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# A Gothic Greenhouse for Town and Country Homes

Cooperative Extension Service  
Virginia Polytechnic Institute  
Blacksburg, Virginia

Circular 892

Revised March 1966

This publication is based on cooperative work between the Departments of Horticulture and Agricultural Engineering of Virginia Polytechnic Institute, Blacksburg, Virginia. Authors are McNeil Marshall, Associate Professor of Agricultural Engineering, Dr. Franklin D. Schales, Assistant Extension Horticulturist, and Dr. P. H. Massey, Jr., formerly Horticulturist, presently Associate Director, Virginia Agricultural Experiment Station.

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# A Gothic Greenhouse for Town and Country Homes

One of the first greenhouses in this country was built in New York State about 1764; it had glass walls, but a solid wooden roof. A year or so later General George Washington built a similar greenhouse at Mount Vernon, indicating his interest in growing horticultural crops. It was heated from a fireplace in an adjacent servant's quarters and was eventually destroyed by fire. However, Washington's greenhouse has been replaced with an authentic replica located on the original site. Now, 200 years later, many town and country home gardeners with like interests have constructed small plastic greenhouses to extend their seasons of gardening enjoyment.

## THE PLASTIC GREENHOUSE

The VPI gothic greenhouse structure, designed and developed through research and testing, has a pleasing and modern appearance which makes it attractive in almost any setting. It is strong and rigid, and may be covered with any type plastic film or fiberglass sheets. It can be covered with plastic all the way down over the sill to the ground. Or, an optional 16" to 24" high sidewall of exterior-type plywood, or other similar material, may be substituted around the base.

## SITE SELECTION

For best greenhouse location, orient the ridge in a north-south direction to obtain maximum uniform sunlight during winter. A site somewhat sheltered from winter winds is desirable. The greenhouse should be located where there is good surface water drainage and be convenient to water, electricity, and the owner's home. If attached to an existing building, it should be on the south side to avoid undue shading.

## MATERIALS LIST

### Lumber:

- 20 "guide blocks" 2"x4"x8"
- 6 "spacer guide blocks" 3/8"x1"x3"
- 40 pcs 1/2"x1 1/2"x10' strips for rafters (rip from seven 2"x4"s)
- 4 pcs 2"x4"x12' rafter spacer blocks, diagonal braces, jambs  
(4 pcs 1/2"x1 1/2"x12' diagonal braces—rip from above)  
(2 pcs 1/2"x1 1/2"x12' door jamb strips—rip from above)
- 2 pcs 2"x4"x16' side sills
- 2 pcs 2"x4"x12' end sills
- 2 pcs 1"x4"x16' ridgeboard
- 10 pcs 2"x4"x8' end framing
- 1 pc 2"x6"x3' door sill

### Foundation:

- Concrete (Forming lumber as required)  
2 cu. yds. 6 bag ready-mixed concrete
- OR Masonry block  
1 cu. yd. 5 or 6 bag ready-mixed concrete  
40 six-inch masonry blocks  
2 bags mortar-mix  
1/4 cu. yd. mortar sand

### Hardware and Miscellaneous:

- 16 anchor bolts 1/2"x8"
- 5 lbs. 6-penny cement coated box nails
- 1 qt. water resistant white glue
- 1 gal. copper naphthenate wood preservative
- 1 gal. white exterior paint
- 2 air intake louvers 12"x12"
- 1 damper motor to operate louvers
- 1 16-inch exhaust fan with guard and gravity louver
- 1 thermostat for ventilation control  
(Heating equipment options vary with planned use.)

### Greenhouse Covering:

- Polyethylene plastic film—outside  
1 pc 16'x13' 4-mil UVI film for ends  
1 pc 16'x22' 4-mil UVI film for sides  
25 pcs 3/8"x1 1/2"x10' strips for holding film  
3 lbs. 4-penny box nails
- Polyethylene plastic film—inside lining  
500 sq. ft. 4-mil UVI film  
25 pcs 3/8"x3/4"x10' strips for holding film  
1 lb. 3-penny box nails
- OR Fiberglass—alternate outside covering  
500 sq. ft. of approximately 5 oz. fiberglass sheeting material of applicable size, plus fastening accessories as recommended by the manufacturer

