THE BRICK INDUSTRY ASSOCIATION
TECHNICAL NOTES on Brick Construction
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Technical Notes 21C - Brick Masonry Cavity Walls - Construction
October 1989

Abstract: This *Technical Notes* describes proper techniques which should be used during the construction of brick masonry cavity walls. These techniques cover: storing materials, completely filling all mortar joints, placing wall ties, flashing and weep holes, keeping the cavity clean and protecting the wall from weather during construction.

Key Words: brick, **cavity walls**, **flashing**, joints, mortar, ties, weep holes, **workmanship**.

INTRODUCTION

This fourth in the series of *Technical Notes* devoted to brick masonry cavity walls covers good construction practices. Other *Technical Notes* in this series are concerned with cavity walls in general, how to insulate them, and how to properly detail them.

The proper construction of a brick masonry cavity wall is as important to proper performance as are the design, the use of quality materials, and proper detailing. Proper construction may not be achieved if it is considered of secondary importance by the designer. Adequate supervision may be necessary to ensure proper construction.

GENERAL

In the construction of a cavity wall there are no changes required in basic bricklaying techniques, only modifications of practices commonly used in the construction of any brick masonry wall. The fundamental principle in a cavity wall is that there shall be no bridge of solid material capable of carrying water across the minimum 2-in. (50 mm) cavity space. Therefore, the construction of two separate wythes, with a clean cavity, is of prime importance. This *Technical Notes* will discuss certain construction practices which are necessary for brick masonry cavity walls to perform successfully.

WORKMANSHIP

The importance of the workmanship used in constructing masonry has been stressed by many, sometimes to the point that it may appear that workmanship alone is responsible for the performance of masonry walls, regardless of the wall design, detailing, or the materials used. While this is by no means true, good workmanship is a very important factor in the construction of high performance masonry. See *Technical Notes* 7 Series for more information on moisture resistance of masonry walls.

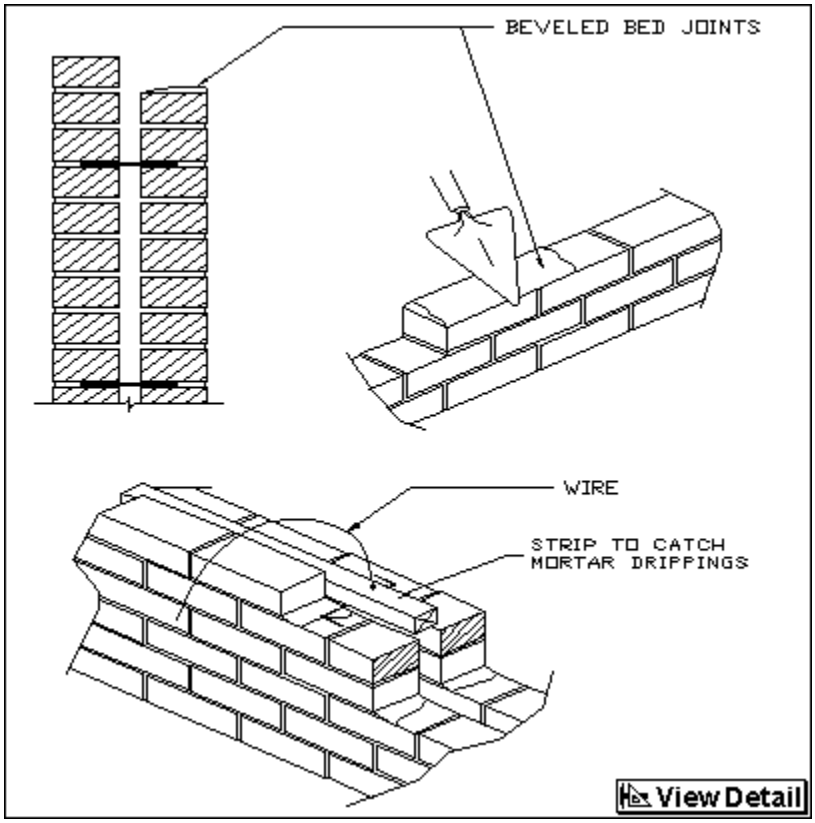
Complete Filling of All Mortar Joints

Extensive laboratory tests at the National Institute of Standards and Technology, formerly the National Bureau of Standards, and elsewhere, as well as hundreds of observations of masonry buildings, indicate that to obtain good masonry performance, there is no substitute for the complete filling of all mortar joints that are intended to receive mortar. Partially filled mortar joints result in leaky walls, reduce the strength of masonry, and may contribute to spalling due to freezing and thawing in the presence of excessive moisture. Therefore, all joints intended to receive mortar in both the exterior and interior wythes should be completely filled as the brick are laid.

