OHIO RIVER VALLEY SOILS SEMINAR

LIABILITY ISSUES IN GEOTECHNICAL ENGINEERING AND CONSTRUCTION

November 6, 1987

PROCEEDINGS

ORVSS - XVIII
LIABILITY ISSUES IN GEOTECHNICAL ENGINEERING
AND CONSTRUCTION

NOVEMBER 6, 1987

PROGRAM

7:30 a.m.	REGISTRATION
8.45 a.m.	Welcome and Opening Remarks
9:00 a.m.	Keynote Address: "Professionalism and Quality: Foundations for the New Road" - Richard Cheeks
SESSION I:	LIABILITY MANAGEMENT Moderator: Keith Coombs
9:30 a.m.	"The Engineers' Standard of Care" C. Robert Lennertz
10:00 a.m.	"Managing Liability in a Consulting Firm" John L. Payne
10:45 a.m.	"Impact of the Differing Site Conditions Provision" - Robert W. Myers
11:15 a.m.	"Legal Issues for Geotechnical Engineers and Contractors" - Bruce Petrie, Jr.
11:45 a.m.	"Earth Retention Design, Ground Movement Monitoring and Liability - A Case History" - Clyde N. Baker, Jr.
12:15 p.m.	LUNCH
SESSION II:	LITIGATION MANAGEMENT Moderator: Richard L. Johnson
1:30 p.m.	"Effective Use of Expert Witnesses - The Baking a Cake Approach" Michael K. Ashar
2:00 p.m.	"Engineering in the Courtroom" F.C. Budinger
2:30 p.m.	"Soil/Acid Immersion Test as Focus of Court Testimony" - Kenneth H. Kastman, David M. Hendron
3:00 p.m.	"How to Control Disputes, Claims and Litigation" - Robert A. Shane
3:30 p.m.	BREAK
SESSION II:	PANEL SESSION Moderator: Richard M. McCandless
4:00 p.m.	"Where do We Go From Here?" Engineer - George J. Thelen Contractor - Tom Buzek Owner - Edwin J. Mascotte Lawyer - David B. Ratterman Insurer - Gerard F. Bonnett Government - George Fabe Arbitrator - Philip S. Thompson
5:30 p.m.	Social Hour
6:30 p.m.	DINNER
8:00 p.m.	Evening Address: "Alternative Dispute Resolution Procedures" Joseph S. Ward, Chairman ASCE National Forensic Engineering Council
9:00 p.m.	Adjourn

PROCEEDINGS OF THE EIGHTEENTH OHIO RIVER VALLEY SOILS SEMINAR

LIABILITY ISSUES IN GEOTECHNICAL ENGINEERING AND CONSTRUCTION

November 6, 1987
Drawbridge Inn
Ft. Mitchell, Kentucky

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KEYNOTE ADDRESS
PROFESSIONALISM AND QUALITY: FOUNDATIONS FOR THE NEW ROAD

J. Richard Cheeks, P.E.[1]

INTRODUCTION

I am honored to participate in this symposium on Liability Issues in Geotechnical Engineering and Construction. The geotechnical community continues to face serious professional liability problems that demand our attention and response. Our colleagues in other disciplines of the design profession face an even more serious crisis.

This presentation provides an historical perspective of the liability crisis, describes how many practicing geotechnical engineers have been able to mitigate this crisis, and suggests what the profession's options are for the future. The bottom line is that we must place more emphasis on the precepts of professionalism and quality if we are to retain our professional status in society. Since these liability issues are affecting all design professionals, my comments today are aimed at the entire profession, including architects. The geotechnical community is in a relatively strong position to lead the profession out of the liability morass, and must do so.

HISTORICAL PERSPECTIVE

Whenever the subject of liability comes up, I am reminded of a comment made to me in 1986 by a professor of Civil Engineering. He said, "If you guys would just do your work right, you would not have a problem." Well, in years gone by, this observation may have been more valid, but in today's litigious society, doing the job in a technically correct manner, in and of itself, is no guarantee that you won't become embroiled in disputes and litigation. In these instances, the loss of productive time, emotional distress, and the direct costs to defend against these claims are substantial, making even complete absolution from guilt a hollow victory. In recent years, we have seen the courts treat tort law in new ways as they have applied the doctrines of strict liability, and joint and several liability, to the work we perform. This alarming trend moves claims into an arena where a "no professional negligence" defense means little. In addition, the courts have removed any requirements for contractual privity to enjoin an engineer in litigation, making third party actions a common threat. In a case concluded earlier this year, a geotechnical engineer was sued by a homeowner over work performed over 15 years ago. After the geotechnical services were completed for a housing project, the developer changed one building lot from a cut site to a cut/fill situation, and serious foundation movements occurred as a result of inadequate fill compaction, and retaining wall design and construction. The resolution of the case included a $50,000 payment by the geotechnical engineer. What possible error did he commit? His job records (15 years old now) did not document the proposed grading scheme for that particular site. This housing project included many other lots involving fill, and the geotechnical engineer provided construction monitoring services for these sites, but his project involvement had been terminated when his client, the original developer, sold the project to a new developer, who declined to retain the engineer's services. This second developer subsequently developed the failed site without any input by the engineer. Unfortunately, this case study is not an isolated example.

America's professionals have been contending with a liability crisis since the mid-1960s, and it has heated up considerably in the mid 1980s. The current crisis has been marked by a

1 President, Stokley-Cheeks and Associates, Inc.; Chairman, ASFE Professional Quality Committee

precipitious increase in the cost, and in some cases unavailability, of professional liability insurance. Indeed, some design professionals must now pay ten percent or more of their gross annual receipts in order to obtain professional liability insurance protection. Still other members of our profession find the coverage unavailable, while more and more are electing to go bare.

Some say this crisis is due to mismanagement of insurance companies. While this may be true in some instances, it should be recognized that the insurance industry--as others--is subject to international economic conditions it is powerless to control. When investment opportunities are rife, the cost of coverage is discounted in order to attract the premium dollars to take advantage of high investment returns on dollars held to pay for future claims. When these conditions change--when investment returns can no longer justify underwriting losses--rates must rise in order to maintain overall profits. The rates now being charged for coverage reflect this cycle, but the cycle itself does not explain the magnitude of the increases.

Some say our nation's civil justice system and an oversupply of attorneys willing to pursue marginal, or even frivilous actions, on a contingency fee basis are the culprits. They cite highly publicized awards that have seemingly turned alleged errors and omissions into lottery tickets. If opportunities for unmerited awards could be reduced, if attorneys found pursuing meritless actions could be held responsible, critics charge, lawsuits would lose their allure. This would reduce the frequency of claims as well as the size of awards, helping to make insurance more available and affordable in the future.

The Association of Soil and Foundation Engineers (ASFE) is convinced, by its own experience, that neither argument completely explains what has happened, and that professional liability is a chronic issue that is likely to continue unless we make changes.

The real problems, ASFE believes, are the movement from the precepts of professionalism, and the erosion of quality, both in the technical aspects of design professional service and in human aspects of the service delivery system. The growing desire to minimize cost and time has encouraged professionals to take shortcuts and, almost invariably, precepts of professionalism and quality control are sacrificed in the process.

A review of professional liability losses reveals that, in most instances, problems could have been avoided had design professionals worked more closely with clients to effect better communication, particularly to educate them about the need for quality and the nature of risks. Indeed, a survey conducted by a major insurer of geotechnical engineering firms concluded that 70 to 80 percent of professional liability claims have resulted from failures of a nontechnical nature, such as:

1. Ineffective communications.
2. Failure to deliver reports or plans on time.
3. Providing guidance or advice that was not asked for.
4. Poor business practices.
5. Acceptance of a partial scope of service.
6. Accepting responsibility when unwarranted.

An example of ineffective communication is the traditional use of the term "Construction Inspection," which once had wide use within the geotechnical community. To the practictioner, the service associated with the term typically involved observation of the construction activity, say fill placement and compaction, and performance of certain tests on the soil to verify compliance with specifications. However, in a case involving an engineer, the courts found him negligent because inspection, according to a court determined definition, meant supervision or superintendence of the contractor's activities, a level of service the engineer did not provide, had no desire to provide, and did not believe he was obligated to provide. As a result of this and other similar legal developments, the geotechnical community has learned to use terms which more precisely define these project obligations. However, the use of the term "Inspection" is still widely used by other segments of the profession.

Following the 1981 collapse of two skywalks of the Hyatt Regency in Kansas City, which killed 114 and injured 185, the American Society of Civil Engineers embarked on a major project to develop the "Manual of Professional Practice for Quality in the Constructed Project". In its introduction this manual states:

> "A...dangerous common denominator can be detected in nearly all project failures and accidents: insufficient understanding of the responsibilities and roles of each member of the construction project team."

Throughout this manual, the precepts of professionalism are stressed as essential for the attainment of quality. The importance of effective communication, professional procurement procedures, and designer involvement through construction and project start up are emphasized repeatedly.

Stated briefly, ASFE believes that today's professional liability crisis is not so much a condition that affects how we will practice, as a condition that reflects how we have been practicing. It is the symptom not the cause. Therefore, if we are to change the circumstances which affect our professional practice in this way, we must look inward. Neither affordable insurance nor tort reform will provide quality. Neither will they provide the professional orientation that can lead to satisfaction. We have seen how low quality took our automobile industry to the brink of extinction. ASFE submits that, unless design professionals change the way they practice, they may soon arrive at the same locale. The frequency of lawsuits and high insurance premiums stand as evidence that change is necessary. We will reduce the runaway nature of these symptoms only when we eradicate the practice conditions which created litigious opportunities.

ASFE can speak with authority to these issues, because conditions affecting all design professionals today are virtually the same as those confronting consulting geotechnical engineers in the mid-1960s.

In 1968, representatives of ten major consulting geotechnical engineering firms met to establish an organization whose purpose would be to identify the cause of these problems, and then develop programs and materials to correct them. Today, ASFE, the organization they created, consists of about 350 member firms, who collectively perform over 80 percent of the geotechnical engineering contracted for each year. A membership retention rate of over 98 percent speaks directly to the effectiveness and value of ASFE to practicing geotechnical engineers..

The research performed to identify the problems was most revealing. To quote Walt Kelley and his famous cartoon character, Pogo, "We have met the enemy...and he is us."

A basic problem was inadequate communication with the client. As a consequence, the client expected a level of assurance that it was simply impossible to provide. And when the inevitable happened, when the unanticipated occurred, it was assumed that an error or omission had been committed. Research also showed that in some cases the seemingly inevitable may actually have been changeable. By providing a more complete service, the number of unknowns could be reduced and the remaining unknowns could be approached more effectively, leading to greater client satisfaction, lower overall project costs, and more professional gratification.

ASFE made tremendous progress. It developed new concepts and procedures which greatly enhanced its members' practice environment.

Then something major happened in 1975. Other design professionals experienced a significant jump in liability insurance rates brought about by increasing claims and another one of the economic cycles to which the insurance industry is subject. In response, many design professionals began to rely on exculpatory wording of different types in an attempt to shift liability. Practices such as construction monitoring were discouraged, due to the additional liability exposure they created. And some design professionals reacted by trying to disavow and/or avoid any direct contact with geotechnical engineers in an attempt to avoid the derivative liabilities associated with our work. These actions only led to a worsening of the situation to what we have today.

It must be remembered that society has an image of professionals, and when we do not deliver what society expects, words will not save us. Neither will our absence from the construction site, nor other veiled attempts to avoid our responsibilities. As professionals, we are expected to perform in certain ways and assume certain responsibilities. If we take inappropriate action to shield ourselves from liability, society will tell us--as it has through judges and juries--that we are wrong. ASFE members have learned this lesson painfully well. And thus it has occurred that in 1987, when design professionals of all types are struggling with the cost and availability of insurance, geotechnical engineers are at the low end of the range. This ability to maintain coverage and price continuity symbolizes a vitally important point: That geotechnical engineers in many instances have been able to create a practice environment which permits more professional satisfaction, more innovation, better relations with clients, and better quality work. In essence, ASFE is leading the profession forward to where it used to be, accomplishing what some said couldn't be done--attaining compatibility between high-quality performance and economic necessity.

How has this been achieved? In a word, EDUCATION. The published works and established programs of ASFE demonstrate how ASFE has made education a paramount concern; education of its members and education of its members' clients. Now, ASFE is initiating a new and exciting emphasis in its education focus by taking the ASFE story to engineering faculty and students. To the extent that this education can be delivered before students enter the real world of engineering, they will be that much better prepared for what awaits them.

It is our belief that a commitment to quality has its roots in the undergraduate and post graduate education of engineers. Those of us in practice find that many young engineers enter the profession without even being aware of the major issues facing it, much less an understanding of these issues. They have received precious little instruction about the importance of professionalism, ethics, or quality.

Somewhat ironically, engineering educators in the past have been criticized for being too idealistic. Yet ASFE's criticism of today's younger design professionals is that they are not idealistic enough. They do not have enough understanding of how things used to be when quality was king, and thus they do not have sufficient desire for the renaissance they can easily work for and establish. The status quo today clearly is not acceptable, just as the status quo in 1968 was not acceptable. ASFE made changes and, in the process, more than a just a few waves.

ASFE PROGRAMS AND MATERIALS

I want to review with you some of the major programs, concepts, and publications developed by ASFE over the last 20 years. These works have been instrumental in establishing improved business practices, implementing loss prevention programs, and improving the overall quality of the delivered service in geotechnical engineering. Many of these concepts are now being adopted by other segments of the design profession, a trend that is essential for continued progress for the profession, and the geotechnical engineering community. As such, the geotechnical community must continue to assist these other groups and promote the concepts we have found to be so successful.

Limitation of Liability

Limitation of liability was an early ASFE concept that created waves, big waves. The basic limitation of liability provision essentially states that the engineer's liability will be limited to a specific amount. Relying on this contract clause creates an opportunity for discussion of liability issues, and for apportioning risk before a project begins.

Early critics charged that a limitation of liability provision was unprofessional. But is it? Every design professional's liability is limited by the resources that can be brought to bear to compensate others for losses. There is nothing unprofessional about discussing this matter at the outset of a project, to help assure that the client understands the situation. In fact, it can be argued, it is unprofessional to not discuss this matter.

Critics said the concept would not hold up in court. But it has.

And the critics also said limitation of liability would not be accepted by owners. But it has been--in fact, so much so that it is now standard procedure for consulting engineers practicing in the geosciences, and there is strong movement afoot by former critics to introduce it to all consulting engineers by means of model contracts. And why not. Among its other benefits, limitation of liability has encouraged owners to make their selections with more care. And those who prefer higher limits generally are willing to help reduce risks by agreeing to a more complete service, one that is more professionally satisfying, while reducing the risk of something going wrong.

Peer Review

ASFE, through the leadership of its Council of Fellows, developed the concept of Peer Review in 1977. ASFE has developed two publications on this subject. One explains how ASFE's Peer Review program works; the other identifies criteria for quality management in design professional practice.

Through the Peer Review program, a firm's operations are reviewed by two or three peers. Initially they review a variety of documentation, such as job descriptions, operations manuals, and the like. Later they visit the firm to review files, interview various personnel, and otherwise examine its quality orientation. At the conclusion of the visit, the firm's CEO receives a report identifying strengths and weaknesses.

Those reviewed say that Peer Review is one of the most valuable services ever received from any organization. Those performing the reviews have characterized their services as the most gratifying of their professional careers.

Report Review

Report Review is yet another program ASFE has developed to foster peer-to-peer interaction in the pursuit of enhanced quality. Through this program, firms which submit materials for review receive others' materials which they review. Before reports and proposals are returned to their originators, a committee reviews them to identify overall strengths and weaknesses, so ASFE may better identify the education required to effect improvements.

Alternative Dispute Resolution

Alternative dispute resolution, or ADR, is another "hot" issue today, being advanced as a concept to settle disputes outside our civil justice system. But the concept is not new to ASFE. It developed the concept of mediation/ arbitration in the mid-1970s, serving as the model for a number of other innovative approaches. ASFE continues to work with a number of other organizations on this important subject, and has been a prime mover in development of a number of other ADR options.

PAESAR

ASFE believes strongly that the need to resolve disputes can be diminished significantly by relying on a design professional selection and retention measure whose nature makes disputes less likely. We hear frequently that design professionals prefer selection and retention measures that eliminate fee for consideration. But this is not true at all. The method espoused by ASFE and similar groups separates consideration of fee from consideration of quality factors. The approach preferred by ASFE has been dubbed PAESAR, an acronym for Professional Architect-Engineer Selection and Retention. ASFE developed a PAESAR handbook to help members educate clients as to what PAESAR involves, and why it should be relied upon. ASFE believes strongly that unless PAESAR is established as the exclusive technique for retaining design professionals, professionalism is at risk.

The key to PAESAR is mutual workscope development. In essence, project design begins with workscope design. As such, workscope design should be discussed only after the client has determined which firm he most wants to do the work. Mutual workscope development helps assure effective communication. The client explains his goals and objectives, risks and restraints; the design professional discusses techniques available to meet the client's needs and expectations. Together, then, they can develop a scope of services uniquely suited to the project and those involved in it. Then, once the workscope is established, the design professional can establish his fee. If the resulting fee is considered too high by the client, the workscope can be reduced and a discussion of the associated risks can occur, simultaneously.

When clients insist that several design professionals submit a fee for performing the work, responding design professionals--in order to set a fee--must develop a workscope on their own. This means each must rely on a variety of assumptions, eliminating an all-important communications process. And, regrettably, one of the most common assumptions made is a client's desire to have design performed as inexpensively as possible, thus encouraging engineers and architects to deemphasize the tasks required to elevate quality. As recent civil engineering failures have demonstrated the cost of low quality can be all too dear. So long as design professionals remain quiet on this subject, and refrain from discussing it with their clients, erosion of quality will continue.

Client Selection

As a corrolary to PAESAR, ASFE members have learned that client selection is very important toward achieving significant loss prevention goals. While the thought of turning down a prospective client is anathema to most of us in practice, the facts are that certain types of clients are involved in professional liability litigation far more so than others. In short, procurement is a two-way street, and it's the professional's responsibility to insist on performing in a professional manner. If a client wants us to act in a less than professional manner, we must learn to say an emphatic "No!" and be prepared to help him understand why, and perhaps walk away from his project.

Expert Witness Service

Another area of great concern relates to expert witness service. ASFE has prepared a comprehensive text on this subject, called Expert. Working with a number of other organizations, it is also on the verge of introducing a document called Recommended Principles for Design Professionals Serving as Expert Witnesses, established to eliminate a serious and growing problem, the hired gun.

In essence, expert witnesses are retained to further the cause of justice. It is their purpose to explain technical issues in a manner that is understandable to lay triers of fact. Unfortunately, it often does not work out this way. Experts too frequently become advocates for their clients' cause, using their special knowledge and standing more to obfuscate than educate; to relate what an attorney or client wants to hear, rather than the truth.

ASFE's recommended principles will help change that. By being adopted by a number of professional organizations, such as ACEC, NSPE, AIA, and ASCE, as well as their various chapters, a standard of practice should emerge. It will make it clear that experts should base their assessments of standards of practice on research, rather than casual opinions or how "I would have done it." It will also indicate that experts should strive to establish what really happened, as opposed to merely proving that a client's version of events might be accurate. And it would also suggest that an expert witness assignment should not be accepted if there is insufficient time or budget to establish the facts for, without the facts, an expert cannot render a valid opinion. Certainly, it is better to offer no opinion at all than one that is misleading in an atmosphere where truth is at a premium.

Case Histories

ASFE has relied extensively on case histories of actual loss experiences, published for the edification of its members. Through analysis of these cases, ASFE has identified some of the basic causes of its members' problems: Inadequate communication, failure to provide a complete service, and sacrificing quality in order to meet foreshortened time schedules or inadequate budgets.

The trail ASFE has blazed in the last 20 years has been extraordinary. It has moved quickly to identify the true nature of professional liability problems and to set in motion the methods and means of resolving them. As a result, practicing geotechnical engineers have moved from dead last to first place in the liability arena. Without these tools, geotechnical engineers would be no better off than all design professionals are today; victims of conditions created by their own complacency.

But, much more work remains. For example, there are serious attempts being made by some groups to define our standard of practice through published codes and standards. While ASFE definitely believes the profession and society will benefit from a realistic definition of the standard of practice, many of the standards now under development are based upon unacceptable precepts, are highly prescriptive, and will result in a serious worsening of liability issues and our overall practice environment. Standards and codes like these signal a failure of the profession to serve the public and to regulate and discipline our own.

Some argue that this failure of our profession has been caused by a failure of the legal system, but this is only part of the picture. Leaders of the profession failed to keep their institutions dynamic, in step with new realities and the changing outlook of society. In response, society stripped the profession of much of its extralegal authority to govern its own for, in truth, this authority was not being exercised. Insofar as maintenance of professional standards is concerned, little was lost because little was being done to maintain them. Our canons of ethics, a cornerstone of professionalism, are ignored, or at least loosely interpreted. Instead of aiming for the bullseye of ethical conduct, many members of our profession continue to aim for the edge of the target, and as a result miss the target all too often. The consequence is mediocrity; a winking at professionalism as engineers and architects fashion their approach as their clients' dollars command.

