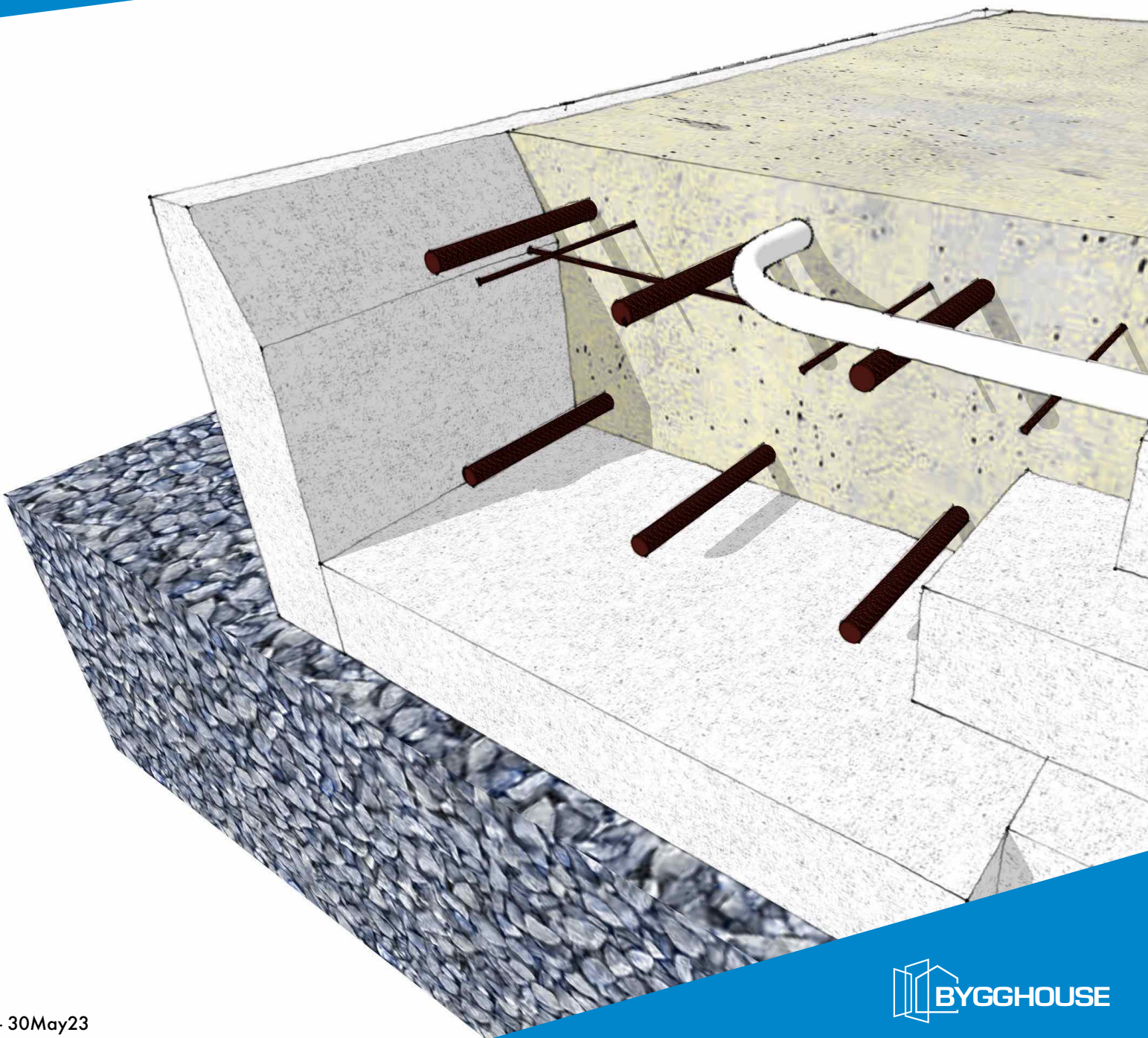
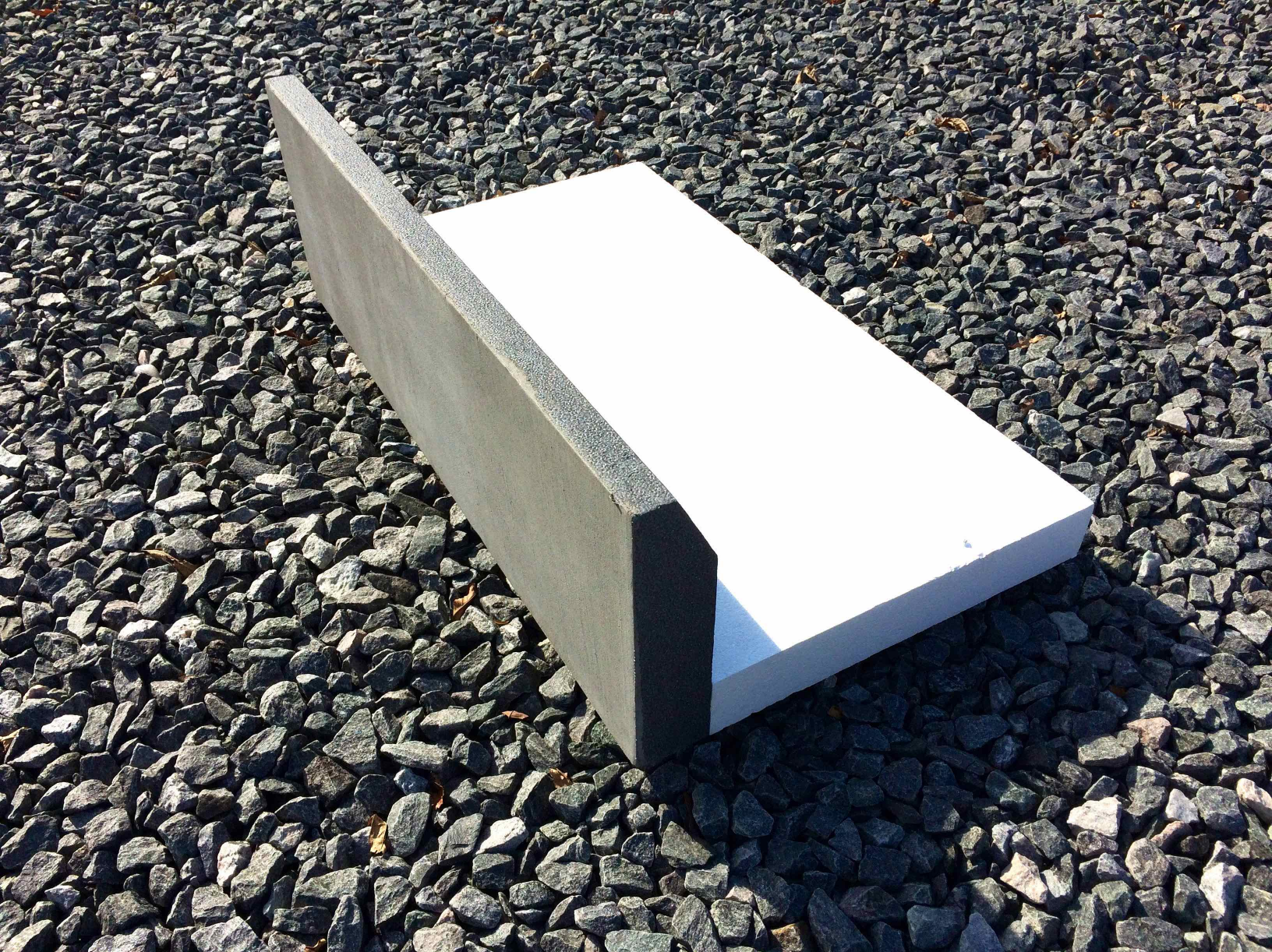


WarmFörm

PLANNING AND INSTALLATION INSTRUCTIONS





Introduction

Welcome to WarmFörm.

WarmFörm Slab Forms are remain-in-place insulated concrete formwork used to create slab-on-grade foundations in Frost Protected Shallow Foundation configurations. WarmFörm save time and labor in comparison to conventional below frost foundation systems, and provide a superior energy efficient foundation for your home.

This instruction booklet will help you learn how to plan out your WarmFörm installation, as well as provide a step by step description of the construction process. Moreover this will provide an understanding of how the system works, and will enable builders who will work with WarmFörm again to become fast and efficient with installing it.

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01 Background

WarmFörm Slab Forms are remain-in-place insulated concrete formwork used to create slab-on-grade foundations in a Frost Protected Shallow Foundation configuration.

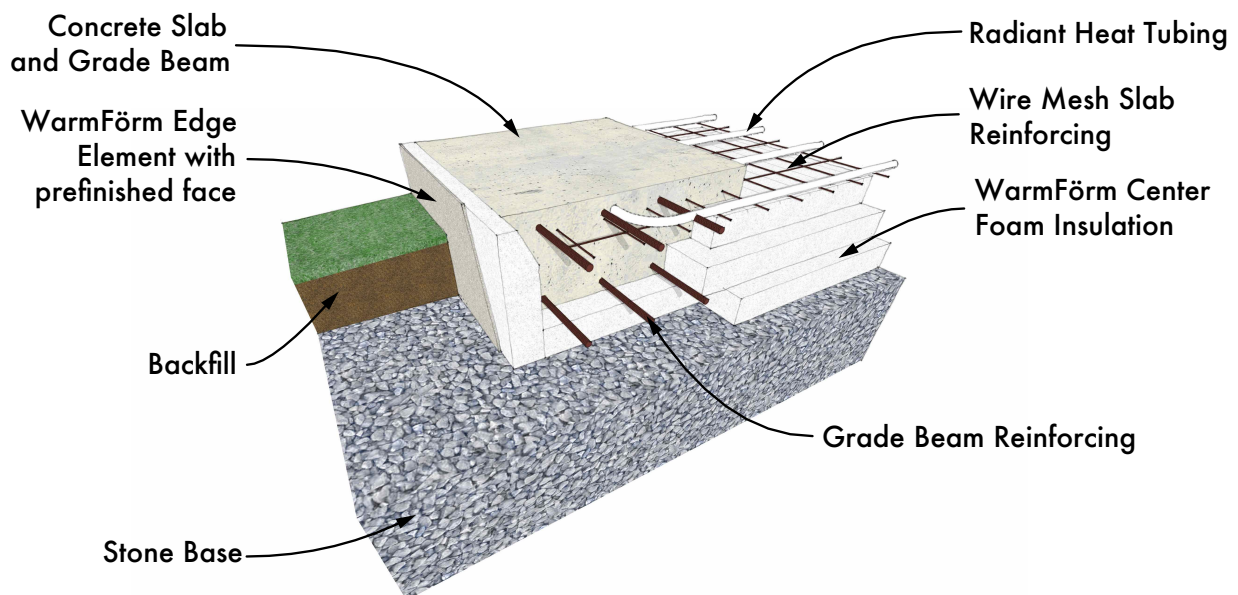
WarmFörm is based on decades of testing and tens of thousands of installed examples in Northern Europe where it is used to eliminate digging, provide an energy efficient and practical formwork system that obviates the need for site finishing of the insulated slab edge, and improves the tolerance of the finished slab. It is especially suited for radiant heat slab applications.

