GEOTECHNICAL SERVICES
UNDERSTANDING RISK AND INCREASING QUALITY BELOW THE FOUNDATION
In this article, Quality Built will endeavor to fundamentally educate insurance and builder professionals on the theory and application of soil mechanics as it relates to construction risk. The findings presented are based upon the personal experience and professional opinions of the primary author, analysis of the most relevant findings of geotechnical design changes including the catalysts which activated those changes, and data obtained through third-party geotechnical reviews for both complex and basic foundation systems. Our objective is to identify the most common risks and the various strategies to eliminate or mitigate each risk.

Quality Built has long been the industry leader in identifying construction risk and in trending data to track industry progress. Yet up until 2010, Quality Built’s process to review foundation design and perform quality assurance inspections was limited to items pertaining to the waterproofing of podium decks, planters, vapor retarders for slab-on-grade foundations, footings, post-tensioned steel placement, the cutting and capping of tendons and rebar placement, etc. While these things are important, there are other factors affecting foundation performance which need to be addressed before construction begins.
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UNDERSTANDING RISK AND INCREASING QUALITY BELOW THE FOUNDATION

What are the most common foundation types and corresponding risks found in the United States?

The type of foundation system utilized for a building is driven primarily by the requirements for subterranean space, site geotechnical conditions, and building loads. Where building loads are high (generally 6+ stories) and/or the soils at the site have limited bearing capacity, most large structures will be founded on deep foundation systems consisting of driven piles, drilled piers, or other methods to transfer building loads down to suitable bearing strata. The most common risks associated with these types of foundation systems tends to occur during construction and includes vibration-induced damage to adjacent structures and caving of excavations.

For light building loads or moderate-sized structures (generally less than 4 stories) on denser soils capable of withstanding moderate loads, foundations typically consist of shallow spread and perimeter footings with slab-on-grade floors. The footings are typically 18 to 24 inches deep and the reinforcement within the slabs and footings is light. Typical risks to these foundations include differential settlement, expansive soil deflection, and, like all other foundations, moisture vapor transmission. Where situated on moderately to highly expansive soils, post-tensioned slabs are commonly used to better resist slab deformation.

For moderate-sized structures situated on soft/loose soil, there are a number of intermediate foundation systems to choose from. These systems include mat foundations, dense aggregate piers, and various soils stabilization techniques (e.g., deep soil mixing). The risks associated with these systems are situated generally between the deep and shallow foundation systems described above.

For any of these building types and soils conditions, there can be either at-grade foundations or foundations located beneath subterranean portions of the structure (typically parking). Where permanent building space is located below grade, another level of complexity is added to the geotechnical design. Such structures will require temporary shoring and/or temporary slopes, lateral earth pressures on basement walls, waterproofing, and, locally, permanent dewatering systems. Subterranean construction is typically utilized in densely populated areas, which usually means there are existing structures nearby. Therefore, the potential for adverse impact on these adjacent structures grows exponentially from such sources as vibration, dewatering, tie-backs, and other construction methods. Typically, the most significant risk is loss of lateral support for adjacent structures as a result of deflection of the shoring system.
Nearly all types of soils can be built upon, but some are far more challenging than others. “Good” soils have characteristics resulting in an inherent ability to be predictable/stable, resist deformation, drain freely, and have minimal volume change post-grading. Unfortunately, the determination of these abilities takes much more knowledge than simply identifying the fundamental type of soil particles (clay, silt, or sand/gravel/cobbles) located at the site.

Granular material (sand and coarser particle sizes) tend to be considered “good” soils because they typically provide higher bearing capacities for foundations, allow water to drain freely, and are typically not subject to post-grading volume change in most situations. However, in other scenarios, granular soils can behave in nearly the opposite manner. For example, where loose sands located beneath the phreatic surface is subject to earthquake loading, the soils may temporarily liquefy and lose ability to support a structure. The consequences can be severe if substantial dynamic settlement or lateral spreading occurs. This is a critical risk to evaluate in California and other high seismic regions. Sands create different risk in various states in the West and Midwest where they are wind-deposited in a honeycombed structure (with minor silt and clay). These loess deposits are susceptible to collapse upon inundation of water. Finally, sand is subject to surficial slope failures where located near the face of natural or fill slopes. Clearly not all sand is “good”.