Can clients be blamed? No. They are not design professionals; they look to architects and engineers for guidance. If their unprofessional requests went ignored, they would stop making them. But far from being ignored, they are leapt at, creating new professional standards--new professional lows. Is it any wonder, then, that engineers and architects are coming to be regarded as technicians, whose attitudes--even sworn expert testimony--can be bought and sold as any other commodity.

And is it any wonder that claims against design professionals are now at an all-time high and likely to go higher. Some say that the claims are not so much a result of design professionals' failings as they are a consequence of a tort law system that has gotten out of hand. True, there are inequities; the tort system has permitted some outlandish awards. Also true, fear of the inequities and the cost of employing the system have encouraged unmerited settlements and continuing attempts to use the law for legalized extortion. But, it is not tort law that fails to evaluate high-risk clients and projects before accepting them. It is not tort law that prepares or accepts inadequate workscopes. And it is not tort law that fails to apply adequate quality control, and fails to provide appropriate tutelage to the profession's future leaders.

Where once the professional gratification derived from serving well stood as a carrot, the fear of retribution at tort now stands as a stick. But that is nothing new. What is new is the high cost and limited availability of professional liability insurance. A few years ago, when this coverage was cheap and abundant, the tort law system--the same one that exists today--was not such a menace. Continuing claims were a cause for concern, but there was no crisis. After all, design professionals were able to transfer the impact of their marginal performance to a third party; a massively rich third party, eager to use premium dollars to feather its own nest. Insurers have suggested that reform of our tort law system is necessary if coverage is to be available in the future, at prices more can afford. While there can be no doubt that tort reform is needed, its impact on insurance rates is sure to be a disappointment without a return to quality, because the vast majority of suits against design professionals involve aspects of tort law that generally are sound.

The root cause of design professionals' insurance problems is their own high rate of claims, brought about principally by their failure to apply precepts of professionalism and maintain quality. Unless there is change in the attitudes of design professionals, the claims situation will deteriorate further.

THE FUTURE

Will the design professions be able to reverse today's sad trends? Possibly, because several groups, including ASFE, are now developing programs and standards geared to elevating the lowest common denominator. But more is needed, because today's design professional practice involves so much more than design. It begins with the structuring of the engagement itself. Unless engineers and architects reassert their responsibility to serve as principal designers of that structure, the context of continuingly more projects will be fashioned by nonprofessionals, and will itself become nonprofessional practice, where the need for expedition and economy has been met by eliminating professional quality and care.

If there is to be reversal of today's trends, it must come from within. After all, who should be in charge of engineering? Owners? Developers? Government officials? Bankers? Lawyers? True, all their concerns must be recognized if engineering, as a profession, is to remain responsive to society's needs. But engineers are the ones who must remain in charge of our profession if those needs are to be met. Engineers and architects must learn more about their professions' past; must appreciate more the attitudes and actions that made their work professional; must apply those attitudes and actions to today's circumstance for the benefit of society, and thereby their own. Will it happen? It depends on where we go from here. We can continue on the present path, or we can take a new road, influenced by the past, designed for the future.

The present road is easier. Lack of aggressive concern has eliminated most bumps, and it goes straight downhill. But somewhere down the road, sooner or later, a tollkeeper will emerge. He will demand that we relinquish our claim to being professionals if we are to travel further. Some may stop, if they can, and try to go back. But by then the road will be crowded; the momentum will be strong.

But what if we do not choose the present road? What does the new one have in store? It will not be easy; that is for certain. And some will jeer because we have chosen it. It moves uphill, not down, and is not paved. It will require us to serve ourselves by first serving society. The financial rewards will eventually be there; they always have been, but we must recognize that taking the new road will certainly require us to make short-term sacrifices. Even more important, we will find professional satisfaction; the knowledge that we have served admirably and well in <u>all</u> our professional activities.

We cannot afford to be backseat drivers in the vehicle of our own profession. We must get behind the wheel and steer; ASFE has done just that. We encourage others to join us on our journey on the new road by building a foundation on professionalism and quality.

Thank you for your attention.

ENGINEER'S STANDARD OF CARE

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Abstract. Today's standard of care is called the professional standard, that level of care practiced by competent engineers. The professional standard has its basis in the common law doctrine of negligence. Arguments are presented that engineers and other professionals should be held to an outcome standard, similar to that applied to manufacturers of products. A more specific definition of standards of practice by the engineering profession is proposed as an alternative to increased liability imposed by the courts.

INTRODUCTION

Although there is always some type of contract between two parties when engineering services are provided (they vary from a very formal contract with much boilerplate attached to a simple oral agreement), the terms of the contract most often play a secondary role in litigation that may follow from a problem that arises out of the project. The majority of claims against geotechnical engineers are by contractors who encounter problems in subsurface construction that increase their cost. Any liability on the part of the geotechnical engineer to the contractor would arise from the application of the principles of tort law, specifically the tort of negligence. The doctrine of negligence, simply stated, is that every person owes every other person the duty to exercise reasonable care and skill in the performance of his duties to avoid injuring another. Four elements must be shown to prove negligence. These elements are (1) a legal duty of care, (2) failure to live up to the standard of due care, (3) this failure of due care being the proximate cause of (4) substantial damage(1).

The cost of construction litigation precludes bringing law suits where there has been no significant damage. The fourth element of negligence is rarely difficult to show. Up until about 30 years ago, architects and engineers were rather well insulated from losses suffered by contractors. The courts relied on "privity of contract" to find that he owed a duty only to the owner. However, the house of privity has long fallen and there is now no question that we owe a duty to any party that may use or be affected by the information we provide. Most typically, there are two disputed elements concerning potential negligence of engineers; (1) that he lived up to the standard of due care and (2) whether any failure on his part in what he did or did not do was the proximate cause of whatever damages the plaintiff suffered. Elements (3) and (4), the standard of care and proximate cause are often intertwined. There are many actual cases where the court could find some deficiency on the part of the engineer, but where the actions or non-actions of the contractor were determinative in what actually happened.

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PROFESSIONAL STANDARD

Against what standard is the geotechnical engineer measured in determining whether he has been negligent in the performance of his duty. As I have indicated, this concept has its basis in fundamental tort law which has its origins in the common law of England. An 1837 case from English common pleas court states the fundamental principles.[2] In this case, the defendant built hay ricks near the boundary of his land, not far from the plaintiff's cottages. It was alleged that the ricks were likely to ignite due to spontaneous combustion and, since they were so close to the plaintiff's cottages, if they did ignite they were likely to damage the cottages. All of that did happen and the owner of the cottages brought an action and obtained a judgment against his neighbor. The court found that the defendant who had built the hay ricks had a duty to proceed with such reasonable caution as a prudent man would exercise under such circumstances. The defendant appealed, arguing that the standard of ordinary prudence was too uncertain to afford any criteria. He should be judged as to whether he acted to the best of his judgment and he ought not to be responsible for the misfortune of not possessing the highest order of intelligence. The Appeals Court upheld the Trial Court holding the test of standard of care as that as a man of ordinary prudence would observe.

American courts over the past 30 years have applied the basic principles of negligence law to malpractice suits against engineers and have developed a body of dicta available to explore or attempt to answer the question of an engineer's standard of care.

The Restatement (Second) of Torts cites the following general standard for all professions, including engineers:

> "Unless he represents that he has greater or less skill or knowledge, one who undertakes to render service in the practice of a profession or trade is required to exercise the skill and knowledge normally possessed by members of that profession or trade in good standing in similar communities."[3]

This standard includes the "performance of skills necessary in coping with engineering and construction problems outside the knowledge of the ordinary layman."[4] The restatement drafters emphasized that competence was the critical factor. "In the absence of any special representation the standard of skill and knowledge required of the actor who practices a profession or trade is that which is commonly possessed by members of that profession or trade in good standing. It is not that of the most highly skilled, nor is it that of the average member of the profession or trade, since those who have less than medium or average skill may still be competent and qualified."[5]

Although the majority of jurisdictions have clearly adopted this professional standard for architects and engineers, many have not adhered to the restatements locality rule. Although attorneys, as a rule, attempt to show a standard by obtaining witnesses that practice in the general area, the need to demonstrate the standard at the specific location of the case in point is weakening. There is certainly a trend towards a national standard.

OUTCOME STANDARD

There have been attempts to hold engineers to a higher standard than the professional standard. These attempts typically borrow concepts of strict liability and implied warranty from products liability law. A manufacturer is liable for injuries caused by his product if the product is both defective and unreasonably dangerous.[6] It is not necessary to show that the manufacturer was negligent in producing the product. Compliance with industry custom is inadequate to avoid liability. The injured party only needs to show that the product was defective at the time he purchased it and that there was an inherent danger in the use of the product in its defective state.

These basic concepts were argued in a case that is well known to California soil engineers. In the case of Swett v. Gribaldo, Jones & Associates,[7] the soil engineer monitored the fill soil at a subdivision site in 1963 and 1964. After completion of the grading the soil engineer submitted a report to the developer in which they stated, among other things, "that the lots are hereby certified complete to rough grade and are now ready for final lot grading and/or residential improvement." The report also stated that this certification does not include any finished lot grading which may be required for residential construction. It specifically stated that final lot grading and foundation construction must be made in accordance with the requirements of our soil investigation report or acceptable methods approved in writing by this office. In March 1967 the plaintiff bought a home built on one of the lots. In the fall, cracks became noticeable and the damage became progressively worse. Ultimately, the damage was such that repair was economically unfeasible. Investigations were made by one or two other soil engineers. I have never found anything in the published reports of the case that specifically described the cause of the apparent ground movement. Evidence was given in the trial of the need of drainage corrections and the substantial difference in the thickness of the fill within the house site. The engineers testifying for the plaintiff stated, in answer to questions posed by the defendant's lawyers, that, based on the information that they had, the method that the defendant's soil engineers used in monitoring and testing the earthwork was consistent with the standards in that area at that time.

After the jury heard all of the evidence in the trial, the judge instructed, at the request of the plaintiff's attorneys, the jury on theories of negligence, express warranty and strict liability. He instructed the jury that they could find that the certification statements that the lot was complete to rough grade and ready for final lot grading or residential improvements represented a guarantee against any problems in the use of the lot. He also instructed them that if they found that there was a defect in the earthwork and if such defect was the proximate cause of the damage, then the defendant's soil engineers were strictly liable for any damage that resulted. With such instructions available to them, it was not surprising that the jury found for the homeowner and against the soil engineer in the amount of $54,000. The soil engineer appealed and the Consulting Engineers Association of California and the Consulting Engineers Council of the United States requested and received permission to file a brief of Amicus Curiae or "Friend Of The Court." The attorneys filing the brief reviewed the law in California concerning the standards used in measuring the liability of an engineer. The Appeals Court accepted the arguments of the appellants and cited a long established rule in California that "Those who sell their service for the guidance of others in their economic, financial and personal affairs are not liable in the absence of negligence or intentional misconduct. The services of experts are sought because of their special skill. Those who hire such persons are not justified in expecting infallibility but can expect only reasonable care and competence. They purchase service not insurance."(8)

EXPERT WITNESS

How do we establish the standards that the engineer should have followed in a given situation? The court; i.e., the judge and jury, must make its determinations on the basis of evidence properly brought before it. The basic forms of evidence are real evidence, objects that speak for themselves, documentary evidence, such as reports and construction records, and testimonial evidence, oral testimony given in a court by a witness. The general rule is that only witnesses that have specific knowledge of a given matter may give testimony to the court and they can speak only of their observations. Witnesses are not ordinarily allowed to express opinions. The jury listens to the facts and makes its decisions on the basis of the facts and the attorney's arguments. The ordinary rules of evidence, however, do not apply to professional malpractice cases. In fact, with rare exceptions, a malpractice case cannot go to the jury unless the opinion of a qualified expert has been given concerning the basic issues in dispute and, in particular, whether the engineer followed accepted practice.

Much has been written during the last 5 years on the role of the expert witness. One of the issues is the adversarious expert versus the objective uncommitted independent expert. I think it is safe to say that, in the usual case, an expert will be used only if the attorney for the party that the expert is testifying for is convinced that the expert's testimony will substantially support the position of his party.

Only a very small part, perhaps less than 5%, of the time billed by expert witnesses is for the trial or the final preparation for trial. By far, the great bulk of a forensic engineer's time is spent in the discovery phase of litigation. The attorneys, many, sometimes most, of whom are employed by an insurance company, attempt to assess the exposure of their client, to serve as a basis for monetary settlement without going to the expense of a trial. Very few malpractice suits in the construction industry reach the trial stage. For this reason there is much uncertainty and differences among jurisdictions as to the specific standard against which a given engineer's work can be measured.

PUBLICATIONS

When a geotechnical engineer accepts an assignment as a consultant or expert witness in a matter in dispute, he has the obligation to more than simply rely on his own practice and experience. He has a duty to be knowledgeable about and refer to accepted treatise on the subject and, most particularly, publications of professional organizations. Accepted text books have been important references in giving testimony concerning standards. This does not mean that a single author, regardless of how prestigious he may be, can by himself establish a standard of practice. Accepted treatise are, however, often referred to by witnesses as practice that he has found, by his own experience, to give good results. Let me cite for example the rather dated publication of the American Society of Civil Engineers, Manual No. 56, on Subsurface Investigations. I know that this manual is often referred to as an indication of accepted standard for an adequate subsurface exploration.

There has been much written in recent months concerning the impact of ASCE's new manual "Professional Practice for Quality in the Constructed Project" on this whole issue of liability.(9) Some argue that this manual will increase the exposure of the design engineer to liability because it will be used as a reference to indicate a standard that is higher than many engineers have been using. I personally believe that this is a valid argument but I do not necessarily feel that it is something that we should object to. I believe the impetus for the substantial work that went into the production of this manual is the Hyatt Regency case. It is rare that our errors result in someone's death, much less the loss of 114 lives. However, geotechnical engineers are involved in work where accidents cause serious injury and sometimes death. Collapse of trenches and sheeting systems, the presence of gas in deep caissons are the most common situations that come to mind.

LITIGATION --- INNOVATION

There are those that argue that our litigous environment is one of the reasons that our construction industry is falling behind that of Europe and Japan insofar as innovation is concerned. This could be a factor but I am more inclined to look at the differences in the structure of the industry. There is a separation between people that design and build here in the states. In Europe and Japan, the same organization usually has both responsibilities. This results in greater incentive for innovative methods.

An example of a method to encourage innovative design was the establishment of a special Federal standard of care for consulting engineers on new waste water treatment plants under the Clean Water Act. The EPA encourages owners to incorporate new innovative methods of sewage treatment in the EPA funded plants. In turn, the consulting design engineers are given contractual immunity from liability for innovative designs in the absence of gross negligence.(10)

CONTRACTUAL DEFINITIONS

I have indicated that the courts primarily rely on tort law in assessing liability in malpractice suits. There are things that can be done in contracts to define standards and possibly limit liability. ASFE spends a great part of its effort and budget in educating its members on standard clauses and material that can be used in proposals and in reports to identify the standards that they are following. These types of documents play an important role when a dispute arises, however, they may not necessarily be determinative. ASFE has promoted the concept of limitation of liability where the parties agree in advance on the maximum dollar amount of an engineer's liability. The courts have upheld the validity of such agreements as long as it can be shown that the agreement is reasonable and that the parties had relatively equal bargaining power.

We believe an activity of the Cincinnati Geotechnical Group is a good example of what local professional groups can do in this area. The Group spent quite a few hours with some legal assistance in preparing a document which states the standard of care of a soil technician on a site grading project. The specific purpose of this document was to try to overcome the position of contractors and many owners that when a soil technician is present on a site grading project, he is running the job; i.e., directing the contractor's operation. If a court would find that the technician was directing the contractor then this would essentially relieve the contractor of any liability and place it all on the technician and his employer.

SUMMARY AND TRENDS

Let's review just where we are relative to the standard of care. The present standard is called the professional standard, that level of care practiced by competent engineers. There may be some differences in the standard in different parts of the country. For geotechnical engineers, such differences probably relate more to differences in geology than anything else. In California the seismic aspects of the site must be considered. We rarely look at this in Ohio. In West Virginia, it may be necessary to identify the coal seams below the site and whether there has been any mining. The standard is certainly higher than that of gross negligence. Gross negligence is recklessness or wanton disregard for the rights of others. There is no strict liability or implied warranty in ordinary investigation and design services. If an engineer is a member of a team that has a financial interest in a project, then an outcome standard may apply. There may be an implied warranty of fitness for the intended use. This is the standard that is being applied today to builders of homes.

There is evidence that courts are raising the standard. I believe the primary reason for this is that there is a change in attitude among engineers and the industry about acceptance of error. I believe that there is less excuse for error today than there once was and that liability is one of the costs that we have to factor into our system. Five-percent of gross fees may not be an unreasonable sum to provide for remedying error. I think the majority of us would feel better about it if the greater part of the money would go to correcting problems rather than paying legal fees, as is the case today.

There is some movement to encourage a more specific definition of the engineer's standard of care. John C. Peck, a Civil Engineer and Professor of Law at the University of Kansas and Wyatt A. Hoch, a practicing attorney, published a well researched paper for the Villanova Law Review and the Magazine "Trial" on the engineer's liability with specific consideration to the structural engineer.(11) They argued that there are four horizons of structural engineering knowledge that can and should be identified by courts as good guidelines in defining the state-of-the-art. The top stratum represents the cutting edge, research on new hypotheses and design solutions. Once the research is proven and generally accepted it becomes part of the second "open literature" horizon, represented by publishing papers discussing the application of the research. After a period of maturation following publication and testing in the literature, then the third horizon "professionally accepted knowledge" arises. The fourth and bottom level of knowledge is the "undergraduate" horizon which encompasses the design information necessary to complete a competent (by current legal standards) traditional structural design. They argue that the fourth and lowest horizon represents the present standard of care. They argue that the standard should be higher to include new developments after they have become part of accepted practice. They propose that the courts reject the professional standard and adopt a new standard that they have named the "informed engineer" standard.

I am not convinced that the standard actually being applied in our courts is not something similar to what the authors call the "informed engineer" standard. One thing I am sure of is that there are substantial variations between jurisdictions. This makes it very difficult to pre-assess liability in individual cases.

I believe one thing that we can all agree upon is that in engineering practice the problem job is an excellent learning tool. The experiences that we gain increase our engineering ability. It is easier when the problems are somebody else's rather than our own.

I just wish we could come up with a system where problems and disputes can be resolved in a more expeditious, less costly manner. There are many people and professional groups talking about this and I have no doubt that changes will be made. It is just that there is such a dichotomy between the way things move in engineering and in law. I don't think we get any projects anymore where we don't have to have the report out yesterday. On the other hand when I am working with lawyers the matters drag on for so long I spend half my time just remembering where I was when I last looked at the material.

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IMPACT OF THE DIFFERING SITE CONDITIONS PROVISION

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"Differing site conditions" or "changed conditions" provisions are contained in Federal Government contracts as well as in the contracts of other State and Local Governments and private owners. The provisions assign to the owner the obligation to bear the cost of the increased effort and time to overcome conditions more adverse than a reasonable bidder would anticipate. Proponents contend that: *(1)* the owner is the ultimate beneficiary of the construction project and accordingly, should reap the reward of a favorable site or suffer the consequence of an adverse site, and *(2)* owners should be in a position to sustain such unanticipated project cost increases; whereas, contending with unforeseeably adverse conditions may bankrupt a contractor. Given the high cost of delay to both owners and contractors on large projects, the total impact of unanticipated adverse conditions may far exceed the costs of the subsurface work, and financially overstress the party ultimately responsible. Opponents argue that contractors attempt to recover losses they incur due to their underbidding the work, or recoup costs incurred as a consequence of inefficient performance unrelated to the site conditions. To the detriment of the contractor, owners and engineers may misuse the differing site conditions provision as well. They may refuse to acknowledge legitimate occurrences, or they may demand inordinate proof. Contractors may also suffer if these parties fail to respond properly, or if the contractor is ill-prepared to prove or fully recover his direct and impact costs. Engineers may also be reluctant to concede the existence of a differing site condition or they may apply unreasonable criteria for foreseeability or mitigation. Additionally, the differing site conditions provision may expose the engineer to substantial claims as well. In the discussion that follows, the above situations are discussed, case histories are introduced, and recommendations to address these problems are given.

INTRODUCTION

In principle, the "differing site conditions" or "changed conditions" provisions found in Federal Government contracts and in many contracts of other State and Local Governments and private owners, is straightforward and logical. When subsurface conditions encountered differ materially from those indicated in the contract documents, or are of an unknown physical condition not recognized as characteristic of the work, the contractors are to be adjusted equitably.

