Engineered Wood Foundations

Emeraldfoundations.com
This manual will serve as a guide to planning and installing an Emerald Foundation system. This system is comprised of a monolithic keyed concrete slab (designed by CSI and provided by others), a wood basement wall system (designed and provided by CSI), and an I joist or floor truss system (designed and provided by CSI). The entire package is an engineered system unlike anything available on the market. The system may not be altered or changed without being subjected to the engineering again. It is critical that the guidelines set forth in this manual and the construction documents provided, be followed carefully in order to insure a foundation guaranteed to last and one that will pass inspection with your local building department.

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I. **Emerald Foundation System overview**

A. The Emerald Foundation System consists of 3 basic parts:

1. A keyed monolithic slab which forms the basement floor. We provide the forms pre assembled for this keyed slab. The builder/contractor is responsible for the excavating and preparation for the slab. Once the slab is poured, the forms stay in the ground and do not have to be stripped. The key in the concrete serves to resist any lateral forces applied to the bottom of the studs when backfilling. Walkout foundations can be accomplished with the same system utilizing a frost protected footing. This system allows the builder/contractor to do the entire basement floor himself. All thickened areas and footings are designed and shown on a slab drawing that will be provided to the builder/contractor.

2. An engineered wood wall panel system. The basement walls are built from foundation grade treated lumber and nailed together with stainless steel nails. The Emerald design software calculates all the loads associated with the wall design to insure proper sizing of members and proper nailing requirements. Wood wall panels can be built up to 12’ tall and are shipped to the site in 8’ lengths. The wall panels are simply and quickly set up around the keyed slab and fastened together in the field according to the engineering sheets provided. We provide the wall panels, the anchors for attachment to the concrete, 2nd top plates, moisture barrier for inside and outside, grade board for around the outside, and all drawings and documentation. The builder/contractor is responsible for providing field fasteners.

3. A floor system for the main floor is the final part of the system. The floor can be engineered floor trusses or engineered I joists. We do not allow conventional dimensional floor systems to be installed on an Emerald Foundation. The Emerald software calculates all diaphragm loads transmitted through the floor system and outputs required fastening and blocking. If an I joist system is used, we will ship all the I joists precut to length and marked for location. Floor trusses will include a placement drawing as well. We provide all joists, required beams, rim material, floor sheathing, blocking material, panel adhesive and hangers required for the floor system. The builder/contractor is responsible for field fasteners.

All Emerald Foundations will include the above items. We can optionally provide wall panels, floors, and roof trusses for the entire project. The three items listed above are all part of the engineering calculations performed by our software and will not, therefore be split up.
II Preliminary design considerations

A. The Emerald wood foundation system is an engineered system that requires information about the entire building. As with any other foundation system, vertical loads from floors, walls, and roofs above must be transferred through the Emerald wall system to the footings below. The Emerald system is unique in that we are now providing engineering for these vertical loads, but also for lateral loads applied by both backfill and wind. These forces must be resisted by the wall system and the floor diaphragm. In order to properly design a system to resist these loads, the following information is necessary for the designer.

1. A functional set of construction plans including
   - floor plans
   - sections
   - roof plans

2. Any areas where the floor diaphragm may have openings (such as stair openings) must be located on the plans. Openings in the floor require special design considerations.

3. Since we are engineering a system to resist lateral loads, it is important to consider any different backfill heights that may occur on your site. A basic site plan indicating backfill heights at all sides of the foundation is necessary. We will also need to consider the garage fill heights if the garage is attached. If you are planning a walkout or view out basement, we will need to be aware of this. Make sure the plans specify what you would like for a ceiling height in the basement as well.

4. Basement window location and sizes. The new building code requires at least one egress opening in every basement. These openings require special engineering to support lateral loads. Please indicate whether you are using a prefabricated window well (supplied by others) or if you want us to provide a treated wood well around these openings.

5. You will need to specify where you want the sump crock located in the basement floor. A sump crock is required for every basement.
6. Prior consideration to plumbing and mechanicals will be worth your time. Cutting floor joists or trusses will not be permitted. The floor diaphragm is a crucial part of the engineering. You should work with your plumber to locate toilets and shower drains so that they do not interfere with structural members in the floor system.

