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The Changing Theories in Masonry: The Complete Drainage System

by Jennie Farnsworth



Photos courtesy of U.S. Wire

Through the years, the ways things are done in masonry may not change, but new theories may arise. Just as mason contractors are no longer content with thinking of the brick veneer as an entity unto itself — rather the veneer and CMU backup wall as the complete, functional masonry system — another change in theory has entered the industry as well.

While previous generations were content with throwing maybe a weep hole here, some netting there, with a dash of flashing on the side, there's a growing trend to think of the complete drainage system as a whole entity, rather than the individual parts. With this theory, a complete drainage system includes the backup wall, air/vapor barrier, insulation, air space, a mortar collection device, flashing, weep vents and the veneer, but without one of these parts, the system will not function properly.

"I think the use of a system is an extremely good idea, but it needs to be more than a system for drainage, though," says Patrick Lee, Director of Sales for Mortar Net in Gary, Ind. "People need to look at these systems in terms of the impact they can have within a cavity wall structure. For instance, the whole idea of airflow, air management within the cavity, in addition to drainage."

Chris Bupp, Northeastern Sales Manager of Mortar Net, expands on this concept.

"We talk about drainage, and that's one issue, but if you get moisture into that cavity, yes, you may drain liquid moisture out, but what's left are damp components that are in that cavity," says Bupp. "The idea is growing that the more airflow that you can get into that cavity to dry out those components, the better off you're going to be."

It's All About Airflow

Who would have thought years ago that when we talked about drainage, we needed to, first and foremost, discuss the airflow in the cavity wall? Experts suggest that, without proper airflow, you may be able to drain the wall, but you won't dry out all of the

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Meeting Dates

Sep 24 *Hazardous Building Materials* - Erik R. Plimpton, PE, CHMM, TRC, Environmental Corp.

Oct 22 *Solar Heating* - Elizabeth Saede, L.S. Remodeling, LLC & Michelle Herbert, 1st Light Energy.

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President's Corner

Bernie Caliendo

As this is my 60th President's column, it will be my last. I find it ironic that this summer, while cleaning out records and files from the past, I came across my original application for membership to CAHI. It was dated August 10, 1993. How I can remember the monthly meetings held at Danny's which became Donato's having 6 to 8 members attend. Surprisingly, there were some interesting topics with some informative guest speakers even though we only needed 2 or 3 tables. No PowerPoint presentations, no sound system and, if we were lucky, maybe there was an overhead projector presentation. The newsletters were a few pages and, due to the efforts of founding member Dave Hetzel and staff at the Home Inspection Institute of America, was mailed out monthly. Some of the founding members helped to arrange meetings and presentations. With that voluntary effort, they set the ground work of what this organization was destined to become. That voluntary effort continues today on behalf of a Board of Directors of up to 9 members.

With the advent of licensing, the need for a continuing education provider expanded immensely and CAHI stood out as the organization to provide the best. In 2001 our goal was to grow and expand benefits to members of the organization. Over the course of the years, the newsletter was expanded in size and quality and our web site went through some growing pains and multiple webmasters. We now believe we have the best to provide exposure in the marketplace. This year we reached an all time high of 198 members and our benefits have grown to include bus trips and free all day seminars.

I have served 11 years on the Board of Directors with 5 of the past 7 years as President. It is now time, as my 3rd consecutive 1-year term as President expires, that I pass on that responsibility. It is my hope for the future that it remains a voluntary board with members coming forward to help serve and contribute their talents and time to keep CAHI moving into the future as the best it can be.

My sincere thanks go out to the many members who have offered their support and encouragement, the many Board members over the years who have supported my efforts for the betterment of the association and last, but not least, my deepest thanks go to founding members Dave Hetzel and Pete Petrino for their tireless dedication over the years!!!

See you at the meetings,

Bernie

September Keynote Speaker

This month's meeting topic is **Hazardous Building Materials**.

Our meeting will feature Eric R. Plimpton from TRC Environmental Corp. presenting "Hazardous Building Materials Issues" encountered by Home Inspectors including Asbestos, Lead Paint, Mold, Radon, IAQ, Soil Vapor Intrusion, Mercury and Others.

2 hours of Continuing Education Credits

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moisture trapped in the wall system — and that means big troubles down the line.

"[Mortar Net] completed moisture drainage testing a number of years ago, with the focus being the use of air and vapor barriers with cavity wall construction," says Bupp. "From these tests, we decided airflow is an equally important consideration when you're designing a drainage system.

