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The Bonding of Brickwork

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BY

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THE BONDING OF BRICKWORK

THIS volume deals solely with the bonding of brickwork and has been compiled with the object of providing information for the use of students, craftsmen, foremen and others engaged in the Building Industry, and it is hoped that the professional men who direct the work of the Industry, or are associated with it, will also find the book useful for reference.

The volume contains over five hundred examples of bonding, embracing the principles of setting out bonds for a great variety of conditions and different classes of work.

In the study of bonding it is necessary to obtain considerable practice in arranging the bricks to obtain a desired result. This can be done either by drawing or by actually building alternate courses by patterns or by model bricks.

At the commencement of the illustrations to this volume there is given a set of line drawings, showing, to a scale of 1 inch to 1 foot, the "bed outlines" of the various forms of cut brick which are utilised for the purpose of obtaining the "bond" under practical conditions. These bed outlines are intended to illustrate patterns, which should be re-drawn to a large scale—or even full size—and cut out in stout cardboard, in such numbers as to allow alternate courses of any example to be set out, one upon the other. In a similar way any new idea of bonding may be tried, or any form of bonding demonstrated.

At the same time the student should not neglect drawing, and many examples should be drawn to scale until facility is obtained in arranging the brick outlines on the paper to an accurate scale to ensure a satisfactory bond.

The practice drawings need not have double-line joints as in the book illustrations. The double lines are given for making the outlines perfectly clear; *for practice, the joints should be done in single lines.*

At the end of the book will be found a number of examples for practice in bonding. These consist of the outlines of portions of straight walls, piers, quoins, junctions, irregular and broken plans, etc. In each case the student should attempt to fill in the appropriate setting out of the bricks in both Old English and Flemish bonds.

In practice all kinds of variations in form or in dimensions will occur. The student should observe examples which differ from his previous studies, make a record of their form and dimensions, work out the bond and add the examples to his collection.

BOND

Bond, in relation to brickwork, means the arrangement of the bricks whereby:

(*a*) an adequate distribution of load is obtained through the mass of brickwork;

(*b*) the mass is tied together so that any individual brick is not easily displaced;

(*c*) some uniform and pleasing arrangement of the faces of the bricks appears on the face of the wall.

Bricks vary in size in different parts of the country, but they approximate to a standard of 9″ long, $4\frac{1}{2}$″ wide and 3″ thick, measured when laid in mortar, centre to centre of the joints. Northern and Midland bricks often measure $9\frac{1}{4}'' \times 4\frac{5}{8}'' \times 3\frac{1}{4}''$ centre to centre of the joints when laid. In every case the $9'' \times 4\frac{1}{2}''$ dimension is the normal *bed* of the brick—laid horizontal—for ordinary walling, and all units cut for bonding purposes, as shown in the illustration facing page 24, maintain their thickness of 3″ (or other thickness), the line pattern for cutting being the form of the *bed*.

It should be noted that for obtaining accurate bonding—maintaining a uniform overlap of brick upon brick—the length of the brick must be equal to "twice the width plus the thickness of a mortar joint".

Kinds of Bond

The two main bonds in use for good class work are *Old English bond* (or English) and *Flemish bond*. Their distinctive difference is in the face appearance; English bond shows alternate *courses* of headers (ends) and stretchers (sides) in elevation; Flemish bond shows *alternate bricks in the same course* as header and stretcher, and the header of one course must lie in the centre of the stretcher in each of the courses above and below it.

The difference is illustrated by Figs. 1 and 2.

There are several bonds which have acquired special names amongst builders, but they are all variations upon the Old English and Flemish bonds. These include English garden and Flemish garden wall bonds; in the former, Fig. 3, three to five courses of stretchers are used to one course of stretchers, and in the latter, Fig. 4, one header is succeeded by three (or more) stretchers in the same course.

Stretching bond, Fig. 5, has all bricks laid as stretchers, giving the maximum overlap of $4\frac{1}{2}''$ in the direction of the length. It is suitable for walls $4\frac{1}{2}''$ thick, and for facing thick walls with a special kind of facing brick. When used for the latter purpose, bond between facing and backing is obtained by metal ties embedded in the joints.

