Single Wythe Masonry Walls and Air Barriers

By Greg Pope ,Righter Group
Wagdy Anis, Shepley Bulfinch Richardson and Abbott
and Philip Daly, Carter & Burgess, Inc

Okay, so you are totally confused about air barriers whether you are an architect, engineer, mason or building owner, and all you want to know is : "Can I construct my building using single wythe masonry and meet code requirements for air infiltration and vapor barrier requirements? The answer is YES. This article aims to demonstrate "how to" in simple terms for the laymen among us all.

Massachusetts was one of the first States in the country to adopt an energy code that includes a requirement for an air barrier. Many other States are planning on adopting similar requirements. Massachusetts requires that the air barrier be continuous, capable of withstanding the positive and negative pressures on the envelope, be durable or maintainable and be joined to the air barrier of adjacent systems in an air tight and flexible manner. The air barrier must also have an air permeability of less than 0.004 cfm/ft2 under a pressure differential of 0.3 inches of water.

AIR BARRIER COATING

Tnemec 156 AB Envirocrete has been tested in accordance with ASTM E 2178-01 and meets the air permeability requirements when applied in two coats of 8 to 10 mils each for a total minimum thickness of 17 mils DFT. This is an elastomeric product and is capable of bridging minor cracks that might be expected in typical single wythe masonry construction. When applied as an air barrier to exposed masonry it is both durable and maintainable.

VAPOR BARRIER

It is important to understand that Tnemec 156 AB is not a vapor barrier. When applied at the above thickness it has a *water vapor* permeance of 3.9 perms, which means it has some water vapor retarding features, but is quite a bit more permeable than allowed for vapor barriers. Installing a vapor barrier will typically require the application of an additional membrane or a furred out sheetrock assembly. However, using Tnemec 156 AB as the air barrier, it is possible to construct single wythe masonry walls leaving an exposed masonry interior without the addition of a vapor barrier and still meet the requirements of the Massachusetts energy code.

In Massachusetts, there is an exception to the vapor barrier requirement of a 0.1 perm vapor barrier, known as Exception #3. Vapor barriers may be omitted in systems where it can be demonstrated that the moisture content of the materials will remain below the equilibrium moisture content that would be achieved at 80% relative humidity. The

calculations necessary to demonstrate these results are complicated and are best demonstrated by using a computer program such as WUFI, a Department of Energy-sanctioned program used in calculating moisture accumulation in building materials and building assemblies. This computer program determines the flow of water vapor through building materials and measures drying or wetting rates of those materials using weather conditions over a 365day period. Using this program the designer can analyze a building assembly and demonstrate that a vapor barrier is not required.

WUFI Pro 3.3

Two computer models were run using WUFI Pro 3.3 software. The first model is for a 12 inch single wythe uninsulated masonry wall with a 35% relative humidity winter interior environment. The second model is for a 12 inch insulated single wythe masonry wall with a 50% RH which is higher than typically found in most building types. Both models were for a building located in the Boston area.

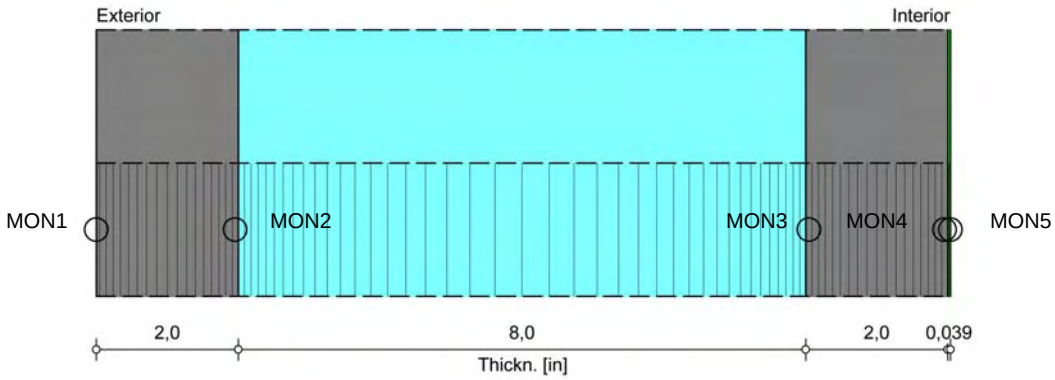
The energy code prescribes minimum insulation requirements for masonry walls but the insulation values required by the tables in the code can be traded off between envelope components when the 'whole building' approach is taken. For example, by modeling the building with Comcheck-EZ envelope compliance software it is possible to omit the insulation in the walls by increasing the R-value of the roof insulation or by decreasing the window area.

Both models assumed four walls of single wythe masonry with few doors or windows, similar to a big box retail building or large institutional structure. All building materials were assumed to start out at a standard 80% initial moisture content. This 80% moisture content is the safe maximum level of moisture content in building products; when they go above or retain 80% RH they begin to degrade, corrode, support mold growth; so above 80% is when "bad things begin to happen". As you view some of the WUFI computer data, above 80% moisture content (of all monitoring points) is considered an unacceptable level.

Monitors were placed in five locations to measure moisture infiltration and drying rates on the single wythe block.. These are: Mon1 - Exterior face, Mon2 - Interior of exterior face, Mon3 - Exterior of the interior face, Mon4- Beneath the coating system (interior) and Mon5 – Interior face of the coating system.

