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Ralph L. Patty

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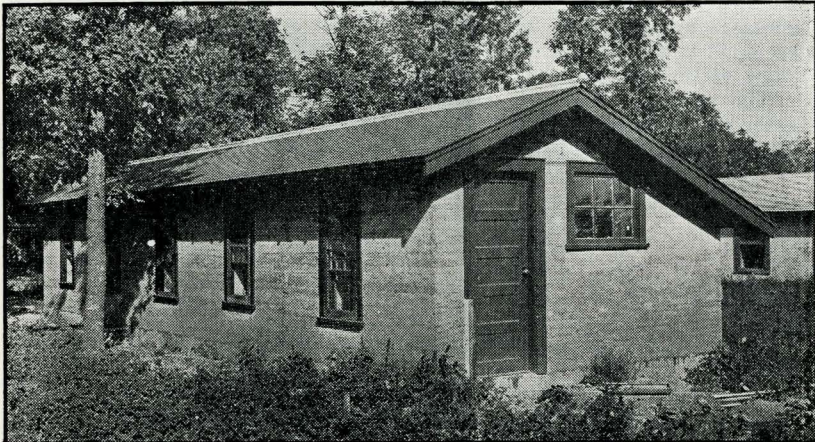
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# Poultry Houses For South Dakota

by  
Ralph L. Patty



**Fig.1—A 14x40 FOOT RAMMED EARTH STATIONARY BROODER HOUSE**

These walls are made of very favorable soil containing 75 per cent sand. The building was constructed on the poultry farm at South Dakota State College in 1936. The building is reasonably fireproof. The walls are entirely fireproof.

South Dakota State College  
Extension Service  
A. M. Eberle, Director  
Brookings, South Dakota

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## Foreword

This circular is a revised edition of Extension Circular 295, "The South Dakota Poultry House." The South Dakota poultry house faces south, has a combination roof, extremely low side walls, a straw loft, and a roosting alcove with extra insulation along the north side. The original South Dakota house was of frame construction and 16 feet wide or deep from front to back. The plan is still shown in this circular with slight changes, the most important of which are a slight increase in the height of the side walls, a stronger tie between the front and rear rafters, and with a change in the outside slats of the straw loft. Placing the slats underneath the loft joists permits a thicker layer of straw at the edges. A South Dakota poultry house plan 20 feet wide and with pisé\* or rammed earth walls is also shown. A 20-foot frame house can also be built from the above two plans. The framing features can be taken from the 16-foot plan except that the height of the side walls should be increased by six inches. The rafter pitch and windows can be taken from the earth house. The windows should be raised six inches for the 20-foot house, as the light will be thrown farther back into the house.

The author wishes to acknowledge the helpful suggestions of Professor W. E. Poley, head of the Poultry Department of the State College, and his kindness in reading the copy for this circular.

Blue prints of these poultry houses can be obtained by sending 20 cents in stamps to the Extension Service, South Dakota State College, Brookings, South Dakota.

The plan for the frame house is No. 311; the plan for the earth house is No. 312.

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\* Pronounced "pee zay" and abbreviated from the French word, "pisé de terra," meaning rammed earth. This material is known throughout Europe as pisé.

# **Poultry Houses For South Dakota**

**RALPH L. PATTY**

**Extension Specialist in Agricultural Engineering**

(Reading time 41 minutes)

The South Dakota poultry house plans described in this circular were designed from a study of plans from other states, trials of houses on the College Poultry Farm, and after the suggestions of former Professor G. L. Stevenson, Clara M. Sutter, Professor W. E. Poley, and O. J. Weisner. The house is designed for the rigorous climate of the north central section of the United States. In the design of this house the cost item has been kept in mind constantly. A better house could be designed and built but not for the reasonable cost of this one. This house is designed for the majority of South Dakota farms and has already been built on a very large number of them. The slightest change in the plan of this house will probably make the inside conditions unsatisfactory in winter.

## **Location of The Poultry House**

The poultry house should be located on high, dry, well-drained ground. It should be reasonably close to the house—the closest stock barn on the farm. The birds are often cared for by the housewife. They need attention often in the winter time. Rodents and thieves are also less apt to bother when the location is close.

The poultry house should be on the opposite side of the barnyard court from the hog pen, if possible. The house should be readily accessible from the dwelling house without the necessity of passing through more than one gate. The house should be located so that the lots will have accessible shade, but no trees which would cut off the sun should be within 30 or 40 feet from the house.

## **South Dakota House Sets East and West**

The South Dakota poultry houses set east and west with the long way facing the south. This is recommended for poultry houses and has advantages because the houses are not so wide but that the sunlight coming through the south windows will light the entire floor to the north wall. Sunlight is more direct through the south windows and a favorable location is provided for the dust bath.

## **The South Dakota Frame House 16 Feet Wide**

### **Size of the House**

The South Dakota frame poultry house is 16 feet wide (front to back). It is built in sections 16 feet long so that each section of the house, 16 by 16 feet, is exactly like the next. A poultry house can, therefore, be built from the South Dakota plan that is of any length which is a multiple of 16, that is, a house may be built 16, 32, 48, or 64 feet long. It could be built longer of course, but a longer house is not recommended. A longer house means greater fire hazard, less chance for segregation in the case of disease, poorer ventilation, and more walking and more time required in caring for the birds. A house of two or three sections is no doubt the very best size for the farm poultry house.

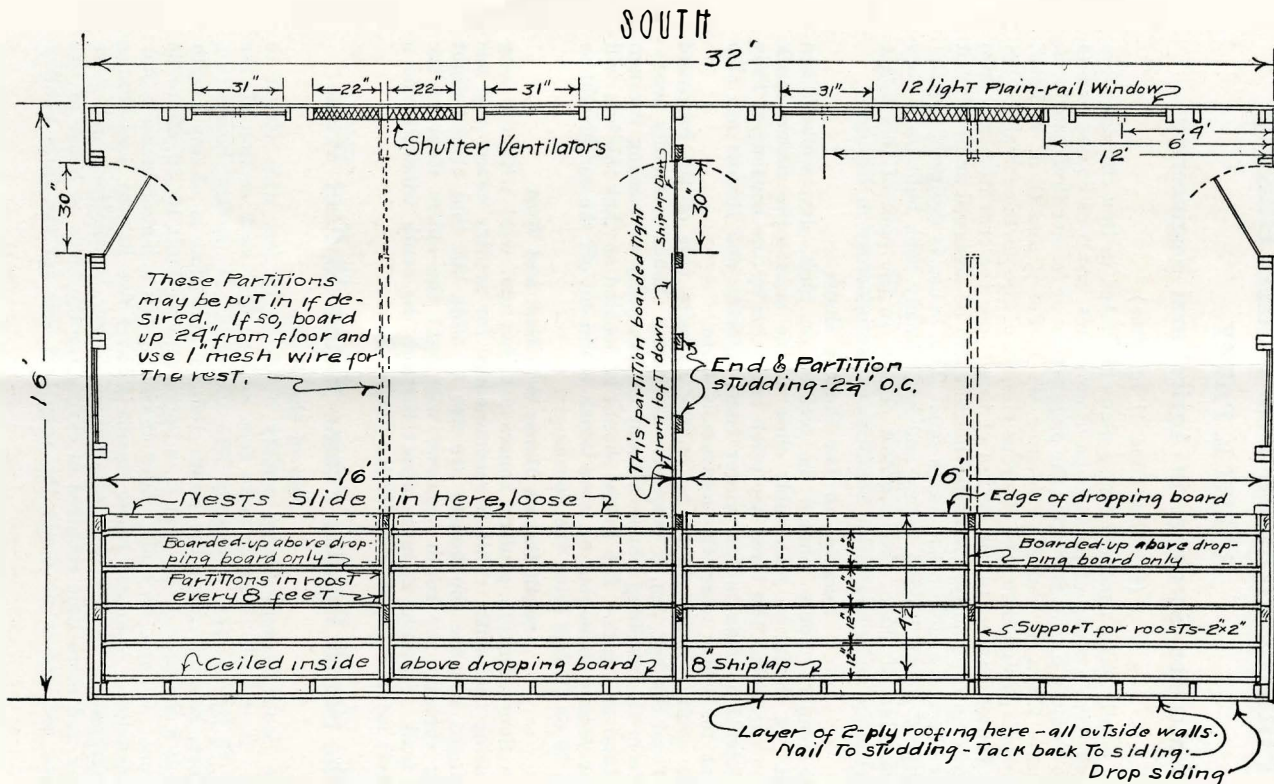


Fig. 2—FLOOR PLAN OF THE SOUTH DAKOTA FARM POULTRY HOUSE

Showing the floor for two sections of the house. The house is 16 feet deep (front to back) and for length is built in 16-foot sections, each exactly like the next. A 32 or 48-foot length is best but a 64-foot house (four sections long) would be practical.