Heading bond, Fig. 6, is sometimes used for effect in panelled work and the like, and is also particularly suited to work which is curved on plan, the short length of the header face allowing a reasonable approach to the required curve (if not too sharp) without cutting the bricks.

Brick-on-edge heading bond, Fig. 7, and brick-on-edge stretcher bond, Fig. 8, are appropriate for thick and thin walls respectively. The wall of Fig. 8 is only 3″ thick (sometimes employed for partitions), while the wall of Fig. 7 may be of any thickness from 9″ upwards and bonded similarly to other walls, on plan.

Dutch bond, Fig. 9, avoids the use of closers in starting the bond. Three-quarter bats are used in the stretching courses to obtain the position of the first stretcher joint, and a header is inserted after this three-quarter bat *in alternate courses* which breaks the continuity of the perpends (vertical joints) so that they occur only in alternate stretching courses.

English cross bond, Fig. 10, inserts a header after the first stretcher in each stretching course.

Mixed garden-wall bond, Fig. 11, has a true Flemish course mixed with three (or more) courses of stretchers.

Wood-slip bonding, Fig. 12, is done by inserting a length of thin wood slip into a horizontal joint to improve the longitudinal bond, which, except in stretching bond walls, is only an effective $2\frac{1}{4}''$ against sidewise withdrawal. Wood slips are effective and allow of nailed fastenings, but are liable to decay and not much used in modern work. If used at all, they should be well-seasoned dry material, and should be bedded in cement mortar which hardens and dries out speedily.

For modern *bonding* wire mesh is employed.

English Bond

Figs. 13 to 16 show walls $9''$ to $22\frac{1}{2}''$ thick, with square stopped ends—or returns. In the $22\frac{1}{2}''$ wall—Fig. 16—the irregularity of the arrangement of the stopped ends should be observed. This bond is suitable where the lower edges of the plans shown represent the face of the wall—to be seen—and assumes that the back will be plastered or occupy an unimportant position. Alternative methods are available, e.g. Fig. 16 (*a*), but they involve more cutting and are not so efficient for supporting load; they may, however, improve the face appearance.

Flemish Bond

Figs. 17 to 20 show walls $9''$ to $22\frac{1}{2}''$ thick, with square stopped ends—or returns. It will be observed in Fig. 18—$13\frac{1}{2}''$ wall—that a bonding unit occurs which is $13\frac{1}{2}''$ square with a half bat in the centre.

The length of the wall consists of a number of such units plus "one brick length". A perfect bond is obtained on the face of the wall, but not on the back, an additional header being required to fill up in each course.

The same kind of irregularity occurs in the $22\frac{1}{2}''$ wall—Fig. 20—one face only being perfectly bonded.

English Bond with Flemish Face

This bond is sometimes called "single Flemish". Figs. 21 to 24 show examples of this bond for walls $13\frac{1}{2}''$ to $36''$ thick.

Quoins (External angles)

Fig. 25 shows a $4\frac{1}{2}''$ wall in stretching bond. Figs. 26 to 31 show the bonding of quoins in English bond walls from $9''$ to $36''$ thick. The general principle is to allow the stretching face course to run through to the angle and so form a header on the return face, then to butt the whole of the heading course of the return wall against these stretchers. Figs. 32 to 34 show similar quoin bonding applied to walls in Flemish bond from $9''$ to $18''$ thick. Figs. 35 and 36 show quoin bonding for walls $13\frac{1}{2}''$ and $18''$ thick in single Flemish bond. The same principle is adopted for Flemish and single Flemish bonds as for English bond, interpreting the stretching course to mean the course which *commences* with a stretcher.

Cavity walls. Figs. 37 and 38 show the quoin bonding for cavity walls, in the first case with two half-brick walls divided by a $2\frac{1}{4}''$ cavity, and in the second case with the inner wall $9''$ thick. *Note: the cavity may vary in width from $2''$ to $3''$.*

Squint quoins. When the quoins are formed by walls not at right angles they are called *squint quoins.* The angle enclosed may be either acute or obtuse. Acute squint quoins in English bond for walls from 9″ to 36″ thick are shown in Figs. 39 to 43.

