

Exploring Greenhouse Structures

GET INTO a car parked under the hot sun with its windows up, and you'll feel as if you've entered an oven. Temperatures inside the car soar as solar energy passes through the car windows. Greenhouses also allow solar energy to enter, but they are designed to do so in order to promote plant growth.



Objective:



Describe greenhouse styles and greenhouse construction materials.

Key Terms:



acrylic structured sheets
benches
even-span greenhouse
fiberglass structured sheets
glass
glazing
greenhouse
greenhouse framework

headhouse
hoophouse
lean-to greenhouse
polycarbonate structured sheets
polyethylene
retractable-roof greenhouse

ridge-and-furrow greenhouse
rolling benches
shadehouse
structured sheets
uneven-span greenhouse

Greenhouse Structures

A **greenhouse** is a structure enclosed by glass or plastic that allows light transmission for the growth of plants.

GREENHOUSE STYLES

There are different styles of greenhouse design. Common design styles include lean-to, even-span, uneven-span, ridge-and-furrow, retractable-roof, and shadehouse.



FIGURE 1. A greenhouse enclosed by glass.

A **lean-to greenhouse** shares a wall with a building and relies on the building structure to provide some support for the greenhouse roof.

An **even-span greenhouse** is a single house that has a roof with an even pitch and an even width. A common even-span greenhouse that uses arching pipes for the framework is called a **hoophouse**.

An **uneven-span greenhouse** has unequal pitches and widths. Use of this style is limited to hillsides. Modern greenhouses are built on level ground. Therefore, uneven-span greenhouses are rarely built.

A **ridge-and-furrow greenhouse** is composed of a number of greenhouses connected along the length of the house. The shared interior walls reduce energy costs and allow for large interior spaces. Ridge-and-furrow



FIGURE 2. A lean-to greenhouse.



FIGURE 3. An even-span greenhouse.

greenhouses are best oriented north and south to reduce permanent shadows on the crops created by the gutters.

A **retractable-roof greenhouse** has a roof that can be opened and closed. The grower opens the roof when weather conditions are favorable to plant growth and closes the roof when the crops need protection. When the roof is open, a greenhouse of this type provides plants with increased light levels and fresh air.

A retractable-roof greenhouse can be used to prepare outdoor crops for the elements before they leave the greenhouse. Other advantages include reduced disease problems (because of better ventilation), reduced irrigation (because of rainfall), and more effective temperature control for DIF.

A **shadehouse** is a structure used to protect plants from wind, heat, and light intensity. Synthetic shade cloth is the most widely used covering material. It can be purchased with varying degrees of shade, depending on the grower's needs.

Headhouse

Many of the tasks that support the production of greenhouse crops take place in a structure attached to the greenhouse known as a **headhouse**. The headhouse might be used as a storage area, a potting area, an office, and/or a shipping area. Some headhouses share the same type of structure as their greenhouses and allow light transmission. Others are built more like garages, are roofed, and are artificially lit.



FIGURE 4. A ridge-and-furrow greenhouse.



FIGURE 5. This headhouse includes material storage, restrooms, offices, a potting lit, and an area to package plants for shipment.

GREENHOUSE FRAMEWORK

The **greenhouse framework** supports the greenhouse covering material. Ideally the framework should be strong yet allow the maximum amount of light to reach the plants. It is

best if it requires little maintenance. In northern latitudes it is important that the framework be strong enough to withstand heavy snow loads.

Aluminum and aluminum/steel-combination frameworks are popular because they are long lasting and considered low maintenance. However, they are more expensive than other frameworks, such as wood, galvanized steel, and angle iron.



FIGURE 6. Aluminum/steel-combination frameworks are long lasting and low maintenance.

GLAZING

The covering of the greenhouse is referred to as the **glazing**. Considerations in choosing a glazing material include durability, light transmission, cost, and impact on heating costs.

Flexible sheets of **polyethylene** are often stretched over the greenhouse framework. This material is not very durable and must be replaced every one to three years depending on the thickness of the poly used. Polyethylene is the least expensive covering material.

Structured sheets, including polycarbonate, acrylic, and fiberglass materials, have grown in popularity. Sheets made with double walls offer good insulation.

Polycarbonate structured sheets are most widely used because they have good light transmission, they resist hail damage, and they are easy to work with. Polycarbonate is much stronger than glass but lighter in weight. It has good insulation properties and is flame retardant.

Acrylic structured sheets have high light transmission, but they cost more than polycarbonate sheets, are prone to hail damage, and are less flexible.

Fiberglass structured sheets have dropped in popularity. Fiberglass discolors after 7 to 10 years and provides poor insulation. It loses light transmission as it wears out, and it becomes extremely flammable as it ages and fibers become exposed.

