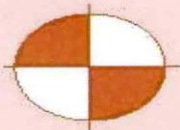


# CHAPTER 1 – HISTORY OF LATH & PLASTER



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CHAPTER 1 : HISTORY OF LATH & PLASTER

# CHAPTER 1 – HISTORY OF LATH & PLASTER

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# CHAPTER 1 – HISTORY OF LATH & PLASTER

## HISTORIC ACCOUNTS

We can find the use of lime stucco and plasterers with exquisite composition, white, fine and thin, often no thicker than an eggshell in very early Greek Architecture. Some of the plaster samples have weathered better than the stone to which it was applied.

By the time of the Roman Empire the knowledge of blending ingredients and firing cement clinker were well known. Concrete buildings, roads, sewers, viaducts and aqueducts are found in various parts of the world as remnants of Roman history, know-how and a pension for permanence. Kilns to manufacture cement and other cementitious binders were set up in many areas of the Empire.

Then, as now, the functional utility of plasters, interior and exterior, were well known. Leviticus 14:42, found in the Old Testament, details re-plastering the interior of a house for sanitation and purging a plague. As a sanitary coating, plaster kept out vermin and insects. Plaster is also a weatherproofing sealant, to protect against wind, rain and sun. Cement plaster (stucco) was adapted for framed structures by adding a concealed layer of felt behind the plaster.



In its ornamental usage, plaster is an art form with many styles and types of enrichments. Plaster is a lining for partitions that divide room areas for privacy and diversified functional usages. As a fireproofing coating, plaster has been required by building codes and by law from the time of the Babylonians, following Nero's fire in Rome and in medieval London as notable examples. Fireproofing of metal structural framing is today a large market for the plastering industry and provides a life/safety benefit to the public. Plaster is also an insulating agent for heat transfer control in boats, refineries and many other commercial usages.

Despite their antiquity, lath and plaster remain modern building materials, giving form and function to the latest design concepts of the most imaginative architectural and engineering minds. The reason for lath and plaster's continued success, even after centuries of use, is abundantly apparent when one looks at all the benefits of lath and plaster. There is little doubt that plaster will continue to survive into the future of construction. New products will be introduced and others will become archaic, but lath and plaster will certainly continue in usage.

## OVERVIEW

Plaster is a cementitious material or combination of materials and aggregates, which when mixed with a suitable amount of water (or in some cases, other liquids) forms a plastic mass that, when applied to a surface, adheres to that surface and sets or hardens, preserving in a rigid state, the form or texture imposed during the period of plasticity. The term "plaster" is used with regard to the specific composition of the material and does not explicitly denote either interior or exterior usage. Traditionally, the cementitious material or binder that binds the aggregate particles into a heterogeneous mass is of three types:

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- Lime
- Gypsum
- Portland cement

While Portland cement is a relatively modern material, forerunners of similar type materials were in use as far back as prehistoric times.

Lath is the base that provides a mechanical and/or adhesive key for the plaster to be applied. For interiors, wood lath was replaced by gypsum lath, also known as “Rock” lath. Today, lath is typically thought of as a metal base (woven, welded or expanded metal) and prominently used for the application of portland cement plaster on exteriors, also known as stucco, over framed structures. In some parts of the country stucco refers to only the cement finish coat. Plaster can also be applied over masonry substrates, interior and exterior, without the need for a lath. This practice (historically known as parging or a parge coat) is centuries old in Europe and still used today all over the world.

## BENEFITS OF PORTLAND CEMENT PLASTER (STUCCO)

Historically Plaster was used in interior walls to combat the “black plague” by keeping pests out of a building. Today interior plaster is most often used as a leveling coat, to make walls and ceilings level or smoother either for their own aesthetic appeal or as the base to which coatings, coverings, tile, frescoes or plaster ornamentation may be applied.

As a weather-resistive barrier, plaster assemblies consist of water-resistive cement surface, a drainage plane behind the plaster to direct incidental moisture back out of the plaster and a concealed water-resistive barrier at the back of the assembly. As a sound dampener and retarder of intruding noises, both airborne and impact, plaster has historically served well. Acoustical plasters are laboratory tested to demonstrate that these plasters can significantly increase STC (Sound Transmission Class) values of partitions.



WOOD LATH BEHIND PLASTER

Using plaster, exterior or interior, provides fire resistance for structures. This may be the most notable feature when looking at the history of lath and plaster, and the inception of building codes around the world. Whether as a hand-applied coating over masonry walls, a wood lath and plaster system or spray-applied coating on heavy steel in modern high-rise buildings, plaster provides an economical and effective insulating layer. This type of fire protection does not rely on a mechanical or electrical system to function. A failure in water supply pressure or malfunction in a relay switch is not possible with a plaster system used for fire protection. This is not to degrade sprinkler systems, just that designers should be cautious of making trade-offs for sprinklers to eliminate or lessen fire-resistive barriers. Building departments have recognized this as an important life/safety issue and plaster has been part of the building codes since their inception.

Aesthetics is probably the most focused benefit of plaster to building owners. A vast variety of textures and colors are available (see chapter 5).



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The explosion of Venetian plasters onto the market would certainly be proof that the visual beauty and romance of plaster is anything but dead. Plaster can be made as glossy as hard polished marble or as more earthy styles to provide a warm look depending on the products and skills of the applicator. The faux painting systems attempt to imitate these traditional plasters, but they are only imitations of the real thing.

## SEISMIC BENEFITS

In framed structures, lath and plaster (stucco) assemblies can contribute significantly to the shear value of the building design. Studies completed from university engineering departments in California and British Columbia have demonstrated that properly applied lath and portland cement plaster have contributed more to the lateral shear value than previously thought. These studies were born from building designers who noted that similar magnitude and type earthquakes in Kobe, Japan and Northridge, California yielded very different results in life/safety performance for residential style buildings. The California stucco-style building seemed to outperform other style buildings with regard to seismic performance. Through full-size mock-ups of wood framed structures clad with stucco, it was discovered that framed structures wrapped with wire netting and securely attached to the framing members, then encased in cement plaster, provided an optimum mix of tensile and compressive strength that helped keep the buildings from collapsing when subjected to the lateral shear of an earthquake. The results were impressive enough to the lead engineer on the seismic testing at the University of British Columbia, Dr. Graham Taylor in Vancouver, British Columbia, to recommend that all public buildings in British Columbia be clad in cement stucco to provide superior life/safety benefits to the public. The research report titled “**Static and Dynamic Earthquake Testing of Rainscreen Stucco**” is available from the Canadian Mortgage and Housing Corporation ( [www.cmhc-schl.gc.ca](http://www.cmhc-schl.gc.ca) ) an overview of the CHMC report .

A claim from the report:

*“Without substantial improvements to the earthquake preparedness of British Columbia’s housing infrastructure, the consequences of a large earthquake could be devastating. Non-structural building components, such as stucco cladding and drywall, can have a major influence on earthquake performance. This research evaluated the earthquake performance of rainscreen stucco cladding (i.e. air cavity behind it) vs. non-rainscreen. Both systems were shown to have the potential to eliminate major structural earthquake damage in residential wood-frame buildings, and the use of long staples instead of traditional nails in the panels is recommended.”*

## LIME PLASTER

The use of lime as the cementitious binder for plasters, interior and exterior, dates back more than 25 centuries. The burning of lime ore is critical to its eventual hardness and workability characteristics. It should be burned or calcined at as low a controlled temperature as possible. An old Roman law required lime putty to be aged a minimum of three years.

Lime mortars are slow setting and long working and had to be applied in several thin successive coats with time allowed for carbonation (the absorption of carbonic acid gas) before succeeding coats or coatings were applied. Lime plasters, on exteriors, required frequent repairs as they are vulnerable to harsh climates.

Lime is made from burning limestone, which is commonly distributed throughout the world’s surface. Lime consists primarily of calcium or magnesium carbonate, or both, and has a wide range of physical and chemical characteristics. Only limestones of extremely high purity (97 to 99 percent) are suitable for producing plaster’s lime. When burned or calcined, lime gives off carbon dioxide and changes to calcium or magnesium oxide.

Until early in the 20<sup>th</sup> century, lime was the binder in most plaster used by interior and exterior plasterers. Lime returns to its rock-like state over a considerable period of time, after application, by a process of recarbonation in which it absorbs free atmospheric carbon dioxide or carbonic acid gas to replace carbon dioxide lost during calcination.

