9.3.1 Joint Design

Control joints are continuous, weakened joints designed to accommodate the permanent shrinkage of portland cement-based products such as concrete masonry. When stress development is sufficient to cause cracks, the cracking will occur at these weakened joints rather than at random locations. Although horizontal joint reinforcement can be used to limit shrinkage cracking, strategically located control joints must also be used to eliminate random cracks and prevent the resulting moisture penetration. Cracking is not as likely to occur in fully reinforced construction, since the reinforcing steel absorbs the tensile stress.

Control joints must also provide lateral stability between adjacent wall sections. *Figure 9-12* shows several common types of joints, all of which provide a shear key for this purpose. Control joints must also be sealed against moisture leakage. The joints are first laid up in mortar just as any other vertical joints would be. After the mortar has stiffened slightly, the joints are raked out to a depth which will allow placement of a backer rod or bond breaker tape, and a sealant joint of the proper depth. Concrete masonry moisture shrinkage always exceeds thermal and moisture expansion because of the initial moisture loss experienced after manufacture. So, even though control joints contain hardened mortar or hard rubber shear keys, they can accommodate reversible expansion and contraction which occurs after the initial curing shrinkage.

In masonry, an expansion joint is a continuous open joint or plane designed to accommodate the permanent moisture expansion of brick and other clay units. Brick moisture expansion always exceeds reversible thermal expansion and contraction, so the joint cannot contain mortar or other hard materials. *Figure 9-13* shows several methods of constructing vertical expansion joints and horizontal soft joints. Compressible fillers may be used to keep mortar out of the joints during construction, because even small mortar bridges can cause localized spalling of the unit faces where movement is restricted (*see Fig. 9-14*). Filler materials should be at least as compressible as the joint sealant which will be used, and the compressibility of the sealant must be considered in calculating joint width.

The required width for control joints and expansion joints can be determined by adding the widths required for thermal movement, moisture movement, and construction tolerances. If the calculated width based on an assumed joint spacing is too narrow for proper sealant function, or too wide for aesthetic reasons, the joint spacing can be increased or decreased and the width recalculated.

Required joint width must take into account the movement capability of the sealant itself in both extension and compression. An elastomeric sealant rated ±25% can tolerate a maximum movement of +25% of the joint width when extended, and −25% of the joint width when compressed. The joint must therefore be four times the expected movement (100/25 = 4). A more elastic sealant rated ±50% requires a joint width twice the expected movement (100/50 = 2). A sealant reported as +100/−50% is governed by its compressibility, so the joint still must be twice the calculated movement to allow room for the compressed thickness of the sealant itself. ASTM C1472 gives a basic formula for calculating joint width for thermal movement ($W_t = \Delta L_t / S$), but to allow for imprecisions in determining surface temperatures, imperfect workmanship, and other unknowns, some researchers recommend using sealants at only a percentage of their rated movement capacity. The amount of reduction should depend on the particular circumstances of a joint design and the desired factor of safety. With

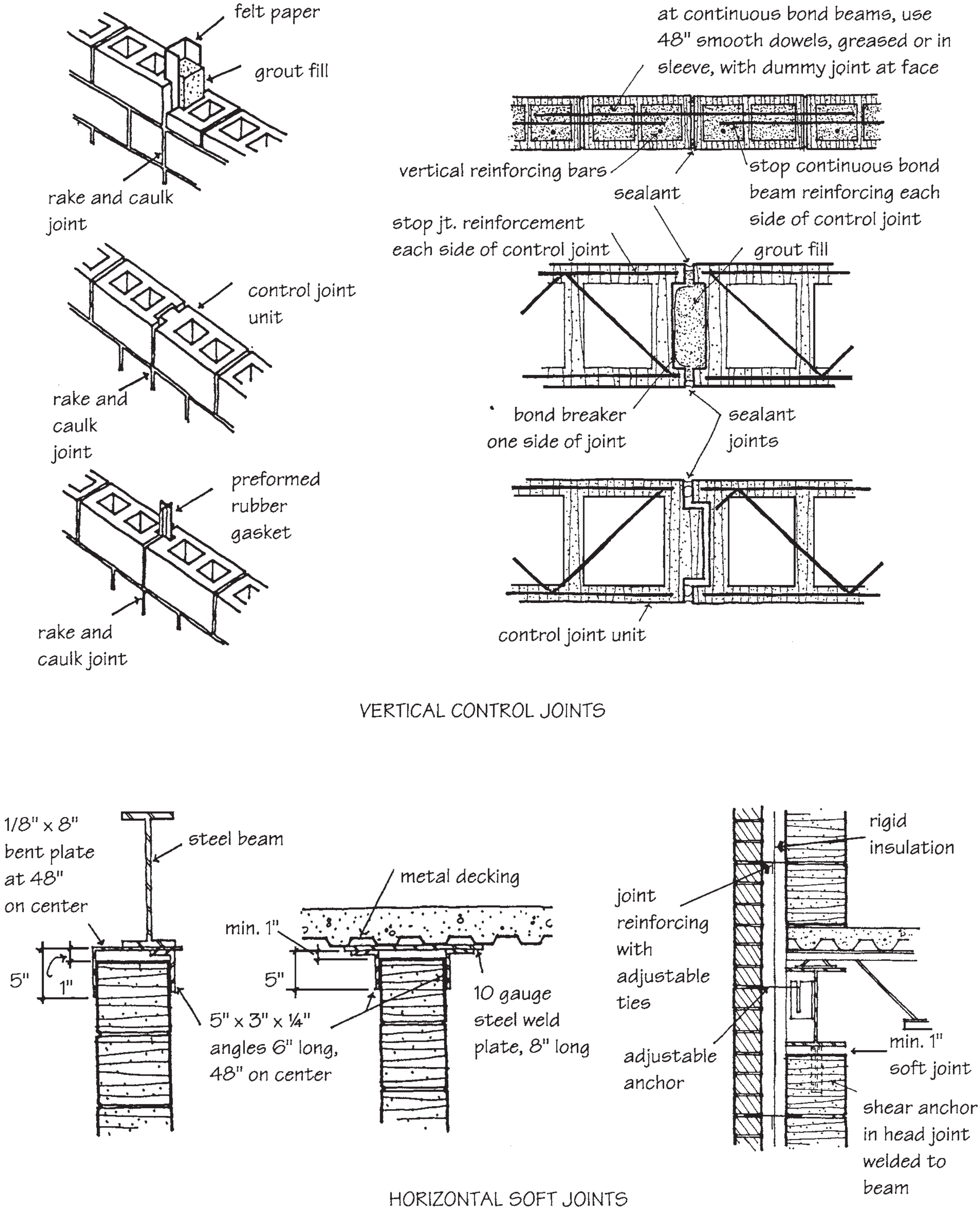

Figure 9-12 CMU control joints for shrinkage crack control and horizontal soft joints to accommodate beam or floor deflection above.