juniors in the office, or a word of recognition, good cheer and thanks for kindnesses received.

Yesterday is past. To-morrow's a mystery. To-day is here. Make use of it to keep out and supersede all Germans.

DESIGN OF RETAINING WALLS.

THE following practical rules for the design of retaining walls to withstand earth pressure have been deduced from experiment and from observation and experience of existing structures which have withstood, for a considerable period, all the destructive influences. For them we are indebted to "The Surveyor," London.

Brick Walls.—In walls constructed of brickwork the following dimensions are extensively adopted: The top of the wall is made 1 ft. 10½ in. in thickness—*i.e.*, 2½ bricks—and at every fifth course downwards, or approximately every 2 ft., the thickness is increased by half a brick, the face of the wall being generally built with a batter of 1 in 6 to 1 in 8. Occasionally a curved batter is adopted. The wall would, of course, be surmounted by a suitable stone coping. Fig. 1 shows a section of a brick retaining wall, 14 ft. high above ground level, with a batter of 1 in 8.

Concrete Walls.—Plain mass concrete walls are often built of the same proportions as brick or stone walls, but with this difference, that expansion joints are generally provided every 10 ft. The same rules as apply to masonry walls will therefore be applicable to concrete. For walls 6 ft. to 10 ft. high a thickness of one-fourth of the height of the wall above the natural ground is generally allowed. For walls above 10 ft. the base thickness is taken as one-third of the height above the top of the footings, the back of the wall being vertical, and the face having a batter of 1 in 6 to 1 in 8. Sometimes the method shown in Fig. 2 is adopted. The height of the wall above ground level is divided into three equal portions. The bottom portion is made equal to ⅓ H, the central portion equal to ¼ H, and the top portion equal to ⅛ H. Another method is shown in Fig. 3. The section is first of all calculated with a vertical back, as described above. This is shown by *aa*, *bb*. Bisect the thickness at the top in the point *d*, and also the height of the wall above ground level in the point *c*. From *d* draw through *c* a line to touch ground level at *e*, and from *e* draw the vertical line *ef*. Divide *df* into any convenient number of equal parts, in this case three, and produce the vertical lines to the base *be*. Then divide *fe* into one more equal part than *fd* contains—*i.e*, four—and draw horizontal lines crossing the vertical ones. From the points of division draw the lines forming the offsets, as shown in the figure by the firm lines. The effect of stepping the back of a wall in this fashion increases the friction of the earth against it, giving increased stability, and therefore offering a greater resistance to overturning. The wall contains no more material, and as the offsets are easily formed, it is much better to convert a wall with a vertical back into the above form.

Surcharged Walls.—Where a retaining wall is surcharged—*i.e.*, retains a bank which slopes upward to a higher level than the top of the wall—the thickness, according to the foregoing rules, must be increased. This class of wall is principally made use of in cuttings, and in some cases walls of this description are built to retain the toe of an embankment, so saving large quantities of earthwork. Fig. 4 shows how the dimensions for this form of wall are arrived at. The height Y is substituted for H, or the height of the wall from ground level, and is the perpendicular at the end of a line L, equal to H, measured along the slope to be retained. The value of Y will necessarily vary with the slope, the extent of variation being shown in the following table:—

Y =	1.71 H	in slopes of	1 to 1
	1.55 H	" "	1½ to 1
	1.45 H	" "	2 to 1
	1.30 H	" "	3 to 1
	1.24 H	" "	4 to 1

It will therefore be seen that a wall calculated to retain earth on a level with its top must be increased .71 in thickness to retain a slope of 1 to 1, and so on with the remaining values of Y. The foundations of all walls should be carried down to a sufficient depth to be below the disintegrating effect of frost. From 2 ft. to 4 ft. is

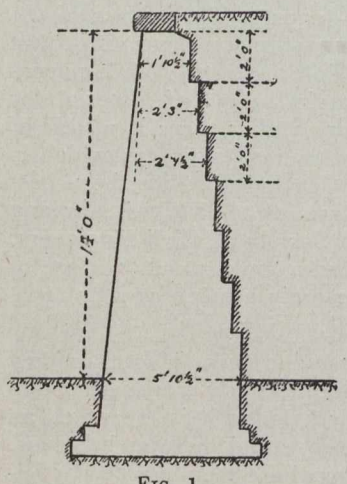

Fig. 1.

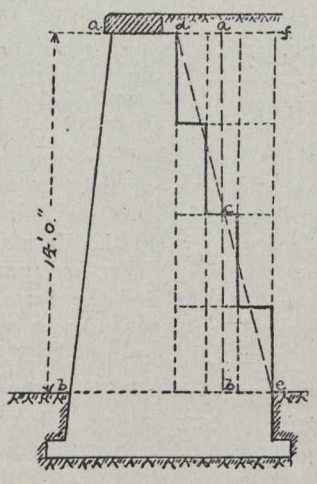

Fig. 3.

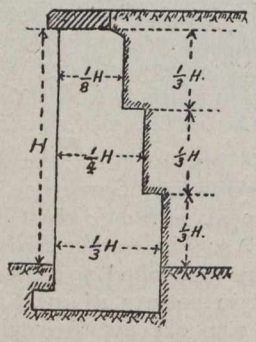

Fig. 2.

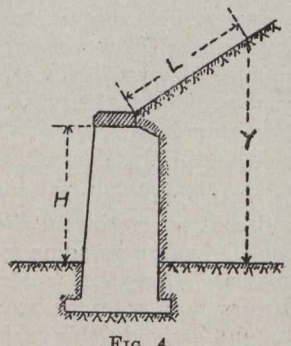

Fig. 4.

Some Types of Retaining Walls.

considered a safe depth for this purpose. Where the supporting earth is of an unstable character, the area of the foundations may be increased to any desired extent by forming steps beyond the thickness of the wall proper, so that the weight of the structure may be distributed over a large surface. Weep-holes, formed of 2-in. or 3-in. pipes, should be provided to drain off any water which may collect behind the wall, one to every 2 or 3 yds. super. of of wall face; while in the case of brick retaining walls, or walls constructed in masonry, it is much better to have these pointed in cement, as there is a tendency for moisture to find its way into the interior of walls which batter.