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Small Plastic Greenhouses

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by: James F. Thompson

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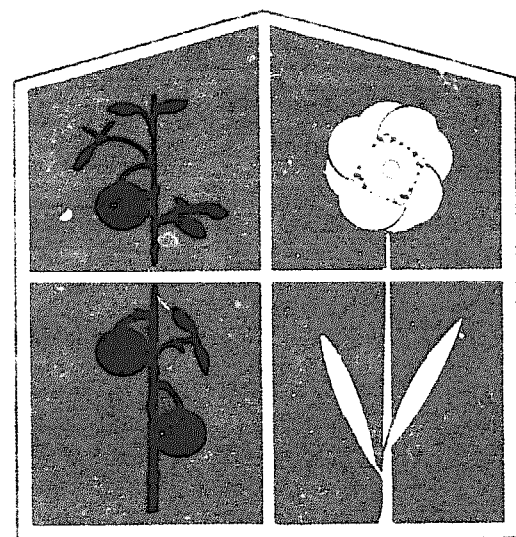
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SMALL PLASTIC GREENHOUSES



Division of Agricultural Sciences
UNIVERSITY OF CALIFORNIA

LEAFLET
2387

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The author is James F. Thompson, Extension Agricultural Engineer, Davis.

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SMALL PLASTIC GREENHOUSES

Many home gardeners find a small greenhouse a relaxing hobby as well as very useful. It can be used to root cuttings and germinate seeds for the outdoor garden, special flowers or ornamentals can be raised, and vegetables can be grown out of season. A carefully chosen and attractive greenhouse can provide many hours of enjoyment. However, before building one, be sure to consider:

- location
- type of construction
- heating and ventilating
- maintenance

LOCATION

A sunny location is best. Locate the house as far from trees as practical. A southern or southeastern exposure is best for maximum light during the winter.

The greenhouse should be convenient to water, fuel for heating, and electricity. The area should be well drained.

TYPES OF GREENHOUSES

Almost everyone can find a greenhouse style to suit his needs. There is a bewildering variety of sizes, shapes, and styles. Greenhouses range from window-box size to 20 or 30 feet wide and 100 or more feet long. The size you choose depends on the area available, how much greenhouse gardening you wish to do, and the cost.

Gothic arch, rigid frame, air supported, shed roof, and conventional pitched roof are just a few of the available shapes. A greenhouse that fits both existing landscape and personal preference dictates the choice. Greenhouses are made with glass, fiberglass, polyethylene, or vinyl coverings. Wood, steel, and aluminum are used for framing.

Glass

Glass houses are very attractive, permanent, and expensive. These houses should be built by a greenhouse manufacturer or purchased in a ready-to-assemble package because they are difficult to construct. Any gardening magazine advertises companies selling these houses.

Fiberglass

Houses covered with fiberglass are durable, attractive, and moderately priced. They are commercially available or can be designed and built by the home handyman. Only transparent or translucent fiberglass weighing 4 to 5 ounces per square foot should be used. Most manufacturers sell a fiberglass made for greenhouses and it should be guaranteed for 10 to 20 years. Except for shading, lower grades and colored panels should be avoided.

Film Plastic

Film-plastic-covered greenhouses are inexpensive and temporary. They are less attractive and require more maintenance than other styles. Clear polyethylene, 4 or 6 mils (0.004 to 0.006 inch) thick, is most commonly used because it is inexpensive and readily available. Unfortunately polyethylene only lasts from 3 to 8 months because it is rapidly broken down by ultraviolet radiation from the sun. Polyethylene treated with an ultraviolet (UV) inhibitor is slightly more expensive but will last 3 to 6 months longer than the regular polyethylene. This film should be used if the greenhouse is to be covered in the summer or fall.

Longer lasting film plastics are available, but they have other disadvantages besides being more expensive. If more permanence is desired, the house can be covered with fiberglass. Polyethylene film costs 2 to 3 cents per square foot, fiberglass, 40 to 60 cents per square foot.

GREENHOUSE CONSTRUCTION

Use seasoned, construction-grade lumber when building the greenhouses described here. Redwood or Douglas-fir is best.

Paint the framework with a white exterior paint to improve appearance and reflect more light.

Posts and wood that touch the ground should be treated with copper naphthenate preservative. Do not use creosote and pentachlorophenol preservatives because they release vapors harmful to plants.

Polyethylene film should be installed on calm days. Film plastic first tears at the places where it touches the greenhouse frame or where it is folded. Wide, unfolded sheets of plastic are available and should be used. A batten strip at least as wide as the rafter will help extend film life. Double headed nails are often used to fasten the plastic since they are easier to remove.

Two layers of plastic can be installed to reduce heat loss as much as 40 percent and eliminate condensation on the plastic. An inside layer of plastic 2 to 4 mils thick is spaced 1 to 4 inches from the outside layer to create a dead airspace. Closer or wider spacing does not create an effective dead airspace.

Although two layers are difficult to install, they are well worth the trouble. Typically, both layers can be installed on the outside of the framework with a 2x2 spacer placed between the layers where they are fastened to the rafters. One sheet is held by the 2x2 nailed just to hold it in place. The second sheet can then be held with the batten strip and nails driven through the 2x2 and an inch or more into the rafter.

In small greenhouses, the inner layer of plastic can be fastened to the inside framework with staples driven over a string. Simply pulling the string removes the staples.

HEATING

Types of Heaters

The greenhouse must be heated for winter use. Many types of heating systems are available.

Home Heating Systems. If a home heater's capacity is adequate, it can be extended to a small nearby greenhouse. However, the heat demand is different than that of the home so a separate thermostat and control system are required. A heating contractor normally will be needed for installation.

Space-Heaters. Either electric, gas, or oil space-heaters are often used to heat small greenhouses. Heated air is circulated by a fan in the heater. Some space-heaters have no fan and so are rather uneven and ineffective. Depending on the size of unit, space-heaters should not be more than 10 to 30 feet apart to produce uniform heating.

Oil or gas heaters must be vented to the outside since the products of combustion are toxic to plants. Electric heaters are easier to install and are convenient but cost more to operate than gas heaters.

Space-Heaters With Ducts. Recently a heating system has been devised to distribute heat more uniformly through the greenhouse. A space-heater with a fan built for moving air in ducts is attached to a clear polyethylene tube (diameter, 12" to 24") hung overhead. The tube has 2- to 3-inch holes punched along it every 2 or 3 feet. Warmed air is blown into the tube and out the small holes to provide uniform heating. When no heat is needed, the furnace can be shut off and the fan left on to ventilate the greenhouse. The fan-heater unit is located near the end of the greenhouse so outside air will be drawn through a door or opening into the fan and tube to be blown throughout the greenhouse. Usually this equipment is not needed for small greenhouses because space-heaters alone are satisfactory and less expensive. Normally, greenhouses are at least 15 to 20 feet wide and 50 to 100 feet long before this equipment is used.

TABLE OF HEAT REQUIREMENTS FOR GREENHOUSES

(B.t.u.'s of Heat Required per Hour per Square Foot of Exposed Surface)						
Desired Minimum Inside Temperature	Lowest Expected Outside Temperature					
	35	30	25	20	10	0
50	18	24	30	36	48	60
55	24	30	36	42	54	66
60	30	36	42	48	60	72
65	36	42	48	54	66	78
70	42	48	54	60	72	84

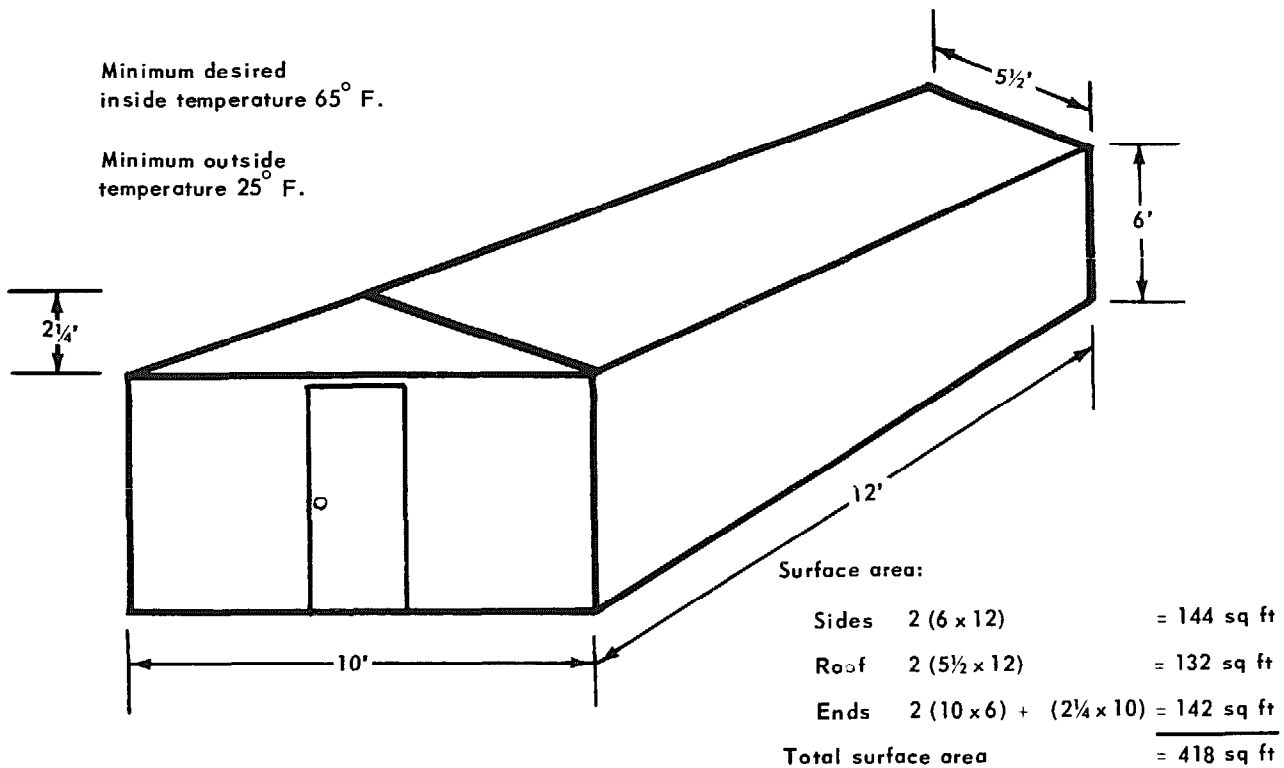
Forced-Air Furnaces. Home forced-air furnaces and ducts are also used to heat larger houses. Clear polyethylene tubes, such as used with the space-heaters and ducts, can be attached to the furnace and hung overhead for distributing the heat. Again, these furnaces must be vented.

wind, quality or tightness of construction, nearness to heated buildings, height of sidewalls, etc. For most construction, each square foot of surface loses 1.2 B.t.u.'s of heat per hour for each degree of temperature difference. The table of heat requirements helps in calculating the heat load.

Amount of Heat

The amount of heat required for a greenhouse depends on the size, minimum outside temperature, minimum temperature required inside, amount of

An example of how the heat requirement is calculated is given in figure 1. In this case a 10- by 12-foot greenhouse needs to be heated 40 degrees above the outside minimum temperature.



From the table — 48 B.t.u./hr/sq ft heat is required or
 48 x 418 = 20,000 B.t.u/hr is the total heat required.

FIGURE 1. How to calculate heat requirement.

Gas or oil heaters are frequently rated according to the total heat input. Some heat escapes through the vent so the usable heat is only about 70 percent of this total. If a gas heater were used in the greenhouse shown in the example, it should have a heat input rating of about

$$\frac{20,000}{0.70} = 28,600 \text{ B.t.u./hr}$$

If two layers of plastic are used, the heat loss is about 70 percent of the loss through a single layer of plastic. If the house in the example is built with a double layer of plastic, the heat requirement would then be $20,000 \times 0.70 = 14,000$ B.t.u./hr. Of course, if a gas heater were used with the double plastic, its heat input would be

$$\frac{14,000}{0.70} = 20,000 \text{ B.t.u./hr}$$

Maintenance and Safety

Choose heaters having a safety switch or safety pilot. Be sure gas heaters are vented.

Clean dust from the burners and ducts before starting heating in the fall.

Check the flame to be sure it is burning with a clear blue color. A yellow flame indicates incomplete combustion and the flame setting should be corrected.

Be sure the thermostat is protected from rain and is operating.

For greater heater efficiency keep the greenhouse doors closed and patch all holes.

VENTILATION AND COOLING

Greenhouses must have air movement for cooling. In winter, air movement is needed to reduce excess humidity, condensation, and dripping of moisture from the roof. Either greenhouse vents or fans can be used.

Vents. A continuous vent at the top or ridge of the greenhouse, combined with vents on the sides, gives the most effective natural ventilation. For small greenhouses, a 1- to 2-foot wide vent is

adequate. In larger greenhouses, a ridge vent $\frac{1}{8}$ the width of the house should be used. For example, if a house is 24 feet wide, at least a 3-foot-wide ($\frac{1}{8} \times 24$) ridge vent should be used.

Side vents are often not used in houses less than 15 feet long, since an open door or a few holes at each end allows enough air to enter on hot days. For very small houses, like those on plans 5941 and 5946, smaller ridge vents, open doors, or end vents provide enough ventilation.

Ridge vents should be opened slightly in cold weather to allow some moisture-laden air to escape. With no ventilation, humidity in the greenhouse becomes too high and condensation, drip, and disease become severe problems.

Circulating Fans. Sometimes small fans are used to circulate air within the greenhouse to try to eliminate stagnant air pockets. These fans should only be used to correct a poorly designed heating and ventilating system. In small greenhouses and in greenhouses with good heating and ventilation systems, they are not of much use.

