भारतीय मानक

Indian Standard

IS 14461 : 2024

सतह से ढकी खेती संरचनाएँ — पारिभाषिक शब्दावली

(पहला पुनरीक्षण)

Surface Covered Cultivation Structures — Glossary of Terms

(First Revision)

ICS 01.040.65; 65.040.30

भारतीय मानक ब्यूरो
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May 2024 **Price Group 5**

Agricultural Systems and Management Sectional Committee, FAD 22

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Agricultural Systems and Management Sectional Committee had been approved by the Food and Agriculture Division Council.

Farming by surface covered cultivation structures and greenhouse cultivation technology has been now widely accepted and practiced by Indian agriculture sector. Its usage has increased over the years and the technology covers large number of new equipment and systems designed, developed and manufactured in the country. Therefore, there is a requirement for development of comprehensive terminology to avoid any ambiguity in the usage of terms and to provide their authentic definitions.

In order to address the above need, this standard was originally published in the year 1997 deriving assistance from:

ASAE EP 460-1995 'Commercial greenhouse design and layout'

ASAE EP 406.2-1995 'Heating, ventilating and cooling of greenhouses' published by American Society of Agricultural and Biological Engineers, USA.

In this revision of the standard, the following changes have been incorporated in order to update the standard as per latest technological advancement and industry requirements:

a) The definition of aeroponics, fan tube cooling, head house, hydroponics, orientation, shade structure and shading have been modified;' and

b) Additional definitions of agricube, aquaponics, controlled environment agriculture (CEA), controller, earth tube heat exchanger, fogging system, heat exchanger, humidification, inflation fan, lighting system, louvers, misting system, open roof greenhouse, plant factory, solar photovoltaic system, sump, urban agriculture, Venlo greenhouse, vertical farm and zero acreage farming (Z farming) have been incorporated.

Apart from the above, the standard has been brought out in the latest style and format of the Indian Standards.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SURFACE COVERED CULTIVATION STRUCTURES — GLOSSARY OF TERMS

(First Revision)

1 SCOPE

This standard cover definition of terms relating to surface covered cultivation structures.

2 TERMS AND DEFINITIONS

2.1 Aeroponics — A plant-cultivation technique in which the roots are suspended in the air while nutrient solution is delivered to them in the form of a fine mist.

2.2 Agricube — An automated micro plant factory which could be accommodated in one's living space for production of high-quality vegetables.

2.3 Air Circulation — The process of moving or mixing air within a greenhouse to control temperature, humidity and carbon dioxide distribution.

2.4 Air Enrichment — The addition of suitable gases and vapors to bring the air composition in the greenhouse growing region to near-optimal level. Generally, it relates to the addition of CO_2 and moisture. However, some other specific gases could also be added depending upon the crop requirements.

2.5 Air Exchange Rate — Refers to replacement of greenhouse air with ambient air. Usually, it is expressed in terms of the replacement of air volume equivalent to enclosed space in greenhouse per unit time, for example, number of air changes per minute.

2.6 Air Infiltration-Exfiltration — The air exchange between outside and inside of greenhouse expressed in the same terms as air exchange rate.

2.7 Air Inflated Greenhouse — Normally refers to two plastic film covers attached firmly to superstructure and air forced between them with the help of a blower to keep both covers separated and inflated.

2.8 Air Supported Greenhouses — The greenhouses in which film is wholly supported by air pressure (1 MPa to 2 MPa). They are normally cylindrical or quonset shaped.

2.9 Aquaponics — A system of aquaculture in which the waste produced by farmed fish or other aquatic animals supplies nutrients for plants grown hydroponically, which in turn purifies the water for aquaculture.

2.10 Aspirate — To circulate air continuously across or through an object.

2.11 Bow/Hoop — Pipe or tubing framework shape used to support the glazing.

2.12 Carbon Dioxide Enrichment — The process of increasing the concentration of carbon dioxide in the greenhouse air.

2.13 Cold Frames and Hot Beds — Cold frames are heated only by the sun whereas hot beds are artificially heated. The purpose is to start or harden off seedlings in the spring or extend the growing season in the fall.

