CHAPTER ONE

BRICKWORK AND MASONRY

FOUNDATIONS AND BASEMENT WALLS

Some portions of the foundations to the warehouse were treated in Vol. II.

It remains here to consider the arrangement and construction of the foundations to the long side walls which are built on sloping ground, and to the independent and attached piers which are used to support the ground floor and to increase the wall bearings for the beams of the upper floors.

1. Foundation treatment due to sloping site. Detail No. 1 shows a vertical section through the site from front to back of the warehouse.

In firm, dry ground it is unnecessary to place the foundations at a greater depth than the levels given, but in soft or unreliable ground it may be necessary to excavate to the surface of a firm underlying stratum of earth, or, if no such stratum exists at a convenient depth, to adopt a special type of foundation.

Assuming firm ground, the depth of the front foundation would be 8 ft., this being regulated by the depth of the basement and the necessary footings and foundation concrete. At the back wall the depth is 4′ 3″ which is sufficient to escape the normal effects of rain, frost and heavy traffic.

Taking into account the differences in ground level and excavation, there is a height of 7′ 6″ between front and back foundation levels.

2. Concrete to stepped foundation. If the difference in level were arranged to take place in one step, fracture of the walls immediately above the junction would be probable, because the higher part of the walls with the greater number of mortar joints and increased weight upon the base would induce more settlement at this part. To reduce or ease off the effect of this non-uniform settlement, stepped foundations are desirable; these minimise the tendency to fracture by distributing the settlement over a series of changes in depth.

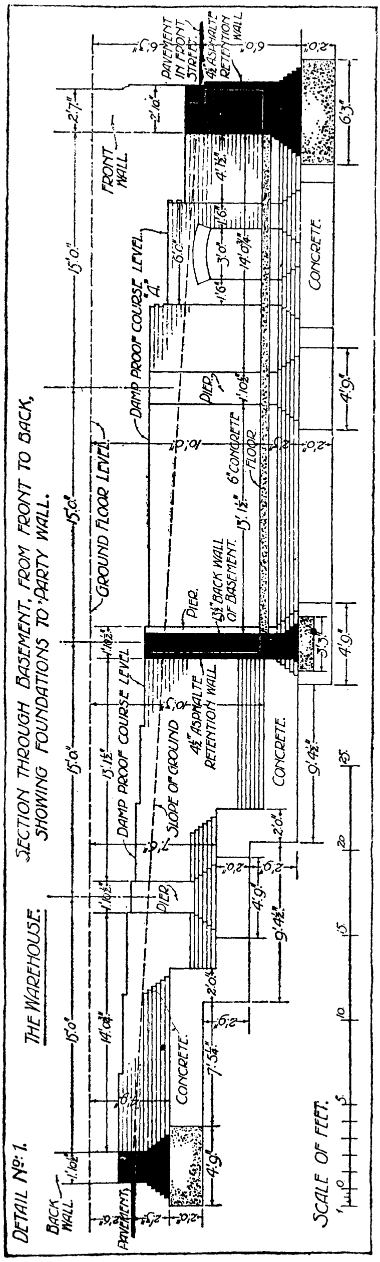
An examination of the stepping in detail No. 1 shows the ground to be "benched" into three level steps. The concrete is carried horizontally and vertically in one continuous mass, with projections for the footings of piers and chimney breasts where these occur.

3. Footings to stepped foundations. In details Nos. 1 and 2 the footings are shown to butt squarely against the vertical cross face of each concrete step, but are returned at the unobstructed end to agree with their projection from the wall. This avoids any bonding difficulties and the vertical step of concrete efficiently transmits the load to the earth at each change of level.

4. Pier and foundations to ground floor pillars. In the line of the cross wall shown in detail No. 2, which forms the back enclosure to the basement at the centre of the building, two pillars are to be erected for supporting the upper floors. For this purpose brick piers are provided 2′ 7½″ square, built of *blue bricks*[1] in cement mortar and capable of supporting 12 tons per sq. ft. of horizontal area. The method of determining the size of these piers and *their foundations* is given in Chapter Five.

