Designing greenhouses

Chapter three

Designing greenhouses

When designing greenhouses it is important to consider the following:

- Its location
- Minimal exposure to prevailing winds.
- Maximum exposure to sunlight. The best orientation would be from east to west with crops oriented north to south to avoid potential shadows.
- Ground level
- away from flood areas.
- Good access.
- near water sources.
- Soil: nutrient-rich soil
- Ventilation: As an essential element, the greenhouse must have ventilation, and it can be present in the upper areas of the two sides. If the greenhouse has windows, an anti-insect and thrips net must be included.

Components of agricultural greenhouses

The iron structure,

which is a structure consisting of multiple pieces of iron that represent the general shape of the greenhouse, which consists of several parts as follows

- The bases are pieces of galvanized iron with a thickness of 2 mm, a length of 40 cm for each piece, and a diameter of 2 inches. These pieces are used in building the main structure of the greenhouse.
- Reinforcement props are mainly used to connect the bases to each other inside the greenhouse, where the greenhouse contains an iron base every 2.5 meters.
- The brackets are a group of iron brackets consisting of two pieces of galvanized iron with a thickness of 2 mm, which are connected to each other by means of a pressed bulb with a length of 2 cm.

- The crop stand, which is a 1.5 mm thick iron stand that connects the bases of the house and the roof of the greenhouse. Its main job is to carry the crop grown inside the greenhouse, and one greenhouse consists of at least 12 carriers.
- Clips are made of sheet metal that differ in length and width based on the area in which they are used inside the greenhouse. Its mission is to fill the gaps inside the greenhouse resulting from the cooling system inside the greenhouse.
- Tensile wires are a group of iron wires with a thickness of 1.5 mm used to tighten and strengthen the protected house from the inside and outside.
- Fixing wires are iron wires that connect the pieces of the structure to each other inside the protected agricultural house.

Front and back facades

- The front end is a group of iron posts and beams connected to each other through iron clips.

- The parts of the front end are covered with 87% light-permeable fiberglass.
- The front end contains fans consisting of 6 blades that suck air and enter it into the greenhouse within the greenhouse cooling system.
- Pieces of galvanized sheet metal must be placed to fill the gaps between the fiberglass and the fans, after their installation, to prevent the entry of wind or air into the greenhouse.
- The rear façade consists of iron beams and posts fastened with iron clips and covered with fiberglass that transmits light by 87%.
- Cooling cells are placed at the back of the greenhouse within its cooling system, and one house needs 10 cooling cells to cool the air.

The cooling system

adapts the air temperature inside the greenhouse according to the type of crop being grown.

- This is done through a main control panel that is set by the agricultural greenhouse operator.
- The fans installed in the front end suck the air in and deliver it to the cooling cells, where the cooling cells work to moisturize the air.
- The cooling pump is a basic pump that recycles water to cool the air by pumping it back into the cooling cells at the back of the house.
- Cooling sheet It is a sheet that is located under the cooling cells and removes excess water during the air conditioning process inside the greenhouse.

What should be known before designing a greenhouse

Greenhouse design requires knowing some things before proceeding with the construction, some of which are related to the configuration of the greenhouse itself, and others related to the location, soil, etc., and the following are the most important things you need to know **before starting your project**:

- 1. **Determine the appropriate location:**

Choosing the right place for the greenhouse is one of the important criteria that cannot be ignored, as it must allow cars to transport crops and deliver fuel, and it is also important that it be close to markets, in addition to containing windbreaks.

- 2. **Provide a good source of irrigation:**

Without sufficient and good irrigation, plants will not be able to grow or even live, so care must be taken to provide this condition.

- 3. **Qualified manpower:**

Whether you want to design greenhouses or greenhouses, you must have the competence and trained hands to do so.

- 4. **Soil preparation:**

The soil should be free of weeds and diseases, and it is important that it allow for future expansion.

- 5. **Provide good drainage**:

This is to prevent water pooling and plant damage and rotting.

Method of designing agricultural greenhouses

- The first thing that must be done when thinking about establishing a greenhouse is to **choose its type**, according to its purpose, as well as the available capabilities, the available space, and the expected return from it.
  To start working, you must follow the following steps:

- **Choose the appropriate direction for the greenhouse**

Most of the greenhouses are rectangular in shape, where determining the direction allows for a greater amount of sunlight, and the best direction that can be adopted is the north-south direction, because it allows natural lighting to reach during the day on both sides of the house.

In the event that you want to design single greenhouses, that is, in which cultivation takes place in the winter season, the east-west direction must be determined, as the sun's rays reach these houses at a low angle.

- **Preparing the greenhouse site**

Moving soil and leveling the surface The first stage of building and assembling the greenhouse is by leveling and stabilizing the surface. This step also involves moving the soil to the correct level according to the water drainage parameters and inclination to improve the working conditions in the greenhouse.

After that, the soil must be cleaned of weeds and diseases, to be suitable for cultivation, and in the event that the surface on which the greenhouse is installed is very irregular, this will require the design of dams in order to adjust the surface leveling restrictions.

- **Create a windbreak**

This step is to establish tree windbreaks, as it is one of the necessary and inevitable things, but in the event that it is not available, it is possible to temporarily rely on windbreaks from nets made of polyethylene, which allows 50% of the air to pass, and at this stage it must be taken into account The height of the nets should be appropriate to the height of the greenhouse, while fenders with a height of 180-240 cm can be used in the case of designing greenhouses, as they raise the air to some extent.

