

Building With Rock

K. B. HUFF



Fig. 1.—A typical native rock farm home.

Rock, broken by the forces of nature into handy sizes and somewhat rounded by long exposure to the weather, is abundant in many parts of Missouri and offers many advantages for use in farm building construction. Whether the building be a roadside market, a farm home, barn, or garage, rock bound together with concrete will be found suitable for its construction. Buildings so constructed are largely storm-proof and fire-resistant. Besides their permanence and negligible maintenance expense, such buildings have the further advantage of extremely low first cost. Rock, gravel, and sand may usually be obtained locally, and the work can be carried on successfully without previous experience or special tools.

The rocks require no special treatment. It is only necessary that they be clean and in sizes easily handled. The wide range of colors and textures lends interest to the work. Sorting the rocks for colors and sizes affords unlimited possibilities for varying the final effect and expressing individual taste.

Usually most rock that has been exposed to the action of the weather, is suitable for building purposes. Such rocks as limestone,

granite, and sandstone, are very durable and are satisfactory for building purposes. The size and shape of the rocks can vary within wide limits. If some are too large they can be broken readily with a sledge.

Laying Out the Foundation

After the size and shape of the building has been determined, the next problem is to lay out the foundation. A practical method of laying out the foundation for a building is shown in Fig. 2. A base line

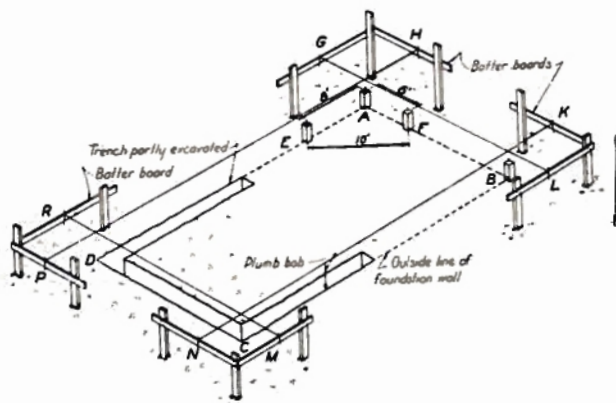


Fig. 2.—This method of laying out a foundation assures square corners.

establishing one side of the building as A-B, is marked off and nails are driven into the tops of the stakes to mark the exact corners of the building. On line A-B stake F is driven 6 feet from A. Stake E is then driven 10 feet from F and 8 feet from A. Nails are driven in the tops of stakes E and F. The measurements must be accurate so that the nails in the stakes are exactly 6, 8 and 10 feet apart. The corner E-A-F is, then, a large right-angle triangle and therefore more accurate than the ordinary steel square. Side A-E extended will represent the side A-D of the building and the point D the third corner. The fourth corner C is located in a similar manner by the triangle method. Strings are then stretched over the stakes and carried to the batter boards as illustrated (HG, KL, MN, PR). The outline of the building having thus been determined the corner stakes are removed and the excavation may be started, either for trench or complete basement as desired. In making the excavation a plank laid flush with the outside edge of the proposed foundation wall will aid in getting a straight excavation and in many cases will prevent the side walls from caving in.

Footings and Foundation Walls

The footing and foundation walls for rock buildings will need to be heavier than for frame buildings because of the additional weight of the building to be placed upon them. It is also important to extend the foundation below frost line in order to prevent heaving and cracking of walls. Common practice is to widen the foundation trench at the bottom to provide necessary footing. A barn footing should be two feet wide. Small residences generally have a footing eighteen inches wide. Footings 12 inches wide will serve to support ice houses, milk houses, and poultry houses.

Care must be taken to get the foundation trench true and especially to give it a flat bottom. This gives it maximum load-bearing capacity. In building the foundation and footing, rock is usually mixed with the concrete. If this procedure is properly followed a good foundation may be built at a reasonable cost. A common mistake is to fill the trench part full of rock and pour a slushy mix of concrete over it. The result is a weak foundation supported on points of rock. Better construction is to start with a layer of concrete mixed to a medium or mushy consistency, placed on the bottom of the trench. Put in a layer of rock, then more concrete. In this way a solid mass of high strength is secured and at the same time a large amount of rock is used. Figure 4 shows a foundation of this type.

