Greenhouse Foundation Design

As with any building, a good solid foundation is crucial for the long term durability and functionality of your greenhouse. A weak foundation will cause your greenhouse to settle over time causing components such as door or roof windows to not open or close correctly in addition to possibly damaging the frame. A poorly anchored foundation will increase the likelihood that your greenhouse will fail in high winds or adverse weather. For this reason it is crucial to take the time to construct a strong and stable foundation that is securely anchored to the ground.

The foundation design depends on greenhouse style, climate, site situation (soil, slope, etc.), desired thermal efficiency, budget, available materials and building codes. For convenience, we have listed some of the most commonly used options for securing your greenhouse to the ground. International Greenhouse Company does not make any claims – expressed or implied – as to the actual performance for any of these options.

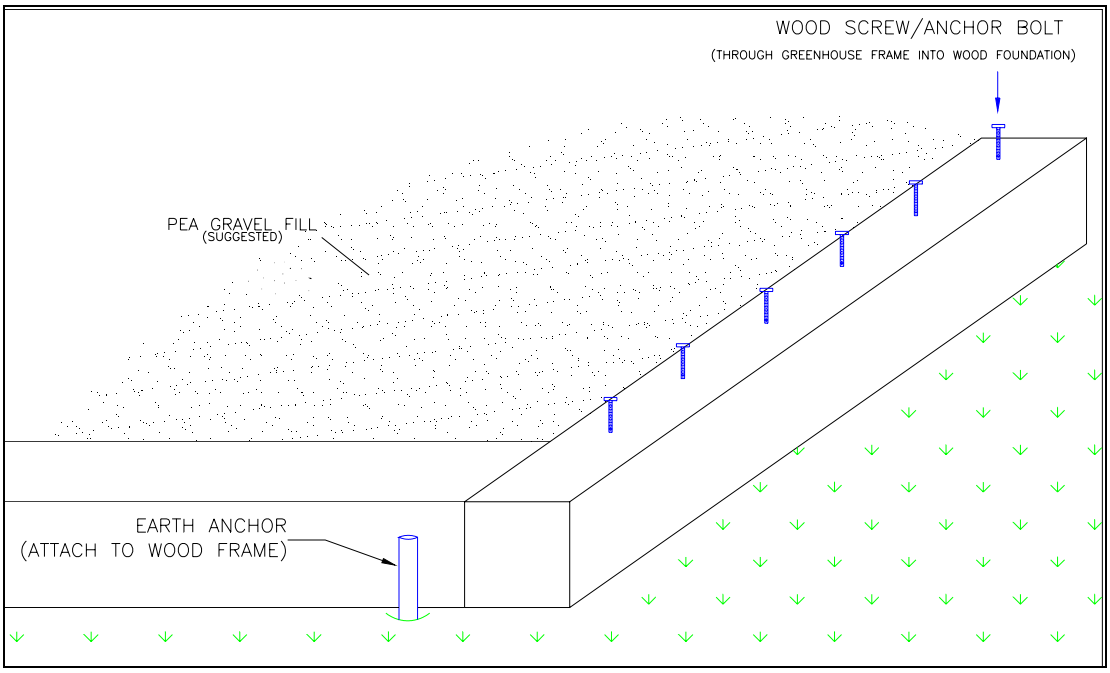
Ground Stakes

Some greenhouse kits may be placed directly on a level patch of ground without an established base as long as “earth anchors” or ground stakes (see left) are used to secure the frame to the ground. Although this method requires the least amount of work it also runs the greatest risk of damage to the greenhouse frame structure since the structure will most likely settle and warp over time. In addition, ground stakes alone may not prevent your greenhouse from blowing over in high winds; particularly if the ground has been saturated by heavy rains. Ground stakes (or “swing set anchors”) can be purchased at most hardware stores.