- **Foundation laying and preparation**

At this stage, the location of the greenhouse is drawn on the ground before proceeding with its construction, by defining a right angle on one side using ropes of lengths 3-4-5 or multiples of these numbers according to the Pythagorean theorem and extending other extensions of the width and length of the greenhouse and marking with lime or any other Another article.

After the crosses must be located on the floor using ground outriggers, so that the first cross is at the first point of the width and length of the greenhouse, and its place is dug deep in the bottom part.

Then we move to the second cross by using the smallest outrigger of 2 m, then the third cross and what comes after it by using the ground outrigger of 2.5 and until the end of the penultimate arch on both sides of the greenhouse.

Thus, it will remain to excavate the places where the crosses are placed to form a foundation on which the greenhouse will be built, then excavate around the outer perimeter of the structure at a depth of 40 cm to bury the plastic.

- **Chassis assembly**

This step of greenhouse design is very sensitive and must be done by experts, as negligence in assembling the structure negatively affects the lifespan of the greenhouse, as well as the duration of the plastic stay on it, and this is done **according to stages, as follows:**

- Distribute the brackets, taking into account their direction.
- Distribution of longitudinal extensions, so that they are 2 meters long at the beginning and end of the greenhouse.
- Distribution of crosses, links, and jumpers, so that T links are in the first and last brackets.
- Distribution of the beams bearing the crop and their flaps and the pod.
- Assemble and erect the brackets.
- Determine the place of tensioning the wire on the first and last arc, then distribute the wire.

- **plastic installation**

In this step of greenhouse design , gauze is placed in the middle of the greenhouse before installing the plastic

To install the plastic on it, where the longer piece is placed in the middle to be able to open

And the closure is easy, and the direction of its installation must be taken into account, so that it is at the top at the overlap area, i.e. opposite the direction of the wind.

- **Installing doors**

This is done by attaching it to the jumpers in the cabin, after completing the previous step.

Specifications to be considered when designing and constructing greenhouses

To design a greenhouse, there are several specifications that must be considered, which include:

- In the event that the houses are adjacent, the roof must be designed with an inclination to allow the drainage of rainwater.
- The width of the greenhouse should be 24m, while the length should not exceed 60m.
- The greenhouse must be spacious, so that farm machinery can enter
- Easily when preparing the ground, as it is better to have a width of 270 cm.
- The design and structure of greenhouses must be compatible with the type of cover used and the availability of sunlight in the area.
- When establishing the greenhouse complex, it is taken into account that the administrative buildings and places prepare the agricultural environment.
- Stores, refrigerators and service operations are in the center of the site, for easy access.
- Doors should be facing south or southeast, to maintain an adequate temperature.
- A house must have two doors, a front door facing southeast, and a back door facing northwest.

Greenhouse construction for safe and resilient structural design

- Greenhouses provide a solid range that constitutes a suitable environment for the production of vegetables and fruits at a reduced and controlled cost, as the basic component of the greenhouse is the structure that connects all components with each other. Structural frames are usually built of iron elements, which are often hollow and galvanized.
- The iron structure can withstand the expected loads. The plastic house is classified as a non-residential structure. This is due to the fact that the iron sections are the basic structural material for this type of construction.
- It is worth realizing that there are no approved rules and standards for the construction of greenhouses locally and in other regions of the world, as they are either limited or unavailable, so it is necessary to work in our future on the availability of comprehensive design guidelines or fixed and approved local engineering standards.

- The desirable specifications of the approved plastic house are the ability to resist local winds and snow loads. The plastic house must have bases capable of supporting the construction with the expected loads. The wide seas (width of the house) usually provide better freedom of movement for equipment and workers.
- The low cost of maintenance and the life span of the facility constitute the primary concern for investors. The idea of greenhouses is based on the system of creating completely identical units, where they can be combined longitudinally and transversely to suit the need and the area of the site, so that the method of picking, collecting fruits and working inside the house is easy, fast and without need. to heavy equipment.
- The Palestinian areas can be divided into three circles according to the expected loads on such facilities, in the following order:
- Areas where the facility is exposed to self-loads only
- Areas where the structure is exposed to self-loads and wind loads
- Areas where the structure is exposed to self-loads and wind loads in addition to snow loads

- by reviewing the reality of the plastic houses common in Palestine, the following instructions were developed that deal with the basic elements of the origin to be taken into account when designing and building the plastic house to be safe and resistant, with an emphasis on the need for a prior and careful engineering study for each case separately

1. Using galvanized and hollow steel columns. These sections can be either circular or tubular.

2. The height of the plastic house should not exceed three meters, unless it was preceded by a careful study.

3. It is better that the distance between one arch is not more than three meters.

4. The need to give sufficient attention to the ground bases, as the bases are very important in the stability of the plastic house, and the bases must always be of concrete and fixed on a layer of well-compacted base course, and it is suggested to make concrete blocks with high tubes 20 cm long vertically ready, which act as support Fixed for the plastic house on the ground level (the foundation)

- 5. The joint must be long enough to act as a continuous support, when the brackets are fixed to the columns
- 6. The need for wind supports to ensure the resistance of the plastic house.
- 7. The longitudinal supports are not less than three and are based on all brackets and are continuous along the length of the plastic house.
- 8. Lateral supports shall be provided efficiently and generously in both directions and symmetrically around the origin as well as internally where functionally possible.
- 9. The length of the sea (bow width) ranges from six to eight meters. Otherwise, it becomes impractical, as the lengths available in the local market range from about six meters.
- 10. The ability to extend in both directions with relative ease and as needed, as well as the possibility of quick disassembly and transportation.
- 11. The entrances and exits of the greenhouses must not be random, but form an integral part of the detailed design.
- Location

Thank you