Numerous studies performed over the years document the significant rise in construction disputes and litigation, and one of their conclusions is that allegations over defective specifications are a leading, if not the primary, cause of these disputes. A large number of these disputes involve site work.

While the efforts of industry associations such as the Associated Soil and Foundation Engineers (ASFE) have done a great deal to reduce claims against professionals and owners, geotechnical and site work-related issues continue to account for a large percentage of construction disputes. However, many of these situations can be avoided when all parties pay attention to the technical specifications and language of the contract.

Technical problems
Compaction specifications
One of the more common site work problems faced by owners, engineers, and contractors is fill placement an
compaction—predominantly regarding material suitability and compaction density.

Contract documents for earthwork construction often specify the type of fill material permitted for use, the method of placement (including maximum lift thickness, type of compaction equipment to be used, and the number of passes), the density to be achieved in terms of percent compaction and allowable moisture content, and the method and frequency of testing. With all these prescriptive requirements, it is no wonder the final product can sometimes cause disputes and disagreements.

For example, a typical specification might require a granular fill with prescribed gradation limits in terms of maximum particle size and allowable percentage of fines (material passing a No. 200 sieve), to be placed in 305-mm (12-in.) lifts and compacted with a minimum of four passes by a 4.5-t (5-ton), smooth-drum vibratory roller. The specification may further require compaction to a minimum density of 95 percent of maximum, density determined using a modified Proctor test, and an allowable moisture content within +/- two percent of optimum. While the above specification may appear typical and unambiguous, several types of disputes can arise.

In this situation, the contract specifications prescribe both the method and the results. So what happens when the contractor strictly conforms to the specification requirements for gradation—i.e. lift thickness, roller requirements, and moisture—but can only achieve 93 percent compaction? In such cases, the contractor may seek relief from the specified requirements, or subject the owner to claims for additional costs to achieve the required compaction.

Using the same scenario, what happens when the contractor achieves the required 95 percent compaction, but the moisture content of the fill material is outside the specified +/- two percent of optimum? Should the fill be rejected? Similarly, what if compaction and moisture conform to the specification requirements, but the gradation is outside the specified limits. All these and similar disputes commonly result in extra costs and lost time in their resolution, both during the project as engineers resolve the technical issues, and later when the owner resolves cost and delay issues with the contractor.
"In 1969, when 10 firms formed Associated Soil and Foundation Engineers, geotechnical engineers were so claims-prone they were virtually uninsurable." — W. Jerrold Samford, PG, ASFE president.

How good is good enough?
While owners and engineers prefer prescriptive specifications for ensuring the contractor performs the work correctly, as we see from the above examples, this approach can be the source of numerous problems. In working to resolve many of the disputes that arise as a result, and in recommending approaches to avoid such disputes in the future, the parties involved should simply focus on the intended purpose of the work.

In the above example, if the intended purpose of the compacted fill is to support footings for a low-rise commercial structure, the ultimate concern is the bearing capacity of the soil to support the footing, along with the allowable settlement that is acceptable from a structural, purpose and use, or aesthetic perspective.

In determining the acceptability of the contractor's non-conforming result, one must ask if the intended purpose can be met with the as-constructed condition. Regarding the underachievement of compaction, the question becomes: "Is 93 percent compaction good enough?"

As is many times the case, design engineers seldom specify a required bearing capacity greater than 20 t/m² or 29 t/m² (2 or 3 tons/sf [tsf]), and detailed geotechnical analysis and testing often confirms that 20 t/m² or 29 t/m² can be achieved with 93 percent compaction.

Similarly, settlement (compressibility) of the soil is often shown through testing not to differ significantly enough between 93 and 95 percent compaction to warrant the more stringent requirement. Detailed geotechnical evaluation often demonstrates that minor non-conformance in gradation are often acceptable without jeopardizing bearing strength or compressibility of the soil.