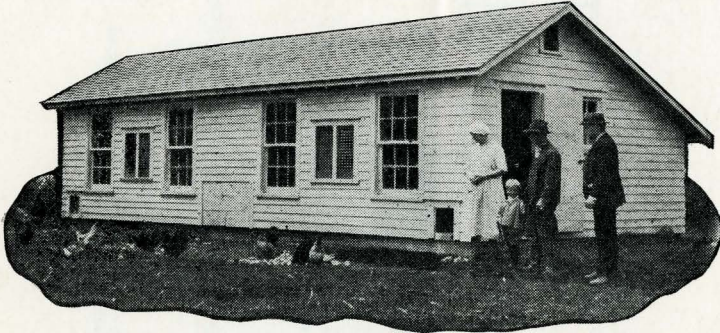


Fig. 3—THE 16x32 FOOT SOUTH DAKOTA POULTRY HOUSE

This house is of frame construction with side walls of sheeting, paper, and lap siding. It is built exactly like the plan and is on the farm of Joel Fahlberg, Beresford, S. D.

One section of this house, 16 by 16 feet, should take care of 70 to 100 laying birds as a maximum number, depending upon their size. The larger type birds need three and one-half feet of floor space for each bird, while for leghorns two and one-half feet will be sufficient. This amount of floor space is slightly less than is generally recommended. For a farm poultry house closed only during the cold months of the year the slightly larger number of birds figured on this basis will be able to keep the temperature up in the house better than the fewer number. The house will be more comfortable and the frost will be better controlled. The 32-foot house then, shown in the plan, will handle from 140 to 200 birds under favorable laying conditions.

#### Foundation

Concrete is the best material for the foundation of the South Dakota poultry house. A depth of one foot below the natural ground level should be sufficient for the foundation of a frame house as the building is light in weight and unless it is plastered will not be injured from heaving due to frost. If a building is plastered, it should go deeper and if the walls are built of tile, the foundation should go to a depth of three and one-half feet as masonry walls are cracked from the heaving action. The foundation should extend one foot above the average level of the ground and after the building is finished, dirt should be graded around the outside of it up to a height of six inches from the top of the foundation. This provides for a drainage away from the house and from under the floor. A fill is then necessary inside the foundation before the floor is laid. If practical, this fill is best made of coarse gravel or hard cinders. At least two or three inches of gravel should be used even when difficult to secure. This fill must be tamped very carefully or, if possible, allowed to settle two or three months, after a thorough wetting down before the floor is finally poured. If dirt is used for the fill, tamping should be more thorough. The foundation should be mixed from screened sand and gravel in the proportion of one part Portland cement, two and one-half parts of sand and five parts of gravel or crushed rock. If bank-run gravel is used then a water-cement ratio of six and one-half gallons of water for each bag of cement is correct.

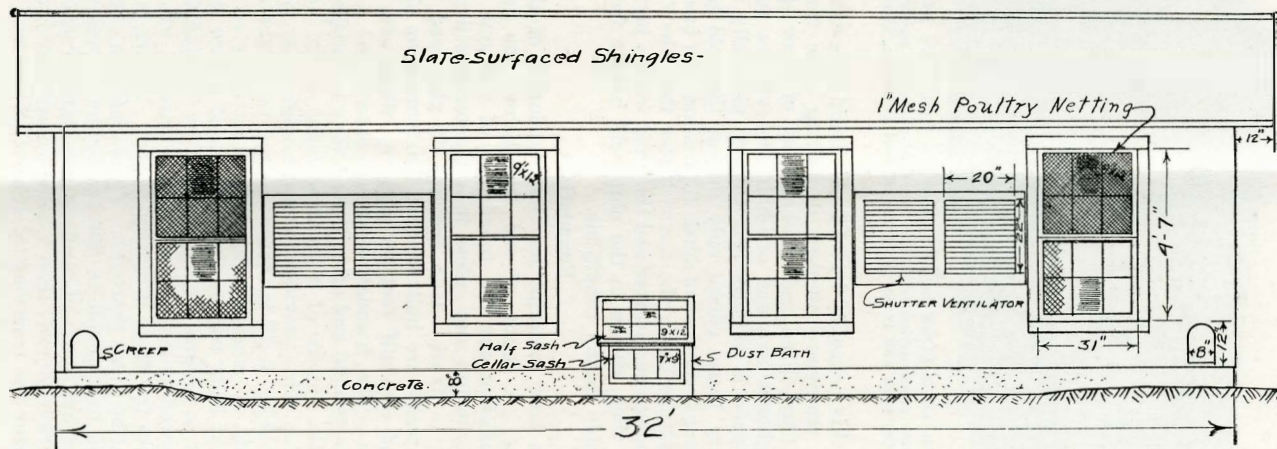


Fig. 4—SOUTH OR FRONT ELEVATION

This shows the south elevation for a house 32 feet long. Each 16-foot section has two 12-light, 9 by 12 pane windows and a pair of shutter ventilators between. At least every other window should be screened on the outside with one-inch mesh poultry wire.

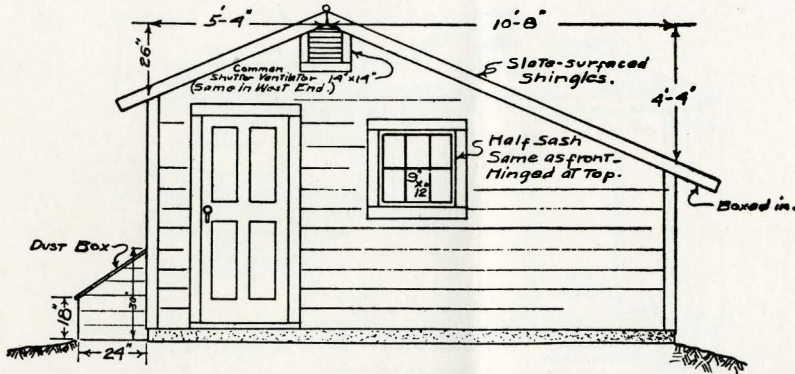


Fig. 5—THE EAST END ELEVATION

This view shows the "rise" and "run" of the rafters for the combination roof of the South Dakota poultry house. It also shows the common shutter ventilator in the gable end of the house. 14" by 14" is the correct size for this shutter ventilator for a 32-foot house. The size should increase proportionately for a longer house. A screen of hardware cloth over these shutters will keep out sparrows.

The west elevation is exactly the same as this.

#### Floor

Concrete is the best material for the poultry house floor. Hollow tile may be used under a one-inch course of Portland cement mortar, as shown in the plan, if the location is poorly drained. There is no objection, and many advantages to concrete for a poultry house floor. The litter kept on the floor insulates the birds from it. It is just as warm as a board floor and usually warmer. A concrete floor may be made as shallow as three inches, providing the foundation under it is firm and providing it is mixed correctly. There should never be more than three parts of sand to one part of cement used in the mixture for the first, or bottom, course of the floor. Coarse aggregate, which is gravel or crushed rock, may be added to this mixture up to five parts without decreasing its strength. (Too much sand for the cement used is what makes poor concrete.)

If bank-run gravel is used then the same water-cement ratio would be used as for the foundation. The bottom course should be mixed relatively dry. A fairly dry mixture makes a stronger floor than a wet one. It should be dry enough so that it needs to be tamped into place.

The top course should be made of cement mortar consisting of cement and sand only, and this course need not be more than one-half to one inch in thickness providing it is put on immediately before the bottom has time to set-up at all. The top course should be mixed one part of cement to two and one-half parts of clean hard sand and troweled with a wood float. A slope of one inch from the back of the house to the front should be made in this floor.

#### Framing

The plan is compact, the side walls low, and the shape of the house gives it strength. Two-by-four studding and rafters are therefore sufficiently strong for the frame of this house. The dimensions are such





exposed. The South Dakota house with combination roof offers the minimum exposed wall as well as economy of material. Either wood or slate surfaced shingles are recommended for the roof of this house. If the slate surfaced shingles are used the better grade which afford a good lap are recommended. Roll roofing is not recommended for the house. When wood shingles are used open sheathing with one and one-half inch spaces should be used under them. Tight sheathing under wood shingles shortens the life of the shingles.

