**THE ROOT CAUSE OF**

**FOUNDATION FAILURE**

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Many houses in the Kansas City area have experienced severe cracking and structural problems due to the extreme weather conditions causing either too much or too little moisture in the soil. Understanding why these problems occur and how they can be prevented will help save money and create piece of mind. In order to understand how changes occur and how they cause structural problems, one must know how a home is constructed and how it shifts when these changes occur.

**FOUNDATION CONSTRUCTION**

The purpose of the foundation is to support the structural frame and to retain the soil around the perimeter. In order to accomplish this, the foundation must be resting on suitable soil capable of supporting the loads imparted, and it must be securely attached to the super-structure to prevent the top of the foundation from shifting laterally.

The foundation consists of two (2) major components. The first component is the footings, which rest directly on the soil. The second component is the foundation walls, which rest on the footings and support the super-structure.

In most new home construction, the footings are 8” deep by 16” wide poured concrete resting on virgin soil. In older homes with concrete block foundation walls, the footings generally consist of poured concrete. However, the footings for homes constructed of limestone rock foundation walls are usually limestone rock, resting on soil. The least common footing used in the Kansas City area is a concrete pier. Concrete piers are used when fill material is encountered and an unsuitable soil condition exists.

With new home construction, most foundation walls are 8” thick poured concrete. These walls vary from 7’ to 10’ tall. Older homes were constructed of either concrete block, limestone rock or clay tile. In order for any foundation system to function properly, it must have suitable soil beneath the footing and the walls must span from the footing to the floor frame without bending or bowing. Also, the top connection to the structural frame needs to be strong enough to resist the lateral forces imparted from the soil.

**STRUCTURAL PROBLEMS**

The most common type of structural problem found in the Kansas City area is lateral movement. Lateral movement exists when the foundation wall shifts either at the top, middle or base. This lateral movement condition usually occurs as a result of poor drainage around the perimeter of the house. If the connections at the top of the wall are broken a significant amount, structural repairs are needed. If only minor lateral movement has occurred, the walls can generally be kept stable by improving and maintaining the exterior grade. However, in order to determine the cause and extent of lateral movement, a licensed Professional Engineer (P.E.) should be consulted before proceeding with repairs.

Differential settlement of a foundation is another possible cause for major structural concern. Settlement of a newer house is usually due to a weak soil condition. If a weak condition exists, a new home will generally start to settle within the first three (3) years. However, older houses can start to settle during drought conditions, especially if large trees exist near the structure. If settlement occurs as a result of inadequate soil or un-compacted fill material, underpinning or other foundation stabilization is needed. However, if the settlement is due to drought conditions, eliminating the drought conditions will usually stop the settlement. In fact, most cases as the soil receives more moisture, it will expand and move the foundation closer to its original position. Therefore, before completing extensive foundation repairs, a Professional Engineer should be consulted to determine the cause and extent of structural damage, and to make repair recommendations.

**EXPANSIVE CLAY SOIL**

The soil throughout the majority of the Kansas City area contains an expansive clay. As the moisture content of the clay soil increases, the soil expands in volume. This expansion is similar to what occurs when a dry sponge becomes wet. When the clay soil expands, structures can experience heaving. As the moisture content of the expansive clay soil decreases, the soil shrinks. This is what occurs when an old farm pond dries-up and large cracks develop.

When a home is constructed, the excavation is back-filled against the foundation walls, the back-fill material is often left un-compacted. As the soil consolidates, poor drainage usually develops. When poor drainage exists, several problems can occur. Poor drainage can double or triple the forces and stresses on the foundation walls which can cause heaving, lateral movement and may increase the potential for settlement.

Most homes with poor drainage experience increased pressure against the foundation walls during wet weather, which can lead to lateral movement. If the lateral movement is significant, foundation repairs are needed. If this condition exists for too long, the foundation walls may need to be straightened or replaced.

In approximately 85% of the homes with wet basements, the water leaks are due to poor drainage around the exterior. By improving the exterior grade and maintaining the gutters and down spouts, the water leaks are usually eliminated (or significantly reduced). In the remaining homes, additional waterproofing measures, such as an interior drain tile system or sump pump, are needed. However, by simply improving the exterior drainage, most wet basements are made dry.

If poor drainage exists during dry weather, a gap can occur between the foundation and the soil. With poor drainage, water will drain into this gap and penetrate the soil. As this condition occurs, the soil may become saturated and expand thereby causing heaving. While this condition generally is not considered a major structural concern, it can cause extensive cracking in the concrete slab, foundation and structural frame. Therefore, in order to minimize the amount of shifting, maintaining positive drainage away from the house is very important.

As the expansive clay soil dries during drought conditions, it will shrink and pull away from the foundation. However, the soil under concrete tends to be unaffected since evaporation of the moisture will not occur through the concrete surface. However, if large trees exist near the home, the tree roots can extend under the concrete surface, remove the moisture from the soil and cause the soil to shrink. This type of soil shrinkage generally does not occur during normal weather conditions.

Most trees will take moisture from the most readily available source. During normal weather conditions, this source is where rain falls. However, when extended periods of dry weather occur, tree roots will extend longer distances and deeper into the soil in an effort to find moisture. As the tree roots develop under the concrete surfaces of a home, they can cause the soil to dry out and shrink. Once this condition has occurred, subsequent dry weather will affect the house since the roots have already developed. Therefore, it may take several years of normal weather conditions or regular watering of the soil to help reduce the roots under the house. Trees with deeper root systems, such as oak trees, tend to have a larger affect on homes versus trees with a shallow root system.

**MAINTENANCE RECOMMENDATIONS**

Most foundation failures and structural repairs needed are due to improper maintenance of the home. Therefore, if the home is properly maintained, the structural problems and repairs can generally be kept to a minimum. In order to properly maintain a home, creating positive drainage around the home and watering during dry weather are essential.

Positive drainage is generally considered to be a 1” per foot drop away from the house for the first 6’ to 10’, and should be maintained throughout the life of the structure. Therefore, after a house is built and the back-fill begins to consolidate, additional back-fill material should be added. Maintaining a properly functioning gutter and down spout system is also important. A large amount of water exists at down spouts and if this water is not drained away, problems will develop. Therefore, cleaning the gutters and checking them during rain storms is important to ensure that they do not over-flow.

As a general rule, it is recommended that the exterior grade be watered 1” to 2 “ of rainfall equivalent per week. This needs to be completed during the growing season and can be suspended in the winter. More moisture may be needed in the months when the humidity drops below normal and drought conditions are prolonged. In addition to watering the first 15’ to 20’ around the home, any large trees which exist near the home should be watered to prevent them from pulling moisture from under the home. Although it is believed that large trees do not need to be watered in order to survive, the trees should be watered in order for the house to survive prolonged drought conditions.

With the expansive clay soil that exists in the Kansas City area, the root cause of foundation failure is the extreme changes in the moisture content of the soil under a home. Therefore, homeowners should maintain positive drainage and water the yard regularly.

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