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TEMPORARY SILOS FOR MICHIGAN

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The silo as a means of preserving emergency feed crops has been forcefully demonstrated during the past few extremely dry, growing seasons. As the drought continues in Michigan and available feed is limited, the need for more silos seems to be evident. For many farmers who are on small rented farms, the initial cost of a permanent silo is prohibitive. There are, however, several types of temporary silos that may be constructed at a very small cost.

The Crib Silo

The crib or snow fence silo is one of the most practical for temporary use. It is constructed of super-imposed strips of snow fence formed into a circle, the ends being securely fastened and the inside lined with a heavy waterproof paper. Figure 1.

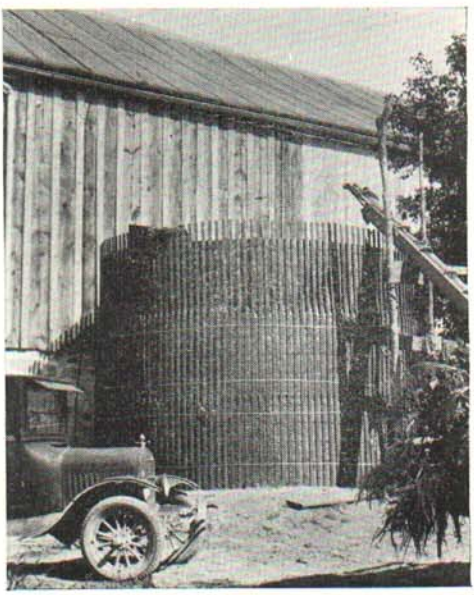

Fig. 1. A well built crib silo, showing details of construction. (Courtesy of American Lumberman.)

History—The crib silo seems to have originated in the arid section of the West about five years ago. In 1931, the South Dakota State College reported favorably upon about 40 that had been constructed the year before. During the same year, the University of Missouri issued Extension Circular No. 281 commenting favorably upon several crib silos constructed in that state. A few of them were built in Michigan, but the drought had not as yet attained such serious proportions as in the West, and the greater number of permanent silos here provided extra storage for feed during that emergency.

Since that time, continued dry weather during the growing season has resulted in decreased feed supply and the number of temporary crib silos has increased in proportion.

Advantages—

1. It provides feed storage at a fraction of the cost of most permanent silos.
2. It can be erected as the silo is being filled.
3. It may be moved from year to year and located where the feed is to be distributed.
4. It provides the renter with a silo that may be taken with him.

Construction—The site selected should be level. If the ground itself is not level, it should be made so and checked with a straight edge and level before the first section of cribbing is filled. At approximately the center of this area, drive a stake. Fasten a wire to this stake and with the other end mark a circle on the ground which is the same size as the proposed silo.

Fig. 2. A temporary crib silo beside a permanent silo.
Courtesy of American Lumberman.

The diameter of a silo usually depends upon the number of livestock to be fed from it and the height upon the length of feeding season. But there are other factors entering into the construction of a crib silo, and the builder must use his own judgment.

A low, wide silo is much more desirable than a high, narrow one because the snow fence will not support the weight of a high column of silage. Past experience indicates that the most desirable width is from 12 to 16 feet and the height from 16 to 20 feet. A 16 foot silo requires one complete 50 foot roll of fence for each section and where this diameter is used, considerable splicing of wire is eliminated and no fence is wasted. If additional reinforcing wires are used around the outside of the silo, the height may be increased.

Before the fence is used it should be thoroughly stretched by attaching one end to a post and using an ordinary fence stretcher on the other end. If the fence is not stretched before it is used, it will do so as the silage settles, resulting in torn paper and spoiled silage.