#### Windows

The amount of glass which has been used in poultry houses in the past, we believe, has been too great for this and other sections as well. Too much glass means a higher temperature in the house in summer and too much radiation of heat in winter. Twelve light 9 by 12 pane, plain-rail windows are recommended, placed exactly as shown in the plan. This figures one square foot of glass to 11 square feet of floor space in a 32-foot house. Plain double strength glass is recommended. Extra frames of glass substitutes may be provided for seasonal replacement, if desired, but these glass substitutes must be cleaned daily in order to secure the satisfactory benefits of ultra-violet rays. The windows in the ends of this house are single sash of the same windows as used in

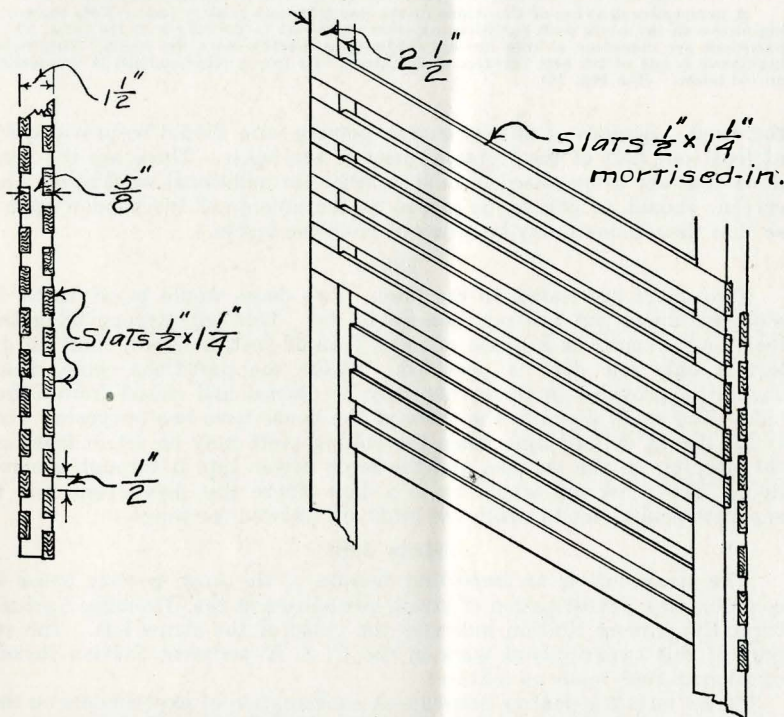


Fig. 7—BAFFLE-BOARD SHUTTER VENTILATOR DETAIL

The shutter ventilators used in the south side-wall are the baffle-board type. All slats are set horizontally and alternately so as to break up a draft. A sideview and an isometric view are shown. The slats and openings are quite narrow.

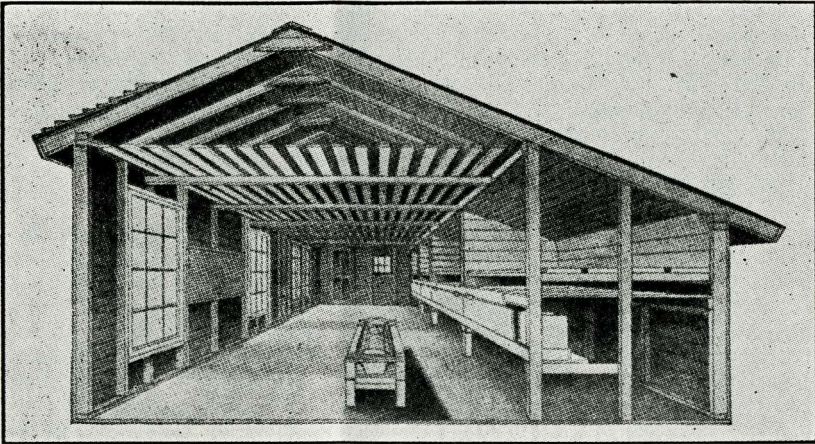


Fig. 8—THE INSIDE OF THE HOUSE IS MOST IMPORTANT

A perspective drawing of the inside of the South Dakota poultry house. Note the roosting-alcove on the north with partitions at every eight feet in the length of the roost. These partitions are important as they prevent drafts from moving down the roosts. This roosting-alcove is one of the best features of the house. Its use is recommended in remodeling an old house. (See Fig. 18)

the front. Screens of one-inch mesh poultry wire should be provided for at least one half of the front windows in the house. These are the windows that are to be raised in mild weather for additional ventilation. The screens should, of course, be placed on the outside of the window casing so that the windows may be adjusted from the inside.

#### Doors

Two doors are shown in the plan. Two doors would be advisable in most instances but are not necessarily so. This will depend upon the location. Usually in a house of more than 32 feet, however, time will be lost if only one door is provided. Where the partitions come, doors should be provided in them that may be opened and closed from either side. The small doors in the front of the house have two purposes. One is for use at culling time when the culling crate may be set in front of the opening on the outside, and the birds driven into it through a small door. The other use would be in a case where this door opens into a separate poultry lot to which the birds are allowed for range.

#### Straw Loft

The straw loft is an important feature of the farm poultry house in cold climates. Investigation of straw loft houses at the Wyoming Agricultural Experiment Station indicates the value of the straw loft. The report of this experimental work in the U. S. Experiment Station Record of August 1928 reads as follows:

“Straw lofts for poultry houses:—A continuation of experiments on the insulation of poultry houses by the use of straw lofts showed that the house with the straw loft was from five to ten degrees warmer in the early morning and from 10 to 20 degrees cooler in midday than the

house without the straw loft. During a cold snap, when the temperature went down to -30 degrees F., the lowest temperature in the house with the straw loft was +4 degrees. None of the hens in the straw loft houses had frozen combs. In the uninsulated houses the temperature reached -4 degrees, and all of the chickens were frostbitten. The eggs from the house with the straw loft had the highest hatchability."

Owing to its supplementary help in ventilation we believe the straw loft in this house will be superior to a tight ceiling which might be installed at the same location. The reason for not building the house higher and extending the straw loft completely across from plate to plate is a saving in cost, and a reduction in the amount of exposed side wall. The straw loft is located six and one-half feet above the floor. It is supported by two-by-four joists spaced 24 inches on center, as shown in the plan. One-by-three inch strips "ripped" at the lumber yard are shown in the plan for holding the straw. Woven wire may be used for this purpose, but if supported so that it will not sag too much, a woven wire loft is slightly more expensive than the slats. If woven wire is used, we recommend two continuous strips of wire netting three feet wide on each side of the straw loft and recommend that the center strip be built on frames in eight-foot lengths so that at the time the straw is changed the frames may be easily slid out of place and the straw taken out or put in through these openings. Not less than one foot of straw, after it has settled, should be used in the straw loft and it should be pushed well back at either edge of the loft. The stringers carrying the loft should be six feet, six inches above the floor. The method of nailing three or four of the outside slats for the straw loft underneath is an important improvement over the old plan. It was suggested by Mr. O. J. Weisner, Extension Poultry Specialist.

### Ventilation

The straw loft in the poultry house has two purposes. One is to cut down the overhead space in the house, and the other is to aid in the ventilation of the house. A straw loft also makes the house cooler in summer. A small amount of moist air moves up through the straw loft and a part of the foul air as well as a part of the moisture is carried out through shutter ventilators in the ends of the house. These shutter ventilators are placed in each gable end of the house as shown in the plan. They should be 14 by 14 inches for the 32-foot house and larger in proportion for a longer house. These shutter ventilators are of the old fashioned vane type. The vanes should be set at an angle to protect the loft from the weather as much as possible. Outside the vanes it is recommended that one-half inch hardware cloth be used over the opening. This will keep out birds. It is sometimes desirable to close one or both of these ventilators in the gable ends of the house in stormy weather or extremely cold weather. A sliding door can be made on the inside for this purpose, to be operated by a one-by-two inch staff extending down below the straw loft in each end of the house. When pushed up, the door closes the opening.

The greater part of the ventilation for this house is secured through baffle-board shutter ventilators placed in the south side walls. This type of ventilation is entirely different from that of stock barns, but birds are quite different from hogs or dairy cows. These shutter ventilators pro-

vide a breathing type of ventilation. The vanes in the baffle-board shutter ventilators are arranged alternately on either side of a frame in such a manner that a wind cannot blow directly through them but will be broken up owing to the position of the vanes. The detail in Fig. 7 shows how these shutter ventilators are constructed. Selected plaster lath might be used for slats in its construction. A width of 20 inches is specified because this will be the width of opening between studding after the cleats or stops are in place to hold the frame in place. The frame of the ventilator should be 22 inches wide. The capacity for them is measured in square inches of frame opening in the wall. From 9 to 13 square inches of frame opening should be provided for each bird that is to be housed. It is not necessary to use exactly the size vanes or slats shown in the plan but if wider slats are used, comparatively wider openings should be left between them.

These shutter ventilators should be left open practically the year round. In mild weather windows should be opened for ventilation in addition to them, and in the most extreme weather only will there be a necessity for closing them. For this purpose a burlap or muslin curtain is recommended. This cloth curtain should be rolled up on a curtain pole or broomstick and tied at the top of the window so that by simply pulling the string of the knot the curtain will roll down of its own weight. The location of the shutter ventilators is recommended exactly as shown in the plan. This is in the center of the south side wall, midway between plate and sill.

Ventilation includes the introduction of fresh air into a stock building and a partial control of moisture and frost deposit. A small amount of moisture or frost deposit does not indicate foul air; it indicates a cold side wall. In order to completely eliminate moisture and frost deposit we must eliminate the cold side wall. This is done only by elaborate insulation which is somewhat expensive. The South Dakota poultry house has practically no insulation and, therefore, is an inexpensive house. It has been designed to meet the demand for a satisfactory laying house at a low cost. There would be no objection to elaborate insulation of the walls in this house other than the additional cost.

#### Inside Equipment

The inside equipment for the laying house is of greatest importance. This includes the roosting alcove, dropping boards, perches, nests, partitions, feeders, etc. Without these the most expensive house will be poor and with these an old house can often be remodeled into quite a satisfactory laying house.

#### The Roosting Alcove

The roosting alcove is the most important inside equipment shown in the plan. The roosting alcove is simply a little open shed similar to an open beef-cattle shed, except that it is built on the inside of the house, for the birds to roost in. It makes a snug, warm and well ventilated place for roosting. It should be built with approximately the same dimensions shown in the plan for the 16-foot house. It is 20 inches high at the back and 39 inches high at the front. It is shown 35 inches above the floor but in case of a remodeling job, for instance, this distance from the floor might vary. The dropping boards make the floor of the roosting alcove.