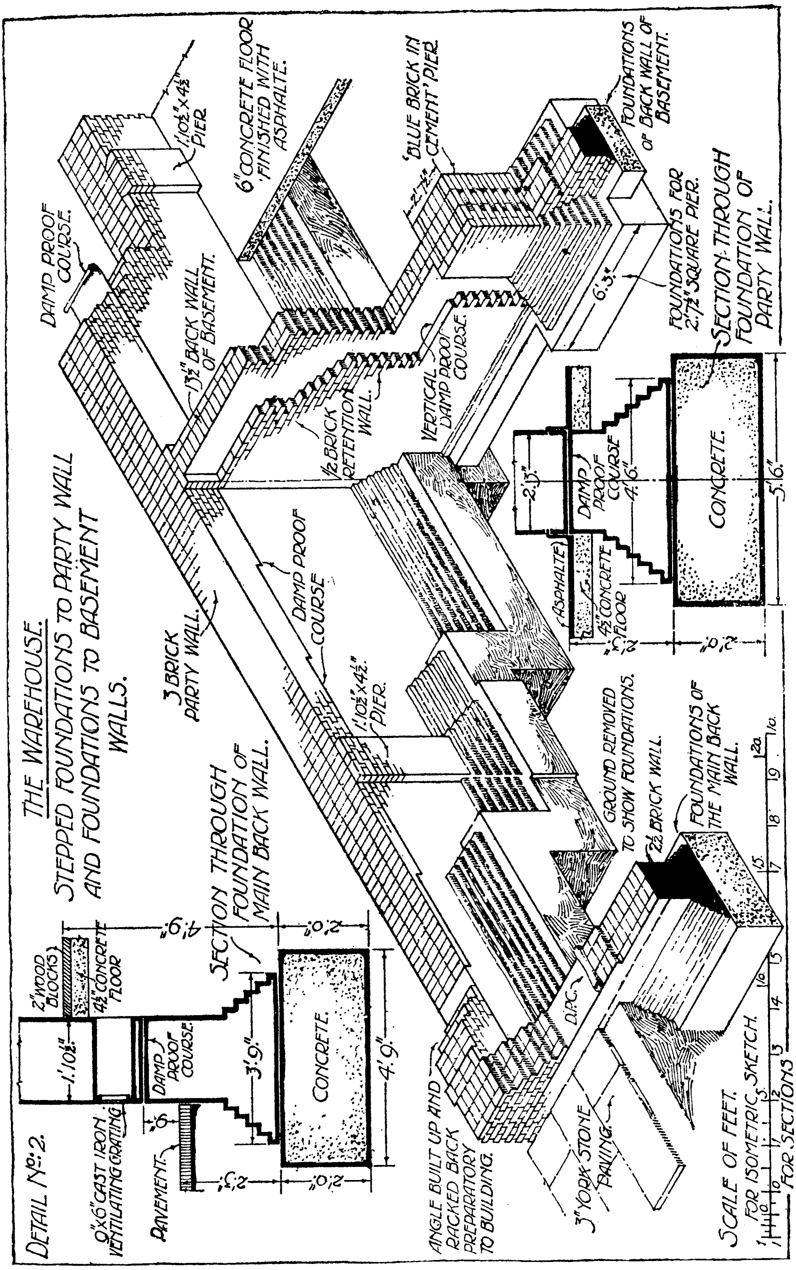
Should large changes of level occur, as at A in detail No. 1, the connection between the levels is made by leaving an open zig-zag joint and pouring molten asphalte into it. The joints are temporarily stopped on the face with clay, until the asphalte is firm.

The damp-proofing treatment of the ordinary main walls of the warehouse was illustrated in Vol. II.