Today, lime is not typically used as a cementitious binder as newer more durable binders have been discovered or invented. Lime is used today as a plasticizer in portland cement plaster/masonry mixes and lime-cement mixes.

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## GYPSUM PLASTER (INTERIOR PLASTER)

Gypsum, one of the world's most commonly distributed minerals, is frequently found in relatively pure deposits. When ground, burned or calcined and blended with set controlling additives, gypsum provides a workable cementitious binder.

Gypsum is hydrous calcium sulfate in the dehydrated form. After losing 75 percent of its chemically combined water during calcination, it is termed hemihydrate. Calcined gypsum, when mixed with water, recombines with approximately the same amount of water lost during calcination and reverts to its hard rock-like crystalline form. The rehydration is called setting. Gypsum plasters are used neat (no aggregate) or aggregated, dependent on the type of plaster and the designed usage and performance.

The long, needle-like crystals of gypsum, formed when the gypsum is setting, interlock around aggregate particles. The crystals interlace with fibers of the gypsum lath, thus developing an adhesion attachment. Plasters applied to a metal or wood lath form a mechanical key for attachment. Wood lath was the most popular interior lath until just about the end of World War II; wood lath is no longer used in the United States and not recommended..

Several types of aggregates may be used. The most common is naturally occurring local sand, screened and graded to a specific particle size or sizes. The proper range size gradations of sand particles influences plaster strength, workability and tendency to shrink or expand. Sand may be the major factor that defines the working characteristic of the plaster, and sand is not economical to ship great distances. Thus, contractors learn which materials and in what ratios work best for local sands. This important fact should not be overlooked.

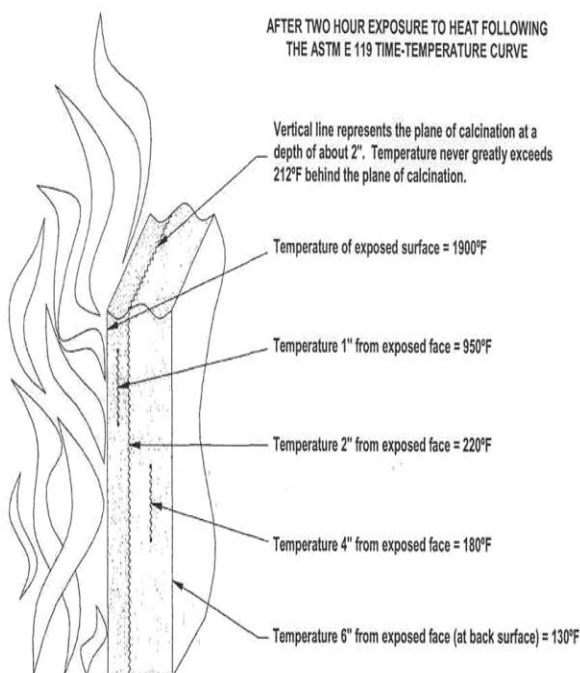
Lightweight aggregates may be pumice, exfoliated (popped in a furnace under controlled conditions) perlite, vermiculite or other minerals in their natural or processed state. In some countries, crushed and graded gypsum particles are used as an aggregate. Sawdust, wood fibers or crushed coal have also been used with some success.

Gypsum plaster possesses the unique characteristic and ability to recalcine. Simply stated, when the gypsum plaster is exposed to heat, the chemically combined water is released as steam to the outer surface. This released steam helps in

fire resistance as it aids in slowing the passage of heat through the gypsum plaster membrane. Much like a fire extinguisher on call around the clock, this is known as a passive fire protection system.

By varying the fineness of grind, types and amounts of admixtures, methods of calcining, etc., several types of gypsum plasters may be produced, some of which may attain compressive strengths in excess of 10,000 pounds per square inch.

Other new types of specialty plasters have been developed in recent years. Veneer plaster or "thin-coat" plaster is a gypsum or gypsum-like finish plaster of high strength that is applied over large-sized gypsum lath with face paper that has been chemically treated specifically for the thin application of veneer plaster. These plasters can be substituted for gypsum wallboard systems.



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Gypsum plasters' use is generally restricted to interior or protected areas due to the fact that prolonged exposure to moisture can cause gypsum plaster to deteriorate. When plastering in areas that will be exposed to moisture or constant high humidity, portland cement plaster is typically recommended instead of gypsum plaster.

## **ORNAMENTAL GYPSUM PLASTER:**

has a very long and rich history around the world. All major cities in the United States have historical buildings with outstanding examples of ornate moldings, cornices and columns. This use of gypsum plaster to imitate other materials was common at one time. For example, the Suzallo Library at the University of Washington Campus is a large building constructed at the turn of the last century. The massive caen stone could go only so high because of the heavy weight of the stone. Lathers and plasterers fulfilled the architect's vision for the interior by continuing higher up with lightweight channel iron and wire tied metal lath. A gypsum plaster was applied to the lath to imitate the caen stone at a fraction of the weight. To this day, architectural students and faculty assume the heavy gothic stone work reaches from the floor to the ceiling in these expansive spaces. The truth is the first eight rows are stone; the rows of stone that continue upward are really lightweight plaster made to replicate the heavy stone. There are other examples of ornamental plaster that have been done to recreate intricate wood carvings. Most general contractors and architects are shocked when they remodel the buildings to find out it was plaster and not wood.

## **PORTLAND CEMENT PLASTER (STUCCO)**

### *HISTORY:*

Portland cement is a modern cement product that found success as it is relatively unaffected by moisture. Used on bridges, roads, swimming pools and countless other structures, portland cement is a commodity and primary building product in the world. Portland cement was invented in 1824 by a British mason named Joseph Aspdin. The name Portland came from the stone it resembled from the Isle of Portland. Portland cement soon became the cement of choice for exterior plaster due to its strength and durability. Portland cement plastering is defined as applying a relatively thin layer or layers of the material over a lath or solid substrate. The term most commonly interchanged with portland cement plaster is stucco. In some regions of the country, the term stucco refers only to the finish coat; in other regions it is assumed the complete thickness of cement is stucco. The differences in nomenclature are not important and the origins of the word stucco are not exactly known. The Italians have historic references to *stucato*; the Germans find historical writings to the word *stucci*. The term stucco most likely was derived from old world Europe and altered to stucco when it reached the United States. Regardless of the origins, stucco refers to and is interchangeable with portland cement plaster. For this manual, the term stucco refers to a complete cement membrane including the finish coat.

### *CHEMICAL REACTION:*

Portland cement does not occur naturally and is produced primarily from a combination of limestone and an argillaceous or clay-like substance, both of which are abundantly available around the world. Chemically, it is essentially a combination of various silicates and calcium aluminates. After being properly blended, burned and ground, portland cement, when water is added, starts a complex reaction that ends as a dense hard mass of amorphous gel. The hydration or hardening requires the presence of moisture usually for several days.

### *EXTERIOR PLASTER USE:*

Portland cement is primarily used for exteriors in plastering (stucco) and interior spaces where elevated moisture or prolonged high humidity is anticipated. It is very durable and relatively unaffected by water and freeze-thaw cycles.

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Architects and designers have found cement plaster (stucco) a cladding that works with a variety of building styles. Few materials can create the old-world warm, rich look of a Tuscan style building and the clean modern lines of a contemporary building. Designers have always appreciated the plasticity of plaster; the ability to radius with no seams and harden to a durable finish.

The weather-resistant ability of portland cement and its ability to resist the passage of moisture have come into question in recent years with the rash of leaky condominiums around the country. Many have mistakenly assumed that liquid moisture has passed through the stucco membrane and thus stucco is not appropriate for wet climates. Properly mixed and applied, a portland cement membrane is water-resistant and yet vapor permeable. Proof of the water resistance of cement is the historical use of portland cement plaster in the construction of ferro-cement boat hulls for pleasure and commercial boats and ships.



Portland cement plaster may be applied to all metallic lath bases. A mechanical key is achieved when the plaster encases the lath. Similar to gypsum plaster, portland cement plaster has long needle-like crystals that interlock with masonry when setting. This makes it possible to plaster directly to masonry and some monolithic concrete, providing the substrate is porous, of sufficient roughness and the plaster being applied is not too thick.