2.14 Condensate — Refers to the water condensed from the air at a cold greenhouse surface.

2.15 Controlled Environment Agriculture (CEA) — A technology for plant production in controlled environment structures such as high tunnels, greenhouses, growth chambers, or indoor vertical farming (warehouse farming).

2.16 Convection Heat Loss — Loss of heat from greenhouse as air moves in convection current to greenhouse top covering.

2.17 Convection Heater — A heater that does not contain a heat exchanger. Hot gases (smoke) are carried through the length of greenhouse in a pipe which serves as heat exchanger as heat passes through its wall to the greenhouse air.

2.18 Controller — A device or mechanism used to regulate or guide the operation of a machine, apparatus, or system.

2.19 Cooling — Generally, the removal of heat from the interior of the greenhouse. However, the term may also be applied to the conversion from sensible to latent energy, as in evaporative cooling.

2.20 Curtain Wall — The non-transparent lower portion of the sidewalls of a greenhouse.

2.21 Double Poly Inflated — Refers to a type of greenhouse covering, where two polyethylene layers are laid over the super structure, fastened at edges and air forced between them to separate the cover.

2.22 Earth-Tube Heat Exchanger — Also known as ground-coupled heat exchanger is an underground heat exchanger that can capture heat from and/or dissipate heat to the ground. They use the Earth's near constant subterranean temperature to warm or cool air or other fluids for residential, agricultural or industrial uses. Transfer fluid in the heat exchanger may be air, water or any other fluid.

2.23 Eave — The connection between the side wall and the roof of a greenhouse.

2.24 Evaporative Pad — Refers to the wetted part of cooling system through which air is drawn by exhaust fan. Heat is extracted from air to evaporate water in pad thereby lowering the air temperature.

2.25 Even/Uneven Span Greenhouses — A single span greenhouse with its ridge line running through the middle of the structure called an even span greenhouse. The uneven span greenhouse has its ridge line running closure to one of its sides.

2.26 Fan and Pad Cooling — A system for cooling greenhouse used during the warmer months of the year. Warm air expelled through exhaust fans in one wall is replaced by air entering through wet pads on opposite wall. The entering air is cooled by evaporation of water in pad.

2.27 Fan Tube Cooling — A system for cooling greenhouses used during warmer months of the year. Cold air entering through a louver high in the gable of greenhouse is directed along the length of the greenhouse through a clear plastic distribution tube.

2.28 Fogging System — A fogging system, in the present context, is a method of increasing relative humidity of an enclosed space, such as a greenhouse, by adding an aerosol of water consisting of water droplets of diameter less than 30 μm (fog) This is achieved with the help of a high-pressure pump that forces water at 5.5 MPa to 7 MPa through special nozzles, which creates a fine aerosol in fog range.

2.29 Footing — The support for the foundation wall. Its size depends on the weight of the wall, structure and other gravity loads, and the supporting soil type.

2.30 Foundation — Foundation is the structural element between the greenhouse super structure and the ground, It must safely transfer gravity, uplift and overturning loads to the ground such as those from snow, crops, and wind.

2.31 Framed Greenhouse — Refers to greenhouses in which an internal superstructure is required to support the glazing material. Both gable roof and arch or curvilinear shapes are possible with this type of greenhouse.

2.32 Free Standing Greenhouses — These are also called single span or ground to ground greenhouses.

2.33 Gable — The triangular end of the greenhouse bounded by the roof on two sides and the end wall on the bottom.

2.34 Girts — Longitudinal members of the framework that support the glazing material on the walls.

2.35 Glasshouse — A term used more commonly in Europe to designate structure used for growing plants that has a transparent cover and an artificial heat source. In some places they are called greenhouses.