Glass is considered the best material for crop production. It has the highest light transmission.

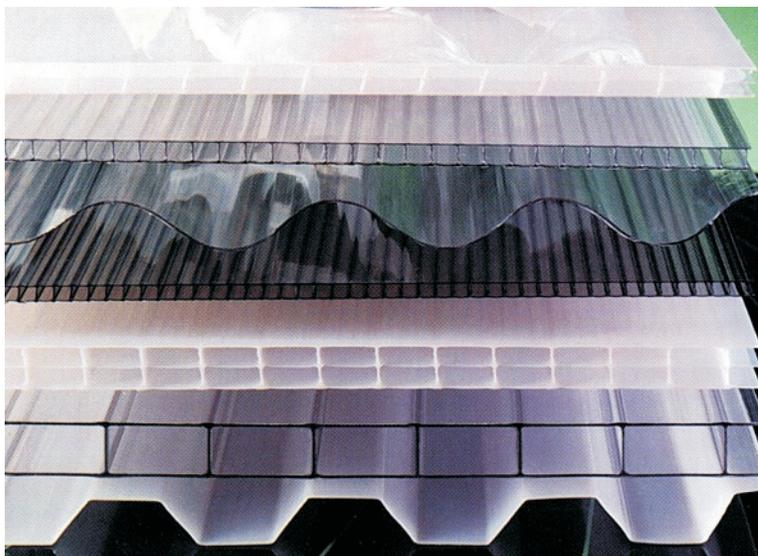


FIGURE 7. Acrylic structured sheets.

The fact that it is very long lasting can make it less costly in the long run than other glazing materials. Tempered glass is stronger than regular glass. However, tempered glass may still break during hailstorms, and it has a high initial cost.

GREENHOUSE BENCHES

Greenhouse **benches** are structures that hold the plants above the ground. Materials used for benches include expanded galvanized steel, aluminum, plastic, and rot-resistant wood. Expanded galvanized steel provides good air circulation and allows water to drain from pots. Benches should be narrow enough for workers to reach for plants and provide care.

Benches are arranged in the greenhouse with aisle space and growing space in mind. Common layouts include conventional arrangements, peninsular arrangements, and movable benches.

Rolling benches are movable benches that maximize growing space. Less space is devoted to aisles in a greenhouse with rolling benches. The benches are placed on pipes. With little effort an entire bench can be moved from side to side.



FIGURE 8. Rolling benches maximize growing space.

Summary:



A greenhouse is a structure enclosed by glass or plastic that allows light transmission for the growth of plants. Common design styles include lean-to, even-span, uneven-span, ridge-and-furrow, retractable-roof, and shadehouse.

Many of the tasks that support the production of greenhouse crops take place in a structure attached to the greenhouse known as a headhouse.

The greenhouse framework supports the greenhouse covering material. Aluminum and aluminum/steel-combination frameworks are long lasting and low maintenance. Other framework materials include wood, galvanized steel, and angle iron.

The covering of the greenhouse is referred to as the glazing. Considerations in choosing a glazing material include durability, light transmission, cost, and impact on heating costs. Glazing materials include polyethylene, glass, and polycarbonate, acrylic, and fiberglass structured sheets.

Greenhouse benches are structures that hold the plants above the ground. Materials used for benches include expanded galvanized steel, aluminum, plastic, and rot-resistant wood.

Checking Your Knowledge:



1. What is a greenhouse?
2. What are the different styles of greenhouses?
3. What materials are used for the framework of greenhouses?
4. What are some considerations when selecting a glazing material?
5. What are greenhouse benches, and what materials are used for benches?

Expanding Your Knowledge:



Locate a greenhouse in your vicinity. Identify the style, the type of framework, and the glazing material. Does it have a headhouse? What types of benches are used in the greenhouse? Ask yourself what are the advantages and disadvantages of the materials used.

Web Links:



Retractable-Roof Greenhouses and Shadehouses

http://www.umass.edu/umext/floriculture/fact_sheets/greenhouse_management/jb_retractable_roofs.htm

Greenhouse Glazing Materials

http://www.uark.edu/~mrevans/4703/learning_units/unit_03/unit_03.html

Greenhouse Benching and Production Surfaces

http://www.uark.edu/~mrevans/4703/learning_units/unit_02/unit_02.html

Environmental Parameters of Interest in Horticultural Production

http://www.uark.edu/~mrevans/4703/learning_units/unit_01/unit_01.html

Greenhouse Management Guidesheets

<http://flowers.hort.purdue.edu/web/GHguides.htm#GHconstruction>