Site conditions, particularly subsurface conditions, represent an area of considerable risk to contractors bidding fixed price or unit price contracts. The differing site conditions clause assigns to the owner the obligation of paying for the increased cost of the additional effort and time expended to overcome conditions more adverse than a bidder would reasonably anticipate. The philosophy that it is to the owner's advantage to include a contract clause that accepts the inherent risk of subsurface conditions is founded upon two premises: *(1)* in the absence of such a clause, bidders include in their bid contingency allowances to provide for unforeseen conditions, and *(2)* over the long run, the increased cost of unforeseen conditions actually encountered is less than the aggregate amount of contingency allowances that contractors routinely add to contracts in which the contractor accepts the risk.

Arguments that proponents customarily offer as support of the use of the differing site conditions clause are: *(1)* the owner is the ultimate beneficiary of the construction project and should accordingly reap the reward of a favorable site and conversely accept the consequence of an adverse site, and *(2)* that owners should be in a position to sustain such unanticipated project cost increases, whereas, encountering an unforeseeably adverse site condition may bankrupt a contractor.

While the theory is simple, planning for, investigating, administering, and providing the resident engineering services on projects where differing site conditions issues arise, can become very complex. Not only is subsurface work one of the earliest activities to be performed, its satisfactory completion is generally critical to the timely completion of follow-on project work. Given the cost of delay on large projects to both owners and contractors, the impact cost attributed to differing site conditions may far exceed the direct costs incurred in overcoming the more adverse subsurface conditions.

The engineer may also become embroiled in issues and exposed to claims where either the owner or the contractor challenge *(1)* the adequacy of his investigation or design, or *(2)* the engineer's failure to promptly respond and professionally evaluate, react, and monitor conditions encountered.

To the owner's detriment, engineers may attempt to mask their improper subsurface investigation, field engineering services, or performance design by failing to contest a contractor's allegation that a differing site condition occurred. Another abuse of the differing site conditions clause occurs when contractors attempt to recover costs arising from their inability to reasonably bid the work, or recoup costs incurred as a consequence of their inefficient performance due to factors unrelated to the site conditions. Even where the site conditions differ materially, the contractors may seek to recover for changed work, unrelated to the adverse site conditions, which they performed in an unnecessarily costly manner.

Abuse of the differing site conditions provision by the owner and engineer can work to the detriment of the contractor as well. Owners may refuse to acknowledge legitimate occurrences, or they may demand inordinate proof. Contractors may also suffer if these parties fail to respond properly, or the contractor may be legitimately due, but ill-prepared to prove or fully recover direct and impact costs. Engineers may also be reluctant to admit to the existence of a differing site condition, or they may apply unreasonable criteria for foreseeability or mitigation. On occasion, the differing site condition encountered may be one that the contractor is totally unprepared for or incapable of overcoming, and, subsequently, his effort to mitigate may be judged inappropriate and unnecessarily costly.

This paper provides insight from the various perspectives of the contractor, the owner, and the engineer. It describes: *(1)* reactions of the parties to the discovery of a differing site condition; *(2)* types of projects where differing site conditions claims most frequently arise: *(3)* conditions identified; (4) frequent responses by the parties; and *(5)* failures observed and recommendations.

REACTIONS OF PARTIES TO DISCOVERY OF A DIFFERING SITE CONDITION

In concept, and generally in practice, the contractor is the first party to discover a differing site condition, and to preserve his right to seek recovery he must report it promptly. However, although the existence of a differing site condition may afford the opportunity for the contractor to seek an adjustment to the contract, the discovery of a differing site condition is generally not perceived by the contractor as a favorable incident. If the conditions significantly affect production to qualify as a differing site condition, the change must be material, and the contract's work plan, sequence, and schedule of completion may be altered. Thus, timing, revised resource requirements, and revised plans to effectively carry out the work may change drastically the nature of the undertaking. Despite language to the contrary, this revised work effort may carry with it considerable risk. Even under the best of circumstances where the owner acknowledges the change and accepts the claim cost increase, the process for modifying a contract will undoubtedly result in delayed reimbursement and thus, at the very least, a more adverse cash flow position.

Concerns that the owner will not acknowledge the differing site condition, or that he may argue that the impact was much less than actually experienced, are not unfounded. Furthermore, so-called "Monday morning quarterbacking" after the job is completed may make it difficult for the contractor to: *(1)* persuade others that his efforts to mitigate were reasonable and *(2)* prove entitlement to the costs claimed.

From the owner's viewpoint, a differing site condition claim, if valid, represents a demand for payment for an unwanted change. Payment for site construction difficulties are frequently perceived by owners as having to pay more for the same basic product. Therefore, even when the owner is persuaded that there was a differing site condition and that the costs incurred were consequential and reasonable, the resolution of the matter rarely provides the owner's representatives with feelings of accomplishment or satisfaction.

Additionally, the owner may conclude that the conditions encountered should have been reasonably anticipated, and it was the improper pre-bid subsurface investigation conducted by the engineer, or inappropriate plans and specifications prepared by the engineer, that led the contractor to anticipate otherwise.

Furthermore, approvals of construction plans and methods or actions by the engineer during construction may provide the bulk of support for a differing site conditions claim. Under these circumstances, the owner may see the engineer as the party having unduly exposed a differing site conditions claim. Under such perceptions, the owner may look to the engineer for paying the claim cost.

For the engineer, the ramifications of a differing site condition claim can be disruptive as well. Most frequently, it is the engineer who must promptly respond on behalf of the owner and examine the site and render a determination as to whether or not differing site conditions exists. If he concurs, he may be called upon to recommend or approve alternate plans and methods, provide a suitable redesign, monitor any increases in the cost and time of construction of the activity directly affected, and measure the impact of the changed work upon the overall construction effort. Justifiably, engineers may become defensive upon the discovery of differing site conditions. The contractor may purport that there was an erroneous or inadequate pre-bid subsurface investigation, or design assumptions led bidders to believe conditions would be substantially different than those encountered. Due to the urgency often accompanying the discovery of differing site conditions, the engineer may be placed under considerable pressure to provide responses with much less information and time for deliberation than he would ordinarily require. Thus, if the engineer acknowledges a differing site condition, his performance in the pre-bid subsurface investigation or design representations in the plans and specifications may lead the owner to suspect the engineer is responsible for the increased costs arising from the differing site condition.

Thus, for each of the three primary parties involved, the discovery of a differing site condition represents a potentially disruptive, unpleasant, and costly experience.

TYPES OF PROJECTS AND CHANGES MOST FREQUENTLY ASSOCIATED WITH DIFFERING SITE CONDITIONS

TYPES OF PROJECTS

Very generally, it may be stated that differing site condition issues arise in excavating the ground, when drilling or driving objects into the ground, or when attempting to construct utilizing earth materials as building product for construction. That projects where differing site condition situations seem most prevalent are: *(1)* tunnels through earth and rock materials; *(2)* open cut excavation projects such as subways and sewers; *(3)* building projects supported on pile foundations; *(4)* below grade building and trench construction projects which encounter groundwater; (4) temporary ground support; and (5) large scale embankments or backfills constructed of excavation spoils or designated borrow sources.

CHANGE REPORTED

Grain Size And Consistency Of Soils. A very frequent change claimed is that the soils encountered were finer in particle size than those represented in the contract documents *(e.g., a significant higher silt to sand content)*. Difficulties attributed to such changed conditions include: reduced trafficability; poor suitability as an aggregate source; inefficiency of deep well dewatering; loss of fines through dewatering; loss of fines through coarse aggregate bedding or base coarse; and the difficulties in submerged backfilling and using dredging equipment.

Conversely, the unexpected prevalence of coarse grain material may also be the subject of differing site condition claims. Seams or pockets of coarse grain material may cause the development of "windows", where freeze wall construction is used. Additionally, unanticipated coarse materials found in rock fissures or other anomalies along tunnel alignments may allow groundwater to be introduced into the excavation more rapidly.

In other instances, behavior not grainsize has been of issue. However, in several of those instances further examination revealed that overlooking the significant effects that particle size plays in the development and maintenance of shear strength, and implementing construction procedures inappropriate for the soil groundwater conditions, could explain the following construction difficulties: *(1)* achieving soil bearing capacity, *(2)* resistance to sheet pile penetration, and *(3)* mobilizing anchor pullout resistance.

In certain instances, the soil consistency, not grain size, has been subject of a differing site condition claim. Cohesive soils may be softer or harder than anticipated, and granular soils encountered, may be looser or denser than anticipated. Unanticipated soft soils may cause unexpected trafficability problems, or excessive subgrade conditioning. On the other hand, unexpected hard clay or dense to very dense sand overburden may make pile driving to a deeper stratum extremely costly or impractical.

Unanticipated Boulder And Rock Quantities. Unanticipated or excessive quantities of boulders encountered in excavation can represent costly removal and handling problems. Additionally, where blasting is required, the presence of boulders can have the effect of making operations inefficient and more costly than contemplated. Further, the presence of a large amount of boulders in excavation spoil effectively reduces the quantity of available backfill. Similarly, encountering rock where it was not anticipated or at elevations higher than anticipated, can significantly affect the cost and time of excavation performance.

Overbreakage describes the condition in which the blasting of excavation penetrates substantially the payline and necessary excavation limit. Thus, extra effort is required to excavate the overbreakage and fill the unanticipated void.

The hardness of rock governs the applicability of construction methods and thus, is a frequent differing site conditions issue. Examples of differing site conditions issues where rock hardness was a factor include: *(1)* pre-drilling for piles, *(2)* penetration of driven piles, and *(3)* tunnel mined by TBM.

Rock classification and competency may also be the subjects of differing site conditions claim. Examples are vertical and horizontal mud slips in limestone formation, and natural gaspockets, which cause blasting to be inefficient in the respective trench and massive rock excavations.

Obstructions Caused By Man-Made Construction And Waste Disposal. Buried and forgotten deposits of boulders or concrete rubble in overburden may cause unexpected difficulty in excavating through for drilling caissons or driving piles. Generally, careful records are not kept of the exact location of disposal, and since there is generally little pattern to the spoil disposal sites, a fullproof detection system has not been developed.

Although not as difficult to cut through as boulders or rubble concrete, uncharted waste timber from a clearing operation or temporary timber construction represents another type of unanticipated condition. For example, on the New York Transit Authority tunnel constructed beneath the Long Island Railroad embankment, part of the design to stabilize the overlying rail embankment included construction of pre-stressed wall ties. Unanticipated timber cribbing left in place when constructing the original embankment and retaining walls had to be cut piece by piece by laborers within 24 in. diameter shafts.

More and more frequently, new construction excavations or foundations encounter hazardous waste. The waste products range from corrosive liquids to noxious and explosive gases that have been uncovered on a variety of sites. Understandably, such sites present long term problems for projects constructed on the site and disrupt and endanger the construction effort.

Unanticipated Groundwater Conditions. Groundwater encountered unexpectedly, or at higher elevations than anticipated, is a frequent change claimed. Groundwater levels shown on soil boring logs, or contract plans and specifications may lead bidders to believe that groundwaters present, would be found at lower than actual elevations or flow more slowly than actually measured.

In other instances, the reported differing site conditions may be that the groundwater level was lower than anticipated. For example, deep dewatering by another contractor in the vicinity may cause a steep groundwater gradient through the proposed construction site, and thus, induce correspondingly higher groundwater flow velocities, preventing satisfactory construction of a freeze wall.

In most instances, contractors' differing site conditions claims contend that the groundwater flows encountered in the open excavations or tunnels are substantially greater than those projected by geotechnical reports, or provisions in the contract specifications and plans. Sometimes, from an owner's/engineer's view point it appears that nothing they can say could please the contractor. On a large project in the mid-west, one contractor claimed the engineer underestimated the quantity of groundwater to be encountered, and that the greater than predicted groundwater flows represented a differing site condition. Another contractor working in close proximity to the first site, brought forth his differing site condition argument, contending that in this instance the engineers had overestimated groundwater flows, and the contractor "quite properly" disregarded the engineer's erroneous prediction. The contractor proceeded to explain that a differing site condition had occurred because the actual groundwater flows exceeded his prediction *(they approached the flows erroneously predicted by the engineer)!*

Adequacy Of Soil For Temporary And Long Term Construction. Correlation testing between soil density and load bearing capability indicated that a silt material, when compacted to the specified density and moisture content, would provide adequate bearing as part of a permanent pavement system. However, a differing site conditions claim arose when, in accordance with the specifications, the contractor attempted to use embankments constructed in this manner, as haulroads, for relatively low ground pressure construction equipment. Without confinement and protection from excessive moisture, the embankments could not support traffic. This points out the need to consider short term as well as long term use capabilities.

In summary, differing site conditions can occur on a wide variety of projects and in an almost unlimited variation of forms. However, it is evident that differing site condition issues are commonly associated with highway and mass transit, environmental, water storage, power, below grade building construction, and deep foundation projects where excavation, earthwork construction, and foundation construction represent a significant undertaking. Considering the types of projects and common forms of differing site conditions, frequently occurring problems can be identified, and steps to prepare for and minimize these problems can be suggested.

PROBLEM IDENTIFICATION AND RECOMMENDATION

UNDERSTANDING THE DIFFERING SITE CONDITIONS CLAUSE

Despite the prevalence of using a differing site conditions clause, often there is a lack of understanding or reluctance to abide by the terms of the provisions, particularly on the part of owners and engineers. This lack of understanding or acceptance of the terms, in many instances contributes to unnecessary delay in the progress of the work, reluctance to modify designs or mandated construction procedures, and the unnecessary development of a hostile relationship between the parties involved. This lack of understanding of the intent and ramifications of the differing site conditions clause has been observed from the field inspection level to the top management levels of owner and engineering organizations.

It is evident, however, that the education of the owner, engineer and contractor on the intent and ramifications of their differing site conditions clause is essential. Even engineers who are thoroughly knowledgable with the clause often do not take the time to explain and prepare their owner clients for the disruptive effect and cost impacts that discovery of a differing site condition may have. When providing the engineer's estimate of construction cost, the employee-engineers or consulting engineers can, by the inclusion of an appropriately designated contingency allowance, bring to the attention of the owner the possible ramifications of encountering a differing site condition may have on the project cost. Resulting delays and disruption to the contractor responsible for the site work, as well as cost impacts to current or follow-on contractors may be very significant. The magnitude of such contingency costs may lead the owner to reconsider the feasibility of the entire project, or to order a more extensive investigation to provide a more definitive and reliable estimate of the time and cost required for subsurface construction. However, the knowledge of such contingencies is vital to small owners or owners who build on a once per twenty year basis, and can not absorb unanticipated costs. It is the type of contingency no owner wants to overlook.

AMOUNT OF SURFACE INFORMATION AVAILABLE

Despite the drastic impact unanticipated adverse subsurface conditions can have upon overall cost and timely completion of a project, it is surprising the sparsity of information that is gathered for many projects requiring major surface work efforts in challenging terrain.

On a large project in the mid-south, no borings were made by the owner for a large segment of the sewer alignment, but the contractor successfully demonstrated in Federal Court that a differing site condition existed. In the absence of information provided by the owner, the contractor's expert relied upon information available from State and County Geologic Surveys. The need for substantial subsurface information about a site is genuine. Not only is the information required by the owner's designer, the information is also required to enable the owner to obtain a reasonable estimate of the cost of construction, including contingencies. Furthermore, the better prepared and better informed the contractor, the more meaningful will be the premises upon which he bids and plans the job. Pre-bid subsurface investigations should be planned to provide sufficient information regarding the area and depth of the construction zone.

REPORTING OF INFORMATION GATHERED IN THE FIELD

Frequently, information from subsurface investigation field logs is transferred in typed form by an engineer on a log for presentation in a report, or transferred to the contract plans which become part of the contract drawings. The failure to thoroughly transfer information from these field logs to the "prepared for presentation" logs has frequently been a crucial issue in a claim for differing site conditions.

Information that the field staff may provide regarding site access for the drilling equipment, reactions the driller "feels" in advancing the hole, and in certain instances even what they smell *(e.g., noxious gases being emitted from the hole)*, often provide vital information to the designer as well as to the contractor. If the owner/engineer prefers to report this information in a "presentable form", he should provide the field logs for the information of the contractor, so that he may make his independent assessments as to which information provided on those logs is critical. In addition to pre-bid field investigations conducted on the site, a research effort of available documents and interviews of knowledgable parties may fill some of the gaps that are missed by the field investigation. As a practice, some technical engineers routinely perform a review of the geologic information available through the local State and Federal agencies, and interview local officials and parties in the area who may be familiar with the local construction, or past use of the land.

REPRESENTATIONS OF GROUNDWATER LEVELS

Despite groundwater elevations, flows and conditions being prevalent subjects of differing site conditions claims, little advantage is taken of the opportunity available to the owner and his investigation team to gather meaningful and long term information about the groundwater levels. This seems particularly true of trench excavation and structural excavation projects. Provisions for monitoring groundwater levels can easily be installed at the same time field investigations are carried out, and at very little cost, groundwater level fluctuations could be routinely monitored.

REPRESENTATIONS OF THE SUBSURFACE CONDITIONS MADE IN THE CONTRACT SPECIFICATIONS

Differing site conditions claims frequently rely upon specific representations made in the contract specifications or on the contract plans. In certain instances, the specific representations in the plans and specifications are representative of the conditions the engineer anticipated on the project. But in other instances, the details or specifications containing these representations were transferred from documents that applied to another project, were standard boiler plate provisions, or were details routinely incorporated in the contract documents. To avoid such misrepresentations, the contract documents should be reviewed on a per project basis to eliminate these inappropriate specifications and details.

QUANTITY ESTIMATES

Overruns and underruns of bid-item quantities *(bid estimate versus actual quantities)* often forms the basis for a differing site conditions claim. The logic of the argument is that bid quantities are indicative of the volume of work and time of performance contemplated by the contract. Examples are underruns in pile length quantities and overruns in the quantities of unsuitable material, consolidation grouting, and select backfill.

When differing site conditions actually occur, it is understandable that there may be substantial differences between the bid quantities and actual quantities required to accomplish the work. Rather than rely on any esculpatory language to the contrary, it is recommended that the bid quantities listed be the most reasonable approximations for conditions anticipated for the site.

THE WORK OF OTHERS

Project timing requirements often create unavoidable circumstances where the work of a contractor may adversely influence another. If adequate information is provided, some adverse impacts may be foreseeable at the time bid documents are prepared, evaluated by the bidders, and priced accordingly. Therefore as part of the pre-bid review, it is recommended that adequate information be provided by the owner and engineer, concerning ongoing or proposed work by others that may influence the present contract.

POST-BID STAGE RECOMMENDATIONS

CHALLENGE TO THE REASONABLENESS OF THE CONTRACTOR'S WORK EFFORT

One of the most frequent defenses raised concerning differing site condition claims is that production was poor from the start of the project, or that it was as bad in other segments of the project. Thus, the failure is the contractor's improper implementation rather than a differing site condition. In order to support a differing site condition claim, the contractor should be prepared to submit to the engineer and owner a reasonable plan by which he intends to carry out the work, and include the justification and reasonableness of any diversions from, or adjustments to, the plan. Often the submittal of such work plans is a contract requirement or an informal arrangement. If the owner or engineer see such plans and have genuine concerns, these concerns should immediately be brought to the contractor's attention.

INCOMPATIBILITY OF CONSTRUCTION METHODS, DESIGN AND CONDITIONS ENCOUNTERED

Despite how confident the owner or contractor may have been in the original methods of design they selected, they should routinely reassess their suitability in view of actual conditions being encountered. In order to carry out these reassessments, it is necessary to have qualified representatives of the owner/engineer and the contractor frequently visit the site and personally assess the conditions.

INSUFFICIENT DOCUMENTATION

Despite the frequency with which differing site conditions issues arise, rarely do any of the parties to a construction contract keep sufficient records to satisfy each other in the event of a dispute. The more detail a contractor has to support a differing site condition, the more likely the owner or the engineer is to acknowledge the occurrence of a differing site condition, and accept cost and time adjustment requests. The problem is best solved when both the owner/engineer and the contractor establish programs to monitor the progress of the work, the daily and per unit production, and the conditions being encountered. Such information enables quantitative analysis *(e.g., the analyses illustrated by Tarkoy)*. However, to reliably record conditions being encountered, the field staffs of both the owner/engineer and the contractor must be sufficiently trained. In one claims situation observed, the owner's inspectors consistently described soils encountered in the lower portions of the sewer trench as silty clay. Whereas, subsurface information made part of the contract documents indicated that soils encountered at this depth would be sands or silty sands. When the daily reports containing the descriptions of the field inspectors were introduced by the contractor in support of his claim, the owner was placed in the unenviable position of having to argue that his field staff consistently had misclassified the soil encountered. Simultaneously, the owner had to convince the arbitration panel that the same inspectors were capable of rendering informed determinations as to whether or not the soil could provide suitable pipe support.

