UNIVERSITY OF KENTUCKY

COLLEGE OF AGRICULTURE

Extension Division

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CIRCULAR NO. 174.

MAKING LIMESTONE MORE AVAILABLE FOR FARMERS.

Plans for Lime-Kiln

Plans for Lime Shed

Lexington, Ky.

September, 1924.

Published in connection with the agricultural extension work carried on by cooperation of the College of Agriculture, University of Kentucky, with the U. S. Department of Agriculture and distributed in furtherance of the work provided for in the Act of Congress of May 8, 1914.

CIRCULAR NO. 174.

Making Limestone More Available for Farmers.

By GEORGE ROBERTS.

Much experimental work has been done in Kentucky to show the value of limestone in soil improvement. For many years extension workers have been conducting demonstrations with farmers for the same purpose. Both the experimental work and the demonstration work have shown beyond doubt that the use of limestone is highly profitable. There is scarcely a farmer who is not convinced of the need of Kentucky soils for limestone and who does not concede its profitableness. Yet, in 1923, not more than 60,000 to 75,000 tons of ground limestone were used, enough to lime only 30,000 to 40,000 acres, which is about one-fourth of one per cent of the improved land of the state, most of which would respond profitably to limestone. At this rate it will take 400 years to lime the improved land of the state.

The question arises, then, "Why is there not a greater use of limestone?" The answer is that limestone is not a retail commodity that can be obtained whenever wanted and in whatever quantity wanted. Until limestone can thus be bought, its use will not become general.

It is the purpose of this circular to suggest plans by which limestone may be put within easier reach of farmers.

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1. COMMERCIAL QUARRIES.

Where farmers are in reasonable shipping distance of commercial quarries, these should be the cheapest source of limestone, for the reason that it can be ground much more cheaply by the large equipment of these quarries. If farmers used more limestone and purchased it thruout the year, quarries could supply it

more cheaply than when there are only brief periods when the demand calls for the capacity of the plant, as is now the case in the spring and fall.

We offer three suggestions for the utilization of the commercial quarry.

a. Direct purchase of limestone in carload lots by an individual or group of individuals, especially at times other than the rush seasons, which are usually April, May, August and September.

b. The cooperative lime shed. These sheds are built by sidetracks and a supply of limestone is kept on hand at all times. With a supply on hand the farmer can utilize any spare time he may have in hauling lime. Many times he may take home a load after delivering a load of produce, when otherwise he would have to drive home an empty wagon. Again, there are many farmers who are not in a position to use a carload of limestone and may not be able to get enough neighbors interested to order a car cooperatively to be hauled away when the car arrives.

The cooperative lime shed requires some one to attend to the unloading and the weighing out of the lime to farmers when they call for it. This service may be paid for by adding enough to the price of the lime to cover the time and expense of the one who renders this service.

Plans are submitted herewith for building such sheds. If larger drawings are desired, they will be furnished at 10 cents a set to cover cost of blueprints.

c. The local retail dealer. There should be a large field for the local retail dealer who will build a lime shed and sell limestone to farmers, adding whatever profit may be necessary to warrant his engaging in the business. This could be done as a side line to some other business, just as coal is often handled. The same plans for the lime shed may be used as suggested above for the cooperative shed.

It is the judgment of the writer that this plan offers the greatest inducement to the use of limestone of any that can be suggested. The local dealer will not only profit in the handling

of limestone, but if he be engaged in other business he will find trade coming to him thru the increased purchasing power of the farmer due to his use of limestone.

2. THE PORTABLE GRINDER.

Many farmers have such a long freight or wagon haul or both that they cannot patronize the commercial quarries, or they may have rock so accessible on the farm or may want limestone in such large quantities that it is cheaper to grind the lime on the farm. This may be done (a) by a privately owned grinder, (b) by a co-operatively owned grinder or (c) by some one with a portable grinder who is engaged in the work commercially. Some operators of portable grinders have found that they can grind for around $2.25 to $2.50 per ton, including quarrying the rock, or for $1.25 to $1.50 per ton when the rock is quarried and placed at the machine.