Cooling Fans. More positive air control is needed if the greenhouse is used in the summer. Fans will ventilate even on a calm, hot, summer day. Also, fans are easier to control automatically than vents. However, fans are more expensive and not normally used except in large houses. The fan exhausts the air from the house, and during warm weather it should change the air once every minute.

Cooling Pads. In large houses, a wetted aspen-fiber pad can be placed at one end and fans at the other to provide additional cooling. As the air is drawn through the wet pad it is cooled by evaporation—as much as 30 degrees on hot days. If additional cooling is needed in small greenhouses, a package evaporative cooler is more satisfactory. The cooler can be mounted to blow cool air into the house at one end and the door opened on the opposite end to exhaust the air. Coolers should change the air once per minute. The volume of the house shown in the heating example is 855 cubic feet—the amount of air a cooler for this house would need to deliver per minute.

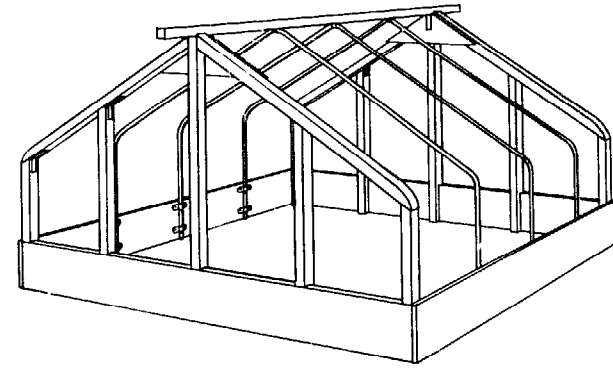
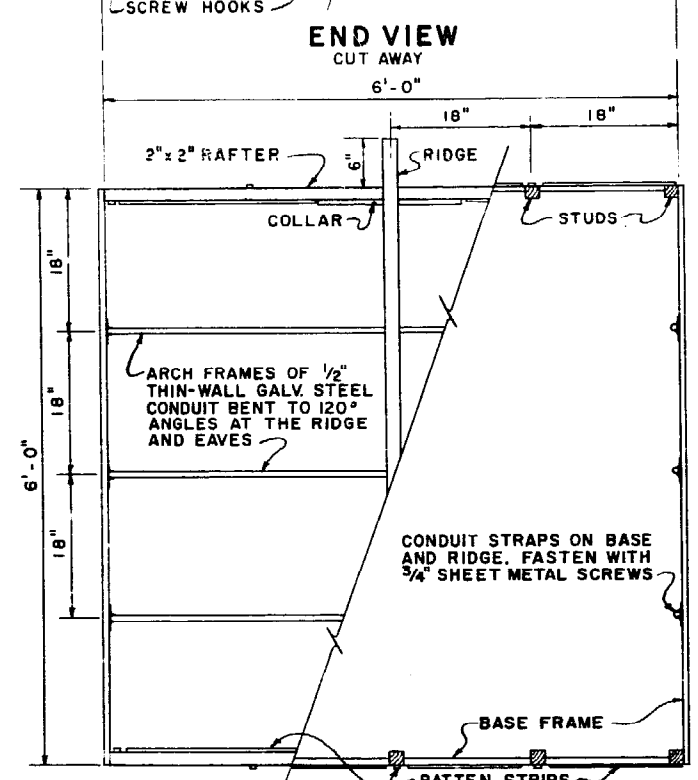
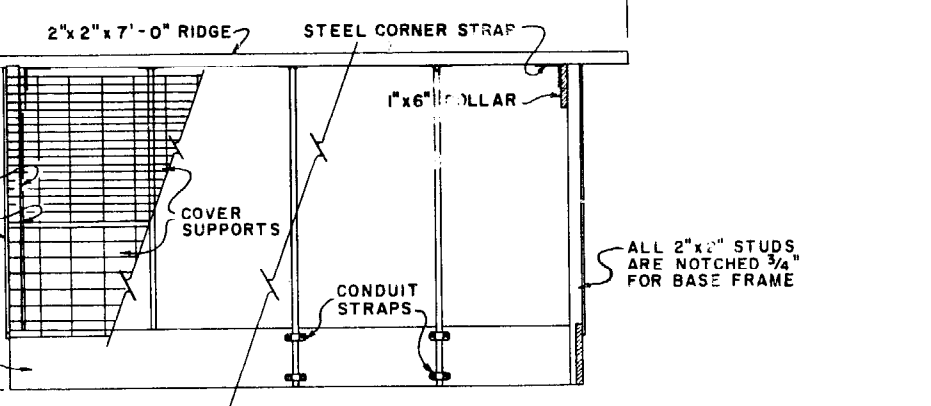
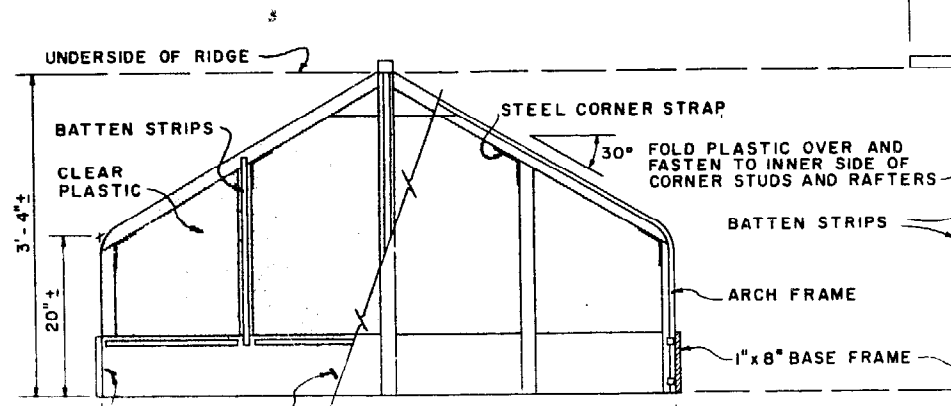
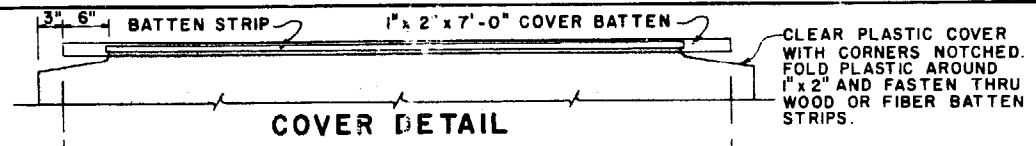
Shading. Shades, of course, besides reducing light, reduce the heat load in greenhouses. Shading compounds that are sprayed or painted on the greenhouse and aluminum, fiberglass, plastic, or wooden screens and panels are available. Partial shading does not normally reduce summer light enough to reduce growth, but it is a good way to reduce the heat load.

Humidification. During hot days the humidity in a greenhouse can become so low that plants are severely dehydrated and even ruined. Moreover, some tropical foliage plants and orchids grow best in high humidities. The least expensive way to increase humidity is to frequently water the gravel under benches and in walkways. Water nozzles that periodically spray a fine mist are also very effective humidifiers. The nozzles can be automated with a timer clock and electric valve.

A time cycle of 1 minute on and 5 to 10 minutes off is common. Commercial greenhouse humidifier units can also be used.

Automation

Watering, heating, cooling, fertilizing and humidifying can all be done automatically. Only the budget limits how many chores are automated. Some people prefer to control all of these operations themselves, considering this part of the enjoyment of the greenhouse. However, some jobs are better handled by automatic controls. Heaters should be controlled by a thermostat. Vents or fans can also be thermostatically controlled, but this is not as necessary. Other automation is nice to have but the heating and ventilation system should be automated first.



DUE TO POSSIBLE VARIATIONS IN ANGLES WHEN THE CONDUIT IS BENT FOR ARCH FRAMES, CHECK THE HEIGHTS SHOWN USING AN ARCH FRAME AS A TEMPLATE.

ALL WOOD SHOULD BE TREATED WITH PRESERVATIVE AFTER CUTTING AND BEFORE ASSEMBLY.

METAL PARTS AND FASTENINGS TO BE GALVANIZED OR OTHERWISE RESISTANT TO CORROSION.

METAL PARTS TO BE FASTENED WITH SCREWS.

WOOD PARTS MAY BE FASTENED WITH SCREWS OR WITH NAILS, CLINCHED WHERE POSSIBLE.

PLASTIC MAY BE FASTENED THRU THE BATTEN STRIPS WITH NAILS, SCREWS OR STAPLES.

SIDE AND TOP COVER SUPPORTS ARE 2 x 4 INCH WELDED WIRE MESH, HOOKED TOGETHER IN PAIRS AND HINGED LOOSELY TO THE RIDGE WITH STRONG CORD.

PERSPECTIVE VIEW
FRAMING ONLY

MATERIAL LIST

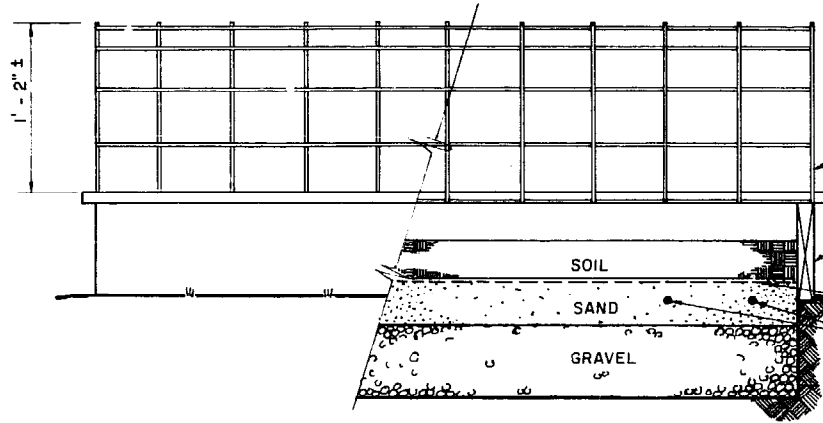
ITEM	QUANTITY	SIZE
BASE FRAME	4 PCS	1" x 8" - 6'-0" LONG
COLLARS	1 "	1" x 6" - 2'-8" "
RIDGE	1 "	2" x 2" - 7'-0" "
RAFTERS	4 "	" - 3'-6" "
STUDS (CENTER)	2 "	" - 3'-4" "
" (OTHER)	4 "	" - 4'-0" "
COVER BATTENS	4 "	1" x 2" - 7'-0" "
ARCH FRAMES	3 "	1/2" DIA. 10'-0" "
CONDUIT STRAPS	15 "	1/2" "
CORNER STRAPS	10 "	1/8" x 1" x 6" "
PLASTIC (ENDS)	2 "	3'-0" x 6'-6" "
" (COVERS)	2 "	6'-0" x 7'-6" "
COVER SUPPORTS	2 "	3'-0" x 6'-0" "
"	2 "	1'-4" x 6'-0" "
BATTEN STRIPS		
SCREW HOOKS	8	
FASTENINGS	SEE NOTES	
SOIL HEATING CABLE	1	360 W. - 120'-0" "

COOPERATIVE EXTENSION WORK IN
AGRICULTURE AND HOME ECONOMICS

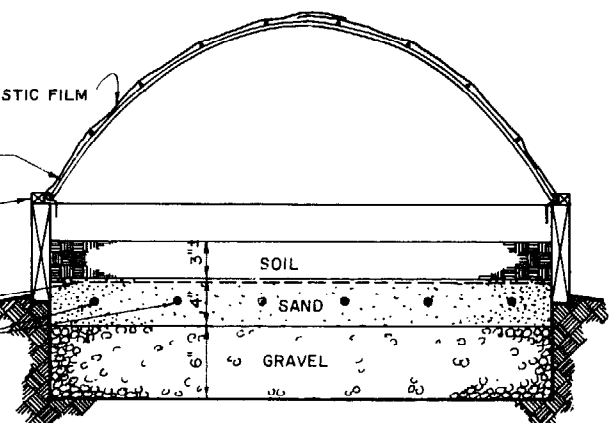
AND
UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

HOTBED & PROPAGATING FRAME

USDA '64 EX. 5971 SHEET 1 OF 1



SIDE VIEW
CUT AWAY



END VIEW
SECTION

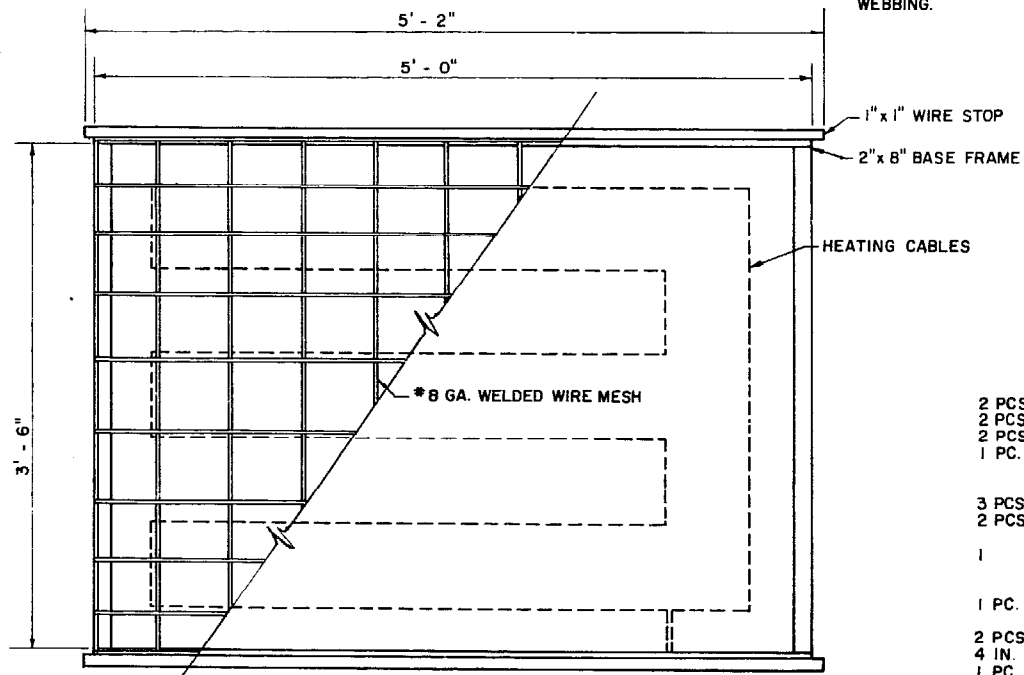
NOTE: SEPARATION OF HEATING CABLES IS VARIABLE TO AMOUNT OF HEAT NEEDED PER SQ. FT. ACCORDING TO GEOGRAPHIC LOCATION. REFER TO LEAFLET NO. 445 U.S.D.A.

