TEK NOTE

Design of Concrete Masonry Veneer

November 2019

This technical bulletin discusses the application of concrete masonry units in anchored veneer construction. Concrete masonry can provide a durable aesthetically pleasing exterior façade over various backing surfaces for a variety of building types. This bulletin focuses on the control of non-structural cracking of concrete masonry veneer to maintain the appearance and water resistance desired.

Cracking in buildings and building materials results from restrained movement. The two primary causes of movement of concrete masonry are temperature change and change in moisture content. In most cases movement of building materials is inevitable and therefore the primary design approach is to accommodate movement.

Temperature change causes all commonly used building materials to expand and contract. Veneer construction is more susceptible to large temperature differentials due to its isolation from the conditioned space. Additionally, where materials of different thermal characteristics are used together in construction, the design should account for potential differential movement.

Concrete masonry units (CMU), as any concrete product, are subject to shrinkage due to drying. Linear shrinkage of block is controlled by ASTM Standard Specification C-90 (ref.1), which places a limit on the maximum drying shrinkage percentage permitted. In the Pacific Northwest, it is recommended that the block density be medium weight.

Keeping the concrete masonry veneer as dry as possible will minimize moisture movement. During construction, in inclement weather, walls should be covered at the end of the workday. A mortar providing good bond strength and workability should be specified. Type N portland cement-lime mortar is adequate for veneer and aids in water resistance. Use tooled mortar joints when possible.

The wall should be sealed when completed with either a clear siloxane or silane-siloxane blend water repellent or an opaque elastomeric coating. If a clear sealer is used an integral water-repellent admixture should be specified for both the block and the mortar, primarily in the western regions of Oregon and Washington. Specifying proper veneer details including flashing and weep holes will ensure that any water penetrating the veneer will be diverted back to the exterior. See *Concrete Masonry Veneer Details* (ref. 2).

Control joints should be designed into the block veneer system to relieve tensile stresses by reducing restraint and permitting longitudinal movement. A panel length to height (aspect) ratio of 1.5 is recommended for spacing of control joints. (See **Figure 1**.) The maximum panel length (control joint spacing) recommended for concrete masonry veneer is 24 ft.

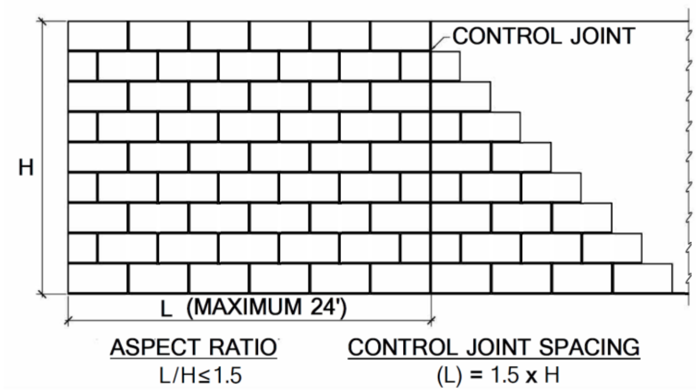

Figure 1. Control Joint Spacing

Brick has different movement properties than concrete masonry. **Where bands of clay brick are included in the veneer design they should be considered as restraints, changing the aspect ratio.** (See **Figure 2.**) Place joint reinforcement at the top and bottom of clay brick bands. If H_1 is less than 10 ft. place joint reinforcement in every CMU course and use a modular spacing of control joints near 16 ft. **This recommendation applies to all short sections of CMU veneer such as wainscots or beneath wall openings.**

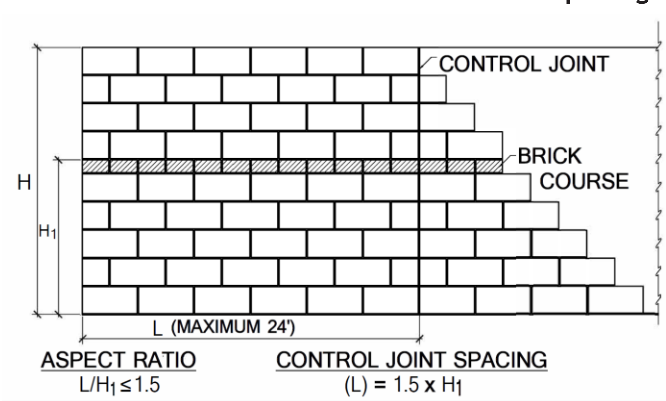

Figure 2. Control Joint Spacing

(for walls with clay brick banding)

In addition to spacing control joints based upon wall aspect ratio as discussed previously, it is recommended to provide joints at locations of stress concentration such as:

- at wall openings (see **Figure 3**.)
- at changes in wall height
- at movement joints in structural support elements
- within 16 in. of outside corners.

