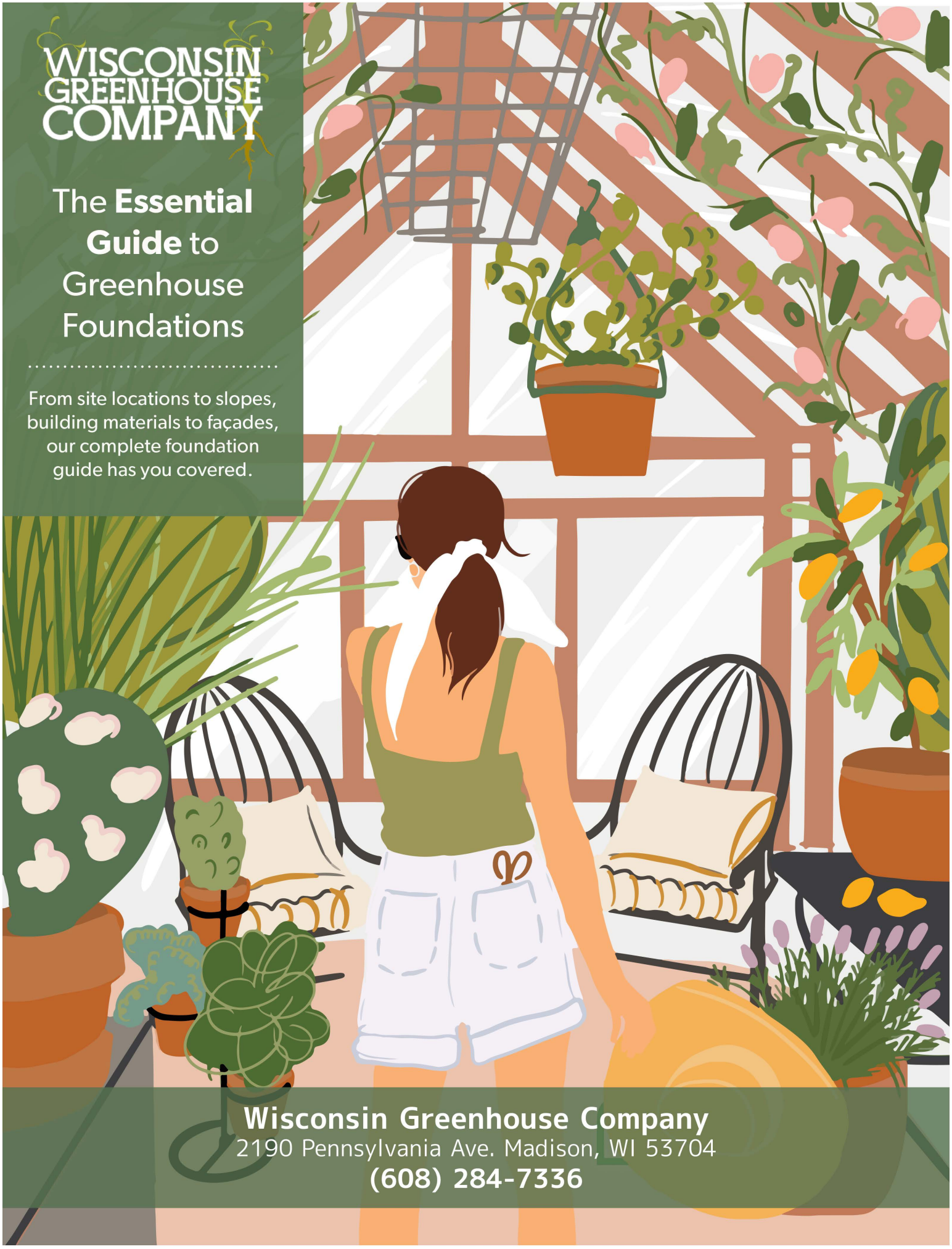
WISCONSIN GREENHOUSE COMPANY

The **Essential Guide** to Greenhouse Foundations

From site locations to slopes, building materials to façades, our complete foundation guide has you covered.



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Do All Greenhouses Require A Foundation?

The simple answer is yes. Planning for a greenhouse is the same as any building. Think about a greenhouse like your home which includes a good foundation, plumbing, power, heating, cooling and water. There is no doubt that planning for a greenhouse takes time and consideration, but the reward of a controlled growing environment is worth the effort.

One of the bigger challenges for our gardeners is creating a plan for a greenhouse foundation. In most cases, if you are looking at a **Cross Country Greenhouse**, you either like the custom options that we offer, the lifetime warranty or need the high wind and snow loads that our quality greenhouse provides. Your research has probably taken you to greenhouse companies that offer a built-in foundation or claim not to need one. At this point, it's important to say that we think there is great value in doing it right the first time. There have been many times when we hear customers unfortunate stories about their big box greenhouse falling over.

This is where we are different. A standard 8x12 greenhouse is 65% heavier than our closest competition. All our components, parts and pieces are the best you can buy. When you offer a lifetime warranty, you don't have a choice but to get the best materials and do your best to build an outstanding greenhouse that will last for generations. Having said that, we understand that we are not every greenhouse gardener's first stop, but we are the last greenhouse for our customers and proud of it.

This Foundation Guide Will Cover:

Why is a foundation not included in my purchase price?

When you flip through our catalog you will notice that every gardener's needs are different, and their design aesthetic is too. You will see greenhouses installed on raised walls of varying heights, rock walls, brick foundations, and pressure treated wood. There are so many choices and not one size fits all. In addition, the cost of lumber and concrete varies in each part of the country not to mention the high cost of shipping materials is prohibitive when you can find the same thing at your local hardware and lumber store. Planning for a greenhouse takes time and please know we are here to help every step of the way.

7 Questions You Should Ask

Here are some questions to consider when planning a foundation and greenhouse.

1 Do you require a permit in your municipality?

A permit is generally required if the structure is meant to be permanent or more than 110 square feet. The guidelines around permits vary according to municipality. Even if a permit is not required, it is still a good idea to follow local guidelines and call before you dig.

2 Will you require engineered drawings?

We are one of the few greenhouse manufacturers that can provide job specific sealed engineered drawings that will be required in most cases where a permit is necessary. If your foundation requires a permit, we can provide those job specific drawings as well.

3 Where is your water access and do you want to incorporate a sink?

If it fits within your budget, a sink is very handy in the greenhouse to clean up and sterilize garden tools. Some gardeners like to incorporate a irrigation system which requires access to water.