FAILURES TO PROMPTLY REACT

It has often been observed in differing site conditions situations that the contractor has not recognized or has been reluctant to promptly give notice of the discovery of a differing site condition. Similarly, the engineer's staff occasionally fails to promptly respond to the notice of a differing site condition. When they do respond, the capability of the staff they send to evaluate the conditions and make the determination may be subsequently less qualified than the experts they would assign in the event a subsequent dispute develops.

Failure on the part of the contractor's staff to give notice of a differing site conditions may bar recovery for any work performed prior to giving notice. Alternatively, slow response on the part of the engineer to notices received from the contractor, may delay the work, and result in unnecessary increased costs. Such inaction may provoke the owner to assess the engineer's increased costs arising from his failure to promptly respond.

Having taken action appropriate to verify the report, the contractor's manager will issue a written notice to the owner. Such notice should not be given prematurely, but on the other hand, should not await receipt of proof from the field. The purpose of the notice is twofold: *(1)* to alert the owner to the contractor's observation that he believes a change in the conditions has occurred, and *(2)* to preserve the contractor's record that the owner has been so informed. In all likelihood a determination as to whether or not a differing site condition has occurred, will be based on the representations available at the time of bid, and a reasonable site investigation by the contractor. These, in turn, will be contrasted against the conditions being encountered at the site.

The owner/engineer should also be prepared to promptly respond to the notice from the contractor that a differing site condition was discovered. These responses are most prompt and effective when staffing and minimum procedures to be followed have been contemplated and drawn up in advance.

INSUFFICIENT EVIDENCE OF A DIFFERING SITE CONDITION

Too often, the amount of information available for trained experts to determine whether or not a differing site condition occurred is insufficient. If the owner/engineer or contractor wishes to take a position on a differing site conditions issue, it is essential that the investigation he relies upon be thorough. To every feasible extent, they should place themselves in a position to be able to document their opinion using photographic records, notes, interviews, and samples of the conditions encountered. They should obtain information as to when the conditions began, when they terminated and how they compared to the conditions prior to the alleged change. They should also determine what specific effects the conditions had on the progress and production of the work. In addition, a list should be prepared of the individual representatives most familiar with the conditions encountered.

MITIGATION OF COST

While a differing site conditions clause assigns to the owner the risk of increased cost and time of performance, the contractor has the obligation to mitigate the cost of overcoming the differing site condition. Thus, the contractor should be continually evaluating progress and alternate methods available to assure that his method is reasonable. Likewise, the owner or his engineer can not wait until the differing site work has been completed, then later argue that the contractor failed to mitigate costs. If the owner/engineer believes the contractor is not actively pursuing the work, or if his approach is one that makes the work substantially more costly than it should be, the owner/engineer should bring this to the contractor's attention.

CONCLUSION

When a differing site conditions clause is incorporated in the contract, the engineer, the contractor and the owner should govern their actions accordingly. Whereas, the owner has accepted the risk of unforeseen adverse conditions, the engineer should allow an appropriate contingency in estimating the cost of the work. Having agreed to include a differing site conditions clause in his contract, the owner has to prepare for the potential cost consequences. The engineer should also recommend steps to be taken prior to bid and during the conduct of the work. Appropriate inspection and administration activities to avoid any cost increases not attributable to the changed conditions should be made, and claim costs that actually incurred should be verified.

The contractor may be able to lower his bid because of the owner's willingness to bear the risk. Likewise, this requires the contractor to monitor the conditions being encountered, give notice of, and document the existence and effects of a differing site condition. Recognizing that in all likelihood the total ramifications of a differing site condition will not be resolved until after the work is completed, he should constantly assess his operations to ensure he meets the test of having properly mitigated the increased costs.

No amount of pre-construction preparation, or monitoring and data gathering during construction, will prevent the discovery of differing site conditions. Nor will it enable any party to form a basis to prove or deny a change that occurred. However, implementation of the above recommendations should minimize the number of representations and provide the factual basis to confidently determine whether a differing site condition has occurred, and to reasonably measure and price any direct and impact costs.

LEGAL ISSUES FOR GEOTECHNICAL ENGINEERS AND CONTRACTORS

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I. EFFECTS OF PROFESSIONAL LIABILITY

Consulting Soil and Foundation Engineers have felt the pain of professional liability. In fact, by 1968, most geotechnical consultants were unable to obtain professional liability insurance coverage; those few who could were forced to pay astronomically high rates.

The reason geotechnical engineers and contractors are so affected is that their work is highly judgmental, fraught with risks and uncertainty, and not easily explained to a judge or jury. In essence, geotechnical engineers must apply their professional training, experience and knowledge of local conditions to findings based on observations of a specific site. They then develop recommendations for the types and extent of tests most suited to investigate the site given the nature of construction involved. Next, they analyze the test results and apply observations to make judgments about subsurface conditions at the site, predict the reaction of these conditions to construction activities, and recommend appropriate foundation design based on their predictions.

No matter how thorough the investigation, nor how competent the geotechnical engineer, there can never be assurance that findings and recommendations are 100% accurate. It is inherent in the nature of subsurface work that "unanticipated conditions" may occur during excavation.

Notwithstanding the above, if a problem results due to soil instability a suit is filed usually against the geotechnical engineer as well as the contractor. The purpose of this article is first to set forth the substantive causes of action that could potentially be brought against a geotechnical engineer as well as the contractor when a defect develops in a structure due to soil instability and second, to focus on avenues to limit such potential liability.

II. THEORIES OF LIABILITY

The substantive causes of action for defects caused by soil instability encompass many different theories of liability, ranging from negligence, breach of implied or expressed warranty, to absolute liability. Annotation, Statute of Limitations: Actions by Purchasers or Contractees Against Vendors or Contractors Involving Defects in Houses or Other Buildings Caused by Soil Instability, 12 A.L.R. 4th 866 (1986).

A. NEGLIGENCE -- PRIVITY OF CONTRACT

The earliest standard imposed liability based on a negligence test and limited those persons to whom the engineer or contractor might be liable to those with whom he had a contract. Thus, the engineer or contractor could not be liable to third parties with whom he did not contract.

The theory of this "contractual limitation" on tort liability was to protect the defendant, in this case the engineer or contractor, from liability to an infinitely large group of plaintiffs. The problem with this approach was that in certain cases, injured parties, whose injuries clearly might have been foreseeable, were outside the protection provided by contractual privity.

In Oakes v. McCarthy Company, 763 Cal Rptr. 127 (Ct. App. 1968), the California Appellate Court addressed this issue. In Oakes a plaintiff, who had purchased a home in a subdivision developed by the McCarthy Company, brought suit against McCarthy and against the Donald R. Warren Co., an engineering company which contracted with McCarthy to provide inspection and supervision services related to the soil in the tract where the homes were located. The plaintiff brought suit when certain fill soil gradually moved, causing a significant amount of stress to the house, which resulted in cracked walls, cracked window frames and broken glass panes. The plaintiff recovered $14,825 from Warren. The jury found that Warren undertook to supervise the actual work of cutting, filling, and compacting the soil in the subdivision and that the fill was not adequately compacted. It found that Warren was negligent because the fill was left permiable, permitting waters to percolate down to the underlying black clay, causing it to expand and slip or creep, thus causing the plaintiff's damages.

On appeal, Warren argued that it could not be liable to the plaintiff because it had contracted with McCarthy and not with the plaintiff. The Appellate Court rejected the "contractual privity" theory and instead adopted the following "foreseeability" test which takes into account the following factors:

1. the extent to which the transaction was intended to affect the plaintiff;

2. the foreseeability of harm to the plaintiff;

3. the degree of certainty that the plaintiff suffered injury;

4. the closeness of the connection between the defendant's conduct and the injury suffered;

5. the moral blame attached to the plaintiff's conduct; and

6. the policy of preventing future harm.

Thus, in light of Oakes, in order for either the contractor or the geotechnical engineer to be held negligent, it must be found that the services performed were not in accordance with the standards of the soil engineering profession or the contracting profession in the area in which such professional was living or working at the time the work was performed. And, moreover, the class of potential plaintiffs will be limited not by the contract, but rather, by the factors enumerated above.

B. IMPLIED WARRANTY

In addition to actions based on negligence there are also actions based on warranty. An action arising from an implied warranty is based on the existence of a duty to advise the owner of defects in soil as part of an implied warranty that construction will be done in a workmanlike manner. Hence, if such contractor knew or should have known that a defect in particular subsoil exists but fails to notify the owner of the existence of the condition he has not performed his contractual obligation in a workmanlike manner and therefore is liable for any resulting damage. Annotation, Duty of Contractor to Warn Owner of Defects in Subsurface Condition, 73 A.L.R. 3rd 1213 (1986).

1. Latent and Apparent Defects

The implied warranty action may take many forms. For example, the contractor may be liable for a failure to notify an owner and/or take steps to correct foreseeable problems arising from soil defects. Decisions have frequently turned in this area on whether the defect is latent or apparent. Contractors have not been held liable for latent defects, typically, on the theory that even a contractor performing a project in a workmanlike manner may not detect a latent defect. Conversely, contractors have been held liable in situations involving apparent defects because a contractor performing a project in a workmanlike manner would not fail to detect an apparent defect. Thus, In Wurst v. Pruyn, 250 La. 1109, 202 So.2d 268 (1967), the court ruled that a contractor was liable for failing to warn that building a foundation near several large trees could cause the soil to shrink and subside (due to water absorption by the trees) thereby leading to failure of the foundation. The Court's ruling was based on the testimony of a licensed engineer who was an expert in soil mechanics, soil investigation and foundation work. Significantly, the Court noted that while the cost of correcting the absorption problem was economically unfeasible, the contractor nonetheless should have presented that option to the owner.

2. The Importance of Specifications

It is important to note that while a contractor may avoid liability for faulty construction attributable to defective plans and specifications, even this rule is subject to some limitations. First, a contractor who makes unauthorized changes in the plans and specifications assumes the risk of any defects in the construction work. See, e.g., Shore Drive Apartments, Inc. v. Frank J. Rooney, Inc., 250 So.2d 478 (Fla. App. 1971).

Second, a contractor may be liable where he fails to disclose defects in plans and specifications provided by the owner or architect. That is, while a contractor is bound to follow plans and specifications, he has a duty to examine the plans and discover defects which are reasonably discoverable; and where the contractor knows or has reason to believe that the plans are defective, but follows then without pointing out such defects to the owner or architect, the contractor will not be entitled to rely on the plans and specifications as a defense to his own liability.

The flip side of this discussion is that where a contractor notifies an owner or architect of a defect in the soil which could potentially cause problems in the structure, despite compliance with plans and specifications, and the owner or architect fails to take appropriate steps to correct the problem, the contractor will not be liable. See, e.g. Ridley Invest. Co. v. Croll, 56 Del. 208, 1982 A.2d 925 (1963).

In short, an action for breach of an express warranty is simply an allegation that the contractor or geotechnical engineer breached his contract with the owner. By identifying and addressing potential defects at an early stage, liability may be avoided.

C. STRICT LIABILITY

The most alarming cause of action is absolute or strict liability. Under strict liability, the plaintiff need not demonstrate fault; he need only establish that the work product was defective and that the defect was the proximate cause of the plaintiff's injury. The defenses of lack of privity or contract, lack of reliance on warranty, and disclaimers are not available in this cause of action because strict liability is grounded in tort. Annotation, Recovery Under Strict Liability and Tort, for Injury or Damage Caused by Defects in Building or Land, 25 A.L.R. 4th 351 (1986).

In Avener v. Long Ridge Estates 272 Cal. App. 2d 607, (2d Dist., 1969), the court held that a corporate land owner and an engineer who had manufactured a residential lot by cutting, grading, filling and compacting it for the purposes of sale to the public and construction of a house thereon could be held strictly liable in tort to subsequent purchasers from the original vendee of the lot for damages proximately resulting from defects in the preparation process. The court noted that the alleged defects were not physical or apparent to a purchaser and that information could have been ascertained by subsurface soil tests and by inspections at the time of the filling and grading. The court said that a party preparing a lot has an obligation, and is strictly liable to a purchaser for defective subsoil conditions resulting from improper filling and grading that causes instability.

III. LIMITATIONS OF LIABILITY

Because engineers and contractors may be held liable under so many different theories today they must exercise caution in their construction of a building project. If there are peculiar conditions of the subsoil which would pose a significant threat to the success of a construction project contemplated in the contract they should advise the person or organization with whom they have entered an agreement of the condition.

Since geotechnical engineers today are faced with the possibility of having to answer extravagant claims which often will result from claims over which they have no control, they should take steps to limit their liability. This concept implies the belief that a person acting in good faith on behalf of another will be responsible in a reasonable measure to that second person, but should not be jeopardized by enormous penalties when unexpected contingencies occur. Limiting liability means that, in the geotechnical engineers contract with the owner, he should include a clause that limits his liability to a given dollar amount - typically $50,000 - or the fee, whichever is higher. The owner is required to include an identical clause in agreements with contractors and subcontractors, thus creating an aggregate limitation that applies to all, with the exception of third parties. There are numerous publications which deal with the issue of how geotechnical engineers should draft their contracts to accomplish limiting their liability. <u>See</u>, <u>The ASFE Contract Reference Guide</u>, 2d Ed. (1986); and <u>The ABC's of Limitation of Liability</u>.

Perhaps the best method for limiting liability of engineers and contractors is for both to work together early on in the project in order to identify potential defects in the soil as they relate to the structure - so that the owner may be apprised and such defects may be remedied before litigation ever ensues.

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"EARTH RETENTION DESIGN, GROUND MOVEMENT MONITORING AND LIABILITY - A CASE HISTORY"

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ABSTRACT

The role of the geotechnical engineer in earth retention design to control ground movements is reviewed. The different perspectives of the design geotechnical engineer working for the owner and the geotechnical engineer consultant working for the contractor on temporary earth retention are discussed. The role of the owner in assessing the cost implications resulting from different geotechnical perspectives is reviewed, using a major downtown Chicago three-level basement excavation as a case history.

The case history involved protection of city streets and utilities, modification in the design to increase safety against slope failure, monitoring of ground movements with inclinometers, monitoring of waler loads on the earth retention system with strain gauges on representative rakers, and a comparison of predicted loads and deflections versus actual.

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INTRODUCTION

A. Our increasingly litigious society

Most of us are well aware that we are living in an increasingly litigious society. Those of us in the geotechnical engineering profession see it most directly in the increasing cost of our professional liability insurance. We also see it in comparing how often we are sued today with 25 years ago. Twenty-five years ago, there seemed to be recognition that the unexpected could always occur in the underground without necessarily meaning somebody was negligent. Contractors maintained property insurance to cover minor to moderate damage to adjacent structures caused by a contractor's excavation. Today, there appears to be an increasing effort on the part of insurance companies to find someone to blame or at least to share the cost.

B. Excavation, ground movements, property damage and litigation

Theory and experience tell us that when an excavation is made in the ground, some ground movement must occur. The probable minimum amount of movement would be the elastic rebound due to stress relief and the maximum would be total excavation wall collapse. Reliably predicting the amount of movement that will occur for a given excavation sequence and retention system is difficult at best and is often impractical due to the influence of even small changes in construction procedures and in anticipated subsurface condition. In addition, determining the amount of movement which can be tolerated before unacceptable property damage occurs is often even more difficult. In spite of this, if the retention system is constructed in accordance with accepted plans and specifications and still ground movements caused unacceptable damage to adjacent structures, the contractor's insurance company is apt to say "my client did his work in accordance with specifications and therefore someother party must be at fault and should pay the cost of repair".

For a given project, the owner or developer typically feels that he has hired the best design engineers and contractors and has a right to expect a competent design and construction that won't result in lawsuits and extra costs. The structural engineer and the contractor are apt to contend that they relied on the report of the geotechnical engineer to develop the most appropriate design and construction techniques. The geotechnical engineer, for his part, usually points out the possibility of soil occurrences which may be different from what he has tested and indicated in his report. Previous construction, old foundations, sewer lines (etc.) can further complicate a soil profile.

The benefits, compensation, and liability related to cost reductions in a retention system design must also be put in perspective. The owner of the project is usually the beneficiary of any construction cost savings resulting from competitive bidding. Sometimes these cost savings may result in reduced factors of safety against ground movements and adjacent property damage. At the same time, the contractor is receiving the bulk of the money spent on the construction to accomplish the design. While the geotechnical engineer may have developed the soil parameters on which the design and construction is based, he receives only a small fraction of a percent of the cost of the project for his fee, yet often bears a disproportionate amount of the liability.

With the foregoing background, in the remainder of the paper we will review the various roles of a geotechnical engineer having to operate within the conflicting perspectives of the parties involved. The paper will conclude with an interesting case history utilizing a major downtown Chicago deep basement project.

THE ROLE OF THE GEOTECHNICAL ENGINEER IN EARTH RETENTION DESIGN

In the writer's experience, on most projects in the United States today, design engineers separate design of permanent structures from design of temporary structures. Usually, the design of temporary structures is relegated to the contractor. (The work is most often actually performed by specialty subcontractors.) In some cases, in an attempt to limit their liability exposure, the design engineers make certain that their design contracts do not include responsibility for review of the contractors earth retention design for fear that such review would increase their liability. These projects often utilize a performance type specification in order to put the responsibility of the retention system performance totally on the contractor. In an effort to ensure a minimum level of competence, however, the specifications will often include experience qualification requirements and will require the contractor to retain a licensed structural engineer and/or geotechnical engineer to design his temporary earth retention system, either having such people on staff or retained independently.

The perspective and objective of the contractor bidding on and building the project is to accomplish the design and specification requirements at minimum costs. Minimum costs can often mean minimum acceptable factor of safety. However, the question "What is a minimum acceptable factor of safety?" requires knowledge of the price of failure and what is an acceptable risk. If the adjacent property damage potential is not too great, the contractor may be willing to risk a failure and thus operate with a theoretical factor of safety which is close to 1. The owner's perspective may, however, be somewhat different. Even if the actual dollar cost of failure is not huge (cost of repairing sidewalk and streets), the owner may be unwilling to accept a significant risk of failure because of concern for damage to his "community image". In this case, an owner might want a significantly higher factor of safety than the contractor. Thus, a geotechnical engineer working for a contractor attempting to win a bid for an earth retention design might reasonably work with a relative factor of safety of 1.2, whereas a geotechnical engineer working for the owner might reasonably desire a relative factor of safety of 1.5.

How should the geotechnical engineer operate within the potentially conflicting perspectives of contractor and owner? The answer is: very carefully.

Whether working for the owner or the contractor, the following guidelines apply:

1. Carefully state all assumptions.

2. Be thorough and detailed in the analysis and note any construction sequencing limitations.

3. Have work reviewed by competent peers, either in-house or external.

4. Predict insofar as practical, approximate earth movements expected if design and sequencing are followed, unless the specifications already give movement limitations.

5. Insist on a monitoring program and have contingency plan recommendations in the event movements significantly greater than predicted occur particularly if there is adjacent property that could be damaged if excessive movement occurs.

6. Insist on a field representative to see that design assumptions are met and required construction sequencing is followed. If concerned about construction control, insist on indemnification.

In many projects, the geotechnical engineer has been retained by the owner for exploration and consultation services, and the contractor has been given full earth retention system design responsibilities. Should the geotechnical engineer become involved in the review of the retention system or should he/she maintain a "hands off" policy in an attempt to keep the full liability on the contractor? Will he get sued anyway if failure occurs?

In our opinion, if asked by the owner to review the design, the geotechnical engineer has a professional responsibility to perform the review recognizing the different perspectives. If after review he thinks the contractor's design is unsafe or marginal (involves an unacceptably low factor of safety and a high risk of excessive movements) he should discuss his concerns with the contractor, reviewing assumptions and calculations. If differences cannot be resolved, he should report the differences of opinion and the reasons for them to the owner.

The writer recently had an opportunity to be involved in the above review type role for a major downtown Chicago deep excavation project which will be described briefly in the next section.

QUAKER TOWER CASE HISTORY

1. The Quaker Tower site is located at the northeast corner of the intersection of Clark Street and the Chicago River. The project consisted of a 40-story office tower with three full basement levels, involving a 36-foot to 39-foot cut below lower level street grade except on the Clark Street side where a raised street level resulted in an effective 55-foot deep cut. A 12-foot high pile supported retaining wall plus small berm provided the initial earth retention system for support of Clark Street. Figure 1 shows the cross section through this site from west to east, including initial grade and final excavation levels. Also shown are the assumed soil profiles with the soil cohesion taken as one half the unconfined compressive strength of 2 inch diameter shelby tube samples. Figure 1A shows the location diagram.

2. The contractor assumed average soil properties based on the site geotechnical engineering report and analyzed for a 36-foot deep cut with surcharge to account for the retaining wall backfill load.

3. The contractor's soldier pile and lagging design assumed an open cut full depth with a berm and with the initial top brace not installed until half of the base mat was poured. Once this top level brace was installed, the next two wale and brace levels were to be installed sequentially with appropriately cut back berms.

