

# Selecting

# Masonry Anchors

# by the Code

By  
Dale Yarbrough &  
Paul Curtis

Masonry has long been the material of choice for residential veneers. However, over the past decade its use has increased significantly in commercial construction as well, especially in low-rise structures.

Unlike reinforced structural masonry, veneer applications are typically designed to ensure all external applied loads are distributed through the veneer to the backup structure utilizing masonry anchors and ties. For the anchorage to properly function and to ultimately ensure successful performance of the veneer, several key issues must be considered: location and spacing of the anchors, the anchors' physical characteristics, and proper construction detailing and installation.

## Design Requirements

Requirements for design and detailing of anchored masonry veneers are specified in Chapter 6 of the *Building Code Requirements for Masonry Structures* (ACI 530-02/ASCE 5-02/TMS 402-02).

Two basic general design requirements are provided by the Code:

- The exterior veneer and backup system must be designed and detailed to resist water penetration including covering the backup, as well as, the use of flashing and weeps.
- The veneer must be designed to accommodate differential movement.

Chapter 6 provides both prescriptive and alternative methodologies for the design of anchored masonry veneer. Basic prescriptive requirements and limitations of the Code are presented in *Table 1*. (Note: The term "tie" denotes a support utilized to attach masonry veneer to masonry backup, whereas "anchor" is defined as a support for attaching masonry veneer to other backup materials.)

Table 1: Basic Prescriptive Requirements for Anchored Veneer

Item	Provision
Limitations	Basic wind speed not to exceed 110 mph
Vertical support	The weight of the veneer must be supported vertically by noncombustible structural supports. (Exception: Anchored veneer may be supported vertically by treated wood foundations provided the height of the supported veneer $\leq$ 18 ft)
Height limitations	Height of veneer with wood frame backing limited to 30 ft at plate (38 ft at gable) above noncombustible foundation Height of veneer with steel-stud backup limited to 30 ft at plate (38 ft at gable) or shall be supported by noncombustible support relieving angles at each story above height limitation Height of veneer with masonry or concrete backing is unlimited. Note: For Seismic Performance Categories D, E, and F each floor must be supported independently
Support deflections	Deflections of vertical supports limited to $l/600$
Anchors/Ties	Anchors/ties may consist of corrugated sheet metal, sheet metal, wire, joint reinforcement, and/or adjustable types
Spacing	Anchors/ties consisting of adjustable two-piece, wire of size W1.7, (9 gage) and/or 22 gage corrugated sheet metal shall be limited to maximum spacing of one anchor per each $2.67 \text{ ft}^2$ All other anchors spaced at a maximum of one anchor per $3.5 \text{ ft}^2$ All anchors have a maximum spacing 32 in. horizontally, 18 in. vertically Additional anchors/ties required around openings and near edges.
Cavity limitations	The wall cavity is measured from the face of the backup to the inside of the veneer. Any insulation, sheathing, vapor barrier, and air space will be positioned within this space. This distance is limited to a maximum of $4 \frac{1}{2}$ ". The minimum air space within the cavity is 1". (Exception: Corrugated sheet metal anchors are limited to a maximum 1" cavity.)
Mortar joint	The thickness of the mortar joint shall be a minimum of twice that of the embedded anchor/tie thickness
Bonding	Veneer laid in other than running bond shall have additional joint reinforcement of size W1.7 (9 gage) spaced no greater than 18" o.c. vertically
Seismic areas	Additional requirements apply to Seismic Design Categories C thru F. (See Code for specifics)

Note: Should the specific conditions of the project preclude the use of the prescriptive requirements (i.e. base wind load is exceeded, cavity is greater than  $4 \frac{1}{2}$ ", etc.), the code allows an alternative method for the design of anchored veneers. The alternative method is based on the principals of rational design and as such requires the services of a registered professional.

## Selection Criteria

The selection and utilization of anchors and ties is specified by the Code and is dependent upon the type of backup material. *Table 2* presents the proper selection criteria.