A slab on grade foundation is well known to be the least expensive way to build. Yet North Americans are only accustomed to slab on grade in frost free areas. WarmFörm allows builders in frost prone locations to build a foundation that is more cost effective than and performs better than traditional deep foundations, and costs less to install. If you want to make a highly insulated structure there is no better way to

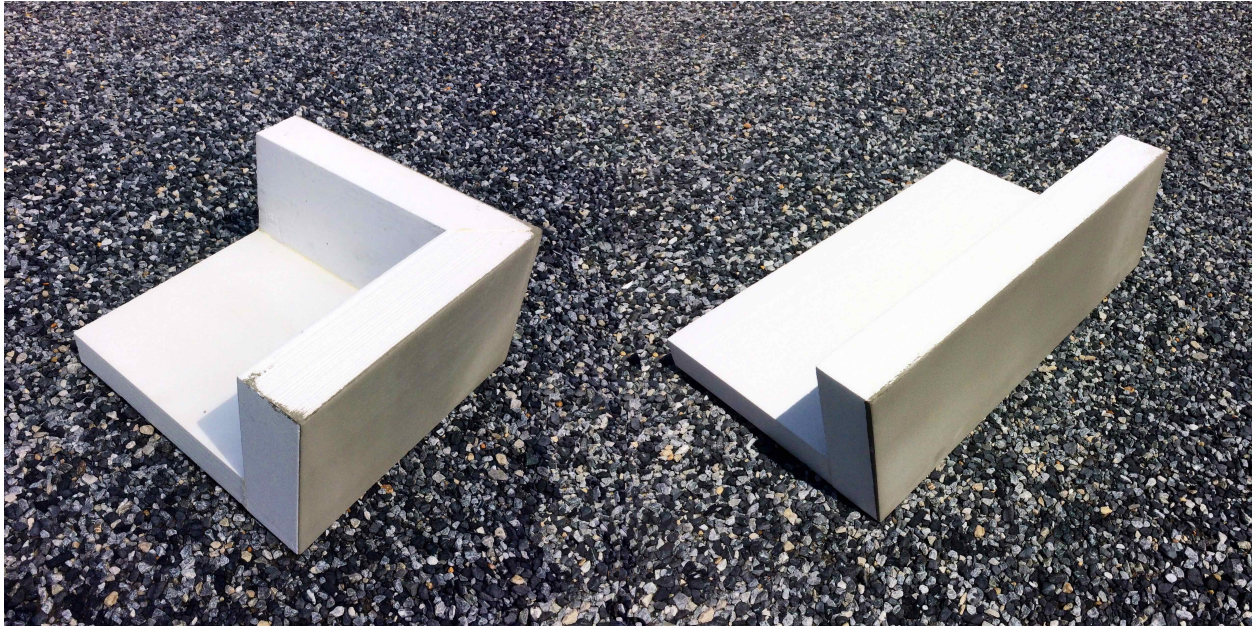
be sure that your insulated envelope completely surrounds your building.

Foundation systems like WarmFörm have been commercialized in Scandinavia for over 30 years. Today there are numerous manufacturers offering a range of similar products. Nearly every new home in Scandinavia is built on a similar frost protected slab, and homeowners enjoy living on warm floors all winter, and enjoy the economy of this construction technique.

Over these many years builders in Scandinavia have refined this product to make it efficient, easy to build, and reliable. We in the US have the benefit of being able to learn from their science, and to take advantage of it without the long learning curve.



By studying the Scandinavian practices closely, ByggHouse has adapted these systems to our dimension standards and building codes to offer an insulated slab form product for North American builders.



WarmFörm consists of slab edge “elements” which are laid out on site to form the perimeter of the slab on grade. These elements are configured as either straight elements which we refer to as edges, or as corners. Inside corners are achieved by butting two straight edges together, and off 90° corners are created by trimming Elements to the proper angle. Elements are cut easily in the field with hand saws, and are attached to one another with dedicated hardware that “clamps” the edges together. The center of the WarmFörm slab is filled

with additional foam layers which determine the shape of the slab and grade beams of the foundation structure. Grade beams rest on the horizontal leg of the edge Elements and building loads are transferred through the high density foam to the stone layers below, and on to the site soils. A properly installed WarmFörm slab foundation system is compliant with current editions of the IRC, Chapter 4, Section R403.3 Frost-protected shallow foundations, and the ASCE 32.01 as incorporated into both the IRC and the IBC.

02 Planning your WarmFörm Foundation

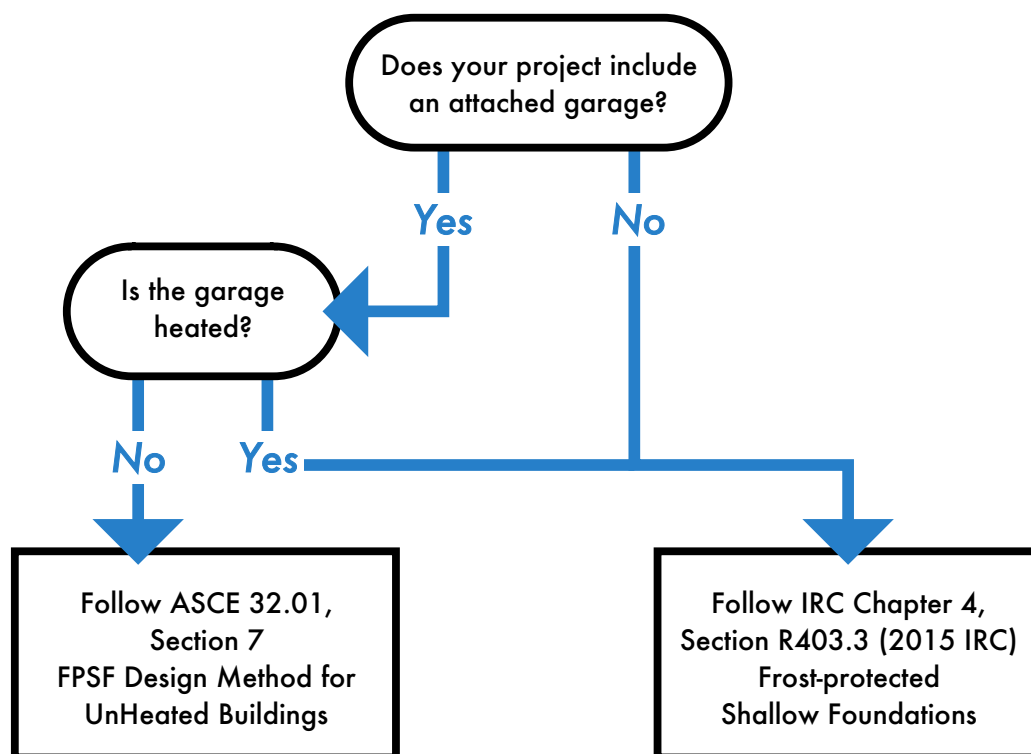
Code background

WarmForm is compliant with the IRC and IBC model codes adopted throughout most of the United States, but some background is helpful to understanding where to look for code guidance, and where to direct your building official who may likely be unfamiliar with Frost Protected Shallow Footings.

The IRC (International Residential Code) contains a simplified design method for Frost Protected Shallow Footings which can be found in Chapter 4, Section R403.3 of most recent editions of the IRC. This is the simplest and easiest method and if possible you should use this, but there are some limitations.

The IRC also incorporates by reference another document, the ASCE 32.01 (American Society of Civil Engineering). You can see this reference in the IRC at Chapter 4, Section R403.1.4.1. The ASCE 32 is the document that originally spelled out the design methods for Frost Protected Shallow Footings for North America, and is also incorporated by reference into the IBC (International Building Code). ASCE 32 includes 3 design methods for Frost Protected Shallow Footings: Detailed, Simplified, and Un-Heated buildings.

You will use either the IRC or the ASCE 32 for your WarmFörm design. The following decision chart will help you determine which of the code design methods to use.



IRC Code check

The IRC design method is the simplest and so we will review the process of going through the Section here. If you are using the ASCE 32, the process is similar and reviewing the IRC method will help you navigate the ASCE 32 if you are using one of those design methods. Take good notes for yourself as you go through the code, so that you may refer back to them if you need to explain the requirements to Building Officials.

The IRC Code will dictate several variables in the configuration of your WarmFörm foundation. Your first step in planning your foundation will be to review the code and determine these variables. The IRC will vary the depth of the system and the width of perimeter insulation based on the location of your building site and the Air Freezing Index for that location. So your first step is to use the tables in the Code to determine your Air Freezing Index. Refer to Table R403.3(2) Air-Freezing Index For U.S. Locations By County. Some counties are not listed in this table if there are multiple values for within the county. In this case you can refer to the contour map Figure R403.3(2). With the Air Freezing Index value from the Table or contour map we can determine your variables.

