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COLLEGE OF AGRICULTURE

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THOMAS P. COOPER, Dean and Director

CIRCULAR NO. 266

HOME STORAGE STRUCTURES AND EQUIPMENT



Storage Mound for Vegetables

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VEGETABLE STORAGE TABLE

Vegetable	Temperature (Degrees Fahr.)	Humidity	Storage Period	Remarks
Beets	34-38	Medium	Nov. to Apr.	Dark place. Keep best in sand.
Brussels Sprouts	34-38	Medium	Nov. to Dec.	Dig. Plant close together in sand, sprouts unpicked.
Cabbage	34-38	Medium	Nov. to Apr.	Sound, hard heads only. Demands good ventilation. Ball head stores best.
Carrots	34-38	Medium	Nov. to Apr.	Dark place. Keep best in sand.
Celery	34-38	Medium	Nov. to Feb.	Difficult; dig with roots, stand upright in moist sand. Darken 3 weeks before use.
Onions	34-38	Dry	Sept. to Apr.	Shallow crates or on slat shelves. Free ventilation. Dry before storing.
Potatoes	34-38	Medium	Nov. to Apr.	Dark. Pile in bulk. Good ventilation.
Turnips	34-38	Medium	Nov. to Apr.	Pile in bulk. Avoid bruising.
Pumpkins and Squash	50-55	Dry	Nov. to Apr.	Avoid bruising.
Sweetpotatoes	50-55	Dry	Nov. to Apr.	Cure at 70° for 3 weeks before storing. Discard all bruised.

CIRCULAR NO. 266

Home Storage Structures and Equipment

By HOWARD MATSON

REQUIREMENTS FOR FRUIT AND VEGETABLE STORAGE*

The successful storage of fruit and vegetables requires the maintenance of proper temperature, humidity and ventilation. (See vegetable storage table.) Vegetables fall into two classes, "warm" and "cool". For the former, comprising squashes, cushaws and sweetpotatoes, a temperature of 50 degrees is needed. Even tho the best possible storage construction is used, some means for heating should be provided. For the "cool" vegetables, turnips, beets, carrots, cabbage and potatoes, the best temperature is between 34 and 38 degrees. The types of storage illustrated assure a proper temperature, in any winter weather to which Kentucky is subject.

The two classes of vegetables differ also in their humidity requirements. The storage for the "warm" vegetables must be dry, whereas that for the "cool" vegetables should be moist. Generally, the soil surrounding the storage place supplies sufficient moisture, but if it is a basement or cellar, without earth floor, it is advisable to sprinkle the floor occasionally.

The storage place for all vegetables should be well ventilated. While this is not so important for the "cool" vegetables, except during the first month or 6 weeks of storage, it is imperative for the "warm" vegetables because "sweating" may cause them to rot. "Sweating" may be prevented by combining proper heating and ventilation.

Fruits require a temperature and humidity similar to that for the "cool" vegetables, except that ventilation is more essential. Fruits absorb odors easily and should not be stored near

*This section was prepared by the Department of Horticulture.

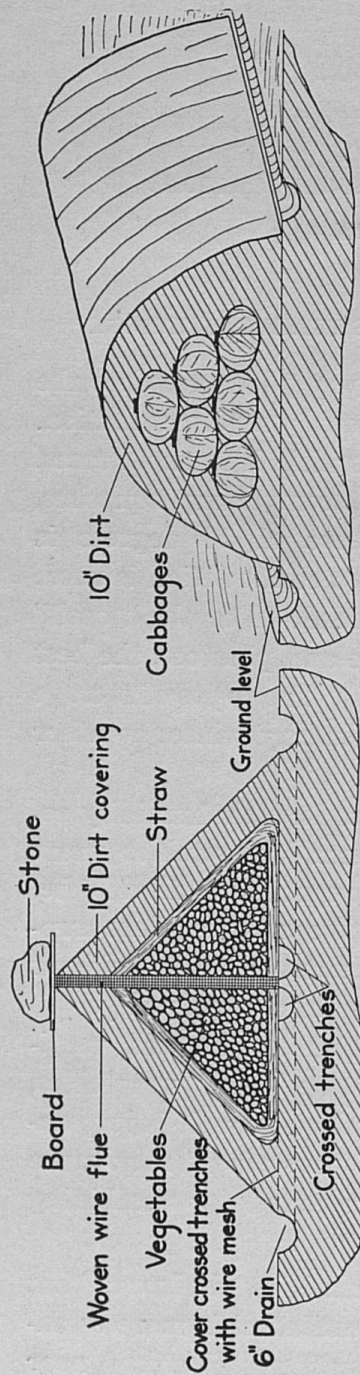


FIG. 1 VEGETABLE STORAGE MOUND (Cross-section)

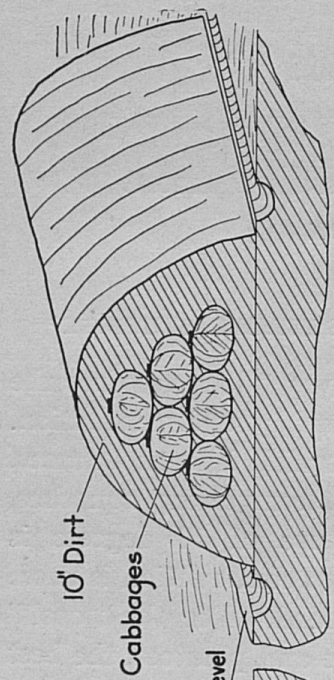


FIG. 2 CABBAGE STORAGE-LONG BANKS (Cross-section)

