



# Let's Talk Dirt

by Walt Keaveny, Risk Manager, MS, PE, PG

## Does this Sound at all Familiar?

A home builder puts up a road side sign that reads "Clean Fill Dirt Wanted." A row of trucks arrive and dump dirt in a ravine located under one area of a planned foundation. A dozer spreads the dirt to make a level pad for the foundation.

Fast forward one year. The homeowner has been moved into their new home for a couple of months. The builder is surprised to get a call from the homeowner expressing concerns about some inoperable doors and windows, noticeable floor slopes, cracks in floor tile, and separations in trim. The quality conscious builder wonders what could be causing the significant foundation movement and related structural distress? After all, the builder used a reputable structural engineer, built in accordance with the plans, and passed all building department inspections.

A subsequent forensic investigation determined the cause of the structural failure to be the fill dirt. The dirt quality



was found to be non-uniform, varying from sand to clay. The dirt thickness was also non-uniform, varying from zero to several feet under portions of the foundation. The fill density was low, since a dozer is not designed to compact fill. This all resulted in both excessive total and differential settlement, and a very expensive repair.

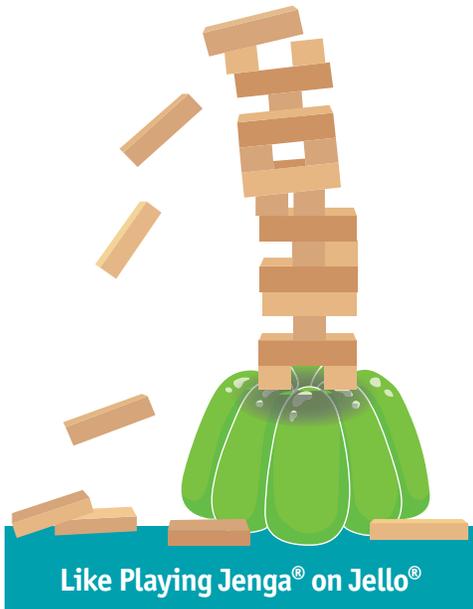
## How often is Dirt to Blame?

Unfortunately fill dirt-related structural failures like this are all too common. In fact, the ground-breaking findings from over 40 years of forensic investigations by

2-10 Home Buyers Warranty indicate that **fill dirt is the leading cause of new home structural failures!** When placed under a foundation, **fill dirt is arguably the most important structural component of a home.** If the dirt that supports the home settles excessively, then every structural element located above it is at risk of failure. Structural engineers do not take into account the potential for unexpected fill settlement in their structural designs. Alarmingly, **nationwide it costs an average of over \$50,000 to investigate and repair a structural failure caused by fill dirt. In some states the average cost exceeds \$100,000.**



**Fill dirt is the leading cause of new home structural failures! When placed under a foundation, fill dirt is arguably the most important structural component of a home.**



Building a home on improper fill dirt is a bit like playing Jenga® on Jello®! Geotechnical engineers recommend that footings bear on either undisturbed natural soil or on “engineered fill.” Most natural soils were deposited over 10,000 years ago during the last ice age, and have had plenty of time to densify. On the other hand, fill relies on mechanical compaction to achieve high density like natural soil. If fill is not densified initially by the weight of proper compaction equipment, unfortunately it will eventually be compacted by the weight of the home.

Structural failures caused by fill are a very severe type of foundation failure due to the high potential magnitude of both total and differential settlement. Since fill is often placed under the entire foundation, all areas of the home are potentially impacted. Settlement causes damaging deflection (i.e., bending) and/

or tilt in the foundation which in turn causes distortion in the superstructure.

### What is Engineered Fill?

“Fill Dirt” as it is broadly called in the construction industry, is formally referred to as “engineered fill” when used below foundations. The need to engineer this important fill is required by governing construction authorities. For example, the International Residential Code (IRC) states “Fill soils that support footings and foundations shall be designed, installed, and tested in accordance with accepted engineering practice.” HUD Sheet 79G, Land Development with Controlled Earthwork, states “For any development in which buildings are to be placed on graded areas, all earthwork shall be designed, engineered, and constructed in such a manner that there will be no adverse differential movement which may cause damage to the structure.”

What is actually “engineered” about fill? Isn’t it all basically the same and just compacted to 95% of maximum density? No -- there are countless types of fill, fill applications, and subgrade conditions. “Engineered” means that a professional geotechnical engineer develops site-specific specifications for fill quality, subgrade preparation, fill thickness uniformity, placement on slopes, lift thickness, moisture content and density (expressed as a percent of max. density of a lab Proctor sample). The engineer also ensures that the natural soils that underlie the fill can safely bear the weight of both the fill and the home. These specifications can be found in the site geotechnical report, if available, or

developed just prior to site development.

Engineered also means that the engineer’s representative observes fill placement operations, and conducts a sufficient number of tests to confirm compliance with specifications. The test results are reviewed by the engineer and documented in a fill certification report. The report should be archived so that in the event of a structural failure builders can protect their liability by demonstrating that the fill met engineering specifications.

### Most often Foundations Don’t Fail - People Do

Foundation failures caused by fill are avoidable. Most often foundations don’t fail - people do. Unfortunately, it is relatively common to overlook the fill under foundations. In part because building departments in most states don’t require confirmation of fill compaction. The fill located under foundations should be engineered - just like structural concrete and structural framing are engineered.



**About the author:** Walt Keaveny, MS, PE, PG is the Risk and Underwriting Manager for America’s leading new home warranty company, 2-10 Home Buyers Warranty. Mr. Keaveny is licensed as both a Professional Engineer and Professional Geoscientist with over 30 years of engineering and construction experience. His articles have been broadly distributed by the NAHB and local HBAs.