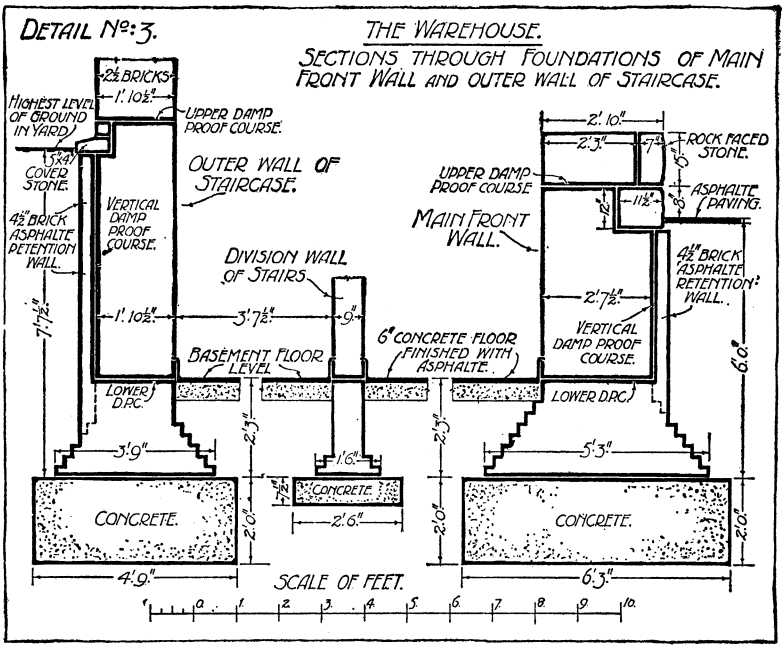
5. Application of vertical damp proof sheeting and retention walls to basement of warehouse. Detail

[1] See Chapter on Materials, Vol. II.


THE WAREHOUSE.
STEPPED FOUNDATIONS TO PARTY WALL AND FOUNDATIONS TO BASEMENT WALLS.
DETAIL No. 2.
SECTION THROUGH FOUNDATION OF MAIN BACK WALL.
SECTION THROUGH FOUNDATION OF PARTY WALL.
DAMP PROOF COURSE.
13½" BACK WALL OF BASEMENT.
1'.10½" x 4½" PIER.
6" CONCRETE FLOOR FINISHED WITH ASPHALTE.
'BLUE BRICK IN CEMENT' PIER.
FOUNDATIONS OF BACK WALL OF BASEMENT.
FOUNDATIONS FOR 2'.7½" SQUARE PIER.
½ BRICK RETENTION WALL.
VERTICAL DAMP PROOF COURSE.
3 BRICK PARTY WALL.
GROUND REMOVED TO SHOW FOUNDATIONS.
2½ BRICK WALL.
FOUNDATIONS OF THE MAIN BACK WALL.
ANGLE BUILT UP AND RACKED BACK PREPARATORY TO BUILDING.
3" YORK STONE PAVING.
D.P.C.
SCALE OF FEET. FOR ISOMETRIC SKETCH. FOR SECTIONS
2" WOOD BLOCKS
4½" CONCRETE FLOOR
9"x6" CAST IRON VENTILATING GRATING
PAVEMENT.
CONCRETE.
(ASPHALTE)
4½" CONCRETE FLOOR
4'.9"
3'.9"
4'.6"
5'.6"
2'.3"
6'.3"

I-2

No. 2 shows the use of a retention wall in the cross wall at the back of the basement, while detail No. 1 illustrates the vertical sheeting at the front wall of the warehouse, taken round the base course at the pavement to keep it out of sight. Further large scale sections are given in detail No. 3 which shows the base of the external staircase wall, the division wall of the stairs, and the foundation and basement walling to the front wall of the warehouse.



6. Pier bonding. In studying detail No. 2 the brick bonding should be noted as further applications of general principles are given.

This detail shows the bonding of the "three-brick" party wall and its attached piers, the junction of the same wall with the back wall of the warehouse, the toothing necessary for subsequent bonding to adjoining property and the bonding of the "three and a half brick" square pier to the "one and a half brick" cross wall in the basement.

7. Open area and lighting of basement to the house. Detail No. 4 gives a section across the open area taken clear of the main entrance and basement doorways, and through one of the basement windows.

