

Keeping Dry

By Larry Janesky

A series on residential basement waterproofing

part I

Photos by Larry Janesky

Most builders say "I don't have a problem with leaky basements." The reality is that a survey of 33,000 new homeowners revealed 44 percent have leaky basements. Sixty percent of existing homes have wet basements at some time, and 88 percent of builders said they have wet basement calls. I used to be a builder myself, and it's understandable that no one wants to admit they build problem homes.

There is no tolerance for wet basements at all. A gallon of water is as intolerable as 6" of water. The fact is, there are some easy ways a builder can meet or exceed even the strictest of codes, and keep his basements dry for decades. These techniques are outlined here. Some of the material relates to the building code, and some are not addressed by the code but are highly recommended by the author.

There are three parts to keeping basements dry.

- 1) Site planning
- 2) Drainage
- 3) Waterproofing

Part I of the series will cover site planning, exterior footing drains and sump pumps.



Site Planning

First, you need to be sure that your house is not below the water table. If you dig a hole as deep as your foundation, and it fills with water from the ground, it would be a good idea to build a house that is only partially below grade, so that the footings are not below the water table. It is unusual for the water table to be a problem, but not unusual to have wet basement problems. This happens because most wet basement problems are caused by temporary backfill saturation from rain, not from high groundwater tables.

Code says that finish grade should be pitched away from the house 6 inches over 10 feet away. I recommend double those requirements— 12" over 10 feet because settling will occur over the years, and the soil will wind up being pitched toward the house. It takes 15 to 20 years for clay to reconsolidate, and five to seven years for silty soils.

It is important not to put a foundation too far into the ground. You want at least 12" of foundation sticking up from the ground even after pitching the finish grade away. This keeps siding dry, and prevents slush and saturated mulch, etc., from causing water to flow over the foundation walls. It also is more difficult for termites to attack the structure undetected. Too much foundation showing is ugly, so plan carefully.

In the case of a stepped foundation down a slope, proper planning and grading will keep soil away from the siding at the steps. Consider small retaining walls if the slope encroaches on the siding at the steps.

After constructing foundation walls, carefully determine where grade will be so that the foundation coating can be sprayed to grade. Spraying above grade is unsightly, and backfilling above the coating will cause wall cracks to leak from wet soil against them.

It is important to take note of the soil your home will sit in. Free draining soils, i.e., soils with less than 12 percent clay or silts, will help prevent many problems but not all. In some cases, there could be a layer of sand on top of a layer of clay far-

ther down. The sand drains freely, but when the water pools on top of the impermeable layer, if there is no where for it to drain, a flooded basement could result. Hence, footing drains are still important even in sandy or free draining soils.

The building code does not require footing drains in free draining soils, but the thought of not having them in any conditions is unsettling.

If the soil is silty, or clayey, which most are, then extra care should be taken in site planning, drainage and waterproofing. If the soil is clay, a porous backfill should be used, covered with a clay cap, pitched away from the foundation.



Pump with ultrasump battery back up pumping system

The site must be considered for drainage. Where will the footing drains go? Daylight is best. Is there enough pitch to run a pipe from the foundation at 1/4 inches per foot to daylight it? Downspouts should be piped underground away to daylight. These pipes need only be 2 feet down. Where will these daylight to, considering they must be pitched?

Is there a driveway that must slope to the house? If so, how will you create a swale in the driveway away from the garage to drain this water? Is a trench drain necessary in the driveway or in front of the garage doors, and where will it drain to? It is not recommended that driveways be drained to a sump pump because of clogging challenges and volume limitations.

Are there any ponds, rivers or streams on the property? If so, it is important to find out the high mark for these in the wettest times of the year. Draining a footing drain to a stream bank, only to find the stream rises well above the pipe at times can lead to a disaster.

Do not plan on using any drywells. Drywells do not work, since they have a finite capacity which is almost sure to be

exceeded at some time.

Remember that about once every seven years we can get a 7-inch rain in one day. Is it acceptable to get water in your basements only then? Most homeowners would say not. So your site/drainage/waterproofing plan must work in the worst of conditions, not just average rainfalls.

Drainage: exterior footing drains

Code says that all concrete or masonry foundations enclosing habitable or usable spaces located below grade shall have a drainage system. The system has to be installed below the area to be protected and discharged by gravity or mechanical means. There are few specifications besides the following — You can use drainage tile (which nobody does anymore), perforated pipe, or gravel or crushed stone. (I take that to mean no pipe at all). If the drain system is gravel or crushed stone, they must extend one foot beyond the outside of the footing and 6 inches above the top of the footing, and be covered with an approved filter material. If a pipe system is used, it should be set on top of a minimum of 2 inches of gravel or crushed stone and the size of the stone shall be larger than the holes in the pipe.