COMPONENT ASSEMBLY

Case: Inside Coating 35% RH

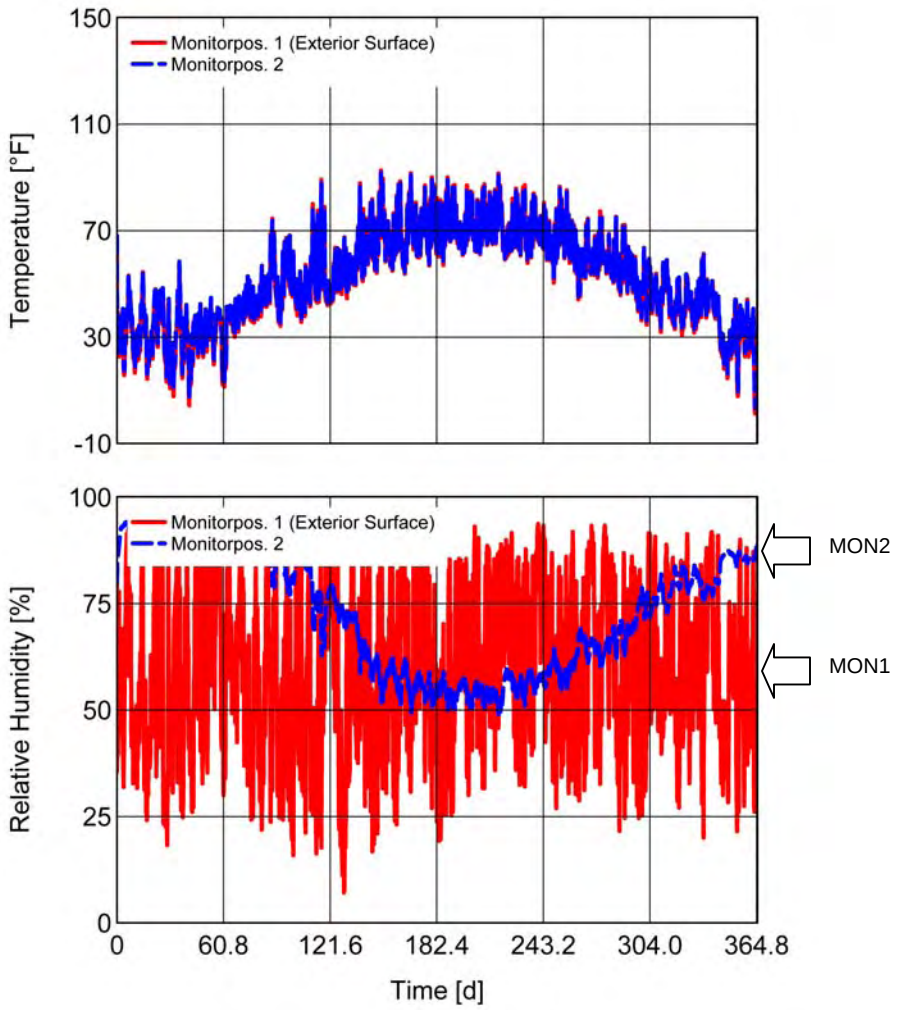


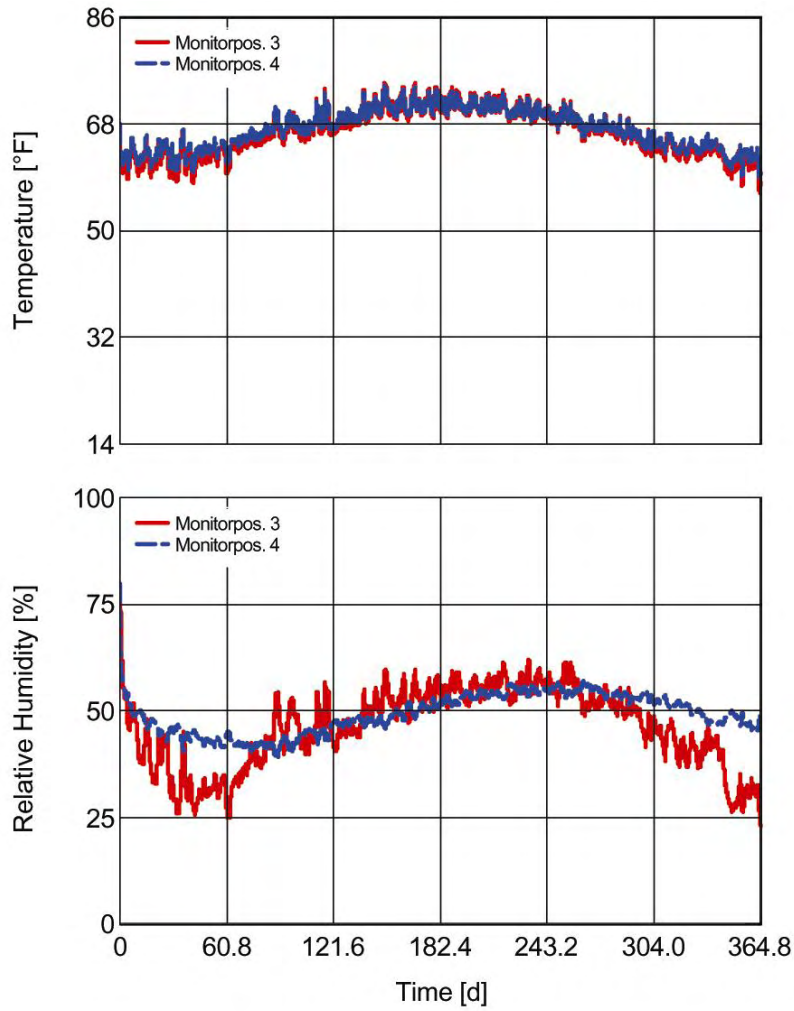
○ - Monitor positions

Materials :

