University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Historical Materials from University of Nebraska-Lincoln Extension

Extension

1932

EC32-713 The Trench Silo in Nebraska

Ivan D. Wood
University of Nebraska at Lincoln

E.B. Lewis
University of Nebraska at Lincoln

Follow this and additional works at: https://digitalcommons.unl.edu/extensionhist

Part of the Agriculture Commons, and the Curriculum and Instruction Commons

Wood, Ivan D. and Lewis, E.B., "EC32-713 The Trench Silo in Nebraska" (1932). *Historical Materials from University of Nebraska-Lincoln Extension*. 1869.
https://digitalcommons.unl.edu/extensionhist/1869

This Article is brought to you for free and open access by the Extension at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Historical Materials from University of Nebraska-Lincoln Extension by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

Extension Circular 713 Revised July, 1932

The Trench Silo in Nebraska

A LARGE TRENCH SILO IN DAKOTA COUNTY

THE TRENCH SILO AS DESCRIBED IN THIS CIRCULAR, UNLESS LINED WITH SOME PERMANENT MATERIAL SUCH AS BRICK, CONCRETE OR STONE, MUST BE CONSIDERED A TEMPORARY STRUCTURE WHICH WILL SERVE FOR A FEW YEARS ONLY AND THEN MUST BE DISCARDED OR REBUILT. IN AN EMERGENCY IT WILL SAVE A CROP EVEN THOUGH THE FARMER HAS LITTLE CAPITAL TO EXPEND OTHER THAN HIS OWN LABOR.

The University of Nebraska Agricultural College Extension Service
and United States Department of Agriculture Cooperating
W. H. Brokaw, Director, Lincoln

FOURTEEN TRENCH SILO FEATURES:

1. Quickly and cheaply built for emergency use.
2. Can be built with unskilled labor and with machinery easily procured on the farm.
3. Any desired capacity can be had by increasing length of trench.
4. Can be built any place where drainage is sufficient for a house basement.
5. Not easily destroyed by storm or fire.
6. Little danger from poison gases.
7. Little trouble from frozen ensilage.
8. Can be filled without a blower.
9. Machines for cutting ensilage in field can be used without extra blower or elevator.
10. No hoisting apparatus required. Ensilage easily removed in wagons, feed carriers on tracks or feed carts.
11. Is better adapted than other silos to preservation of whole corn bundles, when ensilage cutter is not available.
12. Unless trench is lined, caving will result after first year. Open trench is dangerous and unsightly unless roofed.
13. If made too wide, the percentage of spoiled ensilage will be large.
14. It preserves ensilage with relatively small amount of spoiling if corn is cut at proper time, packed and covered with waste material such as chaff, straw, or earth.

The Trench Silo in Nebraska

By IVAN D. WOOD AND E. B. LEWIS

The original idea of using a trench for the storing of ensilage seems to have been the outgrowth of the practice long used in several European countries of storing clover and beet tops in pits. Shortly after the World War, western Canada followed by Montana and North Dakota began to use the trench silo. In Nebraska the true trench silo made its appearance about 1925 or 1926.

Agricultural statistics for 1930 show that only about 48 per cent of the farms in Nebraska are operated by the owners, eastern Nebraska showing about 45 per cent and the western districts about 51 per cent. Many farm owners and most of the renters have felt that most all silos were too high in first cost per ton capacity. The very low first cost of the trench silo seemed to offer a partial answer.

During September 1930, two trench silos were dug at the Agricultural Experiment Station Farm, University of Nebraska, Lincoln, one at the Agronomy Farm and one at the sheep barn on the main campus. Both of these when finished had cross-sections very closely conforming to that illustrated in Figure No. 1.

Pick Well-Drained Location Near Lots

It is exceedingly important that flood water from rains does not enter the trench silo. A muddy floor may cause difficulties in feeding and caving of the side walls may result

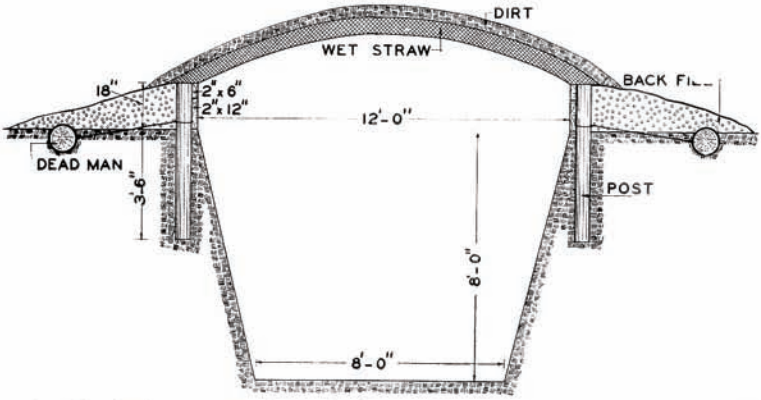

Fig. 1.—Typical cross-section of the type of trench silo built at the College of Agriculture Experiment Farm. Here posts and plank are indicated to hold the back fill of earth at the sides. Logs were used in the experimental silos but not found very sastisfactory, due to spoilage of ensilage near them. Experience in 1931 indicates that a 4 inch layer of dirt laid directly on the ensilage gave good results.

