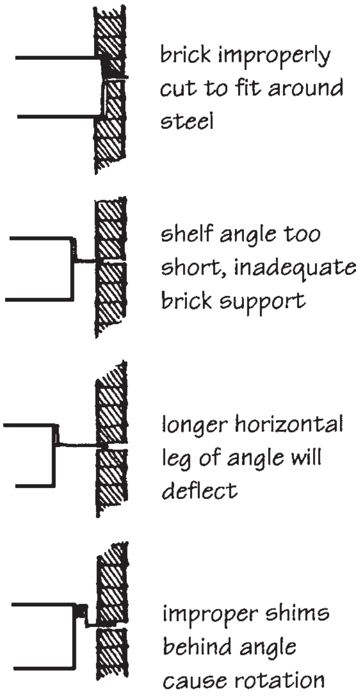


**Figure 15-64** Masonry is often altered to accommodate variations in structural frame.

## 15.6 COLD WEATHER CONSTRUCTION

Cold weather causes special problems in masonry construction. Even though sufficient water may be present, cement hydration and strength development in mortar and grout will stop at temperatures below 40°F. Construction may continue during cold weather, however, if the mortar and grout ingredients are heated and the masonry units and structure are protected during the initial hours after placement. As temperatures drop, additional protective measures are required.

*Mortar and grout* mixed using cold but unfrozen ingredients have different plastic properties from those mixed under normal conditions. For a given consistency, the mix will contain less water, will exhibit longer setting and hardening times, and will have higher air content and lower early strength. Heating the ingredients prior to mixing, however, will produce mortar with performance characteristics identical to those mixed in a more moderate ambient temperature range. Frozen mortar assumes the outward appearance of being hardened, but it is not actually cured and will not develop full design strength or complete bond until it is thawed and liquid water is again available for hydration. Frozen mortar is easily scratched from joints, has a crow's-foot pattern on the surface of tooled joints, and may flake at the surface.

Cement hydration will resume only when the temperature of the mortar or grout is raised above 40°F and its liquid moisture content exceeds 75%. When these conditions are maintained, ultimate strength development and bond will be the same as those attained under moderate conditions.

The rapidity with which masonry freezes is influenced by the severity of ambient temperature and wind, the temperature and absorption characteristics of the units, the temperature of reinforcing steel and metal accessories, and the temperature of the mix itself at the time of placement.

The water content of mortar and grout significantly affects their freezing characteristics. Wet mixes experience more freezing expansion than drier ones, and expansion increases as the water content increases. During freezing weather, low-moisture-content mixes and/or high-suction units are desirable, but mortar and grout consistency must maintain good workability and flow so that surface bond is maximized.

Cold *masonry units* exhibit all the performance characteristics of heated units except that volume is smaller and the potential for thermal expansion within the wall is greater. Wet, frozen units show decreased moisture absorption. Preheated units, on the other hand, will withdraw more water from the mortar because of the absorptive characteristics of a cooling body, but if they are too wet, may still have inadequate absorption. Highly absorptive units, by withdrawing water from the mortar, will increase bond and lower the moisture content, decreasing the potential disruptive expansion that might occur with initial freezing. Units that are dry, but excessively cold, will also withdraw heat from the mortar and increase the rate of freezing.

During cold weather construction, it may be desirable to use a Type III, high-early-strength portland cement because of the greater protection it will provide the mortar. So-called antifreeze additives are not recommended. If used in quantities that will significantly lower the freezing point of the mortar, these additives will rapidly decrease compressive and bond strength. Accelerators that hasten the hydration process are more widely used, but may also have damaging side effects. Calcium chloride is the major ingredient in proprietary set accelerators, and although it is effective, it has a highly corrosive effect on metal reinforcement and accessories. High salt contents of accelerating admixtures may also contribute to efflorescence and cause spalling of the units. In general, the use of set accelerators is not recommended, but when used, such admixtures should be limited to those containing non-chloride ingredients.

*Masonry materials should be stored and protected* at the job site to prevent damage from wet, cold, or freezing weather. Packaged materials and masonry units should be stored elevated to prevent moisture migration from the ground, and covered to protect the sides and tops. Consideration should be given to the method of stockpiling sand to permit heating of the materials if required.

As the temperature falls, the number of different materials which require heating will increase. Mixing water is easily heated. If none of the other materials are frozen, mixing water may be the only ingredient requiring artificial heat. It should be warmed sufficiently to produce mortar and grout temperatures between 40 and 70°F at the time of placement. Water temperatures above 180°F can cause cement to flash set, so sand and water should be mixed first to moderate high temperatures before the cement is added. Masonry sand, which contains a certain amount of moisture, should be thawed if frozen to remove ice. Sand should be warmed slowly to avoid scorching, and care should be taken to avoid contamination of the material from the fuel source. Dry masonry units should be heated if necessary to a temperature above 20°F at the time of use. Wet, frozen masonry units must be thawed without overheating.

The degree of protection against severe weather which is provided for the work area is an economic balance between mason productivity and cost of the protection. Protective apparatus may range from a simple windbreak to an elaborate heated enclosure. Each job must be evaluated individually to determine needs and cost benefits, but some general rules do apply.

Characteristics such as strength, durability, flexibility, transparency, fire resistance, and ease of installation should be considered when selecting