



Reduce Storm Damage to Your Greenhouses

Nature seems to be getting more violent in recent years with frequent earthquakes, increased numbers of hurricanes and record breaking snowstorms. Insurance damage claims have increased considerably. The International Building Code has revised upward its wind and snow loading requirements for some areas of the U.S.

Each year there are reports of greenhouses that have been damaged by weather and natural events. Greenhouse design is different than conventional farm buildings in that the structural profile has to be small to allow maximum light to reach the plants. Most farm buildings are over designed to handle severe weather conditions.

Damage to greenhouses can include racking of the frame, bending of the hoops, broken glass or torn plastic and uplifted foundation posts. Preparation ahead of time can minimize the damage.

Wind loading

Wind forces that act on a greenhouse are influenced by numerous factors including the basics wind speed, building orientation, exposure, height and shape of doors or vents that may be open. The wind passing over a greenhouse creates a positive pressure on the windward side and a negative pressure on the leeward side. These can combine to create a force that wants to collapse or overturn the building. An 80 mph wind can produce a pressure of 16 pounds per square foot (psf). For example, the 10' by 100' sidewall of a gutter-connected greenhouse would have to resist a 16,000 pound force.

Wind can also create a force similar to an aircraft wing that wants to lift the greenhouse off the ground. An 80 mph wind blowing perpendicular to the side of a 28' x 100' hoophouse can create a lifting force of 220 pounds per foot of length or 22,000 pounds of uplift on the whole structure. When you consider the total weight of materials and equipment in the greenhouse is about 6000 pounds, the foundation must have a withdrawal resistance of about 300 pounds each. This is why building inspectors frequently require that the posts be surrounded by concrete.

Although you have no control over the force or direction of severe winds, here are a few tips to help minimize storm damage:

- Check the area for loose objects. Anything that can be picked up and hurled through the glazing should be secured or moved indoors. Metal chimney (stove pipe) sections should be secured with sheet metal screws.
- Inspect for dry or weak tree limbs that could fall on the greenhouse.
- Close all openings including vents, louvers and doors. The effective force of the wind is doubled when it is allowed inside the building. The wind on the outside puts a pressure or lifting force on the structure. The wind inside tries to force the walls and roof off.
- On air inflated greenhouses, increase the inflation pressure slightly by opening the blower's intake valve. This will reduce the rippling effect. Check to see that the plastic is attached securely and that any holes are taped.

- Disconnect the arm to the motor on all ventilation – intake shutters and tape the shutters closed. Then turn on enough exhaust fans to create a vacuum in the greenhouse. This will suck the plastic tight against the frame.
- Windbreaks can reduce the wind speed and deflect it over the greenhouse. Conifer trees (hemlock, spruce, pine, etc.) in a double row located at least 50' upwind from the greenhouse can reduce the damaging effects of the wind. Wood or plastic storm fencing can be used as a temporary measure.

Snow loading

Snow that accumulates on a greenhouse can put significant weight on the structural members. Snow loads vary considerably from 0 along the southern coastline to more than 100 pounds per square foot in Northern Maine. Local building codes specify the design snow load.

Snow can be light and fluffy with a water equivalent of 12" of snow equal to 1" of rain. It can also be wet and heavy with 3" equal to 1" of rain. Snow having a 1" rain water equivalent will load a greenhouse with 5.2 psf. This amounts to 6.5 tons on a 25' x 96' greenhouse.

The following are a few pointers to consider before the next snow season:

- The foundation piers or posts should be large enough to support the weight of the building including crop and equipment loads.
- All greenhouses should have diagonal bracing to keep it from racking from the weight of the snow or force of the wind.
- Collar ties and post connections should have adequate bolts or screws. This is a weak point in some greenhouse designs.
- Allow 10' to 12' between individual greenhouse for snow accumulation and to prevent sidewalls from being crushed in.
- When building new hoophouses, consider using a gothic design that sheds snow easier. In hoop shaped houses, install 2" x 4" posts under the ridge every 10' when heavy snow is predicted.
- The heating system should be large enough to maintain 60°F to melt snow and ice. It takes 250 Btu/hr per square foot of glazing to melt a wet snow falling at a rate of 1"/hour. Heat should be turned on in the greenhouse or under the gutter several hours before the storm begins.
- The plastic should be tight and inflated to at least 0.25" water pressure. This can be checked with a monometer. Any cracked or broken glass should be replaced.
- Energy screens should be retracted to allow heat to the glazing.
- A standby generator should be available with adequate fuel for the duration of the storm to power heaters, fans and blowers.

Selection of greenhouses that meet the International Building Code and good construction techniques are important considerations when building new greenhouses. A little preparation before a storm can minimize damage from severe weather events.

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