4. The geotechnical engineer retained by the owner was asked to review the contractor's design. In his review, he assumed the poorest soil profile from the borings, rather than the average, and considered a 55-foot deep cut when analyzing for the deep seated slide case.

   His analysis indicated a high level of risk of slope failure or, at a minimum, excessive movement, before the top raker could be installed. The theoretical factor of safety was less than 1, if the poorest soil profile was assumed and lateral resistance of the piles supporting the existing retaining wall was discounted.

5. The contractor was asked to review his assumptions and to analyze for slope stability. By using average soil properties and taking into account the bending moment capacity of the piling, the contractor was able to show an overall factor of safety very slightly in excess of 1.

6. Meetings were held with the owner and contractor to resolve differences. The contractor felt his system would work as designed, but expected 6 inches to 12 inches of settlement or movement. The owner was concerned that the city would stop the project, or at least have to close Clark Street if movement or settlement exceeded 6 inches. He believed this would have a bad effect on his image regardless of the cost factors.

7. Methods for reducing the risk of excessive movements and increasing factor of safety were discussed with the contractor. The geotechnical engineer recommended partial excavation and then cross lot bracing to permit the entire mat construction, installing the top raker through the cross lot braced excavation to the mat, and then proceeding as before. See Figure 2. The contractor countered with replacing the cross lot bracing system with a tied back wall on one side, using regroutable ties and with an open cut on the other noncritical side of the excavation where there was ample room for open cut. The geotechnical engineer agreed and the owner and contractor negotiated a price for the additional work. See Figure 3.

8. Inclinometers were used to monitor movement during the various stages of excavation and bracing. Figures 4 and 5 show the inclinometer movement for the center of the Clark Street side of the excavation for two inclinometers located just outside the soldier piles and about 30 feet apart. A third inclinometer was located on Clark Street about 15 feet west of inclinometer I-2. This inclinometer initially showed a similar movement shape but proportionally less, although it ultimately showed maximum movements in the soft clay about equal to inclinometer I-2. See Figure 6. The different curves are dated and show the amount of movement at each of the various stages of excavation and bracing. The amount of actual ground surface settlement that occurred in the area of the inclinometers is shown on Figure 3 and indicates maximum settlement and total volume of settlement approximately equal to the maximum lateral movement and volume of lateral movement in the soft clay or about 6 inches.

In analyzing the observed movements, it is evident that considerable movement occurred during the time that it took to excavate down to the lower tied back wall level and install the soldier beams and regroutable tie backs (approximately 1 to 2 inches). An additional 1 to 2 inches occurred during the length of time it took to excavate and pour the mat foundations and install the top raker level. From the time of the first raker installation until completion of the total excavation and three levels of rakers, an additional 2 inches of movement occurred with an additional approximate 1-inch movement during backfilling and raker removal, for a total movement of approximately 5 to 6 inches. While this movement is greater than was desired, it was not sufficient to cause closing of Clark Street at any time during construction.

9. Vibrating wire strain gages, installed on three rakers (on top, bottom and both sides) located between the inclinometers after the rakers were installed and monitored during maximum loading and again on unloading, showed total loads a little less than projected by the contractor (about 83% of that calculated by the contractor, and significantly less than that calculated by the geotechnical engineer) but with a much different distribution. The contractor's predicted loads and the measured loads at a representative cross section are shown in Figure 7.

It is evident that the top waler carried significantly less load than predicted, whereas the bottom waler carried considerably more load than predicted with the center waler as predicted. It is likely that part of the explanation for the lower total loads and particularly, the lower top brace load is the horizontal load carried by the pile supported retention wall. Another possible explanation for this tendency would be the beginning of a circular slide rotating around the center brace level, thereby unloading the top brace level and increasing load on the bottom brace level. The magnitude of movement below excavation level indicated by the inclinometers lend some credence to this possibility. This also substantiates the geotechnical engineer's concern for a deep seated slide if an attempt had been made to make an open cut all the way to the maximum cut elevation -30 before installing any retention system and bracing.

On the other hand, the fact that the total loads were less than the predicted loads might indicate that the ground was stronger than assumed and the factor of safety greater than calculated, which would support the contractor's belief in the original design.

10. The contractor and the geotechnical engineer maintain a difference of opinion on the likelihood of the original retention system working. The contractor believes that the retention could have worked, provided the excavation was made quickly enough and the mat poured and top raker installed in the shortest possible time. The geotechnical engineer remains convinced that a major slide would have been likely and the work could not have been completed quickly enough to avoid it. At the same time, the magnitude of movements that occurred before the top raker was installed emphasizes the need to get the top raker in as quickly as possible. Slope movements definitely occurred in the excavation slope above the lower level tie back system. It is possible that utilizing driven piles for tie backs could have speeded up the installation process and reduced the length of time the excavation needed to be open prior to installing the top raker. However, driven piling would have introduced greater damage potential to existing foundations if the piling were to hit any of the existing retaining wall pile supports during driving. Alternatively, the slope movements and resulting initial lateral displacements could have been reduced further by making a shallower initial cut and utilizing a two level tie back or brace system for the inner tied back wall. This of course, would have been more costly and would have had to be considered in any cost benefit analysis.

CONCLUSION

In conclusion, it is important to recognize the different perspectives of a contractor and an owner and their respective geotechnical engineers in temporary earth retention design and construction. The value of review of the contractor's design by the owner's geotechnical engineer has been emphasized. The willingness of an owner to pay extra for a safer temporary earth retention design helped foster a more cooperative attitude among all the parties involved.

ACKNOWLEDGEMENTS

The writer wishes to express his appreciation to the developer, BCE Development Properties, inc. for permission to use data from their project, and to the architect and building design structural engineer, Skidmore, Owings & Merrill for their technical support. The writer would also like to thank the general contractor, PCL Construction, and earth retention subcontractor, Schnabel Foundation Company, for their cooperation and assistance. Instrumentation of the rakers was authorized and paid for by Schnabel Foundation Co.

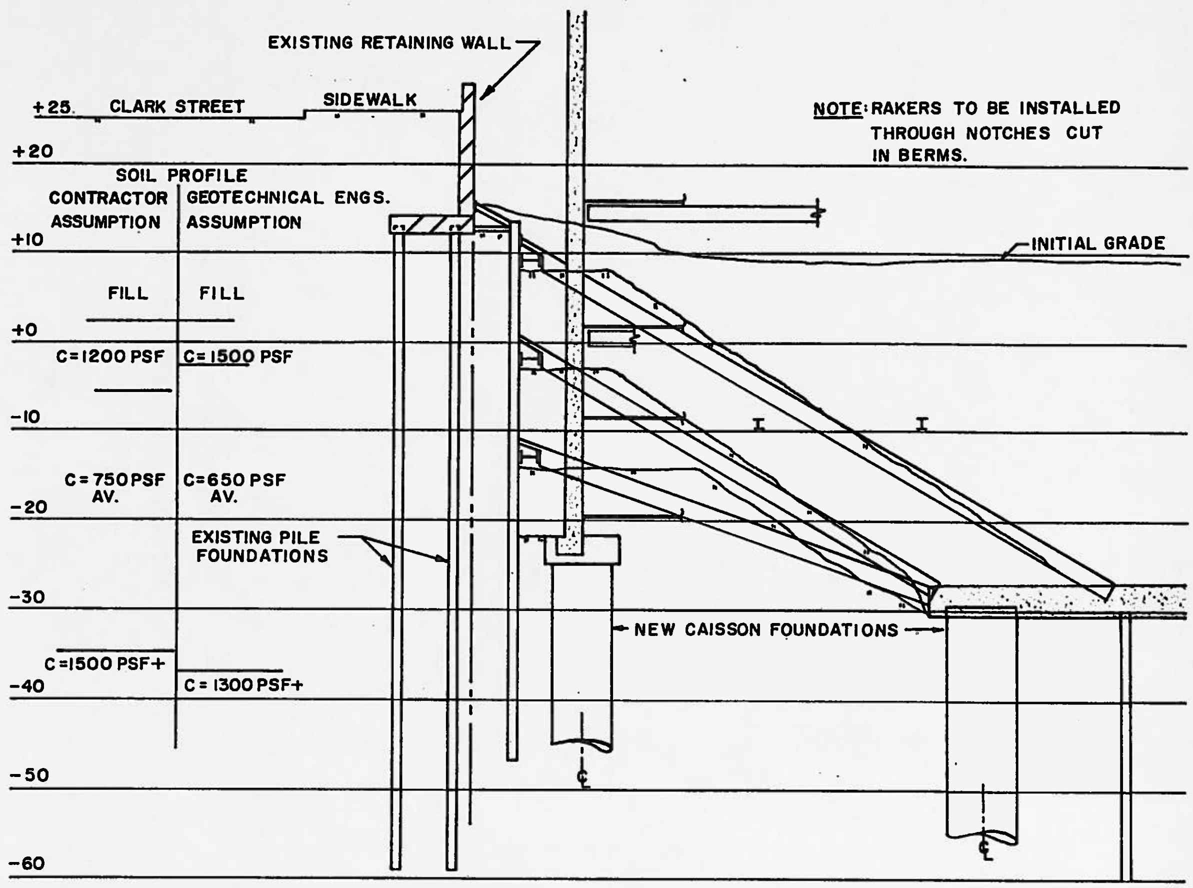


FIGURE 1 - EXISTING & PLANNED CONSTRUCTION

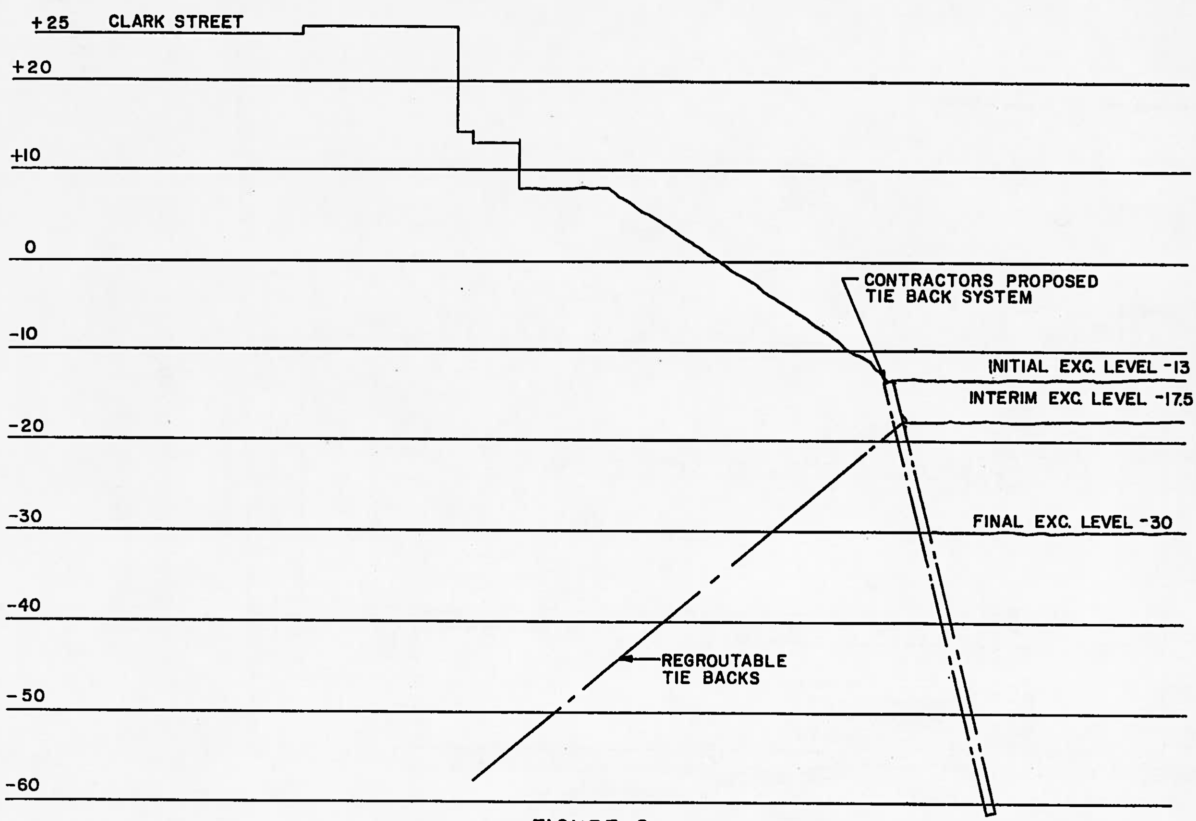
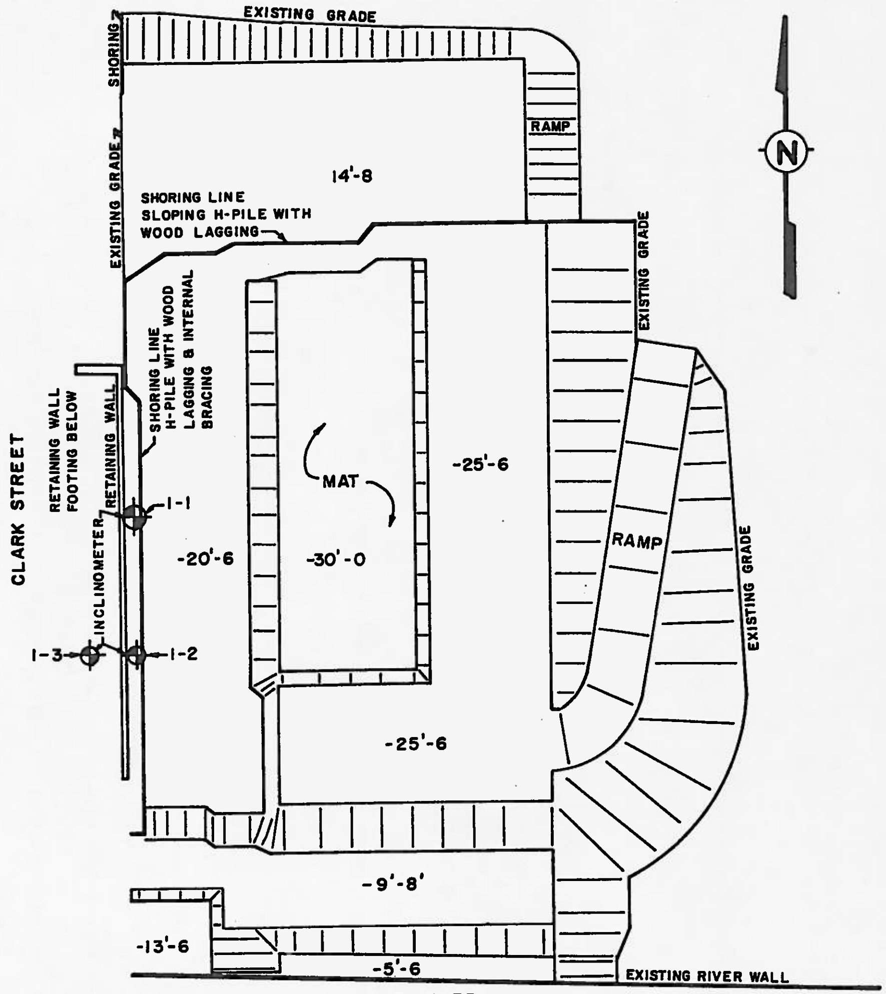


FIGURE 2

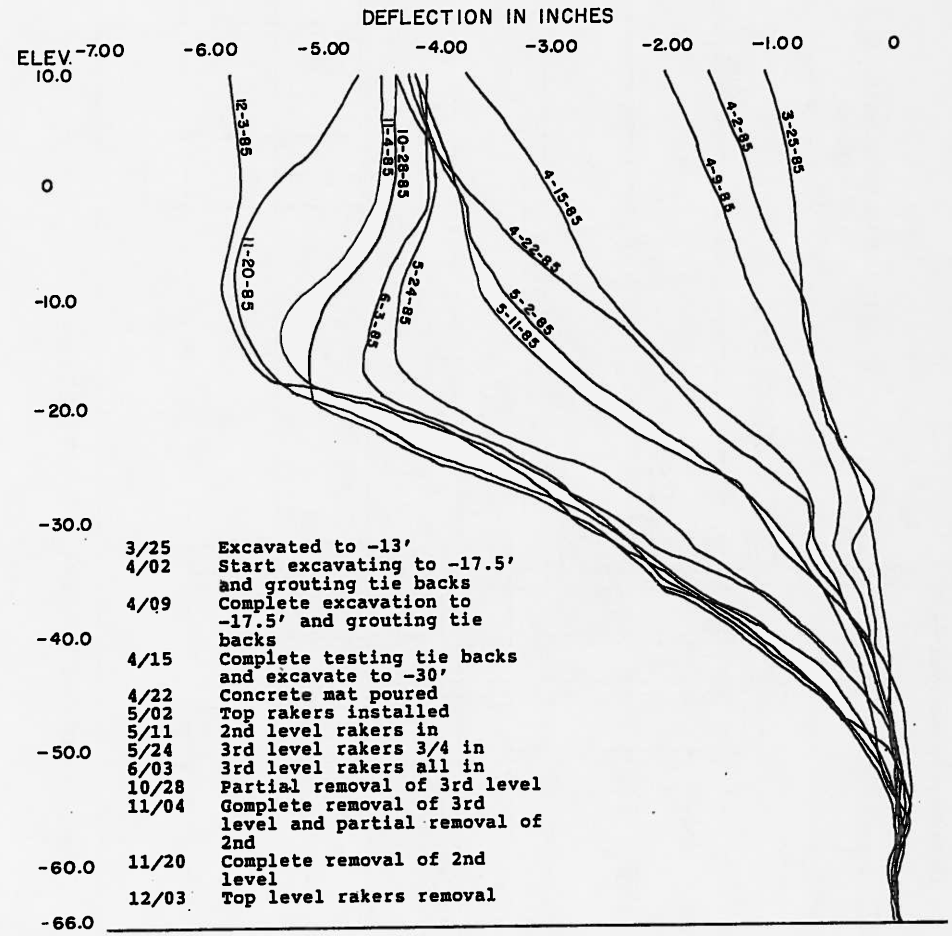
PROPOSED LOWER LEVEL TEMPORARY RETENTION SYSTEMS



NOTE:
ALL ELEVATIONS
ARE C.C.D.