Clay soils are typically associated with “bad” conditions for a number of reasons. The most notorious behavior of some types of clay soil is to swell upon introduction of water. These clays, where located beneath lightly-loaded foundations (particularly slabs), have a tendency to exert swell pressures which can deform a foundation post-construction. This is why it is important to place compacted clay fill soils as wet as feasible to “pre-swell” the fill. Clay can also be relatively impermeable to water and therefore typically exhibits poor drainage. Further, clay soils tend to be softer and not as resistant to deformation under loading, which results in lower bearing capacities for foundations. Finally, claystone or clay seams within sedimentary deposits may lead to landslides in hillside terrain where bedding planes are adversely exposed in slope faces.

The final soil particle size is silt which, compared to sand and clay, is often benign. However, it is usually a minor constituent of predominantly sand or clay deposits and will tend to moderate both the “good” and “bad” characteristics of these soils.

However, “bad” foundation conditions are not limited to soil characteristics. Geologists are important partners to soils engineers, and are essential partners in evaluating hillside developments. This is due to the fact that apparently intact rock and well-consolidated soils are sometimes susceptible to geologic hazards. In addition to assessing the risks of earthquake fault ruptures and ground shaking...
throughout much of the western states (plus certain areas in the Midwest and East), geologists provide vital information for engineers to evaluate risks from landslides, dissolution of carbonate rocks (such as limestone in Florida), presence of unstable organic soils, ground settlement induced by groundwater withdrawal, and other hazards.

It is important to note that in almost all cases, soils located beneath structures will have a tendency to be adversely impacted by the introduction of water post-construction. All soil types within natural deposits or engineered fill will have a tendency to settle as the water lubricates the soil grains and adds weight to the soil mass. Therefore, except for moderately to highly expansive clays, it is important to have the building foundations supported by dense, well-compacted soils and to reduce water infiltration. For expansive clay soils, preventing water infiltration is even more critical since the soils are subject to both settlement and swell pressures.

Why are regions historically considered to be good building sites now considered “problematic”? 

So what specifically is the problem with soils in our country? No, it is not global warming or climate change. Rather the supply of high quality sites with “good” soils conditions in geographically attractive areas is simply declining. Developers are often forced to build on sites with challenging geotechnical conditions, and prospective buyers are generally not particularly interested in absorbing all the costs of properly mitigating these soils conditions through their purchase price. The end result is an increase in projects built over such problems as highly expansive soils, compressible soils, near surface groundwater, and liquefaction- or landslide-prone soils using grading plans and foundation designs that are not suitable to mitigate the associated risks.

Wouldn’t the problematic soils conditions be addressed by the soils report and proper foundation designs be presented on the project plans?

The typical sequence of events relating to the geotechnical design of a project begins with a subsurface investigation (soils report) performed by the project soils engineer. The soils engineer is provided with a basic understanding of what type of building will be constructed and the engineer makes decisions on the type and extent of testing to be performed at the site and in the laboratory. Testing at the site typically includes a selected number of excavations consisting of small-diameter borings, test pits, and/or cone penetrometer soundings, and, for hillside developments, bucket auger borings. The geologic setting, soil stratigraphy, groundwater elevation, and other information is derived from these excavations. Further, soil samples obtained from these excavations are brought to the laboratory to evaluate soil characterization, strength parameters, susceptibility to swell or collapse (volume change), corrosivity, permeability, and various other characteristics. All of this data is then analyzed in conjunction with the soils engineer’s understanding of the proposed construction to provide the conclusions
and recommendations provided in the soils report, including recommendations for the type of foundation system.

The soils report is utilized primarily by the structural engineer to design the foundations and other structural elements in contact with soil, like basement walls. The project civil engineer will incorporate the findings from the soils report to design surface and subsurface drainage provisions, and the architect will often utilize the data to provide subterranean waterproofing design. Finally, when shoring is required to facilitate subterranean construction, the shoring engineer will utilize the strength parameters provided in the soils report to design the shoring system. All of this information is then captured in the structural, civil, architectural, and shoring plans for the project.

There are multiple points at which the site evaluation process can break down, starting with the soils report. Every soils report contains language to the effect that “the site is suitable to support the proposed construction provided that the recommendations in this report are followed.” Unfortunately, this is conclusion is not always justified. The scope of the subsurface exploration program (e.g., borings) may be insufficient to properly characterize the subsurface conditions. For example, the borings may not cover the site sufficiently or may fail to extend deep enough to evaluate the relevant bearing strata. Laboratory testing may be insufficient to gain an accurate understanding of the soils characteristics or predict their future performance under building loads. Even if the field exploration and laboratory testing programs are appropriate, the soils engineer may not accurately analyze the data and/or may provide recommendations that are not suitable for the site conditions. If any of these issues occur, then the other design professional will be performing their design based on flawed design parameters and recommendations.