2.36 Glazing — The transparent or translucent material glass or plastic, used to cover the greenhouse which transmits the desired amount of insolation to the growing area in the greenhouse.

2.37 Gothic Arch — The internal superstructure made with Gothic arches and bound by flexible plastic film.

2.38 Greenhouse — Frames or inflated structures covered with transparent or translucent material in which crops may be grown under conditions of at least partially controlled environment and which are large enough to allow a person to walk within them and carry out cultural operations.

2.39 Greenhouse Environment — The temperature, light, composition of air, humidity and the nature of the root medium in the greenhouse.

2.40 Growth Chambers — These are normally opaque structures where all the environmental parameters, including light, are artificially and precisely controlled.

2.41 Gutter — In a multi-span greenhouse, it is the lowest portion of the roof construction generally, shaped in the form of a wide channel to drain off rain water and to permit people walking on it for maintenance.

2.42 Gutter-Connected Greenhouse — A series of two or more single span greenhouses joined together at the cave by a drain gutter. Interior walls are usually eliminated.

2.43 Head House — A building in close proximity to or attached to a greenhouse. The building may be used for storage, grading, packaging, potting area, workshop, etc.

2.44 Heat Exchanger — A device for transferring heat from one medium to another.

2.45 Heating — The addition of heat to the interior of the greenhouse from any energy source including the sun.

2.46 Horizontal Air Circulation — A system utilizing fans to generate a horizontal air circulation pattern above the plant canopy.

2.47 Humidification — The process in which water vapor is added to the air without changing its dry bulb temperature.

2.48 Hydroponics — The process of growing plants in sand, gravel, or liquid, with added nutrients but without soil.

2.49 Inflation Fan — Fan used to inflate air between double layered poly covering, reduce heat loss by creating a dead air space between the two poly coverings.

2.50 Infiltration — Generally, undesirable air exchange which occurs through small, uncontrolled openings in the greenhouse covering. These exchanges are driven by wind pressure and/or temperature differentials inside and outside the greenhouse. Infiltration rate is generally expressed in terms of internal air volume changes per unit of time.

2.51 Institutional Greenhouses — The greenhouses for academic units, rehabilitation centers, public parks or gardens are classified as institutional greenhouses.

2.52 Lean to Greenhouse — A greenhouse built against the side of another structure such that it has only one slopping roof.

2.53 Life of Glazing Material — The period for which a glazing material will retain most of its transmission qualities, optical and physical properties when continually exposed to naturally occurring weather elements.

2.54 Light Transmittance — The ratio of the light passing through a glazing material to the light incident upon it.

2.55 Lighting System — Electric lighting used in surface covered cultivation structures to regulate the photoperiod to control flowering, or to increase growth to increase crop quality and yield.

2.56 Louvers — A set of angled slats or flat strips fixed or hung at regular intervals in a door, shutter, or screen to allow air to pass through.

2.57 Mechanical Ventilation — Desirable air exchange which occurs through controlled openings when fans are used to move air inside and exhaust air out, of the greenhouse. Fans may be located either at the inlet end (positive pressure) or the exhaust end (negative pressure); however, the most common location is the exhaust end.

2.58 Misting System — A method of adiabatic cooling in confined spaces by adding moisture in mist form, that is, water droplet sizes in the range of 50 μm to 100 μm. The water pressure required in mist formation is 2 to 4 bar.

2.59 Multi-Span Greenhouses — A type of greenhouse construction where individual houses are combined at the gutters, usually to form one open area under the entire roof. Gable shape and curved roof greenhouses are found economical for large areas of 500 m^2 to 10 000 m^2 under commercial cultivations. They are also called ridge and furrow greenhouses.

2.60 Natural Ventilation — Desirable air exchange which occurs in response to temperature and pressure variations inside and outside the greenhouse. These variations are created and maintained by solar energy, internal heat sources, and/or wind.