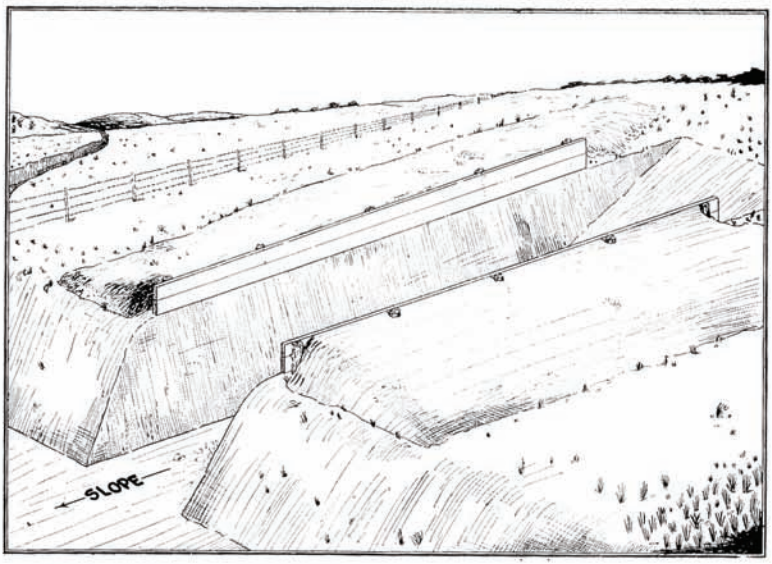

Fig. 2.—Location of a trench silo in a bank with one end opening on a lower level. This makes for easy removal of ensilage where feed carriers and carts are used. It also gives good drainage and permits the easy removal of snow.

from water pouring over them. The importance of good drainage may be realized when seventy out of one hundred men who were interviewed by the Department of Animal Husbandry indicated that the greatest handicap in the use of the trench silo was mud, water, snow and ice which accumulated in the trench or on the sloping runways. In most instances a well drained location near the feed lots and build ings can be found. A very advantageous location is one in which the trench can be excavated in a bank, yet have one end open on a lower ground level as shown in Figure No. 2. This arrangement permits excellent drainage and reduces labor of feeding to a minimum, where feed carriers or ensilage carts are used.

In some cases it may be possible to bring one end of the trench up to the foundation of a bank barn or even to use one foundation wall of the barn as one side of the trench silo as shown in Figure No. 3. In most instances, it is necessary to make the excavation on fairly level ground and in this case the trench is dug with a sloping runway at either end. Even though no convenient location near the buildings can be found, it may pay well to have available the excellent feed that good ensilage provides. Wagons can be easily loaded by

backing them down into the runway of the trench and the ensilage transported to the feed bunks wherever they may be located.

Where sand or gravel beds or rock ledges may be encountered, it is well to investigate the proposed location to a depth of 6 or 7 feet with a soil auger. Most of the sub-soil formations in the uplands of Nebraska stand well if some slope is given to the side walls of the trench. Where sand is present in considerable quantities, it will probably be necessary to line the side walls as described elsewhere in this bulletin.

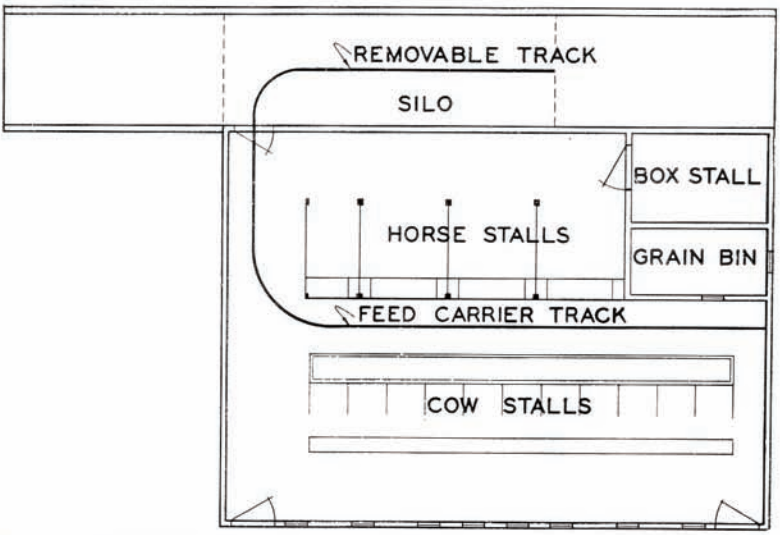

Fig. 3.—Suggestion for using one wall of the basement barn as one side of the trench silo. This places the feed near the point of consumption.

Details About Filling the College Trench Silos

As previously mentioned both silos built on the Experimental Farm had cross-sections conforming to Figure No. 1. The deep section of one silo was 40 feet in length, the other was 75 feet in length, and each had 20 feet of sloping runway at each end.

The silo with 40 feet of main section was built near the sheep barns. When this silo was filled September 23-25, 1930 all of the green fodder was weighed and moisture samples taken. A tractor was used to pack the ensilage. Some water was added the full length of the trench on one side. The reason for adding the water to one side only was to note whether the dry condition of the side of the trench would draw moisture from the ensilage and cause spoilage.

The trips of the tractor the length of the trench averaged one per ton of ensilage. The average per cent moisture of the ensilage was 72.9. (This was about 4% drier than most of the ensilage cut for silos on the Experimental Farm the fall of 1930.)