ALL WOOD SHOULD BE TREATED WITH PRESERVATIVE AFTER CUTTING AND BEFORE ASSEMBLY.

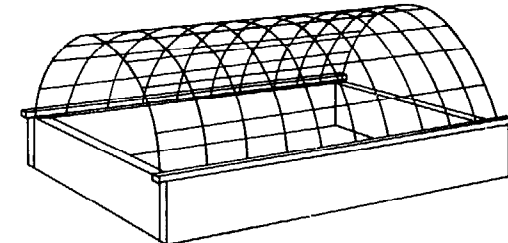
METAL PARTS AND FASTENINGS TO BE GALVANIZED OR OTHERWISE RESISTANT TO CORROSION.

WOOD PARTS MAY BE FASTENED WITH SCREWS OR WITH NAILS.

PLASTIC MAY BE FASTENED BY CLOTHES PINS OR BY PLASTIC WEBBING.



TOP VIEW
CUT AWAY



PERSPECTIVE VIEW
NOT TO SCALE

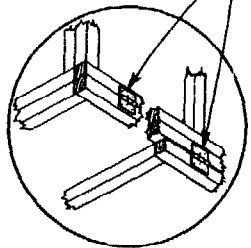
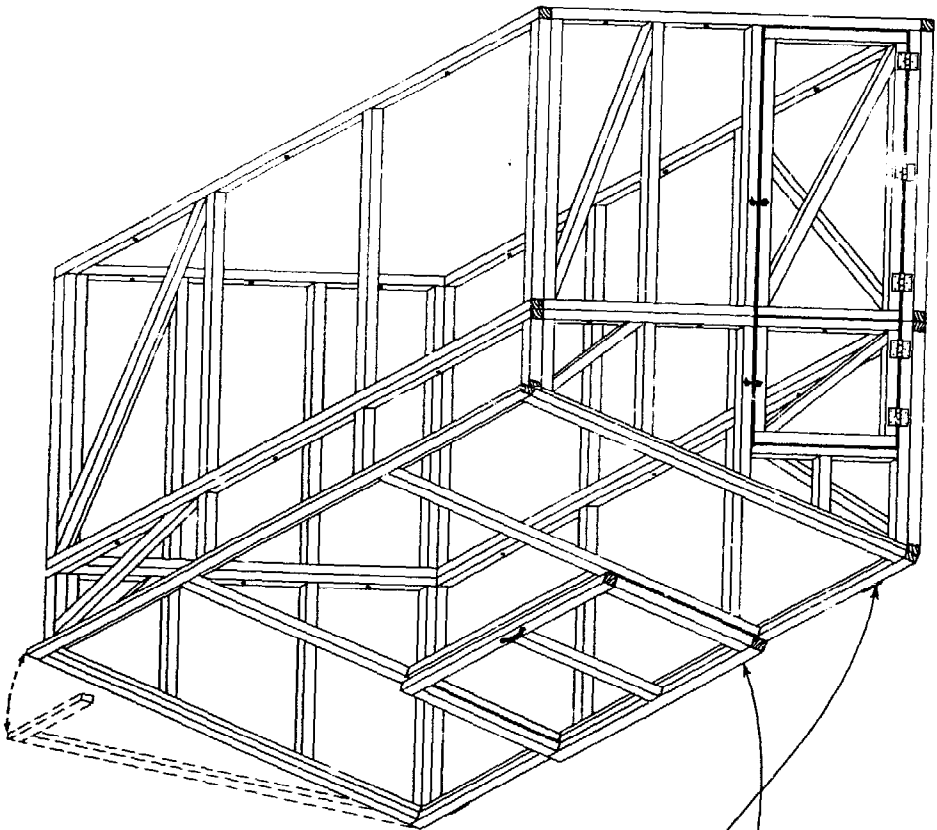
MATERIAL LIST

- 2 PCS. 2" x 8" - 5' LONG FOR SIDES
- 2 PCS. 2" x 8" - 3' - 6" LONG FOR ENDS
- 2 PCS. 1" x 1" WIRE STOP - 5' - 2" LONG FOR SIDES
- 1 PC. NO. 8 GAUGE 6"x6" WELDED WIRE, 5' LONG 4' - 6" WIDE FOR TOP OF WOOD FRAME TO SUPPORT PLASTIC FILM.
- 3 PCS. PLASTIC WEBBING 2" WIDE - 5' LONG
- 2 PCS. PLASTIC FILM, 4 MIL, CLEAR 3' WIDE 7' LONG.
- 1 360-WATT SOIL HEATING CABLE, THERMOSTATICALLY CONTROLLED TO SHUT OFF AT 70°F.
- 1 PC. WHITE PLASTIC FILM, 4 MIL, 5'x8' FOR COVERING FRAME DURING WINTER.
- 2 PCS. CHEESE CLOTH, 3'x7'
- 4 IN. SAND - 2" ABOVE, 2" BELOW HEATING CABLE
- 1 PC. 1/2" HARDWARE CLOTH, 5' x 3 1/2'

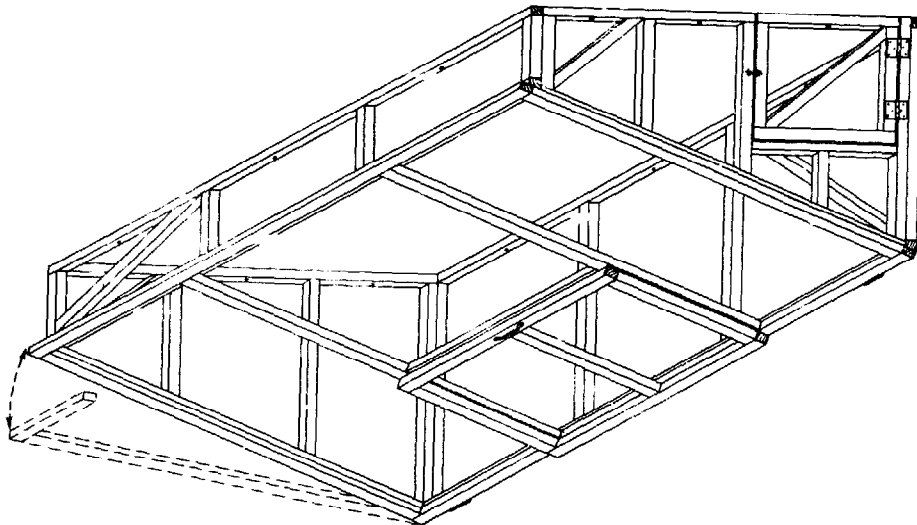
COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS		
AND UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING		
MINI-HOTBED AND PROPAGATING FRAME		
U.S.D.A. '69	6080	SHEET 1 OF 1

COOPERATIVE EXTENSION WORK IN
 AGRICULTURE AND HOME ECONOMICS
 UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING
 AND
 PLASTIC COVERED
GREENHOUSE-GOLDFRAME
 SHEET 1 OF 2 EX. 5941 ORG. '62

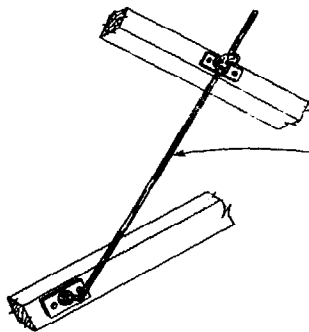
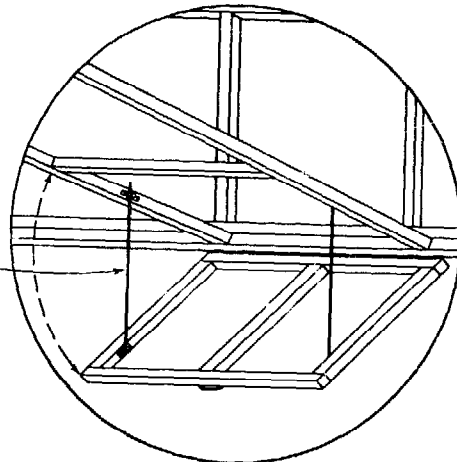
GREENHOUSE ASSEMBLY

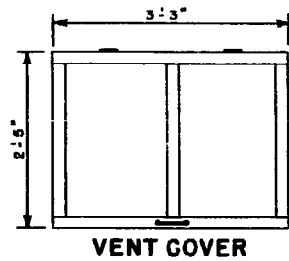
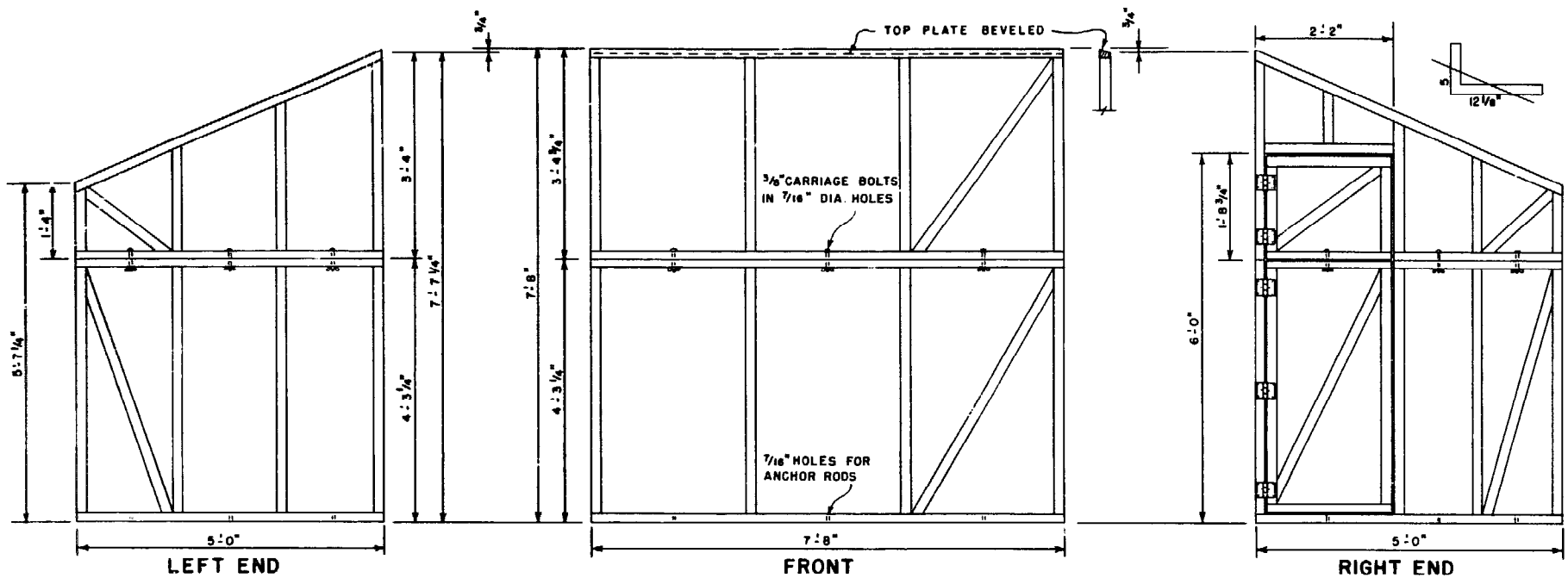


GOLDFRAME UNIT



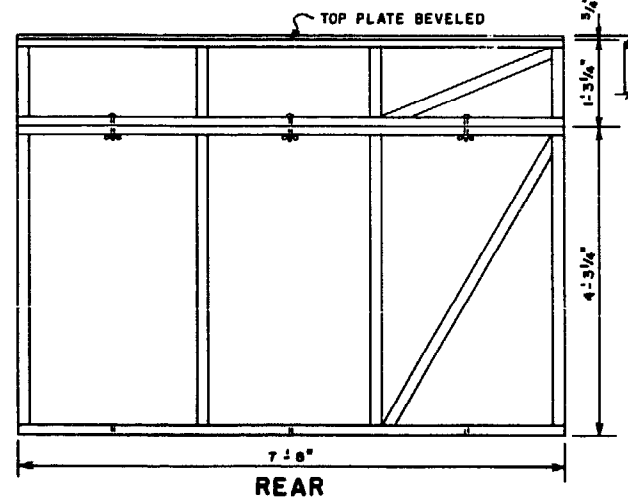
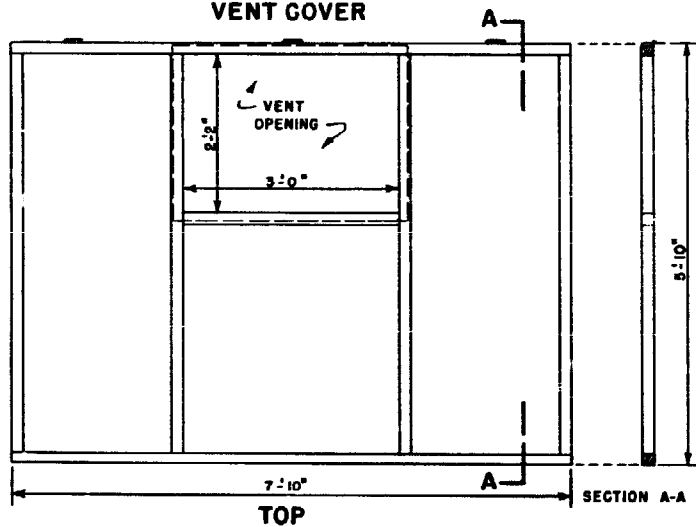
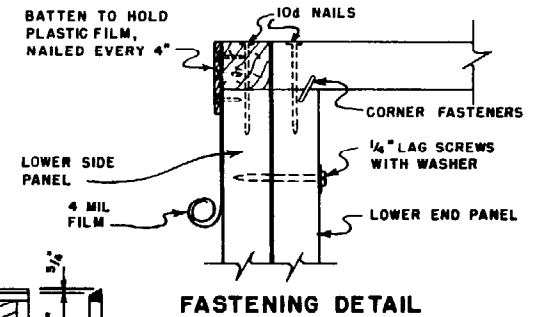
VENT OPEN





PANEL FRAMING DETAILS

ALL FRAMING MEMBERS ARE 2" x 2", TREATED WITH PRESERVATIVE AFTER CUTTING. CHECK ALL DIMENSIONS ON THE JOB. ANCHOR TO GROUND WITH 3/8" x 15" STEEL RODS WITH TOP 2" BENT 90°. 5 PAIR 3" x 3" LOOSE-PIN BUTT HINGES ARE REQ'D.