Assuming that the soils report is thorough and accurate, there is still tremendous risk that the recommendations in the report do not accurately get incorporated into the project plans. As discussed below, this is the most common source of risk on the projects we have reviewed. The structural engineer and/or architect sometimes provide design drawings that are simply not consistent with the recommendations in the soils report. The risk is further exacerbated when the developer changes geotechnical consultants between the design and construction phase. Knowledge gained during the exploration phase becomes lost and the reasoning behind the original soils engineer’s recommendations evaporates, significantly increasing project risk.

Not only are there almost always large areas of good soils conditions in these same areas, there are always ways to mitigate even the most challenging soils.
What are the most common failures?

There exists a broad range of soils claims derived from a myriad of different sources. However, there are common factors that tend to lead to all of these problems and these factors typically can be identified prior to construction. This is based on Brian Kramer’s 20+ years of experience analyzing a broad range of soils claims; including root cause analysis, developing long-term repair recommendations and providing construction oversight, which is the basis of expanding Quality Built’s services to include geotechnical reviews.

The majority of these claims were from projects adversely impacted by differential settlement, expansive soils, and/or moisture intrusion. Differential settlement is the result of loose, soft, or compressible/collapsible soil located beneath a structure experiencing greater settlement in one area versus another. The soils could either consist of natural deposits or compacted fill. This post-construction settlement is typically caused by the introduction of water beneath the structure. The other form of post-construction volume change is swell from expansive clay soils. Some clay particles have a strong affinity for water and will swell if the particles are compacted tightly together. Both settlement and swell can exert imbalanced loads on foundation systems leading to deflections which may exceed the structural capacity of the slabs or footings. The resulting damage often includes cracking of concrete foundations, elevation differential across the floor slabs, and deflection of the overlying framing elements leading to cracking of the interior and exterior wall surfaces.

Subterranean moisture intrusion damage to structures can come in many forms including both free water and water vapor. Free water is the water between the soil particles in the liquid phase that migrates adjacent to or beneath a structure. The movement of this water is primarily driven by gravity, however, it can also move laterally and upward between soils particles via soil suction (negative pore water pressure). Finally, the free water can either be in the form of groundwater (larger, more continuous zones of subsurface water) or perched water (smaller, less continuous pockets of water). For groundwater, full hydrostatic pressures must be taken into account on subterranean horizontal surfaces (slabs) and vertical surfaces (walls) of structures. Alternatively, permanent dewatering systems around the perimeter of the subterranean may be employed to eliminate hydrostatic pressures. For perched water, substantial hydrostatic pressures are less common, but the waterproofing system must effectively shed water that comes in contact with the structure, primarily on vertical wall surfaces.

Water vapor has the potential to adversely impact both subterranean structures and slab-on-grade floor systems. Water vapor is water in the gaseous phase, with the vapor being driven by temperature and humidity differentials. Water vapor pressure gradients are created where a warm, moist environment is communicating with a cool, dry environment. The most common condition generating a strong gradient is an air conditioned (cool, dry) space separated from warmer, moist soil by a concrete slab. The resulting vapor pressure differential in these situations
may result in relatively substantial water volumes transmitting through the slab and into the flooring materials and building. However, settlement, expansion, and moisture intrusion aren’t the only sources of problems that have led to litigation. There are failures derived from less common but often-times far more expensive problems; such as drainage-induced failures of mechanically stabilized earth wall, deep seated landslides, freezing and thawing, and vibration induced damage.

MITIGATING BELOW FOUNDATION RISK

The typical approach to assessing and mitigating risk related to below-foundation conditions is different from how the building industry and the carriers that insure them address other risks. Most carriers will simply avoid certain geographic areas known to possess problematic soils conditions such as critically expansive clays rather than gather site specific information and retain professionals to help mitigate the risk. Not only are there almost always large areas of good soils conditions in these same areas, there are always ways to mitigate even the most challenging soils. Others make an attempt to evaluate the risk by asking for the soils report and verifying it was prepared for the development. However, as you will see below, having a soils report stating that “the site is suitable for the proposed construction” is sometimes not worth much. Worse yet is the concept of a “geotechnical” third-party review being performed by unqualified parties, which is really nothing more than a summary of the soils report. This type of review offers no value to anyone.