4 Can your electical panel handle the extra load?

If you wish to heat your greenhouse with an electric heater, you may need to incorporate a subpanel with 220 volts. Depending on your climate, a 220 volt heater would require more voltage than a typical 115-volt outlet, and with the addition of fan system, most large greenhouse gardeners will need additional power to the greenhouse.

5 Is your yard level? How do your access your site?

Sloped yards require more planning and may take more time to build. Access to the greenhouse location may be an important point should you require any specialty equipment like an excavator.

6 How deep does concrete need to go?

If you require a permit, your city by-laws may state that you need to set the greenhouse foundation beneath the frost line depending on the properties of your soil. Incorporating concrete Sona tubes in colder climates where extensive digging is required could reduce the work needed.

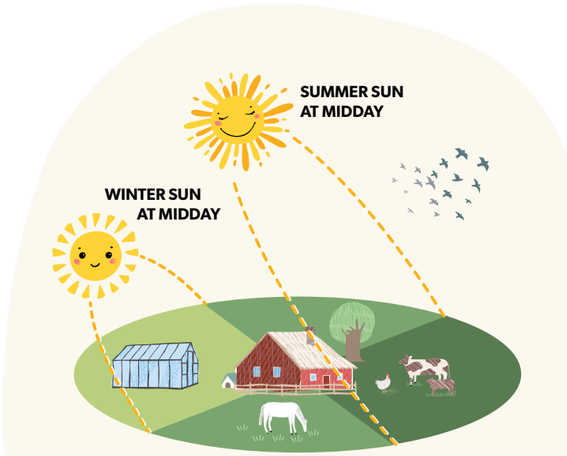
7 What do you need for drainage?

Most contractors will suggest installing a drain into your concrete floor with a bit of a slope to the drain for easy run off. This is a very simple way to clean your greenhouse when neccessary.

Things To Consider **Before** You Build

Selecting Your Site.

The best location for a greenhouse is based on sun exposure, proximity to utilities and easy access. We recommend at least 6 hours of winter sunlight a day for optimum plant growth. One thing that we have learned over the years is to place your greenhouse where you can access it easily and enjoy it the most. Many people assume that a flat, level surface is required, but many customers deal with a sloped yard with a bit more digging and a retaining wall. The good news is that you do not need a perfect spot with our system to make it work as you can see below. This is our Cape Cod 12x16 single glass greenhouse placed on a sloped raised rock wall in Houston. Designed to withstand hurricane force winds, a solid foundation is an important component for your greenhouse to ensure longevity and enjoyment for years to come.



Building a Wood Foundation

A wood foundation is a great, economical choice and supplies are readily available at your local hardware store. It is important to know that we only recommend wood foundations for glass greenhouses 12x16 and smaller and polycarbonate greenhouses 16x20 and smaller. A wood foundation will last 15 to 20 years in typical four-season weather conditions.

Option 1 – Frost Level 11 Inches Or Less

The first step is to dig out the perimeter of the greenhouse. Dig 3-4 inches deep and at least 12 inches wide. We recommend using **concrete pier blocks** in all corners to prevent frost heaves and to ensure that the greenhouse settles properly and remains level. Excavate all four corners to inset the pier blocks. Consider a concrete pier block that has a metal bracket so that you can mechanically connect your timbers for the best support. For larger greenhouses, place inset pier blocks every 6-8 feet for the best results.

Option 2 – Frost Level 12 Inches Or More

If you live in a colder climate where the frost level is deeper than 12 inches, you should consider using **concrete tube supports** as a typical outbuilding in your area. Bracing is not required unless the tubes are placed two feet or more above the ground. Again, it is critical that the pier blocks or tube supports are level, so the greenhouse installs properly.

SUGGESTED TIMBERS FOR WOOD FOUNDATIONS

4x4 Timbers ~ Up to 100 square feet **OR** any greenhouse no larger than 10 feet wide.

6x6 Timbers ~ Necessary with any greenhouse with a truss (a truss typically requires a 5-inch sill to attach); any greenhouse 12" x 16" and over.

Typical 4x4 Pressure Treated Timber

Alternate the timbers in stackable joints and fasten them with galvanized connectors or deck screws for additional strength. For larger greenhouses, two rows of alternating stackable, joints are necessary. If you live in an area prone to high winds, consider tying down your wood foundation by driving a steel rebar into the ground and pin it to the wood or using a pier block with a metal bracket

WHAT ARE '*GREEN-HOUSE FRIENDLY*' SOLUTIONS FOR PRESSURE TREATED WOOD?

If you are using pressure treated wood, you will need to place a barrier between the wood and your aluminum frame. Pressure treated wood is no longer treated with arsenic due to potential long term health hazards. Copper is now used which is corrosive to aluminum as well as other metals.

Popular barriers include 10 mm thick plastic sheeting, rubber, or foam weather membrane.

Other weather resistant non-treated woods are popular alternatives to pressure treated wood. Cedar timbers are a popular choice. If you want to keep foundation costs low, purchase a 1x4 or a 1x6 cedar (or other readily available wood) that will not rot and place it on top of the pressure treated wood.

If you have proper drainage and the foundation is not sitting in pooled water, the foundation should have a 15 to 20 year lifespan. In addition, ensure that the greenhouse base is sitting to the very outside edge to allow water to weep properly.

Weed Screen

When you create a perfect growing environment, you will have unwanted guests. Stop weeds before they start by placing a weed screen or landscape fabric over the entire perimeter and floor of the greenhouse to prevent weeds from becoming those guests who just never leave.

Gravel Floor

The next step is to fill the area with gravel. We recommend 3/4" crush gravel because it is easy to find, and it has the best drainage.

Create a Walkway

An even walking surface is a great idea in a greenhouse. Placing paving stones down the center provides an even walking surface and prevents excessive dirt from tracking in and out of the greenhouse. Consider the height of the paving stones and if you plan to use a wheelbarrow as there will be a step up into the greenhouse. You can match up the height of the paving stones and greenhouse foundation and request a 'door drop' so that the timber threshold is flush to the ground and there is not a significant step up to the greenhouse.

What is a Door Drop?

A door drop is a custom modification that lowers the greenhouse door into the foundation (or allows the door to be flush with the ground). Prior to manufacturing the greenhouse, we will ask for the dimensions of the "drop" which is the total height of the foundation. We will place an order for a custom piece of glass or polycarbonate to install above the door for a perfect fit!