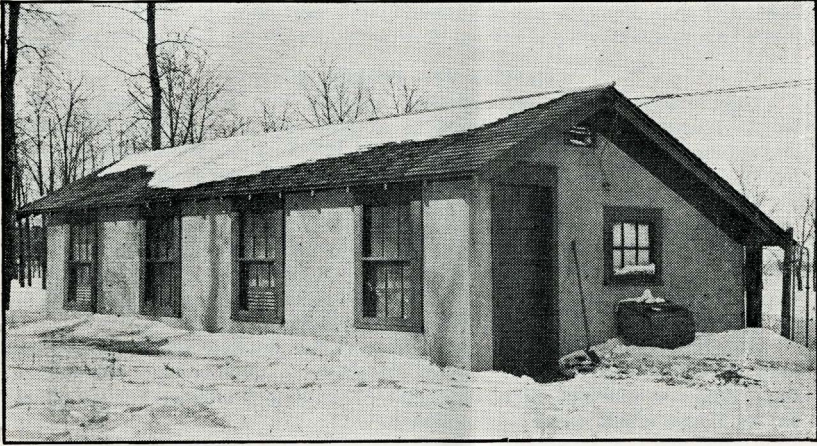


Fig. 9—A RAMMED EARTH POULTRY HOUSE WITH STUCCOED WALLS

These earth walls looked the same as those shown on the cover page, before they were stuccoed, except that the soil used was only medium in quality. The walls would have roughened badly had they been left bare. Winter temperatures averaged 5.9° F. warmer in this house than in a duplicate house of frame construction.

They should be tight so no draft can come up from underneath. The back and roof of the roosting alcove is made by ceiling up inside the studding at the back and under the rafters overhead with matched lumber or with a lumber substitute. At every eight feet in the length of this alcove a tight partition of the same material should be built. This partition should extend well out in front of the perches. These partitions are important as they prevent movements of air from one end of the alcove to the other. It is not recommended that the roosting alcove be built any deeper than is shown on the floor plan.

#### Perches

The depth of the roosting alcove provides for four rows of perches. These perches are seven inches above the dropping board and are made of two-by-two's with slightly rounded corners. Each of these perches is entirely separate and loose. They drop into a slot in the partition of the roosting alcove at each end. When it is desired to clean the dropping boards, the perches may be easily lifted out and shoved to the back out of the way. The notches in which the ends of the perches rest make an excellent trap for killing mites. This system is less cumbersome and will be found an advantage over the method of raising the perches by means of a pulley and line.

The nests are located under the dropping board in the plan. If partitions are used in the house as shown, the nests may also be installed on these partitions. They are built in batteries of six each. Each nest is 14 by 14 inches inside. They are not fastened in any way. Each battery of nests may be pulled out from under the roosts and taken out of the house for cleaning and disinfecting at any time. Seven smaller nests can be built for this space in place of the six large ones if desired. Each

nest will then be 12½ by 14 inches. The nests open at the back for the birds to enter but have a hinged door at the front for gathering the eggs.

#### Heating The Poultry House

Experimental study on artificial heating of poultry houses to date would indicate that the practice is a safe one if not used to excess.

Professor W. E. Poley who is head of the Poultry Department at the South Dakota State College has this to say about artificial heating:

"Experiments on artificial heating of laying houses have been carried on in some states and there is apparently some difference of opinion regarding the wisdom of this practice. It is believed that for the average winters in South Dakota, artificial heat may prove very practical, at least during December, January and February. This especially applies to laying houses which are ordinarily relatively cold.

"Ordinary brooder stoves serve very well for heating laying houses but care should be exercised to provide sufficient insulation as a fire preventive. There is perhaps little necessity of having the temperature of the laying house much above 32 degrees F."

#### The South Dakota Frame House 20 Feet Wide

Some poultrymen think the 16-foot poultry house too narrow and prefer a wider house. A wider house provides more floor space in front of the roosts for feed hoppers, water racks, and other equipment. Some light is sacrificed in the wider house but it will be slightly warmer if the allotted number of birds are kept in it. The birds furnish the heat unless artificial heat is supplied. The house with a 20-foot depth should be built in 20 by 20 foot sections. Each section would be like the next and the length could be 20, 40, or 60 feet long, as desired. The window and shutter ventilator arrangement in the front should be the same as for the 16-foot house but the shutter ventilators and windows should be larger. Each of the two shutter ventilator sections would be 20 by 36 inches in the 20-foot house and the windows would be the same size as shown in the plan for the 20-foot rammed earth house, viz., 12 light, 10 by 14 inch pane, double-hung windows. Full length windows are also advised for the ends of the house. The side walls should be higher in order to let in more light and the windows should be raised to the height shown in the plan for the rammed earth house. Fewer large windows are advised rather than a greater number of small windows because the house will be warmer for the same amount of glass. Reference to each of the two plans, i. e., the plan for the 16-foot frame house and the plan for the 20-foot rammed earth house will furnish all the dimensions and instructions needed for building this 20-foot frame house. The rafter pitches would be taken from the plan for the earth house.

#### A South Dakota Rammed Earth House

Rammed earth or "pisé" walls as they are called in Europe, are monolithic air-proof walls made by ramming moist earth into forms. The forms are similar to those used for pouring concrete walls except that a single section of form only is used for rammed earth. When it is rammed full it is immediately removed and moved ahead where it is ready for making another section of the wall. The sections are joined with "tongue and groove" joints which makes the wall proof against the

infiltration of cold winter air. Since earth is a good insulating material, a good thick wall of rammed earth makes a very valuable wall for the poultry house. In the spring of 1931 an experimental poultry laying house (16 by 32 feet) with rammed earth walls, was built by the State College Experiment Station, Department of Agricultural Engineering. Temperature tests were made in this building by the Poultry Department and comparing it to a frame house of the same size and design and with better than average insulation. The same number of birds was kept in each of these houses and temperature readings were made twice each

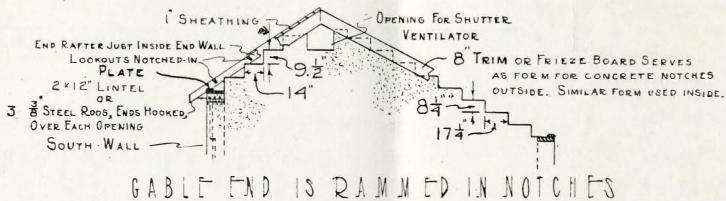
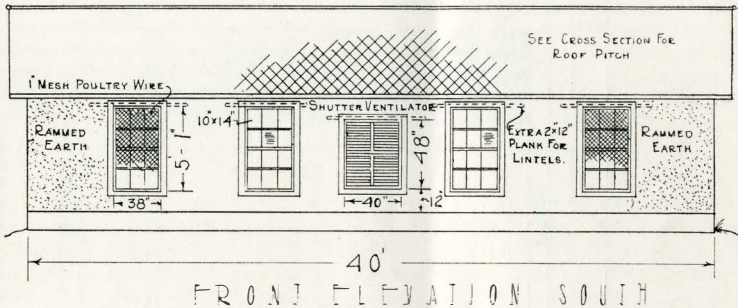


Fig. 10—FRONT AND REAR ELEVATIONS AND GABLE END OF THE RAMMED EARTH HOUSE

A single large ventilator is handier for the 20x40-foot house, and the windows are to be used when additional air is needed. A longer house must have two ventilators. The gable end should be rammed of earth to match the rest of the wall.



