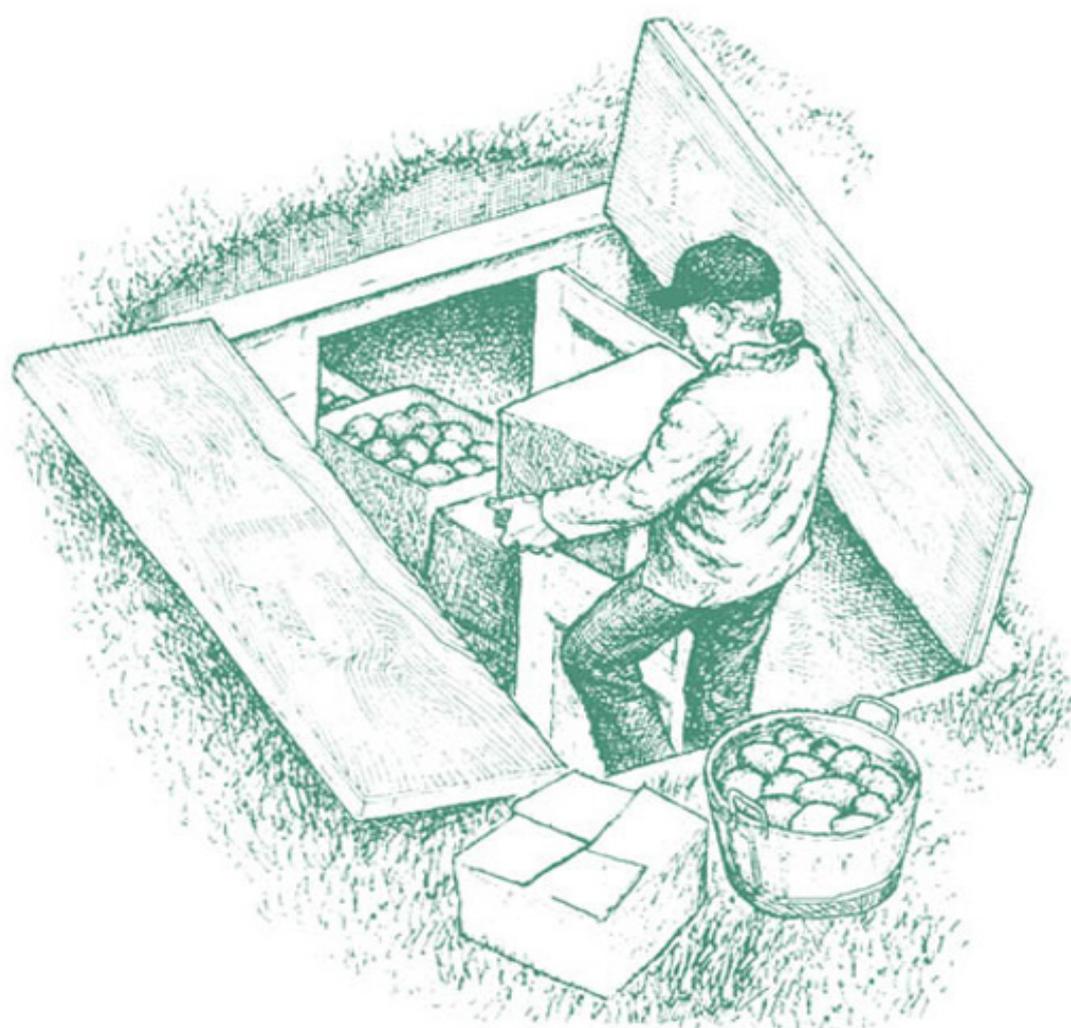


BUILD YOUR OWN UNDERGROUND ROOT CELLAR

PHYLLIS HOBSON



Build Your Own Underground Root Cellar

Phyllis Hobson

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Introduction

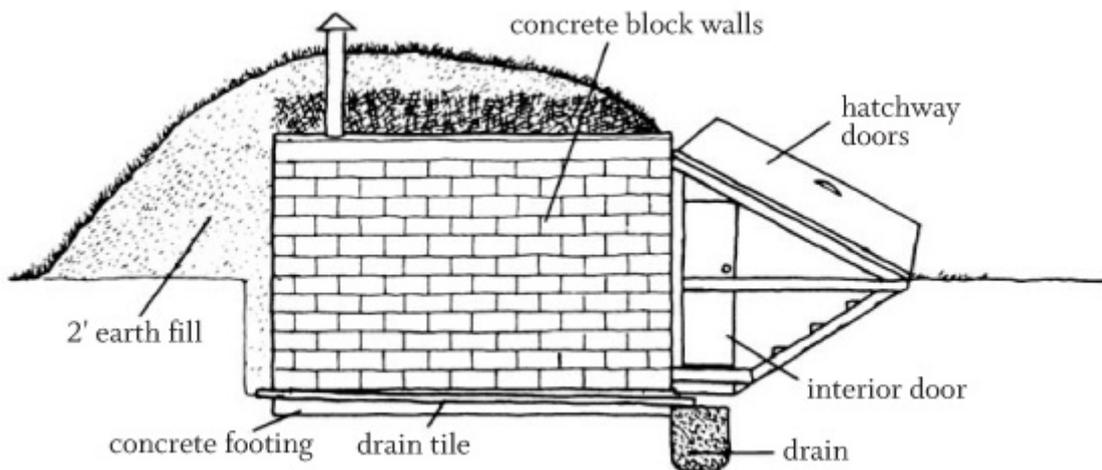
Having a root cellar in your backyard is like having your own private supermarket of fresh fruits and vegetables. Any time you need potatoes for dinner or an apple for a snack, just open the door and walk inside. Anything you need is right there on the shelves.

But a root cellar is more than a convenience. In addition to providing the security of having a year's supply of fruits and vegetables on hand, a root cellar offers sanctuary. In an emergency, it could shelter your family for a few hours, a few days, or even a few weeks, if necessary.

A well-built root cellar can be a good investment. It will save you money for years to come, yet if you build the cellar yourself, the cost of materials is less than you would spend in one winter buying food at supermarket prices.

A good root cellar should provide cool, above-freezing temperatures and good circulation of moderately humid air. The combination root cellar and storm shelter in this bulletin has these features plus several others that make it easy for one person — with no building experience — to build as a spare-time project.

The dirt floor takes advantage of the naturally cool, even temperature of the earth. It also cuts costs and provides needed humidity.



Here is a cutaway view of the completed root cellar.

The concrete block walls are durable and sturdy, with a middle core of air, which acts as an insulator. In extreme climates, the cores can be filled with loose insulation to keep temperatures more even. Concrete block walls are simple to work with. And you can lay a few blocks whenever you have a little time, then resume where you left off the next time.

The walls are topped by a wood frame roof made of 2 x lumber, which can be handled by 1 person. The roof is protected by sheathing, roll roofing, and plastic film, then covered with 2 feet of soil.

Entrance to the cellar is through an air lock created by a 4-foot-wide hatchway at the top of the stairway and another door at the bottom of the stairs. The doors and the entrance wall are insulated to protect the cellar interior.

The cellar is vented for good air circulation, and a drainage system protects the interior from water seepage.

So here it is. This is one root cellar you can afford. This is one you can do all by yourself. And you can build it in your spare time.

If you have a garden and want to store the produce for year-round use, you know you need a root cellar. If you have a family that needs the security of an assured food supply and a safe shelter in time of emergency, you know you should build one. All you have to do is start.

But first, let's decide where to put this 8-foot by 12-foot cellar.

The Right Location

The ideal location for a root cellar is on a hillside or slope facing away from prevailing winds. Even without a slope, choose the highest ground you have for the best drainage possible. Avoid any low-lying areas, or your cellar may fill up with water in the spring.

If possible, pick a spot convenient to both the kitchen and garden. Remember, from harvest season until early summer — during the worst weather of the year — you will probably be visiting it almost every day.

Stay away from large trees, if you can. Tree roots sometimes reach out an incredible distance, and they not only hamper digging, they can invade your cellar walls eventually.

Consider the type of soil. If it is rocky or hardpan clay, hand digging will be difficult, so you will need excavation equipment. If it is too sandy, the dirt walls will collapse as you dig, and you will have to dig the hole larger to allow for sloping walls. If you encounter either condition, it is probably best to look for another location.

You know your land better than anyone else, so look it over for any special problems, such as drifting snow or conflicting traffic patterns. If tractors, lawn mowers, or other vehicles must pass over that spot, choose another location or be prepared to reinforce the roof to avoid a cave-in.

Sometimes the best site for a root cellar is near the foundation wall of a house or garage. Not only is the location convenient, but these buildings usually are constructed where drainage is no problem, and they will protect the cellar entrance from snow drifts in winter, hot sun in summer, and high winds year-round.

Walk around your land until you find the location that's right for you. Then, it's time to gather up a few tools.

Tools

Many of the tools you will need are already in your garage or workshop. Some specialized tools, such as a heavy-duty wheelbarrow, can be rented. Here's what you will need and what you will need them for.