## *CRACKS:*

Portland cement plaster has one characteristic that creates performance and aesthetic problems when not recognized and accounted for. Portland cement (and most concretes) shrinks slightly during hydration and results in the subsequent loss of moisture in mixed water. Such shrinkage generates stress within the portland cement plaster membrane, particularly when the plaster has been applied over lath, which often results in hairline cracks and in some cases minor surface distortion. Other types of stresses that may cause cracking are:

- Stress transfer from the structure
- Thermal shock
- Wind, seismic, vibration or impact stresses

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When the concentration of stresses on the plaster exceeds the maximum strain capacity of the material, cracks to relieve the stress or deformation may ensue. The provisions of integral stress relief mechanisms, such as control joints and/or expansion joints, provide relief from stress build-up and minimize cracking.

## INNOVATIONS:

Many new cementitious coatings and additives have been developed to assist in minimizing cracks in concrete and cement. Epoxies, liquid additives, polymers, fibers and binders have all been used to minimize cracks in portland cement products. One plastering procedure employed recently is to trowel apply a fiberglass mesh into a fresh polymer-enriched cement coating over the entire surface of the cured basecoat of plaster. This provides a strong yet flexible lamina and greatly increases the capacity of the cement membrane to resist stresses.

Pigments are often added to plasters, interior and exterior, for integral color of the finished plaster product. Scraffito is a color-art form in which several layers of differently colored plaster are laid on and after initial hardening are cut back to desired tints to achieve a design effect and color.

## COLOR:

Over the centuries, everything from sea shells to blood was used to integrally color plaster. Natural mineral ores and chromes became the standard for decades. More recently, the move to synthetic pigments has become popular for cements. The impregnation of color into wet plaster, called fresco, dates back to prehistoric days and into medieval Europe. Michelangelo and Leonardo Da Vinci used fresco plaster with regularity. Even with these, cements are typically limited to pastel colors. To create bold, bright or dark colors in portland cement plaster painting was the only option for years. Today acrylic finish coats with integrally blended aggregates provide colors that were unimaginable only a few short years ago. The acrylic finish coats are applied in lieu of the traditional cement finish and have proven to work very well. Acrylic finishes have a wider range of color choices than cement finishes, but cement finish can produce a much wider array of texture possibilities.

Marblecrete or pebble dash is another unusual texture for portland cement plaster. Rock chips or pebbles are thrown into the fresh basecoat to provide a rough aggregate final appearance. Some regional textures are similar to the ones pictured in the manual, but may go by a different name. For example in Canada, “slop dash” is the term used for a heavy dash coat. In Europe, the term *granol* is the common nomenclature for what we refer to as a sand finish. In any language or any part of the world, this is what makes plaster truly unique, skill intensive, artistic and an expression of individuality, whether by the designer or plasterer.



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## *SKILL SETS*

Lathing and plastering are considered skilled trades and require taught methods from masters with extensive practice to learn these skills. In its basic form, anyone can plaster. However, the quality and performance of the plaster would likely not be acceptable to any building owner. Proper lath and plastering require more than stapling lath to framing and the ability to apply plaster with a hawk and trowel. Most construction experts consider plastering, done on the professional journeyman level, one of the highest skill sets of all the construction trades.

The dilemma for designers and building owners is determining who is a master and who is simply imparted with some plaster knowledge that may or may not be a qualified and skilled journeyman. Unfortunately, a simple set of questions or passing a predetermined test does not ensure the designer is dealing with a master journeyman. Even a master journeyman lather and/or plasterer needs time to observe another plasterer to properly evaluate their skill and knowledge of the material.

Where do the journeymen get their knowledge and skills? Apprenticeship programs have been passing along the knowledge of materials and mechanical skills for decades. Apprenticeship programs help keep the trades alive with passing along proper and industry recognized practices and techniques.

Apprenticeship also has the benefit of a continual supply of young motivated talent coming through the programs, as they set up job fairs in local schools. The apprenticeship programs have challenges in modern times; the construction worker has a poor public image and to remain relevant, these programs must add the new products and/or systems constantly being introduced into the market place.

## **MOISTURE MANAGEMENT OF EXTERIOR WALLS**

Moisture management involves protecting conditioned spaces with a cladding. Designers are challenged with a variety of issues concerning exterior cladding from aesthetic appeal, cost, practicality and suitability. However, moisture management may be the most challenging issue to design, detail and install. Exterior moisture and moisture related issues must also consider vapor drive, condensation and the use of air barriers when designing and selecting exterior cladding.

The ultimate goal is to keep the framed wall cavity dry and allow it to diffuse any moisture that may enter the cavity. As such, the envelope design strategy must address both processes of moisture transmission: the movement of bulk water and vapor. This process of moisture migration can vary from one region of the country to another and as such, designing the moisture management of the exterior wall can equally vary. Fortunately, walls and plaster are not new and extensive experience with successes and failures have taught the plastering industry leaders what works and what does not.

## **MOISTURE MANAGEMENT SYSTEMS/ASSEMBLIES**

Exterior cladding systems can vary on the method of how they manage moisture. All exterior systems have a predetermined method, concept or strategy for control of rainwater. Regardless of the concept for moisture management that is selected, the research is unanimous that the primary cause of the moisture related problems that plagued buildings in the 1990s as the “leaky” building crisis was exterior water (rain) finding its way through wall penetrations.

Exterior claddings, particularly plaster (stucco) or plaster-like systems, can generally fit into one of the three following concepts on how they manage exterior moisture (rain):

## **THE BARRIER CONCEPT**

This system is installed as weather and water-tight cladding on the exterior outer-most surface of the building. Bulk water is not expected to penetrate this outer layer or barrier. These systems typically rely on a 100 percent seal to the exterior elements. Sealants are a critical part of these systems and there is often little room for error in installation. Despite criticism, the barrier system can function quite well as an exterior cladding when installed correctly.

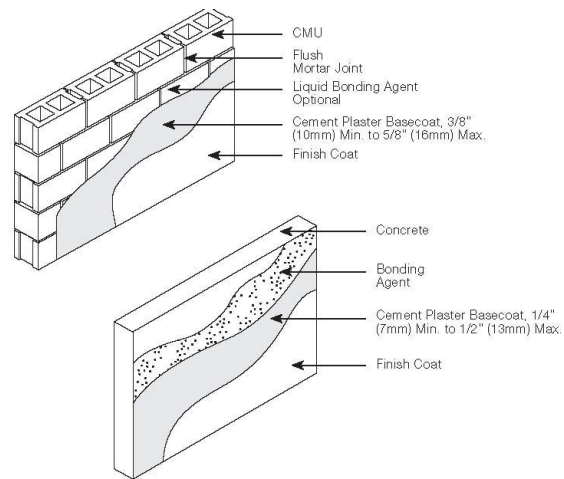
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This typically requires stringent protocol, skilled installers, adherence to manufacturer's details and thorough inspections by qualified persons. Some barrier systems are designed as a thin waterproof coating and others are reliant on the thickness or mass of the wall to prevent moisture from reaching the interior conditioned space. Building codes typically require specific testing ("mass wall" substrate excluded) to prove the system or assembly prevents any bulk water entry. Examples of barrier systems are:

- Concrete Tilt-up Walls
- Single Wyth Masonry walls
- Barrier EIFS
- Sidings with no secondary Water-resistive Barrier
- Skylight Assemblies and Fenestrations



## THE CONCEALED BARRIER CONCEPT

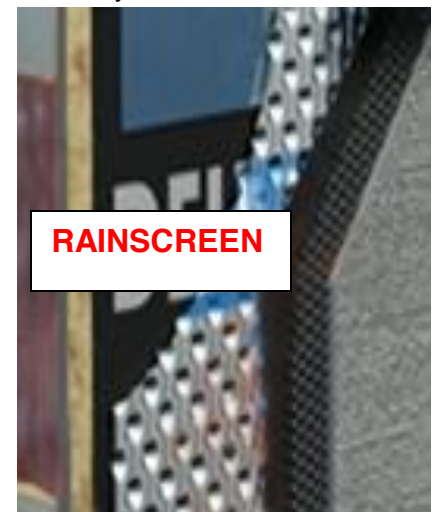
This is the most common conceptual method employed for moisture management with exterior claddings for residential and most commercial work. The principle is to install the outer cladding as a weather-tight cladding intended to deflect as much as 97 percent of the bulk rain or moisture. It is anticipated that incidental or small amounts of moisture will ultimately find its way past the exterior cladding or outer shell. The secondary or "concealed" barrier is installed and integrated with flashings as a last barrier to prevent moisture from entering the wall cavity. The most common concealed or secondary barrier is asphalt saturated building paper, felt or a house wrap type product. The most important concept to follow in this management concept is the "Shingle-Fashion" installation of the concealed barrier and all flashings.