- Concrete Block
- Air Layer
- Concrete, B1
- TNEMEC Envirocrete Series 156

35% RH UNINSULATED 12” CMU





Project: TNEMEC Envirocrete 156 AB / Case 1: Inside Coating 35% RH

Figures 1 and 3 above show temperature of monitor points over one (1) year period, 365 days

Figure 2 and 4 above shows moisture wet/dry of block over one (1) year period, block starts out wet over 80%, but decreases in moisture throughout the year, this effect decreases lower when model is run out over two years. The surfaces of the inner shell dry out very nicely, through the Envirocrete 156 AB.

The 35% RH MODEL for the SINGLE WYTHE WALL

The 35% interior operating RH model used Boston weather with a north facing wall. The single wythe block was a 12 inch hollow core block with no insulation. Two coats of TNEMEC 156 AB ENVIROCRETE Air Barrier coating were roller applied to the interior face of the block in two coats at a film thickness of 8.0 to 10.0 mils per coat. The model includes TNEMEC PRIMAPELL H20 clear, a clear water repellent on the exterior of the wall. Dry-Blok additive or other breathable water repellent coating would have worked also.

The TNEMEC 156 AB ENVIROCRETE **passed** with all significant monitoring points showing moisture content relative humidity lower than 80%. This analysis satisfies "Exception # 3 " for the vapor barrier requirements in Chapter 13 of the Massachusetts code. (see footnote for code data)

RECAP - 35% RH System

Concrete Block 12" ,**Uninsulated**

Air barrier coating System : Two coats of TNEMEC156 AB ENVIROCRETE applied to interior block wall at 8.0 to 10.0 mils DFT per coat

Exterior – Apply one coat TNEMEC PRIMAPELL H2O Exterior Block at 125 to 150 square feet for all exterior wall surfaces or TNEME-CRETE Exterior masonry coating.

The 50% RH MODEL for the SINGLE WYTHE WALL

The 50% interior winter RH model was run with two types of insulation – one with urethane foam and one with Korfil insulation inserts. (Note: Use of foam in place insulation containing urea formaldehyde is not permitted in Massachusetts.) Both of the following WUFI 3.3 cases assume the same exterior weather conditions as the previous model and were run over a one year period.

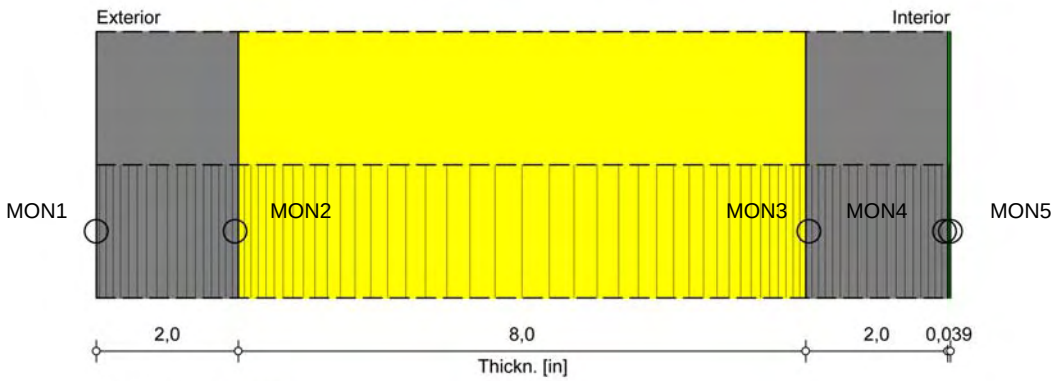
Coating System-Interior- Two coats of TNEMEC156 AB ENVIROCRETE applied to interior block wall at 8.0 to 10.0 mils DFT per coat

Exterior – Apply one coat TNEMEC PRIMAPELL H2O Exterior Block at 125 to 150 square feet for all exterior wall surfaces or TNEME-CRETE Exterior masonry coating.

