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The restoration of historic masonry buildings and structural integrity

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In Greater Boston, many historic, solid mass masonry wall buildings require restoration. This article focuses on the potential negative impact of adding thermal insulation to the exterior building envelope wall systems of historic masonry structures and the benefits of proper restoration of the masonry structure itself coupled with installation air/vapor barrier systems.

When undertaking the restoration of a historic, masonry building, there is controversy over whether adding thermal insulation to the exterior building envelope wall system is a construction practice that will enhance the building's energy efficiency significantly enough to justify the potential risk of causing structural damage to the masonry walls. Building owners, managers and/or developers should give carefully consideration to this issue prior to assuming that insulating the structure is a sound decision.

First, it is important to clarify that historic masonry buildings are at issue when it comes to insulating exterior walls because of their construction type, not their age. They are solid mass masonry wall structures. This building technology began being phased out over 70 years ago with the advent of the brick veneer cavity wall system. The older solid mass masonry building relies on the interior/exterior temperature gradient to dry the wall system, whereas in brick veneer cavity systems, moisture drains internally to the exterior through wall drainage ports, typically referred to as weep holes. And, that is crux of the matter.

Planning Stage Inspection
and Observations

When planning the restoration of a historic masonry building, among the most important early phase issues is to have the building inspected by a building envelope professional who is experienced in both masonry construction and waterproofing. That individual will determine the condition and integrity of the exterior masonry wall structure and the key components that impact its thermal efficiency. That includes the masonry units, mortar joints and wall penetrations.

Historic masonry buildings-residential, educational or commercial-often undergo complete gut renovations. Inspections should be performed after the exterior building envelope walls are devoid of all interior wall finishes, so that the interior faces of exterior walls are fully exposed.

The condition of the exterior masonry walls should be inspected closely to see if they are sound or if there are defects that may be a result of deferred maintenance. Defects have the potential to allow water penetration into the wall assembly from the elements. This condition may be further exacerbated if the demolition includes removal of such building features as fire escapes.

Interior masonry wall surfaces will be inspected for voids through which interior moisture can be introduced into the wall from interior humidity due to moisture exfiltration. The introduction of modern kitchen and bathroom appliances, which generate larger amounts of interior moisture than the

appliances they replace, may actually increase humidity/moisture levels within the masonry wall.

Adding insulation may
result in freeze-thaw cycling
and structural damage

Moisture can enter solid mass masonry wall structures, both from exterior elements e.g., wind-driven rain and snow, as well as from humidity generated from the interior living environment. In their original state, uninsulated masonry walls are subject to beneficial thermal effects of the temperature gradient. During the winter heating season, the thermal dynamic effect of heat passing from the interior heated spaces causes the temperature of the masonry wall to increase, which induces the drying of moisture within the wall assembly. Adding insulation to the interior surfaces of exterior masonry walls will reduce the thermal dynamic effect of heat migration from the warm heated spaces to the exterior unheated environment. This diminished heat migration will decrease the overall temperature of the wall during the heating season, potentially resulting in condensation and frost within the wall assembly.

The combination of colder wall temperatures, longer drying time, and higher indoor relative humidity can potentially result in freeze-thaw cycling within the wall assembly during colder winter months. Freeze-thaw cycling decreases the durability of the masonry wall, resulting in higher probability of structural damage.

During major renovations, there is, however, a general inclination to add thermal insulation to the interior surfaces of the brick masonry wall assembly-to increase energy efficiency and occupant comfort in cold climate regions, like New England. Therefore, the challenge is to increase the energy efficiency of the wall assembly without decreasing its durability.

Recommendations

The first but perhaps least obvious way to increase the thermal efficiency of an exterior masonry solid mass wall assembly is to minimize the amount of moisture which penetrates the wall from the exterior environment. One of the primary sources of water infiltration into the wall assembly is from wind-driven rain and snow. The amount of water penetration from the exterior environment is directly related to the condition of the masonry units, motor joints and wall penetrations. A close inspection of the exterior structure, and subsequent implementation of repairs to any defects found in these areas, is the first line of defense in promoting energy efficiency and durability in any type of wall assembly.

The next step to prevent the introduction of moisture into the wall assembly, which decreases its energy efficiency, is to prevent indoor humidity from defusing into the wall. This is accomplished by installing a vapor barrier on the heated side of the exterior walls. There are both sheet and liquid applied systems that are commercially available for this purpose. An efficient vapor barrier will also incorporate an effective air barrier. When installing an air barrier system, emphasis should be given to include continuity at all wall component interfaces, such as window and door penetrations. Reduced air leakage will drastically increase the occupants' comfort and also promote the overall energy efficiency of the wall assembly.

Lastly, the wall-to-window ratio should be noted when considering the introduction of thermal insulation into a previously uninsulated wall assembly. The key question to ask is, "Will adding insulation to the masonry surfaces significantly improve the overall energy efficiency of the wall sufficiently enough to justify the potential risk to the durability of the wall assembly?" In most historic buildings, the window surface area accounts for a significant percentage of the total wall surface

area. Based on thermal dynamic engineering principles, it is my opinion that adding insulation to high window-to-wall ratio assemblies will often not increase the overall energy efficiency of the wall sufficiently enough to justify the risk to its durability.

In addition, considering that air leakage is often the most significant source of heat loss and potential occupant discomfort, and that air leakage can be addressed through sound masonry restoration and the installation of an air barrier system, the addition of thermal insulation into the exterior wall assembly of historic structures is not typically warranted.

Conclusion

Insulating historic, solid mass masonry structures provides owners no insulation from major potential structural problems. True energy efficiency in the restoration of historic masonry buildings begins and ends with good old-fashioned maintenance and restoration of the masonry structure itself. It will lead to energy cost savings, a cleaner, more comfortable environment, and a healthier building.

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