The "concealed barrier" concept is acceptable for all of North America and has been verified by independent testing as well as actual successful structures with decades of exposure. Examples of a concealed barrier system are:

- Sidings installed over a water-resistive barrier
- Plaster (stucco) systems and assemblies on framed walls
- Metal panels over a water-resistive barrier
- Stone veneers over a water-resistive barrier on framed wall

## THE RAINSCREEN CONCEPT

This system has been around for several decades, but has received significant attention and acceptance due to a rash of leaky buildings. The rainscreen principle is an outer shell that stands off of the primary structure. Significant amounts of water are anticipated to pass the outer shell; the space allows for drainage and air-drying. Low- to mid-rise buildings often employ the use of furring strips to stand the cladding off of the sheathing, thus creating a measurable air space and wide drainage plane. Another theoretical benefit of rainscreen is to displace negative pressures common on energy efficient or airtight buildings. Almost all claddings can be adapted to rainscreen technology by using drainage mats, furring strips or a double wall system. Some commercial curtain wall systems can be classified as "rainscreen" systems. Pressure equalized rainscreen (PER) is a ventilated cladding system that intentionally allows free flowing air to rise and escape from behind the cladding.



## MANAGEMENT CONCLUSION

Rainscreen claddings can add cost in design, materials and time to construct. Rainscreen systems are recommended only for building walls facing extreme exposures to frequent wind-driven rain with limited drying days.

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The selection of which moisture management philosophy to follow is the job of the architect. He/she must consider aesthetics, qualified labor, suitability and cost. Once selected, the detailing of the exterior system is either the architect's job or sublet to the building envelope consultant. The installation of the system is the duty of the contractors.

Barrier and concealed barrier systems are the most cost effective, code compliant and are suitable for most all regions of the country. In areas where annual rainfall is low and the drying potential is great, barrier systems have functioned well, even on large projects when installed professionally. An example of the success of barrier systems would be the large casinos in Las Vegas clad with barrier EIFS.

The success of concealed barrier systems can be documented with thousands of projects from Seattle to South Carolina clad with traditional stucco systems over a traditional water-resistive barrier (grade "D" building paper). Rainscreen has been used in Vancouver, British Columbia with great success.

## MOISTURE (RAIN) AND DESIGN PRESSURE

Outside moisture is considered the rain that falls and hits the wall surface. How it is deflected or manipulated to a desired direction is the management of that moisture. Rainfall, by itself, is relatively easy to manage. It is wind-driven rain that can be a challenge to designers and contractors. The wind provides a driving force that can push water uphill and seem to defy gravity. The wind also has an effect on the building by creating what is known as "negative building pressure." This negative pressure is also created by sealed buildings with mechanical air handling systems. During strong winds, when the building is constructed to be energy efficient and virtually air tight, a negative pressure is created within the conditioned space of the building. The negative pressure is nature trying to equalize the environment or draw air into the building. If the air is carrying liquid water, i.e. rain, and there are openings or conduits for moisture to enter, the building cavity can get wet. This negative pressure on the building exterior typically has little effect on the field of the wall where there are no "through wall" penetrations directly exposed to the outer elements. Some consultants believe the thousands of penetrations used to attach the cladding are natural conduits for moisture intrusion. However, there are two factors that may make this unlikely:

1. The fasteners should be placed over framing members and a water-resistive barrier to form an effective seal. Tears or noticeable holes should be sealed.
2. The outer cladding applied, particularly plaster, acts to further seal small voids and serves as a pressure barrier, thus the negative pressure behind the monolithic cement plaster is zero to negligible. In addition, after a taped and sealed drywall assembly is applied on the interior side of the wall, the negative pressure is reduced.

Portland cement plaster, concealed barrier stucco, as listed in the building code is acceptable and capable of withstanding the design pressure a wall would encounter. Under the components and claddings section of the code, no additional testing is required. New cladding systems or systems without the concealed barrier or drainage provisions established by the code are required to be tested per ASTM E331 prior to installation. Testing should be done at the proper design pressure per the components and claddings section of the code and it is the responsibility of the design team.

## WINDOWS & DOORS

The negative design pressures are more severe and have a direct impact on "through-wall" penetrations, such as doors and windows as they have a direct connection to the interior conditioned space. The windows and doors must be able to withstand the negative pressure and the flashings around these items must also handle the anticipated pressure.



# CHAPTER 1 – HISTORY OF LATH & PLASTER

The vacuum-like pressure created during a wind-driven rain storm can draw rain water through the wall cavity and into interior spaces through small openings, holes in flashings, or fenestration products not designed to withstand this pressure. In taller buildings, the negative pressure effect tends to be greater and tends to increase as the building increases in height. The recommended test for the water resistance of windows and doors is American Architectural Manufacturers Association (AAMA) specification 502-02 and uses ASTM E 1105 as the protocol. AAMA 502-02 has two distinct methods for testing; Method A tests the product within the confines of the main frame (the product). Method B is inclusive of the surrounding flashings. Some states now require testing of a percentage of installed windows and doors on certain building types to verify compliance. This is typically limited to multi-family structures. It is recommended to use only AAMA accredited labs to test windows and doors.

The negative pressure increases even more at the outside corners of the buildings: the building codes recognize this fact and refer to this as the “discontinuity factor.” The discontinuity factor is the reason why windows at the corners of taller buildings are typically required to have a higher “design pressure” rating than the windows in the field walls of the building. There are additional tests conducted by AAMA labs for structural and energy efficiency of the products.

## WINDOWS AND FLASHING

### WINDOW STYLES

There have been basically two styles of windows in the United States for several decades:

- Store Front Windows
- Nail Flange Windows

#### STORE FRONT WINDOW:

These windows are typically made from aluminum, often field fabricated and primarily for commercial usage. There is no nail flange and the two primary focuses for flashing were perimeter sealing and a sill pan to catch incidental water that may find its way through the window’s gaskets or frame. The perimeter sealing relied on a flexible sealant joint that was 100 percent complete and would be replaced every so often over the years with regular building maintenance. Most commercial buildings have a maintenance plan.

#### NAIL FLANGE WINDOW:

These windows came onto the market in the 1960s and were originally made of aluminum. The first recorded window flashing standard was a joint venture between the California Lathing and Plastering Contractors Association (CLPCA), now known as the Western Wall and Ceiling Contractors Association (WWCCA) and the California Window and Door Manufacturers Association (CWDMA) now known as the American Architectural Manufacturers Association (AAMA).

This standard for flashing a “nail-flange” window (AAMA 2400-10) and communication between these two groups still exist today. The product most often used back then was a wax-like flashing paper (Sisal Kraft) around the opening of the window. A sealant joint was not typically done around the window perimeter; incidental moisture that might find its way at these locations would travel toward the window frame and be stopped by the frame and directed downward. The shingle fashion layering of the paper and integrated flashing prevented water entry, and directed water down and out.



# CHAPTER 1 – HISTORY OF LATH & PLASTER

In the 1980s, PVC windows became popular. These windows also had a nail flange. However, some had missing corners and windows with continuous corners were often broken during storage, handling or installation. Some had snap in flanges with open corners that required installers to place foam pads over the opening.

## FLASHING & DOOR OPENINGS

Traditional methods of flashing to prevent water intrusion around the perimeter of each style window, was very different, but when done with the proper intent and fully executed, both window systems worked well.

Many in the construction field have opinions as to the “correct” way to flash a window. Many thought the answers must be buried in the building code and must show the proper method to flash a window. Unfortunately or fortunately (depending your perspective), the Uniform Building Code and other codes in the nation provided little guidance as to “how” to flash a window. The code simply, by design, required penetrations to be flashed as to make them weatherproof. The code never, and still does not intend to direct contractors as a single method of flashing a window and intentionally leaves the options for design, creativity and functionality open to the construction community.

