Foundation Repair Association

Foundation Maintenance

By W. Tom Witherspoon, P.E.

A study of failed foundations (ADSC 2000) estimates the cost of foundation repair at over 12.5 billion dollars annually. The most common cause of foundation failure/problems is poor maintenance, which can normally be prevented. Considering that most remedial action will not completely keep a foundation from moving, it becomes even more important that the homeowner complies with the required maintenance procedures to reduce movement and allow the house to function as originally intended. This is just as important after repairs have been complete because the house may move in an area that has not been repaired or is still dependent upon bearing soil stability for continued performance. Since many foundation repair companies require homeowner maintenance as a condition of their warranty agreement, compliance is also good business and one of the best insurance policies available.

The following categories of maintenance are the most common problem areas and should be addressed in a scheduled sequence to reduce movement before and after foundation repairs to minimize distress in the foundation and the structure it supports.

Slope Maintenance

The foundation should have been installed sufficiently above site grades to allow proper post-construction surface drainage. It is the homeowner's responsibility, however, to maintain these positive drainage conditions.

The primary function of good drainage is to prevent ponding near, or intrusion of water, under the structure, which would increase seasonal moisture fluctuations, or migration of water. Much of the damage caused by expansive soils is due to lack of timely maintenance by the homeowner and is in some part preventable.

Under ideal conditions the slab will maintain its original position. Unfortunately soil is not consistent and the moisture content is seldom at an optimum level in the support soil when the slab is constructed. Many slabs are poured on drier than normal soil that later becomes wet from capillary rise of water from below, causing the thin floors to lift. After repeated drying and rewetting of the support soil, small amounts of soil are squeezed from the interface of the concrete base and the soil base to lower the wall into the ground, much like a car tire miring into a rut. If the soil has a high amount of clay content, it will also deform under pressure, much like children's putty during the swelling stage.

Earth Perimeters

The excavated area outside the foundation is usually filled with loose soil fill when a house is constructed. This is usually called the "backfill area". Maintaining a positive slope in the backfill area next to the house is the most critical aspect of slope maintenance. During the first few months or years, this material often settles. In

many cases settlement is severe enough to reverse or flatten the slope next to the foundation. Reverse or negative drainage will cause ponding of water during precipitation or heavy irrigation. Ponding allows an excessive amount of water to percolate into the ground next to the foundation, which may accelerate this settlement. To avoid this, the homeowner should periodically compact the backfill area by tamping with a heavy piece of wood such as a 4"x4". Hand compaction works best after a rain or snow melt has dampened the ground or with the careful addition of small amounts of water by the homeowner such as with a drip line. Additional soil should be added as necessary to maintain a positive slope away from the foundation. This soil should always be clay, not sand, so moisture can be better maintained and water will run off instead of soaking in spotty high concentrations.

The minimum slope requirement should be 5% for the first 5' away from the foundation (3" of drop) and then at a minimum discharge slope of 1% (approximately 1/8" drop for every foot of distance) from that point on. The type of vegetation may dictate a greater slope to avoid over saturation of the critical perimeter soil. Some type of ground cover is recommended, however, to reduce erosion and lower the frequency of slope maintenance work.

Flat Work

One of the beneficial functions of flat work (sidewalks and patios that are not part of the foundation) adjacent to foundations is the prevention of evapotranspiration and fluctuation of water intrusion to the bearing soils. Therefore, every homeowner should conduct a yearly inspection of concrete flat work and do any maintenance necessary to improve drainage and minimize infiltration of water from rain, snow melt and lawn watering. This is especially important during the first five years for a newly built house because this is usually the time of most severe adjustment between the new construction and environment. The process of inspection and maintenance should continue over the years, but, cracking, settling and other problems should become less common.

Because perimeter fill material may not have been compacted in 4" lifts at optimum moisture (as is normally recommended by engineers), settlement is greater along the house. A negative slope may occur that will allow ponding. This concentration of water will allow permeation through cracks in the concrete and oversaturation of perimeter bearing soils. This deeper saturation will often times cause damage to the foundation and/or basement floors. Because evaporation is limited by the flat work, the ponded water may dramatically increase moisture levels at the crucial perimeter beams and/or piers.