"We went back and reformulated our Weep Vents, reconfigured the mesh a little bit, made a few changes and ended up increasing the airflow by about 36%," he says.

"We could have left them alone because they did fine as far as drainage," adds Lee, "but we're trying to get beyond that concept of just looking at drainage — you look at drainage, you look at air flow, you look at all of the issues."

In addition to increasing airflow through the weep material, experts are now suggesting that weeps at the top of the wall will help attain good airflow and drainage.

"It's almost like trying to pour gas out of a gas can," Bupp suggests. "You know how they have that second valve letting air in so that you can pour gas out of the can. Once you open that second valve, the gas flows out of the can much easier. It was kind of like that concept in a way.

"Actually, vents at the top of the wall have been in use for a couple of years now," he adds. "Basically, the idea is that by having vents at the top and weep materials at the bottom, we get a circulation of air going through the cavity."

Roger Lingofelt, Owner of U.S. Wire in St. Paul, Minn., and maker of Cell Vents, agrees with this concept.

"It makes sense to get the air circulating," says Lingofelt. "I've got a job that we did here on a courthouse where the architect put vents everywhere, and I'm sure that was his thinking."

But won't that just introduce more moisture into the wall?

"I have had that argument, and what I say to people is that it's pretty much a fact that moisture is going to get into that cavity," Bupp explains. "The general consensus seems to be that the benefits of having that additional airflow through the cavity to dry out the components outweighs the potential of getting more moisture in there through those vents."

Putting the Pieces Together

Once you have established the airflow, the rest of the pieces making up the complete drainage system can fall together:

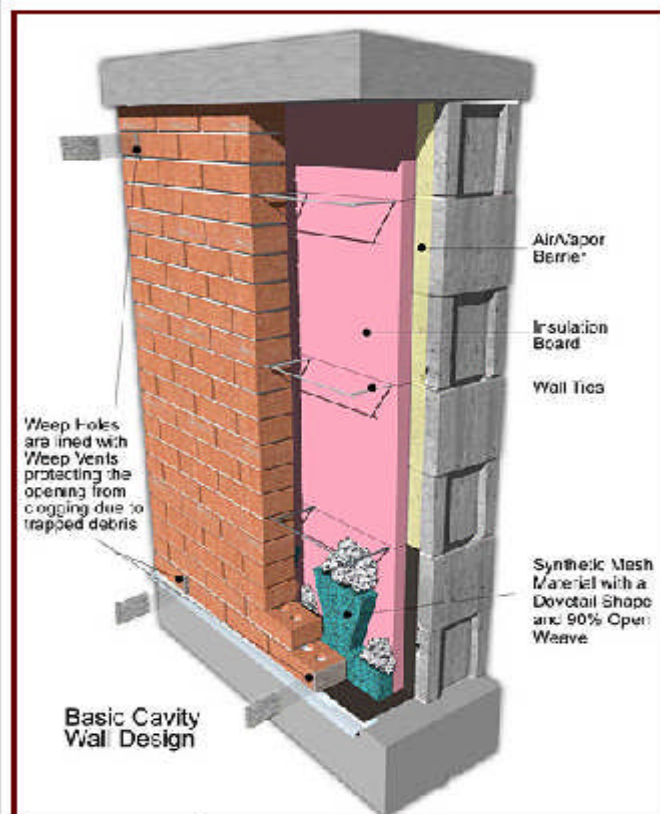


Illustration courtesy of Mortar Net

"What was kind of interesting was, when we first got into this thing, there had been very little testing done in the United States regarding weep vents and air flow," he continues. "Actually, the people to our north in Canada have done a little more testing on that type of thing. I ran across a testing application up in Canada where they tested weep vent products for airflow and found that a lot of the commonly used weep vent materials blocked considerable airflow into the cavity. So that was one of the things that led us to this whole airflow issue."

After running a similar test on Mortar Net's Weep Vent product, Bupp says they weren't very satisfied with the results.

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Photo courtesy of U.S. Wire

- The air barrier stops the airflow from entering the building;
- One to two inches of air space keeps the air moving, drying out the cavity;
- Proper flashing sends water moving in the right direction; and
- A mortar collection device allows the weeps to stay clear at the bottom of the wall.

Unfortunately, without one of these elements installed or working as it should, Bupp says that the complete drainage system will not function properly.