7. Remember that it is not permissible to drill any holes in the studs of an Emerald wall. Drilling holes in the top plates is permitted with restrictions (you cannot drill 4” holes for plumbing vents through the top plates). Any wiring must run through the top plates and down to electrical boxes, not through the studs.
III Soils and site preparation

A. There are two primary considerations regarding soil types and the Emerald system. The soil must be able to support the structure and it must have certain drainage characteristics.

B. Soils must be capable of supporting 2000 lbs per square foot. As a general rule, soils capable of supporting a concrete foundation will also support an Emerald foundation.

C. The Emerald system is an engineered system built around superior drainage characteristics. It is, therefore, important to give proper consideration to the drainage characteristics of the soil that you are building on. The soil classifications given here are based on the “Unified Soil Classification System (ASTM Designation D-2478)”

D. The following is a list of soil classifications with their implications for Emerald use. (See chart on next page for explanation of classifications).

1. Soils classified as GW, GP, SW, SP, GM, SM, GC, SC, ML, and CL are characterized by good to medium drainage characteristics and are allowed for use with Emerald basements or crawl spaces provided the following requirements are met:
   - Backfill is properly graded away from the foundation – ½” per foot for a minimum of 6’ from wall
   - Backfill is free of voids, organic matter, or chunks of clay.
   - Polyethylene sheathing is applied under the basement floor and on exterior walls (see details in concrete and walls section).
   - For basements, a drainage crock with a sump is provided.
   - For basements, a granular drainage layer of gravel, crushed stone, or sand is placed to a minimum depth of 4” under basement floor and wall footings.

2. Soils classified as CH and MH are characterized by poor drainage characteristics and are allowed for use with Emerald basements or crawl spaces when the requirements above are met and a geotechnical investigation report, prepared by a registered design professional, specifies mitigation of the poor drainage characteristics and is approved by the local authority having jurisdiction and the granular drainage layer is increased to 6” deep.

3. Soils classified as OL, OH, and Pt are characterized by poor to unsatisfactory drainage characteristics and are not to be used with an Emerald basements or crawl spaces.
### Table 1 – Types of Soils and Related Design Properties

<table>
<thead>
<tr>
<th>Soil Group</th>
<th>Unified Soil Classification Symbol</th>
<th>Soil Description</th>
<th>Allowable Bearing in Pounds Per Square Foot With Medium Compaction or Stiffness(^1)</th>
<th>Drainage Characteristics(^2)</th>
<th>Frost Heave Potential</th>
<th>Volume Change Potential Expansion(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group I Excellent</strong></td>
<td>G5</td>
<td>Well-graded gravel, gravel-sand mixtures, little or no fines.</td>
<td>8000</td>
<td>Good</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>G6</td>
<td>Poorly graded gravel or gravel-sand mixtures, little or no fines.</td>
<td>8000</td>
<td>Good</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>G7</td>
<td>Well-graded sand, gravelly sand, little or no fines.</td>
<td>6000</td>
<td>Good</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>G8</td>
<td>Poorly graded sand or gravelly sand, little or no fines.</td>
<td>5000</td>
<td>Good</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Group II Adequate</strong></td>
<td>GM</td>
<td>Silty gravel, gravel-sand-silt mixtures.</td>
<td>4000</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>SM</td>
<td>Silty sand, sand-silt mixtures.</td>
<td>4000</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>GC</td>
<td>Clayey gravel, gravel-sand-clay mixtures.</td>
<td>4000</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>SC</td>
<td>Clayey sand, sand-clay mixture.</td>
<td>4000</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Group III Poor</strong></td>
<td>ML</td>
<td>Inorganic silt and very fine sand, rock flour, silty or clayey fine or clayey silt with slight plasticity.</td>
<td>2000</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>OL</td>
<td>Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, loam clays.</td>
<td>2000</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium(^4)</td>
</tr>
<tr>
<td></td>
<td>CH</td>
<td>Inorganic clays of high plasticity, fat clays.</td>
<td>2000</td>
<td>Poor</td>
<td>Medium</td>
<td>High(^4)</td>
</tr>
<tr>
<td></td>
<td>MH</td>
<td>Inorganic silt, microscoop or diatomaceous fine sand or silty soils, silty clays.</td>
<td>2000</td>
<td>Poor</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td><strong>Group IV Unacceptable</strong></td>
<td>OL</td>
<td>Organic silt and organic silt-clays of low plasticity.</td>
<td>4000</td>
<td>Poor</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>OH</td>
<td>Organic clays or plastic or highly organic soils.</td>
<td>$-0-$</td>
<td>Unsatisfactory</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>PT</td>
<td>Peat and other highly organic soils.</td>
<td>$-0-$</td>
<td>Unsatisfactory</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>