WUFI3.3

COMPONENT ASSEMBLY

Case: Urethane foam core 50% RH

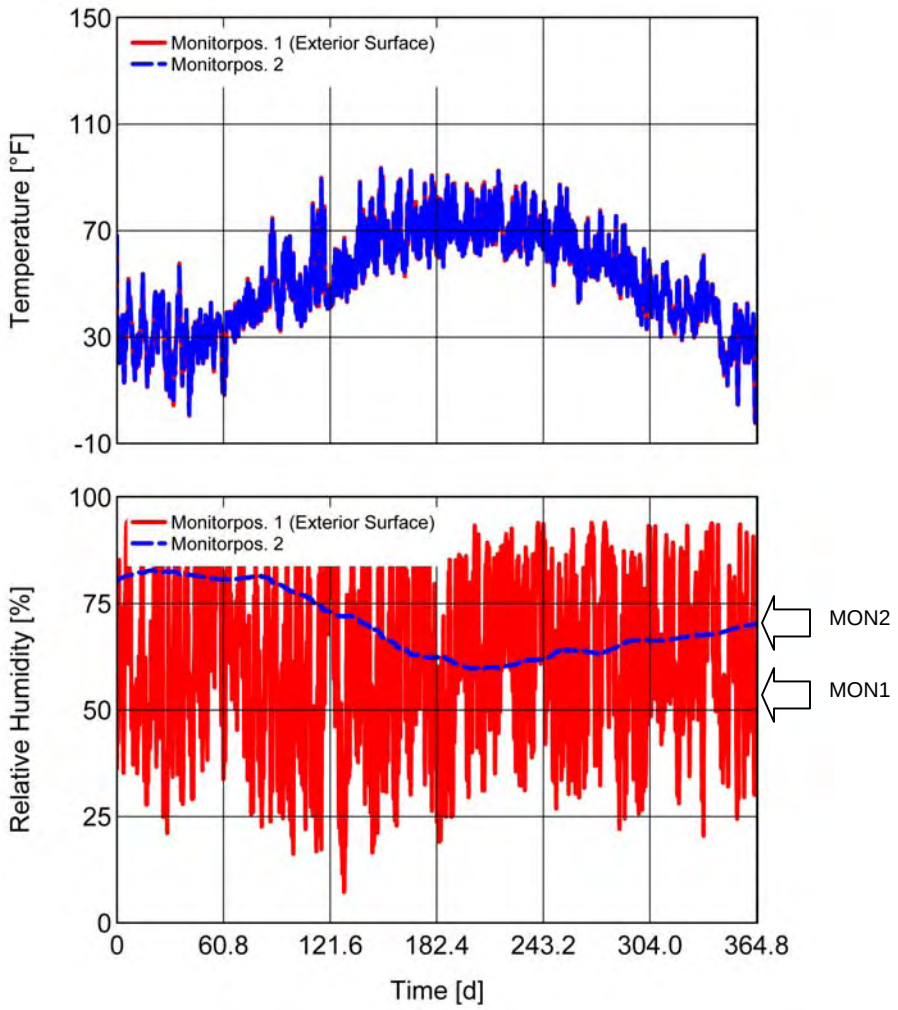


○ - Monitor positions

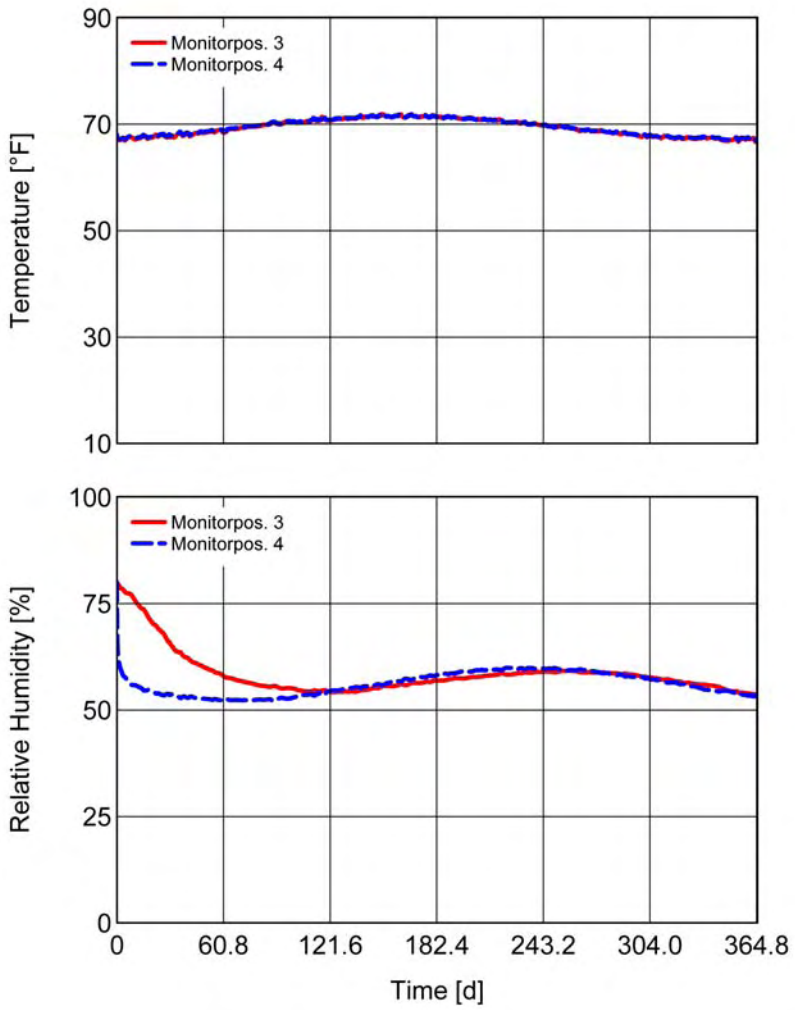
Materials :

- Concrete Block
- PU (heat cond.: 0,03 W/mK)
- Concrete, B1
- TNEMEC Envirocrete Series 156