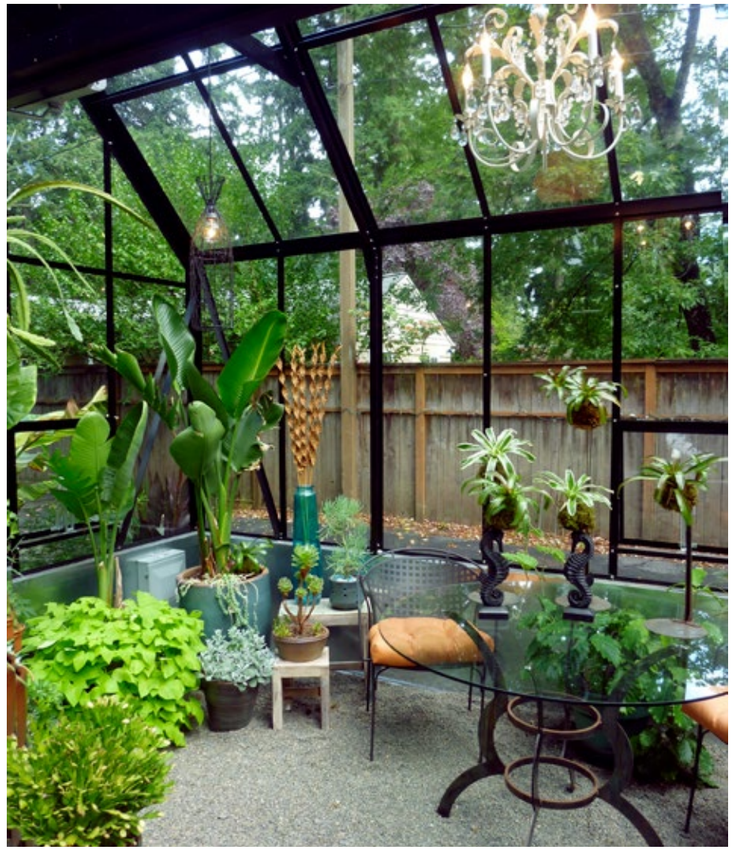
A Note About That Threshold

Given that the greenhouse door does not have a threshold, place one continuous row of 4x4s or 6x6's all the way around the perimeter of the greenhouse. For those greenhouse gardeners wishing to add a raised wall or extra height to the greenhouse foundation, the bottom row of timbers or concrete footing would remain lower. This allows the door to open and close easily, prevents gravel or dirt from spilling out of the doorway and creates structural strength so that the door opening will not shift.

Construction Tip: For larger greenhouses (20 feet or longer), place a pier block or concrete tube at the 6 to 8-foot mark and/or at truss location mark on each of the sidewalls for the best support.

Building a Concrete Foundation

Our recommendation is that any double glass greenhouse or any greenhouse over 12x20 should rest on a concrete footing. Having said that, many customers will choose a concrete foundation for longevity and easy cleaning. A glass greenhouse resting on a concrete footing will last for decades.



If you are currently building a new home, planning for a **concrete pad or footings for a greenhouse** is a great idea and time efficient. Please be sure that you have the exact outside dimensions of the greenhouse before you dig.

Construction Tip: Beveled exterior edges or uneven surfaces can require major modification to the greenhouse or the foundation itself. The foundation must be level and square for the entire area where the greenhouse frame and interior support channels rest. If you are using pour strips, make sure to use them on the inside of the foundation to avoid the greenhouse base hanging over the foundation.

Types of Footings

You have a few choices when it comes to concrete foundations and oftentimes this decision should be in conjunction with your local city planning department.

Spot Footings

A spot pad or footing is used to support a single point of contact, such as under a pier or post. Spot footings are usually a 2x2 square pad, 10-12 inches thick, and made with reinforced concrete.

Continuous Spread Footing

A continuous spread footing is mainly used to provide a stable base around the perimeter of a building. Spread footings are often augmented with interior spot footings. The spread footing supports the weight of the exterior of the foundation walls. The thickness of the footing provides the necessary strength for the support. The width of the footing base provides a large area with which to transfer the weight from the walls to the ground.

Grade Beam Footing

A grade beam footing is a continuous reinforced concrete wall used to support loads with minimal bending. Grade beams are capable of spanning across non-load bearing areas and are commonly supported by soil or pilings. Grade beam footings differ from continuous spread footing in how they distribute loads. The depth of a grade beam footing is designed to distribute loads to bearing points, while the width of a continuous spread footing is designed to transfer loads to the ground.

A Thickened Edge Slab is another type of shallow foundation common with greenhouse structures. The slab will be about 4-6 inches in thickness, except at the perimeter where it will be thickened 12" to 18" or as specified by an engineer.

In terms of overall depth, the foundation should be planned as you would design a typical outbuilding. It is critical to ensure the concrete foundation is built according to your local climate given that our typical 8x12 glass greenhouse is close to 1200 pounds. The concrete must cure and be level and square for easy installation.

Important: All concrete foundations should include the use of rebar to strengthen the concrete as well as using steel mesh in the slab options.

Greenhouse Flooring Options

There are many factors to consider when choosing your greenhouse flooring beyond appearance. Here are some helpful tips to help with your decision-making process

Drainage

Drainage is a crucial consideration in a wet environment like a greenhouse. If you are leaning towards having a solid flooring material, like concrete, keep in mind that you'll need to install drains to help with drying the greenhouse floor and keep your plants healthy and free from mold. You should consider the location of the drains carefully to ensure the drain is not in the middle of a proposed walkway or working area. Other materials such as gravel, concrete pavers, and flagstones drain well and are commonly used.

Decomposition

Organic materials such as bark mulch, sawdust, and wood do not thrive in a greenhouse environment. These materials tend to decompose and become a breeding ground for algae and pests. The original cost savings will become prohibitive in the long term when you need to remove and replace the rotting floor. If you are plagued with pests and or disease, removing and replacing the organic materials can be a back-breaking job.

Price

The cost of flooring materials is one of the factors to consider when selecting greenhouse flooring options. A full concrete slab is up to your discretion. If you do opt to go that flooring route, you should plan to power wash the concrete annually to ensure algae is not forming on the surface. For most areas, gravel is the most cost-effective floor covering and is relatively easy to install.

Heat Retention

More consideration is required for those living in a colder climate. A concrete slab, brick and flagstone will help to slowly release the day's heat during the cooler nighttime hours. This can help decrease your heating costs during colder weather.

Comfort

Standing for many hours while caring for your plants can be hard on your body. If you choose a harder flooring type, such as concrete, you can add rubber mats where you stand most often. This will help to alleviate back pain and are easy to clean.