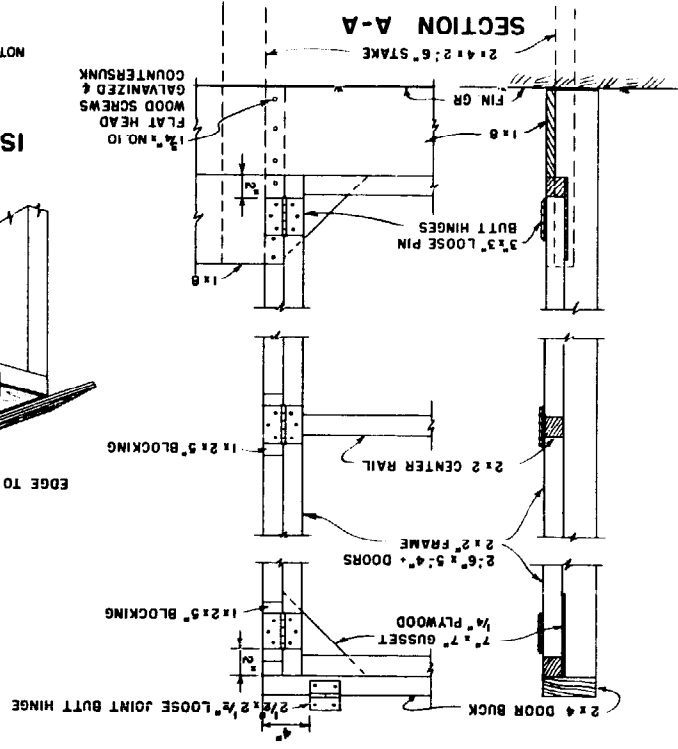
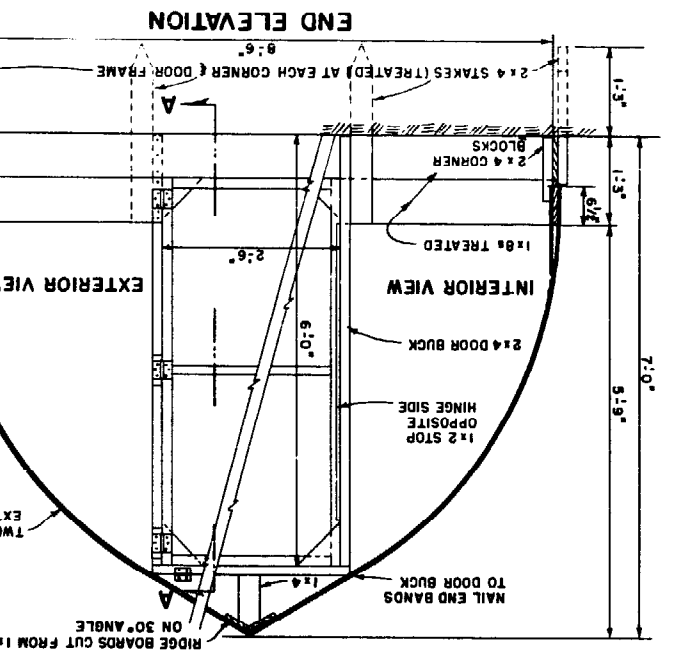
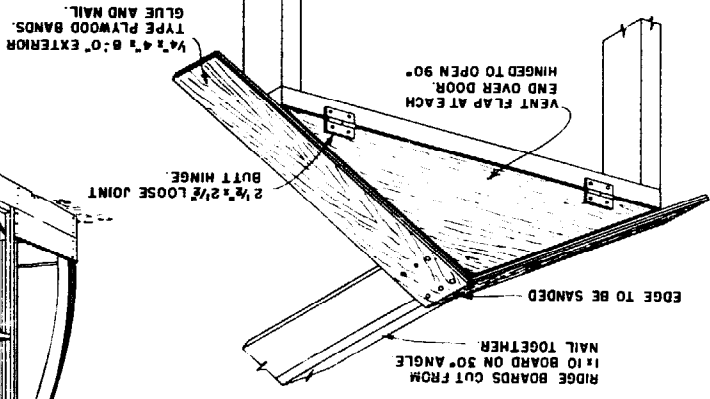
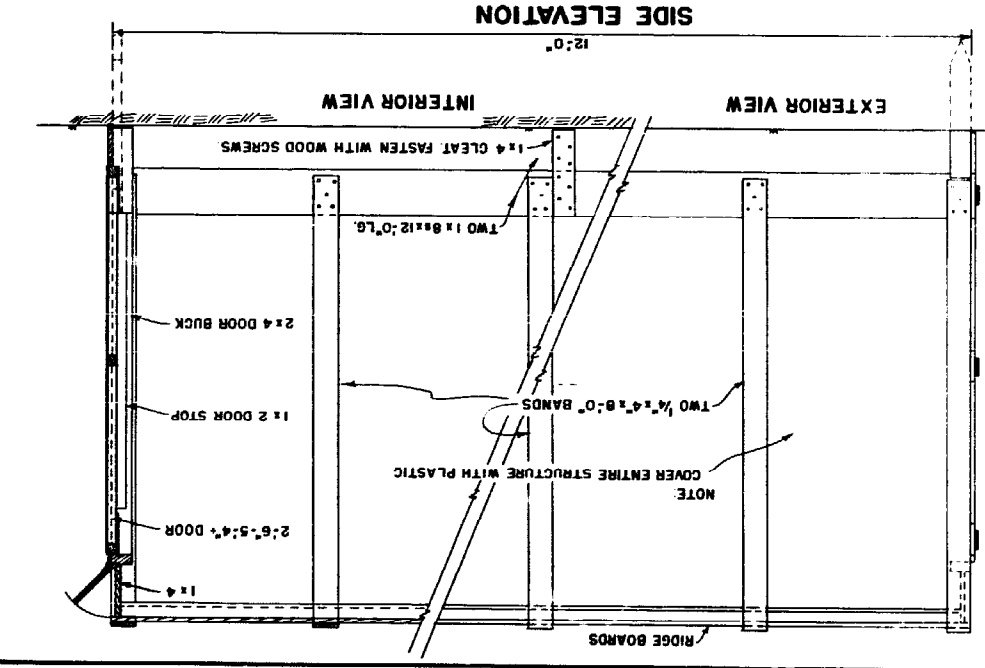
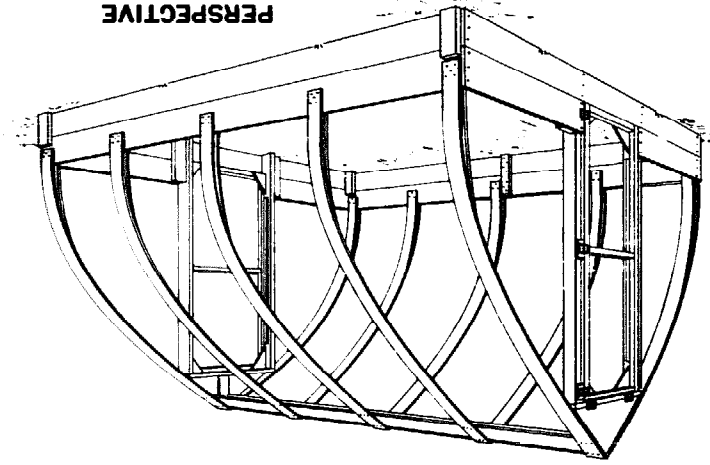


COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS

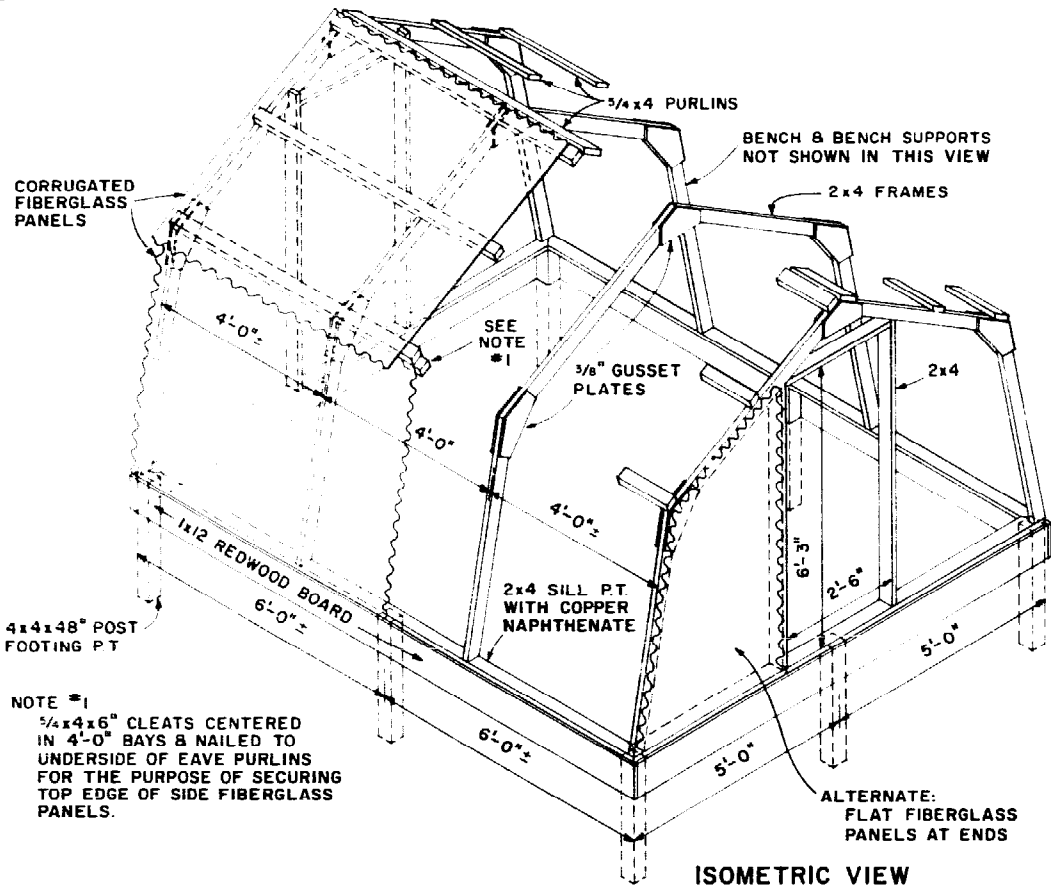
AND UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

PLASTIC COVERED GREENHOUSE - COLDFRAME

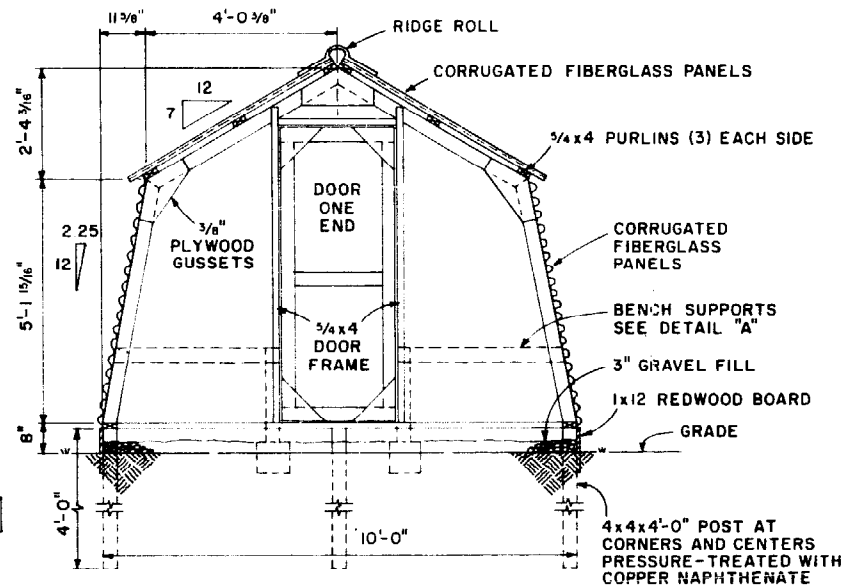
ORE. '62 EX. 5941 SHEET 2 OF 2



NOTE: COVER DOOR WITH PLASTIC FASTEN ENTIRE STRUCTURE TOGETHER WITH WOOD SCREWS UNLESS OTHERWISE NOTED. ALL SCREWS TO BE GALVANIZED



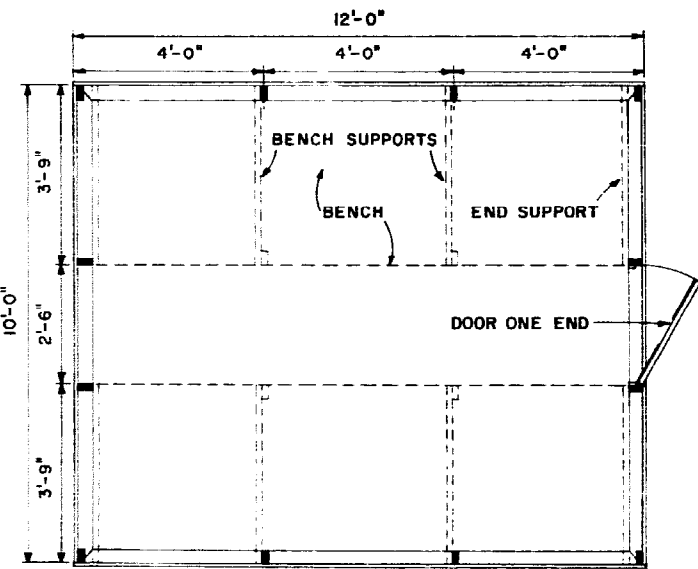
NOTE #1
 1/4 x 4 x 6" CLEATS CENTERED IN 4'-0" BAYS & NAILED TO UNDERSIDE OF EAVE PURLINS FOR THE PURPOSE OF SECURING TOP EDGE OF SIDE FIBERGLASS PANELS.