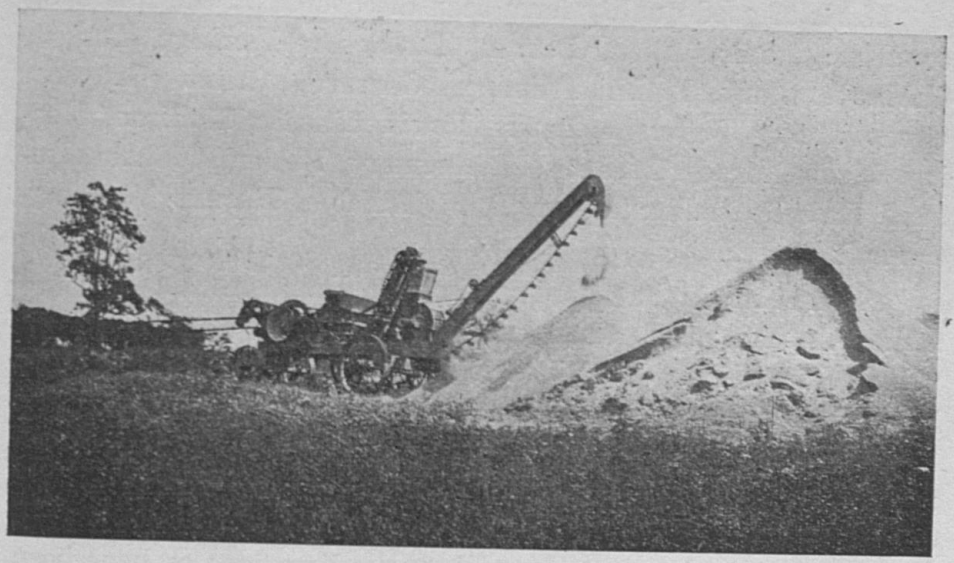


Fig. 1. Ballast Crusher and Limestone Pulver Mounted on Same Truck.

At least one man operating a portable grinder for custom work has found it to his advantage to use a ballast crusher to crack the rock for the grinder. He says this is cheaper than hammer work in preparing the rock. Both machines are mounted on

a strong frame of a truck. The rock is delivered from the first to the second machine by an elevator. The outfit is shown in the accompanying illustration.

3. BURNING LIME.

It has been found by keeping cost records that where wood is plentiful, lime may be burned as cheaply as it can be ground. Records on 4 kilns, representing 230 tons of limestone show an average cost of $2.18 per ton, with a range from $1.90 to $2.47 per ton. One ton of fresh burned lime does the duty of two tons of ground limestone.

Plans and directions for building and burning a limekiln are given herein. If larger drawings are desired, a set will be furnished for 10 cents to cover cost of making the blueprints.

4. USE OF MARLS.

Marls of good quality have been discovered in the following counties: Adair, Allen, Barren, Bath, Breckinridge, Bullitt, Caldwell, Clark, Estill, Fleming, Garrard, Grant, Grayson, Green, Henry, Jefferson, Larue, Lewis, Lincoln, Madison, Marion, Mason, Meade, Monroe, Montgomery, Nelson, Oldham, Pulaski, Russell, Shelby, Taylor, Todd, Trimble, Warren, Washington and Wayne.

A marl might be called an impure limestone that has not solidified. The marls thus far discovered have about half the value of a good grade of limestone. They are soft and can be handled with pick and shovel and spread without grinding. For details concerning marls, how to recognize them and how to tell good ones from poor ones, ask for Experiment Station Circular No. 32 on the Marls of Kentucky. Marls occur on hundreds of farms whose owners wish to use limestone or have been using it, but have never known of their presence.

In one case a deposit 15 feet thick was found in the barnyard of a farmer who wanted limestone but could not get it except at great expense. In another case a man had limed his land the second time with ground limestone and had on his farm

a deposit one-fourth mile long and ten feet thick which was 80 per cent pure. He was planning to buy 100 tons of ground limestone.

HINTS ON THE USE OF LIMESTONE.

