



## TEK NOTE

November 2000

# Rain Resistant Architectural Concrete Masonry

The use of integrally colored concrete masonry as an architectural material has grown in the Pacific Northwest. By combining different block sizes and shapes, colors or surface treatments, architects have designed many striking buildings. The interest in architectural block led to the development of industry recommendations for rain resistance. This updated technical note addresses the design and specification of a concrete masonry wall system for the **western portion** of the states of Washington and Oregon where rain resistance is a major concern. Some of these recommendations may not be applicable to the more arid regions of the Northwest.

This publication focuses on weather-exposed, single-wythe concrete block walls. These walls are assumed to be coated with a clear water repellent rather than an opaque coating for aesthetic reasons. They are also reinforced and grouted to withstand the forces of wind and earthquake, making the use of internal wall flashing impractical.

The basis for these recommendations is a series of water permanence tests conducted at the *National Concrete Masonry Association* (NCMA) laboratory, combined with field experience in the Pacific Northwest. The wall system described in this information was tested in accordance with an extended version of ASTM E 514-90. *Standard Test Method for Water Penetration and Leakage through Masonry*. The wall was subjected to a 62.5 mph wind-driven rain for 24 hours rather than the four hours required by ASTM. Water was applied to the front face of the wall at a rate equivalent to a rainfall of 5.5 inches per hour. (See **Figure 1** for the configuration of the test setup.)

It should be stated here that although this wall demonstrated excellent test performance, maximum resistance to rain penetration is achieved through the use of opaque, elastomeric coating over concrete masonry. As a responsible design professional, one must prioritize the various design requirements for a given construction project before selecting the most appropriate wall system.

A rain resistant concrete masonry wall combines the elements of quality materials, proper design and specification, and good workmanship. We will discuss each of these in some detail.

### Concrete Masonry Units

The concrete masonry units (CMU) shall comply with ASTM Standard C-90. They should be medium-weight units with a density of approximately 115 pounds per cubic foot. The block should contain the recommended amount of an integral water-repellent admixture.

#### Guide Specification

Concrete masonry units shall conform to ASTM Standard C-90-00. Linear shrinkage shall not exceed 0.065 percent. CMU density to be 115 pcf or greater and units shall contain the integral water repellent admixture Dry-Block® or equivalent.

### Mortar

The mortar proportions should be selected to produce a workable mortar and one that provides optimum bond strength. Long-term bond strength is one of the most important variables affecting the water resistance of a masonry wall.

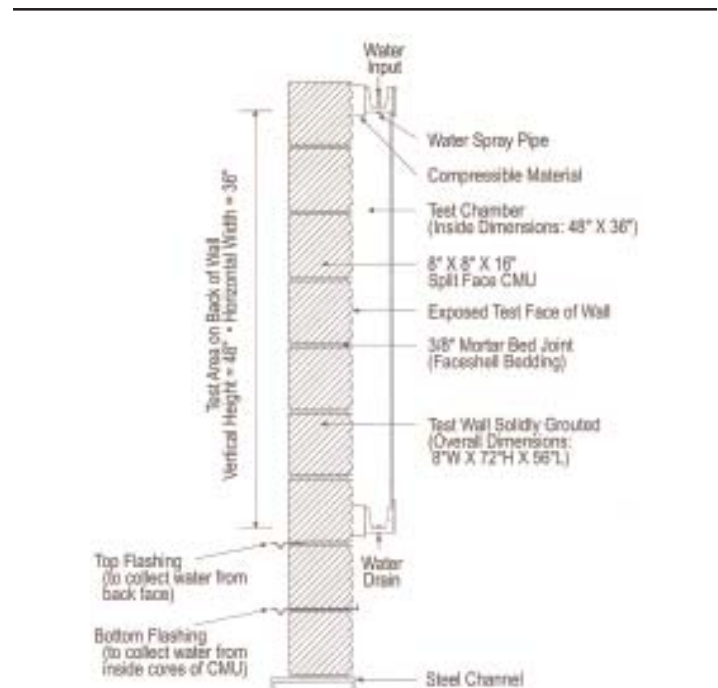


Figure 1. Water Penetration Test Set-Up

Mortar should be mixed with as large a proportion of lime as possible, while still meeting the structural requirements of the project. Specify mortar under the Type S property requirements of ASTM Standard C-270. The Dry-Block® mortar admix should be used in the mortar.

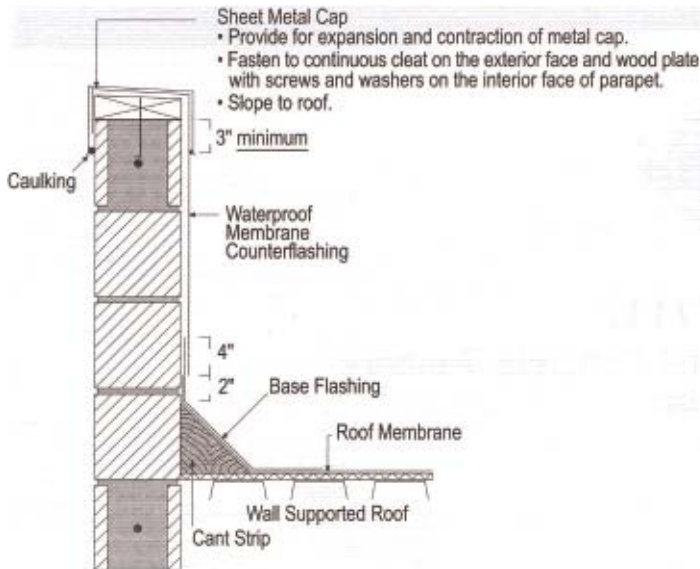
### Design

Proper design and detailing of masonry wall systems is important from all aspects of performance<sup>1</sup>. When focusing on water resistance, flashing and coping details are critical.