Set the first section of snow fence around the circle previously marked out and tie the ends together with the extending ends of wire. Line the inside with the paper which has been cut into convenient lengths. For small diameter silos the paper may be handled in one strip, but several short strips may be more convenient to handle without tearing it. For a 16 foot silo, four strips of paper 14 feet long are suggested. The ends of the paper should lap at least one foot, and a few inches at the bottom should rest on the ground to help make the joint air tight. Clothespins may be used to hold the paper in place until this section has been filled with silage. The paper should not be tacked to the fence, but should be free to move with the silage as it settles. If tacks are used, there is also danger of their pulling out and being fed with the silage.

The first section is now filled with silage uniformly distributed and thoroughly tramped while it is being placed. When it is filled to within a few inches of the top, the second section of fence is set up. This section is placed on top of and inside of the first section with the picket ends lapped about six inches. The paper is placed with the bottom edge lapped about six inches over the top edge of the first strip and held in place until this section is partly filled. A more symmetrical silo can be erected if the picket ends of each section of fence are tied together until after the silo has been filled. The ties are then cut and the silage, paper and fence allowed to settle as a unit.

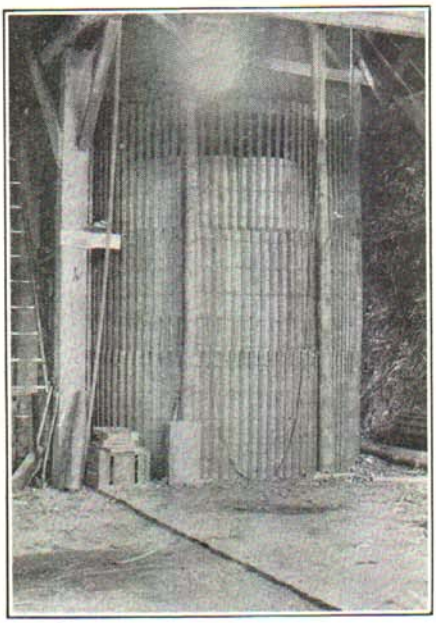

Fig. 3. A crib silo on a barn floor. Additional posts were placed under the floor to support the increased weight.

Each additional section is set up and lined with paper in the same manner. As the silo increases in height, a pole may be set up to which the elevator pipe and distributor may be attached.

Several poles or posts are sometimes set around the outside of the silo for additional support, but with reasonable care in erecting they are not necessary. They interfere with the natural settling of the silage which should telescope the fence and lining into the lower sections.

If additional reinforcing is necessary, strips of number nine wire may be placed around the middle of each section before the next section is completely filled.

Some cover should be provided for the silo as soon as it is filled. A two-foot layer of straw, hay or marsh grass has been found satisfactory.

When the silage is ready for use, the top covering and any spoiled silage should be removed. As the silage is used, the sections of fence are removed, carefully rolled up and stored for use another season. It is not advisable to try to save the paper.

Materials and Cost of Construction—The materials used in the construction of a crib silo can usually be obtained from any lumber yard. The cribbing or snow fence is that used for corn cribs or along the highway to keep the snow from drifting into the road. The pickets are four feet long, one and one-half inches wide and one-half inch thick, securely wired to make a light, durable fence. The fence is available in 50 or 100 foot rolls and costs from $.06 to $.07 a lineal foot.

The best paper is that composed of two thicknesses of waterproof paper bound together with some reinforcing fibre between, such as sisalkraft. Heavy roll roofing may be used if the other is not available, but it is not very satisfactory.

Fig. 4. A trench silo under construction in the Upper Peninsula. Cedar posts were used to line the inside.

Most of the papers are made in various widths, but the most satisfactory is four feet or the same width as the fence. This reduces to a minimum the number of joints in any silo and thereby reduces spoilage which usually occurs at the joints. The paper comes in rolls of from 600 to 1200 square feet and costs approximately $.01 a square foot.

The total cost of materials for a 50 ton silo or one 16 feet in diameter and 16 feet high would be approximately $30, fifteen dollars for the fence and $15 for the paper. The labor cost on such a silo should not be more than $5. The cost per year per ton of silage would be about $.47 based upon a five year life for the fence and new paper each year. A comparison of the costs of storing silage in different types of silos is given in Table 2.

