Wall cavities: Design vs. construction

It's important to understand how much and which types of variation from the actual design are acceptable

PHOTO 1

The mortar bridging and impaction in this 2-inch airspace are unacceptable.

By Walter Laska

One thing is for sure, buildings are never constructed exactly as they are designed. Tolerances, differences in workmanship, and unrealistic expectations are all responsible for variations that exist between the actual design and completed construction. No masonry standards specifically regulate how much and which types of variation from design are allowed within a cavity wall. But recognizing which variations are acceptable is the key to providing a cavity that functions properly.

Cavity design

A cavity commonly consists of two components: insulation board and an airspace. It is essential to install rigid board insulation in many types of structures, such as industrial buildings and public institutions, where an exposed interior CMU wall is desired.

The current edition of the Masonry Standard Joint Committee (MSJC)'s Building Code Requirements for Masonry Structures (ACI 530-95/ASCE 5-95/TMS 402-95) limits the maximum width of a cavity to 4½ inches. (If this width is exceeded, a structural analysis of the wall must be performed.)

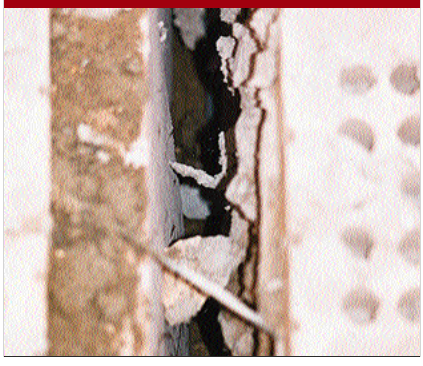
Two conditions ultimately will determine the makeup of a cavity —the size of the airspace (drainage space) and the required R-value of the wall. The airspace should be 1½ to 2 inches wide—large enough that masons can keep it mostly free of mortar. An airspace less than 1½ inches wide is difficult to keep clear of mortar droppings, and an airspace less than 1 inch wide is almost impossible to keep clean. (You can specify a narrower airspace under special conditions, such as masons beveling the mortar bed; but this should be discussed before construction begins to make sure the masonry contractor is familiar with the technique.)

In addition to mortar droppings, the airspace can be affected by the misalignment of rigid board insulation. Some misalignment always occurs, but it can be minimized by specifying that the board be mechanically fastened or adhered to the CMU backup.

Cavity construction

There are three ways in which a constructed cavity will vary from

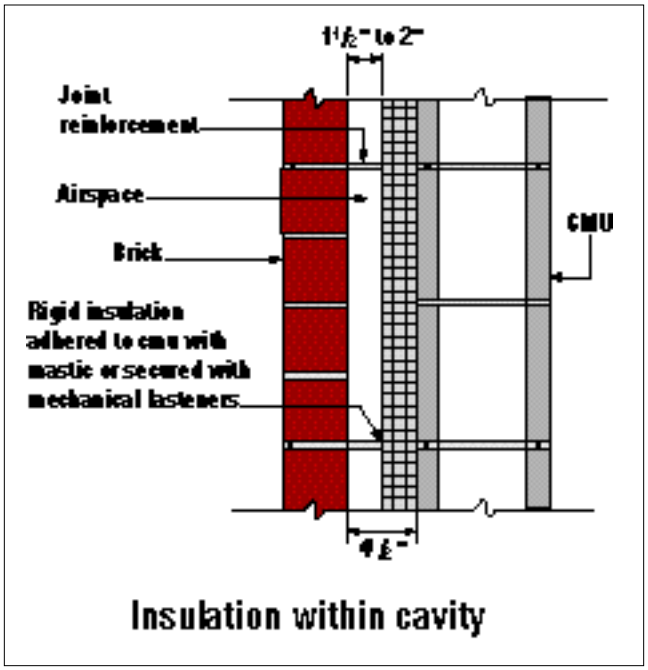
PHOTO 2



These mortar extrusions in a 2-inch airspace do not obstruct the downward flow of water.

the design detail:

1. Allowable construction tolerances. Some decrease in cavity size is acceptable due to allowable construction tolerances, such as the outer wythe of masonry being out-of-plumb. The MSJC Specification for Masonry Structures (ACI 530.1-95/ASCE 6-95/TMS 602-95) allows for the outer masonry wythe to vary from plumb by ±¼ inch in 10 feet or ±⅜ inch in 20 feet, with a maximum allowance of ½ inch. This means that an airspace specified to be 1½ inches wide can be as narrow as 1 inch at some points and would be considered acceptable. However, if the cavity is excessively narrow at numerous locations, this would not be acceptable.



The design of a masonry wall's cavity should consider both the thickness of the insulation board needed to attain the desired R-value and the amount of airspace needed for satisfactory drainage.

2. Mortar droppings and extrusions. Another variation from the design detail is that mortar droppings and extrusions inevitably will occur in the airspace regardless of its width. Mortar in an airspace is considered excessive when it impedes the flow of water down to the wall's flashing and weep-hole system. Mortar extrusions and droppings that form bridges across an airspace are not acceptable (photo 1) because they create avenues for penetrating water to flow into the interior.

An airspace can contain mortar extrusions and droppings—but still be acceptable—if the mortar doesn't completely bridge the airspace (photo 2). You can test for this condition by pouring water down the cavity and examining the wall to see if it drains properly. Occasionally, a cavity can be constructed that is nearly free of all mortar (photo 3), but this can't always be expected.

3. Misalignment of insulation board. The vertical misalignment of rigid board insulation is the other common variation from the cavity design. Some variation is inevitable due to construction and material tolerances. But it is not acceptable for the board insulation to be so misaligned that it exposes the cavity to water bridging (photo 4). Although the insulation doesn't have to be installed perfectly, fitting the board tightly to the backup system will produce an unbridgeable airspace (photo 5).

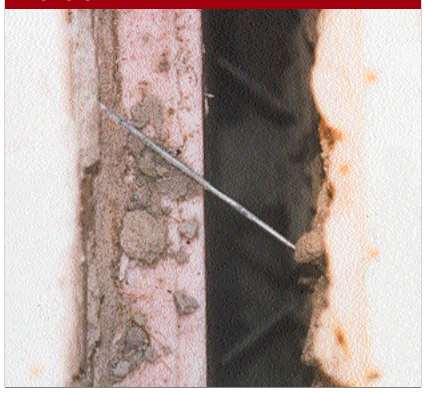
Detail to minimize problems

Walls constructed with cavities can vary greatly from the design detail. A designer should be aware of the bricklaying techniques and logistics involved in constructing a clean airspace. A designer also should be aware of the allowable construction tolerances for masonry before determining the cavity width.

Future problems then can be avoided by designing a large enough airspace in the cavity. Specifying that rigid insulation be secured to the backup wythe also will minimize problems. Proper construction of cavity walls ultimately can be assured through periodic jobsite observations during construction.

Walter Laska is the senior consultant and president of Masonry Technologies Inc. in Downers Grove, Ill., and is a technical consultant for Masonry Construction.

PHOTO 3



This airspace is nearly free of mortar droppings.

PHOTO 4

Misaligned rigid board insulation exposes this airspace to water bridging.

PHOTO 5

This insulation board is acceptably aligned.