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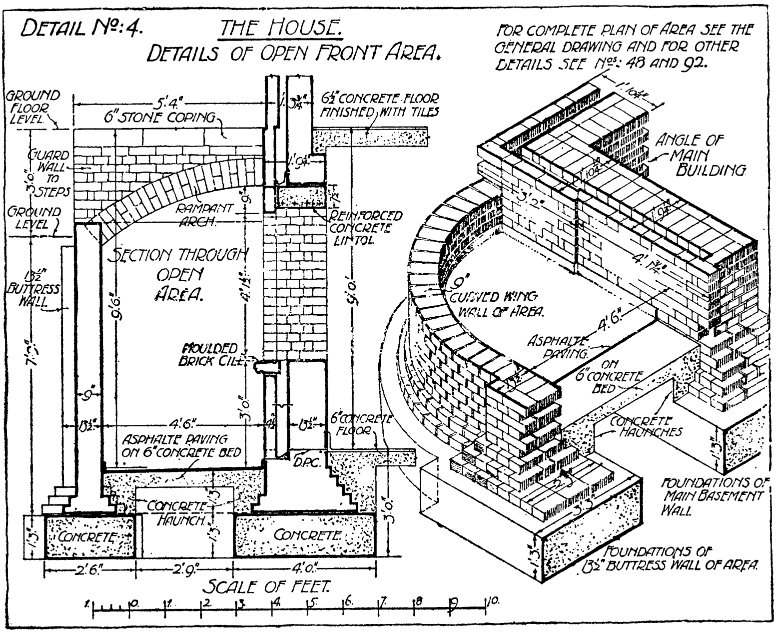
The function of this area is to provide light to the basement by means of the open space in front of the windows, which are below the ground level.

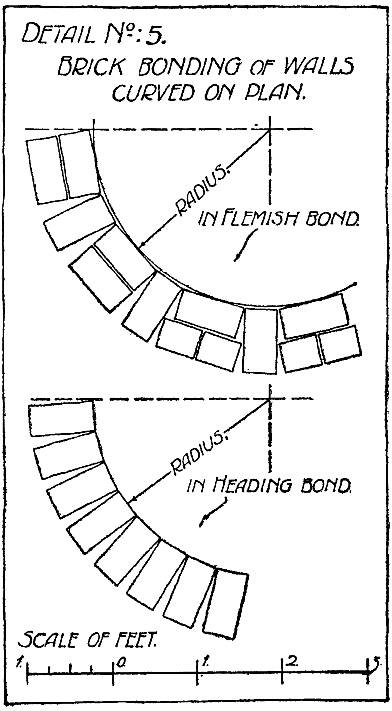
8. Retaining wall. A wall becomes necessary to support or retain the earth outside this area and is known as a retaining wall. The shape and extent of the area are shown on the general plan,



being a rectangle with two quadrant ends, the rectangle lying beneath the main entrance steps with the quadrants open to view and forming wing walls to the excavation.

The earth abutting on these walls exerts a thrust, tending to overturn them into the area. On the straight part of the retaining wall, which acts as an abutment for an arch supporting the entrance steps, the two thrusts—from arch to earth—oppose and tend to balance each other and under these forces alone a 9″ wall would probably serve the purpose; but the quadrant walls have been employed to meet the thrust of the earth towards the open parts of the area by constructing them as vertical arches of header bricks; the thrust is thus transmitted round the arch to the vertical supports, viz. the main wall of the house and the straight piece of retaining wall. Hence, the latter is made $13\frac{1}{2}''$ thick.

9. Construction of wing walls in heading bond. Heading bond has already been referred to as suitable for footings, but its logical application to walling may now be considered.



In brickwork curved on plan and constructed from standard bricks in the ordinary bonds, it is only possible to approximate to the curve except by special cutting of the exposed faces. To diminish the polygonal appearance which would result from laying stretcher bricks as shown in detail No. 5, headers may be employed to obtain a closer approximation to the curve. This arrangement causes wide back joints which can only be allowed where they are concealed as in the example. Where the curvature is too sharp for such an approximation bricks should be cut or special bricks obtained of the true curvature; ordinary bonds may then be employed.

