Successful Home Contracting

How to save thousands of dollars and get a better quality home by acting as your own contractor.

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Lesson Fourteen

Construction!

Clearing, Grading, Utilities, Footings, Foundations, Slab

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This lesson continues the final portion of the course - *superintending* the actual construction of your home. In these final lessons you are learning what to look at and what to look for when you go out to the job site.

In the last lesson the way was prepared for construction to begin. The *Permits* were secured and the *Temporary Utilities* were put in place.

This lesson will carry us from the *Preparation of the Lot* through the *Installation of the Permanent Utilities*, and the construction of the *Footings, Foundation, and Slab*. The next lesson will continue on from *Framing* through the *Fireplace and Chimney*.

**WHAT YOU WILL LEARN IN THIS LESSON**

- How to *Rough Stake* the home.
- About removing and disposing of trees and brush.
- What to look for in *Rough Grading*.
- Getting the *Permanent Utilities* to the site.
- How to make sure the home is in the right location before the footings are dug and poured - *Setback and Yard Requirements*.
- About digging, preparing, inspecting, and pouring the *Footings*.
- Considerations to take into account when you are dealing with *Expansive Soils*.
- What to look for when you check the *Foundations* including:
  - The *Finish Floor Elevation*.
  - Proper *placement* on the footings.
  - *Drains, Waterproofing, and Vents*.
- *Batter Boards* - what they are and how they are used.
- What’s involved in *Masonry and Concrete Foundations*.
- *Rough Plumbing* for a slab.
- What you should know about *Setting Up and Pouring a Slab*.

**CLEAR AND GRADE**

The very first thing you’ll have to do is prepare the lot for construction. Unless you have a flat lot with no trees, you’re probably talking about...
bringing in some kind of equipment to take down some trees and move some dirt around.

**ROUGH STAKING THE HOME**

Before you start, get the house rough-staked to determine its approximate location. If you have had a survey done you'll know where the corners of the property are. Here is where to start laying out the home. The reasons for doing this are twofold: economics and esthetics. It costs money (usually hourly) to clear the construction site. If you know in advance what needs to be done, you can save some time and money. Also, you probably don’t want to remove any more trees than necessary. Knowing where the home will be built will allow you to save the trees that don't really need to come down.

**EROSION CONTROL**

“Erosion control” is really a bit of a misnomer. You won't really control erosion, but you may be required to take special precautions to prevent the runoff from your cleared land carrying mud to adjacent roads and property. Check with your building official. You'll probably use a fencing material that has gained widespread usage in recent years. It allows water to pass through but screens out fine particles.
DISPOSING OF THE TRASH
One decision that will have to be made is what to do with the debris. You can have it hauled away, or, on-site options include burying or burning. The first option is probably the best but most expensive. Check the local fire department before you decide to burn it. If you elect to bury the trash, make sure you choose a location that is well away from the home. A trash hole will settle as the limbs decay and the soil becomes more compacted. This will result in a surface depression. At best this can be an eyesore if it is visible from the home. At worst, it could cause drainage problems or damage to drives, walks, decks, etc. Of course, you may want to have the logs cut into fireplace length and stacked for winter use.

GET AS CLOSE TO FINISH GRADE AS POSSIBLE
It’s good to go ahead and get as much of the grading done as possible at this point. This will make it easier to get around the site, and you will not run the risk of any bad surprises when it comes time to do the finish grading (when the home is completed). Also, some builders like to pour the concrete for their driveway at the same time they pour their slab. This makes it a lot easier to build the home, since you can get out of the mud early. If you’re going to do this, you’ll have to tie down your elevations pretty closely during the rough grading.
UTILITIES

WATER
Again, the sooner you get water to the site, the better. There’s not much for you to be involved with here except to initiate the action. Check with the municipality to see who does what when. Then proceed as required. Not much is likely to go wrong as it will be subject to municipal scrutiny.

SEWER
The sewer connection will not usually be made until the home is completed. The actual connection will be made by the plumber or by the municipality. They will bring in a backhoe, find the tap line, and connect your waste line to it. The plumbing inspector will make sure you have the proper fall (incline or slope) in the waste line from the home to the public sewer line, so that waste products will flow properly away from the home.

WELL AND SEPTIC TANK
There is not much for you to do here. Just make sure that the well and septic tank are located as shown on your plans and are separated by the required minimum distance. Also, make sure that an adequate fall or downhill slope has been provided from where the waste pipe will exit the home to the intake of the septic tank. The subs and the inspectors will handle it all.