In terms of allowable moisture content, if the percent compaction is achieved, there may be no need to require these criteria. There is a limit to the situations in which the as-compactedor moisture content plays a role in the long-term performance of the fill.
Without a site investigation, the contractor will have to rely solely on informative contract documents when bidding.

Conformance or performance?
All this begs the question: "Why does the industry so diligently continue to specify criteria that appear unnecessary or overly restrictive (i.e., the fixation on specifying 95 percent compaction)?"

Perhaps it is because the more common prescriptive specifications do include a margin of safety that has crept into typical designs and silently compensates for variation in the product and/or the materials.

This empirical approach with its margin of safety is also routinely used in the absence of detailed geotechnical testing. Rather than perform testing to develop the specific relationship between percent compaction and bearing capacity for the soil in question, the empirically proven criteria of 95 percent compaction often is selected as a default.

While this approach does save the cost of detailed geotechnical testing, the built-in conservatism of the approach comes with its own added cost as a result of over-specifying the requirements.

These issues bring us to the heart of the matter, which is to recognize the goal of the specification. Is the goal of the contractor's work to conform to the specifications or to deliver site work that meets the performance requirements of the intended use—in this case, to support the commercial structure safely and without excessive settlement?

The obvious answer is to achieve both. However, given the realities of construction, there are times when deviations from specifications need to be addressed. Focusing on performance requirements can provide an opportunity for cost savings by fostering the safe removal of restrictive requirements to provide the contractor more flexibility in achieving the desired end result. Performance-based requirements can also minimize many of the sources of the common disputes mentioned here.

Requirements for performance-based specifications
The concept of performance versus prescriptive specifying is well understood. As a risk allocation method, performance specifications, which define required results of the construction to be performed and criteria for acceptance, place the burden for achieving the desired result on the contractor. Prescriptive specifications, which define the exact properties of the materials and methods of installation place the burden on the owner and his design team. If the prescribed process is followed, the desired outcome will be achieved.

Performance-based specifications often establish the intended end result and leave the selection of methods and materials to the contractor. In its desire to be thorough,
However, the design team often combines the two concepts to create the potential for claims by specifying both the method (lift thickness, number of passes, etc.) and the desired result (percent compaction), which leads to the problems cited. If performance-based specifications are prepared with sufficient care and forethought, the result can meet all the engineering requirements of the intended purpose, with the added potential for savings in costs and reduced risk of extras to the owner.

When considering performance specifications, it is essential the design team determines exactly what it wants of the contractor. The engineer should specify the site work to provide a fill to a set elevation, the minimum compaction or bearing capacity required, and the maximum allowable settlement measured in terms of compressibility. He should also specify how to measure or verify the criteria have been met, and that the contractor submit his methods and materials for approval. This allows the engineer to confirm whether the contractor’s approach is reasonable.

In this manner, one can be sure the contractor’s plan is technically sound and will perform correctly as in a prescriptive specification. The only difference is the removal of potential disputes arising from the methods, material, and level of effort required to achieve the end result. The responsibility for the successful completion and turnover of the end product is no longer shared, but now rests entirely with the contractor. This flexibility can lead to lower costs to the owner.

Using performance-based specifications
The nature of performance-based specifications forces the engineer to refrain from telling the contractor how to do the job. This is a challenge for many engineers, as it requires the release of some control over the job, but one can be pleasantly surprised with the talent and ingenuity of the contractor community. The engineer’s only concern is to focus on the objectives to be met.

For example, the industry routinely specifies that engineered fill material be granular in consistency, often calling for the material to be free-draining as well, thereby severely limiting the amount of fines permitted. While granular material generally outperforms material composed primarily of silts and clays—especially for structural fills—the use of non-granular material should not be precluded out of hand.

Non-granular fill material can perform quite satisfactorily when properly engineered with well-controlled placement and compaction. In many parts of the country, granular materials are more costly, in some areas are not available at all, and non-granular materials have proven acceptable for structural uses.