The Trench Silo

Description—The trench silo is simply a ditch dug in the ground usually with the aid of a plow and slip scraper to a depth of 8 to 12 feet. The width at the top is about 12 feet and at the bottom about 8 feet. For temporary use the side walls are carefully smoothed with a spade, but if the silo

is to be used year after year, a permanent finish for side walls is more desirable. Several materials have been used including plank, poles, brick, stone, plaster or concrete. See Figure 4.

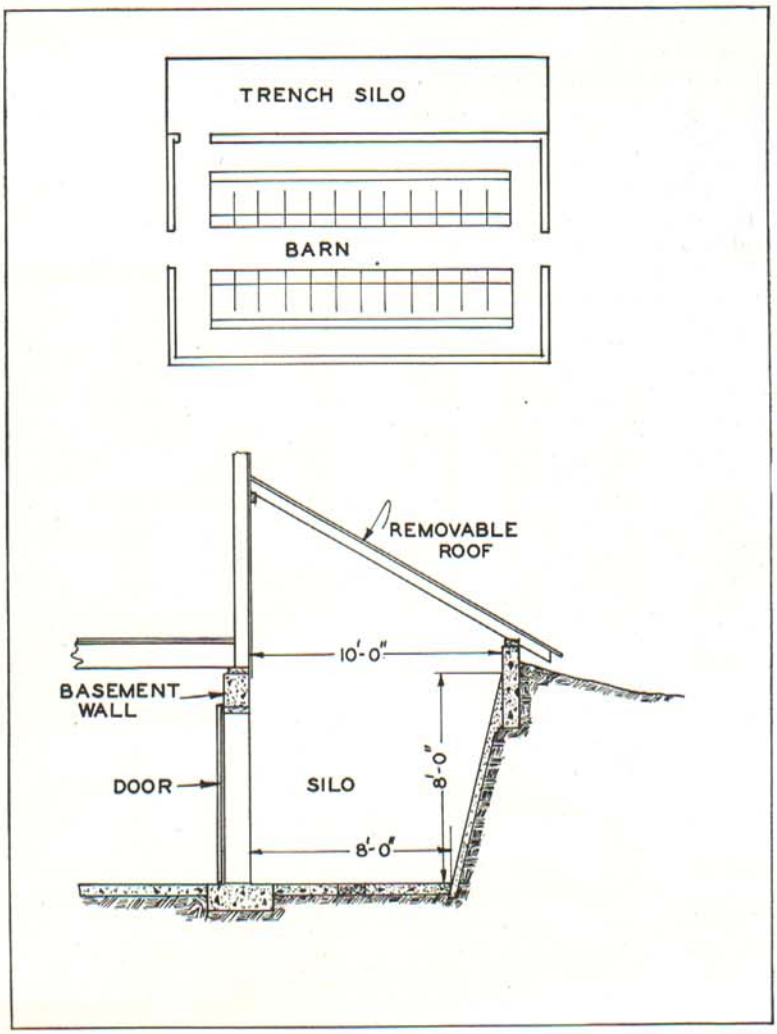

Fig. 5. A convenient location for a trench silo.

History—The trench silo has been used for many years in European countries for storing beet tops and certain legumes. Its first appearance in America seems to have been in Western Canada where several trench silos were built immediately after the World War. From Canada it spread into Montana, Minnesota, the Dakotas, and then into the South and Southwest where soil and drainage conditions were most favorable. During the

past few years the number of trench silos in Michigan has increased. They are particularly popular in the Upper Peninsula where permanent silos are not so numerous as in the Southern part of the state.

Advantages—

1. It is cheaper to construct than most upright silos.
2. It is adapted to temporary or permanent construction.
3. If temporary, it can be constructed with practically no expenditure for materials.
4. If permanent, a large part of the materials used in its construction may be found on the farm.
5. No skilled labor is necessary in its construction.
6. The silo may be filled with simple equipment, consisting of cutting table without blower attachment.
7. The silage does not freeze except under severe conditions.
8. Unchopped fodder may be stored if desirable.