FRUIT AND VEGETABLE STORAGE IN MOUNDS AND BANKS
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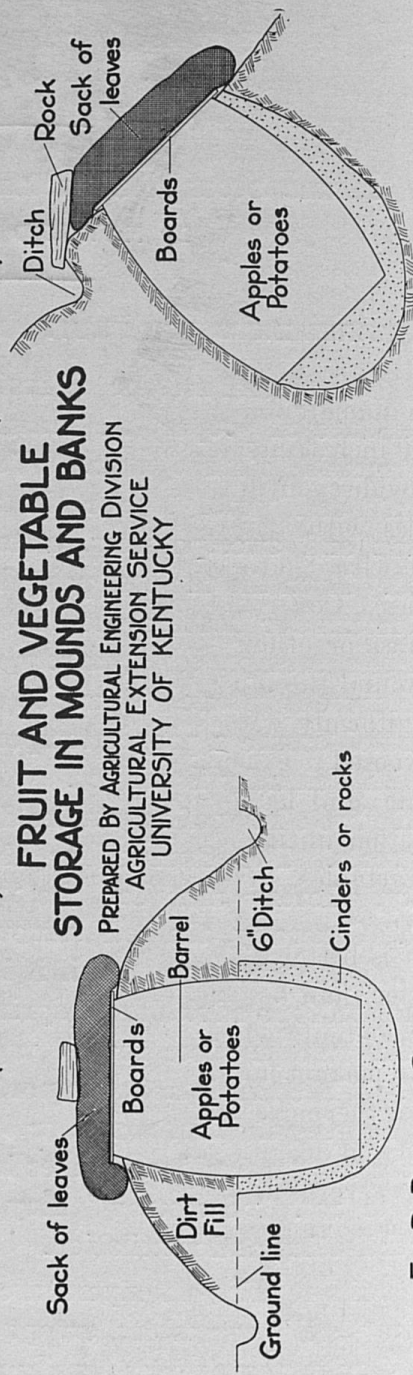


FIG. 3 BARREL STORAGE-MOUND (Cross-section)

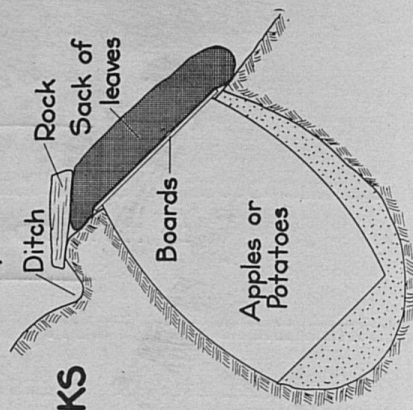


FIG. 4 BARREL STORAGE-BANK (Cross-section)

turnips, cabbage, or onions. Good ventilation and clean conditions are necessary for the retention of quality. Blueprint plans of a well-insulated above-ground apple storage house may be obtained from the Agricultural Engineering Division of the College of Agriculture.

MOUND, BANK, AND BARRELL STORAGE

Mound Storage. This (Fig. 1) is the simplest and least expensive method of storing vegetables where no permanent facilities are available. Level off a well-drained place 4 to 6 feet in diameter in the garden or other suitable location; dig two small 6-inch trenches in the bed, crossing each other like an X, to provide ventilation and emergency drainage; cover these trenches with stiff woven wire or boards and make a flue of woven wire leading straight up from the intersection of the trenches. Cover the earth floor with 4 or 5 inches of straw, hay, crabgrass or other litter; place the vegetables in a cone-shaped pile around the flue; cover with 4 or 5 inches of litter, and cover this uniformly with 8 to 10 inches of soil, leaving a little of the flue exposed. Cover the end of the flue with a board to keep out the rain, and leave the ends of the trenches and flue open for ventilation until necessary to close them to prevent freezing of the vegetables. Ditch around the mound to carry off surface water.

It is better to make several small mounds, 4 ft. to 6 ft. in diameter than one large mound, because it is best to remove the entire contents when the mound is opened. It is almost impossible to make a mound water-tight after it has once been opened and, furthermore, when the pile is too large, the vegetables tend to heat and decay. In the small mounds it is a great convenience to have several kinds of vegetables in the same mound, separated by litter, so that a variety of products may be obtained with little trouble. Potatoes, beets, carrots, turnips, salsify and parsnips keep well under these conditions. Apples may also be kept in this way, but absorb a decided earthy flavor.

Long Banks. Heads of late cabbage may be stored in conical mounds or in a long pile as shown in Fig. 2. By plowing a