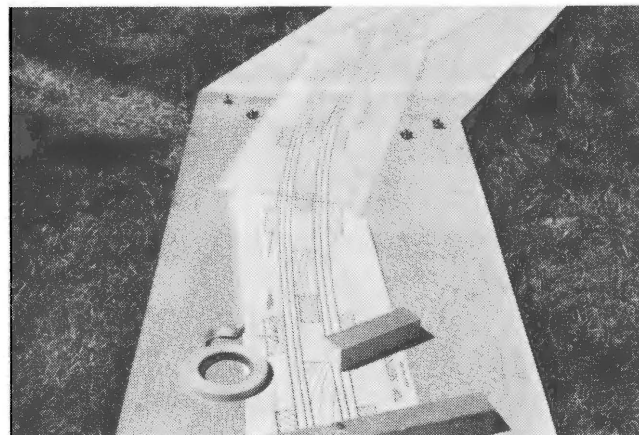
## MAKING THE RAFTERS REQUIRES A JIG

This may appear to be a complicated job since the rafters are made of blocks and strips and are curved. But the rafter jig is easy to build by either of 2 methods when these step-by-step instructions are followed:

**METHOD A.** Making the jig from the enclosed pattern.

1. Cut the pattern into 3 pieces along the dashed lines to separate TOP, MIDDLE, and BOTTOM sections. Trim the ends of the sections along the 2 lines marked "A-B", and the 2 marked "D-C", and fit these ends to each other exactly. Tape the ends together with masking tape to form the RAFTER PATTERN.

2. Secure the assembled pattern to a smooth wooden floor, or to a heavy piece of plywood of sufficient size. Masking tape can be used to hold the pattern in place while the jig is being constructed on it.

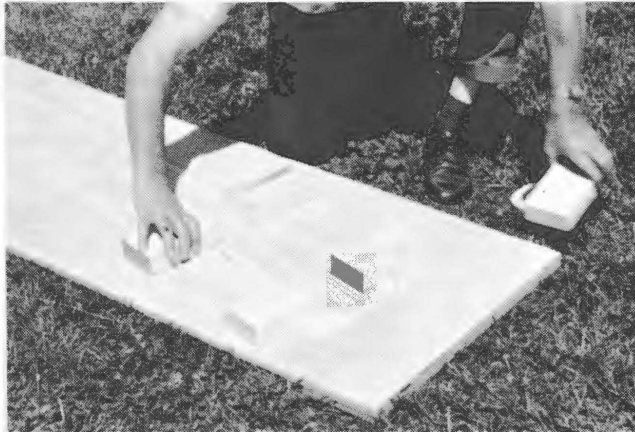


3. Cut the following wood blocks for making the jig:

- 20 guide blocks 2"x4"x8"
- 6 spacer guide blocks  $\frac{3}{8}$ "x1"x3"

4. Nail these pieces firmly to the floor on top of the pattern in the marked shaded spaces. These blocks form the jig; be sure they remain tightly nailed to the floor while you build all needed rafters.

5. If the rafter jig is made on a piece of plywood, it is necessary for the guide blocks to be located on the pattern. The pattern must then be removed and the blocks glued and attached with wood screws. Insert the screws through the plywood from the back and into the 2"x4"x8" blocks. Use glue and small nails to attach the thin spacer guide blocks.



#### METHOD B. Making the jig from the plan.

The jig for the rafters can also be constructed by reproducing to full-scale the "JIG LAYOUT DESIGN" on the plan. Use the guide blocks as described above and nail them to a wooden floor or platform to outline the reproduced rafter design. Place the guide blocks so they will not be in the way of nailing the rafter together.

Rafter jigs made by either method will be practically identical; however, for the sake of uniformity, all rafters for a house should be made in the same jig.

#### BUILDING THE RAFTERS

1. It will be necessary to make 10 rafters. The following pieces are required for each rafter; multiply by 10 for the total number needed.

- 4 pcs.  $\frac{1}{2}$ "x2"x10' — lath
- 2 pcs. 2"x2"x18" — end blocks
- 5 pcs. 2"x2"x6" — spacer blocks

2. Place 2 of the 10' strips inside the jig and separate them by placing an 18" block between the strips at each end. Five 2"x2"x6" blocks are placed between the 2 strips and against the  $\frac{3}{8}$ "x1"x3" jig blocks.



3. Slide the next two 10' strips down in the jig — one on the outside and one on the inside. Now you have in the jig 2 strips on each side with spacer blocks in between.

