Ask Jon Eakes

Insulating problems with historical buildings

Last Updated: Wednesday, July 6th, 2016, Created: Wednesday, July 17th, 2013

Hello Jon
I am the chairman of a church committee with the task of raising money, and doing the admin. for the restoration at St Andrew United.
My concern now is the proper procedure to fully insulate the Church. I am alright with the Attic as well as the crawl space, however I am pondering the correct way to insulate the wall. My source of information is the internet. I am concerned with filling the wall with insulation by means of blowing in the product as I am afraid of causing wall problems. I have considered installing 2" class 3 star foam on the exterior wall with Tyvek applied underneath. The building will be maintained at a suitable temperature. I will be using an air exchanger in the crawl space, and have plastic on the earth floor. There will also be a humidity control in the church. I cannot tamper with the interior as it has plaster walls.
Historic info. advises against filling the core walls in old buildings? Some info. says there is to much concern about Vapour barrier. I am confused with information. Can you advise what is correct.
Thank you, Paul

Hello Paul,
How important is the vapour barrier?
To say that there is too much concern about Vapour Barriers is to dangerously miss the point. We need to be concerned about the control of moisture accumulation, and the Vapour Retarder is one tool in dealing with that. (By the way, vapour retarders don't have to be a plastic sheet inside the wall, they can be painted on: http://joneakes.com/jons-fixit-database/1614-Vapour-barrier-paint-it-does-exist-it-does-work , something very useful in historical buildings.)

The role of HEAT in old buildings
A bit of historical understanding can help present day actions in old buildings. A building that had little or no insulation -- and some of the churches were barely heated and sometimes the larger spaces only heated on weekends -- functioned in a very special way with respect to moisture control. Essentially with no insulation and no vapour control, the heat simply drove the moisture right through the walls. In fact we often say that "heat" was the historical glue keeping these old buildings standing for so many years.
Now, when you cut off the heat with insulation -- the outer shell becomes far colder than ever before and moisture that is driven outward (as moisture will always migrate from hot to cold regions) can now hit cold surfaces quicker and for longer periods of time than previously. The combination of water vapour and cold surfaces leads to condensation and in sub-zero temperatures, to frost and ice accumulation. All of that leads to two potential problems: with organic material like wood studs it can lead to mould and rot; with masonry material, like brick or stone mortar, it can lead to frost expansion, cracking and movement.

Controling moisture before it gets cold
So, when we want to modernize an old building, if we add insulation we must find ways to reduce if not stop the movement of moisture towards the cold building elements, and where possible allow for drying or drainage of any moisture that is deposited in the structure. As a general simplistic rule we say that if you cannot control the moisture, don't insulate. In old churches that often means that there are areas that we can control, like the attic and the crawl space so we do insulate with moisture control and leaving the building section more permeable on the cold side than the warm side (in winter). And there are areas that we cannot control, like complicated intersections in the building

structure, and often small wall areas between large windows -- so we do not insulate those. We then christen those areas with the impressive title of "planned heat losses". What we can often do with those areas is to do a lot of air sealing -- which will have an impressive impact on heating costs without insulation at all. Remember that all air sealing done on the inside of the building will reduce moisture movement into the wall (a good thing) without having much of a conductive insulation effect (which allows heat to drive moisture on through the wall) -- but it does reduce the heat loss because it removes the part of heat loss associated with direct air transport of the heat.

Solid stone walls
Many old churches were made of solid stone. If you are not willing to cover either the inside or the outside with a new covering, then there is little possibility for thermal insulation -- but lots of possibility for air sealing by simply fixing all the mortar cracks and sealing around all penetrations.

Can you insulate in the space behind a masonary wall?
On buildings that have a facing of brick or stone, it is critical to respect the air space between the wall and the masonry facing and not fill it with insulation. This space serves as a drainage path and the air movement in this space serves both as a drying mechanism and as a pressure equalizer to prevent the wind from driving moisture through mortar cracks into the wall. It is called a Rain Screen: http://joneakes.com/jons-fixit-database/910-what-is-a-rain-screen-wall Whatever siding you put on an old building, creating a rain screen with the siding (drained air space between the siding and the wall) will always help the performance and durability of the wall as it helps to let whatever moisture you fail to stop from entering from the indoor atmosphere to escape from the wall. You are making a wall that will forgive you for imperfections on the inside.

Pay attention to where you stop the moisture
In your case it appears that you do have hollow walls, which invites the possibility of blowing insulation into the walls. So let me give you another series of rules.
In an old building full of air leaks and little or no vapour retarder, it is important to keep the outside more permeable than the inside. Actually we can nuance that a bit -- if you block the moisture at all, block it with a vapour retarder before it can reach the point inside the wall where the temperature and vapour hit the dew point. Generally we say that we want a vapour barrier on the warm-in-winter side of the insulation, but actually we want it at a place that is warm enough in winter to not cause condensation -- it can be buried inside the wall: http://joneakes.com/jons-fixit-database/1380-Double-walls-and-buried-vapour-barriers
So in practical terms, if we filled the hollow wall with insulation and then put foam insulation on the outside that was less than twice as much of an insulating value of what you put in the wall, the inside surface of that insulation, which blocks moisture movement much more than any loose fill insulation, would become a stopping point for moisture that got cold most of the winter. That causes condensation. However, in most of Canada, if we have twice as much insulation on the outside of that barrier as on the inside, it doesn't matter if that inside face of the foam was a total vapour barrier -- it would stop moisture, but would be warm enough to not collect moisture. The moisture in the insulation would simply move in and out with the interior atmosphere but there would be no condensation. So calculate what you would get by filling those walls with insulation, and if you can double that R-value with foam on the outside -- you are both safe and warm. If you are restrained (space, budget etc) as to the foam insulation (panels or spray foam) that you can put on the outside, then restrain or leave out what you do on the inside. Always air seal the best you can (inside or outside) -- as this will remove a lot of stress on the wall system as well as greatly reduce heat loss: http://joneakes.com/jons-fixit-database/keyword-filter?keywords[]=Air+Sealing
Another type of exterior insulation that has come and gone on the market are fiber based insulation boards that are totally permeable, they do not block moisture. These products are exterior insulation that is particularly well suited for buildings that have poor air and vapour control on the inside. The latest version of that is Roxul ComfortBoard --

http://www.roxul.com/products/residential/products/roxul+comfortboard+80 . You could put as much as you want of this product over an existing wall causing no moisture problems on the inside.

The wall you might not want to insulate
One additional practicality. If you have any particular wall that is mostly windows and doors, with very little wall -- it becomes very complicated to do any insulating on this wall because you end up having to extend window and door frames to match the new thickness of the wall. The reality is that this wall may actually have very little wall surface and hence that wall surface represents a small portion of the building. In addition that is often on the south side and receives considerable heat gains anyway from the sun. So very often we will work hard on large wall surfaces and only air seal on the complicated sun facing surfaces -- maybe not insulating at all.
I hope this puts the transition of historical buildings into today's heating costs into a bit of perspective.
jon

Keywords:
Moisture, History, Condensation, Siding, Air Sealing, Walls, Vapour Barrier, Air Barriers, Heritage, Water, Insulation