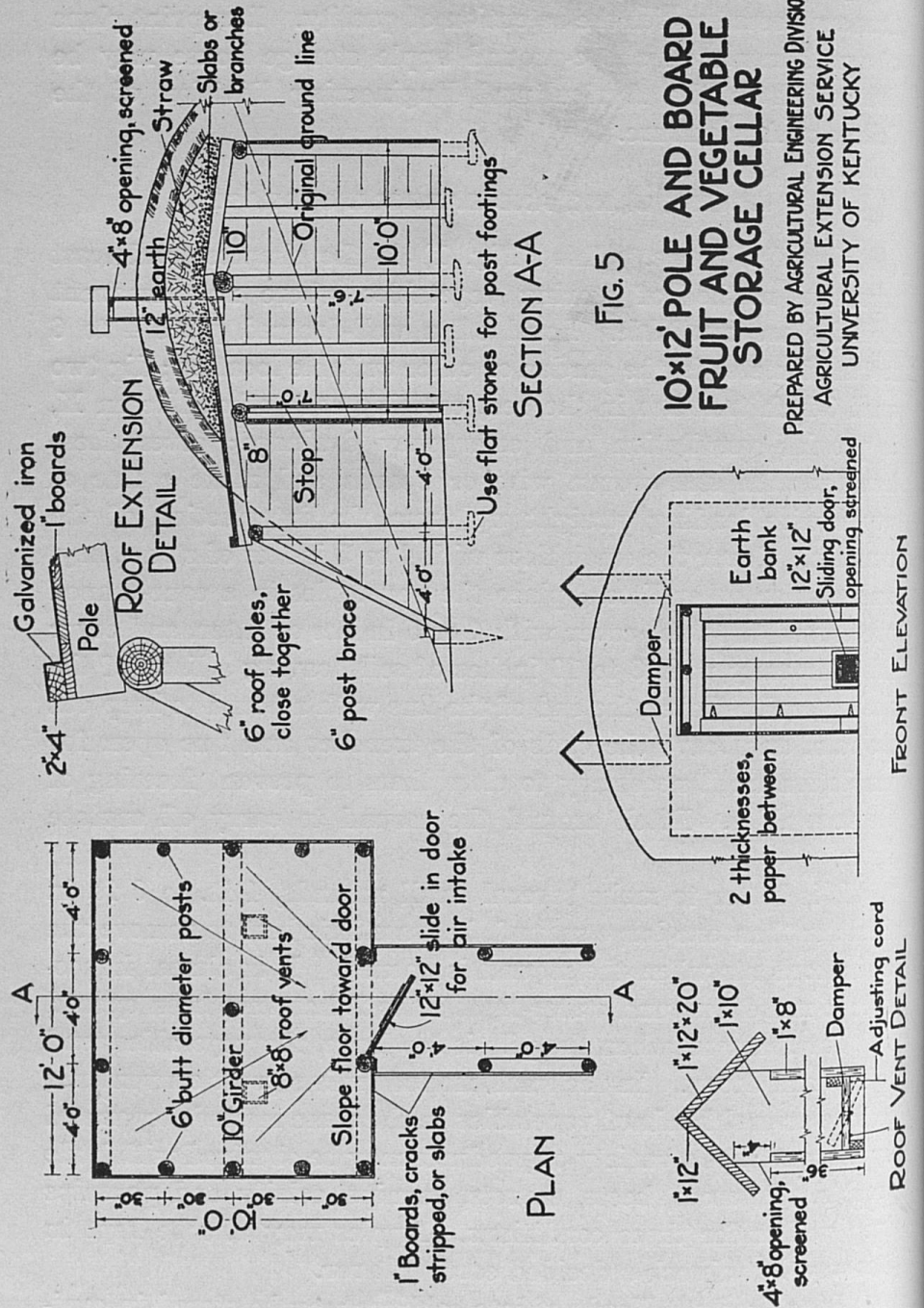


FIG. 5
**10'x12' POLE AND BOARD
 FRUIT AND VEGETABLE
 STORAGE CELLAR**

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furrow on each side of the pile drainage may be provided for surface water. Earth is to be banked over the cabbage to shed water and prevent freezing. The cabbage roots should be cut off so that they will not become exposed and start a rot which might spread to the head.

Barrel Storage. Apples or potatoes and other vegetables may be stored in barrels as in Figs. 3 and 4. In storing apples, select sound fruit which is ripe but not mellow; keep it continuously cool and pack it into the barrel with extreme care. Early on a dry, cool morning dig a pit in a bank or well-drained level site and place the barrel as shown, covering with boards and a sack of leaves or litter. This makes it easy to remove the contents of the barrel as desired. The barrel also may be covered with earth. A bed of cinders or crushed stone beneath the barrel improves drainage. A barrel may also be laid on its side on a bed of litter in a well-drained place and covered with litter and soil. Under any of these conditions surface water should be carried away by a ditch.

STORAGE CELLARS

Pole and Board Cellar. A very satisfactory and economical vegetable storage cellar, somewhat temporary in character but suited to emergency use, may be constructed of poles and rough boards or mill slabs.

Size. The cellar illustrated in Fig. 5 is 10 ft. x 12 ft., which is large enough to store sufficient canned goods and vegetables for the average farm family, and small enough to be well adapted to this method of construction.

Location. The first step in the construction of a storage cellar is the selection of a suitable location. Other things being equal, a cellar located in a bank or hillside is more convenient and easy to build than one in level ground, since it is possible to have the entrance at ground level, providing surface drainage from the floor of the cellar and eliminating the necessity for steps. It is desirable to have the cellar close to the house and this may be the deciding factor. If possible the entrance should

be in a shady place not exposed to the direct force of the prevailing winds.

Ventilation. The outlet vents should have a total cross-sectional area of approximately 1 square inch for each square foot of floor space. Since this cellar has an area of 120 sq. ft., it is necessary to use two 8-in. by 8-in. roof vents to assure sufficient air circulation to make it possible to regulate the temperature and humidity in the cellar. During warm days and cold nights of autumn the ventilating inlet and outlets should be opened at night to allow the cool air to enter and the warm air to escape. In the morning, when the cellar is filled with cold air, the openings should be closed. In winter, when there is danger of the cellar temperature becoming too low, the process should be reversed and the warm air of daytime allowed to enter, thereby raising the temperature. On warm, wet days in winter, the vents should be kept closed.

