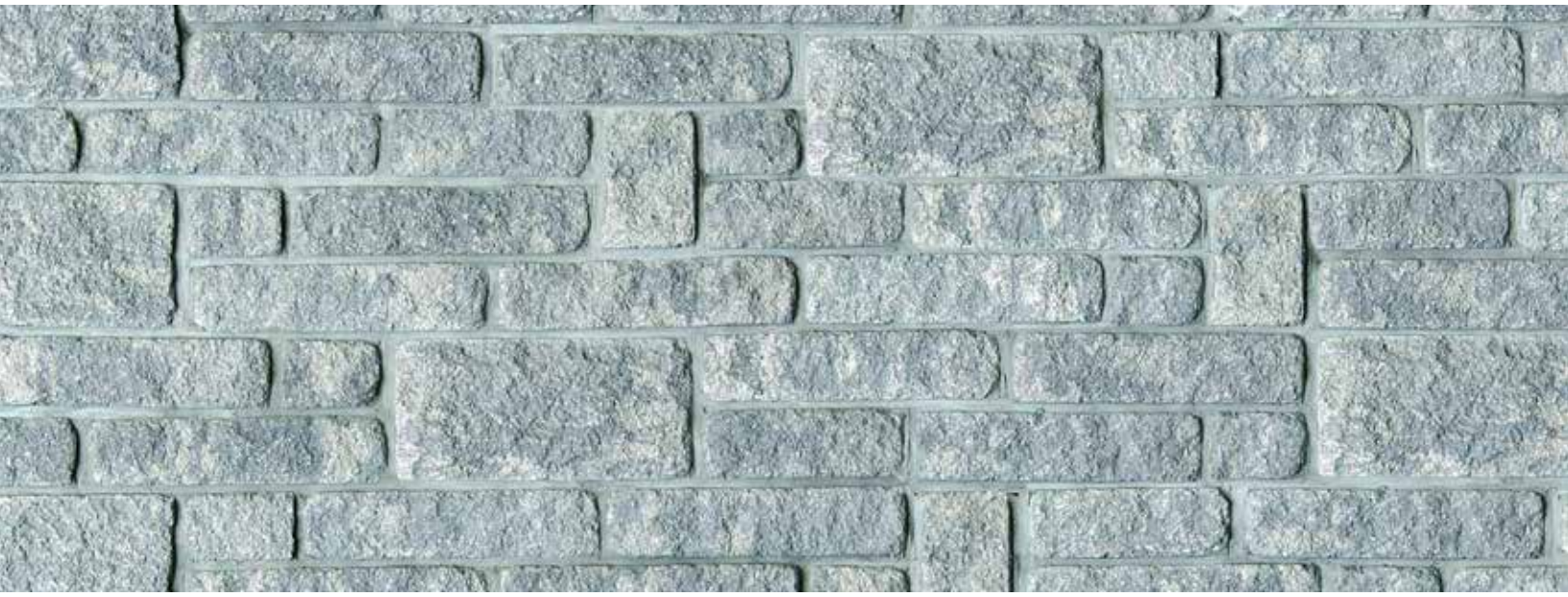

Almond


Rideau


Sterling


Silverado

Newport Stone



90mm x 90mm x 200mm
3.5" x 3.5" x 8"

90mm x 190mm x 127mm
3.5" x 7.5" x 5"

90mm x 90mm x 290mm
3.5" x 3.5" x 11.5"

90mm x 190mm x 267mm
3.5" x 7.5" x 10.5"

90mm x 90mm x 390mm
3.5" x 3.5" x 15.5"

90mm x 190mm x 390mm
3.5" x 7.5" x 15.5"

Pieces per Sq. Ft.	Varies
Pieces per Cube	Varies
Weight per Sq. Ft.	34 lbs.
Weight per Cube	2,754 lbs.
Cube Size	47" Wide x 40" Deep
Coverage per Cube	81 Sq. Ft.

Specifications

Newport Stone is a quality Concrete Masonry Unit.

Newport Stone exceeds CSA A165.2 Series-04 and the ASTM C-55-11 specifications.

Newport Stone will not flake or deteriorate whether it is used above grade, at grade or even below grade.

Pre-split to noted sizes for ease of installation.

Maximum water absorption by mass not to exceed 8 per cent.

Recommended to be installed with Type "N" masonry cement (see TEK 9-1A Mortars for Concrete Masonry).

Newport Stone is manufactured using an integral water-repellent agent which inhibits water absorption and efflorescence for a lifetime of performance.

Minimum compressive strength 4,000 PSI.

Recommended mortar joint 1/2".

Cold weather construction – refer to installation guidelines.

Manufactured Under U.S. Patent 4,335,549 and Canadian Patents 1,169,265 and 2,127,191.

Brick

Brick

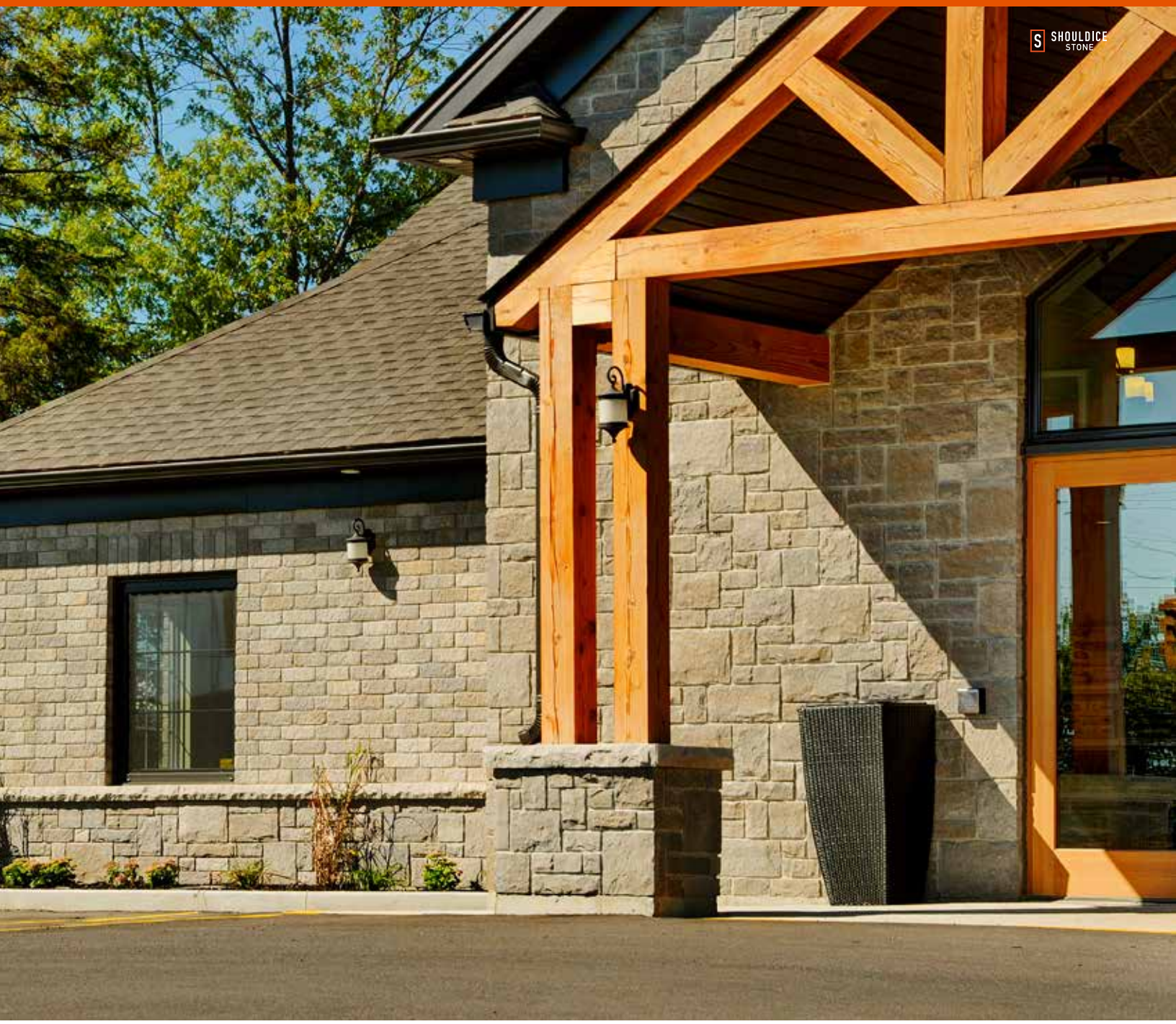
Shouldice Architectural Stone is available in such an extensive variety of sizes, colours, and finishes that we can satisfy the requirements of the most expansive design imagination, especially if that imagination is looking to mix and match.

Choose from 4 hollow core unit sizes and 10 stretcher size alternatives as standards. That's only the beginning as you may select from 9 colour variations in each of 3 texture finishes (Rock Stone, Tapestry, and Tex Stone), organized into our Standard, Legacy, and Elite series options.

The custom possibilities are virtually endless to conceive, design and complete an effectually maintenance-free, enduring project of superb, complex beauty and compelling distinction.

Shouldice Architectural Block is produced in many size variations with almost endless, stunning colour options. If this is not enough we can custom reproduce almost any colour you may desire.

With so many alternatives from which to choose you can elevate the traditional stature of basic block into a unique, distinctive, and striking custom result.



Brick

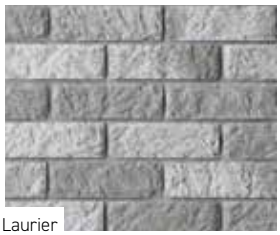
MJ Saratoga Brick

MJ Saratoga Brick

MJ Saratoga Brick is a traditional, brick sized stone. Its innovative pressed-face texture and wide variety of earth tone colour blends make it a great choice for either traditional or contemporary applications. Alternatively, working with our other stone profiles, MJ Saratoga brick is a versatile performer as the primary stone, secondary player or as a design accent. Whatever your choice, Shouldice quality guarantees MJ Saratoga Brick for a lifetime of performance and peace of mind.

Colours


Norton


Laurier


Brockton


Bradford

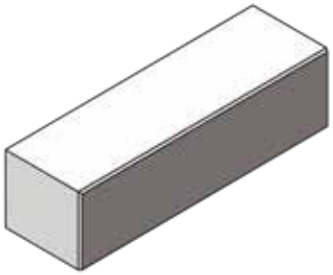

Kingston


Hampton


Wiarton


Roberval

MJ Saratoga Brick



90mm x 90mm x 290mm
3.5" x 3.5" x 11.5"

Pieces per Sq. Ft.	3
Pieces per Cube	231
Weight per Sq. Ft.	32.25 lbs.
Weight per Cube	11.75 lbs.
Cube Size	2,714 lbs.
Cube Size	40" Wide x 40" Deep.
Coverage per Cube	77 Sq. Ft.

Specifications

MJ Saratoga Brick is a quality Concrete Masonry Unit.

MJ Saratoga Brick exceeds the CSA A165.2 Series-04 and the ASTM C-55-11 specifications.

MJ Saratoga Brick will not flake or deteriorate whether it is used above grade, at grade or even below grade.

Maximum water absorption by mass not to exceed 8 per cent.

Recommended to be installed with Type "N" masonry cement (see TEK 9-1A Mortars for Concrete Masonry).

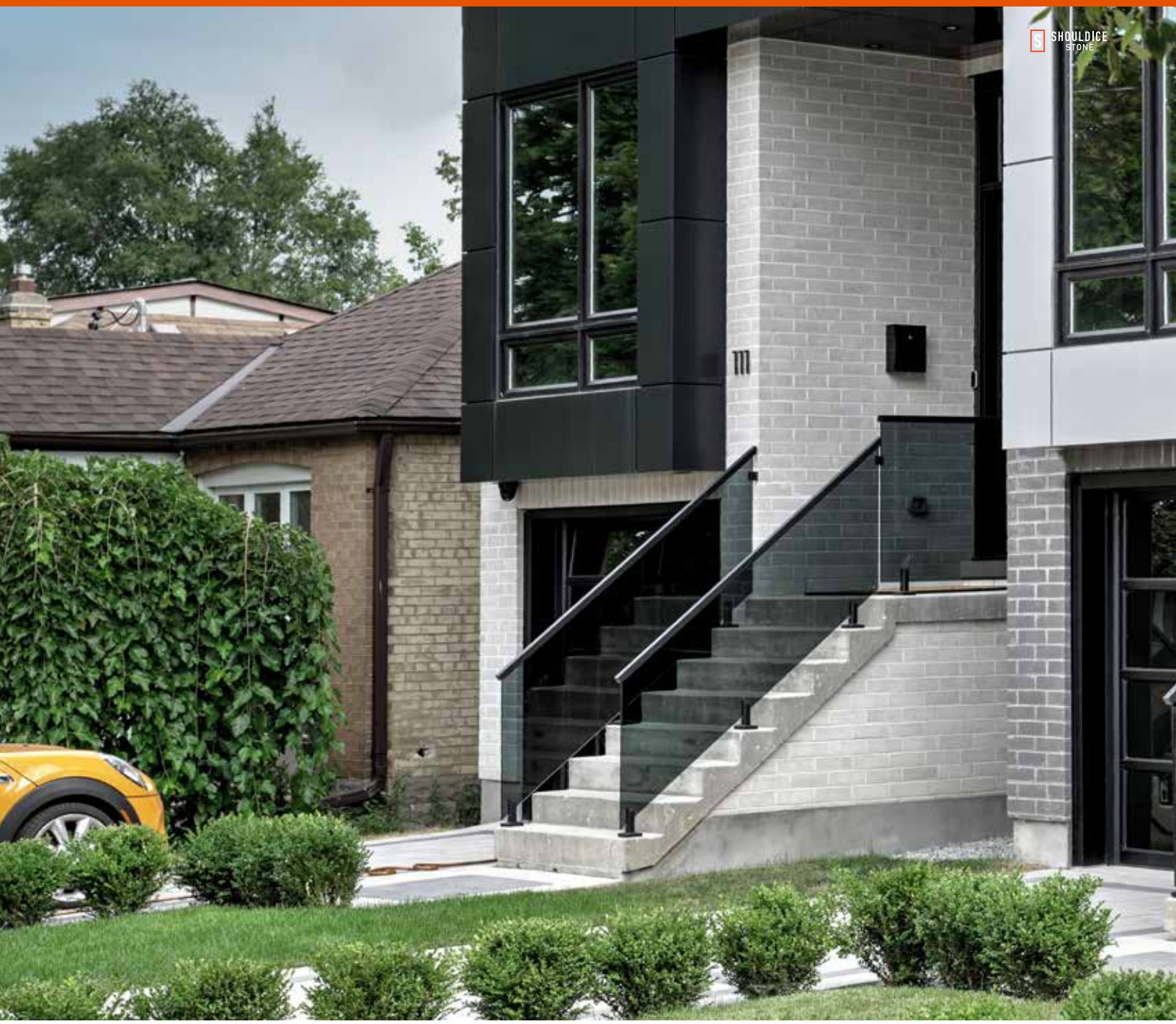
MJ Saratoga Brick is manufactured using an integral water-repellent agent which inhibits water absorption and efflorescence for a lifetime of performance.

Minimum compressive strength 4,000 PSI.

Recommended mortar joint 1/2".

Cold weather construction – refer to installation guidelines.

Manufactured Under U.S. Patent 4,335,549 and Canadian Patents 1,169,265 and 2,127,191.



Brick

Strata Brick Smooth

Strata Brick Smooth

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Polar


Galaxy


Waterford

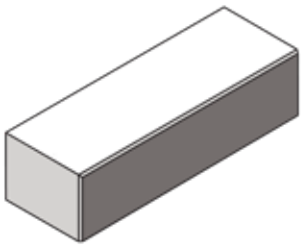

Oxenden


Tutela


Jet


Odessa

Strata Brick Smooth



90mm x 79mm x 257mm
3.5" x 3.125" x 10.125

Pieces per Sq. Ft.	3.9
Pieces per Cube	382
Weight per Sq. Ft.	31 lbs.
Weight per Cube	8 lbs.
Cube Size	3,038 lbs.
Cube Size	40" Wide x 40" Deep.
Coverage per Cube	98 Sq. Ft.

Specifications

Strata Brick Smooth is a quality Concrete Masonry Unit.

Strata Brick Smooth exceeds the CSA A165.2 Series-04 and the ASTM C-55-11 specifications.

Strata Brick Smooth will not flake or deteriorate whether it is used above grade, at grade or even below grade.

Maximum water absorption by mass not to exceed 8 per cent.

Recommended to be installed with Type "N" masonry cement (see TEK 9-1A Mortars for Concrete Masonry).

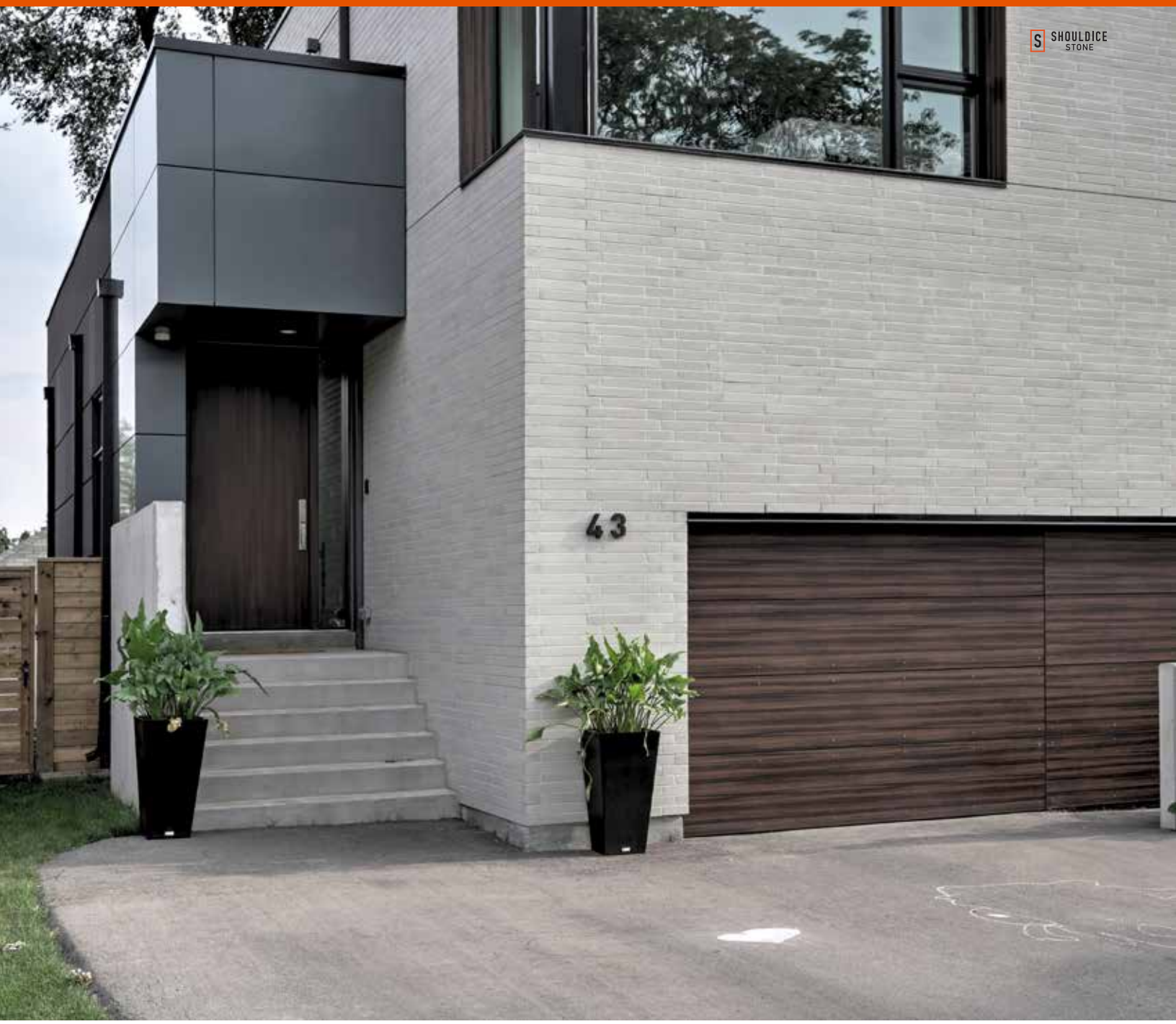
MJ Saratoga Brick is manufactured using an integral water-repellent agent which inhibits water absorption and efflorescence for a lifetime of performance.

Minimum compressive strength 4,000 PSI.

Recommended mortar joint 1/2".

Cold weather construction – refer to installation guidelines.

Manufactured Under U.S. Patent 4,335,549 and Canadian Patents 1,169,265 and 2,127,191.



Brick

Urban Brick Smooth

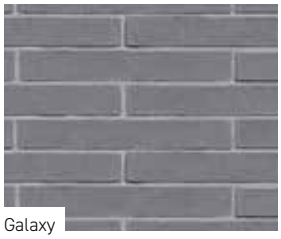
Urban Brick Smooth

Urban Brick Smooth is a popular choice for modern residential and commercial designs. It's available in the whitish-greys of Oxenden and Polar and the contrasting dark shade of Galaxy.

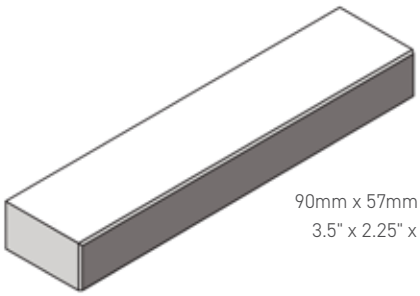
Colours


Polar


Oxenden


Galaxy

Urban Brick Smooth



90mm x 57mm x 397mm
3.5" x 2.25" x 15.625"

Pieces per Sq. Ft.	3.4
Pieces per Cube	352
Weight per Sq. Ft.	31 lbs.
Weight per Cube	9 lbs.
Cube Size	3,224 lbs.
Cube Size	47" Wide x 40" Deep
Coverage per Cube	104 Sq. Ft.

Specifications

Urban Brick Smooth is a quality Concrete Masonry Unit.

Urban Brick Smooth exceeds the CSA A165.2 Series-04 and the ASTM C-55-11 specifications.

Urban Brick Smooth will not flake or deteriorate whether it is used above grade, at grade or even below grade.

Maximum water absorption by mass not to exceed 8 per cent.

Recommended to be installed with Type "N" masonry cement (see TEK 9-1A Mortars for Concrete Masonry).

Urban Brick Smooth is manufactured using an integral water-repellent agent which inhibits water absorption and efflorescence for a lifetime of performance.

Minimum compressive strength 4,000 PSI.

Recommended mortar joint 1/2".

Cold weather construction – refer to installation guidelines.

Manufactured Under U.S. Patent 4,335,549 and Canadian Patents 1,169,265 and 2,127,191.

NEW PRODUCT

Norman Brick Smooth

Norman Brick Smooth is our newest addition to our brick lineup with crisp, linear lines and a slender profile, this brick is well-suited to both classic and modern designs.

Colours

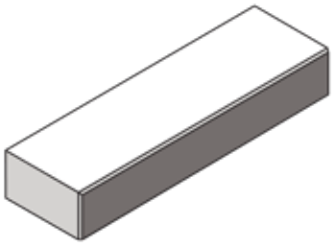

Polar


Pearl White


Oxenden

NEW PRODUCT

Norman Brick Smooth



90mm x 57mm x 290mm
3.5" x 2.25" x 11.5"

Pieces per Sq. Ft.	4.6
Pieces per Cube	464
Weight per Sq. Ft.	32 lbs.
Weight per Cube	7 lbs.
Cube Size	3,232 lbs.
Cube Size	47" Wide x 40" Deep
Coverage per Cube	101 Sq. Ft.

Specifications

Norman Brick Smooth is a quality Concrete Masonry Unit.

Norman Brick Smooth exceeds the CSA A165.2 Series-04 and the ASTM C-55-11 specifications.

Norman Brick Smooth will not flake or deteriorate whether it is used above grade, at grade or even below grade.

Maximum water absorption by mass not to exceed 8 per cent.

Recommended to be installed with Type "N" masonry cement (see TEK 9-1A Mortars for Concrete Masonry).

MJ Saratoga Brick is manufactured using an integral water-repellent agent which inhibits water absorption and efflorescence for a lifetime of performance.

Minimum compressive strength 4,000 PSI.

Recommended mortar joint 1/2".

Cold weather construction – refer to installation guidelines.

Manufactured Under U.S. Patent 4,335,549 and Canadian Patents 1,169,265 and 2,127,191.

Dimensional Stone

Dimensional Stone

Our Dimensional Stone lineup is available in four different textures in a variety of shapes, sizes, and weight options for largescale projects making it suitable for classic or contemporary designs. They can also be manufactured in our full range of standard and custom colours.

Tapestry

Our most refined finish, *Tapestry* bricks feature a polished surface with bevelled edges.

Tex

Tex, short for textured, is distressed to give it a relatively course finish. Some *Tex* colours are speckled with contrasting tones from the exposed aggregate.

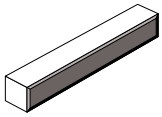
Smooth

As the name suggests, Smooth has a relatively untextured finish. *Smooth*, our newest offering, is how each brick appears when it comes out of the kiln. The surface texture falls between the polished finish of *Tapestry* and the slightly distressed look and feel of *Tex*.

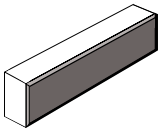
Rock

Each of our *Rock* bricks has a one-of-a-kind, highly textured profile. The name *Rock* comes for the rock-like appearance of this finish.