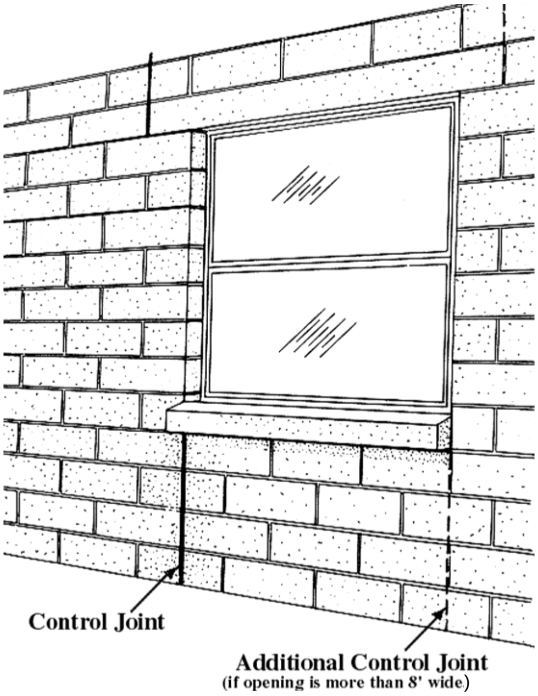

Figure 3. Control Joint at Window Opening

Horizontal joint reinforcement embedded in mortar aids in the control of cracking by increasing the tensile strength of a wall. It is recommended in *Control Joints for Concrete Masonry Walls* (ref. 3) that the minimum equivalent area of reinforcement be 0.025 in^2/ft. of height. This reinforcement area equates to 9 gauge ladder-type joint reinforcement at 16 in. on center. With half-high (4 in.) units the wire spacing reduces to 12 in. on center. The wire can be placed in alternate joints from the veneer ties. Joint reinforcement should be discontinuous at a control joint as illustrated in **Figure 4**.

The criteria for design of concrete masonry veneer systems is found in the *Building Code Requirements for Masonry Structures* (ref. 4). This latest code permits an increased maximum distance of $6^5/_8$ in. between the inside face of the veneer and the backing with specific types of ties.

Veneer ties should be corrosion resistant, and capable of transferring horizontal loads to the structural system. **Corrugated metal ties are not recommended.** All ties should be securely attached to the backup. Tie spacing may be increased by using the alternative design procedures in the masonry code.

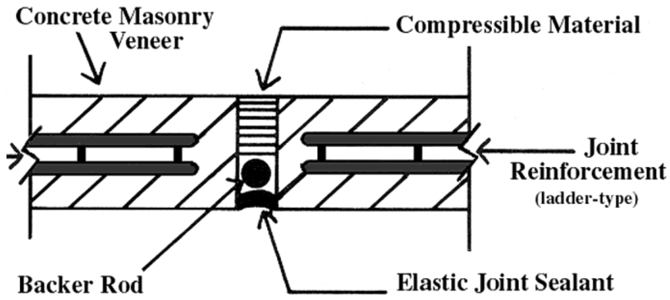

Figure 4. Typical Control Joint

The structural backup should be designed to provide adequate stiffness. The maximum deflection that should be permitted for the backup when considered alone at full lateral design load is recommended to be L/600 to L/720. Reinforced concrete masonry is an excellent backup wall for veneer. Its physical properties are identical to the concrete masonry veneer thereby eliminating differential movement. In addition, it provides a stiff backup with deflection amounts well below the recommended maximum limits. National Concrete Masonry Association technical bulletin 3-6C (ref. 5) provides additional design information.

REFERENCES:

1. ***Standard Specification for Loadbearing Concrete Masonry Units***, ASTM C-90-16a. American Society for Testing Materials, 2019.
2. ***Concrete Masonry Veneer Details***, TEK 5-1B. National Concrete Masonry Association, 2003.
3. ***Control Joints for Concrete Masonry Walls***, TEK 10-2D. National Concrete Masonry Association, 2019.
4. ***Building Code Requirements for Masonry Structures***, Chapter 12. The Masonry Society, TMS 402/602-16.
5. ***Concrete Masonry Veneers***, TEK 3-6C. National Concrete Masonry Association, 2012.

GUIDE SPECIFICATION

Concrete masonry units shall conform to ASTM C-90. Linear Shrinkage shall not exceed 0.065 percent. Unit density to be 110 pcf or greater.

Joint reinforcement shall conform to ASTM A-951 with wire conforming to ASTM A-1064. Coating shall be in conformance with ASTM A-153, Class B-2 for exterior walls.

Northwest Concrete Masonry Association
16300 Mill Creek Blvd, #208
Mill Creek, WA 98012
425.697.5298
www.nwcma.org