- *Pointed-ended, long-handled shovel* to dig the excavation and the footing trench and to move wet concrete and gravel.
- *Square-ended trench shovel* for squaring up the sides and bottom of the footing trench.
- *Garden hoe* to spread wet concrete in the footing trench and mix concrete and mortar.
- *Metal tape measure* at least 20 feet long.
- *Sturdy wheelbarrow*.
- *Masonry trowel* to apply mortar between blocks. The end of the wooden handle is useful to tap the blocks in place.
- *Mortarboard* to hold mortar as it is applied.
- *Jointer tool* to compact mortar in the joints.
- *Level*, 36 to 48 inches long, to check plumb and level of the wall as it is built.
- *Plumb bob* to lay out the footing trench.
- *Wooden float* to level off the top of the concrete footing.
- *Straight 1 x 6 board, measuring 8 feet*, marked every 8 inches to check the level of each course of blocks and the accuracy of the horizontal mortar joints. Sometimes called a story-board.
- *Pair of mason's line stretchers* to hold a line taut between corner blocks as a guide for each course.
- *Masonry chisel* to cut blocks.
- *Hammer* to pound chisel, stakes, and nails.

- *Crosscut saw* to cut lumber to fit.
- *Saber or keyhole saw* to cut the vent hole in the roof.
- *Carpenter's plane* to trim roof rafters.
- *Screwdriver* to attach hinges and door handles.
- *Wrench* to tighten nuts on top plate.
- *Caulking gun* to caulk around footing and air vent.
- *Applicator* (brush, roller, trowel, or 6-inch putty knife) to apply waterproofing to wall exterior.

Make Your Own Tools

You can save money by making your own tools from scraps. Here are some examples.

- Mortarboard. Cut a square about 12 inches by 12 inches of $\frac{1}{2}$ -inch or $\frac{3}{4}$ -inch plywood.
- Wooden float. Cut a piece of 1 x 6 lumber 12 inches to 14 inches long. Glue a piece of 2 x 2 lumber to the top for a handle or screw on a purchased metal handle.
- Line stretcher. A metal clip or small corner brace can be used to hold the line taut between end and concrete blocks.
- Jointer tool. Make a tool of $\frac{1}{2}$ -inch rod by bending one end up for a handle. Or improvise with a wooden dowel.

Materials

Here are the materials you will need to build a low-cost, 8-foot by 12-foot by 8-foot concrete block root cellar. The list is divided into construction steps, so you can buy the materials as you go along, and budget the costs over time. You may find, however, that you can save on delivery costs by buying all of one type of material at the same time.

For Step 2

16 stakes to mark off footing: 2" × 2" × 3'

8 boards: 1" × 3" × 4'6"

mason's line or stout string: 150'

For Step 4

30 stakes: 1" × 2" × 12"

ready-mix concrete: 1 cubic yd. (or 6 bags of cement, 12 cubic ft.

of sand, and 24 cubic ft. of $\frac{3}{4}$ " gravel)

For Step 5

24 hollow core concrete blocks: 8" × 8" × 16"

4 hollow core corner blocks: 8" × 8" × 16"

1 strip of $\frac{3}{8}$ " plywood: 2" × 8"

masonry cement: 14 bags (for Step 8 as well)

mortar sand: 11 cubic yd. (for Step 8 as well)

For Step 6

perforated plastic drain tile: 40'

90° elbows for drain tile: 2

1" to 1½" gravel or stone: 2 cubic yd.

For Step 7

2 boards: 2" × 8" × 69"

2 boards: 2" × 8" × 32"

scrap lumber for bracing and props

For Step 8

262 hollow core concrete blocks: 8" × 8" × 16"

56 hollow core corner blocks: 8" × 8" × 16"

6 lintel blocks: 8" × 8" × 8"

reinforcing bars

2 boards: 1" × 2" × 69"

concrete mix: 1 cubic yd. (for Step 10 as well)

For Step 9

loose insulation: 50 cubic ft.

¼" mesh hardware cloth: 20 sq. ft.

14 anchor bolts: ⅝" × 10"

For Step 10

Stairway wall: use pressure-treated lumber

2 boards: 2" × 4" × 96"

2 boards: 2" × 4" × 30½"

2 boards: 2" × 4" × 39"

2 boards: 2" × 4" × 98¾"

2 boards: 2" × 4" × 70½"

2 boards: 2" × 4" × 86¾"

4 sheets ½" exterior plywood: 4' × 8'

wood preservative (copper naphthenate): 2 gal.

Stairway: use pressure-treated lumber

2 boards: 2" × 12" × 74"

10 boards: 2" × 4" × 12"

5 boards: 2" × 12" × 36"

4 pieces scrap 2 × 4s: about 2' long

Interior door

2 sheets ½" plywood: 4' × 8'

2 × 4 boards: 20' (can be pieced together)

insulation (foam, batt, or loose)

Hatchway doors

2 sheets ½" exterior plywood: 4' × 8'

2 × 4 boards: 40' (can be pieced together)

insulation (foam, batt, or loose)

1 board: 1" × 6" × 8'

For Step 11

2 boards for the top plate: 2" × 8" × 12'

2 boards for the top plate: 2" × 8" × 6'9"

2 boards for headers: 2" × 10" × 11'9"

2 boards for end rafters: 2" × 12" × 8'

11 boards for rafters: 2" × 12" × 7'9"

3 sheets of ¾" or 1" exterior plywood: 4' × 8'

1 roll tar paper roofing: 4' × 80'

roofing nails

For Step 12

¾" plywood: 7½" × 7½"

2 boards: 1" × 2" × 7½"

¾" leaf hinge

hook and eye

self-stick weatherstrip foam: 30"

plastic screen: 8" × 8"

4" solid plastic sewer pipe: 4'

plastic flange with inner diameter of 4"

1 galvanized hood to fit sewer pipe

For Step 13

roofing tar: 4 gal.

12 bales straw

6-mil plastic sheeting: 100-foot roll

waterproof plastic tape: 1 roll

foundation coating

cement plaster

caulking compound

For Step 14

Interior door

2 boards: 2" × 4" × 6'

2 boards: 2" × 4" × 3'

6" T-hinges: 3

1 board: 1" × 2" × 69"

2 pieces of scrap lumber: 2" × 4" × 8"

door handle: 1

hook and eye

Hatchway doors

3 boards: 2" × 6" × 102¼"

2 boards: 2" × 6" × 39"

4 boards: 2" × 4" × 96"

6" T-hinges: 6

door handles: 2

All lumber should be treated with a wood preservative, such as copper naphthenate sold under various brand names. Wood should be soaked in the liquid, if possible, or generously painted with the solution, according to the manufacturer's directions. Be prepared to store all materials under cover to keep them as dry as possible before and during construction.

Concrete blocks and lumber should be stacked on planks off the ground and covered with tarps or plastic sheeting. Keep bags of cement well protected in a dry place, especially after the bag has been opened. Even the sand and gravel should be kept as dry as possible. Wet sand will add a great deal of water to the concrete mix and possibly weaken it.

While you are waiting for the materials to be delivered, you can get out your tape measure and shovel. You are ready to start digging.

Cutting Costs

The materials needed to build this concrete block root cellar cost about \$1,200, a bargain if you amortize the cost over the 20 or more years the cellar could be used.

But if you are looking for ways to trim the cost, it can be done by making the most of any materials you may have or can buy cheaply in your area. Remember, in a root cellar, you are not interested in appearances. The only thing that counts here is size and strength.

More than \$500 of the cost of the cellar was spent on concrete and concrete blocks, which have doubled in price in the past few years. Used blocks, sometimes available for the taking if you tear down an unwanted building, work just as well as new. You can cut the cost of the cellar in half by substituting used railroad ties, stacked horizontally, cedar logs set on end, or large stones mortared in place for blocks.

Another \$500 was spent on lumber. Some of this was used for stakes and framing. Scrap lumber of different sizes can be used instead.

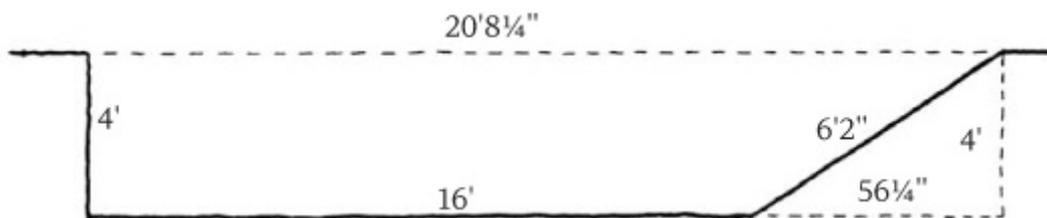
Used doors, often available at salvage yards, or a discarded freezer or refrigerator door and frame can be used instead of the insulated plywood doors in Step 10.

“Found” materials, such as sawdust, loose straw, even dry sand, could be used instead of commercial insulation to fill the cores of the blocks in the entrance wall and the doors.

Building the Cellar

Step 1 Excavating

For your 12-foot by 8-foot root cellar, dig a hole 16 feet long by 12 feet wide by 4 feet deep with an entrance ramp 4 feet wide and sloping 6 feet, 2 inches from the ground level to the bottom of the hole. The floor should be as level as possible.



Step 1. Here is a cutaway view of the excavation. The excavation is 12 feet wide.

Step 2 Marking Off

Beginning 32 inches from the entrance end, pound 4 stakes in the ground to mark off an area 6 feet, 8 inches wide by 10 feet, 8 inches long, keeping the stakes equidistant from the dirt walls.

Check to make sure the corners are square by measuring diagonally from corner stake to corner stake. The distance should be equal. Adjust, if necessary.

Stretch a cord along the ground around the outside of the 4 stakes and tie the ends together. This line marks the inside dimensions of the block walls.

