Technical Bulletin: 032803

Cement Plaster (Stucco) Walls - Recommendations for Successful Moisture Control

Building Materials Technical Services

Residential Insulating Systems

1) Exterior Wall Exposure

The construction of building walls using masonry exterior finish materials is not uncommon. Stucco is often approved for architectural purposes as a "natural finish" alternate to stone or brick in many housing developments. The potential for moisture problems arises with the stucco finish system when it is improperly installed, surface and joints are left unsealed or under sealed, or the surface deteriorates through exposure to the weather. Even after surface sealing, the exterior finish may still have some "holes" cause by mechanical features, such as an expansion joints or improper flashing.

Exposure to a driving or prolonged rain event may cause the stucco wall assembly to absorb significant moisture. The moisture at the surface can move into the wall in several ways. First, the wind can force significant moisture through the openings (cracks) and into the interior. A second driving force for moisture through the walls is capillary action. Capillary movement occurs when the surface tension of the liquid water draws the water through small openings into the wall much the same as a paper towel picks up a spill. Finally, the vapor diffusion of water also contributes to the entry of moisture into the wall. This is especially true in humid climates. None of these mechanisms depend on gravity to force the moisture into the wall. Therefore, simple flashing is not the solution.

What about after the rain quits? The sun or warmth of the day returns and the heat will dry the surface by evaporation. This is true, however, the same warming that dries the surface also drives a portion of the moisture, in the form of water vapor, further into the wall structure. With no mechanism within the structure to slow this surge of moisture, the water vapor will continue through the wall until it condenses on a surface whose temperature is below the dew point of the moisture. If the amount of condensation is significant, the surface becomes wet and the potential for damage can occur.

2) The Construction Question:

So how can you prevent moisture from being driven into the wall? The obvious solution is to build a watertight wall. But, nobody builds a hermitically sealed wall system. For example, although aluminum and vinyl siding have solid surfaces, they have openings that might provide a path for high-speed wind driven rain and water vapor diffusion. Since the obvious solution is not always acceptable, the real question should be: "How can I build a stucco wall assembly that minimizes the penetration of moisture from the outside?"

3) Building Physics – What is needed?

By examining the building physics that controls a situation, we can often develop a solution to a problem. First, we have a source of moisture at the outside surface of the wall. This moisture is no problem so long as it stays at the surface. If given enough time, the moisture will dry to the external environment. But when the sun comes out and heats the wet wall, the moisture turns to vapor (essentially steam). This vapor source creates a large vapor pressure gradient that attempts to drive some of the moisture into the wall. How can we reduce the amount of moisture entering the interior of the wall when it is being forced by this large vapor pressure gradient? Fortunately, there are two potential solutions. The first solution (sometimes called a rain shield) is to vent the vapor back to the outside. This is accomplished by using a vented air cavity interior to the exterior finish layer. The space serves two purposes. It vents the moisture vapor to the outside and also serves as a capillary break. The second solution is to block the vapor by placing a vapor-retarding layer on the side of the sheathing facing the exterior surface. This layer slows the flow of water vapor into the wall, thus preventing a moisture overload. The ideal solution would, therefore, include both treatments in some combination.

4) The Building Code Solution?

In general, the local, effective building codes, must always be followed. Unfortunately, some codes offer very little advice to guide our discussion. The following paragraphs summarize the current code guidance for cement plaster (stucco) finish systems.

The 2000 International Building Code in its Chapter 14 on Exterior Walls, Section 1403.2 on Weather Protection states: "Exterior walls shall provide the building with a weather resistant exterior wall envelope. The exterior wall envelope shall be designed and constructed in such a manner as to prevent the accumulation of water within the wall assembly by providing a water-resistive barrier behind the exterior veneer, as described in Section 1404.2 and a means of draining water that enters the assembly to the exterior of the veneer, unless it is determined that penetration of water behind the veneer shall not be detrimental to the building performance." An exemption is given for masonry walls in this same section. It states: "A weather-resistant exterior wall envelope shall not be required over concrete or masonry wall designed in accordance with IRC Chapters 19 and 21, respectively."

Section 1404.2 states that: "A minimum of one layer of No. 15 asphalt felt, complying with ASTM D 226 for Type 1 felt shall be attached to the sheathing, with flashing as described in Section 1405.3, in such a manner as to provide a continuous water-resistive barrier behind the exterior wall veneer." Section 1405.3 simply states that flashing is required to prevent moisture entrance around all details.

In Section 1405.14 on Cement Plaster (Stucco), the 2000 IRC states: "Cement plaster applied to exterior walls shall conform to the requirements specified in Chapter 25." In Chapter 25 Section 2510 on Cement Plaster (Stucco), it states in Section 2510.7 Weather Resistant Barriers: "Weather-resistant barriers shall be installed as required in Section 1404.2 and, where applied over wood-based sheathing, shall include a weather-resistive vapor permeable barrier with a performance at least equivalent to two layers of Grade D paper."