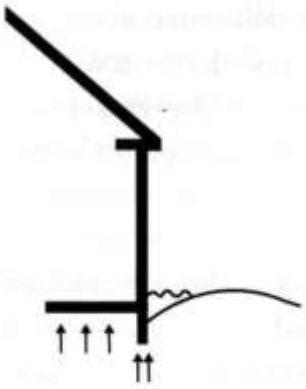
When this tilting of flat work occurs, the concrete should be replaced or mudjacked to reverse the negative slope. If a minimum of 1% slope (again about 1/8" for every foot of distance) is maintained, however, it will only be necessary to seal all cracks and ports of entry to prevent vertical water migration. This will include the perimeter joint around the foundation grade beam. A urethane or other flexible sealant should be used that will allow some movement but prevent water passing below the slab.

Flower Beds

Changing the site by the addition of flower beds, patios, fences, swimming pools, etc., may cause water ponding, which will exacerbate the wet cycles. Therefore, proper drainage considerations during such additions must be made.

Flatwork Settlement

Nurserymen will specify peat, bark, sandy loam and other planting substances, which, in conjunction



Earth Perimeters

Flower Beds Trapping Water

with bed borders, will increase moisture levels above that desirable. Therefore, flower beds must have some provisions for elimination of excess water. This may be in the form of weep holes, drain barriers or other removal systems. The problems created by flower beds are not a popular subject since homeowners will resist good engineering to beautify their house. There should be a balance between vegetation utilized for aesthetic demands and harming moisture equilibrium in the bearing soils.

One of the primary problems in flower bed design is installation of a concrete or steel barrier that will resist normal water run-off. If these barriers are desired, they should have openings cut to allow water passage and avoid over-saturation.

The use of highly permeable materials such as peat, bark, etc., should only be used if topography allows installation of subsurface drainage to collect excess water and discharge it away from the foundation. This will also require installation of an impermeable barrier at the bottom of the flower bed to help collect water for removal by the drain medium.

Shrubs planted in the flower bed should be chosen for their compatibility to the shallow barrier of the bed. Short and very contained root growth will be a plus to proper health and maintenance of the bed vegetation.

In the flower bed, the slope should be a minimum of 5% (5/8" for every foot of distance), unless ample subsurface drainage can be created to discharge water away from the foundation.

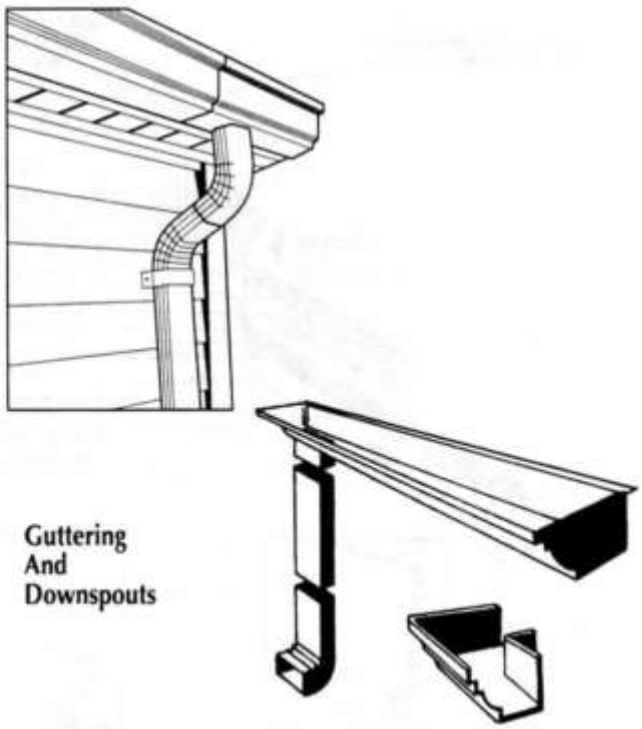
Gutters And Downspouts

Gutters should be inspected twice a year, once in the spring and again in the fall. All debris should be cleaned out and metal gutters checked for rust. If there are trees near the roof, gutters may have to be cleaned out more often.

Check the slope of the gutters, since poor slope causes water to accumulate in low spots, building up debris and accelerating rusting. Slope of the gutters should be a minimum of 1" of fall for each eight feet of length. The gutter can be installed so that it drains in one direction. If, however, any single length of gutter is more than 35' long it should be installed to drain both ways from the center or have downspouts at a spacing of not more than 20' on center.