1. In nearly all parts of the state one ton of finely ground limestone per acre will be sufficient to produce clovers, including sweet clover. Two to four tons should be applied for alfalfa. On most soils two tons will be sufficient. One ton will not last as long as two tons, but it is better to have all of the farm limed with one ton per acre than half of it limed with two tons per acre.

2. Reliming should be determined by whether clover is growing successfully. The writer recently saw in Laurel county unusually heavy clover on land limed 12 years ago at the rate of 4 tons per acre and good sweet clover on land limed at the rate of 1½ tons per acre six years ago. On the Kentucky soil experiment fields, good clover was produced in 1924 on land that was limed in 1913 and 1917 with coarse limestone at the rate of 2 tons per acre each time. The two limings were equivalent to about 2.5 tons of pure limestone that would pass screen of 10 meshes to the linear inch. Once land is gotten in good condition to grow clover, very little additional liming will be necessary, in most cases, if the land is properly cared for by good rotations and the return of manure.

2. Limestone is most effective when finely ground. Stone that does not pass a sieve of 10 meshes to the linear inch is not very effective. Screenings may be sold cheaply enough to justify buying them for the fine material in them. Usually the ¼-inch to dust stone will contain about 75 to 80 per cent of material that will pass a 10-mesh sieve. Limestone coarser than this is of doubtful economy at any price. Cases are known in which the coarse material ran as high as 47 per cent.

4. Limestone may be spread either before or after plowing. If spread before plowing it should be disked in before plowing. It should also be disked in when spread on plowed ground.

Limestone and acid phosphate may be spread at the same time and disked in together. Acid phosphate should not be applied before limestone. Acid phosphate and limestone may be mixed before spreading. Limestone and acid phosphate applied together should be disked in before rained upon. Generally it is not advisable to use rock phosphate on recently limed ground. It may be used two or three years after liming. Limestone may be spread at any time of the year. It should not be left on the surface if it will wash away.

5. For alfalfa it is well to apply limestone a year or two ahead of the crop. Experiments have proved that this produces better alfalfa. For clover, it is a good practis to spread the lime on the ground for corn or some other preceding crop. The increases of the preceding crops will often pay for the limestone, and the tillage distributes the lime better for the clover.

Limestone does not often directly benefit tobacco, but it will indirectly benefit it in a rotation in which clover is grown.

6. Limestone may be spread with a shovel if care is exercised. It is necessary to get accustomed to a "swing" of the shovel that will throw the limestone evenly in a fairly broad strip. A man standing in the rear of a wagon can cover a strip about 15 feet wide at a "sling." The shovel is swung around in a semicircle on a horizontal line and so held that the limestone leaves it in a uniform stream. The "lick" must be learned by practis. The writer has seen two men spread two tons of limestone on an acre in this way in less than an hour.

7. Limestone may be spread with a manure spreader by observing the following rule: Set the spreader at the lowest number of loads it will spread per acre. Divide the amount of limestone desired per acre by the number of loads at which the spreader is set. This gives the weight of limestone to be used each load. Spread enough litter on the apron of the spreader to prevent the stone from sifting thru.

8. Time will be saved if the lime can be spread from the wagon as hauled to the field. This can be done with the ordinary lime spreader by removing the tongue and putting in a

stub tongue which can be hooked to the rear axle of the wagon so as to draw the spreader close up to the rear of the wagon box. A man shovels limestone into the spreader while another drives. If two or more wagons are being used, the spreader may be used on each wagon in this way.

If an end-gate spreader is being used, an extra sprocket may be bought for each wagon in service and the spreader attached to each wagon as it is unloaded. The end-gate spreader has the advantage of spreading a wider strip than other types of spreaders.

9. A method sometimes used for spreading with shovels is as follows: Divide the weight of application desired per acre by 40, which gives the application for four square rods. Place this amount in piles two rods apart and then spread with a shovel.