50% RH FOAM INSULATED 12” CMU



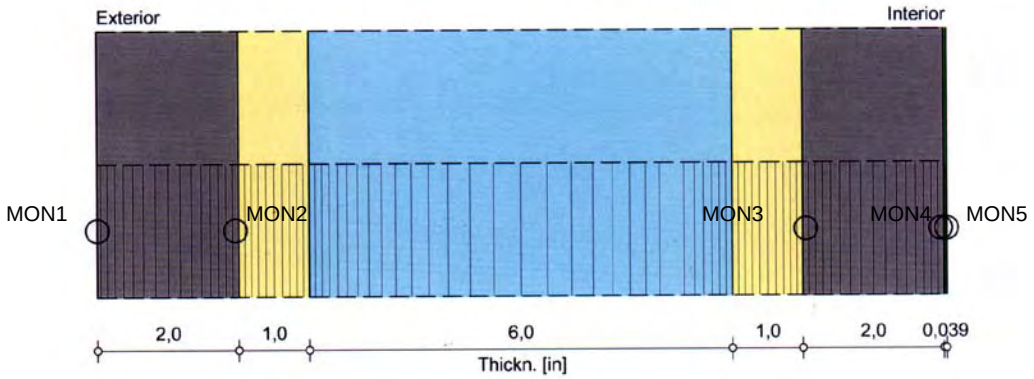
50% RH FOAM INSULATED 12” CMU



WUFI3.3

COMPONENT ASSEMBLY

Case: Korfil Core

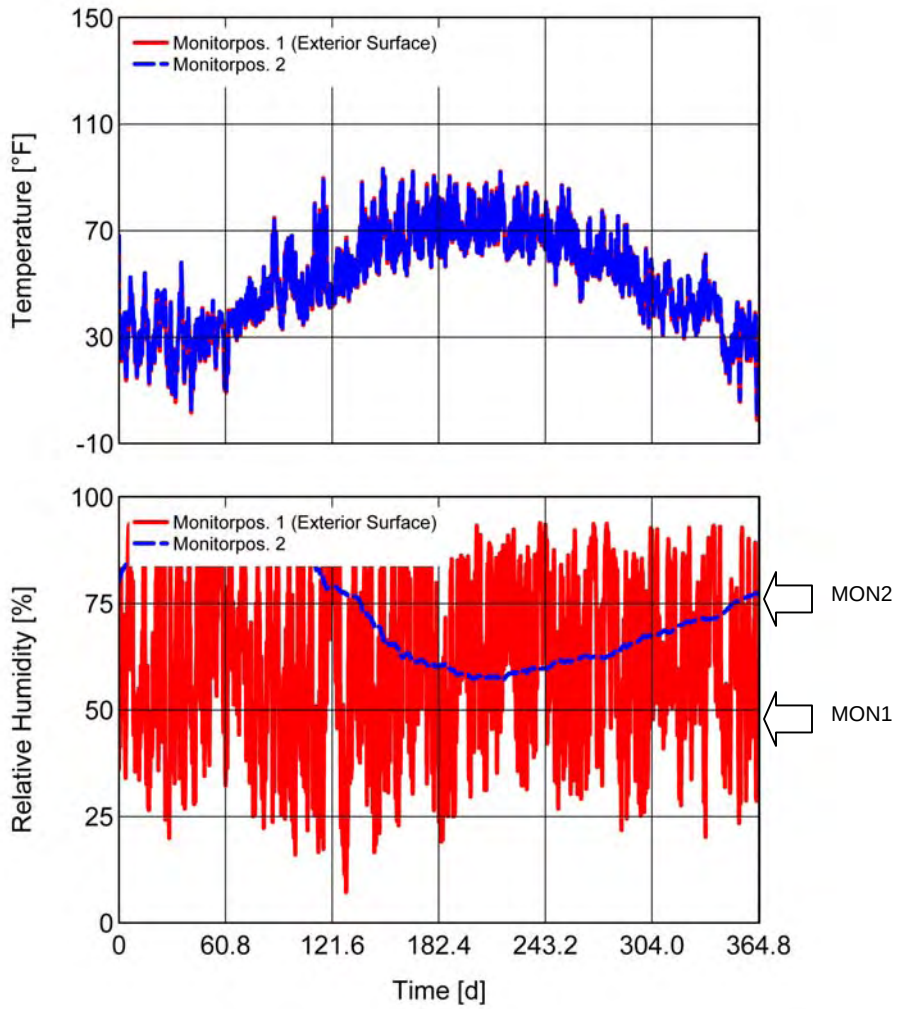


○ - Monitor positions

Materials :

- Concrete Block
- Expanded Polystyrene
- Air Layer
- Expanded Polystyrene
- Concrete, B1
- TNEMEC Envirocrete Series 156

50% RH 12 ” CMU WITH INSULATION INSERTS



Project: TNEMEC Envirocrete 156 AB / Case 9: Korfil Core

Note: Notice in both insulated core filled models the moisture content never rises above 80% RH after initial construction of the block .All other monitoring points stay below the 80%, as the building dries out after construction, moisture content will continue to fall.

The 50% RH model had the same Boston weather, but with foamed in place urethane or Korfil inserted insulation. TNEMEC 156 ENVIROCRETE AB flexible air barrier coating and paint finish was roller applied to the interior face of the block at 8.0 to 10.0 mils DFT per coat, with the same PRIMAPELL H2O clear sealer applied to the exterior (again Dry-Blok works too, instead of the water repellent). The results were the same as the 35% model, no increase of moisture content above the 80% level.

RECAP - 50% RH System

Concrete Block 12" **Insulated -** Urethane foam or Kor-Fil inserts

Air barrier coating System : Two coats of TNEMEC156 AB ENVIROCRETE applied to interior block wall at 8.0 to 10.0 mils DFT per coat

Exterior – Apply one coat TNEMEC PRIMAPELL H2O Exterior Block at 125 to 150 square feet for all exterior wall surfaces or TNEME-CRETE Exterior masonry coating.

CONCLUSIONS

Conclusions of both models– Based upon the WUFI MODELS of 35% and 50 % interior operating RH, the use of an *interior* air barrier addresses the single wythe block wall for a majority of building types. The implementation of the TNEMEC 156 AB roller-applied (low VOC, water-borne) air barrier would solve numerous design and construction issues that have been raised regarding the use of single wythe block as a building material with respect to meeting air barrier and vapor barrier building code requirements.

