WET BASEMENT AND CRAWL SPACE PROBLEMS, CAUSES, AND REMEDIES --TIPS FOR HOMEOWNERS, AND HOME BUYERS

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The primary purpose of this booklet is to inform the homeowner, home buyer, and home builder about the cause of wet basements and crawl spaces plus effective measures for preventing or correcting problems. This information will enable the public to build, select, or repair homes wisely. The booklet is also intended to provide a common basis for communication among the homeowner or buyer, realtor, builder/contractor, inspector/regulator, insurer, mortgager, and attorney.

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WET BASEMENTS OR CRAWL SPACES--SOURCES OF IMMEDIATE AND LONG-TERM PROBLEMS.

Standing water inside and/or seepage into residential crawl spaces and basements can cause frustrating problems for the homeowner. These problems can be both immediate and long term. For example, standing water and mud inside crawl spaces make it very difficult and messy to gain access under the house for inspecting, maintaining, and servicing electrical circuits, drains and water lines, heating and air conditioning, and other utilities. Wet basements and crawl spaces are sources of high humidity, which can produce surface condensation, mildew and fungi, musty odors, and an unhealthful environment. Such moisture can cause deterioration of floor joists, beams, subflooring, insulation, and electrical-mechanical systems. Prolonged water around the footer and foundation wall can soften the soil and weaken its bearing capacity, increasing the possibility of wall settlement and cracking. Serious seepage under the foundation footer may erode soil away and cause the wall to drop or crack. Excessive moisture can eventually penetrate the subflooring and buckle the flooring or cause warping, making doors and cabinets difficult to close or open. Since crawl space or basement dampness always moves toward the drier upstairs areas, higher humidity will result in costlier heating and air conditioning bills. In the case of crawl spaces, if the underflooring insulation collects moisture, or sags from excessive wetness, the heating and air conditioning costs are driven even higher. Finally, wet basements and crawl spaces reduce the value of the house--at least by the amount that would be required to repair the damage and to eliminate the cause of the problem. Some homeowners are reluctant to discuss or admit their water problem, for fear that the publicity of an actual or even a perceived problem would reduce the value of their investment. Homeowners, in such situations, should immediately seek professional assistance in assessing the source and extent of the problem and in finding a remedy.

CAUSE OF WET BASEMENTS AND CRAWL SPACES

Most wet basements or crawl spaces are caused by surface water which is not adequately drained away from the foundation wall. Sources of this water include the following:

- Roof water if no guttering is present
- Roof water if the guttering leaks or overflows because of clogging from leaves and bird nests
- Roof water if the downspouts (leaders) are clogged or do not have sufficient means at their outlets to drain water away from the foundation wall. Frequently, a downspout ends at the corner of the house without a splash pad (splash block) or elbow (shoe), leaving roof water to concentrate at that point and seep into the soil next to the foundation wall. A typical 2000 square foot roof can produce almost 1250 gallons of water during just 1 inch of rainfall. If the rainfall is steady and prolonged, the opportunity for this roof water to soak into the ground next to the foundation wall is high.
- Excessive watering of flower beds and shrubbery around the foundation wall. Once the upper soil layer or mulch bed air spaces are filled with water, the excess water either runs off or seeps into the ground next to the wall. Prolonged and excessive watering can contribute a large amount of water to crawl spaces or basements.
- Rainwater runoff from the adjacent lawn, walks, or driveway areas if the landscaping forces water to drain toward the house instead of away. If surface runoff is directed toward the foundation wall, this water will pond and eventually soak into the soil, thus becoming a potential source of basement or crawl space water. Downspout splash pads are not very effective if they drain onto a backward-draining slope toward the foundation wall.

Water or dampness problems in basements or crawl spaces are sometimes caused by other factors:

- Subsurface or groundwater may be intercepted or dammed up by a basement or foundation wall. Houses which are built downslope on or at the base of hillsides are particularly vulnerable since there is greater opportunity for surface water to soak into the soil to become groundwater and because groundwater flows downhill by gravity. Foundation walls act like dams and can intercept and trap this subsurface water, causing pressure build-up on the outside and forcing water through joints and cracks in basement walls or seepage under the footer.