10. On many soils that are only very slightly acid, such as the limestone soils of Kentucky, often a small amount of limestone will be sufficient to produce clover. The following practis is recommended for trial where limestone is difficult to obtain:

Mix 700 pounds of finely ground limestone or slaked lime and 300 pounds of acid phosphate. Drill the mixture on an acre with fall-sown grain or spring-sown oats. Seed a mixture of red and alsike clover on the grain in the late winter or early spring.

11. In liming land, leave a small strip unlimed in order to check on the results.

12. *Important.* Except on the better bluegrass soils, a phosphate is just as necessary as limestone. In fact, in most cases limestone used without a phosphate will be disappointing. Ask for Circular 123, which will show you how profitable limestone and phosphates are when used together.

13. Marls are much easier to handle if well weathered. It is a good plan to blow out with dynamite a supply a year ahead of the time it is desired to use it. A dam or other obstruction should be placed on the lower side of the loosened mass to prevent its washing away, as it will readily do on a slope.

Plans and Specifications for Building and Burning a Lime-Kiln

By EARL G. WELCH and JAMES B. KELLEY

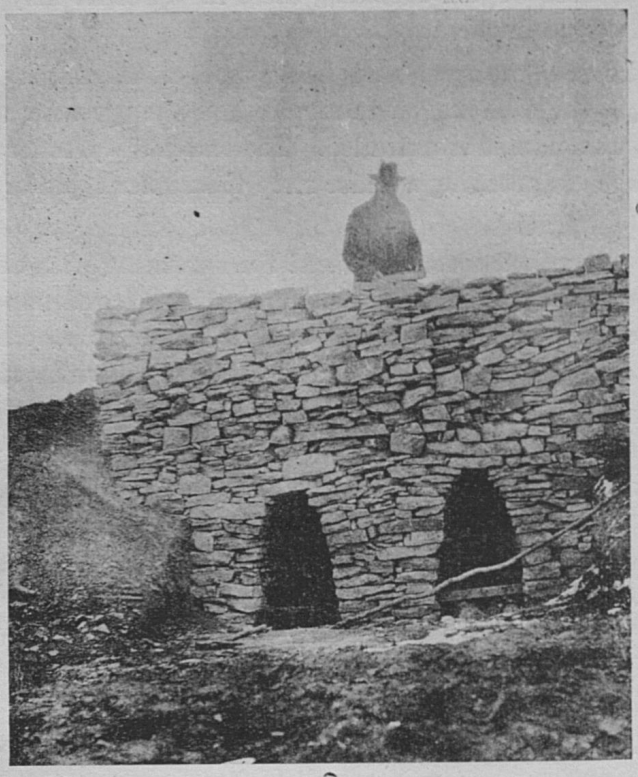


Fig. 2. Front View of Limekiln.

Size of Kiln. The dimensions, capacities and quantity of fuel required to burn various sizes of kilns are given in the following table:

No. of Eyes	Length of Pit	Width of Excavation	Capacity in Tons of Rock	Fuel Required, Cords of Wood
1	15 ft.	5′	30	10
2	15 ft.	9′	60	20
3	15 ft.	13′	90	30
4	15 ft.	17′	120	40

Excavation. As shown on the drawings, the excavation for the kiln should extend back into a hill fifteen feet, having the top of the bank in rear 6 feet to 10 feet above the bottom of the pit. In excavating, the back and the sides should be made straight and perpendicular to the level bottom.

Building Eyes. The foundation for the "eyes" or fire boxes are made by laying large flat limestones in the bottom of the pit according to the dimensions shown. After the foundations are laid, construct the eyes, starting at the rear and finishing at the front. Smooth, flat rock should be selected for this purpose. The eyes are formed by extending each rock two or three inches over the one below, depending upon the thickness of the rock used, so that the eye takes the form of an inverted V about 36 inches high. A flat rock about 6 inches thick and at least 2 feet long is laid across the gap at the top in place of using a keystone. All the joints should be broken and occasionally a long rock placed across the spans between the eyes to tie them together. The stones in the walls of the eyes should be kept level.

Filling the Kiln. After the eyes are completed, and before building the outside walls the pit should be filled to the top of the ground with broken stones. The heavier rocks should be placed directly over the eyes and the smaller ones at the top of the kiln. Continue to fill the kiln as the walls are built.