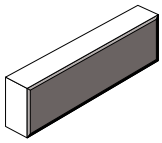
Technical Drawings



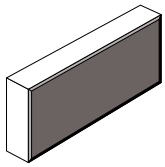
90mm x 90mm x 590mm
3.5" x 3.5" x 23.25"



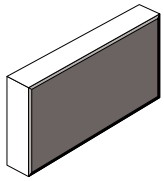
140mm x 140mm x 590mm
5.5" x 5.5" x 23.25"



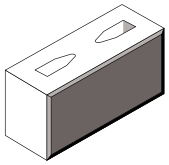
90mm x 190mm x 590mm
3.5" x 7.5" x 23.25"



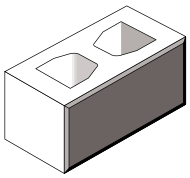
90mm x 290mm x 590mm
3.5" x 11.5" x 23.25"



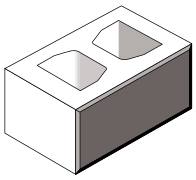
90mm x 390mm x 590mm
3.5" x 15.5" x 23.25"



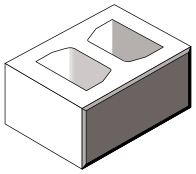
140mm x 190mm x 390mm
5.5" x 7.5" x 15.5"



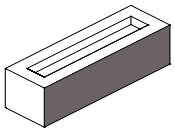
190mm x 190mm x 390mm
7.5" x 7.5" x 15.5"



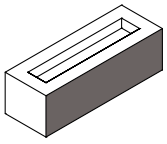
240mm x 190mm x 390mm
9.5" x 7.5" x 15.5"



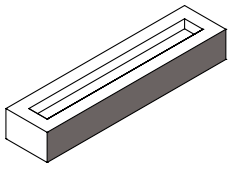
290mm x 190mm x 390mm
11.375" x 7.5" x 15.5"



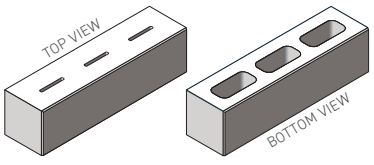
90mm x 79mm x 257mm
3.5" x 3.125" x 10.125"



90mm x 79mm x 290mm
3.5" x 3.125" x 11.5"



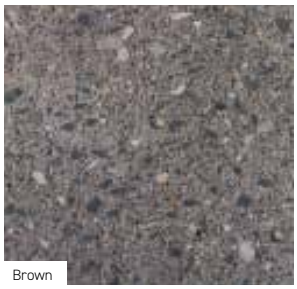
90mm x 57mm x 397mm
3.5" x 2.25" x 15.625"

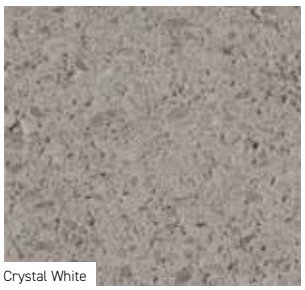


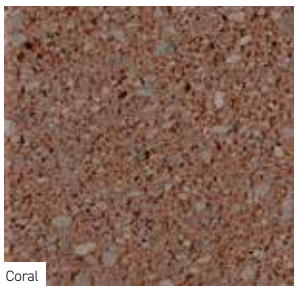
90mm x 90mm x 390mm
3.5" x 3.5" x 15.5"

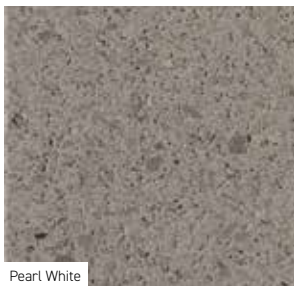
Colours

Colour swatches displayed here are in Tapestry, but are available in other profiles: Smooth, Tex, and Rock. In addition to the dozens of standard colours we have for our stone & brick products, our in-house R&D team can create a custom colour to match almost any sample you provide.


Brown


Crystal White

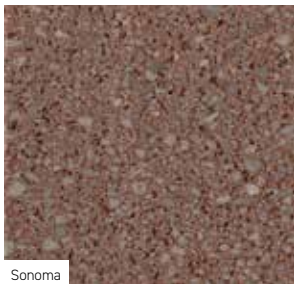

Coral


Pearl White


Tulsa


Balon


Ultra White

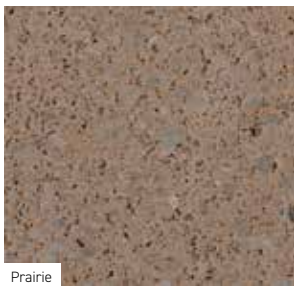

Sonoma


Pewter


Desert Buff


Silverado

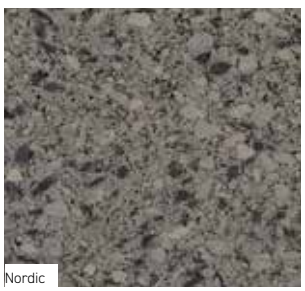

Chamois

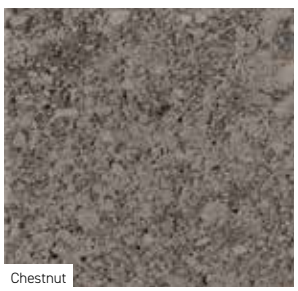

Prairie

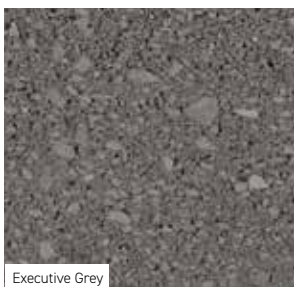

Galaxy


Moss

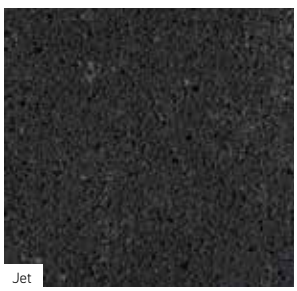

Antique Bronze


Nordic

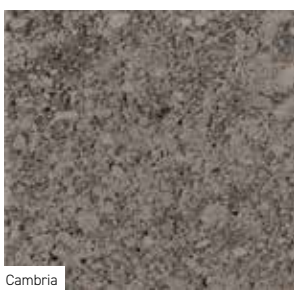

Chestnut


Executive Grey

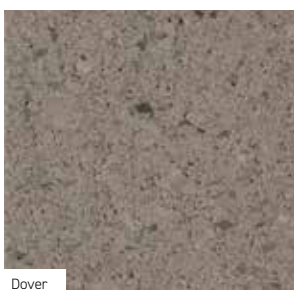

Briar

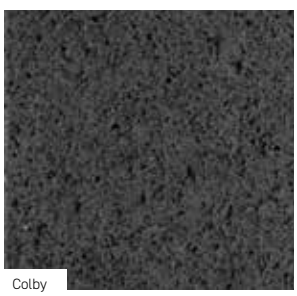

Jet


Latte


Cambria


Suede


Dover


Colby

Vancouver Island University,
Health and Wellness Centre

SHOULDICE STONE

Cowbell Brewing Co.

Blyth, Ontario

SHOULDICE STONE

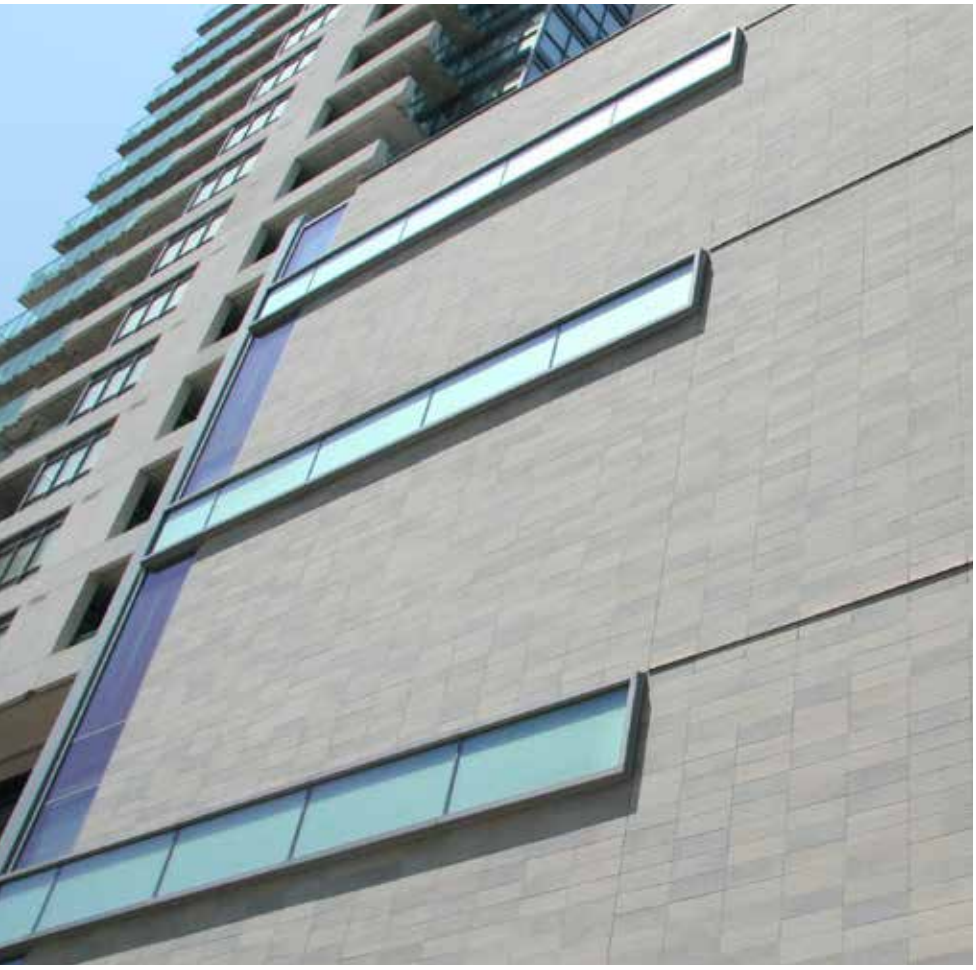
Bank of America

SHOULDICE STONE

Celia Franca Centre

Canada's National Ballet School

SHOULDICE STONE



Stone Installation

Masonry Cement

Shouldice Designer Stone recommends the use of Type N masonry mixed at a ratio of 3 to 1 with clean sharp masonry sand. Type S masonry should not be used in conjunction with standard veneer applications.

Use consistent batching procedures when mixing mortar and take adequate mixing time. Tool the joint after the mortar has begun to stiffen slightly. Should a joint be tooled too soon (in a wet condition) a light joint results. Conversely, if a joint is allowed to become too stiff, a dark burned joint will result.

Shouldice Designer Stone is manufactured using an integral water repellent agent which inhibits water absorption and efflorescence. The low absorption rate may affect set up time of the mortar joints in cool weather. This slow set-up time will be an advantage in warm, dry weather but it is important to keep all material covered and dry in wet or cold conditions to ensure tooling of the joint can be done at the proper time.

Installation
Estate & Shale Stone

One pallet of Estate Stone covers 84 SF; there are seven layers on each pallet, Each layer consists of three different heights and multiple lengths in correct proportions for installation. The lengths have been calculated to reduce cutting to a minimum. The three heights can be coursed with a 1/2" bed joint to reach imperial coursing. Avoid placing the larger stones in groups. Spread each size equally through the wall breaking the horizontal mortar joints regularly. Vertical mortar joints should not exceed 12" (300 mm) with a minimum of 2" (50mm) overlap on the stone below.

Shouldice Shale Stone has been designed to emulate the innate qualities of natural limestone coursing. It conveys all the variety and random features that can be found in Natural Stone. Shale Stone consists of 7 heights of stone which combine to create a stunning natural appearance not found in other manufactured stones.

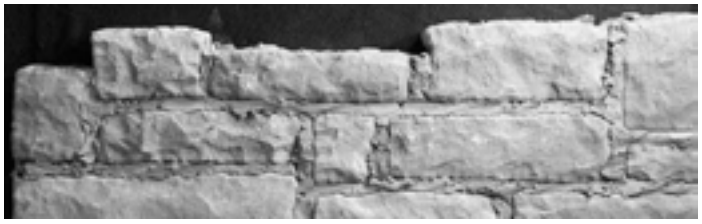
When cutting is required a chisel, mechanical splitter or a masonry saw may be used remembering to turn the cut end into the wall leaving the factory finish exposed.

Getting Started

The larger stones can be leveled using two smaller stones equal to it in height.

When leveling smaller stones, use a second small stone on top in order to achieve the appropriate height required to create a level course.

Overlap head joints at least 2" and try not to exceed 3 courses of a vertical joint.



Leveling the top of each stone produces the best result as the Shale Stone units are irregular. Building up the mortar bed will be required to compensate for these variances, much the same as natural limestone, adding character to the overall appearance.

To avoid excessive cutting, lay full units the length of the wall, chasing the cut to a corner or an opening. When cutting or splitting is required, remember to turn the cut edge into the wall and leave the textured ends exposed.

Installation
Q Stone

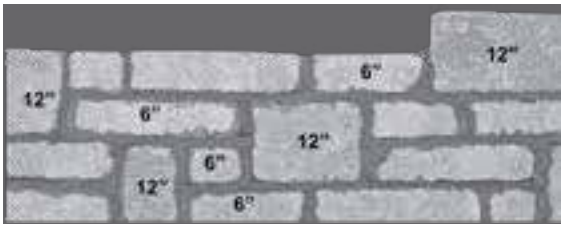
Q-Stone is the ultimate choice in stone for elegance, permanence and warm visual beauty. Pre-Split, Pre-Blended and Pre-Packaged with Antique and Rock-Stone all on two cubes. Follow the installation guidelines in a one cube 6" size to one cube 12" size ratio for a perfect 55/45 bond ratio in the complete wall. Cube coverage 6" size 81 - SF and 12" size - 64 SF.

Getting Started

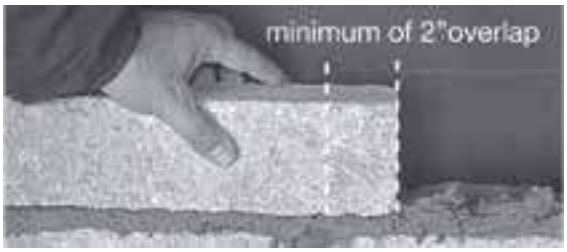
Spread smaller stone 6" size along scaffold with the 12" size.

Lay 6" size in running bond, placing 12" size at intervals so the 12s and 6s are installed at approximately the same time. Use the 12" size stones to break the horizontal lines formed by the 6" size stones.

Distribute the 12" size stones evenly throughout the wall. Use a 1/2" mortar bed joint to maintain 12" coursing. Use a chisel or splitter to cut the stones when required (wear eye protection).



Leave textured split ends facing out at openings and corners. Always try to maintain a maximum 12" vertical mortar joint height and a minimum 2" overlap.



Overlap head joints a minimum of 2".

To avoid excessive cutting, lay full units the length of the wall, chasing the cut to a corner or an opening. When cutting or splitting is required, remember to turn the cut edge into the wall and leave the textured ends exposed.

Installation
Newport Stone

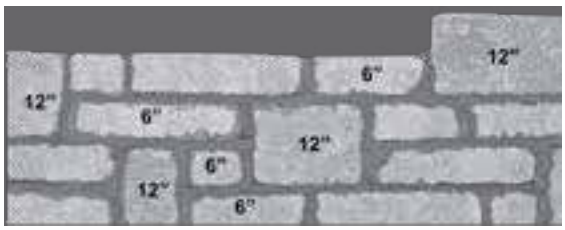
One cube of Newport Stone contains enough material to cover 81 sq. ft. of wall, 54 sq. ft. of 4" high and 27 sq. ft. of 8" stone. The 8" high is packaged on the top of the cube and is to be blended in the wall with the 4" high size. The 4" size will cover 2/3 the wall area and the 8" size 1/3 the wall area in a perfect 66% - 33% bond ratio. The vertical coursing of Newport Stone is 8" high and stones should overlap a minimum of 2" using a 1/2" mortar joint.

Getting Started

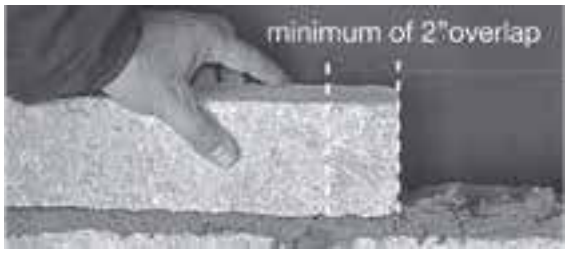
Spread smaller stone 6" size along scaffold with the 12" size.

Lay 6" size in running bond, placing 12" size at intervals so the 12s and 6s are installed at approximately the same time. Use the 12" size stones to break the horizontal lines formed by the 6" size stones.

Distribute the 12" size stones evenly throughout the wall. Use a 1/2" mortar bed joint to maintain 12" coursing. Use a chisel or splitter to cut the stones when required (wear eye protection).



Leave textured split ends facing out at openings and corners. Always try to maintain a maximum 12" vertical mortar joint height and a minimum 2" overlap.



Overlap head joints a minimum of 2".

To avoid excessive cutting, lay full units the length of the wall, chasing the cut to a corner or an opening. When cutting or splitting is required, remember to turn the cut edge into the wall and leave the textured ends exposed.

Corner Installation
All Profiles

Getting Started Building Corners


Use the 10 1/2" long units in both the 4" and 8" size to build the corners.



To create angle corners, cut the stone with a chisel at the desired angle. Use a chisel or splitter to cut the stones when required (wear eye protection). Rub the cut end with a broken piece to restore the weathered face.



Allow mortar joints to dry to thumbprint stiffness then strike with the desired tools, e.g., Concave, Flush or Raked joint. Sweep the wall with a soft brush to clean up the joints.

SHOULDICE
STONE

Brick Installation

Brick Installation

Shouldice Designer Stone Architectural units, sills, copings and water tables should be handled carefully. Installation of product constitutes acceptance.

- Ensure that all specified flashing and damp-proofing is installed.
- Flashing and weep holes must be installed above and below openings, the bottom of the walls and any points where water may gather.
- All head joints at copings and sills and all stone sections with projecting profiles and/or exposed top joints should be raked and made into sealant joints. Only the ends extending under the wall should be mortared joints.
- Do not bridge coping and sills over control or expansion joints.
- All sills and copings or pieces with projecting profiles should be protected during construction.
- During construction, cover open walls when rain or snow is anticipated.
- Failure to follow the above instructions may allow excessive and harmful moisture to accumulate in the wall system.

Please reference the Technical Specification section for more information on Control Joints, Flashing, etc.

Masonry Cement

Shouldice Designer Stone recommends the use of Type N masonry mixed at a ratio of 3 to 1 with clean sharp masonry sand. Type S masonry should not be used in conjunction with standard veneer applications.

Use consistent batching procedures when mixing mortar and take adequate mixing time. Tool the joint after the mortar has begun to stiffen slightly. Should a joint be tooled too soon (in a wet condition) a light joint results. Conversely, if a joint is allowed to become too stiff, a dark burned joint will result.

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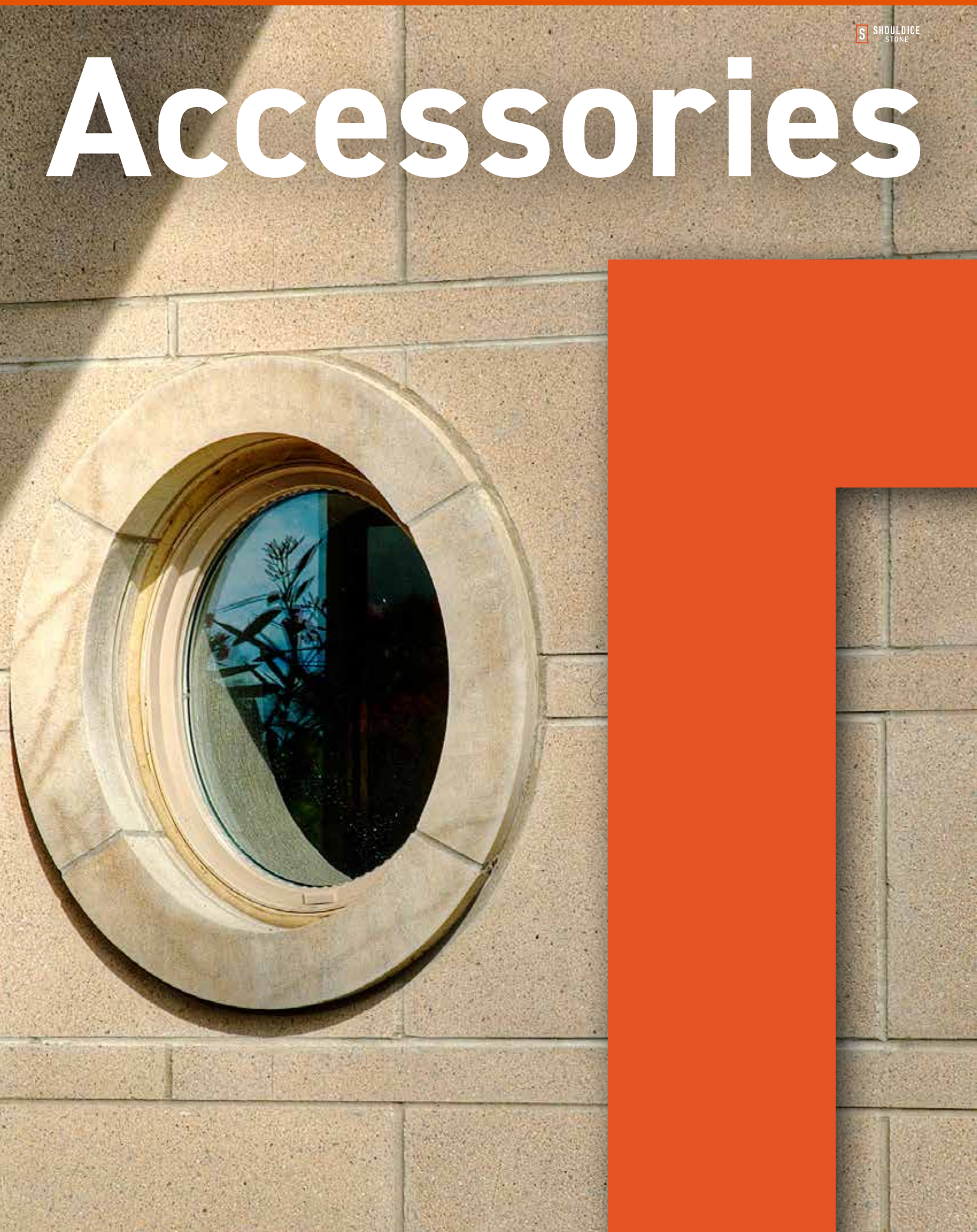
Accessories



Accessories

Personal expression. That is the primary purpose for Charington accessories.

We have provided this 3-D rendering as a tool to assist your contemplation of the many ways that Charington accessories can be put to work. Our hope is that these examples will stimulate your imagination and encourage you to consider how Charington accents can express your unique vision and bring it to life.

There is a wide range of types, styles and sizes of Charington accessories to achieve the distinctive style you are looking for, be it subtle refinement or modern flair. The choice and decision are yours.

Match the legend below with the letters on the illustrations to visualize all of the possibilities.

A distinctive characteristic of Charington accessories is that they contribute to the same high standard of design performance when applied to either the very latest in contemporary construction or to buildings that are entirely traditional.

- **A** Header
- **B** Emerald Gemstone
- **C** Diamond Gemstone
- **D** 424 Tapestry Sill
- **E** Cornerstone Candles
- **F** Arch
- **G** Stencil Stone
- **H** Keystone

Adhered Thin Stone Veneer

We can create a thin overlay version of any of our bricks or stone for speciality applications. Our standard overlay thickness is 1" (32 mm) but we can create custom thicknesses as well.

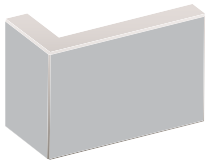
Mechanically Fastened Thin Stone Veneer

Mechanically fastened thin stone veneer is a type of stone cladding that is attached using a patented mechanically fastened clip system. This method of installation is commonly used for both interior and exterior walls. The clip system creates a secure attachment to the building substrate.

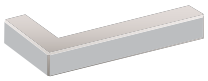
Additionally, this method allows for a faster and more efficient installation process any time of year.

Corner Stones

Corner Stones are a Shouldice Stone innovation designed to impart a visual bearing of volume and mass uncommon to typical veneer. All Corner Stones are custom crafted by skilled artisans to interpret the essence of an innovative spirit.

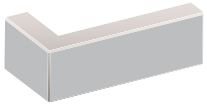


90mm x 390mm x 590mm x 290mm
3.5" x 15.325" x 23.25" x 11.325"

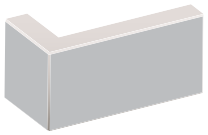


90mm x 90mm x 590mm x 290mm
3.5" x 3.5" x 23.25" x11.325"

90mm x 140mm x 590mm x 290mm
3.5" x 5.5" x 23.25" x 11.325"



90mm x 190mm x 590mm x 290mm
3.5" x 7.5" x 23.25" x 11.325"



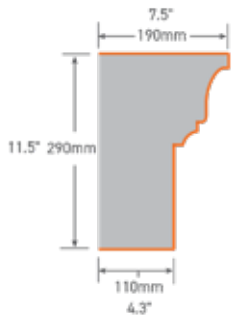
90mm x 290mm x 590mm x 290mm
3.5" x 11.325" x 23.25" x 11.325"

OFOE

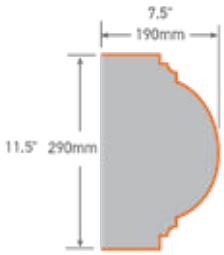
OFOE stands for "one face, one corner," meaning a brick with an edge profile that matches the face. These are used on a corner or the end of a row where you want both exposed sides to have the same appearance. This can be done in any of our brick finishes: ***Smooth, Tex, Rock*** and ***Tapestry.*** We can also finish multiple faces of a brick if desired.