2.61 Night Curtain — Movable blankets which add thermal resistance during the night time and can be stored during daylight hours. Night curtains are made of thin materials that will pleat and store in a relatively small space.

2.62 Open Roof Greenhouse — Open-roof greenhouse offers maximum natural light and ventilation to the greenhouse crop. Each roof section is hinged at the gutter and is connected to a rack-and-pinion or push-pull drive system. Controller operated motors push the roof sections open, in effect making the entire roof into a vent.

2.63 Orientation — Refers to the positioning of greenhouses in such a way so that maximum winter light is transmitted to the plants. Orientation of a greenhouse is a compromise between wind direction, and solar radiation received by the greenhouse. While any greenhouse should admit adequate sunlight for photosynthesis, it should be strong enough to resist heavy wind loads. Single-span greenhouses with latitude above 40° north should have ridge running east to west to allow low angle light during winters to enter from south side rather than the two ends. Below 40° north the ridge of single span greenhouses could be oriented either north-south, or east-west since the angle of the sun is much higher. Most locations in India are at latitudes lower than 40° north. Therefore, sunlight is generally, adequate irrespective of the orientation. Instead, the orientation should be such that the ridge line is perpendicular to the wind direction to protect the greenhouse from wind damage. In case of multi-span greenhouses, the gutter should be oriented north-south so that the shadow of the gutter is not stationery throughout the day and the zones of permanent shadow are avoided. Fans for evaporation cooling should be located on the leeward side of the wind direction.

2.64 Over Wintering Structures — These are generally, pipe framed structures of arch shape and covered with transparent polyethylene film. Generally, these structures are unheated and prevent damage from frost.

2.65 Packaged Heater — A heating device with its own fan and controls. Heat may be supplied from natural gas, oil steam or electrical energy.

2.66 Perimeter Heating System — A row of heating pipe just inside the perimeter wall of a greenhouse.

2.67 Photodegradation — Radiation in the form of ultra-violet light that contributes to decomposition of plastic material. Absorber or inhibitors must be present for longevity.

2.68 Phytotrons — The most advanced climate controlled greenhouses and growth chambers for crop research purposes.

2.69 Pier — A column of concrete, masonry, or pressure treated lumber used to support greenhouse individual frame members.

2.70 Pit Greenhouses — Greenhouses that are built partially below ground (one meter or more) often attached to another building, roofed with transparent material that faces south, and normally heated only by the sun.

2.71 Plant Factory — A closed growing system which permits to achieve constant production of vegetables round the year. The facility utilizes artificial control of light, temperature, moisture, and carbon dioxide concentrations.

2.72 Plastic Greenhouse — A greenhouse employing plastic film or sheets as glazing material.

2.73 Purlin — A component of the greenhouse frame running the length of the greenhouse which connect the trusses together.

2.74 Quonset — This greenhouse shape is achieved when the internal superstructure is made by semi-circular hoops and covered with a flexible plastic film.

2.75 Radiation Heat Loss — The radiation of heat from a warm body such as plants in a greenhouse, to a cooler body such as covering on the greenhouse or sky.

2.76 Rafter — A frame component spanning the space between the cave and the ridge.

2.77 Range — A series of single span greenhouses, usually interconnected, or two or more sections of the gutter-connected greenhouses.

2.78 Reglaze — To replace the glass or the glazing compound which seals the glass or greenhouse.

2.79 Ridge — The highest part of the roof of a greenhouse usually forming a major structural component of greenhouse.

2.80 Ridge and Furrow — A type of greenhouse construction where individual houses are combined at the gutter usually to form one open area under the entire roof.

2.81 Saw Tooth Greenhouse — A type of multi-span greenhouse with the top of its end projections resembling the shape of a saw serrations.

2.82 Service Road — The road connecting the greenhouse production facility to the public road. The service road leads directly to the stores of the greenhouse.

2.83 Shade Structures — Framed structures, somewhat lighter than those for greenhouses, providing 35 percent to 75 percent shading and which are permeable to wind.

