impermeable. Water from the cylinder is admitted to occupy the space between the top of the specimen and the under side of the cover and to fill both vertical and horizontal tubes ; the water is then shut off. As the water passes through the specimen, it flows along the horizontal tube ; this rate of flow is obtained by observing the end (or meniscus) of the water and measuring from the scale the distance this travels in a given time. The 8-in. head of water gives a pressure in excess of that caused by a very strong force of wind against a wall down which rain is pouring (see also p. 99).

STRENGTH.—It is not necessary to specify the strength of bricks unless they are required for the construction of piers, etc., which have to support heavy concentrated loads. The reason for this is that the compressive strength of brickwork constructed of relatively inferior bricks will be quite adequate to resist the normal weight which it will be required to support. Thus, whilst the brickwork at the ground level of a two-storied house will not usually be subjected to a greater load than $1\frac{1}{4}$-tons per sq. ft., it would be a very poor brick which had a crushing strength of less than 60-tons per sq. ft. The average crushing strength of bricks serves as an approximate index only of the compressive strength of brickwork, as much depends upon workmanship, height in relation to thickness, etc. A rough approximation of the strength of brickwork built in cement mortar (1 : 3) and good hydraulic lime mortar (1 : 3) is respectively one-third and one-fifth that of the individual bricks.

The crushing strength of bricks is determined in a compression machine such as that shown at E, Fig. 9 (see p. 32). A brick is usually tested on bed and placed in the machine between two pieces of plywood, any frogs being filled flush with cement mortar. The compressive strength varies enormously between batches from the same kiln and even of individual bricks from the same burning. As an illustration of this, tests carried out in the Building Laboratory of the Manchester College of Technology on six bricks obtained from a kiln at the same time showed the crushing strength to vary between 1,450 and 2,410-lb. per sq. in. This variation is partly due to the different position of the bricks in the kiln. It is because of this variation that at least six (preferably twelve) specimens of a brick should be tested and the mean figure taken.

This variation is also shown by the following figures in brackets which indicate the approximate crushing strengths of specimen wire-cut, pressed and hand-made bricks (six of each type) from well known and reputable manufacturers: Wire-cut commons and facings (1,800 to 5,000-lb. per sq. in.), pressed commons and facings (2,500 to 6,000-lb. per sq. in.) and hand-made facings (2,000 to 5,000-lb. per sq. in.). Engineering bricks (see p. 17) have crushing strengths varying from 8,000 to 18,000-lb. per sq. in.

FROST ACTION.—External walls constructed of porous underburnt bricks are particularly vulnerable to damage by the action of frost. Such damage is due to the absorbed water expanding (to about one-eleventh of its volume) as it freezes and exerting pressure on the pore walls which the comparatively soft material is unable to resist. Disintegration thus results, and when this is repeated during severe winters, disfigurement due to pitting and cracking of the surface and damaged arrises may become very pronounced. Brickwork of poor quality bricks with overhand struck joints (see p. 31, Vol. I), that below the ground level, and copings are particularly subject to damage by frost. It does not affect brickwork of sound, hard-burnt bricks.

Frost Resistance Test.—A simple, but effective, apparatus in which bricks and other building materials may be tested for frost resistance is shown in Fig. 35 and described on p. 100. This test can also be carried out in a watertight metal container which is partly filled with a freezing mixture consisting of 2 parts ice and 1 part common salt. The brick to be tested, after being immersed in water for twenty-four hours, is wrapped in a piece of cloth, totally immersed in the mixture, the lid is shut and the container is placed in a box so that it is encased by a 3-in. thickness of cork, sawdust or similar insulating material. After being frozen at $-10°$ C. for eighteen hours the specimen is removed, thawed by running water, unwrapped and examined. The freezing and thawing cycle is repeated for at least ten times. Certain bricks, well known for their durable qualities, are not affected even if subjected to forty freezings, whilst others, only suitable for internal work, will show serious disintegration after ten freezings. This apparatus does not give such good results as that illustrated in Fig. 35, as the immersion of the specimens in the freezing mixture appears to improve their resistance to frost action on account of their impregnation with salt.

A good test, but one which does not give immediate results, consists of digging a hole and placing in it two bricks on end, one above the other, with the upper brick half exposed. These are left for a year. In a normal winter successive frosts will cause a poor brick to crack across at ground level, whilst the lower one may show signs of flaking. Sound bricks will not be affected.

Efflorescence Test.—A brick is partially immersed on end in a dish of distilled water, and the water absorbed is evaporated from its upper surfaces. Any salts liable to form efflorescence are brought to the surface by the water in its passage through the brick.

CLASSIFICATION OF BRICKS

Bricks may be classified according to (1) quality and (2) usage.

1. CLASSIFICATION ACCORDING TO QUALITY.—Bricks from a kiln are divided into three classes, namely : (*a*) *firsts*, which are best and are selected by hand ; (*b*) *seconds*, which are selected bricks but are not equal to " firsts " on account of some imperfection in regard to colour or shape or both ; (*c*) *thirds*, which are the remainder of the kiln, the best being only suitable for interior work.

2. CLASSIFICATION ACCORDING TO USAGE.—A conveniently broad division of bricks is in accordance with their suitability for (*a*) interior purposes, (*b*) exterior purposes, (*c*) pressure-resisting purposes and (*d*) fire-resisting purposes.

(a) *Bricks for Interior Purposes.*—Common bricks are invariably specified for internal walls, as neither strength, durability nor appearance are important.

If the walls are to be plastered it is essential (especially if the bricks have a large suction capacity) that the walls shall be copiously watered before the first coat is applied, otherwise an excessive amount of water will be absorbed from the plaster and this may cause failure. It is also important that the bricks shall not contain nodules of lime (see pp. 1 and 14), as the water applied to walls prior to plastering will be absorbed, causing the lime to slake and the resultant expansion to crack or splinter the bricks.

It is essential that certain brick partitition walls, particularly those on upper floors, shall be as light as possible, and perforated or hollow bricks or blocks (see U, V, W and Y, Fig. 5) are suitable for this purpose.

Sometimes facing bricks, and not commons, are required for internal walls, such as those for churches, corridors, class-rooms, etc. Light-coloured bricks, such as " silver-greys " (p. 12) and sand-lime bricks (p. 17) are used for such purposes on account of their satisfactory light-reflecting qualities. White, etc.,