

Best Practices for Keeping Single-Wythe Concrete Block Masonry Dry

The masonry industry has traditionally promoted wall systems designed with built-in redundancy preventing water penetration. These double-wythe walls, also referred to as cavity walls, provide a clear space between the wythes of masonry where water can drain and exit to the building exterior. If the decision is to design exterior walls with only a single-wythe of masonry, then the decision is made primarily in the interest of performance and reduced cost.

Because single-wythe block walls do not have the benefit of a continuous drainage cavity or backup wythe, they rely on a number of design and construction techniques to ensure the successful performance that masonry is known for, according to the International Masonry Institute (IMI). Special measures should be taken by the architect, developer, material supplier and contractor in their respective roles as designers and builders of dry single-wythe concrete masonry. This overall attention to detail and quality will lead to high quality masonry practices, especially where economy is the primary directive.

This article is meant to be a helpful discussion of some “Best Practices” that should be considered by all parties involved when keeping single-wythe masonry dry. It is not meant to be comprehensive as to what should be done or not done in this regard. Members of the Expanded Shale, Clay and Slate Institute (ESCSI) manufacture quality structural grade lightweight aggregate that is intended to be the primary ingredient of structural-grade lightweight concrete masonry units. This article will focus on the need for taking a “system” approach when designing and constructing single-wythe walls employing block made with heavy weight or lightweight aggregate or even a blend of the two. All elements are important to consider and are therefore not rated in importance.

Moisture Sources

Driving rain provides water in liquid form applied to the exterior wall surface with force. Portland cement based materials are generally too dense to allow water to quickly pass through. Water usually enters the wall through the interface of improperly filled joints and lack of bond between the mortar and the concrete masonry unit. Cracks caused by building movement and other gaps present due to construction or design also allow water to enter the masonry.

Capillary suction allows concrete to draw in liquid water from rain, plumbing leaks or any other source that may be present. The use of integral water repellent greatly reduces the absorption characteristics of the concrete block and mortar. Significant pressure in addition to capillary action may allow for water intrusion due to the absorption characteristics of the masonry. While surface-applied water barrier treatments may keep out suction on the surface of the wall, if water gets through cracks or openings in the masonry, untreated internal masonry may still absorb this renegade water and allow it

to flow through to the interior cavity. For this reason, in addition to painted, stained or clear exterior coatings, both the block and mortar should contain a quality integral water repellent in order to render all concrete in the single-wythe masonry system hydrophobic.

Water vapor is another source of water intrusion. Although integral water repellents make materials in masonry more hydrophobic, they have less impact on water vapor moving through the masonry. Water vapor will reach its dew point and condense and should be considered by the designer. Proper detailing of flashings and quality workmanship is paramount when employing single-wythe concrete masonry construction.

In regard to single-wythe walls, IMI states, “Since there is nothing between the harsh outside environment and the climate controlled indoor space other than an 8” thick block wall and a coat of plaster or drywall, it is imperative that the block contain an integral water repellent.” In addition, when the block is shipped to the jobsite, it should be accompanied by an integral water repellent mortar additive from the same manufacturer used in making the block. This insures a uniform water repellent performance in all areas of the exterior opaque wall system. Follow manufacturer’s instructions in regard to the use of integral water repellents. Therefore, integral water repellent must be specified in the construction documents and project drawing notes. Calling out this requirement clearly alerts the masonry contractor that the integral water repellent should be included in the bid. Unfortunately, some construction managers and contractors try to cut corners by omitting integral water repellent. While saving some initial cost, the walls are almost sure to leak over time, resulting in costly repairs and unhappy clients.

Mortar Joints

In addition to containing an integral water repellent in the mix, mortar joints need to be controlled for quality by the masons actually laying the block. Head joints especially should be the full thickness of the block’s face shell for optimal water resistance. The joints should be tooled when they are thumbprint-hard employing a concave or vee profile to ensure a good bond between the block and the mortar. The architect relies on the integrity and skills of the mason for these techniques that will contribute to water resistance of the wall.

Flashing and Weep Holes

Since there is no drainage space for water in single-wythe masonry other than through the empty cores in the block, positive drainage relies on an effective flashing system and weep holes to channel this water into the cores. Functionality and performance is reliant upon the complete “system” including: integral water repellent (IWR) in CMU and mortar, and a system of through-wall flashing, weeps or venting. Architects and specifiers can detail effective flashing, however, they rely and work together with masons who execute construction details to ensure water resistant walls. When a mason is selected to construct single-wythe walls, the qualifications should include a commitment to provide quality installation that is consistent with architectural drawings.

