"Conceptualizing a Greenhouse"

People enjoy plants, as a general rule, and most enjoy being close to plants. The more exotic and rare are usually significantly sought after (orchids, tropical fruits, and bonsai), but the more common flora is also necessary (to the economy, the environment, and for food).

Horticulture comes from the Latin words 'hortus' (Garden) and 'cultivatus' (To encourage growth through care *or* To seek friendship with another entity). Today we can define horticulture as using scientific processes to control the growing conditions, thus controlling the growth of plants, *according to one's artistic ideal*. Basically, a horticulturist is someone whom blends science and art - driven by cultural, biological, and political needs.

In order for a plant to survive from sprout to adult, in a foreign location, it must have a tightly controlled environment[1]. Tropical plants need to stay moist and warm; temperate plants need periods of cold; and sensitive plants need shade, clean air, and clean water. The best way to accomplish precise control of the weather is to enclose a space that can be manipulated through artificial means. These artificial means can be such things as sprinklers, fans, and heaters in a Greenhouse. It's like having a security blanket, food, and water on hand at all times for the plant. The horticulturist brings plants from all over the world to peoples back yards, windowsills, and fields.

1. Referring to the area immediately surrounding the plant

Everybody needs food and many people enjoy a shapely hedge, both can be birthed of a greenhouse. One can grow plants in unusual ways and encourage a desired product in unusual areas.

Step 1: the types of plant(s) being grown are selected. Step 2: a location, with exploitable traits must be singled out. Then the growing environment is separated from the outside environment, at a level appropriate to the plants. Step 3: suitable framing and covering is selected and installed. Step 4: Water, nutrients, and adequate gaseous exchange are supplied within the enclosure at all times while pests, diseases, and weeds are to be managed and excluded at all times. Degree of separation from the outside, level of climate control, and location depends on the plants being grown and the desired end product.

Step 1: Plant Selection

Purpose dictates design; therefore the first thing to consider is: what's to be grown and why is it being grown? (The purpose of the greenhouse) Is the greenhouse for personal or business use? Is the person running the greenhouse a professional or a hobbyist? Types of plants/greenhouses may include **Ornamentals, hobby, herbal/medicinal, nursery (tree or landscape), food, and research[2].**

Step 2: Design

Once the purpose of the greenhouse has been determined the structure must be designed to apply the desired amount of climate control required for the plant. The fundamental design must provide an elemental barrier to the outside (rain, snow, wind), shade, or temperature control. It may be set up for display purposes (ornamentals), containment (GMO), or commercial production (Nurseries). Materials are a factor when

2. See Glossary of Terms

considering design; a landscaping company that needs to grow hundreds of shrubs would only want minimal barrier against the elements to prevent transplant shock while keeping the plants hardy, but will also want some protection for the younger, more sensitive plants. This company may want a long, open ended, house covered with light screening or high transmittance plastic. A research company wanting to test a newly modified GMO will need to provide glass barriers, hepa filters, water recyclers, concrete floors, and emergency containment systems (to prevent any escape of foreign DNA).

Design: Frames

Frames are typically steel in today's world (see your typical home and garden store) but plastics, resins, and alloys are being implied more and more for added support and strength while reducing costs. Wooden frames are not used much anymore except for the hobbyist's backyard frames, this is mostly due to the great availability of lumber compared to other materials. Wood frames should be avoided due to the fact that they are hard to bend and they attract insects and rot. The main vertical support beams should be anchored securely in the ground (either to a frame or with concrete) and the skeleton should be made of a bendable material (for Quonset and dome style) or rigid unbreakable materials (for gable/peaked roofs). Lightweight and strong straight pieces should be used for the 'backbones' of the frame.

Quonset

www.bettergreenhouses.com

Gable covered w/ solex™ (exolite)

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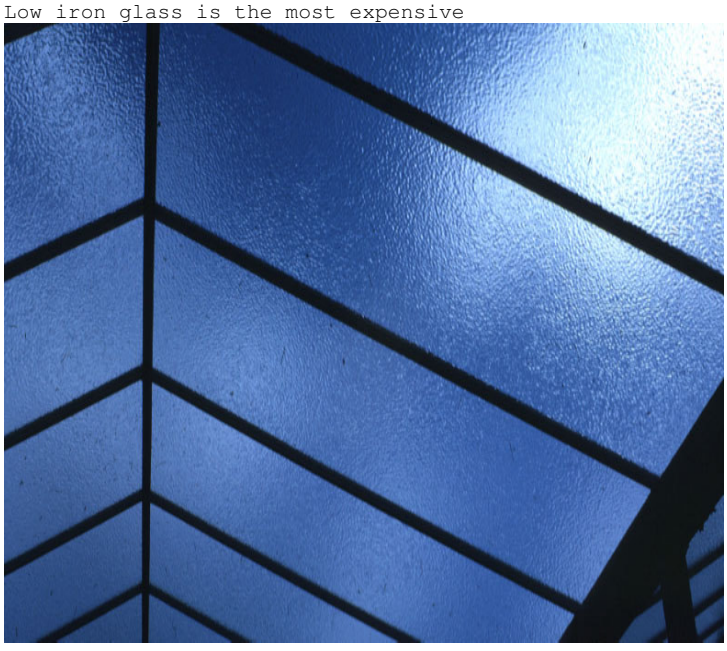
Design: Coverings