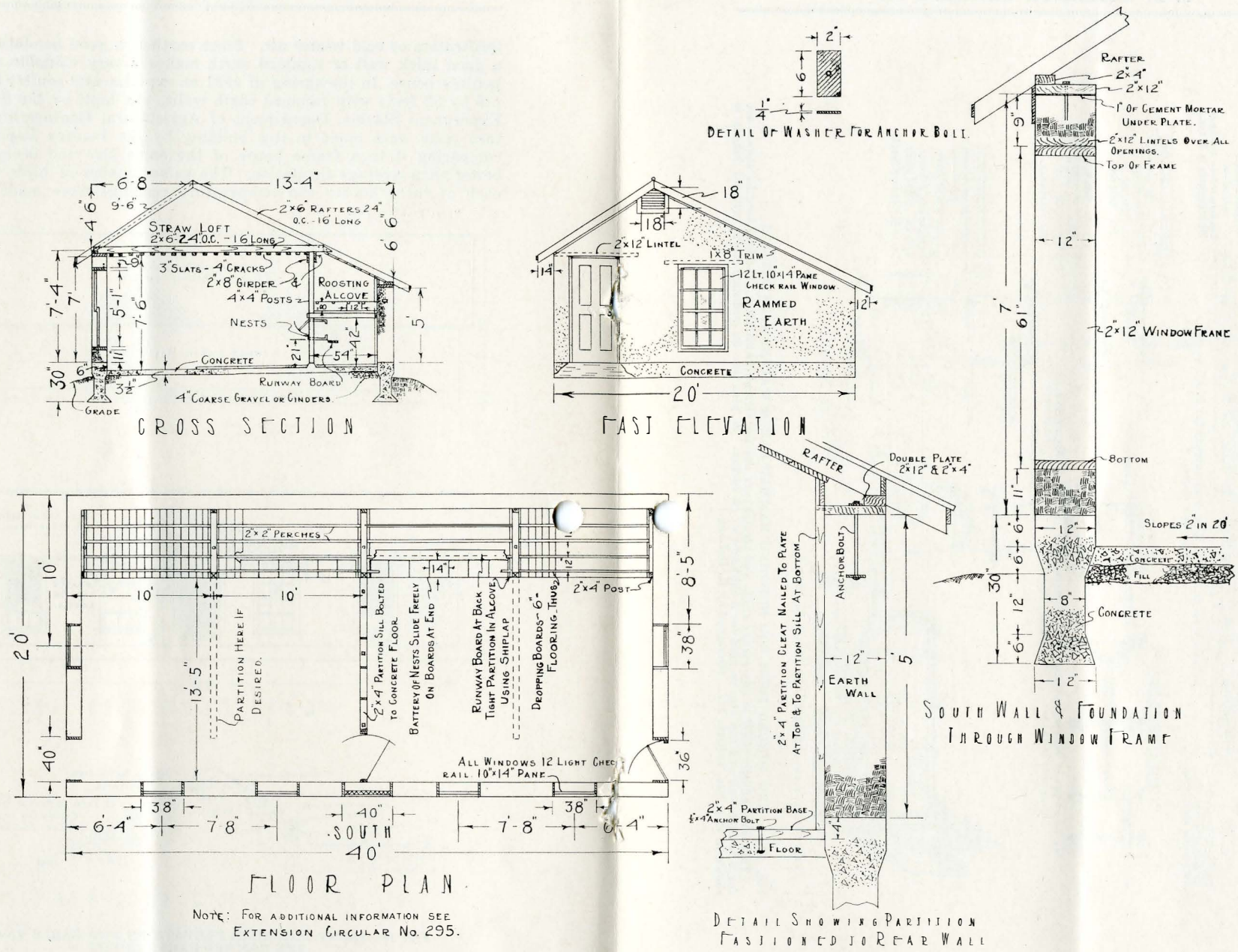


Fig. 11—FLOOR PLAN AND DETAILS FOR A 20x40-FOOT SOUTH DAKOTA POULTRY HOUSE WITH WALLS OF RAMMED EARTH

This plan calls for a house with a width of 20 feet instead of 16. There are two reasons for this. The thicker walls take up more floor space and the wider house allows more room for feed hoppers and equipment. The thickness of the walls as shown is 12 inches. They will be quite satisfactory, but 14-inch walls will control the frost better and take little longer to build.



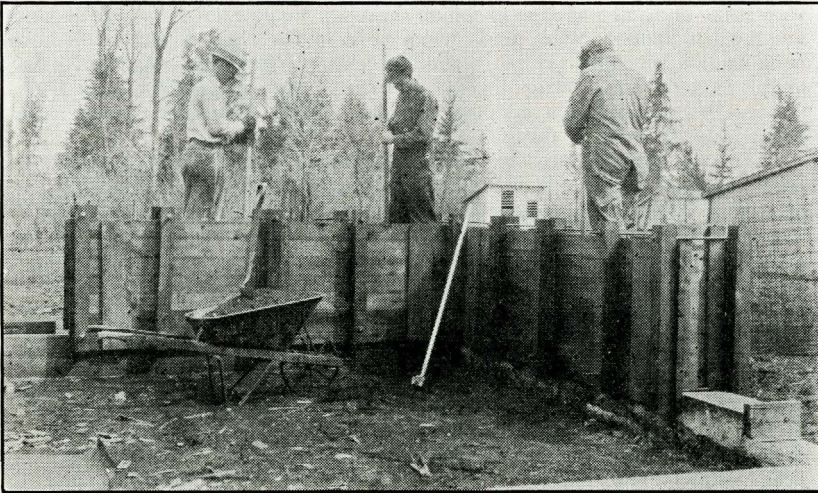


Fig. 13—RAMMING THE FIRST CORNER SECTION OF THE POULTRY HOUSE

This is the old type of form without hinges. Otherwise they are practically the same. After the wall is rammed within six inches of the top of the forms, the forms are immediately removed and moved ahead on the wall ready to be filled again. The 4 by 4-inch stay-braces are none too heavy for this purpose and the wing-nuts shown in the picture are very necessary to the quick moving of the forms. A layer of loose dirt  $4\frac{1}{2}$  to 5 inches deep is added each time.

day, viz., at 7:30 a. m. and at 1:00 p. m. For the five coldest months of the year, the early morning temperature in the earth house averaged 5.9 degrees F. warmer than in the frame house. At the same time, the daily fluctuation of temperature in the earth house was 6.0 degrees F. less than in the frame house. Members of the Poultry Department at the State College have been so well pleased with this house that a stationary brooder house (14 by 40 feet) with rammed earth walls has since been built on the poultry farm, and Professor W. E. Poley is now planning on a third house of the same material. The laying house from which the temperature readings were taken was built 16 by 32 feet to exactly match the frame house with which it was compared. A wider house is desirable, however, because the earth walls take up more of the space and it provides more floor room for the feed hoppers and other equipment. A wider house also provides more floor space for scratching and exercise. A plan is therefore shown in this circular for a 20 by 40 foot rammed earth poultry house (See Figures 10 and 11) with 12-inch walls. Since this plan was drawn the brooder house mentioned above was built with 14-inch walls and with so little extra work that this thickness is recommended especially for the northern half of the state. The plan as shown can be used for a 14-inch wall without any important changes and the insulating value will be increased in direct proportion to the increased thickness. This wall is expected to be practically proof against frost deposit at this latitude.

Rammed earth walls are recommended not because they are inexpensive to build but because of their value both as to durability and to

warmth. They are as fire-proof as masonry walls and at the same time are much warmer. Such walls when built of the right kind of soil have been known to stand for more than a century. The following is a paragraph taken from a letter dated February 3, 1937, from Dr. H. B. Humphrey. Dr. Humphrey's address is Cabin John, Maryland, three miles beyond the District of Columbia.

"As you know, I have long been convinced of the superior merits of rammed earth walls and certainly would not hesitate a moment to employ this method of construction in preference to any other with which I am familiar, especially for such a climate as obtains here on the Atlantic Seaboard, where, in summer, we have excessive heat and high humidity and, in winter, probably as changeable weather as is to be found anywhere in the United States. We have occupied our rammed earth residence now since December, 1923, and can truthfully testify to its superiority over brick, stone, concrete, or any other building material employed in this section. It scores high from the standpoint of insulation against heat and cold. It, also, is superior to brick, stone, and concrete in a highly humid region for the reason that dry earth tends to absorb moisture and thus to condition the humidity within rooms enclosed by such walls. The upkeep is virtually nothing and the resistance to ravages of storm and wind is surprising. In sections of the country where common labor may be employed at wages ranging from \$1.00 to \$2.50 per day, this method of construction certainly is less expensive than that involving the use of prepared materials."

Dr. Humphrey has been very much interested in this type of construction for many years. Further along in his letter he mentions an old rammed earth residence built in the city of Washington in 1773, on 13th Street and Rhode Island Avenue, N. E. Washington. He says this house is in a perfect state of repair today.

Rammed earth walls are smooth and solid. They do not settle and let the plate-line sag. They can be plastered inside or stuccoed outside very readily, if desired. Nails can be driven into these walls when they are comparatively green but it is probably best to embed nailing blocks in the wall when it is rammed, for nailing purposes. Nailing blocks of any size or length can be rammed into a wall up to one-half the thickness of the wall at least, and it is done by merely placing the loose block in the form against the side and ramming the wall around it. In building the poultry house no nailing blocks are necessary, if the methods are followed as called for. Earth walls will resist a reasonable amount of abrasion without marring but if they should be marred at any time, they can be given a coat of cement stucco very easily. The stucco is nailed directly to the wall and no metal lath or other bonding agent is necessary.