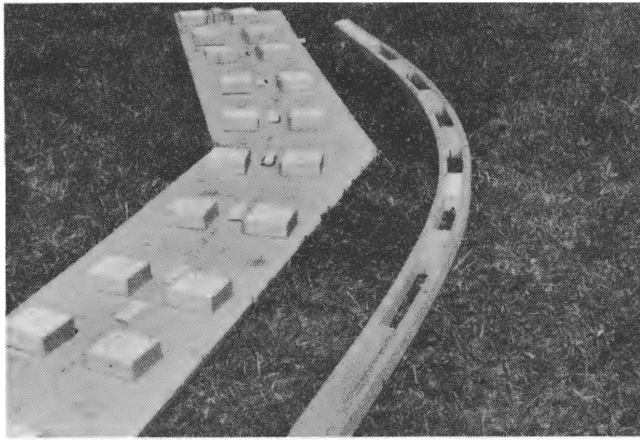
4. Water-resistant glue can be used between the strips and the spacer blocks, and between the strips to increase the strength of the rafter.

5. Nail the strips to the 2"x2"x6" spacer blocks from each side near the ends and in the center with 6-penny, cement coated nails, using 3 or more nails in each side of the block.



6. Cut the rafter ends to correspond exactly with the pattern. Remove the completed rafter from the jig and proceed with the building of all the rafters needed for the project.





### THE FOUNDATION

#### CONCRETE

1. Lay out the 12'x15' foundation, making sure it has square corners; diagonal outside corner to corner measurements should be exactly 19'-2½" when square.

2. Excavate for the footing by digging a 10"-wide trench at least 9" deep.

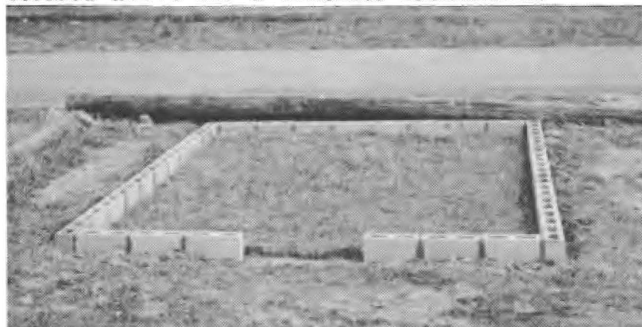
3. For a concrete foundation, the wall has to be formed with 2" lumber. Wire form boards together to prevent spreading and use spacers to insure uniform 5" wall thickness.



4. Approximately 2 cu. yds. of 6 bag ready-mixed concrete of low water content are required to pour the footing and walls at the same time. Insert anchor bolts (according to the plan) for securing sills to foundation wall.

#### MASONRY BLOCK

1. Lay out and excavate for footing as described above for a concrete foundation.



2. Pour 5 bag ready-mix, or equal, concrete footing according to plan detail.

3. Lay up 6" masonry block wall on the concrete footing and cement anchor bolts in place in the cinder block holes.

4. This foundation requires about 1 cu. yd. of concrete for the footing, 40 cinder blocks, 2 bags of mortar mix, and ¼ cu. yd. of mortar sand.



#### USE WOOD PRESERVATIVES

For longer life, all lumber used in constructing the greenhouse rafters and framework should be treated with a wood preservative that is nontoxic to plants and harmless to the plastic covering. "Cold-soaking" the lumber 36 to 48 hours in a 2% copper naphthenate solution is a satisfactory wood preserving treatment. One or more coats of this solution may also be brushed on the lumber, with the degree of preservation being relative to the amount of copper naphthenate that soaks into the wood. Trade-named copper naphthenate-type wood preservatives are obtainable at local lumber and hardware suppliers.

Do not use creosote, pentachlorophenol, or other wood preservatives toxic to growing plants or harmful to the plastic film covering.