BILL OF MATERIAL For 10 ft. x 12 ft. Pole and Board Storage Cellar

Amount	Size	Article	Use
70 bd. ft.	Length 14'	1" boards	Door and ventilators
90 bd. ft.	Length 12'	1" boards	Sides of passageway
90 bd. ft.	Length 12'	1" boards	Rear wall
150 bd. ft.	Length 10'	1" boards	End walls
60 bd. ft.	Length 8'	1" boards	Front walls
20 bd. ft.	Length 8'	1" boards	Roof of passageway
40 bd. ft.	2" x 6" x 8'	1" boards	Door casing
17 pcs.	6" x 8'	Poles	Walls and columns
2 pcs.	8" x 12'	Poles	Plates
1 pcs.	10" x 12'	Poles	Girder
3 pcs.	6" x 10'	Poles	Roof Extension
36 pcs.	6" x 6'	Poles	Roof poles
20 sq. ft.	No. 26 ga.	flat galv. iron	Roof of passageway
20'	1/2" x 2"	Strip	Door stop strip
500 sq. in.	1/4"	Hardware cloth	Door, ventilators and drain
24 sq. ft.		Building paper	Door
1 1/2 pr.	6"	Galv. T hinges	Door
1/4 lb.	4d	Common nails	Framing
1/2 lb.	6d	Common nails	Framing
15 lbs.	10d	Common nails	Framing
2 lbs.	20d	Common nails	Framing
1 lb.		Galv. roofing nails	Passageway roof
12 ft.		Wire or cord	Ventilator control
1		Door lock or latch set	
15		Flat stones for post footings	
		Straw and brush	

CONSTRUCTION PROCEDURE

Floor and Walls. Make the excavation, sloping the dirt floor toward the door. Set the stone footings for the posts at

such depths as brings the tops of the posts at the correct elevations, as shown in Section A-A, Fig. 5. Make each wall separately on the floor of the cellar and raise it into place, beginning with the rear wall and continuing with the end and front walls. After the two front wall sections are erected, build the walls for passage-way and set them up.

Roof Framing. Place the 8-in. plates and the 10-in. girder, and fasten on the roof poles, allowing space for the two outlet vents. The plates and girder should be hewed flat on the under side to provide a better bearing surface, and the roof poles notched to fit on them. Lay the rough board roof over the passageway and cover it with 26-gage flat galvanized iron, bending it up over a board at the lower end of the roof, as shown in Roof Extension Detail, Fig. 5, to turn rain water to one side of the passageway.

Outlet Vents. Build the outlet vents of 8-in. and 10-in. boards as illustrated in Roof Vent Detail, Fig. 5, being careful to cut the 8-in. boards short enough to leave a 4-in. opening on each side under the 12-in. boards which are put on to form the cover. These 4-in. openings must be screened to prevent the entrance of birds, rodents and insects. Fasten the damper in place at the lower end of the vent before the last 8-in. board is nailed, being sure that it turns with sufficient friction to keep it in position at any point from full opening to complete closure. Paint the vents and nail them in place between the roof poles.

Roof Covering. Lay branches across the poles to form a mat 6-in. to 8-in. thick when pressed down. Cover with plenty of straw to keep the earth covering from sifting thru, mounding the straw at the ridge to give additional slope. Pile dirt against the front wall of the cellar and against the sides of the passageway, and complete the mound with 12 inches of earth, well packed, on top of the straw. Seed the earth with grass seed to provide a sod cover to prevent washing and improve its appearance.

Door. Build the door of two layers of boards, with building paper between, and apply a stop strip all around the frame inside the door to reduce air leakage. Make a screened opening 12-in. square in the bottom of the door for an air inlet, with an