The easiest way to check the slope of a gutter is to use a garden hose or pour a bucket of water into it and see if the water flows out smoothly or ponds in low spots. The gutter should then be adjusted to remove any high or low spots that prevent the smooth flow of water.

Downspouts should be checked for clogging at the same time the gutters are checked.



Guttering And Downspouts

Clogging often occurs at the elbow where downspout and gutter meet. The elbow can be removed for cleaning, but it may be necessary to use a plumber's snake to clean the downspout. If there is a problem with leaves, a leaf strainer or leaf guard is a good buy as long as neither prevents proper function of the gutter.

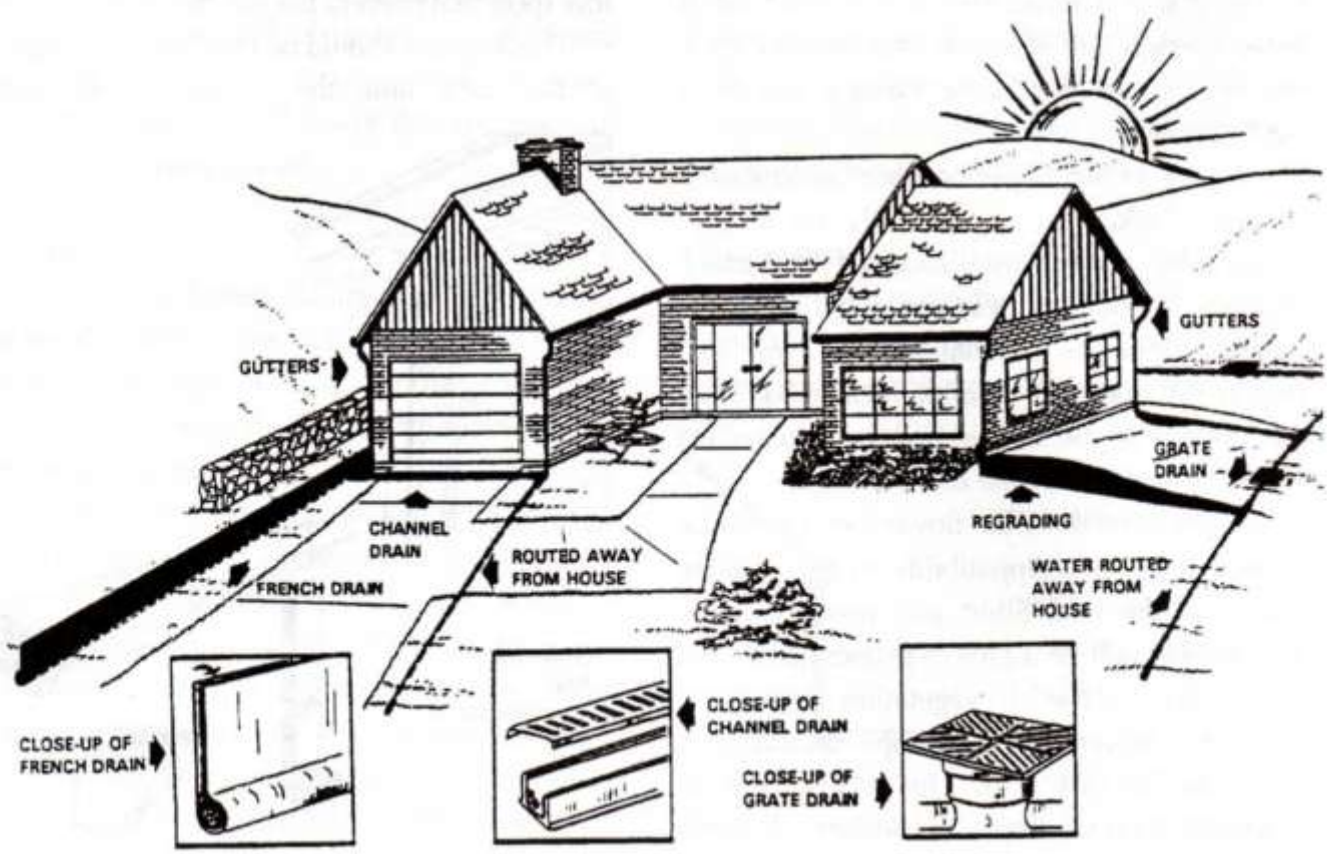
Splash blocks should be long enough and sloped enough to carry all water well away from the foundation and beyond the backfill area. Water should be discharged no closer than 5' from the foundation. Usually it is necessary to add a downspout extension in order to get the water far away from the foundation. It is possible to purchase extensions that have flexible elbows that can be bent up to make it easier to mow the lawn. The extensions should be left down at all times. Special roll-up type downspout sheets (plastic tubes) that attach to the end of the downspout are also available. These plastic tubes extend when filled with water and roll up when empty. If erosion is a possibility, splash blocks can be placed at the discharge point to prevent associated problems.