#### CONSTRUCTING THE GREENHOUSE

##### A. Conventional construction method:

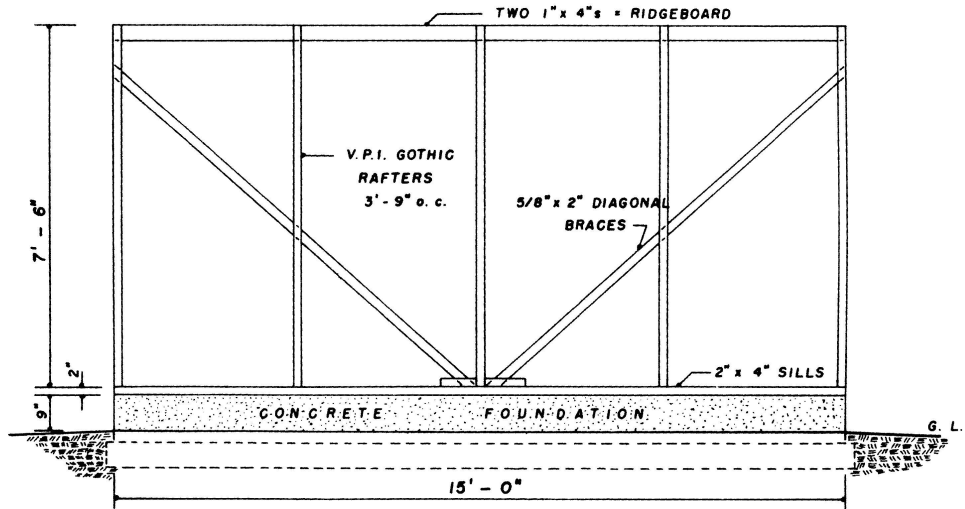
1. Fit the 2"x4" sills on the foundation and secure in place with anchor bolts, washers, and nuts.

2. Mark off rafter locations on sills and ridge-board and nail the respective rafter ends in place. Use 8- and 10-penny cement coated box nails.

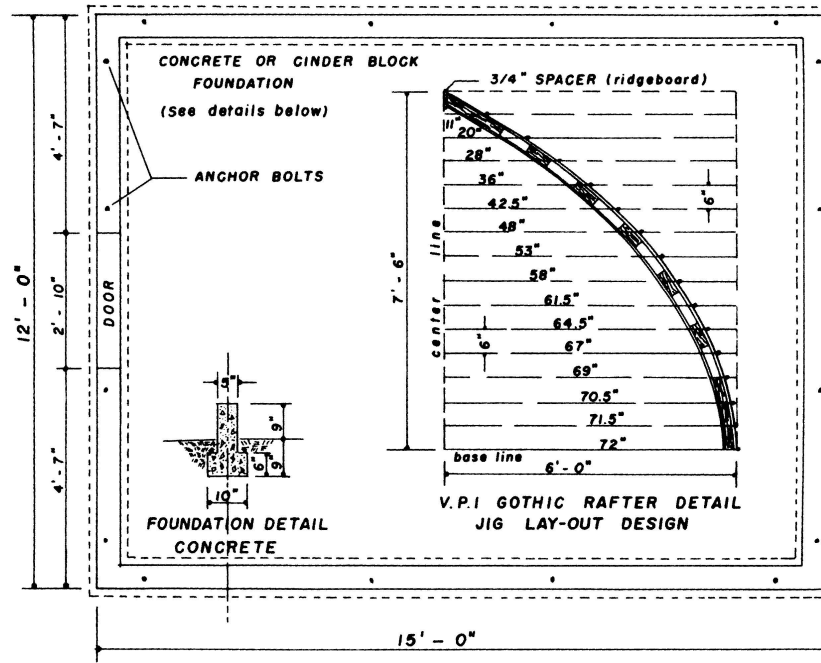
3. Weave the diagonal braces through the rafters from the peak at each end of the house down to the bottom of the center rafter. Straighten and plumb the rafters before nailing or bolting the diagonal braces in place.

4. Frame the ends of the greenhouse, using 2"x4"s. Provide for the 2'6"x6'8" door and the air intakes in one end and openings for fan and heater in the opposite end, as shown in the plan.

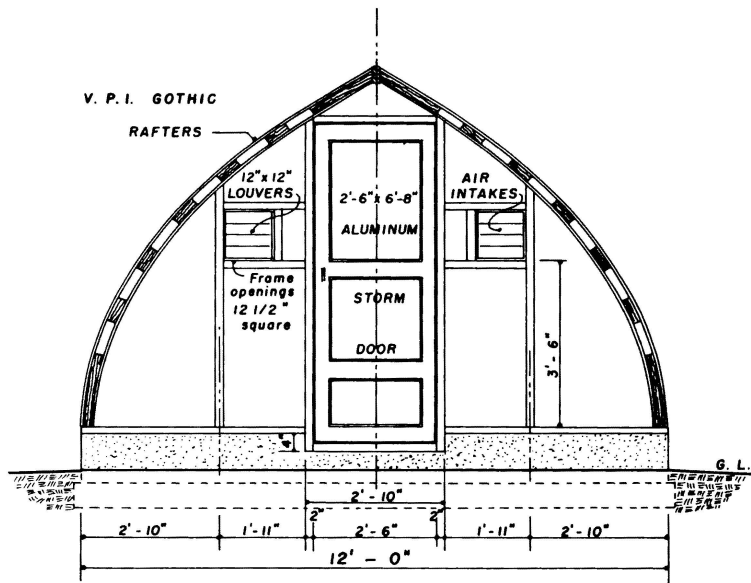
5. The door can be fabricated if desired; how-