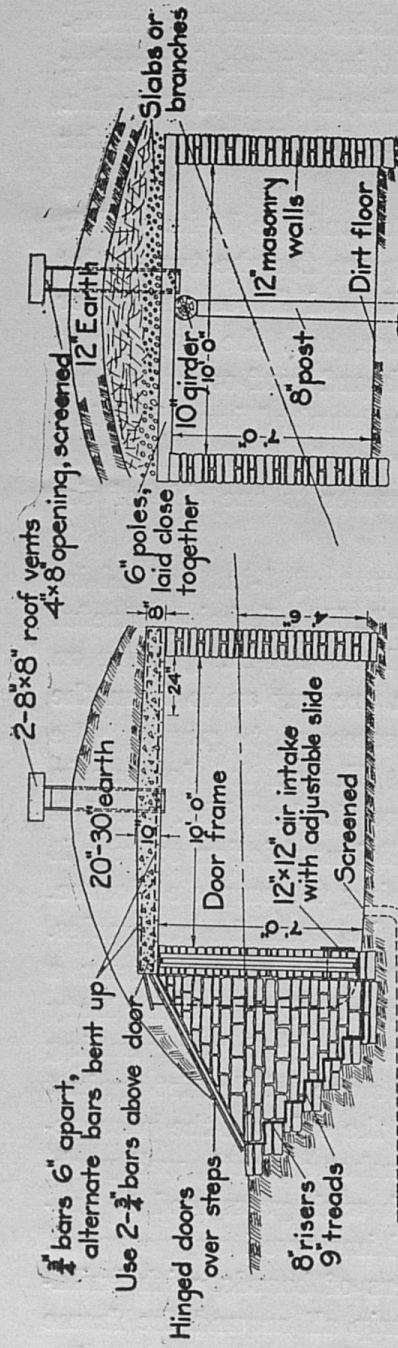


FIG. 6 CROSS-SECTION
Masonry construction - pole roof
Grade entrance, not shown

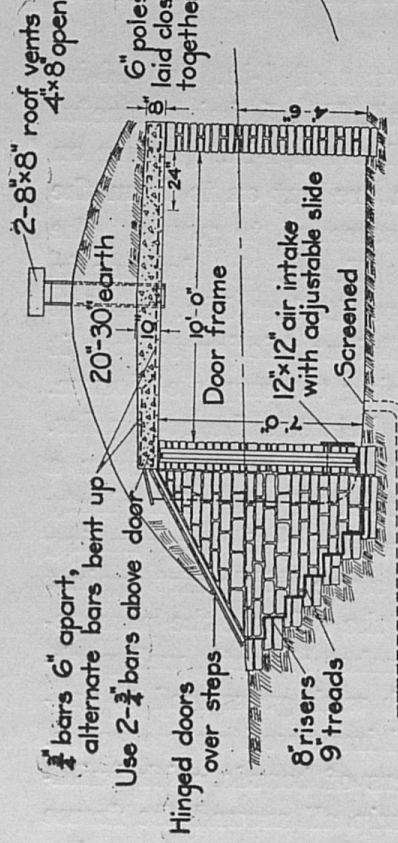


FIG. 7 CROSS-SECTION
Masonry construction - concrete roof
Floor below ground level

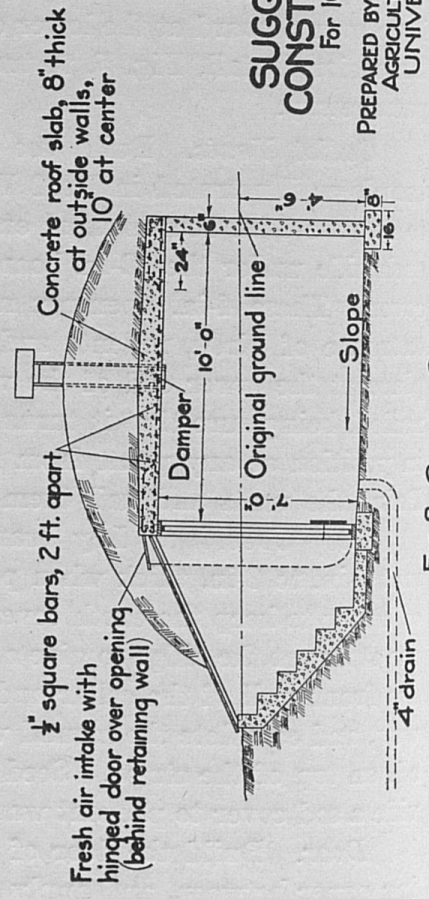


FIG. 8 CROSS-SECTION
Concrete cellar - floor below ground

**SUGGESTIVE OPTIONAL
CONSTRUCTION METHODS**
for 10x12' Storage Cellar

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adjustable slide for regulating the air circulation. At times it may be advisable to let the door stand open.

Masonry Cellar, Pole Roof. On many Kentucky farms lumber is scarce but stone is plentiful, and in these places the masonry-walled cellar illustrated in Fig. 6 may be used. The stones should be laid in 1:3 portland cement mortar, filling the joints thoroly to make the wall strong and water-tight. Poles may be used for roof rafters, supported at the center by a 10-in. girder as shown. The girder should rest on the stone walls at each end of the cellar and on an 8-in. post in the center. In laying the roof poles, care should be taken to allow room for the two roof vents. The roof covering may be finished with branches or slabs, straw, and earth placed as described for the pole and board cellar.

BILL OF MATERIAL For 10 ft. x 12 ft. Masonry Cellar, Pole Roof.

70 bd. ft. of 1" boards 14' long		Door and ventilators
20 bd. ft. of 1" boards 8' long		Roof of passageway
40 bd. ft. of 2"x6" boards, 8' long		Door casing
20—12'—6" butt diameter poles		Roof rafters
1—7'—8" butt diameter poles		Column
1—14'—10" butt diameter poles		Girder
20 sq. ft. of 26 ga. flat galv. iron		Roof of passageway
15 cu. yds. of stone		
30 sacks of cement—300 lbs. lime—3 cu. yds. sand		Mortar
20'	1/2"x2" Strip	Door stop strip
500 sq. in.	1/4" Hardware cloth	Door, ventilators and drain
24 sq. ft.	Building paper	Door
1 1/2 pr.	Galv. T hinges	Door
1/4 lb.	4d Common nails	Framing
1/2 lb.	6d Common nails	Framing
3 lbs.	10d Common nails	Framing
2 lbs.	20d Common nails	Framing
1 lb.	Galv. roofing nails	Passageway roof
12 ft.	Wire or cord	Ventilator control
1	Door or latch set	
	Straw and brush	

Masonry Cellar, Concrete Roof. Where poles are not readily available, or if permanent construction is desired, the masonry cellar may be built with a reinforced concrete slab roof, as shown in Fig. 7. The roof slab is 8 ins. thick at the sides and 10 ins. at the center, and is reinforced with 3/4 in. bars running from wall to wall, spaced 6 ins. apart and placed 1 1/2 ins. above the bottom of the concrete slab. Ends of bars are hooked to provide good anchorage. Alternate bars are bent up at a point 24 ins. from the inside of the cellar wall as shown in the draw-

ing. Temperature steel consisting of $\frac{1}{2}$ in. square bars running at right angles to the $\frac{3}{4}$ in. bars are spaced at 24 ins. intervals and laid directly on top of the main reinforcement members. Before pouring the concrete, set two wood frames in place to provide openings for the ventilator flues. In mixing the concrete do not add more than 5 gallons of water per sack of cement used, and proportion the sand and stone to give best workability.