Today, there are several methods and hundreds of products to flash windows. It is up to the architect to determine the method most appropriate for the window, project and wall system selected. Lacking clear direction from the architect, the contractor installing the window should ask for direction. Failing direction, the contractor, to protect himself, should follow a recognized authoritative source for flashing

There are several methods to flash a window. If a building envelope expert has been contracted, his/her method should be followed to the letter with no deviation. If the envelope consultant has a design or specific method, he/she should accept liability for the design and any prescribed alterations or deviations. The envelope consultant should be asked to review and approve the installation of window flashing.

If the envelope consultant’s method to flash the window is not practical, possible, or makes a contractor uncomfortable, a formal letter should be sent to the architect advising him/her of the situation and/or concern. It is not recommended to proceed and alter the window flashing procedure without clear direction. Point out that there are established and recognized flashing procedures that have been accepted by the industry and defensible in court. Some excellent options and reliable flashing procedures are published by AAMA (The American Architectural Manufacturer’s Association). AAMA 2400-02 is a basic and simple flashing procedure; these are options available online for free and carry some of the highest industry and code approvals. Most window manufacturers have AAMA 2400 available on their Web sites and refer to them in the installation specifications. The AAMA flashing procedure is based on the same flashing procedures published by the plaster industries for more than 50 years. It is recommended to stay with the AAMA or another established procedure, such as ASTM and follow the instructions to the letter.

*It is the architect’s responsibility to provide guidance direction on windows and flashing. It is the builder’s responsibility to coordinate the trades to make the system water-resistant, it is the subcontractors responsibility to integrate his system with the flashings as directed.*

## PERFORMANCE GRADE WINDOWS

The design pressure (DP) or performance grade of a window is critical to architects and to general contractors. Architects are responsible to run the calculations on the buildings they design and instruct the general contractor which windows meet the design pressure requirements for that project. It is not the responsibility of the wall and ceiling contractor to verify the correct DP of windows and doors. Not all manufactured windows and doors have been tested or rated by AAMA. Building owners and/or general contractors can verify the DP rating by looking for the gold AAMA label on the window frame. A silver AAMA label is only for energy and thermal ratings. If no gold label is present on the window or door, it should be assumed the product will only comply with the lowest DP rating listed by AAMA.



# CHAPTER 1 – HISTORY OF LATH & PLASTER

This manual does not cover the design pressure rating of the various windows and doors on the market. Designers are encouraged to research and fully understand the method to determine the design pressure and then evaluate the window and door manufacturer's test information on design pressure. Conventional three-coat exterior cement plaster and the attachments as described in the IBC (International Building Code), ASTM C1063 and C926 are suitable for the highest design pressure ratings listed within the building codes.

It is recommend that designers and general contractors verify that the windows ordered and shipped meet the minimum design pressure rating (DP rating) or Performance Grade for the building as specified by the architect. A water-tight wall and good flashings are useless if the window itself leaks into the cavity during wind-driven rains. The following are the guidelines published by AAMA: Visit [www.aamanet.org](http://www.aamanet.org) for more information.

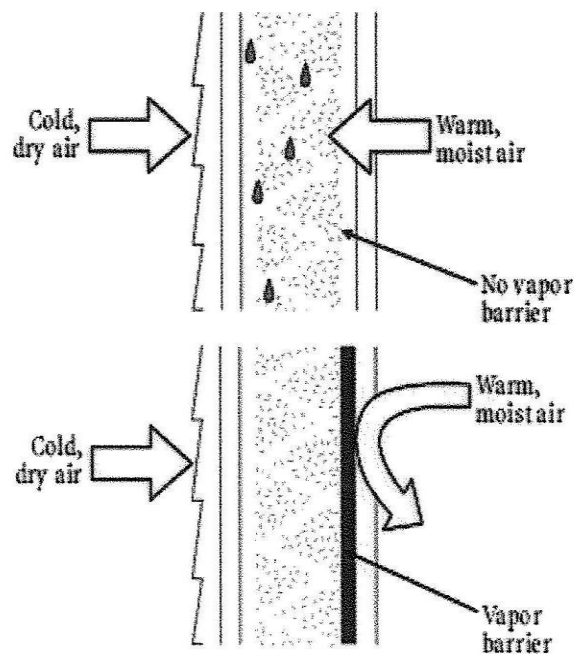
Residential (R)	DP 15
Light Commercial (LC)	DP 25
Commercial (CW)	DP 30
Architectural (AW)	DP 40

The additional cost for a higher DP rated window is typically minimal. Value engineering a lower rated window is ill advised. Sill pans are not required on solid integral flange windows, if the fenestration is adequately rated for the structure

## VAPOR & VAPOR DRIVE

Vapor, for the construction industry is defined as water in its gaseous state and vapor drive is the pressure or movement of that water as forces in nature try to equalize it. While inside moisture may not be as problematic as exterior rain driven moisture, it should not and cannot be ignored. Inside moisture would be considered the water vapor or condensation from the inside of the building. Typically this has not been found to be the primary source of the moisture problems that plagued the construction industry in the late 1990s. Relatively recent energy code requirements that required a vapor barrier on the inside portion of the cavity wall for colder climates has created controversy about the use of vapor barriers and whether it caused the rash of moisture-related problems. While most experts agree that it may have contributed to the moisture problems, it is rarely ever the major source of a moisture problem.

Vapor drive is greatly influenced by temperatures and these factors should be considered if using a vapor barrier, when to use a vapor barrier and where to place the vapor barrier. Warm water vapor is more active and will tend to drive across to cooler air vigorously. In short, nature abhors a vacuum and tries to equalize all spaces. For example, a building exposed to 100 degrees F heat and 80 to 90 percent humidity on the outside, when the inside is 70 degrees with 50 percent relative humidity, will have the water vapor molecules on the outside trying their hardest to get to the inside and even things up. If the temperature differences are more drastic, the amount of pressure or drive is increased. This is why cold storage facilities require special attention to wall construction, as the vapor drive can be dramatic compared to a traditional building.



# CHAPTER 1 – HISTORY OF LATH & PLASTER

## VAPOR CONTROL (VAPOR BARRIERS/RETARDERS)

The function of a vapor barrier is to retard migration of water vapor through a wall assembly. Where it is located in an assembly and its permeability is a function of climate, the characteristics of the materials that comprise the assembly and interior conditions of that building. It should be noted that air barriers and vapor barriers are not the same nor do they function the same. However, air barriers that can additionally block the transportation of moisture-laden air, may additionally function as a vapor barrier.

Cold climate regions of the country are familiar with the use of vapor barriers or retarders under gypsum wallboard. This practice spread around the country, was used indiscriminately and resulted in some negative consequences in certain regions. The primary purpose of the vapor barrier was to prevent assemblies from getting wet; unfortunately, the vapor barrier sometimes prevented the assembly from drying out.



There has been a tremendous focus on types of vapor barriers and their location in the wall assembly or if they are even appropriate for exterior walls. This is primarily a result from the attention of mold and mildew found within wall cavities. The birth of the vapor barrier was the initial response to the energy crisis that started in the late 1970s and resulted in code requirements for a vapor barrier to be installed on the warm side (typically under the interior gypsum wallboard) of the exterior walls. The vapor barrier most commonly specified has been a polyethylene film (plastic sheet).

Several independent labs and associations have performed tests and investigated hundreds of projects. The consensus is the polyethylene film cannot be directly linked to the rash of moisture problems and while the vapor barrier was appropriate for very cold climates, they may have been overkill for many other areas of the country. As a result, the revised Energy Code policies have created classifications for vapor barriers and now include vapor retarders.

The use and degree of vapor control depends largely on where the building is constructed in the country. It should be noted that not all walls require vapor barriers or are even recommended. Generally, the colder the climate, the more beneficial a vapor barrier/retarder is on the inside of the exterior wall.

## VAPOR RETARDER REQUIREMENTS

Vapor retarders reduce moisture condensation within floor, wall and ceiling cavities and are defined by ASHRAE as, “The element that is designed and installed in an assembly to retard the movement of moisture by vapor diffusion”.

Most interior finish materials are permeable. Water vapor can move through them, by a process called "diffusion," into or out of structural cavities. If vapor diffuses into structural cavities, and if the cavities are cold enough, water vapor can condense on insulation, sheathing, or framing members. Besides the obvious problems of wet materials, damp insulation loses some of its R-value.