Because the materials delineated above are readily accessible at most hardware and do-it-yourself stores in a variety of makes and colors, they can add to the aesthetic qualities of a house.

Sub-Surface Drains

Subsurface drains will many times be utilized when topography, vegetation or construction does not make it possible to drain at the surface. These may consist of drain inlet basins, trench drains, funnel drains, etc. If correctly installed, subsurface drains should require little maintenance. The most important thing to remember is to avoid covering or obstructing the drain where it discharges and to maintain adequate slope. It may occasionally be necessary to clean out roots, nests or other debris from inlet basins or discharging ends of the pipe.

Inlet basins should be inspected every 6 months to ensure these do not become clogged with leaves, grass, soil or other debris, which would negate function. The bottom of these inlets normally has a sedimentation basin that requires removal of dirt as fill adds up over



time. It may also be necessary to back wash main lines when discharge becomes a noticeable problem. If problems persist, running of a mechanical snake may be necessary to remove the obstruction.

Settlement problems in a yard will many times crush piping and reduce the discharge flow, which will cause sedimentation to occur and subsequent closure of the drain lines. Damage may also result from the driving of heavy trucks across the surface. In any case, repair will normally require excavation and replacement of the drain line. This may be an even greater possibility if clay tile is used in lieu of heavy duty pvc.

Location of clean-outs and discharge lines will be a plus to locate problems and initiate corrective action. Therefore, a drawing of lines and locations should be made during installation for future reference.

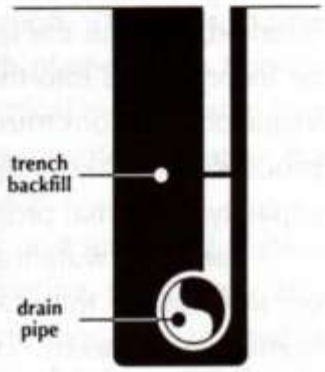
Capillary/French Drains

Capillary drains are installed to intercept and collect moving subsurface water and discharge it away from the structure. Unless the slope allows, this will many times require installation of a deep sump and pump to collect water and discharge it through a shallow drain line.

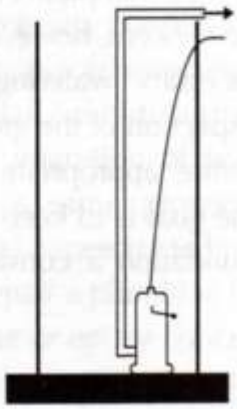
The pumps utilized in this operation may malfunction and unless an alarm system is installed there will be no warning. Therefore, it is advisable that the homeowner inspect the sump at least every 6 months to make sure trash, debris or pump failure has not occurred. If a solid sump well cover is used, there will be less potential for debris, but the homeowner will not be able to view the sump and determine if it is functioning. Therefore, the addition of an alarm is recommended to provide a warning to the homeowner prior to the onset of other problems, such as upheaval or water intrusion into the structure.

Discharge lines should have clean-outs to allow removal of obstructions by use of a snake or by jetting. Because effectiveness of these systems is largely unknown until problems occur, it is wise to also backwash the system from the discharge end and/or at the sump at lease every 2 years. The effectiveness of this backwash will normally be seen by a discharge of debris, which may have clogged the system.

Capillary drains are many times utilized as moisture barriers along the perimeter of a foundation to shed water and stabilize sub slab moisture. This will include extension of an impermeable barrier material under flower beds and up along grade beams. Therefore, it is important for the homeowner to avoid any planting action that may puncture the barrier material. If this damage occurs, it will be necessary to patch the hole with materials that maintain the integrity of the barrier.