Gem Stones

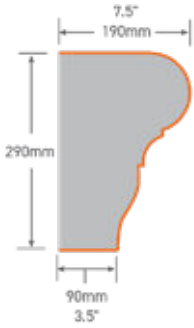
Gem Stones help transform the ordinary into the extraordinary. With eight distinct profiles to choose from, Gem Stones are primarily used for custom banding, but can also be used for other highlight features.



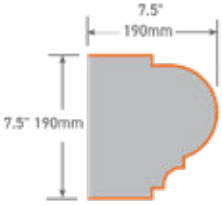
Emerald



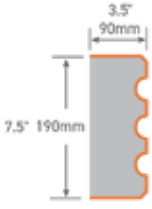
Opal



Ruby

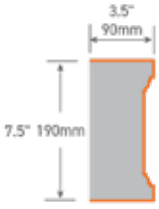


Sapphire

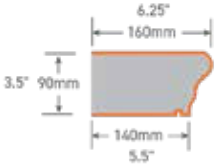


Flutonia

Topaz



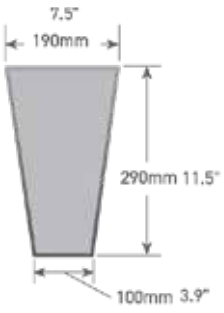
Diamond



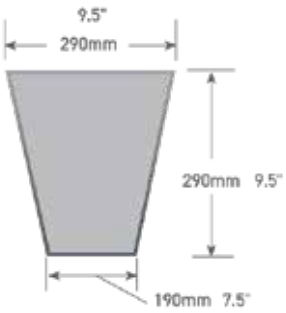
Jade

Keystones

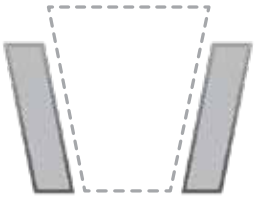
We have three standard keystones in stock, available with or without complementary wings. We can also create custom keystones to your required specifications.



Keystone #1



Keystone #7

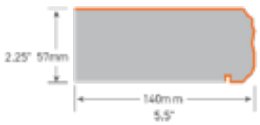


Wings

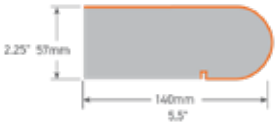
Sills

Sills can be used to blend in or stand out from your primary cladding choice.
Sills are available in a variety of profiles, lengths and textures to suit any design.

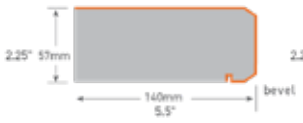
Sills 224



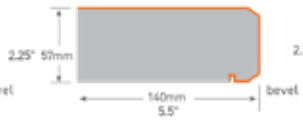
224 Rock



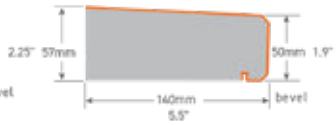
224 Full Radius



224 Tapestry

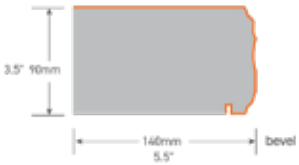


224 Tex

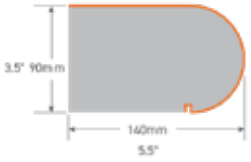


224 Sloped

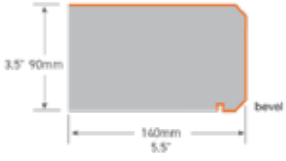
Sills 424



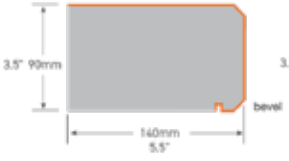
424 Rock



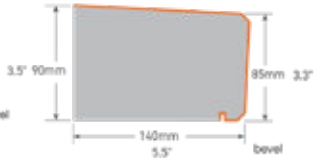
424 Full Radius



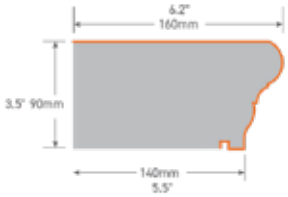
424 Tapestry



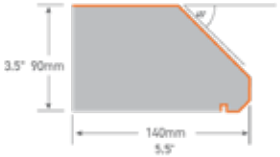
424 Tex



424 Sloped

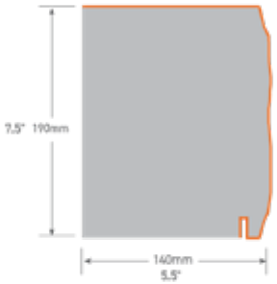


424 Jade

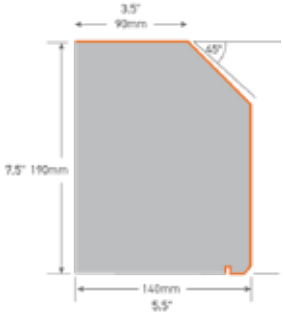


424 Water Table

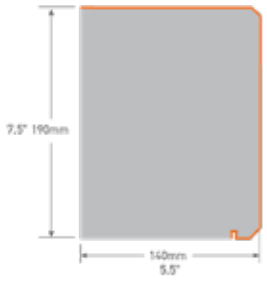
Sills 824



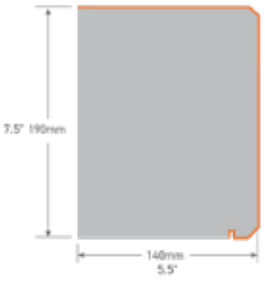
824 Rock



824 Water Table



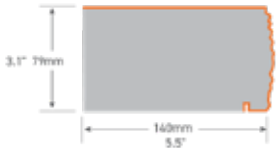
824 Tapestry



824 Tex

824 Sloped

Sills 336

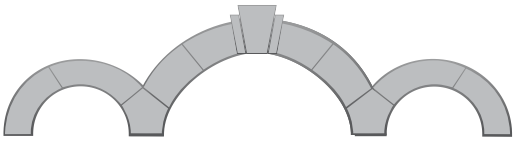


336 Rock

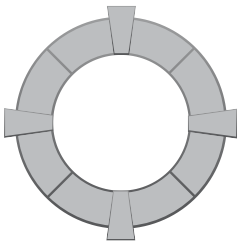
Window Surrounds

Add an element of sophistication with Window Surrounds. There are six standard profiles, including Tudor and Georgian, as well as custom options, all available in multiple colours and textures.

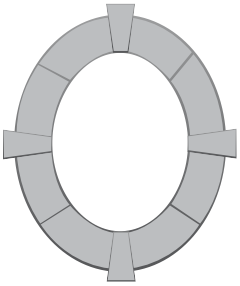
Profiles



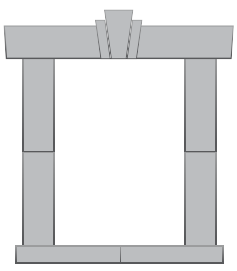
Custom



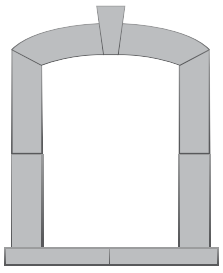
Circle



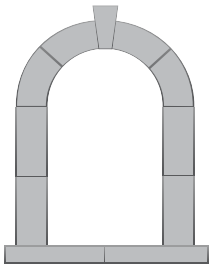
Oval



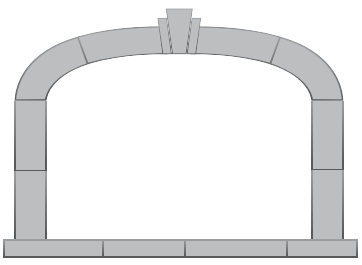
Tudor



Georgian



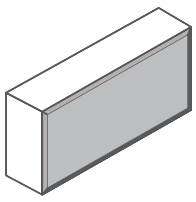
Roman



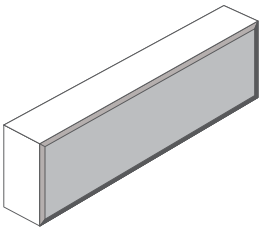
Stuart

Stencil Stones

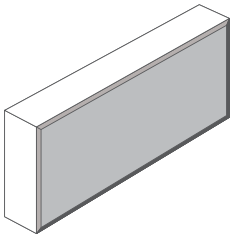
With Stencil Stones you can add the ultimate customized element to commercial or residential façades. There are four standard sizes of Stencil Stone and custom-sized options are also available.



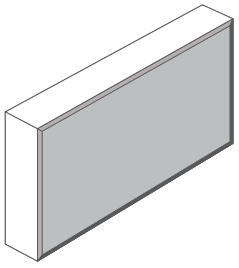
90mm x 190mm x 390mm
3.5" x 7.5" x 15.325"



90mm x 190mm x 590mm
3.5" x 7.5" x 23.25"



90mm x 290mm x 590mm
3.5" x 11.325" x 23.25"



90mm x 390mm x 590mm
3.5" x 15.325" x 23.25"

Technical Specifications

LEED Credits

Shouldice Designer Stone manufacturers Stone Products that support the principles of LEED with raw materials, production, life cycle costing and performance. The benefits of additional durability, design and economic efficiency are an integral component in every piece of Shouldice Designer Stone.

What is LEED?

Leadership in Energy and Environmental Design (LEED) is a rating system devised by the United States Green Building Council (USGBC) to evaluate the energy & environmental performance of buildings and encourage market transformation to sustainable design. Detailed information on the LEED program is available at www.usgbc.org where the program outlines the intent, strategies, requirements and technologies required. Information on LEED Canada is available from the Canada Green Building Council at www. cagbc.org.

What is the Goal of LEED?

LEED's overall goals are to improve occupant well-being, environmental impacts and economic returns of new buildings.

LEED Certification Points

The stone products of Shouldice are governed by LEED NC (For New Construction) that provides a checklist of prerequisites and voluntary credits in six basic categories: sustainable sites (SS), water efficiency (WE), energy and atmosphere (EA), materials and resources (MR), indoor/environmental quality (EQ) and innovation and design (ID). Projects earn points by meeting technical requirements specific to LEED NC 2.2 (US) or LEED NC 1.0 (CAN).

Why use Concrete Masonry?

Shouldice stone products support the principles of Green Management and by using Shouldice Concrete Masonry you will contribute to earning LEED points in the LEED credit categories. The aggregates used to produce Shouldice stone products are manufactured from the natural reserves of stone that Mother Nature created millions of years ago. These resources are processed to an aggregate that is blended with recycled reserves, cement, iron oxide colours and stabilizing ingredients to create a stone product that rivals the beauty of natural stone with a guaranteed Lifetime of Performance.

The Key Top 10 benefits
realized include:

1. The Mass Factor for Energy Performance (EA) Credit 1
2. Construction Waste Management – (MR) Credits 2.1 & 2.2
3. Recycled Content – (MR) Credits 4.1 & 4.2
4. Local/Regional Material Use – (MR) Credits 5.1 & 5.2
5. Durable Building – (MR) Credit 8
6. Flexible by Design – (ID) Credit 1.x
7. Fire Resistance – (ID) Credit 1.x
8. Buildings with Minimal Maintenance – (ID) Credit 1.x
9. Resource Protection – (ID) Credit 1.x
10. Designed for Disassembly – (ID) Credit 1.x

Shouldice... The Natural Choice in Stone

The natural resources used to produce Shouldice Stone are blended with ingredients in state of the art manufacturing complexes that create stone products which may be used not only above grade but at grade and below grade when required. The integral quality of Shouldice stone allows this unrestricted use, a factor that is not always available from other manufactured stone producers. Shouldice stone is manufactured with the same composition of materials that are used in load bearing high-rise construction, bridge overpasses and every construction project demanding strength and performance. This is proof to the integral quality and value of Shouldice stone, a product that performs and replicates stone in every sense of the word and potentially contributes to the following list of sustainable attributes.

CAGBC

LEED attributes:

The Mass Factor for Energy Performance
(EA) Credit 1 (Points 1-10)

The weight of Shouldice stone at nearly 40# (18kg) per square foot provides a mass factor that absorbs the ambient air temperature and releases this stored energy throughout the day or night. This energy performance results in heating and cooling cost savings.

Waste Management
(MR) Credits 2.1 & 2.2 (Points: 2)

The manufacturing process utilizes advanced technology for absolute control during production. Capture, treatment and recycling provides minimal impact on the environment and all Shouldice stone may be crushed and recycled during manufacture or anytime during the life of the stone. Job-site efficiency is realized with the components of Shouldice stone BEING modular by design for minimal jobsite treatment needs in cutting, shaping or trimming.

Recycled Content
(MR) Credits 4.1 & 4.2 (Points: 2)

Shouldice stone is manufactured with the maximum percentage of re-cycled raw materials that will not affect the quality of the stone. There are no toxic emissions and all excess water is treated and reused.

Local/Regional Material Use
(MR) Credits 5.1 & 5.2 (Points: 2)

All natural aggregates used are from sources and reserves located at the manufacturing complexes which are some of the most natural and pure deposits in the world. This single source of quality raw materials provides a guarantee of consistent quality wherever the stone is used. The major North American markets for Shouldice stone are within 500 (800km) miles by road or 1500 miles (2400km) by rail.

Durable Building
(MR) Credit 8 (Points: 1)

The durability of stone combined with a system including drainage cavities and durable fasteners results in a long service life for the building envelope.

Innovative Design

(ID) Credits

(Points: 1-4; Max. Points in ID Category are 4)

The modular components of all Shouldice stone products allows their use on intricate designs with the synergy of reducing additional load bearing structural capacity. Architectural expression without comparison along with the Shouldice stone guarantee and a lifetime warranty are without equal in the industry.

Fire Resistance

(ID) Credit (Points: 1)

Shouldice stone will not burn... Period! This results in additional life safety for occupants and protection from external fire hazards.

Buildings with Minimal Maintenance

(ID) Credit (Points: 1)

Shouldice stone quality allows application without restriction and this integral quality provides a lifetime of performance with minimal if any maintenance required.

Resource Protection

(ID) Credit (Points: 1)

The natural ingredients of Shouldice stone are inert (neutral) by design and have minimal impact on the environment.

Designed for Disassembly

(ID) Credit (Points: 1)

Shouldice Fusion Stone is an innovative thin stone system installed with stainless steel clips and screws allowing disassembly with common power tools.

CAGBC

Fire Resistant Rating

Shouldice Designer Stone CMUs

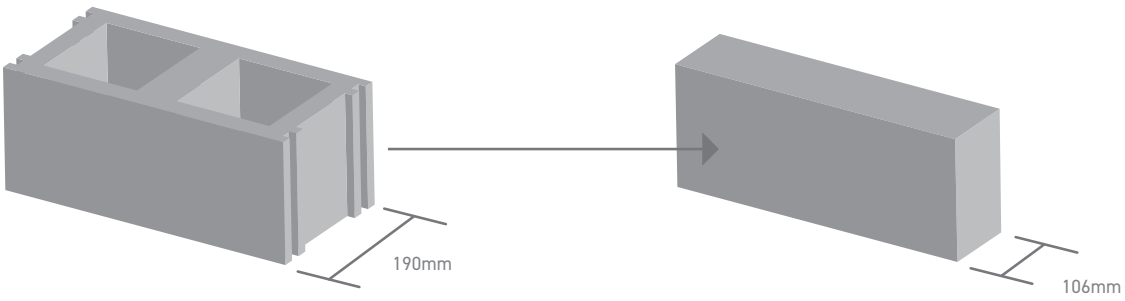
Concrete masonry is widely specified for fire walls and barriers as it is non-combustible, durable and economical to construct. All Shouldice Masonry products are independently tested to determine the performance for the products. The two important factors in rating are dependent on types and quantities of aggregates used and second, the equivalent thickness.

For a basic understanding of the Equivalent Thickness the example below demonstrates the effect of thickness with cored units. All fire ratings are based on the equivalent thickness of the units expressed as a solid number.installed with stainless steel clips and screws allowing disassembly with common power tools.

Size	% Solid	Equivalent Thickness (mm)	Fire Rating (hours)
90 mm Solid	100	90	1.4
90 mm Hollow	73	66	0.8
140 mm Hollow	57	80	1.1
190 mm Hollow	55	105	1.8
240 mm Hollow	53	127	2.4
290 mm Hollow	51	148	3.2

53% Solid Unit

Equivalent Thickness



The table below shows the thickness and its effect on fire rating with different types of concrete. Shouldice manufactures with Type 'S' concrete unless otherwise noted.

Wall of Solid Concrete	Minimum Required Equivalent Thickness (mm) for Fire Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Type S / N Concrete (mm)	44	59	73	95	113	142	167

MSDS

Section I
MATERIAL IDENTIFICATION AND USE

Material Name: Designer Stone

Manufacturer's/Supplier's Name:
Shouldice Designer Stone Ltd.

Address: 281227 Shouldice Block Road
Shallow Lake, Ontario N0H 2K0

Telephone: 1-800-265-3174

Chemical Family: Portland Cement Product

Chemical Formula: Mixture Cementitious Material Aggregates and Water

Trade Name: Masonry Veneer

Material Use: Construction Materials

Section II
HAZARDOUS INGREDIENTS OF MATERIAL

Designer Stone is a mixture of inert gravel or rock, sand, Portland cement and water. It may also contain chemical admixtures and / or granulated slag and or iron oxide colour, which have no effect on the hazards associated with the use of the product. The chemical reaction is complete in Designer Stone.

Section III
PHYSICAL DATA FOR MATERIAL

Odour and Appearance: odourless, grey unless coloured Freezing Point: (0° C)
Solubility in Water: 0.1%

Section IV
FIRE AND EXPLOSION HAZARD OF MATERIAL

Not applicable.

Section V
REACTIVITY DATA

Not applicable.

Section VI
TOXICOLOGICAL PROPERTIES OF MATERIAL

(I) Portland Cement and Portlandite Toxicological Properties: The hazardous ingredients when in contact with water produce calcium hydroxide, with an alka-linity level of pH12 to pH13. This level of alkalinity can cause skin and eye irritation.

Route of Entry: Skin contact, eye contact, inhalation and ingestion.

Effects of Acute Exposure: Cement and wet cement mixtures can dry skin, cause alkali burns and irritate the eyes and the upper respiratory tract. Ingestion can cause inflammation of the throat.

Effects of Chronic Exposure: Cement dust can cause inflammation of the tissue lining the interior of the nose and the cornea (white) of the eye. Hypersensitive people may develop allergic dermatitis.

(II) Quartz (SiO2)

Route of Entry: Skin contact, eye contact, and inhalation.
Effects of Acute Exposure: Exposure to dust may irritate respiratory system, eyes and skin.

Effects of Chronic Exposure: (1) Chronic exposure to respirable dust levels exceeding exposure limits has caused pneumoconiosis.

(2) Chronic exposure to respirable sand and gravel dust containing quartz at levels exceeding exposure limits has caused silicosis, a serious and progressive pneumoconiosis which can be disabling, and in extreme instances, lead to death. Symptoms may appear at any time, even years after exposure have ceased. Symptoms of silicosis may include shortness of breath, difficulty in breathing, coughing, diminished chest expansion, reduction of lung volume and heart enlargement and/or failure. The only reliable method of detecting silicosis is through chest x-ray. Silicosis may aggravate other chronic pulmonary conditions and may increase the risk of pulmonary tuberculosis infection. Smoking aggravates the effects of silica exposure.

Section VII
PREVENTATIVE MEASURES

Personal Equipment: Use gloves, boots and clothing to prevent skin contact. Wear safety glasses or goggles to prevent contact with eyes. Wear an approved respirator if exposed to dust from hardened concrete when sawing or using other demolition.

Engineering Controls (Specify): Provide ventilation when sawing or using other demolition techniques to reduce dust concentrations.

Waste Disposal: At approved landfill or waste disposal sites in accordance with local regulations.
Handling Procedures & Equipment: As Above.

Storage Requirements: Not Applicable.

Special Shipping Information: Not Applicable.

Section VIII
FIRST AID MEASURES

Wash exposed areas of body with soap and water; irrigate eyes with large amounts of water; consult a physician in case of severe exposure.

Section IX
PREPARATION DATE OF MSDS JANUARY/2013

The information contained on the Material Safety Data Sheet is based on hazard information from sources considered technically reliable and has been prepared in good faith in accordance with available information. No warranty, express or implied, is made and the supplier will not be liable for any damages, losses, injuries or consequential damages which may result from the use of or reliance on any information contained herein.

1e.14 **Anchored Veneer Support**

ACI 530/ASCE 5/TMS 402 Support Requirements for Anchored Masonry Veneer

In accordance with the prescriptive detailing requirements of the Building Code Requirements for Masonry Structures (Ref. 1.8), the weight of anchored veneer is to be vertically supported by noncombustible structural supports. When combustible supports are used, the following limitations are to apply:

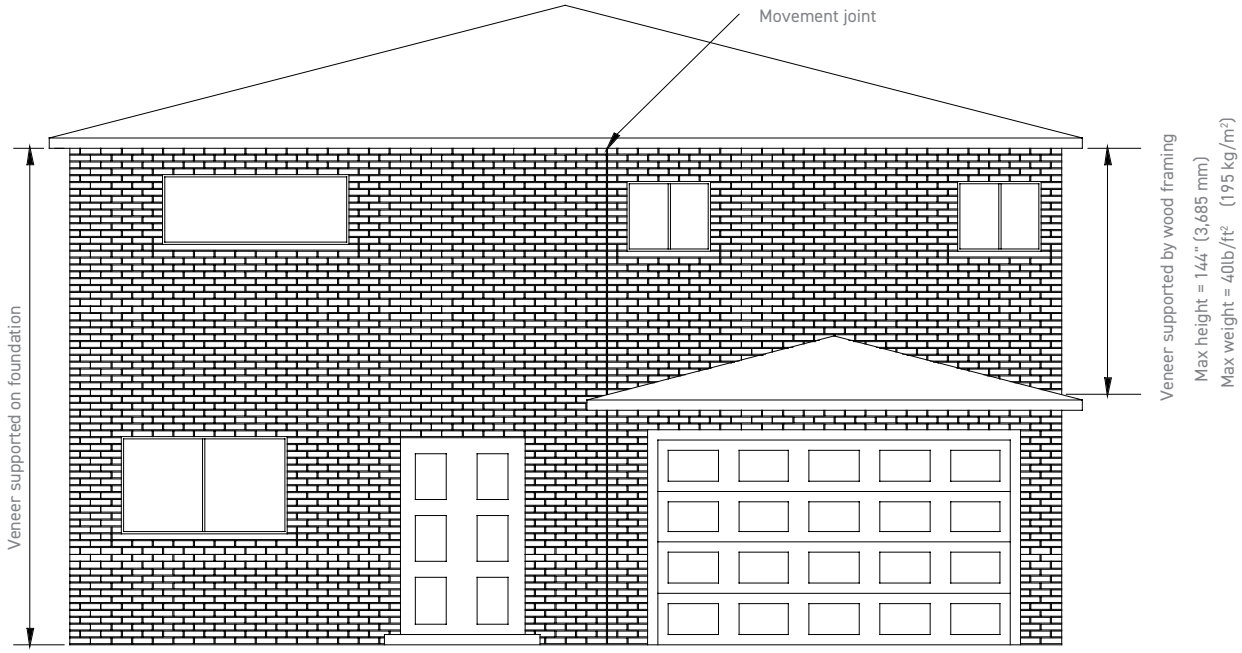
• Anchored veneer supported vertically by preservative treated wood foundations is not to exceed a height of 18 feet (5,486 mm) above the support.

• Interior anchored veneer may be supported on wood construction when the installed weight is not more than 40 lb/ft (195 kg/m).

• Exterior anchored veneer may be supported on wood construction if the installed weight is 40 lb/ft (195 kg/m) or less and the height is not more than 12 feet (3,658 mm).(Note that concrete masonry veneer 4 inches (102 mm) or less in nominal thickness and 130 lb/ft (2110 kg/m) or less in density has an installed weight of less than 40 lb/ft).

Anchored veneer supported by lintels, floors, wood construction, or other spanning elements not continuously supported shall be designed such that the deflection is limited to l/600 or 0.3 inches (7.6 mm), whichever is less.
Anchored veneer with a backing of wood framing shall not exceed a height of 30 feet (9,144 mm) (38 feet (11,582 mm) at gables). Veneer with a backing of cold-formed steel framing may exceed these heights if the weight of the veneer is supported by noncombustible construction at each story above these height limits. There are no prescriptive height limitations for veneer with concrete or masonry backing.

Unless pressure treated wood suitable for contact with masonry is used, veneer must be designed and detailed so that it is not in direct contact with wood or other similar material susceptible to moisture damage. When different sections of a veneer assemblage are supported by wood construction and by the foundation, respectively, a movement joint must be placed between each section to isolate the



1e.15 **Anchored Veneer Support**

ACI 530/ASCE 5/TMS 402 Anchor Requirements for Anchored Masonry Veneer

The following types of anchors are permitted under the prescriptive requirements of the Building Code Requirements for Masonry Structures (Ref. 1.8) for anchored masonry veneer.

Corrugated Sheet Metal Anchors Corrugated sheet metal anchors, used with wood backup, are required to be at least 7/8 inches (22 mm) wide, have a base metal thickness of at least 0.03 inches (0.76 mm), and have corrugations with a wavelength of 0.3 to 0.5 inches (7.6 to 13 mm) and an amplitude of 0.06 to 0.10 inches (1.5 to 2.5 mm).