Location—The factors to be considered in locating a trench silo are, surface drainage, type of soil and convenience for feeding. Surface water should drain away from the silo. If it seeps into the silo the walls may cave in and spoil part of the silage. The remaining silage is also harder to remove. Ground water should be kept out of the silo, preferable by natural drainage, but if necessary, a drain can be laid around the sides near the floor. If a permanent floor is laid, it should be provided with a drain. Otherwise, a pump may be necessary to remove any surplus water before the silo is refilled.

The trench silo may be excavated in a light, sandy loam that will hold its shape while the trench is being dug, but light enough to be well drained. A soil free from clay, hardpan or loose rock is desirable.

The most convenient place for feeding will usually be near the barn. A very practical arrangement in connection with a bank barn is shown in Figure 5, where one wall of the barn serves as one side of the silo. Sometimes a silo in the field is more convenient for feeding as well as filling. This is especially true for feeding lambs or steers.

Method of Construction—The excavation for a trench silo can be made with a team or tractor and a plow and slip scraper. When the trench has been dug to the approximate dimensions, the side walls and bottom are finished with a spade. The sloping side walls let the silage settle more uniformly and eliminate many air pockets that would otherwise be present if the walls were straight. The usual dimensions are 12 feet at the top, eight feet wide at the bottom, eight feet deep and any desired length. The cross sectional area corresponds to the diameter of an upright silo and will vary with the size of the herd. The length corresponds to the height of an upright silo and will vary with the length of feeding season. Capacities of different size silos and the dimensions suggested for different size herds are shown in Table 1.

Some trench silos have been used for one or two years without any lining on the inside walls. If used year after year, however, the silage begins to spoil around the edges due perhaps to bacteria which remain in the soil. The earth walls begin to scale off leaving pockets which must be patched up or smoothed by widening the silo. For this reason the walls are usually lined with some more permanent material. See Figure 6. The curbing