Measurements were taken 5 hours after filling operations ceased and showed the rounded ensilage to be 2 feet higher than the top of the logs at the sides of the trench. With these conditions at filling time the ensilage when settled completely filled the trench shown in Figure No. 1.

Silage Weighed 45 Pounds Per Cubic Foot

All ensilage was weighed out of this trench as it was fed and it was found to weigh almost 45 pounds to the cubic foot. The main section, 40 feet in length, held slightly more than 80 tons of ensilage and the two sloping 20 foot ends held about 26 tons. From these conditions at filling time and from weights of ensilage taken out it was shown that approximately 2 tons of ensilage were stored for every foot in length of the main trench, and about .6 of a ton stored for each foot of the end slopes.

The number of pounds of ensilage per cubic foot in this experimental silo was higher than has been generally accepted as the weight to be expected but it is believed the conditions under which the information was secured can easily be duplicated on any farm. Several have estimated the weight of ensilage in these trench silos at from 30 to 40 pounds and most of the estimates are 30 to 35 pounds per cubic foot. Where the fodder is dry when cut for ensilage or where poor packing is done or both conditions are true, it is probable that 30 to 35 pounds per cubic foot is all that should be estimated. Where filling conditions are similar to those met at the Agricultural College in the fall of 1930 it is felt that 45 pounds per cubic foot can be depended upon.

How Much Will Stock Eat?

The following table may be used to determine the approximate amount of ensilage required for any farm. The amounts shown are figured for a full allowance of ensilage and would be reduced if supplemented with considerable quantities of other feeds.

Approximate Daily Ration

KIND OF STOCK	Pounds fed per Day	KIND OF STOCK	Pounds fed per Day
Beef Cattle			
Cows	50 to 60	Work Horses	10
Weanling Stock Calves	30 to 40	Colts	5
Yearling Stockers	40 to 45	Breeding Ewes	3 to 5
Fattening Calves	20	Fattening Lambs	2
Fattening Yearlings	25	Dairy Cows	40 to 50
Fattening Two year Olds	35	Yearling Dairy Heifers	25 to 30

If it is desired to feed ensilage to 10 head of dairy cows and 20 head of fattening calves the requirements per day would be:

10 cows, 40 pounds each	400 pounds
20 fattening calves, 20 pounds each	400 pounds
Total	800 pounds per day or
	24,000 pounds per month

When an average of 800 pounds of ensilage per day was taken out of the two experimental trench silos at the Agricultural College no waste occurred. The table on the next page is given to aid in determining the dimensions best fitted to a farm.

These data are based on 45 pounds per cubic foot. In the main 40 foot section of the trench near the sheep barns the

Fig. 4.—Starting the excavation for the trench silo at the sheep barn. The ground was plowed with a two-way plow and removed in Fresno scrapers drawn by tractor power .

CAPACITY OF TRENCH SILOS

			Tons of Ensilage for Various Lengths							
Depth	Top Width	Bottom Width	30 feet	40 feet	50 feet	60 feet	70 feet	80 feet	90 feet	100 feet
6 ft.	8 ft.	6 ft.	28.35	37.8	47.25	56.7	66.15	75.6	85.05	94.5
6 ft.	10 ft.	7 ft.	34.42	45.9	57.37	68.85	80.32	91.8	103.27	144.75
6 ft.	12 ft.	8 ft.	40.5	54.0	67.5	81.0	94.5	108.0	121.5	135.0
7 ft.	8 ft.	6 ft.	33.0	44.0	55.0	66.0	77.0	88.0	99.0	110.0
7 ft.	10 ft.	7 ft.	40.1	53.5	66.9	80.3	93.7	107.0	120.4	133.8
7 ft.	12 ft.	8 ft.	47.2	63.0	78.7	94.5	110.2	126.0	141.7	157.5
8 ft.	10 ft.	6 ft.	43.2	57.6	72.0	86.4	100.8	115.2	129.6	144.00
8 ft.	12 ft.	8 ft.	54.0	72.0	90.0	108.0	126.0	144.0	162.0	180.0
8 ft.	14 ft.	10 ft.	64.8	86.4	108.0	129.6	151.2	172.8	194.4	216.0
10 ft.	14 ft.	9 ft.	77.4	103.2	129.0	154.8	180.6	206.4	232.2	258.0
10 ft.	16 ft.	11 ft.	90.6	120.8	151.0	181.2	211.4	241.6	271.8	302.0

These figures do not include ensilage in the runways.

ensilage weighed out 80 tons or 2 tons per foot of length. The weight of the ensilage in the deep section with quality considered good enough to feed sheep was 50 pounds per cubic foot. This included none of the discolored or burned out ensilage on top which was light in weight.

Dig Silo With Farm Tools and Labor

A trench silo is well adapted to emergency use because it can be quickly constructed when a corn crop is drying up or has been frosted before maturity. The tools and equipment necessary to construct one may be found on most every farm. One man with a plow, slip scraper and a spade could do the job if the time element were not important. Two men and two teams can work to good advantage, one plowing while the other runs the scraper. A crew of three men, using four horses on a Fresno and two on the plow also make a good working unit. The four horses on the Fresno will move big loads of dirt. The extra man holds the plow or scraper or trims up the side walls with a spade in spare moments.