Traction

Your greenhouse will oftentimes be wet or covered in spilled soil. This can lead to slips and falls if the proper precautions are not in place. If you decide to have a gravel floor, fill with ¾" crushed gravel for the best traction and drainage. Adding concrete pavers in the aisle for a walkway and work area is a great idea. For greenhouses over 14 feet wide, two aisles are common with a center bench.

Weeds

Remember your greenhouse will create an environment that plants will love – and that includes weeds! Before you lay down a floor base such as gravel, pavers, or dirt, be sure to put landscape fabric (weed screen) underneath. This will save you time and the hassle of pulling unwanted weeds on your greenhouse floor.

Prevent Pests From Getting Into Your Greenhouse

If you have a community of burrowing animals around your property like moles, gophers, rats, and more; it's a good idea to take some preventative steps early in the game. Gardeners have been using chicken wire for years. Here are some suggestions:

1. ***Place chicken wire over or under the landscape fabric (weed screen) on the floor of the greenhouse***
2. ***Install the chicken wire on the outside perimeter wall to prevent them from burrowing in from the sides***

Remember to purchase chicken wire with the smallest holes as mice can burrow and fit through very small spaces. It's also a good idea to install the chicken wire as deep into the perimeter walls as you can. Ultimately, a greenhouse is an ideal space for animals to try and enter. There's food and it's warm. Prevention is key so that you don't have unwelcome guests in your greenhouse.

Installing a Greenhouse on a Sloped Yard

One of our most popular questions is whether you can build a greenhouse on a sloped yard. There are times when the perfect location is not possible, and a little work is required to create a viable site for your greenhouse.

First, determine what the slope is:

A **Find the RISE:**
The difference in elevation between the high and low ends of the slope.

B **Find the RUN:**
The horizontal distance between the two ends of the slope.

C **Divide the Two**
Divide the **RISE** by the **RUN**.

1: Place a stake at the highest point on the slope. Insert stakes every 8 feet until you get to the lowest point.

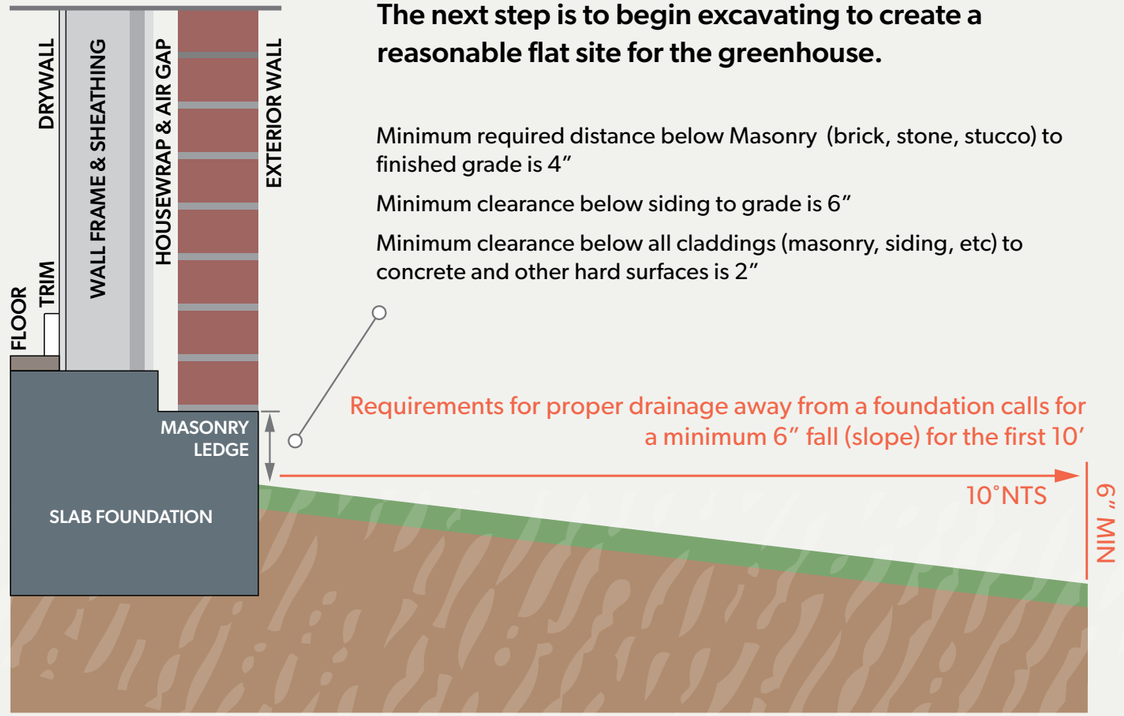
2: Attach a line to the bottom of the first stake at ground level. Connect it to the next stake until it is level. Keep going until you have connected the last stake and it is all level.

3: Measure the length of the line. Measure the distance from the ground to the string on the lowest stake.

4: Divide the rise by the run. A 1 foot rise divided by a 50 foot run is .02. Move the decimal two places to the right to convert the answer to a percentage. The slope is 2 percent.

Jogs in the Foundation

If your ideal location requires jogs in the foundation or a breezeway connecting two areas, the first step is to send in a photo of the area. Almost anything is possible with a bit of planning and an excavator!



http://www.jwkhomeinspections.com/proper-drainage-grading-slope-needed-foundation.html

The next step is to begin excavating to create a reasonable flat site for the greenhouse.

Minimum required distance below Masonry (brick, stone, stucco) to finished grade is 4"

Minimum clearance below siding to grade is 6"

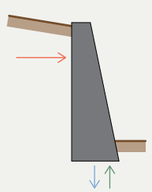
Minimum clearance below all claddings (masonry, siding, etc) to concrete and other hard surfaces is 2"

If the slope is considerable, you might have to build a retaining wall to support the soil.

Creating a stable and level site will simplify the greenhouse installation greatly. It will also help to ensure the longevity and the strength of the greenhouse when harsh weather conditions take place.

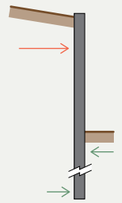
KEY: Earth Pressure Vector / Gravity Vector Of Wall / Reactive Force Vector (Not All Shown)

Gravity Wall



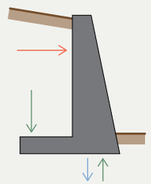
Standard wall type that holds the earth mainly through its own weight. Can pivot and topple relatively easily, as the internal leverage of the earth pressure is very high.

Piling Wall



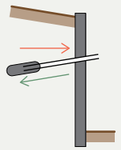
Using long piles, this wall is fixed by soil on both sides of its lower length, If the piles themselves can resist the bending forces, this wall can take high loads.