- Nearby springs may have been filled in or covered up by the developer. Unless the springs were properly drained away from the lot or subdivision, such water will eventually seep into the surrounding fill, become a pool of groundwater, and eventually force itself laterally and upwardly into basements and crawl spaces.

- Nearby creek(s) may overflow during storm runoff and either directly flood basement or crawl space areas, or contribute to the groundwater, which may become sufficiently high to cause seepage into the basement or crawl space area. Homeowners may not experience the effects of groundwater seepage or overflowing creeks for months or years after purchasing a house because of drought or infrequent out-of-bank flooding. However, when such conditions do occur, they may come suddenly without warning and cause serious problems after the warranty period has expired.

- Improperly installed, clogged, collapsed, or leaky drains may not allow downspout water or foundation wall water to escape. Perimeter, footer, or foundation drains are installed around the exterior of a house below the basement floor to intercept and dispose of subsurface water to eliminate groundwater build-up and seepage under the house. If these drains are improperly installed or become clogged with silt or roots, they will not operate as intended. Sometimes an otherwise good perimeter drain gets covered up at its end(s) during the final backfilling or landscaping stages of construction and the intercepted water has no place to go but to build up behind the foundation wall and eventually to seep into the basement or crawl space.

- Underground drains leading away from downspouts may not have sufficient slope to carry water away; may empty into the adjacent lawn and get covered with topsoil; may become crushed during landscaping or become pinched at their outlets; or may lead to an area which ponds and backs up water. The end result in all these cases is leakage or overflowing at the bottom of the downspout and water penetrating the foundation area.

- Soil continuously draws water up from subsurface groundwater sources in a crawl space like a blotter by a mechanism known as capillary attraction. The finer the soil (e.g. clays), the more aggressive the capillary pumping action. As the water rises to the surface, it evaporates into the crawl space. Such ground moisture can be a significant source of dampness and humidity under a house, even without standing water. The presence of capillary water is often indicated by a whitish residue, left on the ground surface of the crawl spaces, resulting from evaporation of water containing minerals and salts. Lack of a moisture barrier, such as plastic sheet, will allow this capillary action and evaporation to contribute almost unlimited moisture sources to crawl space areas. Figure 1 illustrates how surface water and moisture can enter a crawl space area.

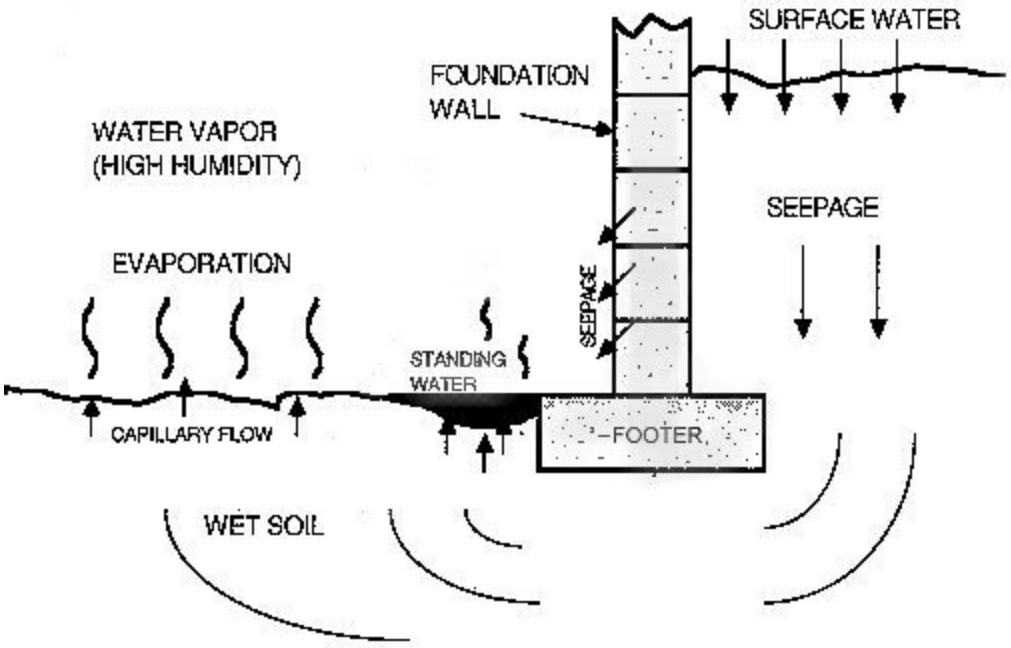

Figure 1. Typical paths of water and moisture into a crawl space area.