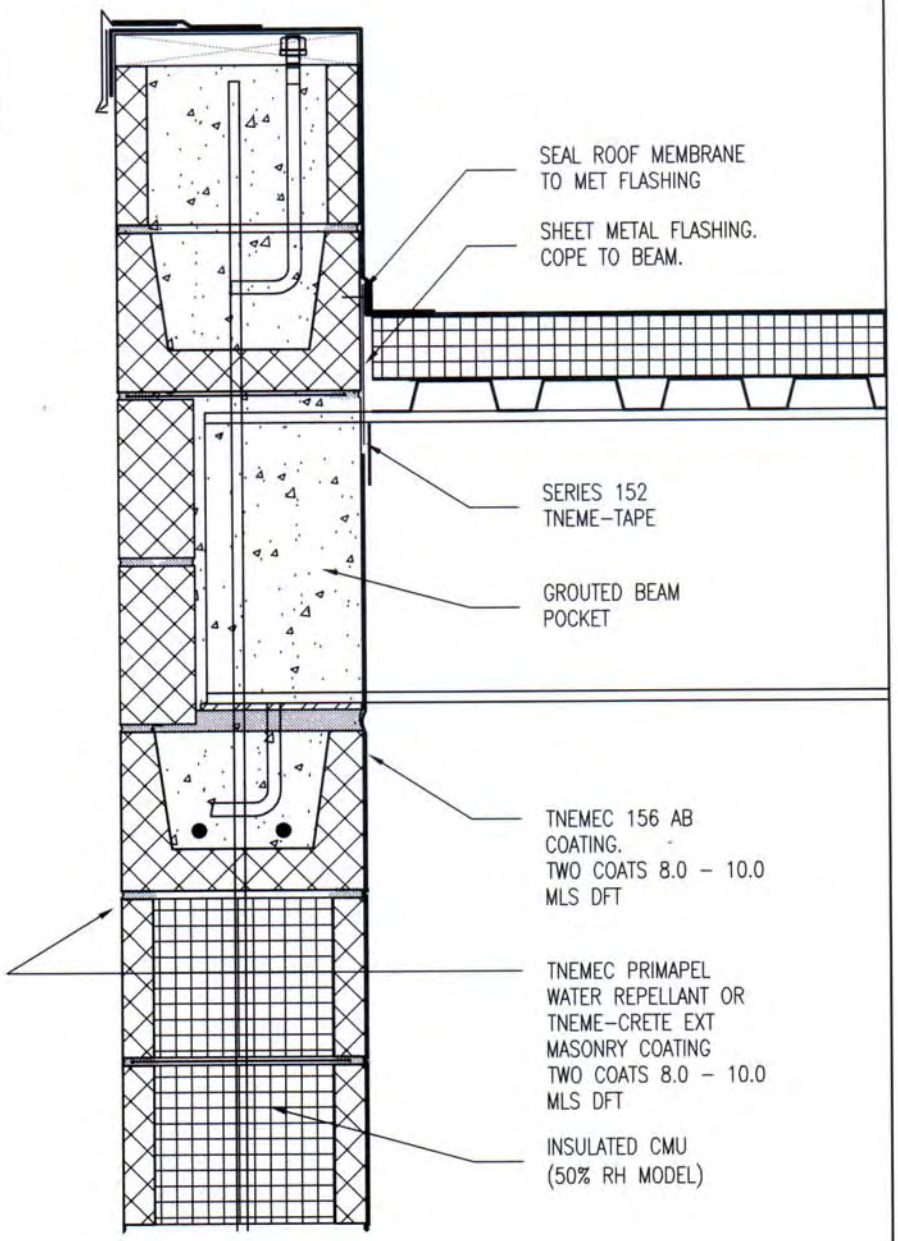
When applying the air barrier to the interior of the wall particular, attention must be paid to the tie-in of the wall air barrier to the roof air barrier. Details for construction should be refined for your building's specific needs. The schematic details below indicate some approaches to working around the structural steel to achieve these tie-ins. These details show several approaches for dealing with the issue of creating a continuous air barrier utilizing metal, sheet membranes and solid grouted bond beams for an efficient and cost affective approach.

Air barriers, including roller-applied should still be applied by an ABAA (Air Barrier Association of America)-certified installer since the coating film needs to be void free and applied at a specific thickness.

So the answer is YES, one can in fact meet building energy code requirements using single wythe construction in combination with a number of design and modeling techniques.

References:
Air Barrier Association of America, http://www.airbarrier.org
WUFI 3.3 Computer Air Barrier modeling

