

Keeping Water Out with Single-Wythe Walls

By Donald Harvey, P.E.

Single-wythe concrete block construction takes advantage of the structural and aesthetic qualities of masonry construction while saving money. Single-wythe construction is now commonly used in retail (big box) construction, institutional facilities, warehouse and light industrial construction in the Rocky Mountain Region.

In order to confirm that a single-wythe concrete block wall built with common local materials could provide acceptable weather resistance, the Rocky Mountain Masonry Institute (RMMI) conducted a series of three ASTM E-514 tests to evaluate performance of a lightweight concrete block system. The test represented the types of materials and construction methods that would commonly be used in this region.

The study indicated that concrete block, even block with lightweight aggregate, can be effective in resisting moisture penetration if used with both an integral water repellent and an appropriate spray-applied water repellent. The use of integral water repellent in the masonry and penetrating water repellent made the lightweight block very moisture resistant, even under the very severe E514 test conditions.

The ASTM E514 test involves the wetting of a 4 foot by 3 foot area of a single-wythe wall while pressurizing the outside surface using a chamber to simulate wind pressure. The block aggregate selected for the test was specifically chosen as a worst case scenario for moisture penetration. The block mix included expanded shale, scoria,

and pumice lightweight aggregate. Both the block and mortar contained an integral water repellent (IWR). The E514 test simulates a 62.5 mph wind and sheeting rain (3.4 gal/ft²/h) for at least four hours. This test is generally understood to provide a benchmark for performance under more severe conditions than an installed assembly is ever likely to experience.

The panel was tested three times:

- The first test was performed approximately 28 days after the block was laid, prior to cleaning of the wall.
- The second test was performed after the wall had been cleaned using aggressive power washing.
- The final test was performed after the application of an RTV silicone penetrating water repellent.

The water resistance of the wall assembly during all three tests was excellent. The amount of water collected from the block cells and the amount of water collected from the interior wall face were not enough to measure in any of the three tests.

The Rocky Mountain Masonry Institute recommends using integral water repellent in both the block and in the mortar. The repellent in the mortar should be compatible with the repellent in the block. After construction, apply breathable spray-applied water repellent that works with the chemistry of the block. Additionally, pay

attention to proper detailing with control joints, flashing, backer rod and sealant, and install the mortar using double-buttered head joints.

For a copy of the white paper on the testing, contact RMMI at 303-893-3838 or Atkinson-Noland & Associates at 303-444-3620.

Masonry material properties for the wall tested by the Rocky Mountain Masonry Institute.

Property	Value
Concrete Block Density	102.8 pcf (lightweight)
Concrete Block Coarse Aggregate	Pumice, Scoria, and Expanded Shale
Mortar Type (per ASTM C270)	Type S
Mortar Cement Type	Portland Cement
Mortar Batching Method	Pre-Blended, Performance Specification



The Sun MicroSystems building is an example of how single-wythe concrete masonry construction can be aesthetically pleasing. Photographer: Jackie Schumacker, 2002.