“Perm ratings” indicate how well materials resist moisture penetration through diffusion. The lower the perm rating, the better a material prevents moisture diffusion. Installing a vapor retarder on the warm side of insulation prevents water vapor diffusion into the cavity. Facing on insulation is a vapor retarder.

Polyethylene sheets may serve as vapor retarders for unfaced insulation. Some interior primers and paints are formulated to act as vapor retarders and comply with energy code requirements.



# CHAPTER 1 – HISTORY OF LATH & PLASTER

## WALL VAPOR RETARDERS & THE CODE

Energy code requires a one-perm vapor retarder in walls for some zones of the country. Faced insulation may meet both R-value and vapor retarder requirements. When unfaced batts or blown-in insulation are used, a vapor retarder must be provided (when a vapor retarder is required). Vapor retarder paints or polyethylene sheets are common and accepted wall vapor retarders. Most wall and ceiling bureaus prefer primer or paint with a low perm rating when a vapor retarder is required. Vapor Retarders are classified into three categories:

- Class I 0.1 perm or less
- Class II 1.0 perm or less and greater than 0.1 perm
- Class III 10.0 perm or less and greater than 1.0 perm

## PERMEABILITY

Rated in perms, is a measure of the rate of transfer of water vapor through a material (1 perm = 1 grain/sf-hour per inch of mercury). Vapor retarders have permeability ratings of 1.0 or lower. A more accurate, and useful, categorization of materials would be:

- Impermeable ( $\leq 1$  perm)
- Semi-permeable ( $>1 - 10$  perms)
- Permeable ( $>10$  perms)

Categories are per test procedure ASTM E-96 Test Method “A” (the desiccant method or dry cup method).

Examples of vapor barriers/retarders are:

- Polyethylene is a Class I vapor retarder or vapor barrier.
- A Kraft-faced fiberglass batt is a Class II vapor retarder.
- Latex painted gypsum board (one coat of latex paint) is a Class III vapor retarder.



# CHAPTER 1 – HISTORY OF LATH & PLASTER

## PERM RATINGS OF COMMON BUILDING MATERIALS\*

Material	Thickness (inches)	Permeance
<b>Structural Materials</b>		
Concrete (1:2:4 mix)	1	3.2
Brick masonry	4	0.8
Concrete block	8	2.4
Portland cement plaster	3/4	11.0
Gypsum wall board	3/8	50.0
Exterior plywood	1/4	0.7
Interior plywood	1/4	1.9
<b>Thermal Insulations</b>		
Air (still)	1	120.0
Extruded polystyrene	1	0.4-1.2
Expanded polystyrene	1	2.0-5.8
Polyisocyanurate	1 (foil face)	0.05
Polyisocyanurate	1 (no foil)	26.0
<b>Plastic Films and Metal Foils</b>		
Aluminum foil	1 mil	0
Polyethylene	4 mil	0.08
Polyethylene	6 mil	0.06
<b>Building Papers, Felts and Roofing Papers</b>		
Saturated and coated rolled roofing		0.05
Asphalt Kraft (building) paper		35.0
Kraft thermal insulation facing		1.0
Foil thermal insulation facing		0.5
#15 asphalt felt		1.0
Olefin (spunbond high density fiber)		11.7 – 50+
<b>Material Permeance of Coatings</b>		
<b>Paints (1 coat)</b>		
Vapor retarder paint		0.6-0.9
Selected primer-sealer paint		0.9
Standard Primer-sealer		6.28
Vinyl-acrylic primer		8.62
Semi-gloss vinyl-acrylic enamel		6.61
<b>Paints (2 coats)</b>		
Aluminum varnish on wood		0.3-0.5
Enamels on smooth plaster		0.5-1.5
Various primers plus one coat		
flat oil paint on plaster		1.6-3.0

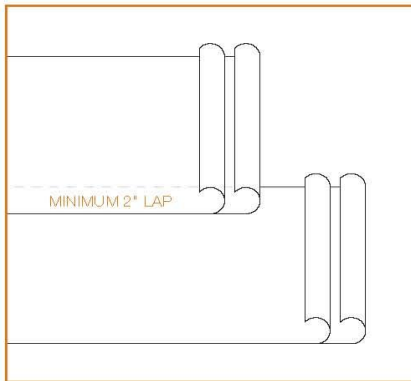
\*These values are from Oregon State University and ASHRAE Perm ratings for specific paints should be verified by independent testing using ASTM E-96A or equivalent TAPPI test standards.

# CHAPTER 1 – HISTORY OF LATH & PLASTER

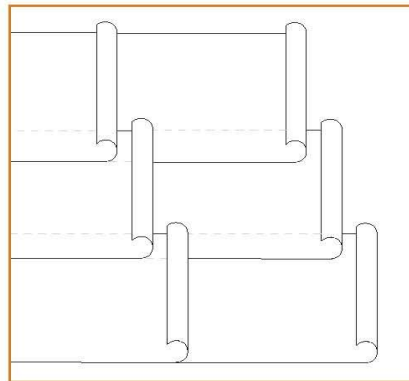
## WATER-RESISTIVE BARRIERS (GRADE “D” SATURATED KRAFT PAPER OR EQUAL)

Asphalt saturated kraft paper has been used for decades with portland cement plaster and with great success. The asphalt paper has some unique properties that make it very appropriate for cement plaster (stucco). When the first coat of cement is applied, the paper will absorb some moisture from the cement coating, the paper swells and wrinkles slightly, pushing the fresh plaster to form shallow channels or “waves” on the back of the plaster membrane. The asphaltic paper then releases from the cement to form a small “weep” plane for incidental moisture that may find its way past the plaster. This assembly is code approved, proven to work in high-wind driven rains and is cost effective.

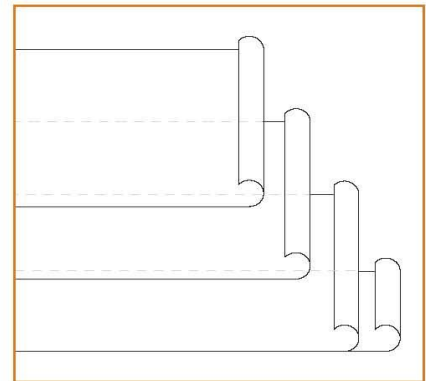
### Applying Water-Resistant Barriers



1. Double Layer Method



2. Separate Layers Method



3. 50% Lap Method

Method #2 is recommended when a house wrap is used as a base layer.

Asphalt saturated kraft paper is rated based on its is how long it resists bulk water from penetrating it and its vapor permeability. The 4 rating classes are from “A” to “D”; with D being the most commonly used. Grade D paper is perfect blend of good water-resistance and vapor permeability. The available water resistance in the product is rated in minutes. Sixty-minute (60) Grade D is more water-resistant than 10 minute with very similar vapor permeability ratings (35 grams PSM/24hr) Adding two layers of Grade D paper will lower the vapor permeability only slightly. Building codes require two layers over wood based sheathing, to add water protection and provide vapor permeability. Grade B paper is not permeable, and if used on exterior walls for plaster, the wall cavity should have some another source of venting. Felts also tend to be lower in permeability and are not typically recommended for exterior walls with cement plaster. Felts tend to stick to plaster, crack and split when applied in cold weather or folded over 90° angles.

## AIR BARRIERS

In recent years there has been an increased focus on the use of “air barriers.” particularly for commercial, hotel, institutional and high-rise construction. The heightened awareness of moisture intrusion, mold, and unhealthy indoor air quality on some buildings, has led researchers to re-examine and refine the air movement through exterior walls. Air movement through a building’s exterior walls is a concern as the air carries moisture which impacts materials’ long term performance and structural integrity, fire behavior (smoke spread), indoor air quality (air pollutants and microbial reservoirs) and thermal energy.

Understanding the importance of an air barrier and where it should be located, requires intimate knowledge of the climate, building type, design pressure distribution and the building mechanical systems. There are diagnostic protocols to determine the airflow and pressures on a building.

# CHAPTER 1 – HISTORY OF LATH & PLASTER

The key to understanding air flow is to understand pressure. This air pressure is an interrelationship between the mechanical air handling system and the building envelope. Commonly employed strategy is to close large holes in the building envelope while controlling air pressure on the interior from HVAC equipment.