While this all makes sense, workmanship is a big factor that will determine if the system is effective or not. Many times black coiled slotted pipe is used. This pipe is very difficult to keep straight, and all the dips in the pipe cause poor flow and clogging. For this reason, I recommend rigid PVC pipe. There are two rows of holes in this pipe, and they are to be installed downward, at four and eight o'clock positions. This is so silt and sediment washing downward with the water do not wash into the pipe.

Many times you see a job site where the sidewalls of the excavation have fallen in, washed in or been trampled in by workers, so the soil is up to the top of the footing. To get the soil out, it needs to be hand dug in most cases. Too often it is not dug out enough or the pipe is lifted over that section, causing poor drainage and clogging.

In many cases, the footing-drain installation is looked at as something that is a no-brainer, grunt laborer task, and not much attention is paid to it by any skilled eyes and heads. It's no wonder we have failures.

I would start out with an exterior footing drain with the excavation cleaned to the bottom of the footing. Then take a 6-foot-wide roll of filter fabric and roll out the lower edge onto the soil against the footing, leaving the rest laying on the ground away from the foundation and up the sidewalls of the excavation. Then place 3 inches of stone down on top of the fabric and level off by hand. Then set the 4-inch rigid perforated PVC pipe so that it is level at worst around the entire foundation. At best, a few inches of pitch to the outlet is all you can get because you don't have a lot of elevation to work with.

Then backfill with 3/4-inch stone over the top of the pipe to an elevation of 8 inches above the top of the footing. A rule of thumb is that one yard of aggregate will do 12 feet of exterior footing drain. Therefore, a 150-foot house will require 12.5 yards plus waste from ineffective placement. Then pull the filter fabric up over the top of the stone and against the wall, using shovels of sand or stones to hold it in place. If the fabric is not long enough to reach the wall, add another course.

Vertical risers of solid 4-inch pipe should be run up from the footing drains to each window well location, and a grate installed on the end of the pipe. These window well drains should terminate 4 inches below the window sill. The areaway around the window should extend below this level, so that the well can be filled with stone aggregate covering the grate so leaves do not block the drain grate.

The filter fabric is just that, a filter. Over time it will clog. So to prevent this from happening, I would put 6 inches of coarse sand on top of the filter fabric. This progression of materials will keep the drain clear longer than any other practical way I know. The fabric wrapped all the way around keeps the drain rock and pipe

clean. The sand keeps the fabric clean, and the soil will not wash into the sand because the voids in the sand are not large enough.

Exterior footing drains should always be run to daylight if that is possible. Care should be taken that there are no areas that could become blocked, and that the pipe is pitched 1/4 inch per foot, or more if possible. If the footing drain around the foundation is very long, such as over 200 feet, then added measures to drain it would be a good idea. For example, you could put two outlets to daylight at different locations if possible, or you could use a 6-inch pipe to daylight.

Sump Pumps

Even if the exterior footing drain drains to daylight, a sump liner and removable airtight lid should be installed in every new home. This way if there ever were a problem with the drainage system, a pump could be installed in minutes with very little trouble. Without a sump liner, there is jackhammering and excavating that needs to be done in the occupied home to fix the problem afterwards to install a sump as part of the solution anyway. If it is never needed, no harm is done with a flush airtight lid installed.

If the exterior footing drain cannot run to daylight, then you have to drain it to a sump on the interior of the basement. You can cast a 5- or 6-inch sleeve through the footing so a 4-inch pipe can easily slide through it, and a tee fitting can be used properly. I recommend only one such pipe through the footing at the sump location so that this pipe can run direct through the sidewall of the sump liner. By installing more than one pipe through the footing to drain exterior footing drain water to a single sump, you are using the subfloor area as a drain for the exterior footing drain water, which is almost never a good idea.

The pump installed should be able to pump 1/2-inch solids so it is unaffected by some silt. It should have a check valve and rigid 1 1/2-inch discharge line to the exte-

rior. Once this pipe has left the building, it should be converted to 3 or 4-inch pipe and run horizontally to its exit. This could be a swale, wooded area, ditch, storm sewer, etc. By increasing the diameter of the pipe, you significantly reduce the chances of it clogging or freezing, and remove the burden of the pump pushing the water from that point on, provided, of course, the pipe is pitched outside. There are special fittings called "IceGuard" that will automatically eject the water onto the surface if the pipe freezes and the pump runs.

The sump should have an airtight lid as we have mentioned to prevent moisture from the sump from evaporating into the basement environment for the life of the home. It also keeps out insects, odors and radon gas, and prevents objects from falling in. As a safety feature, it keeps children from falling into the sump hole.