- Closed, inadequate, ineffective, or no crawl space venting around foundation walls will force the buildup of humidity in the space beneath a house. Given the combination of high humidity and low temperature, condensation can form on heating/AC ducts, joists, underflooring, and insulation. This environment, together with likely darkness, encourages mildew and other fungi to form.

- Damp or wet basements and crawl spaces may be caused by ruptured water or sanitary lines either just outside the wall or under the house. If a crawl space is unusually wet and muddy, inside leaks may be difficult to find and repair. Outside pipe leaks may be even more difficult to find, since water may appear several feet away from the actual leak. Old field drains under a house may also be a source of unwanted water.

EXAMPLES, EFFECTS, AND CAUSES OF CRAWL SPACE AND BASEMENT WATER INTRUSIONS

Figure 1. Outside seepage water entering crawlspace area from under foundation wall.

Figure 2. Roof downspout leader pulled away from drain pipe, causing roof water to fall, collect and soak into the foundation soil and weaken the footer's ability to support the foundation wall.

Figure 3. Classic example of mildew formed on heating & A/C ducts (brownish-gray areas) due to high humidity and poor ventilation. Note insulation falling away from underflooring area because of high
moisture content.

Figure 4. Roof water is improperly directed from roof downspout leader toward foundation wall.

Figure 5. Temporary use of corrugated plastic drainage pipe carry roof water away from foundation wall to several downspout leaders.

PREVENTING AND REMEDYING WET BASEMENTS AND CRAWL SPACES

- Most new home construction complaints arise from inadequate site drainage and "water problems." Proper drainage of surface water is a primary element in preventing wet basements, damp crawl spaces, eroded banks, muddy yards, and possible failure of a foundation system.

The Council of American Building Officials (CABO) code for 1 and 2 family dwellings requires that "Lots shall be provided with adequate drainage and shall be graded so as to drain surface after away from foundation walls" R-301.3). Many local governments have adopted this code or similar building codes such as the Standard Building Code (Southern Building Code Congress International, Inc.--SBCCI); Basic/National Building Code (Building Officials and Code Administrators--BOCA); and Uniform Building Code (International Conference of Building Officials--ICBO) as a standard for permitting and inspecting new home construction or for alteration of existing homes.

The Federal Housing Administration (FHA) of the Housing and Urban Development (HUD) Agency generally relies on the code adopted by local ordinance. In case there is no code, FHA/HUD uses the CABO code for new construction.

Generally, surface water drainage should be directed from all sides of the house and off the lot in a manner that will

- Minimize possibility of dampness in basements and crawl spaces
- Prevent standing or ponding water on the site
- Prevent soil erosion
- Adversely affect the supporting foundation soil behavior.

Walks, driveways, retaining walls and other landscape improvements should be constructed so as not to interfere with drainage. Walks should not be used as drainage channels.

Site grading plans should specify minimum slopes from the house (usually 2 to 5%), depending on location, type of soils, frost depth, and soil moisture, to ensure water drainage for some specified distance (usually 6 to 25 feet) away from supporting foundations. In cases where minimum slopes or distances cannot be attained, paved gutters or other drainage structures acceptable to the Building Inspector may need to be installed.

Maximum slopes are usually specified to prevent erosion or unstable banks around the house and yard.

Roof water should be directed to a downspout and away from the foundation wall toward a suitable ditch, swale, or drainage pipe to prevent ponding or backflow as shown in Figure 2. All drainage structures should be properly connected to adequate outlets that are protected, where necessary, by recorded permanent easement.