Now refer to Table R403.3(1) Minimum Footing Depth And Insulation Requirements For Frost-Protected Footings In Heated Buildings. This table will give us the values we need. First we want to determine the minimum footing depth. This value for Footing Depth will be used to determine the thickness of the stone base layer under the WarmFörm system. WarmFörm relies on the

stone base to achieve this minimum depth. This is possible because the stone base used under WarmFörm is considered a Frost Resistant Fill, and as such it is considered part of the foundation system for meeting the required value for Footing Depth.

Next we want to determine the R-Value and Width of perimeter insulation. There are different values for corners and edges and there are diagrams which explain the configuration of these elements. Note that for some climates this perimeter insulation is not required at all. We do not provide this insulation as it is ordinary and available at any building supply. You must determine how much you need here and arrange for it to be ready for your installation. We recommend using XPS foam insulation for this component, and using 2" or thicker as required to meet the R-Value required. 2" will be more than is called for most regions and is a safety measure which has little cost.

You will also note that Table R403.3(1) provides a required R-value for vertical insulation which is the insulation covering the vertical edge of the slab. WarmFörm's standard configuration insulation value will satisfy this requirement for any of the given Air Freezing Index values, so you do not need to be concerned about meeting this requirement - WarmFörm has you covered.

Now you have the size of all the elements you need to make a complete Frost Protected Shallow Foundation. And if you've kept good notes, you will be able to guide your Code Official through these requirements to explain that you are in compliance.

Understanding the details of the system

Stone base: The WarmFörm System rests on a stone base that is placed on the sites undisturbed sub-base as exposed once organic soil is stripped from the building area. Conceptually once the topsoil is stripped away you are building on top of the sub-base, not digging into it. The WarmFörm Foundation is an additive process, not removal and infill. The stone base begins upon your undisturbed sub-base, or if any soil preparation was required for your site, it begins upon that prepared sub-base.

The stone base is standard drainage fill of coarse stone. The top 2" of the base layer should consist of a smaller grade stone which will ease leveling. This should be a size that is easy to rake, and allows you to quickly adjust the level of the stone as you layout. Additionally we recommend a 3-4ft wide band of stone fines directly under the perimeter elements. This strip makes it quick to adjust to level using a whisk or hand broom. Sand is not appropriate here as it will hold moisture. Use a small crushed stone that drains readily. Specifically each layer should meet the ASTM spec for Frost Resistant Fill, and as follows:

- Main base layer equal to a washed, evenly graded mixture of crushed stone or gravel, 100% passing 1 1/2" sieve, no more than 5% passing No.4 sieve.
- 2" topping layer equal to a washed, evenly graded mixture of crushed stone or gravel, 100% passing 3/4" sieve, no more than 5% passing No.4 sieve.
- Setting strip under the perimeter elements of a 1/4" crushed washed stone, thickness as necessary to adjust perimeter

Drainage piping: The need for drainage piping will depend on your site, but generally the assumption is that once your WarmFörm is placed and top soil returned to the perimeter the stone base may actually form a basin which should have drainage. Ideally this drainage can be piped by gravity to daylight downslope on another part of the site. If not, other means of drainage must be considered including sumps, or elevating the stone base above adjacent soils to avoid collecting ground water in the drainage fill. This piping is common perforated drainage piping installed in the conventional way. This is typically at the perimeter of the stone bed, and should not interfere with other below slab piping and utilities. Note that Radon Gas ventilation piping may be needed for your site. This vent piping is also typically within the footprint of the slab and should not interfere with the drainage piping even though it extends into the same stone base. Typically the gaps in the stone base can be relied on to transport radon gas to the vent pipe, and the extension of branches is usually not required. Terminate your radon vent pipe with a "T" fitting at the top of the stone base.

WarmFörm Elements: Resting directly on top of the stone base and following the perimeter of your slab are the WarmFörm Elements. These are L shaped in profile, with a horizontal leg that supports the grade beam at the perimeter of your slab, and a vertical leg which contains the concrete while it sets up and provides the insulation for the edge of the slab. Four profiles are available with varying thickness of vertical face insulation. These are

made with high density Type IX foam which is capable of supporting building loads up to the design pressure limits. The Elements come in straight edge pieces 4ft in length, and corner pieces approximately 2'-4" square. The Elements have a reinforced concrete facing on the exterior which removes any need to finish the slab edge or cover and protect the insulation - it is already done for you. Once the Elements are set, level, and square, they are locked together with two types of fasteners: WarmFörm Edge Clamps are metal "staples" that are inserted into the top of the vertical leg locking together the top of the Elements; and WarmFörm Joining Plates which are similar to the plates used in plate nailed trusses - these lock together the horizontal leg of the elements holding them in place until the slab is poured.

Center Insulation: This refers to the three layers of foam which infills the center area of your building footprint. This foam is typically of a lower density, type II, dense enough to support the slab on grade. Parts of the first layer if located below internal grade beams or point load footings must be of a higher density equal to the material in the horizontal leg of the WarmFörm Elements, type IX. The first layer of center insulation fills the entire area within the perimeter elements. The second layer is set back from the slab edge to define the perimeter and center area grade beams and footings. The top layer steps back another 4" from the second layer widening the grade beams towards the top. Insulation layers are fastened to one another using WarmFörm Foam Spikes. These pin the layers together into a monolithic piece which enables it to resist floating to the surface during the pour.

Skirt Insulation: Additional foam around the perimeter of the foundation is called for by code in some climates. This foam extends out from the edge of the bottom of the WarmFörm and is completely covered by backfilled soil. The width, and thickness as determined by required R-value is set out in the IRC. We recommend using a minimum of 2" of XPS foam, even if the IRC allows less. Follow the IRC's allowances for R-value per inch for different foam materials.

Radon Vapor Barrier: No matter what type of foundation system you use, in some locations a barrier is required to prevent Radon gas coming out of the soil from entering the interior of the house. Along with the Vapor Barrier a vent pipe extending into the Stone Base will conduct radon gas to above the roof of the house where it can harmlessly dissipate. The Vapor Barrier sheet is installed on top of the first layer of center foam, and extends all the way to the top of the perimeter WarmFörm Elements. You do this because you want to be sure that any gas under the vapor sheet can not find its way into the house, which it might do if allowed to enter the exterior wall system. All seams and penetrations in the Vapor Barrier sheet must be taped closed and tight.

Reinforced Concrete Grade Beam: These are the primary load bearing footings for your structure and they are integrated into the edge of your slab and below any internal load bearing walls or point loads from columns and posts. The size of these grade beams, and the reinforcing of these must be designed by your architect or structural engineer to be suitable for the loading conditions of your structure. WarmFörm can be configured to work with most conventional load bearing conditions. There is a maximum design pressure of 1200 PSF for these foundation elements which your engineer should follow.

Reinforced Floor Slab: This is the ground floor of your house! The concrete slab is typically reinforced with welded wire mesh. Fiber inclusions are a popular method for reinforcing slabs today, but plastic fibers will not resist differential movement along slab cracks, so we recommend welded wire mesh even if you are using fiber. If you will have radiant heating integrated into your slab, the PEX tubing will be set up before the concrete slab is poured.

Anchor Bolts: WarmFörm can work with most forms of anchor bolts and tie down straps. Threaded rod anchors work fine, be aware of the length needed for the depth of the WarmFörm grade beam and order the correct size. For strap tie-downs, confirm that they can be located in the proper place and do not conflict with the exterior insulation layer of the Edge Elements.

Soil Backfill: Before your concrete slab is poured you will need to backfill soil around the perimeter of your slab. This backfill helps oppose the weight and outward pressure of the wet concrete until it sets up and will prevent accidental blow-outs. When your construction work is complete you will want to have top soil and landscape treatment in this area. Be mindful of perimeter skirt insulation if any when planting shrubs. Do not use plantings over the skirt insulation whose roots will eventually be in conflict with the insulation.

Wall Assembly: WarmFörm is compatible with a wide range of wall systems. WarmFörm is meant for creating energy efficient houses, so its likely that your wall system will be thicker for higher insulation values. WarmFörm can easily accommodate these deeper walls because it has the full depth of the perimeter grade beam available for bearing. Some caution should be taken with conventional thinner wall types when used with our Standard Profile. 2x6 based walls are fine, if aligned even with the end of the tapered slab edge. This will put 3.5" of the wall, equal to a 2x4, squarely over the edge of the grade beam. Smaller 2x4 walls may be problematic as they can put too much bearing past the edge of the grade beam. Review such assemblies carefully with your architect or engineer.

WarmFörm includes some special fasteners that hold the Elements and Center Foam together until the concrete sets up.

WarmFörm Edge Clamps: These are fork like clamps that are inserted into the top edge of the Elements. The taper of their tines are such that they pull the adjacent Elements tightly together. These are easily tapped into the foam with a hammer. Overlaying construction will prevent them from coming out.

