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Polyhouse: How to Set Up a Polyhouse and Their Cost

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A polyhouse is a type of greenhouse that are uses a plastic covering to create a controlled environment for growing plants. Polyhouses are also known as hoop greenhouses, grow tunnels, or high tunnels. Polyhouses are made of translucent materials like polyethylene or plastic sheeting. They are typically smaller and more suited to small-scale growing than greenhouses, which are available in a wider range of sizes.

Polyhouses are used to:

1. Extend the growing season: Polyhouses allow for year-round cultivation.
2. Protect plants from harsh weather: Polyhouses protect plants from harsh weather conditions.
3. Improve crop quality: Polyhouses help monitor crop development and growth, and manage water and nutrient supply.
4. Increase crop production: Polyhouses can increase crop production by 10-12 times, depending on the crop type.

Types of Polyhouse

There are two types of polyhouses

1. Natural ventilation polyhouse
2. Environmental controlled polyhouse

1. Natural Ventilation polyhouse: This kind of polyhouse will have a foggier system and natural ventilation to ward off pests and diseases. Protecting plants from unfavourable climatic conditions is the goal of naturally ventilated polyhouses. These polyhouses are less expensive. One of the problems with these polyhouses is that they lack any environmental management system other than appropriate ventilation and a fogged system to prevent damage from weather anomalies and other natural agents.

2. Environmental controlled polyhouse: In this kind of polyhouse system, crops are cultivated all year round by providing a regulated environment with variables like temperature, humidity, fertilizer automation, CO2, and rooting material. Many controlling systems are being put in this kind of polyhouse farming to increase productivity. These elements may increase crop yield during the off-season.

These polyhouse systems are further divided into three subcategories.

1. Low-tech or inexpensive polyhouse.
2. Polyhouse of medium cost or medium technology.
3. A high-end or expensive polyhouse.

Environmental controlled Polyhouses	Classification	Costs involved
Low-tech or inexpensive polyhouse.	• This kind is appropriate for cold weather. • Using shade netting, you can regulate the temperature and humidity.	Rs.300 to 500/m^2
Polyhouse of medium cost or medium technology.	• These polyhouses can be used in dry and mixed weather conditions. • This system uses thermostats, exhaust fans, cooling pads, and mist controllers to regulate temperature and humidity.	Rs.800 to Rs.1100/m^2
A high-end or expensive polyhouse.	• Automatic control system for temperatures, humidity, fertilisers, irrigation, and other complete environmental factors for continuously growing crops.	Rs.2000 to Rs.3500/m^2

Low-tech Polyhouse System: This polyhouse system is very simple to maintain and can be created using inexpensive materials. Polyhouses are typically constructed using native materials like bamboo and wood. The most common cladding material is Ultra Violet (UV) film. This kind is appropriate for cold weather. Using shade netting, you can regulate the temperature and humidity. In this form of polyhouse, no other controlled devices will be employed.

Medium-tech polyhouse system: In this system, galvanised iron pipes are used to construct the polyhouse. The entire polyhouse structure is secured to the ground with screws and the canopy cover is fastened to the house's framework with screws to prevent any damage from wind movement. This system uses thermostats, exhaust fans, cooling pads and mist controllers to regulate temperature and humidity. These polyhouses can be used in dry and mixed weather conditions. This is pretty helpful for plants needing proper care throughout their life cycle.

High-Tech Polyhouses system: A system for High-Tech polyhouses includes an automatic control system for temperatures, humidity, fertilisers, irrigation and other complete environmental factors for continuously growing crops

Crops suitable for polyhouse: Green beans, Bell Peppers (Capsicum), Cabbage, Spinach, Chipotle, Carrots, Tomatoes, Cucumbers, Coriander (Cilantro), Eggplants (Brinjal), Okra (Lady Finger), Summer squash, leafy greens, broccoli, microgreens, lettuce, herbs, ginger, and turmeric. Watermelons, peaches, strawberries, raspberries, and citrus fruits are among the fruits suitable for polyhouse farming.