The principles are the same as for square quoins but a difficulty occurs because the splayed end of the first stretcher measures more than the normal width of a brick. This brick is therefore reduced by a splay cut (which may be long or short) and a tapered closer is usually inserted, although the exact form may be varied considerably, as shown by comparison of Fig. 39 and the other plans.

The more nearly parallel and the larger the closer, the more satisfactory is the work from the point of view of soundness and practical cutting.

Figs. 44 to 48 show acute squint quoins in Flemish bond for walls 9″ to 36″ thick, and Figs. 49 to 52 give similar quoins for walls in single Flemish bond from $13\frac{1}{2}$″ to 36″ thick. Where Flemish bond is adopted a certain amount of irregular arrangement and cutting will always occur. An examination of the various examples will show however that in every case there is an alternating stepped arrangement in the entry of one wall into the other in the pairs of courses shown.

Figs. 53 and 54 show a more modern idea of arranging the outer angle of a squint quoin. The sharp corner is avoided by allowing an "inset" or "recessed" formation, in which uncut faces of the bricks appear on the recessed faces and the bonding is much sounder and more capable of transmitting loads.

This method is a great improvement over the older form with sharp angles, because the latter required either purposely made "squints" or it caused to be exposed the cut splayed ends of the quoin bricks.

Figs. 55 to 59 show obtuse squint quoins for walls 9″ to 36″ thick in English bond. It should be observed that in all these examples, in order to use an ordinary sized brick for the squint quoin, the header end of the brick is reduced to $2\frac{1}{4}$″ and is followed by a queen closer. The stretcher face is $6\frac{3}{4}$″ long and thus a perfect face bond is established. Fig. 56 (*a*) shows how the square angle of the quoin brick may be retained to form a dog-tooth quoin by allowing the sharp angle to overhang.

Figs. 60 to 64 show similar obtuse square quoins in Flemish bond for walls from 9″ to 36″ thick and Figs. 65 to 68 show single Flemish obtuse quoins for walls from $13\frac{1}{2}$″ to 36″ thick. The same general principles apply to these cases as for the English bond quoins and earlier examples of squint bonding.

Reveals

Recessed jambs with $4\frac{1}{2}$″ reveals and $2\frac{1}{4}$″ deep recesses are shown in English bond in Figs. 69 to 73 for walls 9″ to 36″ thick. The main principle is to employ a bevelled half bat and king closer to commence the reveal in the heading course, and then to employ bevelled closers and bats as required to make up the bond in the recesses.

Figs. 74 to 78 show the same range of reveals in English bond with the recesses $4\frac{1}{2}$″ deep, as required for vertical sliding sash boxes. In this case a half bat is used to start the heading course and bevelled closers immediately follow.

Figs. 79 to 81 show English bond with reveals 9″ wide and recesses $4\frac{1}{2}$″ deep. In this case the cutting is entirely behind the face bricks and introduces bevelled closers, bevelled bats and king closers, all being obviously simple in their use and suitability.

A similar complete series of examples is given in Figs. 82 to 84 for $2\frac{1}{4}$″ recesses and $4\frac{1}{2}$″ reveals in Flemish bond, and in Figs. 85 to 88 with $2\frac{1}{4}$″ recesses and 9″ reveals. Figs. 89 to 92 show $4\frac{1}{2}$″ recesses and 9″ reveals, also in Flemish bond.

Fig. 93 shows how to form a $13\frac{1}{2}$″ reveal with a $2\frac{1}{4}$″ recess in English bond. This is sometimes required in deeply recessed doorways.

Attached Plain Piers

Figs. 94 to 98 show the bonding of attached plain piers with $2\frac{1}{4}$″ projection to 9″ walls in English bond, for piers varying from 9″ to 36″ wide.

Observe that the heading course of the pier enters the stretching course of the wall in each çase, and that bevelled cutting only occurs in the stretching course of the pier.

Figs. 99 to 101 show similar piers, $2\frac{1}{4}$″ projection and $13\frac{1}{2}$″ to $22\frac{1}{2}$″ wide, attached to walls in English bond, $13\frac{1}{2}$″ thick; and a similar series in 18″ walls is shown by Figs. 102 to 104.