## Materials

Physical characteristics of anchors and ties are prescribed within the Code, as well as the *Specification for Masonry Structures* (ACI 530.1-02/ASCE 6-02/TMS 602-02). Anchors and ties generally fall within five categories; corrugated, sheet metal, wire, two-piece adjustable, and joint reinforcing. All five types utilized for veneer applications must be protected from corrosion by galvanizing or epoxy coatings in conformance with the Specification. Anchors used in exterior wall applications should be hot-dip galvanized after fabrication or be constructed of stainless steel. (Note: Material selections for anchors and ties should be chosen with caution. Corrosion can occur at the contact point of dissimilar materials.)

## Corrugated Anchors

Though typically used for residential applications, corrugated anchors are allowed for use in commercial veneers. They must be a minimum of 7/8-inch wide, have a minimum thickness of 22 gage, have corrugation wavelengths and amplitudes in accordance with the Specification. They may not be utilized when the cavity dimension exceeds 1 inch. It is important to note that residential work allows 26 gage material. Bring a micrometer along for your inspections to verify the 22 gage material. The thickness must be over .030 inches for stainless and .036 for hotdip. These are usually the least expensive anchors to use and you get what you pay for: minimal tension strength and very little compression strength.



Table 2: Requirements for Anchor Selection

Backup	Anchor Selection
Wood	Any anchor type permitted
Steel (heavy and light gage)	Adjustable anchors only
Masonry	Wire, adjustable, or joint reinforcement
Concrete	Adjustable anchors only

## Sheet Metal Anchors

Sheet metal anchors are more commonly seen in commercial applications. However, due to their lack of adjustment, their appropriate use and value must be evaluated. Sheet metal anchors too must meet certain criteria as prescribed by the Code. They must be a minimum of 7/8-inch wide, have a minimum thickness of 0.06-inches (16 gage), and be bent, notched, or punched to provide equal performance in pull-out or push-thru. Unlike the typical corrugated wall ties, these anchors have been pre-bent in the factory, which will provide greater strength.



## Wire Anchors

Wire anchors are commonly utilized in both residential and commercial applications. The requirements of the Code for wire anchors are very simple: they must be a minimum wire size of W1.7 diameter (9 gage) and must have their ends bent to form a minimum of a 2-inch extension.



## Fastening Anchors to the Backup

The anchors should be fastened to the backup with products of similar metals. For **wood frame backup**, use corrosion-resistant nails that will penetrate at least 1¼-inch into the studs. Corrosion-resistant self-tapping metal screws that penetrate at least ½-inch into the stud should be used for **metal studs**. Use zinc screws with hotdip anchors and stainless screws with stainless anchors. The screw should incorporate a washer at the head of the screw to seal the hole created by the screw. With stainless, you will have a stainless screw drilling into a galvanized steel stud. The amount of moisture necessary to cause a galvanic reaction at that location is unlikely as long as the wall is properly designed. **Concrete and masonry backup** can use a variety of expansion anchors, Tapcons, or masonry expansion shield anchors. If there is insulation, sheathing, or a vapor barrier in your cavity wall, a suitable anchor must be chosen that will make positive contact with the backup and seal the hole so all loads are transferred without damage to the insulation or sheathing.

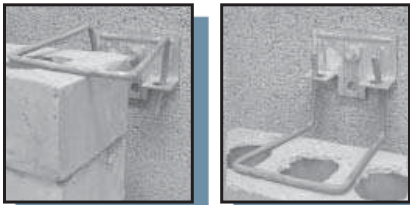


Steel stud screw with washer

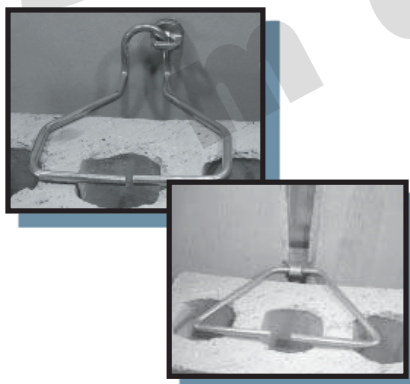
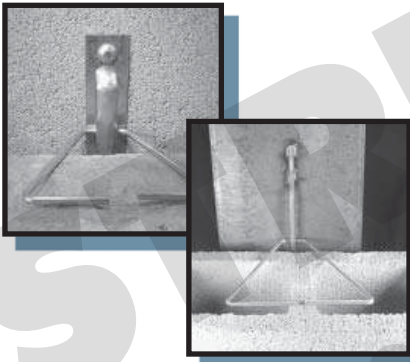
## Adjustable Anchors

