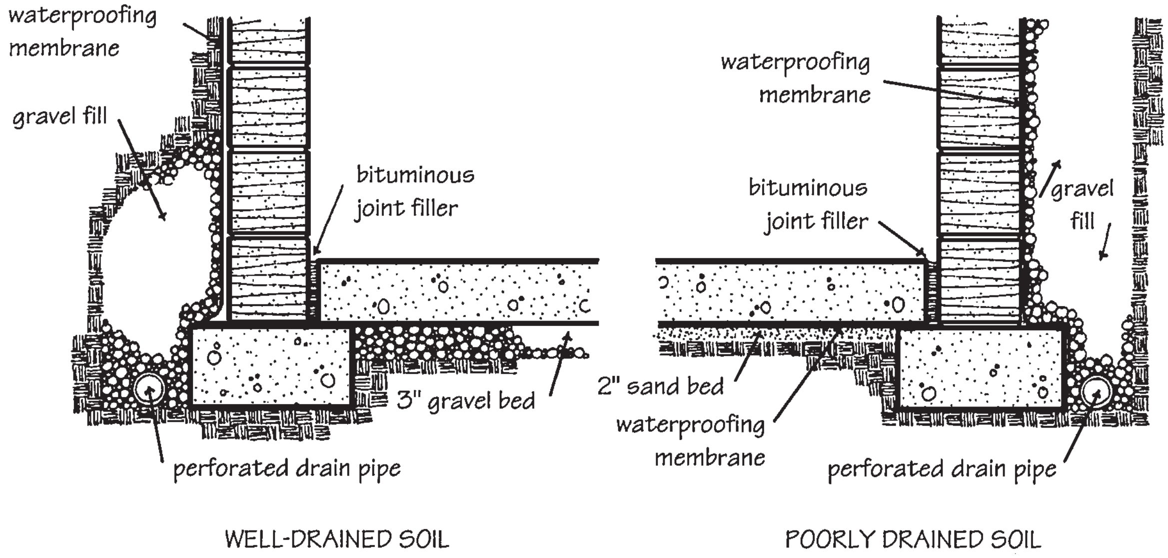


**Figure 9-52** Below-grade waterproofing for masonry basement walls. (*From BIA* Technical Note 7.)

These may be fluid-applied bituminous products, elastomeric sheets, bentonite clay, or any tested and approved waterproofing system (see Chapter 13).

### 9.4.5 Condensation and Vapor Retarders

Differences in humidity between inside and outside air cause vapor to diffuse through a wall. A masonry wall that has absorbed moisture during a rain and is then warmed by solar radiation can have a temporarily elevated vapor drive. Even if rain has not penetrated to the wall cavity, this vapor drive can raise humidity levels enough to support mold growth on sheathing and framing materials. Condensation can cause wood framing members to warp or decay, metal to corrode and insulation to lose its effectiveness. Masonry can shrink or expand, effloresce, or suffer damage from freeze-thaw cycles.

Warm air has higher saturated vapor pressure than cool air. If separated by a wall, the higher-pressure vapor will migrate through the wall toward the lower-pressure atmosphere. During the winter this flow is from inside the building toward the outside. In warm, humid climates, this flow may reverse during the summer, with vapor traveling from the outside in. When vapor passes through a wall that is warm on one side and cool on the other, it may reach its dew point and condense into water within the wall. The temperature drop through a composite wall is directly proportional to the thermal resistance of the various elements. The drop in vapor pressure through the wall is in proportion to the vapor resistance of the constituent parts. Winter condensation problems are most frequent in insulated buildings of tight construction with occupancies or heating systems that produce high humidity. The relative humidity of the air within a building is increased by cooking, bathing, washing, or other activities using water or steam. This rise in the moisture content of the air increases the vapor pressure substantially above that of the outdoor atmosphere, and tends to drive vapor outward from the building through any permeable materials in the enclosure.