Figs. 105 to 114 show similar ranges of attached piers $4\frac{1}{2}$″ projection in English bond for $13\frac{1}{2}$″ and 18″ walls.

Flemish bond. Attached piers in Flemish bond walls are illustrated for various widths and $2\frac{1}{4}''$ projection and in walls from 9″ to 18″ thick in Figs. 115 to 124, and piers in single Flemish bond walls $13\frac{1}{2}''$ thick are similarly illustrated in Figs. 125 to 127. Piers having a projection of $4\frac{1}{2}''$ are shown for Flemish bond and single Flemish bond, over a similar range to the above, in Figs. 128 to 143.

In all these piers a similar principle is followed, as described above, except that where the bonding is to Flemish bond walls, bevel bats and king bats and closers are employed: reference to particular examples will make this clear. It should be noted that all the above examples assume that the piers occur in suitable positions to facilitate bonding. In practice many variations may occur when, through faulty work or faulty selection of positions or spacing dimensions, the pier does not come in line with appropriate joints; much unnecessary cutting may then result. The correct thing is to ensure that the bonding surrounding the pier is correctly set out, to work outwards from the pier in each direction and to allow any necessary broken bond to occur in the centres of the bays between the piers. Where work is judiciously planned, with well-selected dimensions, and the work is executed by a good craftsman, it should always be possible to adjust the bonding in a satisfactory way which at least approaches to the ideal bond shown in the examples described above.

Attached piers with chamfered angles. These need no special description as they are bonded on principles already understood by the student. Chamfer bricks with

$2\frac{1}{4}''$ splays are used; these are of standard pattern. The least projection of the pier is $4\frac{1}{2}''$ and Figs. 144 and 145 show examples of such piers $13\frac{1}{2}'' \times 4\frac{1}{2}''$ projection, and $18'' \times 9''$ projection, which are suitable for load carrying under floor beams, roof trusses, etc.

Double Attached Piers

A range of examples of double piers—one on each face of the wall—is shown in Figs. 146 to 152. In some of these examples where the projection is $4\frac{1}{2}''$, it is more convenient to place the stretching course of the pier in the stretching course of the wall. Such cases call for some initiative on the part of the student and craftsman, and there may be quite satisfactory alternative ways of solving the problem. Good architectural appearance is an important consideration in all this work where the face of the wall is to be left exposed. Jointing, its disposition and balance, is therefore to be considered.

Figs. 153 to 155 are a few special cases of attached piers.

Junctions

Figs. 156 to 160 show right-angled (or square) junctions in English bond for walls from $9''$ to $36''$ thick.

The principle in every case is to allow the heading course of the abutting wall to enter $2\frac{1}{4}''$ into the stretcher face of continuous wall and to make up the remaining $2\frac{1}{4}''$ by queen closers. The effective bond is therefore $2\frac{1}{4}''$, which is really the maximum amount for this bond, and occurs at every alternate course.

Figs. 161 to 165 show a similar series in Flemish bond. The principle is the same as that adopted for English bond junctions, with slight variations and adjustments which are required by the alternating header and stretcher in the same course.

Figs. 166 to 169 illustrate suitable junctions between walls in which *one face of each* is in Flemish bond.

Splay junctions. The principle of joining two walls which meet on the splay (any angle other than a right angle) is to adapt the previous method of allowing the heading course of the abutting wall to enter the stretching face of the continuous wall by at least $2\frac{1}{4}''$, and to butt the stretching course (by splayed cutting) against the continuous wall. Awkward cutting cannot be avoided in these cases, and the endeavour of the craftsman should be (*a*) to ensure an adequate tie between the walls, and (*b*) to use as few small pieces of cut brick as possible. Note that in the thicker walls the entry of the heading course of the abutting wall is often carried to the back of the face stretchers.

Figs. 170 to 175 show examples of splayed bonding applied to walls in English bond.

Cross junctions. Where two walls (of the same or of different thicknesses) cross each other at right angles, alternate courses run through. Figs. 176 to 181 show acceptable arrangements for the bonding of such walls. The student should practise similar bonding for walls of different thicknesses and walls on the splay, and should note that considerable variation in practical conditions may occur according to the exact position at which the crossing takes place.