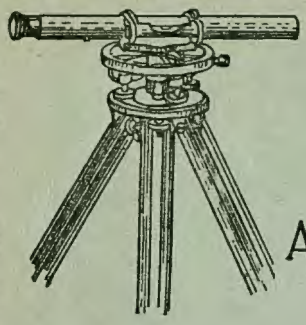

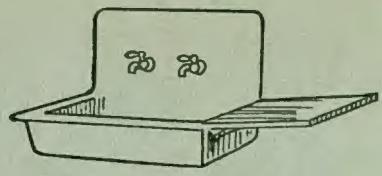

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IMPROVED BUILDING FOUNDATIONS

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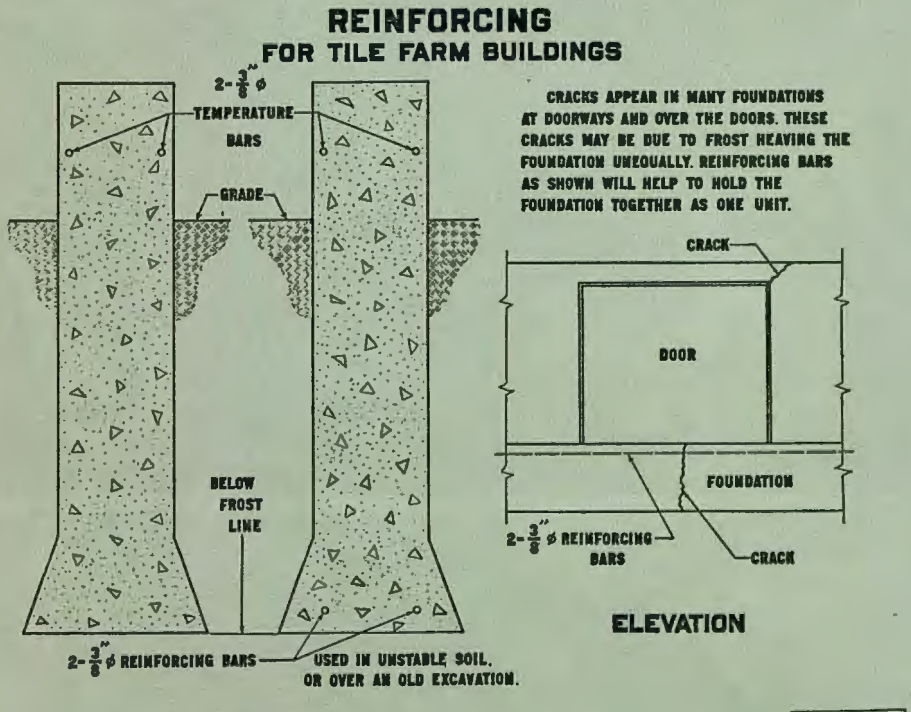
Because of the recent revival in building construction, especially of the heavier and more complicated buildings, frequently with masonry walls, there has developed a need for stronger and better foundations to support these increasing loads. The importance of a good foundation cannot easily be over-emphasized; the security of the entire structure depends upon a solid, permanent support.

The design of a foundation depends generally on a number of variables, notably: the soil—whether peat, clay, sand, or gravel; the type of structure—of wood or masonry; the loads expected—which vary with the height of the structure; and its purpose—that of housing livestock, machinery, or grain. A knowledge and consideration of all of these features is necessary before a satisfactory foundation can be properly constructed. Good drainage away from the walls and footings is also required, particularly in unstable soils. The surest method is to lay tile along the lower level of the footing and parallel to it, at a distance of about a foot.

It is possible to have some variety in materials for foundations. Where heavy loads are not anticipated and reinforcing is omitted, stone, rock, concrete blocks, or clay tile, with mortar joints, are often suitable. Plain concrete is especially good. If large rock or stone are placed in concrete, they should be dropped in after some of the concrete is poured into the bottom of the trench, and no stone should have a diameter as great as the wall thickness.