If the external convex surface of such a wall is to be exposed, the side joints are not permissible and the bricks must then be rough-axed to a wedge shape, or purpose made bricks obtained.

Construction of Walls

10. Thick walls. In the warehouse the brick walls vary in thickness from 9″ to 27″ and some of the thicker walls are compounded of stone facings and brick backing.

Thick walls are bonded on the usual principles, stretchers being employed on both faces of a course having an even number of half bricks in thickness and on the opposite faces of alternate courses when the thickness is an odd number of half bricks; the rest of the work is packed with headers and joints are *not* broken across the thickness of the wall.

The bond in straight portions of the walls should be studied together with the adaptations in junctions and angles; see detail No. 2.

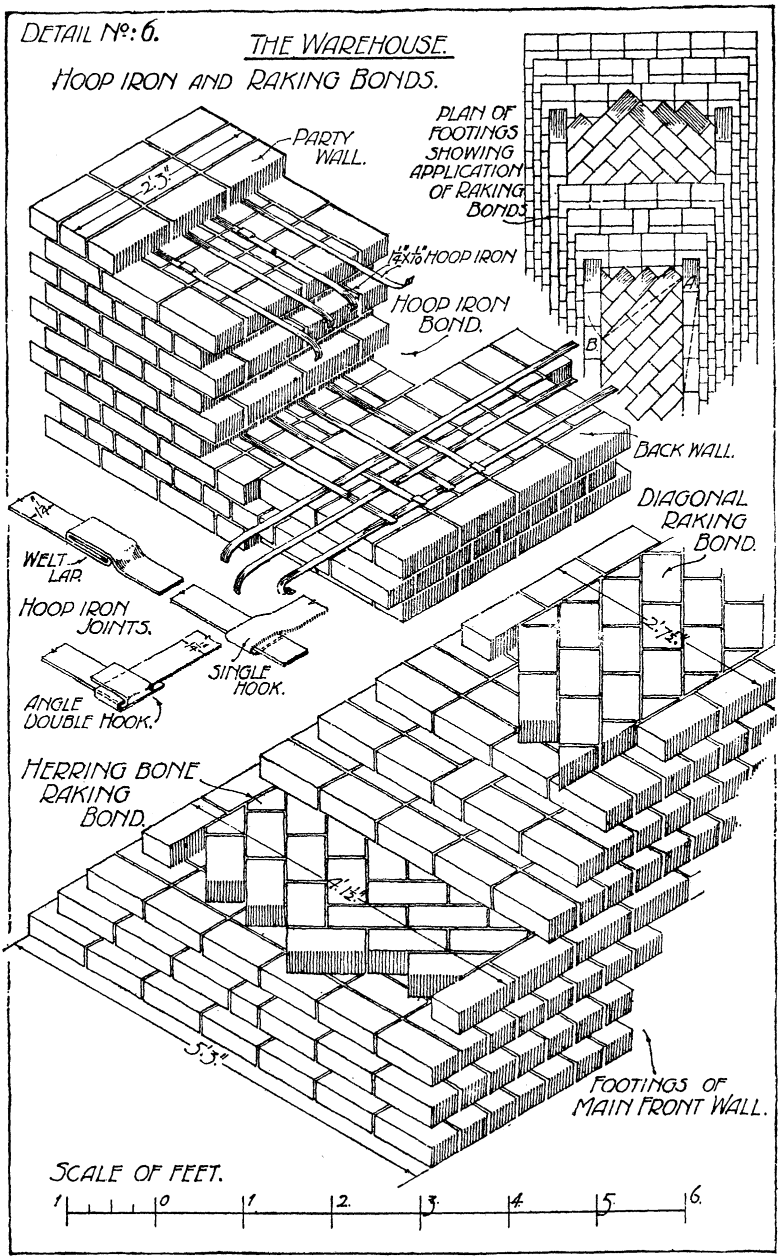
11. Deficiencies in ordinary bonds. In Vol. I it is stated that there are deficiences of bonding in thick walls. The chief defect is caused by filling the centre of the stretching courses with header bricks, causing lack of longitudinal as compared with transverse tie in the body of the wall, the former being $2\frac{1}{4}''$ and the latter $4\frac{1}{2}''$. In high, heavily loaded walls a fault in the natural foundation which allowed settlement to occur, especially near the quoins of a building, would probably produce disturbance and withdrawal of the bricks longitudinally, because quoin settlement induces horizontal movement of part of the mass of work towards the quoin. The distribution of concentrated loads from floor girders, roof trusses, etc. in the direction of the length of thick walls is not so proportionately effective as in thin walls, because of the small side lap of the headers which form the greater bulk of the walling.