"The whole concept of a drainage system is that the water gets out the base of the wall or to the top of an opening of a window or door," Bupp explains. "Without these other elements installed properly or detailed correctly, this most likely will not occur."

Lingofelt agrees, and says, "Water will get in that wall, either from the roof and the flashing, around a window, or maybe when the bricklayers struck the mortar, he or she didn't get it tight. That wall has to breathe somehow to get that moisture out."

However, mason contractors and other builders have historically thought of each item in the cavity wall as an entity unto itself, without making the connection to the system as a whole.

"I think it has become pretty standard to have some sort of masonry dropping deflection device or a drainage piece in the cavity, whether it's pea gravel — which is not widely used — Mortar Net, or any one of the straight strip products," says Lee.

He further explains that, beyond the mortar collection device, builders typically pick and choose items — from weeps and house wraps, to even flashing — to install in the wall, leaving others behind.

"You can almost come up with every sort of combination, yet very few examples of all of these parts in combination," Lee says.



Photo courtesy of U.S. Wire

Getting Involved

While mason contractors are getting an understanding that drainage needs to be thought of as a whole, specifications are partially to blame for the lack of follow-through.



Photo courtesy of Mortar Net

Speaking on the lack of all drainage items being included, Lee says, "I think it's partially due to the fact that spec devices, such as MASTERSPEC, don't actually put standards in very much. Product equality is sort of assumed, even though I don't think anyone would argue that pea gravel is not the same as any of the other products that are out there, yet they're put in the specs as if they were the same," he says. "When you do a MASTERSPEC and there is no standard attached, I think you do a disservice to the mason contractor, who is obviously going to have cost issues on their end, whether it's through the general contractor or through them directly.

"I also think that, when you put in something as a system, in theory you have a whole idea of what that wall is going to accomplish," he continues. "But when you put in specs by line item, you've caused a problem because obviously when value engineering kicks in at any level, the system is not looked at as you intended when you specified it — it's looked at as a line item. So you may destroy your system, without intending for that to happen, simply because you didn't spec it as a system."

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That's where mason contractors need to get involved. First, Lee says that a mason contractor's influence on the general contractor can often make a difference.

"The second thing is, change orders are a huge way in which a mason contractor can affect a job, simply by convincing a general contractor or whoever is in-charge at that particular job site that a change order is not only wise, but will benefit them in the long-run," Lee advises. "One of these elements can be value engineered out at one stage, but then approved at another stage through a change order based on information that the mason contractor brings to the general contractor."

Obviously, the final issue you have control over is making sure everything is installed properly.

"Make sure your masons do the job right when you're building the wall," warns Lingofelt. "Don't create a problem that you'll have to try to solve later."

After all, if the wall's not draining properly, who are they going to call?

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Facts About Ventilation and Moisture Control

Information from North America Insulation Manufacturers Association (NAIMA)

In this issue, we examine attic ventilation, crawl space ventilation, and vapor retarders.

Moisture accumulation within a building structure can cause problems such as water stains, ice damage, peeling paint, wood deterioration, mold and mildew. Water forms when water vapor migrates through the structure and condenses on a cool surface.

There are three basic ways to minimize potential water vapor condensation problems in attics, floors and walls:

- Provide sufficient ventilation to reduce excessive water vapor build-up within the home;
- Ventilate building sections so that excessive water vapor is dissipated to the outdoor air;
- Use vapor retarders to limit water vapor transmission into building cavities.

Ventilation and circulation with outdoor air are the major moisture control strategies for attics and crawl spaces. In most parts of the country, passive ventilation is important for attics and crawl spaces, and mechanical ventilation is desirable for kitchens, laundries and baths. All of these strategies are designed to remove water vapor from the structure so that condensation will not occur.

Vapor retarders limit the migration of water vapors from warmer areas to the cold surfaces in walls, roof/ceilings and sometimes areas below floors. Vapor retarders reduce the amount of water vapor available for condensation.

Attic Ventilation

NAIMA recommends the following widely used ventilation strategies:

- Provide ventilation for each separate space to the outside with ventilating openings protected against the entry of rain and snow.
- The total net free ventilating area shall be no less than 1/150 of the attic floor area if no vapor retarders are used, or 1/300 of the attic floor area when a vapor retarder having a permeance of one perm or less is used.