Sheet Metal Anchors Sheet metal anchors, used with wood backup, shall be at least 7/8 inches (22 mm) wide, have a base metal thickness of at least 0.06 inches (1.5 mm) and shall have corrugations as given above for corrugated sheet metal anchors or be bent, notched or punched to provide equivalent performance.

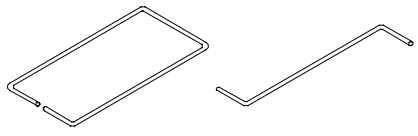
Wire Anchors Wire anchors, used with wood or masonry backup, shall be at least W1.7 (MW 11) wire and have ends bent to form an extension from the bend at least 2 inches (51 mm) long. Note that for multiwythe walls designed for composite action, "Z" ties are not permitted for the use with hollow masonry units.

Joint Reinforcement Anchors Ladder-type or tab-type joint reinforcement is permitted for use with masonry backup if the cross wires used to anchor the masonry veneer are at least W1.7 (MW 11) wire and the wires are spaced no further than 16 inches (406 mm) on center. Cross wires shall be welded to longitudinal wires, which shall be at least wire size W1.7 (MW 11).

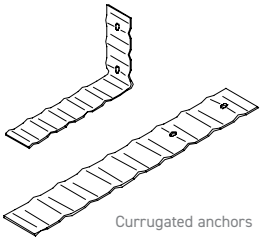
Adjustable Anchors Sheet metal and wire components of adjustable anchors shall conform to the requirements for corrugated sheet metal anchors, sheet metal anchors or wire anchors. Adjustable anchors with joint reinforcement shall also meet the requirements for joint reinforcement anchors. Adjustable anchors must also comply with the following requirements (refer to Figure 4A.1 for further guidance):

- The maximum clearance between connecting parts of the tie shall be 1/16 inches (1.6 mm).
- Adjustable anchors shall be detailed to prevent disengagement.
- Pintle anchors shall have at least two pintle legs of wire size W 2.8 (MW 18) each and shall have an offset not exceeding 1 1/4 inches (32 mm).

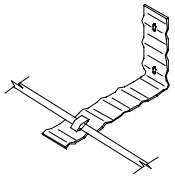
Other veneer anchors are permitted when their performance is equivalent to the above.



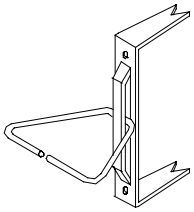
Wire anchors



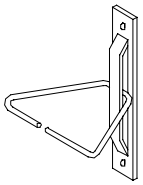
Currugated anchors



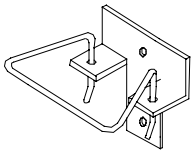
Currugated anchor with wire



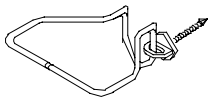
Base and vee anchor with prongs



Base and vee anchor



Eye and pintle anchor

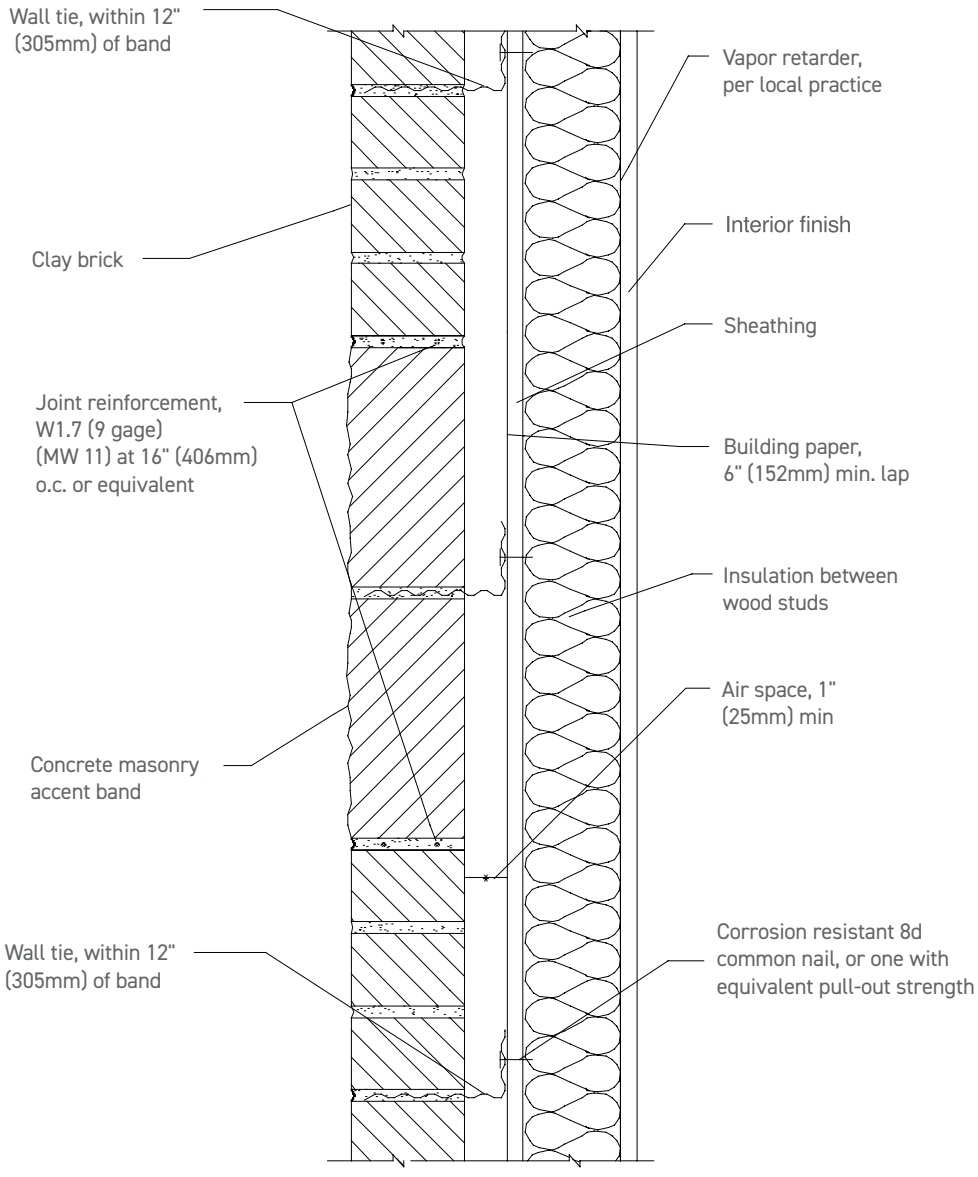


Wire and screw anchor

9d.3 **Band Over Wood**

Concrete Masonry Band in Clay Brick Veneer Over Wood Framing Backup

When concrete masonry banding is used over a wood framing backup, it is imperative that joint reinforcement be used in the concrete masonry band, even if it is not used in t he surrounding clay brick masonry. See also the notes to Figure 9D.1. A 1" (25 mm) air space between wythes is considered appropriate if special precautions are taken to keep the air space clean (such as beveling the mortar bed away from the cavity or carefully pulling a piece of wood up the cavity to collect mortar droppings as veneer construction proceeds). Otherwise, a 2 inch (51 mm) air space is preferred. Proprietary drainage products can be used to create a drainage cavity, which takes the place of the clear air space.



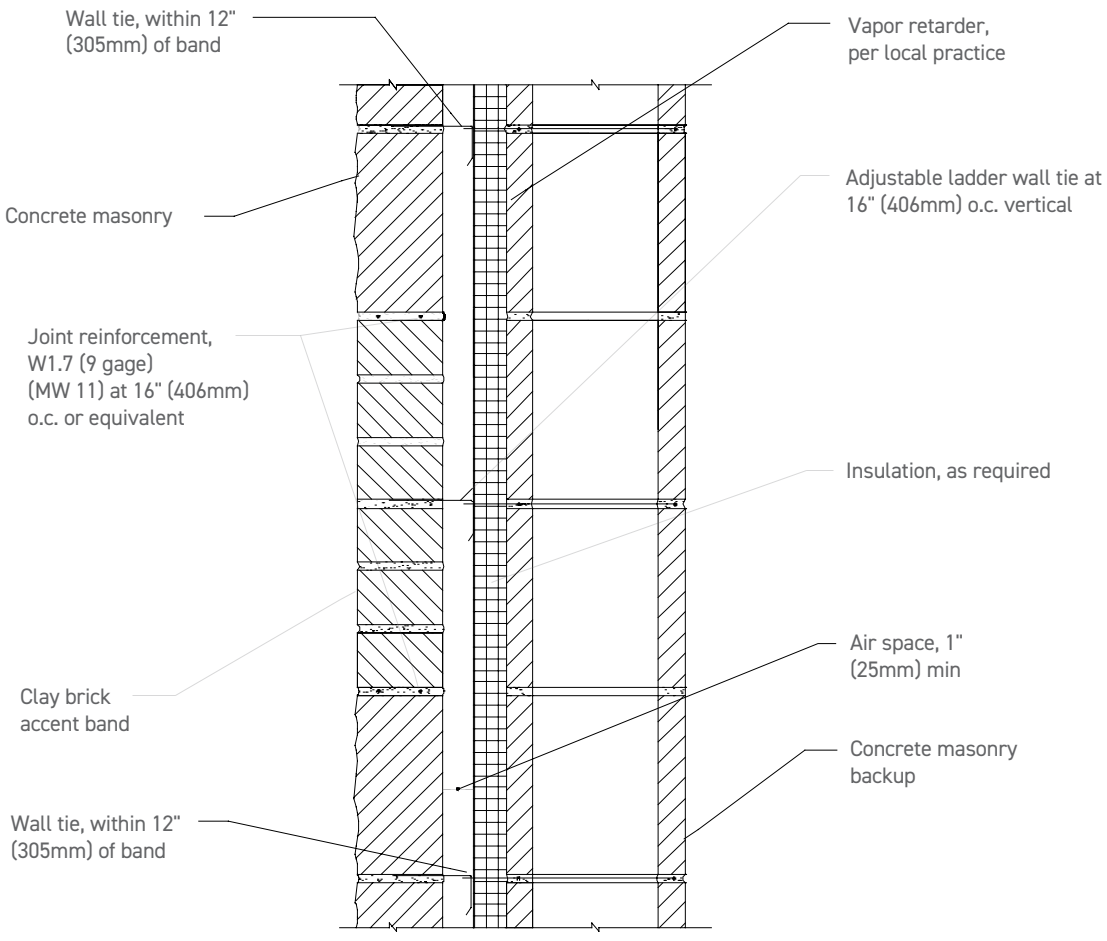
Clat Brick band in cm

Multi-Course Clay Brick Band in Concrete Masonry Veneer

The recommendations to control differential movement for clay brick masonry bands in concrete masonry are very similar to those for a concrete masonry band in clay brick veneer: joint reinforcement above and below the band and wall ties within the band. Seismic clip-type wall ties are recommended, as they provide an adjustable wall tie and joint reinforcement in one assembly.

With this construction, it is imperative that the veneer control joint not contain mortar as it goes through the clay brick band. Mortar in this joint will restrict brick expansion, reducing the movement joint's effectiveness. Note that although control joints in structural masonry walls must permit free longitudinal movement while resisting lateral or out-of-plane shear loads, veneers are laterally supported by the backup and do not require a shear key.

A 1" (25 mm) air space between wythes is considered appropriate if special precautions are taken to keep the air space clean (such as by beveling the mortar bed away from the cavity or drawing a piece of wood up the cavity to collect mortar droppings). Otherwise, a 2 inch (51 mm) air space is preferred. Proprietary insulating drainage products can be used without the need for a clear air space.



(a) Section

19-4a **Flashing Strategies**

Introduction

The primary role of flashing is to intercept the flow of moisture through masonry and direct it to the exterior of the structure. Due to the abundant sources of moisture and the potentially detrimental effects it can have, the choice of flashing material, and the design and construction of flashing details, can often be as key to the performance of a masonry structure as that of the structural system.

The type of flashing material to be used is governed by both environmental and design/build considerations. Environmental considerations include such factors as the physical state of moisture present (liquid, solid, or vapor), air movement, and temperature extremes as well as temperature differentials. Design/build considerations include the selection of the proper type of flashing material, location of the flashing, structural, and installation details. Drawings for flashing details, often the only method of communicating the necessary information between the designer and contractor, should be comprehensive and show sufficient detail for the proper interpretation and installation of flashing systems. TEK 19-5A Flashing Details for Concrete Masonry Walls (ref. 3) includes such details.

Although flashing is the primary focus of this TEK, it should be understood that the role of vapor retarders, air barriers, and insulation are also important elements to consider for any wall design as the performance of the entire system can be dependent on the design of its individual components.

Effect Of Moisture On Masonry

The damage caused to a masonry structure (or its contents) due to the infiltration of moisture can take many forms, depending on the source and the physical state of the water. For example, in the liquid state, water penetrating to the interior of a building may cause considerable damage to its contents. In some extreme cases, water trapped within the masonry may freeze, inducing spalling and cracking of the masonry units or mortar. Alternatively, water vapor can lead to condensation inside the cores and on the surfaces of masonry if the dew point temperature is reached. During cold weather, below 28°F (-2°C), water vapor can accumulate on a cold surface and from frost or increase the quantity of ice within the masonry.

Although it is commonly thought that moisture problems stem only from the external environment, this is not always the case. For example, in some instances it is possible for the humidity of interior air to cause water damage to the exterior of a structure. This damage may appear in the form of water stains, ravelled mortar joints, spalled surfaces, or efflorescence.

Design Considerations

Water Movement

In the design of any structure, the presence and movement of water in any of its three forms needs to be considered. Significant forces that influence water movement include wind pressure, gravity, and moisture absorption by the material. Dynamic wind pressure on the surface of an exposed wall can drive exterior moisture (in the form of rain or irrigation water) into the masonry. Gravity, which is always present, draws the free water vertically downward, while the absorptive characteristics of the masonry can cause moisture migration in any direction by capillary action.

It should also be recognized that these forces do not act independently of one another. For example, wind-driven rain may enter masonry through cracks at the interface between mortar and units and migrate downward through the wall due to the force of gravity, or it may be transferred horizontally through the wall either by pressure or by flowing across the webs of the units or mortar bridges. Wind-driven rain can also be absorbed by masonry units and carried from the exterior surface to the interior surface by capillary action. Additionally, ground water may be drawn upward by the wicking action of units placed on porous foundations or by contact with moist soil.

Designers should never assume that any material is capable of rendering a wall totally impervious to water penetration. Surface treatments, designed to reduce the quantity of water entering a masonry structure, are helpful in this regard but should not be considered as a sole means of protection. Available as clear and opaque compounds, the effectiveness of surface treatments depends on their composition and compatibility with the masonry. They also do not reduce the movement by capillary action (wicking) of any water that does penetrate the masonry face through cracks or defects in the mortar/masonry.

The use of integral water repellent admixtures in concrete masonry units and mortars can also reduce the amount of water entering the masonry. In addition, they inhibit water penetrating the masonry face from wicking to the back face of the wall. Proper selection and application of surface treatments and integral water repellents can greatly enhance the water resistant properties of masonry, but they should not be considered as substitutes for flashing. See TEKs 19-1 and 19-2A (refs. 8 and 2) for more information on water repellents for concrete masonry.

19-4a **Flashing Strategies**

Flashing Location
The proper design of masonry for resistance to water penetration includes consideration of the various types of wall construction such as single wythe, cavity, veneer, etc. During the design phase it should be understood that all exterior masonry walls may be subjected to some degree of water penetration and/or water vapor movement during its design life. Flashing is recommended for all locations where moisture may potentially penetrate into a wall and where the free drainage of water is blocked. Some of these critical locations include the top of walls and parapets, at all horizontal obstructions such as over openings, beneath sills, above shelf angles, at the base of walls, and in walls at ground level to serve as a moisture retarder to reduce the amount of water wicked up into the masonry above grade.

When selecting the flashing material for a particular application, the service conditions, projected life of the structure, and past performance characteristics of the flashing materials should be reviewed. Flashing should be designed to perform satisfactorily for the design life of the building since repair or replacement can be very labor intensive and expensive.

Flashing Materials
A wide variety of flashing materials are available. The selection of the type of flashing material to use can be influenced by several factors including cost, durability, compatibility with other materials, ease of installation, aesthetic value, and performance. Table 1 summarizes some of the attributes for various flashing materials. The advantages and disadvantages of each must be weighed for each individual project to provide the most cost-effective and desirable choice.
Prefabricated flashing boots may be available for inside and outside corners and end dams. These boots eliminate the need for cutting, folding, or tucking the flashing materials at these locations. However, due to construction tolerances, some of these prefabricated items, particularly those of rigid materials, may be difficult to fit into their intended location.

Sheet Metals
Stainless steel is technically any of a large and complex group of corrosion resistant iron chromium alloys possessing excellent weather and chemical resisting properties. Preformed sections must be properly sized so that on site modification is minimized. Stainless steel flashing with a conventional annealed finish should comply with Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip, ASTM A 167 (ref. 6). Generally, Type 304 stainless steel with a minimum thickness of 0.010 in. (0.25 mm) is satisfactory. Lap sections require solder conforming to Standard Specification for Solder Metal, ASTM B 32 (60% tin and 40% lead) (ref. 5). Stainless steel drip edges used in combination with other flashing materials offer an economical compromise with a durable drip edge.

Copper is a nonferrous metal possessing good ductility and malleability characteristics. Like stainless steel, it also possesses excellent weather and chemical resistant properties. Preformed sections or sheet materials are easily modified to conform to site requirements. However, it should be cautioned that once weathered, copper flashings produce a green patina that may impart a green stain to adjacent masonry surfaces that some find objectionable.

Galvanized steel is less expensive than stainless steel but is subject to corrosive attack from salts and acids. The galvanized coating also may crack at bends, lowering the corrosion resistance. As with stainless steel, it is also difficult to form and to solder laps effectively.

Composites
Combinations of metals and plastics are supplied by some dealers. The composition and application of these combined materials should be determined before use. Composites utilizing copper are the most popular since they combine the durability and malleability of copper with the nonstaining characteristics of a protective coating. Composites containing aluminum should be avoided.

Plastics and Rubber Compounds
Plastics are categorized as polymeric materials of large molecular weight, usually polyvinyl chloride (PVC) or polyethylene. Manufacturers of plastic flashings should be consulted for documentation establishing the longevity of the plastic in a caustic environment (pH = 12.5 to 13.5), the composition of the plastic, ease of working at temperatures ranging from 20 to 100°F (-7 to 38°C), and ability to withstand exposure to ultraviolet light.

Ethylene Propylene Diene Monomer (EPDM) is a synthetic rubber that is used as a single ply roofing membrane as well as flashing. It has better low temperature performance than PVC and will not embrittle. It offers ultraviolet light and ozone resistance and can be left exposed.

Self-adhering, rubberized asphalt membranes consist of a composite of flexible plastic film for puncture and tear resistance combined with a rubberized asphalt adhesive layer. This material adheres to itself, requiring less effort to seal laps or corners which speeds installation. It also self-adheres to the substrate which prevents water from migrating under the flashing and is self-healing in the event of punctures. However, it should not be applied to damp, dirty, or dusty surfaces and typically has a lower installation temperature limit of 25°F (-4°C). Because it degrades in the presence of extended UV exposure, it should not be left exposed and requires a metal drip edge.

19-4a **Flashing Strategies**

Construction Practices

To perform, flashing must be designed and installed properly or it may aggravate rather than reduce water problems. Flashing should be longitudinally continuous or terminated with end dams. Longitudinally continuous requires that joints be overlapped sufficiently, 4 in. (102 mm) minimum, to prevent moisture from entering between the joints and they must be bonded (joined) together with adhesive if they are not self adhering to prevent water movement through the lap area. With metal flashings a ¼ in. (6.4 mm) gap joined and sealed with a pliable membrane helps in accommodating expansion (ref. 3).

Flashings should be secured at the top by embedment into the masonry, a reglet, or should be adhesively attached so that water cannot infiltrate or move behind the attachment. For multi-wythe construction, the flashing should project downward along the outer surface of the inner wythe and then project outward at the masonry joint, shelf angle, or lintel where it is to discharge the water. Every effort should be made to slope the flashing towards the exterior. Effectively placed mortar or sealant material can help promote this drainage. The flashing should continue beyond the exterior face of the masonry a minimum of ¼ in. (6.4 mm) and terminate with a sloped drip edge. An additional design consideration for flashings includes ensuring that all materials are compatible. For example, contact between dissimilar metals can result in the corrosion of one or both of the metals. Additionally, the coefficients of thermal expansion for the flashing and masonry materials differ. All flashing details should be designed to accommodate the resulting differential movement.

Other recommended practices involve the use of tooled concave mortar joints to reduce water penetration through the mortar joints. Masons should be careful to ensure that mortar dropped onto the flashing is minimized. This can be accomplished by beveling the mortar on the face shells adjacent to the cavities in cavity wall construction. In addition, cavity drainage mats, gravel beds, screens, or trapezoidal drainage material (filter paper) can be used to prevent mortar droppings from collecting on the flashing, which can form dams and block weep holes. Mortar collection devices at regular intervals or filling the cells with loose fill insulation a few courses at a time as the wall is laid-up, can be effective in dispersing minor mortar droppings enough to prevent clogging.

Flashing Location

Weep holes, the inseparable companion to flashings, should provide free movement of water out of the concrete masonry cores, collar joints, or cavities. Any construction practice that allows forming the weep holes without inhibiting water flow may be used. Cotton sash cords and partially open head joints are the most common types of weep holes. Cotton sash cords should be removed prior to putting the wall into service to provide maximum unobstructed drainage. If necessary, insects can be thwarted by inserting stainless steel wool into the openings or using plastic or metal vents.

Vents

Weep holes often serve a dual function, first for water drainage and second as vents. Vents are desirable in some masonry wall systems to help reduce the moisture content of the masonry during drying periods. Air circulation through the cores and cavities within the masonry promotes equalization of moisture content throughout the masonry. Vents are considered desirable where air is confined within masonry, such as in parapets or areas of high humidity such as natatoriums.

Maintenance

Maintenance programs should involve preserving the "as-built" design documents, records pertaining to inspections during the life of the structure, and continuing appraisal of the performance of the structure in addition to conventional repair and upkeep. Documentation of inspections, if efflorescence and water stains are observed, and logs of reported water penetration and their identified location, assist in determining proper corrective actions. Pictures with imprinted dates are suggested.

Knowledge of the wall design and construction can influence repair decisions. If flashing and weep holes were omitted during construction, it may prove effective to simply drill weep holes and vents to promote drainage and drying. Weep holes so drilled should be either at the intersection of the bed and head joints or into the cores at the bottom of the wall. Vents should be installed at the top of the wall or directly below bond beams. See TEK 8-1A Maintenance of Concrete Masonry Walls (ref. 4) for more detailed information on maintenance of concrete masonry walls. When considering maintenance options, it is important to ensure that a masonry wall's moisture control measures are kept intact. Thus, applying sealant beads, pargings, or coatings to a wall should be carefully weighed. Weep holes and vents should be maintained in an open condition to allow evacuation of moisture.

Summary

Flashings are essential at foundations, bond beams, above and below openings, at shelf angles and at copings. Weep holes and vents reduce the moisture content of masonry walls. Proper selection of flashing materials, proper detailing, and proper installation will help ensure satisfactory performance.

1. The Building Envelope: Solutions to Problems, Proceedings from a national seminar series sponsored by Simpson Gumpertz & Heger Inc., 1993.

2. Design for Dry Single-Wythe Concrete Masonry Walls, TEK 19-2A, National Concrete Masonry Association, 2002.

3. Flashing Details for Concrete Masonry Walls, TEK 19-5A, National Concrete Masonry Association, 2003.

4. Maintenance of Concrete Masonry Walls, TEK 8–1A, National Concrete Masonry Association, 2002.

5. Standard Specification for Solder Metal, ASTM B 32-00, American Society for Testing and Materials, 2002.

6. Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip, ASTM A 167-99, American Society for Testing and Materials,1999.

7. Through-Wall Flashing, Engineering and Research Digest No.654, Brick Industry Association.

8. Water Repellents for Concrete Masonry Walls, TEK 19-1, National Concrete Masonry Association, 2002.

19-5a **Flashing Strategies**

Introduction

At critical locations throughout a building, moisture that manages to penetrate a wall is collected and diverted to the outside by means of flashing. The type of flashing and its installation may vary depending upon exposure conditions, opening types and locations and wall types. This TEK is a collection of typical flashing details that have proven effective over a wide geographical range. The reader is also encouraged to review the companion TEK 19-4A Flashing Strategies for Concrete Masonry Walls (ref. 3) which addresses the effect of moisture on masonry, design considerations, flashing materials, construction practices, and maintenance of flashing.

Cavity Walls

For cavity walls, as illustrated in Figure 1, the cavity ranges from a minimum of 1 in. (25 mm) to a maximum of 4 ½ in. (114 mm) wide with a minimum of a 1 in. (25 mm) clear airspace if insulation board is placed in the cavity. Cavities wider than 4 ½ in. (114 mm) are permitted only if a detailed analysis is performed on the wall ties per the Building Code Requirements of Masonry Structures (ref. 1) The 1 in. (25 mm) clear airspace works only
if the mason takes precautions to insure that mortar will not bridge the airspace. Such precautions would include beveling the mortar bed away from the cavity or drawing a piece of wood up the cavity to collect mortar droppings. If precautions are not taken, it is suggested that a wider airspace be utilized, i.e. 1½ to 2 in (38 to 51 mm). Proprietary insulated drainage boards or mats are available that provide an unobstructed drainage path that eliminate the need for a clear airspace (ref. 4).

