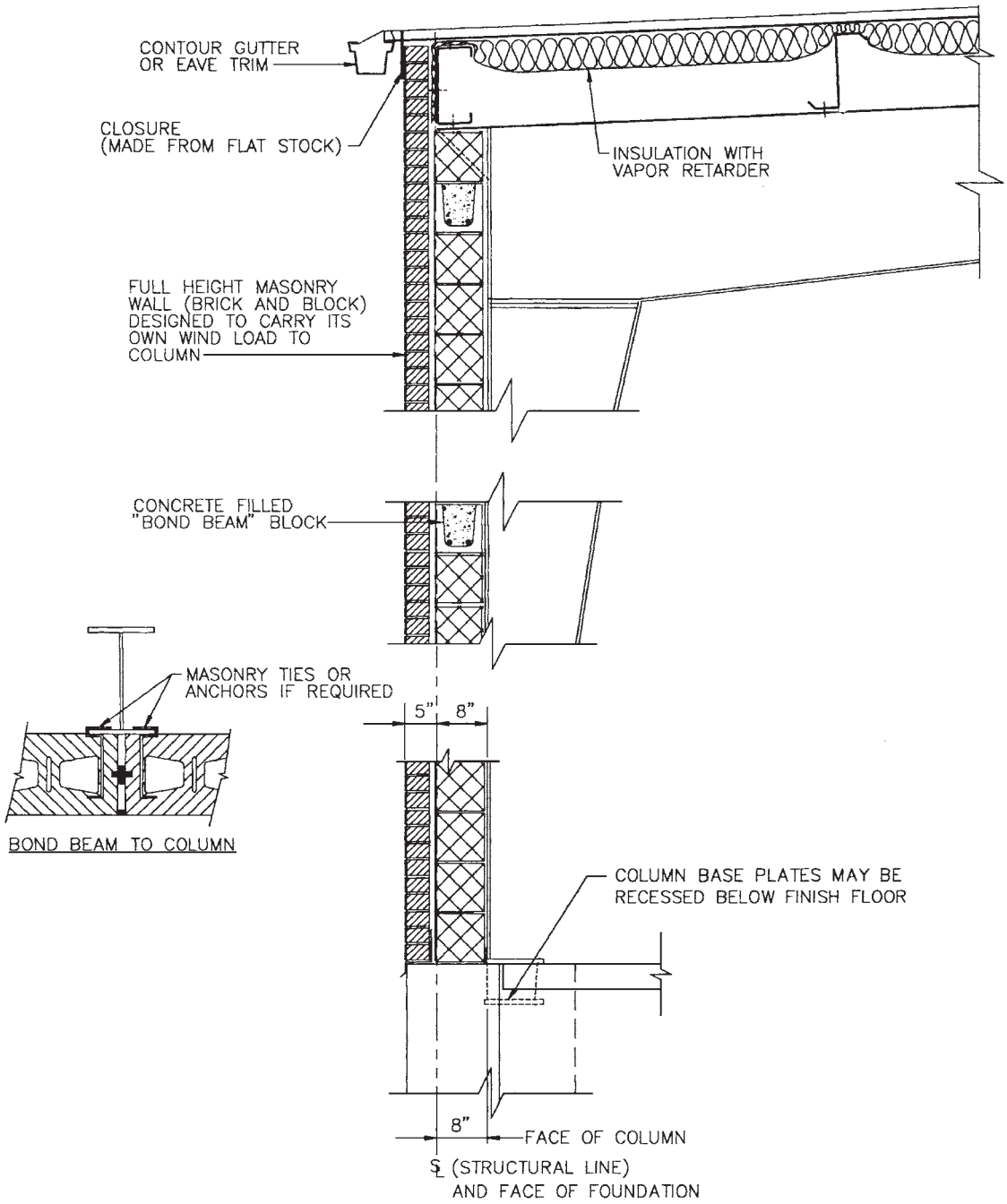

FIGURE 7.28 Horizontally spanning full-height brick and CMU cavity wall. (*Butler Manufacturing Co.*)

After fabrication, clay- and concrete-based products tend to move differently with moisture changes. Oven-fired brick has practically no moisture at first and gains it later, steadily expanding in the process. In contrast, CMU is born wet and is cured in a water-saturated condition, gradually losing moisture and shrinking.[12] It can only be hoped that, by the time the two materials are installed, most of the initial volume changes will have already taken place.

In a similar vein, brick and block react to temperature changes differently; normal-weight CMU may expand or contract up to 15 percent more than brick. Even more importantly, the exterior brick is directly affected by solar radiation and undergoes larger swings in temperature than the block separated by an air space. (A simple but often overlooked method of reducing brick thermal movement is to use light-colored brick.)

Differential thermal movement can be mitigated by expansion and control joints spaced at close intervals, such as 18 to 25 ft. Expansion and control joints are often confused but are quite different in nature. Expansion joints in brick are filled with compressible materials, while control joints in CMU allow it to shrink and are normally filled with rigid inserts for normal-to-wall transfer of forces between the adjacent blocks.

The most common standard for face brick is ASTM C 216,[13] which covers about 93 percent of all the bricks sold in this country.[14] ASTM C 216 includes three types of brick: FBS for common use, FBX for applications requiring tight control of unit sizes, and FBA for deliberately nonuniform size and texture of units as is sometimes preferred by architects for a rustic look.

Mortar affects performance of brick and should be selected with care. The lower the mortar strength, the more deformation the wall can tolerate. A good overall choice for brick veneer, especially of that subjected to severe freeze-thaw cycles, is mortar conforming to ASTM C 270[15] type N. The mortar of type S has a higher flexural strength than that of type N; mortar of type M is reserved for loadbearing brick applications.

In contrast to brick, CMU backup walls usually contain steel reinforcing and require mortars of type S or M. With two different types of mortar required for brick and CMU, proper supervision of the installation is essential.

There are many other fine points of masonry design that experienced architects and engineers learn throughout their careers. For good masonry wall performance, it is critical for design professionals to provide all pertinent details in the contract documents and to insist on good field supervision, even if the rest of the building system is "pre-engineered."

7.5.2 Brick Veneer over Steel Studs

This wall type is common in conventional construction, prized for its visual appeal, light weight, ease of insulation, and cost efficiency. The system, developed in the 1960s, consists of steel studs spaced 16 or 24 in on centers, interior gypsum wallboard, building paper or other waterproofing on exterior-grade sheathing, and brick veneer separated from sheathing by an air space and attached to steel studs with adjustable metal ties (Fig. 7.29). The space between wall studs is often filled with fiberglass batt insulation.

Some argue that this complex wall system has become extremely popular too fast, before its weak points have been fully understood. Indeed, there are precious few sources of information on its long-term durability and on proper construction details. One of the best is *Technical Note* 28B by the Brick Industry Association (formerly Brick Institute of America).[16] The note contains detailed recommendations on structural design criteria, avoiding water penetration, minimum size of air space, maximum tie spacing, and other important aspects of the brick curtain-wall design.

It is not our intent to engage in a comprehensive discussion of this complicated system. Instead, we outline a few issues crucial to its performance in pre-engineered buildings.

A wall made of brick veneer over steel studs represents a simplified example of cavity-wall rain screen. It is assumed that some water will eventually get into the cavity. A proper functioning of waterproof building paper, flashing, and weep holes is therefore critical for a leak-free performance.

To be effective, flashing needs to extend through the wall and protrude at least 1/4 in beyond its exte-