The actual work of installing the septic tank and drain field is usually done with a backhoe, which is a tractor with two attachments - a broad shovel on the front, which is good for lifting large amounts of material (soil, gravel, etc.), and a long jointed “arm” on the back, with a narrow shovel, which is used for digging holes or trenches. The backhoe is used to dig the pit for the septic tank and the trenches for the drain field. It can also be used for placing the gravel bed on which the drain tile (pipe) is laid, and for backfilling the pit and trenches after all is in place. The septic tank is a concrete box, where your sewage will be held, while it is broken down by bacterial action. It is lifted and lowered into place with a crane - usually mounted on the truck which delivers it (see picture).

Here are some other references on the subject.
FOOTINGS

HUBBING THE HOME

Hubbing is where the home is accurately located with corner stakes. Here you want to check carefully to make sure that the required setbacks from all property lines have been established. Be careful that you understand the difference between the property line and the curb at the street. In most
cases there is a right-of-way . . . a strip of land between the curb and your property line that belongs to the municipality. Your setbacks will be measured from the property line - not the curb.

In most cases, your front property line coincides with the right-of-way. A quick way to find the general location of the right-of-way is to find it’s width on your lot plan, then measure half the width from the center of the street. In other words, if the right-of-way is 60 feet wide, find the center of the street, and measure over 30 feet onto your property.

If you are planning to have your home located at the minimum distance allowable from the right-of-way, you should have it staked using the property boundaries which have been accurately determined by a physical survey of the lot, in which the corners of the lot have been marked with steel posts driven into the ground.

**SETBACK AND YARD REQUIREMENTS**
The most important thing you will have to be involved with at this point is the actual location of your home. Check the minimum setback, side,
and rear yard dimensions and make sure they are adequate. This is a good time to confirm that your setback meets the zoning requirements, if any. It’s a lot easier to move the house around while it’s still just a line on the ground. Once the footing is dug and poured, moving it becomes a more difficult and expensive proposition. If the home has an overhang, check with the zoning department to see if the setback is measured from the foundation or the overhang line.

**CHECKING FOR SQUARENESS**

Once the corners are established, it is a good time to check the footing for squareness. Having everything straight and square in your home begins with the footings. One way to check for squareness is to *measure the diagonals*. This method is illustrated in the drawing above. Note that some builders erect batter boards to locate the footings, while others simply locate...
the corners, draw the footings on the ground with powdered lime, dig the footings, and then erect batter boards as a guide to building the foundations.

**LAYING THE FOOTING OUT ON THE GROUND**

The footings can be “drawn” on the ground with paint or powdered lime. Your footing sub may do this. You should check all dimensions against the foundation plan to make sure they are accurate. The exterior foundation wall of your home will be centered on the footing, so the footings will be a little bigger than the house.

Here are more resources.

**DIMENSIONS**

The width and depth of the footing may or may not be specified on your plans. Typical dimensions for a poured concrete footing in many parts of the country are 16" wide by 8" deep. This may vary depending on the bearing capacity of the soil and other factors. Remember, the bottom of the footing must be below the *frost line* - that is the depth that water freezes in winter. This keeps the footing from heaving during winter freezes. If you use a sub who is experienced in putting in footings in your area, he will know what is required.

**DIGGING AND PREPARATION**

The footing may be dug by hand or mechanically with a trencher. Hand work is normally required to remove loose dirt, straighten walls, flatten the bottom, etc. The footings must be dug down to undisturbed soil. No filling is allowed. If local codes or soil conditions require that the footings be reinforced, steel reinforcing bars are placed in the bottom of the trench. These must be raised and supported off the ground. This can be accomplished with little wire seats designed just for this purpose, or by simply jacking the steel up on something like pebbles until the concrete is poured.
FORMING
The footing may be formed by the trench itself, as in the drawing (right), or with actual wood forms - as shown in the photo on the next page.

STEPPING
If the lot slopes, the footing may be “stepped” with forms. If masonry foundation walls are to be laid, the top of the footing should be as level as possible.

Here's what it may actually look like on the ground. The strings were removed while the footings were dug.