1. Allowable bearing value may be decreased 25 percent for very compact, coarse-grained gravelly sand or silt. Clayey silts, or other high plasticity clays.
2. The precipitation rate for good drainage is over 4 inches per hour, medium drainage is 2 to 4 inches per hour, and poor is less than 2 inches per hour.
3. For expansive soils, consult local soils engineer for verification of design assumptions.
4. Unsatisfactory expansion might occur if these soil types are dry but subject to future wetting.

E. If you have questions about which type of soil you are working with on your property, you can do the following:
1. Check with a local excavating company
2. Check with your local health department – they will need to perk test the lot for a septic permit
3. Local geological surveys are available on the web or from your local authorities.
4. Hire a professional to give you a soil report.
IV Drainage

A. The Emerald foundation is a system built around superior drainage characteristics. When properly engineered and installed, the system will provide much better drainage than any other foundation system available. It is essential that the drainage details outlined here be followed carefully.

B. All Emerald basements require a sump crock to be installed in the basement floor. The crock must have a sump pump that pumps water to daylight. The granular drainage system is set up to channel water to the crock. (See detail 4.1 for requirements). The crock location is provided by the homeowner/builder.

C. The crock is included in the price of the Emerald Foundation.

D. The Emerald foundation must have a granular drainage layer applied under the basement floor and footings. Based on the soil type, the granular layer will be either 4” or 6” of gravel, crushed stone, pea stone, or coarse sand. This will allow water to flow at a controlled rate to the crock. Gravel or stone must be washed, and free from organic, clayey, or silty soils. The maximum size stone must not exceed ¾” and must not contain more than 10% of fine material that will pass through a 3/16” sieve.

E. A drawings showing the concrete slab and drainage channels will be submitted with the Emerald Foundation package from us.

F. Prior to pouring the concrete, you will need to cover the granular layer with a 6mil polyethylene sheet.

G. Wall panels are set and anchored to the concrete slab. All panels must have good bead of butyl caulk applied at the seams. The caulk is not for waterproofing, it is to provide a seal for expansion and contraction of wood panels.

H. After all the panels are set and prior to backfill, a 6mil polyethylene slip sheet must be applied to the outside of the wall system (see detail 4.2). The slip sheet must be applied according to the details provided. The purpose of the slip sheet is to have moisture from the outside and the inside of the structure be directed to the foundation drainage system. It is not a waterproofing agent applied to the wall system. The slip sheet must not be replaced with some other form of waterproofing.

I. After the structure has been backfilled, the soil must be graded away from the structure ½” per foot for a minimum distance of 6’.

J. We recommend that a gutter system be installed to channel run-off water from the roof away from the structure.
Detail 3.1

Cont bead of butyl caulk between poly and grade board

Cont bead of butyl caulk between poly sheet and PWF wall

NOTE: Any vertical splices in the poly must be overlapped 6" and have a continuous bead of butyl caulk run the full vertical distance

Detail 3.2

4' deep granular fill around crack

NOTE: Crock must be equipped with a sump to pump water to daylight.

Prefabricated treated wood crock with 3/4 plywood cover supplied by CSI shown

1'-10" 3' min
V. **Concrete**

A. The Emerald Foundation System has been developed in cooperation with a professional engineering company. The system is built around certain common methods. We are not providing a range of different footing types. Our system utilizes a monolithic slab with thickened footings and a common key which runs around the outside of the foundation.