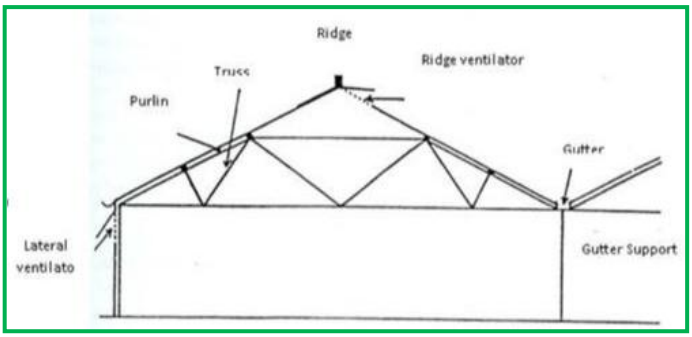
Material are required for set up the poly house system

1. Components
2. The design of the polyhouse
3. Structure of the polyhouse
4. Orientation of the polyhouse (height, dimension, spacing, water system, wind system, fertigation system).
5. Maintenance

1. Components required for polyhouse: The list of components required to set up a polyhouse is described below:

- **Roof:** A polyhouse transparent cover.

- **Gable:** Transparent polyhouse wall.
- **Cladding material:** A translucent material that is attached to the walls and roof of a polyhouse.
- **Rigid cladding material:** A cladding material that is so rigid that any distortion of the structure may cause harm to it. Eg. Glass.
- **Flexible cladding material:** A cladding material has such flexibility that any deformation of the structure won't cause damage to it. Example: plastic film.
- **Gutter:** It is located between two spans at an elevated level. It collects and drains snow and rain.
- **Column:** A vertical structural component supporting the polyhouse framework.
- **Purlin**: A part that connects the columns to the cladding supporting bars.
- **Ridge**: The tallest horizontal portion at the roof's top.
- **Girder**: A horizontal structural element that joins columns on gutter height.
- **Bracings**: To protect the building from the wind.
- **Arches:** Materials for supporting and enclosing members.
- **Foundation pipe:** The link between the structure and the ground.
- **Span width:** The gutters' centre-to-centre distance in multi-span polyhouses.
- **Polyhouse length:** The length of the polyhouse measured from the roof.
- **Polyhouse width:** The width of the polyhouse in the gutter's direction.



Cladding materials: -The covering materials placed on the basic structure with the assistance of fastening mechanisms (i.e., inserted aluminium or GI profiles with zig-zag springs) are known as cladding materials. Polythene is the most cost-effective cladding material. There are now UV-stabilised clear fibreglass and polycarbonate panels for roofing that are strong, unbreakable, and lightweight. Due to their economic viability, plastics are employed in tropical and subtropical regions instead of glass or fibreglass. For the growth of plants, plastics form confined environments. Compared to polythene without UV stabilisers, LDPE (low-density polyethylene) and LLDPE (linear low-density polyethylene) will last for 3–4 years.

2. Polyhouse Design: -During seasons of climatic change, producers in some locations commonly question the load that their polyhouses can endure. External and internal loads impact all structures, including storage buildings, greenhouses and polyhouses. These loads are conveyed to the ground through the frame members and foundation. Typical categories for loads include dead loads, live loads, wind loads and in some places, snow loads.

The structure must carry the following loads and be fabricated that way.

- **Dead load** is the weight of all fixed construction, cladding, HVAC systems, water pipes and other service equipment that is attached to the frame permanently.
- **Live load** is the term for weights that have been added by use, such as hanging baskets, shelves etc. The polyhouse must be built to support a live load of no more than 15 kilograms per square meter. When applied in its center, each roof component should be able to support 45 kg of focused weight.
- **Wind load:** The polyhouse must be able to withstand winds of at least 110 km/h and 50 kg of wind pressure per square meters.

3. Structure of polyhouse: The polyhouse construction is as follows:

1. Galvanised iron pipes are to be used to construct the polyhouses. The foundation can be 30 cm in diameter (or 60 cm x 60 cm x 60 cm) and one-metre-deep in PCC of a 1:4:8 ratios. Additionally, PCC with a 5 cm thickness should be used to cover the vertical poles up to a height of 60 cm. This prevents the poles from rusting.
2. Structures in tubes are desirable. Avoid channel structures because they could distort as a result of wind pressure.
3. For the polyhouse to have the greatest structural strength, a column should extend all the way to the top.
4. Structures must be able to support both live and dead crop loads.
5. Telescopic foundations should be used instead of conventional ones.
6. Hot-dip galvanising with a minimum thickness of 2mm is preferred.
7. A poly-grip mechanism secured with zig-zag springs and overflow film should be pushed well below the soil. Roll-up sides and side vents should be covered with insect-proof nets.