This footing is being formed by the walls of a trench. Notice the steel reinforcing bars supported off the bottom of the trench.
KEYING
When a formed concrete foundation wall is to be used, the footing is prepared to tie the two together and keep the foundation wall from moving on the footing. This is accomplished by forming a groove or key in the top of the footing. This is easily done with a piece of wood immediately after the concrete is poured. Steel reinforcing rods are also used to tie the two together.

COMBINATION FOOTING/SLAB
With an engineered or monolithic slab, the footing is set up and poured at the same time as the slab. This is done by digging the footing and forming the outside edge (see the photo on the opposite page).

INSPECTION
Remember that you will probably be required to have the footing inspected at this point. An inspection of the footing is required in most jurisdictions prior to pouring the concrete.

The inspector will check the bottom of the trench to make sure the soil is firm.
If he finds spongy soil, he may require additional excavation until undisturbed soil is reached.

**CONCRETE**
The concrete should be a 2500 psi mixture. Get it from a reputable ready-mix plant.

**FOOTING DRAINS**
In certain situations, particularly in basement construction, it is desirable to install a drain pipe to remove water from the foundation area. This will probably consist of a flexible, perforated plastic pipe which is laid in a bed of crushed stone or gravel. Placing a piece of felt paper (roofing) over the pipe, you can prevent it from getting filled with silt.

*This footing drain is along the outside of the wall*

*This footing drain runs along the footing on the **inside** of the structure. It is intended to keep water out of the garage.*
FOOTING PADS
In addition to the footing for the exterior walls, you may also have footing “pads” for interior load bearing piers. These will be shown on your foundation plan. Check their locations. One thing that is often missed is the footings for exterior porches, stoops, and decks. Footing pads should be dug and poured at the same time as the rest of the footings.

EXPANSIVE SOILS
In some areas of the country where expansive soils are present, the footing design is extremely important to the ability of the completed structure to withstand soil movement and subsequent structural damage. If you are in such an area, it would be advisable (or even required) to have an engineer design and supervise the installation of your foundation. There are probably structural engineers in your area (check your Yellow Pages) who specialize in designing for expansive soils.

OTHER DESIGNS
There are other footing/foundation designs which you may encounter, such as piles (beach house construction), or the All Weather Wood Foundation which may use a gravel foundation. You already know from the design stage if you are using one of these, and probably have a good idea of what is involved. Just be careful to make sure your sub is comfortable and experienced with the work he is to do.

Here are some more references on footings and foundations.

FOUNDATIONS
Whatever materials or methods you are using for your foundations, you will need to carefully check all dimensions and locations. Again, check your setback, side, and rear yard dimensions to make sure they meet zoning code requirements. Make sure the foundation is square (see p. 481).
GENERAL ON FOUNDATIONS

EXCAVATION
There will generally be some excavation involved with getting the site ready for foundations - especially if the footings had to go deep or if you will have a basement.

BACKFILLING
Once the foundation has been built, you’ll have to backfill around the outside to bring the soil back up the finish grade level. Don’t do this until you’ve completed installing footing drains (p. 485) and foundation waterproofing (later in this section).

FINISH FLOOR ELEVATION
An important element to check is the finish floor elevation, which is determined by the height of the foundation walls. This must be set at a height that will allow the finish grading to carry water away from the home. Also, if you are using a septic tank, you will need a certain amount of fall (slope) from the house to the tank to insure proper drainage from the home into the septic tank. Your plumber can give you this information once the tank is installed.

If you will have a wood floor system with a crawl space, the code requires 18" clearance between the ground and the bottom of floor joists
and 12" clearance between the girders and the ground (see sketch on p. 486). This has to be taken into consideration when setting the height of the foundation.

**MOST COMMON DESIGN**

99% of all foundation/floor systems (excluding slabs) will use a masonry or cast-in-place concrete foundation. If you are using some other system, e.g., piles, talk with your subs and inspectors to determine acceptable quality and structural integrity.

**SITTING ON THE FOOTINGS**

Make sure that the foundation walls, piers, etc. are sitting squarely on the footings and not hanging over the edge.

**VENTS AND ACCESS**

If you have a crawl space under the home, you will need to provide for ventilation and access. The amount of fresh air ventilation required is specified in your building code. It will be expressed in terms of the square footage of the crawl space and/or the linear footage of the

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*This poured concrete foundation wall (still in its metal forms) is sitting squarely on its footing.*

*This foundation was the wrong size. The framer had to let the house overhang the foundation in order for things to work out according to plans. Some patching will be necessary.*
foundation wall. Make sure your foundation walls are set up to accept some sort of foundation vents and access door.