The technologies behind greenhouse coverings are always advancing. The original materials were metal wiring and eventually glass panes. Today glass is stronger and transmits more light than in the past. Glass is the way to go for optimum containment and strength (flat glass can be bent for increased strength) but can get very pricey.

Bent 'Flat-Glass' opening roof

Low iron glass is the most expensive



Plastics can be used (such as the clear rolls of window plastic and pond liners) but they can inhibit light transmittance (reducing light quality[3] as well as light quantity[3]) by as much as 50% and break down under harsh conditions quickly. Polyvinyl covering are designed for specific applications and are very tough. Some coverings may filter out a specific amount/type of UV (Ultra Violet) light, others may be suited for cold climates, and others may deflect wind but allow gaseous diffusion. "Exolite" is a type of rigid corrugated acrylic that allows most of the light through but bounces it around inside the plastic's walls before letting it travel through to the plants, this allows for high light levels but without any direct sunshine.

Exolite

Shade cloth is made in different levels of light elimination and may be applied in multiply layers to increase shading (thereby decreasing light quantity and not quality).

Step 3: Location

One must think proactively when placing the structure. In the northern hemisphere, you get maximum sun coverage (minimal shading from other sources) by placing the greenhouse on the southern side of hills or other structures. Building next to existing structures or on hillsides are good because the large mass act as a windbreak and

3. Quantity refers to the amount of light passing through the cover Quality is the light waves usable by the plant.
Combined the two are called Photosynthetic Active Radiation (PAR)

will reduce the stress on the coverings and climate control equipment. Lowering wind and building away from dusty/dirty areas also reduces airborne contaminates. The middle of a field is only a good choice if the plants being grown must stay as isolated as possible from nature (otherwise the greenhouse would be under the full forces of the weather). In large cities greenhouses are built on the tops of buildings, on porches, and inside apartments (artificial lighting and ventilation is required). Many **tissue culture** labs and genetic research labs have greenhouses attached directly to the facility so that **acclimatization** or observation may be done with out any contamination to or from outside environments.

Step 4: construction

Once the plants, site, materials, and design have been thoroughly conceptualized, and a conceptual drawing is sketched and labeled, the field is prepared. The perimeter of the greenhouse is measured and marked with ribbon and posts. Holes; for posts and trenches; for irrigation, wiring, and foundation are dug according to plan. If the greenhouse has a foundation it is now poured, otherwise the main support posts will be placed in their holes and anchored with concrete or gravel. Irrigation and wiring conduit is laid out and covered (with dirt, gravel/cinder, or concrete). Next the frame is set up and the wiring and irrigation tubes are integrated to keep hose ends and equipment off the ground. Usually any benches would be brought into the greenhouse in pieces, to be set up after the covering is applied. In some cases they may be too large and must be set up before the covering is applied to avoid complications.

Construction: applying the covering

Applying the covering can be the hardest part. Polyvinyl and plastic must be rolled over the top of the greenhouse and require the use of a crane or bucket arm (and friends to hold things down), polyvinyl must be stretched tight to ensure wind resistance and proper light transmittance. Glass and acrylic panes are difficult to handle in windy conditions and can be very heavy (and break when dropped). Some sections may be so heavy that the roof must be assembled first and then elevated, afterwards the walls are constructed and the roof is lowered down onto the walls. In warm climates the lower portion (skirting) may be left out to allow air flow. In colder climates the skirting is made of concrete or glass and air flow must be created with fans.

Concrete skirting glass house

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For plants requiring colder conditions a 'pad-and-fan' cooling system can be installed. Whereby using exhaust fans, at one end, to draw outside air, at the other end, across a wet filter and cooling the greenhouse. Furnaces or water heaters may be installed for plants, grown during winter, that require warmer conditions.

Now all conditions are set and all equipment has been thoroughly tested. The plants may be set up and the grower only need watch, clean, and wait patiently. Soon the pineapple (a tropical fruit) may be grown in New York and the Empire apple (that requires cold winters) may be grown in Hawai'i.