Recommended Control Joint Spacing For Above Grade Exposed Concrete Masonry Walls§‡	
Length to Height Ratio	Spacing Between Joints (ft.)
1-1/2	20

§ Table based on 9 gauge horizontal joint reinforcement spaced 16 in. on center.
‡ Spacing based on experience over wide geographical area. Adjust spacing where local experience justifies, but not to exceed 20 ft. on center.

Figure 10-47 Control joint spacing for concrete masonry veneers. (*From National Concrete Masonry Association,* TEK Bulletin 10-4, *NCMA, Herndon, VA.*)

ommended in *Fig. 10-47*. Joint reinforcement may be omitted in CMU veneers if a sufficient number and spacing of control joints are provided to allow for adequate shrinkage crack control.

10.6.4 Stone Veneer

There are two basic types of stone veneer: (1) rubble or cut stone laid in mortar beds, and (2) thin stone slabs mechanically or adhesively attached. Mortar bed construction is generally used in low-rise residential and commercial buildings (*see Fig. 10-48*). The stone may be laid up against a backing of concrete, wood or metal studs, or unit masonry with wire or corrugated sheet metal anchors. The connections must be flexible enough to compensate for the irregularities of mortar bed height. Anchors should be spaced a maximum of 32 in. on center horizontally and 18 in. on center vertically as for other veneer, with the same maximum of 2.67 sq ft per anchor. Metal anchors must have $^{5}/_{8}$-in. mortar coverage at the outside face of the wall to prevent rusting and corrosion. Type N mortar is recommended.

Stone slab veneers are used as cladding on commercial buildings of low-, medium-, and high-rise construction. The total area of each stone slab depends on the type of stone and its thickness. The IBC requires a 2-in. minimum thickness and limits each slab to a maximum of 20 sq ft. All anchoring systems must be designed to resist a horizontal force equal to twice the weight of the veneer. Some types of stone are drilled around the perimeter for insertion of corrosion-resistant metal dowels. Dowels may be spaced no more than 18 to 24 in. on center, with a minimum of four for each stone unit. Each dowel is secured to the backing with wire or sheet metal anchors (*see Fig. 10-49*). The space between the veneer and the backing surface may be spot-bedded at anchor locations and for alignment. Stone slabs may also be sawed or kerfed at the edges to receive bent metal strap anchors (*see Fig. 10-50*). Carelessly cut kerfs can propagate cracking, and unless filled with a compatible elastomeric sealant, may also retain water. Face joints are usually also filled with an elastomeric sealant rather than with mortar, which might be subject to shrinkage cracking and subsequent moisture penetration (*see Fig. 10-51*). The sealant provides a weather-resistant joint and also permits slight movement of the units to relieve stress.

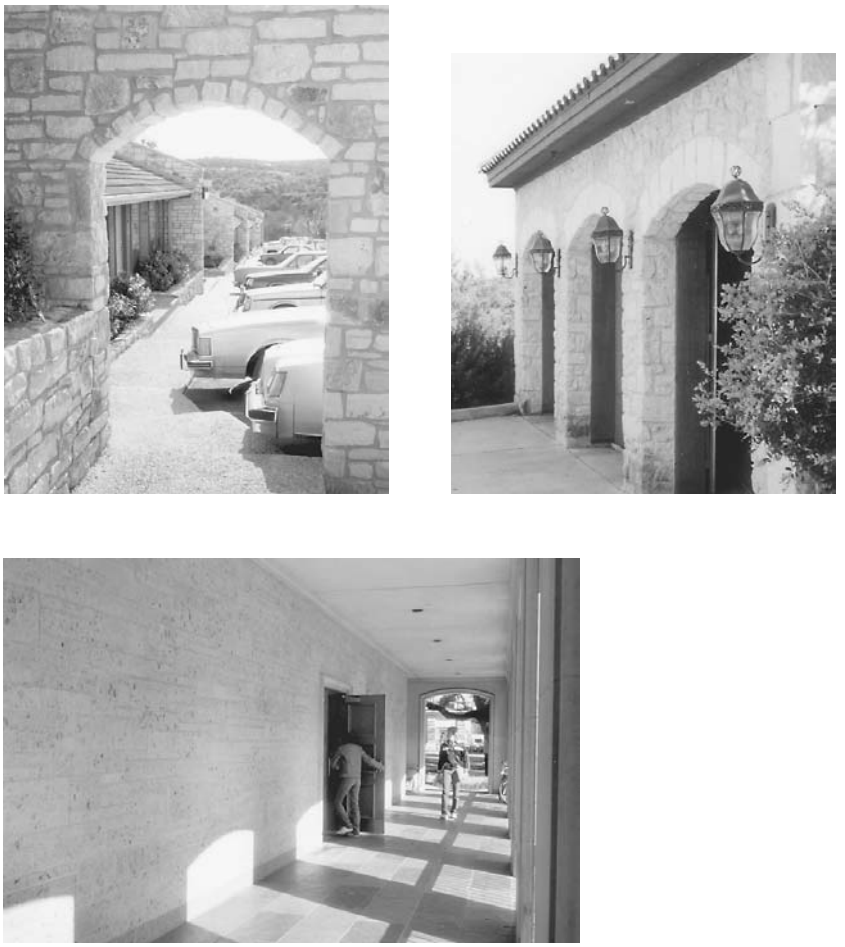

Figure 10-48 Mortar-bedded stone veneer.

Joint size should be carefully calculated to assure proper sealant performance while accommodating movement and fabrication tolerances (see Chapter 9). Only non-staining sealants compatible with the stone should be used, and stainless steel anchors are recommended.

The design of thin stone cladding systems and anchorages is a very specialized field requiring the services of an engineer or architect experienced in this technology. Specifications should require conformance with ASTM C1242, *Guide for Design, Selection and Installation of Exterior Dimension Stone Anchors and Anchoring Systems,* to assure minimum standards of performance, and designs should be based on recommended factors of safety. Some experts have called safety factors "factors of ignorance" because they are traditionally larger when loads and stresses are uncertain, when the material strength is highly variable, and when the material is not very forgiving. Safety factors for stone have always been very conservative compared to those for ductile materials such as steel. One reason for the conservatism is that stone is a natural material rather than a closely controlled, manufactured product, so physical properties can vary widely, even for the same type of stone from the same quarry (see Chapter 5). Some stones also lose strength after repeated heating-cooling and freeze-thaw cycles, and others gain or lose strength with wet-dry cycles.