#### Foundation For Rammed Earth Poultry House

Good concrete foundations are advisable for earth walls. For a small building they should extend 18 inches below the ground level in good load-bearing soil, and should be spread to a good wide footing at the bottom. The footing should be not less than the width of the wall (and this width for low walls and in a favorable location). The top of the foundation must be widened so as to have a width equal to the width of the wall, as shown in the plans. In mixing concrete not more than seven

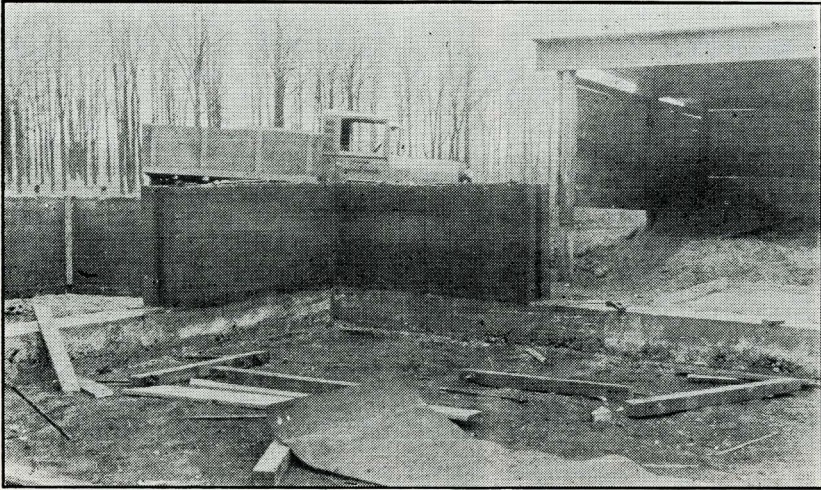


Fig. 14—THE FIRST CORNER SECTION COMPLETED

The forms were removed immediately and are ready to set up for a straight section of side-wall. The end groove is shown at each end of the section. When the adjacent sections are built these grooves will be filled and the wall is weather proof. At the right background is shown a temporary shelter to keep a portion of the dirt dry at all times.

gallons of water should be used for each bag of cement and bank-run gravel added until the mixture is of the right consistency, according to the "water-cement" ratio test. If the sand is screened from the gravel the ordinary foundation mixture of 1-3-5 (one part of cement, three parts of sand, and five parts of gravel—or crushed rock) would be used. The flared type of foundation shown in the plan has been used for different buildings at the Experiment Station and is entirely satisfactory. The full width of the wall must be carried in the concrete foundation for a full six inches below the top, for walls of this height, as shown in the plan.

#### Forms For Ramming Earth Walls

The plan for the forms which are used in ramming pisé or rammed earth walls are shown in Fig. 12. They are built to extend around the corner of the building. After building the corner sections the forms can be straightened out and used on the straight side walls, of course, or they can be used as two forms. The forms are built of two-inch material and the form boards are held together by ordinary one-inch nailing cleats. Although it is not absolutely necessary, it is better to have this two-inch lumber dressed and matched, i. e., with tongue and groove. This work can be done at a carpenter shop or if ordered through the lumberyard, it can be had at an extra cost of only two dollars per thousand feet. As soon as the sides are built they should be given two coats of linseed oil to keep them from warping. These forms will then last for several years. One form in use at the present time has been used for building walls equal to five or six poultry houses and is still in good

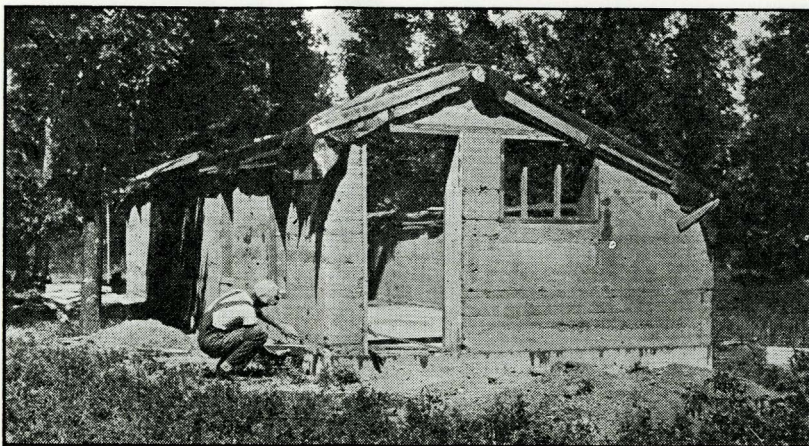


Fig. 15—PROTECTING THE TOP OF RAMMED EARTH WALLS  
DURING CONSTRUCTION

This wall is expected to stand for 100 years without any protection after the roof is finished, but until that time the top of the wall must be protected at all times. Sisalkraft paper or old strips of prepared roofing are good for the purpose. The lower edge should stand away from the wall. Note the 2x6-inch vertical braces set inside the plank window frame to reinforce it while the wall was being rammed above it.

shape. After the sides of the form are finished the end gates are made, as shown in the plan. They are not made to fit in a certain groove, but are moved to any place in the form that is desired, and held in place by temporary cleats, so as to make the rammed section of wall any length that is wanted. The end gate has a beveled two-by-four cleat on one side. This leaves a groove in the end of the wall section. (See Fig 14) When the next section of wall is rammed this groove is rammed full of dirt and a "tongue and groove" weather-proof wall is the result. The outside corners of the building should not be sharp. For this reason a diagonal strip about the size of quarter-round is tacked into the corner of the form so as to bevel the corners. The strip may be made by ripping a one-by-one inch strip across the diagonal. The form can be made as short or as long as desired but will, of course, be heavy to handle if longer than shown. It should not be much shallower than is shown because it will require moving too often. When set up for ramming, the forms are held together by bolts and four-by-four inch vertical stays. The wall is rammed around these bolts and when the form is full (about six inches from the top) the bolts are pulled out and the form moved ahead. In resetting the form, the form rests on the bottom row of bolts either on the foundation if starting, or on the top of the last wall section below. The form is leveled up and a few two-by-two inch spacers are used when the form bolts are drawn up. These come out as the section is rammed. Before starting to fill the form a coat of used crank case oil is brushed onto the inside of the forms. This keeps it from sticking to the wall and the oil may serve as a slight protection to the wall surface while it is green.

### Favorable Soil for Earth Walls

The most favorable soil for earth walls is a light sandy soil which contains not more than 25 per cent of silt and clay. Heavy clay soils are unfit for use. A medium soil may be satisfactory with less than 30 per cent of sand, providing the rest is largely silt and not heavy clay. A reliable and accurate test for the favorability of soils for this purpose has been developed by the Experiment Station and is reported in Experiment Station Bulletin 298\*. Sand or bank run gravel can easily be added to the average soil making it a very favorable soil. A very favorable soil is one that will stand for more than 100 years without a protective covering. It will usually contain around 75 per cent of total sand. Sandy soil rams solid more quickly than do the other kinds and the time spent in adding sand as the dirt is turned over on the mixing board, will be much more than regained in the time of ramming.

### A Simple Test Of Soil For Rammed Earth Work

A simple test can be made to determine whether a soil falls in the class of good soils or not. Take an average sample of the soil in a flat pan and dry it in a hot oven for three or four hours. A wash basin will

\* Arrangements have been made to have samples of soil tested in the laboratories of the Agricultural Engineering Department at a cost of one to two dollars each. Care should be taken that the soil is representative of the soil that is to be used. A quart of soil in a salt sack is sufficient for testing.

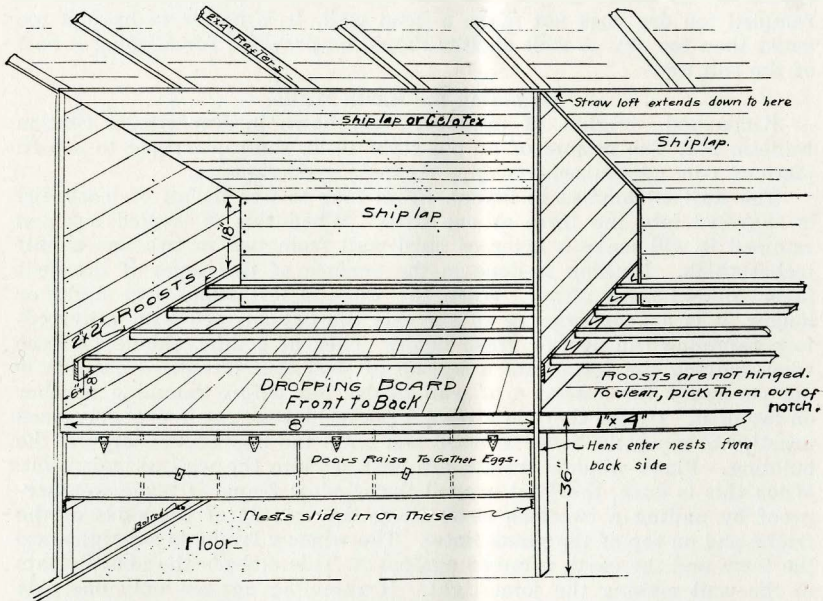


Fig. 16—LOOKING BACK INTO THE ROOSTING ALCOVE

This alcove makes a comfortable place for the birds to roost. The perches drop into notches at the ends. They are not fastened. In cleaning they are scooped to the back. The nests also are loose, sliding back under the dropping-board on the 1"x4" ties. If the dropping boards are laid from front to back as shown, they will be much easier to clean.

answer perfectly for this purpose. The amount of soil should be more than a quart. Next, pulverize the soil fairly well so it will not have many lumps in it. Pebbles of all sizes should be left in the sample. Fill a quart cup with the dry dirt and settle it down so the cup is entirely full. Place the dirt in a wash basin or other flat pan and cover with water, then stir with the hand and pour off the dirty water. Fill the pan with clean water and repeat this operation until all the fine silt and clay particles are floated off. It will take only a few minutes until all the dirt is gone and the water will remain clear. What is left in the pan will be clean sand and some of it will be very fine. Dry the sand and measure it in a measuring cup. If there is a full cup of sand there is approximately 30 per cent of sand by weight in the soil, and it will be fairly good for rammed earth work. If there is more than a cup of sand, it will be still better. If there is nearly three cupfuls, it should be excellent for the work.