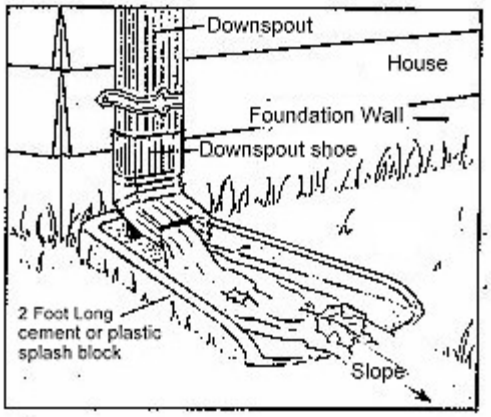

Figure 2. Correct installation of downspout shoe and splash block at foundation wall. Note that ground surface slopes away from house.

House plans and landscaping should be developed to prevent "dead" drainage areas around the foundation wall--areas where rainfall has no place to flow away except by ponding and soaking into the soil near the foundation wall. Areas bounded by the front entrance/sidewalk/garage/driveway are especially vulnerable to trapped pockets of surface water.

Adjacent creeks, drainage swales, rivers, and lakes should be checked for historic or calculated flood hazard levels. Usually, first-floor or habitable space floor elevations are required to be above the level of a 100-year return frequency flood; however, more frequent flooding may be allowed in crawl spaces and certain basements.

- Another vital step in preventing water in basements and crawl spaces is to intercept outside subsurface or groundwater with a perimeter drain at the footer base level around all sides of the house where the exterior ground surface is higher than the inside floor or crawl space level. While foundation drains are clearly necessary for houses with basements or potentially habitable living space below exterior ground surface, they may also be necessary in crawl spaces where water, soil, and/or earth floor elevation conditions warrant their use. The drains should always be installed at or below the level of the area that is to be protected (i.e. basement floor or crawl space ground surface) and should discharge by gravity to a positive outfall such as an approved drainage ditch or swale, or into a storm system. In some cases, sump pits and pumping may be required.

- Another means of preventing subsurface moisture penetration and dampness in a basement or crawl space is the use of waterproofing of foundation walls of below-grade habitable rooms and damp-proofing of basements and other foundation walls, where necessary, to protect crawl spaces. Specifications for water proofing and damp-proofing foundation walls can be found in adopted local building codes.

- Excessive moisture may be prevented form entering a basement from the walls by the use of a vapor barrier installed on the warm side (in winter) of the insulated walls. Building codes usually specify the material(s), maximum vapor transmission rate, venting, etc., appropriate for construction.

- Excessive moisture vapor can be prevented from entering a crawl space area with the use of an effective and correctly installed vapor barrier over the ground surface. Approved types of polyethylene or asphalt saturated felt materials, thickness, and joint/seam construction are specified in local building codes. Torn pieces, poor or non-overlapping joints, missing sections, or improperly sealed corners and edges at the walls, fireplaces, and interior piers must be avoided to produce an effective vapor barrier.

- Necessary in crawl space areas under houses without basements is the installation of adequate wall ventilation openings around the foundation walls. The purpose of these openings is to provide cross ventilation for preventing and relieving the buildup of water vapor inside the crawl space. Most building codes specify minimum vent opening areas (usually about 1 square foot of net opening for each 150 square feet of crawl space), opening location or arrangement, corrosion-resistant wire mesh screen, and any reduction in ventilation opening area allowance if an approved vapor barrier is used.

- In case water does get inside a crawl space, it must be able to drain out. The crawl space ground surface should slope or drain to a common low point, where water can drain by gravity through the foundation wall or under the footer to an outside drainage ditch or swale. Outside surface water should not be allowed to back up into the crawl space through this drain.

In older houses where any of the above defensive or primary moisture and water control methods are missing, measures should be taken to install appropriate drainage facilities, vapor barriers, or ventilation openings. Installing any of these elements after a house has been built will be more costly than while the house is constructed.

In some cases it may be necessary to use secondary measures to alleviate a wet basement or crawl space problem--either along with the above measures or alone, depending on the situation. Additional measures include the following:

  - Installing trenches or gravel/perforated pipe French drains around the inside perimeter of the foundation wall and from other central low areas of the crawl space to intercept water which manages to enter under the house. This drain system should converge at a common low point in the crawl space and be piped under the footer or through the foundation wall, as appropriate, to a ditch or swale outside, where water can freely drain away without backing up or allowing outside water to enter.