French Drain


Sump Pumps

Irrigation/Sprinkler Systems

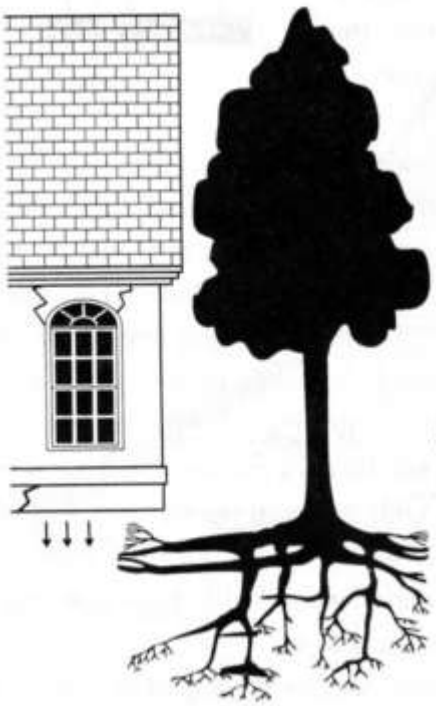
Watering of lawns and house perimeters must be regulated to maintain consistent moisture content under the foundation. Therefore, allowances for shrubs, plants and trees must be regulated for each segment of the yard. It is advisable that watering along foundation perimeters should be on a maintenance basis in corroboration with seasonal needs. This should be in conjunction with plant and tree requirements so that added water will not be siphoned from under the foundation.

Seasonal monitoring will necessitate different

watering for the sides that receive added and hotter sunlight (south and west sides), which increases evaporation. This monitoring will also take into consideration time of day for watering. Most authorities recommend early morning watering so that less evaporation will occur.

It must be understood that overwatering can be just as damaging to the foundation as under watering. If an electronic sprinkler system is installed, each of the factors listed above must be incorporated into the sequence and timing. Visual observations must also be included in the process to make adjustments beyond the capacity of normal programming.

A variety of watering heads and systems are on the market that can be customized to a homeowner's needs. There are bubble sprays, side sprays or angle sprays that discharge from riser heads or pop-ups and can be mixed to provide complete coverage. Where evaporation is a concern, however, a drip system will provide necessary watering very efficiently. A close inspection of the ground surface is necessary to ensure appropriate volumes and consistency. The goal is to keep the soil near and under the foundation a consistent moisture (neither wet and/or muddy nor dry and cracked).



Soil Shrinkage Due To Moisture Removal By Roots

An inspection of the sprinkler system should be performed at least twice a year to determine if zones are functioning properly and if heads are improperly discharging/broken or if leaks have occurred that will provide uneven watering. This will, in the case of electronic watering systems, require running through the system to determine if times, duration and frequency have been maintained.

Vegetation And Trees

Studies from England and the United States have proven conclusively that trees can cause damage to foundation stability and in more severe cases complete foundation failure. Engineering studies map the effect of moisture withdrawal, which can severely damage a slab-on-grade foundation and cause movement in a pier and beam foundation system. Even when the perimeter of slab has been underpinned, the interior slab will often deform as moisture migrates to the perimeter as a result of root capillary action.

Planting of shrubs, flowers and trees should be with the understanding of mature growth. Since additional moisture withdrawal will occur, distance and watering patterns must be planned. If distance away from the foundation cannot be maintained, root barriers may be necessary to reduce and/or eliminate penetration under the slab and subsequent moisture withdrawal during times of drought. The depth of this barrier may vary according to tree or plant root expectations. These barriers, if properly constructed, can also serve as a moisture barrier, which will add stability to moisture contents under the foundation. Several agriculture agencies have material available which provides projected root and moisture requirements for different types of vegetation.

Trees should not be planted closer to the foundation than approximately the mature height of the tree. Some studies also indicate

the tree limbs should not invade the footprint of the house at maturity. There is a variance with different types of trees that will necessitate their planting even further away. If the proper distance cannot be maintained, it may be necessary to install a root barrier to reduce the risk of future problems. Pruning of tree branches so that they do not extend over the structure can also be an effective way to limit root growth under the foundation.

The plants should fit the environment. In areas where droughts frequently occur, it may be necessary to substitute drought resistant plants and trees to incur less action on the foundation and provide easier maintenance of the foliage.

Plumbing Leaks

Leaks in water and sewer lines will change the soil equilibrium under a foundation and can lead to differential movement/damage. Therefore, it is necessary to recognize signs that indicate problems exist.