Foundations for small buildings need not be water-tight. The mixture commonly used for the foundation when using bank run material (a mixture of sand and gravel) is 1 part cement to 6 parts bank run material. Where screened sand and gravel are used, the mixture should be 1 part cement, $2\frac{1}{2}$ parts sand and $4\frac{1}{2}$ parts gravel. In either case only enough water is added to the mix to produce a mushy consistency.

In many of the smaller types of buildings the rock wall can be built up from the footing. When the foundation wall is built in this way, forming for the foundation above the ground is unnecessary. The poultry house shown in Fig. 9 was built in this way. In buildings having basements an inside form will be necessary, or if the ground caves badly, a double form will be needed. Recommended practices for building a water-tight basement should be followed, since it can best be made water-tight at the time of construction.

Many rock buildings have the foundation built with forms above the ground, usually to the floor line. The rock construction is then started on the level top of this foundation. Figures 1, 8 and 16 show a dwelling, barn, and milk house with this type foundation.

Where concrete floors are desired they are generally built after the walls are completed. If the soil on which the floor is laid is well

drained the concrete can be placed directly on it after all refuse, grass roots, and similar materials have been removed and the ground has been leveled off and well tamped. If drainage is poor and soil water is likely to be present a six-inch fill of rock or gravel, well compacted, is recommended. Poultry house and granary floors should always be well above the ground line.

Building the Forms

The first thing that must be done in building the walls is to construct an inside form. No outside forms are needed. Two methods of building inner forms are used. In the most commonly used method, the complete inner form is built before the masonry work is started.

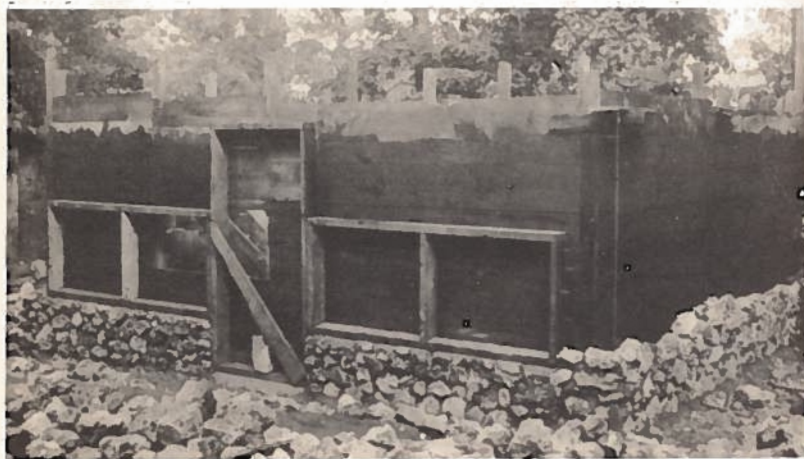


Fig. 3.—Complete inner forms were built before rock walls were started. Window frames and door frames are nailed on outside of forms.

(See Figure 3.) This method is recommended for the beginner and for the construction of all small buildings. The studs supporting the sheathing should be set not over 3 feet apart and should be well braced to prevent bulging of the side walls. The same type of bracing shown in Fig. 4 should be used.

The sheathing should be nailed to the studs only enough to hold it in place and the nails pulled as the walls are built up. This makes the forms easier to remove when the walls have hardened. Oiling the side of the form coming in contact with concrete with old crankcase oil prevents concrete from sticking to forms. If studs of the proper length are selected they may be used as rafters after the rock wall is completed. The sheathing may also be used in completing the building.