Cantilever Wall



The cantilever wall (which may also extend in the other direction) uses the same earth pressure trying to topple it to stabilize itself with a second lever arm.

Anchored Wall



This wall keeps itself from toppling by having cables driven into the soil or rock, fixed by expanding anchors (can be combines with other types of walls.

Planning a Foundation for a Building Attached Greenhouse

Whether you are planning to attach a greenhouse to your home, barn, shed or commercial property, there are some things to consider during the planning process that will impact your choice for a foundation.

Ridge Height

Consider the area where the greenhouse will be attaching. Determine how much clearance exists between the ground and the eave or soffit area. Do you plan on adding a raised wall as well? Make sure you account for this additional height in your measurements.

As a custom greenhouse manufacturer, we can adjust your ridge height to fit snugly underneath your soffit or if you wish to attach into your roof line, we can jog the end walls around your eave.

Attaching Wall

Are there existing doors and/or windows that need to be built around?

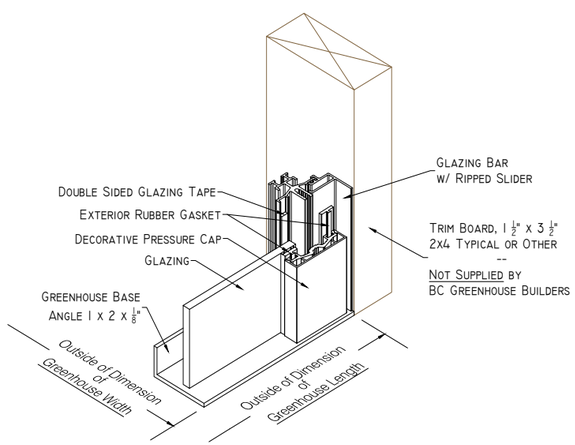
For greenhouses longer than 12 feet, a truss is required for additional support, and we will adjust the position based on the attaching wall.

Will you require a special section for an in-fill? We can extend the glazing wall to be flush with the side of your house/ building in cases where we attach to the outer fascia of your roof overhang.

Do you require an additional door placed in a gable end or the sidewall? We can increase the sidewall height to accommodate our standard 74" door. Ensure that you have the necessary width for the door threshold in your foundation details.

Are there access stairs to work around? We can build the greenhouse to suit a dropped foundation and/or a walk-in greenhouse.

What do you need for a foundation? A concrete foundation is recommended for a building attached greenhouses as our greenhouses are a lifetime product and will last as long as your house.



Trim Board Details for Building Attached Greenhouses

A trim board is additional construction material, supplied by the customer, that is used as a flat surface to fasten a greenhouse frame to.

When purchasing a building attached greenhouse such as a gable-attached or lean-to style (or lean-to which is also gable-attached), we will supply you with a trim attachment elevation drawing, showing the dimensions, angles and generic materials that will be needed. This trim board will be fastened to your building in preparation for the greenhouse installation to occur afterwards.

Typical Trim Board Sizes:

STYLE	SIDE WALL	ROOF LINE
Gable Attached	2x4 1½" x 3½"	2x8 1½" x 7¼"
Lean-To	2x4 1½" x 3½"	2x6 1½" x 5½"

*Typical lean-to greenhouses 14' and longer require a truss which will also need a trim board to attach to.

The sizing of the trim board can vary. It is important that the proper dimensions are confirmed so that your greenhouse foundation is correct. For example, if the trim board is 2" thick, your total foundation will need to be 2" longer to account for the addition of the trim board.

Tips:

- The thickness of the trim board will always need to be added to the exterior dimensions of the greenhouse we supply when preparing your foundation.
- Ensure that you have the proper foundation dimensions for your greenhouse; specific options or customizations can change the standard dimensions required.
- Trim board material is not included with your greenhouse purchase and will need to be sourced at your local hardware store.

Ask our greenhouse experts for the **Complete Trim Board** sales tool for more information.

Ground to Air Heat Transfer, Geothermal, and Walipinis

If you are looking to grow fruits and vegetables year-round, but live in a variable climate, you may be considering options for energy-friendly heating. There is a general rule of thumb that greenhouse lighting is much cheaper than heating, so let's explore the idea of underground greenhouses!

Soil below your local frost line has a consistent year-round temperature and water barrels inside your greenhouse can quickly store solar heat gain which builds up during sunny days. You have varying options depending on your budget.

Disclaimer: *Building a Walipini or GAHT (ground to air heat transfer) greenhouse is not your average greenhouse build. It is highly technical and not for the everyday backyard gardener. If this is out of scope for you, feel free to skip this section.*

How it Works:

The temperature of the soil just below the ground level tends to have a consistent temperature of 50 – 60 F (10 – 16 C) year-round, regardless of where you live. It also tends to have an 8-week lag time in temperature changes at the surface level making it a very consistent way to heat a greenhouse throughout the colder months. Digging downwards when building your foundation may help to capture some of that heat in colder months.

Key heat and light transmission principles for understanding the performance of underground greenhouses:

Radiation & emissivity: Sunshine radiates through air and glazing and directly heats materials that it shines upon. The emissivity of a material is how much light will be absorbed; the blacker the material the more light (and heat) it will absorb. You can also reflect light with white or shiny surfaces, increasing the brightness of a space will spread productive growing light all around.

Conduction: Materials like stone and metals will transfer heat effectively to cool areas. Use insulators where you want to slow the transfer of heat to cold areas.

Convection: Hot air rises and will then leave cool areas near the ground.

Heat capacity: Much like a battery, different materials will have different capacities to store heat. Water has a high heat capacity, so it is good at storing heat energy.

Maximize solar heat gain in winter by integrating the south facing glass at an optimum angle

Due to the underground nature of greenhouse, the structure will experience limited light transmission in the winter months especially. Introduce the use of high-performance LED lights for better plant growth.

Important: If you live in an area with a high-water table, this may not be an option for you. We recommend having any of these geothermal heating options **at least 5 feet above** the water table.