Wood Foundation

Building a foundation out of wood is simple and inexpensive making it an excellent option for many hobby greenhouses. An excellent option is to use 4"x4" ACQ pressure treated wood for the base secured by steel stakes driven into the ground. ACQ is a nontoxic pressure treated wood product using copper based preservative with a high retention rate. Being biodegradable in soil, any leaching of the preservative that may occur is safe for plants and humans making it perfect for greenhouse applications. If ACQ wood is not available naturally resistant woods such as cedar, redwood, or cypress can also be used since these woods naturally inhibit decay.

Whatever wood is used should be cut to fit the exact perimeter dimensions of your greenhouse. Once the wood is cut, lay the boards together on the ground like you are going to set the greenhouse kit on top of them. At that point take the time to use a long carpenter’s level to ensure that each side of the greenhouse base is level. Add or remove soil as needed to level the site.



When the foundation is level secure the timbers together at each corner using galvanized steel lag bolts. Lag bolts should be three or more inches longer than the first board it is screwed through to insure a proper hold. We recommend laying some type of ground cover or weed barrier inside the completed base as an easy way to keep weeds from growing up inside your greenhouse while still allowing water to drain through the fabric.

Once the wood foundation is completed it is crucial to make sure that your base is square. This is done by taking two diagonal measurements of the wood base (one from the front left corner to the back right corner and the other from the front right corner to the back left corner) and adjusting the wood until the two measurements are the same. Once the base is square you can anchor it to the ground using some type of earth anchor (see above) or ground stake (see right).

The length of these anchors should be no less than 12” depending upon the type of soil (loose or compacted) in your area.
Now that you have finished building a foundation for your new greenhouse, the inside should be filled with 2 to 3 inches of pea gravel (see right), wood chips or some type of material that will allow for good drainage. Obviously, this task is much easier if it is done before securing the greenhouse

to your new wood base. Once your floor has been completed, your greenhouse kit can now be secured to the wood base per the manufacturer's instructions.

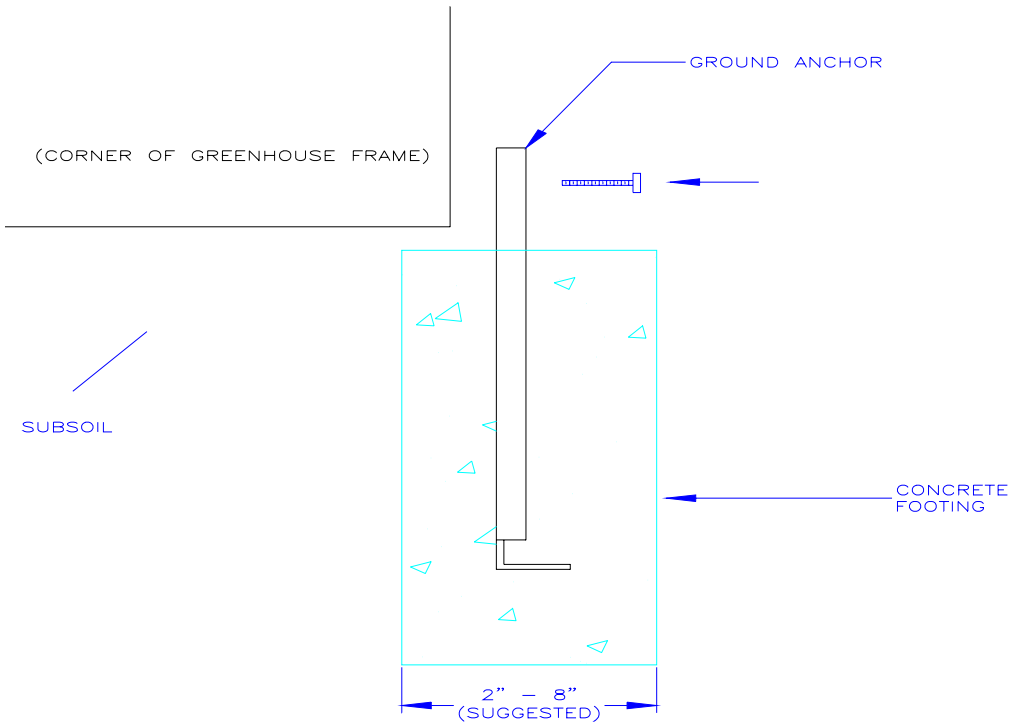
Concrete Piers or Perimeter Walls

This type of concrete foundation is generally used with greenhouses that have been engineered to meet a particular load rating requirement.