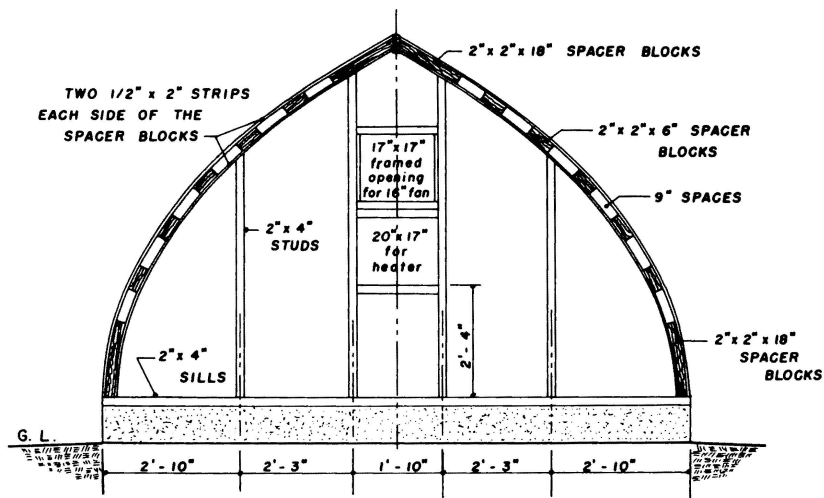
SIDE ELEVATION



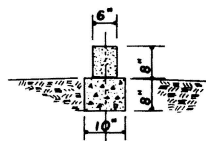
FLOOR PLAN



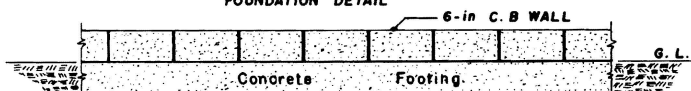
**FRONT ELEVATION**



**BACK ELEVATION**



**FOUNDATION DETAIL**



**ALTERNATE CINDER BLOCK FOUNDATION**

COOPERATIVE EXTENSION WORK IN AGRICULTURE AND  
HOME ECONOMICS  
AGRICULTURAL ENGINEERING DEPARTMENT  
V. P. I. BLACKSBURG, VA  
U. S. DEPT. OF AGRICULTURE COOPERATING

THIS PLAN DEVELOPED BY THE VIRGINIA AGRICULTURAL  
EXPERIMENT STATION BLACKSBURG, VIRGINIA

DATE: 11/65 DRAWN: *M.H.* SHEET: 1 OF 1 PLAN NO. N 3:15 E  
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ever, an aluminum storm door may be purchased at small cost and will provide a neat installation.

**B. Semi-prefabricated construction method:**

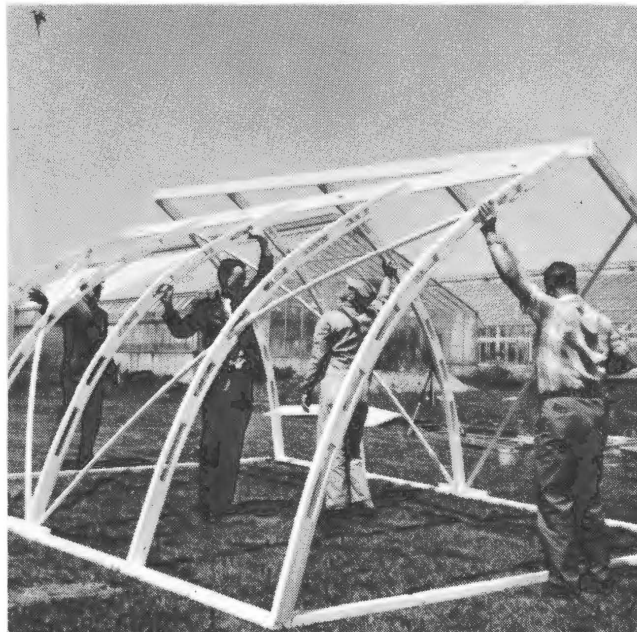
1. Cut the end 2"x4" sills to fit in between the side sills so the house will be exactly 12' wide.