As shown in Figure 1, the flashing in a cavity wall at the intersection of the foundation should be sealed to the exterior faceshell of the backup wythe, project downward to the foundation surface, outward to the exterior face of the wall, and terminate with a sloped drip. Weep holes or open head joints should be located a maximum of 32 in. (813 mm) apart. Flashing at lintels and sills (shown in Figures 2 and 3, respectively) is very similar. Although not shown, vents can be installed in the vertical head joints at the top of masonry walls to provide natural convective air flow within the cavity to facilitate drying. The use of integral water repellent admixtures in concrete masonry units and mortars can also reduce the amount of water entering the masonry. In addition, they inhibit water penetrating the masonry face from wicking to the back face of the wall. Proper selection and application of surface treatments and integral water repellents can greatly enhance the water resistant properties of masonry, but they should not be considered as substitutes for flashing. See TEKs 19-1 and 19-2A (refs. 8 and 2) for more information on water repellents for concrete masonry.

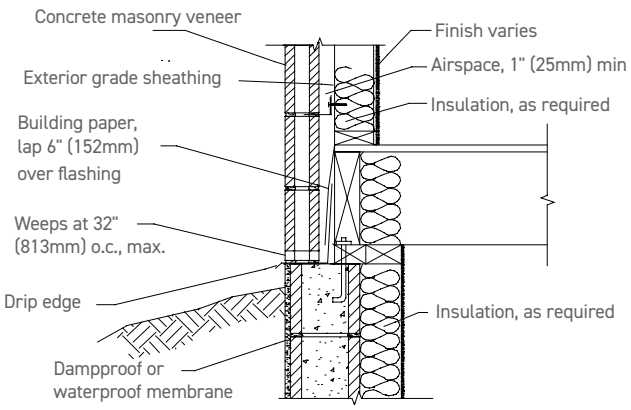


Figure 1

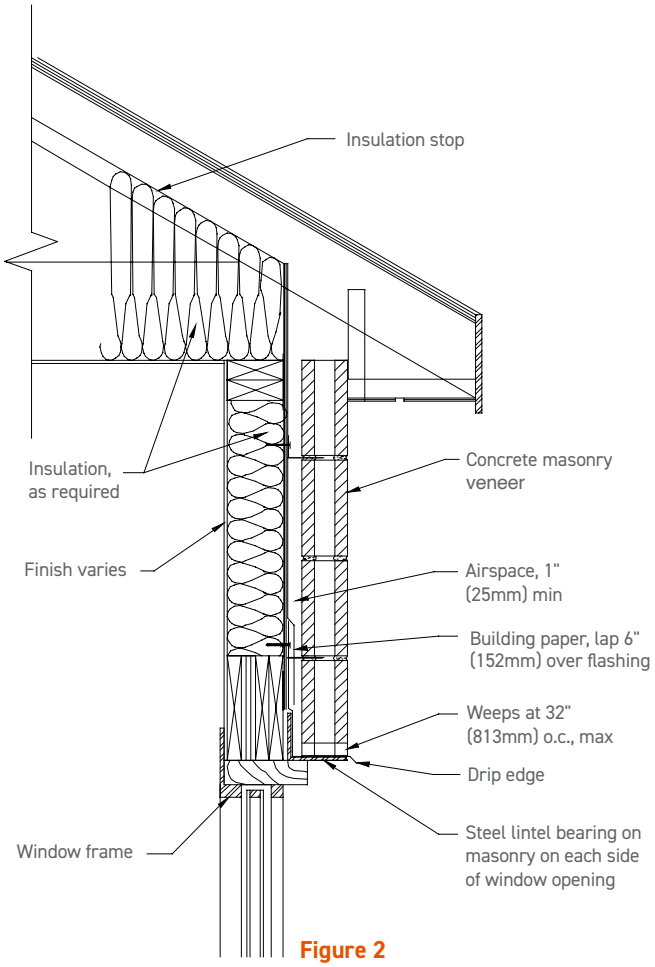


Figure 2

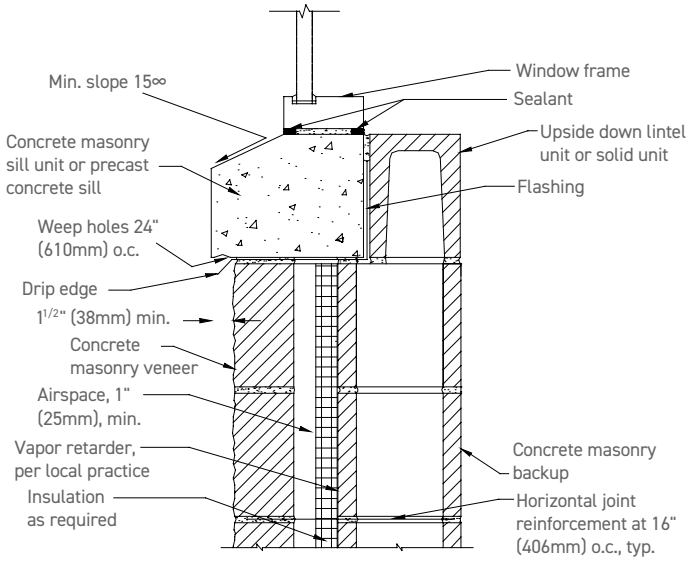


Figure 3 (b Sill)

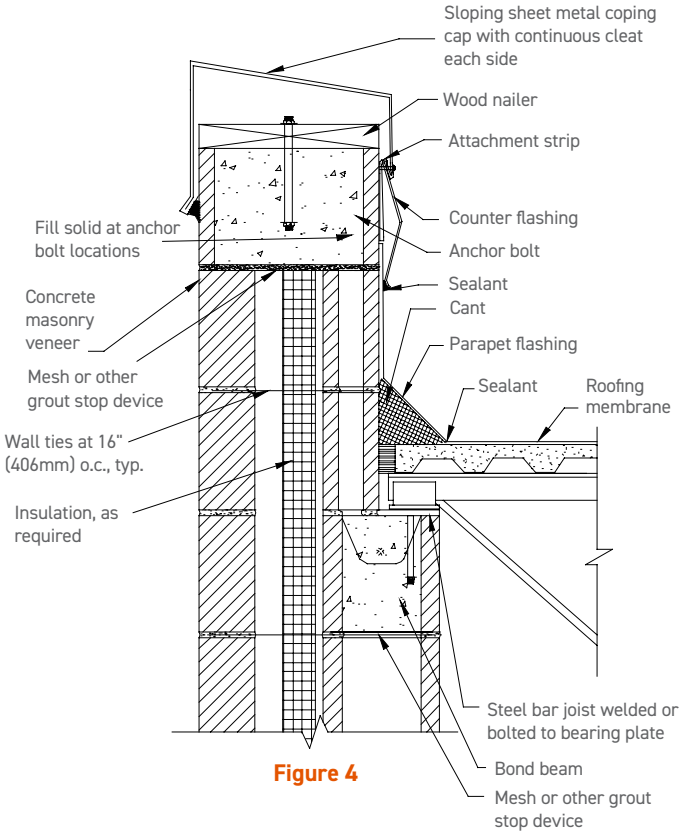


Figure 4

Flashings At Copings And Caps

The type of flashing detail to use on low-sloped roofs will in part depend on the type of roofing membrane being used. As with any flashing detail, the materials used should result in a uniform and compatible design. For example, joining two materials with significantly different coefficients of thermal expansion (such as metal flashing and bitumen roofing membrane) can cause tearing and failure of the joint. Many roofing membranes also shrink as they age. As a result, roofing membranes extending over the top of a parapet may pull the parapet off the wall as the roofing membrane shrinks. Counter flashing provides a solution to these problems as shown in Figure 4. Counter flashing also facilitates the reroofing process by allowing easy removal and access to the flashing membrane fasteners.

During placement of the final courses of masonry in parapets, and commencing with the second course below the coping/cap location, a grout stop should be placed over cores so that grout can be placed for the positioning of anchor bolts (Figure 4).

In coping installations it is imperative that penetrations of through-wall flashing be tightly sealed to prevent water infiltration. A full mortar bed is required to be placed on the through-wall flashing to allow proper positioning of coping units. Full head joints are placed between the coping units as well as properly spaced control joints. The joints between the coping units should then be raked and a joint sealant applied.

Coping units should be sized such that overhangs and a drip reveal are provided on both sides of the wall. Metal caps require wood plates for anchorage, which in turn are usually attached to the wall with anchor bolts. The cap should be sloped to prevent water from draining onto the exposed surface of the masonry and should extend at least 4 in. (102 mm) over the face of the masonry and sealed on both sides. Smooth face or uniform split face CMU should be considered for use under the cap to ensure a relatively tight fit between the masonry and cap that might be hindered by uneven CMU units such as split-face units.

19-5a **Flashing Details**

Splicing Flashing

When splicing of the flashing is necessary, extra precautions are required to ensure that these discreet locations do not become sources of water penetration. Flashing should be longitudinally continuous or terminated with an end dam as shown in Figure 5. The splicing of flashing materials consisting of plastic and rubber compounds is achieved by overlapping the joint a minimum distance of 4 in. (102 mm). The lapped area is then bonded together with adhesive if the flashing material is not self-adhering.

Lap splicing of metal flashing is not recommended as it has a different coefficient of thermal expansion than that of concrete masonry. As the temperature fluctuates, the flashing material will expand and contract differently than the masonry material, which can result in sealant failure and a potential point of entry for moisture. A typical flashing splice is detailed in Figure 5. Here, the two sections of sheet metal type flashing that are to be spliced are first installed with a ¼-in. (6.4 mm)

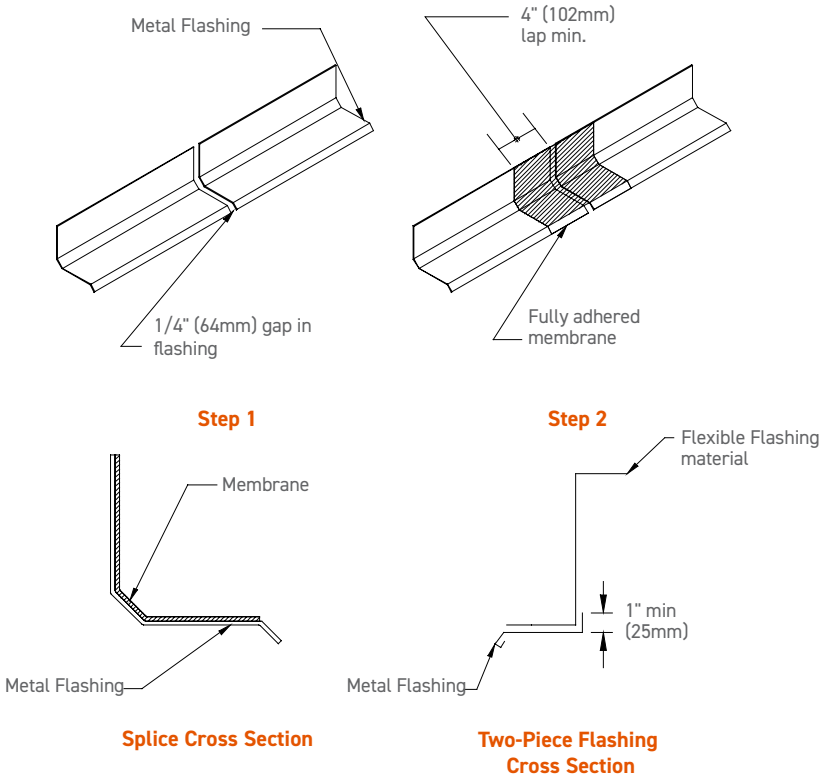
1. Building Code Requirements for Masonry Structures, ACI 530-02/ASCE 5-02/TMS 402-02, reported by the Masonry Standards Joint Committee, 2002.

2. Design for Dry Single-Wythe Concrete Masonry Walls, TEK 19-2A, National Concrete Masonry Association, 2001.

3. Flashing Strategies for Concrete Masonry Walls, TEK 19-4A, National Concrete Masonry Association, 2003.

4. Flashing...Tying the Loose Ends, Masonry Advisory Council, Chicago, IL, 1998.

5. Generic Wall Design, Masonry Institute of Michigan, 1998.



Masonry Cement Mortars

The role of mortar in construction is to join the individual units together, resulting in masonry with the desired performance characteristics. To satisfy the Architect, Engineer, Contractor, Mason, Owner team, the mortar must possess:

In the Plastic State

Workability

The workability of plastic mortar depends on its ability to be spread easily, its ability to cling to vertical surfaces, and its resistance to flow during placement of a masonry unit.

Water Retention

This property resists rapid loss of mixing water to the air on a dry day or to an absorptive masonry unit. Rapid loss of water causes the mortar to stiffen quickly making it difficult to obtain a good bond and weather tight joints.

Consistent Rate of Hardening

Consistent rate of hardening assists the mason in laying the masonry units and in tooling the joints to the same degree of hardness. Uniform colour of masonry joints reflects proper hardening and consistent tooling times.

In the Hardened State

Bond

The term "bond" refers to a specific property that can be subdivided into: (1) extent of bond or degree of contact of the mortar with the masonry units; and (2) tensile bond strength, or force required to separate the units. A chemical and mechanical bond exists in each category.

Many variables affect bond including (1) mortar ingredients, such as type and amount of cementitious materials, water retained, and air content; (2) characteristics of the masonry units, such as surface texture, suction and moisture content; (3) workmanship, such as pressure applied to the mortar bed during placing; and (4) curing conditions, such as temperature, relative humidity and wind.

Durability

Corrosion by aggressive environments and unsound materials may contribute to the deterioration of mortar joints, the major destruction is caused by water entering the mortar and freezing. Because air-entrained mortar will withstand hundreds of freeze-thaw cycles, its use provides good protection against localized freeze-thaw damage.

Strength

Compressive strength of mortar is largely dependent on the type and quality of masonry cement used in preparing the mortar. It increases with an increase in cement content and decreases with an increase in air-entrainment, lime content and water content. Strengths should meet the property specification of ASTM C270.

Appearance

Uniformity of colour and shade of the mortar joints greatly affects the overall appearance of a masonry structure. Atmospheric conditions, admixtures, and moisture content of the masonry units are some of the factors affecting the colour and shade of mortar joints. Others are uniformity of proportions in the mortar mix, water content, and time of tooling the mortar joints.

Retempering

Fresh mortar should be prepared at the rate it is used so that its workability will remain about the same throughout the day. Mortar that has been mixed but not used immediately tends to dry out and stiffen. Loss of water by absorption and evaporation on a dry day can be reduced by wetting the mortar board and covering the mortar in the mortar box, wheelbarrow, or tub.

If necessary to restore workability, mortar may be retempered by adding water; thorough remixing is then necessary. Although small additions of water may slightly reduce the compressive strength of the mortar, the end result is acceptable. Masonry built using plastic mortar has a better bond strength than masonry built using dry, stiff mortar.

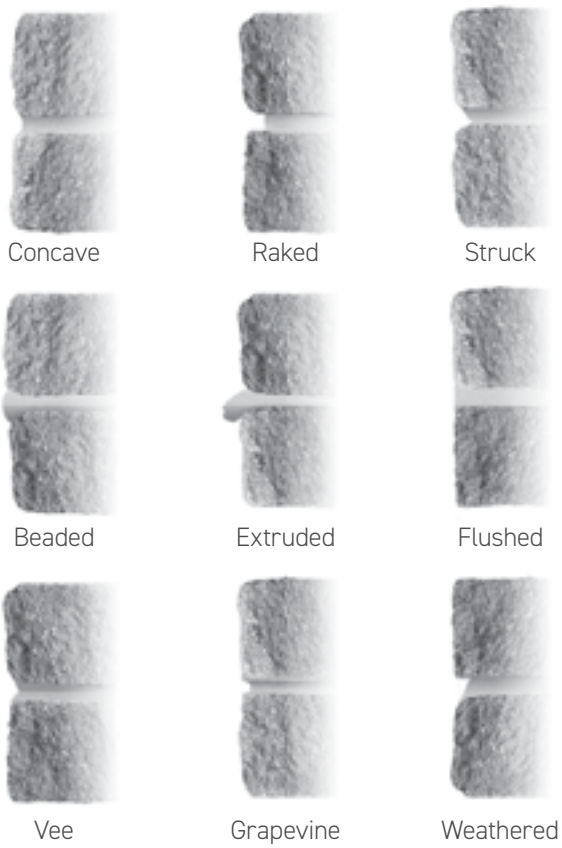
If colour mortar is used, no retempering should be permitted. Additional water may cause a significant lightening of the mortar.

Mortar Joint Common Types

Selection of Type of Joint

Properly cured and tooled mortar joints serve two major purposes to a masonry wall; by tooling the joint, the mortar is compacted and provides a weather-resistant bond between masonry units, and by changing joints, different overall wall appearances will result.

Joints recommended for weather resistance are: concave, vee, flush, and weathered. The raked, beaded, grapevine, struck, and extruded joints are recommended where exposure to moisture is minimal or for interior work. To control the uniformity of colour of mortar joints in a wall, care should be taken to use consistent batching procedures when mixing, adequate mixing time, and most important to tool the joint after the mortar has begun to stiffen slightly. Should a joint be tooled too soon (in a wet condition) a light joint results; and conversely, if a joint is allowed to become too stiff, a dark, burned joint will result.



Concave mortar joint

Concave mortar joint

9-1a **Mortar For Concrete Masonry**

Introduction

While mortar represents only a small proportion of the total wall area in concrete masonry construction (approximately 7 percent), its influence on the performance of a wall is significant. Mortar serves many important functions: it bonds units together into an integral structural assembly, seals joints against penetration by air and moisture, accommodates small movements within a wall, accommodates slight differences between unit sizes, and bonds to joint reinforcement, ties and anchors so that all elements perform as an assembly.

Mortar Materials

The American Society for Testing and Materials (ASTM) maintains national standards for mortars and materials commonly used in mortars, as follows:

Portland cement (ASTM C 150, ref. 4d) is a hydraulic cement (sets and hardens by chemical reaction with water) and is one of the main constituents of mortar. Types I (normal), II (moderate sulfate resistance), and III (high early strength) are permitted according to ASTM C 270 (ref. 4f). Air-entrained portland cements (IA, IIA, and IIIA) may be used as alternatives to each of these types.

Masonry cement (ASTM C 91, ref. 4b) is a hydraulic cement consisting of a mixture of portland cement or blended hydraulic cement and plasticizing materials (such as limestone, hydrated or hydraulic lime) together with other materials introduced to influence such properties
as setting time, workability, water retention, and durability. Masonry cements are classified as Type M, Type S, or Type N according to ASTM C 270. In addition, Type N masonry cement can be combined with portland cement or blended hydraulic cement to produce Type S or M mortars.
Mortar cement (ASTM C 1329, ref. 4j) is a hydraulic cement similar to masonry cement, with the added requirement of a minimum bond strength requirement.
Blended hydraulic cements (ASTM C 595, ref. 4g) consist of standard portland cement or air-entrained portland cement (denoted by -A) combined through blending with such materials as blast furnace slag (S), or pozzolan (P & PM) which is usually fly ash. Types IS, IS-A, IP, IP-A, I(PM), or I(P-M)-A blended cements may be used as alternatives to portland cement to produce ASTM C 270 compliant mortars. Types S or SA (slag cement) may also be used in mortars meeting the property specification requirements of ASTM C 270 (Table 2 of this TEK). Quicklime (ASTM C 5, ref. 4a) is calcined (burned-decarbonated) limestone, the major constituents of which are calcium oxide (CaO) and magnesium oxide (MgO). Quicklime must be slaked (combined chemically with water) prior to use. The resultant lime putty must be stored and allowed to hydrate for at least 24 hours before use. Consequently, quicklime is rarely used in mortar.

Hydrated lime (ASTM C 207, ref. 4e) is a dry powder obtained by treating quicklime with enough water to satisfy its chemical affinity for water. ASTM C 207 designates Type N (normal), Type S (special), and air-entraining Type NA and Type SA hydrated limes. Slaking of hydrated lime is not required, thus hydrated lime is immediately usable and much more convenient than quicklime. ASTM C 207 limits the amount
of unhydrated oxides in Type S or Type SA hydrated limes, assuring the soundness of mortar made using these limes. Types N or NA lime are not typically used in mortar; however, they are permitted if shown by test or performance record
to not be detrimental to the soundness of the mortar. Air-entrained limes are only permitted in mortars containing nonair-entrained cement.

Aggregates (ASTM C 144, ref. 4c) for mortar consist of either natural or manufactured sand. Manufactured sand is the product obtained by crushing stone, gravel, or air cooled blast furnace slag. It is characterized by sharp, angular shaped particles. Gradation limits are established in ASTM C 144 for both natural and manufactured sands. Aggregates which fail these gradation limits may be used, as long as the resulting mortar complies with the property specification requirements of ASTM C 270, as shown in Table 2.

Water for masonry mortar (ASTM C 270, ref. 4f) must be clean and free of deleterious amounts of acids, alkalis, or organic materials. Potability of water is not in itself a consideration, but the water obtained from drinking supply sources is considered suitable for use.

Modifiers (also sometimes called admixtures or additives) for masonry mortars (ASTM C 1384, ref. 4k) are available for various purposes. Modifiers are functionally classified as bond enhancers, workability enhancers, set accelerators, set retarders, and water repellents. Since chlorides accelerate the corrosion of steel reinforcement and accessories ASTM C 1384 stipulates that modifiers add not more than 0.15% water-soluble chloride or 0.20% acid-soluble chloride by weight of portland cement. Similarly, the Specifications for Masonry Structures (ref. 3) limits admixtures to no more than 0.2% chloride ions. The document also limits pigments for coloring to no more than 1 to 10% by weight of cement depending upon the pigment type.

Effect of Materials on Mortar

With the diversity of materials available, masonry mortars can be formulated to produce the desired properties for most specific job requirements. Each of the individual ingredients (cement, lime, sand, water, and any modifiers present) contributes to the performance of the mortar. Portland cement provides strength and durability. Lime imparts workability, water retention, as well as some limited cementitious and autogenous healing properties. Sand acts as a filler and provides body to the mortar while helping to reduce shrinkage and control cracking. Water acts as a mixing agent, a lubricant, and is also needed for hydration of the portland cement.

The various material options alter the characteristics of the mortar in a predictable manner. Changes in cement type promote slight changes in setting characteristics, workability, color, and strength development. Use of air-entrained cement or lime generally results in decreased water demand, improved workability, increased freeze-thaw resistance, and decreased bond strength. Masonry cements, used singly or in combination with portland cement, provide mortars with excellent workability and freeze-thaw durability; however, bond strengths may be reduced. Consequently, design allowable flexural tension values vary based on mortar type and cementitious materials or lime used for unreinforced masonry (ref. 1).

Changes in sand type and gradation affect mortar properties. Natural sand gives improved workability at a lower water demand because of the spherical particle shape, while manufactured sands require additional water due to their angular shape. In general, well graded aggregates reduce segregation in a plastic mortar, which in turn inhibits bleeding and improves workability. Sands deficient in fines generally produce harsh mortars, while sands with excessive fines typically result in mortars with lower compressive strengths.

Types of Mortar

Building codes generally specify mortar types as referenced in ASTM C 270, Standard Specification for Mortar for Unit Masonry (ref. 4f). Four mortar types, M, S, N and O are included in this standard. However, Types M, S, and N are typically required by building codes. Building codes also may restrict the use of some mortars for particular applications. For example, in seismic performance categories C, D, and E (seismic zones 3 and 4), as well as for the empirical design of foundation walls, mortar Types S or M are required (ref. 1). Glass unit masonry requires Type N or S mortar (ref. 1).

Proportioning Mortar

All mortar types are governed by either of the two specifications contained in ASTM C 270: the proportion specification or the property specification. Only one of the specifications should be called for in the project documents, not both. The proportion specification (Table 1) prescribes the parts by volume of each ingredient required to provide a specific mortar type.
A combination of portland cement and lime may be used as the cementing agent in each type of mortar. Also, masonry cements or mortar cements subject to the provisions of ASTM C 91, Standard Specification For Masonry Cement, are available that meet the requirements of M, S, and N mortars with or without further addition of cement.

As an alternative, approved materials may be mixed in controlled percentages as long as the resultant mortar meets the physical requirements designated in ASTM C 270, as shown in Table 2. The aggregate ratio noted in Table 2 must be followed.

9-1a **Mortar For Concrete Masonry**

Table 1 – ASTM C 270 Proportion Specifications Requirements
(ref. 4) Proportions by volume (cementitious materials)

Mortar	Type	Portland cement or blended cement	Mortar cement			Masonry cement			Hydrated lime or lime putty	Aggregate ratio (measured in damp, loose conditions)
			M	S	N	M	S	N	1/4	
Cement-Lime	M	1	-	-	-	-	-	-	over 1/4 to 1/2	
	S	1	-	-	-	-	-	-	over 1/2 to 1 1/4	
	N	1	-	-	-	-	-	-	over 1 1/4 to 2 1/2	
	O	1	-	-	-	-	-	-	-	
Mortar Cement	M	1	-	-	1	-	-	-	-	Not less than 2 1/4 and not more than 3 times the sum of the separate volumes of cementitious materials.
	M	-	1	-	-	-	-	-	-	
	S	1/2	-	1	-	-	-	-	-	
	S	-	-	-	-	-	-	-	-	
	N	-	-	1	-	-	-	-	-	
	O	-	-	1	-	-	-	-	-	
Masonry Cement	M	1	-	-	-	-	1	-	-	
	M	-	-	-	1	-	-	-	-	
	S	1/2	-	-	-	-	1	-	-	
	S	-	-	-	-	1	-	-	-	
	N	-	-	-	-	-	1	-	-	
	O	-	-	-	-	-	1	-	-	

Note: Two air-entraining materials should not be contained in mortar.