The other method of form construction which is occasionally used is commonly called a movable form, see Figs. 4, 5A, and 5B. With this

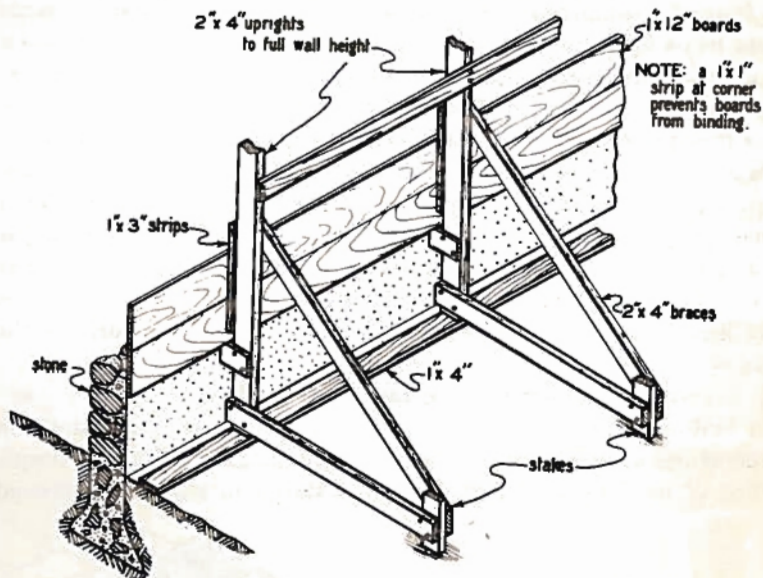


Fig. 4.—Movable form boards have been raised for second course. Form boards are not nailed but rest on blocks nailed to side of studs.



Fig. 5A.—Strip in place behind form, showing nail which can readily be withdrawn allowing strip to be removed.



Fig. 5B.—Removing strip after nail has been pulled. This allows form to be taken off and raised.

method a few boards are used and moved up as the wall is laid. Boards having straight edges and surfaced on one side are recommended for this type of construction. In using a form of this type enough boards should be on hand to permit the work to proceed without interruption yet allowing the walls to acquire sufficient strength to stand alone. Boards 12 inches wide or more are preferable to narrower ones because they permit a greater height of wall to be built in one course.

To allow forms to be moved easily and without disturbing the supports, a removable strip is used as a backing at each stud and at each corner. Any piece of 1 by 2 or 1 by 3-inch lumber 2 or 3 feet long is suitable for the purpose except at corners where a 1 by 1-inch piece is used. When the corner strips and those on the studs are removed the form boards are easily loosened and raised without disturbing the studs.

Building an Insulated Wall

In buildings where artificial heat is to be used or where uniform temperatures are desired, an insulated wall should be built. A simple method of building an insulated wall is shown in Fig. 6. No special

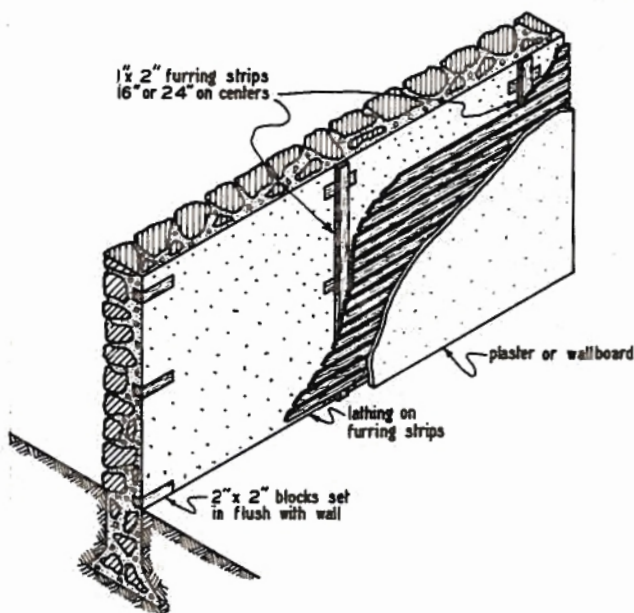


Fig. 6.—This type of wall is recommended for dwelling construction.

forms are necessary and in general the same construction practices as already described are followed. However, as the wall is being laid up,

2 by 2 by 4-inch blocks are laid in the wall next to the forms and are spaced sixteen inches or two feet apart horizontally and two feet apart vertically. A spike is driven in the top and bottom of each block to insure good anchorage in the wall. When the forms are removed the inside surfaces of these blocks are exposed and 1 by 2-inch strips are nailed vertically to those blocks. Now we have an inside surface which is the same as standard wood construction and across these furring strips lath and plaster or wallboard can be applied. This method gives a 1-inch air space which is a good insulator and which prevents a condensation of moisture on the inside wall. This is necessary if the inside walls are to be kept dry, especially where artificial heat is used in the building.