Neighbors Might Pool Equipment

Where several neighbors contemplate digging silos it will pay to pool equipment and operate on a larger scale. For speed and ease of operation a crew of three men operating two light tractors, two 5 or 6 foot Fresnos, one two-bottom plow and a 6 foot wheel road grader will usually make excellent headway unless the ground is too hard. For extremely hard ground it may be necessary to use a road plow or even to resort to explosives.

Fig. 5.—Fresno scrapers handled large loads but could not be used near the walls.

Stake Out Dimensions

The first step in excavating the trench silo built near the sheep barn at the Agricultural College in 1930 was to stake out the size of the ground. The si.o proper was to have been 12 feet wide at the top, 8 feet wide at the bottom, 40 feet long, and 8 feet deep. At each end was a 20 foot runway making a total length of 80 feet. Stakes were set at all corners and at points where runways were to join the main part of the silo. The top soil was plowed and immediately removed with one 5 foot Fresno grader and one common slip scraper, each pulled by light tractors. As soon as dirt was removed the plowing was resumed and the scrapers started again as shown in Figure No. 4. A two-way plow was found better than the common variety as plowing operations could start at one side and continue to the other side without the necessity of making rounds.

It was not possible to plow and scrape near the side walls so a light wheel road grader was used to remove the shoulder which remained as shown in Figure No. 6. In the absence of a road grader it would be possible to get much nearer to the side walls by using one slip scraper with a chain hitch and one Fresno, the slip scraper being used along the walls and the Fresno near the center. A plow can be used nearer the walls when hitched about 4 feet behind the doubletrees.

Figure Actual Time and Expense

Very little difficulty was encountered in getting up and down the runways with tractors and machinery. The side walls required a slight amount of trueing up with a tile spade when the excavation was finished. The actual time required for various operations is shown in the following table: (Size of silo 15½ foot top width, 8 foot bottom, average 7 foot excavated depth, two 20 foot sloping runways at ends).

Item	No. of Hours
Road Grader	2
Plow	6
Fresno (5 foot)	21.5
Slip scraper	16.5
Killefer (deep tillage tool)	1
Two-way plow	2.5
Man labor	116
Tractor	60
Fuel	62 gallons
Oil	4.5

Advantages of Sloping Side Walls

The side walls of the trench silo are generally sloped about one foot inward for each four feet of depth whether or not

Fig. 6.—A small wheel type, road grader proved very useful in removing dirt near the walls. Very little hand work was necessary in finishing the walls.

a permanent lining is used. Several instances have come to attention where one side of the silo was made straight and one sloping. Without exception the greater amount of spoiled ensilage was found next to the straight wall. The advantages of the sloping walls are:

1. Packing of the ensilage is more easily accomplished because tractor, team or truck can get closer to the edge than with perpendicular walls.
2. As the ensilage settles there is less likelihood of air pockets forming, to cause spoilage.
3. There is less likelihood of destructive caving when dirt walls are used without any type of lining.
4. Gives greater stability where masonry or other types of lining are constructed.

Building on Bottom Land or in Sandy Locations

It is not always possible to make excavations to depths of 6 or 7 feet due to high water table or sandy conditions of the soil. Even under these circumstances the trench silo can be constructed with a fair degree of satisfaction. In sandy soils the slope of the side walls may be made much flatter than those shown in the drawing. Successful silos have been built

with walls which sloped one foot or more inward for each foot of depth.

In river bottom lands the excavation might be made 2 feet or less in depth but dirt could be brought in and piled along the sides of the silo to give height to the walls.

Temporary Linings

In one experimental silo a section of the side wall was lined with tough waterproof paper and another section lined with 1 inch boards placed vertically. As far as could be determined neither of these linings could be called worth while. In fact, near the logs at the top of the trench more spoilage resulted from pockets formed when the settling ensilage forced the temporary linings to give way. This was especially true where paper linings were used. The results would, no doubt, have been different had heavier plank been used as described later in this circular.

May Use Unlined Walls for a Year or Two

The unlined dirt walls of the two silos at the College of Agriculture, University of Nebraska, are in fairly good condition after two years of use. The trench at the sheep barn is in excellent condition and can be filled for the third time with little work on the walls. The dirt and other debris on the bottom can be removed with a few hours work. When built this silo had a top width of about 15½ feet. It has caved until after eighteen months of exposure it measures approximately 17 feet at this point. The one at the Agronomy Farm can be filled for the third time with very little repair.

When unlined walls are used, some slaking and caving can be expected. It may be necessary to trim the side walls to a new cross-section by removing three to four inches of soil with sharp spades before filling time each year. This slightly increases the size of the trench but exposes a new layer of earth which will resist caving for a time.

Need Wood or Masonry Walls Eventually

Wall linings of some type are desirable if the trench silo is to be made permanent. Unlined earth walls may serve the purpose for a few years but constant trimming and straightening of the sides will eventually give a trench too wide for practical use. In soils which are given to caving a lining will be necessary at once and under other conditions some type of permanent side wall construction, either wood or masonry, should soon be resorted to if possible.

Inasmuch as drainage is important, it is suggested that wall linings be carried up above the natural grade from 12

to 18 inches as shown in Figures No. 3, No. 7 and No. 8. As dirt is scraped from the trench it can be back-filled against the trench lining as shown to prevent surface water running in. In the case of the unlined trench, a log or old telephone pole can be staked down to hold the dirt as shown in Figures No. 1 and No. 6.