Conformance to the property specification of ASTM C 270 is established by testing laboratory prepared mortar during a pre-construction evaluation of the mortar proposed for the project. The laboratory then establishes proportions for mortar, based on successful tests. These proportions are then followed when preparing field mortar.

9-1a **Mortar For Concrete Masonry**

Table 2 – ASTM C 270 Proportion Specifications Requirements* (ref.4)					
Mortar	**Type**	**Avg.compressive strength at 28 days min.psi (MPa)**	**Water retention, min%**	**Air content max%**	**Aggregate ratio (measured in damp, loose conditions)**
Cement-Lime	M	2500 (17.2)	75	12	Not less than 2 1/4 and not more than 3 1/2 times the sum of the separate volumes of cementitious materials.
	S	1800 (12.4)	75	12	
	N	750 (5.2)	75	14**	
	O	350 (2.4)	75	14**	
Mortar Cement	M	2500 (17.2)	75	12	
	S	1800 (12.4)	75	12	
	N	750 (5.2)	75	14**	
	O	350 (2.4)	75	14**	
Masonry Cement	M	2500 (17.2)	75	18	
	S	1800 (12.4)	75	18	
	N	750 (5.2)	75	20**	
	O	350 (2.4)	75	20**	
*Laboratory prepared mortar only.					
**When structural reinforcement is incorporated in cement-lime mortar, the maximum air content shall be 12%.					
***When structural reinforcement is incorporated in masonry cement mortar, the maximum air content shall be 18%.					

Masonry Mortar Properties

Many properties of mortar are not precisely definable in quantitative terminology because of a lack of definitive standards by which to measure them. For example, mortars can be rated on the basis of obtaining visually satisfactory mortar joints. Depending on the particular circumstances for a given project, the criteria for mortar selection are based on design considerations, mortar properties in the plastic state or mortar properties in a hardened state. Consideration of each is necessary to achieve a desired result.

Properties of Plastic Mortar

Workability is the property of mortar characterized by the smooth plastic consistency which makes it easy to spread. This is the property of most importance to the mason. A workable mortar spreads easily under the trowel; adheres to vertical surfaces during unit handling, placement, and bedding; maintains alignment as other units are positioned; and provides a watertight, closed joint when tooled. Once mix proportions have been established, the addition of water should be consistent with that required to improve mortar placement without sacrificing the ability to support the masonry unit. Adequate water content promotes intimate contact between the unit and mortar, which is essential for satisfactory bond. While water content has the greatest influence on the workability of a mortar, cementitious materials, aggregate gradation, and air-entrainment also contribute to a lesser degree.

Water retention of mortar is a measure of the mortar's ability to retain its plasticity when subjected to the atmosphere or the absorptive forces of a concrete masonry unit. Mortars with low water retention stiffen more quickly, making it difficult for the mason to bed and adjust the masonry unit during placement. Mortars with desired water retention characteristics allow the mason to lay a mortar bed two or three units ahead before placing subsequent units. Water retentivity is dependent on properties of the cementitious materials, sand gradation, and mortar proportions.

9-1a **Mortar For Concrete Masonry**

The time lapse between spreading a mortar bed and placing block should be kept to a minimum, because the workability will be reduced as water is absorbed into the block. If too much time elapses before a block is placed on a fresh mortar bed, units are less easily positioned and the bond will be reduced.

Evaporation of the mixing water from mortar may require retempering (mixing in additional water). This generally is not harmful as long as it is done prior to hydration of the mortar. To avoid the stiffening effects of hydration, mortar must be placed in final position within 21/2 hours after the original mixing (ref. 3) unless special set retarding admixtures are used.

Properties of Hardened Mortar

Properties of hardened mortar that affect the performance of the finished concrete masonry include bond, compressive strength, and durability. These properties are difficult to measure other than in laboratory or field specimens prepared under controlled conditions. However, ASTM C 1324, Standard Test Method for Examination and Analysis of Hardened Masonry Mortar, (ref. 4i) provides procedures for petrographic examination and chemical analysis for components of masonry mortar in the hardened state. A 0.35 oz. (10 g) sample is usually sufficient for both the petrographic and chemical analysis. When obtaining the sample, however, it is important to ensure that the sample is representative of the mortar in question, i.e. original mortar as opposed to pointing mortar or other mortars used on the project.

Bond is a term used to describe both the extent of contact between mortar and unit and the strength of adhesion. Bond is a function of several factors including mortar properties, unit surface characteristics, workmanship, and curing. Other factors being equal, bond strength will increase as the compressive strength of the mortar increases, although not in direct proportion. Bond may also be effectively increased through the use of properly designed mortars having water contents which provide good workability.

Compressive strength is perhaps the most commonly measured property of mortar but is perhaps the most misunderstood. Whenever compressive strength results are intended to be used to determine conformance of a mortar to the property specifications of ASTM C 270, compressive strength tests must be conducted in accordance with the laboratory procedures required by ASTM C 270. The mortar compressive test in ASTM C 780, Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry, (ref. 4h) is only to verify the consistency of materials and procedures, not to determine mortar strength (ref. 3). It contains no requirement for minimum compressive strength of field mortar and states that the strength should not be construed as being representative of the actual strength of the mortar. The reason is that the mortar strength in the wall will be much higher than the field test because of the reduced water cement ratio due absorption of mix water into the masonry units and a greatly reduced shape factor in the mortar joint versus the mortar test cube.

Durability of mortar also is an important consideration for parapets or other walls with an extreme exposure to the weather. Oversanding or overtempering can decrease durability. High strength mortars and air entrained mortars provide increased durability. For more detailed discussion on field testing of mortar see TEK 18-5, Masonry Mortar Testing (ref. 2).

1. Building Code Requirements for Masonry Structures, ACI 530-99/ASCE 5-99/TMS 402-99. Reported by the Masonry Standards Joint Committee, 1999.
2. Masonry Mortar Testing, TEK 18-5. NCMA, 1995.
3. Specifications for Masonry Structures, ACI 530.1-99/ASCE 6-99/TMS 602-99. Reported by the Masonry Standards Joint Committee, 1999.
4. 2001 Annual Book of ASTM Standards, American Society for Testing and Materials :

4a. C 5-79 (1997), Standard Specification for Quicklime for Structural Purposes.
4b. C 91-99, Standard Specification for Masonry Cement. 4c. C 144-99, Standard Specification for Aggregate for Masonry Mortar.
4d. C 150-00, Standard Specification for Portland Cement. 4e. C 207-91(1997), Standard Specification for Hydrated Lime for Masonry Purposes.
4f. C 270-00, Standard Specification for Mortar for Unit Masonry.
4g. C 595-00ae1, Standard Specification for Blended Hydraulic Cements.
4h. C 780-00, Standard Test Method for Preconstruction and Constructio Evaluation of Mortars for Plain and Reinforced Unit Masonry.
4i. C 1324-96, Standard Test Method for Examination and Analysis of Hardened Masonry Mortar.
4j. C 1329-00, Standard Specification for Mortar Cement. 4k. C 1384-01, Standard Specification for Admixtures for Masonry Mortars.

Cold Weather Construction

When masonry construction is carried on during periods of freezing weather, proper facilities should be available for preparing the mortar and protecting the fresh masonry work against frost damage. The most important consideration is that sufficient heat be provided to ensure hydration of the cement. After combining all ingredients, mortar temperature should be within the range of 4°C (40°F) to 49°C (120°F). Mortar temperatures in excess of 49°C (120°F) may cause excessively fast hardening with resultant loss of compressive and bond strength.

The use of an admixture to lower the freezing point of mortars during winter construction should be avoided. The quantity of such materials necessary to lower the freezing point of mortar to any appreciable degree would be so large that mortar strength and other desirable properties would be seriously impaired.

Recommendations for Cold-Weather Construction: The following table gives requirements at various cold-weather temperatures for heating of materials and protections of construction.

Above 4°C
Normal Masonry Procedures. No heating (40°F) required. Cover walls with plastic or canvas at end of work day to prevent water entering masonry.

Below 4°C
Heat mixing water. Maintain mortar (40°F) temperatures between 4°C (40°F) and 49°C (120°F) until placed.Cover walls and materials to prevent wetting and freezing. Covers should be plastic or canvas.

Below 0°C
In addition to the above, heat the sand. Frozen (32°F) sand and frozen wet masonry units must be thawed. With wind velocities over 24 kmh (15 mph), provide windbreaks during the work day and cover walls and materials at the end of the work day to prevent wetting and freezing. Maintain masonry above 0°C (32°F) using auxiliary heat or insulated blankets for 16 hours after laying units.

Below -7°C
In addition to the above, dry masonry units (20°F) must be heated to -7°C (20°F). Provide enclosure and supply sufficient heat to maintain masonry enclosure above 0°C (32°F) for 24 hours after laying units.

Refer to NCMA Tek 3-1C All Weather Concrete and Masonry Construction or contact the Shouldice Head Office for more information.

10-1a **Crack Control**

Crack Control In Concrete Masonry Walls

Cracks in buildings and building materials normally result from restrained movement. This movement may originate within the material, as with volume changes due to moisture loss or acquisition, temperature expansion or contraction, may result from movements of adjacent or supporting materials, such as deflection of beams or slabs. In many cases, movement is inevitable and must be accommodated or controlled.
Designing for effective crack control requires an understanding of the sources of stress which may cause cracking. It would be a simple matter to prevent cracking if there were only one variable. However, prevention is made more difficult by the fact that cracking often results from a combination of sources.

Causes Of Cracking

There are a variety of potential causes of cracking. Understanding the cause of potential cracking allows the designer to incorporate appropriate design procedures to control it. The most common causes of cracking in concrete masonry are discussed below.

Shrinkage/Restraint

Cracking resulting from shrinkage can occur in concrete masonry walls because of drying shrinkage, temperature fluctuations, and carbonation. These cracks occur when masonry panels are restrained from moving.

Drying Shrinkage

Concrete products are composed of a matrix of aggregate particles coated by cement which bonds them together. Once the concrete sets, this cementitious-coated aggregate matrix expands with increasing moisture content and contracts (shrinks) with decreasing moisture content. Drying shrinkage is therefore a function of change in moisture content.
Although mortar, grout, and concrete masonry units are all concrete products, unit shrinkage has been shown to be the predominate indicator of the overall wall shrinkage principally due to the fact that it represents the largest portion of the wall. Therefore, the shrinkage properties of the unit alone are typically used to establish design criteria for crack control.
For an individual unit, the amount of drying shrinkage is influenced by the wetness of the unit at the time of placement as well as the characteristics and amount of cementitious materials, the type of aggregate, consolidation, and curing.

Specifically, drying shrinkage is influenced in the following ways:

- Walls constructed with "wet" units will experience more drying shrinkage than drier units ;
- Increases in cement content increase drying shrinkage;
- Aggregates that are susceptible to volume change due to moisture content will result in increased shrinkage; and units that have undergone at least one drying cycle will not undergo as much shrinkage in subsequent drying cycles (ref. 7).
- Typical drying shrinkage coefficients range from 0.0002 to 0.00045 in./in. (mm/mm) or 0.24 to 0.54 in. (6.1 to 13.7mm) in 100 ft (30.48 m).

Temperature Changes

Concrete masonry movement has been shown to be linearly proportional to temperature change. The coefficient of thermal movement normally used in design is 0.0000045 in./in./°F (0.0000081 mm/mm/°C) (ref. 2). Actual values may range from 0.0000025 to 0.0000055 in./in./°F (0.0000045 to 0.0000099 mm/mm/°C) depending mainly on the type of aggregate used in the unit. The actual change in temperature is, of course, determined by geographical location, wall exposure, and colour.
As an example, a wall constructed during 70°F (21°C) weather and subjected to a minimum temperature of 0°F (-18°C) results in a shortening of about 0.38 in. (9.7 mm) in a 100 foot (30.48 m) long wall using the 0.0000045 in./in./°F (0.0000081 mm/mm/°C) coefficient.

Carbonation

Carbonation is an irreversible reaction between cementitious materials and carbon dioxide in the atmosphere that occurs slowly over a period of several years. Since there currently is no standard test method for carbonation shrinkage, it is suggested that a value of 0.00025 in./in. (mm/mm) be used. This results in a shortening of 0.3 in. (7.6 mm) in a 100 foot (30.48 m) long wall.

Restraint

As previously mentioned, the above phenomenon produce movement in the wall. When external restraint is provided that resists this movement, the result is tension within the wall and a corresponding potential for cracking. Typically, concrete masonrywalls are restrained along the bottom of the wall

(mainly by the foundation) with partial restraint along the top of the wall. The ends of the typical concrete masonry wall panel may be partially restrained by pilasters or wall intersections, but this partial restraint usually does not significantly alter the wall's cracking potential. Exceptions to the typical restraint condition include cantilevered walls which are restrained along their base, but free (unrestrained) at the top. It is conservative to base general crack control design criteria on a condition of restraint along the top and bottom of the wall.

Differential Movement

Various building materials may react differently to changes in temperature, moisture, or structural loading. Any time materials with different properties are combined in a wall system, a potential exists for cracking due to differential movement. With concrete masonry construction, two materials in particular should be considered: clay brick and structural steel.

Differential movement between clay brick and concrete masonry must be considered when the two are attached since concrete masonry has an overall tendency to shrink while clay brick masonry tends to expand. These differential movements may cause cracking, especially in composite construction and in walls that incorporate brick and block in the same wythe.

Composite walls are multi-wythe walls designed to act structurally, as a single unit in resisting applied loads. The wythes are typically bonded together using wall ties at prescribed intervals to assure adequate load transfer. When the composite wall includes a clay brick wythe bonded to a concrete masonry wythe, ladder-type joint reinforcement, or box ties are used to provide some degree of lateral movement between wythes. In addition, expansion joints are installed in the clay brick wythe to coincide with control joints in the concrete masonry wythe.

When clay brick is used as an accent band in a concrete masonry wall, or vice-versa, the differential movement of the two materials may result in cracking unless provisions are made to accommodate the movement. To reduce cracking, slip planes between the band and the surrounding wall, horizontal reinforcement or more frequent control joints or a combination thereof can be used to control cracking. See Crack Control for Concrete Brick and Other Concrete Masonry Veneers (ref. 6) for more information on these approaches.

Thermal movement differences also need to be taken into consideration when using masonry in conjunction with structural steel. In addition to differences in thermal coefficients, steel shapes typically have a much higher surface area to volume ratio and tend to react to changes in temperature more quickly. This is normally accommodated with slotted and flexible connections. Concrete Masonry Walls for Metal Buildings (ref. 5) provides more detailed information on this subject.

Excessive Deflection

As walls and beams deflect under structural loads, cracking may occur. Additionally, deflection of supporting members can induce cracks in masonry elements. To reduce the potential for cracking, the following alternatives are available:

- Adding reinforcing steel into the masonry to cross the expected cracks and to limit the width of the cracks,
- Limiting the deflection of members providing vertical support of unreinforced masonry to acceptable levels (less than or equal to l/600 nor more than 0.3 in. (7.6 mm) due to dead load and live load when supporting unreinforced masonry) (ref. 2), and;
- Utilizing movement joints to effectively panelize the masonry so that it can articulate with the deflected shape of the supporting member.

Structural Overload

All wall systems are subject to potential cracking from externally applied design loads due to wind, soil pressure or seismic forces. Cracking due to these sources is controlled by applying appropriate structural design criteria such as allowable stress design or strength design. These criteria are discussed in detail in Allowable Stress Design of Concrete Masonry and Strength Design of Concrete Masonry (refs. 1 and 9).

Settlement

Differential settlement occurs when portions of the supporting foundation subside due to weak or improperly compacted foundation soils. Foundation settlement typically causes a stair-step crack along the mortar joints in the settled area as shown in Figure 1. Preventing settlement cracking depends on a realistic evaluation of soil bearing capacity, and on proper footing design and construction.

Footings should be placed on undisturbed native soil, unless this soil is unsuitable, weak, or soft. Unsuitable soil should be removed and replaced with compacted soil, gravel, or concrete. Similarly, tree roots, construction debris, and ice should be removed prior to placing footings. Adding reinforcement in foundations can also lessen the effects of differential settlement.

10-1a **Crack Control**

Crack Control Strategies

In addition to the proper design strategies discussed above for structural capacity and differential movement, the following recommendations can be applied to limit cracking in concrete masonry walls.

Material Properties

Traditionally, crack control in concrete masonry has relied on specifying concrete masonry units with a low moisture content, using horizontal reinforcement, and using control joints to accommodate movement. Prior to the 2000 edition of ASTM C 90 (ref. 8), low moisture content was specified by requiring a Type I moisture controlled unit. The intent was to provide designers an assurance of units with lower moisture content to minimize potential shrinkage cracking. However, there are several limitations to relying on moisture content alone since there are other factors that influence shrinkage which are not accounted for by specifying a Type I unit. Additionally, Type I units were not always inventoried by concrete masonry manufacturers. Most importantly, Type I units needed to be kept protected until placed in the wall, which was proven to be difficult on some projects. Because of the above problems associated with the Type I specification, ASTM removed the designations of Type I, Moisture-Controlled Units and Type II, Nonmoisture Controlled Units from the standard.

Due to removal of the unit type designations from ASTM C90, two methods of determining control joint spacings have been devised irrespective of unit type: 1). Empirical crack control criteria which is based on successful, historical performance over many years in various geographic conditions and 2). Engineered crack control criteria based on a Crack Control Coefficient (CCC) that includes the combined effects of movement due to drying shrinkage, carbonation shrinkage, and contraction due to temperature change. The first is presented in NCMA TEK 10-2B, Control Joints for Concrete Masonry Walls - Empirical Method (ref. 4) and the second in TEK 10-3 Control Joints for Concrete Masonry Walls - Alternative Engineered Method (ref. 3). The empirical method is the most commonly used method and is applicable to most conventional building types. The engineered method is generally used only when unusual conditions are encountered such as dark coloured units in climates with large temperature swings.

Control Joints

Control joints are essentially vertical separations built into the wall to reduce restraint and permit longitudinal movement. Because shrinkage cracks in concrete masonry are an aesthetic rather than a structural concern, control joints are typically only required in walls where shrinkage cracking may detract from the appearance or where water penetration may occur. TEK 10-2B (ref. 4) provides much more detailed information on control joint details, types and locations.

Reinforcement to Limit Crack Width

In addition to external restraint, reinforcement causes some internal restraint within the wall. Reinforcement responds to temperature changes with corresponding changes in length; however, reinforcement does not undergo volumetric changes due to moisture changes or carbonation. Consequently, as the wall shrinks, the reinforcement undergoes elastic shortening (strain) which results in compressive stress in the steel. Correspondingly, the surrounding masonry offsets this compression by tension. At the point when the masonry cracks and tries to open, the stress in the reinforcement turns to tension and acts to limit the width of the crack by holding it closed.

The net effect is that reinforcement controls crack width by causing a greater number (frequency) of cracks to occur. As the horizontal reinforcement ratio (cross-sectional area of horizontal steel vs. vertical cross-sectional area of masonry) increases, crack width decreases. Smaller sized reinforcement at closer spacings is more effective than larger reinforcement at wider spacings, although horizontal reinforcement at spacings up to 144 in. (3658 mm) is considered effective in controlling crack widths in some areas.

Studies have shown that reinforcement, either in the form of joint reinforcement or reinforced bond beams, effectively limits crack width in concrete masonry walls. As indicated previously, as the level of reinforcement increases and as the spacing of the reinforcement decreases, cracking becomes more uniformly distributed and crack width decreases. For this reason, a minimal amount of horizontal reinforcement.

Walls in high seismic areas with a relatively large amount of horizontal reinforcement may not require control joints, as the reinforcement alone reduces the width of shrinkage cracks to a size that can be treated effectively with water repellent coatings. Experience has shown that this can be accomplished in walls with at least 0.2% of horizontal reinforcement (ref. 3). See Table 1 for the size and spacing of reinforcement to meet this criteria.

References

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2. Building Code Requirements for Masonry Structures, ACI 530-02/ASCE 6-02/TMS 402–02. Reported by the Masonry Standards Joint Committee, 2002.

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4. Control Joints for Concrete Masonry Walls - Empirical Method, TEK 10-2B. National Concrete Masonry Association, 2001.

5. Concrete Masonry Walls for Metal Buildings, TR–149. National Concrete Masonry Association, 1996.

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7. Measuring Shrinkage of Concrete Block - A Comparison of Test Methods, E.L. Saxer and H.T. Toennies, Pages 988-1004, 1957.

8. Standard Specification for Loadbearing Concrete Masonry Units, ASTM C 90-03. ASTM International, 2003.

9. Strength Design of Concrete Masonry, TEK 14–7A. National Concrete Masonry Association, 2002.

Table 1 – maximum Spacing of Horizontal reinforcement to meet the Criteria As>0.002 Au[1]

Wall thickness, in (mm)	Maximum spacing of horizontal reinforcement, in (mm) Reinforcement size		
	No. 6 (M19)	No. 5 (M16)	No. 4 (M13)
Ungrouted or partially grouted walls			
6 (152)	48 (1219)	48 (1219)	32 (813)
8 (203)	48 (1219)	40 (1016)	24 (610)
10 (254)	48 (1219)	32 (813)	16 (406)
12 (305)	48 (1219)	24 (610)	8 (203)
Fully grouted walls			
6 (152)	32 (813)	24 (610)	16 (406)
8 (203)	24 (610)	16 (406)	8 (203)
10 (254)	16 (406)	16 (406)	8 (203)
12 (305)	16 (406)	8 (203)	8 (203)

1. A includes cross-sectional area of grout in bond beams

10-4 **Crack Control**

Introduction

Concrete masonry veneer is used to provide a beautiful, economical and highly durable exterior. Concrete brick are widely used over concrete masonry, concrete frame, steel or wood structural backup. Concrete brick masonry also offers tremendous architectural versatility. The finished appearance of the wall can be altered by changing the unit size, unit or mortar colour, as well as the masonry bond pattern. A wide range of surface textures is also available, such as split face, Rock-Stone, Tex-Stone, or Tapestry. In addition, concrete brick can be used to provide a traditional clay brick appearance, while offering the flexibility available with the colours and architectural finishes of conventional concrete masonry products. Tumbled concrete brick and surface colour coatings are also available to simulate the look of antique brick.

The term "brick" historically refers to a masonry unit that can be held in the hand, although the term is often associated with fired clay masonry. Concrete masonry veneers that resemble brick are constructed using either concrete brick units or half-high concrete masonry units, as shown in Figure #1. Concrete brick units most commonly have a nominal thickness of 4 in. (102 mm), lengths of 9 3/4 or 12 in. (247 or 290 mm) and heights from 3 to 3 1/2 in. (64 to 152 mm). The specified size of a concrete brick is typically 3 5/8 x 3 x 9 3/4 in. (90 x 75 x 247 mm). They are usually laid with bed joints 3/8 in. (10 mm) thickness to provide a constructed height of 3 3/8 in. (86 mm), so that three courses of concrete brick equals one 9 3/4 in. (247 mm) high module. In many cases, additional sizes and configurations are available.

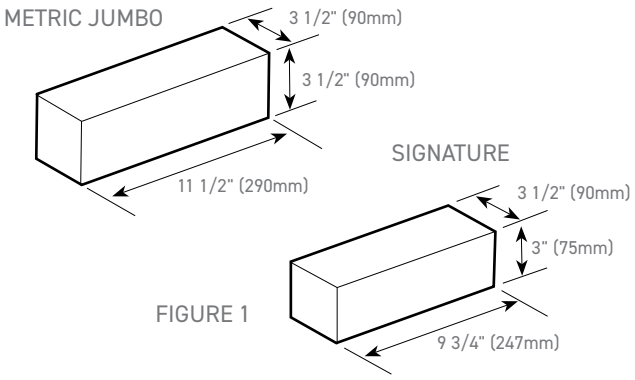

FIGURE 1

This TEK addresses crack control measures specifically developed for concrete masonry veneers to accommodate cracking resulting from internal volume change of the concrete masonry. Potential cracking resulting from externally applied loads is not covered. Further information on concrete masonry veneers is available in TEK 3-6A Concrete Masonry Veneers, TEK 16-2A Concrete Brick Structural Design Considerations and TEK 16-3A Structural Backup Systems for Masonry Veneer (refs. 3, 4 and 5).

Concrete Brick Compared To Clay Brick

Building with concrete brick has some intrinsic differences from building with clay brick due to different material properties. One should not be substituted for the other without due consideration of these differences.

Concrete masonry walls have an overall tendency to shrink, whereas clay brick walls tend to expand. Both concrete and clay masonry may use movement joints to accommodate this movement, although the type of joint is different for clay than for concrete masonry. When control joints are required, concrete brick requires only vertical control joints whereas clay brick typically requires both vertical and horizontal expansion joints to accommodate panel expansion. In commercial construction, horizontal expansion joints are most often installed at each floor level below steel shelf angles used to support the clay brick. Concrete brick installations may include shelf angles as lintels over openings or in curtain wall construction.

Placing concrete brick units also differs from placing clay brick, because the production techniques differ between concrete and clay brick. Concrete brick have very consistent dimensional tolerances compared to clay brick. Concrete brick should not be wetted prior to placement. Concrete brick unit properties are summarized in TEK 1-1C, ASTM Specifications for Concrete Masonry Units (ref. 7).

When clay brick banding is incorporated in a concrete masonry veneer, a horizontal slip plane is used to accommodate differential movement between the two materials. See TEK 10-1A, Crack Control in Concrete Masonry Walls (ref. 11) for more information.

Crack Control Recommendations

Concrete masonry veneer units, like all concrete products, tend to decrease in volume as drying occurs. This potential shrinkage should be provided for in the design, detailing and construction to minimize shrinkage cracking. Shrinkage cracks in concrete masonry are an aesthetic, rather than structural, concern. Because veneers, by definition, are primarily aesthetic, crack control for veneers is often a high design priority.