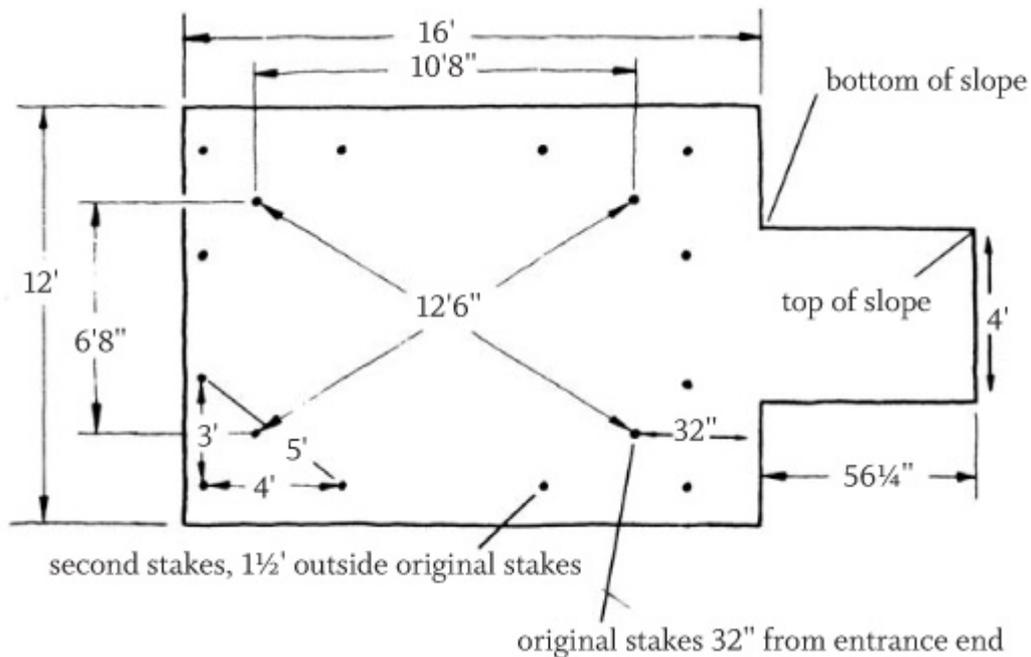
To mark off a footing trench, pound 4 more stakes in a rectangle 1½ feet outside the marked area. Again, measure diagonally to be sure the corners are square.

This next step will help you mark off right angles for your corners. Pound 2 more stakes at right angles to each of the new stakes, at least 4 feet away. Nail 2 batter boards (1 × 3s) near

the top of the stakes to tie the stakes together. Check that the corners are square by measuring from the corner stake 3 feet down 1 leg and 4 feet down the other. The distance between these 2 points (the hypotenuse of the triangle) should be 5 feet. Adjust the stakes and batter boards if necessary.

Using nails in the top of the boards to keep the cord in place, stretch a line between the batter boards exactly 4 inches inside the original line (which measures 6 feet, 8 inches by 10 feet, 8 inches).

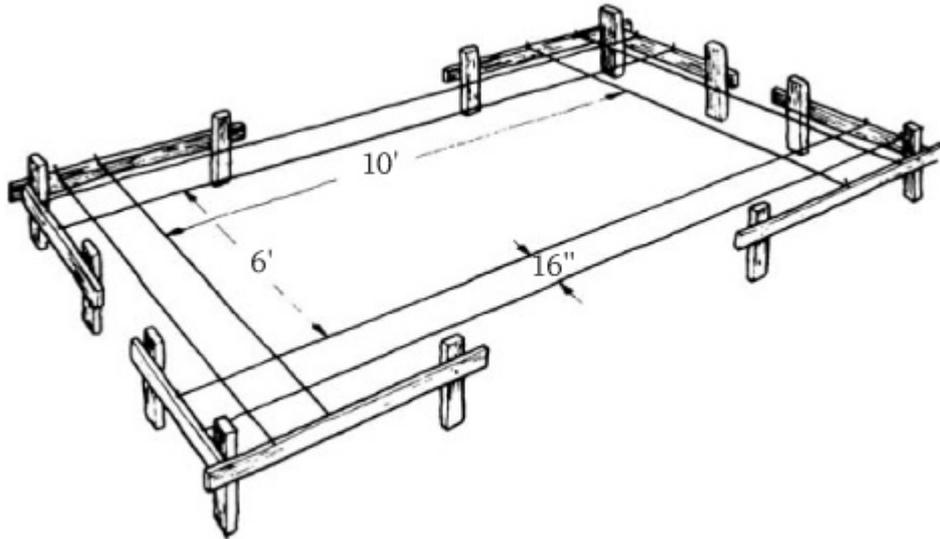
Pull up the original 4 stakes and cord. The new line above the ground marks the inside edge of the footing trench. Now stretch another line 16 inches outside the new line. Nail to the top of the batter boards as you did the first line.



Step 2. Marking the foundation.

- 1. Pound 4 stakes to mark off an area 6 feet, 8 inches by 10 feet, 8 inches. The corners are square if the distances from corner to corner are equal.*
- 2. Pound a second set of 4 stakes 1 1/2 feet outside the original stakes.*
- 3. To square the corners made by these new stakes, measure 3 feet in one direction and 4 feet in the other*

direction, so that the distance between them makes a 5-foot line, as shown in the lower left corner.



Step 2. Once the stakes are in place, batter boards are nailed to the top of the stakes, and lines are stretched between the boards to mark the footing trench. The inside line is exactly 4 inches inside the original line. The outside line is 16 inches beyond that.

Step 3 Digging the Footing

Dig a trench 16 inches wide and 9 inches deep all the way around the hole between the 2 lines. Keep the corners square and the bottom level.

When the trench is dug, check from each corner, eyeing the length of the string lines to make sure the trench is straight. Make any adjustments necessary before pulling up the batter board construction.

Step 4 Pouring the Footing

To insure a level footing for the block walls, pound the 1 × 2 stakes in the ground down the center of the trench every 2 or 3 feet. The tops of the stakes should extend 8 inches from the bottom of the trench and should be perfectly level. Use a

mason's level and a straight 2 × 4 board cut 8 feet long to check the level.

When the stakes are all in place, dampen the trench with a garden hose or a few buckets of water; then fill the trench with wet concrete. Level it just to the tops of the stakes, using a wooden float. There is no need to pull up the stakes.

A 1:2:4 concrete mix (1 part cement, 2 parts sand, 4 parts gravel) is recommended for footings. If you mix your own, a clean, dry water bucket makes a good measure. Mix the dry ingredients thoroughly in a wheelbarrow, then add just enough clean water to make a stiff mixture. Too much water will make a weak concrete, so be careful not to use more than 5 or 6 gallons of water for each bag of cement.

It's easier, but more expensive, to buy ready-mixed concrete. You can have large amounts delivered in a mixer-truck, but most dealers have small trailers to haul behind our car for the small amount you will need.

When the wet concrete is leveled, lay scrap pieces of 2 × 4s or other wood in the center of the footing. Remove the wood as soon as the concrete sets up. This will create a groove for the mortar to lock the bottom row of blocks to the footing.

Give the wet concrete at least 3 days to cure before you start laying the blocks. Spray the surface with water once a day to keep it damp. In cold or very hot weather, keep it covered with straw, canvas, or old blankets.

Step 5 Laying the First Course

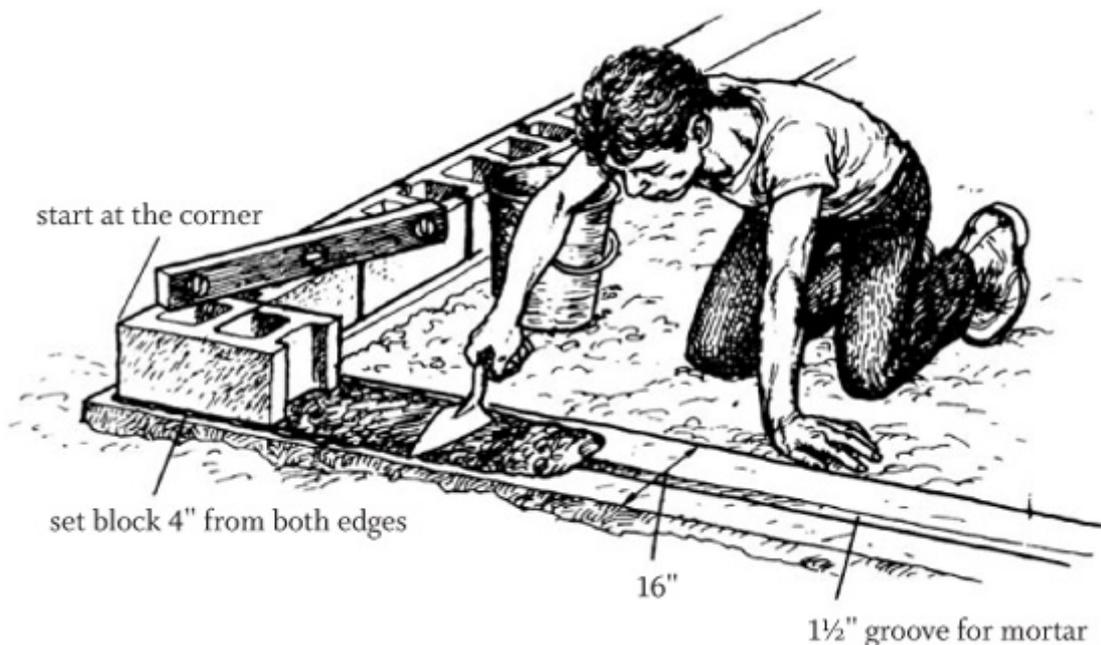
To make sure the blocks are going to fit the footing, make a trial run by setting the first course (1 row of blocks all the way around) in place without mortar.