Keeping the Cavity Clean

It is vital that the cavity be kept clean of mortar droppings and other foreign materials. If mortar falls into the cavity, it may form "bridges" for moisture passage, or it may fall to the flashing, blocking the weep holes.

Over the years many methods have been developed and considerable time and discussion have been devoted to the proper method to use in keeping the cavity clean. One method is to take a wooden or metal strip, slightly smaller than the cavity width, and place it in the air space. This strip rests on the wall ties as the wall is built. Wire or rope is attached to the strip. Then, as the brickmason builds the wall, this strip is easily lifted out. Before the next row of ties is placed, any mortar which may have fallen into the cavity is removed (Figure 1).



Keeping the Cavity Clean

FIG. 1

Another method is to place every third brick or so in the course above the flashing of the exterior wythe dry and wedge it into proper position so that it can be removed for final cleaning of the cavity. Mortar droppings at the base of the cavity can be easily removed and weep holes provided when the brick are mortared in the wall.

In addition to the above mentioned methods of cleaning the cavity, the brickmason can use techniques that, if properly applied, should eliminate a considerable amount of mortar falling into the cavity in the first place (Figures 2 through 7).

1. After spreading the mortar bed, the brickmason should bevel the cavity edge with the flat of the trowel (Figure 2). When mortar is spread in this manner, very little will be squeezed out of the bed joints into the cavity when the units are laid (Figure 3).

2. The brick units are next rolled into place, keeping most of the mortar on the outside (Figures 4, 5 and 6).

3. After the brickmason has placed the unit on the bed joint any mortar fins protruding into the cavity should be flattened over the backs of the unit, not cut off (Figure 7). This prevents the mortar from falling into the cavity and provides a smooth surface which will not interfere with insulation materials which may be placed in the cavity.