The materials just mentioned are commonly adequate when the soil is stable, and not subject to excessive loads. All masonry is strong in compression, or the tendency toward crushing or reduction in size. Concrete properly made can withstand compressive forces of 4,000 pounds to 6,000 pounds per square inch, with other masonry in proportion. While it may be strengthened yet more with reinforcing steel, this is not usually necessary. Masonry in tension (the tendency to stretch) is comparatively weak, concrete having a resistance of only 300 to 400 pounds per square inch when properly made. This is not satisfactory when acting as a tensile member; hence it must be reinforced with steel bars having a tensile strength of 15,000 to 20,000 pounds per square inch.



The thickness of a masonry wall foundation is usually between 8 and 12 inches. This is often determined by the size of units used, either a single large unit or two thicknesses of smaller size. Strength is not necessarily the determining factor, but the insulating value of thicker walls may be the reason for increased size.

Unless the anticipated loading is extremely light, it is certainly advisable that the foundation or footing extend below the frost line. This distance may be as great as six feet in certain exposed northern localities. This depth is necessary to prevent heaving in the spring, unless located on hard-pan or especially firm sand and gravel. Other advantages of depth are the protection from undermining by livestock and dangerous erosion by rain water about the foundation base.

The bearing capacity of the soil is what actually determines the width of the foundation at its base. If the 8- or 12-inch thickness of wall does not provide sufficient soil bearing area, it is recommended to use a footing or a wider base. This may be a rectangular section of added width or simply a slant cut with a spade along each lower edge of the excavation, as shown on the illustration. The bearing power of soils varies from about one ton per square foot in alluvial soils or wet clay to three tons on hard-pan or firm dry clay, sand, or gravel. The footing width required is computed easily, when the total expected load is known.

Reinforcing

When steel reinforcing rods are required for greater strength, much better bond is secured with deformed steel bars. These are held firmly in the concrete with no danger of slippage such as might occur with smooth rods. They may be located anywhere in concrete, or in the mortar joints between successive courses of tile or blocks. It is worthless to use wire or fencing material for reinforcing, as it is not strong enough to be of real service. Also metal chunks, gears, sheets, and springs are of no value as they serve only to fill space and are not of sufficient length to develop bond strength between the steel and the concrete.

Wherever masonry construction is subject to a tensile strain, steel reinforcing should be used. Steel should be located as close as possible to the edge or corner of the concrete wall. This will make the maximum strength available. Concrete of

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at least ¾-inch thickness should always be provided on all sides of the steel for sufficient bond and protection from exposure and rust.

Building corners are usually found to be weak spots, and here the reinforcing is of greatest importance. These bars must be bent and extended at least a yard in each direction. They also protect the masonry from cracks due to expansion and contraction caused by freezing, thawing, and change in temperature and humidity. In many small buildings, only this so-called "temperature steel" of small ⅜-inch diameter bars is used throughout the foundation along each edge, as indicated on the drawing.

For a heavily loaded structure, more steel may be necessary. If building corners are well supported, with uncertain bearing along the wall between corners, the steel should be placed along the lower foundation edges. Conversely, if corners of the structure are not well supported, the reinforcing should be laid along the upper two edges of the wall, ¾-inch in from the surface.

If the inside area of the structure is excavated, with backfill outside, the bars should be located near the inner edges of the concrete. On the other hand, where heavy loads are found within, as in a grain bin, it is necessary to furnish reinforcing near the outer surface of the foundation.

Reinforcement is especially needed above masonry doorways and window openings. The masonry lintels must be strengthened with steel bars, as without them independent sections of wall would not be securely tied together.

To provide adequate bond between bars placed end to end, in the absence of sufficiently long rods, they must overlap from 12 inches to 18 inches, so that they will act as one continuous unit.

A steel bar should not be placed at the center of a wall, as this is inefficient. More effect can be secured with the same quantity of steel by using two bars one-half the size and placing them each along the extreme upper and lower sections.

This discussion has not included any technical information for the design of large structures. For that purpose, an engineer should be secured to make the necessary computations. Common farm buildings, however, are sturdy if reinforced as above suggested. In many instances, all that is required is a careful arrangement of "temperature steel" throughout.