Place the blocks 4 inches in from the inside edge of the concrete footing, and slip a 2-inch by 8-inch strip of $\frac{3}{8}$ -inch plywood between each 2 blocks to allow for the mortar. Lay 9 blocks lengthwise down the 2 side walls. Then place 5 blocks between them on the 2 end walls. Blocks should always be placed with the large core side down. Adjust, if necessary, to

make the blocks fit, then mark the placement on the footing with chalk. Remove the blocks.

Starting at 1 corner, spread a layer of mortar along the chalk line from the corner down both walls. The mortar should be 1 inch thick by 8 inches wide by the length of 2 blocks.

Set a corner block on the mortar and tap it into place with the trowel handle until the block is level and plumb, and the mortar is $\frac{3}{8}$ -inch thick. Scrape off excess mortar under the block on both sides.



Step 5. Spread the mortar 1 inch thick. Tap the block in place and scrape off excess mortar.

Spread mortar $\frac{1}{2}$ -inch thick on the end of a stretcher block, and set it in place end to end with the first block in the bed of mortar. Again tap the block into place and scrape off all excess mortar. This mortar can be used again.

Repeat with another block placed at right angles to the first along the other wall.

Continue laying blocks all the way around the footing, spreading mortar on the footing and on the end of each block and checking to be sure each block is level before setting the next. Use corner blocks on each corner. Spread mortar on both ends of the last block in the course and carefully ease it in. It may take a couple of tries.

As the mortar between the blocks and between the blocks and the footing begins to stiffen, it will pull away slightly from the blocks. To correct this and make the walls more waterproof, run a mason's jointer or a metal or wooden rod along the joints to force the mortar in the cracks. This operation is called tooling, and it will leave a concave impression between blocks.

Tool all joints and wipe off any excess mortar.

Step 6 Laying the Drain Tiles

With the first course of blocks in place, pour 2 inches of gravel around the outside perimeter. Then, lay a line of 4-inch perforated plastic drain tile on top. Be sure the holes on the tile face down on the gravel. Slope the tile 2 inches from back to front. Join sections of tile according to manufacturer's directions, using 90-degree elbows at the corners. Make sure the tiles are not clogged with dirt.

At each front end of the drain tiles, dig a hole about 3 feet in diameter (or as large as possible) and 3 feet deep. Fill both holes with gravel, and lay tile to the center of each. Cover the tiles with 12 inches of crushed stone or gravel.

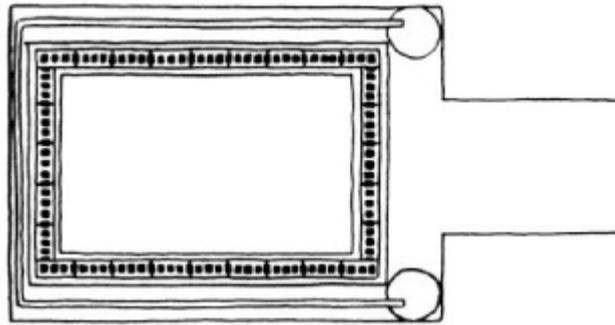
If your land is wet, and if the ground slopes away from the root cellar, it is a good idea to run the drain tile all the way to the outside to allow the water to drain on the ground.

Step 7 Marking the Doorway

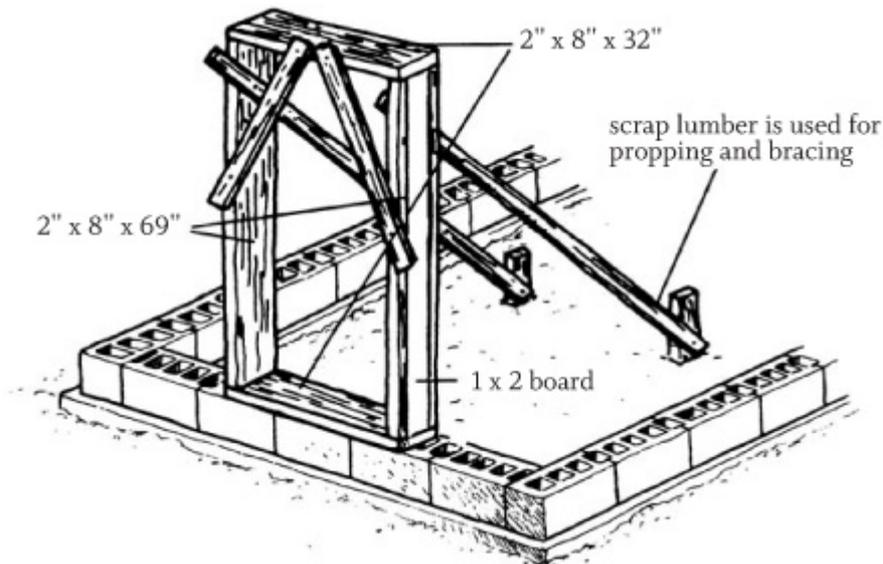
Mark off a 32-inch rough opening in the center of the entrance wall. The doorway should be opposite the entrance ramp and should be positioned as evenly with the blocks as possible to avoid the time-consuming job of cutting blocks to fit. The door is set on top of 1 course of blocks to discourage mice, chipmunks, and water from entering the cellar.

To make the door frame, nail together the 2 × 8 lumber as shown, with a 1 × 2 centered on and nailed into the side jambs. The 1 × 2s will be mortared into the grooves of the concrete

blocks. Brace the door frame temporarily with scrap lumber. The sill should be flush with the outside edge of the concrete blocks.



Step 6. The drain tiles are laid when the first course of blocks are in place. Slope the tile 2 inches from back to front. The tiles drain into a 3-foot drain filled with gravel.



Step 7. The door frame is propped in place on the first course of blocks.

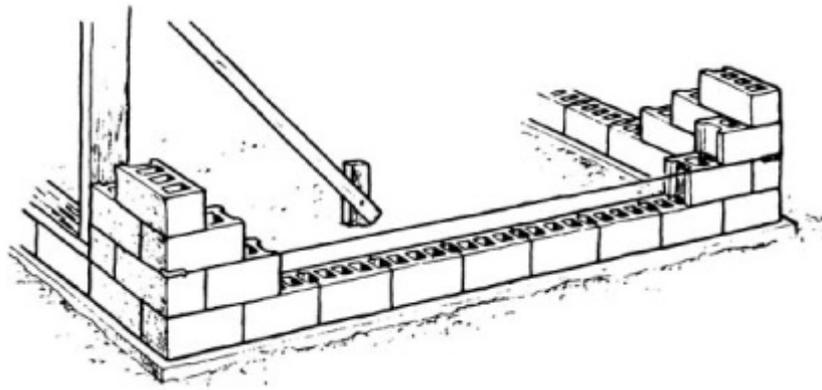
Step 8 Building the Walls

Beginning at a back corner, spread mortar on the top edges of the first course of blocks 2 blocks long in each direction. Build the corner 3 blocks high. Repeat on all 4 corners, using corner blocks where needed.

Hook a mason's line around the ends of the corner blocks and stretch a taut line from corner to corner. Using this line as a guide, fill in the second course of blocks along 1 wall, then

move the line to the next wall. Continue building up the walls, first on the corners, then filling in the course, all the way around. As you finish each course, move the mason's line up to the next corner block. Tool all joints as they begin to stiffen. Build the entrance wall around the door frame, using blocks cut to fit. Continue until the walls are 11 blocks high all the way around.

Over the doorway, insert the lintel. To make the lintel, lay 6 lintel blocks end to end so a channel is formed. Place reinforcing bars in the channel and fill with concrete. Let dry. Turn the lintel over and gently set in place. Adjust until the mortar joint is the same thickness as the other horizontal joints.



Step 8. Stretch a taut line from corner block to corner block to align each course of blocks.



Step 8. Build the entrance wall around the door frame. To cut a block to fit around the frame, use a hammer and chisel to mark a cutting line all the way around the block. Place the chisel on this line and rap sharply with the hammer. It may take a few tries to cut through. Trim off any rough edges.

Step 9 Insulating and Topping the Walls

Before laying the top course of blocks, insulate the entrance wall by filling the cores of the blocks with sawdust or commercial insulation pellets. In a northern climate, you may want to insulate all walls.

Cut $\frac{1}{4}$ -inch mesh hardware cloth into 6-inch-wide strips, and lay the strips over the tops of the eleventh course of blocks on all 4 walls. The strips should be cut in pieces as long as possible.

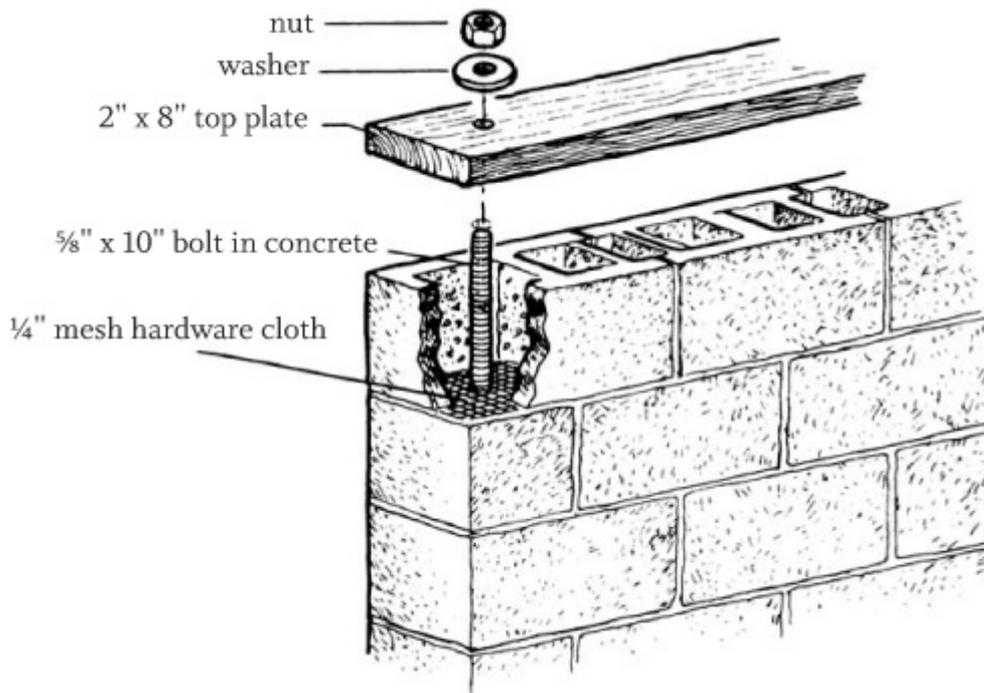
Now proceed with the final course of blocks, spreading the mortar on the hardware cloth as necessary.