B. A concrete slab drawing will be submitted with the design package from Emerald. The drawing will contain all necessary information for the concrete slab. All details shown on the drawing must be adhered to. Below is a typical cross section of a slab used with the Emerald system.

C. A 3 ½” key is provided around the outside of the slab. This allows the bottom of the wall studs to be retained when they are backfilled. The width and depth of the key is typical unless an unusual design is encountered. Emerald Foundations provides the pre assembled forms to form this keyed slab. The forms remain in the ground after pouring the slab.
D. The Emerald system can accommodate walkout basements as well. We use the same concrete slab design with a frost protected footing. This eliminates the need for concrete footings and stem walls at the walkout area. Frost protected footing details will be included on the slab drawing if they are required.

E. As with conventional slab on grade construction, The Emerald system allows you to pour the slab first, then build on top.

F. Every Emerald foundation includes the \( \frac{1}{2}'' \times 8'' \) Galvanized Titan anchors required to anchor the wall panels to the concrete. All wall panels are predrilled for code compliant anchor locations so the builder/contractor will simply need to drill the \( \frac{1}{2}'' \) diameter holes in the concrete and screw the anchors in at these locations.
VI_CWF Walls

A. A wall panel layout will be supplied with the wall panel package. This layout will have all the dimensions, panel numbers, and all pertinent nailing/fastening information required for installation.

B. All wall panels will come with bottom plates predrilled for anchors. Anchors are supplied with the package. The builder will have to drill the ½” holes in the concrete for the anchors.

C. Start wall erection at one corner. Set walls tight to key and nail corners together as specified on the plans.

D. Work around the building setting wall panels in order.

E. Each panel joint (wall panel to wall panel) must be caulked with butyl caulk (supplied with package). Apply the calk so it beads to the outside of the panel ¼” when the panels are drawn together.

F. Fasten panel together according to nailing spec supplied on plan.

G. All fasteners used on Emerald walls must be stainless steel type 304 or 316.

H. Any inside corners must be through bolted according to spec’s given on plan.

I. We recommend that you set, join, and brace walls prior to anchoring in order to insure proper fit around slab key.

J. Apply 2nd top plate (supplied with package) to the top of the walls. Make sure to follow joint lap and nailing information provided on plan. All 2nd top plates must be nailed with stainless steel nails.

K. Any field cutting of treated materials will require application of 2 coats of a copper based preservative.

L. After walls are erected and prior to backfilling, a 6mil polyethylene slip sheet must be installed around the outside of the wall system. The following items pertain to the installation of this sheeting.

1. Make sure to check with your local building official about his inspection requirements before you install this sheeting.

2. 6mil polyethylene sheeting is to be applied over the below grade portion of the exterior surface of exterior basement walls prior to backfilling.

3. Joints in the sheeting are to be lapped 6” and sealed with butyl caulk running vertically up the seam from top to bottom.

4. A single horizontal bead of butyl caulk is to be applied at the top of the sheathing to bond it to the treated plywood.

5. Sheeting at ground level is protected by a run of ½” treated plywood (grade board – supplied with package) attached to the foundation wall at 8” above grade and 4” below grade.

6. The polyethylene sheeting extends upwards to the top of the grade board.
7. The joint between the grade board and the wall is caulked full length with butyl caulk prior to fastening the grade board to the wall.
8. The polyethylene sheeting extends downward to the bottom of the wall, but not over the footing.

M. Walkout, view out, or walls with windows may require special nailing or sheathing. Consult the wall panel plan for any special circumstances you may have.

N. Windows located below grade require window wells to retain backfill and allow egress. Structural window wells can be purchased separately or can be supplied by Emerald. Details for window wells and attachment to basement walls will be provided on the plan.