A sump should have at least two more features:

- First, an alarm system to alert the homeowner to pump failure for any reason before the floor gets wet. By relying on a sump pump to keep a basement dry, it is only a matter of time before the homeowner is flooded. I am not suggesting that sump pumps are not a practical option. They solve major drainage issues and can save considerable expense. However, they should be backed up by an alarm at the very minimum, and an automatic battery back-up pump system or a generator at best.

- Second, an airtight floor drain in the airtight sump lid. This seemingly small feature is important because basements can become flooded from other sources such as plumbing leaks, water heaters, dishwashers, washing machine hoses, etc. A floor drain in the sump lid will at least give the water a place to go.

Larry Janesky is president of Basement Systems Inc. in Seymour, Conn. He holds 11 patents on basement waterproofing products.

Keeping Dry

part 2

A series on residential basement waterproofing

By Larry Janesky | Photos by Larry Janesky

Part 1 of the 100-part series covered site planning and aspects of drainage such as exterior drains and sump pumps. Part 2 continues discussion of drainage — draining gutter water, backfilling, hybrid interior drainage systems and dirt crawl spaces — and waterproofing.

Draining Gutter Water

Another component of the drainage system for a structure is to pipe the gutter downspouts away from the foundation. This can be accomplished with 4-inch PVC pipe buried to a suitable discharge location. The pipe should be pitched as much as possible to create a self-flushing condition where possible. Remember that leaves and other debris will likely be washing down the downspouts despite the best efforts to avoid it. Therefore, using 45-degree bends or long sweep 90-degree bends is better than short 90-degree bends. Further, a large volume of water can be expected in times of heavy rain. Using six-inch pipe is not unreasonable, as it will carry much more water and resist clogging. Never connect downspout water into footing drains no matter how far down the line you are considering it. Bring both to separate daylight outlets.

I would add that aluminum leader pipes that take the water from the gutter to the ground be “oversized” at 3 inches by 4 inches, instead of the normal 2 inches by 3 inches. These larger ones will take twice as much water and resist clogging much better than the little ones. Further, when you have a long gutter, put two outlets on it. Standing outside in a heavy rain (which nobody ever does) will convince anyone of the value of larger downspouts and more of them.

Further, gutters should have some form of screening to prevent leaves from blocking them. There are many great products unlike screening which will accomplish this.

Backfilling

Code says that you must backfill and compact in 6- to 8-inch lifts. In all my years of being around job sites, I can't remember ever seeing this done. Therefore, there is lots of room for the settling of loose soils, which inhale vast quantities of water.

Floor Base

The code currently requires a minimum of 4 inches of porous fill under the floors of wood foundations. I think it should be required on all foundations. This layer will drain into a sump if and as necessary, because the sump liner is perforated. I also believe a vapor barrier should be installed under every floor to isolate the home from the ground forever. Without it, water vapor will travel through the floor and into the house enve-

SuperSump

lope forever.

Some concrete contractors will complain because the water from the concrete comes to the surface making it harder to finish. If they stuck to a 4- to 5-inch slump and did not add any water, this would be less of a problem. As an alternative, the vapor barrier could be laid down before the stone aggregate, which would give the water some place to go when pouring the floor. I recommend a 4-mil, cross-laminated, high density polyethylene. It resists puncturing very well. If you don't have this material handy, then 6-mil polyethylene will suffice. Low slump concrete is also important on poured walls to prevent excessive cracking.



The less slump to the concrete, the less shrinkage cracking and higher compressive strength. The aggregate bed under the floor provides a good base and drainage under the slab. A vapor barrier is beneath the aggregate.

Hybrid Interior Drainage Systems

The code does not call for interior footing drains. This supports the position that wet basements are not caused by rising water tables, but rather saturated backfills. Interior footing drains are used for the most part in retrofit applications for an existing basement that is wet. There are systems designed today such as Basement Systems' CactusBoard system, that will ensure the basement floor does not get wet no matter what happens to the walls or exterior footing drains. To accomplish this, these systems need a way for wall seepage to get into them without getting on the floor.

Instead of waiting for a problem to arise, it is very simple to install a system like CactusBoard before the floor is being poured. This way the homeowner will have a 20-year warranty that the floor will be dry from day one. CactusBoard is a dimpled, L-shaped drainage molding that is laid on top of the footing before the floor is poured. It is 4 1/2 inches high and 6 inches wide, and creates a space between the floor and wall and across the top of the footing to drain water from the walls and footing/wall joint, to the aggregate under the floor. This space is important because even with a waterproof coating, wall cracks can leak above the coating. Nobody plans the wall to leak, but it happens time and time again. With an interior system

like CactusBoard in place, no matter what happens (exterior footing drain failure, wall leakage, footing-wall joint leakage) the basement will be dry.

