Ask Jon Eakes

Insulating an above grade block wall from the inside

Last Updated: Tuesday, September 10th, 2013, Created: Monday, March 14th, 2011

This article deals with a block wall above grade. For a below grade block wall see Basement Perimeter Drainage and Leaking Foundations.

Bryan is faced with a totally un-insulated cinder block wall with 1x2 strapping and a plaster covering. He is thinking about stripping it back to the block and then working from the inside to make an insulated wall, accepting that he might have to loose a couple of inches of floor space. Here I explain why we do what we do in a case like this, and why some of his ideas like installing paper and sealing foam insulation may not be necessary.

Working from the inside always tends to confuse things but let me establish a couple of principles that are easily seen on standard new construction, that we can adapt to your inside job.

VAPOUR RETARDER

First we want the best vapour retarder to be on the warm-in-winter side. "Vapour" and "Retarder" are both important words. I say Vapour because we are dealing with air born humidity, not liquid water. I say Retarder because we never really do stop it all, all we do is slow it down more or less efficiently. In most construction that is the 6 mil poly sheet put on the warm side of the insulation.

RAIN SCREEN

Now we also generally use a water barrier as part of a "rain screen" and this is generally brown building paper or house wrap like Tyvek put over the house structure on the outside before the siding or brick. The purpose of this "barrier" is to shed any liquid water that manages to penetrate the siding or cladding, and direct it out of the house (weep holes on the bottom of brick walls, or the open bottom of siding). See animation: What is a Rain Screen Wall?

AIR BARRIER

In addition we need something called an "air barrier" and now things get confused. The air barrier's function is simply to stop all air flow through the wall in both directions. But it gets a bit more complicated, or interesting if you prefer, depending on how you make this air barrier. The vapour retarder goes on the warm-in-winter side of the insulation, the moisture barrier goes under the siding, generally with an air space between it and the siding -- but the "air barrier" can go anyplace at all in the wall assembly -- and its properties must change depending on where it is located so as to not trap moisture in the wall. See animation: What is the difference between a vapour barrier and an air barrier?

For many years the most common technique was to seal the poly vapour retarder and make that plastic sheet into a combined air/vapour barrier. That works, no problem.

Then they invented house wraps that would not only shed water but block the wind. These were generally placed on the cold-in-winter side of the insulation, hence they must not be a vapour retarder. That is why Tyvek and all the other house wraps are specifically made to be "permeable" -- they shed liquid water, stop the wind but allow vapour through easily. If we have a sealed house wrap creating our air barrier, we do not need to seal the poly vapour retarder -- no more messy details trying to seal that plastic sheet.

One other alternative that is successfully used is "air-tight-drywall", air sealing the drywall and floor/ceiling assemblies -- even painting the drywall with vapour retarder paints -- and now there is a building paper on the outside to shed liquid water, simple old inexpensive building paper, and no poly over the insulation -- the painted and edge sealed drywall system provides both vapour and air protection. See details on Vapour barrier paint

All of that is to pose the question as to why you might do or not do each of the things you suggest doing to your wall.
So let's assume you have stripped down to the bare block wall.
1- Supposedly there is already a water shedding barrier under your siding or cladding, whatever that might be. If it is old stucco directly on the blocks you may be missing that. If it is more modern stucco with a drainage layer - or brick - or siding, you do have that water shedding drainage layer. The only reason to put a water barrier over the inside of the blocks would be if you were worried about water leakage, and if that is the case, you need to reflect a bit as to where the water would go if you did catch some with this sheet. If it just goes to the floor, it could help keep the wall dry but not the house below the bottom of the wall.
2- If you find that there is a lot of air draft coming through the block wall, we may want to deal with that -- and some people put Tyvek over the block just for this purpose. If however the problem is just at joints or window openings, the air flow may be more effectively and more easily stopped with caulking or foam in a can -- before anything else is put on the wall at all.
3- Then foam insulation is very useful and compact to install. Note that if you have already blocked all the air flow through the wall, there is no need to seal the foam. In fact it is probably a good idea to not seal the foam, allowing any vapour that might get past your vapour retarder to escape outwards slowly through the joints in the foam and right through the blocks. Here is a key point. Old houses can never be renovated perfectly, so keep in mind that we want any vapour control mechanisms to be carefully planned out. In a heating climate vapour pressure is moving from warm to cold -- moving outward through the wall. Hence we always want the best vapour retarder to be the furthest on the warm side, and any other vapour retarders to stop less moisture -- meaning that the "drain" potential of the wall is always more open than the "entry" potential. The vapour retarder on the warm side of the wall must be better than any other retarder in the wall -- or to put it in practical terms, we don't want that wall of foam insulation to be a better vapour barrier than your poly sheet. Hence we do not seal the joints -- but remember that we did already stop the air flow with the caulking or foam in a can.
4- Now you can put any type of batt insulation over the foam insulation -- but even here we have a restriction. Because of the presence of the batt insulation, the inside face of the foam insulation will be colder than if it was just under the drywall. If we put on very thick batt insulation we could drop the temperature of the foam insulation well under the dew point, meaning that any vapour that moves through the wall will cause condensation on this surface. One technical rule of thumb that allows for burying a poly vapour retarder between two layers of insulation that is considered safe for most of Canada is to always have twice as much insulation on the cold side than on the warm side. Technically this keeps inner face of the foam above the dew point temperature most of the time. From practical experience we have found that houses clad with at least 1-1/2" of extruded polystyrene (R-7.5) do not give us trouble in most regions of Canada but note that this foam is found on the outside of the water shedding building paper or house wrap, so any condensation that might form would not wet the wall.
So if you wanted to put on 1-1/2 inches of extruded polystyrene right over the inside of the air sealed cinder blocks, then strap over them and add insulation, technically since all of this is "inside the wall" you should restrain yourself to half as much batt insulation as foam insulation -- about R-4. If you wanted to put in R-7 batts, you should technically have about R15 of foam to avoid all condensation on the surface of the foam.
To save space, most people would put two to three inches of foam insulation (R-10 to R-15), use the foam panels like Dow's Wall Mate, that have recessed spaces for 1/2 or 1/3 strapping (depending on the region). This strapping is screwed back to the frame, falls on 2' centres and is flush with the front of the Styrofoam. This gives less total insulation than foam plus batts, but is actually very effective foam because of little thermal bridging. The vapour retarder and drywall could go directly over this with much less floor space eaten up and no structural wood purchased. Most importantly there is no place for moisture to collect.
5- Then yes you should add that 6 mil poly vapour barrier on the warm-in-winter side of the insulation, but you don't need to seal it -- the air sealing job is already done at the face of the cinder blocks.

6- After that any drywall would work and I don't know why you would bother with 5/8" fire code unless you have a multiple family house and this wall needs the protection. The extra thickness of drywall has very little thermal insulation value and the block wall is already a fire protection. I would use ordinary 1/2" drywall.

Keywords:
Air Barriers, Air Flow, Air Sealing, Blocks, Caulking, Codes, Condensation, Construction, Drafts, Drainage, Drywall, Foam, House, House Wrap, Humidity, Insulation, Moisture, Moisture Barrier, Paint, Plaster, Plastic, Protection, Rain Screen, Sealing, Seals, Strapping, Structure, System, Techniques, Temperature, Vapour Barrier, Water, Wind