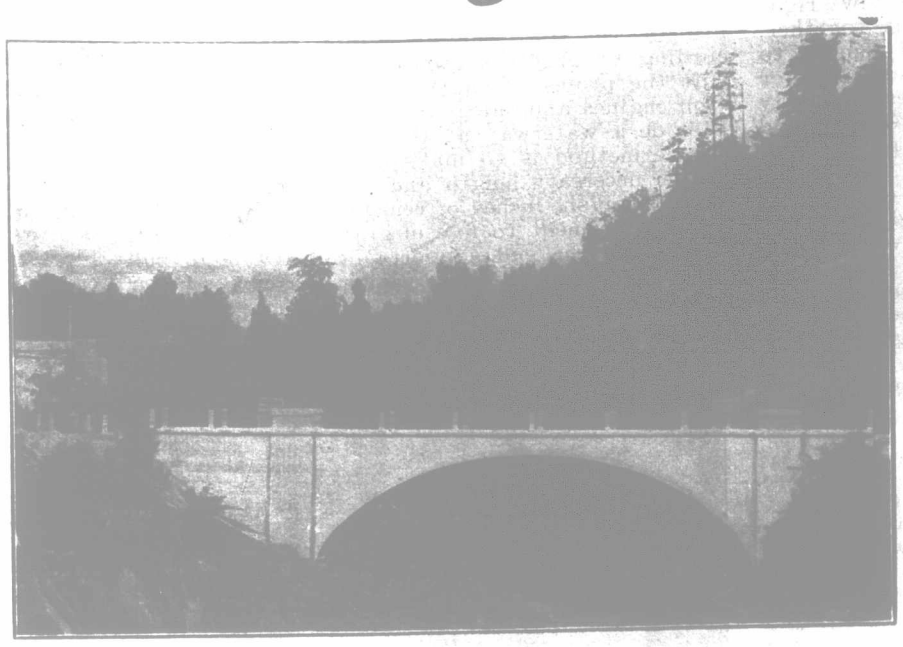
Cement-Concrete in Building: Its Nature and Uses.

Cement-concrete—what is it, how is it made, and how is it used? Another name for artificial rock or stone, the use of concrete has wrought one of the greatest revolutions of the past twenty-five years. Artificial stone has stood the test of twenty centuries, but modern cement-concrete is of comparatively recent use. It is inexpensive, because water and gravel are cheap, skilled labor is not required, and competition has brought down the price of cement. As wood became scarce and dear, builders began to appreciate the durability, economy, sanitary advantages and utility of the new substitute. Its use has created one of the greatest industries of modern times in Canada and the United States—the manufacture of cement, and latterly of concrete-making machinery. The uses to which it has been put include the construction of walls, floors, walks, pavements, culverts, bridges, building blocks, tiles, steps, posts, tanks, troughs, siloes, chimney caps, etc.



Concrete Arch.

Built in the summer of 1907, at Massey, Ont., by the Provincial Government, designed and supervised by W. A. McLean, Engineer of Highways. Said to be the longest concrete highway bridge in Canada; span, 94 feet; length over all, 154 feet.

CONCRETE MATERIALS AND PROCESS.

By concrete is meant a mass hardened or grown together. If we rightly comprehend the nature of the process, we can better understand the kind of materials to be used, and the way to combine them. In the process of making concrete, three materials enter: Cement, the "aggregate" (sand, gravel, or broken stone), and water. A cement-concrete mass hardens in three ways: First, to some extent by drying out, or evaporation; second, by absorption of carbonic acid from the air, and hardening, as carbonate of lime (limestone); and third, the sand, the silicate of aluminia in the cement and the water form the silicate of lime and aluminia, which is the principal product. In the chemical action and crystallization which take place, the favoring conditions are sufficient warmth and water, fineness of material, intimate mixing and time. As the crystals form, the particles of sand or gravel are caught and bound together, forming the artificial stone or rock. The strength of good concrete is shown by the fact that, in cutting through a wall six months or a year old, the stones embedded will break before the bond. Hence, the final strength depends upon the perfection of crystallization and the admixture or "aggregate." Therefore, anything of a loamy or clayey nature, bits of wood, soft sandstone, slate, shale, etc., must be avoided. They break easily, and the cement will not adhere. The sand or gravel can be tested by rubbing it between the hands. If it discolors them badly, it is not good. A handful of good material dropped in a vessel of water will sink quickly to the bottom without discoloring the water or showing a layer of mud. Then, the sand should be coarse, because it makes a stronger concrete, and takes less cement. The cement itself must be perfectly dry, smooth to the feel, and free from lumps. If stored, it should be in an absolutely dry place (never on the ground), otherwise it will take up moisture and solidify, losing strength.