When the final course is in place, mix a batch of 1:2:4 concrete, and fill the cores of the top course of blocks, smoothing off the top. As you fill the cores, imbed a $\frac{5}{8}$ -inch by

10-inch anchor bolt in the concrete every other block. The nut end should protrude from the concrete about 2 inches.

Allow the mortar and concrete fill to cure at least 3 to 5 days. If the weather is very cold or very hot, keep it covered, but do not wet down.

Meanwhile, you can work on the stairway and doors.



Step 9. This cutaway view of the top course shows the placement of the hardware cloth, anchor bolt, and top plate.

Step 10 Building the Stairway and Doors

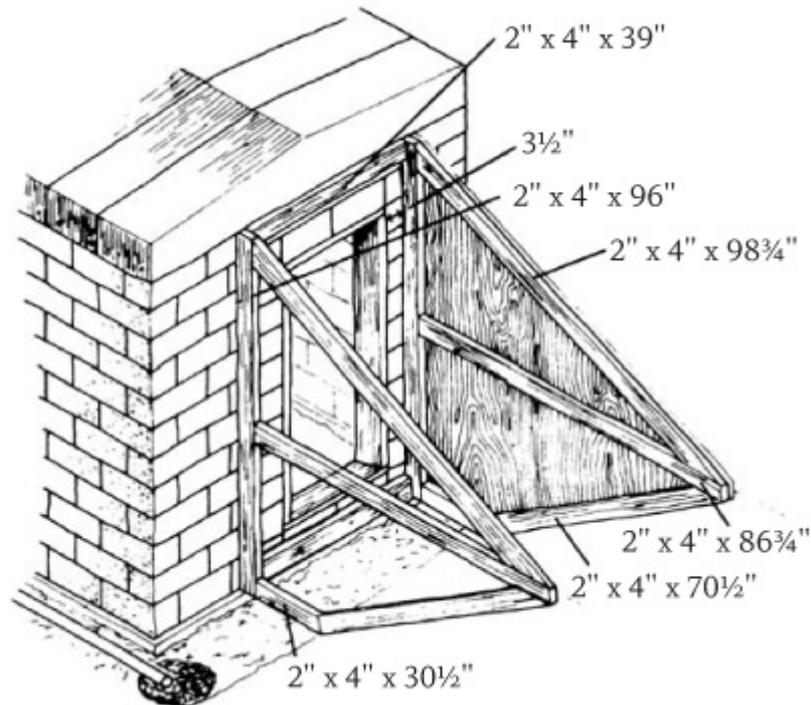
Stairway Wall. Using pressure-treated lumber, build a framework for a stairway wall and hatchway door support as illustrated. Cover the outside of the framework with 1/2-inch exterior grade plywood that has been painted with wood preservative.

Stairway. Dig 4 holes 6 inches in diameter and 3 feet deep at the top and bottom of the stairway slope.

To make the stringers, cut 2 pieces of 2 × 12s to measure 74 inches. Trim the ends to fit the slope of the entrance ramp.

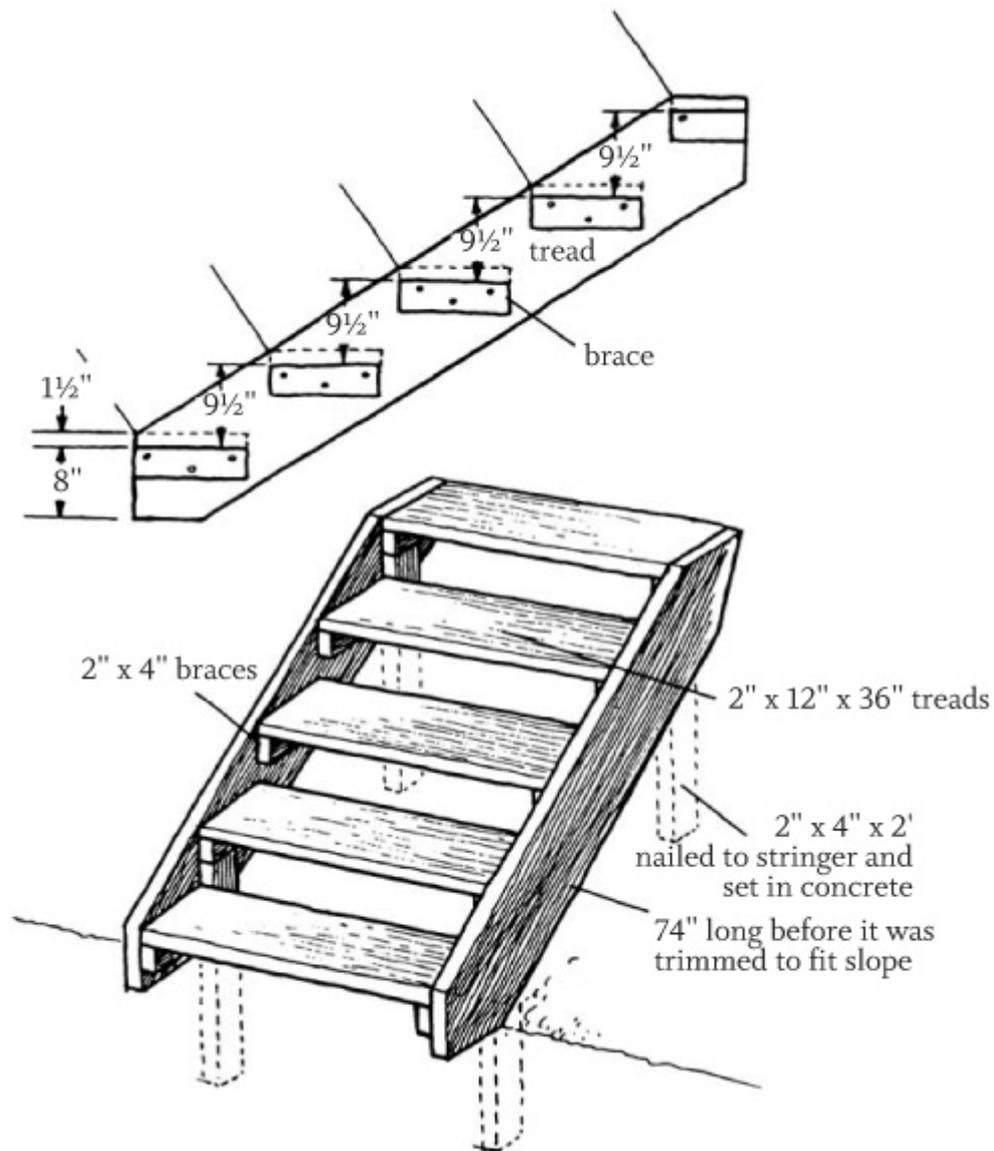
Securely nail 10 12-inch pieces of 2×4 s to form braces on both stringers for treads. The first braces should be nailed so that the top edges of the braces are 8 inches above the bottom edges of the stringers. The other braces should be nailed $9\frac{1}{2}$ inches apart, measuring from the top of one brace to the top of the next brace.

Make 5 treads from 2×12 s to measure 36 inches, and nail them in place on the top edge of the braces.



Step 10. To make the stairway wall and hatchway door support, construct a frame of 2×4 s around door opening, as shown. Attach the frame to the block wall, using concrete nails. At right angles to the pieces that frame the door, build a 2×4 frame for the stairway wall. The bottom $2" \times 4" \times 70\frac{1}{2}"$ board should match the ground slope. Nail securely in place and repeat on other side of the doorway.

Set the stairway in place on the slope. Nail 2-foot-long pieces of 2×4 s to the inside of the stringer so they extend into the holes you dug. Place a few rocks in the bottom of each hole. Then fill the holes with wet concrete mixture to hold the stairway in place.