Dirt Crawl Spaces

With regard to dirt crawl spaces, the code says you need 1 square foot of ventilation for every 150 square feet of dirt floor area. As a homeowner, I wouldn't want that much cold air blowing under my castle. Fortunately, the code allows for 1/10 that much ventilation if you have a vapor barrier down on the dirt. My question is, for the cost of the vapor barrier, and the cost of the energy penalty and cold floors, why would you ever do it any other way?

Waterproofing

Coatings applied to the outside of foundation walls fall into two categories — dampproofing and waterproofing. Dampproofing is an inexpensive asphalt coating that is simply a porosity reducer. It has no ability to bridge cracks, and emulsifies in water. The code does not say what to dampproof with and how thick it should be. Dampproofing is ineffective at stopping water, especially over long periods of time. Nevertheless, dampproofing is all a builder needs by code unless the home is being built in "areas where a high water table or other severe soil-water condition is known to exist," which then requires waterproofing.

Waterproofing is much different. A waterproof coating has rubber-like qualities which allow it to stretch and bridge wall cracks and other defects. It is thicker than dampproofing, going on at 60-mils dry thickness in most cases. Waterproof coatings can be asphalt mixed with rubber, or all rubber coatings. They usually have to be heated up to be sprayed on, and are much more expensive than dampproofing. A damp-proof coating costs about 30 cents per square foot, where a waterproof coating will cost about \$1.25 per square foot including a protection board stuck to the coating to protect it from backfill damage. The extra cost is well worth it.

The new International Code says that "in areas where a



This plastic form creates a drainage space for unplanned wall seepage.

high water table or other severe soil water condition is known to exist" you need waterproofing, not dampproofing. The interpretation I got was unless the basement is in free draining soils, it must be waterproofed, even if it is only unfinished space. I can picture arguments over what constitutes free draining soils. Based on the code, it would seem to me that a soils engineer would have to come in and deter-



One type of high quality waterproofing is a gray, all rubber membrane. Others are black asphalt with rubber polymers added to give them flexibility.

mine the exact type of soil according to the unified soil classification system. Further, what exactly is a "severe soil water condition" anyway? If the builder digs a hole in dry clay, does that mean it's a severe soil water condition? I was told yes, and I agree.

The house is going to be there a long time, and during this time, it will be subject to many heavy rains. Remember our zero tolerance for water in the basement. We know that dampproofing will not protect a home under hydrostatic pressure. So now all we need to do is figure out which homes are subject to hydrostatic pressure and which are not. This is pretty tricky stuff considering we need to know this before the house is built. Nevertheless, the answer is all houses are because when you get a cloudburst dumping several inches of water an hour, coming off the roof so fast it piles over the gutters, the soil is temporarily under a hydrostatic pressure condition until it does drain. Therefore, waterproofing is the way to go. Some states or localities elsewhere already require

waterproofing exclusively.

These days, most foundations are poured concrete. Water cannot leak through a 10-inch thick section of poured concrete. It does leak in through joints, cracks, form ties and other imperfections. Thus we are coating 100 percent of the below grade area to prevent 1 percent from leaking. This 1 percent, however, is susceptible to moving, expanding and widening. Therefore, the material we use to coat it must be up to the challenge of bridging these pathways for water without failing. Waterproofing will do this.

There are some things to know about waterproofing. First there are different qualities of materials that are considered waterproofing. Asphalt is cheaper than rubber. If there is more rubber in a product, it will perform better and cost more. Some waterproof coatings are rubber mixed with asphalt, and therefore are black. It is difficult to tell just what grade of product you are getting with a black waterproof coating, as some are better than others. There also are all-rubber polymers that have no asphalt and can be gray or green in color.

In waterproofing, the materials make up more than half of the costs. Therefore, an unscrupulous contractor could spray the material on thinner than specified to save money. In dampproofing these tricks are done all the time, cutting the material with diesel fuel, leftover paint, and just about anything that is cheap. If the wall is black, it passes inspection.

Special care should be taken that the joint between the footing and wall is sealed. This means the top of the footing has to be clean before the wall is sprayed. Form ties should be knocked off both inside and out before spraying takes place.

Special care should be taken as well to determine finish-grade height so the coating can be sprayed to it. In many cases, this elevation is miscalculated, and the backfill winds up against 6 inches or more of untreated wall, which no doubt causes leaks when the inevitable shrinkage cracks appear and continue to get bigger over three years.

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