Rough Rock Linings Impractical

A number of trench silos with rough rock walls have been constructed in the state but the results have not been encouraging. The rock walls caused too many air pockets during the settling process and too much waste ensilage resulted.

If after the rock walls are laid, two or three heavy coats of cement plaster were applied as shown in Figure No. 7, this difficulty would largely be avoided. The rock lining might well be used up to the ground surface and above that solid concrete would be more likely to give good results.

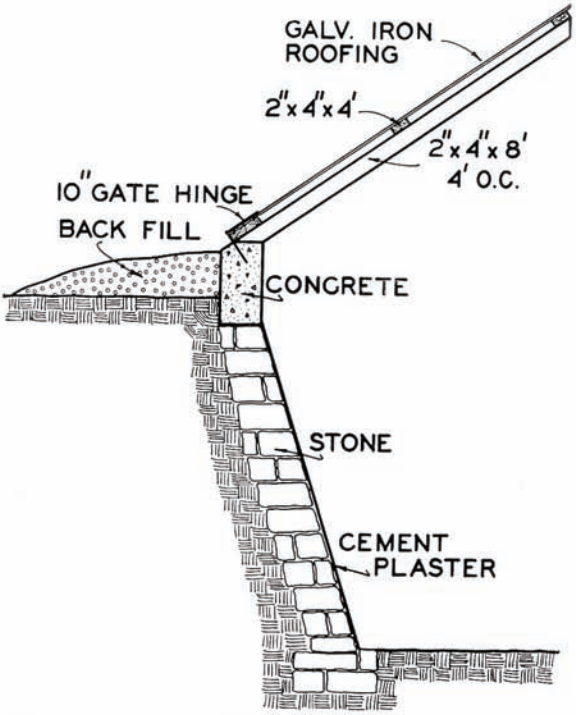

Fig. 7.—If stone walls are used the thickness should be about 12 inches.. Two or more coats of cement plaster will give the walls a smoother finish.

Concrete Linings may be Successful

No experience has been had with concrete linings of any type at the Agricultural College but the following suggestions are given for those who may wish to try them. Figure No. 8 shows one method of plastering the side walls of a trench which has been successful in sections of the state where well drained soils stand well without caving. The plaster is applied in two or more coats to the side walls until a total thickness of 2 inches is obtained. One part of Portland cement, 2½ parts of sand and a little lime will give about the right mixture. When the dirt in the walls is dry it should be moistened before the plastering process is attempted, and the finished wall should be kept wet and protected from the sun for a week or more.

Referring again in Figure No. 8, it will be noticed that a solid concrete wall 8 to 10 inches thick is used above ground to retain the back fill. A wall of this type is constructed at either side of the proposed silo before any excavating is done by digging a trench 18 inches deep with a tile spade and setting up forms for the part above ground. The wall can be made much more stable by digging post holes in the bottom of the trench at intervals of 8 feet and filling these with concrete as the trench and forms are filled. Reinforcing rods made of one or more one inch pipes extending from the bottom of the post hole into the wall add to the strength of the whole structure.

Plastered walls are thin and will be easily broken if struck with a tractor lug, or wheel hub while packing. That part of the wall above grade is thick and not easily damaged mechanically or by frost.

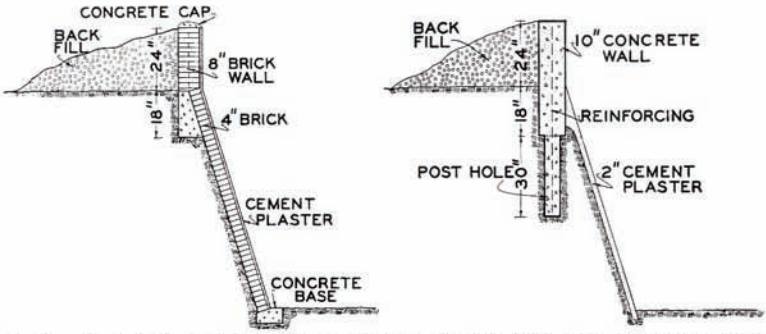

FIG. 8.—A 4-inch brick wall as shown at the left can be successfully used in well drained soils which do not cave badly.

Plastered walls of a 2-inch thickness as shown at the right have been used in soils which stand well.

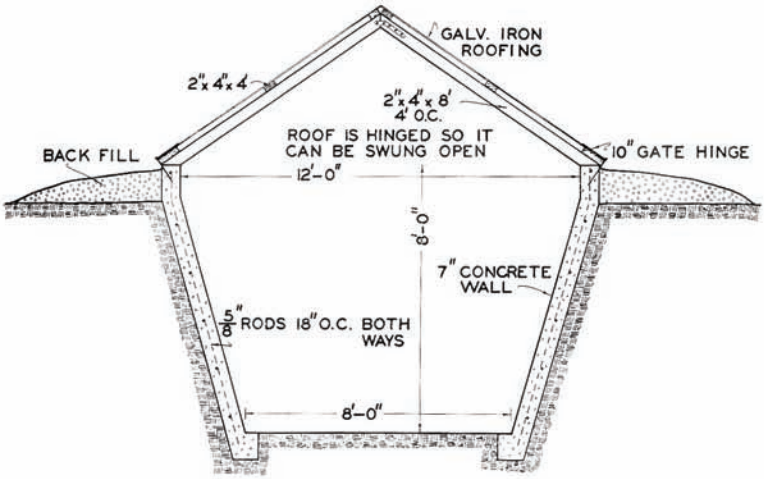

FIG. 9.—Reinforced concrete and other masonry construction give smooth trench linings and prevent caving of the side walls.

