

Construction and Cost of Silo at Weldwood.

During the summer of 1911 a monolithic, round cement-concrete silo, 14 x 40 feet was built at "Weldwood," the 112-acre farm near London, Middlesex Co., Ont., purchased last spring by the publishers of "The Farmer's Advocate," to be operated in the interest of its readers. In accordance with the system of the farm, strict account was kept of every item of labor and material, save only the gravel, which was part of a pile hauled for several purposes, but which has been very closely estimated. The actual construction of the cement work (foundation, walls and floors) was done by a contractor, D. Stevenson, of Hubrey, Ont., at his standard charge of \$2.50 per foot of height, amounting to \$100 for 40 feet, besides the board of four and, part of the time, five men. His gang also excavated the foundation. A portion of the gravel was hauled by contract. The rest is charged at what it actually cost us to lay down, counting horse time at 10 cents per hour per horse, and teamster's time at the rate of 15 cents per hour on the road. Other labor, such as watering the walls, digging drain, etc., was charged at rates actually paid, ranging from 15 to 20 cents an hour.

EXCAVATION.

The silo is situated at the east end of the barn, opposite a central feed passage along which a feed truck is wheeled directly into the silo chute. The outside perimeter is $3\frac{1}{2}$ feet from the barn. The circle for the excavation was laid out as follows: Measuring $3\frac{1}{2}$ feet, plus 10 inches (intended thickness of the silo wall at the ground), plus 7 feet (the interior radius), we locate the center of silo. Drive a round stake here. In one end of a 10-foot board bore a hole large enough for this stake to go through, and in the other end, at a point 8 feet 3 inches from the central stake, drive a spike. Using this board as radius, describe a circle with the spike. Mark this circle with stakes at intervals of 12 inches. In digging excavation, it was flared outwards three inches as sunk, thus providing for a foundation wall 18 inches thick at bottom, and 15 inches thick at ground level. Our excavation was about $2\frac{1}{2}$ feet deep, or the height of one ring. Picks and shovels were used to loosen and throw out the dirt, which was wheeled away in barrows. Pains was taken to have the perimeter neat, since the cement-concrete was to be filled directly against this. Around the bottom of the bank, and just outside the perimeter, a row of three-inch cement tile were laid to drain the foundation. From this a line of tile was also laid to the center, where an upright tile, protected by a perforated steel plate, was built into the cement floor subsequently laid. This was to carry off a possible excess of corn juice that sometimes accumulates in the bottom of silos. A common tile outlet for both drains has since been laid, commencing at a point opposite the intersection of the two. Four men worked one and a half days excavating, removing dirt and placing tile in silo foundation.

THICKNESS OF WALL.

The wall was built with the patent adjustable steel curbs extensively used in Western Ontario. These permit the battering or drawing in of the outside of the wall, while maintaining the inner surface plumb. Our foundation wall was made 18 inches thick at the bottom, and drawn to 15 inches at the top, as already intimated. Commencing here on the ground level at 11 inches (instead of 10, as planned, it was reduced to 6 inches at the top).

DESCRIPTION OF CURBS.

Each curb consists of a series of steel plates $2\frac{1}{2}$ feet wide, bolted together, and constructed in such a manner that one curb or ring rests directly on top of another. Each ring, as placed, is hooked to the one below it by hooks and eyes attached to the rings. To provide for battering, there is one open joint on each curb where the end of one plate laps inside the end of its neighbor. At this point there are three latches with chains attached, one near the top, one in the middle, and one near the bottom. When the top chain is shorter than the ones below it, the circumference of the upper edge is correspondingly lessened, producing a battering of the wall.

Two complete pairs of curbs or rings are required to build a silo, the first one being removed, raised, and set on the second when the latter has been filled, and so on, turn about. Two rings a day may thus be safely built. Three are sometimes attempted, but not without risk, especially in cool, moist or frosty weather, when the cement sets slowly or imperfectly. By way of additional stiffening, a three-inch pole was laid on top of the iron braces. This pole was short enough to fit

loosely when the rings were round, but would fit tightly at any diameter where the rings were narrowing. At each lift it would be tried all round, and left in the narrowest place. Two such braces are sometimes used, and are better than only one.

To keep the inside perimeter true, there were a series of five braces (unpatented), each brace forming the fifth segment of a circle, except for the width of a wedge. Connecting the two ends of each segment or arc rim is a horizontal bar of iron, connected with the rim plate by three ties. These five braces are wedged around the upper edge of the inner curb, as placed for filling. To keep the rings spaced the proper distance apart, twenty dividers were used. These consist of wooden sticks eleven inches long at the start, but short-

gravel pile, and shifted over as the latter was used. Proportions were gauged by filling with gravel a bottomless box, one foot deep, made of 3-foot boards (inside dimensions being 3 ft. x 2 ft. 10 inches), raising the box, and dumping on top of the gravel heap one sack of cement. This was calculated to give a mixture of eight parts gravel to one of cement. The foundation course was made about one to ten, the first ring above ground one to seven, the bulk of wall one to eight, and the last two rings one to six or seven. These varying proportions were approximated by using a little more or less gravel, as the case might be, to each sack of cement. This was shovelled over three times dry, being at each turning thrown on top of an accumulating cone, to insure an even



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Levelling up the steel curbs and mixing the cement and gravel.

ened at each lift about a quarter of an inch to allow for the contraction of the wall. They are set in between the curbs horizontally at short intervals around the perimeter.