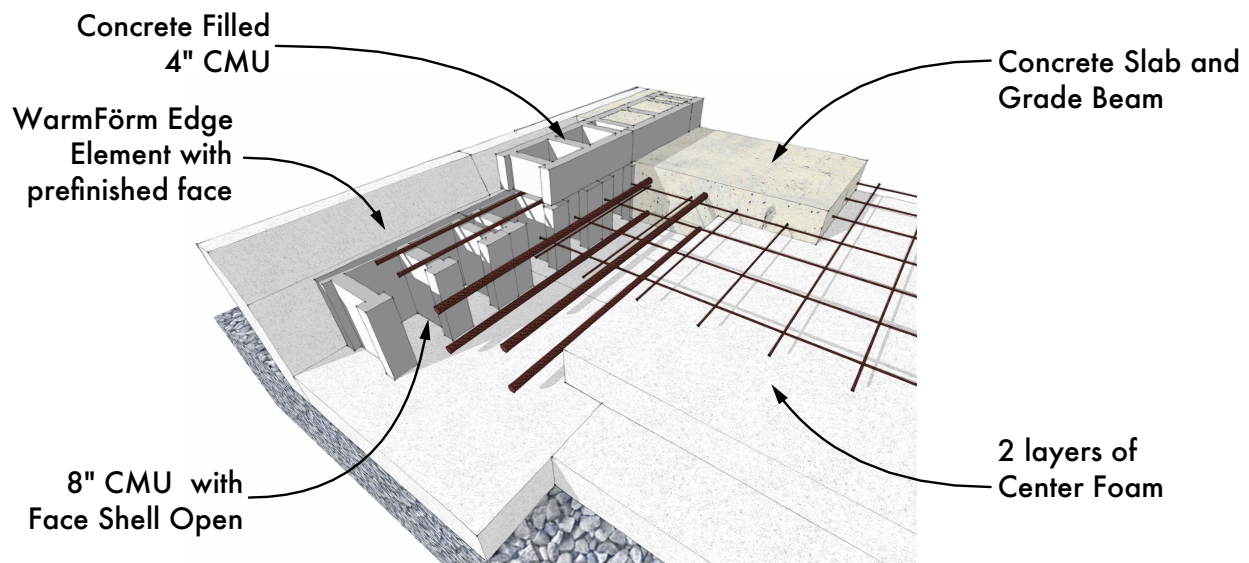
WarmFörm Joining Plates: These are conventional gang nailed joining plates most often used in the truss industry. Here we use them on the horizontal legs of adjacent Edge and Corner Elements. They are tapped into the foam and once covered by concrete they remain in place and prevent the horizontal legs of the Elements from spreading apart.

WarmFörm Foam Spikes: These are barbed nail like fasteners which are passed through the overlying Center Foam layers to lock them to the underlying layers. These Spikes once in place will prevent your foam layers from floating to the top of your concrete pour.

The proper number of each of these fasteners will be included in your order.

Considerations for Garages

Traditionally the treatment of the foundation at a garage differed from the rest of the house, most often because traditionally the house was on a basement or crawlspace while an attached garage was on a slab on grade. With a WarmFörm foundation everything is on slab, so everything can be more similar.



Historically the building code required a 4" minimum step up from an attached garage into a house. This was a requirement developed to make it more difficult for carbon monoxide to find its way into a dwelling from the garage. This small step was understood to prevent the CO which typically settled to the floor, from flowing into the interior space. More recently however this requirement has been removed from the model codes, primarily to make homes more adaptable for accessibility. In this case sloping of the slab towards the garage door and away from the door to the interior can provide the same protection against the migration of CO into the home. However some States have maintained the requirement for the 4" step. WarmFörm can provide solutions for both conditions.

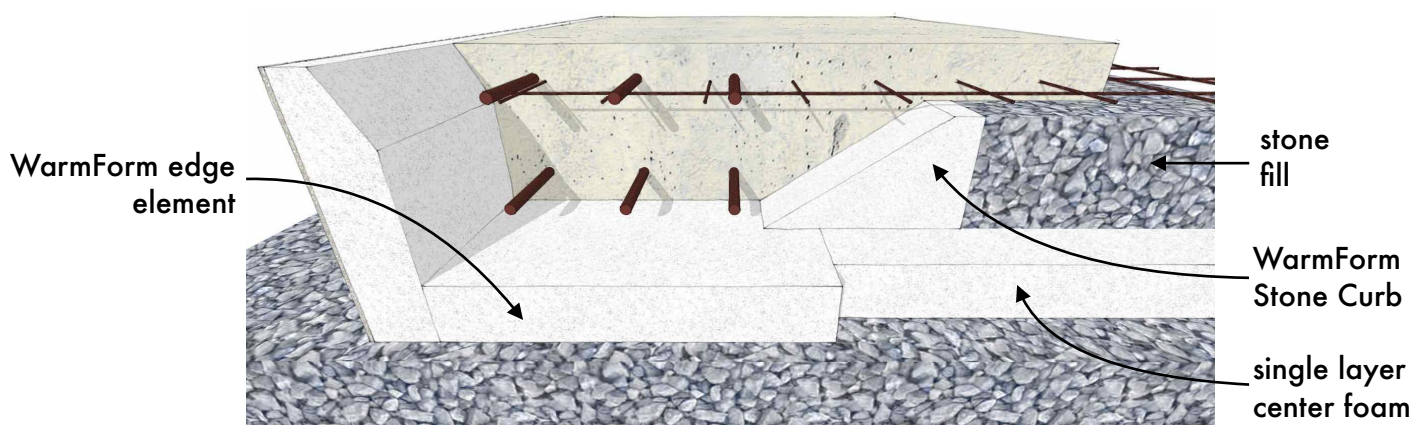
Where the goal is to avoid the step into the house, the Garage slab is designed level with home floor slab and sloped to the garage door and away from the door to the home interior. Here the WarmFörm elements are used in the conventional way, and the slab must be designed and formed to provide the proper slope. In some cases it may be favorable to omit a portion of the top layer of underlying foam, or reduce its thickness at the lowest areas of the slab to maintain the thickness of the slab as it slopes down.

Where a depressed garage slab is desired a raised curb can be formed around the perimeter of the WarmForm using widely available Concrete Masonry Units which are filled with concrete to create the raised curb (see illustration above).

Alternate slab center fill options

Because WarmForm is set on an easy to prep level stone bed, it requires 12" of fill at the center to form a 4" thick slab. WarmForm uses layers of foam to quickly achieve this, as it can be set by the same crew laying out the perimeter and does not require work by other sub-contractors or trades. However we recognize that some customers wish to minimize foamed plastic use in construction and at WarmForm we support these customers by offering components which simplify the use of alternate fill materials such as foamed glass gravel, or ordinary stone fill.

The WarmForm Stone Curb is an accessory that allows you to easily substitute 8" of granular fill for two of the usual center foam layers. The Stone Curb is an 8" tall dam which is used to define the inside perimeter of the foundation grade beams, and leaves a tidy receptacle for 8" of granular fill at the slab center areas.



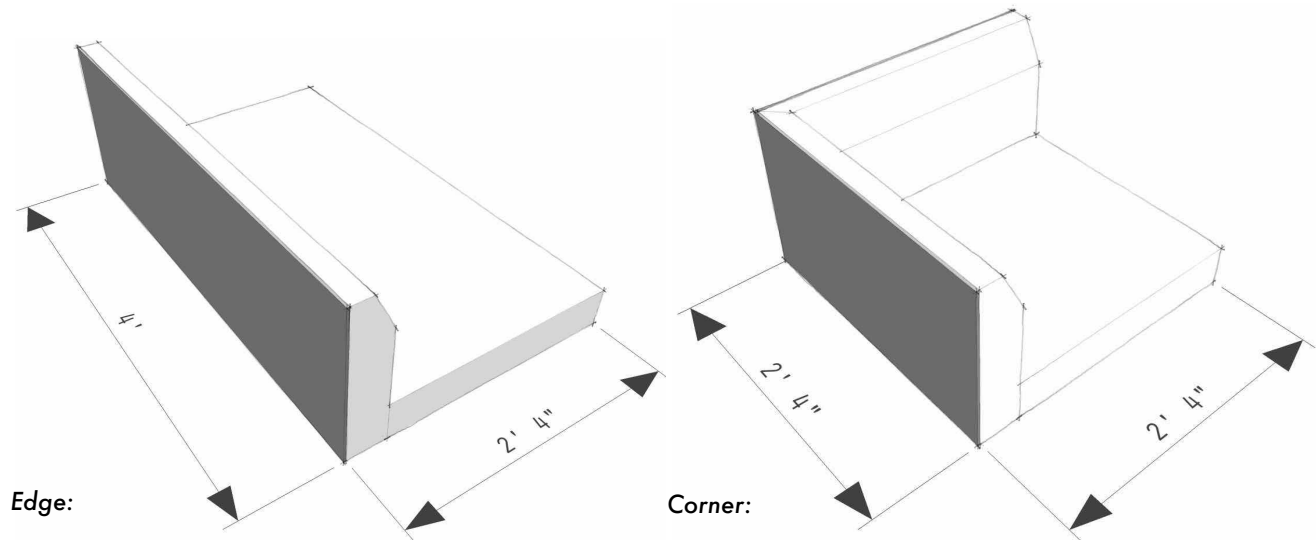
Be mindful of the following concerns when using this alternate slab center fill option:

- The WarmForm Stone Curb may be positioned as needed to form grade beams in required widths.
- Center fill must be lifted in and vibrated to compaction level specified by the foundation engineer. It is recommended that backfill be complete before compaction, to resist spreading of forms.
- Anchor the Stone Curb in place with WarmForm Foam Spikes or other landscape spike.
- Mitre or trim corners in field to layout inside edges of grade beams to required widths.

Layout of foundation design

A WarmFörm foundation consists of Perimeter Elements which provide a pre-finished exterior face to your insulated slab, and Center Foam which forms the slab and grade beam elements and eliminates the need to do stone lifts and compaction after your perimeter is set.