**WATERPROOFING**
Waterproofing is required where you will have a living or storage space below grade - as with a basement. Get a specialist to do and guarantee the work. Waterproofing is usually accomplished by painting on an asphalt type material. With masonry construction, you may also have a membrane, like polyethylene, in conjunction with the paint-on material.

**MASONRY FOUNDATIONS**
If your home has a masonry foundation, here are some of the things you will need to look at when checking the job progress.

**PLUMB AND LEVEL**
Using a four or five foot level, check the walls to make sure the top surface (the one on which the floor system is to be built) is level, and that the walls themselves are plumb (straight up and down).
FACING
Some foundations are built of common (concrete) brick or concrete block and faced with architectural brick. If yours is of this type, check the color, texture, style, etc. of the face brick. Also make sure the mortar joint is the one you have selected. If you are using a concrete foundation, but plan a brick veneer, make sure the foundation wall is properly designed to support the framing and the veneer.

HEADERS AND TIES
If you have two “layers” to your foundation wall (block or common brick faced with architectural brick), the two must be tied together with in some fashion. This may be accomplished with header bricks that bond the two courses together or with metal wall ties. Look to make sure some form of bonding is being used. Also, some masonry patterns require joint reinforcing. This is done with a prefabricated wire product made specifically for that purpose. Get your masonry supplier to show you a sample and explain where it is required in your area.
**TOP COURSE**
Most codes require the top course of a masonry foundation wall to be a solid masonry unit or a hollow unit filled with concrete or mortar.

**PIERS**
If piers are required by your plan, check their location and dimensions. Talk with your framing sub to make sure piers are set at the proper level to support beams or girders.

![This house, built in a low spot, is supported entirely on piers](image)

**CONCRETE FOUNDATIONS**

**FORMS**
Concrete foundations will be poured into forms that are placed on top of the footings. Typically, these will be metal forms held together by a system of posts and pins. An inspection may be required before the concrete is poured. Again, check all locations and dimensions - before the pour.

**REINFORCING**
Steel reinforcing rods (re-bars) may be required to reinforce the concrete. If you are using a cast-in-place concrete foundation, ask beforehand what reinforcing will be required. Then check to make sure it is in place before the pour.

![See how this pier had to be shimmed at the top so that it would support the structure in a level manner.](image)
BEAM POC- KETS AND PIPE HOLES
Talk with your framing sub to see if any pockets are required to catch beams. Talk with your plumber to see where he may need holes for water, sewer, or gas lines. With some foundation systems, it may be easier to punch holes in after the wall has been poured.

TIE DOWN BOLTS
Some codes require that the flat 2x (called a sill), which sits on the foundation wall, be anchored to the foundation wall with bolts which are set in the mortar joints of the wall.

PORCH AND STEP TIE-IN
Sometimes porches and steps share a common footing with the home. When they don't, there should be some provision to tie them directly to the foundation.

The pictures on page 494 illustrate a couple of ways of doing this.
In one, some triangular supports are cast as part of the foundation. In the other, steel bars will tie the porch to the foundation wall when the porch is poured.

**A WORD ABOUT BASEMENTS**
Basement walls are foundations walls which are underground. Sometimes these walls need to be thicker than above ground walls, because they are supporting the inward pressure of the soil which has been backfilled around them. The zoning administrator and your architect know about this, and it should already be incorporated in your plans and specs.

If you'll have windows in your basement, remember to see that the proper opening is left in the foundation wall when it is built or formed.

**SLAB**
If your home is to have a wood floor instead of a slab, you can skip this section, and go on to *Framing* (Lesson 15).

**SLAB PLUMBING**
The supply and waste lines which pierce the slab are put in place before the slab is poured - in fact, before it is even set up to be poured. The most important thing to check here is the location of all pipes which the plumber has installed. You can do this by measuring from the foundation walls (if these are used) or the forming for the edge of the slab.
Here is a foundation with integral "haunches" (supports) for a porch.

This solution simply has some steel reinforcing rods poking out of the foundation wall. These will be imbedded in the porch when it is poured, thus tying the two together.

Here is what can happen when the porch is not tied to the foundation. See how the porch has settled and pulled away from the home? That thing on the right is an electrically controlled water meter.
This hole was cast into the foundation wall by including a cardboard tube in the forms. That's the main waste (sewer) pipe coming through the hole. Notice the foam insulation that has been sprayed around the pipe. There is a basement on the other side of the wall. The vertical pipe and cap is a clean-out for the sewer pipe.