CONDUCTING A PROPER GEOTECHNICAL REVIEW

In order to truly understand the geotechnical risks at a project, Quality Built LLC evaluates three fundamental components, or phases, of the geotechnical design process. In order to give you a clear understanding of these phases, we will provide examples of what we have found that was problematic in the past year.
Phase I: Subsurface Investigation and Laboratory Testing

This phase entails evaluating the extent that the soils engineer performed a suitable site investigation and laboratory testing program. Typical questions include: Did the project soils engineer excavate a sufficient number of borings, cone penetrometer tests, and/or test pits and were these excavations placed in the appropriate locations and taken to sufficient depths to properly characterize the subsurface soils conditions? Further, did the engineer perform the appropriate laboratory tests to characterize the site soils and predict their future behavior? Finally, are subsequent soils reports (e.g., compaction reports) consistent with the original investigation? This is the phase that we have found the fewest number of problems that could adversely impact projects.

However, where we did uncover issues, the potential risk was substantial:

1. An original subsurface investigation report for two-story condominium buildings in Northern California identified a previously existing basement that, once removed, would require 10 feet of structural fill. However, the subsequent compaction report stated that only 2 feet of fill was placed during grading. To ensure that the full excavation and infill of the previous basement was actually performed, we reviewed photographs taken during grading and additional test data. Our review ultimately prompted two changes to mitigate risk. The first included a substantial revision of the compaction report to properly memorialize the actual grading operations. Second, the builder agreed to strengthen the continuous footings in one building that extended from dense native soils on one side and 10 feet of compacted fill on the other, thus reducing the risk of differential fill settlement distress.

2. A six-story apartment building in Seattle was evaluated where the project geotechnical engineer concluded that the building could be supported on shallow footings using an 8,000 psf allowable bearing capacity, which is very high. However, our review of the test pit excavations performed at the site revealed that the test pits did not even extend down to the depth of the proposed building footings. Further, no laboratory tests were performed on the site soils to evaluate their in-place strength parameters. Therefore, there existed no data in the soils report to substantiate the bearing capacity design recommendation. Fortunately, the project soils engineer was able to provide data from nearby projects to justify the design and the design was supported by footing inspection reports and photographs.
Phase II: Geotechnical Analyses and Recommendations

In the course of performing its duties the project soils engineering firm performs various calculations to evaluate the design soil strength parameters and to predict the performance of the soils beneath the structure at the specific site. The firm also provides all of the recommendations necessary for the other design professionals (structural engineer, architect, civil engineer, etc.) to further design the building and site. During this phase of our geotechnical review we evaluate if the soils engineers’ recommendations are consistent with the calculations. Here are examples of where the soils report field exploration was sufficient yet the engineering analyses resulted in poor designs:

1. A multiple duplex and MFD structure project was located in Texas where three different soils engineering firms performed investigations and provided recommendations for the project. However, the client and other members of the project team were unsure as to which geotechnical firm was the soils engineer of record. Further, the foundation design provided by the soils report was barely sufficient to withstand even moderately expansive soils although the site consisted of very highly expansive clay soils. Had this discrepancy not have been brought to the attention of the builder, the slabs would have been subjected to substantial swell pressures likely resulting in excessive deformation of the slabs and overlying structures. To mitigate this risk, the structural engineer provided a more robust slab design and tremendous focus was placed on pre-wetting the near surface clay soils prior to slab construction.

2. On a large percentage of projects we review in California, Colorado, and various other states, there is disconnect between the soils engineer’s recommendations and the current ACI guidelines (ACI 302.1R) for slab underlayment (e.g., trimmable compactible material in lieu of washed concrete sand). Considering the large number of litigation cases involving moisture vapor intrusion through concrete slabs, the type of vapor retarder and ideal location within the slab bedding materials should be well understood by the soils engineer. For example, on a townhome project with a semi-subterranean garage in Los Angeles, the soil engineer recommended a 6 mil vapor retarder in the middle of a 4-inch sand layer. Since washed concrete sand is highly susceptible to disturbance during the placement of reinforcing steel and concrete (resulting in highly uneven slab thicknesses), we recommended the use of trimmable, compactible, well-graded, silty sand, per ACI, to provide a more stable bearing surface.
Phase III: Integration of Design Professional on Plans