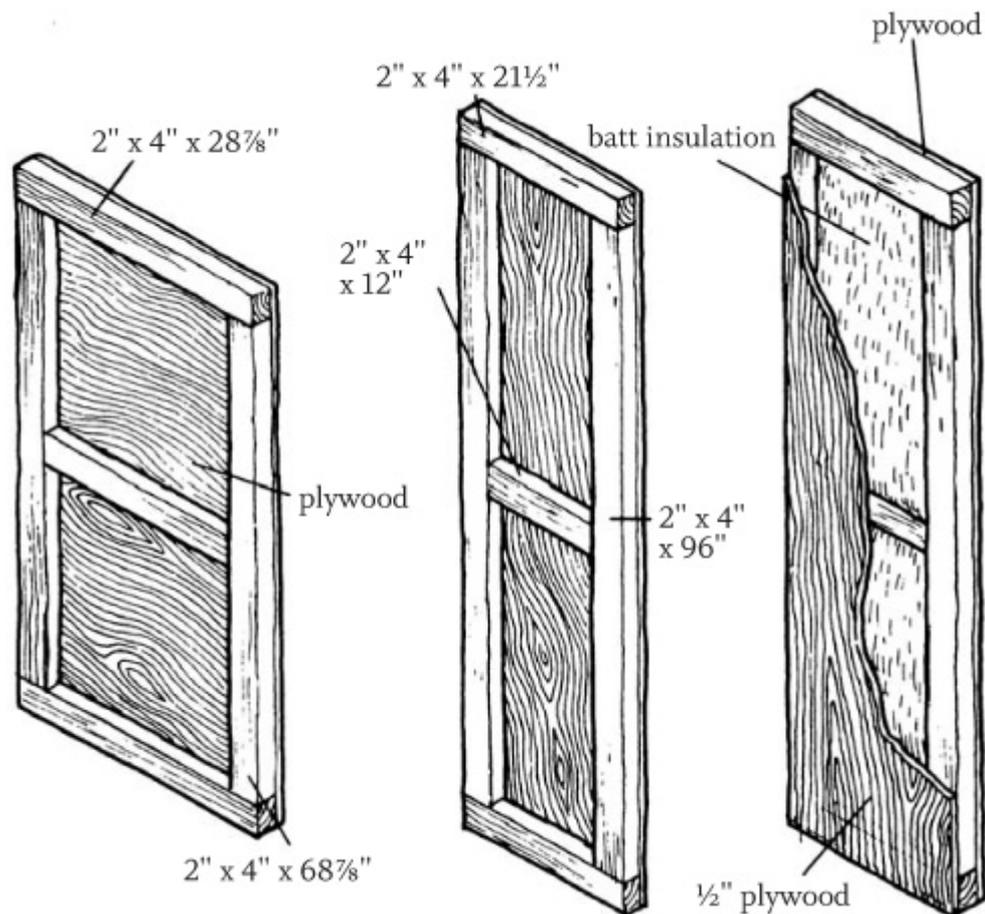
Step 10. The stairway is set in place on the entrance slope.

Interior Door. Nail 2×4 pieces along the outside edge and across the middle of 1 of the $28\frac{7}{8}$ -inch by $68\frac{7}{8}$ -inch plywood pieces. Fill the 2 recesses with insulation and top with the other plywood sheet. Nail in place.

2 Hatchway Doors. Cut the $\frac{1}{2}$ -inch plywood to make 4 pieces measuring $21\frac{1}{2}$ inches by 96 inches. Frame 2 of the pieces with 2×4 s as you did the interior door. Nail in place. Fill the center cores with insulation and nail the other 2 pieces of plywood on top.

Nail a 1×6 board the length of the right hand door on the edge with the board extending 2 inches over the edge. This

board will overlap the opening and shut out drafts when the doors are closed.



Step 10. The partially completed interior door (left) and hatchway doors (right) are constructed with 2 × 4 frames with plywood backing.

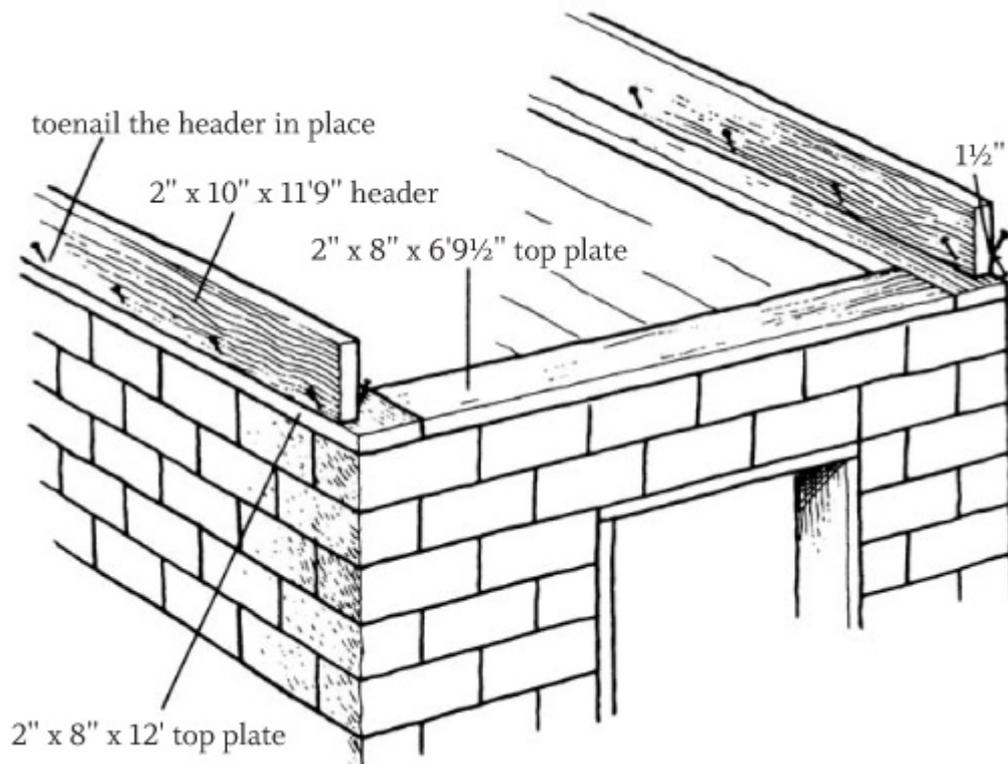
Don't Have the Time This Year?

If building a concrete block root cellar is a bigger undertaking than you are ready for this year, you can make simpler root cellars. Bulletin A-87, *Cold Storage for Fruits & Vegetables*, tells you how to make a root cellar in your basement, plus how to store fruits and vegetables in pits, trenches, and barrels. A-87 also provides detailed charts of the storage life expectancies and recommended storage conditions for a variety of fruits and vegetables.

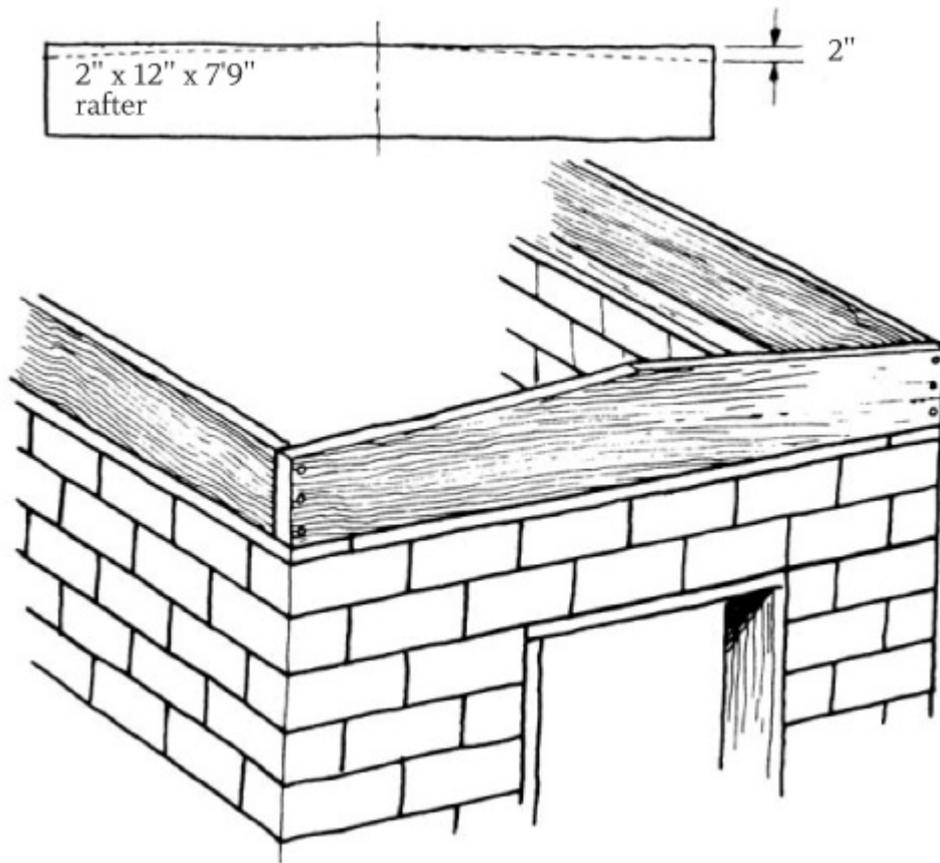
Step 11 Roofing the Cellar

Attach 2 × 8 boards to the top of the block walls by drilling holes in the boards for the bolts you embedded in the concrete. The 2 × 8s may be pieced together, if necessary. Fasten the top plate securely with nuts.

Taper both ends of the 13 rafter boards as shown (p. 23) with a saw or plane. Set aside.



Step 11. Set the header on edge and toenail to the top plate 1 1/2" from each end.



Step 11. Attach the end rafters first. Then attach the middle rafters. The rafters can be sawed or planed to achieve the 2" slope.

