with the other styles shown a complete blockade might occur; this is a matter of importance in wooded countries.

Stone culverts in cold climates are laid in cement mortar, including covers, and the paving is flushed with grout until full; and in all climates apron walls should be sunk two feet to three feet at each end, to prevent leakage along and under the walls and paving, otherwise the action of frost and undermining will both be destructive; but in mild climates such culverts are usually laid dry, and if attention is paid to the bonding and laying, the structure may last indefinitely. This class of work is shown on Fig. 32. Wherever the fall is rapid, paving should be laid beyond the lower end, as in Fig. 30, and may even consist of a very heavy flat stone floor, if the grade of the culvert is excessive. Culverts should, of course, be laid to the natural cross section, no matter how steep—in order to get the outlet low enough to prevent undermining, the direction of the discharging stream, in plan, is immaterial—water will get away somehow, but, in profile, there should never be an increase in the rate of fall, just below the lower end, unless on solid rock. If the foundation bed is solid, the cove which holds up the paving may be left of correct height to carry it, but if the foundation is poor, it will be best to build first a layer of concrete one foot to two feet thick, and commence masonry work and paving on this, or, in case the foundation is always to be under water, a grillage (platform) of timber will be suitable, as in timber box culverts.

Weak foundations are often the cause of failure on stone culverts, and all doubtful ones should be tested by the engineer himself, by driving an iron bar down in several places, but it is best to be on the safe side; a little

Plate V.

scale 1 in-8 ft.

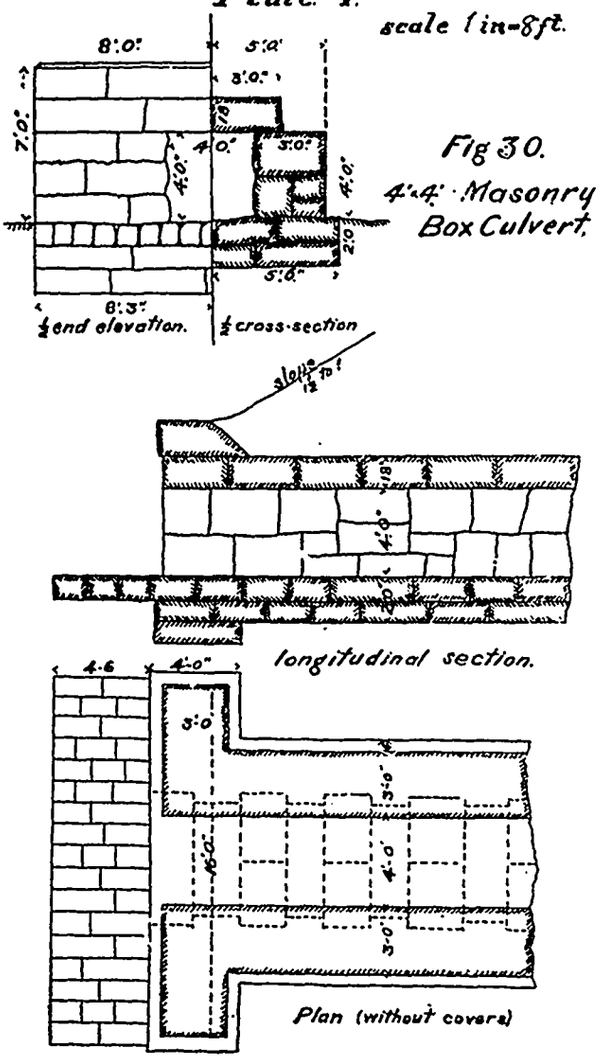

Fig 30.
4'x4' Masonry Box Culvert.

Plate IV

scale 1 in-8 ft.

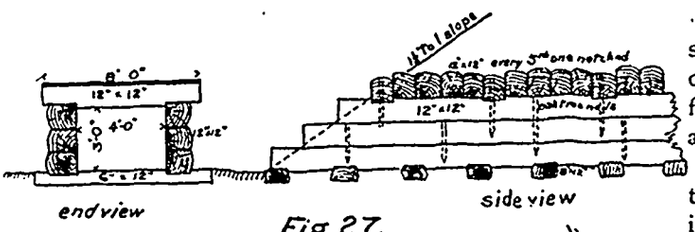

Fig. 27.
3'x4' Timber Culvert.

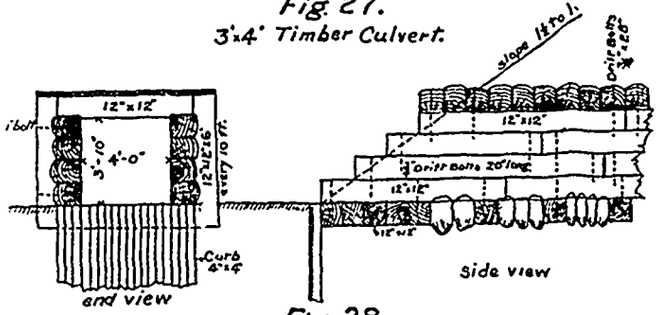

Fig. 28.
4'x4' Timber Culvert.
(C.P.R.)

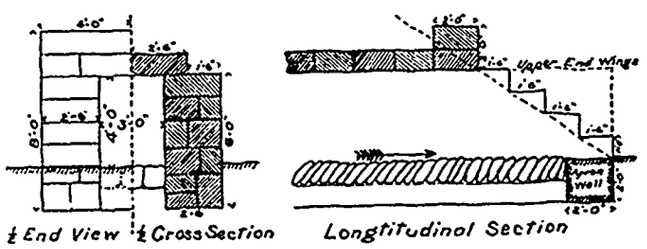

Fig. 29.
3'x4' Masonry Box Culvert.

sediment on the paving will do no harm, and will be swept out at each storm, whereas if the discharge end is too high, first a hole is worn, and finally the lower end is undermined and falls down.

If possible, culverts should be located at right angles to the centre line, and this can usually be done by diverting the entering stream, and using the material in the embankment adjacent. Skewed structures are expensive in many ways, more particularly, however, with arched culverts. The inspection of stone culverts during construction should be a rigid one, as rascally work can be hidden quicker in this class of masonry than in any other. Especially inspect the covers as to soundness and proper bearing on the walls, which should be from 9 inches on small culverts to 15 inches for large ones; they should have full bearings at each end, and be well spauled and mortared at the joints, to keep out earth and water. In bringing embankments against all culverts, care must be taken not to shove them over; filling should, if possible, be carried on on both sides at the same time, but if not, then earth should be shovelled over, up to the level of the top of the covers, before a high bank is brought forward. These remarks apply more particularly to arched culverts. The use of solid concrete box culverts to take the place of masonry ones is on the increase. They can be built cheaper, and when a knowledge of the science of cements and proper concrete making is more general, such construction will be largely adopted.

Specification for Stone Box Culverts laid in mortar.—"Culvert masonry shall be built of good, sound, large, flat-bedded stones, laid on their natural and horizontal beds. The stones used must not be less than three feet in