2. Mark off rafter locations on sills and the ridgeboard 1"x4"s. Slots 1/4" deep may be rabbetted out to receive the respective rafter ends.

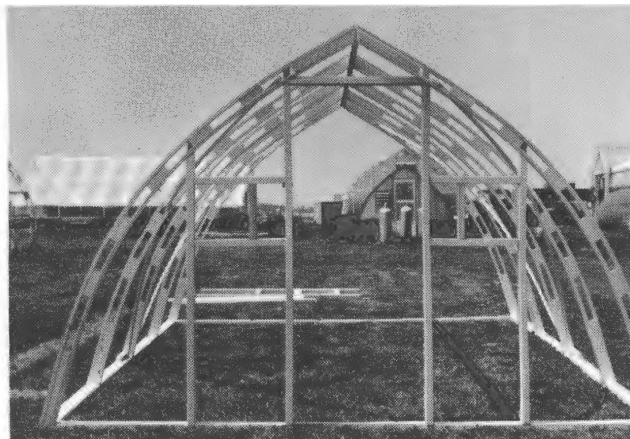
3. Secure rafters to sills and ridgeboards with nails or wood screws. Slip the diagonal braces in place but do not fasten permanently until house is erected and plumbed.



4. Erect the assembled rafter-halves by fastening the ridge-boards together and securing the pre-cut end sills in place. Metal straps are good for fastening the sills together at the corners; wood screws or small bolts may be used.



5. Frame the ends of the greenhouse to provide openings for ventilating fan and heater in one end and 2'6"x6'8" door and air-intake louvers in the opposite end.



6. When completed, the greenhouse can easily be set on the prepared foundation by 4 people.



**PLASTIC COVERING MATERIALS**

Plastic covering materials, of various types and thicknesses, are now being used on lightweight commercial greenhouse structures as economical substitutes for glass. Some films last longer than others; this characteristic is usually reflected in cost of the manufacturing process and cost to the consumer.

**COVERING THE HOUSE WITH PLASTIC FILM**

The most economical covering now in general use is 4-mil ultra-violet inhibited polyethylene film. It will last through one cold weather season, from about October to May. Approximately 550 square feet of film are necessary for the outside covering. The same is required for a recommended inner-liner to conserve heat inside the greenhouse. In applying the outside film



covering, the ends of the greenhouse should be covered first. Use wood lath strips to secure the film to all end-framing members covered; nail on with 4-penny box nails spaced about 6" apart. Cut out film-covered openings, after strips have been applied, for door, fan, and louvers when they are ready to be installed.



Use a 16'x22' sheet of plastic film to cover the sides of the house. Place over the house and position it to obtain complete coverage. Fasten the film to the ridge with lath strips to hold it in place. Then stretch film down over the sides so that it is uniformly smooth and taut; secure at each end-rafter and along the bottom sill with wood lath strips. The intermediate rafters do not need to be stripped but can be, if desired. Also, 4'-wide plastic film can be used, lapping and stripping at each rafter, as an alternate method of covering the greenhouse.



## COVERING THE HOUSE WITH FIBERGLASS

Bending fiberglass sheets to fit the curvature of the gothic rafters presents no problem. Clear fiberglass weighing approximately 5 ounces per square foot should be used. It should be applied with wood screws having neoprene washers; holes should be drilled for the wood screws. The manufacturer's instructions for application should be followed as closely as possible to get a neat and satisfactory installation.

An inner-layer of polyethylene film may be used to reduce heating costs.

In areas where heavy snow accumulation is likely to be a problem, sidewalls of plywood or masonry blocks may be built up 18" to 30".



## VENTILATING AND HEATING

Automatic ventilating and heating systems are desirable to avoid giving constant attention to the control of inside environmental conditions. A 16" exhaust-type fan with gravity shutter, motorized air intake louvers in the opposite end of the greenhouse, and a gas-fired, forced warm-air furnace constitute such an automatic system. A SPDT heating-cooling thermostat can be used to control the system.