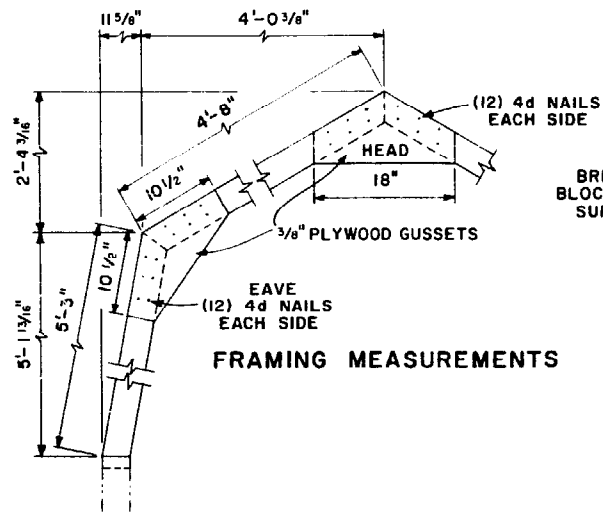
CROSS SECTION

ALTERNATE:
 FLAT FIBERGLASS PANELS AT ENDS

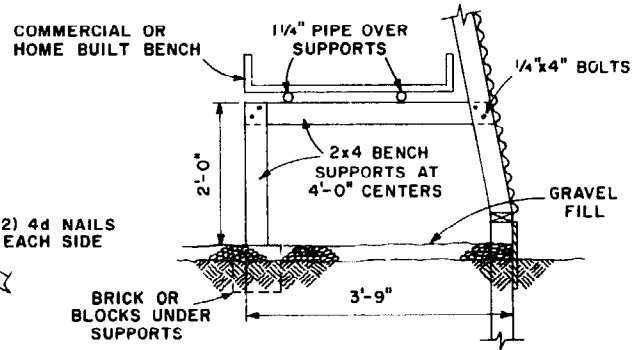
ISOMETRIC VIEW



PLAN



FRAMING MEASUREMENTS



DETAIL "A"

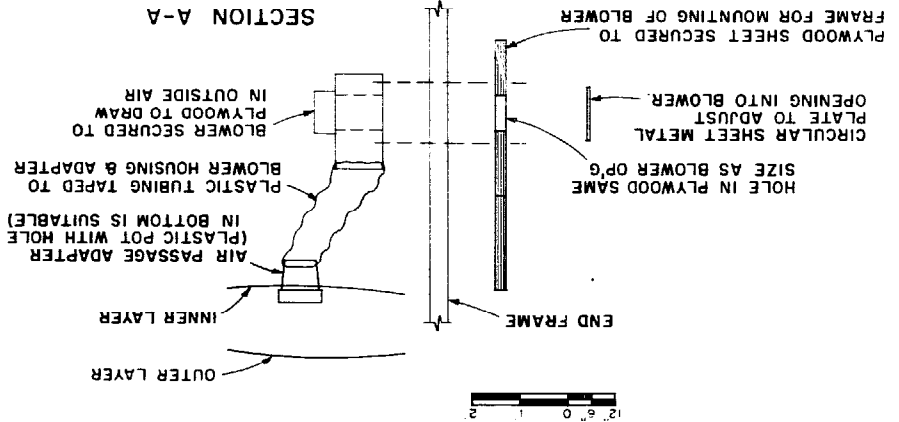
COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS			
AND UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING			
HOME GREENHOUSE			
N J	74	6181	SHEET 1 OF 2

BASED ON: UNIV. OF ILL. CIR. 880 & RUTGERS PLAN NO. 158

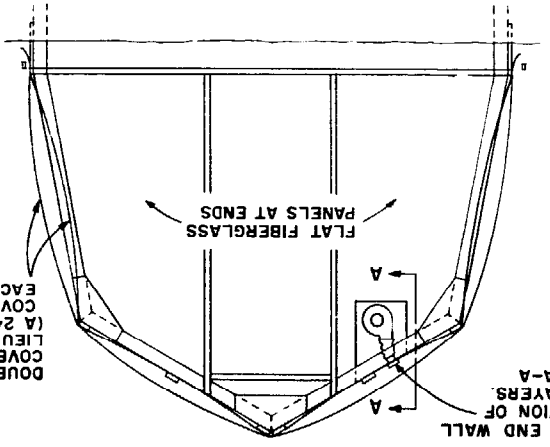
HEATING: TO MAINTAIN A TEMPERATURE DIFFERENCE OF 60° BETWEEN INSIDE & OUTSIDE 30,000 BTU/HR. SINGLE COVERING 20,000 BTU/HR. DOUBLE COVERING CONNECTION TO HOME HEATING SYSTEM IS MOST DESIRABLE. IF NOT POSSIBLE, USE GAS OR OIL HEATERS VENTED TO THE OUTSIDE. ELECTRIC HEATERS ARE EASY TO INSTALL, CLEAN, BUT EXPENSIVE TO OPERATE. WHEN USING OIL OR GAS, BE SURE TO PROVIDE A FRESH AIR SUPPLY DIRECTLY TO THE HEATER TO SUPPLY OXYGEN FOR COMBUSTION. VENTILATING: REQUIRE A TWO SPEED FAN RATED AT 1000 CFM. AN AUTOMATIC AIR INLET OF 2 SQ. FT. IS REQUIRED. THE FAN CAN BE MOUNTED IN ONE GABLE END AND AIR INLET IN THE OTHER. BOTH SHOULD BE CONTROLLED BY A THERMOSTAT FOR MORE INFORMATION SEE USDA BULLETIN NUMBER 357 "BUILDING HOBBY GREENHOUSES."

ENVIRONMENTAL CONTROL

SECTION A-A



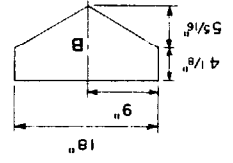
ALTERNATE CROSS SECTION



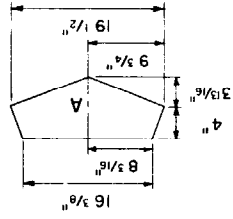
DOUBLE LAYER & MILL PLASTIC COVERING. AIR INFLATED. IN LIEU OF FIBERGLASS PANELS. (A 24x10' ROLL OF PLASTIC WILL COVER HOUSE 4 TIMES. ONCE EACH YEAR FOR 4 YEARS.)

BLOWER AT END WALL FOR INFLATION OF PLASTIC LAYERS. SEE SECT. A-A

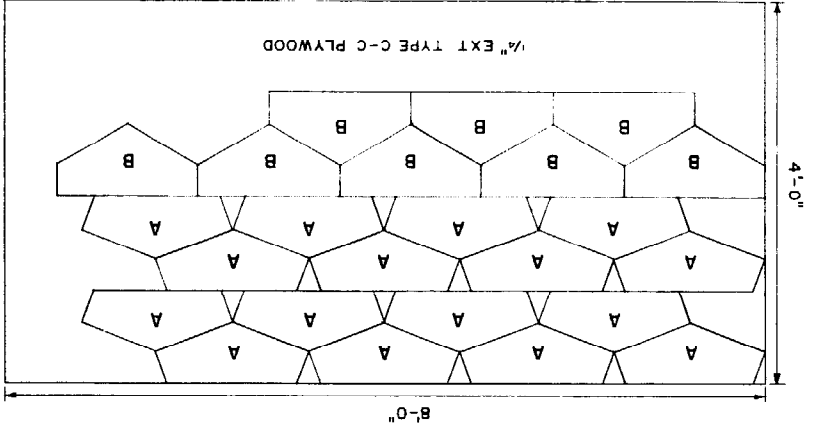
8 REQ'D HEAD GUSSETS



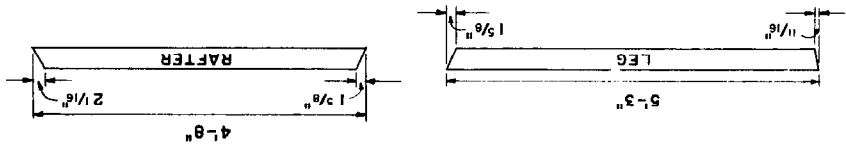
16 REQ'D SIDE GUSSETS



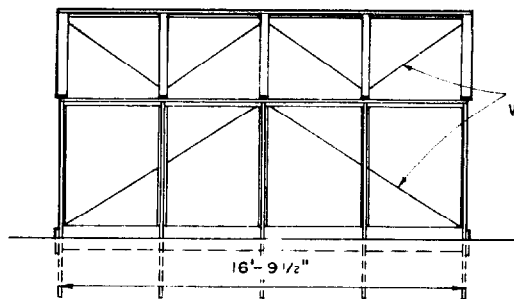
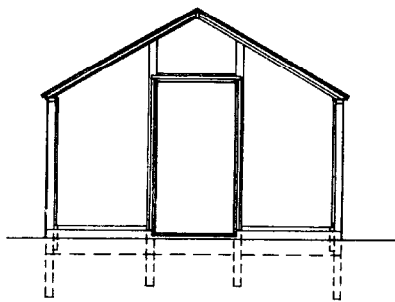
PLYWOOD SHEET CUTTING DIAGRAM



FRAME CUTTING LAYOUT (CUT FROM (8) 2x4x10')

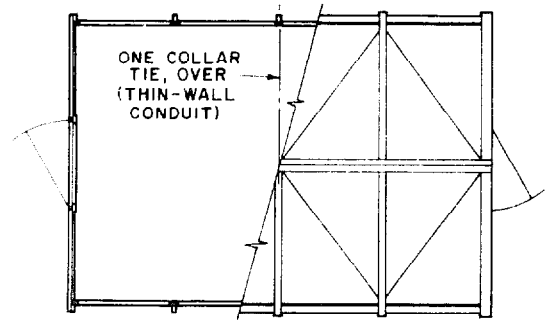
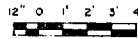


BILL OF MATERIALS
 CORRUGATED FIBERGLASS REINFORCED PANELS (F.R.P.) * 5 OZ. COATING:
 ROOF PANELS (6) 2x10' CUT IN HALF
 SIDE PANELS (5) 2x12' 2 SHEETS EACH SIDE
 5 TH SHEET CUT LENGTHWISE
 END PANELS (9) 2x8' OF WHICH 5 ARE LOCATED AT END WITH NO DOOR
 RIDGE ROLL (1) 12' LENGTH
 LUMBER:
 (8) 2x4x10' TO MAKE FRAMES
 (2) 2x4x10' SILL AT ENDS (PT COPPER NAPHTHENATE)
 (2) 2x4x12' SILL AT SIDES (PT COPPER NAPHTHENATE)
 (2) 2x4x16' END FRAMING
 BENCH SUPPORTS NOT INCLUDED
 (8) 3/4x4x12' FOR PURLINS & DOOR
 (2) 4x4x16' PT POST FOR FOOTINGS
 (2) 1x12x12' B (2) 1x12x10' REDWOOD BOARDS
 (1) 4x8x1/4" EXTERIOR TYPE CC PLYWOOD SHEET FOR PLYWOOD GUSSETS. SEE CUTTING DIAGRAM
 * CHECK WITH FIBERGLASS SUPPLIER FOR NECESSARY RELATED HARDWARE & COVERING INSTRUCTIONS
 NAILS, HINGES & LATCH