Fig. 7 also illustrates the entrance construction for a cellar dug in level ground, and the provisions for an air inlet and a floor drain. The steps are protected from rain by hinged doors, and the double thickness door is used at the cellar entrance. The 12-in. square air intake, opening into the cellar at the floor line, should be built and set in place before the retaining wall for the steps is laid up. The air intake should have a hinged door at the top, and an adjustable slide at the opening into the cellar to regulate the intake area.

The floor drain may be 4" tile. Its opening must be covered with $\frac{1}{4}$ " hardware cloth to exclude rats, mice and snakes.

BILL OF MATERIAL For 10 ft x 12 ft. Masonry Cellar, Concrete Roof.

100 bd. ft. of 1" boards 14' long		Doors and ventilators
60 bd. ft. of 2"x6" boards 8' long		Door casing
15 cu. yds. stone		
24 sacks of cement		Roof
2 cu. yds. sand		Roof
3 cu. yds. of gravel or crushed stone		Roof
325' of $\frac{3}{4}$ " concrete reinforcing bar		
90' of $\frac{1}{2}$ " sq. reinforcing bar		
30 sacks of cement		Mortar
300 pounds of lime		Mortar
3 cu. yds. sand		Mortar
20' $\frac{1}{2}$ "x2" Strip		Door stop strip
500 sq. in. $\frac{1}{4}$ " Hardware cloth		Door, ventilators and drain
24 sq. ft. Building paper		Door
4 $\frac{1}{2}$ pr. 6" Galv. T hinges		Doors
$\frac{1}{4}$ lb. 4d Common nails		Framing
$\frac{1}{2}$ lb. 6d Common nails		Framing
5 lbs. 10d Common nails		Framing
5 lbs. 20d Common nails		Framing
12 ft. Wire or cord		Ventilator control
1 Door lock or latch set		

Fig. 8 shows a cross-section of a concrete storage cellar which is equally well adapted to level and hillside locations, and is here illustrated with the floor below ground level. In constructing this cellar the 8-in. by 16-in. footings and 6-in. walls should be poured first and allowed to cure for a week before the

top slab is poured. All concrete should be kept moist for at least 10 days after placing in order that it may cure properly and reach its maximum strength, instead of merely drying out. The suggestions for ventilation and entrance are the same as for the masonry cellar, except the concrete steps. The roof vents could be made permanent by using two 8" sewer tile in place of the wooden shafts illustrated, or one 12-in. metal ventilator might be placed in the center of the cellar.

BILL OF MATERIAL For 10 ft. x 12 ft. Concrete Storage Cellar.

100 bd. ft. of 1" boards 14' long	Doors and ventilators
40 bd. ft. of 2"x6" boards 8' long	Door casing
70 sacks of cement	
6½ cubic yards of sand	
11 cu. yds. of gravel or crushed rock	
90' of ½" square reinforcing bar	
325' of ¾" concrete reinforcing bar	
20' ½"x2" Strip	Door stop strip
500 sq. in. ¼" Hardware cloth	Door ventilator and drain
24 sq. ft. Building paper	Door
4½ prs. 6" Galvanized T hinges	Doors
¼ lb. of 4d Common nails	
½ lb. of 6d Common nails	
5 lbs. of 10d Common nails	
5 lbs. of 20d Common nails	
12 ft. Wire or cord	Ventilator control
1 Door lock or latch set	

BASEMENT STORAGE ROOM

Suggestions are shown in Fig. 9 for the construction of a 10 ft. x 12 ft. storage room in the basement of a house. The room may be built in a corner so that the basement walls serve as two of the sides. At least one window, preferably two, should be included. The partition walls may be built of two layers of tight sheathing, with building paper between, nailed to each side of 2 in. by 4 in. studding. The door should be of double thickness, with paper between.

Whether the basement floor be concrete or dirt, a slat floor should be used to support barrels, boxes, etc., in order to permit a circulation of air beneath them. Wall shelves may be provided for canned goods and for crates and boxes.

Practical methods of providing air inlets and outlets are illustrated in Figs. 10 and 11. A wooden ventilating chute replacing one pane of a basement window serves as an effective air inlet if provided with a damper as shown. If there are two