A basement formed with concrete walls. Notice the window wells.
Precise positioning is important so that pipes to be located in walls actually end up in the walls, and toilets are properly located.

If a pipe ends up in the wrong place, after the slab has been poured, it may have to be jack-hammered out and relocated — a time-consuming and expensive process.

A wall drain is required for the washer. A floor drain is also required for the washer and the water heater if they are located in areas where damage to the home would occur in event of a leak. Check to make sure these are in place where they should be.
Copper water supply pipes will be under pressure once the water is turned on. To prevent the chance of leaks in inaccessible places, there should be no soldered joints in them either in or under the slab.

All pipes passing through the slab should be protected with a rubber sleeve to minimize abrasion and possible damage from natural vibrations and movement.

The plumbing inspector will check the installation before the slab is poured to make sure it meets the plumbing code.

**BACKFILLING THE SLAB**

Dirt will usually need to be added (backfilled) to bring the surface on which the slab will rest to within 4" of the top of the foundation wall.

Good clean soil (no debris or vegetation) is to be used. If more than a foot or so is needed, it should be com-
pacted with a mechanical tamper to prevent settling.

**SUPPORTING THE SLAB**
The slab will be supported at its edge by the foundation wall. In the middle it will rest directly on the ground. In cases where the filled area is especially deep (over three feet), additional support for the slab can be easily provided by digging down to undisturbed soil with a post hole digger every eight to ten feet on

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This foundation has been backfilled for a slab. It has been filled right up to the top. A wood form will be nailed around the outside so that the slab can be poured to rest directly on the wall. Notice the steel rebar which was put in the foundation wall, and has been bent over to go in the slab - tying the two together.
When the slab is poured, the concrete will flow down into these holes and provide additional support for the slab. Another method of providing additional support for the slab is to build some piers for it to rest on (see photo on page 497).

**SET UP**

Typical elements in the slab (from the ground up) include a 4" sand or gravel base, 4 mil polyethylene, and #10 wire, welded into a 6" x 6" mesh. There will also be (or should be) some form of insulation around the perimeter of the slab. This will probably be styrofoam.

Check the *depth of the sand* or gravel to make sure is four inches.

Get your pest control sub to treat the sand and soil under the slab for termites before laying the poly.

Edges of the *poly should overlap* at least six inches, with no places uncovered.

The *wire mesh* may be held up off the poly by some artificial means (rocks, pieces of wood, etc.) or, more typically, it will simply be lifted slightly by the concrete finishers as the concrete is being poured. Ideally, the wire mesh will be located about one third of the way up from the bottom of the slab.

Make sure that the *perimeter insulation* is properly sized and placed according to your plans and specifications.
CONCRETE
The concrete should be a 3000 psi mixture.

FINISH
The poured slab will be finished with a power trowel machine until it is smooth and flat. If the garage is poured at the same time, it should slope towards the door so that water will drain out.

Concrete is leveled with "floats" and finished (smoothed) with trowels. Hand floats have a long handle which allows the worker to reach way out to the middle without walking on the fresh concrete. This worker is using a power trowel.
The slab should also drain towards floor drains for the washer and water heater. Otherwise, it should be level. This can be checked with a tightly stretched string.

**STRUCTURAL SLABS**

These are slabs which have tensioned steel. The tensioning may be applied before (prestressed) or after (post-tensioned) the slab is poured. The steel gives added strength, and allows a combination footing and slab to be formed in one pour. This type of construction is also desirable or even required in areas with poor bearing capacities, e.g. sand.

We recommend that this type of construction be designed, inspected, and certified by a qualified engineer. That means your engineer, or his representative, should inspect the slab setup just prior to actually pouring the concrete. In the case of a post-tensioned slab, he should also supervise that process after the slab is poured.

**Summary**

In this lesson we have looked at *Site Preparation, Utilities, Footings, Foundations,* and the *Slab.* We basically took each area in turn and examined the things you need to check on when you visit the site. With the footings, we paid particular attention to the location. With each subject we moved through the construction looking for areas which require your special attention.

**Looking Forward**

In Lesson Fifteen we’ll move on in our examination of the superintending of the construction. We’ll be looking at the Framing, the Roof, and Masonry Construction - including masonry walls and fireplace/chimney construction.