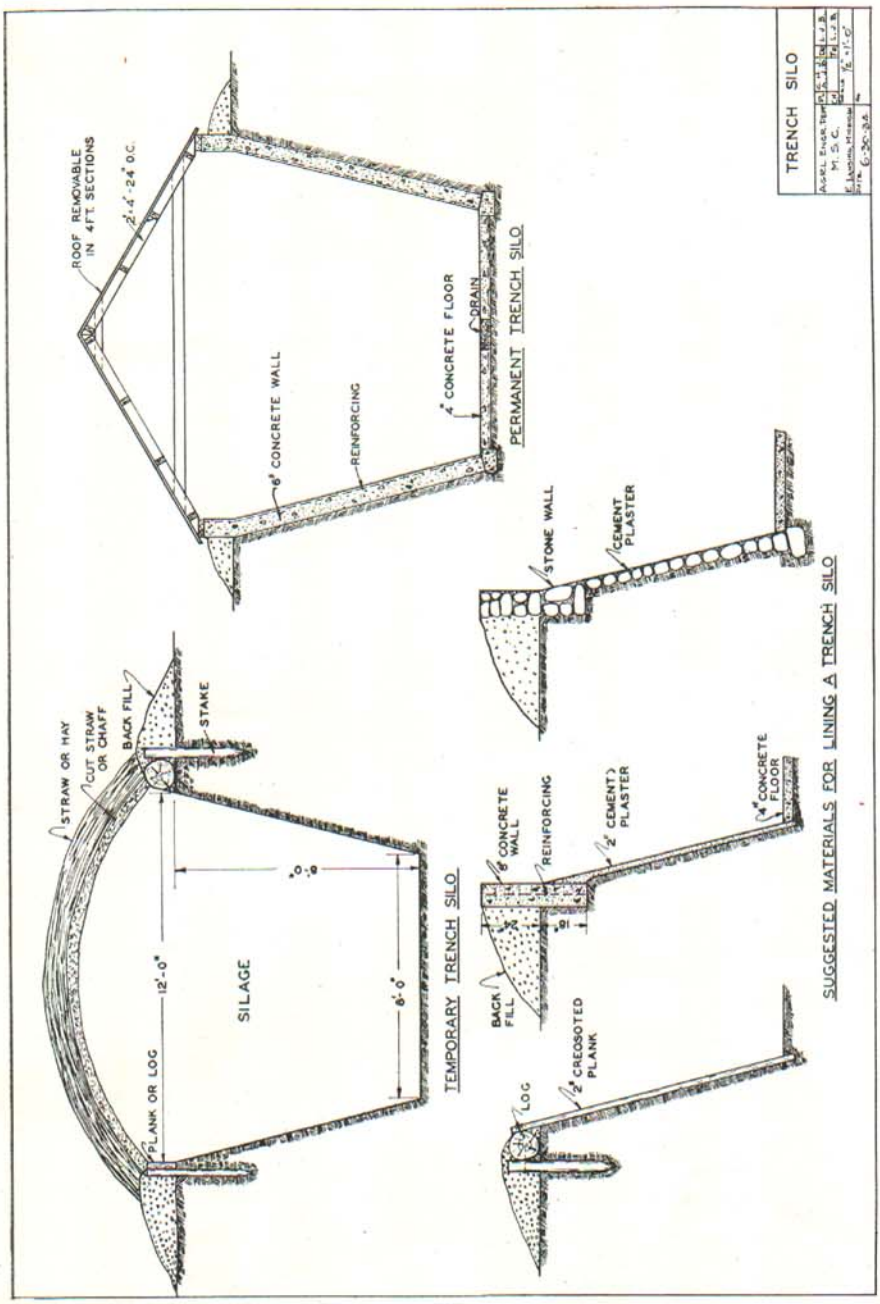

Fig. 6. Construction details of a trench silo.

Table 1. Approximate size of trench silo needed for different size herds if three tons of silage are allowed per cow per year.

Number of Cows	Tons Needed	Top Width in Feet	Bottom Width in Feet	Depth in Feet	Length in Feet
6	18	7	6	6	30
8	24	7	6	6	38
10	30	8	6	6	35
12	36	8	6	7	38
14	42	10	8	8	30
16	48	10	8	8	35
20	60	10	8	8	42

around the top which may be either logs, plank, concrete or stone acts as a retaining wall for the excavated earth and reinforces the edge of the trench against caving in. Plank or poles are not as satisfactory for a permanent lining as some of the other finishes because it is difficult to obtain a smooth, even surface after the lumber begins to warp. Where they are used, the wood should be thoroughly seasoned and painted with a preservative.

Plaster is not permanent if applied directly to the earth bank. A better method is to lay poultry mesh along the bank held in place by iron or wood pegs driven into the earth and the plaster applied over it in two or more courses. A total thickness of two inches seems to be satisfactory. The plaster is made by mixing one part of Portland cement and one-tenth part of lime with three parts of sand and enough water to make it workable.

The stone is laid up in the same way that brick or block would be laid and the surface made smooth with a trowel coat of cement plaster.

The concrete finish is reinforced with iron rods running both ways or with wire mesh and poured in forms the same as for any wall.

Fig. 7. A covered trench silo. The cover is constructed with alternate sections removable for convenience in filling.

Cost—The cost of a temporary trench silo is practically all for labor. The trench for a 50 ton silo can be excavated by three men and a team in two days. Allowing $3 a day for the team and $2 a day for the men, the total labor costs would be $18. Some materials must be used to reinforce the edges of the trench and for the cover. The cost for these materials should not exceed $10, making a total cost of about $28 to $30.

As the length of life is increased by adding more permanent materials to the side walls, the total cost of the silo increases. A permanent 50 ton trench silo lined with reinforced concrete will cost about $100.