Adjustable or “two-piece” anchors are quickly becoming the anchor of choice for most design professionals. The ability of the anchor to adjust to varying field conditions as well as the availability of a multitude of backup attachments allows the designer to choose just the right anchor for the application. The Code provides certain requirements for adjustable anchors. Specifically, adjustable anchors that contain sheet metal and/or wire parts

must meet the requirements for those types of anchors as detailed above. In addition, the connecting parts of the adjustable anchor must fit together in such a manner to prohibit more than 1/16 inch “play”, and must be detailed to prevent accidental disengagement caused by brick expansion. Anchors containing pintles must have two pindle legs of a minimum wire size of W2.8 (3/16-inch) and shall have a maximum offset of 1 ¼-inch.



*Pindle Legs have a maximum of 1 ¼-inch offset from the backup plate both above and below the slots.*



Note: Some manufacturers’ currently produce “single-leg” pintles for use in two-piece anchors. The Code, however, does not currently allow the use of single-leg pintles due to concerns relating to anchor instability and veneer deflection. As of the date of this publication, testing is being performed that may provide insight into the performance of single-leg pintles.

### **Joint Reinforcing**

Joint reinforcing is most commonly used when the masonry backup’s vertical coursing and the veneer’s vertical coursing are appropriately aligned. (Note: Selection of joint reinforcing must therefore be done with extreme caution. Adjustment is not permitted of the cross wires to accommodate mismatched coursing issues.) Either ladder or tab-type reinforcing is permitted by the Code. Cross wires must be welded to the longitudinal wires, be spaced at 16 inches on center maximum, and have a wire size of a least W1.7 (9 gage).

### **Anchor Performance**

Proper performance of veneer anchors and ties is directly related to the amount of embedment provided for in the selection, design, and manufacture of each type. The Code requires each type of anchor to extend a minimum of 1 ½-inch into the veneer mortar joint and must have at least 5/8-inch mortar cover on the outside (veneer face).

### **Field Observation**

The proper performance of veneer anchors and/or ties is based on many criteria as established above. However, none of the design selection elements will negate poor installation. Anchors and ties are typically installed by the mason, though some two-piece units may be partially installed by the framing crew. As such, it is best to perform observations during the actual installation of the veneer so any problems or misunderstandings encountered can be corrected immediately.

Typical issues to consider during veneer installation:

- Proper anchor utilization
- Certificate of Compliance Document (verifying anchor size and steel type.)

- Anchor spacing
- Sufficient mortar (grout) and proper anchor embedment
- Proper flashing(s) and weeps
- Alignment of joints for joint reinforcement coursing
- Joint Reinforcement must be installed simultaneously with veneer. Bending of the reinforcement to accommodate placement of the veneer later is prohibited.

Tips for observation:

- Carry a small magnet to determine proper material types (Type 300 series stainless in non-magnetic. Type 400 series stainless steel can be magnetic, however, it is less expensive than the 300 series and it doesn’t meet the code. A rare exception to this rule is machining of the 300 series, such as tapping a hole, may cause it to become magnetic.) If an anchor has been machined and is magnetic, the manufacturer should provide steel certificates verifying the 300 series.
- Check wood and steel framing back ups from the inside to insure anchors are properly attached to the framing members.
- Always carry a small measuring device and a flashlight (for verification of completed walls).

### **Conclusion**

Masonry veneers can be used successfully for commercial applications provided proper anchor selection, specific anchor detailing, and proper material selections are made by the design professional, and the installation of such is properly executed in the field. ■

*Dale Yarbrough, P.E. is a Consulting Engineer in Cheyenne, Wyoming.*

[www.level3da.com](http://www.level3da.com)

*Paul Curtis is President and 3rd generation Co-owner of Heckmann Building Products Inc., manufacturer of masonry anchors and ties.*

[www.heckmannbuildingprod.com](http://www.heckmannbuildingprod.com)