4. Orientation of polyhouse: The polyhouse's orientation strikes a balance between the latitude of its position, the direction of the wind and the sort of temperature regulation. In order to allow low-angle light to penetrate from the sides rather than the ends, single polyhouses with latitudes above 40°N should have ridges going east to west. The polyhouse ridge should be positioned from north to south below 40°N due to the significantly higher sun angle. Due to this direction, the gutter's shadow can migrate across the polyhouse. The polyhouse's positioning and orientation should prevent the neighbouring polyhouse from casting a shadow on it. They should be positioned East to West to prevent the shade impact from one polyhouse to another. However, the latitude and wind direction should also be taken into account.

The orientation of the polyhouse is subcategorised into: -

- Wind system
- Dimensions of polyhouse
- Spacing between polyhouses
- Height of the polyhouse
- Water system
- System for fertigation

I. Wind system for polyhouse: If the polyhouse is naturally ventilated, it is imperative to maximise the benefit of the wind's natural direction. The polyhouse's maximal dimension (length) should be perpendicular to the wind direction, particularly in the summer. The natural wind direction for a fan and pad polyhouse should match the airflow direction of the fan.

II. Dimensions of the polyhouse: The size of NAV GH should not exceed 50m x 50m. The larger the polyhouse, the more heat will accumulate due to poor ventilation. The length of a polyhouse that uses evaporative cooling shouldn't exceed 60m.

III. The spacing between polyhouses: In order to prevent exhaust from one polyhouse from entering the adjacent polyhouse, there should be 10 to 15 m between each naturally ventilated polyhouse.

IV. Height of the Polyhouse: The maximum height for polyhouses measuring 50m × 50m is 5m, but this height can be adjusted to fit the smaller polyhouse. The wind stress on the structure and glazing increases as the polyhouse height increases. The width of the side ventilation can be 2 m, while the width of the roof ventilation is 1 m.

V. Watering system: A micro irrigation system is the finest irrigation solution for plants in a polyhouse. Equipment for drip irrigation or micro

sprinklers can be employed. The irrigation system should ensure that water doesn't get on the flowers or foliage, which might cause disease and pest issues. In a micro-sprinkler system, water is forced under high pressure *via* nozzles positioned on a supporting stand at roughly one foot. This makes it easier to water the plants at their base.

VI. System for Fertigation: In a fertigation system, an automatic mixing and dispensing unit is installed, which comprises three systems pumps and a serving device. After being individually dissolved in tanks, the fertilisers are combined in a specific ratio, and drippers are used to apply the mixture to the plants.

Fertilisers: The amount of fertiliser used must depend on the growing medium. Because soilless mixes have a poorer capacity to hold nutrients, fertiliser must be applied more frequently. The pH range of 5.5 to 6.5 results in the greatest availability of essential components. On the whole, while macro components are more easily accessible at pH 6 and above, microelements are more easily accessible at lower pH ranges.

5. Maintenance: The upkeep of the transparent films represents the primary polyhouse expense. Since dust builds on them and reduces their ability to transmit light, the biofilm on the walls and roof needs to be cleaned periodically. Every year, the polyhouse must be solarised. Insect traps must be installed, or biological insect control must be used in polyhouse farming. It is necessary to routinely clean the irrigation system's pipes and sprinklers to avoid the buildup of bacteria that could infect plants.

The cost required to set up a polyhouse

The type of system you select and the building site will affect the price of your polyhouse. Here are some specifics on polyhouse construction costs. These numbers could vary from time to time and from region to region. Take this as a rough estimate for building poly houses.

❖ **The price of building a polyhouse varies depending on the type of polyhouse:**

1. Without cooling pads and exhaust fan systems, a low-tech polyhouse will cost between Rs. 400 and Rs. 500 per square metre.
2. Medium-priced, medium-tech polyhouse with cooling pads and exhaust fan systems costs between Rs. 900 and Rs. 1200 per square metre (without automation).
3. High-tech polyhouses cost between Rs. 2500 and Rs. 4000 per square metre with a fully automatic control system.