35% OR 50% RH MODELS



DETAIL AT ROOF

REFERENCE DETAIL: REGISTERED PROFESSIONAL TO REVIEW PRIOR TO USE

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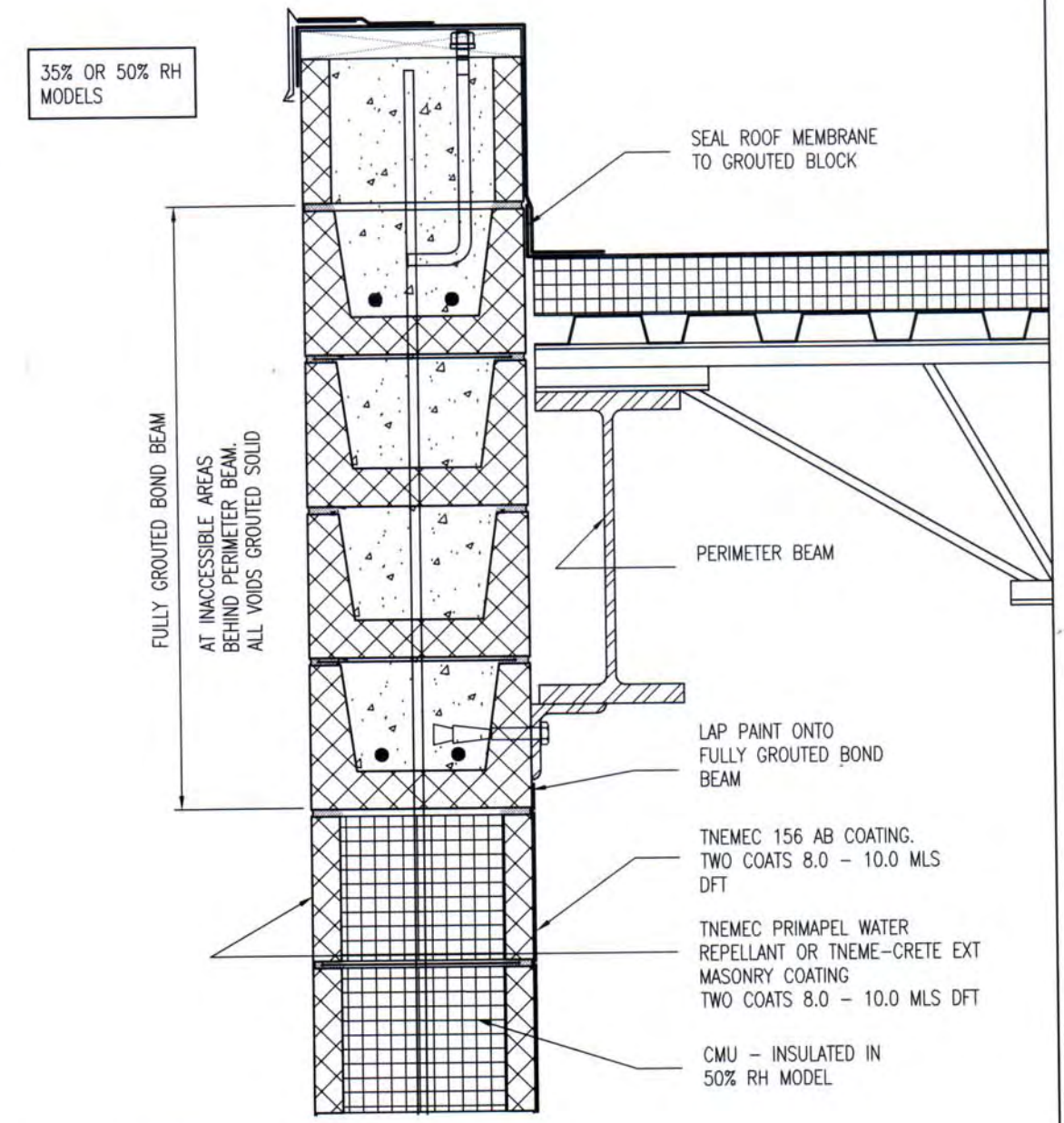

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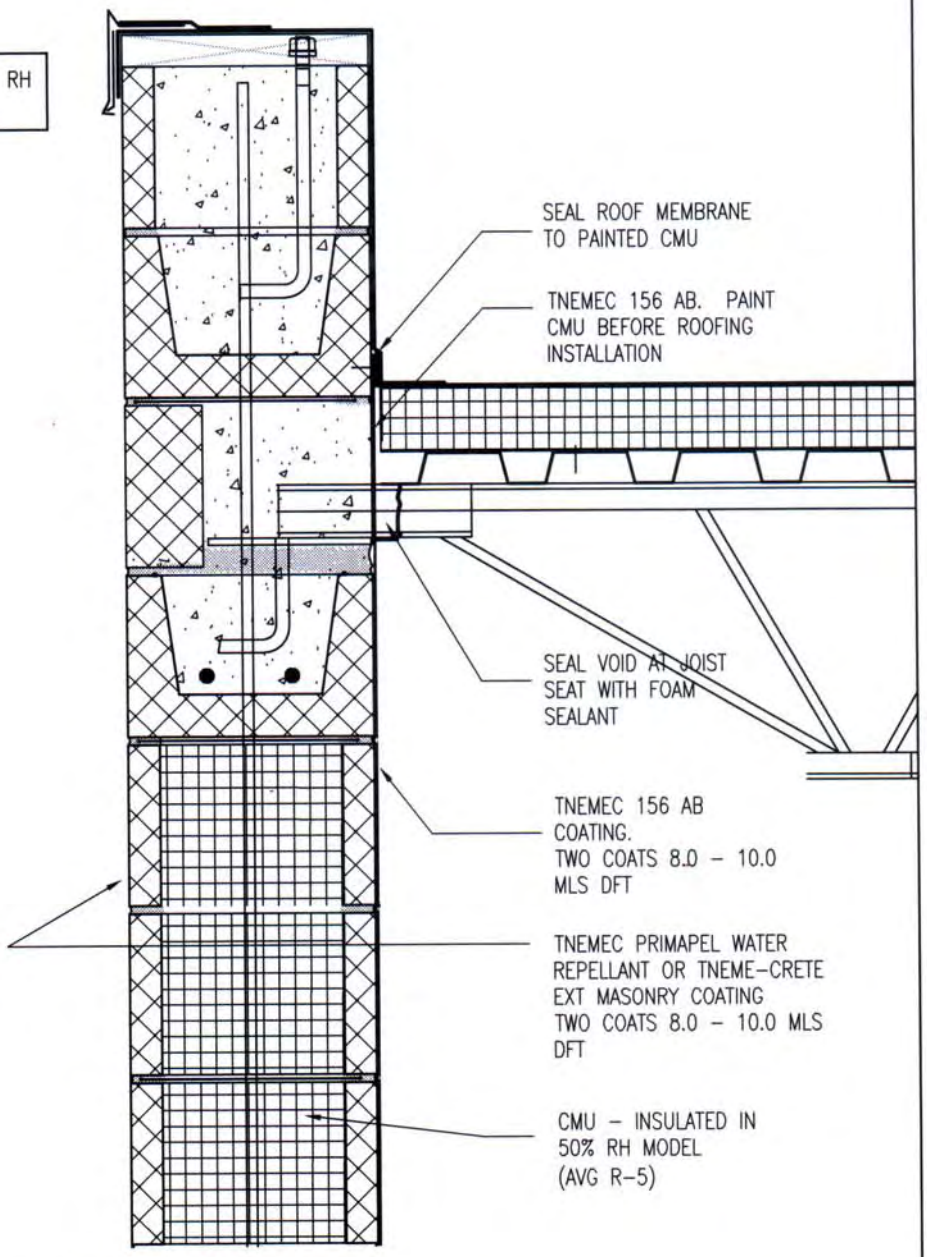