O. Do not drill or notch any members of the wall system. Drilled or notched members in the wall system will render the engineering null and void.
VII Subfloor system

A. The Emerald system offers two different floor system options.
   1. I joist floor system dropped inside of Emerald walls – see detail 7.1
   2. Top chord bearing floor truss system with bottom chord thrust plate
      see detail 7.2
B. The floor system above an Emerald foundation is a crucial part of an EWF
   system. This is why our system is offered only two different ways and why
   we will not sell an Emerald system without the floor system as well.
C. Lateral loads generated by winds and soil pressure are distributed to the walls
   below through the floor system. The floor system keeps the walls from
   collapsing inward and also helps to resist racking loads resulting from
   different backfill heights.
D. The 3rd plan supplied with an Emerald system is an engineered floor layout.
   This layout will include elements from a normal floor layout which you are
   used to looking at. It will also contain information pertaining to the lateral
   loads and what must be done to resist these loads. The important aspects are
   as follows:
   1. When joists or trusses run parallel with a wall, blocking is required in
      between the wall and the floor trusses. This blocking resists the pressure
      exerted on the walls to cave inward. The blocking will usually be attached
      to the trusses with a specific nailing pattern to attach through the OSB
      subfloor above.
   2. The plan will also show where this blocking is located. It is important to
      follow these details exactly.
   3. Where I joists run perpendicular to the wall studs, the floor system is
      dropped down to run between the studs. The I joist is attached to a rim
      board which effectually resists the inward pressure of the wall.
   4. When using a floor truss system, the floor truss is a 3” top chord bearing
      floor truss. The bottom chord is extended to fit snug against a 2 x 4 thrust
      plate (supplied with package) which is attached to the stud wall.
   5. All nailing and attachment spec’s must be followed in order for a properly
      engineered PWF system.
E. Check with your local building official about inspection requirements prior to
   covering any of this framing.
Detail 7.1 – I joist floor option

Engineered rim board attached to inside of PWF wall full length at ends of I joists

2 x 4 thrust plate nailed across all studs at ends of floor trusses

Detail 7.2 – Floor truss option
VIII Backfill

A. Do not backfill until the following requirements are met
   1. Emerald wall system is completely installed and all connections are as specified on the plans.
   2. Emerald walls are anchored as specified on plans
   3. 6mil polyethylene sheathing is applied as specified
   4. Sub floor system above is installed and all attachments have been made according to the specifications on the drawings
   5. The building official has passed all the rough framing inspections associated with the concrete slab, PWF walls, and sub floor framing.

B. See detail 7.1 for a graphic illustration of the backfill requirements. The backfill process begins with the same granular material (gravel, crushed stone, pea stone, etc) as was used under the footings. This must applied to a height of 12” above the bottom of the wall in soils with good to medium drainage.

NOTE:
6mil Polyethylene slip sheet to run from top of grade board to bottom of wall.

4” Granular layer under slab and footings to extend up 12” as shown

Detail 8.1
C. Backfill remaining height with a good to medium drained soil.
D. Do not backfill higher than what is specified on the plans provided to you. All engineering calculations are based on the backfill height specified.
E. Do not backfill one side all at once. Backfill evenly around the whole structure. Add backfill material about 2 – 3 feet at a time.
F. Do not run heavy equipment parallel with the wood walls. Have the excavator push material into the backfill cavity perpendicular to the walls. Heavy equipment should not operate closer that 4’ from wood walls.
G. Take care to protect the 6mil slip sheet when backfilling.
H. Do not compact the backfill area. Let it settle naturally. Do a final grade away from the structure at a later time if necessary.
IX  Plumbing, Electrical and Mechanical trades