Walipinis and Underground Greenhouses

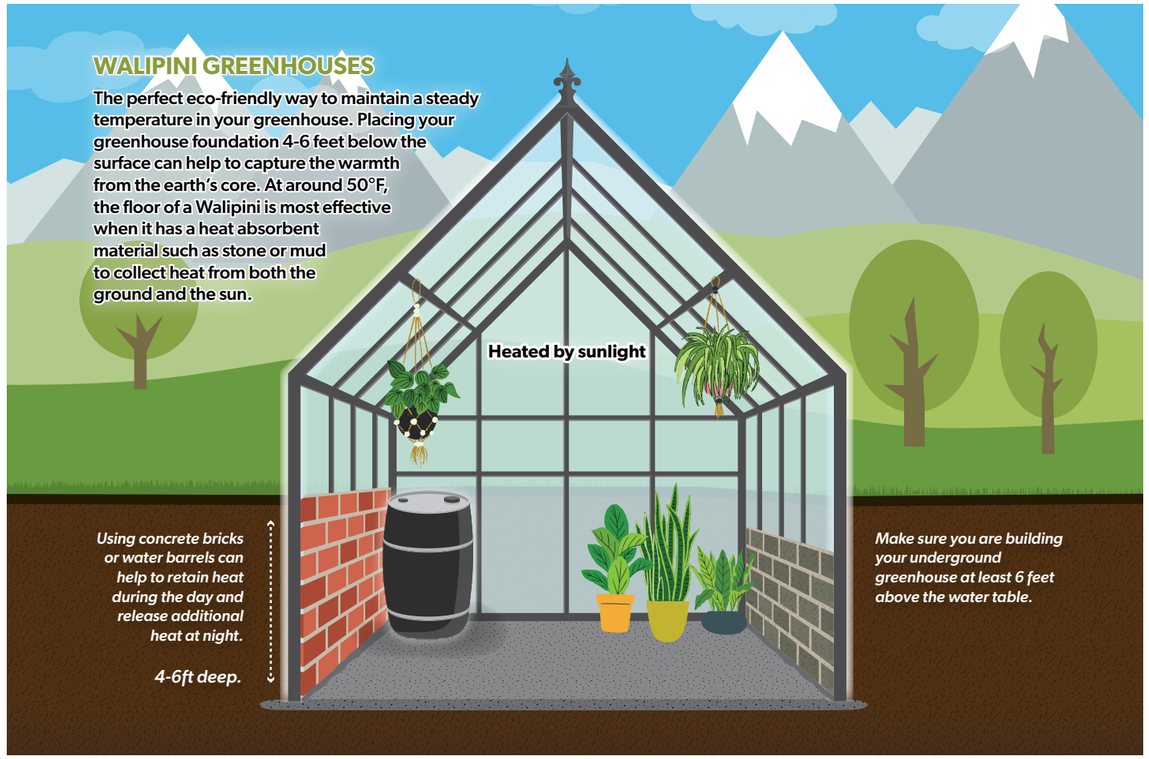
Typically, a Walipini foundation will be recessed between 4 - 6 feet below ground level. The interior walls can be constructed from any material that is able to absorb heat well such as stone, mud bricks, or any dense and sturdy natural material.

The greenhouse roof above ground captures radiant solar heat gain within the greenhouse. As the internal greenhouse zone heats up, the hot air will slowly transfer the heat into the materials inside of the greenhouse zone via convection and conduction, including the surrounding foundation and soil. At night, the heat is released back into the greenhouse. Effectively, during a sunny day the thermal mass inside the greenhouse will cool the greenhouse (by absorbing heat) and will start heating the greenhouse as the sun sets (by releasing that stored heat). Depending on the area you live in however you may still need to use an added heat source in cold snaps.

Ground to Air Heat Transfer Systems and Geothermal Greenhouses

Sometimes known as a climate battery, these air-tube circulation systems transfer heat that builds up inside the greenhouse and exchanges it with the soil under the greenhouse. The Ground to Air Heat Transfer System (GAHT for short) is installed underneath a greenhouse, roughly 2 – 5 feet below the floor. These systems use the soil to moderate the heating, cooling, and humidity of the greenhouse. Make sure you have good drainage around the exterior of your foundation, so you don't have any pooling water filling your GAHT.

When solar energy is collected inside the greenhouse, fans move air from the interior peak of the greenhouse and circulate the warm air underground through perforated tubes and back up the floor of the greenhouse. The heat gets slowly transferred to the soil for later use, and the air is then recycled back into the greenhouse to maintain a steady temperature. When temperatures drop, the air continues to be recycled through the tube ducts, picking up the heat that was previously stored and what naturally occurs below the surface. While maintaining the temperature, the airflow also collects humidity in the air and transfers it directly to the ground as water droplets!



The ground in which the tubes store the heat should be prepared with a combination of crushed gravel and a screen-like material. The perforated tubes underground are wrapped in a screen and placed with crushed gravel filling around them. Air from the tubes can circulate around the spaces between the gravel and permeate the ground. Any condensation that occurs must have a way to drain out of the tubes into the surrounding ground.

If you are currently building a new home and interested in optimizing the greenhouse using geothermal energy collection, it's a great idea to apply the same benefits to your greenhouse. However, it is recommended that gardeners also employ other methods to retain heat to reduce the size of the heat pump required. Some of these methods include reducing air gaps, installing energy curtains, insulating the exterior of the foundation perimeter, using air circulation to prevent hot and cold air pockets, staging plants according to temperature ranges (cold loving plants lower to the ground and tropical plants that require high temperatures above bench height) and installing electronic temperature controls to ensure optimum performance. Utilizing geothermal heat pumps and GAHT systems are a long-term benefit as it is expected that it will take approximately 10 years to payback the initial investment based on average fuel costs.

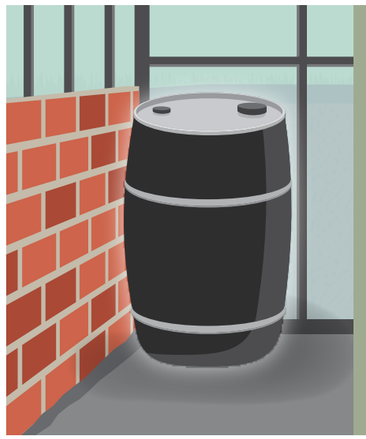
Combine the principles together. For example:

Your primary source of heat is solar radiation which you want to facilitate reaching as far into the greenhouse as possible; whichever surfaces the sun reaches will heat up. For surfaces that can absorb heat, like concrete or water barrels, paint these black so they absorb as much of the light as possible. For surfaces that you don't want absorbing heat, have these as shiny or white surfaces so they reflect and scatter light. Use insulation on the exterior of your foundation in the first 2 feet of soil depth in order to protect the foundation from bleeding heat into the surrounding ground which will slowly conduct to the surface. Use ceiling fans in a down-draft direction to push the heat which rises to the roof, down and causes it to mingle with materials throughout the greenhouse (along with providing good air circulation for plants).