Based on our history of performing third-party geotechnical reviews, this is by far the greatest source for geotechnical risk on a project. When recently asked by a client why I had a concern with a certain aspect of the foundation design, I said, “Well, do you want me to start with the soils report, the structural plans, or the architectural plans, because all three are providing completely different designs.” Most design professionals retained on the projects we review prepare a good work product. However, it is rare that we find a concerted effort by any party to ensure that the recommendations and/or design from the various design professionals are well understood, consistent, and properly depicted on the plans. The end result is that the recommendations contained in the soils report are sometimes depicted incorrectly on the design drawings used for construction. Recent examples of design busts that were moving into construction include:

1. A five-story structure over subterranean in Los Angeles required shoring to support the subterranean excavation. The soils report for the project provided lateral earth pressure design parameter to use for shoring. However, the specific shoring plans for this project used incorrect lateral earth pressures and referenced the wrong design soils report (and firm) entirely. Therefore, there was a substantial risk of shoring failure and resulting damage to adjacent structures. The design team was fortunately able to determine that the existing shoring design had a sufficient factor of safety to support the actual design pressures and the project proceeded without incident.

2. Another L.A. structure with 25 feet of subterranean parking was designed by the project soils engineer to have active dewatering since it would be below the anticipated groundwater elevation. Based on our review of the architectural, structural, and civil drawing, there was no active dewatering system indicated on the plans. Not only did the dewatering system not get included in the project plans that were to be used for construction, but the basement walls did not even have a waterproofing design. Subsequent to our review, the plans were changed to incorporate a permanent dewatering system and waterproofing submittals were prepared. If these changes were not made, there would have been a high risk of substantial volumes of water infiltrating the subterranean parking structure.

3. A nearly 40-story tower in Washington had an experienced design team that prepared a quality soils report and project plans with excellent subsurface drainage and waterproofing designs. However, based on our review of the project plans, the plans provided a design that did not integrate the above-grade waterproofing into the subsurface waterproofing. Failure to terminate these systems properly created risk for water intrusion into the upper level of the subterranean parking structure. Our findings were provided to the developer’s architect and waterproofing consultant to enable them to improve upon their design and reduce risk.
OVERALL RESULTS FROM PREVIOUS GEOTECHNICAL REVIEWS

Based on our geotechnical reviews over the past year, Quality Built’s geotechnical reviews have identified moderate to major geotechnical concerns in approximately 15 to 25% of the projects. Approximately 30% of the projects have relatively minor soils issues identified or would be determined to have minimal adverse impact on the projects. An example of this group would be identifying no reinforcing steel in a parking garage slab or using welded wire mesh (which almost never ends up where it belongs) in lieu of rebar for a home slab. Neither of these situations is catastrophic, but providing the client with more knowledge to assess the cost to benefit of using a better design has proven valuable. The remaining approximately 50% of the projects fall into a difficult-to-assess category in that the client and/or design team state they were always intending to build it the right way. In other words, the clients suggest that the errors and/or omissions we identified in the reports or on the plans were minor and would have been resolved during construction. Maybe so. But at a minimum, there would be plenty of fodder left for a plaintiff geotechnical expert if the project ever progressed into litigation.

So when does it make sense to perform a geotechnical review for a project? Unfortunately, we do not have enough data to see discernible patterns in high-risk projects either by project type, location, or even complexity of design/construction. We have reviewed very basic projects and found substantial risk. At the other extreme, we have completed the review of a very large project built over highly-compressible bay muds involving deep soil mixing, drilled displacement piles, lightweight cellular concrete, sheet piles, and other mitigation techniques to arrest the predicted 18 inches of settlement and have found virtually nothing to improve upon. Therefore, the only guidance at this point is to include a geotechnical review unless you are confident that the builder/developer has a process to ensure that the type of risks we have found in each of the three phases is identified. More specifically:

1. The builder/developer should be confident that the extent of the geotechnical field exploration and laboratory testing program performed by the soils engineer is sufficient to properly characterize the site. This would include both the quantity and types of tests performed.
2. The geotechnical analyses performed by the soils engineer should be accurate and address all relevant geologic and geotechnical aspects of the project. Further, the recommendations provided in the soils report need to provide appropriate design parameters for use by the other design professionals.
3. The builder needs to ensure that the soils engineer, structural engineer, architect, and other design professionals on the project are fully integrated relative to the geotechnical design of the project. Specifically, they need to ensure that the recommendations contained in the soils report are fully incorporated into the project plans and that the various project plans are consistent.
CASE STUDIES:
CONSTRUCTION DEFECT LITIGATION
The following summaries are derived from relatively recent construction defect litigation cases in which Brian Kramer was retained as a geotechnical expert to provide testimony on the subject matter. The goal is to provide the reader examples of what soils or foundation problems have led to litigation, the lessons learned during the case, and how the solutions changed our designs as engineers.

