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EFFECTS OF SOIL MOISTURE CONTENT ON RESIDENTIAL FOUNDATIONS

Keeping excess water away from foundations during wet months and supplementing the soil with moisture (watering your foundation) during dry months may be the single most important control measure used to preserve the structural integrity of a home. Defects in foundations may occur when the supporting soil is too wet *or* too dry. Uneven moisture content in the soils around a foundation can also cause foundation damage. This is true regardless of the type or age of the foundation.

Excess Soil Moisture Conditions:

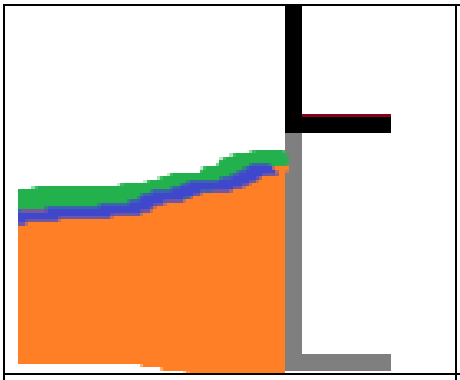
In the rainy season, water can soak into the soil adjacent to a foundation and cause excess soil pressure on foundation walls. Expansive clay soil can expand to several times its dry volume when it becomes saturated. Soil pressure can often be more than a thousand pounds per square foot. Excess pressure may crack or move foundation walls inward, and in my opinion is responsible for at least 80% of home foundation failures. Expansion of soils below the slab can cause slab upheave. Typically, this is a result of underlying issues and not a direct effect of the weather. Broken water supply pipes and sewer drain lines below the slab can increase moisture content and hydraulic pressure resulting in damage to the slab and flooring material above. Always maintain sprinkler systems by properly winterizing them. A broken supply pipe may go unnoticed until the next monthly water bill and by that time it may be too late. Slab upheave from excess soil moisture may result in more than unsightly cracking. I have observed slab upheave cause an interior basement wall to raise approximately three inches which caused the first floor living area to exhibit a three inch rise in the center.

Foundation wall with inward movement.

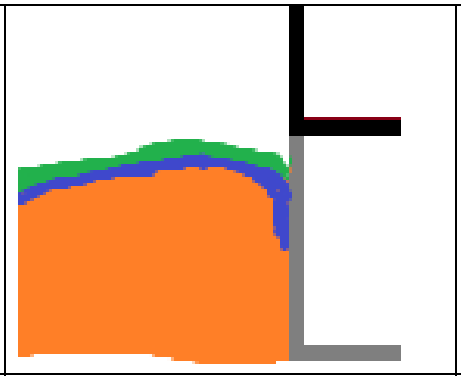
Slab upheave.

Drainage and Slope:

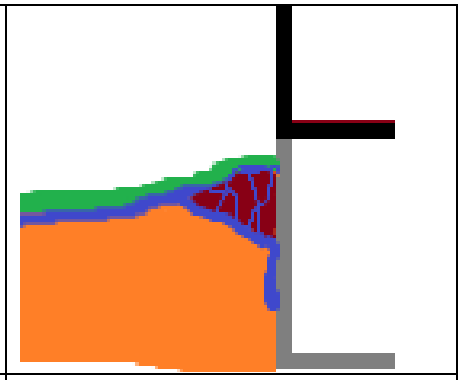
Maintaining proper drainage can help minimize foundation cracks and adverse movement due to excess hydraulic pressure and soil expansion. Drainage maintenance is generally an easy task but must be continually examined and modified as grade and drainage characteristics change with time. New home construction generally has the soil around the home placed as loose fill. Initially the contractor places the soil with a proper slope away from the foundation; over time voids in the soil collapse and the soil particles become closer together resulting in the fill material gradually settling. This often results in a negative slope, or section of surface soil around the foundation that drains water towards the home. Some surface soil may also erode away during rain events. Replacing eroded soil and/or filling settlement locations with additional material must be completed to maintain a positive slope. The recommended material is a clay based material as it will, when properly hydrated, shed water away from the foundation. Topsoil placed near the foundation may have a positive slope but because of the soil properties will allow the water to percolate through the fill soil and down the foundation. It is recommended to maintain a positive slope at a minimum of four to six feet from the foundation.