This is another example where common prescriptive specifications have empirically become the standard for many engineers. To extract the full advantage of performance-based specifications, the engineer must question the need for whatever requirement is ultimately specified. He should refrain from over-specifying to provide a margin for error unless the owner is willing to pay the premium. If this is the case, at least recognize the margin or error may be all you are buying, and not a noticeable increase in performance.

The following suggestions can provide

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Looking For Quality? Look For SGCC.
The site work contractor should submit his methods and materials for approval to ensure his approach is reasonable.

A start in determining what criteria and requirements are important in specifying performance-based requirements for earthwork:

1. **Percent compaction**
   Use geotechnical testing to determine the degree of compaction required to yield bearing capacity and compressibility characteristics that meet the intended purpose. Is there any reason to specify the method (i.e., lift thickness, number of passes, etc?)

2. **Moisture control**
   Avoid confusing moisture control that facilitates compaction with moisture control that affects soil properties such as swell and collapse, permeability, and so forth. If these characteristics are not an issue for your project, there may be no reason to specify moisture control as an acceptance criteria, and it can be left to the contractor to facilitate compaction efforts.

3. **Gradation**
   If bearing capacity, compressibility, and settlement criteria can be met with non-granular material, and if the particular properties of a free-draining material are not required, there may be no need to restrict the contractor to potentially more costly granular material.

**Contract problems**
In addition to technical considerations, one of the first things to address at the outset of any project is which party will assume the predominant risk for site condition uncertainties—owner or contractor. This drives the formation of the specifications and determines how obligations and acceptance criteria are conveyed to the contractor.

Most professionals practicing in this area are familiar with the contractual mechanisms pertaining to risk allocation for the project, such as differing site condition clauses, waivers, and other exculpatory clauses, all of which limit or allocate risk. Regardless of the document, consistency of all information presented is an important fundamental concept. While this appears simplistic, it is violated all too often, exposing the owner to potential costly disputes.

If the owner and design team intend to assign the risk of site characterization to the contractor, then a certain amount of care needs to be taken to assure the project description, and general and technical information are consistent with that intent. It is important to avoid unnecessary representations that undermine the intended assignment of risk to the contractor.

For example, the contract documents for a river dredging project provided certain technical information as well as general site characterization. The contract contemplated suction dredging and contained the following general descriptive information:

The bottom sediments of the dredge work area consist primarily of fine medium, and coarse sand; and fine medium, and coarse gravel. Gradation curves for representative sediment samples are presented in Figure 6.3. The bottom is littered with larger cobbles and boulders ranging from 6 inches to 24 inches in diameter.

The purpose of the dredge work was to remove contaminated bottom sediment. As such, contractors were denied access to the river bottom during the bidding stage to avoid re-suspension. The contract did not contain a differing site condition clause and intended to make the contractor responsible for the risk of changed conditions. It was also the intent of the contract documents to provide a general description of the bottom sediment and allow prospective bidders to draw their own conclusion from the technical information contained in the gradation curve and other technical data provided.

During the project, the contractor claimed the job was misrepresented in the contract documents, as he encountered an inordinate and unexpected amount of larger cobbles and boulders. The contractor based his claim on representations made in the general description—that the site was primarily sand and “littered” with larger cobbles and boulders. The contractor claimed, that based upon the representations in the project
Inclusion of both site investigation and differing site condition clauses in the contract documents can lead to dispute.

description, the bid was based on encountering a minimal amount of larger cobbles and boulders.

Despite the intent of the contract documents for the contractor to develop his own conclusions regarding site conditions, the description provided certain representations and raised a number of questions. If the site was "littered" with larger cobbles and boulders, did the contract documents intend to portray a large or a minimal number of cobbles and boulders? While terms such as sand, gravel, and boulders are easily understood, the term 'littered' is subject to interpretation.