SUBJECT:
PERMEABLE SLAB SECTIONS LEADING TO DAMAGED FLOORING

Claim:
Plaintiffs claimed that a combination of permeable concrete slabs and insufficient vapor retarder design and/or construction was causing damage to floor coverings in residential, commercial, and industrial buildings. The damage observed typically included staining, peeling, or bubbling of rubber-backed flooring (e.g., linoleum, vinyl composite tiles, etc.). Damage sometimes included re-emulsification of the adhesives leading to oozing at the edges of tiles.

Lessons Learned:
The observed damage described above was becoming more commonplace despite no apparent change to construction methods and materials. Mr. Kramer testified in numerous cases as this issue progressed from an early “research” phase to the current state. During this process, a determination was made that the change from oil to water-based adhesives in the mid 1990s, driven by new volatile organic compound reductions standards by Air Quality Management Districts, was a major cause of this problem. Floor cover adhesives that normally performed well in the high alkaline environment of concrete were now deteriorating in even normal slab moisture transmission environments. The industry learned that it was important to use more robust vapor retarders and include a pH-reducing penetrant on the concrete slab where moisture sensitive flooring would be used. This lesson is applicable to all slab-on-grade projects nationally with moisture sensitive floor coverings. Quality Built focuses closely on the slab section design during our geotechnical evaluation to help mitigate this risk.
SUBJECT: DAMAGE TO EXISTING STRUCTURE FROM EXCAVATIONS

Claim:
Numerous cases have been filed alleging damage to existing buildings from the installation of tiebacks and shoring of excavations. The plaintiffs would often claim that deflection of the soldier piles and lagging, tieback anchor pull-outs, localized “blow-outs” of soil behind the shoring, or the vibration associated with construction led to damage of their structures.

Lessons Learned:
Relatively deep excavations adjacent to existing structures are a major source of risk. Though the causations presented above rarely lead to actual damage, they all can theoretically lead to damage when the existing building is in the zone of influence of the new excavation. Therefore, the industry has increased its use of critical risk mitigation measures such as pre-construction surveys, settlement monuments, zero deflection shoring design, and vibration monitoring. Geographically, the greatest risk for these types of claims are in congested urban environments where deep excavations close to existing structures is more common. During our geotechnical review, we pay close attention to the shoring design and the implementation of the above referenced risk mitigation measures.
SUBJECT: SULFATE ATTACK ON CONCRETE FOUNDATIONS

Claim:
Plaintiffs claimed that concrete foundations in contact with soils containing relatively high concentrations of sulfate would be subject to sulfate attack. They claimed that water soluble sulfates would enter into relatively permeable concrete and cause chemical deterioration of the cement matrix and physical damage to the concrete. Plaintiffs further argued that the concrete foundations were not in conformance with Uniform Building Code provisions.

Lessons Learned:
The claim of widespread damage due to sulfate attack was clearly a red herring since there were almost no actual examples of sulfate attack causing sufficient damage to residential foundations to warrant a repair. However, the industry was dramatically impacted by this widespread claim before it was ultimately disproved in a trial where Mr. Kramer served as one of the defense experts. In order to ensure conformance with all interpretations of the building code, the industry adjusted its requirements for minimum water-to-cement ratios and cement types where concrete foundations would be in contact with high sulfate soils. This design criteria would apply to all parts of the country where soils contain high percentages of sulfate. Quality Built reviews the laboratory testing provided by the soils engineer and resulting concrete recommendations as part of our geotechnical review.
SUBJECT: LANDSLIDE DAMAGE TO PROPERTIES

Claim:
Hillside developments with fill or natural slopes have been the subject of various lawsuits where slope failures have caused damage to the developed project and/or to adjoining properties. Landslides are generally categorized as deep seated (gross stability) or shallow (surficial stability) failures. They are typically triggered by the introduction of water into the failure area, which results in added weight and reduced soil strength. The most common failures are relatively shallow (less than approximately 5 feet deep) and consist of slump failures or debris flows (mudslides). Debris flows often run onto adjoining properties and create damage that leads to litigation.