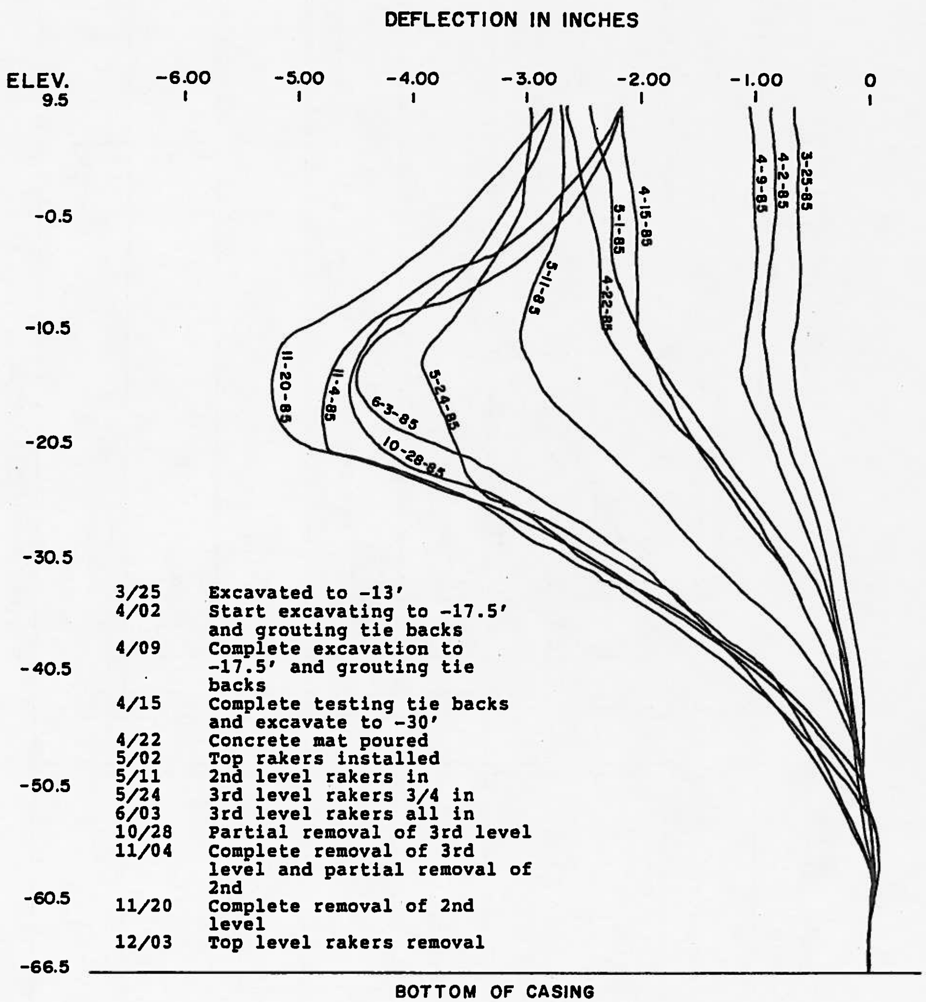
SITE LOCATION DIAGRAM

FIGURE 1A



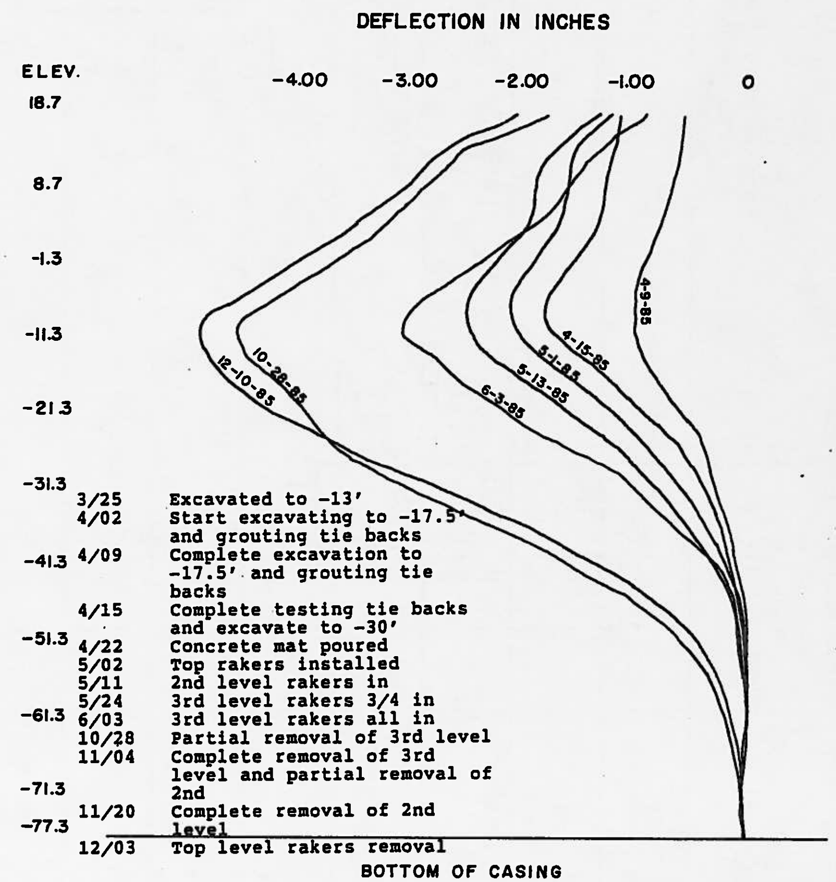
INCLINOMETER OBSERVATIONS I-1

FIGURE 4



INCLINOMETER OBSERVATIONS I-2

FIGURE 5



INCLINOMETER OBSERVATIONS I-3

FIGURE 6

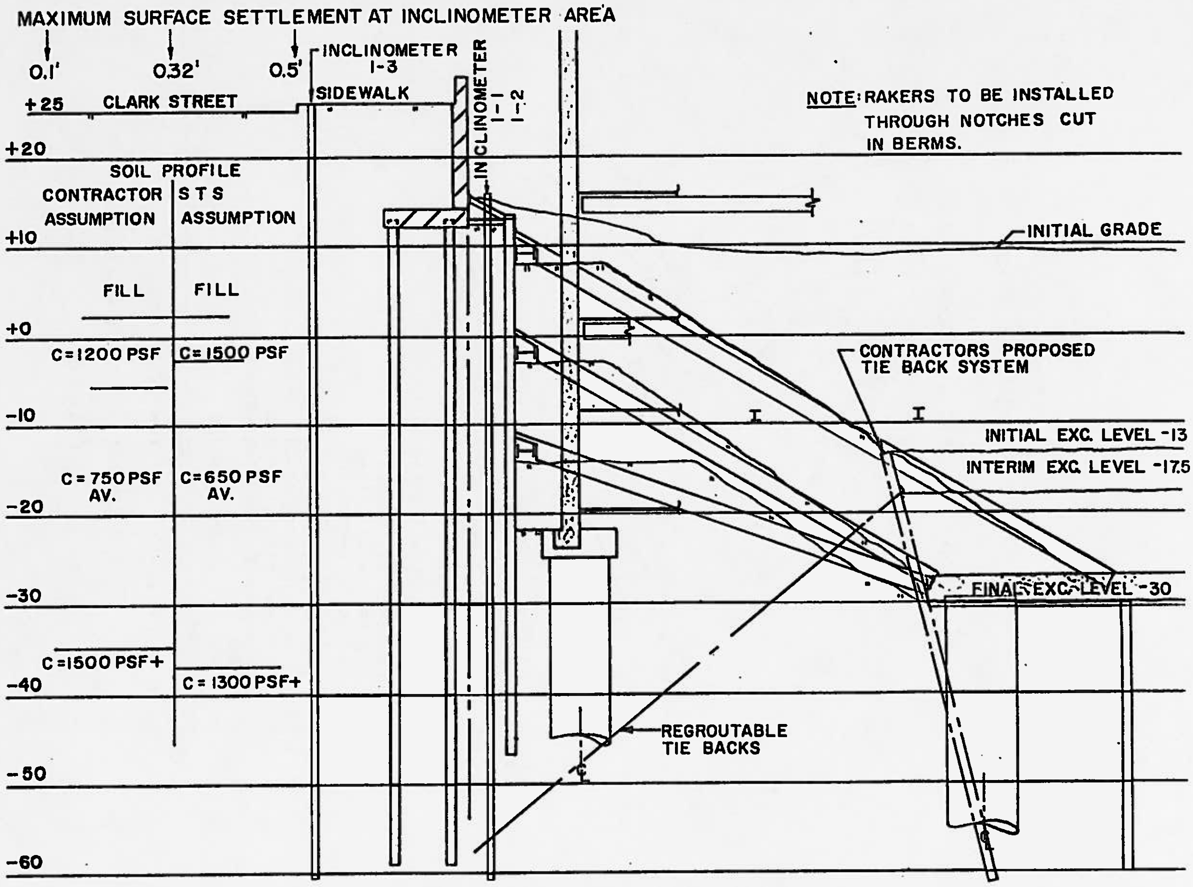


FIGURE 3-FINAL RETENTION SYSTEM

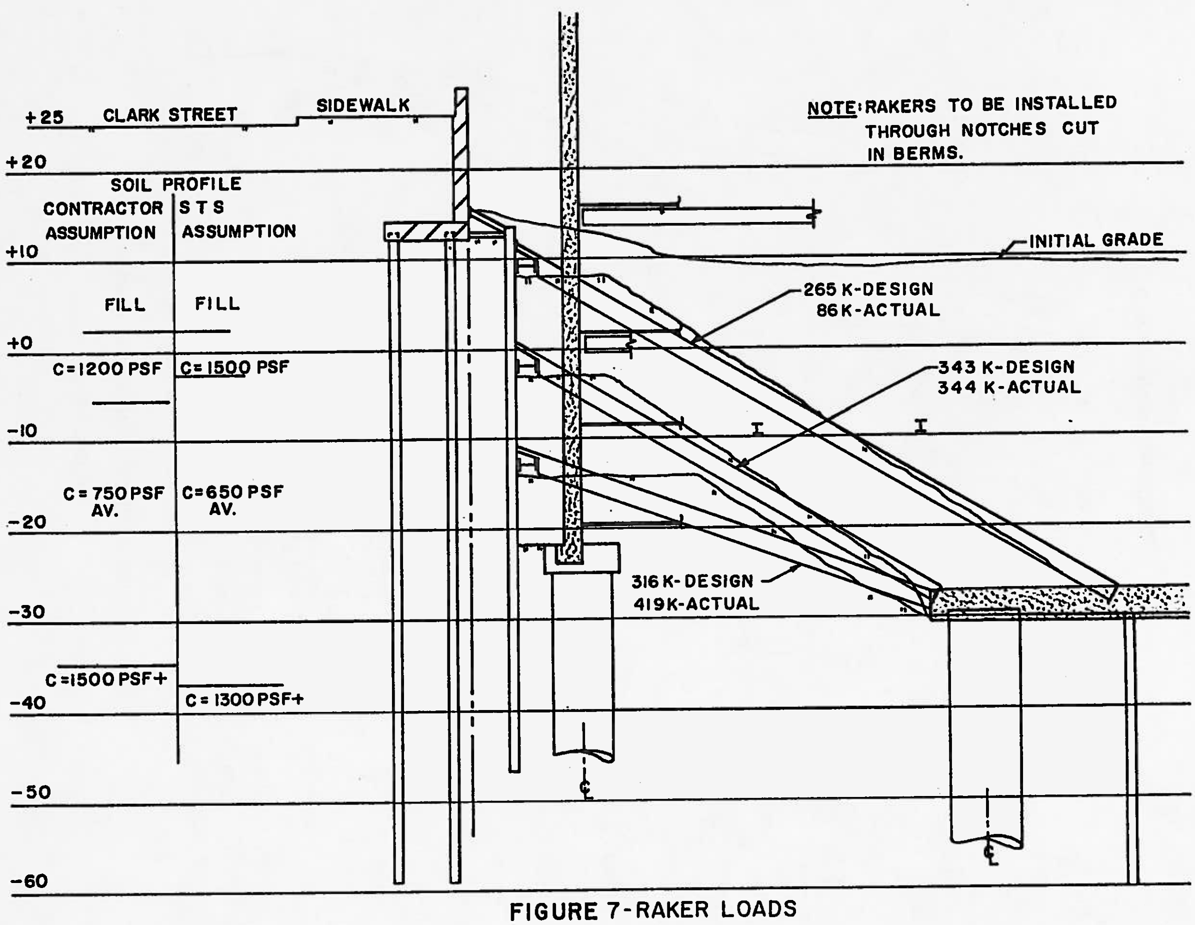


FIGURE 7-RAKER LOADS

EFFECTIVE USE OF EXPERT WITNESSES
THE "BAKING A CAKE APPROACH"
By
Michael K. Ashar, P.E., J.D.

Mr. Ashar has worked for the U.S. Army Corps of Engineers, Huntington District, since 1968. For the past nine years he has worked as Project Manager at the Corps' Cleveland Area Office in the U.S. EPA Construction Grants Program representing the U.S. Government for approximately $300 million in wastewater treatment construction. His projects include deep, large diameter tunnels involving exotic excavation techniques. Mr. Ashar is an attorney, admitted to the Ohio Bar and is currently engaged in private practice. He received a Bachelor of Engineering Science (B.E.S) from Marshall University in 1971. He is a registered P.E. in Ohio, W.VA., Kentucky, and Indiana. He received his Juris Doctor from the University of Akron School of Law in 1985.

A construction dispute should be approached with meticulous evidentiary preparation. As in any legal controversy, the credibility of the evidence is crucial. In a dispute involving geotechnical matters, an expert witness is the central figure in your credibility game. Thorough preparation of the case, using the expert, is important. The key to your case will be that expert's ability to communicate effectively to lay persons who have little or no background in geotechnical engineering. Thus, the technical data and its significance in the engineering problem must be translated to the nonengineers by artful analogy and comparisons in concrete, visual terms grounded in symbols of everyday life. The "baking a cake" approach describes the use of such an analogy to explain a sample problem involving subsurface difficulties encountered in the construction arena. The "baking a cake" approach is not the only vehicle for translating engineering problems in the courtroom. The point here is that the expert witness must use effective communication to interest the decision maker in the testimony. Communication devices such as the "baking a cake" method are designed to aid the decision maker in understanding the evidence, to bolster the credibility of the expert witness, and ultimately to convince the decision maker of the merits of your case.

Your scenario is a dispute involving subsurface or geotechnical problems at the construction site. No matter which side of the dispute you happen to represent (the contractor, the owner, or the design engineer) you are faced with the most complicated and controversial problem area encountered in the construction arena today. You also may face financial disaster if the dispute is not resolved in your favor. You analyze and agonize: "How do I prepare my case? Who will I use to present my side? Have I done everything possible to avoid the dispute? How much is my presentation going to cost? Do I have enough time?"

Pause for a minute. What do you really need to do in order to maximize your chances of a favorable decision?

You need to convince the decision maker with a presentation that supports your position in the dispute. What makes your presentation convincing? The answer is simple - THE CREDIBILITY OF YOUR EVIDENCE! In preparing your case, you must fix this basic premise in your mind and gear all your efforts to support that credibility. If some portion of your position is not probable, not reasonable, or not practical, then do not use it! Remember that credibility is everything.

Now that I have hammered the notion of credibility into your consciousness, how do you obtain this great recipe for success? This answer is not so simple. A subjective concept, "credibility" means different things to different people. You can minimize the subjective aspect by making a few well-considered decisions as you prepare for judgment day.

The technique for presenting an effective case applies to either side of a dispute. It is valid in the courtroom, before the arbitration panel, or at the negotiating table. The most critical consideration in the credibility game is the individual credibility of the witnesses who will present your position to the decision maker. In this seminar, we are talking about geotechnical engineers. Hence, you have a very special kind of witness -- the expert witness. Selecting your expert is a key decision.

Your choice depends on the level of expertise needed, which in turn depends on the remedy you seek to recover (or defend against). Smaller value disputes do not justify expending a lot of time and money on independent experts. Often personnel already on staff possess the requisite expertise to resolve these controversies. But now comes the big six or seven figure dispute. Your staff engineer or technician cannot carry the ball on this one alone. There are several reasons for this. The higher the stakes, the more suspect is your employee-expert's credibility. He has a vested interest in the outcome; possibly his very livelihood depends on it. His opinion is thus subject to attack for bias. Secondly, unless he is a specialist in the geotechnical field, his expertise is limited. His credibility immediately becomes suspect if his credentials do not measure up to the scope of the project or the special expertise involved.

You now turn to the independent geotechnical expert who is hired on a case-by-case basis for the specific purpose of explaining soil problems encountered or not encountered at the job site. Examine her general credibility. She must be a highly trained specialist in the subject matter of the dispute, so that her opinion will carry weight. Preferably she has several years experience in the geotechnical field, and teaches as well as practices. You have retained her to testify as to her opinion, but she is not an employee and does not depend on you for her livelihood. Bias claims are thereby minimized, as her concern for her reputation will outweigh her "loyalty" to a particular client. Your expert is there principally to present your case to the decision maker.

Beware that you do not simply select the first expert available. The task of choosing the best expert for your case is a critical decision. Your expert should have prior experience in the specific technical area of your dispute. Prior trial or similar adversarial experience as an expert witness is also important. Good character and reputation are a must. Can he or she evaluate the impact the soil problems have had on the job? If not, perhaps a second expert on scheduling and impact costs may be needed. Above all, personally interview each potential expert yourself and evaluate his demeanor, confidence, communicability, and believability. The emphasis here is on the ability to communicate. If your expert cannot present himself convincingly to you, he will be even less convincing to others. Finally, after you have selected your expert or experts, provide him or her with the resources he or she needs to do the job well. The worst thing you can do is hire Albert Einstein and make him work with a child's chemistry set.

Now that you have your expert on retainer, the next step is to give him all the facts surrounding the dispute including those that tend to hurt your case. He must be thoroughly familiar with the weaknesses so that he can discount them in your favor when the opposition confronts him at deposition or in the courtroom. Provide him with all the support he needs to perform a complete site investigation and any other required research. Here again, all opposing views must be thoroughly explored and analyzed so that effective counterarguments can be developed. At this point the expert should prepare a comprehensive report written in technical language. This report must fully set out the facts, his conclusions, the bases for his conclusions, rebuttal of opposing viewpoints, and impact on the overall job.

Now you have this great technical report, which nobody can understand, that explains the whole problem in terms of cause and effect. But it is written in a foreign language - "engineeringese". The ordinary layperson cannot pronounce or spell ninety percent of the words let alone understand what they mean or how they relate to the dispute at hand. But who usually ends up deciding most of these big dollar disputes? Juries do! Who sits on juries? Ordinary lay persons. Similarly, few judges and arbitrators, if any, are geotechnical experts. You and your expert must translate this impressive but incomprehensible masterpiece of technical literature into terms and concepts encountered in everyday life.

If you have hired the correct expert witness, he will be able to provide the translation in the most effective manner. The trick is to know your audience. A typical, or "generic", juror is a person of above-average intellect, with a high school education and probably a couple of years of college or trade school. This person has another characteristic that cannot be underestimated -- common sense. Our generic juror is also likely to be a woman, in her thirties, who has at least a part-time job outside her home. Chances are, she will not have much training in geotechnology, but she does have intelligence and that wonderful common sense. She will also take very seriously her responsibility as a juror.

How do you translate soil mechanics to the generic juror? You draw an analogy to a process which is common in every day life. I have selected the recipe approach as a communication device -- what I call "the baking a cake approach". You could use another metaphor, of course; your aim is to project a visual, spatial image of your concept. Abstract technical terms cannot evoke such an image. I chose the cake for our example here, because virtually everyone has some experience with recipes or cakes, if only because everyone eats and has birthdays. The point is to find an analogy that provides a simple and direct format for your message.

For example, you have a contract to build the floating type reinforced concrete substructure for an apartment complex. The contractor excavates down to the proper depth and behold, the invert elevation is located near the top of a varved clay zone. This poses no problem so long as the area is not disturbed further. But the owner decides he wants a ten foot basement instead of an eight foot one. A change order is issued and the contractor excavates the extra two feet. The ground disturbance well into the varved clay zone results in a hole full of toothpaste. <u>You</u> know the technical explanation for this problem and you understand its impact on the entire job. Now your expert must translate. Using the cake analogy, compare your excavation to preparing the batter and putting it in the oven, using layer pans. You wish to construct a tiered layer cake (your apartment building) with the larger bottom layers (substructure) graduating to smaller layers, each layer supporting the one above it. While the cake is in the oven, the layers are stable. Just like the original invert, the cake layer will be all right so long as it remains undisturbed until it has baked. But you get careless in cleaning up the kitchen and you bang into the oven door, thus disturbing the layers by jostling them, just as the contractor has disturbed the invert by excavating the extra two feet. The cake "falls". The larger layers, now uneven and lumpy, - analogous to your new invert elevation -- cannot support the upper layers -- your substructure. Once it collapses your cake cannot be rehabilitated. You have to start over. Virtually all subsurface difficulties of this type can be explained in a similar manner.

Having devised your illustration, the next step is to prepare the component parts. The better experts prepare by building representative models of a simplistic nature incorporating only those facts necessary to understand the basic issue at hand. For your cake illustration, you might not use an actual cake, but a model which imitates a real cake would suffice. You can use other types of models, of course, depending the concepts you wish to demonstrate.

For example, suppose your problem involves inadequate foundation material for a large floating type reinforced concrete structure. The structure is heavy and the supporting soil is highly reactive and susceptible to differential settlement across the area of the foundation slab, depending on water content in the soil. A lay person would expire of boredom or incomprehension after the first three minutes given only a technical verbal narrative of this situation. However, you can heighten interest and comprehension by using an ordinary cement brick mounted on a dry household cleaning sponge. Apply water to one side of the sponge and - presto - you have created the Leaning Tower of Pisa. Your model has provided a simple demonstration of a very common, but complex soils problem. Here again, the analogy to the layered cake can be added for clarification. Models do not have to be elaborate or necessarily expensive to be effective. In fact, the simplest and least costly models usually work best.

Another device available to the expert is the chart or graphic representation. These are especially effective for demonstrating delays and schedule impacts. The "baking a cake" analogy works extremely well here, especially with simplified CPM networks or bar charts. For example, you can't put the icing on a birthday cake until the liquid batter is baked and solidified just as you can't properly backfill an excavation until the ground water is removed and stabilized. However, the expert must take care not to overcomplicate and clutter his drawings with too much detail. As with the other media, simplicity works best. Also, make sure that your charts are large enough to be seen across a room, and use colors for emphasis.

After preparing the models and graphics, the expert should translate all the technical language used in his report into common words and phrases that the lay person can understand. The story should be developed in a step-by-step manner incorporating the models and graphics, much the same as writing a cake recipe.

Once the recipe is prepared, the expert should go over his entire presentation several times to work out the bugs. Then the expert must rehearse (with the lawyer if a trial or arbitration is involved) until his delivery becomes natural and flawless.

Now comes judgment day, time for the expert to present his story to the decision maker. Here is where the emphasis on credibility pays off. Every little detail becomes critical. Make sure that the expert dresses properly for the circumstances. The impression your expert makes when the decision maker(s) first sees him will set the tone for his credibility throughout the proceeding. Dressing too formally or too casually is as damaging as using foul language. Conservative dress is a good rule for all your witnesses. His demeanor should be evaluated and the necessary adjustments made beforehand lest some peculiar idiosyncrasy destroy his credibility before he utters one word.