A. Plumbing and electrical can be done as in a conventionally framed house with the following exceptions or considerations
   1. It is not permitted to drill holes in the Emerald studs. Any electrical wiring or plumbing lines must run down through the plates at the top of the wall.
   2. Soil lines and incoming water lines from the well may penetrate the plywood sheathing but not the wall studs. Where penetrations in the sheathing occur, take care not to destroy the polyethylene slip sheet on the outside of the wall. Seal around all penetrations with butyl caulk. Make sure the slip sheet is sealed and closed around the penetration as well.
   3. Holes in the top plates must be in the center of the plate and must not be larger than 1”
   4. Floor joists and trusses must not be cut or moved. As was stated earlier, the floor system is a critical part of the engineering in this system. Trades will often times just cut a joist out if it is in the way and tell the builder to get a repair order or header the opening off. It is important to communicate with your sub contractors and let them know that they will be liable for the expense involved in having the system re engineered and fixed.
   5. Standard I joist opening and cut out rules will apply to this system as well.
   6. The Emerald system utilizes 2 different floor types to accommodate mechanicals located in the floor (floor truss system) or mechanicals dropped below the floor in a chase (I joist floor system).
   7. Consideration should be given to these trades in the planning stage. It may be less expensive, overall, to use a floor truss system and have shorter EWF walls than to use an I joist system and have taller PWF walls.
   8. We recommend locating some interior walls in the basement that can be utilized for heat runs and locating your electrical service panel.
X Insulation

A. One of the unique things about the CSI-PWF system is the ability to conform to the new energy code without the additional costs associated with a conventional masonry foundation.

B. See detail 10.1 below for a graphic illustration of insulating the PWF wall.

C. The PWF wall can be insulated with fiberglass or a blown in product as shown above. Keep the insulation up 2” off the floor surface. Insulate all the way up to the top of the stud wall. A vapor barrier, such as 6 mil polyethylene must be attached to the inside of the wall and extend down to 12” below the grade line. It is then tucked behind the insulation at the outside of the stud cavity. This will keep moisture from condensing between the plywood and the insulation in cold weather.
XI Finishing

A. The Emerald Foundation System will accommodate any type of interior finish that you apply to a conventional foundation wall. You may run screws or drive nails into the Emerald stud wall just as you would in any other wall. Drywall or paneling can be applied as you would to a conventionally framed wall.

B. One consideration with Emerald walls is that the studs are designed to, and will deflect slightly. The PWF wall is designed to move slightly. It will not crack as a masonry wall will, but it will deflect. This could cause problems with cabinet or certain furniture installations against the wall. If it is crucial that the wall studs be perfectly straight, you may consider a furring wall in this area.

C. The ceilings may be finished the same way you would finish any basement ceiling.
XII – Garage Foundations

A. Garage foundations are easily accomplished with the Emerald Foundation System as well. It is not necessary to use the keyed slab design with a garage foundation as the lateral loads at the bottom of the wall are quite small. We normally utilize a typical 8” x 16” footing for the garage foundation walls, located below grade as specified by code.

B. If the garage is attached to the house, there are a few special things that must be done.
   1. A full height stem wall must be placed between the garage stem walls and the basement walls. This wall sets on a 2’ extension of the basement footing and serves as a transition between the garage walls and the basement walls. See detail 12.1 for more details.
   2. A 2 x 4 knee wall must be placed against the basement wall and under the concrete slab adjoining the wall. This wall is unsheathed and toe nailed to the basement walls. This serves to support the concrete slab in case any deflection and settling of fill occurs at backfill. The wall sets on the edge of the extended footing which already exists on the Emerald foundation. See detail 12.2 for more details.
   3. As with any garage, it is important to locate all OH door and service door entrances so provision can be made for these.

C. Garages located away from the house need only the footings plus and Emerald stem wall located on the footing.

D. As with other Emerald walls, we will supply the anchors required for garage walls and the wall panels will be pre drilled for proper locations.

E. We are not providing any special forms for garage walls as the footing is a normal 8” x 16” footing.

F. See detail for drainage requirements on attached garages.

G. No grade board or vapor barrier is required on garage foundation walls.
Detail 12.1

Where garage PWF wall intersects basement PWF wall - extend footing 3' past pwn wall - continue provision drainage from garage footing to basement footing.

Detail 12.2

2 x 4 Fnd Grd kneewall from top of stepped footing to bottom of garage slab. Toe nail studs to PWF wall with 16d SS nails top and bottom.
XIII – Crawl Space foundations

A. The Emerald foundation system is fully adaptable to crawl space foundations as well as full basements.
B. A keyed slab may or may not be required depending on the differential backfill heights. We will need to know the specific details in order to determine what type of footing is required.