12. Methods of improving longitudinal bond in thick walls. There are several methods available for improving longitudinal tie, amongst which are reinforcement by hoop iron, or wire mesh and by placing bricks diagonally between the stretchers across the centre of the wall.

13. Hoop iron bond. Detail No. 6 shows the junction between the party wall and back wall of the warehouse, where strips of hoop iron, about $1\frac{1}{4}'' \times \frac{1}{10}''$, are laid longitudinally, one strip to each half brick of the centre headers, the series being repeated at every sixth joint. When two walls intersect at a tee junction, the terminals are single hooked over the outside strip; at an angle junction the external strips are double hooked and the others single hooked; joints in the length of a strip are welt-lapped. All joints are hammered flat and where pieces cross each other in series they may be interlaced as shown. To preserve hoop iron it may be galvanised or preferably coated with hot tar and immediately drawn through fine, dry sand which adheres and give a grip for the mortar.

Modern forms of reinforcement, including wire mesh and expanded metal and which may be used instead of hoop iron, are explained and illustrated in Vol. II.

14. Raking bonds. The oldest method of improving longitudinal tie is to fill the space between external stretchers with bricks inclined to the face of the wall, thus increasing the "length tie" with little reduction of transverse strength. The arrangement is known as "raking bond" and may be applied at every fifth course in the height of plain walls, the bricks in consecutive alternate raking courses being inclined in opposite directions. Footings are greatly improved by raking bond. There are two common forms: (*a*) diagonal bond, and (*b*) herring-bone bond.


DETAIL No: 6.
THE WAREHOUSE.
HOOP IRON AND RAKING BONDS.
PARTY WALL.
PLAN OF FOOTINGS SHOWING APPLICATION OF RAKING BONDS
HOOP IRON
HOOP IRON BOND.
BACK WALL.
DIAGONAL RAKING BOND.
WELT LAP.
HOOP IRON JOINTS.
SINGLE HOOK.
ANGLE DOUBLE HOOK.
HERRING BONE RAKING BOND.
FOOTINGS OF MAIN FRONT WALL.
SCALE OF FEET.
1 0 1 2 3 4 5 6

Diagonal bond is the more effective because a number of bricks may be placed end to end as shown to the right of detail No. 6, the extreme corners of the series being in contact with the stretchers.

To set out the bricks in a drawing, observe that the ends of the diagonal drawn across three bricks are here required to be in contact, hence obtain this length from the plan of three stretchers, take any point A on the boundary as centre, and with the diagonal as radius strike an arc to cut the opposite boundary at B. Upon this construct the right-angled triangles on each side, and repeat by parallel courses. This bond may be applied to any course which is three bricks or more in thickness; it is shown applied to the first course above the footings in the front warehouse wall, which is 2′ 7½″ thick at the basement level.

When applied to footings the latter should be at least four bricks thick and the *headers should be retained at the outside of the course.*

15. Herring-bone bond is used in similar positions and is shown applied in the same detail. It is more suitable for very thick walls, because the bricks are laid in courses inclined at 45° in two directions. The object of laying out the pattern should be to use the maximum number of whole bricks.