Tobiasson developed a graph to indicate areas of the United States where winter temperatures are cold enough to consider the use of a vapor retarder in roofs and wall assemblies (*see Fig. 9-53*). Summer condensation problems are most frequent in air-conditioned buildings in hot, humid climates along the Gulf of Mexico and the southeastern Atlantic coast. Warm, humid outdoor air diffuses through permeable materials in the building envelope and may reach its dew point if the temperature of the indoor air is cool enough. Tobiasson also developed a map indicating areas in which a vapor retarder may be needed to prevent summer condensation (*see Fig. 9-54*).

### 9.4.6 Calculating Condensation

The potential for condensation can easily be calculated if indoor and outdoor design temperatures and humidities are known, as well as the thermal and vapor resistances of the component wall materials. Saturated vapor pressures

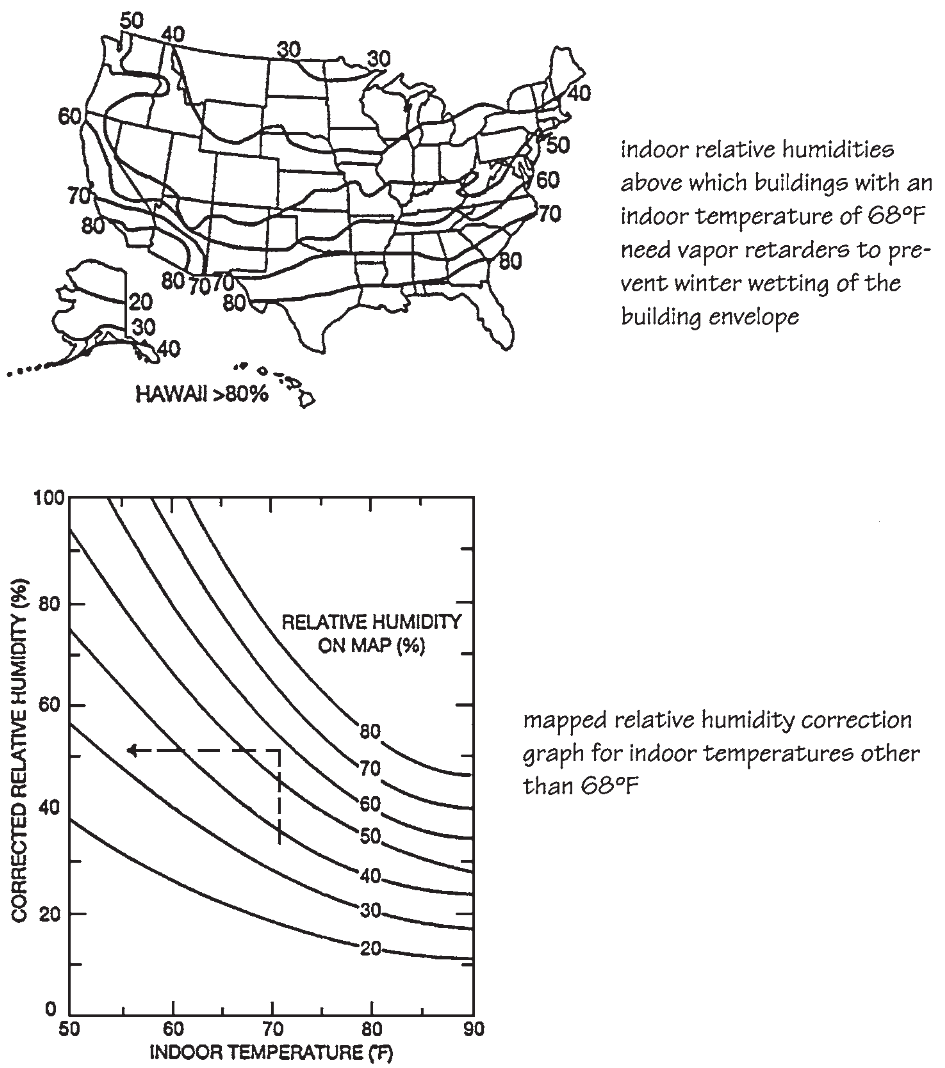


**Figure 9-53** Recommendations for use of vapor retarders to prevent winter condensation. (*From Tobiasson and Harrington,* Vapor Drive Maps of the U.S., *1985.*)