Crack Control is Vital in Single-Wythe Masonry

Movement joints are to be indicated as to type and location on the project drawings according to the Mandatory Requirements Checklist in the Specification for Masonry Structures, TMS 602 – 11. Details

of design of these joints as well as the selection of appropriate sealant strategies should be provided and executed with professional care. Horizontal crack control is vital in single-wythe masonry and it is strongly recommended that this be installed in the system every other course (16") of concrete block masonry in order to direct tension to the control joints. The masonry industry provides generous information on the design and placement of movement joints.

Cleaning

Walls should be kept clean during construction using a brush and water. Practice has shown that pressure washing or acid cleaning of cured masonry may diminish the effectiveness of the mortar joint's ability to resist water penetration.

Surface Treatment

After cleaning, a surface-applied water repellent treatment may be applied to help keep water from entering the masonry. This does not affect its breathable characteristic that will still allow water vapor to escape. Penetrating surface treatments such as silicone resins, silanes and siloxanes are recommended for this purpose. Follow manufacturer's directions and recommendations when applying.

These are just a few of the considerations regarding single-wythe masonry. They are intended to create awareness of the attention needed to get the best water resistance performance that single-wythe masonry can provide.

Concrete Block Manufacturing

For recommended combined grading of lightweight and sand used in concrete block, see the ESCSI Publication, "Recommended Combined Aggregate Gradation for High Quality Lightweight Concrete Masonry Units," available for download at www.escsi.org. Or refer to ASTM C 331 for the same information.

We have identified several "Best Practices" for constructing dry single-wythe masonry. This is provided only for consideration and is intended as helpful information.

- a. Concrete mix design should be analyzed to provide tight and well compacted concrete in the block. Fine textured surface is recommended.
- b. For lightweight block mix design, use quality lightweight aggregates, such as expanded shale, clay and slate structural grade lightweight aggregate produced by members of the ESCSI.
- c. All exterior block of any density should be specified as containing an integral water repellent and conform to manufacturers performance requirements for water resistance.
- d. All exterior mortar used in masonry is required to have integral water repellent compatible with treated block. Follow manufacturer's directions.

- e. Concrete masonry units, in addition to being properly cured by the manufacturer, should have a minimum 14 day drying time prior to installation.
- f. Use weakest mortar possible to enhance sealing of mortar joint.
- g. Include flashing, as a system, at all appropriate locations such as above bond beams, windows and doors. Also provide weep holes at the base of the wall. Consider providing a foundation “block pocket” approach to help prevent water from getting inside.
- h. Provide completely filled head and bed joints the width of face shells.
- i. Provide horizontal bed joint reinforcement at 16” vertical spacing.
- j. Control and movement joints shown on construction documents according to industry recommendations.
- k. Sand blasting to clean masonry is unacceptable and will cause the masonry to leak.
- l. In addition to the use of an integral water repellent strategy, apply surface treatment (paint, stain or clear) to prevent surface penetration due to wind driven rain. If chemicals are used to clean masonry, surface treatment is strongly recommended.
- m. Use CMU, precast or metal wall caps and install according to industry recommendations.
- n. Consider providing a minimum 8” overhang at roof line to direct water away from wall.
- o. Provide 4” to 6” projection on all roof scuppers.
- p. In the design stage on parapet walls, when using a 2x8 board on top of the wall for attaching the cap, the following must occur: 1) a water proof gasket material (e.g. rubber) needs to be installed between CMU and the board, 2) the cap must come down on the CMU a minimum of 4”, not including the board to prevent water penetration. (Wind driven rain will run water upward/vertically at a rate of 1” per 10 mph of wind.)

Sources:

- a. Water Resistant Single-Wythe Concrete Masonry Walls, International Masonry Institute, September 2002
- b. Design For Dry Single-Wythe Concrete Masonry Walls, NCMA TEK 19-2A, 2008
- c. Designing and Building Dry Single-Wythe Block Walls, Masonry Advisory Council, Jason Yana, April 2011, www.maconline.org
- d. Helpful suggestions from industry in providing dry single-wythe masonry. Check www.escsi.org for all the benefits lightweight masonry provides in energy reduction, productivity, structural contribution and more.