  - In cases where basements collect seepage of surface water, either (1) a basement floor drain should be installed at the low point(s) and piped outside to a convenient ditch or swale, or (2) a sump pit or collection chamber should be dug below the basement floor, lined, and a sump pump installed to remove the collected water to a convenient location away from the foundation wall. The sump pump can be actuated automatically by a float system or be manually operated as needed. A sump system could also be installed in a crawl space if gravity drainage is impractical.

  - In case the yard area slopes toward the house and surface water collects or ponds near the foundation wall, a V-ditch or swale should be constructed around the house to allow surface drainage from both the foundation wall and the other yard areas to an adequate ditch or storm drain. Such cases often exist where the front street is higher than the first floor of the house or when the house is built on the side of a hill. Figure 3 illustrates how this problem can be solved.

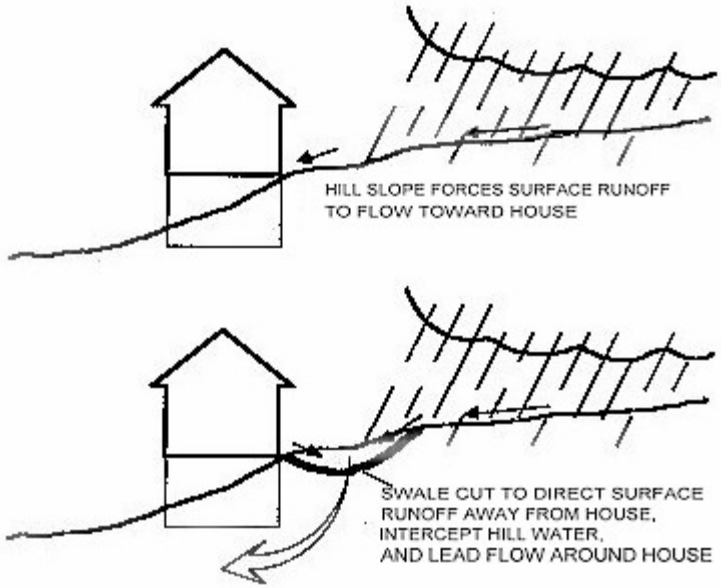

Figure 3. Correction of reversed slope drainage problem using swale or ditch

- If flower bed and shrubbery watering around the foundation wall is producing a significant source of water for the basement or crawl space, and the flower bed or shrubbery cannot be relocated, consider the installation of heavy plastic sheet under the flower bed so that any water which soaks deeply into the soil is intercepted and carried safely away by gravity at least six to eight feet from the house to a gravel collection drain or swale.

TIPS FOR HOME BUYERS, HOMEOWNERS, AND HOME BUILDERS

"A teaspoon of prevention is worth a gallon of cure" certainly applies to new home builders--at least in avoiding water problems in basements or crawl spaces. Buyers of new or older homes should be cautious about drainage. The best time to sign a contract is on a rainy day!

New home buying/building tips

The following tips are suggested to avoid water problems when building or buying a newly-built home:

- Work with an engineer or architect, to help you locate the new house on the lot and at an elevation which would minimize potential surface or groundwater drainage problems and save drainage costs.

- If a flowing stream or dry ditch borders your lot, check with local planning agency authorities or a hydrologic engineer for potential flooding, whether in a designated 100-year flood hazard zone or in an area where lesser but more frequent flooding could occur or has occurred.

- Work with a reputable home builder who can give you reference names or locations for houses that he has built. If the house you are looking at is already built, find out who constructed it and ask your realtor for references to homes built by the same builder. Visit these sites and check for patterns of any drainage problems.

- Assume that the local building inspector will not check new home construction for landscaping or site drainage. This matter is usually left up to the builder and buyer to resolve. However, if you don’t feel competent to make your own inspection, hire an engineer or architect to help you check slopes, foundation wall water proofing/damp-proofing, underground drains, general surface and roof water

drainage, and general quality of construction. If you suspect a potential problem, ask the local building inspector for advice.

- Check to make sure that the perimeter foundation drain, basement drain(s), or crawl space drain has an unobstructed outlet to a ditch or swale which leads away from the house.