Parapet wall flashing and coping is one area that is often times not detailed properly. Parapets are exposed to extreme wind-driven rain conditions and can be a primary location of water entry into a building. **Figure 2** illustrates the recommended detail at parapet walls. Note that the recommendation is to extend the sheet metal cap three inches over the face of the masonry unit, not to only have three-inch legs on the metal cap. Refer to the *Sheet Metal and Air Conditioning Contractors Association* literature for proper design of sheet metal, including laps and weathertight installation.

The waterproofing membrane extends to the top outside edge of the masonry wall and down the exterior face past the wood plate. On the parapet wall

<sup>1</sup>Additional references include *National Concrete Masonry Association Notes*, Numbers 10-1A and 10-2A addressing crack control.



**Figure 2. Parapet Wall Detail**

interior face, the membrane is continuous, extending down to counterflash the base flashing, eliminating the cost and maintenance of a metal reglet and counterflashing.

The top course of block at the parapet should have a smooth face texture, even if the wall is constructed of split face or split ribbed block. This will permit a complete seal at the juncture of the block and metal cap.

### Construction Practices

All block walls should be laid with full mortar coverage on horizontal and vertical face shells. Block should be laid using a "double butter" technique for spreading mortar head joints. This practice provides for a mortar to mortar contact as two block are laid together in the wall. Hairline cracking in the head joint is avoided.

All mortar joints should be tooled concave with a rounded or "V" jointer. The forming of these concave tooled joints densifies the mortar at the surface and seals the joints. (See **Figure 3.**) Mortar joints should be double struck.

Concave and "V" joints direct water away from the building interior, unlike rake joints that create a ledge for water collection. Brush or flush mortar joints, which are common when laying split ribbed concrete block, do not provide the same degree of weather protection as a tooled joint.

All exterior walls exposed to wind-driven rain should be **solid grouted**, filling all the cells with grout. Severity of exposure varies considerably due to factors such as roof overhang, site location, orientation, etc.

**Concave Joint** - Most common joint used. Tooling works the mortar into the joint to produce a good weather joint. Pattern is emphasized.



**"V" Joint** - Tooling compacts the mortar tight and provides a good weather joint. Used to emphasize joints.



**Figure 3. Recommended Mortar Joints for Best Weather Protection**

Although the test walls were constructed without a grout admixture, the use of superplasticizers or shrinkage compensating admixtures can be advantageous<sup>2</sup>. Approval of the building official is required prior to using a grout admixture.

During inclement weather, tops of unfinished walls must be covered at the end of the work day. The cover should extend two feet down both sides of the masonry and be securely held in place. After completion of the walls, immediately install the wall cap to prevent excessive amounts of water from directly entering the masonry.

### Cleaning

Architectural concrete masonry should be left clean at the completion of the project. The masonry wall should be kept clean as it is constructed by standard procedures using a brush and water. High pressure water cleaning or light abrasive blast cleaning can also be effective. Contact your concrete block supplier or mason contractor for additional cleaning information.

Whatever cleaning methods are utilized, care should be taken to avoid impairing the water resistance of the mortar joints. Discoloring of the concrete masonry units should also be prevented. **Do not** use muriatic acid to clean architectural concrete masonry.

It is advisable to test clean a small, inconspicuous location before proceeding with cleaning the entire wall.

### Clear Water Repellent

It is recommended that exterior walls be clear coated to aid in water resistance as well as help to keep them clean. The application of a water repellent, combined with the other items discussed in this technical note, will also help to minimize efflorescence. The more resistant to rain penetration a wall is, the less efflorescence potential it has.

A clear siloxane water repellent is recommended.<sup>3</sup> This type of product chemistry was found to perform best during testing at NCMA. Specifiers should provide complete information to limit substitutions of unacceptable products. This material should be specified in the masonry section.

The water repellent should be applied per the manufacturer's recommendations. Inspection is important to ensure compliance. The applicator should have experience in applying clear masonry coatings or be approved by the water repellent manufacturer.

### General

It is recommended that a jobsite mock-up panel be constructed prior to the pre-installation meeting. The size of the mock-up panel should be specified (minimum 4 x 4 feet) along with any critical details to be included. The panel should represent completed masonry work. The specification should designate the accepted mock-up as the project standard.

A pre-installation meeting is recommended prior to beginning construction of concrete masonry wall systems. The architect, general contractor, mason contractor, and concrete masonry unit supplier should be present. Any questions concerning the masonry work should be discussed at this time. Everyone should be made aware of the importance of working together and their role in constructing a successful concrete masonry building.

The information presented in this technical note provides the industry's current recommendations on this subject based upon completed laboratory testing and actual field experience. In the future, modifications to this information may be made as masonry material innovations occur and/or additional testing is completed.

This information is intended for the use of professional personnel competent to evaluate the significance of limitations of the reported findings and recommendations, and who will accept responsibility for the application of the material. The complete laboratory test report is available upon request.

<sup>2</sup> National Concrete Masonry Association Technical Note, Number 9-4 provides additional grout information.

<sup>3</sup> Fabrishield 653 was used in the NCMA test program.