Filling Machinery—The cost of filling the trench silo is much less than for an upright silo. See Figure 7. The only equipment necessary at the silo is a cutting table and some source of power. No blower is required which reduces the cost of the cutting machinery about 75 per cent as compared with that used in filling upright silos. In some cases it may be desirable to put whole bundles of corn or other fodder into the silo. This practice is not common, but has proved satisfactory. In fact, the first crops ensiled, were stored in this way.

The Sheet Metal Silo

Another silo which may be more permanent than temporary yet one that is economical to construct is the sheet metal silo shown in Figure 8. This silo was built as an experiment in 1930 by the Department of Agricultural Engineering at Michigan State College in cooperation with J. W. Wagoner, at Williamston. It is constructed of corrugated sheet metal on the inside of wooden hoops. The hoops keep the silo from bulging and the metal gives it stiffness and rigidity.

Method of Construction—A nail that was to be the center of a ten foot diameter circle was driven into a plank at the center of the platform. A board pivoted on the nail at the center with another nail driven through it five feet from the first nail was used to lay out the circle. Around the edge of this circle 2″ x 4″ blocks were securely nailed at intervals of twenty-four inches. Similar blocks were nailed about six inches back of each of the first blocks. The thin strips of lumber were bent around the outside of the inner block and held in place by wedges driven between the strips and the outside block. As soon as the four strips were in place and wedged tight together they were nailed from both sides with 8 d nails spaced about one foot apart. At each joint a four inch strip of sheet iron was wrapped around the hoop and nailed to keep the ends from pulling loose. A barn floor would be an ideal place to build these hoops and would eliminate the expense and labor of building the platform.

As soon as each hoop was completed it was set up as shown in Figure 8B. The hoops were set upon two timbers which had been leveled so that the walls of the silo would be straight. Each one was properly spaced and braced in its respective position. The hoops were spaced two feet on center in the bottom half and three feet on center in the top half of the silo. As soon as the last hoop had been set in place the sheet metal was nailed as shown in Figure 8C. The sheet metal strips were 12 feet long and lapped six inches at the end. The top sheet over the bottom makes a smooth joint which will not interfere with the settling of the silage. The side laps included two corrugations and all joints were sealed with plastic asphalt

cement. A space equal to the width of one sheet of metal minus the two side laps extended the full length of the silo for the door. The door is made of full width strips of sheet metal of any convenient length put in place while the silo is being filled. The outward pressure of the silage holds the door in place.

The completed silo was raised by using a block and tackle and gin poles. See Figures 8D and 8E. A rope was placed around the silo just above the center hoop and the tackle attached to the barn. The gin poles were used to