- If you are considering the purchase of a newly built house, pay special attention around the outside and the basement or crawl space for

    - backsloping lawns and landscaping toward foundation walls.

    - backsloping driveways (toward garage), stoops, walks or patios which force surface water toward the foundation wall. If necessary, use a level to check the slope direction.

    - a very flat lot with little opportunity for drainage away from the house and lot.

    - standing water inside crawl space--check next to foundation walls.

    - pattern of wet concrete blocks on inside basement walls below grade; check for whitish salt deposits on inside foundation walls as a result of leaching from moisture seepage and evaporation.

    - potential or observed surface drainage from the street or from neighbor's roof toward your foundation wall or garage.

    - downspouts which drain to the foundation wall, where water has no place to escape away from the house.

    - depressions around the foundation that can collect surface water and cause seepage into the ground.

- If you have specific questions about construction or drainage matters, refer to applicable building codes and inspection/permit requirements; local stormwater ordinances; local subdivision and zoning ordinances; and local flood damage protection ordinances and maps required by the National Flood Insurance Administration (NFIA). These sources are available at your local planning office, building inspector's office, or library.

- Above all, don't be timid about asking the realtor or builder questions. Document your questions or concerns in writing.

Older home buying tips

The following recommendations are made to the prospective older home purchaser:

- Visit the house during or shortly after a prolonged or heavy storm. Check for water in the basement or crawl space. Ask the realtor about any known water problems--inside or outside--by the previous owner.

- Check with the neighbors to see if the house that you are looking at has had a history of drainage problems or wet/damp basement or crawl space.

- For houses with basements, carefully check for stain signs of standing water around the walls or seepage coming through the walls, especially along the wall(s) having the highest outside ground level. Look for whitish salt deposits on inside foundation walls left from moisture seepage and evaporation. For houses with crawl spaces use a flashlight and check for current or previous water ponding, mud, mildew, condensation on various surfaces, or sagging or wet insulation.

- Check the basement and crawl space for musty odors and signs of mildew, condensation on surfaces, and unusually heavy rust deposits. Try to determine the source of the moisture--foundation wall seepage; capillary moisture from the crawl space ground; water or sanitary pipe leakage; poor crawl space ventilation; or combination of problems. Check the inside corners for cracks and separation of blocks at the joints from foundation settlement.

- Don't accept a realtor's or builder's suggestion that water seepage into basement or crawl spaces is normal and should not be a concern. Either ask that the source of the problem be eliminated or look for another house!

Tips for homeowners who currently have water problems

- Check to see if the house is in warranty--if so, discuss the problem with the builder and ask him to correct it. If he refuses, contact your attorney for advice.

- If the warranty period has expired, have an expert in drainage engineering determine the cause of the problem, whether or not it is serious, and if so, what can be done to correct it.

- Check to see if all surface and subsurface drains are functioning. Use a hose to see if roof and gutter water is being directed away from the foundation wall. Refrain from heavy watering of flower beds and shrubbery next to the house. Observe the path of all surface drainage around the house during prolonged or heavy rainfall. Watch for ponding near the walls. Check to see if the foundation drain is operating by looking for evidence of seepage from the ends.

General Tips

Make use of local organizations, governmental offices and experts if you have concerns about drainage around your house or about wet basement or crawl space. Check with people from these organizations for professional services or recommendations:

- Local/county Soil Conservation Service Agency

- County hydrologist or engineer

- City engineering office

- Local building inspector or code enforcement office

- Local planning office staff

- Agricultural Extension Service

- Professional engineer or hydrologist

- University Civil Engineering or Agricultural Engineering departments who have experts in drainage, foundation, and structures
- Local Home Builders Association
- Local Realty Board
- Local remodelers' or contractors' organizations
- Local Better Business Bureau
- Professional/commercial house inspectors.

Some problems may be solved simply by repairing an obvious gutter or downspout leak, while other problems may have causes which are difficult to identify and very expensive to fix. Severe crawl space water problems may cost several thousand dollars to remedy. Always use a competent professional to help you find and eliminate the source of your problem. Don't settle on quick and cheap fixes which merely deal with the symptoms of the problems.

Above all, remember that in many home purchases, it's BUYER BEWARE!