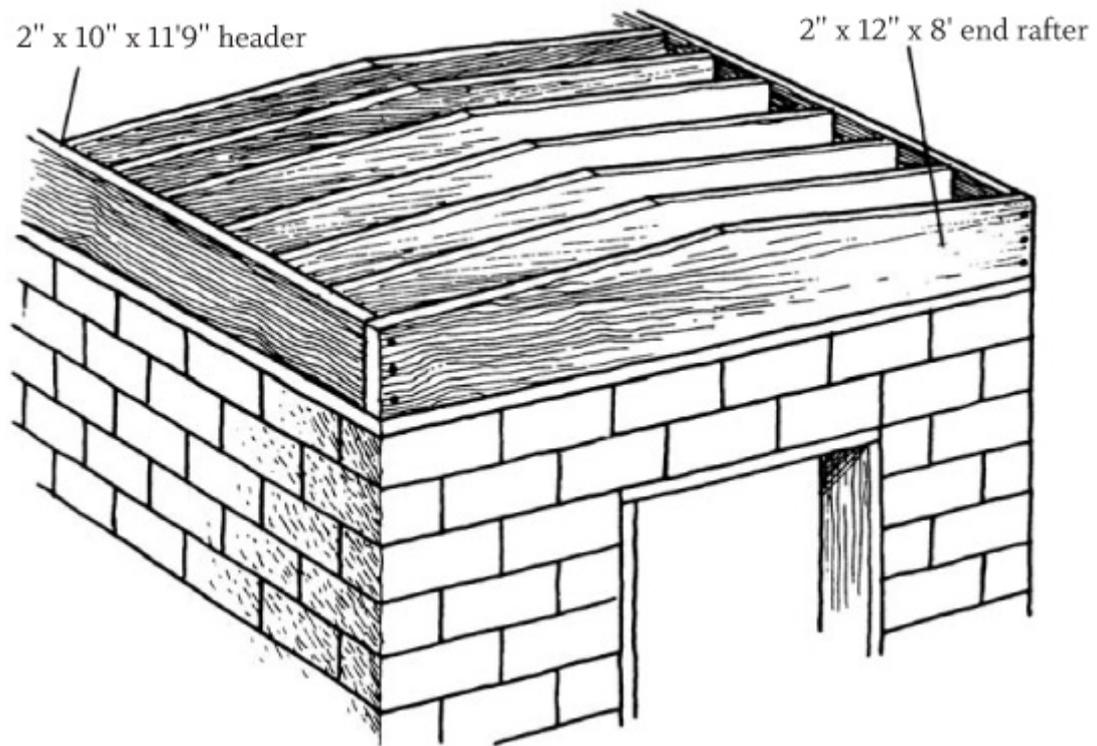
The headers should be set on edge on the 12-foot top plate you bolted to the top of the block walls and toenailed in place 1½ inches from each end.

Set the 2 full-length 2-inch by 12-inch by 8-foot rafters on edge at each end of the headers. Nail to the top plate and to the ends of the headers, creating an open box on the block walls.

One at a time, set the 11 rafters in place across the top of the building between the 2 headers every 12 inches the length of the building. Toenail the rafters to the top plate, and nail through the headers into the ends of the rafters on each end.

When all the rafters are nailed in place, cover the top with ¾-inch or 1-inch exterior grade plywood, and nail in place. Fill any holes around the edge of the roof with batt insulation, stapled in place. Then cover the entire roof with layers of roll roofing. Begin the layers at each side, overlapping each layer 2

inches and extending it at least 1 foot over on all sides. Nail in place, using blind nailing cement.



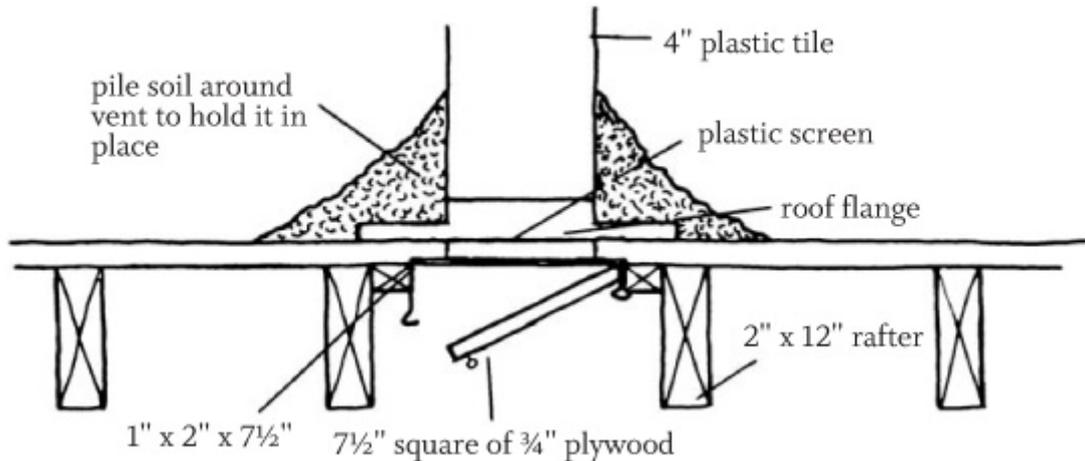
Step 11. Nail the rafters in place between the 2 × 10 headers.

Step 12 Installing the Air Vent

Between the second and third rafters from the rear wall, drill a small hole in the roof. Using a saber saw or a keyhole saw, and starting from the hole you made, cut a 6-inch hole in the roof, centered between the rafters.

Cut an 8-inch square of screen. Staple this to the underside of the hole to keep out insects.

Cut 2 pieces of 1 × 2s to measure 7½ inches long. Nail these to the rafters on both sides of the hole you just cut. Cut a piece of ¾-inch plywood to measure 7½ inches square. Attach the plywood piece to one side of the 1 × 2s with a ¾-inch leaf hinge. Close the plywood hatch door against the other piece of 1 × 2 with a simple hook and eye. Weatherstrip around the edges of the plywood.



Step 12. Side view of roof vent assembly.

On top of the roof, screw the plastic flange to the plywood, centering it over the hole. Knock out the center, if necessary, by tapping it with a hammer. Then slip a 4-foot length of plastic sewer pipe into the flange. Caulk around the bottom of the vent and install the galvanized hood on top.

Step 13 Waterproofing the Exterior

Cover the roof with roofing tar. Pile soil around vent pipe to hold it in place. Over the rest of the roof, place 1½ feet to 2 feet of baled straw “slices.” Top this with 2 to 5 layers of 6-mil plastic sheeting. Fold the plastic over the edges on all sides well below the top plate. The soil covering will hold it down securely.

Cover the exterior of the block walls with a ½-inch coating of cement plaster (1 part cement, 3 parts sand). Then coat with foundation coating.

Caulk well along the bottom edge between the first layer of blocks and the footing with commercial caulking.

Step 14 Installing the Doors

Interior Door. Remove the props and braces from the door frame installed in Step 7. Insulate around the frame by stuffing

pieces of batt insulation into any gaps between the concrete blocks and frame.

Nail 2×4 lumber to the edge of the door frame all the way around on the outside of the wall. Shim, if necessary, to form a snug fit.

Attach the interior door to the 2×4 frame with screws, using 3 6-inch T-hinges. Install a latch or hook and eye on the outside to hold the door closed. Nail a 1×2 stop to the side jamb located on the inside of the root cellar along the edge of the door.

Attach an easy-to-grasp handle (metal or homemade) at a convenient height.

Hatchway Doors. Face the top of the stairway wall frame with 4 2×6 s laid flat and flush with the inside edge of the 2×4 supports to make a frame 50 inches wide. Attach 2 sets of double 2×4 s (3 inches thick) to the outside edge of the 2×6 frame. The doors will fit between these and be hinged to them.

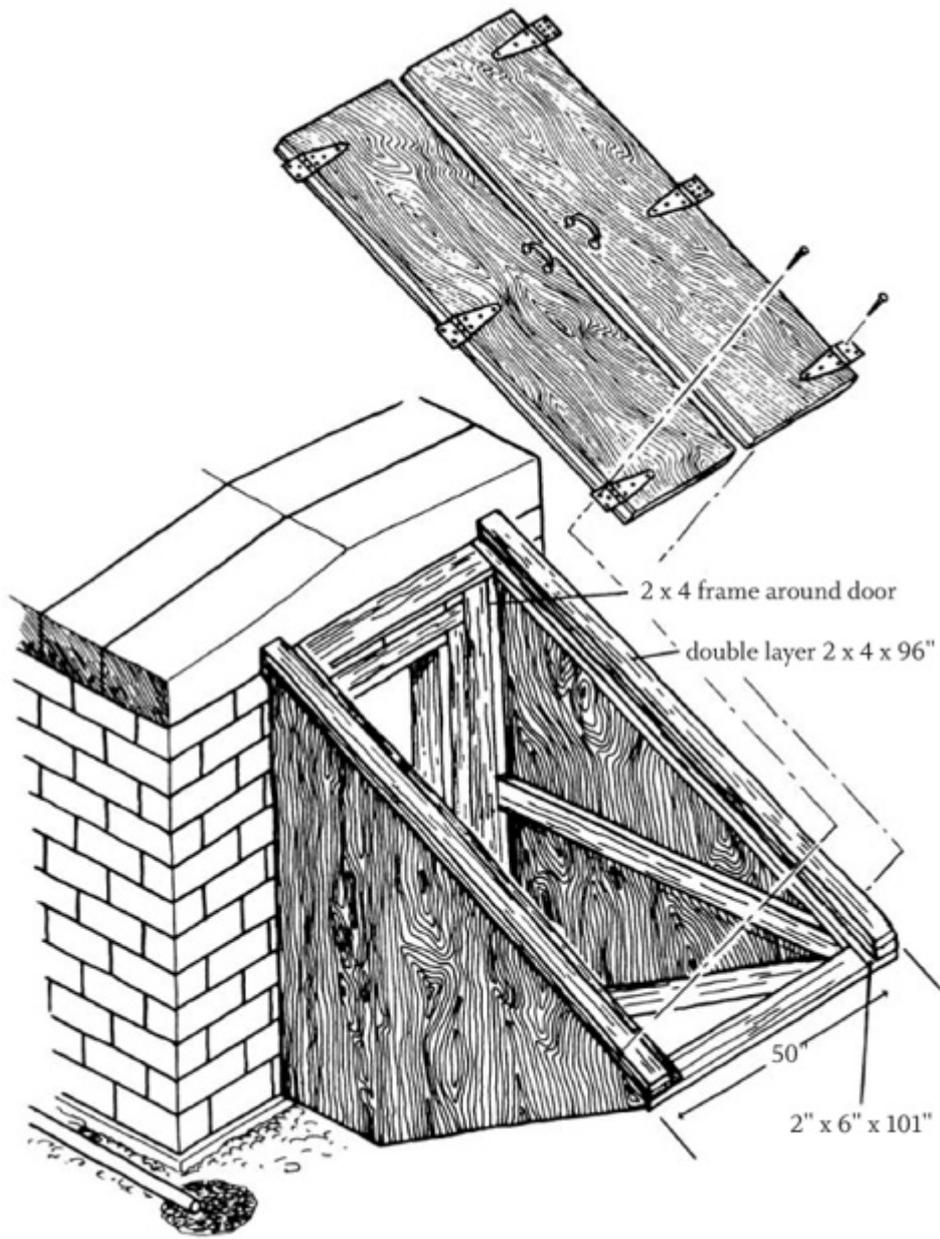
Lay the 2 doors on the frame and attach with 6-inch T-hinges on each door. Attach large handles at a convenient height for opening.