Steps to Determine Attic Ventilation Needs

- Measure area to be vented.
- Divide this number by either 150 (no vapor retarder) or by 300 (vapor retarder in place).
- Multiply by the appropriate factor from Table 1 to learn the total gross vent area needed.

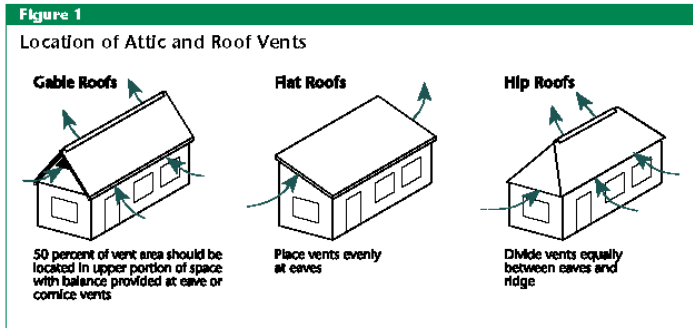
Table 1	
Obstruction Chart	
TYPE OF COVERING	AREA OF OPENING
1/4" hardware cloth	1 times required net free area
1/4" hardware cloth and rain louvers	2 times required net free area
1/8" mesh screen	1.25 times required net free area
1/8" mesh screen and rain louvers	2.25 times required net free area
1/16" mesh screen	2 times required net free area
1/16" mesh screen and rain louvers	3 times required net free area

Caution should always be exercised to assure that ventilators are not obstructed. Blocking or baffles should be used at the eaves to keep insulation material away from soffit vents and provide a 1" free airspace.

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- Determine where vents will be located. (See examples in Figure 1.)



Cathedral, flat and hip roof/ceilings with vapor retarders need a vent area of 1 sq. ft./300 sq. ft. of ceiling. Total ventilation may be achieved by placing half of the required vent area at each eave. Without a vapor retarder, the vent area should be doubled.

The most effective ventilation is provided by a combination placement of the vents with 50 percent of the area at the roof peak and 50 percent at the soffits or eaves.

Net Free Vent Area

The stated vent areas for attics, roof/ceilings, and crawl spaces refer to net free areas through which air can pass unobstructed. When screening, louvers, or rain/snow shields cover vents, the area of vent openings should be increased to offset the area of the obstruction. Use manufacturers' stated net free areas whenever available. If no information is available, use the conversion factors for determining gross area of vent openings listed in Table 1. Caution should always be exercised to assure that ventilators are not obstructed. Blocking or baffles should be used at the eaves to keep insulation material away from soffit vents. Recommendations for air space between the roof sheathing and the insulation may vary. As a general rule of thumb 1" is often used.

Crawl Space Ventilation Recommendations

The Building Foundation Design Handbook (Labs et al. 1988) notes that ground cover membranes such as 6-mil (0.006 in.) polyethylene that restrict evaporation of soil moisture are the single most important way to prevent

condensation and wood decay problems in crawl spaces. The ground cover material should have a perm rating of no more than 1.0 and must be rugged enough to withstand foot and knee traffic.

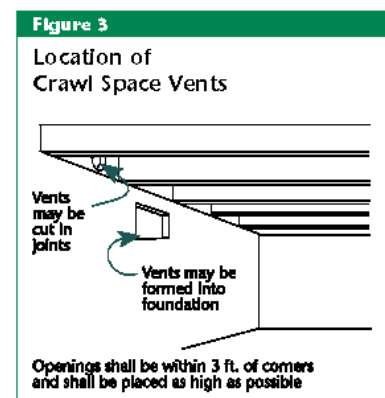
All debris must be removed and the soil should be leveled before laying the membrane. Overlap edges 4 to 6 in., and continue the membrane up the face of the wall to the grade level if the interior grade is below the outside grade.

Traditional building practices and building codes have included provisions for crawl space ventilation. In recent years, some researchers are finding that crawl space vents may not be necessary, especially in southern climates where vents can introduce hot, humid air into the crawl space. As more information becomes available, building codes may change their ventilation requirements. The following vent area recommendations reflect the current prevalent building code requirements.

A rectangular crawl space requires a minimum of two vents, located no farther than 3 ft. from corners. The vents should be as high on the wall as possible to best capture breezes, and landscaping should be planned to prevent obstruction of the vents. The total free (open) area of all vents should be at least 1/1500 of the floor area. In the absence of a ground cover, the vent area should be increased to 1/150 of the floor area. Ventilation alone should not be relied upon where soils are known to be moist.