Monolithic concrete walls should give excellent results. The foundation is laid first as shown in Figure No. 9, the forms are set up and a section of wall is run in, care being taken to see that the reinforcing rods are in the proper place.

Might Use Other Masonry Linings

There is reason to believe that several types of masonry other than those mentioned can be used. Brick, concrete block, hollow tile or any other material which is used in the walls of above ground silos can undoubtedly be used as linings for the trench. In the use of masonry linings it is important that water be kept out from behind the wall, and for that reason the masonry is carried above the grade line and back-filled to throw the drainage away from the trench. Linings of plank have not proven very successful in many instances due to the fact that the boards do not lie closely to the dirt walls. This allows air leakage which in turn spoils ensilage. This condition could undoubtedly be helped somewhat if mud or damp earth was puddled behind the plank to exclude the air as the wall was constructed. At this time there are no experimental data available as to the best structural use of the various trench linings. The drawings are given as suggestions.

Trench Silo Filling Not Hard Work

Hard work seems to have connected itself to most silo filling methods. This was undoubtedly true when the heavy green corn bundles were lifted on and off wagons by man power. Corn binders with elevators to place the bundle on the rack have helped this situation somewhat but the appearance of a field type ensilage cutter has removed much of the hard work of silo filling. This machine which cuts the green stalks, chops them into ensilage and delivers it to a wagon drawn behind a tractor, the power take-off of which drives the cutting and elevating mechanism. The field cutter is well adapted to use with trench silos since the loads of cut ensilage can be driven directly into the trench and unloaded. Often strips of woven wire laid in the bottom of wagon or truck boxes in such a way that the entire load can be rolled

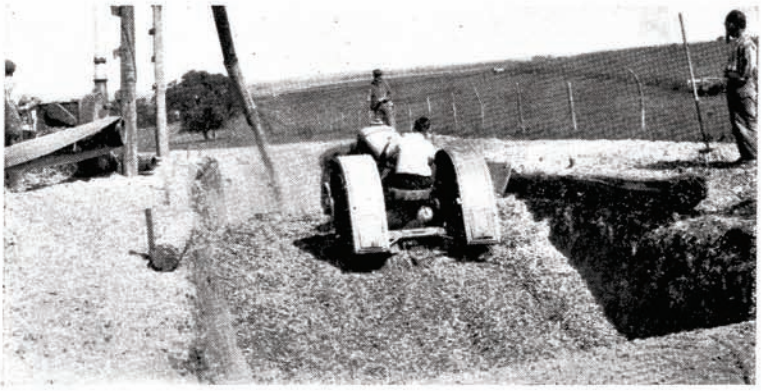

Fig. 10.—Running a light tractor over the ensilage during the filling process proved an effective means of packing.

out at once by hooking a solidly anchored chain into the wire at the front end of the wagon and then driving ahead until the load has rolled clear. Tractors, horses, wagons and trucks are all used to do the packing.

Many farmers are trying to lighten filling costs and lessen the housework of feeding a large number of men by filling over a longer period and using smaller crews. With a small crew the farmer does not need to work early and late doing chores, nor bother with a large amount of exchange labor nor wait too long before filling because all his neighbors are busy.

FIG. 11.—The cutter may remain in one place. The ensilage is then spread out with a team and scraper.

Also, the ensilage has more time to settle and more can be placed in the silo and the corn need not be cut so far in advance of filling as is often true when large crews are used.

Whole Bundles May be Used

During the 1931 crop season several farmers filled trench silos with whole corn bundles and reported that good ensilage resulted. In an emergency the man with no equipment other than a corn binder could store whole corn bundles by packing them cross-wise of the trench in the center but lengthwise near the side walls. The packing and covering must be well done as described for cut ensilage.

Packing Ensilage With Tractor, Truck, or Horses

It has been previously mentioned that a tractor was used to pack the ensilage in the two experimental silos. When care is taken trucks, wagons, horses or combinations of any of these serve very well. Even packing over every part of the trench is to be strived for and the more solid the packing the greater amount of feed stored. Two or three trips along the length of the silo for every load of fodder will do a very good job of packing provided a light weight tractor or equivalent weight is used.

Filling Silo With Stationary Cutter

When the field cutter is not available the green bundles are ordinarily hauled in and cut with a power operated stationary cutter set at one side of the silo. The ensilage is delivered by means of a distributor pipe to the trench but it may be necessary to set the machine several times in filling a long silo unless some additional means of distribution is used. The

entire trench may be easily filled at one setting by placing the machine near the center and using a team with a Fresno scraper to distribute the cut corn. It is allowed to pile up under the distributing pipe until a considerable amount has collected when the team and scraper are used to remove it first in one direction and then in the other.