If sewer lines are frequently stopped-up and roots are observed when clean-out rooters are used, a sewer test should be conducted to determine the presence and location of the break. Repair of a break should be made immediately to avoid damage and future problems.

If abnormal water bills indicate a sudden surge in water usage, wet spots occur that cannot be explained or the owner should hear the sound of water running in a bathroom (note: The bathroom nearest the water supply line will provide the best indication of a water leak), a test of the pressure lines should be conducted. If leaks are found, they should be repaired immediately.

If hot spots occur in the floor or unexplained water should pool, it is a good idea to call a plumber. Catching leaks early will many times avoid extensive foundation damage that may be very difficult to repair.

Plumbing Leak Repairs

Leaks will often occur under a slab-on-grade foundation that require breakout of a segment of the slab to gain entry and repair the plumbing. Care should be taken to perform proper compaction of the soil when repairs have been completed. This will require adequate moisture in the utilized soil and compaction of layers no thicker than 3" to restore soil bearing to as it existed prior to excavation. The vapor barrier should be repaired with plastic and a bonding material to provide a vertical moisture stop from vertical capillary action or water migration that may enter the living space.

Even in the case of post tensioned slabs, a minimum of #3 reinforcing steel bars, at a spacing of 12" on center, should be utilized by drilling into the existing slab horizontally and epoxying the reinforcing steel bars to provide integrity. A bonding agent should be utilized at the edges to provide the necessary bonded joint between existing and newly placed concrete. It is normally advisable to install a moisture shield at the surface to prevent migration of water through the concrete. This same procedure should be employed if it was necessary to break through a grade beam to repair a plumbing line except that non-shrink grout or epoxy concrete should be used to remold the beam.

Reinforcing Steel Exposure

Many times concrete will blister or peel along the grade beam and reveal post tensioning cable ends or conventional reinforcing steel bars. If left unprotected, corrosion will slowly reduce the originally intended strength of these reinforcing steel members. Therefore, it may be necessary to properly clean the steel and remove all bond and then install an epoxy grout or non-shrink grout to build back the beam and protect reinforcement. In more severe situations, it may be necessary to drill and epoxy reinforcement dowels/stirrups to build out the grade beam and provide adequate coverage of the reinforcing steel.

Brick, Rock Or Cladding Cracks

Movement, weathering and freeze damage will often times create cracking in the brick veneer or mortar that will allow passage of moisture into the vulnerable wall material. Because this will often lead to deterioration of wood members, it is advisable to seal these cracks with a urethane, mortar or caulk that will prohibit weathering problems. Where obvious structural problems are visible such a lateral displacement of veneer, lateral shields or other retainers will be required to prevent additional movement damage.

Vent Covers

The original purpose of vent covers is to provide adequate circulation of air under the floor of a pier and beam foundation so that moisture will not build up and cause deterioration of wood members. Although coverage of these vents will save money in reducing heating bills, it will often provide the unwanted environment for wood rot. Therefore, it is not advised that these covers be utilized unless other means of air circulation are available such as a subfloor vent fan(s).

Recent revelations of houses where the growth of bacteria was so invasive and so deadly that the houses could not be salvaged, have led to a new examination of detection and prevention of such growth.

Animal Damage

Dogs, skunks, armadillos, snakes etc. will many times burrow under a slab or pier and beam foundation. This will undermine the bearing soil and may provide entry for water that was not possible prior to the excavation. Therefore, it is necessary to back fill the segment and/or place an impenetrable shield to prevent further entry. It is also important to restore positive drainage to prevent foundation moisture instability.

Termite Damage

Wood should not touch the ground at any place near a foundation. This will only invite termites and provide avenues for their passage to more appetizing segments of the structure. Therefore, the homeowner should take care to avoid laying, placing or constructing wood that engages the ground. This includes removal of any wood pieces that may exist in the crawl space of a pier and beam foundation. When you add moisture to wood on the ground, you provide a perfect environment for growth of termites and other wood eating insects.

Interior Doors

It is a known fact that most slab-on-grade foundations will move differentially, which can cause misalignment of interior doors. Therefore, some flexibility in the fit of the doors will reduce the inconvenience of this movement.

Interior doors should have a minimum 1/8" to 3/16" clearance between the top and side with the frame. This will allow some seasonal movement prior to sticking. It is also a good idea to provide adequate clearance off the carpet or floor to further buffer movement and allow for different heights of carpet and/or flooring.