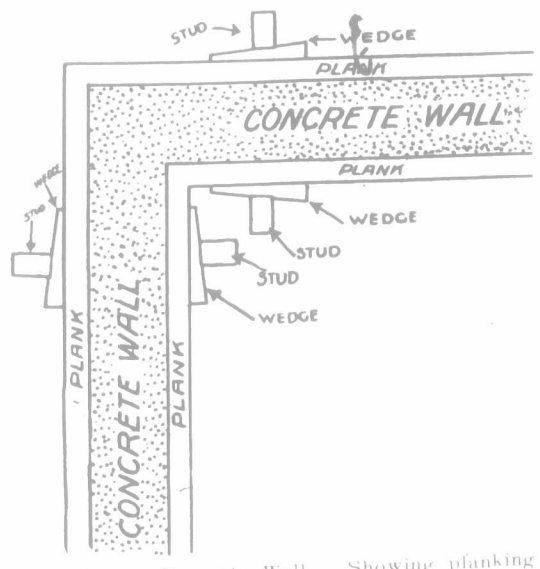


Fig. 1.—Corner Concrete Wall. Showing planking and supports. Two bevel wedges at each stud, one at top, other at bottom of plank.

MIXING.

In mixing the materials, first spread the requisite number of measures or shovelfuls of gravel on the large, water-tight platform, and then throw on the proper proportion of cement. Mix dry thoroughly by turning over and over again with a shovel or hoe, until the whole shows a uniform color. The water is then added gradually in sufficient quantities to thoroughly wet the mass, working quickly with hoe or shovel as the water is poured or sprinkled on. For large jobs, machine mixers are in use. There must be enough water in the mass so that the process of crystallization will go on to completion, otherwise the wall or block, as the case may be, will prove spongy, and continue taking up moisture from the air or from the soil below, and, when cold weather comes, the alternate freezing and thawing will disintegrate or crumble the concrete. Dry, porous silo walls are, therefore, said to be the cause (through absorption of moisture) of dry, mouldy ensilage around the outside. If broken or cobble stones are to be added to the mixture, they should be well wetted first to remove dirt and provide them with moisture, or they may withdraw too much from the mixture. On the other hand, the mixture should not be too sloppy, or it may be weakened and run into pockets when laid. Once mixed, the concrete should immediately be placed in the floor, wall or mould, and be well packed or rammed, which is most essential, otherwise it will begin to "set" on the platform, and, when disturbed, will never harden so well again. Adding more water in the attempt to retemper or mix again will almost completely destroy it. Once laid, the wall or floor should not be disturbed until set hard. Cement-concrete work obviously should not be done in frosty weather, or in buildings where the frost can reach the mass before "setting." These general directions will apply to practically all classes of cement work.

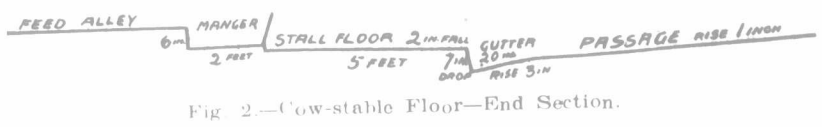


Fig. 2.—Cow-stable Floor—End Section.

[Note.—The cut shows 20-inch. bottom for gutter; 24 inches is better; and some prefer 20-inch. bottom for manger.

CONSTRUCTION OF WALLS.

