8.6.3 Vapor Retarders and Air Barriers

Under certain conditions of design, it may be necessary to add a vapor retarder or air barrier to an insulated masonry wall to control the flow of water vapor. An acceptable retarder is one with a moisture vapor permeance of less than 1 perm. Vapor retarders and air barriers may be in the form of bituminous materials, foil, or plastic films, or the insulation itself may serve this function. They may be attached to the insulation, or they may be incorporated separately in or on the wall. For maximum effectiveness, air barriers must be continuous and without openings or leaks through which airborne vapor might pass. (See Chapter 9 for additional information regarding moisture control.)

8.6.4 Insulation Location

The most effective thermal use of massive construction materials is to store and reradiate heat, so that insulation location should be based on climatic exposure. *Figure 8-38* shows that the location of the insulation within the

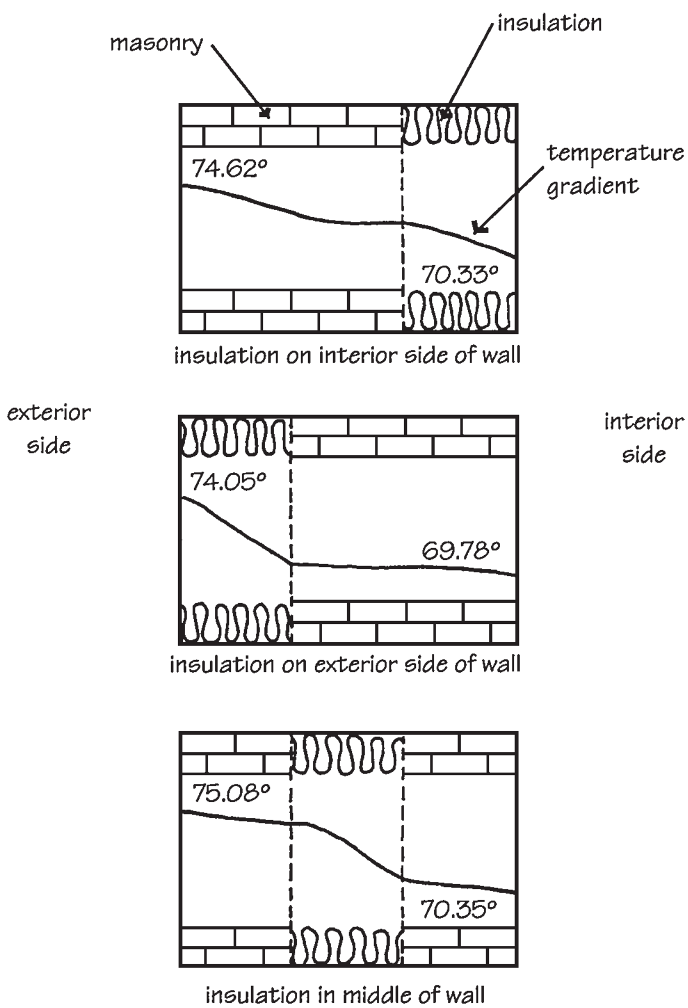

Figure 8-38 Temperature profiles for three different insulation locations. *(From Donald Watson, ed., Energy Conservation through Building Design, McGraw-Hill, New York, 1979.)*

wall section has an effect on heat flux through the wall which is not accounted for by standard *U*-value calculations. In the thermal research conducted by NIST and NCMA, the effects of variable insulation location were studied. It was found that indoor winter temperature fluctuations were reduced by half when insulation was placed on the outside rather than the inside of the wall, and that the thermal storage capacity of the masonry was maximized. In cavity walls, performance in hot and cold climates is improved if the insulation is placed in the cavity rather than on the inside surface. Insulation location can affect the potential for condensation, so vapor flow as well as heat flow should be considered in optimizing wall performance.

8.7 ENERGY CONSERVATION

Masonry construction can be used in several ways with passive solar design. It can (1) provide a solar screen to shade glass areas on a facade, (2) collect and distribute solar warmth in winter, and (3) intercept excessive heat and solar radiation during the summer. In passive solar design, the buildings themselves collect, store, and distribute heat. A key element is the use of thermal mass—heavy materials which absorb and reradiate large amounts of energy. Passive measures such as cross ventilation, evaporation, exhaustion of hot air by convection, and absorption of heat by thermal mass can provide up to 100% of a building's cooling needs in summer. Masonry is particularly cost effective in these applications because it simultaneously provides supporting structure, spatial definition, acoustical separation, fire separation, finished surfaces, and thermal storage.

Solar energy systems for buildings are divided into two categories: active and passive. Active systems use solar collectors, heat storage tanks, pumps, heat exchangers, and extensive plumbing and electrical controls. Buildings may take any form, and although building orientation is important, it need not be as critical since solar collectors can be oriented for optimum performance regardless of the building's orientation. Passive buildings, on the other hand, *must* be oriented in relation to the seasonal and daily movements of the sun to maximize heat gain in the winter and to minimize solar loads in the summer. Solar heat gain through walls, windows, roofs, skylights, and other building elements can dramatically reduce winter energy requirements. If thermal energy flow is by natural means, such as radiation, conduction, and natural convection, and if solar energy contributes a significant portion of the total heating requirement, the building is considered a passive solar-heated structure.

Thermal mass alone does not constitute passive solar heating or cooling. Buildings must be designed as total systems in order to take advantage of masonry's thermal mass. Using climatic data for each building site, the architect or engineer must determine the optimum amount and location of thermal mass, the type of glass, orientation of windows, and the best use of shading devices, ventilation, daylighting techniques, insulation, landscaping, and efficient heating and cooling equipment. Thermal mass is only one part of passive solar design.

The National Codes and Standards Council of the Concrete and Masonry Industries has published the *Thermal Mass Handbook: Concrete and Masonry Design Provisions Using ASHRAE/IES 90.1-1989.* The handbook is intended to help design professionals take advantage of thermal mass principles in complying with the energy codes. It is an excellent design aid with in-depth coverage that is beyond the scope of this book. The handbook is available through the National Concrete Masonry Association in Herndon, Virginia.