Building the Walls. The front should be built to a height of 10 feet. The side walls are built on the ground at the outside of the pit, extending up the slope from the front wall. The front and side walls should be level at the top and be securely tied together at the corners. If necessary, a back wall may be built. All the walls should be 2 feet thick and absolutely plumb.

Plastering the Kiln. The outside of the walls should be plastered wtih wet clay and the top of the kiln covered with at least 8 inches of wet clay or earth to prevent the escape of heat.

Firing. Well seasoned cordwood is very desirable for firing the kiln. The rock should be seasoned for 12 to 14 hours with a slow fire when the firing is first started. After seasoning,

the fires should be kept as hot as possible. The fires should be hot so all of the wood will be thoroly burned and ashes will give no trouble. It is not necessary to provide a flue as a suf-

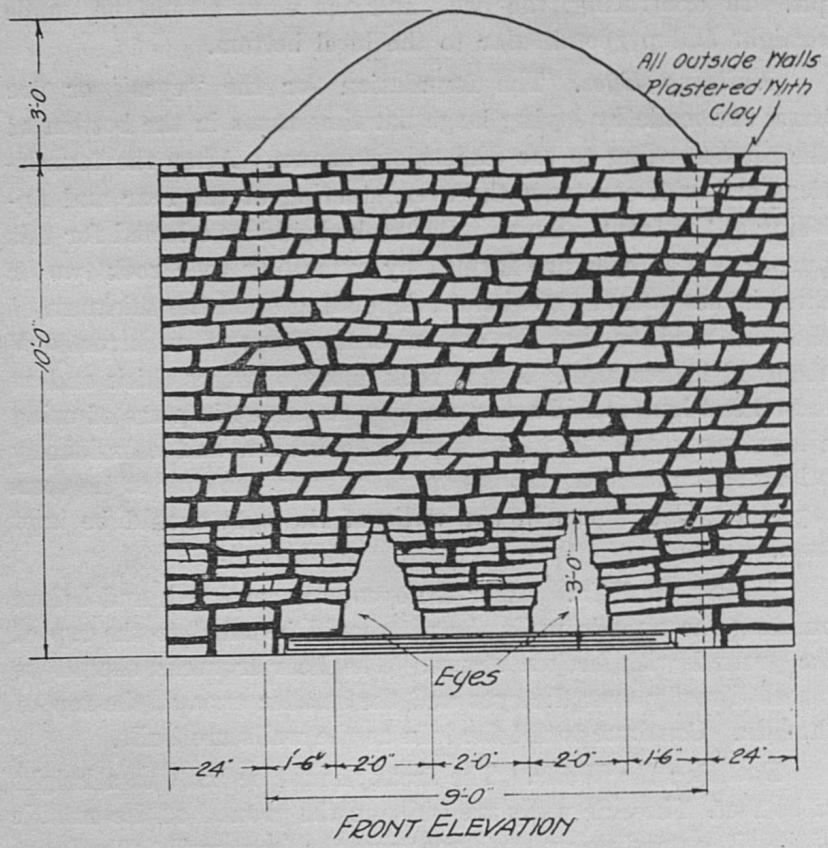


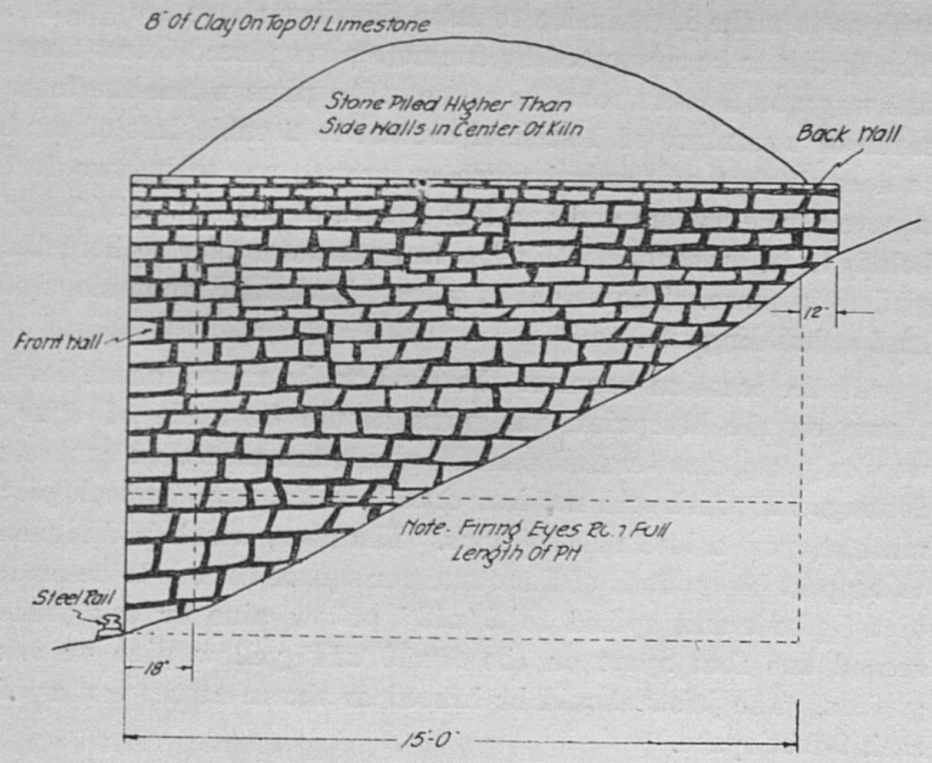
Fig. 3. Plan for Limekiln.

ficient draft is secured thru the rock and earth and while the rock is burning a heavy, black smoke escapes from the top of the kiln.

The kiln is usually considered sufficiently burned when the heavy, black smoke ceases and a crowbar driven into the top will not meet the usual resistance of the unburned rock. A sample of the burned rock taken from the top of the kiln should slack readily when placed in water.

The length of time required for firing will depend to a large extent upon the quality of the wood and the ability of the fireman to keep a hot fire. The average kiln requires 7 days and 7 nights of continuous burning.

Slaking the Lime. It will be necessary to slake the lime before spreading it. This may be done by adding just enough water gradually to make it slake and crumble out dry. If too much water is added the lime will be pasty. It takes about 30 pounds of water to 100 pounds of fresh burned pure lime to completely slake it. However, a smaller quantity than this will crumble the lime so that it may spread. The lime will slake itself in time by absorbing water.