The use of an air barrier may be a sealed interior gypsum wallboard system, an exterior product used as a combination water resistant barrier or a specifically designed product only being used as an air barrier. Fluid applied products have begun to gain popularity as an air barrier, as well as sprayed insulations. An important concept is to be continuous with no breaks or interruptions in the system. When an air barrier is decided to be used, it is recommended that a building science specialist be contacted to verify proper location in the wall assembly, material selection and installation. Not all buildings will benefit from an air barrier.\*

The call to build a more energy-efficient and air-tight building has caused yet another industry within construction to market products, assemblies and systems that offer attractive but sometimes costly additions to the wall envelope. The 2112 IECC (International Energy Conservation Code) has clarified the definition of a continuous air barrier and allows the criteria be met in one of three ways:



12/15/2011

## 1. MATERIALS

Air barrier materials are defined by their air permeance. To be defined as a air barrier material the air permeance must be equal to or less than  $0.02L/(s \cdot m^2) @ 75Pa$  ( $0.004 \text{ cfm/ft}^2 @ 1.57 \text{ psf}$ ) when tested in accordance with ASTM E 2178. The air permeance is the amount of air that migrates through materials and not through holes or gaps. It is possible to have a water-resistant barrier, vapor barrier and air barrier in one product. They shall be deemed to comply with the ICC “provided joints are sealed and materials are installed as air barriers in accordance with the manufacturer’s instructions”<sup>1</sup>. Examples of code-approved wall materials are:

- Minimum 3/8” thick plywood or oriented strand board
- Minimum 1/2” Extruded polystyrene or foil-back polyisocyanurate insulation board
- Minimum 1 1/2” of closed- cell spray foam with a minimum density of 1.5 pcf
- Minimum 4 1/2 “ of open cell spray foam with a minimum density between 0.4 and 1.5 pcf
- Minimum 1/2” exterior or interior gypsum board or cement board
- Cast-in-place and precast concrete
- Fully grouted concrete block masonry
- Sheet steel or aluminum
- Minimum of 5/8” thick of portland cement/sand parge, or gypsum plaster.

## 2. ASSEMBLIES

They meet the criteria set forth by the code when tested in accordance with ASTM E 2357, E 1677 or E 383. Additionally, the following two assemblies comply providing they meet the following:

- a. the air barrier is continuous and “air barrier joints and sealants shall be sealed including sealing transitions in places and changes in materials”<sup>1</sup>
- b. air barrier penetrations and paths of air leakage “shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and locations.”

The assemblies per the 2012 IECC are:

- CMU walls “coated with one application either of block filler and two applications of a paint or sealer coating.”<sup>2</sup>
- Minimum 1/2” portland cement /sand parge, stucco or plaster.

<sup>1</sup> 2012 International Energy Conservation Code

# CHAPTER 1 – HISTORY OF LATH & PLASTER

## 3. WHOLE BUILDING TEST

A completed building can be tested in accordance with ASTM Standard E 779 or an equal method that is approved by the local code official. Additionally local and/or state codes can be more stringent than the national building code-minimum.

*\*An air barrier “specialist” can be consulted to offer advice on appropriate products, assemblies and/or systems that maybe beneficial to a project while keeping the added expense to a minimum.*

For more information on air barriers visit [www.buildingscience.org](http://www.buildingscience.org)

## INNOVATIONS IN LATH & PLASTER

Lath and plaster are some of the oldest materials in America and is still going through innovation changes. Polymers are added to impart performance characteristics; laths are now made from plastic or stainless steel. The creation of decorative foam shapes applied to the cement brown coat has added flair and decorative style to what was plain stucco surfaces.



These lightweight, cost effective foam details are adhesively applied to the basecoat of plaster prior to the finish coat. These are typically factory made and cut with hot wires or lasers and can be of almost any shape or detail desired. A polymer enriched cementitious coating and fiberglass (impact) mesh is applied to the foam shape at the factory or on site to provide abuse resistance. The most common decorative shapes used are:

- Window and door surrounds
- Cornices
- Quoins
- Decorative bands

Foam shapes may be used in other areas, as well. As new materials are created, the envelope will be pushed and designers must use caution when and where to use foam shapes and what materials are or are not compatible.

## EIFS

EIFS (Exterior Insulation and Finish Systems) were invented in Germany after the World War II. The system of foam plastic sheets adhered to a masonry structure and then coated with a fiberglass mesh and polymer coatings provided an energy-efficient stucco-like cladding, that solved a desperate nation’s need.

The system was later introduced into North America and at first was limited primarily to commercial buildings.

The system worked well as commercial contractors and their workers are typically better trained and most buildings have a maintenance plan.



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As the EIFS market was pushed into the residential market, problems occurred. The original “barrier” EIFS was not forgiving to errors in installation, design and/or lack of maintenance. The problems were not limited to EIFS, as all claddings are susceptible to leaking, but EIFS received much of the blame. The end result was the manufacturers added a secondary moisture barrier behind the system to allow for some forgiveness in the system and a lack of building maintenance. Today, EIFS are regaining market share and co-exist with traditional cement stucco as claddings that provide owners unique and different qualities. With increase demands in Energy savings, EIFS is poised to make a strong comeback and meet the demands of the future. More information can be found in chapter 8, “EIFS”.

## ONE COAT STUCCO

One-coat stucco was born out of the energy crisis of the 1970s. The Southwest states passed a law requiring all buildings to up the R-value of all exterior walls to save energy. Achieving the higher R-value was not possible with the current use of 2x4 studs and required builders to switch to the use of 2x6 studs for the exterior walls. The extra width allowed more insulation. The stucco manufacturers developed a new plaster system that would allow developers to continue the use of 2x4 studs and achieve the higher energy rating.

The one-coat stucco system uses a “tongue and groove-style” insulation board applied over the studs (TSIB recommends sheathing behind all vertical plaster assemblies). “One coats” can also be “unsulated” and installed to sheathing. A wire netting is applied over the foam panels and a special proprietary plaster is applied in one coat 3/8 inch thick. The finish can either be cement stucco or acrylic finish.

The system is still in use today in many regions of the country. There has been some controversy over the system. Most plaster bureaus see one-coat plaster as a successful system when installed correctly with a few modifications or upgrades and limited to residential and light commercial construction. Typically it is recommended to upgrade the lath from a minimum 20 gauge to a 17 gauge. It is then recommended to increase the 3/8 inch basecoat to a 1/2 inch basecoat. The slight increase in cost has been found to increase the performance substantially.



## (DAS or DAFS) DIRECT-APPLIED FINISH SYSTEMS

These systems are a sheathing product applied to framing and only the joints are treated. In some cases, the entire sheathing surface is covered with a mesh and skim coat of polymer enriched plaster. These systems are proprietary and work well in very mild climates or protected areas. They are not recommended for areas directly exposed to direct weather conditions. A DAS is often substitute for a more traditional cement plaster on exterior ceiling or soffits and has proven to be serviceable if protected from rain. A DAS should only use an acrylic finish coat and follow manufacturer’s recommendations.

## CEMENT BOARD SYSTEMS

These systems are a two layer of sheathing assembly that have a cement panel applied over a base sheathing with a water-resistive barrier(s) applied between layers. The joints of the sheathings are typically staggered and the cement board receives a mesh and skim coat of polymer enriched cement and an acrylic finish coat. The cement board system, when installed per manufacturer’s instructions, has proven serviceable in a wide variety of climates.

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## CI (CONTINUOUS INSULATION) & THREE-COAT PLASTER/STUCCO

Continuous insulation for a full thickness (7/8 inch) cement stucco assembly is not new and has been code approved for decades. The first CI stucco assemblies were used on cold storage facilities on the west coast as early as the in the 1950's. In some cases cement plaster was directly applied to foam sheathing, but usually with a metal lath base. The TSIB offers three basic CI assemblies based on extensive experience, all are generic, code-approved and have been proven to work on a variety of structures. More information can be found in chapter 7, "Plaster & The Energy Codes".

## THE HISTORY OF THE "LEAKY BUILDING CRISIS"

The predominant source of moisture intrusion was discovered to be the outside source of moisture (wind-driven rain). However, the interior vapor barrier did contribute to the problem in more ways than one. Leaking buildings are nothing new and since the beginning of construction, buildings have leaked. The problem was traditionally somewhat minor and certainly controllable. Beginning approximately in the mid to late 1980s the "crisis" started and began to escalate completely out of control. However, the extent of the problem was not fully realized until the late 1990s. This rash of leaky buildings across North America created the birth of construction defect experts; construction attorneys that blossomed right up to the turn of the century.