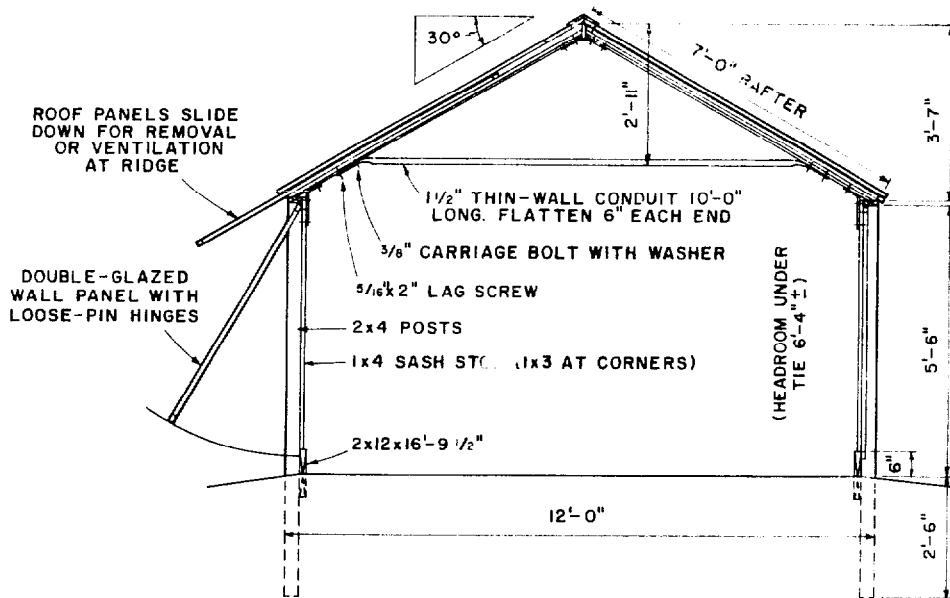


NO 9 GALVANIZED WIRE TIES, TWISTED

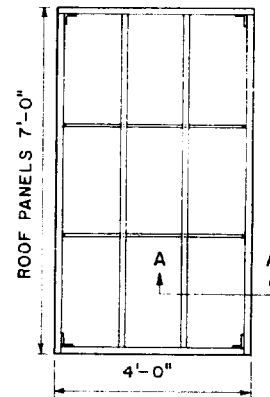
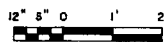
FRAMING ELEVATIONS



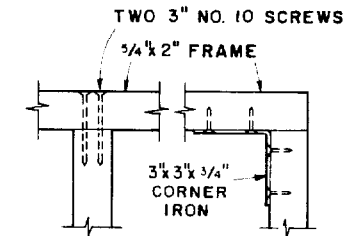
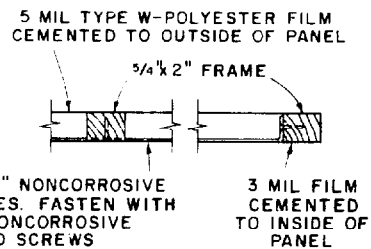
FRAMING PLAN



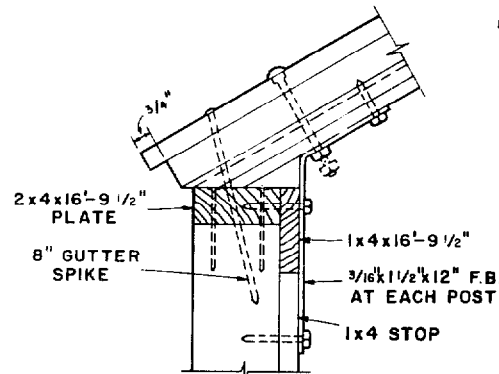
CROSS SECTION



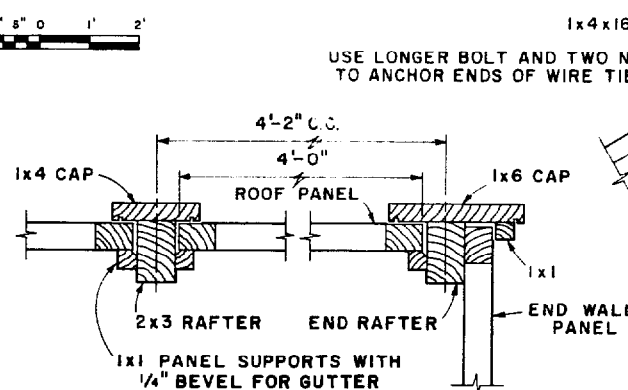
ROOF SASH PANEL



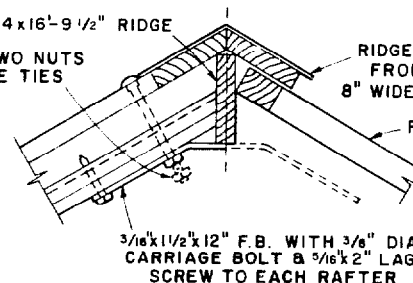
SECTION A-A
NOT TO SCALE



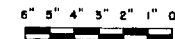
EAVE CONNECTIONS



RAFTER DETAILS

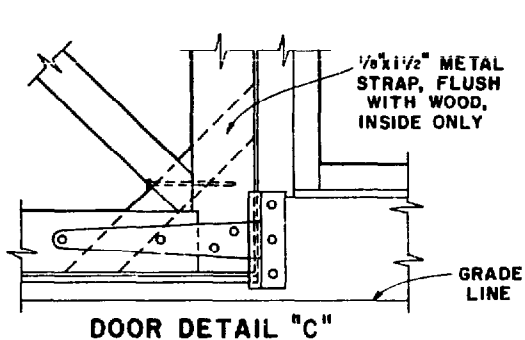


RIDGE DETAIL

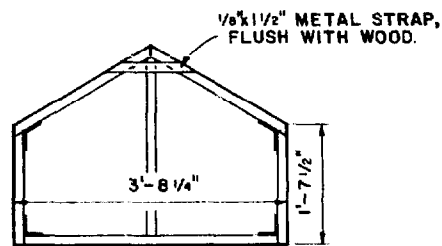


NOTE:
CONSULT LOCAL HEALTH AND BUILDING CODE AUTHORITIES BEFORE STARTING CONSTRUCTION.

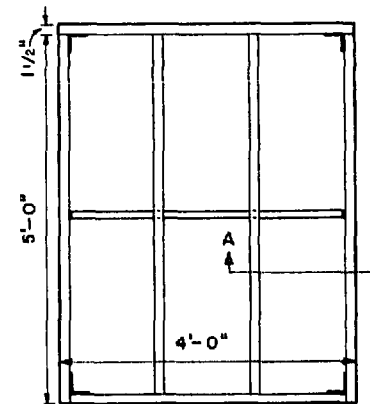
COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS		
AND UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING		
PLASTIC GREENHOUSE		
USDA '76	6251	SHEET 1 OF 2



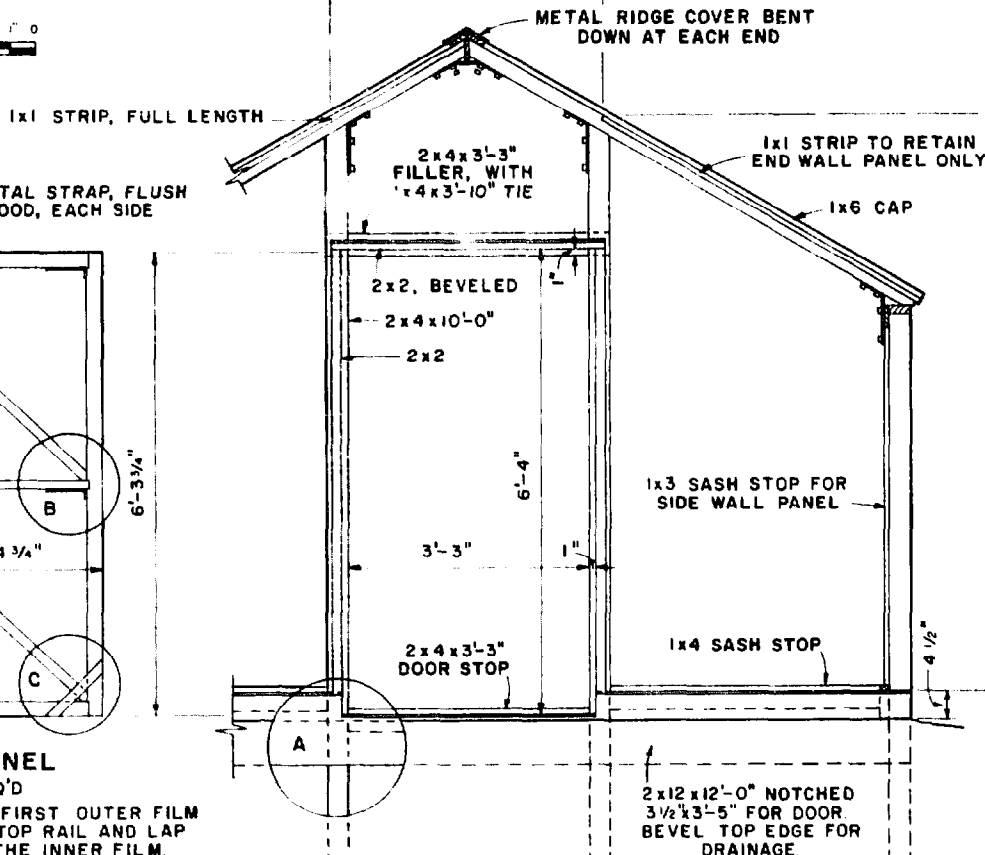
DOOR DETAIL "C"



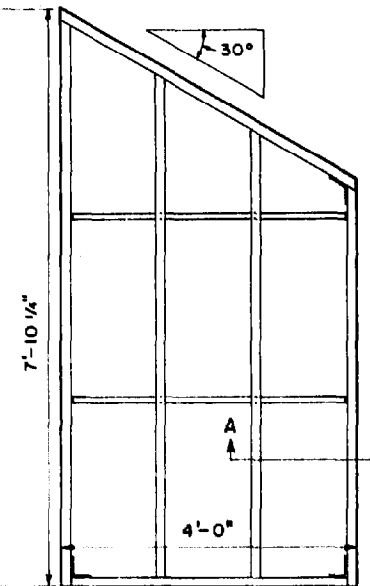
GABLE SASH PANEL
TWO REQ'D



SIDE WALL SASH PANEL
EIGHT REQ'D



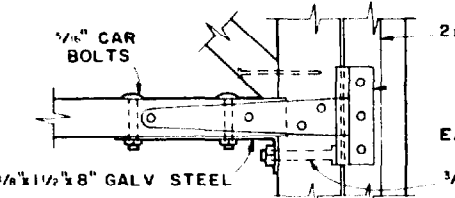
END WALL FRAMING



END WALL SASH PANEL
FOUR REQ'D. TWO RIGHT & TWO LEFT

NOTES:
THE ROOF PANELS ARE HELD IN CLOSED OR PARTLY OPEN POSITIONS BY 6d DOUBLE-HEADED NAILS IN HOLES DRILLED THROUGH LOWER END OF RAFTER CAP INTO PANEL FRAME.
INSTALL RESILIENT WEATHER STRIPPING TO CLOSE THE SPACE BETWEEN THE PLATES AND ROOF PANELS.
ALL WOOD PARTS TO BE TREATED, AFTER CUTTING, WITH A COPPER-NAPHTHENATE PRESERVATIVE.
ALL METAL PARTS SHOULD BE OF NON-CORROSIVE METAL OR HOT-DIP GALVANIZED STEEL.

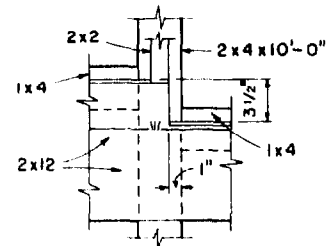
APPLY FILM TO INSIDE FIRST OUTER FILM SHALL EXTEND OVER TOP RAIL AND LAP THE TOP EDGE OF THE INNER FILM.



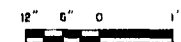
DOOR DETAIL "B"

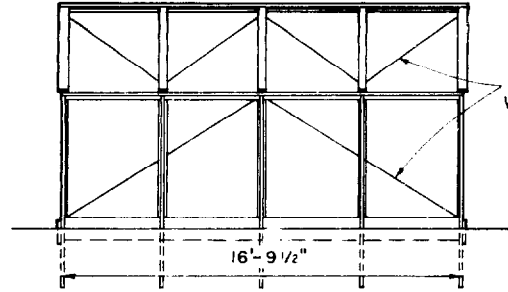
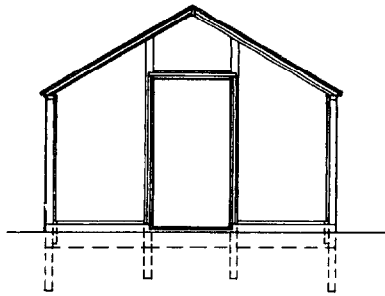


8" GALVANIZED T-HINGE WITH BRASS PIN PIN SHOULD BE REMOVABLE. INSET SO LEAVES ARE FLUSH WITH THE SURFACE OF WOOD MEMBERS FOR EASE IN APPLYING OR REPLACING THE PLASTIC FILM



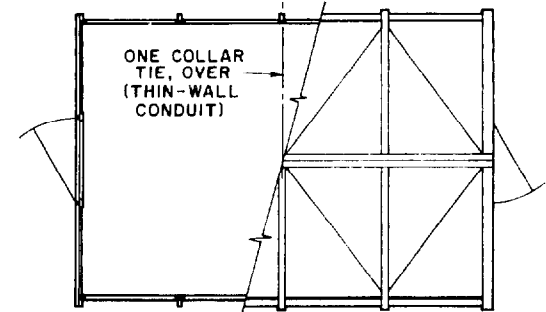
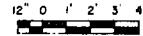
SILL DETAIL "A"