Step 15 Covering the Cellar

Using the soil you removed in Step 1, first fill in around the 3 sides of the block walls, tamping it down well as you go by walking on it. Pile the dirt up to the roof, then cover the roof, being careful not to disturb the air vent or the roofing.

Cover the roof with 2 feet of soil, gradually tapering it out to the sides so there is at least $1\frac{1}{2}$ feet covering all 3 sides. Pile the soil carefully around the hatchway door frames, packing it well.

You may need to bring in additional soil, but earth is the cheapest insulator for your cellar, so don't stint on this step. When the cellar is well covered, seed with a good ground cover to make the area more attractive and hold the soil in place in heavy rains.



Step 14. Face the stairway wall frame built in Step 10 with 2 × 6s and 2 × 4s. Then attach hatchway doors to the frame.

Adapting the Cellar to Your Needs

An 8-foot by 12-foot root cellar is large enough to store a year's supply of food for a family of 6 and serve as a short-term storm shelter.

If your family is large, and you want the security of an emergency shelter that will provide long-term protection as a shelter, you may want to increase the size of your cellar.

You can increase the length of the cellar, but it is advisable to keep it 8 feet wide. This span is strong enough to support the weight of the earth piled on top, yet inexpensive to build, since it makes good use of 4-foot by 8-foot plywood sheets.

As a rule, allow 8 feet in length for a family's food storage plus 2 feet for each adult who may use it as a shelter. To house a family of 6 adults and provide the family's food supply, a shelter should be 8 feet wide by 20 feet long.

If you increase the length to more than 16 feet, however, you should add a partition wall cross the center of the cellar. This not only strengthens the roof but creates 2 storage areas with differing storage conditions. It also adds convenience and privacy to your shelter.

Add to the length in increments of 16 inches, the size of 1 block. And don't forget to increase the length of the concrete footing and the 2 top plates accordingly.

Unless you want to keep your cellar to the bare necessities, the convenience of some additional features may make them worth the additional cost. Other features may be necessary because of unusual circumstances, such as underground water or extreme temperatures.

Before you build your root cellar, you may want to consider the following options.

- **Electrical wiring.** Electric lights are not a necessity in a root cellar. You can always use a flashlight or a lantern. If you wish to postpone the cost, you can add electricity later. But 1 or 2 light bulbs would add

considerable convenience and could serve as a heat source in winter.

To wire your cellar, bury no. 14 underground cable from a box or outlet at the house and enter the cellar at the roof. Attach a porcelain fixture to a rafter.

- **Concrete steps.** If soil moisture is a problem in your area, you may want to substitute concrete steps for the wooden steps for greater durability. Use 2 × 8 scrap lumber to build a crude concrete wooden form up the slope. Brace it well. If you are using ready-mixed concrete for the footing, you will save money by pouring the steps at the same time.
- **Walling the stairwell.** If you pour concrete steps, you may wall in the stairwell area by increasing the width of the stairway forms to 5 feet, 6 inches, and using the steps as footings for the block walls.
- **Concrete floor.** Although a dirt floor is preferable for storing food, a concrete floor is more comfortable for shelter use. You may want to hire a professional to pour an 8-foot by 12-foot slab instead of Steps 2, 3, and 4. But if you have a few friends willing to help you, you can do it yourself.

After you have dug the footing trench in Step 3, dig out the floor area and the 4-foot walkway to the slope 4 inches deep. Cover the entire floor with a 12-foot by 16-foot piece of 6-mil plastic sheeting and fill the hole with concrete mix. It's a lot easier to have the mixer truck dump it for you, but you can do it with a cement mixer. You will need the friends to help spread the concrete and level it off.

- **Sump pump.** If underground water is a problem in your area, you may want to install a sump pump with a hose to pump the water to another area.

Get the Most from Your Root Cellar

With a few thermometers and a humidity gauge, you can learn to take advantage of the natural temperature and humidity differences that will exist in your cellar. Usually, the coolest, most humid area is near the door on the floor. The warmest, driest area is at the ceiling toward the back.

Storage Containers

Almost any container you have on hand or can buy cheaply can be used in your root cellar.

You will need crates or baskets for those foods, such as potatoes and apples, which need containers through which air can circulate freely. For those foods, such as onions and garlic, which need warm, dry storage, mesh bags — the kind onions, potatoes, and fruits sometimes come in — are excellent. Other produce can be stored in wooden or metal barrels, metal tubs and pails, plastic or metal garbage and trash containers, or sections of 18-inch and 24-inch tile.

All floor containers should be raised off the dirt floor to prevent rotting and rusting of containers, and mold and insect infestation of the food. Crude wood pallets, sometimes available for free at building or garden centers or appliance stores, are ideal for this purpose.

You can buy heavy-duty metal shelving or make your own of 2 × 12 lumber with 2 × 4 shelf braces. For maximum strength, there should be a vertical support every 4 feet, and these supports should be attached to the roof supports. A piece of scrap aluminum or plastic under the vertical supports will help retard rotting. The boards also may be treated with 2 coats of commercial wood preservative.

Nail 2 × 4 shelf braces to the vertical supports. Cut shelves to fit and set in place, but do not nail down so that shelves may be removed for cleaning and airing.

Storage Requirements of Individual Fruits and Vegetables

Each fruit and vegetable has its own storage requirements, but there are a few rules of thumb to remember..

- Store only the best produce. Before storing, remove any injured or overripe produce and use immediately, can, or freeze. Inspect your produce every week to remove any that has spoiled.
- Do not wash produce before storing. Even if washed vegetables are allowed to dry, enough moisture may collect in crevices to encourage mold and spoilage.
- Store strong-flavored vegetables, such as cabbages and turnips, separated from the more delicately flavored produce, or they will transmit flavors. Packing all fruits and vegetables in layers of dried leaves, straw, or crumpled newspaper will help absorb excess odors.
- Onions, pumpkins, and squash need dry storage conditions with good air circulation. Onions can be braided and hung from the ceiling. Large squash and pumpkins should be kept on high shelves. Squash should be cured before being brought into the cellar.
- Tomatoes are the only exception to the rule of storing mature vegetables. Place green tomatoes in layers of straw or newspaper. They will keep 4 to 6 months in a warm, dry area of your cellar.
- Root vegetables, such as beets, carrots, parsnips, rutabagas, salsify, and turnips store best in containers, layered with moist sand. Properly maintained they should keep for 9 to 12 months.
- Store potatoes and apples (separately) in crates or baskets. Apples and potatoes should not be stored together because the apples will release a gas which will cause potatoes to sprout.

- Cabbages keep well when they are stored 3 heads deep in crates or baskets, or stacked upside down, roots intact, on shelves. Wrap each head in newspaper or bury in leaves.
- Celery, head lettuce, endive, and escarole should be lifted from the garden and replanted in moist sand, in the root cellar, where they will keep for 1 to 2 months. Treated the same way, cauliflower, brussel sprouts, and kohlrabi will keep for 2 to 3 months, if you remove their leaves.

Root Cellar Maintenance

A well-constructed root cellar does not require much maintenance, but you will need to check it at least once a day the first winter to make sure the temperature stays above freezing.

In very cold weather, you will need to close the air vent, and you may want to supply a small amount of heat with a kerosene lantern or a couple of 100-watt light bulbs. Be careful, though; a kerosene or electric heater gives off too much heat.

Once a year the cellar should be cleaned and aired thoroughly to avoid plant disease and insect infestation. Choose a dry day in early summer just before harvest, when the shelves and bins are almost empty. During the annual clean-up, open the doors as far as possible for 2 or 3 days, take out all the containers and shelves and scrub them well with soapy water, then let them air in the sun a day or two. Sweep or rake the floor and whitewash the walls.

Remove and discard any sand, sawdust, or leaves in which root vegetables were stored. Replace with new material in the fall.

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