In this example the application is made to the centre course of footings, which is five and a half bricks wide and is shown with stretchers on the external faces. This arrangement illustrates a defect common to such work as the distribution of load to the stretchers is not satisfactory. Headers, if employed, would enter the walling 6¾″ and thus remedy the defect.

It should be noted that raking bonds are rapidly going out of use for large and important work. They are still used in restoration work, however, and in odd cases where metal bonding material is not available as and when required.

Arches

16. Rampant arch. When an arch is arranged with its supports at different levels, it is called a "rampant" arch. If the arch is required to rise above the higher support its outline is preferably a compound curve, but the simplest and soundest form is half of an ordinary segmental arch, and this type is suitably applied in the support provided to the steps of the main entrance to the house, as shown in detail No. 4 and to a larger scale in detail No. 10.

The arch has a span of 4′ 6″ and consists of a single rough brick ring faced at the ends with a 9″ gauged arch and bonded thereto; it springs from the 13½″ retaining wall of the area and abuts against the main wall of the building below the doorway.

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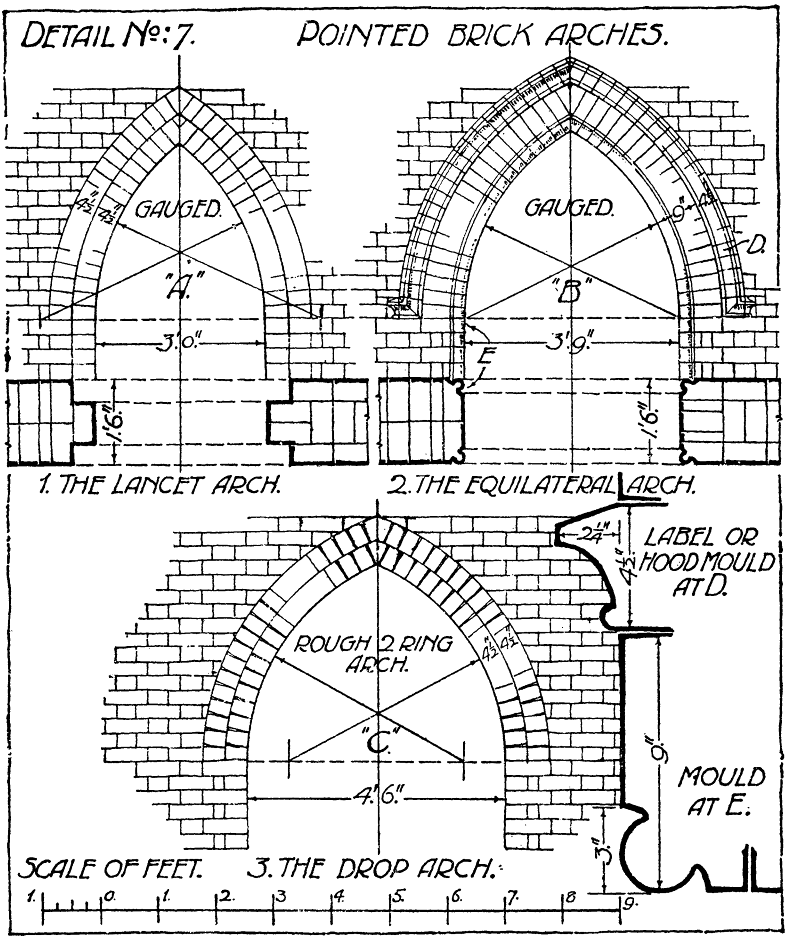
17. Pointed arches. Arches formed by two arcs of curvature intersecting to produce a sharp angle at the crown are known as pointed or Gothic arches. They are commonly applied in, and are a special feature of, certain periods of medieval or Gothic architecture.



Forms of pointed arch. When the ends of the springing line and the crown of the arch lie upon the angles of an equilateral triangle, the arch is named "equilateral"; to describe the intrados curve the centres are at the ends of the springing line and the radius is equal to the span.