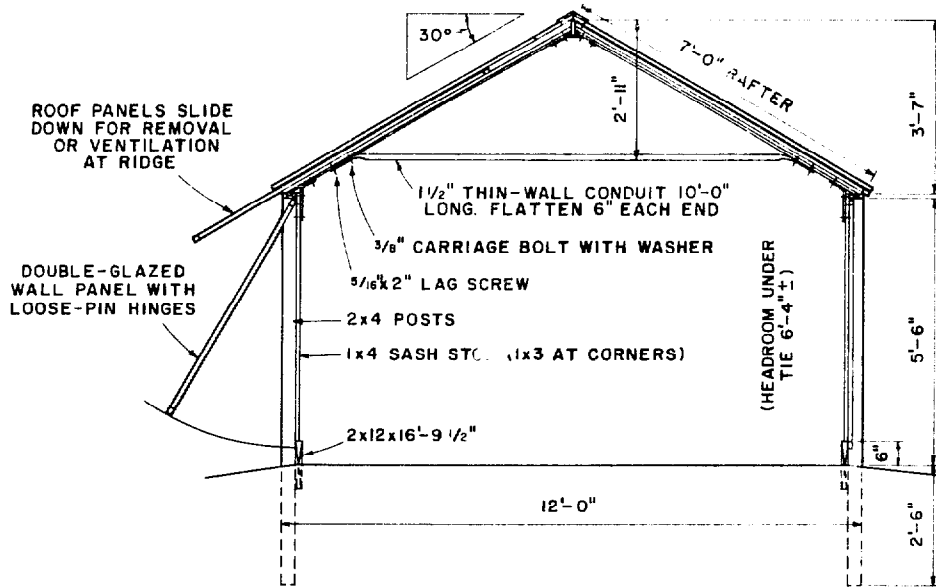


NO. 9 GALVANIZED WIRE TIES, TWISTED

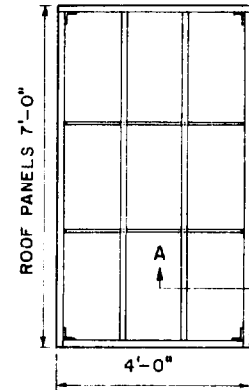
FRAMING ELEVATIONS



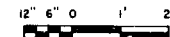
FRAMING PLAN



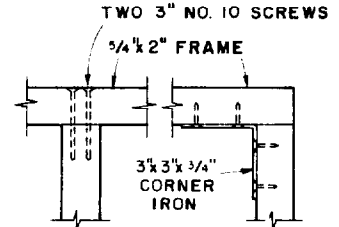
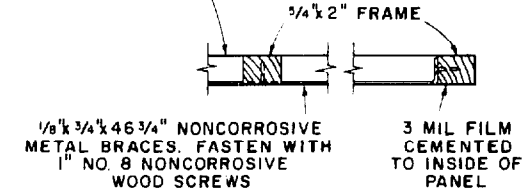
CROSS SECTION



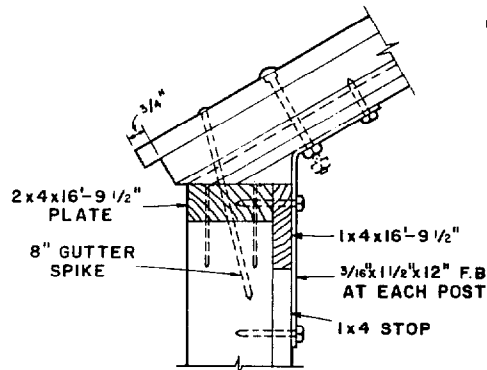
ROOF SASH PANEL



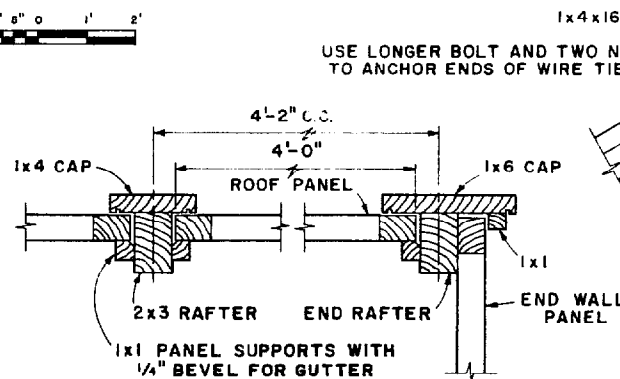
5 MIL TYPE W-POLYESTER FILM CEMENTED TO OUTSIDE OF PANEL



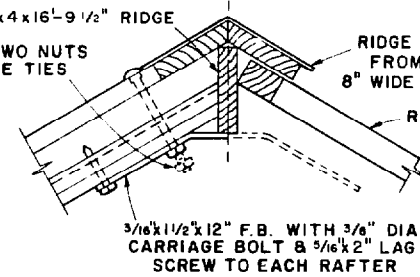
SECTION A-A
NOT TO SCALE



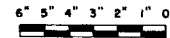
EAVE CONNECTIONS



RAFTER DETAILS



RIDGE DETAIL



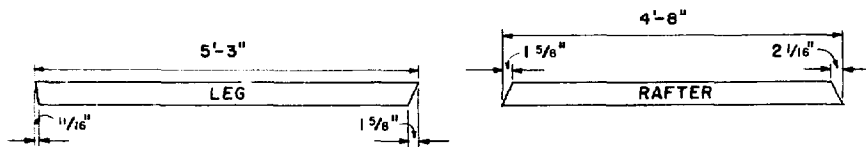
NOTE:
CONSULT LOCAL HEALTH AND BUILDING CODE AUTHORITIES BEFORE STARTING CONSTRUCTION.

COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS

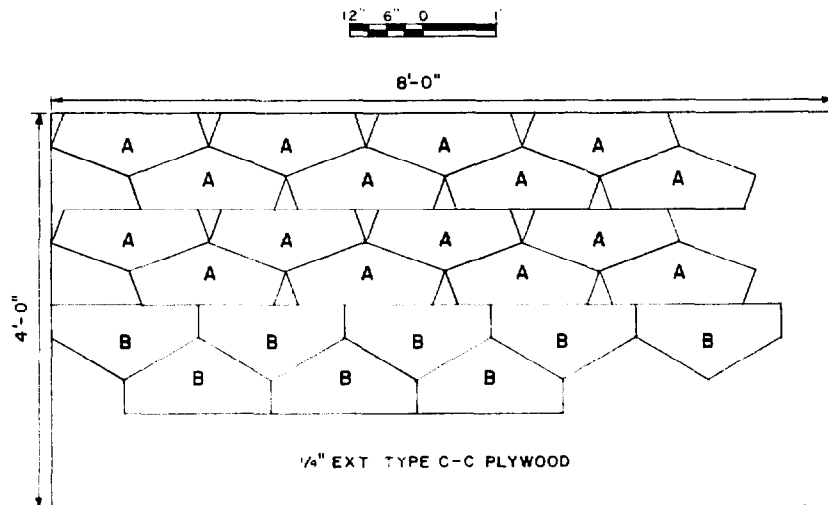
AND UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

PLASTIC GREENHOUSE

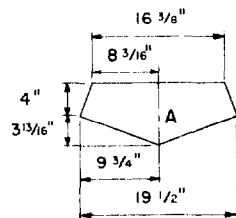
USDA '76 6251 SHEET 1 OF 2



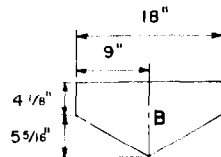
FRAME CUTTING LAYOUT (CUT FROM (8) 2x4x10')



PLYWOOD SHEET CUTTING DIAGRAM



SIDE GUSSETS
16 REQ'D

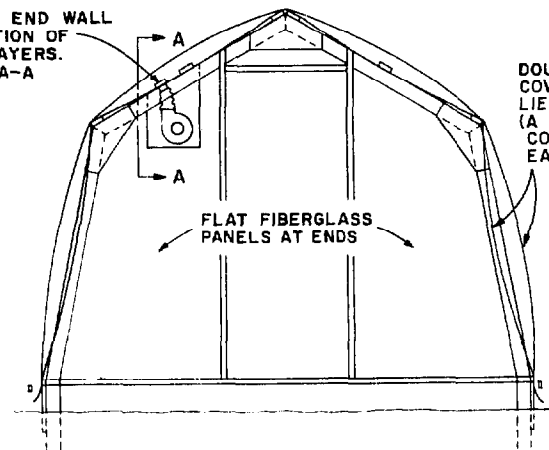


HEAD GUSSETS
8 REQ'D

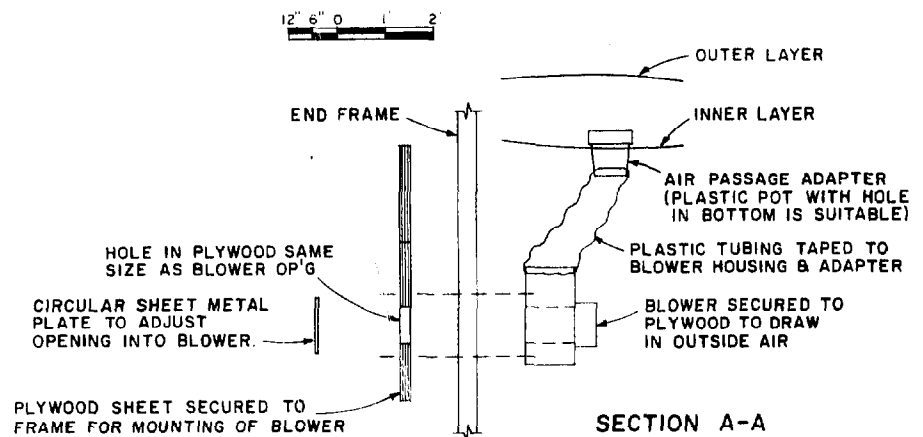
BILL OF MATERIALS

- CORRUGATED FIBERGLASS REINFORCED PANELS (F.R.P.) •
5 OZ COATING:
- ROOF PANELS (6) 2x10' CUT IN HALF
SIDE PANELS (5) 2x12', 2 SHEETS EACH SIDE
5 TH SHEET CUT LENGTHWISE
END PANELS (9) 2x8' OF WHICH 5 ARE LOCATED
AT END WITH NO DOOR
- RIDGE ROLL (1) 12' LENGTH
- LUMBER:
- (8) 2x4x10' TO MAKE FRAMES
 - (2) 2x4x10' SILL AT ENDS (PT COPPER NAPHTHENATE)
 - (2) 2x4x12' SILL AT SIDES (PT COPPER NAPHTHENATE)
 - (2) 2x4x16' END FRAMING
 - BENCH SUPPORTS NOT INCLUDED
 - (8) 1/4 x 4 x 12' FOR PURLINS & DOOR
 - (2) 4x4x16' PT POST FOR FOOTINGS
 - (2) 1x12x12' & (2) 1x12x10' REDWOOD BOARDS
 - (1) 4x8x1/4" EXTERIOR TYPE CC PLYWOOD SHEET FOR PLYWOOD GUSSETS SEE CUTTING DIAGRAM
 - CHECK WITH FIBERGLASS SUPPLIER FOR NECESSARY RELATED HARDWARE & COVERING INSTRUCTIONS
- NAILS, HINGES & LATCH