Now you must qualify your expert. Start with his high school education and work chronologically forward. A very effective approach is to simply ask the expert to explain his qualifications as an expert, having practiced this beforehand, of course. Civic contributions are often as credibility enhancing as a Ph.D. Include all honors received, scholarly and otherwise. Authorships and lecture engagements pertinent to the subject are particularly impressive. Next, present his entire work history on the subject starting with his first engagement as a trainee or apprentice. Then focus on his expertise in the geotechnical field, rehashing all his experience in the particular subject matter of the dispute. A word of caution: be careful not to use overly technical terminology. Some "engineeringese" must be used, but utilize plain language whenever possible. Refuse offers from your opponents to concede his expertise before the decision maker has heard his full story.

As the expert presents your case, make sure all the technical bases for his position are included. You can use the "baking a cake" approach along with the models and graphics to reduce the boredom index and increase understandability. A precise technical record delineating the expert's position is essential, though, for preserving the record for appeal purposes. This is usually best accomplished by submitting his written report into evidence. You will normally be permitted to do this in arbitrations and jury or bench trials.

Now comes cross examination. If your expert has prepared properly, he should already know the weaknesses of his position. The expert must be able to effectively explain and/or rebut each counterargument without hesitation and surprise. If he is able to do this well, imagine the positive impact upon his credibility. The chances of being confronted with a heretofore unconsidered counterargument should be negligable. Make sure the expert is cautioned to respond factually and not argumentatively as he is questioned. Nothing is more damaging to a witness's credibility than using irrelevent hypothetical fact situations in defense of his position. No suppositions please! Your expert is not an advocate. That is the lawyer or negotiator's job. Let the opponent argue with your expert, not vice versa. If your expert is having problems, help him out. Use timely objections or breaks in the proceeding.

In the final analysis of an effective expert witness, the main focus is credible communication. Nowhere is this more necessary than in the technical fields, encountered in the construction industry. The "baking a cake" approach is just one method that has proved successful. You are limited only by your creativity.

ENGINEERING IN THE COURTROOM

F.C. Budinger, P.E.

Forensic work can be exciting and rewarding to the engineer, but requires absolute honesty and objectivity.

This paper provides techniques to help the engineer limit his testimony to technical areas of expertise which will allow the court the prerogative of making the judgments.

The paper provides techniques so engineers can take advantage of their technical knowledge to avoid being discredited by attorneys whose turf is the courtroom.

It discusses attorney versus engineer client privilege, possible conflicting roles and viewpoints, and use of analagies in testimony. It outlines basic relationships such as the difference between a witness of fact and an expert witness.

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He stood there appearing bigger than life thumbing through a stack of papers. I felt satisfied about completion of my testimony, having established under direct examination the technical parameters to support my client's position. However, anticipation of cross examination left me somewhat apprehensive. The opposing attorney was president of the Bar Association and was well reputed for tearing witnesses apart. I realized that the papers he was thumbing through were my deposition of 2 weeks ago, and Mr. Loophole was obviously looking for some way to catch me in a contradiction, either real or apparent.

I was later to learn that, in legal jargon, this is termed "impeaching the witness," which is getting him to say something which contradicts that which was said previously (direct examination or deposition). Attorneys often attempt to do this by judicious use of complicated questions, to which they may only allow yes or no answers. Another technique is to combine three or four questions to lure the expert witness into responding with an answer that could be twisted to support the opponent's position.

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The technique used in this case, however, was one of inventing hypothetical situations which, though not applicable to the case in point, would lead the expert into an answer which could be twisted to develop a contradiction, either real or apparent.

Needless to say, when engineers find themselves in unfamiliar territory (what could be less familiar than a courtroom) we often feel very uncomfortable and apprehensive. We feel as though we are genuinely on the lawyer's "turf", and indeed we are. However, the subject of the questioning is engineering which may be as unfamiliar to the attorney as the courtroom procedure is to the engineer. So while we may physically be on the attorney's turf, in reality we are on the engineer's, and if we understand this position, it can be used to great advantage.

Fortunately, I was able to recognize this at the time and responded to Mr. Loophole's question with a detailed technical answer, presented in engineering jargon. While I was well aware that this would not answer his hypothetical question in terms the jury could understand, I didn't really think it mattered because the question was not relevant to the case.

Show Command of Subject

Because he asked the question for the purpose of impeaching my testimony, the appropriate answer was one that would limit his ability to do that. The detailed technical answer left the attorney in a position of confusion, from which he could not spring his trap. The effect on the jury was likewise favorable, in that they could sense the trap being set, and sympathized with the witness. Furthermore, the technical response indicated a command of the subject necessary to have been qualified as an expert.

Exactly what is an expert witness? On television we see the opposing attorney jumping to his feet yelling "hearsay" in objection to a witness basing his testimony on something someone said. A lay witness of fact is limited in his testimony to those things to which he has direct knowledge, and can express judgements, opinions, or indirect knowledge of fact on within tight limitations. The expert, however, due to his court acknowledged education, work experience and/or specific knowledge and understanding of technical principals, is entitled to express opinions based upon any relevant information to which he is privy.

An interesting fact to bear in mind is that the lay witness of fact can be subpoenaed for deposition or testimony with only nominal ($10 in Washington) compensation. The expert on the other hand may market his services for whatever price he feels is reasonable.

Most of us are familiar with criminal proceedings from television or jury duty. As a result we are somewhat comfortable with the idea that the defendant's guilt must be proven beyond a reasonable doubt. While this is essential to provide society with the assurance that innocent people are not likely to be imprisoned, it is not the case in civil actions. In a law suit the plaintiff need only establish (prove) that negligence by a preponderence of evidence, i.e., a much lesser standard than "beyond reasonable doubt."

Consequently, it is often valuable in engineering testimony to explain our degree of certainty as a percentage. Perhaps we are 80% certain of our conclusion, or maybe only 60%. But our expression of that certainty as a percentage enables the court to properly weigh our testimony in light of other evidence. In some instances, when the actual percentage is closer to 50% than 100%, it may be advisable to simply state an opinion as "more than probable than not."

Engineers Should Get Involved

As our country has more lawyers than engineers, it stands to reason that we have much more litigation than other places, such as Japan, where engineers far outnumber attorneys. As a result, the engineer here is more apt to find himself involved as a consultant or expert in litigation of subjects involving his discipline. Consequently, it behooves us to be prepared as engineers to provide this service to our community and legal system.

Many engineers are reluctant to get involved in forensic work, primarily because they are intimidated by lawyers, and feel quite uncomfortable in the courtroom environment. However, some of us find forensic evaluation quite interesting and legal work very stimulating. Because I practice geotechnical engineering in a community which does not require or use much soil evaluation, we have the opportunity to work on a substantial number of failures.

Although not many of them end up in litigation, enough do, so that perhaps 10% of our activity is forensic. There is nothing like a full-scale geotechnical failure to provide us with an opportunity to test the theories. Few projects are more rewarding than those where the facts are predictable by geotechnical theory, in contradiction to all other available records and testimony.

One such case involved a small bank building where the vault was sliding away from the rest of the structure. You can't imagine anyone more nervous than a banker who sees his vault full of money leaving his immediate control. Evidence indicated that the vault must be moving on a wedge of soil sliding to compress the backfill on an adjacent trench. Calculations of the active earth pressure wedge from the shear strength and geometry suggested that the trench would be 6' deep at the corner of the vault, with the backfill essentially uncompacted.

This was in contrast to testimony from the contractor, plumber, architect, inspector and owner, each of whom believed the sewer line to be 50' away and only 3' deep. You can imagine the satisfaction derived from digging up the line and finding it exactly where the soil mechanics theory had indicated it should be, 6' deep and uncompacted.

Explain in Lay Language

When we testify as experts, it is important to remember that we are attempting to explain sometimes complex engineering principles to lay people who seldom have the educational background to understand the theory on which our testimony is based. Consequently, it behooves us to explain our position, theory, or conclusions in terms that can be followed by non-engineers.

I find it extremely helpful to translate units into terms that can be visualized, and to create analogies which provide proportionality for the average non-engineer. For instance, EPA requirements for clay liners of sewer lagoons call for permeability of 10^{-7} cm/sec. But who, engineer or layman, can picture velocities in centimeters per second. Yet, oftentimes environmental hearings bog down on the question of whether or not this is adequate to protect the environment. I find it quite helpful to translate cm/sec into terms that are easy for anyone to visualize. By expressing 10^{-7} cm/sec as 1 ft/yr, the layman realizes that at this permeability rate, 30 years of migration wouldn't get the contaminants across the road. Consequently, he begins to understand the degree of protection involved.

Another example involved a hearing on water rights. Adjacent land owners felt that the water demands of the subdivision would somehow compromise the performance of their wells. The question involved an intermittent pumping rate of 200 gpm (gallons per minute). Again, how can we expect the layman to visualize 200 gpm for 1 hour/day and 100 gpm for 6 hours/day. The numbers sound vague and invoke some element of fear. However, when I explained that the total amount of water requested for the subdivision amounted to something on the order of 30% of the rain that falls on the site , the opposing arguments lost much of their force.

Analogies Help the Jurors

Another example involved a case where the challenge was based upon the effect of runoff being injected into the subsoils by drywells. The opposition's expert had stated that percolation of the run-off through fissures in the basalt, would cause high pore water pressures in the underlying clay. This he concluded, with substantial academic development, could cause instability and possible landslides. In rebuttal, I had to agree with the theory expressed by Mr. Paladin but disagreed with his conclusions based upon that theory. As his credentials far surpass my own, professional disagreement without some convincing argument was not likely to enhance my client's position.

Fortunately I was able to develop an analogy to put the expert's theory into terms the jury could visualize. I indicated that, while indeed high pore pressures could develop, the degree necessary to produce the instability described would require exceeding the surcharge of the basalt. By comparing the thickness of the basalt at 170 pcf (pounds per cubic foot), with the head of water at 62.4 pcf necessary to balance that, I described a hypothetical chimney full of water reaching 150' in the air in order to develop sufficient pressure to produce the described instability. Needless to say, the jury was able to understand and put into perspective the irrelevancy of the argument.

Although Lawyers are interested in justice, their immediate function is to protect or advocate their client's position regardless of the facts. And, if they were defending us, would we want it any other way? We as engineers must learn to work with attorneys whose attitude is one of strict advocacy. However, as engineers we must also remain extremely objective while still viewing the situation from our client's position. If we allow ourselves to get caught up in the emotional position of the client or the advocacy position of the attorney, we would limit our value to both.

We do the client no service by throwing a questionable case enthusiastically into litigation, only to see it dissolve in the courtroom. Oftentimes, the client and his attorney can benefit most from a fair technical assessment of their actual position, strong or weak as it may be. Often, until the engineer comes on board, the clients and attorneys have little idea of their relative strength or weakness. I remember one case where a condominium was sliding off the hill, and the seller (my client) was eager to defend his position of liability. In viewing the situation from his perspective, the best advice I could give him was to settle quick and get released before the situation got substantially worse.

Don't Be Hired Gun

Some attorneys disagree with the foregoing attitude and insist that the expert witness speak as a strong advocate for their client's position. However, most attorneys appreciate the objectivity and impartiality which stems from a straight forward and candid assessment of the situation. While there are questions in legal circles as to which approach is more effective, there is little question among engineers as to which provides us with a reputation for ethical conduct and credibility.

Seldom is 100% of the data supportive of our client's position. I feel that, not only does the engineer's testimony carry more clout, but also that the client's interests are better served when the negative side of the story is presented under direct examination, along with the positive side. In this manner, we can honestly testify that we have looked at the pros and the cons and have considered all of the evidence before arriving at our conclusions.

Consider the effect on the jury when, after giving only the positive evidence to support our conclusions, the opposing lawyer on cross examination brings out the fact that there is opposing evidence which we had failed to mention. The appearance, obviously, is that we had something to hide from the jury. In my opinion, the former approach provides substantially stronger support for our position.

I remember a case I discussed with the plaintiff's attorney who thought he might need my services. After some time I was contacted by the defense attorney on the same case also seeking my services. As I had previously discussed it with the plaintiff, I called him and asked if he wanted to make a commitment or if I was free to go with the opposing side. He responded with something to the effect that my testimony would be the same regardless of whose side I was on, so he would be just as happy to have the opposition pay my fees. While I am sure he intended his statement as a "put down" because I don't take the position of strict advocacy, I took it as a genuine compliment on my objectivity. Consequently, I felt good about the whole thing, even though I didn't get work from either side.

Prepare Questions for Attorney

Good attorneys spend a great deal of time on homework to fully acquaint themselves with the technicalities of their case. Others, unfortunately, play it by ear and come to court largely unprepared. Sometimes the questions on direct examination are so far from being technically appropriate that the answer cannot convey the desired information.

It is generally much better if the attorney keeps his questioning to a minimum and allows the engineer to just explain things. However, at times the attorney's zeal for advocacy, combined with his lack of engineering understanding, leads to questions so poorly worded that the answers are far from what he expected. In such cases, it is wise for the engineer and the attorney to jointly prepare for the pending examination to be sure the questions are phrased in proper engineering jargon.

What happens when an engineer is called upon to testify against his own client? This could be perceived as a conflict of interest. The engineer certainly doesn't wish to anger his client or jeopardize future work. However, I have found that by avoiding the advocate role, remaining strictly objective, and resisting any tendency to be judgmental, a truly professional client will not be offended. In fact, in my experience, testimony against a client has often led to greater respect and more work from that client.

It is important for us to remember that it is up to the judge or the jury to make the final determination of who is right and who is wrong. Although the attorneys on either side may try to put words into our mouths that would have us essentially judging the case, it is wise to avoid this and stick with the facts and well founded opinions. Thus we can lend knowing assistance to the ultimate trier of fact.

For instance, if we say "the standards of the profession in our area call for three test borings to depths of about 25', and the report we were called upon to review contained two borings to 10'," we are not being judgmental. However, if we were to say that the defendant failed to live up to the standards of the profession, by not drilling enough holes to adequate depths, we would be issuing judgments that are the prerogative of the court. Furthermore, the standards we set with our testimony will become binding on us, should we someday find ourselves in the unfortunate position of defendant.

Use Visuals

Technical items are almost always better explained through diagrams, photographs or drawings. As many of us have conducted lectures or seminars, we are familiar with slide projection and overhead transparencies as effective tools of communication. However, the courts are discriminating in what may or may not be considered evidence, and are prone to deliberate over that evidence after completion of the trial.

Consequently, the courts favor hard copy materials such as photographic enlargements, prepared posters and large sketches. It is not easy to deliberate over evidence erased from a chalkboard 3 days ago. I find that a large newsprint pad on an easel can be quite effective. These are generally available in courtrooms and can be used quite effectively, particularly if the witness happens to have a pocket full of colored felt pens.

While client confidentiality is a matter of ethics to be adhered to in the strictest sense, the law recognizes client confidentiality for only one profession, their own. Therefore, entire files can be subpoenaed by the opposition, who can rummage through them in search of any material which may help their case. However, if our invoice goes to the client's attorney, then our files are considered privileged by the attorney-client realationship, and not subject to discovery. When engineers take a forensic job, it is a good idea to confront the attorney or client with this question. If the attorney wishes to protect the findings from discovery, he will generally have you bill him rather than his client.

While many engineers cringe at the thought of testifying in the courtroom, I find forensic engineering quite stimulating. It is a real challenge to develop new ways to explain engineering principles to the layman, and I enjoy the opportunity of assisting the court and jury by presenting an explanation of physical technicalities upon which a fair adjudication can be based. This can be extremely difficult, but is manageable if I have prepared and presented objective and honest testimony.

Data upon which we base our testimony is often very limited, and we must clearly define those limitations and indicate that our opinions are subject to them. Failure to do so results in giving the opposition the opportunity to attack our credibility, knowledge and integrity by pointing out in the courtroom that we, "really didn't run any laboratory tests to verify our opinions."

Forensic work can be exciting and rewarding but requires absolute honesty by the engineer.

Tips For Forensic Appearances

- Be Technically Prepared
  - Read Depositions, Affidavids, Complaints, Etc.
  - Bring Files, Calculations and Notes
- Be Physically Prepared
  - Draft Exhibits to Respectable Scale
  - Bring Photos, Colored Felt Pens & Calculators
- Prepare Your Attorney
  - Provide A Resume So He Can Establish Credentials
  - Provide Technical Questions Properly Phrased
- Be Properly Groomed & Attired
  - Dress As Attorneys Do In Your Area, or Slightly More Formal
  - On The Stand Sit Up Straight, Hands Relaxed In Lap
- Be On Guard
  - Do Not Let Attorneys Put Words In Your Mouth
  - Listen Carefully And Have Questions Restated If Necessary
- Be Prepared With Analogies Or Calculations
  - Simplify Calculations So Jury Can Follow
  - Use Units And Examples The Layman Can Visualize
- Be Prepared To Wait
  - Bring A Notepad To Take Notes On Other's Testimony
  - Bring Projects That Can Be Worked On Discretely

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SOIL/ACID IMMERSION TEST AS FOCUS OF COURT TESTIMONY

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ABSTRACT

A case history summarizing litigation concerning a leaking hazardous waste site is presented. The site was developed in 1977, was sold in 1980, and was found to be leaking in late 1981. The permitted hazardous waste site was closed by the state when it was determined that off-site migration of chemicals posed a threat to the environment. The new owner was sued by the prior owner when purchase payments were stopped. The new owner counter-sued for breach of warranty.

Testimony provided on behalf of the new owner is discussed. The approach to testimony was to:

- Develop a clear understanding of the inter-relationship between geology, hydrogeology, and contaminant transport mechanisms and,
- Develop multiple lines of evidence to establish whether chemical migration had occurred prior to the sale of the property.

Court testimony included graphics to explain difficult technical concepts to the judge and a physical demonstration that the highly acidic disposed waste fluids were incompatable with the natural soil and environment.

The court judgement, rendered on behalf of the new owner, cited that a simple breach of contract warranty had occurred. The sale contract and operational permit for the site implied that the site was free of defects at the time of sale. The court testimony indicated that chemical migration and attack of soils had started immediately upon introduction of waste fluids into the natural clay lined facilities and that the site was therefore not free from defects upon purchase.

INTRODUCTION

A hazardous waste site in the west central United States was developed in 1977 and permitted by the state soon after. The site was purchased by a new owner in 1980. The site was found to be leaking in late 1981 when volatile organic chemicals were detected in a creek approximately 1/2 mile downgradient from the site. The permitted hazardous waste site was closed by the state in early 1982 when it was determined that the off-site migration of chemicals posed a threat to the environment.

The new owner ceased purchase payments to the prior owner when the site was closed. The prior owner sued the new owner for breach of contract.

The new owner counter-sued contending that a breach of warranty had occurred. The new owner claimed that the contract implied a warranty that the site was free of defects. The original owner argued that the site was a state-of-the-art design when developed and was properly permitted by the appropriate regulatory agencies and that they could not have known that the site was leaking when sold.

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APPROACH TO COURT TESTIMONY

Court testimony relating to technical issues was provided on behalf of the new owner. The site conditions were technically complex, but conditions were thoroughly investigated, monitored, and documented. The approach to providing testimony was to:

- Develop a clear understanding of the inter-relationship between geology, hydrogeology, and contaminant transport mechanisms, and
- Develop multiple lines of evidence to establish whether chemical migration had occurred prior to the sale of the property.

Court testimony included visual graphics and physical demonstrations to explain difficult technical concepts. Poster graphics (24 in. x 36 in.) were used to provide a step by step presentation of technical aspects of the testimony.

A focal point of the court testimony included a physical demonstration that the highly acidic waste fluids which were placed in natural clay lined ponds were incompatible with the natural soil and environment.

SITE CONDITIONS

Site conditions were comprised of deeply weathered and unweathered residual, carbonate-rich shales (Permian Age Wellington Shale formation). The deep weathering produced a 50 to 60 ft thick mantle of soil and weathered rock. The geologic profile was comprised of a series of horizontally consistent but vertically gradational soil and rock zones including:

- a thick residual clay soil,
- a dissolving carbonate water-bearing zone (the A-level),
- a clayey, highly weathered shale low permeability zone,
- a solutioned-gypsum ground water network at the top of bedrock (the B-level), and
- intact bedrock

Two distinct ground water levels are present beneath the site. The shallower level (A-level) occurs in the weathered residual soil zone approximately at the 35 to 45 ft depth. The lower level (B-level) occurs at the contact between the weathered profile and unweathered bedrock (50 to 60 ft depth). Nested wells confirmed that there was a hydraulic separation and little natural communication between these two water bearing zones. Permeability values in the horizontal transmissive zones ranged from 10^{-1} to 10^{-4} cm/sec. Values in the low permeability materials ranged from 10^{-7} to 10^{-9} cm/sec.

CONTAMINANT MIGRATION PATHWAYS

Contaminant transport was first identified when volatile organic compounds were detected in a spring issuing into a small creek approximately 3200 ft north of the site. The first test result, which was obtained approximately 4 years after initial waste disposal, implied a minimum contaminant transport rate of about 800 feet per year.