2.84 Shading — Refers to covering of the greenhouse with the material that reduces the light intensity below 20 000 lux, either to lengthen the

dark period or facilitate cooling of greenhouse environment.

2.85 Sill — The portion of greenhouse that rest on the curtain wall and to which the side walls, sash bars are attached.

2.86 Single Span (Ground-to-Ground) Greenhouse — Greenhouses covering 100 m^2 to 500 m^2 floor area, each functioning as a separate unit.

2.87 Solar Greenhouse — The conventional greenhouses are designed primarily to capture light and they tend to overheat on sunny days, loose heat on cloudy and cold days and loose heat rapidly after sundown each day. Solar greenhouses differ in the sense that they are designed to collect and retain solar energy and thus reduce the use of fossil fuels for heating.

2.88 Solar Photo Voltaic System — A system designed to make usable solar power available by means of photovoltaics.

2.89 Spectral Transmittance — The transmittance of light in the various regions of the spectrum.

2.90 Steam-Trap — A device that allows condensate water to return to boiler, but prevent passage of steam from heating coil into the condensate return.

2.91 Sump — A pit, well, or the like in which water or other liquid is collected.

2.92 Temporary Greenhouse — A structure used for short term production, for watering or hardening of plants. It is usually glazed with transparent plastic film.

2.93 Thermal Radiation Transmittance — The ratio of the heat, that is, radiated through a glazing material to the thermal radiation incident upon the inside surface.

2.94 Tower Greenhouse — Multistoried greenhouses where conveyors are used to move plants from lower regions to higher regions. Tower greenhouse makes more effective use of vertical space.

2.95 Truss — A structural component of greenhouse frame spanning the width of the greenhouse and consisting of rafter, chords and struts which are welded or joined together.

2.96 Ultra-Violet (UV) Stabilization — The plastic covers being susceptible to photo degradation, both polyethylene and vinyl films are affected by ultra-violet light. They become brittle and torn/susceptible to tear when exposed to solar radiation. Stabilizers are mixed to make polyethylene UV stabilized.

2.97 Urban Agriculture — The agriculture which produces, processes and markets food to fulfill daily needs for consumers in a town, city, or metropolitan area by employing efficient methods of production, using and recycling natural resources and city wastes to produce a variety of products and livestock.

Plant factories, vertical farming, and rooftop greenhouses are in fact components of a closed-field production system in urban agriculture.

2.98 Venlo Greenhouse — A design that consists of galvanized steel superstructure supporting a gable glass roof using single panes of glass from the ridge to the gutter with no purlins or girts. It maximizes energy efficiency and light transmission into the structure. It is named after the city of Venlo in the Netherlands, and better suited to cold and cloudy climates.

2.99 Ventilation — The process of exchanging air inside the greenhouse with outside air to control greenhouse temperature, humidity, oxygen and carbon dioxide levels.

2.100 Ventilation Rate — The volume of air exchanged per unit time per unit floor area. Ventilation rate is often expressed as m^3/m^2 of greenhouse floor area (alternatively, as internal air volume changes per unit of time).

2.101 Vertical Farm — Essentially an indoor farm located in an urban area and based on a high-rise multi-level factory design. Typical features include innovative use of renewable energy, recycled water augmented by rainwater or water from a desalination plant, automatic air-temperature and humidity control, solar panel lighting and heating, and tunable 24 hour LED illumination.

2.102 Weatherability — The resistance of a greenhouse glazing material to degradation due to weather effects.

2.103 Zero Acreage Farming, or 'Z Farming' — Method of farming that does not use farmland or open space and, instead, it uses otherwise unused spaces in urban areas. Roof top farms/gardens, edible walls, indoor farms, or vertical greenhouses are some of the examples of Z farming.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Agricultural Systems and Management Sectional Committee, FAD 22

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This Indian Standard has been developed from Doc No.: FAD 22 (23618).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Published by BIS, New Delhi