The dirt should be just moist and is not mud in any sense, as is the material for making adobe bricks. A simple and satisfactory test can be made for the proper moisture by pressing a fair sample of it in the hand and dropping it from the waistline onto a hard floor. It should stick together but it should not make a mud ball and it should break into many pieces when it strikes the floor. The persons operating the rammers will soon learn to tell very quickly when the moisture is right. If the dirt is too wet it will be springy and will not ram down hard and solid. It should be as moist as possible and still ram solid since dirt that is rammed too dry does not make a good wall. It is better to have it too moist than too dry. A rude shelter should be provided for keeping a part of the soil dry.

#### Ramming the Earth Walls

Kinds and weights of rammers are shown in Experiment Station Bulletin 277. The bottom of an old style 10-lb. sadiron welded to a 5-ft. piece of 1-in. galvanized iron pipe makes a good rammer.

The wall is rammed in layers. From four to five inches of loose dirt is shoveled into the form at one time. When this is leveled out and rammed it will make a layer of hard wall from two to two and a half inches thick. Nothing is done to the surface of this layer if the next layer follows right away. When the work is left stand over night or longer, it is a good practice to sprinkle the dry surface with water before ramming the new or fresh layer. This, of course, should be done when moving the form onto a section of wall that has dried out. It is not necessary for a section of wall to dry out before ramming another on top of it. Unless there is a reason for it, however, it is probably good practice to move the form forward and build the new section around the building. Plank window frames are best set into the wall as it is built. When this is done, the joint around the window frame is made weather-proof by nailing a two-inch cleat along the outside of the sides of the frame and on top of the plank lintel. The window frame is set right into the form and the earth rammed against it. This embeds the above cleats in the wall making the joint tight. If ramming against only one side of the window frame, cleats are nailed back of it making it serve as an end gate. The cleats will prevent the springing of the window frame. If ramming against the window frame from both sides at the same time, heavy braces can be fitted in the frame to resist the pressure from



the sides. In ramming above a window frame even when reinforced with a plank lintel, braces are used in the frame, as shown in Fig. 15.

It will probably take a crew of three inexperienced men between two and three weeks to build the earth walls and set up the window frames for this large poultry house.

#### Anchoring the Plate

The plate on top of the rammed earth wall is anchored by bolting in the same way as the sill of a frame building is anchored to the concrete foundation. The bolts should be embedded in the earth wall for a depth equal to the thickness of the wall and should extend above the wall to secure the plate. A flat anchor plate is embedded at the head of the bolt while the usual heavy washer is used on top of the plate. While it is easy to keep the top of the wall quite level, it will not be perfect, and a thin layer of fresh mortar is spread onto the top of the wall as the plate is leveled and screwed down. The two-by-twelve inch plate is not absolutely necessary on this wall but the reason for using it is to protect the top of the wall after the roof has given out and in case it should be neglected. A two-by-eight inch plate would be heavy enough to furnish the anchorage for the roof and would be satisfactory. After the plates are in place the roof framing for the building is the same as for a frame building.

#### Ramming the Gable End

Reference to Fig. 11 shows the gable end of the house to be rammed in notches. If the notches are rammed to the dimensions shown, the gable end will fit the pitch of the roof. The notches are made by ramming one step and then moving the cleats and the end gate in the form. It is not necessary to move the form itself each time. The reason for ramming the end in notches will be readily understood after a little experience with this material. As it is rammed, the earth tends to level out and it will be found impossible to ram the gable end, leaving the top with the slant desired. After the notches are finished, they are filled with stiff concrete. The frieze board, or trim, is placed on the outside which will make a form for the concrete. Another inch board is placed for the inside and the concrete filled in. If the gable end is built slightly higher than the bottom of the rafters the end rafter may be set in place just at the inside edge of the end wall and it will then serve as a part of the inside form for filling in the concrete. The two-by-two inch lookouts are then notched into the frieze board and the first rafter and extending to the second rafter to which it butts and is nailed. If a two-by-six inch barge rafter is used, the lookouts should be two-by-four inch and notched to two inches at the rafters.

The author is very much in favor of ramming the gable ends of the earth poultry house rather than to build them up of lumber. We have used both methods. The work is not so tedious as it might seem. If built of lumber, this part of the building will fail or give out long before the earth wall. It will have to be repaired and painted and we think the building is less attractive. Of course, the frame wall would not be nearly as warm as the earth wall and would collect more frost, but with the straw loft this factor would not be so important. The frost and moisture would help to rot this siding in the gable ends, however.



tain enough sand to resist the weathering action should have a protective covering. A heavy clay soil is not fit to use for rammed earth, and neither paint nor stucco will stay on it. (See Exp. Sta. Bul. 298.) A rammed earth wall made from a soil that seems to be favorable for adobe will not stand satisfactorily with any kind of covering. Up to the present time three different protective coverings have been used. Cement stucco is one of these. The walls should not be stuccoed for three to six months after they are finished. A lean stucco is better than a rich stucco. A stucco made from one part of Portland cement, four parts of good well-graded sand, one-fourth part of commercial mortar mix is best. For the first coat the sand should be screened through a coarse sand screen. For the second coat a fine sand screen of 12 mesh to the inch is better. The first, or scratch, coat of one-fourth to three-eighths inch is roughly applied and nailed to the wall while it is fresh. The nails should be driven at random and about 12 inches apart. If the wall is not too hard, 16 d. nails can be used; otherwise, 10 d. nails are advised. The nailing should follow as soon as possible and should not be delayed more than 15 minutes at the most. This coat should be roughened by scratching lightly as is done by stucco men. Any time from three days to six months later, the second coat should be put on. A third or finish coat of any of the many kinds can be used, if desired, but for service the two coats will be sufficient for farm buildings. The second coat should be troweled smooth and after it begins to set-up, an attractive sand finish can be given it with a carpet float. A good stucco man will put both coats of stucco on this house in eight hours.

Dagga plaster covered with two coats of paint makes a good covering for an earth wall. It is tedious to put on but is different. It can also be put on by the amateur plasterer better than stucco. Dagga plaster is a mixture of sand, clay, and water, so it costs nothing. It is made by mixing two parts of sand and one part of sandy clay with water until like mortar. A trial can be made of it and if it checks upon drying, the proportion of sand should be increased. Two coats of dagga plaster should be applied like stucco and after 20 days of drying weather it should be painted. The first coat should be a priming coat of linseed oil, or a sizing coat of ordinary cheap glue dissolved in hot water after soaking over night, at the rate of one pound of glue to the gallon. After this sizing coat, the outside house paint is applied the same as for lumber.

Ordinary house paint has been used for painting rammed earth walls directly on the earth surface. In all cases it has not been satisfactory. Up to the present time paint has been satisfactory on walls in which the dirt used does not contain more than 15 per cent clay. Paint has one advantage in that it does not hide the identity of the material as does stucco. When walls are painted, a priming coat of linseed oil or glue sizing is used.

#### Inside Finishing

Reference to the plans shown in Figs. 10 and 11 will furnish instructions and directions for finishing the house on the inside. This house is not built in 20-foot sections, but is shown as a 40-foot unit having only one large shutter ventilator. The reason for this is to make the construction of the earth wall simpler and stronger. The longer house would make each compartment of the roosting alcove 10 feet instead of eight.

Birds have a tendency to pick at earth walls and especially so, if they are in need of grit. They will not actually damage the walls but they will mar it slightly if there is a possible chance at a joint or sharp corner. Inasmuch as these walls are expected to last 100 years or more, it is advisable to plaster a strip of the wall for 24 inches above the foundation and also at the back and ends of the roosting alcove. The regular stucco mixture given above should be used. A single coat is sufficient and it should be nailed with the smaller 10 d. nails as it is applied.

### The Portable Chick Brooder and Colony House

The plan for a portable brooder and colony house calls for a building that is 10 feet wide by 12 feet deep—front to back. The house faces the south with two large windows in the south and a door on the side that is most convenient for its location when in use as a brooder house. This house has a capacity of 250 to 300 chicks and a 52-inch hover. The building is not elaborate at all. It is designed for low side walls and so the lumber will cut to advantage. The bill of material shown on the plan (See Fig. 17) is figured quite closely and no allowance is made for staging lumber. The floor is the most important part of a brooder house because this is where the chicks are. It is almost necessary to have the