## STUDIES & RESEARCH

A plethora of studies and scientific research came about to further explain and often confuse the industry. Some of the research yielded good information but, some studies were result-based, driven to purposely fulfill a self-serving agenda or sell a product. Designers are strongly cautioned to read all reports with an open and yet skeptical mind.

## HOW & WHY DID THIS HAPPEN?

Some may think "the crisis" has a simple, easy explanation. The answers are often complicated and a combination of events or circumstances that created "the perfect storm". It is often helpful to learn from the past to keep from making the same mistakes. The following is a recap of some of the major events that happened to create the perfect storm. It is meant to assist designers and contractors to better understand what transpired.

## THE FIFTIES & SIXTIES

In the 1950s and '60s the construction trades had apprenticeship schools that reached approximately 85 percent of the total workforce. These apprenticeship schools had a curriculum on flashing that was taught universally.

Flashing procedures were simple and basic, and were accepted without reservation on the vast majority of projects around the country. The lathers and carpenters were a predominant driving force behind the plan. These trades understood basic flashing procedures and passed them along to their apprentices on a continual basis for decades. As they matured, many carpenters and lathers became superintendents for the general contractor, because of their all around knowledge of construction and flashing.

The flashing procedure they learned was the same as the younger guys in the field were installing. Simple and basic flashing procedures used on a universal scale with little to no arguments, kept buildings reasonably dry.



PASADENA PROJECT—At Mutual Savings & Loan building in Crown City: Pete Berger of Berger Bros., plastering contractors; J. J. Devlin, superintendent for Del E. Webb Company; Paul Berger; George L. Throop Jr. of material supply firm; Terry Golnick of United States Gypsum.

# CHAPTER 1 – HISTORY OF LATH & PLASTER

Architects were schooled in drafting skills with vellum paper and pencils. This method of creating elevations and details gave the young architect a sense and appreciation of where each layer of material was placed and why. Buildings were a simpler design with typically only generic and basic materials to work with. If an architect made a mistake, the trained field personnel typically caught the mistake and simply fixed it on site.

Energy was cheap and buildings were anything but airtight; whether intentional or not, this allowed buildings to breathe. This vapor permeability allowed buildings to dry out as air or vapor passed through the wall cavities. The aluminum nail fin window came onto the market. The rigid attachment fin would be straight, true and tight against the framing. The shingle style flashing paper called “Sisal Kraft” was the perfect answer for the residential market. Many of the first windows also had a slip or drop type flange lip that additionally helped keep water out.

Most buildings had the minimum sheet-metal, kick-out flashing etc., Z bar and weep screeds that were installed by sheet metal contractors. These subcontractors, along with the lathers kept flashings in place to help keep moisture problems to a minimum. Plastering contractors had to learn, at most, two or three exterior cladding systems and these systems were almost the same, at least with regard to moisture management. Building designs for the most part were pretty basic in shape and thus relatively easy to flash. Commercial buildings had storefront windows where the installers would routinely install a window system with a metal sill pan. Life was good and not too complicated.

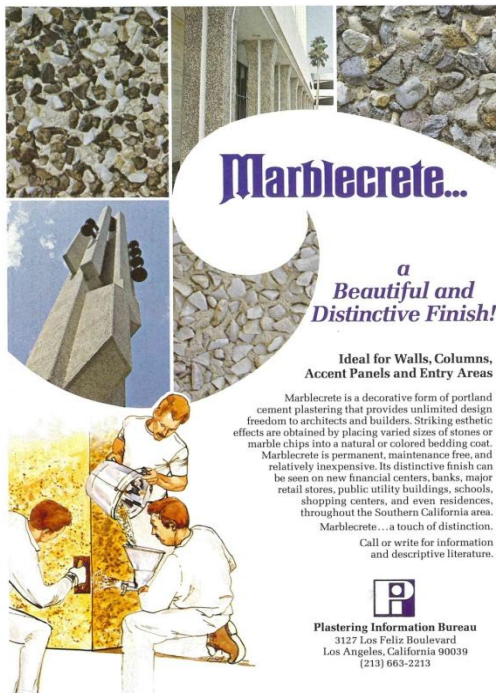
## THE SEVENTIES & EIGHTIES

Starting around the late '70s and well into the '80s, the industry had a perfect storm brewing. The trade unions began to lose market share at an alarming rate. As a result, apprenticeship training began to slide until only a handful of trained people hit the market and they found themselves outnumbered when flashing procedures were discussed. That meant a lot of trades people lost the clear, simple and universal direction on flashing a window. New, untrained craftsmen thought the flashing procedure was unnecessary. Architects started to draw with AutoCAD systems and many classes on basic

building practices had to shift to this new technology of point plotting and learning the software programs. Something had to give way and it did—the construction details.

Energy costs started to become a concern and new laws required tighter buildings and vapor barriers inside the walls to conserve energy consumption. The end result was a building that did not breathe and combined with poor flashing practices, was a recipe for disaster. More problems compounded the situation. Some general contractors began to draft construction managers from colleges with no construction experience to run projects. What they lacked in flashing knowledge, they made up for in pushing schedules and subcontractors to a faster pace to save money. The general contractor also found other ways to save money; they shifted sheet-metal work to other trades and treated sealant work as a non-essential subcontract. Meanwhile, plastering contractors had to learn more and more new cladding systems, the number kept growing and moisture management principles varied. Building designs became more complicated with complex details. Storefront installers lost apprentice training and the use of sill pans became a distant memory.

The vinyl window was born and the straight metal nail fin became a wavy and easily breakable plastic fin. The perfect storm came together and led to a mass of leaky buildings. Finger pointing was abundant and no one party was totally to blame.



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# CHAPTER 1 – HISTORY OF LATH & PLASTER

## THE NINETIES TO TODAY

The birth of construction defect attorneys and forensic experts started to grow exponentially in the 1990s because of “the perfect storm”. The experts opened up buildings, documented the decay and presented their cases to the insurance companies covering general and subcontractors. Since the insurance companies were making money hand-over-fist with investments, they paid out with little fight. The investments then turned sour, the flashing practices of the trades improved and the damage presented was now not so convincing. The insurance companies decided to start fighting back. The forensic experts found the new road not as easy as the decade before. Most forensic experts starting losing cases or not getting the big awards they promised the clients. Fortunately (for them), the experts have now shifted to the front of the project as the building envelope consultant.



There is certainly an abundance of scientific data to review about vapor and moisture control for exterior wall assemblies, and while the many do not discount the scientific data, it is possible to focus solely on the science and ignore common sense in an effort to sell products or services to solve a very basic problem. In reality, most building problems with regard to moisture intrusion can be pinpointed to a failure to follow some basic time-proven design or installation practices with regard to good flashing, recommended industry practices and standards.

## WHY DID EIFS GET THE BLAME?

EIFS suffered the brunt of the “leaky building” fallout, partly due to the fact that EIFS emerged on the market in strong force about the same time the leaks started to appear. It made them an easy target and EIFS was “banned” in certain regions of the country. Flashing procedures improved, the leaks stopped. The easy answer: It must be EIFS fault. Some EIFS dealers sold EIFS to unqualified contractors and this exacerbated the situation and the EIFS industry has paid for that mistake.

## THE FUTURE

While some have thought lath and plastering would die out, it continues to be reinvented while holding onto its roots. For the lather, tying of wire has given way to the modern screw gun, and modern plaster pumps would seem to make the hawk and trowel obsolete. However, the traditional tools and materials of the lath and plaster trade seem to be able to make room for modern innovations while keeping their place as relevant today as they were over a century ago. Designers are encouraged to explore new innovations and are charged with not allowing the past to die out with regard to lath and plaster.

A successful lath and plaster installation relies primarily on the skill of the applicator and his or her knowledge of materials. Designers are strongly recommended to use only properly trained plastering contractors with a record of success and demonstrated knowledge of the craft. Verify the experience and use the local plaster bureau as one would use the Better Business Bureau. Refer to your local plaster bureau for assistance and guidance with material selections, specification writing, contractor qualifications and solving job site issues.

<sup>1</sup>. 2012 International Energy Conservation Code