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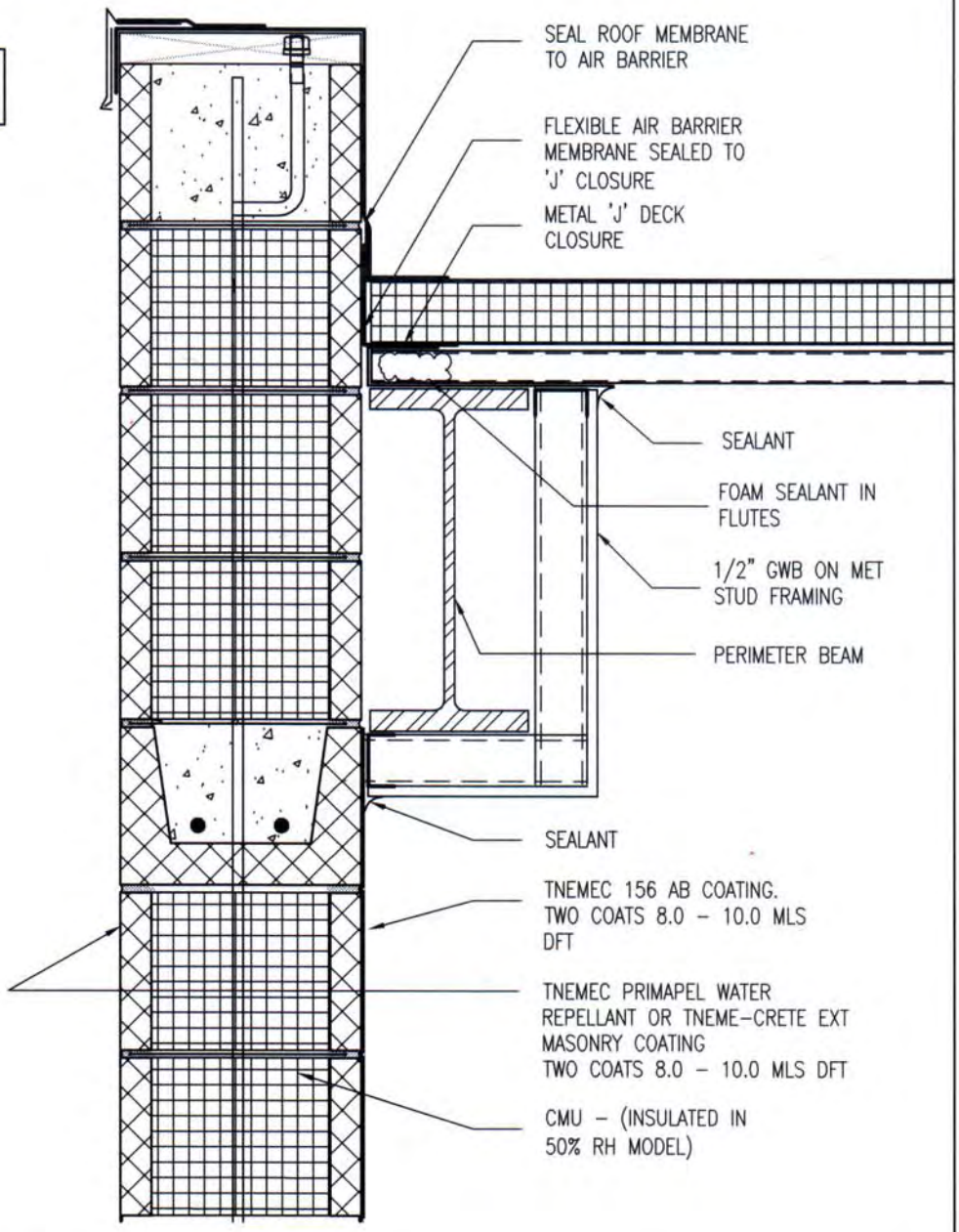

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