Steps to Determine Crawl Space Ventilation Needs

- Measure square footage to be ventilated.
- If ground cover vapor retarder is not used, divide the square footage by 150 to determine needed vent space. Then consult the obstructions chart



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and multiply venting by the number given for the type of material used. If ground cover vapor retarder is used, vented area may be reduced to 1/1500 of the floor area.

- Determine location of needed vents. (See Figure 3.)

Vapor Retarders

A vapor retarder (barrier) is defined by ASTM C 755 as a material that has a water vapor permeance (perm) rating of one (1) or less. The terms vapor retarder and vapor barrier are used interchangeably and describe the same materials. For consistency, the term retarder will be used here.

What Does A Vapor Retarder Do?

Occupants of buildings, appliances, and plumbing equipment generate moisture that is carried in the air as a vapor. As moisture vapor moves from a warmer interior through construction materials to a cooler surface, the moisture may condense as water, which

may damage the building. It is for this reason that vapor retarders, which retard the flow of moisture through construction materials, are installed in buildings. By locating vapor retarders as close as possible to the warm-in-winter (heated interior) surface of the building, the moisture vapor flow is restricted before it has a chance to condense to water. (See Figure 4.)

Vapor Retarder-Faced Insulations

The vapor retarder facing should be installed toward the warm-in-winter side of the construction except where noted. This means that in ceilings the vapor retarder faces down, in walls it faces the inside, and in floors over unheated spaces it faces up. With the exception of reverse-flange insulation, the stapling flanges are on the same side as the vapor retarder. In warm, humid climates local practice should be followed regarding the use of and/or placement of vapor retarders.

Note: The ASHRAE Handbook of Fundamentals, Chapter 23, Thermal and Moisture Control in Insulated Assembly Application, contains information on the placement and use of vapor retarders in various climates including humid climates such as Florida, the Gulf Coast, or Hawaii.

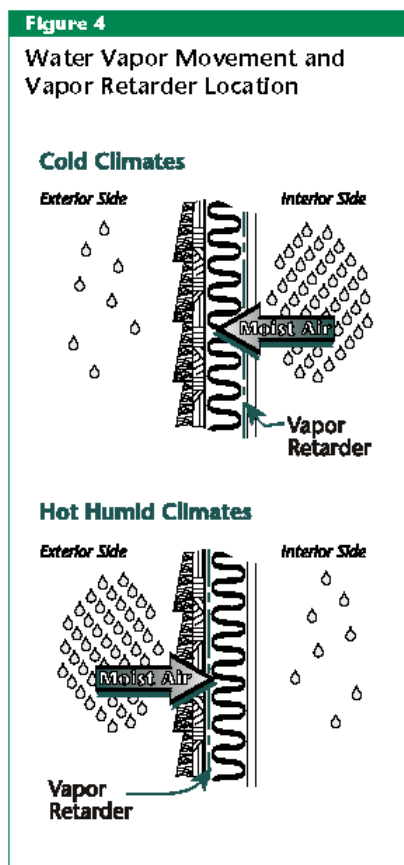
When Is A Vapor Retarder Required?

Good construction practice calls for installing vapor retarders in walls of all new buildings. Local building codes should be followed with regard to the need for vapor retarders in ceilings. When it is convenient to do so, vapor retarders should be installed in existing buildings. In some cases local building codes may conflict with common building practices regarding the use of vapor retarders. Always confer with local building departments before beginning construction.

Cautions!

Always follow these rules when working with vapor retarder-faced insulation:

- Many facings are flammable. Because of this, when vapor retarders face building spaces intended for human use, they must be covered. These spaces include garages, storage rooms, utility rooms and laundries. NAIMA recommends



