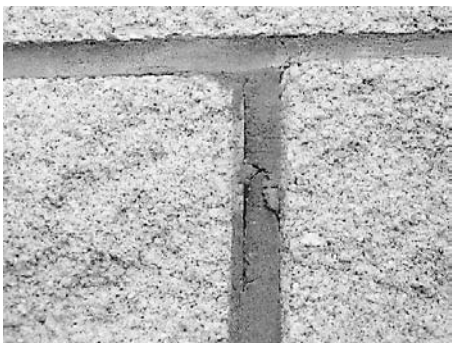
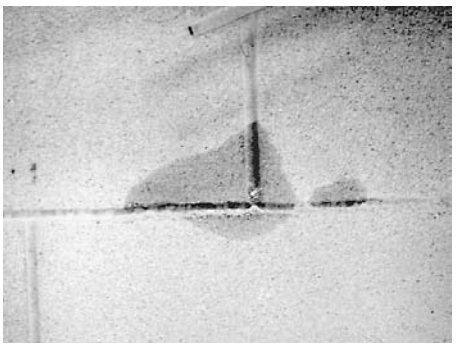


void in exterior mortar joint caused by poor workmanship



interior wall surface wetting caused by defective mortar joint at left

Figure 10-34 Neither water-repellent admixtures in the units and mortar nor multiple coats of field-applied water repellent can prevent this type of joint from leaking.

The IBC and MSJC Codes have stringent requirements for cavity wall ties. The two-piece adjustable ties of $^{3}/_{16}$-in.-diameter (W2.8) wire must be spaced at a maximum of 16 in. on center vertically and horizontally, providing one tie for every 1.77 sq ft of wall area. Rigid rectangular or Z ties of $^{3}/_{16}$-in.-diameter (W2.8) wire are permitted a maximum spacing of 24 in. on center vertically by 36 in. on center horizontally, with one tie for every $4^{1}/_{2}$ sq ft of wall area because the ties are stiffer than adjustable ties. Rectangular ties are for use with hollow masonry units, and Z ties for use with solid masonry units. Rigid ties should be limited to use in

- Cavity walls where the backing and facing wythes
  - Are of the same type of masonry with similar expansion and contraction characteristics
  - Are laid up at the same time
  - Are not separated by cavity insulation
  - Are constructed of units which course out at the same heights
- Multi-wythe walls grouted and reinforced so that backing and facing wythes react together under applied loads (i.e., composite walls)

When concrete masonry is used as the backing wythe in a cavity wall, the joint reinforcement required to control shrinkage cracking can be outfitted with adjustable ties to connect to a facing wythe of clay or concrete masonry. Three-wire joint reinforcement and joint reinforcement with fixed tab ties can also be used to connect the wythes of some types of cavity walls (see Chapter 7), but they do not provide as much flexibility for differential movement as adjustable ties. Spacing requirements for different types of wire ties are covered in Chapter 12.

10.5.1 Composite Walls

Because of the differential moisture shrinkage of concrete masonry and moisture expansion of clay masonry, contemporary composite walls most often consist of backing and facing wythes of the same material, that is, a concrete masonry backing with concrete masonry facing or a brick backing wall with a

brick facing. Composite walls may be laid with the backing and facing wythes separated only by a $^3/_8$-in. or $^3/_4$-in. collar joint which is filled with mortar as the wall is built. Most composite walls, though, are constructed with a wider space between the wythes, which can be grouted in low lifts as the wall is built or in high lifts after several courses or an entire story height is built (see Chapter 12 for grouting procedures). When the wythes of composite walls are laid contiguously, they may be bonded together by overlapping masonry headers or connected with rigid metal ties or metal joint reinforcement. Code requirements for spacing of masonry headers and metal ties are discussed in Chapter 12. Metal ties are less conducive to through-wall water penetration than masonry headers and are far more commonly used today, but composite walls of either kind are less resistant to rain penetration than cavity walls.

Composite walls resist rain penetration primarily by absorbing and storing moisture until it is evaporated back to the atmosphere. Like single-wythe walls, they are relatively unforgiving of design and construction errors because they too lack the redundant protection of a drainage cavity. For this reason, cavity walls are more suitable for exterior envelope applications. Composite walls can provide loadbearing capacity combined with finished masonry surfaces on both sides for interior applications (*see Fig. 10-35*).

10.5.2 Cavity Walls

Cavity walls are among the strongest and most durable of exterior building wall systems and are often the first choice for educational buildings, municipal buildings, government buildings, and others which will have a long service life. Although they may consist of brick backing and facing wythes or concrete masonry backing and facing wythes, cavity walls are most often constructed with concrete block as the backing wall and brick as the facing. The open cavity between the two wythes of masonry facilitates drainage of penetrated moisture when it is properly fitted with flashing and weeps. The wire ties used to connect the wythes are less prone to transferring moisture from the outer to inner surfaces than multi-wythe walls connected with masonry headers. Wire ties also create less thermal bridging than masonry headers, and the cavity between wythes can be partially filled with insulation for better overall thermal resistance and energy efficiency.

Two-piece adjustable ties permit differential thermal and moisture movements between the backing and facing wythes of a cavity wall. When constructed of dissimilar materials such as concrete and clay masonry, this differential movement can be significant. A concrete masonry backing wall experiences permanent moisture shrinkage as the latent moisture from the manufacturing process evaporates, and a clay masonry facing experiences permanent moisture expansion as the brick reabsorbs atmospheric moisture after it is fired (see Chapter 9). These opposing movements can be accentuated when cavity insulation increases the temperature differential between inner and outer wythes. Chapter 12 discusses the many ways in which masonry cavity wall wythes can be connected with adjustable ties. Regardless of the type of connector used, adjustable ties are limited to a maximum vertical offset of $1^1/_4$ in., and maximum play of $^1/_{16}$ in. (*see Fig. 10-36*).

In most areas of the United States, the exterior brick wythes of cavity walls should be constructed of Grade SW units, because the facing is isolated from the rest of the wall and therefore exposed to temperature extremes as well as driving rain. Type N mortar is suitable for most cavity wall construc-