Under this method, a hole or "pier" is augured into the soil below the frost line for every greenhouse leg (there are two "legs" per greenhouse arch). The dimensions of this pier should follow the greenhouse manufacturer's instructions or recommendations. Lacking this recommendation the size of the pier should be based on the overall size of the greenhouse and the type of soil (loose or compact); however, it should never be less than 12" deep by 8" in diameter (see above). Obviously, the larger the pier the more stable and durable your greenhouse structure will be.

It is important to check with your local building inspector to determine their requirements (if any) and to see if an inspection is required before any concrete is poured.

GROUND ANCHOR PIER FOUNDATION



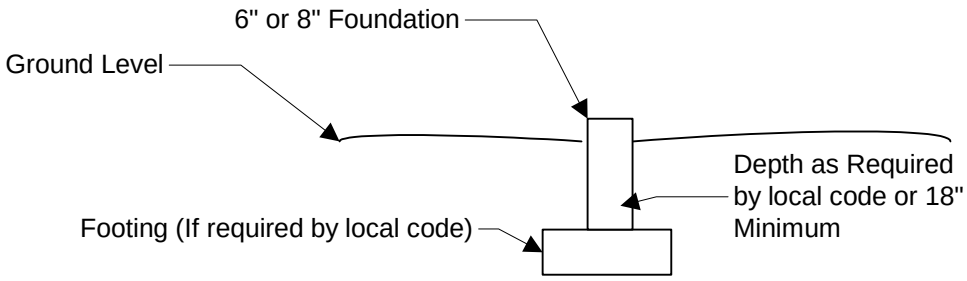
Once all holes are augured, each is filled with concrete with one of three structural components suspended in the concrete pier:

1. The leg or column of the greenhouse itself
2. Some type of ground stake or earth anchor (see above diagram) that is then secured to the greenhouse frame
3. Foundation or “J” bolts that are then secured to the greenhouse column

Concrete Perimeter Footing and Wall

For some kits another option to pouring piers is to form a continuous concrete “perimeter footing and wall”. The footing is formed and poured first by digging a trench in the soil to below the frost line and set your forms. The footing is usually twice as wide as the wall and equally as thick; however, we strongly recommend that you check with your local building inspector to determine any sizing requirements and to see if an inspection is required before the footing is poured.

Once the footing has hardened, go ahead and form up for the foundation wall. The wall height should be a minimum of 6 inches above grade as pictured below:



The greenhouse base can be attached using concrete anchor bolts (see picture below) which are available at most home centers and hardware stores. Certain kits will require anchor bolts to be set for every arch; if not, space bolts within 1 ft. of each corner then space additional anchor bolts no more than 4 ft. apart along the perimeter of the frame.

For greenhouses with fixed benches, one advantage of a perimeter footing (instead of a slab) is that concrete walkways can be poured between benches while the area underneath the benches can be filled with pea gravel for easy and efficient drainage.

Concrete Slab

A concrete slab can provide a durable and easy to maintain base for a greenhouse. For most greenhouses, the floor should be several inches above the outside grade to prevent water from draining into your greenhouse (see picture left). Generally, the concrete foundation should be poured 1" longer and wider than the outside dimensions of the greenhouse. Although a 3” thick floor is adequate for most home greenhouses a 4” thick slab will help to minimize cracking. Regardless of the slab thickness the outside edges should be thicker to provide additional support and to reduce cracking from freezing weather.

Select the Type of Mix

There are many types of premixed masonry products available. Choosing one can be a confusing task. To simplify the selection process, narrow the field to three basic mixes.

- **Regular concrete mix** is a mixture of sand, gravel, and Portland cement. Regular mix should be used in conjunction with wire remesh. Remesh adds stability to the concrete and helps ensure the pad doesn't develop large cracks. Regular mix works best when it's poured in warm weather.