Types of Rock Walls

There are two general types of rock walls; namely, *cobblestone* wall and *flat rock* wall. The cobblestone wall is built with somewhat

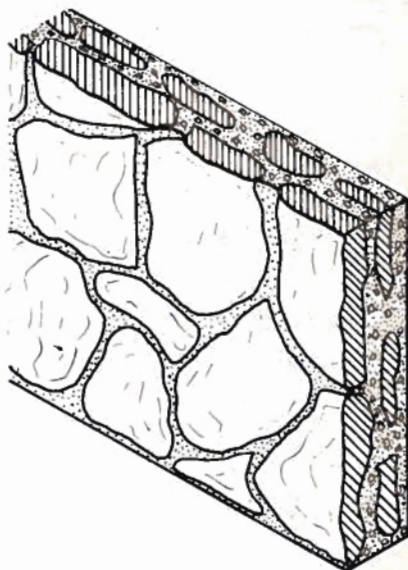
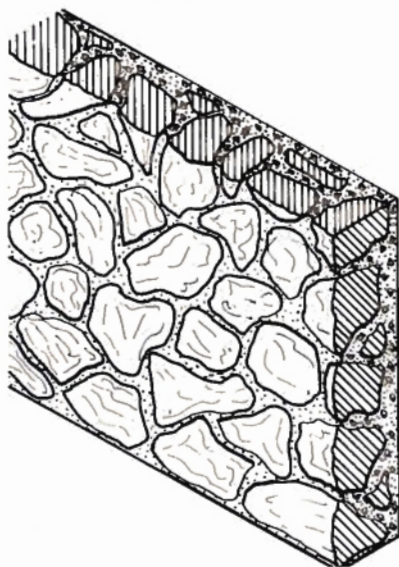


Fig. 7A.—Cobblestone Wall

Fig. 7B.—Flat Rock Wall.

rounded or irregular shaped rocks of variable sizes, but which have one thickness slightly less than the thickness of the wall. These rocks are placed in the wall at random and no effort is made at selection. The appearance of rows is avoided and the joints are crossed. In other words, the appearance of artificiality should not be given, but

the wall should have a natural rustic beauty. The larger part of each rock is kept toward the outside, resulting in small or scarcely evident mortar joints. Each rock is tied into the joint and back-up mix to



Fig. 8.—General purpose barn built of cobblestone.

produce a very strong wall. Rocks for cobblestone construction are usually weathered field rock, unbroken and of a size easily handled and placed with one hand



Fig. 9.—Missouri type 30x30 Poultry House built of flat rocks. Rock poultry houses have proved very satisfactory in Missouri.

In building the flat rock wall (Fig. 9) much larger rocks are used. Care is usually exercised in selecting colors, sizes, and shapes of rock

to be used. Where a supply of flat limestone, ledge rock, sandstone, or natural field rock up to 8 inches thick, having flat faces, and with diameters from 1 to 3 feet or occasionally even larger are available, the flat rock wall is rapidly built and is very satisfactory. The rock is also often broken or chipped with a stone hammer to fit a given place or to produce needed color effect. In all cases sufficient width of back-up concrete should be used to give the wall strength and rigidity. Rocks 4 to 6 inches thick would be used in an 8-inch wall. Rocks 6 to 8 inches thick would be used in a 10-inch wall. There will be considerable variation here of course, and if the space between the rock and form is several inches, small stones may be used to help fill up the space. With the flat rock wall special treatment is usually given the joints.