While movement due to moisture change is the primary focus when addressing nonstructural movement in masonry walls, temperature changes can also cause reversible shrinkage and expansion. It should be noted that darker masonry units as well as those installed on southern and western exposures will experience larger daily temperature variations due to solar exposure, and hence may require more attention to adequately address wall movement.

Crack control measures for concrete masonry veneers are similar to those for other concrete masonry walls. In fact, conventional concrete masonry crack control measures, such as those in TEK 10-2B, Control Joints for Concrete Masonry Walls—Empirical Method (ref. 1), have been used successfully for concrete masonry veneers in many cases.
Crack control recommendations for concrete masonry veneers are summarized below and are described more fully in the following sections.

Crack Control Recommendations for Concrete Masonry Veneers*
Control joints: maximum panel length to height ratio of 1 1/2, and maximum spacing of 20 ft.(6.1m) and where stress concentration occurs
Joint reinforcement: at 16 in. (406mm) o.c.
Mortar: Type N
*Adjust as needed to suit local conditions and experience

Unit Characteristics

Because the units used for veneers are often produced specifically for veneer applications, the physical properties may differ from those of larger concrete masonry units. These differences can impact how the concrete masonry veneer moves and reacts to changes in moisture content and temperature. Hence, crack control recommendations have been tailored specifically for concrete masonry veneers.

Ensuring that the concrete masonry units are relatively dry when laid and remain dry during construction will also help minimize initial drying shrinkage of the wall.

Techniques to minimize water absorption by the veneer will also help limit subsequent movement due to moisture loss. Some manufacturers have had success in reducing veneer movement by incorporating integral water repellents in the veneer units during manufacture. When used in the units and added to the mortar on site, integral water repellents help minimize water absorption.

Mortar

Using a lower compressive strength mortar helps ensure that when cracks do occur, they occur in the mortar joint rather than through the unit. Type N mortar is often specified for concrete brick veneers, because it tends to be more flexible than other mortar Types. ASTM C 270, Standard Specification for Mortar for Unit Masonry (ref. 6) recommends that Type S mortar be used in parapets, chimneys and other exposed applications.

Joint Reinforcement

Horizontal joint reinforcement effectively limits crack width by holding any cracks that form tightly together. For this reason, joint reinforcement, spaced at 16 in. (406 mm) on center, is recommended in concrete masonry veneers, although acceptable performance has been achieved without joint reinforcement in some cases.

To protect joint reinforcement from corrosion, Specification for Masonry Structures (ref. 9), requires at least 5/8 in. (16 mm) of mortar cover between the joint reinforcement and the weather-exposed face of the masonry.

When both joint reinforcement and control joints are used, the joint reinforcement should be discontinued at the control joint to avoid restricting horizontal movement at the joint.

10-4 **Crack Control**

Figure 2 - Example of Residential Control Joint Placement

Control Joints

Control joints are vertical separations built into the veneer and located where stress concentrations are likely to cause cracks. The joints allow unrestrained longitudinal movement, thereby relieving horizontal tensile stress that may develop due to shrinkage.

Ideally, a control joint should be located wherever masonry volume changes are likely to cause cracking. Because this can be difficult to determine in practice, the following are general guidelines for locating control joints.

For veneer panels without openings or other points of stress concentration, control joints are used to effectively divide a wall into a series of panels. In general, it is desirable to keep these panels as square as possible to minimize cracking between the control joints. When this is not possible, the panel length to height ratio should be limited to 1 1/2, with a maximum control joint spacing of 20 ft. (6.1 m). Control joint spacing should be adjusted where local experience justifies.

Whenever possible, control joints should be located where stress concentrations occur, such as: at changes in wall height or thickness; at inside corners; within 4 in. (102 mm) of outside corners; and near one or both sides of large door and window openings. Note that every opening does not necessarily require control joint(s), particularly in buildings with many small openings (see Residential Construction section, below). Note that control joints should line up with the end of the lintel, rather than be placed through the lintel, as shown in Figure 2.

Veneers are typically attached to a structural backup with adjustable ties or anchors (for tie and anchor types, design criteria and spacing requirements, see TEK 12-1A, Anchors and Ties for Masonry (ref. 8)). Ties should be placed within 12 in. (305 mm) of the control joint. When flexible ties are used, control joint locations need not align with control joints in the backup when a masonry backup wythe is used, although it is considered good practice to align them. If the veneer is rigidly bonded to a masonry backup, however, control joints should extend through the backup and veneer in the same location.

Residential Construction

Control joint recommendations for larger buildings typically call for a control joint at each window, and on both sides of the window if the window is over 6 ft (1.8 m) wide (ref. 1). However, this may be difficult to accomplish in residential construction because of the large number of relatively small openings. One strategy is to use control joints to divide the wall into panels that are no longer than they are high. Because residential buildings typically have fewer stories than commercial, this often results in closer control joint spacings than are common in commercial buildings.

Figure 2 shows a residential facade with recommended control joint locations. As an alternative to the right-hand joint shown in Figure 2, a control joint could be placed through or to one side of the garage door. Horizontal joint reinforcement placed at 16 in. (406 mm) o.c. will help compensate for not placing control joints at every window opening.

In residential construction, veneers are most often supported by wood frame construction (see Figure 3). Detailed requirements for masonry veneer over wood frame are described in TEK 3-6A, Concrete Masonry Veneers (ref. 3).

Control Joint Construction

Structural masonry walls require that control joints permit free longitudinal movement while resisting lateral or out-of-plane shear loads. Because veneers are nonstructural, veneer control joints need only permit unrestricted longitudinal movement. This can be accomplished by raking out the mortar joint and installing a backer rod and appropriate sealant, as shown in Figure 4. The backer rod and sealant allows in-plane movement while keeping the joint weathertight.

Several strategies are used to make control joints less noticeable. Perhaps the simplest approach is to locate the vertical control joint behind a downspout. If the architectural style allows it, a recess can be built into the veneer to create a vertical shadow line and provide an inconspicuous control joint location, or the control jopint can be aligned with another architectural feature. When quoins are used, the control joint can be placed adjacent to the edge of the quoin to make it less noticeable.

References

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2. Water Repellents for Concrete Masonry Walls, TEK 19-1. National Concrete Masonry Association, 1995.

3. Concrete Masonry Veneers, TEK 3-6A. National Concrete Masonry Association, 1995.

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6. Standard Specification for Mortar for Unit Masonry, ASTM C

7. ASTM Specifications for Concrete Masonry Units, TEK 1-1C. National Concrete Masonry Association, 2000.

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9. Specification for Masonry Structures, ACI 530. 1-99/ASCE 6-99/TMS 602-99. Reported by the Masonry Standards Joint Committee, 1999.

10. Crack Control in Concrete Masonry Walls, TEK 10-1A. National Concrete Masonry Association, 2001

Cleaning Instructions for Masonry

Description

Vanatrol is a masonry cleaning material designed for the removal of excess mortar, job dirt and normal stains while preventing the appearance of vanadium (green) stains in white and other light coloured masonry materials. Vanatrol also substantially reduces manganese and iron stains in brown, black and grey coloured brick. A special wetting system actually softens excess mortar and creates a "clinging" action that holds the cleaner on the surface of the masonry work. Other exclusive ingredients slow the drying time and allow for thorough rinsing, thus preventing the cleaner from drying into the wall and creating streaks.

Recommended Cleaning Procedures

Test recommended strengths on a small area of the building, using polyethylene or rubber buckets only. Allow test areas to thoroughly dry before determining results.

a) Thoroughly saturate a large portion of the masonry surface to be cleaned. The purpose of saturation is to keep the cleaning solution to the surface and prevent the wall from drying out before the final rinsing process, thereby preventing streaks. When working from staging, keep all lower areas "surface wet" to prevent runoff streaks.

b) The prepared cleaning solution may be applied with a low pressure sprayer (under 60 p.s.i.). A densely packed, soft fibered masonry washing brush is preferable, although on rough textured brick and block, a stiff fibered brush may be of assistance.

c) Allow the cleaning solution to remain on the wall for approximately 5 minutes. Waiting period will vary with absorption rate of the masonry surface and drying conditions. Scrape off excess mortar deposits and re-apply cleaning solution. If scrapers are required, it is recommended that small pieces of brick or wood be used.

d) Rinse thoroughly with fresh water, removing all cleaning compound and impurities.

Note

Avoid repeated re-application of the cleaning solution over the same area. Continued applications will cause too much solution to penetrate the wall and may result in a white detergent film. If mortar deposits are not softened after initial application, merely allow the solution to remain on the wall for a longer period of time.

CAUTION

This product is extremely corrosive and vapours may be harmful. Avoid contact with eyes, skin and clothing. Do not breathe fumes. If splashed in eyes or on skin, flush thoroughly with water. If swallowed, give 3 or 4 glasses of milk or water. Do not induce vomiting. Call physician immediately.

Refer to NCMA Tek 8-2A Removal of Stains from Concrete and Masonry or contact the Shouldice Head Office for more information.

Removing Stains from Masonry

Description
There are many common substances which can cause unattractive stains on masonry walls.

Ink stains, coffee stains and paint stains are only some common substances which can cause unattractive discolourations on masonry walls. The question is, how to get rid of them?
The following article offers helpful hints on how to identify and remove stains which can occur on masonry.
The information contained in this article has been supplied by Lafarge Canada Inc.

Coffee Stains
Coffee stains can be removed by applying a cloth saturated in glycerine diluted with four times its volume of water. Javelle water or the solution used on fire stains is also effective.

Copper, Bronze & Aluminum Stains
Copper and Bronze stains are nearly always green, but in some cases they may be brown. Aluminum stains appear as a white deposit.

For copper and bronze stains, mix together in dry form, one part ammonium chloride (sal ammoniac) and four parts powdered talc. Add ammonia water and stir until a thick paste is obtained.

"For ordinary blue writing inks make a solution of sodium perborate in hot water." Place this over the stain and leave until dry. When working on glazed tile, use a wooden paddle to scrape off the paste. An old stain of this kind may require several applications. Aluminum chloride may be used in the above procedure instead of the sal ammoniac.

For aluminum stains, scrub with a 10 per cent solution of muriatic acid.

Ink Stains
Different inks require different treatments. For ordinary blue writing inks, make a solution of sodium perborate in hot water.

Mix with whiting (which may be obtained at any paint store) to a thick paste, apply in a 5 mm layer, and leave until dry. If some of the blue colour is visible after this poultice is removed, treat it by the method for iron stains. Sodium perborate can be obtained from any druggist. Many red, green, violet, and other bright-coloured inks are water solutions of synthetic dyes. Stains made by this type of ink can usually be removed by the sodium perborate poultice described above. Often the stain can be removed by applying ammonia water on cotton batting. Javelle water is also effective, used the same as ammonia water, or mixed to a paste with whiting and applied as a poultice.

A mixture of equal parts of chlorinated lime and whiting reduced to a paste with water may also be used as a poulticing material.

Some blue inks contain Prussian blue, a ferrocyanide of iron. These stains cannot be removed by the perborate poultice, Javelle water, or chlorinated lime poultice. Such stains yield to treatment of ammonia water applied on a layer of cotton batting. A strong soap solution applied the same way may also be effective.

Indelible ink often consists entirely of synthetic dyes. Stains may be treated as outlined above for that type. However, some indelible inks contain silver salts which cause a black stain. This may be removed with ammonia water. Usually, several applications are necessary.

Iodine Stains
An iodine stain will gradually disappear of its own accord. It may be removed quickly by applying alcohol and covering with whiting or talcum powder. If on a vertical wall, mix talcum to a paste with alcohol, apply some alcohol to the stain, then cover with the paste.

Iron Stains
Mix seven parts lime-free glyercine with a solution of one part sodium citrate in six parts luke-warm water, mix with whiting or kieselguhr to make a thick paste. Apply paste to stain with trowel, and scrape off when dried out. Repeat until stain has disappeared and wash thoroughly with clear water. (Ammonium citrate may produce quicker results than sodium citrate).

Oil Stains
Make a paste of a solution of 0.5 kilograms of trisodium phosphate to 5 litres of water and whiting. Spread this paste in a layer about 15 mm thick over the surface to be cleaned and leave it until it dries (approximately 24 hours). Remove the paste and wash surface with clear water.

An alternative treatment consists of the application of a poultice made by adding powdered talc or whiting to a five per cent solution of caustic soda.

Paint Stains
For fresh paint, apply a commercial paint remover or a solution of trisodium phosphate in water – 1 kilogram of trisodium phosphate to 5 litres of water. Allow to stand and remove paint with a scraper and wire brush. Wash with clear water.

Perspiration Stains
Secretions from the hands or oil from the hair may produce stains on concrete. The best treatment is that recommended for fire stains (see below). Bad stains may require several treatments.

Plant Growth
Occasionally an exterior masonry surface that is not exposed to sunlight and remains in a constantly damp condition will exhibit signs of a plant growth such as moss. "An iodine stain will gradually disappear but may be quickly removed by applying alcohol and covering with whiting."

Application of ammonium sulfamate (marketed under the manufacturer's brand name and available in gardening supply stores) according to directions furnished with the compound has been used successfully in the removal of such growths.
Although it is not believed that an unsightly residue will be left on the face of the wall, any powdery deposit can be removed by washing with water.

Smoke and Fire Stains
Make a smooth, stiff paste of trichlorethylene and powdered talc. Apply with a trowel, cover to prevent rapid evaporation and scrape off when dried.

Precaution should be taken to ventilate a closed space in which trichlorethylene is used, as the fumes are harmful. Soap and water applied with a stiff-bristle brush are frequently effective in removing soot and coat-smoke stains. A small amount of powdered pumice added to the soap solution may increase its effectiveness.

Tobacco Stains
Dissolve 1 kilogram of trisodium phosphate in 6 litres of water. In a separate container, make a smooth, stiff paste of 350 grams of chloride of lime with water. Pour the former into the paste and stir thoroughly. Make a stiff paste of this with powdered talc and apply and remove in the same way as described above for iron stains.

To apply with a brush, add about 10 milliliters of sugar to each kilogram of powdered talc. This mixture is a strong bleaching agent and is corrosive to metals.

Vanadium or Molybdenum
Occasionally a green stain will appear on buff or gray clay facing brick or tile. This may be a form of efflorescence resulting from vanadium or molybdenum compounds in the clay unit.

"Hydrochloric acid shouldn't be used in removing efflorescence from vanadium or molybdenum compounds."

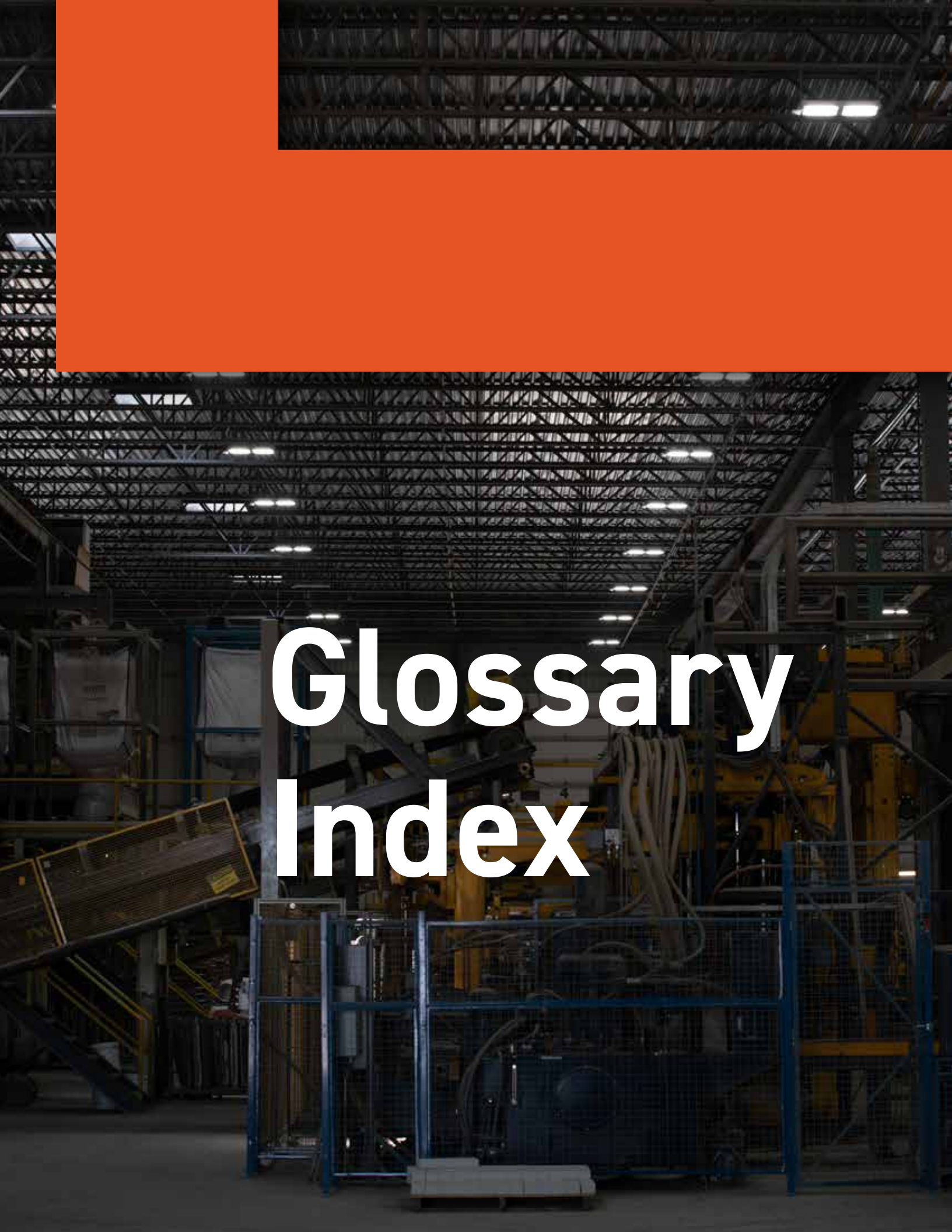
Hydrochloric acid should not be used in attempting to remove efflorescence resulting from such compounds. The acid may react with the vanadium or molybdenum compounds, converting them to an insoluble brown stain that is practically impossible to remove except with abrasives.

A cleaning method that has been used successfully in many such cases is to wash the wall with a solution of caustic soda, such as one part sodium hydroxide crystals (lye) to 10 parts water.
The wall should be washed with clear water, both before and after the application of the caustic soda solution, and precautions taken to protect the clothing and skin of the person using the solution.

Vanadium salts will green when precipitated from an acid medium and white when precipitated from a basic medium. Acid conditions on the face of the brick should be avoided. Carbonic acid in rain water is sufficient to cause vanadium salts to turn green.

Wood Stains
Under damp conditions, wood will rot and cause chocolate coloured stains that are readily distinguished from most other stains by its dark colour.

The best treatment is that recommended for fire stains. Action may be accelerated by first scrubbing the surface thoroughly with glycerine diluted with four times its volume of water.



Glossary Index

6-9a: **Glossary of Concrete Masonry Terms**

"A" block: Hollow masonry unit with one end closed by a cross web and the opposite end open or lacking an end cross web. (See "Open end block.")

Absorption: The difference in the amount of water contained within a concrete masonry unit between saturated and ov-en-dry conditions, expressed as weight of water per cubic foot of concrete. [4]

Accelerator: A liquid or powder admixture added to a cementitious paste to speed hydration and promote early strength development. An example of an accelerator material is calcium nitrite.

Adhesive anchor: An anchoring device that is placed in a pre-drilled hole and secured using a chemical compound.

Admixture: Substance other than prescribed materials of water, aggregate and cementitious materials added to concrete, mortar or grout to improve one or more chemical or physical properties. [3]

Aggregate: An inert granular or powdered material such as natural sand, manufactured sand, gravel, crushed stone, slag, fines and lightweight aggregate, which, when bound together by a cementitious matrix forms concrete, grout or mortar. [3]

Air entraining: The capability of a material or process to develop a system of uniformly distributed microscopic air bubbles in a cementitious paste to increase the workability or durability of the resulting product. Some admixtures act as air entraining agents.

Anchor: Metal rod, tie, bolt or strap used to secure masonry to other elements. May be cast, adhered, expanded or fas-tened into masonry. [1]

Angle: A structural steel section that has two legs joined at 90 degrees to one another. Used as a lintel to support masonry over openings such as doors or windows in lieu of a mason-ry arch or reinforced masonry lintel. Also used as a shelf to vertically support masonry veneer. Sometimes referred to as a relieving angle.

Arch: A vertically curved compressive structural member spanning openings or recesses. May also be built flat by using special masonry shapes or specially placed units. Area, gross cross-sectional: The area delineated by the out-to-out dimensions of masonry in the plane under consideration. This includes the total area of a section perpendicular to the direc-tion of the load, including areas within cells and voids. [1]

Area, net cross-sectional: The area of masonry units, grout and mortar crossed by the plane under consideration, based on out-to-out dimensions and neglecting the area of all voids such as ungrouted cores, open spaces, or any other area devoid of masonry. [1]

Axial load: The load exerted on a wall or other structural element and acting parallel to the element's axis. Axial loads typically act in a vertical direction, but may be otherwise de-pending on the type and orientation of the element.

Backing: The wall or surface to which veneer is secured. The backing material may be concrete, masonry, steel framing or wood framing. [1]

Beam: A structural member, typically horizontal, designed to primarily resist flexure.

Burnished block: (See "Ground face block.")

Bedded area: The surface area of a masonry unit that is in contact with mortar in the plane of the mortar joint.

Blast furnace slag cement: A blended cement which incorporates blast furnace slag.

Blended cement: Portland cement or air-entrained portland cement combined through blending with such materials as blast furnace slag or pozzolan, which is usually fly ash. May be used as an alternative to portland cement in mortar.

Block: A solid or hollow unit larger than brick-sized units. (See also "Concrete block, concrete masonry unit, masonry unit"

Block machine: Equipment used to mold, consolidate and compact shapes when manufacturing concrete masonry units.

Bond: (1) The arrangement of units to provide strength, stability or a unique visual effect created by laying units in a prescribed pattern. See reference 6 for illustrations and descriptions of common masonry bond patterns. (2) The physical adhesive or mechanical binding between masonry units, mortar, grout and reinforcement. (3) To connect wythes or masonry units.

Bond beam: (1) The grouted course or courses of masonry units reinforced with longitudinal bars and designed to take the longitudinal flexural and tensile forces that may be induced in a masonry wall. (2) A horizontal grouted element within masonry in which reinforcement is embedded.

Bond beam block: A hollow unit with depressed webs or with "knock-out" webs (which are removed prior to placement) to accommodate horizontal reinforcement and grout.

Bond breaker: A material used to prevent adhesion between two surfaces.

Bond, running: The placement of masonry units such that head joints in successive courses are horizontally offset at least one-quarter the unit length. [1] Centering head joints over the unit below, called center or half bond, is the most common form of running bond. A horizontal offset between head joints in successive courses of one-third and one-quarter the unit length is called third bond and quarter bond, respectively.

Bond, stack: For structural design purposes, Building Code Requirements for Masonry Structures considers all masonry not laid in running bond as stack bond. [1] In common use, stack bond typically refers to masonry laid so head joints in successive courses are vertically aligned. Also called plumb joint bond, straight stack, jack bond, jack-on-jack and checker-board bond.

Bond strength: The resistance to separation of mortar from masonry units and of mortar and grout from reinforcing steel and other materials with which it is in contact.

Brick: A solid or hollow manufactured masonry unit of either concrete, clay or stone.

Cantilever: A member structurally supported at only one end through a fixed connection. The opposite end has no structural support.

Cap block: A solid slab used as a coping unit. May contain ridges, bevels or slopes to facilitate drainage. (See also "Coping block.")

Cavity: A continuous air space between wythes of masonry or between masonry and its backup system. Typically greater than 2 in. (51 mm) in thickness. (See "Collar joint.")

Cell: The hollow space within a concrete masonry unit formed by the face shells and webs. Also called core.

Cementitious material: A generic term for any inorganic material including cement, pozzolanic or other finely divided mineral admixtures or other reactive admixtures, or a mixture of such materials that sets and develops strength by chemical reaction with water. In general, the following are considered cementitious materials: portland cement, hydraulic cements, lime putty, hydrated lime, pozzolans and ground granulated blast furnace slag. [3]

Cleanout/cleanout hole: An opening of sufficient size and spacing so as to allow removal of debris from the bottom of the grout space. Typically located in the first course of masonry. [2]

Cold weather construction: Procedures used to construct masonry when ambient air temperature or masonry unit temperature is below 40°F (4.4°C).

Collar joint: A vertical longitudinal space between wythes of masonry or between masonry wythe and backup construction, sometimes filled with mortar or grout. Typically less than 2 in. (51 mm) in thickness. [1] (See also "Cavity.")

Color (pigment): A compatible, color fast, chemically stable admixture that gives a cementitious matrix its coloring.

Column: (1) In structures, a relatively long, slender structural compression member such as a post, pillar, or strut. Usually vertical, a column supports loads that act primarily in the direction of its longitudinal axis. (2) For the purposes of design, an isolated vertical member whose horizontal dimension measured at right angles to the thickness does not exceed 3 times its thickness and whose height is greater than 4 times it thickness. [1]

Composite action: Transfer of stress between components of a member designed so that in resisting loads, the combined components act together as a single member. [1]

Compressive strength: The maximum compressive load that a specimen will support divided by the net cross-sectional area of the specimen.

Compressive strength of masonry: Maximum compressive force resisted per unit of net cross-sectional area of masonry, determined by testing masonry prisms or as a function of individual masonry units, mortar and grout in accordance with ref. 2. [2] (See also "Specified compressive strength of masonry.")