- **High early strength concrete mix** is best for cold weather pours. High early strength mixes have the same ingredients as regular mixes and an additive that shortens the setup time for the concrete. The shortened setup time helps the concrete cure before it can freeze in cold conditions. High early strength concrete also requires remesh.

- **Fiber-reinforced mixes** have the same ingredients as regular mix and synthetic fibers that help strengthen the concrete's bond. Fiber-reinforced concrete can be poured without using wire remesh.

Compare the properties of each mix to your needs and choose the one that suits your application best.

Prepare the Site

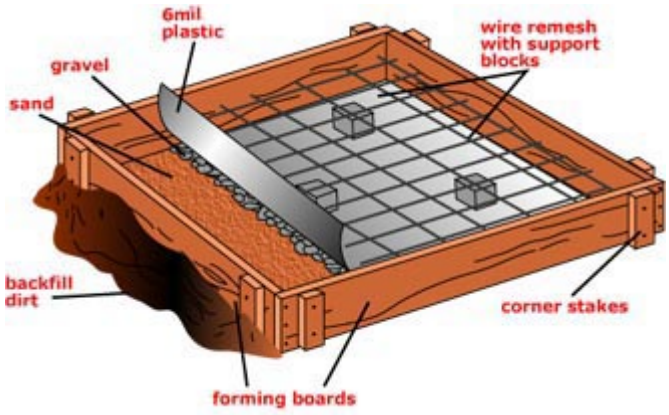
Determine the best location for the pad. Try to choose a location that is already level to reduce the need for digging.

1. Mark the corners for the pad with stakes. Make sure the stakes are square. Set the stakes 6" back from each corner. Dig out the area inside

the stakes 6" deep. Most concrete pads are 4" deep; digging to 6" gives you enough room to lay a good base for the pad.

2. Use a tamper to compact the bottom of the hole. Fill in 2" of the bottom of the hole with gravel and fine sand. Compact the gravel and fine sand with a tamper.

3. To promote water run-off, the pad needs a slight slope. One-quarter inch of drop per foot of length is usually sufficient. Determine which direction you want the water to drain, then stake and nail the first forming board on the high side of the pad. The stakes should be on the outside of the form to help steady the forming boards. Check the forming board to ensure that it is level from end to end. Install the second forming board at the low side of the pad. Use a line level to check for level between the first and second boards. The bubble in the level should read slightly toward the high side of the pad. Adjust the boards as needed. Stake and nail the last two forming boards. Backfill behind the boards with soil removed from the hole so they don't deflect (move) when the concrete is poured.



4. Cover the bottom of the hole with 6 mil plastic. The plastic serves as a vapor barrier and helps prolong the life of the pad.

5. If you aren't using fiber-reinforced concrete, cut and fit wire remesh into the form. Place the remesh on small blocks so that it rests at half the height of the pad.

Pour the Concrete

If you liked making mud pies, you're going to love pouring concrete. Have all your tools ready before you start mixing the first batch.

1. Mix the concrete according to the manufacturer's instructions.

2. Coat the insides of the forming boards lightly with cooking oil. The oil keeps the concrete from bonding to the boards and simplifies removing the forming boards later. Fill the form with wet concrete. Be sure to work the concrete into the corners.

3. Screed the concrete with a 2x4 long enough to reach across the pad. Rest the 2x4 on top of the forming boards and work it back and forth in a sawing motion. As you work the board back and forth, pull it from one end

of the pad to the other. Make several passes with the screed board to even out the pad and knock down the high spots. Make several passes with the screed board to even out the pad and knock down the high spots. Fill any low spots with fresh concrete and screed the pad until the top is flush with the form.

4. While the concrete is still wet, use a wooden or metal float to smooth the pad. Move the float in a semicircular motion along the top of the pad. Hold the leading edge of the float slightly above the concrete to avoid gouging the surface. As you float the surface, the gravel is forced down and excess water and air pockets rise to the top. Continue floating until the slab is smooth.