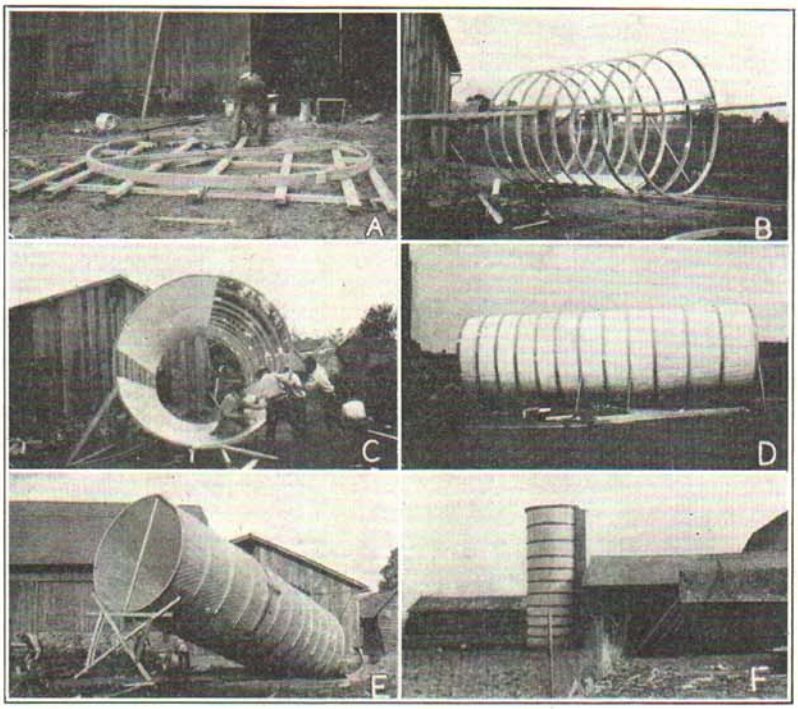

Fig. 8. Consecutive steps in building a sheet metal silo.

hold the silo from swaying and help raise it. A concrete floor and curb had been previously constructed and the silo was set in place upon it. See Figure 8F. An eight inch layer of concrete was then poured around the outside to help anchor it.

Materials—Where native timber is available, there are several kinds of lumber that would be well adapted for making silo hoops. Perhaps the most desirable would be elm, oak or ash. Any of these woods should be painted as soon as possible, preferably before the silo is erected. Yellow pine is probably the most available commercial timber, and if the boards are free from knots, it is entirely satisfactory. Such woods as cypress, redwood and western cedar are more durable, but also more expensive.

The sheet metal should be 24 or 26 gauge corrugated metal coated with two ounces of zinc per square foot. The sheets come in any length from five to 12 feet and a 10 or 12 foot length is probably most practical. Three 10 foot lengths would make a silo about 28 feet high and three 12 foot lengths, one about 34 feet high. The most practical size has not been determined, but a 50 ton silo or one 10 feet by 30 feet would find a place on most dairy farms for additional feed storage.

Cost—The silo illustrated here was 10 feet wide and 30 feet high and cost approximately $150. The cost for materials was about $100, and the labor was estimated at $50. See Table 2 for comparison of silo costs.

Table 2. Yearly overhead cost on different types of silos.

Type of Silo	Capacity	Estimated Cost	Estimated Life	Cost per Year	Cost per ton of Silage per Year
Temporary Crib	50 tons	Mat. $ 30 Lab. 5	Fence—5 yrs. Paper—1 yr.	$23.75	$0.47
Temporary Trench	50 tons	Mat. $ 10 Lab. 20	2 yrs.	$18.15	$0.36
Semi-permanent Sheet Metal and Wood Hoops.	50 tons	Mat. $100 Lab. 50	10 yrs.	$30.00	$0.60
Permanent Trench	50 tons	Mat. $ 60 Lab. 40	20 yrs.	$14.15	$0.28
Permanent Upright	80 tons	Mat. $200 Lab. 100	20 yrs.	$42.00	$0.53
Permanent Upright	80 tons	Mat. $350 Lab. 150	40 yrs.	$57.50	$0.72

The cost estimates in Table 2 do not include charges for filling but do include all items charged against construction. The overhead cost on all of the permanent silos was computed from the following formula which includes interest, depreciation, taxes, repairs and insurance:

$$C = \frac{I\ (1.03 + .09y)}{y}*$$

Where C = yearly overhead cost
I = initial investment
y = estimated life in years

The yearly costs of the temporary silos were computed in a similar manner, but some of the factors such as taxes and insurance that may not apply to temporary construction were omitted from these calculations.

*Method of Computing Machinery Costs, E. C. Sauve, Michigan Quarterly Bulletin, May, 1931.

Summary

It is not intended that temporary silos shall replace permanent silos, but:

When feed supplies become uncertain, a temporary silo provides a practical and economical means of storing any crop that can be ensiled.

It is possible with a temporary silo to convert roughage that might otherwise be wasted into palatable feed.

The temporary silo provides storage for surplus feed at small additional cost.

Temporary silos have a low first cost and material from the farm may often be used in their construction.