Chemical analyses were performed on over 1500 samples of ground and surface water obtained during the site investigation. Tests included volatile organic compounds, base-neutral organic compounds, acid extractable organic compounds, metals, pesticides, herbicides and PCBs. A narrow off-site migration pathway was identified, primarily by the presence of volatile organic compounds. Other test parameters were generally absent from the migration pathway.

The site investigation further suggested that contaminant transport occurred through a series of vertical pathways until reaching the horizontally oriented active weathering front in the gypsum-rich bedrock where contaminants then migrated horizontally with the regional ground water system.

The horizontally oriented pathways of high permeability were naturally occurring, consistent with their natural deposition and subsequent weathering patterns. The vertically oriented pathways were artificially created and included:

- Inadequately plugged subsurface investigation boreholes, and
- Flow paths resulting from chemical reactions of disposed waste fluids with natural carbonate-rich soils.

SOIL/ACID IMMERSION TEST

Records indicated that highly acidic waste fluids, having a pH on the order of 0.5, were initially disposed into the on-site treatment ponds. The very low pH values were significantly lower than the pH of 4.5 of fluids tested in laboratory permeability tests performed during the initial (1976-1977) site investigation. The highly acidic waste fluids reacted with the natural carbonate materials remaining within the residual clay soils at the base and sides of the treatment ponds. The chemistry was simple:

H_2SO_4	+ $CaCO_3$	= $CaSO_4$	+ H_2O	+ CO_2
Sulfuric Acid	+ Calcium Carbonate	= Calcium Sulfate	+ Water	+ Carbon Dioxide

A physical demonstration of the chemical reaction was presented in court. A cylindrical sample of natural residual clay soil from the same level as the treatment pond base was placed in a beaker which was then partially filled with pH 0.5 sulfuric acid. An immediate, violent, bubbling reaction occurred in the beaker which was placed several feet from the judge. The reaction proceeded until the cylindrical clay column became consumed by the chemical reaction and the entire soil sample collapsed into the acid solution. Within a half hour the sample had disintegrated into a pile of soil fragments and the bubbling and fizzing reaction began to cease.

Discussion in the subsequent court judgment indicated that the judge had been convinced by this soil/acid immersion test demonstration that chemical attack of the natural subsurface environment had occurred immediately upon disposal of the acidic waste fluids. Initial disposal occurred three years prior to the sale of the property.

POSTER GRAPHIC PRESENTATIONS

Graphic poster boards were used to demonstrate key aspects of the complex technical conditions. Examples of the use of poster boards included:

- Plan views of the site,
- Geologic cross-sections,
- Ground water level contour plan views,

- Cross-sections demonstrating contaminant transport pathways,
- Contaminant travel time relationships, and
- Schematic concepts of remedial activities.

The court judgment referenced various exhibits as being instrumental in providing an overall view and understanding of the complex technical issues relating to the site.

KEY ASPECTS OF THE JUDGMENT

A judgment was rendered on behalf of the new owner in the breach-of-warranty suit. The suit by the prior owner against the new owner was dismissed. The court judged that at the time of sale, the waste disposal site then operated by the former owner, was leaking chemical and acidic waste contaminants and that these contaminants had already meandered off-site. The judge further ruled that since inception of the operation of the site the former owner had negligently dumped regularly and continuously sufficient and significant quantities of chemicals and acidic wastes into the treatment ponds. "The undisputed chemical effect of this evidence is that, as they were unneutralized at the time of dumping, the exposure of these acids to the carbonate nodules found in the clay content of the sides and the walls gave rise to an immediate and disruptive reaction. . . ." The judge ruled that the chemical reaction clearly preceeded the time of the sale and probably occurred from the outset of facility operation.

The judge further ruled that the site conditions existing at the time of sale represented a simple breach of contract principally relating to the parties respective warranties. Although the prior owner was judged to have good reason to believe that in the absence of actual knowledge that the site was, in fact, leaking at the time they made their various representations, that the site did indeed leak and that they were responsible. The court ruled that although offered in good faith, the prior owner could not be relieved of the very responsibility that they would have been required to accept had there been no sale. While the prior owner represented that the site was in compliance with the permit, as a matter of fact, it was not and thus the contract warranty was breached.

The sucess of this case was a result of being able to demonstrate, in very simple terms, the exact nature of critical aspects of how and when the leak occurred. The approach of using multiple lines of evidence to evaluate the critical parameters and the use of a single court room demonstration to physically illustrate a critical aspect of the case were the two elements that allowed the judge to make a clear decision in this case.

HOW TO CONTROL DISPUTES, CLAIMS AND LITIGATION

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This paper is my perspective, from years of involvement in the disputes, claims and litigation of others. Suggestions will be given to manage and control the atmosphere of and issues involved in the dispute process.

Disputes which are internal to a project are commonly handled horizontally, directly by the individuals on-site. While this method is preferable, the reluctance of individuals to become involved often interferes with the process. Principals or others in authority must be involved. This vertical integration must be achieved early.

Dispute management is addressing issues through constructive confrontation. A dispute is often more difficult to deal with than a claim. A dispute may ebb and flow while a claim is a specific demand. A claim presents the option to settle. If disputes or claims are not resolved, frustration often leads to litigation. All is not lost, but the game is different.

One method to control litigation is by coordinating a joint defense. If that is not possible, assign the matter to an attorney and then control the attorney. Only by limiting the costs of defense can settlements that are simply extortion be avoided. Attorneys are trained to evaluate liability and fight legal battles, not to resolve disputes or settle claims. Those responsibilities are yours. Do not be afraid to initiate settlement discussions early and often. It is not a sign of weakness. It will save you money and aggravation.

The management and control of disputes by principals is a hands-on, continuous, and aggressive process that resolves disputes, settles claims and ends litigation.

The frequency and severity of design/construction claims is increasing. This may be caused by a poor system for handling problems and a lack of understanding of alternatives to dispute resolution.

The alternatives to the legal institution are not easy to understand or inexpensive to use. There is no doubt that returning control of claims to parties directly involved is a chore and requires perseverance. To find a better way, your efforts are essential.

The distinction between a project problem and a claim is often difficult to discern. Only experience can help you make that judgement. Principals should take steps to be informed about all problems during projects including: delays, changes in the work, extra work, suspension of work, differing site conditions, changed conditions, acceleration of work, disruption of work, unreasonable performance standards, design defects and lack of coordination. These problems sometimes lead to disputes, claims and litigation. Overall, there are two categories of claims:

I. Internal disputes or claims that arise from within the project. These claims are caused by relationships, site conditions, technical matters, or performance; and

II. External claims that arise against the project. These claims can be caused simply by the existence of the project, off-site damages caused by construction activities, or can result from a chain of events, of which the project is a link. External claims are difficult to deal with because they create adversaries of team members.

The handling of every dispute or claim is different, regardless of which category is involved. Each claim is unique. The biggest differences in handling claims lie in the nature of the relationships of the parties and the claimant's level of sophistication, knowledge and understanding of the design/construction industry.

Internal and external claims have some things in common. Any claim is everyone's problem. If it is not resolved, everyone will have to hire an attorney. Lawsuits commonly result in cross-complaints among project members. Each party, with an attorney, creates activity. In fact, when the number of attorneys rises arithmetically, the activity and costs rise exponentially.

How can you keep claims out of the legal system? The primary goal should be to coordinate all activity. This is easier said than done. External claims must be handled by a unified group or its representative. This group may experience in-fighting, creating an environment similar to that of internal claims. External claims must be coordinated through a single source if we are to change the current legal system. Success at this stage returns benefits out of all proportion to the effort. This effort is claim management at its best.

The goal is to alter, manage and control disputing behavior, while resolving the underlying problem or claim. This is sometimes referred to as constructive confrontation. To do this, it is necessary to create a non-embarrassing and non-emotional atmosphere. Control does not need to be initiated by a responsible party or from within the chain of command created by the project itself. Any pragmatic, reasonable, and diplomatic individual can take charge. The key is to spell out the grievances while giving all parties room to respond.

This activity is a small investment compared to what occurs in its absence. The potential long-term benefit is worth the short-term risk. It is better to muddle through a confrontation than to avoid one. Recognize that there are various interests as well as perceptions at work. Parties tend to align and position themselves early. Issues then become clouded by relationships.

At the first indication of any problem, don't react. A reaction is an emotional "knee-jerk" that exposes your primary self-interest. Providing a response is the preferred course of action. To respond you will need to confront yourself first. Then define, analyze, develop alternatives and evaluate the consequences before coordinating the decision-making process. A response is a measured, non-accusatory statement that anticipates the reactions of others prior to its delivery. Recognize that the responsibility for the problem and its cost will be determined in the decision-making process, not before. This entire process must include all parties. If someone refuses to participate, however, proceed and share. This may be an obstacle that adds to the problem but does not necessarily alter the solution.

A dispute handled horizontally, directly by the individuals present on-site, is preferable. Often the reluctance of individuals to be involved or a lack or negotiation skill interferes with the process. Principals or others in authority must be involved. The need for vertical integration must be recognized early. This recognition is a learned skill. Because hindsight is 20/20, one can often identify the moment when this decision was not made. This lesson always costs money. Establish a reporting system within your practice that involves a principal in all disputes.

Dispute management is addressing the issues while controlling the atmosphere of conflict. All significant communication must be confirmed in writing and copied to all parties, not just your client. Each communication should ask for clarifications and a response. You should not fear putting things in writing, but it is critical that correspondence be reviewed by someone outside of the problem. Whether this independent review is by another principal of the firm, an expert, your insurance representative, or an attorney is dependent upon the nature of the writing. Again, each claim is unique even though there are a few common scenarios. There is no correct way nor any single approach to handle all situations.

Recognize that using an attorney as your resource will alter the flow. Your attorney's focus is to act in your best interests. Although that sounds good, you have the same goal for your client. No one's self-interests should dominate. Self-interests tend to leave important facts out of communication. Tell people what your interests are, because if you don't they will assume the worst. Without those facts, other parties may sense a slanted or biased intent. You lose. What you do is commit the logical fallacy of converse accident. By using only those facts that favor or support your position, you appear overly conservative. You will be perceived to have made hasty generalizations and misused the circumstances, to your advantage. It is necessary to assume some risks and the risk of truth does not require further explanation.

It is important at this stage to use common words and phrases in writings. Avoid any legal term or others will assume that you are talking to your attorney and they will do likewise. Avoid technical terms because it is lay-juries that will evaluate this correspondence eventually, if a trial results. As examples, the words: failure, distress, over-stressed and deflection have been used in a fashion inconsistent with the intended message. If you use a technical term, belabor the point by defining the term in common language.

A dispute is often more difficult to deal with than a claim. A dispute ebbs and flows while a claim is a specific demand. A claim presents the option to settle. The issue is not whether or not parties will pay money, but to whom they will pay money. Any settlement or resolution is better than no settlement or resolution. In fact, in a good settlement, no one is happy. This may sound strange, but gauging your success based upon the level of pain experienced and the movement or compromise of all parties is appropriate. You will compromise eventually. Save yourself the agony and the expense by recognizing the probable development of the claim. You will know when to quit bending.

As an aside, insurance company actuaries review claims on an annual basis. They use loss development models to track results. Historically, we know that the older the claim, the more it costs. Benefit from that knowledge and you will suffer less in the long run. These views are based upon a limited number of observations. Insurance companies only get involved in a few of the thousands of projects. Most projects conclude without claims and, in fact, most claims conclude with little or no payment. Five percent of all claims result in seventy-five percent of all payments. Most of the money paid is for the cost of attorneys, not for the cost of claims. Recognition of this should temper your approach to claims.

A word of caution: if you do settle a claim early and the resolution is a repair, that repair should be contracted for and controlled by the owner of the property, not you. Just remember that if you don't own it, you can't fix it but you can reimburse the owner for the expense.

Regardless of your efforts, an internal dispute may become a claim. A claim is handled in a similar fashion but there is an edge to it. A specific demand has been made. Here, it is necessary to open or reopen lines of communication. Do not polarize; if parties are aligning, step back and call in an outsider for help. This may be a professional negotiator, mediator, or facilitator. (Management and labor have used this technique for years with excellent results.) It is necessary to recognize when the communication flow needs assistance. You must be willing to make the suggestion to use an outsider. Many disputes escalate because parties consider the open suggestion to mediate as a sign of weakness or an admission of fault. This is not true among sophisticated problem solvers.

If disputes or claims are not resolved, frustration often leads to litigation. All is not lost, but the game is different. The litigation of complex matters simply lines the pockets of attorneys on all sides. Considering this, the resolution of a claim becomes a business decision. Remember that there is no vindication in trial. Your professional reputation is not at stake in the handling of claims, your pocketbook is. What causes claims is not always the same as what causes payment, and you must deal with all aspects.

If a lawsuit is served by mail, do not sign the acknowledgment of receipt of service. You normally have 20 days to make this decision. Use this time, do not surrender it. There is no obligation for you to sign the acknowledgment and return it to the attorney. However, if you do not, proper service may be performed and you will be responsible for that cost. (The risk of that is nominal since service costs range from $30 to $50.) Contact your insurance company immediately. A lawsuit served in this fashion is often a plea for attention and full-blown litigation is not necessarily the desired outcome.

If a lawsuit is served on you or on your organization, in person, you have no choice but to accept it. Simply note the date served and again, call your insurance company immediately. Often the filing of a response can be postponed by offering to cooperate. The trade is fair. You do not pay attorney's fees and may be able to coordinate a resolution or at least clarify your involvement.

The first thing to do when you are sued is to take a deep breath and relax. Ignore the lawsuit the day it arrives, read it the next day, and sleep on it again before making any decisions. The point is simply to allow the subconscious mind to interpret the frustrations underlying the allegations. Attorneys write lawsuits intending to inflame emotion and exaggerate demands to polarize parties. Look at the language within the suit. A plaintiff makes allegations and prays for compensation. Show some sympathy.

One way to control litigation is by coordinating a joint defense. Most attorneys resist any attempt to unify the defense. In many cases, this method has been successful. All parties must waive any and all conflicts created by using one attorney. This works best defending those lawsuits arising external to the project. The attorney that represents the project should be reimbursed on an equal share basis unless a proportional arrangement can be made that ties the level of project involvement to the cost of defense. You will not waive any rights you have against one another by proceeding in this manner. Cross-complaints can follow later if necessary; they do not need to precede the main action. The only reason they do is because some court cases have found it appropriate to bring all players into the action so that only one trial is conducted. Now, attorneys are using those decisions as their "right to work". Parties should agree to mediate or arbitrate proportionate contributions after a verdict or award has been determined.

If a joint defense cannot be coordinated, don't give up. Find at least one other party with similar interests and share an attorney.

If your initial attempts to control litigation are not successful, assign the matter to an attorney and control the attorney. All activity by attorneys must be controlled by the client. In fact, convincing other parties of this can change the focus of lawsuits. Attorneys are trained to evaluate liability and fight legal battles, not to resolve disputes or settle claims. Those responsibilities remain yours. Depending upon your exposure in the case, the level of control over your attorney is a decision made based upon the risk that you and your insurance company are willing to retain. Litigation is risky, regardless.

There are lawsuits that must be fully discovered and are extremely expensive. These cases are rare. The majority of the cases in which engineers are involved represent a greater exposure from defense costs than from loss or liability. Recognizing this, it is necessary that your attorney follow your instruction. Even without a joint defense some activities can be shared. All defendants have the same task of discovering, clarifying and limiting plaintiff's damages. Have only one attorney pursue the damages issue.

Most attorneys play poker with lawsuits but the preferred game is chess. Why hide relevant facts or known liability? The cost to defer settlement exceeds the anticipated savings. Any delay will ultimately cost you more, because experts will find new damages or inflate consequential damages, thereby increasing the settlement amount. Get everything out into the open and deal with it early on, even if others do not.

For a case with relatively low exposure, attorneys should respond to the complaint in a minimal fashion and not initiate any discovery without prior approval. Do not allow interrogatories, except for a few admission interrogatories. Do not allow attendance at depositions, except for those of experts and a few key players. It is much easier to obtain a copy of the deposition transcript that you can review for significance, bringing that material to the attention of counsel. Anything that is said in a deposition can be corrected by expert testimony later or during trial.

Discovery is a very expensive form of investigation and is overrated. On some cases you may direct your attorney to respond only to properly filed and promulgated discovery.

Your attorney's telephone conversations with other attorneys should be minimal. If your attorney is talking to people, it is costing you money. Occasionally, attorneys educate each other without helping your position.

An attorney should not be allowed to write correspondence that exceeds three pages. More depth may be necessary for the attorney to handle the case, but not for your evaluation. Regurgitation is not the reporting of significant fact.

Do not allow your attorney to file cross-complaints for legal reasons. If you have no reason to sue someone, don't.

Good defense counsel prepares a trial binder early. The focus is on your performance in light of the claims or allegations made. Elaborate explanations or justifications do not fly. Keep it simple.

Only by limiting the costs of defense and the magnitude of that expense can settlements that are simply extortion be avoided. Do not be afraid to initiate settlement discussions early and often. This is not a sign of weakness and will save you money and aggravation.

If you are the primary party at fault, you must accept responsibility and settle on fair terms as early as possible. In this circumstance, settlement negotiations must be aggressively pursued. If you are not at fault, your position is more difficult. The controversy may cost more to defend than you risk losing. This is where attorney control must be your main focus. Attorneys have an inherent conflict of interest in settling cases: the interests of the law firm. You pay the price of litigation, not your attorney.

Management and control by principals is a hands-on, continuous, and aggressive process. There is no substitute for you. The choice is between your time or your money. Do not give in. End the tyranny of the process. The responsibility is yours. Just remember that if you don't let your attorney do the work, it does not mean the work does not need to be done. You must do it. Most of you are good business managers and negotiators already or you would not be in practice. Engineers have the ability to review and interpret state and federal regulations relating to their field. The language and technical expertise required for law is no more involved than for engineering. Take the time to learn the legal system and terminology. You will save yourself money. Recognize the function of a lawyer and retain control.

There is a continuum: problems-disputes-claims-lawsuits. A resolution can occur at any point, but as the process becomes more formal, it involves more people and becomes more expensive. It is up to you to handle problems, resolve disputes, settle claims and end litigation.

PROCEEDINGS OF
OHIO RIVER VALLEY SOILS SEMINARS

ORVSS I:	BUILDING FOUNDATION DESIGN AND CONSTRUCTION, October 16, 1970, Lexington, Kentucky
ORVSS II:	EARTHWORK ENGINEERING, START TO FINISH October 15, 1971, Louisville, Kentucky
ORVSS III:	LATERAL EARTH PRESSURES, October 27, 1972, Fort Mitchell, Kentucky
ORVSS IV:	GEOTECHNICS IN TRANSPORTATION ENGINEERING, October 5, 1973, Lexington, Kentucky
ORVSS V:	ROCK ENGINEERING, October 18, 1974, Clarksville, Indiana
ORVSS VI:	SLOPE STABILITY AND LANDSLIDES, October 17, 1975, Fort Mitchell, Kentucky
ORVSS VII:	SHALES AND MINE WASTES: GEOTECHNICAL PROPERTIES, DESIGN AND CONSTRUCTION, October 8, 1976, Lexington, Kentucky
ORVSS VIII:	EARTH DAMS AND EMBANKMENTS: DESIGN, CONSTRUCTION, AND PERFORMANCE, October 14, 1977, Louisville, Kentucky
ORVSS IX:	DEEP FOUNDATIONS, October 27, 1978, Fort Mitchell, Kentucky
ORVSS X:	GEOTECHNICS OF MINING, October 5, 1979, Lexington, Kentucky
ORVSS XII:	GROUNDWATER: MONITORING, EVALUATION, AND CONTROL, October 9, 1981, Fort Mitchell, Kentucky
ORVSS XIII:	RECENT ADVANCES IN GEOTECHNICAL ENGINEERING PRACTICE, October 8, 1982, Lexington, Kentucky
ORVSS XIV:	FOUNDATION INSTRUMENTATION AND GEOPHYSICAL EXPLORATION, October 14, 1983, Clarksville, Indiana

ORVSS XV: PRACTICAL APPLICATION OF DRAINAGE IN GEOTECHNICAL ENGINEERING, November 2, 1984, Fort Mitchell, Kentucky

ORVSS XVI: APPLIED SOIL DYNAMICS, October 11, 1985, Lexington, Kentucky

ORVSS XVII: NATURAL SLOPE STABILITY AND INSTRUMENTATION, October 17, 1986, Clarksville, Indiana

ORVSS XVIII: LIABILITY ISSUES IN GEOTECHNICAL ENGINEERING AND CONSTRUCTION, November 6, 1987, Fort Mitchell, Kentucky

Some of the proceedings of current and previous Ohio River Valley Soils Seminars are still available at nominal cost. Address inquiries to:

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