For ordinary barn walls, one foot thick is sufficient, but less will do for lighter structures. The foundation should invariably be dug below the frost line, and the footing or base a couple of inches wider than the wall it carries. Carry it down below soft spots, also, to avoid cracking in wall above. A mixture of one part Portland cement to twelve parts coarse gravel, with plenty of field stones bedded in and well tamped down, makes the foundation; and, for the wall above ground, one part Portland cement to 10 of good sharp gravel. The more broken or field stone bedded in, the less cement will be required. Do not bed in stone large enough to run all the way through the wall or to show at the surface. If the site is wet, put tile drains around the outside. For the mould or curbing, good smooth, two-inch planks, with strong, upright, two-inch scantlings, well braced, are used opposite each other, with strips nailed across top (See Fig. 1). Enough planking should be provided to carry two courses all round the building, if small and the work is to be pushed; but if sufficiently large, so that by the time the end of the course is reached, the beginning will have set, then the wall can be laid truer with one above another. Walls may be either plumb or battered.

HOLLOW WALLS.

As an improvement upon solid walls, to which objection is found on account of dampness, the solid monolith not affording sufficient insulation, hollow walls, tied with galvanized-iron strips, concrete piers or bricks connecting the two faces (3 or 4 inches thick each), are advised. An American cement expert suggests core boxes, tapered to prevent them slipping down, and resting on round iron rods (greased), which may be withdrawn before the mass "sets," or tie straps. The cores are made in sections about two feet high. In another style, the boxes are made collapsible, and run up full height of the wall, and, when finished, collapsed and lifted out. A simple plan for making a four-inch air-space in a foot wall, by using inch boards, separated two inches by strips 1 x 2 inches, was described in "The Farmer's Advocate" for March 5th. The strips have rounded edges, and project above boards, so they can be turned and pulled out. The ends of the boards next solid portions (corners, windows and doors) are cut on the slope to let them out, and notches are cut on lower side for the ties. In many places, large hollow bricks or hollow cement blocks are superseding the solid wall, which is used merely for the base or foundation.

STABLE FLOORS.

Loam or soft surface soil should be removed down to solid clay, and the firmer it is, the less foundation or first-coat material will be required. In many cases, where there is a hard, yellow subsoil, the "finishing" coat of, say, two inches thick under animals and driveway, and even less in the feed passages, complete the floor. The ground should first be graded to suit the finished floor, say, according to Fig. 2. The feed alley is cemented, and usually level, and there is a six-inch drop to bottom of manger, which is about two feet wide. Then there is a two-inch drop to stall platform, which has a fall back to edge of manure drop of about 1½ inches in 5 feet in case of cows, and 2 inches in case of horses or steers. The drop at manure gutter is 6 or 7 inches, the bottom of which slants up, say, 3 inches in 24 inches wide. From outer edge of gutter to wall, there is a rise of 1 or 2 inches in the passageway. This style of gutter keeps the manure water next the drop, and is easier to clean than when made like a square trough. If, because of soft ground, a bottom coat a few inches thick is deemed necessary, one part Portland cement to ten of good coarse gravel and cobblestones is sufficient. For the finishing coat of 1½ or 2 inches, one part Portland cement to five, if the gravel is of good sharp quality, will make a strong floor, mixed as already described, well packed down with heavy iron tamp, using plaster-

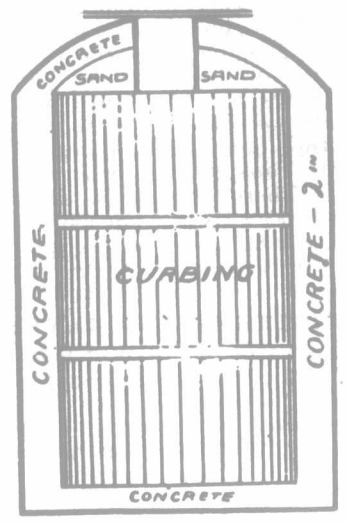


Fig. 3.—Round Concrete Cistern, with Manhole.