5. After the concrete begins to set, use an edging tool along the sides of the pad. The edging tool breaks the pad loose from the form and compacts the sides of the pad. For large pads, use a grooving tool every 6' to 8' to make control joints in the pad.

6. Surface the pad. One of the most popular and simplest surfaces for concrete is the broom finish. Dampen the bristles of an ordinary street broom and drag it lightly across the pad's entire surface. The broom makes small ridges in the concrete and provides traction to the surface of the pad.

Cure and Seal the Pad

Proper curing and sealing promotes high strength and long life in the concrete. Follow these steps to protect your pad:

1. Cover the pad with plastic for forty-eight hours to prevent it from flash drying on top.

2. Uncover the pad and remove the forming boards. Allow the pad to continue curing according to the manufacturer's instructions.

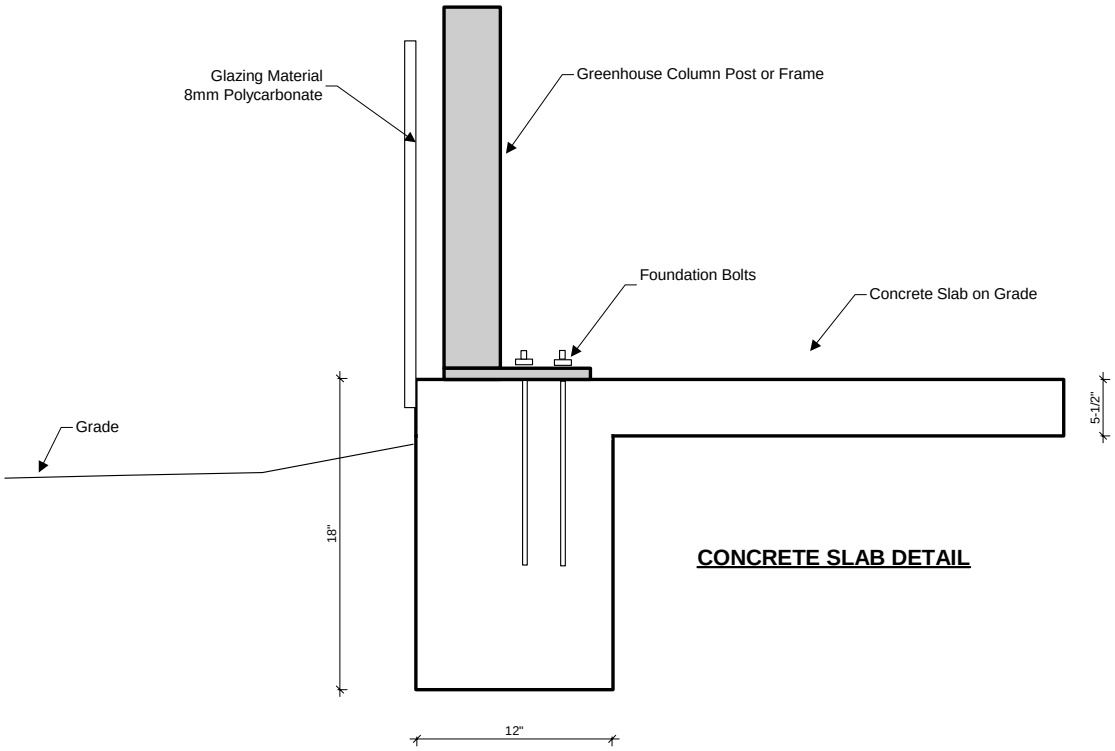
3. After the pad cures, apply concrete sealer to protect it.

The above section on concrete slabs was provided courtesy of Lowes.com

Anchoring Greenhouse to Pad

Once the pad is finished, the greenhouse can be secured to the pad using concrete anchoring bolts (see right). Using a special tool, these bolts are driven into the concrete leaving the threaded end of the bolt sticking up out of the slab. These bolts are then used to secure one or more structural components of the greenhouse frame (typically the base or arches) to the concrete slab.

A typical concrete slab detail is listed below. Please note this is for reference only since every greenhouse kit is different.



When properly done, a concrete slab will provide a clean, durable floor for your greenhouse.