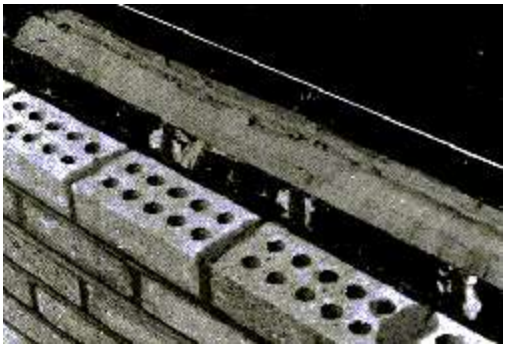


FIG. 2

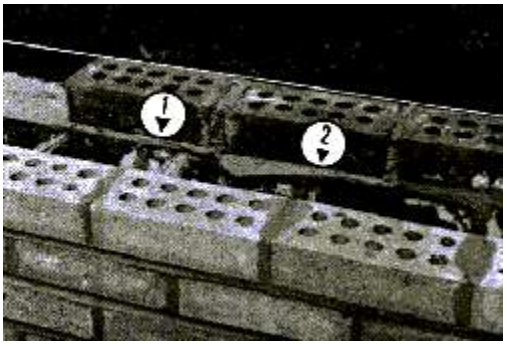


FIG. 3

FIG. 4

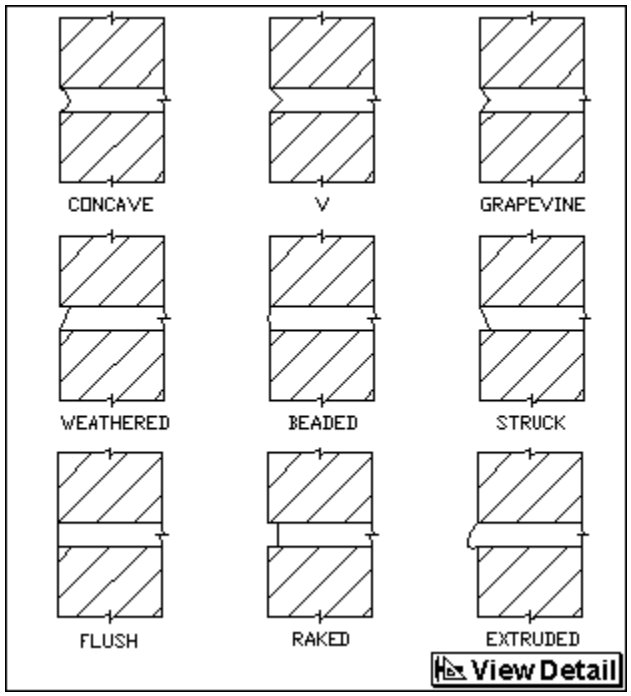
FIG. 5

FIG. 6

FIG. 7

Tooling

Weather tightness and textural effect are the basic considerations of mortar joint finish selection and execution. Properly "striking" or "tooling" the joint helps the mortar and brick units bond together and seal the wall against moisture. Nine common joint finishes are shown in Figure 8 in order of their decreasing weather tightness. Compression of the mortar makes the concave, V, and grapevine joints the most weather tight and acceptable to use. The remaining six joint types are not recommended for exterior use. All holes in the mortar joints should be filled. Joints should be tooled when the mortar is "thumbprint" hard.



Typical Mortar Joints

FIG. 8

Weep holes

Weep holes must be placed at the base of the cavity and at all other flashing levels. They provide a means of draining away any moisture that may have found its way into the cavity. Weep holes must provide a clear access to the cavity and must be placed directly on the flashing for proper drainage.

Weep holes can be easily created or installed by various methods. In order of effectiveness these are:

1. Eliminating each second or third head joint.

2. Inserting oiled rods, rope or pins in the head joint at a maximum of 16 in. (410 mm) o.c. and removing before final set of the mortar.

3. Placing metal or plastic tubing in the head joint at a maximum of 16 in. (410 mm) o.c.

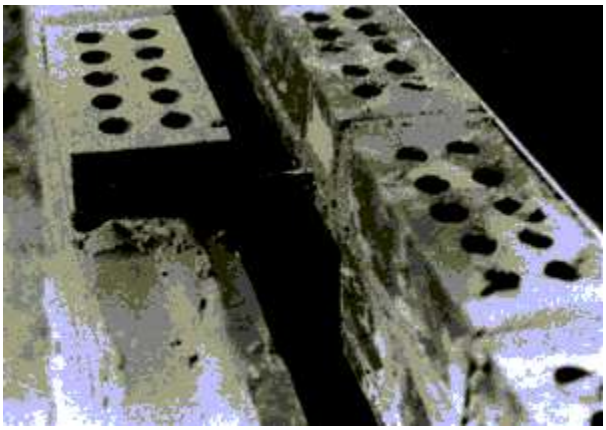
4. Placing sash cord or other suitable wicking material in the head joint at a maximum of 16 in. (410 mm) o.c.

Insulation Placement

The installation of insulation in a cavity wall is covered in *Technical Notes* 21A Revised. In addition, the literature of the insulation manufacturer should be consulted before beginning construction.

Tie Placement

In a properly constructed cavity wall, both wythes of masonry must be adequately and properly tied together. The main concern to the designer is assurance that all of the ties are in place and remain operative, firmly embedded in and bonded to the mortar. To achieve this, the two wythes of the cavity must be laid with completely filled bed joints, and the ties must be in the correct position so that later disturbance of the wall assembly is unnecessary. There exists extensive data showing that wall ties have excellent tying capacity if they are well embedded in the masonry, and also that the cavity wall is a weak structural member if few working ties must do the job of many (Figure 9).



Cavity wall metal ties are embedded in bed joints as units are laid.