SIDE ELEVATION

Fig. 4. Plan for Limekiln.

Plans and Specifications for a Lime Shed.

By J. B. KELLEY.

Size and Capacity. Blueprint E-70-90-1 contains the plans and detail drawings of a lime shed designed to hold three carloads of 40 tons each of crushed limestone for agricultural purposes. The lime bin is approximately 10 feet wide and 36 feet long and can safely be filled to a depth of 6 feet. As crushed limestone is very heavy, the building must be built according to the drawings and the following specifications in order to withstand the pressure exerted by the stone.

Footings, Piers and Floors. The plans show the construction of the piers and floor for a shed where the building site is such as to make it desirable to raise the floor above the ground. The shed is to be supported by concrete piers placed 5 feet apart one way and 9 feet apart the other. The piers which are to be made of a mixture of 1 sack of cement to 2 cubic feet of sand to 4 cubic feet of crushed stone or gravel, are to be two feet square at the bottom and one foot square at the top. A ¾″x22″ bolt is to be embedded 12 inches in each outer pier to hold the girders in place. The height of piers will depend upon slope of land at building site.

If the location requires the shed to be raised above level shown on the blueprint, the piers should be made of 8″x8″ wooden posts, cross-braced with 2″ plank and placed on concrete footings 12″ thick and not less than 2 feet square, as each pier must support a load of 13½ tons. The floor, which is designed to support 600 pounds of limestone per square foot, is to be made of 2″ plank and spiked to 2″x12″ yellow pine or oak joists spaced one foot apart on the 6″x10″x14′ yellow pine or oak girders. The joists should be braced as shown at the center of each 9-foot space.