Lessons Learned:
The geotechnical engineering community has gradually been increasing its focus on evaluating the risk of surficial slope instability on both fill slopes and unimproved areas of existing slopes. This is another subject matter where the expertise of a licensed geologist is critical. Where natural slopes exist, it is important that the history of slope failures in the area is understood and the slopes susceptible to future failure are either stabilized or at least contained within the developed property. For fill slopes, the use of relatively cohesionless sands near the outer face of the slope is discouraged. Further, recommendations for proper, specialized compaction techniques are incorporated in the soils reports. Mr. Kramer has testified in various cases involving both shallow and deep seated failures involving fill and natural slopes. Particularly with the upcoming El Niño rains in the west, Quality Built will be looking intently at the risk of slope failure at a site and the analysis and recommendations provided in the soils report.
SUBJECT: RETAINING WALL FAILURES

Claim:
Excessive deflection of traditional cantilevered cast-in-place concrete or concrete masonry unit retaining walls has periodically led to construction defect litigation. However, with the increasing use of alternative wall systems such as segmental block walls, mechanically stabilized earthen walls, gravity walls, etc., many with proprietary designs, the potential for failures may be increasing. Many of these systems are designed to accommodate more movement than a cantilevered wall and remain structurally sound. However, even without failure of the wall system, the excessive deflection of the wall could lead to relaxation of the backfill soils creating settlement or lateral displacement of the soils beneath structures built behind the wall.

Lessons Learned:
Mr. Kramer has testified in various construction defect cases involving damage to structures located behind some of these alternative wall systems. The most common cause for failure of these walls is improper subsurface drainage design and/or construction behind the wall. Since many of these wall systems rely heavily upon the strength of the soils behind the walls, excessive water in the backfill behind the walls will lead to greater pressure on the wall system and lower soil strength capacity. For wall systems that utilize anchors (geosynthetics, soil nails, etc.) in the backfill soil zone, the proper compaction of these soils is even more critical to ensure good performance. During the geotechnical review, Quality Built looks closely at the type of soils being used for backfill and the provisions for subsurface drainage.
Brian Kramer, PE, GE
Quality Built, LLC
Chief Executive Officer

Brian Kramer, PE, GE has a proven history as a successful engineer with expertise derived from many years of managing projects ranging from construction of single-family residences to heavy civil construction. Mr. Kramer also has over 20 years of experience as a civil and geotechnical engineer, directing design engineering and construction oversight efforts of nearly every type of construction project. With over 20 years of experience as a geotechnical and concrete expert in various litigation cases, Mr. Kramer has been deposed on a broad range of geotechnical claims and has testified successfully in numerous trials. Mr. Kramer’s litigation experience and the breadth and depth of his engineering expertise has qualified him to lead Quality Built’s technical staff and offer forensic consulting and expert witness services as Principal Engineer. Mr. Kramer specializes in matters involving geotechnically-related structure distress, construction materials testing, and performance of foundations. Mr. Kramer’s education, experience, and affiliations include:

EDUCATION:
Master of Business Administration, University of California, Irvine, 2000
Bachelor of Science in Civil Engineering, San Diego State University, 1992

REGISTRATIONS:
Registered Geotechnical Engineer, California, GE 2571
Registered Civil Engineer, California, RCE 54282

AFFILIATIONS:
- Advisory and Development Council Member, California State University, Long Beach, College of Engineering
- Member, Chi Epsilon Civil Engineering Honor Society
- Member, Young Presidents Organization (YPO)
- Member, Sigma Chi Fraternity
- Former Board Member, California Transportation Foundation
EXPERIENCE:
Chief Executive Officer, Quality Built, LLC
March 2010 to Present
As CEO, Mr. Kramer provides the technical direction and managerial oversight to Quality Built, LLC. The company was founded on extensive litigation experience and a long history of conducting inspections for the construction industry. Due in part to the leadership and technical acumen provided by Mr. Kramer, Quality Built, LLC is the largest national provider of third-party site observations, inspection management, and risk management services of its kind to the residential construction industry. Mr. Kramer provides technical oversight for engineers, architects, and building inspection experts within the firm.