There are two types of Perimeter Elements - Edges and Corners. The dimensions of these Elements in our Standard Profile are as follows:



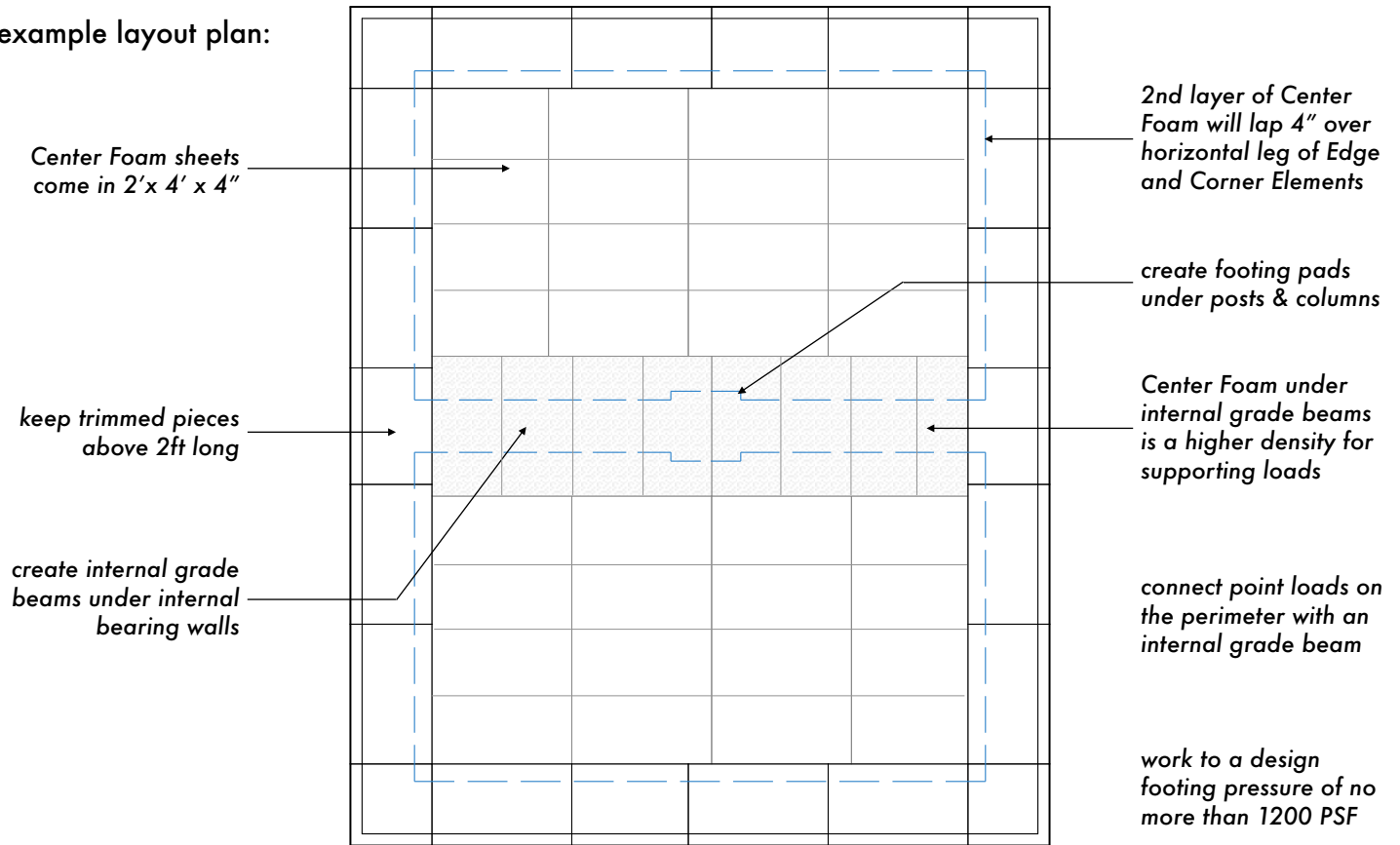
These Perimeter Elements are arranged around what will be the edge of your floor slab to provide formwork for casting the slab and remain in place permanently to provide insulation for your house. Once the slab is cast the job is done - there is no exterior finishing required.

In order to determine how many Elements you need you can look at the length of each side of your house and calculate how many pieces. If your house is 22 ft long you first subtract 2'4" for each corner, and then divide the remainder by 4ft. Round up to the next whole number - one piece will be trimmed to fit. Note, if your fractional Edge piece is less than 2ft you should combine it with the adjacent full piece and trim two to half the combined distance. For example if you have 17ft of edge between your corners then your trimmed piece would be 1ft. Instead combine the 1ft remainder with the adjacent 4ft Edge, and divide in half. Trim two pieces to 2'-6" to complete the side.

Inside corners are formed by butting two Edge Elements together, and then trimming them to make an inside corner.

The placement of your second layer of center foam will determine the width of your perimeter grade beam. The grade beam can be up to 20" wide to maintain a 4" overlap with the edge elements. Work with your engineer to size the grade beam, and do not exceed the code required footing design pressure of 1200 PSF for your footings. This allows an adequate margin of safety for the compressive strength of the foam below your footing.

example layout plan:



Where your house has an internal bearing wall you will need to create a grade beam that crosses your slab. The Center Foam placed below the internal grade beam will be a higher density foam than the Center Foam placed under the slab. The under footing foam is the same density as the WarmFörm Perimeter Elements.

If your house has point loads from columns or posts you will need to size the footing pad below them to keep the bearing pressures below the footing design pressure of 1200 PSF. Posts that are located in the exterior walls have some special considerations. Since posts in exterior walls land on the edge of the grade beam the reinforcing for the grade beams around the bearing points must be designed to resist reverse bending. Since the forces from these posts want to twist the grade beam, the post locations are typically connected to the opposing column by an additional grade beam. In this way the twisting force from both posts will balance each other out.

When you determine the overall dimension of your WarmFörm foundation you should take into account the profile of your house wall. WarmFörm profiles are designed to coordinate with an exterior insulation layers of different thicknesses. The Standard profile works well with exterior insulation around 2" thick, PH4 profile with 4" thick insulation, PH6 with 6" and PH8 with 8" or more out-riggers of Larsen Truss type walls. If your insulation is less than one of these profiles you can shift your stud wall outward, but you should consult with your structural engineer to confirm that you still have adequate bearing over the grade beam.

The rest of your planning is similar to any other slab-on-grade project.



03 Installing WarmFörm

Preparation

You have found a building site for your home. You need to confirm soil conditions before finalizing where your house will stand.

Ground conditions: Your house must stand on solid ground, otherwise you may need to use piles. A geotechnical engineering report will tell you if the ground is solid to build on, and if not they will identify bearing specs for pilings. Some municipalities may require such a report in order to build. Other locations may have well known soil conditions. At this point you should be very familiar with the standard WarmFörm Details and know the layers of base that will be under your home.

Your first step is site preparing the building site for your home. Your excavator must remove the top-soil and organic matter so you have a clear site of undisturbed soil. Top-soil may be stockpiled on site for later use. You should be installing a drainage pipe around the perimeter of your house at the bottom of your stone base, and this piping should drain down slope to a

place where it can come to daylight on your site. This will prevent water from remaining in the stone base under your home.

Now you need to bring your utilities into the house. Water supply lines, sanitary drains, Electrical and Gas service piping need to come from their sources to the designated locations on your floor plan. You will need to set up your String Lines and Fences in order to accurately place these utilities. String Lines should be set at the top of your WarmFörm perimeter elements, 16" above the top of your Stone Base. The String Lines will likely be disturbed during the setting of the Stone Base, but if you place your Fences a good distance from your building line you should be able to avoid disturbing them, which will make re-establishing your strings easier later. Place piping for water, sewer and electricity and gas, with enough vertical extension to rise above your slab.

Everything is now ready for your Excavator or Stone Supplier to place your Stone Base. We recommend that the top few inches of your Base stone be of a finer grade which is easier to rake in order to ease leveling. It is important that your Stone Base meet ASTM standards for Frost Resistant Fill. It must drain water readily and be free of fine grains or soils that would hold water. Your supplier should be aware of this so you get the correct material. We have the following recommendations as a guideline for your Stone Base Material. This should be confirmed and verified by your own engineer, builder, or stone supplier. Stone base as follows:

- Main base layer equal to a washed, evenly graded mixture of crushed stone or gravel, 100% passing 1 1/2" sieve, no more than 5% passing No.4 sieve.
- 2" topping layer equal to a washed, evenly graded mixture of crushed stone or gravel, 100% passing 3/4" sieve, no more than 5% passing No.4 sieve.
- Setting strip under the perimeter elements of a 1/4" crushed washed stone, thickness as necessary to adjust perimeter elements to level.

These specs will make sense to the stone supplier and they will know exactly what these materials are. Note: The setting strip is meant to be easy to sweep with a broom to adjust level. You may find some of this will fall between the spaces of the larger stone while you build up enough to adjust your elements level.



You should strive to make your stone base as level as possible. Use laser based layout tools and professional surveyors as necessary. A level base will minimize work later on, and ensure your concrete slab achieves the proper thickness. Now with your stone in place you can re-establish your string lines, and begin placing the WarmFörm perimeter elements.

Placing Elements

Begin with the corners. Place a thin layer of fine stone Setting Strip material under the perimeter elements, and sweep this to adjust your elements to level. Place the corner elements at the string lines and then proceed with the straight edges on each side. The WarmFörm edge clamps may be partially inserted into the top of the vertical leg to stabilize the elements as you layout, but removed if necessary to make adjustments.



Continue to place the straight edge elements until you have a complete perimeter. Make cuts where appropriate to the shape of the slab. Place full length Elements first, with trimmed lengths used to close each side. You should avoid trimmed pieces under 2ft long by combining short pieces with adjacent elements. For example if your remaining gap is 1ft, you should include the adjacent 4ft element to make a 5ft space, and then finish the side with two pieces trimmed to 2ft 6 inches.



The WarmFörm edge elements can be cut with a handsaw. When cutting through the cement coated face you should be conscious of the cutting stroke of the type of saw you are using. You should work so that cutting stroke of the saw is pulling the cement coating against the foam. This will reduce the chance of the coating delaminating from the foam or chipping off. Some customers have had good luck cutting thru the cement coating first with a diamond wheel on a hand held grinder, followed by hand sawing the remaining foam.