Mixing the Concrete for the Walls

With both the cobblestone type of wall and the flat rock type of wall, the aim is to secure a strong water-tight wall. It is therefore essential that the concrete used in the wall provide the needed strength and also water-proof the joints.

When building the cobblestone type of wall, since no treatment is given the joints except to rake them out, the concrete mixture used must be water-tight. Water-tight concrete is built by using not over 6 gallons of water to each sack of cement, and using a mixture of sand and gravel of such proportion as to produce a smooth, dense concrete. The suggested mixture used for laying up the cobblestone wall is 1 part cement, $2\frac{1}{2}$ parts of sand, and $2\frac{1}{2}$ parts of gravel. This mixture with enough water added to make a mushy consistency will result in very strong water-tight concrete. Where bank run material, containing sufficient sand for a smooth finish is used, a mixture of 1 part of cement to $4\frac{1}{2}$ parts of bank run is about right. Both these mixes will usually not require more than 6 gallons of water per sack of cement.

When constructing the flat rock wall, the finished wall is water-proofed by pointing the joints with plain, or colored mortar. A mixture of 1 part cement to 3 parts of sand with or without the addition of 10% lime is commonly used. This mixture is used as a bed for the rocks as they are laid as well as for filling the joints, and it is this that makes a water-tight wall. If colored mortar is used, it is added to the joint after the main fill is made.

For the concrete back-up between the forms and the rock, a mixture of 1 part of cement to 6 parts of bank run sand and gravel is satisfactory. Or a mixture of sand and gravel separately would require 1 part cement, $2\frac{1}{2}$ parts sand, and $4\frac{1}{2}$ parts of gravel.

The sand and gravel should be clean and the largest particles should not be over 1 inch in size. If larger particles are present, time will be saved in laying up the wall by screening the sand and gravel through a 1-inch screen. It is very important that the sand and gravel be free from dirt, leaves, or other foreign matter in order to make good quality concrete. Should there be any doubt as to the cleanness of these materials they should be washed or another source of supply found.

Only clean water should be used for mixing the concrete. A good rule is to use only water that is suitable for drinking. The concrete should be thoroughly mixed either with a machine mixer or by hand. The mixture of concrete is usually shoveled in behind the rock for speedy work and is worked in with the trowel. A machine mixer, wheel-barrow, and runway all around the building make the work faster and easier.

Concrete should be thoroughly mixed so that all particles are completely coated with the cement paste. With a machine mixer it is recommended that the concrete be mixed a minute to a minute and one-half after all materials are in the mixer.

In hand mixing a platform not smaller than 8 x 12 feet with tight joints and smooth surface should be used. The dry materials are placed on this platform and mixed with square pointed shovels until uniform in color. The proper amount of water is then added and the concrete mass turned until completely mixed.

In building with rock, experience has shown that one sack of cement will build from 12 to 20 square feet of wall 8 to 12 inches thick. The average is about 16 square feet of wall with each sack of cement used.

Laying Up the Wall

Rock walls when properly constructed have practically the same strength as a concrete wall of the same thickness. In preparing the materials for rock construction, the supply of rock is sorted for pieces of suitable size, color and shape. The amount of rock needed will be slightly less than the volume of rock wall to be built.

Cobblestone Wall.—Before the rock is placed in the wall a mortar bed should be placed so that each rock will be completely bedded in mortar. (See Fig. 10.)

Rock walls should never be built less than 8 inches thick. The thickness is determined by the size of rock available and the type of building.

The thickness of the wall is easily kept uniform, a simple method being to measure the distance with the trowel. (See Fig. 11.) Take for an example the construction of a 10-inch wall in a barn. A mark

would be made on the trowel handle 10 inches back from the point. The outside line of the wall can be determined by putting the point of the trowel against the form, and thus making the outside of the



Fig. 10.—Preparing mortar bed. Fig. 11.—Placing rock by measuring out from form.

wall as straight as the form behind it. This method saves the trouble and bother of stretching a line.