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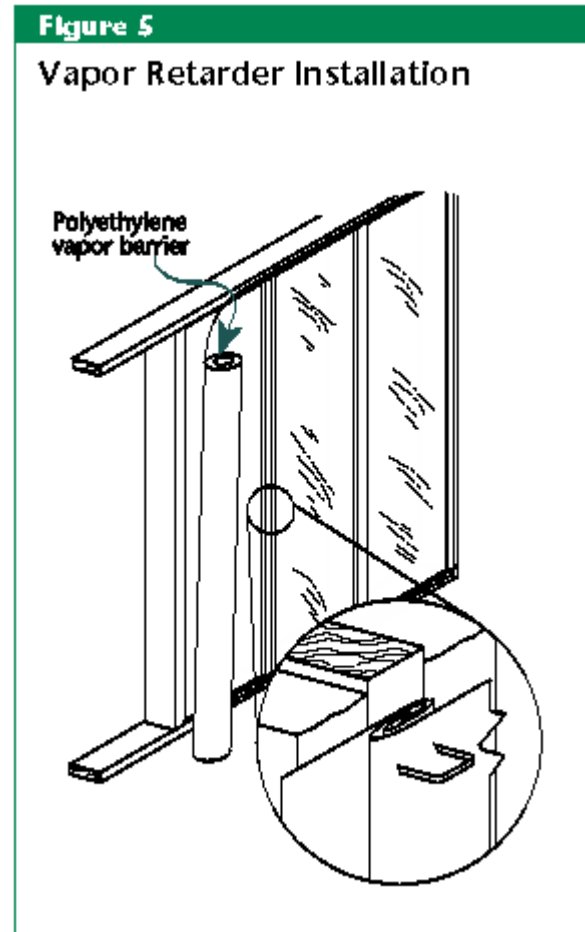
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that this statement be printed on all combustible facings:

"This vapor retarder is flammable and should not be left exposed. Special care should be taken when working close to the facing with an open flame."

(For exposed applications, insulations with special, strong, reinforced flame resistant facings are available.)

- Batt and blanket insulations may be installed one on top of the other in ceilings where there is adequate space. Only the bottom layer should have a vapor retarder, which should face down toward the space that is warm-in-winter. Additional layers should be unfaced. If unfaced insulation is not available, use the faced type but remove the facing completely before installation.
- Repair damaged vapor retarders. Rips or tears in the vapor retarder facing may be repaired by covering the damaged area with scrap vapor retarder material and taping it in place or, in the case of small rips, by using duct tape or polyvinyl tape. Gaps around windows, doors and other openings should be covered with vapor retarder facing or taped.
- Avoid electrical wiring when stapling vapor retarders or facings. Care should be taken not to staple into electrical wiring when installing faced batts and blankets or separate vapor retarders.



Other Vapor Retarder Materials

The use of separate vapor retarders with unfaced insulation is becoming more common. They should face the warm-in-winter side of the framing. Four-mil, or thicker, polyethylene sheeting, available in rolls, is rolled out horizontally and stapled to the face of the framing, at top, bottom and the side. If one sheet of poly is not wide enough to cover the area and a second sheet of polyethylene is required, they should be overlapped on the stud space where they meet and stapled to adjoining studs.

Foil-backed gypsum board is also an effective vapor retarder. Other options for providing a vapor retarder include gypsum board manufactured with a vapor retarder or vapor retarder type paint, which may be used in renovations.

References

For more information consult the following:

1. ASHRAE Handbook of Fundamentals, Chapters 20 and 23, American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. Atlanta, GA.
2. C755-Selection of Vapor Retarders for Thermal Insulation, ASTM, Philadelphia, PA.
3. Covering Vapor Barriers, NAIMA, 1988, Alexandria, VA.

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4. Mineral Fiber Batts and Blankets, NAIMA, 1989, Alexandria, VA.
5. Loose Fill Mineral Fiber, NAIMA, 1989, Alexandria, VA.
6. Moisture Control Handbook, ORNL/SUB/89-SD350/1, Oct. '91, Oak Ridge National Laboratory, Oak ridge, TN.
7. National Center for Appropriate Technology, Moisture and Home Energy Conservation, 1983, Butte, MT.
8. Building Foundation Design Handbook, Oak Ridge National Laboratory, 1988.

Additional, more current, references suggested include the following:

9. Builders' Manual, Canadian Home Builders Association, Ottawa, Ontario, 1994.
10. EEBA Field Guides for Different Climates, Energy Efficient Building Association, Minneapolis, MN, 1997.
11. CABO One & Two Family Dwelling Code, 1995 Edition. The Council of Building Officials, Falls Church, VA 1995.
12. "Moisture Control Handbook," J. Lstiburek, J. Carmody 1991.

About NAIMA

NAIMA is a trade association of North American manufacturers of fiber glass, rock wool, and slag wool insulation products. NAIMA's role is to promote energy efficiency and environmental preservation through the use of fiber glass, rock wool, and slag wool insulation products and to encourage safe production and use of these insulation products.

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