Concrete: A composite material that consists of a water reactive binding medium, water and aggregate (usually a combination of fine aggregate and coarse aggregate) with or without admixtures. In portland cement concrete, the binder is a mixture of portland cement, water and may contain admixtures.

Concrete block: A hollow or solid concrete masonry unit. Larger in size than a concrete brick.

Concrete brick: A concrete hollow or solid unit smaller in size than a concrete block.

Concrete masonry unit: Hollow or solid masonry unit, manufactured using low frequency, high amplitude vibration to consolidate concrete of stiff or extremely dry consistency.

Connector: A mechanical device for securing two or more pieces, parts or members together; includes anchors, wall ties and fasteners. May be either structural or nonstructural. [1]

Connector, tie: A metal device used to join wythes of masonry in a multiwythe wall or to attach a masonry veneer to its backing. [1] (See also "Anchor.")

Control joint: A continuous unbonded masonry joint that is formed, sawed or tooled in a masonry structure to regulate the location and amount of cracking and separation resulting from dimensional changes of different parts of the structure, thereby avoiding the development of high stresses.

Coping: The materials or masonry units used to form the finished top of a wall, pier, chimney or pilaster to protect the masonry below from water penetration.
Coping block: A solid concrete masonry unit intended for use as the top finished course in wall construction.
Corbel: A projection of successive courses from the face of masonry. [1]
Core: (See "Cell.")
Corrosion resistant: A material that is treated or coated to retard corrosive action. An example is steel that is galvanized after fabrication.
Course: A horizontal layer of masonry units in a wall or, much less commonly, curved over an arch.
Crack control: Methods used to control the extent, size and location of cracking in masonry including reinforcing steel, control joints and dimensional stability of masonry materials.
Cull: A masonry unit that does not meet the standards or specifications and therefore has been rejected.
Curing: (1) The maintenance of proper conditions of moisture and temperature during initial set to develop a required strength and reduce shrinkage in products containing portland cement. (2) The initial time period during which cementitious materials gain strength.
Damp-proofing: The treatment of masonry to retard the passage or absorption of water or water vapor, either by application of a suitable coating or membrane to exposed surfaces or by use of a suitable admixture or treated cement.
Damp check: An impervious horizontal layer to prevent vertical penetration of water in a wall or other masonry element. A damp check consists of either a course of solid masonry, metal or a thin layer of asphaltic or bituminous material. It is generally placed near grade to prevent upward migration of moisture by capillary action.
Diaphragm: A roof or floor system designed to transmit lateral forces to shear walls or other lateral load resisting elements. [1]
Dimension, actual: The measured size of a concrete masonry unit or assemblage. Dimension, nominal: The specified dimension plus an allowance for mortar joints, typically 3/8 in. (9.5 mm). Nominal dimensions are usually stated in whole numbers. Width (thickness) is given first, followed by height and then length. [1]
Dimension, specified: The dimensions specified for the manufacture or construction of a unit, joint or element. Unless otherwise stated, all calculations are based on specified dimensions. Actual dimensions may vary from specificified dimensions by permissible variations. [1]
Dowel: A metal reinforcing bar used to connect masonry to masonry or to concrete.
Drip: A groove or slot cut beneath and slightly behind the forward edge of a projecting unit or element, such as a sill, lintel or coping, to cause rainwater to drip off and prevent it from penetrating the wall.
Drying shrinkage: The change in linear dimension of a concrete masonry wall or unit due to drying.
Dry stack: Masonry work laid without mortar. Eccentricity: The distance between the resultant of an applied load and the centroidal axis of the masonry element under load.
Effective height: Clear height of a braced member between lateral supports and used for calculating the slenderness ratio of the member. [1]
Effective thickness: The assumed thickness of a member used to calculate the slenderness ratio.
Efflorescence: A deposit or encrustation of soluble salts (generally white), that may form on the surface of stone, brick, concrete or mortar when moisture moves through the masonry materials and evaporates on the surface. In new construction, sometimes referred to as new building bloom. Once the structure dries, the bloom normally disappears or is removed with water.
Equivalent thickness: The solid thickness to which a hollow unit would be reduced if the material in the unit were recast into a unit with the same face dimensions (height and length) but without voids. The equivalent thickness of a 100% solid unit is equal to the actual thickness. Used primarily to determine masonry fire resistance ratings.
Expansion anchor: An anchoring device (based on a friction grip) in which an expandable socket expands, causing a wedge action, as a bolt is tightened into it.
Face: (1) The surface of a wall or masonry unit. (2) The surface of a unit designed to be exposed in the finished masonry.
Face shell: The outer wall of a hollow concrete masonry unit. [5]
Face shell mortar bedding: Hollow masonry unit construction where mortar is applied only to the horizontal surface of the unit face shells and the head joints to a depth equal to the thickness of the face shell. No mortar is applied to the unit cross webs. (See also "Full mortar bedding.")
Facing: Any material forming a part of a wall and used as a finished surface.
Fastener: A device used to attach components to masonry, typically nonstructural in nature.

Fire resistance: A rating assigned to walls indicating the length of time a wall performs as a barrier to the passage of flame, hot gases and heat when subjected to a standardized fire and hose stream test. For masonry, fire resistance is most often determined based on the masonry's equivalent thickness and aggregate type.

Flashing: A thin impervious material placed in mortar joints and through air spaces in masonry to prevent water penetration and to facilitate water drainage.

Fly ash: The finely divided residue resulting from the combustion of ground or powdered coal.

Footing: A structural element that transmits loads directly to the soil.

Freeze-thaw durability: The ability to resist damage from the cyclic freezing and thawing of moisture in materials and the resultant expansion and contraction.

Full mortar bedding: Masonry construction where mortar is applied to the entire horizontal surface of the masonry unit and the head joints to a depth equal to the thickness of the face shell. (See also "Face shell mortar bedding.")

Glass unit masonry: Masonry composed of glass units bonded by mortar. [1]

Glazed block: A concrete masonry unit with a permanent smooth resinous tile facing applied during manufacture. Also called prefaced block.

Ground face block: A concrete masonry unit in which the surface is ground to a smooth finish exposing the internal matrix and aggregate of the unit. Also called burnished or honed block.

Grout: (1) A plastic mixture of cementitious materials, aggregates, water, with or without admixtures initially produced to pouring consistency without segregation of the constituents during placement. [3] (2) The hardened equivalent of such mixtures.

Grout, prestressing: A cementitious mixture used to encapsulate bonded prestressing tendons. [2]

Grout, self-consolidating: Highly fluid and stable grout used in high lift and low lift grouting that does not require consolidation or reconsolidation.

Grout lift: An increment of grout height within a total grout pour. A grout pour consists of one or more grout lifts. [2]

Grout pour: The total height of masonry to be grouted prior to erection of additional masonry. A grout pour consists of one or more grout lifts. [2]

Grouted masonry: (1) Masonry construction of hollow units where hollow cells are filled with grout, or multiwythe construction in which the space between wythes is solidly filled with grout. (2) Masonry construction using solid masonry units where the inyterior joints and voids are filled with grout.

Grouting, high lift: The technique of grouting masonry in lifts for the full height of the wall.

Grouting, low lift: The technique of grouting as the wall is constructed, usually to scaffold or bond beam height, but not greater than 4 to 6 ft (1,219 to 1,829 mm), depending on code limitations.

"H" block: Hollow masonry unit lacking cross webs at both ends forming an "H" in cross section. Used with reinforced masonry construction. (See also "Open end block.")

Header: A masonry unit that connects two or more adjacent wythes of masonry. Also called a bonder. [1]

Height of wall: (1) The vertical distance from the foundation wall or other similar intermediate support to the top of the wall. (2) The vertical distance between intermediate supports.

Height-to-thickness ratio: The height of a masonry wall divided by its nominal thickness. The thickness of cavity walls is taken as the overall thickness minus the width of the cavity.

High lift grouting: (See "Grouting, high lift.")

Hollow masonry unit: A unit whose net cross-sectional area in any plane parallel to the bearing surface is less than 75 % of its gross cross-sectional area measured in the same plane. [4]

Honed block: (See "Ground face block.")

Hot weather construction: Procedures used to construct masonry when ambient air temperature exceeds 100°F (37.8°C) or temperature exceeds 90°F (32.2°C) with a wind speed greater than 8 mph (13 km/h).

Inspection: The observations to verify that the masonry construction meets the requirements of the applicable design standards and contract documents.

Jamb block: A block specially formed for the jamb of windows or doors, generally with a vertical slot to receive window frames, etc. Also called sash block.

Joint: The surface at which two members join or abut. If they are held together by mortar, the mortar-filled volume is the joint.

Joint reinforcement: Steel wires placed in mortar bed joints (over the face shells in hollow masonry). Multi-wire joint reinforcement assemblies have cross wires welded between the longitudinal wires at regular intervals.

Lap: (1) The distance two bars overlap when forming a splice. (2) The distance one masonry unit extends over another.

Lap splice: The connection between reinforcing steel generated by overlapping the ends of the reinforcement.

Lateral support: The means of bracing structural members in the horizontal span by columns, buttresses, pilasters or cross walls, or in the vertical span by beams, floors, foundations, or roofs.

Lightweight aggregate: Natural or manufactured aggregate of low density, such as expanded or sintered clay, shale, slate, diatomaceous shale, perlite, vermiculite, slag, natural pumice, volcanic cinders, diatomite, sintered fly ash or industrial cinders.
Lightweight concrete masonry unit: A unit whose oven-dry density is less than 105 lb/ft3 (1,680 kg/m3). [4]
Lime: Calcium oxide (CaO), a general term for the various chemical and physical forms of quicklime, hydrated lime and hydraulic hydrated lime.
Lintel: A beam placed or constructed over a wall opening to carry the superimposed load.
Lintel block: A U-shaped masonry unit, placed with the open side up to accommodate horizontal reinforcement and grout to form a continuous beam. Also called channel block.
Loadbearing: (See "Wall, loadbearing.")
Low lift grouting: (See "Grouting, low lift.")
Manufactured masonry unit: A man-made noncombustible building product intended to be laid by hand and joined by mortar, grout or other methods. [5]
Masonry: An assemblage of masonry units, joined with mortar, grout or other accepted methods. [5]
Masonry cement: (1) A mill-mixed cementitious material to which sand and water is added to make mortar. (2) Hydraulic cement produced for use in mortars for masonry construction.
Medium weight concrete masonry unit: A unit whose oven-dry density is at least 105 lb/ft3 (1,680 kg/m3) but less than 125 lb/ft3 (2,000 kg/m3). [4]
Metric: The Systeme Internationale (SI), the standard international system of measurement. Hard metric refers to products or materials manufactured to metric specified dimensions. Soft metric refers to products or materials manufactured to English specified dimensions, then converted into metric dimensions.
Mix design: The proportions of materials used to produce mortar, grout or concrete.
Modular coordination: The designation of masonry units, door and window frames, and other construction components that fit together during construction without customization.
Modular design: Construction with standardized units or dimensions for flexibility and variety in use.
Moisture content: The amount of water contained within a unit at the time of sampling expressed as a percentage of the total amount of water in the unit when saturated. [4]
Mortar: (1) A mixture of cementitious materials, fine aggregate water, with or without admixtures, used to construct unit masonry assemblages. [3] (2) The hardened equivalent of such mixtures.
Mortar bed: A horizontal layer of mortar used to seat a masonry unit.
Mortar bond: (See "Bond.")
Mortar joint, bed: The horizontal layer of mortar between masonry units. [1]
Mortar joint, head: The vertical mortar joint placed between masonry units within the wythe. [1]
Mortar joint profile: The finished shape of the exposed portion of the mortar joint. Common profiles include:
Concave: Produced with a rounded jointer, this is the standard mortar joint unless otherwise specified. Recommended for exterior walls because it easily sheds water.
Raked: A joint where 1/4 to 1/2 in. (6.4 to 13 mm) is removed from the outside of the joint.
Struck: An approximately flush joint. See also "Strike."
Net section: The minimum cross section of the member under consideration.
Nonloadbearing: (See "Wall, nonloadbearing.")
Normal weight concrete masonry unit: A unit whose oven-dry density is 125 lb/ft3 (2000 kg/m3) or greater. [4]
Open end block: A hollow unit, with one or both ends open. Used primarily with reinforced masonry construction. (See "A" block and "H" block.)
Parging: (1) A coating of mortar, which may contain damp-proofing ingredients, over a surface. (2) The process of applying such a coating.
Pier: An isolated column of masonry or a bearing wall not bonded at the sides to associated masonry. For design, a vertical member whose horizontal dimension measured at right angles to its thickness is not less than three times its thickness nor greater than six times its thickness and whose height is less than five times its length. [1]
Pigment: (See "Color.")
Pilaster: A bonded or keyed column of masonry built as part of a wall. It may be flush or project from either or both wall surfaces. It has a uniform cross section throughout its height and serves as a vertical beam, a column or both.
Pilaster block: Concrete masonry units designed for use in the construction of plain or reinforced concrete masonry pilasters and columns.
Plain masonry: (See "Unreinforced masonry.")
Plaster: (See "Stucco.")
Plasticizer: An ingredient such as an admixture incorporated into a cementitious material to increase its workability, flexibility or extensibility.
Post-tensioning: A method of pretressing in which prestressing tendons are tensioned after the masonry has been placed. [1] See also "Wall, prestressed."

Prestressing tendon: Steel element such as wire, bar or strand, used to impart prestress to masonry. [1]
Prism: A small assemblage made with masonry units and mortar and sometimes grout. Primarily used for quality control purposes to assess the strength of full-scale masonry members.
Prism strength: Maximum compressive force resisted per unit of net cross-sectional area of masonry, determined by testing masonry prisms.
Project specifications: The written documents that specify project requirements in accordance with the service parameters and other specific criteria established by the owner or owner's agent.
Quality assurance: The administrative and procedural requirements established by the contract documents and by code to assure that constructed masonry is in compliance with the contract documents. [1]
Quality control: The planned system of activities used to provide a level of quality that meets the needs of the users and the use of such a system. The objective of quality control is to provide a system that is safe, adequate, dependable and economic. The overall program involves integrating factors including: the proper specification; production to meet the full intent of the specification; inspection to determine whether the resulting material, product and service is in accordance with the specifications; and review of usage to determine any necessary revisions to the specifications.
Reinforced masonry: (1) Masonry containing reinforcement in the mortar joints or grouted cores used to resist stresses. (2) Unit masonry in which reinforcement is embedded in such a manner that the component materials act together to resist applied forces.
Reinforcing steel: Steel embedded in masonry in such a manner that the two materials act together to resist forces.
Retarding agent: An ingredient or admixture in mortar that slows setting or hardening, most commonly in the form of finely ground gypsum.
Ribbed block: A block with projecting ribs (with either a rectangular or circular profile) on the face for aesthetic purposes. Also called fluted.
Sash block: (See "Jamb block.")
Scored block: A block with grooves on the face for aesthetic purposes. For example, the grooves may simulate raked joints.
Screen block: An open-faced masonry unit used for decorative purposes or to partially screen areas from the sun or from view.
Shell: (See "Face shell.")
Shoring and bracing: The props or posts used to temporarily support members during construction.
Shrinkage: The decrease in volume due to moisture loss, decrease in temperature or carbonation of a cementitious material.
Sill: A flat or slightly beveled unit set horizontally at the base of an opening in a wall.
Simply supported: A member structurally supported at top and bottom or both sides through a pin-type connection, which assumes no moment transfer.
Slenderness ratio: (1) The ratio of a member's effective height to radius of gyration. (2) The ratio of a member's height to thickness.
Slump: (1) The drop in the height of a cementitious material from its original shape when in a plastic state. (2) A standardized measurement of a plastic cementitious material to determine its flow and workability.
Slump block: A concrete masonry unit produced so that it slumps or sags in irregular fashion before it hardens.
Slushed joint: A mortar joint filled after units are laid by "throwing" mortar in with the edge of a trowel.
Solid masonry unit: A unit whose net cross-sectional area in every plane parallel to the bearing surface is 75 percent or more of its gross cross-sectional area measured in the same plane. [4] Note that Canadian standards define a solid unit as 100% solid.
Spall: To flake or split away due to internal or external forces such as frost action, pressure, dimensional changes after installation, vibration, impact, or some combination.
Specified dimensions: (See "Dimension, specified.")
Specified compressive strength of masonry, f'm: Minimum masonry compressive strength required by contract documents, upon which the project design is based (expressed in terms of force per unit of net cross-sectional area). [1]
Split block: A concrete masonry unit with one or more faces purposely fractured to produce a rough texture for aesthetic purposes. Also called a split-faced or rock-faced block.
Stirrup: Shear reinforcement in a flexural member. [1]
Strike: To finish a mortar joint with a stroke of the trowel or special tool, simultaneously removing extruded mortar and smoothing the surface of the mortar remaining in the joint.
Stucco: A combination of cement and aggregate mixed with a suitable amount of water to form a plastic mixture that will adhere to a surface and preserve the texture imposed on it.

Temper: To moisten and mix mortar to a proper consistency.
Thermal movement: Dimension change due to temperature change.
Tie: (See "Connector, tie.")
Tolerance: The specified allowance in variation from a specified size, location, or placement.
Tooling: Compressing and shaping the face of a mortar joint with a tool other than a trowel. See "Mortar joint profile" for definitions of common joints.
Unreinforced masonry: Masonry in which the tensile resistance of the masonry is taken into consideration and the resistance of reinforcement, if present, is neglected. Also called plain masonry. [1]
Veneer, adhered: Masonry veneer secured to and supported by the backing through adhesion. [2]
Veneer, anchored: Masonry veneer secured to and supported laterally by the backing through anchors and supported vertically by the foundation or other structural elements.
Veneer, masonry: A masonry wythe that provides the finish of a wall system and transfers out-of-plane loads directly to a backing, but is not considered to add load resisting capacity to the wall system. [1]
Wall, bonded: A masonry wall in which two or more wythes are bonded to act as a composite structural unit.
Wall, cavity: A multiwythe noncomposite masonry wall with a continuous air space within the wall (with or without insulation), which is tied together with metal ties. [1]
Wall, composite: A multiwythe wall where the individual masonry wythes act together to resist applied loads. (See also "Composite action.")
Wall, curtain: (1) A nonloadbearing wall between columns or piers. (2) A nonloadbearing exterior wall vertically supported only at its base, or having bearing support at prescribed vertical intervals. (3) An exterior nonloadbearing wall in skeleton frame construction. Such walls may be anchored to columns, spandrel beams or floors, but not
Wall, foundation: A wall below the floor nearest grade serving as a support for a wall, pier, column or other structural part of a building and in turn supported by a footing.
Wall, loadbearing: Wall that supports vertical load in addition to its own weight. By code, a wall carrying vertical loads greater than 200 lb/ft (2.9 kN/m) in addition to its own weight. [1]
Wall, multiwythe: Wall composed of 2 or more masonry wythes.
Wall, nonloadbearing: A wall that supports no vertical load other than its own weight. By code, a wall carrying vertical loads less than 200 lb/ft (2.9 kN/m) in addition to its own weight. [1]
Wall, panel: (1) An exterior nonloadbearing wall in skeleton frame construction, wholly supported at each story.
(2) A nonloadbearing exterior masonry wall having bearing support at each story.
Wall, partition: An interior wall without structural function. [2]
Wall, prestressed: A masonry wall in which internal compressive stresses have been introduced to counteract stresses resulting from applied loads. [1]
Wall, reinforced: (1) A masonry wall reinforced with steel embedded so that the two materials act together in resisting forces. (2) A wall containing reinforcement used to resist shear and tensile stresses.
Wall, retaining: A wall designed to prevent the movement of soils and structures placed behind the wall.
Wall, screen: A masonry wall constructed with more than 25% open area intended for decorative purposes, typically to partially screen an area from the sun or from view.
Wall, shear: A wall, bearing or nonbearing, designed to resist lateral forces acting in the plane of the wall. [1]
Wall, single wythe: A wall of one masonry unit thickness.
Wall, solid masonry: A wall either built of solid masonry units or built of hollow units and grouted solid.
Wall tie: A metal connector that connects wythes of masonry.
Wall tie, veneer: A wall tie used to connect a facing veneer to the backing.
Water permeance: The ability of water to penetrate through a substance such as mortar or brick.
Waterproofing: (1) The methods used to prevent moisture flow through masonry. (2) The materials used to prevent moisture flow through masonry.
Water repellency: The reduction of absorption.
Water repellent: Material added to the masonry to increase resistance to water penetration. Can be a surface treatment or integral water repellent admixture.
Web: The portion of a hollow concrete masonry unit connecting the face shells.
Weep hole: An opening left (or cut) in mortar joints or masonry face shells to allow moisture to exit the wall. Usually located immediately above flashing.
Workability: The ability of mortar or grout to be easily placed and spread.
Wythe: Each continuous vertical section of a wall, one masonry unit in thickness. [1]

References

1. Building Code Requirements for Masonry Structures, ACI 530-02/ASCE 5-02/TMS 402-02. Reported by the Masonry Standards Joint Committee, 2002.

2. Specification for Masonry Structures, ACI 530.1-02/ASCE 6-02/TMS 602-02. Reported by the Masonry Standards Joint Committee, 2002.

3. Standard Terminology of Mortar and Grout for Unit Masonry, ASTM C 1180-03. ASTM International, 2003.

4. Standard Terminology of Concrete Masonry Units and Related Units, ASTM C 1209-01a. ASTM International, 2001.

5. Standard Terminology of Masonry, ASTM C 1232-02. ASTM International, 2002.

6. Concrete Masonry Bond Patterns, TEK 14-6. National Concrete Masonry Association, 1999.

Shouldice Specifications

A. PRODUCT

1.0 Stone Masonry
1.1 Masonry Units shall be manufactured by:
Shouldice Designer Stone
Shallow Lake, Ontario N0H 2K0
Tel: 1-800-265-3174
1.2 Masonry Units shall meet CSA-A165.1 Series-04 and ASTM C90-03, Specifications for load-bearing units or CSA-A165.2 Series-04 and ASTM C55-03 for veneer units.
1.3 Manufacturer shall supply test data to support Specifications requirements.
1.4 Units shall be manufactured with an integral water repellent additive.
2.0 Application
2.1 Units shall be used for _____

Spec. Note
A: Identify Veneer, Loadbearing Exterior, Loadbearing Interior, Non-Loadbearing Interior/Exterior, Grade Level.

3.0 Classification
3.1 Unit size(s) shall be _____

3.2 Unit width(s) shall be _____

3.3 Unit Colour(s) and texture(s) shall be _____

Spec. Note
A: Refer to Shouldice Designer Stone Profile reference Sheet for unit sizes and widths.
B: Refer to Shouldice Designer Stone Colour reference Sheet for colour(s) and texture(s) identification.
4.0 Appearance
4.1 Units shall be (Tapestry) or (Rock-Stone) or (Tex-Stone) with a standard (3/8") 9mm bevel on all exposed edges on Tapestry, optional on Tex-Stone.
4.2 Units shall be uniform and consistent in colour
4.3 Units shall have the following options: (Double Bullnose), (Single Bullnose), (Heavy Bevel) (Tapestry Margin), (Vertical Score), (Horizontal Score).
4.4 Refer to drawings for unit option(s) locations and Quantities.

Spec. Note
A: Contractor will be held responsible for ordering the correct stone quantities for the entire project.
B: Contractor will be held responsible for correcting stone colour matching on second orders.
C: Manufacturer shall take all the necessary steps to ensure colour matching on second orders.
5.0 Delivery
5.1 Manufacturer shall deliver product to job site as scheduled.
5.2 Manufacturer shall separate stone layers in each cube with spacers to prevent product damage.
5.3 Manufacturer shall not be held responsible for any unforeseen delays due to outside influence.
5.4 Stone cubes shall be shrink wrapped at time of delivery.
5.5 Product shall be delivered on wooden pallets.
6.0 Storage and Handling
6.1 To encourage product recycling, all wooden pallets shall be maintained in good condition.
6.2 Masonry contractor shall be held responsible for damaged wooden pallets.
6.3 Product shall be placed on stable soil.
6.4 Product shall not be stacked greater than two cubes high.
6.5 White products shall be stacked one cube high only.
6.6 Product shipment shall comply with Government regulations.
6.7 Product shall remain shrink wrapped until time of installation.
6.8 Contractor shall be held responsible for damaged product that resulted from rough on-site handling and/or storage practice.
7.0 Mortar Types
7.1 Mortar for exterior above / below grade.
7.1.1 Loadbearing: Type S based on specifications.
7.1.2 Non-Loadbearing: Type N based on specifications.
7.2 Mortar colour shall be _____.
7.3 Mortar joint shall be concave unless otherwise specified.

B. EXECUTION

1.0 Laying Units

1.1 Contractor shall construct a sample panel prior to construction. To be approved by owner representative.

1.2 Placement of material in wall by contractor shall Constitute product acceptance.

1.3 Product shall be installed using approved masonry construction techniques as indicated in governing Building Codes and Standards.

1.4 Stone shall be installed using ½ running bond unless otherwise specified.

1.5 Control joints located at _____spacing and above / below all wall openings.

1.6 Weep holes shall be at 600mm O.C. unless otherwise specified.

1.7 Weep holes shall be located above all flashing locations.

1.8 A waterproof non-staining cover shall be extended over walls and down sides sufficient to protect walls from wind driven rains after each work day.

1.9 Protect completed wall from mortar droppings using a non-staining covering.

2.0 Cleaning Stone

2.1 Contractor shall only use masonry cleaners as approved by owner representative.

2.2 If cleaning is required, use a mild masonry detergent applied with a soft nylon brush. Contact the office for more detailed information. Pressure washers should not be used as a means for removing excess mortar or splatters. Before proceeding further, obtain architects approval.

SHOULDICE STONE

LIFE'S BUILDING BLOCKS

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