Watering Side Walls Did Not Help

When the trench at the sheep barn was filled the suggestion was offered that the soil was too dry on the sides of the trench, that much of the moisture in the ensilage would be absorbed in to the bank and cause undue spoilage. For this reason about 8½ tons of water were added to one side of the feed during the filling process. When the ensilage was removed about the only difference noted was in the per cent moisture content. Very little spoiled ensilage was found on the trench sides except near the top in either experimental silo.

Experience of trench silo users in dry sections of the state indicate that use of water on side walls is beneficial when the dirt is dry at filling time.

Dirt, Wet Straw or Hay Used for Cover

During the 1930 season, different thicknesses of straw, a single thickness of tough waterproof paper under a layer of straw and straw under a three or four foot depth of alfalfa were used as a covering for the two experimental silos at the Agricultural College. The most spoilage occurred where the paper was under the straw and the least amount was found where the three or four feet of alfalfa was stacked over 12 to 14 inches of straw. Water was thrown on all the straw covering. Probably less spoilage would have occurred at the sides of the top if the straw cover had extended out further. That is, if the top of the trench is 12 feet wide then the covering should be 15 feet or more in width. It often happens that hay is fed at the same time as the ensilage. This hay can often be stacked on the trench as a cover with very satisfactory results.

During the 1931 season a 3 to 4 inch dirt cover placed directly on the ensilage was used on one of the silos at the Agricultural College. This earth was placed with a slip scraper and was easily removed as the ensilage was fed. The results were extremely satisfactory as almost no waste was observed, in fact, all of the ensilage of the top was successfully used.

FIG. 12.—Between the two white lines is the zone of spoiled ensilage. It was thickest at "A" due probably to air pocket near the logs and also insufficient cover at this point.

During the season of 1930-31 when the straw covers were used on the two silos at the Agricultural College, the silage was fed from the end, the thickness of the slab depending on the amount used per day. In each silo the men attempted to work from top to bottom about two times in five days. From 600 pounds to 4,000 pounds were taken out with the only waste being the spoilage at the very top when the original straw was removed. This waste on the top varies from 4 inches at the middle to 18 inches near the logs at the sides as shown in Figure 12. The total waste can best be shown in the following summary table:

Summary Table

Trench Silo near Sheep Barn, 1930-31

Excavated depth 7 feet, depth from top of logs 8 feet, top width 15½ feet, bottom width 8 feet, two 20 foot inclines at ends.

Tons ensilage put in silo	114.84 tons
Tons water used	8.66 tons
Total tonnage into silo	123.50 tons
Tons good ensilage taken from silo	99.26 tons
Tons waste ensilage taken from silo	7.19 tons
Total tons taken from silo	106.45 tons
Volume of total ensilage when packed	4806.9 cu. ft.
Weight per cu. ft. of ensilage taken out	44.29 lbs.
Total cost per silo *	$96.43
Weight per cu. ft, of waste	13 pounds
Weight per cu. ft. of good ensilage	50 pounds
Waste in % of tonnage taken out	6.76%
Shrinkage in %	13.81%
Average moisture of ensilage put in	72.9 %
Average moisture of ensilage taken out	72.7 %
Average moisture of waste ensilage	63.97%
Average moisture of good ensilage	75.64%

* In finding the total cost of this silo man labor was figured at 35 cents and charges made on all equipment on an hourly basis.

FIG. 13.—A litter carrier may be used to pull the ensilage out of the trench.

Easy to Get Ensilage Out

One great advantage of the trench silo is the ease with which ensilage can be removed. No hoisting equipment is necessary. Where sloping runways are used, it is possible to back a wagon down the incline, fill it with ensilage and haul it to the desired location for feeding. If the trench can be located in a bank as shown in Figure No. 2 it is very practical to use a feed carrier on an overhead track. The track into the silo can be supported on temporary cross pieces which are laid in place as the ensilage is fed further and further back. Another successful method used where the trench silo is built in a bank, consists of the construction of a car from the wheels such as are used on a handcar trailer. This car should have sloping sides and hold 700 to 1000 pounds of ensilage. It can be pushed into the silo, filled and shoved out into the feed lot as shown in Figures No. 14 and No. 15.

Roof Keeps Out Rain and Snow

The use of a roof has certain advantages which cannot be well overlooked. During the warm season rain water can be kept out and the floor kept dry. In winter drifting snow is often a nuisance and a good roof will prevent it from entering where it is not wanted. A cheap and temporary roof for the trench silo can be made by laying poles across placing brush over the poles and then using a heavy coat of straw or a lighter coat of straw with some earth over it.

Any type of roof to be most convenient should be removable so as to permit driving into the silo with teams at filling time or when feeding. A practical type of construction is shown in Figure No. 8. This shows sections of the roof about 8 feet long hinged at the top of the wall lining and so arranged as to open at the ridge of the roof and lay back on the ground at filling time. Another type is so arranged that whole sections of the roof can be lifted off in 6 foot sections at filling time. For portable roofs where lightness is a factor, frame

Fig. 14.—Car coming out of the large trench silo in use on the W. A. Apperson farm near Tecumseh. The car runs on rails of 2"x4" material. It holds 750 to 800 pounds and is eased down the slope with a rope snubbed about a post. The scheme was developed by W. A. White, Apperson's manager and partner.

construction covered with corrugated, galvanized metal is popular.