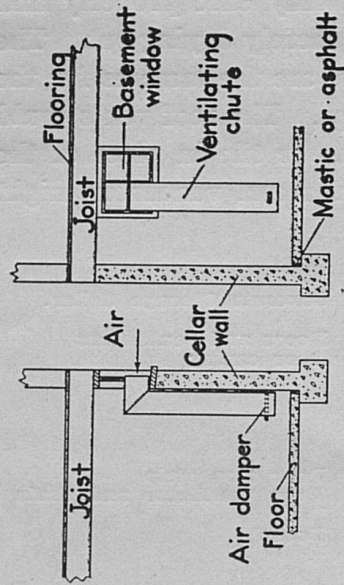


FIG. 10 AIR INLET DETAIL
for basement storage room

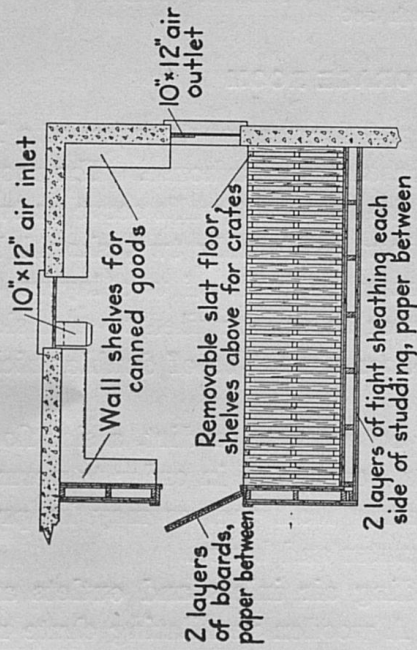


FIG. 9 PLAN
10x12' storage room in basement of house

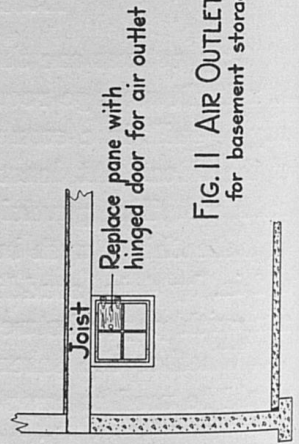


FIG. 11 AIR OUTLET DETAIL
for basement storage room

**SUGGESTIVE CONSTRUCTION DETAILS
FOR BASEMENT STORAGE ROOM**
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windows in the storage room, a hinged door may be used in place of an upper pane in the second window to serve as an air outlet, or it may be placed in the same sash with the inlet if necessary.

PRECAUTIONS AGAINST A WET CELLAR

Methods of preventing a wet cellar are illustrated in Figs. 12, 13, and 14. In excavating for a basement, a trench should be cut back into the earth walls far enough to permit the laying of a line of 4-in. drain tile all around the foundation footing, as shown in Figs. 12 and 13. If the basement floor is concrete it should be laid to slope toward a floor drain which may be connected to the tile line around the footing.

In order to keep water away from the foundation wall it is very important that the rain water from the roof be conducted away from the house. The downspout should be connected to a sewer-tile drain, with cemented joints, leading to a convenient outlet. Earth should also be piled up slightly around the house so that surface drainage will be away from it. If the foundation wall is made of stone, concrete block, tile, or other masonry units, they should be laid in 1:3 Portland cement mortar, and all joints should be thoroly filled. For a concrete foundation wall, not more than 5 gallons of mixing water should be added for each sack of cement used, and the sand and stone should be proportioned to give the best workability.

Difficulty is often experienced in making a water-tight joint between a concrete basement floor and the foundation wall. This can be avoided by using the construction method illustrated in Fig. 14. When the floor is being poured, wedge in 3 well-oiled thicknesses of beveled siding all around the inside of the foundation wall as shown. When the floor has hardened, remove the pieces of siding, taking out the center wedge first, and fill the space with hot tar. This prevents seepage of water from beneath the floor.

Inside treatment of a leaky basement usually is ineffective and is likely to be a waste of time, materials and money. To make a permanent repair, dig down outside the foundation wall