LEVELLING AND RAISING CURBS.

For the first course of $2\frac{1}{2}$ feet we used only the inner curb, the edge of the excavation serving in lieu of an outer one. After being connected up with the bolts, and set on the earth floor in proper condition, the curb was carefully levelled with ordinary spirit level set on a sixteen-foot straight-edge. Any low section was pried up with crowbar, pick or spade, and supported with a chip of stone or anything solid and handy. This was continued round and round till the curb was properly trued up. The braces were then put in.

When the first ring had been filled, the second pair of curbs was put on, the inner one set on the

and thorough admixture of gravel and cement, so that every particle of gravel would be surrounded with a coating of cement. Then, as it was turned for the fourth time, it was sprinkled with two and a half or three 12-quart pails of water. The moistened cement was shovelled over once more, then shovelled into barrows, wheeled to the silo, shovelled into the forms, and tamped with an eight-pound sledge hammer in the hands of a 165-pound man walking around in the rings as he tamped. The concrete, as put into the rings, had thus been shovelled six times. It was about damp enough that, when pressed in the hand and released, it would keep the impress of the hand. Builders who adhere to the practice of tamping find it impossible to keep the steel curbs in shape if the concrete is too sloppy, although we understand that the more recent method of constructing reinforced concrete is to make the mixture very

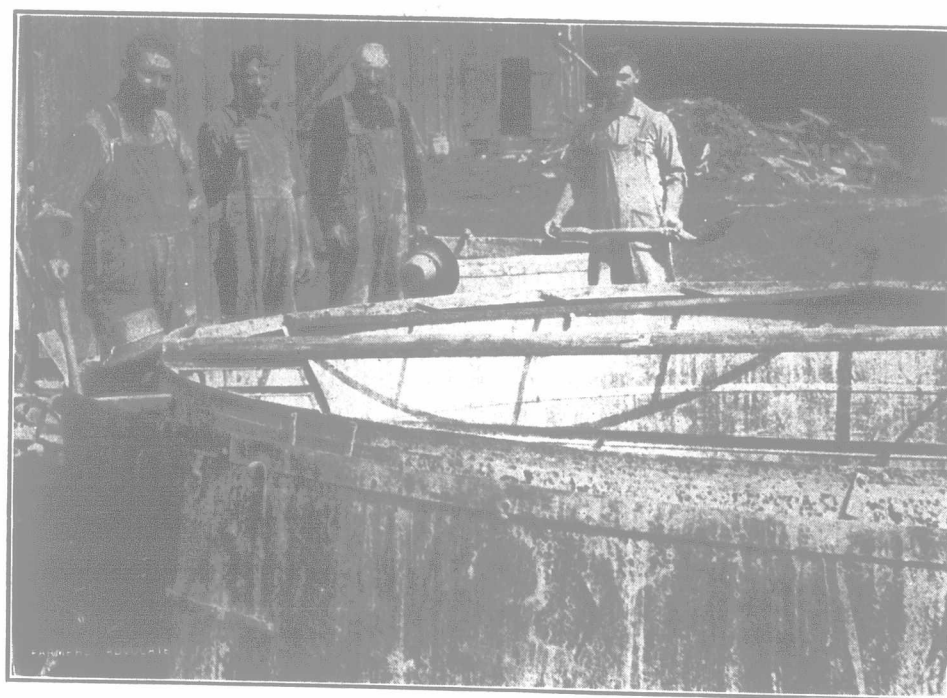
sloppy, and pour it into the moulds without tamping. Our contractor is a Scotchman who follows the old plan, and we must say that he does first-class work at whatever he undertakes. Each ring was filled evenly all the way round from bottom to top to keep the pressure balanced in all directions. As each curb was filled, cobble stones were laid in courses around the center of the wall, care being taken to avoid having any stone nearer than two inches to either outer or inner surface.

REINFORCEMENT.

In the first ring above ground, and every subsequent ring, as built, two bands of $\frac{3}{8}$ -inch round annealed iron were placed, spaced 15 inches apart, the varying lengths forming each ring being hooked together by bending the ends. Wherever a door space interrupted the reinforcing band, a piece of iron was placed vertically on each side of the door, and the reinforcing iron hooked around it. Across the top of each door a four-foot length of heavy straightened wagon tire was imbedded in the cement.

DOORS.

To leave openings for five doors, a mold was



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Ready to fill the steel curbs for the first course above ground.

one below, the outer curb resting on the projecting edge of the 15-inch cement foundation. Each time the rings were raised, the inner curb was levelled with the spirit on long straight-edge, while the outer one was also trued, though with less care, by applying the spirit-level across the upper edges of the two rings.

MIXING CEMENT AND FILLING RINGS.

The cement-concrete, consisting of clean, sharp gravel and Portland cement, was mixed by hand on a platform of twelve 12-foot planks, laid side by side on scantlings, the two outside planks only being nailed. The platform was placed beside the