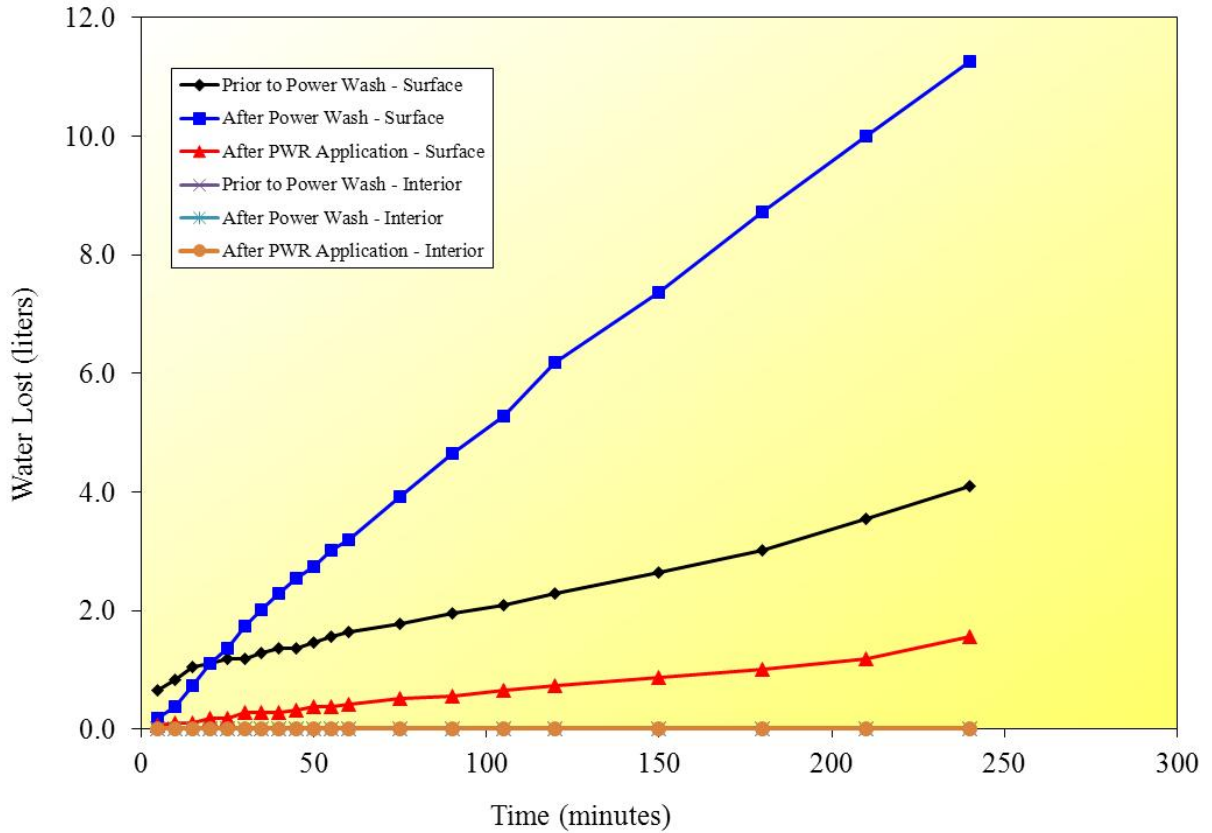


View of single-wythe concrete block wall prior to testing. The perimeter of the specimen is coated with plaster in accordance with ASTM E514 requirements.



A single-wythe concrete block wall and ASTM E514 test setup. The clear box is pressurized to simulate wind, and the spray bar at the top of the box sprays water onto the block surface to simulate rain.

Concrete Masonry Wall Water Penetration Tests ASTM E514



Total water penetrating beyond the wall exterior surface and total water penetrating to the interior over time for the three E514 tests. No water was collected at the interior for all three tests.

CHECKLIST for SINGLE WYTHE CONSTRUCTION

We performed a series of ASTM E-514 tests on some locally-manufactured block that led us to believe that single wythe construction can be effective IF you follow ALL our recommendations. Single wythe construction is not redundant or forgiving. You cannot take any shortcuts. Specifically, we recommend:

1. Use integral water repellent in both the block and in the mortar. The repellent in the mortar should be compatible with the repellent in the block.
2. Apply a breathable spray-applied water repellent on top of the block in addition to the integral water repellent. This product should be chosen to work with the chemistry of the block.
3. Minimize cracking by installing horizontal reinforcing (ladder-style, not truss-style reinforcing) at 16" on center, vertically.
4. Install enough control joints to prevent excessive shrinkage cracking. Follow the guidelines described in NCMA Tek Note 10-2B.
5. Double-butter the head joints so that you get full mortar fill here.
6. Use concave tooling for the mortar joints. Do NOT allow other tooling styles. They are not as water repellent.
7. Make sure that excess water does not get into the building.
 - a. Protect horizontal exposures (parapets, sills, changes in plane) with appropriate flashing.
 - b. Make sure that the grading at the base of the building slopes away from the building.
 - c. If you have gutters and downspouts, make sure that the downspouts discharge the water at least 48" from the building.
 - d. Do not allow scuppers to let water flood down the face of the wall. (Scuppers are OK for overflow drainage only).
8. Assume that water will eventually penetrate your walls. Make plans to flush this moisture harmlessly to the exterior.
 - a. Install flashing and weep holes (or a proprietary weep system) above all bond beams.
 - b. Install flashing and weep holes (or a proprietary weep system) at the base of the wall.
 - c. Make sure you have a change in plane at the base of the building. Do NOT align the exterior sidewalk, the top of the foundation and the first floor level with each other.
9. Install backer rod and sealant where masonry meets metal. These materials move differently with temperature change and you will develop a crack where they join if you use mortar instead of sealant.
10. If you choose to install insulation in your single wythe wall, use rigid insulation NOT batt insulation. You cannot protect the back side of the batts from moisture. You can also install insulation in the ungrouted core holes.
11. Do NOT install vinyl wall paper or other non-breathable wall covering on single wythe walls that are exposed to weather on one side.
12. Clean the walls in a timely manner. Wait at least 7-10 days so the mortar is cured. Do not wait more than 30 days or you will have to be too aggressive in cleaning the wall. Use a chemical to clean the block that is acceptable to the block manufacturer. Do NOT use Muriatic acid.
13. Do NOT clean by sandblasting. Sandblasting opens up tiny hairline cracks and can lead to water intrusion.

Single-wythe concrete block wall recommendations from the Rocky Mountain Masonry Institute.