Disclaimer: *Hazards may exist when building an underground space:*

Radon gas can be naturally present in the ground and having an enclosed space can cause it to accumulate to elevated levels.

Always consider the presence of gasses that are heavier than air which can displace oxygen; use an oxygen monitor, provide good ventilation, and avoid rotting organic material that can produce carbon dioxide.



Pro Tip: You can use concrete bricks or black water-filled barrels to collect more heat throughout the day. Google the term 'thermal heat sinks' for more passive energy ideas.

Notes on Permits and Permitting

It's important to determine if a permit is required for your new greenhouse. We understand that the idea of obtaining a permit may seem daunting but know that our team is here to help walk you through every step of the process. Here are some guiding points to help:

How to Know if You Need a Permit

Securing a permit depends on your municipality's building codes and they vary county to county. Other factors include foundation type, proximity to property lines or setbacks, glazing and size of the greenhouse. We find that structures less than 110 square feet do not usually require any permitting for a non-permanent structure. A pressure treated wood foundation is considered temporary and easily moved.

What to do Before You Start the Permit Process

Prior to connecting with your city or county planner's office, it's a good idea to have a quote and a foundation/greenhouse dimension sketch from us. Additionally, it's handy to have one of our catalogs to show our standard wind and snow loads. These documents help the planning department to understand your greenhouse is a quality product, that is not going to degrade easily, fall over in a storm or look unsightly in the neighborhood.

How Foundations Factor into Permitting

When choosing your foundation, permitting is something to keep in mind. If you were considering a home-attached greenhouse, a permit is usually required as you are making changes to the building envelope. There are times when a permit is also required for your greenhouse foundation build. This is typically for larger, more complex projects.

How Snow and Wind Factor into Permitting

Your municipality may have specific requirements about wind and snow loads. Zoning officials will want to ensure that the greenhouse meets local building codes and can withstand weather conditions in your area to ensure safety for everyone. Please share these details with our team because we can meet any wind or snow load requirement. Our standard is 85 mph winds and 32 psf for snow and we can upgrade much higher.

Other Factors in Permitting

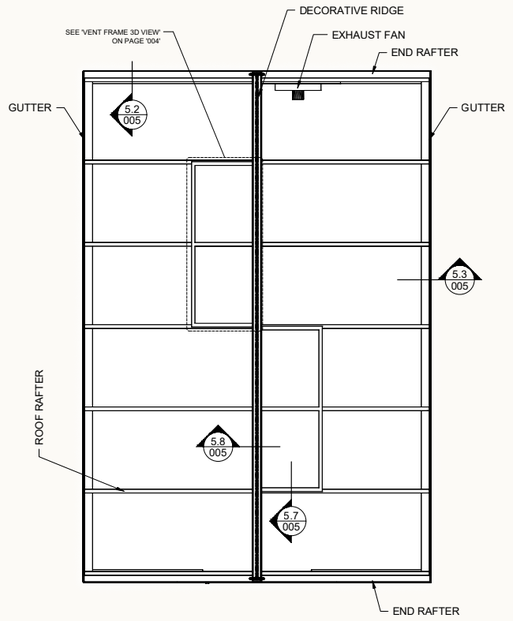
The planning department may want to know about utility hookups including electrical, water and any possible HVAC systems. It's a good idea to think about whether you will have lighting in the greenhouse overnight that may impact neighboring houses too.

What You Will Need if You Require a Permit

If you do require a permit, we can supply the necessary engineered shop drawings to secure the permit in any state or province. Please note that there is an additional charge for this service, and it generally adds approximately eight to twelve weeks to the lead time of the project. Some planning departments will accept non-engineered job-specific drawings so check with your contact to see if this is a possibility as these are included with your greenhouse purchase. If a permit is necessary, BC Greenhouse Builders will not commence manufacturing the greenhouse until everything is approved by our engineers and your local planning department.

Engineered Shop Drawings for Foundations

Engineered shop drawings are prepared by our design team and signed off by an accredited engineering firm. These detailed drawings cover the plans for wind and snow loads, bracing, and provide fabricators with the information needed to manufacture all of the components of a structure including utility hook-ups. In terms of engineered drawings for knee walls and foundations, the required thickness of the concrete is important to consider. For a greenhouse with a regular support truss, a 6-inch-wide concrete foundation is sufficient. More substantial greenhouse structures (14-foot and wider Cape Cod models, 16-foot and wider Cottage models or 18-foot and wider Traditional or Pacific models), should have a footing that is at least 8 inches wide as the interior structural supports require a wider surface for attachment. In some instances, the greenhouse could require a 10 inch or wider foundation particularly in areas that require a higher-than-average wind load.



Occasionally some customers will require a separate permit to engineer and design the foundation to suit the weight and substance of the greenhouse if they are building the foundation themselves. If the foundation is simple in design, we can offer the engineered shop drawings for the foundation as an added option.

Greenhouse Tip:

Many greenhouse gardeners like to experiment with passive heat sources and will paint the concrete dark colors to absorb the sun's energy, particularly on the north wall.

Concrete Slab vs. Footing

When would you build a slab over a footing? A concrete slab is ideal for those that want a faster, easier foundation that does not go down as deep. Typically, these types of foundations would be thicker around the perimeter and then steel mesh applied in the slab. An engineer should review this type of foundation to ensure it can sustain the required loads and meets local building codes.

Thresholds with Concrete Foundations

If your greenhouse has our upgraded storefront door, we suggest extending the concrete foundation by two inches to provide more support for the threshold of the door. In addition to this, some customers choose to build a stoop or landing area in front of the greenhouse for container plants and easier access. Ensure that this landing has a slight slope away from the greenhouse to prevent water pooling into the greenhouse.

Importance of drainage with a concrete foundation

As you can guess, you need proper drainage underneath the greenhouse. You will want to make sure that the water comes out and is expelled away from the structure and does not pool underneath. Many customers choose a simple center drain and add standard plumbing pipes to move water away from the greenhouse. Taper the concrete down and towards the grate for easy drainage.

Plumbing, Electrical and Heating

Plumbing

When planning for your concrete foundation, the best idea is to rough in the plumbing and electrical ahead of time. Given that this is a permanent structure, many customers choose to line the PVC pipe so that you can plumb or wire after the fact to avoid headaches. Consult your plumber and electrician before pouring your foundation. For wood foundations, it is common to run the plumbing and electrical under the wood after it's constructed.