Care should be taken that no rock touch the inside forms. In order to be sure of a sufficient thickness of concrete on the inner side of the rock wall, the handle of the trowel may be used as a gauge and none of the rock placed closer to the wood forms than the thickness of the trowel handle.

As each rock is laid it is tamped into place and all crevices between the rocks filled with concrete. The concrete between the rocks and next to the forms is spaded and packed with the trowel so as to insure a solid wall and a smooth inner surface when the forms are removed.

Small rocks can be worked into the walls next to the forms and between the larger rock. This practice will save much concrete. However, care should be taken to observe the rule that no rock touch the inside forms.

Flat Rock Wall.—A flat rock wall is built in a similar manner except that two concrete mixes are usually used. A sand cement mortar is used as a bed for the rocks and between the rocks. A somewhat leaner mix is used to fill in between the rock and the form.



Fig. 12.—Tamping rock firmly into place.



Fig. 13.—Spading concrete into place.

Exterior Finish

The appearance of the wall can be varied to suit the owner, though much depends on the type of materials. A rough wall can be made using rocks of irregular and jagged surfaces or a smooth wall can be obtained by selecting rocks having flat or rounder surfaces. Further variation can be obtained by blending the various colors and by pointing with plain and colored mortar.

In general, there are two ways to finish the outer surface of the walls. The two methods are commonly known as pointed and unpointed work. In the latter the surplus mortar is raked out of the joints with a trowel after it has hardened enough so that it does not smear. By this method practically no mortar remains visible in the finished wall. (See Fig. 15.) In the pointed work, the joints which are raked out are filled with a special mortar which seals each joint. This special mortar is made by mixing one part cement to two or three parts of sand. Mineral coloring materials, finely ground and thoroughly mixed in the mortar, may be used to produce colored joints. The amount to be used will have to be determined by trial and only enough should be used to produce the color desired.



Fig. 14.—Working small rocks into mortar.



Fig. 15.—Raking surplus mortar out of joints.

Reinforcing

Reinforcing rods are desirable in all rock walls especially at the corners and over all openings such as windows and doors. The reinforcing at the corners should be placed at intervals of about 2 feet and should be continuous around the corner for at least 2 feet on each side. The common old iron found on the average farm such as wagon tires, old sicklebars, etc. is suitable for this purpose. It should be clean and not too rusty. Old pipe is not suitable reinforcing material.

Curing

The proper curing of all types of concrete work is very important if maximum strength is to be obtained. If rock walls are exposed to the sun and wind before hardening much of the water necessary for curing will evaporate and the walls will dry out. This condition will occur more when the movable form is used. To keep the walls moist and to guard against too rapid evaporation, the wall should be sprinkled as soon as it has hardened enough to stand such treatment. The work should be kept moist with wet sacks during the early hardening period of about six days. On most construction jobs too little water is used after the work has been completed.



Fig. 16.—Two Room Milk House. Rock construction makes a very sanitary milk house.

Other Construction Details

Window and door openings are provided with sills and lintels as in other types of masonry construction. Frames for doors and windows, using either plank or box frame as required, are set in place and tacked to the inside form. The sills should be sloped to the outside for good drainage. It is good practice to nail a 1 by 2-inch strip around the outside of the frames midway between the front and back so as to insure solid anchorage and to prevent a crack from opening up, if the frame dries out after the building has been completed. It is a good practice to prime all wood construction such as window and door frames with linseed oil and white lead before they are placed in the wall. In the construction of homes, public buildings, etc. it is usually desirable to have concrete sills and lintels. These may be cast in place or precast. The plate for the roof should be securely anchored to the wall before the roof is constructed. This can be accomplished by placing bolts at intervals of about 4 feet in the wall as it is being finished. The plates are then anchored to these bolts which hold them securely in place.



Fig. 17.—Substantial and non-rotting corner post built with field rocks found on the farm.

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE AND THE UNITED
STATES DEPARTMENT OF AGRICULTURE COOPERATING

J. W. BURCH, Director, Agricultural Extension Service
Distributed in furtherance of the Acts of Congress of May 8, and June 30, 1914