FIG. 14 JOINT DETAIL
Method for making water-tight joint

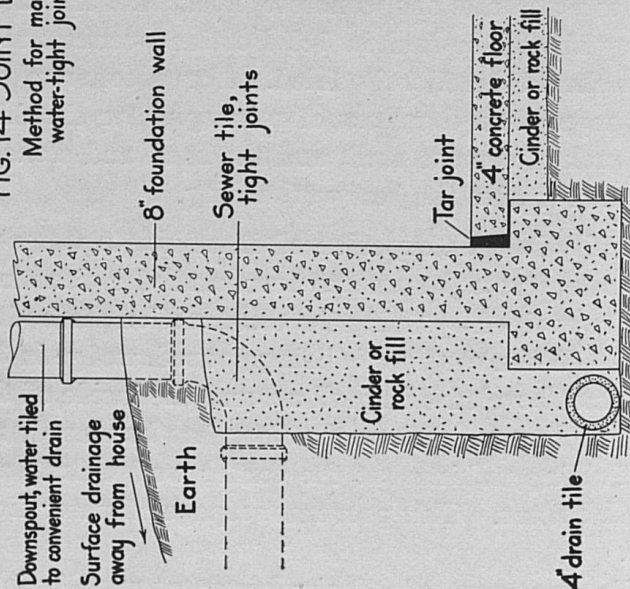


FIG. 13 CROSS-SECTION
Foundation wall and footing

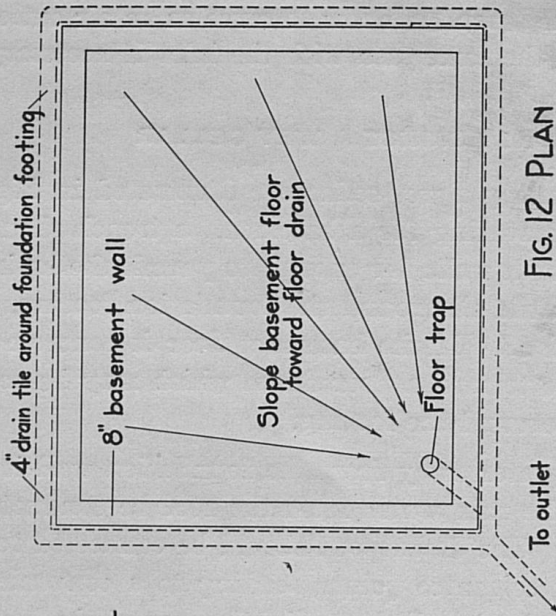


FIG. 12 PLAN

METHODS OF PREVENTING A WET CELLAR

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and lay a line of tile completely around the footing, connecting it to a suitable outlet. Clean the outside surface of the wall and give it a $\frac{1}{2}$ in. coating of cement plaster, then fill the excavation with cinders or crushed stone to within a foot of the surface of the ground, to permit water to seep quickly down to the tile. Complete the filling of the excavation with earth, piling it high enough against the foundation wall to throw surface water away from the house. Make certain that the downspouts from the roof are connected to tight tile lines leading to an outlet.

STORAGE EQUIPMENT

Bushel Crate. Bushel crates, like that shown in Fig. 15, are much more satisfactory as storage containers than barrels, boxes, and baskets, for free circulation of air around the fruit or vegetables.

BILL OF MATERIAL For Bushel Crate.

10—9/16"x2½"x17⅞"—A
8—9/16"x2½"x12⅞"—B
4—9/16"x2½"x11⅞"—C
3—9/16"x2½"x16"—D
1 lb. 4d box nails

Slat Floor. A slatted platform or false floor made of 1 in. by 3 in. strips nailed to 2 in. by 4 in. or pole stringers should be used on the floor in any type of storage cellar. Crates, boxes, barrels, etc., set on the platform will not rot from contact with the soil, and there will be a better circulation of air thruout the cellar.

Fruit-Jar Rack. A simple rack for the various sizes of fruit jars may be made from the sketch in Fig. 17. Diagonal

BILL OF MATERIAL For Fruit-Jar Rack.

2—1"x10"x12'-0"	Shelves
1—1"x10"x10'-0"	Ends
1—1"x 3"x12'-0"	Diagonal Braces
1—1"x 2"x12'-0"	Shelf Cleats

braces should be used in the back, and if the shelves are made longer than 4 feet, support should be provided in the middle. When used in a basement storage room, jar racks and vegetable

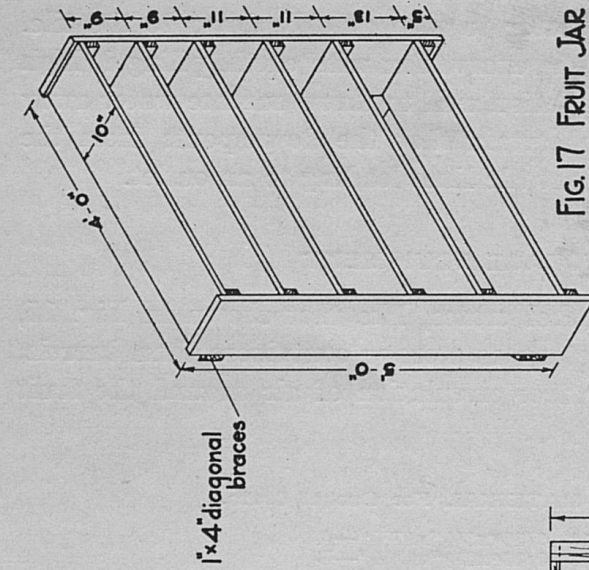


FIG. 17 FRUIT JAR RACK

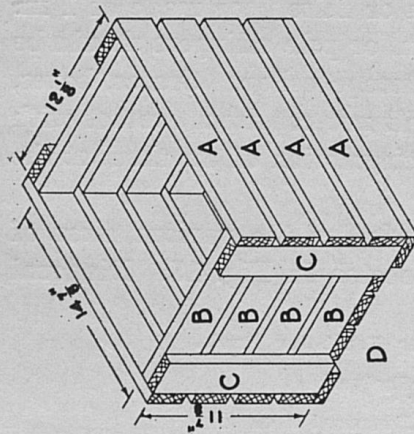


FIG. 15 BUSHEL CRATE

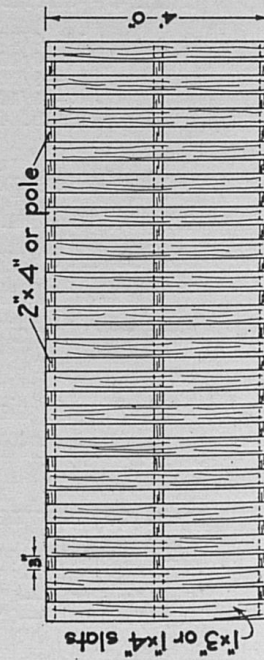


FIG. 16 REMOVABLE SLAT PLATFORM
For barrels, boxes, baskets, crates

FRUIT AND VEGETABLE STORAGE DEVICES

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shelves may be suspended from the first-floor joists if desired. Wider shelves of slatted construction may be used for the storage of crates and boxes, to permit a circulation of air thru and around them.

Requests for further information on specific problems pertaining to fruit and vegetable storage should be addressed to the Division of Agricultural Extension, Experiment Station, Lexington, Kentucky.

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Articles 11 and 12, which relate to the powers of the courts in the event of a state of emergency, are also contained in the Constitution. The provisions of these articles are also contained in the Constitution of the Republic of South Africa, 1996.

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