Positive Drainage.



Negative Slope.



Top Soil Drainage.

Positive Slope.

Negative Slope.

Desiccated Soil Conditions:

During the dry season soils can desiccate and shrink. Once soil starts to desiccate, the rate of evaporation increases because more cracks create more surface area for moisture to escape. During significant rainfall events occurring after drought periods water may enter cracks and erode soil from beneath the foundation which can cause settlement. When soil next to a foundation shrinks it can form a gap between the supporting soils and the foundation walls. The foundation walls may begin to shift because the pressure once created by the hydrated soils is no longer present. Shrinkage of the soil below the slab due to excess drying may cause differential movement of the slab. Significant cracks can occur if the perimeter soils are dry and shrinking and the center soils are retaining moisture. This occurs when the center soils desiccate at a slower rate than the perimeter soils because they are protected (think about microwaving a frozen meal; the inner section may be frozen while the outer section is warm). This can cause the perimeter slab to settle while the interior slab remains supported resulting in cracks in the slab and flooring material above (i.e. tile). If cracks or gaps are observed in the soil around a home or a gap is observed between the foundation and supporting soils it is likely that the soils are desiccated and need to be rehydrated.

	
Desiccated soil beneath a footing.	Gap between bearing soils and foundation.

Watering a Foundation:

Consistent soil moisture content around a foundation during dry months can be achieved by watering your foundation on a regular basis. While hydrating the soils around the foundation is generally recommended during extended dry periods; it should be performed on the exterior soil, at the surface, and allowed to percolate downward. A dry sump pump pit may seem like an ideal location to add water, it will likely cause more harm than good. Water poured into the sump pump pit will not likely ever reach the exterior foundation soils and will instead act like a broken water line beneath the slab and cause unwanted upheave. Correcting desiccated soils is not as simple as flooding the area with a garden hose. Rapid application of water after drought periods may enter the cracks too quickly erode soil from beneath the foundation, similar to significant rainfall events, which can cause settlement. Rehydration of the soils around a foundation should begin approximately four to six feet away from the foundation which will allow the soil to expand and the moisture to migrate toward the dryer soil near the foundation. Preventative measures can be taken by placing soaker hoses approximately two feet from the foundation. It is never recommended to apply water directly next to the foundation. Always hydrate the soils around a foundation evenly. Uneven moisture content caused by hydrating soils only at some sections of the foundation (flower beds) and not on others can damage a foundation. Daily monitoring of soil moisture content when watering a foundation is key to prevent oversaturation of soils. Soils that are no longer absorbing water should not continue to be watered as this can cause excess hydraulic pressure on the foundation, over expansion of the soil and water intrusion. Some areas around a foundation may require more water than others if they are in a naturally drier area such as recessed entryways, beneath covered decks or patios and gabled ends.

	
Watering soils 4-6 feet from foundation.	Soaker/Sprinkler hose.

General Concrete Construction:

One thing to note is that most all concrete will develop cracks during its lifetime. Many of these cracks are what we refer to as 'typical cracks' and are generally not considered structurally significant. Foundation walls are a mixture of cement, aggregate and water. The same principles apply to cement as to the clay soils as they dry. When concrete dries, it shrinks and can result in cracking. Several controls can be implemented during the construction phase to limit cracking. However because hydrating the concrete mix allows it to be more workable it is likely that most residential foundations will develop typical cracks. Two of the most common control measures for limiting concrete cracking during construction:

- Prevent excess water from being used in the concrete mix; more water means that the concrete will flow more readily and be easier to install. This not only increases the likelihood of cracks but decreases the overall finished strength of the concrete.
- Proper curing of the concrete; when concrete dries out too fast it can cause cracking. Concrete does not harden by drying out, rather it hardens when a chemical reaction occurs between the cement particles and the water known as hydration. This is usually an environmental (temperature and humidity) concern but can be controlled by using polyethylene sheets to cover slabs, watering slabs, leaving the forms in place as long as practicable and if necessary using portable heaters or blanket (straw over polyethylene) in colder months.