BLOWER AT END WALL FOR INFLATION OF PLASTIC LAYERS. SEE SECT. A-A



ALTERNATE CROSS SECTION

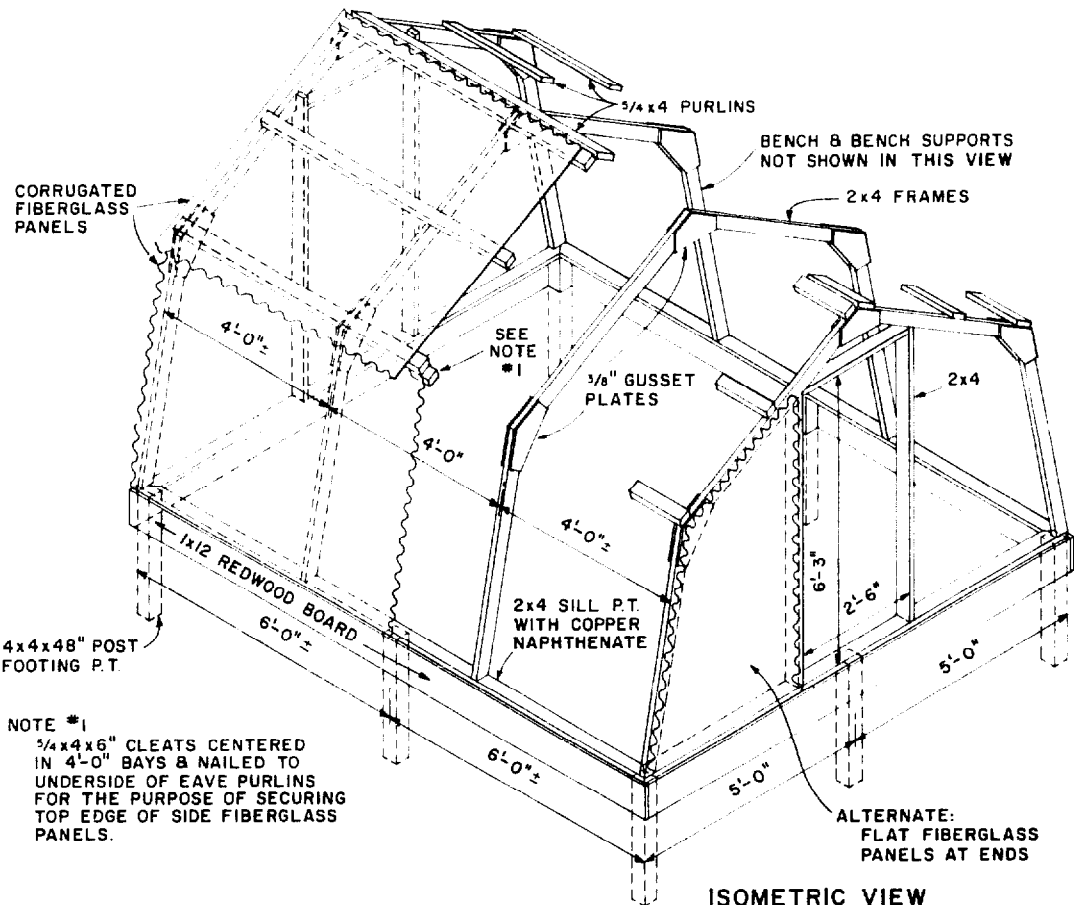


SECTION A-A

ENVIRONMENTAL CONTROL

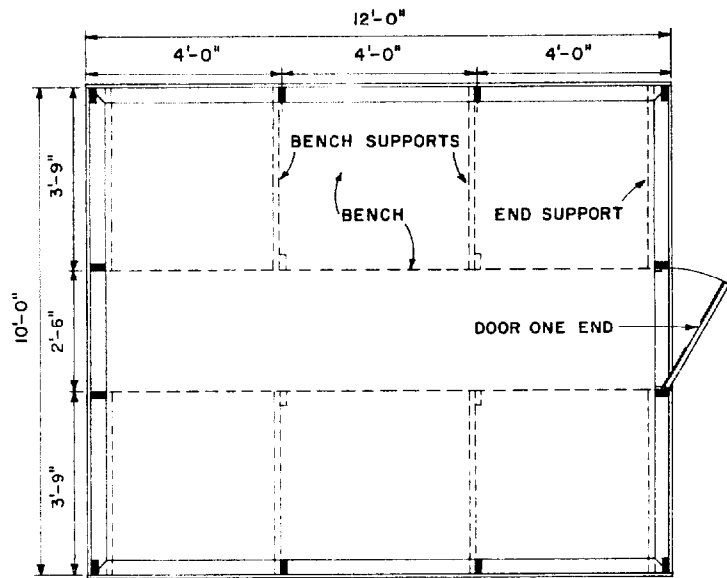
- HEATING:
TO MAINTAIN A TEMPERATURE DIFFERENCE OF 60° BETWEEN INSIDE & OUTSIDE
30,000 BTU/HR SINGLE COVERING
20,000 BTU/HR. DOUBLE COVERING
CONNECTION TO HOME HEATING SYSTEM IS MOST DESIRABLE. IF NOT POSSIBLE, USE GAS OR OIL HEATER VENTED TO THE OUTSIDE. ELECTRIC HEATERS ARE EASY TO INSTALL, CLEAN, BUT EXPENSIVE TO OPERATE. WHEN USING OIL OR GAS, BE SURE TO PROVIDE A FRESH AIR SUPPLY DIRECTLY TO THE HEATER TO SUPPLY OXYGEN FOR COMBUSTION.
- VENTILATING:
REQUIRE A TWO SPEED FAN RATED AT 1000 CFM. AN AUTOMATIC AIR INLET OF 2 SQ. FT. IS REQUIRED. THE FAN CAN BE MOUNTED IN ONE GABLE END AND AIR INLET IN THE OTHER. BOTH SHOULD BE CONTROLLED BY A THERMOSTAT FOR MORE INFORMATION SEE USDA BULLETIN NUMBER 357 "BUILDING HOBBY GREENHOUSES."

COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS		
AND UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING		
HOME GREENHOUSE		
N. J.	'74	6181 SHEET 2 OF 2

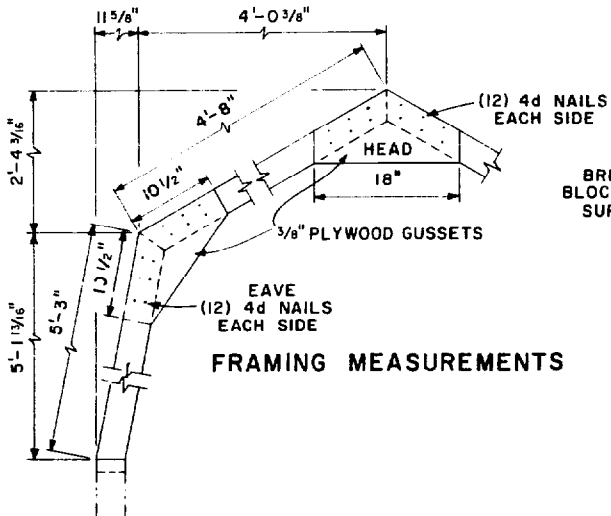


NOTE #1
 1/4 x 4 x 6" CLEATS CENTERED IN 4'-0" BAYS & NAILED TO UNDERSIDE OF EAVE PURLINS FOR THE PURPOSE OF SECURING TOP EDGE OF SIDE FIBERGLASS PANELS.

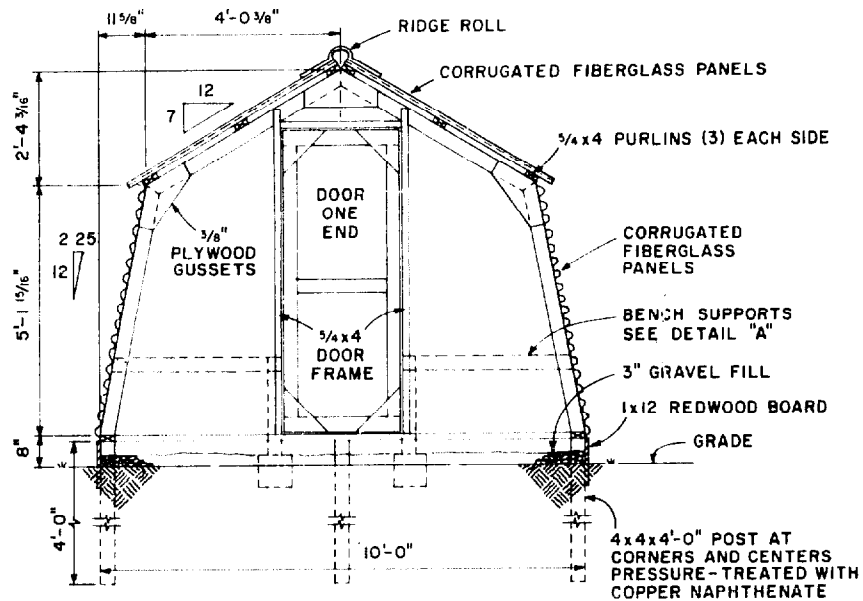
ALTERNATE: FLAT FIBERGLASS PANELS AT ENDS



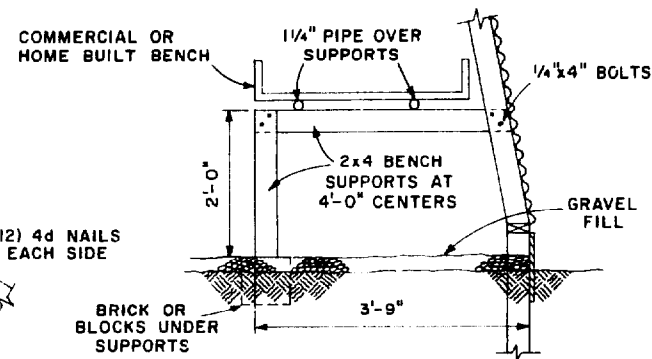
PLAN



FRAMING MEASUREMENTS



CROSS SECTION



DETAIL "A"

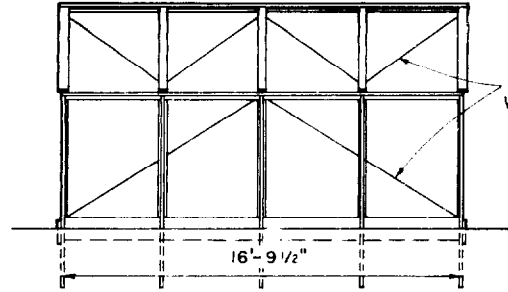
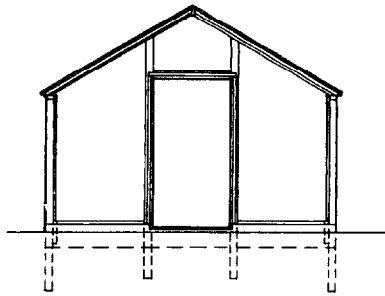
COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS

AND UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

HOME GREENHOUSE

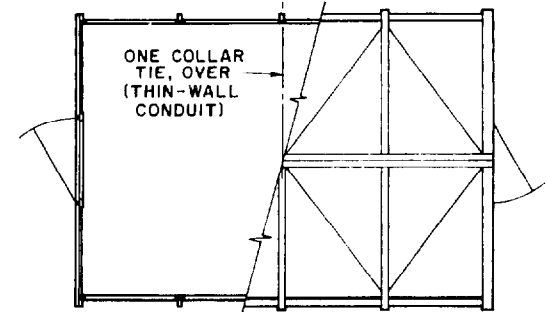
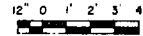
N J	'74	6181	SHEET 1 OF 2
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BASED ON: UNIV. OF ILL. CIR. 880 & RUTGERS PLAN NO. 158

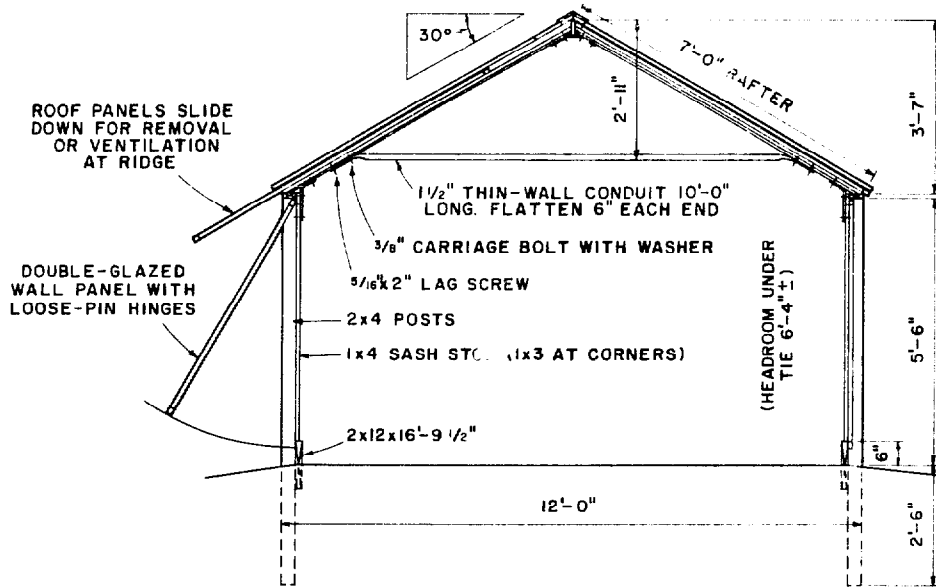


NO. 9 GALVANIZED WIRE TIES, TWISTED

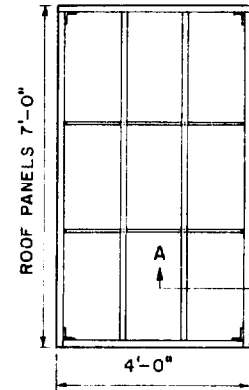
FRAMING ELEVATIONS



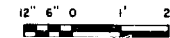
FRAMING PLAN



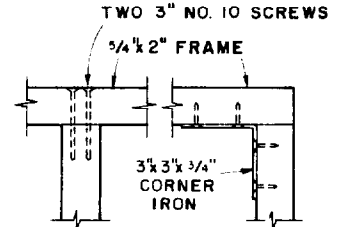
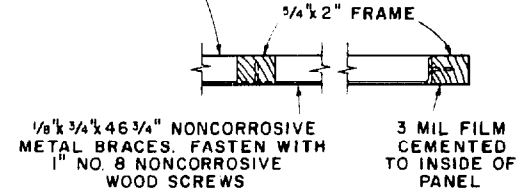
CROSS SECTION



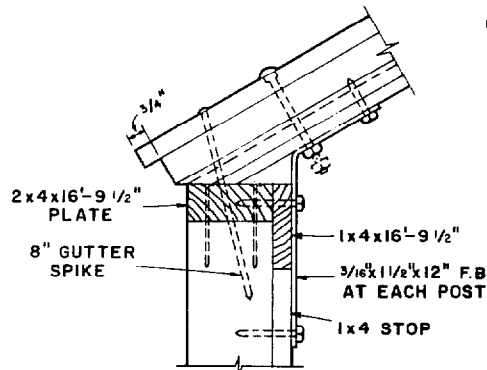
ROOF SASH PANEL



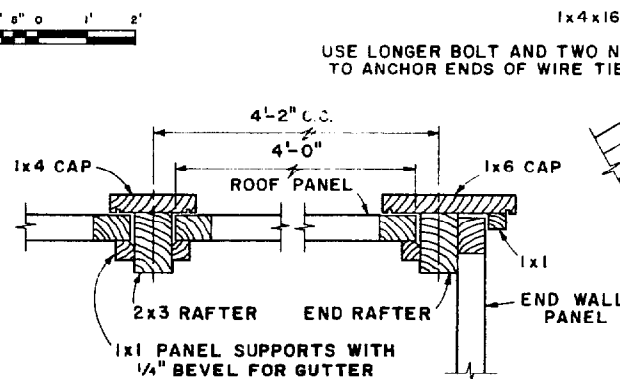
5 MIL TYPE W-POLYESTER FILM CEMENTED TO OUTSIDE OF PANEL



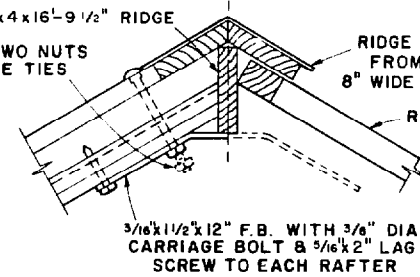
SECTION A-A
NOT TO SCALE



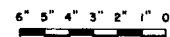
EAVE CONNECTIONS



RAFTER DETAILS



RIDGE DETAIL



NOTE:
CONSULT LOCAL HEALTH AND BUILDING CODE AUTHORITIES BEFORE STARTING CONSTRUCTION.

COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS

AND UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

PLASTIC GREENHOUSE

USDA '76 6251 SHEET 1 OF 2