ICBO (International Congress of Building Officials), through its evaluations services subsidiary, has established acceptance criteria for many wall assemblies. AC11 (Acceptance Criteria for Cementitious Exterior Wall Coatings), covers primarily stucco construction. In Section 4.7, for direct application over sheathing states: "For recognition under the UBC, IBC and IRC, two layers of Grade D building paper complying with UBC Standard 14-1 are required over wood-based sheathing." It also continues: "An alternative to two layers of Grade D paper is as follows: One layer of Grade D paper with a 60 minute water resistance rating, plus one layer of EPS or XEPS (polystyrene expanded bead board or extruded polystyrene foam). The EPS or XEPS must have a horizontal tongue and groove joints meeting the requirements of exhibit A." (Exhibit A shows a typical tongue and groove detail in a 1" minimum thickness board.).

AC 38 is the ICBO acceptance criterion for weather resistive barriers. In Section 5.1, the special requirements section, the requirement for direct applied exterior plaster, EIFS or cementitious exterior coating systems over wood sheathing, is two layers of Grade D weather resistant barrier. However, if the house is sheathed with 1-inch minimum thickness, tongue and groove jointed, polystyrene foam sheathing, a single layer of "higher performance" Grade D paper can be used over the foam sheathing.

5) Weather Resistant Barriers

Since all the above references require a "Grade D" type weather resistive barrier material or equivalent, we need to review the specification for weather resistive barriers. The ICBO acceptance criterion for weather resistive barriers is AC38. This criterion is limited to sheet materials used on exterior walls as weather-resistive barriers under UBC Sections 1402.1 and 2506.4, water-resistive barriers under IBC Sections 1404.2 and 2510.6, and weather-resistant sheathing paper under IRC Section R703. This specification combines the requirements for paper-based, felt-based and polymeric-based barriers. In AC38, a Grade D Weather Resistive Barrier is defined as having the properties shown in Table 1 below.

Cement Plaster (Stucco) Moisture Control

In Section 5.2 of AC38, the 60-minute water resistance rating criteria is defined as: (1) for paper based or polymeric based barriers test for water resistance in accordance to ASTM D 779, tests shall demonstrate a minimum water resistance of 60 minutes, or (2) polymeric-based barriers may be tested using the AATCC Test Method 127-1985, except that the specimens are to be held at a hydrostatic head of 55 cm for 5 hours. Either test is to be conducted using pre-conditioned specimens as defined in Section 4.1 of that specification.

6) Conclusions:

Owens Corning recommends that the installation of any material must first follow the local applicable building codes. After a review of the information above, Owens Corning recommends the use of one of the following treatments for limiting outside moisture penetration into cement plaster (stucco) walls. The choice of treatments depends upon the method of installation and the sheathing used.

1. For cement plaster (stucco) applications over a masonry wall, moisture control may not be required. Consult your local code office.

2. Where a vented ½" to 1" thickness, air break cavity is provided between the cement plaster (stucco) and the moisture vapor retarder, only a single layer of Grade D paper, or equivalent, is recommended to protect the wood sheathing. (See Note 1)

3. For cement plaster (stucco) applied directly against the wood sheathing, two layers of Grade D paper, or equivalent, is the recommended moisture retarding treatment to protect the wood based sheathing.

4. If the wall is covered with 1 inch minimum thickness, tongue and grooved, polystyrene foam sheathing, a single layer of 60 minute water resistance rated, Grade D paper, or equivalent, is recommended over the wood based sheathing.

Table One - Grade D Weather Resistant Barrier Properties - ICBO AC38 (UBC 14-1)

Dry Tensile Strength	ASTM D 882	20 lbs/in
Water Resistance	ASTM D 779	10 minutes
Permeance	ASTM E 96	> 5 perm
Flexibility @ 32F	Fold over a 1/16" rod	No cracking

Note 1: Type 1 Felt, commonly called No. 15 asphalt felt, complying with ASTM D 226, Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing, may not perform as a weather resistive barrier in the same way as a Grade D Kraft Waterproofing Building Paper as described in UBC 14-1. ASTM Specification D 226 is a material specification and does not require property performance levels for vapor permeance, water resistance and cold temperature flexibility that the UBC 14-1 code requires (See Table One above). In addition, ASTM D 226 Type 1 Felts may, or may not be, perforated during production. Unless an ASTM D 226, Type 1 Felt has been specifically designed to perform as a Weather Resistive Barrier meeting the performance requirements of the above table, its use for the applications described above is not recommended.