The placement of phrases and punctuation is also key, as shown in the first sentence of the excerpt:

The bottom sediments of the dredge work area consist primarily of fine medium, and coarse sand; and fine, medium, and coarse gravel.

The placement of the semi-colon led to a dispute as to whether the site was primarily sand, or primarily sand and gravel. At this point, regardless of who had the correct interpretation of the term 'littered,' and whether the site was primarily sand or sand and gravel is immaterial. Once the dispute proceeded to litigation, both sides had already lost by incurring cost, delay, and aggravation.

Problems like this can be minimized or avoided altogether by following some basic suggestions when preparing contract documents:

1. Unless it is your intent to assume responsibility for deviations, keep subjective descriptions or opinions to a minimum, or eliminate them altogether.

2. Let technical data speak for itself. If the contract documents are providing all the technical data collected, allow the contractor to make his own interpretations.

3. Ensure general descriptions are consistent with the intent of the contract and technical data.

The problem of risk allocation

As a risk allocation method, many contracts contain some form of differing site condition clause. This clause, which provides relief for the contractor when he encounters conditions materially different from those represented in the contract documents—or could not have been reasonably anticipated—eliminates the need for large contractor contingencies to cover hidden conditions. The differing site condition clause forces both owner and contractor to share the risk of unanticipated conditions.

To further define the conditions under which the contractor can recover for a differing site condition, and to minimize some of the risk from claims, many owners include a site investigation clause in the contract documents. These clauses require certain representations from the contractor regarding his familiarity with site conditions.

Problems can arise, however, when the owner or his design team rely on the site investigation clause to deny what might otherwise be a differing site condition. These clauses typically contain certain representations regarding the scope of the investigation, and require the contractor's reliance on those results to the exclusion of other information furnished by the owner.

For instance, the site investigation clause may require the contractor to state he has performed sufficient independent investigation and testing to become fully acquainted with the conditions of the site, and based his bid on that information. Should a contractor then make a claim under the differing site condition clause, the owner and its agent immediately deny the claim based on the provisions of the site investigation clause. This does not always work out as the owner thinks it will.

In one case, an asphalt contractor was hired by the State Department of Transportation (DoT) to widen a section of road. During the course of the project, the contractor encountered quantities of unsuitable materials exceeding what was represented in the contract documents. After exhausting the administrative remedies, the contractor sued DoT. At issue was the contractor's right of recovery, and if he had such a right, how much borrow had been required and how much unsuitable material had to be removed and disposed.

The courts found in favor of DoT, concluding th
The contractor's bid was based on his own investigations into subsurface conditions. Hence, it is the contractor's problem. On appeal, however, the State Supreme Court considered whether the contractor was entitled to additional compensation for removing and disposing of excess unsuitable material. The court noted the contract contained a differing site condition clause, which stated in part:

During the progress of the work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the Contract...

DoT countered with the following excerpt from the contract documents (which it used right from the start):

The submission of a bid will be considered conclusive evidence that the bidder has examined the site of the proposed work, proposal, plans, standard drawings, specifications... and any other documents specified in the proposal before submitting a bid and is satisfied as to the conditions to be encountered in performing the work and requirements specified in the proposal... The submission of a bid will be considered conclusive evidence that the bidder is satisfied with regard to the subsurface conditions to be encountered in the work.

The Supreme Court rejected DoT's arguments, stating that to apply these arguments would render meaningless the language of the differing site condition clause. Thus, the contractor was entitled to additional compensation. Clearly, a reliance on remedy-limiting clauses or other exculpatory language as the sole rationale to deny claims comes with its share of risk.

As shown with the above examples, common site work problems that lead to claims and disputes can usually be avoided when misrepresentations are eliminated, language in documentation is clear, and project participants focus on the intent and purpose of the work, and not just what looks good on paper. The design team and specifying engineers may consider these suggestions as a starting point for developing specific solutions for their own unique projects.

Notes