Where the building site is on a level with the railroad tracks it may be advisable to use concrete foundation and floor. The foundation should be made of 1-2½-5 mixture (one bag cement, to 2½ cu. ft. of sand, to 5 cu. ft. of crushed stone or gravel), and it should extend 18 inches below surface of ground and

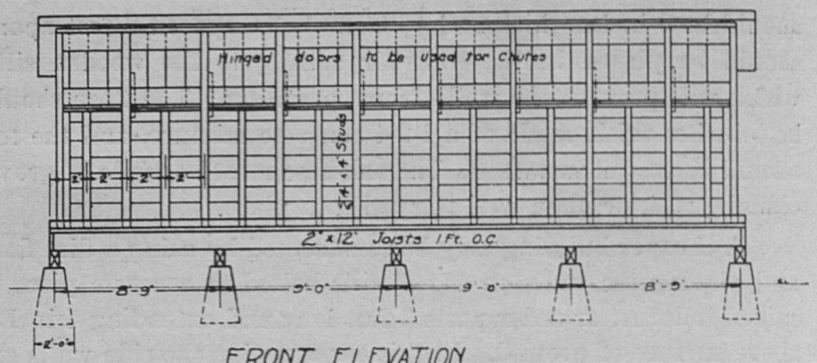
extend six inches above level of floor. The foundation wall should be 8 inches thick and ½″x12″ bolts, spaced 2 feet apart, should be placed in the wall for bolting to the wooden sills, which will prevent the walls from spreading. The floor should be 5 inches thick, made of a 1-2-4 concrete mixture, and the top should be trowel smoothed. The sub-base must be made of gravel cinders, rock or clay, well tamped into place.

A cheaper building may be constructed by using a dirt floor and placing the walls on 4″x4″ sills bolted to concrete piers or spiked to locust or cedar posts 3 feet long and extending 4 inches above surface of ground. In this construction the side walls are to be tied together at bottom every 6 feet with 2″x4″ well spiked to opposite studdings. In some localities it may be necessary to make front of shed on track side 12 feet high in order to easily unload the lime into the building.

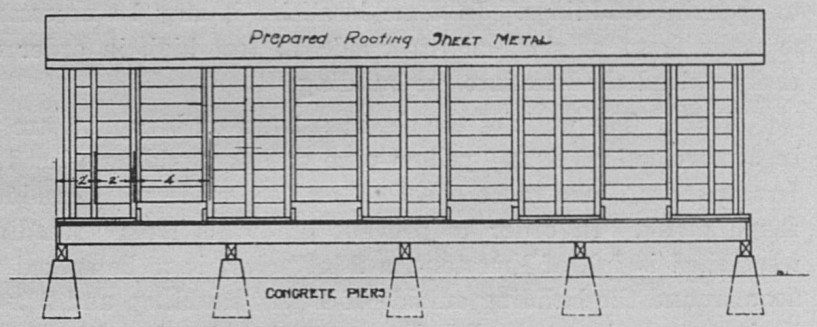
Walls. The walls of the shed as shown on blueprint are to be constructed of 4″x4″ yellow pine or oak studding placed 2 feet apart and are to be sheathed on the inside with one-inch rough plank. In order to prevent the walls from spreading when shed is full of limestone, a 2″x4″ cleat is to be spiked to floor around the building outside of 4″x4″ studding, and 2″x4″ tie braces as shown on drawing are to be placed 4 feet apart thruout length of building.

Roof. The roof is to be framed of rough 2″x4″x12′ rafters placed 2 feet apart as per plans, and sheathed up solid if prepared roofing is used, and with boards placed 1 foot apart if covered with sheet metal.

Doors. On the front or railroad side 4′x4′ hinged doors are to be provided to be used as chutes for unloading cars. In the rear the 4-foot door openings are to be cribbed up 6 feet high with 2-inch planks in guides so they can be easily removed. The bottom plank is to be placed at an angle as shown, so that it can be easily removed with a shovel, permitting the limestone to come out on to the wagon loading platform.