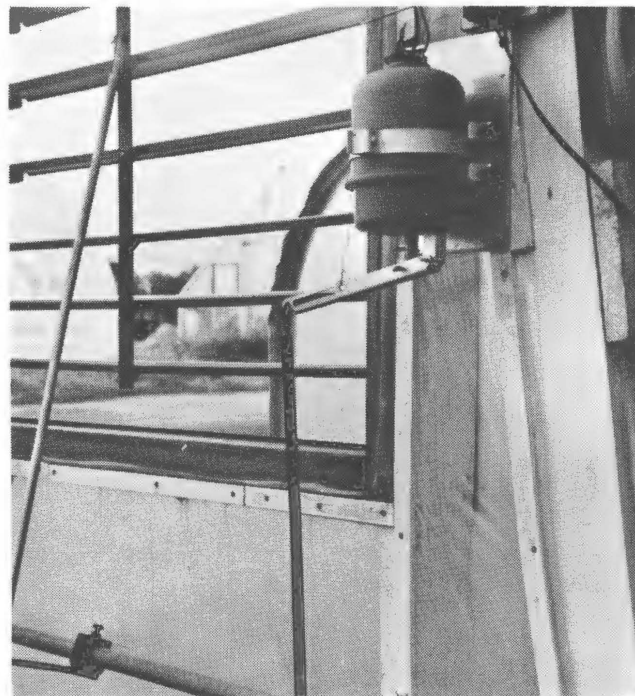
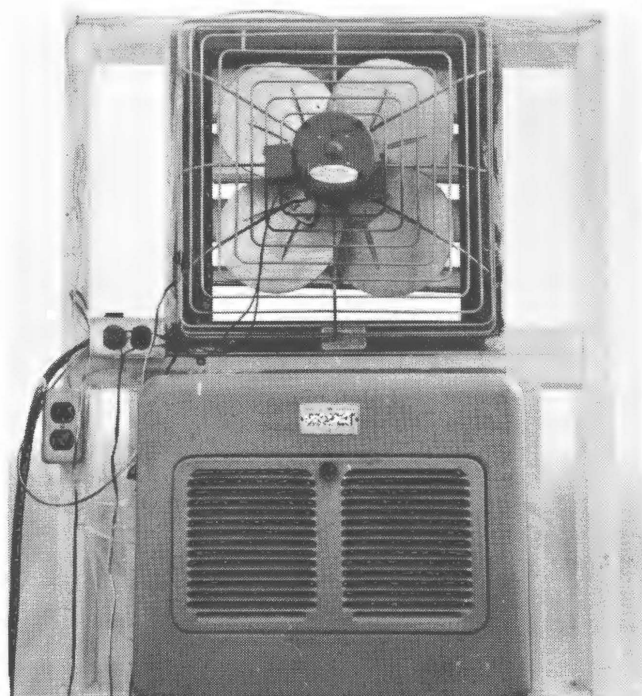
Motorized air intake louvers require mechanical linkage from the damper-type motor to the louver. They may be controlled by a separate thermostat or by the one that operates the exhaust fan.

Heating equipment should maintain the desired temperature in the greenhouse. Four 1,650-watt electric space heaters with fans and thermostat have been used to heat a 12'x15' gothic greenhouse. Properly vented oil-burning space heaters, with proper care and attention, may also be



used for heating. Adjacent to a residence, it may be possible to heat the greenhouse from the home heating system. In Virginia, the heat loss

from a 12'x15' double-layer plastic film covered greenhouse is approximately 20,000 btu per hour in coldest weather.



#### SUMMARY

The gothic greenhouse for town and country offers gardening enthusiasts an opportunity to extend their enjoyment throughout the entire year. Successful greenhouse gardening, however, demands proper attention to the details of heating, watering, and ventilation. Extension Circular 764, "Starting Early Plants," gives techniques of seeding and transplanting and should be useful to the greenhouse gardener.

Trade and brand names are used only for the purpose of information and the Cooperative Agricultural Extension Service does not guarantee nor warrant the standard of the product, nor does it imply approval of the product to the exclusion of others which may also be suitable.





ISSUED IN FURTHERANCE OF COOPERATIVE EXTENSION WORK, ACTS OF MAY 8 AND JUNE 30, 1914, IN COOPERATION WITH THE U. S. DEPARTMENT OF AGRICULTURE. W. E. SKELTON, DIRECTOR OF EXTENSION SERVICE, VIRGINIA POLYTECHNIC INSTITUTE, BLACKSBURG, VIRGINIA 24061.