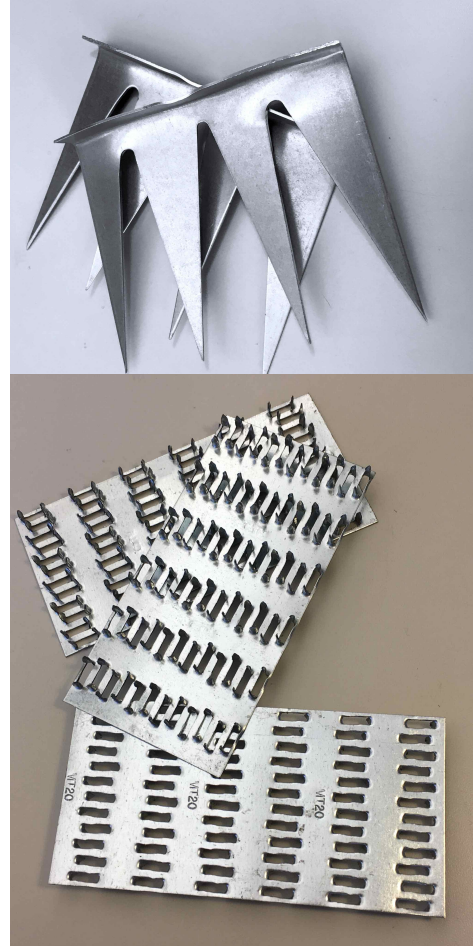
Completing the perimeter placement

When the perimeter is complete you can finish inserting the metal Edge Clamps the rest of the way. These are tapped in with a hammer, or plastic or rubber mallet.

Note: the shape of the clamps will draw the Elements tightly together. Follow the edge clamps with the Joining Plates on the horizontal leg placed about 6" in from the inside edge. You will find that the Joining Plates do not embed tightly into the foam. Do not be concerned - when covered with wet concrete the Joining Plates will be pressed tightly to the foam and they will prevent the edge pieces from separating. That is their job.

Lay down first layer of center foam & Radon/Vapor barrier

Time to insulate the center below your slab. Place the first layer of foam following your layout diagram. Ensure that the Stone Base is flat and level so that your slab does not end up too thick or too thin. Make your foam pieces level and tight without gaps. Trim around the pipe penetrations and seal with canned spray foam sealant.



If you have any internal grade beams and column pads crossing the slab you must remember to use the high density Type IX foam under these foundation elements. You should have laid out these areas when you drew your layout diagram, so follow your drawing and put the high density foam in the proper locations.

When the first layer of foam is in place it is time to lay the Radon/Vapor barrier sheet. You will likely have a seam between rolls to cover your entire slab, so be prepared to seal it with the manufacturer's recommended tape in order to make it air tight. Give yourself about 12" of overlap where the sheets join. You will also need to seal it around your pipe penetrations. You should run this up the vertical inside face of the perimeter forms and terminate it at the outside edge. This will require you to fold it at the corners to make a neat transition. Inside corners typically require additional material to cover the corner, which you can simply tape at the seams to keep airtight. There has been a recent trend towards thicker plastic sheet for below slab vapor barriers. Thicker plastic is stronger and less likely to suffer punctures from construction activity. However in a WarmFörm installation the vapor barrier is well protected and its often fine to use a thinner 6 or 8 mill sheet.



Measure and place the second layer of center foam

The second layer of foam will overlap the horizontal leg of the perimeter elements, and will leave a gap where any internal grade beams cross the slab. Your joints should be staggered from the first layer, and your layout diagram should reflect this. Follow your drawings. Again seal around your pipe penetrations with spray foam.

You should now use the plastic Foam Spikes to lock the 2nd layer of foam to the first layer. Put a spike in the opposite corners of each center foam piece - 2 per each 2'x 4' piece. At the perimeter elements be sure to get your spikes into the edge element where the 2nd layer overlaps it. The Foam Spikes will puncture the vapor barrier - this is normal and the weight of the slab will hold everything tightly together so that these punctures will not be a significant source of air leakage.



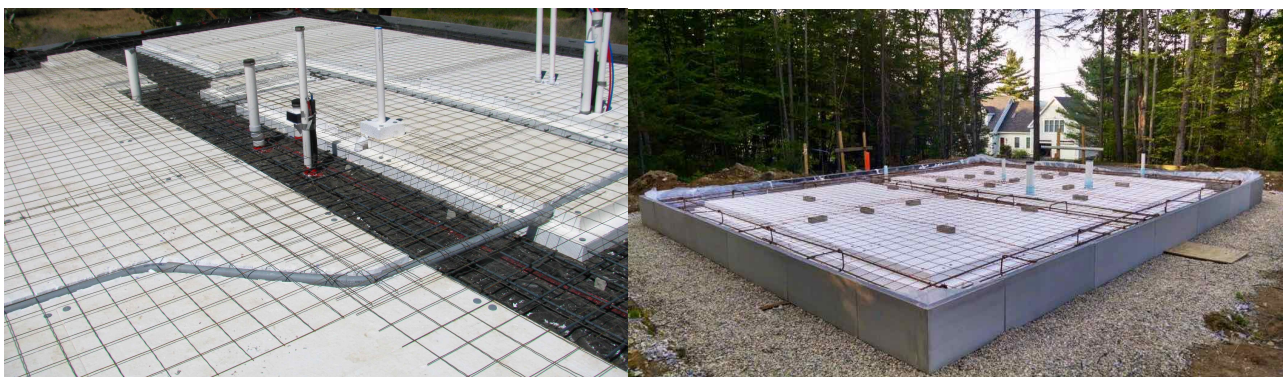


Measure and place the third layer of center foam

Now it is time for the 3rd and final layer of foam. This layer should set back 4" from the edge of the 2nd level per the configuration shown in the WarmFörm Standard Details. Your layout drawing should reflect this, so follow your drawing. Fasten the 3rd layer to the 2nd with the foam spikes in the same fashion as before. This will lock all the center foam together and ensure that none of the foam pieces float up during the concrete pour. Your foam should be topping out at 4" below the top of the perimeter elements to result in a 4" slab. When you are done the foam insulation is all in place.

Place slab and grade beam reinforcing

Your perimeter grade beams and grade beams crossing the slab will be reinforced with deformed steel bars according to the design of your engineer or architect. Your slab will have



a layer of welded wire mesh over the entire extent of the slab. Anchor bolts for your exterior walls will be set into place now at the proper spacing. If you will have radiant heat in your slab then the network of heating tubing will also be installed at this stage.

Speedies Mesh Spacers

Your WarmForm package will include a Swedish mesh spacer called Speedies. These are molded plastic fittings made to raise your mesh 2" to the center of your slab for ideal placement. Speedies spacers are light and compact, and are so much easier to work with than the concrete bricks that are often used. Speedies come in a nested stack, like a paper cup, that's easy to carry and light to lift. You can place these approximately 3ft apart by dropping one at each step of your natural walking stride. The Speedies have large openings in their sides to allow the concrete to flow into them so they don't compromise the strength of your slab. The shape and size of the Speedies is such that it will always support the 6"x6" grid of your mesh, so you do not have to waste time positioning them to catch the mesh – they will always support the mesh no matter how they are placed. And don't worry about walking on them before you pour your concrete – they are strong enough to take it. Speedies are a faster and easier way to work.

Now you can prepare for the concrete pour.



Perimeter Insulation if required

If your location requires perimeter insulation this is the time to install it. Follow the Code requirements for protection of the foam and use foam of the proper thickness to achieve the R value called for by Code for your location. Then before the concrete pour is made you must backfill the perimeter of the WarmFörm elements half way up their height - 8". This soil provides support to the vertical leg of the forms until the concrete sets up.

Place Concrete

Time to cast your WarmFörm Slab. Start by filling the perimeter Grade Beam to half the beam depth. Allow the concrete to settle before pouring the rest of the slab. You must be careful at the edge beam when using a vibrator - it can damage the foam forms, so avoid contacting the WarmFörm elements with the vibrator.

After the perimeter Grade Beams, and Grade Beams crossing the slab are half filled you can proceed to place the rest of the Grade Beams and slab. Your concrete contractor is likely boxing out around your toilet and shower drain locations, so that these plumbing elements can be set flush to the floor. The slab around them will be filled in later when the rough in plumbing work is done. Any spilling or splattering on the face of your WarmFörm can be washed away during clean up.

Your concrete contractor will finish the surface, and then the work is done. There is no formwork to remove, and the outside face of the slab insulation is already finished. Follow the instructions for the curing and setting of your slab. Once the slab has cured you need the concrete to dry out to the recommended level. Then you can begin building your house on top of it.



Appendix

Technical Information on WarmFörm Materials

EPS Foam Insulation: WarmFörm utilizes Foam-Control® EPS (expanded polystyrene) rigid board foam plastic for fabrication of Edge Elements and for under slab center foam. Foam-Control EPS is manufactured in conformance with numerous standards:

- ASTM C578 (Thermal Insulation)
- ASTM E 2430 (EIFS boards)
- ICC ES AC12 (Foam Plastic Insulation)

WarmFörm Foam-Control EPS Properties

Properties:			ASTM C578 EPS Type	
			Type II center foam under slabs	Type IX under grade beams, vertical face
units:				
Nominal Density		lb/ft ³ (kg/m ³)	1.50 (24)	2.00 (32)
Density, min.		lb/ft ³ (kg/m ³)	1.35 (22)	1.80 (29)
Design Thermal Resistance per 1.0 in. thickness	25°F	°F.ft ² .h/Btu (°K.m ² /W)	4.8 (0.84)	5.0 (0.88)
	40°F	°F.ft ² .h/Btu (°K.m ² /W)	4.6 (0.81)	4.8 (0.84)
	75°F	°F.ft ² .h/Btu (°K.m ² /W)	4.2 (0.73)	4.4 (0.77)
Thermal Resistance min per 1.0 in. thickness	25°F	°F.ft ² .h/Btu (°K.m ² /W)	4.6 (0.81)	4.8 (0.84)
	40°F	°F.ft ² .h/Btu (°K.m ² /W)	4.4 (0.77)	4.6 (0.81)
	75°F	°F.ft ² .h/Btu (°K.m ² /W)	4.0 (0.70)	4.2 (0.73)
Compressive Strength @ 10% deformation, min.		psi (kPa)	15.0 (104)	25.0 (173)
Flexural Strength, min.		psi (kPa)	35.0 (242)	50.0 (345)
Water Vapor Permeance of 1.0 in. thickness, max., perm			3.5	2.5
Water Absorption by total immersion, max., volume %			3.0	2.0
Oxygen Index, min., volume %			24	24

EPS from our material suppliers has a flame spread index of less than 25 and a smoke-developed index of less than 450 when tested in accordance with ASTM E84/UL 723 for densities from 0.7 - 3.0 lb/ft³.