FRONT ELEVATION



REAR ELEVATION

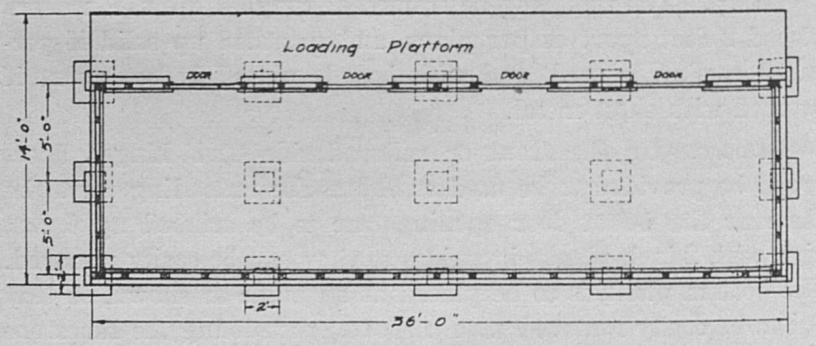


Fig. 5. Plans for Lime Shed.

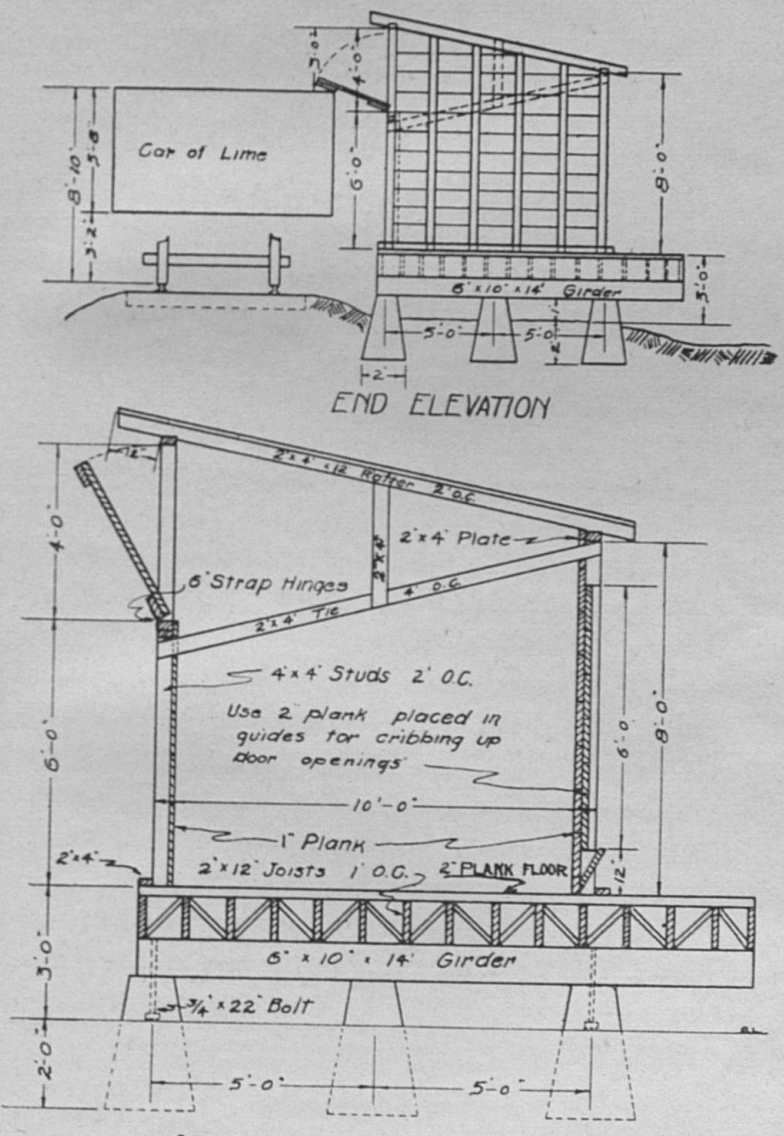


Fig. 5—Continued. Plans for lime shed.

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