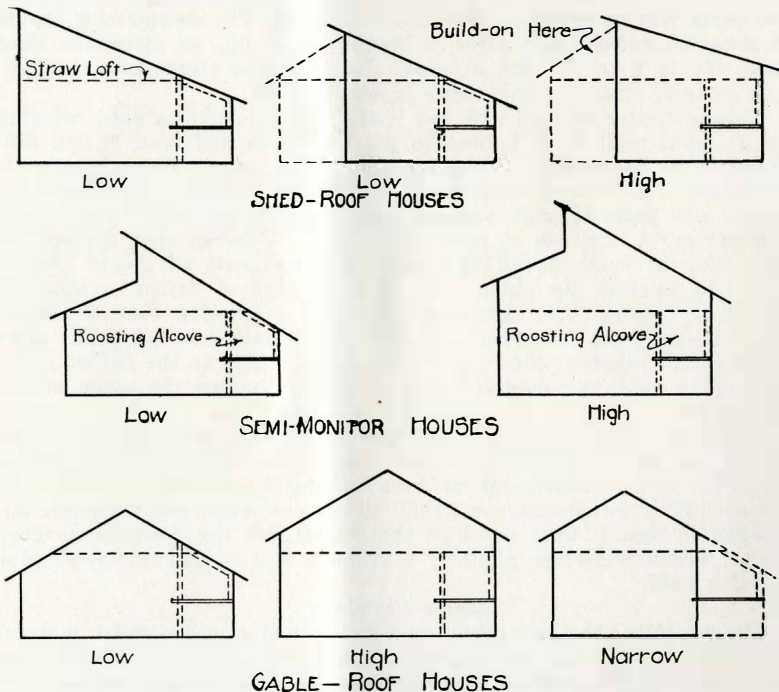


Fig. 18—SUGGESTIONS FOR REMODELING DIFFERENT TYPES OF OLD POULTRY HOUSES

The dotted lines indicate the changes that are made in remodeling the old house. The solid lines indicate the house as it was originally.

double floor and paper between as shown. The single strip of prepared roofing around the lower part of the house is for the purpose of insuring this part of the wall against draughts. Dropsiding for this building should be selected with care. If it contains too much moisture when the house is built it will shrink as it dries out. If the siding is kept well painted it will protect the lumber from swelling and shrinking and insure a warmer wall. The comparatively long eave projection on the south is for the purpose of shading the windows on hot summer days when the building has been moved to the stubble field for a colony house. The small ventilating doors at the back are also for use in summer and should be kept tightly closed for the brooder house. Additional ventilation for the brooder house should be had by adjusting the lower sash of the front windows. The purpose of having the poultry wire over the windows is to provide their adjustment without letting any of the chicks get away. There is a slight advantage in building the house with the longer dimension north and south. A narrow building is, of course, a cold building and with the long or broad side to the north in this region, the building is slightly colder than with the broad side to the west. In moving this building after it has settled solidly, if the runners are loosened with a long bar before the team or tractor makes the pull, it will save it considerably.

### **Some Suggestions For Remodeling Old Poultry Houses**

The proper width, the straw loft, the roosting alcove, and the shutter ventilators are the desirable features. The shutter ventilators are not shown here but they should be installed exactly as shown in the South Dakota poultry house plans. The windows should be installed like those in the South Dakota house. The settled straw should be approximately 12 inches thick.

A study of the sketches in Fig. 18 should suggest a way to remodel any ordinary old poultry house. Three common types of houses are shown: the shed-roof house, the semi-monitor house, and the gable roof house. Different widths and heights of houses are shown and the dotted lines indicate the changes that might be made in them.

#### **Remodeling the Low Wide Shed Roof House**

In the low, wide, shed-roof type, shown at the upper left, a roosting alcove can be installed on the north side, the straw loft can be put in overhead and shutter ventilators installed in the south and in the ends of the house similar to the South Dakota poultry house plan. In putting in the straw loft it may be necessary to lower the windows in the side wall of the old house. If the roof is too low to allow for a straw loft, celotex or a similar wood substitute, or shiplap might be used for ceiling over head.

#### **To Remodel the Low Narrow Shed Roof House**

If the old house is a low and narrow shed-roof house an addition may be built onto the south side, making a combination roof house of it. If the old house should be 12 feet wide it would be advisable to add six feet onto the width, making the total width 18 feet. In the wider house the straw loft might be raised three to six inches higher so the windows could be raised to throw light a little farther back. The roosting alcove and shutter ventilators should be installed.



**Fig. 19—A REMODELED POULTRY HOUSE**

This house was originally a low and narrow shed roof house and was remodeled according to the top center sketch in Fig. 18.

#### **To Remodel the High Narrow Shed Roof House**

The high, narrow shed roof house should be remodeled in the same way as the one above except the straw loft will extend straight across the house and over the roost as well. The shutter ventilators and roosting alcove should be installed.

#### **To Remodel the Low Semi-Monitor Roof House**

In remodeling the low semi-monitor roof house the roosting alcove and straw loft would go in as shown in the figure. The straw loft will cut off the light from the windows in the notch of the roof. They will be useless for lighting but do no harm if left. If a shutter ventilator is set in the frame in place of the two end sash, this will provide for the circulation of air over the straw loft in place of the ones in the gable end.

#### **To Remodel the High Semi-Monitor Roof House**

In remodeling the high semi-monitor roof house the only difference from the above would be that the straw loft would extend completely across the house overhead and, therefore, over the roosting alcove. (See Fig. 18) Since old houses of this type are apt to be wide, it is advisable to install the straw loft and windows six inches higher so the light can come in better. Shutter ventilators should be installed in the south and the roosting alcove in the back.

#### **To Remodel the Low Wide Gable House**

In this type of house the straw loft can extend only about one-half way across the ceiling. (See Fig. 18) The shutter ventilators should be installed in the south side wall and in the gable ends of the house, as shown in the South Dakota poultry house. The roosting alcove would be installed as shown.

#### **To Remodel the High Gable Roof House**

The straw loft should extend straight across in this type of house and over the roosting alcove. If the house is wide, the straw loft and windows should be raised and the layer of straw should be slightly thicker in this

wide and high loft. The roosting alcove and shutter ventilators should be installed in the usual way.

#### To Remodel the High Narrow Gable Roof House

The best way to remodel this type of old house is to build onto the north side, making the roosting alcove in the new part that is added. The old studding can then be doubled and left for posts at each eight feet and the windows can be left high in the south side for lighting. This house will become a combination roof house and the shutter ventilators and roosting alcove should be installed exactly as in the South Dakota poultry house.

#### The Shed Roof Is Inefficient

Our purpose in building plan service is to encourage the efficient use of money in making farm improvements. The use of the shed roof on farm buildings is an example of waste.

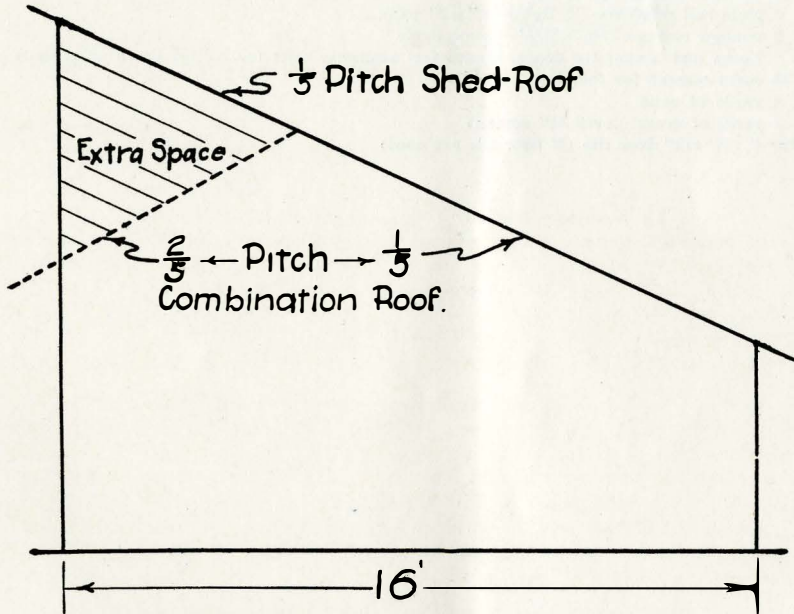


Fig. 20—A SHED ROOF AND COMBINATION ROOF COMPARED

The shed roof requires more lumber, has a longer rafter span, a shorter life with most roofing materials, and does not lend itself well to a straw loft.

**BILL OF MATERIAL FOR 32-FOOT HOUSE**

(Two 16-foot sections. No allowance for staging.)

- 550 bd. ft. 8" shiplap—16' long
- 17 pcs. 2"x4"—20 ft. long—rafters
- 42 pcs. 2"x4"—16 ft. long
- 29 pcs. 2"x4"—12 ft. long—studding and braces
- 680 bd. ft.—6" drop siding, best grade
- 800 bd. ft.—roof sheeting
- 14 pcs. 1"x4"—16 ft. long—casings, etc.
- 24 pcs. 1"x6"—16 ft. long—rip for slats in loft
- 6 squares—2-ply rubberoid roofing for wall lining
- 7 squares—slate surfaced asphalt shingles
- 2 pcs. 1"x12" barn boards, clear (for boxed rear cornice)
- Shutter ventilators may be made of goods box material, half-inch lumber or plaster lath
- 2 doors—30"x6'-3"
- 2 door casings for above—unless home made
- 4 window casings 31"x4'-7"
- 5 plain-rail windows—12 lights—9"x12" pane
- 2 window casings 27½"x31½"—home made
- Locks and hinges for doors, hinges for windows, bolts for bolting down sills; nails
- 36 sacks cement for foundation and floor
- 4 yards of sand
- 7 yards of gravel (over ¼" screen)
- 500 4"x12"x12" floor tile (If floor tile are used)

**Extension Service**

**South Dakota State College of Agriculture and Mechanic Arts**

**Brookings, South Dakota**

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