Thermal Performance - The R-value of EPS remains constant and does not suffer from R-value loss as does extruded foam products that rely on blowing agents to create the foam structure. The closed cell structure of Foam-Control EPS contains air and not blowing agents which deplete over time.

Exposure to Water and Water Vapor - The mechanical properties of EPS are unaffected by moisture. Exposure to water or water vapor does not cause swelling.

Quality Assurance/Building Code Compliance - Foam-Control EPS meets or exceeds the requirements of ASTM C578, "Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation." Foam-Control EPS is monitored for Quality Control and Listed by Underwriters Laboratories Inc. The International Code Council Evaluation Service recognizes Foam-Control EPS for building code compliance. Please see ICC ES ESR-1006.

Resistance to Termites, Mold, and Mildew - WarmFörm utilizes EPS from several sources which utilize different ranges of treatment. These treatments are based on borates and insecticides which provides resistance to termite & insect infestation. The treatment makers are definitive about their effectiveness on termites. They are less specific about other insects. Experience shows larger bodied insects take longer to react to the treatments. Please review literature on the following treatments for complete information:

- PREVENTOL® TM-EPS – active ingredient Imidacloprid:
1[(6-Chloro-3-pyridinyl)methyl]-N-nitro-2-imidazolidinimine
- CELLUTREAT® – active ingredient borates (disodium octaborate tetrahydrate or DOT)

The treatments pervade the entire EPS structure, and cutting or exposing EPS core material does not compromise the treatment effectiveness.

EPS will not decompose and will not support mold or mildew growth. EPS provides no nutrient value to plants or animals.

Cement Face Coating: WarmFörm utilizes BASF Finestone A/BC 1-Step cement coatings. A/BC 1-Step is a polymer modified portland cement base coat mixture optimized for adherence to WarmFörm EPS. This coating is reinforced with A/BC mesh embedded into the base coat. This base coat is suitable for overlay of other masonry and stucco finishes, but none is required.

Disclaimer

This information is for guidance only, and further technical considerations may be needed for geological variations and soil conditions of your site, and further engineering for the design of your concrete slab. WarmFörm's instructions and documents are informational only and should not be construed as detailed construction drawings.

ByggHouse provides WarmForm "As Is" and makes no representations or warranties, either express or implied, of merchantability, fitness for a specific purpose, accuracy of dimensions, handling in shipment, or suitability with soil or geology. Use of WarmFörm is at the customer's risk.

ByggHouse contact information

ByggHouse LLC
45 South Centre Street
Merchantville, NJ 08109
856 662 4909

WarmFörm Standard Details

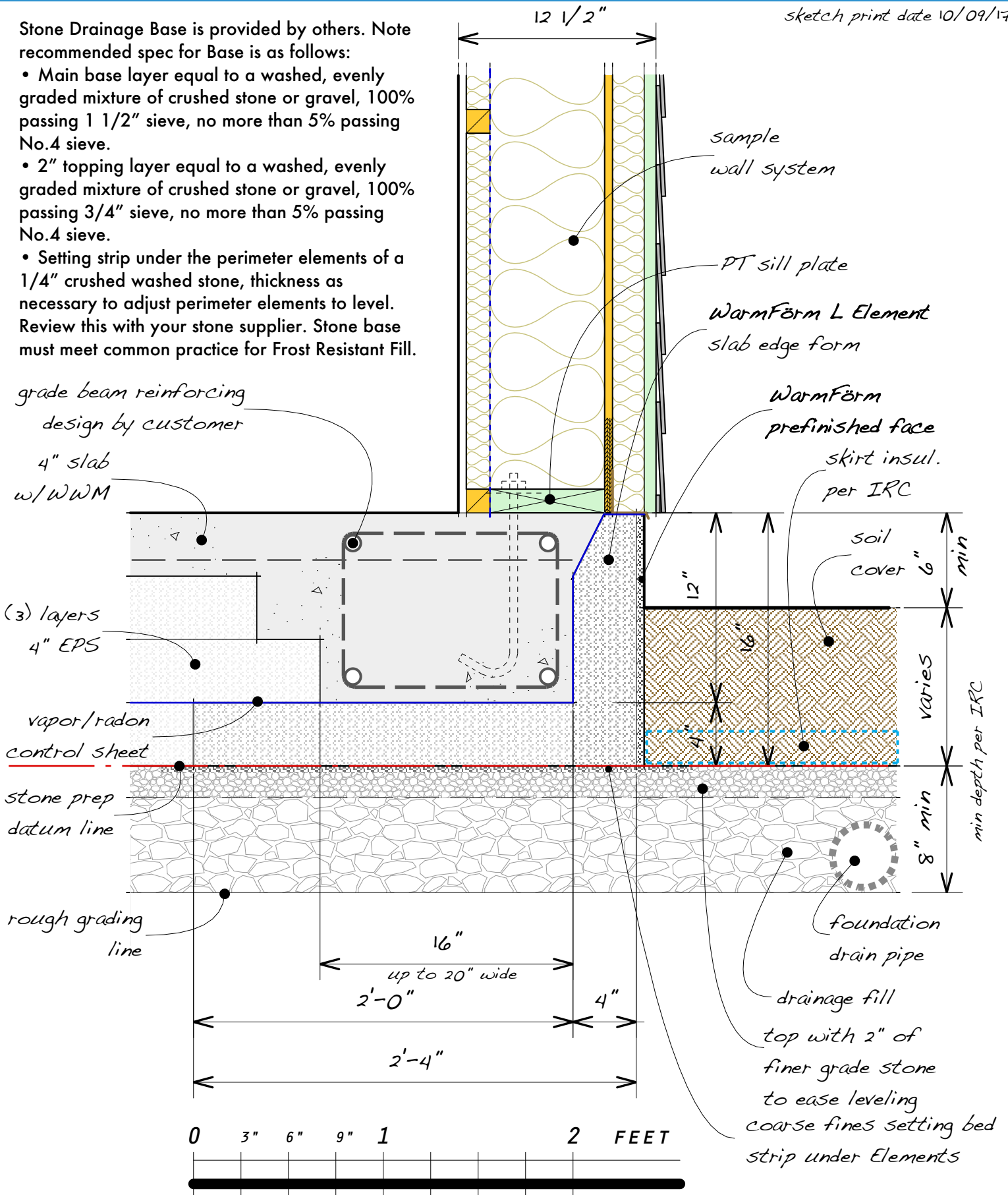
The following pages illustrate the standard details for WarmFörm Frost Protected Shallow Slab on Grade Foundations. The full range of WarmFörm profiles are illustrated:

- WarmFörm Standard Profile
- WarmFörm PH4 Profile
- WarmFörm PH6 Profile
- WarmFörm PH8 Profile

sketch print date 10/09/17

Stone Drainage Base is provided by others. Note recommended spec for Base is as follows:

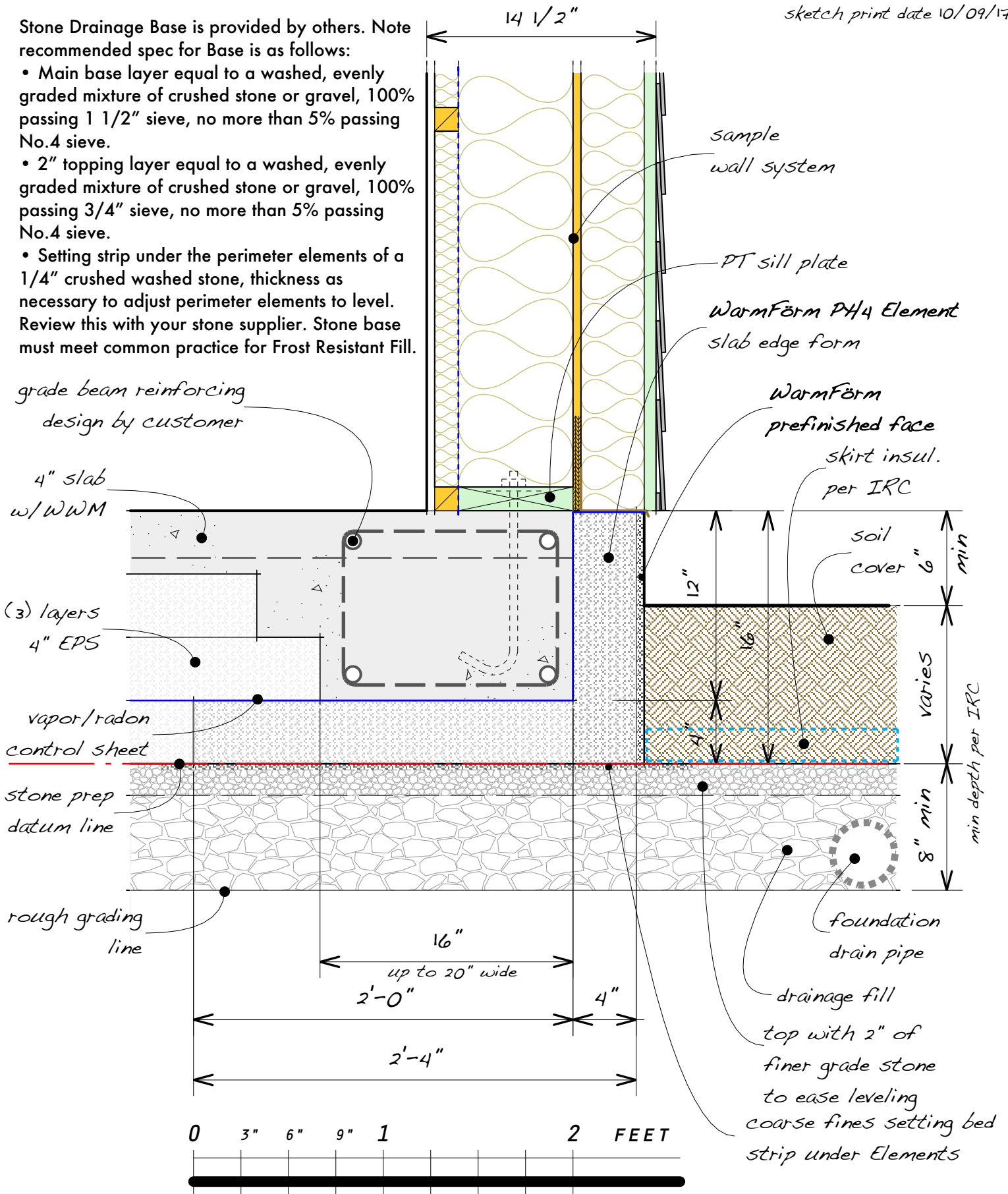
- Main base layer equal to a washed, evenly graded mixture of crushed stone or gravel, 100% passing 1 1/2" sieve, no more than 5% passing No.4 sieve.
- 2" topping layer equal to a washed, evenly graded mixture of crushed stone or gravel, 100% passing 3/4" sieve, no more than 5% passing No.4 sieve.
- Setting strip under the perimeter elements of a 1/4" crushed washed stone, thickness as necessary to adjust perimeter elements to level. Review this with your stone supplier. Stone base must meet common practice for Frost Resistant Fill.