Heating and Electrical

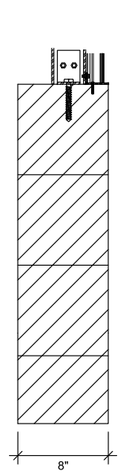
A 220 volt heater requires a 220 volt outlet which usually means installing a new electrical sub-panel. If you are thinking about a gas heater, it's a good thing to bring in a gas fitter before the concrete gets poured. Many people ask where power should be brought into the greenhouse. We believe the best location is to put the electrical panel on either side of the door for easy access to control and switches.

The Challenge With Staying Off The Grid

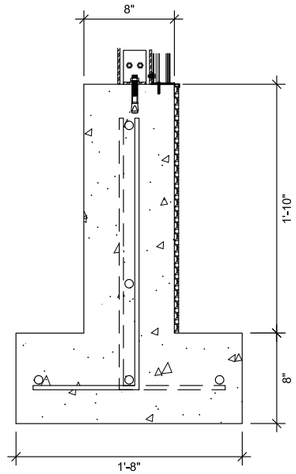
Many of our customers would like to stay off the grid and while we understand the benefit of this, the trickiest part is air circulation. Air circulation is one of the most overlooked necessities in a greenhouse because it prevents condensation, aids pollination, moves hot and cool air pockets, and helps to prevent infestation.

The challenge in any passive greenhouse is finding the right way to constantly move air around. There have been some advancements in solar powered fans but be certain to check the reviews and make sure that it is powerful enough to move the volume of air in your greenhouse. When you do have the right fan in place, create a micro weather system for the best results! Place your heater on the floor pointing into greenhouse closest to the door (the source of heat loss). Put a circulating fan on bench level pointing up and towards the door. This will create a circular motion of needed air for your plants and increase efficiency in the greenhouse. Circulating fans will be your best friend. Talk to us about your circulation and ventilation needs!

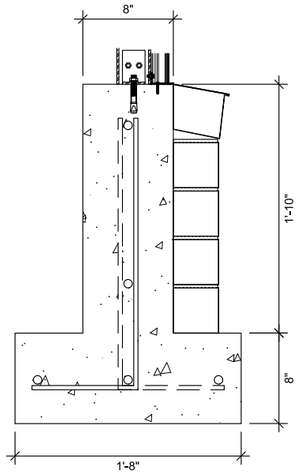
Foundation Types - Section Details



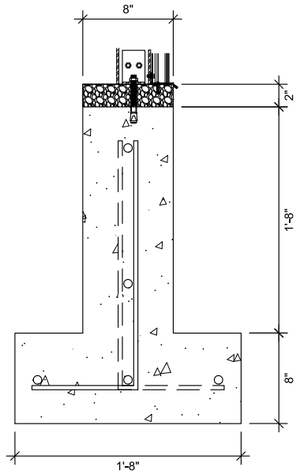
WOOD FOUNDATION SECTION



CONCRETE FOUNDATION SECTION w/ FOOTING & STONE COPING



CONCRETE FOUNDATION SECTION w/ FOOTING & BRICK FACING



CONCRETE FOUNDATION SECTION w/ FOOTING & STONE CAP

Brick and Rock Façades

A rock or brick facade is a gorgeous decorative feature for a greenhouse. This accompanying photo has a beautiful rock facade which blends so nicely with the landscape.

The most important detail to consider with façade is that the wall is built to the dimensions of the greenhouse and the façade is then attached to it. You will want to make sure that you purchase a flashing to ensure that water is not going to penetrate in between the footing and the façade. Alternatively, some customers like to add a decorative stone cap that is attached to the top of the concrete wall and sits past the edge of the façade as pictured here.

Should you wish to create a full brick foundation, we recommend hiring an experienced bricklayer to ensure that the foundation is level and square and meets the minimum thickness to bear the structural loads.

Price Considerations for a Foundation

Costs of a greenhouse foundation can vary widely based on labour and material costs in your area. Always base estimates on a site inspection as certain conditions can greatly affect cost including:

Slope: If your yard has a significant slope, this could mean the difference between 2 yards of concrete and 5 yards of concrete. Also, the hours of labour need to be factored in since a few hours may be needed to dig out a retaining wall.

Ground Quality: Is there a presence of moisture or large rocks that need to be considered before laying the foundation? Will you need a mini excavator to clear the area?

Accessibility: Another factor to keep in mind is how easily accessible is your yard? How will the contractor bring materials into your space? There have been instances where the customer's yard is difficult to access, even by wheelbarrow, and gravel needed to be carried in by hand, bucket by bucket full. Not a fun day, but great exercise!

Material Costs: Depending on your location, prices may change for certain materials. For example, if you are set on having a cedar-built foundation and live in New Mexico, it will cost you significantly more than your friends in the

Pacific Northwest. However, if you go with readily available materials in your region, you can often save money. For example, a customer from Texas used beautiful limestone for her greenhouse floor because it can be locally sourced.

Labour Costs: If you can lay the foundation yourself, you can save in this area. Not everyone has the means or the back strength for the job.

Approximate Foundation Costs		
8x12	Pressure Treated Wood (1 row on grass or concrete pad, gravel and pavers)	**$900 – $1,400**
8x12	Slab (1 – 1.5 yards of concrete based on a 4" depth)	**$2,500 – $4,000**
8x12	Perimeter Foundation (3 – 4 yards of concrete split between the kneewall and concrete curb)	**$5,000 – $7,000**
12x16	Pressure Treated Wood (1 row on grass or concrete pad, gravel and pavers)	**$1,200 – $1,700**
12x16	Slab (2 – 3 yards of concrete)	**$4,000 – $5,500**
12x16	Perimeter Foundation (5 – 8 yards of concrete)	**$9,000 – $12,000**
16x20	Pressure Treated Wood (1 row on grass or concrete pad, gravel and pavers)	**$1,800 – $2,500**
16x20	Slab (3 – 4 yards of concrete based on 4" depth)	**$3,000 – $6,000**
16x20	Perimeter Foundation (7 – 10 yards of concrete based on footing buried to meet municipality code and with 16" + kneewall)	**$13,000 – $18,000**

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Disclaimer:

The information contained in this book is intended to help readers make informed decisions about their greenhouse foundations. It should not be used as a substitute for advice by a professional contractor or engineer. It is based on situations and experiences over several decades. Although the author and publisher have endeavored to ensure that the information provided herein is complete and accurate, this is not information certified by an engineer. BC Greenhouse Builders shall not be held responsible for loss or damage of any nature suffered as a result of reliance on any of this book's contents or any errors or omissions herein. If job specific certification is required, please consult an engineer.

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