Chief Executive Officer, Twining, Inc.
December 2003 to September 2012
As Principal Engineer and CEO of Twining, Inc., Mr. Kramer provided the technical direction and engineering oversight for one of California's largest and most well respected geotechnical and materials engineering consultancies. With over 300 employees and five state-of-the-art laboratories serving on projects throughout the state, Mr. Kramer led a team of engineers, geologist, technicians, and scientists providing design and construction QA/QC services on some of the most prominent projects in California. Notable projects included the LAX 25L Replacement Runway, UCI Hospital, Bolsa Chica Lowlands Restoration Project, and numerous high-rise building projects.

Founder, President and Principal Engineer, Testing Engineers – L.A.
August 1998 to November 2003
T.E.L.A. provided geotechnical and materials engineering, testing, and inspection services to public and private sector clients in the greater Los Angeles area. Mr. Kramer founded the company and served as President and Principal Engineer for the firm, where he provided managerial and engineering oversight for all staff and projects. Typical construction projects consisted of mid- to high-rise structures, hospitals, schools, residential and commercial developments, and infrastructure projects. In his capacity as a geotechnical and materials engineer, he was retained as an expert witness in hundreds of construction defect litigation cases, providing testimony in deposition and at trial.

Senior Project Manager, Ninyo & Moore Environmental and Geotechnical Consultants
March 1992 to August 1998
Ninyo & Moore is one of the largest geotechnical and environmental consulting firms in the southwestern U.S. In the capacity of Staff Engineer through Senior Project Manager, Mr. Kramer performed extensive engineering analyses on major private and public sector projects. He subsequently served as Senior Project Manager for the engineering and/or construction testing and inspection services on numerous large-scale projects, including some of the largest transportation projects in Southern California. In that position, he managed the operations of satellite offices, provided senior–level management and engineering guidance, and served as a geotechnical expert on numerous construction defect litigation cases.
REPRESENTATIVE TECHNICAL EXPERIENCE:

- Geotechnical investigations, analyses, and preparation of reports for the development of residential, commercial, and public use facilities
- Provision of forensic consulting and expert witness testimony, including forensic evaluations of distressed residential and commercial structures, and evaluation of earthquake damage, in construction defect litigation cases
- Design input for slabs and foundation systems, including shallow foundations, dense aggregate piers, and deep foundations consisting of driven piles or caissons
- Design and implementation of subsurface exploration programs involving small and large diameter auger borings and cone penetrometer testing
- Supervision of field testing and inspection technicians on major construction projects, including personnel involved in field density testing, concrete field testing and inspection, soils and materials sampling, and production plant inspection
- Performance of tunneling, dewatering, and blasting zone of influence studies for excavations
- Analyses of excavation stability, including anchored bulkheads and trench shoring, and surficial and gross slope stability
- Reviews and approval of project plans and specifications, typically as the soils/geotechnical engineer of record for the project
- Review of geotechnical and materials specifications to ensure conformance with project specifications and applicable codes, including Caltrans, SSPWC, DSA, OSHPD, and CBC
About Quality Built, LLC

Business Organization
Quality Built has provided quality assurance inspection and risk assessment services to insurance companies, financial institutions, and builders for the past 19 years.

Registered Principal Officer:
Principal Engineer / Chief Executive Officer:
Brian C. Kramer, R.C.E., G.E.
Registered Geotechnical Engineer, California, GE 2571
Registered Civil Engineer, California, RCE 54282

Duns Number: 96-252-2616
Certificate of Authorization No.: 29039
Licensure Date: 03-18-10

Qualifications
Quality Built is an advanced construction consulting firm providing building inspection services. Our inspectors have performed quality inspections on more than 8,000 construction projects across the United States and we have supplied our services to over 500,000 homes to date. Our clients include some of the largest home builders in the country, as well as several hundred small and regional home builders, insurance carriers and financial institutions. We have provided services for all types of construction including single-family, multi-family, high-rise condominiums and commercial properties.

Quality Built applies emerging technologies that are scalable as part of our methodology for achieving operational excellence. Our proprietary and proven inspection systems serve the needs of construction-related industries by providing customized inspection programs and robust data processing services.

ISO Certification
We are the only firm of this type whose Quality Management System is ISO 9001:2008 registered. ISO 9001 is a group of defined standards for quality management systems which is controlled by the International Organization for Standardization.