sketch print date 10/09/17

Stone Drainage Base is provided by others. Note recommended spec for Base is as follows:

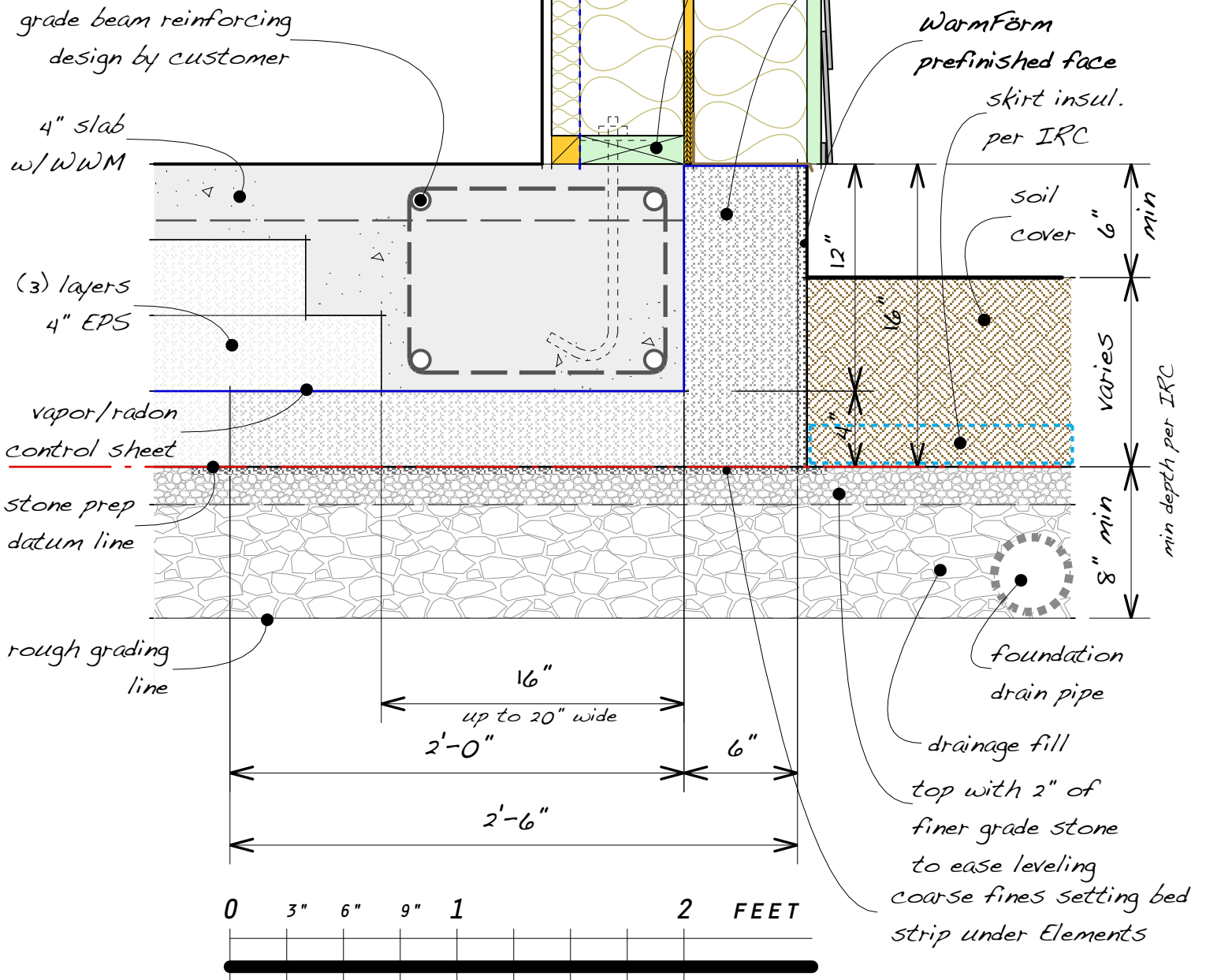
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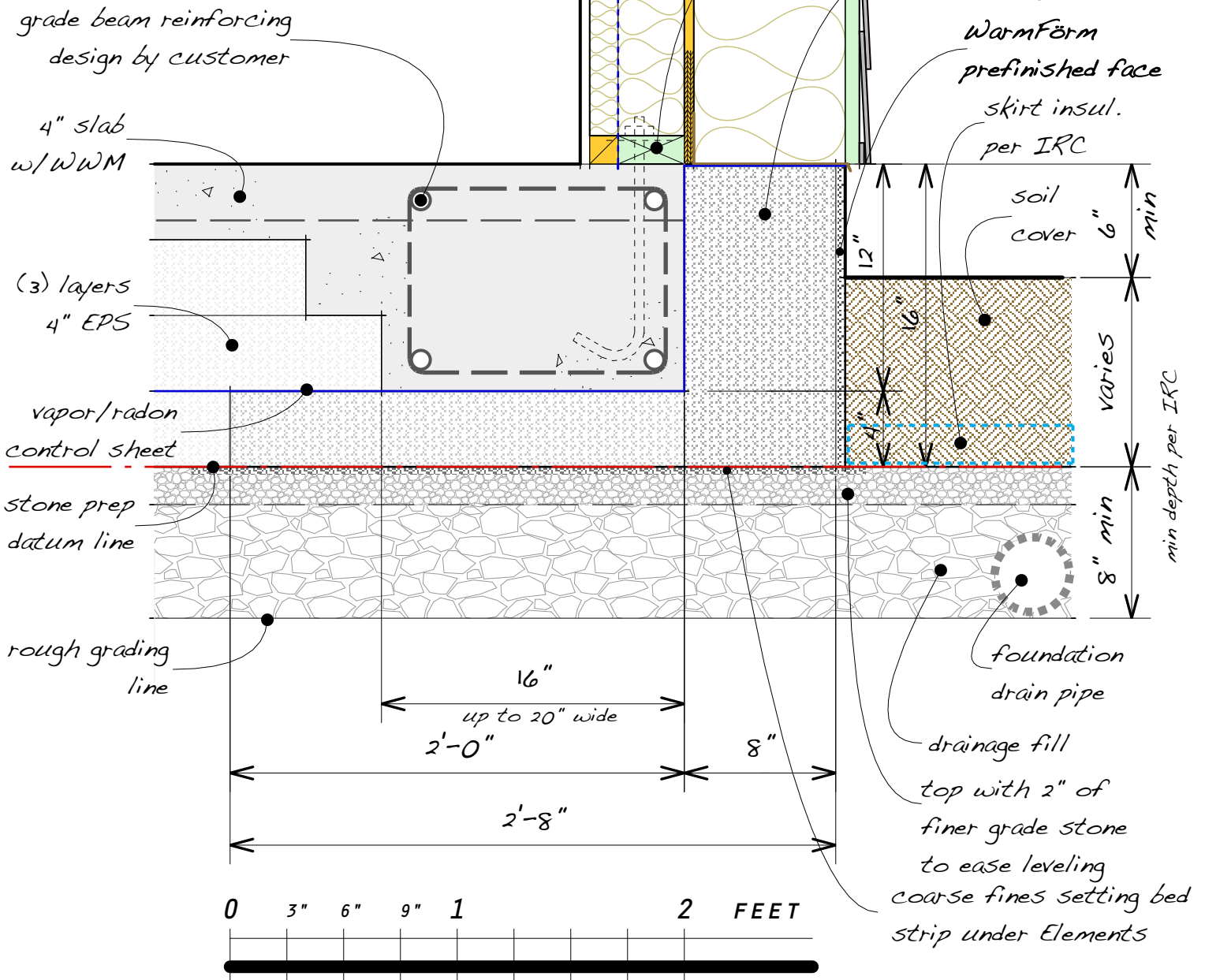
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For other components shown in this drawing refer to WarmForm Typical Section Details.

- Stone Curb may be positioned as needed to form grade beams in required widths.
- Center fill must be lifted in and vibrated to compaction level specified by foundation engineer. Recommended that backfill be complete before compaction, to resist spreading of forms.
- Anchor the Stone Curb in place with WarmForm Foam Spikes or other landscape spike.
- Mitre or trim corners in field to layout inside edges of grade beams.