H. J. Gramlich, Chairman of the Department of Animal Husbandry, adds this comment about—

Quality of Ensilage From Trench Silos

Trench silos have been used rather extensively for several seasons in Nebraska. Observations made on the quality of the ensilage, together with actual results in feeding the same, have indicated that there is no appreciable difference between the product produced in these silos and that from above-ground units. There doubtless is slightly more waste; however, the quality of the larger part of the ensilage in a trench silo may actually be better than that from an above ground one due to the fact that so thorough a job of packing has been done.

The past winter has been one which very forcibly brought to the realization of Nebraska stockmen the value of ensilage. With a great deal of snow in corn fields, it was practically impossible to graze stalks to advantage. Likewise, it was very difficult to haul fodder. The problem of getting ensilage out of the silo was relatively simple compared to the handicaps experienced where trying to utilize the products from the field. One big advantage of the silo lies in the fact that ensilage can be fed over a long period. A trench can be opened the first of October and ensilage fed therefrom continually until May 1. If there is some left when pasture becomes available, it would be comparatively simple to cover the exposed surfaces with earth and keep ensilage over the summer.

The trench silo is not an object of beauty and must look for approbation on a basis of utility. Many Nebraska farm-

ers are experiencing their first use of ensilage as a result of the construction of trench silos. When prosperity again comes to the state, folks will know the value of ensilage and may then consider constructing more permanent and attractive structures in which to preserve their roughage in the form of ensilage.

TWELVE ESSENTIAL FACTS

1. Trench silos can be cheaply and easily built for any desired capacity with tools and labor to be found on most any farm. They are not easily destroyed by storm or fire and there is little danger from poison gases or frozen ensilage.

2. Location should be such that flood water cannot enter and where there is no danger from ground water.

3. Ensilage weighed out of an experimental trench silo at the University of Nebraska Experiment Farm in 1930 weighed 45 pounds per cubic foot. The silo was 8 feet deep, 12 feet wide at top and an 8 foot bottom width. The freshly cut ensilage contained 72.9% moisture and was packed with one trip of a light tractor over the surface per ton capacity.

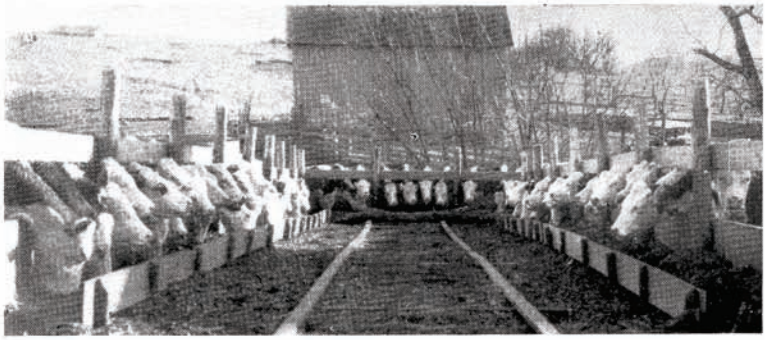

Fig.15.—The track leads down into the feed lot where 168 head of white faced cows found the silage to their liking in the winter of 1930-31.

4. Ensilage is removed from a trench silo from the end in layers like slicing a loaf of bread. If exposed to air too long some spoilage will occur. The cross section of trench should be kept small enough to permit an average of about 2 to 3 inches per day to be fed.

5. Trench silos can be dug with small amount of equipment but for ease of operation and quick construction neighbors may well pool equipment and use two Fresno graders, one

plow, small wheel type road grader and two tractors or eight head of horses.

6. One experimental silo with 7 feet of excavated depth, 12 foot top width, 8 foot bottom width the main part of the trench 40 feet long and with a 20 foot incline at each end, was built at the University of Nebraska Experiment farm at a cost of $96.00 figuring 116 man hours of labor at 35 cents per hour and making a charge for all equipment used. The actual cash outlay to a farmer would have been for 62 gallons of gasoline and 4½ gallons of oil.

7. A slope of one foot inward for each 4 feet of depth is recommended for the side walls as it permits ease of packing, eliminates danger of air pockets and prevents caving where dirt walls are used.

8. Temporary lining of plank and tough water proof paper in experimental silos did not prove worth while from the standpoint of preventing spoilage of ensilage. Unlined walls stand well in certain soils. Under other conditions a lining of plastered rock, concrete block, brick or clay tile may be necessary.

9. Filling may be accomplished with the least effort by using a field cutter, hauling the ensilage in and dumping it into the pit by driving down the inclines. The unloading may be accomplished by putting woven wire strips on the wagon before loading and pulling these strips out by hooking a rope to them and driving ahead. A cutter and blower may be used at the pit.

10. In so shallow a silo as the trench type, packing is essential to increase the capacity and eliminate the danger of air pockets along the edges. Either teams, trucks or light tractors may be used to good advantage.

11. Coverings of wet straw over which two or three feet of alfalfa hay was stacked gave good results at the experimental silos. Most spoilage occurred where a tough water proof paper was placed over the ensilage and covered with wet straw.

12. A covering of 3 to 4 inches of dirt directly on the ensilage gave excellent results. No spoilage was noted where it was used.

Distributed in furtherance of cooperative agricultural extension work. Acts of May 8, 1914, and June 30, 1914. Extension Service of The University of Nebraska Agricultural College and U. S. Department of Agriculture cooperating. W. H. Brokaw, Director of Agricultural Extension Service.

(7-32-10M)