FIG. 9

There must be at least one 3/16-in. (4.76 mm) diameter steel wall tie in every 4 1/2 sq ft (0.4 m^2) or #9 gauge wire for each 2 2/3 sq ft (0.25 m^2) for a cavity wall whose cavity is no greater than 4 in. (100 mm). If the cavity width is greater than 4 in. (100 mm), a wall tie analysis should be performed. The most common type of wall tie for brick

masonry construction is the Z tie. In addition, there are the rectangular and U-shaped ties which are to be used when the backup units are hollow masonry units with cells laid vertically.

From a performance standpoint, the most important factors for wall ties are:

1. Being corrosion resistant.

2. Placing ties at proper spacing. Spacing of ties should be reduced by one half for ties with drips. Crimping of the metal ties to form a drip is not necessary, and will decrease the strength of the tie.

3. Full bedding of the bed joint and placing the wall tie in the mortar 5/8 in. (16 mm) from either edge of the brick.

Horizontal Joint Reinforcement. Prefabricated horizontal joint reinforcement may be used to tie the interior and exterior wythes. Truss type joint reinforcement should never be used to tie the wythes of a brick and block cavity wall together. Instead, ladder type reinforcement which allows for the in-plane movement between the wythes is recommended.

Horizontal joint reinforcement is not usually required in brick masonry walls since they are not subject to shrinkage stresses. The use of horizontal joint reinforcement makes the placing of the cavity wall ties more convenient and there is less concern over omitting them.

PROTECTION

Storage of Materials

The manner in which materials are stored at the construction site may have an influence on their future performance. Materials should be stored to avoid wetting by rain or snow, and also avoid contamination by salts or other matter which may contribute to efflorescence and staining.

Masonry Units. Masonry units should be stored off the ground to avoid contamination by dirt and by ground water which may contain soluble salts. They should also be covered by a water-resistant membrane to keep them dry.

Cementitious Materials. Cementitious materials for mortar should be stored off the ground and under cover.

Sand. Sand for mortar should also be stored on high ground, or ideally, off the ground to prevent contamination from dirt, organic materials and ground water, any of which may contribute to efflorescence and may be deleterious to mortar performance. In addition, it is advisable to store sand and other aggregates under a protective cover. This will avoid saturation and freezing in cold weather.

Flashing. Flashing materials should be stored in places where they will not be punctured or damaged. Plastic and asphalt coated flashing materials should not be stored in areas exposed to sunlight. Ultraviolet rays from the sun break down these materials, causing them to become brittle with time. Plastic flashing exposed to the weather at the site for months before installation should not be used. During installation, flashing must be pliable so that no cracks occur at corners or bends.

Protection of Walls

Rain. Masonry walls exposed to weather and unprotected during construction can become so saturated with water that they may require weeks, or even months (depending upon climatic conditions), to dry out. This prolonged saturation may cause many of the slightly soluble salts to go into solution, thus raising the possibility of efflorescence. Such conditions may also contribute to the contamination of the masonry with soluble salts from elsewhere in the construction (concrete, concrete block, plaster, trim, etc.).

During construction, all walls should be kept dry by covering the top of the wall with a strong, water-resistant membrane at the end of each day or shutdown period. The covering should overhang the wall by at least 24 in. (610 mm) on each side, and should be secured against wind. The covering should remain in place until the top of the cavity wall is completed or protected by adjacent materials.

Freezing. Leaky walls can sometimes be attributed to the freezing of mortar before it has set, or the lack of protection of materials and walls during cold weather construction. Therefore, when building in cold weather, all materials and walls should be properly protected against freezing. This involves the following items: storing of materials, preparation of mortar, heating of masonry units, laying precautions, and protection of work. *Technical Notes* 1 Series, "Cold Weather Masonry Construction," contains recommendations for construction and protection of masonry during freezing weather. ACI-ASCE 530.1 Specifications for Masonry Structures also has requirements for cold weather construction.

SUMMARY

This *Technical Notes* provides the basic information required for good construction of brick masonry cavity walls.

The information and suggestions contained in this *Technical Notes* are based on the available data and the experience of the technical staff of the Brick Industry Association. The information and recommendations contained in this publication must be used in conjunction with good engineering judgment and a basic understanding of the properties of brick masonry and related construction materials. Final decisions on the use of the materials and recommendations contained in this publication are not within the purview of the Brick Industry Association and must rest with the project architect, engineer, owner or all.