GREENHOUSES

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The purpose of a greenhouse is to provide protection for crops from climatic extremes such as rainfall, hail and temperature. In general the greater the degree of protection provided the higher is the cost of this protection.

There are so many different types of greenhouse structures, covering materials and accessory systems for environmental control that it is difficult to decide what is the best to use in any given situation. The decision is a compromise of many factors including the crop or crops to be grown in the greenhouse, their management, environmental requirements, the climatic conditions in the area where the greenhouse is to be built, the availability of capital and the cost of maintenance of the greenhouse.

A greenhouse can be designed specifically for one crop or so that it remains flexible and can be used for several different types of crops, should the economic viability of the enterprise change. Certain aspects of crop management such as the arrangement of beds and watering systems are also important to allow efficient use of the space inside the greenhouse.

Choice of Site. As greenhouses are an expensive capital item care should be taken to choose a suitable site. The area should be level with a high natural light intensity and sheltered from severe winds. Preferably, the area should be well drained with a soil type of medium to light loam. Soils with poor drainage and physical characteristics can be improved but this involves additional cost. An adequate supply of water and electricity is required on the site as well as good road access in all weather conditions.

Spacings and Land Use. Greenhouses should be spaced to avoid mutual shading. Spacing is determined by the height of the ridge and the elevation of the sun in winter, and must be balanced against the economic use of land and the cost of other services, such as transport and heating.

Design. Regardless of its use every greenhouse must meet certain functional requirements. It must be designed to withstand the wind loads imposed on it without failure or significant deformation. Since no Australian standard exists for wind loadings on greenhouses, reference should be made to Australian Standard 1170 which sets out the minimum design loads on structures.

The Design Wind Velocity is obtained from the Regional Basic Design Wind Velocity (Table 1) adjusted for (i) mean return period (expected frequency of occurence of the wind velocity), (ii) geographic location, (iii) terrain category, (iv) shielding and (v) height above the ground.

Table 1. Values of regional basic design wind velocity (m/s) for major centres for a 25-year mean return period.

Centre	Regional Basic Design Wind Velocity (m/s)	Centre	Regional Basic Design Wind Velocity (m/s)
Adelaide	40	Melbourne	37
Brisbane	45	Mildura	31
Cairns+	50	Perth	37
Hobart	39	Sydney	41

+ Tropical cyclone area.

For structures built in tropical cyclone areas (coastline north of latitude 27°S and extending 50 kilometres inland) the regional basic design wind velocity must be multipled by a factor of 1.15.

Some of the factors which influence the wind load on buildings are the height to width ratio, shape and orientation. The wind generally hits the surface of the building at an angle and an aerodynamic effect develops which causes a suction, or uplifting force on some building surface (Figure 1). Hence adequate foundations and footings must be provided to resist uplift, overturning and downward acting loads. Standardization of greenhouse designs to meet local building requirements would be useful to ease the problems currently being experienced by nurserymen when building a new greenhouse.

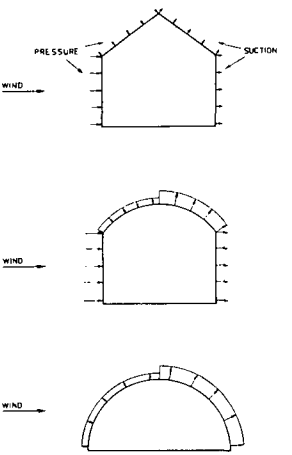

Figure 1. Wind pressure and suction effects on various structure shapes.

Structural Materials. The most common structural materials are wood, galvanized steel and aluminum. Decay resistant wood species or treated lumber should be used if a reasonably long life is desired.

Galvanized steel pipe is popular for greenhouse use due to its ease of construction. Aluminum is being used more extensively by commercial greenhouse manufacturers, due to its light weight and excellent durability.

Structural Influences on Ventilation and Heating. The final success of a greenhouse will generally depend upon the ability of the operator to control the environmental conditions within the greenhouse. Although any shape structure can be successfuly ventilated or heated, some designs greatly increase the difficulty or cost in providing an adequate system. In these cases, a less than optimum system is often installed, which then creates problems in management.

Natural ventilation is achieved by the chimney effect created by warm buoyant air in the structure and the wind. The amount of ventilation achieved is dependent upon the location and the area of the vents, the air temperature differentials in and around the structure, and the wind speed and direction. In some structures, such as a low polyethylene tunnel and in many of the large multipan structures, it is sometimes difficult to achieve adequate natural ventilation (Figure 2). Where the efficiency of natural ventilation is low, positive air movement and controlled ventilation rates can be achieved by fan forced ventilation and evaporative cooling systems.

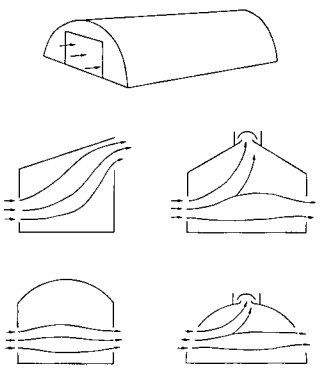

Figure 2. Natural ventilation effects on various structure shapes.

For economical heating the structure should be as air tight as possible as unwanted ventilation is a source of heat loss. Badly fitting ventilators and doors and spaces between the walls and roof or floor should be avoided as these result in considerable increases in running costs.

Height of Greenhouse. The height of the house in the work areas should never be less than 2m. Houses lower than this are difficult to work in and hence a loss in efficiency of labor results. For tall crops, the height of the greenhouse would have to be greater than 2m. An increase in roof height improves natural ventilation during still conditions and allows the desired environment to be more easily obtained.

In terms of heating costs, the important factor is the amount of exposed wall or ceiling area (since heat passes through the covering material) rather than the volume of air in the greenhouse. An increase in height of a greenhouse does increase the wall area, however this increase is small in comparison to the total surface area of the greenhouse.

Roof Slope. The roof slope affects the runoff of condensed water from the ceiling. Slopes of 28°C are generally considered as minimum, if runoff without severe dripping is to occur.

Access. In most greenhouses it is necessary on occasions to remove large quantities of old plants, soils or rooting media. In order to use labor more efficiently, large doorways at least 2.5m wide and 2m high should be provided to permit the use of tractors and large equipment for tillage operations. The doorways should be in the most suitable positions for the easy flow of materials and produce.

The Future. As the greenhouse chosen may influence the management and cropping of your enterprise for 10 to 20 years and, as the costs of construction continue to rise, the need for informed judgment in the choice of a greenhouse becomes greater. It is impossible to forecast all the developments which will occur in greenhouse technology in the future, but there are indications that low energy usage greenhouses or those using solar energy will become popular. Hence the general aim should be to build a structure which will allow changes to be made to cropping, management or mechanization with the minimum of expense.

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